USE OF ESRI TECHNOLOGY FOR DISASTER MANAGEMENT

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Abstract:

Disaster management can be defined as the organization and management of resources and responsibilities for dealing with all humanitarian aspects of emergencies, in particular preparedness, response and recovery in order to lessen the impact of disasters[1]. However all the information regarding disasters cannot be easily explained to the authorities who are far from the site of disaster, this is where the role of mapping the area affected by disaster comes into play, which can be used to not only easily explain the exact situation in time of disaster but can also be very useful in pre planning during a disaster.

This paper basically aims to cover how ESRI technology such as the ArcGIS is used to great effect during times of disasters, and based on real life case studies how it can be further improved to deal with catastrophic situations and help come out of such situations in a faster and effective manner. The paper will bring out various ways in which GIS is already used in times of disasters to help overcome the situation and analyze them and then bring out various situations where the existing technology could have been used in a better manner, also suggesting certain innovations which can help improve the use of GIS in times of disasters and make it more effective.

One of the key points covered in the paper will be about 'live mapping' of the area facing a disaster, with an specific example, citing the situation in Orissa during the recent Phalin cyclone.

The use of ESRI technology such as the ArcGIS has amazing potential in helping authorities plan and execute their actions in times of disaster and the integration of these technologies in real time with the common people can go a long way in alerting people, spreading news about the disaster and helping them overcome the situation as fast as possible.

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Introduction

A disaster is a sudden, calamitous event that seriously disrupts the functioning of a community or society and causes human, material, and economic or environmental losses that exceed the community's or society's ability to cope using its own resources. Though often caused by nature, disasters can have human origins.[1]
Disasters may be natural or man-made, but they have the potential to cause great amount of damage, so it must be made sure that damage caused is as low as possible, and following the traditional policy of "Prevention is better than cure". Disaster management can be basically done in 5 phases, which are Planning, Mitigation, Preparedness, Response and Recovery.

Planning

Preventive steps can go a long way in saving the damage done during a disaster and GIS technology can be very helpful in taking preventive measures in preparation for a disaster. Preventive steps can only be taken by planning out the course of action. Preventive steps need anticipation and planning of the worst possible scenarios and how they can be solved. Key areas need to identified, and priority order is set for all the identified key areas. Authorities working far from the area in question need to be aware of positions of all the key areas and this is where role of mapping comes into play. Mapping of the entire area can be done and can be represented in a simplified manner which will make the identification easier, which can also be done using ArcGIS, and ESRI product.

Disaster management programs start with locating and identifying key locations. Using GIS technology, consequences of potential emergencies or disasters can be evaluated. Potential disasters can be viewed with other map data (streets, pipelines, buildings, residential areas, power lines, storage facilities, etc.), which can help the authorities to understand the ground reality and they can begin to formulate mitigation, preparedness, response, and possible recovery needs. Lives, property, and environmental values at high risk from potential emergency or disaster are given highest priority. Authorities can instruct the officials near the area in question to focus on areas where mitigation efforts will be necessary, where preparedness efforts must be focused, where response efforts must be strengthened, and the type of recovery efforts that may be necessary. ESRI technology like the ArcGIS facilitates this process by allowing planners to view the appropriate combinations of spatial data through computer-generated maps.

Mitigation

Based on the data represented in maps using GIS technology, various mitigation efforts may be planned, which are then carried out in this step so as to reduce the potential dangers that a disaster may bring along with itself. They may include evacuation of people from certain areas, repair and rehabilitation of structures or development of protection facilities for areas in high danger from the disaster.

Preparedness

Preparedness may include preplanned steps which may be taken during time of disasters. These pre planned steps are decided during the planning phase with the help of various layers of GIS data that is developed and these steps can help the public get prepared for steps to be taken during a disaster.

Response

This is the key element of disaster management; GIS technology is used to great effect in the response part of disaster management, however using certain methodologies can help improve how GIS technology is used during the time of disasters, which is discussed further in this paper.

