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Conditional Weather Resampling Method for Seasonal Ensemble Streamflow Prediction

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Ensemble Streamflow Prediction (ESP) is a commonly used method for water resources planning on the seasonal time scale. The starting point for the ESP is the current state of the hydrological system, which is generated form a short historical simulation up to the time of forecast. Starting from this initial state, a hydrologic model is run to produce an ensemble of possible realizations of future streamflows, taking meteorological time series from historical years as input. It is assumed that these historical weather time series represent climatology. One disadvantage of the original ESP method is that an expected deviation from average climatology is not accounted for. Here, we propose a variation to the ESP, in which shorter periods from historical time years are resampled and assembled to generate additional possible realizations of future weather. The resampling is done in such a way as to incorporate statistical deviations from the average climate that are linked to climate modes, such as El Niño Southern Oscillation (ENSO) or Pacific Decadal Oscillation (PDO). These climate modes are known to affect the local weather in many regions around the world. The resampling of historical weather periods is conditioned on the climate mode indices, starting with the current climate index value and searching for historical years with similar climate indices. The resampled weather time series are used as input for the hydrological model, similar to the original ESP procedure. The method was implemented in the operational forecasting environment of Bonneville Power Administration (BPA), which based on Delft-FEWS. The method was run for 55 non-operational years of hindcasts (forecasts in retrospect) for the Columbia River in the North-West of the U.S. An increase in forecast skill up to 5% was found relative to the standard ESP for streamflow predictions at three test-locations.