Monitoring Cyclone Sidr plight over the largest river delta of the world

On November 15, 2007 the horrible category 4 Cyclone Sidr attacked Bangladesh leaving lots of casualty and damages. Landfall of the Cyclone led to heavy and destructive floods that harmed the country in few days; more than 3200 people dead and about 1000 missing.

Why floods in Bangladesh?

Three major rivers, the Brahmaputra, Ganges and Meghna streaming from Himalaya Mountains converge in a vast land and pour into the Bay of Bengal through the largest river delta in the world; this land is Bangladesh, which is built over the flood plains of those three rivers. The flat land within each plain is fertile and the country is densely populated. Floods on any of the three rivers can therefore affect large number of people. When all three rivers run high with monsoon rains and melting snow from Himalaya much of Bangladesh immerses in water. Floods cause fertility of the cultivable land and thus are advantageous for the agriculture sector; however, excessive flood is a calamity.

With only 1-2m height from sea level in most parts Bangladesh is a very low-lying country. Rise in sea level, narrowness of Bengal Bay tip to the north, tropical storms that whip up wind speeds of up to 225km/h and send waves with the height up to 8m crashing into the coast, shallow sea bed and the fact that water coming down from Ganges and Brahmaputra rivers can not escape when the water level rises, all contribute to the severe floods. Furthermore, due to the effects of deforestation in Nepal, there has been an increase in the flood risk of the two major rivers Ganges and Brahmaputra running through Bangladesh. Deforestation leads to more water in rivers, which allows more sediment to build up that leads in turn to higher risk of flooding. Moreover, since Bangladesh is adjacent to warm ocean, cyclones commonly happen there that increase the risk of flooding. Cyclones create chaos in the water that destroys banks and dams. Flood plains are very populated due to the fertility of the soil and many people are forced to farm on the slopes. Deforestation and agricultural practices loosen the soil and cause its flow into the rivers when it rains. As a result, the depth of the riverbed decreases that is also a reason for floods occurrence. To overcome such the frequent threat of the lives and economy of the country, development or access to early warning systems has been of great importance to enable the people and government to take action timely.

Extent of havoc

Floods have caused widespread plight in Bangladesh throughout history, especially during the recent years 1987, 1988, and 1998, but in 1970, a category 3 storm that made landfall in western Bangladesh caused 300,000 deaths which was one of the most deadly natural disasters in modern history. In 1991 an estimated 138,000 people died as a result of a cyclonic tidal wave; a network of cyclone shelters and a warning system introduced after the 1970 disaster was very effective in lower death toll.

The most recent flooding occurred mid-November 2007. Over 70 percent of the land area was flooded damaging or destroying over 12 million houses with more than 23

million people affected by devastating floods; of the country's 64 districts, 15 were affected, 11 of them badly. Flooding has also hit the neighboring Indian state of Assam, affecting more than 12 million people and killing about 180 people. In Nalbari district, 241 villages were submerged completely. In addition to severe shortages of drinking water, diseases such as bronchitis and diarrhoea spread and killed many people. According to the government now more than 3,400 people have been confirmed dead and 360,000 people is estimated left homeless by Cyclone Sidr.

Space remote sensing and Geomatics serving disaster relief

Monitoring, control and managing such the widespread calamity requires continuous synoptic and detailed observation of the area. As a result space technologies such as remote sensing, GIS, GPS and communications can lend effective hand and play useful role. That is the case about the outspread mid-November flooding of Bangladesh. Many disaster relief and humanitarian organizations in national, regional and global level have been mobilized and equipped to assist the Bangladeshi people entrapped in the harsh floods. As the sources for information and data collection and providing as well as securing the means for communications national and international state and private space agencies and organizations have been of assistance for managing, control and monitoring the disaster.

