

## Full Issue 8.3

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# **Genocide Studies and Prevention: An International Journal**

**Humanitarian Technologies and Genocide Prevention**

**Volume 8.3 - 2014**



# Genocide Studies and Prevention: An International Journal

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## Volume 8.3 - 2014

*Humanitarian Technologies and Genocide Prevention*

### GSP Editorial Board

*Editor's Introduction* ..... 1

### Yasemin Irvin-Erickson and Douglas Irvin-Erickson

*Introduction to the Special Issue* ..... 3

### Articles

#### Tommy O'Connell and Stephen Young

*No More Hidden Secrets: Human Rights Violation and Remote Sensing* ..... 5

#### Nathaniel A. Raymond, Brittany L. Card and Isaac L. Baker

*A New Forensics: Developing Standard Remote Sensing Methodologies to Detect and Document Mass Atrocities* ..... 33

#### Brittany L. Card and Isaac L. Baker

*GRID: A Methodology Integrating Witness Testimony and Satellite Imagery Analysis for Documenting Alleged Mass Atrocities* ..... 49

#### Jaimie Morse

*Documenting Mass Rape: Medical Evidence Collection Techniques as Humanitarian Technology* ..... 63

### Essays Review

#### Christopher Tuckwood

*The State of the Field: Technology for Atrocity Response* ..... 81

#### Colette Mazzucelli

*Humanitarian Technologies and Genocide Prevention: A Critical Inquiry* ..... 87

### Book Reviews

*Hidden Genocides: Power, Knowledge, Memory,*

edited by Alexander Laban Hinton, Thomas La Pointe, and Douglas Irvin-Erickson,

reviewed by Uğur Ümit Üngör ..... 101



## Film Reviews

Rithy Panh, *The Missing Picture*,

reviewed by Lior Zylberman .....103

### New Directions for GSP

Issue 8.3, entitled “Humanitarian Technologies and Genocide Prevention,” is the first issue of *Genocide Studies and Prevention* (GSP) published completely under the direction of the new editorial board. The transition from a printed, fee-based subscription journal to an open access online journal began a couple of years ago with some fundamental strategic considerations undertaken by the IAGS-Board headed by Alexander Hinton and Daniel Feierstein. The aim was to broaden the reach of the journal far beyond the original audience so that new authors could become interested in being published in GSP.

### Open Access

A lot can be said in favor of open access and its electronic design: On the one hand, there are the political developments in the academic world, especially in Europe, Australia, Latin America and the US, that occurred in the last decade. In these countries, open access has increasingly established itself as a standard publishing tool, often promoted by government funds. On the other hand, the access to the usually expensive journals (whether online or traditional print publications) is very limited, particularly in the global south. Yet especially these regions are continuously gathering scientific attention and producing outstanding research. From the point of view of the IAGS and the Editorial Board, it is therefore of central importance for the successful development of the journal to obtain authorship and readership from the global south.

### The Transitional Editorial Board

The IAGS Board, and the Transitional Editorial Board appointed in 2012, pressed this development ahead. At first, the already existing and extremely complex ties between the journal and the former partners, which often involved considerable financial obligations, had to be broken. An exceptional host for the new open access, online-version, the University of South Florida, was found. Scholar Commons, a service of the USF Tampa Library, is the digital showcase where GSP is located. Technically, the journal is run through the system “bepress” devised by the University of California Berkeley. The new partners not only provide their technical equipment, but they have also provided an impressive number of personnel to assist the transformation process. USF, Scholar Commons, and bepress have proven to be exceptional partners. It must be explicitly stated that their complete support is free of charge. As a consequence, IAGS is able to invest its means into supporting global scholarship without having to raise overall membership fees, which can prohibit many scholars, students, practitioners, and activists based outside of North American and Europe from participating in the IAGS.

### New Rules & Procedures

We, the Editorial Board appointed in 2014 and as yet in charge, have revised or introduced a number of standards and procedures. The aim is to develop transparent and reliable procedures for all parties involved—authors, reviewers, editors, readers. Amongst other features, new submission guidelines, guidelines for reviewers, procedures regulating how submitted contributions should be handled, and a language policy for multi-lingual publishing were devised. Furthermore, current commonly accepted standards of quality are systematically implemented. These include a double blind peer review of all articles that follows a preliminary assessment by the Editorial Board.

### Content and Strategic Development

The upcoming issues will be special issues for programmatic reasons. In the future, methods, technologies and theoretical approaches, as well as hitherto little researched events, will become primary foci. In addition, each issue will include book and film reviews. These thematic issues will be complemented by articles chosen from the contingent of constantly submitted articles discussing various themes and approaches. The journal is multi-disciplinary and therefore welcomes articles from a wide variety of fields, written with the aim of bringing different and alternative disciplinary analysis to an audience outside of that specific field.

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Amy Fagin, Beyond Genocide, 20th Century Illuminations

Melanie O'Brien, Griffith University

Rafiki Ubaldo, Media and Communication, IAGS

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## Introduction to the Special Issue

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This issue of *Genocide Studies and Prevention* is the beginning of an important discussion on the role of humanitarian technologies in genocide prevention. As technology continues to develop and change the world around us, it is only fitting that we find new and creative ways of making technological advances work in the interests of humanitarian action. The articles in this issue contribute to this effort, opening up new directions in the field of genocide studies and prevention that will hopefully spur new forms of scholarship, advocacy, and humanitarian work.

The field of genocide prevention is a well established subfield in the discipline. One could say it extends back to 1948 with the work of Raphael Lemkin. Or, as professors Gary J. Bass (*Freedom's Battle*) and Davide Rodogno (*Against Massacre*) have shown in their recent books, genocide prevention is perhaps as old as the tradition of humanitarian intervention. Regardless, the study of genocide prevention was first systematized in the 1990s. This scholarship focused on risk analysis models, early warning signs, and strategies for coordinating early intervention at the state and civil society levels—nationally and internationally, locally and globally.

Genocide prevention as a distinct field of study gained global recognition in 2004 when Juan Méndez was named as the first United Nations Special Advisor on the Prevention of Genocide. The Office of the Special Advisor was created following the genocides in the former Yugoslavia in the early 1990s and Rwanda in 1994. These were genocides that the UN organizations and the world community failed to prevent or respond to, even though the cases were easily preventable. Independent scholars and UN investigations determined there were two causes for this failure. These included information and communications weaknesses within the UN. But, more important was the UN member states' clear lack of political will. The Special Adviser's office was tasked with collecting information on serious violations of human rights and international humanitarian law that might lead to genocide, and providing recommendations for dealing with each case. Genocide prevention was now institutionalized in global politics, with clear channels of conveying information and recommendations to the Security Council. But, when comes to shifting political will towards actually preventing genocide, much work still needs to be done.

States, and the leaders of states, often deny that genocides or humanitarian crimes occur in their own regions or, for that matter, in the regions of their neighbors and geopolitical "friends." What is more, even when the facts of genocide and mass atrocities are clearly established, states, governments, and leaders who have the authority and capability to act often deny the facts, or downplay the significance of the evidence. While the technologies discussed in this issue will probably have little effect on the political sensitivities surrounding genocide prevention, they do promise to help smooth out some of the complexities of this work. Recent developments in crisis mapping, crowd-sourcing, and citizen-based monitoring have introduced real-time data into early-warning and early-response systems. High-quality satellite imagery and remote-sensing technologies are increasingly available to civil-society actors. Through these technologies, scholars and human rights organizations can analyze and monitor the development of armed conflicts anywhere in the world, at unprecedented levels of accuracy and timeliness. This makes it difficult for states and governments to deny that genocide is being committed, and it can help move political will by making the humanitarian costs of denial very clear to the entire world.

Indeed, technology will not prevent genocide, but it can help fill important gaps in our global efforts to do so. Preventing genocide begins with ensuring that all individuals enjoy equal rights, dignity, and belonging as citizens regardless of their group belonging or identity. Genocide is more than mass killings. A complex social process, genocide includes the manufacturing of imagined, social differences. Yet, it is not simply differences in identity that generate genocidal conflict and violence. Rather, as the Special Advisor Adama Dieng has often pointed out, it is the implication of these differences in terms of power, wealth, resources, economic opportunities, citizenship and basic rights. For the Special Advisor's office, the early prevention of genocide is therefore a question promoting good governance and an equal respect for human rights and diversity. In terms of the office's mandate, this means working to oppose discrimination, hate speech, the incitement of violence, and other violations of human rights. But it also means working to eliminate political and economic inequalities, and promoting a common sense of belonging, both in states and national communities, but also in the world.

Humanitarian technologies fit into this larger project by helping to raise public awareness of ongoing conflicts to pressure governments and international organizations to act responsibly. They can also contribute to deepening the genocide risk analysis frameworks—used by scholars, advocacy groups, and the Special

Advisor's office—by helping to monitor for increases in discrimination or human rights violations committed against groups, revealing the deployment of state security forces around vulnerable populations, or even detecting and monitoring genocidal acts themselves.

There is a final aspect of humanitarian technologies that is relevant to genocide prevention: criminal prosecutions. The International Criminal Court is empowered to investigate and prosecute alleged perpetrators for genocide, among other crimes, if a state is unwilling or unable to exercise jurisdiction. In such prosecutions, remote sensing technologies can be vital for identifying conflict sites, or even mass graves, after genocide has occurred. As several of the articles in this issue point to, technological advances are also crucial for improving our ability to collect and preserve courtroom evidence—including evidence of mass rapes. This is not simply a matter of documenting evidence digitally, but analyzing and preserving forensic evidence, and improving the chains of custody of this evidence. Combined, these efforts contribute to the larger goal of building a culture of prevention and fighting impunity.

The four research articles in this issue are written by scholars working at the cutting-edge of humanitarian technologies. Tommy O'Connell and Stephen Young use high resolution and medium resolution satellite imagery from the Gereida region of Darfur, Sudan to help identify useful tools for supporting eye witness testimony and reports on human rights violations. In the second article, Nathaniel A. Raymond, Brittany L. Card, and Isaac L. Baker discuss the development of Mass Atrocity Remote Sensing, or MARS. Looking specifically at the Abyei region of Sudan, on the boarder of South Sudan, Raymond, Card, and Baker highlight the potential methods for standard forensic approaches for analysing high-resolution satellite imagery to identify evidence of alleged mass atrocities. In the third article that compliments O'Connell and Young, Card and Baker outline an innovative methodology for integrating witness testimony and satellite imagery analysis to document mass atrocities. In the fourth article, Jaimie Morse considers three principal forms of medical evidence to document sexual violence and their use in these settings: the patient medical record, the medical certificate, and the sexual assault medical forensic exam (commonly known as the "rape kit"). Combining archival research with interviews of activists, healthcare practitioners, lawyers, investigators, and other experts, the author traces the collection and use of medical evidence to document mass rape since the establishment of the ICTR and ICTY, and argues that medical evidence collection techniques represent an emerging humanitarian technology that may influence what comes to count as sexual violence, which crimes are deemed justiciable, and how sexual violence comes to be remembered.

The issue concludes with two review essays. Christopher Tuckwood, the executive director of The Sentinel Project, reviews the state of the field, outlining the ways technologies are being used by non-state actors to gather, analyze, and communicate information for the sake of predicting, preventing, and mitigating atrocities. For those readers who are new to the use of humanitarian technologies, Tuckwood's essay provides a fine introduction to the other articles. In the final review essay, Colette Mazzucelli provides a critical evaluation of the state of the field, charting the development of humanitarian technologies amidst concerns for privacy, the rights of victims and the accused, and new ethical considerations raised in the era of "big data."

Finally, issue 8.3 marks the beginning of a new feature of *GSP*: film reviews. Much like academic book reviews, film reviews will present scholarly reviews of films that are of interest to readers of the journal. In the inaugural essay, Film Review Editor Lior Zylberman reviews Rithy Pahn's documentary, *The Missing Picture*. The film reviews will be a forum to assess the aesthetic, entertainment, social, cultural, and academic merit and significance of current and classic films that are of interest to *GSP*'s readership. While scholarly in form, the reviews need not be written only by film and media scholars and we encourage submissions from across the disciplines. With this issue, the journal also launches a reformatted book review section under the direction of Tetsushi Ogata. Moving forward, *GSP* welcomes reviews of books written in any language in the world, encouraging submissions that will help bridge linguistic divides between scholars of genocide around the world. This includes reviews of English books written in other languages, as well as non-English books reviewed in English. As a goal, in addition to reviewing books from around the world, each issue of *GSP* will present reviews of major, recent books in genocide studies as well as reviews of books that push beyond the immediate boundaries of genocide studies to consider issues that are of immediate concern to our readers.

Yasemin Irvin-Erickson  
Douglas Irvin-Erickson

# No More Hidden Secrets: Human Rights Violation and Remote Sensing

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## Abstract:

**Aim:** This study used both high resolution and medium resolution satellite imagery to test three semi-automated remote sensing methods, in an attempt to identify useful tools to support eye-witness testimony and reports on human rights violations. As huts are routinely burned down during attacks on a village, particularly in Sudan, the number of huts and villages burned can be used to corroborate on-the-ground reports.

**Methods:** Three remote sensing methods (Supervised Classification, Change Detection, and Feature Extraction) were performed on imagery from both before the attacks in February 2006 and after the attacks to examine any useful trends that could be used by researchers when manually examining the satellite data.

**Results:** In general, Supervised Classification methods performed unsatisfactorily. Some classes, such as water and agriculture, had high accuracy rates; however pixels classified as villages performed poorly. The Change Detection method delivered inconclusive results. Feature Extraction, when combined with the kernel density "hot spot" method, appears to be a useful tool to identify villages. The after imagery had no surviving villages in the study area, so Feature Extraction could not be completed on the after imagery and an accurate assessment of the method cannot be fully ascertained.

**Conclusions:** The results of this study indicate that Feature Extraction is a useful ancillary tool to the practice of manual identification, particularly in places similar to Darfur with semi-arid grassland and rural huts and villages. In addition, the kernel density function when paired with Feature Extracted is a useful tool for visual analysis of clustered villages.

**Keywords:** human rights, genocide, remote sensing, GIS, satellite imagery, Darfur, Sudan

## Introduction

Mass violence and human rights violations have been occurring throughout human history, but only recently has the prospect come forward of using advanced technology to study, prosecute, and possibly prevent these crimes from happening. There is continued debate about the knowledge that Western countries had about the Holocaust,<sup>1</sup> but it can be argued that the genocide committed by the Nazis during World War II (the murders of Jews, Soviets, Romani, homosexuals and Jehovah's Witnesses, among others) continued to be a "terrible secret" because the international community lacked adequate and compelling information to act.<sup>2</sup> Some articles bring up the situation of the 1994 mass killings in Rwanda as evidence that information alone may not be sufficient enough to move the international community to act. The beginnings of the Rwandan genocide were reported in the Western press, and when the killings began, a small United Nation (UN) force reported from their position in Rwanda, and CNN and other media sources broadcast continually about the problems. UN Secretary General Boutros Boutros-Ghali appealed for the international community to stop the killings, but there was no large-scale action taken by any nation or the UN.<sup>3</sup>

However, many scientists have been trying to use technology to push public action. There are numerous studies on using satellite imagery and remote sensing to study mass violence and its direct and indirect effects, like refugee camps, burnt villages, or the disappearance of agriculture. As satellite technology grows and develops, the idea of creating an early warning system becomes more of a possibility. Projects like Amnesty International's *Eyes on Darfur* and Google/US Holocaust Museum's *Crisis in Darfur* both showcased satellite imagery and analysis to the general public to help persuade and educate. In a one year timeframe from 2007-2008, over 1.2 million individuals visited Amnesty International's website to learn about the Darfur crisis. Amnesty International identified twelve at-risk villages that were vulnerable to violence. The website has imagery of these villages, and actively tracked and monitored new imagery to determine if any violence had occurred. This imagery was paired with human rights organizations' documentation and eyewitness reports to ground truth the data, and also to provide a human aspect for the visitors of the site to relate to.<sup>4</sup>

This study used both high resolution and medium resolution satellite imagery to test three semi-automated remote sensing methods, in an attempt to identify useful tools to support eye-witness testimony and



reports on human rights violations. As huts are routinely burned down during attacks on a village, particularly in Sudan,<sup>5</sup> the number of huts and villages burned can be used to corroborate on-the-ground reports. As projects like *Eyes on Darfur* relied on manual examination of imagery, which is time consuming, a semi-automated method can speed up the analysis and expand areas that are monitored with limited resources. The Gereida region in Darfur, Sudan (Figures 1 and 2) was chosen as a study area for multiple reasons: Amnesty International and the American Association for the Advancement of Science (AAAS) published reports of villages being burned by Janjaweed horsemen between November of 2005 and February of 2006 around the town of Gereida; high resolution IKONOS imagery of the region was able to be acquired for both before and after the attacks occurred; and medium resolution Landsat ETM+ (Enhanced Thematic Mapper Plus) imagery before and after the attacks were available for the study region.



Figure 1. Map of Darfur and Sudan.

Data source: GADM database of Global Administrative Areas, January 2012.  
<http://www.gadm.org/> (accessed August 25, 2013). Basemap: ESRI data and maps, 2012.

High resolution satellite imagery typically allows the viewer to discern objects (cars, houses, etc.), while medium resolution imagery is used for more regional examinations, such as identifying delineations between farmland and forested areas. Because high resolution imagery can “zoom in” more than medium

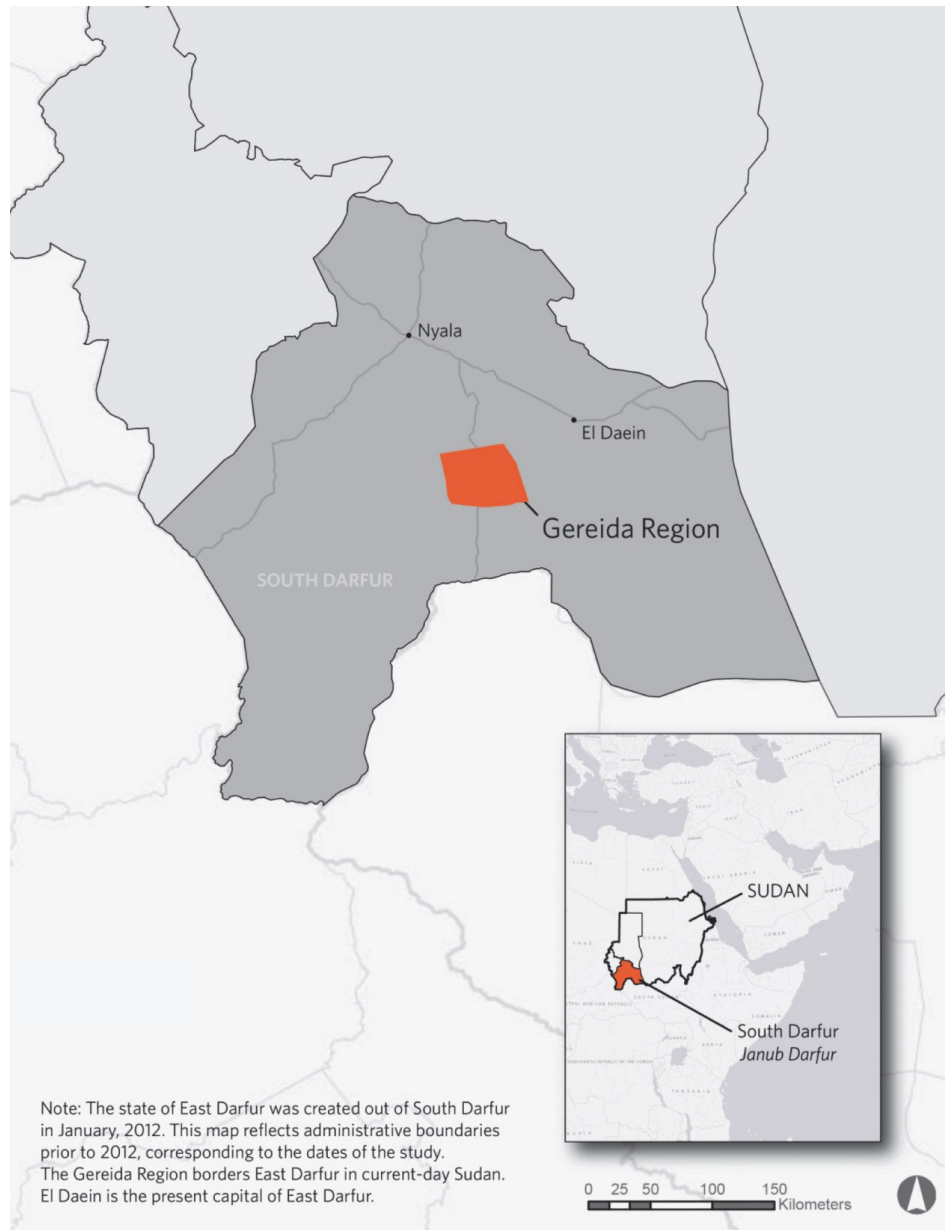


Figure 2. Map of Gereida Region.

Data source: GADM database of Global Administrative Areas, January 2012.

<http://www.gadm.org/> (accessed August 25, 2013).

resolution, the area that is captured in a single image is smaller. The three remote sensing methods (Supervised Classification, Change Detection, and Feature Extraction) are semi-automated processes that can aid in the manual analysis of satellite imagery. These methods will be discussed more fully in this article. Data limitations occurred during this study causing some inconclusive results, but Feature Extraction emerged as a remote sensing method with positive results, indicating that it could be a useful tool to support eye-witness testimony gathered by human rights organizations (Table 1).

Remotely sensed data has been used as evidence of systemic human rights violations in Darfur, Sudan since 2003. The U.S. State Department's Humanitarian Information Unit used satellite imagery and Geographic Information Science (GIS) data to map where villages had been destroyed, allegedly by the Sudanese government, as well as other humanitarian issues that affected vulnerable populations like droughts and flooding.<sup>6</sup> In addition to the higher resolution imagery like those used to identify destroyed villages,



Table 1. Study results and conclusions overview.

Method	Imagery used	Results	Conclusions
Supervised Classification	IKONOS: Before Attacks	<ul style="list-style-type: none"> <li>• Mahalanobis distance classifier performed most accurately</li> <li>• Village classification accuracy: 78.54%</li> <li>• Total pixels classified as villages: 36.53% (actual is 3.27%)</li> </ul>	Inconclusive: High rate of false positives
	IKONOS: After Attacks	<ul style="list-style-type: none"> <li>• Mahalanobis distance classifier performed most accurately</li> <li>• Village classification accuracy: 78.70%</li> <li>• Total pixels classified as burnt villages: 12.93% (actual is 3.27%)</li> </ul>	Inconclusive: High rate of false positives
	Landsat ETM+: Before Attacks	<ul style="list-style-type: none"> <li>• Mahalanobis distance classifier performed most accurately</li> <li>• Village classification accuracy: 45.47%</li> <li>• Total pixels classified as villages: 27.62% (actual is 0.55%)</li> </ul>	Inconclusive: High rate of false positives and low rate of accuracy
	Landsat ETM+: After Attacks	<ul style="list-style-type: none"> <li>• Mahalanobis distance classifier performed most accurately</li> <li>• Intact village classification accuracy: 71.44%</li> <li>• Burnt village classification accuracy: 70.56%</li> <li>• Total pixels classified as villages: 38.27% (actual is 0.55%)</li> </ul>	Inconclusive: High rate of false positives
Change Detection	IKONOS N/R/B IKONOS N/R/G Landsat 4/3/2 Landsat BuRa	<ul style="list-style-type: none"> <li>• No clear visual patterns of change resulted at any of the change thresholds</li> </ul>	Inconclusive: No clear patterns
Feature Extraction	IKONOS N/R/B	<ul style="list-style-type: none"> <li>• Huts correctly identified: 83.89%</li> <li>• False positive rate: 34.09%</li> </ul>	Inconclusive: High accuracy, but also high rate of false positives
	IKONOS N/R/G	<ul style="list-style-type: none"> <li>• Huts correctly identified: 47.43%</li> <li>• False positive rate: 17.73%</li> </ul>	Inconclusive: Low accuracy, but low rate of false positives
	Kernel Density Estimation (IKONOS N/R/G imagery)	<ul style="list-style-type: none"> <li>• Villages identified (no masking): 43/77 - 55.84%</li> <li>• Villages identified (cloud masking): 43/54 - 79.62%</li> </ul>	Inconclusive, but positive: No huts were extracted in the clouded areas, but a high rate of correctly identified villages with KDE after clouds were masked

medium resolution imagery can also be used to examine indirect results of violence, such as abandoned agricultural areas or the disappearance of livestock. Remote sensing methods can give researchers information that can be corroborated by on the ground accounts, or eyewitness reports from victims. Marx and Goward<sup>7</sup> argue, however, that methods have changed very little since 2003, and very few organizations have used

either high resolution imagery or medium resolution imagery, like MODIS (Moderate-Resolution Imaging Spectroradiometer, a sensor aboard the Terra and Aqua satellites), to track or detect fires that are violence related. Less than thirty academic articles are published on the subject in a given year, but since 2000, burned area detection has increased in use, based on a recent survey.<sup>8</sup>

High resolution satellite imagery has been studied as a way of counting affected population by the traces of systematic burning of huts in villages. Sulik and Edwards<sup>9</sup> conducted a pilot project in 2010 to develop tools to identify villages and huts using high-resolution satellite imagery. The goal of the study was to determine the feasibility of accurately quantifying the number of huts for a given village using Feature Extraction methods, in this case for a village in Darfur, Sudan. Because of the limited access to Darfur, the estimates of death tolls from 2003 to late 2009 vary widely; 200,000-400,000 deaths, as reported by human rights organizations, down to the government of Sudan's official number of 9,000. This tool could be applied in the future to determine overall population in an area and population shifts as the result of loss/addition of dwellings, and is also suggested by the authors to be useful for advocates and policy-makers to circumvent the on-the-ground data collection limitations.<sup>10</sup>

The AAAS Geospatial Technology and Human Rights program provided Sulik and Edwards with standard Quickbird images of Jonjoma village in North Darfur, Sudan. A binary classification was conducted to separate the huts (and hut material) from all other features (such as soil or rock), which are considered background noise. A binary classification is a method in which the computer analyzes each pixel in the image and determines if it matches hut material or does not by using the spectral signatures of the pixels. A spectral signature is the amount of electromagnetic radiation (sunlight) reflected for a range of light wavelengths. The signature acts almost as a fingerprint for an object or material, and can be used to group pixels together by their shared properties (classification). The classification results were overlaid on pre-attack and post-attack imagery to identify any changes. Some errors occurred, specifically tree shadows causing false positives because they have a similar spectral signature, size, and shape as thatched huts, making it difficult to distinguish between the two. The techniques discussed in the article are accurate enough to warrant further investigation (67% identification accuracy), and would prove useful for most semi-desert landscapes where it is difficult to separate individual settlement structures from surrounding features.<sup>11</sup>

As new satellite technology increases spatial resolution, affordability, and faster access, scientific research points to a greater use of remote sensing and GIS in the future for the study of human rights issues. Mass violence and human rights violations have been major problems for the world populace, and the use of satellite imagery to monitor those issues by human rights organizations is growing based on the research and projects being published. Based on this research, searching for human rights violations by examining the loss of huts in rural areas is a useful tool to corroborate victim and eye-witness testimony. By using Feature Extraction methods and applying it in a timely fashion to other areas that have reports of violence, a faster and more thorough understanding of the incident or incidents can give governments and organizations more tools to respond to, and possibly forestall, deaths in situations of mass violence.

## Study Area

The history of violence in Darfur has been well documented,<sup>12</sup> and this article uses attacks that occurred in 2006 as a focus for the remote sensing methods being studied. This study concentrates on the area around the town of Gereida (Figure 2), approximately 100 km south of the Janub (South) Darfur capital of Nyala in Sudan. Amnesty International reported that on February 16, 2006, villages in the surrounding area around Gereida were attacked by the Janjaweed. Thirty-three people were killed, villages were looted, and over 1,500 heads of cattle and camels were stolen. The villages were inhabited by members of the Masalit tribe, a non-Arab ethnic group that resides in Chad and Sudan, and part of the Darfuri rebel alliance.<sup>13</sup> The Masalit live in a primarily agricultural society, growing peanuts, sorghum, millet, and other grains as both cash crops and subsistence.<sup>14</sup> Between November 2005 and February 2006, over 300 people were killed in the region, with more than sixty villages burned. The number of internally displaced persons (IDPs) grew to nearly 90,000, swelling Gereida with makeshift tents and shelters.<sup>15</sup> As of 2010, Gereida was the largest IDP camp in the world with over 100,000 displaced people.<sup>16</sup> The town of Gereida and the IDP camp are immediately to the north of the area covered by the high resolution IKONOS satellite imagery in this study, and thus outside of the study area. Known villages in the high resolution imagery study area that were destroyed were Tigla, Arediba Araj, Umrokbi, Gubai, Umtraigo, Gandako, Hashaba, and Rajaj.<sup>17</sup> Reports on villages around, and including, Tigla indicate that prior to the attacks in February 2006, 48 settled locations were counted. After the attacks, all 48 locations were destroyed, which had contained 1,660 structures.<sup>18</sup>

## Data and Methodology

### Methods Overview

Remote sensing is the process of acquiring and analyzing data without physically contacting the target, and in this article will refer to imagery collected by satellites. Three remote sensing methods (Supervised Classification, Change Detection, and Feature Extraction) were performed on imagery from both before the attacks (before imagery) in February 2006 and after the attacks (after imagery) to examine any useful trends that could be used by researchers when manually examining the satellite data (Figure 3). As illustrated in Figure 3, no huts exist after the attacks in the image on the right.

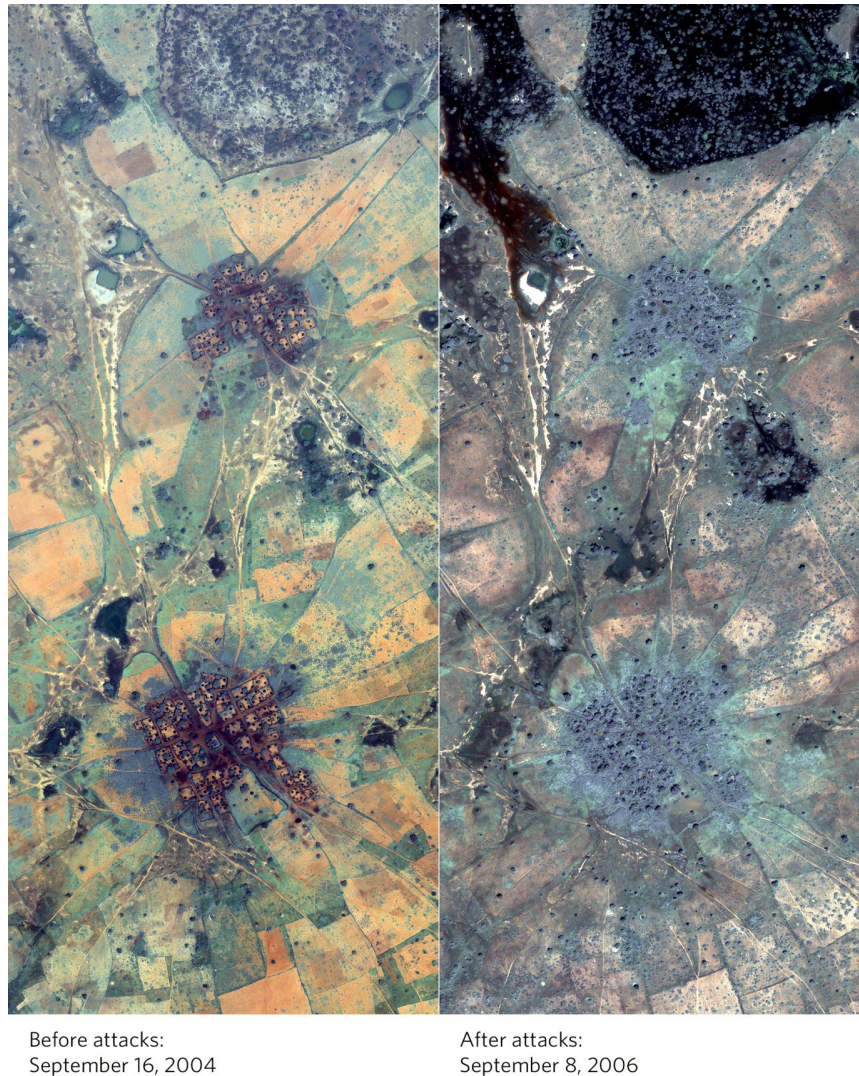


Figure 3. Satellite imagery of a village before and after the February 2006 attacks. Satellite imagery courtesy of the DigitalGlobe Foundation / GeoEye.

Satellite imagery is typically a digital file composed of millions of pixels, similar to images from a digital camera. There are two differences, however. Satellite imagery is georeferenced (tied to specific spots on earth using a coordinate system like latitude/longitude), and each pixel contains data for the sunlight reflected from objects in different wavelengths – from visible light like red or blue wavelengths, to invisible light like near infrared or ultraviolet wavelengths. Every material reflects light a certain way, and the combination of data from different wavelengths can create a spectral signature for that material. The data for each wavelength spectrum (blue light, near infrared light, etc.) is stored in separate files called bands, and when these bands are combined, can be used to create stacked imagery. This stacked imagery can be created to show the actual



true color of an area (RGB), or create false-color imagery to highlight differences in another wavelength (Near Infrared/Red/Blue is often used to monitor vegetation, as infrared wavelengths are highly reflected by living vegetation). Each pixel in georeferenced imagery represents a distance that can be used in analysis. Satellite imagery collected using a sensor that has a 0.5 meter spatial resolution, for example, means that each pixel is a square 0.5 meters wide. Medium resolution imagery has a coarser spatial resolution (less detail), and a sensor like Landsat ETM+ has a resolution of 30 meters.

Supervised Classification is a method to classify pixels by their spectral signature. As each material (soil, water, etc.) has a spectral signature, pixels that share similar spectral signatures can be classified by a remote sensing program. In Supervised Classification, the user provides sample signatures that the program should classify each pixel into by highlighting areas as training sites, while Unsupervised Classification lets the computer group pixels by shared signatures automatically and the user decides what those classes are after the fact. Supervised Classification is useful for identifying classes in the imagery like forests, water, and urban area. Problems can arise, however, when lower spatial resolution imagery is used, because there is a higher probability that pixels will combine two different spectral signatures, making classification difficult.

Change Detection typically takes two sets of classified imagery (either supervised or unsupervised) from the same geographic area and measures the number of pixel changes from one class to another. This can be very useful in identifying what percentage of forest has been converted to agriculture, or where flooding has occurred, for example. Change Detection can also be used for unclassified imagery by identifying the change in value of the spectral signatures for each specific pixel. For example, burned material will have the spectral values decrease, and Change Detection can identify those changes if the decrease is large enough.

Feature Extraction is a method that combines identification of spectral signatures with an algorithm to detect spatial patterns, such as rectangular objects or linear roadways. This method is often used for detecting buildings and roads as they are fairly homogenous spectrally and uniformly geometric, and because Feature Extraction can be much faster than manually tracing a roadway or building outline by hand. Users develop training sites, which tell the program what to look for, both spatially and spectrally. In the case of this study, the training sites were created by manually outlining a subset of huts in the study region using circles. The output data in Feature Extraction is different than in either Supervised Classification or Change Detection. In the two latter methods, the output is raster data, which consist of pixels. In Feature Extraction the output is vector data, which is data composed of points, lines, and polygons. These vector data can be easily imported into a GIS program and analyzed using a variety of tools. In the case of this study, point data were used to demarcate the huts, and a kernel density function was performed on the vector output data.

A kernel density function is used to visualize the frequency of objects in a specific area, and is also known as a hotspot map. The function counts the number of points surrounding each point by calculating the distance from the target point to every point in the study area (using a mathematical method called inverse distance weighting). The points are weighted by the number and distance of other points to it (with a nearer and more densely concentration of points giving more weight), and a color map is created using the weighted averages. The darker areas have the highest concentration of points, while the lighter areas have the lowest concentration. The outcome is a map that visualizes where the highest concentrations of points are located, allowing a viewer to quickly identify areas that are densest.

Supervised Classification, Change Detection, and Feature Extraction were used in this study in an attempt to identify useful methods for verifying reports of burned villages. Villages in Darfur are composed of conical huts (also known as ghotiyas or tukuls) in small compounds. The huts have walls constructed with mud bricks and a thatched roof made from local grasses.<sup>19</sup> Fences surrounding the compounds are also made of local grasses and branches, and enclose a large residential hut surrounded by multiple smaller huts that hold large ceramic pots used for food and grain storage. Small corrals are sometimes built inside the fences using local wood to hold livestock. Dirt pathways and roads are visible in the satellite imagery connecting the villages and hut compounds, and can be used to locate villages by tracing paths between them. As huts are burned during an attack, the charred remains form a black circle of ash where the walls once stood, while ceramic pots are often smashed to prevent repopulation.<sup>20</sup>

### *Data*

Three types of satellite imagery were acquired for this study. The high resolution imagery used to identify individual huts was IKONOS imagery, which was acquired through the DigitalGlobe Foundation's Satellite Imagery Grant.<sup>21</sup> The DigitalGlobe Foundation is a non-profit organization that awards imagery

grants to researchers and students for use in a variety of studies including climate change research, forestry management, national security, and human rights. The DigitalGlobe Foundation graciously awarded satellite imagery for this study for an area of villages in the Gereida region, corresponding to dates from before and after the February 2006 attacks. High resolution OrbView 3 imagery, which was used as reference imagery for the methods, and medium resolution Landsat ETM+ imagery were acquired through the United States Geological Survey's (USGS) EarthExplorer. The Landsat ETM+ imagery was used for Supervised Classification and Change Detection, as the spatial resolution was too low to identify huts using Feature Extraction.

