EuroSea & OceanPredict

Workshop on

Ocean Prediction and Observing system design

Exeter, 29 June -1 July 2022

POSTER ABSTRACTS

Hybrid event

Status: 26 June 2022

Workshop sessions

WS sessions	Session descriptions
1	**Session 1: OSEs & OSSEs in support of observing system design** This session will cover efforts in EuroSea, OceanPredict and the wider obs/modelling community on Observing System Experiments (OSEs) and Observing System Simulation Experiments (OSSEs) and its potential of contributing to the design of the whole ocean observing network and to achieve synergies between the various contributing observing systems. In addition, this session will look to explore how OSEs (and OSSEs) can be adopted to provide robust, reliable and regular messages on the observing system performance applying best practice approaches for system set-up.
2	**Session 2: Extreme marine events – observing, modelling, forecasting and user accessibility** In this session we seek to provide insight into the marine extreme events monitoring and forecasting efforts. Of particular importance is the interaction and co-creation of products and services with the stakeholders (scientists, industry, policy makers) along with the development and documentation of best practices to observe and forecast extreme marine events.
3	**Session 3: Coastal Ocean: Modelling, observing system design and product utility** This session will explore what downscaling approaches are needed to go from coastal circulation to high-resolution bay, estuary or river models, what observing systems are effective to constrain coastal ocean phenomena and what data assimilation methods can be applied to constrain phenomena at smaller spatial and times scales. The session will also look at the utility of current coastal modelling and forecasting tools for users and whether these are sufficient for their applications.
4	**Session 4: EuroSea & OceanPredict – support for the UN Ocean Decade** A major requirement for the success of the Ocean Decade will be to establish national and international frameworks of partnerships and coordination. This will allow all components of the sustained ocean information value chain to strengthen each other and contribute collectively to achieve a well understood and predicted ocean from the deep seas to the coastal ocean, generating sustainable societal benefit. Both, EuroSea and OceanPredict's objectives support this vision. By combining their expertise and communities and reaching out to partners (GOOS, GEO Blue Planet, G7/FSOI, etc), they can provide a basis for knowledge exchange and new findings in the fields of ocean observations, observing system co-design, observing system evaluations and their utility and shared best practices for improving ocean predictions to benefit users. The outcome from this workshop session will be overarching and aims to work towards wide reaching recommendations to benefit all communities involved. It aims to develop plans for future activities and support the UN Ocean Decade programmes and projects.

Poster abstracts list (by session)

ID	First name	Surname	Affiliation	Abstract title
1 – OSEs & OSSEs in support of observing system design				
1.1	Théo	Brivoal	Mercator Ocean international	A new kilometric resolution zoom over the North-East Atlantic based on NEMO 4.2 (IMMERSE) version
1.2	Matthew	Carr	SAEON	Operational ocean modelling within South Africa; a downscaling approach
1.3	Gianpiero	Cossarini	National Institute of Oceanography and Applied Geophysics - OGS	Assessing the impact of BGC-Argo data assimilation into the Copernicus operational model system of the Mediterranean Sea biogeochemistry
1.4	Danni	Du	University of Colorado, Boulder	Assessing the Impact of Ocean In-situ Observations on MJO Propagation across the Maritime Continent in ECMWF Subseasonal Forecasts
1.5	David	Ford	Met Office	Assimilating synthetic Biogeochemical-Argo and ocean colour observations into a global ocean model to inform observing system design
1.6	Carine	G. R. Costa	MetOcean Solutions, part of MetService New Zealand	Improving ocean forecasts with subsurface data assimilation in the northeast shelf of New Zealand
1.7	David	Gwyther	University of New South Wales	OSSEs reveal subsurface temperature observations improve estimates of circulation and heat content in a dynamic WBC
1.8	Hyun-Chul	Lee	IMSG at NOAA/NWS/NCEP/EMC, USA	An Evaluation of Impacts from Ocean Observing Systems in NCEP GODAS in the Tropical Ocean
1.9	Elisabeth	REMY	Mercator Ocean International	Leveraging the multi-system glider data assimilation experiments within EuroSea to the international level
1.10	Robert	Weller	Woods Hole Oceanographic Institution	Ocean Reference Stations: Long-term, open ocean observations of surface meteorology and air-sea fluxes are an essential component of the observing system
2 – Extreme marine events – observing, modelling, forecasting and user accessibility				

2.1	Louise	Delhaye	RBINS	Acoustic and optical turbidity response to altering particle size distribution during extreme events
2.2	Matías	Dinápoli	Centro de Investigaciones del Mar y la Atmosfera (CIMA/CONICET-UBA) - Instituto Franco-Argentino para el Estudio del Clima y sus Impactos (UMI IFAECI/CNRS-CONICET-UBA)	Improving the short-range forecast of storm surges in the Southern-West Atlantic Continental Shelf using EnSRF data assimilation
2.3	Chaimaa	JAMAL	Hassan II University of Casablanca, Faculty of Sciences BenSik	Spatial and temporal variability of the coastal upwelling activity of the Moroccan Atlantic coast, 1994- 2020
2.4	Diego	Pereiro	Marine Institute	An observing and modelling system to monitor and forecast extreme marine events
2.5	Oscar	Reyes-Mendoza	CONACyT-ECOSUR	Marine Heatwaves and Marine Cold-spells on the Yucatan Shelf-break Upwelling region and its relationship with Red tide
2.6	Amr	Salama	Department of Physics and Astronomy, University of Bologna, Italy.	Past and future changes in the Benguela upwelling system with global warming
2.7	Claudia G	Simionato	Center for Oceanic and Atmospheric Research and International Research Laboratory French-Argentinean Institute for the Study of Climate and its Impacts (IRL IFAECI/CNRS-IRD-CONICET-UBA), Buenos Aires, Argentina	Development and implementation of an operational ocean sea level and waves forecasting system at the Southwestern Atlantic Continental Shelf
2.8	Anna	Teruzzi	Istituto Nazionale di Oceanografia e di Geofisica Applicata - OGS, Italy	Effectiveness of an operational forecasting system to predict anomalous 2022 water formation and intense bloom event in the southeastern Mediterranean Sea

3 – Coastal Ocean: Modelling, observing system design and product utility				
3.1	Mauro	Cirano	Federal University of Rio de Janeiro (UFRJ/REMO)	Ocean Forecast and Analysis Systems evaluation based on the NOAA AX97 High-Density XBT transect
3.2	Adam	Drozdowski	Fisheries and Oceans Canada	Progress towards operationalization of six port scale models on the east and west coast of Canada
3.3	Flávio	Martins	Centre for Marine and Environmental Research (CIMA), University of Algarve (UAlg)	Coastal Simulation Experiments Supporting NAUTILOS New Observing Methodologies
3.4	Artash	Nath	Founder, Monitor My Ocean	Monitoring Underwater Anthropogenic Noise Levels in Global Oceans: Using COVID-19 Lockdown as Baseline
3.5	Yolanda	Sagarminaga	AZTI	Tracking HABs' origins in the eastern Cantabrian Sea with coastal models and satellite imagery
3.6	Anju	Sathyanarayanan	Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Bremerhaven, Germany	Influence of data assimilation on a biogeochemical ocean model for the North and Baltic Seas
3.7	Jozef	Skakala	Plymouth Marine Laboratory	Introducing ensembles to the biogeochemical component of the operational system for the North-West European Shelf
4 – EuroSea & OceanPredict – support for the UN Ocean Decade				
4.1	Boyko	Doychinov	Balkan and Black Sea Business Institute within Regional Cluster "North-East"	INVOLVEMENT OF SMALL-SCALE FISHERMEN IN THE PROCESS OF MONITORING AND COLLECTING PRIMARY DATA IN THE COASTAL WATERS OF THE BLACK SEA
4.2	Anna	Katavouta	National Oceanography Centre, UK	FLAME: Future Coastal Ocean Climates
4.3	Stavriana	Neokleous	University of the Aegean	Ranking of the coastal areas of Cyprus regarding their vulnerability in pollution episodes using GIS and multiple-criteria analysis.

