PROJECT FINAL REPORT

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Executive Summary

This report is a summary of work that has been done during ICOS preparatory phase spanning 2008-2013 in the preparation of the future research infrastructure. ICOS is a distributed infrastructure that aims to provide the long-term observations necessary to quantify and understand greenhouse gas fluxes over Europe and over ocean regions adjacent to Europe. The ICOS measurements are designed to allow daily determination of (mainly natural) sources and sinks at scales down to approximately 50 x 50 km^2, and will be a basis for understanding the carbon exchange processes between the atmosphere, the terrestrial surface, and the ocean. ICOS is the European component of a global carbon observing system.

ICOS had its early design and was first initiated in 2006 by researchers working in EU funded FP-6 projects, mainly Carboeurope and Carboocean. It was reviewed and endorsed by the European Strategic Forum for Research Infrastrucutres (ESFRI) the same year.

During the preparatory phase, technical and scientific work has been performed in preparation for the construction of the key elements of the infrastructure, in particular the atmospheric and the ecosystem network of stations. The ICOS network consists of a growing number of ecosystem and atmospheric stations that collect measurements on a continuous basis (measuring respectively atmospheric GHG concentration, ecosystem flux and associated variables).

ICOS garnered interest from the ocean carbon science community in Europe, and plans have been made to operate a network of systematic ocean observations of air sea CO_2 fluxes using ships and fixed point stations in addition to atmospheric and ecosystem observations. The activity of this ocean network was not included in the preparatory phase project funded by the EU, but is now an integral part of the infrastructure.

The preparatory phase also enabled the design, review and construction of central facilities that will support the network during its operations. These facilities include:

- A Central Analytical Laboratory (CAL) for calibration, quality control and atmospheric analyses for the entire network,
- An Atmospheric Thematic Centre (ATC) responsible for atmospheric instrument development/servicing and data processing,
- An Ecosystem Thematic Centre (ETC) supporting the collection of total ecosystem flux measurements and component fluxes and carbon pools, including data processing and instrument development,
- A data distribution centre, the Carbon Portal, providing discovery of and access to ICOS data products such as derived flux information.

The design and implementation plan of these four central facilities has been achieved during the preparatory phase, and construction has begun for the CAL, ATC and ETC. Each facility underwent a review process including detailed applications by candidate host countries, reviews of applications by a panel of international experts, and feedback and refinement of proposals. Resulting host countries are: Germany for the Central Analytical Lab; Italy, Flanders and France for the Ecosystem centre; France and Finland for the Atmospheric centre; and recently (May 2013) Sweden and The Netherlands for the Carbon Portal.

In addition, an Ocean Thematic Centre has been designed and an application from Norway, the United Kingdom and Spain has been received and reviewed shortly after the preparatory phase was terminated.

The implantation of ICOS will take place in two phases: An interim phase (on-going) and an operational phase (when the ERIC will be established). During the operational phase until at least 2013, the network will be run in an operational mode, and greenhouse gas concentrations and fluxes will be determined on a routine basis.

The governance of the future operational infrastructure has been established through negotiations and consensus including scientists and stakeholders from relevant supporting ministries, agencies and research councils. The current state of the ICOS legal organization is a set of statutes approved by a number of institutions, from 16 European countries, which will be submitted end 2013 for the creation of an ERIC. An interim Project Coordination Office is established in Finland (FMI, University of Helsinki). It is responsible for overall coordination outreach until the start of the ERIC.

Summary description of project context and objectives

Background and mission statement

ICOS is an infrastructure that aims to provide the long-term observations required to understand the present state of greenhouse gas natural fluxes over Europe for terrestrial ecosystem fluxes and ocean-atmosphere fluxes. Climate change is one the most challenging problems that humanity will have to cope with in the coming decades. The Intergovernmental Panel on Climate Change (IPCC) has concluded that the observed rise of global temperatures is *very likely* due to increasing greenhouse gases in the atmosphere. It is *virtually certain* that the increase of these greenhouse gases is driven by man-made emissions overtaking the natural cycles.

The perturbed global biogeochemical cycles of these greenhouse gases are a major driving force of current and future climate change. The concentrations of CO_2 and CH_4 in the atmosphere exceed by far the natural range observed over the last 650‘000 years. Current levels of CO_2 have increased by 40% from pre-industrial times and they continue to rise, as fossil fuel emissions are climbing up at a rapid rate. Current levels of CH_4 are nearly two and a half times the pre-industrial value.

The causes of the observed CO_2 increase in the atmosphere are fossil fuel combustion and modifications of global vegetation through land use change, in particular deforestation. The natural carbon cycle reacts to this perturbation by absorbing approximately half of the annual anthropogenic emissions to the atmosphere in the ocean and in te terrestrial ecosystems, effectively halving the radiative forcing due to man-made CO_2 emissions. It is not clear, however, if these natural CO2 sinks will operate in the future under a changing climate and increasing human impacts. The causes of the observed CH_4 increase are human activities related to livestock production, rice cultivation and fossil fuel extraction and distribution. At the current atmospheric level of CH_4, the natural oxidizing power of the atmosphere cleans up almost all the CH_4 injected by human and natural sources but expected increases of natural and anthropogenic emissions will further raise CH_4 mixing ratios.

Deeper understanding of the driving forces of climate change requires full quantification of the greenhouse gas emissions and sinks and their evolution at regional scale. Regional greenhouse gas flux patterns, variability and trends allowing characterizing tipping-points and vulnerabilities can be assessed by long term, high precision observations in the atmosphere and at the ocean and over terrestrial ecosystems. It is the mission of ICOS to provide the long-term measurements that allow quantifying greenhouse sinks over the territory of Europe and oceans regions adjacent to Europe.

Rationale of a European Integrated Carbon Observing System

European countries have been at the forefront of setting-up an international treaty to reduce emissions, with the Kyoto Protocol. Yet, measurements in the atmosphere have shown that since 1990, the Kyoto Protocol base year for reducing GHG emissions, radiative forcing of these long-lived agents had actually increased by 26% by 2008. Further,

the current basis of observations is not sufficient to determine with sufficient accuracy the CO_2, CH_4, N_2O balance of the European continent, with current uncertainties ranging from 50% to 100% (Schulze et al. 2009).

In the long run, information from a European GHG observation system like ICOS will narrow down future uncertainties, providing observational evidence of the current state of the carbon cycle perturbation. Some of the variables that are observed by ICOS have been classified as essential climate variables by the Global Climate Observing System (GCOS) and are observed through advanced sets of observation networks. An infrastructure like ICOS has significant relevance to climate change mitigation and adaptation in three ways:

- Implementing effective European management strategies to safeguard climate requires a full knowledge of the natural carbon cycle. Individual nations may implement emission controls but a comprehensive strategy of emission offsets and natural sink conservation must be designed to effectively curve down the increase of CO_2 (and CH_4) concentrations in the future.
- It is possible that continued greenhouse gas emissions will take European ecosystem services past what are referred to as “tipping points”. Tipping points describe thresholds beyond which positive feedback mechanisms in the Earth system are activated whereby increased climate forcing leads, for example, to an increase in natural CO_2 emissions from the biosphere, in a spiral of increasing global warming. Knowledge of these thresholds of the natural carbon cycle response to climate change is badly needed,
- Uptake of anthropogenic CO_2 by the Earth system causes changes to ecosystems, both beneficial and damaging. One likely beneficial change is the fertilization effect, through which plants grow faster in a richer CO_2 environment and thus perhaps sequester a larger fraction of the CO_2 emitted by human action. A damaging consequence is acidification of the oceans caused by the uptake of CO_2 by seawater, with substantial consequences on marine ecosystems. These ongoing effects of a higher CO_2 atmosphere need to be monitored.

Key types of observations

The essential purpose of ICOS is to generate high precision GHG dataset that enable the establishment of accurate carbon budgets from regional to local scales, with a contribution to global observations. This will help in estimating the effectiveness of the measures undertaken to control emissions and manage the carbon cycle, and underpin this with new understanding of carbon cycling in the Earth system and climate feedbacks. The core elements to observe the reservoirs and exchange fluxes of ICOS are in the following three categories.

Atmospheric domain

Measurements of CO_2 and CH_4 concentrations in the atmosphere are needed to quantify large-scale fluxes, using atmospheric transport models. This approach was initiated in 1957 when the first atmospheric CO_2 measurement site was installed at the Mauna Loa observatory. Today, the global atmospheric network consists of about 150 sites around the globe. This network has limited coverage over the continents and almost no coverage in the Tropics. Inversion of these data using transport models has provided most of our knowledge of the global sources and sinks distribution to date. Inversion results indicate the existence of a carbon sink over northern ecosystems and of a tropical terrestrial sink as well. The network is developed through research projects.

- Surface-based in situ stations observations of high precision CO_2 and CH_4 concentrations across a global network of a dense network of surface stations, covering geographically the European territory as well as key vulnerable regions outside of Europe, including oceanic areas.
- Meteorological parameters (wind speed/direction, temperature, pressure, humidity, mixing layer height) to relate the observed greenhouse gases concentrations to the origin of the air mass.

- Complementary in-situ observation of isotopes of CO_2, CH_4 and N_2O, and O_2/N_2 ratio to evaluate land and ocean sink ratio, and the locations of these sinks.

Terrestrial domain

In order to interpret the atmospheric concentrations above continents in terms of carbon cycle processes, additional measurements are needed at the surface. Eddy covariance techniques allow continuous monitoring of CO_2, H_2O, heat fluxes over vegetation canopies. At present, over 400 tower sites are globally operating on a long-term and continuous basis for CO_2, H_2O, and heat fluxes. Researchers also collect data on site vegetation, soil, hydrologic, and meteorological characteristics at the tower sites. The network is comprised of several sub-networks, most notably with a dense network in Europe. The European network includes about 100 towers. For coherent CH_4 and N_2O eddy covariance measurements the picture is quite different. NITROEUROPE-IP includes 14 intensive measurement having chamber measurement facilities with good temporal resolution and some of the sites are also running direct eddy covariance measurements. Outside Europe there are also several sites carrying out direct measurements, but no real network like for CO_2 exists.

Temporal resolution of a day or so for eddy flux towers is sufficient to capture the variability in terrestrial fluxes driven by changing weather patterns (e.g. the effect of frost or drought on forests) and transform them into operational systems. However, terrestrial ecosystem carbon fluxes are so heterogeneous and variable that it will be impossible to measure fluxes over all kinds of ecosystems continually over Europe and adjacent regions. Other integrating parameters, such as biomass and soil carbon inventories are needed to upscale the flux data, in combination with satellite images. This is called the bottom up approach.

- In situ observations of ecosystem fluxes made by the eddy-covariance technique, with observations of CO_2, water vapor and heat fluxes at representative locations, including a range of successional stages and land-use practices and intensities. Over wetlands and rice paddies, CH_4 eddy-covariance flux observations should also be made. A global network of about 500 flux measurement stations is envisioned.
- Inventories of the spatial and global distribution of litter and soil organic carbon content in the upper meter of soil, measured in situ typically at ten-year intervals, again including nutrient content, and measures of decomposability.

Ocean domain

- A global ocean CO_2 flux measurement network measuring the surface CO_2 partial pressure difference between atmosphere and seawater (pCO_2) with a coordinated combination of research vessels, ships of opportunity, and autonomous drifting buoys.
- Complementary pCO_2 observations in coastal oceans, requiring a variety of platforms (fixed stations, frequent ship transects)
- Dissolved carbon content of the ocean with global coverage, measured typically at 10-year intervals, to estimate the input of anthropogenic CO_2 into surface waters.

Key objectives of the preparatory phase of ICOS

The objectives for preparing the European Infrastructure ICOS during the period 2008-2013 were:

- To obtain the agreement of involved countries, and their funding commitment to ensure the construction of the infrastructure, and its long term viability at operational level,
- To establish an efficient centralized Coordination of the infrastructure at the European level, that will guide the process of building the necessary components, organize the expenditure assessment and the fund raising, and the outreach at the project level,
- Develop the Carbon Portal, a unique web-based data center providing access to the ICOS measurements, and to other relevant carbon cycle data, in particular fossil fuel emissions,
- To select the best sensors for making routine measurements of these core parameters, based upon best available technology,
- To select the best sites for atmospheric and ecosystem observations for the future operational network,
- To harmonize and further develop methods for establishing the central facilities of the infrastructure: a Central Analytical Laboratory, an Atmospheric Thematic Centre and an Ecosystem Thematic Centre,
- To run the infrastructure as a demonstration study of one year, with few sites,
- To link ICOS with Earth Observation international coordination bodies and programs, and other greenhouse gas observing networks around the world through the WMO Global Atmosphere Watch program.

These objectives were achieved during 2008-2013 in the work plan through eight complementary work packages:

- Establish a management scheme with an efficient centralized coordination, to organize the construction of ICOS, to associate new investigators (WP 1), to elaborate a legal organization and governance model (WP 2) and to obtain the necessary funding commitments for beginning the Operational Phase of ICOS by the end of this project (WP 3),
- Involve the providers of external datasets, in particular fossil fuel emission maps, which must be linked to ICOS (WP 4), and the users of the infrastructure data and facilities (WP 8),
- Carry out network design studies to optimally select about 30 main atmospheric sites and 30 main ecosystem sites, and additional associated regional sites. Regularly update the list of ICOS core and secondary atmospheric and ecosystem parameters (see Table 2; WP 5),
- Establish the operational measurement criteria for atmospheric and ecosystem parameters, and test and evaluate new methodologies and sensors developed in collaboration with SMEs, in order to select the best available technology for the ICOS observing sites (WP 5),
- Define the ICOS data services in linkage with users (WP 8) and develop the necessary hardware and software for the Atmospheric Thematic Centre and the Ecosystem Thematic Centre (WP 6),
- Make the technological choices for standard fabrication, atmospheric intercomparison protocols, flask analysis and radiocarbon analysis of the Central Analytical Laboratory (WP 6). Define and test independent quality control mechanisms for atmospheric and ecosystem observations (WP 6),
- Deploy during the last year of the project the ICOS Demonstration Experiment, a prototype of the future ICOS operational network, but containing only few sites (WP 7),
- Establish a web-based data center, the Carbon Portal, giving access to ICOS data products and to all relevant carbon cycle datasets, in particular fossil fuel emission maps (WP 8),
- Provide a strategic plan for the infrastructure deployment during the next 20 years, and a detailed implementation plan for the first 5 years of operations (WP 8),
- Adopt and implement the internationally established calibration and quality-control mechanisms requested under the recently approved (October 2005) WMO/GAW Global Atmospheric CO_2 and CH_4 comprehensive monitoring network of GCOS (Global Climate Observing System). This will considerably strengthen the network in Europe, in particular concerning harmonization and quality assurance, with anticipated dissemination to the global scale (WP 5, WP 6),

- Contribute to the implementation of GEOSS (Global Earth Observation System of Systems) and of the IGOS-P (Integrated Global Observing Strategy - Partnership) strategy for Atmospheric Chemistry Observations (IGACO) and for Integrated Global Carbon Observations (IGCO).

How these objectives have been attained is detailed in sections below.

Towards the implementation of ICOS after its preparatory phase

The ESFRI working group has placed ICOS on its strategic roadmap, in October 2006. The infrastructure concept and design is based upon research breakthroughs and accumulated experience achieved during the CARBOEUROPE-IP research project. Advancing towards an operational global network, the ICOS infrastructure is expected to be funded by the EU and by governments of the member states. The implementation of ICOS will take place in two steps:

- During the Preparatory Phase in 2008-2013, remaining technological problems will be solved; funding commitments endorsed by the governments, and building of the central facilities will be initiated.
- During the follow-up Operational Phase in 2013-2031, the network will be run in an operational mode, and greenhouse gas fluxes determined on a routine basis.

A strategic choice will be made of having:

- Few Main Sites at which the largest number of mandatory Core Parameters will be measured operationally with the highest precision.
- A larger number of Associated Regional Sites, at which measuring the full list of parameters at the highest precision will not be mandatory.

This preparatory project will finalize all technical choices for establishing core parameter measurements. Few Additional Parameters are also important to measure for meeting the ICOS objectives, but they cannot yet be measured routinely. This project will support targeted research to develop prototypes for routine measurement of these parameters.

A permanent quality control system will be established to ensure the long term integrity of the Main Sites. We aspire to have over Europe about 30 atmospheric and 30 ecosystem main sites.

Determining accurately the time and space distribution of greenhouse fluxes at a high resolution requires however a much larger number of Associated Regional Sites (European researchers already operate more than 30 atmospheric sites and over 60 ecosystem sites.

The associated sites will form the basis of the Regional Observing Network. ICOS will support the Regional Observing Network through a common data management system, powerful outreach tools, access to cheap and low maintenance sensors and standards to ensure that these sites can be maintained with a minimum baseline funding. Access to funding will also be facilitated by ICOS.

The successful deployment and long-term operational viability of ICOS also requires central facilities. An efficient Central Coordination Office, a Central Analytical Laboratory for calibration, quality control and atmospheric flask and radiocarbon analyses, an Atmospheric Thematic Center and an Ecosystem Thematic Centre for data processing, analysis and instrument development/servicing will be established during the Preparatory Phase.

A common data center, the Carbon Portal, will provide free access to ICOS data services, links to fossil fuel emission inventory data, and outreach material towards science and policy communities, and to the general public.

Description of the main S&T results/foregrounds

WP1: Consortium Management

As the work package (WP) responsible for the management of the consortium, the main objectives included the efficient management of the project, to guide the consortium towards the establishment of an infrastructure, to add new partners as necessary and to deliver the final and strategic implementation plan in collaboration with the ICOS beneficiaries.

The daily management of ICOS, with 2O partners has included the following groups: Executive Board, Focal Points and Advisory Board. Meeting minutes for each group are available on the website. The EB has had monthly teleconference along with numerous exceptional meetings both through teleconferences and direct meetings during the annual meetings held yearly. The project office (PO), based in France, has concluded three amendments, five periodic reports, one final report, numerous dissemination articles, four Stakeholder's Handbooks, several brochures, and posters. In an effort to increase the visibility of ICOS both nationally and internationally, the PO has attended and actively contributed to EC funded meetings dedicated to infrastructure management such as ePPCC (European Preparatory phase Projects Coordination Committee) and CoPoRI (**Co**mmunication and P**o**licy development for Research **I**nfrastructures in Europe) as well as all ESFRI (European Strategy Forum on Research Infrastructure) workshops.

This work package was not only focused on the day-to-day management of the project but unlike other EU project concerned basically with the management of the consortium; this WP was also responsible for setting up and implementing the strategy for the establishment of a world-class research infrastructure.

As such, from 2008, the consortium lobbied to have ICOS on national roadmaps for research. At the end of the project, ICOS is now on 13 member roadmaps.

In order to accomplish this, from the beginning of the project, the project office (PO) along with the Executive Board (EB) established a list of National Focal Points (FP's). Each Focal Point was chosen by the participating countries ministry handling environmental research and given mandate to establish the ICOS network in their country. Additionally, the PO sought to establish contact with the funding agencies of each beneficiary. The ICOS interim Stakeholder's Council (ISIC) was established in April 2010 as a means for the ICOS preparatory phase members to obtain first-hand knowledge of infrastructure progress in each participating country and for each counties ministerial and/or funding representative to be able to provide expert council as well as their approval or adoption on a variety of strategic decisions affecting future members such as sight selection, facilities locations, legal, governance and financial implementation at the start of the construction phase of ICOS.

The first meetings were chaired by France, followed by Finland and finally by Germany. During the duration of the project, there have been 11 ISIC meetings since October 2010.

In an effort to ensure a future consortium representative of Europe and the long-term observations required to understand the present state of greenhouse gas natural fluxes, the PO worked diligently to include new members including Norway, Israel, and Poland. Norway has been the driver for including ocean atmosphere fluxes into the future consortium. Israel has been instrumental for establishing land ecosystem carbon sequestration potential, changes in ecosystem functioning and ecosystem services, and monitoring of local background greenhouse gases. Poland has been instrumental in setting up the ICOS infrastructure in their country and will contribute numerous atmospheric and ecosystem stations ready for monitoring.

