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Can runoff event types explain some scatter in nitrate C-Q relationships?

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Nitrate contamination of rivers from agricultural sources, is a challenging problem for water quality management. The relationship between solute concentrations and streamflow rates (C-Q) observed at catchment outlets provide useful information on hydrological functioning and biogeochemical transformations at catchment scale. Nevertheless, nitrate C-Q relationships (linear regression in log space) often exhibit a considerable scatter.

During runoff events, different nitrate transport paths within the catchment might be activated, generating a variety of responses in nitrate concentration. We hypothesize that the differences in characteristics of runoff events, such as different portions of rainfall and snowmelt contributions or antecedent wetness states, can explain some observed scatter in long-term C-Q relationships of nitrate.

To investigate this hypothesis, we analyzed low frequency nitrate data from 184 German catchments during different types of runoff events and quantified the deviations of the C-Q relationship for different event types. First, we computed the long-term C-Q relationships for each study catchment. Then, we attributed each nitrate grab sample to the corresponding runoff event type or non-event conditions, based on the nature of the inducing event and the antecedent wetness states of the catchments. Finally, we quantified the deviations from the long-term C-Q relationship.

We found pronounced deviations of different event types from the long-term C-Q relationships in most of the study catchments. During snow-impacted events, deviations are normally positive, indicating higher nitrate concentrations than the long-term C-Q relationships. On the other hand, deviations of rainfall events during dry antecedent conditions are mostly negative. Moreover, for

rainfall events during wet antecedent conditions, we do not find persistent deviations from long-term C-Q patterns. Pronounced differences in event runoff coefficients among different event types indicate that contrasting levels of hydrological connectivity are a key control of C-Q deviations among different event types.