

Rapid response mapping to support disaster management in Himalayan region

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ICIMOD

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International Symposium

**Benefiting from
Earth Observation**

Bridging the Data Gap for Adaptation
to Climate Change in the HKH Region

Presentation Outline

- Introduction
- Global and regional efforts on space-based information
- Space-based applications in emergencies : Examples
- Conclusion & Way Forward
- A video on Pakistan Floods from ground to space

Introduction

- One of the sustainable development **challenges** of any nation is the nation's capacity and capabilities to manage its environment and disasters is to preserve the elements of the fundamental life support systems-air, clean water, food, wholesome environment, etc. against threats of disasters
- Recent earthquake in Sichuan of China, Nargis cyclone in Myanmar, outbreak of Koshi barrage embankment, floods in Pakistan are eye openers to the global community, including the whole HKH region, in its efforts towards disaster management and reduction.
- Disaster prevention, **management** and **reduction** therefore present major challenges that require prompt attention by everyone.

Types of Disasters

- Disasters can be classified in general into two major types although with the understanding that the boundary between environmental problem and disaster could be transitional, implying that a breakdown of the environment may lead to a disaster;
 - Natural Disasters
 - Anthropogenic (Human-Induced Disasters)
- Effects of these disasters could be extremely damaging to the infrastructures, causing environmental degradation, disease, hunger and death

Natural Disasters

- These occur naturally and they are triggered by natural forces, usually of geologic and meteorological origin. They are usually beyond human prevention, although the impacts can be managed; examples include
 - Earthquakes, volcanic eruptions, landslides, tsunamis, cyclones/hurricanes, coastal flooding and erosion, river flooding due to heavy rainfall and drought with associated desertification and food insecurity

Anthropogenic (human-induced disasters)

- These are disasters triggered directly or indirectly by human activities.
- They are classified as industrial and technological disasters and other human induced elements such as toxic emission from industrial plants, auto-and motor-vehicles and hazardous waste disposals, flooding, forest fire and oil spill with associated environmental degradation, domestic and road accidents, etc.

Jaipur Oil Fire in India
October 2009



Global efforts in Disaster management and reduction

Global initiatives

- Declaration of International Decade for Natural Disaster Reduction (1990-99), with international strategy for Disaster Reduction focusing on consolidating global efforts.
- UNESCO: Initiative of building a culture of prevention and reducing vulnerability of population at risk
- International Charters –A fall-out of UNISPACE III, supporting major disaster managers with up-to-date space data on voluntary basis
- CEOS: International forum coordinating the use of space-based data in solving many problems including disaster management
- GEOS: GEOSS initiative, with over 60 countries, aimed at revolutionizing use of integrated satellite systems in solving many problems including disaster management

Global efforts in Disaster management and reduction

Global initiatives

- IGOS-P: Integration of Earth/Atmospheric observing system such as GOOS, WWW-GOS, GCOS, etc for the understanding of ozone depletion, global warming, sea level rise, floods, drought, etc
- DMCII: International partnership and first world coordinated satellites for disaster management: this initiative includes NigeriaSat-1, HJ-1
- World Conference on disaster reduction held in Kobe, Hyogo, Japan, Jan, 2005, with Hyogo framework to build nations/communities resilience to disaster (2005 –2015)
- UNOSAT, UNSPIDER

Regionally

- Sentinel Asia and APSCO
- UNDP, FAO, UNICEF, UNEP, WFO, UN-HABITAT, UNESCO, WMO and WHO addressing disaster reduction within the framework of their respective field of activities

Use of space data in disaster management

Management of natural disasters is often beyond the scope of ground based capabilities and investing in Space technologies in disaster relief and mitigation is therefore well justified

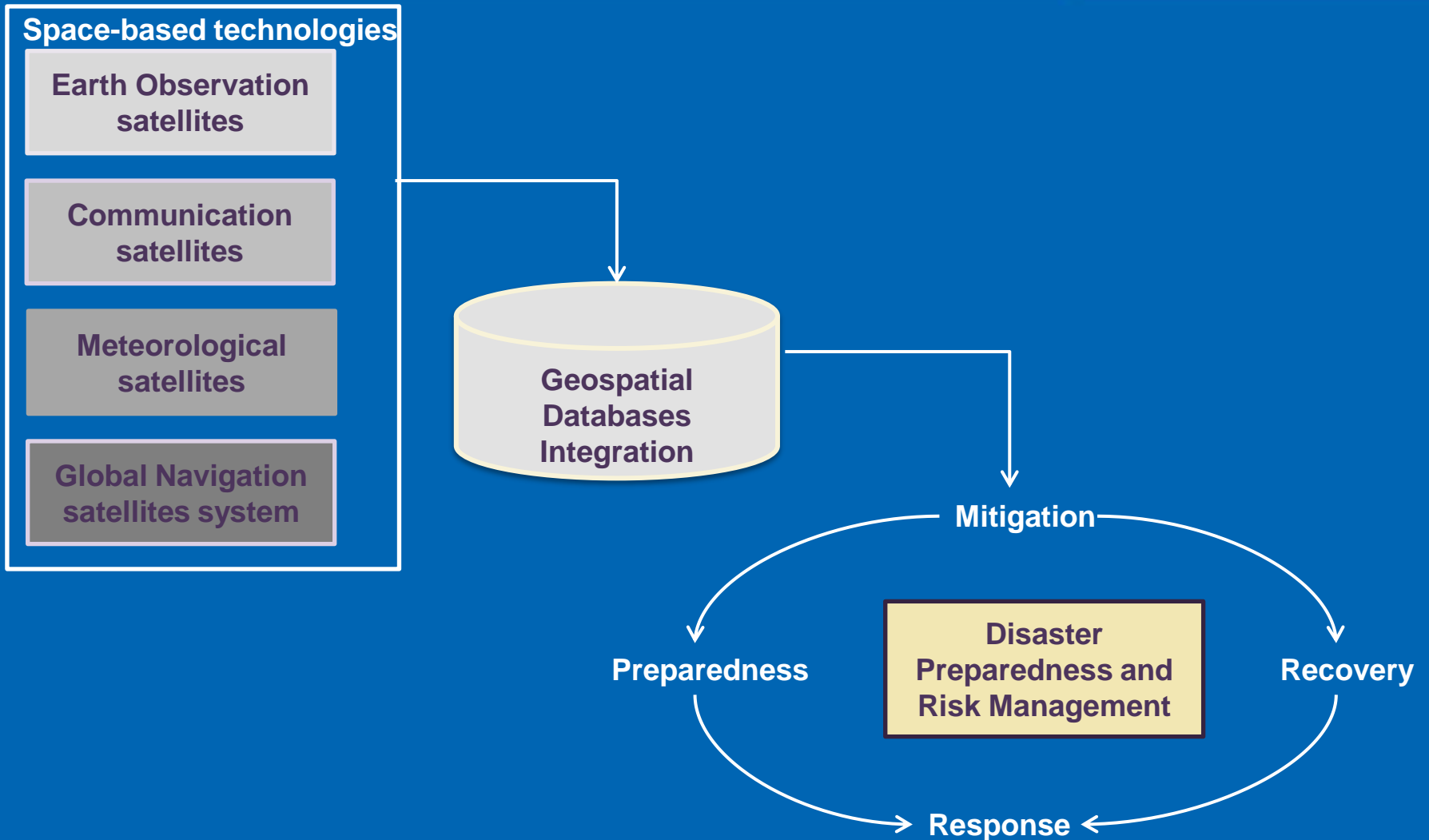
Potential application in two primary phases:

- **Hot Phase** (dealing with emergency response)
 - Warning –of population at risk to save life & properties using communication network
 - Crisis Management –mapping of damages, forecasting evolution and further danger, providing support to relief staff to facilitate access & communication, etc
- **Cold Phase** (period preceding or following disasters)
 - Risk Reduction –controlling vulnerability in terms of measures put in place to reduce impact e. g land use practices, risk maps, check dams/dykes, etc
 - Damage Assessment –access destructive impact, rehabilitation work, etc
- Use all available space tools: Earth observation (remote sensing and meteorology), Communication and GNSS satellites and other space-based geodesy.

