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A new portable infrared laser spectrometer for field measurements of N2O and CH4 emissions at the air / land interface

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A new type of portable infra red spectrometer (SPIRIT : SPectromètre Infra-Rouge In situ Troposphérique) using a quantum cascade laser and a patented new long multipass optical cell has been set up for the simultaneous flux measurements of two Greenhouse Gases (GHG): nitrous oxide (N2O) and methane (CH4), at the air land interface. The basics of the instrument, the data derivation for trace gas concentration determination in the atmosphere, and the chamber method to derive emission fluxes of these GHG from lands are described.
The analytical performances of SPIRIT are tested in two types of lands in Region Centre (France): (i) an anthropogenized sphagnum peatland (Laguette; Neuvy sur Barangeon) characterized by vascular plants invasion (ii) a sandy soil in the site of INRA-Orléans. The ability of SPIRIT to assess with precision spatial and temporal dependence emissions of these GHG in the field is demonstrated. In addition emission modes (diffusive episodes and bubbling events) can be observed and quantified due to the high frequency (1 Hz) of the concentration measured.
SPIRIT adaptation for detailed process-oriented studies of GHG flux emissions is also demonstrated by the investigation of emission dependence as a function of biotic and abiotic parameters (including diurnal cycle sensibility and emission modes); processes of C exchanges between different compartments of the biota can be studied. Such investigations are required for a better understanding of the lands to atmosphere exchange mechanisms of GHG and for the prediction of feedbacks on GHG emissions in response to anthropogenic or climate change perturbations of terrestrial ecosystems.
Implications of SPIRIT in other air lands studies are also presented.