Generating ocean initial conditions for the Weather-Induced Extremes Digital Twin

Accurate ocean initial conditions are beneficial to coupled ocean - atmosphere forecasts in various ways, depending on context. On short time scale (days), some extreme, societally high-impacting meteorological events such as tropical cyclones are associated with exceptionally intense air-sea exchanges, thus requiring good knowledge of the initial state of the upper ocean layers. As the forecast evaluation time scale gets longer (seasonal, decadal), the information contained within the atmospheric initial conditions becomes virtually ineffective to the advantage of that contained within the ocean's. In phase one of the Destination Earth (DestinE) initiative of the European Union, ECMWF, along with many European partners, has been responsible for developing and delivering the first digital twin of weather extremes (Extreme DT). As many other, this digital twin relies on the fusion of observations and cutting-edge, high-resolution versions of Earth system models. A method for generating realistic high-resolution initial conditions, scalable and affordable at eddy-permitting resolutions, is required for this tool. In this presentation, we introduce a new ocean initial condition generation method built to meet the needs of the extreme DT. This method consists in running preliminary nudged ocean-standalone experiments, using the NEMO ocean model, which is used within ECMWF's Integrated Forecasting System. Our new hybrid method can be significantly cheaper than relying on ocean data assimilation, particularly at high resolutions. However, it touches on several matters related to the ability of ocean models to be diverted from their natural equilibrium by being constrained towards increasingly realistic states. In this presentation, we will present our ocean initial condition generation method and evaluate the resulting skill of coupled ocean - atmosphere forecasts on a few testcases.

Charles Pelletier, Christopher Roberts, Frederic Vitart, Magdalena Alonso Balmaseda, Kristian Mogensen, Phil Browne, Hao Zuo, Sarah Keeley (all ECMWF)