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Assessment of Uncertainty in Hydrologic Projection for Distinct River Basins under Climate Change

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Quantifying and reducing the uncertainty in future projection of runoff change are key issues in aiding water resources managers for decision making under the stress of changing climate. In this study we focus our attention on the hydrologic uncertainties attributed from different local geospatial characteristics. To investigate the hydrologic uncertainty under climate change, two river basins in Oregon, USA were selected. The basins are located in proximity to each other where the identical temperature marine climate characterizes the dry summers and wet winters for both basins. However, one river basin is dominated by snowfall and snowmelt in the winter and early spring seasons, the other is dominated by rainfall for all seasons. Precipitation Runoff Modeling System (PRMS), , a physically-based and semi-distributed hydrologic model developed by the U.S. Geological Survey, is used to assess the uncertainty from various sources. This study uses the simulations of eight General Circulation Models (GCMs) and two emission scenarios to address the uncertainties arise from the GCM structure and emission scenarios. Latin Hypercube Sampling (LHS) is employed to sample the PRMS model parameter space and estimate the behavioral parameter sets according to the Nash-Sutcliffe efficiency criterion. Our results showed considerable differences in the river basins future projections as a result of climate change. Changes in winter runoff are more affected by hydrologic model parameter uncertainty in the snowfall-dominated basin, while they are less affected in the rainfall-dominated basin. The differences in the amount and timing of snowmelt as a result of model parameter uncertainty contribute to the variations of change in winter runoff in the snowfall-dominated basin. This also indicates that climate change impact assessment in the snowfall-dominated region would need more caution for interpreting the runoff projection where reliability in hydrologic model parameters will play an important role.

Key words
Hydrological uncertainty, Climate change impact, Water resources, Snowmelt, PRMS