Observation satellites like IKONOS have sensors that collect data across multiple wavelengths and are broken into bands. Each band focuses on a certain wavelength spectrum (such as blue visible light or near infrared light). These different bands have different spatial resolutions, depending on the strength of the light it is capturing. Panchromatic bands capture all visible light, producing black and white imagery, and tend to have higher spatial resolutions than other bands. The multispectral bands (Near Infrared, Red, Green, and Blue bands) can be combined with the panchromatic band to increase the spatial resolution, resulting in pan-sharpened imagery. This article will abbreviate near infrared bands as N, red bands as R, green bands as G, and blue bands as B.

All satellite imagery was acquired in the GeoTiff format, and was processed in ERDAS IMAGINE and converted to .img format. Supervised Classification, Change Detection, and Feature Extraction were performed in ERDAS IMAGINE, and vector files were exported into ArcGIS and analyzed. The normalized burn ratio imagery was created using the image calculator in Idrisi Selva, and exported into ERDAS IMAGINE. Feature Extraction was performed in ERDAS IMAGINE using the Feature Analyst module by Overwatch Systems.

The high resolution IKONOS panchromatic (black and white) imagery has 0.82 meter resolution, with a multispectral resolution of 3.2 meters. The panchromatic and multispectral imagery can be merged to create 1 meter resolution pan-sharpened data. The satellite has a swath width of 11.3 kilometers, which is the width of the area collected in the imagery. Four bands were used in this study; Blue (0.445 – 0.516  $\mu\text{m}$ ), Green (0.506–0.595  $\mu\text{m}$ ), Red (0.632–0.698  $\mu\text{m}$ ), and Near Infrared (0.757–0.853  $\mu\text{m}$ ).<sup>22</sup> Three dates were acquired for the study area, two dates before the attacks (September 16, 2004 and September 24, 2004), and one date after the attacks (September 8, 2006). Pan-sharpened false-color infrared (N/R/G and N/R/B) imagery was created, as well as pan-sharpened true-color imagery (R/G/B).

High resolution Orbview 3 imagery was used as reference in identifying features in the Landsat ETM+ imagery. The Orbview 3 imagery was obtained through the USGS EarthExplorer for dates before and after the attacks. Five panchromatic images were acquired with 1 meter resolution for April 29, 2005 (two images) and December 27, 2006 (three images). The data for both dates were adjacent to each other and were in the region covered by the Landsat ETM+ imagery. As the IKONOS after attack imagery did not contain any existing villages or huts, the Orbview 3 imagery was used to identify villages that existed in late 2006. These villages were used to create training sites for the Supervised Classification of the Landsat ETM+ imagery, as well as reference for analyzing the Change Detection results. The Orbview 3 imagery did not show any signs of genocide or burned villages after the attacks in February 2006. Orbview 3 imagery was not used for the remote sensing methods testing.

Landsat ETM+ imagery was collected for before and after the attacks, but with a larger period of time between them. The dates collected were for October 17, 2000 and August 31, 2006. Landsat ETM+ has a swath width of 183 kilometers, and eight bands were available, ranging from 15m - 60m resolution. The panchromatic band, band 8, has a 15 meter resolution, while bands 1 (B), 2 (G), 3 (R), 4 (N), and 7 (Mid-Infrared) have spatial resolutions of 30 meters.<sup>23</sup> Multiple band combinations were created, all pan-sharpened to 15 meter resolution using band 7. False-color infrared imagery was created using bands 4, 3, and 2 (N/R/G). A second false-color infrared image was created using a combination described by Sulik and Edwards<sup>24</sup> that stacked bands 4, 3, and 1 (N/R/B). A normalized burn ratio (BuRa) image, taken from research performed by Key and Benson<sup>25</sup> was created using an image calculation in Idrisi:  $\text{BuRa} = (\text{B4} - \text{B7}) / (\text{B4} + \text{B7})$ . These bands show the greatest sensitivity to fire and burn effects, as band 7 increases with fire damage, and band 4 decreases.<sup>26</sup>

Landsat 7, the satellite that collects the Landsat ETM+ imagery, had its Scan Line Corrector (SLC) fail in May of 2003, resulting in a zig-zag type pattern of the imagery, and the post-collection correction results in the duplication of data in portions of the imaged area.<sup>27</sup> Approximately 22 percent of a Landsat ETM+ scene will be lost due to the SLC failure, with the errors the most pronounced along the edges of the scene.<sup>28</sup> The Gereida region and the IKONOS imagery is located in the southwest corner of the Landsat imagery, and therefore the study area for the 2006 Landsat ETM+ imagery has errors associated with the SLC failure.

The Landsat ETM+ imagery that was acquired was corrected, however errors persisted and the 2006 Landsat ETM+ imagery is not a completely accurate representation of the area, even though it is still useful.

One problem that was encountered early in the study was that the high resolution IKONOS imagery had clearly defined villages and huts in the before imagery, while after the attacks all villages and huts in the study region were burned, leaving no control data (remaining villages) to examine before and after changes. Lower resolution Landsat ETM+ imagery was acquired to attempt to compensate for the lack of intact villages in the IKONOS imagery. As the Landsat ETM+ data encompassed the IKONOS region, villages identified in the IKONOS imagery were used to find pixels with the same spectral signatures in the Landsat ETM+ imagery, as well as classifying pixels that had similar spectral signatures to burned villages in the after imagery. Orbview 3 imagery was also used in a similar fashion to identify villages, as well as shrubs, grasslands, and other features, in the Landsat ETM+ imagery (Figure 4). However, the Orbview 3 imagery did not contain any burned villages for either date collected, and was only used as verification data to compare the before and after classified Landsat ETM+ imagery.



Figure 4. Orbview 3 imagery showing a village to the east of the study area. Satellite imagery courtesy of the USGS EarthExplorer.

As this study was intended to determine if there were any useful semi-automatic ways to analyze burned villages to assist manual examination of imagery, no masking of clouds or other objects took place. Clouds can cover portions or all of an area in satellite imagery, and a typical method to reduce the distorted or missing data under cloud cover is to segment the imagery into clouded and cloud free



portions, called masking. Some imagery, particularly the IKONOS imagery from before the attacks, had cloud cover (September 16, 2004 imagery had 22% cloud cover, and September 24, 2004 imagery had 17% cloud cover). The intention of not masking cloud cover was to ascertain if any useful information could be extracted from those areas for use in a manual analysis, as some villages were visible beneath the cloud cover upon visual inspection.

### *Technical Details*

Supervised Classification uses the spectral signatures of pixels in the imagery to classify them into feature classes determined by the user. The goal of the Supervised Classification method in this article was to identify villages in the study area, both intact and burned. Once the villages have been identified in both before and after attack imagery, theoretically, they can be counted and paired up with human rights organization reports to corroborate violations. Multiple Supervised Classifications were conducted on both the high resolution (IKONOS) and lower resolution imagery (Landsat ETM+) using ERDAS IMAGINE. False-color infrared imagery was created for both the IKONOS and Landsat ETM+ imagery by stacking the near-infrared, red and green bands (bands 4, 3, and 2). The resulting multispectral imagery was pan-sharpened using the panchromatic band (band 8 in the case of Landsat ETM+) in a resolution merge in ERDAS IMAGINE, resulting in the IKONOS imagery having a spatial resolution of 1 meter, and the Landsat ETM+ imagery having a spatial resolution of 15 meters.

Training sites were developed by hand for different landscape features, and were only created for clearly defined features. Google Earth satellite imagery, photography from Google Earth, and Orbview 3 imagery were used to help identify and confirm features. The features used were agriculture, arroyo (dry river beds), grassland, open water (rivers, lakes, and ponds), rocks (in the northern section of the Landsat ETM+ outcrop existed), trees and brush, and villages (both intact and burned).

The after imagery included existing villages and burned villages, of which the Landsat ETM+ imagery had both, while the IKONOS imagery only had burned villages. In addition, individual huts were identified for the IKONOS imagery to attempt high resolution classification. The total number of huts identified was 3,190 in 77 villages. The definition of a village in this study was a clustering of three or more compounds, which consisted of huts surrounded by fencing. Huts were identified based on previous articles' descriptions, in particular Sulik and Edwards 2010 article on Feature Extraction in Darfur.<sup>29</sup> Classification training sites were created for the before and after attack imagery using separate signatures, because features had changed between the time periods and different signatures were necessary for the IKONOS and Landsat ETM+ imagery.

Three classification techniques were performed on the imagery using the training sites: Gaussian Maximum Likelihood, Minimum Distance to means, and Mahalanobis Distance. The maximum likelihood classifier uses variance and covariance to identify the statistical probability of a given pixel being part of a predetermined class.<sup>30</sup> Maximum likelihood is considered the most powerful method, and one of the most widely used.<sup>31</sup> Minimum distance is a method that, by using a scatterplot of all pixels, identifies the minimum distance between a given pixel and the mean of a class of predetermined pixels. Because of the simplicity, minimum distance fails to take into account variations in spectral signatures, and "is not widely used in applications where spectral classes are close to one another in the measurement space and have high variance".<sup>32</sup> Regardless, this method was employed in this study as it is a commonly used tool and is accessible to researchers. Mahalanobis Distance classification is a method based on the minimum distance algorithm, but it uses a covariance matrix. It is regarded as the most accurate of the three principle classification methods in ERDAS IMAGINE and is most used for cluster analysis.<sup>33</sup> One reason for the high accuracy rates is that it can filter out shadows in addition to classifying highly varied clusters of objects.<sup>34</sup> As villages tend to be highly clustered, and trees and huts cast shadows depending on what time of day the imagery was taken, in theory the Mahalanobis distance classification would be ideal for identifying villages in a given area.

The three classification methods were performed using five sets of satellite imagery. Three IKONOS imagery sets were classified: September 16, 2004, September 24, 2004, and September 8, 2006. Two sets of Landsat ETM+ imagery were classified: October 17, 2000 and August 31, 2006. The three classification methods were performed on the false-color infrared imagery for all five sets of data, resulting in fifteen classification results. The results were saved as .img files, and contingency matrices were calculated (Tables 2, 3, 4, and 5). The contingency matrices show the number of pixels that are classified for each class, as well as

percentages of pixels classified per class, and the accuracy of each class classification in relation to the training site pixels (i.e. what percentage of pixels in the training sites for each class were classified correctly). An analysis of the percentages in conjunction with the number of pixels was used to determine which classifier would be most useful to identify burned villages.

The remote sensing method of Change Detection is used to “discriminate areas of land cover change between dates of imaging.”<sup>35</sup> Typically, classified imagery (either resulting from Supervised Classification or Unsupervised Classification) from two time periods of the exact same study area is used to determine if pixels have changed classes, but this is dependent on the quality and accuracy of the classification methods. The Supervised Classification results in this study did not produce satisfactory data that would be beneficial for Change Detection. As a result, this study used stacked imagery that was not classified in any form, with multiple combinations of bands tested. The expectation in using the stacked imagery is that because villages can be identified by visual examination, and burned villages can be identified in the false-color infrared imagery in particular, the Change Detection method would be able to identify villages that have changed from “existing” to “destroyed” based on the dramatic change in pixel values. Both the IKONOS imagery and the Landsat ETM+ imagery were used to detect changes in the spectral signatures of the study area. The IKONOS Change Detection used the false-color N/R/G and N/R/B imagery. The Landsat Change Detection used false-color infrared imagery and the normalized burn ratio calculated imagery. Change Detection was performed between the before and after imagery, and vector outlines of the villages were layered on top for visual examination of the results. As this study is to find methods that aid in the manual examination of satellite imagery, patterns of change in and around villages were visually analyzed. Thresholds of change were used in an attempt to isolate villages or patterns in the data. The thresholds are percentages of change in the pixels’ signature, either an increase or decrease in intensity per band. Both IKONOS and Landsat ETM+ imagery used thresholds of 5% to 50%, with an increase incrementally by 5%.

Feature Extraction is a method to discern features by a combination of shape, size, and spectral signature. This method is very useful for identifying buildings and streets due to their geometric patterns. This study used Feature Extraction in an attempt to isolate individual huts, which when compared between before and after imagery, would give an estimate on how many huts were burned and where. The problem with the imagery acquired is that all huts in the imagery from after the attacks took place had been burned and none survived, based on a visual analysis. This method explored Feature Extraction in the before imagery only, with the intention that the method could be applied to other regions in the area in future studies if they have both surviving and destroyed villages or huts in the same data.

Feature Extraction was performed using Feature Analyst for IMAGINE. The IKONOS imagery was used for Feature Extraction, as the Landsat ETM+ imagery was too coarse to identify individual huts. Two pan-sharpened stacked images (N/R/G and N/R/B) were used for the Feature Extraction. The second combination (N/R/B) was used in another Feature Extraction study that resulted in satisfactory results.<sup>36</sup>

Using the Feature Analyst vector tools, polygons were placed over randomly picked huts across the image, with the polygons being created in a circular fashion to match the borders of the huts. 98 huts were recorded in the feature class. Parameters were set in the Learning module of the program, which instructs the program as to what shape the target features are. The closest parameter to the size and shape of the huts was Bull’s-eye 1, which was circular with a pattern width of 5 cells. The Feature Analyst manual recommends the Bull’s-eye 1 for small man-made features. The extraction process was started, and two sessions of hierarchical learning were conducted to teach the Feature Extraction module the correct and incorrect polygons that represent the huts. The Remove Clutter by Shape function was performed on correctly and incorrectly identified features, with the perimeter, area, and compactness parameters selected. An aggregate function was first performed, which eliminated any polygons with less than 15 pixels, but this resulted in poor outcomes due to large areas of pixels being identified as huts that bear no relation in shape to the training polygons, therefore the shape function was used. This function resulted in a series of polygons, which were converted to points in the program, and the shapefiles were brought into Esri ArcMap for analysis.

Additionally, the hand count of huts in the study area used in the classification method was utilized for Feature Extraction, with a total of 3,190 individual huts. Polygons were created to count a subset of these huts in two villages, and an outline of all villages in the study area, resulting in a total of 77 villages. These data were imported into ArcMap for analysis, and comparison counts between the extracted data and the hand-counted data were performed.



## Results

### Supervised Classification Results

#### Before Attacks Imagery Classification: IKONOS (2004 09 16)

The Supervised Classification method performed on the IKONOS imagery from before the attacks delivered inconclusive results. The Supervised Classification method using the village signature with the highest accuracy rate was the Mahalanobis Distance classification (Table 2). Table 2 compares the percentage of pixels accurately classified with manually identified pixels. Values other than total pixel counts are percentages. Dark green values signify high accuracy (above 80%). Light green values signify medium accuracy (between 50% and 80%). Orange values signify low accuracy (less than 50%). Percentage of Total indicates the number of pixels in the image classified compared to all pixels. For pixels identified as villages, a high percentage is a poor result as villages constitute a very small percentage of the overall study area. In these data, the percentage of total pixels identified as villages is 36.52%. Classified pixels identified as villages were manually identified as agriculture 30.83% of the time, which is a poor result.

Table 2. Supervised Classification accuracy results for IKONOS imagery from before the September 16, 2004 attacks.

		Manually identified pixels			
		Villages	Agriculture	Trees and Shrubs	Water
Classified pixels	Villages	78.54	30.83	22.07	11.01
	Agriculture	6.6	67.58	0.73	0.36
	Trees and Shrubs	1.93	0.14	34.91	2.99
	Water	0.53	0.01	1.35	74.39
	Arroyo	12.4	1.44	40.94	11.25
	Total pixel count	156502	751306	14347	22284

		Manually identified pixels		
		Arroyo	Total pixel count	Percentage of Total
Classified pixels	Villages	32.65	488920	36.52%
	Agriculture	9.11	554148	41.39%
	Trees and Shrubs	4.01	25583	1.91%
	Water	14.44	74616	5.57%
	Arroyo	39.78	195485	14.60%
	Total pixel count	394313	1338752	100.00%

Mahalanobis Distance is a classifier that performs best on highly clustered objects, and was expected to have the highest accuracy among the three classifiers. The villages were accurately classified with a rate of 78.54%, with the majority of the other pixels originally trained as villages being classified as arroyo. All of the Supervised Classifications had problems with the clouds in all of the IKONOS imagery, as a cloud mask was not applied. The downside of this classification, and all others performed on this imagery is that a large amount of pixels in the entire image were classified as villages (36.52%). The IKONOS imagery, when manually counted, had 11.69% of pixels classified as villages, while the Landsat ETM+ imagery had 3.27% pixels classified as villages. This resulted in an unsuccessful classification when paired with a visual analysis of the imagery to determine if villages could be identified (Figure 5). In addition to villages being used as training pixels, another classification signature was created using individual huts, and a binary classification (a method in which each pixel is classified as one of two classes) and multi-feature classification were performed. Both of these performed poorly, as the accuracy rate was satisfactory (97.18% for multi-feature and 84.62% for binary), but a high percentage of pixels in the entire image were classified as huts (10.21% in the multi-feature and 41.78% in the binary classifications) which is not useful in identifying villages (Figure 6). The other IKONOS data set from 2004 (September 24, 2004) had similar results.



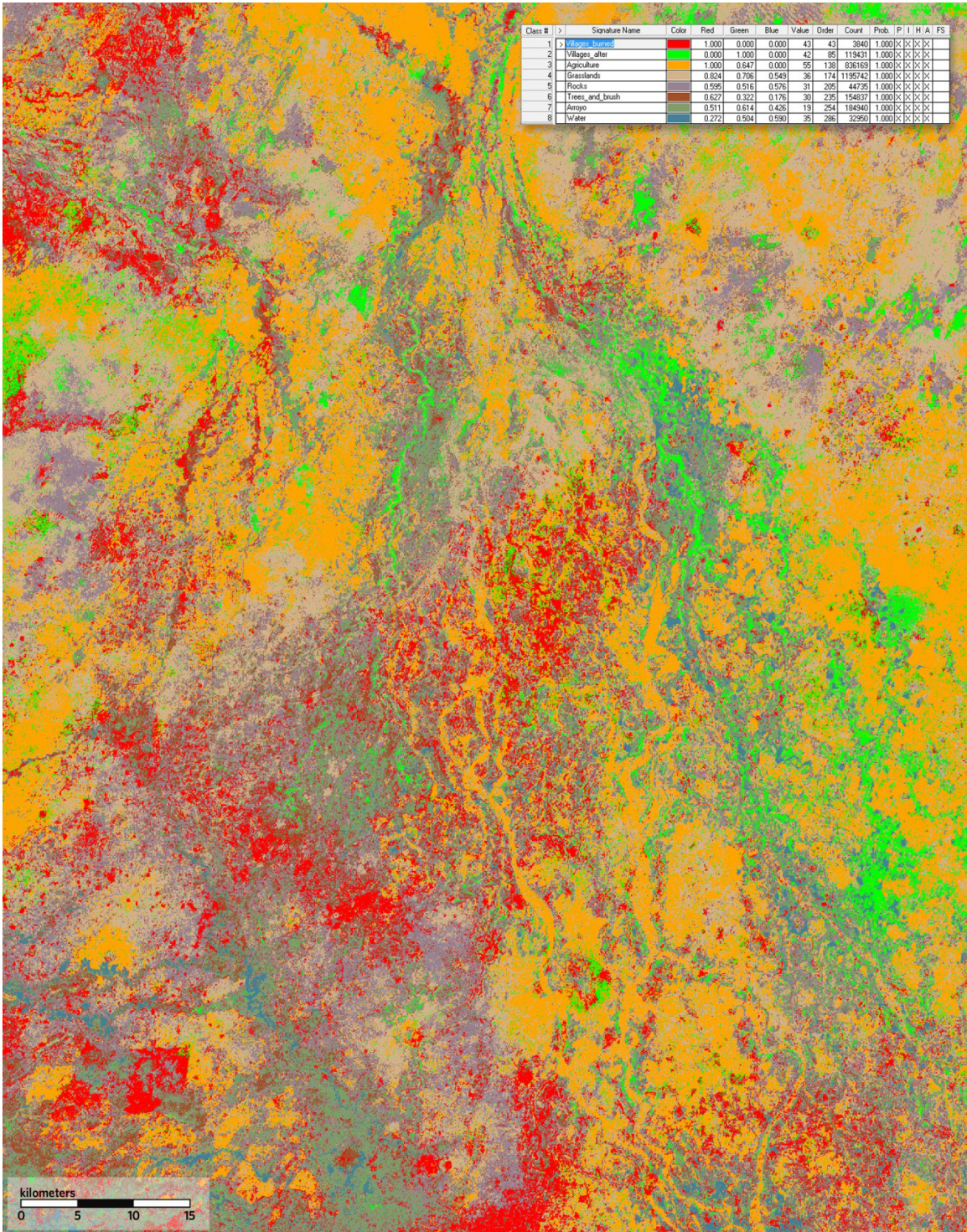


Figure 5. Supervised Classification results.  
Satellite imagery courtesy of the DigitalGlobe Foundation / GeoEye.



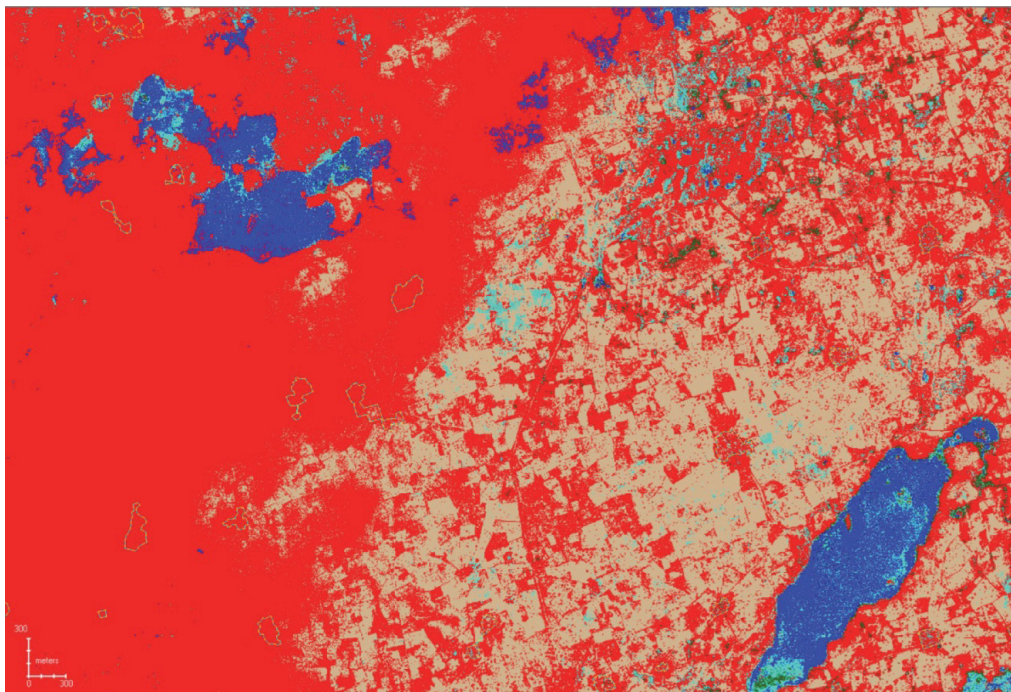


Figure 6. Supervised Classification results – IKONOS imagery before attacks.  
Satellite imagery courtesy of the DigitalGlobe Foundation / GeoEye.

#### **After Attacks Imagery Classification: IKONOS (2006 09 08)**

The Supervised Classification method performed on the IKONOS imagery from after the attacks delivered inconclusive results. The classification that performed with the highest accuracy rate among the three was maximum likelihood (Table 3). Table 3 compares the percentage of pixels accurately classified with manually identified pixels. Values other than total pixel counts are percentages. Dark green values signify high

Table 3. Supervised Classification accuracy results for IKONOS imagery from after the September 8, 2006 attacks.

		Manually identified pixels			
		Burned Villages	Agriculture	Trees and Shrubs	Grassland
Classified pixels	Burned Villages	78.7	2.14	16.38	0.73
	Agriculture	0.6	78.05	1.53	4.25
	Trees and Shrubs	16.53	3.44	62.15	9.77
	Grassland	1.51	12.57	6.15	79.76
	Water	0.34	0.06	0.81	0.01
	Arroyo	2.32	3.74	12.98	5.48
	Total pixel count	1134946	4488366	756508	852859

		Manually identified pixels			
		Water	Arroyo	Total pixel count	Percentage of Total
Classified pixels	Burned Villages	0.01	2.98	1173611	12.93%
	Agriculture	0.17	0.89	3574086	39.37%
	Trees and Shrubs	0.48	23.78	1328047	14.63%
	Grassland	0	30.22	1857726	20.46%
	Water	98.33	1.7	70993	0.78%
	Arroyo	1.01	40.42	1074790	11.84%
	Total pixel count	27830	1818744	9079253	100.00%



accuracy (above 80%). Light green values signify medium accuracy (between 50% and 80%). Orange values signify low accuracy (less than 50%). Percentage of Total indicates the number of pixels in the image classified compared to all pixels. For pixels identified as villages, a high percentage is a poor result as villages constitute a very small percentage of the overall study area. In these data, the percentage of total pixels identified as burned villages is 12.93%. Classified pixels identified as burned villages were manually identified as trees and shrubs 16.383% of the time. Pixels classified as water had a very high accuracy rate – 98.33%.

A comparison between villages burned and villages that survived is not possible using these data, because all of the villages in this region were burned. The accuracy of burned villages in the classification was 78.7%, with agriculture having an accuracy of 78.05% and grasslands with an accuracy of 79.76%. All three classifications had high accuracy rates for water, with the maximum likelihood accuracy being 98.33%. However, as is the problem with the classification of the IKONOS 2004\_09\_16 imagery, the percentage of the entire image being classified as villages is high (12.93%), and a visual analysis confirms this as there are a large number of false positives if used to identify burned villages (Figure 7). The IKONOS imagery, when manually counted, had 11.69% of pixels classified as villages.

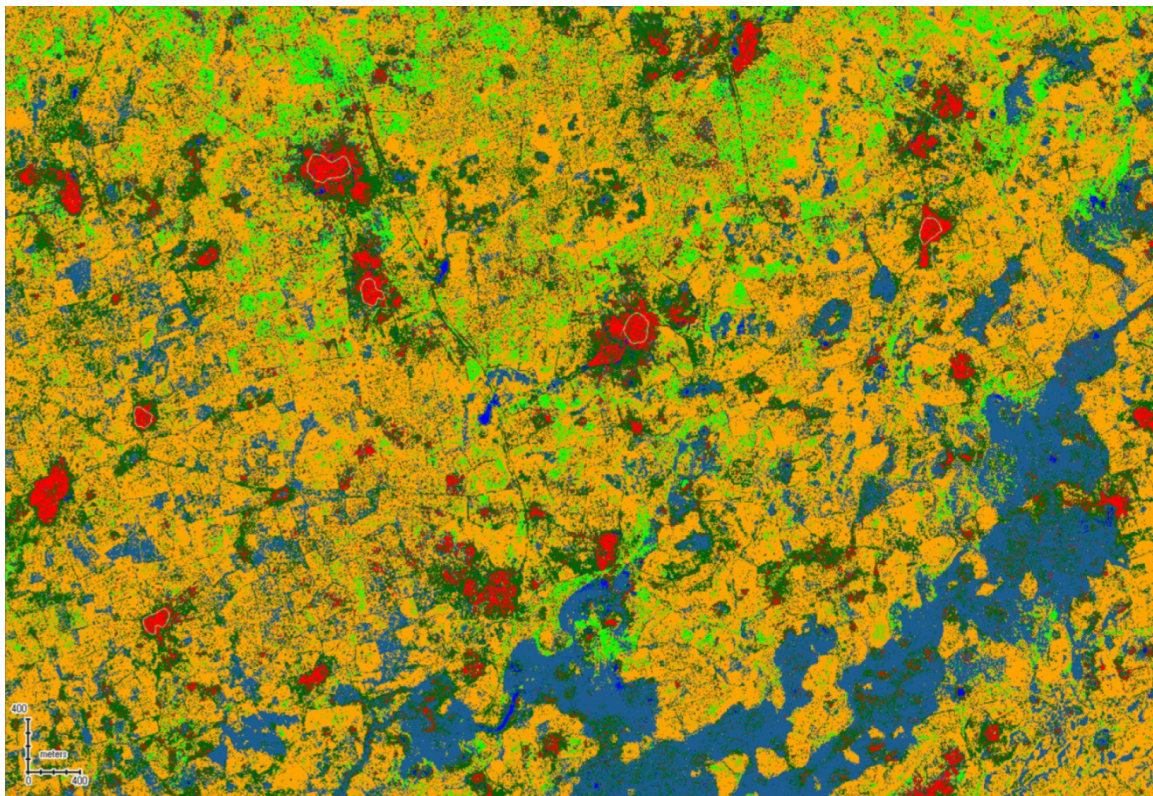


Figure 7. Supervised Classification results – IKONOS imagery after attacks. Satellite imagery courtesy of the DigitalGlobe Foundation / GeoEye.

#### **Before Attacks Imagery Classification: Landsat ETM+ (2000 10 17)**

The Supervised Classification method performed on the Landsat ETM+ imagery from before the attacks delivered inconclusive results. The most successful, in terms of accuracy rates, was the Mahalanobis distance classifier (Table 4). Village classification accuracy was 45.47%, while agriculture had an accuracy of 84.61% and water had an accuracy of 90.02%. Grassland classification performed poorly, with an accuracy of 27.62% (with the majority of the remaining pixels classified as village – 42.19%). 27.62% of all pixels in the image were classified as village. The Landsat ETM+ imagery had 3.27% pixels classified as villages. Similar results existed in with the other classification methods used (maximum likelihood and minimum distance). Visual analysis of the imagery resulted in no clear patterns relating to villages. Table 4, below, compares the percentage of pixels accurately classified with manually identified pixels. Values other than total pixel counts are percentages. Dark green values signify high accuracy (above 80%). Light green values signify medium

Table 4. Supervised Classification accuracy results for Landsat ETM+ imagery from before the October 17, 2000 attacks.

		Manually identified pixels				
		Villages	Agriculture	Trees and Shrubs	Grassland	Open Water
Classified pixels	Villages	45.47	9	11.07	42.19	0.27
	Agriculture	20.27	84.61	2.34	14.74	0.61
	Trees and Shrubs	7.43	1.46	40.09	4.68	2.9
	Grassland	7.27	2.66	0.4	29.56	0
	Open Water	0.21	0.03	9.93	0.01	90.02
	Arroyo	7.79	1.68	27.89	5.19	5.88
	Rocks	11.57	0.57	8.28	3.64	0.31
	Total pixel count	111448	592385	420608	1827929	25207

		Manually identified pixels			
		Arroyo	Rocks	Total pixel count	Percentage of Total
Classified pixels	Villages	3.27	12.82	939972	27.62%
	Agriculture	2.37	0.88	812589	23.87%
	Trees and Shrubs	13.96	11.14	329949	9.69%
	Grassland	0.04	0.38	566232	16.64%
	Open Water	13.95	4.57	120247	3.53%
	Arroyo	61.08	28.41	477856	14.04%
	Rocks	5.33	41.8	156705	4.60%
	Total pixel count	381234	44739	3403550	100.00%

accuracy (between 50% and 80%). Orange values signify low accuracy (less than 50%). Percentage of Total indicates the number of pixels in the image classified compared to all pixels. For pixels identified as villages, a high percentage is a poor result as villages constitute a very small percentage of the overall study area. In these data, the percentage of total pixels identified as villages is 27.62%. Classified pixels identified as villages were manually identified as grassland 42.19% of the time. Pixels classified as open water (90.02%) and agriculture (84.61%) had a high accuracy rate. Pixels identified as grassland had a low accuracy rate (29.56%), as over 42% were identified as villages.

#### **After Attacks Imagery Classification: Landsat ETM+ (2006 08 31)**

The Supervised Classification method performed on the Landsat ETM+ imagery from before the attacks delivered inconclusive results. The classification with the highest accuracy was the Mahalanobis distance classifier (Table 5). Burnt villages classification had an accuracy of 71.44%, and surviving villages had an accuracy of 70.56%. However, as with all of the other classifications performed in this study, a large amount of false positives exists (all pixels classified as villages, either burned or surviving, accounted for 38.27% of the total image). Agriculture and grasslands had satisfactory accuracy, however, particularly with the maximum likelihood classification (72.66% for agriculture and 66.33% for grasslands), and visual analysis shows that the classification generally matches the false-color infrared imagery. Areas around villages burned were typically grassland, while areas around surviving villages were typically agriculture. This could be useful in a future study in identifying abandoned villages, due to drought, famine, or violence, but only in a study examining past events. Visual analysis shows that the villages, especially cities such as El Daein close to the center of the study area, have a high concentration of agriculture radiating out, and the Supervised Classification method is able to capture this. Table 5 compares the percentage of pixels accurately classified with manually identified pixels. Values other than total pixel counts are percentages. Dark green values signify high accuracy (above 80%). Light green values signify medium accuracy (between 50% and 80%). Orange values signify low accuracy (less than 50%). Percentage of Total indicates the number of pixels in the image classified compared to all pixels. For pixels identified as villages, a high percentage is a poor result as villages constitute a very small percentage of the overall study area.



Table 5. Supervised Classification accuracy results for Landsat ETM+ imagery from after the August 31, 2006 attacks.

		Manually identified pixels				
		Villages before	Villages after	Agriculture	Grassland	Rocks
Classified pixels	Villages before	71.44	2.56	1.22	5.34	5.72
	Villages after	2.79	70.56	16.73	52.46	9.76
	Agriculture	0.89	14.33	72.99	10.88	0.44
	Grassland	0.29	3.5	3.92	12.4	1.31
	Rocks	2.84	1.75	0.38	5.85	31.04
	Trees & Shrubs	5.91	1.14	1.32	3.3	11.63
	Arroyo	15.84	5.66	3.46	9.77	40.07
	Water	0	0.48	0	0	0.03
	Total pixel count	3838	119436	836198	1195889	44731

		Manually identified pixels				
		Trees & Shrubs	Arroyo	Water	Total pixel count	Percentage of Total
Classified pixels	Villages before	5.94	4.59	0.09	100085	3.89%
	Villages after	8.93	7.88	0.08	884457	34.38%
	Agriculture	6.45	8.89	0.02	784171	30.48%
	Grassland	8	0.73	0	199582	7.76%
	Rocks	2.53	1.21	0.02	95325	3.71%
	Trees & Shrubs	7.05	2.97	0.04	73748	2.87%
	Arroyo	60.56	71.68	3.39	398508	15.49%
	Water	0.54	2.06	96.35	36996	1.44%
	Total pixel count	154894	184939	32947	2572872	100.00%

### Change Detection Results

The Change Detection method delivered inconclusive results. The IKONOS imagery had changes shown for all change thresholds. Calculations of the number of pixels that increased were performed for each change percentage. At the 10% or greater threshold of change, the IKONOS NRB data had an increase in 81.86% pixels (Table 6) and a decrease of 6.47% pixels (Figure 8). In Figure 8, pixels that increased in value (right image) are shown in green; decreases are shown in red. The NRG data had 10.17% of pixels increase (Table 7), while 16.88% of pixels decreased. At a 25% change threshold, 0.95% of pixels in the N/R/G data rose with a decrease of 4.91%, while 20.11% of pixels increased and 5.15% decreased in the N/R/B data (Figure 9). In Figure 9, villages are circled in the right image in white. There was no significant change in the villages. Visual analysis of the Change Detection data led to inconclusive results in regards to villages and burnt areas. Polygon outlines were layered over the results, but in all cases there was no clear pattern to discern by eye.

Landsat ETM+ imagery also had inconclusive results from the Change Detection. The Landsat Normalized Burn Ratio (BuRa) imagery had overwhelming increases in change at 5%, and the thresholds for change were increased by 5% up to 50% to see if any patterns would emerge. At a 20% change or greater, the Landsat 432 data had 0.97% of pixels increase, and 1.55% decrease (Table 8). At the 35% threshold, change was negligible, with an increase of 0.03% of pixels and decrease of 0.47% of pixels. The BuRa data at the 20% threshold had a 75.29% of pixels increase, with 4.85% of pixels decreasing (Table 9).

