FCJ-201 Visual Evidence from Above: Assessing the Value of Earth Observation Satellites for Supporting Human Rights

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Abstract: Public access to data collected by remote sensing Earth Observation Satellites has, until recently, been very limited. Now, citizens and rights advocacy groups are increasingly utilising satellite-collected images to interrogate justice issues; to document, prevent and verify rights abuses; and to imagine and propose social change. Yet while other communication technologies have received substantial critical analysis regarding their value as tools of social justice, activism and resistance, satellites have received comparatively scant attention. This article examines the uses of satellite-collected images in human rights contexts including the opportunities, challenges and risks they pose. We conclude this examination by arguing that if satellites are to be used effectively to collect evidence from above by rights advocates, greater attention to and capacity for ensuring accountability from below is required.

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Introduction: Satellites as Earth Observers

Digital technologies provide new opportunities for human rights advocates to mobilise people, coordinate activities, uncover and document abuses, publish findings and engage new audiences (Notley and Hankey, 2013). Earth Observation – which involves gathering information about Earth or activities on Earth via remote devices – offers important opportunities to capture information that may otherwise be unobtainable. Balloons, planes, helicopters, drones and submarines are all capable of remote sensing and all of these technologies can be used in human rights contexts. However, of all these Earth Observation vessels, this article focuses on satellites given their rapid development and application in human rights contexts.

Earth Observation via satellites began when the first artificial satellite was sent into space by the Soviet Union in 1957 during the Cold War. Named Sputnik ('fellow traveller of the Earth'), the 83kg capsule was credited with starting a 'space race' (Wang, 2008) – a race initially driven by government and military objectives. The first Sputnik was a very simple satellite that communicated with Earth via radio pulses, which were monitored by governments and amateur radio enthusiasts around the world (Siddiqi, 2003). While Sputnik 1 was a simple satellite with limited capacity and was not used for Earth Observation, it paved the way for the ongoing development of satellite technology as a global communication infrastructure.

At the time of writing, there are an estimated 1265 publicly listed or known satellites are in orbit and active (Union of Concerned Scientists, 2015). These satellites range in size from a basketball to a small bus and they have very different capacities. This live, interactive satellite map (https://in-the-sky.org/satmap), created by radio presenter and scientist, Dominic Ford, highlights the ubiquitous presence of satellites: they scan and document every ocean and nation. The Citizen Science Satellite Database Project (http://www.ucsusa.org/nuclear_weapons_and_global_security/solutions/space-weapons/ucs-satellite-database.html) created by the Union of Concerned Scientists (2015), provides details about the ownership, capacity and function of all known, active satellites. [1] This database suggests that in terms of access and use, the largest proportion (509) of existing orbiting satellites are for the exclusive use of governments and their militaries, while 75 are listed for civil use, 462 are for commercial use and the remaining have mixed ownership/use. This database also shows that the together the US government, US organisations and US companies own more orbiting satellites (514) than any other country.

The primary function of most satellites is communication (including global broadcasting as well as data and voice services), but around 10 percent of satellites use remote sensing technologies for Earth Observation. Different sensor types determine how these technologies create images and what they are able to observe and these include optical, radar and infrared sensors (Johnston, 2013). The approximately 130 currently operational Earth Observation Satellites collect images for diverse purposes including the monitoring of disasters, sea salinity, pollution, soil moisture, climate, polar ice, forest cover, rainfall and coastline changes. They have also been used to manage natural resources, urban development, criminal behavior, crop yields and conflict (Union of Concerned Scientists, 2014). In addition to these known uses of Earth Observation Satellites, information gaps remain around the nature and quality of the data many of these satellites capture, the uses to which the data is put, and the actors operating and funding the satellites. Dual or hidden uses of satellite data (for example, satellites suspected of covertly being used for surveillance or reconnaissance) have likely contributed to the paucity of publicly available data and to the lack of international and national legal requirements that could enforce greater transparency.

In this article we use the term and concept of 'human rights' in keeping with the ways we have experienced it being used in our own work in the human rights sector and by human rights advocates – that is, to refer to concerns about or actions taken to support the basic needs of and justice for all people, but particularly of marginalised and persecuted groups and individuals. These concerns and actions include a focus on summary executions and torture, arbitrary arrest and detention, employment issues, forced evictions, state corruption, access to health care and the impact of toxic waste on the environment. In terms of their value to human rights work, Earth Observation Satellite images have been useful for the collection of evidence for legal and advocacy purposes, the documentation of change for education and public deliberation initiatives, and as tools supporting pre-emptive action for preventing rights violations (Xue, Li, Guang, Zhang and Guo, 2008: 4339; Levinger, 2008: 69).

Our aim in this article is to discuss different uses of Earth Observation Satellites, both within and outside of human rights contexts, in order to identify key opportunities and risks for their ongoing and extended use in supporting human rights. Our article concludes by considering what we can learn from these examples in terms of practical and legal measures that may be required to support equitable and ethical uses of Earth Observation Satellites in human rights contexts. As practice-based researchers who regularly work with the human rights sector and rights advocates,

we hope that this article's findings are accessible to and of practical use to the human rights sector as well as to the researchers and academics that support this sector.

The politics of image mapping

Following the technological developments that followed the launch of Sputnik 1, advanced Earth Observation via satellite commenced in 1972 with the launch of NASA's first Landsat satellite. The US Government opened up access to LANSAT images in 2008 [2] after keeping the images in their exclusive domain for 40 years. The US Government claims that it collected and used LANSAT images solely for environmental reasons. Today, multiple Landsat satellites take around 84 minutes to fully orbit the Earth; they each visually record the entire Earth every 16 days (Time Magazine, 2014).

LANSAT's documentation of Earth connects with a long history of state-controlled mapping. Mapping of the world has historically been driven by desires to secure military dominance, control natural resources, and to assist with taxation and inventory (Crampton, 2003: 138). Thematic mapping, such as geo-profiling, has long been used for crime control as part of a broader trend of using statistical analysis to guide governance. These kinds of purposeful maps were never 'ideologically neutral… rather, in entering the existing power matrix, they replicated dominant positions toward geopolitical realities' (Stahl, 2010: 78). Indeed, such mapping practices followed on, argues Crampton, from 'the positivist conception of science that emerged at the end of the seventeenth century [that] gave epistemological primacy to observable data' that was supposedly objective and value-free (Crampton, 2003: 138). Further, in claiming the objectivity of maps, map commissioners have often effectively legitimised hierarchies of governance and control, targeting certain populations for differential treatment, identification, labeling and surveillance, with some citizens being held above the law, and others bearing its brunt.

