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The fluvial flux of dissolved nitrogen from the UK – amounts, controls and prognosis

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The UK is now recognised as one of world's hotspots for fluvial N export. This study attempts to quantify in-stream N transfers and, therefore, the loss of N at the terrestrial source; what controls these fluxes, and therefore what the prognosis is. In order to assess loss at source and loss in transit to the oceans this study takes two approaches. Firstly, the study considers the relationship between the flux of dissolved N species in a number of rivers and the soil, land use and hydroclimatic characteristics of the contributing catchment. The flux of dissolved organic nitrogen (DON), nitrate and ammonia was calculated from concentration and discharge data for the period 2001 to 2007 in 169 catchments across the UK. The results suggest that DON, nitrate and ammoniacal N flux from the terrestrial biosphere of the UK can be explained in terms of land use and soils in contributing catchments. The study also suggests that is is possible to describe the behaviour of each of dissolved species considered and that of the total dissolved N flux using an export coefficient model. In-stream losses of DON, nitrate and ammonium were estimated and the losses of dissolved N species leaving the soil source were reconstructed. Secondly, an export modelling approach was employed to estimate the transfer of nitrate from the terrestrial biosphere to the stream network across the whole of the UK from 1925 to 2007. The release of nitrate is calculated from a description of annual soil N mineralisation and immobilisation combined with an export coefficient model. Long-term records of land use (including – agriculture, forestry and urban); livestock; human population and atmospheric deposition are employed. The study shows specifically that:
i) The flux of nitrate from UK soils in the period since 1925 has varied between 420 and 1463 ktonnes N/yr, with two peaks, one in 1944 and one in 1967. The first of these peaks was caused by enhanced mineralisation of soil organic matter following radical land use change in the 1940s, and the second was a multifactorial response to land use change and agricultural intensification in the 1960s.
ii) The current trend in N release from soils appears to be downward but the current fluvial flux at the tidal limit is slowly increasing. It is possible that in the near future nitrate-N losses at the tidal limit will, in some years, exceed N losses from soils implying additional N sources for the fluvial network. This apparent gain can be explained by the breakthrough of high-nitrate groundwater into surface waters. Transfers from groundwater reflect delayed transport of N influences by historical land use and management practices.
iii) Predicted losses from UK soils at source imply that the UK will soon become a net source of total reactive N species.
The next stage of research is to compare the fluvial fluxes to other components of the terrestrial N budget in the UK.