Integrated non-CO_2 Greenhouse gas Observing System

Deliverable D1.3			
Title: Detailed description of the InGOS infrastructures offering TNA			
Delivery date Annex 1	Month 6		
Actual delivery date	Month 20	31/05/2013	
Lead participant	Work package	Nature	Dissemination level
ECN (1)	**WP1 (NA1)**	**Report**	**Public**

Deliverable description

This report provides at the time of writing an up–to–date overview of the TNA infrastructures and the possibilities to use these. The report is a frozen version of the dynamic descriptions of the TNA services on the website, as these evolved until the end of the 1st reporting period. The website description of the TNA services exists already since the start of the project. This report will also be available from the website.

1. Access to Stations, Facilities and measurement Services

One of the most important tasks of InGOS is to give external users access to the stations, facilities and services. In order to get access to the stations and facilities, external users will have to apply through the InGOS website. This facilitates the planning and the financial commitments needed in order to provide the support. Users can also in most cases apply for travel and subsistence support. Information and access/submission of proposals is organized via the InGOS project website: www.ingos-infrastructure.eu.

2. TNA Access to Sites; Site descriptions

2.1 TNA1

2.1.1 Cabauw tall tower

- Coordinates: 51°58'12.81″N, 4°55'34.33″E
- Height: 213 m
- Base level: -2m ASL
- Country: Netherlands
- InGOS observations: CH_4, N_2O, SF_6, H_2, ^{222}Rn, fluxes of CH_4, N_2O
- Responsible partner: ECN
- Responsible PI: Alex Vermeulen (a.vermeulen@ecn.nl)

General

Cabauw tower is owned and operated by the Netherlands MetOffice KNMI. It is a super site for (micro)-meteorological, air pollution, aerosols, greenhouse gas, climate and remote sensing observations. A consortium existing of 8 Dutch institutes use the tower as a platform for their observations: CESAR. Other projects besides InGOS where Cabauw plays an important role are for example ACTRIS and PEGASOS. The tower is a steel structure with a diameter of 2 meter. Half of the inside is in use by the elevator. The other half has a stair and platforms every 2.5 meter. Outside the tower is equipped with platforms and three horizontal arms at every 20 meter height. The arms can be lifted hydraulically for mounting or maintaining equipment.

Cabauw has already been in use for greenhouse gas observations by ECN since 1992, starting of with CO_2 and CH_4 at 200m AGL. Since 2000 concentrations are measured at four elevations: 20, 60, 120 and 200m AGL. In 2004 the high precision measurements in the framework of the CHIOTTO project started with observations of CO_2, CH_4, N_2O, CO and SF_6. In 2007 H_2 vertical gradient observations

were added. In 2006 and 2007 ^{222}Rn observations were added at 200m and 20m AGL respectively. KNMI and WUR also operate CO_2 flux observations at three elevations.

Surroundings

The area of Cabauw is very flat and main land use is agriculture with predominantly grassland on peat/clay mixed soil type. At the east of the tower you find a small town called Lopik. Bigger cites are like Utrecht NE, 20 km), Rotterdam (WSW, 30 km), The Hague (W 40 km) and Amsterdam (N, 40 km) can be seen from the top of the tower under very clear conditions. At 2 km south of the tower the river Lek (leg of river Rhine) meanders from east to west, surrounded by orchards on the fertile river banks covered with river clay.

Infrastructure and facilities

The measurement equipment is mainly located in the large cellar under the central building of the tower. Temperature is very stable and a large floor area is available (>200 m2). Air is drawn through 1/2″ dekabon tubing from the measurement levels for analysis. Air is dried by permapure dryers at the inlet to dewpoints around -5 ^{o}C and in the cellar further by cryocoolers to dewpoints below -40 ^{o}C. Equipment can also be installed at the tower, inside the steel pipe or outside at a platform, after consultation of the tower owner.

Power is available at request up to 16A, 230V or eventually also 380V can be supplied. Surrounding the tower a large grassland area of several ha is part of the facility. Part of this is used for (micro)meterological, climate and remote sensing observations. The tower is equipped with a high speed internet connection.

The tower can be reached by public transport (bus from Utrecht) or car, the highway A2 exit IJsselstein is approximately 15 km from Cabauw tower.

References for Cabauw observations

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- Arnold, D., Vargas, A., Vermeulen, A. T., Verheggen, B., and Seibert, P. : Analysis of radon origin by backward atmospheric transport modelling. Atmos. Environ., *44*, 494-50, 2010

2.1.2 Weybourne observatory

- Coordinates: 52°57'01.5"N 1°07'19"E
- Height: 10 m
- Base level: 21 m ASL
- Country: United Kingdom
- InGOS observations: CH_4, N_2O, SF_6, halocarbons
- Responsible partner: UEA
- Responsible PI: Bill Sturges (w.sturges@uea.ac.uk)
- Website: http://weybourne.uea.ac.uk/

General

Weybourne Atmospheric Observatory (WAO) is a coastal site located on the North Norfolk coastline near Weybourne, North Norfolk, UK. Over the last decades the Weybourne Atmospheric Observatory (WAO) has become established as a world class facility at which fundamental research, background monitoring and teaching have all been successfully carried forward. WAO has been the focus of many international experiments designed to look into the chemistry of the free troposphere and is currently supported through NCAS composition and NCAS FGAM as a national capability resource.

Infrastructure and facilities

The site at Weybourne has the ability to host large scale scientific campaigns with the capacity to provide 3 phase, 32 amp and 16 amp external power. The two well provisioned laboratories are air conditioned and secure. A small office provides the ability to network internally with access to the web. Provision can be made to access computer controlled instrumentation from afar. Active support by the local landowner enables the use of an adjacent grass airfield capable of handling balloon, microlight and small aircraft platforms. Campaign activities are well supported by the local community with accommodation plentiful in the locale.

Supporting trace gas analysis of the atmospheric boundary. Particular expertise in the determination of VOC's, OVOC's, Carbon Dioxide and GHGs. Long term data sets are available for ozone, Carbon monoxide NOx CN and SO2. Sophisticated instrumentation for the measurement of local meteorology including sodar, rass and sonic anemometry are also available on site.

2.1.3 SMEAR Hyytiala

- Coordinates: 61°51'N, 24°17'E
- Height: 127 m tower
- Base level: 181 m ASL
- Country:Hyytiälä, Juupajoki, Finland
- InGOS observations: CH_4, N_2O, SF_6, H_2
- Responsible partner: UHEL
- Responsible PI: Ivan Mammarella(ivan.mammarella@helsinki.f)
- Website: http://www.atm.helsinki.fi/SMEAR/index.php

General

The heart of SMEAR is the Finnish Centre of Excellence (FCoE) on physics, chemistry, meteorology and biology of climate change and air pollution. The SMEAR station offers comprehensive data sets, and all data is available for visitors.

The site offers a calibration tank, by which soil chambers can be tested and intercompared for trace gases. It has been utilized for carbon dioxide and it can be provided for N_2O tests with small modifications. A tall tower of the height 127 m with profile measurements of methane and N2O is under operation during the project and can be utilized for a footprint campaign.

The SMEAR II (Station for Measuring Forest Ecosystem-Atmosphere Relations) station is located in a rather homogenous Scots pine (*Pinus sylvestris* L.) stand on a flat terrain at Hyytiälä Forestry Field Station of the University of Helsinki (61°51'N, 24°17'E, 181 m above sea level) 220 km NW from Helsinki. The managed stand was established 1962 by sowing after the area had been treated with prescribed burning and light soil preparation. The station represents boreal coniferous forests, which cover 8% of the earth's surface and store about 10% of the total carbon in the terrestrial ecosystem. The biggest city near the SMEAR II station is Tampere, which is about 60 km from the measurement site with about 200 000 inhabitants. Another long-term field site for carbon (carbon dioxide, methane and VOC) and energy exchange studies and soil (peat) processes is located close to the SMEAR II station at the Siikaneva wetland (fen) area. SMEAR II is also an Integrated Carbon Observation System (ICOS) site.

At SMEAR II measurements are carried out at a number of storage pools and interfaces involving three different layers, extending from the soil to the atmosphere. Several different methods, operating simultaneously but at different spatio-temporal scales, are applied to monitor the material and energy fluxes between the different pools, aiming at understanding the processes responsible for these fluxes. For example, the surface between a tree and the atmosphere, or between the soil and the atmosphere, can be enclosed in a chamber, and the corresponding flux of interest can then be determined from the mass balance of the chamber. Turbulent fluxes can be measured by micrometeorological techniques. Concentration gradients in the air and soil can also be used for making flux estimates by applying available transport coefficients.

The main components of SMEAR II are i) an instrumented, 127 m tall mast, ii) systems for monitoring aerosols and air ions, iii) instrumentation for monitoring tree functions and radiation (by two 25 m towers) and iv) two instrumented mini catchments. The mast monitors CO2, H2O, CO, O3, SO2, NO, NO2, temperature and wind speed profiles, properties of solar and thermal radiation of the stand and fluxes of CO2, H2O, O3, aerosols, and several volatile organic compounds between the canopy and atmosphere. The mast measurements are usually reported as half an hour means. Aerosol and ion size distributions are measured in order to be able to study ion, cluster and aerosol dynamics. Chamber techniques are used to monitor tree processes generating the fluxes between trees or soil and the atmosphere. The most relevant processes are: photosynthesis, respiration, transpiration, NOx emission and deposition, O3 deposition and emission of volatile organic compounds. The fluxes between the soil and the atmosphere, as well as between the soil and the canopy, are also important. The catchments are closed with a dam, and the run-off from the area is monitored. The leakage of

