Ocean Observations for Societal Benefits

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Secretary,

Ministry of Earth Sciences, India

OceanObs'09

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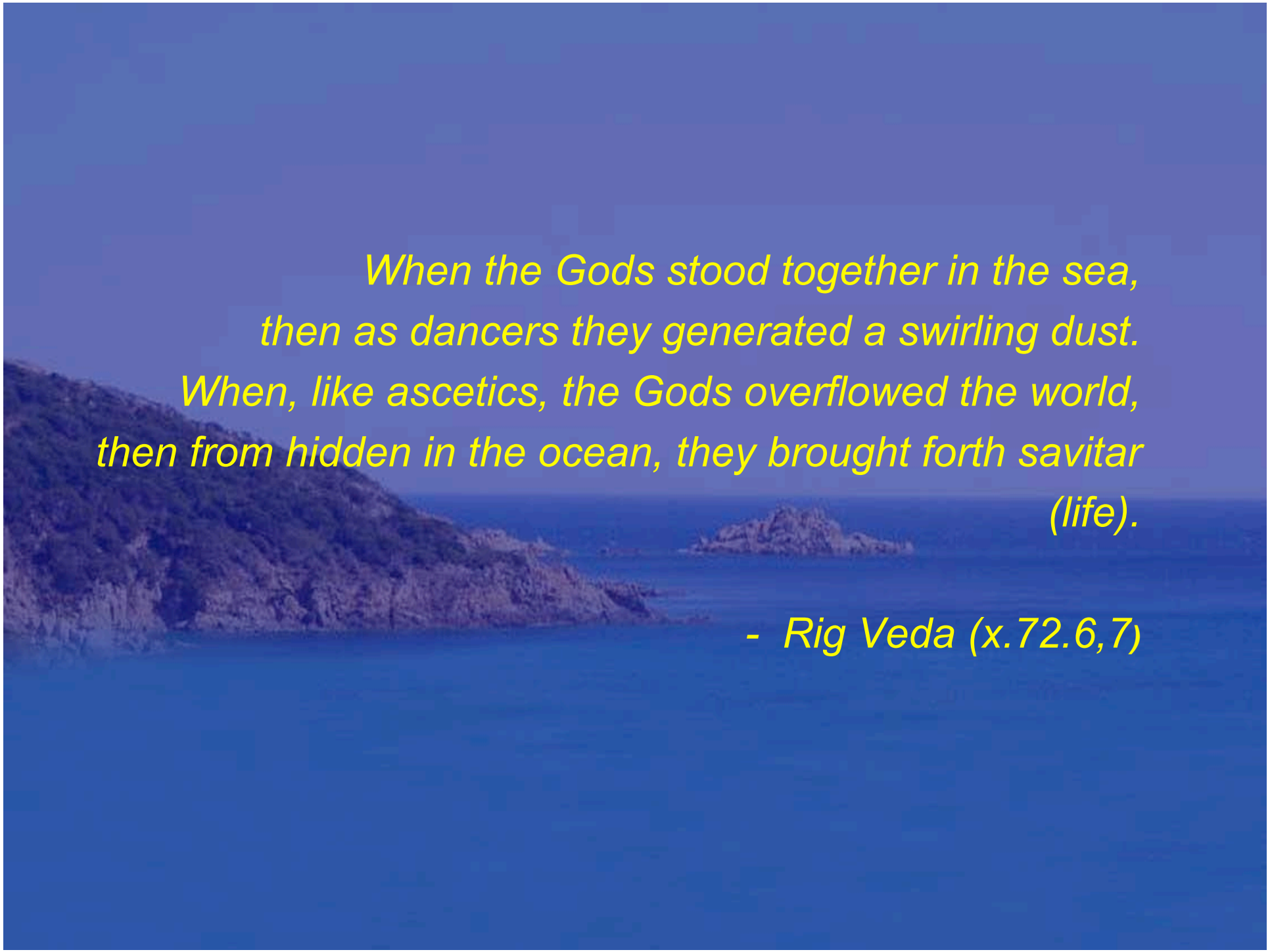
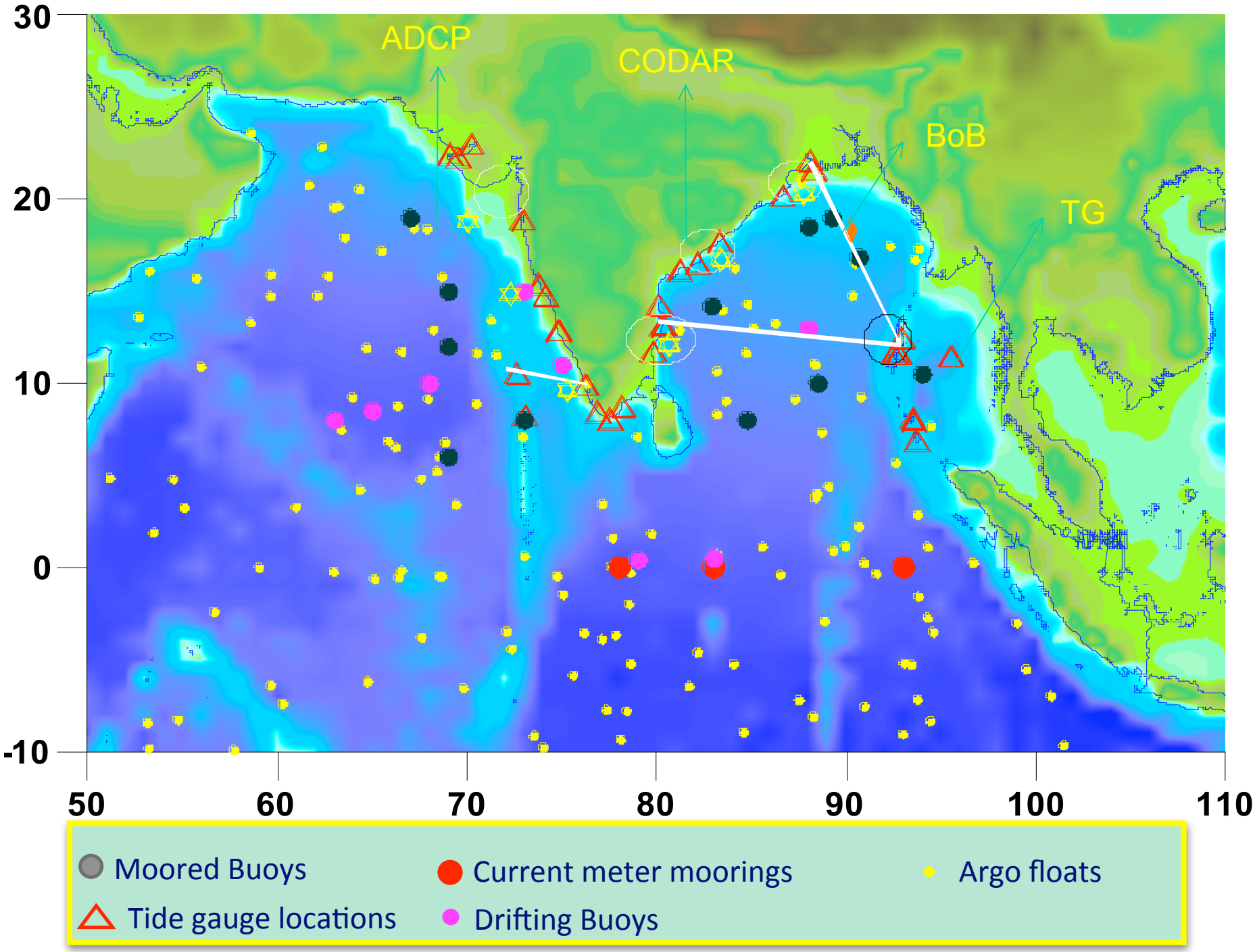
Venice, Italy


When the Gods stood together in the sea,
then as dancers they generated a swirling dust.
When, like ascetics, the Gods overflowed the world,
then from hidden in the ocean, they brought forth savitar (life).
- Rig Veda (x.72.6,7)

Developing/Improving Services for Societal/Economic/Environmental Benefit

- Weather (General)
- Weather advisories specific to agriculture, aviation, shipping, sports, etc.
- Monsoon
- Climate Change
- Disasters (cyclone, earthquake, tsunami, sea level rise)
- Fishery Resources
- Coastal and Marine Ecosystems
- Non-living resources (poly-metallic nodules, cobalt crust, gas hydrates, etc)