The project office has played the central role in establishing the Central Facilities (CF) of the project: Atmospheric Thematic Center, Ecosystem Thematic Center, Central Analytic Laboratory, the Carbon Portal and the Ocean Thematic Center (still in progress). Initially, interested groups were organized to produce a concept paper detailing

the ideal functioning of the CF in question for the future ICOS infrastructure. Once these concept papers were approved by ISIC members, open calls were published on the ICOS website asking for applications to host the different central facilities. Applicants needed to provide a detailed application along with ministerial letters proving support of the CF. Independent international renowned reviewers with specific expertise were contacted and provided both with the central facility concept paper as well as a detailed review form. At the end of the process, ISIC members decided on the final attribution of the CF to the host country.

The final and strategic implementation plan of ICOS includes the science case of the Infrastructure and its specific objectives, as well as the definition and future implementation of the networks of stations in three domains, atmosphere and ecosystem stations and ocean fixed points and vessels. This document summarizes the efforts documented during the preparatory phase to build and operate these networks.

Through the results obtained by the project office and the preparatory phase consortium, the EC has a successful blueprint on how EC funded preparatory projects can become research infrastructures.

WP2: Legal and Governance Work

WP2 collected, analysed, presented and explained to all partners/stakeholders the different possible legal and organisational models available for ICOS. WP2 held meetings and distributed questionnaires in order to gather the partners' views and preferences. Following in-depth analysis, presentations/explanations/focus group sessions, the newly-available ERIC was adopted as the preferred ICOS long-term legal and organisational model.

Dedicated working groups (legal and financial) were set up by the partners wherein the ERIC structure, statutes, functions and finances would be discussed for proposal to ISIC. It was decided that the ERIC would be headquartered in Finland, and that ERIC would be a distributed structure where the Central Facilities would operate alongside (but not as part of) the ERIC. The Carbon Portal is part of the ERIC.

The statutes are presently at advanced stage, and preparations are being made for submission (est. June 2013) of the key documentation to the European Commission for pre-approval.

- Main results

Analyses of Legal model

During the early phases of the Preparatory Phase, WP2 undertook a two-phase study to consider the requirements of the several partners and the aims and projected life-span of ICOS. This allowed WP2 to understand and gauge the possible compatible organisational models available at national, European and international level. The vehicles/models which were analysed were as follows:

- **International structures**
  - International Organisation (IO)
  - Memorandum of Understanding (MoU)
- **European structures**
  - *Societas Europea*
  - European Grouping of Territorial Cooperation
  - European Economic Interest Grouping
  - European Research Infrastructure Consortium
- **National structures**
  - French Société Civile
  - UK Private Company Limited by Guarantee
  - German "Verein"
  - Swiss Public Foundation
  - The Belgian (non-profit) Association

For each of the models, the legal, organisational, structural and financial considerations were studied and presented to the ICOS partners / stakeholders in the form of detailed reports and Power Point presentations. Focus group meetings were also organised where legal representatives of the ICOS Partners convened to discuss points in more depth and detail. The main issues were legal personality, liability, IPR/data, membership, voting, law of the headquarters State, and central facilities, contributions, personnel, employment, tax, exemptions (tax/procurement).

The ERIC was a new Community instrument specifically designed as a legal vehicle for research infrastructures of pan-European interest, with a scientific non-commercial character, providing world-class services to researchers. The ERIC was, therefore, recommended early on in the analysis process as a potentially suitable/preferred option for ICOS. Key benefits of the ERIC include:

- Full and separate legal personality recognised in all Member States
- Joint contribution of members to the objectives of ERIC
- Flexibility internal structure, setting-up and administration
- Limited liability
- Applicability of EU law and law of the statutory seat
- Exemptions from Value Added Tax, duties and procurement rules
- Possible additional privileges/exemptions conferred by State of statutory seat

Process for selecting legal model and drafting the constitutional documents

Detailed reports, a full draft application package, draft statutes, several organisational options and dedicated meetings were presented to the ICOS partners during the Preparatory Phase. In light of the delays in receiving approval of the ERIC model by the different partners, and considering the time required for the full incorporation of an ICOS ERIC and the full preparation of all associated documentation, WP2 suggested a two-phased approach, starting with a short-term legal form (e.g. Memorandum of Understanding), to be followed by the permanent legal form. A short-term legal form would ensure that ICOS can progress, even if the ERIC or other permanent structure was not accomplished in time. As a second alternative, WP2 suggested a basic ERIC be set up by founding members, and observer members who would join at a later date.

First different WP2 proposed approaches were discussed with stakeholders (ministries and funding organisations) during the ICOS stakeholders' conferences that were organised back-to-back with ICOS PPP (Preparatory Phase Project) annual meetings. To speed up the discussions, process and decision making PPP and WP2 suggested to establish a ICOS Stakeholders' Interim Council (ISIC) as a means for the ICOS PP members to obtain first-hand knowledge of infrastructure progress in each participating country and for each countries ministerial and/or funding representative to be able to provide expert council as well as their approval or adoption on a variety of strategic decisions affecting future operations, including the decision of the approach how to continue with the selection of the legal model and to found the ICOS legal entity. The first ISIC meeting was held in June 2010 in Helsinki and have been followed by 10 ISIC meetings afterwards. Altogether 16 countries have participated in the interim council decision making of ICOS statutes and organisation of the governance of ICOS RI.

By the WP2 suggestion the stakeholders at the ISIC launched the concept of a Letter of Intent (LOI), wherein Partners were requested to approach their respective Ministries/government authorities to obtain declarations of interest in collaborating in the implementation of ICOS and in the setting up of a legal entity with legal personality and full legal capacity. The LOI stipulated further that: (i) an ERIC would be considered; (ii) the signing State would do its best to contribute actively and constructively towards achieving the aims of ICOS and to support its national partner institution(s); (iii) the signing State understood Finland's readiness to host the seat of ICOS in Helsinki; (iv) ICOS would have distributed Central Facilities where data will be collected for coordinated processing and/or calibration.

This instrument has been signed by a total of 14 countries, thus clearing the way for in-depth discussions, preparations, proposals and decision regarding the specifics of the future ICOS ERIC. The tasks included the ICOS ERIC's scope, legal status, incorporation, governance, membership, financial contributions, statutes and related documentation with the several Central Facilities.

The executive board (EB) of ICOS preparatory phase proposed to the ISIC in Brussels (30 May 2011) to create a working group (WG) composed of few stakeholders, their legal counsels and representatives of the ICOS EB to draft all the needed constitutional documents for the ICOS ERIC submission. All the countries that have signed the Letter of Intent with the intention to becoming a full member of ICOS ERIC would be members of the legal and statutes working group (LWG). The tasks of the LWG are:

- to form consensus proposals on ICOS ERIC governance and legal agreements
- to draft all the needed constitutional documents
- to propose consensus solutions and legal documents (statutes and contract drafts) for ISIC approval

The LWG have been drafting the following documents:
Constitutional documents:

- ICOS ERIC Statutes
  + Annex 1. List of members and observers
  + Annex 2. Membership contributions (Financial WG)
- Technical and Scientific description
- Internal financial rules (Financial WG)
- Data policy document
  + Finland responsibility: Declaration of the ERIC host country, tax exemption

ICOS Internal document that are in progress:

- Contractual agreements between ICOS ERIC – CFs and ICOS ERIC – networks
- Internal rules (by-laws) of ICOS ERIC

The meeting with ICOS stakeholders in 2008 -2013:
Stakeholder conferences:

- 1st stakeholders Conference and Kick-off meeting, May 19-20 2008, Paris
- 2nd stakeholders Conference and Annual Meeting, May 12-13 2009, Amsterdam
- 3rd stakeholders Conference and Annual Meeting, November 16-18, 2009, Rome
- 4th stakeholders Conference and Annual Meeting, May 30 - June 2 2010, Helsinki
- 5th Stakeholders Conference and Annual Meeting, May 30-June 1, 2011, Brussels
- 6th Stakeholders Conference and Annual Meeting, May 30-June 1, 2012, Norway
- 7th Stakeholders Conference and Annual Meeting, May 26-June 1, 2013, Biarritz

ISIC and LWG meetings:

- 1st ISIC meeting, 2 June, 2010 Helsinki
- 2nd ISIC videoconference meeting 19 October, 2010
- 3rd ISIC meeting 1 March, 2011, Brussels
- 4th ISIC meeting 30 May, 2011, Brussels
- 5th ISIC meeting, June 2011, Helsinki
  - LWG Set-up meeting, Frankfurt, July 1 2011
  - LWG Preparatory Telco, Aug 25
  - 2nd LWG meeting, Frankfurt, Sept 6
  - LWG Preparatory Telco, Sept 14
  - LWG Preparatory Telco, Sept 28
- 6th ISIC meeting, 7 Oct 2011
  - LWG Web-conference, 19 December 2011
  - LWG meeting, 2 Feb 2012
- 7th ISIC meeting, 28 Feb 2012
  - LWG Web-conference, 31 March 2012
  - LWG face-to-face meeting, 3 May 2012
- 8th ISIC meeting, 1 June 2012
  - LWG meeting, 19 Sept 2012 with EC legal adviser
  - LWG Telco, 25 Sept 2012
  - LWG face-to-face meeting, 17 Oct 2012
- 9th ISIC meeting, 18 Oct 2012
  - LWG Statutes workshop, 14 Dec
  - LWG Web-conference, 14 Jan (data policy)
  - LWG Web-conference, 21 Jan (data policy)
- 10th ISIC meeting, 22 Jan 2013

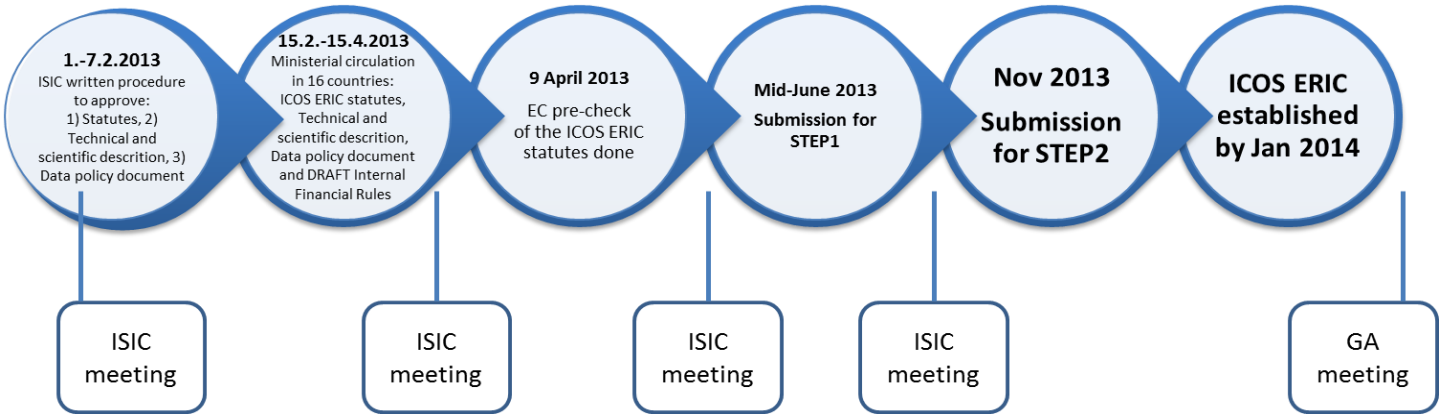
- Ministerial circulation, 15 Feb – 15 April
- EC pre-check, 2 – 9 April
- LWG Statutes workshop, 2 May

- 11th ISIC meeting 28 March 2013
- 12th ISIC meeting, 28 May 2013 (after the preparatory phase has concluded)

Status of ICOS ERIC submission

Ministerial circulation of the 1) ICOS ERIC statutes, 2) Technical and scientific description, 3) Data policy document and 4) DRAFT Internal Financial Rules took place in the ministries and funding agencies of the ISIC member countries in 15 Feb -15 April 2013. The ICOS ERIC statutes were sent to EC pre-check in early April. Final, minor modifications are to be approved in the ISIC meeting in 28 May and the ICOS ERIC Statutes and other documents mentioned above will be sent to the European Commission by Mid-June 2013 to start the ERIC application process Step 1. The next application step (Step 2) with the signatures from the participating countries will take place in November 2013. At the moment when the European Commission publishes the ICOS ERIC Statutes in the Official Journal the legal organization for implementing of ICOS is established. This is planned to take place by the end of this year (2013).

The constitutional meeting of the ICOS ERIC General Assembly will take place in the first quarter of year 2014, convened by the ICOS ERIC host country, Finland. The first GA meeting will approve the first year budget, elect a Chairperson, nominate the Director General of ICOS ERIC, SAB members, and RI Committee members, and approve any internal rules.
The figure below illustrates the time line for establishment of the ICOS ERIC.



Transitional organisation of ICOS

Following SJ Berwin's prior suggestions, Finland has proposed a transitional structure to govern the transition from PPP to ERIC. The governance and preparations before the establishment of the ICOS ERIC and full operational phase would be ensured by means of interim governance bodies, and with the support of the transitional Head Office in Helsinki. This proposal was approved in Stakeholders' Interim Council ISIC October 2012 and will come fully into effect when the PPP ends. ISIC is already functioning as the highest decision making body to approve all the constitutional documents and strategic issues. ISIC will be replaced by ICOS General Assembly of the ICOS ERIC.

Interim ICOS RI Committee will be established to continue the work of the PPP Executive Board until the ICOS ERIC is established. The members for the ICOS RI Committee have been nominated and the Committee in April 2013. The current SAB for the PPP is proposed to continue as an interim SAB to give external advice for ICOS RI. These interim bodies would start when the PPP ends in March 2013.

The ICOS RI station network extends gradually as the countries become member of ICOS ERIC. The transitional Head Office coordinates the activities of the CFs together with the interim ICOS RI Committee. The ICOS ERIC and Head Office set-up team, nominated by ISIC in October 2012, will help in establishing the interim governance bodies for

the transition period. This will include drafting the Terms of Reference for these bodies, getting approval for those from the ISIC, and coordinating their activities.

WP3: Expenditure and resource analysis; financial arrangements

Sixteen countries have been involved in the financial negotiations, with nominated delegates in ICOS Stakeholders' Interim Council meetings. 8 countries with nominated representatives in the Financial Working Group (FWG), chaired by Finland, have developed the details of financial principles over several face-to-face meetings and teleconferences.

The tasks for the FWG were to:
1) provide a global budget for the first 5 years of the ERIC and the ICOS RI with principles for calculation of annual country contributions and the contributions for the first 5 years
2) produce an Internal Financial Rules –document and
3) produce the statutes for financial issues.

The FWG has drafted the financial ANNEX 2 of the ICOS ERIC statutes describing the Financial principles and membership contributions for the first five years. Financial principles and membership contributions for the first five years will be approved in the interim Council (ISIC) meeting May 28, 2013. The budget will be finally approved by the first ICOS ERIC General Assembly during the first quarter of 2014.

In last 12 months the financial negations between the partners has been completed, including the financial planning of ICOS RI and annual membership contributions. The Internal Financial Rules has been drafted, and is now a complete version is ready for the official establishment of ICOS ERIC. The common reporting system for Central Facilities financial planning was drafted and accepted in fall 2012. More close collaboration and discussion between the Head Office and Central Facilities was established in a special workshop.

Work progress:

- First face to face meeting on May 9th 2012
  - Advances so far were discussed
  - Discussion paper on financial issues was presented
  - Most important and sensitive issues were identified and discussed
  - First recommendations for the ISIC
  - First action items listed

- Web conference, June 21st 2012
  - First proposal on sharing the common costs
  - Tasks for CFs for station fees, station lists and service lists

- Face to face meeting, September 10th 2012,
  - Second proposal on sharing the common costs
  - station fees, station lists and service lists
  - Preparing of the proposal for the ISIC
  - Transparency of the budgets and reporting

- Web conference, September 24th 2012
  - Final drafting of the proposal of calculation method of the common costs for ISIC

- Web conference, November 30th 2012
  - Annex 2 first drafting
  - Internal Financial Rules first drafting
  - Global budget issues

- Face to face meeting, December 10th 2012,
  - Drafting of the financial statutes and the Annex 2
  - Terminology for governance and financial issues ICOS RI

- Web conference, January 7th 2013
  - Approval of the Annex 2 and Financial statutes proposal for ISIC

- Web conference
  - Final editing of the Internal Financial Rules before sending them for ministerial circulation

- Face to face meeting, April 19th 2013
  - Discussion and finalization of the documents on financial planning (ICOS ERIC and ICOS Central Facilities) and annual membership contributions, for the ISIC meeting on May 28th
  - Final editing of the Internal Financial Rules for the ISIC meeting on May 28th

Achievements related to Financial Issues:

- Feb 2012: -Financial Working group established.
- Oct 2012: -Common reporting sheet for ICOS Central Facilities financial planning accepted in ISIC
- Jan 2013: -Decision on the calculation method for the annual membership contributions in ISIC
  -Statute articles related to the financial issues accepted in ISIC
  -Annex 2, financial principles and initial commitments accepted in ISIC
- March 2013: -Countries provided the station lists for the first five years
  - Central Facilities provided the contributions needed based on station number and type
- April 2013: -ICOS Central Facilities five year financial plans provided
  -Annex 2 on membership contributions finalised for the Step 1
  -A complete version of Internal Financial Rules finalised for the acceptance of the ISIC in May 28th

The project office coordinated the compilation of the expenditure and resource analysis chapter that was published yearly in the ICOS stakeholder handbook from 2008 to 2012.

WP4: ICOS integration in environment of carbon data providers

The value of ICOS data and derived data products to a wider user community is largely increased if strong links to other carbon datasets from related research and monitoring activities are established. The basic idea of this work package was to establish strong links to providers of external core data to ICOS and to provide access to a wide range of external carbon cycle data products.

First step was to establish a complete list of Essential Carbon Variables (ECAV) according to Integrated Global Carbon Observation[1] (IGCO). A comparison of these IGCO variables to those planned for ICOS (see report in paragraph about

1 The overall goal of the Integrated Global Carbon Observation (IGCO) Theme is to develop a flexible yet robust strategy for deploying global systematic observations of the carbon cycle over the next decade.

'main science and technological results') showed that spatially integrating observations or spatially integrated data and vertical atmospheric measurements are the key external products to complement ICOS measurements. The former include maps of fire extents and frequency, biomass, soil carbon content, and fossil fuel emissions.

Locating direct or indirect sources of data for these variables was the second focus of ICOS WP 4. Meetings with data providers were conducted, but could not be finalized in terms of concrete agreements as well as hardware and software requirements since the final decision about the Carbon Portal has not been made during ICOS PP. Nevertheless, data from already completed projects dealing with ICOS-related data (e.g. CarboEurope) were successfully integrated into the databases of the thematic centers. Important data gaps were identified and strategies to fill them were suggested.

In parallel, data sharing principles were negotiated with important data owners. During these negotiations a process with the objective to reach a consensus on the implementation of the data sharing principles for the Global Earth Observation System of Systems (GEOSS) was established. Instead of negotiating individual bilateral agreements this process was supported. The respective white paper of GEOSS was commented.

The final task was to establish an infrastructure to make external data available for users via the Carbon Portal of ICOS. However, during the development of the Carbon Portal concept it turned out that data publication strategies and data policies were to divers to integrate external data in the ICOS' Carbon Portal. Consequently, the Carbon Portal concept was supplemented by a metadata strategy, which makes ICOS data visible as well as citable and allows the incorporation of metadata about external data providers, who are expected to provide metadata according to international standards and protect the data with the least possible intellectual property rights, preferably dedicated to the public domain, in a machine-readable form.

During ICOS PPP software infrastructure to collect, treat and distribute data in the framework of the extended demo experiment was developed (see below). CarboScope™, part of a carbon portal demonstrator was established

- Main science and technological results

Report: Specification of external data products and providers

In this report, submitted in November 2009, a complete list of Essential Carbon Variables (ECAV) according to Integrated Global Carbon Observation (IGCO) was established. As of January 2010 it has been decided to adopt the term Essential Carbon Cycle Variables (ECCVs) instead of Essential CArbon Variables (ECAVs), to avoid confusing them with Essential Climate Variables (ECVs). The list was also published in the internet via the COCOS website (http://www.cocos-carbon.org/). By comparing this list with the proposed terrestrial and atmospheric ICOS measurement activities important external data products to complement ICOS data were identified.