substances with the run-off is monitored by taking samples for chemical analysis. The water content and tension, CO2 and temperature profiles are monitored. Solar radiation is the source of energy for several processes in the trees and the atmosphere. Therefore, irradiance, diffuse irradiance, photosynthetically active radiation and radiation balance are monitored above the canopy. Stem diameter changes are monitored both above and under bark continuously with a precision of less than 1 µm. This allows us to indirectly estimate the water tension in xylem and phloem, which is an ecophysiologically important parameter, but very difficult to determine.
The present instrumentation at SMEAR II includes detailed in-situ aerosol physical characterization (AIS/NAIS, DMPS; APS) size distribution 1nm – 20 000 nm), in-situ aerosol chemical characterization (AMS, HTDMA, VDMPS), aerosol density (ELPI/DMPS), aerosol optical properties (nephelometer, aethalometer), in-situ cloud condensation nuclei concentration (total and size segregated CCN), sun photometer (Cimel CE-318, part of AERONET) for column aerosol burden, ceilometer, trace gases (sulphuric acid, OH, O3, NO, NO2, NOx, ammonia, precursor gases for aerosol particles (VOC, with PTRMS, sulphuric acid with CIMS), green house gases (ICOS site), ion chemistry (API-ToF), solar radiation (spectroradiometer, UVA, UVB, PAR, Global, IR, albedo), radon, external radiation, soil chemistry and dynamics, forest growth from cell level to canopy level.
Modality of access under this proposal:
The heart of SMEAR is the Finnish Centre of Excellence (FCoE) on physics, chemistry, meteorology and biology of climate change and air pollution. The SMEAR station offers comprehensive data sets, and all data is available for visitors. There are no principle time limits to perform observations at the site as long as it does not interfere with other projects.
Support offered under this proposal:
The site offers a calibration tank, by which soil chambers can be tested and intercompared for trace gases. It has been utilized for carbon dioxide and it can be provided for N2O tests with small modifications. A tall tower of the height 127 m with profile measurements of methane and N2O is under operation during the project and can be utilized for a footprint campaign.
In general, scientific and technical support to users is provided through collaboration with existing research and monitoring activities at the site. The continuous technical support is available. Depending on the project, the research is carried out co-operation with several post-graduates and senior group members. The capacity of Hyytiälä Forestry Field station (where SMEAR II is operating) to accommodate and to provide all necessary logistic support is superb. Hyytiälä has 150 beds. Visiting scientists can always be accommodated at Hyytiälä. Raw data collected at SMEAR II station is available on-line. At SMEAR station, the linking of visitors' instruments with the existing measuring setup is easy and a necessary technical support is offered. Whether visiting scientists are using the data obtained with existing measurements facilities or bringing their own instrumentation, their degree of independence is high. Coordinating the research efforts between the host group and the visiting scientist will be emphasized when the visitors have common interests with host group so that maximal mutual benefit can be gained.
SMEAR II has a high profile when it comes to visibility and relevance in the atmospheric research community. SMEAR II is a key station in several observational and also experimental networks. Particularly the combination of continuous, comprehensive measurements and new and state of the art instruments coupled to the available expertise makes the use of the site for further research highly attractive in the European context. This is also shown by the number of visiting scientists and international field campaigns over the last few years.

2.1.4 Risø willow field

- Coordinates: 55°41'31.95" N, 12°6'14.69" E
- Height: 213 m
- Base level: -2m ASL
- Country: Denmark
- InGOS observations: CH_4, N_2O, CO_2
- Responsible partner: DTU
- Responsible PI: Per Ambus(peam@kt.dtu.dk)
- Website:

General

Comprises a 10 ha willow [Salix triandra x S. viminalis & Salix schwerinii x S. viminalis x S. vim.] energy crop plantation established in 2010 on fertile (loamy sand soil) agricultural land. The site is subject to slurry fertilization kg ha-1, (30 t digested slurry). Situated on Risø owned land next to the institute and the Risø tall tower.

CO, N2O and CH4 chamber- and CO2 EC-flux measurements initiated in July 2010. Mains power and data connection available. Application of N2O real-time analyzer (LGR Offaxis ICOS) for EC- and chamber measurements is planned April 2012. Additional activities comprise monitoring of soil environmental parameters.

Infrastructure and facilities

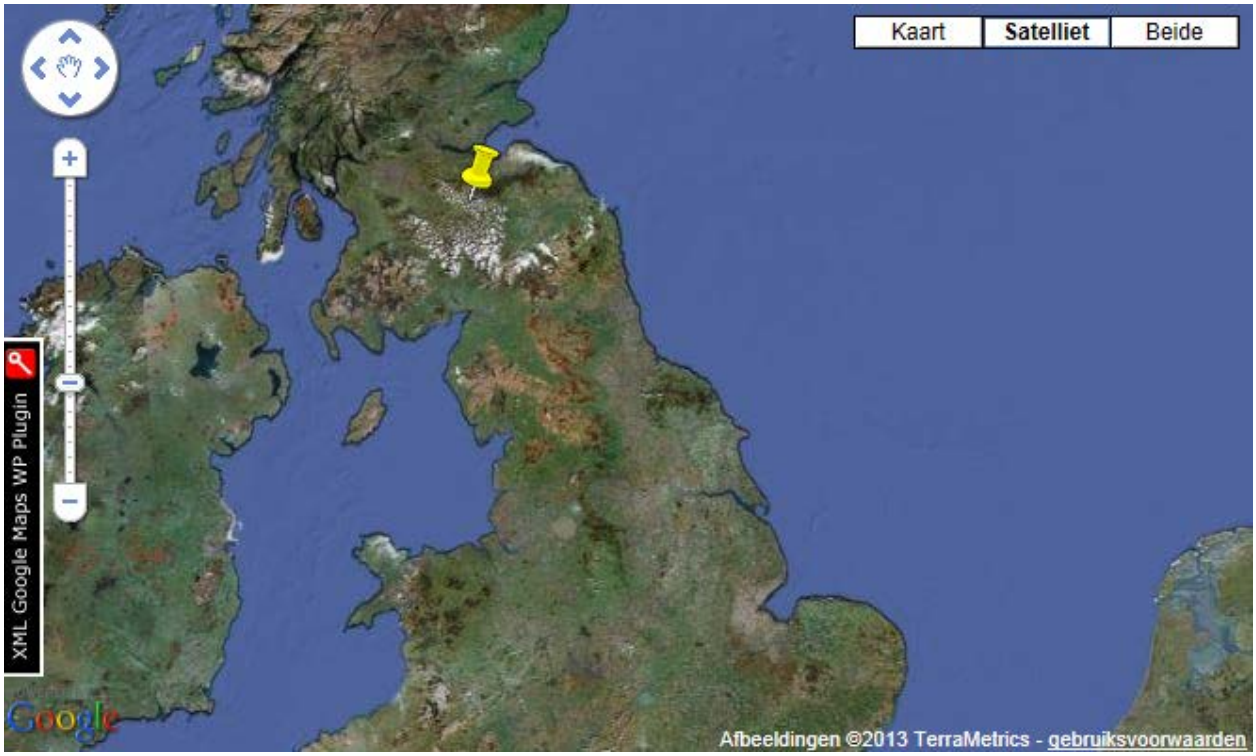
Users are allowed physical access to the infrastructure including the possibility to set up own instrumentation for inter-comparison purposes on campaign basis. Access to state-of-the-art analytical instrumentation (GC; IRMS) might be provided in adjacent lab based on specific demands. During the course of the project, participation in N2O measuring campaigns will be offered for inter-comparison of flux measurement techniques across scales, improving current techniques and develop new ideas. Technical support and recommendations for establishing GHG flux measurements with conventional

and new state-of-the-art technologies as carried out at the location. However, provision of specific utilities and consumables, not in conventional use at the infrastructure is not offered.

The N2O skills training course

At the willow site the N2O skills training course was organized from 22-25 April 2013. Objective of the course was to provide training for students from Eastern Europe and developing nations who needs to achieve skills in measuring soil-atmospheric exchange of N2O in the field using manual gas sampling in static gas-flux chambers. The course took three days and included both theoretical and practical activities. A key part of this task is to show new users the capabilities of new techniques, and the course ran in parallel to a trans-national field campaign hosted by DTU with participants from research groups in Germany (Karlsruhe Institute of Technology; Thünen Institute; Universität Bremen), The Netherlands (ECN) and Denmark (DTU). This campaign has the objective to compare different approaches for N2O flux measurements including Eddy Covariance and static chambers by application of different analytical instruments (QCL; Off-axis ICOS; FTIR; GC).

2.1.5 Easter Bush



- Coordinates: N 55°51'56, W 3°12'25.4
- Height: X 5m tower
- Base level: 193 m ASL
- Country: Scotland
- InGOS observations: CH_4, N_2O
- Responsible partner: CEH
- Responsible PI: Eico Nemitz(en@ceh.ac.uk)
- Website:http://www.ceh.ac.uk/sci_programmes/INGOS.html

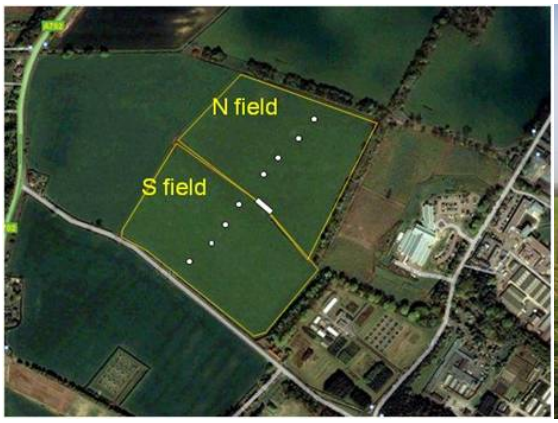
General

Easter Bush has been a key site of GREENGRASS, a validation site under the CarboEurope IP and a Level-3 site of NitroEurope IP. Instrumentation is located on the boundary of two fields that generally receive the same management, with the wind coming from the S field for 80% of the time. The site is conveniently located within walking distance to CEH's Edinburgh laboratory and a range of ongoing measurements and excellent site infrastructure (100A of mains power, broadband connection) is available.

Ingos Activities at Easter Bush

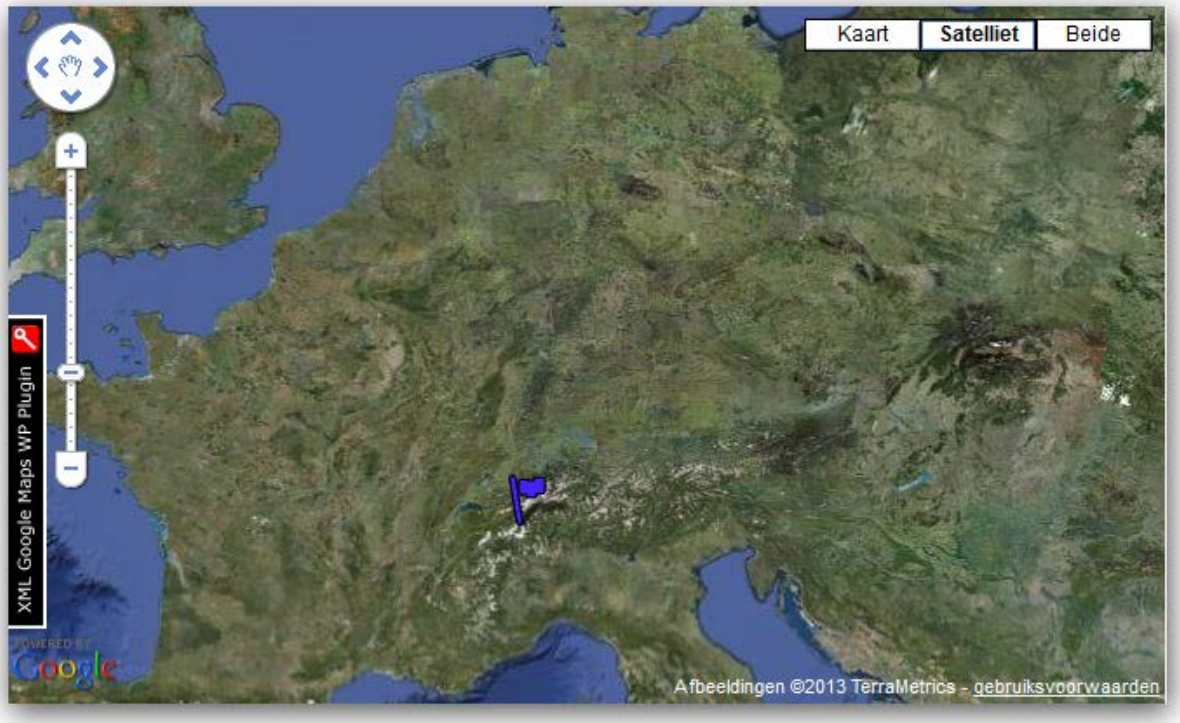
The following activities are planned at Easter Bush during InGOS:
•N2O fluxes will be measured continuously with a state-of-the-art continuous wave quantum cascade laser absorption spectrometer (Aerodyne mini CW-QCL) from Feb 2012 to Feb 2013, providing an extended possibility to intercompare instrumentation.
•The South field will be ploughed up and reseeded in February/March 2012 for the first time after 25 years. This event provides an excellent opportunity to study the effect of this management on greenhouse gas emissions. Groups wishing to contribute should contact Ute Skiba or Eiko Nemitz.
•Easter Bush will host the N2O flux intercomparison campaign on a managed grassland for the period 3rd to 28th June 2013. This will feed in to the NA5 workpackage where InGOS aims to optimise and standardise flux measurement systems for non-CO_2 greenhouse gases.

