GNSS Scientific Applications and related projects in Bangladesh Space Research and Remote Sensing Organization

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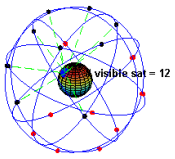

United Nations/Abdus Salam International Centre for Theoretical Physics Workshop on the "Use of Global Navigation Satellite Systems for Scientific Applications" from 1-5 December, 2014, Trieste, ITALY

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- Overview of RS and GPS at SPARRSO
- GNSS in RS Applications at SPARRSO
- GNSS Applications in other Organizations
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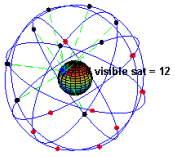


Overview of RS and GPS at SPARRSO

- The history of RS technology in Bangladesh dates back to 1968 when the first APT station was set up.
- Bangladesh ERTS program was initiated in 1972, when NASA launched the ERTS-1 satellite

➢ At present SPARRSO receives data from FY-2D/2E, MTSAT, NOAA-AVHRR and Terra/Aqua MODIS.

➢ The history of GPS technology in SPARRSO dates back to 1985 when the Buoy station was set up in the Bay of Bengal for collecting Atmospheric Information under ACEMP project funded by USAID. But unfortunately it was missing during devastating cyclone 1991.

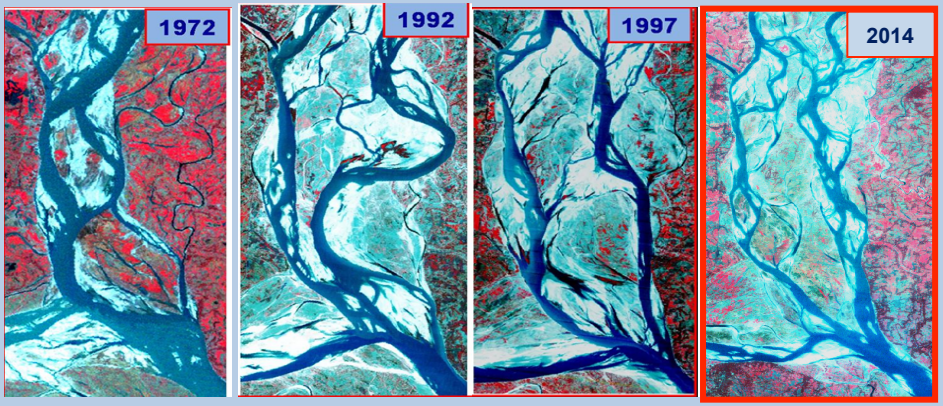
➢ At present SPARRSO has a number of hand held GPS sets including Promax-3 RTK GPS

Atomic Energy Commission → Space and Atmospheric Research Center (SARC)

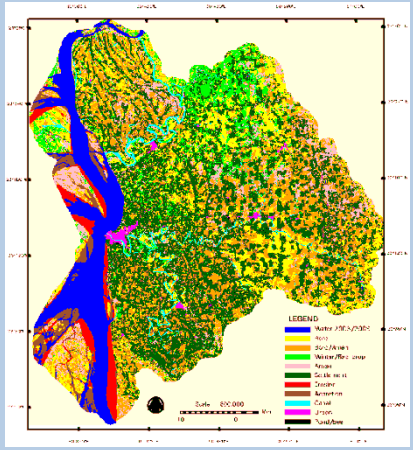
USA Launched ERTS (Earth Resources Technology Satellite) In 1972 → ERTS Program → BLP (Bangladesh Landsat Program), 1975

SARC and BLP → **SPARRSO (1980)**

Buoy 1985



River Course Monitoring



Land use Zooning

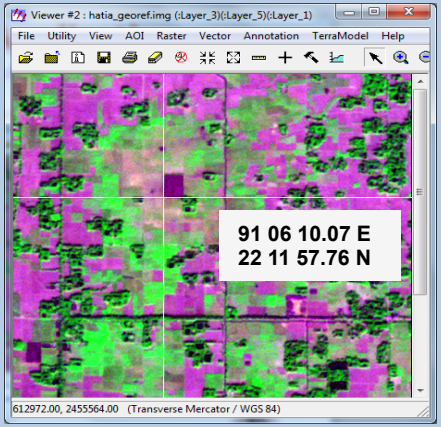
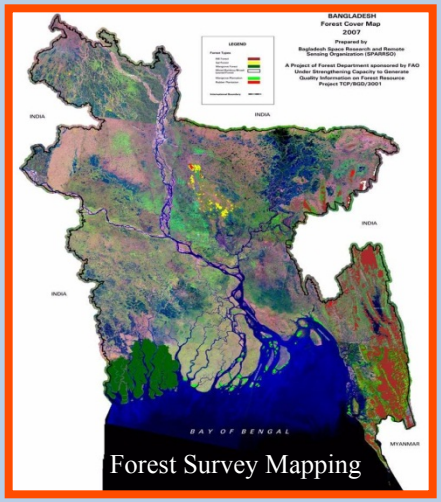
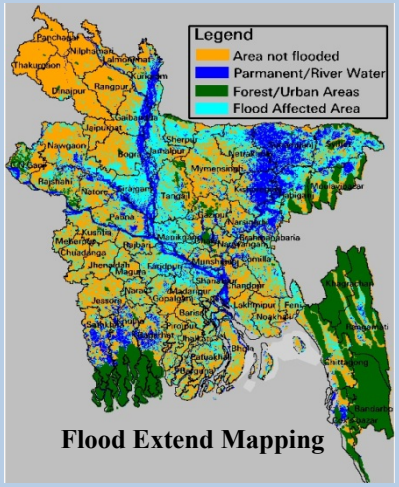


Image Geo-Referencing

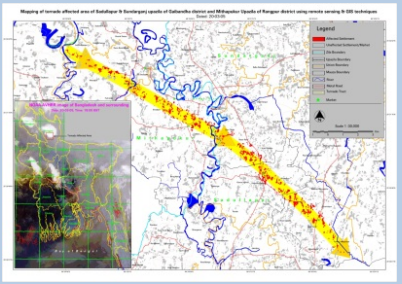


Forest Survey Mapping

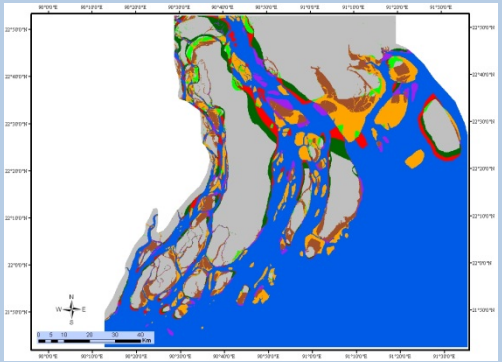
GNSS in RS Applications



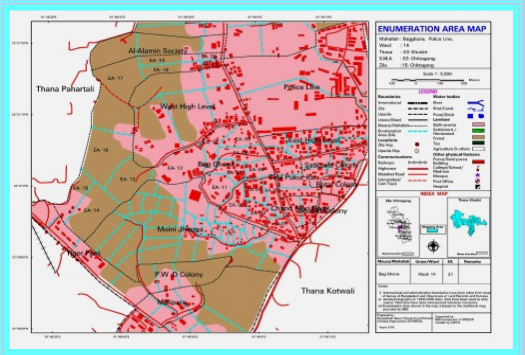
Flood Extend Mapping



Post Tornado affected area Mapping

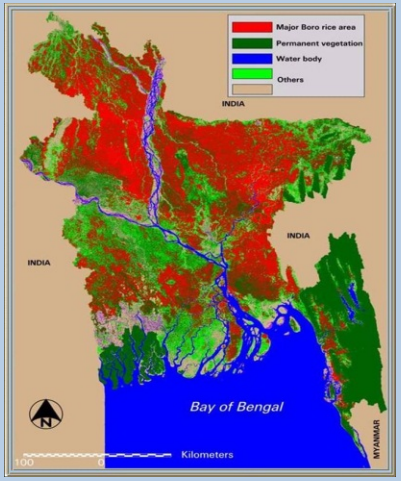


Coastal Zone Management



Enumeration Area (EA) Mapping

Water bodies Management



Crop Area Estimation

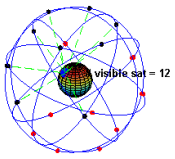
GNSS in RS Applications

- SPARRSO activities are related to a large number of RS fields like meteorology, forestry, fisheries, agriculture, water resource, oceanography, environment, disasters, etc.

✓**When** and **Why GPS Required for RS Applications?**

Generally, three times we used GPS during RS data generation (data reception to map production)

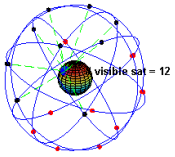
- **GPS required for Image Geo-Referencing by GCP from Ground**
- **Accuracy assessment of Geo-referenced data/image**
- **GPS required for Validation of O/p Products of RS data**



GNSS in RS Applications

GPS for Image Geo-Referencing

- Satellite imagery is often a part of the GIS database. In order to align the image with other GIS data layers, it must be corrected geometrically and referenced to ground locations (x,y).
- Ground control points (GCPs) collected by GPS are used to reduce distortion and to place the image pixels in proper geographic location (x,y).



GNSS in RS Applications

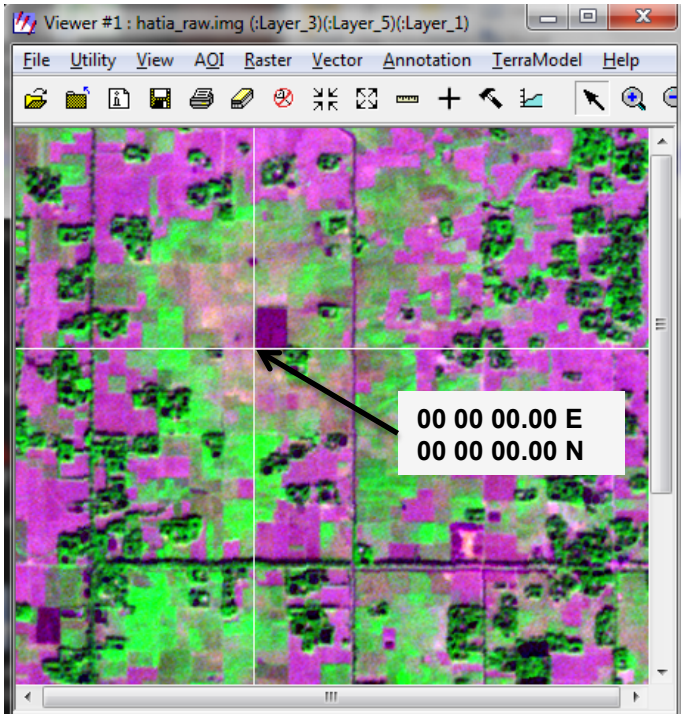
Collection of GCP

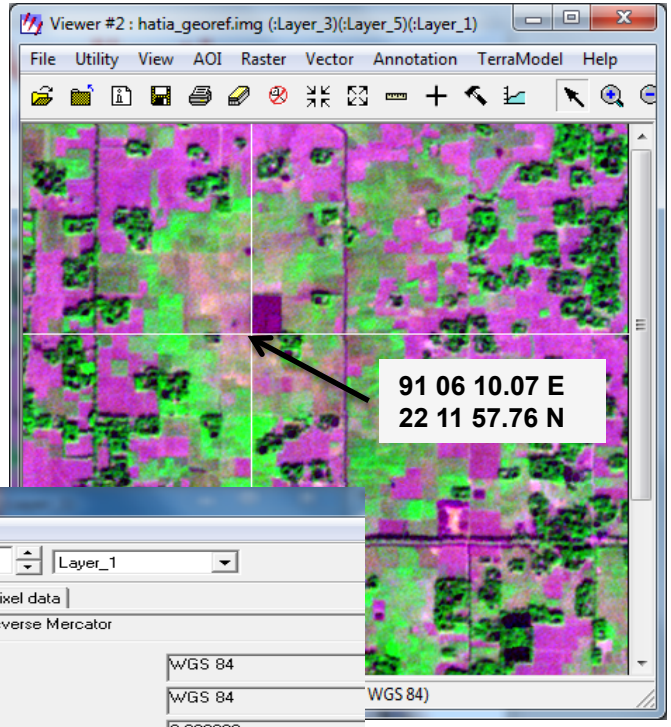
- GCP are coordinates (X,Y) collected at easily identifiable locations. They need to be visible on the image and be located in a place where coordinates can be collected.
- Road intersections are a common choice.

