

Advancing Actionable Seasonal Forecasts with DL

A Post-Processing Comparison in the Blue Nile Basin

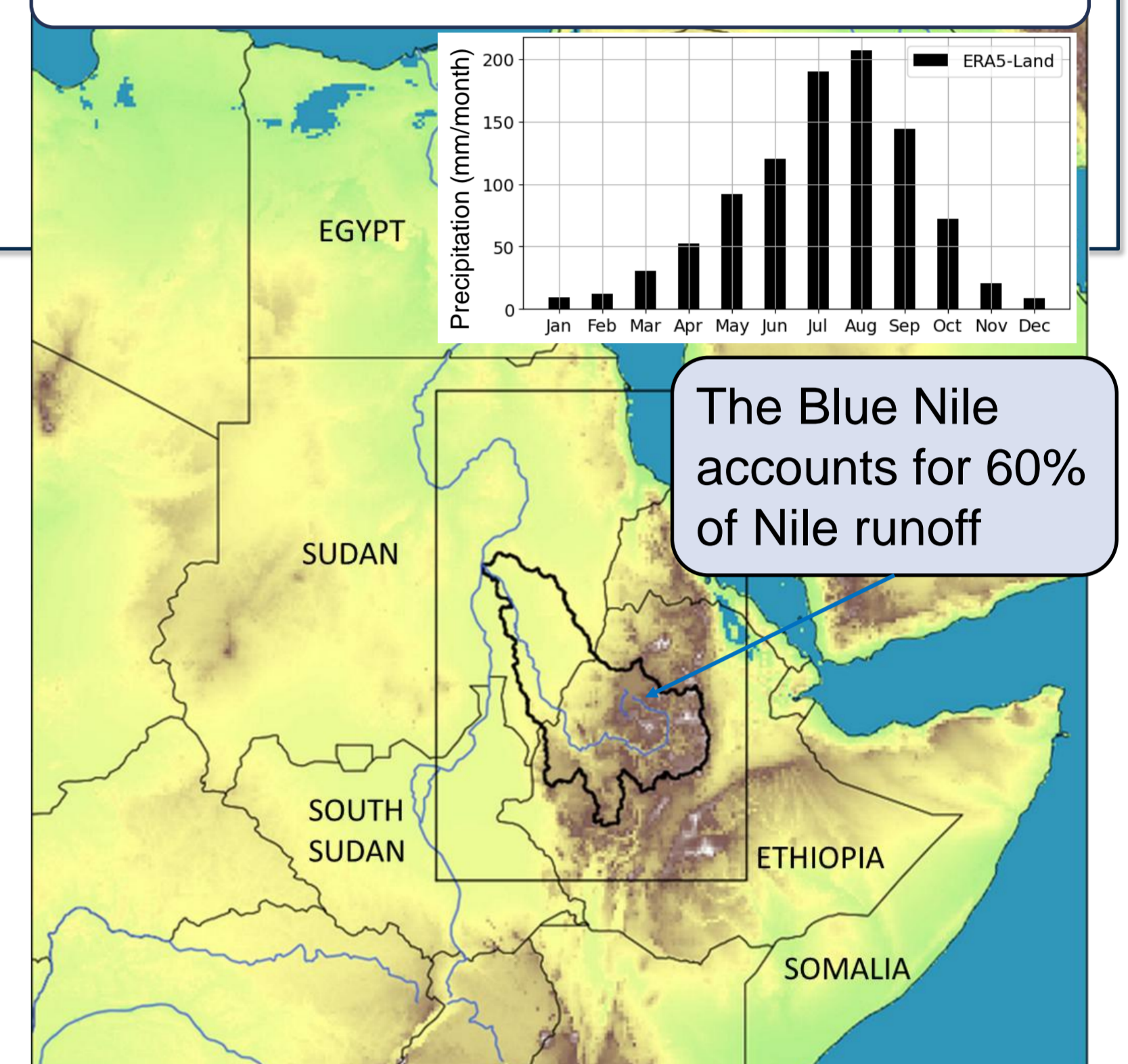
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The need for skillful regional seasonal forecasts for impact-oriented applications

- Seasonal forecasts support proactive decision-making (e.g., agriculture, water management)
- Downstream impact models require high-resolution and physically consistent inputs
- However, coarse resolution and pixel-wise post-processing limit their regional applicability
- → Advanced post-processing approaches are required to produce regional forecasts

