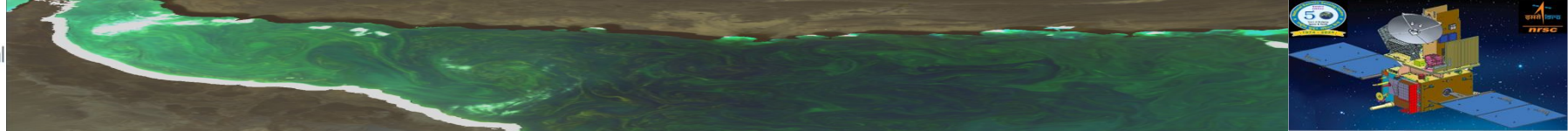


Ocean Colour Science and Applications at ISRO

Dr. P V Nagamani
National Remote Sensing Centre
Indian Space Research Organisation
Hyderabad



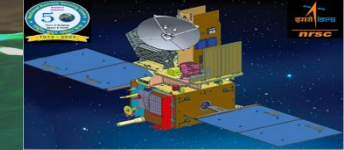
Payloads

- Ocean Color Monitor (OCM-3)
- Sea Surface Temperature Monitor (SSTM)
- Ku-Band Scatterometer (SCAT-3)
- ARGOS

Mission Objectives

- To ensure the data continuity of Ocean colour and wind vector data to sustain the operational applications.
- To improve the applications, some additional datasets such as SST & more number of bands in Optical region for fluorescence and in IR region for atmospheric corrections.
- To develop / improve related algorithms and data products to serve in well-established application areas and to enhance the mission utility.

Band No	OCM-3		Potential Applications
	Central wavelength (nm)	Band width (nm)	
1	412	20	Yellow Substance absorption
2	443	10	Low Chl-a concentration
3	490	10	Medium Chl-a concentration, Diffuse attenuation coefficient
4	510	10	High Chl-a concentration
5	555	10	Chl-a reference, turbidity
6	566	10	Trichodesmium identification
7	620	10	Suspended sediments, cyanobacteria, turbidity in case-2 waters
8	670	10	Baseline for Chl fluorescence
9	681	08	Chlorophyll fluorescence
10	710	10	Baseline for Chl fluorescence, red edge
11	780	10	Atmospheric correction
12	870	20	Atmospheric correction, spectral scattering
13	1010	40	Atmospheric correction for turbid waters, aerosol-white foam discrimination



Operational Products

- Chlorophyll Concentration (Chl-a)
- Diffuse Attenuation Coefficient (DAC)
- Total Suspended Matter (TSM) , Rrs *

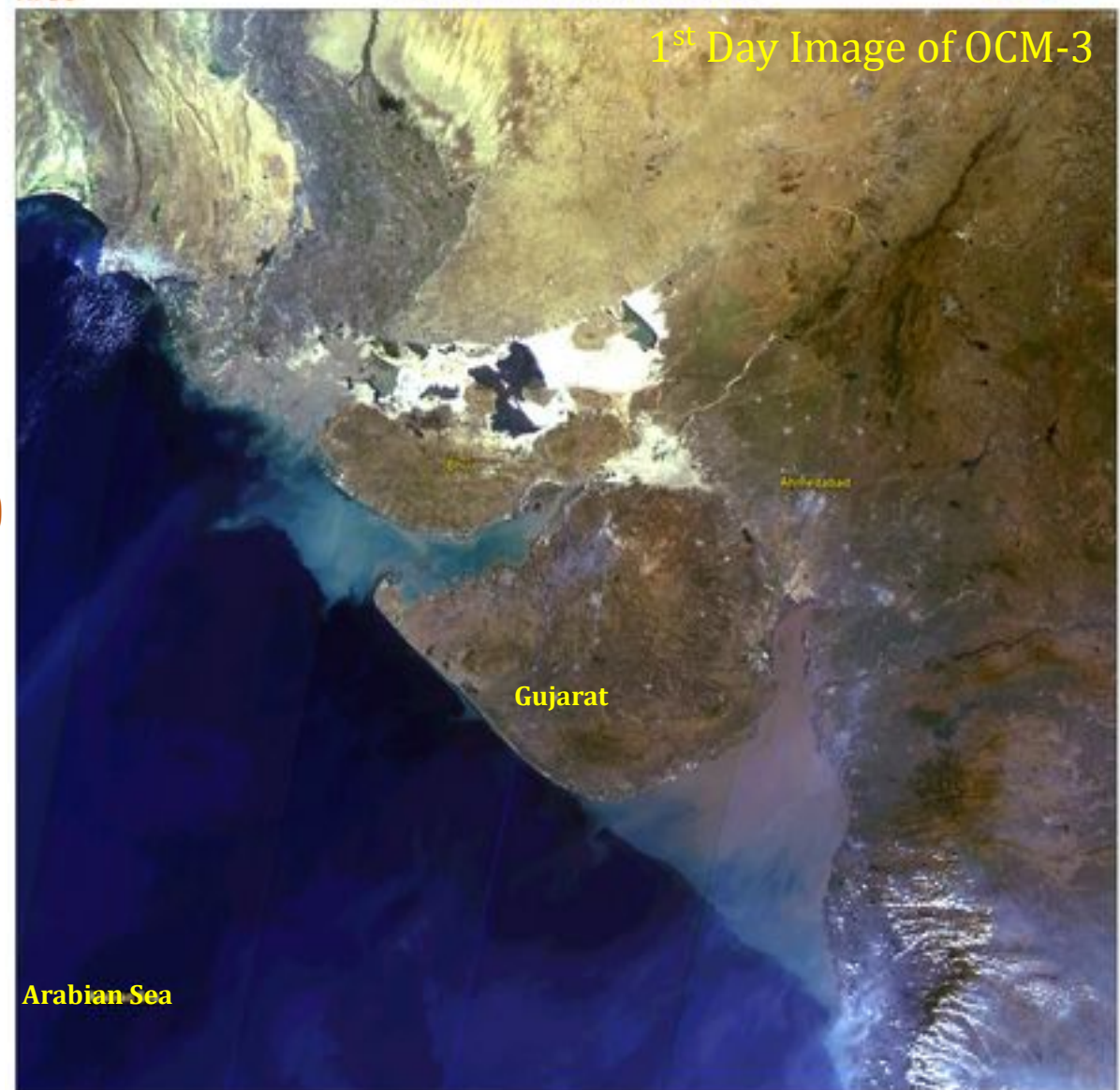
New Science Products

- Colored Dissolved Organic Matter (412nm)
- Inherent Optical Properties (total absorption and total backscattering)
- Upwelling Indices (Ekman transport/Ekman Pumping)
- Surface Nitrate Maps

R&D Products

- Normalized Fluorescence Line Height (nFLH)
- Algal Bloom Detection Index (ABI)
- Phytoplankton Size Class (PSC)
- Particulate Organic Carbon (POC)

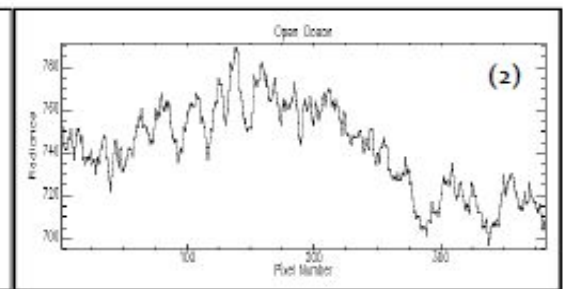
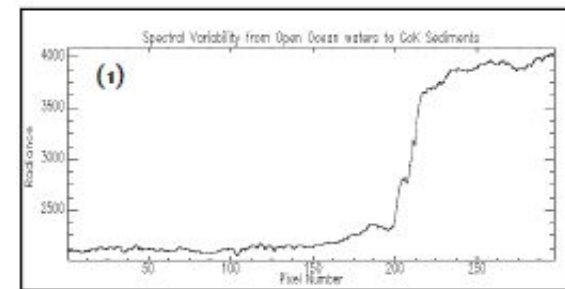
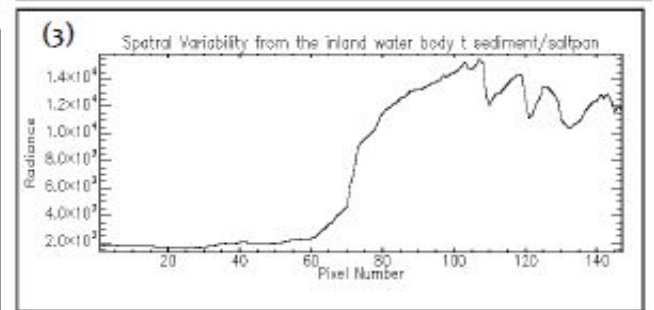
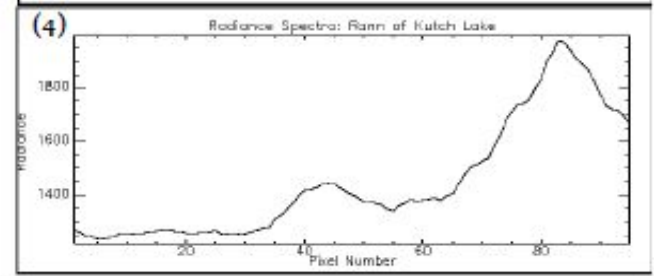
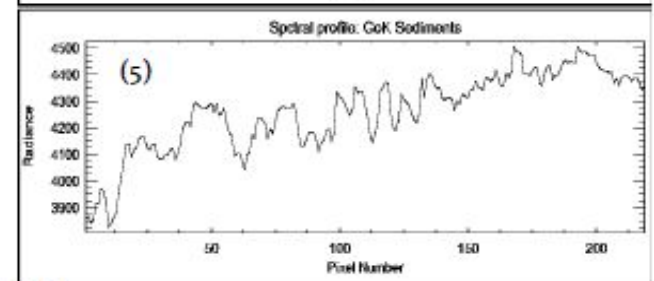
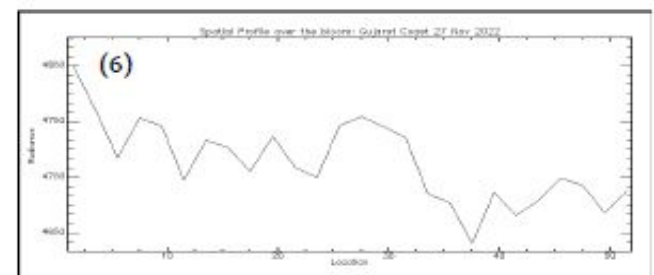
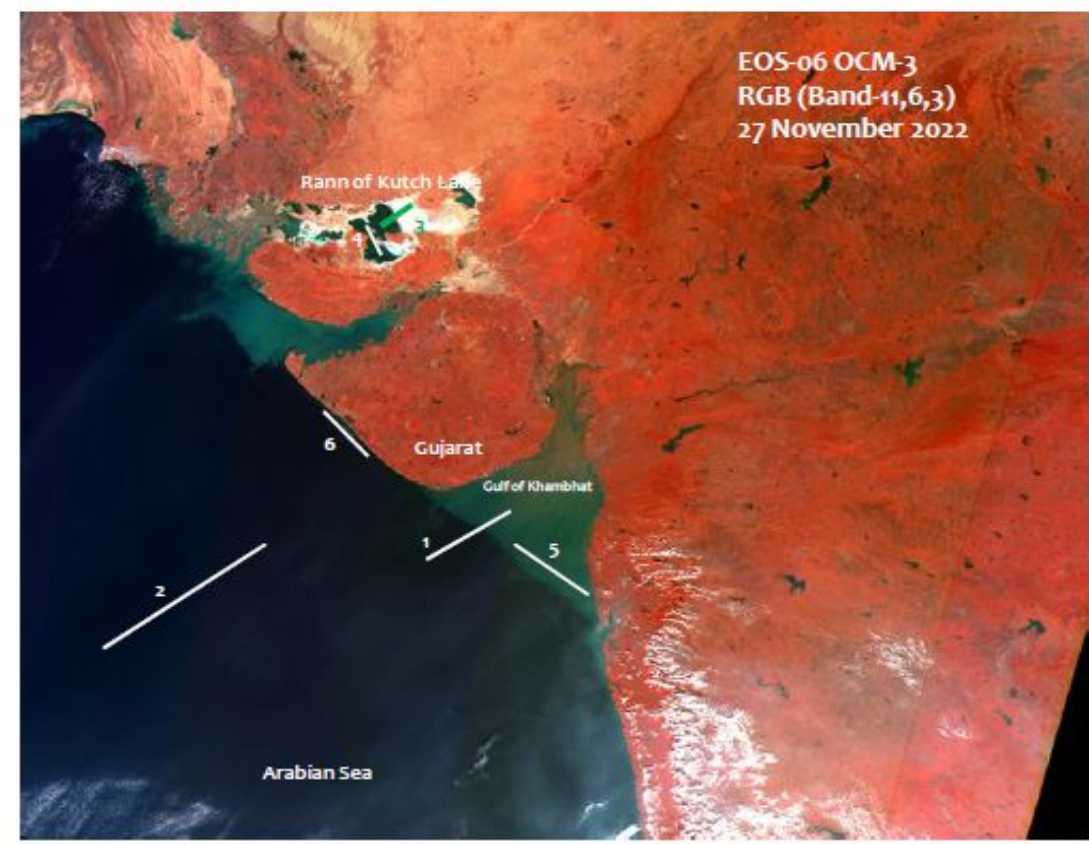
1st Day Image of OCM-3



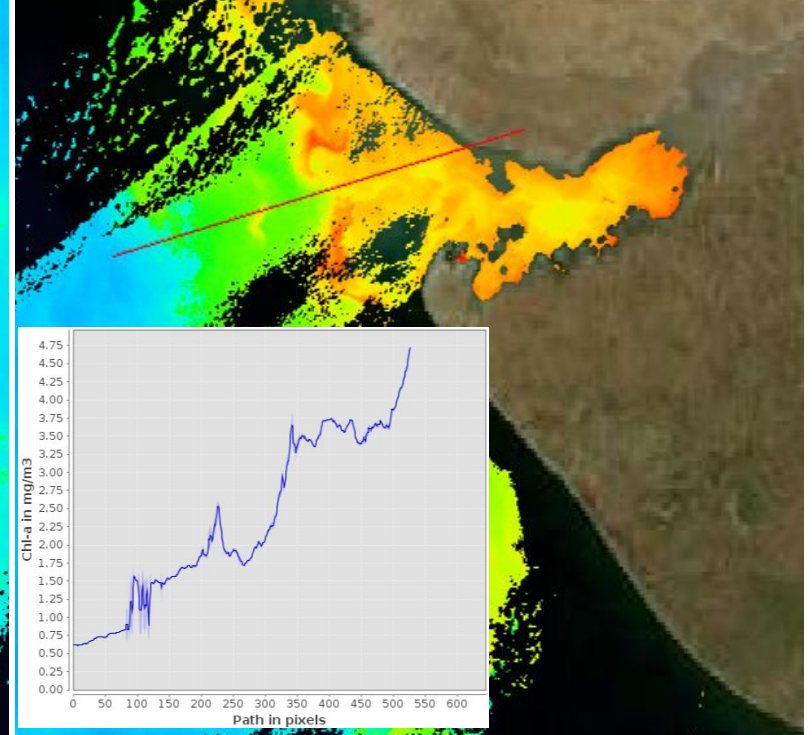
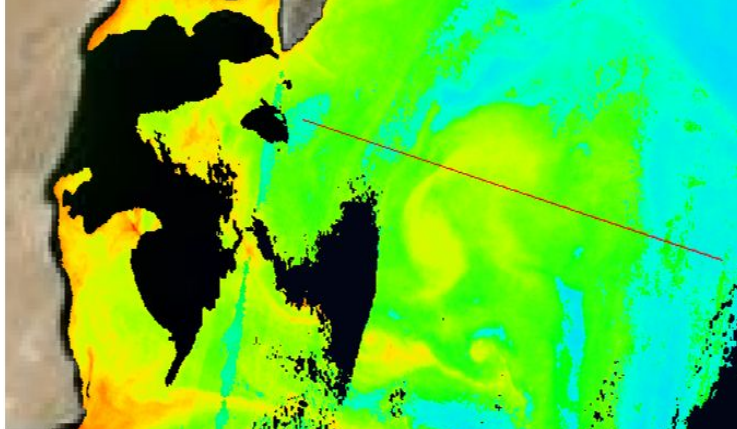
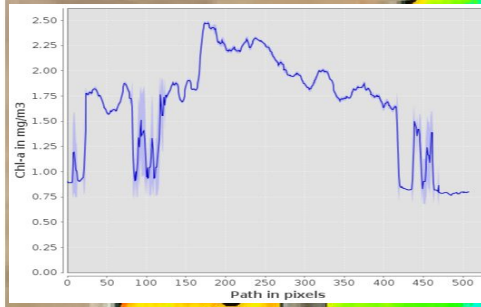
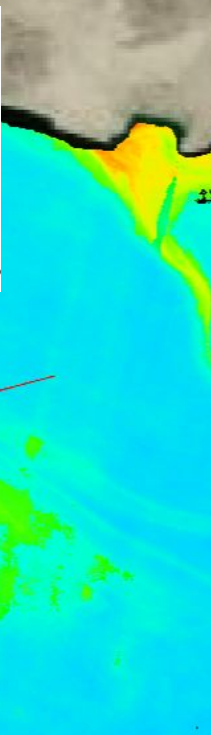
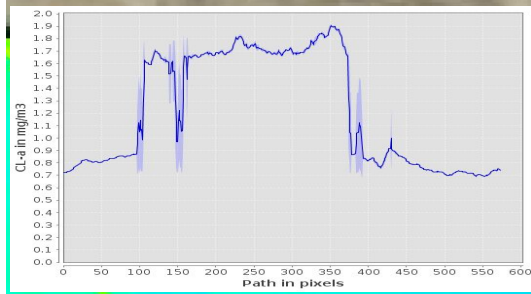
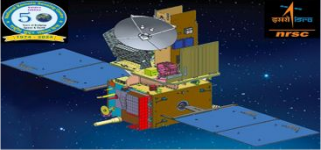
Spatial Variability over Different Classes



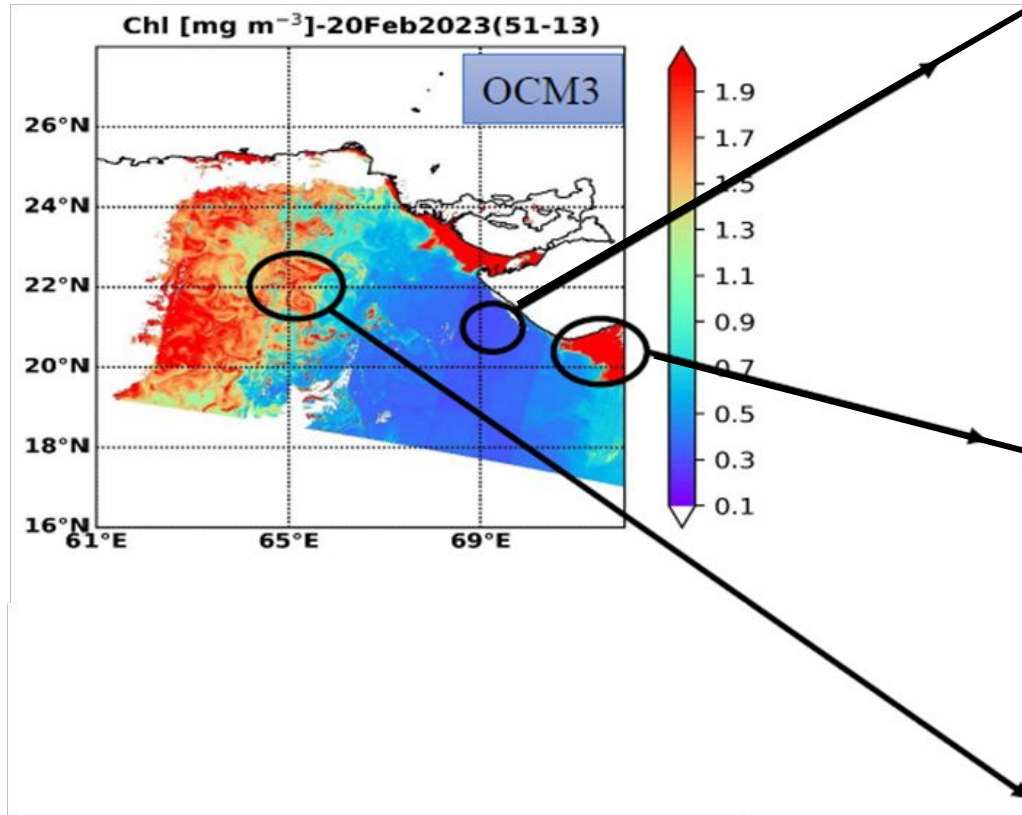
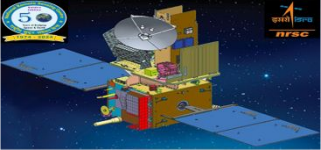
- Processing LAC & GAC through SeaDAS
- Very good spectral signatures to delineate
 - Open Ocean
 - Coastal Ocean
 - Blooms
- Flags & masks as per the OBPG guidelines
- Able generate the standard products for
 - LAC
 - GAC
- Generated L2, L3 binned products
- Validation using in-situ observations are being carried out.
- The operational algorithm of OCM3 (geo-physical products retrieval & atmospheric correction) is validated with OLCI.



