Development of a flood forecasting system integrating climate information

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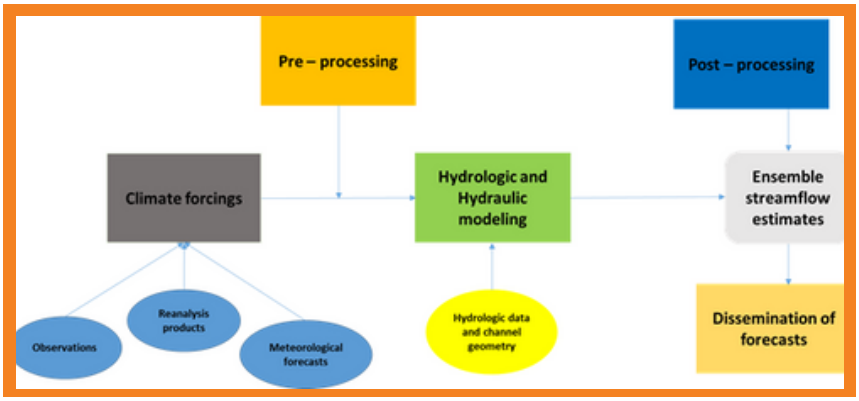
Climate change is easily perceived in rising temperatures at global scale, and it has the capability to alter the hydrological cycle at regional scale. Many studies across the globe have shown the effects of climate change in terms of increased frequency and intensity of extreme precipitation, changes in seasonal precipitation patterns and different aspects of floods. In India, low pressure systems that typically occur during the monsoon cause floods and are influenced by the climate drivers whose association with hydrology may vary because of the climate change. Therefore, it is important to integrate climate information on both short- and long-term scales in flood modeling and management.



Flood modeling including flood forecasting seen as non-structural measure to mitigate flood effects, and having reliable information at advance lead times greatly benefits. In this regard, climate at both short- and long-term scales on a river basin scale must be incorporated into the flood forecasting systems. Streamflow modeling has witnessed great advances but are in the research settings, and the operational mode of streamflow modeling is in its early stages. The current operational flood forecasting system in India is mainly driven by statistical- and empirical-methods and does streamflow estimation including flood forecasts at specific locations. Importantly, it does not provide uncertainty that is associated with forecasts which result from multiple sources including climate.

The efforts addressing the issues have been put together by relevant agencies using models of both open source and commercial, e.g., such as Hydrologic Engineering Center - Hydrologic Modeling System (HEC - HMS) and MIKE.

One important requirement for all these models is availability of significant amounts of data, which has been on the rise in recent years. The other aspect is to modify the model or model elements to reflect the regional processes including changes in land use and land cover - highlights the need to develop indigenous models that are capable of providing ensemble information at desired locations incorporating the climate information.

In this regard, a widely used conceptual model, i.e., Sacramento Soil moisture accounting (SAC-SMA) is employed over the Narmada river basin, India. While the proposed framework is similar to the ensemble streamflow modeling framework that is used elsewhere, we like to explore the physics of processes with model parameters so that models can represent indigenous models with less effort with a goal to bring the methodology on other river basins. We plan to explore methods that integrate climate information, multiple hydrologic and hydraulic models and statistical models so that probabilistic streamflow is estimated - it assists in efficient mitigation measures.

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Climate change, extreme rains and floods - challenges and opportunities

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As a child, I was curious to find a place where rain appears magically. However, this is no longer an intriguing proposition. In the city of Hyderabad, I see rain, heavy in some parts while merely drizzling in others, and no rain at all in other parts still.

This aspect i.e., spatial variability of rainfall has always existed, but having it within a small geographical area, such as within Hyderabad city, is relatively new and has been associated as one important effect of anthropogenic climate change. This presents new challenges such as frequent flooding that we have witnessed in major cities and river basins across India and its neighboring countries. This also highlights the need for new various capabilities in the context of rainfall and runoff estimation.