

Earth Observation System for Climate Change: ISRO's Initiatives and Perspectives

Country Report : India



**Indian Space Research Organisation
Department of Space**

APRSAF 17th, Nov 23-26th , 2010 Melbourne, Australia



Indian Imaging Capability

Geo stationary



INSAT-2E
VHRR, CCD

1999

KALPANA-1
VHRR

2002

INSAT-3A
VHRR, CCD

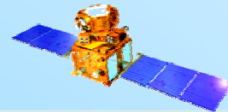
2003

Sun Synchronous



TES
PAN

2001



RESOURCESAT-1
LISS 3; LISS 4;
AWiFS

2003



CARTOSAT-1
PAN, F/A

2005



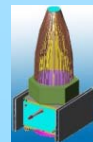
**CARTOSAT-2
& 2A, PAN**

2007/ 08



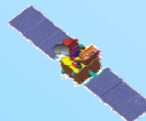
IMS - 1
HYSi, MX

2008



RISAT-2
X-SAR

2009



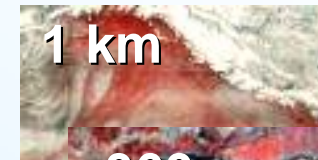
Oceansat-2
OCM, SCAT, ROSA

2009

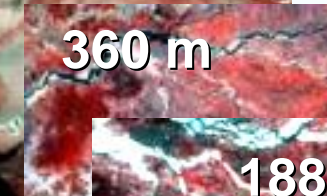


CARTOSAT-2B
PAN

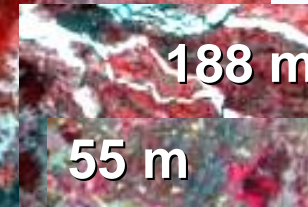
2010



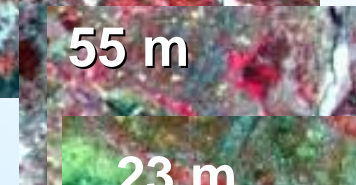
1 km



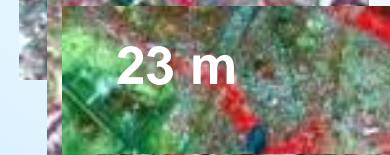
360 m



188 m



55 m



23 m



5.8 m

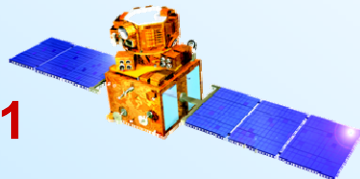


1 m



Land Observations

RESOURCESAT-1



Natural resources Mapping & Inventory

- 3 Cameras (AWiFS, LISS 3, LISS 4)
- Repetitivity: 5 days (AWiFS) to 24 days (LISS 3) & Revisit : 5 days (LISS 4) with tilting 26° tilt
- Spatial resolution of 5.8 m (LISS 4) to 56 m (AWiFS)
- Swath of 23 km (LISS 4) to 800 km (AWiFS)

CARTOSAT - 2/ 2A/ 2B



Cadastral Map; Urban/Rural Infrast.

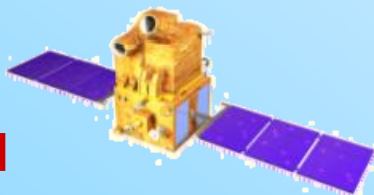
- Panchromatic camera; Step & Stare imaging; steerable along & across
- Spatial resolution: 0.8 m
- Swath of 9.6 km
- Revisit : 4 days

RISAT-2



- X- Band SAR
- Multipolarimetric

CARTOSAT-1



Large scale mapping, DEM

- Two panchromatic (0.50 - 0.85 m) cameras
- Spatial resolution 2.5m and cover a swath 30 km
- Revisit : 5 days
- Along Track Stereo viewing (+26° / -5°)

IMS-1



Resource mapping; spectral characterisations

Hyper Spectral Imaging (HySI)

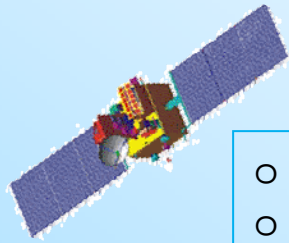
- 64 bands; Res. 505 m; Swath 130 Km.
- 400-950 nm range

Multispectral Imaging (MX0)

- 4 bands (B, G, R, IR)
- 37 m resolution
- 151 km Swath

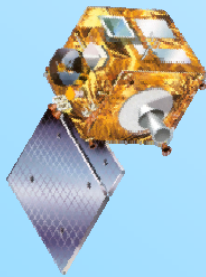
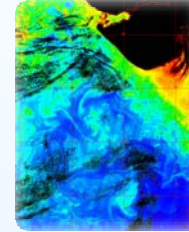


Ocean and Atmosphere Observation



OCEANSAT-2

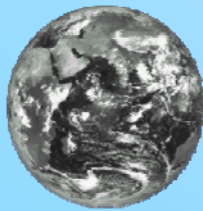
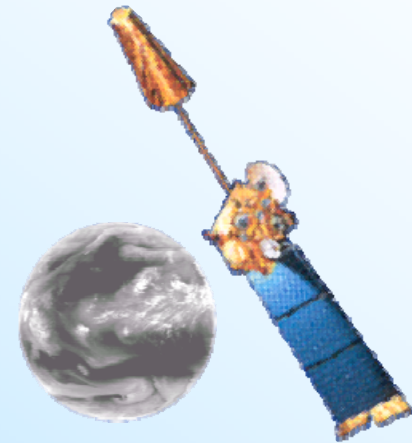
- 8-band **OCM**
- Ku-Band Pencil beam **Scatterometer** with
- Radio Occultation Sounder for Atmospheric studies (**ROSA**)