Meeting Regional Challenges in Disaster Management / Reduction

- Many organisations in the region particularly India and China are charged with one responsibility or the other in space-based disaster management and reduction. In India, for example, the under-listed Agencies play major roles.
 - Disaster Management Center, (ISRO) implement the national space policy and programmes, including space geodesy and coordination of disaster early warning systems
 - Indian Institute of Tropical Meteorology , charged with the responsibility of providing meteorological data for disaster prediction/early warning
 - SAARC DMC, coordinates program related to disaster decision makers
 - Geological Survey of India : produces geological maps and other related data

Phases of Disaster Management

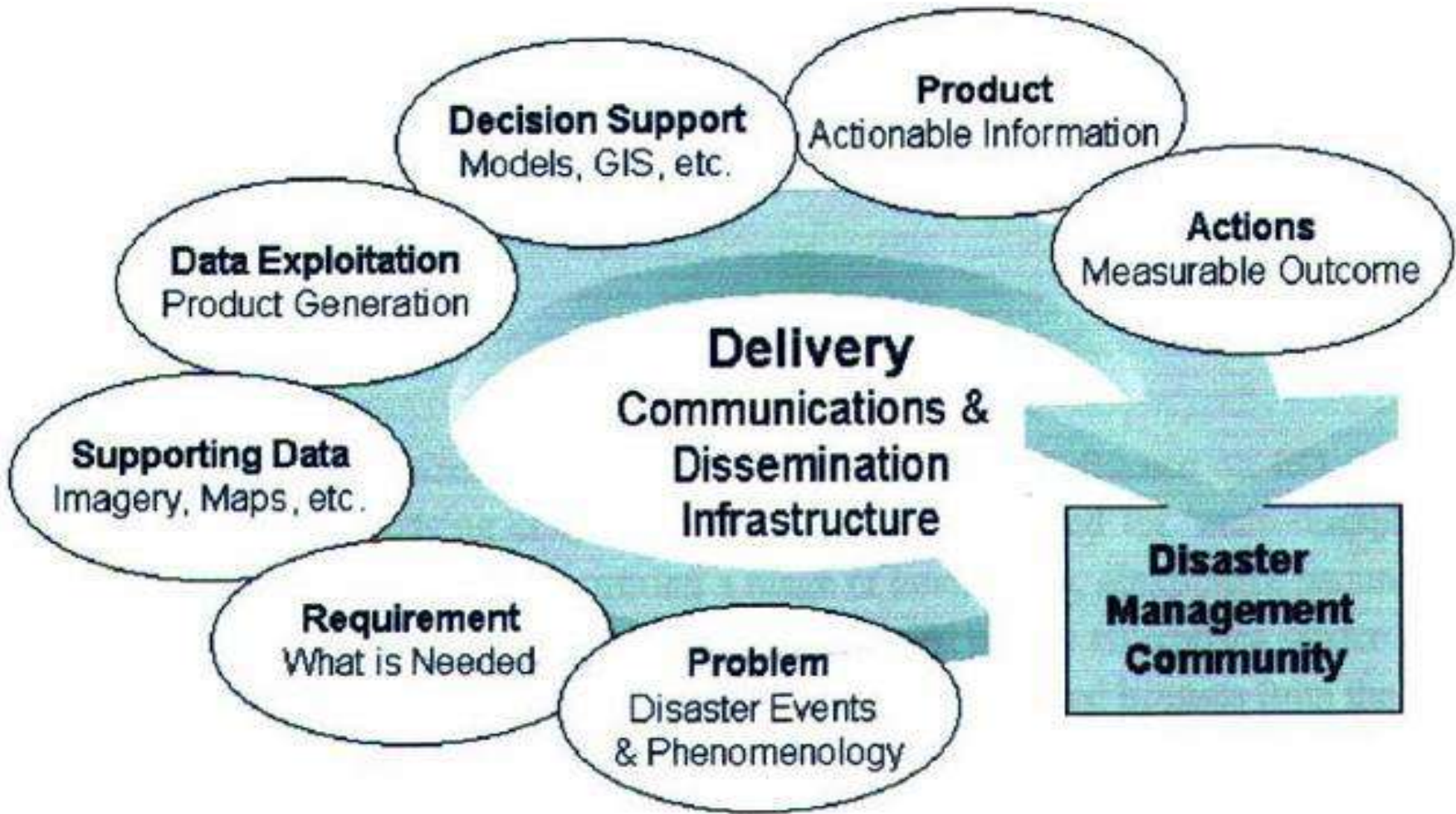


Space technology for Disaster management

Space technology has come a long way to help mankind in managing almost all the areas of all types of disasters.




- Geo-satellites help in monitoring the weather, provide uninterrupted communication links, acts as warning and data collection centre.
- The geo mobile component can even provide communication even in Orissa type of cyclone.
- The LEO spacecraft can provide met data, through optical & microwave remote sensing, can picture and monitor pollution, floods, avalanches, landslides, river course etc.
- Spacecraft can even carry sensors to pickup ELF waves, which are supposed to be emitted during earthquakes & volcano activities.