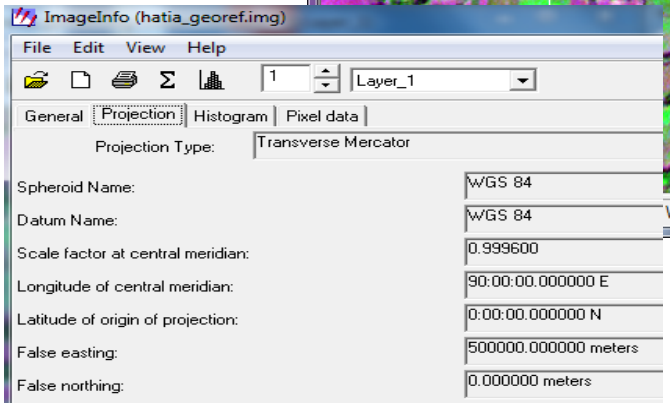
GNSS in RS Applications

How many Ground Control Points (GCP) required?

- Three or more GCPs and some software can be used to establish a geographically corrected grid to which the pixels in the image may be adjusted.
- The more precise the GCPs, the better the corrections will be.

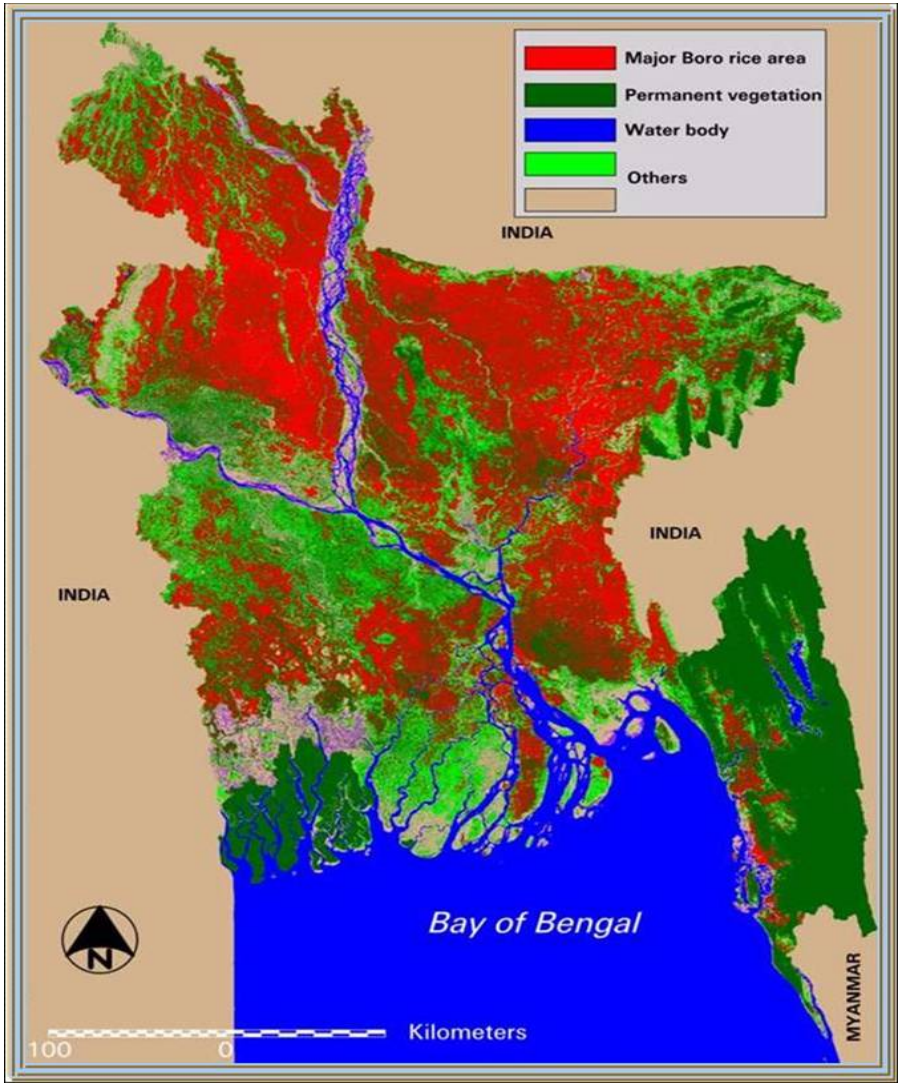






GNSS in Agriculture Monitoring

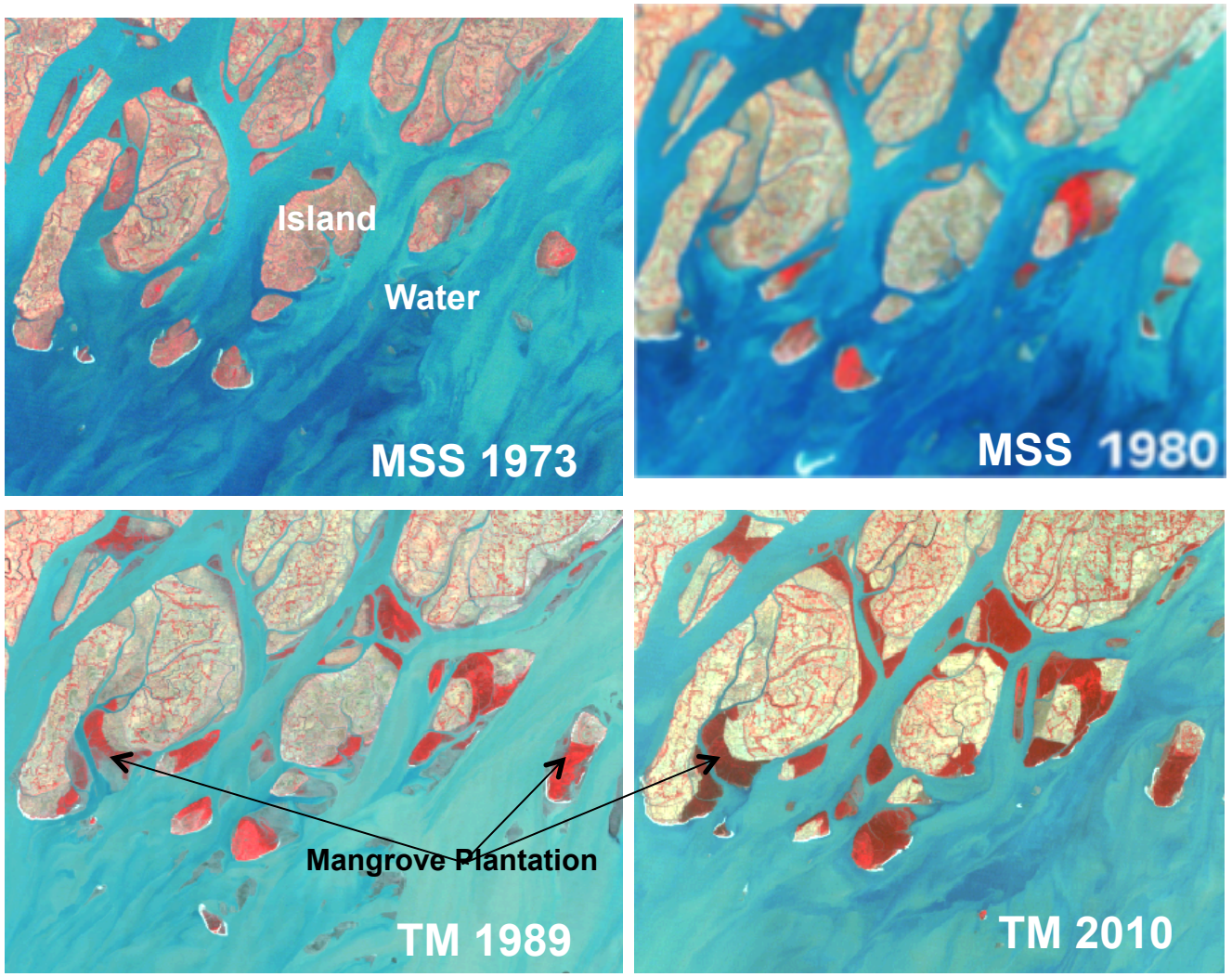
- Bangladesh economy is mainly based on agriculture.
- Almost 80% of the total population depends on agriculture.
- For monitoring the distribution of crops area in real time basis we are using GPS and RS technology since last two decades.
- It is helpful for policy making for food security.



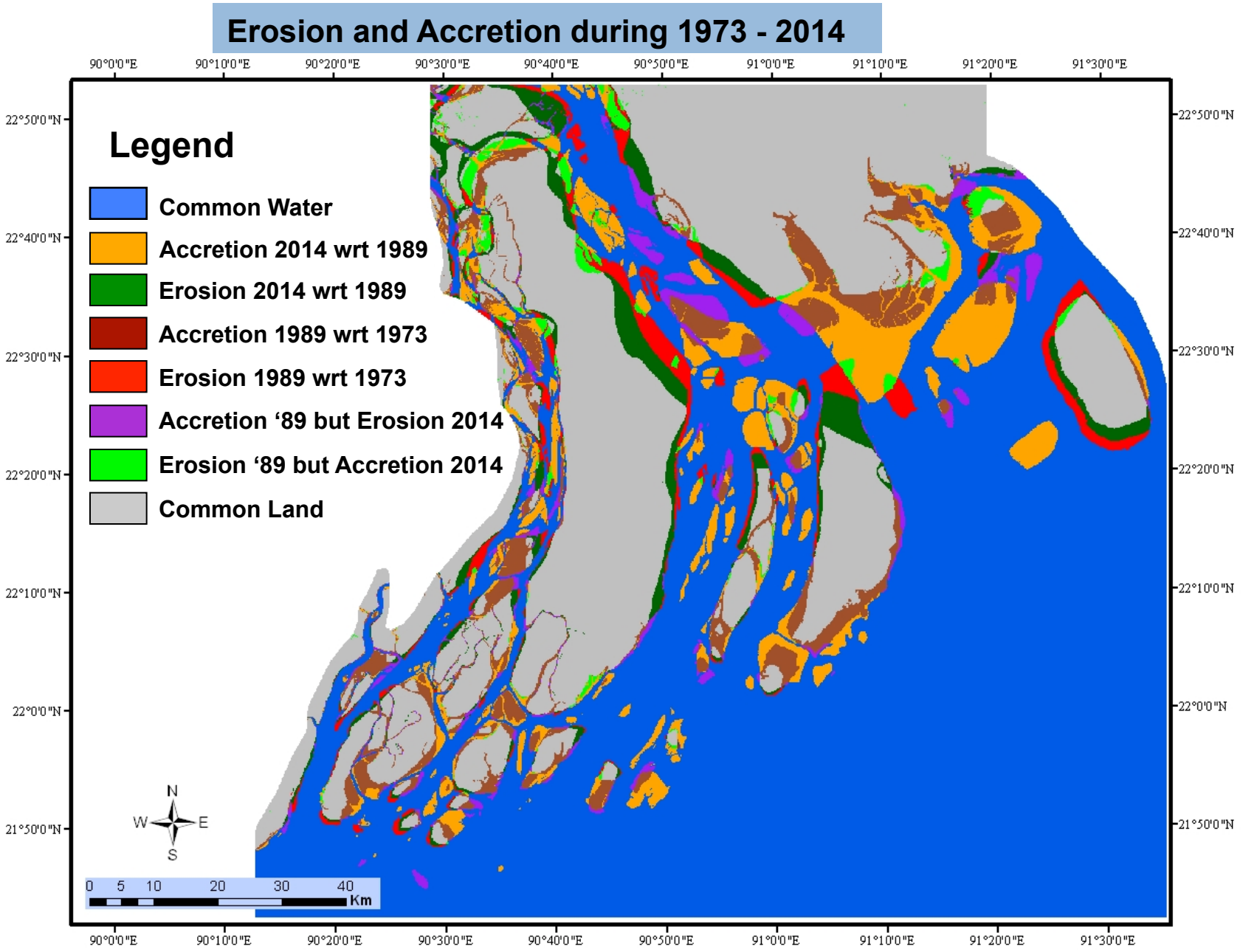
Use of RS and GPS in coastal zone Management

(Expansion of Afforestation Area)