Image mapping of the Earth via satellite is no less a discursive or political act (Warf, 2005: 297) since it always begins by foregrounding locations of perceived significance. Decisions made about what will be observed from satellites and how this data is used can be led by powerful discourses that establish 'good', 'bad', 'necessary' and 'justified' actors and activities – discourses which are in turn often determined by local and international political interests. Even when the point is to image the entire Earth, apparently without prejudice, as is ostensibly the case with LANSAT, satellite owners and their clients are still making choices about what image data to clean, analyse, censor, promote and distribute. Examples of politics embedded within satellite image mapping include constructing the myth of 'clean war' by showing bombs as '"fireworks" in the night sky but selectively reducing image resolution so that bodies are never pictured' (Stahl, 2010: 79), or even by taking a 'tree-centric' view when monitoring native vegetation degradation that deliberately obscures or ignores grasses and shrubs (Bartel, 2005: 326). Indeed, a major criticism of the use of satellite images as evidence of crimes or for human rights work (and we will return to this criticism later in this article), is the tendency for images to be treated 'scientifically' and 'managerially' (Perkins and Dodge, 2009: 2), disengaged from complex on-the-ground realities and presented in a way that suggests they are objective truth (Virilio, 1989).

In addition, surveilling particular places and people from above by capturing images also introduces visual politics. According to Michel Foucault, the politics that are always embedded in visual representations of reality can be resisted. Such resistance does not have to be anti-science but, rather, should be 'an insurrection against the centralizing power effects that are bound up with the institutionalization and workings of any scientific discourse organized in a society such as ours' (Foucault, 2003: 9). Supporting Foucault's proposal, Crampton contends: 'The target to be analysed is not science, its methods or techniques, but the rationality which informs it and gives it its truth status' (Crampton, 2003: 141). In this vein, Perkins and Dodge (2009: 1–3) have argued that emerging non-state-led mapping initiatives (which are often online, open and participatory initiatives that frequently make use of satellite images) can be used to chart out social alternatives that undermine inequality and destabilise the practice of mapping as a form of social control by powerful elites. They find that examples of this include efforts to 'reaffirm the rights of indigenous peoples; argue local cases in resource struggles, confront globalization and multi-national power, encourage community involvement in sustainable lifestyles; reassert the role of the past in contemporary contexts; or celebrate the local in an age apparently dominated by uniform and mechanized production and global style' (Perkins and Dodge, 2009: 2–3).

Similarly, a shift in use and users of Earth Observation Satellite technology, paired with the wide distribution of these images via the Internet, has been celebrated by some as the 'democratisation' of this technology (Curtis, Mills and Leitner, 2006: 2; Perkins and Dodge, 2009: 5). However, detracting from the democratic rhetoric surrounding Earth Observation via satellite is the government and military origins of these technologies, which continue to influence their ongoing use. Stahl contends that 'from the beginning, the public reception of 3D satellite imagery was intimately woven into a highly developed military-media complex': televised satellite images allowed news anchors to engage in armchair strategic commentary during the Gulf War in the 1990s and citizen consumers to view the war through the 'gun gaze' as though playing a video game (Stahl, 2010: 67). And although significant numbers of satellites are now not owned by militaries or states, both continue to have significant sway over how and when commercial companies can take or sell certain aerial images for public consumption while they also have and control access to the highest quality images available. For example, in 2001, the US restricted the sale of satellite images of Afghanistan for several weeks after concluding a military operation (Baker and Williamson 2006: 7) and in 1995, during the Bosnian war, the US military delayed releasing satellite images of mass graves to the media to prevent criticism of their inaction in relation to the prevention of the mass murders (Perkins and Dodge 2009: 3).

The use of satellite images to support human rights work

Despite what will likely be perduring political tensions regarding the ethics of different uses of satellite images, the gradual opening up of access to non-state actors has allowed civil society actors – human rights advocates, environmentalists, students, NGOs, artists and other groups with social change aspirations – to circulate satellite images beyond the reach and outside the influence of the state (Perkins and Dodge, 2009: 5; Kaempffer, 2013: 73). This is significant since, as Scott Edwards, project manager of Amnesty International's Satellites for Human Rights initiative states, 'images remain a universally understood language and are one of the most effective instruments to mobilise people worldwide' (cited in Levinger, 2008: 73). Beyond their use as visual campaign tools, Bartel describes how satellite images have 'provided powerful illustrations of the concept that our planet and its resources are finite' (Bartel, 2005: 325). Baker and Williamson (2006: 7) note that the use of satellite imagery as 'eye candy' in news programs can support the public's engagement in news stories they might otherwise have ignored. Finally, satellites images offer important opportunities for the collection of evidence of crimes or abuses. While there have been relatively few legal cases where satellite images have been accepted as legal evidence by courts, there are an increasing number of examples where rights advocates are collecting these images for this potential future use and this collected evidence is at times used to influence policy and political responses (we mention a number of these legal cases that *have* made use of satellite images later in this article).

In terms of the value of satellite images in human rights contexts, some observers have gauged the effectiveness of satellite images for human rights campaign development or as educative tools as 'uncertain at best' since the impact of such images on violence or crime reduction is 'impossible to prove' (Levinger, 2008: 73–74). Others have claimed that the efficacy of even high-resolution images is too limited (Al-doski, 2013: 13) or have questioned their contribution to the timely detection and prevention of human rights violations (Marx and Goward, 2013: 110). These criticisms and

limitations are important to engage with, especially given the costs of acquiring high-resolution images and the limited resources to which most human rights focused organisations and advocates have access.

Certainly the usefulness of satellite images varies according to purpose and the nature of the images collected. [3] While a high-resolution system has limited geographic coverage, a broad coverage system cannot focus in on smaller objects (Johnston, 2013). In terms of their value as evidence, low-resolution images are capable of tracking conflict-indicative events such as fires and large movements of refugees (Al-doski, 2013: 12), as well as land cover changes across continents (Bartel, 2005: 325) and are also useful for providing information on the systematic nature and scale of violence, which is important for building cases for genocide (Marx and Goward, 2013: 108). Freely available satellite images via services like Bing and Google offer low-resolution images; however these images are never timely and are frequently several years old, severely limiting their value. Despite this, even these outdated and free low-quality images have been useful for some kinds of human rights analysis. For example, a UK citizen, Eliot Higgins, began using free satellite images to help verify evidence of illegal arms trading in the Syrian conflict without any backing, formal training or organisational resources (Eliot Higgins 2013; Tactical Technology Collective 2013). Similarly, InfoAmazonia (http://infoamazonia.org/) uses historical and real-time satellite images from different sources (including free and open access services) alongside on-the-ground reports from communities, organisations and journalists, to document and stop illegal forest clearing. [4] Moderate resolution images can detect changes to villages (Marx and Goward 2013: 107), providing evidence of fairly large-scale human rights violations such as identifying mass graves in the Bosnian Herzegovia conflict in 1993 and in Darfur in 2003 (Prins, 2005). High-resolution images, spatial and temporal, can provide insight into rapid changes in near real time, to count refugee tents or examine damage to individual structures (Checci, Stewart, Palmer and Grundy, 2013: 2), determine population dynamics (Hagenlocher, Land and Tiede, 2012: 27), and produce corroborating evidence for eyewitness reports (Marx and Goward 2013, 104). High-resolution images from commercial providers have growing use among the human rights sector. For example, Human Rights Watch (2012, 2014) has used such images to provide evidence of villages being razed in Burma and Syria. The American Association for Advancing Science (AAAS) Geospatial Technologies Project also used these kinds of images to provide evidence that the Sri Lankan army had likely bombed an area after it became an agreed Civilian Safety Zone (AAAS 2009). [5] A high-resolution image usually means that anything greater than 3–10 meters in size can be viewed reasonably clearly. Importantly, access to even higher resolution is set to increase in 2015 following a change to US laws. Previously, companies have not been permitted to provide the public with satellite images with features smaller than 50cm (meaning that any object smaller than this size could not be clearly seen). According to the largest remote sensing commercial image provider, Digital Globe, their new ultra definition satellites will be able to show 'manholes and mailboxes' (cited in Purdy, 2014; Oremus, 2014). While this may enhance the potential for satellite images to further human rights work, access to this kind of image resolution introduces a host of new ethical issues, discussed later in this article.