Disaster Management Community



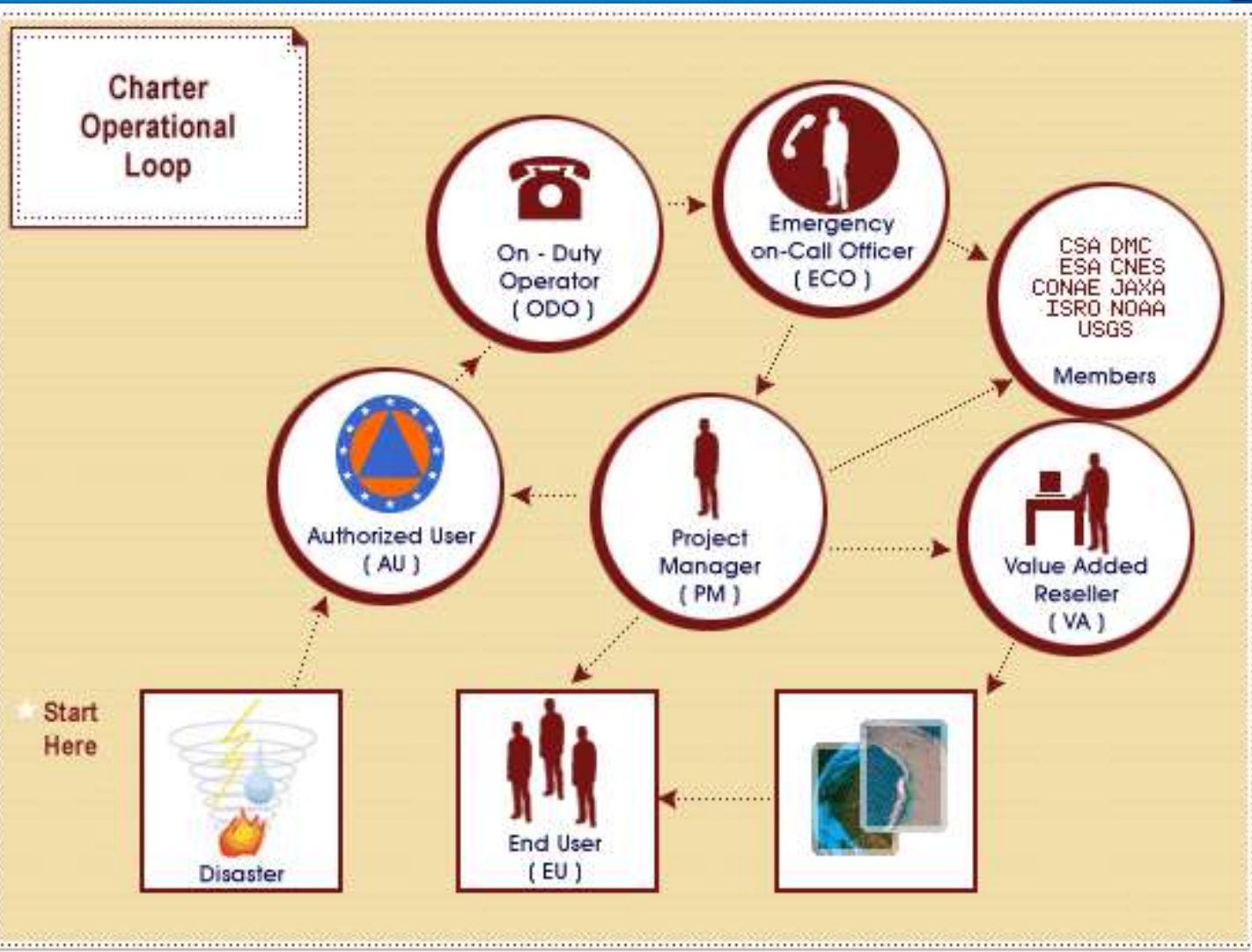
- Following the UNISPACE III conference held in Vienna, Austria in July 1999, the European and French space agencies (ESA and CNES) initiated the International Charter "Space and Major Disasters", with the Canadian Space Agency (CSA) signing the Charter on 20 October 2000.

Charters Members

Member	Space Resources
 European Space Agency (ESA)	ERS, ENVISAT
 Centre national d'Études spatiales (CNES)	
 SPOT	SPOT
 NSPO	Fermosat
 Canadian Space Agency (CSA)	RADARSAT
 Indian Space Research Organisation (ISRO)	IRS
 National Oceanic and Atmospheric Administration (NOAA)	POES, GOES
 Argentina's Comisión Nacional de Actividades Espaciales (CONAE)	SAC-C
 Japan Aerospace Exploration Agency (JAXA)	ALOS
 United States Geological Survey (USGS)	Landsat
 Digital Globe	Quickbird
 GeoEye	GeoEye-1
 DMC International Imaging (DMC)	
 Centre National des Techniques Spatiales (Algeria)	ALSAT-1
 National Space Research and Development (Nigeria)	NigeriaSat
 Tubitak-BILTEN (Turkey)	BILSAT-1
 BNSC/Surrey Satellite Technology Limited (UK)	UK-DMC
 BNSC/Qinetiq (UK)	TopSat
 China National Space Administration (CNSA)	FY, SJ, ZY satellite series

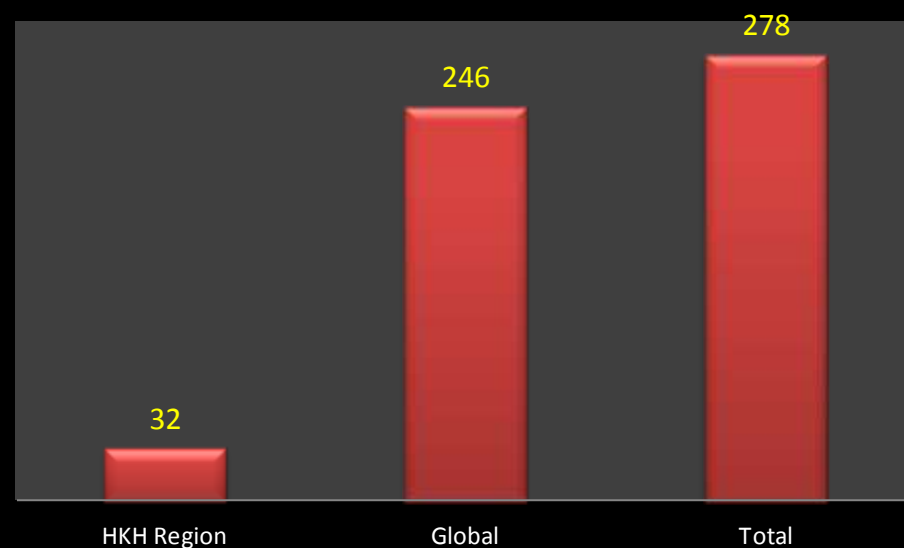
- Initiated in November 2000
- 10 members are the current space agencies of the charters

Functioning Charter



International Charters Activation

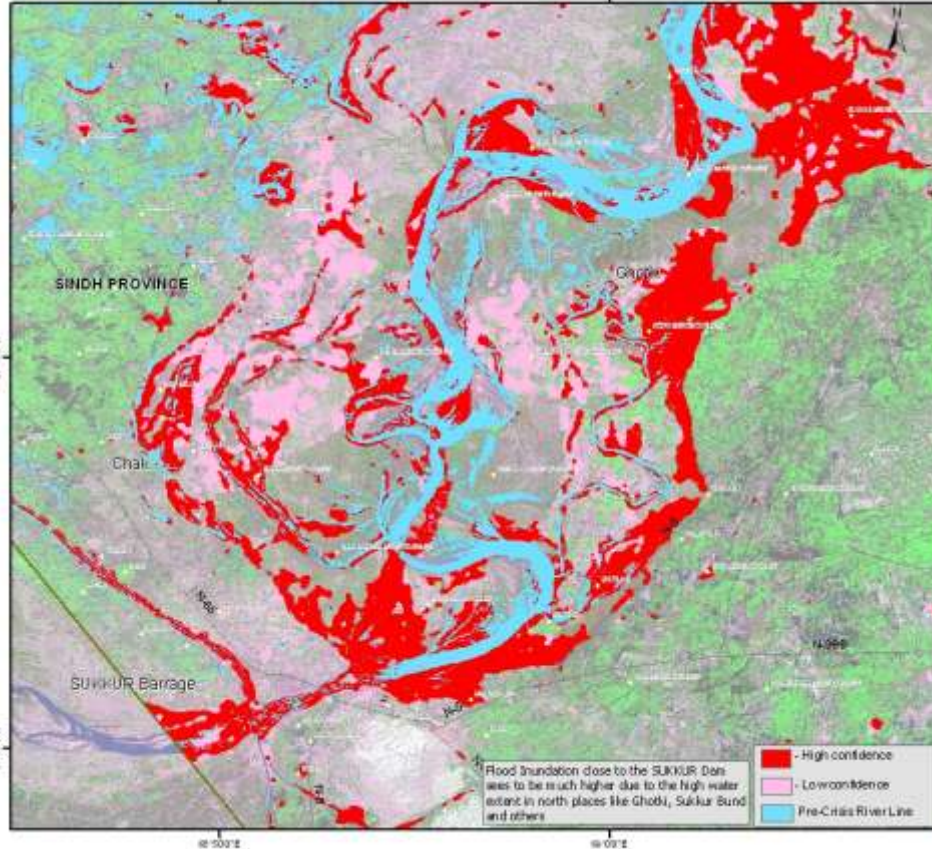
Charter Activation	Total	HKH Region	Global
2000	1		1
2001	11	1	10
2002	17		17
2003	17	2	15
2004	21	1	20
2005	25	4	21
2006	25	1	24
2007	43	6	37
2008	40	5	35
2009	39	1	38
2010	39	11	28
	278	32	246



