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Diel fluctuations of viscosity-driven riparian inflow affect streamflow DOC concentration

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The mechanistic assumption for diel fluctuations of DOC concentrations in stream water generally refers to different instream processes. At the outlet of the forested Weierbach catchment (0.45 km2), we installed a UV-Vis spectrometer for 18 months that measured in-situ the light absorption spectrum of the stream water from 220 nm to 720 nm every 15 minutes. Additionally, the spectrometer directly calculated the DOC concentration in the stream. During days that were not affected by rainfall-runoff events we generally observed diel DOC fluctuations with a maximum value in the afternoon. We investigated the origin of the DOC by using SUVA-254, the specific UV absorbance at 254 nm. The SUVA-254 index is a good indicator for the aromaticity of DOC. DOC from terrestrial sources has a higher aromaticity and therefore higher SUVA-254 values. Based on this relationship and the observation of SUVA-254 peaks in the afternoon we identified that the DOC peaks in the stream were caused by an increased input of terrestrial DOC in the afternoon. We explained the increased terrestrial DOC input with the viscosity effect in the riparian zone that was observed in the Weierbach catchment. In the upper layers of the saturated riparian zone water gets heated during the day, eventually leading to a decrease in water viscosity and therefore an increase in hydraulic conductivity. Consequently, more water from the DOC-rich upper layers of the riparian zone tends to flow towards the stream and contributes to streamflow in the afternoon. In this study we showed that not only instream processes are responsible for the diel fluctuations in DOC concentrations. Also viscosity-driven diel fluctuations in terrestrial DOC input should be considered for explaining diel DOC patterns. We believe that our findings are also of relevance for explaining diel fluctuations of other parameters in stream water.