ADCP
CODAR
BoB
TG
30
20
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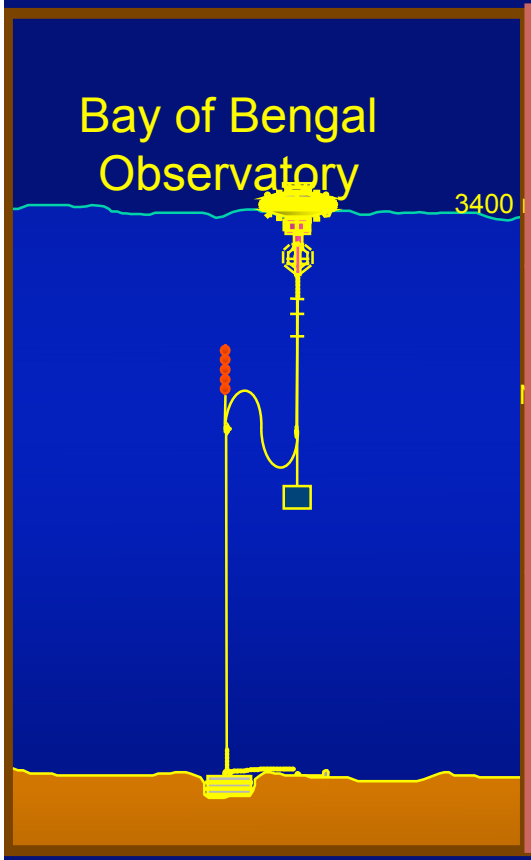
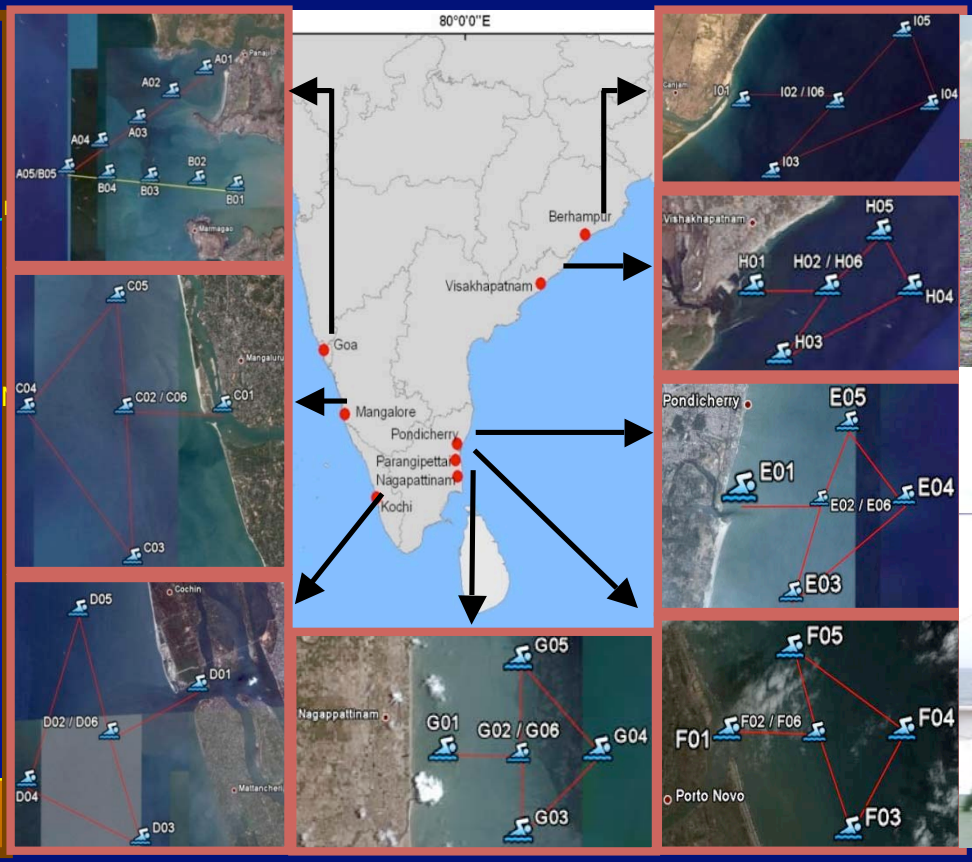
110
Moored Buoys
Current meter moorings
Argo floats
Tide gauge locations
Drifting Buoys

Specific Ocean Observations





WAVESCAN BUOY (Deep water)

Circulation & heat budget
Air-sea interaction
Tropical convergence zone
Cyclone

•Monthly bio-optical and sampling at 8 pre-defined transects covering case 1 & 2 waters. Development of regional algorithms

Wave Rider buoys
AWS on ships

Water quality parameters measurement twice a year at 76 locations

Ocean Observations through Satellites

NOAA (AVHRR)

TRMM

TOPEX

Jason

ERS

Radarsat

RISAT

Saral

Megha Tropiques

Oceansat

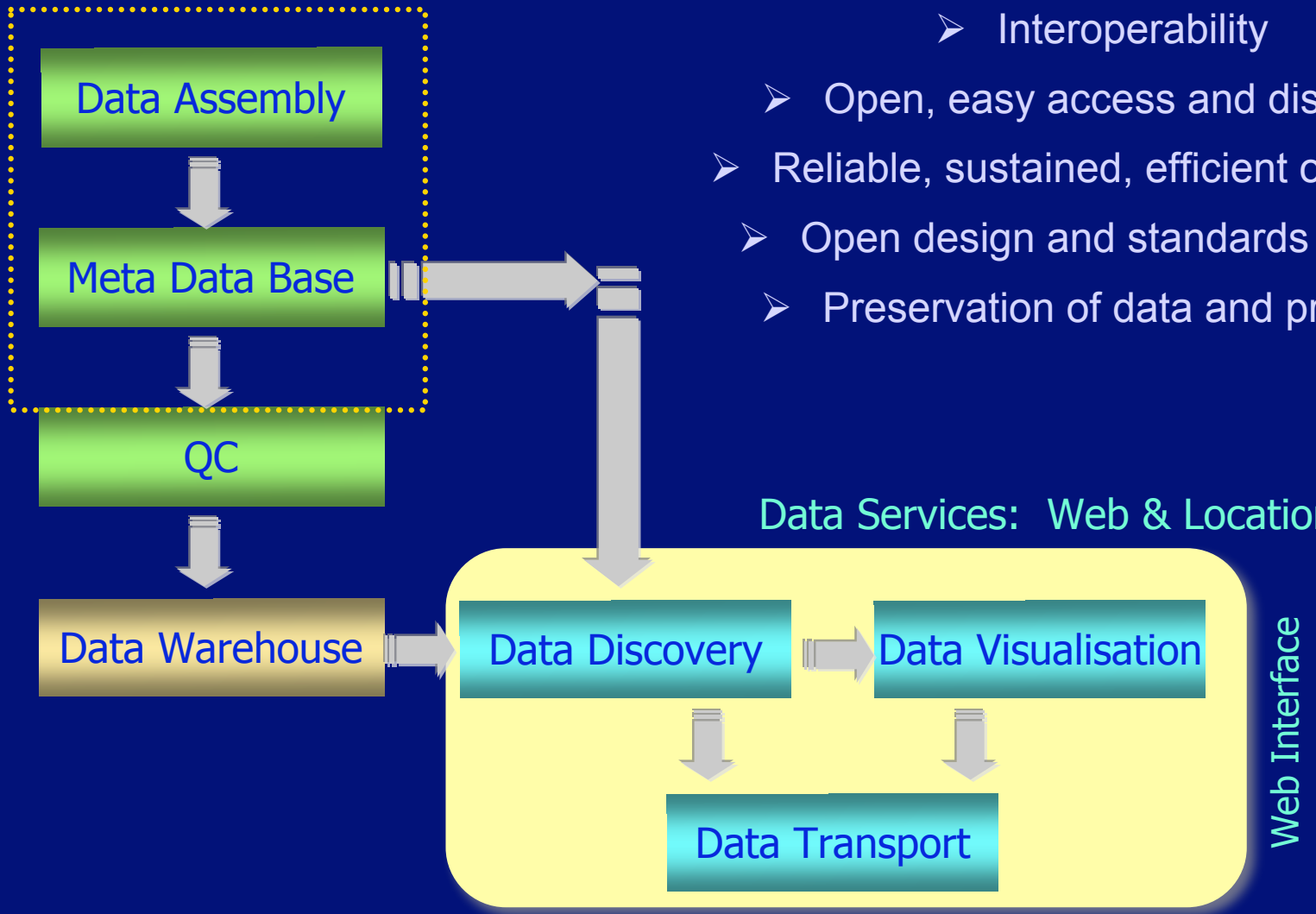
INSAT

Resource sat

Cartosat

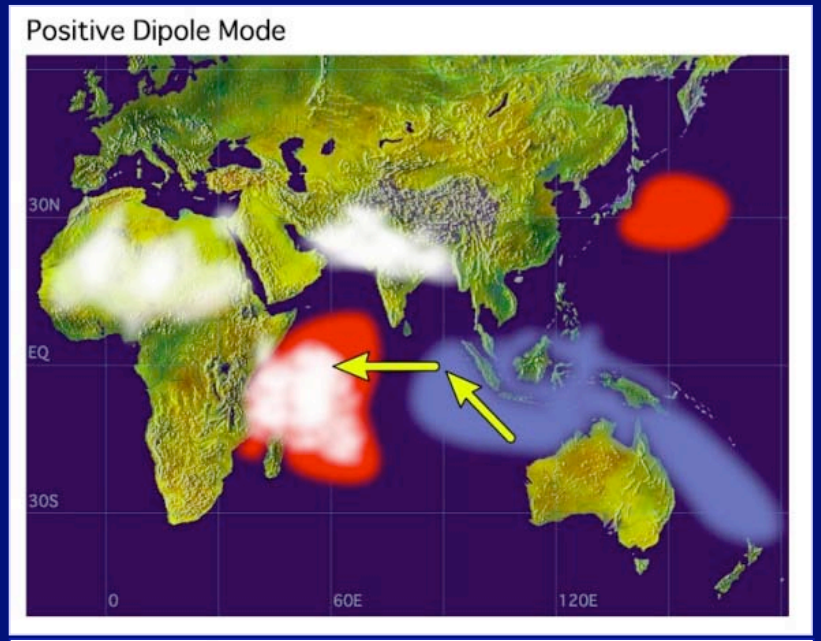
Radiometer (VIS-TIR)	Radiometer (VIS, NIR)	Radiometer (MW)	Altimeter	Scatterometer	SAR
◆ SST	◆Ocean Colour ◆Coastal Process	◆Wind Speed ◆SST ◆Sea Ice Extent	◆Wave Ht. ◆Sea Level ◆Sea Ice Elevation	◆Surface Wind Vector	◆Wave Spectrum ◆Sedim-ent