Pakistan Floods

- ALOS AVNIR Data

Flood Inundation map [SUPARCO GRID-4] for the SINDH Province, Pakistan



Primary Source
 Satellite Data used :
 After Crisis :
 AWIFS - IRS P6 31 July 2010
 AVNIR - JAXA ALOS 05 August 2010
 Before Crisis :
 ETM+ - LANDSAT 2002/2003

Overview of Flood Inundation Map for the Sindh province. This map presents the flood inundated areas for the grid suggested by SUPARCO, Pakistan following recent heavy monsoon rains. This analysis is based on pre and post-disaster satellite imagery collected by IRS P6-AWIFS data and AVNIR - JAXA ALOS.

Floods were classified into high and low confidence using spectral differences and classification method. Please note that the exact limit of the flood waters is uncertain due to the coarse spatial resolution of the satellite sensors used for this analysis. This analysis has not yet been validated in the field. Please send ground feedback to MENRIS Division, ICIMOD.

Secondary Source

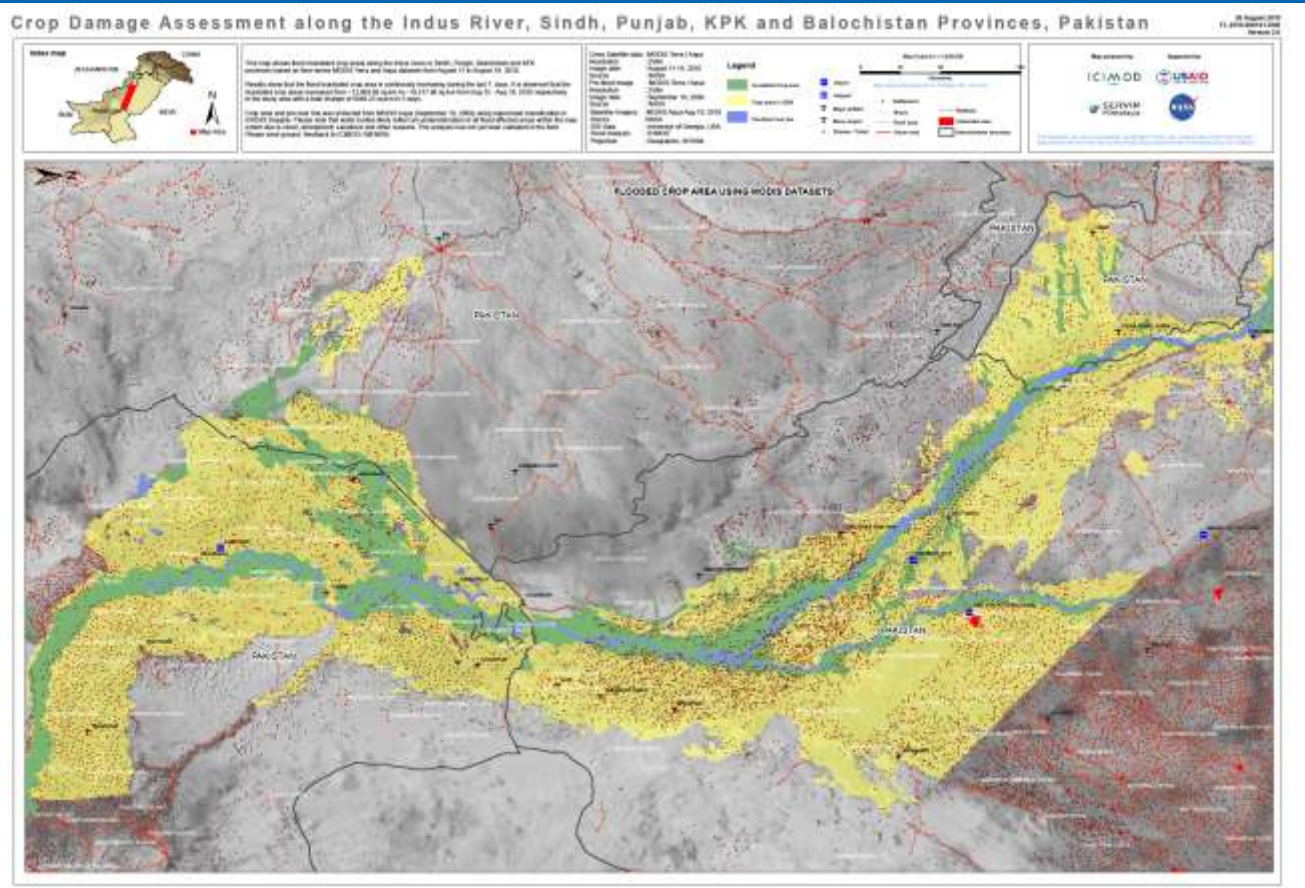
Infrastructure layer:
 Locality
 Administrative Regions
 Road Type
 Provinces

Satellite Data (background)
 Landsat ETM+ N-42-25

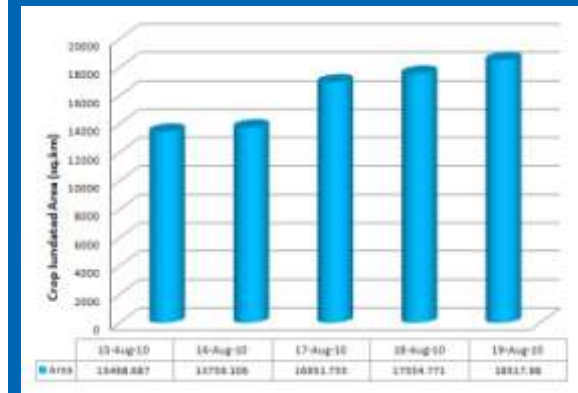


Flood inundation close to Sukkur dam seems to be much higher due to the high water extent in northern places like Ghotki, Sukkur bund and other neighboring areas. Using Isodata algorithm in ERDAS high and low confidences of water extent was mapping and additionally pre-crisis river lines was extracted using Landsat ETM+ of 2003 imagery

Flood Water Inundation in Cropland using Time-series MODIS Data



- MODIS Terra / Aqua over 10 days was used to assess flood areas affected by crop
- Cropland was mapped using September 2009 MODIS data