At the 35% or greater threshold, the BuRa data had 24.90% of pixels increase, with 3.03% of pixels decreasing. Visual analysis proved to be inconclusive, similar to the IKONOS imagery. When examining the village outlines layered over the result data, some villages clearly had an increase in the BuRa, while other similarly sized and shaped villages had no change. The inconclusive results may have occurred due to the fluctuation of rainy and dry seasons. In 2000 the Darfur region experienced a drought, which was confirmed using TRMM data analysis, and between 2000 and 2007 rainfall remained at relatively low levels, with the rainy season shrinking from four months (May-September) down to July and August only.<sup>37</sup> TRMM is the Tropical Rainfall Measuring Mission, a satellite used to monitor and collect rainfall data. In addition, the Landsat ETM+ imagery was not collected at the same time period. In 2000 imagery was collected on October 17, up to possibly

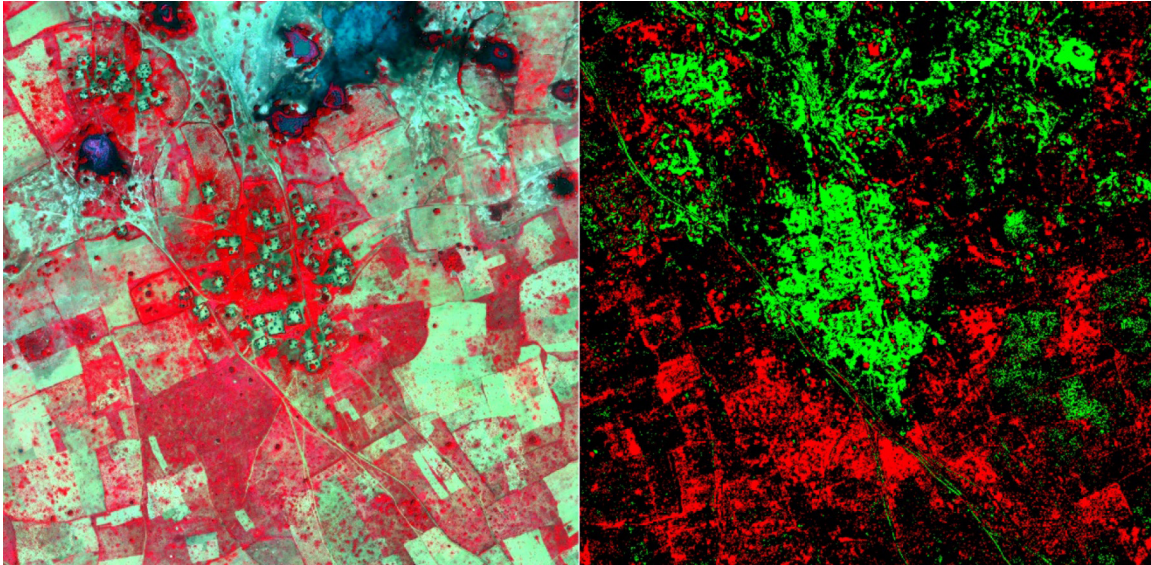


Figure 8. Change Detection results showing a 10% threshold.  
Satellite imagery courtesy of the DigitalGlobe Foundation / GeoEye.

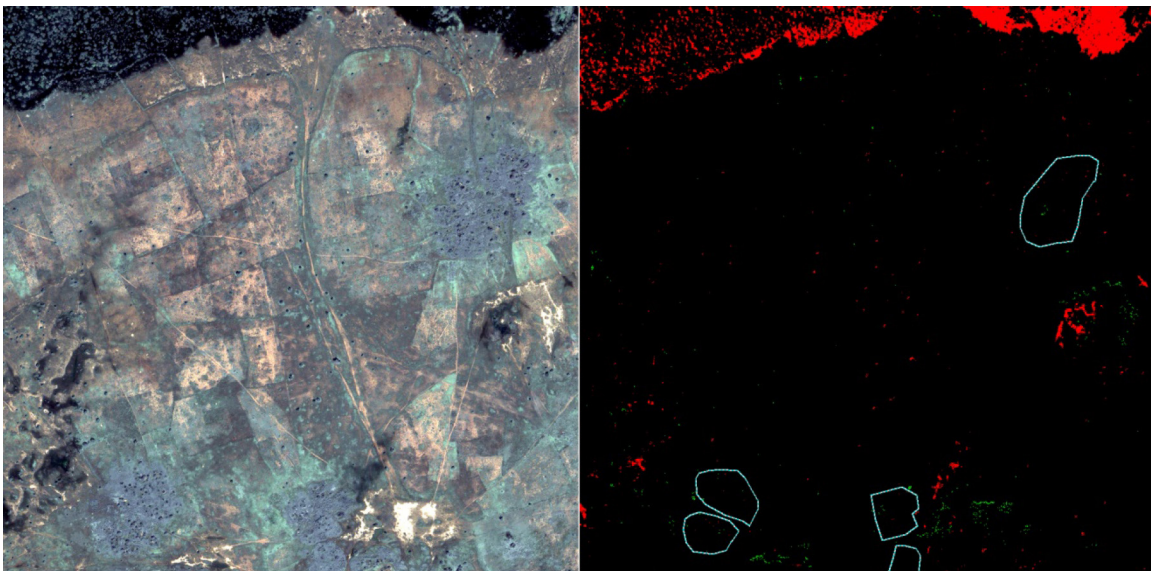


Figure 9. Change Detection results showing a 25% threshold.  
Satellite imagery courtesy of the DigitalGlobe Foundation / GeoEye.

Table 6. Change Detection results for IKONOS NRB (Near Infrared, Red, Blue) imagery.

IKONOS - NRB IMAGERY			
		pixels	percentage
5%	increase	188761931	89.48%
	decrease	14689650	6.96%
	total	210962241	
10%	increase	172694206	81.86%
	decrease	13636913	6.46%
	total	210962241	
15%	increase	138195692	65.51%
	decrease	12671106	6.01%
	total	210962241	
20%	increase	87748643	41.59%
	decrease	11747926	5.57%
	total	210962241	
25%	increase	42418173	20.11%
	decrease	10860276	5.15%
	total	210962241	
30%	increase	17784252	8.43%
	decrease	10011995	4.75%
	total	210962241	
35%	increase	7865557	3.73%
	decrease	9182877	4.35%
	total	210962241	
40%	increase	3344800	1.59%
	decrease	8360078	3.96%
	total	210962241	
45%	increase	1391394	0.66%
	decrease	7530360	3.57%
	total	210962241	
50%	increase	515260	0.24%
	decrease	6694053	3.17%
	total	210962241	

This table shows the results of Change Detection by threshold percentage, listed on the left. The pixels column shows the number of pixels in the image that increased or decreased in spectral value at or higher than the threshold percentage. The percentage column shows the percentage of total pixels for the image that changed spectral value for each change threshold.



Table 7. Change Detection results for IKONOS NRG (Near Infrared, Red, Green) imagery.

IKONOS - NRG IMAGERY			
		pixels	percentage
5%	increase	50632869	24.00%
	decrease	66716271	31.62%
	total	210962241	
10%	increase	21464315	10.17%
	decrease	35609772	16.88%
	total	210962241	
15%	increase	8422701	3.99%
	decrease	20398548	9.67%
	total	210962241	
20%	increase	3614651	1.71%
	decrease	13792281	6.54%
	total	210962241	
25%	increase	2018248	0.96%
	decrease	10357915	4.91%
	total	210962241	
30%	increase	1498172	0.71%
	decrease	8003561	3.79%
	total	210962241	
35%	increase	1282507	0.61%
	decrease	6418611	3.04%
	total	210962241	
40%	increase	1052952	0.50%
	decrease	5475760	2.60%
	total	210962241	
45%	increase	718539	0.34%
	decrease	4756362	2.25%
	total	210962241	
50%	increase	378217	0.18%
	decrease	3578885	1.70%
	total	210962241	

This table shows the results of Change Detection by threshold percentage, listed on the left. The pixels column shows the number of pixels in the image that increased or decreased in spectral value at or higher than the threshold percentage. The percentage column shows the percentage of total pixels for the image that changed spectral value for each change threshold.

Table 8. Change Detection results for Landsat 432 imagery.

LANDSAT - 432 IMAGERY			
		pixels	percentage
5%	increase	33182041	14.31%
	decrease	55669862	24.00%
	total	231937721	
10%	increase	14071238	6.07%
	decrease	33062395	14.25%
	total	231937721	
15%	increase	9428343	4.07%
	decrease	20308051	8.76%
	total	231937721	
20%	increase	7359853	3.17%
	decrease	11767553	5.07%
	total	231937721	
25%	increase	3958626	1.71%
	decrease	7677445	3.31%
	total	231937721	
30%	increase	1119488	0.48%
	decrease	5226545	2.25%
	total	231937721	
35%	increase	227627	0.10%
	decrease	3941835	1.70%
	total	231937721	
40%	increase	68499	0.03%
	decrease	2635863	1.14%
	total	231937721	
45%	increase	47841	0.02%
	decrease	1641322	0.71%
	total	231937721	
50%	increase	39652	0.02%
	decrease	842727	0.36%
	total	231937721	

This table shows the results of Change Detection by threshold percentage, listed on the left. The pixels column shows the number of pixels in the image that increased or decreased in spectral value at or higher than the threshold percentage. The percentage column shows the percentage of total pixels for the image that changed spectral value for each change threshold.

Table 9. Change Detection results for Landsat Normalized Burn Ratio imagery.

<b>LANDSAT - NORMALIZED BURN RATIO IMAGERY</b>			
		pixels	percentage
5%	increase	36676605	63.24%
	decrease	1981967	3.42%
	total	57992061	
10%	increase	35680123	61.53%
	decrease	1933714	3.33%
	total	57992061	
15%	increase	33551679	57.86%
	decrease	1921691	3.31%
	total	57992061	
20%	increase	29514444	50.89%
	decrease	1902601	3.28%
	total	57992061	
25%	increase	23092557	39.82%
	decrease	1729253	2.98%
	total	57992061	
30%	increase	15781727	27.21%
	decrease	1509018	2.60%
	total	57992061	
35%	increase	9782117	16.87%
	decrease	1188746	2.05%
	total	57992061	
40%	increase	5614822	9.68%
	decrease	741897	1.28%
	total	57992061	
45%	increase	2928586	5.05%
	decrease	332728	0.57%
	total	57992061	
50%	increase	1281840	2.21%
	decrease	126961	0.22%
	total	57992061	

This table shows the results of Change Detection by threshold percentage, listed on the left. The pixels column shows the number of pixels in the image that increased or decreased in spectral value at or higher than the threshold percentage. The percentage column shows the percentage of total pixels for the image that changed spectral value for each change threshold.

three months after the rainy season had ended. In 2006 imagery was collected on August 31, which was at the tail end of the rainy season. Accurate data was not found for rainfall amounts for those two years, but because of the drought it is possible that Change Detection did not produce conclusive results because of the change in vegetation and moisture content in the area.

#### *Feature Extraction Results*

The N/R/G Feature Extraction resulted in a total of 2,676 correctly identified huts (out of 3,190 hand-counted huts), for a success rate of 83.89% (Figure 10). The Feature Extraction also incorrectly identified 1,384 polygons/points as huts outside of villages. This results in 34.09% features identified by the Feature Extraction as false-positive. In Figure 10, huts identified by feature extraction (red dots) are compared to manually identified huts (green dots) in a village in the study area. Features were extracted using the Feature Analyst module in ERDAS IMAGINE.



Figure 10. Feature Extraction results in a sample village., IKONOS imagery dated September 16, 2004.

Satellite imagery courtesy of the DigitalGlobe Foundation / GeoEye.

The N/R/B Feature Extraction resulted in a total of 1,513 correctly identified huts (out of 3,190 hand-counted huts), for a success rate of 47.43%. The Feature Extraction also incorrectly identified 326 polygons/points as huts outside of the villages, resulting in a 17.73% false-positive rate.

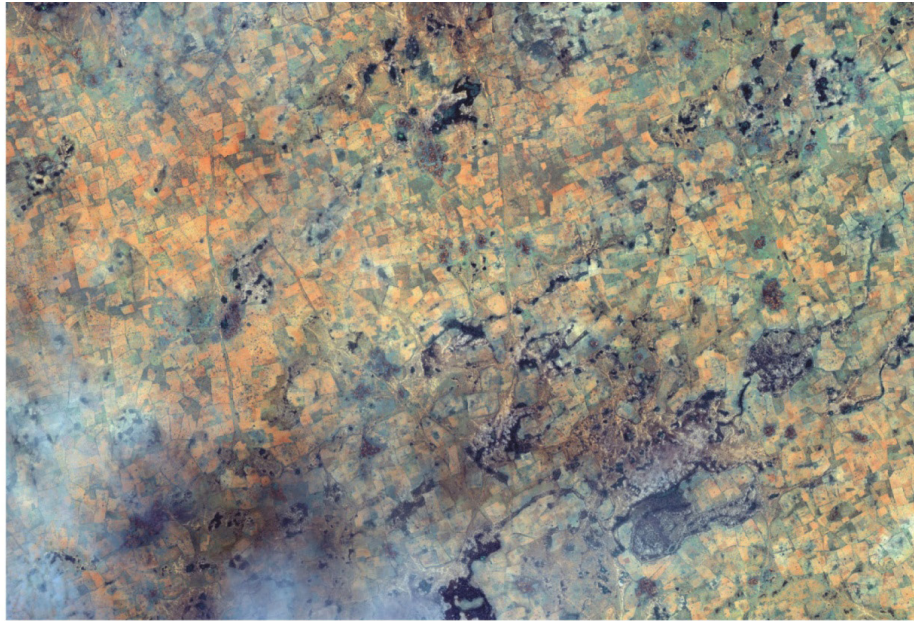
The features brought into ArcMap were analyzed using a kernel density module, resulting in a visual graphic showing where the features are concentrated (Figure 11).

This image was layered over the true-color pan-sharpened image, and the transparency reduced to 50%, allowing for the geography of the area to show how it correlates to the kernel density image. A visual analysis of the images shows that the clusters of huts can be identified by the kernel density image – false positives occur where incorrectly identified features are located, particularly in the South East corner of the study area where the arroyo is, however the false positives are not as clustered as the huts and do not affect the kernel density image as the geometry of the shapes indicate natural features (Figure 12).

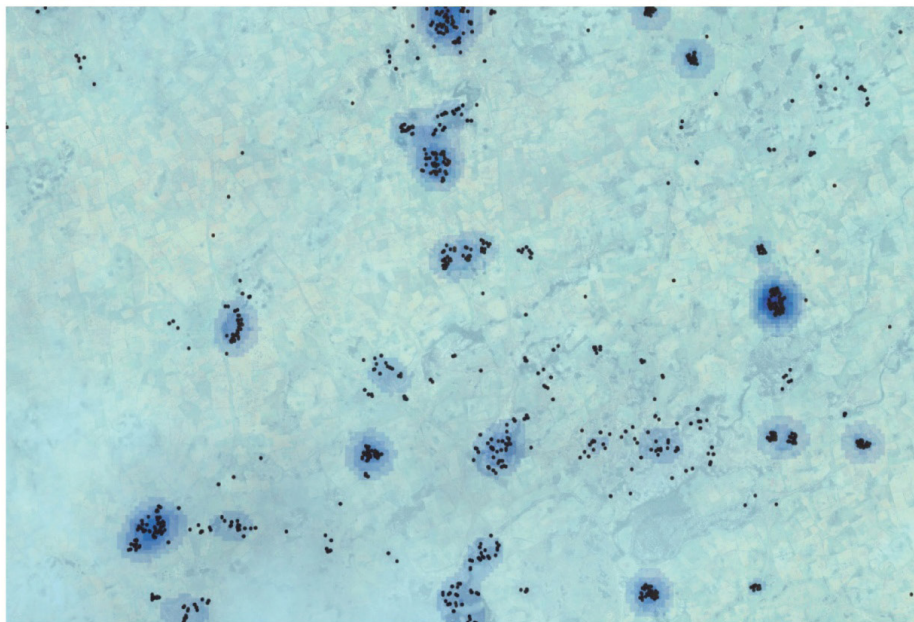
A count of villages combined with a count of hotspots yields two results. Clouds in the southwest corner of the study area prevented Feature Extractions from occurring in that area, as no points were selected during the process. Seventy seven villages were counted in the study area, and 43 hot spots were counted after the kernel density function was performed on the NRB imagery, resulting in an accuracy of 55.8% of hotspots matching villages. However, if the villages in the cloud region are taken out, 54 villages are counted, and the resulting accuracy of hotspots matching villages is 79.6%. As clouds were not masked in this study, any villages under cloud cover would have been segmented from the village count if the masking had been performed.

Feature Extraction, when combined with the kernel density “hot spot” method, appears to be a useful tool to identify villages. Unfortunately for this study (and for the Darfuri affected), the 2006 high resolution imagery had no surviving villages or huts in the study area. Because of this, Feature Extraction could not be





Base layer showing satellite imagery, above.



Kernel Density Estimation 'hotspots' over satellite imagery with extracted features (black dots), above.

Figure 11. Kernel Density Estimation overlaying satellite imagery.  
Satellite imagery courtesy of the DigitalGlobe Foundation / GeoEye.

performed on the after imagery, and an accurate assessment of the extraction/kernel density method cannot be ascertained. The results also indicate that clouds should be masked before the Feature Extraction and village counting is performed, even though some villages are visible in the cloud covered area. However, the visual analysis of the kernel density results points to its usefulness when identifying villages, and in theory, villages that no longer exist in the after imagery would not have the clustering of features that the before imagery would depict. A custom Feature Extraction algorithm could also have a positive effect on the accuracy of identifying huts, as the Feature Extraction tools used in this study were part of the standard Feature Analyst toolset available for ERDAS IMAGINE.

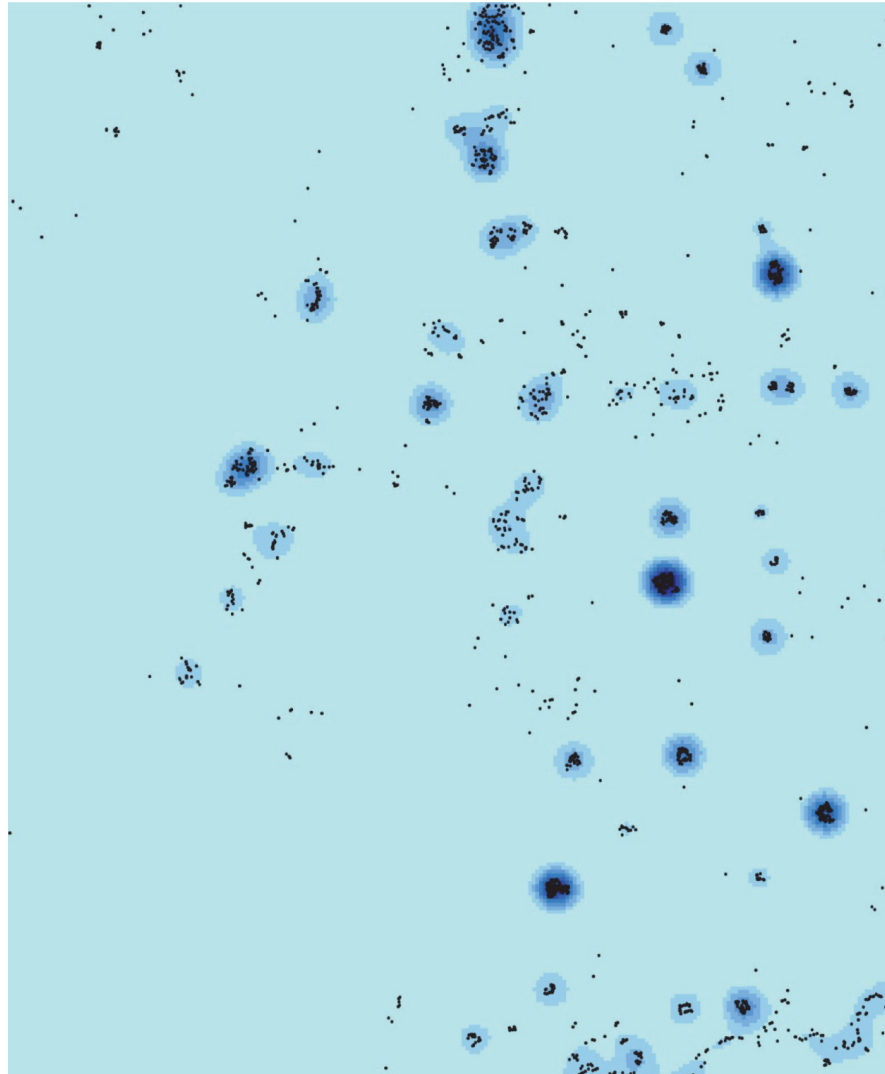


Figure 12. Village Hotspot map through kernel density.

## Conclusions

Satellite imagery and remote sensing methods offer much potential in verifying and tracking human rights violations and mass violence. The results of this study indicate that Feature Extraction is a useful ancillary tool to the practice of manual identification, particularly in places similar to Darfur with semi-arid grassland and rural huts and villages (Table 1). In addition, as this study used a stock algorithm in the Feature Analyst software module, custom algorithms could be produced that offer much higher accuracy rates. While the data difficulties in this study resulted in inconclusive results, the outcome suggests that both before and after imagery of burned villages can be examined using a combination of Feature Extraction and the kernel density function to identify villages. The before and after kernel density maps theoretically would be compared for change, and any missing “hotspots” could indicate a burned village and warrant further examination. In addition, the results of the Feature Extraction method indicate that masking of clouds, normally a common practice, gives more positive results than non-masking.

While some research suggests that geospatial analysis in the field of human rights has slowly increased in the past decade, other research indicates that these methods are being performed by a growing number of organizations on a variety of cases. This growth is exciting for the human rights and remote sensing fields, as these studies continue to be important due to human rights violations across the world. The use of satellite imagery is one tool (out of many) that human rights workers can use for corroboration of mass violence, as well as evidence of past mass violence in criminal trials. As of the writing of this article, Darfur is still

experiencing violence between the government, rebels, and various tribes. The BBC reports that as of May 2013 approximately 300,000 people have died since the most recent wave of violence started in 2003, and over 1.4 million people are homeless, either as foreign refugees or IDPs.<sup>38</sup> The International Criminal Court issued an arrest warrant for President al-Bashir in March of 2009,<sup>39</sup> on charges of war crimes and crimes against humanity based on his role in the Darfur crisis. However because of the intricacies of international law, the arrest warrant was delivered to the Sudanese government, who most likely will not execute the warrant.<sup>40</sup> While diplomacy and international politics play a major role in stopping and holding governments responsible for human rights violations, remote sensing also plays an important role in verification. Combined with human rights organization information from groups like Amnesty International or the United Nations Human Rights Council, satellite imagery and remote sensing methods can provide the world a window into previously unseen areas where atrocities occur.

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# A New Forensics: Developing Standard Remote Sensing Methodologies to Detect and Document Mass Atrocities

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## **Abstract:**

**Aim:** The aim of this article is to highlight potential methods applicable to a standard forensic approach for the analysis of high-resolution satellite imagery that may contain evidence of alleged mass atrocities.

**Methods:** The primary method employed is the retrospective analysis of a case study involving the use of high-resolution satellite imagery analysis to document alleged mass atrocities. The case study utilized herein is the Satellite Sentinel Project's reporting on the May 2011 sacking of Abyei Town by Government of Sudan-aligned armed actors. In the brief case study, categories of objects, patterns of activities, and types of alleged mass atrocity events are applied to the Abyei Town incident.

**Results:** Categories of activity patterns, visible phenomena, and relevant objects leaned from the Abyei Town case study may provide a scalable example of how accepted forensic standards for remote sensing analysis of alleged mass atrocities may be further developed.

**Conclusions:** The methods and frameworks applied in this research to the Abyei Town case study should be tested and refined through further case studies. The sources of these case studies may be both past reports by civil society, governments, and international judicial bodies and new analyses of previously unanalyzed high-resolution satellite imagery of alleged mass atrocities.

**Keywords:** satellite, imagery, forensic science, pedagogy, mass atrocities, human rights, remote sensing, Sudan, war crimes, analysis

## **MARS: The Application of Remote Sensing to Mass Atrocity Contexts**

Prior to the United States Government allowing the commercial sale of high-resolution satellite imagery in the early 1990's, high-spatial resolution<sup>1</sup> (afterwards, "high-resolution") satellite imagery was almost solely available only to governments, their militaries, and their intelligence agencies.<sup>2</sup> This change in policy has enabled NGOs and international agencies to begin employing this specific type of remote sensing technology to document alleged mass atrocity events.<sup>3</sup>

The use of high-resolution satellite imagery analysis to document mass atrocity events, which is referred to hereafter as Mass Atrocity Remote Sensing (MARS), has demonstrated utility for these groups.<sup>4</sup> Remote sensing can provide unique, sometimes otherwise unavailable, information about events occurring in extremely non-permissive environments,<sup>5</sup> over large geographic areas, and across long and multiple timeframes. Regions where mass atrocity events occur are typically inaccessible to outside observers, particularly civil society groups and international agencies.

There are several distinct applications for MARS involving the analysis of high-resolution satellite imagery, including retrospective documentation of events for accountability and advocacy purposes,<sup>6</sup> detection of potential indicators that a mass atrocity may soon occur,<sup>7</sup> and as a data source for researching historical activity

patterns that may occur during certain armed conflicts.<sup>8</sup> Some advocacy organizations currently employing MARS to document specific types of mass atrocities include Human Rights Watch, Amnesty International, the Enough Project, and Physicians for Human Rights. Reports released by these organizations have focused on nations that include Syria, Sudan, Nigeria, Burma, and Central African Republic.<sup>9</sup>

Academic research institutions also conduct high-resolution satellite imagery analysis of alleged atrocity events, and their research has helped support the adoption of these tools and methods by civil society groups. Notable examples of these types of research centers include the American Association for the Advancement of Science's (AAAS) Geospatial Technologies and Human Rights Project<sup>10</sup> and the Harvard Humanitarian Initiative's (HHI) Signal Program on Human Security and Technology.<sup>11</sup>

International agencies and governments are involved in this type of work as well. The United Nations Operational Satellite Applications Programme (UNOSAT) is a leading example of the increased use of remote sensing by international agencies in potential mass atrocity producing contexts.<sup>12</sup> UNOSAT has provided analysis of imagery, generated maps, and created other products related to the mass displacement of civilian populations in South Sudan, Syria, and elsewhere.<sup>13</sup> Recently, the United States Department of State's Humanitarian Information Unit has started releasing commercial imagery of alleged mass atrocity events to voluntary technical organizations, NGOs, and other civil society groups.<sup>14</sup> Examples of MARS-relevant data released so far by the US State Department through this initiative include commercial imagery captured over Syria, among other locations, where armed conflict is ongoing.<sup>15</sup>

Additionally, intelligence services and other executive agencies of various national governments, including the European Union<sup>16</sup> and the United States' intelligence community, are increasingly expressing public interest in improving mass atrocity Early Warning Early Response (EWER) capabilities.<sup>17</sup> The full scope of the interest and investment of these agencies in MARS applications, however, is difficult to fully assess, in part, due to the classified nature of some of these activities.

In the past approximately twenty years, MARS-type analyses of high-resolution remote sensing data, including aerial reconnaissance photography, have been admitted as evidence in cases before the International Criminal Tribunals for the former Yugoslavia and Rwanda, the International Criminal Court (ICC), and the International Court of Justice (ICJ), amongst other national and international venues.<sup>18</sup> However, it can be argued that civil society's use of high-resolution remote sensing specific to the mass atrocity context is still very much a recent development.

### **The MARS Methodology Gap**

Despite the growing number of organizations engaged in this space, little formal pedagogy specific to this emerging field exists. Thus, efforts to professionalize and standardize the application of remote sensing in the context of mass atrocities has lagged behind the pace at which organizations are adopting this technology for these purposes. Analysts using these technologies have little documented past practice to draw upon.

The net result is that MARS practitioners are currently without accepted forensic standards specific to corroborating through primarily remotely observed phenomena whether an alleged mass atrocity has likely occurred.<sup>19</sup> This core gap is the result, in part, of little extant research intentionally treating MARS as its own distinct discipline within remote sensing, with its own distinct operational challenges and requirements.

As a consequence, MARS appears to most often be applied by organizations to create incident specific analysis products. These products may aim to enhance current situational awareness or support advocacy efforts to shift public opinion and policy around a particular issue.<sup>20</sup> Few current MARS products, however, appear specifically intended to create generalizable knowledge leading to the development of standard methodologies for applying MARS across incidental and regional contexts.

Some analysis techniques originally developed for military intelligence purposes (known as "geospatial intelligence" or "GEOINT") that are relevant to MARS work can sometimes be gleaned from both unclassified and declassified United States Government imagery and analysis products.<sup>21</sup> While of general value to the MARS field, past GEOINT practices alone are not enough of an antecedent to develop standard theoretical and methodological approaches to MARS work.

Publicly available GEOINT examples rarely include previous analyses of mass atrocity incidents. A notable exception is declassified satellite imagery and aerial reconnaissance photography related to the 1995 Srebrenica massacre. This imagery was later released after it was used as evidence exhibits in the International Criminal Tribunal for the former Yugoslavia.<sup>22</sup> The Srebrenica images are unique in this regard.

Original, cross contextual MARS-specific research will thus be required if analysts are to learn what potentially observable objects and corresponding activity patterns involving those objects may be detectable

through remote sensing. Additionally, this research should seek to understand the unique identifiable characteristics of activity patterns that may generally occur during mass atrocity events within certain regions (i.e., East Africa, Middle East, North Africa, etc.) and environments (i.e., desert, savannah, mountains, urban settings, etc.). Research should prioritize geographic areas and contexts where past experience demonstrates mass atrocity events are more likely to occur.<sup>23</sup>

### **A New Forensics of Remotely Observed Objects and Activity Patterns**

MARS-relevant patterns should be based upon certain repeating observable objects (i.e., military vehicles, newly razed buildings, shell craters, etc.) and phenomena involving these objects and features (i.e., apparent troop movements, infrastructure construction patterns, indiscriminate bombardment, civilian displacement, house-to-house searches, etc.) found in some form across these contexts and regions. These observable objects and phenomena may be visible either prior to a mass atrocity event occurring, during the alleged perpetration of a mass atrocity event by armed actors, or as a result of changes to objects and the surrounding physical environment after a mass atrocity event has allegedly occurred.

This task is complicated, though, by the fact that the remote collection of evidence from alleged mass scale crimes requires its own unique set of criminalistics (i.e., scientific methods for collecting and analyzing evidence). Currently, there are no established criminalistics for MARS.<sup>24</sup> The establishment of criminalistics for MARS will likely be based on indicators and phenomena that have few antecedents in both traditional criminal forensics and what can be learned from non-classified examples of GEOINT.

The lack of previous antecedents for this type of forensic analysis is partly due to the fact that MARS practitioners analyze events occurring within areas of interest (AOI) that can encompass several thousand square kilometers and across timeframes spanning several days, months, or even years. Thus, a new discipline of remote forensic analysis specific to the evolving MARS field must be developed from the integration of several sources of past practice. These sources of applicable past practice may include, though are not limited to, the following fields: Remote sensing analysis of environmental factors, photogrammetry, crime scene investigation by law enforcement agencies, and military and intelligence approaches to geospatial intelligence collection and analysis.

To develop a forensic science tailored to support MARS applications, a common approach for identifying and classifying examples of activity patterns comprised of certain observable objects with potential probative value should be identified, tested, and subjected to peer review. This approach should draw on the growing body of public, incident specific reports, like those mentioned above, that are being generated in recent years by NGOs, academic researchers, and international agencies.

In time, legal standards of what constitutes potential evidence of specific mass atrocities could likely be cross-referenced and integrated with these case studies for the purposes of identifying and agreeing evidence examples. Eventually, best practices for MARS evidence collection, annotation, and storage may be able to be developed from that resulting corpus of evidence examples.

This paper, however, solely addresses only one of the methodological and pedagogical gaps mentioned above. That gap is the absence of a standard approach for the classification of phenomena involving observable objects into categories of activity patterns relevant to certain mass atrocity events.

The analysis of one case study—the alleged May 2011 razing of Abyei town by Sudan Armed Forces—is examined within this article. The case study data is derived from the reports of the Satellite Sentinel Project<sup>25</sup> and the HHI Signal Program study, “*Sudan: Anatomy of a Conflict*.”<sup>26</sup> The goal of the case study is to demonstrate a potential framework for approaching the challenge of standard identification and classification of MARS-related activity patterns and observable objects.

Though specific to objects and patterns common to the context of armed conflict in East Africa, the authors intend for the framework to be of broader value outside Sudan and similar nations. It is expected that this initial approach may likely have some relevance for MARS practitioners conducting analyses of alleged mass atrocities across diverse regional and operational contexts. Other similar case studies from different regions, timeframes, and/or operational contexts may aid in refining and scaling this evolving methodology for general use.

### **Case Study: The Alleged May 2011 Razing of Abyei Town by Government of Sudan-Aligned Forces**

In January 2011, the people of the nation that is now South Sudan voted in a referendum to overwhelmingly secede from Sudan. A bloody, decades long civil war between Sudan and southern Sudan ended with the signing of the Comprehensive Peace Agreement (CPA) in 2005. The accord provided an opportunity for the southern part of the nation to vote on self-determination.<sup>27</sup> In July 2011, South Sudan officially became the world’s newest nation.



Figure 1. Map of the Abyei Administrative Area.

However, the CPA did not resolve the final status of the Abyei Administrative Area, a region straddling a long-contested border area between Sudan and South Sudan. Thus, at the time of the January 2011 referendum, Abyei residents technically belonged to both West Kordofan state, Sudan and Bahr-el-Ghazal, a state in what is now South Sudan.<sup>28</sup>

The majority of Abyei's population is from the Ngok Dinka, a southern Sudan-aligned ethnic group, who inhabit the region's largest city, Abyei Town, as well as most of the area immediately surrounding it. The second largest ethnic group present the region is the Misseriya, an Arab ethnic group traditionally aligned with Sudan. The Misseriya, semi-nomadic pastoralists, move seasonally into the Abyei region to graze their cattle via a series of traditional migration routes, known as *murhals*.<sup>29</sup>

A referendum to resolve the status of the Abyei region was originally scheduled for around the same time as the vote to decide the future of southern Sudan. Ordered by a decision from the Hague-based Permanent Court of Arbitration (PCA) in 2009, the referendum was intended to peacefully resolve the tensions between Sudan and the then southern Sudanese.<sup>30</sup>

However, the PCA decision was not implemented due to disputes over Sudan's insistence that the Misseriya, who are seasonal residents, be allowed to vote in the referendum.<sup>31</sup> Towards the end of 2010 and in the spring of 2011, clashes broke out between the Misseriya and southern Sudanese-aligned forces inside the Abyei region, leading to the destruction of villages and the forced displacement of primarily Ngok Dinka civilians.<sup>32</sup>

Forces aligned with both Sudan and southern Sudan took up positions inside the Abyei region, constructing fortifications and hardening their emplacements. It was during this time that Sudanese regular forces, in addition to Misseriya militias apparently already operating within Abyei, began to build-up their strength at bases inside Sudanese territory. These tanks, planes, infantry, and other units were arrayed within air and ground strike range of Abyei Town.<sup>33</sup>

The tense situation, which had been punctuated for months by seemingly isolated incidents of violence, devolved into an all-out invasion of Abyei Town by Sudanese forces. Following a shootout between Sudan Armed Forces (SAF) and Sudanese People's Liberation Army (SPLA) at the Dokura checkpoint on the night of May 19, 2011, SAF engaged in artillery bombardment of SPLA positions at Todach and Tajalei, areas to the north of Abyei Town proper on May 20.<sup>34</sup>



By the end of the next day, May 21, Abyei Town was firmly in the control of SAF-aligned forces. Over 30,000 residents of the town had fled. Houses were on fire. Misseriya militia and SAF forces allegedly moved freely throughout Abyei Town, despite the presence of UN peacekeepers, looting and burning civilian property on a large scale.<sup>35</sup>

Over the next few days, more than a third of all standing structures in Abyei Town were razed, the World Food Programme compound was looted, and the central market was destroyed.<sup>36</sup> Four senior former prosecutors and US State Department war crimes officials would later determine that the actions of SAF-aligned forces during the Abyei Town incident potentially rose to the level of war crimes.<sup>37</sup>

### Categories of Observable Objects Likely Relevant to the May 2011 Abyei Incident

The following observable objects, or “observables”, may often be observed using remotely sensed imagery in the context of other rural and semi-urban East African armed conflict settings, including the ongoing conflict in Darfur, Sudan.<sup>38</sup> The 2011 razing of Abyei Town in the disputed Abyei Region bordering Sudan and South Sudan, the case study in this article, falls within this specific context. Some likely techniques a MARS analyst would employ to identify (or “type”) these observables are included for each category of object as well.

The table below is based on data solely from the Signal Program for Human Security and Technology at the Harvard Humanitarian Initiative’s (HHI) 2013 satellite imagery-based study, Sudan: Anatomy of a Conflict. It is specific to that study’s section on the alleged May 2011 razing of Abyei Town by Government of Sudan-aligned forces (GoS).<sup>39</sup>

While these observables are common in multiple East African MARS settings, the table is not meant to be exhaustive, nor are all examples inclusive to the context of the Abyei Town incident.<sup>40</sup> The table is intended to both serve as a practice example of a MARS specific observable object and typing chart, as well as a resource to inform the interpretation of imagery examples later in the case study.