KALPANA

CCD Camera Bands (μm)	
Visible	: 0.62 – 0.68
Near Infra Red	: 0.77 – 0.86
Short Wave IR	: 1.55 – 1.69
Resolution	: 1 km

INSAT-3A



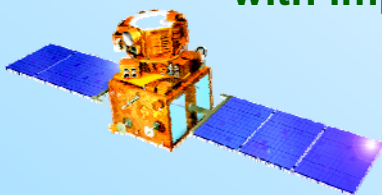
VHRR Bands (μm)	
Visible	: 0.55 – 0.75
Water Vapour	: 5.70 – 7.10
Thermal Infra Red	: 10.5 – 12.5
Resolution	: 2 km for Visible; 8 km for TIR



EO Missions - Near Future (Planned)

RESOURCESAT-2

To provide continuity for Resourcesat-1 with improved services



Payloads

- LISS 4 (5.8 m & 70 km swath)
- LISS 3 (23m & 141 km swath)
- AWiFS (55 m & 800 km swath)

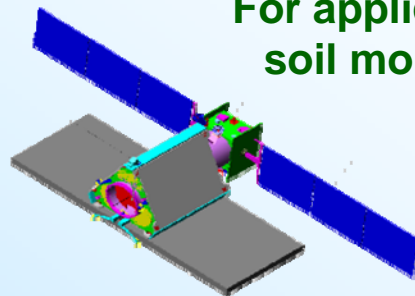
Orbit : 800 km

Local time: 1030 hrs

Launch by end of 2010

RISAT-1

For applications in agriculture, soil moisture, flood & water spread etc.



Payloads

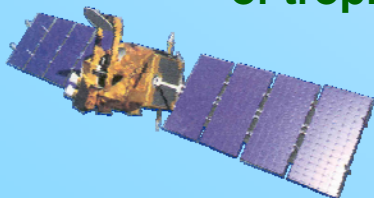
C band SAR 5.35 GHz frequency; 5 imaging modes

Orbit : 560 km in sun-synchronous

Launch in first quarter of 2011

MEGHA-TROPIQUES

For better understanding life cycles of tropical convective system



A Joint ISRO-CNES Mission

Orbit : 867 km with inclination of 20 deg.

Payloads

- Microwave Radiometer : MADRAS
- Earth Radiation Budget : SCARAB
- Humidity Profiler : SAPHIR

Launch in 2011

INSAT-3D

For improved understanding of weather systems



Payloads

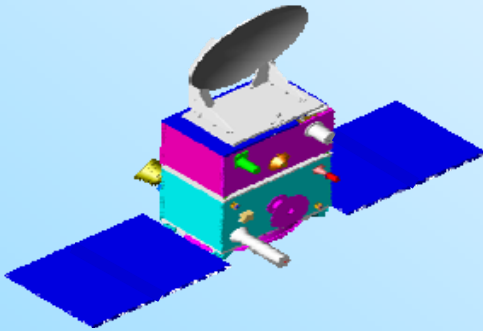
- 19 channel Sounder
- 6 Channel Imager

Launch by 2011

EO Missions - Near Future (Planned)

SARAL

Satellite with ARGOS and AltiKa - Joint ISRO-CNES Mission



- **Payloads:**

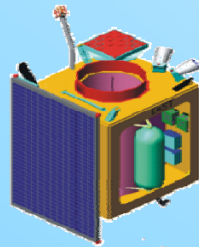
- Ka-band Altimeter (~35.5GHz)
- Dual frequency Radiometer (23.8/36.8 GHz)

Launch in 2011

**Polar - sun-synchronous; Inclination of 98.38 Deg;
Altitude ~800 km; Repeat cycle of 35 days**

GEO-HR Imager

Geosynchronous orbit



- Payloads:**

- High resolution multi-spectral VNIR (HRMX-VNIR): 50m Res.**
- Hyper spectral VNIR: 320m Resolution**
- Hyper spectral SWIR (HyS-SWIR): 192m resolution**
- High resolution Multi-spectral (HRMX-TIR): 1.5km Resolution**



ISRO's Climate Change Research Activities

Mapping Indicators of Climate Change using Space inputs

- Glacial Retreat in Himalaya
- Change in Polar Ice Cover
- Upward Shift in Timberline & Vegetation in Alpine zone
- Bleaching of Coral Reefs
- Desertification
- Disasters - Flood, Drought

Monitoring the Agents of Climate Change

- GHGs & Other Gases - Variability of atmospheric CO/ CO₂/ NO₂/ CH₄
- Biomass burning/ forest fire
- Terrestrial Carbon
- Atmospheric Aerosols & Trace gases

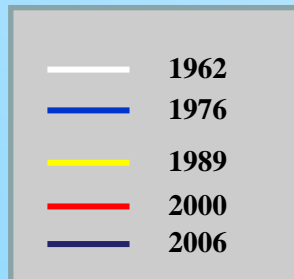
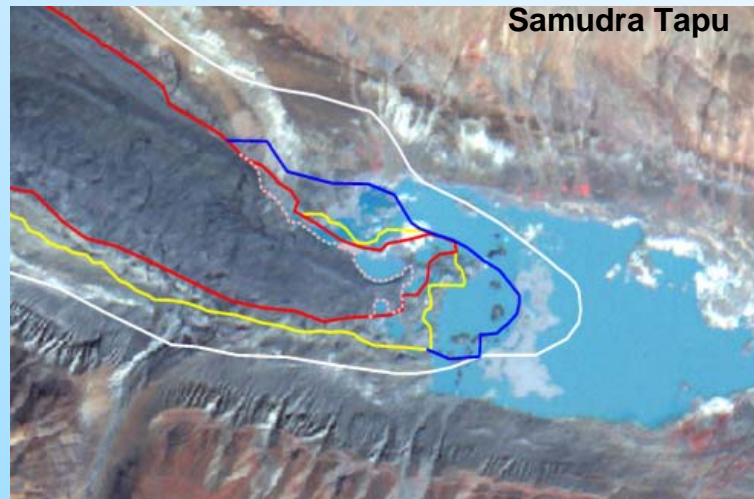
Modeling the impact of climate change

