Correction of the underdispersion of hydrological ensemble predictions and data assimilation

submitted by Rio Tinto

Rio Tinto operates several hydroelectric power plants in Canada and uses hydrological models in order to predict future contributions to various reservoirs. Since the hydrological model is continuous, it can be represented by a process describing the evolution of the water balance in space and time. The uncertainty in the model inputs and model structure, however, generates gaps between the states simulated in the model and the observed states. In the majority of cases, the ensemble predictions given by the model are overconfident and do not reflect the true system uncertainty. We are looking for a method that measures the “missing” uncertainty in predictions for diverse periods of the year, where the hydrological processes vary a lot (e.g., rain in summer, snow in winter, melting in spring). Moreover, when we are about to run the model, there may be a significant gap between the true state of the hydrological system and the state considered by the model. An assimilation method for finding the best predictor of the true current state, based on the model states, should be implemented. In this case, the analysis of the errors and uncertainties of hydrological prediction should depend upon the assimilated state at the time of launching the prediction. Such a system will incorporate the statistical assimilation of the states of the hydrological model and of the measured predictive uncertainty; it will allow the computation of high-quality (unbiased and adequately dispersed) hydrological predictions, as well as reducing the uncertainty pertaining to hydrological predictions. Ultimately such a system will allow the company to use the water resource in a more efficient manner and produce more hydroelectricity with the same amount of water.