There are also a host of other ethical issues and frictions related to the new relationships being forged between commercial satellite image providers and human rights focused organisations. One example which elucidates some of these issues and frictions is DigitalGlobe's relationship with the human rights initiative, the Satellite Sentinel Project (SSP). DigitalGlobe's website states that the company is able to collect three million square kilometres of images every day and that its (private, commercial) image library is the largest in the world. [6]While Digital Globe has a commercial focus, it also has a 'philanthropic' program. The majority of the company's resources are only accessible via a user-pays system (with governments comprising its largest clientele base), but Digital Globe is also a key partner in SSP.

SSP was founded by American actor, George Clooney, and former US State Department official, John Prendergast, to track the genocide in Sudan that has claimed more than 400,000 lives since 1989. For the past decade, ethnic black African rebel groups have resisted the Arab government-sponsored apartheid in Darfur. And for the past decade, Sudan's president, Omar Al-Bashir, has used his army and militias to attempt to exterminate black African civilians and rebels. Al-Bashir has been indicted by the International Criminal Court on three counts of genocide. Yet this humanitarian catastrophe continues, virtually unimpeded by international intervention. When Clooney visited Sudan in 2010, he claimed he was surprised that the world should be able to view his own house in LA on Google Earth but not have any way of monitoring the crimes being committed in Sudan. As a result, he instigated the formation of the SSP.

In collaboration with DigitalGlobe, when SSP researchers want to investigate reports of atrocities (impending or ongoing) in Sudan or South Sudan, they direct a satellite to be positioned accordingly so they can carry out timely analysis of what is going on. SSP analyses these images and at times releases them via its website and to the press in order to 'tell the stories that alleged war criminals don't want told' (Satellite Sentinel Project, no date). SSP claims to have located mass graves, documented villages that have been burnt to the ground and captured images that have pre-empted violence, by analysing events like the extension of an existing air strip, the mobilisation of armed forces and the build-up of tanks and artillery.

While the international press has by-and-large hailed the SSP a humanitarian feat, the project has also received criticism from some commentators who have asked if it is ethical for a US company-backed NGO to unilaterally carry out this kind of surveillance of an African country (Tovrov, 2012). While such criticism may be valid, it also overlooks the argument that such action is the prerogative of many international human rights NGOs who claim that immediate action is required – action that states and multilateral institutions are often unable or unwilling to undertake due to their own political and legal interests and constraints. However, initiatives such as SSP are unlikely to be replicated en-masse any time soon in other contexts or by diverse actors such as small NGOs given the high costs involved. While DigitalGlobe subsidises the SSP project by providing images and expert analysts, some of the remaining costs are allegedly covered personally by Clooney, specifically from his Nespresso advert profits (Makershi, 2013). Since the kind of resources and favours Clooney's project receives for addressing rights violations are not available to most human rights NGOs and rights advocates, it is clear that there is an unequal power dynamic at play. In this way, these kinds of celebrity-commercial-NGO relationships can introduce new tensions into human rights work in terms of the types of work, geographies and causes that are prioritised by celebrities and private funders and the new power dynamics introduced by their vested interests. Further, it is not yet clear how valuable the satellite images SSP is collecting will be if the International Criminal Court proceeds with criminal cases relevant to the images being taken. These issues relating to the use of satellite images in human rights contexts – of unequal access, ethical concerns and the veracity of the images as legal evidence – will be considered in the following sections.

Satellite access and power

Since 2011, businesses with a focus on commercial opportunities in space (the so-called 'NewSpace Industry') have mushroomed from 100 to 700 companies. Roughly 70 per cent of these companies are privately held and around 30 per cent are publicly traded (David, 2014). Yet human rights advocates who take issue with the ethical practices of a satellite company – or the companies, governments and military bodies they do business with – do not have many choices if they want to access and use high resolution satellite images of places covered only by a few companies' satellites. This is particularly the case since DigitalGlobe acquired its main competitor, GeoEye, in 2013. If we see satellites as critical global communication infrastructure, this raises questions about whether measures are needed to address and in the future prevent a commercial high-resolution Earth Observation Satellite monopoly.

Without interventions, acquiring the kind of high-resolution data to which SSP has access is likely to remain prohibitively expensive for most human rights advocates and organisations. In a survey of damage from drone attacks in the Federally Administered Tribal Areas (FATA) in Pakistan, Laygo, Gillespie, Rayo and Garcia found that a high-resolution QuickBird 2 image from the commercial provider, GeoEye, providing '0.41m resolution data

in the panchromatic and 1.65 meter data in the multi-spectral' cost US$1200 'for a 10.6km2 area. … [This resolution] allowed a sufficient view of individual structures' but was not high enough to see or count casualties (Laygo, Gillespie, Rayo and Garcia, 2012: 137, 139). They calculated that obtaining weekly imagery from GeoEye of one city in FATA for a year would cost approximately US$64,000 (Laygo, Gillespie, Rayo and Garcia, 2012: 139).

One way to reduce costs associated with satellite Earth Observation is to use moderate resolution sensors (with a spatial resolution of greater than 10 metres) to monitor large areas of land. When there is an indication that a violation has taken place or is imminent, high-resolution imagery can be purchased for in depth analysis (Marx, 2013: 3). Another strategy using relatively more affordable Earth Observation technology is to observe nighttime light variation to monitor conflict (Li, Chen and Chen 2013: 2302). Yet these kinds of measures can miss crucial data, and do not obviate the substantial expense of specialist interpretation requiring specialist experts, hardware and software (Sulik and Edwards, 2013: 2524).

The issue of access also raises concerns about who has and who should have access to close-up images taken by commercial providers. Do we need interventions to ensure this capacity is not open only to those with power, influence or money? Should there be legal and ethical guidelines that define who should have access and the ability to use these images, when, and for what purposes? Who should draft such guidelines? These are important questions given that even satellite images that are supposedly available to 'everyone' reveal an ongoing digital participation gap. For example, after Hurricane Katrina, the 'pattern of placemarks that defined the event signified destruction in wealthier neighborhoods while rendering poorer black neighborhoods silent' (Stahl 2010: 68), which suggests that making something theoretically available to everyone online does not address equity or capacity deficits or underlying exclusions, prejudices and discriminations. We argue that just as addressing the internet's 'digital divide' requires more than public access points, the participation gap in terms of who can effectively use Earth Observation images will similarly require additional support like multi-lingual software, guides and training.