More information on the N2O intercomparison campaign:
To verify a variety of N_2O flux measurement setups using eddy covariance, REA or gradient method on the same field, for a duration of 4 weeks. All instruments will be running in parallel for the first few days measuring background conditions, and continue for a three week period following the fertilisation event. All system will be calibrated together with the same gas standards. There will be the opportunity to interface various analysers with a common anemometer / data acquisition system or to test independent complete systems against a reference. Data analysis will be performed individually with own methodology and in parallel following a common protocol.



2.2 TNA 2

2.2.1 Jungfraujoch (Switzerland)



- Coordinates: 53°20′ N, 9°54′ W
- Height: 5 m inlet
- Base level: 3580m ASL
- Country: Switzerland
- InGOS observations: CH4, N2O, SF6, H2, 222Rn, halocarbons
- Responsible partner: Empa
- Responsible PI: Stefan Reimann (stefan.reimann@empa.ch)
- Website: http://www.ifjungo.ch

General

Jungfraujoch is a high-Alpine station (3580 m asl) located in the centre of Western Europe. It is a station in the Global Atmosphere Watch (GAW) program of the World Meteorological Organization (WMO) and it is included in the Swiss National Air Pollution Monitoring Network (NABEL). During extended periods, the Jungfraujoch is decoupled from the tropospheric boundary layer below and can be used as a background site. On the other hand, transport of polluted boundary layer air to the height of the Jungfraujoch occurs periodically because of meteorological transport connected with the passage of fronts, foehn winds, or thermally driven convection during anticyclonic periods in summer. A recent modelling study assessing the representativeness of monitoring sites in Europe based on backward Lagrangian Particle Dispersion Modelling categorized Jungfraujoch as ‚mostly remote'. It is therefore very much used to study transport processes between the boundary layer and the unpolluted troposphere.

Surroundings

The High Alpine Station Jungfraujoch (3580 m above sea level) is situated in the northern part of the Swiss Alps and belongs to the first topographical barrier for the frequent westerly winds in central Europe. Its location is relatively remote, with the nearest villages more than 8 km in horizontally and 2.5 km in vertically distance and is only weakly influenced by local anthropogenic sources. Therefore, it can be used to monitor pollutant emissions from a wider area surrounding the Alps. The emission source regions, which have a detectable impact on the measurements at Jungfraujoch, have been investigated by Reimann et al. (2008). It was concluded that emissions from an integrated area in central Europe including Switzerland, northern Italy, France, southern and western Germany, the Benelux countries, and to limited extent north-eastern parts of Spain could be observed at Jungfraujoch.

Infrastructure and facilities

Within the Swiss National Air Pollution Monitoring Network (NABEL) the whole suite of non-CO_2 greenhouse gases are measured by Empa. Measurements of CH_4 and N_2O are performed continuously since 2005 by using a GC-FID and a GC-ECD, respectively. In the last year CH_4 measurements have been upgraded by a Cavity Ringdown Spectrometer (CRDS) and N_2O measurements by Quantum Cascade Laser Spectrometry (QCL) will be added in 2012. Furthermore, CO_2 and CO_2 isotopes (QCL) are measured continuously by the University of Bern and Empa, respectively (Uglietti et el., 2008; Tuzson et al. 2010). Around 50 halocarbons are measured at Jungfraujoch with the MEDUSA system (Vollmer et al., 2011). These measurements are part of the global AGAGE measurement network. Furthermore, measurements of reactive trace gases (e.g. Balzani-Lööv et al., 2008) and aerosols (e.g. Cozic et al., 2008) are among the most comprehensive ones worldwide. In addition, vertical column measurements of some of the halogenated greenhouse gases (SF_6, CFC 12, HCFC 22) and other substances by Fourier Transform Infrared Spectroscopy (FTIR) related to global change have been performed routinely at the Jungfraujoch for many years (Zander et al., 2008).

The actual research plan includes 16 long-term projects of 21 teams being part of European and global networks. Advanced measuring techniques are being used for environmental research. Most of the research programs, but in particular the long-term investigation of the physics and chemistry of the

Earth's atmosphere, are expected to contribute significantly to more than 25 internationally and nationally coordinated research initiatives.
Research groups working at the Jungfraujoch participated, among others, in the following major programs/networks:

- GAW Global Atmosphere Watch
- AGAGE Advanced Atmospheric Gases Experiment
- CHARM Swiss Atmospheric Radiation Monitoring Program
- NDACC Network for the Detection of Atmospheric Composition Change
- UNEP United Nations Environment Programme
- ANETZ automatic measuring network of MeteoSwiss
- RADAIR Swiss network for the survey of radioactivity in air
- NABEL Swiss National Air Pollution Network
- ACCENT-plus European network on Atmospheric Composition Change
- IMECC Infrastructure for Measurements of the European Carbon Cycle
- ASRB Alpine Surface Radiation Budget Network
-

References for Jungfraujoch observations

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2.2.2 Mace Head (Ireland)

- Coordinates: 53°20′ N, 9°54′ W
- Height: 10 m tower
- Base level: 25m ASL
- Country: Ireland
- InGOS observations: CH_4, N_2O, SF_6, H_2, ^{222}Rn, halocarbons
- Responsible partner: Univerity Bristol
- Responsible PI: Simon O'Doherty (s.odoherty@bristol.ac.uk)
- Website: Mace Head dedicated website

General

Located on the west coast of Ireland, the Atmospheric Research Station at Mace Head, Carna, County Galway is unique in Europe, offering westerly exposure to the North Atlantic ocean (clean sector, 180 degrees through west to 300 degrees) and the opportunity to study atmospheric composition under Northern Hemispheric background conditions as well as European continental emissions when the winds favour transport from that region. The site location, at 53 degrees 20 minutes N, 9 degrees 54 minutes W, is in the path of the mid-latitude cyclones which frequently traverse the North Atlantic. The climate is mild and moist, being dominated by maritime air masses. From collected data we see the distribution of mean hourly wind direction in 10 degrees intervals from June, 1990 to August, 1994 which shows that, for this period, the wind was within the clean sector for 50.6% of the time, this amount varying annually from 44.9% (1993) to 55.3% (1992). Calm conditions (average 0.6% for this period) are not included in the calculations. Annual rainfall is approximately 1200 mm. October to December are the wettest months, with April and May being the driest. Relative humidity is generally high, at about 80-85%. Average air temperature is about 10 degrees Celsius (~15 degrees Celsius in summer, ~5 degrees Celsius in winter). Sea temperature ranges from about 10 degrees Celsius in winter to about 15 degrees Celsius in summer. Sunshine is scarce, averaging 1290 hours per annum. May is the driest and sunniest month (179 hours), and December is the dullest (38 hours).

Surroundings

It is 88 km west of Galway city (population approximately 60,000) which is the nearest major conurbation. The main Atlantic shipping routes are over 150 km away, while the transatlantic air corridors are over 80 km away. There are three small islands offshore which are within the clean sector, but these are uninhabited and do not appear to influence any of the measurements made at the site. The meteorological records show that on average, over 60% of the air masses arrive at the station via the clean sector. These air masses are ideal for carrying out background aerosol and trace gas measurements. Significant pollution events also occur at the site when European continental air masses, generally originating from an easterly direction, reach Mace Head. The Mace Head research station, is uniquely positioned for resolving these different air masses and for comparative studies of their constituents and characteristics.

Infrastructure and facilities

Other ancillary constructions include a 10 m meteorological tower and platforms for the positioning of sampling equipment. Meteorological data such as wind speed, wind direction, pressure, temperature, relative humidity and rainfall are recorded at the station. Solar radiation and UV levels are recorded continuously. The facilities at the site consist of three laboratory buildings, one at ~300m and two at ~90m from the shore (~50m from high water), 23m and 10m aluminium walk-up towers and a converted 20 ft cargo container laboratory. The site is a part of a number of international research networks including the Advanced Global Atmospheric Gases Experiment (AGAGE), the Atmospheric/Ocean Chemistry Experiment (AEROCE), World Meteorological Organisation/Global Atmospheric Watch (WMO/ GAW), Tropospheric Ozone Research (TOR, a EUROTRAC project), Budget of Ozone over the Atlantic (BOA) and the Climate Monitoring and Diagnostics Laboratory/National Oceanic and Atmospheric Administration (CMDL/NOAA) co-operative flask sampling network.