Spatial Variability: Eos-06 OCM

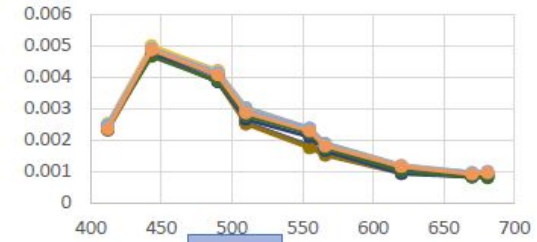


Spectral Variability: Eos-06 OCM



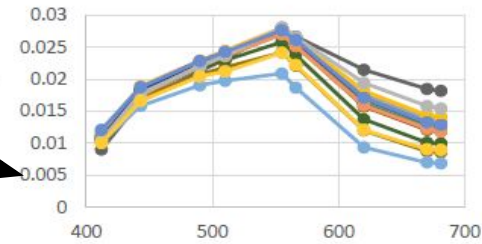
Open Ocean

OCM Rrs (open ocean)



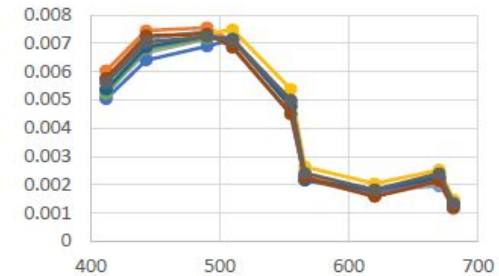
Gulf

OCM Rrs (Coastal)

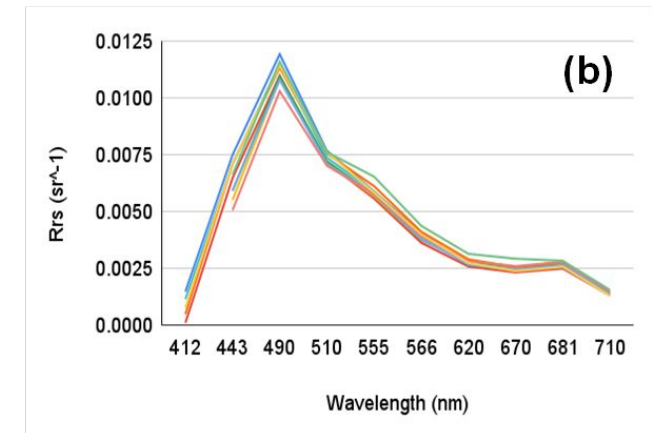
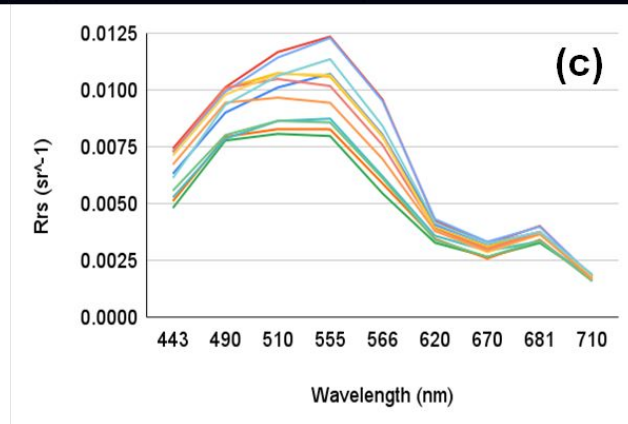
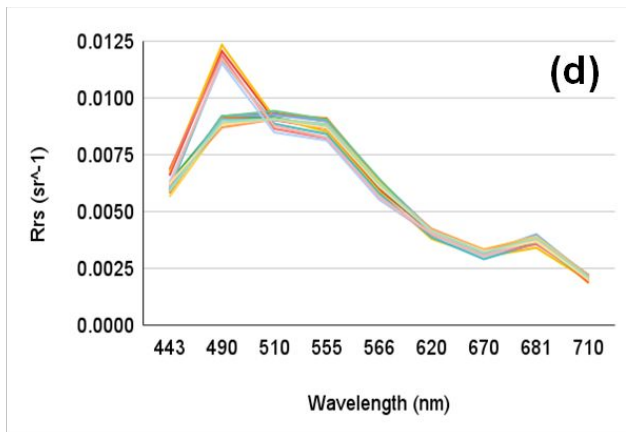
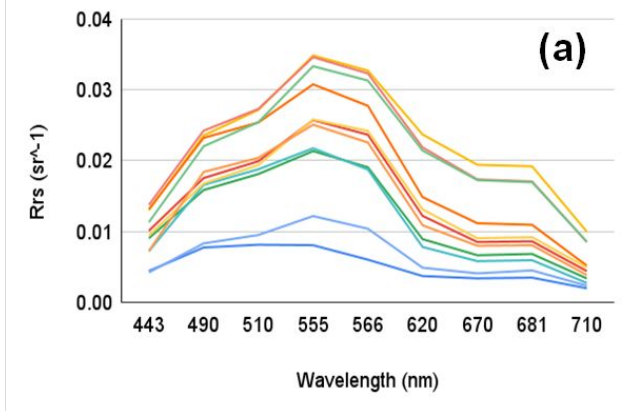
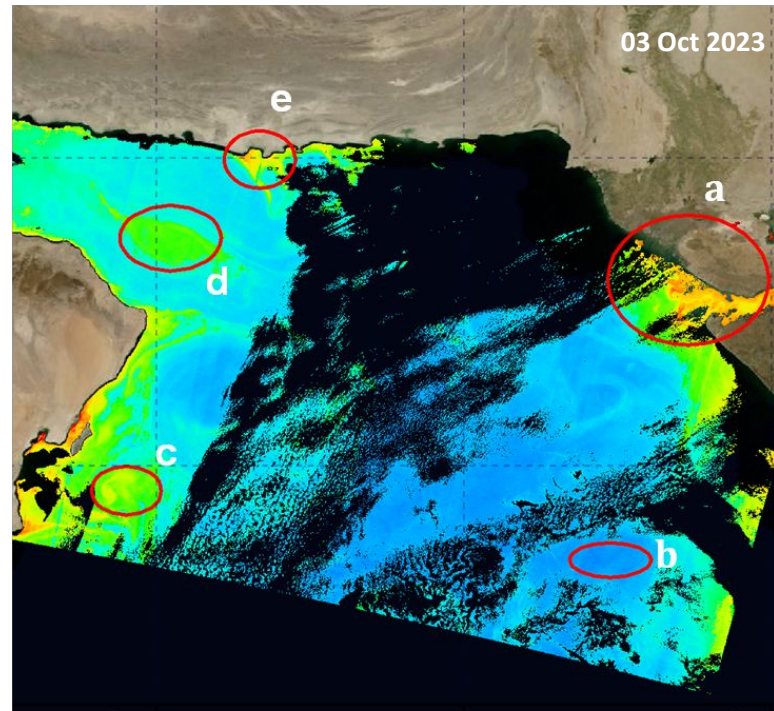
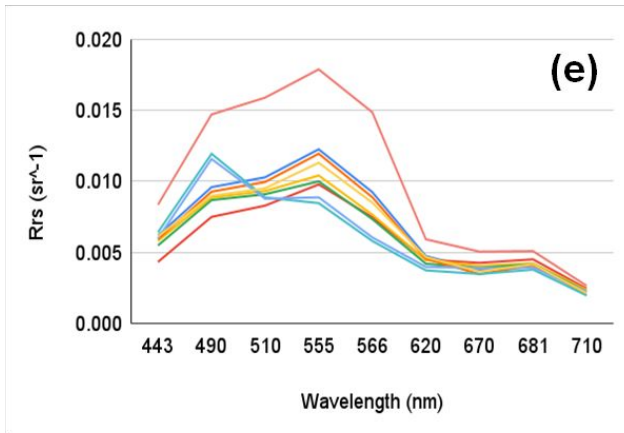
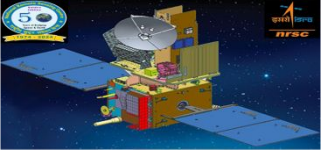


Bloom

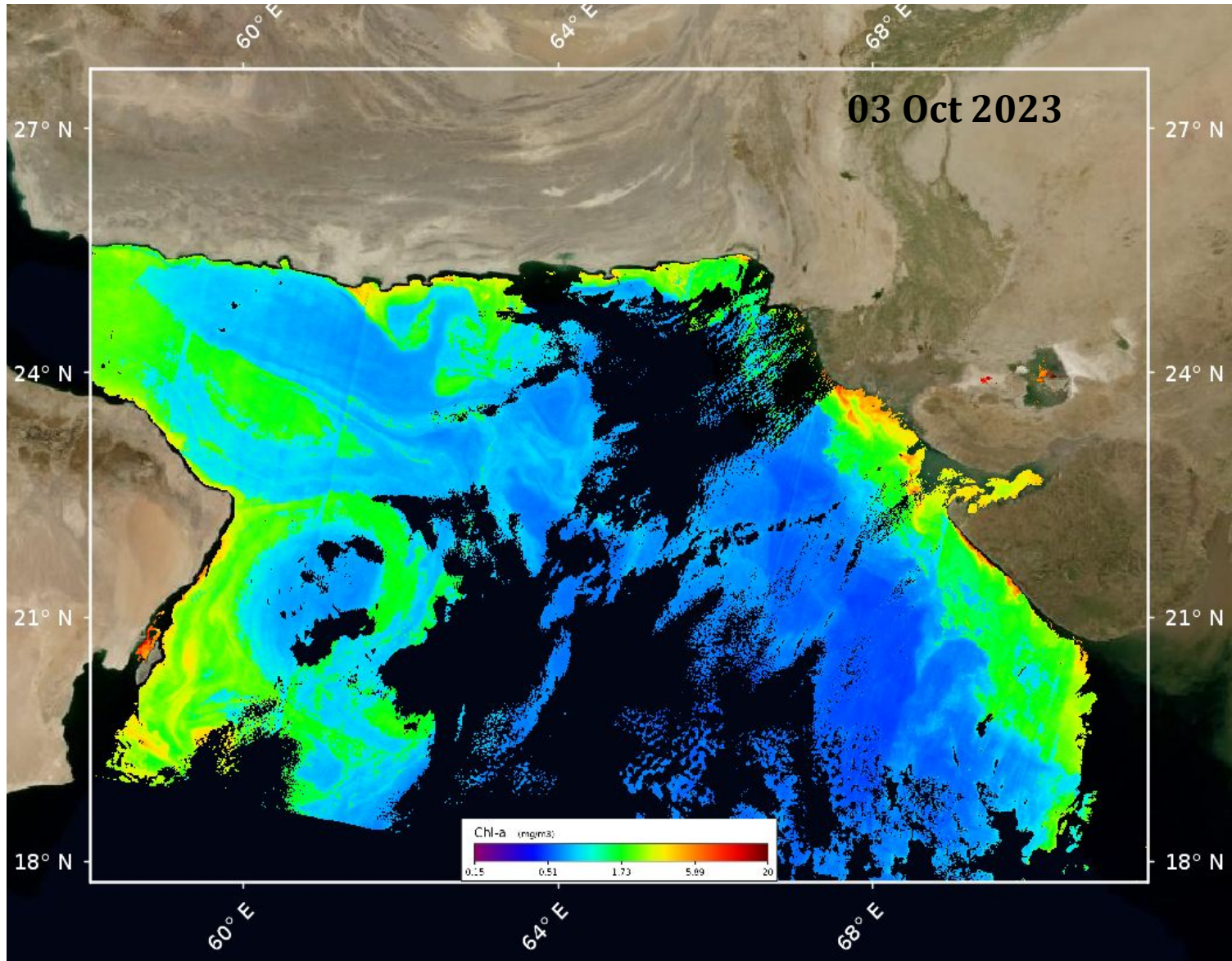
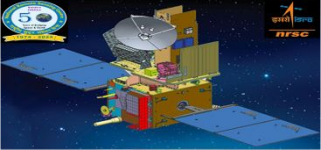
OCM Rrs (Bloom)



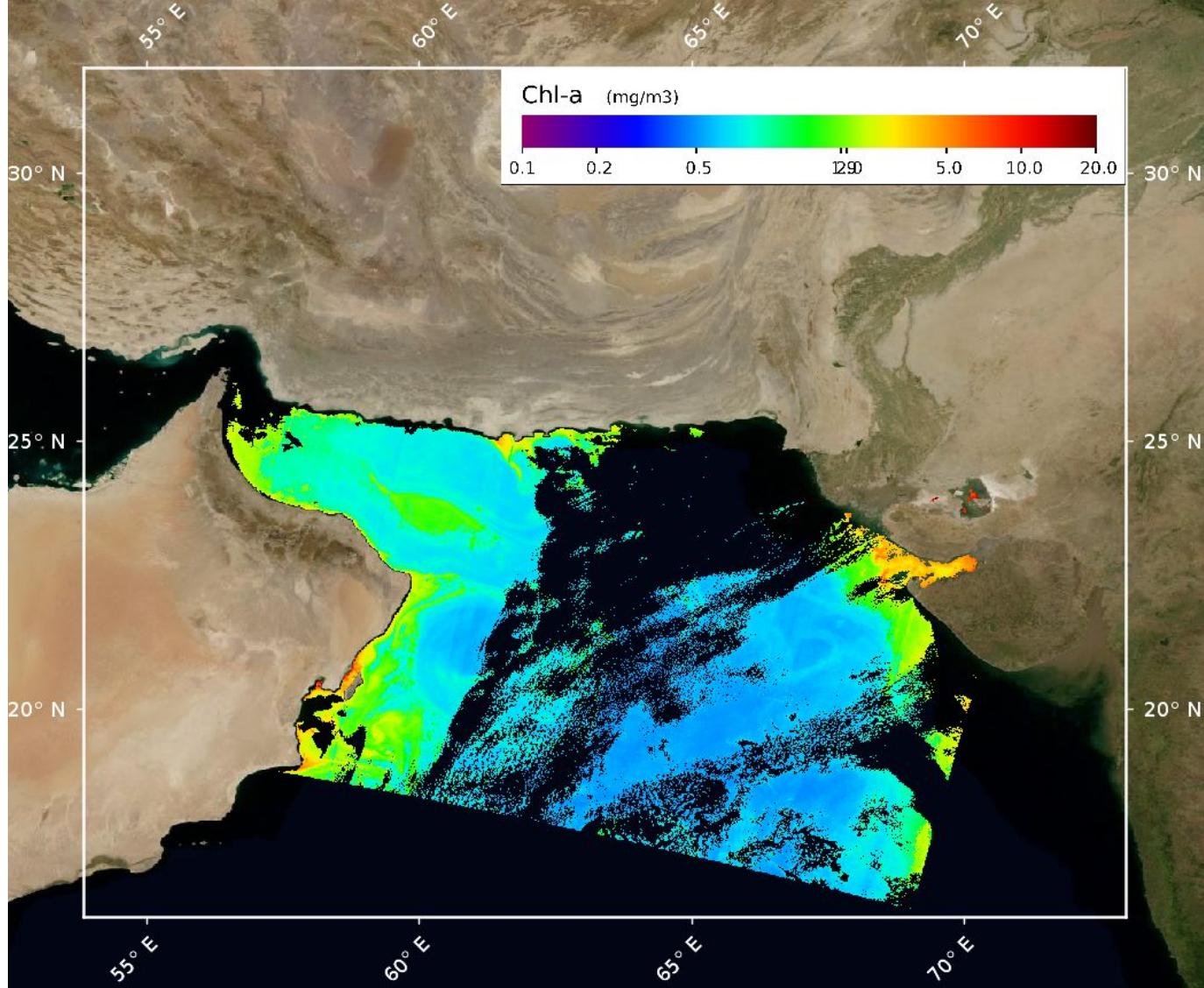
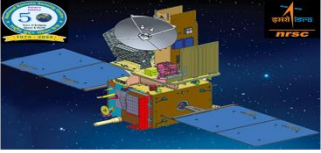
Spectral Variability: Eos-06 OCM



