A deep learning approach for coastal downscaling: the northern Adriatic Sea case-study

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Abstract

Current regional-scale oceanographic operational systems may lack the resolution needed for coastal applications, where fine-scale dynamics such as river outflow and local processes are poorly represented. Artificial intelligence based techniques for interpolation and fine-scale reconstruction can be applied for studying coastal dynamics. In this talk, we propose a deep learning method based on a UNet-like architecture for coastal downscaling of marine ecosystem modeling products. Our method is applied to the northern Adriatic Sea, a marginal region of the Mediterranean characterized by strong spatial and temporal variability, where river inputs significantly influence the physical and biogeochemical state and dynamics, especially near the coast. To address these challenges, we trained a neural network on a reanalysis dataset, covering the period from 2006 to 2017, with a horizontal resolution of about 750 m, using as input the regional-scale products of the Marine Copernicus Service for the Mediterranean Sea, and the flow-rates on 19 rivers discharging into the northern Adriatic Sea. We demonstrate that our architecture is capable of recovering fine-scale features that are not captured by low-resolution models. An interesting application of our method concerns the optimization of regional short-term forecasting systems. In particular, the Copernicus Marine Service daily provides ten-day forecasts for both physical and biogeochemical variables at the Mediterranean scale. The trained neural network can be applied to these products on the northern Adriatic Sea to obtain either more accurate initial conditions for nested downscaling simulations or directly high resolution forecasts at a very low computational cost.

Although this presentation focusses on the northern Adriatic Sea, the robustness of the method, as demonstrated by the validation metrics, suggests that it can be effectively applied to other study areas.