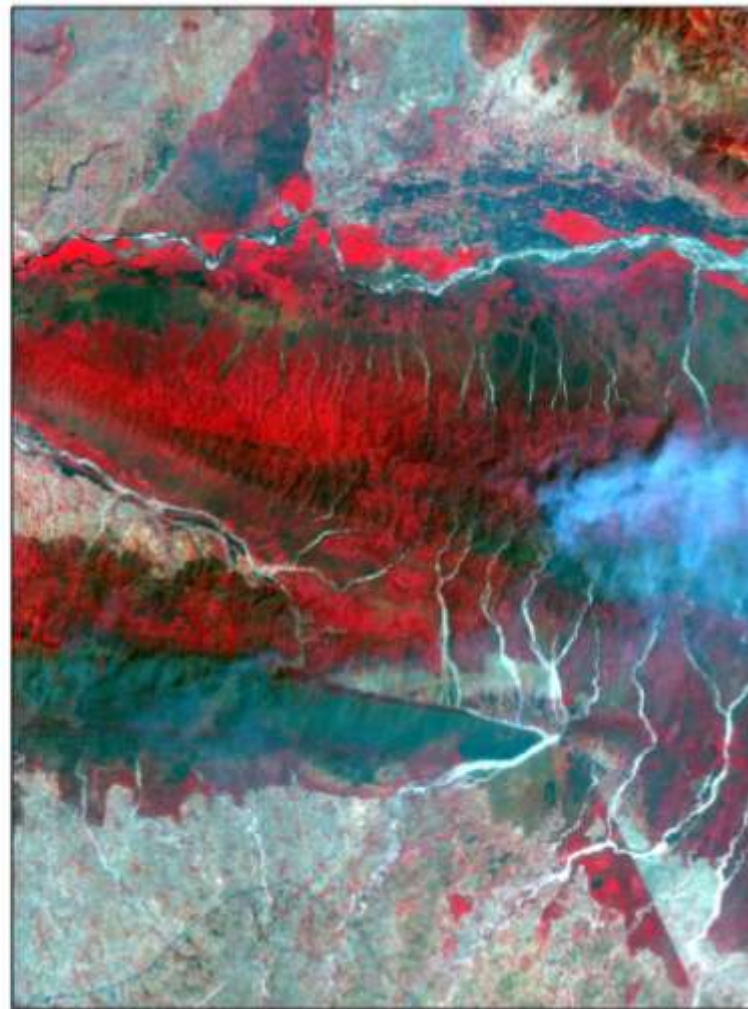
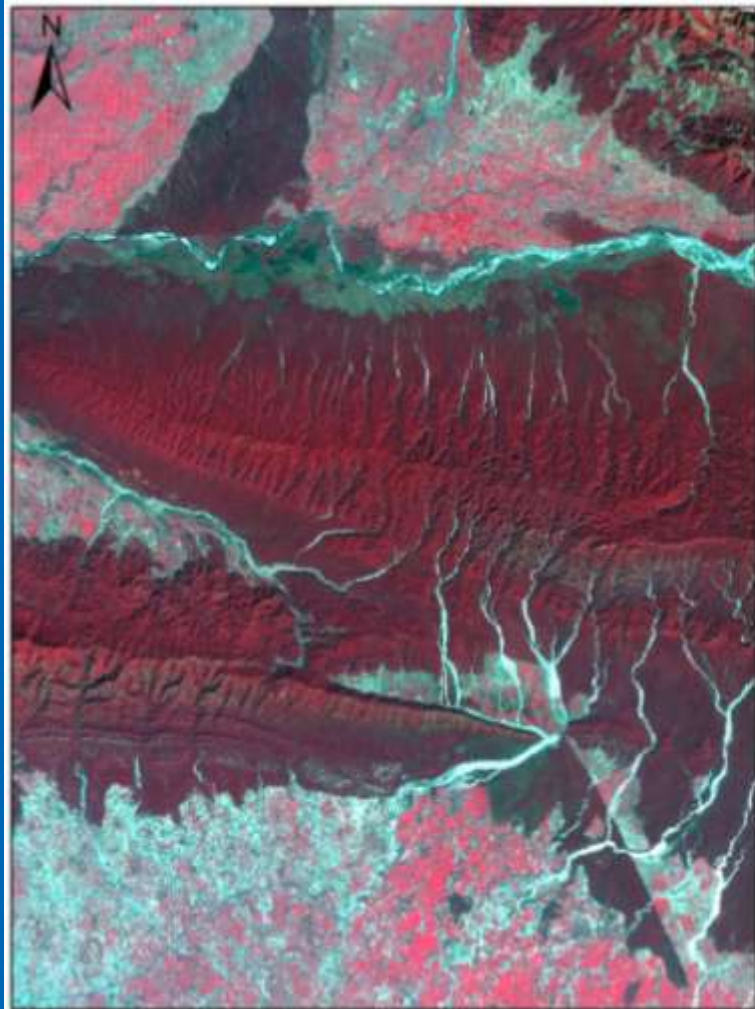


It is observed that the inundated crop areas increased from approx. 13,468.69sq.km to approx. 18,517.98sq.km from Aug 15-19 respectively in the study area with a total change of 5049.23sq.km in 5 days.

