# SIXTH FRAMEWORK PROGRAMME
# PRIORITY 1.1.6.3
# GLOBAL CHANGE AND ECOSYSTEMS

**Contract for:**

## INTEGRATED PROJECT

***Annex I – "Description of Work"***
***Implementation Plan for the first 18-Months***
***(January 2004 – June 2005)***

| | |
|---|---|
| **Project acronym:** | **CarboEurope-IP** |
| **Project full title:** | **Assessment of the European Terrestrial Carbon Balance** |
| **Contract no.:** | **GOCE-CT-2003-505572** |

**Date of preparation of Annex I:** **13 November 2003**

**Start date of contract:** **01 January 2004**

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# 1. Project Summary

The overarching aim of the CarboEurope-IP is to understand and quantify the present terrestrial carbon balance of Europe and the associated uncertainty at local, regional and continental scale. In order to achieve this, the project addresses the three major topics:

1. Determination of the carbon balance of the European continent, its geographical patterns, and changes over time. This is achieved by (1) executing a strategically focussed set of surface based ecological measurements of carbon pools and $CO_2$ exchange, (2) further enhancement of an atmospheric high precision observation system for $CO_2$ and other trace gases, (3) execution of a regional high spatial resolution experiment, and (4) integration of these components by means of innovative data assimilation systems, bottom-up process modelling and top-down inverse modelling. The key innovation of the CarboEurope-IP is in its conception as to apply single comprehensive experimental strategy, and its integration into a comprehensive carbon data assimilation framework. It is solving the scientific challenge of quantifying the terrestrial carbon balance at different scales and with known, acceptable uncertainties. The increase in spatial and temporal resolution of the observational and modelling program will allow for the first time a consistent application of a multiple constraint approach of bottom-up and top-down estimates to determine the terrestrial carbon balance of Europe with the geographical patterns and variability of sources and sinks.
2. Enhanced understanding of the controlling mechanisms of carbon cycling in European ecosystems, and the impact of climate change and variability, and changing land management on the European carbon balance. This is achieved by (1) the partitioning of carbon fluxes into their constituent parts (assimilation, respiration, fossil fuel burning), at local, regional and continental scales, (2) the quantification of the effects of management on net ecosystem carbon exchange based on data synthesis, and (3) the development, evaluation and optimisation of ecosystem process models.
3. Design and development of an observation system to detect changes of carbon stocks and carbon fluxes related to the European commitments under the Kyoto Protocol. This is achieved by (1) atmospheric measurements and a modelling framework to detect changes in atmospheric $CO_2$ concentrations during the time frame of a Kyoto commitment period, and (2) the outline of a carbon accounting system for the second Commitment period based on measuring carbon fluxes, stock changes by soil and biomass inventories, vegetation properties by remote sensing, and atmospheric concentrations.

CarboEurope-IP integrates and expands the research efforts of 67 European contractors and around 30 associated institutes. CarboEurope-IP addresses basic scientific questions of high political relevance.

# 8. Detailed implementation plan – first 18 months

## 8.1 Introduction – general description and milestones

### Overarching goals during the first 18 months

The following overarching goals will be achieved by CarboEurope-IP during the first 18 months:

- To quantify the European carbon balance and its inter-annual variability for the period 1998 to 2003
- To have executed the first 6 months of the Intensive Observational Campaign of the regional experiment
- To carry out an initial analysis of Net Primary Productivity (NPP), Net Ecosystem Productivity (NEP) and Net Biome Productivity (NBP) for the different land cover and land use types for the Main Sites of the Ecosystem Site Network
- To have all observation systems in place and fully operational.

### Specific goals

For clarity within the complex structure of the Integrated Project, all work packages (WPs) are directly linked to the Activities described before as part of the Components.

**Component 1** (**Ecosystem)** will have all flux stations up and running (WP 1.1) in order to assure a long-term record during the CarboEurope-IP duration. The Quality Control of measuring stations will be in operation (WP 1.2). The initial soil sampling will have taken place and soil samples will be in the analysis process (WP 1.3), and the forest, grassland, and cropland activities (WPs 1.4, 1.5, 1.6) will have initial estimates of NPP based on data from FP5 and new measurements and have selected their sites to study management effects and will have initial results from ecosystem models.

**Component 2 (Atmosphere)** will have upgraded 4 stations to complete the network of continuous $CO_2$ and $^{222}Rn$ observations (WP 2.1). One new tall tower for continuous $CO_2$ measurements will be operational (WP 2.2). The networks of 24 multiple species flask sites (WP 2.3) and of 4 aircraft sites for vertical flask sampling profiles (WP 2.4) will be operational. A methodology for accurate CO calibration will have been established, and a network of 5 high precision bi-weekly radiocarbon observation sites will be operational (WP 2.6). A selection of up to 10 eddy flux towers will be made to implement measurements of calibrated $CO_2$ concentrations (WP 2.7).

**Component 3 (Regional Experiment)** will have developed the data management system and produce the fossil fuel emission map (WP 3.1) all observation platforms will be in place (WPs 3.2, 3.3). In addition, and the Test Campaign will have been carried out. The RECAB campaigns will be reanalysed and major parts of the data assimilation system and the modelling scheme will have been developed (WP 3.4).

**Component 4 (Continental Integration)** will have implemented the database (WP 4.1), and a first version of the ecosystem model driver and auxiliary datasets will have been produced (WP 4.3). A detailed gridded forest carbon inventory database will be established for the modelling activities and the methods will be established for upscaling of soil and forest inventory data by means of neural network techniques (WP 4.2). A first assessment of the European carbon balance and its variability for the time period 1998-2003 will have been produced by top-down (atmospheric inversion calculations, WP 4.4) and different bottom-up methods (neural networks and process-based ecosystem models, WP 4.5). A first scenario simulation of the evolution of the European carbon balance 1850-2100 will have been carried out (WP 4.7).

**Dissemination**

The first annual conference will have been organised. The Policy Group (DISS4) will be in action and collaborate intensively with running FP5 efforts.

**Demonstration**

The demonstration activity in Thuringia will have started.

**Training**

The first summer school will have been organised.

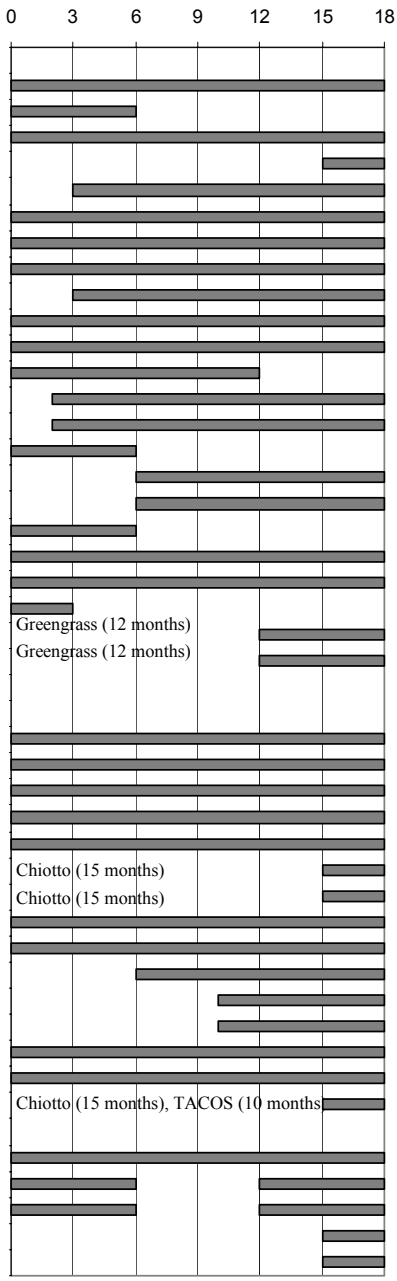
The test phase of the educational training at secondary school level will be finished.

**Project management**

The IP Co-ordinator and the management team will have managed the project, organised the CarboEurope-IP Kick-off meeting and the first annual meeting.

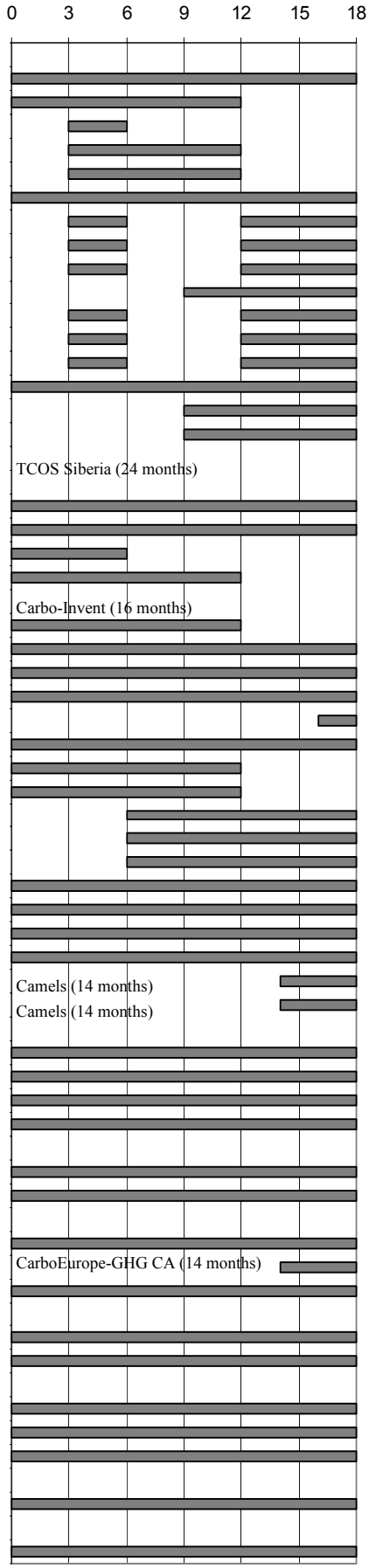
# 8.2 Planning and timetable

## Timetable of workpackages and tasks




**Component 1 Ecosystem**
**WP 1.1 Eddy covariance fluxes**
Task 1.1.1 Establishment of the CarboEurope-IP eddy covariance flux network
Task 1.1.2 Data on carbon, water and energy exchanges
Task 1.1.3 Assessment of carbon budgets of the European landscape elements
Task 1.1.4 Assessment of ecosystem site network
**WP 1.2 Quality assurance**
Task 1.2.1 Footprint and quality assessment of main flux sites
Task 1.2.2 Improvement of quality control procedures on eddy covariance data
Task 1.2.3 First analysis of nocturnal fluxes and associated problems due to complex topographies
**WP 1.3 Soil**
Task 1.3.1 Mapping soil types
Task 1.3.2 Soil sampling
Task 1.3.3 Carbon immobilisation in soils
**WP 1.4 Forest**
Task 1.4.1 Harmonise data acquisition
Task 1.4.2 Model Parameterisation
**WP 1.5 Cropland**
Task 1.5.1 Data consolidation
Task 1.5.2 Start Meta-analysis
**WP 1.6 Grasslands/Wetlands**
Task 1.6.1 Standardised protocols
Task 1.6.2. Model parameterisation and validation
Task 1.6.3 Contribution to upscaling