Table 1. MARS-Relevant Observables and Corresponding Typing Methods (Alleged Razing of Abyei Town by Sudan-Aligned Forces, May 2011)

MARS-Relevant Observables	Typing Methods
<u>VEHICLES:</u> <ul style="list-style-type: none"> <li>● Military-use ground vehicles (i.e., tanks, armored personnel carriers, heavy transport trucks, water and fuel tankers, etc.)</li> <li>● Civilian-use ground vehicles (i.e., Land cruisers, lorries, etc.) <ul style="list-style-type: none"> <li>○ NGO/UN branded vehicles</li> <li>○ Fuel, water transport tankers</li> <li>○ Livestock transport vehicles</li> <li>○ Earthmovers (i.e., backhoes and road graders)</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>● Dimensions, color patterns, and unique features of an object can be compared with publicly available databases, such as Jane’s reference materials (hereafter, “DCU comparison”).</li> <li>● Observable Object Context Analysis (hereafter, “OOC Analysis”): The context in which specific observable objects repeatedly appear can often help indicate their identity and/or current use (i.e., Presence of white, uniformly shaped vehicles at a known hospital may likely be ambulances, etc.).</li> </ul>
<u>AIRCRAFT:</u> <ul style="list-style-type: none"> <li>● Fixed wing (i.e., fighter jets, transport planes, bombers, etc.)</li> <li>● Rotary wing (i.e., attack helicopters, transport helicopters, etc.)</li> </ul>	<ul style="list-style-type: none"> <li>● DCU Comparison.</li> <li>● OOC Analysis.</li> <li>● Measurement of runway length to help determine minimum takeoff and landing requirements for aircraft present.</li> </ul>
<u>ARTILLERY:</u> <ul style="list-style-type: none"> <li>● Towed artillery (i.e., Howitzers, other large caliber ordnance that can be pulled behind a vehicle)</li> <li>● Mechanized tube artillery (i.e., multiple launch rocket systems, etc.)</li> <li>● Fixed artillery (i.e., large, long-range weapons that are not mobile)</li> </ul>	<ul style="list-style-type: none"> <li>● DCU Comparison.</li> <li>● Presence of “V” shape at back of long, gun-shaped weapon consistent with towed artillery.</li> <li>● Object placement in circular depression (also called an “artillery berm”).</li> <li>● Position of “gun barrel” feature on the object changes over time.</li> </ul>

<p><u>MILITARY INFRASTRUCTURE:</u></p> <ul style="list-style-type: none"> <li>● Permanent encampments (i.e., major bases, including unit headquarters, containing more permanent buildings and infrastructure)</li> <li>● Temporary encampments (i.e., forward operating bases created as part of operations, fortifications, groups of tents, etc.)</li> <li>● Air bases (i.e., airstrips, aprons, hangars, logistical support buildings and equipment, fuel tanks, air traffic control, and communications towers, etc.)</li> </ul>	<ul style="list-style-type: none"> <li>● Presence of external and/or internal security perimeters comprised of trenches, berms, checkpoints, guard towers, fences, wooden corrals, or fighting positions (“foxholes”).</li> <li>● OOC analysis of military vehicles in and around structures, perimeters, etc.</li> <li>● Visible communications infrastructure, including radio towers, satellite dishes, etc.</li> <li>● Potential housing, supply and logistics buildings (i.e., barracks, motor pools, ammo dumps, external water and fuel tanks, etc.).</li> <li>● Tents of various shapes, colors, sizes, and arrangements.</li> </ul>
<p><u>CIVILIAN INFRASTRUCTURE:</u></p> <ul style="list-style-type: none"> <li>● Civilian dwellings <ul style="list-style-type: none"> <li>○ Tukuls (traditional huts)</li> <li>○ Metal roof structures</li> </ul> </li> <li>● Water points (including catchment basins, boreholes, water towers/tanks)</li> <li>● Agriculture <ul style="list-style-type: none"> <li>○ Fields</li> <li>○ Orchards</li> <li>○ Irrigation infrastructure</li> </ul> </li> <li>● Markets</li> <li>● Religious sites <ul style="list-style-type: none"> <li>○ Mosques</li> <li>○ Churches</li> </ul> </li> <li>● Hospitals/clinics, schools</li> </ul>	<ul style="list-style-type: none"> <li>● Tukuls: Circular mud and thatch structures with cone shaped roofs, often surrounded by a some form of corral or other enclosure composed of brush.</li> <li>● Non-tukul structures consistent with civilian dwellings: Square/rectangular buildings with reflective roofs, presence of corrals, walls, or other enclosures.</li> <li>● Water points, etc.: Gathering of animals, crowds around standing water, enclosure with large basin or pump house, etc.</li> <li>● Agriculture: Visible evidence of cultivation, presence of nearby trenching (i.e., possible irrigation), trees arrayed in rows, etc.</li> <li>● Market: Presence of irregular stalls with metal, tarp, and/or fabric roofs; livestock holding areas; gathering of vehicles.</li> <li>● Religious sites: Mosques may or may not have visible minaret structures present, dome, or Mecca-facing orientation. Churches may or may not have visible steeples. In both cases, non-imagery data corroboration is required.</li> <li>● Hospitals/clinics, schools: These and other similar structures require non-imagery data corroboration. Though features present in imagery may support identification, none of these features are usually dispositive by themselves.</li> </ul>
<p><u>HUMANITARIAN INFRASTRUCTURE:</u></p> <ul style="list-style-type: none"> <li>● Humanitarian agency compounds <ul style="list-style-type: none"> <li>○ Warehouses</li> <li>○ Administrative Buildings/Tents</li> <li>○ Motor pools</li> </ul> </li> <li>● Displaced persons camps <ul style="list-style-type: none"> <li>○ Tents</li> <li>○ Water and Sanitation infrastructure</li> <li>○ NGO/UN vehicles</li> <li>○ IDP/Refugee built housing (i.e., tarp and/or stick huts)</li> </ul> </li> </ul>	<p><i>Humanitarian compounds and/or displaced persons camps may be characterized by some or all of the following features:</i></p> <ul style="list-style-type: none"> <li>● Presence of uniform colored vehicles (usually white Land Cruiser-type).</li> <li>● Uniform or similar shaped temporary structures (i.e., tents) with agency logos sometimes visible on roof.</li> <li>● Large numbers of tarp and/or stick based structures (with or without corrals).</li> <li>● Apparent WASH (Water, Sanitation, and</li> </ul>

	Hygiene) infrastructure (either stockpiled or deployed), including tanker vehicles, washrooms/shower houses, water storage vessels, etc. ● Helipad and/or airstrip with white painted fixed wing transport, rotary, or other aircraft.
<u>TRANSPORTATION INFRASTRUCTURE:</u> ● Roads ● Bridges ● Bus stations/transit centers	● Roads: Presenting as dirt tracks, surfaced (i.e., paved) roads, or as elevated dirt tracks (i.e., roads built-up out of compressed earth). ● Bridges: Can be concrete or metal structures present over rivers. ● Bus stations/transit centers: Characterized by the routine presence of buses, transport vehicles, often located in towns/cities of larger size.

### Primary Imagery Analysis Methods for Identifying Mass Atrocity-Related Activity Patterns

MARS analysts may use multiple accepted remote sensing analysis methods, either individually or in combination, to identify observable objects and apparent patterns of activity involving those objects. Of particular importance to the MARS analyst is the observation of changes to the physical environment over time. These observations can occur based on the analysis of one or more satellite images of one or more AOIs over a timeframe of days, months, or years.

Analysts attempt to draw probabilistic inferences about the potential causal and/or correlative relationships between the absence, presence, or change in position of observable objects and changes to the physical environment of an area. Three methods, in particular, are useful for analyzing activity patterns and attempting to understand their significance:

- *Multi-temporal Change Detection:* Multi-temporal change detection involves the comparison of two or more images of the same area captured at different times.<sup>41</sup> The analyst will attempt to detect differences in the coloration, visual properties, presence, absence, and/or position of objects across the images, drawing inferences from those changes. This analysis is often performed with the support of imagery analysis software, such as ERDAS Imagine or other computer programs.<sup>42</sup>
- *Multispectral Analysis:* Multispectral images are satellite images that capture more than one wavelength (or band) of electromagnetic energy.<sup>43</sup> A commonly used multispectral band is near-infrared (NIR), which is most often used for detecting changes to vegetation, especially ground cover, in a satellite image.<sup>44</sup> This approach is especially helpful in seeing vehicle tracks, such as tank or tire tread marks.
- *Non-imagery Data Cross-Referencing:* Whenever possible, imagery is cross-referenced with non-imagery data to help identify observables, provide context to their behavior and disposition, or to help identify the potential AOI itself. Non-imagery data may include history of past conflict, the affiliation of armed actors, and relationships between ethnic or religious groups. There are many sources of non-imagery data in MARS contexts that may be cross-referenced with imagery. Some of the most common include news articles, reports from NGOs and international agencies, such as the UN, crowd sourced map data, and even the public statements of the alleged perpetrators themselves. It is optimal for MARS analysts to structure their collection of non-imagery data by its spatio-temporal metadata (i.e., place and time information common to each report) to more effectively integrate these streams with remote sensing data.

### Factors Affecting the Identification of Objects and Activity Patterns

The analysis of remote sensing data of an object alone does not allow an analyst to scientifically reach a level of absolute certainty as to the definitive identity of that object, nor to the nature of its status and/or activity at the time the image was captured. An object or phenomenon present in remote sensing data can, at most, only be “consistent with” the known visual properties that object is believed to have when apparently visible in a satellite image.<sup>45</sup>

Thus, identifying MARS-related objects (and the activity patterns which they comprise) to the highest level of probabilistic certainty possible depends, in large part, on three interdependent sets of factors. These factors can affect—both negatively and positively—the degree to which an analyst can reach the highest level of probabilistic certainty possible:

- A) *Available Data*: The volume, quality, and potential relevance of both imagery and non-imagery data available to the MARS practitioner related to the area of interest required to identify the presence of the visual properties consistent with these objects and patterns;
- B) *Technology*: Certain MARS-relevant objects and patterns may or may not be detected through available remote sensing technologies and analysis methodologies across any or all operational contexts and situations;
- C) *Relevance*: An analyst's understanding of what objects and patterns are potentially relevant to MARS analysis, including the visual characteristics and properties of the objects comprising those patterns.

First, it is the interplay of these three sets of factors that often determine what observable objects present in imagery an analyst may be able to reliably identify. Second, the interaction of these factors also help determine what inferences and insights about the potential activity of those objects an analyst may be able to draw.

Lastly, these factors also impact the degree to which a MARS analyst may or may not be able to connect any apparent activity patterns to any specific types of alleged mass atrocities that may be detectable through remote sensing. To assess and mitigate how these factors may affect the quality and accuracy of analysis, analysts should be fluent in the basic technical capabilities and expected limitations of publicly available remote sensing technologies.

### **Limitations of Remote Sensing Technologies**

Until June 2014, the highest resolution of publicly available (i.e., non-classified) satellite imagery accessible to civilian actors is approximately 50 centimeters.<sup>46</sup> At this resolution, analysts can expect to reliably identify, or “type”, certain categories of commonly repeating objects the size of vehicles, buildings, and major infrastructure, such as roads and bridges, through satellite imagery analysis. Crowds of livestock and people can sometimes be visible, though the exact composition, size, and object type of these crowd configurations cannot be reliably determined. Additionally, “micro interactions”, such as the movement of small groups of individuals and the positioning of small weapons, cannot be reliably identified and tracked.

However, it must be noted, that both the quality of imagery, the number of recent and/or relevant images of an AOI available (known as “temporal resolution”),<sup>47</sup> and the level of corroborating non-imagery data available to the MARS analyst are dynamics that may also determine whether an observable object can be typed. Multiple factors outside of the analyst's control determine the overall quality of a high-resolution satellite image.

These factors may include, though are not limited to, the angle at which the satellite was positioned when the image was captured (known as “off-nadir angle”);<sup>48</sup> the position of the sun overhead at the time of the image (known as “solar azimuth angle”);<sup>49</sup> the presence of clouds, smoke or other particulate matter in the air at the time the image was taken; and the degree to which seasonal variables effect the presence of trees, ground cover vegetation, and other flora that may obscure objects present in the image.<sup>50</sup>

Cross-referencing imagery with all available potentially relevant non-imagery data is necessary. Corroborating analytic conclusions about objects and other phenomena present in an image rarely can occur based on imagery alone. Some of these sources of non-imagery data useful for corroboration of imagery analysis can include eyewitness testimony, news articles and other open source reports from NGOs.

Data with probative value for MARS analysis may also be gleaned from ethnographic studies of populations present within the AOI. Past studies of regionally and culturally specific macro trends related to armed conflicts, economic development, and population movements may also be of value.

One of the defining features of MARS analysis is its inherently interdisciplinary nature, as the diverse sets of factors listed above demonstrate. Thus, practitioners are often faced with a heterogeneous mixture of potentially relevant data, often in several languages. These diverse streams of data may require simultaneous application of multiple mixed quantitative and qualitative methods to analyze them.



Additionally, predictable situational variables across regional, operational, and environmental contexts of MARS analysis must also be taken into account. Identifying these variables can help analysts anticipate and acquire the potential sources of imagery and non-imagery data that may be required to apply MARS to a specific regional context.

### **Repeating Situational Variables Across MARS Contexts**

Each potential MARS context is shaped by its own particular set of dynamic variables. However, most of these variables can be isolated into distinct categories and anticipated to some degree. Categories of situational variables repeating across MARS contexts may include the following:

- *Natural Environment*: Climate type and seasonal variations can affect MARS analysis significantly. Deserts, for example, have higher visibility than jungles due to having little to no tree canopy. Additionally, regionally specific rainy seasons can cause major changes in ground vegetation, and their corresponding cloud cover may severely restrict the use of space-based sensors during that period;
- *Civilian Disposition*: Assessing the disposition of civilian populations that are potential targets of alleged mass atrocities is a critical consideration. These dispositions can include sedentary agrarian, urban industrial, semi-nomadic, or fully nomadic pastoralist. In some cases, multiple dispositions can be found within one geographic area or ethnic group;
- *Civilian Livelihoods*: Understanding how different civilian populations with different dispositions support themselves is key to evaluating if they have been targeted for attack. Contextually specific observable objects may be likely indicators of intentional attacks against that population. For example, agrarian civilian populations that cultivate crops may have those crops intentionally burned if attacked. Apprehending these likely indicators helps analysts identify potential activity patterns consistent with specific types of mass atrocity events (i.e., indiscriminate bombardment, forced displacement, destruction and looting of civilian property, etc.);
- *Armed Actors*: Potential armed actors present in MARS contexts can vary significantly across scenarios. Often, multiple force types are present at once. There are two primary categories for the varying force types of armed actors: Regular and irregular. Regular forces are the standing military and/or security services of a nation state. Irregular forces are not members of organized military or security services, and can include rebel groups, militias, mercenaries, mobs, paramilitary forces, and other non-state fighters.
- *Force Profile*: Conducting an assessment of the mean (or baseline) military capability of both regular and irregular forces specific to a MARS context is critical for building a force profile of different armed actors. A force profile of each armed actor in a MARS context is important to have for two reasons. First, understanding the unique capabilities of one force versus another provides important circumstantial data that helps differentiate what unit may have perpetrated an alleged mass atrocity event. For example, tanks appear in a recently attacked village that had been previously controlled by a force that does not possess tanks. An analyst may be able to more fully corroborate the identity of the attackers if they can show that the force hostile to that village's population is known to have those particular types of tanks in its arsenal. Secondly, understanding the force profile for each force helps analysts identify units consistent with the capabilities of that force in the field. For example, an analyst can use his or her assessment of the mean military capability of a force to attempt to track the movements of observable objects consistent with that assessment over time.

### **Inferred Observable Object Activity Patterns and Evidence of Alleged Perpetrator Actions**

In the table below, three apparent categories of actions by GoS-aligned forces, the alleged perpetrators of the May 2011 attack on Abyei Town, are broken down across four categories. These categories are based on the observable objects outlined in the table above, their apparent activity patterns, unique phenomena that helps corroborate the perpetrator's apparent action, and the analysis methods that could likely be used to interpret the imagery data.

Previously analyzed DigitalGlobe imagery by HHI's Signal Program provides examples of each of the three alleged perpetrator actions. Additionally, explanatory notes, based on the HHI study, *Sudan Anatomy*

of a Conflict, are included to explicate the analytic process apparently employed. Each imagery example has the number of the relevant alleged perpetrator action that appears to have occurred.

Table 2. MARS Indicators and Activity Patterns Consistent with Alleged Perpetrator Actions (Alleged Razing of Abyei Town by Sudan-Aligned Forces, May 2011)

Alleged Perpetrator Action	Observable Object Indicators	Apparent Activity Patterns	Unique Corroborating Phenomena	Analysis Methods
<u>1. Apparent Intentional Targeting of Civilian Populations and Forced Displacement</u>	Destroyed structures consistent with civilian dwellings, civilian-use facilities.	Dismounted actors (i.e., on foot) moved building to building burning and/or breaking apart structures.	Absence of ground burn pattern between the razed structures is consistent with intentional destruction of buildings.	Primary: Multi-temporal change detection. Secondary: Non-imagery data cross-reference for reports of attacks and displacement.
<u>2. Apparent Targeting of Humanitarian Facilities, Looting of Civilian Property and Humanitarian Supplies</u>	Irregular shaped objects consistent with debris appears in vicinity of structures consistent with civilian-use/ humanitarian agency infrastructure. Buildings may be either razed or still appear intact.	Dismounted actors haphazardly moved and ransacked items originally within the structures outside of the structures. Often this results in the division of items amongst a group of alleged perpetrators, sometimes as payment for their actions.	The sudden appearance of piles of items, humanitarian goods (i.e., food sacks, etc.), and other unknown objects in an area known to have been recently assaulted by an armed force. Additionally, presence of irregular objects in transport vehicles moving away from area towards friendly territory may be consistent with looting.	Primary: Multi-temporal change detection. Secondary: Non-imagery data cross referencing and object typing of any uniform objects, particularly UN or ICRC (International Committee of the Red Cross) standard use items, such as food sacks; cross-reference reports of attacks.
<u>3. Apparent Forcible Military Control of Area (i.e., Invasion by Hostile Actor)</u>	Observable objects are dependent on force profile of suspected aggressor force. These objects may include, heavy armor vehicles (i.e., tanks), light armor vehicles (i.e., APCs, armored cars, etc.), artillery, Land Cruiser-type vehicles, and/or evidence of dismounted units (i.e., tents, crowds assembled in formations, checkpoints).	Rapid movement of mixed vehicles into an area, which may or may not include either fire support operations by air assets and/or artillery. Forces also likely engaged in operations to secure area and conduct searches, resulting in checkpoints, vehicle patrols on side streets, etc.	Sudden appearance of multiple observable objects consistent with the known force profile of an armed actor in an area that they previously did not control. Analysts should expect to see vehicle track patterns on and around main roads, cratering, and other evidence of combat operations. Other activity patterns consistent with other alleged perpetrator acts are likely occurring at this time (i.e., looting, destruction of building, etc.).	Primary: Multi-temporal change detection; Observable object context (OOC) analysis; and dimensions, color patterns, and unique features (DCU) analysis. Secondary: Non-imagery data cross-referencing reports of force movement.

Imagery captured on 26 May 2011 (Figure 2), soon after the Government of Sudan-aligned forces' invasion into Abyei Town, shows evidence consistent with the majority of the main market area having been burned. The activity pattern is characterized in part by the lack of scorch marks between many of the buildings. The apparent trend of burned structures with uniform gaps in the scorched earth between groups of them is consistent with the intentional destruction of this area by likely dismantled forces. This pattern of destruction was further corroborated by publicly released ground photographs taken during that time<sup>51</sup> and by a UN report.<sup>52</sup>



11 February 2011. QuickBird-2 satellite.

26 May 2011. WorldView-2 satellite.

Figure 2. Apparent Intentional Destruction of Civilian Property, Targeting of Civilian Populations, and Forced Displacement. (Alleged Perpetrator Actions 1 and 2). *Images courtesy of DigitalGlobe.*

Approximately 30 percent of Abyei Town's apparent civilian dwellings, many of them tukuls, traditional circular mud and thatch huts, appear to have been razed during the invasion.<sup>53</sup> The lack of scorched earth between the tukuls and other apparent civilian structures is indicative of intentional burning by dismantled forces (Figure 2.1).



26 May 2011. WorldView-2 satellite.

Figure 2.1. Intentional Targeting of Civilian Populations and Forced Displacement. (Alleged Perpetrator Action 1). *Image courtesy of DigitalGlobe.*



This image shows the World Food Programme's storage facility, located in central Abyei Town (Figure 2.2). In the image captured after the SAF invasion, two tent-like structures are no longer visible and shelves appear overturned in the center of the facility. Activity consistent with looting can be corroborated based on both the regular shaped objects consistent with WFP-size grain sacks, as well as the irregular-shaped objects consistent with unknown debris, present in the streets and loaded on to vehicles in close proximity to the facility. UN reports confirm the looting of 800 metric tons of food and medical supplies from the facility.<sup>54</sup>



11 February 2011. QuickBird-2 satellite.

26 May 2011. WorldView-2 satellite.

Figure 2.2. Apparent Targeting of Humanitarian Actors and Looting of Humanitarian Supplies. (Alleged Perpetrator Action 2). *Images courtesy of DigitalGlobe.*

During the invasion, imagery revealed the presence of armored vehicles and towed artillery consistent with units known to be employed by SAF. The above image shows three T-55 main battle tanks loaded onto heavy equipment transports (HETs), as well as four additional T-55's off-loaded and facing southward.<sup>55</sup> Also facing southward are three pieces of unhitched 105mm artillery guns and an armored infantry-fighting vehicle, also consistent with the SAF force profile (Figure 2.3).

The positioning of the artillery in a southward direction, toward southern Sudan, is dispositive forensic evidence that those observables are likely controlled by SAF at the time the image was captured. At that time, SAF troops were reportedly moving due south at that time towards SPLA positions along the River Kiir.<sup>56</sup> The artillery appears to be facing in that vector to provide fire support, if needed, in the direction of the SPLA frontline.



26 May 2011. WorldView-2 satellite.

Figure 2.3 Apparent Forcible Military Control of an Area. (Alleged Perpetrator Action 3). *Image courtesy of DigitalGlobe.*



### Suggestions for Further Research

As the Abyei Town incident case study is intended to demonstrate, MARS analysis can be approached in a systematic and standardized way that relies on the iterative comparison of accepted examples of past practice over time. The approaches articulated herein should be studied and built upon through further research that will require the committed involvement of expertise and resources from a diverse community of entities. These actors may include academic institutions, human rights and humanitarian NGOs, international legal experts and bodies, governments, private business, and most importantly, the communities affected by mass atrocities themselves.

If such research is pursued, MARS may eventually have a place in mass atrocity investigations as its own formalized profession. As a result, MARS may be able to play a similar to the role that DNA analysis, ballistics, forensic anthropology, or any number of traditional forensic sciences currently play in multiple domestic and international criminal justice settings.

Examples of best practices should be both identified and created where required. This effort should occur across various mass atrocity contexts, geographic regions, and operational objectives (i.e., collection of evidence for accountability versus early warning, etc.) for MARS to become a truly scalable tool.

Component pieces that may eventually provide a common forensic methodology for MARS should include, though are not limited to, the following:

- A common approach for the standard identification of potentially relevant observable objects, likely visual properties and/or phenomena associated with those objects, and tested methods to aid in their identification;
- Accepted methods for the identification and testing of apparent activity patterns to determine whether they are consistent with an alleged mass atrocity event type and/or alleged perpetrator action;
- The creation of a common, publicly accessible repository for MARS evidence examples to be presented and critiqued by practitioners. Such an evidence repository may also require the agreement of an annotation method, taxonomy, and presentation guidelines for collecting and storing these examples that should be common to the field;
- Development of common standards for creating, field testing, and evaluating algorithmic feature extraction applications for the automated identification of MARS related phenomena in imagery. The continuing development of algorithmic feature extraction programs presents potential challenges and opportunities for the MARS space that will have to be assessed;
- Research into how remote sensing in mass atrocity contexts may either protect or endanger vulnerable populations or physical evidence on-the-ground, particularly human remains found in mass graves. Related inquiry should occur into determining whether remote surveillance of alleged perpetrators has any causal relationship to changes in the behavior of these actors in any way;
- The integration and cross-referencing of international humanitarian and human rights law (IHHRL) standards, particularly the Geneva Conventions and the Rome Statute, with MARS examples of forensic evidence. This research effort may require interdisciplinary collaboration between the MARS community and IHHRL experts to develop a common reference for forensic examples of alleged war crimes, including genocide.

Significant challenges, however, will have to be overcome to further develop, agree upon, and disseminate a forensic science specific to MARS. The difficulty in accessing sources of geospatial data of alleged mass atrocity acts and related operational patterns has plagued the field for some time. The often exorbitant cost of high-resolution satellite imagery, as well as a limited number of high-resolution satellites available to proactively task, have been major barriers to the advancement of this field.

Innovations to remote sensing, including the deployment of “micro-satellites”, which are often less costly to build, maintain and replace, may offer potential remedies to some of these longstanding barriers to affordable, recently acquired data.<sup>57</sup>

However, new, less costly technologies alone may likely not be enough to support the evolution of this subfield of remote sensing into an established forensic science. Proportionate investment in the agreement of common standards, methods, evidence examples, and the training and development of practitioners is also simultaneously required.

Remote sensing offers potentially powerful insights into the alleged mass atrocities perpetrators commit in some of the world's most inaccessible environments. It is incumbent upon researchers and practitioners of MARS to begin the difficult yet necessary process of becoming more than simply one application of this technology, but instead, a constant process of scientific innovation.

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# GRID: A Methodology Integrating Witness Testimony and Satellite Imagery Analysis for Documenting Alleged Mass Atrocities

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## **Abstract:**

**Aim:** This article documents the development and initial use case of the GRID (Ground Reporting through Imagery Delivery) methodology by the Harvard Humanitarian Initiative (HHI). GRID was created to support corroboration of witness testimony of mass atrocity related-events using satellite imagery analysis. A repeating analytic limitation of employing imagery for this purpose is that differences in the geographic knowledge of a witness and an imagery analyst can limit or impede corroboration.

**Methods:** The primary method used in this article is a case study of HHI's development and use of GRID. The GRID methodology was designed during HHI's work with the Satellite Sentinel Project. It was deployed to corroborate reports that mass graves were being created in Sudan in the summer of 2011.

**Results:** The results of this specific case study are examined, step-by-step guidelines for using GRID are provided, and possible areas for further research are discussed.

This case demonstrates that the GRID methodology facilitates corroboration when differences exist between the local geographic knowledge of a witness and the more cursory geographic knowledge of an analyst.

**Conclusions:** The initial use of GRID warrants further research into potential applications in other regional and operational contexts. Future use cases will help advance GRID as a standardized methodology for use by different types of groups that utilize satellite imagery. Distinct research should also focus on operational, cultural, psychological, and ethical impacts of this methodology due to its involvement of the witness in the imagery analysis process.

**Keywords:** humanitarian, human rights, mass atrocities, satellite imagery, mass graves, Sudan, remote sensing, testimony, witness

## **Introduction**

The analysis of satellite imagery for humanitarian and human rights purposes during or after armed conflict has become more common over the past twenty years. Satellite imagery was first developed in the late 1950's during the Cold War by the United States and Soviet Russia as the governments sought new ways to gather intelligence on the other. This technology remained largely confined to government applications until the 1990's when the United States Government authorized the commercial collection and sale of satellite imagery. Since then, both high and low-resolution satellite imagery have become available to civilians.<sup>1</sup>

Although financial, technical and access barriers still exist; high-resolution satellite imagery analysis has become increasingly utilized by non-governmental organizations (NGOs), international agencies, and academic institutions for human rights and humanitarian operations.<sup>2</sup> This includes the employment of satellite imagery analysis to document destroyed civilian dwellings, the build-up of forces at military facilities, patterns of population fluctuation at displaced persons camps, and to help identify the apparent locations of alleged mass grave sites.<sup>3</sup>

As part of this work by NGOs, satellite imagery analysis has become increasingly employed to document evidence of a reported gross human rights violation and corroborate witness testimony relevant to that event.<sup>4</sup> Organizations such as NGOs, academic research centers, and local and international tribunals collect witness testimony through interviews of conflict-affected populations to document evidence of alleged violations of international human rights standards and humanitarian law. During these interviews, the populations may still be present in the conflict zone or they may have fled to other areas, including other countries. Reported acts

may include the specific targeting of certain populations, the intentional destruction of communities, and the creation and presence of mass graves.

Collecting and corroborating these reports are critical for advocacy, research, and accountability purposes but this can present many challenges. For example, the collection of testimony may be perceived as biased and the ground corroboration of reports may be difficult in locations that do not allow direct access to the areas where the events allegedly occurred.<sup>5</sup> Also, if interviews are secured with those involved in carrying out the acts, they may not want to provide self-incriminating information. Misleading or incorrect information may also be presented by victims if they believe revealing the truth would cause threats to their security.<sup>6</sup>

In light of these challenges, additional methods for collecting information about events have emerged. One of these methods is the use of remote sensing, particularly satellite imagery, to provide unique and otherwise unobtainable information about events that have occurred or are occurring on the ground. Satellite imagery analysis may offer visual evidence that documents and corroborates information provided by a purported witness.

Although the integration of these methods may appear simple, major analytic and methodological challenges exist. This paper examines one commonly repeating analytic limitation of employing this technology and details a methodology that was developed with the intent of solving this challenge. The common limitation is that profound differences routinely exist between the often hyper-local or indigenous level of geographic knowledge possessed by an alleged witnesses to a mass atrocity event while the analyst may have significantly cursory geographic knowledge of the area of interest (AOI) being examined through remote sensing. This discrepancy in geographic knowledge between the witness and the analyst can limit or even impede potential corroboration of the reported event through satellite imagery analysis. For example, if the analyst is unable to identify on a basic map the locations of alleged mass graves as described in a witness' testimony due to a lack of detailed geographic information of the area, then the ability of an analyst to identify that alleged gravesite's location within a satellite image is also limited.

Different types of organizations employing satellite imagery for purposes of corroborating witness testimony have experienced the challenges posed by a lack of location-based information. For example, the UN Fact Finding Mission on the Gaza Conflict commissioned satellite imagery analysis after its founding in April 2009. The analysis produced primary and secondary evidence corroborative of witness testimony collected during the Mission's investigation that included evidence showing the destruction of industrial infrastructure, greenhouse complexes, and commercial and residential buildings. Although extensive evidence was collected:

There were significant and sometimes glaring limits to the applicability of satellite imagery analysis in the case of Gaza. Of particular concern was the inability, because of a systematic lack of accurate GPS data on important facilities throughout Gaza, to locate in the satellite imagery several important factories, schools, and hospitals of direct interest to the Mission investigations.<sup>7</sup>

The impacts of this limitation on the analytic process are extremely important to note. Evidence collection and corroboration may be limited by the inability to obtain location-based data for relevant areas, such as schools, hospitals, and neighborhoods, which appear in satellite imagery and cannot be determined by their unique observable features alone.

This limitation was also experienced by researchers at the Harvard Humanitarian Initiative (HHI) who utilized satellite imagery in an attempt to corroborate reports of recently created mass graves in Sudan in the summer of 2011 as part of their work with the Satellite Sentinel Project (SSP). To address this problem, HHI researchers created the GRID (Ground Reporting through Imagery Delivery) methodology as a process for cross-referencing witness testimony with extant satellite imagery. Although the general process of cross-referencing testimony with imagery was not new, the GRID methodology actively involved the witness in the analytic process. GRID is based on the premise that witness testimony can often provide critical, otherwise unavailable, location-based information that can guide remote sensing analysis to identify recent changes in the physical environment. To do this, the methodology offers guidelines for the creation of a GRID map using a satellite image. The GRID map is then sent to the witness so that the map, a satellite image overlaid with alphanumeric quadrants, can be used to help communicate information back and forth.

Through GRID's controlled involvement of a witness in the workflow of satellite imagery analysis, relevant local geographic knowledge may be communicated from the witness to the analyst. GRID also maintains the integrity of the corroboration through a double blind process in which the witness is not allowed to view imagery captured on or after the day of the alleged event in question. By only being provided imagery captured before the alleged event, the witness cannot be influenced by the presence of any visual differences between a "before" and "after" image. The subsequent imagery analysis resulting from this process may yield more corroborative evidence, particularly from non-permissive environments, which can then facilitate further investigation.

### **HHI's Challenge Identifying Locations in Kadugli**

HHI developed and deployed GRID while monitoring Kadugli, South Kordofan, Sudan while working as part of SSP. SSP was a first-of-its-kind collaboration between HHI, DigitalGlobe, the Enough Project, Google, and Not On Our Watch. The project was launched with a stated mission of deterring a return to full-scale war between Sudan and then-southern Sudan by detecting threats to and documenting attacks on civilians along the contested border.<sup>8</sup>

Each organization played a unique role within the consortium. DigitalGlobe, a commercial high-resolution satellite imagery provider, supplied the project with retrospective and near-real time imagery. HHI managed the day-to-day operations of the 18-month SSP pilot phase, which concluded in July 2012. These operations included the collection and corroboration of open source media, ground reports and near-real time satellite imagery to document violence and predict threats to vulnerable populations. The Enough Project, a Washington D.C.-based advocacy organization, managed communication operations and provided reports from ground sources to analysts at HHI. Google provided some base layer imagery to SSP and access to Google Earth Pro. Not On Our Watch, an NGO founded by a group of celebrities, including George Clooney, Don Cheadle, Matt Damon, Brad Pitt, David Pressman and Jerry Weintraub, provided the seed money for the project. Not On Our Watch's stated mission is to utilize artists, activists and cultural leaders in an effort to end mass atrocities.<sup>9</sup>

At the end of May 2011, the primary focus of SSP was monitoring the aftermath of the Government of Sudan's invasion of Abyei Town. However, attention quickly shifted to Kadugli when fighting erupted between Government of Sudan-aligned forces and the Sudan People's Liberation Army on June 5, 2011. As fighting spread throughout the town, civilians, primarily the Nuba people, were targeted by forces, predominantly those aligned with the Government of Sudan. Roadblocks were constructed around the town that reportedly prevented civilians from fleeing. Freedom of movement restrictions also reportedly prevented civilians from accessing medical and humanitarian assistance. As violence continued throughout the summer, Government of Sudan-aligned forces reportedly committed atrocities against civilians. This included house-to-house searches, mass killings and the subsequent burials of Nuba civilians and others.<sup>10</sup>

The UN and media outlets reported some aspects of the atrocities allegedly committed in Kadugli. However, the increasingly non-permissive environment restricted the ability of humanitarian personnel, the United Nations Mission in Sudan (UNMIS) and international observers to access affected populations and investigate alleged atrocities being contemporaneously reported in that area, including the allegations that new mass graves had recently been created in the vicinity.

Despite these restrictions, some details about purported mass gravesites were being publicly reported by sources, including UNMIS. In the leaked "UNMIS Report on the Human Rights Situation During the Violence In Southern Kordofan Sudan," UNMIS personnel confidentially reported to headquarters claims made by those they interviewed that alleged gravesites had been created during the fighting. However, UN forces were unable to successfully verify these claims because of pervasive insecurity. UNMIS reported in that same leaked report that when UN military observers (UNMOs) attempted to verify the presence of mass graves somewhere between the Sudan Armed Forces (SAF) 14th Division Headquarters and the Kadugli Market, UNMOs were "arrested, stripped of their clothes, and believed that they were about to be executed when a senior SAF officer intervened."<sup>11</sup>

HHI researchers also began directly receiving multiple eyewitness reports, which were communicated to HHI through a staff member of the Enough Project, that multiple mass graves had recently been dug throughout Kadugli. HHI researchers then sought to corroborate the witness testimony, ideally in near-real time, using satellite imagery. This documentation would also create and preserve a narrative of the deteriorating human security situation during that time. However, researchers quickly realized that they had no standard

practice for identifying the reported locations of the graves within the satellite imagery and corroborating features present within the imagery that may be consistent with the reported graves.

This problem arose because assessing the potential probative value of reports collected from ground sources proved contingent on identifying locations within satellite imagery of Kadugli. However, the locations were described in such granular and regionally specific details that HHI researchers could not locate the alleged location of the graves through the resources publicly available to them. Additionally, SSP did not have an available ground team that could be deployed, nor did the increasingly non-permissive and insecure environment allow for the deployment of a ground team to confirm these reports if one had been available. Without ground access, satellite imagery proved the only available means of corroborating the testimony of the alleged eyewitnesses.

As a result, HHI researchers integrated two primary sources of available data, witness testimony and remote sensing, to create the GRID methodology. By incorporating the witnesses' testimony into the remote sensing analysis workflow, researchers used GRID to utilize and capture local geographic knowledge that in some cases enabled researchers to understand an area on a similarly granular level as that of a ground source.

