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Development of a probabilistic streamflow forecasting system for New Zealand

M. Clark, **R. Woods**, R. Ibbitt, J. Schmidt, D. Rupp, and M. Uddstrom
NIWA, P.O. Box 8602, Christchurch, New Zealand (mp.clark@niwa.co.nz)

Streamflow forecasts are inherently uncertain. Such forecasts are typically produced by forcing a hydrologic model with historical station data to estimate land surface moisture states at the start of the forecast period (e.g., snowpack and soil moisture), and then forcing the hydrologic model with local-scale weather and climate forecasts spanning days to months into the future. Uncertainties in streamflow forecasts therefore stem from uncertainties in weather and climate forecasts, uncertainties in basin initial conditions, and uncertainties in the hydrologic model itself.

Given all sources of uncertainty, streamflow forecasts are necessarily probabilistic. Probabilistic streamflow forecasts are produced using ensemble methods, in which a finite number of equally plausible climate forecasts are run through a hydrologic model to produce a finite number of equally plausible forecasts of streamflow. Hydrologic uncertainty is incorporated into this framework by initializing the hydrologic model with different land surface moisture states and by running the hydrologic model with different parameter sets (or using a number of different hydrologic models). Probabilistic assessments of risk are then be produced by simply counting the number of ensemble members above a pre-defined threshold.

This presentation will review recent research in New Zealand on methods to produce probabilistic streamflow forecasts. It will provide examples of methods to quantify uncertainty in precipitation fields; methods to quantify uncertainty in hydrological models (parameters, structure); methods to assimilate observations into hydrological models, and reduce hydrological uncertainty; and methods to construct ensembles of weather and climate forecasts from publicly-available atmospheric models in a form that is suitable for use in hydrological models. The presentation will also discuss interactions among the various sources of uncertainty and the associated difficulties in

explicitly quantifying total hydrological uncertainty.