Full poster abstracts

in order of session

Session 1: OSEs & OSSEs in support of observing system design

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Abstract 1.1: Théo Brivoal, MOI

A new kilometric resolution zoom over the North-East Atlantic based on NEMO 4.2 (IMMERSE) version

Théo Brivoal, Jérome Chanut

Mercator Ocean International

In the context of the IMMERSE project, we present here a new high-resolution configuration over the North-East Atlantic based on the NEMO model in its version 4.2 and AGRIF. The configuration is based on already existing eNEATL36 (extended North – East ATLantic) configuration, which covers the Iberian – Biscay – Ireland area and the western Mediterranean Sea at a 1/36° resolution. It incorporates a kilometric resolution (1/108°) AGRIF zoom that covers the Atlantic and Mediterranean French and Spanish coasts and includes the Gibraltar Strait, Corsica, and Sardinia. Two-way exchanges are enabled between the nest and the parent configuration. First, we will present a validation of the configuration over a 1.5-year target period from January 2017 to June 2018 against satellite data and in-situ observations. Then, we will investigate the impact of the high-resolution nest on the representation of small-scale processes by comparing the simulation with a twin experiment over the same period but without nest.

Abstract 1.2: Matthew Carr, SAEON

Operational ocean modelling within South Africa; a downscaling approach

Carr, M[1], Veitch, J[1], Fearon, G[2] and Russo, C[1]

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[2] *University of Cape Town (UCT), South Africa*

Operational ocean modelling in South Africa is a developing field and currently lacks robust, mature operational systems. However, existing infrastructure and collaboration within the community provides opportunities for rapid development. The Sustainable Ocean Modelling Initiative: a South AfricaN Approach (SOMISANA) looks to use existing infrastructure within the field to develop operational ocean modelling systems within South Africa.

Operational modelling development within SOMISANA focuses on a downscaling approach, using freely available global models to force high-resolution coastal and bay scale configurations. The performance of three global ocean models were assessed within the Southern African region through a combination of remotely sensed and in situ observations. This work was used to identify which global models were suitable inputs for the high-resolution coastal configurations, as the performance of global ocean model was shown to vary locally.

An operation forecast systems has been developed for the Algoa Bay region (~33.9°S, 25.6°E). The model was developed using the Coastal and Regional Ocean Community model (CROCO). The configuration uses a curvilinear grid with a resolution of ~3km at the boundaries to ~500m within the bay. Evaluations within situ observations showed the model accurately represented the temperature and currents within the region. Off-line particle tracking was applied to the model output order to routinely simulate hypothetical oil spills from nearby oil bunkering operations.

A second operational model is currently under development for the southern Cape coast, from Table Bay to Cape Agulhas (~33.3°S, 18.4°E to ~34.8°S, 20.1°E). The configuration was validated against remotely sensed and in situ observations and shown to reproduce coastal sea surface temperature (SST) with more accuracy than the global models and merged satellite products. A key finding from model development was the importance of using a nested configuration to ensure a smooth transition between the coastal and global model. The CROCO configuration uses a parent nest at the same resolution (~9km) as the global models to ensure a smooth transition from the global ocean model.

These operational systems are the first step towards operational ocean modelling within South Africa and represent exciting opportunity for further development.

Abstract 1.3: Gianpiero Cossarini, OGS

Assessing the impact of BGC-Argo data assimilation into the Copernicus operational model system of the Mediterranean Sea biogeochemistry

Gianpiero Cossarini, Carolina Amadio, Anna Teruzzi, Laura Feudale, Giorgio Bolzon, Stefano Salon

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The BGC-Argo network provides an invaluable amount of observations for ocean biogeochemistry allowing analysis-forecast model systems to correct not only surface concentrations of biogeochemical variables but also subsurface features such as depth and magnitude of subsurface chlorophyll maximum, nutricline depth and shape, and oxygen subsurface maximum and minimum zone.

In the present work, results of the Copernicus analysis-forecast biogeochemical system for the Mediterranean Sea (Med-MFC-BGC) are used to investigate the impact of the BGC-Argo framework in this semi-enclosed basin, where the BGC-Argo floats have been proved to be effective in sampling most of its sub-areas.

Diagnostic metrics are computed to evaluate the space-temporal impact on biogeochemical dynamics of the three different assimilated variables: chlorophyll, nitrate and oxygen. Different impacts (i.e., in terms of area, persistency and magnitude of the changes) at surface and subsurface layers in the different seasons are observed for the three assimilated variables, providing insights to optimize the float life cycle that could possibly maximize the benefit of the BGC-Argo framework for operational purpose.

Comparison among the impacts of multi-platform (i.e., satellite ocean color and BGC-Argo) assimilation is also provided, showing how the benefits of multivariate profiles assimilation are directly linked to the sampling frequency and dimension of the BGC-Argo network with respect to the consolidated satellite observation assimilation in the different seasons. Increasing the numbers of profiles for the most expensive sensors (e.g., nitrate) through neural network pseudo-observations would enhance the benefits of BGC-Argo profiles assimilation.

Abstract 1.4: Danni Du, University of Colorado

Assessing the Impact of Ocean In-situ Observations on MJO Propagation across the Maritime Continent in ECMWF Subseasonal Forecasts

Danni Du

University of Colorado, Boulder

When the Madden-Julian Oscillation (MJO) propagates eastward from the Indian Ocean into the western Pacific, it tends to decay and sometimes stall over the Maritime Continent (MC). The MJO events passing the MC (MJO_P) and those stalled have significantly different SST patterns. Oceanic processes can contribute to such SST differences. Therefore, ocean subsurface data assimilation (DA) prior to the hindcast initialization can potentially contribute to better MJO prediction over MC. Two sets of ECMWF ensemble subseasonal hindcasts over two decades are analyzed. The all_obs is initialized from the ocean reanalysis with all subsurface observations assimilated, while the no_insitu is initialized without subsurface DA. We will first present the forecast mean state biases in the SST field and their difference between these two experiments. We will then present results from the MJO analyses. The filtered OLR anomaly field is used to identify the MJO tracks. 79 MJO_P events are identified using NOAA interpolated OLR, among which only 35 and 37 events are successfully predicted by all_obs and no_insitu respectively. We see no significant improvement in MJO forecast skill over the MC in all_obs compared to no_insitu. To explain why ocean DA doesn't lead to better MJO hindcasts, we will show the Moist Static Energy (MSE) budget analysis results, which reveals that a systematic meridional wind bias in the model dominates the underestimation of the MSE accumulation for MJO convection. We will also show the MLD mean biases for two experiments, which suggests that the forecast model loses information gained from DA. These results will guide future development of models in our forecast systems to improve the impact of observations on subseasonal forecasts.

