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Evaluating Hydrologic Processes and Their Drivers For a Large Geographical Domain

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Hydrologic processes are well understood in many locations worldwide and this understanding is commonly encoded as perceptual models of hydrologic behavior. Currently lacking is a large-scale synthesis of this understanding: it is difficult to accurately describe the relation between the drivers of hydrologic behaviors and the resulting hydrologic processes for a given point in space. As large-sample and large-domain modeling is increasingly used, knowledge of the relationship between drivers and processes is crucial to inform modeling decisions, such as the choice of process parametrizations and spatial discretization. Therefore, there is a need to investigate the relationship between hydrologic drivers and processes for large geographical domains. Here, we report progress on a detailed analysis of the connection between hydrologic processes and drivers.

Previous studies have investigated the relationship between hydrologic signatures and drivers, identifying climate attributes as the dominant driver in most locations. However, these previous studies did not find clear results for the importance of additional drivers and/or did not focus on a clear connection to hydrologic processes. We investigate the importance of additional drivers, such as land use, subsurface properties, and topography, and their relationship with hydrologic processes in different hydrologic landscapes. These landscapes are derived from a large community-driven initiative and are intended to provide a high-level division of the North American continent into smaller regions that should have distinct hydrologic behavior. For this purpose, we use large sample datasets for the United States and Canada, which help systemize the importance of drivers in time and space and the processes they influence.

We evaluate the inter and intra-region variations in signatures and drivers using various statistical analysis methods. Preliminary results confirm that (i) these hydrologic landscapes capture meaningful differences in dominant processes and (ii) the statistical analyses often highlight the most influential drivers within each region and their resulting processes. We will use the gained knowledge to adjust model structures to improve process representation across the continent.