**Component 2 Atmosphere**
**WP 2.1 Ground level stations continuous CO2 and 222Rn measurements**
Task 2.1.1 The European network of CO2 stations
Task 2.1.2. Continuous sampling of 222Rn at the stations
Task 2.1.3. Quantification of representativeness "errors"
**WP 2.2 Tall towers continuous measurements of CO2, CH4, SF6, N2O, CO**
Task 2.2.1 The network of tall towers
Task 2.2.2 Linking tall towers concentration profiles and local ecosystem fluxes
**WP 2.3 Flask air sampling for multiple species analysis**
Task 2.3.1. The European co-operative flask sampling network
Task 2.3.2. Multiple-species interpretation of the European carbon balance
Task 2.3.3. Development of innovative techniques
**WP 2.4 Vertical aircraft profiles of in situ CO2 and flask samples**
Task 2.4.1. The European network of aircraft sites (2004-2006)
**WP 2.5 Quality control of atmospheric measurements**
Task 2.5.1. Dynamic monitoring of inter-laboratory comparability of calibration scales
**WP 2.6 Radiocarbon and CO analysis to quantify fossil fuel emissions**
Task 2.6.1. Determine the fossil fuel CO2 component in Europe from 14CO2 measurements
Task 2.6.2. Provide a calibration of CO as a proxy for fossil CO2 at three urban stations
**WP 2.7 Calibrated CO2 concentration measurements at eddy covariance towers**
Task 2.7.1. Feasibility study to calibrate atmospheric CO2 eddy covariance towers
Task 2.7.2. Pilot network of calibrated CO2 at eddy covariance towers




**Component 3 Regional Experiment**
**WP 3.1 Experiment planning, data consolidation and data management**
Task 3.1.1 Data consolidation
Task 3.1.2 Test campaign
Task 3.1.3 Experimental planning
**WP3.2 Surface flux and aircraft flux measurement**
Task 3.2.1 Surface flux measurements
Task 3.2.2 Aircraft flux measurements
Task 3.2.3 Test over large cities
**WP 3.3 Scalar Concentration measurements**
Task 3.3.1 CO2 concentrations and 14C at one to two tall towers
Task 3.3.2 Test flights for boundary layer CO2 concentrations and 13C
Task 3.3.3 Boundary layer structure and evolution
**WP3.4 Modelling and integration**
Task 3.4.1 Reanalysis of RECAB campaigns
Task 3.4.2 Slow cycle modelling
Task 3.4.3 Fast cycle modelling **Component 4 Continental Integration**

**Component 4 Continental Integration**
**WP 4.1 Auxilliary data database**
Task 4.1.1 Primary datasets to be compiled as drivers for the TEMs
Task 4.1.2 Surface biophysical products from various spaceborne instruments
Task 4.1.3 Compilation of minor and background carbon fluxes
**WP 4.2 Land carbon inventories**
Task 4.2.1 A detailed representation of European scale forest inventory data
Task 4.2.2 Cooperation framework for soil carbon monitoring
Task 4.2.3 Concepts for methods for integration of georeferenced data
Task 4.2.4 Methods for “Bottom Up” calculation of carbon budgets on plot level
**WP 4.3 Inverse atmsospheric model development, evaluation and application**
Task 4.3.1 Continue and improve the European inverse modelling
Task 4.3.2 New inverse set up to infer fluxes at high spatial and temporal resolution
Task 4.3.3 Conduct a series of network representativity and optimization studies
Task 4.3.4 Implement multi-species simulations
**WP 4.4 Bottom-up model development, evaluation and application**
Task 4.4.1 NEE fluxes for the forest sector by NetworkNEE
Task 4.4.2 High resolution process-based stand modelling with PROXELNEE
Task 4.4.3 TEM modelling on the Eurogrid over the entire Europe
**WP 4.5 Development of a carbon data assimilation system**
Task 4.5.1 Model validation and Uncertainty Analysis
Task 4.5.2 Development and application of a CDAS

**DATA**
Task DATA.1 Database structure
Task DATA.2 Standards for uniform meta-information terminology
Task DATA.3 Standard for data protocols

**Demonstration**
Task DEMO Update the inventory of the State forest of Thuringia

**Dissemination**
Task DISS1 Dissemination to public and policy
Task DISS2 Joint EU/US Assessments

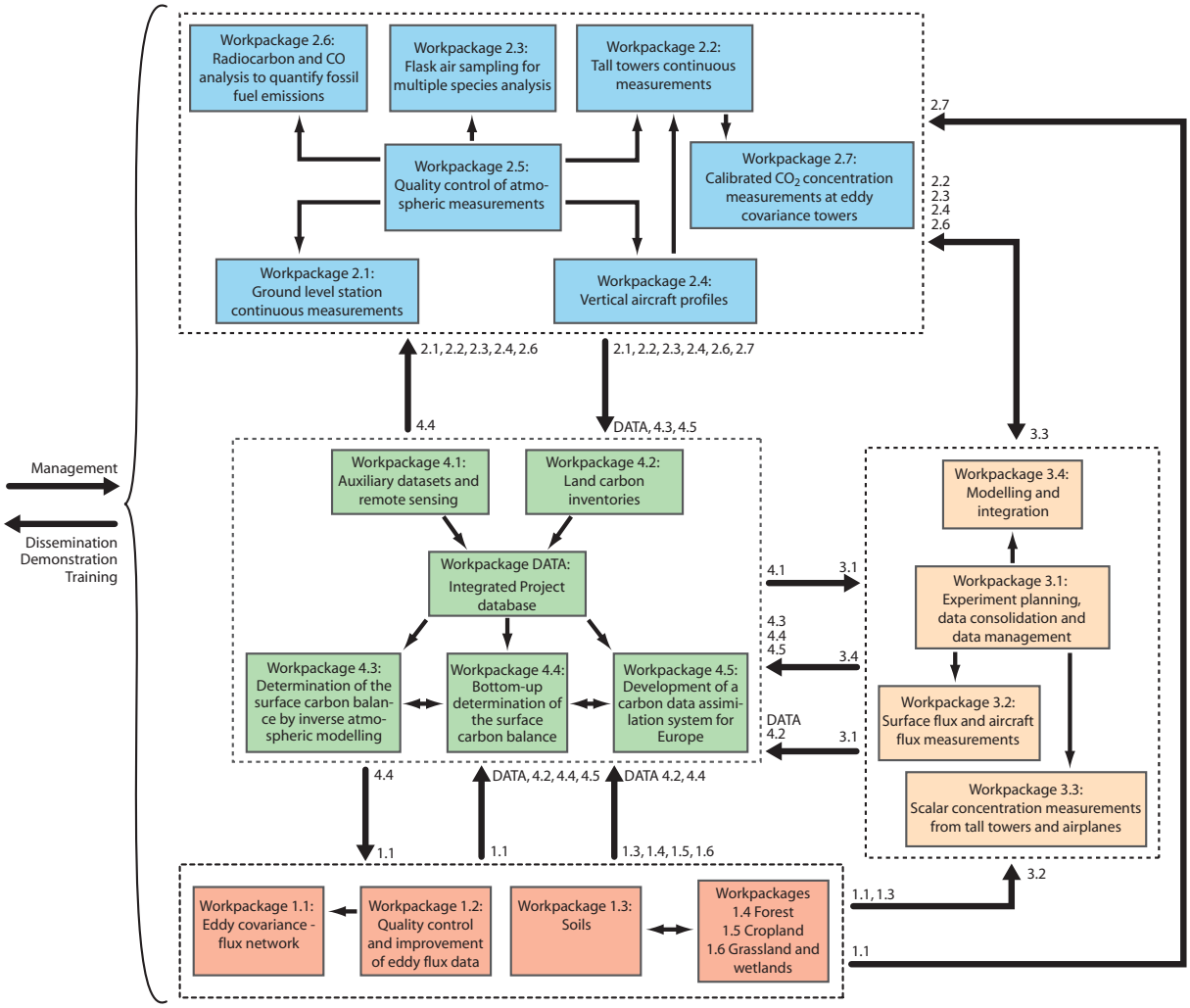
**Innovation**
Task INNOV

**Training**
Task TRAIN1 Advanced Training Course in Airborne Flux Measurements
Task TRAIN2 Training at secondary school level

**Management**

**Gender Action Plan**

## Graphical presentation of workpackages



## 8.3 Workpackage list/overview

| Work-package No | Work package title | Lead contractor No[1] | Person-months[2] | Start month[3] | End month[4] | Deliv-erable No[5] |
|---|---|---|---|---|---|---|
| 1.1 | Ecosystem - Eddy covariance fluxes | UNITUS | 511 | 1 | 18 | 1.1.1<br>1.1.2<br>1.1.3<br>1.1.4<br>1.1.5 |
| 1.2 | Ecosystem - Quality control | FUSAGx | 33 | 1 | 18 | 1.2.1<br>1.2.2<br>1.2.3<br>1.2.4 |
| 1.3 | Ecosystem - Soil | MPI-BGC | 72 | 1 | 18 | 1.3.1<br>1.3.2<br>1.3.3 |
| 1.4 | Ecosystem - Forest | UEDIN | 6 | 1 | 18 | 1.4.1<br>1.4.2 |
| 1.5 | Ecosystem - Cropland | UNIABDN | 18 | 1 | 18 | 1.5.1<br>1.5.2<br>1.5.3<br>1.5.4 |
| 1.6 | Ecosystem - Grassland/wetland | INRA | 24 | 1 | 18 | 1.6.1<br>1.6.2<br>1.6.3<br>1.6.4 |
| 2.1 | Atmosphere – Surface stations continuous measurements | CEA-LSCE | 17 | 1 | 18 | 2.1.1<br>2.1.2 |
| 2.2 | Atmosphere – Tall towers | ECN | 9 | 1 | 18 | -* |
| 2.3 | Atmosphere – Flask air sampling | UBERN | 29 | 1 | 18 | 2.3.1<br>2.3.2 |
| 2.4 | Atmosphere – Vertical aircraft profiles | CEA-LSCE | 20 | 1 | 18 | 2.4.1<br>2.4.2<br>2.4.3 |
| 2.5 | Atmosphere – Quality control | MPI-BGC | 0 | 1 | 18 | -* |
| 2.6 | Atmosphere – Radiocarbon and CO for fossil fuels | UHEI-IUP | 14 | 1 | 18 | 2.6.1<br>2.6.2 |
| 2.7 | Atmosphere – Calibrated CO2 concentrations at eddy towers | ALTERRA | 3 | 1 | 18 | - |
| 3.1 | Reg. Experiment – Experimental planning, data consolidation | CNRM | 47 | 1 | 18 | 3.1.1<br>3.1.2<br>3.1.3<br>3.1.4<br>3.1.5<br>3.1.6 |
| 3.2 | Reg. Experiment – Surface and aircraft measurements | IBIMET-CNR | 23 | 1 | 18 | 3.2.1<br>3.2.2<br>3.2.3 |
| 3.3 | Reg. Experiment – Concentration measurements and CBL structure | MPI-BGC | 15 | 1 | 18 | 3.3.1<br>3.3.2<br>3.3.3 |
| 3.4 | Reg. Experiment – Modelling and | VU-A | 46 | 1 | 18 | 3.4.1 |

[1] Number of the contractor leading the work in this work package.