Abstract 1.5: David Ford, Met Office

Assimilating synthetic Biogeochemical-Argo and ocean colour observations into a global ocean model to inform observing system design

David Ford
Met Office, UK

A set of observing system simulation experiments was performed. This assessed the impact on global ocean biogeochemical reanalyses of assimilating chlorophyll from remotely sensed ocean colour and in situ observations of chlorophyll, nitrate, oxygen, and pH from a proposed array of Biogeochemical-Argo (BGC-Argo) floats. Two potential BGC-Argo array distributions were tested: one for which biogeochemical sensors are placed on all current Argo floats and one for which biogeochemical sensors are placed on a quarter of current Argo floats. Assimilating BGC-Argo data greatly improved model results throughout the water column. This included surface partial pressure of carbon dioxide (pCO_2), which is an important output of reanalyses. In terms of surface chlorophyll, assimilating ocean colour effectively constrained the model, with BGC-Argo providing no added benefit at the global scale. The vertical distribution of chlorophyll was improved by assimilating BGC-Argo data. Both BGC-Argo array distributions gave benefits, with greater improvements seen with more observations. From the point of view of ocean reanalysis, it is recommended to proceed with development of BGC-Argo as a priority. The proposed array of 1000 floats will lead to clear improvements in reanalyses, with a larger array likely to bring further benefits. The ocean colour satellite observing system should also be maintained, as ocean colour and BGC-Argo will provide complementary benefits.

Abstract 1.6: Carine G R Costa, MetOcean Solutions

Improving ocean forecasts with subsurface data assimilation in the northeast shelf of New Zealand

Carine G. R. Costa[1], Helen Macdonald[2], Joanne O'Callaghan[2], Joao M. A. C. Souza[1], and Rafael Santana[2]

[1]MetOcean Solutions, part of MetService New Zealand
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An accurate forecast of the coastal ocean in the northeast shelf of New Zealand can assist in preparing for and responding to marine disasters such as oil spills and marine heatwaves. Data assimilation techniques are used in state-of-the-art ocean forecast systems to combine models and observations in real-time, providing a better representation of the ocean state. Our goals are to implement a proof-of-concept forecast system with data assimilation in the northeast shelf of New Zealand, to evaluate model performance and to quantify the impact of adding subsurface data on the modeled ocean currents. Our hypothesis is that substantial gains are obtained by assimilating subsurface high-resolution data from ocean gliders. The model is based on the Regional Ocean Modeling System (ROMS) with an Incremental Strong-Constraint 4-Dimensional Variational scheme. The 2-km model grid was forced with ECMWF and nested into a NZ-wide 3-D ROMS model. The system was designed to assimilate satellite sea surface height (SSH), sea surface temperature (SST), and glider temperature (T) and salinity (S) over a 3-day window, which provide initial conditions to 7-day forecasts. The gliders measurements were collected along the shelf break and continental slope from Paihia to the Coromandel Peninsula during 2022 autumn season. The forecasts were performed for a total of 4 weeks, from late March to late April. Two different experiments were conducted, one with satellite and glider data (E1) and another with satellite only (E2) to account for the impact of assimilating subsurface into the model. Forecast validation against the assimilated data for E1 yield average RMSEs of 0.10 m for SSH, 0.46◦C for SST, 1.23◦C for glider T and 0.17 for glider S. The comparisons against the independent, not assimilated, CORA temperature data provided averaged RMSEs of 1.8◦C (3 Argo profiles) and 0.5◦C (4 surface drifters) through the forecast horizons. The potential improvements of ocean dynamics near the shelf break with real-time glider observations assimilation will be presented.

Abstract 1.7: David Gwyther, University of New South Wales

OSSEs reveal subsurface temperature observations improve estimates of circulation and heat content in a dynamic WBC

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Western boundary currents (WBCs), form the narrow, fast-flowing poleward return flows of the great subtropical ocean gyres and are sources of rapidly varying mesoscale eddies. Accurate simulation of the vertical structure, separation latitude, and ocean heat content of WBCs is important for understanding the poleward transport of heat in the global ocean. However, state estimation and forecasting in WBC regions, such as the East Australian Current (EAC), the WBC of the South Pacific subtropical gyre, is challenging due to their dynamic nature and lack of observations at depth. Here we use Observing System Simulation Experiments to show that subsurface temperature observations in a high eddy kinetic energy region yield large improvement in representation of key EAC circulation features, both downstream and 600 km upstream of the observing location. These subsurface temperature observations (in concert with sea surface temperature and height measurements) are also critical for correctly representing ocean heat content along the length of the EAC. Furthermore, we find that a more poleward separation latitude leads to an EAC and eddy field that is represented with far reduced error, compared to when the EAC separates closer to the equator. Our results demonstrate the importance of subsurface observations for accurate state estimation of the EAC and ocean heat content that can lead to marine heatwaves. These results provide useful suggestions for observing system design under different oceanographic regimes, for example, adaptive sampling to target high energy states with more observations and low energy states with fewer observations.

Abstract 1.8: Hyun-Chul Lee, IMSG

An Evaluation of Impacts from Ocean Observing Systems in NCEP GODAS in the Tropical Ocean

Hyun-Chul Lee* and Daryl Kleist**

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The currently operational Global Ocean Data Assimilation System (GODAS, Behringer, 2007) assimilates observational in situ profile data from EXpendable BathyThermograph (XBT) and Conductivity Temperature Depth (CTD), stationary fixed moorings, autonomous Argo floats, and remotely sensed sea surface temperature. With GODAS, these ocean observing systems are fundamental to NCEP's operational efforts for monitoring the ocean state and also for providing ocean initial states of forecasting multi-week to seasonal variability in the NCEP CFSv2. In order to evaluate the impact of the observation system in the NCEP operational ocean products, a series of observing system experiments (OSE, Lee, et al., 2020) have been carried out, and the observational innovations and the analysis increments associated with individual ocean observations in NCEP's GODAS were calculated. Based on these observational innovations from the OSE runs, Assimilation Impacts of Observing Systems (AIOS) and Forecast Impacts of Observing Systems (FIOS) were evaluated and applied to monitor the spatio-temporal impacts of ocean observing systems in the current operational NCEP GODAS. In this presentation, we show recent results from AIOS and FIOS in the regions of the tropical Ocean.

Abstract 1.9: Elisabeth Remy, MOI

Leveraging the multi-system glider data assimilation experiments within EuroSea to the international level

Victor Turpin[1], Elisabeth Remy[2], Ali Aydogdu[3], Romain Escudier[2], Pierre Testor[4], Brad deYoung[5]

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[5] *Memorial University of Newfoundland, Halifax, Canada*

Ocean gliders offer a unique capacity to monitor the coastal and shelf environment at high resolution from the surface down to depths of 1000 m. They can be deployed and recovered from small vessels on a regular basis or provide targeted observations for a specific purpose.
Within EuroSea, different assimilation experiments are being conducted by Operational Ocean Prediction Centers to assess and improve the assimilation of glider data. The goal of these experiments is two-fold:

- To understand how the assimilation of glider data constrains the ocean circulation,
- To refine assimilation strategy to enhance their value.

The assimilation experiments focus on how gliders can improve the representation of specific processes in coastal and shelf ocean analysis, in the Mediterranean Sea and the North East Atlantic. Their role is complementarity to the inclusion of data from satellite and in situ observing systems currently assimilated in ocean operational system. Besides the quantification of the impact of glider assimilation, we specifically assess their capacity to improve convection events, eddy representation or transport through key sections. An intercomparison between different operational systems is also planned.
Based on the multi system experiment results and in collaboration with the OceanGliders program, we will discuss how international coordination can support the use of gliders globally to monitor and forecast ocean processes and phenomena that are relevant for societal applications. We will provide a vision of the potential benefits of an international strategy on glider data assimilation in areas for which gliders are well suited for conducting long-term observations.
A closer collaboration between OceanGliders and Ocean Prediction Centers should support greater consideration of the observational needs. It will also contribute to the development of best practices for ocean observing using gliders and data quality control, essential for an optimally tuned assimilation system.