JAXA Satellite Imagery Forest Fires in Nepal

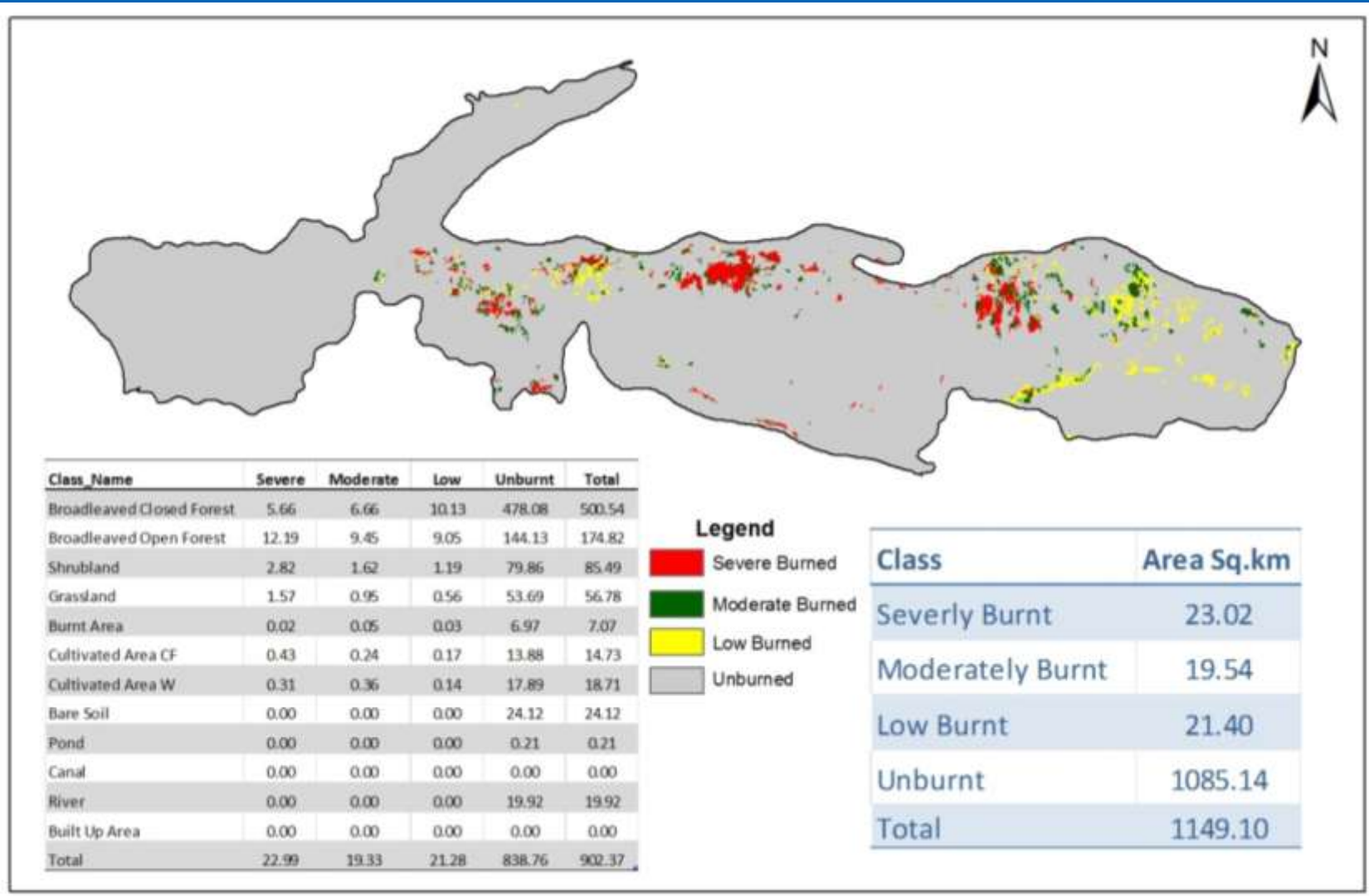
Before image – 18 Feb 2010

After image – 04 April 2010



Burnt Area Assessment

- Chitwan National Park, Nepal



Hunza Landslides Insights....

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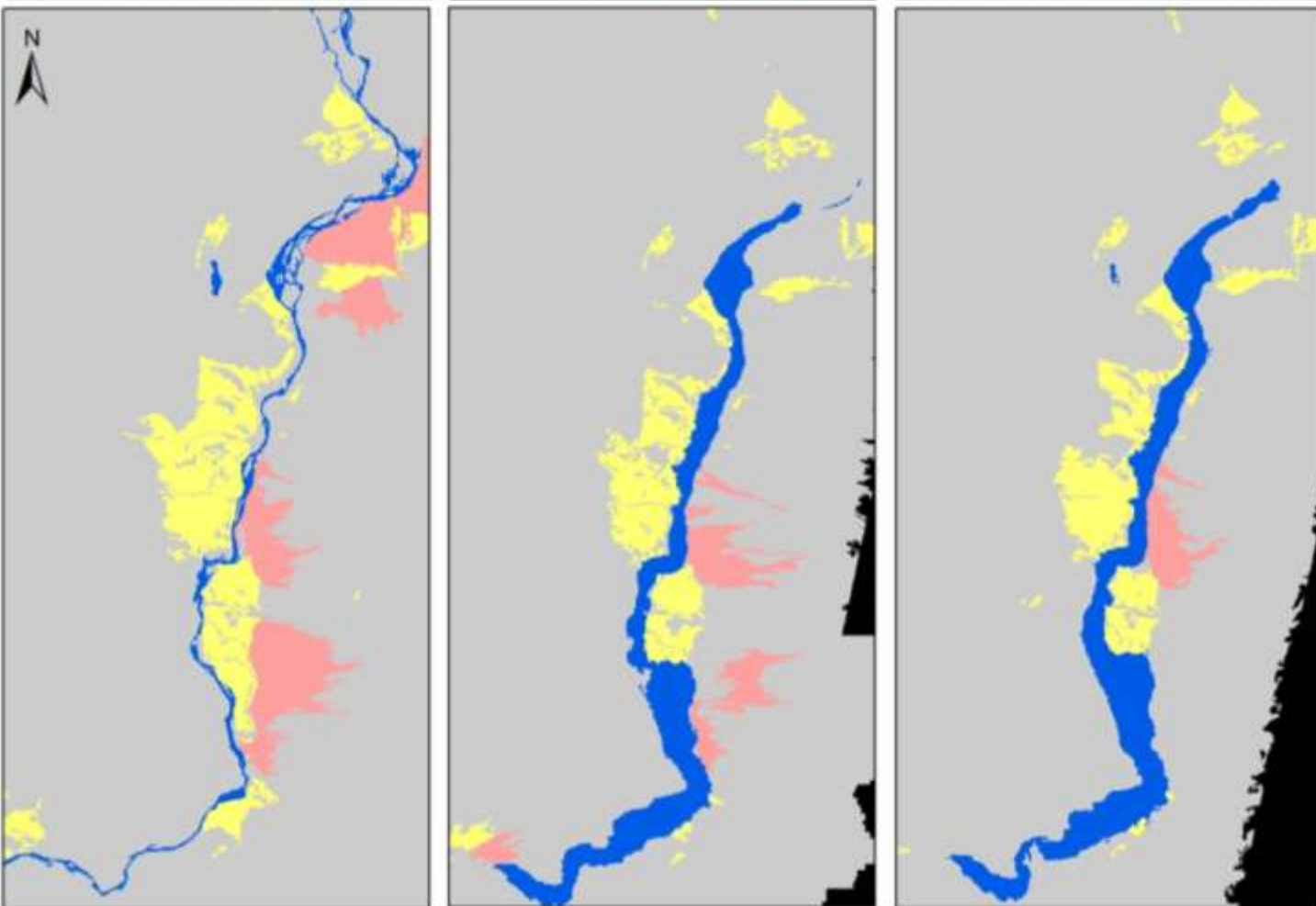


