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Combined FTIR-micrometeorological techniques for long term measurements of greenhouse gas fluxes from agriculture

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The exchange of trace gases between the biosphere and the atmosphere affects the atmospheric concentrations of gases such as methane, carbon dioxide, nitrous oxide, carbon monoxide, ammonia, volatile organic compounds, nitrogen dioxide and others. The quantification of the exchange between a biogenic system and the atmosphere is necessary for the evaluation of the impact of these interactions. This is of special interest for agricultural systems which can be sources or sinks of trace gases, and the measurement of the fluxes is necessary when evaluating both the environmental impact of agricultural activities and the impact of atmospheric pollution on agricultural production and sustainability.

With the exception of CO2, micrometeorological measurements of the fluxes of greenhouse gases from agricultural activities are still mostly possible only in campaign mode due to the complexity and logistical requirements of the existing measurement techniques. This limitation precludes studies of fluxes which run for longer periods, for example over full seasonal or growing cycles for both animal- and crop-based agriculture.

We have developed an instrument system for long-term flux measurements through a combination of micrometeorological flux measurement techniques such as Relaxed Eddy Accumulation (REA) and Flux-Gradient (FG) with the high precision multi-species detection capabilities of FTIR spectroscopy. The combined technique is capable of simultaneous flux measurements of N2O, CH4 and CO2 at paddock to regional scales continuously, over longer terms (months, seasonal cycles, years). The system was tested on a 3 weeks field campaign in NSW, Australia on a flat, homogeneous circular grass paddock with grazing cattle. The flux of the atmospheric trace gas CO2 was measured with three different micrometeorological techniques: Relaxed Eddy Accumulation, Flux-Gradient, and Eddy Correlation. Simultaneously, fluxes of CH4 and N2O were measured by REA and FG technique.