Abstract 1.10: Robert Weller, WHOI

Ocean Reference Stations: Long-term, open ocean observations of surface meteorology and air-sea fluxes are an essential component of the observing system

Robert A Weller*[1], Roger Lukas[2], James Potemra[2], Albert. J. Plueddemann[1], Chris Fairall[3], Sebastien Bigorre[1]

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One goal of the ocean observing system is to accurately quantify ocean surface meteorology and the air-sea exchange of heat, freshwater, momentum, and other constituents. However, there are few sustained surface observing sites in the open ocean. As a result, information about the air-sea exchanges of heat, freshwater, and momentum is often drawn from models or derived from combinations of model and remote sensing inputs. It is essential going forward that one element of the ocean observing system should be Ocean Reference Stations, where high quality surface meteorological data are collected in a sustained fashion, withheld from assimilation, and used to compute bulk formulae fluxes. The resulting long time series serve as benchmarks for assessing the observing system's ability to quantify the air-sea fluxes and motivate improvements to models and to hybrid flux products. Means and low-passed air-sea fluxes from three long-term surface moorings are compared to coincident records from three atmospheric reanalyses (ERA5, NCEP2, and MERRA2) and from CMIP6 coupled models. Biases in the reanalyses' means and low-passed wind stresses and net air-sea heat fluxes are significantly larger than the observational uncertainties and vary in time. These reanalyses and most CMIP6 models fail to provide as much heat into the ocean as observed.

Session 2: Extreme marine events – observing, modelling, forecasting and user accessibility

Abstract 2.1: Louise Delhaye, RBINS

Acoustic and optical turbidity response to altering particle size distribution during extreme events

Matthias Baeye, Louise Delhaye, Michael Fettweis

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Benthic lander deployments equipped with optical and acoustic sensors (OBS, ABS) were used to study the sediment processes in the Belgian coastal turbidity maximum zone. By combining all available data sets, it was possible to improve the understanding of the behaviour of cohesive and non-cohesive sediments and their dynamics. It is suggested that cohesive and non-cohesive SPM dynamics may occur simultaneously in the study area under relatively strong hydrodynamic conditions. In the more recent years, the in-situ particle sizer (LISST100X) more often revealed particle size distributions (PSD) that were shifted towards the fine sand range during strong currents. Under these conditions, the OBS did not increase uniformly compared to the increase in ABS backscatterance. These results are compared to independent observations from the LISST100X, revealing a shift in the PSD towards the sand fraction. Optical and acoustic sensors are indeed sensitive to changes in the PSD as widely described in literature. Generally, acoustic backscatterance is more sensitive for larger solid particles than the OBS. Size classes of the LISST100X were checked against OBS turbidity and remarkably, the higher size classes correspond readily to 2-phase response curves. One curve pleads for cohesive sediment dynamics as flocculation will lead to increasing volume concentration of the flocs. On the other hand, the other curve (less steep slope) agrees with the presence of solid grains (fine sands) in suspension. The larger flocs occur during slack water while the solid grains occur during extreme currents. In the more recent years, we cannot exclude that the increase in sand in suspension is correlated with the beach nourishment works.

Abstract 2.2: Matias Dinapoli, CIMA/CONICET-UBA

Improving the short-range forecast of storm surges in the Southern-West Atlantic Continental Shelf using EnSRF data assimilation

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In this study the assimilation of tide gauge and altimetry data into a 2D-barotropic numerical model for the Southern-West Atlantic Continental Shelf (SWACS) was developed. To do this, the preoperative 4-day storm surges ensemble prediction system developed by Dinápoli et al. (2021) was implemented for the SWACS. This new configuration, called "Model for Storm Surge Simulations'' (MSSS), considers a curvilinear grid that covers the SWACS with higher resolution along the shoreline (from 2 km to 10 km). MSSS was forced with the astronomical tide from TPXO9; daily continental discharge observations and the atmospheric variables forecasted by the Global Ensemble Forecast System of the National Centers for Environmental Prediction (GEFS). Tidal gauge and altimetry data were sequentially assimilated every 1 hour using the Ensemble Square Root Filter (EnSRF).

Results showed that EnSRF's innovations produce a positive impact upon the forecast skill up to 1.5 days, hence the 4-day forecast can be divided into two parts: the first 2 days with a stronger dependence on the initial conditions and the other 2 days purely driven by the external forcing. In addition, it was found that an assimilation window of 6 h was long enough to produce a proper model initial condition. Under this configuration, EnSRF removed biases and improved the timing of the MSSS forecasted solutions. Larger improvements were observed at the northern SWACS where non-deterministic processes, such as the atmospheric circulation, explain a large part of the sea surface height variability. There, data assimilation reduced the forecast errors up to 5%. At the southern SWACS no larger improvements were found because of the strong and deterministic tidal dynamic. Our results proved that the incorporation of EnSRF into MSSS can significantly improve the forecast of sea surface height in the SWACS and, evenmore, the accuracy of the short-range (~6 h) detection of storm surges.

Abstract 2.3: Chaimaa jamal, , SOCIB

Spatial and temporal variability of the coastal upwelling activity of the Moroccan Atlantic coast, 1994- 2020

Chaimaa JAMAL[1-2*], Ahmed MAKAOUI[2], Melissa CHIERICI[3], Aziz AGOUZOUK[2], Mohammed IDRISSI[2], Fatima Zohra BOUTHIR[2], Omar ETTAHIRI[2] and Mouna Latifa BOUAMRANI[1]

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The pelagic ecosystem of the Moroccan Atlantic coast is among the most productive ecosystems in the world. It is characterized by the presence of four upwelling areas whose activity is seasonal in the northern part and permanent in the southern part. This work examines the climatological variability of the upwelling phenomenon through the study of the variation of physico-chemical parameters from the CTD collected in situ at two areas located respectively in the north (Cap Cantin (32°30'N)) and in the south (Cap Boujdor (25°30'N)) of the Moroccan Atlantic coast over a period of 26 years (1994-2020). During this work, we used vertical distributions of temperature, salinity, oxygen and phosphate to a depth of 500 meters to detect mean upwelling activity during the four seasons. The results obtained confirm the seasonality of the upwelling activity in the Moroccan Atlantic coast. Indeed, in Cape Cantin area, the evolution of physical and chemical parameters such as temperature, salinity, dissolved oxygen and phosphates revealed a seasonal variability of the upwelling activity. The peak of activity of the resurgences is detected in summer season accompanied by a relaxation in autumn. In Cape Boujdour area, a strong upwelling activity was observed in summer, spring and winter seasons. While in autumn, the activity was very low and drifts south of Dakhla. Thus, this variability will have an important impact on the evolution of the biogeochemical cycle of carbon in these areas, which could lead to monitor the impact of climate change on the pelagic ecosystem of our Moroccan Atlantic coast.