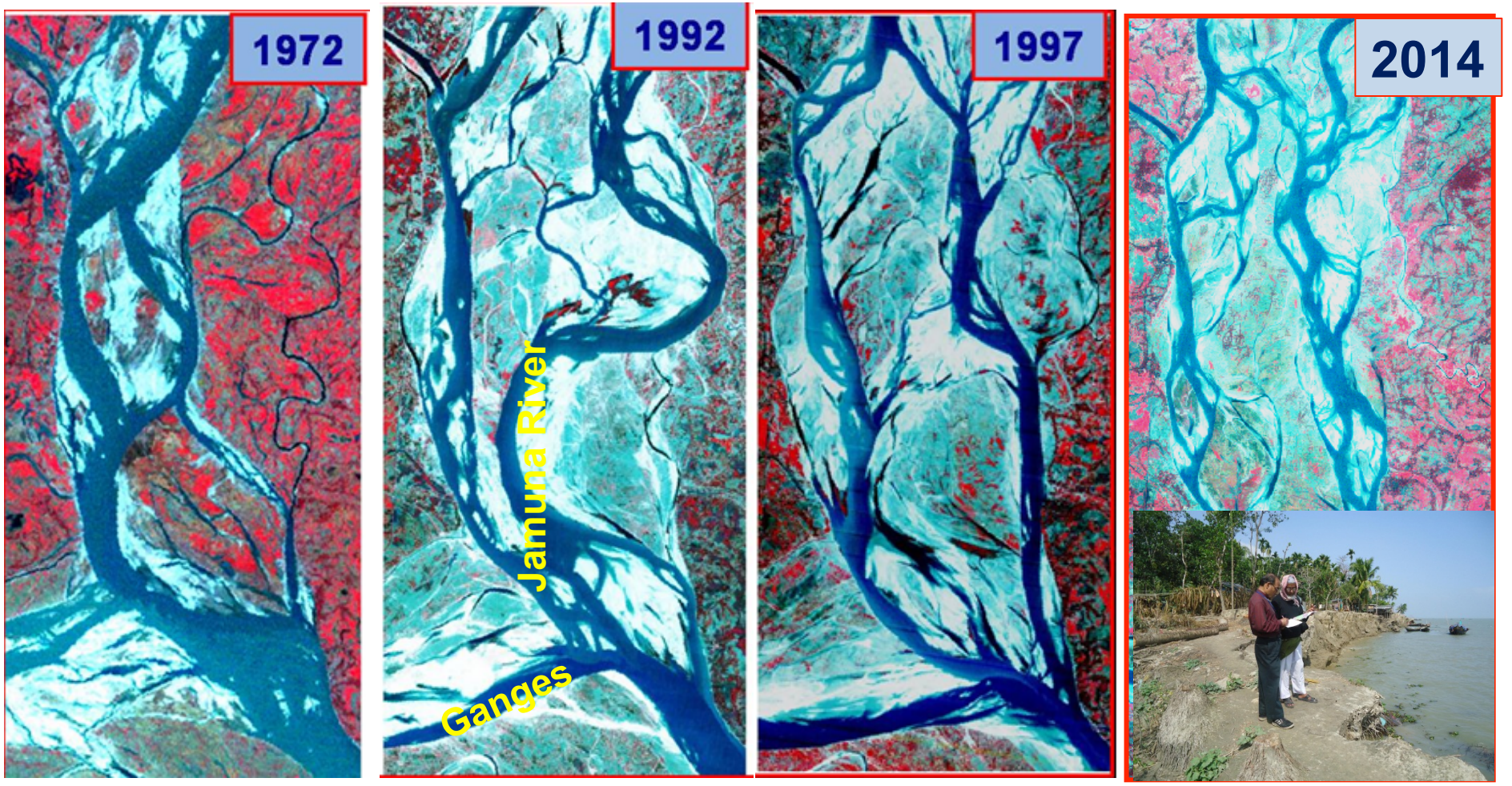
GPS extensively used under Mangrove afforestation project (BGD 85-031, 1990) of SPARRSO for reclaim land area.



Use of RS and GPS in coastal zone Management



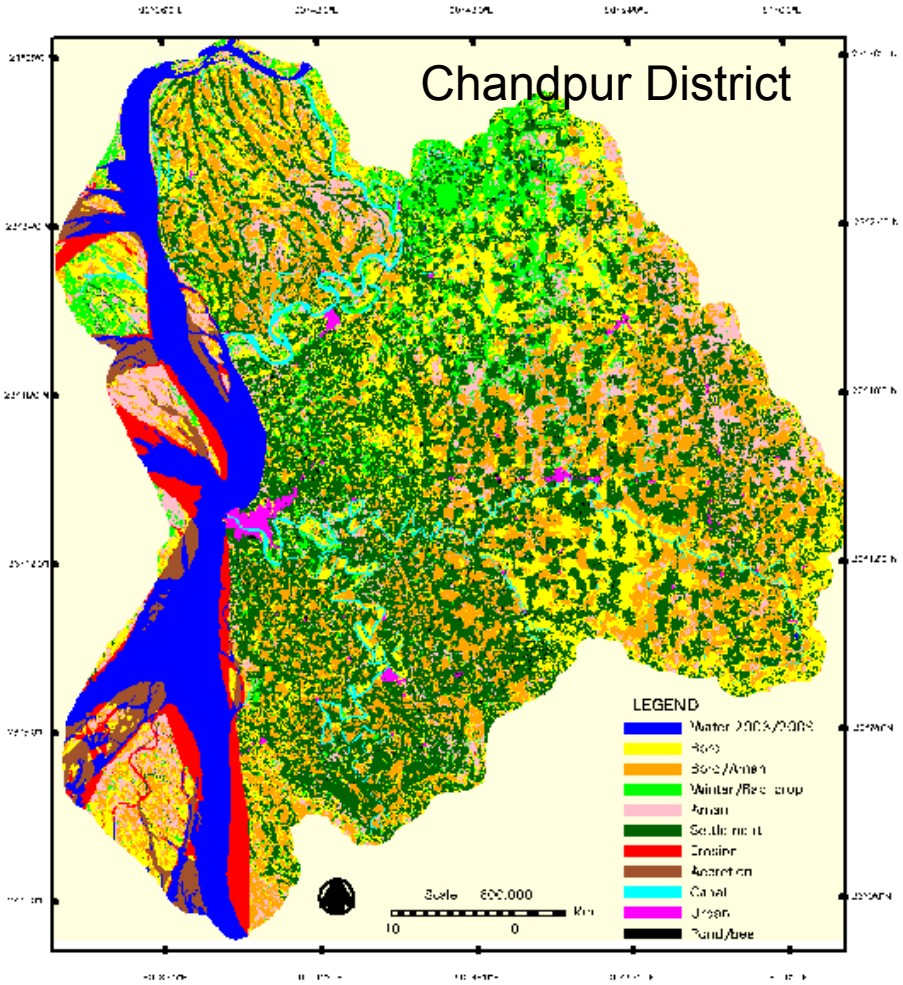
Geomorphological Changes of River Course Monitoring

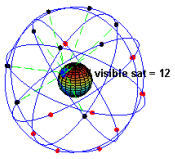


- Maps were prepared showing the morphological changes of river
- Geo-referenced of both the data were verified using GPS based field survey
- Real time observation of River Course could be measure using GPS

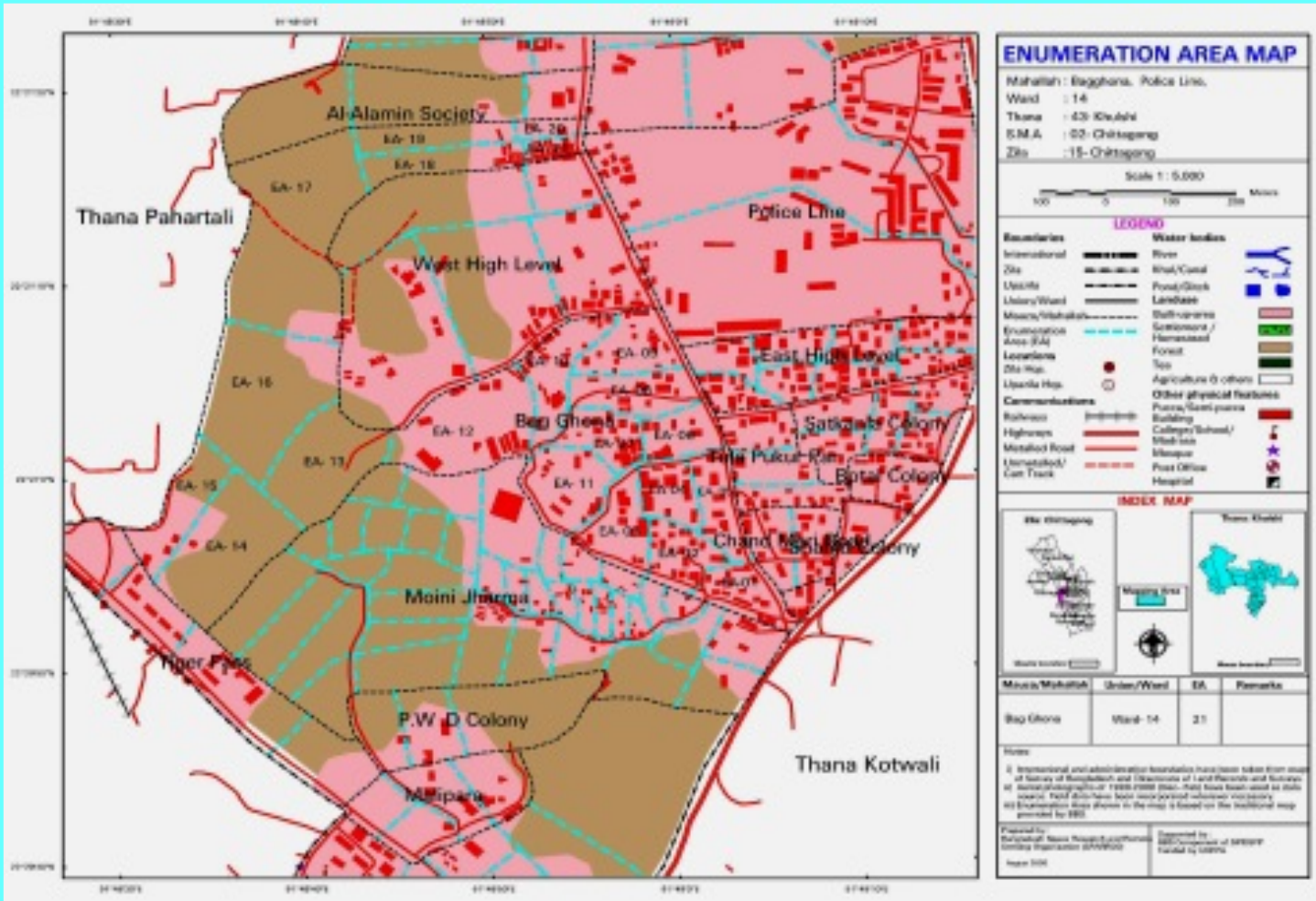
RS and GPS used in Land use Zoning

- SPARRSO carried out a project on Coastal Land Zoning under the Ministry of Land for land use classification for coastal area (21 Districts)
- LISS-III 2009 and TM 2007data have been used
- **Geo-referenced** and **classification** of thematic layers were **verified using GPS based field survey**





