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Deep learning-based downscaling of seasonal forecasts over the Iberian Peninsula

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Seasonal climate predictions can forecast the climate variability up to several months ahead and support a wide range of societal activities. The coarse spatial resolution of seasonal forecasts needs to be refined to the regional/local scale for specific applications. Statistical downscaling aims at learning empirical links between the large-scale and local-scale climate, i.e., a mapping from a low-resolution gridded variable to a higher-resolution grid.

Statistical downscaling of gridded climate variables is a task closely related to that of super-resolution in computer vision, and unsurprisingly, several deep learning-based approaches have been explored by the climate community in recent years. In this study, we downscale the SEAS5 ECMWF seasonal forecast of temperature over the Iberian Peninsula using deep convolutional networks in supervised and generative adversarial training frameworks. Additionally, we apply the traditional analog method for statistical downscaling, which assumes that similar atmospheric configurations (e.g., the predictors) lead to similar meteorological outcomes in a K-Nearest Neighbors fashion.

The deep learning-based algorithms are trained on the UERRA gridded temperature dataset and several ERA5 reanalysis predictor variables. Finally, we evaluate the accuracy of our deep learning-based downscaling of SEAS5 temperature and compare it to the analog downscaling and a bicubic interpolation, as the simplest baseline method.