References for Mace Head observations

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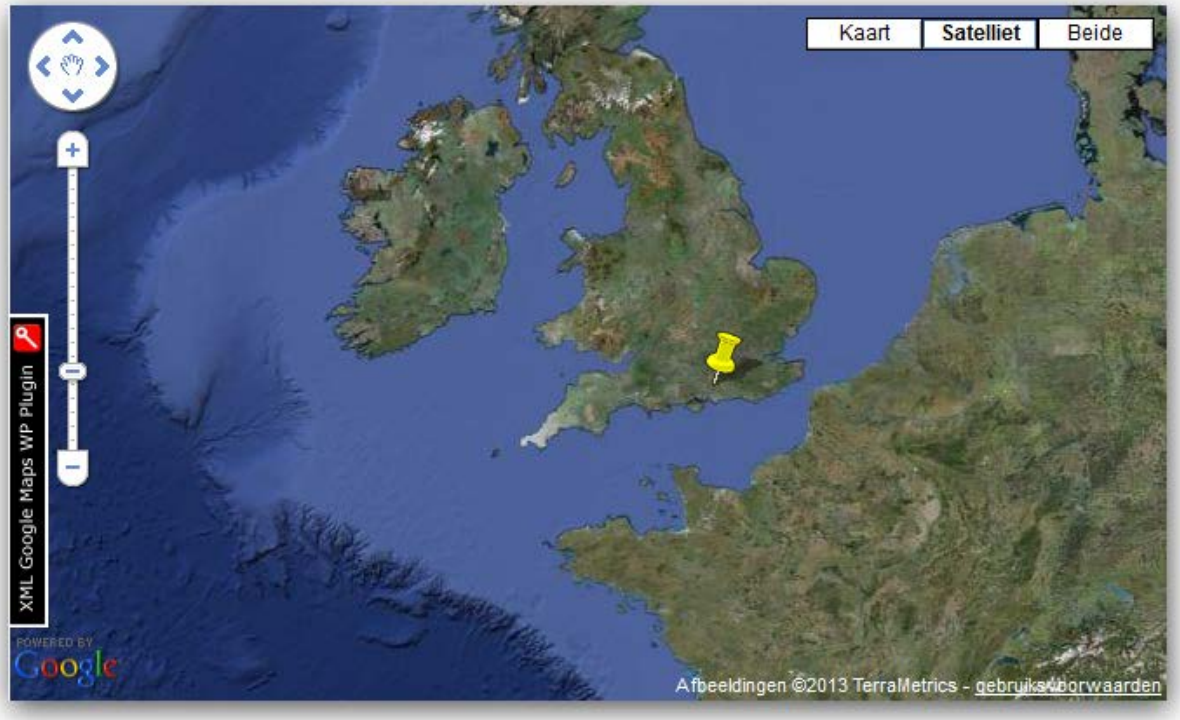
2.2.3 GGLES – Egham (United Kingdom)



- Coordinates: 51°25'30 N, 0°34'2.0 W
- Height: –
- Base level: 22m ASL
- Country: United Kingdom
- InGOS observations: Isotope lab
- Responsible partner: Royal Holloway, University of London
- Responsible PI: Dave Lowdry(d.lowry@es.rhul.ac.uk)
- Website: GGLES dedicated website

General

The greenhouse gas laboratory at RHUL contains the isotope measurement facility. This has two systems capable of measuring carbon isotopes of methane and carbon and oxygen isotopes of CO_2 to high precision. The facility also has a CRDS instrument capable of measuring CH_4 and CO_2 concentrations to high precision and accuracy and a Peak Performer for measurement of H_2 and CO. The facility currently makes isotopic and mixing ratio measurements, particularly on methane samples from a wide range of sites around the world, from the high Arctic sites of Zeppelin and Alert, down to the Falkland Islands in the South Atlantic. The infrastructure also provides calibration services to the London Air Quality Network of CO_2 analysers, and analytical services for the internal postgraduate Masters course on Environmental Diagnosis and Management.

Infrastructure and facilities

Access can be provided to the Greenhouse Gas laboratory for analytical and training purposes, and to the high level air sampling inlet or the surrounding campus for sample collection. The unit of usage will be one day of access to the facilities, in particular for junior scientists, and the availability of laboratory staff to provide assistance and training.

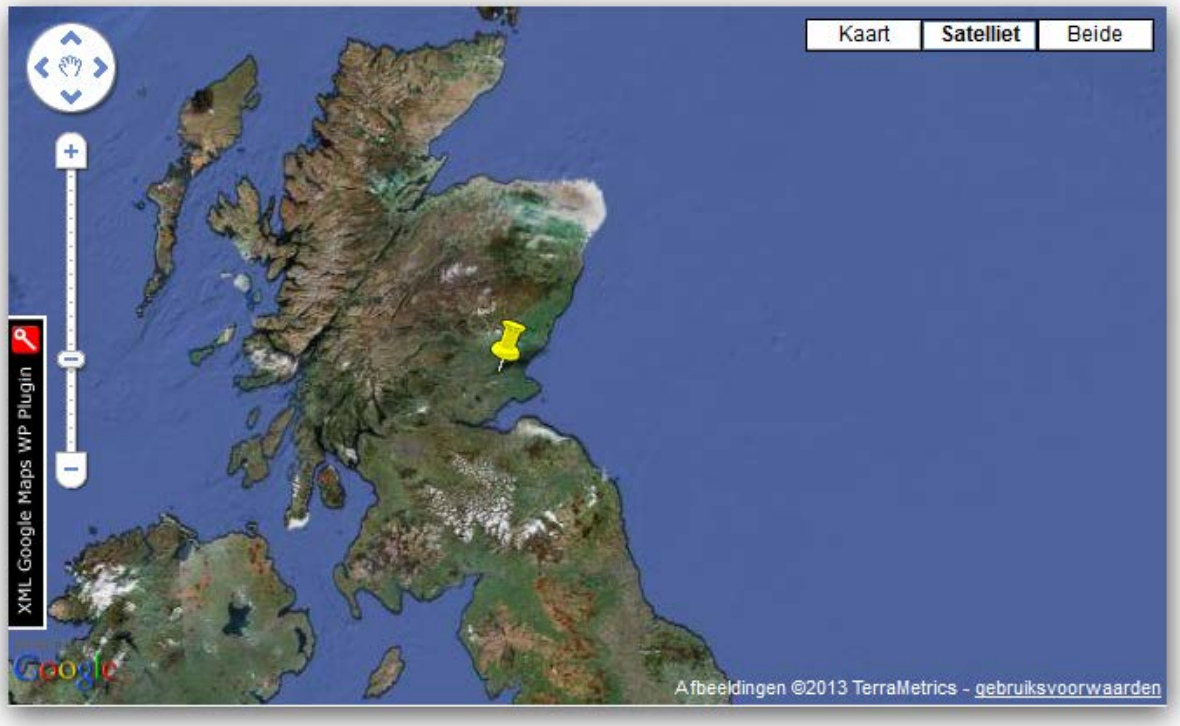
Support offered under this proposal:

The support falls into three main categories:

• Access to the laboratory to make mixing ratio measurements on the users own samples.
• Access for users to collect samples from the site for later measurement, or to set up their own equipment and make direct measurements.
• Access for a comparative study of new isotopic techniques with the well-established high precision methodology used at RHUL, particularly during the large diurnal variations sometimes experienced on site.

The facility can also offer training in the use of the CRDS technology in comparison with traditional GC techniques.

2.2.4 Angus (United Kingdom)



- Coordinates: N 56.5551, W 2.9858
- Height: 230 m tower
- Base level: 400 m ASL
- Country: Scotland
- InGOS observations: CH_4, N_2O,SF_6,Radon
- Responsible partner: UEDIN
- Responsible PI: (j.moncrieff@ed.ac.uk)
- Website:http://www.metoffice.gov.uk/atmospheric-trends/sites/angus

General

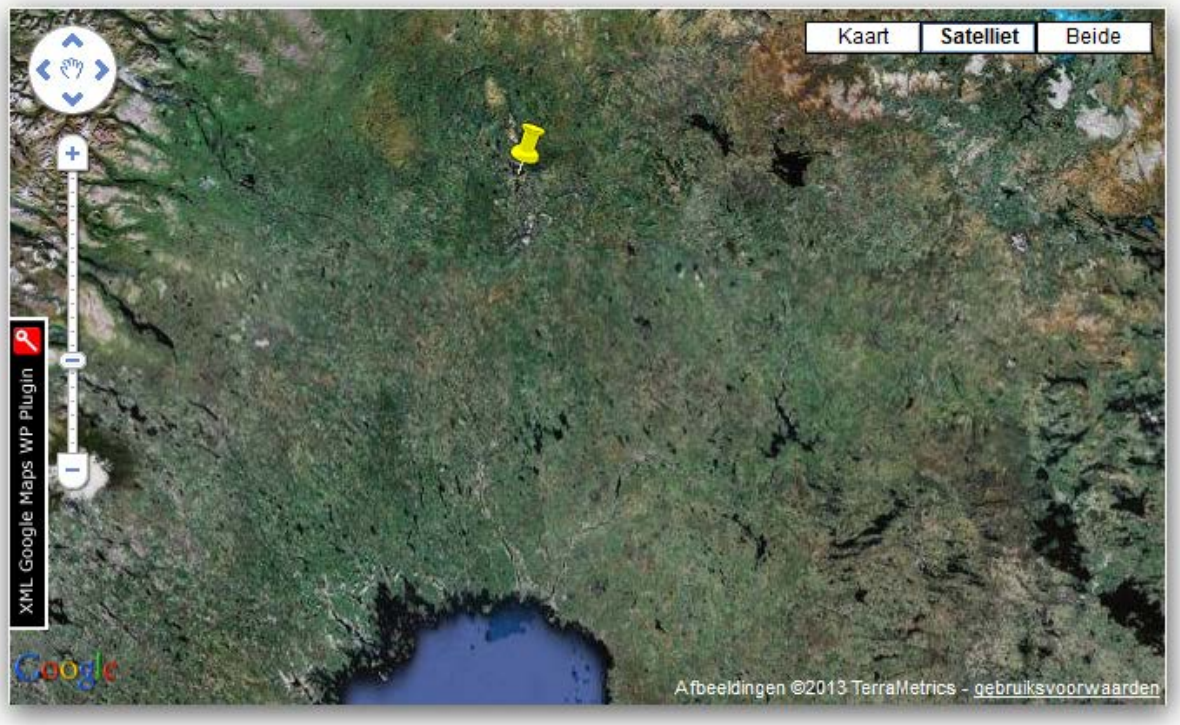
TTA is located on the east coast of Central Scotland, 8 km to the north-west of Dundee. The tower is a combined TV/radio broadcast mast owned and operated by Arqiva in the UK. The tower is 313 m asl on the Sidlaw Hills and the tower has two intake lines (at 50 m agl for radon 222; at 222 m agl for intake of greenhouse gases). The site was established as part of the CHIOTTO project with first measurements in 2005. Measurements have been continuous since and the site was part of the IMECC programme. Instrumentation at the site includes Hp/Agilent Gas Chromatographs for CH_4, N_2O and SF_6; an RGA3 GC for H_2 and CO; a Li-7000 IRGA for CO_2. A Picarro Quantum Cascade Laser will be installed by the end of 2010 for atmospheric CO_2 and CH_4 concentration measurements in association with NERC CEH (Bush). Air temperature, atmospheric humidity and atmospheric pressure are recorded at 3 levels on the tower and also at ground level; wind speed and direction are recorded at 4 m agl at the base of the tower. A broadband connection at the site permits on-line retrieval of the data. Footprint analysis shows that TTA samples most of its signal from north Britain; about 85% of the signal comes from the relatively unpolluted areas to the west and north-west of the site. Research at the site involves PhD students examining source attribution and boundary-layer modelling. Data from TTA is used by met offices in the UK and Norway. TTA is also a site where boundary-layer profiling of greenhouse gases is centred using UEDIN's research aircraft. TTA will be a target site for the new DIAL system.

Access

Collaborators at TTA will operate with UEDIN through the contact points of Prof. John Moncrieff and Robert Howard. Travel to and from the site is monitored by the operator to ensure safety at the site and visitors must be accompanied at all times. Access will be provided to the existing analysis infrastructure at TTA and help will be provided installing visitors equipment and integrating it into the existing system.