- Impact on Food Security
- Hydrology
- Coastal Zone
- Ocean Productivity
- Land Surface Changes in Regional Climate Simulations over India
- Role of Indian Ocean in Climate variability

Rapid assessment of LULC using multi-temporal AWiFS data.

Typical Climate Change Indicators from EO

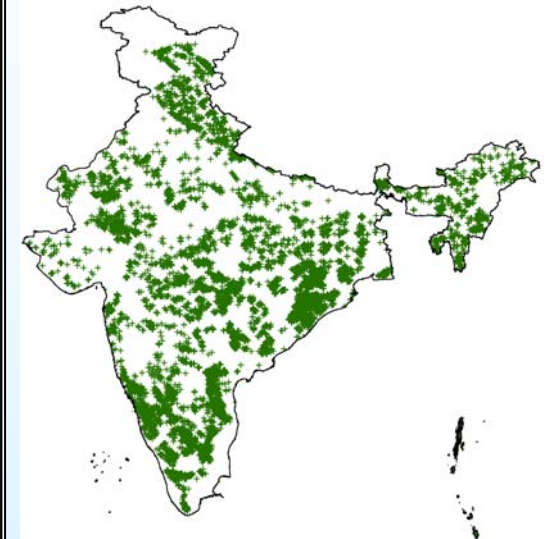
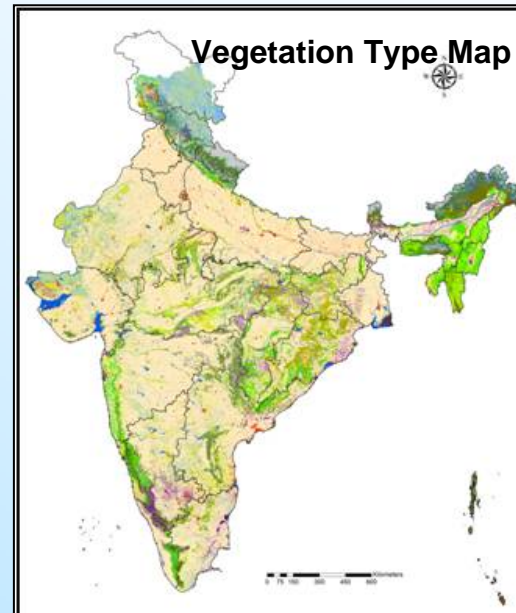
Retreat of Glacier



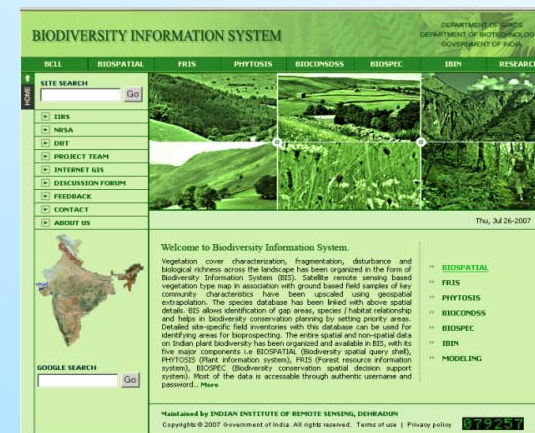
Year	Area of Glacier (sq. km.)	Loss in Area (ha)
1962	73.07	----
1976	72.41	66
1989	72.17	24
2000	71.93	24
2006	71.83	10

