SURF: A Relocatable Platform for On-Demand High-Resolution Ocean Modelling for the Digital Twins.

In today's world, the accessibility of operational large-scale, regional ocean models from the Copernicus Marine Environment Monitoring Service (CMEMS), combined with the availability of advanced computing infrastructures such as cloud computing and high-performance computing, is making the creation of high-resolution on-demand digital representation of the ocean a reality. There is a growing international interest in the implementation of limited-area, shelf-coastal, high-resolution numerical models to deepen our understanding of the marine system and its sensitivities in a changing climate. High-resolution models are essential for simulating processes at spatial and temporal scales that are too small to be accurately resolved by global and regional coarse-resolution models. The Structured and Unstructured grid Relocatable Ocean platform for Forecasting (SURF) is an innovative open-source model-building tool designed to facilitate the deployment of nested high-resolution numerical models in any region of a large-scale ocean forecasting system. SURF is based on two hydrodynamic cores with different spatial discretization methods: the NEMO model (finite difference method on a structured mesh) tailored for open ocean and shelf applications, and the SHYFEM model (finite element method on an unstructured mesh) more suitable for coastal implementations. SURF workflow integrates these numerical models and several pre- and post-processing procedures for the required input fields and numerical outputs. SURF provides pre-processing for bathymetry, initial and lateral boundary conditions, and atmospheric forcing, as well as post-processing for visualization and analysis of results. The platform is distributed as a Virtual Machine and Container Images, leveraging highly portable virtualization technology to ensure SURF's accessibility and ease of deployment across various computational environments. This enhances its usability for a wide range of applications, including governmental and educational institutions, commercial enterprises, and more. A Graphical User Interface (GUI) is currently under development to provide an intuitive and efficient way for users to interact with the SURF platform. The GUI aims to simplify the model-building process and enhance the visualization and analysis of results, ensuring a user experience that is simple, fluid, intuitive, and efficient. This relocatable ocean model system is intended to be a valuable tool that supports various Decision Support System (DSS) that may require currents, sea level, temperature and salinity forecasts at high resolution, such as oil spill monitoring, search and rescue operations, navigation routing, fisheries and tourism. In these scenarios, on-demand regional and coastal Digital Twin of the Ocean

(DTOs) can be highly beneficial to policy advisors, stakeholders, and decision-makers, helping to mitigate the impact of hazards on communities and minimize the risk of potential losses resulting from incorrect decisions.

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