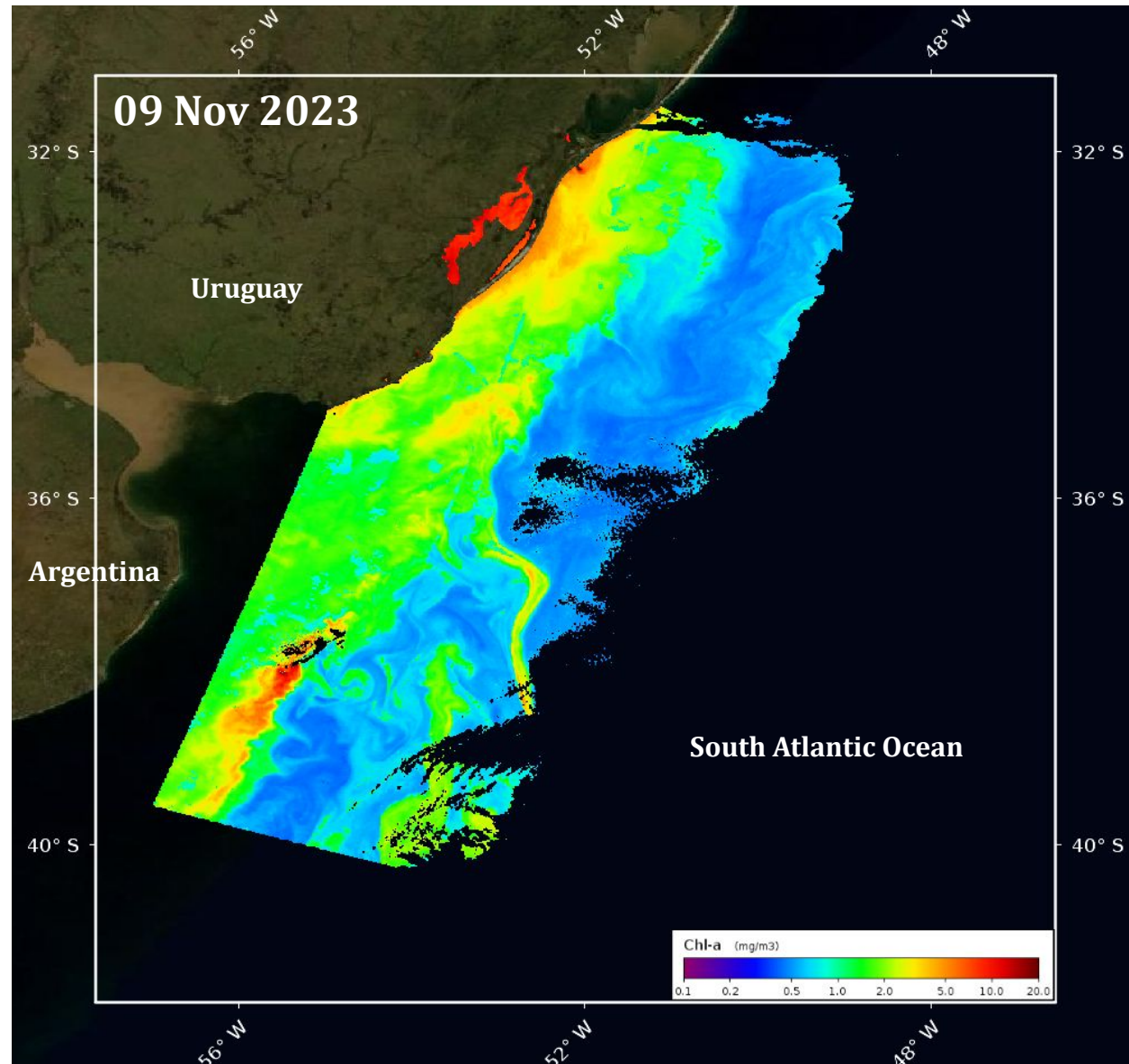
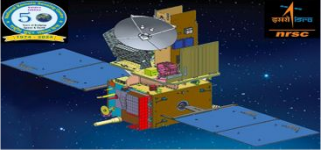
Phytoplankton Blooms: Northern Arabian Sea



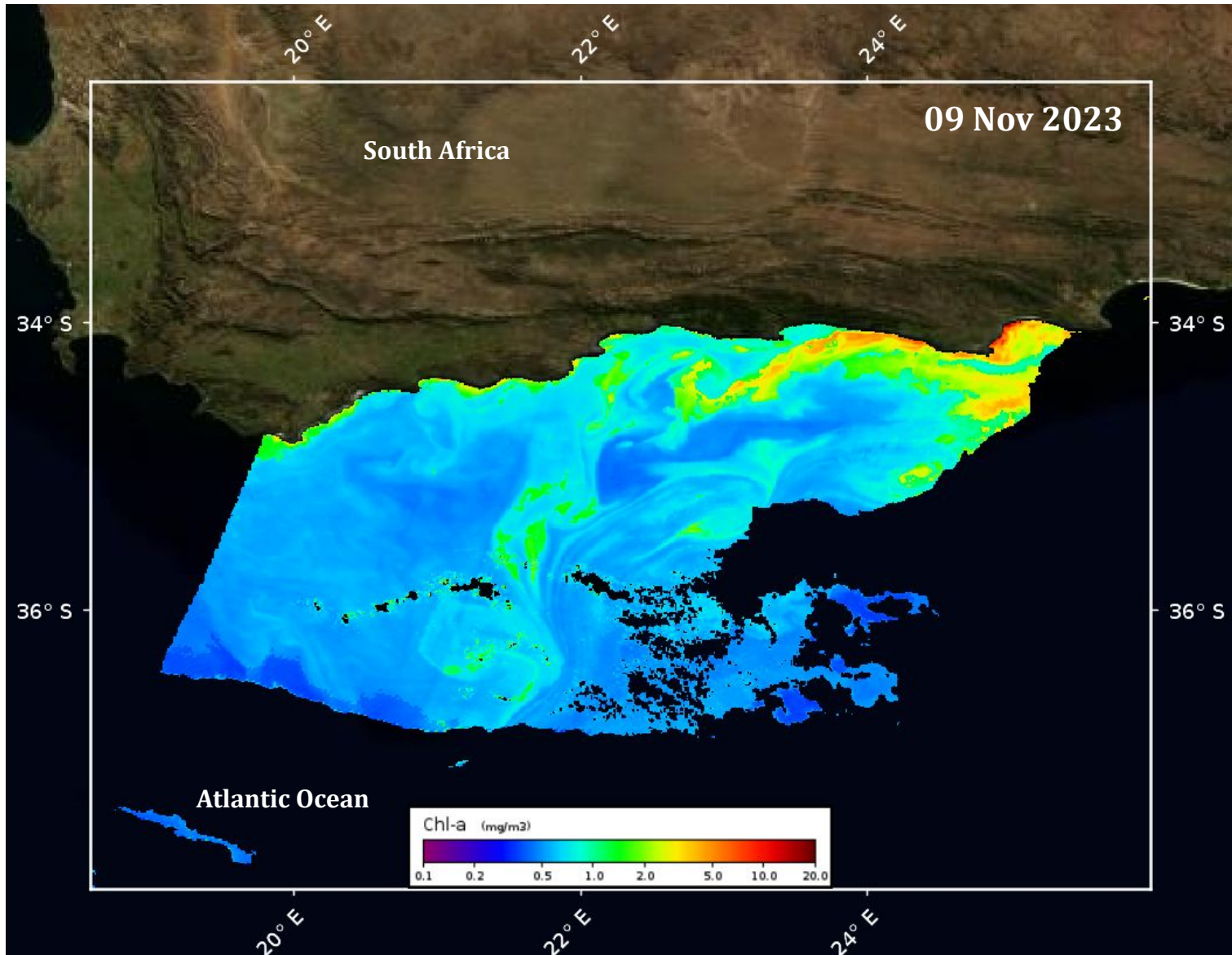
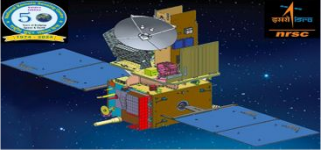
Phytoplankton Blooms: Northern Arabian Sea

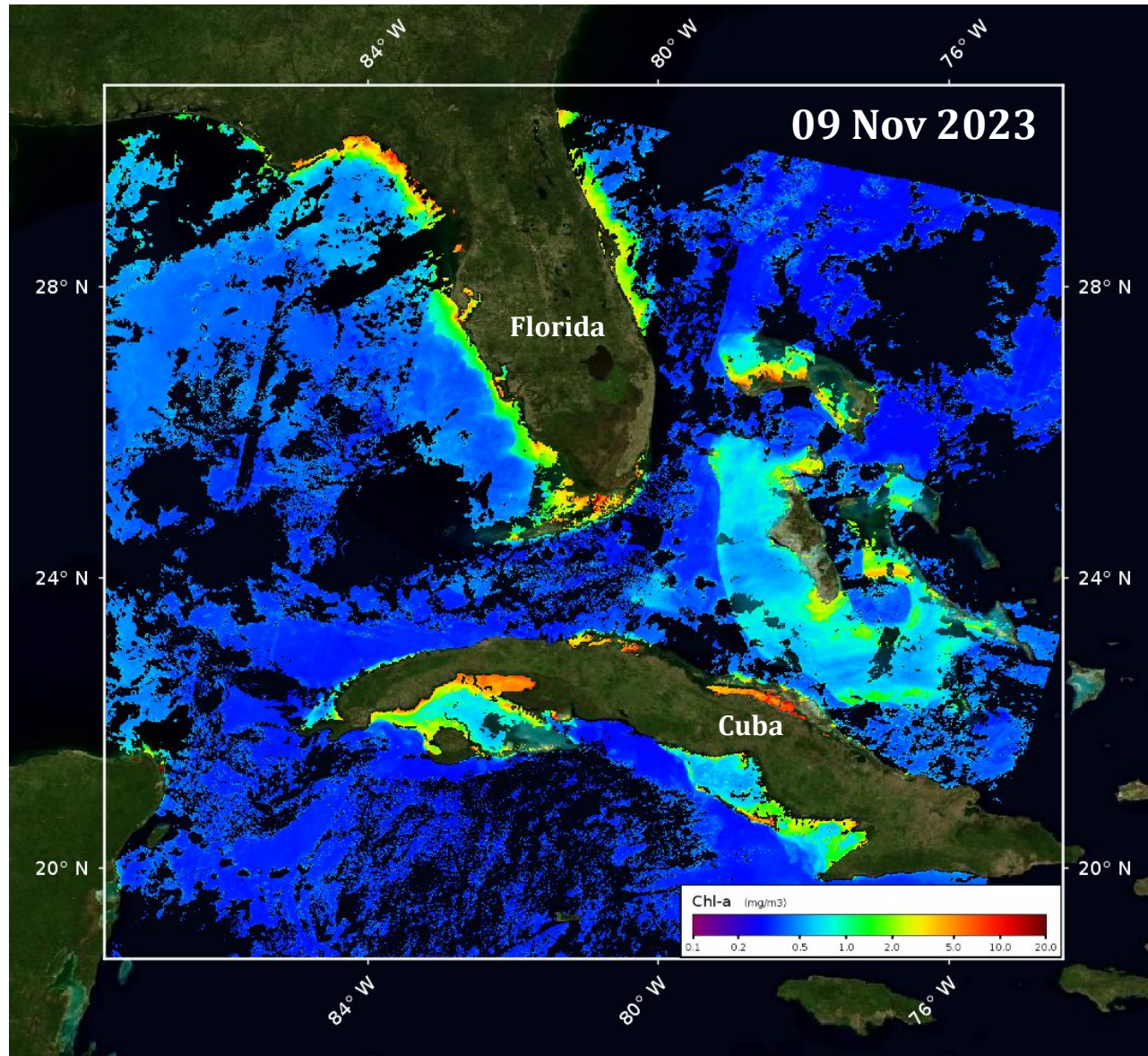
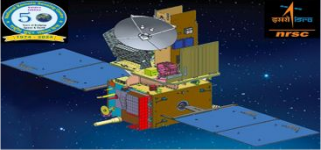


Phytoplankton Blooms: Argentina Coast

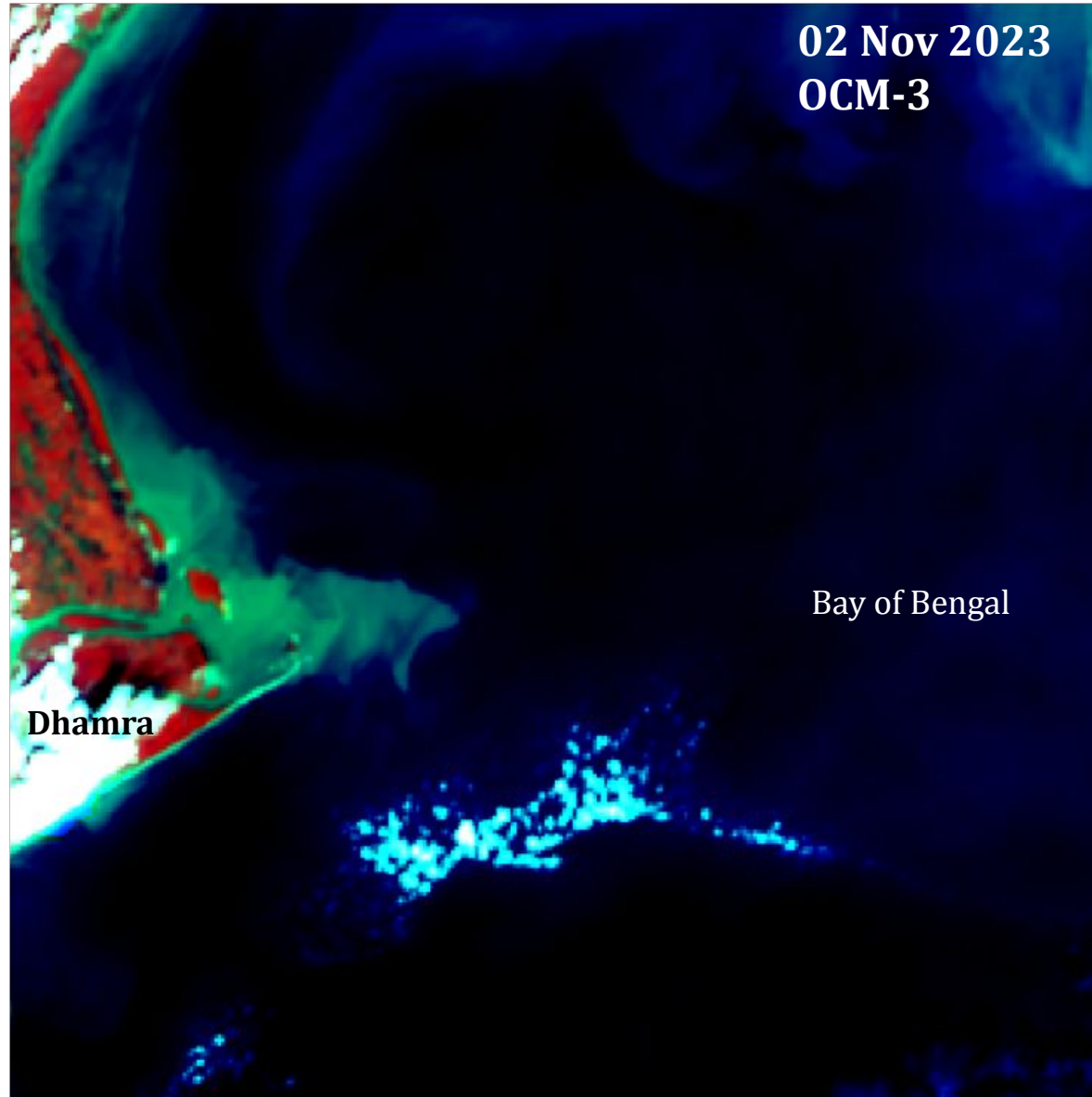


Phytoplankton Blooms: South African Coast

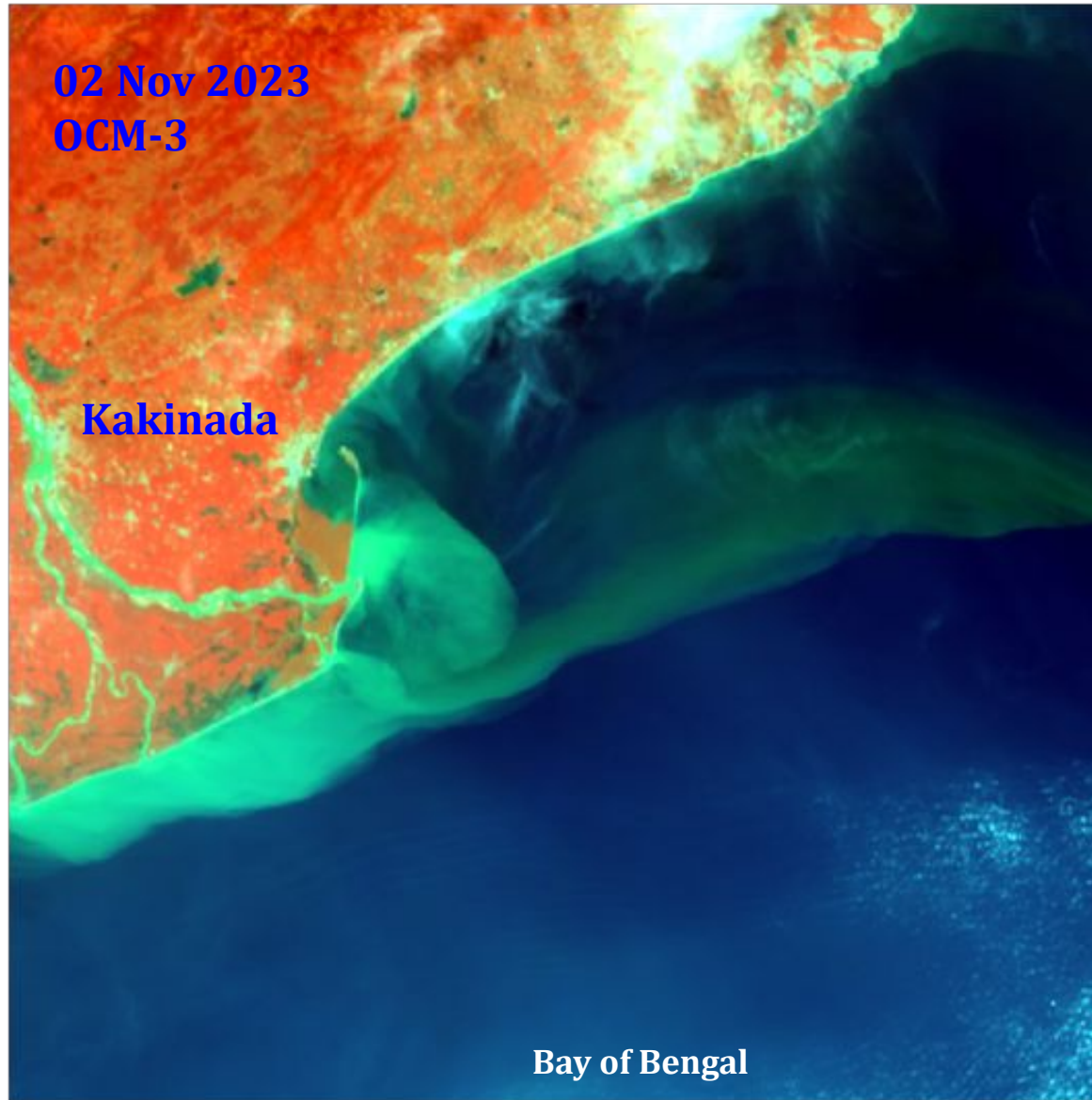
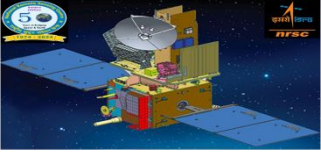