At the same time, not everyone wants all citizens to be able to use satellite images. Some governments are concerned that broader access to satellite images of Earth can challenge national security and sovereignty. For example oil pipelines in Yemen were attacked by protesters based on knowledge acquired through Google Earth (Stahl, 2010: 66); the Chinese government covertly used 'a supposedly benign environmental monitoring project', to access 60cm-resolution images of the entire island of Taiwan (Bloom, 2009); and Tunisian activists used Google Earth to identify the location of images to prove the presidential plane was being used extensively for personal reasons such as European shopping trips (Tactical Technology Collective, 2009). Subversive uses of publically available satellite images prompted the Russian Lieutenant General, Leonid Sazhin, to exclaim in 2005: 'Terrorists don't need to reconnoitre their target. Now an American company [Google] is working for them' (Stahl, 2010: 66). In response to these kinds of concerns, powerful governments have in some instances successfully pressured commercial providers such as Google Earth to withhold image data thought to contain sensitive information and to block other citizens' and other countries' access to various images (Kaempffer, 2013: 74). Regardless of the ethics motivating government concerns, the potential for some governments to deliberately conceal and manipulate particular images, without judicial oversight, undermines the reliability and democratic accessibility of publicly available Earth Observation Satellite images.

In a clear acknowledgment of the value of satellite images in humanitarian efforts and the need to extend access, the United Nations launched their own satellite program (UNOSAT) in 2003. This program provides training, expertise in image analysis and satellite solutions 'to relief and development organisations within and outside the UN system to help make a difference' (UNITAR, 2013). This program has four focuses: the environment, governance, peace and security, and research. However, while the program has carried out some important work and contributed to capacity development, these efforts are implemented within the remit established by and under the influence of member states; this means UNOSAT's impact is arguably limited, particularly when it comes to addressing egregious and highly contested state-committed human rights abuses. The program is also relatively small and it does not offer significant training opportunities to NGOs working on diverse issues.

Several non-government initiatives are trying to ensure Earth Observation Satellite technologies are put in the hands of international and local grassroots human rights advocates. Notably, the American Association for the Advancement of Science (AAAS) has a Geospatial Technologies Project which 'partners with human rights organisations to provide technical assistance in using geospatial technologies to strengthen advocacy campaigns, support legal cases, and enhance response coordination and prevention efforts' (AAAS, 2014a: para 4), and uses of NASA's Landsat satellite images from 1987 to 2013 to document Land Cover and Land Use Change across Bahrain at the request of the Bahrain Center for Human Rights (AAAS, 2014b). AAAS has established ethical guidelines for their work and has documented their approach and techniques in ways that support transparency and can be used to inform future work in this area. Indeed its work provides an important starting point from which to consider how the use of satellites for human rights may be ethically opened up to rights advocates in valuable ways.

Satellite images as legal evidence

Human rights uses of satellite images include collecting evidence not just for advocacy purposes but also for evidence in legal cases, as the previously mentioned Satellite Sentinel Project claims to do. However, there have thus far been relatively few national or international cases where satellite images have been admitted as legal evidence by courts. Barriers to the legal use of such images range from issues of copyright ownership; the lack of certification and verification systems for digital data; judicial mistrust of digital data; a lack of data use policies; interpretation concerns among judges, lawyers and expert witnesses; and conflicting laws including those related to privacy (Purdy and Lueng, 2012; Doldirina, 2012; Wright, 2012; Billet, 2012). Added to these barriers is the potentially problematic persuasive nature of visual evidence in the courtroom. The visual, according to Perkins and Dodge, 'carries very different connotations to the linguistic, and mapping and imagery themselves are read in very specific ways, as icons of fact, standing for disembodied objectivity' (Perkins and Dodge 2009, 4). David Tait (2007) draws on the work of Jennifer Mnookin and Samuel Solomon to probe two common perceptions of visual images used as evidence in courts. The first perception holds that images can be used as tools of logic that aid memory and help map connections. The counter-position views images as tools of persuasion, seduction and deception (Tait, 2007: 312). Tait finds that subscribers to this second view perceive that a danger exists that a satellite image submitted before an international or national-level criminal court as evidence might be given greater credence because of its visual status and the awe-inspiring technology that produced it, despite 'inherent risk that all computer-created images have been '"always already" manipulated' (Buccafusco, 2004: 621).

A related debate concerns the difference between "objectivity" and "neutrality", or the several meanings of "objectivity" that carry varying degrees of honesty and reflexivity. These concerns could be broadly classed into two groups – one dealing with the modernist guise of "scientific objectivity" that disguises power relations and agendas in the taking and use of satellite images, and the other with the "neutrality" of process which guarantees that (as close as possible to) replicable procedures have been carried out in the use or production of specific technologies in order to support the verification of the "authenticity" of the images as evidence. The first concern, in relation to satellite images as legal evidence, would focus on issues of access to images, and power regarding meaning making and acting on readings of those images. The second concern would emphasise the evolution of Earth Observation Satellite technologies which have been driven by technology capabilities alongside military and commercial needs, rather than legal or ethical concerns, resulting in a lack of authenticity certification systems (Purdy and Leung, 2012). This means the veracity of images can always be disputed both in legal and in advocacy contexts. The manipulation of satellite images can occur at a number of stages in the image making process: at the stage of pre-launch satellite calibration, during data collection or digital image processing, during storage and archiving, or at the various points of retrieval and application (Markowitz, 2001: 236). For example, Sweden's government was caught modifying a

Google Earth photograph of its National Security Headquarters by replacing buildings with trees (Stahl, 2010: 66). Satellite signals can also be distorted by those on the ground who are conscious of being observed. In the Australian context, Bartel recounts that land owners were caught '"adding" spurious cover to approximate vegetation' on land on which vegetation had already been removed or degraded (Bartel, 2005: 329). Purdy (2013) cites a similar example of Italian olive growers 'planting cheap umbrellas' to substantiate their claims for EU farm subsidies; these umbrellas appeared to resemble olive trees on (presumably low to medium quality) satellite images. The risk of Earth Observation Satellite images being manipulated after being taken, or of ground conditions being distorted to foil image interpreters, is therefore very real and this complicates the use of such images in legal contexts.

