

Development of a daily scale hydrological forecasting system for the Júcar river basin

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Author: Avesani Federico

Advisor: Pulido Velázquez, Manuel Augusto
Co-Advisor: Macián Sorribes, Héctor

Keywords

Valencià	Castellano	English
Xúquer	Júcar	Júcar
ECMWF	ECMWF	ECMWF
Meteorología	Meteorología	Meteorology
Quantile mapping	Quantile mapping	Quantile mapping
Modelo HBV	Modelo HBV	HBV model
Previsions	Predicción	Forecasting

Background and goals

Fresh water availability and allocation has always been, in human history, a critical topic. Climate change is expected to furtherly exacerbate the water resources problem, thus the need for an efficient decision support system, supported by reliable hydrological forecasts. These are produced by hydrological models, usually in the form of rainfall-runoff models, fed by weather forecasts. The HBV model is an example of conceptual rainfall-runoff model, which have been broadly tested in several different study case and for different applications. Long term ensemble forecasts and hindcasts are able to predict weather variables, among which precipitation and temperature with lead times of several months. Among others, the ECMWF SEAS5 systems provides daily-scale weather forecasts with a 7 month-lead time. The bias correction of long term forecasts is a necessary process to account for inherent mistakes present in the forecasts. While preserving the predictive skill of the forecasts, bias correction amends the dispersion errors and biases present in the forecasts and downscales the forecasts to the scale of application. The goal of the present study is to create an hydrological forecasting system, fed with bias corrected ECMWF weather forecasts, able to provide robust and reliable previsions on the future state of the Júcar river basin.

Resumen

El trabajo propuesto trata de desarrollar un sistema de predicción de las condiciones hidrológicas del río Júcar, a través del modelo HBV y de previsiones meteorológicas para los siguientes siete meses proporcionadas por el ECMWF (European Centre for Medium-Range Weather Forecasts). El modelo se calibra con datos históricos, y las previsiones se manipulan a través de un método estadístico de post-procesamiento (Quantile mapping), que trata de mejorar la calidad de las predicciones. Las subcuencas consideradas son las vertientes a los embalses de Alarcón, Contreras y Bellus.

Resum

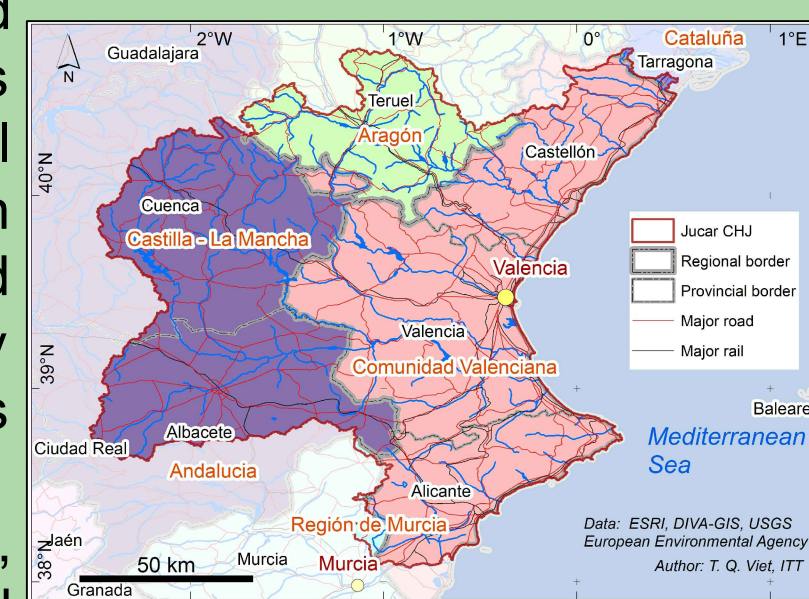
El treball proposat tracta de desenrotllar un sistema de predicció de les condicions hidrològiques del riu Júcar, a través del model HBV i de previsions meteorològiques per als següents set mesos proporcionades per l'ECMWF (European Centre for Medium-Range Weather Forecasts). El model es calibra amb dades històriques, i les previsions es manipulen a través d'un mètode estadístic de post-processament (Quantile mapping), que tracta de millorar la qualitat de les prediccions. Les subconques considerades són els vessants als embassaments d'Alarcón, Contreras i Bellús.

