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Establishing weights of members in a multi-model ensemble

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In recent years, multi-model ensemble methods have been utilized in hydrology to integrate several model outputs to simulate and predict events. Apart from using the ensemble as multiple predictions of equal weight or probability, a weighting scheme can be applied to improve the probability density function and derivatives such as the ensemble mean. The weighting scheme can be static or dynamic.

A multi-model ensemble of discharge simulations for the Rijnland water system in the Netherlands was processed using several weighting schemes. The ensemble was constructed using multiple catchment characteristics and forcing data sources available for the area, resulting in 24 members. The first weighting scheme used equal weights. The second was a static weighting scheme using the relative historic performance of a member as its weight. Performance metrics, i.e. bias and NSE were used. Dynamic weighting was using previous day relative performance to establish the weight for the members. Firstly error (distance) of simulated to observed discharge was used. Secondly trend of the previous day simulated discharge was used by giving zero weight to the members with wrong trend.

For the static weighting, results showed that the simple equal weight was already giving satisfactory results. The scheme with previous-year performance only gave a small improvement to the ensemble mean as compared to the mean with uniform weights. The weighting using combined performance metrics also gave a small improvement. The dynamic weighting using previous-day error resulted in stronger improvements. Giving zero weight to half of the members with high error was resulting in a significant improvement of ensemble mean NSE. The weight based on the trend, however, only improved the ensemble mean a little bit compared to the equal weighting. Note that part of these results may be specific to the case study water system of Rijnland, which is a highly controlled water system.