Geophysical Research Abstracts
Vol. 12, EGU2010-12112, 2010
EGU General Assembly 2010

The contribution of different hydrological mechanisms to nitrate removal in a re-connected floodplain.

Fotis Sgouridis (1), Catherine (Kate) Heppell (1), Geraldene Wharton (1), and Mark Trimmer (2)

(1) Department of Geography, Queen Mary University of London, London, United Kingdom (c.m.heppell@qmul.ac.uk), (2) School of Biological and Chemical Sciences, Queen Mary University of London, London, United Kingdom.

The lowland, rural floodplain of the River Cole at Coleshill (Oxfordshire, UK) was hydraulically re-connected in 1995 as part of an EU-*Life* Restoration Demonstration project (Holmes and Nielsen, 1998). By re-claiming arable land and encouraging overland flows from the river and a surrounding ditch system onto the floodplain, the project aimed to increase flood storage and habitat diversity. However, the influence of overland flooding on the water chemistry of surface and groundwater was not studied. The objectives of this research were to identify the main hydrological mechanisms responsible for the inundation regime of the re-connected floodplain and assess the relative importance of each mechanism with respect to (i) the transport of nitrate and (ii) the creation of the necessary conditions for denitrification.

Water levels were continuously monitored in two floodplain zones: (a) a buffer strip and (b) a re-claimed floodplain meadow receiving overbank flows from both the river and a surrounding ditch system, over a two year period through a network of groundwater wells, and the monitoring was complemented by river and groundwater chemistry measurements.

The results for the monitoring period 2006 - 2008 have shown that the floodplain meadow and the buffer strip were flooded between 13 and 28 % of the year, both exceeding the predicted duration of overbank flooding by the restoration project (2-4% of the year). Due to the low-angle topography and the heavy clay character of the floodplain alluvium, saturation conditions persisted for long periods of time, typically ranging between 5 and 26 continuous days, thus creating the necessary suboxic conditions for nitrate attenuation processes in the soil. Overbank flooding constituted the most important hydrological mechanism resulting in soil saturation (on average 13 overbank events per hydrological year) contributing > 80 % of the floodwater volume per event, while the annual average nitrate loading associated with overbank flooding ranged between 177 and 305 kg N ha^{-1}. Bank storage and reversed groundwater ridging were observed at the onset of certain out-of-bank events, but were restricted in extent by the low hydraulic conductivity of the floodplain sediments (0.17 - 0.83 m d^{-1}). Saturation excess overland flow was also observed during high magnitude events (rainfall intensity > 5 mm h^{-1}) but contributed $< 20\%$ of the floodwater volume and had little effect on the nitrate loading. Between 50 and 97 % of nitrate was removed along the groundwater discharge pathways between the floodplain and the river, whilst dilution could only account between 28 and 66 % of the observed reduction in groundwater nitrate concentration. Finally, an empirical denitrification model, NEMIS (Hénault and Germon, 2000), was employed to predict the contribution of denitrification to nitrate removal during overbank flooding. The results indicated that up to 39 % of river nitrate, supplied by flooding, could be removed by denitrification during winter floods, while 36 % of nitrate removal was predicted during summer floods, highlighting the importance of re-connected floodplains for nitrate removal in the light of the predicted increase of summer flooding caused by climate change.

References

Hénault, C. & Germon, J. C. 2000. NEMIS, a predictive model of denitrification on the field scale. *European Journal of Soil Science*, 51(2): 257-270.

Holmes, N. T. H. & Nielsen, M. B. 1998. Restoration of the rivers Brede, Cole and Skerne: a joint Danish and British EU-LIFE demonstration project, I-Setting up and delivery of the project. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 8: 185-196.