



## **Normal isn't better: why normalizing the support of StorAge Selection functions is unnecessary and inhibits catchment intercomparison**

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The development over the last several years of StorAge Selection (SAS) functions as a generalization of transit time distributions has improved our ability to interpret catchment tracer data, and spurred progress toward the development of better models of solute transport at the catchment scale. However the SAS framework depends on the parameterization of a probability distribution that is an emergent catchment property, whose relationship to the measureable characteristics of the landscape is not well understood at this time. That relationship is essential if the SAS approach is to advance our ability to make predictions about stream solute dynamics in ungauged basins.

One way to develop the needed understanding is to compare SAS functions inferred from tracer timeseries data collected in multiple catchments. However I argue that certain methodological details of the SAS approach threaten to stymie this intercomparison. This threat is easily avoided, but is not widely understood.

The central issue revolves around whether to express the SAS function as a probability distribution of age-ranked storage, or age-ranked storage normalized by total storage. Some regard the latter as preferable, since the SAS function can then be parameterized from the menu of probability distributions defined on the [0,1] interval (e.g. a beta distribution). However to accomplish this normalization one must know the total storage in the catchment. This quantity is challenging to define conceptually, let alone measure with any degree of accuracy. By normalizing the support of the SAS function by total storage, this murkiness and uncertainty is passed on to the entire function – from the young fractions whose contributions might be somewhat constrained by stable isotope data, to the older fractions that are not so constrained. This uncertainty then has the potential to obscure any patterns in the empirical data that might relate catchment architecture to SAS function form.

Since methods to quantify the age-dependent uncertainty of SAS functions are not yet developed, the danger of this normalization is not well understood. In this presentation I will use synthetic examples (where the 'true' SAS function is known) to demonstrate the problem. I will also show how avoiding the problem is trivial – simply express the SAS function as a probability distribution over age-ranked storage, without normalization.