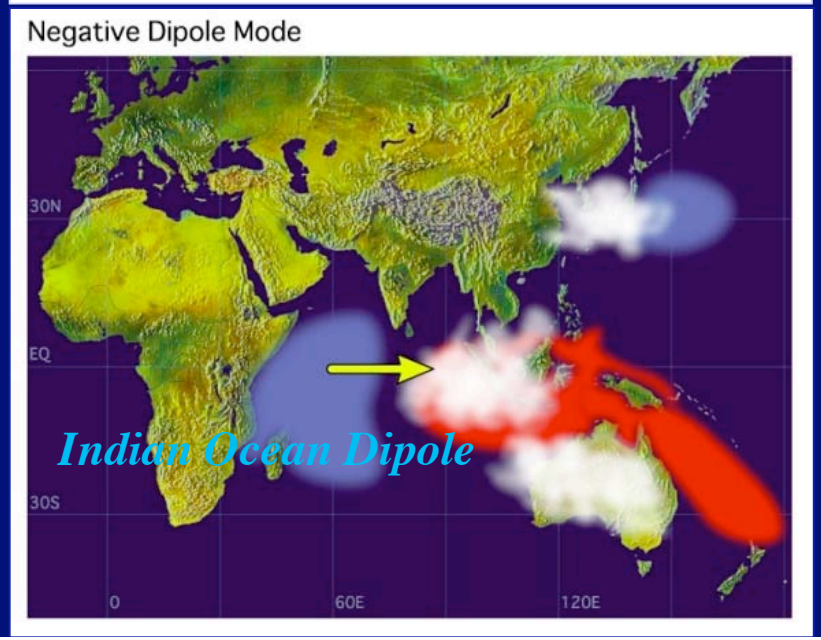
Data Base Organization & Services



- Interoperability
- Open, easy access and discovery
- Reliable, sustained, efficient operations
- Open design and standards process
- Preservation of data and products

Role of Indian Ocean in Climate





Seasonal monsoon variability

Cyclones and synoptic scale events

Intraseasonal (30-90 day period) oscillations, Madden-Julian Oscillation

Interannual variations: ENSO and the Indian Ocean Dipole (IOD)

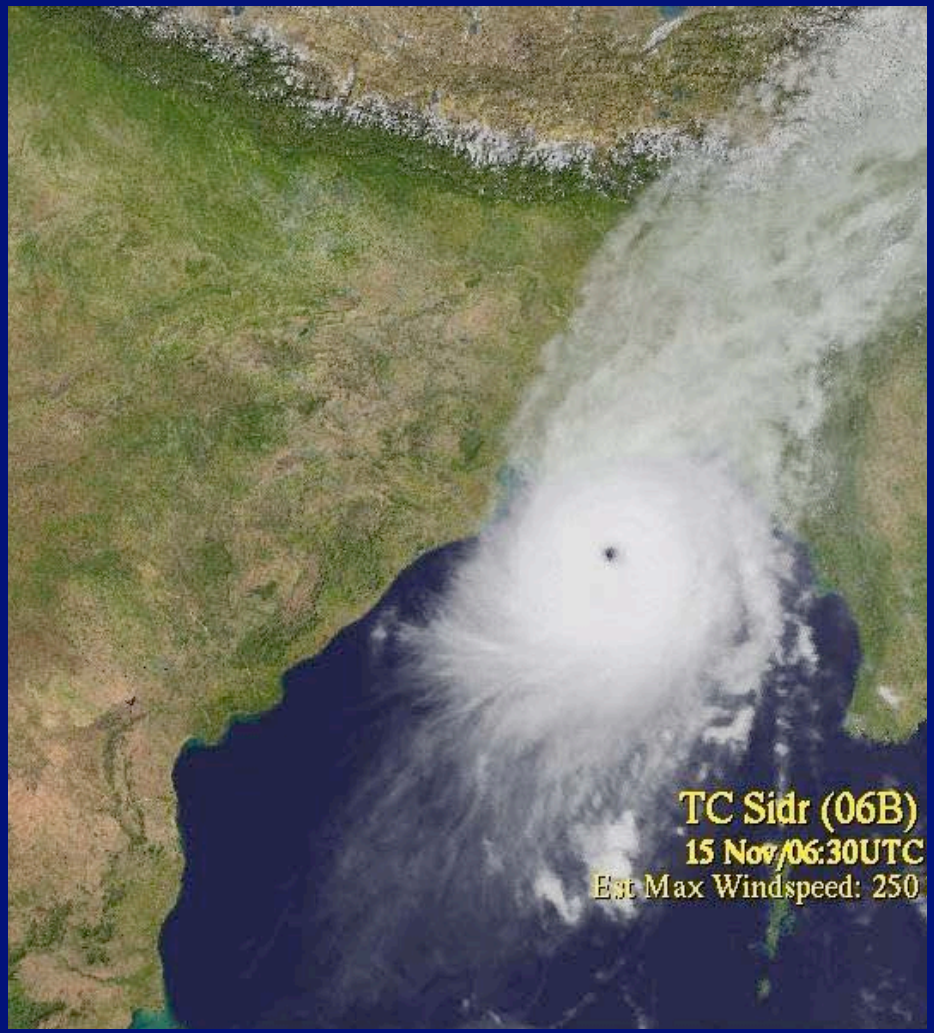
Decadal variability

Warming trends since the 1970s

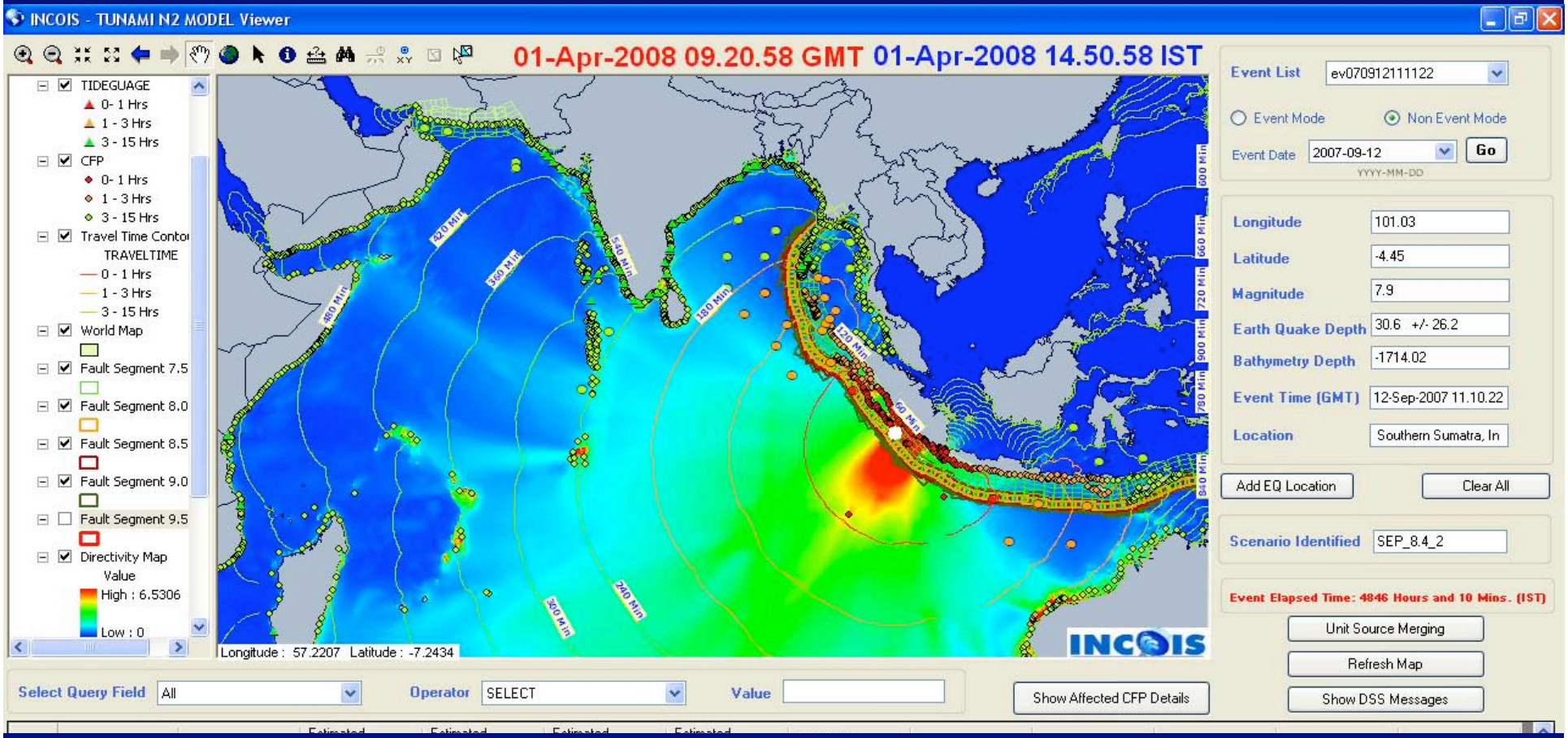
Ocean circulations: Indonesian Throughflow, monsoon currents

Cyclones

- Likely to increase in intensity and frequency
- Prediction of track and landfall point needs to be improved
- Associated rainfall, wind velocity, surge and inundation areas prediction is a major challenge.

