Production of Semi Real Time Media-GIS Contents using MODIS Imagery

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Keywords: Media-GIS, MODIS, Semi real time, spatial data visualization, Mobile contents

Abstract:
Delivering environmental disaster information, *swiftly*, *attractively*, *meaningfully*, and *accurately*, to public is becoming a competitive task among spatial data visualizing experts. Basically, the data visualization process has to follow basics of spatial data visualization to maintain the academic quality and the spatial accuracy of the content. Here, “Media-GIS”, can be promoted as a one of the latest sub-forms of GIS, which targets mass media. Under Media-GIS, “Present” or the fist component of three roles of data visualization takes the major workload compare to other two, “Analysis” and “Explore”. When present contents, optimizing the main graphical variables like, *size, value, texture, hue, orientation,* and *shape*, is vital with regard to the target market (age group, social group) and the medium (print, TV, WEB, mobile). This study emphasizes on application of freely available MODIS true colour images to produce *near real time* contents on environmental disasters, while minimizing the production cost. With the brake of first news of a significant environmental disaster, relevant MODIS (250m) images can be extracted in GeoTIFF and KLM (Keyhole Markup Language) formats from MODIS website. This original KML file can be overlayed on Google Earth, to collect more spatial information of the disaster site. Then, in ArcGIS environment, GeoTIFF file can be transferred into Photoshop for production of the graphics of the target spot. This media-friendly Photoshop file can be used as an independent content without geo-references or imported into ArcGIS to convert into KLM format, which has geo-references. The KLM file, which is graphically enhanced content with extra information on environmental disaster, can be used in TV and WEB through Google Earth. Also, sub productions can be directed into print and mobile contents. If the data processing can be automated, system will be able to produce media contents in a faster manner. A case study on the recent undersea oil spill occurred in Gulf of Mexico included in the report to highlight main aspects discussed in the methodology.

1. Introduction

The word “Media” became a popular term among global community, with increased activities of media as a propaganda tool and business in last century. Media (the plural of "medium") is the truncation of the term "media of communication," referring to those organized means of dissemination of facts, opinions, entertainment and other information, through media such as newspapers, magazines, outdoor advertising, film, radio, television, the World Wide Web, books, CDs, DVDs, videocassettes, computer games, and other forms of publishing (newworldencyclopedia, 2008). The rapid improvements in these electronic and print media fields have boosted a tremendous development in online and broadband Internet access with more than one billion users in U.S. and international markets by late 2005 (Microsoft Co. 2007). In this environment, media reports related to natural disasters are also have to adjust for the demand, since most of such incidents are directly linked to security of human society. Apart from that, the sympathy on victims of environmental disasters has forced media to pay a bigger attention on those incidents. The victims of disasters like; earthquakes, hurricanes and tsunamis are perceived as 100% blameless, while the victims of wars do not enjoy such absolute status (Stroehlein A., 2010). However, the missing component in these environmental disaster contents is the *lack or very limited use of location based images and maps* (Perera and Tateishi, 2007). Few samples from recent web-based environmental disaster reports (Thompson Reuters Foundation – AlertNet, 2010) are presented in the table 1, which shows this acute shortage of map or image information.

Table 1. A sample from recent media reports on natural disasters.

Date/ Country	Location and the nature of the disaster/damage reported in the Reuters news item	Map/ Image
05/03/2010 **Vietnam**	The Mekong Delta is facing a serious drought. The Red River, which helps millions of Vietnamese in the north, is at its lowest in last 100 years.	No
04/04/2010 **Uganda**	The landslide from heavy downpour and floods has been killed 55 people while 300 are still missing in Bududa District, some 275km northeast of Kampala.	No
03/04/2010 **France**	"Entire pieces of land are covered by seawater and now unworkable," in coastal town of L'Aiguillon-sur-Mer, in the hardest hit area of western France by flood.	No
03/04/2010 **Indonesia**	Landslide in Bandung district in West Java province on 23 February buried more than 40 people and displaced about 1,000.	No
22/03/2010 **Portugal**	The number of people missing after floods hit the resort island of Madeira has jumped to 32, while the official death toll is 42.	No

Source: Thompson Reuters Foundation – AlertNet 2010 Feb-March, http://www.alertnet.org/

News items in Table 1 are directly link to specific locations of the world, but none of the content contained any map or image to show the disaster site. Specially, news about environmental disasters needs a map or an image to show the on the location of the incident. From the other hand, when news travels around the world within few seconds through high speed broadband network, it's beneficial for readers to have some information about the news location, as those places are often far away from the readers. The present study is proposing a method based on MODIS daily images to produce media-GIS contents for natural disasters with paying attention to basics in GIS and spatial data visualization.

