DOC and Nitrate Export Linked to Dominant Rainfall-Runoff Processes, End-Members and Discharge – a Long-Term High Frequency Measurement Campaign

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Background & Methods

Innovative Measurements
- Field deployable UV-Vis spectrometer (spectro: lyser)
- 2 year times series
- In-situ high frequency (15 min) measurements of DOC, nitrate, turbidity and the light absorption spectrum from 220 to 720 nm (cross-section of 2.5 nm)

Research Area
- 45 ha headwater experimental catchment
- 100% forested (mixed forest)
- Loamy soils (0.5 to 2 m)
- Bedrock: schist

Calibration of In-Situ Measurements
Automatic sampling of several events and weekly to biweekly manual sampling. Comparison of the lab results of the grab samples with the in-situ measurements of the spectrometer.

Linking DOC and Nitrate Concentrations to Rainfall-Runoff Processes

Event Separation & DOC and Nitrate Concentration in Runoff

- High flows in winter: high nitrate concentrations
- Recession periods in spring: increasing DOC and decreasing nitrate concentrations.
- Lowflow and low flow in summer: strong rainfall events creating DOC and nitrate peaks.

Separating Fluxes during Events

DOC and Nitrate Export

Export separation between first (1) & second (2) peak and evenflow (E) & baseflow during event (B)

Concentration Probability Separated by Events & Discharge Volume

Over the entire 2 year period, the majority of DOC and nitrate export happens during the 2nd peak (E2) and the baseflow periods. During first peaks, a higher ratio of DOC (compared to total export) is exported than for nitrate.

Conclusion
DOC and nitrate export show an almost linear constant relationship with discharge volume. Exceptions are the low flow periods in summer and fall (e.g. April to July and September to October 2014):
- Steeper slope for DOC, due to higher importance of export during first peaks (E1).
- Flatter slope for nitrate, due to inexistence of second peaks (E2).

Results & Conclusion

Wet initial conditions:
Double runoff peak behaviour:
Delayed 2nd peak explained by a delayed runoff reaction via subsurface/shallow groundwater flow with increased nitrate concentrations.

Dry initial conditions:
One runoff peak together with a strong peak in DOC and nitrate concentration explained by a fast near surface runoff reaction.

DOC and Nitrate Concentrations in Various End-Members

Groundwater, R=rainfall; RF=riverine zone, SS=soil solution, SW=stream water, TH=throughfall
- Biweekly sampling of various end-members.
- Soil water has a high DOC concentration than groundwater and vice versa for nitrate.
- High DOC (& nitrate) concentration in throughfall.

DOC: highest concentration at low flows & first peak
Nitrate: highest concentration at high flows

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