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LandscapeDNDC used to model nitrous oxide emissions from soils under an oak forest in southern England

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Nitrous oxide (N_2O) is an important greenhouse gas, having a global warming potential of approximately 300 times that of carbon dioxide (CO_2), and plays a significant role in depleting stratospheric ozone. Its principal source is microbial activity in soils and waters. Measured values of N_2O emissions from soils show high temporal dynamics and a large range as a result of inter-related physico-chemical factors affecting the microbial processes, thus making predictions difficult. Emissions often occur in pulses following re-wetting, frost-thaw or management events such as N-fertilization, which further complicates predictions. Process-based models have been developed to help understand this emission variability and as potential tools for IPCC Tier 3 reporting on national emission inventories.

Forests are promoted as sinks for CO_2 and can be used as renewable sources of energy or longer term CO_2 storage if timber is used in products such as in construction and furniture, provided appropriate replanting takes place. It is important that the effect of any changes in forest management and land use as a result of a desire to reduce CO_2 emissions does not increase N_2O emissions from forest soils, which are still poorly understood, compared to agricultural soils.

LandscapeDNDC (Haas et al 2012) has been developed as a process-oriented model, based on the biogeochemical model, DNDC (Li et al, 1992), in order to simulate biosphere-atmosphere-hydrosphere exchanges at site and regional scales. It can model the carbon and nitrogen turnover and associated greenhouse gas (GHG) emissions of forest, agricultural and grassland ecosystems, and allows modelling of impacts of regional land use change over time. This study uses data (including forest growth, GHG emissions and soil moisture) from an oak forest, known as the Straits Enclosure, at Alice Holt in Hampshire, where extensive measurements have been made by Forest Research since 1995. It involves validation of the site scale model and internal parameters of LandscapeDNDC for use with an oak forest in SE England and as a result facilitates the broadening of its application. Modelled N_2O soil emissions are compared with measurements from soil chambers in the forest.

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