Satellite Imagery - ALOS AVINIR Image

10 Sep 2009

30 May 2010

13 June 2010

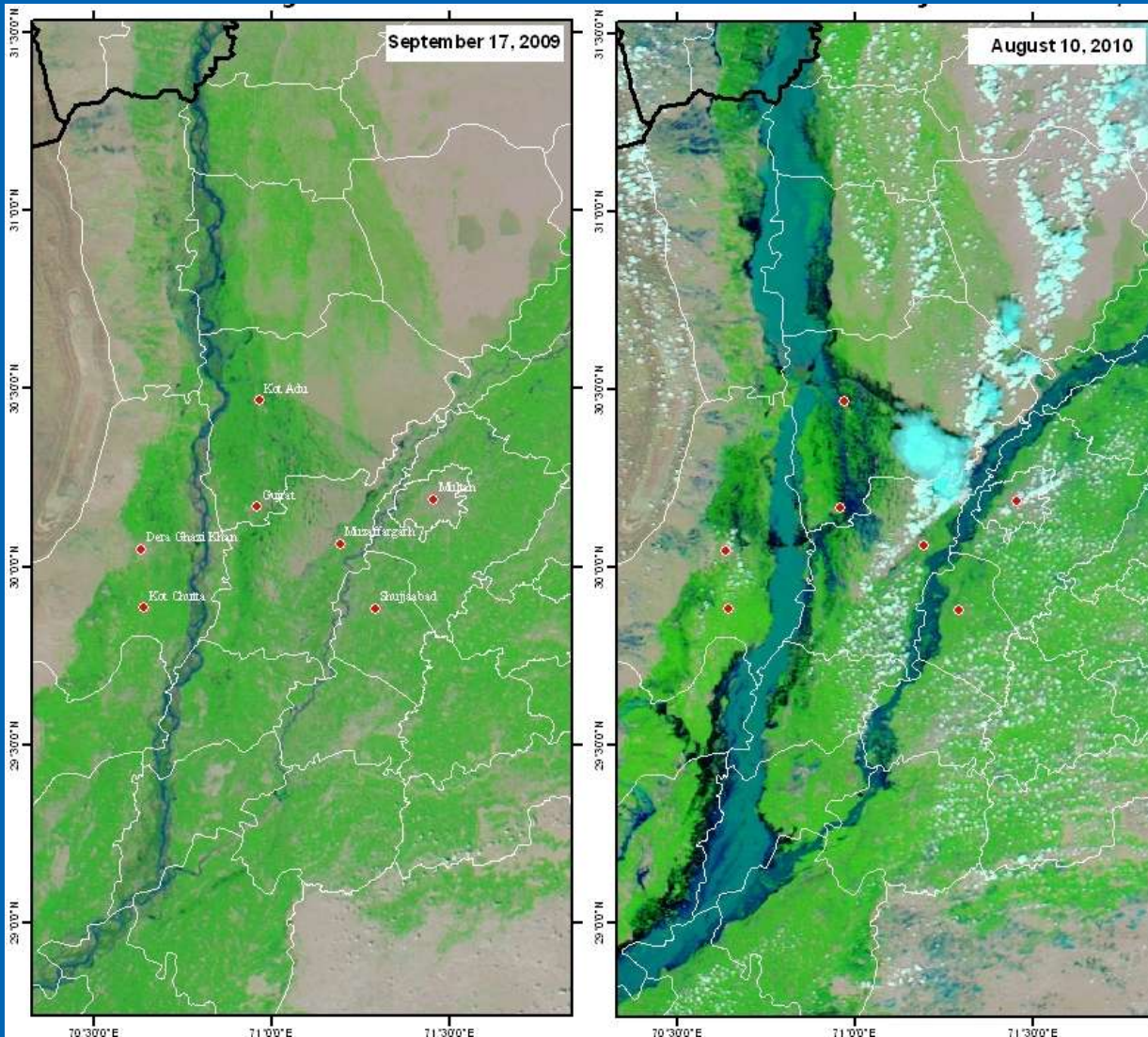


Space-based applications in emergencies : Examples



Flood Water Extent – MODIS

(Pre and Post Disaster)



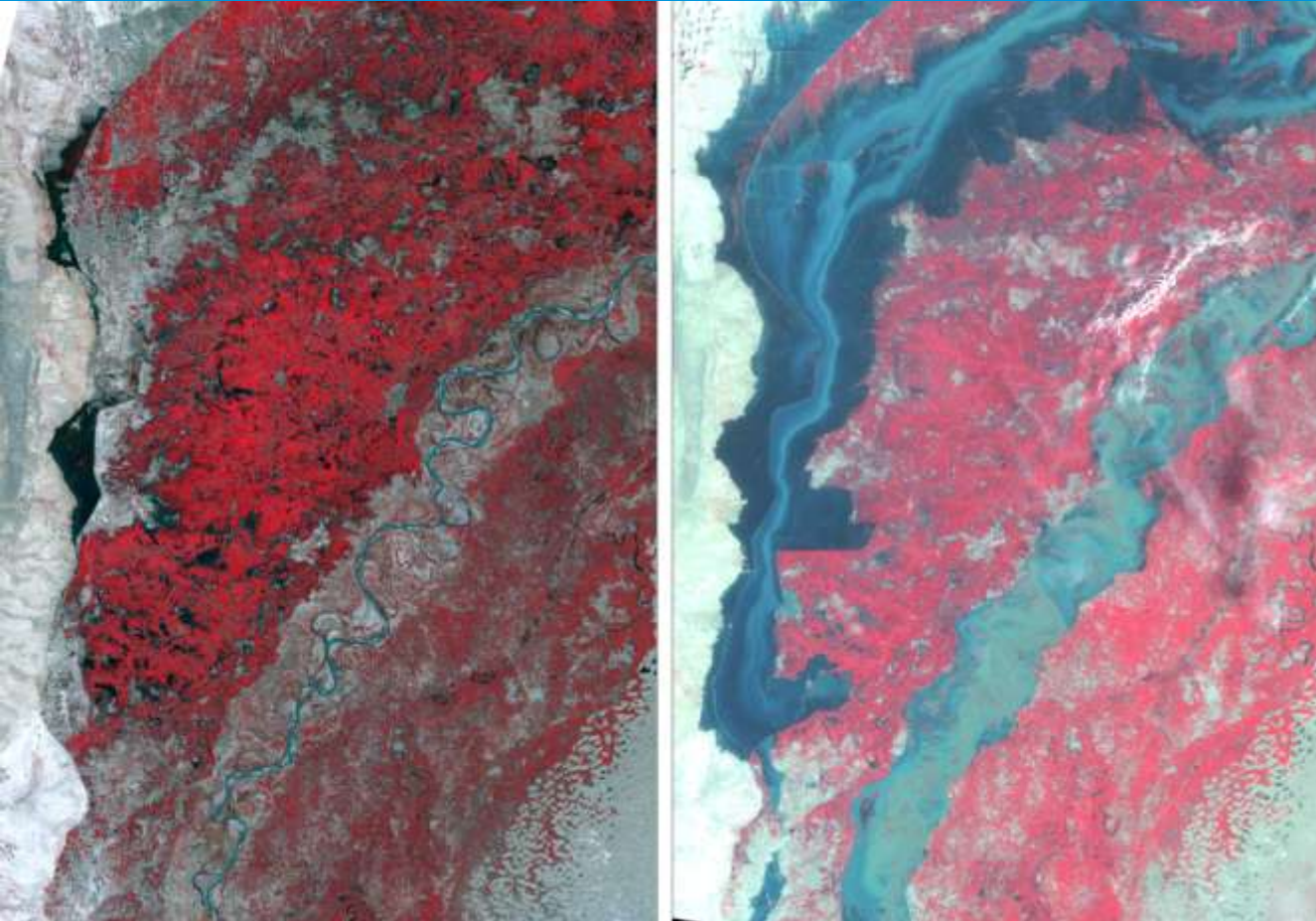
MODIS Terra Image

Before – Sep 17, 2009
After – Aug 10, 2010

Space-based applications in emergencies : Examples

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Before Crisis
Oct 10, 2003

After Crisis
Aug 24, 2010

Landsat Data

Disaster Information / Dissemination

Pakistan Disaster Networks

- Pakistan Space and Upper Atmosphere Research Commission (SUPARCO)
- National Disaster Management Authority (NDMA)
- Pakistan Meteorological Department (PMD)
- World Wide Fund for Nature, Pakistan (WWF)
- International Water Management Institute

