

## **ABSTRACT**

To determine the discharge flowing through a given section in a river is an important task that must be done due to its usefulness in different situations such as irrigation, defining environmental discharges, allocation of water resources, design of civil works, flood forecasting and more. Consequently, flow forecasting through hydrological modelling is of great importance since it allows to know with anticipation the possible discharges that might be seen in the future and to act in consequence. Nevertheless, ungauged basins where there is lack of direct measurements of meteorological information to force the models is one encountered problematic affecting the forecasts. In the present study is evaluated the possibility of using meteorological predictions coming from MOLOCH model to force the FEST-WB hydrological model to perform discharge forecasting. This, under the hypothesis that the committed error of the prediction is negligible when using forecasts up to 24 h. The study is done in a well-known area such as the Seveso-Olona-Lambro river basins located in northern Italy. Thus, the main hydro-meteorological variables are analysed by carrying out a comparison between spatialized observed meteorological data coming from ARPA and meteonetwork weather stations and meteorological predictions. Moreover, a sensitivity analysis following the one-factor-at-time methodology is accomplished with the aim of defining which forcing mostly affects flowrate forecasts. It is shown that discreet correspondence of information with an underestimation trend - particularly for large values - is verified for discharge at hourly and daily scale, and that underestimation of precipitation - especially in summer - and overestimation of solar radiation are the main reasons of this. Hence, to improve the predictability when coupling the two models, some actions should be evaluated to enhance the correspondence of the meteorological forcings.

# PERFORMANCE EVALUATION OF THE MOLOCH METEOROLOGICAL MODEL FOR DISCHARGE FORECASTING OVER THE SEVESO-OLONA-LAMBRO RIVER BASINS



Flow forecasts through hydrological models is of great importance since it allows us to know the possible discharges that could be seen in a river section, and to act in consequence. However, some problems affecting the forecasts may arise due to different factors such as the difficulty on predicting some phenomenon, for example convective precipitation, the characteristics of the basin, and so on. In the present study we take meteorological forecasts coming from MOLOCH meteorological model and use them as input of the FEST-WB hydrological model, with the scope of performing discharge forecasts and overcome the problem related to lack of direct hydro-meteorologic measurements in ungauged basins. This is done in a well-known area such as the Seveso-Olona-Lambro river basins were comparison with direct measurements and, consequently, evaluation of the meteorological forecasts can be performed.

## AIMS OF THE STUDY

With this, we pose the following aims of the study:

1. Analyse observed vs. forecasted data in order to evaluate how good is the correspondence of the information.

2. Evaluate the impact of each meteorological variable over the hydrological response by means of a sensitivity analysis.

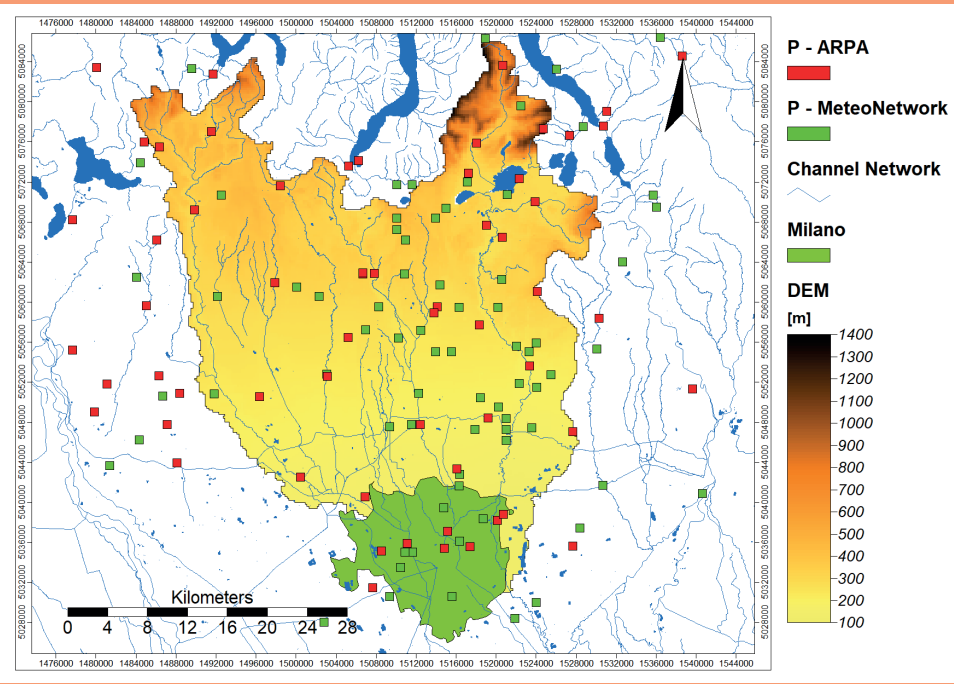
## MATERIALS

In respect of the materials, as stated before, we used two different models:

**MOLOCH:** the meteorological one with high spatial resolution (1.25 km), operating at short range (24 – 48 h forecasts), and it gives the output with hourly frequency.

**FEST-WB:** a physically based, distributed hydrological model, with a discretization of 200 by 200 m and outputs at hourly frequency.

Additionally, the used information was the following:  
Observed weather data from 2003 to 2020 coming from ARPA Lombardia and Meteonetwork weather stations.  
Forecasted weather data from 2013 to 2020 coming from MOLOCH model.



