



Indian Services Supporting the Asian Region

Presenter: Ashim Kumar Mitra

Ram Kumar Giri, Gargi Rakshit
Mrutyunjay Mohapatra

India Meteorological Department
Ministry of Earth Sciences

Govt. of India



Utilization of satellite data by IMD

I. List the satellite data used by India Meteorological Department-IMD

GEO satellite data

- **INSAT-3DR/3DS:**

- Monitoring tropical cyclones, monsoon, and severe weather events.
- Rainfall estimation and cloud motion vector analysis.
 - Fog and snow detection.
 - Atmospheric temperature and humidity profiling.
 - Sea surface temperature monitoring

- **GOES:**

- Atmospheric profiling, lightning detection, and severe storm monitoring.
- Cyclone tracking

- **HIMAWARI:**

- High-resolution monitoring of tropical cyclones in the Indian Ocean region.
- Cloud motion vectors, sea surface temperature (SST), and fog detection.

- **METEOSAT:**

- Monitoring precipitation, tropical cyclones, dust, fog and heatwaves.

- **Geo-KOMPSAT-2A (GK-2A):**

- Monitoring SST, surface winds, and extreme weather events in the Asia-Pacific and Indian Ocean.

Utilization of satellite data

LEO satellite data

Oceansat-3:

- Sea surface winds monitoring.
- Ocean state forecasting and cyclone prediction.

NOAA (15, 18, 20):

- Temperature and humidity profiles using the Advanced Microwave Sounder Unit (AMSU).

MetOp Series (A, B, C):

- Sea surface winds monitoring.
- Ocean state forecasting and cyclone prediction.

Terra/Aqua:

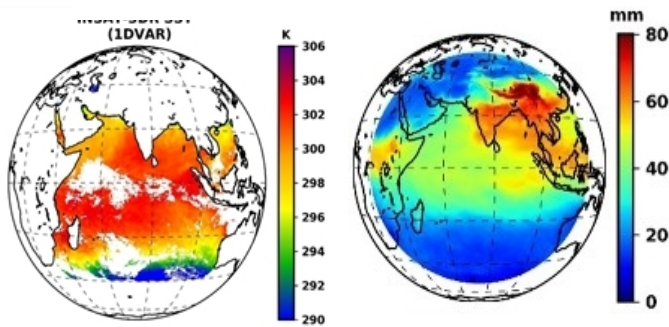
- Monitoring aerosols, vegetation, and land surface temperatures using

MODIS.

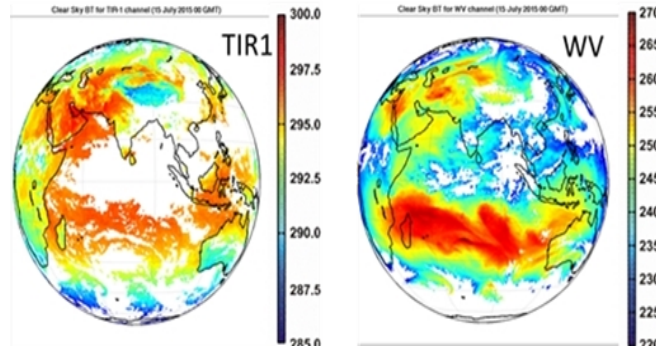
Uses of Geostationary Satellite Products

- Multi-Mission Meteorological Data Receiving and Processing System** : Complete processing of INSAT-3DS/3DR satellites, including Data Reception, Processing, Parameter Retrieval, Visualisation/Dissemination, and Validation developed by ISRO-IMD. 15 Additional parameters apart from daily operational products.

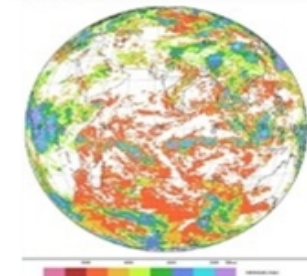
1D-VAR Algorithm for SST & TPW



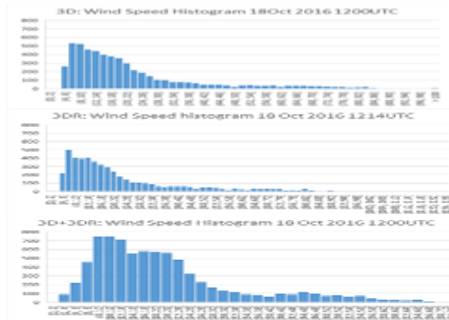
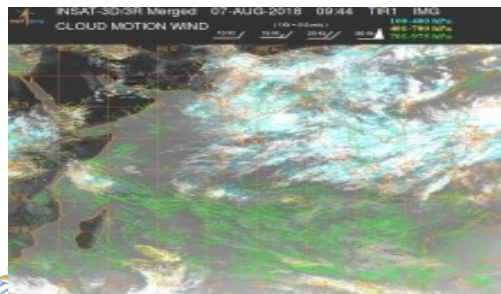
Clear sky Brightness Temperature



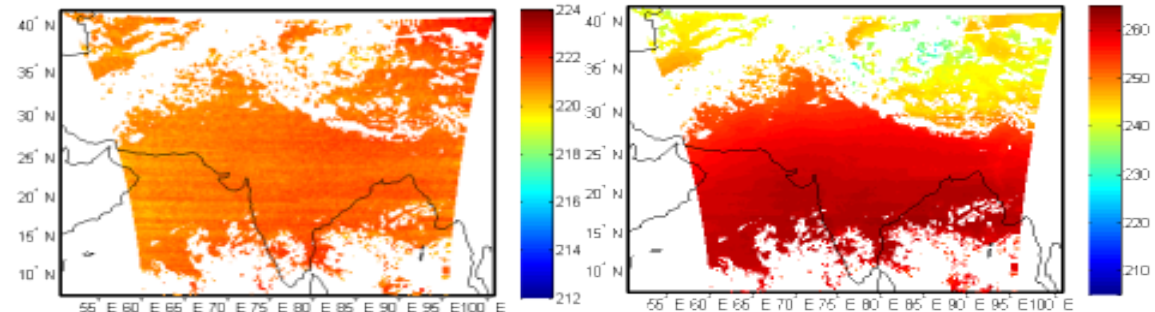
Cloud Top Pressure



INSAT-3D/3DR Staggered Winds



INSAT-3DR Sounder Clear Sky Brightness Temperature (CSBT)



METEOSAT, HIMAWARI, Products available from EUMETCAST, CIMSS, CIRA

Uses of Polar Orbiting Satellites Products

Oceansat-3 (2022):