Mean loss of glacier area is around 5.4%

Impact on Biodiversity



Field Sample Locations

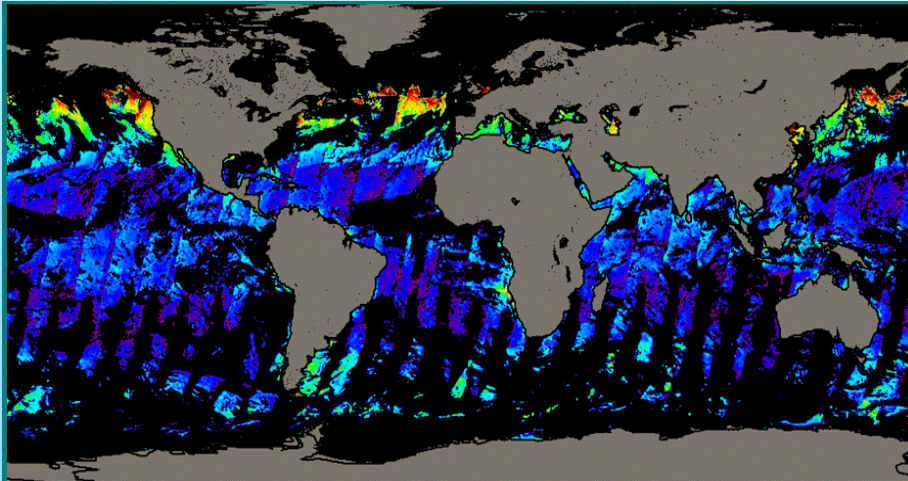


- 190 Vegetation Types
- > 6,000 Sample database of species

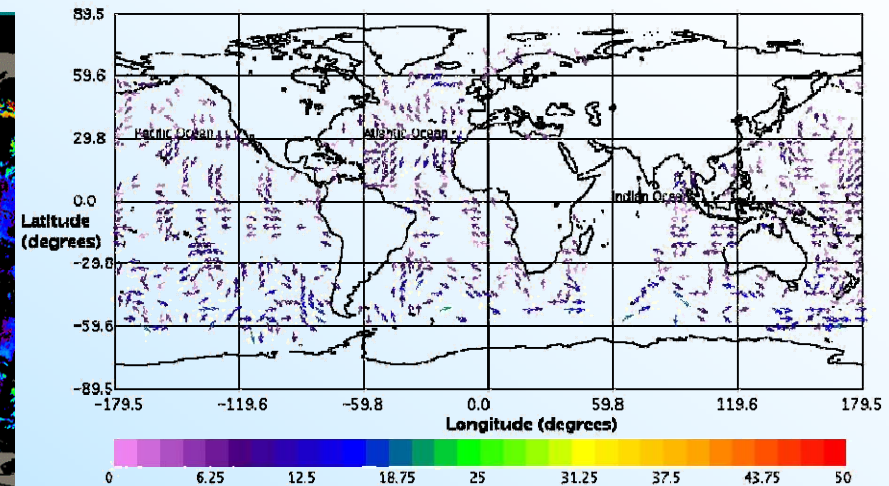


OCEANSAT-2

...to study the physical and biological aspects of oceanography.



Chlorophyll-a Image



Wind Vector Image

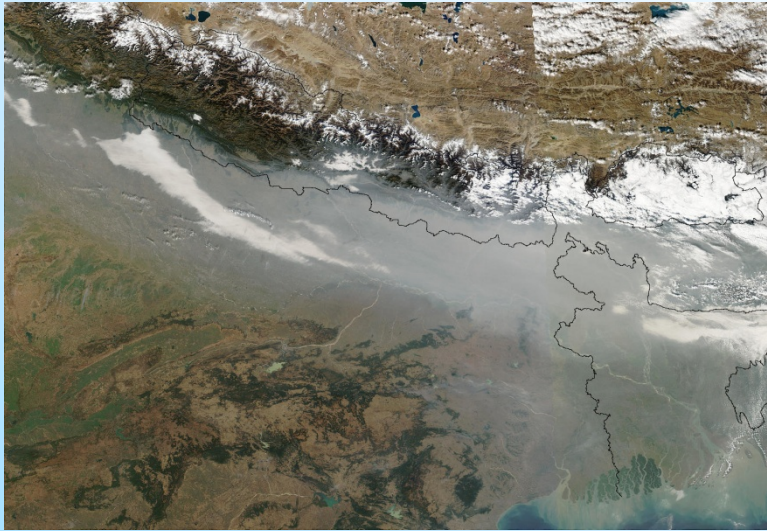
Payloads

- An 8-band Ocean Colour Monitor (**OCM**) with 360 m spatial resolution
- A resolution Ku-Band Pencil beam **SCATTEROMETER** with a ground of 50 km x 50 km
- Radio Occultation Sounder for Atmospheric studies (**ROSA**) - Developed by the Italian Space Agency – ASI

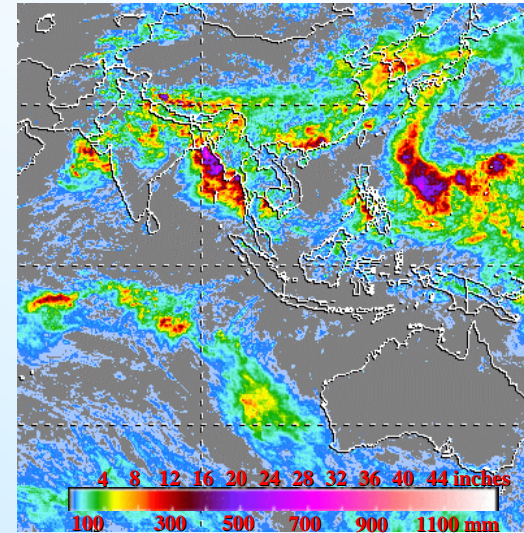
Status

- OCM: 4 Geophysical products (Chlorophyll, Sedimentation, AOD, Attenuation Coefficient) are operational
- GAC products uploaded to NRSC website
- Scatterometer derived wind vector data operational
- Near real time Scatterometer derived global data dissemination through EUMETCAST and sharing with NASA, NOAA & ESA

