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Assessment of a short-term machine learning streamflow forecasting in small Alpine catchments leveraging Deutscher Wetterdienst ICON climate forecasting model

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Data-driven methods are widely adopted to forecast short-term streamflow with lead time up to a few days. Flood risk mitigation, multi-use water management and hydropower plants schedule are the most common fields to use forecasting results. Increasing the accuracy and limiting the uncertainty of the predictions are common needs and also this work would evaluates these aspects combining regional climate models and machine learning techniques. Thus, the research question addressed regards the suitability of the machine learning algorithm fed by the ICON forecasting regional climate model for short lead time streamflow prediction in a small and complex Alpine environment.

A data-driven forecasting procedure is used for streamflow forecasting on a lead time of two days in small Alpine catchments of the Alto Adige Province (Italy). Bias correction of the ICON prediction data inputs against the historical data and the machine learning module compose the two steps data-driven methodology that we propose. Historical time series of precipitation and temperature provided by weather stations have been used for training the machine learning algorithms, while the ICON prediction data of precipitation and temperature have been adopted for testing them. The use of historical data has been essential for collecting a reasonable amount of data required for algorithm learning. The methodology performance evaluation is on the meteorological correction and on the hydrological forecasting.

This first assessment shows promising results for two-day head streamflow prediction even in the context of small catchments with complex orography. This finding suggests that the merging of robust data-driven methodologies with high-resolution detailed weather prevision inputs can be a consistent breakthrough for reliable hydrological short-term forecasting. In conclusion, the flexibility of machine learning and ensemble climate prediction allows for adequate management of uncertainty along the prediction procedure, which is crucial in hydrological applications.