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DYAMOND-II simulations with IFS-FESOM2

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This presentation will give an overview about an ongoing collaboration between the European Centre for Medium-Range Weather Forecasts (ECMWF) and the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research (AWI). Our recent development is a single-executable coupled configuration of the Integrated Forecasting System (IFS) and the Finite Volume Sea Ice-Ocean Model, FESOM2. This configuration is set up to participate in the DYAMOND project alongside ECMWF's default IFS-NEMO configuration. IFS-FESOM2 and IFS-NEMO are tentative models to generate "Digital Twin" storm-scale, coupled simulations as envisioned in the European Destination Earth (DestinE) and Next Generation Earth Modelling Systems (NextGEMS) projects.

FESOM2 has a novel dynamical core that supports multi-resolution triangular grids. The model and its predecessor FESOM1 have been used in many studies over the last decade, with a focus on the role of the polar regions in global ocean circulation. The impact of eddy-permitting and locally eddy-resolving resolution has been addressed in CMIP6 and HighResMIP simulations as part of the AWI-CM-1-1 global climate model, while simulations with up to 1km resolution in the Arctic Ocean have been performed in stand-alone mode.

Initially, two coupled IFS-FESOM2 configurations have been tested: A coarse-resolution setup with a nominal 1° ocean, and a DYAMOND-II configuration with 0.25° ocean and IFS at 4.5km global resolution on average. For the latter configuration, FESOM2 is mimicking the "ORCA025" tri-polar curvilinear grid of the NEMO model, whose grid boxes have been split into triangles. Initialisation is from ECMWF's analysis for IFS and NEMO, and from an ERA5-forced ocean spin-up for FESOM2. We discuss technical challenges with respect to the hybrid OpenMP and MPI parallelization in a single-executable context, describe a novel strategy for resource-efficient writing of model output, and summarise future applications such as exploring the impact of flexible FESOM2 grid configurations on the atmosphere - with ocean simulations that resolve leads in sea ice and ocean eddies almost everywhere.