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

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1. INTRODUCTION

The problem: Bias and variance in seasonal forecasts.

SEASONAL FORECAST:

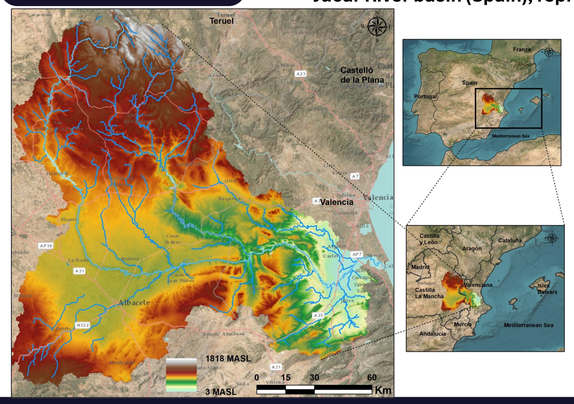
- Seasonal hydrological forecasts are essential for efficient water resource management in semi-arid Mediterranean basins
- Uncertainty propagation from meteorological inputs to hydrological models significantly affects the reliability of streamflow predictions
- Correction of both meteorological and hydrological predictions is crucial to improve forecast robustness and support informed decision-making

Still difficult to obtain reliable quantile estimates: **HIGH UNCERTAINTY** [1]

Additional information is needed (e.g. Macroclimatic Variables or Ocean-Atmospheric Indices) or post-process models to enhance the skill or performance [1, 2]

2. STUDY AREA

Júcar River basin (Spain), representative of the Mediterranean context

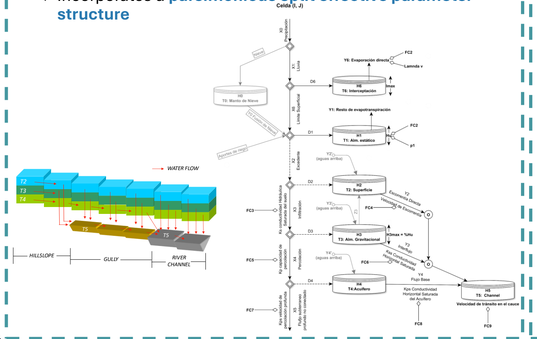


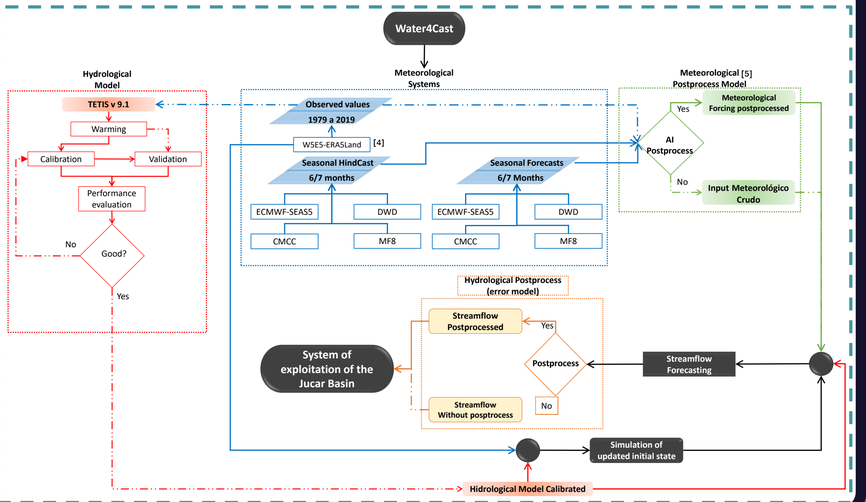
- Area: 21.578,5 km²
- Mediterranean climate
- High rainfall variability
- Multiple reservoirs (Contreras, Alarcón, El Molinar, Cortes, Tous, Forata, Bellus…)
- Characterized by water deficit and high anthropogenic pressure that exacerbates planning and operational challenges

3. METHODOLOGY

TETIS [3]

