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Characterization of phosphorus transport at spring melt in small agricultural watersheds of Eastern Canada

Eric van Bochove, Georges Theriault*, Jian Zhou, Jalal Khaldoune, Jean-Thomas Denault, Hubert Perrodin, Michel Nolin
Agriculture and Agri-Food Canada
* theriaultg@agr.gc.ca

Abstract:

This project took place in the Bras d'Henri River watershed (150 km2) located south of Quebec City. With its intensive farming system and a marked intensification of hog production in recent years, soils in this area present increasingly high phosphorus (P) contents. The small agricultural micro-watershed (240 ha) under study is characterized by the dominance of spodosols with high soil P sorption capacity and a P balance mostly in equilibrium. Nevertheless, problems of soil water erosion and surface runoff still contribute significantly to the first order stream nonpoint source pollution by P which was monitored at the watershed outlet from 2006-2007 and 2007-2008 winters. Yearly temporal patterns of particulate and soluble P transport are critical to assess P bioavailability for algae in streams but remain poorly documented particularly at snowmelt runoff. Early snow accumulation on wet soils generally results in unfrozen soils which allow meltwater infiltration at spring melt. In contrast, frozen soils present a high risk of snowmelt erosion. This project showed that snow water equivalent accumulating in different proportions onto the landscape (20-95%) and depressions (5-80%) was critical for agricultural soil and stream bank erosion at spring. Soil freezing status and water infiltration at snowmelt were studied and analyzed by the use of a GIS application. Soil temperature maps were classified at the watershed scale using RADARSAT-1 images, topography (slopes), soil types, land use, soil management, and in situ soil surface (Hobo) and soil profile (thermocouple) temperature data. Main snowmelt resulted in significant losses of particulate reactive P (0.4 mg L-1) to surface water.

Impact Statement:

Outputs: The project has joined a series of disciplines (pedology, hydrology, earth observation, agronomy, land surveying) together to acquire a better understanding of the snowmelt impacts on water quality at an agricultural watershed scale.

Outcomes: Soil freezing status maps were generated at different time during winter and main snowmelt periods. Snow water equivalent on-land repartition assessment methodology was developed and applied prior to main snowmelt in spring. Water quality parameters at watershed outlet were monitored periodically with a particular emphasis on phosphorus.

Partnerships: This segment of the WEBs (Watershed Evaluation of BMPs) project was made possible with the participation of multiple partners starting with the producers that have generously made their land accessible and Ducks Unlimited Canada as a major financial contributor.

Leverage Resources: Agriculture and Agri-Food Canada has supported this research under the Greencover Program (WEBs project). The Canadian Space Agency has also played a key role with its Earth Observation - Government Related Initiatives Program.

Lessons Learned: Impacts of snowmelt on water quality at the watershed scale in Eastern Canada are still not well understood. Preliminary results obtained from this research show that the spring melt period is a crucial event that can transport substantial quantities of sediments and phosphorus to surface water.

Category: Other Water Resource Topics
Type of Presentation: Poster Presentation