Kolloquium
Boden und Wasser

23. Oktober 2014, 16 ct – 18 Uhr
Hörsaal Fahnenbergplatz (Rektoratsgebäude)

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Water quality on time scales from hours to decades: dispersive transport at the hillslope scale, catchment travel-time distributions, non-self-averaging, and challenges for trend detection

Stream water quality varies across a wide range of time scales, under the influence of hydrological forcing, anthropogenic drivers, and biogeochemical processes. Catchments also store waters over a wide spectrum of residence times, further complicating efforts to understand water quality trends. Here I explore these issues using water quality time series spanning the periodic table, from H^+ to U, on time scales from hours to decades.

Catchments are characterized by preferential flow, strong conductivity gradients, and heterogeneity on all scales. These properties lead directly to the strongly skewed, nearly scale-free travel time distributions that describe many catchments. These distributions, in turn, give rise to fractal scaling in stream chemistry across diverse solutes and wide ranges of time scales.

I show that these water quality time series share a universal 1/f spectral signature, and are not self-averaging: that is, averages taken over longer and longer time periods do not converge to stable means. Such time series defy the Central Limit Theorem and the standard regimen of statistical tests that are based upon it. Statistically significant trends arise much more frequently, on all time scales, than one would expect from conventional statistics. These same trends are also poor predictors of future trends – much poorer than one would expect from their calculated uncertainties – and having more data makes these problems worse. The implications of these findings for trend analysis and change detection will be discussed.