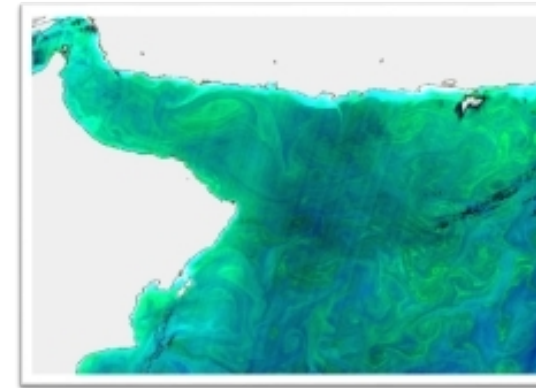
- **Ku-band Scatterometer (SCAT-3)** Exp. High Res. (6.25 km) mode
- **13-band Ocean Colour Monitor (OCM-3)** Narrow Bandwidth
- **2-band Sea Surface Temperature Monitor (SSTM)**
- **ARGOS** by CNES

Major Applications

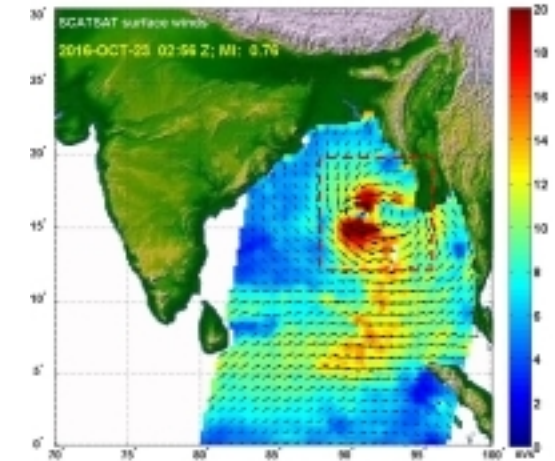
- **Ocean:** Ocean biology and ecosystem, Ocean State Forecast, Potential Fishing Zone Identification, Coastal zone management
- **Atmosphere:** Cyclogenesis, Track/Intensity Prediction, Numerical Weather Prediction, Air quality
- **Land:** Vegetation classifications/ growth assessment, Hydrology
- **Cryosphere:** Sea ice dynamics, Surface melting

International satellites:

- ASCAT
- NOAA, DMSP, SSMI, ATMS CRIS
- Available products from US Navy NRL, CIMSS, CIRA etc



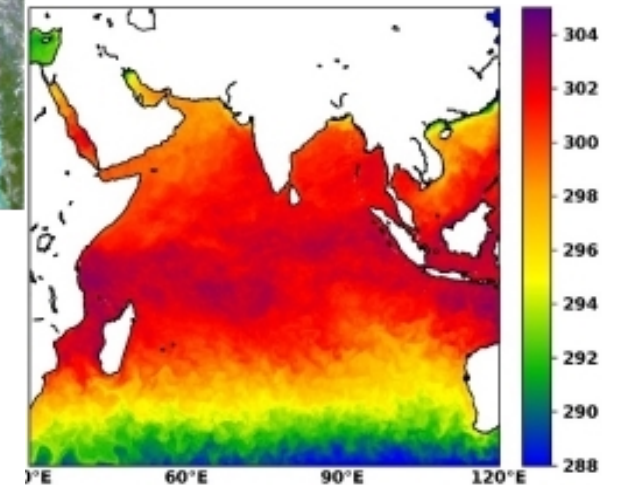
Algal Bloom from Oceansat-2, OCM in the waters of Gulf of Oman and north-west Arabian Sea



Tropical Cyclogenesis of Tropical cyclone KYANT (Bay of Bengal)