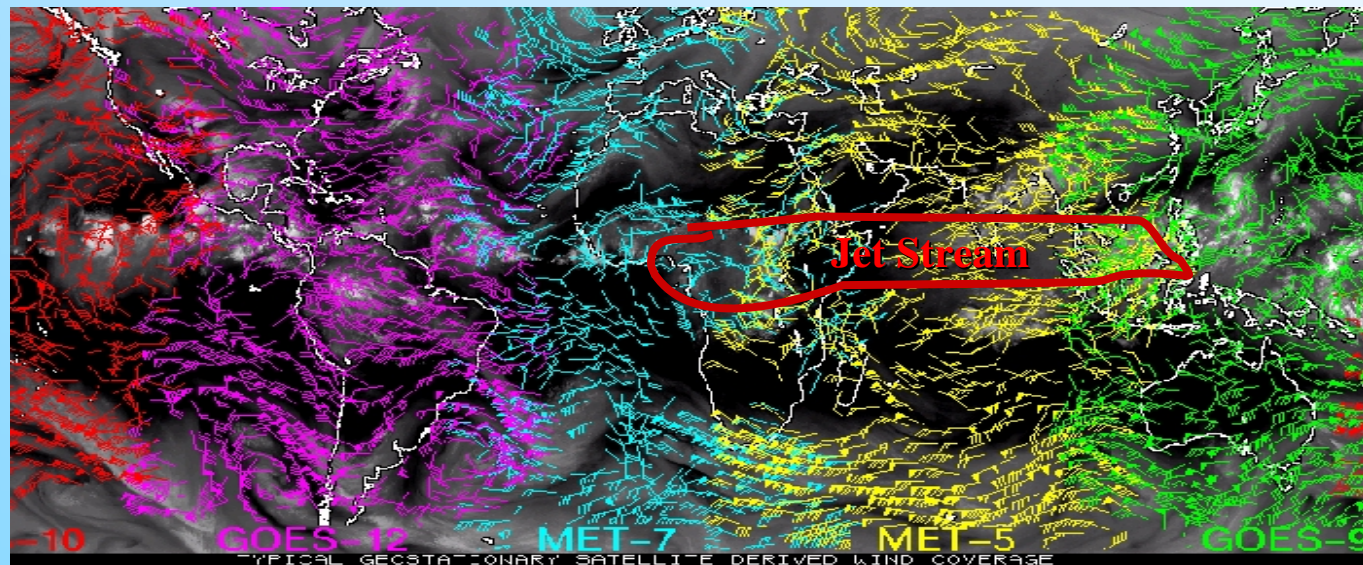
Operational Use of INSAT Data



Extensive Fog cover over N. India

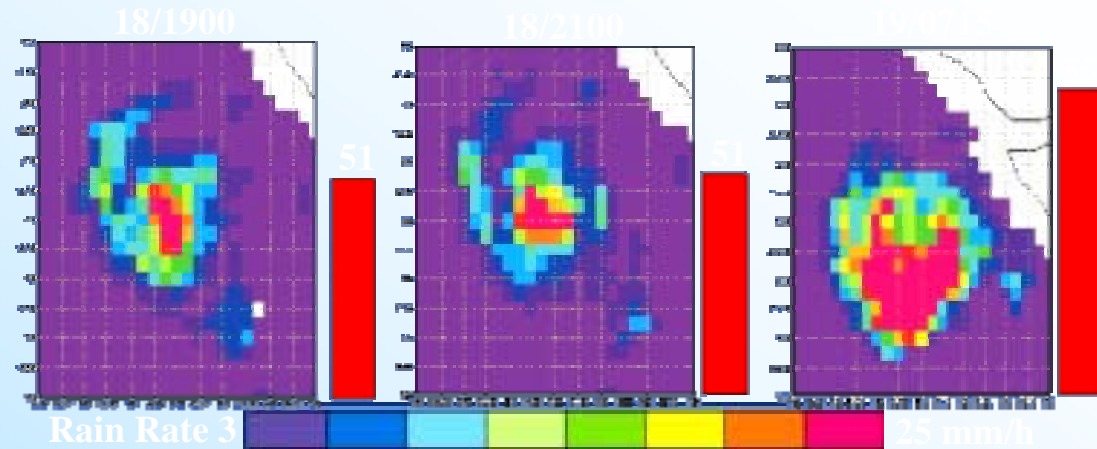


Heavy Rainfall Warning



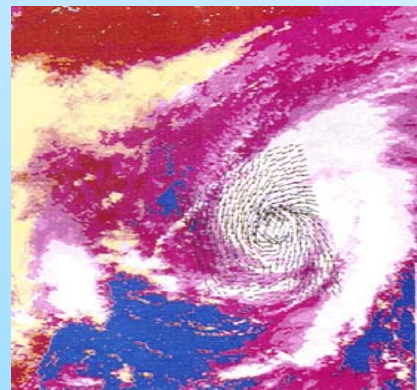
Wind Patterns & Wind shear

Improved Cyclone Prediction / Warning

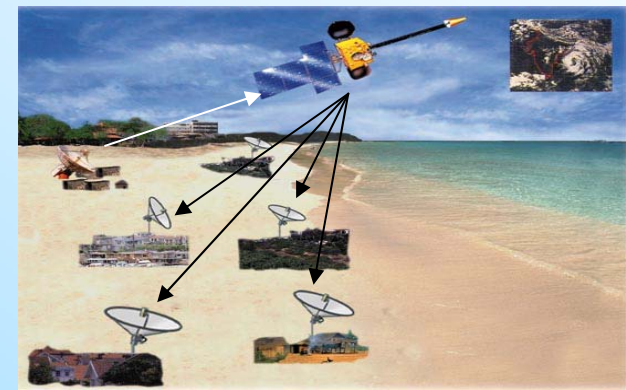


Rain intensities from microwave data

Technique developed with
Space data & genetic
algorithm for cyclone track
prediction
 $\pm 40-45$ kms
for 24 hrs forecast

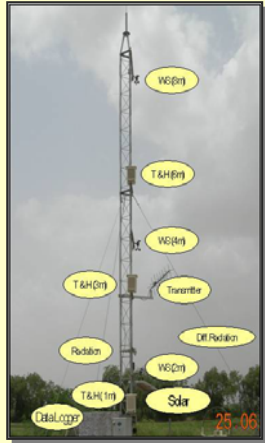


Cyclone wind
structure



Cyclone Warning Systems

Ground Infrastructure



Agro Metrological Stations (AMS)

- Vegetation Response to Climate and CO₂ Uptake
- Network of Micrometeorological (Canopy scale) Measurements
- Sensors for Radiation balance, Energy Balance, Water balance