Tall Tower Angus has been used in CHIOTTO and IMECC projects and data is available from the databases of both these earlier projects. We have a website describing some of the work at TTA (http://www.geos.ed.ac.uk/abs/research/micromet/) and we are currently implementing a near real-time display of data from the tower (in addition to the NRT results available via IMECC). Data from TTA is being used in a number of 'geoscience outreach' projects targeting members of the general public and schoolchildren; this sort of outreach will increase in future. A number of popular radio programmes done by the BBC have featured TTA (e.g. (http://www.bbc.co.uk/programmes/b00t4q11) and the science surrounding it; posters and presentations continue to be delivered to scientific and non-scientific audiences (e.g. http://planetearth.nerc.ac.uk/multimedia/story.aspx?id=776). Data is also used in research projects in European Met Offices in the UK and Norway.

2.2.5 Pallas/Sodankylä (Finland)



- Coordinates: 68°00′N, 24°14′E
- Height: 10 m
- Base level: 315 m ASL
- Country: Finland
- InGOS observations: CH_4, N_2O,SF_6,Radon
- Responsible partner: FMI
- Responsible PI: (Tuomas.Laurila@fmi.fi)
- Website:http://fmigaw.fmi.fi/

General

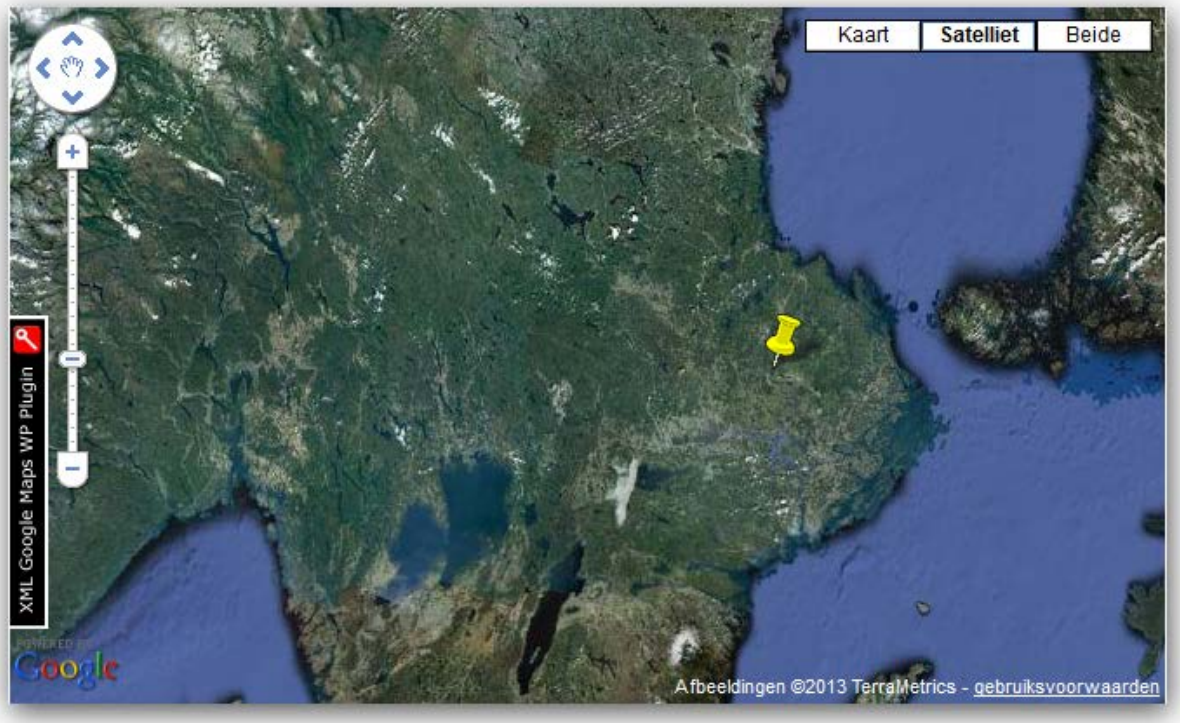
Finnish Meteorological Institute (FMI) Pallas-Sodankylä WMO GAW-site in Finnish Lapland comprises of two infrastructures: Arctic Research Centre at Sodankylä (FMI-ARC) and the clean air site at Pallas 150 km NW of Sodankylä. The former site has a long history dating back to the first geophysical year in 1882/83. The clean air site at Pallas was established in the beginning of 1990's and in 1994 the two sites were officially combined to form a major site in the World Meteorological Organization (WMO) coordinated Global Atmosphere Watch-program, officially known as Pallas-Sodankylä GAW site. The roles of the two sites are (roughly) such that surface measurements of GHGs, Aerosols and other background chemistry compounds are done at Pallas and GHG-, Ozone, and NO_2 total columns, upper air soundings, and radiation measurements in Sodankylä. Both sites are equipped with meteorological towers which enable the flux measurements of heat, momentum, water vapour, CO_2, and aerosol particles in a boreal spruce (Pallas) or pine (Sodankylä) forest. In Pallas, CO_2, CH_4 and N_2O fluxes are measured on a near-by wetland. For characterization of surface properties Sodankylä has in situ surface, snow and soil measurements that are complemented by static tower spectrometer for surface reflectance from UV to Near IR as well as a tower MW radiometer and a MW radar (scatterometer). Total column GHG concentrations are measured by TCCON FTIR spectrometer. It is used also to validate Japanese GOSAT and in the future OCO-2 satellite observations. Early 2011, we will start atmospheric concentration measurements of CO_2 and CH_4 and a gas cylinder filling station. Pallas node of the twin site operates several field sites at different environments The main locations

for monitoring the tropospheric air composition are at Sammaltunturi mountain top site and at Matorova. The monitoring programme includes CO_2, N_2O, CH_4, SF_6, NO_x, O_3, CO, SO_2, light hydrocarbons, black carbon, PM_{10}, radon-222, aerosol particle number concentration and size distribution, aerosol scattering coefficient, main inorganic ions (e.g. $SO_4^{2-}$and NH_4^+), persistent organic pollutants (POP) and heavy metals in the air and in precipitation, electrical conductivity and ionisation rate of the air, and surface weather parameters. At Kenttärova boreal spruce forest we measure fluxes of heat, momentum, water vapour, and CO_2. At Lompolojänkkä wetland (northern aapa mire) we measure methane, CO_2 and water vapour fluxes using eddy covariance technique.

Access

Access is provided to the measurement systems, accommodation, office and telecommunication facilities are available to users. The overall ensemble is used annually by around 50-100 international users.Visits are usually of a short duration either campaigns, installation trips or utilization of local archives of data and meta information. Since the visits usually relate to the core functions of the Pallas-Sodankylä there is a host group where the visitors, so willing, can integrate themselves during the access period. Hence he/she has the same possibilities to technical and logistical support as regular personnel.

2.2.6 Norunda (Sweden)



- Coordinates: 60°05′N, 17°28′E
- Height: 102 m tower
- Base level: 70 m ASL
- Country: Sweden
- InGOS observations: CH_4, N_2O,SF_6,Radon
- Responsible partner: Lunds Universiteit (ULUND)
- Responsible PI: (Anders.Lindroth@nateko.lu.se)
- Website:http://www.icos-sweden.se/SE_norunda.html

General

The Norunda site is unique since it is one of the few high towers (102 m) located in a forest and with an extensive forested fetch area. It is easy to access being only 1 hour drive from the main airport in Sweden, Stockholm-Arlanda. The site has been used since 1994 for studies of exchanges of greenhouse gases (CO_2 and CH_4), energy and water using micrometeorological methods (EC and gradients). EC fluxes of CO_2 are measured at 33 m and at 102 m. The tower is equipped with a 12-level profile system for air temperature and humidity and CO_2 concentration. Wind speed is measured at 7 levels. Profile of CH_4 is measured at 3 levels above the forest using up to date CRD analyser. Soil effluxes of CO_2 are measured with an automatic chamber system consisting of 5 units with one measurement per hour per unit. The meteorological measurements in the tower include also incoming and outgoing PAR as well as short- and long wave radiation, direct and diffuse PAR, below canopy PAR, PRI sensor, phenology camera, precipitation and snow depth. Tree water uptake is measured during the growing season using sap flow sensors. The Norunda site is part of the Swedish ICOS from 1 July 2010. A laboratory building is located 30 m from the base of the tower with space available for external users. Internet access is available.

An building near the tower contains lodging facilities for up to 5 people at the same time. There are also fully equipped kitchen, shower and toilet facilities available. Limited laboratory space can be provided as well as mains power, telephone and internet connection. There will be personnel at the site during normal working hours that can advise and to some small degree assist with installation of equipment. All ICOS related data collected at the site will be freely available for all users of the facility. Other data can also be made available according to separate agreements. The site has been used by external groups for e.g., soil respiration studies, tower measurements of volatile organic compounds (POPs) and it is currently involved in a study concerning airborne LIDAR measurements and mapping of vegetation for modelling purposes (N. Kljun, Swansea, UK).

The Norunda station is open for access year around and for long as well as shorter campaigns. The evaluation of TNA proposals will verify that there will be no unwanted interference with existing measurements at the site. There are personnel working permanently at the site since the site is now part of Swedish ICOS. The field lab is available for installation of equipment, with access to mains power, internet, telephone etc.

A web site is under construction as part of the new Swedish ICOS infrastructure. The site will contain detailed information about accessibility, measurements, data flow, accommodation, lab space etc etc.

An interactive database containing flux and meteo data from 1994 and onwards is available for all users. Near real-time site data is available through the IMECC interface. Daily graphics showing the status of measurements and web camera are available at http://www.nateko.lu.se/IMECC/daily_status_month.shtml.

2.2.7 Grignon/Orleans (France)

- Coordinates: Grignon 47°51′N, 1°54′E Orleans 47°57′N 2°06′E
- Height: Grignon 5 m, Orleans m
- Base level: Grignon 70m, Orleans: 131m ASL
- Country: France
- InGOS observations: CH_4, N_2O,SF_6,Radon
- Responsible partner: Institut National de la Recherche Agronomique (INRA)
- Responsible PI Grignon: (loubet@grignon.inra.fr)
- Contact Orleans: (martina.schmidt@cea.fr)
- Website:http://www.agroparistech.fr/Ferme-experimentale-de-Grignon,746.html

General

Two fields in the centre and north region of France. Field one is in Thiverval-Grignon and field two near Marchéville.

The two sites are equipped with the latest and most sensitive Quantum Cascade Lasers (QCL) which are operated, in eddy-covariance in Grignon and with fast boxes in Orléans. The QCL of Orléans is a sensitive instrument developed by CNRS and the QCL of Grignon has been recently acquired from aerodyne. The Grignon site is moreover equipped with the full range of meteorological and carbon and heat flux instrumentation used in Carbo and Nitroeurope.

The field sites of Grignon and Orléans are representative agricultural sites where N_2O fluxes have been measured by chambers for over 5 years in Grignon and more than 1 year in Orléans. The expertise acquired on the N_2O fluxes will be essential to design and plan experimental campaigns where new techniques can be tested, knowing in advance the magnitude of the N_2O flux to be expected. Moreover, the timing and quantity of nitrogen supplied to the field can be controlled. During the last three years the Grignon field site has hosted 4 international and national campaigns for measuring fast chemistry, isotopic fluxes of oxygen and carbon, HONO and NO_x/O_3 fluxes. The Orléans field is currently part of a national observatory for the N_2O emissions and linked with the tower of Le Trainou.Similarly the site of Grignon is representative of the agricultural fields near Paris. Finally,

the two field sites contain a range of fields that can be chosen with regard to the soil and management options.

