Geophysical Research Abstracts
Vol. 20, EGU2018-6532, 2018
EGU General Assembly 2018

Groundwater storage as a major control of seasonal stream water quality dynamics during both base and storm flows

Ophelie Fovet (1), Remi Dupas (1), Gerard Gruau (2), Laurent Jeanneau (2), Anne Jaffrezic (1), Laurent Ruiz (1), Guillaume Humbert (3), Marie Denis (2), Sen Gu (2), Laurent Strohmenger (1), and Chantal Gascuel-Odoux (1)

(1) UMR 1069 SAS, INRA AgroCampus Ouest, Rennes, France (ophelie.fovet@inra.fr), (2) UMR 6118 Geosciences Rennes, OSUR, CNRS, Universite Rennes 1, Rennes, France, (3) UMR 6553 ECOBIO, OSUR, CNRS, Universite Rennes 1, Rennes, France

Stream water quality exhibits dynamics at various time scales that are controlled by the spatiotemporal dynamics of hydrobiogeochemical compartments, particularly by the dynamics of their connectivity to the stream. Based on long-term catchment observations from the AgrHyS Observatory (France), we established relationships between stream water quality and groundwater storage dynamics on various time scales. Those observations combine stream water concentrations of Dissolved Organic Carbon (DOC), Nitrates (NO_3) and Phosphorus (SRP) concentrations, and a network of piezometers along 2 transects to characterize groundwater storage and quality in space and time.

At the annual scale, the rise of groundwater table is delayed between the riparian area (early autumn) and the upslope area (winter). This time lag along the hillslope is identified as the dominant control of the seasonal signal in stream base flow nutrient concentrations.

-DOC and SRP are mobilized from organic upper soils layers when reached by the groundwater table. Firstly, groundwater table rises in the riparian area, and connects the C and P sources in the organic rich riparian soils leading to high stream DOC and SRP concentrations. Then, while groundwater connectivity remains high in the riparian area, these sources are depleted leading to a progressive decrease in stream base flow DOC and SRP concentration. In the recession and low flow periods, shallow groundwater contribution decreases and other processes can influence stream concentrations.

-NO_3 are mobilized from upslope shallow groundwater and therefore nitrate annual dynamics follows the annual fluctuations of catchment water storage. At the start of the water year, the water table rise in the denitrified riparian area leads to low stream nitrate concentrations. Then, the water table rise in the upslope area leads to sudden increase in stream nitrate concentration. In the recession period, the nitrate concentration decreases variably depending on the dynamics of the groundwater recession, itself controlled by climate and vegetation demand.

Groundwater dynamics appear to control concentration dynamics not only during base flow period but also during storm events. Most of the storms occur during winter when groundwater is high and sub-surface connectivity maximal. Conversely, the events that occur during dry periods can depict very different stream concentration response because of reduced subsurface connectivity due to deeper groundwater table, leading to more variable storm flowpaths.

The two studied hillslopes show contrasting groundwater nitrate concentrations, soil organic matter and soil phosphorus content. These differences are mainly attributed to the difference in soils-groundwater interactions and in past and current farming practices.

This conceptual model of the effect of spatio-temporal variations of groundwater table depth on soil and stream water quality highlights the importance of shallow groundwater in controlling the non-stationarity and the spatial variability of water quality response in catchments. This offer new constrains for modelling water quality at different time scales.