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Spatial variability based streamflow predictions across United States: Role of climate and topography in predictability at ungauged basins

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Predictions of streamflow in ungauged basins are required in many regions of the world and across a wide range of environmental settings. However, the physiographic and climatic conditions that favor better predictability at ungauged catchments are still not fully known. In this study, we use the data from 756 gauged catchments across the continental United States to simulate daily streamflow at ungauged catchments using the distance-weighted average of streamflow values from neighboring gauged catchments. Results show that $\sim$ 40% of the catchments have high predictability with NS > 0.7, while 25% of the catchments have poor predictability (i.e. NS < 0.3). High predictability catchments (NS > 0.7) are mostly located along Appalachian Mountains in the east, Rocky Mountains, and Cascade Mountains in Pacific Northwest. Low predictability catchments (NS < 0.3) are located mostly in the drier regions west of Mississippi river. Positive trends with respect to NS are observed in channel slope, runoff ratio, baseflow runoff ratio, and the slope of flow duration curve. Results suggest that good predictions at ungauged basins are more likely in runoff dominated regions than in ET dominated regions. High predictability catchments tend to be in energy limited humid regions, whereas low predictability catchments are more likely to be in water limited dry regions. By identifying the high and low predictability regions within US, this study provides a better understanding of the conditions that control spatial variability of hydrologic response within a region.