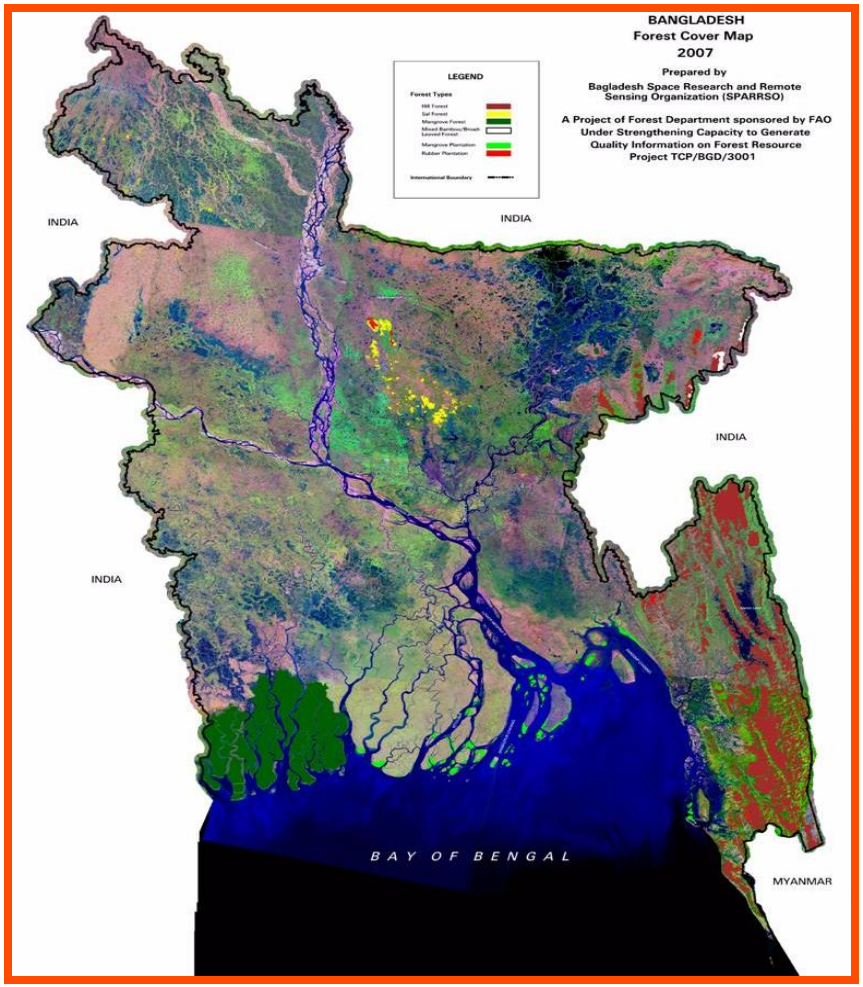
Enumeration Area (EA) mapping using Air-bone data

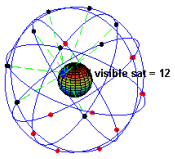


- **SPARRSO has successfully completed the project "Preparation of Digital EA maps using aerial photographs", funded by UNFPA for BBS.**
- **Huge number of aerial photographs has been geo-referenced using ortho software coupled with GCP collected by GPS. Results also verified by GPS.**

Forest Area Mapping using RS and GPS

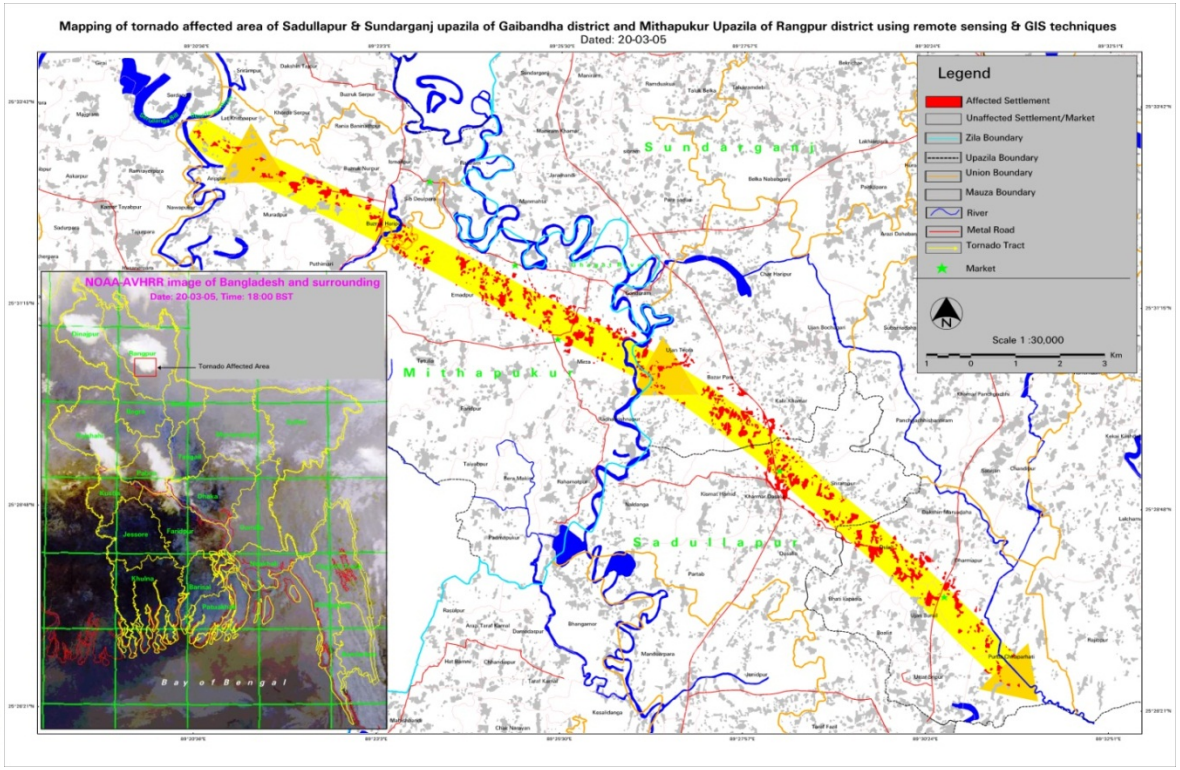
- SPARRSO completed Country-level Forest Cover Mapping using TM Satellite data
- The project was jointly supported by Bangladesh Forest Department and FAO
- Field verification has been done using GPS.



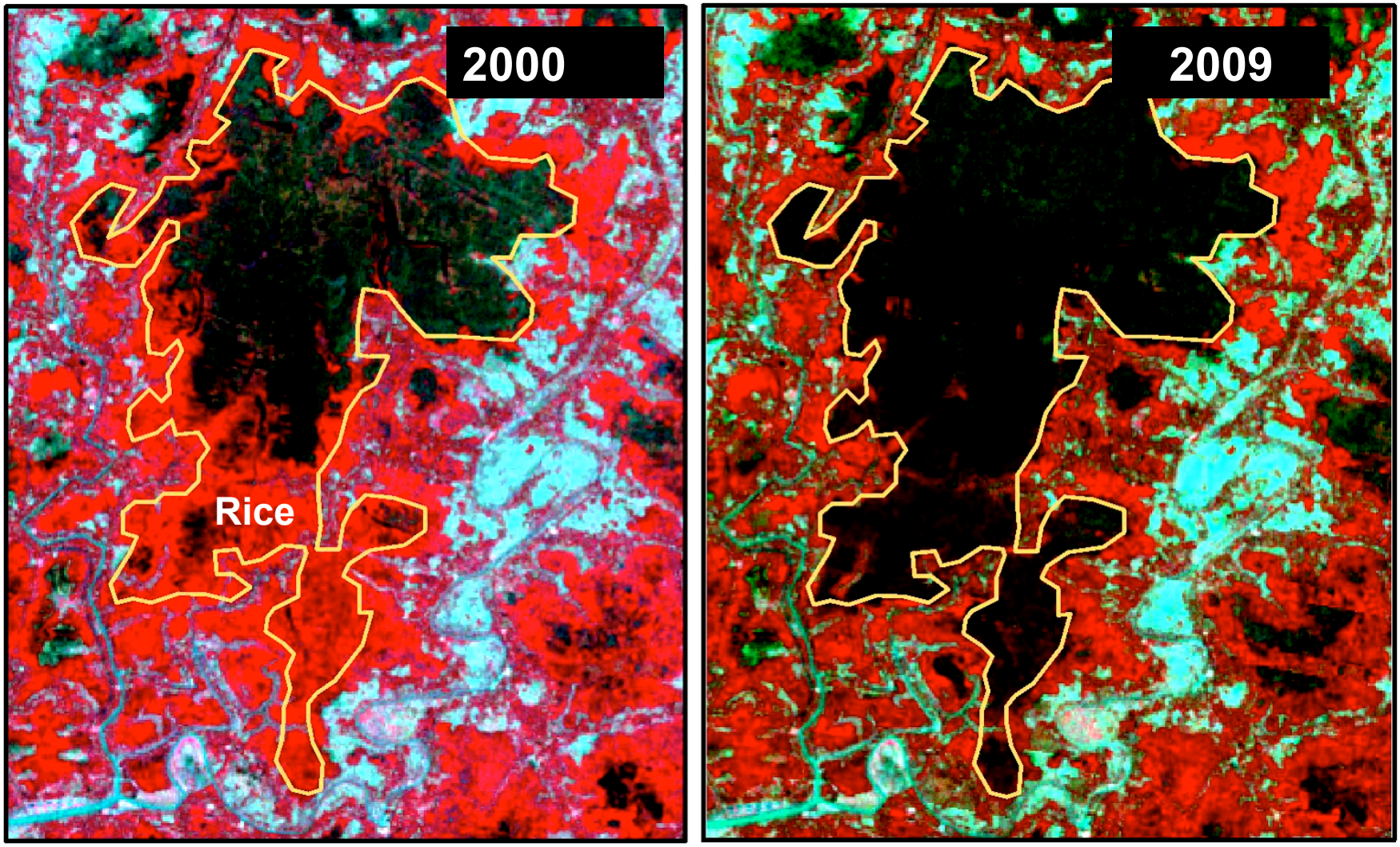


GPS in Post-Tornado Affected Area Mapping

- Every year country is affected by tornado and many lives and properties are hampered.
- GNSS can help to mapping tornado affected areas timely and accurately.
- This would be helpful for decision makers and planners for relief and rehabilitation operations precisely.

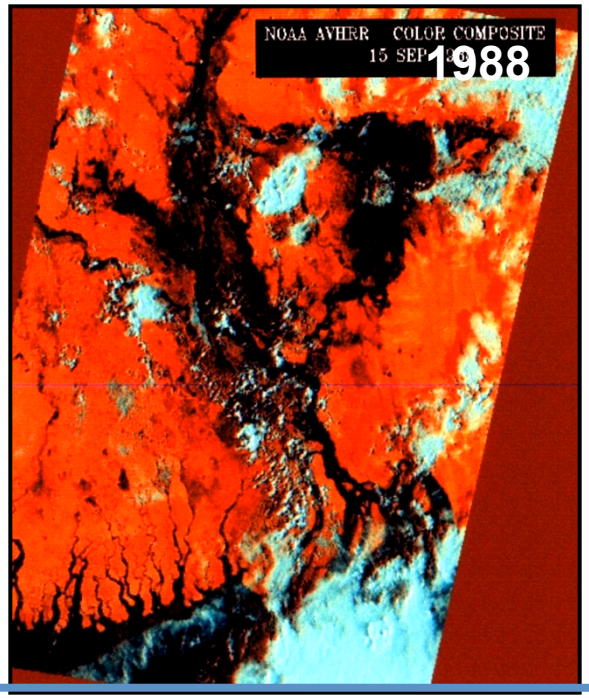


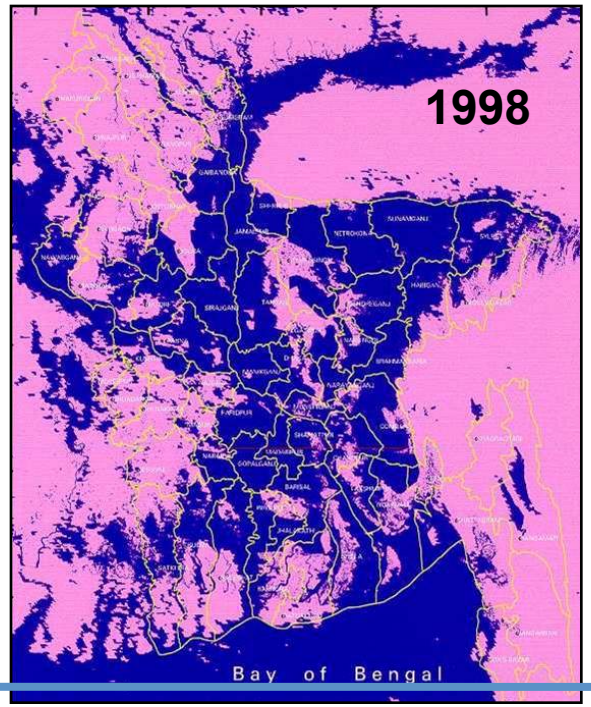
Monitoring of Water-Logging using RS, GIS and GPS Technique

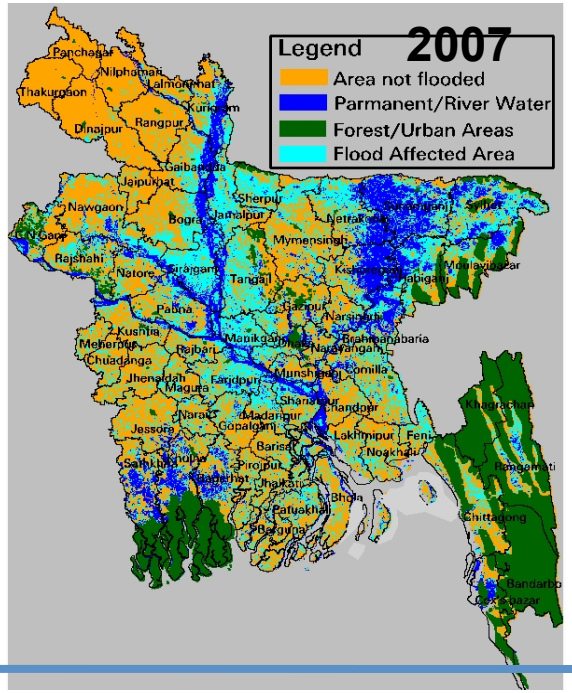


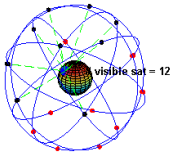
GPS in Flood Affected Areas Mapping

- Almost every year Bangladesh is affected by flood and loses lives and properties.
- Combination of GPS and RS technology can help in mapping flood extend.
- This would help in *relief and rehabilitation* work precisely.







