

Evaluation of multi-model ensemble forecasts at subseasonal timescales for southern Africa

Background and motivation

Weather forecasts are a critical component of the early warning chain, as weather variables significantly influence hydrometeorological disasters. However, accurately predicting tropical rainfall, particularly prevalent in the tropics, remains a major challenge for numerical weather prediction (NWP) models (e.g., Rein et al. 2025, Walz et al. 2021, and Vogel et al. 2018). Inaccurate forecasts often lead to misinformed or poorly targeted anticipatory actions. This issue is particularly acute at subseasonal timescales, often referred to as the "predictability desert", despite this being a critical window for effective early warning, especially in sectors such as energy, agriculture, and disaster risk reduction. Addressing this challenge may be through, improving forecast verification practices, employing multi-model ensembles, or increasing the number of ensemble members to better account for model uncertainty.

Tasks

In this Master's project, you will address the above challenge by evaluating an ensemble of forecast models contributing to the subseasonal to seasonal (S2S) database, with the aim of identifying those best suited for the Southern Africa region. Furthermore, you will investigate the potential benefits or limitations of increasing ensemble sample size through two approaches: (a) constructing a multi-model ensemble, and (b) applying enhanced neighbourhood sampling, like in Rein et al. (2025). You will assess the forecasts performance using proper scoring rules; the Brier score (BS) and continuous rank probability score (CRPS) and determine their skill relative an extended probabilistic climatology (EPC).

Organisational information

The master thesis will contribute to ongoing efforts in the Co-Design of Hydrometeorological Information System for Sustainable Water Resources Management in Southern Africa (Co-HYDIM-SA) project, which aims at enhancing water security in the region. The student will therefore actively collaborate with researchers from a wider group of German and African organisations.

The thesis will be supervised by Prof. Andreas H. Fink (andrea.fink@kit.edu) and Dr. Simon Ageet (simon.ageet@kit.edu). Please contact them for further information.