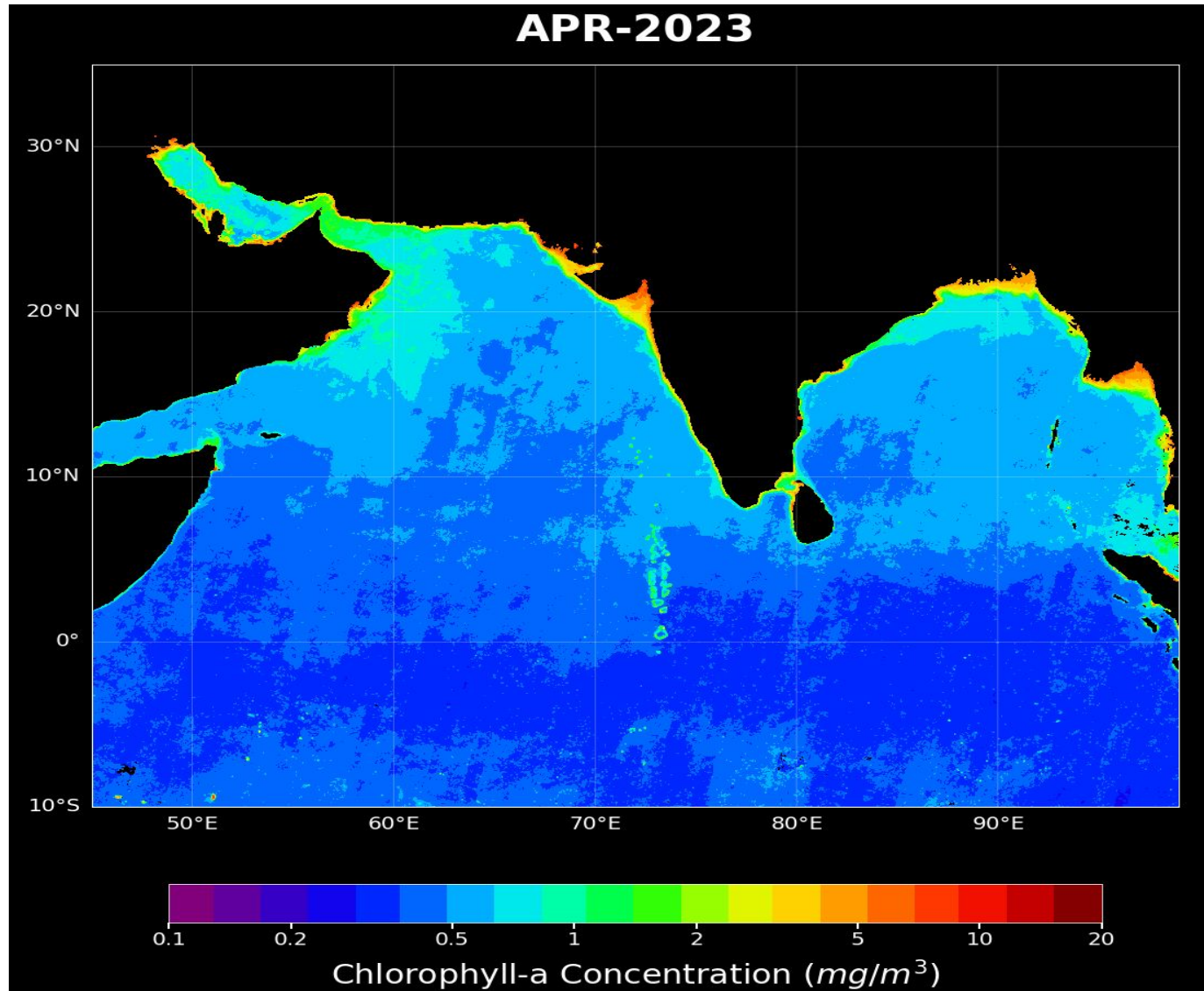
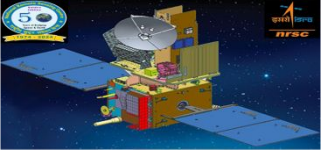
Sediment Plume: Odisha Coastal Waters



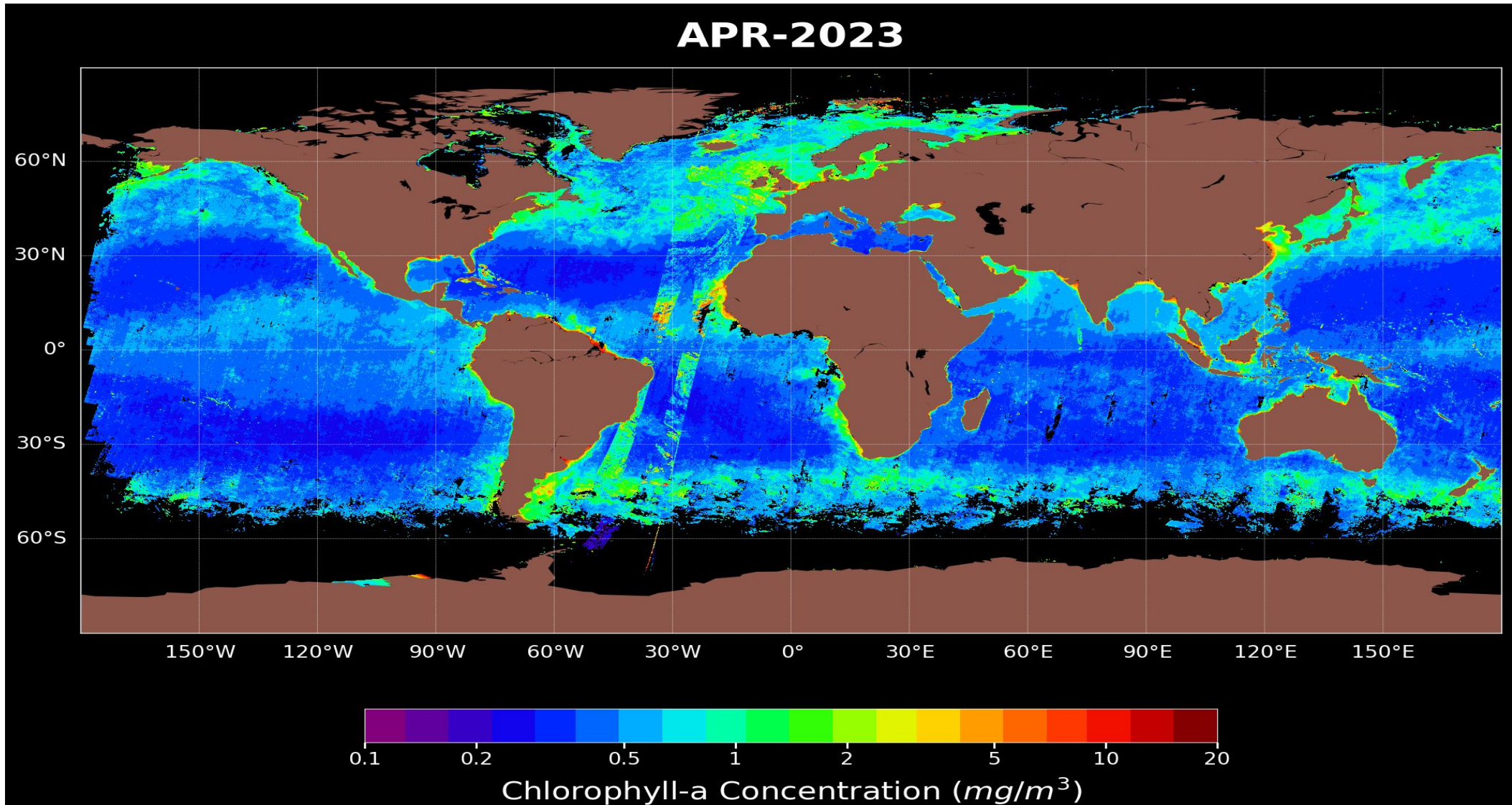
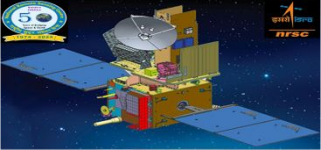
Sediment Plume: Off Godavari



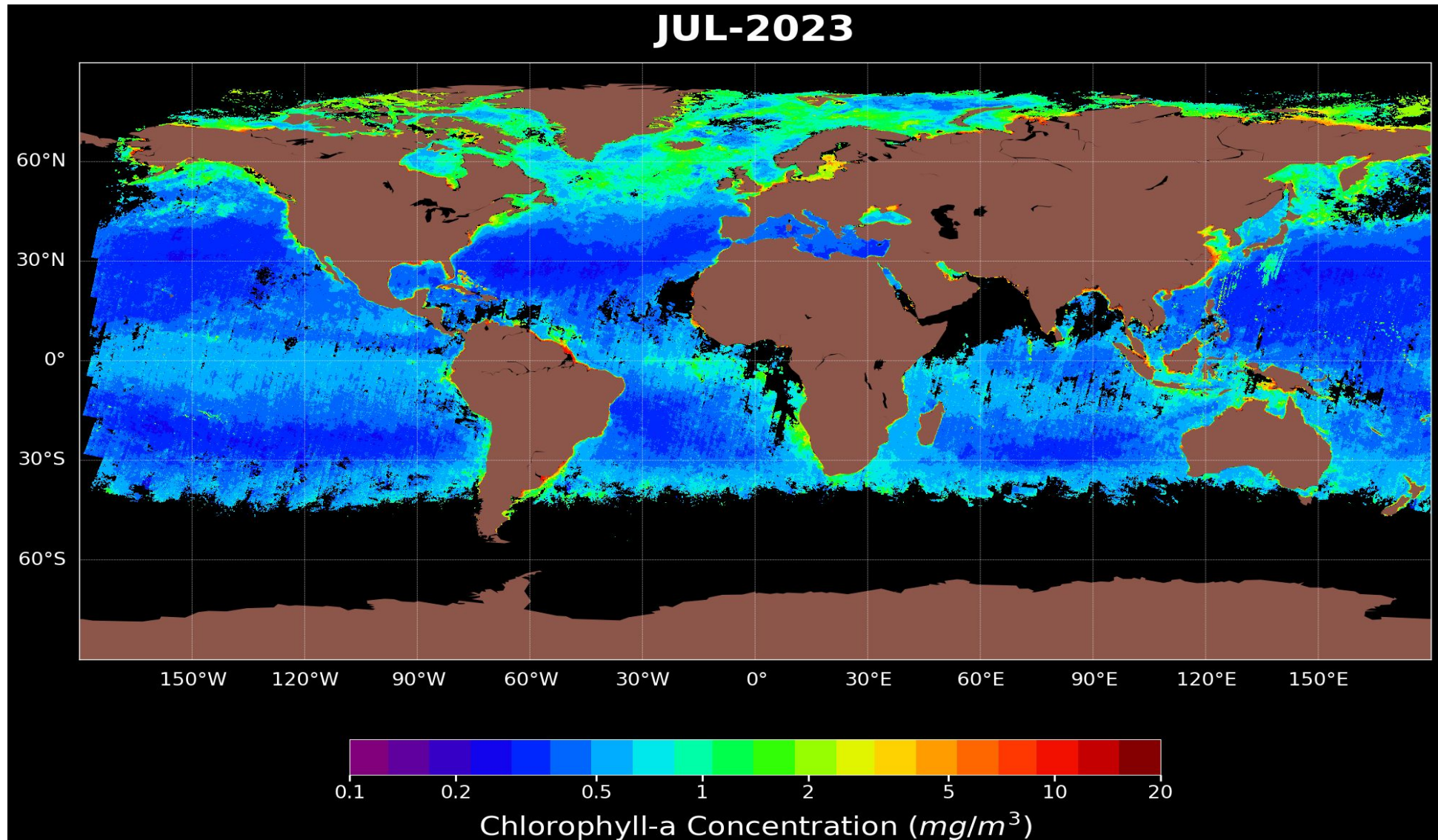
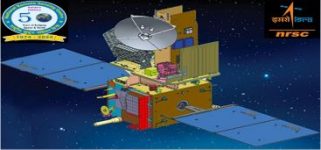
Level-3 Binned Products: Eos-06 OCM



