

## Joint ECMWF/OceanPredict workshop on Advances in Ocean Data Assimilation



Contribution ID: 34

Type: **Poster presentation**

### Evaluation of the new Black Sea Reanalysis system

Ocean reanalyses are becoming increasingly important to reconstruct and provide an overview of the ocean state from the past to the present-day. In the scope of the Copernicus Marine Environment Monitoring Service (CMEMS), a new Black Sea (BS) reanalysis, BS-REA (BSE3R1 system), has been produced by using an advanced variational data assimilation method to combine the best available observations with a state-of-the-art ocean general circulation model between 1993-2019. The hydrodynamical model is based on Nucleus for European Modeling of the Ocean (NEMO, v3.6), implemented for the BS domain with horizontal resolution of  $1/27^\circ \times 1/36^\circ$ , and 31 unevenly distributed vertical levels. NEMO is forced by atmospheric surface fluxes computed via bulk formulation and forced by ECMWF ERA5 atmospheric reanalysis product. At the surface, the model temperature is relaxed to daily objective analysis fields of sea surface temperature from CMEMS SST TAC. The exchange with Mediterranean Sea is simulated through relaxation of the temperature and salinity near Bosphorus toward a monthly climatology computed from a high-resolution multi-year simulation, and the barotropic Bosphorus Strait transport is corrected to balance the variations of the freshwater flux and the sea surface height measured by multi-satellite altimetry observations. A 3D-Var ocean data assimilation scheme (OceanVar) is used to assimilate sea level anomaly along-track observations from CMEMS SL TAC and available in situ vertical profiles of temperature and salinity from both SeaDataNet and CMEMS INS TAC products. Background-error covariances are decomposed in vertical covariances and horizontal correlations. The former is modelled through 15-mode multi-variate Empirical Orthogonal Functions. Horizontal correlations are modelled through a first-order recursive filter. Comparisons against the previous Black Sea reanalysis (BSE2R2 system) show important improvements for temperature and salinity, such that errors have significantly decreased (about 50%). Temperature fields present a continuous warming in the layer between 25-150 m, within which there is the presence of the Black Sea Cold Intermediate Layer (CIL). SST exhibits a positive bias and relatively higher root mean square error (RMSE) values are present in the summer season. Spatial maps of sea level anomaly reveal the largest RMSE close to the shelf areas, which are related to the mesoscale activity along the Rim current. The BSE3R1 system has produced very accurate estimates which makes it very suitable for assessing more realistic climate trends and indicators for important ocean properties.

#### Which theme does your abstract refer to?

Ocean and coupled reanalysis

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**Session Classification:** Poster session 2

**Track Classification:** Ocean and coupled reanalysis