HIGHLIGHTS FOR POSTER PRESENTATION ENTITLED:

A Framework for Enhancing Seasonal Hydrological Forecasting in the Jucar River Basin (Spain)

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1. Introduction

It is imperative to acknowledge the significance of seasonal hydrological forecasts in the context of efficient water resource management in semi-arid Mediterranean basins.

Uncertainty propagation from meteorological inputs to hydrological models has been demonstrated to have a significant effect on the reliability of streamflow predictions.

It is imperative to rectify both meteorological and hydrological predictions. This is essential for enhancing the robustness of forecasts and facilitating informed decision-making processes.

2. Study Area

The Júcar River basin in Spain is a suitable representative of the Mediterranean context.

The second area is 21.5785 square kilometers.

The region is characterized by a Mediterranean climate, which is typified by hot, dry summers and mild, wet winters.

The phenomenon of elevated spatial variability in rainfall is a subject of scientific inquiry.

The region is distinguished by a persistent water deficit and elevated levels of anthropogenic pressure, which collectively intensify the planning and operational challenges.

Six important reservoirs have been identified in the region, including Contreras, Alarcón, El Molinar, Cortes, Tous, Forata, and Bellus, among others.

3. Methodology

The integration of raw and corrected meteorological predictions is a process that is facilitated by the utilization of artificial intelligence.

The next step is to complete distributed hydrological modeling of the basin using TETIS v9.1.

The utilization of ISIMIP meteorological data (W5E5 dataset) was employed for the calibration and validation of a hydrological model spanning the period from 1981 to 2019.

A hindcast was conducted from 1995 to 2014 using four seasonal prediction systems: ECMWF_SEAS5, CMCC_SPSv35, DWD_GCFS21, and MeteoFrance System8. These systems were initiated on a monthly basis for a total duration of 240 months, from January 1995 to December 2014. The forecast horizon for these systems was six months for each launch.

Application of fuzzy logic to the correction of meteorological forcings.

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Calibration of the hydrological model was conducted at 24 control points over the period from 2009 to 2019, and its validation was performed at 1981 to 2008.

Four combinations were evaluated: The following pairs of variables were examined: Raw Meteo–Raw Hydro, Adjusted Meteo–Raw Hydro, Raw Meteo–Adjusted Hydro, and Adjusted Meteo–Adjusted Hydro.

A total of 57,600 hydrological simulations were evaluated from two scenarios (meteo-raw and meteo-postprocessed), four forecast systems (ECMWF_SEAS5, CMCC_SPSv35, DWD_GCFS21, and MeteoFrance System8), 240 months (January 1995 to December 2014), and 120 ensembles (25 from ECMWF_SEAS5, 40 from CMCC_SPSv35, 30 from DWD_GCFS21, and 25 from MeteoFrance System8).

4. Results

Meteorological post-processing with artificial intelligence (AI) enhanced the CRPSS by 10-20%, contingent on variable, month, and lead time considerations.

The NSE index demonstrated a substantial enhancement when corrected meteorological data was employed, attaining values above 0.5 in contrast to the negative values obtained with uncorrected meteorological data.

The enhanced reliability of predictions is particularly evident in scenarios characterized by elevated uncertainty, which is typically defined as a lead time exceeding three months.

5. Conclusions

The integration of AI-based meteorological corrections with hydrological error adjustment has been demonstrated to effectively mitigate uncertainty propagation.

The proposed methodology can be replicated in other basins that exhibit similar characteristics.

This constitutes a valuable tool for adaptive water resource management in the face of climate variability.

This approach is consistent with the concept of water resilience to climate change and drought management, underscoring the necessity of adapting management practices to new conditions.