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Impact of the statistical method, training dataset, and spatial scale of post-processing to adjust ensemble forecasts of the height of new snow

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Forecasting the height of new snow (HS) is essential for avalanche hazard survey, road and ski resorts management, tourism attractiveness, etc. Meteo-France operates the PEARP-S2M probabilistic forecasting system including 35 members of the PEARP Numerical Weather Prediction system, the SAFRAN downscaling tool refining the elevation resolution in mountains, and the Crocus snowpack model representing the main physical processes in the snowpack (compaction, melting, etc.). It provides better HS forecasts than direct NWP diagnostics but exhibits significant biases and underdispersion. Therefore, a post-processing is required to be able to provide automatic forecasting products of HS from this system.

For that purpose, we compare the skill of two statistical methods (Nonhomogeneous Regression with a Censored Shifted Gamma distribution and Quantile Regression Forest), two predictor datasets for training (22-year reforecast with some discrepancies with the operational system or 3-year real time forecasts similar to the operational system) and two spatial scales of post-processing (local scale or 1000 km² regional scale).

The improvement relative to the raw forecasts is similar at both spatial scales. Thus, the regional validity of post-processing does not restrict the application at points with observations. The impact of the training dataset depends on lead time and on the evaluation criteria. The long-term reforecast improves the reliability of severe snowfall but leads to overdispersion due to a discrepancy with the initial perturbations used in the operational system. Finally, thanks to a larger number of predictors, the Quantile Regression Forest allows an improvement of forecasts for specific cases when the the rain-snow transition elevation is overestimated by the raw forecasts.

These conclusions help to choose an optimal post-processing configuration for automatic forecasts of the height of new snow and encourage the atmospheric modelling teams to develop long reforecasts as homogenous as possible with the operational systems.