Summary

The proposed work aims to develop a system for predicting the hydrological conditions of the Júcar river, through the HBV model and weather forecasts for the next seven months provided by the ECMWF (European Center for Medium-Range Weather Forecasts). The model is calibrated with historical data, and the forecasts are manipulated through a statistical method of post-processing (Quantile mapping), which tries to improve the quality of the predictions. The sub-basins considered are the slopes to the Alarcón, Contreras and Bellus reservoirs.

Case study

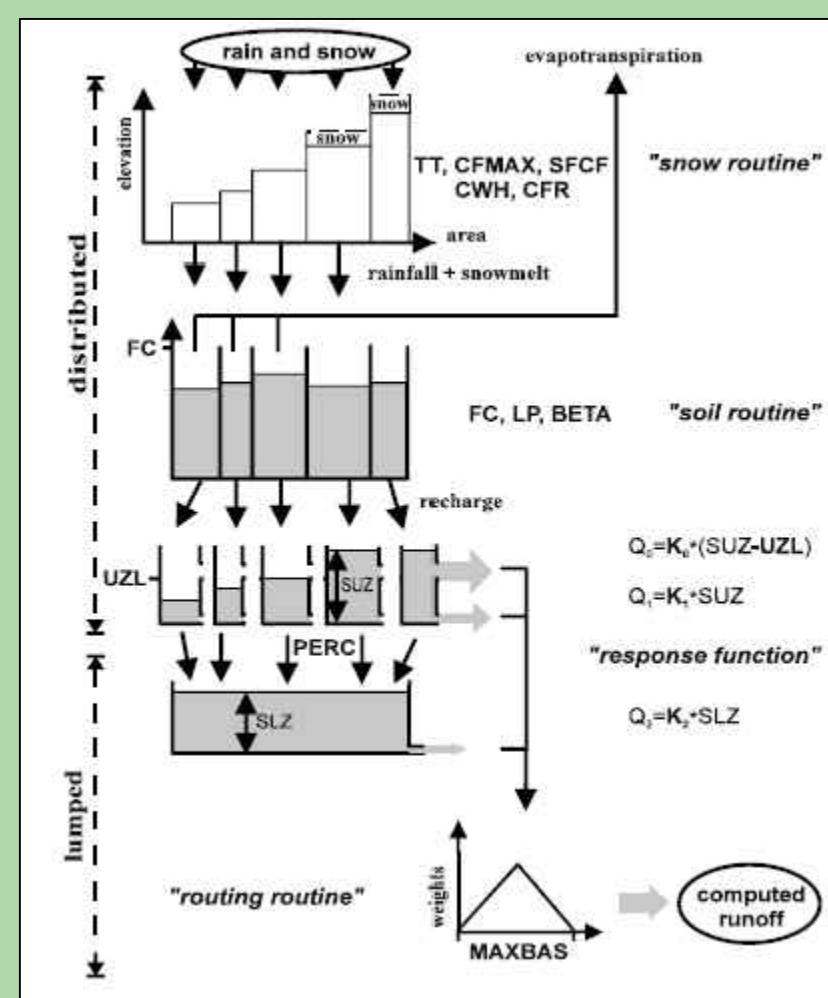
The Júcar river basin, located in eastern Spain, is characterized by a typical mediterranean climate, with long, dry summers and mild winters. Occasional heavy and short precipitation events are common in autumn. The water use is intense, with a ratio of used resources to renewable resources close to 1.