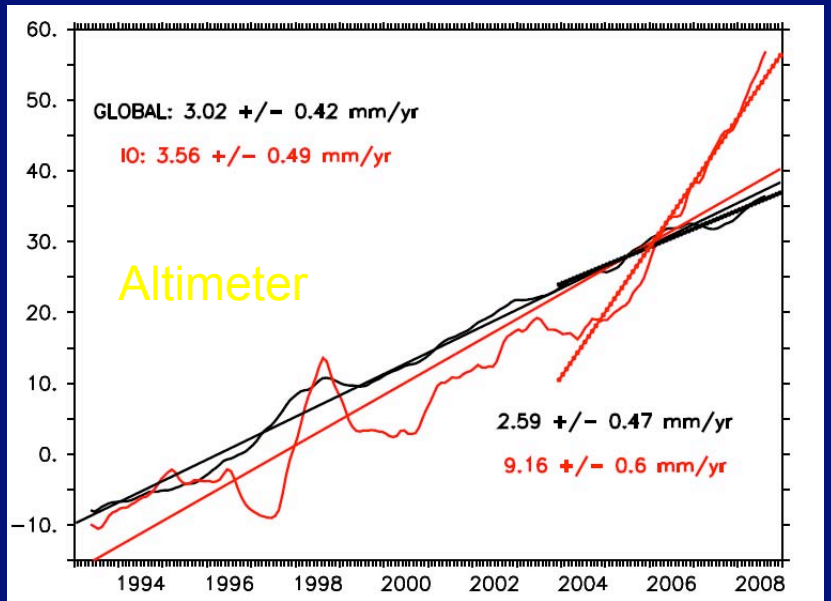


Tsunami Travel Time and Run Up Height



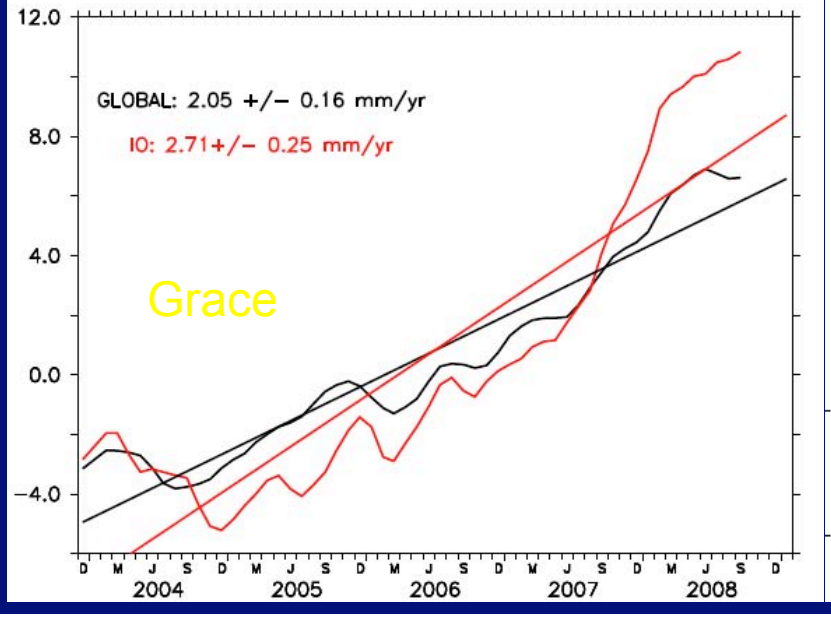
- The TUNAMI N2 model is customized for Indian Ocean region Travel times, Directivity maps, Surge heights and Extent of inundation
- A large database of Scenarios for different magnitudes (6.5, 7.0, 7.5, 8.0, 8.5, 9.0 & 9.5) and depths (10, 20, 40, 60, 80 & 100 km) for 100 x 50 km grid
- Forecast is given for 1800 coastal forecast points

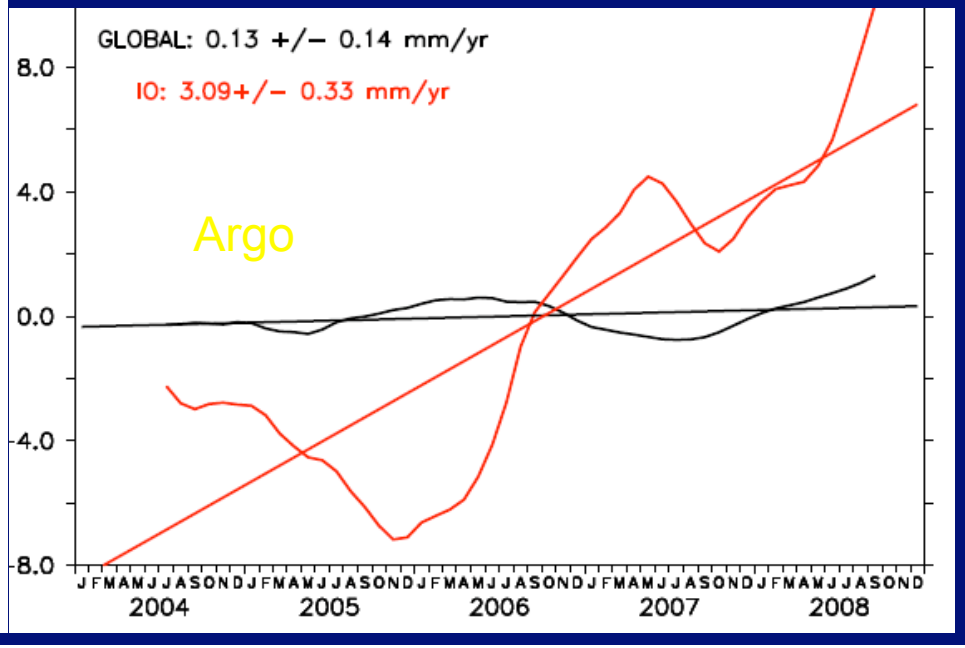
Sea Level Rise



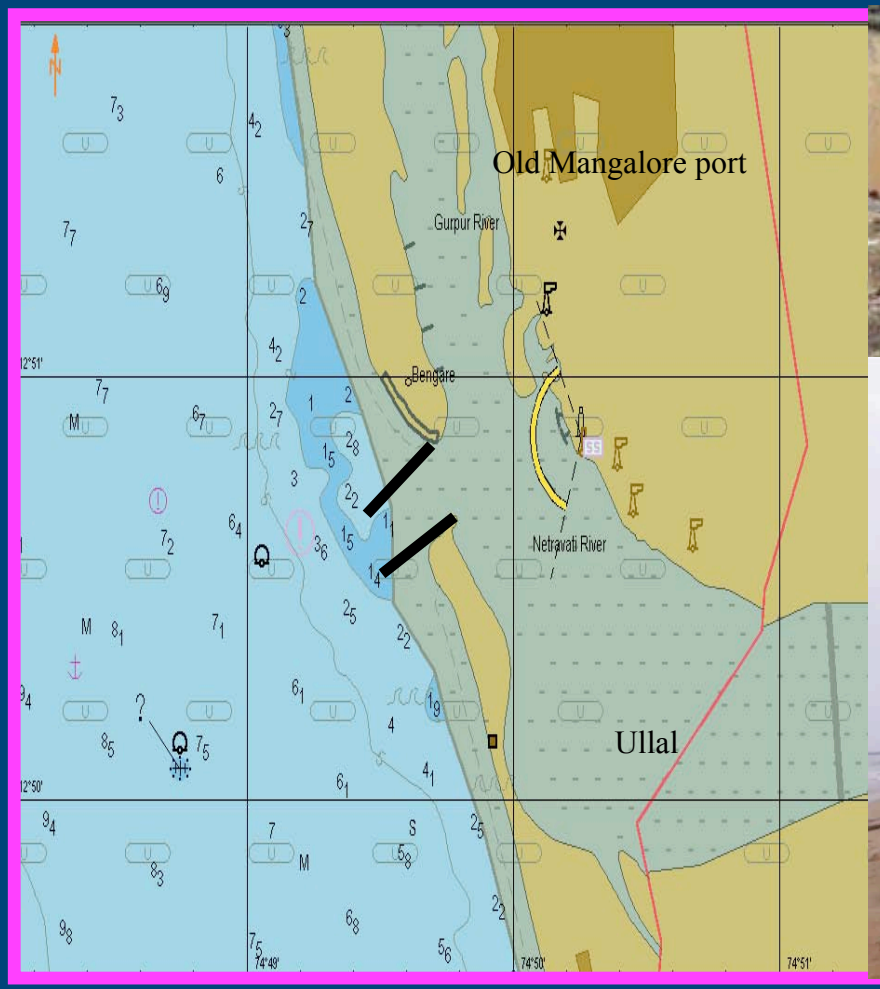
Global average sea level rose at an average rate of 1.8 mm per year over 1961 to 2003. The rate is faster over 1993 to 2003: about 3.1 mm.