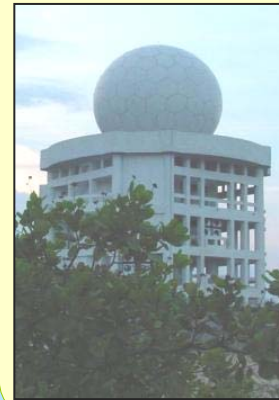
Carbon Flux Tower

- Size of current pool of carbon in vegetation & soils
- Quantitative estimates of C flux viz., GPP, NPP & respiration
- Fluxes controlled by environmental variables & vegetation types



Automatic Weather Station (AWS)

- Continuous Recording of:
 - temperature
 - atmospheric pressure
 - wind speed and direction
 - rainfall
 - relative humidity
 - solar radiation



Doppler Weather Radar (DWR)

- Continuous monitoring of extreme weather events
- Radar network for entire coastal areas, NE region, major cities, ...

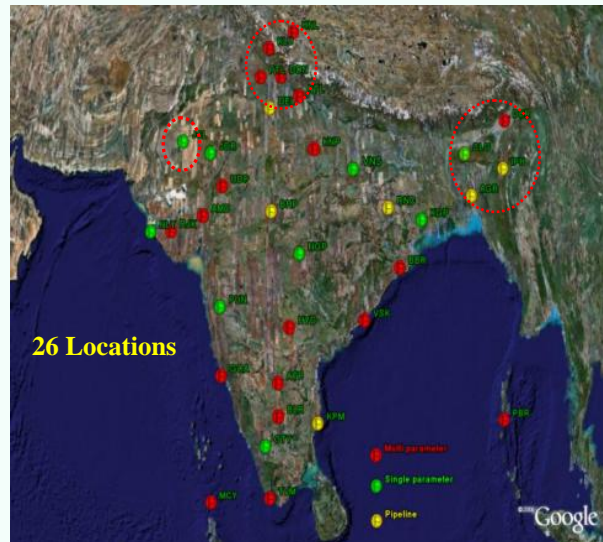
Atmospheric Boundary Level Network

Mixed Layer Heights obtained from indigenously developed Pisharoty Sondes

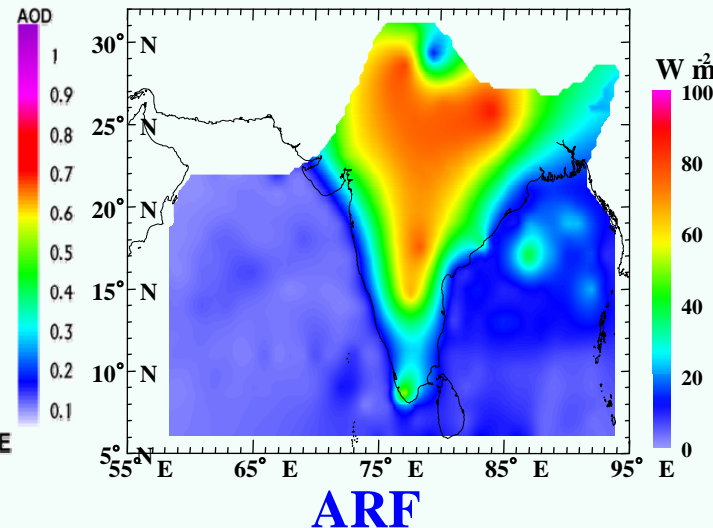
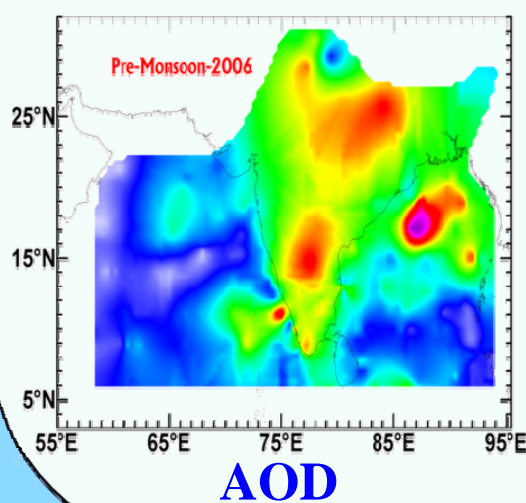
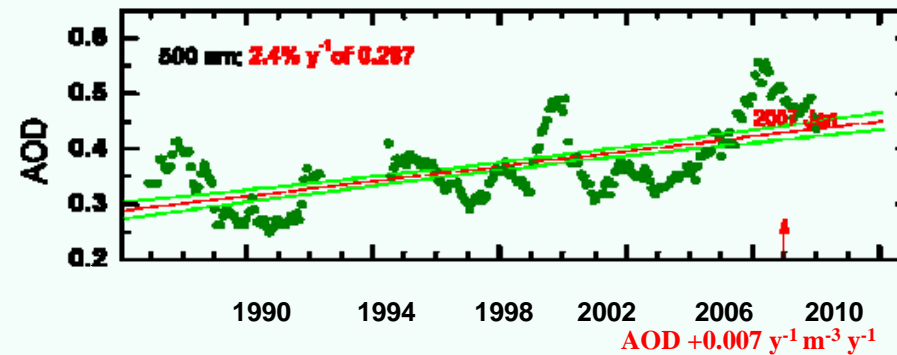
Mapping & Monitoring Climate Change Agents

