# 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: N2O Chamber Intercomparison Campaign 2014, Hyytiälä, Finland

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Duration: 29 June – 3 July 2014 (4 RWD)

Infrastructure: Hyytiälä, Finland

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

Chamber measurements are associated with systematic and random errors, mainly related to estimation of the flux based single chamber measurement, and related to the large spatial variability of the soil flux and the low spatial coverage of the measurements. Recently N2O LASER instrumentation has become available for soil N2O flux measurement, and has practically eliminated the problem of random error when estimating the flux for a single chamber. Systematic errors are typically related to pressure changes inside the chamber, effects of wind speed, or leaking of the chamber. Chamber measurements are based on the assumption that the soil gas storage under the chamber does not change, but pressure and wind effects violate this assumption. In an ideal case, the gas flux during the enclosure saturates, an exponential function is fitted to the gas concentration data against time, and the flux is calculated in the beginning of the enclosure using the fitted parameters of the exponential function. However, if gas is accumulating in the soil, the rate of change of gas concentration in the chamber headspace is too low in the beginning, causing erroneous curvature for the exponential function. This naturally leads to underestimation of the flux. If the case is the opposite, for example is the fan is ventilating the chamber headspace too efficiently, then using exponential fit causes overestimation of the flux.

* 1. *Previous research relevant to the topic*

Systematic errors of CO2 chambers have been quantified by Pumpanen et al. (2004) and systematic errors of static CH4 by Pihlatie et al. (2013) and Christiansen et al. (2011). In this study, we aim to gain more knowledge on the errors, and also provide methods to control them.

* 1. *Links with current research of the applicant*

I am currently working on a chamber dataset from the InGOS N2O field campaign at Risø, DTU, which took place in April 2013. One objective of the campaign was to compare N2O fluxes quantified using five different chamber systems deviating in chamber design, detector type (ECD, Quantum Cascade Laser, Fourier Transform InfraRed spectroscopy), and calibration standard gas. Uncertainty aggregation will be performed for each chamber system. Finally, chamber flux rates are compared with N2O fluxes measured by eddy covariance technique.

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

In this study, we wish to investigate how much changes in the soil gas storage under the chamber affects the N2O flux estimation, how to identify this in data analysis, and how to correct the flux for the storage effect. In addition, in this study we measure the leaking of the chambers.

* 1. *Connection with the InGOS objectives*

The N2O Chamber Intercomparison Campaign in Hyytiälä, Finland, is described in the InGOS project description (DOW Task 5.2)

1. **Methods and materials (legal and ethical issues)**
   1. *Research method*

We will test the chambers at different sand depths (5, 10, 15, 20 cm) and at different wind speed velocities (0 and 5 m s-1) using a calibration tank, where the control N2O flux is measured based on the N2O concentration change inside the tank. During the campaign, all investigated chambers will be treated as similarly as possible with respect to enclosure time and N2O analysis. This is done in order to ensure a uniform protocol throughout the campaign and thus produce the most comparable results. If the chamber is equipped with fan and/or pressure vent-tube, these attributes should be used as in a normal operation. Once the soil collar has been installed in the sand bed and the whole system has been allowed to settle for 1.5 hours, the chamber measurement can start. We have chosen a fixed chamber enclosure time of 15 minutes for all chambers.

* 1. *Research materials, instrumentation*

I will bring a two-part static chamber (collar and chamber). The physical dimensions of the chamber is 60 \* 60 \* 15 cm (B \* W \* H). I also bring an extension part, which results in a 60 cm high chamber. Two N2O lasers (Aerodyne QCL) are used for continuous N2O analysis from the chambers. Hence, the chambers are used in non-steady-state flow-through mode.

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

Not relevant

1. **Implementaton: timetable, budget, distribution of work**
   1. *Timetable for the research including personnel efforts*

Sunday 29 June: Arrival to Hyytiälä and preparation

Monday 30 June: 07:00-20:00 N2O flux measurements at sand depth 1 and 2

Tuesday 1 July: 07:00-20:00 N2O flux measurements at sand depth 3 and 4

Wednesday 2 July: 07:00-20:00 N2O flux measurements – additional tests

Thursday 3 July: Departure

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

Flight tickets 310 EUR

Train tickets (Tikkurila-Orivesi) 100 EUR

InGOS contribution to shipping of chamber using DHL 90 EUR

**Total budget 500 EUR**

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

Chamber shipped with DHL to Hyytiälä on 11 June.

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

At least one peer-reviewed scientific paper

* 1. *Applicability and feasibility of the research results*

In this study, we will develop a methodology to correct N2O flux measurements for errors related to changes in the soil gas storage under the chamber.

* 1. *Publication plan*

At least one peer-reviewed scientific paper

* 1. *Data access plan*

Data will be made available in a relevant database

1. **Key literature**

*List of references used in the working plan*

Christiansen, J. R., Korhonen, J. F. J., Juszczak, R., Giebels, M., and Pihlatie, M.: Assessing the effects of chamber placement, manual sampling and headspace mixing on CH4 fluxes in a laboratory experiment, Plant and Soil, 343, 171-185, DOI 10.1007/s11104-010-0701-y, 2011.

Pihlatie, M. K., Christiansen, J. R., Aaltonen, H., Korhonen, J. F. J., Nordbo, A., Rasilo, T., Benanti, G., Giebels, M., Helmy, M., Sheehy, J., Jones, S., Juszczak, R., Klefoth, R., Lobo-do-Vale, R., Rosa, A. P., Schreiber, P., Serca, D., Vicca, S., Wolf, B., and Pumpanen, J.: Comparison of static chambers to measure CH4 emissions from soils, Agricultural and Forest Meteorology, 171, 124-136, DOI 10.1016/j.agrformet.2012.11.008, 2013.

Pumpanen, J., Kolari, P., Ilvesniemi, H., Minkkinen, K., Vesala, T., Niinisto, S., Lohila, A., Larmola, T., Morero, M., Pihlatie, M., Janssens, I., Yuste, J. C., Grunzweig, J. M., Reth, S., Subke, J. A., Savage, K., Kutsch, W., Ostreng, G., Ziegler, W., Anthoni, P., Lindroth, A., and Hari, P.: Comparison of different chamber techniques for measuring soil CO2 efflux, Agricultural and Forest Meteorology, 123, 159-176, DOI 10.1016/j.agrformet.2003.12.001, 2004.