EGU24-19311, updated on 15 Aug 2024
https://doi.org/10.5194/egusphere-egu24-19311
EGU General Assembly 2024

Statistical downscaling of seasonal forecast temperature using a climate-informed AI approach

Yanet Díaz Esteban[1], Qing Lin[1], Arthur Hrast Essenfelder[2], Andrea Toreti[2], Fatemeh Heidari[1], Edgar Fabián Espitia Sarmiento[1], and Elena Xoplaki[1,3]
[1]Justus Liebig University, Center for International Development and Environmental Research, Giessen, Germany (yanet.diaz.esteban@gmail.com)
[2]European Commission, Joint Research Centre (JRC), Ispra, Italy
[3]Department of Geography, Climatology, Climate Dynamics and Climate Change, Justus Liebig University Giessen, Senckenbergstrasse 1, 35390 Giessen, Germany

Climate predictions on seasonal timescales are of major importance for the scientific, planning and policy communities to understand the impacts of climate variability and change and emergent risks, and thus develop appropriate adaptation and mitigation strategies. Nevertheless, the coarse spatial scale of that data limits its use in decision making. Downscaling is therefore emerging as a solution to transfer the climate information to a scale suitable for impact studies and climate-related risk assessments. In this study, a method for downscaling seasonal forecast temperature is presented, that integrates a Deep Residual Neural Network (DRNN) with an analog-based approach to increase the information from climate predictors. The advantage of the proposed approach is the incorporation of relevant large-scale variables, such as the geopotential height from different ensemble members, which supplies the model with varied information from the atmospheric circulation instead of using only a single input field as a predictor. This allows the model to capture the complex relationships between climate drivers and local scale variables such as temperature, that provides a great potential to reduce the large biases in climate model outputs. The DRNN based downscaling is applied to minimum and maximum temperature from ECMWF seasonal forecast at 1° resolution, downscaled to a resolution of 1 arcminute (~1.2 km), in a region that covers Germany and surrounding areas. The results are assessed against observations using both deterministic and probabilistic metrics and show an overall agreement between the downscaled product and the ground truth. This work demonstrates the added value of post-processing of seasonal forecasts, especially for applications of early warnings of extreme events and the associated hazards on a sub-seasonal to seasonal scale.