These external data should include spatially integrating observations or databases for extrapolating point measurements to areal coverage. These include climate, columnar gas concentrations, land cover type, biomass, vegetation activity, vegetation disturbances, soil characteristics, nutrient deposition from the atmosphere, and fossil/bio-fuel emissions. In addition, point data on lateral carbon and nutrient transport with harvested biomass, rivers, and sediment is needed.

Providers of some of the data identified. One possible metadata scheme (DataCite) was explored (see 'Generated foreground').

Update on Land Cover Change (together with COCOS)

This report, submitted in January 2010, describes the specifications for land use observations, lists the available land cover products from remote sensing and describes possible use as ECCV. Data providers and their respective internet portals are listed.

The White Paper on the GEOSS Data Sharing Principles

The white paper develop data sharing principles for the Global Earth Observation System of Systems (GEOSS), was commented.

- Generated Foreground – These are the results that have been created within the project which directly assist the beneficiary and EC in to performing further research

Metadata and digital object identifier

Instead of presenting external data directly through the Carbon Portal, a metadata exchange will be preferred. The need to define relevant metadata standards has been stressed in the Carbon Portal concept paper. Furthermore, an agreement on metadata exchange format shall be made to facilitate exchange with other data centers. The German DataCite group based at the TIB, Hannover was visited in June 2012. The DataCite initiative comprises three main components that are of high importance for ICOS:

- Digital object identifiers: DataCite provides a persistent approach to access, identification, sharing, and re-use of datasets. For this purpose, a digital object identifier for datasets (doi) connects the dataset to a metadata schema, which fulfils several key functions, mainly providing a standard citation format for datasets and promote dataset discovery.

- Metadata: DataCite hosts a minimum metadata set that can be defined by the users themselves but has to follow the basic scheme and provide a link to the data. ICOS itself develops and hosts an extended set of metadata. From my point of view this should be done by the Carbon Portal team.

- Citation system: A citation system is under construction. DataCite and main publishers of scientific journals are going to sign an agreement soon that aims to establish data citation in scientific papers.

DataCite is a very interesting system for ICOS, since ICOS has a high degree of freedom to develop its own metadata schema within DataCite.

Identification of data gaps

A comparison of variables measured by ICOS with the ECCVs indicated several areas where external data is needed: vegetation activity, fire extent and frequency, soil carbon content, land use and land use change, C-fuel emissions, lateral transports, and nitrogen deposition. In addition, the need for an explicit specification of ECCVs with regard to spatial and temporal resolution, update cycle, and accuracy was identified.

- Vegetation activity: Many global satellite products are available for spatially integrating CO_2 fluxes, vegetation activity, and weather. These are listed in detail in the IGOS Carbon Theme Report (Ciais et al. 2004). Many of the products are available from the European Space Agency via LSA SAF.

- Fire extent and frequency: The Global Fire Monitoring Center (GFMC, http://www.fire.uni-freiburg.de) is an activity of the UN International Strategy for Disaster Reduction (UN-ISDR). Within its framework several satellite products are currently available for the past: global burnt areas 2000–2007 (1 km, daily), global fire probability maps 1982–1999 (8 km, weekly), ane the ATSR World Fire Atlas 1995–present).

- Soil carbon content: IIASA and FAO have recently published a new version of its Harmonized World Soil Database (version 1.1, http://www.iiasa.ac.at/Research/LUC/luc07/External-World-soil-database/HTML/). It has a resolution of 30 arcseconds (≈1 km at equator). Its content includes information on the organic C concentration and bulk density of the soil down to 100 cm. A specialized European product, the European Soil Database v. 1.2 contains information on C concentration in the upper 30 cm. A derived map with 1 km resolution is available. Additional information on soil depth and bulk density from the SPADE soil profile database allows estimating

carbon content. The FP7 project iSOIL (http://www.isoil.info), started in 2008, will expand techniques for mapping soil fast and reliably. When those techniques are applied across Europe in the future, more reliable soil carbon maps may become available in the future.

- Land use, land use change: The CORINE land cover data with a spatial resolution of 100 m is currently the best product available covering the EU. It exceeds the 1-km resolution of the Global Land Cover 2000 database. Specialized products for wetlands are provided by the GlobWetland project (http://www.globwetland.org).

- C-fuel emissions: Several historic maps of fossil fuel emissions are currently available produced by different methods (T3 annual, EDGAR FT2000, EDG annual, IER hourly). A recent study (Peylin et al. 2009) concluded that "changes in the estimated monthly biosphere flux (Fbio) over Europe, using two inverse modelling approaches, are relatively small (less that 5%) while changes in annual Fbio (up to ~0.15 Gt C/yr) are only slightly smaller than the differences in annual emission totals and around 30% of the mean European ecosystem carbon sink. These results point to an urgent need to improve not only the transport models but also the assumed spatial and temporal distribution of fossil fuel emission maps."

- Lateral transports: Maps of modeled soil erodability produced in the Pan-European Soil Erosion Risk Assessment project (PESERA, http://eusoils.jrc.ec.europa.eu/ESDB_Archive/pesera/pesera_cd) may be used until more specialized products become available. The GlobWetland project provides specialized maps that may allow calculating riverine transports and carbon storage in lake sediments.

- Nitrogen deposition: The natural co-operation partner for measurements of nitrogen deposition is the NitroEurope project (http://www.nitroeurope.eu/). ICOS sites should be established at existing NitroEurope sites or jointly with new NitroEurope sites. It is in the interest of ICOS that the N deposition measurements continue beyond the end of NitroEurope in 2011.

WP5: Strategic and logistical work for ICOS network

Within this work package the strategic and logistic work for the ICOS Network has successfully been conducted. The fundamental task of the work package was to assure that the particularities of the network operation, its design, sensor specification, 14C observations and costs were described and quantified. This included the following objectives

- Estimate the investment and running costs of the network, feeding back into WP 3
- Characterize the overall properties of optimal observing networks to constrain the European carbon balance and its ability to detect its changes, including the fossil fuel CO_2 component
- Define a guideline for validation of the performance of atmospheric sensors and evaluate new instruments for the atmospheric parameters by intensive tests and field campaigns
- Define the core set of ecosystem observations, standard methodologies, choice of sensors, protocols of data acquisition, long term reliability and quality control and test and prototype the ICOS ecosystem observation package for long-term, cost-effective ecosystem monitoring
- Develop and implement at selected sites a methodology to use high-precision $^{14}CO_2$ measurements and continuous CO observations as a quantitative tracer for fossil CO_2

In addition, several specific objectives have been addressed in the following tasks:

Task 5.1 Network design (CEA-LSCE, MPI-BGC, VUA)

A network design taskforce was set up and an assessment has been initiated with the aim to quantify the potential of candidate atmospheric networks to quantify regional scale budgets of the greenhouse gases CO_2 and CH_4 using various high-resolution inversion systems. An initial selection of 140 existing tall towers (towers or masts with at least 100 m height) was made based on the spatial distribution of emissions within the surrounding of the tall towers, selecting more or less clean background stations and stations in closer proximity to strong emissions with potential to constrain fossil fuel emissions and their changes. First analysis of footprints (sensitivities of mixing ratio observations to upstream surface-atmosphere fluxes) for a candidate network revealed that spatial coverage is quite patchy, implying the need for more spatial homogeneity of the network. This design question is further assessed in the GEOCARBON project.

Task 5.2 Atmospheric Thematic Center: measurement technology analysis (CEA-LSCE, MPI-BGC, UHEI-IUP)

ICOS atmospheric stations are divided into two categories which differ in the list of required parameters monitored in continuous and/or periodical mode. In addition to the core parameters which are mandatory for each station, we have established a list of additional parameters which are recommended for their scientific value. A periodic assessment and update of the core/additional parameter list was undertaken based on lab and field tests discussed during five dedicated workshops. The updated list has been included in the Stakeholder Handbook and in D5.5. It will be regularly re-evaluated according to new development in the greenhouse gases metrology.

For each core/additional parameter ICOS targets high quality data which involves high precision measurement and stringent data quality management procedure. ICOS measurements must comply with the compatibility goal established by WMO for the greenhouse gases and related tracers (GAW report n° 194), and updated every two years. As a result of tests and evaluations performed during the last 4 years we have produced a list of sensors which are compliant with ICOS requirements (D5.5). Several studies were performed to evaluate the possibility of developing operational sensors for additional parameters such as O_2/N_2, Radon-222, automated flask sampling systems (Rosenfeld, 2010; Schmithüsen, 2012). An airborne lightweight instrument package was evaluated at one of the regular vertical profile sites that have been used in CARBOEUROPE-IP. Two field campaigns have been organized to test operational retrievals of boundary layer height (Haeffelin et al., 2012; Milroy et al., 2012). In addition to the list of sensors the report D5.5 is also providing requirements and/or recommendations for the integration of the sensors in the ICOS station, the sampling of the air, the calibration protocols, the data and quality management. The costs of the procurement and operation of the equipment has been investigated and is also given in the stakeholder handbook.

Prototype sensors and protocols were evaluated under real field conditions in a quasi-operational context in the demonstration experiment (D5.3; D7.2)

Task 5.3 Ecosystem Thematic Center: measurements technology analysis

The ecosystem sites measure a large number of variables ranging from continuous high frequency meteorological and concentration values to periodic campaign to evaluate slow changing quantities like biomass and soil carbon content. The preparation of a final list of variables to monitor has been the result of an important discussion to find the best trade-off between completeness and cost effectiveness. The list produced and included in D5.5 is ecosystem specific and it is used as reference in the methodological discussion.

Similar to the atmospheric observation, a list of operational criteria was established for ecosystem sites CO_2, H_2O and heat fluxes, taking particular care on data quality treatment, robustness and reliability over long term periods. A periodic revision of the core/additional variable will be given, depending upon sensor development progress.

An instrument package for ecosystem flux measurements was tested at few sites for several months to assess its performances. A standard set of instruments was also selected after a comparison campaign with multiple instruments that have been organized in the Roccarespampani site in Italy.

Several Working Groups have been established in order to prepare the protocols documentation that will be published in a special issue in a peer-reviewed journal. Participation to the Working Group is open and can be done registering on the Ecosystem ICOS Demo Experiment site (see WP7 report). The testing and analysis of the performances of four methane gas analysers suitable for eddy covariance measurements was carried out (Peltola et al., 2012). The field testing of four nitrous oxide analysers was also carried out. The data is under post processing and the final analyses have started.

The measurements of short and long-wave radiation, diffuse radiation and spectral reflectance were standardized together with common protocols for soil moisture and sap flow. These are now further developed in the working groups of the ETC.

A scientific evaluation report (D5.2) and financial plan were worked out and are part of the stakeholder handbook.

Task 5.4 Technical analysis for ^{14}C-based methods for fossil fuel emissions inference (UHEI-IUP)

A new methodology and a respective instrument prototype package was developed based upon CO measurements properly "calibrated" with parallel high-precision $^{14}CO_2$ measurements, to be applied as a quantitative surrogate tracer for the fossil fuel CO_2.

To validate emissions changes for all central Europe, we therefore propose quasi-continuous two week integrated $^{14}CO_2$ observations at all Class-1 ICOS RI atmospheric sites. These measurements must be performed at the highest possible precision (better than 2‰), which is aimed at in the ICOS Central Radiocarbon Laboratory (CRL), currently set up at the University of Heidelberg, Germany (see WP6). In order to allow for estimating the fossil fuel component at high temporal resolution, we will apply the methodology developed by Vogel et al. (2010) using continuous CO observations as fossil fuel CO_2 proxy.

Main science and technological results

The main results comprise the following items:

- Concepts and technical implementation plans for the atmospheric and ecological networks (ICOS Stakeholder Handbook)
- D5.2 ICOS Report #5. Scientific evaluation report with selection of ICOS sensors and list of measurement operational criteria
- D5.3 Preparation and successful operation of atmospheric sensors and ecosystem measurement set-ups at few selected sites for the ICOS Demonstration Experiment in WP 7
- D5.4 Technical analysis (report) to derive hourly fossil CO_2 mixing ratios from radiocarbon and CO (Vogel et al., 2010, 2013)
- D5.5 ICOS Report #6. Final scientific and technical evaluation report (best possible design of ICOS Operational Phase network), final recommendations on atmospheric and ecosystem parameters and instruments and recommendations on operational fossil fuel CO_2 monitoring,

Generated Foreground – These are the results that have been created within the project which directly assist the beneficiary and EC in to performing further research

The main achievement of work package 5 is its contribution to the design of the atmospheric and ecological sensor packages and its implementation in ICOS. Specific papers containing the fundamental science aspects of this work include: Groenendijk, M., et al. (2011), Groenendijk, M. (2012), Levin, I., B. Kromer, and S. Hammer(2013),

Rosenfeld, M. (2010), Schmithüsen, D. (2012), Vogel, F.R., S. Hammer, A. Steinhof, B. Kromer and I. Levin (2010) and Vogel, F.R., B. Thiruchittampalam, J. Theloke, R. Kretschmer, C. Gerbig, S. Hammer and I. Levin (2013).

The material produced in the WP5 is used as the basis for the construction of the ICOS sites and for this reason a perfect foreground result for the scientific community involved in the ICOS infrastructure preparation.

WP6: Strategic and logistical work of ICOS central facilities

Within this work package the strategic and logistic work for the ICOS Research Infrastructure Central Facilities (CF) has successfully been conducted. The fundamental task of the work package was to assure that functional central facilities (ATC, ETC and CAL) will be achieved within the project. This extended from the definitions of main tasks up to specific implementation plans of the respective facilities and thus included the following steps:

- Drafting of requirements, tasks and a first resource assessment of the ATC, ETC and the CAL in respective Concept Papers in 2009 with an additional questionnaire for candidate laboratories to document their qualification for the CAL-tasks (Report #7 D6.1, part 1).
- Arranging a selection process for the respective Central Facility, i.e. application / selection of a review panel of international leading researchers / discussion of applications, reviews and responses by the applicants in the Executive Board to provide a basis for the decision on the locations for ATC, ETC, and CAL by the ISIC. As condition for the application as CAL, performance reports have been prepared by the applicants (Report#7 D6.1, part 2).
- Elaborated implementation plans have been prepared for ATC, ETC, and CAL (Report D6.6).
- Iterative assessment updates of investment and running costs of the Central Facilities for the capacity needs of the respective ICOS monitoring networks were presented (concept paper 2009, Stakeholder Conferences in Rome Nov 2009 and Brussels May 2011; 5 year financial plan for ISIC-Financial Working Group Nov 2012)
- In the last year of the preparatory phase, the carbon portal (CP) concept paper was finalized. An open call was made and after an international independent review, the CP was attributed to the bid made by Sweden.

In addition, several specific technical questions have been addressed as groundwork for the operation of the CF, as summarised in the following tasks:

Task 6.1: Atmospheric and Ecosystem Thematic Centers data services

The Atmospheric Thematic Center (ATC) has established the protocol to submit datasets to the database on a daily basis. Eleven pre-ICOS stations are currently submitting their data to the central server located at LSCE. Automatic processing chains are operational for CO_2, CH_4, CO, Radon analysers, and meteorological sensors. Standardized JAVA request can be used to extract all the information available in the database. The software applications *ATC-Config* and *ATC-QC* have been developed to provide user-friendly interfaces for the stations PIs who have to check and validate the dataset. Authorized users may also extract directly the time series from the ATC database using java requests. The atmospheric datasets are also available on the ATC web site: https://icos-atc-demo.lsce.ipsl.fr/. For each station an interactive visualisation tool has been set up for the most recent CO_2 and CH_4 data (e.g.: https://icos-atc-demo.lsce.ipsl.fr/puy-de-dome-data). In addition a suite of quick-looks and statistics are updated every day for each station (e.g.: https://icos-atc-demo.lsce.ipsl.fr/node/76). A special data delivery of Near Real Time data has been implemented for the MACC2 project (https://icos-atc-demo.lsce.ipsl.fr/dataMACC). The concept of a QC mobile lab for the atmospheric network has been developed.

For the Ecosystem component, new metadata and ancillary data collection systems have been developed and tested during the ICOS Preparatory Phase Demo Experiment. The Ecosystem Thematic Center finalized the methods to submit continuous measurements with their metadata associated to each single sensor and to import them in the database and use the information in the data processing and distribution. The new system is based on the submission of one variable for each sensor so that the aggregation and QC can be done centrally, following standard procedures that have been developed in the context of Task 5.3. It has been proven that the method is flexible enough to allow the inclusion of new emerging variables keeping the structure stable. For example, new parameters linked to the cropland biomass have been recently proposed and added with minor efforts. The system is now under discussion also with other international initiatives such as AmeriFlux and FLUXNET with the aim to agree on a common standard that will facilitate data exchange and cross-network synthesis activities. Also the raw data used to calculate fluxes have been checked in terms of submission and processing, because one of the main ETC responsibilities will be this flux calculation and application of corrections in a centralized and standardized way. Multiple calculation schemes for processing of eddy covariance fluxes have been implemented in the ETC server in order to quantify uncertainty and tested in the context of the Demo Experiment. The results have been particularly encouraging and interesting (see reports D7.2 and D7.3): first of all it has been possible to process the data centrally, getting results similar to what the sites managers calculated; on the other side, the use of different processing schemes, difficult to implement for a single research group, allowed to quantify the uncertainty and also showed clearly that the use of standardized methods is crucial when different sites are compared.

Tasks 6.2, 6.4 and 6.5: Central Analytical Laboratories (CALs) and inter-comparison procedures

The role of a Central Flask and Calibration laboratory (ICOS FCL) with respect to the WMO Central Calibration laboratories has been clarified and approved at the WMO expert meeting on CO_2 and other greenhouse and trace gases in 2009. The suitability of a filling site for reference gases for the calibration of field instruments within the monitoring networks has been checked and procedures for adjusting of the composition of such reference gases have been elaborated, based on previous work within IMECC (Report M6.3). A calibration strategy for the atmospheric stations has been worked out, providing information on the required capacity to be offered to the ICOS monitoring networks by the CAL (Report D6.2). A comprehensive intercomparison framework for the ICOS atmospheric component has been worked out by a QC working group, based on the concepts of the general ICOS Data Quality Assurance Strategy document (see Stakeholder Handbooks) and findings of Task 6.3 of this work package as well as previous work in IMECC. This Quality Management concept has been integrated as chapter 6 in the Atmospheric Station's Specification document. As above-mentioned the design, assessment of concepts and implementation plans for the components of the Central Analytical Laboratories Task 6.2, 6.4 and 6.5 all have been achieved.

Task 6.3: End-to-end Quality Control procedures via inspection teams

Two inspection teams for end-to-end QA/QC procedure of atmospheric and ecosystem monitoring stations, respectively, have been formed (Report D6.4).

After thorough testing of the Fourier Transform InfraRed (FTIR) Spectrometer and the procedures of parallel analysis at the home laboratory (UHEI) the atmospheric team has successfully performed campaigns at two stations (Cabauw, The Netherlands, and OPE, France). These campaigns demonstrated the feasibility of identifying problems at stations (e.g. leaks or mis-assigned calibration standards). The results as well as further recommendations for a comprehensive quality management of atmospheric networks such as ICOS have been published (Hammer et al., Atmos. Meas. Tech., 6, 1201-1216, 2013).

The ecosystem inspection team has visited four sites (Las Majadas, Spain, Hyytiälä, Finland, Soroe, Denmark, and Rzecin, Poland). The roving eddy covariance system consisted of a sonic anemometer (Gill R3) and three different kinds of gas analyzers with the closed path LI-7000 analyser appearing best suited for this purpose in terms of

reliability and data coverage. All data (station and travelling system) were processed by the same ETC software (*EddyPro*) which will in future be used for ICOS ecosystem site eddy covariance data. In general the flux results compared quite well and in some cases observed larger differences pointed to issues of combinations of specific instruments. Based on the experiences of this test campaign recommendations for the use of a mobile eddy covariance system in future ecosystem station QA/QC activities have been elaborated. The tested approach is recommended with some minor changes for quality control of the ecosystem flux data.

