Semi-real time media contents on haze hazard in Ganges River Basin

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Abstract: The world most populated river basin, Ganges river basin, which runs from the central Himalayas to the Bay of Bengal, faces numerous natural and manmade environmental disasters. With the increase of population and industrial activities in resent decades in the basin, a hazardous haze layer in winter months are forming annually over the basin, causing many deaths and other health complications. The thick haze in winter months further increases cold temperature while hazardously decreasing the visibility for road and air traffic. Due to the gravity of this hazard, it's important to bring haze cover information to public to enhance the understanding and to get the appropriate attention to the situation. Here, production of semi-real time media contents on the hazard plays a vital role. Moderate resolution daily MODIS satellite data are highly suitable to monitor the haze for such content production. This research uses freely accessible MODIS data to monitor haze development and movements over Ganges basin to produce semi-real time mass media contents. The content making is emphasized on academically sound image processing and production of easy to understand graphic products.

1. The hazard

The region affected by haze cover (figure 01), addressed in this study is related to the increase of cloud cover over Indian Sub-Continent in recent decades.

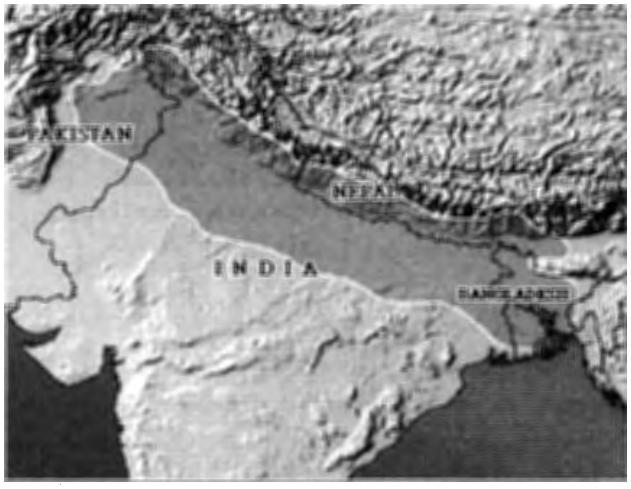

Figure 01. Approximate area (in pink color) affected by haze over Ganges River Basin.

The increase of cloud cover over northern Indian sky attracted the attention of scientists from early 1990s. In a 2001 study, Noriis explains the clear increase (from about 13.3% of sky to 14.5%) of low-level cloud cover over Indian sub-continent from 19950 to 1990 (Norris, 2001). Scientists suspect this increase is related to the increase of aerosol over Indian Ocean, which increased by the population and industrial growth of the region (Alles, 2008). In another study, author's preliminary estimation suggested an increase of 5% in cloud cover due to the aerosols increase (Kaufman and Koren, 2006). The smog conditions associate with the increase of these clouds, named as "Asian Brown Cloud (ABC)", first came to wide attention after UN sponsored a detailed study (INDOEX, the Indian Ocean Experiment), which concluded in year 2002 by a panel of about 200 scientists. INDOEX measurements indicated cloud droplet concentrations are greater over the polluted northern Indian Ocean than the relatively clean southern Indian Ocean (Norris, 2001). The study found the amazing extent and threat of the cloud, which contains unusual amounts of 'heavy' pollutants such as soot, ash and other black carbon aerosols.

Figure 02. Bentinck Street, Calcutta (source: Musleah R., 2008)

Another study found the biofuel combustion is the largest source of black carbon emissions in India (Venkataraman, et al., C, 2005) India's air pollution, because it is also rich in black carbon, has reached the point where scientists

fear it may have already altered the seasonal climate cycle of the monsoons (Alles, 2008), and many direct and indirect deaths and health hazards. Figure 02 shows a typical busy Indian city scene (Bentinck Street, Calcutta), which has all micro levels of air-pollution that considers as one of the major reasons for the formation of hazardous haze. According to the UN, this Asian smog cloud (the huge haze layer), affects millions of people of the region. The present study concentrates on bringing satellite data related to these research findings in a simple graphical form to general public to enlighten the public interest of this newly formed natural hazard.

2. Data

Delivering scientific information to general public has a genuine need, although the lack of freely available suitable data plays as a barrier for that. In order to observe the haze layer over Ganges River basin, it's important to obtain suitable satellite data at daily interval. The geometrically corrected true-color MODIS products (by NASA) on daily basis are one of the highly suitable data sets for this purpose. At 250m resolution, these automatically generated near-real-time images give substantial amount of information to observe haze cover. Figure 03 shows the daily image scene layout over Ganges River Basin (pink area shows the area of interest of this study).

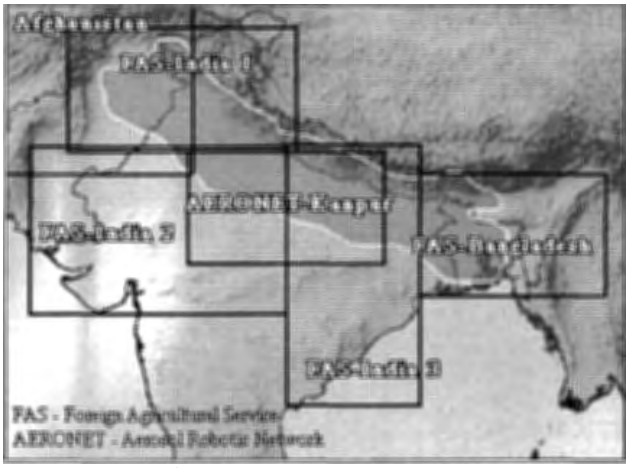

Figure 03. MODIS image subset layout.