Recovery

GIS technology can be used to assess the actual damage and based on this assessment; recovery work can be started so that the area affected by the disaster can come back to normalcy once the disaster is over.

Real Time GIS Mapping for Disaster Management

During times of disasters each and every one prays for the well-being of their family and friends, and it is often difficult to reach them during such situations individually considering breakdown of communication channel, however, it might be easier to know the location of the people on one common platform, which may be possible using GIS technology.

Earlier this year, ESRI announced that ArcGIS is now enabled to use real time data, "ArcGIS GeoEvent Processor for Server delivers the flexibility to incorporate virtually any source of real-time data into a GIS. It contains ready-to-use input connectors for the most common data stream sources, including built-in GPS connectors for Sierra Wireless and Trimble, and specific data streams for air traffic control, vessel positions, and others. GeoEvent Processor also provides an extensibility framework for creating custom connectors. Connectors can be configured to work over common transport protocols, including UDP, TCP, and XMPP, and tap into vehicle telematics used by CompassCom, networkfleet, and many others.

ArcGIS provides users with exciting new capabilities to incorporate real-time information into decision making. ArcGIS users can manage the flow of real-time data by collecting data streams from sensors; processing and analyzing this data in real time to determine the course of action; and finally presenting relevant information to users as a map via an e-mail, instant message, etc. These capabilities are delivered through the new ArcGIS for Server extension, ArcGIS GeoEvent Processor for Server.

GeoEvent Processor is sure to be a game changer in many industries, including fleet and asset management, telematics, defense and intelligence operations, public works, public health, forestry, mining, water and petroleum management, public safety and emergency management, transportation, and utilities."[3]

This new innovation can be great use during times of disaster and can be used to determine the location of individuals and representing in on a map, which can be published on a public forum, and can bring relief to all the people worried about the well-being of their family and friends.

This idea has been inspired from Google Person Finder, a google.org project, which is activated during times of disasters and emergencies and helps to find out information about people during times of disasters. Using the same ideology, we can take it to another level by integrating information received with ArcGIS and represent them on a map.

Information can be received in many ways, which may include but may not be limited to on site sources, information submitted by public online, GPS data from smartphones etc. These data may not be very accurate but can help give users a rough idea of location and other information about people.

On site sources may be authorities working in the area, who can provide vital information on the current situation in the certain location, which can be represented on the map, with a tag on that location, showing the information, or volunteers who share first-hand information which can again be represented on maps.

Public in effected places can send in information like their position, any messages via internet, if possible, which can then be represented on a map, an example of such a situation is provided ahead.

People can connect to apps on their smartphones and share their location which can again be mapped and displayed in a public forum.

Not only this, but before an emergency situation people can be try and be updated with actual scenarios of an impending disaster if real time mapping of the movement of winds, water bodies etc. can be done, thus this will be another key area where real time mapping can come into play.

Case Study – Use of GIS in Odisha during Cyclone Phalin

Very Severe Cyclonic Storm Phailin was a powerful tropical cyclone that caused substantial damage in Andhra Pradesh and Odisha, India, in early October 2013. The system was first noted as a tropical depression on October 4, 2013 within the Gulf of Thailand, to the west of Pnom Penh in Cambodia. Over the next few days, it moved westwards within an area of low to moderate vertical wind shear, before as it passed over the Malay Peninsula, it moved out of the Western Pacific Basin on October 6. It emerged into the Andaman Sea during the next day and moved west-northwest into an improving environment for further development before the system was named Phailin on October 9, after it had developed into a cyclonic storm and passed over the Andaman and Nicobar Islands into the Bay of Bengal.