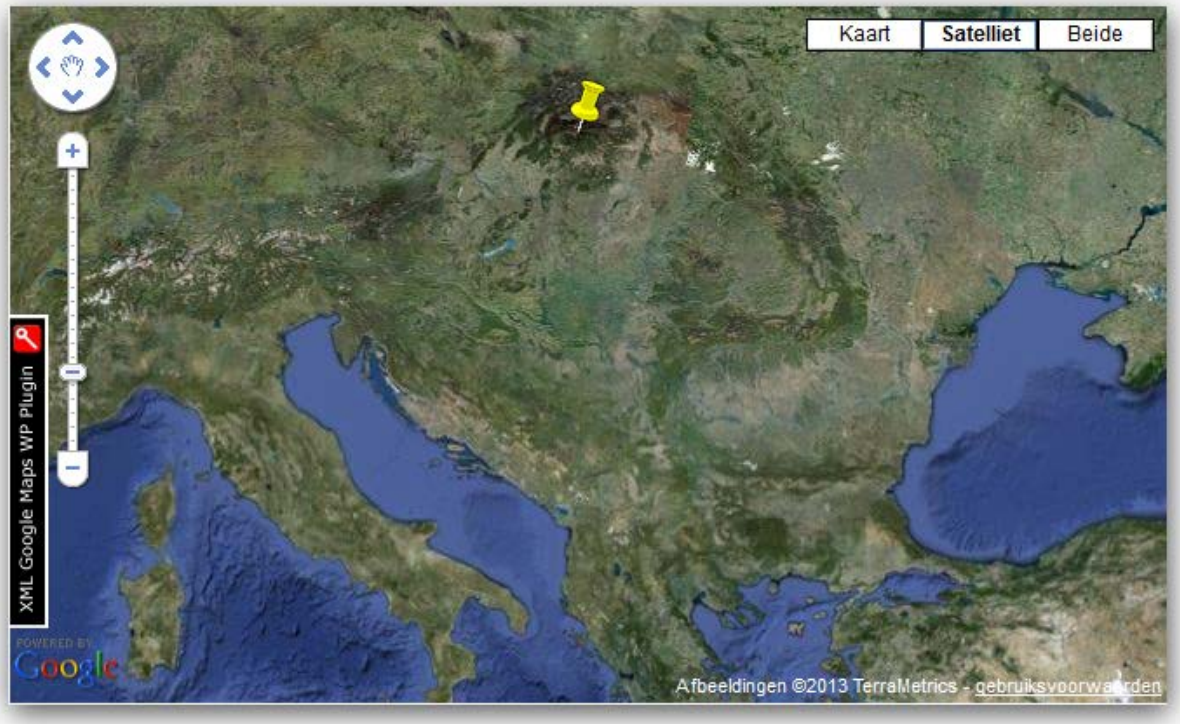
Trainou tower at Orleans

The Trainou tall tower (TRN) is located in France at 100km South of Paris and 20km North/West of Orleans. It is surrounded by the Orléans Forest and small cities. The 200m height tower is owned by the French telecommunication company TDF. It has been equipped in 2006 with air inlet at three elevations: 50m, 100m and 180m above the ground, and with meteorological sensors at 180m and 10m. LSCE (Laboratoire des Sciences du Climat et de l'Environnement) has installed one shelter to host several continuous analysers and one flask sampling unit. Currently there is one gas chromatograph analysing CH_4, N_2O, SF_6, CO, and one non-dispersive infrared analyser for CO_2. Another GC will be setup in 2008 to measure H_2 and CO, and Radon measurements will be installed at the 100m level. A small aircraft is flying over the tower, up to 3000m agl, once a week for CO_2 in-situ measurements and flask sampling. Internet access is available and the instruments can be remotely controlled from LSCE at Gif sur Yvette. One technician is performing routine operations once a week.

The field sites of Grignon and Orléans will be open to experimentalists that would like to test their N_2O flux measurement systems against our eddy-covariance, auto-chamber and fast boxes measurements. The expected outcomes will be validation of new techniques for measuring N_2O fluxes.

The users will benefit to access to the field and field lab. They will benefit from past expertise on the N_2O flux measurement techniques by auto chambers and eddy-covariance as well as knowledge on N_2O emission process modelling which will help both planning the best experimental periods and analysing the measured N_2O fluxes. Moreover the users will benefit from an excellent expertise in N_2O flux modelling from agricultural fields with the NOE model and the CERES-EGC models developed at Orléans and Grignon.

2.2.8 Kasprowy Wierch (Poland)

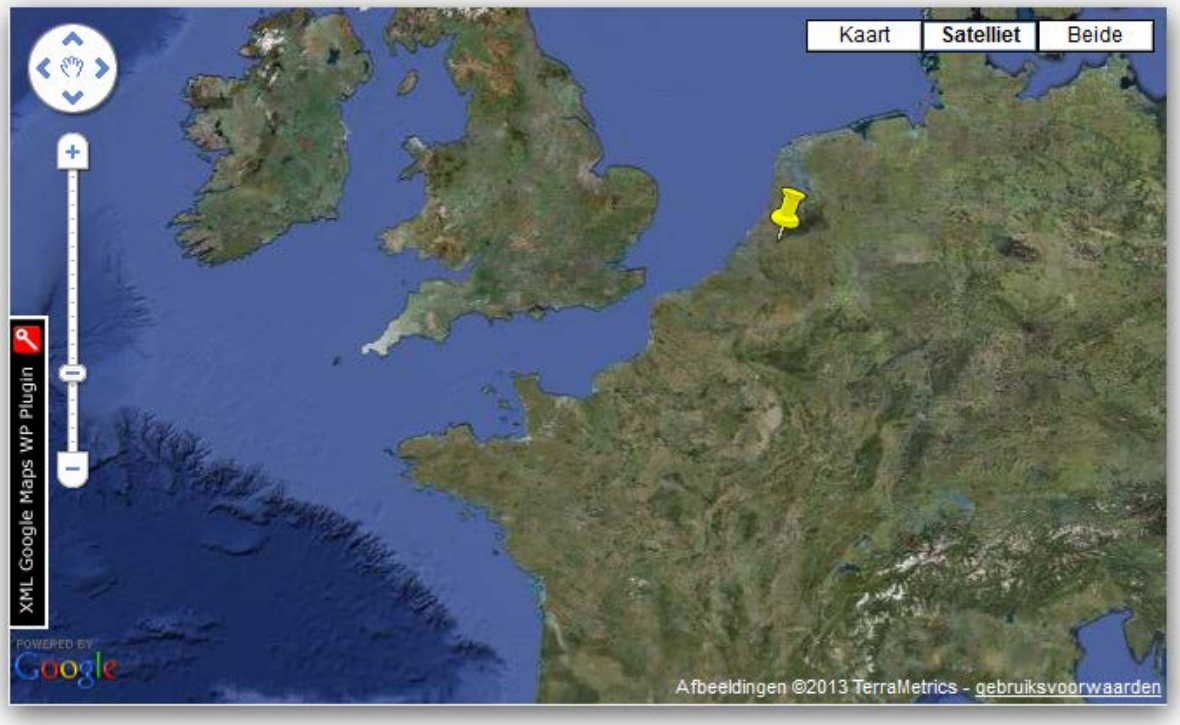


AGH-UST
www.ftj.agh.edu.pl/zfs
At the top of Tatra mountain peak (1989m a.s.l.) (19°14'N 19°59'E),nearest city is Zakopane (6km north and 1000m down)

High-altitude site located on top of Kasprowy Wierch mountain, in the Polish Tatra, ca. 400 meter above the tree line. The Kasprowy Wierch Trace Gas Measurement Station (KASLAB) has been established in 1994 as a first Polish remote observatory where main greenhouse gases (CO_2 and CH_4) were measured with high precision. The existing record of atmospheric mixing ratios of these two gases covers 16 years and is one of the longest in this part of Europe.
The KASLAB station has been present in several EU-founded projects (Escoba, MethMoniteur, CarboEurope, IMECC). In the framework of the on-going IMECC project a near real-time data transmission system has been developed and implemented for CO_2 measurements. This system has improved measurement data quality by real-time monitoring of the key operational parameters of the instruments located on the station. In addition, there is an on-going work related to integration of mixing ratio measurements with meteorological parameters for automatic near real-time data flagging procedure.
The Kasprowy Wierch is envisaged as one of key sites of the Polish network of stations for atmospheric GHG measurements, in the framework of ICOS-Poland. The concept of ICOS-Poland has been recently officially endorsed by the Polish Ministry of Science and Higher Education and was placed on the list of 15 infrastructure projects constituting Polish roadmap to the European ESFRI initiative. The first meeting of the potential contributors to ICOS-Poland was held in September 2010. The project proposal for ICOS-Poland will be prepared in October 2010.
Scientific programme of the station includes not only "in situ" analysis of meteorological conditions and atmospheric chemistry but also sampling of air, aerosol, rain and snow for the physical and chemical analysis by many national and international partners.
Actually distributed activities:
• atmospheric mixing ratios of CO_2, H_2 (GC technique), with time resolution of 3 to 4 measurements per hour – data delivered to international databases;

• radiocarbon content in monthly cumulative samples of atmospheric CO_2 – cooperation with IAEA and international radiocarbon community.
• δ2H in atmospheric H_2 (IMECC TA flask sampling programme in collaboration with Utrecht University, the Netherlands).
• O_2/N_2 ratio (IMECC TA flask sampling programme in collaboration with RUG Groningen, the Netherlands).
Currently 3 external users have access to the site.
AGH-UST will provide: Physical access to the site, Engineering and infrastructure support equivalent to that provided to existing measurement programmes at the site, Advice on sampling protocols most suitable to the station. Flask sample collection of dried atmospheric air. Intercalibration services for routinely measured gases including Rn222 activity
Station has its own web page and information as well as some results are available for international access. There is intense didactic programme on-going at Kasprowy Wierch – many groups of university, high school and elementary school students are visiting the station several times per year. Some of them are cooperating with the station later on.
The KASLAB station has been present in several EU-founded projects (Escoba, MethMoniteur, CarboEurope, IMECC). In the framework of the ongoing IMECC project a near real-time data transmission system has been developed and implemented for CO_2 measurements. This system has improved measurement data quality by real-time monitoring of the key operational parameters of the instruments located on the station. In addition, there is an on-going work related to integration of mixing ratio measurements with meteorological parameters for automatic near real-time data flagging procedure. There is also possibility to install impactors and other kind of aerosol samplers. Moisture and snow sample are available. We expect that the number of external users of the equipment will increase as new techniques will be available.

