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Effect of initial conditions of a catchment on seasonal streamflow prediction using ensemble streamflow prediction (ESP) technique for the Rangitata and Waitaki River basins on the South Island of New Zealand

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Increased access to water is a key pillar of the New Zealand government plan for economic growths. Variable climatic conditions coupled with market drivers and increased demand on water resource result in critical decision made by water managers based on climate and streamflow forecast. Because many of these decisions have serious economic implications, accurate forecast of climate and streamflow are of paramount importance (eg irrigated agriculture and electricity generation). New Zealand currently does not have a centralized, comprehensive, and state-of-the-art system in place for providing operational seasonal to interannual streamflow forecasts to guide water resources management decisions. As a pilot effort, we implement and evaluate an experimental ensemble streamflow forecasting system for the Waitaki and Rangitata River basins on New Zealand's South Island using a hydrologic simulation model (TopNet) and the familiar ensemble streamflow prediction (ESP) paradigm for estimating forecast uncertainty.

To provide a comprehensive database for evaluation of the forecasting system, first a set of retrospective model states simulated by the hydrologic model on the first day of each month were archived from 1972-2009. Then, using the hydrologic simulation model, each of these historical model states was paired with the retrospective temperature and precipitation time series from each historical water year to create a database of retrospective hindcasts. Using the resulting database, the relative importance of initial state variables (such as soil moisture and snowpack) as fundamental drivers of uncertainties in forecasts were evaluated for different seasons and lead times. The analysis indicate that the sensitivity of flow forecast to initial condition uncertainty is depend on the hydrological regime and season of forecast. However initial conditions do not have a large impact on seasonal flow uncertainties for snow dominated catchments. Further analysis indicates that this result is valid when the hindcast database is conditioned by ENSO classification. As a result hydrological forecasts based on ESP technique, where present initial conditions with histological forcing data are used may be plausible for New Zealand catchments.