During the next day Phailin intensified rapidly and became a very severe cyclonic storm on October 10, equivalent to a category 1 hurricane on the Saffir-Simpson hurricane wind scale (SSHWS). On October 11, the system became equivalent to a category 5 hurricane on the SSHWS before it started to weaken during the next day as it approached the Indian state of Odisha. It made landfall later that day, near Gopalpur in Odisha coast at around 2130 IST (1600 UTC). It subsequently weakened over land as a result of frictional forces, before it was last noted on October 14, as it degenerated into a well-marked area of low pressure.

Officials from Odisha's state government said that around 12 million people may be affected. As part of the preparations, 600 buildings were identified as cyclone shelters and people were evacuated from areas near the coast, including Ganjam, Puri, Khordha and Jagatsinghapur districts in Odisha.The cyclone has prompted India's biggest evacuation in 23 years with more than 550,000 people moved up from the coastline in Odisha and Andhra Pradesh to safer places.[4]

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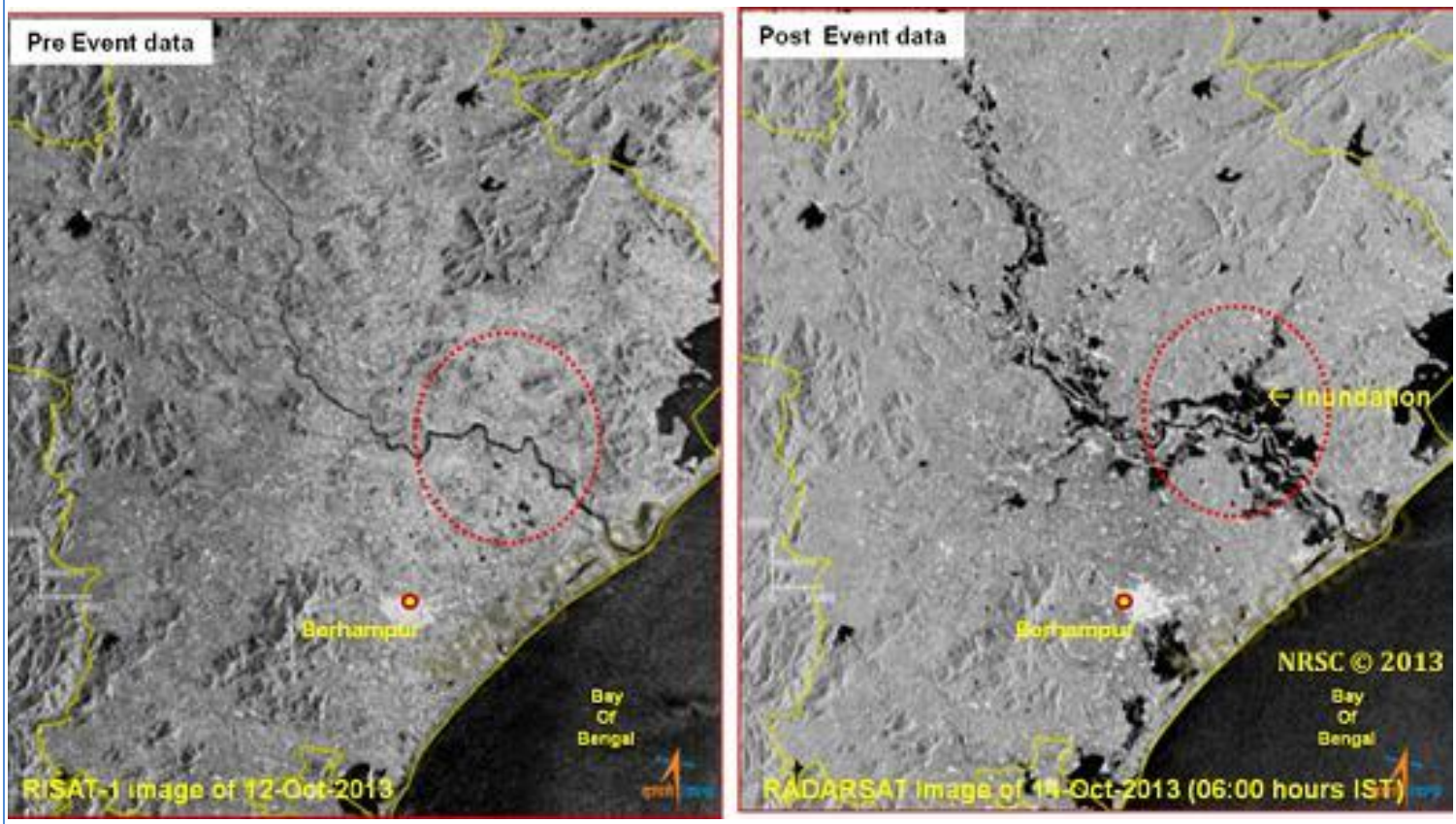

