# InGOS – Integrated non-CO2 Observing System

Detailed workplan, appendix to the online application. Request for access to an infrastructure (TNA1-TNA2-TNA3). The plan must not exceed 6 pages in 12 pt single line spacing, applications exceeding this limit will not be evaluated. The following information should be included in order to be evaluated:

1. **Project name (acronym), name and contact information of the researcher(s), duration of the project (dates, number of working days), type and name of the infrastructure requested**

Project name: comparison of N2O flux micro-météorological set-ups (INRA)

Acronym: N2O-micromet-INRA

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Duration of the project: 3 to 28 June 2013.

Infrastructure: TNA1 supersite Easter Bush (Edinburgh, UK).

1. **Background**
	1. Significance of the research

Large uncertainty remains on the global estimates of N2O emissions because of the difficulty of measurements and the large spatial and temporal variability. It is thus crucial to improve the inter-comparability of the N2O flux measurements at numerous sites. This research intends to provide a full comparison and validation of instrumentation, operation and flux calculation with micro-meteorological methods (gradient and eddy-covariance) and standardize protocols.

* 1. Previous research relevant to the topic and how the proposed project links to this

The INRA Institute has already been involved in several projects on N2O flux measurements.The Grignon site was used as a level 3 arable site in the NitroEurope project and provided both real-time micrometeorology and flux measurements; the INRA-EGC team is involved in both field monitoring (Laville et al, 2011; Loubet et al, 2011; Vilain et al, 2012) and N2O emission modeling (Lehuger et al, 2011). The OS2 site (Orleans, France) is a 30 km2 region, mostly on arable use. It has been studied for 4 years with a special focus on the spatial variability of soil nature and N2O fluxes (Gu et al, 2011) in the frame of a FEDER project (Spatioflux, 2008-2012). This project led also to the development of a lab-built QCL spectrometer called Spirit, especially dedicated to the measurement of N2O (Guimbaud et al, 2011). The originality of this instrument is the special design of its multi-pass cell, ensuring robustness during field use (Robert et al, 2007).

* 1. Links with current research of the applicant

The INRA-EGC is involved in several projects on greenhouse gas monitoring such as ICOS or reactive nitrogen studies (FP7 Eclaire).

The OS2 site is also involved in a national project on the nitrogen cycle at landscape scale (‘Escapade’). N2O fluxes are further monitored by manual chamber techniques but, because of the sporadic nature of N2O emissions and the problem of spatial variability integration when chambers are used, the medium-term objective is the installation of a micrometeorological measurement system, for real time monitoring at least during key periods.

1. **Objectives**
	1. Hypothesis and research objectives

The objective of this project is twofold:

* to provide an inter-comparison of the whole micro-meteorological set-ups built by INRA with both a commercial (Aerodyne) and a lab-built QCL spectrometer (Spirit), with other micrometeorological set-ups during a dedicated campaign. This will especially enable instrumentation validation to ensure the quality of future monitoring.
* To do an inter-comparison of the standard INRA N2O flux measurement systems with a gradient system coupled to a Fourier Transform Infrared spectrometer in the frame of the 13.2 task of the JRA1 workpackage. This system was developed by Ecotech and it is a new version of the FTIR developed at the University of Bremen (Thorsten Warneke and Hella van Asperen). It will be operated by Marie Laborde (AerosolConsultingML).
	1. Connection with the InGOS objectives and the ‘fitness’ of the use of the requested infrastructure to the objectives

This project is part of the INGOS inter-comparison campaign for N2O flux measurement with micro-meteorological methods, which will take place at Easter Bush supersite of the Centre for Ecology and Hydrology (CEH) in Edinburgh (3rd to 28th June 2013).

Large N2O fluxes have already been observed in this supersite, which should make easier validation of new instruments such as the SPIRIT QCL spectrometer and the FTIR.

1. **Methods and materials (legal and ethical issues)**
	1. Research method, explaining how to reach the objective

We will bring two micro-meteorological systems (gradient and EC). A whole infrastructure is offered by the CEH. The set-up will be run in parallel with other system from several European partners and will benefit of a common anemometer and data acquisition systems. The monitoring is expected to cover period of low and large fluxes (before and after fertilization).

* 1. Research materials, instrumentation

The first micro-meteorological system will be an EC system used with an Aerodyne QCL spectrometer dedicated to N2O-CH4 and H2O measurement.

