

Effect of Sampling Frequency on Estimates of Annual Nitrous Oxide Fluxes

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Quantifying nitrous oxide (N₂O) fluxes, a potent greenhouse gas, from soils is necessary to improve our knowledge of terrestrial N₂O losses. Nitrous oxide fluxes are renowned for their high temporal variability. Frequency of sampling is therefore critical when determining annual N₂O fluxes and associated emission factors using manual chambers. We investigated the effect of sample frequency on estimates of annual N₂O fluxes using published data collected on a subdaily-basis with automated chamber systems. Study sites varied geographically (Australia, China and Germany), and included 28 data sets from agricultural and forest soils in temperate, semiarid and subtropical climates. Annual fluxes based on subdaily N₂O fluxes ranged from <0.1 to 8.1 kg N ha⁻¹ yr⁻¹ depending on the study site, and were calculated using at least three replicate chambers per experimental treatment. The effect of sampling frequency on estimates of annual N₂O-N fluxes was assessed using a modified jackknife technique. Average daily flux measurements were calculated for each replicate chamber in each dataset from the sub-daily flux measurements as we did not consistently observe diurnal flux variations at each location. Each site's daily flux population was subsequently subsampled daily, three times per week, weekly, bi-weekly and 4-weekly, and for each permutation of the time interval, for each dataset. Estimates of annual N₂O-N flux for a given chamber, site and frequency permutation were then calculated by linear interpolation and integration of daily fluxes with time. We demonstrated daily sampling was largely required to achieve annual N₂O fluxes within 10% of the 'best' estimate. Decreasing the regularity of measurements either under- or overestimated annual N₂O fluxes, with a maximum overestimation of 935%. Measurement frequency could be lowered using an informed sampling strategy based on environmental factors known to affect temporal variability, but still required sampling more than once a week.