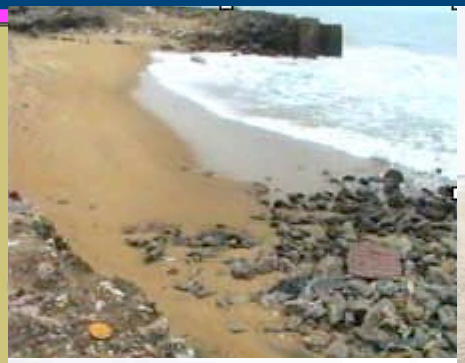
In the Indian Ocean the SLR during 2004-08 is about 9 mm.





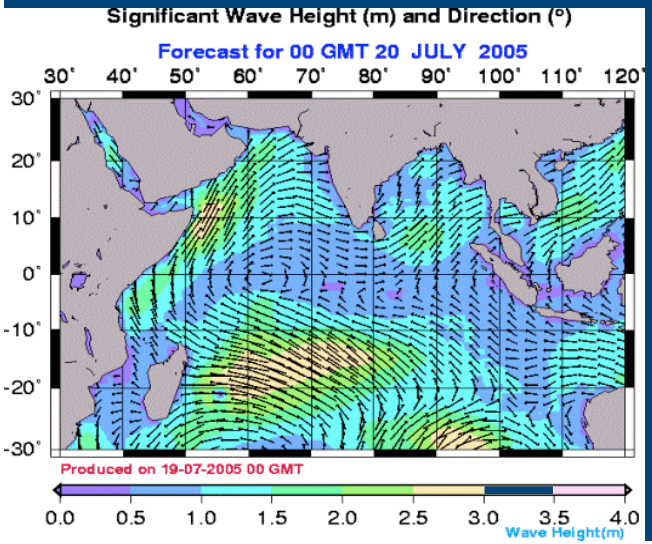
Sea Level Rise: Coastal Erosion

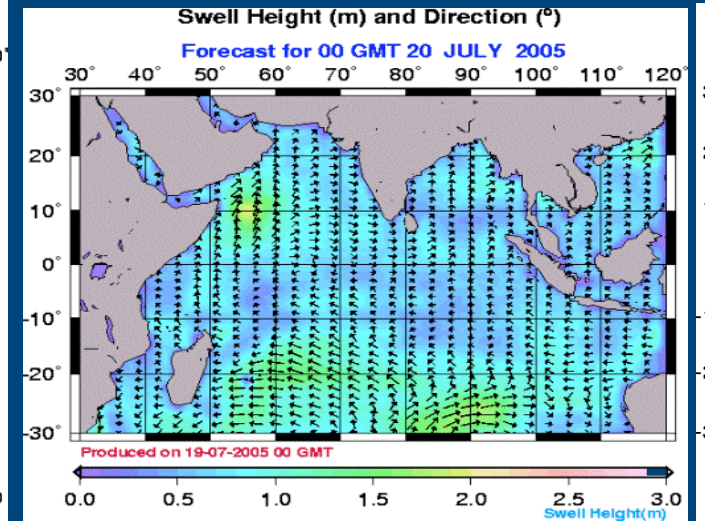


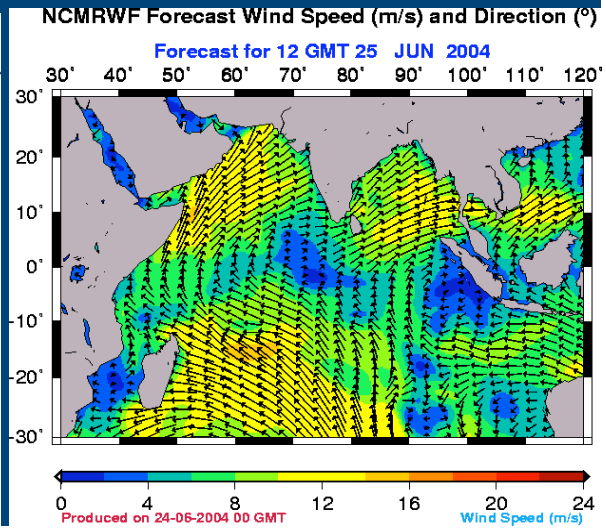


Enabling Marine Operations - Ocean State Forecast

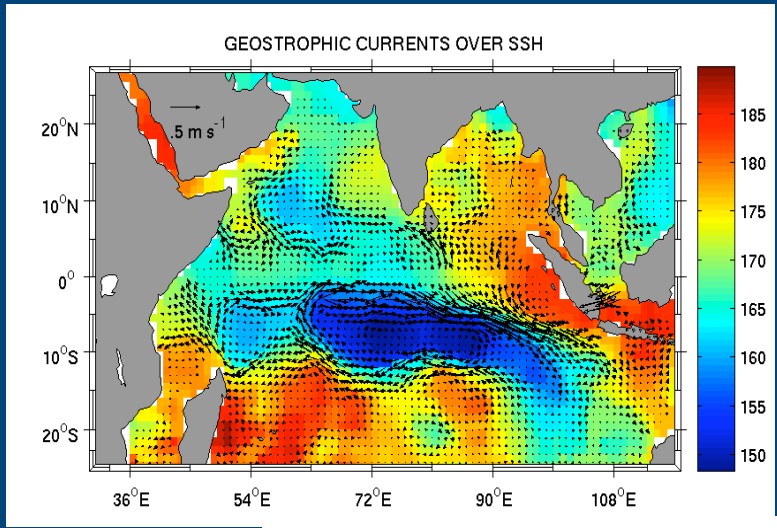
- Daily forecast for
  - Wave and swale Height and Direction
  - Tidal Currents
- Forecast is for Five days at 6 and 3 hourly Interval
- Dissemination in the form of images and data
- Dissemination via web and email