2. Linking GIS and graphics with media contents

In order to build a successful link between disaster news and location based maps and images, GIS (Geographic information systems) can be extensively used. A GIS is a computer-based system to aid in the collection or capture, maintain, store, analysis, and distribution of spatial data and associate attributes (Bolasted, 2008; Nationmaster.com 2010). In application, GIS is the technology, which can be used for scientific investigations, resource management, and development planning. For example, a GIS might allow emergency planners to easily calculate emergency response times in the event of a natural disaster, or a GIS might be used to find wetlands that need protection from pollution (USGS Geography Publications, 2008). The present study focuses application of GIS for media content, while promoting this sub-division of GIS, "media-GIS".

The power of a GIS comes from the ability to relate different information in a spatial context and to reach a conclusion about this relationship (USGS Geography Publications, 2008). Obviously, all natural disaster incidents contain this location reference character. When a flood disaster occurred, it is important to know where the extreme rainfall was recorded and directions of flood flow. If it's a volcano eruption, we search the exact location and the extent of the surface damage. However, as Table 1 presented, most of these environmental disasters based news are reaching to the customers without locational information in *visual form*. The degree of involvement of these graphical contents in the environmental disaster contents clearly increases the commercial and information value of the news item. Figure 01 simplified this relationship under three cases, i.e., extensive, partial, and non-existence of location based graphic contents.

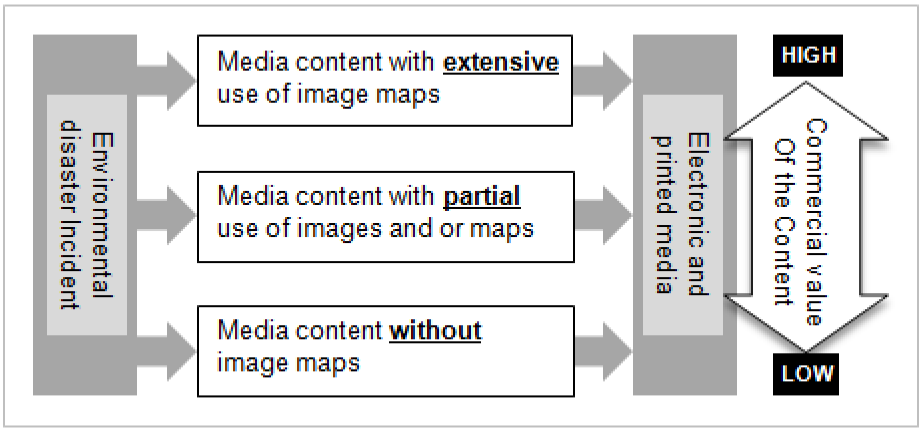

Figure 01. The value of environmental disaster content changes according to the involvements of image maps in contents.

Even though it's a sub-division of GIS, media-GIS contains number of basic GIS components as describes in figure 02. If we isolated single media-GIS content, it starts with the brake of environmental disaster news. As the production flow explains (figure 02), content maker should search relevant data, collect data including archived information related to the incident. Production of the content and relay it to the customer or viewer through appropriate media platforms ends the process. To maximize the commercial and graphical value, this production process must maintain number of standards (discussed in following sections and in methodology in figure 4).