[2] The total number of person-months allocated to each work package.

[3] Relative start date for the work in the specific work packages, month 0 marking the start of the project, and all other start dates being relative to this start date.

[4] Relative end date, month 0 marking the start of the project, and all ends dates being relative to this start date.

[5] Deliverable number: Number for the deliverable(s)/result(s) mentioned in the work package: D1 - Dn.

| | | | | | | |
|---|---|---|---|---|---|---|
| | integration | | | | | 3.4.2<br>3.4.3<br>3.4.4 |
| 4.1 | Cont. Integration – Auxilliary Data Database | JRC-IES | 19 | 1 | 12 | 4.1.1 |
| 4.2 | Cont. Integration – Land carbon inventories | ALTERRA | 26 | 1 | 18 | 4.2.1<br>4.2.2<br>4.2.3<br>4.2.4<br>4.2.5<br>4.2.6<br>4.2.7 |
| 4.3 | Cont. Integration – Inverse atmospheric modelling | CEA-LSCE | 30 | 1 | 18 | 4.3.1<br>4.3.2 |
| 4.4 | Cont. Integration – Bottom-up model development, evaluation | MPI-BGC | 36 | 1 | 18 | 4.4.1 |
| 4.5 | Cont. Integration – Development of a carbon data assimilation system | MET-OFFICE | 0 | (24) | | -* |
| DATA | Central Database | MPI-BGC | 18 | 1 | 18 | DATA 1<br>DATA 2 |
| DEMO | Demonstration | TLWJF | 12 | 1 | 18 | DEMO1 |
| DISS | Dissemination | MPI-BGC | 0 | 6 | 18 | DISS1<br>DISS2<br>DISS3<br>DISS4<br>DISS5<br>DISS6 |
| INNOV | Innovation | UEDIN | 0 | 6 | 18 | INNOV1<br>INNOV2<br>INNOV3<br>INNOV4<br>INNOV5 |
| TRAIN | Training | IBIMET-CNR, SAUG | 7 | 1 | 18 | TRAIN1<br>TRAIN2<br>TRAIN3 |
| CO | IP co-ordination and management | MPI-BGC | 36 | 1 | 18 | CO1<br>CO2<br>CO3 |
| GENDER | Gender action plan | Gender committee | 0 | 1 | 18 | Gender1<br>Gender2<br>Gender3 |
| | TOTAL | | 1070 | | | |

* Part of FP5 project

## 8.4 Deliverables list (first 18 months)

| Deli. No. | Deliverable name | WP No. | Lead participant | Estimated indicative person months | Nature | Delivery date (project month) | Dissemination level |
|---|---|---|---|---|---|---|---|
| 1.1.1 | Protocol for measurements and data delivery finished and | 1.1 | UNITUS | 12 | R | 6 | PU |
| 1.1.2 | Highly standardised and fully operational eddy covariance flux network | 1.1 | UNITUS | 403 | O | 6 | PP |
| 1.1.3 | Data base with past datasets, historical time series and first year continuous flux data of carbon, water energy and the associated meteorological and ecological variables at the IP Main Sites | 1.1 | UNITUS | 6 | O | 12 | PP |
| 1.1.4 | First assessment of carbon budgets and associated errors by land use/ cover types | 1.1 | UNITUS | 30 | R | 18 | PU |
| 1.1.5 | Assessment of ecosystem site network – first results | 1.1 | UNITUS | 60 | R | 18 | PU |
| 1.2.1 | Footprint dependent data quality check of the Main Sites | 1.2 | UBT-MET | 6 | R | 18 | PU |
| 1.2.2 | Provision of quality control-tools and new calculation schemes for eddy covariance measurements | 1.2 | UBT-MET | 3 | O | 12 | PP |
| 1.2.3 | Estimation of storage and advection terms in 2 sites | 1.2 | FUSAGx | 20 | R | 18 | PU |
| 1.2.4 | Preliminary evaluation of night flux correction algorithms for night flux | 1.2 | FUSAGx | 7 | R | 18 | PU |
| 1.3.1 | Initial geo-referenced soil map in the footprint of up to 12 main tower sites | 1.3 | MPI-BGC | 12 | O | 18 | PU |
| 1.3.2 | Geo-referenced geo-statistical soil sampling of 100 cores in the footprint of up to 12 selected tower sites | 1.3 | MPI-BGC | 24 | O | 18 | PP |
| 1.3.3 | Analysis of texture, C/N and partly of carbon chemistry in a smaller number of cores (<300 for 12 sites) in progress | 1.3 | MPI-BGC | 36 | O | 18 | PP |
| 1.4.1 | Stand characteristics of the forest sites: including structure, roughness, albedo, management cycle | 1.4 | UEDIN | 3 | O | 18 | PP |
| 1.4.2 | Exploration of the climatological and management information as control of the C-fluxes | 1.4 | UEDIN | 3 | R | 18 | PU |
| 1.5.1 | Standard protocols for measurements on all non-flux cropland components | 1.5 | UNIABDN | 1 | R | 6 | PU |
| 1.5.2 | Collation and quality control of non-flux cropland components from all cropland sites | 1.5 | UNIABDN | 2 | O | 12 | PP |
| 1.5.3 | Preliminary analysis of European trends in impact of climate and management on cropland $CO_2$ (and non-$CO_2$ GHG) fluxes | 1.5 | UNIABDN | 9 | R | 18 | PU |
| 1.5.4 | Preliminary evaluation and improvements of cropland ecosystem models | 1.5 | UNIABDN | 6 | R | 18 | PU |
| 1.6.1 | Data on vegetation, NPP and its components at the grassland/wetlands sites of the cluster network | 1.6 | INRA | 1 | R | 18 | PU |
| 1.6.2 | Data on components of the carbon balance of the main sites | 1.6 | INRA | 2 | O | 18 | PP |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1.6.3 | Calibration of the grassland model with the first year data and simulation of fluxes from each main grassland site | 1.6 | INRA | 15 | O | 18 | PP |
| 1.6.4 | Simulated $CO_2$ fluxes of grasslands for current agricultural management scenarios | 1.6 | INRA | 7 | O | 18 | PP |
| 2.1.1 | An atmospheric network of 12 surface $CO_2$ and $^{222}Rn$ stations | 2.1 | CEA | 11 | O | 12 | PP |
| 2.1.2 | A database of atmospheric measurements, updated each 6-months, with raw concentration data, selected data, and auxiliary information | 2.1 | CEA | 6 | O | 18 | PP |
| 2.3.1 | Network of up to 24 flask sampling stations in Europe out of which 10 are run by CMDL | 2.3 | UBERN | 15 | O | 6 | PP |
| 2.3.2 | Dataset to separate the European $CO_2$ gradients into components (oceanic, terrestrial, fossil) | 2.3 | UBERN | 14 | O | 12 | PP |
| 2.4.1 | Four aircraft sites (each 20 days) on an East-West transect in temperate Europe | 2.4 | CEA | 5 | O | 6 | PP |
| 2.4.2 | Representativity of Schauinsland mountain station based on aircraft and ground level data (scientific paper) | 2.4 | CEA | 7 | P | 18 | PU |
| 2.4.3 | Flask multiple-species data of aircraft profiles at 10 levels per flight | 2.4 | CEA | 8 | O | 12 | PP |
| 2.6.1 | Network of 5 high precision bi-weekly integrated $^{14}CO_2$ monitoring sites | 2.6 | UHEI-IUP | 6 | O | 6 | PP |
| 2.6.2 | Establishment of first CO calibration site in Heidelberg | 2.6 | UHEI-IUP | 8 | O | 18 | PP |
| 3.1.1 | Maps of soil (structure C-content) for fast and slow carbon models | 3.1 | INRA | 6 | O | 12 | PP |
| 3.1.2 | Maps of land use for carbon models | 3.1 | CNRM | 3 | O | 12 | PP |
| 3.1.3 | Maps of biophysical parameters (albedo, roughness etc), | 3.1 | CNRM | 6 | O | 12 | PP |
| 3.1.4 | Climatology based on downscaled synoptic weather data at 8 km resolution | 3.1 | CNRM | 6 | O | 12 | PP |
| 3.1.5 | Fossil fuel inventory at 2km resolution | 3.1 | USTUTT | 12 | O | 12 | PP |
| 3.1.6 | Experimental plan for the experimental and intensive observation period | 3.1 | CNRM | 14 | O | 13 | PP |
| 3.2.1 | Set of flux data for the main vegetation sites | 3.2 | IBIMET-CNR | 6 | O | 18 | PP |
| 3.2.2 | Datasets of fluxes of water vapour, heat, momentum and $CO_2$ for selected transects during the test campaign and the extended and intensive observation period | 3.2 | IBIMET-CNR | 9 | O | 18 | PP |
| 3.2.3 | Emission checks on city fluxes with the flux aircraft | 3.2 | IBIMET-CNR | 8 | R | 15 | PU |
| 3.3.1 | Installation and protocol for $CO_2$ concentration measurements of tall towers | 3.3 | MPI-BGC | 3 | O | 12 | PP |
| 3.3.2 | Datasets of concentrations of $CO_2$ and other trace gasses in the CBL and for larger scale transects for the test campaign | 3.3 | MPI-BGC | 6 | O | 18 | PP |
| 3.3.3 | Datasets of boundary layer evolution with radio sounding and profiler systems | 3.3 | MPI-BGC | 6 | O | 18 | PP |
| 3.4.1 | Reanalysis and consolidated datasets of RECAB campaigns | 3.4 | VU-A | 24 | O | 15 | PP |