...in the Blue Nile Basin



Precipitation datasets

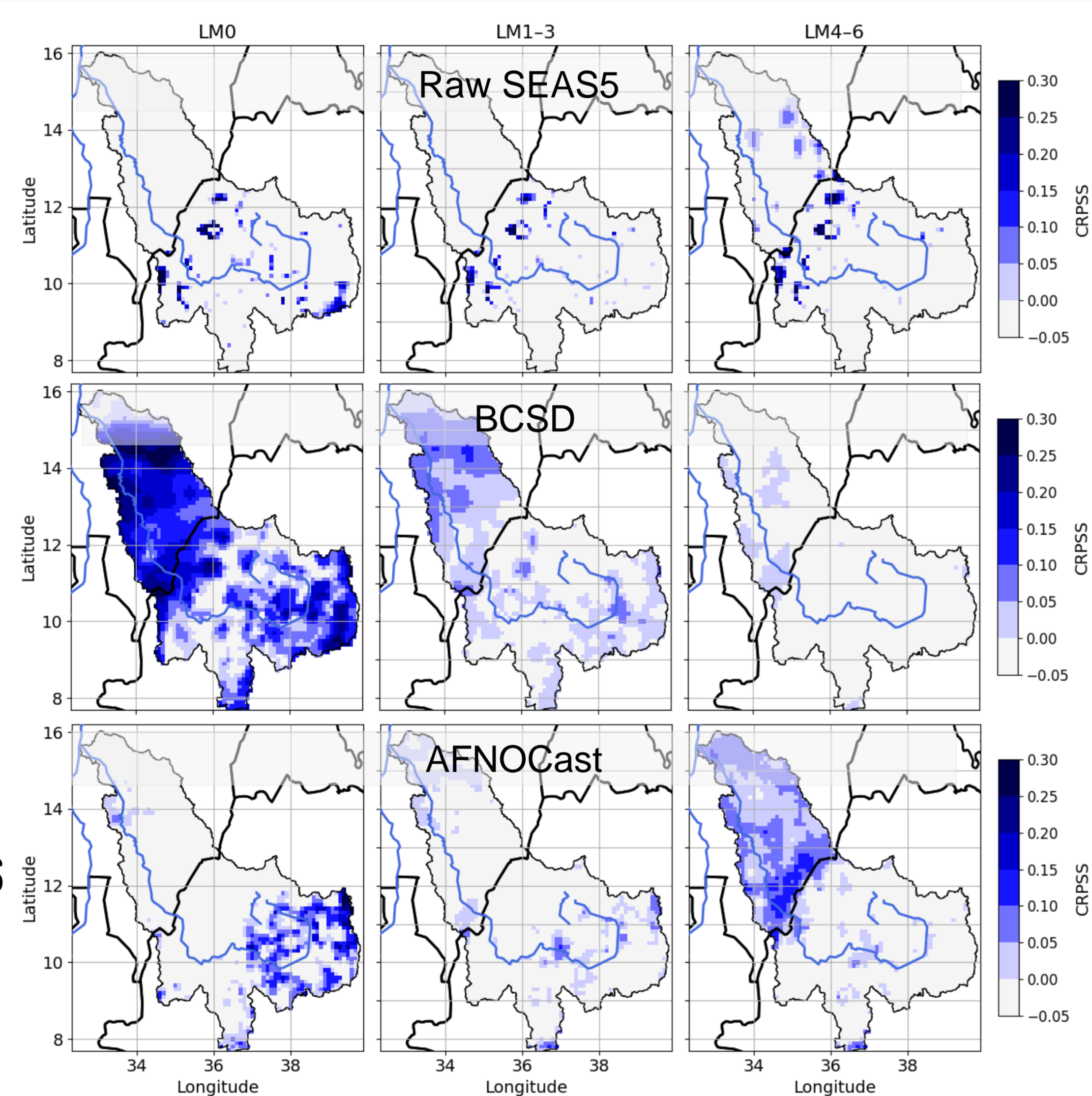
- ECMWF re-analysis: ERA5 (0.25°)
- ECMWF re-analysis: ERA5-Land (0.1°)
- Satellite and Station-based: CHIRPS v2.0 (0.1°)
- ECMWF seasonal forecast: SEAS5 (0.25°)