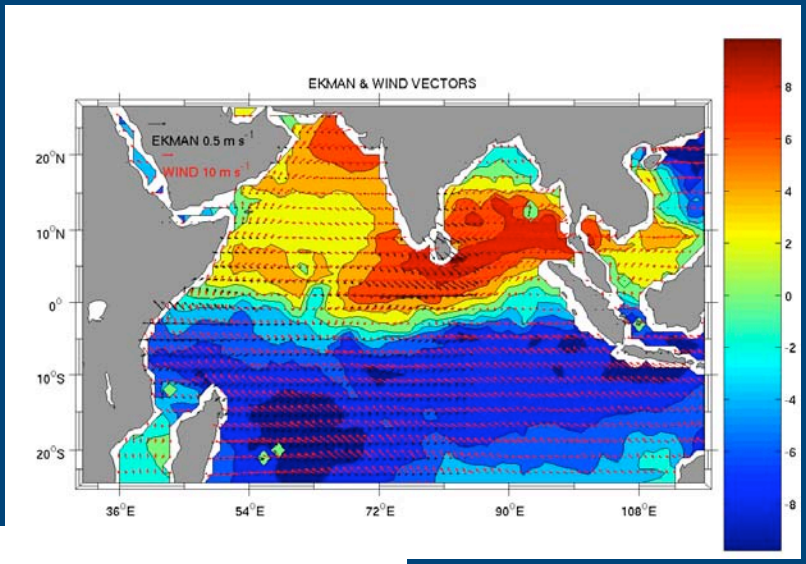


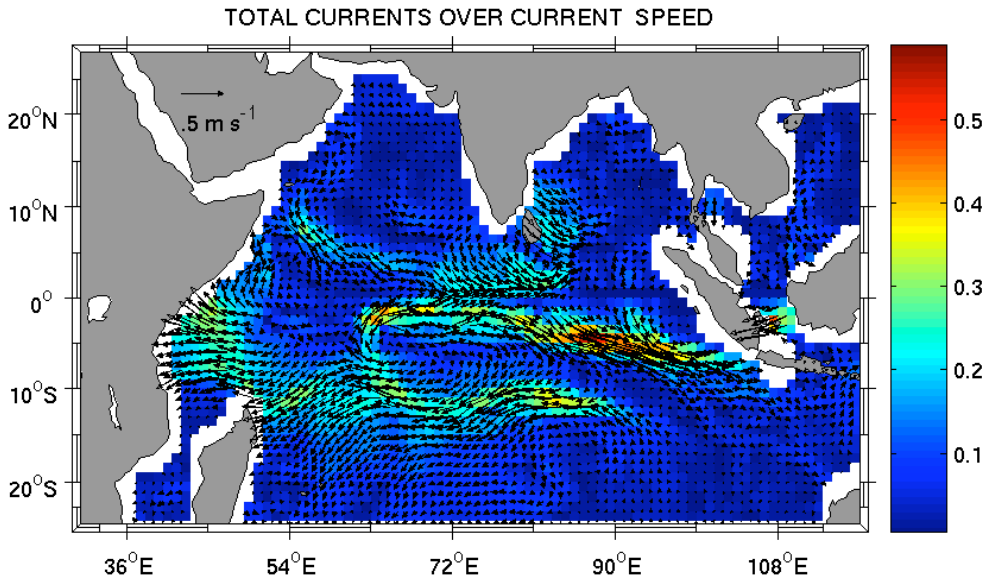




Ocean currents from Argo, Altimeter and Scatterometer

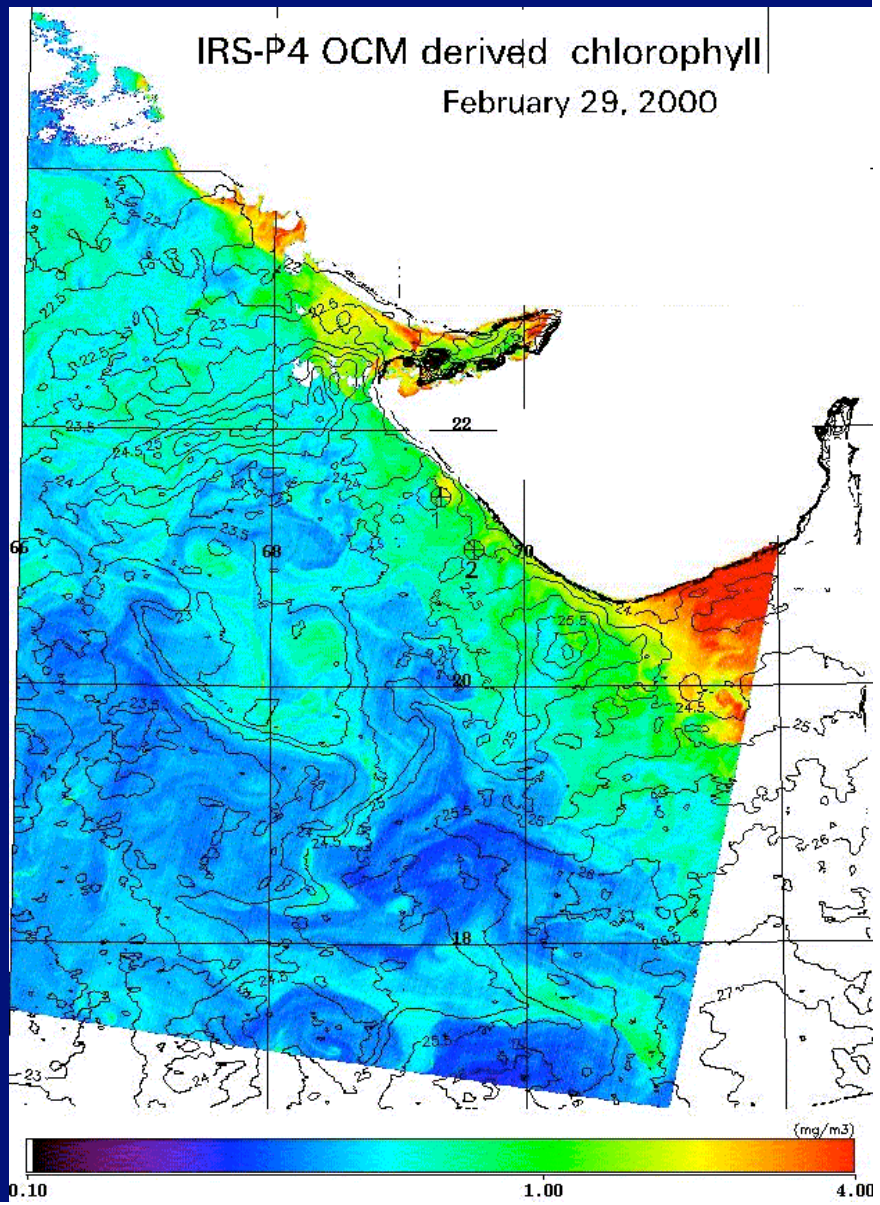




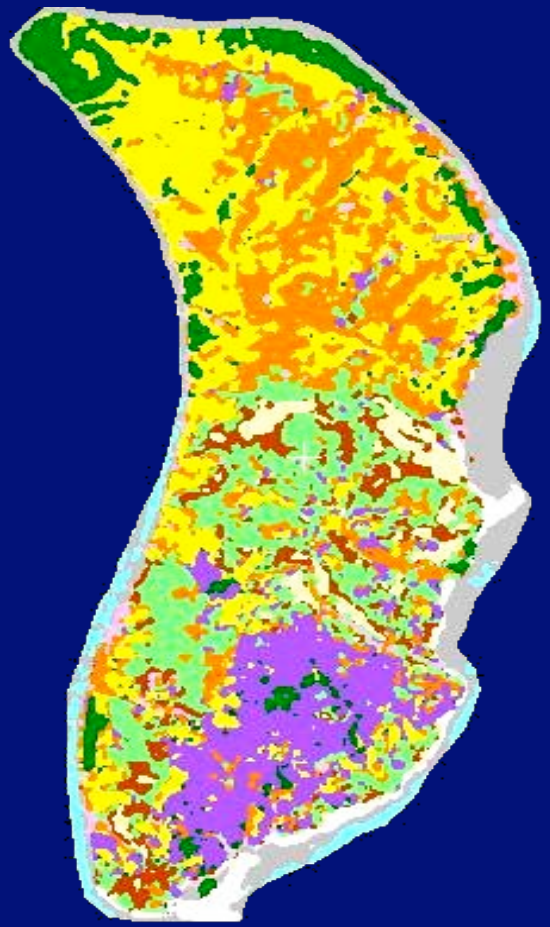


Potential Fishery Zones

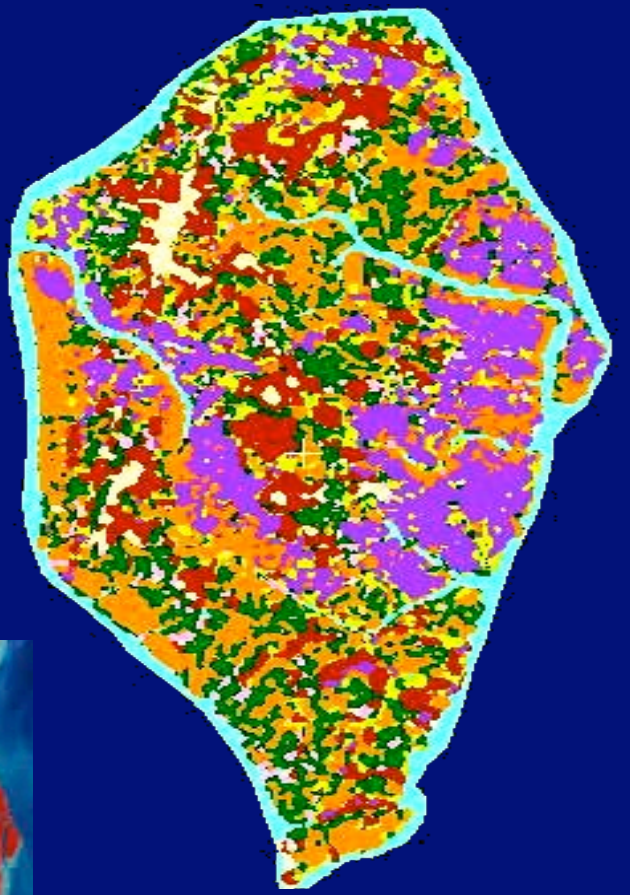
- Fronts (colour and thermal; Diverging), upwelling zones, eddies, rings, plume fronts, shelf-break fronts.
- Advisories provided thrice a week in 9 Local languages and English through web, e-mail, fax, radio and TV. 37000 users.
- Efficient fishing:
- Success Rate:~80 %, Reduction in search time: 60-70 per cen, tIncrease in Catch: 2 – 4 Times, Increase in Net Profit: 2 – 4 Times
- Production of fisheries has not increased.



Biodiversity of Mangroves - Sunderbans



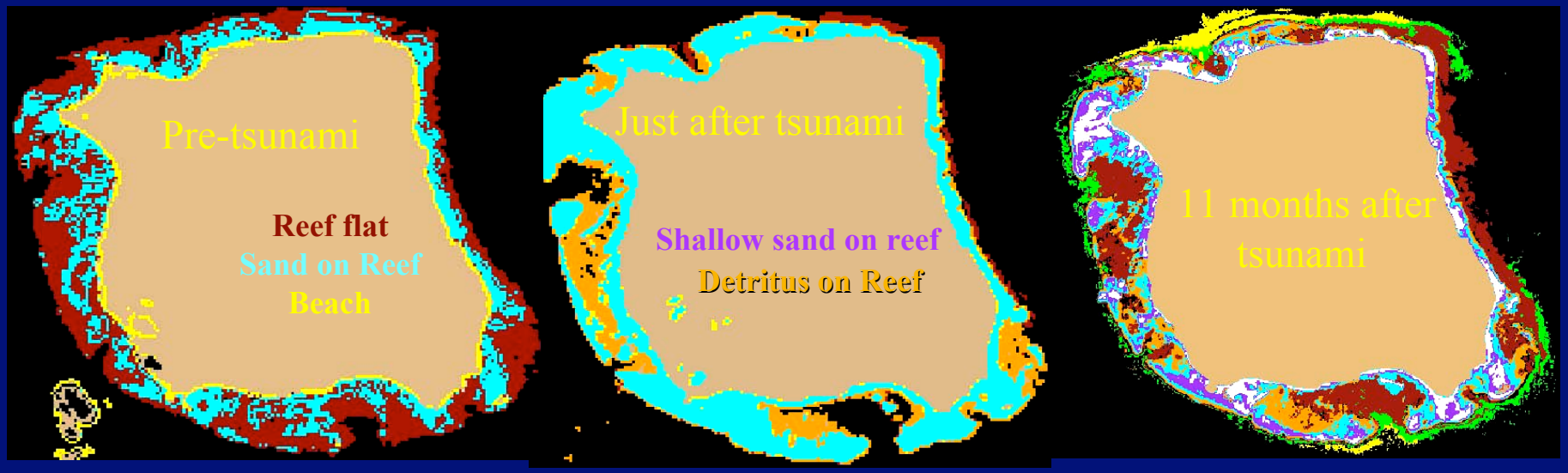
Avicennia dense
Avicennia marina dense
Avicennia sparse
Aegialitis-Ceriops-Excoecaria D
Phoenix dense
Marsh vegetation
Grass (Dhanchi)
Saline blanks
Inter-tidal mudflat
Sand
Creek