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|---|---|---|---|---|---|---|---|
| 3.4.2 | First evaluation of the carbon fluxes on the long term at high resolution with a number of SVATS | 3.4 | VU-A | 10 | O | 15 | PP |
| 3.4.3 | Mesoscale evaluation of CO2 atmospheric cycles in the CBL using a number of mesoscale models calibrated against past campaign | 3.4 | VU-A | 10 | O | 15 | PP |
| 3.4.4 | Comparison of high resolution surface fluxes with surface fluxes retrieved by large scale inverse modelling in the same area | 3.4 | VU-A | 2 | O | 18 | PP |
| 4.1.1 | Data report available for auxiliary datasets accessible through database | 4.1 | JRC-IES | 19 | O | 18 | PP |
| 4.2.1 | Detailed database of gridded forest carbon inventories ready for use by the modelling activities | 4.2 | ALTERRA | 7 | O | 8 | PP |
| 4.2.2 | Co-operation framework established by JRC and national soil carbon monitoring experts | 4.2 | JRC | 10 | O | 12 | PU |
| 4.2.3 | Report on literature study | 4.2 | ALTERRA | 2.5 | R | 18 | PU |
| 4.2.4 | Draft on methods compendium | 4.2 | ALTERRA | 11 | R | 18 | PP |
| 4.2.5 | Evaluation report of methods for implementing land carbon inventories (regarding the GPG LULUCF) | 4.2 | JR | 2.5 | R | 18 | PU |
| 4.3.1 | Report with assessment of spatial and regional variability of the European carbon balance 1998-2003 based on the top-down approach | 4.3 | CEA | 18 | O | 18 | PP |
| 4.3.2 | Report on the representativity and optimal design of the atmospheric observation network (Atmosphere Component) | 4.3 | CEA | 18 | R | 18 | PU |
| 4.4.1 | Report describing the bottom-up and top-down assessment of the European carbon balance and it's constituent fluxes for the target time period 1998-2003 | 4.4 | MPI-BGC | 36 | R | 18 | PU |
| DATA 1 | Protocol of meta-data terminology and catalogue of spatial data products | DATA | MPI-BGC | 9 | O | 12 | PP |
| DATA 2 | Bluebook of standard formats for measurement data and spatial data | DATA | MPI-BGC | 9 | O | 18 | PP |
| DEMO1 | Enhanced observing system and database established | DEMO | MPI-BGC | 12 | O | 18 | PP |
| DISS 1 | First CarboEurope-IP conference | DISS | MPI-BGC | 0 | O | 13 | PU |
| DISS 2 | Cross participation to meetings between CarboEurope and NACP | DISS | MPI-BGC/CEA | 0 | O | 14 | PU |
| DISS 3 | Data-policy for exchanging data between CarboEurope and NACP | DISS | CEA | 0 | O | 9 | PU |
| DISS 4 | Joint Science sessions at EGS and AGU conferences | DISS | CEA | 0 | O | 12 | PU |
| DISS | Broad international contacts via GCP | DISS | MPI-BGC | 0 | O | 12 | PU |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 5 | | | | | | | |
| DISS 6 | Active science/policy interface | DISS | MPI-BGC | 0 | O | 12 | PU |
| INN OV1 | First innovation reports to be distributed and discussed at the Steering Committee and placed on the web site | INNOV | UEDIN | 0 | R | 12 | PU |
| INN OV2 | Network of contacts outside the CarboEurope community, including the private sector and the forestry agencies in the Partner countries | INNOV | UEDIN | 0 | O | 18 | PU |
| INN OV3 | First brainstorming workshop to identify new measurement techniques and emerging technologies | INNOV | UEDIN | 0 | O | 12 | PU |
| INN OV4 | Contacts with private sector and interesting private investors in carbon-related issues | INNOV | UEDIN | 0 | O | 18 | PU |
| INN OV5 | Links with related and evolving projects in Europe and elsewhere | INNOV | UEDIN | 0 | O | 18 | PU |
| TRAI N1 | Advanced Training Course in Airborne Flux Measurements | TRAIN | IBIMET-CNR | 1 | O | 8 | PU |
| TRAI N2 | Educational package for adaptation and dissemination by involved multipliers | TRAIN | SAUG | 3 | R | 18 | PU |
| TRAI N3 | Educational section for secondary schools on CarboEurope website | TRAIN | SAUG | 3 | R | 18 | PU |
| CO1 | Legal management | CO | MPI-BGC | 2 | O | 18 | PP |
| CO2 | Financial management | CO | MPI-BGC | 4 | O | 18 | PP |
| CO3 | Scientific co-ordination of the IP as a whole and of the Components | CO | MPI-BGC | 30 | O | 18 | PP |
| Gend er1 | Gender committee established | Gender | Gender committee | 0 | O | 1 | PP |
| Gend er2 | Female researchers´ network and mentoring programme established | Gender | Gender committee | 0 | O | 6 | PP |
| Gend er3 | First annual gender action report | Gender | Gender committee | 0 | R | 14 | PU |
| | | | TOTAL | 1070 | | | |

## 8.5 Workpackage descriptions

### Component 1 Ecosystems

### WP 1.1 Eddy covariance fluxes and data management

| Work package number | WP1.1 | Start date or starting event: | Month 1 |
|---|---|---|---|
| Activity type | RTD | | |
| Participant id (Person-months) | MPI-BGC(32), TUD-IHM(48), UBT-PE(24), INRA(30), CNRS-CEFE(9), UNITUS(36), JRC-IES(9), CEALP(15), RISOE(11), UCOP(1), LUND(14), SLU-PE(5), CEAM(13), CTFC(9), ISA-UTL(12), IST(6), ALTERRA(8), VU-A(12), FUSAGx(9), UA(5), UEDIN(18), TCD(8), NERC.CEH-WAL(8), UCC(8), UH-DPS(18), FMI(18), ILE(22), SZIU(27), UPOZ(22), FAL(18), WUR-NCP(18), UPS-Orsay(18) | | |

**Objectives**

- To establish a European eddy covariance network with harmonised standards of operation
- To provide continuous flux measurements of carbon, water and energy from representative land cover types of Europe
- To provide data of non-$CO_2$ trace gases for selected ecosystems
- To provide flux data for model parameterisation and up-scaling to the European continent
-

**Description of work**

**Task 1.1.1 Establishment of the CarboEurope-IP eddy covariance flux network:** The current distribution of flux towers which are coming from past European projects and national programmes, as well as new implemented sites, which have been selected as CarboEurope Cluster network need to be harmonised in terms of methodologies, protocols of measurements and data sharing. This task has the goal of creating a comprehensive and highly standardised network of sites which will be the back-bone of the entire ecosystem component of the IP.

**Task 1.1.2 Data on carbon, water and energy exchanges:** The eddy covariance network will provide a comprehensive data base of carbon, water and energy fluxes and associated variables based on high standardisation procedures. In the first phase of the project the existing data base will be adapted and implemented with both the existing datasets coming from the several European and national projects and the new data coming from the network. In selected sites, where these are relevant, other non-$CO_2$ fluxes will be measured, if external funding is available, and collected a in the data-base.

**Task 1.1.3 Assessment of carbon budgets of the European landscape elements:** Carbon budget estimates will be carried out by means of annual sums and gap filling with state-of-the-art methodologies and errors and uncertainties will be evaluated. Annual carbon budget data will be used to assess the variability and diversity of European landscape components.

**Task 1.1.4 Assessment of ecosystem site network**

It is planned to generate a comprehensive scientific analysis using multivariate statistical analysis and optimisation theory to assess the current distribution of flux sites and to redesign the spatial distribution of sampling in terms of ecosystem, climate, soils and management regimes. This analysis will occur within the first two years. The results of the analysis could be in maintaining some of the stations but a reallocation of the existing network in undersampled areas or specific ecosystems of particular relevance will be considered. This result could be used in the future for implementation of an operational carbon data observation system at European level.

**Task 1.1.5** Establishment and operation of ecosystem data centre

**Deliverables**

1.1.1 Protocol for measurements and data delivery finished and approved (Month 6)
1.1.2 Highly standardised and fully operational eddy covariance flux network (Month 6)
1.1.3 Data base with past datasets, historical time series and first year continuous flux data of carbon, water energy and the associated meteorological and ecological variables at the IP Main Sites (Month 12)
1.1.4 First assessment of carbon budgets and associated errors by land use/ cover types (Month 18)
1.1.5 Assessment of ecosystem site network – first results (Month 18)

**Milestones and expected result**

Month 1: Workshop on approval on new harmonisation and calibration standards
Month 3: Full operational status of the networks with common standards
Month 7: Start data delivery at six-monthly interval to the database
Month 18: workshop on assessments of carbon budgets by land use and land cover types

**WP 1.2 Quality assurance**

| Work package number | WP1.2 | Start date or starting event: | Month 1 |
|---|---|---|---|
| Activity type | RTD | | |
| Participant id (Person-months) | FUSAGx (12), CEALP (6), LUND (3), TUD-IHM (6), UBT-MET (9) | | |

**Objectives**

- To perform footprint dependent flux evaluations and data quality tests for all Main Sites
- To update flux quality control tools and to provide them to all flux sites
- To improve the understanding of the atmospheric processes that develop at night, and the advection and storage at different sites subjected to different topographies.

**Description of work**

**Task 1.2.1 Footprint and quality assessment of main flux sites:** Each of the Main Sites of the cluster flux network will be evaluated by means of quality checks on eddy covariance data as well as for the representativeness of the fluxes of the respective footprints. To this purpose each Main Site footprint will be evaluated on the basis of a georeferenced land use/cover digital map. This information will be provided to the flux database as additional information for modellers as well for further flux corrections and error analysis.

**Task 1.2.2 Improvement of quality control procedures on eddy covariance data:** New methodological components (planar fit rotation, ogive-test) as well as suitable quality control procedures will be developed. An high quality sensor set-up and associated methodical issues will be developed to investigate the energy balance closure as a control method for eddy covariance measurements. The Waldstein-Weidenbrunnen site of the University of Bayreuth will be used as a data quality test station.

**Task 1.2.3 First analysis of nocturnal fluxes and associated problems due to complex topographies:** Accurate measurements of $CO_2$ fluxes during night conditions will be performed. To this end, a mobile advection and storage measurement system will be set up. In this first phase it will be installed during short campaigns (2-3 months) at 2 sites already equipped with eddy covariance systems and characterised by different topographies. The aims of the comparison is to define the topographic and the meteorological conditions under which night advection and storage are important. This will allow the evaluation of the classical u* correction currently used during night periods and the proposition of a more precise method.