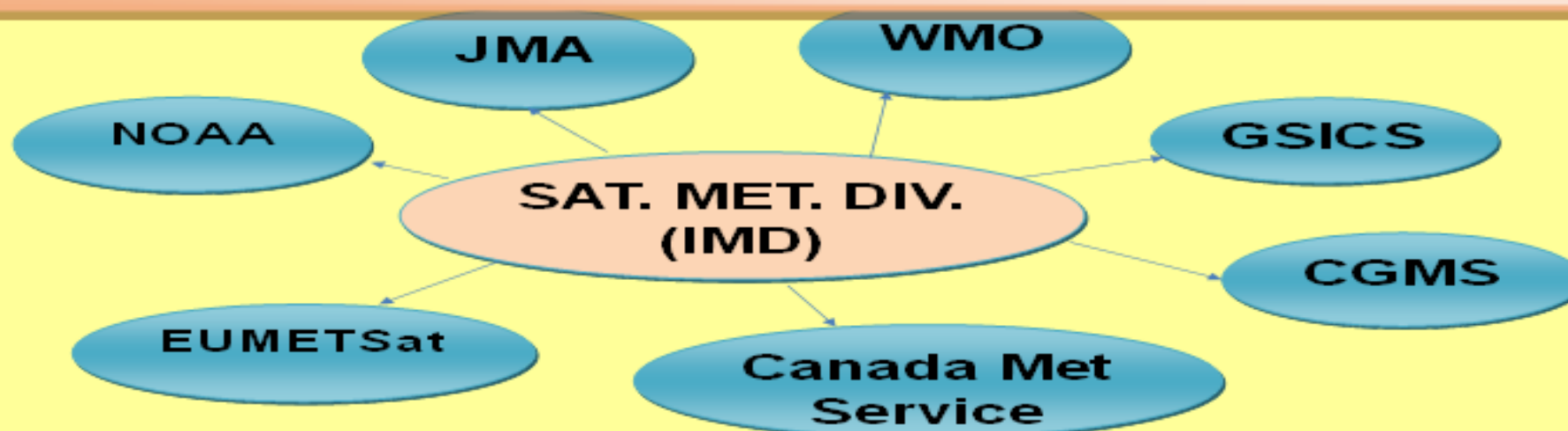


Sediment Discharge in Irrawaddy Delta

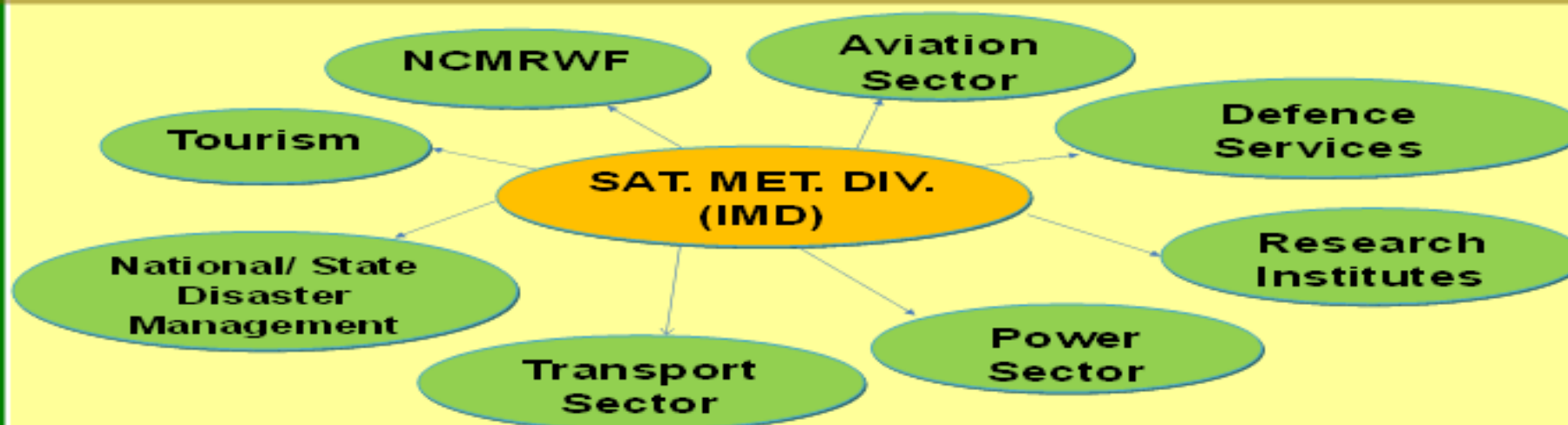




International Collaboration



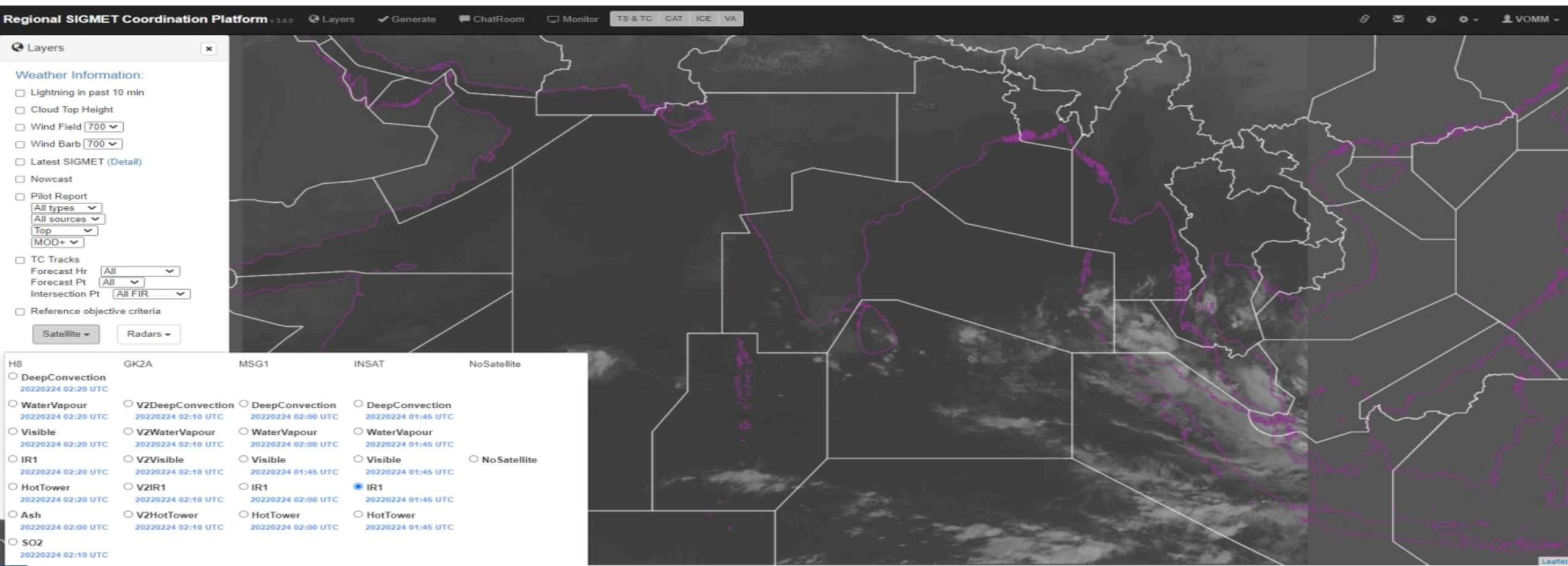
Stake Holders



INSAT Data transfer for SIGMET Coordination platform



Seamless data transfer of INSAT 3DR and 3DS to Hong Kong Observatory has been established for the regional SIGMET Coordination platform. (2022)





Capacity building and training needs

- ❖ Recent capacity-building initiatives have significantly improved the ability of forecasters to interpret and apply satellite data for operational weather forecasting and disaster management.
- ❖ Conducted training sessions on INSAT-3DR/3DS data processing and visualization using platforms like RAPID.

Trainings:

- ❖ Advanced techniques for satellite data processing and analysis, including machine learning applications in meteorology.
- ❖ Utilization of multispectral satellite imagery for severe weather event monitoring (e.g., fog, cyclones, and extreme rainfall).

Training Material:

- ❖ Interactive, hands-on modules covering topics like geostationary satellite data, atmospheric sounding, and model assimilation.



- ❖ Training materials and sessions should be available in English as the primary language.



OUR TRAININGS & CAPACITY BUILDING

Course	Duration	No. of Participants	No. of batches in a calender year	Name of marine weather module
Intermediate Training Course/Integra ted Meteorological Training Course	4 months	60 -100	3	Marine Meteorology
Forecasters Training Course	6 months	50 - 60	2	Physical Oceanography & Ocean Atmosphere interaction
Advanced Meteorological Training course	12 months	8-15	1	Oceanography & Marine Meteorology + Physical Oceanography & Ocean Atmosphere interaction
Trainee Meteorologist Gr-II course	12 months	10-20	1	Oceanography & Marine Meteorology + Physical Oceanography & Ocean Atmosphere interaction

