Poster #21-74

Exploring the Synchrony of Hydrologic Exchange Processes Along River Corridors

Jesus D. Gomez-Velez[1*], Judson W. Harvey[2], Durelle Scott[3], Noah M. Schmadel[2], Xingyuan Chen[4] (Co-PI), Tim Scheibe[4] and Bowen He[1]

[1] Vanderbilt University, Nashville, TN
[2] United States Geological Survey, Reston, VA
[3] Virginia Tech, Blacksburg, VA
[4] Pacific Northwest National Laboratory, Richland, WA

Contact: jesus.gomezvelez@vanderbilt.edu

BER Program: SBR
Project: PNNL SBR SFA
Project Website: https://sbrsfa.pnnl.gov/

This element of the PNNL SFA seeks to understand and quantify the hydrologic connectivity of river corridors by studying relationships among river channels, hyporheic zones, floodplains and ponded waters and their relative roles in hydrologic exchange. 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. In this work, we used the model Networks with EXchange and Subsurface Storage (NEXSS) to assess when and where different hydrologic exchange processes are active along rivers within the continental United States. In particular, we investigate the synchrony of exchange between river channels and their adjacent hyporheic zone, floodplain, and ponded waters. Synchrony is expected to amplify the biogeochemical effects of river corridor connectivity, resulting in a dominant control for water quality at the local and watershed scales. Asynchrony, on the other hand, is expected to attenuate the effects of connectivity. Using a simple routing scheme, we translate NEXSS estimates of fluxes and residence times into a cumulative measure of river corridor connectivity at the watershed scale, differentiating the contributions of hyporheic zones, floodplains, and ponded waters. We find that the relative role of these exchange subsystems changes seasonally, driven by the intra-seasonal variability of discharge. We also find that the interplay between exchange processes varies with location, typically characterized by asynchrony in low-order streams and synchrony in high-order rivers. Understanding the competing nature of exchange processes is critical to represent connectivity in physics-based models for water quality and to design, implement, and evaluate sustainable water management practices at the scale of the nation.