**Deliverables**

1.2.1 Footprint dependent data quality check of the Main Sites (Month 18)
1.2.2 Provision of quality control-tools for eddy covariance measurements (Month 18)
1.2.3 Estimation of storage and advection terms in 2 sites (Month 18)
1.2.4 Preliminary evaluation of night flux correction algorithms for night flux (Month 18)

**Milestones and expected result**

Month 3: workshop on co-ordination of flux footprint and quality evaluation of Main Sites
Month 6: Installation of the advection/storage measurement set up at the first site
Month 12: Final assessment of data quality of flux towers and improvements
Month 16 : Installation of the advection/storage measurement set up at the second site
Month 18 : Assessment of carbon exchanges errors and uncertainties at all sites

**WP 1.3 Soil**

| Work package number | WP1.3 | Start date or starting event: | Month 1 |
|---|---|---|---|
| Activity type | RTD | | |
| Participant id (Person-months) | MPI-BGC (36), SLU-FS (12), SLU-DEER (6), SUN (6), TUM (6), MLU (6) | | |

**Objectives**

- To start assembling soil information in the footprint of all Main Sites
- To provide initial soil information to estimate soil carbon changes at selected sites
- To increase process understanding of carbon immobilisation in soils
-

**Description of work**

**Task 1.3.1 Mapping soil types**: Soils in the footprint of the Main tower Sites need to be mapped in a harmonised way. Based on existing data on carbon concentrations of soil types we will derive an initial estimate of soil carbon pools at all Main Sites in the course of the project. The Task will start this mapping initiative at up to 12 Main Sites (Verification Sites, to be determined at Kick-Off Meeting).
**Task 1.3.2 Soil sampling**: We will take the initial set of samples in the footprint of up to 12 Verification Sites (3 deciduous forest, 3 coniferous forest, 3 grassland, 3 cropland). We will take 100 samples in 7 depths per site, and analyse 100 samples in 5 depths for C/N, bulk density and stone content.
**Task 1.3.3 Carbon immobilisation in soils**: A subset of 10 cores per soil sampling site will be taken for a detailed analysis of soil texture, the light fraction of C-particles as a measure of labile C, and analysis of $^{13}C$, $^{14}C$, $^{15}N$, C mineralisation and specific compounds that indicate change in carbon stocks in specific pools. The chemical analyses will start in the first 18 month but will probably take as long as the CarboEurope-IP lasts.

**Deliverables**

1.3.1 Initial geo-referenced soil map in the footprint of up to 12 main tower sites (Month 18)
1.3.2 Geo-referenced geo-statistical soil sampling of 100 cores in the footprint of up to 12 selected tower sites. Initial determination of carbon stocks in 100 cores per site by horizon (Month 18)
1.3.3 Analysis of texture, C/N and partly of carbon chemistry in a smaller number of cores (<300 for 12 sites) in progress (Month 18)

**Milestones and expected result**

Month 12: Sampling of 12 sites, mapping of soils at up to 12 sites terminated
Month 3: Initiate analysis of samples

**WP 1.4 Forest**

| Work package number | WP1.4 | Start date or starting event: | Month 1 |
|---|---|---|---|
| Activity type | RTD | | |
| Participant id (Person-months) | UEDIN (6) | | |

**Objectives**

- To provide data on vegetation, leaf area index, NPP and its components at the forest Main Sites.
- To provide relationships between NPP and NEP and forest structure, age, global warming potential (e.g. GHGs) and nitrogen deposition.
- To investigate the effects of management and disturbance, including afforestation and reforestation on the net carbon balance.
- To simulate with process-based models the seasonal, inter-annual variation in net trace gas ($CO_2$, $CH_4$, $N_2O$) fluxes for selected forests at site level.
- To provide data for model parameterisation and up-scaling to the European continent for forests

**Description of work**

Some of the above data have already been collected in FP5 CarboEurope. It is anticipated that many sites will require some upgrading of their practices to supply harmonised data, to ensure that all the required variables for modelling are collected adequately.

**Task 1.4.1 Harmonise data acquisition**: The first step is to identify what is missing, and for those where data are available, to check consistency of the methodology. Visits will be made to all sites to collect structural and management data, and to ensure that NPP measurements are being made to a common protocol. Special attention will be paid to chronosequence sites, and to sites where typical types of disturbance are observed. New measurements of the decay rates of coarse woody debris will be required, as in the FP5 project CarboAge and Forcast it was evident that fluxes from this source remain important over many years.

**Task 1.4.2 Model Parameterisation**: Flux models developed in FP5 will be parameterised with the data obtained from the forest sites, and verified against the observed flux data. It will be possible from these models to estimate the impacts of climate warming, elevated $CO_2$ and changes in management practices.

**Deliverables**

1.4.1 Stand characteristics of the forest sites: including structure, roughness, albedo, management cycle (Month 12)
1.4.2 Exploration of the climatological and management information as control of the C-fluxes (Month 18)

**Milestones and expected result**

Month 3: Communicate with site managers, establish protocols and data exchange mechanisms
Month 12: Site visits, data collection
Month 12: Begin evaluation of data using models
Month 18: Preliminary report on model performance, data quality and data gaps

**WP 1.5 Cropland**

| **Work package number** | **1.5** | **Start date or starting event:** | **Month 1** |
|---|---|---|---|
| **Activity type** | RTD | | |
| **Participant id (Person months)** | UNIABDN (18) | | |

**Objectives**

- To collate data provided from cropland Main Sites on crop type, development of leaf area, NPP and its components
- To investigate emission of other GHG gases under different types of management using data provided by cropland Main Sites and from other sources
- To collate data on the effect of agricultural practices on soil organic carbon input (root biomass, organic manure, straw etc.) provided by cropland Main Sites for the present and the past
- To simulate with process-based models the seasonal, inter-annual and long-term variations in net trace gas ($CO_2$, $CH_4$, $N_2O$) fluxes for croplands at site level
- To provide data for model parameterisation and up-scaling to the European croplands

**Description of work**

**Task 1.5.1 Data consolidation**: This task will start to compile data from all cropland sites to begin to quantify NPP and its components, non-$CO_2$ GHG fluxes, and start to delineate how these factors are affected by climate, crop type and management. This will involve a range of data being collected under standard protocols which will be developed for the measurement of all cropland components (e.g. bulking, number of samples, where and how to sample, methods of analysis etc.), and for data formats (for standardisation and compatibility with flux data).

**Task 1.5.2 Start Meta-analysis:** This task will not only provide initial data needed to complement the flux measurements for the clusters, but also provide initial quantitative and predictive understanding of what controls the fluxes in cropland sites. This WP builds heavily on ongoing work in Europe and its main purpose is to synthesise work funded through other sources. By collating data from all cropland sites across Europe, a meta-analysis (e.g. multiple regression, multivariate analysis, general linear modelling) and modelling of the data (using ecosystem models such as Century, MAGEC/Sundial/RothC, STICS, DNDC) will allow the impacts of climate, soil type, crop type and management to be delineated.

**Deliverables**

1.5.1 Standard protocols for measurements on all non-flux cropland components (Month 6)
1.5.2 Collation and quality control of non-flux cropland components from all cropland sites (Month 12)
1.5.3 Preliminary analysis of European trends in impact of climate and management on cropland $CO_2$ (and non-$CO_2$ GHG) fluxes (Month 18)
1.5.4 Preliminary evaluation and improvements of cropland ecosystem models (Month 18)

**Milestones**

Month 1: Begin collation and quality control of non-flux cropland site data already available (management, site history etc.)
Month 5: Draft standard protocols circulated for comment to all cropland sites
Month 6: Begin collation and quality control of ongoing non-flux cropland data (e.g. NPP, fertiliser addition etc.)
Month 6: Standard protocols finalised and approved
Month 12: Assessment of data quality of non-flux cropland data and improvements
Month 12: Begin testing data using meta-analysis and cropland ecosystem models
Month 18: Preliminary report on model performance, data quality and data gaps

**WP 1.6 Grasslands/Wetlands**

| Work package number | 1.6 | Start date or starting event: | Month 1 |
|---|---|---|---|
| Activity type | RTD | | |
| Participant id (Person months) | INRA (18), FAL (6) | | |

**Objectives**

- To provide ecological parameters and NPP components of the grassland/wetlands sites of the clusters network including harvest and grazing
- To investigate the carbon balance at selected grassland/wetland sites
- To provide data for model parameterisation and up-scaling to the European continent for grasslands

**Description of work**

**Task 1.6.1 Standardised protocols for measurement of ecological (e.g. vegetation) parameters and of the components of NPP at the grassland/wetland sites:** The relevant information on vegetation structure, site history, regime of management will be collected from all sites. Secondly a full protocol of measurements of NPP and its components will be designed. Data on vegetation, development of leaf area, NPP and its components including harvest and grazing will be collected by this activity and provided to the flux data base.

**Task 1.6.2. Model parameterisation and validation:** A mechanistic grassland ecosystem model (PASIM) developed under the FP5 project 'Greengrass' will be further adapted to predict the net exchange of greenhouse gases from permanent and short duration grasslands. In his first phase the PASIM model will be parameterised and evaluated against the data from the main grassland sites of the cluster network.

**Task 1.6.3 Contribution to upscaling.** A coupled version of the PASIM and ORCHIDEE first developed under the FP5 project 'GreenGrass' will be parametrised by region and grassland type in order to contribute to the bottom-up simulation of pan-European $CO_2$ fluxes over grasslands.

**Deliverables**

1.6.1 Data on vegetation, NPP and its components at the grassland/wetlands sites of the cluster network (Month 18)

1.6.2 Data on the components of the carbon balance of the main sites (Month 18)

1.6.3 Calibration of the grassland model with the first year data and simulation of fluxes from each main grassland site (Month 18)

1.6.4 Simulated $CO_2$ fluxes of grasslands for current agricultural management scenarios (Month 18)

**Milestones**

Month 1: workshop on measurement protocols and standardisation of experimental plot management at the main grassland/wetland sites

Month 18. A version of the PASIM model suitable for long-term simulations of trace gas fluxes and carbon sequestration potentials for sown grasslands, permanent grasslands.

Month 18 : Assessment of the annual NPP and its components at the main grassland/wetland sites.

**Component 2 Atmosphere**

**WP 2.1 Ground level stations continuous $CO_2$ and $^{222}Rn$ measurements and data management**

| **Work package number** | **WP2.1** | **Start date or starting event:** | **Month 1** |
|---|---|---|---|
| **Activity type** | RTD | | |
| **Participant id (Person-months)** | CEA-LSCE (8), UHEI-IUP (6), CIO (0), UBERN (3), FMI (0), UKRAK (0), ISAC-CNR (0), CESI (0), ENEA (0), SU (0) | | |

**Objectives**

- Continue to monitor $CO_2$ and $^{222}Rn$ continuously at a core of up to 12 European stations
- Deliver to the database raw concentration data, selected concentration data, and auxiliary information on meteorology and other relevant species

**Description of work**

**Task 2.1.1 The European network of $CO_2$ stations:** *In situ* hourly mean $CO_2$ concentrations and meteorological data from up to 12 ground-level stations will be collected from 10 laboratories and delivered to the database in a harmonised format. Useful data products such as statistics on concentration variability, seasonal cycles, monthly means will be computed and placed in the database. Data and meta-data will be documented and updated every 6-month.

**Task 2.1.2. Continuous sampling of $^{222}Rn$ at the stations:** $^{222}Rn$ is a tracer of air masses under recent continental influences. It is widely used to validate vertical mixing (e.g. PBL depth) and synoptic transport in models. In Europe, a network of 9 $^{222}Rn$ stations already exists, but we need to integrate it with $CO_2$ observations. Then, $^{222}Rn$ recorded on a quasi continuous basis (every 1/2 hour) will be used to select $CO_2$ data for regional representativity.