Following the incidence of the tropical Cyclone Sidr that hit the coastal districts in the Bay of Bengal on 15th November the United Nations Office for Outer Space Affairs (UNOOSA) activated the *UN International Charter on Space and Major Disasters* for the World Food Program and UNOSAT, the UN program created to provide the international community and developing countries with enhanced access to satellite imagery and GIS services which are used mainly in humanitarian relief, disaster prevention and post crisis reconstruction. The project was managed by the Center for Satellite Based Crisis Information (ZKI) of German Space Agency (DLR). It is a service of DLR's German Remote Sensing Data Center which function is rapid acquisition, processing and analysis of satellite data and provision of satellite-based information products on natural and environmental disasters for humanitarian relief activities and in the context of civil security. The analyses are tailored to meet the specific requirements of national and international political bodies as well as humanitarian relief organizations. The data applied by ZKI was the 10m-resolution Spot and 16m-resolution Terra SAR-X image of the area. According to UN estimates the cyclone has affected 6.7 million people in 30 of the country's 64 districts, causing severe economic losses.

Under its Earth Watching Project European Space Agency (ESA) uses satellite remote sensing to monitor emergencies as they happen; keep track of a flood, alert coastguards to pollutants in the water, detect burning fires or assisting authorities in rebuilding after disasters. ESA's European Space Research Institute (ESRIN) and Eurimage started the Earth Watching project in 1993 to supply satellite data and pertinent information quickly in cases of natural disasters. Cyclone Sidr was monitored and screened by Erath Watching using the data and information collected by ESA's ENVISAT-ASAR (Advanced Synthetic Aperture Radar) and Medium Resolution Imaging Spectrometer (MERIS) images. Applying SAR imagery in monitoring the flooded and stormy areas where cloud cover is an obstacle in case of such typhoons emerges very effective tool.

Hawaii based Pacific Disaster Center (PDC), has also monitored the advent of Sidr and its behavior. PCD provides applied information research and analysis support for

the development of more effective policies, institutions, programs, and information products for disaster management and humanitarian assistance communities of Asia Pacific region and beyond. The Center supports customers' disaster management requirements by providing timely, accurate, and relevant informational and analytical products in emergency cases. Using available remote sensing and GIS techniques along with its Asia Pacific Natural Hazards and Vulnerabilities Atlas, PDC has followed and studied the movement of typhoon.

United States Earth Observatory and Natural Hazards Program of NASA, National Oceanic and Atmospheric Administration (NOAA), US Geological Survey (USGS) and some other organizations covered the incidence of Typhoon Sidr. Using different sensors onboard of the variety of satellites the calamity's different dimensions has been monitored continuously. The data of Moderate Resolution Imaging Spectro-radiometer (MODIS) of Terra has been used while the data from Tropical Rainfall Measuring Mission (TRMM) that is a joint mission between NASA and the Japanese Space Agency (JAXA) was also contributed to the monitoring the event as an example.