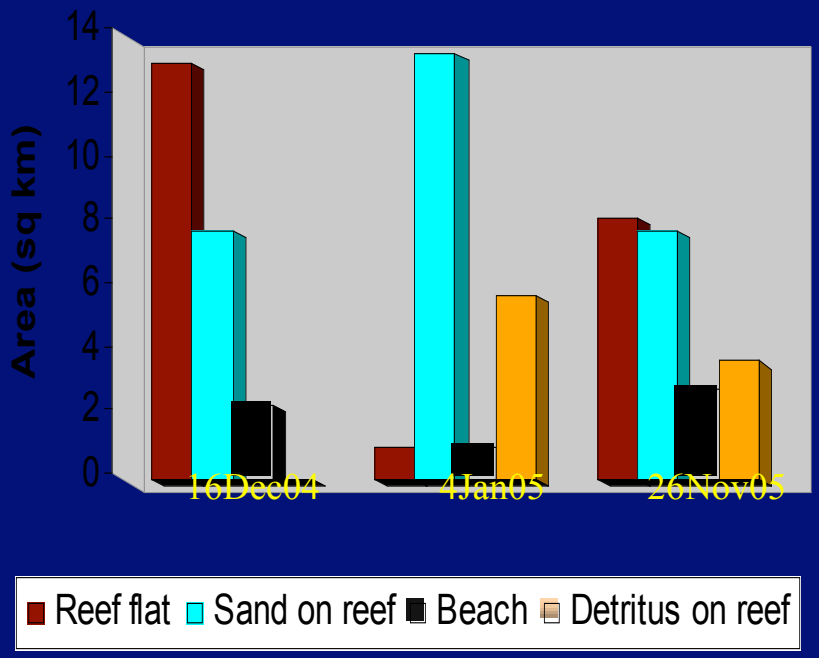


- Fragmentation
- Saline Blanks

Impact of anthropogenic activity

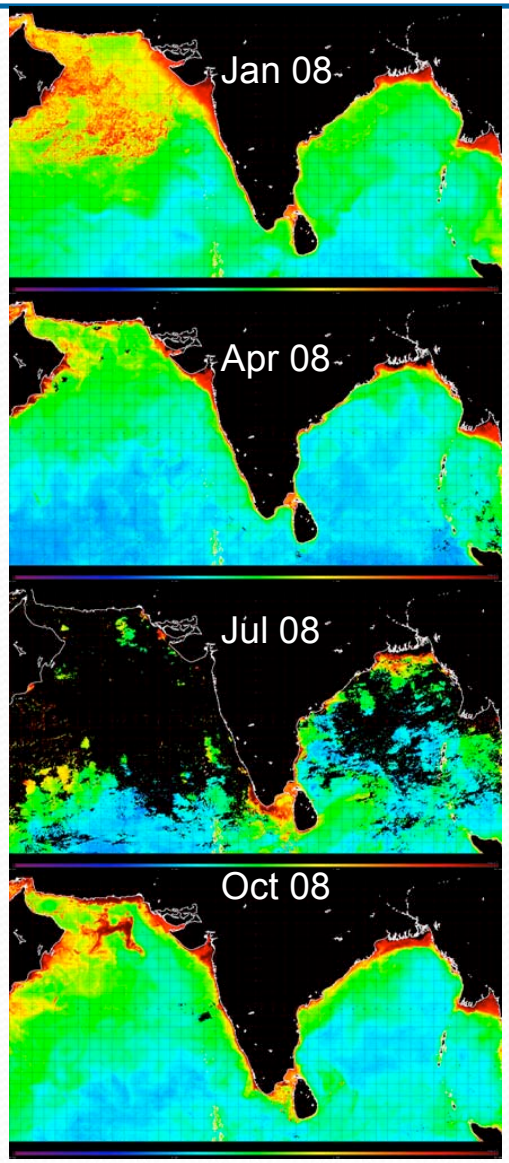
Impact of Tsunami & Reef Resilience
Sentinel Island, S. Andaman

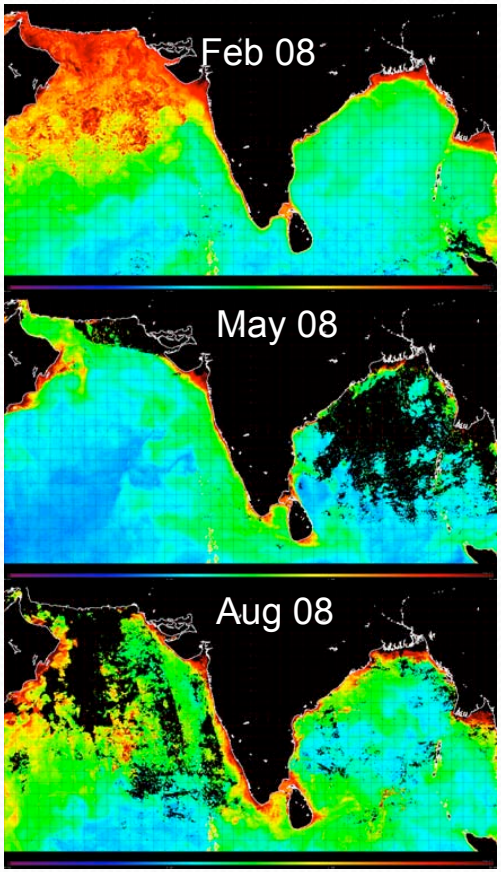


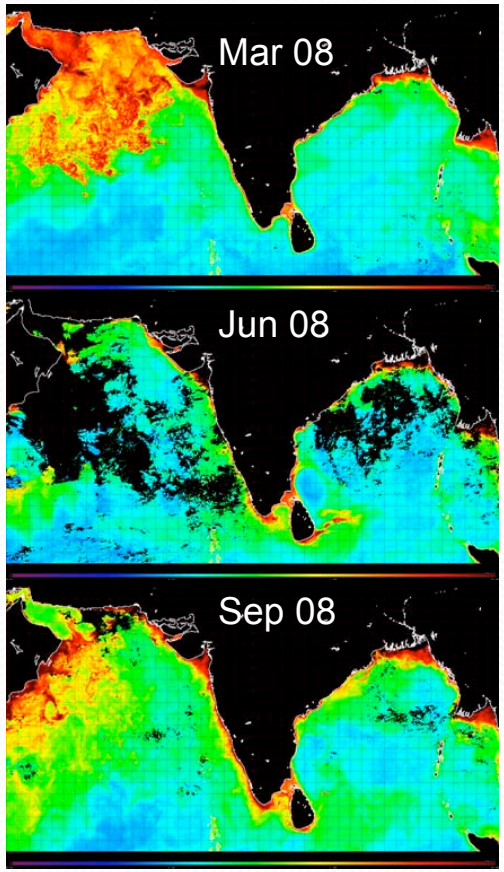


- Tsunami caused deposition of sand & detritus on the coral reef.
- After 11 months (Nov 2005), significant reef resilience noticed. Sand and detritus have been reduced significantly.
- Recovery may be attributed to healthy condition of reef and no anthropogenic pressure.

