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Global estimates of N2O emissions: a comparison of top-down and bottom-up approaches

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Nitrous oxide (N2O) levels have been steadily increasing in the atmosphere over the past few decades at a rate of approximately 0.3% per year. This trend is of major concern as N2O is both a long-lived greenhouse gas and an Ozone Depleting Substance (ODS). Recently, N2O emissions have been recognised as the most important ODS emissions and are now of greater importance than emissions of CFCs. The growth in atmospheric N2O is predominantly due to the enhancement of surface emissions by human activities. Most notably, the intensification and proliferation of agriculture since the mid-19th century, which has been accompanied by the increased input of reactive nitrogen to soils and has resulted in significant perturbations to the natural N-cycle and emissions of N2O.

We present a comprehensive inter-comparison of N2O emission estimates from two independent methods, which fall into the categories of 'top-down' and 'bottom-up' methods, specifically these are the atmospheric inversion and emissions-factor approaches. For the atmospheric inversion, we use a global dataset with atmospheric transport modelled by the LMDZ model, while the emissions factor approach involves defining emission rates for different biomes that are based on in-situ flux measurements in-conjunction with ecosystem and soil types as well as meteorological parameters. Emissions from the two approaches are then compared for different biomes and geographical areas.

We find both approaches show high emissions in the tropical regions, which appear to dominate global N2O emissions in terms of both natural and agricultural emissions. Temperate North America and Europe are also important regions for N2O emissions but to a lesser extent than the tropics.