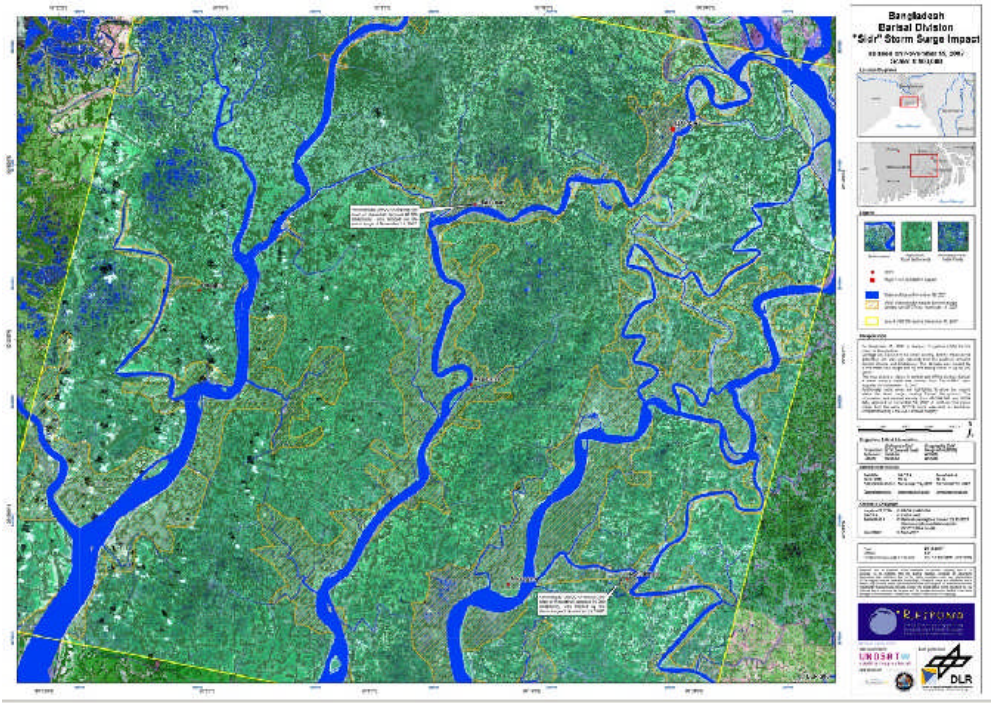
Data and information acquired from remote sensing and geo-information technologies were also applied by the domestic organizations in Bangladesh. Bangladesh Meteorological Department used satellite images of the Cyclone to track its movement and effects. Bangladeshi branch of Habitat for Humanity involved in building and rehabilitating people hit by disasters which operates mainly through Habitat Resource Centers and related satellite centers in local communities employed its facilities to assist 150 families who were affected by Cyclone Sidr. The result of the study made by ZKI applied by the World Food Program (WFP) that has been distributing high-protein and energy cookies, rice and polypropylene bags to the people hit by flood. Newly established Operations Coordination Room, Disaster Management Bureau, Flood Forecasting and Warning Center, Bangladesh Disaster Preparedness Center were the entities that applied remote sensing imagery in Cyclone Sidr disaster reduction and management.

Parviz Tarikhi

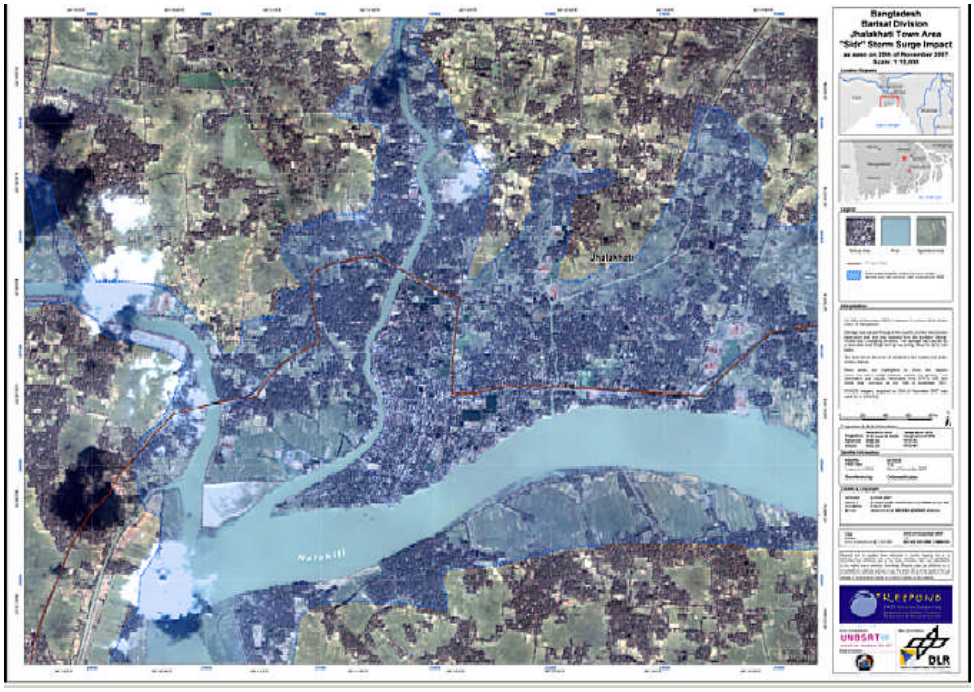
Parviz Tarikhi *is a space science and technology senior expert based in Iran. As a candidate for a PhD degree in Physics he presently focuses on microwave remote sensing. In course of his cooperation with the United Nations Committee of Peaceful Uses of Outer Space (UN-COPUOS) since 2000, he worked as the Committee Bureau member in the capacity of Second Vice-Chairman and Rapporteur in 2004-06. He has co-chaired the Action Team number one of the Recommendations of UNISPACE-III "Develop a comprehensive worldwide environmental monitoring strategy" since 2001. He is also a freelance journalist and technical writer.*