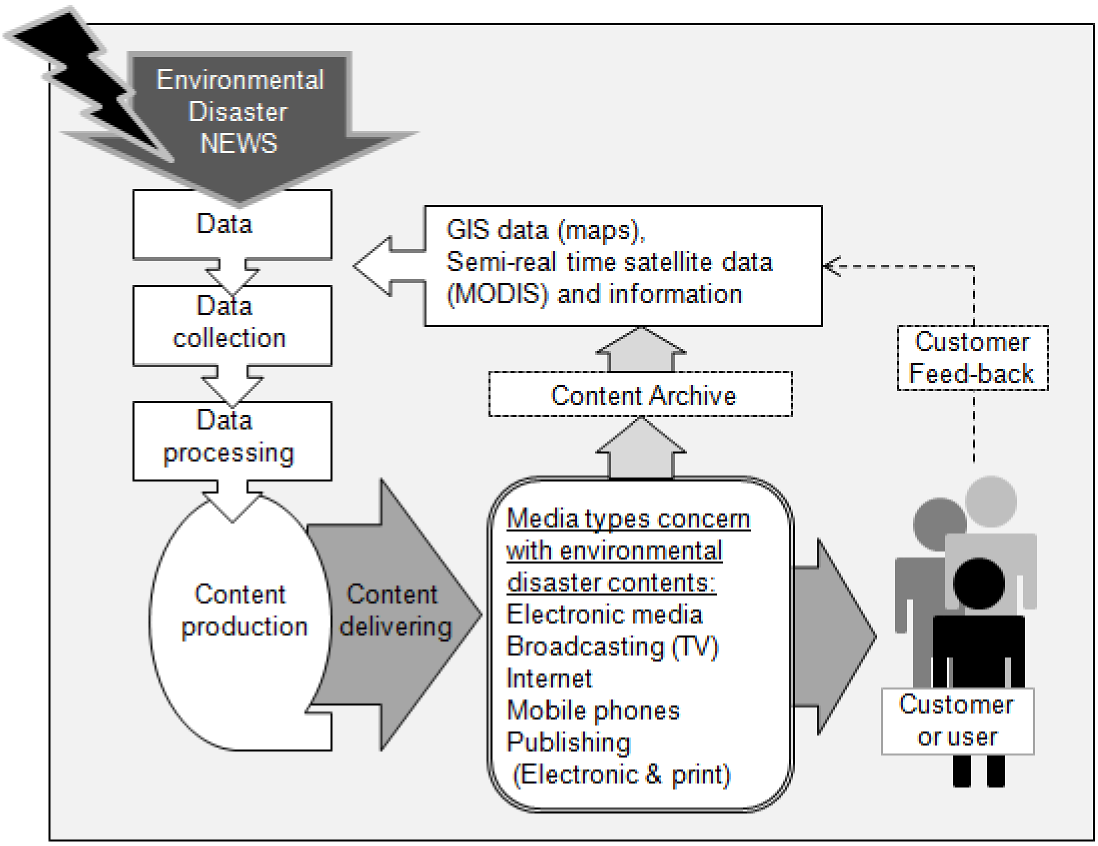

Figure 02. The simplified production flow of media-GIS contents

3. Media-GIS contents

Media-GIS can be defined as a computer-based system that explore, collect, maintain, store, analyze, and distribute, *graphic contents* of *environmental disasters and other significant incidents* with spatial attribute to electronic and print media, with a *high esthetic quality*. The ultimate goal is to enrich the user knowledge with geospatial information of the incident and increase the awareness of the disaster, while improving the quality and profits of media business. Under this context, media-GIS content production has to focus on maximizing five basic qualities or standards (Perera and Tateishi, 2008). Some of these facts have mentioned in Microsoft document too with regard to new developments in media contents in Internet (Microsoft Co. 2007). Content maker should have a basic knowledge and skill in; GIS, remote sensing data handling, and graphic production, to pay the correct attention to following aspects or media-contents.

1. Accuracy
2. High esthetic quality
3. Speed
4. Low cost
5. Reusability

3.1. Accuracy

Since contents bringing first hand information to public, the *geographical* and *informative* accuracy must be maintained at a high level. It's easy to maintain a substantial accuracy of the product, when the GIS database is registered with a base map, which can be linked to MODIS image products (the major data source emphasized in this study). Geographical accuracy is very important, when data layers merge and also to use the content in future through the archive. If the content is paying bigger attention on informative accuracy, geographic registration may get a lesser importance.

3.2. High esthetic quality

The use of colors (hue), fonts (size and color), and symbols must be carefully selected to meet the technical requirements of the respective media, and target viewers including age groups. Graphics should not hinder the original information of the image. Font sizes must be large enough to read easily, and priorities of words in the graphic must be carefully balanced to maintain the informative and visual quality. For web media, graphics must have smaller file size (JPG/GIF file formats) to support fast download of the content. For TV media, full color heavy TIF graphic products can be created, but easy to read and less complicated graphics must be the produced. The content producer has to study new technological developments in graphic production fields, regularly. Specially, web based data visualization and presenting methods are facing a very radical development always (Friedman V., 2007; Ostrow, A., 2007).

