StorAge Selection functions as a subgrid parameterization of groundwater transport in watersheds - progress and challenges

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Water age is a useful conceptual framework both for empirically analyzing tracer data, and for translating the resulting understanding into computational tools for water quality prediction. In this talk I will discuss how the development of StorAge Selection (SAS) functions over the last several years has spurred progress toward the goal of improving water quality predictions at the catchment scale, while also clarifying serious challenges that currently hold us back from achieving that goal.

Empirical studies using SAS are now demonstrating more clearly than ever that the age distribution of the stream water is heavily skewed, time-variable, and weakly bounded. The complexity of flow pathways in the shallow subsurface means some water can be delivered to the outlet very quickly, and other water can move through storage over years, decades and centuries, with a distribution that is heavily skewed compared to the simple case analogous to a ‘well-mixed’ tank. SAS functions provide a means to capture this complexity in a probability distribution that captures the emergent effect of the finer-scale complexity without resolving it explicitly. Furthermore they can account for the time-variability of transport processes.

However it is also becoming clear that the observed tracer data variance in the short term is primarily determined by, and informative of, only the younger components of the flow. This challenges us to avoid over-interpreting empirical observations, and may stymie efforts to compare SAS functions between watersheds if not addressed carefully.