OUR SERVICES



CYCLONE INFORMATION

AGROMET ADVISORY SERVICES

RAINFALL INFORMATION

**CLIMATE HAZARD &
VULNERABILITY ATLAS**

URBAN METEOROLOGICAL SERVICES

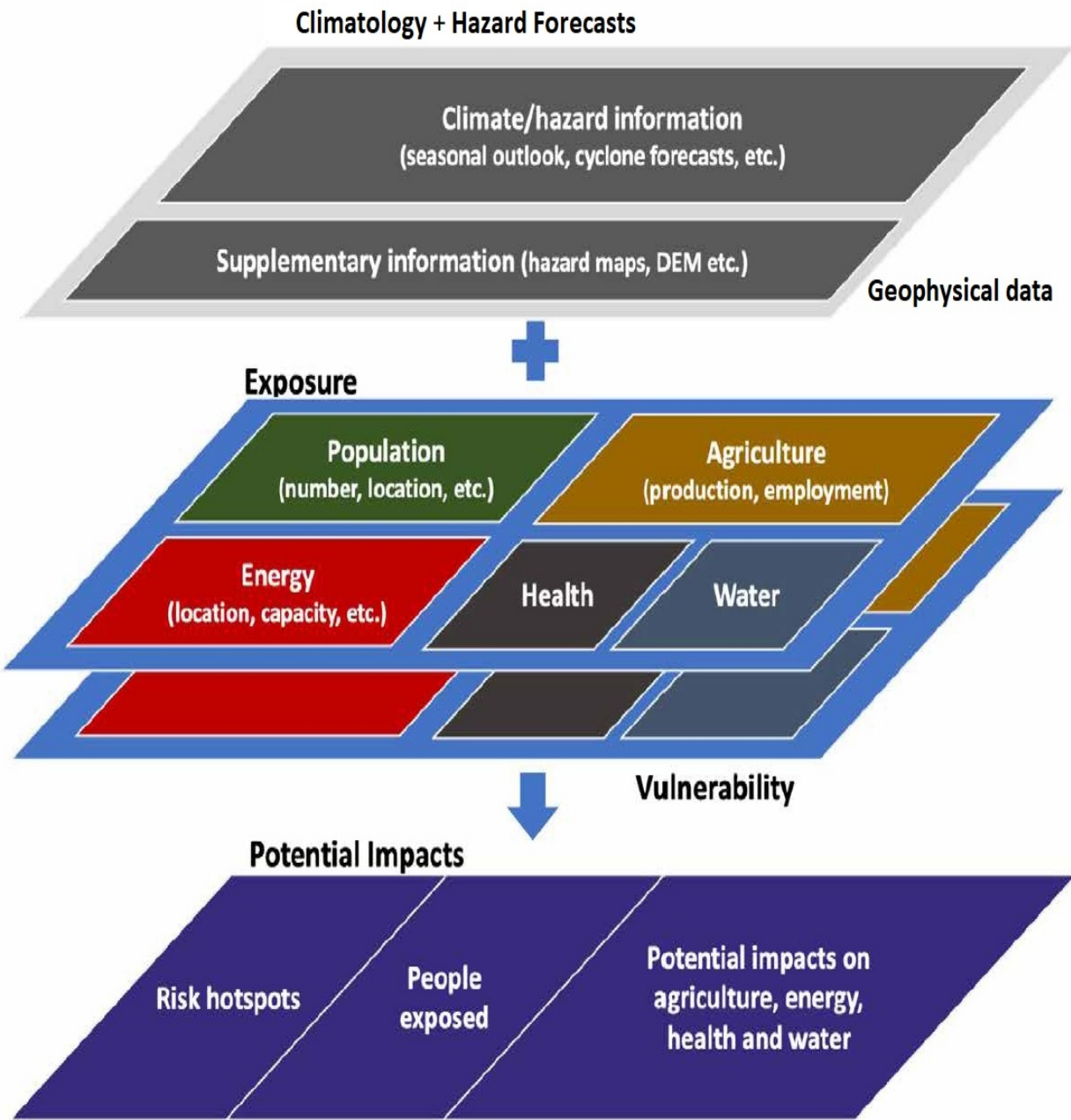
MONSOON INFORMATION

AVIATION SERVICES

CLIMATE SERVICES

GEOSPATIAL SERVICES

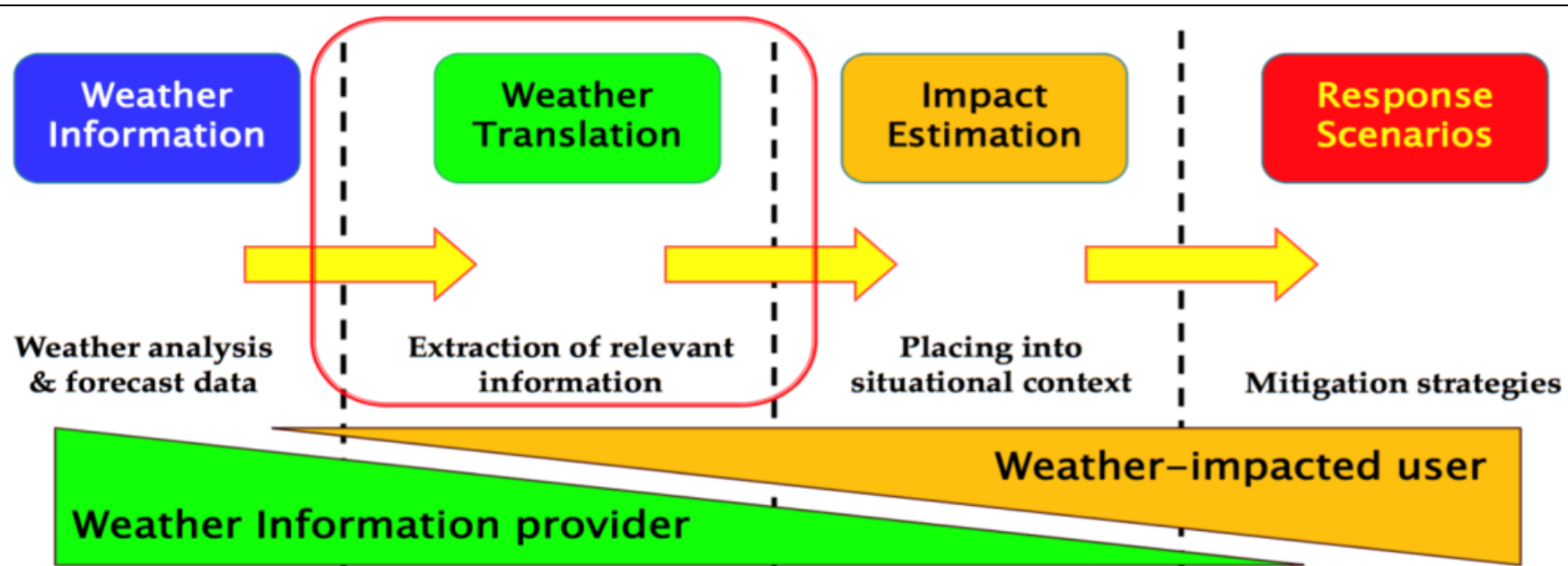
Satellite role in Impact Based Forecasting



