

AI4PEX: Ocean biogeochemistry and extremes

The objective of the new EU HORIZON project 'AI4PEX' (Artificial Intelligence for Enhanced Representation of Processes and Extremes in Earth System Models) is to advance our understanding and representation of key processes underpinning the most uncertain feedbacks in the Earth system, hence support the development of robust climate mitigation and adaptation strategies from multi-decadal to longer time scales. AI4PEX will develop innovative techniques, model-data integration strategies and data-driven models to accurately and efficiently assess and study Earth system feedbacks and extremes.

Our research performed within AI4PEX will focus on the ocean heat and carbon uptake and transport and marine extremes, and understanding the main sources of uncertainties in the Earth system feedbacks and impacts of climate extremes on the ocean biogeochemistry in the open oceans and coastal areas. In this regard we will conduct these novel modeling activities (1) Ensembles of Earth system model (ESM) simulations at medium resolution with high-frequency outputs, machine learning (ML) methods will be implemented to reconstruct data on the ocean heat and carbon transport and extremes by leveraging the model simulations and observations; (2) High-resolution model simulations to better represent the extremes, we further investigate the governing processes and precursors of individual and compound extreme events using ML methods based on high-resolution simulations and high-resolution observation-based fields together with a large ensemble of medium-resolution simulations; (3) Multi-decadal to long-term projections of the ocean heat and carbon uptakes and marine extremes with ESM simulations by implementing the learned constraints under CMIP7 scenario forcings.