### **GRID Methodology**

HHI addressed these issues by creating a methodology to utilize the geospatial and temporal data provided by witnesses testimony to aid in the analysis of satellite imagery and corroborate the reports to more quickly, accurately and independently identify possible mass grave sites. The GRID platform utilizes remote sensing and geospatial analytics to corroborate ground reports, particularly those from non-permissive environments, by engaging the witness in the analytic process using a double blind method of inquiry to ensure independent corroboration.

### **Spatial and Temporal Data**

Witness testimony and satellite imagery each provide their own fields of temporal (time-specific) and spatial (location-specific) data about an event or observed phenomenon, such as the creation of an alleged mass gravesite. Temporal and spatial data contained in witness testimony can provide critical information to guide the analysis of satellite imagery. Additional details provided by witness testimony, such as the presence of a certain type of vehicle in proximity to the alleged gravesite, may also aid the analysis of the imagery. For this information to be of probative value, the analyst must have a process for integrating, analyzing and cross-referencing this data. The incorporation of this testimony can better guide the analyst to search a particular geographic area within the imagery.

Temporal and spatial data can be communicated in various ways. Both types of information serve distinct roles in the satellite imagery analysis process. Spatial data guides the analyst in identifying what specific geographic areas should be focused on during the analytic process. Examples of what type of information can be communicated include identifying a specific city, neighborhood, or street, as well as the presentation of information in context to a particular building, area, such as a park or other locally known geographic marker. The analyst must be able to identify where a specific location provided by the witness is located within available imagery if the testimony is to have probative value, let alone corroborative potential. For example, a witness reports observing a mass grave being dug near a specific school. Unless the imagery analyst knows where this school is located within the imagery, then this critical piece of information cannot be effectively used to locate the grave.

Location information can be obtained through publicly available geocoded datasets, like the United Nations "P-Codes";<sup>12</sup> regional, state, county or city maps; online crowd sourced mapping projects, such as OpenStreetMap, or platforms like Google Maps or Google Earth. Despite growth increases in available mapping data, not all areas of the world are equally mapped. If an analyst is unable to obtain location data relating to the AOI they are analyzing, the analyst may be limited in their ability to corroborate and identify the reported location of a mass grave or other mass atrocity-related phenomena.

Like spatial data, temporal data is equally essential information for the analyst to have during the imagery analysis process because this information guides what dates of available imagery should be analyzed by establishing the parameters for "before" and "after" imagery that will be analyzed. Examples of types of temporal information a witness may communicate about an alleged event includes the day on which the event allegedly occurred, the specific time (i.e. hour) the event occurred, and/or a specific part of the day, such as the morning, afternoon or evening, in which the event purportedly happened. For example, if a witness reports having seen a grave dug on April 16, 2011, then the imagery analyst would want to analyze imagery



captured on or after that date to determine if it contains any potential evidence corroborating the reported event through comparison with the most recent image collected before that day.

### **Creating a GRID Map**

To create the GRID map, the analyst must first receive some basic spatial and temporal data from the witness about the alleged event. Core temporal data in the testimony, such as when the witness reports having first seen the grave, for example, allows the analyst to identify the most relevant “before image” from the imagery archive available to the analyst. The before image must have been collected on a date preceding the date on which the alleged event purportedly happened. To ensure a double blind process, the before image of the area is what will be deployed to the witness within the GRID frame so that no perceived visual features are present that may influence the reply of the witness.

The before image is marked with a vector compass and generally recognizable landmarks (i.e. a park, a bridge, well-known buildings, etc.) are annotated. This annotated image is overlaid with a GRID map format, which is comprised of alphanumeric labels in the margins that assign identities to each square of the GRID (A-1, B-3, C-5, etc.). These markers facilitate the communication of geospatial references of the location and provide a confined area of interest for imagery analysis.

These markers also allow the witness to communicate granular details through the common language provided by the alphanumeric quadrants. The gridded map format, including the alphanumeric margins, vector compass, and text annotation tools, are available in geospatial analysis software programs such as ArcGIS. This function may allow the GRID map to be created while the image file itself retains its key geospatial properties, such as coordinates and vectors. This approach was implemented by HHI in the early stages of GRID. HHI analysts would later develop a customized template using graphic design software in conjunction with ERDAS Imagine.

Next, a distance ruler is embedded in the image as a scale. The ruler’s unit of measurement, meters, kilometers, inches, feet, etc., is subjective to the aperture and altitude (also referred to as the level of zoom) of the image. When imagery is presented at higher altitudes, more land area is visible in the image, but less overall detail is discernable because the resolution is poorer. By using remote sensing software, one can hone in on a specific area of interest and use a zoom function to set the aperture of the image at a lower altitude, allowing objects on the ground to be visualized in greater detail. This function is useful when a witness identifies a square on a high altitude GRID image, yet key landmarks needed for verification, such as a house or a trench are only visible at lower altitudes. The analyst could extract the identified square, zoom to a lower altitude, and resend to the witness for further comment.

The markings are annotated on the image based on the premise that when provided a vector, a distance, and generally known local landmarks, eyewitnesses will likely be able to utilize satellite imagery relevant to their community. The witness’ participation in the analysis process gives the individual an active role in documenting the alleged atrocity. This active role occurs while also maintaining chain of custody of the potential evidence and helping to preserve the impartiality of the analytic process.

### **Transferring and Annotating the GRID Map**

The GRID images can be transferred back and forth between the investigators or analysts and the witness in either digital formats or physical paper copies. When transferred digitally, a GRID image can be sent as an attached email file through an interlocutor, or directly to the witness, providing they have Internet access. Primary attention should be paid in all cases to assessing and mitigating potential threats to the witnesses’ security stemming from digitally receiving and transferring this type and volume of digital information.

Once the GRID is received, the witness can download the image and annotate areas of interest with basic editing software on their computer. For example, a witness could use MS Paint to circle and label key locations so that investigators and analysts can better identify areas of interest. If computer and software access is not available, and if an investigator can physically reach the witness, a physical printout of the GRID can be used. The GRID can be annotated by pen and returned later to the analyst in person or it can be sent by email when the witness can access it safely.

### **Change Detection Process**

Once the GRID is transferred back to the analyst, at least two sets of images of the identified area must be obtained in order to begin the process of what is referred to as “multi-temporal” change detection.<sup>13</sup> The first image, or a before image, is captured by satellites before the date of the reported event. When selecting

the before image, it is important to find an image as close to the date of the event as possible in order to exclude other potentially similar occurrences such as construction, agricultural digging, or natural erosion that may have caused visual changes to the topography of an area over an extended period of time. The second image, or an after image, is an image taken of the area of interest after the event has been reported, still being as close as possible to the date of the report. Then, with time and resources permitting, a third image taken on an even later date may be used to show further evidence of change, which can create a time window for the event.

When the image set is ready, the identification process can vary depending on what type of imagery is available for analysis. Panchromatic imagery is black and white, multispectral 3-band imagery has three layers of red, green and blue which creates natural color, and multispectral near-infrared (NIR) has the three layers found in multispectral 3-band plus an additional layer of red, mainly used for remote sensing analysis of vegetation.

When conducting change detection using one of these three imagery types, the analyst needs to detect earth disturbance patterns by visually noticing changes present in images taken on two different dates. During visual change detection, information relating to landmarks and their distances in proximity to the grave that are provided by the witness are highly valuable to the analyst. For example, when the witness identifies an image square containing the alleged gravesite area, the witness could relay if it was 15 meters from a main road or approximately 20 meters from a farm. It is beneficial for the analyst to be experienced in identifying observables in the satellite imagery specific to the area they are monitoring. In the case of Sudan, the analysts at Harvard were knowledgeable of the typical housing and building structures, vehicles, farm and orchard layouts, and other important visual indicators of the areas under observation.

The use of NIR multispectral imagery provides an additional benefit to the change detection process when identifying disturbed earth patterns that could be difficult to see in non-NIR satellite imagery. The NIR imagery's fourth layer of red can help differentiate vegetation that is healthy or growing from damaged or desiccated vegetation. This is because vegetation in an active growth cycle exhibits a stronger reflective property. This growth would appear as a more prominent red color in unmanipulated NIR imagery, whereas surrounding vegetation that is desiccated or damaged, or earthen soil lacking vegetation would exhibit less of the red color, or not at all.

### **Role of the Interviewer and Security Considerations**

For the necessary information to be obtained, an interviewer must have contact with the witness to not only obtain and relay testimony, but to also facilitate the witness' interaction with the GRID. As in traditional human rights interviews, a common language known by both the interviewer and interviewee must be identified so that the interview can be conducted. The interviewer may or may not be a third-party interlocutor. Additionally, an organization may choose to use an interlocutor so that their analysis team does not communicate directly with the ground source. Keeping these processes separate may ensure that a false identification does not occur because the interviewer cannot use their own knowledge of the analytic process to lead the witness during their communication.

Whether the interview process is conducted remotely, by phone or email, or in person, the interviewer should ensure that all communication occurs in an environment that is as secure as possible. An organization should also deploy GRID in accordance with their security standards. When communicating with a witness electronically, the interviewer may encrypt their email to mitigate the risk of electronic interception by an outside entity. This step is imperative if the witness is communicating to the interviewer within a non-permissive environment. The encryption of email transmissions, as well as a secure storage system for the data, may ensure that chains of custody procedures are better protected. Additionally, the interviewer should discuss security considerations with the witness before the interview so that measures can be taken to ensure the witnesses' safety.

### **HHI's Use of GRID**

HHI delivered GRID maps to multiple self-identified eyewitnesses to cross-corroborate reports of three alleged mass graves sites in Kadugli, including one site that was also independently reported by UNMIS. When GRID appeared to aid in the identification and cross-corroboration of these reported sites, SSP released public reports about the potential existence of the alleged mass gravesites. In all of the SSP reports, the eyewitnesses were never publicly identified and any potentially identifying information was removed from the public product, such as gender specific pronouns.

One example of such a corroboration was reported on August 17, 2011. Satellite imagery substantiated the testimony of an alleged eyewitness to the creation of an alleged mass grave outside the Khalil Yagoup Garden in Kadugli. In “Cover Up: New Evidence of Three Mass Graves in South Kordofan,” SSP reported:

An eyewitness reported directly to SSP that on 9 June, while hiding in the Khalil Yagoup private garden in the Hagar Al Nar neighborhood of Kadugli, the individual witnessed a Sudanese Red Crescent Society (SRCS) land cruiser parked in front of the garden. According to the witness, two men wearing what appeared to be SRCS aprons took a dead body out of the vehicle and placed it on the ground. The eyewitness then reported seeing a yellow earthmover with five or six bodies in its bucket, which were subsequently dumped into a hole approximately four meters outside the fence surrounding the garden. The dead bodies had blood on their clothes, according to the eyewitness. On a map of the area, the eyewitness independently identified the location where the grave was allegedly dug. In imagery captured by DigitalGlobe on 2 June, there are no signs of disturbed earth at the location identified by the eyewitness. The next available satellite image of the site, taken on 4 July, shows disturbed earth at the location the eyewitness identified on the map. Additional imagery captured on 4 and 6 August, shows grass growing on the site the eyewitness claims is a grave.<sup>14</sup>

Although the report does not mention the GRID methodology specifically, it does recount the situation of the witness independently identifying the grave’s location on a map that was used by SSP to corroborate the allegations. This report also highlights additional details communicated by the witness pertaining to the alleged event.

Four basic steps were taken by HHI researchers to create and deploy a GRID frame to corroborate the Khalil Yagoup Garden Grave in Kadugli. These steps are:

- 1) Construct and dispatch the initial GRID map: A gridded map, which included the Hagar al Nar neighborhood and the main road leading north, was sent to the interlocutor who transmitted it to the ground source. The date of the image used in the GRID was collected before the alleged event seen by the witness. The witness was made aware of the date of the image. The map was annotated with specific points of interest, a vector, and alphanumeric bars to both orient the source and help them communicate geospatial references back to the interlocutor;
- 2) Analysis and verification from ground source: After recognizing the annotated areas and the vector (situated northward), the source then confirmed that the area of the grave excavation was in square B-3 of the map (Figure 1);
- 3) Construct and dispatch of a second, enhanced GRID map: Once the confirmation of square B-3 was received, the area was analyzed at a higher resolution, re-gridded and transmitted back to the source via the interlocutor to identify a more precise location of the excavation. The witness provided further confirmation of a precise location (Figure 2).

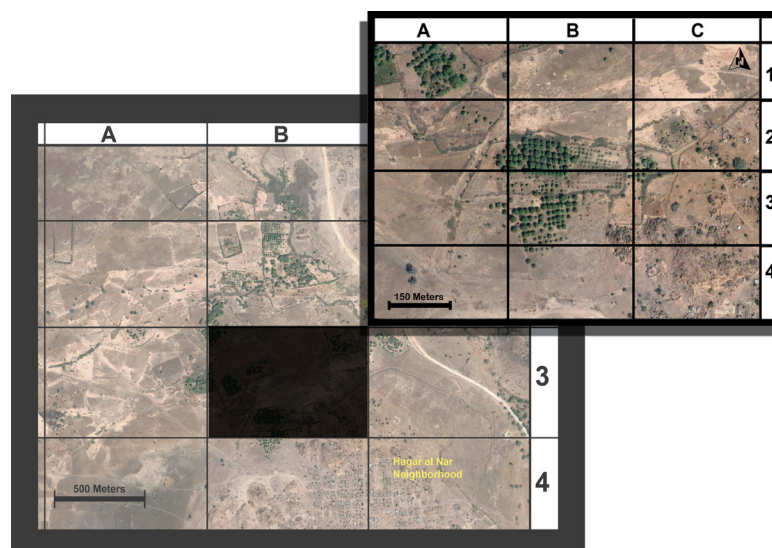


Figure 1. Using the alphanumeric quadrants on the GRID map, the witness identified square B-3 as the area of interest. Square B-3 was then enlarged at a higher resolution, reformatted as a GRID map and sent back to the witness for further inquiry. © [DigitalGlobe]. Reproduced by permission of DigitalGlobe. Permission to reuse must be obtained from the rightsholder.



- 4) Verification and confirmation through remote sensing analysis: Through the method of change detection, analytic imagery comparisons of the location before and after the event and the use of multispectral image processing, the HHI's imagery analyst was able to confirm the presence of the precise spot of recently disturbed earth consistent with the reported mass grave (Figure 3).

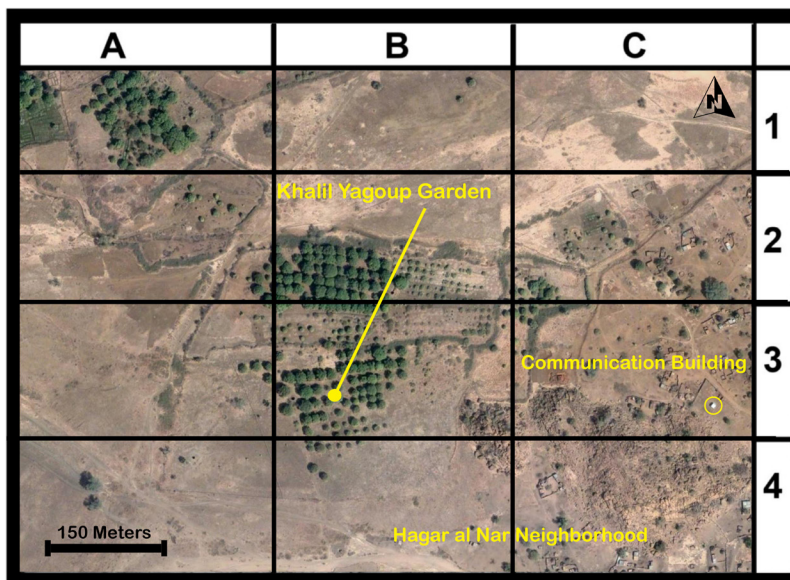


Figure 2. A GRID map marked by a witness and sent back to an analyst can provide valuable location-based information to build a robust geospatial database. Possible marked areas may include neighborhoods, public gardens, infrastructure and buildings. © [DigitalGlobe]. Reproduced by permission of DigitalGlobe. Permission to reuse must be obtained from the rightsholder.

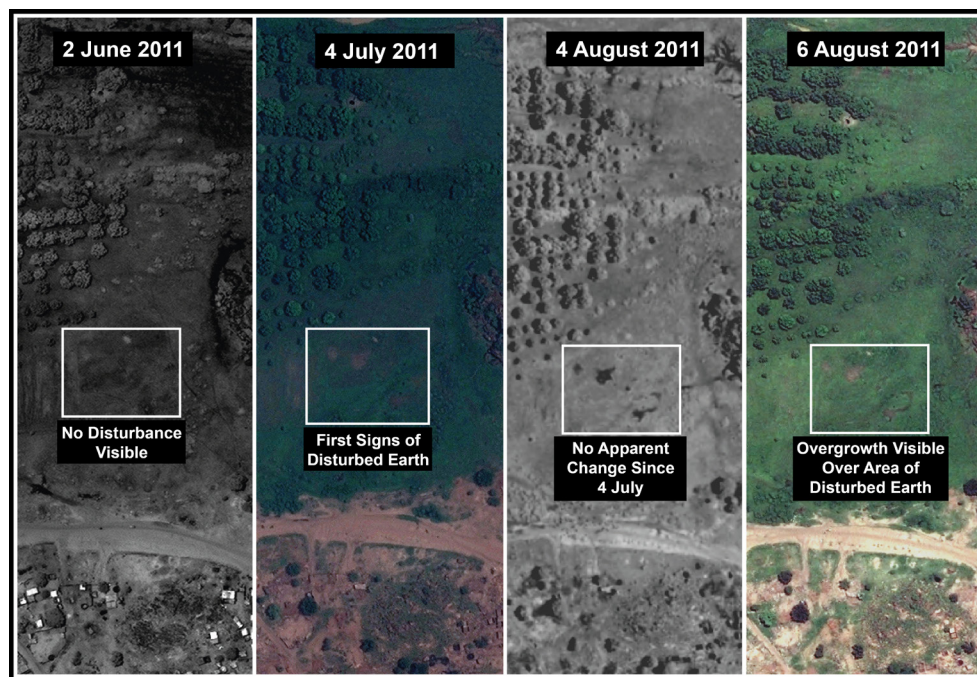


Figure 3. Near-infrared satellite imagery was used to conduct change detection analysis reveals disturbed earth consistent with the location and time period of the grave observed by the witness near the Khalil Yagoup Garden. © [DigitalGlobe]. Reproduced by permission of DigitalGlobe. Permission to reuse must be obtained from the rightsholder.

### Potential Outcomes and Contributions

GRID enhances the ability of organizations to corroborate reports of gross human rights violations by allowing them to investigate allegations from both permissive and non-permissive environments. Non-permissive environments create unique challenges for corroborating witness testimony. For example,



Human Rights Watch states that their researchers interview both victims and witnesses “when investigating reported human rights abuses in order to understand accurately what occurred.”<sup>15</sup> The collection of location information relating to abuses is integral. As part of these interviews HRW researchers “always try to get to specific locations where violations are known to have occurred, or are ongoing.” However, “security conditions and time limitations can greatly affect where researchers can conduct investigations.”<sup>16</sup> In these types of environments, ground investigations may be restricted or prohibited, sometimes by the perpetrators themselves.

In these cases, remote sensing, particularly satellite imagery, is uniquely positioned to document evidence of events occurring in the area based on witness testimony. As it may be unknown when access to the area may be granted, this documentation can also allow an organization to more immediately capture information relating to a continuing crisis where evidence of alleged acts may be affected over time. This utilization of satellite imagery has been identified as a secondary source of information, meaning that satellite imagery analysis can “provide corroborative evidence to help evaluate the accuracy of reported incidents or claims from sources of unknown reliability.”<sup>17</sup> This corroborative act may even produce evidence to support legal investigations into alleged violations of international humanitarian law.<sup>18</sup>

Further, satellite imagery analysis can be employed without witness testimony as a primary source of information. This means that the satellite imagery itself can provide direct evidence “when on-site investigations and access to witnesses are impossible normally due to insecurity, government prohibitions, or physical inaccessibility.” It has further been argued that, “Under these conditions, satellite imagery has proved to be one of the only viable means of independent, objective, and systematic collection of significant evidence of possible war crimes.”<sup>19</sup> The double blind nature of the GRID process can help protect the probative value of both satellite imagery and witness testimony. This is because the witness cannot be lead to an assumption when indicating the location of the event in the satellite image because the witness is only allowed to view imagery captured before the event reportedly occurred.

### **Additional Applications**

Although this paper discusses how GRID was employed to corroborate reports of mass graves, GRID can potentially be deployed in a diverse range of environments and conflict situations to help corroborate many different types of reported acts. These include, but are not limited to, the following:

#### **Confirming threats to civilian freedom of movement**

GRID’s deployment, particularly in non-permissive environments, may enhance the accurate, time-sensitive identification of checkpoints set-up by alleged perpetrators during mass atrocity event scenarios. Checkpoints during mass atrocity events can be used to both prevent civilians from fleeing an area and block humanitarian actors from entering. GRID enables responders to collate multiple reports of a checkpoint’s location on a regular basis. Satellite imagery analysis can then be used to confirm the reported locations of checkpoints in a map format. Information about the structure, size, color, disposition, and force capacity present at those locations are also key details provided by the witness that may be captured by GRID, potentially assisting analysts and organizations in documentation and decision making.

#### **Early warning of potential mass atrocities**

GRID can be deployed before an atrocity occurs to help identify the alleged build-up of the military assets by potential perpetrators of mass atrocities. Witnesses or those who receive reports about the build-up of assets can communicate this information through GRID to governments, NGOs, and humanitarian personnel. For example, in the summer of 2011 reports were received by HHI from ground sources about the build-up of the Central Reserve Police training center in Kadugli. This force was originally created for riot control but was later reportedly used by South Kordofan Governor Ahmed Haroun as a paramilitary militia.

A ground source in close contact with an interlocutor reported that the location of the CRP training center was in the area of the El Shaeer neighborhood, near UNMIS’ Kadugli headquarters. HHI created a GRID of the El Shaeer neighborhood, including UNMIS headquarters, and deployed it via the interlocutor to the ground source. The ground source was able to positively identify and mark the training center in quadrant C-2. Once the GRID map marked by the source was received, analysts were able to positively confirm the location, which it was then able to monitor its build-up during the days of fighting.

### **Location of extrajudicial detention centers**

GRID can be used to locate centers where civilians are being allegedly held illegally and subjected to torture, extrajudicial killing, and other gross human rights abuses. Data gathered from GRID would allow an organization's ground staff and headquarters to quickly triangulate reports of centers where human rights abuses are reportedly being committed, allowing fact finding and human rights monitors to more easily locate those facilities and deploy monitors to these centers.

### **Satellite Imagery Acquisition and Analysis**

A key component of GRID's methodology is the use of either open source imagery or purchased commercial imagery. Creating the GRID from open source imagery, imagery that is publicly available, is free and can be deployed in its basic form. Sources like Google Earth, Google Maps or Bing Maps often have high-resolution imagery of different areas around the globe. Access to these websites and software allows groups to be able to develop their own versions of GRID tailored to their objectives and context. If an organization uses open source imagery to create the initial GRID that is deployed, purchasing imagery may be necessary to conduct analysis for near-real time corroboration.

If an organization has an imagery budget available, purchasing commercial satellite imagery can occur through an imagery provider, like Astrium or DigitalGlobe. Additionally, third party retailers that specialize in digital GIS and remote sensing data, like MapMart, may sell satellite imagery from major companies. The cost structure of purchasing satellite imagery is typically dependent on if the imagery is archival or a new acquisition. For example, as of October 2013, Astrium's standard archive imagery captured by their Pleiades very-high resolution satellites is \$13 (USD) per square kilometer and a standard new acquisition is \$23 (USD) per square kilometer. These prices can make purchasing imagery expensive depending on the number of square kilometers in the area of the interest. Most commercial companies have online catalogues of the imagery in their archive available for purchase. The aforementioned imagery catalogues of these providers also include various search filters that factor in attributes like cloud cover percentage and image quality. Entering relevant dates and additional data such as weather conditions may also yield positive results for imagery.

Employing GRID may shorten the amount of time spent analyzing the satellite imagery because the analyst may be more quickly guided to areas of interest by the witness testimony. Subsequently, the ability of an organization to only purchase what imagery that is necessary for their analytic process may be increased. This is because an analyst can focus their imagery purchases to areas identified by the witness through GRID. In cases where near-real time satellite imagery can be obtained and analyzed, the length of time between the testimony collection and its corroboration may be reduced.

### **Limitations**

The GRID methodology appears to have successfully cross-referenced information from witness testimony and remote sensing data in the instances described above. However, limitations to the acquisition of potentially relevant satellite imagery and factors affecting the quality of available imagery may hinder and/or prevent GRID's application in some cases.

The acquisition of the imagery necessary to perform multi-temporal change detection, the main imagery analysis method employed as part of GRID, can be difficult if the satellites do not frequently capture imagery of the area of interest. The analysts at HHI benefitted from a robust imagery archive of Kadugli captured both before and after the creation of alleged mass graves as a result of intensive, persistent monitoring of the area. This rare operational context, which yielded large volumes of relevant imagery data at high temporal resolution, shortened the duration between before and after imagery, likely producing more reliable results. Similar archives resulting from proactive monitoring may not always be available to an organization, however.

Although analysts may be able to acquire current imagery over an area of interest, other avenues may be required to obtain a before image captured closer to the date of an event to obtain the baseline data necessary for multi-temporal change detection. When using open source imagery, like from Google Earth, it is important to verify the date of the image capture. Google Earth currently provides the date of the image capture, as well as the company or organization whose satellites captured the image. The time-slider tool in Google Earth allows the analyst to view images taken on different dates over an area. In particular, the analyst should pay attention to the top left of the viewer window to see the date of the image acquisition, and the bottom center of the viewer window to see which company or organization captured the image. To verify that the information is correct, the analyst can record this information and see if the company has an online catalogue of their

imagery. Most of these catalogues, like DigitalGlobe's ImageFinder or Astrium's GeoStore, allow the user to draw a polygon precisely around any area of a digital map of the earth, and see what imagery, along with the dates, has been collected within that polygon. If the dates coincide with the information provided by Google Earth, the probability is high that the data is accurate. Also, the results provided by these catalogue searches are often accompanied by a low-resolution image sample (i.e. 10 meter image sample of a 0.5 meter image), of the collect. A more experienced imagery analyst can use unique visual indicators within the sample image specific to the date of collection, such as large cloud formations or scorched earth patterns, and match them to the image on Google Earth.

If the analyst needs to perform multispectral analysis to assess vegetation, this cannot be performed using imagery available from Google Earth. This is because the exported image from Google Earth is a standard image format, such as a JPEG. It is important to note that the analysis of vegetation, as it relates to disturbed earth, can be an important factor in the analysis of satellite imagery to identify alleged mass grave locations.

Another challenge is the presence of heavy clouds in the imagery that may obscure the areas of interest. It is necessary to not only be aware of the weather conditions of an area being monitored by remote sensing, but to also factor that into the decisions of when to task a satellite company for image requests. In the case of Sudan, it was important for the analysts at HHI to not only be cognizant of what days would present the most cloud cover over an area of interest, but to be knowledgeable of when the rainy season occurs annually throughout the country.

The landscape of an area of interest is also a significant factor in the acquisition and analysis of imagery. For example, the landscape in Sudan varies from heavily forested areas, mountainous, rocky terrain, to flat, sparsely vegetated desert lands. When analyzing areas of interest within the town of Kadugli in particular, the imagery analysis benefitted from the region being lightly forested with developed neighborhoods that provided unobstructed surface area throughout the imagery. Locations that are heavily forested can be more difficult, sometimes impossible, to analyze due to dense tree cover obscuring activity. Certain land formations, such as caves, can also be used to conceal any activity that could be captured by satellites, thus making positive identifications through change detection improbable.

In the event that imagery would need to be acquired to document activity occurring at night, the options to acquire and analyze night-time imagery are currently limited, and can be much more costly to purchase. Many commercial satellite companies do not provide the imagery due to their satellites incapability of capturing adequate high-resolution imagery at night. Though it is currently not common, some satellites such as ImageSat International's EROS B are capable of capturing detailed, panchromatic night-time imagery. However, it is important to consider that if immediacy of the acquisition is required, the revisit rate over an area for EROS B averages every 3.5 days, as opposed to other commercial satellites daily revisit rate.

### **Conclusion: Overcoming Barriers to Adoption, Pursuing Future Research**

Based on the experience of researchers at HHI, gaps in an analyst's knowledge of hyper-local location-based information relating to a specific AOI can limit or prohibit the cross-corroboration of witness testimony through satellite imagery analysis. The ad hoc development of GRID by HHI was specific to the operational context of Kadugli, Sudan in the summer of 2011. GRID provided analysts unique, otherwise unavailable location-based information for the cross-corroboration of alleged mass graves. This successful initial use warrants further research into GRID's potential application in other regional and operational contexts is urgently required.

It is acknowledged that due to this methodology's reliance on access to imagery recently collected relative to the date of event, the ability of an organization to utilize this method may be contingent on one or more of several institutional and technical factors. To overcome these barriers, increased amounts of data and access to geospatial resources are required. Currently, the landscape of the commercial geospatial data is rapidly changing. The emergence of micro-satellite providers such as Skybox Imaging may eventually deliver less costly and more timely geospatial data to organizations undertaking similar types of data collection. The expanding availability of open source data, such as imagery loaded to Bing and Google Earth, is also critical for increasing potential sources of no-cost data.

The development of GRID can benefit two distinct groups currently using or seeking to utilize geospatial technology. First, professionals, like researchers and practitioners, who employ satellite imagery to corroborate testimony can integrate GRID into their current practices as a complimentary methodology. Second, digital mapping projects led by citizens can employ GRID as a standardized methodology. The rise of neogeography over the past five years has resulted in citizens, primarily volunteers, with little to no training participating

in crowdsourcing projects to produce and analyze geographic data, including volunteered geographic information.<sup>20</sup> Some of these projects involve the analysis of geospatial data like satellite imagery.<sup>21</sup> As work by these groups is continuing to increase, standardized methodologies and tools must be made available, especially for those who do not have access to formal training.

Additionally, GRID raises questions as to how the active participation of the witness impacts this type of mixed methods approach. Marguerite Madden and Amy Ross (2009) explored “mixed quantitative and qualitative methods of GIScience technologies and field-collected narratives” to assess violence in Uganda. This research raised critical questions pertaining to viability of this mixed methods approach. As part of this research, Madden and Ross collected narratives from the field to support the analysis of satellite imagery accessed using Google Earth.<sup>22</sup> This work led to the conclusion that, “In some respects quantitative data extracted from the satellite imagery support verbal accounts of personal histories, events, and experiences.”<sup>23</sup> The experience of HHI in developing GRID supports Madden and Ross’ conclusion. However, it must be noted that although the combination of these data sources is not a novel approach, the purposeful involvement of the witness is a unique dynamic that must be researched further.

This paper’s discussion of the GRID supplements current practice by outlining specific methodological and technical details of how to involve a witness in the analytic process. In turn, additional areas that future research may address includes understanding the role cultural differences may play in transmitting information related to mass atrocities; the potential positive and negative psycho-social implications and impacts GRID may have for alleged witnesses; and most critically, how to technically ensure both witness security and chain-of-custody of evidence.

Such research may further develop GRID as a standard evidence collection methodology for other organizations engaged in this space. It is the hopes of the authors that this research can lead to the development of a standardized tool that can be made widely available to the human rights, humanitarian, and remote sensing communities. Future applications of GRID, including the development of a common GRID tool, must be developed in accordance with accepted research ethics and prioritize the serious security concerns vulnerable populations face in non-permissive, mass atrocity-producing environments.

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# Documenting Mass Rape: Medical Evidence Collection Techniques as Humanitarian Technology

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## Abstract:

**Aim:** Emerging global networks of human rights activists, doctors, and nurses have advocated for increased collection of medical evidence in conflict-affected countries to corroborate allegations of sexual violence and facilitate prosecution in international and domestic courts. Such initiatives are part of broader shifts in human rights advocacy to document human rights violations using rigorous, standardized methodologies. In this paper, I consider three principal forms of medical evidence to document sexual violence and their use in these settings: the patient medical record, the medical certificate, and the sexual assault medical forensic exam (commonly known as the “rape kit”).

**Methods:** Combining archival research with interviews of activists, healthcare practitioners, lawyers, investigators, and other experts, I trace the collection and use of medical evidence to document mass rape since the establishment of the International Criminal Tribunals for Rwanda and the former Yugoslavia.

**Results:** The use of medical evidence collection techniques to document sexual violence during and shortly after armed conflict or mass violence against civilians is still relatively new and not well institutionalized. When available, medical evidence has been used to document patient disclosures, describe patterns of crime, prompt investigation, issue indictments, and provide context evidence to establish international crimes occurred.

**Conclusions:** Drawing on approaches in science and technology studies, law and society, and cultural sociology, I argue that medical evidence collection techniques represent an emerging humanitarian technology that may influence what comes to count as sexual violence, which crimes are deemed justiciable, and ultimately how events come to be remembered, within and beyond courts.

**Keywords:** medical evidence; rape kits; sexual assault medical forensic exam; medical certificate; mass rape; sexual violence in conflict

## Introduction

Calls to address sexual and gender-based violence in conflict have garnered international attention, marked most recently by the largest global event ever held on the subject in June 2014: the United Kingdom's Global Summit to End Sexual Violence in Conflict, co-hosted by British Foreign Secretary William Hague and United Nations High Commissioner for Refugees Special Envoy Angelina Jolie. At the Global Summit, the United Kingdom's Foreign and Commonwealth Office (UK FCO) published and disseminated the UK's new International Protocol<sup>1</sup> (hereafter, UK protocol), which is intended to guide first responders in collecting and preserving evidence of sexual violence during or shortly after armed conflict, even if prosecution is unlikely to occur until much later. Although medico-legal interventions are not the focus, the protocol names specially trained doctors and nurses as among the first responders who may collect victim testimony, create and maintain documentation of disclosures by patients, and, where possible, collect and preserve physical evidence.

A principal focus of the UK's Global Summit and the launch of the UK protocol was to increase investigation and prosecution of sexual violence in armed conflict.<sup>2</sup> Although landmark cases at the

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International Criminal Tribunal for Rwanda (ICTR) and the International Criminal Tribunal for the Former Yugoslavia (ICTY) have successfully established rape as a war crime, a crime against humanity, and, in the *Akayesu* case,<sup>3</sup> an instrument of genocide, few subsequent cases referred to the International Criminal Court (ICC) have led to arrest or prosecution. Despite continued advocacy and ongoing ICC investigations<sup>4</sup> into allegations of mass atrocities<sup>5</sup> in several countries, barriers to prosecution persist in both domestic and international courts.

Intended to address these barriers to prosecution, a growing number of interventions in conflict and post-conflict areas involve training healthcare practitioners in medical evidence collection techniques to corroborate allegations of rape and other forms of sexual<sup>6</sup> violence. Such initiatives often seek to combine specialized medical care and treatment for survivors of sexual violence with increased medical documentation of patient narratives, physical injuries, and psychological sequelae in order to facilitate prosecution in domestic and international courts. However, new procedures, rules, and norms often accompany new techniques and may conflict with existing norms, practices, and political interests in the environments in which they are introduced. As a result, processes of transnational diffusion and circulation of new techniques inevitably involve resistance, adaptation, and innovation by domestic actors who often must do substantial work to make new laws, rules, norms, and technologies – often formulated in the Global North – relevant in new contexts and environments – often in the Global South – to which they are not always well-suited.<sup>7</sup>

Attempts to standardize, professionalize, and more routinely implement medical evidence collection techniques and adapt them to a somewhat new purpose are part of broader shifts in the field of human rights advocacy to document and measure human rights violations using rigorous and standardized methodologies. Activist-professionals have marshaled their disciplinary tools and expertise to produce evidence of mass atrocities through a variety of technologies, including the use of sophisticated sampling and survey techniques to produce population-based estimates of mortality, morbidity, and more recently sexual violence in war; application of death investigation techniques and forensic science to exhume mass graves and identify human remains; and acquisition of commercial satellite images to capture population displacement and destruction of physical structures. Similarly, medical evidence collection techniques are designed to measure and record characteristics of sexual violence and its effects on patient-victims that may serve as a tool to advance human rights advocacy, prompt investigation, and bear witness to atrocities.

