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How runoff components affect the export of DOC and nitrate: a long-term and high-frequency analysis

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The forested Weierbach catchment (0.45 km2) in Luxembourg exhibits a distinct double discharge peak behavior in response to rainfall events occurring during wet initial conditions. During dry conditions only a single discharge peak is generated. For two years, we monitored with a UV-Vis spectrometer every 15 minutes in-stream nitrate and dissolved organic carbon (DOC) concentrations. The observed concentrations always increased during the first discharge peak – both during dry and wet conditions. Additionally, nitrate concentrations increased during the second discharge peak in wet conditions, while the DOC concentrations would remain constant. Relying on additional biweekly end-member data of precipitation, throughfall, soil water and groundwater, we linked the first peak to near surface flowpaths. The second peak was related to shallow groundwater reactions and subsurface flowpaths. Soil water had higher DOC concentrations and the shallow groundwater exhibited higher nitrate concentrations.
The mass export of nitrate and DOC is mainly controlled by the discharge yield. Nevertheless, this relationship is altered by changing flowpaths during different wetness conditions in the catchment. During dry conditions - when second discharge peaks are absent – the nitrate export is less relevant and DOC export is dominant. Our study highlights the benefits of in-situ, long-term, and high-frequency monitoring protocols for comparing DOC and nitrate exports with runoff components that are rapidly changing during events, as well as gradually evolving between seasons.