



AI- enhanced seasonal predictions of Mediterranean cyclones

Leone Cavicchia¹, Guido Ascenso², Luca Proserpio², Enrico Scoccimarro¹, Silvio Gualdi¹, Matteo Giuliani², and Andrea Castelletti²

¹Fondazione CMCC, Italy

²Department of Electronics, Information, and Bioengineering, Politecnico di Milano, Milano, Italy

Intense cyclones form frequently in the Mediterranean region, with the potential to cause damage to life and property when they hit highly populated coastal areas. Cyclone impacts are caused by the associated strong winds, flash flooding and storm surge. The social and economic impacts are not limited to the Mediterranean area, as cyclones forming in the region can affect Central Europe. While the skill of weather models to forecast such events has dramatically improved over the last decade, the seasonal predictability of Mediterranean cyclones lags behind due to the limitations on horizontal resolution in probabilistic forecasts requiring a large ensemble of simulations. Improving the prediction at a seasonal scale of those extreme events would be of great benefit for society, enabling better disaster risk management and reducing the economic losses they cause. A better prediction of climate extremes would also directly benefit a number of economic sectors such as the insurance and re-insurance industry.

The goal of this work, within the CLINT Horizon project, is to use Artificial Intelligence techniques to enhance the skill of a state-of-the-art seasonal prediction system for predicting Mediterranean cyclones. Here we present results making use of a hybrid AI approach linking the occurrence of those extreme events to their large-scale drivers. The training and validation of different machine learning models is performed using ERA5 reanalysis data. The trained models are then applied to the output of the CMCC operational seasonal forecasts in hindcast mode, and the skill of the modelling chain is assessed. The performance of machine learning models of varying complexity (e.g. random forest, gradient boosting, convolutional neural networks) is evaluated.