Main science and technological results

The main results comprise the following items:

- Concepts and technical implementation plans for the ATC, ETC, CAL and CP (as separate documents and respective sections in the ICOS Stakeholder Handbook)
- Operational data processing and data visualisation tools and data access to ICOS Demo Experiment data (Task 6.1: www.europe-fluxdata.eu/icos; https://icos-atc-demo.lsce.ipsl.fr/)
- Calibration strategy for the atmospheric monitoring network (Task 6.2: Report D6.2)
- Procedures for preparation of real air reference gas mixtures with specified composition of multiple species (Task 6.2: Report M6.3)
- Procedures for the operation of a travelling instruments as quality check for in-situ atmospheric and ecosystem flux measurements (Task 6.3: Hammer et al., Atmos. Meas. Tech., 6, 1201-1216, 2013; Report by Kolle and Dolman: ICOS QA/QC feasibility study for ecosystem flux measurements)

Generated Foreground – These are the results that have been created within the project which directly assist the beneficiary and EC in to performing further research

The main achievement of work package 6 is its contribution to establishing key components of the ICOS Research Infrastructure. The required preparatory work for the set-up and implementation of the three Central Facilities ATC, ETC and CAL has been finalised with the prospect to get them fully operational in the year 2016.

WP7: Demonstration Experiment

The Demonstration Experiment (DE) WP had as main aim to test the functioning of the future ICOS system (site-central facility-carbon portal). In particular the objective was to test the end-to-end data stream from the acquisition of the measurements, their transmission to the Central Facility, the QAQC, processing and calculation and finally the distribution, while taking into account the existing international standard in order to facilitate the integration of ICOS with others similar initiatives especially in the USA.

The results of the Demonstration Experiment, including the suggestions for the construction and operative phases of the ICOS infrastructure have been reported in a document (ICOS Report #8 adequacy assessment of sites/sensors/facilities for Operational Phase).

To complete the demonstration of the main activities of the future ICOS infrastructure, an analysis of the use of the future ICOS data, in particular in relation to the reduction of errors and uncertainty in the European Carbon balance estimation was also part of this WP.

Task 7.1 Data collection (VUA, CEA-LSCE, MPI-BGC, UNITUS, UEDIN, UHEL, ISBE)

The data collection has been the first step for the demonstration experiment and started in April 2011 to assess the capability and detect limits of the future ICOS network and data flow between sites and Thematic Centers. In this context four ecosystem sites and four atmospheric sites has been selected to submit near real time data to the Thematic Centers and at the end of the experiment also a consolidated version. Originally the data acquisition was planned for six months but the importance of the test suggested extending the duration for additional 6-12 months.

The sites that have been part of the demo experiment have been selected on the basis of past performances and are: Soroe-Denmark, Hyytiala-Finland, Rzecin-Poland and Las Majadas-Spain for the ecosystem sites and OPE/ANDRA-France, MaceHead-Ireland, Cabauw-Netherlands, Puijo-Finland for the atmospheric part. To these sites additional 7 atmospheric sites (Carnsore Point and Malin Head (Ireland), Ridge Hill and Tacolneston (UK), Ivittuut (Greenland), Puy de Dôme, Biscarosse (France)).

and one ecosystem site with complex terrain have been added to the demonstration experiment in the last year of the project.

The Ecosystem data are routinely submitted to the ETC in Viterbo and they have been made available at the address www.europe-fluxdata.eu/icos in the Demo Experiment page. There it is possible to see a scheme of the tower, all the sensors installed and their characteristics and the last 48 hours of data, available both as plot and as ASCII files to download without any password.

The atmospheric data are automatically transferred to the ATC database at Gif-sur-Yvette once a day, where they are automatically processed. They are available on the ATC web site (https://icos-atc-demo.lsce.ipsl.fr/). For each station an interactive plot application is available, and several quicklooks are updated every day as a support of the quality control process. A special pipe has been made available to the MACC-II European project which is assimilating atmospheric time series.

Task 7.2 Evaluate data flows and processing and standardized datasets (UNITUS, CEA-LSCE, ISBE)

The main objective of this work-package was to identify where the data flow between sites and thematic centers have the main difficulties and problems in order to propose possible solutions and improvements to be transferred to the ETC and ATC preparation activity. The intrinsic differences in the data acquired by ecosystem and atmospheric sites and also the different data processing chains, required to focus the attention to specific aspects of the atmospheric and ecosystem data elaboration; for this reason the activity is also reported separately for the two groups of sites.

Ecosystem:

The main differences between ICOS and the previous ecosystem sites networks organization (e.g. CarboEurope) is that the data processing is under the responsibility of the Ecosystem Thematic Center instead of the single site PI or staff. This is a major change that needed to be tested in order to confirm that it is possible and that all the information needed to correctly process the data are collected. This is particularly important for the fluxes (CO_2, LE and H) that need a complex calculation.

The raw data collected at each of the DE sites and covering one full year of measurements have been processed centrally by the ETC database staff using different combinations of the possible (and most used) schemes available, using also the metadata collected using an improved template created and tested during the activity, and compared with the site manager version of the calculated fluxes.

The comparison between the PI and centralized versions showed scatters of different magnitude at the four sites involved, due to correction options that vary also from site to site. However the results obtained highlighted the

importance of a centralized processing in order to avoid introducing differences that would made multi-site use difficult. On the other side the differences obtained between the processing options should be considered as a source of uncertainty and it is important to take this into consideration during the ETC data unit setup. Finally it has been confirmed that the metadata collected are sufficient for a proper data processing.

Atmosphere:

Several protocols have been set up in order to ensure the quality of the measurements and the centralized data processing of the Atmosphere demonstration experiment. Near real time data transmission using beta version of the ATC processing software is in place. The software uses a special interface, to adapt to different calibration cylinders connections, calibration sequence description, and thresholds values for physical parameters such as temperature, and an alert system is in place in case of rupture in the processing chain.

The processing performs a first quality control of the time series where some data are automatically flagged based on a set of criteria specific for each station (e.g. flushing time, max/min accepted values for temperature, pressure, molar fractions, etc.). In addition, each station PIs has to validate the dataset by using his own expertise and the information archived in the logbook of the station. To facilitate this work the ATC has produced a graphical interface directly linked to the database. A catalogue of data products (quicklooks, textfiles) updated every day and made available on the ATC website (https://icos-atc-demo.lsce.ipsl.fr/icos-data-products) is also used for QC of the data time series (e.g. instrument precision, calibration and target gas measurements, etc…).

For each greenhouse gas sensor, two target gases are used to verify the reproducibility of the time series. Flasks are also regularly sampled at several stations, which will provide an independent measurement of CO2, CH4 and CO that we can compare to in-situ monitoring.

During the demo experiment the calibration sequence could be optimized (minimum injection time, frequency, etc.). All calibration gases and all flasks regularly sampled at the site were also provided and analysed by the CAL. Information related to the calibration gases and samples were transferred to the ATC data base, which also collected in NRT the raw data from each site.

A comprehensive quality management for the atmospheric network has been published (Hammer et al., Atmos. Meas. Tech., 6, 1201-1216, 2013). After thorough testing of the Fourier Transform InfraRed (FTIR) Spectrometer (instrument used as a reference for the side by side comparisons) and the procedures of parallel analysis at the home laboratory (UHEI), in situ campaigns demonstrated the feasibility of identifying problems at stations (e.g. leaks or mis-assigned calibration standards).

In the end, the analysis of one year of atmospheric dataset coming from a dozen of stations has demonstrated that the collection, processing and distribution of data in near real time is feasible. Sampling and calibration protocols have been evaluated, as well as the methodology to ensure the QA/QC of the time series using specific measurements at each stations and one inspection team. The Demo Experiment also showed the necessity of a strong collaboration between the atmospheric stations and the central facility. The ATC data center has developed a database which enables a full traceability of the data processing. It has also developed several tools and data products as a support of quality control by the stations PIs. Involvement of the engineers and scientists to regularly use those tools is crucial for the success of the high precision monitoring program as expected in ICOS. The analysis of the results has been summarized, including the suggestion for the implementation of the best practices, in the ICOS Report #8, deliverable of this WP.

Task 7.3 Demonstration cases of European carbon balance estimates with real data (CEA-LSCE, MPI-BGC, UNITUS, VUA)

A model-based error reduction study conducted by Kadygrov et al., under internal review, gave the following results: "First performance assessment of different configurations of the Integrated Carbon Observing System (ICOS, a European network of atmospheric mole fraction continuous measurements) for constraining European biogenic CO2 fluxes (simply called NEE, for Net Ecosystem Exchange, in the following). A high-resolution (6 hourly, 0.5º latitude, 0.5º longitude) atmospheric inversion system is used for this purpose. The uncertainty of the inverted fluxes is computed by the system for three weeks in July and in December 2007 in an Observing System Simulation Experiments framework. We analyze it at the model grid scale (0.5°), at the country scale and for the domain covering almost all continental Europe including western part of Russia and Turkey (roughly 6.8*106 km2) after temporal aggregation at the two-weekly scale. Several network configurations are tested, from 23 to 66 sites, in order to assess the dependency of the flux uncertainty on the network extension. At 0.5º resolution, the error reduction with respect to the prior error from biosphere model reaches up to 69% in regions with the highest measurement density. Assimilating the data from a network with 23 sites (current network) significantly reduces the uncertainty on bi-weekly NEE by 50% from the prior uncertainty, to the value of ~ 43 TgC/month (over Europe) for July. The error reduction for December 2007 is ~ 66%, with a posterior error ~ 26 TgC/month. Expanding the ICOS atmospheric network to 66 stations further reduces the uncertainty of bi-weekly NEE by 64% (~33 TgC/month) and 79% (~15 TgC/month) relative to the prior errors for July and December respectively. When the results are integrated over the well-constrained Western European domain, uncertainty reduction shows no seasonal contrast. The effect of decreasing the prior error correlation length to 150km (from 250 km in the default setting) or of reducing the transport model error by a twofold factor depends on the scale of aggregation and differs for initially-well and initially-poorly constrained areas. With the given extension of the network, further improvements for the regions with smaller observation density can be brought by improving the quality of the transport model. We show that with a dense ICOS atmospheric observation network, the 2-week CO_2 flux uncertainties are reduced by up to 50-80 % for countries like Finland, Germany, France and Spain, and this significantly improves our knowledge about European ecosystems CO_2 fluxes.

Main science and technological results

The main results of the demonstration experiment comprise the following items:

- Field test of the possibility to acquire, transmit and process in Near Real Time the measurements collected at ecosystem and atmospheric sites.
- D7.2 ICOS Report #8 with indications for the future connection between sites and thematic centers
- Development of new tools for data collection, QAQC, processing and distribution that are currently under implementation at the ATC and ETC.
- Quantification of the uncertainty and importance of its consideration when measurements are collected and distributed

Generated Foreground – These are the results that have been created within the project which directly assist the beneficiary and EC in to performing further research

The Demonstration Experiment provided a lot of information, data and indication that have been transferred to the following activities. ICOS Preparatory Phase started with the aim to create the basis and test difficulties and possibilities of the future ICOS infrastructure. The Demo Experiment has been an excellent test activity and all the finding are an important basis for the ICOS construction. The DE was extended in time in view of the success and usefulness of its first phase.

WP8: Interaction with Users

WP8 was in charge of the interaction with users. This ambition was achieved mainly through the following means:

- Potential users of ICOS data have been listed in collaboration with the National Focal Points and the ICOS outreach committee. User categories have been defined and their needs characterized from a survey. This survey was based on the answers received to a dedicated questionnaire that has been widely distributed. The ICOS User Needs Report has been approved at the 2011 ICOS annual meeting. It contains key element for: i) shaping the ICOS outputs, including the Carbon Portal, around the users' needs; ii) allowing potential users to efficiently exploit the ICOS products; iii) providing essential information for the ICOS implementation and operational phase; iv) and contributing to the rationale of a strategic document that can be presented to governments and other potential donors for requesting financial support to ICOS. It also provides useful information for improving the communication strategy of the next ICOS phase and for the development of an effective and user friendly web portal (**Task 8.1**).

- A series of outreach activities have been organized to involve ICOS users, including press releases and high-profile events. Contacts with policy communities, and international Earth Observation coordination bodies and programmes started through the engagement in the GEO (Group on Earth Observations process), the Global Terrestrial Observing System (GTOS) programmes. Synergy and collaboration with other relevant projects like COCOS, or ICRI has been continuous (**Task 8.2**).

- The attribution of the Carbon Portal within the operational infrastructure took place just after the end of the preparatory phase (May 2013), but early in the project, within the ICOS website, a Carbon Portal demonstrator (CarboScope™) was established as an innovative user friendly interface to visualize and compare various carbon data sources relevant to ICOS. The last version includes access to a broad range of flux products (inversions, model outputs, climatologies), a broad range of visualization options, a modernized design and improved texts. Much work has been also performed to develop modern web accesses to general images, quicklook at the data, data reports and actual data for the atmospheric and ecosystem ICOS extended demonstration experiments. Last, two meetings have also been organized to define the Carbon Portal of the operational infrastructure and help writing its concept paper (**Task 8.3**).

- Training activities have been organized in the second half of the project, through a series of technical workshops gathering the atmospheric and ecosystem communities of ICOS, once the first Thematic Centres were selected. For dissemination toward pupils and students, ICOS-PP has collaborated with the FP7 EU project CarboSchools+ (that linked researchers from several leading carbon science laboratories in Europe with secondary schools around pedagogical projects), and with the climate-KIC (Knowledge and innovation community) (**Task 8.4**).

- Endorsement of governments for the operational phase was achieved at the last general assembly, when the ICOS Stakeholder Interim Council (11 countries represented) met and planned step 1 of the ICOS ERIC creation in front of the European commission in summer 2013 (**Task 8.5**).Main science and technological results

Potential Impact of ICOS including socio-economic impact and wider societal

Socio-economic impact

The preparatory phase of the ICOS research infrastructure has wide-ranging socio-economic implications: improving the information on regional carbon fluxes available to the public and decision makers, technological externalities

(innovation required to meet the needs of the infrastructure's development), general socio-economic benefit of public investment in infrastructure projects, and potential improvement to climate prediction models. European companies involved in carbon observations can benefit from the development of ICOS by gaining competitive advantages on the global market. These types of impact can be analysed following the various lines of achievements in ICOS.

The process initiated by the ICOS stakeholder interim council (ISIC) toward setting up a legal entity (ERIC) (WP2) for ICOS and commitment of countries to supporting ICOS indicate a strengthened activity that gradually create or sustain jobs in research and development. The direct participation of more than a dozen countries across Europe, with the construction and maintenance of monitoring sites and associated research activities (WP5), is a positive indicator of local investment, with detailed expenditure analysis carried in WP3; in countries hosting central facilities, the impact is even higher (WP6) with public investment sustaining research, engineering and administrative positions, as well as procurement typically reaching European companies (SMEs).

Network design (Task 5.1) highlights the need to develop a denser network in most countries, and to install station in currently under sampled regions. Under sampled regions comprise countries in the South and East quarters of Europe, where public expenditure in R&D is generally low. This calls for further national and European investment in these regions, supporting national development of the knowledge economy. Capacity building and the stronger involvement of organization in Eastern Europe has been the subject of WP8 (see Milestone 8.4). This strategic activity will continue with the interim head office of ICOS established to bridge the gap between the end of the preparatory phase and the creation of a European ERIC organization.

Structuring the European landscape of greenhouse gas data provision also has a major impact by enabling the production of quality controlled (WP6) data available to citizens and decision makers, including elaborated products offered by the Carbon Portal (WP4), targeted both to the public and policy makers.

The capabilities of the ICOS research infrastructure's concept has been evaluated through the Demonstration experiment (WP7). The Demonstration experiment has been an opportunity for European SMEs to get better acquainted with the ICOS requirements. Innovation in these companies has been fostered by the high standard of ICOS's requirements. Companies who have participated to the experiment by enhancing products include 3 European LIDAR manufacturers, gas analyser manufacturers, service companies, and part manufacturers. The Demonstration experiment and the development of ICOS have brought European SMEs and large groups to identify the emerging market of atmospheric measurement of greenhouse gases. Several scientific papers were co-authored jointly by scientists and engineers from ICOS partners and from the manufacturers. Several of these companies initiated technological development programs to provide rugged instruments using different measurement strategies. User involvement (WP8) has shown that companies initiated the design of tomorrow's services related to greenhouse gas observations in the frame of public-private partnerships. Technology transfer opportunities offered from European public research organizations to companies include the integrated atmospheric station and ecosystem data processing software (WP6).

User involvement (WP8) targeted more particularly the scientific community and the GMES (now Copernicus) programme of the European Commission and the European Space Agency. Data are initially being used in model parameterization and in atmospheric inverse modelling. Copernicus aims at developing operational Earth observation services that provide information to decision makers, business and the public in the fields of atmospheric, land and marine monitoring and forecast. Horizontal services address emergencies, security, and climate. In four of these six fields, ICOS has been identified as an important data provider of in-situ carbon observations. Copernicus has an estimated cost per EU inhabitant of about €1.07 per year, for an expected minimum financial benefit by 2030 of ~€29.4 Bn. Public investment is anticipated to generate revenue 3.2-fold the initial investment, with the creation of 48,000 jobs. Links for data provision of ICOS to Copernicus atmospheric services has been strengthened immediately once the Demonstration Experiment has given positive results.

Wider societal implications of the project

The EU's target of reducing greenhouse gas emissions by 20% relative to 1990 levels by 2020 embodies its objective to fight climate change and is at the heart of the Europe strategy for sustainable growth. Both policy-induced and voluntary actions can help reduce carbon emissions and increase carbon sinks, but significant changes in the carbon budget are likely to require policy interventions. This is called for by European citizens. When asked who within the EU is responsible for tackling climate change, 41% of respondents answered the national governments, 35% answered the EU (TNS Opinion & Social, 2011). European citizens now identify climate change as a key issue with the potential to affect their lives directly and expect their national and European governing bodies to take action through policy. According to this same study, « There is also a positive view of the economic benefits of tackling climate change – almost eight in ten (78%) respondents agree that it can boost the economy and create jobs, a big increase since 2009 (when 63% agreed). At least two-thirds of respondents in each Member State share this view. »

ICOS participates to this effort by monitoring greenhouse gases in the atmosphere and by providing independent and rigorous observations required to assess the regional fluxes of carbon, both in the ecosystems and from fossil fuel burning at high spatial and temporal resolution. One of the tools in tackling climate change has been the European Trading Scheme. Besides the carbon market created by this system, carbon market intelligence has emerged. Carbon market intelligence is now a key part of the carbon-finance market, and is addressed by an emerging sector that aims at delivering the information required for the effective sale or purchase of carbon-based credits or other financial instruments (Maslin and Poessinouw, 2012). This study estimates carbon monitoring alone as a market being worth 4565 million euros in 2010-2011. ICOS will contribute by making the required data available to assess the aggregate emissions in Europe, and by providing a backbone network on which national or urban networks can rely for metrology and interoperability.

As a European research infrastructure, ICOS is designed to address the needs of scientists in Europe as well as globally. Currently, ICOS gather specialists from Europe and the US to engage in discussions on common issues related to its design. In the future, engagement of the scientific user community as well as policy-makers will be the key to success as clearly identified during the project. As a concrete example, the construction of the Ecosystem part of the ICOS infrastructure in France has created a continuous dynamics grouping research institutions (institutes, universities, public agencies), 3 Ministers (Research, Ecology and Agriculture and Forests) and a number of corporate companies, SMEs, private entities and public agencies (Regions, Department, Cities) as well as partners in Education (Rectorat, Académies, Schools, and High Schools). In Spain, for example, ICOS research has supported has been used by the ministry of Agriculture, Food and Environment (MAGRAMA) and its "*Oficina Española del Cambio Climático*" in developing climate change policies and strategies to mitigate/adapt to climate change. Overall ICOS will enable better scientific and industrial research, and will directly strengthen the European Research Area.

