Geophysical Research Abstracts
Vol. 13, EGU2011-13145, 2011
EGU General Assembly 2011

Pollution swapping in wetland systems designed to mitigate diffuse pollution from agricultural land

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Diffuse pollution from agricultural land continues to present significant challenges to water quality research and management. One option that is of growing interest is the use of constructed ponds and wetlands for the treatment of runoff from agricultural land. Initial evidence from these constructed systems, from analogous constructed systems used to treat point-source effluents and from natural and semi-natural wetlands, suggests that multiple pollutants can be retained within wetlands. Transformations of trapped sediment and nutrients in these artificially wet areas of the landscape can result in pollution swapping, where a decrease in one pollutant may lead to an increase in another pollutant or pollutant loss via another pathway, and there is a possibility that mitigation features may become hot spots for the transfer of pollutants from land to water or air. Swapping may occur between pollutants themselves (e.g. net retention of nitrogen versus net export of phosphorus and carbon), but also between transport pathways, chemical forms, and physical fractions for individual pollutants. If fluxes of these nutrients via pollution swapping pathways are significant, it becomes important to consider the priorities for catchment management and whether mitigation of the target pollutant is appropriate in this situation, or whether the pollution swapping risk is too great. Currently, catchment management in the UK does not account for linkages of different pollutants, or provide the opportunity for joined up thinking and decision making on the role of different pollutants and local priorities. We argue that in order to obtain sustainable management of water quality, we need to have a more holistic approach to the management of diffuse pollution. A recent review of pollution swapping potential for a number of different mitigation options has highlighted the potential impacts of pollution swapping in agricultural systems, and the shear lack of evidence available and consideration of this issue in the management of water quality. In this paper, we present recent data collected from a UK catchment containing a constructed wetland, which indicate that although mitigation of P, N and C is occurring in the wetland, elevated concentrations of dissolved fractions of N, P and C in groundwater immediately underlying the wetland occur, suggesting a risk of leaching of pollutants from the wetland into the wider groundwater system. This novel data and increased understanding of the effects of mitigation will be important for future water quality models that are increasingly challenged to link land management activity with the net impact of that activity on water quality in receiving water bodies.