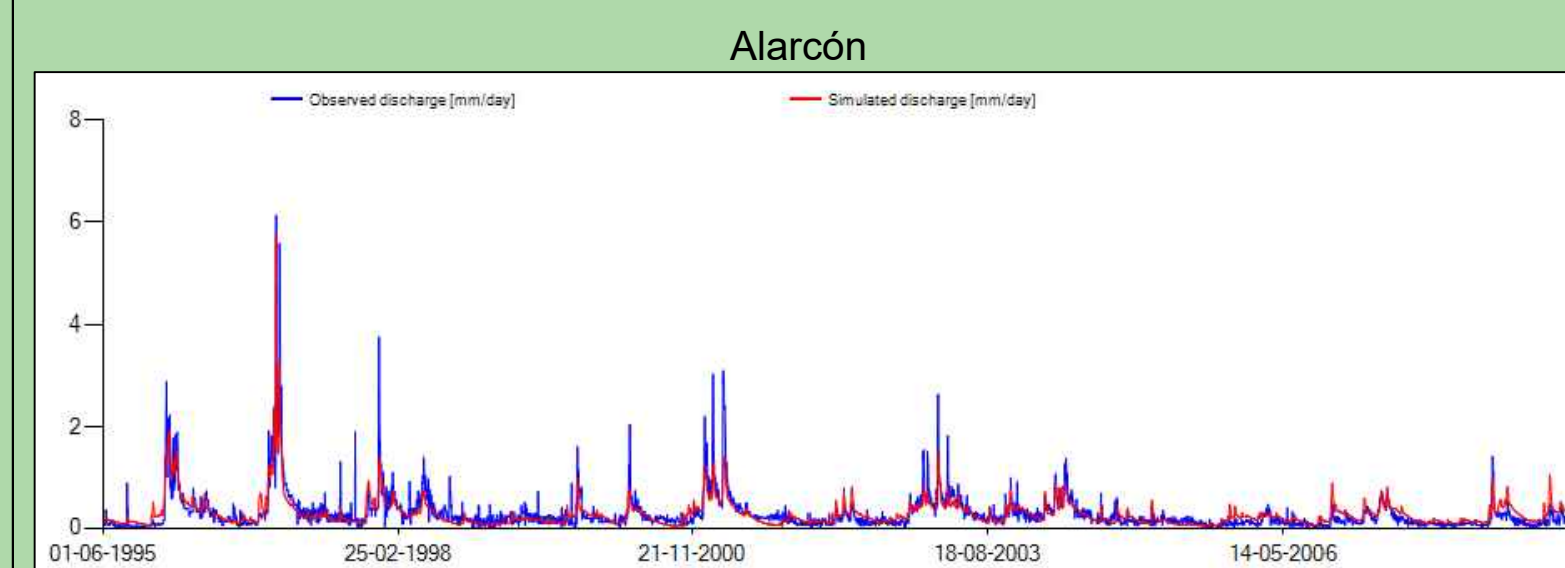
HBV model

The model structure is composed by 4 routines:

- snow accumulation and melt;
- groundwater recharge and actual evaporation;
- groundwater storage and discharge;
- channel routing.