ICOS will also inform EU citizens by providing a suite of openly-available elaborated products, helping the general public to have access to reliable information on greenhouse gas in the atmosphere and to the distribution of sources and sinks of CO_2 and other greenhouse gases.

It is hoped that the work provided for in ICOS will improve the societal work on mitigating of and adaptation to climate change by provide independent emission estimates that can be used for the verification of bottom-up emission inventories. The results will also be synthesised and used in monitoring and evaluation of carbon accounting for national inventories, LULUFC and the Kyoto flexible mechanisms.

References:

TNS Opinion & Social, 2011. Special Eurobarometer 372 CLIMATE
CHANGEhttp://ec.europa.eu/public_opinion/archives/ebs/ebs_372_en.pdf

M. Maslin and M. Poessinouw (2012). Emergence of the carbon-market intelligence sector. *Nature Climate Change*. doi:10.1038/nclimate1492

Project public website and relevant contact details

The address of the project website is www.icos-infrastructures.eu. It has been operational since April 2008. Beneficiaries can find all legal documents and documents relating to media relations on the website, some areas are password protected for confidentiality.

The website underwent a new and better organization in 2010 such that registered users now have access to all documents pertaining to their user group visible on one page. This has eliminated searching on the site for documents that could be accessed. A web statistics tool has been in place since July 2009 shows approximately 2.5 million hits. From the main ICOS website, a menu provides access to national ICOS websites for the different countries partners. Links to these websites, still under development, are active. The general public also has the opportunity to follow ICOS news, review different employment opportunities within the ICOS network, obtain pertinent publications, and download copyrighted photos and other dissemination/outreach materials and link into the ICOS professional community by subscribing to Linkedin.

Home page

The Carbon Portal demonstrator, CarboScope™ currently on the ICOS website continues to provide monthly optimized CO_2 and CH_4surface flux maps, globally and regionally, derived from atmospheric measurements like the one ICOS will generate. Three different labs in Europe contribute to this effort providing their own computations thus giving an estimate of the robustness of the results.

CarboScope Home page

ICOS beneficiaries and Focal Points as well as their websites can be seen from the website.

A European research infrastructure dedicated to high precision observations of greenhouse gases fluxes

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ICOS consortium members as well as the EC have access to the website and to all reporting documents and deliverables. Confidential documents reserved for Stakeholders and ministerial representatives are also available and are password protected.

Use and dissemination of foreground

Section A

A consortium agreement has been put in place to define the management of pre-existing knowledge and exchange of data within the consortium. The plan for the use of the results of the ICOS data and data products were initially planned in WP8 and then further elaborated by the beginnings of a data policy in WP3. ICOS aims to provide observational data and derived products addressing the needs of the following communities:

- Research communities
- Policymakers/stakeholders involved in negotiating carbon reduction policies
- Carbon trading communities
- Regional authorities and carbon inventory agencies
- Private land owners and industrial contributors of greenhouse gas emissions
- Operational centres assimilating atmospheric composition data
- And the general public interested in greenhouse gas emissions and global change

In this project, several tasks in WP8 were put into place to collect information and plan for the use of the results. Early on, a user survey was conducted and user communities were identified. An important accomplishment was the Demonstration Experiment that collected, processed and displayed data generated from a select number of sites. This information was made available through the ATC and ETC websites (https://icos-atc-demo.lsce.ipsl.fr/, http://gaia.agraria.unitus.it/icos/icos-demo-experiment). The Demo experiment was a success both in terms of technical specifications of the infrastructure, and in terms of near real time data display and provision to targeted users.

Dissemination of knowledge throughout the duration of the project consisted of:

- Project website (www.icos-infrastructure.eu)
- Annual meetings coupled with Stakeholders Conferences
- ICOS mentioned as high priority in most of the beneficiary countries roadmaps
- A report on user feedback about the ICOS sample data and services generated during the demonstration experiment (D7.2)
- A revised Stakeholder's Handbook each year updating country network profiles and financial information about each country
- Yearly publications in Research Innovation highlighting ICOS. This publication is distributed to 30,000 addresses within Europe including the EC and all NGO's.
- Updated brochures and 4-page flyers distributed at all meeting
- An ICOS Booth at the EGU 2011 as well as ICOS information available at all GEO meetings
- A LinkedIn group (linkedin.com) to ensure presence in social media.
- Websites of the ATC and ETC (https://icos-atc-demo.lsce.ipsl.fr/, http://gaia.agraria.unitus.it/icos/icos-demo-experiment).
- Availability of national websites created by the Project office.
- Press releases and press conference

A press release in 2010 regarding the Demonstration Experiment was successfully disseminated in Europe resulting in media interviews for partners in Italy, where a press conference was organized. Another press release announcing the collaboration with Earth Networks was also released at the European level, resulting in press coverage across Europe.

Several beneficiaries have arranged for special media-oriented seminars within their networks. For example, in conjunction with the inauguration of ICOS Sweden in September 2012, media reported about this using televised media as well as in newsprint. The media was also present at the establishment at some of the new sites in Sweden.

In the Netherlands, the inauguration of ICOS-Netherlands took place at the Cabauw tower with a press conference an associated website.

In Italy, the ICOS preparatory phase inspired the development of an integrated monitoring station (ABC-IS located in Ispra) devoted to the monitoring of ecosystem mass and energy fluxes, atmospheric GHG concentrations and air pollutants. The development plan of the station was presented during the joint JRC/ESFRI workshop held in Ipsra in June 2012. The ABC-IS facility is used to disseminate JRC's activity and the objectives of ICOS to visitors of the Institute and to the general public (e.g. during JRC open day). In Israel, Weizmann made available data to the public, government ministries and national forestry organization (KKL) through their two websites (http://www.weizmann.ac.il/ESER/People/Yakir/YATIR/; and http://www.weizmann.ac.il/GGI/ as well as in the annual meetings of the main stake holder (KKL, national forestry organization). In Spain, CEAM upgraded the ecosystem flux station "Majadas del Tietar" that participated to the ICOS Demonstration experiment in 2011. This station is providing the most complete micrometeorological variables suite of the Mediterranean European area on a near real time basis. The use of the data provided by the station is largely increasing, especially by the remote sensing community (already 4 Spanish remote sensing groups from universities and national research institutes are using it on a regular basis), and the station is used a platform to test and develop continuous spectral measurements, as a prototype for hyperspectral continuous measurements with changing field of view. The station is also used for educational purpose by Spanish institutes and the Wageningen University.

Plans are to make the data publicly available in near real time to be use both for educational and research purpose. A preliminary prototype of this future service can be found at http://ceamflux.com/MAJADAS/index.html

Section B

ULUND: ICOS Sweden is classified as a national infrastructure meaning that it is open for access of other researchers as well. There is a simple application procedure to be applied by the projects that wish to use the sites. Some limited support can be given to such external projects as well. All data from ICOS Sweden sites are freely available to the scientific community worldwide.

UA: Funding commitments for the construction of ICOS were obtained from Flemish and Federal Belgian governments

- Press conference on ICOS with the Flemish Minister for Innovation, Mrs. Ingrid Lieten on 7 May 2012: formal launch of Flemish participation in ICOS infrastructure network
- Several meetings with Federal Belgian Science Policy Office (BELSPO): 02 April 2009, 29 juni 2009, 2 September 2011, 13 January 2012, 11 March 2013, 20 March 2013

Participation in several meetings of the Legal Working Group of ICOS (19 September 2012), ICOS statutes workshop (13 December 2012), ICOS Facility Workshop (05.03.2013)
Internal meetings to prepare the construction of the Ecosystem Thematic Center (a.o. in February 2011 ; February 2012).

Section A (public)

This section includes two templates

- Template A1: List of all scientific (peer reviewed) publications relating to the foreground of the project.

- Template A2: List of all dissemination activities (publications, conferences, workshops, web sites/applications, press releases, flyers, articles published in the popular press, videos, media briefings, presentations, exhibitions, thesis, interviews, films, TV clips, posters).

Template A1: list of scientific (peer reviewed) publications, starting with the most important ones

NO.	Title	Main author	Title of the periodical or the series	Number, date or frequency	Year of publication	Relevant pages	Permanent identifiers[2] (if availables)	Is/Will open access[3] provided to this publication ?
1	Respiration acclimation contributes to high carbon-use efficiency in a seasonally dry pine forest.	Maseyk, K.	*Global Change Biology*	7/14	2008	1553-1567	DOI: 10.1111/j.1365-2486.2008.01604.x	YES
2	The CO2 exchange of biological soil crusts in a semiarid grass-shrubland at the northern transition zone of the Negev desert, Israel.	Wilske, B.	*Biogeosciences*	3/5	2008	1969-2001	DOI: 10.5194/bgd-5-1969-2008	YES
3	Quality control of CarboEurope flux data. Part I: Coupling footprint analyses with flux data quality assessment to evaluate sites in forest ecosystems.	Göckede, M.	*Biogeosciences*	2/5	2008	433-450	DOI: 10.5194/bg-5-433-2008	YES
4	Leaf area index is the principal scaling parameter for both gross photosynthesis and ecosystem respiration of Northern deciduous and coniferous forests.	Lindroth, A.	*Tellus B*	2/60B	2008	129-142	DOI: 10.1111/j.1600-0889.2007.00330.x	YES

[2] A permanent identifier should be a persistent link to the published version full text if open access or abstract if article is pay per view) or to the final manuscript accepted for publication (link to article in repository).

[3] Open Access is defined as free of charge access for anyone via Internet. Please answer "yes" if the open access to the publication is already established and also if the embargo period for open access is not yet over but you intend to establish open access afterwards.

5	H2O and CO2 fluxes at the floor of a boreal pine forest.	Kulmala, L.	*Tellus B*	2/60B	2008	167-178	DOI: 10.1111/j.1600-0889.2007.00327.x	YES
6	Biophysical controls on CO2 fluxes of three Northern forests based on long-term eddy covariance data.	Lagergren, F.	*Tellus B*	2/60B	2008	143-152	DOI: 10.1111/j.1600-0889.2006.00324.x	YES
7	Forest floor versus ecosystem CO2 exchange along boreal ecotone between upland forest and lowland mire.	Tupek, B.	*Tellus B*	2/60B	2008	153-166	DOI: 10.1111/j.1600-0889.2007.00328.x	YES
8	Surface-atmosphere interactions over complex urban terrain in Helsinki, Finland.	Vesala, T.	*Tellus B*	2/60B	2008	188-199	DOI: 10.1111/j.1600-0889.2007.00312.x	YES
9	Flux and concentration footprint modelling: State of the art.	Vesala, T.	*Environmental Pollution*	3/152	2008	653-666	DOI: 10.1016/j.envpol.2007.06.070	YES
10	Net carbon dioxide losses of northern ecosystems in response to autumn warming.	Piao, S.	*Nature*	451	2008	49-53	DOI: 10.1038/nature06444	YES
11	Afforestation of semi-arid shrubland reduces biogenic NO emission from soil.	Gelfand, I.	*Soil Biology Biochemi*	7/41	2009	1561-1570	DOI: 10.1016/j.soilbio.2009.04.018	YES
12	Water limitation to soil CO2 efflux in a pine forest at the semiarid "timberline"	Grünzweig, J.M.	*JGR Atmosphere*	G3/114	2009		DOI : 10.1029/2008JG000874	YES
13	Biotic and abiotic factors affecting the d13C of soil respired CO2 in a Mediterranean oak woodland.	Maseyk, K.	*Isotopes in Environmental and Health Studies*	4/45	2009	343 - 359	DOI: 10.1080/10256010903388212	YES
14	Temporal and among-site variability of inherent water use efficiency at the ecosystem level.	Beer, C.	*Global Biogeochemical Cycles*	2/23	2009		DOI: 10.1029/2008GB003233	YES
15	Photosynthesis of boreal ground vegetation after a forest clear-cut.	Kulmala, L.	*Biogeosciences*	11/6	2009	2495-2507	DOI: 10.5194/bg-6-2495-2009	YES
16	Latitudinal patterns of magnitude and interannual variability in net ecosystem exchange regulated by biological and environmental variables.	Yuan, W.	*Global Change Biology*	15	2009	2905-2920	DOI: 10.1111/j.1365-2486.2009.01870.x	YES
17	The urban measurement station SMEAR III: Continuous monitoring of air pollution and surface-atmosphere interactions in Helsinki, Finland.	Järvi, L.	*Boreal. Env. Res*	14	2009	86-109		YES
18	Contributions of climate, leaf area index and leaf physiology to variations in gross primary production of six coniferous forests across Europe: a model-based analysis.	Duursma, R.A.	*Tree Physiology*	5/29	2009	621-639	DOI: 10.1093/treephys/tpp010	YES

19	Spring initiation and autumn cessation of boreal coniferous forest CO2 exchange assessed by meteorological and biological variables.	Thum, T.	*Tellus B*	5/61	2009		DOI: 10.1111/j.1600-0889.2009.00441.x	YES
20	Long-term measurements of the carbon balance of a boreal Scots pine dominated forest ecosystem	Ilvesniemi, H.	*Boreal Environment Res*	14	2009	731-753		YES
21	Comparison of net CO2 fluxes measured with open- and closed-path infrared gas analyzers in urban complex environment.	Järvi, L.	*Boreal Environment Res*	14	2009	499-514		YES
22	Exceptional carbon uptake in European forests during the warm spring of 2007: a data-model analysis.	Delpierre, N.	*Global Change Biology*	6/15	2009	1455-1474	DOI: 10.1111/j.1365-2486.2008.01835.x	YES
23	Ecohydrology of a semi-arid forest: partitioning among water balance components.	Raz Yaseef, N.	*Ecohydrology*	2/3	2010	143-154	DOI: 10.1002/eco.65	YES
24	Implication of weekly and diurnal ^{14}C calibration on hourly estimates of CO-based fossil fuel CO_2 at a moderately polluted site in south-western Germany.	Vogel, F.	*Tellus*	5/62B	2010	512-520	DOI: 10.1111/j.1600-0889.2010.00477.x	YES
25	A recent build-up of atmospheric CO2 over Europe. Part 1: observed signals and possible explanations.	Ramonet, M.	*Tellus B*	1/62B	2010	1-13	DOI: 10.1111/j.1600-0889.2009.00442.x	YES
26	Is the recent build-up of atmospheric CO2 over Europe reproduced by models : an overview with the atmospheric mesoscale transport model CHIMERE.	Aulagnier, C.	*Tellus B*	1/62B	2010	14-25	DOI: 10.1111/j.1600-0889.2009.00443.x	YES
27	European CO2 fluxes from atmospheric inversions using regional and global transport models.	Rivier, L.	*Climatic Change*	1-2/103	2010	93-115	DOI: 10.1007/s10584-010-9908-4	YES
28	The European carbon balance. Part 1: fossil fuel emissions.	Ciais, P.	*Global Change Biology*	5/16	2010	1395-1408	DOI: 10.1111/j.1365-2486.2009.02098.x	YES
29	Isotopic composition and concentration measurements of atmospheric CO2 with a diode laser making use of correlations between non-equivalent absorption cells.	Croize, I.	*Applied Physics B-Lasers and Optics*	1-2/101	2010	411-421	DOI: 10.1007/s00340-010-4162-z	YES
30	Carbon dioxide exchange and canopy conductance of two coniferous forests under various sky conditions.	Dengel, S.	*Oecologia*	3/164	2010	797-808	DOI: 10.1007/s00442-010-1687-0	YES

31	Link between continuous stem radius changes and net ecosystem productivity of a subalpine Norway spruce forest in the Swiss Alps.	Zweifel R	*New Phytologist*	3/187	2010	819-830	DOI: 10.1111/j.1469-8137.2010.03301.x	YES
32	Management Effects on European Cropland Respiration.	Ceschia, P.	*Agriculture, Ecosystems & Environment*	3/139	2010	346–362	DOI: 10.1016/j.agee.2010.09.001	YES
33	Contribution of semi-arid forests to the climate system.	Rotenberg, R.	*(Perspective: Drylands in the Earth System. D.S. Schimel. Science*	5964/327	2010	451-454	DOI: 10.1126/science.1179998	YES
34	Effects of spatial variations in soil evaporation caused by tree shading on water flux partitioning in a semi-arid pine forest.	Raz Yaseef, N.	*Agri. Forest Met*	3/150	2010	454-462	DOI : 10.1016/j.agrformet.2010.01.010	YES
35	Detecting the critical periods that underpin interannual fluctuations in the carbon balance of European forests.	le Maire, G.,	*J. Geophys. Res.*	G3/115	2010		DOI: 10.1029/2009jg001244	YES
36	Water balance of a boreal Scots pine forest.	Ilvesniemi, H.	*Boreal. Env. Res*	15	2010	375-396		
37	Flux measurements of CH4 and N2O exchanges.	Kroon, P.S.	*Agricultural and forest meteorology*	6/150	2010	745-747	DOI: 10.1016/j.agrformet.2009.11.017	YES
38	Terrestrial biogeochemical feedbacks in the climate system.	Arneth, A.	*Nature Geoscience*	3	2010	525-532	DOI: 10.1038/ngeo905	YES
39	Greenhouse gas fluxes in a drained peatland forest during spring frost-thaw event.	Pihlatie, M.K.	*Biogeosciences*	5/7	2010	1715-1727	DOI: 10.5194/bg-7-1715-2010	YES
40	A case study of eddy covariance flux of N2O measured within forest ecosystems: quality control and flux error analysis.	Mammarella, I.	*Biogeosciences*	2/7	2010	427-440	DOI: 10.5194/bg-7-427-2010	YES
41	Autumn temperature and carbon balance of a boreal Scots pine forest in Southern Finland.	Vesala, T.	*Biogeosciences*	1/7	2010	163-176	DOI: 10.5194/bg-7-163-2010	YES
42	Verification of greenhouse gas emission reductions: the prospect of atmospheric monitoring in polluted areas.	Levin, I.	*Philosophical Transactions A*	1943/369	2011	1906-1924	DOI: 10.1098/rsta.2010.0249	YES
43	A European summertime CO2 biogenic flux inversion at mesoscale from continuous in situ mixing ratio measurements.	Broquet, G.	*JGR Atmosphere*	D23/116	2011		DOI: 10.1029/2011JD016202	YES

44	Source attribution of the changes in atmospheric methane for 2006-2008.	Bousquet, P.	*Atmospheric Chemistry and Physics*	8/11	2011	3689-3700	DOI: 10.5194/acp-11-3689-2011	YES
45	Global CO2 fluxes inferred from surface air-sample measurements and from TCCON retrievals of the CO2 total column.	Chevallier, F.	*Geophysical Research Letters*	24/38	2011		DOI: 10.1029/2011GL049899	YES
46	Importance of fossil fuel emission uncertainties over Europe for CO(2) modeling: model intercomparison.	Peylin, P.	*Atmospheric Chemistry and Physics*	13/11	2011	6607-6622	DOI: 10.5194/acp-11-6607-2011	YES
47	Methane emissions from sheep pasture, measured with an open-path eddy covariance system.	Dengel, S.	*Global change biology*	12/17	2011	3524-3533	DOI: 10.1111/j.1365-2486.2011.02466.x	YES
48	The carbon balance of two contrasting mountain forest ecosystems in Switzerland: similar annual trends, but seasonal differences.	Etzold, S.	*Ecosystems*	8/14	2011	1289–1309	DOI: 10.1007/s10021-011-9481-3	YES
49	Increasing net CO2 uptake by a Danish beech forest during the period from 1996 to 2009.	Pilegaard, K.	*Agricultural and Forest Mereorology*	7/151	2011	934-946	DOI: 10.1016/j.agrformet.2011.02.013	YES
50	Seasonal variation of photosynthetic modelparameters and leaf area index from global Fluxnet eddy covariance data.	Groenendijk, M.	*J. Geophys. Res.*	G4/116	2011		DOI: 10.1029/2011JG001742	YES
51	Assessing parameter variability in a photosynthesis model within and between plant functional types using global Fluxnet eddy covariance data.	Groenendijk, M.	*Agricultural and Forest Meteorology*	1/151	2011	22-38	DOI: 10.1016/j.agrformet.2010.08.013	YES
52	A first assessment of the SMOS data in southwestern France using in situ and airborne soil moisture estimates: The CAROLS airborne campaign.	Albergel, C.	*Remote Sensing of Environment*	10/115	2011	2718-2728	DOI: 10.1016/j.rse.2011.06.012	YES
53	Soil environmental conditions rather than denitrifier abundance and diversity drive potential denitrification after changes in land uses.	Attard, E.	*Global Change Biology*	5/17	2011	1975–1989	DOI: 10.1111/j.1365-2486.2010.02340.x	YES
54	Two-year dynamics of foliage labelling in 8-year-old Pinus pinaster trees with (15)N, (26)Mg and (42)Ca-simulation of Ca transport in xylem using an upscaling approach.	Augusto, L.	*Annals of Forest Science*	1/68	2011	169-178	DOI: 10.1007/s13595-011-0018-x	YES