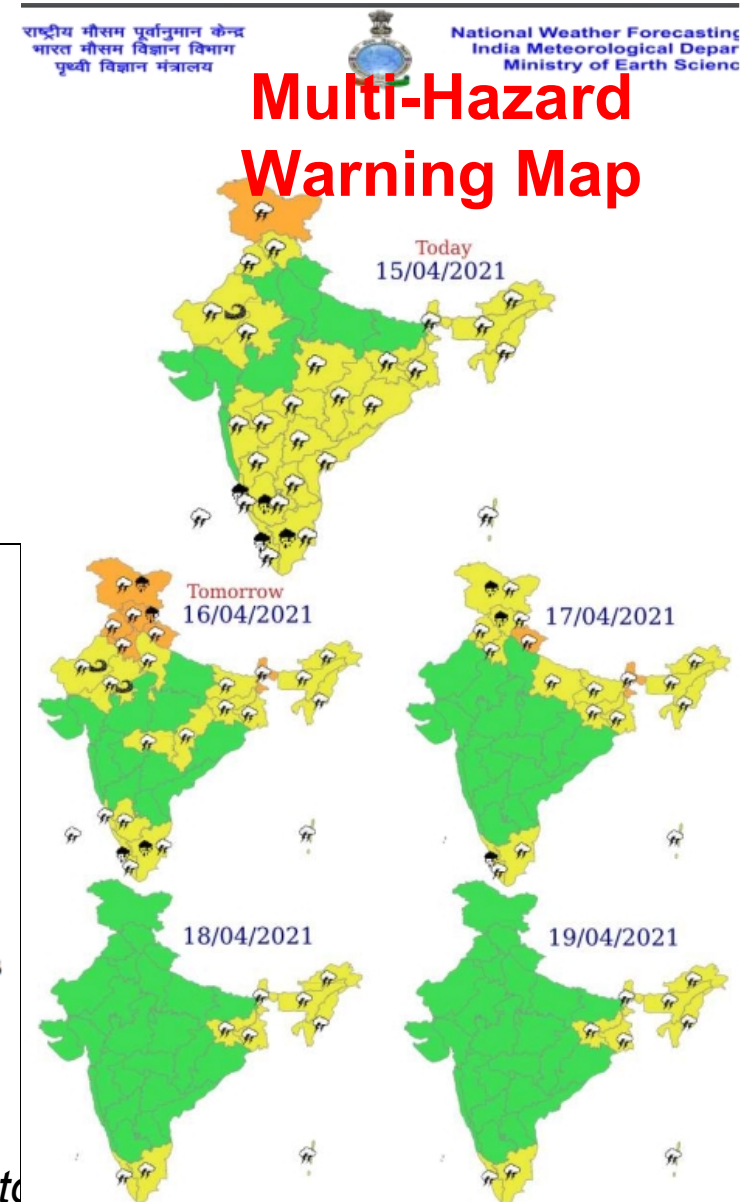
- **Administrative layers** (State, district, city, ward boundary & etc.)
- **Digital Elevation Model Data**
- **Land Use Land Cover**
- **Meteorological data** (Observation and Forecasts)
- **Climatology**,
- **Infrastructure layers** (Rail, Road, Buildings & etc)
- **Demographic Data** (Population, livestock & etc)
- **Major Point of Interest (POI)**- School, college, hospital, Airport, bus stand, Telcom. towers, Major industries, water resources, structures, shelters & etc.
- **Impact Matrices for Hazards** (Rainfall, Cyclone, Wind, Storm Surge, Heat/Cold Wave, Thunderstorm, Lightning)

Role of Satellite in Impact-based Forecasting in India

- Relevant information from weather forecast is extracted and placed into situation context to produce impact estimations;
- With potential impact information, response scenarios are set-up
- Geospatial information plays a key role along with hazard, vulnerability, exposure and risk analysis

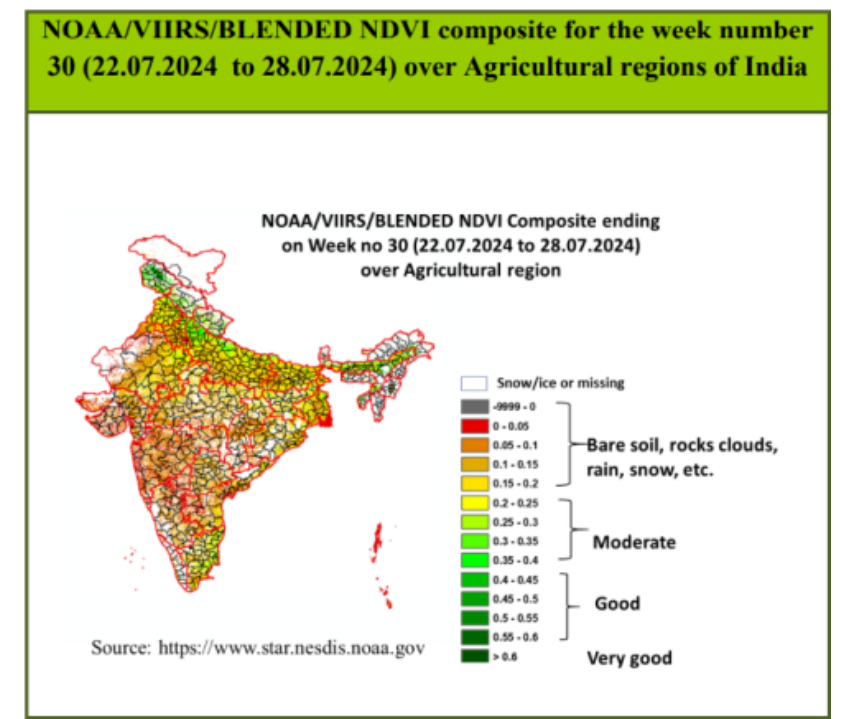
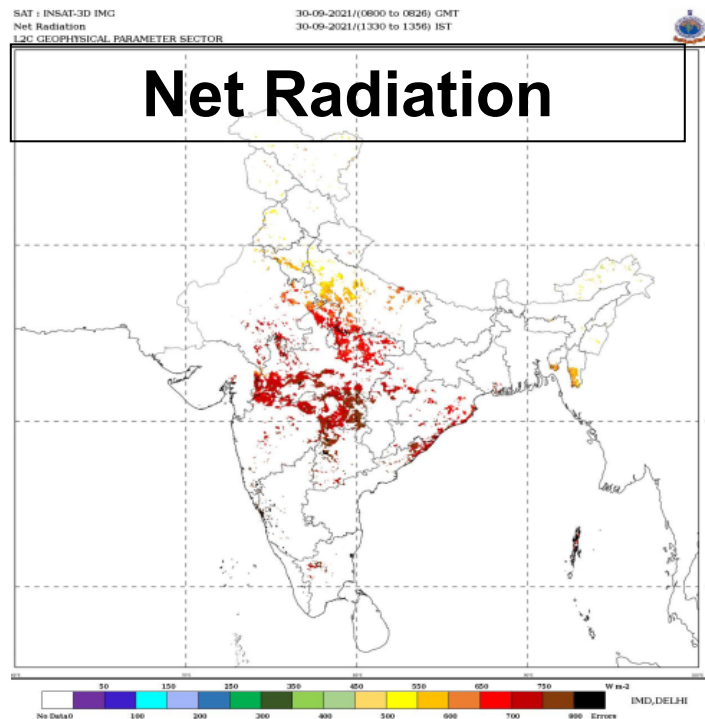
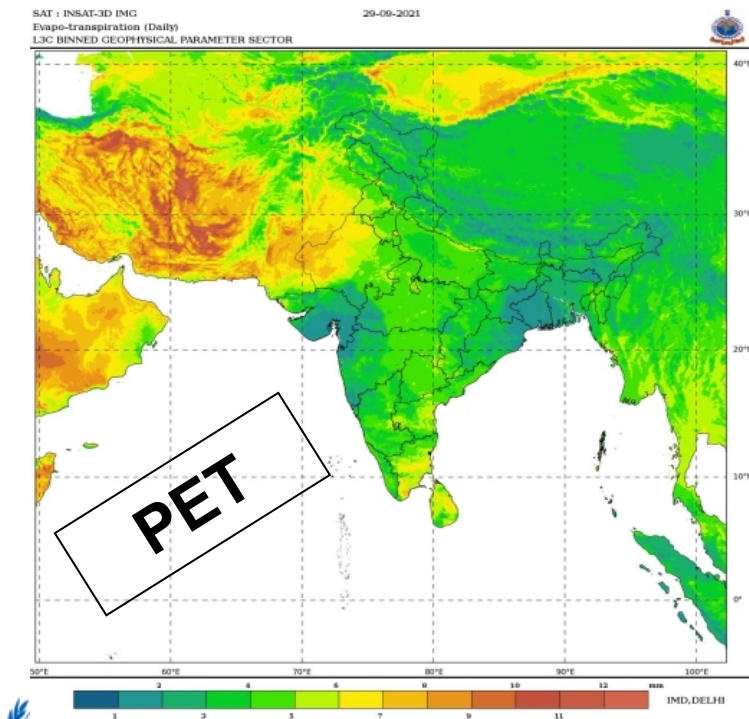