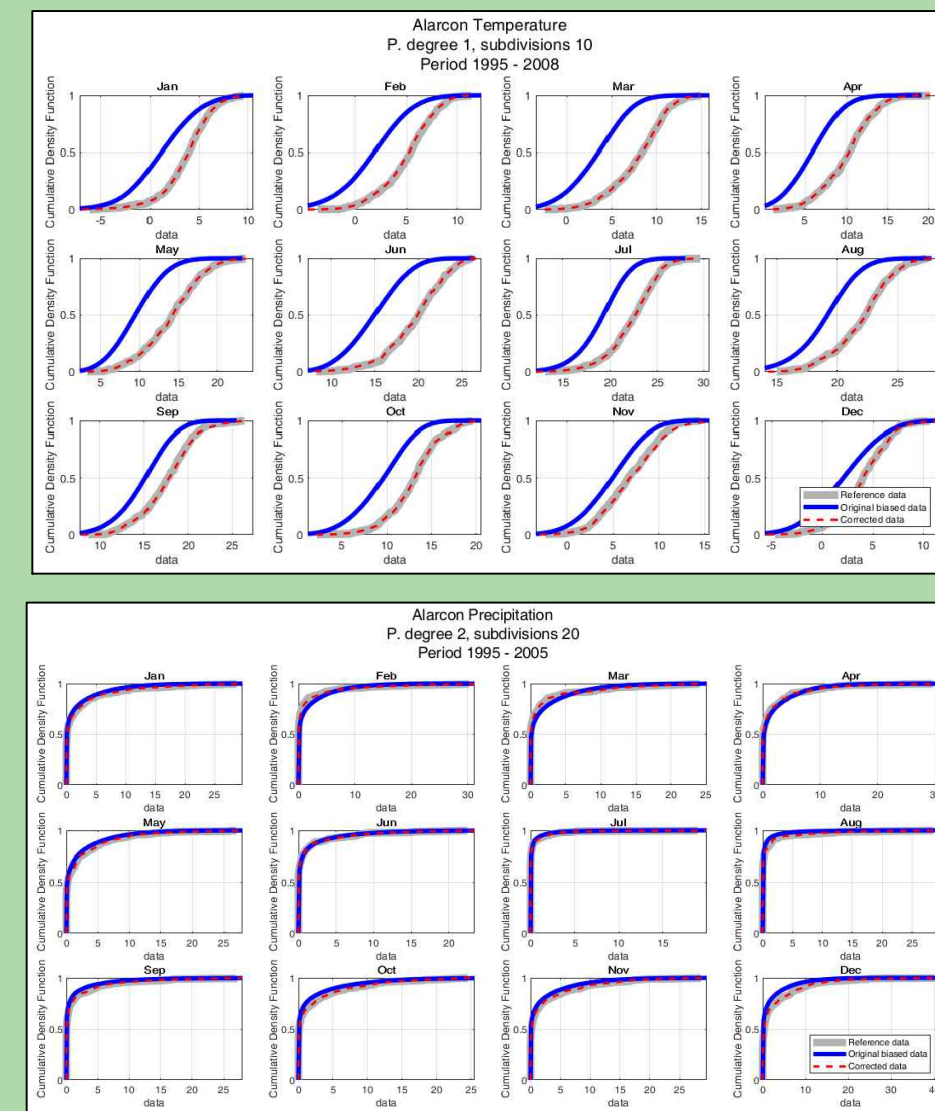


Calibration and validation are carried out with the in-built GAP tool. Simulations results show a very good agreement with observations.