Keywords: Upwelling, Ocean Acidification, Physical and Chemical Parameters, Moroccan Atlantic coast

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Abstract 2.4: Diego Pereiro, MI

An observing and modelling system to monitor and forecast extreme marine events

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Climate change is affecting the ocean with increased warming, acidification and deoxygenation observed around the world ocean. The changing environmental conditions endanger natural habitats and aquaculture activities. The recent deployment of a monitoring station at the Deenish Island (Southwest of Ireland) salmon farm, together with the availability of remote-sensing SST and hydrodynamic and biogeochemical models, makes it possible to provide stakeholders with up-to-date observations and forecasts of the marine conditions and harmful events at the farm. Here, a web service delivering such information is presented. Even though the service is still under development, it will provide an open-access portal to the latest buoy recordings of temperature, pH and dissolved oxygen concentration, remote-sensing SST, and hindcasts and forecasts from the Met Office's Northwest Shelf Analysis and Forecast system. In addition, information on the occurrence of marine heat waves and low-oxygen events will be also displayed. Finally, using remote-sensing and modelling, similar information will be delivered for a wider area covering from 50ºN, 12ºW to 53ºN 8ºW. This service is aimed at informing the aquaculture sector in the region and stakeholder feedback will be of paramount importance for future improvements

Abstract 2.5: Oscar Reyes-Mendoza, CONACyT-ECOSUR

Marine Heatwaves and Marine Cold-spells on the Yucatan Shelf-break Upwelling region and its relationship with Red tide

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Since the historic marine temperature has been changing and consequently the ecological processes, this work studies the presence and magnitude of anomalous events at the sea surface temperature (SST) from a climate change perspective in a Non-eastern upwelling system. Concepts and metrics for Marine Heatwaves (MHW) and Marine Cold–Spell (MCS) were applied over the marine region of the Yucatan continental shelf and Yucatan Channel. To calculate the MHW/MCS and climatology between 1982 to 2019, a remote historic dataset of SST was used. Furthermore, a frequency-domain cross-correlation analysis between SST and Chlorophyll-a was conducted to analyze a temporal relationship among those anomalies and the Red tide that struck the coastal region, in the year 2011. Results indicate that MHW/MCS have varied spatially and temporarily over the marine region of the Yucatan shelf, and have become more frequent and longer in the last twenty-years, tending to keep increasing in some subregions. MCS events are of equal or greater significance than MHW, mainly in the inner–shelf subregion, where more than 110 days of MCS were recorded in 2011. The extreme biological event reported that year could be explained by MCS. The results will be head to local government as scientific information to promote mitigation action in co-creation.

Abstract 2.6: Amr Salama, UniBo

Past and future changes in the Benguela upwelling system with global warming

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The Benguela upwelling system (BUS) is one of the most productive marine systems in the world. It is about 50 times more productive per unit area than the global ocean average. Equatorward alongshore winds with the Coriolis effect, advect Benguela coastal water offshore, resulting in raising the deep cold nutrients-rich water to the photic layer and enhancing productivity. It is anticipated that as global warming proceeds, upwelling favorable winds further intensify, leading to an increase in the upwelling intensity and duration. Furthermore, enhanced upper-ocean stratification and reduced ventilation are expected because of sea surface warming. Such alterations could have drastic impacts on the biogeochemistry of the BUS and may cause negative events including deoxygenation, acidification, and changes in phytoplankton biomass. Thus, investigating the past and future response of the BUS to global warming is crucially important. To address this issue, a coupled 3D physical-biogeochemical model was implemented based on NEMO (Nucleus for European Modelling of the Ocean) and BFM (Biogeochemical flux model). The novelty in this work is that the coupled model was constructed via an online nesting approach to maintain a high resolution and to provide better boundary conditions for the BUS domain. A two-way online nesting was applied, where the nesting grid (parent) covers the global ocean with a horizontal resolution of 1/4°, while the nested grid (child) for the Benguela domain has a resolution of 1/16°, and both grids have 75 vertical layers. The coupled model is run over a hindcast simulation encompassing the period from 1980 to 2020, and a projection simulation from 2020 until 2050 under one of the representative concentration pathways (RCP's). The model's bottom topography was collected from GEBCO, while the atmospheric forcing was retrieved from ERA5, and because of the significance of river freshwater input in such simulation, the coupled model was forced with runoff data from the Global Flood Awareness System (GLOFAS). Regarding the BFM model configuration, it considers multi plankton functional groups, nutrients forms, and O2 dependent processes. Finally, the model is validated using in situ and satellite observational data for sea surface temperature, salinity, chlorophyll-a, oxygen, and dissolved inorganic nutrients.

Abstract 2.7: Claudia G Simionato, CIMA/CONICET-UBA

Development and implementation of an operational ocean sea level and waves forecasting system at the Southwestern Atlantic Continental Shelf

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The authors are principal investigators of a project which proposes to form an institutional network of science, technology and innovation organizations that will develop, implement and give support and continuity to a state-of-the-art sea level and waves forecasting system. in coproduction with the National Meteorological Service (SMN). About 30 researchers and technicians from the involved institutions participate in the project.

The initiative, funded by the Inter-Ministerial Pampa Azul Initiative of Argentina, will develop operational applications for the forecast and hindcasting of sea level and nested currents at intermediate resolution (average 4 km) throughout the entire South Western Atlantic (Argentinean) Continental Shelf (SWACA), at high resolution (1 km) in regions with depths less than 50 m along the entire coastline and very high resolution (100 m) in some high-impact regions. A similar scheme will be adopted for wave forecasting and hindcasting, starting from a global application with 1° resolution up to very high-resolution applications (1 km and less) for the shallow areas of the SWACA. These systems will be transferred and run operationally in the National Meteorological Service (SMN) and the results will be made available by the SMN and the Hydrographic Service. A web portal will be developed to provide free and open access to the information produced (forecasts and hindcasts/reanalysis) to the society (including both the public and private sectors); we foresee that it will facilitate a better management and exploitation of marine resources, as well as the monitoring of climate variability. The project will also focus on promoting state-of-the-art scientific developments in relation to operational modelling of the ocean and training of human resources, in order to increase the bases of knowledge and technology, scientific production and critical mass that Argentina has for face challenges of this nature and to give continuity to the efforts made during the project.

Finally, the project will seek to work with the multiplicity of potential users to motivate the use of the new tools and induce/co-produce with them an analysis and survey of the needs of Argentina in relation to the operational modelling of the ocean. In the future, the number of variable and nested operational applications and products available may be enhanced in partnership with local institutions and companies. Some of the possible applications to be developed are, for example,

search and rescue, dispersion of pollutants, support for energy production, design and maintenance of structures, etc.

Keywords: forecast, hindcast, reanalysis, services.

Abstract 2.8: Anna Teruzzi, OGS

Effectiveness of an operational forecasting system to predict anomalous 2022 water formation and intense bloom event in the southeastern Mediterranean Sea

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Biogeochemical seasonal cycle in the Mediterranean Sea is characterized by late-winter earlyspring phytoplankton blooms driven by vertical mixing events that bring nutrients to surface layers. Relatively intense bloom events are usually observed in areas where mixing is strong and persistent enough to significantly impact concentration of nutrients in surface layers. The MedMFC production center of the Copernicus Marine Service operationally provides analysis and forecasts of the Mediterranean Sea, and demonstrated its capability to correctly simulate physical conditions and typical seasonal cycle and bloom events. A markedly intense bloom was forecasted in spring 2022 by the Med-MFC system in the southeastern basin (in the Cretan area), in particular chlorophyll was 50% higher than usual, and patches of high chlorophyll concentration lasted for 3/4 weeks. Comparison with satellite observations confirmed the notable event and its anomaly with respect to past bloom events in the area. In this work, we investigate the processes occurring in the area in spring 2022 using physical and biogeochemical Med-MFC products as well as available observations. Results show that the spring 2022 event is particularly strong with respect to climatology of the area, and provide indications on the relationship between the bloom and the forcing physical processes, e.g., water mass formation and mixing. The spring 2022 example demonstrates how physical-biogeochemical ocean forecast systems can be a valid tool to monitor anomalous ocean health conditions and extreme marine events in a real time framework.

