Title: Diagnosis of streamflow prediction skills in Oregon using Hydrologic Landscape Classification

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Abstract: A complete understanding of why rainfall-runoff models provide good streamflow predictions at catchments in some regions, but fail to do so in other regions, has still not been achieved. Here, we argue that a hydrologic classification system is a robust conceptual tool that is well equipped to characterize the success or failure of a rainfall-runoff model at regional scales. We use a spatially lumped rainfall-runoff model to predict daily streamflow at 88 catchments in Oregon and analyze its performance within the context of Oregon Hydrologic Landscape (OHL) classification developed by scientists at EPA. OHL classification is used to better understand the physio-climatic conditions that potentially favor high (or low) hydrologic predictability within Oregon. Results show that high predictability catchments (Nash-Sutcliffe efficiency NS > 0.75) are predominantly classified as having very wet climate, winter seasonality of water surplus (rain dominated), low aquifer permeability, and low to medium soil permeability. Most of these catchments are located in the western part of Oregon (west of the Cascade Mountain Range). Conversely, low predictability catchments (NS < 0.6) show propensity towards spring seasonality of water surplus (snow dominated), high aquifer permeability, and medium to high soil permeability. They are mainly located in the volcano-influenced regions near the High Cascades. Results suggest that poor characterization of snow processes and difficulty in estimating external gains and losses of deep groundwater are the primary reasons for low predictability in Oregon. We recommend that low predictability catchments must be dealt with on a case-by-case basis, where a combination of increased model complexity and additional input data is likely to improve streamflow predictions.