3.3. Speed

Speed can be maximized at three different levels;

1. *Data mining, downloading, and converting* into GIS database. Faster internet connection as well as knowledge in relevant data sources are considered here.
2. *Graphic production process,* in ArcGIS, Photoshop, and Google Earth environments. Here, skills and experience in Photoshop as well as basic knowledge in other software packages helps to increase the production speed.

3. Media content itself must have the correct file size (in kilobyte) and file format (jpg, GIF) to enhance the *speed of data mobility* in respective media portal.

3.4. Low cost

Free availability of MODIS satellite data is the major advantage for environmental content production. Initial cost for ArcGIS will be a significant limitation, its worth to explore the applicability of other software packages. Google Earth functions are freely available through Internet and Initial cost for Photoshop is relatively low; the older CS version is between US$350 to US$650 over the Internet. Older versions are much cheaper and strong enough to produce excellent graphics.

3.5. Reusability

All media-GIS contents must be systematically archived for future use. Here, final content as well as interim products can be archived by topic, date, and by geographic region. Some end products can be used without any additional change, to display historic conditions and comparison presentations. A proper archive system including customer feedback (see figure 02) will directly contribute to lower the overall production cost and increase the quality of contents.

4. Image maps

Image maps, the prime products in media-GIS, are geometrically registered satellite images or aerial photographs, which have no or minimal distortions. Image maps are extensively use in various entities, from private GIS users, academics, to extensive users like NASA to; *present, and explore* land surface information in details (Short, 2010; Sultan et al, 2008). Hence, image maps can be easily included into a GIS system to be analyzed further or, present as a graphic content. Systematic production of image maps is coming under geographic data visualization. In geographic data visualization, there are three major objectives, i.e., *data presenting, data analyzing,* and *data exploring* (Kraak, 1999). Graphic contents of media-GIS too have to fulfill at least one of these objectives, to become successful products. While a bulk of media-GIS graphic contents may present information, some of them may analyze the incident related information further. However, throughout all these steps, optimizing the main graphical variables like, *size, value, texture, hue, orientation,* and *shape*, is vital. Especially, size, hue (colour) and shape of the graphic elements are critical for the target media market. Under the case study section, the *presentation* aspect will be discussed with multi-temporal images as the GIS component.

5. Data and Methodology

5. 1. MODIS data

After MODIS (MODerate-resolution Imaging Spectrometer) data became available (Barnes et al., 2003) scientific community has successfully conducted a large number of application studies on earth surface and atmosphere. (Friedl et al., 2002; Hall et al., 2003; Zhan et al., 2002). Today, these MODIS data products such as MODIS NDVI (MODIS WEB, 2010; Perera and Tsuchiya, 2009; USGS, 2007) and true color image data (NASA, MODIS web, 2010; MODIS Rapid Response Systems, 2006; Gumley et al., 2003) are freely available through NASA. Rapid production of graphic contents for media-GIS can be benefited from these freely available pre-processed NASA's MODIS products specially; images with 250m spatial resolution. Table 2 summarized some of the important information of MODIS data with respect to media content use. The content producer must aware the possible file sizes, depending on the sub-scene and image format, before download data.

A large sub scene in tiff format may exceed 80 MB in file size and takes a substantial time to download if the network connection is slow. Figure 03 shows some of the available sub scene layouts, which cover nearly all-important populated spots on the earth.

Table 2. MODIS information useful for media contents (source: various MODIS sites).

Element	Information
Orbit	705 km, 10:30 a.m. descending node (Terra) or 1:30 p.m. ascending node (Aqua), sun- synchronous, near-polar, circular
Swath Dimensions	2330 km (cross track) by 10 km (along track at nadir)
Spatial Resolution	250 m (bands 1-2), 500 m (bands 3-7), 1000 m (bands 8-36)
True color band combination	Band 1 (Red) Band 4 (Green) Band 3 (Blue)
Available file format	For Media graphics: Geo-TIFF, JPG, and KMZ (Keyhole Markup Language Zipped - file format needed for Google Earth overlay).
Available ready to use sub-scenes	Aerosol Robotic Network (AERONET) USDA Foreign Agricultural Service (FAS) Fire Information for Resource Management System (FIRMS), Antarctica, Arctic, Other (see figure 3)
Available image formats	JPG image with ancillary files (.zip), KMZ file for GoogleEarth GeoTIFF file, metadata (including time of input data) worldfile | Display projection file
Available image products	MODIS True color, Band 7-2-1 combination, NDVI image Subsets are available at 2km, 1km, 500m and 250m resolution.
Data access	Free through the internet (http://rapidfire.sci.gsfc.nasa.gov/subsets/)

