# InGOS – Integrated non-CO2 Observing System

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**

We are partner of the LIFE+IPNOA project "Improved flux Prototypes for N2O emission from Agriculture" (2012-2016), coordinated by West Systems S.r.l., which aims to develop a portable prototype for measurements directly in the field of N2O emissions in agricultural soils and to reduce these emissions in Tuscany agriculture (website: [www.ipnoa.eu](http://www.ipnoa.eu)).

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We will participate to the "INGOS N2O chamber inter-comparison campaign 2014" from 16 to 18 of July 2014 (3 days), in two persons, arriving at Hyytiälä on 15 July.

We will bring with us IPNOA chamber. Our portable system is equipped with a circle closed dynamic chamber, vented with a fan and made in steel. The chamber dimensions are 30 cm in diameter and 10 cm height, the pressure is maintained in equilibrium between air and chamber volume through a relief vent. The chamber is combined with a PVC collar that exactly match the size of the chamber and a gasket around the flange of the soil chamber provides a seal between the chamber and the collar.

1. **Background**

Chamber measurements are associated with systematic and random errors. The major error sources are systematic and random error of the estimation of the flux based single chamber measurement and the error associated by the large spatial variability of the soil flux and the low spatial coverage of the measurements. Systematic errors of CO2 chambers have been quantified by [Pumpanen et al. (2004](#_ENREF_11)) and systematic errors of static CH4 by [Pihlatie et al. (2013](#_ENREF_10)) and [Christiansen et al. (2011](#_ENREF_1)). Until recently, soil N2O fluxes have been measured based on static chambers and analyzing air samples on a gas chromatograph (CG). Detecting small changes of N2O concentration is difficult with a CG, and thus in many cases, the analysis of gas concentrations has been the largest source of error in soil N2O flux estimations.

We would be very interested in participating in the "soil INGOS chamber inter-comparison campaign 2014" in Hyytiälä in assessing the uncertainty related to chamber measurements, especially relating to the characteristics of the chamber. Indeed, the objectives of IPNOA project are: 1) to develop and validate two prototypes for measuring soil N2O fluxes and to improve the monitoring of N2O from agricultural soils; 2) to carry out field trials in two representative sites with the aim to identify the best management practices (BMPs) for reducing N2O emissions from the mainarable crops of Tuscany; 3) to scale up these BMPs from field to regional level, through suitable modelling in order to identify and to promote the measures for an effective reduction of the N2O emissions.

The participation to the INGOS chamber inter-comparison campaign is part of IPNOA objective 1), that aims to test the systems developed for direct N2O emissions measures.

1. **Objectives**

The research objective are:

* Errors of N2O soil efflux estimations
  + Bad precision of gas chromatography
    - eliminated by N2O LASERs
  + Systematic errors of flux estimation from one chamber
    - pressure effects can be estimated
      * Emphasis on the workshop
    - Leaking may be a problem
      * Emphasis on the workshop
  + Random errors caused by high spatial variability
    - Soil N2O concentration in conjunction with “quick” manual chamber measurements may give more accurate average flux
      * Emphasis on the workshop

Our aims are to:

* To measure leaking rate of the chambers
  + different wind speeds
  + different collar installation depths
    - This can be calculated, when the chamber concentration go to steady state
* To measure the sensitivity for storage problems
  + Venturi effect
  + Ventilating the chamber (different fan speeds)

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

Instrumentation

* N2O lasers (LosGatos from Helsinki group and 2 from Braunschweig (Aerodyne))
* New calibration tank
  + the depth of the sand bed can be adjusted
  + Possibility to measure gas profile (or concentration) in the sand
  + Circular shape, possibility to fit 1mx1m chamber, surface area of sand bed 2 m2
* Fans needed to create wind outside the chamber
* Small anemometers needed to measure wind speeds (also inside the chamber; only wind velocity is needed, no direction).

Initial measurement procedure

* The measurement setup, see above (old setup) and [Pumpanen et al. (2004](#_ENREF_11))
  + Control flux is measured based on the concentration change inside the tank
  + “Chamber flux” is measured based on the concentration change inside the chamber
* Ideally only one chamber per time in measurement, because Control flux = flux from sandbed + chamber flux (both fluxes weighed by surface area, typically chamber covers only about 20% of the pumpeli surface area).
  + This allows measuring gas concentration below the chamber, in addition to outside the chamber in sand bed
* The sand depth can be adjusted (with the new calibration tank)
* Gas concentration inside the Pumpeli (calibration tank) does not affect the systematic error of the flux estimation. This is according to theory, and also verified by [Pihlatie et al. (2013](#_ENREF_10))
  + In last campaign ([Pihlatie et al., 2013](#_ENREF_10)) a lot of time was used by changing the flux level and waiting the system to stabilize
  + We do not need several “flux levels”, but good to have some replicate measurements.
  + The reference flux and gas concentration in the chamber decrease with time.
* The concentration in the sand bed must be stabilized between the measurements. Stabilization time must be checked from the sand concentration data. The time depends on sand depth.
* It would be nice to have different soil (sand) types
  + In last campaign ([Pihlatie et al., 2013](#_ENREF_10)) a lot of time was used by changing the sand, especially to fine and wet sand
    - The differences of the transport coefficient between the sands was small
    - We can save a lot of work and time by using only coarse quartz sand. It is also a more healthy option (fine quartz sand goes to lungs)
  + Instead, we can change the depth of the sand to change the transport coefficient.
* 3 replicates x 3 wind speeds x 3 sand height = 27 measurements / chamber
* larger sand depths require longer stabilization times
  + only 2 wind speeds for sand depth 3?
* Schedule for participants
  + Sunday/Monday: Day of the arrival: Arrival + half day preparations
  + Tue-Wed: 2 days for the basic measurements
  + Thu: go home, or additional tests and repeating if something went wrong
  + Thu or Fri: Departure
  + Visit in total 3-5 days.
* In total about 15 chambers:
  + Small chambers: 4 chambers / week
    - 2 weeks -> 8 chambers
    - two chambers in test at time
  + Large chambers: 2 chambers / week
    - 4 weeks -> 8 chambers

1. **Implementaton: timetable, budget, distribution of work**

We will participate to the N2O campaign measurements from 16 to 18 of July 2014, in two persons. We will arrive at Hyytiälä on 15 July, in the evening.

The total budget we are requesting for travel and logistic is of 500 € for travel and 150 € for accommodation at Hyytiälä, per person.

1. **Expected results and possible risks**

We expected to improve the knowledge on systematic and random error in N2O measurements related to the chamber characteristics in order to improve our system. We are interested in publishing the results obtained in this campaign on a peer reviewed publication.

1. **Key literature**
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