Forecasting of Marine Heatwaves in the Mediterranean Sea: A Machine Learning Approach

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Mediterranean Sea is recognized as a climate change "hot spot" region, where extreme warm temperature events, named as Marine Heatwaves (MHWs), have occurred frequently over the past decades. Here, we employ a machine learning approach to produce short-term forecasts of MHWs in the basin, using a U-Net Convolutional Neural Network (CNN) model, customized for forecasts with lead times of 3 and 7 days. Using sea surface temperature data to compute spatiotemporal binary label maps corresponding to MHW existence, the model is able to provide forecasts on the entire grid based on a novel CNN set-up. In addition, we explore various oversampling strategies to address spatial imbalances in the dataset, due to the absence of MHWs, and different validation metrics. This research opts for developing a reliable, early warning indicator for MHWs in the basin. In light of the heightened stress on Mediterranean marine ecosystems due to MHWs, this information is crucial for marine management authorities and stakeholders, providing them with essential lead time to implement effective mitigation strategies in response to MHW impacts.