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TOPIC OF RESEARCH: SEASONAL FORECASTING FOR WATER MANAGEMENT IN KOSI BASIN

FINDINGS

The research "Seasonal forecasting for water management in Kosi basin' introduces a novel basin-scale forecasting framework specifically tailored to the Kosi River Basin. Sixteen Large-Scale Climate Predictors (LSCPs) were initially selected based on their presumed influence on ISMR. Pearson correlation analysis at lead times of one to three months identified fourteen significant predictors ($p < 0.15$) for model development.

Seven ML algorithms were tested using a randomized train-test split, with Logistic Regression (LR) outperforming others in terms of mean accuracy. The LR model was further optimized using Leave-One-Out Cross-Validation (LOOCV) across all predictor combinations. The resulting Seasonal Prediction Model (SPM) generated probabilistic forecasts for Above Normal (AN), Normal (N), and Below Normal (BN) rainfall categories. Validation results showed accuracies of 81%, 71%, and 71% at one-, two-, and three-month lead times, respectively.

These categorical probabilities were then input into a Conditional Stochastic Weather Generator (CSWG) to produce daily rainfall ensembles at sub-basin levels. The generated rainfall closely mirrored observed monthly distributions, demonstrating the model's applicability for integrated water resource management and hydrological modelling in the Kosi Basin.

This research offers several novel contributions:

1. It adopts a basin and sub-basin level framework, aligning with the scale most appropriate for effective water management.
2. It incorporates a diverse set of LSCPs for model development.
3. It evaluates multiple ML algorithms, selecting the most effective based on performance metrics.
4. It employs optimized predictor combinations to enhance forecast accuracy.
5. The developed model is robust, semi-parametric, and adaptable for application in other basins.
6. It includes uncertainty assessment at daily and sub-basin levels.

It establishes and visualizes significant teleconnections between various LSCPs and seasonal rainfall patterns in the Kosi Basin. In conclusion, the present research reinforces the critical interdependence between seasonal climate forecasting and water resource management. Fostering collaboration between climate scientists and water managers is essential to developing resilient, adaptive, and forward-looking water management systems in an era of increasing climate variability. A limitation of the present research is that the the data from Global Precipitation Measurement Mission was available for 20 years period only (from 2000 to 2020). The availability of data for more than 20 years say 30 years or more could have led to better forecasts of seasonal precipitation. There are several pointers to future work. Perturbations leading to generation of new values of daily precipitation ensembles other than observed historical values could improve upon the results of the studies further. With updated values of large-scale climate indices, the forecasting accuracy of seasonal precipitation can be substantially increased.