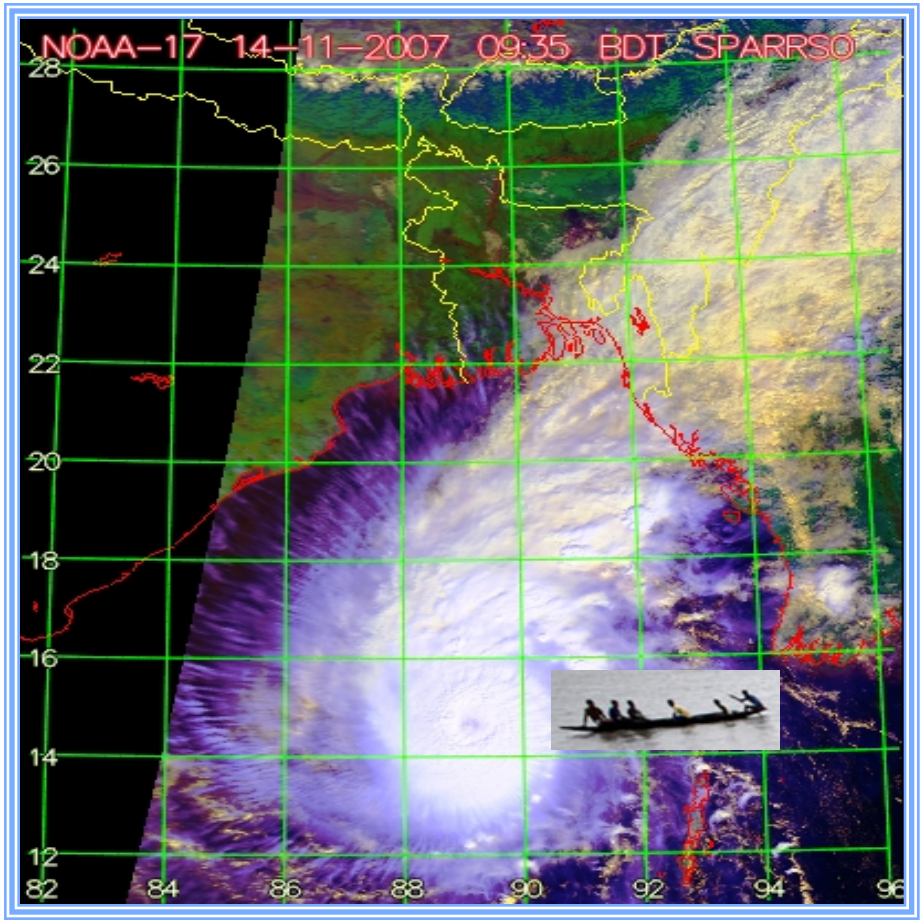


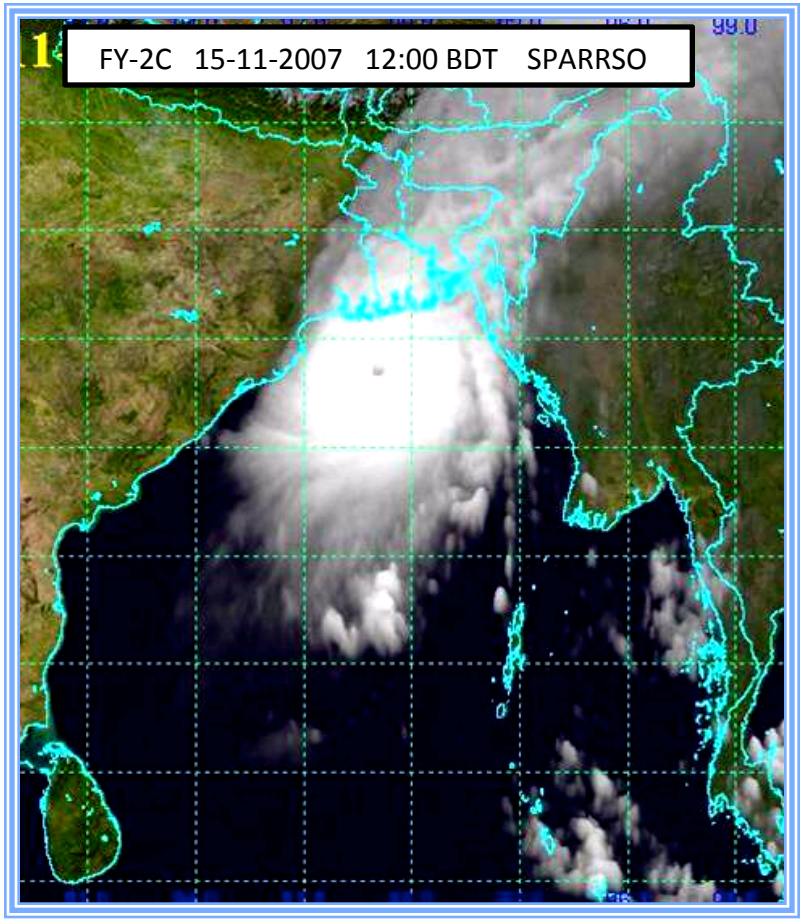
RS and GPS in Fishery Resource Monitoring

- Remote sensing and GPS technology are using for surveying, monitoring and analysis of the fisheries resources of the country.
- Maps prepared showing the geographical location of different types of water bodies with infrastructure facilities using RS and GPS

GNSS in Fishing Vessel/Boat Monitoring

- Almost every year Bangladesh is visited by **cyclone** and many **fishing boats** have been **missing**.
- **GNSS technology** could be used for search and rescue (SAR) operations and thus save lives and properties.



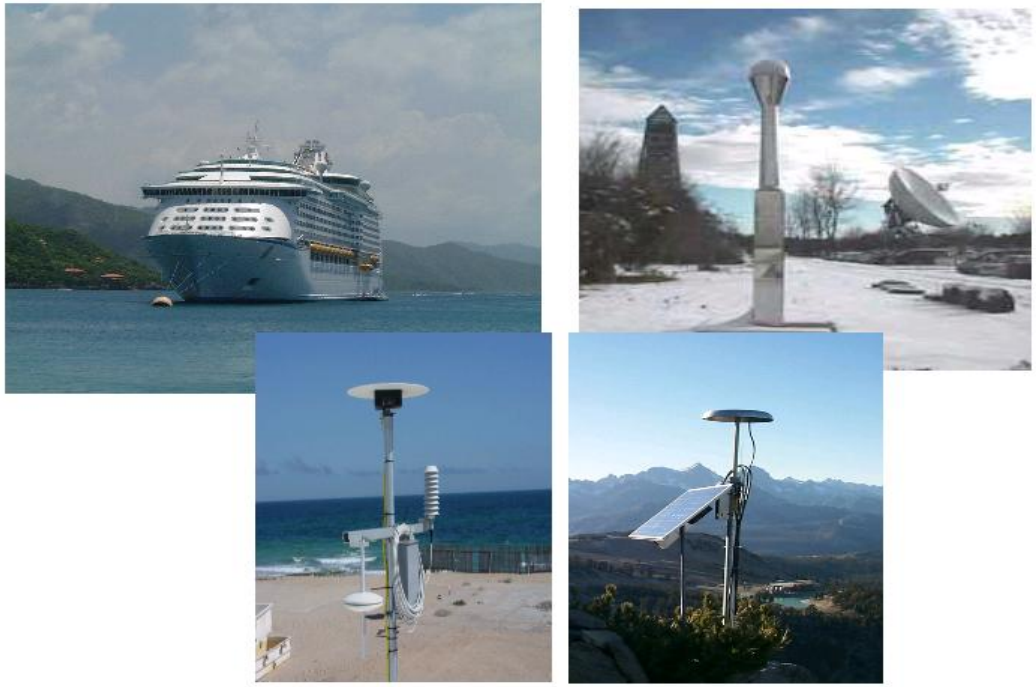


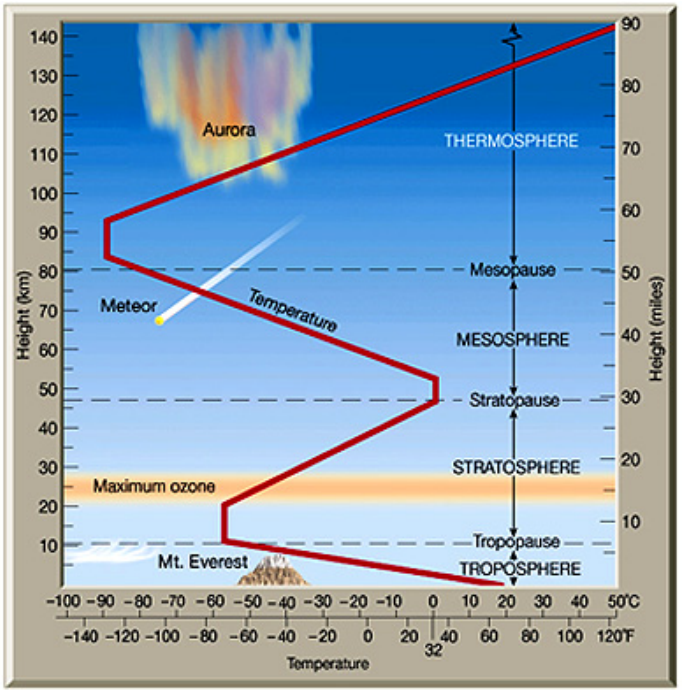
RS, GIS and GNSS in Cadastral Mapping

- **Preparation of a digital land use (Cadastral) map is one of the agenda of Bangladesh Government.**
- **Combination of RS, GIS and GNSS technology, we would be able to make an accurate Cadastral map of Bangladesh**

GNSS in Meteorology

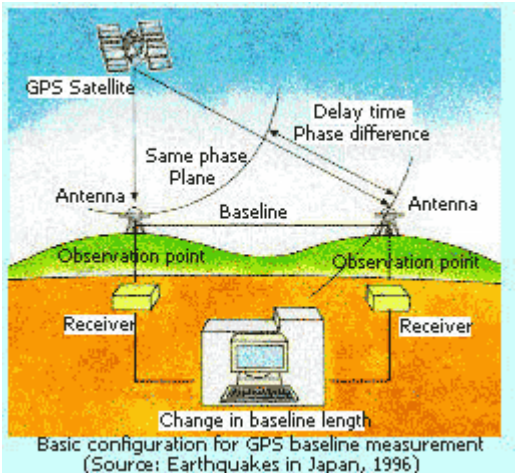
- Using **GNSS** to sense the Earth's atmosphere and measure the **temperature** and **water vapor** content to **improve the accuracy** of weather prediction.