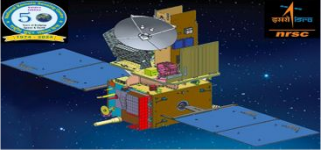
Level-3 Binned Products: Eos-06 OCM



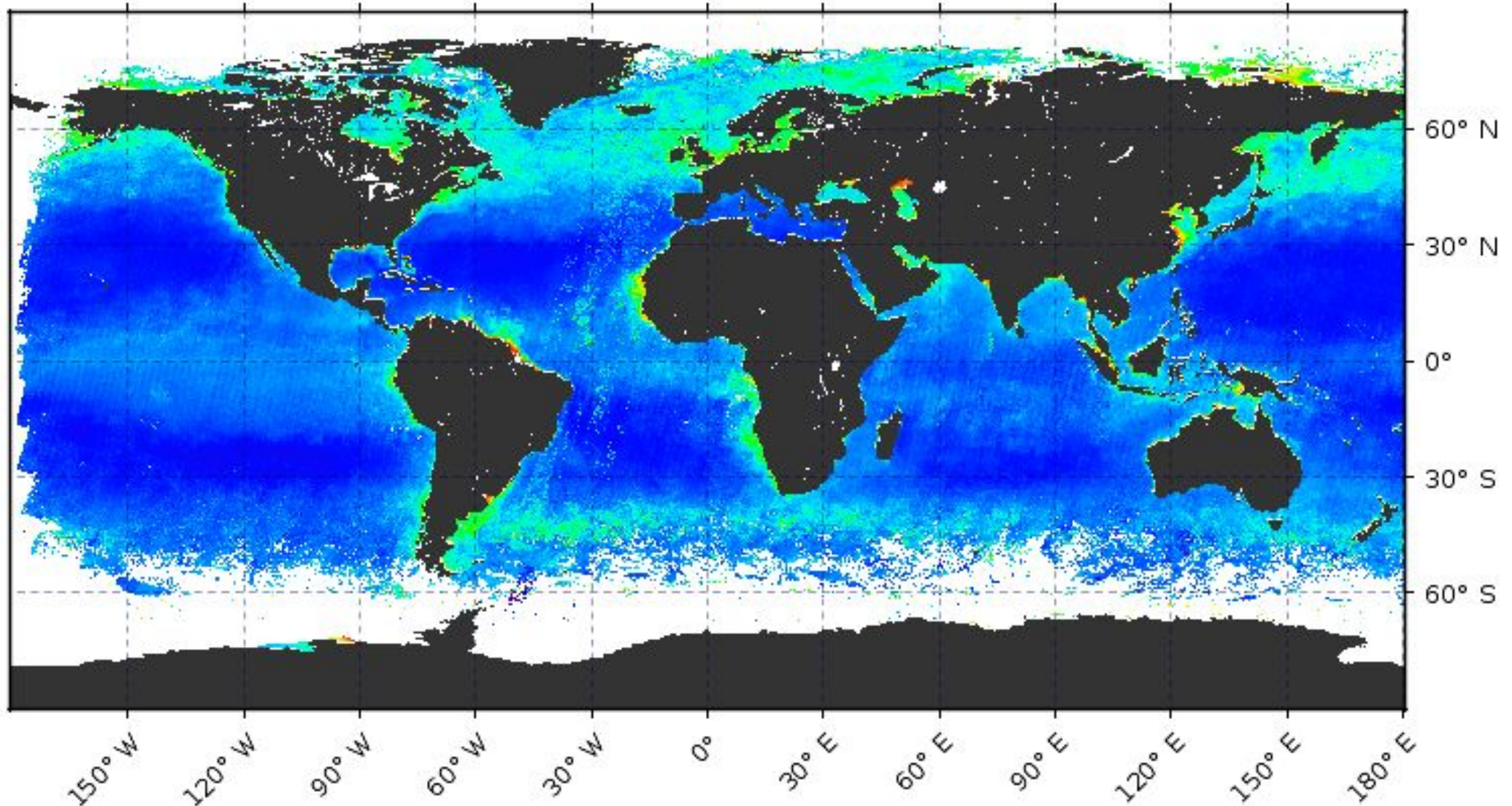
Level-3 Binned Products: Eos-06 OCM



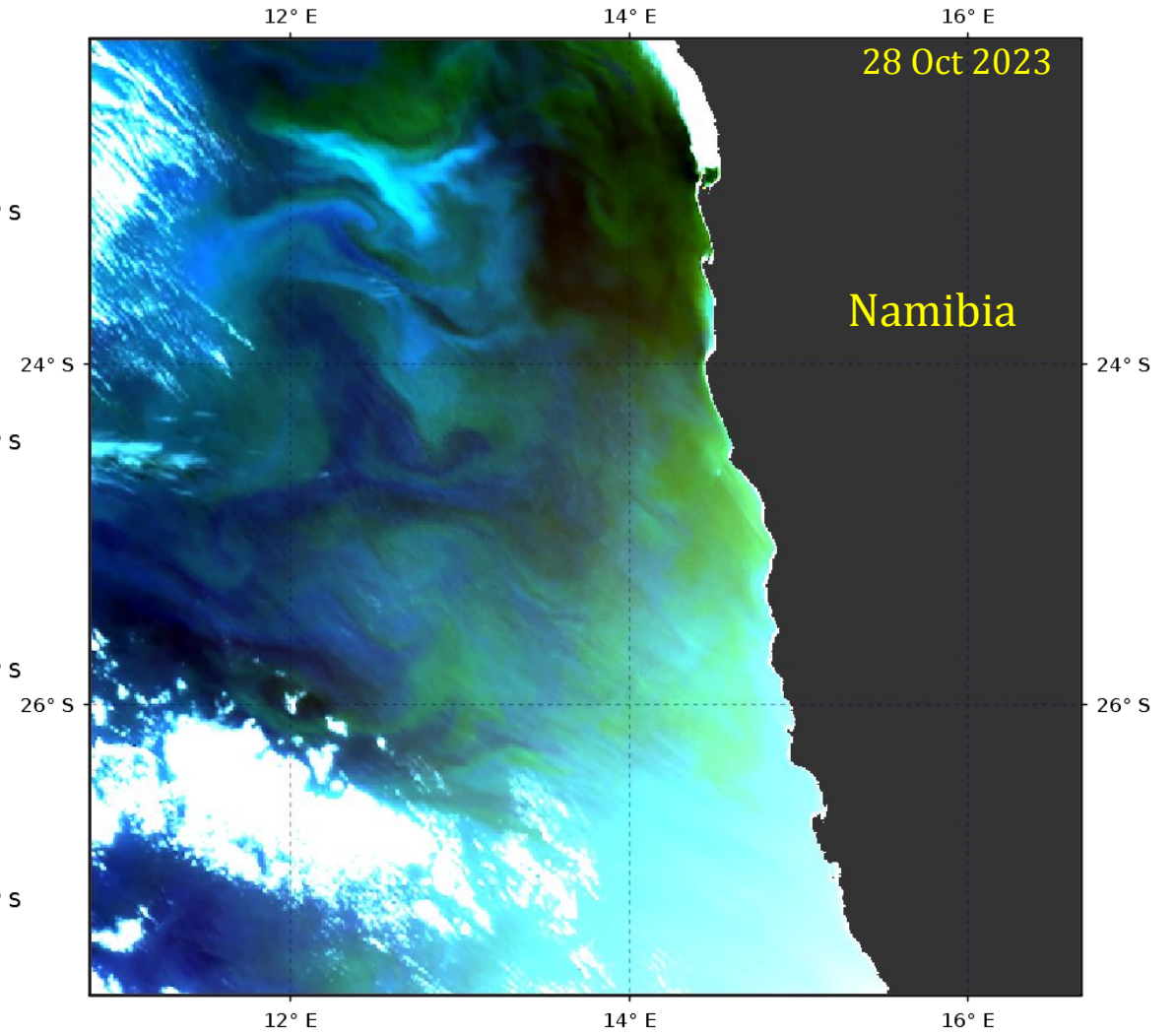
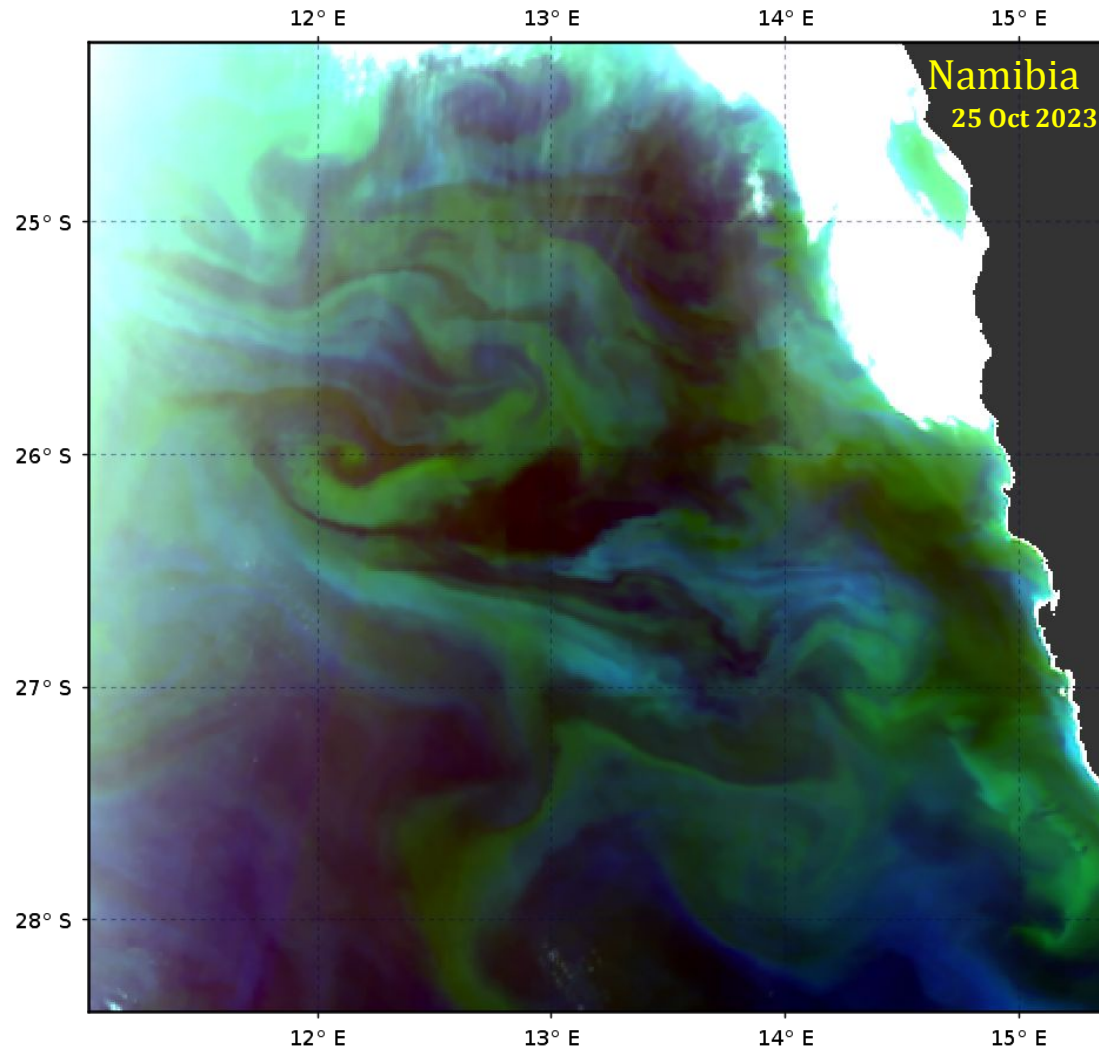
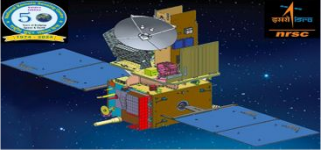
Level-3 Binned Products: Eos-06 OCM



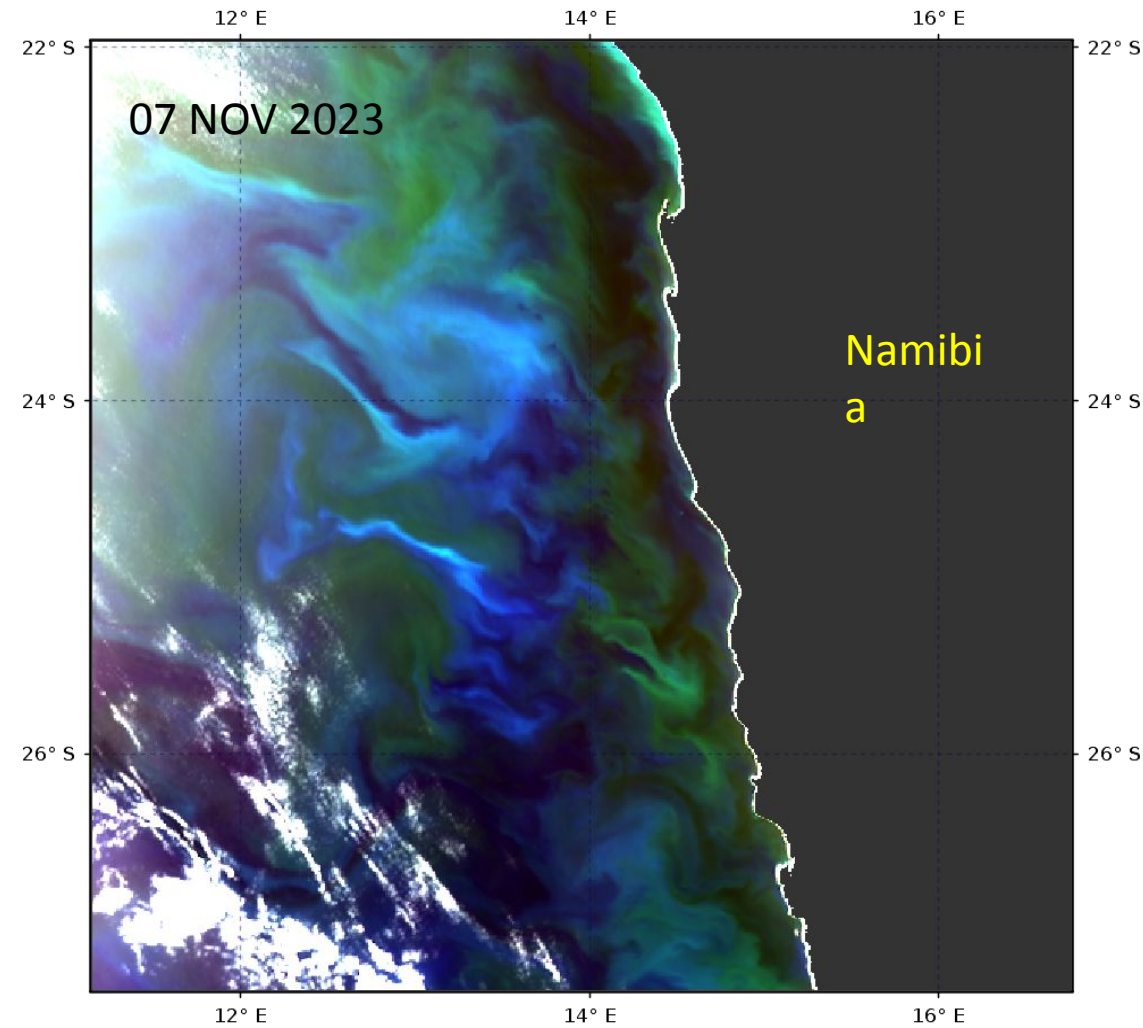
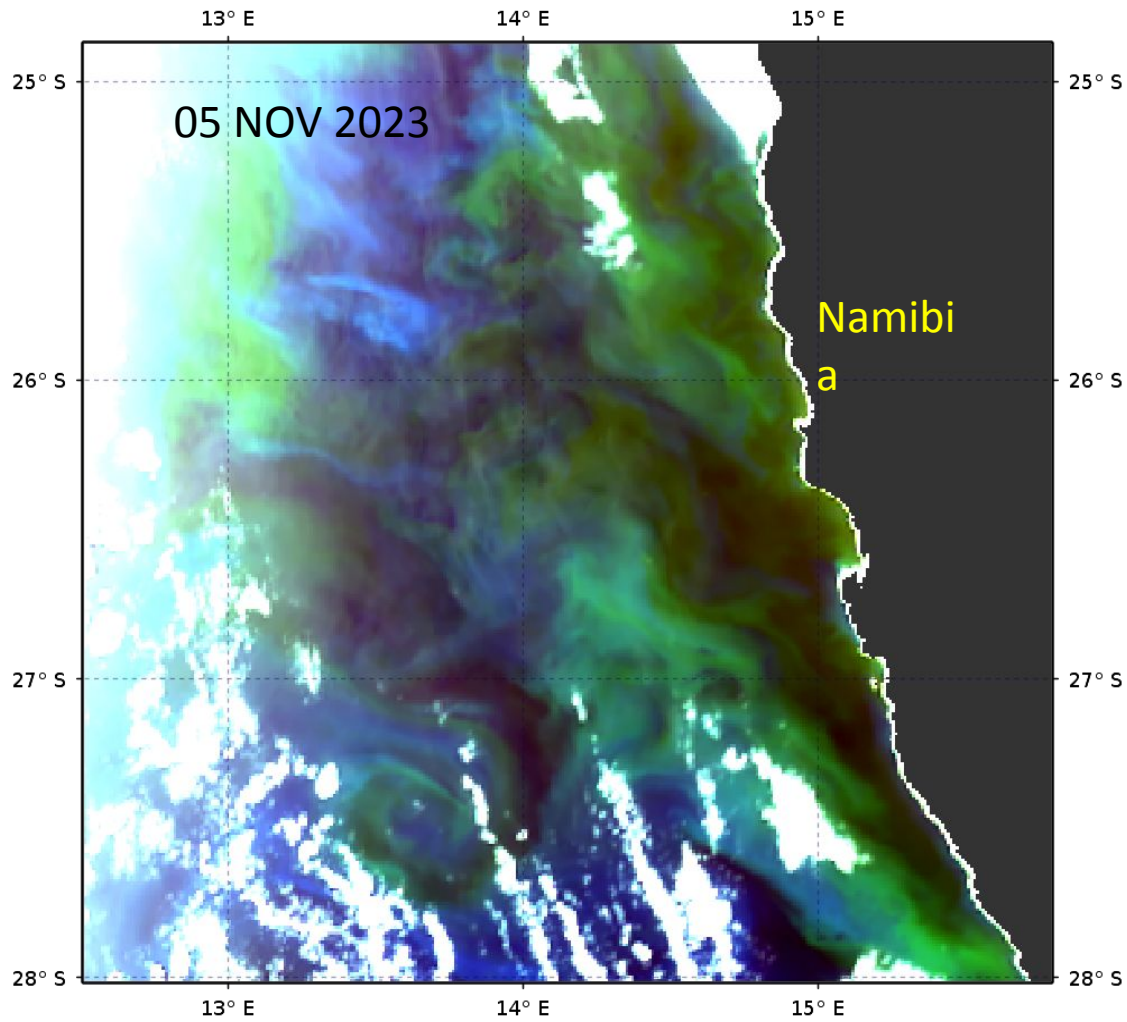
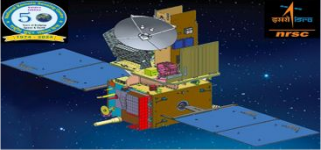
Apr_May_Aug_Sep_2023



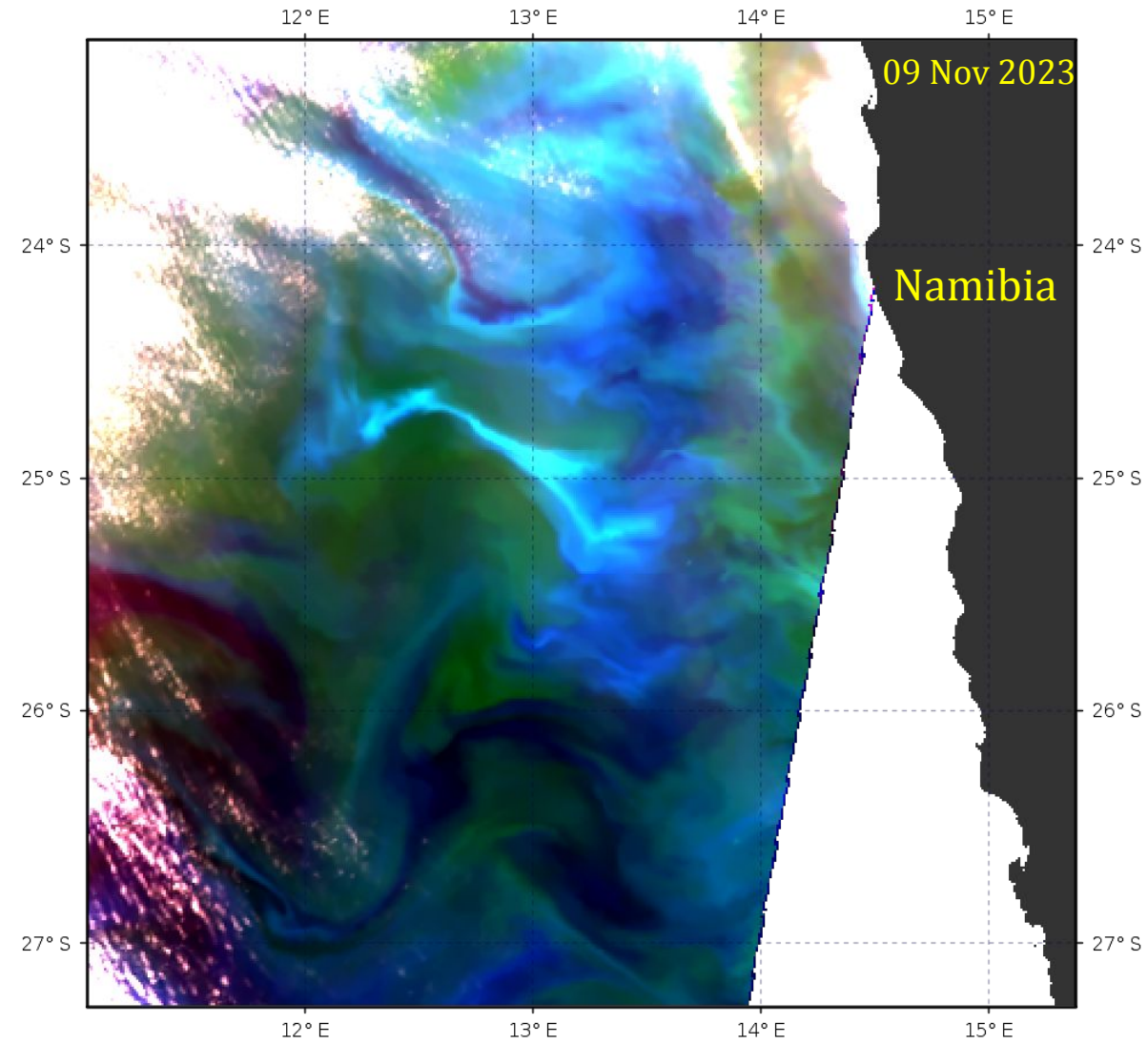
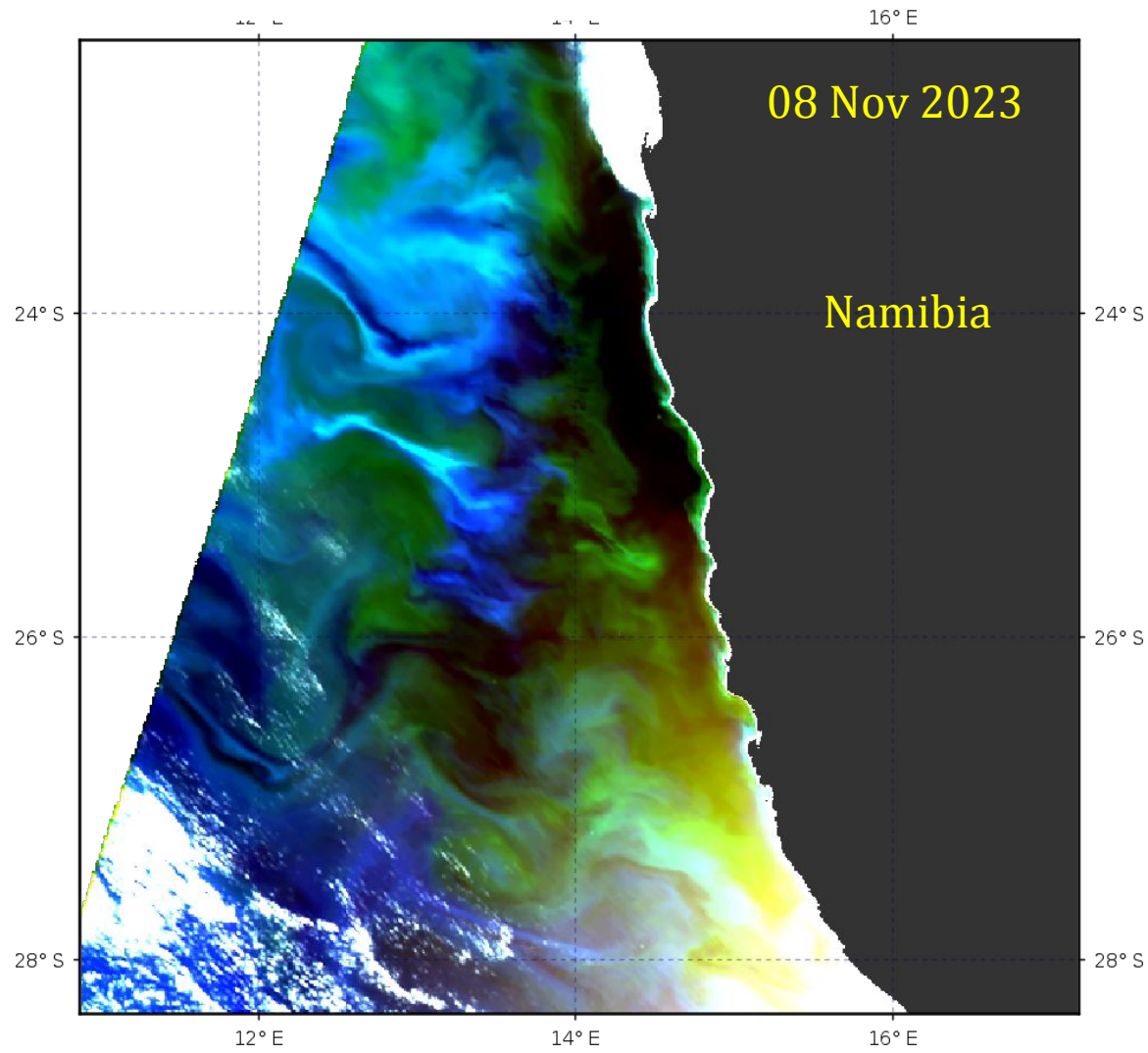
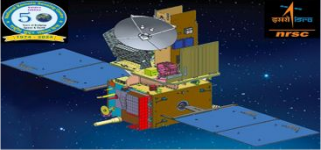
Phytoplankton Blooms: Eos-06 OCM



