# 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:** Soil N2O chamber inter-comparison campaign 2014

**Applicant/Participant:** Carolyn-Monika Görres

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**Project duration:** 06.07. - 10.07.2014 (5 days)

**Supersite:** Hyytiala SMEAR II station, Finland

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

Soil chamber techniques are widely used for estimating soil trace gas fluxes, e.g. N2O fluxes. Together with the eddy covariance technique, they provide the best way to quantify trace gas fluxes from ecosystems and to study the underlying processes. However as with any other measurement technique, flux measurements by chamber techniques are associated with systematic and random uncertainties (e.g. Wang et al. 2013). These have to be properly quantified and accounted for to provide reliable trace gas flux estimates. The major sources of flux uncertainty are related to systematic errors of the single chamber measurement, as well as errors associated with the large spatial variability of the soil source/sink and low spatial coverage of the measurements.

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

The proposed inter-comparison campaign of soil N2O chamber systems follows the studies of Pumpanen et al. (2004), Christiansen et al. (2011), and Pihlatie et al. (2013), which dealt with the quantification of systematic errors of soil chambers used for CO2 and CH4 flux measurements. All these studies relied on the infrastructure provided by the Hyytiala SMEAR II station, Finland.

* 1. Links with current research of the applicant

The applicant employs manual and automated chamber techniques to estimate CO2, CH4 and N2O fluxes from different ecosystems. Besides studying the processes underlying soil greenhouse gas fluxes, the applicant has also experience in estimating flux uncertainties related to systematic and random errors (Görres et al. 2014). The applicant is currently comparing the performance of a custom-made automated chamber system for simultaneous measurements of soil CO2, CH4 and N2O fluxes (AGPS, Umwelt- und Ingenieurtechnik GmbH Dresden, Germany; FGGA and N2O/CO analyzer, Los Gatos Research, Moutain View, CA, USA) with an off-the-shelf automated chamber system for soil CO2 fluxes (LI-8100 and LI-8100-104, LI-COR Biosciences, Lincoln, NE, USA) under field conditions. Testing the AGPS under constant laboratory conditions during the soil N2O chamber inter-comparison campaign would perfectly complement the field tests.

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

The main objectives of the inter-comparison campaign are to gain more knowledge on the errors related to N2O chambers, and to provide methods to control them. Participants will bring their own chambers for sensitivity test of systematic errors related to chamber leaking, and pressure changes caused by gas storage in the soil underneath the chamber. The sensitivity of the chambers to errors will be estimated by combining data from different chambers into one dataset. Ideas how to deal with the errors will be further developed during the campaign and tested using the data set. Furthermore, it will also be tested if soil N2O concentrations can be used to estimate soil N2O fluxes.

* 1. Connection with the InGOS objectives and the ‘fitness’ of the use of the requested infrastructure to the objectives

The soil N2O chamber inter-comparison campaign in Hyytiälä, Finland, in 2014 is a part of the InGOS activities (Task 5.2, QA/QC chamber flux measurements).

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

Various soil chamber systems differing in size, shape and material will be tested during the inter-comparison campaign. The proposed testing will be performed on a chamber calibration system present at the experimental station in Hyytiala (for description see Pumpanen et al. 2004, Christiansen et al. 2011, Pihlatie et al. 2013). The reference flux of N2O through a sand bed will be compared with the simultaneously measured soil chamber flux on the top sand surface, thus allowing direct comparison between both fluxes, and subsequent determination of the possible under-/over-estimations of tested chambers (Pihlatie et al. 2013). The depth of the sand bed is adjustable to simulate different soil transport coefficients. Additionally, the chambers will be subjected to different wind speeds to check for possible disturbance effects on the flux rates. The N2O concentration will be determined using a laser N2O gas analyser. The N2O fluxes will be calculated according to Pumpanen et al. (2004), Christiansen et al. (2011) and Pihlatie et al. (2013).

The University of Helsinki will provide needed laboratory instrumentation and devices, as e.g. automatic N2O gas analyser, calibration tank and fans. The applicant will provide a soil chamber for testing which is commercially available as an automated chamber from Umwelt- und Ingenieurtechnik GmbH Dresden, Germany.

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

The applicant will take part at the inter-comparison campaign from July 6 to July 10, 2014. She will assist with the installation and testing of the soil chamber from her institute. On July 6, the preparation of the calibration for this specific chamber will start. July 7 and 8 are subjected to a common test protocol which is applied to all chambers throughout the campaign to ensure the most comparable results. On July 9, the applicant will run some additional tests looking at different sample flow rate of the automatic N2O analyzer, vent performance, and air-tightness of the chamber sealing. These tests address specific questions which arose with this chamber during field application. On July 10, the chamber will be deinstalled and prepared for transportation back to the Universiy of Antwerpen, Belgium.

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

The travel costs amount to approximately 350 Euro (return flight Frankfurt – Helsinki 253.96 Euro, train Helsinki – Orivesi – Helsinki approximately 100 Euro). The applicant also requires accommodation at the experimental site for 4 nights (4 x subsidence of 50 Euro = 200 Euro). The total requested budget for this project is therefore 550 Euro.

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

Not applicable.

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

The soil N2O chamber inter-comparison campaign will provide recommendations for soil N2O chamber design, sampling procedures, and flux calculation methods, which will contribute to improvement of soil N2O measurements in future research projects.

* 1. Publication plan

The organizers of the inter-comparison campaign expect to publish peer-reviewed publications based on the campaign – as has been done for the CO2 and CH4 inter-comparison campaigns - and all the participants are invited to participate as (co)authors.

* 1. Data access plan

Results of the inter-comparison campaign will be submitted to the InGOS database of specific measurements

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

Christiansen JR, Korhonen JFJ, Juszczak R, Giebels M, Pihlatie M (2011): Assessing the effects of chamber placement, manual sampling and headspace mixing on CH4 fluxes in a laboratory experiment. Plant and Soil 343: 171-185.

Görres C-M, Kutzbach L, Elsgaard L (2014): Comparative modeling of annual CO2 flux of temperate peat soils under permanent grassland management. Agriculture, Ecosystems and Environment 186: 64-76.

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

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

Wang K, Zheng X, Pihlatie M, Vesala T, Liu C, Haapanala S, Mammarella I, Rannik Ü, Liu H (2013): Comparison between static chamber and tunable diode laser-based eddy covariance techniques for measuring nitrous oxide fluxes from a cotton field. Agricultural and Forest Meteorology 171-172: 9-19.