Geophysical Research Abstracts
Vol. 21, EGU2019-8056, 2019
EGU General Assembly 2019

Using streamflow electrical conductivity to infer the high-frequency behaviour of major ions: theory and application to a semi-urban catchment in Switzerland

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The hydrologic response in most catchments takes place within a few hours and so the window to observe transient catchment behavior is very narrow. Missing the rising limb and the early recession of a storm often means losing the most informative part of a timeseries. Hence, measuring stream water at high frequency is key to understanding catchment behavior, but it can become rather expensive, especially when measurements take place at multiple locations and over long periods.

When direct high-frequency measurements are unfeasible, it can be possible to reconstruct high-frequency timeseries for some major ions starting from low-frequency solute concentration measurements and quasi-continuous electrical conductivity (EC) data. This methodology has been previously tested in an undisturbed upland catchment and it is here applied to nested subcatchments from a semi-urban watershed near Lausanne, Switzerland.

Application to individual storm events shows that, in most cases, major ions have a similar dilution pattern and the EC-based method provides an accurate estimate of their dilution. The EC signal also reveals diurnal patterns during low-flow period and, in winter, it can help quantify the effects of road salting. This allows drawing some first conclusions on the transport processes that characterize these catchments. While results are specific to this case study, the approach is general and can be used to reconstruct event-scale behavior at other locations worldwide.