Short Project Summary

Seasonal Hydrological Forecasting System for SaWaM

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Semi-arid regions are characterized by low annual precipitation with large intra- and inter-annual variability. An apt example of this is the region of Khuzestan in Iran where the hydrological conditions flipped in two consecutive years. The region saw one of its driest years in record in 2017/18 and record-breaking flooding in 2018/19. With such level of uncertainty, the water management community in such regions will greatly benefit from hydrological forecasts provided a few months in advance. Numerical modeling of these regions, however, is not trivial due to existing anthropogenic features (e.g. dams) that are adaptation measures for semi-arid conditions.

Distributed hydrological models are state-of-the-art tools in hydrological modeling that enables model-based-action at local scale. Nonetheless, a major issue of distributed models is scalability wherein model output varies greatly with resolution of simulation. We employ the mesoscale hydrological model, mHM, which overcomes this issue with Multiscale Parameter Regionalization, MPR (Samaniego et al. 2010) and Sub-grid Catchment Contribution, SCC (Shrestha et al. 2020) techniques, producing seamless scalable state variables, fluxes and, overall, a quasi-scale independent basin hydrology. With mHM at its core, we setup the seasonal hydrological forecasting system that issues monthly forecasts/indicators up to six months in advance.

Methods and Data

The methods mainly consist of two parts. First, we set up the model in mHM for the project study regions incorporating the major reservoirs. The model is optimized against water level at the reservoirs (sample in Figure 1).

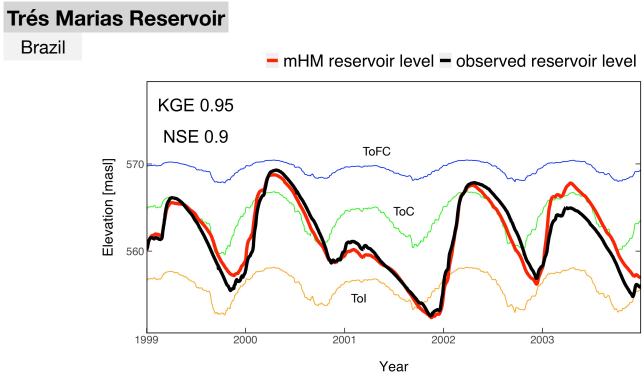

Figure 1: Goodness of fit of simulated reservoir water level by mHM. ToFC – top of flood control, ToC – top of conservation and ToI – top of inactive are rule curves fitted by the model.

Secondly, we establish an automated model chain for production of seasonal hydrological forecasts. The workflow (Figure 2) entails tasks ranging from downloading of model forcing data from the project server (THREDDS) till uploading of indicators back to the server for visualization.

The physiographical data for model setup was extracted from mHM global database. The model is forced using ERA5-land reanalysis and SEAS5 forecasts from ECMWF, with the latter being bias corrected and downscaled to 0.1°.

Results and Conclusions

A sample seasonal forecast for the Sudan flood of 2019 is shown (Figure 3). Overall *above normal flow* conditions in June (start of the rainy season) were already tracked at six months lead time (L6). This is a fitting example of the ability of the system to provide indication in advance. Nonetheless, the spatial extent gets heavily updated in L1 compared to the pattern from L6 and L3. In conclusion, the seasonal forecasting system of SaWaM is able to give good “indication” of hydrological conditions, even at the forecast horizon (L6). This information

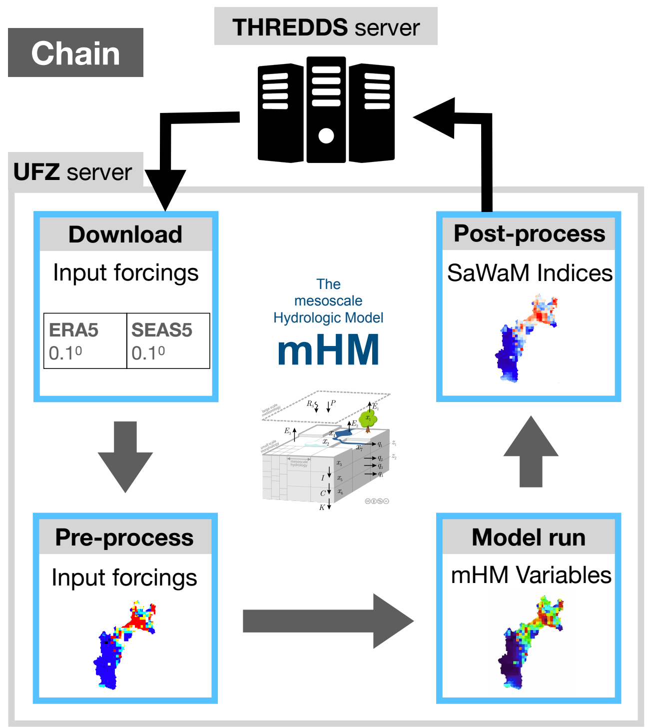

Figure 2: The schematics of the Seasonal Hydrological Forecasting System's processing chain as part of WP3 of SaWaM

is already of great value for water management and the decision-making community in uncertain hydro-climatological, semi-arid regions. However, the accuracy of the magnitude and especially the spatial extent improves as the point of time approaches L2/ L1. This re-iterates the fact that meteorological forcings are the drivers of hydrological models and their quality, preprocessing and improvement is of utmost importance in seasonal hydrological forecasting.

References

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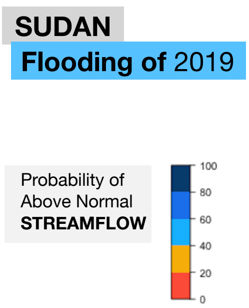

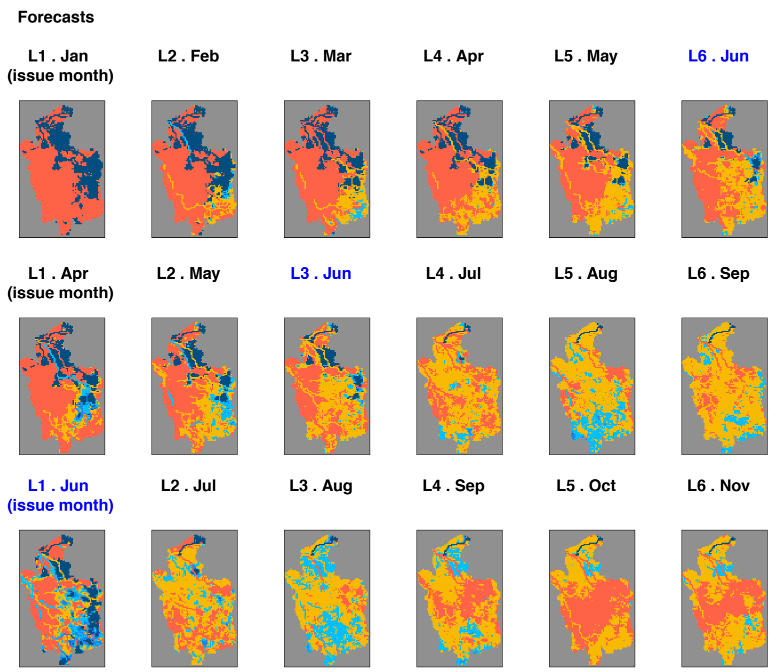

Figure 3: Seasonal forecasting for the Sudan flood 2019. The "indication" of flooding is seen to be tracked with 6 months lead time.

mHM simulations (PK Shrestha, L Samaniego, O Rakovec. Helmholtz Centre for Environmental Research – UFZ)