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Effect of climate, intra and inter-annual variability, on nutrients emission (C,N, P) in stream water: lessons from an agricultural long term observatory of the temperate zone

Chantal Gascuel-Odoux (1,2), Dupas Remi (1,2), Durand Patrick (1,2), Fovet Ophélie (1,2), Gruau Gerard (3), Jaffrezic Anne (1,2), Humbert Guillaume (1,2), Merot Philippe (1,2), and Sen Gu ()

(1) INRA, Soil Agro and hydroSystem, Rennes, France (chantal.gascuel@rennes.inra.fr), (2) Agrocampus Ouest, Soil Agro and hydroSystem, Rennes, France, (3) CNRS, Geosciences Rennes, France

Agriculture greatly contributes to modify C, N and P cycles, particularly in animal breeding regions due to high inputs. Climatic conditions, intra and inter-annual variabilities, modify nutrient stream water emissions, acting in time on transfer and transformation, accumulation and mobilization processes, connecting and disconnecting in time different compartments (soil, riparian areas, groundwater). In agricultural catchments, nutrient perturbations are dominated by agricultural land use, and decoupling human activities and climate effects is far from easy. Climate change generally appears as a secondary driver compared to land use. If studied, generally only one nutrient is considered. Only long term, high frequency and multiple element data series can decouple these two drivers.

The Kervidy-Naizin watershed belongs to the AgrHyS environmental research observatory (http://www6.inra.fr/ore_agrhys_eng), itself included in RBV (French catchment network of the CZO). On this catchment, 6 years of daily data on DOC, NO_3, SRP, TP concentrations allow us to analyze the effect of seasonal and inter-annual climatic variabilities on water quality (C, N, P). Different papers have been published on the effect of climate on nitrate (Molenat et al, 2008), SRP and TP (Dupas et al, 2015) and DOC (Humbert et al, 2015). We will present first results comparing the effect of climate on these three major solute forms of C, N and P. While C and P dynamics are very close and controlled by fluctuation of water table downslope, i.e. in riparian areas, mobilizing C and P in time, nitrate dynamics is controlled by GW dynamics upslope acting as the major N reservoir. As example, the dryness conditions in summer appears a key factor of the C and P emissions in autumn. All the three solute forms interact when anoxic conditions are observed in riparian zones. These basic processes explain how climatic variability can influence and explain interactions between C, N and P emissions in stream water.

These results underline three major lack in most of our observatories: high frequency data as flood event are important for C and P emissions; multiple element approach, as very few observatories have currently C, N and P, their solute and particulate forms; climate but also soil wetness, GW fluctuations explaining biotransformation and connection between reservoirs on catchments, so that linking hydrological and biogeochimical condition is necessary to explain export. These lacks of observations is a barrier to develop process based models assessing and predicting the effect of climate on water quality.

References

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