2.2.9 Horstermeer (Netherlands)



- Coordinates: Horstermeer
- Height: 117 m.
- Base level:
- Country: Netherlands
- InGOS observations: CO_2, N_2O, CH_4
- Responsible partner: VUA
- Responsible PI: j.van.huissteden@vu.nl
- Website:http://www.falw.vu.nl

General

At the Horstermeer experimental wetland restoration site we monitor ecosystem CO_2, CH_4 and N_2O exchange since 2003. Eddy covariance for CO_2 started in 2003, for CH_4 in 2005; N_2O emissions have been determined with chambers. The eddy covariance equipment for CH_4 is based on the Los Gatos Cavity Ringdown Laser. However, in 2011 we plan to replace this with a LiCor open path methane analyser. In 2011 also an automatic chamber system will be installed. Grid power supply is available at the site. Currently we are developing facilities for online data access for the eddy covariance system. In collaboration with ECN a relaxed eddy covariance system for N_2O and other low concentration greenhouse gases will be tested at the site.

The site is a former agricultural area on peat soil. In the late 90's a wetland restoration project has been started for which the water table has been raised to just below the soil surface, and all agricultural management has ceased. The area is developing towards a reed-sedge peatland. In 2005-2009, a comparative study on the greenhouse gas balance has been made by comparing with agriculturally managed sites. The site is located within the footprint of the Cabauw tall tower.

The site offers a unique opportunity to quantify greenhouse gas balance changes from changing management and vegetation succession. It is expected that the coming years a further increase of the water table will occur.

Access

Access and space will be provided for users of existing instruments and/or for additional instruments mobilised for intercomparison studies on CH_4 and N_2O flux measurements, and related process studies. Access of a user or user group is admitted after request to the operating organization, based on a clear description of work and planned instrumentation. VUA will then provide scientific, technical, logistic and administrative support for external users of the site. Administrative support will include a request to the terrain owner for admission of the site. Logistic support may consist of assistance with transport of equipment to and from the site. Technical support may consist of advice on equipment installation, connection to power supply and technical assistance with installation and maintenance of equipment. If required, temporary office facilities can be offered at VUA, at 25 km distance of the site.

A website for the Horstermeer site will be developed, in the future this will also include online data access. The transnational access will allow a wider user community to set up ecohydrological experiments and monitoring of ecosystem exchange of greenhouse gases, under conditions of continuing vegetation succession. We expect that the number of external users will increase; the availability of a multi-year data set on greenhouse gas fluxes, and a large body of basic soil and ecosystem data will be an asset for the potential user community.

2.2.10 Hegyhátsál (Hungary)

- Coordinates: 46°57′N, 16°39′E
- Height: 117 m.
- Base level:
- Country: Hungary
- InGOS observations: CO_2, N_2O, CH_4, SF_6, ^{14}C
- Responsible partner: HMS
- Responsible PI: ()
- Website:http://www.nimbus.elte.hu/hhs/

General

Hegyhátsál tall tower greenhouse gas monitoring station consists of a 117 m tall TV/radio transmitter tower owned and operated by Antenna Hungária Corp. and meteorological instrumentations, gas analysers operated by the Hungarian Meteorological Service. The tower is located in a rural environment, in a fairly flat region. Instrumentation is mounted on the tower at four elevations: 10 m, 48 m, 82 m, and 115 m. The region is as free from direct anthropogenic influence as it is possible in the densely populated, highly industrialized Central Europe. Department of Meteorology, University of Eötvös Loránd, Budapest, and the Nuclear Research Institute of the Hungarian Academy of Sciences also participate in the monitoring and research activity performed at the station. The primary aim of the infrastructure is to monitor the atmospheric GHG budget and the GHG exchange between the biosphere and the atmosphere. Existing instrumentations consist of an automated gas chromatograph for the monitoring of CH_4, N_2O and SF_6 mixing ratios, CO_2 analyser for the monitoring of atmospheric CO_2 mixing ratio, two eddy covariance systems (3 m and 82 m) for the monitoring of CO_2 exchange between the surface and the atmosphere, sampler units for whole air samples and for specific ^{14}C measurements. The station has a dedicated internet line for instrument control and data transfer.

Access

Technical assistance to the operation of the instruments and scientific contribution to the interpretation of the measurements will be provided. This latter involve the use of the results of the permanent local measurements. In the past most of the external users deployed their instruments at the station and controlled them via internet, while the technical maintenance was provided by the station's staff. Scientific evaluation of the results were performed jointly

The station is widely known from the scientific literature, especially in Europe where the station has participated in several European scale projects. Measurements are frequently cited on international conferences. The station has a public web-site where the infrastructure is presented. As the scientific profit of the European Community is proportional to the area covered by the monitoring network, a monitoring site extending the region monitored, like in the case of Hegyhátsál, gives extra benefit.

2.2.11 Lutjewad (Netherlands)

- Coordinates: 53°24′N, 6°21′E
- Height: 60 m.
- Base level:
- Country: Netherlands
- InGOS observations: CO_2, CH_4, N_2O, SF_6, CO, 222Radon
- Responsible partner: RUG-CIO
- Responsible PI: ()
- Website:http://www.rug.nl/ees/onderzoek/cio/projecten/atmosphericgases/lutjewad2/index

General

Lutjewad atmospheric monitoring and sampling site is located on the Waddensea dike in the north of the Netherlands, 25 km northwest of Groningen in a rural area. Lutjewad is monitoring the Greenhouse gas balance of the Netherlands and north-western Europe. The whole infrastructure is operated by the University of Groningen, Centre for Isotope Research. Due to its unique location it is possible to sample there background air from the North Sea with northerly winds, as well as continental air, influenced by the highly populated and industrialized areas in the west of the Netherlands (Amsterdam-Rotterdam) and in the northwest of Germany (Ruhr area). The station is equipped with a 60 m tall tower, carrying instrumentation and air inlets (60 m, 40 m , 7 m above ground). In the laboratory building next to the tower, monitoring and sampling instruments are running and can be remotely controlled from the Groningen institute (or any other place on special arrangement) via high-speed internet connection. Instrumentation includes a gas chromatograph (CO_2, CH_4, N_2O, SF_6 and CO concentrations), a 222Radon monitor, a flask sampler and cryogenic air dryer, and integrated $^{14}CO_2$ sampling (wind-direction controlled). Twice a day, Radon and CO_2 soil fluxes are measured from a soil chamber, upgrading to include CH_4 and N_2O-fluxes is underway. In the beginning of 2011, continuous oxygen concentration monitoring will be started. In the tower, an CO_2 Eddy-covariance system is installed at 50 m height to monitor the regional biosphere-atmosphere exchange. This includes the exchange fluxes of the wetlands and tidal flats to the north. A

scintillometer makes use of the church tower in the village of Hornhuizen at 2 km distance, measuring energy fluxes above the agricultural area at 25 m height. Basic meteorological data are sampled at the three air intake heights

Access

Both short-time accompanied visits or long-time running of instruments after user-installation and under user's remote control are possible. Visiting instruments may form an extension of the station's measurement program, but instruments for comparison studies are welcome as well. In principle, virtually all kinds of instrumentation can be accommodated. Even modeller-visits to the station might turn out to be useful, in order to learn about the local topography and to discuss Lutjewad- data based model results.

The station infrastructure along with recent results, on-going projects and near-real-time data are presented on the station website. The station is known within the European atmospheric Greenhouse Gas community from participation in several EU-funded projects (AeroCarb, CarboEurope-IP, IMECC, GHG-Europe etc.). Scientific results are published in peer-reviewed literature, the datasets are used in dedicated as well as all-European modelling studies by international modelling groups.

2.2.12 Polwet (Poland)

- Coordinates: Rzecin near Poznan
- Height: 4.5 m
- Base level: 54 m a.s.l.
- Country: Poland
- InGOS observations: CO_2, H_2O, CH_4, N_2O
- Responsible partner: PULS
- Responsible PI: Bogdan Chojnicki (bogdan.chojnicki@up.poznan.pl)
- Website:http://www.puls.edu.pl

General

The experimental site is located in the middle of a semi-natural wetland (lake overgrown by a floating carpet of mosses) which is unique in a scale of a central Europe. POLWET is often treated as a reference site to other more degraded bogs of central Europe. The site offers complete infrastructure for Eddy Covariance measurements of CO_2 and H_2O fluxes (since 2004) and CH_4 fluxes from 2011 (planned). POLWET site was one of the core site of CarboEurope-IP and NitroEurope-IP and will be one of the main ecosystem site within the ICOS-PL (presently in preparatory phase). Additionally, the automatic chamber measurements of CH_4 and N_2O fluxes are carried out since 2009 and manual chamber measurements of CH_4 and CO_2 fluxes since 2005 and 2007, respectively. Within POLWET infrastructure we can offer an access to fully equipped EC and weather stations, two LOSGATOS fast CH_4 analysers, chambers, technical laboratory analytical tools/software and both DC and AC power supply

Access

As the core site within the CarboEurope and NitroEurope projects, the POLWET site has offered highly qualified measurement results to the projects databases since 2004. The site have had a lot of visitors from different countries which were familiarized with EC and chamber measurements theory and techniques. Some of them initiate this measurements on their own sites. Few workshops were organized for national and international users to disseminate the knowledge and experience in GHG

fluxes measurements. The site is well equipped to do some comparison studies of different GHG measurement systems.
The Rzecin scientific infrastructure was already used by scientific workers from both national and foreign institutions e.g. Adam Mickiewicz University, Poznan (Poland), Technical University of Munich (Germany), University of Bayreuth (Germany), University of Neuchâtel (Switzerland). All these scientists received a full both scientific and technical support from Meteorology Department. There is already link with Rzecin description at Meteorology Department home page however the separated Rzecin site will be developed as a source of broad information about capabilities and relevance of studies realized at this unique wetland. The Rzeicn site is the only CarboEurope station in Poland where GHG measurements are carried out in complementary mode. The development of this by involving it in the framework of InGOS project will support substantially ecological infrastructure in central Europe. The increase of users number is expected since the InGOS project will help to introduce an international standards to Rzecin site. The observations carried out on this wetland will be more relevant to other measuring sites. The obtained results will be useful for other scientists e.g. paleoecologists or ecologists for their methods development and calibrations at wetland conditions.