Yet evidence collection techniques may in fact help to define what they purport to measure, thereby having profound symbolic and material effects on the perceived credibility of victims' narratives of events and ultimately which narratives are included in formally recorded histories of mass atrocities. In the case of human rights advocacy, documentation of rights violations often is explicitly intended to have such definitional effects in order to name and thereby symbolically sanction crime. Such evidence may also suggest that specific violations of international humanitarian law have occurred and establish the jurisdiction of specialized international and hybrid courts to investigate Heads of State and other high level officials who may be responsible. For example, estimated counts of numbers of persons killed, displaced, or raped have been at the center of debates about whether or not genocide occurred in the Balkans<sup>8</sup> and Darfur.<sup>9</sup>

The use of medical evidence collection techniques with surviving patients<sup>10</sup> during and shortly after armed conflict and episodes of mass violence against civilians is still relatively new and not well institutionalized, even in settings in which specialized physician training and capacity to collect and analyze forensic evidence<sup>11</sup> exist. Therefore, in this paper, I consider three forms of medical documentation and their associated evidence collection techniques and provide examples of their use in documenting sexual violence in contexts of armed conflict, humanitarian emergencies, and mass violence against civilians: the patient medical record, the medical certificate, and the sexual assault medical forensic exam and its associated forensic evidence collection kit (often referred to as the “rape kit”).<sup>12</sup>

Drawing on approaches in science and technology studies, law and society, and cultural sociology, I argue that, like other technologies, medical evidence collection techniques designed to corroborate rape<sup>13</sup> reflect their historical origins in place and time, and their character, use, and potential effects are likely to vary in new contexts of armed conflict and mass violence. Historically such techniques were developed to document individual harms to individual victims by direct perpetrators and collect corroborative evidence for use in domestic courts. Their adaptations for use in contexts of armed conflict and mass violence signal the differences in scale between individual and collective crimes of sexual violence and the barriers to prosecution of sexual violence as an international crime in the national jurisdictions in which it has occurred, with potentially far-reaching effects within and beyond courts.



This paper is divided into six sections. First, I describe the data and methods on which I draw. Next, I provide an overview of the historical origins of medical evidence as a means of corroborating allegations of rape in domestic courts and the differences in scale that arise when attempting to prosecute sexual violence as a violation of international humanitarian law. To illustrate these differences, I describe the legal definitions of crime, more flexible evidentiary standards, and innovative rules of procedure and evidence developed by the ICTY and ICTR to facilitate prosecution of sexual violence as a war crime, crime against humanity, and instrument of genocide and demonstrate how they differ from national jurisdictions. In sections three, four, and five, I discuss three types of medical evidence and provide examples of their recent use in contexts of armed conflict, humanitarian emergencies, and mass violence against civilians as a means of documenting and adjudicating individual and collective crimes of sexual violence in such environments: re-purposing routinely collected patient medical records as evidence in investigation and prosecution of international crimes of sexual violence; issuing medical certificates as part of basic medical care in humanitarian emergencies; and offering sexual assault medical forensic exams during and immediately following episodes of mass violence against civilians for use in the national jurisdictions in which the crimes occurred. Finally, given the relatively recent introduction of these techniques in settings of armed conflict and mass violence and the limited research available to date, I offer questions for consideration and propose areas for future research. I suggest that medical evidence collection techniques may influence what comes to count as sexual and gender-based violence in armed conflict, which crimes are deemed justiciable, and ultimately how events come to be remembered. In this way, medical evidence collection techniques represent an emerging humanitarian technology that may contribute to formally recorded histories of mass atrocities while simultaneously reflecting and influencing understandings of sexual violence in war and representations of survivor experiences.

## Methods

My approach combines archival research with interviews of activists, healthcare practitioners, lawyers, investigators, and other experts who have sought to use their professions, expertise, and evidence collection techniques in service of human rights advocacy—individuals who have been instrumental in generating medical evidence to document sexual violence as a central component of women's rights and human rights advocacy since the 1970s, with particular emphasis on the evolution of such techniques to address sexual and gender-based violence in war as a focus of international advocacy since the 1990s.<sup>14</sup> In this paper, I consider uses of medical evidence broadly defined, including routinely collected treatment records, medical certificates, sexual assault medical forensic exams (commonly known as “rape kits”), adaptations of medical forensic exams developed for use with survivors of torture, and statistics generated from aggregated, de-identified data based on such records. I describe how medical evidence, when available, has been used to characterize patterns of crime, provide context evidence, facilitate the issuance of indictments, and support case prosecution before specialized international and hybrid courts since the establishment of the ICTY and ICTR. I draw on publicly available reports, court documents from cases brought before specialized international and hybrid courts, and published research articles to reconstruct this recent history and inform my understanding of contemporary uses of medical evidence collection techniques for these purposes.

## Differences in Scale and Context: Historical Origins of Medical Evidence to Document Rape in Domestic Courts and its Contemporary Uses in Settings of Armed Conflict, Humanitarian Emergencies, and Mass Violence Against Civilians

Medical evidence has long been used to adjudicate crime, and doctors have served as expert witnesses in court for this purpose since at least the 19<sup>th</sup> century. However, attempts to standardize and professionalize medical evidence collection techniques in order to improve available evidence and facilitate legal advocacy on behalf of surviving patient-victims appear to be relatively recent, beginning in the 1970s and continuing to the present. For example, beginning in the 1970s, practitioner-activists allied with the reform agenda of the anti-rape wing of the second wave feminist movement in the United States sought to reform law enforcement and healthcare approaches to sexual violence. They attempted to create more victim-centered models of care, in part by advocating for routine collection of medical forensic evidence by specially trained healthcare personnel in order to corroborate allegations of rape.<sup>15</sup> Similar reforms have been implemented in Western Europe. During the same period, doctors associated with the global anti-torture movement sought to provide specialized medical care and treatment for survivors of torture, document and classify physical injuries and psychological trauma resulting from different methods of torture, and facilitate prosecution; these efforts

ultimately led to the adoption of the *Istanbul Protocol*<sup>16</sup> designed to guide physicians in conducting medical forensic exams with survivors of torture.

Initially, these techniques and guidelines were developed for use in domestic jurisdictions. Since the 1990s, increased medical documentation of physical injury and collection of forensic evidence (when possible) have been codified as a component of specialized medical care and treatment for survivors of sexual violence in medico-legal guidelines adopted by the World Health Organization (WHO) in 2003.<sup>17</sup> These guidelines outline best practices in medical care for surviving victims of sexual violence. In 2004, these guidelines were adapted for use with refugees and internally displaced persons.<sup>18</sup>

In contrast, in the 1970s, the relatively young professional field of what has come to be known as “transitional justice” and its associated Truth Commissions and specialized international and hybrid courts established to prosecute war crimes, crimes against humanity, and genocide post-Nuremberg had yet to emerge. Historically, medical evidence of sexual violence during armed conflict was not available or required as corroborative evidence in specialized international and hybrid courts. However, in the last 10-15 years, an increasing number of organizations have introduced or adapted medical evidence collection techniques for use in settings of ongoing or recent armed conflict, mass violence, and humanitarian emergencies. While feminist scholars of transitional justice have long identified barriers to seeking justice in court for survivors of sexual violence, few studies to date have examined the origins and effects of medical evidence collection techniques introduced to document mass rape and meet the evidentiary requirements of international and domestic courts.

To contextualize these developments within the recent history of transitional justice and international criminal law post-Nuremberg, I provide a brief overview of the legal definitions of rape and other forms of sexual and gender-based violence developed by the ICTY and ICTR, their innovative rules of procedure and evidence, and the tensions that arise when international crimes of sexual violence are prosecuted by domestic courts in the national jurisdictions in which the crimes occurred.

#### *Prosecuting International Crimes of Sexual Violence Before the International Criminal Tribunals for Rwanda and the Former Yugoslavia*

In 1993, the ICTY was established to prosecute mass atrocities in the Balkans, the first such international court since Nuremberg. As John Hagan has chronicled in his ethnography of the early years of the ICTY, prosecutors were initially reluctant to investigate and prosecute sexual violence cases.<sup>19</sup> Internal advocacy by predominately female prosecutors and investigators pushing for investigation against the backdrop of public outrage at reports of mass rape within Bosnia was instrumental in prompting the court to bring the first rape cases before an international court. Part of this advocacy included the establishment of protective measures for victims of sexual violence that signaled the divergence of the court from legal requirements of corroboration and proving lack of consent typically required in national jurisdictions. These innovations in rules of procedure and evidence have become understood as among the landmark achievements heralded by the ICTY<sup>20</sup> and were later adopted and codified as part of the founding Rome Statute<sup>21</sup> of the ICC.<sup>22</sup>

Evidentiary requirements are closely tied to available definitions of crime, modes of liability, and procedural protections for victims in domestic and international courts. The crime of rape illustrates key differences between international and domestic courts and their implications for survivors’ access to justice.

#### **Defining the act of rape**

Definitions of rape as a crime under international humanitarian law were first developed within the jurisprudence of the ICTR and ICTY.<sup>23</sup> A landmark decision by the ICTR, the *Akayesu* case, established that rape could be legally and criminally sanctioned as an instrument of genocide and a crime against humanity. The decision defined rape broadly as “a physical invasion of a sexual nature, committed on a person under circumstances which are coercive”;<sup>24</sup> the court also recognized forced nudity as a form of sexual violence constituting inhumane acts as crimes against humanity.<sup>25</sup> In the subsequent *Furundžija* case, the ICTY provided an explicit judicial definition of rape in terms of human vaginal, anal, or oral penetration with genitalia or with objects through coercion or the use or threat of force.<sup>26</sup>

Subsequently, the ICC Elements of Crimes defined rape (as a crime against humanity) as the invasion of the body of the victim by the perpetrator (including oral, anal, or vaginal penetration with genitalia or objects) through the use or threat of force, coercion, or by taking advantage of a coercive environment. Both men and women can be victims.<sup>27</sup> Domestic criminal penal codes may or may not criminalize all forms of sexual violence recognized by the international courts.

### **Establishing the context in which rape occurred**

In addition to demonstrating that an act of rape occurred (however defined), prosecutors must also establish that the specific elements of the relevant category of international crime have also been met. In the case of war crimes, crimes against humanity, and genocide, this explicitly involves an environment of coercion, such as armed conflict or mass violence. For example, the definition of crimes against humanity in Article 7 of the Rome Statute<sup>28</sup> stipulates that any of the enumerated acts<sup>29</sup> must have been committed as part of a “widespread or systematic attack” directed against civilians.

### **Determining modes of liability**

International courts also attempt to prosecute those most responsible at the highest levels in the chain of command. Sometimes high level perpetrators can be tied directly to the crime; more often prosecutors must link lower level, direct perpetrators not only to victims, but also to remote perpetrators with command or superior responsibility. This has been a particular challenge in cases of sexual violence. In domestic jurisdictions, similar challenges may arise. Innovative legal strategies to hold high level perpetrators accountable under rubrics such as “joint criminal enterprise” and command responsibility may not be available, and liability modes based on conspiracy differ from jurisdiction to jurisdiction. They may not be available to prosecutors in local jurisdictions.

### **Innovative Rules of Procedure and Evidence**

Reflecting these differences in scale and context, the ICTR and ICTY Rules of Procedure and Evidence (RPE) established protective measures for victims of sexual violence that differ from many national jurisdictions. Rule 96 of both the ICTR RPE<sup>30</sup> and ICTY RPE<sup>31</sup> established the following protections for victims of sexual violence:

- 1) Corroboration of victim testimony is not required;
- 2) Information about the victim’s prior sexual conduct cannot be admitted as evidence;
- 3) Lack of consent can be inferred from the environment of coercion that characterizes war, mass violence, and detention.<sup>32</sup>

The ICC RPE codified similar protections in Rules 70, 71, and 72.<sup>33</sup> Additionally, according to Rule 63 of the ICC RPE, corroboration is not required to prove *any* crime within the jurisdiction of the ICC. In international courts, victim testimony alone is sufficient to prosecute and convict. In practice, corroborating evidence strengthens cases. However, such corroboration need not be physical evidence, such as medical or forensic evidence; witness testimony and other forms of documentary evidence can serve this purpose as well. For example, all of the landmark rape cases at the ICTY<sup>34</sup> relied on victim and witness testimony to establish criminal responsibility for rape.<sup>35, 36, 37, 38, 39</sup> Similarly, the landmark rape cases at the ICTR<sup>40</sup> also relied on victim and witness testimony.<sup>41, 42</sup>

### **The element of non-consent: rape as a war crime, crime against humanity, and genocide**

In this context, the question of whether or not lack of consent should be an element of the crime when rape and other forms of sexual and gender-based violence are committed as part of armed conflict and mass violence has been a point of debate in the field.<sup>43</sup> Many scholars and practitioners have argued that lack of consent can be inferred from the environment of coercion that characterizes detention, armed conflict, and mass atrocities.<sup>44</sup> Parallels have been made to domestic laws prohibiting torture and criminalizing rape of inmates by prison guards in which lack of consent is assumed.<sup>45</sup>

Even if lack of consent is an element of the crime under international law, prosecutors must provide evidence that a coercive environment exists, rather than prove lack of consent by the victim to the particular act in question. These alternative grounds to establish lack of consent may not be available under domestic penal codes, although laws prohibiting torture may be.

### ***Prosecuting International Crimes of Sexual Violence in National Jurisdictions***

The founding Rome Statute of the ICC established the ICC as a court of last resort to which plaintiffs only have recourse if local courts are unable or unwilling to prosecute those responsible. This principle of complementarity positions national courts as the first place that victims must seek justice. However, even

when existing national laws or treaty obligations may be understood to enable prosecution of international crimes in local courts, available definitions of crime, modes of liability, and rules of procedure and evidence may differ from those established by the ICC and other specialized international and hybrid courts. For example, unlike international specialized and hybrid courts, corroborating evidence is often required in national jurisdictions, and medical or forensic evidence may be a formal or informal requirement in order for a case to go forward in court.

In response to these requirements, efforts to facilitate prosecution of war crimes and crimes against humanity within the national jurisdictions in which they have occurred have led to an increasing number of initiatives to introduce, standardize, and professionalize medical evidence collection in order to increase the availability of medical evidence whenever possible. In the next three sections, I discuss three types of medical evidence that have been collected in settings of armed conflict, humanitarian emergencies, and mass violence against civilians: the patient medical record, the medical certificate, and the sexual assault medical forensic exam. .

### **Re-Purposing Routinely Collected Patient Medical Records as Evidence for Investigation and Prosecution of International Crimes of Sexual Violence**

Individual patient records held by hospitals, clinics, or non-governmental organizations can be used to corroborate victim testimony and to generate statistics based on aggregated, de-identified patient data that may facilitate investigation, indictment, and prosecution. The patient medical record documents the medical encounter: why a patient seeks healthcare, what symptoms or injuries the patient reports, and what diagnoses, treatment, or recommendations a healthcare provider makes. In this way, patient records can be used as a source of data for statistics generated from complex or rudimentary medical chart extraction. Such statistics may describe patterns of patient reporting, injuries, pregnancies, related medical procedures (such as abortion where it is legal), and other reported and observed health sequelae.

In addition, routinely collected medical records can provide corroborating evidence even when they were not initially collected for the purposes of criminal investigation and prosecution. Hospitals and clinics in a specific geographic area may be among the first places that surviving victims go after a specific event (such as a massacre), during ongoing war, or after they have arrived at refugee camps receiving those displaced and fleeing armed conflict. Of course, healthcare systems may be severely under-resourced, poorly functioning, or completely demolished during and immediately following armed conflict. For this reason, specialized healthcare services may not be available to a majority of victims of conflict-related sexual violence. Nevertheless, where medical care exists, however rudimentary it may be, there have been attempts to increase the capacity of existing healthcare personnel to treat and sometimes also medically document rape.

To describe such re-purposing of existing medical records for the purposes of investigation and prosecution, I discuss three examples of such uses of the patient medical record: (i) establishing that mass rape had occurred in the former Yugoslavia in 1992 based on medical records, (ii) introducing evidence of post-traumatic stress disorder in the *Furundžija* case at the ICTY, and (iii) providing context evidence in the *Taylor* case at the Special Court for Sierra Leone (SCSL).

#### *Estimating Mass Rape Using Hospital Records in the Former Yugoslavia*

The war in the former Yugoslavia began in 1992, and media reports suggested that large numbers of women had been raped as part of the armed conflict. In January 1993, an investigative team including four doctors visited hospitals and medical centers in Croatia, Bosnia, and Serbia. They were able to document the number of women seeking medical care according to physician reports and existing medical records at six hospitals in Zagreb, Sarajevo, Zenica, and Belgrade. The findings of the expert team are included as Annex II in the report submitted to the UN Commission on Human Rights in February 1993 by Tadeusz Mazowiecki, Special Rapporteur of the Commission.<sup>46</sup> Based in part on their findings, the Special Rapporteur concluded that rape was widespread, but noted that the specific number of victims of rape could not be estimated based on available data.

In Annex II to the Special Rapporteur's report, the expert team reported that 119 pregnancies related to rape had been documented, either disclosed directly to physicians by victims seeking healthcare or as part of procedures to secure access to second trimester abortions. Based on the assumption that only one out of 100 incidents of rape result in pregnancy, they estimated that these pregnancies represented approximately 12,000 incidents of rape, with the caveat that many of these women reported being raped more than once. The team also documented rates of birth, abortion, and sexually transmitted diseases, in addition to pregnancies. They



compared the ratio of deliveries to abortions in 1992 with the ratio in the preceding year (1991) to determine if elevated rates of abortion could be observed. They found stable rates in Zagreb and Belgrade, but found some evidence of elevated abortion rates in Sarajevo and Zenica in 1992.

Five months later, in August 1993, one of the members of the investigative team co-authored an article entitled “Rape as a Crime of War: A Medical Perspective” in *The Journal of the American Medical Association* (JAMA).<sup>47</sup> The JAMA article summarized the methodology of the investigative team and reported the same number of pregnancies resulting from rape that were published as Annex II to the Special Rapporteur’s report. The authors noted that this number probably represented only a fraction of all pregnancies resulting from rape due to widespread reluctance of victims to disclose. They also estimated that these 119 pregnancies recorded at a small sample of only six hospitals in Bosnia, Croatia, and Serbia represented 11,900 incidents of rape, based on existing medical data suggesting that a single act of unprotected intercourse results in pregnancy about 1% - 4% of the time. They further suggested that “techniques of medical science” could help “validate testimony of individual rape” with procedures used in criminal cases in the United States, including collection of sperm if the victim reports within 24-48 hours of the incident and preserving the placenta after an abortion for later DNA identification.

Although these figures do not appear to have been cited in ICTY court records or indictments, they suggested that rape was widespread and laid the foundation for using similar techniques in other conflicts. By comparing “baseline” (i.e., peacetime) and wartime pregnancy/abortion rates, observed spikes in pregnancy and abortion rates could document elevated, and therefore possibly war-related, pregnancies and abortions, which in turn could suggest that widespread rape during war had occurred. The authors of such statistics recognize that associations between elevated pregnancy and abortion rates and periods of armed conflict are only suggestive and could be the result of causes other than war-related rape. Nevertheless, such documentation techniques were used to suggest that rape was widespread and prompt further investigation.

These efforts to use patient records and service utilization data to estimate numbers of persons raped during the conflict resemble similar uses of population-based demographic and health surveys for this purpose. In countries where demographic and health survey data was collected prior to armed conflict, existing data can be used to establish “baseline” prevalence rates of rape and sexual violence. These estimates can then be compared to the results of subsequent surveys and used to estimate elevated rates during armed conflict. More recently, researchers have sought to combine health surveys with crime victimization surveys developed in the field of criminology to also ask about perpetrators.<sup>48,49,50,51</sup>

#### *Introducing Evidence of Post-Traumatic Stress Disorder in The Furundžija Case at the ICTY*

Although the landmark rape cases at the ICTY did not involve physical evidence (including medical evidence) as corroboration of victim testimony in compliance with innovative rules of procedure and evidence at the ICTY described above, one landmark ICTY rape case, *Furundžija et al.*,<sup>52</sup> involved the introduction of a psychological assessment and diagnosis of PTSD as evidence of psychological trauma experienced by the victim as a result of rape. What unfolded in court suggests the potential liabilities of introducing medical and psychiatric evidence that may be used against the victim in the context of adversarial court proceedings.

In the *Furundžija* case, the prosecution failed to disclose until the end of the trial that the victim had received services at the Medica Women’s Therapy Center, a nongovernmental organization operating in Zenica, Bosnia. The defense then petitioned for the court to admit what the court called a “medical certificate” from the organization, intending to show that the victim had sought psychological counseling, had been in serious emotional distress due to the trauma of the rape, and exhibited symptoms of PTSD. In this case, the medical certificate was an internal intake form with the victim’s name redacted to conceal her identity; it was not a medical certificate issued by a doctor for the purposes of criminal investigation that I will discuss below. The victim denied having received psychological treatment at the organization and said that she had never received a diagnosis of PTSD or treatment for such a diagnosis. Nevertheless, once the evidence was admitted, the defense seized the opportunity to use the certificate as evidence of PTSD in order to bolster its argument that, since PTSD is sometimes associated with unreliable memory, the victim’s testimony should not be considered credible.

Although the court eventually ruled that the victim’s testimony was both credible and persuasive and subsequently convicted the accused, the victim still had to return to court to respond to questions by the defense about the reliability of her memory, her ability to identify the accused as present during the crimes in question, and her own credibility as a witness to the abuses she herself suffered. For victim advocates following

this trial, the fact that the defense attempted to use a psychiatric diagnosis against the victim in court was an outrage. This case also speaks to the fact that medical evidence often has an ambivalent, indeterminate character: it can be inconclusive; it requires interpretation; and rarely can it prove that a crime occurred without victim and witness testimony establishing that elements of the crime in question have been met and proven beyond a reasonable doubt.

#### *Using Aggregated Data From Medical Records as Context Evidence in The Taylor Case at the SCSL*

Investigators can derive patterns of crime from aggregated, de-identified medical records and witness testimony provided by doctors about patterns of patient help-seeking. In aggregate, such records and witness testimony can be used to document large numbers of patients seeking medical care within a specific window period following acute moments of political unrest, massacres, or military campaigns in order to prompt investigation, issue indictments, and provide context evidence in court. Context evidence helps to establish that a particular series of events are plausible and occurred in a particular place by particular groups of perpetrators to particular groups of victims.

In the *Taylor* case<sup>53</sup> prosecuted under the jurisdiction of the SCSL, aggregated data from patient medical records was introduced as context evidence. In this case, the court's judgment included documentary evidence about the number of women seeking medical care at a nongovernmental organization in Freetown after being abducted by RUF and AFRC, forced into sexual slavery, and sometimes treated as "bush wives" by these armed groups.

This nongovernmental organization, the Sierra Leonean Chapter of the Forum for African Women Educationalists (FAWE), had established a sexual violence counseling and health care program after the January 1999 Freetown invasion and documented serving 1,862 female abductees within its first six months of operation, most of whom were from Freetown. A gynecologist working with the FAWE medical team (Prosecution Witness TF1-081) compiled a report describing the characteristics of patients seeking medical care from the FAWE medical team from March to December 1999. He testified that in this period the medical team treated 1,168 patients; of these, 77% of patients were women, 58.5% had been sexually abused or raped, 52% suffered from sexually transmitted diseases, and 17.1% had become pregnant.<sup>54</sup>

In this way, medical records helped to demonstrate that rape of civilians was widespread and systematic, thereby serving as context evidence that crimes against humanity had been committed. Given the sheer numbers of victims affected, high-level persons would have to have been aware that it was occurring and therefore could be held responsible for the crimes in question. As this example suggests, even when a formal sexual assault medical forensic exam is not conducted, a doctor may still testify to the fact that a particular group of victims sought medical care for health problems and concerns following rape, and in this case, repeated assaults in the context of sexual slavery.

Unlike specialized international and hybrid courts, often in national jurisdictions a formal medical certificate is required in order for medical documentation of rape to be admissible in local and national courts, even in the context of armed conflict, humanitarian emergencies, and mass violence against civilians. I turn to the issuance of medical certificates below.

#### **Issuing Medical Certificates as Part of Basic Medical Care in Humanitarian Emergencies**

The medical certificate is a formal, medico-legal document used in many national jurisdictions that is completed by a doctor and provides an official record of medical findings following the report of a crime or legal claim that involves medical opinion. In cases of rape and other forms of sexual violence, the requirements for obtaining a medical certificate<sup>55</sup> vary across national jurisdictions. In some jurisdictions, a victim must first report the crime to police in order to obtain a government-mandated form and then take it to a doctor to be completed. In other jurisdictions, doctors may be able to issue a certificate at the time of the initial visit when the patient first discloses rape to the healthcare provider, or after the initial visit at the victim's request based on the notes in the patient's medical chart. In some countries, only government doctors are allowed to complete medical certificates; private or foreign doctors associated with humanitarian organizations may not have legal standing in domestic courts. Doctors may require that victims pay a fee for completion of the certificate, which can be a significant barrier to victim access. Once issued, a victim can submit the medical certificate to law enforcement personnel (such as police) for the purposes of criminal investigation and prosecution. In some jurisdictions, a completed medical certificate is required in order for a victim to file a case in court.

The practices surrounding medical certificates vary cross-nationally and depend in part on the evidentiary requirements of domestic laws criminalizing rape, and in part on both formal judicial practices and informal norms stipulating which doctors may participate in criminal investigation and whether or not medical evidence is required for prosecution. However, it is not uncommon for a medical certificate to be required in order for a victim to press charges within national jurisdictions that require corroboration of victim testimony.<sup>56</sup> In these contexts, if a victim cannot seek medical care or cannot afford to pay for a medical certificate (where a fee is required), then the possibility of prosecution may be foreclosed if no other evidence or witness testimony is available.

Such corroboration may be required even if the rape was committed as part of armed conflict or mass violence but is being prosecuted as a violation of national laws.<sup>57</sup> As discussed above, while some countries have adopted elements of the Rome Statute in their domestic penal codes and effectively enable prosecution of violations of international humanitarian law within domestic jurisdictions, they may or may not have adopted the innovative rules of procedure and evidence developed by the specialized international and hybrid courts. For this reason, without judicial intervention, victims may be questioned about consent or prior sexual conduct, even when rape is committed in the context of political violence or armed conflict.

Of course, the issuance of medical certificates based on medical care received during or after armed conflict depends on the ability and willingness of physicians to provide them. For organizations providing medical care as part of humanitarian aid in emergency settings, participating in criminal investigation may jeopardize their access to populations in need of their assistance, particularly if the perpetrators in question are State or State-linked actors who may be able to revoke their permission to operate within national borders or may interfere with their operations. The same concerns would be true in areas in which Heads of State are effectively unable to govern, leaving local populations and humanitarian organizations vulnerable to interference by local militias in the surrounding area. In order to be permitted access to areas of unrest and ensure the safety of medical personnel, many emergency medical organizations uphold the principle of medical neutrality, namely that medical professionals must treat any person in need of care regardless of political affiliation and parties to the conflict must not attack or interfere with the delivery of medical care to civilians or soldiers.

For the purposes of exploring medical evidence as a type of humanitarian technology, the issuance of medical certificates highlights the tensions between humanitarian aid and criminal justice mandates that have emerged when rape has been reported, documented, or adjudicated in the context of armed conflict. These tensions may arise whether criminal investigation is being pursued under national or international criminal law. They may occur even when there is no active investigation at the time of medical evaluation, but medical evidence is being collected and stored for future use by the victim.

For many with whom I have spoken, the experience of the emergency medical organization Médecins Sans Frontières/Doctors Without Borders (MSF) in Sudan is emblematic of these tensions. The MSF Foundation/CRASH report authored by Françoise Bouchet-Saulnier and Fabien Dubuet on MSF's experience with investigations and legal proceedings<sup>58</sup> mentions the temporary imprisonment of the MSF head of mission and field manager in Khartoum in 2005 on suspicion that MSF had given the ICC medical evidence of rape after the ICC announced its decision to indict Sudanese President Omar al-Bashir. Although these two expatriates were released, MSF was ordered to leave the country. Since this incident, some organizations working in similar contexts may have become more conservative in their willingness to issue or handover medical certificates to victims, especially those seeking justice in highly politicized court proceedings or unstable political environments.

MSF's 2009 report *Shattered Lives: Immediate Medical Care Vital for Sexual Violence Victims* discusses MSF's experiences working with rape victims in several countries. Medical certificates are considered one component of medical care for survivors of sexual violence.<sup>59</sup> MSF issues medical certificates at the request of patients and gives them to patients directly; MSF will also store certificates on behalf of victims for later retrieval in case the victim would like to pursue prosecution in the future.

MSF's presence in Congo-Brazzaville in the 1990s led to some of its first efforts to provide specialized medical care for rape victims.<sup>60</sup> MSF staff were witnessing and hearing reports of mass rape as part of widespread violence and displacement. However, MSF realized once it began issuing medical certificates to patients disclosing rape in Congo-Brazzaville that, even when mass rape is overwhelmingly evident, often there is no visible, physical evidence of injury. The physician must report this fact of no clinical findings on the medical certificate. For this reason, the medical certificate may not assist victims in pursuing prosecution in court.

However, MSF decided to issue medical certificates to all victims, even if there were no detectable clinical findings, in part because this documentation may be the only formal recognition that the victim may ever

have. As in all cases, the physician notes that the patient sought medical care and records what the victim reported about the assault. Although MSF was not a government actor and could not formally sanction the crime, the issuance of a medical certificate was still thought to be an important and symbolic act of recognition for victims.

MSF's decision to issue medical certificates as a means of formally recognizing the experience of patient-victims irrespective of whether or not victims are able to pursue prosecution in court mirrors the stated reasons that doctors who pioneered the development of medical forensic exams for documenting injuries and psychological trauma among survivors of torture gave when the *Istanbul Protocol* was published, namely that the act of medical documentation is a form of bearing witness to the grave abuses that survivors have endured.<sup>61</sup> Early nurse reformers in the U.S. criminal justice context in the 1970s and 1980s who advocated for routine implementation of sexual assault medical forensic exams in hospital emergency departments stated similar intentions in their published writings: to symbolically sanction crime and communicate to victims that their experiences were being taken seriously and everything possible would be done to facilitate prosecution and hold perpetrators accountable, regardless of whether or not cases ultimately go to court.<sup>62</sup>

Standards of evidence collection may vary widely such that the medical certificate may or may not represent the findings of a standardized sexual assault medical forensic exam. In order to standardize and professionalize medical examination and associated medical evidence collection techniques for use in national jurisdictions, some initiatives have attempted to introduce, adapt, or strengthen existing implementation of domestic and international guidelines that instruct physicians and other qualified health professionals such as nurses in how to conduct a formal sexual assault medical forensic exam. In the next section, I discuss medical forensic exams conducted with surviving, adult patients.

### **Offering Sexual Assault Medical Forensic Exams During and Immediately Following Episodes of Mass Violence for Use in Domestic Courts**

The sexual assault medical forensic exam is a standardized set of procedures and evidence collection techniques that is conducted by physicians and, in some jurisdictions, nurses or other qualified healthcare personnel. Like other medical procedures, sexual assault medical forensic exams are conducted according to guidelines and protocols, in this case ones that lay out evidence collection routines and classify the physical injuries associated with the incident. Where available, the forensic evidence collection kit (often referred to as the "rape kit") is one component of the exam that includes collection of physical and biological specimens, such as semen, saliva, blood, hair, debris, and other possible sources of trace DNA that is sent to forensic laboratories for analysis. Forensic specimens may be used to establish recent sexual contact, identify the suspect (if unknown), and link the victim to the accused or link the victim/accused to the crime scene.<sup>63</sup> If the suspect is unknown, the possibility of forensic identification of the assailant is quite limited unless the suspect is in custody.<sup>64</sup>

Practitioners complete a form or medical certificate on which they record the victim narrative, document patient and suspect characteristics, and summarize their observations. If possible, they record and photograph physical injuries when visible. Ideally, the exam also includes specialized medical treatment such as prophylactic treatment of bacterial sexually transmitted infections, Post-exposure Prophylaxis (PeP) to prevent HIV infection in high burden settings, provision of emergency contraception if possible, and referrals to psychosocial support, counseling, and legal advocacy for patient-victims.

The WHO 2003 *Guidelines for Medico-Legal Care for Victims of Sexual Violence* described above codify sexual assault medical forensic exams as they were first developed within domestic criminal justice contexts in Western Europe and North America and later adapted for use outside of these contexts in middle- and low-income country contexts.<sup>65</sup> For this reason, many national governments, including those in conflict and post-conflict settings, have adopted these guidelines as best practice in their national jurisdictions and healthcare systems, but the degree of implementation and the capacity to collect and analyze forensic evidence varies widely.

Based on WHO guidelines and peer guidance<sup>66</sup> published by physicians in medical journals, it appears that initial efforts to address rape in humanitarian emergencies attempted to adapt best practices developed in industrialized countries in North America and Western Europe for use in humanitarian emergency settings, particularly in refugee camps. Their references to models originally developed for use in domestic courts in industrialized countries suggests the influence of earlier advocacy to develop standardized sexual assault medical forensic exams on these later initiatives attempting to combine specialized medical care and evidence collection in humanitarian emergencies and post-conflict settings.



For example, the 2004 WHO guidelines developed for use in humanitarian emergencies recommends collection of forensic evidence as among the “essential components” of medical care after a rape, as long as capacity to conduct forensic analysis exists.<sup>67</sup> These 2004 WHO guidelines were published in the same year that the United Nations High Commissioner for Refugees (UNHCR) published *Sexual and Gender-Based Violence Against Refugees, Returnees and Internally Displaced Persons: Guidelines for Prevention and Response* as an update to their prior set of guidelines on this issue, first published in 1995.<sup>68</sup> These UNHCR and WHO guidelines emerged from the same international meeting hosted by the UNHCR in 2001.

As the discussion above suggests, the availability of forensic evidence collection and analysis varies dramatically across contexts. Even where forensic laboratories are ostensibly available, capacity and willingness to conduct forensic analysis of rape kits may or may not be. At present, the use of DNA evidence in many jurisdictions is simply not available. However, even in jurisdictions in which forensic laboratory capacity is quite limited, law enforcement agencies may treat the availability of forensic evidence as necessary in order to proceed with a case. For example, a legal advocate in Burundi working with MSF reported that law enforcement authorities are very reluctant to take sexual violence cases in the absence of forensic evidence.<sup>69</sup> Although resource-poor settings often do not have adequate facilities or infrastructure to properly collect and store physical evidence (such as semen, blood, saliva, or other sources of trace DNA such as a victim's clothing), or to conduct DNA analysis, some projects, such as the American Bar Association's Rule of Law Initiative in the Democratic Republic of Congo (DRC), have attempted to introduce rape kits.

Given the limited infrastructure available and the likely delay between incidents and subsequent medical evaluation during or after armed conflict, some organizations such as Physicians for Human Rights (PHR) have adapted the *Istanbul Protocol* for use in these contexts.<sup>70</sup> As noted above, these guidelines are designed to assist physicians in conducting medical forensic exams to document evidence of physical injury and psychological sequelae among survivors of torture. PHR developed a new medical certificate for use in the Eastern Region of DRC in collaboration with Dr. Denis Mukwege, the founder of Panzi Hospital in Bukavu, and local police officers and judges. The certificate is based, in part, on an adapted version of the *Istanbul Protocol* and was included as a model form in the UK protocol (Annex 10). Notably, it does not include testing biological specimens for DNA in areas in which forensic analysis is not commonly available, such as the Eastern Region of DRC.

### Discussion and Suggestions for Future Research

These developments raise a number of important questions: How do evidence collection techniques both reflect and come to define not only what counts as sexual violence in conflict, but also what types of claims are considered credible in the context of war crimes and mass atrocities? What are the dynamics of taking technologies developed to investigate individual claims in a domestic context (such as the medical forensic exam) and using them to prosecute cases of mass atrocities? When physical evidence is not available, does medical documentation itself become a de facto substitute for formal legal sanctioning through the courts? Can victim and witness testimony facilitate prosecution in its absence?

As described above, medical evidence collection techniques were originally developed to establish individual harms to individual victims by direct perpetrators. In environments of mass atrocities and humanitarian emergencies, these techniques are often being used to corroborate individual allegations of crime that, when considered within the broader political context in which they are occurring, are very often being committed on a far greater scale than that for which the techniques were originally designed. Even when cases involve direct perpetrators (acting alone or together), future case adjudication itself depends on a functioning legal system, which may or may not exist. Additionally, State or State-linked actors — those in a position to facilitate or impede criminal investigation and prosecution — may themselves be among those accused of committing, aiding, ordering, or failing to prevent the violations of international humanitarian law in question. Such environments recall long-standing challenges of prosecuting State officials and other high level persons responsible for torture and State-led violence in the jurisdictions in which the crimes occurred. In these circumstances, using available evidence to facilitate criminal investigation of direct or remote perpetrators with command or superior responsibility may prove difficult or impossible, and very real concerns about security — in addition to social stigma — may impede victim disclosure.

Given the scale of violence often in question and persistent barriers to prosecution, an important question is what effects medical evidence and its associated medical evidence collection techniques may have outside of courts, particularly during the patient-provider encounter in which they are implemented. Based on the

examples described, I suggest two possible effects of these techniques within and outside of courts that merit future research: (1) their potential influence on what comes to count as sexual violence and which crimes are deemed justiciable and (2) their potential influence on formally recorded histories of mass atrocities, both within and outside of courts. I discuss each of these in turn.