Further, perhaps owing in part to the focus and purpose of the 2002 Open Skies Treaty, the point of which was to promote mutual aerial observation of and by all signatory parties and to provide unrestricted worldwide access to Earth Observation data, there are no definitive rules on the admissibility of satellite images to regional or international courts – much depends on the particular court and case (Nunez, 2012: 2). Satellite images were successfully used in a case before the Inter-American Court of Human Rights, *Saramaka People v Suriname (2007)*, to contribute to the Court's finding that a dam and logging activities on the traditional land of the Saramaka people constituted a breach of their human rights; in a case that went before the International Criminal Tribunal for the Former Yugoslavia (ICTYR), satellite data was used in conjunction with testimonies from survivors of the atrocities committed at Srebrenica to locate mass graves and provide evidence to the court of mass executions (Nunez, 2012: 14). But in other international court cases, courts have expressed a reluctance to rely on expert witness testimonies that were derived from satellite images, with the European Court of Human Rights citing in one instance that it believed the images presented to it were of houses that may have been built to mislead those monitoring conflict in Mogadishu (Nunez, 2012: 15). The lack of uniform guidelines around satellite image evidence admission and interpretation in the international justice system indicates that unless active steps are taken to address existing problems and limitations and to forge a new, discursive sense of the role of visual images in human rights law, such images may be useful in non-legal forms of advocacy but have very limited value in supporting legal justice.

The need for ethical standards

Aside from the issues plaguing the legality and verifiability of satellite images in courts, it is also of concern that no universal or widely agreed ethical standards or rules regarding the use of satellite images exist. The commercial focus of most satellite owners puts them in a dubious position for evaluating and self-monitoring the safe, fair and ethical use of their products. While commercial Earth Observation Satellite providers could argue that they are already bound by some ethical regulatory frameworks if they are signatories (whether voluntarily or by requirement of their national regulatory agencies) to the International Charter for Space and Major Disasters, which provides guidelines for the supply images to aid disaster-relief efforts (ASPRS, 2009), in reality this agreement covers very little in terms of the full spectrum of humanitarian need for the collection of aerial images. And of the approximately 250 requests made each year for images, only 20 per cent or so are provided. The vast majority of those provided over the past decade were produced by a French government-owned satellite (Stryker and Jones, 2009; NESTA, 2014). As Mark Brender, the vice-president of marketing at GeoEye in 2009, stated: 'The agreement is for between two to three scenes for NGOs every year. Outside of that, commercial entities take precedence. …I will happily sell you hi-res pictures of North Korea's missile bases today for $10 per square kilometre' (cited in Bloom, 2009: para 12). Therefore it is important to acknowledge that while commercial providers have a role to play in supplying images to rights advocates, this may not be led by altruistic motivations, may conflict with military agreements, and will always be limited without policy interventions. Given this there have been calls to review the Charter and to examine how it might be updated to ensure companies are pushed to provide timely images that meet humanitarian needs (see NESTA, 2014).

There are also ethical issues relating to the commercial-military relationships that are forged by the buying and selling of satellite images. In 2011, DigitalGlobe stated that around 60 per cent of its income is derived from the US Government and a significant amount of this is likely to come from military operations (Ungerleider, 2011). Jason Gursky, an analyst who covers the defence industry for Citigroup, has stated that the US military will use DigitalGlobe's range of surveillance capabilities to pinpoint targets as they broaden their mission in Iraq against the terrorist group who call themselves Islamic State (Meyer, 2013).

While rights advocates and NGOs might have reservations about buying from a company who is supporting military operations, there are other potential ethical issues related to the questionable or unethical deployment of satellite images taken and used under the banner of 'human rights'. For example, Lisa Parks (2009) has criticised the United States Holocaust Museum and Google Earth's collaboration, 'Crisis in Darfur', as promoting the 'spectacular individual consumption of another "African tragedy" through Western eyes while missing opportunities to provide a context for the conflict (for example, of trade routes, desertification, or the location of contested natural resources)' (cited in Stahl, 2010: 69). While the collaboration did receive popular support and favourable coverage, Parks (2009) and others have claimed that the 'Crisis in Darfur' exhibit was an extension of colonial 'othering', an attempt to lighten the 'white man's burden' in the neocolonial era, while doing little to untangle the complexity of the dynamics of the violence in Darfur in ways that might help to address it.

Another critical ethical issue relating to the use of Earth Observation Satellite images for human rights is that of privacy and security. Purdy (2014) foresees the emergence of serious new privacy concerns under the 2015 change to US law to allow public access to satellite images with features smaller than 50cm. The issue here, he explains, is that 'space treaties [developed between the 1960s and 1980s] are dated and impotent when it comes to governing modern satellites' (Purdy, 2014: para 9). [7] These treaties do not place limitations on access to or the purchase of images and do not account for the operation of satellites by private companies 'untroubled by regulations' (Purdy, 2014: para 10).

Changes to understandings of what constitutes a citizen's right to control privacy comprise part of what Ishay refers to as the rise 'of a more bureaucratized, cyber-controlled society' (Ishay, 2008: 352). The fact that that Earth Observation satellite images are being taken of the Earth and its human population without their permission or participation in decision-making complicates satellite images' utility as a human rights resource. The ethics of satellites observing and the practice of documenting everything and anything also creates friction with a current discourse of suspicion and discomfort which emerges from new public knowledge regarding the widening and deepening of state and corporate surveillance, particularly through the internet and the amassing and aggregation of personal data and metadata. This can mean that taking images from above – even if this is clearly for human rights purposes – can introduce new complexities that may arouse public suspicion, anger and resentment.

Furthermore, for those working in the area of human rights, caring for the vulnerable and maintaining their confidentiality and trust is central. Curtis, Mills and Leitner (2006: 10) have demonstrated that any map that contains geographic coordinate data can be traced back to real addresses. Mapping carried out without adequate precautions may therefore result in the undue exposure of vulnerable populations. These concerns about visibility are warranted; satellites 'routinely' map backyards and military satellites, writes Bartel, and they can '"see" in resolutions of centimetres' (Bartel, 2005: 329). However, from both a legal and ethical perspective rights exist in hierarchies and some trump others depending on the crisis at hand. As Crampton observes, 'opposing surveillance by appealing to civil liberties is problematic because the latter are easily constructed in different ways. … Rights are always partial and limited' (Crampton, 2003: 145). In any case, as von der Dunk (2014) details, the outdated, vague and currently limited 2002 Outer Space Treaty fails to address privacy issues, thereby relegating privacy to the domain of national rather than international law as far as space-generated data is concerned. Consequently, privacy rights in respect to space satellite data collection are likely to be weak and contestable and vary considerably from country to country.