Images:

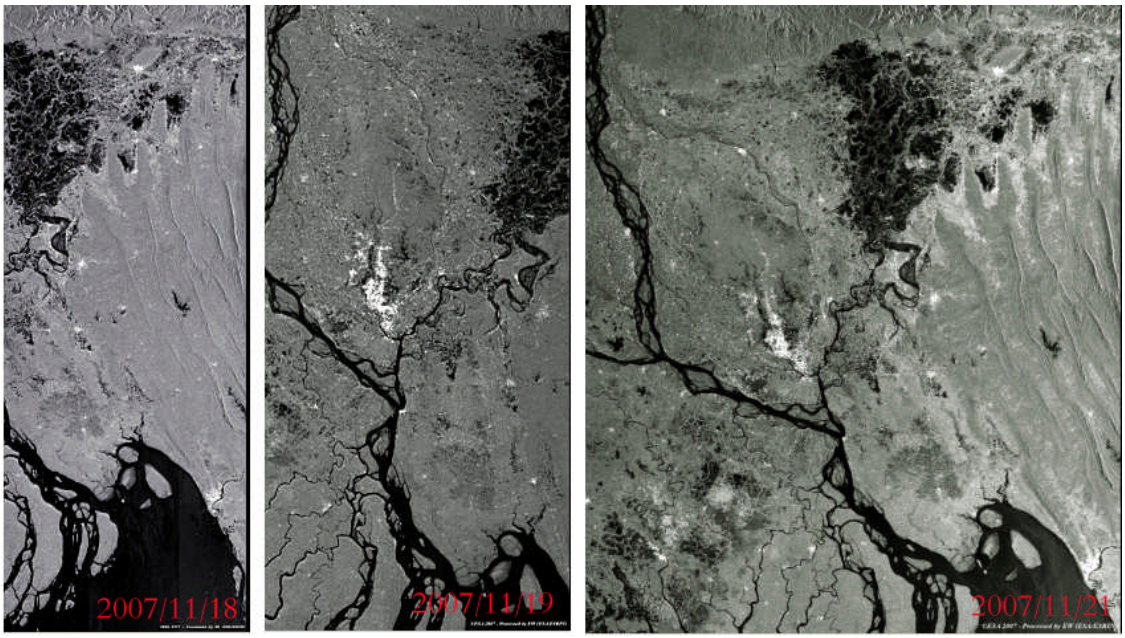
[images: 21-11-2007.jpg (up) and 23-11-2007.jpg (down)]



[Images caption: *DLR Satellite Image Map; impact of storm hit during Cyclone Sidr in Bangladesh, Above: Barisal Division, November 21, 2007- Below: Jhalakathi, November 23, 2007*]

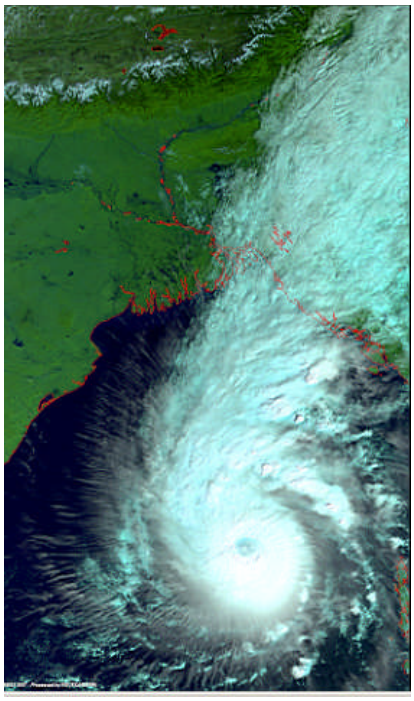


[image: ASA-2007-11.jpg]



