EGU24-12420, updated on 16 Jan 2025
https://doi.org/10.5194/egusphere-egu24-12420
EGU General Assembly 2024

Can convection permitting forecasts solve the tropical African precipitation forecasting problem?

Felix Rein[1], Andreas H. Fink[1], Tilmann Gneiting[2,3], Philippe Peyrille[4], James Warner[5], and Peter Knippertz[1]

[1]Karlsruhe Institute off Technology, Institute of Meteorology and Climate Research, Department Troposphere Research, Germany (felix.rein@kit.edu)

[2]Institut für Stochastik, Karlsruhe Institute off Technology, Karlsruhe, Germany

[3]Computational Statistics, Heidelberg Institute for Theoretical Studies, Heidelberg, Germany

[4]Centre National de Recherches Météorologiques, Meteo-France, Toulouse, France

[5]UK Met Office, Exeter, United Kingdom

Forecasting precipitation over Africa, the largest landmass in the tropics, has been a long standing problem. The unique conditions of the West African monsoon result in large and long lasting mesoscale convective systems. Global numerical weather prediction (NWP) models have gridsizes in the 10s of kilometers, particular when run in ensemble mode, leaving convection to be parameterized. This often results in precipitation being forecast on too large scales, in the wrong places, and with too weak intensity, ultimately leading to little to no skill in tropical Africa.

It has been argued that convection permitting (CP) NWP forecasts would cure some of the problems described above but those have only recently become feasible in an operational setting, although ensembles are still deemed to be too expensive. Here, we systematically compare regional deterministic CP and global ensemble forecasts in the region over multiple rainy seasons for the first time. We analyze CP forecasts from AROME and Met Office Tropical African Model, and seven global ensemble forecasts from the TIGGE archive, both individually and as a multi-model ensemble. In order to create an uncertainty estimate, we create neighborhood ensembles from CP forecasts at surrounding grid points, which allows for a fair comparison to the ensembles and a probabilistic climatology. Considering both precipitation occurrence and amount, we use the Brier score (BS) and the continuous ranked probability score (CRPS), along with their decompositions in discrimination, miscalibration and uncertainty, for evaluation.

Using neighborhood methods, deterministic forecasts are turned into probabilistic forecasts, allowing a fair comparison with ensembles. All numerical forecasts benefit from Neighborhoods, improving their BS and CRPS in terms of both miscalibration and discrimination. We find all individual forecasts to have skill over most of tropical Africa, with some ensemble models lacking skill in some regions and the multi model showing the most overall skill. The CP forecasts TAM and AROME outperform non-CP forecasts mainly in the region of the little dry Season and the Soud. However, large areas of low skill in terms of CRPS remain and even with high resolution, numerical models still struggle to predict precipitation in tropical Africa.