#### *Potential Effects on What Comes to Count as Sexual Violence and Which Crimes are Deemed Justiciable*

Evidence collection processes to document human rights violations involve systems of classification<sup>71</sup> and their attendant processes of standardization,<sup>72</sup> quantification,<sup>73</sup> and commensuration,<sup>74</sup> which simultaneously reflect and create categories of physical injury, trauma, and violence. These categories and methods of classification in turn help to define what they purport to measure – a process of reactivity<sup>75</sup> that science studies scholars have documented in a number of areas of empirical inquiry. Hacking demonstrates how the availability of categories to describe actions or events in fact can alter the meanings ascribed to those actions or events,<sup>76</sup> suggesting the necessity of attending to what Hacking has called the “historical ontology” of particular concepts and the associated things and types of people that they seek to represent.<sup>77</sup>

In the present case, medical evidence collection techniques may shape the category of sexual and gender-based violence in conflict itself: which crimes count, what is construed as culpability, who is considered a perpetrator. In this way, evidence collection techniques and the records they produce meet Griswold’s definition of a cultural object as “shared significance embodied in form.”<sup>78</sup> In essence, evidence collection techniques not only put descriptions of physical injury and trauma into a particular form, they also produce a particular narrative of events that the technology both mediates and codifies. Further, the meaning or significance associated with the cultural object under study is likely to vary across time, space, and actors involved, particularly as the techniques and routines travel globally.

Typically doctors are not able to *legally* establish whether or not the crime of rape (as it is defined in available penal codes) occurred based on the findings of the exam. Indeed, they are often encouraged to limit their comments to whether or not the medical findings (if any) are *consistent with* the victim’s account. However, they may testify to the fact that a victim sought treatment, what the victim told the doctor about the alleged assault, whether the medical findings are consistent with the victim’s narrative, and what medical interventions were required, if any. The narrative recorded by the doctor is considered a formal victim statement in many jurisdictions; if it differs from statements given to the police, then it may be used to cross-examine the victim or undermine the victim’s credibility in court. Further, if the doctor is the first to record the victim’s narrative, then it can be treated as the most contemporaneous statement made by the victim about the crime and would carry more weight, raising the stakes of ensuring accurate and skilled recordings by medical professionals.

The presence or absence of evidence is often tied to the *perceived* presence or absence of the crime itself. The extent to which physical evidence of sexual violence is visible to, and therefore detectable by, a physician during an exam varies greatly, depending on a number of factors: the victim’s ability to seek medical care after the assault, the availability of specialized documentation techniques, the nature and circumstances of the crime itself, and the presence of any other injuries resulting from other aspects of the crime (such as beating or maiming), and, in some cases, pregnancy. If a medical exam is conducted months or years after the incident, physical evidence of injury may not be detectable. This is also often true even when a victim is able to seek medical care within the recommended window period of 24-48 hours.

In the spaces where medicine and law overlap, legal definitions of crime and evidentiary standards of courts influence the character, use, and effects of medical evidence collection techniques designed to meet their requirements. Medical certificates may require a brief, formulaic rendering of facts to meet demands for standardized recounting of medical findings for use in court.<sup>79</sup> In an adversarial context, available evidence of harms may be used to undermine victim testimony.<sup>80</sup> Additionally, the application of techniques originally designed for individual case prosecution in a new context of collective crimes and mass atrocities may reinforce problematic assumptions that prosecution must continue to turn on proving individual lack of consent. By contrast, as UN High Commissioner for Human Rights Navanethem Pillay has argued, the environment of coercion and mass violence should render the question of individual consent irrelevant, if not absurd.<sup>81</sup> In this way, legal definitions and their associated evidentiary requirements may shore up particular understandings of social problems, such as what constitutes sexual violence in conflict, and obscure others.

Yet a persistent reason for the emphasis on medical documentation and issuance of medical certificates for victims is the symbolic meaning that such a document is intended to communicate to patient-victims. As MSF’s experience suggests, it is common that victims do not have visible marks or injuries on the body,

even when mass rape is widely evident and known to all. Without visible, physical evidence, the exam cannot be said to produce clinical findings. However, although the doctor may not be able to say whether or not rape occurred, he or she can issue a formal document verifying that the patient-victim sought medical care and that he or she reported the assault to a medical professional. This may be among the only acts of formal recognition that a victim may experience.

#### *Possible Effects on Formally Recorded Histories of Mass Atrocities*

A central concern is whether or not the availability of medical evidence of sexual violence in conflict-affected countries may influence the construction of formally recorded histories of mass atrocities, both within and outside of courts, and ultimately how these atrocities come to be remembered. In suggesting these effects, in this paper I briefly highlight the specific links between evidence and prosecution, thereby focusing on formally recorded histories constructed through courts. However, medical documents produced as part of routine medical care, as well as those produced explicitly in anticipation of future court proceedings, could provide a formal record of events, even if a case is never heard before a court.

As the new UK protocol notes, although physical evidence may seem like the best form of evidence, this is not necessarily the case. Documentary evidence and victim and witness testimony must often provide the link between the direct perpetrator and the individual victim, and further link the direct perpetrator to remote perpetrators with command or superior responsibility. A potential liability of the diffusion of these techniques, even in settings in which their institutionalization is shallow or relatively weak, appears to be that the availability of medical evidence collection techniques may in fact reinforce the expectation that physical evidence is – or should be – available if the claim is credible, that it is the “best” type of evidence, or that it is necessary in order to facilitate prosecution under domestic criminal law or international humanitarian law. However, medical professionals in this field have long documented that absence of clinical findings can be consistent with the victim’s narrative, for example, if injury is unlikely to have occurred due to coercion or threat of force (rather than use of force), or if there is a delay between the assault and the medical exam. Nevertheless, absence of evidence may be misinterpreted as evidence that the crime did not occur, having a potential discrediting effect on the victim’s narrative of events and impeding subsequent criminal investigation and prosecution.

If cases are prosecuted as international crimes in national jurisdictions, then existing domestic penal codes relating to rape and their associated legal and evidentiary requirements often must be met. If the elements of crimes, more flexible evidentiary standards, and procedural protections developed in international courts have not been adopted within national jurisdictions, then providing evidence of lack of consent and meeting both formal and informal requirements of corroboration will likely impede case adjudication and conviction. Indeed, in some national jurisdictions, cases cannot be submitted to the prosecutor’s office without a medical certificate, underscoring the importance of medical documentation, the absence of which may serve as a potential barrier to investigation and prosecution, especially in conflict or post-conflict settings with weak or non-existent healthcare systems.

In this way, medical documents and their associated evidence collection techniques – through both their *presence* and their *absence* – may influence legal processes of case selection, which in turn may structure the rendering of the historical record that emerges from courts. In suggesting the possibility of these effects, I bring together scholarship on measurement and classification,<sup>82</sup> in science and technology studies with scholarship on the materiality of cultural objects<sup>83</sup> and the cultural and political work that objects do<sup>84</sup> through studies of the relationship between law, courts, and collective memory formation.<sup>85</sup> While proponents of criminal trials and Truth Commissions point to their potential to create a historical record of atrocities, hold perpetrators accountable, and promote respect for human rights,<sup>86</sup> advocates of these approaches also recognize that legal procedures and evidentiary requirements of criminal trials may impede a full accounting of events.<sup>87</sup>

Given the possible effects suggested, future research should consider not only the impacts of these techniques according to their intended outcomes of affirming victims and increasing investigation and prosecution, but also how these techniques have been adapted for use in new environments and what their effects have been, both within and beyond courts. Given that national jurisdictions are positioned to take the lead in adjudicating violations of international humanitarian law since the establishment of the ICC, a key question is whether or not national jurisdictions will follow conventional evidentiary standards associated with domestic criminal law when prosecuting sexual violence as an international crime in local courts. The extent to which local jurisdictions develop innovative legal strategies similar to the international courts or

adopt procedural protections for victims of sexual violence will likely shape the current and future role of medical evidence in documenting and facilitating prosecution of international crimes of sexual violence.

## Endnotes

- 1 United Kingdom Foreign and Commonwealth Office. *International Protocol on the Documentation and Investigation of Sexual Violence in Conflict: Basic Standards of Best Practice on the Documentation of Sexual Violence as a Crime Under International Law*, First Edition: June 2014. [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/319054/PSVI\\_protocol\\_web.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/319054/PSVI_protocol_web.pdf).
- 2 For additional information on the UK's initiative to Prevent Sexual Violence in Conflict, please see the project website: <http://preventsexualviolenceinconflict.tumblr.com>, accessed October 7, 2014.
- 3 *Prosecutor v. Jean-Paul Akayesu*, Case No. ICTR-96-4-T, International Criminal Tribunal for Rwanda (ICTR Judgment 1998).
- 4 According to the founding Rome Statute of the ICC, violations of international humanitarian law under the jurisdiction of the ICC include war crimes, crimes against humanity, genocide, and the crime of aggression. Article 7 of the Rome Statute of the ICC explicitly names several forms of sexual and gender-based violence as crimes against humanity. In this paper, I focus on rape and other forms of sexual violence.
- 5 I use the term mass atrocities to refer broadly to violations of international humanitarian law in the context of armed conflict and mass violence against civilians.
- 6 In this paper, I use the term "sexual violence" to reflect the generally accepted nomenclature in the field of study. However, I wish to note that the term "sexualized violence" that some victim advocates have adopted in order to acknowledge many types of violence that are not limited to rape of women by men better reflects my approach to the subject. Legal definitions of rape and sexual assault vary by country and often also by jurisdiction. Legal definitions may or may not reflect social, political, or medical definitions. Available definitions may be limited to a very narrow understanding of "rape" as it was historically criminalized under domestic penal codes. The World Health Organization's 2002 "World Report on Violence and Health" offers an expansive definition of sexual violence but focuses on women victims (see Chapter 6). In the context of armed conflict and mass violence against civilians, sexualized violence may involve rape with objects or intentional injury to the genitalia and reproductive organs that is so severe as to amount to a form of maiming or intentional disfigurement, such as irreparable fistula or forcible penile amputation. Article 7 of the Rome Statute also recognizes sexual slavery, enforced prostitution, forced pregnancy, and enforced sterilization as forms of sexual and gender-based violence. As this brief overview suggests, a comprehensive discussion of what has come to be understood as sexual and gender-based violence (and what has not), as well as how amenable each type may be to medical documentation, is beyond the scope of this paper. Although I do not attempt to resolve the question of what counts, I hope to signal this heterogeneity and my attention to victims of all genders.
- 7 Carol A. Heimer, "Resilience in the Middle: Contributions of Regulated Organizations to Regulatory Success," *Annals of the American Academy of Political and Social Science*, 649:1 (2013): 139-156.
- 8 John Hagan, *Justice in the Balkans: Prosecuting War Crimes in the Hague Tribunal* (Chicago: University of Chicago Press, 2003).
- 9 John Hagan and Wenona Rymond-Richmond, *Darfur and the Crime of Genocide* (Cambridge: Cambridge University Press, 2009).
- 10 In this paper, I focus on techniques to document sexual violence among surviving patients; however, similar techniques can be used in the context of death investigation and recorded in autopsy reports.
- 11 The adjective "forensic" is often used almost interchangeably with the adjective "legal" (but sometimes implicitly) in order to refer to something with a legal purpose or that is intended for use in court. For example, the World Health Organization's 2003 *Guidelines for Medico-Legal Care of Victims of Sexual Violence* distinguishes medical examination (for the purposes of clinical treatment) and forensic evidence collection. The document defines "forensic evidence" with respect to its purpose (p. 57): "The objective of forensic evidence is to prove or exclude a physical connection between individuals and objects or places. Such evidence comprises a wide variety of substances or objects, the analysis of which requires specific, often specialized scientific skills." Forensic specimens may include semen, saliva, blood, clothing (for adherent foreign materials such as semen, blood, hair, fibers), hair, foreign material (e.g. vegetation, matted hair or foreign hairs), urine, or other sources of trace DNA. Likewise, the guidelines define the "forensic examination" with respect to its intended use in court (p. 56): "A forensic examination is formally defined as a 'medical examination conducted in the knowledge of the possibility of judicial proceedings in the future requiring medical opinion'. Although the principal aim of a forensic examination is to serve the needs of the judicial system, there can never be a justification for compromising medical care or treatment of a patient to allow a forensic procedure to be performed." As this paper will suggest, medical documentation of physical injuries and other possible clinical indicia of sexual violence during the course of a medical examination suggests the overlap of medical (treatment) and forensic (evidence collection) components in practice.
- 12 The medical forensic exam is a collection of procedures and technologies that are packaged together and described in associated medical guidelines and protocols. I refer to this constellation of techniques in the singular as a humanitarian technology, although I will explore the collection and use of its component parts and antecedents, such as the individual patient record and the rape kit, in addition to the medical forensic exam itself.



- 13 As I discuss in greater depth elsewhere, a particular tension in the field is that medical evidence collection techniques to corroborate rape appear to have been initially developed to collect evidence that would meet historically specific definitions of “rape” as penile-vaginal penetration of a woman by a man (other than her husband) through the use of force and with evidence of victim resistance. Over time practitioners have attempted to broaden the use of techniques to capture evidence of other forms of sexual violence, and cases which involve both the use and threat of force.
- 14 This article draws on research conducted by the author as part of a study of the historical development and standardization of the “rape kit” and the sexual assault medical forensic exam since the 1970s (Northwestern University Institutional Review Board number STU00045675) and the history and use of medical evidence to document political and sexual violence (Northwestern University Institutional Review Board number STU00094517). Part of the research involves interviews of experts and other public figures who have gone on the record with their opinions and observations in the past and have agreed to be quoted by name.
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# The State of the Field: Technology for Atrocity Response

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**Abstract:** Technology is rapidly advancing in both sophistication and accessibility. This is particularly true of information and communications technology (ICT), adoption of which is growing rapidly in less-developed countries. Such tools provide a great deal of promise for practitioners dedicated to mass atrocity response, which encompasses prediction, prevention, mitigation, and documentation for the purposes of this article. First, this article considers the current technological landscape as it applies to human rights and outlines the various tools and techniques which are relevant to mass atrocity response, including mobile phones, social media, crisis mapping, satellite imagery, and unmanned aerial vehicles. This overview concludes with analysis of likely future trends in the field of technology as applied to mass atrocity response.

**Keywords:** humanitarian technologies, genocide, atrocity response, data gathering, crisis mapping

## Introduction: The Technological Landscape

This year marks the twentieth anniversary of the Rwandan genocide and much has been made of what has changed – and what has stayed the same – in the two decades since that mass slaughter. The world today is a very different place than in 1994, with a wide range of tools available to those aiming to prevent mass atrocities. Among these are the Responsibility to Protect (R2P) doctrine and the International Criminal Court, both of which have developed in an atmosphere of steadily changing attitudes amongst both policymakers and members of the general public with regard to where sovereignty ends and where the need to protect civilians begins. In 2014 it seems strange to think that it was once almost absurd to expect governments to at the very least consider concrete action to prevent, mitigate, or punish mass atrocities on humanitarian grounds. However, the new tools available to the preventers of mass atrocities go beyond the normative, judicial, and diplomatic realms. In fact, these tools also extend beyond what governments alone can achieve with regard to preventing crimes against humanity. The rapid advancement of technology over the past two decades means that non-state actors have the ability to gather, analyze, and communicate information for the sake of predicting, preventing, and mitigating atrocities.

Technology in all its many forms is pervasive in every aspect of modern life and is now essential to the ways that people work, learn, communicate, socialize, and organize themselves. This is certainly true of developed countries but also increasingly so in less-developed regions, where many entrepreneurs and other creative people have found ways to do more with less. Such localized solutions to localized problems explain why, for example, subscribers to mobile phone-based financial services outnumbered traditional bank account holders in nine African countries as of June 2014.<sup>1</sup> Naturally, considering the general excitement surrounding the role of technology—commonly referred to in the humanitarian realm as information and communication technology, or ICT—in so many aspects of modern life all over the world, much of that enthusiasm and promise extends to humanitarians, including those in the atrocity prevention field. This is a time of great opportunity for those working to stop crimes against humanity if they are creative and open to new possibilities.

The reason for this opportunity is clear upon closer inspection of the technological landscape in 2014. According to the International Telecommunications Union (ITU), the United Nations agency responsible for overseeing various aspects of ICTs, the number of mobile phone subscriptions is on track to reach nearly 7 billion by the end of this year, which represents a mobile penetration rate (i.e. the proportion of a given population who own mobile phones) of 90% in developing countries.<sup>2</sup> Even more importantly, the number

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of these subscriptions representing mobile broadband (i.e. internet-enabled) users is expected to reach 2.3 billion within the same time frame. Combined with the number of people accessing the internet through other means, the total number of internet users by the end of 2014 will near 3 billion.<sup>3</sup>

All of this means that we now live in a time of unprecedented speed and reach in communications. Twenty years ago the most advanced piece of technology that the majority of humans could access was a television or a fax machine; although personal computers, the internet, and mobile phones were becoming more common, they remained expensive and out of reach for most people and were seen more as toys or work tools than as parts of everyday life. This meant that most people with an interest in world events had to rely upon mass media to get information and so were at the mercy of producers and editors who decided what they should watch, listen to, or read. Most adult humans now have the theoretical ability to reach out and communicate with virtually anyone else in the world – even in some of the poorest, remotest, and most violent parts of the planet. This newfound ubiquity of mobile technology is changing economies, governance, development, and numerous types of service delivery and social interactions worldwide. The human rights and human security fields enjoy many of these benefits since NGOs, governments, and activists now have the ability to gather and analyze data about ongoing conflicts and atrocities in new and compelling ways. This is more than just an academic exercise too since many organizations, such as the Sentinel Project, are focused on using technology to actively assist the people on the ground, living in harm's way.

The potential presented by ICTs is clear; the questions to answer now are, just how are these new tools being used in mass atrocity response and what lies ahead? A couple of notes on terminology are warranted before delving further into this subject. First, although the term genocide is still obviously valuable and in common usage, this article takes a broader view towards mass atrocities generally, as is the policy of the author's organization. Such an approach prioritizes the saving of lives in any situation of systematic violence against a civilian population and avoids the often interminable and unproductive debates that surround whether or not a given situation should be classified as genocide. Second, the discussion here is about *response* to mass atrocities rather than exclusively prevention. Although the prediction and prevention of mass atrocities including genocide remains the absolute ideal in this field, the reality is that such crimes will continue to occur in some form and on some scale for the foreseeable future. Therefore, those opposed to them must be prepared to engage and respond at all stages of the process starting with early warning and proceeding through prevention, late warning and mitigation of the impacts of atrocities that do occur, direct assistance to threatened communities and survivors, documentation of abuses, advocacy for intervention, and post-atrocity justice and reconciliation.

### Tools Versus Techniques

Fortunately, ICTs can offer support to all the forms of mass atrocity response listed above. This article aims to provide a high-level overview with an equal focus on techniques and the categories of tools that support them, illustrated with current examples. This highlights one of the key truths of using technology for any endeavour since the tools in question are just that – tools. Just as with any type of work, technology only enhances human skill, intelligence, and effort rather than replacing them. There is well-founded optimism surrounding technology – particularly mobile phones and social media – and its potential to improve the human condition, but this has in the past led to seemingly untempered and unquestioning enthusiasm for the potential in question. Fortunately, recent years have seen a marked decline in the brand of “cyber utopianism” that predicted the inevitable arrival of human rights and liberal democracy following rapidly on the heels of internet access in many of the world's dangerous places. Very few observers still believe that simply introducing an unspecified category of tools labeled “technology” will be the panacea to defend human rights and save lives.

ICTs alone do not respond to mass atrocities but in the hands of skilled and knowledgeable practitioners they can drastically enhance and augment the impact of such activities. It is also worth noting that “technology” is not a new category of tools which only recently came into existence. Activists, human rights defenders, and other humanitarians have long been using the best tools at their disposal in support of their causes, whether this was the printing press used to produce political pamphlets, underground radio stations used to coordinate resistance movements, typewriters and photocopiers for publishing banned literature, or social media used to mobilize protests. Anti-atrocity activities should be defined as much or more by what responders are *doing* rather than just what they are *using* in order to do it. For example, though not directly related to mass atrocities, the so-called “Twitter revolution” of pro-democracy protests in Iran in 2009 was

characterized in Western eyes more by the exciting new tools the opposition was using rather than what they were trying to achieve. In reality, Twitter and similar tools were merely used to spread a political message and encourage popular engagement in the cause – both activities which have happened throughout history long before the advent of social media. In fact, the regime against which the protesters voiced their opposition had itself come to power three decades prior during a series of mass protests which could just as well have been dubbed the “tape recorder revolution” for the means by which the exiled opposition leader of the time smuggled his message to the masses.

The need to focus on human behavior and effective techniques before considering the tools which can support them is essential for effective mass atrocity response. This is especially true since activities like early warning have broad applicability but the form that such an effort takes is highly dependent on local conditions. For example, a mobile phone-based crowdsourcing system might work for gathering data in a settled and highly connected (if still impoverished) part of rural Kenya with 80% or greater mobile penetration; however, that exact same system would almost certainly fail amongst a displaced and heavily persecuted minority population in Burma (Myanmar) where mobile penetration is likely below 10% at the time of writing. These are the two countries where the Sentinel Project has the greatest direct experience and will be mentioned amongst the examples below whenever possible.

### *Communications and Data Gathering*

Regardless of what type of technology is being discussed, when we talk about ICT for mass atrocity response (or defending human rights more broadly), we almost always mean enhancing the ability of relevant actors to gather, transmit, store, analyze, and disseminate information. This is true whether we are referring to mobile phones, social media, big data, geospatial imaging (such as satellites or unmanned aerial vehicles, discussed further below), or mesh networks. This changing landscape means that data can now be gathered with unprecedented speed and scale thanks to practices such as *crowdsourcing*, which solicits incident reports and other data from members of the general population in an area of interest. This concept first came to international prominence in Kenya, where the 2007 general election sparked several weeks of serious violence which killed 1,200 people and displaced hundreds of thousands of others. Under the circumstances, getting accurate information was a serious challenge for many journalists and members of the general public. Fortunately, one journalist employed the concept of taking in reports from members of the public via text messaging (i.e. short message service, or SMS) and the internet before mapping them onto what ultimately became the Ushahidi crisis mapping platform, which is discussed further below. Such rapid gathering of data would have been impossible without widespread use of mobile phones, a situation which has only improved since the creation of Ushahidi.

Of course, crowdsourcing is not a perfect method of gathering data and has been criticized for running the risk of taking in faulty or duplicate reports which can contaminate a data set. However, many techniques are available to mitigate this risk and improve the quality of data, including cross checking reports from multiple sources and another method known as *crowdseeding*, which gathers data from trained, trusted informants distributed throughout an area of interest. This was used with some success by the Voix des Kivus research project in the eastern Democratic Republic of Congo, which mitigated various economic, security, and infrastructural challenges in the conflict-affected South Kivu province by distributing mobile phones to specific members of the population and training them on how to submit coded reports of incidents such as militia movements.<sup>4</sup> Although this approach results in much smaller amounts of data being gathered, any shortfalls in quantity are theoretically compensated in quality.

The Sentinel Project is currently operating a project in southeastern Kenya called Una Hakika (Swahili for “Are you sure?”), which takes a hybrid approach to crowdsourcing and crowdseeding since the two have complementary strengths and weaknesses. Una Hakika operates essentially as an information service which uses mobile phones to monitor and counter the spread of misinformation (e.g. “someone has supplied the Orma with 3,000 AK-47s to destroy the Pokomo” or “a Pokomo health worker tried injecting poison into Orma children”) which has been linked to interethnic violence in the Tana Delta over the past two years. This monitoring is done by soliciting rumour reports from members of the general public, working to verify whether or not they are true, and then reporting back to the community with neutral, accurate information so that people can make more informed decisions about how to interact with neighbouring ethnic groups. Recognizing that simple crowdsourcing would not produce reliable or responsive data, the Una Hakika team also incorporated crowdseeding by training nearly two hundred community ambassadors spread throughout

sixteen villages. These community ambassadors act as the human face of Una Hakika and facilitate the effective intake and verification of rumour reports as well as helping to dispel incendiary misinformation.<sup>5</sup>

The rapid rise of internet usage also means that data gathering can happen without the active participation of those producing the data. For example, while crowdsourcing and crowd seeding require people to directly and actively submit data to a given project, *data mining* or *web mining* are automated methods of gathering data which observe online activity. One example of this is Syria Tracker,<sup>6</sup> which is a crisis mapping project that presents a geographical visualization of thousands of human rights violations and killings during the current civil war in Syria. The data to produce this map is gathered using the Healthmap<sup>7</sup> platform, which searches thousands of online sources for reports of killings, combined with reports by individual observers actually in conflict zones. When verified and combined, these sources produce what is considered a very accurate picture of the death toll in Syria.<sup>8</sup> Rather than just gathering online reports of real-world incidents itself, web mining can also be used to observe online behaviour itself, which can be a useful warning indicator in an increasingly online world. One example of this is the Sentinel Project's Hatebase<sup>9</sup> platform, which monitors Twitter for usage of hate speech terms and uses machine learning techniques to determine which instances do or do not qualify as hate speech since this is highly context dependent. If the vision of Hatebase is fully realized, it could become a useful early warning tool when real-time hate speech trends and patterns are matched with real-world events being tracked through other means in order to find correlational relationships.

### *Crisis Mapping*

Once data is gathered it needs to be interpreted and one of the best ways of doing this in a crisis situation is visualization, which enables analysts to quickly derive intuitive insights from the data. The wide range of ways for data to be visualized forms an entire field in itself, but one of the most relevant to mass atrocity response is crisis mapping, a technique made famous by Ushahidi (explained above) and exemplified in numerous deployments around the world. One of the best-known of these is related to a natural disaster but demonstrates the potential here. An earthquake brought massive destruction to Haiti in 2010 and one of the key elements of the initial response was a deployment of Ushahidi which was able to rapidly gather and visualize reports of conditions in various parts of the country which could then be used by responders to more effectively direct resources to help people in need.<sup>10</sup> While some critics have highlighted the weaknesses of this approach, particularly in relation to the potential unreliability of the data gathered, the speed with which situational awareness was established and maintained gave Ushahidi a distinct advantage in this case when compared to traditional methods involving dedicated teams of observers traveling to areas to conduct damage and needs assessments. Such tools have clear advantages for mass atrocity response, whether for the sake of early warning, delivering humanitarian aid, or documentation, an example of which is Threatwiki, a tool developed for situation tracking and visualization in countries at risk of mass atrocities.<sup>11</sup> More effective understanding of such situations in a geographical and chronological context will contribute to more effective responses.

### *Documentation*

Not every mass atrocity situation will be prevented and so there remains a need to document crimes and bring their perpetrators to justice when they do end; many of the tools outlined above also have value in this area. One of the most interesting contemporary cases of technology being used for atrocity documentation is the Satellite Sentinel Project (no connection the Sentinel Project for which the author works), which launched in December 2010 and uses commercially available satellite imagery to document abuses in Sudan.<sup>12</sup> This consortium of NGOs, private companies, and researchers is able to observe in near real time when either government or rebel forces attack civilian populations, combining this imagery with reporting by observers on the ground to raise the alarm. Although this work has mostly been done in order to support advocacy efforts at this point, it also has clear potential for early warning since forces can theoretically be observed as they gather and move towards civilian targets. If integrated into a broader early warning system that fuses multiple data sources, satellite imagery has impressive potential value due to the greater access it grants to otherwise dangerous or denied areas. Although images require other data to give them context, there is an intrinsic emotional and documentary power to them, as exemplified by Amnesty International's satellite reconnaissance of North Korean prison camps in October 2013 in order to demonstrate the scale and nature of mass political repression in that most secretive of states.<sup>13</sup>



## Future Trends

It seems fitting to conclude an article examining the potential for technology to serve mass atrocity response by looking towards what the future may hold. Of course, it is impossible to predict the future, particularly the future of technology both in terms of technical advances themselves as well as the social and cultural conditions surrounding the use of technology. Just as the form and impact of social media today would come as a surprise to most people two decades ago, the technologies of two decades from now will likely be just as surprising, as will the ways in which people use them. That being said, there are some general trends which seem likely to continue.

First amongst these trends is that advanced technology will continue to become cheaper, more usable, and therefore more accessible to mass atrocity responders. Historically speaking, this is the general pattern seen as many technologies that were initially developed for military, governmental, or industrial use eventually come into the hands of the general public in one form or another. This can be seen in how things like aircraft, radios, and even the internet developed. Until a few years ago, the idea of an organization based in civil society being able to use satellite imagery to spy upon the harmful activities of a foreign government would have seemed impossible, but as private companies have opened up a field which was once the sole preserve of a few powerful states, it has become a reality. Although still very expensive compared to other means of data collection, multiple NGOs have now made extensive use of satellite imagery in the defense of human rights. Another field following the same pattern is that of unmanned aerial vehicles (UAVs), which are more popularly known as drones. Although commonly associated with military or state intelligence activities, these devices are finding increasing use for disaster response, law enforcement, conservation, commercial activities, and even recreation. The capabilities of devices that would have cost hundreds of thousands of dollars to obtain ten years ago can now be had for hundreds of thousands of dollars. Several NGOs such as the World Wildlife Fund are now using UAVs for anti-poaching work to protect endangered species<sup>14</sup> and it seems likely that the near future will also see UAVs used for protecting endangered humans by providing airborne early warning of attacks.<sup>15</sup>

The second trend is a shift already underway from macro-level early warning and response to mass atrocities down to the micro-level. For many years, early warning projects of all types have focused on state-level prediction of mass atrocities, which often fails to take into account the remarkable degree of sub-national diversity of security situations in many countries as well as the potential for non-state actors to independently engage in mass atrocity crimes. Although state-level early warning certainly has great value for focusing monitoring and intervention efforts, truly effective prevention and mitigation require a more granular view of the situation which will enable more localized responses, an area in which mass atrocity responders can learn a great deal from the disaster management field.<sup>16</sup> This shift is likely to occur not only in terms of geographical focus but also chronology with the ultimate result being a change from predicting which countries are likely to experience mass atrocities in three to five years to predicting which cities, towns, and villages are at risk within the next month, week, or day. Such an approach is certainly possible with the tools outlined above. Once effective localized early warning is the norm, localized early response is likely to follow, which itself is increasingly likely to include the people who are most threatened in the prevention of atrocities which target them. Such strengthening of communal resilience will be built upon the continuing reality that the international community is not coming to the rescue in most mass atrocity scenarios and people must therefore rely upon themselves for self-protection, which includes many non-violent options.<sup>17</sup> Such options will become increasingly realistic and effective as technology advances and creative, committed people continue working to find new ways of using these tools in opposition to the gravest abuses of human rights.

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# Humanitarian Technologies and Genocide Prevention: A Critical Inquiry

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## Introduction

The prevalence of conflict within states, specifically after the end of the Cold War, continues to influence teaching and research in genocide studies<sup>1</sup> as scholars reflect on the emergence and evolution of the field since the late 1970s.<sup>2</sup> State fragmentation and the collapse of empire notably in the former Soviet Union led to a shift in focus away from primarily structural or systemic-based explanations to identity or local-oriented inquiries. Fundamental transformations influenced by the information and communications technology (ICT) revolution and “a novel redistribution of power among states, markets and civil society”<sup>3</sup> mark our experience of globalization at the start of the 21<sup>st</sup> century. States, particularly the most powerful, must confront the “marketplace of ideas” and the “movement of public opinion”<sup>4</sup> as the proliferation of non-governmental organizations (NGOs) and the strength of “networked actors”<sup>5</sup> lead to “new approaches to activism”.<sup>6</sup> “Networked politics”<sup>7</sup> is emerging with a particular relevance to genocide studies as an approach that “focuses on networks as actors where networks are particular forms of coordinated collective action aimed at influencing international outcomes”.<sup>8</sup> The ability of what Owen defines as “networked actors” to influence outcomes, using their power in both positive and negative ways, matters decisively in our world today. More specifically, “new forms of action that are enabled by networked technology”<sup>9</sup> must prompt reflective, critical inquiry and analysis; how do humanitarian technologies and their impact over time matter to the study and, more fundamentally, the prevention of genocide as well as individual human experiences of transitional justice?<sup>10</sup>

## Anchoring the “Local-Level” in Genocide Matters

A recent initiative, *Build Peace*, is creating a unique community of practitioners, activists, technologists, and scholars to chart the future of technology and its impact on the ground in conflict transformation. Led by Helena Puig Larrauri, Michaela Ledesma, Rodrigo Davies, and Jennifer Welch, *Build Peace* convened an initial conference held at the MIT Media Lab on 5-6 April 2014.<sup>11</sup> The various panels and working sessions organized that weekend continue to initiate conversations pertinent to an evaluation of humanitarian technologies. How do these on-going discussions inspire our critical analysis as a scholarly community of the relevance of humanitarian technologies in the context of “preventing genocide?”<sup>12</sup>

The *Build Peace* conference underlines the necessity to study local contexts before even thinking about the ways humanitarian technologies may support conflict transformation. This point is most relevant in cases of genocide prevention, particularly given the need for a thorough understanding of the culture, history, languages, politics, and religions in a society as well as its legal system, which often influences access to elementary, secondary, and university education, public sector employment, and the allocation by state leaders of resources among different groups.

As the study of comparative genocide theory expands, scholars undertake research that integrates a variety of disciplines, including critical theory and post-colonial approaches. This evolution since the 1980s raises questions about the “definitional boundaries” of genocide studies as a distinct academic field.<sup>13</sup> Is Darfur a “civil war” or should we use “genocide” to explain mass violence in Sudan? The emergence of humanitarian technologies induces us to question the specific role of civil society, in its local and transnational dimensions,<sup>14</sup> to sustain a debate in the “global public sphere”<sup>15</sup> that is less about the character of the conflict and more focused on the information necessary to help citizens “recognize emerging intergroup tensions that are likely to lead to violent abuses”.<sup>16</sup>

Contemporary analyses delve more deeply “to acknowledge the diversity of civil society actors, discourses, and agendas...alongside states and international organizations in the politics of genocide” emphasizing “the

\* The author expresses her appreciation to Kyle Matthews, Cristian M. Silva Zuniga, Stefan Schmitt, Tristan Brand, and Jen Ziemke.

dynamics of contestation and struggle” as well as “the role of civil society actors in shaping the evolving global humanitarian regime to guide the international response to any particular crisis”.<sup>17</sup> These analyses miss the mark in the ways societal actors must engage with humanitarian technologies to prevent genocide. The adaptation of remote sensing and satellite imagery must strengthen the **proactive** capability of humanitarian technologies to provide accurate, consistent, and early detection.

Of critical importance is the ways in which early detection is combined with the strategic use of social media to convey, as broadly as possible, verifiable information. Reports of propaganda campaigns or large-scale displacement or hate speech<sup>18</sup> for example, must be confirmed through a reliable source triangulation process of various inputs, as appropriate to the particular case. Data made available by local village monitors on the ground, via text message, over community radio, broadcast on television, via satellite images, aerial photographs or geospatial content, and/or mapping in cyberspace provides the context in which early detection for genocide prevention may thrive as a result of civil society engagement.

Humanitarian technologies have the potential to sharpen the focus of a prevention lens if their use may support action taken to avert “a lesser atrocity than genocide”.<sup>19</sup> In this context, we must ask if humanitarian technologies have the impact necessary to interrupt oppression<sup>20</sup> in cases when, for example “...Those who are deemed to no longer belong to the community are stripped of any protection, formal and informal, that membership in the community provides against a predatory state”.<sup>21</sup> To interrupt oppression is defined as the ethical responsibility to engage, which is essential in that “...unresolved hatred and emerging violence in a society can grow into recurrent massacres, even war or genocide, destruction on a vast and hideous scale”.<sup>22</sup>

The difference humanitarian technologies can make depends largely on whether ‘civil society,’ driven primarily by ‘accountability,’ grasps the ethical responsibility to communicate information necessary to counter the ‘predatory society,’ driven often by “violent norms”.<sup>23</sup> The absolute power of an alliance between the ‘predatory society’ and its counterpart in the state often silences local ‘civil society.’ For humanitarian technologies to have any chance to be effective as instruments of prevention, the “conspiracy of silence”,<sup>24</sup> which purposefully denies the genocidal intent to perpetrate deliberate and systematic extermination, must be broken. The break must occur from the inside, at the “local-level,” on the ground in the specific context where the “emerging intergroup tensions,” analyzed by Hamburg, occur.

The decisive importance of the “local-level” is underlined in the analysis of transnational advocacy networks, otherwise known as TANs, in the literature.<sup>25</sup> The silence of local actors hinders the potential impact of the “boomerang pattern,” which aims to address the blockages civil society actors encounter in a repressive state. Outreach by local actors, who seek leverage through pressure on their state by transnational advocacy networks, is critical. In those instances when “emerging intergroup tensions” are a reality, the anchor of the local to the transnational in civil society advocacy provides openings for the use of documented evidence from satellite imagery and remote sensing analyses. The impact of transnational advocacy in tandem with evidence documented through the applications of humanitarian technologies is a subject ripe for prevention research in cases where mass atrocities are likely. Inquiry is needed to shed light on the ways in which transnational advocacy, supported by evidence documented from the ground and sky, may raise the stakes for genocidal leaders who expect to act with impunity.

In this context, Hamburg makes the case for the need “to have information ready at hand about practical measures for prevention that follows the public health model—an approach that uses empirical research to identify high-risk factors and apply a wide array of strategies, tools, and practices for preventing violent outbreaks of all kinds”<sup>26</sup> (Figure 1).

For instance, our early reflections and experiences as a genocide studies community regarding the relevance of humanitarian technologies to identify, measure, monitor, document, and research large-scale displacement<sup>27</sup> as a “precipitating factor”<sup>28</sup> in the prevention of mass atrocities tend to re-enforce a holistic, interdisciplinary focus in our pedagogy.