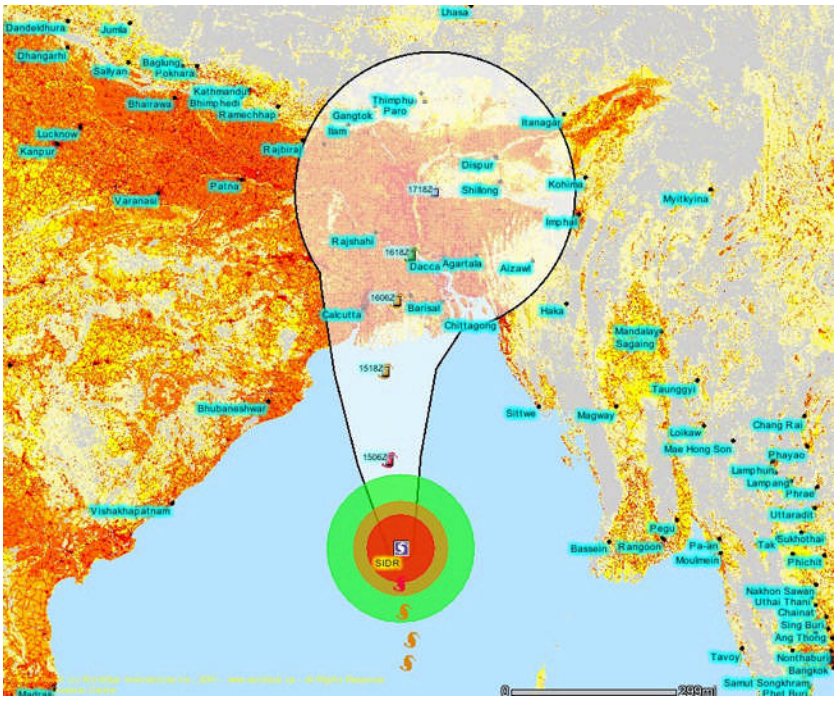
[Images caption: *These ENVISAT_ASAR Image Mode Precision images were acquired over central-east Bangladesh where floods (in black) are visible after the passage of Cyclone Sidr devastated the area. The acquisition date is shown at the bottom right of each image. The images resolution is 150m.*]

[image: MER-2007-11-14.jpg]