International Organizations and Development Agencies

- UN-SPIDER
- European Commission
- Asian Development Bank and WFP
- USDA

Mountain Geoportal

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The screenshot shows the Mountain GeoPortal website. At the top left is a banner image of snow-capped mountains with the text 'Mountain GeoPortal' and 'Mountain Environment and Natural Resources' information System (MENRIS) below it. To the right of the banner is the ICIMOD logo and the tagline 'FOR MOUNTAINS AND PEOPLE'. Below the banner is a navigation menu with links: ICIMOD, Applications, Methods & Tools, Geo-data Services, Training & Education, Download, Home | About Us, and a search box. On the left side, there is a vertical menu titled 'Application Themes' with categories: Air & Atmosphere, Disaster & Natural Hazard, Ecosystem & Biodiversity, Land Cover / Land Use, Socio-economy &, Livelihoods, and Water & Cryosphere. The main content area features a section titled 'Pakistan Flood 2010'. It contains a paragraph describing the flooding in July 2010, a link to 'Download Flood Water Extent using MODIS data from August 12-29, 2010', and a link to 'Click here to view Near-RealTime Interactive Map Viewer'. Below this is a sub-section titled '39 Pakistan Flood Maps and Geodatabases' with a date filter for 'September 8, 2010'. A map thumbnail shows flood waters in the region of West of Dadu, Johi and Khairpur Nathan Shah, Mehar Tehsils, Sindh Province, Pakistan. The text next to the map states: 'This map shows daily variation in flood water extent covering Jati and Shah Bunder Tehsils along the Indus rivers in parts of Sindh provinces based on MODIS Terra datasets from September 1 and September 5-8, 2010. More than 100 sq kms of flood waters have inundated...'. On the right side of the main content area, there is a 'Downloads' section with a list of links: Data Acquisition date from Charter (xls), UNOSAT Pakistan Geodatabase, Google Earth File (12 August), Google Earth File (14 August), Google Earth File (13 August), Google Earth File (18 August), and Flood Water Extent using MODIS data from August 12-29, 2010. Below the downloads is a 'RELATED LINKS' section with links to: NASA Earth Observatory, Pakistan Flood Relief Effort 2010, Pakistan Flooding - Maps & Satellite Images from ESRI, Pakistan Meteorological Department, and Sentinel Asia.

- More than 40 flood maps
- Flood Geodatabases
- Flood using Google KML

ICIMOD Data in Other portal

Portal

- **Sentinel Asia**

http://dmss.tksc.jaxa.jp/sentinel2/thumbnailEmob.action?subset_name=Emergency+Observation&requestId=ERICIM000010

- **European Commission**

http://ec.europa.eu/dgs/jrc/index.cfm?id=1410&obj_id=11360&dt_code=NWS&lang=en

- **UN-OCHR One Response Pakistan**

- <http://pakresponse.info/index.php?id=3>

- **United States Geological Survey (USGS)**

http://edcftp.cr.usgs.gov/pub/data/disaster/201007_Floods_Pakistan/docs_misc/Flood_Maps/ICIMOD/

- **Dutch International Hydrology Portal**

<http://www.hydrology.nl/>

- **SUPARCO Flood Maps**

<http://floodmaps.lums.edu.pk/>

- **Pakistan GIS**

http://pakgis.blogspot.com/2009/05/pakistan-flood-2010-water-extent-from_16.html

Media

- <http://www.scidev.net/en/news/pakistan-flood-data-wasted-say-critics.html>
- <http://propakistani.pk/2010/09/06/pakistan-flood-data-got-wasted-critics/>
- <http://www.thenews.com.pk/07-09-2010/islamabad/3438.htm>

Conclusion

- It is evident that the global community has not relented in its efforts to finding appropriate and long term solutions to natural disasters.
- Sudden occurrences as the recent tsunami disaster in south east Asia or floods in Pakistan is a reminder in our national and Himalayan regional efforts to embark on space-based initiatives and set-up/strengthen the relevant facilities and early warning systems for disaster management and mitigation.
- HKH region is called upon to be proactive in the implementation of UNISPACE III recommendations, including active participation in the proposed activities of DMISCO

Conclusion

- Fostering regional cooperation like ICMOD organization in the region should be supporting in order build and strengthen capacity of using space-based information for DRM
- The establishment of a space-based programme, similar to GMES/ RESPOND, that will serve as a channel for research & forecast and response to any disaster in each country is strongly recommended.
- Space system-based solutions to disaster reduction are inevitable; any investment in support of such national programmes and initiatives to meet the challenges of disaster management and reduction and the achievement of a sustainable national and regional development should be encouraged.

Thank You!!

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Presymposium workshop on “Space-based information for Disaster Preparedness and Risk Management”

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October 2 – 3, 2010



Group Session

1. Identify strategies to bridge the gaps between the Space Technologies (information) and the Disaster Management Communities among the Regional Member Countries of ICIMOD
2. Improve the communication and coordination among regional and international stakeholders regarding access to and use of space based information during major disasters
3. Identify Gaps and needs to strengthen national Institutes and capacity building in utilizing space based information for disaster Preparedness and Risk Management
4. Role of regional organizations like ICIMOD in space based information for disaster preparedness and risk management

Identify strategies to bridge the gaps between the Space Technologies (information) and the Disaster Management Communities among the Regional Member Countries of ICIMOD

1. Wider awareness among the DMC including NGOs about the sources and types of space-based information on disasters. Space-based information must be available to all the DMC for rapid and effective response to disasters
2. Need for launching national and regional level capacity building programs to train the DMC in handling the space-based information. Involvement of Universities, national institutes, private sector in capacity building in geo-information management is recommended

Contd.....

3. Need to reduce lag time in processing of space data. Near real time transfer of space-based information to the DMC when and where they are needed to assess the impacts and plan response
4. Need for giving preference by Space-agencies to data acquisition during the event of disaster. Further, there is need for designing and launching of constellation of satellites devoted to disasters only
5. Value added space-based information need to provided to the DMC for better and quick implementation of the DM measures
6. There is need for more number of initiatives like SAS, and UNSPIDER for supplying space-based information for rapid response

Contd.....

7. Restriction-free data dissemination policies need to be encouraged by the member countries.
8. Need for giving preference by Space-agencies to data acquisition during the event of disaster. Further, there is need for designing and launching of constellation of satellites devoted to disasters only
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Group 2: Improve the communication and coordination among regional and international stakeholders regarding access to and use of space based information during major disasters

- ## Issues with Space Agencies

 1. Time required to send the imagery
 2. How to send and receive the large data
 3. Available capacity to download data
 4. Data Format
 5. Data policy of space agencies
 6. Need to optimize as soon as quickly available
 7. Complex situations even inside a country and regional issues etc
 8. Activate the charter onboard with the Govt.

Group3: Identify Gaps and needs to strengthen national Institutes and capacity building in utilizing space based information for disaster Preparedness and Risk Management

- Disaster management and Geoinformatics applications to be included as an elective or compulsory subject in all undergraduate courses e.g. engineering, medical, planning, architecture, management, geography programs etc.
- Training Need Assessment and User Need Assessment through consultation workshops, preparatory meetings etc.
- Establishing Geoinformatics centers in existing Disaster Training Institutes and empowering them
- Short term courses as per user requirement
- More E-learning courses i.e. Self learning, Moderated online courses and blended learning

Group 4: Role of regional organizations like ICIMOD in space based information for disaster preparedness and risk management

- Build upon existing strengths and mandate
- Play role in disaster preparedness as well as emergency response
- Platform for knowledge sharing
- Role in capacity building with partner organisations
- Mapping centre (risk and vulnerability maps, emergency products)
- R&D and methodology development
- Data centre: collect, store, disseminate
- Effective contribution by building regional and international partnerships