The Nested Nature of Hydrologic Systems and Its Implications for River Corridor Processes

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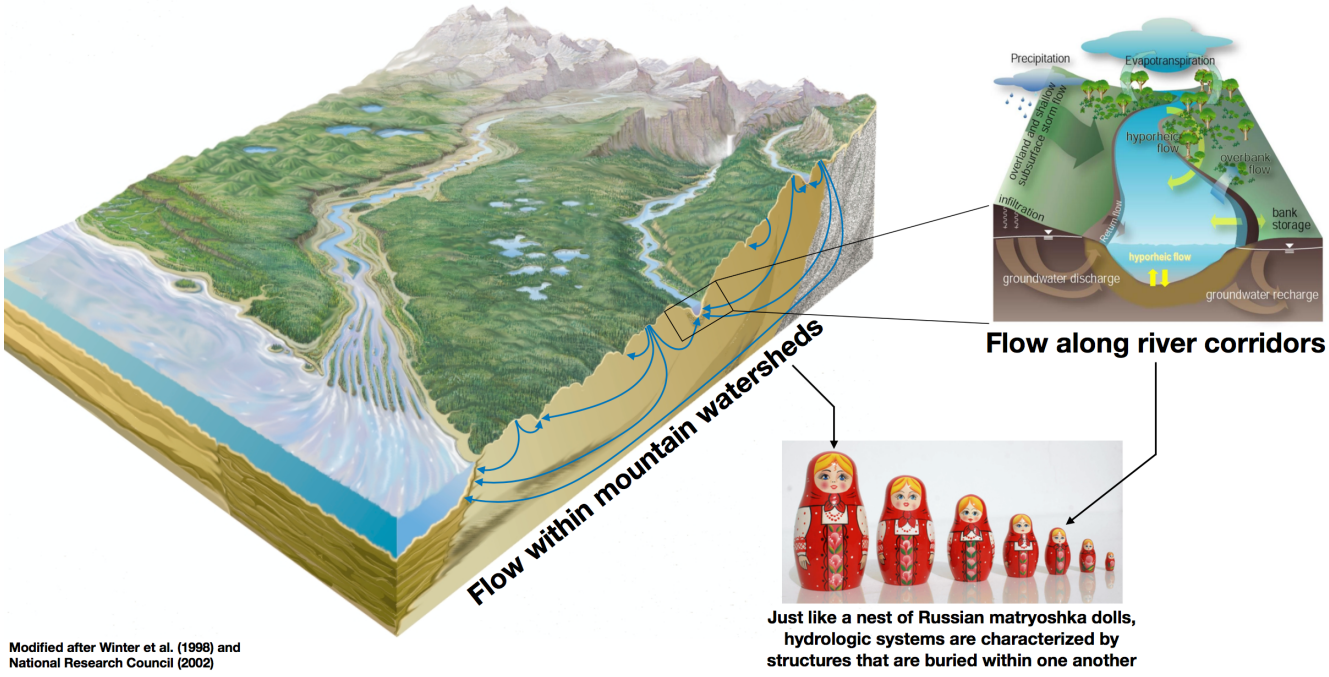
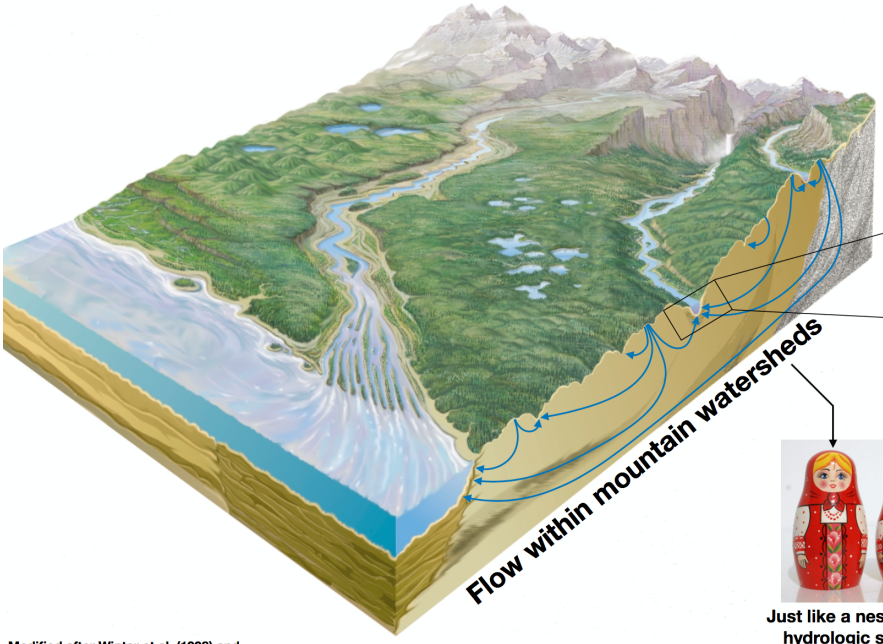
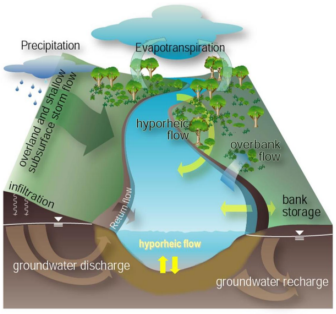
Mechanistic understanding of watershed and river corridor processes is critical for modeling and prediction and to sustainably manage water resources under present and future socio-economic and climatic conditions. Just like a nest of Russian matryoshka dolls, hydrologic systems are characterized by structures that are buried within one another. As we unpack smaller dolls, we find commonalities but also important differences that set aside each scale. For more than half-a-century, starting with Hubbert's and Tóth's seminal works, we have conceptualized hydrologic systems as a collection of nested flow paths ranging from small-scale circulation underneath river bedforms to large regional groundwater flow. This nesting has significant implications for flow, storage, and transformations within hydrologic systems, and therefore it is fundamental to transfer information across scales appropriately. In this talk, I explore the role of nesting in river corridors and investigate how nesting of flow paths influences critical reactions controlling water quality due to increasing contact time with geochemically and microbially active sediments in hyporheic zones, floodplain areas, and ponds and lakes. I focus on our ability to use local scale understanding to propose up-scale models that can be used for predictions along river networks over continental scales. Parsimonious models that take advantage of this understanding will play a vital role in the design, implementation, and evaluation of sustainable management practices that target both water quantity and quality at the scale of the nation.





Modified after Winter et al. (1998) and National Research Council (2002)



Flow along river corridors

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