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Pre-operational high-resolution ocean models of the Lakshadweep Sea (Indian Ocean)

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According to Food and Agriculture Organization (FAO), the fisheries sector is a major contributor to coastal economy, ensuring nutritional security and generating employment opportunities is the central Indian Ocean covering Lakshadweep (India), Maldives and Sri Lanka. Harvesting of fish in this region happens mainly in coastal waters up to 100m depth. The fishing pressure on the stock in these waters has increased? Considerably and the deep-sea fishery has become an area for expansion in developed countries (FAO). However, fisheries in high seas pose scientific and technical challenges. High value fish are strongly influenced by the physical environment such as temperature, currents etc. Being able to predict this environment with high degree of accuracy is an invaluable tool for assisting on this expansion.

In order to help forecast the physical environment in the Lakshadweep Sea at medium to high resolutions we have developed two pre-operational data assimilating models at 1/20 (called LD20) and 1/60 (LD60) degrees of resolution based on with NEMO v3.6 as an engine. Both models have 50 geopotential computational levels with full steps in the vertical, they use Smagorinsky scheme for horizontal diffusion, bi-Laplacian viscosity for momentum, and k −epsilon turbulence scheme. The models use time-splitting algorithm with the ratio of baroclinic to barotropic time steps equal to 20. The Galperin parametrization is used to preserve the stratification. The models take initial and boundary conditions as well as data for assimilation from a global model at 1/12 degree resolution available from EU Copernicus Marine Service (CMEMS). The bathymetry is taken from GEBCO_2021. Meteorological forcing comes from the Met Office global model (NWPn768 and NWPn1280), and the tides are forced using OTIS tidal scheme (https://www.tpxo.net/otis). Both models run within Rose/Cylc software environment (https://metomi.github.io/rose/2019.01.2/html/index.html), a toolkit for orchestrating the running models that automatically executes tasks according to their schedules and dependencies.

The LD20 and LD60 models use a novel model-to-model data assimilation scheme (Shapiro and Ondina, 2021) by which the observations are assimilated indirectly, via a data assimilating parent model (CMEMS for LD20 and LD20 for LD60). The models have been run for 5 years from 01.01.2015. As expected, the models reveal more granularity of temperature, salinity and currents, particularly in the coastal areas. The model skill was assessed against The Operational Sea Surface

Temperature and Ice Analysis (OSTIA) system. The results show improvement of the bias and Root-mean-square-error in the higher-resolution models compared to the lower-resolution ones. The model outputs can be helpful in the identification of small-scale ocean fronts which are linked to Potential Fishing Zones (Solanki et al, 2005)

References

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