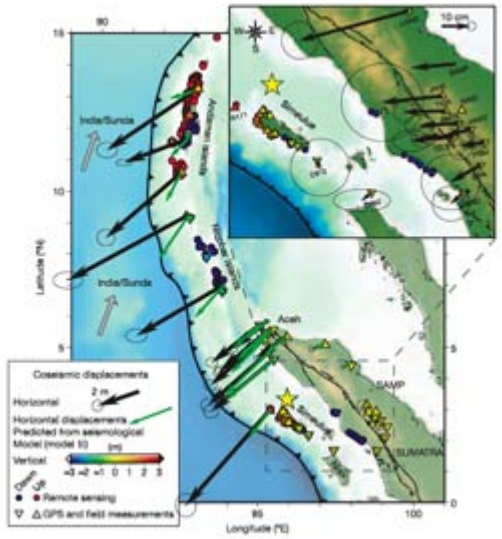


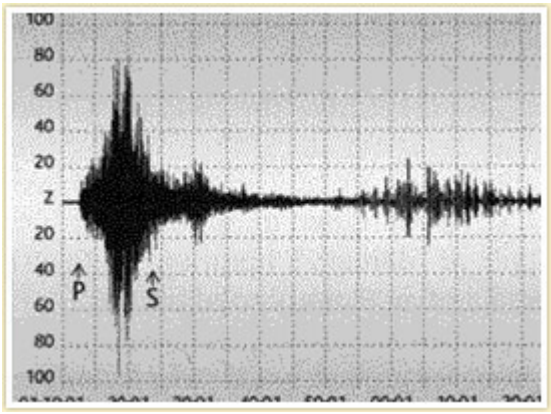
GPS In Earthquake Monitoring

- GPS can be used to monitor the **crustal movement**. It can also be used for the **earthquake prediction**. But it is only in the **research & theoretical** analysis phase now.



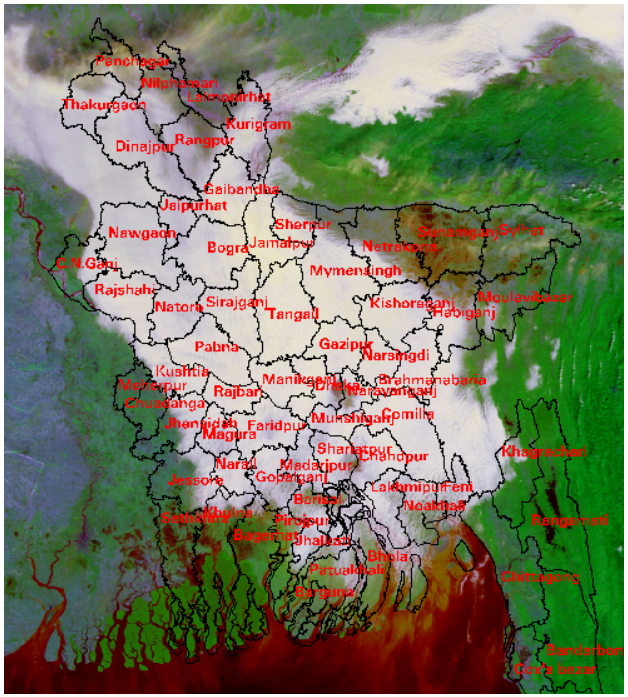
Basic configuration for GPS baseline measurement
(Source: Earthquakes in Japan, 1996)





GPS in Transportation Monitoring

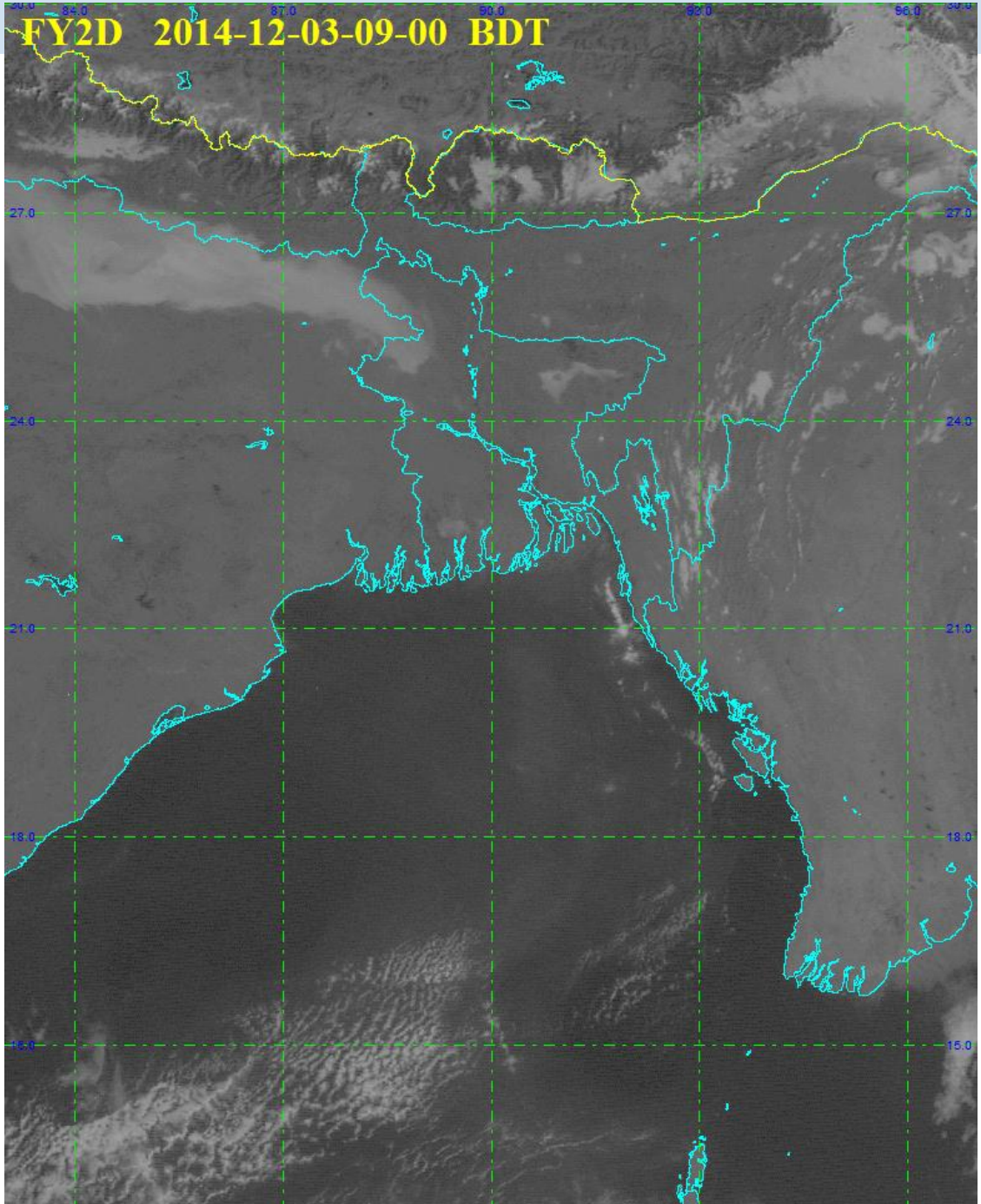
- **Road accidents** are quite a common occurrence in Bangladesh and at least 4,000 deaths per year.
- **Dense fog** in winter season causes noticeable road and river accidents.
- **GNSS** technology can help to monitor the vehicles and minimize the accidents.



Ferry Service

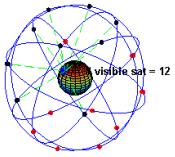
Ferry Service

Today's Picture



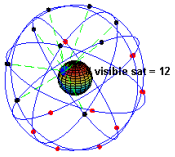
Organizations using GNSS Technology

- **The Survey of Bangladesh (SOB)** deals with survey and mapping under the Ministry of Defense. It is the leading organization of aerial photographs and GNSS Station.
- **Local Government Engineering Department (LGED)** deals with technical support to local government bodies for planning and implementation of development program using RS and GPS
- **Directorate of Land Records and Surveys (DLRS)** is entrusted with the mandate to carryout periodical cadastral survey and settlement operations for preparing, updating and publishing land records of every piece of land of the country.
- **Bangladesh Water Development Board (BWDB)** uses GPS in flood monitoring, especially in determining location of flood and its extension.
- **Civil Aviation Authority, Bangladesh** extensively used GNSS for flight navigation
- **BIWTA , NAVY, Air force etc.**
- **Academic Institutions**

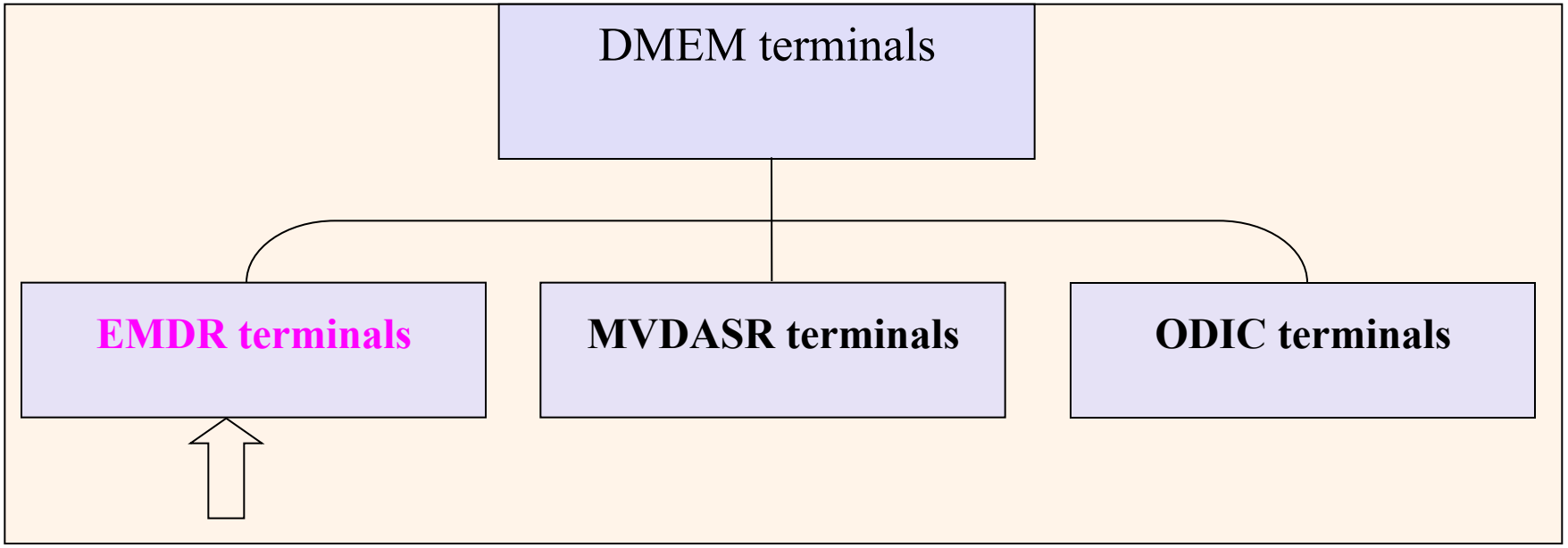


GNSS Projects undertaken by SPARRSO Collaboration of APSCO

Sl No	Name of Project	Output	Remarks
1	**GNSS Terminals for Emergency Management and Disasters Rescue (EMDR)**	Two prototype Terminal will be developed	Feasibility Study has been Completed by Lead country China
2.	**Research on Determining of Ionospheric Signature of Earthquake by Ground-based Ionospheric Sounding**	Earthquake Research	Feasibility study is under process
3	**International GNSS Monitoring and Assessment Service (iGMAS)**	Improve the weather Prediction	Feasibility study is under process



Design and development of the terminals for emergency management and disaster rescue

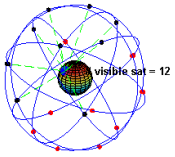


DMEM: Disaster Mitigation and Emergency Management
EMDR: Emergency Management and Disaster Rescue
MVDASR: Maritime Vessels Distress Alarm with Search and Rescue
ODIC: Ocean Disaster Information Collection (Terminal Based on the Buoy)