The “questioning of *geographical* boundaries as well as case selection” is salient<sup>29</sup> in terms of pedagogy, as we integrate applications of humanitarian technologies in the study of genocide and its prevention. As the literature scholars may access grows, anchoring the “local-level” means reflecting on “individual empowerment”<sup>30</sup> and its significance for prevention efforts. Moreover, research to ascertain the impact of humanitarian technologies on prevention has the potential to open the genocide studies field even further to scholarship from around the world.<sup>31</sup> Specifically, two developments in recent years, increased affordability of humanitarian technologies and broader social media access to data, allow more recent applications to focus attention worldwide on genocides perpetrated in the Global South.<sup>32</sup>



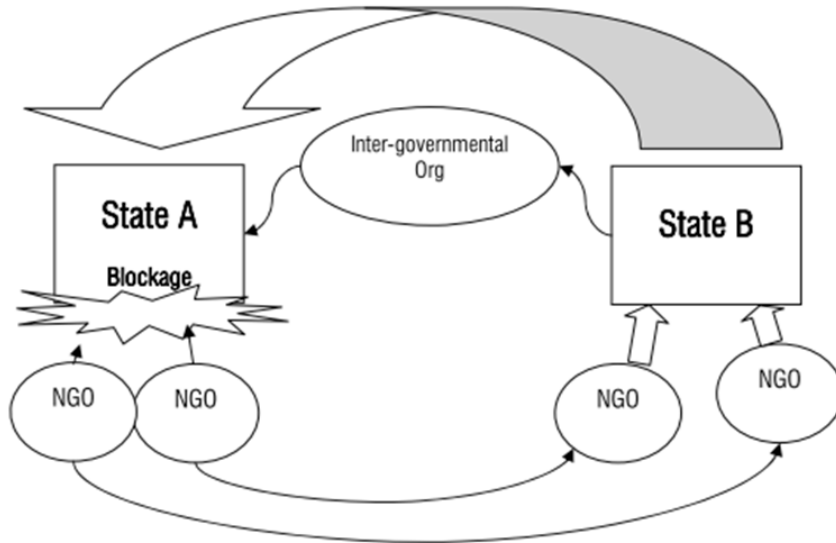


Figure 1. The “boomerang pattern,” developed by Keck and Sikkink, to activate TANs. Interrupting Oppression in Repressive States Prone to Mass Violence: Are humanitarian technologies effective in local contexts where civil society encounters its predatory state-society counterparts?

### Innovations in Case Selection and Pedagogical Methods

#### Inquiries in the “Classroom without Borders:” Linking Transitional Justice and Genocide Prevention using Documented Evidence Captured by Humanitarian Technologies

In one noted case study, starting in 2006, Amnesty International USA (AIUSA) in cooperation with the American Association for the Advancement of Science (AAAS), and with a grant from the Save Darfur Coalition, recorded irrefutable evidence of systemic destruction in Darfur.<sup>33</sup>

The most vulnerable populations want “all eyes” to focus continuously on their plight in the hope that genocide may be averted. The “Eyes on Darfur” project did provide ample information of events on the ground. The site is a repository of in-depth analysis as well as individual testimony from the conflict area highlighting displacement of persons as well as destruction of villages (Figure 2).<sup>34</sup>



Figure 2. Imagery to Retain a Watchful Eye for Devastation in Ishma, Darfur, 2009, Digital Globe.<sup>35</sup>

Yet, we must question the extent to which the use of technology in this project served a deterrent effect. Scott Edwards, in a response to our colleague Patrick Meier, notes that “the mere act of observation...changes nothing about the reality of our world”.<sup>36</sup> To leverage the deterrent power of satellites and other remote sensing tools requires that perpetrators of atrocities fear naming and shaming as well as the documentation of their crimes. The expansion of monitoring capacity however innovative or humanitarian, technologically speaking, is likely to remain limited if at least three other challenges are not addressed simultaneously.

First, local actors encounter critical difficulties to connect with transnational advocacy networks. We must be cognizant of the significant challenges to empower individuals in local settings via their connection with TANs as part of the engagement that defines communication in the global public sphere. Educational inquiries in the “classroom without borders” must assess the possible influence of the “boomerang pattern” comparatively, developing case studies in different geographical locations, and, increasingly, diachronically across diverse time periods.<sup>37</sup>

The concept of the “global network university” implemented at New York University introduces a twenty-first century idea of learning, research, and service to expand the classroom experience in ways that may animate teaching and facilitate these inquiries.

It is insufficient to question if satellite imagery analysis can also sustain justice by raising the stakes to deter genocidal leaders as long as a second challenge is not met: namely, the need to strengthen the international justice system in ways that give leaders intent on murder cause to fear documented evidence provided by remote sensing, as we expand “the monitoring capacity of watchdogs”.<sup>38</sup>

Third, we must reflect on the groundbreaking analysis presented by members of the Satellite Sentinel Project (SSP). This Project, which uses the public deployment of remote sensing and data collection technologies, faced the early challenge of “leveraging SSP’s unique information to motivate international response to the alleged abuses in Sudan”.<sup>39</sup> Once again, this observation speaks to the limits of humanitarian technologies in the face of weaknesses inherent in civil society, the international justice system, and political will. Most states do not act to prevent genocide in the national interest.<sup>40</sup>

There is no denial possible in the face of evidence documented to date: remote sensing technologies have broad applicability. Images from the sky capture “widespread destruction of buildings and communities... detect mass graves, document forced displacement, observe troop buildup, document effects of extractive industries, find secret detention facilities” as “the ability of watchdogs to task satellites to capture new images dramatically expands the reach of human rights NGOs”.<sup>41</sup> Of particular importance to a focus on genocide prevention and its relevance to considerations of transitional justice is that satellite images cannot document victims, only crimes. This fact has profound implications in thinking about “restorative justice” with its focus on “the needs of victims and broader society rather than the more narrow demand of punishing violators”.<sup>42</sup>

Moreover, if the crime does not leave “a clear and obvious physical effect in space,” the “scope and severity of the violations” cannot be assessed without direct access to the area in conflict.<sup>43</sup> Satellite images cannot demonstrate genocidal intent or conspiracy. Therefore, we must assess their deterrent potential in indirect ways. Can expanding the monitoring capacity of watchdogs offer grassroots actors increased leverage in conflict areas? By forging linkages to NGOs that make transnational advocacy possible, can much-needed efforts to mobilize the will to intervene be sustained by those local actors whose voices most need to be heard? Research inquiries that investigate systematically the expanded uses of humanitarian technologies in areas impacted by mass violence may provide some preliminary answers. Such findings may be of particular relevance as “genocide studies scholars further investigate the challenges of post-conflict settings and engage in advocacy for the prevention and punishment of genocide”.<sup>44</sup> The cross-fertilization between transitional justice and genocide studies will mark the development of each field with connections further established as international courts gather more evidence captured by humanitarian technologies to prosecute violations of international humanitarian law.<sup>45</sup>

The detection and documentation of mass atrocities through the development of standard remote sensing also requires accepted forensic standards. In questioning the relevance of humanitarian technologies to genocide prevention, we must be aware of the gap that is the “absence of a standard approach for the classification of phenomena involving observable objects into categories of observable patterns relevant to certain mass atrocity events”.<sup>46</sup>

Before educators analyze the uses of remote sensing platforms and data sensing technologies to explore with students the latest innovations in genocide prevention, it is helpful to introduce knowledge acquired from different field experiences in the “classroom without borders”.<sup>47</sup> These initiatives provide first-hand

encounters with local contexts in which transitional justice concerns intersect with the priorities of genocide prevention. One such encounter occurs regularly during the academic year in Guatemala at the International Field Initiatives and Forensic Training (IFIFI) Multidisciplinary Field School,<sup>48</sup> in collaboration with the *Fundación de Antropología Forense de Guatemala* (FAFG),<sup>49</sup> and especially with the leadership of Fredy Peccerelli, Executive Director, Guatemalan Forensic Anthropology Foundation.

Our colleague Kyle Matthews, Montreal Institute for Genocide and Human Rights Studies (MIGS), Concordia University, travelled to Guatemala with photographer Tristan Brand to observe the work of a group of forensic anthropologists “digging for truth”<sup>50</sup> as part of a memorialization initiative that “incorporates youth and the new generations in learning about history in order to help prevent the atrocities of the past from being repeated.”<sup>51</sup>

The struggle against impunity in post-conflict Guatemala is a restorative project with the objective to “report and publicize past crimes.”<sup>52</sup> Researchers question the role of memory initiatives in dealing with “the culture of silence that perpetuates impunity” by integrating a mapping process, which allows for the recovery of memory of “different violations suffered during the armed conflict” (Figure 3).<sup>53</sup>



Figure 3. In the highlands of Quiché province, Kyle Matthews, along with other forensic workers, students and local residents, listens to the testimony of a man who recalls the murder of his wife and infant daughter. (Photograph: Tristan Brand).<sup>54</sup>

Unlike official truth commissions, which may not adequately capture local realities,<sup>55</sup> the mapping process is a grassroots effort that aids Guatemalans in the outreach to different social sectors, notably indigenous survivors as well as displaced peoples, in an effort to resist forgetting.<sup>56</sup> Although humanitarian technologies are increasingly available, their uses remain limited without the necessary forensic evidence gathered on the ground by native populations with the assistance, increasingly, of international students conducting field research (Figure 4).

Humanitarian technologies must continue to adapt in ways that allow for the integration of increasingly large volumes of data gathered in local mapping processes, which utilize forensic anthropology as well as other scientific disciplines, including forensic archaeology,<sup>58</sup> to gather the necessary evidence as “a first step along the road to societal reconciliation.”<sup>59</sup> The groundbreaking work of non-governmental organizations (NGOs) such as Physicians for Human Rights (PHR) is particularly relevant to assess the impact of humanitarian technologies in genocide prevention given the need to map the transitional justice literature to “contribute to furthering useful links and cross-fertilization”<sup>60</sup> between transitional justice and genocide



studies. Innovative pedagogy in the “classroom without borders,” including the integration of transitional justice field work opportunities for students in their academic programs, offers educators the occasion to begin making productive connections in learning, research, and service between these fields (Figure 5).



Figure 4. A student collects a cheek swab for a DNA sample from an Ixil woman, whose brother was murdered. (Photograph: Tristan Brand).<sup>57</sup>



Figure 5. Fragments of bone at a DNA laboratory in Guatemala City. DNA samples from over 6000 sets of human remains, taken from over 1000 burial sites have been analyzed at the Guatemalan Forensic Anthropology Foundation's (FAFG's) Headquarters. (Photograph: Tristan Brand).<sup>61</sup>



Data collection platforms, like KoBo, are “driven by actual field-based needs and challenges such as limited technical know-how”.<sup>62</sup> The practical evolution of these platforms makes their use feasible even in remote areas. In these settings, where remote sensing and data collection represent “a substantial paradigm shift from traditional, often retrospective, collection of evidence corroborating alleged human rights violations”,<sup>63</sup> as in the experience of the Satellite Sentinel Project (SSP), the need is still urgent to report “predisposing factors” to mass violence and to document observations from the ground, especially in the majority of cases when monitoring from the sky is not possible (Figure 6).

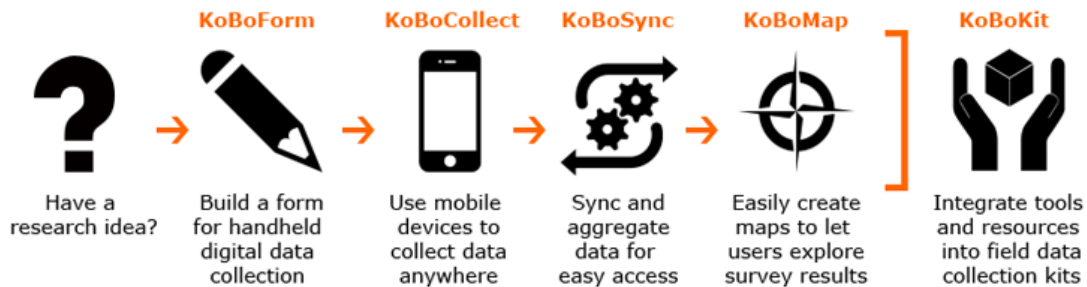


Figure 6. Kobo platform (Source: <http://irevolution.net/2012/05/08/kobo-platform/>).

The search for documented evidence must utilize scientific inquiry as “the right to truth” in post-conflict societies becomes more critical to understand “the circumstances of past human rights violations in order to prevent their recurrence”.<sup>64</sup> Physicians for Human Rights engages in “forensic human identification projects” in a growing number of countries, including Cyprus, Guatemala, Colombia, and, most recently, in Afghanistan<sup>65</sup> and Libya. The Director of PHR’s International Forensics Program, Stefan Schmitt, provided an opportunity to Cristian Silva, Director, International Field Initiatives in Forensic Training (IFIFT), to attend one of the PHR programs, which led to the idea of the Multidisciplinary Field School in Guatemala pioneered by Fredy Peccerelli.

The need to establish the “necessary forensic infrastructure in transitional justice contexts”<sup>66</sup> presents tremendous challenges for local areas. For this reason, education makes a critical difference in the various countries where Physicians for Human Rights mobilizes colleagues to implement projects. The Multidisciplinary Field School experience of transitional justice in Guatemala provides one example. It is insufficient to introduce humanitarian technologies exported from outside the area where genocide occurs. In the absence of a local infrastructure, without the recognition of the legal, technical, and scientific perspectives to define and determine the scope of mass fatality, how can there be justice to address the rights of victims or the obligations of a state in question when we speak in the literature of “never again?” (Figure 7.)<sup>67</sup>



Figure 7. A forensic anthropologist works to isolate fragments of human bone from other materials. Human remains are registered, analyzed, and a biological profile is built to help identify victims and their cause of death. (Photograph: Tristan Brand).<sup>68</sup>

The experiences of Physicians for Human Rights in Afghanistan prompt additional reflections that reference the “regime type and the state” in national-level approaches to explain why genocide occurs,<sup>69</sup> as we acknowledge the limits of humanitarian technologies in our search for “clues to future prevention.”<sup>70</sup> In Afghanistan, perpetrators of past crimes are often in power with some leaders “implicated in on-going abuses.”<sup>71</sup> In thinking about “international justice in preventing human rights abuses” as one of the “pillars of prevention,”<sup>72</sup> we must acknowledge formidable blockages at the national level. The Sharia principle that only victims can forgive is difficult to reconcile with their pursuit of justice in an environment that does not provide for safe access to the judiciary to urge the investigations of past crimes.<sup>73</sup> Given the serious challenges to the rule of law in Afghanistan,<sup>74</sup> training courses and projects for civil society groups there provided skills in basic crime scene documentation and allowed students to participate in the exhumation of a set of human remains in a single grave located in the Ministry of the Interior compound (Figure 8).<sup>75</sup>



Figure 8. Exhumation of a set of human remains at the Ministry of Interior Compound (Source: <http://physiciansforhumanrights.org/library/reports/securing-afghanistans-past-gap-analysis-report.html>).

Afghanistan’s civil society faces tremendous obstacles to influence policy on issues of transitional justice. The lack of coordination among civil society organizations (CSOs) as well as between local and international organizations is cited as most problematic in their efforts “to keep the idea of transitional justice alive”<sup>76</sup> in the country. One consequence of the dedication to local training by Physicians for Human Rights was the founding in 2011 of the Afghanistan Forensic Science Organisation (AFSO) with “the stated objective to document and secure the country’s mass grave sites.”<sup>77</sup> The following year humanitarian technologies, including Global Positioning System (GPS) surveying,<sup>78</sup> were used to document thirteen mass graves with forensic reports issued to local and judicial authorities, civil society as well as victim organizations.<sup>79</sup>

The uses of humanitarian technologies can make a difference if their applications may be referenced to strengthen the connection between “expert” and local knowledge in a sustained effort to avoid marginalizing local experiences and practices,<sup>80</sup> as in AFSO initiatives to conduct awareness raising workshops in the communities where mass graves were surveyed and documented.<sup>81</sup> As research is undertaken that pertains to local initiatives, particular data ethics questions come to light, to which this inquiry must now turn.

### **Civil Society and Data Ethics: Queries for a New Era** **The Impact of Humanitarian Technologies on Genocide Prevention Research**

In the early twenty-first century, the ways in which digital technology applications and data collection methods impact on education raise unprecedented questions. As the genocide studies community reflects on the influence of humanitarian technologies in prevention efforts, academics and activists alike must grapple with data ethics in a holistic manner. While research still “remains largely unconnected and ‘silo-ed’”<sup>82</sup> in the fields of transitional justice and genocide studies, “data increasingly flows through and is used by people and organizations across sectors and across domains.”<sup>83</sup> This is one of the points made during “The Social, Cultural, and Ethical Dimensions of ‘Big Data’” conference organized in New York City on March 17, 2014 by the Data & Society Research Institute, the White House Office of Science & Technology Policy, and New York University’s Information Law Institute.

Civil society must grapple increasingly with the ethics of what is known as “big data,” defined in one way as “things one can do at a large scale that cannot be done at a smaller one to extract new insights or create new forms of value in ways that change markets, organizations, the relationship between citizens and governments.”<sup>84</sup> In this context, “the relationship between big data uses and power, notably the issue of

power differentials in relation to data analytics,<sup>85</sup> is particularly relevant to reflections in the genocide studies community. More fundamentally, if “society will need to shed some of its obsession for causality in exchange for simple correlations: not knowing *why* but only *what*,”<sup>86</sup> attention must be focused more normatively, and much more purposefully, on the ways in which “those who are tracked by data analytics may lose access to their information or may be unaware of how it is being used.”<sup>87</sup>

The normative focus of inquiry is of particular relevance to cases long neglected in genocide prevention research, which pertain to sexual violence in conflict. Do constructivist and feminist perspectives sufficiently inform research analyzing women’s victimization in comparative studies?<sup>88</sup> In asking this question, researchers must rely increasingly on sensitive data, which documents sexual violence in cases ranging from the Democratic Republic of Congo to the Republic of Colombia. In these cases, there are specific needs that involve establishing procedures, identifying best practices, and upholding professional ethics,<sup>89</sup> which are each critical in reflecting on the ways data ethics impacts on research in the genocide studies community.

As we consider the need to establish procedures to protect the vulnerable, interviewers must be specifically trained to document evidence of sexual violence in conflict, which may be used to prosecute the perpetrators. There are specific responsibilities interviewers have in this context, including to evaluate safety and security risks to the interviewees, to learn how to craft ethical and open-ended questions, and to focus on obtaining informed consent from the interviewees.<sup>90</sup>

The identification of best practices highlights civil society’s responsibility to address the “social structure of denial”<sup>91</sup> and to map local, communal, regional, national, and global actors engaged to end sexual violence in conflict. What are the best practices that allow civil society actors to share widely testimonies of survivors of sexual violence in conflict using social media and mobile technology without endangering victims? In addition, best mapping practices must be identified, which may offer a graphic overview of tensions in civil society, including local communities in conflict, without exposing those on the ground to physical danger.

The commitment to uphold professional ethics requires those who conduct field research to collect evidence of sexual violence in conflict using humanitarian technologies to fulfill their responsibility to communicate with the Institutional Review Boards for Protection of Human Subjects at their respective universities. As more field work integrates sensitive data that is accessible, this commitment still does not consistently address the fact that “even when researchers try to be cautious about their procedures, they are not always aware of the harm they might be causing in their research.”<sup>92</sup> Their responsibility is to uphold professional ethics involving potential harm, consent, and disclosure of the data acquired. This is particularly significant in thinking about how to upload local narratives<sup>93</sup> to avoid marginalizing local experiences, as we address a global policy concern by disclosing testimonies of sexual violence in conflict.

Sexual violence in conflict is a crime against humanity, which “as international case law develops...when intended to destroy a group, will most likely be declared genocide on the basis of the five acts listed in Article II of the Convention.”<sup>94</sup> These acts are: “(a) Killing members of the group; (b) Causing serious bodily or mental harm to members of the group; (c) Deliberately inflicting on the group conditions of life calculated to bring about its physical destruction in whole or in part; (d) Imposing measures intended to prevent births within the group; and (e) Forcibly transferring children of the group to another group.”<sup>95</sup>

The broad campaign to stop rape now involves global civil society defined by Castells as local community engagement, the evolution of non-governmental organizations, the development of social movements, and public opinion mobilization.<sup>96</sup> The “glocal”<sup>97</sup> process aims to upload accurately and securely data, the first-hand testimonies of local experiences to inform a global conversation on sexual violence in conflict, which connects survivors directly to activists.<sup>98</sup> This process aims to exert constant pressure on states whose leaders are complicit in the mass rape of women.

Civil society is increasingly responsible to collect, organize, and share the most sensitive data, acquired through humanitarian digital technologies, to combat sexual violence in conflict. Transnational advocacy networks, particularly non-governmental organization (NGO) activists, are called to use this data obtained within complicit states in the search for justice and to effect transformative change. There is a broad array of ethical questions in research design, particularly related to data collection and storage during the field experience before embarking on analysis and reporting, as these relate to genocide prevention in this particular case. The genocide studies community has the responsibility to begin its outreach to colleagues, such as those in the Ethics of Data in Civil Society (EoD) network, who are working to formulate “principles of ethical digital data use in civil society that might stand the test of time and weather the pace of innovation, both in technology and in civil society organizing.”<sup>99</sup>

## Conclusion

The applications of humanitarian technologies in genocide studies may increasingly focus our attention on the restorative justice approach and pillars of prevention, notably the need for “a continuous flow of accurate information on emerging conflicts”.<sup>100</sup> Our ethical responsibility in research is to question consistently if the integration of data acquired through humanitarian technologies empowers or marginalizes survivors. As younger and younger victims increasingly suffer human rights atrocities around the world, “public awareness of the plight of children and of what is or is not being done to alleviate it, has been greatly heightened by the instant media access which is a feature of life in twenty-first century society”.<sup>101</sup>

May the voices of the marginalized in conflict areas also be heard in accordance with the principles of the Universal Declaration of Human Rights?<sup>102</sup> A future challenge for genocide prevention is to identify through comparative analyses the ethical uses of humanitarian technologies by researchers, particularly to acquire data from post-conflict areas during investigations of “predisposing and precipitating factors”.<sup>103</sup>

As “big data” becomes available and the digital revolution drives “much of the increasing complexity and pace of life we are now seeing”,<sup>104</sup> the temptation exists in research to reduce individuals and societies to “communication systems, without much concern for the substance of the “messages” these networks carry”.<sup>105</sup> The ethical foundation of genocide prevention research is in the substance of the messages. Progressively, are researchers likely to be “strategically positioned *within* national contexts”<sup>106</sup> as “rooted cosmopolitans”<sup>107</sup> to interpret the messages conveyed? Their presence as such is necessary to actualize the promise offered by humanitarian technologies in genocide studies.

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**Hidden Genocides: Power, Knowledge, Memory,**  
**edited by Alexander Laban Hinton, Thomas La Pointe, and Douglas Irvin-Erickson,**  
**Newark: Rutgers University Press, 2013, 230pp \$80.00 (hbk), \$28.95 paperback**

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**Reviewed by Uğur Ümit Üngör**

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This book begins with an interesting problematization: why do some genocides become prominent in academic research, public awareness, and political recognition, whereas others do not? Is it a question of power making knowledge in public consciousness (i.e. political), or do neutral scholars mark some events as genocide due to their specific features (i.e. academic)? The editors have assembled a diverse range of chapters that all address these questions for particular cases, countries, and regions, and all offer different answers to them. Due to the common theme underlying each chapter, the book does not suffer from incoherence vexing many edited volumes.

Dirk Moses examines the long and arduous process of the establishment of the Canadian Museum for Human Rights (CMHR) in Winnipeg. As Ukrainian, Armenian, Jewish, and Palestinian community advocates scuffled to secure a prominent place in the museum, they forgot about the communities that were arguably entitled to primacy in terms of representation: the native Canadians. The glaring disregard for the very community on whose land the museum would stand is a comment on the self-centered preoccupations of diaspora community organizations. Elisa von Joeden-Forgey's fresh chapter unmasks the legal categories produced in Imperial Germany to deal with *Eingeborenen* ("natives"), a category of human beings who were not protected by the state and against the state – such as floggings in Germany's colonial possessions. Hiding mass violence could thus be a function of the legal system.

Daniel Feierstein breaks down the popular belief that genocide is predicated upon a binary system of bad perpetrators versus good victims. He argues that since genocide is about destroying identity, "any attempt to tackle genocidal social practices must begin with this construction of identity and otherness" (p.75). Argentina is used as an example of genocide in which the government destroys its own population. Theorizing from the Soviet Union or the Khmer Rouge would have elucidated his point even further. Donna Lee-Frieze's chapter on the Stolen Generations argues that the kidnapping of Aborigine children, kept behind a veneer of decency by the Australian government, was a genocide by absorption. Like Feierstein, she uses Levinas' philosophy of Self and Other to examine that genocide as a form of "noncorporeal violence" (p.91).

Most chapters offer a new perspective or a fresh interpretation, but Walter Richmond's chapter also provides empirical evidence. It sheds light on a genocide that remained hidden behind another hidden genocide: the 1820 Russian destruction of Kabardia, in which an entire tribal society was comprehensively destroyed, partially expelled, and forever subjugated. Based on painstaking research on Russian sources, the chapter also convincingly suggests that the British government helped 'hide' the genocide by forgetting and ignoring it. (In much of this, one hears the echoes of how Britain and the United States ignored and silenced the 1940 Katyn massacre due to the expediency of the alliance against Hitler.)

Adam Jones untangles the clew of violent episodes in the Great Lakes region, in which the 1994 Rwandan genocide has become canonical, at the expense of other, similar violence. He is right in arguing that comparative research can de-contextualize a genocide from its broader environment of mass political violence, and warns against bracketing off the Rwandan genocide from a) the prehistory of multi-directional violence in Rwanda or b) the genocides in neighboring countries such as Zaire/DRC or Burundi. Throwing his caution to the wind may cause us to lose track of connections, continuity, and spillover. Alex Hinton's deeply touching chapter illustrates "how complicated histories are contested and depicted in reductive ways" (p.153). It revolves around the devastating testimony of Chlat, a Cambodian man who lost most of his family, survived the genocide himself, but fell victim to AIDS 30 years later. The chapter clarifies how the liberating Vietnamese government shifted away from the Khmer Rouge, but also adopted some of its rhetoric, and diverted attention away from the genocide mostly for geopolitical reasons. Yes, the Khmer Rouge had annihilated the Vietnamese minority in Cambodia, but at least they had been anti-Western.

The book has some minor flaws: the chapter by Chris Mato Nunpa is not a research essay, but a vehement political denunciation of the United States. The chapter by Hannibal Travis makes some good points, but is generally overstated, and somewhat pharisaical. In a nutshell, it argues: "Scholars of the Armenian genocide are complicit in an ongoing concealment of the Assyrian and Greek genocides" (p.172). The chapter neither

recognizes the real differences between these cases, nor distinguishes between Pontic Greeks and western Anatolian Greek population. The same processes of hiding genocide have occurred in Greece, as Pontic communities have struggled long to have their experiences fully acknowledged. Travis also seems to be unaware of evidence by Greeks and Assyrians themselves: the Greek parliament commemorated Turkey's destruction of Ottoman Greeks, but reserved the nomenclature 'genocide' for the treatment of the Ottoman Armenians. Many historical sources including interviews with Assyrian survivors suggest that genocidal intent among the CUP elite was strongest towards the Armenians. Most importantly, Travis seems to miss the point of the book by committing the same sin he denounces: he disregards the massacres of Yezidis, the mass deportation of Kurds, massacre against the Alevi Kurds of Koçgiri (all during World War I) and the Dersim genocide of 1938. To quote a point cogently made by Adam Jones: in periods of severe political crisis, genocides can be reciprocal (pp.135-6), but Travis' chapter also omits the expulsion and massacre of Muslims in the Balkans during the twin wars of 1912-1913, and the Greek massacres against Turks during their military occupation of Anatolia.

All in all, Hinton, La Pointe, and Irvin-Erickson offer us a useful prism through which to examine and weigh conventional accounts of genocide. The book functions like a photo negative inverter: it reveals cover-ups and makes the invisible visible. Law, politics, international relations, scholarship, all can play a role in 'hiding' genocides. Up to a certain degree, a critical, detached, and intellectually autonomous position can help uncover them.

# The Missing Picture - Film Review, Director: Rithy Panh, Documentary Cambodia/France, 2013

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Reviewed by Lior Zylberman  
Translated by María Belén Riveiro

“In the middle of life, childhood returns (...) I seek my childhood like a lost picture”, those are the opening words pronounced by Rithy Panh in *The Missing Picture* (*L'image manquante*). His film is focused solely on recovering that loss. However, we will soon realize that his childhood was not lost. The Khmer Rouge took it away from him between 1975 and 1979, in his native Cambodia.

Rithy Panh was born in Phnom Penh in 1964. At the age of 11, he had to abandon his birthplace. His family, like many others in every city, was displaced to the ‘rehabilitation’ camps in a forced evacuation. When the Khmer Rouge regime was overthrown, Panh escaped to Thailand, and later immigrated to France. In France, he enrolled in Cinema Studies, and built a career. While he embraced both fiction and documentary genres, his filmography has been centered on the regime of the Khmer Rouge. From *Site 2* (1989) to *The Missing Picture*, Panh has constantly put into practice several ways of representing the years of the genocide and its consequences. *S-21, la machine de mort Khmère rouge* (2003) is probably Panh’s most renowned movie. The film focuses on Tuol Sleng, the former school that was turned into a detention and torture center under the name of S-21. In this documentary film, Panh interviewed survivors as well as former torturers, and created conditions for both the victims and the perpetrators to spend some time together again. In 2011, Panh then went on to release a sequel entitled *Duch, le maître des forges de l'enfer*. In this film, Panh presents a long interview with Kaing Guek Eav, better known as Duch, the former director of S-21. The interviews took place in a prison while Duch was on trial before the Extraordinary Chambers in the Courts of Cambodia for the crimes he committed during the reign of the regime. He was later convicted of crimes against humanity, murder, and torture for his role during the Khmer Rouge rule of Cambodia and sentenced to 30 years imprisonment, later extended on appeal to life in prison.<sup>1</sup>

In previous documentaries, Panh had chosen, in Bill Nichols’ terms, a participatory mode<sup>2</sup>. In other words, he interviewed several social actors, yet he remained behind the camera. Panh, the filmmaker, did not bring his subjectivity into play: he depicted experiences, created situations, but did not place himself in front of the camera in order to directly intervene to voice his own experiences as a survivor. However, he made a particular subjective turning in *The Missing Picture*. In this movie the story mainly revolves around the self: Rithy Panh. In its French version, while Randal Douc, an actor, tells the story, the texts are co-written by Panh and Christophe Bataille.<sup>3</sup> The story is about the childhood memories that the filmmaker has never buried. When evoking these memories, Panh not only remembers exploitation, hunger, and starvation suffered under the regime of Pol Pot, but he also remembers that when he was 13 years old, he lost his whole family in a short period of time. His brother in law was executed. His father decided to starve to death. His mother let herself die in hospital after one of her daughters, and Panh’s sister, passed away. In addition, Panh’s nephews passed away in similar conditions.

After the opening titles the camera is immersed into the water and comes to the surface again giving pictures of the sea. Water connotes birth, time, life, and transformations. All things come from the sea and return to the sea. There is no coincidence in the fact that towards the end of the documentary the pictures of the sea reappear. His childhood, Panh suggests, returns in the middle of life as in “water [that] is sweet and bitter”. After going through troubled times, Panh is now, at the age of 50, looking back to his childhood; or maybe, as he points out, his childhood is demanding his attention. The movie becomes the search for his childhood, a lost picture. Using water and clay, Panh creates his own men, his own actors, through this models of clay, Panh’s memories emerge.

The filmmaker asks us to believe him. He wants us to work with him, to believe that everything he is telling us is true. Briefly, he urges us to imagine. Panh does not have any actual pictures of his childhood; his memories vacillate, and he resorts to his imagination to rebuild them.<sup>4</sup> In this way, Panh undertakes the reconstruction of the days spent in the ‘rehabilitation’ and labor camp. At the same time he denounces the workings of the regime of the Khmer Rouge. The models made out of clay, painted and characterized as different people, are still, motionless, against a background of cardboard. Nevertheless, the camera moves around them, apparently bringing life to the inanimate. The story being told helps us combine all the elements

so that what is in our imagination comes to life. Panh acknowledges that his testimony is driven by a need: “They say [that] talking helps. You understand, you get over it.”

Nominated for an Oscar for Best Foreign Language Film in 2013, and winner of the award *Un Certain Regard* at the Cannes Film Festival of that same year, this movie suits clearly two purposes. On the one hand, and from a historical and political viewpoint, *The Missing Picture* aims at recounting the history of the Cambodian genocide, using Panh’s own life experiences to denounce the crimes. On the other hand, Panh creates an autobiography where the personal dimension meets the public dimension; in this way, the personal history converges with the Cambodian collective history.

If the images Panh is seeking to capture had been recorded through technical means, such as film or photography, reproducing them would have become unbearable for the viewer (and also for Panh). In this way, Panh’s film entails a challenge towards horror representations, noteworthy for its search for new expressions to represent genocidal violence. Resorting to another kind of representation, Panh makes bearable what would have been unbearable. According to Jacques Rancière, “the treatment of the intolerable is thus a matter of *dispositif* of visibility”<sup>5</sup>; as in *S21*, *The Missing Picture* adopts the same strategy: in the words of Rancière, “[t]he whole strategy of the film is to redistribute the intolerable, to play on its various representations”<sup>6</sup>.

Furthermore, and to anchor in reality his way of recalling his story, Panh resorts to records of an archive that run parallel to the story. In some parts, it is a story that suggests the images are propaganda material; and in others parts the images are superimposed one on the other (Figure 1). Seen as superimposed, the images help achieve a peculiar combination of imaginations: on the one hand, two resources are combined to create an image working as synthesis; on the other hand, the story being told informs us that the forced evacuation of the families in Phnom Penh happened as in this combination-superimposition Panh creates. He thus creates his own visual-historical archive.



Figure 1.

Panh also intervenes faintly on the screen in a repeated manner. In the beginning, for example, the screen shows Panh looking for “missing pictures” in a shed crammed with old film canisters, with a close-up on his eyes. Later on, he carefully breaks down the world made out of clay, to create a sequence where his image is out of focus, to illuminate the images of a child with whom he grew up. This helps Panh “find” his own childhood (Figure 2). “And my childhood returns. Now, it’s the boy who seeks me out,” Panh states, “I see him, he wants to speak to me. But words are hard to find”. The dialogue takes such a toll on Panh that his image remains blurred.

Although it is not his voice we hear, we instead hear Panh’s consciousness speaking to us. The tone chosen, the volume, calmed and intimate, are similar to a prayer and/or a confession. In this way, we can argue that Panh resorts to documentaries as a “therapy of self-examination”.<sup>7</sup> Michael Renov developed the idea of techno-analysis in relation to the potential of documentaries as tools for self-inquiry. Through his movie,





Figure 2.

Panh does not feel that his efforts have been in vain; his imaginative work has allowed him to state, finally, that “[t]hese pictures are not missing, they are inside me”. The sea returns as the final image, the camera immersed into the water and rising again to the surface: Panh is reborn, and the opportunity allows him to own his memories.

*The Missing Picture* should not be taken only as a movie sparked by a cathartic need. It is a creation of a committed filmmaker, searching for truth and justice in his homeland, Cambodia. Therefore, Panh explores and capitalizes on the opportunities offered by cinema to share and to present us a period in which he and his people suffered. Panh took the risky and unusual choice of visual treatment of his story to produce images of the unimaginable, the unthinkable. He tells a detailed story of the everyday life, and at the same time reflects upon political, social, and philosophical issues.

Title of the Film: *The Missing Picture* (*L'image manquante*); Director: Rithy Panh; Producers: Bernard Comment, Catherine Dussart, Martine Saada; Country/Countries: Cambodia/France; Year of release: 2013; Production Company: Bophana Production, Catherine Dussart Productions, Arte France.

### Endnotes

- 1 *Prosecutor v Kaing*, 001/18-07-2007/ECCC/TC, 26 July 2010; *Prosecutor v Kaing*, 001/18-07-2007-ECCC/SC, 3 February 2012.
- 2 Bill Nichols, *Introduction to Documentary* (Bloomington: Indiana University Press, 2001).
- 3 Bataille, a professional writer, collaborated on the writing of Panh's memoirs, *The Elimination*. In fact, *The Missing Picture* is partly based on this book.
- 4 In a certain way, Panh's idea is similar to the one depicted in the sequence of the abduction of Albertina Carri's parents, which used Playmobil dolls in the movie *Los Rubios* (Albertina Carri, 2003).
- 5 Jacques Rancière, *The Emancipated Spectator* (New York: Verso, 2009), 101-102.
- 6 Rancière, *The Emancipated Spectator*.
- 7 Michael Renov, *The Subject of Documentary* (Minneapolis: University of Minnesota Press, 2004).