For each of this geographic area, the archive imagery is available online (MODIS 2008).

Production of contents from these images needs two major background environments,

I. Information about the haze hazard occurrence

Most of MODIS data sets including aerosol and cloud data collected by AQUA and TERRA satellites can be freely download from the WEB. MODIS Aerosol imageries (with 2 days of time lap) can be used to track down haze conditions, by entering fixed searching parameters for Ganges river basin region. Figure 04 shows 2 images of high aerosol (JD: 2008022) and low aerosols existence (JD: 2008289) over lower river basin region (LAADS WEB 2008). Also, searching these images must be combined with local weather reports and news sources about haze or fog conditions.

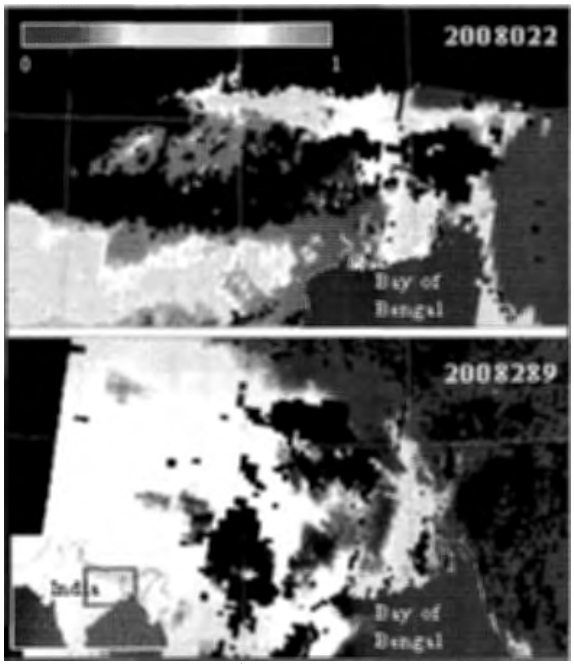

Figure 04. High and low concentrations of aerosol optical thickness data (LAADS WEB 2008).

II. A GIS data set

The GIS (geographic information systems) data set is impotent to produce contents with a consistence and better accuracy. Here, a basic data environment is sufficient with raster map layers, which can be re-directed to edit in Photoshop environment. The entire area under Ganges river Basin can be found under geometrically corrected (Plate Carree projection with WGS_1984 coordinate system) MODIS subset products, and other data must be corrected to match with same coordinate system. But, final images are producing at low resolution for visualization purpose, and no operational use must be encouraged. Data layers like, political boundaries, major cities, major roads, rivers, and elevation data are sufficient at initial stage to merge with MODIS images. But the use of data types like distribution of rainfall and temperature, population, and air pollution, are highly productive, if

combined into the system.

3. Methodology

For proposed near-real-time haze hazard content production, basic knowledge and skills in; GIS, remote sensing data handling, and graphic production, are needed. This is for the maintenance of accuracy of contents, speedup of the content production, and to achieve a high quality in data visualization.

3.1. Accuracy

Since contents bringing first hand information to general public, the geographical and informative accuracy must be maintained at a high level. Simply, it's easy to maintain a substantial accuracy of the product, if the GIS database is registered with MODIS subset collection of the Ganges River Basin. When data layers are ready to be imported from any remote sensing software environment into base graphic templates in Photoshop environment, rest of the works will be more graphic oriented than conventional image processing.

3.2. Speed

Speed can be maximized at two different levels. The first is data mining, downloading, and converting into GIS database. Once the Ganges River Basin region is well studied, relevant subsets can be identified (figure 03). The second level is graphic production process, which mainly maintains by a large database template in Photoshop. The template helps to focus on any sub region of the river basin and also to produce smaller size contents for respective media need. Here, graphic skills in Photoshop will be helpful to minimize times.

3.3. Quality

The use of colors, fonts, and symbols in contents must be carefully selected to meet the technical requirements of the respective media, and target viewers including age groups. For web media, graphics must have small 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. Font sizes must be large enough to read easily, and priorities of words must be maintained to balance the informative quality. All graphic products in original TIF format with all image layers must be systematically archived.

4. Sample contents

Figure 05 and 06 shows two samples produced to demonstrate the use of MODIS data to capture haze and smog conditions over northeast Ganges River Basin, India.

Figure 05 (top) and 06. Changes occurred in haze and smog conditions over northeast India within seven days. It's clear that bout 700 km long huge smog concentration has moved away by Jan 07.

These samples only show changes of smog and haze conditions within 7 days with major cities of the region. These images can be used in TV, printed, or in WEB media, and each JPG file has only less than 85K of data. A smaller version can be produced to obtain a JPG file with just 35k of data volume by just reducing the size (e.g. 70%), without loosing information. Also updating same series of images will cost less time, once the initial template produced for Jan 01 Image. When data stored in an archive, comparisons can be conducted with next hazard seasons as well as with other regions of the Indian sub-continent.

5. Conclusion

The development of the link between "general public understanding" and scientific achievements in "haze hazard monitoring" over Ganges River Basin is emphasized in this study. Using freely available near-real-time MODIS satellite imagery products, an affective production procedure is proposed to create contents suitable for TV, prints, or WEB media. Integrating weather data into the system will enhance the practical use of these contents greatly.

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