Aerosol Monitoring, Land and Marine Campaigns

Environmental Observatory Network



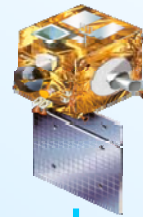
Major Finding



MWR-MKIII Patented

Integration of Space & Ground Observations

GPS Sonde



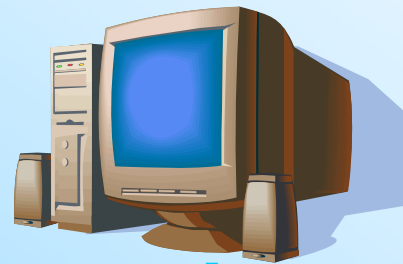
100 m Met. tower



**Polarimetric
Doppler Weather Radar**



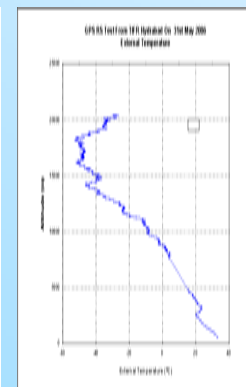
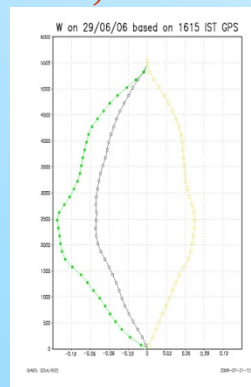
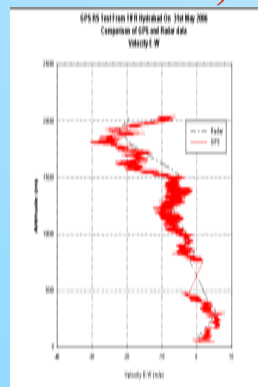
Met. Ocean Data Centre



MST Radar



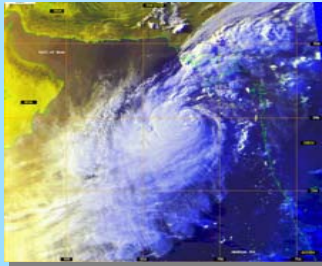
MM5, ARPS, RCM models



**Automatic
Weather Stations**



Disaster Management Support Decision Support Centre



Welcome to NRSC - DSC Home page - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Home Search Favorites Go Google Settings

Address http://192.168.0.24/DSC/index.jsp

ISRO - Disaster Management Support Programme
Decision Support Centre

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Committed to the Nation to...

Watch Collect & Process Analyze Disseminate Use Feedback

...for Disaster Management

Functional Chart | International Charter | e- Information | Related Links | Disclaimer

Disaster Type	State Name	Disasters
Flood	ANDHRA PRADESH	Agri. Drought
Cyclone	ASSAM	Flood
Agri. Drought	BIHAR	Flood Agri. Drought
Landslide	CHATTISGARH	Agri. Drought
Earthquake	GUJARAT	Flood Agri. Drought
Forest Fire	JHARKHAND	Agri. Drought
Other Disasters	ORISSA	Flood
	RAJASTHAN	Agri. Drought
	UTTAR PRADESH	Flood Agri. Drought
	WEST BENGAL	Flood

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News

28 Jan Dr.Madhavan Nair,ISRO dedicates DSC site to the nation:28-1-09 [more»](#)

Number of Visitors 8784

Local intranet

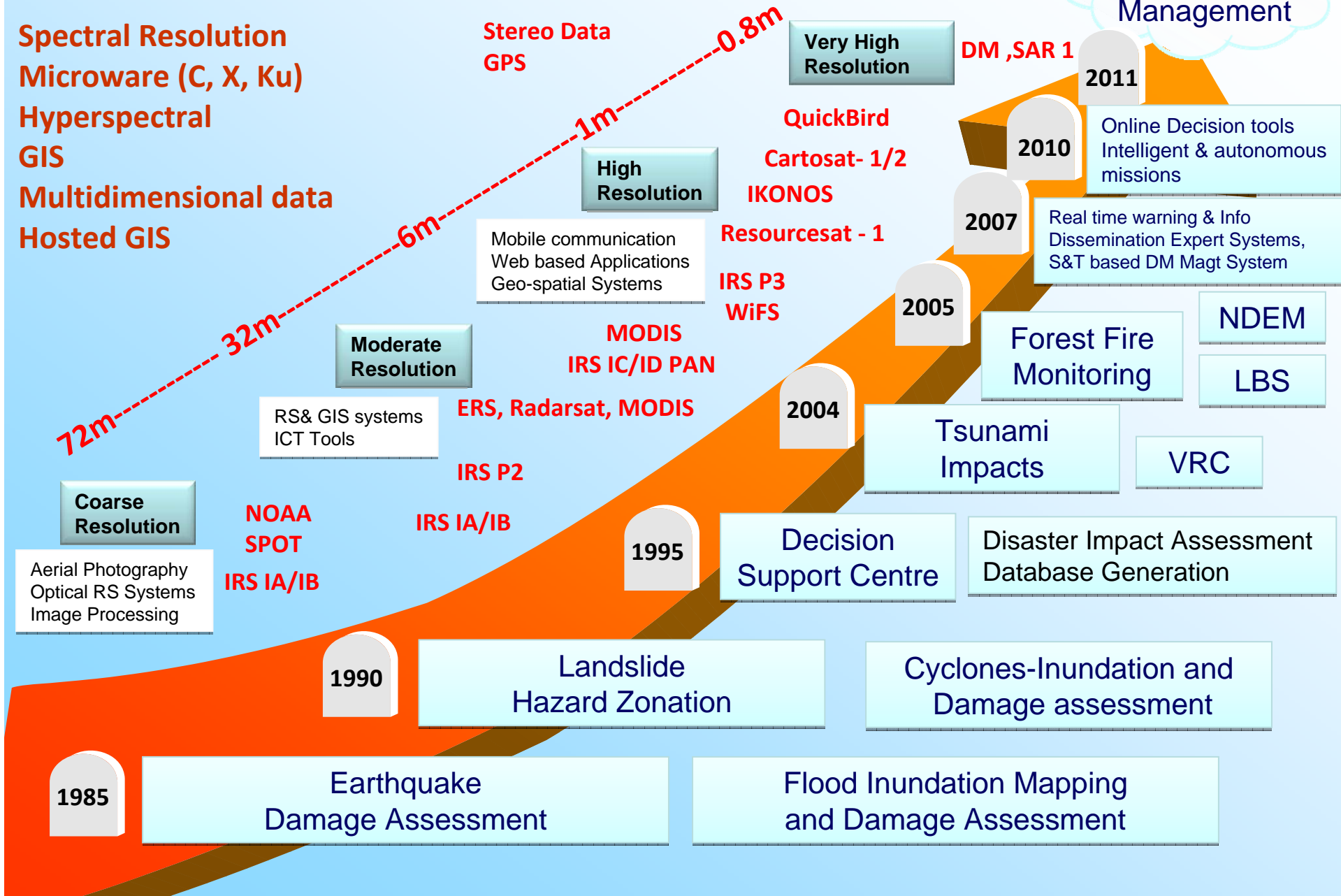
Natural Disasters : Drought, Flood, Cyclone, Forest Fire, Earthquake, Landslides