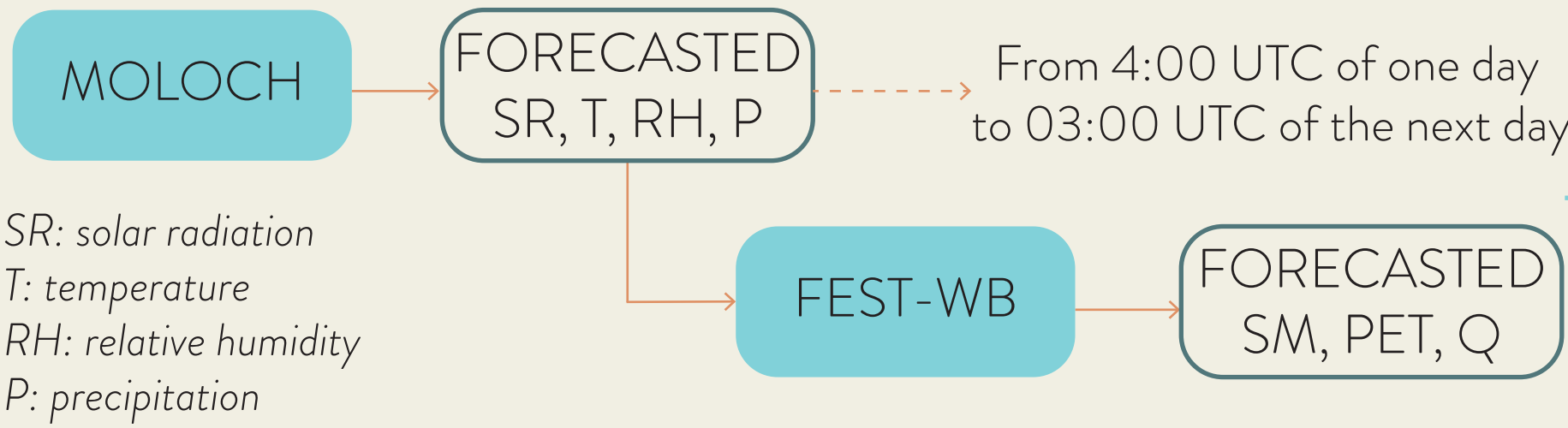
## METHODS

Different treatments of the data were performed to homogenize and facilitate posterior analyses:

Quality control of observed weather data to overcome the wrong data acquisition problem.  
1. Identify and analyse values that might not have physical meaning.

Pre-treatment of forecasted weather data: to make them readable by the hydrological model.

Then, the coupling strategy of the two models was set by taking the first 24 hours of forecasts:



The simulations to be done were also defined:

1.1 With observed data only (2003-2020)

1.2 With forecasted data (2013-2020)

2. Four simulations related to the sensitivity analysis with the one-factor-at-time (OAT) methodology, where only one variable used in the simulation is forecasted (see table).

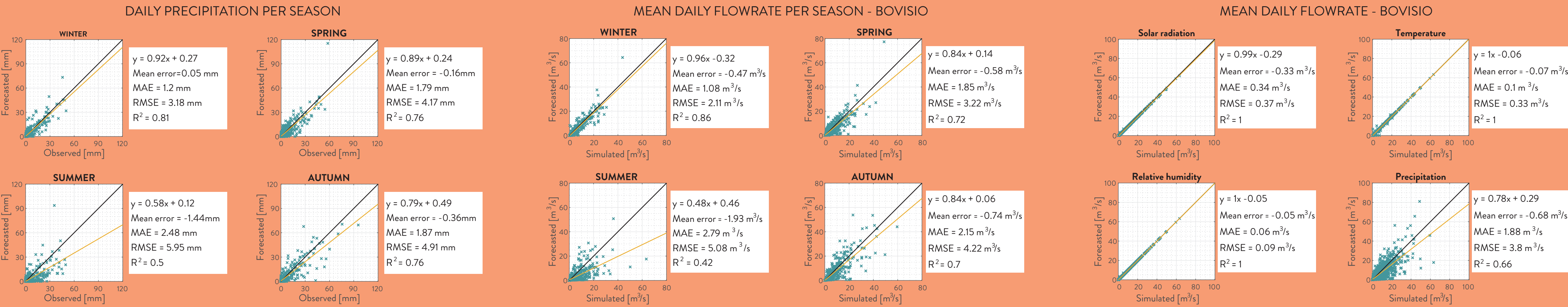
SIMULATION	OBSERVED	FORECASTED
#1	T, RH, P	SR
#2	SR, RH, P	T
#3	SR, T, P	RH
#4	SR, T, RH	P

## RESULTS

1. For the comparison we put particular interest in the seasonal behaviour of precipitation, since we expected that variable to be the one mostly influencing the discharge, and the discharge itself at a section where the natural behaviour of the area of study could be observed, in this case, Bovisio station (Seveso Basin) where no hydraulic works were present.

It is observed:  
- Good behaviour in Winter, Spring and Autumn.  
- Bad correspondence in summer due to convective precipitation.  
- Underestimation when high observed values were verified in all seasons.  
For mean daily discharge, similar behaviour is verified.

2. Concerning the sensitivity analysis, precipitation is the variable influencing the discharge forecasts results.



## CONCLUSIONS

- Very good performance in T, SR, RH was observed.
- Underestimation trend of forecasted discharge is present due to underestimation of precipitation.
- The use of meteorological forecasts as direct measurements for discharge estimation is possible. Particular attention should be paid for P.
- Future developments should be related to improve the reliability of the MOLOCH model, especially for P, for example with some suitable bias correction methods to be tested.