55	Ground-Based Optical Measurements at European Flux Sites: A Review of Methods, Instruments and Current Controversies.	Balzarolo, M.	*Sensors*	8/11	2011	7954-7981	DOI: 10.3390/s110807954	YES
56	Biofuels, greenhouse gases and climate change. A review.	Bessou, C.	*Agronomy for Sustainable Development*	1/31	2011	1-79	DOI: 10.1051/agro/2009039	YES
57	Drought effects on water relations in beech: The contribution of exchangeable water reservoirs.	Betsch, P.	*Agricultural and Forest Meteorology*	5/151	2011	531-543	DOI: 10.1016/j.agrformet.2010.12.008	YES
58	Leaf functional response to increasing atmospheric CO(2) concentrations over the last century in two northern Amazonian tree species: a historical delta(13)C and delta(18)O approach using herbarium samples.	Bonal, D.	*Plant Cell and Environment*	34/8	2011	1332-1344	DOI: 10.1111/j.1365-3040.2011.02333.x	YES
59	Influence of tree species on richness and diversity of epigeous fungal communities in a French temperate forest stand.	Buee, M.	*Fungal ecology*	4/1	2011	22-31	DOI: 10.1016/j.funeco.2010.07.003	YES
60	Seasonal dynamics of the bacterial community in forest soils under different quantities of leaf litter.	Chemidlin Prevost-Boure, N.	*Applied Soil Ecology*	47/1	2011	14-23	DOI: 10.1016/j.apsoil.2010.11.006	YES
61	Seasons differently impact the structure of mineral weathering bacterial communities in beech and spruce stands.	Collignon, C.	*Soil biology and biochemistry*	10/43	2011	2012-2022.	DOI: 10.1016/j.soilbio.2011.05.008	YES
62	Temporal dynamics of exchangeable K, Ca and Mg in acidic bulk soil and rhizosphere under Norway spruce (Picea abies Karst.) and beech (Fagus sylvatica L.) stands.	Collignon, C.	*Plant and soil*	1-2/349	2011	355:366	DOI: 10.1007/s11104-011-0881-0	YES
63	A functional specialization of Eucalyptus fine roots shown by contrasted potential uptake rates for nitrate, strontium and rubidium tracers depending on soil depths.	Da Silva, E.V.	*Functional Ecology*	5/25	2011	996–1006	DOI: 10.1111/j.1365-2435.2011.01867.x	YES
64	Effects of farm heterogeneity and methods for upscaling on modelled nitrogen losses in agricultural landscapes.	Dalgaard,T.	*Environmental Pollution*	1/159	2011	3183-3192	DOI: 10.1016/j.envpol.2011.02.043	YES
65	In situ assessment of the velocity of carbon transfer by tracing 13C in trunk CO(2) efflux after pulse labelling: variations among tree species and seasons.	Dannoura, M.	*New Phytologist*	1/190	2011	181-192	DOI: 10.1111/j.1469-8137.2010.03599.x	YES

66	Sensitivity analysis for models of greenhouse gas emissions at farm level. Case study of N2O emissions simulated by the CERES-EGC model.	Drouet, J.L..	*Environmental Pollution*	11/159	2011	3156-3161	DOI: 10.1016/j.envpol.2011.01.019	YES
67	Plant-herbivore interactions affect the initial direction of community changes in an ecosystem manipulation experiment..	Dumont, B.	*Basic and Applied Ecology*	3/12	2011	187-194	DOI: 10.1016/j.baae.2011.02.011	YES
68	Long-distance edge effects in a pine forest with a deep and sparse trunk space: In situ and numerical experiments.	Dupont, S.	*Agricultural and Forest Meteorology*	3/151	2011	328-344	DOI: 10.1016/j.agrformet.2010.11.007	YES
69	NitroScape: A model to integrate nitrogen transfers and transformations in rural landscapes.	Duretz, S.	*Environmental Pollution*	11/1595	2011	3162-3170	DOI: 10.1016/j.envpol.2011.05.005	YES
70	Seasonal variations of belowground carbon transfer assessed by in situ (13)CO(2) pulse labelling of trees.	Epron,D.	*Biogeosciences*	5/8	2011	1153-1168	DOI: 10.5194/bg-8-1153-2011	YES
71	Optimizing spectral indices and chemometric analysis of leaf chemical properties using radiative transfer modeling.	Feret, J.-B.	*Remote Sensing of Environment.*	10/115	2011	2742-2750	DOI: 10.1016/j.rse.2011.06.016	YES
72	Dry deposition of reactive nitrogen to European ecosystems: a comparison of inferential models across the NitroEurope network.	Flechard, C.R.	*Atmospheric Chemisty and Physics*	6/11	2011	2703-2728	DOI: 10.5194/acp-11-2703-2011	YES
73	Assessing the ability of mechanistic volatilization models to simulate soil surface conditions: a study with the Volt'Air model.	Garcia, L.	*Science of the Total Environment*	19/409	2011	3980-3992	DOI: 10.1016/j.scitotenv.2011.05.003	YES
74	Pine forest investigation using high resolution P-band Pol-InSAR data.	Garestier, F.	*Remote Sensing of Environment*	11/115	2012	2897-2905	DOI: 10.1016/j.rse.2010.08.028	YES
75	Ontogeny partly explains the apparent heterogeneity of published biomass equations for Fagus sylvatica in central Europe.	Genet, A.	*Forest Ecology and Management*	7/261	2011	1188-1202	DOI: 10.1016/j.foreco.2010.12.034	YES
76	Polycyclism, a fundamental tree growth process, decline with recent climate change. The example of Pinus halepensis Mill. in Mediterranean France.	Girard, F.	*Trees-Structure and Function*	2/25	2011	311-322	DOI: 10.1007/s00468-010-0507-9	YES
77	Remote sensing of ecosystem light use efficiency with MODIS-based PRI.	Goerner, A.	*Biogeosciences*	8	2011	189-202	DOI: 10.5194/bg-8-189-2011	YES

78	What factors influence the stem taper of Eucalyptus: growth, environmental conditions, or genetics?	Gomat, H.Y.	*Annals of forest science*	1/68	2011	109:120	DOI: 10.1007/s13595-011-0012-3	YES
79	Modelling forest carbon balances considering tree mortality and removal.	Grote, R.	*Agricultural and Forest Meteorology.*	2/151	2011	179-190	DOI: 10.1016/j.agrformet.2010.10.002	YES
80	Effect of topography on nitrous oxide emissions from winter wheat fields in Central France.	Gu, J.	*Environmental Pollution*	11/159	2011	3149-3155	DOI: 10.1016/j.envpol.2011.04.009	YES
81	Monitoring elevation variations in leaf phenology of deciduous broadleaf forests from SPOT/VEGETATION time-series.	Guyon, D.	*Remote Sensing of Environment*	2/115	2011	615-627	DOI: 10.1016/j.rse.2010.10.006	YES
82	Assessing and improving the representativeness of monitoring networks: The European flux tower network example.	Sulkava, M.	*Journal of geophysical researchJ*	G3/116	2011		DOI: 10.1029/2010JG001562	YES
83	Distinct patterns of changes in surface energy budget associated with forestation in the semiarid region.	Rotenberg, R.	*Global Change Biology*	4/17	2011	1536-1548	DOI: 10.1111/j.1365-2486.2010.02320.x	YES
84	Long term and seasonal courses of leaf area index in a semi-arid forest plantation.	Sprintsin, M.	*Agri. Forest Meteor.*	5/151	2011	565-574	DOI: 10.1016/j.agrformet.2011.01.001	YES
85	Increase in water-use efficiency and underlying processes in pine forests across a precipitation gradient in the dry Mediterranean region over the past 30 years.	Maseyk, K.	*Oecologia*	2/167	2011	573-585	DOI: 10.1007/s00442-011-2010-4	YES
86	Hydraulic adjustments underlying drought resistance of Pinus halepensis.	Klein, T.	*Tree Physiology*	6/31	2011	637-648	DOI: 10.1093/treephys/tpr047	YES
87	The paper trail of the 13C of atmospheric CO2 since the industrial revolution period. Environ.	Yakir, D.	*Res. Lett. 6 034007*	3/6	2011		DOI: 10.1088/1748-9326/6/3/034007	YES
88	The Potential of Carbonyl Sulfide as a Proxy for Gross Primary Production at Flux Tower Sites.	Blonquist, J.M.	*J. Geophys. Res*	G4/116	2011		DOI: 10.1029/2011JG001723	YES
89	Semiempirical modeling of abiotic and biotic factors controlling ecosystem respiration across eddy covariance sites.	Arneth, A.	*Global Change Biology*	1/17	2011	390-409	DOI: 10.1111/j.1365-2486.2010.02243.x	YES
90	Photosynthetic production of ground vegetation in different-aged Scots pine (Pinus sylvestris) forests.	Kulmala, L.	*Canadian Journal of Forest Research*	10/41	2011	2020-2030	DOI: 10.1139/x11-121	YES

91	Controls on winter ecosystem respiration in temperate and boreal ecosystems.	Wang, K.	*Biogeosciences*	7/8	2011	2009-2025	DOI: :10.5194/bg-8-2009-2011	YES
92	Long-term direct CO2 flux measurements over a boreal lake: Five years of eddy covariance data.	Huotari, J.	*Geophys. Res. Letters*	18/38	2011		DOI: 10.1029/2011GL048753	YES
93	On the temporal upscaling of evapotranspiration from instantaneous remote sensing measurements to 8-day mean daily-sums.	Ryu, Y.	*Agricultural and forest meteorology*	152	2011	212-222	DOI: 10.1016/j.agrformet.2011.09.010	YES
94	Availability, accessibility, quality and comparability of monitoring data for European forests for use in air pollution and climate change science.	Clarke, N.	*iForest*	4	2011	162-166	DOI: 10.3832/ifor0582-004	YES
95	Towards a transnational system of supersites for forest monitoring and research in Europe – an overview on present state and future recommendations.	Fischer, R.	*iForest*	4	2011	167-171	DOI: 10.3832/ifor0584-004	YES
96	Effects of climate variability and functional changes on the interannual variation of the carbon balance in a temperate deciduous forest.	Wu, J.	*Biogeosciences*	5/8	2011	9125-9163	DOI: 10.5194/bgd-8-9125-2011	YES
97	Soil carbon model alternatives for ECHAM5/JSBACH climate model: Evaluation and impacts on global carbon cycle estimates.	Thum, T.	*J. Geophys. Res.*	G2/116	2011		DOI: 10.1029/2010JG001612	YES
98	Photosynthesis of ground vegetation in different aged pine forests: Effect of environmental factors predicted with a process-based model.	Kulmala, L.	*J. Vegetation Science*	1/22	2011	96-110	DOI: 10.1111/j.1654-1103.2010.01228.x	YES
99	Long-term energy flux measurements and energy balance over a small boreal lake using eddy covariance technique.	Nordbo, A.	*J. Geophys. Res.*	D2/116	2011		DOI: 10.1029/2010JD014542	YES
100	The balance of the carbon budget.	Levin, I.	*Nature*	488	2012	35-36	DOI: 10.1038/488035a	YES
101	Evaluation of mixing-height retrievals from automatic profiling lidars and ceilometers in view of future integrated networks in Europe.	Haeffelin, M.	*Boundary Layer Meteorology*	1/143	2012	49-75	DOI: 10.1007/s10546-011-9643-z	YES

102	Variation of CO2 mole fraction in the lower free troposphere, in the boundary layer and at the surface.	Haszpra, L.	*Atmospheric Chemistry and Physics*	18/12	2012	8865-8875	DOI: 10.5194/acp-12-8865-2012	YES
103	Seasonal variation of N2O emissions in France inferred from atmospheric N2O and Rn-222 measurements.	Lopez, M.	*JGR Atmosphere*	D14/117	2012		DOI: 10.1029/2012JD017703	YES
104	High accuracy measurements of dry mole fractions of carbon dioxide and methane in humid air.	Rella, C.	*Atmos. Meas. Tech. Discuss*	4/5	2012	5823-5888	DOI: 10.5194/amtd-5-5823-2012	YES
105	Establishment and two-year growth of a bio-energy plantation with fast-growing Populus trees in Flanders (Belgium): Effects of genotype and former land use.	Broeckx, L.S.	*Biomass Bioenerg*	42	2012	151-163	DOI: 10.1016/j.biombioe.2012.03.005	YES
106	On the choice of the driving temperature for eddy-covariance carbon dioxide flux partitioning.	Lasslop, G.	*Biogescience*	12/9	2012	5243–5259	DOI: 10.5194/bg-9-5243-2012	YES
107	Intercomparison of MODIS albedo retrievals and in situ measurements across the global FLUXNET network.	Cescatti, A.	*Remote Sensing of Environment*	121	2012	323–334	DOI: 10.1016/j.rse.2012.02.019	YES
108	Inverse carbon dioxide flux estimates for the Netherlands	A.G.C.A. Meesters et al.,	*J. Geophys. Res.*	D20/117	2012		DOI: 10.1029/2012JD017797	YES
109	Are NIRS spectra useful for predicting site indices in sandy soils under Eucalyptus stands in Republic of Congo.	Bikindou, F.	*Forest Ecology and Management*	266	2012	126-137	DOI: 10.1016/j.foreco.2011.11.012	YES
110	Stand-level patterns of carbon partitioning and light use efficiency of Eucalyptus grandis across a gradient of productivity in São Paulo State.	Campoe, O.C.	*Brazil. Tree Physiology*	6/32	2012	696-706	DOI: 10.1093/treephys/tps038	YES
111	Soil carbon balance in tropical grassland: estimation of soil respiration and its partitioning using a semi-empirical model.	Caquet, B.	*Agricultural and Forest Meteorology*	158-159	2012	71-79	DOI: 10.1016/j.agrformet.2012.02.008	YES
112	Challenges and limits of stable isotopes in environmental research.	Chabbi, A.	*Organic Geochemistry*	12/42	2012	1437-1439.	DOI: 10.1016/j.orggeochem.2011.12.003	YES
113	Farm nitrogen balances in six European landscapes as an indicator for nitrogen losses and basis for improved management.	Dalgaard,T.	*Biogeosciences*	12/9	2012	5303-5321	DOI:10.5194/bg-9-5303-2012	YES

114	Quantifying the influence of climate and biological drivers on the interannual variability of carbon exchanges in European forests through process-based modelling.	Delpierre, N.	*Agricultural and Forest Meteorology*	154-155	2012	99-112	DOI: 10.1016/j.agrformet.2011.10.010	YES
115	Modelling the contribution of short-range atmospheric and hydrological transfers to nitrogen fluxes, budgets and indirect emissions in rural landscapes.	Drouet, J.L..	*Biogeosciences*	5/9	2012	1647-1660	DOI: 10.5194/bg-9-1647-2012	YES
116	When does grazing generate stable vegetation patterns in temperate pastures?	Dumont, B.	*Agriculture, Ecosystems and Environment*	153	2012	50– 56	DOI: 10.1016/j.agee.2012.03.003	YES
117	Turbulent Structures in a Pine Forest with a Deep and Sparse Trunk Space: Stand and Edge Regions.	Dupont, S.	*Boundary-Layer Meteorology*	2/143	2012	309-336.	DOI: 10.1007/s10546-012-9695-8	YES
118	Do changes in carbon allocation account for the growth response to potassium and sodium applications in tropical Eucalyptus plantations?	Nouvellon, Y.	*Tree Physiology*	6/32	2012	667-679	DOI: 10.1093/treephys/tpr107	YES
119	Eddy covariance measurement of ammonia fluxes: Comparison of high frequency correction methodologies.	Ferrara, R.M.	*Agricultural and Forest Meteorology*	158-159	2012	30-42	DOI: 10.1016/j.agrformet.2012.02.001	YES
120	Accounting for surface cattle slurry in ammonia volatilization models: the case of Volt'Air.	Garcia, L.	*Soil Science Society of America Journal*	6/76	2012	2184-2194	DOI : 10.2136/sssaj2012.0067	YES
121	LCA of cropping systems with different external input levels for energetic purposes.	Goglio, P.	*Biomass and Bioenergy*	42	2012	33-42.	DOI: 10.1016/j.biombioe.2012.03.021	YES
122	Pinus halepensis Mill. Crown development and fruiting declined with repeated drought in Mediterranean France.	Girard, F.	*European Journal of Forest Research*	4/131	2011	919-931	DOI: 10.1007/s10342-011-0565-6	YES
123	Improving ammonia emissions in air quality modelling for France.	Hamaoui-Laguel, L.	*Atmospheric Environment*		2012		DOI: 10.1016/j.atmosenv.2012.08.002	YES
124	Relative humidity effects on water vapour fluxes measured with closed-path eddy-covariance systems with short sampling lines.	Fratini, G.	*Agricultural and forest meteorology*	165	2012	53-63	DOI: 10.1016/j.agrformet.2012.05.018	YES
125	Dynamics of evapotranspiration partitioning in an open-canopy semi-arid pine forest as affected by rainfall patterns.	Raz Yaseef, N.	*Agricultural and forest meteorology*	157	2012	77-85	DOI: 10.1016/j.agrformet.2012.01.015	YES

126	A field-compatible method for measuring alternative respiratory pathway activities in vivo using stable O2 isotopes.	Kornfeld, A.	*Plant, Cell & Environment*	8/35	2012	1518-1532	DOI: 10.1111/j.1365-3040.2012.02507.x	YES
127	Differential ecophysiological response of a major Mediterranean pine species across a climatic gradient.	Klein, T.	*Tree Physiol.*	1/33	2012	26-36	DOI: 10.1093/treephys/tps116	YES
128	Fraction of natural area as main predictor of net CO2 emissions from cities.	Nordbo, A.	*Geophys. Res. Letters*	20/39	2012		DOI: 10.1029/2012GL053087	YES
129	Seasonal and annual variation of carbon dioxide surface fluxes in Helsinki, Finland, in 2006-2010.	Järvi, L.	*Atmos. Chem. Phys*		2012		DOI: 10.5194/acp-12-8475-2012	YES
130	Revised eddy covariance flux methodologies - effect on urban energy balance.	Nordbo, A.	*Tellus B*	64B	2012		DOI: 10.3402/tellusb.v64i0.18184	YES
131	Modeling GPP in the Nordic forest landscape with MODIS time series data – Comparison with the MODIS GPP product.	Schubert, P	*Remote Sensing of Environment*	126	2012	136-147	DOI: 10.1016/j.rse.2012.08.005	YES
132	Does canopy mean nitrogen concentration explain variation in canopy light use efficiency across 14 contrasting forest sites?	Peltoniemi, M.	*Tree Physiology*	2/32	2012	200-218	DOI: 10.1093/treephys/tpr140	YES
133	Quantifying transpirable soil water and its relations to tree water use dynamics in a water-limited pine forest.	Klein, T.	*Ecohydrology*		2013		DOI: 10.1002/eco.1360	YES
134	Assessment of a multi species in-situ FTIR for precise atmospheric greenhouse gas observations.	Hammer, S.	*Atmos. Meas. Tech*	*5/6*	2013	*1153-1170*	DOI: 10.5194/amt-6-1153-2013	YES
135	Feasibility study of using a “travelling” CO_2 and CH_4 instrument to validate continuous in-situ measurement stations.	Hammer, S.	*Atmos. Meas. Tech*	*5*	2013	7141-7185	DOI: 10.5194/amtd-5-7141-2012	YES
136	29 % N2O emission reduction from a modelled low-greenhouse gas cropping system during 2009–2011.	Goglio, P.	*Environmental Chemistry Letters, in press (published online).*	2/11	2013	143-149	DOI:10.1007/s10311-012-0389-8	YES
137	Regional inversion of CO2 ecosystem fluxes from atmospheric measurements: reliability of the uncertainty estimates	Broquet, G.	*Atmos. Chem. Phys. Discuss.*	13	2013	5769-5804	DOI: 10.5194/acpd-13-5769-2013	YES
138	Atmospheric $^{14}CO_2$ trend in Western European background air from 2000 to 2012.	Levin, I.	*Tellus B*	*65B*	2013		DOI: 10.3402/tellusb.v65i0.20092	YES