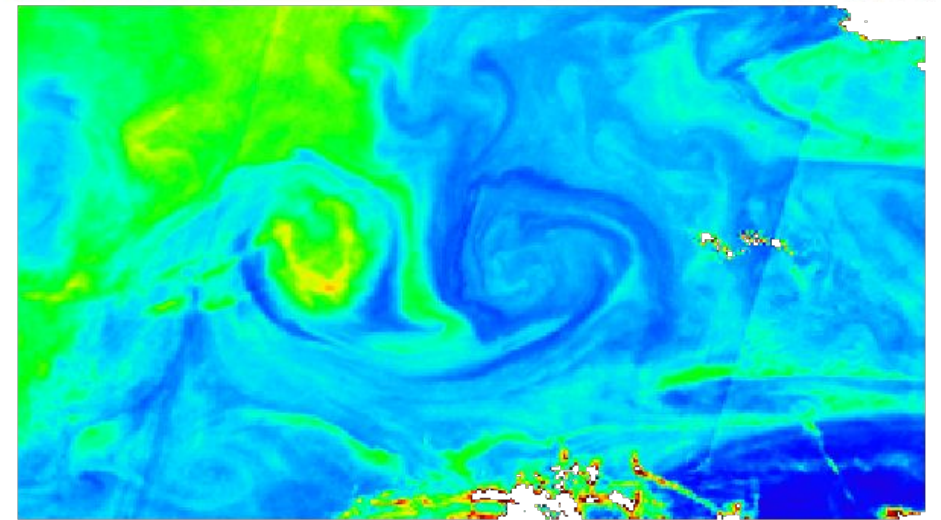
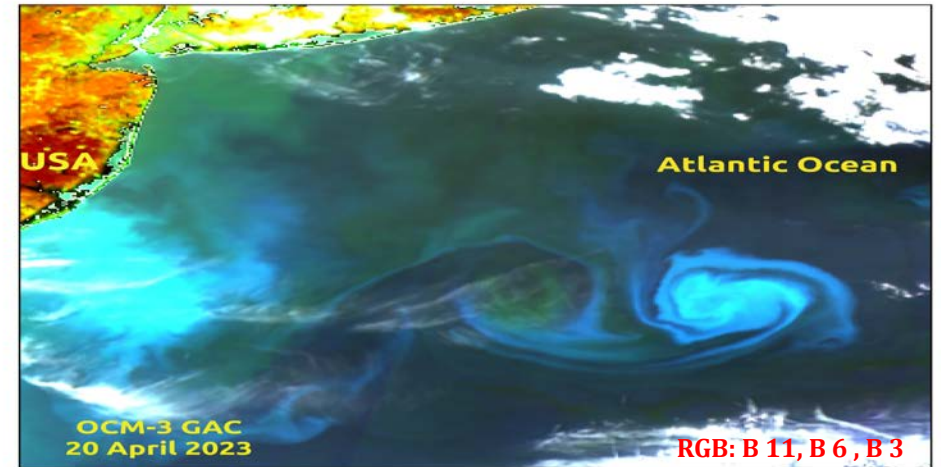
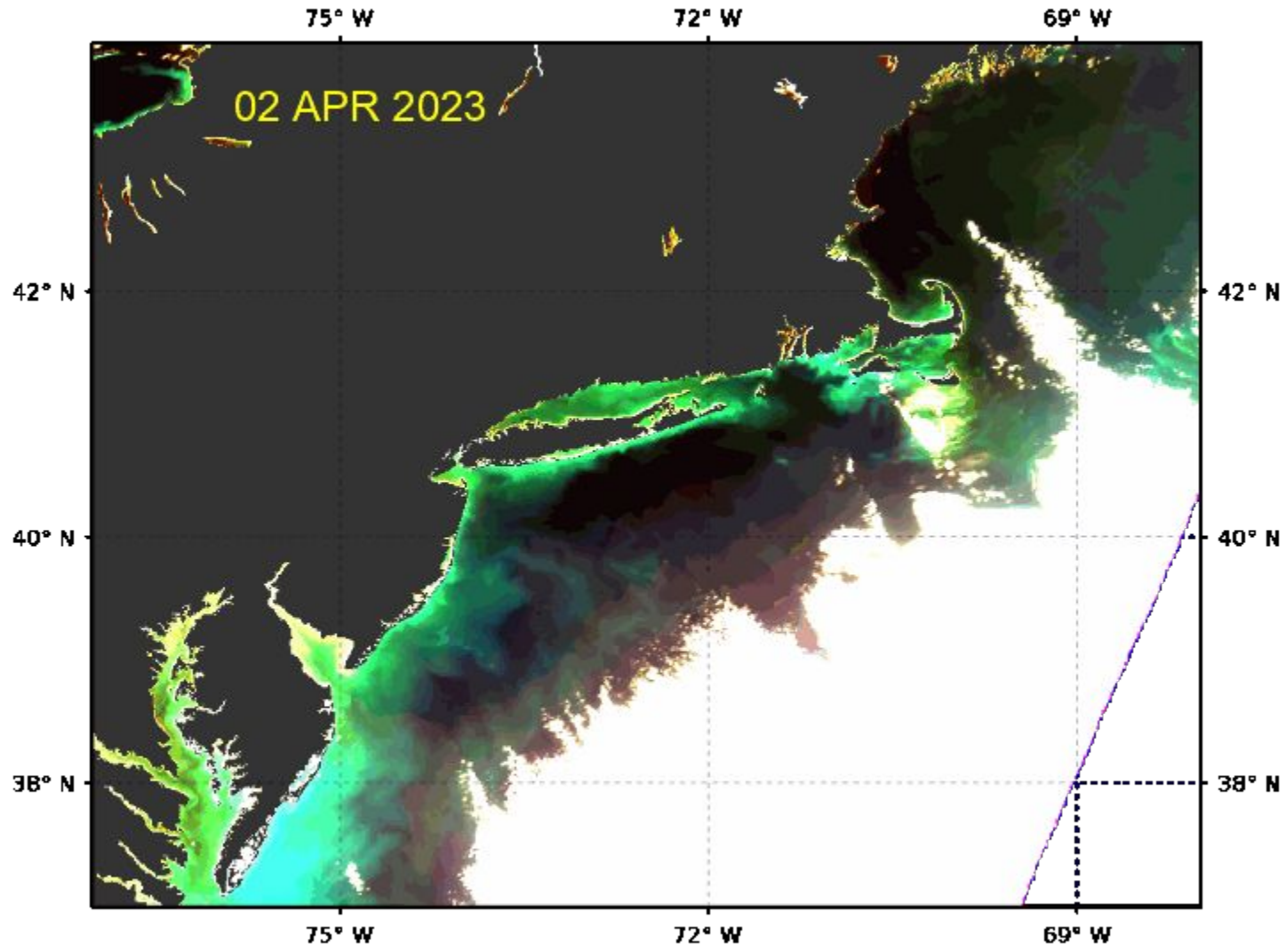
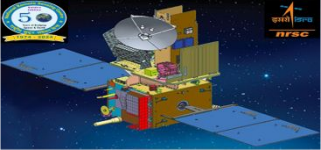
Phytoplankton Blooms: Eos-06 OCM



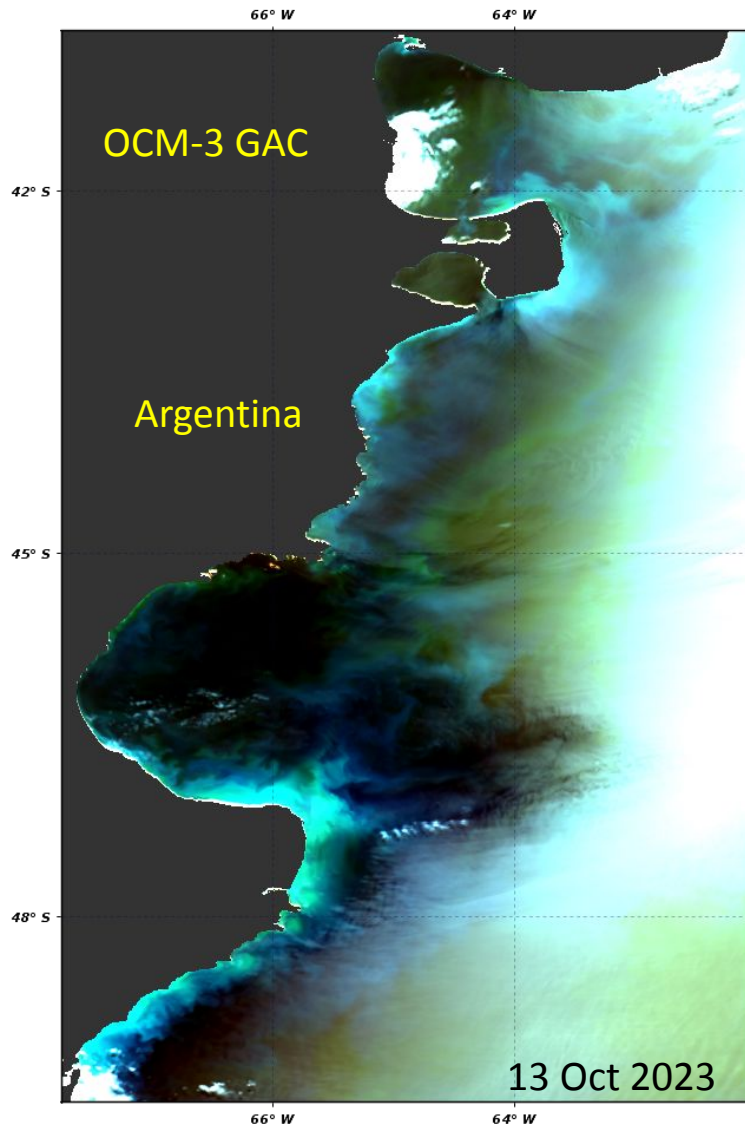
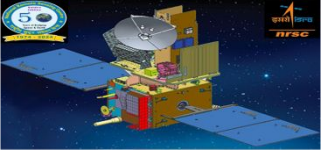
Phytoplankton Blooms: Eos-06 OCM



Evolution of Phytoplankton Bloom off the US East Coast

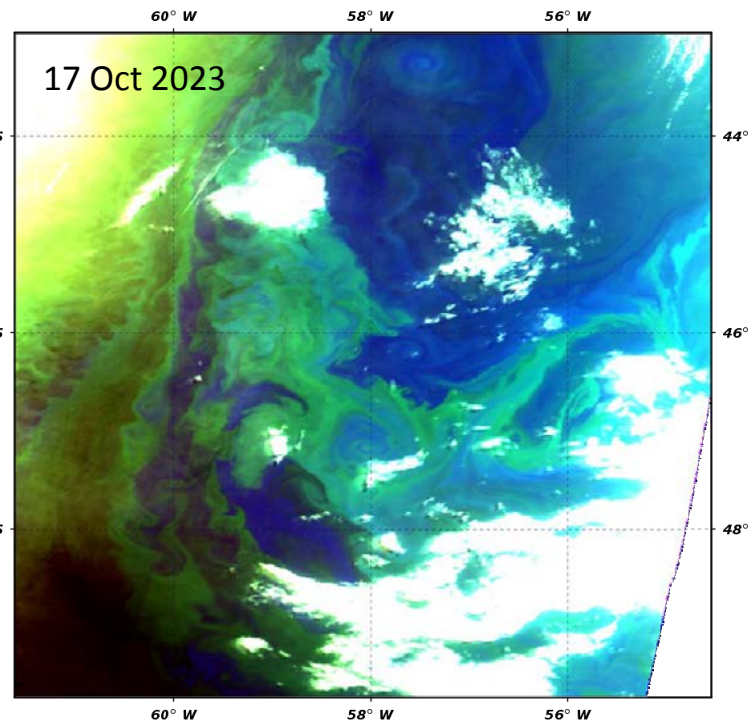


Phytoplankton Blooms & Services: Global

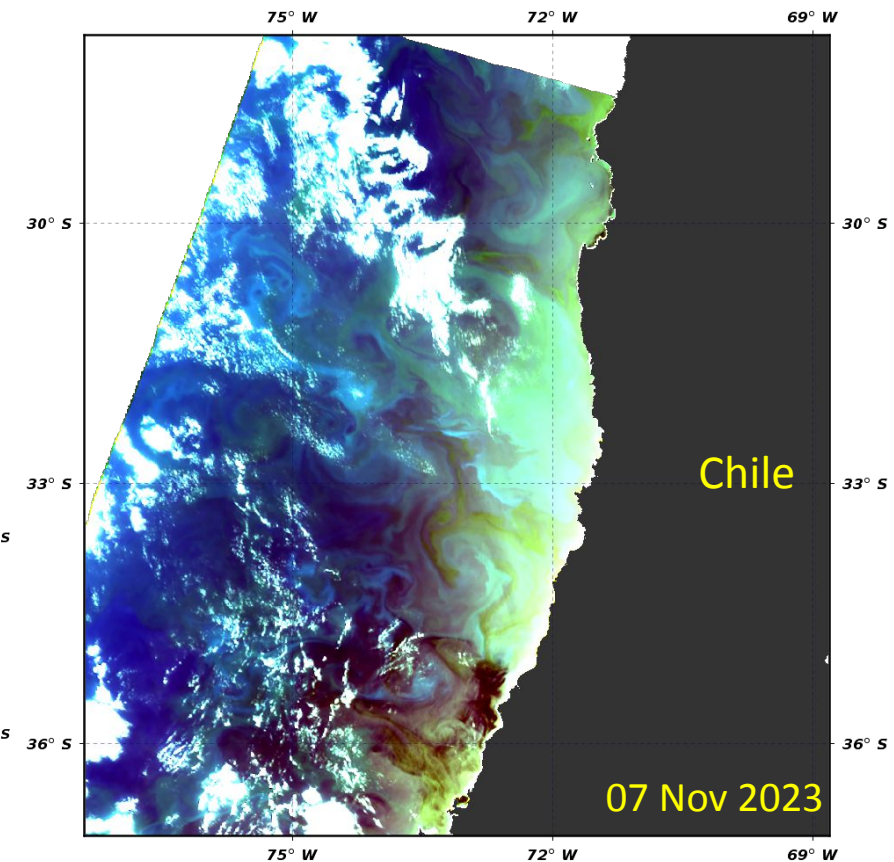


15/11/2023

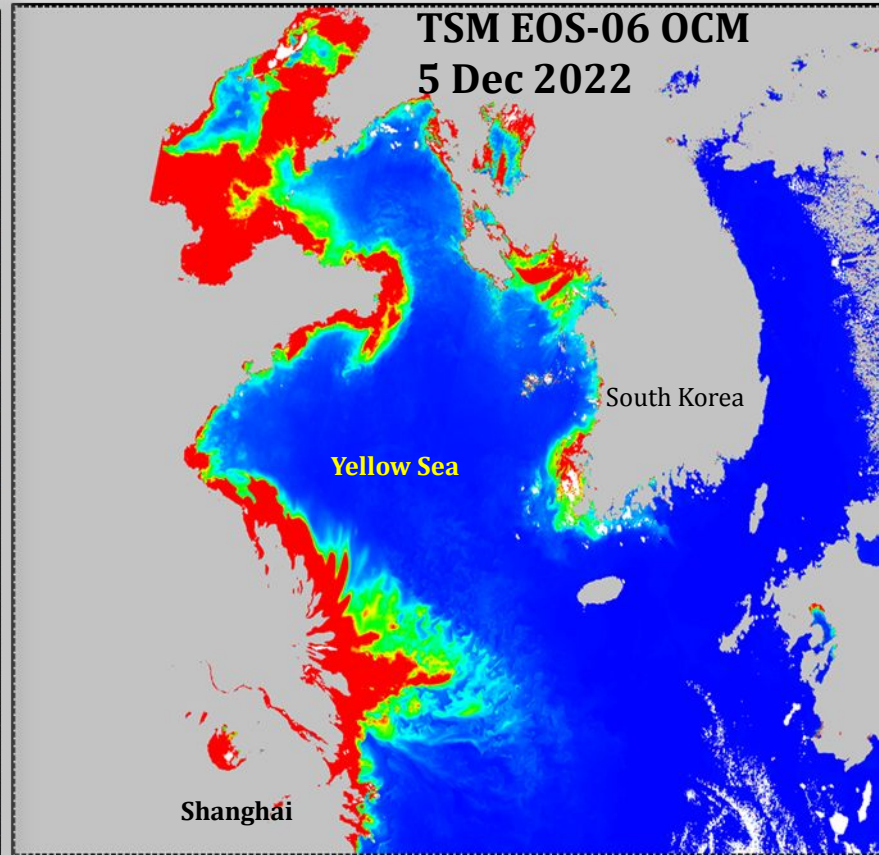
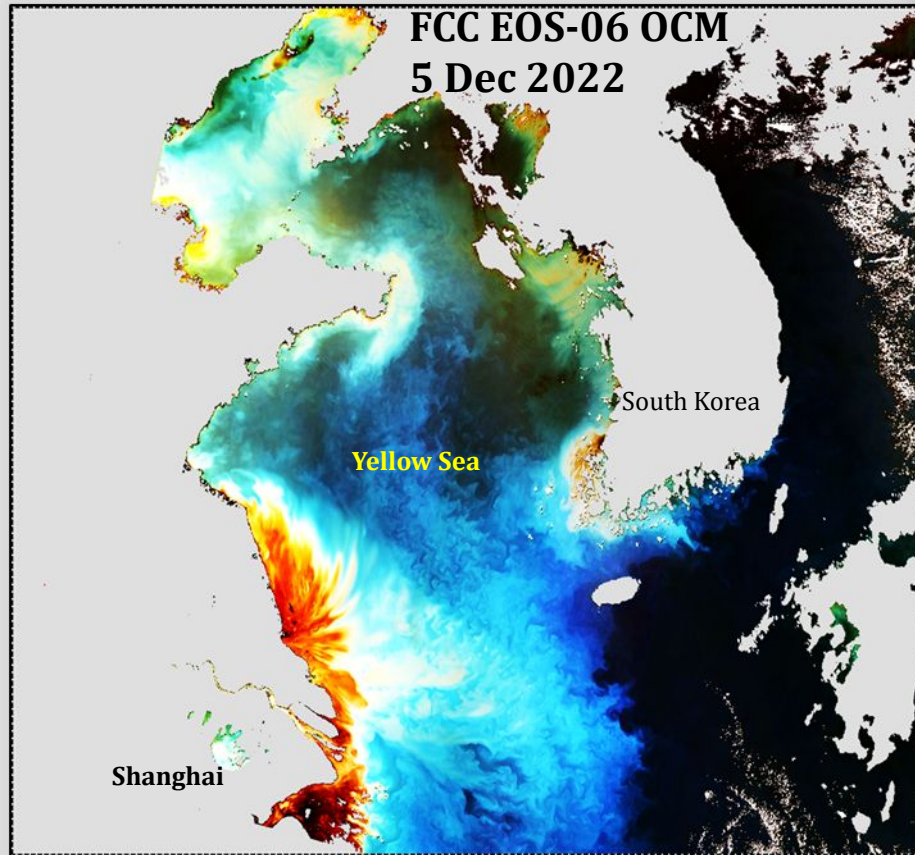
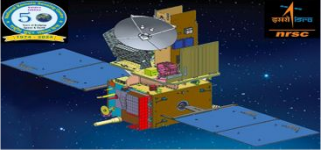
Recent Phytoplankton Bloom off the coast of Argentina and Chile