Session 3: Coastal Ocean: Modelling, observing system design and product utility

Abstract 3.1: Mauro Cirano, UFRJ/REMO

Ocean Forecast and Analysis Systems evaluation based on the NOAA AX97 High-Density XBT transect

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The Western Boundary Currents (WBC) can be described as intense, narrow, and well-defined currents that flow along the continental margins. Found in all major oceanic gyres they are especially important for the oceanic transport of volume and heat; they also have a strong influence on regional climate. The Brazil Current (BC) is characterized as a superficial, warm, and saline flow, which extends to approximately 500 m depth, being the WBC that closes the South Atlantic Subtropical Gyre. The BC is particularly important for transporting heat, mass, and nutrients to high latitude regions along the South American continental margin. The longest sustained monitoring system of the BC active today is the NOAA-AX97 High Density XBT transect, characterized by an average bimonthly sampling at the 22ºS since 2004. Strong interaction of the flow with bathymetric features, coastal upwelling, eddy variability and recirculation gyres are some of the important features that influence the BC at this latitude. To estimate geostrophic velocities along the NOAA-AX97 XBT transect, the salinity is estimated using historical T-S relationships for the region. In addition, the absolute dynamic height is calculated by imposing the Argo-based monthly climatology value of absolute dynamic topography at the reference depth (z = 500 m), which is approximately the interface between the Central and Intermediate waters. Finally, the absolute geostrophic velocities are calculated using the thermal wind relation. This methodology has been validated with satellite altimeter data. Ocean Forecasting and Analysis Systems (OFAS) are increasingly being used for ocean and weather forecasts along the Brazilian continental margin. In this work, over 70 NOAA-AX97 XBT transects are evaluated against nine OFAS reanalysis datasets: i) the HYCOM/NCODA GOFS3.1; ii) the Mercator GLORYS12V1; iii) the CSIRO BRAN2020 iv) the Mercator GLORYS2v4; v) the ECMWF ORAS5; vi) the CMCC C-GLORSv5; vii) the AOSC/U. Maryland SODA3; viii) the JPL/Nasa ECCO2 and ix) the UK Met Office GloSea5. The main goal of this work is to assess the structure, location, and variability of the BC in both eddy permitting and eddy resolving OFAS. This study is part of a long-term strategy to improve the knowledge about the dynamics and impacts of the oceans along the Brazilian continental margin. Furthermore, these analyses are useful for inferring structural inconsistencies in models, as well as pointing out recommendations for improving observational sampling.

Abstract 3.2: Adam Drozdowski, DFO

Progress towards operationalization of six port scale models on the east and west coast of Canada

A Drozdowski, M. Dunphy, S. Taylor, M. Krassovski, H. Blanken, S. St-Onge Drouin, R. Horwitz

Fisheries and Oceans Canada

The oceanography sub-initiative of Canada's Ocean Protection Plan (OPP) aims to develop high-resolution operational port-scale hydrodynamic models, to enhance safe navigation and response to events such as oil spills. Six priority ports have been selected for this purpose and are being developed and validated towards fully operational status which would provide clients with 48-hour forecasts every six hours. The port models are forced by the Coastal Ice-Ocean Prediction System (CIOPS) and the High-Resolution Deterministic Prediction System (HRDPS). Both are operational products available from Environment and Climate Change Canada (ECCC). An overview of the six port models will be provided with a summary of the preliminary validation and progress towards operationalization.

Abstract 3.3: Flavio Martins, University of Algarve

Coastal Simulation Experiments Supporting NAUTILOS New Observing Methodologies

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Coastal water systems tend to have strong hydrodynamic variability and require intensive observation efforts in time and space. Such observations are mandatory to assess physical, chemical, and biological processes that are very patchy by nature in coastal systems (e.g., mesoscale features), and highly variable in time due to the fluctuations of environmental forcings. The next step in the evolution of marine monitoring systems will be the widespread adoption of autonomous in situ sensing. New technological solutions are being developed to lower the costs of acquiring, deploying, and maintaining coastal monitoring and observing stations.

NAUTILOS is an H2020 project with the objective of filling marine observation and modelling gaps for chemical, biological and deep ocean physics variables through the development of a new generation of cost-effective sensors and samplers, the integration of the aforementioned technologies within observing platforms, and their deployment in large-scale demonstrations in European seas. The ultimate goal is to make monitoring capacities of the marine environment widely available to both traditional and non-traditional data users.

A central activity of this project is to evaluate the effectiveness of these newly available low-cost technologies on the capacity of coastal numerical forecasting of physical, chemical, and biological variables. To answer this question, a set of Observing System Simulation Experiments (OSSE) is being prepared in three different European coastal areas with distinct meteoceanographic conditions: i) Mediterranean Sea, ii) SW Iberian Coast, iii) Hardangerfjord, Norway. Physical, biogeochemical and plastic drifting models are being combined and applied in these sites. The final objective is to assess how the availability of low-cost sensors and platforms will affect, and hopefully improve, the forecasting capabilities of coastal water models.

In this poster, the overarching structure of the planned OSSE is presented, as well as its integration in the overall NAUTILOS project. Preliminary results for the three sites are shown and discussed, while the strategy for OSSE implementation is examined. In Figure 1 the general methodology for OSSE implementation is depicted. The “pre-Nautilos” and “post-Nautilos” simulation experiments will be compared against Nature Run (NR) to assess improvements. a Free Run (FR) is used as control.

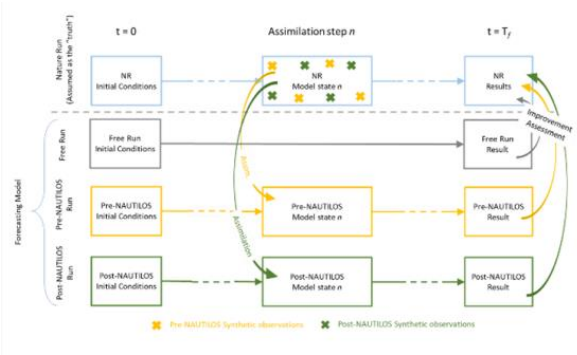

Figure 1: General OSSE methodology for the NAUTILOS Project..

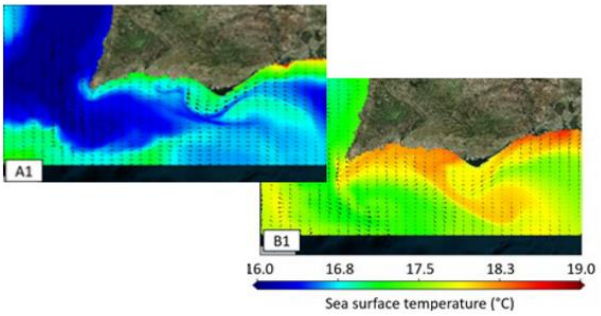

Figure 2: SW Iberian NR SST fields in an upwelling (A1) and Countercurrent (B1) situations

In SW Iberia the MOHID modelling system is used in Its SOMA operational configuration, downscaling CMEMS-MERCATOR (GLOBAL_ANALYSIS_FORECAST_PHY_001_024) solution after analysis [1]. In Figure 2 the SW Iberian NR SST fields in two different situations are shown. A EnKF method will be used. Ensemble members will be created by time-shifting forcings over a correlated time window. In the Mediterranean Sea the HCMR POSEIDON operational system based on the POM model is being tested with an hybrid ensemble data assimilation scheme [2]. In Figure 3, comparisons of seasonal winter climatology for the Mediterranean Sea during the years 2010-2014 are shown. Sea surface height (SSH) and sea surface temperature (SST) comparisons were performed for the four seasons, showing an increase of correlation and a decrease of RMSD of the NR when compared to the FR in the Taylor Diagram (not shown).

