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An intuitive approach towards the search for similarity principles in watershed hydrology

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A great many attempts have been made to come with dimensionless similarity variables that are able to help characterize hydrologic response at the watershed and hillslope scales. Most of these have failed to catch the imagination of the hydrological community – this has to do with inadequate data on a large enough sample of catchments, and the lack of unifying theories to underpin these similarity indices. Conversely, the lack of dimensionless similarity variables and an associated classification system has been an impediment towards the development of new theories. In this paper we pursue simple intuitive reasoning to formulate or re-iterate a number of existing or new dimensionless similarity parameters that may be useful in watershed hydrology. We start with E_p/P, the ratio of annual potential evaporation to annual precipitation, which is a basic measure of climate. The second number we consider is the ratio of average or typical 1D soil moisture storage capacity, W, to annual precipitation, W/P. On the sub-annual time scale, other climatic measures include the ratio of the amplitude of seasonal variation of potential evaporation to precipitation. Similarly we can include the ratio of the standard deviation of soil moisture storage capacity spatially within the catchment, δW, to the annual precipitation, $\delta W/P$. The above measures only can explore the physical controls on monthly and annual water balances. The amount of time that water spends inside the catchment is important for the monitoring of antecedent conditions, and short-term rainfall-runoff responses. The ratio of mean duration of storm events and the amount of time water is held within various compartments of the watershed determine the nature of partitioning of incoming precipitation into the various elements. This leads to a series of dimensionless similarity parameters. The residence time in the watershed can be explained in terms of medium or surface properties and the lengths of travel and this leads to a further set of dimensionless numbers.

The talk will present the complete set of dimensionless numbers, the ideas for which are essentially drawn from the literature. It will conclude with a discussion of the research that is needed to assess explanatory power of these numbers.