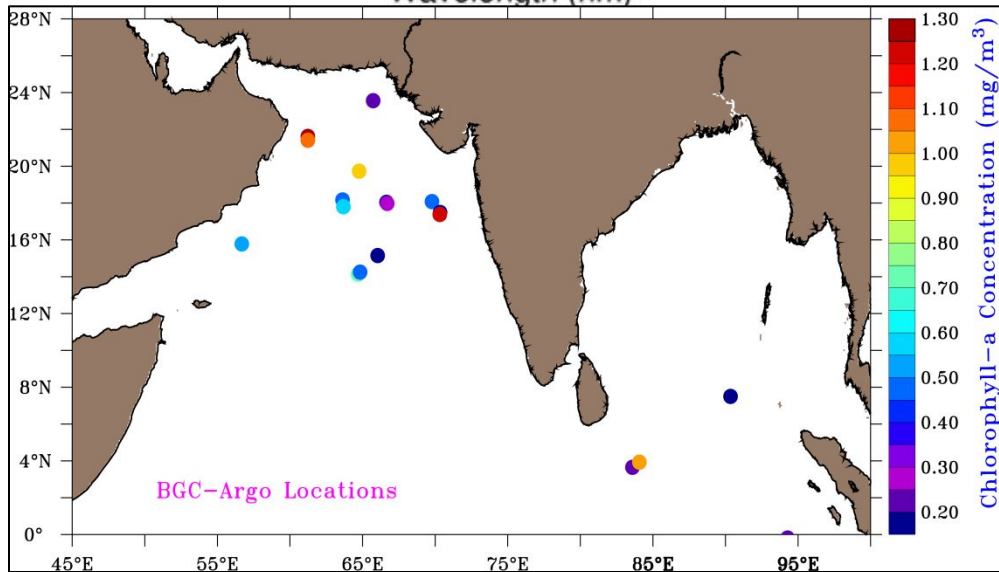
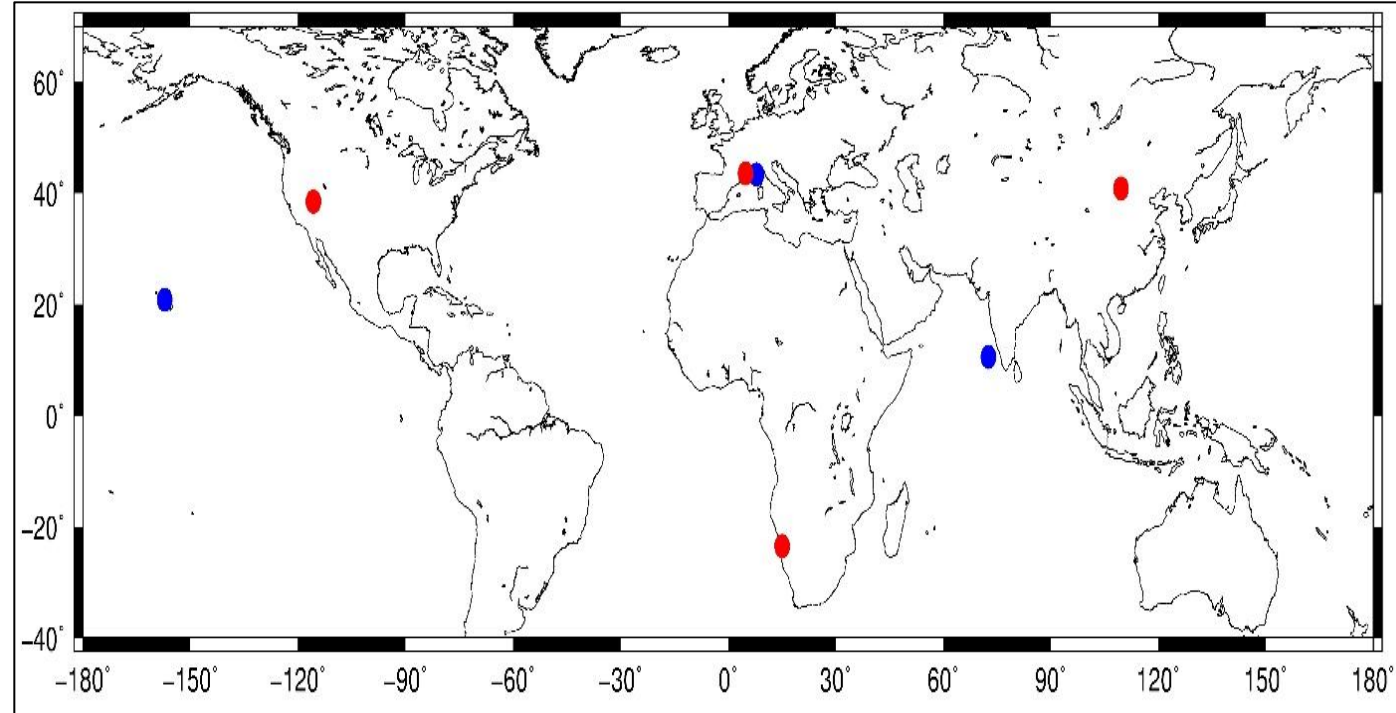
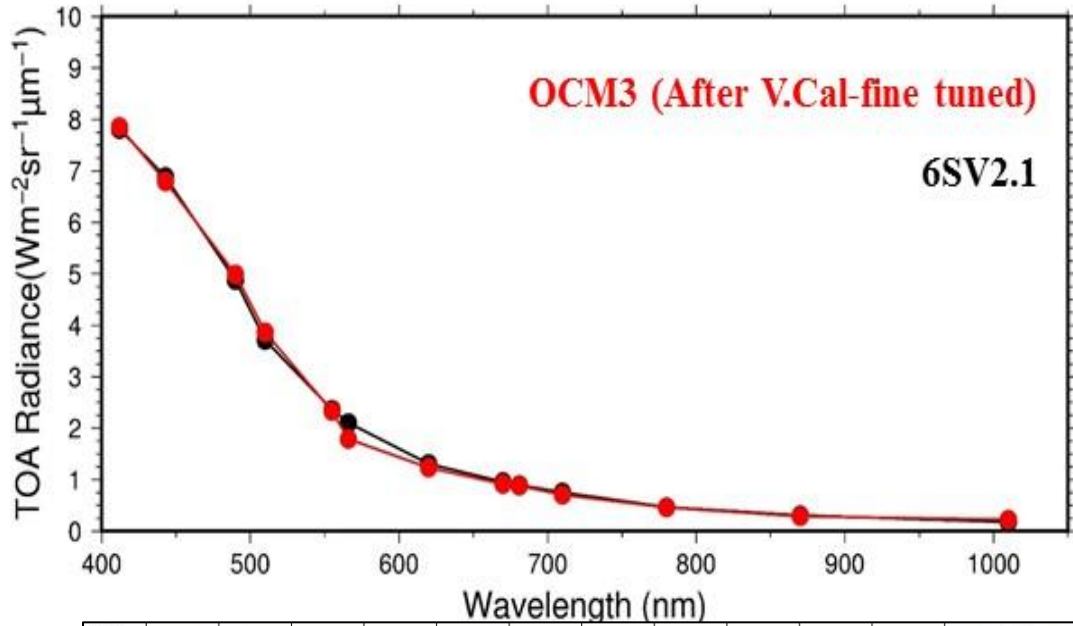
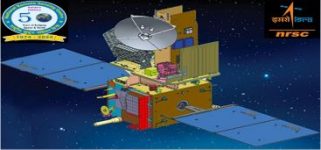
Inventory of current ocean color validation activities



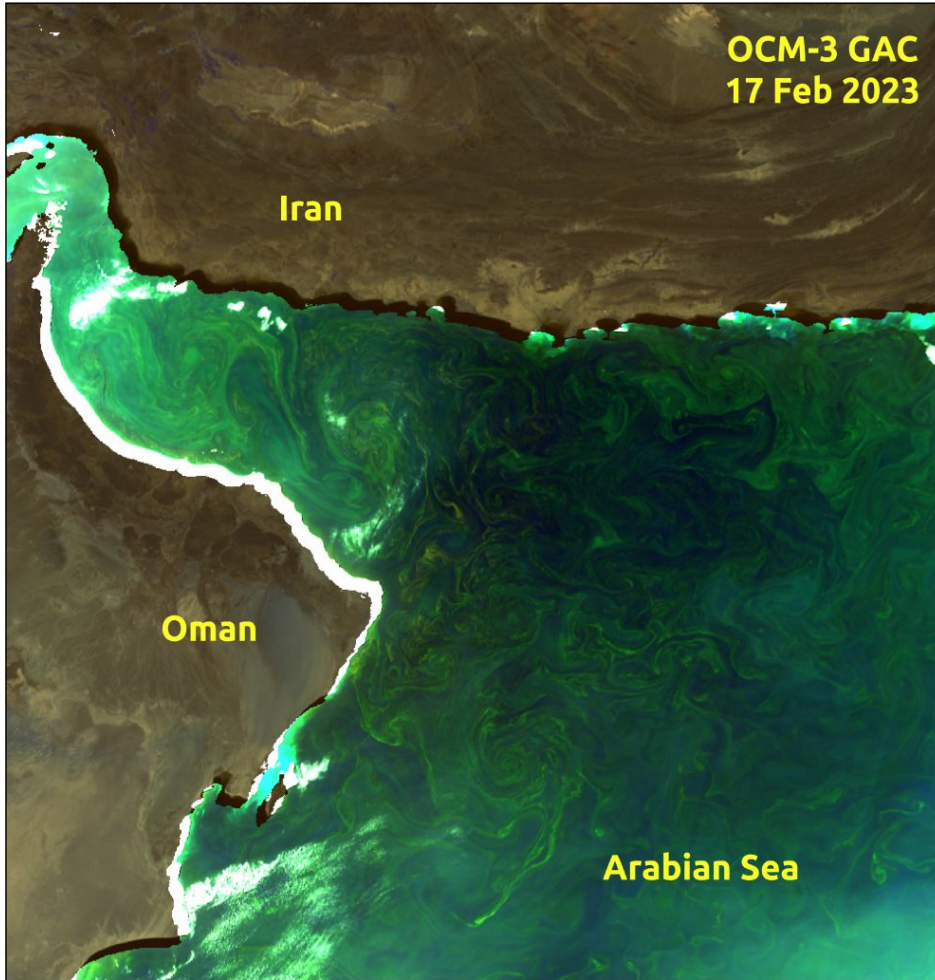
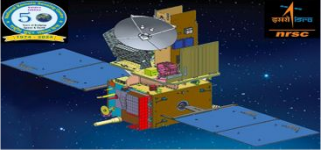
Sediment Plume Dynamics by EOS-06 OCM



Validation Program: Overview



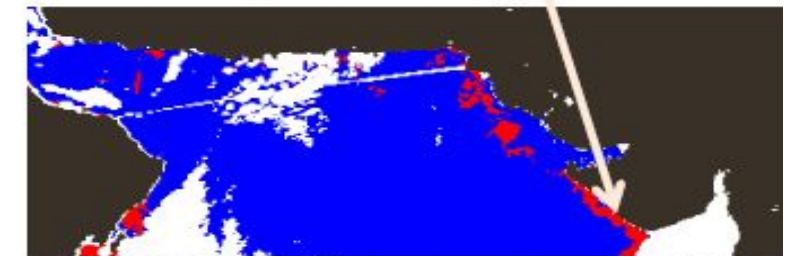
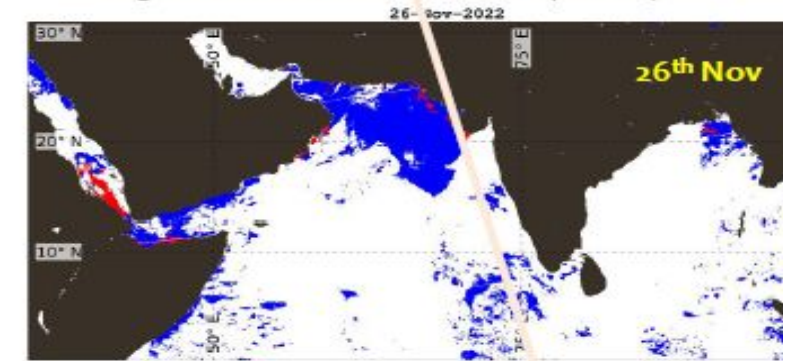
Phytoplankton Blooms & Services: NIO



Patch of Algal Bloom is identified from OCM3 corresponding to Algal Bloom Advisory by INCOIS

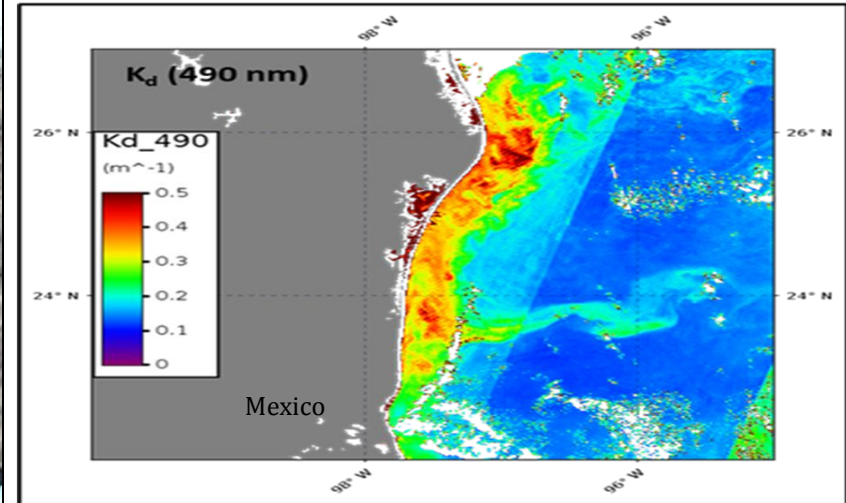
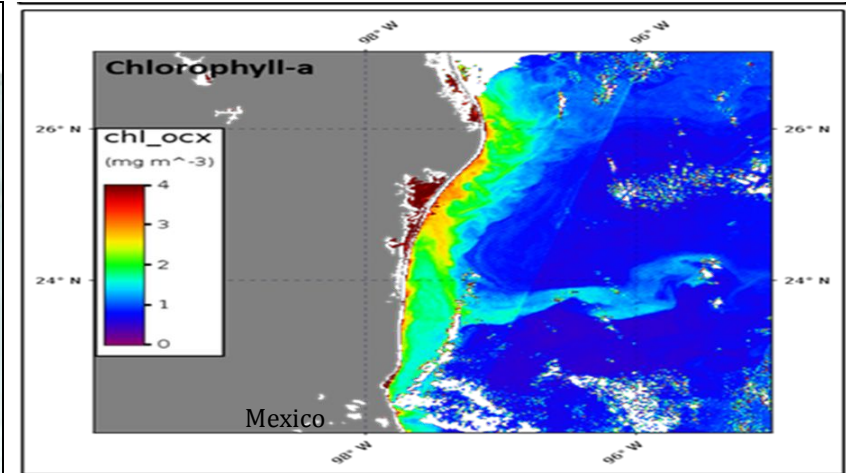
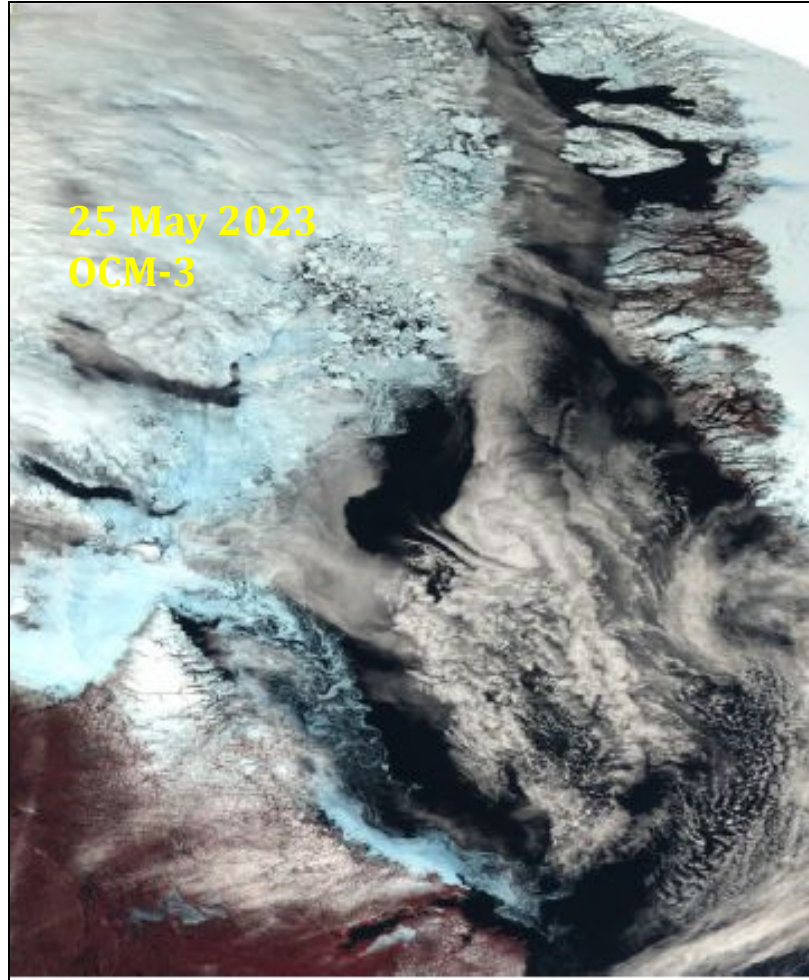
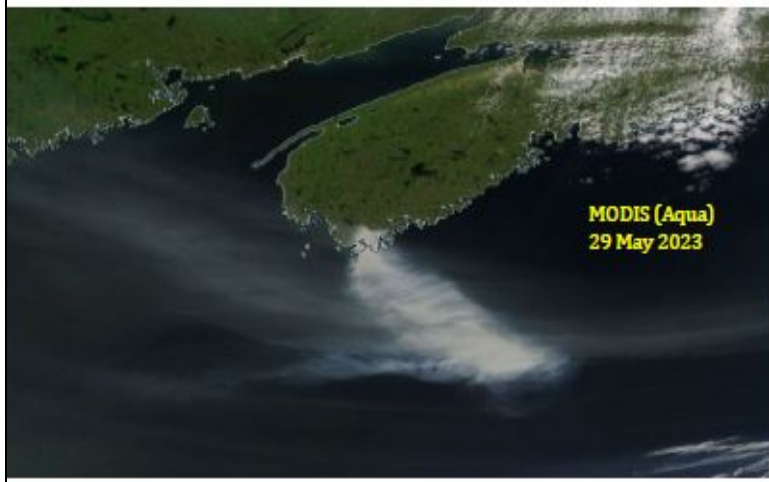
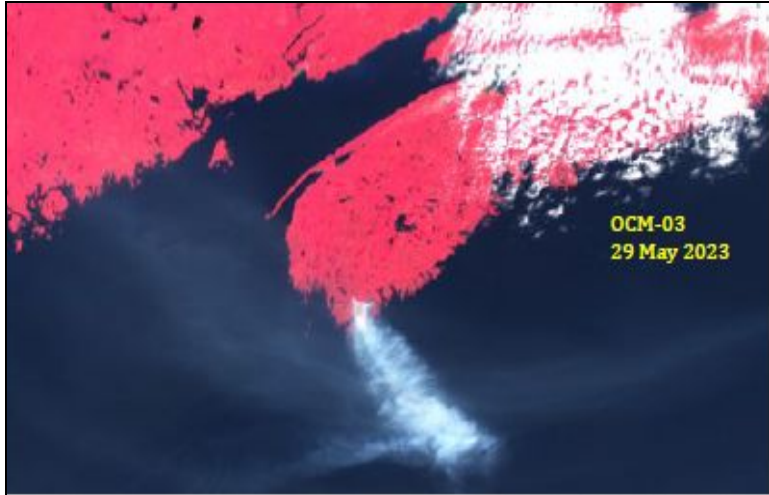
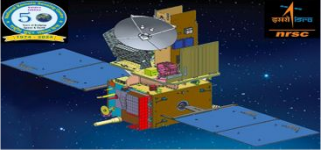