In addition, to return to our earlier point about the way images can be treated 'managerially' in a manner that removes them from context, we need to ask if satellite images might problematically displace or replace other forms of human rights evidence. In *Infoglut*, Mark Andrejevic (2013) outlines the way that emerging attempts to 'make sense of more data than can be fully understood or absorbed' can result in 'solutions' that 'bypass or short-circuit' other forms of discursive, narrative representation and interpretation (Andrejevic, 2013: 4). While Andrejevic's analysis is focused on critiquing the value of big data, particularly personal data collected via the internet, applying this same reasoning to satellite images means that we need to consider what happens, for example, to on-the-ground personal testimony when no satellite images are available to back-up claims made; or what happens to on-the-ground collected evidence if this is contradicted by supposedly 'objective' satellite images. In this way 'the shifting information environment has important consequences for questions of power and politics', especially when 'few have access to the infrastructure for storing and making sense of large amounts of data' (Andrejevic, 2013: 4). To address this we may need to consider how satellite images can be supported by 'thick data' which values on-the-ground stories and experience and 'reveals the social context of and connections between data points' (Wang, 2013: para 6). One example here of good practice is the aforementioned InfoAmazonia, which has pioneered the use of satellite data for reporting, but in doing so has also made the decision to add observations from the ground from local NGOs and communities. Gustavo Faleiros, who founded the site, explains: 'Satellites do see a lot of things, but they do not tell you the reasons why an area of forest has been cleared. …[Is it] now being used for cattle ranching or mining? You can guess based on your experience, but the real story, the characters involved, the human dimension will emerge from the ground reporting' (IJNet, 2014: para 5). Thus we can see how ethical guidelines and practices can be used to ensure context is considered and images are not presented as objective truth but instead are seen as one part of a complex picture that includes the local voices and experiences of vulnerable and exploited populations.

There are also ecological ethical concerns relating to the use of satellites. While a full discussion of this issue is beyond the scope of this article, it is worth noting that decades of satellite launches have resulted in tens of thousands of trackable pieces of 'space junk' orbiting our planet (as well as millions of pieces too small to track), 'posing a collision risk for further ventures' and environmentally polluting space at a time when many are professing its significance to our future (Watson, 2011). Trevor Paglan's artwork series,* Debris*, features photographs of the human-made debris, garbage, and flotsam in Earth's orbit, while his work,* The Last Pictures *http://paglen.com/lastpictures/, raises broader questions about what we are leaving in space for future generations and what these artefacts will reveal – or obscure – about us. While the future consequences of a growing body of space junk are unknown, it is clear the space industry is not being forced to minimise its footprint in space through appropriate regulation, nor is it required to pay any of the future costs likely to be associated with removing this junk from space.

One solution to push forward ethical uses of satellite images may be to require organisations, businesses, governments and individuals to undergo licensing or accreditation from an independent world governance body before being allowed to take or purchase images – at least for images being taken for use as legal evidence. However, this kind of regulation could easily work against human rights organisations that may need to act quickly to address issues in a timely way and covertly for security and safety reasons, and it may lead to powerful actors preventing others from accessing images. A more informal possibility that could be used to address the problems preventing effective use of satellite images in human rights contexts we have outlined in this article would be for NGOs, human rights advocates and relevant companies to agree to a charter that focuses on ethical guidelines and practices. In any case, we argue that at the very least a discussion among human rights organisations, legal experts and the broader public is required to better understand different ethical concerns and expectations and to consider ways these might be appropriately addressed.

Conclusion: Supporting equitable and ethical use of Earth Observation Satellite images in human rights contexts

Earth Observation via satellite is a fast-growing practice urgently in need of public deliberation, oversight and regulation. We have not yet seen the potential for satellite images to be used in human rights contexts fully realised, largely because of the cost and capabilities required to do this and the limited resources of most human rights NGOs. However, in the absence of either transparency requirements about satellite use to assist public understanding of what satellites observe, or of any universal or even widely accepted ethical guidelines for use, it is also difficult to fully evaluate the capacity of this technology for contributing to the advancement of human rights. What is clear from examining recent examples and some current practices and uses in the area of human rights is that a number of measures are required to support the equitable, ethical and reliable use of Earth Observation Satellite images in human rights contexts.

First, those seeking to use Earth Observation Satellite images for human and environmental rights and advocacy purposes need more open and equitable access to high quality images. Currently, commercial copyright agreements and influential governments are determining who is able to access images. This limits the potential for equitable and fair use of Earth Observation satellite images.

Second, human rights advocates and organisations need to be able to access knowledge and training to more broadly develop their capacity to effectively make use of Earth Observation images in their work. Collecting, analysing, cleaning and verifying satellite images requires expensive and specialist support. It is important that human rights' advocates and organisations have the ability to access this support or, where possible, to gain sufficient knowledge to carry out this work themselves.

Third, there is a complete lack of transparency in terms of knowing how satellite images are being used and by whom. While we know that commercial interests are driving investments into Earth Observation Satellites, there is a dearth of information about who is buying images, for what purposes, and when. Greater transparency from governments and the commercial sector are necessary if there is to be any real opportunity for human rights actors to be permitted to scrutinise and make use of the Earth Observation already being carried out by satellites. Having said this, the current lack of transparency and regulation may work to the advantage of and provide new opportunities for NGOs who are often denied on-the-ground access to people and locations by states or corporations, thus preventing their ability to adequately monitor and document human rights violations.

Fourth, there remain substantial issues relating to privacy rights and the law that must be addressed at a global level. The battle over citizens' privacy rights in relation to their personal internet and phone metadata is currently waged in many states where governments are in the process of introducing legislation which would permit states increased access to copious archives of metadata to investigate not only their own citizens but international actors too. The rights of states to access and use personal metadata have at times been tempered by national laws or international agreements, such as those made through the European Union. The issue of how citizens or organisations might best protect their own right to privacy by preventing secret satellite surveillance from above and safeguard their right to know when this has happened is even more complicated. What is clear is that without international agreements, we will have a constant 'cat and mouse' game where satellite providers simply move satellites, company bases and data storage in order to evade stricter privacy laws. Added to this legal privacy rights issue, verification and authenticity mechanisms are required to prevent falsified images from circulating in the public domain or genuine images from being denounced as false by human rights violators.

Fifth, ethical guidelines need to be established so as to set out the appropriate purposes and processes for using Earth Observation Satellites. This needs to be done at a global level for those operating and purchasing satellite images but could also be achieved on a smaller scale and more informally by those wanting to align themselves with human rights values and practices.

Without these advancements, many human rights advocates will continue to be excluded from taking advantage of these images while others may be forced into the position of using practices or commercial providers that may be involved in supporting, inadvertently or otherwise, rights violations and in undermining their otherwise important contributions to human rights.

