Integrated non-CO_2 Greenhouse gas Observing System

InGOS – Integrated non-CO_2 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 N_2O chamber inter-comparison campaign 2014, Hyytiälä, Finland

   Applicant/Participant: Katerina Machacova
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   Project duration: 16.6.-4.7.2014, 19 days
   Supersite: Hyytiala SMEAR II station, Finland

2. **Background**
   a. Significance of the research

Soil chamber techniques are widely used for estimation of N_2O and CH_4 (and CO_2) fluxes from soil/forest floor surfaces, and newly also for comparison with results obtained from micrometeorological techniques (Eddy covariance (EC)/flux gradient techniques) for investigation of N_2O and CH_4 fluxes from ecosystems (e.g. Mammarella et al. 2010; Wang et al. 2013a,b). However, their usage can be linked with systematic and random errors/uncertainties (e.g. Wang et al. 2013b).

The campaign will allow comparing different types of soil chamber systems used for detection of N_2O emissions from soil. The chambers sensitivity to systematic errors will be investigated.

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

The proposed inter-comparison campaign of soil N_2O chamber systems follows the studies of Pumpanen et al. (2004), and Christiansen et al. (2011) and Pihlatie et al. (2013) dealing with quantification of systematic errors of soil chambers used for CO_2 and CH_4 flux measurements, respectively.

c. Links with current research of the applicant

The applicant focuses in her research on determination of N_2O and CH_4 emissions from different tree species and from soil surfaces under usage of different types of chamber systems (e.g. Machacova et al. 2013a,b). Her participation on the inter-comparison campaign will improve the experimental design, and data processing and their evaluation in her future experiments.

3. Objectives

a. Hypothesis and research objectives

The main objective of the inter-comparison campaign is to compare soil chamber systems of different design and site used for N_2O measurements and to identify uncertainties of chamber N_2O fluxes caused by instrumentation problems and systematic errors. Tests of systematic errors related to chamber leaking and pressure changes will be performed. General guidelines for chamber designs and flux calculation methods will be proposed to reduce possible errors concerning N_2O soil chamber measurements in the future.

b. Connection with the InGOS objectives and the 'fitness' of the use of the requested infrastructure to the objectives

The soil N_2O chamber inter-comparison campaign in Hyytiälä, Finland, in 2014 is a part of the InGOS activities (Task 5.2, QA/QC chamber flux measurements).

4. Methods and materials (legal and ethical issues)

Various soil chamber systems differed 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 N_2O through a sand bed will be compared with simultaneously measured soil chamber flux on the top sand surface thus allowing direct comparison between the both fluxes, and subsequent determination of the possible under-/over-estimations of tested chambers (Pihlatie et al. 2013). Different sand types as a medium with known soil porosity and density will be used. The N_2O concentration will be determined using a laser N_2O gas analyser. The N_2O 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 N_2O gas analyser, calibration tank and fans. The Global Change Research Centre AS CR, v.v.i. (GCRC) will provide three soil chambers for testing (two automatic and one manual).

5. Implementaton: timetable, budget, distribution of work

a. Timetable for the research including personnel efforts, favorably table wise

The applicant Katerina Machacova will take part at the inter-comparison campaign from June 16 to July 4 2014. Her main task will be to help with the laboratory instruments and devices, with chamber handling, and by tests of the sensitivity of the chambers to errors. She will further assist with the installation of the soil chambers brought from her institute (GCRC) and with their testing.

b. Total budget for travel and logistical support as requested

The estimated travel costs are in the order of 500,- Euro for a return flight (Prague – Helsinki) and train/bus tickets in Finland and Czech Republic. The applicant will further require accommodation at the experimental site for 18 nights. The budget requested for this project is: travel costs 1x500,- Euro and subsidence for 19 days: 19 x 50,- Euro = 950,-Euro. Total budget 500 + 950 = 1450 Euro.

6. Expected results and possible risks

a. Expected scientific impact of the research

The soil N_2O chamber inter-comparison campaign will provide recommendation for soil chamber designs, sampling procedures, and flux calculation methods, which will contribute to improvement of soil chamber measurements in the future.

b. Publication plan

One joint peer reviewed publication with results of the inter-comparison campaign is expected to be published.

c. Data access plan

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

7. Literature

Christiansen J R, Korhonen JFJ, Juszczak R, Giebels M, Pihlatie M (2011) Assessing the effects of chamber placement, manual sampling and headspace mixing on CH_4 fluxes in a laboratory experiment. Plant and Soil 343: 171-185.

Machacova K, Papen H, Kreuzwieser J, Rennenberg H (2013a) Inundation strongly stimulates nitrous oxide emissions from stems of the upland tree *Fagus sylvatica* and the riparian tree *Alnus glutinosa*. Plant and Soil 364: 287-301.

Macháčová K, Pihlatie M, Vanhatalo A, Halmeenmäki E, Aaltonen H, Kolari P, Aalto J, Pumpanen J, Pavelka M, Acosta M, Urban O, Bäck J (2013b) Can pine trees act as sources for nitrous oxide (N_2O) and methane (CH_4)? Report Series in Aerosol Science 142: 362-366.

Mammarella I, Werle P, Pihlatie M, Eugster W, Haapanala S, Kiese R, Markkanen T, Rannik U, Vesala T (2010) A case study of eddy covariance flux of N_2O measured within forest ecosystems: quality control and flux error analysis. Biogeosciences 7: 427–440.

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 CH_4 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 CO_2 efflux. Agricultural and Forest Meteorology 123: 159-176.

Wang JM, Murphy JG, Geddes JA, Winsborough CL, Basiliko N, Thomas SC (2013a) Methane fluxes measured by eddy covariance and static chamber techniques at a temperate forest in central Ontario, Canada. Biogeosciences 10: 4371–4382.

Wang K, Zheng X, Pihlatie M, Vesala T, Liu C, Haapanala S, Mammarella I, Rannik Ü, Liu H (2013b) 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.