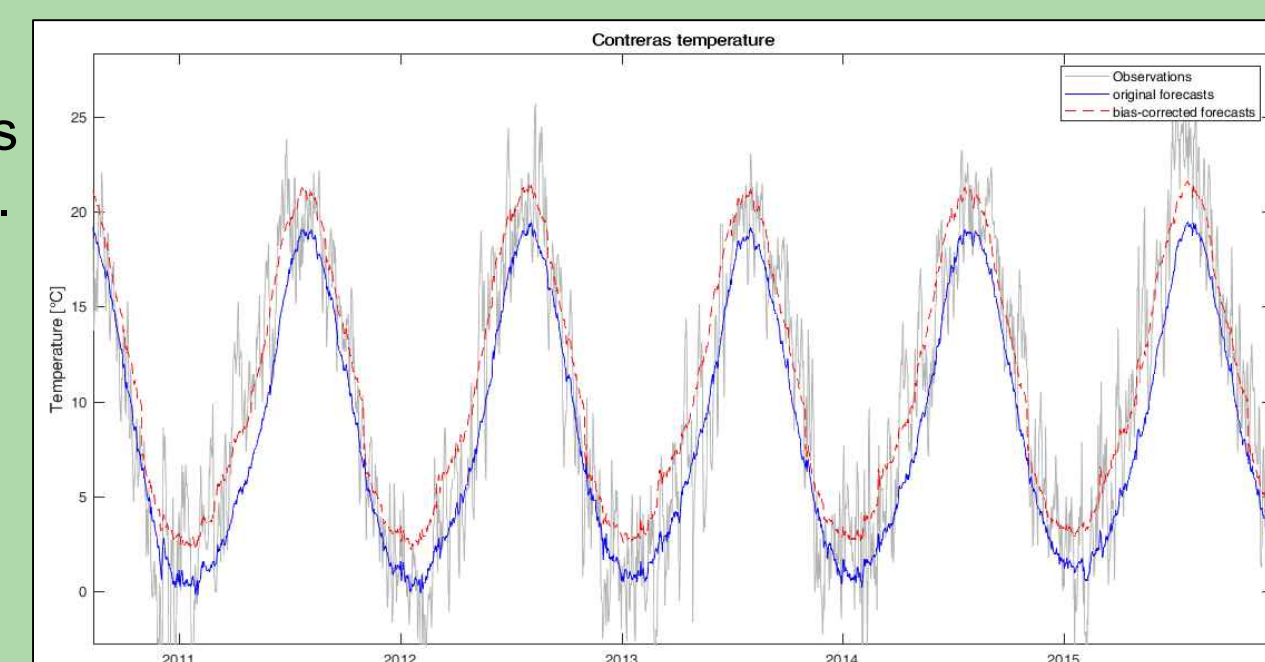


Meteorological forecasts and bias correction

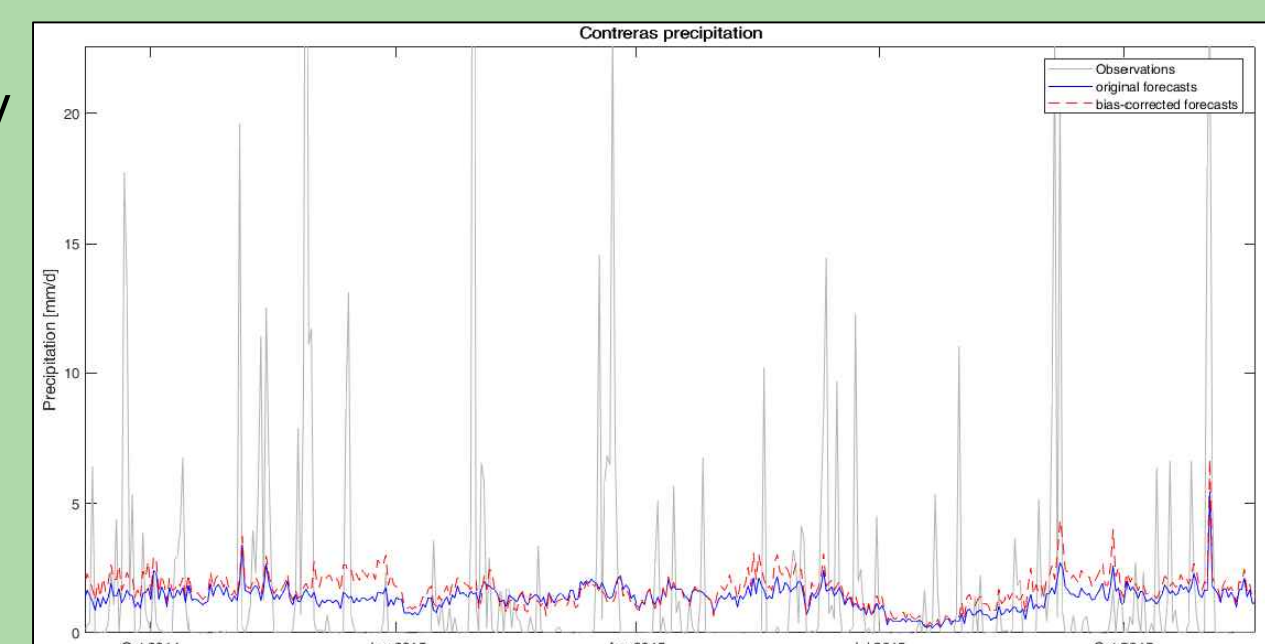
SEAS5 forecasts are created using computational models to calculate the evolution of the atmosphere, ocean and land surface. The SEAS5 system consists of an ocean analysis to estimate the initial state of the ocean, a global coupled ocean-atmosphere general circulation model to calculate the evolution of the ocean and atmosphere, and a post processing suite to create forecast products from the raw numerical output. The bias correction method exploited is the quantile mapping, which adjusts the CDF of the forecasts according to that of the observations.



The algorithm works well with temperature...