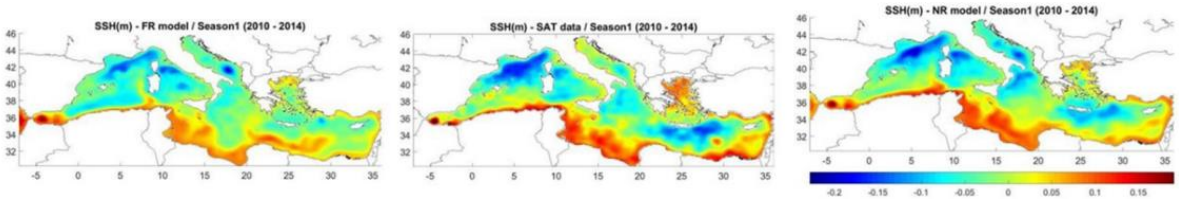

Figure 3: Comparison of the seasonal winter climatology of sea surface height (SSH) for the years 2010-2014 as derived by the FR (left) and the NR (right) against AVISO+ altimetry data (middle).

In the Hardanger Fjord System (Norway) NIVA's ROHO160 operational model, based on the ROMS model, coupled with the ERSEM Biogeochemical model is used, downscaling CMEM's GLORYS12V1 solution [3]. In Figure 4, two snapshots of the one-year NR biogeochemical simulation are presented. The high nitrate loads from land origin are evident in the right frame, impacting the coastal zone, in opposition to the low load situation in the left frame.

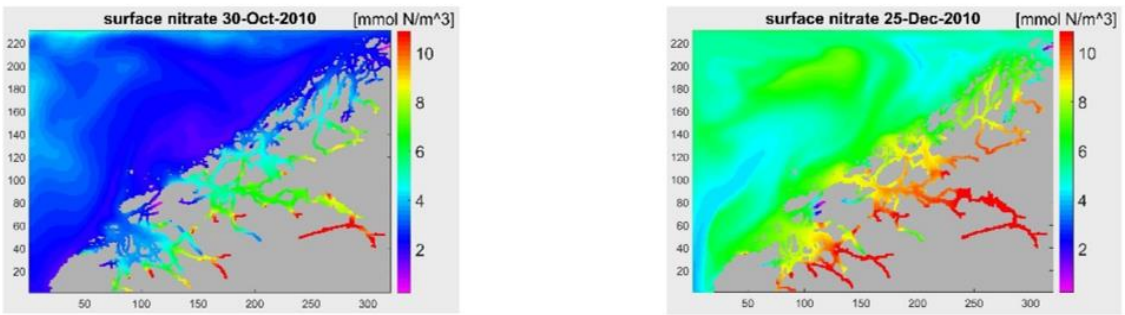

Figure 4: Snapshots of the ROMS-ERSEM biogeochemical NR's one year simulation. Low (left) and high (right) land source nitrate loads

As a conclusion, this poster presents a first step of the simulation activities being undertaken within the NAUTILOS project. The final results will show the improvements obtained in ocean prediction by using the new observation platforms and novel low-cost sensors developed in the project.

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Abstract 3.4: Artash Nath, Monitor My Ocean

Monitoring Underwater Anthropogenic Noise Levels in Global Oceans: Using COVID-19 Lockdown as Baseline

Artash Nath

Founder, MonitorMyOcean.com

Yearly increases in global trade, 80% of which occurs via the sea routes mean underwater noise levels are rising in oceans globally. Low-frequency noise from marine shipping is an underwater acoustic pollutant. The noise spectrum overlaps with frequencies marine mammals use to communicate and navigate, leading to stress and increasing collision with ships. The research established a model to measure the contribution of anthropogenic activities to underwater noise levels.

The COVID-19 lockdown led to a decline in marine traffic globally. The model quantified the reductions in noise levels before and during the lockdown in the Arctic, Atlantic, Pacific Oceans, and the Mediterranean Sea. Underwater ocean sound peaks between 10 – 100Hz and is dominated by noise from shipping traffic. Twenty years of cumulative hydrophones (underwater microphones) data from seven ocean observatories were analyzed at 1Hz spectral and 1 min temporal resolution. Power spectral densities were calculated, aggregated into monthly long-term spectral averages, and noise levels in the 63Hz third-octave band compared to previous years.

The study found that global oceans quietened by an average of 4.5dB, or the peak sound intensity decreased 2.8 times during the lockdown period. The maximum decrease was at locations close to major shipping channels and cruise tourism destinations. The findings were validated by comparing shipping traffic using the satellite-based Automated Identification System. The study proved that strategic “anthropauses” such as shifting of shipping lanes or moratoria in deep-sea mining can be an effective strategy to reduce underwater noise levels and give marine mammals a chance to reverse the decline in their population.

An open-source web application MonitorMyOcean.com was created to provide updated anthropogenic noise levels in global oceans up to 1kHz third-octave band. Policymakers can determine if measures such as shifting shipping channels or moratorium on new shipping routes are leading to “Quieter Oceans.”

Abstract 3.5: Yolanda Sagarminaga, AZTI

Tracking HABs' origins in the eastern Cantabrian Sea with coastal models and satellite imagery

Y. Sagarminaga[1], L. Ferrer[1], M. Revilla[1], O. Solaun[1], I. Zorita[1], A. Fontán[1], M. González[1], J.G. Rodriguez[1], A. Laza-Martínez[2]

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In 2016, the Basque Government legally declared the Ondarroa-Lekeitio coastal section as a "Bivalve Mollusc Production Area" (BMPA), where production of mussels (Mytilus galloprovincialis) is taking place on offshore longlines. An integrated marine observing system (IMOS) was established in 2019 to monitor the presence of biotoxins and study its possible relation with the environmental conditions during the toxic episodes. This system includes, besides the shellfish biotoxin analysis, phytoplankton identification in water samples, in-situ hydrographic measurements with CTD and a continuous in-situ fluorescence sensor, a 3D coastal model (CROCO) and a Lagrangian particle tracking model (SOFT), high and mid resolution satellite imagery (MODIS-AQUA, MODIS-TERRA, VIIRS, Sentinel-2 and Sentinel-3), and ancillary meteorological (wind, precipitation, and irradiance) and river input observations (flow and nutrients) from close meteorological and hydrographic stations. From January 2019 to December 2021, the concentration of biotoxins in mussels has exceeded the regulatory limits several times, mostly due to the okadaic acid, a "Diarrheic Shellfish Poisoning" toxin produced by the dinoflagellate Dinophysis acuminata in this area. Also, yessotoxins and "Paralytic Shellfish Poisoning" toxins produced by other dinoflagellates have caused the banning of the production in some occasions. However, the "Amnesic Shellfish Poisoning" toxin, which is produced by some Pseudo-nitzschia species, has been seldom detected. In this presentation we will show how the simulations of the coastal models, complemented with satellite images and in-situ observations during some toxic episodes, have been used to identify their most probable origins in the surrounding area. The simulated surface water circulation patterns have been locally validated with the release of a large number of Identified Floating Objects (IFOs) to study and reproduce surface water circulation patterns.