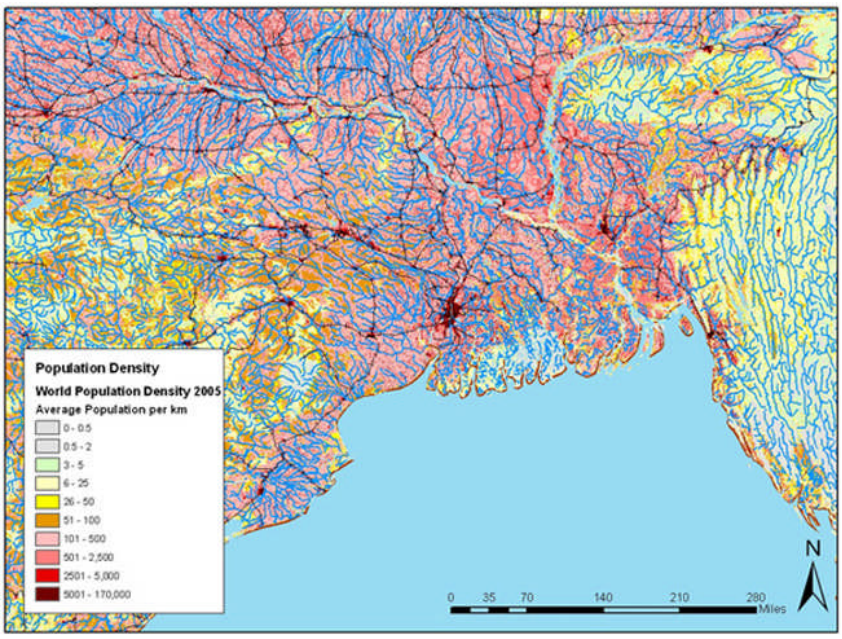


[Image caption: *This Medium Resolution Imaging Spectrometer (MERIS) image (composite of bands 11, 14 and 3) collected on 14 November 2007 was acquired over the Bay of Bengal where the Cyclone Sidr is visible near the south coasts of Bangladesh. The image resolution is 1200m.*]

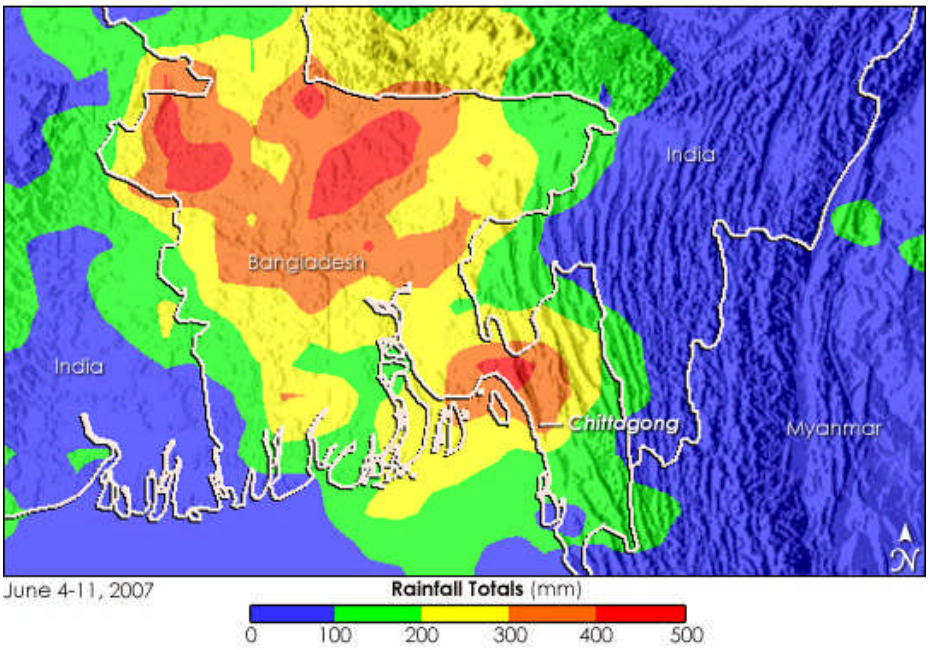
[images: WS-TC-Sidr.jpg (up) and WS-TC-Sidr-Pop.jpg (down)]



[Images caption: *Above image captured from PDC's Asia Pacific Natural Hazards and Vulnerabilities Atlas, shows the movement of Typhoon Sidr incident in Bangladesh in the evening, Friday 16th November 2007 - The map below also created by PDC, shows the density of the population in the area affected by Sidr.*]



[image: TRM1.jpg]



[Image caption: *This image shows rainfall totals over Bangladesh between June 4 and June 11, 2007. The rainfall totals are from the Multi-satellite Precipitation Analysis, which is based on measurements from TRMM satellite. Rainfall totals range from 0 to 100 millimeters (4 inches), shown in blue, to 400 mm (15.7 inches) to 500 mm (19.7 inches), shown in red. Most of the country received between 200 and 300 millimeters (7.9 to 11.8 inches) of rain during the week-long period, though there are several pockets of heavier rain. Chittagong sits in one such pocket, where up to 400 mm (15.7 inches) of rain fell.*]