Biography

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References

- American Association for the Advancement of Science (AAAS). 'High-Resolution Satellite Imagery and the Conflict in Sri Lanka' (2009), http://www.aaas.org/geotech/sri_lanka_2009
- American Association for the Advancement of Science (AAAS). 'Geospatial Technologies and Human Rights' (2014a), http://www.aaas.org/page/geospatial-technologies-and-human-rights
- American Association for the Advancement of Science (AAAS). 'Case Studies: 'Geospatial Technologies and Human Rights' (2014b), http://www.aaas.org/case-studies
- Al-doski, Jwan, Shattri Mansor, Helmi Zulhaidi and Mohd Shafri. 'War Impacts Studies Using Remote Sensing', *IOSR Journal of Applied Geology and Geophysics* 1.2 (July-August, 2013): 11–15.
- Andrejevic, Mark. *Infoglut: How Too Much Information Is Changing the Way We Think and Know* (New York: Routledge, 2013).
- Baker, John and Ray Williamson. 'Satellite Imagery Activism: Sharpening the Focus on Tropical Deforestation', *Singapore Journal of Tropical Geography* 27 (2006): 4–14.
- Bartel, Robyn. 'When the Heavenly Gaze Criminalises: Satellite Surveillance, Land Clearance Regulation and the Human-Nature Relationship', *Current Issues in Criminal Justice* 16.3 (2005): 322–339.
- Billet, Carole. 'Satellite Images as Evidence for Environmental Crime in Europe: A Judge's Perspective', in Ray Purdy and Denise Leung (eds.) *Evidence from Earth Observation Satellites: Emerging Legal Issues* (Leiden, NLD: Brill Academic Publishers, 2012): 321–355.
- Bloom, James. 'Way Up There – And Personal', *The Guardian*, 28 January (2009), http://www.theguardian.com/technology/2009/jan/28/satellite-photography-privacy
- Buccafusco, Christopher. 'Gaining/Losing Perspective on the Law, or Keeping Visual Evidence in Perspective', *University of Miami Law Review* 58 (2004): 609–652.
- Checci, Francesco, Barclay Stewart, Jennifer Palmer and Chris Grundy. 'Validity and Feasibility of a Satellite Imagery-based Method for Rapid Estimation of Displaced Populations', *International Journal of Health Geographics* 12.4 (2013): 1–12.
- Crampton, Jeremy. 'Cartographic Rationality and the Politics of Geosurveillance and Security', *Cartography and Geographic Information Science* 30.2 (2003): 135–148.
- Curtis, Andrew, Jacqueline Mills and Michael Leitner. 'Spatial Confidentiality and GIS: Re-engineering Mortality Locations from Published Maps About Hurricane Katrina', *International Journal of Health Geographics* 5.44 (2006): 1–12.
- David, Richard. 'The Final Investing Frontier'. *The Fiscal Times*, 25 August (2014), http://www.thefiscaltimes.com/Articles/2014/08/25/Space-Final-Investing-Frontier#sthash.TfrwkM7I.dpuf
- Doldirina, Catherine. 'The Impact of Copyright Protection and Public Sector Information Regulations on the Availability of Remote Sensing Data', in Ray Purdy and Denise Leung (eds.) *Evidence from Earth Observation Satellites: Emerging Legal Issues.* (Leiden, NLD: Brill Academic Publishers, 2012): 293–310.
- Foucault, Michel. *Society Must Be Defended*. (New York: Picador, 2003).
- Hagenlocher, Michael, Stefan Lang and Dirk Tiede. 'Integrated Assessment of the Environmental Impact of an IDP Camp in Sudan Based on Very High Resolution Multi-temporal Satellite Imagery', *Remote Sensing of Environment* 126 (2012): 27–38.
- Higgins, Eliot. 'A Beginner's Guide to Geolocating Videos', in *Evidence and Influence Micromagazine*: Tactical Technology Collective (2013), https://micromag.evidenceandinfluence.org/article/a-beginners-guide-to-geolocating-videos/
- Human Rights Watch. 'Syria: Thousands of Houses Unlawfully Razed.' 30 Jan (2014), http://www.hrw.org/news/2014/01/30/syria-thousands-houses-unlawfully-razed
- Human Rights Watch. 'Burma: Satellite Images Show Widespread Attacks on Rohingya'. 17 November (2012), http://www.hrw.org/news/2012/11/17/burma-satellite-images-show-widespread-attacks-rohingya
- IJNet. 'Data Journalism Site InfoAmazonia Will Add Ground Reporting to Its Environmental Coverage. *International Journalists Network* (2014), http://ijnet.org/blog/data-journalism-site-infoamazonia-will-add-ground-reporting-its-environmental-coverage#sthash.8fXjNDfH.dpuf
- Ishay, Micheline. *The History of Human Rights: from Ancient Times to the Globalization Era* (2nd ed.) (Berkeley: University of California Press, 2008).
- Johnston, Shaida. 'Technical Introduction to Satellite EO', in Ray Purdy and Denise Leung (eds.), *Evidence from Earth Observation Satellites: Emerging Legal Issues,* (Leiden, NLD: Brill Academic Publishers, 2012), 11–43.
- Kaempffer, Nicholas. 'Bullets, Bombs, and Ice Cream: The Unintended Consequences of Google Earth's New Cartographic World: Observations with Respect to Insurgent Surveillance Target Acquisition', *Canadian Military Journal* 13.3 (2013): 71–75.
- Laygo, Katrina, Thomas Gillespie, Noel Rayo and Erin Garcia. 'Drone Bombings in the Federally Administered Tribal Areas: Public Remote Sensing Applications for Security Monitoring', *Journal of Geographic Information System* 4 (2012): 136–141.
- Levinger, Matthew. 'Geographical Information Systems Technology as a Tool for Genocide Prevention: The Case of Darfur', *Space and Polity* 13.1 (2008): 69–76.
- Li, Xi, Fengrui Chen and Xiaoling Chen. 'Satellite-Observed Nighttime Light Variation as Evidence for Global Armed Conflicts', *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing* 6.5 (October, 2013): 2302–2315.
- Makarechi, Kia. 'George Clooney Spends Nespresso Paycheck on Spy Satellite to Keep Tabs on Omar Al-Bashir', *The Huffington Post*, 21 July (2013): http://www.huffingtonpost.com/2013/07/31/george-clooney-nespresso-spy-sattelite_n_3681937.html
- Markowitz, Kenneth. 'Legal Challenges and Market Rewards to the Use and Acceptance of Remote Sensing and Digital Information as Evidence', *Duke Environmental Law and Policy Forum* 12 (2001): 219–264.