GNSS Terminals for Emergency Management and Disaster Rescue

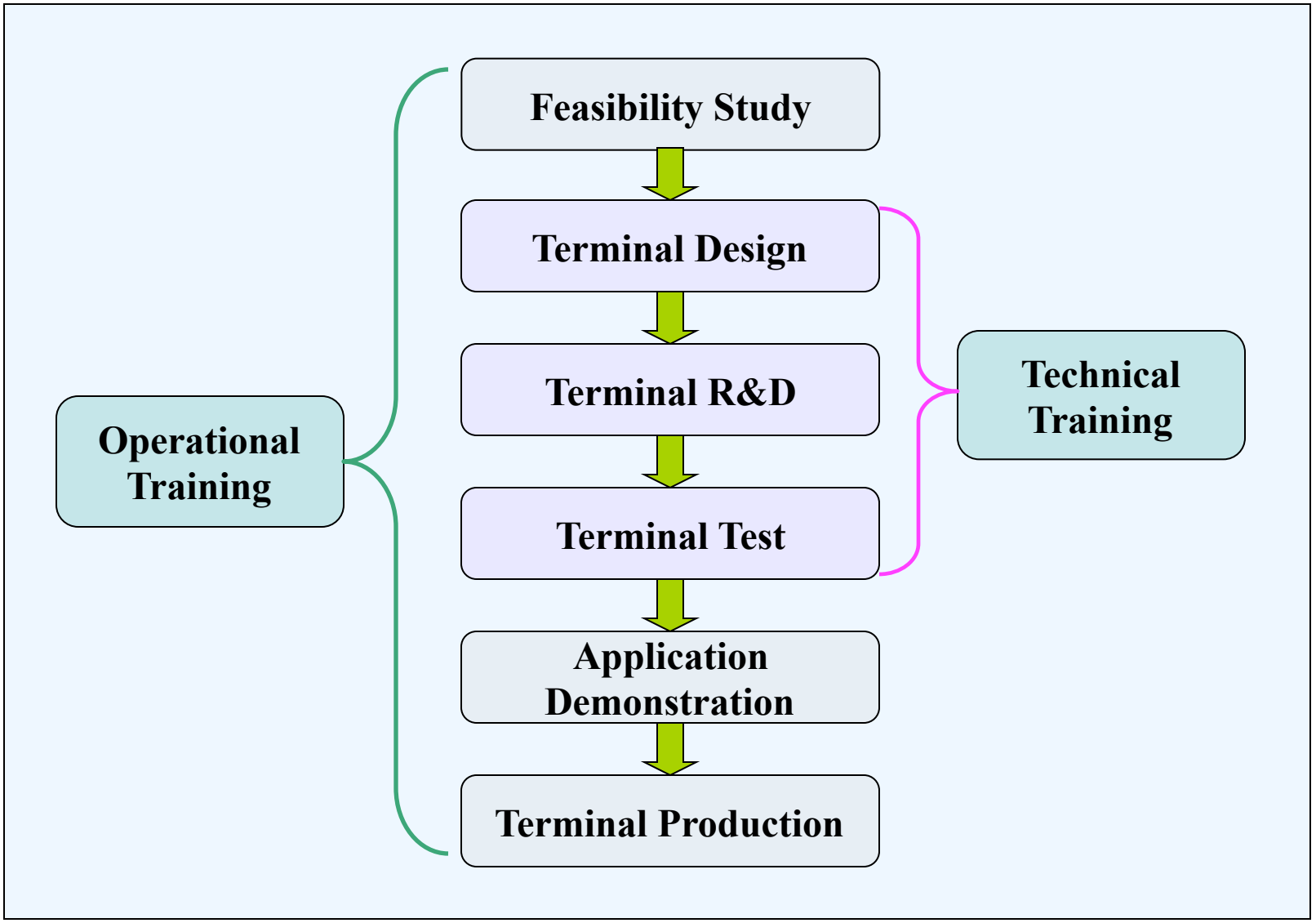
Project Objectives

- ✓ To research and development of terminals for disaster and emergency management based on BeiDou –compatible system, to make reduction of disaster losses and accidents
- ✓ To promote personnel training and technology exchanges among APSCO member states.



