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Ensemble hydro-meteorological predictions for end users

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Three questions are central from the end user water manager perspective towards ensemble hydro-meteorological forecasts. The first question is "Why do we need hydro-meteorological forecasts for our water system at all?" This usually comes from the need to increase management horizons to enhance anticipatory management of extreme events. The second question is "How should we use these ensemble forecasts in our water management?" The third is "Now that we know how we should use them, do the benefits outweigh the costs?" Of course there are many refinements to these questions and other possible formulations of these questions. To the third question, for example, we scientist normally add that we are looking for the "expected" benefits. The question of the benefit is asked to inform policy makers to help decide on whether to include the use of ensemble forecasts in their operational strategy and guidelines. The second question needs to be answered before you can answer the third. We first need to know how the ensemble hydro-meteorological forecasts can be best produced, and how they can be best used in decision making for operational management. The criterion to determine what is the best way of using the forecasts, e.g. to know how to use them, is usually "the expected benefit". Therefore, an iterative process is needed in which for several strategies the expected benefit is determined to find the strategy that gives the maximum expected benefit (hence, question 2 and 3 are interdependent of each other). Of course, optimisation methods can help in reducing the number of strategies that need to be tried before the best strategy is found. Because operational management concerns real-life applications, formalising the benefits, in order to come up with a well-defined optimisation problem and objective function, is usually much more complicated than, for example, setting up an auto-calibration problem.

A framework is presented that helps water management authorities and their operational water managers to answer their questions about ensemble forecasting and to decide whether it is beneficial for the management of their particular water system to use the forecasts. The framework is implemented for a case study on flood control in the Netherlands. Optimal anticipatory water management strategies on the basis of ensemble hydro-meteorological forecasts are presented. The results show that flood damage can be reduced significantly with limited costs of adverse effects.