139	Can we evaluate a fine-grained emission model using high-resolution atmospheric transport modeling and regional fossil fuel CO_2 observations?	Vogel, F.	*Tellus B*	*65B*	2013		DOI: 10.3402/tellusb.v65i0.18681	YES
140	Biometric and eddy covariance-based assessment of decadal carbon sequestration of a temperate Scots pine forest.	Gielen, B.	*Agric. For. Meteorol*	174-175	2013	135-143	DOI : 10.1016/j.agrformet.2013.02.008	YES
141	The relationship between carbon dioxide uptake and canopy colour from two camera systems in a deciduous forest in southern England.	Mizunuma, T.	*Functional ecology*	1/27	2013	196-207	DOI: 10.1111/1365-2435.12026	YES
142	Long-term stem CO_2 concentration measurements in Norway spruce in relation to biotic and abiotic factors.	Etzold, S.	*New Phytologist*	4/197	2013	1173-1184	DOI: 10.1111/nph.12115	YES
143	Modelling the decadal trend of ecosystem carbon fluxes demonstrates the important role of functional changes in a temperate deciduous forest.	Wu, J.	*Ecological Modelling*	260	2013	50-61	DOI: 10.1016/j.ecolmodel.2013.03.015	YES
144	Using agroecosystem modeling to improve the estimates of N2O emissions in the Life-Cycle Assessment of biofuels. Waste and Biomass Valorization.	Dufossé, K.	*Waste and Biomass Valorization*		2013		DOI: 10.1007/s12649-012-9171-1	YES
145	Life cycle assessment of eucalyptus short rotation coppices for bioenergy production in southern France.	Gabrielle, B.	*Global Change Biology Bioenergy*	1/5	2013	30-42.	DOI: 10.1111/gcbb.12008	YES
146	Use of change-point detection for friction–velocity threshold evaluation in eddy-covariance studies.	Barr, A.	*Agricultural and forest meteorology*	172	2013	31-45	DOI: 10.1016/j.agrformet.2012.11.023	YES
147	Ecosystem photosynthesis inferred from carbonyl sulfide flux measurements.	Asaf, D.	*Nature GeoScience*	6	2013	186-190	DOI: 10.1038/NGEO1730	YES
148	Transpiration and annual water balance of Aleppo pine in a semiarid region: implications for forest management.	Schiller, G.	*Forest Ecol. Managem*	298	2013	39-51	DOI: 10.1016/j.foreco.2013.03.003	YES
149	Relationships between stomatal regulation, water-use, and water-use-efficiency in two coexisting key Mediterranean tree species.	Klein, T.	*Forest Ecol. Managem*	302	2013	34-42	DOI: 10.1016/j.foreco.2013.03.044	YES
150	Field intercomparison of four methane gas analyzers suitable for eddy covariance flux measurements.	Peltola, O.	*Biogeosciences*	12/9	2013	17651-17706	DOI: 10.5194/bgd-9-17651-2012	YES

151	Testing the applicability of neural networks as a gap-filling method using CH_4 flux data from high latitude wetlands.	Dengel, S.	*Biogeosciences*	5/10	2013	7727-7759	DOI: 10.5194/bgd-10-7727-2013	YES
152	Tube transport of water vapor with condensation and desorption.	Nordbo, A.	*Applied Physics Letters*	19/102	2013		DOI: 10.1063/1.4804639	YES
153	Interannual variability of net ecosystem productivity in forests is explained by carbon flux phenology in autumn.	Wu, C.	*Global Ecol. Biogeogr*		2013		DOI: 10.1111/geb.12044	YES
154	Nitrogen balance of a boreal Scots pine forest.	Korhonen, J.F.J.	*Biogeosciences*	2/10	2013	1083-1095	DOI: 10.5194/bg-10-1083-2013	YES
155	Comparison between static chamber and tunable diode laser-based eddy covariance techniques for measuring nitrous oxide fluxes from a cotton field.	Wang, K.	*Agricultural and forest meteorology*	171-172	2013	9-19	DOI: 10.1016/j.agrformet.2012.11.009	YES

TEMPLATE A2: LIST OF DISSEMINATION ACTIVITIES

NO.	Type of activities[4]	Main leader	Title	Date/Period	Place	Type of audience[5]	Size of audience	Countries addressed
1	Publication	COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	Finding the Balance	13/05/2011	Research Innovation article on ICOS	Scientific community (higher education, Research) - Policy makers		All European countries
2	Publication	COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	Updated ICOS brochure	25/05/2011	Gif-sur-Yvette, France	Scientific community (higher education, Research) - Policy makers - Medias		All European countries

[4] A drop down list allows choosing the dissemination activity: publications, conferences, workshops, web, press releases, flyers, articles published in the popular press, videos, media briefings, presentations, exhibitions, thesis, interviews, films, TV clips, posters, Other

[5] A drop down list allows choosing the type of public: Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias, Other ('multiple choices' is possible).

3	Press releases	UNIVERSITA DEGLI STUDI DELLA TUSCIA	ICOS Demonstration Press Release	11/05/2011	Rome, Italy	Scientific community (higher education, Research) - Policy makers - Medias		All European countries
4	Media briefings	HELSINGIN YLIOPISTO	Pohjoiset metsät saattavat pahentaa ilmastonmuutosta	08/01/2008	YLE TV1, News Broadcast 20:30, Finland	Civil society		Finland
5	Publication	HELSINGIN YLIOPISTO	Tutkimus: Metsät ovat luultua heikompi jarru ilmastonmuutokselle	03/01/2008	Helsingin Sanomat, Finland	Civil society		Finland
6	Articles published in the popular press	HELSINGIN YLIOPISTO	Lämpimät syksyt lisäävät luontoperäisiä hiilidioksidipäästöjä	03/01/2008	Helsingin yliopisto, kotisivut, Finland	Civil society		Finland
7	Interviews	HELSINGIN YLIOPISTO	Kuuma vaara. Ilmastonmuutos on tullut jäädäkseen. Vain aikataulu on epävarma.", Yliopisto-lehti, int	20/03/2008	Helsinki University Bulletin, Finland	Scientific community (higher education, Research)		Finland
8	Interviews	HELSINGIN YLIOPISTO	Too much to take in – About climate change"1/2008, interview by Meri Siippainen	03/04/2008	Helsinki University Bulletin, Finland	Scientific community (higher education, Research)		International
9	Interviews	HELSINGIN YLIOPISTO	Ilmastonmuutos ja havumetsät	03/04/2008	Finland	Civil society		Finland
10	Presentations	HELSINGIN YLIOPISTO	Micrometeorology and environmental physics: From Karman vortex streets to phloem mass transport	15/04/2008	Univ. Jyväskylä, Dept. of Physics, Finland	Scientific community (higher education, Research)		Finland
11	Articles published in the popular press	HELSINGIN YLIOPISTO	Trees absorbing less F60 Online edition of India's National Newspaper	10/01/2008	http://www.hindu.com/seta/2008/01/10/stories/2008011050191400.htm	Civil society		India
12	Publication	COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	ICOS Stakeholder's Handbook	30/05/2008	http://www.icos-infrastructure.eu/docs/pub/PO_stakebook2008_ref_200805.pdf	Scientific community (higher education, Research) - Policy makers		International

13	Conference	COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	ICOS 1st Stakeholders Conference	19/05/2008	AMSTERDAM, THE NETHERLANDS	Scientific community (higher education, Research) - Policy makers		International
14	Workshops	COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	ICOS 1st Atmospheric Stations Instrumentation Workshop	17/11/2008	LSCE, Gif-sur-Yvette, France	Scientific community (higher education, Research)		International
15	Workshops	THE UNIVERSITY OF EDINBURGH	Meeting on verification of LULUC fluxes	06/01/2009	Edinburgh	Policy makers		United Kingdom
16	Conference	HELSINGIN YLIOPISTO	Strengthening of Finnish Atmospheric Research and Research infrastructures, Integrated Carbon Observ	06/03/2009	University of Helsinki, Helsinki, Finland	Scientific community (higher education, Research)		International
17	Publication	COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	ICOS-Stakeholder's Handbook 2009	29/05/2009	http://www.icos-infrastructure.eu/docs/pub/PO_stakebook2009_ref_200905.pdf	Scientific community (higher education, Research) - Policy makers		International
18	Workshops	VERENIGING VOOR CHRISTELIJK HOGER ONDERWIJS WETENSCHAPPELIJK ONDERZOEK EN PATIENTENZORG	XXVI GEOSS Workshop	03/05/2009	Stresa	Scientific community (higher education, Research)		International
19	Conference	COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	ICOS 2nd Stakeholders Conference	13/05/2009	Paris, France	Scientific community (higher education, Research) - Policy makers		International
20	Conference	DANMARKS TEKNISKE UNIVERSITET	Information on implementation of ICOS in Denmark and research opportunities	12/10/2009	Carlsberg Academy, Denmark	Scientific community (higher education, Research) - Policy makers		Denmark

21	Conference	COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	ICOS 3rd Stakeholders Conference	16/11/2009	ROME, ITALY	Scientific community (higher education, Research) - Policy makers		International
22	Workshops	COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	ICOS 2nd Atmospheric Stations Instrumentation Workshop	23/11/2009	LSCE, Gif-sur-Yvette, France	Scientific community (higher education, Research)		International
23	Publication	COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	ICOS: A European research infrastructure greenhouse gas emissions	13/05/2010	http://www.icos-infrastructure.eu/docs/pub/Icos4pager%2006%2003%202012.pdf	Scientific community (higher education, Research)		International
24	Conference	DANMARKS TEKNISKE UNIVERSITET	Investigation of research interest of ICOS data in Denmark	29/06/2013	Denmark	Scientific community (higher education, Research)		Denmark
25	Publication	VERENIGING VOOR CHRISTELIJK HOGER ONDERWIJS WETENSCHAPPELIJK ONDERZOEK EN PATIENTENZORG	Climate Change Conference	12/03/2010	Copenhagen, Denmark	Scientific community (higher education, Research)		International
26	Presentations	HELSINGIN YLIOPISTO	Pecha Kucha talk	14/04/2010	University of Helsinki, Helsinki, Finland	Civil society		Finland
27	Presentations	HELSINGIN YLIOPISTO	Annual meeting of University Deans	24/04/2010	University of Helsinki, Helsinki, Finland	Scientific community (higher education, Research)		Finland
28	Publication	COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	ICOS-Stakeholder's Handbook 2010	27/05/2010	http://www.icos-infrastructure.eu/docs/pub/PO_stakebook2010_ref_201205.pdf	Scientific community (higher education, Research) - Policy makers		International

29	Conference	VERENIGING VOOR CHRISTELIJK HOGER ONDERWIJS WETENSCHAPPELIJK ONDERZOEK EN PATIENTENZORG	GEO 20-nd workplan meeting	17/05/2010	Pretoria	Scientific community (higher education, Research) - Policy makers		International
30	Publication	COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	ICOS 4th Stakeholders Conference	31/05/2010	Helsinki University, Finland	Scientific community (higher education, Research) - Policy makers		International
31	Interviews	WEIZMANN INSTITUTE OF SCIENCE	YLE TV1	17/06/2010	Aamu-TV, Finland	Civil society		Finland
32	Interviews	HELSINGIN YLIOPISTO	Energy usage of peat	13/07/2010	Radio Päivän Peili, Finland	Civil society		Finland
33	Conference	Eidgenössische Technische Hochschule Zürich	New Phytologist Symposium	12/08/2010	Oxford, UK	Scientific community (higher education, Research)		International
34	Publication	CENTRUM VYZKUMU GLOBALNI ZMENY AV CR VVI	Presentation of ICOS and ICOS-CZ	22/08/2010	Seoul, South Korea	Scientific community (higher education, Research)		International
35	Publication	HELSINGIN YLIOPISTO	Turpeen käyttöä on syytä vähentää (energy usage of peat)	29/08/2010	Helsingin Sanomat	Civil society		Finland
36	Conference	Eidgenössische Technische Hochschule Zürich	Annual Conference of the Gesellschaft für Ökologie (GfÖ)	31/08/2010	Giessen, Germany	Scientific community (higher education, Research)		Europe
37	Workshops	COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	2nd ICOS IMECC workshop on Quantitative Network Design	09/09/2010	RHUL, EGHAM, UNITED KINGDOM	Scientific community (higher education, Research)		Europe
38	Publication	CENTRUM VYZKUMU GLOBALNI ZMENY AV CR VVI	Global Climate Change - Challenge to Human Society of 21st century	09/11/2010	Olomouc, CZ	Scientific community (higher education, Research)		Europe

39	Articles published in the popular press	HELSINGIN YLIOPISTO	Usage of peat for energy	25/11/2010	Etelä-Suomen Sanomat	Civil society		Finland
40	Workshops	COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	ICOS 3rdAtmospheric Stations Instrumentation Workshop	30/11/2010	LSCE, Gif-sur-Yvette, France	Scientific community (higher education, Research)		International
41	Conference	VERENIGING VOOR CHRISTELIJK HOGER ONDERWIJS WETENSCHAPPELIJK ONDERZOEK EN PATIENTENZORG	COP XVI side event	15/12/2010	Copenhagen Denmark	Scientific community (higher education, Research) - Policy makers		International
42	Conference	NSTITUT NATIONAL DE LA RECHERCHE AGRONOMIQUE	European Conference on ICOS ecosystem Protocols	30/06/2011	Biarritz France	Scientific community (higher education, Research)		Europe
43	Type of activitiesFlyers	LUNDS UNIVERSITET	ICOS Sweden – a Swedish national infrastructure for the measurement of greenhouse gases	30/06/2011	ICOS Sweden Coordination Office, Lund University, Sweden	Scientific community (higher education, Research) - Civil society - Policy makers - Medias		Sweden
44	Articles published in the popular press	LUNDS UNIVERSITET	ICOS – a new infrastructure for research on GHSs (in Swedish)	30/06/2011	Stockholm	Civil society		Sweden
45	Web sites/Applications	LUNDS UNIVERSITET	ICOS Sweden	30/06/2011	ICOS Sweden Coordination Office, Lund University, Sweden	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias		International
46	Presentations	WEIZMANN INSTITUTE OF SCIENCE	Ilmastonmuutostutkimuksesta - public talk on climate change	02/02/2011	Kustannusosakeyhtiö Otava	Medias		Finland
47	Publication	CENTRUM VYZKUMU GLOBALNI ZMENY AV CR VVI	Introducing ICOS and its national part to Danish-Czech business community	10/03/2011	Tucapy, CZ	Industry		CZ, DK

48	Publication	CENTRUM VYZKUMU GLOBALNI ZMENY AV CR VVI	Adaptation of Forest Ecosystems to Air Pollution and Climate Change	22/03/2011	Antalya, Turkey	Scientific community (higher education, Research)		International
49	Conference	COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	ICOS 6th Annual Meeting and Stakeholders Conference	30/05/2011	BRUSSELS,BELGIUM	Scientific community (higher education, Research) - Policy makers		International
50	Conference	NSTITUT NATIONAL DE LA RECHERCHE AGRONOMIQUE	Data logger programming	28/09/2011	Clermont Ferrand	Scientific community (higher education, Research)		France
51	Conference	VERENIGING VOOR CHRISTELIJK HOGER ONDERWIJS WETENSCHAPPELIJK ONDERZOEK EN PATIENTENZORG	8-th International Carbon Dioxide Conference	13/09/2011	Jena Germany	Scientific community (higher education, Research)		International
52	Conference	VERENIGING VOOR CHRISTELIJK HOGER ONDERWIJS WETENSCHAPPELIJK ONDERZOEK EN PATIENTENZORG	GEO Carbon Conference: Carbon in a Changing World	26/10/2011	ROME, ITALY	Scientific community (higher education, Research)		International
53	TV clips	LUNDS UNIVERSITET	Raising the measurement mast at the ICOS Sweden site Svartberget	11/10/2011	Sweden	Civil society		Sweden
54	Flyers	COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	ICOS: A European research infrastructure greenhouse gas emissions	28/06/2012	http://www.icos-infrastructure.eu/docs/pub/CEA-ICOS%2020-05.pdf	Scientific community (higher education, Research) - Industry - Policy makers - Medias		International

55	Conference	VERENIGING VOOR CHRISTELIJK HOGER ONDERWIJS WETENSCHAPPELIJK ONDERZOEK EN PATIENTENZORG	Co-Leading GEO task CL-02	28/06/2012	Greece	Scientific community (higher education, Research) - Policy makers		International
56	Conference	LUNDS UNIVERSITET	ICOS – a new pan-european research infrastructure	03/01/2012	Sweden	Scientific community (higher education, Research)		Sweden
57	Conference	CENTRUM VYZKUMU GLOBALNI ZMENY AV CR VVI	EuroGEOSS 2012 Conference	24/01/2012	Madrid, SP	Scientific community (higher education, Research)		International
58	Press releases	UNIVERSITEIT ANTWERPEN	Royal Prince Philip	02/02/2012	Lochristihttp ://www.deredactie.be/permalink/1.1211450	Medias		Belgium
59	Publication	CENTRUM VYZKUMU GLOBALNI ZMENY AV CR VVI	2nd ECRA Executive Committee	06/02/2012	BRUSSELS,BELGIUM	Scientific community (higher education, Research)		International
60	Workshops	COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	ICOS 4thAtmospheric Stations Instrumentation Workshop	16/02/2012	LSCE, Gif-sur-Yvette, France	Scientific community (higher education, Research)		Europe
61	Workshops	Eidgenössische Technische Hochschule Zürich	CSIRO	04/04/2012	Canberra, Australia	Scientific community (higher education, Research)		Australia
62	Publication	CENTRUM VYZKUMU GLOBALNI ZMENY AV CR VVI	HORIZON 2020 with ICOS	26/04/2012	Prag, CZ	Scientific community (higher education, Research)		International
63	Publication	COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	ICOS-Stakeholder's Handbook 2012	17/05/2012	http://www.icos-infrastructure.eu/docs/pub/PO_stakebook2012_ref_201205.pdf	Scientific community (higher education, Research) - Policy makers		International

64	Publication	UNIVERSITEIT ANTWERPEN	Minister Lieten	07/05/2012	Brasschaat http://kanaalz.rnews.be http://www.atv.be/item/meettoren-brasschaat	Medias		Belgium
65	Workshops	Eidgenössische Technische Hochschule Zürich	Talk at the Hawkesbury Institute of the Environment	09/05/2012	University of Western Sydney, Australia	Scientific community (higher education, Research)		Australia
66	Publication	THE UNIVERSITY OF EDINBURGH	An ICOS guide for Earth Observers' COST project (in-situ optical measurements at flux towers	23/05/2012	BRUSSELS,BELGIUM	Scientific community (higher education, Research)		Europe
67	Presentations	CENTRUM VYZKUMU GLOBALNI ZMENY AV CR VVI	Seven Years of CZELO (Czech Liaison Office for Research and Development)	30/05/2012	Brussel, BE	Scientific community (higher education, Research)		International
68	Conference	COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	ICOS 6th Annual Meeting and Stakeholders Conference, Bergen	31/05/2012	BERGEN,NORWAY	Scientific community (higher education, Research) - Policy makers		International
69	Workshops	JRC -JOINT RESEARCH CENTRE-EUROPEAN COMMISSION	JRC-ESFRI Joint Workshop on Research Infrastructures in the Environment Domain	06/06/2012	Ispra	Scientific community (higher education, Research)		Europe
70	Conference	CENTRUM VYZKUMU GLOBALNI ZMENY AV CR VVI	ICOS Poland Conference	18/06/2012	Mierzęcice, PL	Scientific community (higher education, Research)		International
71	Workshops	FUNDACION CENTRO DE ESTUDIOS AMBIENTALES DEL MEDITERRANEO	Eurospec interaction with the Integrated Carbon Observation System (ICOS)	27/06/2012	Madrid (Spain)	Scientific community (higher education, Research)		International
72	Interviews	HELSINGIN YLIOPISTO	Climate change interview	15/06/2012	NTV, Russia	Civil society		Russia
73	Presentations	DANMARKS TEKNISKE UNIVERSITET	Meeting with Ministry for Research	10/08/2012	Denmark	Policy makers		Denmark