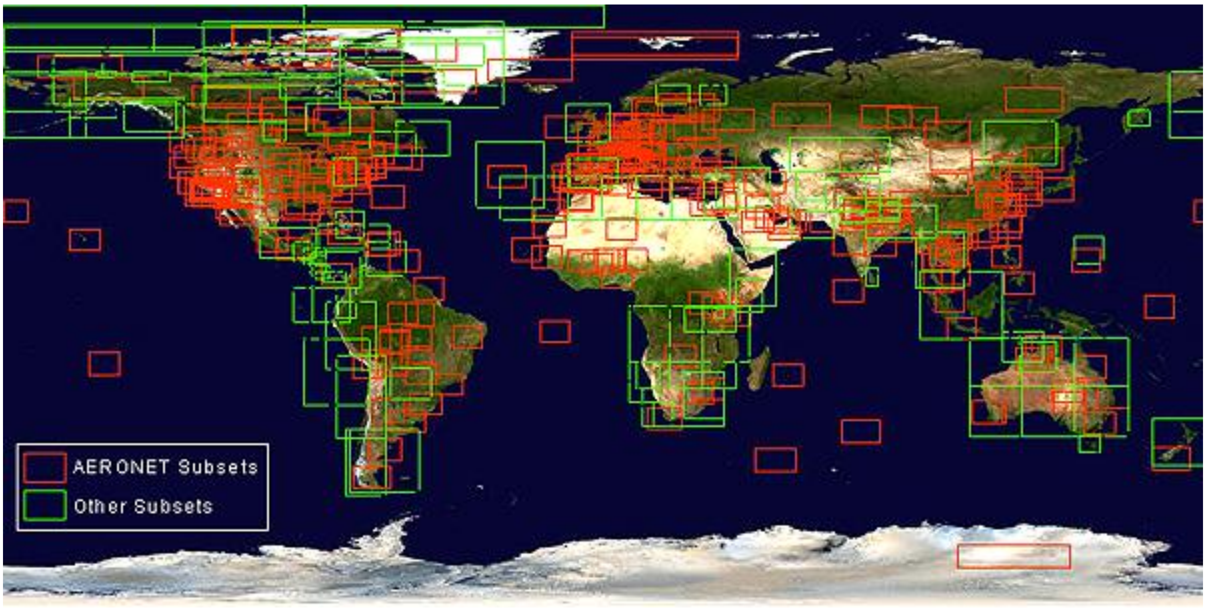

Figure 3. Geometrically and radiometrically corrected MODIS image subsets cover most of the important spots of the world (AFS, FIRMS, Antarctica, and Arctic subset frames are not included here).

Figure 4. Methodology: data processing and content production flow.

5.2. Methodology

The Methodology can be explained using a flowchart with action steps, which starts with the brake of the natural disaster news (figure 04). Here, the content production process discusses the methods used in case study included in this study. The flow starts with item “A” and explains two outputs, “B1” and “B1”, which related to media-GIS contents without and with geo-reference. Each production step under the methodology is included in the flowchart, which ends with recycling archived contents. Archived contents can be used as historical contents without any change or with appropriate changes to produce a new content. This study focuses on MODIS data, however, media-GIS graphic contents are not limited MODIS data, and open to any other graphic or map layer with geographic reference as the base data set. According to the level of skills in graphics and image processing, each content producer may take different data processing routings to produce media content, other than the process explained in figure 4. Also, according to the need, Photoshop processing step can be by-passed through producing contents in Google earth environment alone. Likewise, only Photoshop and MODIS JPG images are reasonably enough for certain customers, as indicated in step “B1”. However, firm registration of data layers into a GIS database will ensure the higher level of spatial accuracy as well as systematic content archive for future use.