Post-processing methods

- Statistical framework: **BCSD**
- Deep Learning (DL)-based: **AFNOCast**
- Adapted **Fourier Neural Operator Networks in 3D** for **Seasonal Forecasts** AI for process speed up
- Code available as python package: **PyCast-S2S**

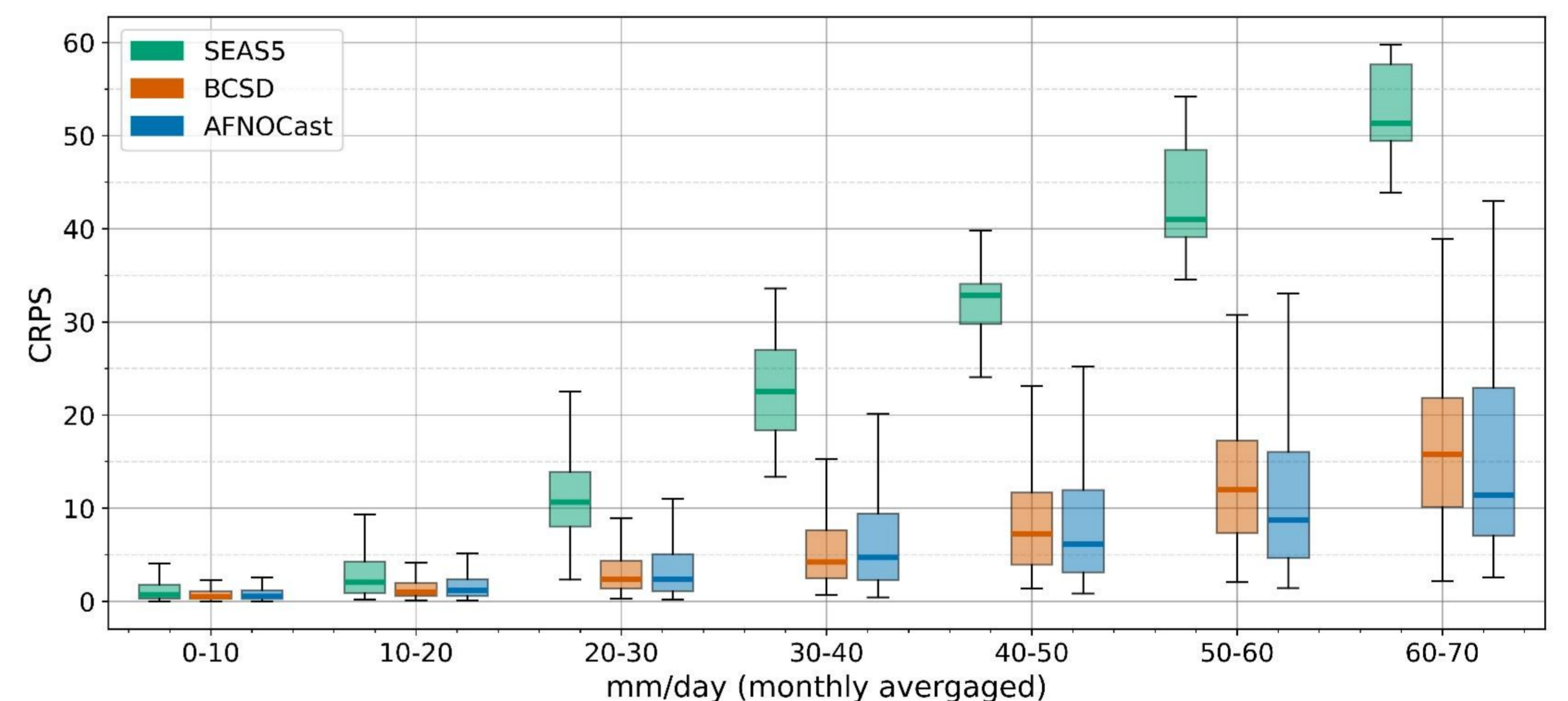
Benefits of post-processing: Improved forecasts at high resolution

The Continuous Ranked Probability Skill Score (CRPSS) showing the improvements compared to climatology in blue.



