World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:17, No:09, 2023

Downscaling Seasonal Sea Surface Temperature Forecasts over the Mediterranean Sea Using Deep Learning

Authors : Redouane Larbi Boufeniza, Jing-Jia Luo

Abstract : This study assesses the suitability of deep learning (DL) for downscaling sea surface temperature (SST) over the Mediterranean Sea in the context of seasonal forecasting. We design a set of experiments that compare different DL configurations and deploy the best-performing architecture to downscale one-month lead forecasts of June–September (JJAS) SST from the Nanjing University of Information Science and Technology Climate Forecast System version 1.0 (NUIST-CFS1.0) for the period of 1982–2020. We have also introduced predictors over a larger area to include information about the main large-scale circulations that drive SST over the Mediterranean Sea region, which improves the downscaling results. Finally, we validate the raw model and downscaled forecasts in terms of both deterministic and probabilistic verification metrics, as well as their ability to reproduce the observed precipitation extreme and spell indicator indices. The results showed that the convolutional neural network (CNN)-based downscaling consistently improves the raw model forecasts, with lower bias and more accurate representations of the observed mean and extreme SST spatial patterns. Besides, the CNN-based downscaling yields a much more accurate forecast of extreme SST and spell indicators and reduces the significant relevant biases exhibited by the raw model predictions. Moreover, our results show that the CNN-based downscaling yields better skill scores than the raw model forecasts over most portions of the Mediterranean Sea. The results demonstrate the potential usefulness of CNN in downscaling seasonal SST predictions over the Mediterranean Sea, particularly in providing improved forecast products.

Keywords : Mediterranean Sea, sea surface temperature, seasonal forecasting, downscaling, deep learning
Conference Title : ICAPRS 2023 : International Conference on Atmospheric Physics and Remote Sensing
Conference Location : Toronto, Canada
Conference Dates : September 18-19, 2023