2.2.13 Las Majadas (Spain)

- Coordinates: 39°56‘29” N, 5°46’24” W
- Height:10m
- Base level:260
- Country: Spain
- InGOS observations:
- Responsible partner: CEAM
- Responsible PI: ()
- TNA access request page for Las Majadas
- Website:http://www.ceam.es

General

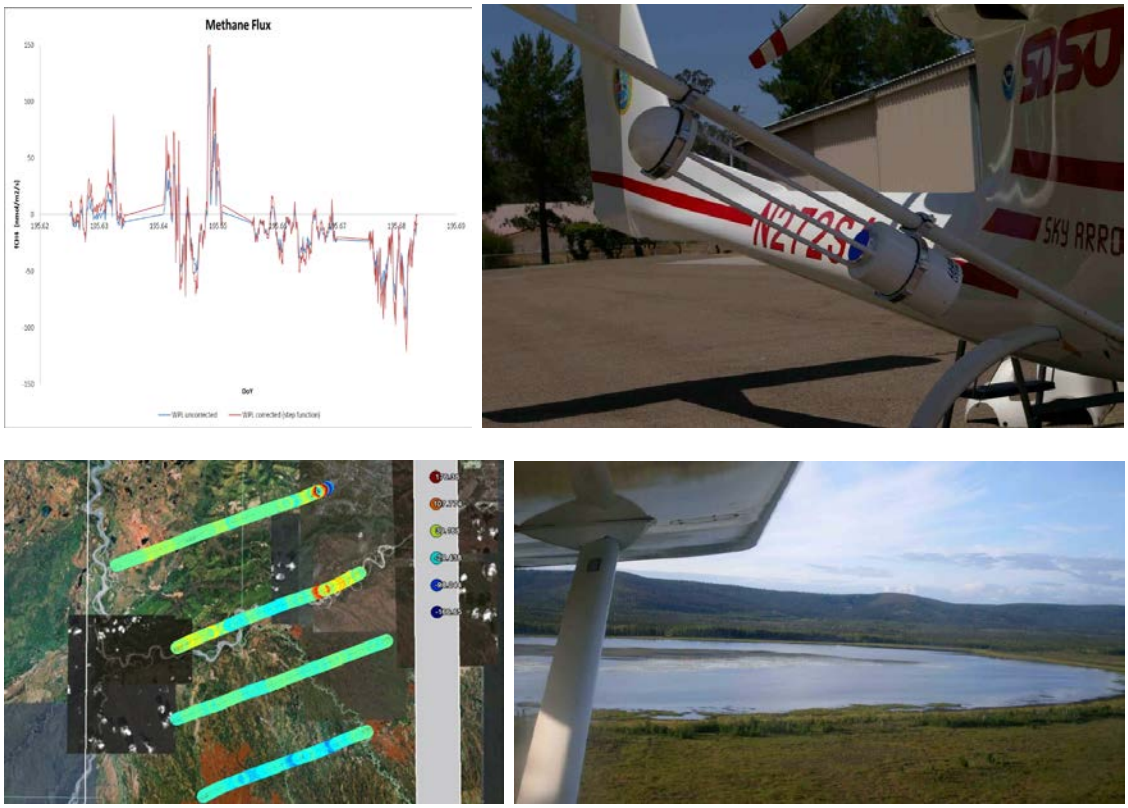
The “Las Majadas” ecosystem infrastructure consists of a high-profile, state-of-the-art flux tower station. Extensive monitoring (fluxes, micrometeorology, soil conditions, N deposition, phenology, reflectance vegetation indexes, etc) is maintained at the site. The site is a well-established observational facility for ecosystem process studies, is located in a dehesa ecosystem (Holm Oak open woodland with pasture) in Las Majadas del Tietar, Extremadura, Spain. Access to users is focused on international visiting scientists and research groups who wish to conduct process-based ecosystem studies in such Mediterranean ecosystem. Users will be offered to conduct in-situ analysis, field measurement campaigns and/or to deploy their measurement instruments and scientific devices at the infrastructure.

Access

Access will be offered for short-term and long-term installation of instruments and scientific devices, field campaigns and in-situ analysis. Depending on the planned research activities and the scientific needs, users can choose between different infrastructure locations existing at the site. Typical duration of work will vary depending on the infrastructure and the type of access, but is expected to be in the range of several days to several months. In order to avoid conflicting interests and schedules, and disturbance of the normal research activities at the infrastructure, set-up of equipment as well as field campaigns will have to be scheduled and planned well in advance of the access with the infrastructure management

A web-page displaying basic information and near real time data of the site is under development and will be operative and available at the beginning of the project.

3 Access to facilities: TNA3 – Aircrafts for CH_4 flux and concentration measurements



Measurements with the open path licor CH_4 sensor attached to the wing of the Sky-Arrow airplane.

The aircraft observations we offer in this WP allow to characterize the spatial and temporal variations of methane fluxes and the resulting concentration gradients around a site. Aircraft are available at WUR (Netherlands) and LUND (Sweden). The aircrafts used will be two Sky-Arrows ERA 650, equipped for eddy covariance flux measurements of CH_4, CO_2 and H_2O. They can fly at low altitude and with a moderate speed which gives a fairly small flux footprint. They are thus suitable for investigation of spatial variability of surface fluxes of typical European land use areas. They can also perform vertical profile measurements across the planetary boundary layer providing information about the spatial variability of GHG concentrations. The aircrafts will be equipped with state-of-the art CRD sensor for CH_4 measurements at high frequency. Only a few aircrafts in the world (if any) are capable of performing such measurements today. Thus it will provide a unique research infrastructure to INGOS.

The Lund aircraft will preferably serve the sites located in northern Europe, particularly wetland areas that have high methane emissions. The second aircraft from WUR will preferably serve the sites located in central/ western Europe, particularly wetland areas that have high methane emissions, or areas of intensive livestock production, or urban/industrial areas. The aircrafts have a relatively short operational range and should therefore preferably be used not too far away from its home base.

The aircraft observations can be accessed in campaigns comprising 4-5 flight days during a 2-week stand by period. The weather is a parameter that always must be considered in aircraft measurements. There

are currently no users of the facility since it is under development. After approval of an application the users will need to discuss in detail with the providers how the aircraft campaigns will be performed. One unit of access consists of 4-5 flying days to a total amount of 20 flying hours. The campaign must be performed during a specified 2-week period. Since the success of a campaign is very weather dependent, and the weather is difficult to forecast long time ahead, a close dialog between users and providers is required. The provider cannot guarantee complete flexibility but the users requests will be accommodated as far as possible. Each provided unit of access will be comprised of two persons. A research scientist and the pilot that will take part in preparation and execution of the campaigns. The research scientist will be responsible for the data collection and analysis for the whole campaign. Analysed and geo referenced data on fluxes and concentrations will be provided to the user for further analyses. It is expected that the data obtained during campaigns are shared between provider and user for joint publications.

4 Access to facilities: TNA4 – Calibration service and Cucumber Reference Laboratories

The infrastructure offering access is a group of European trace gas laboratories for greenhouse gas analyses that have well-established programmes of comparison activities that allow to assess the compatibility of their analysis data.

Standards production laboratories:

The access to the infrastructure will not imply the presence of the user at the installations. It rather involves the provision of a high pressure cylinder with valid security certificate by the user to the infrastructure.

Continental gas filling site and high precision laboratory for the analysis and calibration of N_2O, SF_6, H_2 and stable Isotopes of greenhouse gases (CH_4 and CO_2):

- MPG Jena, Germany: www: http://www.bgc-jena.mpg.de

Marine background gas filling site and high precision laboratory for the analysis and calibration of 46 halocarbons, including SF_6, PFCs, HFCs, HCFCs, CFCs, and halons:

- UNIVBRIS Bristol, United Kingdom www: http://acrg.chm.bris.ac.uk/acrg/

These two installations complement one another as they have expertise in different kinds of measurements and such can only serve requests for standard gases for species they are equipped to calibrate. With both laboratories the infrastructure will have the ability to provide calibration gases for all tracers within the scope of InGOS.

Cucumber reference laboratories:

- CEA: Gif-sur-Yvette, France www: http://www.lsce.ipsl.fr
- UEA: School of Environmental Sciences, UK www: http://www.uea.ac.uk/env
- UHEI: Institut für Umweltphysik, Germany www: http://www.iup.uni-heidelberg.de

Each of the “Cucumber central laboratories” (UHEI, CEA, UEA) will be the contact point for a different group of monitoring stations participating in the “Cucumber” round robin exercise. The service offered by these laboratories is the high-precision, high-accuracy analysis of comparison standards (in high pressure cylinders filled with calibrated air) and the regular verification of the stability of the air composition in these cylinders. This serves as a reference for the field stations to check the performance of their measurements. High-frequency comparison activities between the Cucumber central laboratories assure a known comparability between theselabs and allows an assessment of the agreement of all field stations involved. Any potential systematic biases at single stations can be identified as well as drifts that might originate from composition drifts in field standards or instable detector behaviour. Ultimately, this allows the non-CO_2 greenhouse gas datasets collected by all fieldstations in the project to be merged and used in synthesis and modelling studies.

These laboratories have the instrumental capabilities and expertise to perform high-precision analysis of various non-CO_2 greenhouse gases (N_2O, CH_4, SF_6, (H_2)) by gas chromatography. In addition, they each

hold laboratory standard sets from the respective UN World Meteorological Organization (WMO) “Central Calibration Laboratories” to assure accurate assignment of values for these tracers in high-pressure cylinders.

5 Access to facilities: TNA5 - Isotopic Analysis of Methane

The trans-national access offered here is the provision of methane isotope analysis to users. The InGOS infrastructure includes state-of-the-art analytical facilities for analysing methane isotopes at Royal Holloway, University of London (specialising in δ^{13}C-CH4) and at Utrecht University (specialising in D-CH_4). These facilities are both in operation, and are among a small handful of such labs worldwide capable of high precision isotopic measurement of methane at the low concentrations (<2ppm) in ambient air (as distinct from local source studies in which the air is methane-rich and the analysis less difficult).

Typical programs will include 10-50 samples each, for up to 10 international groups per year. These measurements are valuable in identifying source characteristics. Utrecht and Royal Holloway can offer these analyses across the infrastructure partnership. Work will be on flask and bag samples of air from many partners in the infrastructure. This supply of highly specialist analytical access to other partners and field groups facilitates local and regional methane source studies. Samples will be collected at measurement stations or during field campaigns by partner groups, and then shipped or posted to the analytical laboratories. Isotopic analyses will be carried out by the service labs, forming scientific partnership with collecting groups.

Analyses will be at RHUL for δ^{13}C-CH4, and at UU for D-CH_4. In some cases, flasks will be analysed at both labs for both C and D isotopes. Access will be on the basis of scientific excellence. In general, access will be planned prior to the field campaign (e.g. Arctic cruise), or on a routine basis for planned sampling. Access will also be granted ad hoc for samples collected during unusual meteorological events (e.g. 2003 French heat wave). Users will be fully informed about isotopic methodology and source implications.

Carbon isotope analysis sample requirements

1. Tedlar / Kynar bags of 3 or 5 litre volume
2. Steel canisters – minimum 1.6 litres at >1.25 bar overpressure
3. Glass flasks – minimum 2 litres at 1 bar overpressure

Required volumes allow for measurement of CH_4 mixing ratio by CRDS prior to isotopic analysis in triplicate. Isotopic analysis only is possible on smaller volumes if mixing ratios can be provided.
Shipment of bags is by far the cheapest option if postage payment by weight can be made. Maximum storage time of filled bags prior to analysis should be no more than 3 months. RHUL can supply sampling bags if required.

Hydrogen isotope analysis sample requirements

1. Steel canisters, minimum 1 litre – preferably >0.6 bar overpressure (lower pressures possible on request, please ask for information)
2. Glass flasks, minimum 1 litre – preferably >0.6 bar overpressure (lower pressures possible on request, please ask for information)
3. Tedlar / Kynar bags of 3 or 5 litre volume – manual analysis

Maximum storage time of filled bags prior to analysis should be no more than 3 months

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