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Hydrological controls on denitrification in riparian ecosystems

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Abstract. Nitrous oxide fluxes and denitrification rates were measured in situ over a year at a riparian site in the UK. An exponential relationship was found between denitrification rates and soil moisture, with a sharp increase in denitrification rate at a water-filled pore space of 60–80%. Similar relationships were found in other studies compiled for comparison. The present study is unique in measuring denitrification in an "intact" ecosystem in the field, rather than in cores in the field or the lab. The exponential relationship between denitrification rate and soil moisture, with a "threshold" at 60–80% water-filled pore space (20–40% gravimetric moisture), has proven to be comparable across a wide range of ecosystems, treatments and study conditions. Whereas moisture content determines the potential for denitrification, the absolute rate of denitrification is determined by available nitrate (NO_3^-), dissolved organic carbon and temperature. As a first approximation, denitrification rates can be simply modelled by using a general exponential relationship between denitrification potential and water-filled pore space (or volumetric/gravimetric water content) multiplied by a constant value determined by the nitrogen status of the site. As such, it is recommended that the current relationship used in INCA to relate denitrification to soil moisture be amended to an exponential form, with a threshold of approximately 70% for the onset of denitrification.

Keywords: nitrous oxide, denitrification, soil moisture, nitrogen, eutrophication, riparian

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