

## **Hybrid modelling for seasonal forecasts of European heat wave and cold spell propensity**

Seasonal Forecasts are critical tools for early-warning decision support systems, that can help reduce the related risk associated with hot or cold weather and other events that can strongly affect a multitude of socio-economic sectors. Recent advances in both statistical approaches and numerical modeling have improved the skill of Seasonal Forecasts. However, especially in mid-latitudes, they are still affected by large uncertainties that make their application often complicated.

The MSCA-H2020 project ARTIST aims at improving our knowledge of climate predictability at the seasonal time-scale, focusing on the role of unexplored drivers, to finally enhance the performance of current prediction systems. This effort is meant to reduce uncertainties and make forecasts efficiently usable by regional meteorological services and private bodies. A statistical/dynamical hybrid model is designed through the synthesis of (a) a cutting-edge dynamical Seasonal Prediction System and (b) a statistical model based on advanced Machine Learning (ML) techniques. Such a hybrid approach may become critical to improve climate forecasts, because it combines the theoretical foundation and interpretability of physical modeling with the power of Artificial Intelligence (AI), that can reveal unknown or disregarded spatiotemporal features.

ARTIST focuses on seasonal prediction of temperature hot/cold extremes in Europe, and in particular on heat wave and cold spell propensity across the target season. From a list of possible candidate drivers, a feature selection approach is used to identify the best variable subset for the prediction of seasonal extreme temperature propensity. The first attempt to solve this selection problem is made with the Guided Hybrid Genetic Algorithm (GHGA, Jung and Zschleischer, 2013). GHGA is wrapped around a Random Forest, that repeatedly works with a different variable subset to minimize a cost function. Land-surface candidate predictors, often overlooked by previous literature, represent a large portion of the initial feature set. We also try to improve the physical interpretability of our results by focusing on the Mediterranean area, where we link predictors and targets throughout a regularized regression approach.

Preliminary results are encouraging and indicate that a hybrid approach can partly overcome the problematics of dynamical seasonal forecasts for extreme events in mid-latitudes.

## REFERENCES

Jung, M., & Zscheischler, J. (2013). A guided hybrid genetic algorithm for feature selection with expensive cost functions. *Procedia Computer Science*, 18, 2337-2346.