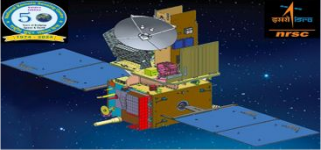
Algal bloom information services (INCOIS)



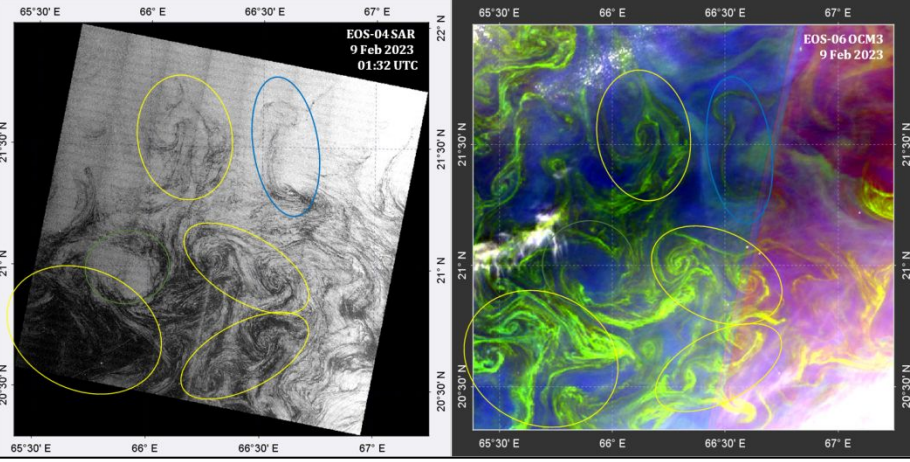
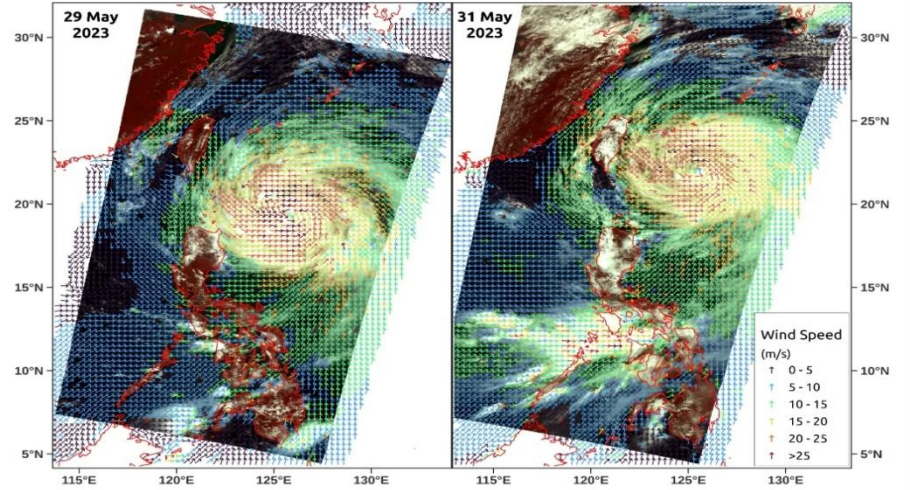
Noctiluca Scintillans bloom: Arabian Sea

Extended Applications of EOS-06 OCM

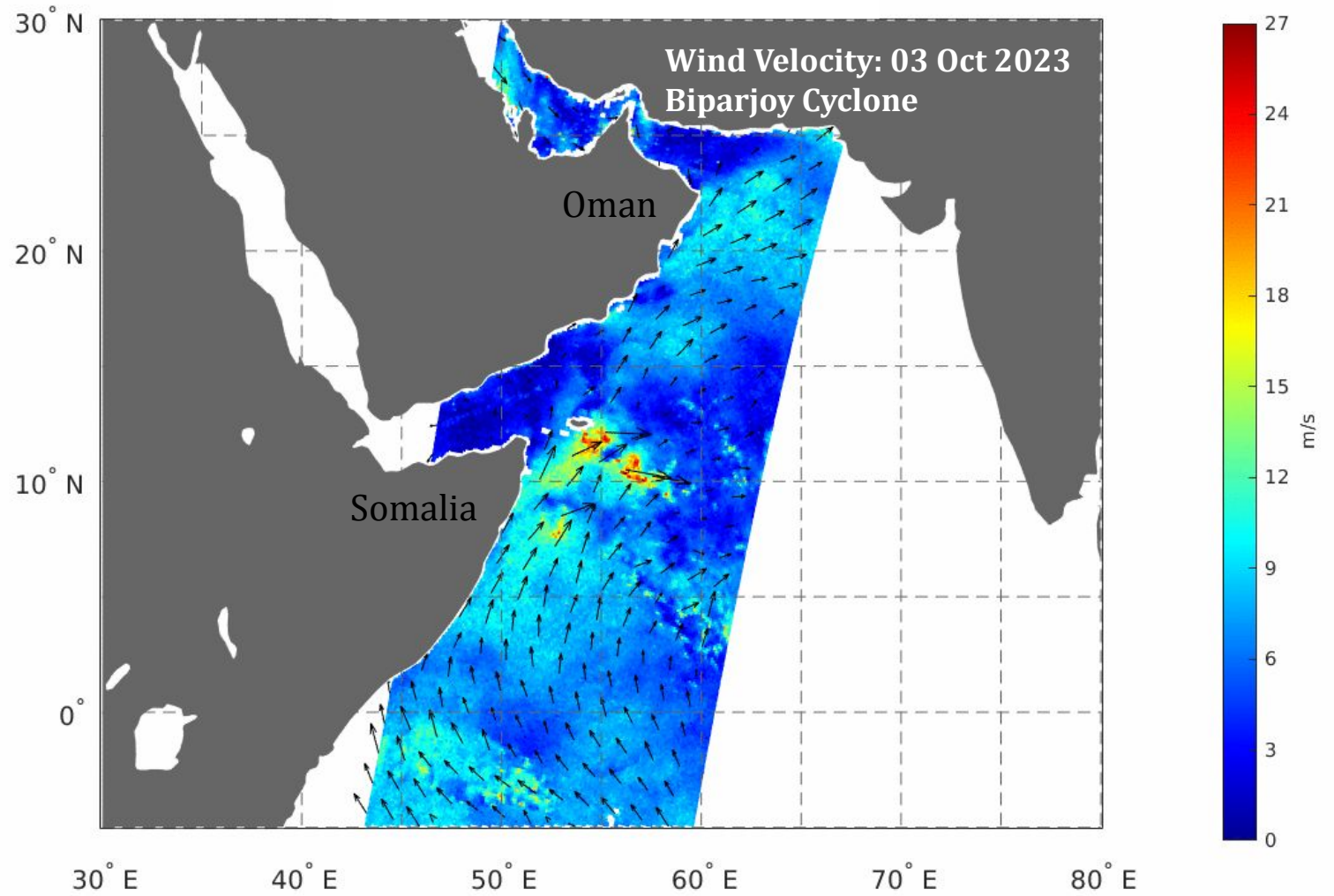




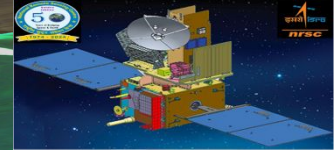
EOS-06 Scat Winds over OCM3 Cyclone Mawar



15/11/2023



Inventory of current ocean color validation activities

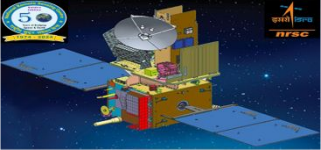


Operational Applications :

- ❖ Cyclone Forecasting
- ❖ Ship Routing
- ❖ Shoreline Management Studies
- ❖ Harbor and port management
- ❖ Oil spill management
- ❖ Search and rescue
- ❖ Ship Detection in coastal waters
- ❖ Pollution Dispersion studies

Scientific Studies:

- ❖ Designated as ECV- Climate studies of ocean circulation variability, Heat Transport etc.,
- ❖ Wind-Wave-Current Interaction studies
- ❖ Understanding Coastal Ocean circulation
- ❖ Air-Sea interaction studies
- ❖ PFZ Forecast studies



NICES National Information System for Climate and Environment Studies

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GATEWAY FOR EARTH & CLIMATE DATA PRODUCTS AND INFORMATION

NICES

CLIMATE STORIES

Total Currents 25 km | 23-Jun-2022

Ocean Surface Currents

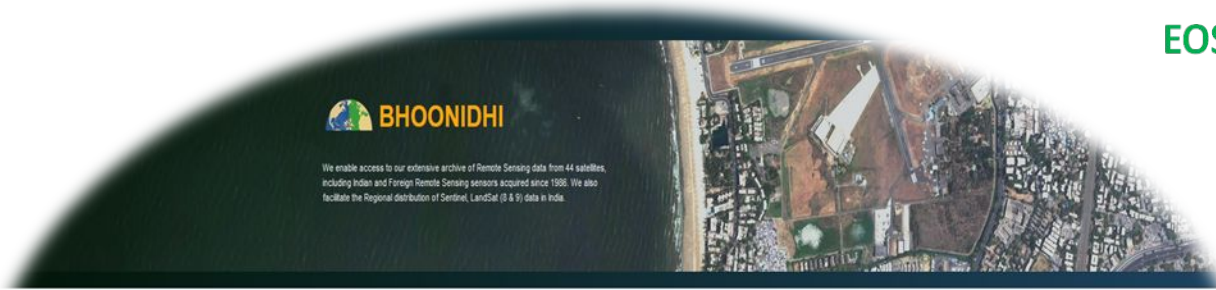
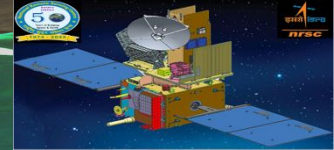
A data set of daily ocean surface currents from 1993 to 2022 at 25km resolution are generated by synergising the Altimeter (MADT) derived Geostrophic currents along with Scatterometer (Winds) derived Ekman currents. Seasonal cycle of the major current systems (Eg- WICC, EICC, ITF etc.) in the Indian Ocean is compared with in situ data. Interannual variability of these major current systems is analysed using trend and wavelet analysis (WICC showing semi annual dominant mode) describing the dominant modes of variability and their interannual variations. [Read More...](#)

HIGHLIGHTS

- NICES workshop at Birla Institute of Scientific Research
- MoU signing ceremony between CCRI & NRSC
- Observations of GHGs as Climate Indicator
- Deciphering the Signatures of Convective Rain Cells
- Wind power potential over Indian region
- Hot Weather Outlook
- Fog intensification - Probable region

<p>High Pressure Liquid Chromatography (HPLC)</p> <ul style="list-style-type: none"> Lab Instrument Measures different Chlorophyll pigment concentrations of water column 	<p>Hyperspectral Underwater Radiometer</p> <ul style="list-style-type: none"> Field Instrument Measures underwater Light Fields, nLw, Rrs, Chlorophyll, CDOM 	<p>Inherent Optical Profiler</p> <ul style="list-style-type: none"> Field Instrument Measures Absorption & backscattering, Chl of water column
<p>905 Titrand</p> <ul style="list-style-type: none"> Lab Instrument Used for Potentiometric titration for Total Alkalinity 	<p>Fast Repetition Rate Fluorometer</p> <ul style="list-style-type: none"> Field Instrument Measures photosynthesis parameters of water column, [RCII], σ_{PSII}, PAR 	<p>Conductivity Temperature & Depth Sensor (CTD)</p> <ul style="list-style-type: none"> Field Instrument Measures temperature and salinity profiles of water column
<p>Nutrient Analyzer</p> <ul style="list-style-type: none"> Lab Instrument Nutrient concentrations of water samples (N, P etc) 	<p>LI-COR 840A</p> <ul style="list-style-type: none"> Field Instrument Gives Atmospheric concentration of CO₂ 	<p>Thermo Scientific Pacific P11 (Milli-q)</p> <ul style="list-style-type: none"> Lab Instrument High Purity water for Lab titrations
<p>Coulometer</p> <ul style="list-style-type: none"> Lab Instrument Measures Dissolved Inorganic Carbon in water samples 		

Bhoonidhi: ISRO Earth Observation Data Hub



EOS-06 – LAC, GAC, SCAT-3

EOS-06 - GAC,LAC,SCAT-3



Search, View and Download,

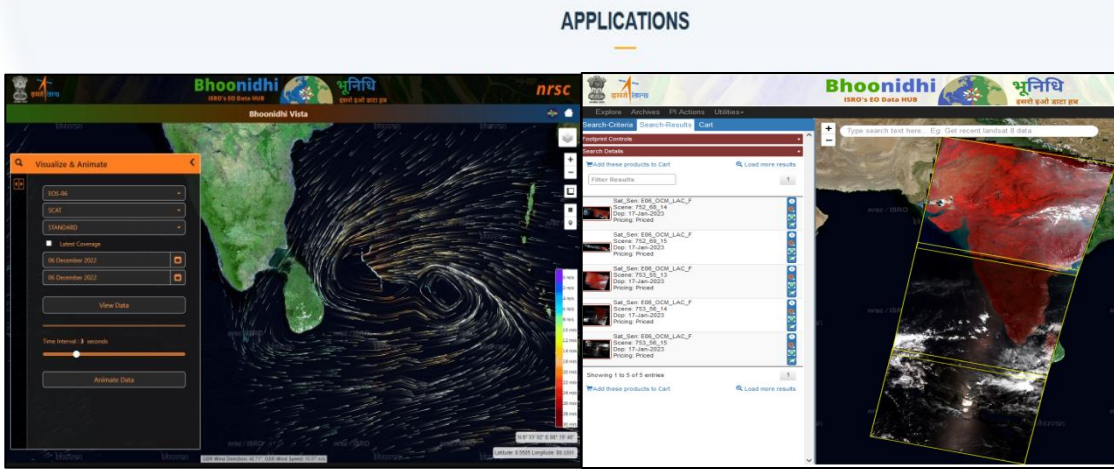
Visualize the NRT daily acquired data and temporal cycle based mosaic,

Orbit Viewer - Live satellite/orbit tracking Quick View of all satellites at predicted UTC time.

Proforma (PI) ,
Place work order

Quick animation of a point AOI

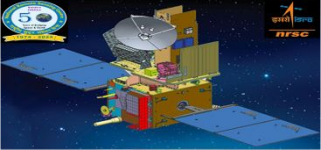
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bhoonidhi.nrs.gov.in/vista/index.html

bhoonidhi.nrs.gov.in/upagrah



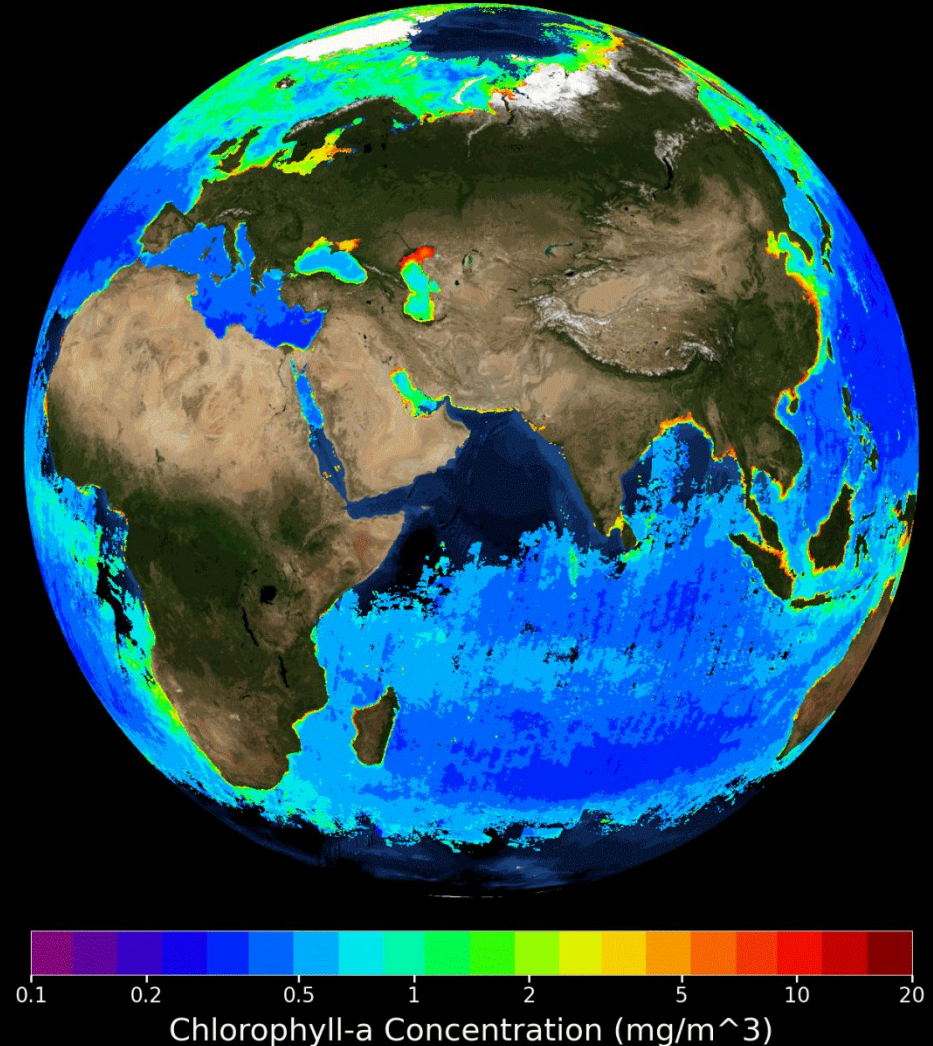
- Continuation of Cal-Val activities from the global in-situ sites, Bio-Argos and cruises
- Oceansat-3A as the continuity mission for EOS-06
- Availability of Advanced R&D and Evaluation Products for the global ocean
- Usage of real time winds for Atm.correction
- Assimilation of Ocean Color Products into Ocean Biogeochemical Model

*Thank
you!*

15/11/2023

Way Forward...

June - July 2023



Inventory of current ocean color validation activities

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