ChloroGIN: Ocean Colour Products

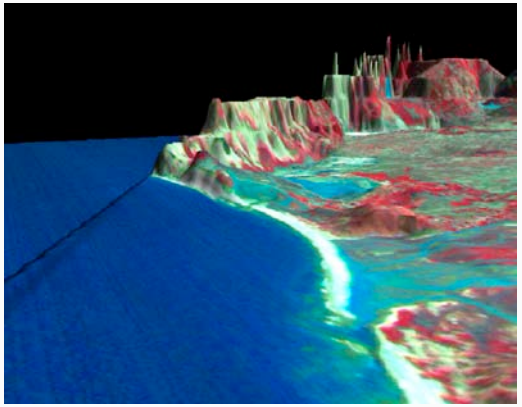


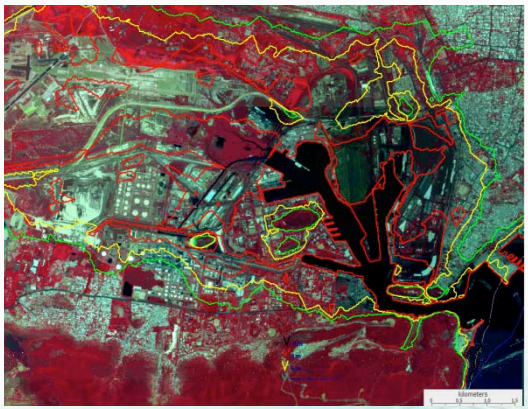




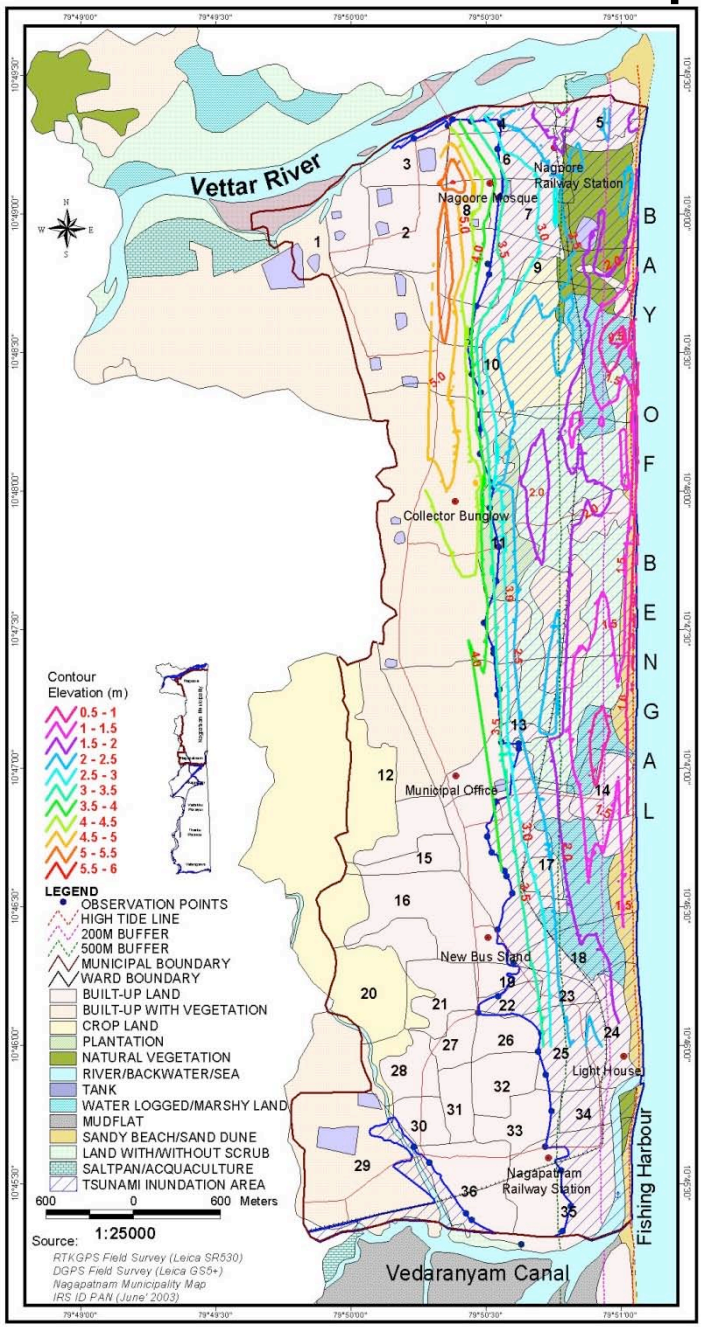
Monthly composite of Chlorophyll_a derived from MODIS – Aqua over northern Indian Ocean

Coatsal Inundation Mapping



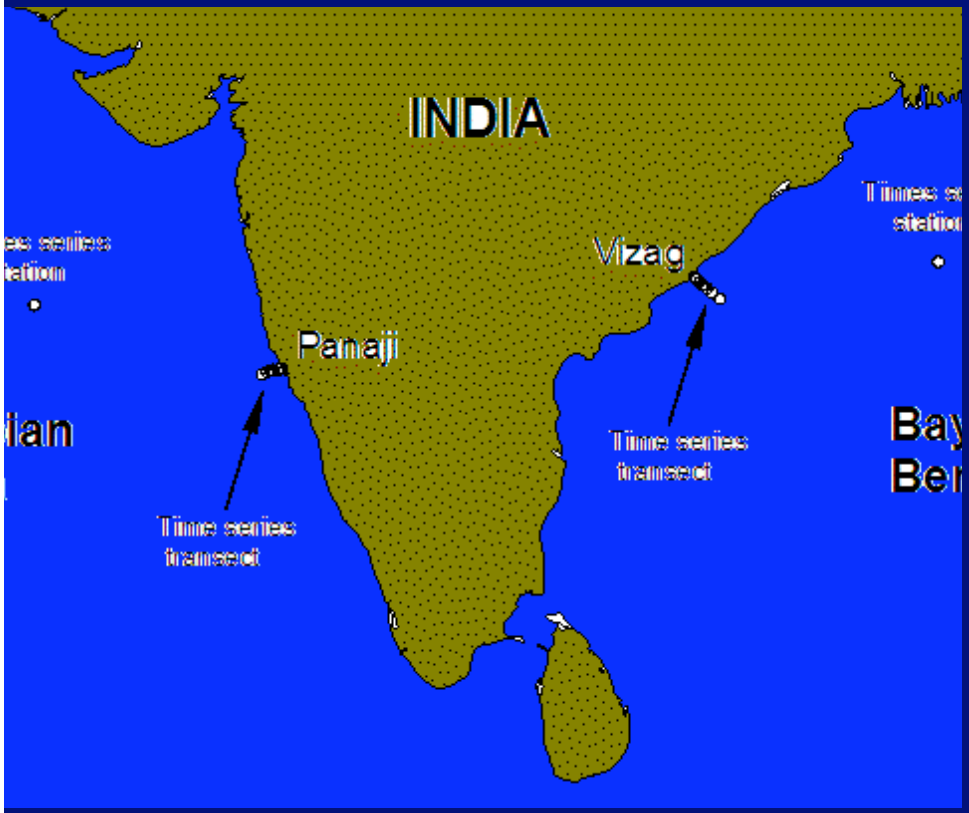


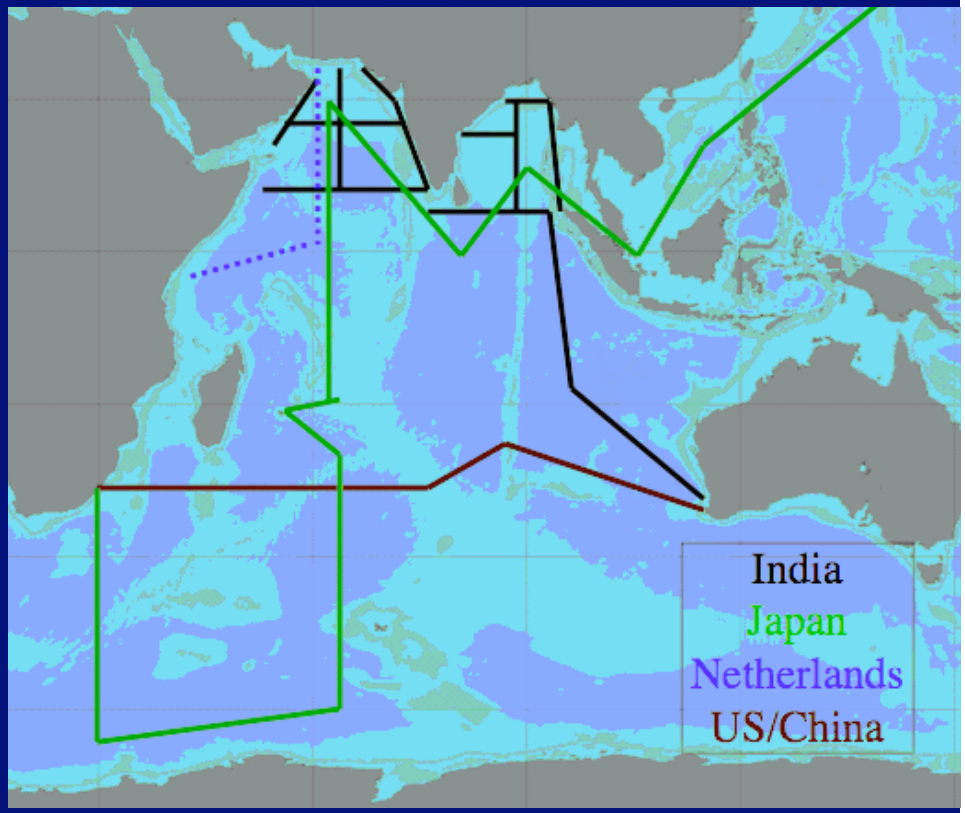
Bathymetric Survey for Cuddalore



- **Coastal Inundation scenarios simulated for 5 historical Earthquakes using TUNAMI N2 model and the predicted inundation areas have been overlaid on cadastral level maps of 1:5000 scale.**
- **Coastal Bathymetry: Maps of Special Order are required (Accuracy 0.5 M)**
- **Coastal Topography: Contour Intervals of 0.5 M at 1:25, 000 Scale are required**
- **Topography Data being generated using Cartosat and ALTM Surveys**
- **Bathymetric Survey conducted for a few vulnerable areas. Detailed survey being planned for other areas.**
- **Multi-hazard Vulnerability Mapping, Real-time Tsunami Inundation Forecasting & 3D GIS – Proposal being submitted to MoES to be taken up at a cost of 15 Cr.**

Bio-Geochemistry of Ocean





•Monitoring of Biochemical Processes and modelling

2 coastal and open ocean time series measurements

Marine ecosystem dynamics and carbon cycling

The distribution of TEs in the oceans and their depositional fluxes hold clues to productivity variations / climate change.

HIERARCHY OF SOLUTIONS

SOCIETY

COMMUNITY DEVELOPMENT

NR INVENTORY MONITORING

PROCESSES SUSTAINABILITY

NATIONS

EARTH

LOCALE-LEVEL PRESCRIPTIONS

INDIVIDUALS

Thank You