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Coupled C, N and P controls on photosynthesis, primary production and decomposition across a land use intensification gradient and implications for land atmosphere C exchange

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The coupling of C, N and P cycles has rarely been studied through the air- land-water continuum. This is essential if we are to enhance land-atmosphere models to account for N and P limitations. It is also important for developing integrated catchment management solutions to deliver improved water quality combined with a wide range of other ecosystem functions and services.

We present results from a project which is part of the interdisciplinary pan-UK NERC Macronutrient Cycles Programme (macronutrient-cycles.ouce.ox.ac.uk/). Our aim is to quantify how coupled C, N & P cycles change across a land use intensification gradient from arable to grass, woodland and bog ecosystems and identify the implications for land-atmosphere C exchange. We focus on three key processes; photosynthesis, annual net primary productivity and decomposition and explore their consequences for biodiversity. Other aspects of the project track delivery to, and transformations within, the freshwater and coastal systems. When we explore relationships between C, N and P, results indicate all habitat types fall on a single land use intensification gradient. Stoichiometry suggests plant productivity is primarily N limited. P limitation occurs rarely but at all levels of intensification. Soil priming shows our soils are primarily C limited and, surprisingly, soil acidity provides one of the most powerful single predictors of processes and ecosystem services perhaps as it is a good integrator of many soil properties. Incorporating this knowledge into the UK land-atmosphere model JULES will improve aNPP projections. These are then being used as inputs into a plant species model called MULTIMOVE to enable future scenarios of climate change, land use and air pollution on habitat suitability for > 1400 plant species to be explored. The enhanced Jules model will ensure both N and P limitations on C fluxes from above and below-ground are incorporated into future UK scenario applications.