74	Presentations	LUNDS UNIVERSITET	Inauguration of ICOS Sweden	21/09/2012	Norunda, ICOS Sweden site, Sweden	Scientific community (higher education, Research) - Civil society - Policy makers		SW DK NO FI
75	Press releases	LUNDS UNIVERSITET	Observing climate from high masts, inauguration of ICOS Sweden (in Swedish)	25/09/2012	Lunds Universitet	Medias		Sweden
76	Articles published in the popular press	LUNDS UNIVERSITET	New measurement station for a unique project	19/09/2012	Norunda, ICOS Sweden site, Sweden	Civil society		Sweden
77	TV clips	LUNDS UNIVERSITET	Inauguration of ICOS Sweden	19/09/2012	Norunda, ICOS Sweden site, Sweden	Civil society		Sweden
78	Articles published in the popular press	LUNDS UNIVERSITET	Masts to measuring GHGs in a European network	17/10/2012	Norunda, ICOS Sweden site, Sweden	Civil society - Policy makers		Sweden
79	Workshops	COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	ICOS 5thAtmospheric Stations Instrumentation Workshop	08/10/2012	Arona, Italy	Scientific community (higher education, Research)		Europe
80	Workshops	CENTRUM VYZKUMU GLOBALNI ZMENY AV CR VVI	120 s for innovative companies (workshop	16/10/2012	Brno, CZ	Scientific community (higher education, Research) - Industry		CZ
81	Articles published in the popular press	LUNDS UNIVERSITET	High level climate measurements (in Swedish)	14/11/2012	Lund University	Scientific community (higher education, Research)		Sweden
82	Workshops	CENTRUM VYZKUMU GLOBALNI ZMENY AV CR VVI	Workshop: Eddy covariance measurement in Vietnam, Russia and Czech Republic	28/11/2012	Hochimin City, Vietnam	Scientific community (higher education, Research)		Vietnam
83	Conference	UNIVERSITA DEGLI STUDI DELLA TUSCIA	ICOS at the AGU	19/12/2012	San Francisco, USA	Scientific community (higher education, Research)		International

84	Workshops	INSTITUT NATIONAL DE LA RECHERCHE AGRONOMIQUE	Annual Assembly of ICOS Ecosystem stations	13/02/2013	Murol, Grignon, Paris (x3), Sarrebourg, Saint-Martin-de-Londres,	Scientific community (higher education, Research)		France
85	Presentations	VERENIGING VOOR CHRISTELIJK HOGER ONDERWIJS WETENSCHAPPELIJK ONDERZOEK EN PATIENTENZORG	Chairing the Terrestrial Observation Panel of GCOS	06/02/2013	Rome and Geneva	Scientific community (higher education, Research) - Policy makers		International
86	Films	THE UNIVERSITY OF EDINBURGH	Does forest colour tell us how much carbon is being absorbed	16/01/2013	internet	Scientific community (higher education, Research) - Policy makers		International
87	Workshops	INSTITUT NATIONAL DE LA RECHERCHE AGRONOMIQUE	Eddycovariance winter school	09/01/2013	Gembloux	Scientific community (higher education, Research)		France
88	Workshops	VERENIGING VOOR CHRISTELIJK HOGER ONDERWIJS WETENSCHAPPELIJK ONDERZOEK EN PATIENTENZORG	The ICOS Carbon Data Portal planning workshop	10/01/2013	AMSTERDAM,THE NETHERLANDS	Scientific community (higher education, Research)		Europe
89	Workshops	FUNDACION CENTRO DE ESTUDIOS AMBIENTALES DEL MEDITERRANEO	ICOS and EUROSPEC: Opportunities and synergies for spectral measurements networking at European sca	25/01/2013	Lisbon (Portugal)	Scientific community (higher education, Research)		Europe
90	Publication	COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	ICOS-Stakeholder's Handbook 2013	15/05/2013	http://www.icos-infrastructure.eu/docs/pub/Stakeholder_Handbook_201303.pdf	Scientific community (higher education, Research) - Policy makers		International
91	Workshops	CENTRUM VYZKUMU GLOBALNI ZMENY AV CR VVI	120 s for innovative companies (workshop)	13/03/2013	Brno, CZ	Scientific community (higher education, Research) - Industry		CZ

92	Conference	COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	ICOS Annual Meeting & Stakeholder's Conference	26/03/2013	Biarritz France	Policy makers		International
93	Publication	COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	Fluctuations in the Carbon Cycle	28/02/2013	International Innovation	Policy makers		International
94	Films	UNIVERSITEIT ANTWERPEN	Behind the Science	11/04/2013	National Geographic TV http://www.behindthescience/natgeographic	Medias		Belgium
95	Presentations	UNI RESEARCH AS	Status of the OTC	25/04/2013	University of East Anglia	Scientific community (higher education, Research)		Europe

Section B (Confidential[6] or public: confidential information to be marked clearly)

Part B1 - The applications for patents, trademarks, registered designs, etc. shall be listed according to the template B1 provided hereafter.

The list should, specify at least one unique identifier e.g. European Patent application reference. For patent applications, only if applicable, contributions to standards should be specified. This table is cumulative, which means that it should always show all applications from the beginning until after the end of the project.

Template B1: List of applications for patents, trademarks, registered designs, etc.

Type of IP Rights[7]	Confidential	Foreseen embargo date	Application reference(s) (e.g. EP123456)	Subject or title of application	Applicant (s) (as on the application)
	Click on YES/NO	dd/mm/yyyy			
Registered design	no	-	24073	Equipment for gas emisions measurement from vegetation or soil, especially at places with fluctuating water table	ISBE (CzechGlobe) - Jiri Dusek, Stanislav Stellner, Marian Pavelka
Registered design	no	-	24236	Equipment for gas emisions measurement from vegetation or soil	ISBE (CzechGlobe) - Jiri Dusek, Stanislav Stellner

[6] Note to be confused with the "EU CONFIDENTIAL" classification for some security research projects.
[7] A drop down list allows choosing the type of IP rights: Patents, Trademarks, Registered designs, Utility models, Others.

Part B2
Please complete the table hereafter:

NO	Type of Exploitable Foreground[8]	Description	Confidential	Foreseen embargo date	Exploitable product(s) or measure(s)	Sector(s) of application[9]	Timetable, commercial or any other use	Patents or other IPR exploitation (licences)	Owner & Other Beneficiary(s) involved
		of exploitable foreground	Click on YES/NO	dd/mm/yyyy					
1	General advancement of knowledge	Flux data at ICOS ecosystemsite	NO		data set	1.4	immediate	not applicable	ETHZURICH: Buchmann N (PI) and several PhD students and postdocs over the last couple of years
2	General advancement of knowledge	Equipment installed at site	NO		scientific equipment for flux measurements	1.4	immediate	not applicable	ETHZURICH: Buchmann N (owner)
3	General advancement of knowledge	Environmental Data	NO		Environmental Data on green- house gases	1.4	2014-2034	not applicable	INRA and ICOS-ERIC
4	General advancement of knowledge	Protocols& new instruments for environmental monitoring	NO		instruments	1.4	2014-2034	not applicable	INRA and ICOS-ERIC
5	General advancement of knowledge	Automatic soil CO2 efflux system	NO		ES equipment	1.4	immediate	not applicable	ISBE (CzechGlobe)

[8]A drop down list allows choosing the type of foreground: General advancement of knowledge, Commercial exploitation of R&D results, Exploitation of R&D results via standards, exploitation of results through EU policies, exploitation of results through (social) innovation.
[9] A drop down list allows choosing the type sector (NACE nomenclature) : http://ec.europa.eu/competition/mergers/cases/index/nace_all.html

Report on societal implications

Replies to the following questions will assist the Commission to obtain statistics and indicators on societal and socio-economic issues addressed by projects. The questions are arranged in a number of key themes. As well as producing certain statistics, the replies will also help identify those projects that have shown a real engagement with wider societal issues, and thereby identify interesting approaches to these issues and best practices. The replies for individual projects will not be made public.

A General Information *(completed automatically when **Grant Agreement number** is entered.*

Grant Agreement Number:	211574
Title of Project:	Integrated Carbon Observation System
Name and Title of Coordinator:	Dr. -Philippe Ciais, Coordinator

B Ethics

1. Did your project undergo an Ethics Review (and/or Screening)? • If Yes: have you described the progress of compliance with the relevant Ethics Review/Screening Requirements in the frame of the periodic/final project reports? Special Reminder: the progress of compliance with the Ethics Review/Screening Requirements should be described in the Period/Final Project Reports under the Section 3.2.2 *'Work Progress and Achievements'*	***No***
2. Please indicate whether your project involved any of the following issues (tick box) :	***NONE***
RESEARCH ON HUMANS	
• Did the project involve children?	
• Did the project involve patients?	
• Did the project involve persons not able to give consent?	
• Did the project involve adult healthy volunteers?	
• Did the project involve Human genetic material?	
• Did the project involve Human biological samples?	
• Did the project involve Human data collection?	
RESEARCH ON HUMAN EMBRYO/FOETUS	
• Did the project involve Human Embryos?	
• Did the project involve Human Foetal Tissue / Cells?	
• Did the project involve Human Embryonic Stem Cells (hESCs)?	
• Did the project on human Embryonic Stem Cells involve cells in culture?	
• Did the project on human Embryonic Stem Cells involve the derivation of cells from Embryos?	
PRIVACY	
• Did the project involve processing of genetic information or personal data (eg. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)?	
• Did the project involve tracking the location or observation of people?	
RESEARCH ON ANIMALS	
• Did the project involve research on animals?	
• Were those animals transgenic small laboratory animals?	
• Were those animals transgenic farm animals?	
• Were those animals cloned farm animals?	
• Were those animals non-human primates?	
RESEARCH INVOLVING DEVELOPING COUNTRIES	
• Did the project involve the use of local resources (genetic, animal, plant etc)?	
• Was the project of benefit to local community (capacity building, access to healthcare, education etc)?	
DUAL USE	
• Research having direct military use	0 Yes xNo
• Research having the potential for terrorist abuse	

C Workforce Statistics

3. Workforce statistics for the project: Please indicate in the table below the number of people who worked on the project (on a headcount basis).

Type of Position	Number of Women	Number of Men
Scientific Coordinator	**4**	**12**
Work package leaders	**3**	**6**
Experienced researchers (i.e. PhD holders)	**19**	**54**
PhD Students	**19**	**18**
Other	**19**	**35**

4. How many additional researchers (in companies and universities) were recruited specifically for this project?	**25**
Of which, indicate the number of men:	**17**

D Gender Aspects

5. Did you carry out specific Gender Equality Actions under the project?

○ Yes
● No

6. Which of the following actions did you carry out and how effective were they?

		Not effective				Very effective
■	Design and implement an equal opportunity policy	○	○	●	○	○
■	Set targets to achieve a gender balance in the workforce	○	○	●	○	○
■	Organise conferences and workshops on gender	○	●	○	○	○
■	Actions to improve work-life balance	○	○	○	●	○
○	Other: Individual beneficiaries did carry out some actions in their institutions as noted above					

7. Was there a gender dimension associated with the research content – i.e. wherever people were the focus of the research as, for example, consumers, users, patients or in trials, was the issue of gender considered and addressed?

○ Yes- please specify

● No

E Synergies with Science Education

8. Did your project involve working with students and/or school pupils (e.g. open days, participation in science festivals and events, prizes/competitions or joint projects)?

● Yes- please specify
-Ecological projects for high-school children (VUA)
-Carboschool +project (CEA)
-ICOS related presentations (UHEL)

○ No

9. Did the project generate any science education material (e.g. kits, websites, explanatory booklets, DVDs)?

● Yes- please specify
-Publication of paper with pupils (VUA)
-Website, pamphlets (CEA)
-ICOS brochures (UNITUS)

○ No

F Interdisciplinarity

10. Which disciplines (see list below) are involved in your project?

● Main discipline[10]:

○ Associated discipline[10]: | ○ Associated discipline[10]:

G Engaging with Civil society and policy makers

11a Did your project engage with societal actors beyond the research community? *(if 'No', go to Question 14)*

● Yes
○ No

11b If yes, did you engage with citizens (citizens' panels / juries) or organised civil society (NGOs, patients' groups etc.)?

○ No
○ Yes- in determining what research should be performed
○ Yes - in implementing the research
● Yes, in communicating /disseminating / using the results of the project

11c In doing so, did your project involve actors whose role is mainly to organise the dialogue with citizens and organised civil society (e.g. professional mediator;

○ Yes
● No

[10] Insert number from list below (Frascati Manual).

communication company, science museums)?		

12. Did you engage with government / public bodies or policy makers (including international organisations)

○	No
●	Yes- in framing the research agenda
●	Yes - in implementing the research agenda
●	Yes, in communicating /disseminating / using the results of the project

13a Will the project generate outputs (expertise or scientific advice) which could be used by policy makers?

●	Yes – as a **primary** objective (please indicate areas below- multiple answers possible)
●	Yes – as a **secondary** objective (please indicate areas below - multiple answer possible)
○	No

13b If Yes, in which fields?

Agriculture		**Energy**		Human rights	
Audiovisual and Media		Enlargement		Information Society	
Budget		Enterprise		Institutional affairs	
Competition		**Environment**		Internal Market	
Consumers		External Relations		Justice, freedom and security	
Culture		External Trade		Public Health	
Customs		Fisheries and Maritime Affairs		Regional Policy	
Development Economic and Monetary Affairs		Food Safety		**Research and Innovation**	
Education, Training, Youth		Foreign and Security Policy		Space	
Employment and Social Affairs		Fraud		Taxation	
		Humanitarian aid		Transport	

13c If Yes, at which level?

- ● Local / regional levels
- ● National level
- ● European level
- ● International level

H Use and dissemination

14. How many Articles were published/accepted for publication in peer-reviewed journals?		**155**
To how many of these is open access[11] provided?		**155**
How many of these are published in open access journals?		
How many of these are published in open repositories?		
To how many of these is open access not provided?		
Please check all applicable reasons for not providing open access:		
❑ publisher's licensing agreement would not permit publishing in a repository ❑ no suitable repository available ❑ no suitable open access journal available ❑ no funds available to publish in an open access journal ❑ lack of time and resources ❑ lack of information on open access ❑ other[12]: ……		
15. How many new patent applications ('priority filings') have been made? *("Technologically unique": multiple applications for the same invention in different jurisdictions should be counted as just one application of grant).*		
16. Indicate how many of the following Intellectual Property Rights were applied for (give number in each box).	Trademark	
	Registered design	**2**
	Other	
17. How many spin-off companies were created / are planned as a direct result of the project?		
Indicate the approximate number of additional jobs in these companies:		

18. Please indicate whether your project has a potential impact on employment, in comparison with the situation before your project:

■	Increase in employment, or	❑	In small & medium-sized enterprises
❑	Safeguard employment, or	❑	In large companies
❑	Decrease in employment,	❑	None of the above / not relevant to the project
■	Difficult to estimate / not possible to quantify		

19. For your project partnership please estimate the employment effect resulting directly from your participation in Full Time Equivalent (*FTE = one person working fulltime for a year*) jobs	*Indicate figure:*
Difficult to estimate / not possible to quantify	■

[11] Open Access is defined as free of charge access for anyone via Internet.
[12] For instance: classification for security project.

I Media and Communication to the general public

20. As part of the project, were any of the beneficiaries professionals in communication or media relations?

○ Yes ● No

21. As part of the project, have any beneficiaries received professional media / communication training / advice to improve communication with the general public?

○ Yes ● No

22 Which of the following have been used to communicate information about your project to the general public, or have resulted from your project?

■	Press Release	■	Coverage in specialist press
■	Media briefing	■	Coverage in general (non-specialist) press
■	TV coverage / report	■	Coverage in national press
■	Radio coverage / report	■	Coverage in international press
■	Brochures /posters / flyers	■	Website for the general public / internet
■	DVD /Film /Multimedia	■	Event targeting general public (festival, conference, exhibition, science café)

23 In which languages are the information products for the general public produced?

■	Language of the coordinator	■	English
■	Other language(s)		

***Question F-10*:** Classification of Scientific Disciplines according to the Frascati Manual 2002 (Proposed Standard Practice for Surveys on Research and Experimental Development, OECD 2002):

FIELDS OF SCIENCE AND TECHNOLOGY

1. NATURAL SCIENCES

1.1 Mathematics and computer sciences [mathematics and other allied fields: computer sciences and other allied subjects (software development only; hardware development should be classified in the engineering fields)]

1.2 Physical sciences (astronomy and space sciences, physics and other allied subjects)

1.3 Chemical sciences (chemistry, other allied subjects)

1.4 Earth and related environmental sciences (geology, geophysics, mineralogy, physical geography and other geosciences, meteorology and other atmospheric sciences including climatic research, oceanography, vulcanology, palaeoecology, other allied sciences)

1.5 Biological sciences (biology, botany, bacteriology, microbiology, zoology, entomology, genetics, biochemistry, biophysics, other allied sciences, excluding clinical and veterinary sciences)

2 ENGINEERING AND TECHNOLOGY

2.1 Civil engineering (architecture engineering, building science and engineering, construction engineering, municipal and structural engineering and other allied subjects)

2.2 Electrical engineering, electronics [electrical engineering, electronics, communication engineering and systems, computer engineering (hardware only) and other allied subjects]

2.3. Other engineering sciences (such as chemical, aeronautical and space, mechanical, metallurgical and materials engineering, and their specialised subdivisions; forest products; applied sciences such as geodesy, industrial chemistry, etc.; the science and technology of food production; specialised technologies of interdisciplinary fields, e.g. systems analysis, metallurgy, mining, textile technology and other applied subjects)

3. MEDICAL SCIENCES

3.1 Basic medicine (anatomy, cytology, physiology, genetics, pharmacy, pharmacology, toxicology, immunology and immunohaematology, clinical chemistry, clinical microbiology, pathology)

3.2 Clinical medicine (anaesthesiology, paediatrics, obstetrics and gynaecology, internal medicine, surgery, dentistry, neurology, psychiatry, radiology, therapeutics, otorhinolaryngology, ophthalmology)

3.3 Health sciences (public health services, social medicine, hygiene, nursing, epidemiology)

4. AGRICULTURAL SCIENCES

4.1 Agriculture, forestry, fisheries and allied sciences (agronomy, animal husbandry, fisheries, forestry, horticulture, other allied subjects)

4.2 Veterinary medicine

5. SOCIAL SCIENCES

5.1 Psychology

5.2 Economics

5.3 Educational sciences (education and training and other allied subjects)

5.4 Other social sciences [anthropology (social and cultural) and ethnology, demography, geography (human, economic and social), town and country planning, management, law, linguistics, political sciences, sociology, organisation and methods, miscellaneous social sciences and interdisciplinary , methodological and historical S1T activities relating to subjects in this group. Physical anthropology, physical geography and psychophysiology should normally be classified with the natural sciences].

6. HUMANITIES

6.1 History (history, prehistory and history, together with auxiliary historical disciplines such as archaeology, numismatics, palaeography, genealogy, etc.)

6.2 Languages and literature (ancient and modern)

6.3 Other humanities [philosophy (including the history of science and technology) arts, history of art, art criticism, painting, sculpture, musicology, dramatic art excluding artistic "research" of any kind, religion, theology, other fields and subjects pertaining to the humanities, methodological, historical and other S1T activities relating to the subjects in this group]