Source: Baode Chen and Xu Tang (2014) Translating weather forecasts into impact information



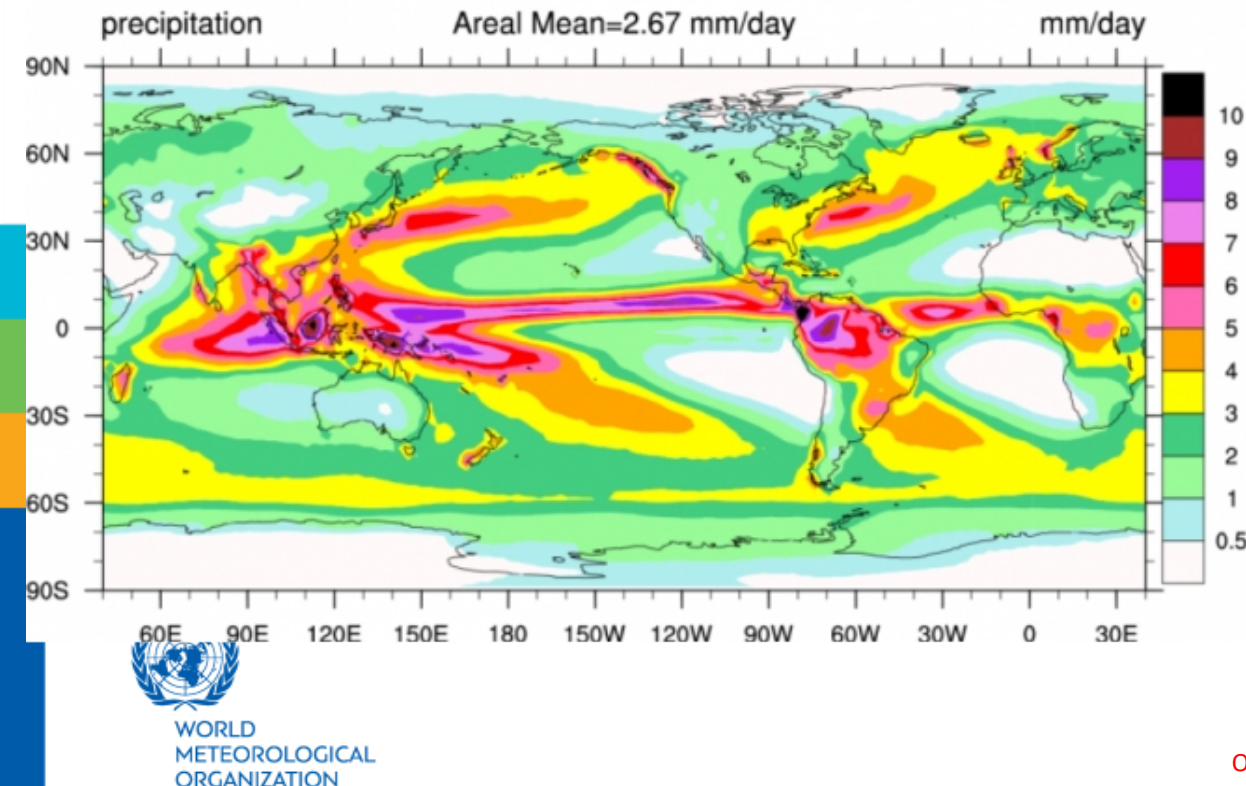
Agrometeorology

- Satellite-derived rainfall, soil moisture, soil moisture, evapotranspiration, surface temperature, NDVI, net radiation products are important for agrometeorology.
- IMD issues agrometeorology bulletins twice in week utilizing these satellite products.
- Also useful for the preparation of seasonal crop calendar.