Fig 1: Pre and Post Cyclone images: Cyclone Phalin
(These images are taken from the NRSC website) [5]

National Remote Sensing Centre, NRSC, provided updates on its website and also the status of the cyclone through the various satellites used to track the cyclone trail. One of the images posted on their website shows the comparative status pre and post cyclone

According to the Orissa Disaster Management Authority website, its mandate reads - "The prime objectives of developing the GIS database are to help disaster managers at State, District and Block level for: Pre-disaster planning and preparedness, Prediction and early warning and Damage assessment and relief management"

The Orissa Space Applications Centre (OSAC) has been able to create a space-based natural resource atlas of Orissa. ISRO has provided new techniques of acquiring high-resolution space-based data. The new technique known as SIS-DP (Space-based information support for decentralised planning) is now able to create large scale geographical information system (GIS) data on land cover, settlements, soil, slope, water sources, road network, public utilities, communication network, health care and so on.

11 Indian remote sensing satellites in service, the National Remote Sensing Centre in Hyderabad is able to provide data that helps agencies forecast cyclones more than 72 hours in advance and evacuate people.[6]

Real time mapping could have been used during the Cyclone Phalin disaster so as to provide key information to people of Orissa and Andha Pradesh to provide real time position of the approaching cyclone and estimated place where it might hit so that people are aware of the exact position where cyclone might strike and with what speed.

Real time Information could have also been used to provide information to the entire world about the real time position of their family and friends. Information can be received in many ways, like on site sources, information submitted by public online, GPS data from smartphones etc. These data may not be very accurate but can help give users a rough idea of location and other information about people. Also this requires collaboration of authorities, media and general public for its success, and with GIS mapping, this data can be easily represented.

On site sources may be authorities working in the area, who can provide vital information on the current situation in the certain location, which can be represented on the map, with a tag on that location, showing the information, or volunteers who share first-hand information which can again be represented on maps. For example authorities might share a location, let's say a village in Orissa like Gopalpur, and tell the exact situation in the area. So a tag can be made at Gopalpur and information can be mentioned on a public forum.

Public in effected places can send in information like their position, any messages via internet, if possible, which can then be represented on a map, an example of such a situation is provided ahead, for example someone can send in their particulars and location in form of area and this can be represented on the map and people can search for their family or friends by heir particulars.

People can connect to apps on their smartphones and share their location which can again be mapped and displayed in a public forum. For example, people can connect to an app, which will take their GOS coordinates and that can simply be mapped, telling the world that they are at that particular location.

I believe that everyone should make all possible efforts to help each other in some way or the other, especially in such a situation and this can be one small step to reduce the suffering s of people going through a disaster and their family and friends.

Conclusion:

The feasibility of this project may be in question considering the accuracy of data and the amount of information which maybe received during emergency situations, however we need to believe in the fact that, any information shared is better than zero information shared during such times and thus this idea could be followed up.

Emergency management programs are developed and implemented through the analysis of information. The majority of information is spatial and can be mapped. Once information is mapped and data is linked to the map, emergency management planning can begin. Once life, property, and environmental values are combined with hazards, emergency management personnel can begin to formulate mitigation, preparedness, response, and recovery program needs.

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