5.3. Is “semi real time” achievable task?

MODIS images are acquiring two times a day, 10.30 and 13.30 by Terra and Aqua satellites respectively. The definition of “*semi real time*” is open for discussion; however, MODIS has the capability to record at least some of the disaster incidents, which spread over large region, within 24 hours time span. The controlling factors for content limitations of the satellite making speed are coming from cloud cover and availability of pre-corrected image coverage. However, weather related incidents are having an advantage here, since clouds are part of the contents.

6. The case study: Deepwater Horizon Oil Well Disaster

The case study presents here mainly focused on TV media, with some references to WEB and mobile media portals. As discussed in previous sections, optimization of esthetic quality of the content while maximizing the production speed considered as the basic object in this case study too.

One of the most disastrous oil spills in human history occurred in 20th April 2010 with the blast of under-sea oil well, “Deepwater Horizon”, which is located in Gulf of Mexico. The environmental and economic damage was massive and the involved oil company, BP, set a $20 billion fund for damage claims. The spill continued well over 10 weeks with a spill of 40,000 barrels per day, causing a huge environmental catastrophe in the region (Guardian, 2010)

NASA published series of MODIS images from the very beginning of oil spill, but those descriptive image maps were not extensively used in commercial media. The image (640 x 480 pixels) in figure 05 was produced targeting TV media through the methodology explained in figure 4. The content has no vector GIS layers, but its raster image map layers (or GIS component) are showing multi-temporal conditions of oil spill. In fact, the “*semi real time*” aspect of the image sequence can be found with the latest image (figure 8) while historical images (figure 6 and figure 7) are to explain the evolution of the spill.

Each of the graphic content has respective KMZ file, which can be used in Google Earth to zoom-in and display the content on Google earth, as presented in figure 06. If these graphic contents are to be used in WEB media, any of 640 x 480 graphic content can be saved as JPG file (50% quality), which only has a file size around 50K. If image reduced up to 75% without losing information, JPG file will be about just 30K. The exact same media content can be re-produced for mobile media with spending very little extra time on production. Apart from the concerns discussed in production process (figure 4), mobile media demand graphic contents with small files size, which should be less than 100k to accommodate various capabilities in mobile phones. As Mobile Advertising Guidelines explains, media contents may use the maximum image size of 320 pixels by 240 pixels, which is the recommended size for large MMS (multimedia messaging service) video (Mobile marketing association, 2009). The figure 9 shows the re-produced mobile media content into 320x240 size, with about 18k file size. The case study presented here only focused on production aspects of the media contents and facts related to the spill were not discussed in length.