Abstract 3.6 Anju Sathyanarayanan, AWI

Influence of data assimilation on a biogeochemical ocean model for the North and Baltic Seas

Anju Sathyanarayanan[1], Xin Li[2], Eefke van der Lee[2], Alexandra Marki[2], Ina Lorkowski[2], Lars Nerger[1]

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The forecasting of physical and biogeochemical variables has always proven to be a challenge in marginal and coastal seas. In the last decades we have seen an increase in the occurrence of harmful algal blooms and oxygen depletion zones in the North and Baltic Seas which affects marine life and local economy. Hence it is important to predict their occurrences to take effective measures that ensure a healthy interaction between marine and terrestrial ecosystems. Over the years, data assimilation has played a significant role in improving model accuracy for operational forecasting. In this study, we assess the impact of assimilating in-situ variables such as temperature and salinity along with satellite temperature and chlorophyll data in an operational forecast model with the aim to improve the forecast of ocean variables in the North and Baltic Seas. For this purpose, we use the data assimilation software PDAF coupled to the biogeochemical ocean model HBM-ERGOM, which is used operationally at the BSH, and perform data assimilation using an ensemble Kalman filter. We conduct data assimilation experiments for a one-year period from October 2018 to September 2019. The study will discuss and quantify the effects of the data assimilation on the oceanographic and biogeochemical variables in the model and on the coupled interaction of ocean physics and biogeochemistry.

Abstract 3.7: Jozef Skalala, PML

Introducing ensembles to the biogeochemical component of the operational system for the North-West European Shelf

Jozef Skalala

PML

We present recent work where we introduced perturbations into the most sensitive parameters of the biogeochemical model ERSEM. The ERSEM parameters were selected based on a sensitivity/observability analysis using an O (10^4) ensemble of 1D simulations. The parameter perturbations were incorporated into a 30 member ensemble of the physical-biogeochemical model (NEMO-FABM-ERSEM) running for the North-West European Shelf (NWES). The ensemble was used to perform hybrid assimilation of ocean color derived total chlorophyll. The hybrid DA was validated and its performance was compared with the ensemble of 3DVars. These new developments have the potential to better represent the background covariance matrix and in the future they can substantially improve the monitoring and forecasting capability of the operational system for marine biogeochemistry on the NWES.

Session 4: EuroSea & OceanPredict – support for the UN Ocean Decade

Abstract 4.1: Boyko Doychinov, Balkan and Black Sea Business Institute

Involvement of small-scale fishermen in the process of monitoring and collecting primary data in the coastal waters of the Black Sea

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Observing and studying the seas and oceans provides prediction of trends and changes. Stakeholders benefiting from systematic observations include various members of the Blue Network whose work and life are related to the ocean.

The inclusion of new entrants in the network for monitoring and collecting primary data can significantly improve the modeling and prediction process. The participation of people involved in various maritime professions can contribute to expanding the possibilities for predicting the oceans.

For the last 10 years, Balkan and Black Sea Business Institute within Regional Cluster "North-East" has been actively working to involve small-scale fishermen in the process of monitoring and collecting primary data in the Black Sea coastal waters. Given the frequency of boats going to sea / 2-3 times a day / the collection of samples of sea water and data on air and water temperature, water quality, wind, as well as samples of different marine flora and fauna allows to improve the monitoring and modeling of the processes in the respective region.

The first project of Balkan and Black Sea Business Institute in Byala, Varna Destrict has been operating successfully since 2016. In 2014-2015, a project proposal was developed for the construction of a market facility for fish storage and first point of sale in Byala, which received funding under the Operational Program for Development of the Fisheries Sector. The second phase took place in 2015-2016 and included training and equipping small-scale fishermen in the process of monitoring and collecting primary data in coastal waters.

In 2019, our second project started, which is being implemented at the Fisheries Port "Quarantine" in Varna, Bulgaria. Unfortunately, due to the Covid-19 Pandemic, the project has been delayed, but the final phase of training fishermen is under way and will finish next month.

In the summer of 2022, a new project is expected to be launched in Tutrakan, Bulgaria, on the Danube River.

The planned next stages include the expansion of the network of fishing centers on the Southern Black Sea coast of Bulgaria, as well as the inclusion of partners from other countries in the Black Sea basin.

Abstract 4.2: Anna Katavouta, NOC

FLAME: Future Coastal Ocean Climates

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Whilst climate change is increasingly better understood and modelled on global scales, marine climate impacts are most acutely felt on smaller scales along the coast and across shallow coastal seas – the Global Coastal Ocean (GCO), where human populations are reliant upon coastal ocean resources and services and where they are vulnerable to coastal hazards.

FLAME – Future Coastal Ocean Climates, has been submitted for endorsement as a core project under the UND CoastPredict Programme (coastpredict.org). Its overarching aim is to improve our understanding and projections of the GCOs response to future climate on decadal to centennial time scales, the impact that this will have on coastal ecosystems, services and coastal populations and to provide a range of regionally to locally relevant downscaling, predictive and hazard assessment tools that are easily and freely accessible to all. Here we will present the suites of key activities that FLAME partners will target, working across a range of polar, subpolar, subtropical, tropical coastal ocean regions. We welcome new collaborators from all institutes and initiatives to help strengthen delivery of our objectives and widen the number of regional case studies already planned.

Ultimately, we seek to engage a wide community of coastal ocean modellers and analysts, with the ambitious aim of working towards a Global Coastal Ocean Model Intercomparison Programme (in the regional climate downscaling sense) able to provide high resolution, high process-fidelity, downscaled Global Coastal Ocean assessments to intergovernmental panels, regional and nationally focused climate impact exercises.

Abstract 4.3: Stavriana Neokleous, University of the Aegean

Ranking of the coastal areas of Cyprus regarding their vulnerability in pollution episodes using GIS and multiple-criteria analysis

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The coastal zone is considered one of the most diverse and sensitive ecosystems worldwide where a variety of human activities and facilities are met. However, this unique ecosystem is severely influenced by human overexploitation. Therefore, the impact assessment of human activities on the quality of the coastal environment is necessary in order to establish a strategic coordination framework for decision-making regarding the sustainable use of coastal areas. The aim of this paper is to evaluate and rank the coastal areas of Cyprus in terms of their vulnerability to possible pollution incidents using an integration of Geographical Information Systems (GIS) and multiple-criteria analysis. The methodology includes data collection, design of a geodatabase where the relevant datasets are appropriately stored, data processing using spatial analysis methods in the framework of a GIS, zoning of the Cypriot coastline, application of multiple-criteria analysis based on appropriate evaluation criteria relevant of the characteristics of the coastal zone of Cyprus and finally, sensitivity analysis. The Regime multiple-criteria analysis was applied twice. In the first, highest priority was assigned to the criteria representing the environmental impact of a pollution incident; the results showed that Zone 2 (Akamas and Pegeia Peninsula) is ranked first, Pafos (Zone 3) in the 2nd place and Larnaca (Zone 7) in the 3rd place. During the second application of the method, highest priority was assigned to the criteria representing the economic impact of a pollution incident; Pafos (Zone 3) was ranked first, followed by Zone 6 that pertains to Larnaca district and Zone 2 in the 3rd place. The proposed methodology could be widely applicable in other coastal areas and could be used as a tool in the decision-making process to support the establishment of a management plan focusing on the prevention of pollution in coastal zones with an emphasis on the most vulnerable ones.