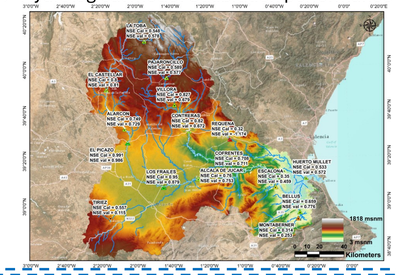
- **Integral** HM
- **Conceptual** (tank structure) model with **physically based parameters**
- **Distributed** in space
- Incorporates a **parsimonious split effective parameter structure**



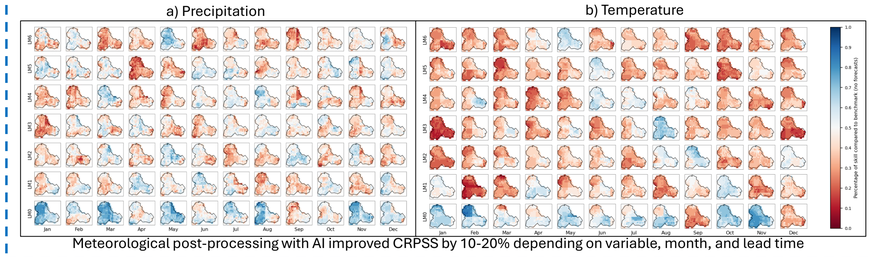


4. RESULTS

❖ Hydrological model Calibration performance

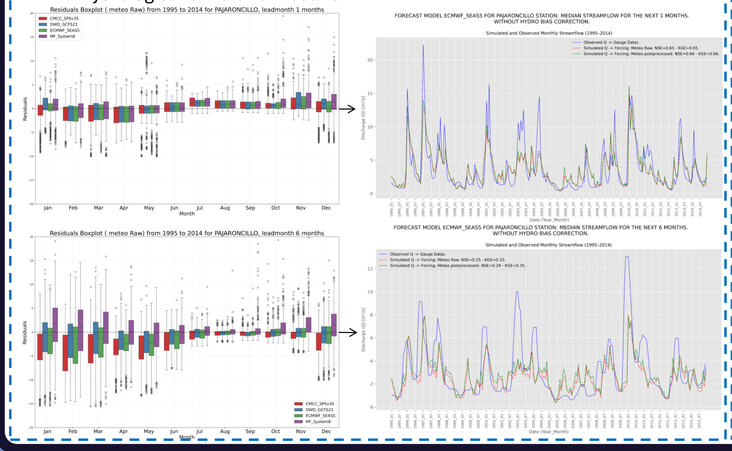


❖ Skills (CRPSS) Hindcast from ECMWF SEAS5 1995-2014

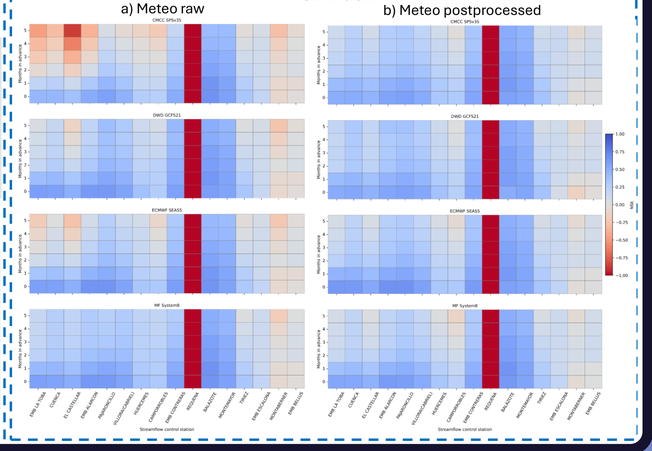


Meteorological post-processing with AI improved CRPSS by 10-20% depending on variable, month, and lead time

❖ Hydrological Simulation results



❖ NSE index.



5. CONCLUSIONS

- The combination of AI-based meteorological corrections with hydrological error adjustment effectively reduces uncertainty propagation
- NSE index significantly improved with corrected meteorological data, reaching values above 0.5 vs. negative values with uncorrected meteorology
- The proposed methodology is replicable in other basins with similar characteristics
- Constitutes a valuable tool for adaptive water resource management in the face of climate variability
- The approach aligns with water resilience to climate change, highlighting the importance of adapting management practices to new conditions

6. REFERENCES

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7. ACKNOWLEDGEMENTS

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