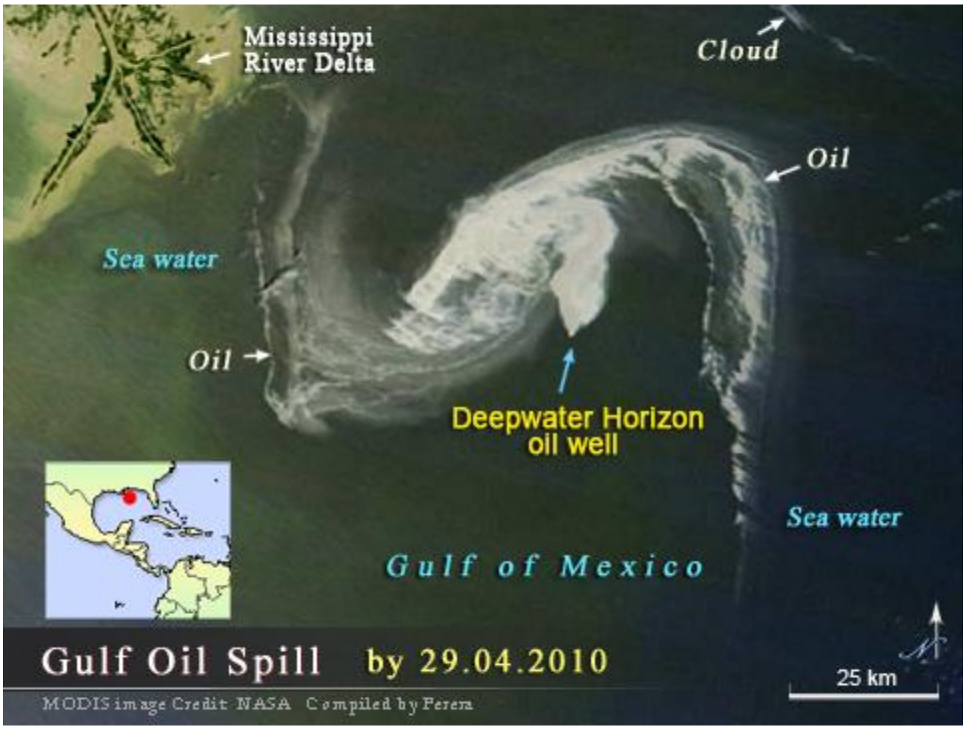

Figure 5. The early stage of the oil spill disaster.

Figure 6. Displaying the media content on Google Earth.

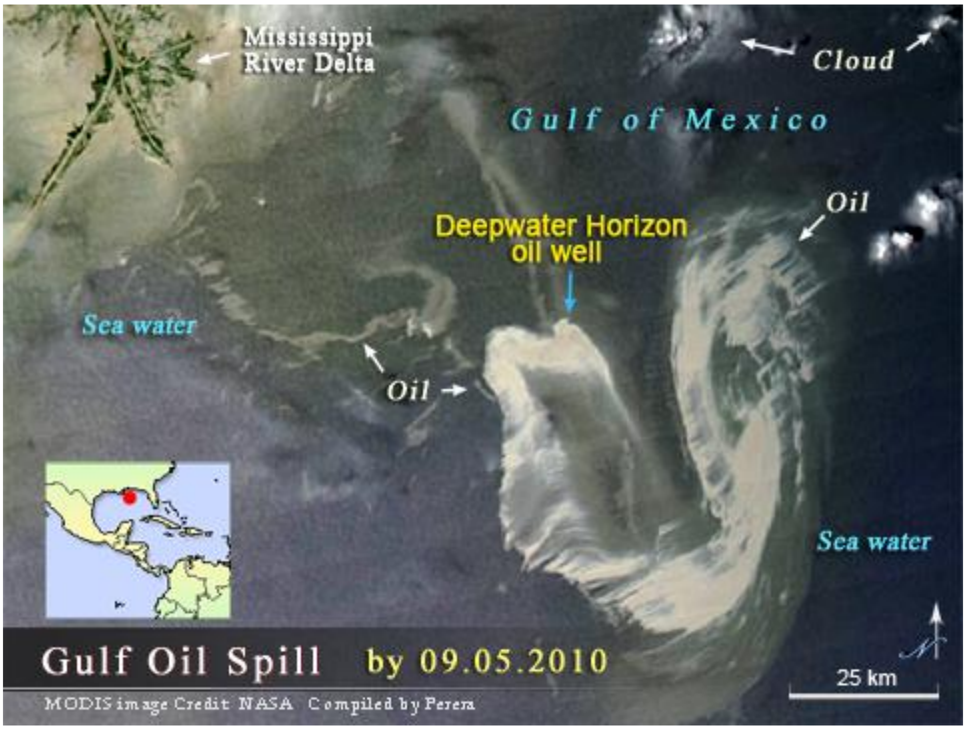

Figure 7. Oil spill after 10 days from the blast. The massive oil slick, which spans over 100km from the oil well is clearly visible. Viewers can understand the extent and direction of oil movement.