**Task 2.1.3. Quantification of representativeness "errors":** Near the ground, the variability in concentrations (e.g. diurnal cycle) is huge, because the air is to a large extent influenced by local sources and sinks. In order to filter the effect of local (few tens of km) variability from the regional signal, one needs to continuously monitor concentrations. *In situ* $CO_2$ continuous data will be selected empirically into "local" and "regional" using meteorological information and back-trajectory analysis. Alternatively, we will test very-high resolution atmospheric transport models fitted with local emission maps to simulate the concentration variability around each site and model the data selection.

**Task 2.1.4** Establishment and operation of atmosphere data centre

**Work plan**

- Operate 8 existing continuous $CO_2$ stations: Mace-Head (IRL), Westerland (D), Schauinsland (D), Plateau Rosa (I), Puy de Dome (FR), Cimone (I), Pallas (FIN).
- Support 5 additional continuous stations: Lutjewad (NL), Jungfraujoch (CH), Lampedusa (I), Zeppelin (NW) and Kasprowy (PL).
- Co-locate continuous monitoring of $^{222}Rn$ with $CO_2$ measurements, by adding $^{222}Rn$ equipment at, Westerland (D), Zeppelin (NW) and Lutjewad (NL).
- Report to the database each 6 months raw $CO_2$ and $^{222}Rn$ data, meteorology, selected data with minimised local influences, and wherever possible other relevant species data such as $CH_4$ and pollutants.

**Deliverables**

2.1.1 An atmospheric network of up to 12 surface $CO_2$ and $^{222}Rn$ stations (Month 12)

2.1.2 A database of atmospheric measurements, updated each 6-months, with raw concentration data, selected data, and auxiliary information (Month 18)

**Milestones and expected result**

Month 12: Atmospheric Network operational

Month 18: Database with 6-monthly update of data

**WP 2.2 Tall towers continuous measurements of $CO_2$, $CH_4$, $SF_6$, $N_2O$, CO,**

| Work package number | WP2.2 | Start date or starting event: | Month 1 |
|---|---|---|---|
| Activity type | RTD | | |
| Participant id (Person-months) | ECN (9), MPI-BGC, CEA-LSCE, UBARC, UNITUS, ELU, LUND, UEDIN | | |

**Objectives**

- Operate a network of up to 9 tall towers for continuous regionally representative $CO_2$, $CH_4$, $SF_6$, $N_2O$, CO and $^{222}Rn$ (selected sites) measurements.
- Deliver to the CarboEurope measurement database concentration data, selected background concentration data, and ancillary information on meteorology
- Linking of flux measurements in 3 tall towers and nearby located smaller flux towers to the vertical concentrations profile

**Description of work**

**Task 2.2.1 The network of tall towers:** We will continue to support the routine operations of up to 8 tall towers once the FP5 project CHIOTTO terminates in 2005. *In situ* concentration and meteorological records from the tall towers will be delivered to the database in a harmonised format compatible with ground level stations data. One additional tall tower will be equipped starting in 2004 at La Muela to better constrain regional fluxes over the Iberian Peninsula. One tall tower in Southern France will be added to the network for one year during the Regional Experiment planned in the IP, measuring $CO_2$ only.

**Task 2.2.2 Linking tall towers concentration profiles and local ecosystem fluxes:** At tall towers where there are eddy covariance systems measuring NEE, this information will be used to screen out local influences and assess regional representativity of tall towers concentration time series, this work is part of a workpackage of the CHIOTTO project called Accompanying Flux Tower Operation. In Task 2.2 we will simulate the vertical profiles of concentrations along the masts at Norunda, Hegyhatsal and Cabauw, and relate them to available eddy covariance data in the same masts or in flux towers nearby, using 1-D or 3-D high resolution PBL-transport models. At all tall tower sites, the nocturnal accumulation of $CO_2$ and other atmospheric species ($CH_4$, $N_2O$ and $^{222}Rn$ where available) in shallow night-time boundary layers will offer the possibility to obtain independent estimates of night-time Ecosystem fluxes, where possible using $^{222}Rn$ of known sources to quantify unknown respiratory emissions of $CO_2$.

**Description of work part of Chiotto FP5 project (no funding)**

- Continue to support the 8 tall towers routine operations after FP5 project CHIOTTO terminates at Hegyhatsal (Hu), Cabauw (NL), Orléans (FR), Ochsenkopf (G), Edinburgh (UK), Florence (I), Norunda (S) and Bialystok (PL).
- Deliver to the database tall tower concentration records with compatible data format as the ones of ground level stations.
- Coupling of vertical concentration gradient measurements and eddy flux measurements in tall towers and nearby flux towers for Cabauw and Norunda using detailed 3D models and study of night-time boundary layer accumulation of $CO_2$ and other greenhouse gases

**Work plan of CarboEurope-IP**

Install one additional tall tower site for $CO_2$ only at La Muela (SP) by 2005

**Deliverables:** None

**Milestones and expected result**

Month 18: Tall tower at La Muela (SP) expected to be operational in the atmospheric observing system

**WP 2.3 Flask air sampling for multiple species analysis**

| Work package number | WP2.3 | Start date or starting event: | Month 1 |
|---|---|---|---|
| Activity type | RTD | | |
| Participant id (Person-months) | UBERN (9), CEA-LSCE (8), MPI-BGC (9), CIO (0), UHEI-IUP (3) | | |

**Objectives**

- Flask sampling of air at 8 continuous surface stations, 5 tall towers, 4 aircraft sites (10 altitudes), and 11 "flask sampling only" sites
- Interpret multiple-species flask measurements of $\delta^{13}C$-$CO_2$, $\delta^{18}O$-$CO_2$, $CH_4$, CO, $N_2O$, $SF_6$, $O_2$:$N_2$ to apportion in conjunction with WP5 the European $CO_2$ gradients into components. fossil, biospheric, oceanic, and to infer large scale isotopic fractionation by European ecosystems

**Description of work**

**Task 2.3.1. The European co-operative flask sampling network:** The five European laboratories of this Workpackage have the capability to make high precision multiple species measurements in flask air samples. These laboratories are well experienced at working together within EU programmes for more than 10 years. Common work includes analytical developments, sharing of sampling devices and flasks, as well as frequent intercomparison exercises. We will collect weekly flask samples at 21 European locations for analysis of $CO_2$, $CH_4$, $N_2O$, $\delta^{13}C$ in $CO_2$, $\delta^{18}O$ in $CO_2$, CO and at a subset of stations for $O_2$:$N_2$ as part of a co-operative effort involving Europe, USA and Australia. All flask data will be reported in a harmonised way to a Central Database.

**Task 2.3.2. Multiple-species interpretation of the European carbon balance:** Co-ordinated flask sampling at aircraft sites, tall towers and ground-level stations will provide multiple species information of unique value to separate air-sea exchange (using $O_2$:$N_2$), terrestrial fluxes ($^{13}C$ and $^{18}O$ in $CO_2$), and fossil fuel emissions (CO, $SF_6$, NMHCs). The multiple species inferences will place strong independent constraints on bottom up estimates of the fluxes. Flask data of $CH_4$ and $N_2O$, in conjunction with tall towers records will enable us to infer the European sources of these gases. We will analyse $\delta^{13}C$-$CO_2$ and $\delta^{18}O$-$CO_2$ isotope records to determine the large scale time-varying isotopic fractionation of European ecosystems via the isotopic source signature of air added to or removed from the mean atmospheric signal.

**Task 2.3.3. Development of innovative techniques:** We will work on analytical developments for adding new species measurements with high-precision in flask air, focused on Ar:$N_2$ (tracer of transport over land); linear NMHC (tracers of air pollution), and $\delta^{13}C$ in $CH_4$ (tracer to apportion $CH_4$ sources).

**Work plan**

- Continue to support European flask sampling activities at 23 sites, including cross-sampling by different laboratories at common sites to assure intercomparability of flask measurements
- Interpret flask records $\delta^{13}C$ in $CO_2$ and $O_2$:$N_2$ gradients among sites to independently separate terrestrial and oceanic components.
- Use isotopic $\delta^{13}C$ in $CO_2$ and $\delta^{18}O$ in $CO_2$ flask records to determine large scale isotopic fractionation patterns of European ecosystems
- Use tracers such as $SF_6$, and APO (a linear combination of $O_2$:$N_2$ and $CO_2$ to correct for land biotic sources) to validate transport parameterisations in atmospheric tracer transport models
- Report each 6 months flask sample data to database

**Deliverables**

2.3.1 Network of up to 24 flask sampling stations in Europe out of which 10 are run by CMDL (Month 6)

2.3.2 Dataset to separate the European $CO_2$ gradients into components (oceanic, terrestrial, fossil) (Month 12)

**Milestones and expected result**

| |
|---|
| Month 12: Network of up to 24 flask sites<br>Month 18: Database with 6 month flask samples data |

**WP 2.4 Vertical aircraft profiles of *in situ* $CO_2$ and flask samples**

| Work package number | WP2.4 | Start date or starting event: | Month 1 |
|---|---|---|---|
| Activity type | RTD | | |
| Participant id (Person-months) | CEA-LSCE (8), MPI-BGC (9), UEDIN (0), ELU (0), UHEI-IUP (3), UBARC (0) | | |

**Objectives**

- Measure regular "low-frequency" each 20-days vertical profiles of atmospheric $CO_2$ using small aircraft at 4 sites
- Collect flask samples onboard aircraft each 20 days at 10 altitude levels and analyse them for $\delta^{13}CO_2$, $\delta^{18}O$-$CO_2$, $CH_4$, CO, $N_2O$, $SF_6$, $O_2$:$N_2$

**Description of work**

**Task 2.4.1. The European network of aircraft sites (2004-2006)**

We will continue the effort undertaken in 2000-2003 within FP5 to characterise the vertical gradients of $CO_2$ and other species in the lower troposphere using small aircraft. Two aircraft sites among the 6 operating now will however be stopped: Schauinsland (D) in 2005 and Thüringen (D) in 2004. We will continue to fly four small aircraft each 20 days in the interval 2004-2006 with flask sampling at 10 altitudes in order to obtain a multiple species dataset of 6-years long on an East-West transect across Europe at Hegyhatsal (H); Bialystok (PL); Orleans (FR); Griffin (UK). Those four aircraft sites are geographically co-located with tall towers. The aircraft flask results will be reported to the data base together with *in situ* information on sampling and on atmospheric structure (temperature and humidity). Another aircraft site will be installed in Northern Spain with national funding.