BCSD dominates at short lead times, AFNOCast at longer horizons

Both methods reduce the ensemble error (CRPS). But AFNOCast outperforms BCSD for heavy rainfall

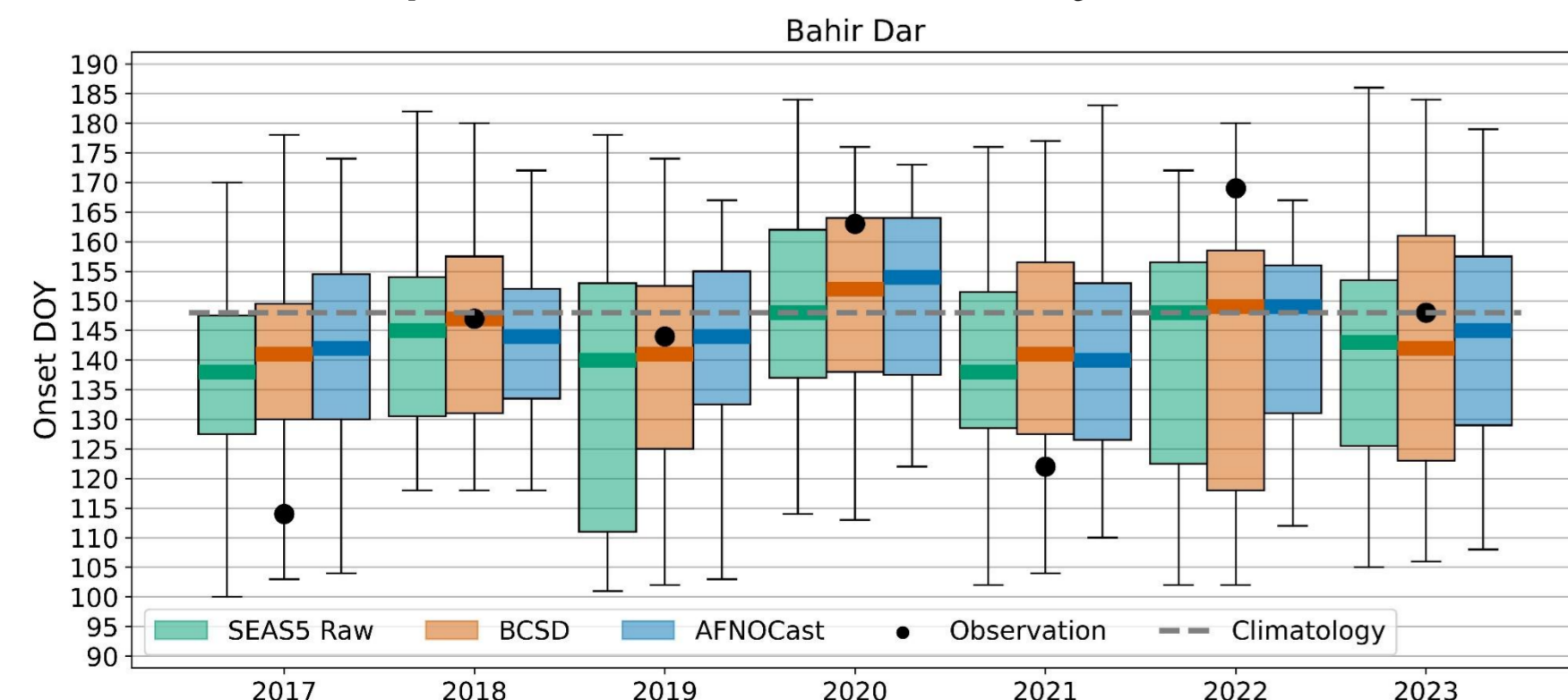


The Continuous Ranked Probability Score (CRPS) describes the ensemble error, and is binned for increasing rainfall intensities

Wiegels et al. (2026) Improved seasonal precipitation forecasts for the Blue Nile Basin: a deep learning approach