The second system will provide aerodynamic gradient with a three-level set-up coupled to on-line analysis by the SPIRIT spectrometer. This analyzer is a lab-built CW-QCL spectrometer dedicated to the simultaneous measurement of N2O, CO2 and H2O (low resolution measurements for water vapour). The SPIRIT instrument is working at a 0.7Hz frequency, which is not fast enough to provide EC at the typical measurement height for field investigation.

* 1. Governance procedures, safety precautions, permit requirements and procedures

No special safety precautions or permits are required for the proposed work.

1. **Implementation: timetable, budget, distribution of work**
	1. Timetable for the research including personnel efforts, favorably table wise

Arrival date: 4 June 2013

System installation: 5-6 June 2013.

Measurements from 6th to 27th June 2013.

Uninstallation 27th June 2013.

Departure 28th June 2013.

Two teams of 2 persons will come to install both systems. It is planned that one person will stay during the first half of the campaign to ensure a correct operation of the EC system.

The spirit instrument is still under development and does not yet work in a fully automated way. One person are planned to stay during the whole campaign to care of troubleshooting and ensure the maintenance (including a daily pumping of the SPIRIT QCL and a regular pumping of the optical detectors).

Two persons will come for the uninstallation.

The global day x person number is planned to be 62 (accounting for all persons during installation/campaign/uninstallation and travels). This results in 43 days onsite (units of access).

* 1. Total budget for travel and logistical support as requested

Analyzers will be transported with a van and the transportation cost (through Eurotunnel) is estimated at 1180 euros for a return trip. Other persons will travel by plane. The whole cost of transportation is estimated at 2950 euros. The accommodation and food is estimated at 5500 euros for the whole campaign.

INRA has already a 5000 euros budget in InGOS for this task.

Funding is thus asked for the accommodation, because of the non-automatic operation of one of the systems. For 62 days with a daily subsistence of 50 euros/day, 3100 euros funding is thus asked.

* 1. Plan for specific logistal needs like visa, import/export licenses etc.

None.

1. **Expected results and possible risks**
	1. Expected scientific impact of the research

The comparison of instruments and flux measurement systems is expected to provide robust protocols for future monitoring of N2O fluxes.

It will also provide a full characterization of the performances of new gas analyzers, as the SPIRIT spectrometer and the FTIR (task 2 of JRA1) and to compare them to commercial analyzers.

* 1. Applicability and feasibility of the research results

This research will be supported by the facilities offered by the Easter Bush site.

* 1. Publication plan

It will be determined by the InGOS partners.

* 1. Data access plan

Idem.

1. **Key literature**
	1. List of references used in the working plan

Guimbaud, C., V. Catoire, S. Gogo, C. Robert, M. Chartier, F. Laggoun-Défarge, A. Grossel, P. Albéric, L. pomathiod, B. Nicoullaud and G. Richard*,* 2011 *A portable infrared laser spectrometer for flux measurements of trace gases at the geosphere-atmosphere interface,* Meas. Sci. Technol.*,vol 22, 075601.*

Gu, J., Nicoullaud, B., Rochette, P., Pennock, D.J., Hénault, C., Richard, G., 2011. Effect of topography on nitrous oxide emissions from winter wheat fields in central France. Environmental Pollution 159, 3149-3155.

Laville, P., Lehuger, S., Loubet, B., Chaumartin, F., & Cellier, P. (2011). Effect of management, climate and soil conditions on N 2O and NO emissions from an arable crop rotation using high temporal resolution measurements. *Agricultural and Forest Meteorology*, *151*(2). doi:10.1016/j.agrformet.2010.10.008

Lehuger, S., Gabrielle, B., Laville, P., Lamboni, M., Loubet, B., & Cellier, P. (2011). Predicting and mitigating the net greenhouse gas emissions of crop rotations in western Europe. *Agricultural and Forest Meteorology*, *151*(12). doi:10.1016/j.agrformet.2011.07.002

Loubet, B., Laville, P., Lehuger, S., Larmanou, E., Flechard, C., Mascher, N., … Cellier, P. (2011). Carbon, nitrogen and Greenhouse gases budgets over a four years crop rotation in northern France. (P. Ambus, U. Skiba, K. Butterbach-Bahl, & M. A. Sutton, Éd.)*Plant and Soil*, *343*(1/2). doi:10.1007/s11104-011-0751-9

Robert, C., 2007. Simple, stable, and compact multiple-reflection optical cell for very long optical paths. Applied Optics 46, 5408-5418.

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