Second International Operational Satellite Oceanography Symposium

The Second International Operational Satellite Oceanography Symposium (OSOS2) was held virtually May 25-27, 2021. OSOS2 was the culmination of a tremendous effort by the all-volunteer Programme Committee and staff at both agencies over the last two years. The Programme Committee was co-chaired by Dr. Estelle Obligis of EUMETSAT and Dr. Veronica Lance, of NOAA.

EUMETSAT took the lead host role of this virtual symposium which was originally planned to take place in Darmstadt. NOAA served as host in 2019 for the 1st OSOS, held in College Park, MD at the NOAA National Center for Weather and Climate Prediction. This year's event garnered 479 registered attendees from 57 countries – with peak daily attendance at 338 online at one time. This dramatic increase was due in part to being a virtual meeting (overcoming travel barriers), but also because of esteem-building for the symposium arising in the Operational Satellite Oceanography community following the successful 2019 event.

A combination of oral presentations, panels, and poster sessions informed attendees about the latest in Operational Satellite Oceanography science and issues. Over 70 poster presentations and over 30 talks were made available during nine interactive poster and oral sessions. The recordings and presentation slides remain available for viewing on the meeting website. A Symposium Report is planned. The third OSOS will be hosted by NOAA in 2023.

The ambitious program tackled in the OSOS2 agenda grew directly out of recommendations for future actions collected during OSOS1 and with guidance and input from the distinguished 23-member OSOS2 Programme Committee. Satellite remote sensing of ocean properties is a technology of continuously increasing maturity and scope. Sea surface temperature, sea surface height, ocean color, sea ice, ocean winds, roughness-derived parameters (*e.g.*, oil spills) and other measurements are now available on a routine and sustainable basis. Some of these products are integral to operational applications for routine and event-driven environmental assessments, predictions, forecasts, and management. Yet ocean satellite data are still underutilized and have a huge potential for contributing further to societal needs and the "blue economy". The Second Operational Satellite Oceanography Symposium focused on the use of satellite data in coupled numerical models for ocean, weather, climate and environment analysis and prediction; and in operational applications for coastal waters. The following themes and cross-cutting topics directed our progress:

Themes:

- Data Assimilation
- Satellite Data in Coupled Models

- Coastal and General Applications
- Facilitating the use of data across the user spectrum

Topics:

- Coupled Modelling
- Arctic and Coastal Regions
- Safety/Disaster/Extreme Events
- Ecological Forecasting
- Environmental Analysis and Prediction
- Water Quality
- Coastal Hydrology
- Artificial intelligence/machine learning
- Strengthening Research-to-Operations-to-Research

An optional training day was held following the OSOS2 meeting on May 28, 2021 led by Copernicus staff trainers with contributions from NOAA CoastWatch team members.

OSOS2 Symposium outcomes to inform future space agency action included:

- Address product uncertainties
- Reduce latency for NRT but maintain non-time critical higher quality products
- Improve spatial and temporal resolution (a forever challenge)
- Data reduction and pre-processing have their place for some uses
- Increase operational in-situ data collection systems for calibration & validation
- Gaps in observations: currents, waves, salinity, bathymetry
- To fill gaps in coastal products, both new analytical methods for existing sensors as well as new high-res instruments
- Generate consistent, accurate, state of the art long-term time-series
- Simplify complex satellite data into straightforward information that is fit-for-purpose (e.g., indicators)
- Keep working on harmonizing data policies (standards, format….)
- Agency data should be open and free
- Expand use of satellite observations in models for initialization or data assimilation
- Assimilation of L1 is developing for better forecast, products available earlier but well calibrated
- Other applications prefer higher level “ready-to-use” analysis products
- AI is present all along the value chain. Further develop the synergy with AI at all levels.
- Investigate and reinforce connections between ocean and its multi-directional interfaces (atmosphere, land, sea ice, waves, lake). Ocean as part of the earth system
- Always improve access to data (visualization, extraction)
- Prioritise hosting processing (we process the data where they are) to avoid moving around ever larger data volumes
- Host tools and models for user access
- Infrastructure is key (more and more data, more and more complex models), can be shared

- Software engineering is more and more important
- And especially Democratization of data

Symposium highlights included the meeting welcome by newly appointed EUMETSAT Director Philip Evans**;** an introduction to the UN Decade of Ocean Observations for Sustainable Development by Vladimir Ryabini, Executive Secretary of the Intergovernmental Oceanographic Commission (IOC) of UNESCO; Day 1 Keynote Address by Fraser Davidson, CNES, entitled: *An overview of present data assimilation activity, future developments and exploring how to further integrate knowledge and value of data assimilation to further benefit all components of the operational oceanographic value chain;* Day 2 Keynote Address by Phillip Browne, ECMWF, entitled: *Coupled Data Assimilation at ECMWF – how satellite observations are used in coupled numerical weather prediction;* and the penultimate symposium session which assembled an international panel of space agency representative to speak to the Operational Agency Outlook (Figure 1).

OSOS2 recordings, presentation slides, and posters remain available here.

OSOS2 Space Agency Panel: Top left, Cara Wilson NOAA NMFS (panel moderator); Top center, Estelle Obligis – EUMETSAT; Top right, Pierre Yves LeTraon – Mercator Ocean; Bottom left, Mitch Goldberg – NOAA NESDIS; Bottom center, Paul M. DiGiacomo – NOAA NESDIS STAR; Bottom right, Fabienne Jacq – European Commission. Photo Credit NOAA