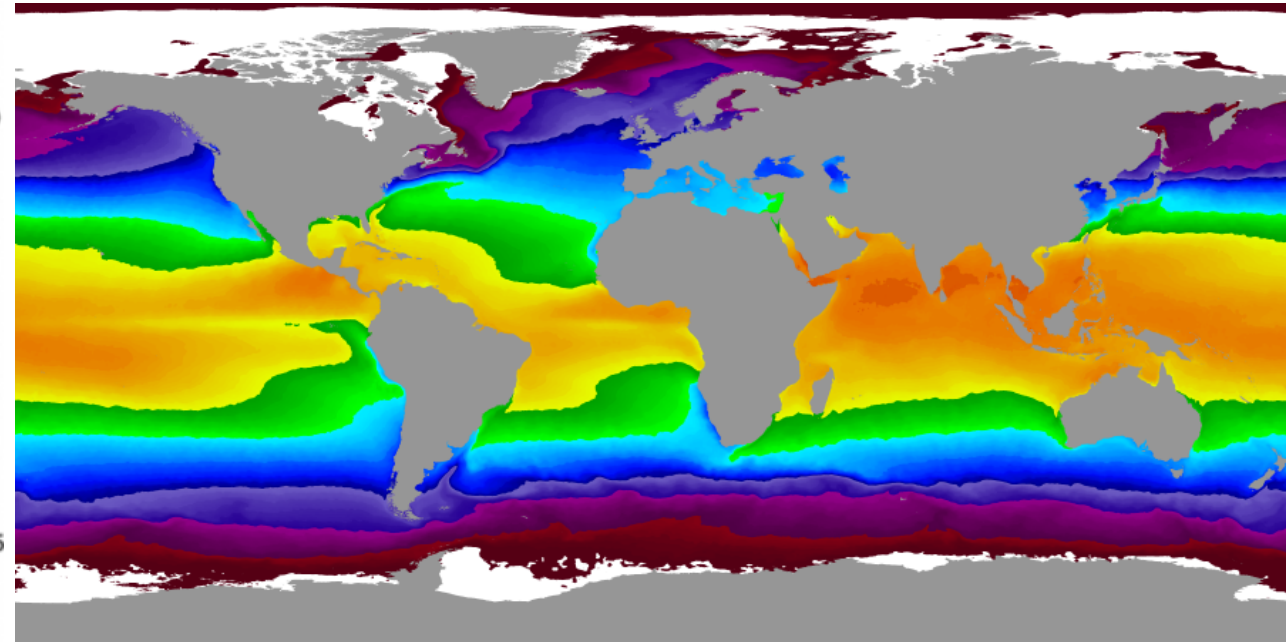


Climatological Applications

- Long-term datasets of satellite-derived rainfall, SST, OLR and other products enable computation of their global climatology.
- These climatological products are vital for assessment of climate change and climate variability and associated impacts.
- Application for identification of hotspots for extreme weather and climate events.

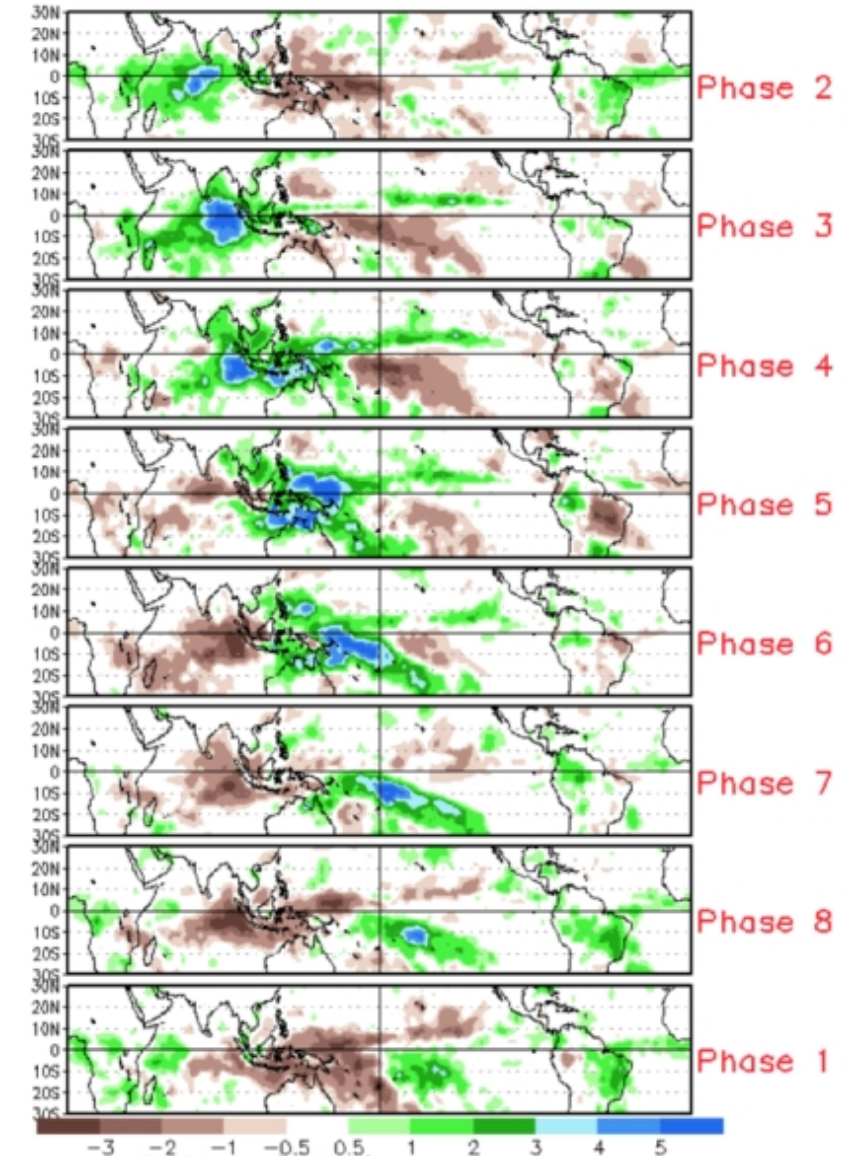
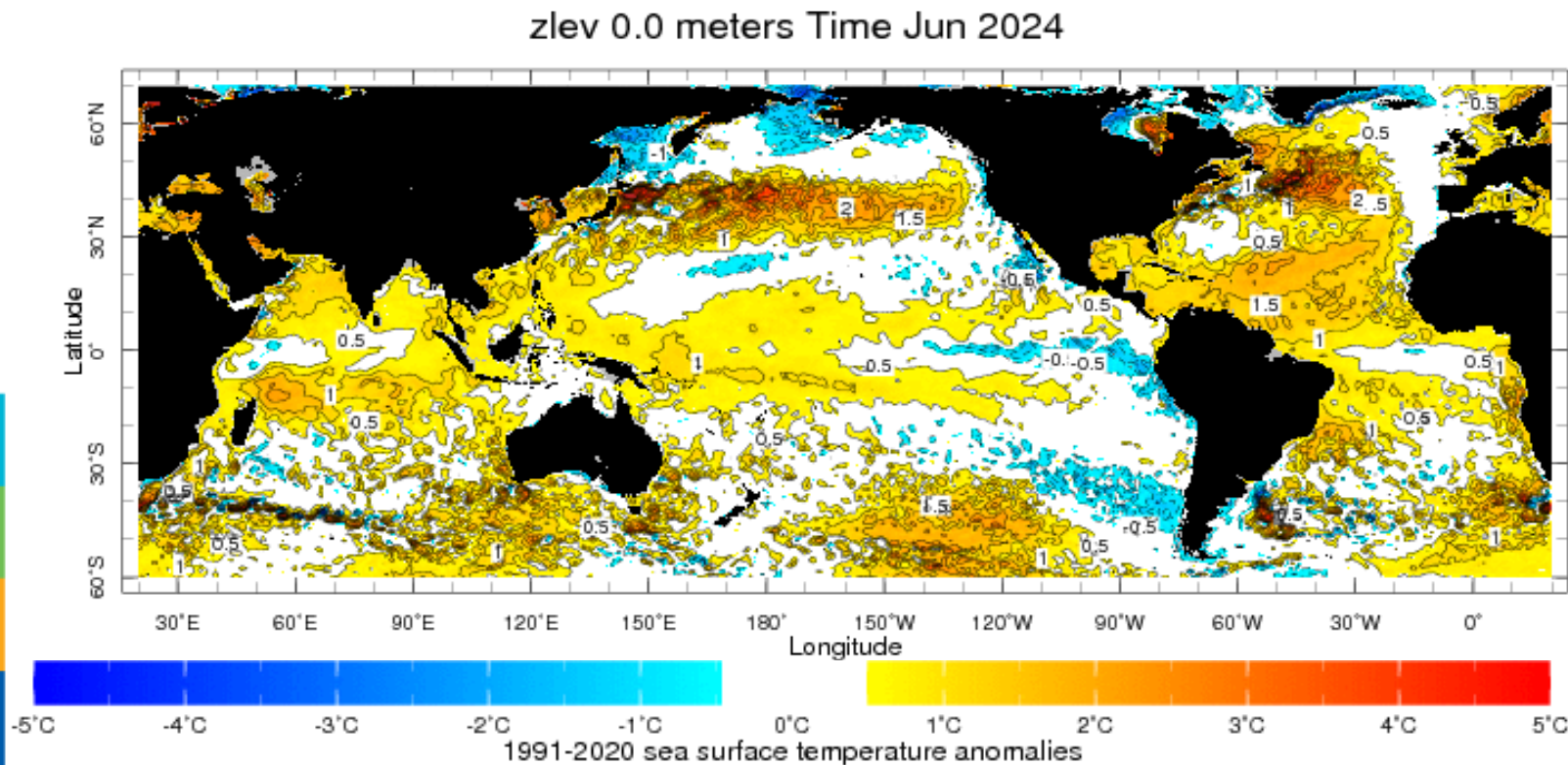