Disaster Management Support

Spectral Resolution
Microware (C, X, Ku)
Hyperspectral
GIS
Multidimensional data
Hosted GIS

Space based navigation
High speed communication
Sensor web, GRID

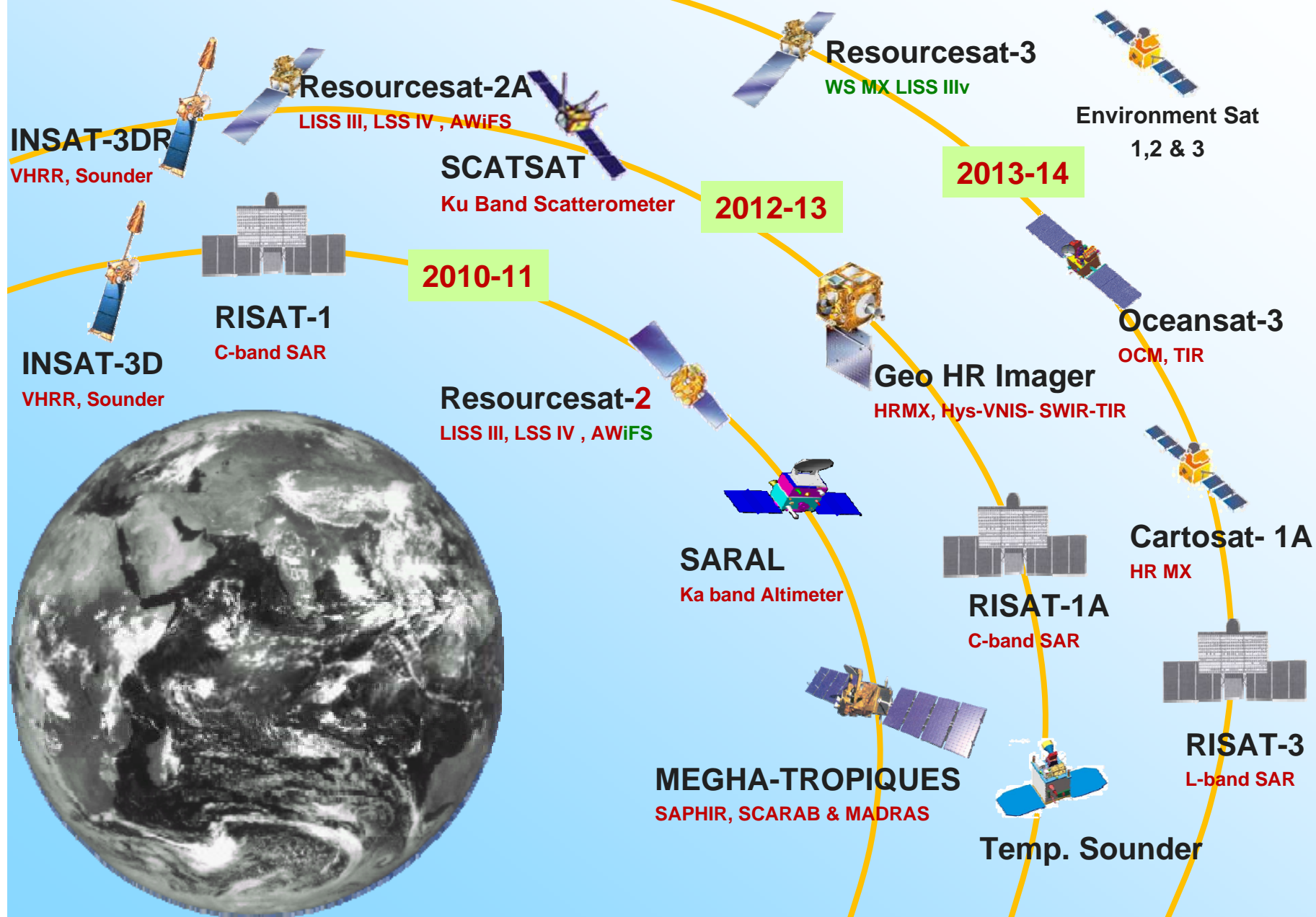
Integrated
Emergency
Management





Future EO Missions - Over View

under Planning





Thank You

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