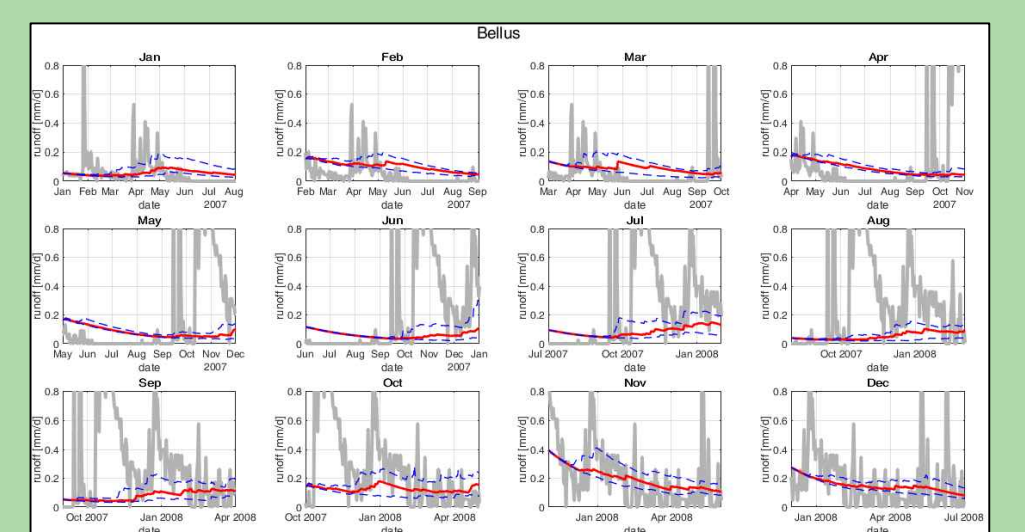
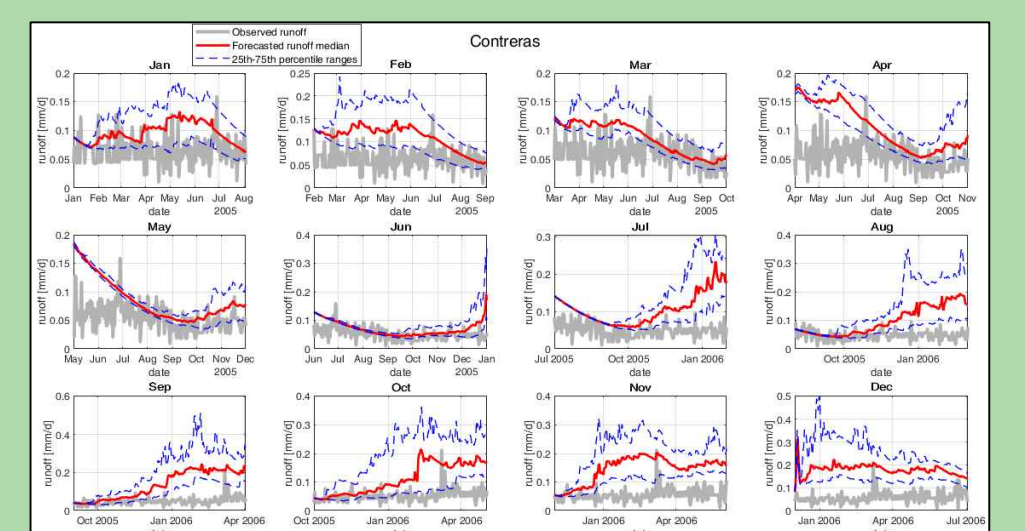
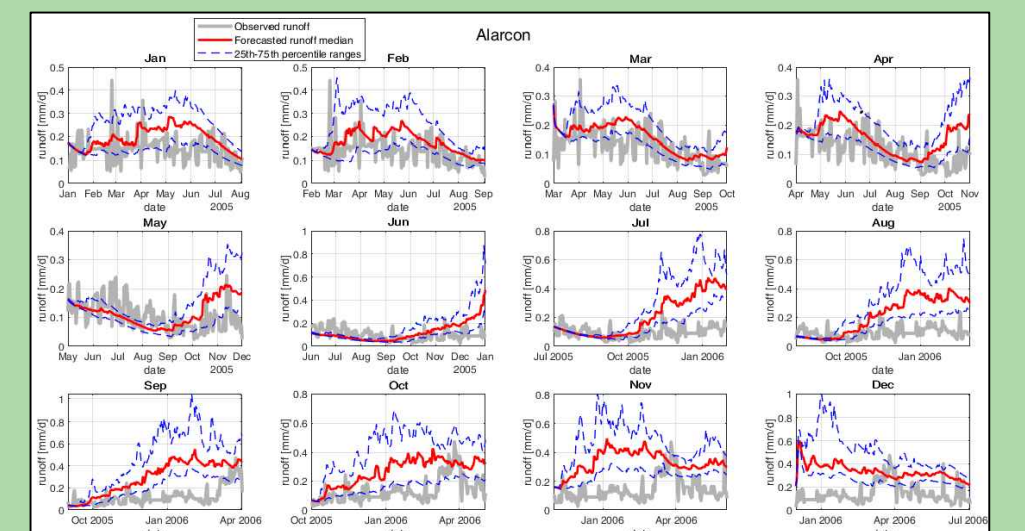
But not as satisfactorily with precipitation forecasts.



This is due to the fact that Quantile mapping is an unconditional method: it does not preserve the connection between the pairs of forecast and observation values.

Hydrological forecasts

The bias corrected forecasts are fed to the calibrated HBV model, generating a 25 members-ensemble hydrological forecast. There is a good agreement with the trend of the observed runoff, especially in dry periods, which are consistently forecasted up to 7 months before. More wet periods are sometimes not well forecasted.



References

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