**Work plan**

- Fly each 20-days over Orleans (FR) tall tower before 2006 up to 3 km, with *in situ* $CO_2$ and CO, flask sampling
- Fly every 20 days over Griffin (UK) tall tower before 2006 up to 3 km with flask sampling
- Fly every 20 days over Hegyhatsal (Hu) tall tower before 2006 up to 3 km, with flask sampling
- Fly every 20 days over Bialystok (PL) tall tower before 2006 up to 3 km, with *in situ* $CO_2$, flask sampling
- Fly every 20 days over Schauinsland (D) until 2005 with *in situ* $CO_2$ and CO to assess representativity of the mountain station
- Equip Griffin and Hegyhatsal aircraft with $CO_2$ *in situ* instruments in 2005

**Deliverables**

2.4.1 Data from four aircraft sites (each 20 days) on an East-West transect in temperate Europe (Month 6)

2.4.2 Assessment of representativity of Schauinsland mountain station based on aircraft and ground level data (scientific paper) (Month 18)

2.4.3 Flask multiple-species data of aircraft profiles at 10 levels per flight (Month 12)

**Milestones and expected result**

Month 6: Network of 4 aircraft sites with flask sampling profiles each 20 days

**WP 2.5 Quality control of atmospheric measurements**

| Work package number | WP2.5 | Start date or starting event: | Month 1 |
|---|---|---|---|
| Activity type | RTD | | |
| Participant id (Person-months) | MPI-BGC (0), UHEI-IUP (0), CEA-LSCE (0), CIO (0), UBERN (0), UNITUS (0), UEDIN (0), ECN (0), ELU (0), ALTERRA (0), LUND (0) | | |

**Objectives**

Quantify and monitor in a dynamic fashion calibration scale differences of Greenhouse Gases and related tracer measurements between the European laboratories and field stations contributing to the Atmospheric Observing System

**Description of work**

**Task 2.5.1.** Dynamic monitoring of inter-laboratory comparability of calibration scales
We will continue after FP5 projects stop in 2005 the frequent exchange every 2 months of flask samples filled with air of known concentration to assess differences in $CO_2$, $CH_4$, $^{13}C$-$CO_2$, $^{18}O$-$CO_2$, N2O, and CO between the 4 laboratories with flask analytical capabilities. We will also develop an $O_2/N_2$ intercomparison strategy for 3 participating European laboratories, and establish links of these $O_2/N_2$ scales with the internationally recognised scales in the USA. Based on the experience gained in the ongoing FP5 projects, we will decide in 2006 whether high pressure or low pressure cylinders are most appropriate and cost-effective to carry out frequent laboratory intercomparisons. Intercomparison results will be reported to the database using web technology, and to the WMO-GAW international $CO_2$ Experts group.

**Description of work part of Tacos and Chiotto FP5 projects (no funding)**

- Continue frequent exchange of flasks and low pressure cylinders between participating laboratories in Tacos
- Develop frequent exchange of high pressure cylinders among the tall towers being set up in CHIOTTO
- Develop $O_2/N_2$ intercomparison methodologies, with emphasis on linking European measurement scales to the international scales in TACOS

**Deliverables**

None (part of FP5)

**Milestones and expected result**

None (part of FP5)

**WP 2.6 Radiocarbon and CO analysis to quantify fossil fuel emissions**

| Work package number | WP2.6 | Start date or starting event: | Month 1 |
|---|---|---|---|
| Activity type | RTD | | |
| Participant id (Person-months) | UHEI-IUP (6), CIO (0), CEA-LSCE (8), UKRAK (0) | | |

**Objectives**

- Continue the existing $^{14}CO_2$ observational network in Europe to directly derive the monthly mean fossil fuel $CO_2$ component at polluted and background sites.
- Establish methodology for "calibration stations" in Western, Central and Eastern Europe to provide an ongoing calibration of CO as a proxy for fossil fuel $CO_2$ (determine the mean $CO/CO_2$ ratio of fossil fuel sources)

**Description of work**

**Task 2.6.1. Determine the fossil fuel $CO_2$ component in Europe from $^{14}CO_2$ measurements**

We will continue high-precision quasi-continuous $^{14}CO_2$ sampling and analysis at the marine stations Mace Head and Izaña to accurately define the changing Atlantic $^{14}CO_2$ background in mid northern latitudes. We will continue high precision (<3‰) $^{14}CO_2$ measurements at the high altitude Alpine site Jungfraujoch, at the mountain site Schauinsland as well as at the coastal site Lutjewad for direct determination of the fossil fuel $CO_2$ component over Europe.

**Task 2.6.2. Provide a calibration of CO as a proxy for fossil $CO_2$ at three urban stations**

We will establish a set of three CO/fossil $CO_2$ "calibration" stations in urban/industrial polluted environments representative of Western Europe and Eastern Europe. Those sites are Paris, Heidelberg and Krakow. In Paris, France where 90% of the electricity production is non-fossil, the CO/fossil $CO_2$ ratio is one of the highest in Western Europe because it reflects car traffic only. In Heidelberg Germany, we have both industrial emissions with a "clean" combustion efficiency and car traffic from recent car fleet. In Krakow Poland, we expect industrial processes with higher $CO/CO_2$ emission ratio and car traffic from older car fleets. We will continue $CO_2$, CO and weekly-integrated $^{14}CO_2$ measurements at Heidelberg for calibration of CO as a proxy for fossil fuel $CO_2$ and to develop the methodology for the Paris and Krakow calibration sites.

**Work plan**

- Continue high-precision quasi-continuous $^{14}CO_2$ sampling and analysis at the marine stations Mace Head and Izaña to define the marine $^{14}CO_2$ background in mid northern latitudes.
- Continue high precision (<3‰) $^{14}CO_2$ measurements at Jungfraujoch (CH), Schauinsland (G) and Lutjewad (NL) for direct determination of the fossil fuel $CO_2$ component over Europe.
- Establish first "CO calibration site" at Heidelberg (G) to develop methodology for future sites in Western (e.g. Paris) and Eastern (e.g. Krakow) Europe

**Deliverables**

2.6.1 Network of 5 high precision bi-weekly integrated $^{14}CO_2$ monitoring sites (Month 6)
2.6.2 Establishment of first CO calibration site in Heidelberg (Month 18)

**Milestones and expected result**

Month 6: Monthly mean fossil fuel $^{14}CO_2$ component at 5 European sites
Month 18: Methodology of accurate CO calibration

**WP 2.7 Calibrated $CO_2$ concentration measurements at eddy covariance towers**

| **Work package number** | **WP2.7** | **Start date or starting event:** | **Month 1** |
|---|---|---|---|
| **Activity type** | RTD | | |
| **Participant id (Person-months)** | ALTERRA (2), CEA-LSCE (0.5) | | |

**Objectives**

- Select up to 10 eddy towers to implement calibration tests

**Description of work**

**Task 2.7.1. Feasibility study to calibrate atmospheric $CO_2$ eddy covariance towers**

- Continuation, as part of Tacos, of the development of a simple instrumental modification to calibrate $CO_2$ on top of Eddy Covariance towers.
- Develop a methodology to use $CO_2$ records on short towers in regional inversion, based on ongoing research in the US, on analysis of tall towers profile data at Hegyhatsal (Hu) and Cabauw (NL), and of the Pallas (Fi) station where there is a nearby eddy covariance tower.

**Task 2.7.2. Pilot network of calibrated $CO_{2\,at}$ eddy covariance towers**

- We will begin to implement $CO_2$ calibration on top of up to 10 eddy flux towers selected for flat terrain, as a joint activity with the Ecosystem Component of the IP.
- By Month 24, implementation of $CO_2$ calibration on top of 3 eddy flux towers selected for flat terrain and small local sources influence

**Deliverables**

None

**Milestones and expected result**

Month 12: Sites and partners selected for pilot network of calibrated $CO_{2\,at}$ eddy covariance towers

**Component 3 Regional Experiment**

**WP 3.1 Experiment planning, data consolidation and data management**

| Work package number | WP3.1 | Start date or starting event: | Month 1 |
|---|---|---|---|
| Activity type | RTD | | |
| Participant id (Person-months) | CNRM (13), VU-A (6), CEA-LSCE (6), USTUTT-IER (12), IBIMET-CNR (2), CNR-ISAFOM (2), INRA (6) | | |

**Objectives**

- start to collect existing main climate, weather, soil and land use data of the area
- to produce a 2 km resolution database of fossil fuel emission for the area
- to write the experimental plan using a high-resolution modelling framework
- to develop and maintain an easily accessible system for data entry, storage and retrieval for all regional modelling efforts

**Description of work**

**Task 3.1.1:** Data that had been collected by CNRM for HAPEX-Mobilhy and subsequent hydrological monitoring efforts will be made available and extended where needed. The data consists of land cover, albedo, roughness, soil, and hydrology maps. Data will be updated as needed. New is the development of additional databases carbon storage in soils and biomass (INRA), and on fossil fuel emissions at 2 km resolution. New maps show land cover and management history and crop rotation at a level of detail to which they remain reliable.

It is important that these data are available and maintained at a high level of temporal and spatial accuracy through a single institution (CNRM in Toulouse). The University of Stuttgart will produce emission maps to a 2 km resolution using regional level emission data and land cover maps.

**Task 3.1.2:** We plan to execute a small test campaign in May 2004 to determine the best deployment strategy of the instruments, and to acquire high-resolution remote sensing images of the area from the Sky Arrow research aircraft. Based on the results of this experiment we will fine-tune our experimental plan for the yearlong observations developed in Task 1.3. The test campaign will also test the regional weather forecasting system for future flight planning.

**Task 3.1.3:** Based on existing data on mesoscale weather we will use regional inverse models to plan flight patterns and the position of additional flux towers. This will produce an experimental plan in which the systems are deployed in those areas where they give the greatest contribution to efforts reducing the uncertainty in the a-priory estimate. This will also indicate the preferred time frequency of the measurements and the preferred mode of operation e.g. Lagrangian vs. Eulerian. Preliminary testing of this plan is foreseen in June 2004.

**Deliverables**

3.1.1 Maps of soil (structure C-content) for fast and slow carbon models (INRA, Month 12)
3.1.2 Maps of land use for carbon models (CNRM/INRA, Month 12)
3.1.3 Maps of biophysical parameters (albedo, roughness etc) (CNRM, Month 12)
3.1.4 Climatology based on downscaled synoptic weather data at 8 km resolution (CNRM, Month 12)
3.1.5 Fossil fuel inventory at 2km resolution (USTUTT, Month 12)
3.1.6 Experimental plan for the experimental and intensive observation period (all, Month 12)

**Milestones and expected result**

Month 12 Maps of land cover, biophysical properties, soils and biomass inventory
Month 12 Inventory of fossil fuel emissions at 2 km resolution
Month 12 Downscaled weather at 8 km resolution
Month 12 Experimental plan for the experimental and intensive observation period

**WP3.2 Surface flux and aircraft flux measurement**

| **Work package number** | **WP3.2** | **Start date or starting event:** | **Month 1** |
|---|---|---|---|
| **Activity type** | RTD | | |
| **Participant id (Person-months)** | IBIMET-CNR (4), INRA (12), CNR-ISAFOM (1), ALTERRA (2), CNRM (4) | | |

**Objectives**

- To start to measure of $CO_2$ fluxes and energy balance above the main vegetation types
- To measure fluxes of heat, water vapour, $CO_2$ and momentum with a low flying research aircraft (Sky Arrow) during the test campaign
- To test the feasibility of measuring the city emissions of Bordeaux and Toulouse at test campaigns

**Description of work**

In the first 18 months an intensive campaign will test the logistics in month 17 (May 2005). The Extended Observation Period is planned for 2006.