- Marx, Andrew. 'A New Approach to Detecting Mass Human Rights Violations Using Satellite Imagery', *United States Holocaust Memorial Museum* (2013), http://www.ushmm.org/confront-genocide/preventing-genocide-blog/genocide-prevention-blog/detecting-human-rights-violations.
- Marx, Andrew and Samuel Goward. 'Remote Sensing in Human Rights and International Humanitarian Law Monitoring: Concepts and Methods', *The Geographical Review* 103.1 (2013): 100–111.
- Nesta. 'An International Right to Images from Space' (no date), http://www.nesta.org.uk/international-right-images-space
- Notley, Tanya and Stephanie Hankey.'Human Rights Defenders and the Right to Digital Privacy and Security', *Human Rights and Information Communication Technologies: Trends and Consequences of Use* (Hershey, PA: IGI Global, 2013),.
- Nunez, Ana Cristina. 'Admissibility of Remote Sensing Evidence Before International and Regional Tribunals', *Innovations in Human Rights Working Paper for Amnesty International* August (2012), http://www.amnestyusa.org/pdfs/RemoteSensingAsEvidencePaper.pdf.
- Oremus, Will. 'The First Images From the World's Most Powerful Commercial Satellite', *Slate*, 29 August (2014), http://www.slate.com/blogs/future_tense/2014/08/29/digitalglobe_worldview_3_sharpest_ever_commercial_satellite_images_show.html
- Parks, Lisa. 'Digging into Google Earth: An Analysis of "Crisis in Darfur"', *Geoforum* 40.4 (2009): 535–545.
- Perkins, Chris and Martin Dodge. 'Satellite Imagery and the Spectacle of Secret Places', *Geoforum* (2009): 1–15.
- Prins, Erik. 'Use of Satellite Imagery to Document Human Rights Abuses and Humanitarian Disasters: Possibilities, Potentials and Putting It into Action. A Report conducted for Amnesty International Danish Section (draft)' (2005), http://www.prinsengineering.com/Remote%20sensing%20draft2_2005.pdf
- Purdy, Ray. 'Ruling on Sharper Satellite Images Poses a Privacy Problem We Can No Longer Ignore',* The Conversation*, 18 June (2014), http://theconversation.com/ruling-on-sharper-satellite-images-poses-a-privacy-problem-we-can-no-longer-ignore–28133
- Purdy, Ray. 'George Clooney isn't the only one with an eye in the sky', *The Conversation*, 2 September (2013), http://theconversation.com/george-clooney-isnt-the-only-one-with-an-eye-in-the-sky–17670
- Purdy, Ray and Denise Leung. 'Introduction', in Ray Purdy and Denise Leung (eds.) *Evidence from Earth Observation Satellites: Emerging Legal Issues.* (Leiden, NLD: Brill Academic Publishers, 2012): 1–10.
- Satellite Sentinel Project. 'Our Story' (no date), http://www.satsentinel.org/our-story
- Siddiqi, Asif. *Sputnik and the Soviet Space Challenge* (Gainesville, Florida: The University of Florida Press, 2003).
- Stahl, Roger. 'Becoming Bombs: 3D Animated Satellite Imagery and the Weaponization of the Civic Eye', *MediaTrobes* 2 (2010): 65–93.
- Stryker, Timothy and Brenda Jones. 'Disaster Response and the International Charter Program', Photogrammetric Engineering and Remote Sensing Journal of the American Society for Photogrammetry and Remote Sensing 72.12 (December 2009),
- http://asprs.org/a/publications/pers/2009journal/december/highlight.pdf
- Sulik, John and Scott Edwards. 'Feature Extraction for Darfur: Geospatial Applications in the Documentation of Human Rights Abuses', *International Journal of Remote Sensing* 31.10 (2013): 2521–2533.
- Tactical Technology Collective. 'From My Point of View', in *Exposing the Invisible* (2013), https://exposingtheinvisible.org/
- Tactical Technology Collective, 'Reveal the Truth' in *10 Tactics for Turning Information into Action*, (Bangalore: Tactical Technology Collective, 2009), https://archive.informationactivism.org/en/viewtactic10v2
- Tait, David. 'Rethinking the Role of the Image in Justice: Visual Evidence and Science in the Trial Process', *Law, Probability and Risk*6.1–4 (2007): 311–18.
- Time Magazine. 'Time and Space', (2014) http://world.time.com/timelapse/
- Tovrov, Daniel. 'George Clooney And The New Ethics Of Satellite Surveillance', *International Business Times*, 16 March (2012),
- http://www.ibtimes.com/george-clooney-new-ethics-satellite-surveillance–214303
- United Nations. *United Nations Treaties and Principles on Outer Space*. New York (2002): http://www.unoosa.org/pdf/publications/STSPACE11E.pdf
- Ungerleider, Neal. 'Google Earth, Foreign Wars, and the Future of Satellite Imagery', *Fast Company*, 29 November (2011): http://www.fastcompany.com/1797768/google-Earth-foreign-wars-and-future-satellite-imagery
- Union of Concerned Scientists. *USC Satellite Database* (last updated 31 July 2014), http://www.ucsusa.org/nuclear_weapons_and_global_security/solutions/space-weapons/ucs-satellite-database.html#.VQdlC2SUdVp
- Union of Concerned Scientists. *USC Satellite Database* (last updated 11 March 2015), Union of Concerned Scientists, http://www.ucsusa.org/nuclear_weapons_and_global_security/solutions/space-weapons/ucs-satellite-database.html#.VQdlC2SUdVp
- Virilio, Paul. *War and Cinema: The Logistics of Perception*, trans. Patrick Camiller (London; New York: Verso, 1989).
- Von der dunk, Frans. 'Outer Space Law Principles and Privacy', in Ray Purdy and Denise Leung (eds.) *Evidence from Earth Observation Satellites: Emerging Legal Issues.* (Leiden, NLD: Brill Academic Publishers, 2012): 241–258.
- Wang, Zuoyue. *In Sputnik's Shadow: The President's Science Advisory Committee and Cold War America* (United States: Rutgers University Press, 2009).
- Wang, Tricia. 'Big Data Needs Thick Data', *Ethnography Matters*, 13 May (2013), http://ethnographymatters.net/blog/2013/05/13/big-data-needs-thick-data/
- Warf, Barney. 'Review: The Political Mapping of Cyberspace by Jeremy W. Crampton', *Geographical Review* 95.2 (April 2005): 296–298.
- Watson, Fred. 'Space Junk and the Environment: it's a Very dark Picture Indeed', *The Conversation*, 6 July (2011), http://theconversation.com/space-junk-and-the-environment-its-a-very-dark-picture-indeed–2187
- Wright, Meredith. 'The Use of Remote Sensing Evidence at Trial in the United States—One State Court Judge's Observations', in Ray Purdy and Denise Leung (eds.) *Evidence from Earth Observation Satellites: Emerging Legal Issues.* (Leiden, NLD: Brill Academic Publishers, 2012): 311–320
- Xue, Yong, Yingjie Li, Jie Guang, Xiaoye Zhang and Jianping Guo. 'Small Satellite Remote Sensing and Applications: History, Current and Future', *International Journal of Remote Sensing* 29.15 (2008): 4339–4372.

Notes

[1] This was the most comprehensive and up-to-date database of functioning satellites that we were able to find in our research. The database is completely derived from online sources including news reports (all of which are listed in the database). The database therefore is likely to be incomplete, not accounting for additional secret military satellites in orbit.

[2] LANSAT images can be viewed here http://landsatlook.usgs.gov/

[3] The secrecy and prevalence of military satellites, but also more broadly the materiality and space junk caused by all satellites, is rendered visible by Trevor Paglan's artwork series, *The Other Night Sky*, where he uses the online data of amateur satellite watchers to track and photograph classified American spacecraft in Earth's orbit.

[4] Higgins has now established a website to help 'citizen journalists'. It provides step-by-step instruction on how to use satellite images to collect and corroborate evidence.

[5] These high quality images are generally provided by two commercial companies: GeoEye or Digital Globe, although GeoEye was acquired by Digital Globe in 2013.

[6] See: https://www.digitalglobe.com/products/data/satellite-tasking

[7] These treaties, and corresponding principles, have been brought together in the following document: ‘United Nations Treaties and Principles on Outer Space’ (http://www.unoosa.org/pdf/publications/STSPACE11E.pdf).

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