GNSS Terminals for Emergency Management and Disaster Rescue

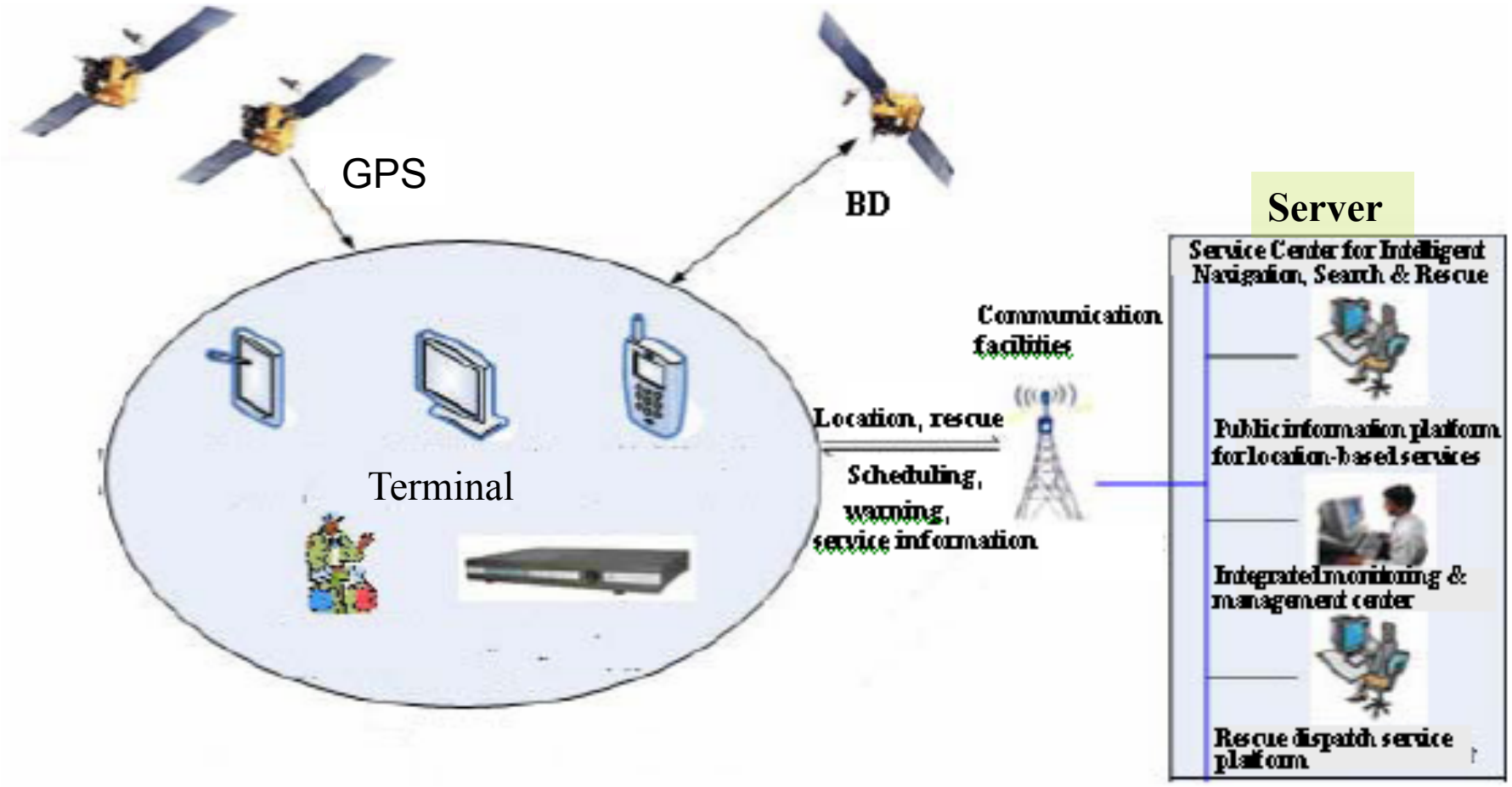
Project Contents



GNSS Terminals for Emergency Management and Disaster Rescue

Project Contents

(2) *Terminals design and development*

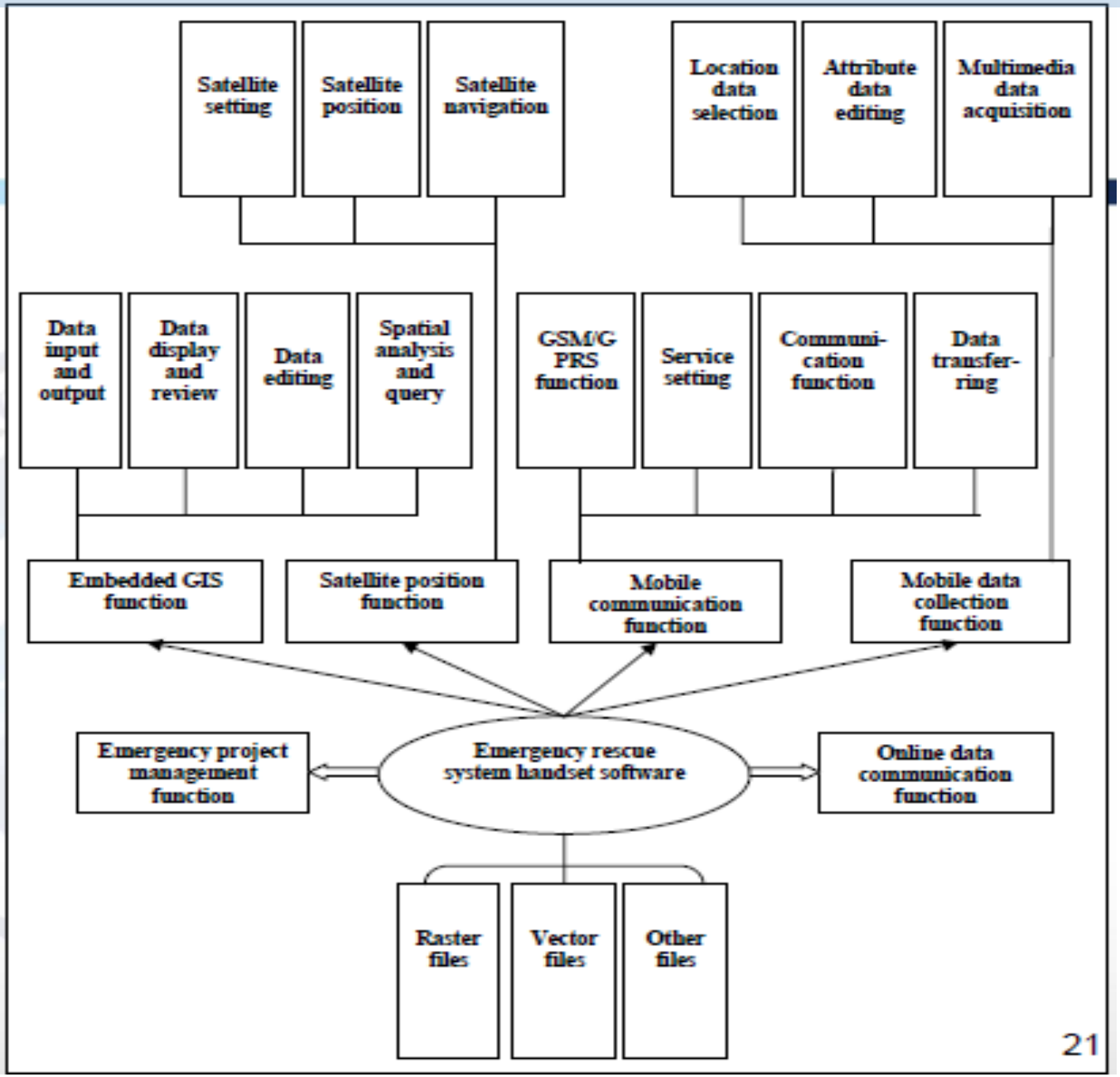


Digital disaster mitigation and emergency management system architecture

GNSS Terminals for Emergency Management and Disaster Rescue

Terminals design and development

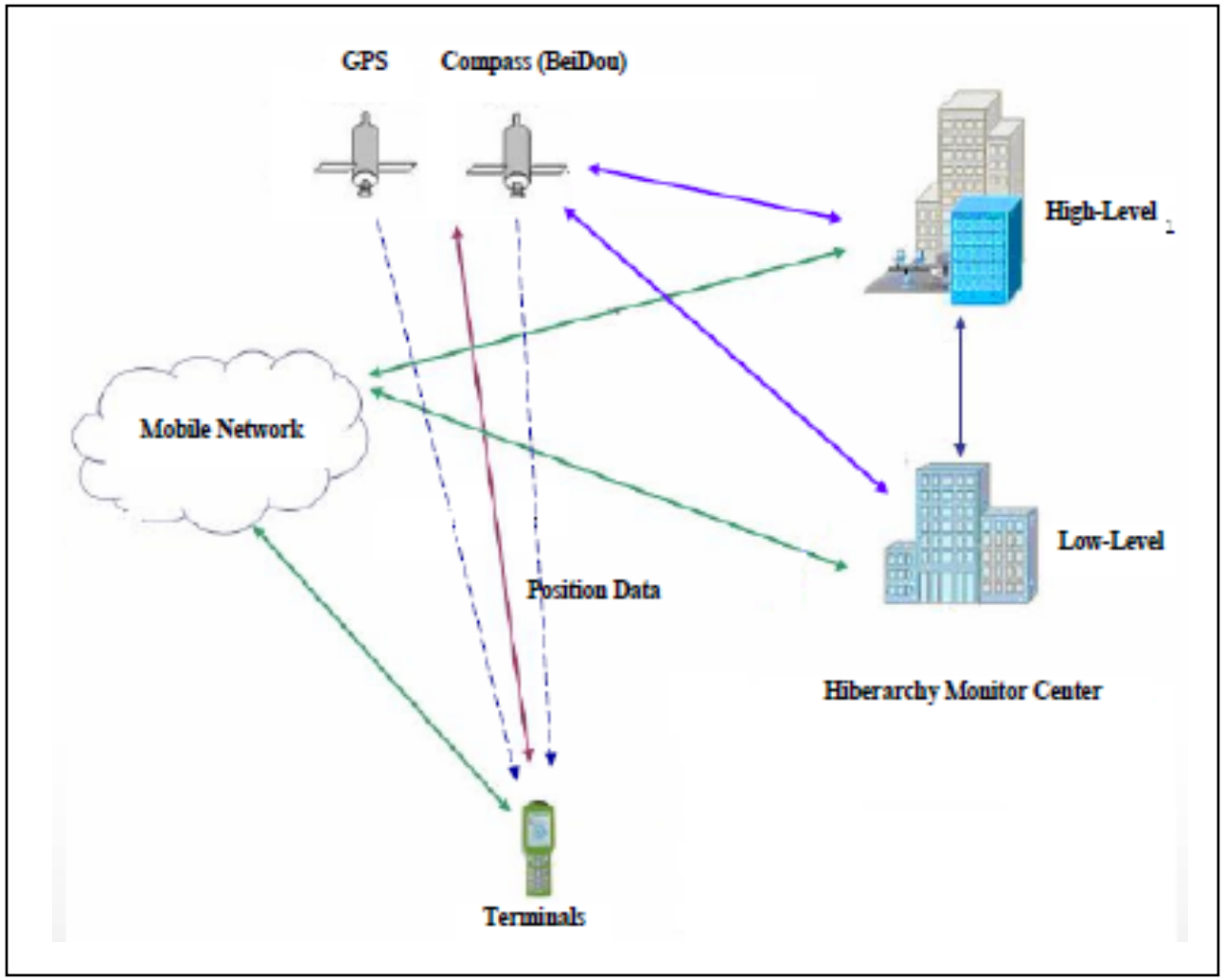
Software System



GNSS Terminals for Emergency Management and Disaster Rescue

Project Contents

(3) *Application demonstration*

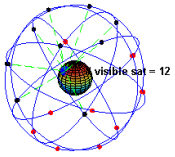


EMDR application demonstration systems will be set up in areas of which have serious natural disasters in chosen participating APSCO member countries.

Project Contents

(4) ***Training and promotion***

- GNSS technology and application training courses will also be organized by Lead Country China for the GNSS related researchers and engineers of APSCO member states to promote APSCO GNSS technology and application capabilities



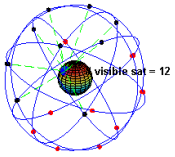
GNSS Terminals for Emergency Management and Disaster Rescue

Implementation plan (Master Schedule of Project)

Task name	Duration	2013	2014	2015
Project Management	**783d**	→	→	→
Kick-off				
Mission/System Requirement Analysis				
System Requirement Review				
Preliminary Design	**70d**	→		
System				
Receiver				
Communication Server				
Preliminary Design Review				
Critical Design & Development	**322d**	→	→	
System				
Receiver				
Communication Server				
Test				
Critical Design Review				
Demonstration	**262d**		→	→
Demonstration Scenario Definition				
Demonstration Deployment				
Result Assessment				
Market Development Plan				
System Acceptance Review				
Training	**326d**	→	→	
Technical				
Operational				
Operational Readiness Review				

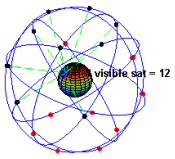
Conclusion and Recommendation

- GNSS is not **so well-known** technology in Bangladesh. It is therefore essential to create **awareness** of the usefulness of the technology among potential users.
- Such awareness can be created through the arrangement of **workshops/seminars** on the applications of GNSS as well as conduct collaboration **projects/data shearing in various fields.**
- In Bangladesh, as an economically developing country, users should be given an opportunity to access the GNSS technology at an **affordable price**. Therefore, the **cost of the GNSS receiving** systems should be **reduced**.
- GNSS can **do all** but we can't **think all.**

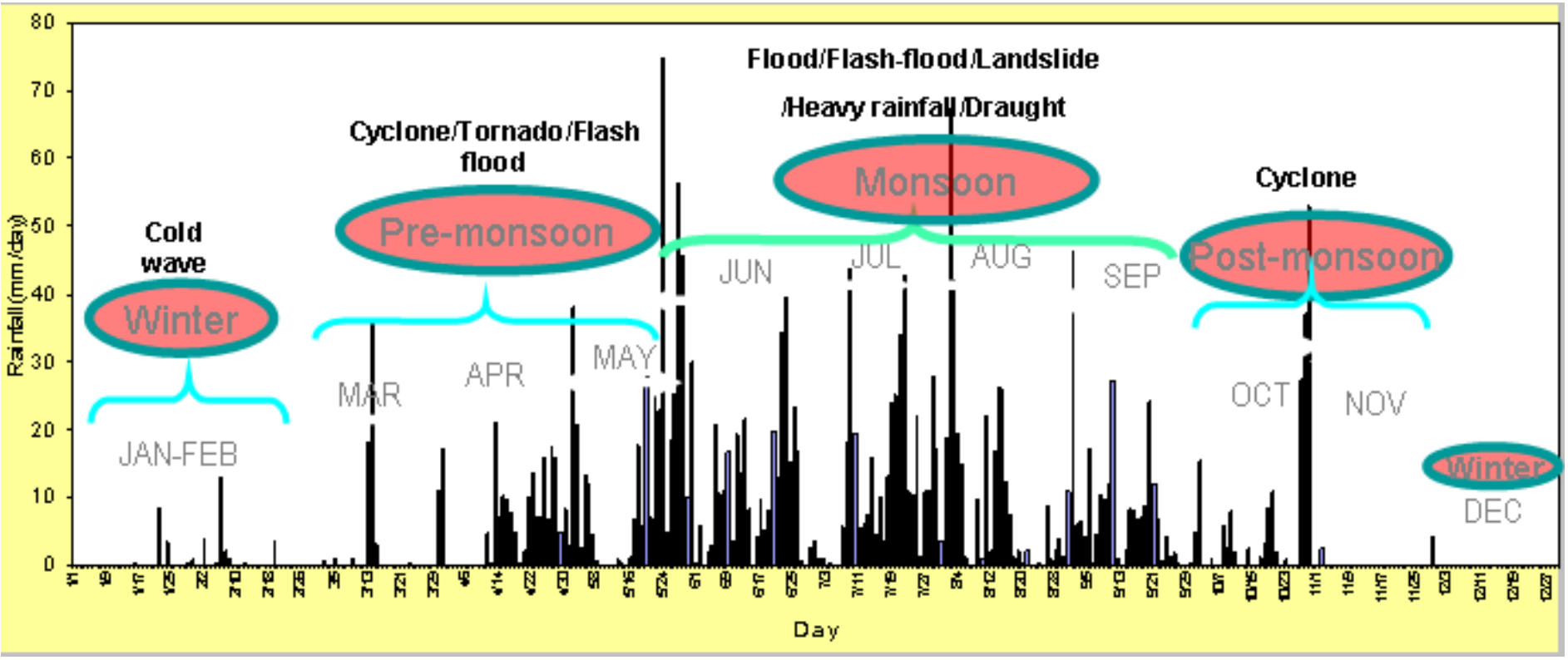


Acknowledgements

- UN-OOSA for selecting me and provided Travel Facilities
- Abdus Salam ICTP for given me the hosting Facilities



Thanks



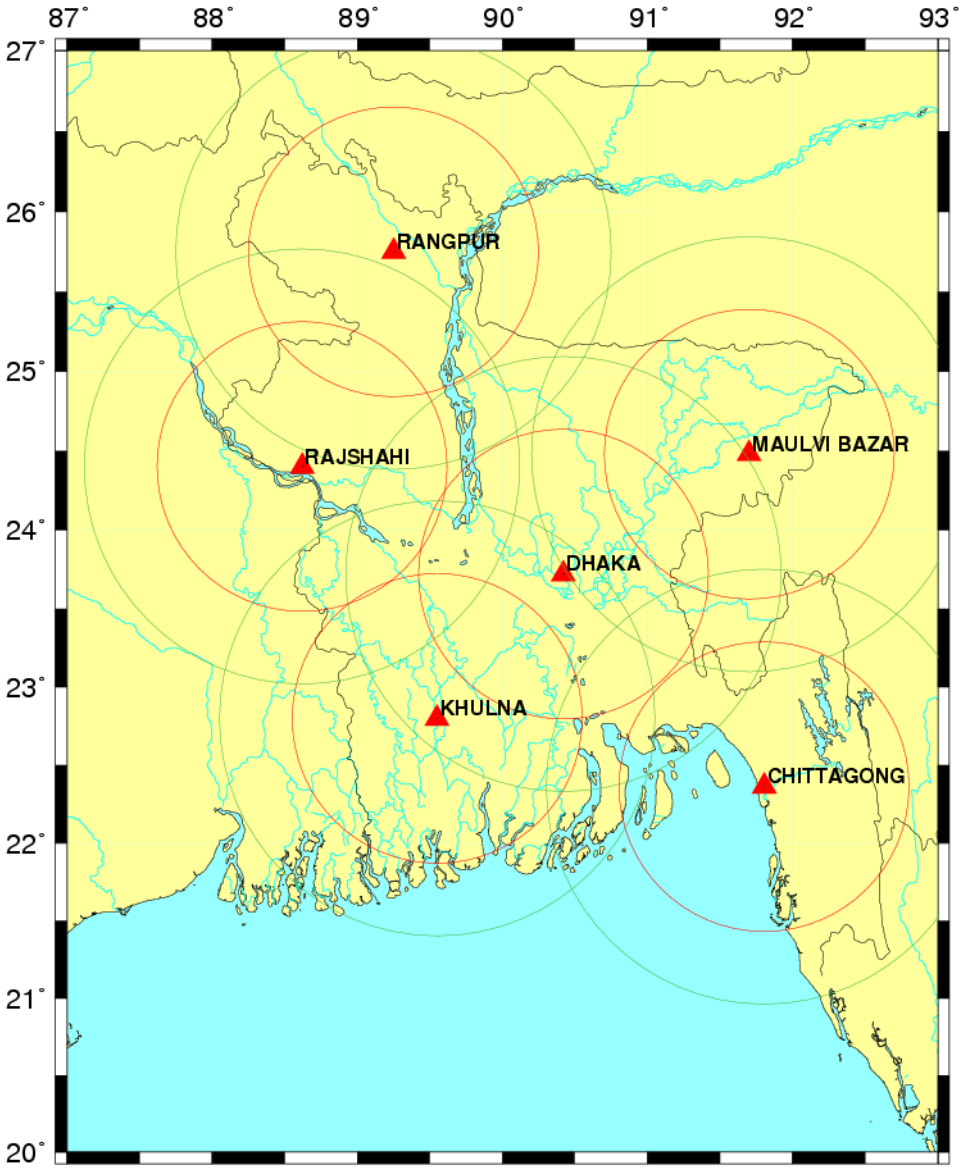
Climatologically Seasons and its Characteristics

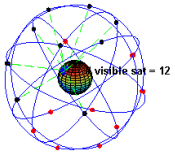
PERMANENT GNSS STATION
(Continuously Operating Reference Station)

- Established in: 2011
- Number of Stations: 6
- Data Acquisition Rate: 1 Second
- Type of Receiver: Trimble Net R9
- Data Transfer from Receiver to Server:

  GPRS
- RTK Correction: GPRS

Location of Six Permanent GNSS Station





GNSS Receiver for Updating Topographic Map

- **SOB produced different kinds of topographic maps on various scales**
- **Mobile Mapper and Hand Held GPS Receiver are used for collecting topographic data to update the map**