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Hyporheic exchange flows - hydrology challenges for biogeochemical understanding

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Hyporheic exchange flows provide a connection for biogeochemical interaction between the surface stream channel and the adjoining shallow subsurface areas of the catchment. Hydrologic interpretation of hyporheic exchange flows is critical and a continuing challenge, in developing quantitative understanding of the biogeochemical processes in streams and their catchments. Three challenges for understanding hyporheic exchange flows relate to (1) the time scales along the flowpaths, (2) the catchment's landscape determinants of the flowpaths, and (3) the influence of these flows in catchment solute dynamics. In the breadth of research in the current literature the challenges to further understanding of hyporheic exchange flows are being met with analysis in a variety of modeling contexts. The modeling contexts are supported and ultimately derived through experimentation and measurement in the field.

Ongoing field studies (with the authors' many colleagues) in streams in Colorado (Mineral Creek, Silverton, Colo.) and Montana (Stringer Creek, Tenderfoot Experimental Forest, Montana) are documenting meter-scale variations in stream-catchment connections of which hyporheic exchange flows are a component. Transient Storage Models (TSM) are a tool for interpretation of the in-stream responses of solute transport for streams influenced by hyporheic exchange flows. The USGS code OTIS [http://co.water.usgs.gov/otis/] is a TSM used in numerous streams [for examples, see http://smig.usgs.gov/SMIG/transtor_reader1.html]. Work by several investigators continues to develop the utility of the TSM while a variety of process-based tools are being used, again by several investigators, to develop understanding of the hydrologic mechanisms by which streams are connected with their catchments.