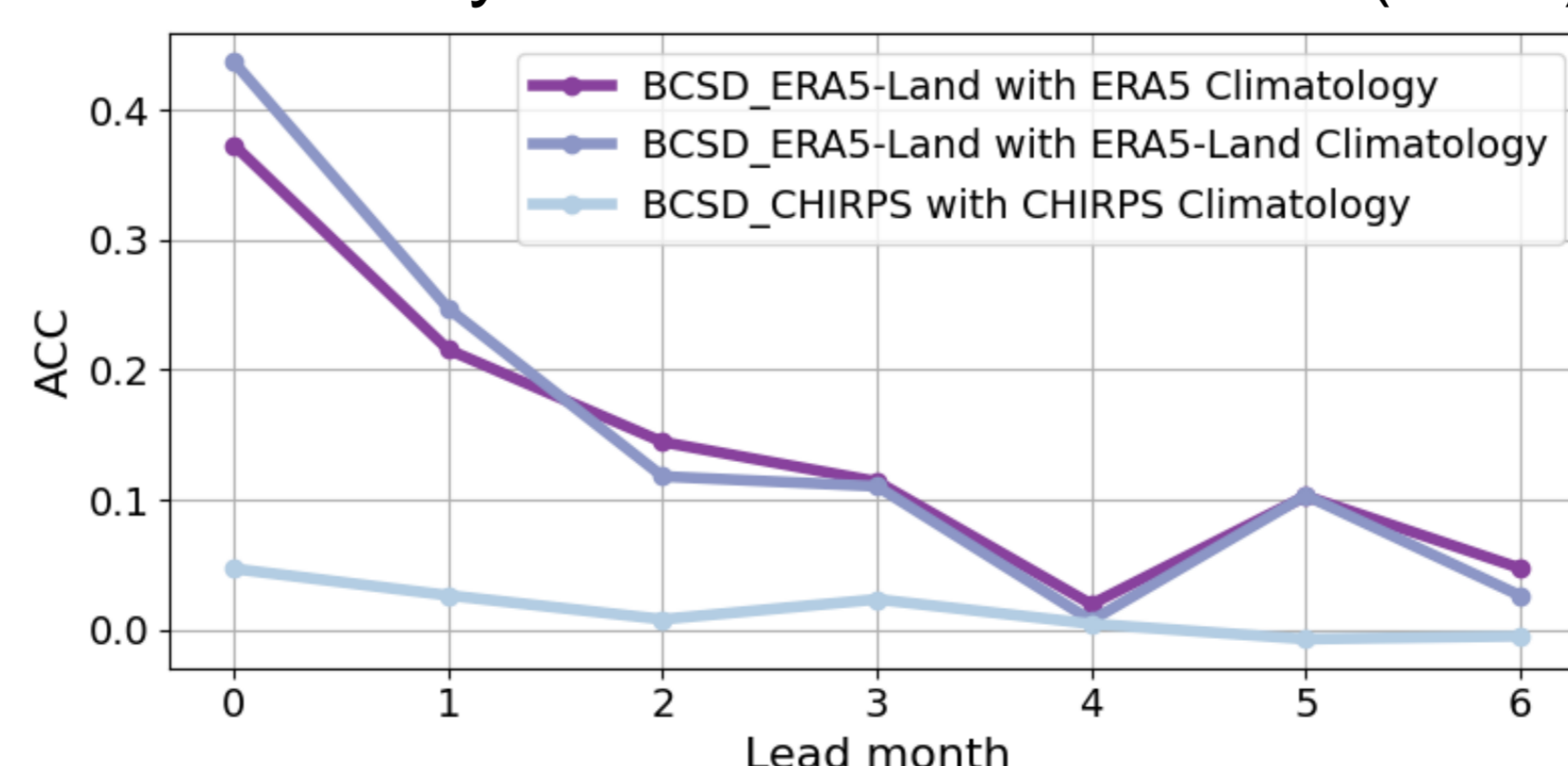
Limitations of post-processing

Onset prediction for the city Bahir Dar



The trend of SEAS5 is reproduced in AFNOCast and BCSD: Seasonal onset prediction remains constrained by the raw SEAS5 signal

The Anomaly Correlation Correlation (ACC)



Forecast skill is highly sensitive to the choice of reference dataset: ACC varies substantially across reference products

Outlook

- Transition to sub-seasonal forecasts (ECMWF) on a global domain
- Extension of AFNOCast to a multi-variate AI framework
- Participation in the S2S AI Weather Quest for "real-time" global benchmarking
- Linking improved regional forecasts and applying them subsequently to hydrological, sediment and crop modelling