SST Climatology (May)



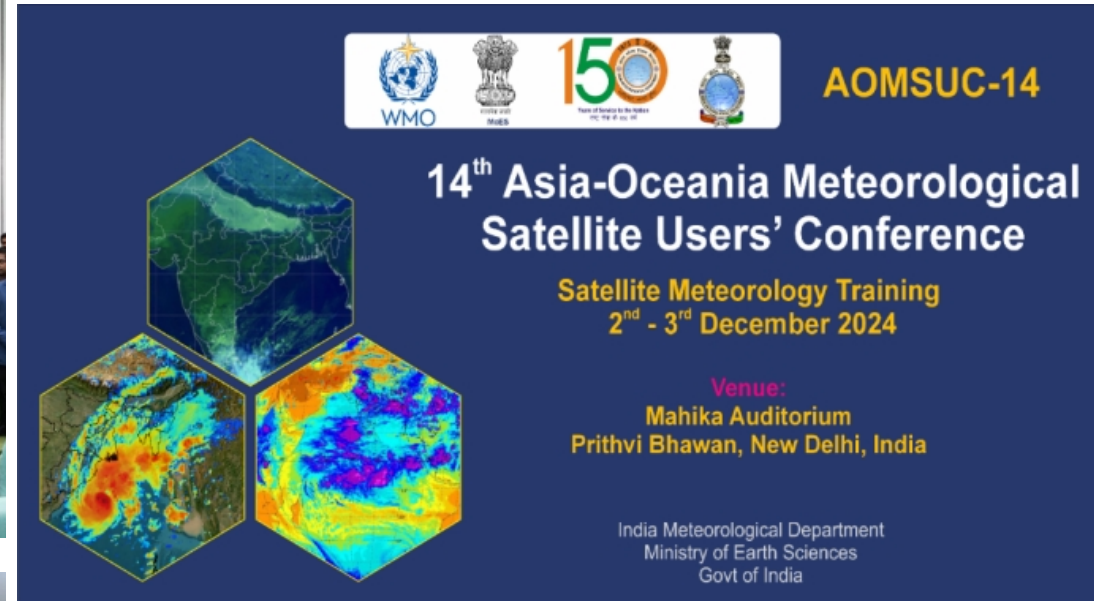
ENSO/IOD/MJO monitoring

- Satellite-derived SST and OLR anomalies provide information regarding ENSO/IOD and MJO, respectively which influences the Indian summer monsoon rainfall and its intraseasonal variability.



India Meteorological Department (IMD) under the Ministry of Earth Sciences, in New Delhi, India, from December 2 to 7, 2024.

This event highlighted advancements in satellite technology and their application in addressing critical regional challenges, including climate change, extreme weather events, and disaster management.



Key Highlights:

Training Workshops (December 2–3, 2024):

Scientific Sessions (December 4–6, 2024):

Joint WMO RA II and RA V Meeting (December 7, 2024):

The conference attracted over **150 participants** from **23 countries** (Tonga, Australia, Fiji, Vietnam, Tuvalu, Maldives, USA, Tajikistan, Indonesia, Solomon Island, Japan, Myanmar, Hongkong, Kyrgyz Republic, Kazakhstan, Mongolia, Saudi Arabia, Bahrain, Oman, Iran, South Korea, China, Israel), including WMO representatives, national meteorological services, and leading satellite agencies.



FUTURE PLANS

Multispectral - Visible Near Infrared, Hyperspectral Imager - Visible Near Infrared,
Hyperspectral Imager - Short Wave Infrared, Multispectral - Long Wave Infrared.

GEO: INSAT-4th Generation Satellite

a) Advanced Imager (legacy: GOES-ABI)

- 16 bands from 0.5 – 13.5 μm with spatial resolution 500m for VIS and 2 km for IR
- Faster scanning for nowcasting applications
- FD (Full Disk), India (3000 km x 3000 km) and Mesoscale (1000 km x 1000 km)
- Capability to provide FD image every 5 minute, India every 2 minutes and Mesoscale images every 30 seconds.

b) Lightning mapper

c) Hyperspectral Infrared Sounder

- Better quality assurance through CAL/VAL
- Better data assimilation : 90 of data assimilated in models are satellite based
- It improves short range forecast by 10-15%

Thank You