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Verifying the UK N_2O emission inventory with tall tower measurements

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Nitrous oxide (N_2O) is a key greenhouse gas (GHG), with a global warming potential ∼300 times greater than that of CO_2. N_2O is emitted from a variety of sources, predominantly from agriculture. Annual UK emission estimates are reported, to comply with government commitments under the United Nations Framework Convention on Climate Change (UNFCCC). The UK N_2O inventory follows internationally agreed protocols and emission estimates are derived by applying emission factors to estimates of (anthropogenic) emission sources. This approach is useful for comparing anthropogenic emissions from different countries, but does not capture regional differences and inter-annual variability associated with environmental factors (such as climate and soils) and agricultural management. In recent years, the UK inventory approach has been refined to include regional information into its emissions estimates (e.g. agricultural management data), in an attempt to reduce uncertainty.

This study attempts to assess the difference between current published inventory methodology (default IPCC methodology) and a revised approach, which incorporates the latest thinking, using data from recent work. For 2013, emission estimates made using the revised approach were 30 % lower than those made using default IPCC methodology, due to the use of lower emission factors suggested by recent projects (www.ghgplatform.org.uk, Defra projects: AC0116, AC0213 and MinNO). The 2013 emissions estimates were disaggregated on a monthly basis using agricultural management (e.g. sowing dates), climate data and soil properties. The temporally disaggregated emission maps were used as input to the Met Office atmospheric dispersion model NAME, for comparison with measured N_2O concentrations, at three observation stations (Tacolneston, E England; Ridge Hill, W England; Mace Head, W Ireland) in the UK DECC network (Deriving Emissions linked to Climate Change). The Mace Head site, situated on the west coast of Ireland, was used to establish baseline concentrations. The trends in the modelled data were found to fit with the observational data trends, with concentration peaks coinciding with periods of fertiliser application and land spreading of manures. The model run using the 'experimental' approach was found to give a closer agreement with the observed data.