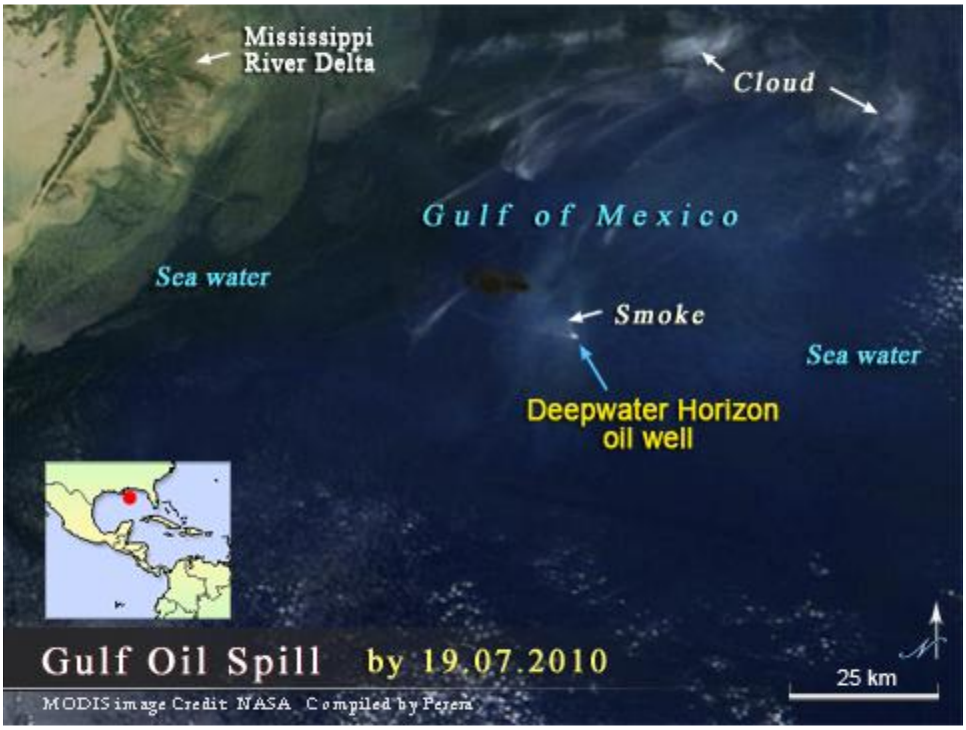

Figure 8. The condition after undersea oil leak closed. The MODIS image still shows some smoke from the oil well. This latest image is the "semi real time" media content.

Figure 9. Re-production of the content for mobile media use.

7. Recent trends

The navigation in the Web in entirely new ways using innovative, visually stunning, and useful, data visualization tools have introduced to media world due to the growing commercial competition (Ostrow, A., 2007) in recent years. Also, some of the latest developments in web based content production pay deeper attention to the visual character, such as visualizing words and visual web searching (Friedman V., 2007). With these aggressive developments in media world, content production is also facing an endless challenge to meet new demands. These developments have influenced to introduce new modules in leading GIS software packages too. Today, using ArcView, ArcEditor and ArcInfo, user or the content producer can understand the geographic context of data, allowing user to see relationships and identify patterns in new ways (ArcView - overview 2010).

From the other hand, powerful yet user friendly functions in Photoshop CS package provide rich tools to produce and manage graphic contents through the links with GIS software. Google earth plays integral role in data exploring and presenting, by combining these graphic products with earth context using KML/KMZ file formats. All these developments are vital to maximize the targeting audience and improve accessibility into new media contents. GIS technology is becoming a great assistance in this regard, to produce spatially accurate and academically sound contents by incorporating subject and software developments (ESRI, 2010) into commercial production of media contents for environmental disasters and other natural environmental incidents.

Apart from MODIS images, potentials are growing to acquire other low cost and high resolution satellite images in media-GIS content production. Also, these developments will expand activities in spatial data visualization, satellite data interpretation, as well as graphic designing and visual arts to facilitate growing demands in media-GIS contents. Eventually, these promising developments in media-GIS will establish new job opportunities for remote sensing and GIS specialists in media world. From the viewer side, incorporation of spatial information into media content will enhance and improve the understanding of ever-changing global environment.

8. Conclusions

Media-GIS, a recently developed sub-field of GIS produces contents while focusing on optimization of esthetic quality of the content and production speed, which is not very common practice in GIS and remote sensing studies. However, scientists have to guide content producers in this new field of application, since basics in spatial data visualization and accurately registered GIS data sets are important to set a sound and reliable working culture in media-GIS. Freely available MODIS sensor images can be successfully apply as the “semi real time” base data set in media-GIS content productions on environmental disasters, specially, when the disaster has a wider spatial impact. The case study presented in this study explained one sub-section of media-GIS; *presenting* disaster information using firmly registered multi-temporal image layers. Also, the potentials of use of the content in different media portals were discussed. When the content has the graphically attractive and geographically explained or registered spatial character, people will obtain a better understanding about changing global environment and natural disasters, apart from the increase of commercial value of the related news item.

Acknowledgement:

The author is grateful to Dr. Kevin McDougall, Dr. Armando Apan, and Dr. Badri Basnet of Faculty of Engineering and Surveying, University of Southern Queensland, for the valuable comments, institutional support and encouragements given throughout the study.

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