**Task 3.2.1**: Biospheric surface fluxes of heat momentum, water vapour, $CO_2$, and, at some sites, $O_3$ and N will be measured half-hourly using the eddy covariance technique at four permanent sites. The Laqueuille grassland is monitored since 2001 and the 35 yr-old Pine forest Le Bray since 1996 as part of the French flux cluster. Two sites represent a regrowth of clearcut forest (Bilos, since 1999) and a vineyard (Couhins). A roving eddy system will be added during the extensive measurement campaign using a battery-powered open-path system. We will take account of both C3 and C4 plants as their atmospheric signature is different.

**Task 3.2.2**: One Sky-Arrow of the Italian partner IBIMET fully equipped for flux measurements will be used during the test campaign in 2005 to perform at least 8 different transects over the area to quantify the spatial heterogeneity. This plane, also equipped with high resolution remote sensing (visible-infrared), will make high-resolution images of the area that can be used for planning of future flights. We will use a second Sky Arrow from ISAFOM to acquire high resolution remote sensing imagery along selected transects near potential tower sites.

**Task 3.2.3**: At selected periods we will use the Sky Arrow to fly transects downwind of the major cities in the area, Toulouse and Bordeaux to test the feasibility of obtaining independent checks on the emissions of large cities.

**Deliverables**

3.2.1 Set of flux data for the main vegetation sites (Month 18)

3.2.2. Datasets of fluxes of water vapour, heat, momentum and $CO_2$ for selected transects during the test campaign and the extended and intensive observation period (Month 18)

3.2.3 Emission checks on city fluxes with the flux aircraft (Month 15)

**Milestones and expected result**

Month 18 Datasets of high resolution spectral imagery from the aircraft near actual and potential tower sites

Month 6 Identification additional sites for extended observation period based on land use classification and potential to contribute to uncertainty reduction

Month 15 Emission estimate from Bordeaux using Sky Arrow fluxes

Month 18 Full 1.5 year of flux data according to Ecology protocol

Month 18 Datasets of fluxes of $CO_2$, temperature, momentum and heat from the flux aircraft for the test campaign

**WP 3.3 Scalar Concentration measurements**

| **Work package number** | **WP3.3** | **Start date or starting event:** | **Month 10** |
|---|---|---|---|
| **Activity type** | RTD | | |
| **Participant id (Person-months)** | MPI-BGC (6), CEA-LSCE (3), CNRM (2), VU-A (4) | | |

**Objectives**

- To start to take high precision measurements of $CO_2$ concentrations and $^{14}C$ at one to two tall towers at the in- and outflow of the domain.
- To execute test flights with small aircraft to sample boundary layer $CO_2$ concentrations and $^{13}C$.
- To test continuous measurements of windspeed and temperature in the boundary layer with a profiling system during the test campaign
- To perform twice daily radiosoundings and fly the Piper during the test campaign in the centre of the domain

**Description of work**

In the first 18 months an intensive test campaign will test the logistics in month May 2005. The Extended Observation Period is planned for 2006.

**Task 3.3.1:** At the inflow and outflow positions of the domain (near Toulouse and Bordeaux) one to two towers equipped with high precision gas chromatographs will measure the concentrations of $CO_2$, and $^{14}C$. CMDL NDIR-$CO_2$ sensors are built for this purpose. Implementation will start in 2005.

**Task 3.3.2**: A small commercial plane will sample the boundary layer structure for $CO_2$, $^{13}C$ and CO for 3 to 5 days. Flask samples will be analysed at MPI-BGC. Isotopic effects of C3 and C4 plants are expected. Flights are planned on 1 day every week to take 3 profiles at 5 levels in the boundary layer during the test campaign. Intensive radiosounding to monitor the CBL will be performed during selected days of the test campaign 2005.

**Task 3.3.3**: The structure and evolution of the boundary layer must be known in efforts aimed at improving regional estimates. Thus, considerable effort is put into acquiring high quality data. We will extend the routine WMO observations at Bordeaux during the test campaign to test the logistics and feasibility of this operation. We will also install UHF profile systems and RASS_Sodar systems at a location where they contribute most to our understanding of the heterogeneity of the area during the test campaign. The French Piper will be fly to determine the regional concentrations $CO_2$ and other trace gases during the test campaign 2005.

**Deliverables**

3.3.1 Installation and protocol for $CO_2$ concentration measurements of tall towers (Month 12)
3.3.2 Datasets of concentrations of $CO_2$ and other trace gases in the CBL and for larger scale transects for the intensive test campaign (Month 18)
3.3.3 Datasets of boundary layer evolution with radio sounding and profiler systems. (Month 18)

**Milestones and expected result**

Month 18 Tall tower for $CO_2$ concentration installation finished
Month 18 Test datasets of boundary layer evolution with radio sounding and profiler systems.
Month 18 First datasets of $CO_2$ concentrations of CBL using profiling aircraft and transect flight

**WP3.4 Modelling and integration**

| Work package number | WP3.4 | Start date or starting event: | Month 1 |
|---|---|---|---|
| Activity type | RTD | | |
| Participant id (Person-months) | VU-A (6), CNRM (23), CEA-LSCE (6), ALTERRA (9), CEAM (2) | | |

**Objectives**

- To reanalyse the Recab campaign with prototype assimilation and downscaling models.
- To develop a multiple constraint data assimilation system that produces the best possible estimates of the regional carbon balance at the grid of the atmospheric model (2 km) for the year 2005
- To produce the basic parameters, and calibrated models for the long term (20 years) bottom up estimate at 2 km resolution of the carbon balance of the region

**Description of work**

**Tasks 3.4.1.** The main purpose of this workpackage is to provide estimates of the carbon balance of the region using all available data and atmospheric model information. This is done for the slow and fast carbon cycle in a slightly different manner. In the first 18 months we will initiate the development of this regional CDAS in parallel with effort in CAMELS. We will reanalyse the RECAB campaigns with mesoscale models (RAMS, Meso-NH) and apply down scaling techniques (inverse models), to guide both the development of the data assimilation system and the planning of the experiments. This will lead to a "proof of concept".

**Task 3.4.2:** For the slow cycle, we will use the 8 km resolution downscaled weather information that is available at CNRM and will be extended for use in biogeochemical models. These models will be calibrated with flux data for the main land use types and then run for a 20-year period. The required input data on land use history and management is obtained in WP1. We intend to use the MesoNH model, which will be extended to carry $CO_2$ in the simulation. We will concentrate on setting up uniform calibration and model procedures in the first 18 months.

**Task 3.4.3:** For the fast cycle we will use a data assimilation system at mesoscale that mirrors the system developed for the large scale (Camels and Continental Integration Component). We will mainly use the French Arome system developed at CNRM for this purpose and extend it to carry $CO_2$ in the assimilation procedure. We will adapt Arome to carry $CO_2$ in the first 18 months.

**Deliverables**

3.4.1 Re-assessment and consolidated datasets of RECAB campaigns (Month 15)

3.4.2 First evaluation of the carbon fluxes on the long term at high resolution with a number of SVATS (Month 15)

3.4.3 Mesoscale evaluation of CO2 atmospheric cycles in the CBL using a number of mesoscale models calibrated against past campaign (Month 15)

3.4.4 Comparison of high resolution surface fluxes with surface fluxes retrieved by large scale inverse modelling in the same area (Month 18)

**Milestones and expected result**

Month 15 "proof of concept" for regional data assimilation and experiment (Blueprint of a full regional data assimilation system capable of assimilating land surface, remote sensing, atmospheric data at regional scale)

**Component 4 Continental Integration**

**WP 4.1 Auxilliary data database**

| **Work package number** | **WP4.1** | **Start date or starting event:** | **Month 1** |
|---|---|---|---|
| **Activity type** | RTD | | |
| **Participant id (Person-months)** | JRC-IES (19) | | |

**Objectives**

To compile georeferenced and gridded datasets of:

- drivers for the different bottom-up models and modelling approaches from remote sensing and statistics
- minor carbon flows
- background carbon fluxes for correct specification of boundary conditions for the European scale modelling systems

**Description of work**

The work will build on the resources developed in the Carbodata project and the CarboEurope-GHG concerted action. The work performed in this activity will primarily consist of an assessment of the quality and adequacy of the data sets and to georeference the information on the grids needed by the models.

**Task 4.1.1:** Primary datasets to be compiled as drivers for the TEMs include:

Present and past climate and weather data

Land use history for the different terrestrial sectors (forest, agriculture, grasslands, wetlands)

Nutrient inputs (aeolian, through streams and rivers, direct anthropogenic (fertiliser))

**Task 4.1.2:** Surface biophysical products from various spaceborne instruments:

These include the Fraction of Absorbed Photosynthetically Active Radiation (FAPAR) and the spectral surface albedo at spatial resolution varying from about 2 to 10 km, a temporal resolution of 10 to 30 days, and for 5 consecutive years starting in April 2000, over Europe including the Eastern countries.

**Task 4.1.3:** Compilation of minor and background carbon fluxes of:

Improved fossil fuel emissions (temporal and spatial distribution)

CO emissions from fossil fuel burning

VOC emissions from terrestrial ecosystems

Carbon flows induced by trade products

Carbon and alkalinity flows generated by erosion and transported by river fluxes

Carbon storage and storage changes in reservoirs and lakes

Carbon fluxes from the continental shelves and the marginal seas

North Atlantic carbon fluxes

Background carbon fluxes on terrestrial and oceanic surfaces world-wide (on 50 to 100 km global grid)

**Deliverables**

4.1.1 Data report available for auxiliary datasets accessible through database (Month 18)

**Milestones and expected result**

Month 6 First set of TEM model driver data based on existing climate (Univ. of East Anglia) and land use history (Ramankutty and Foley, 1999) datasets, compiled on Eurogrid and delivered to database

Month 6 FAPAR and albedo in high spatial resolution at Main Sites and aggregated on Eurogrid for 2000-2003 available through project database.

Month 12 First version of minor and background carbon fluxes compiled on Eurogrid and delivered to database.

**WP 4.2 Land carbon inventories**

| Work package number | WP4.2 | Start date or starting event: | Month 1 |
|---|---|---|---|
| Activity type | RTD | | |
| Participant id (Person-months) | ALTERRA (7), EFI (6), JRC-IES (10), JR (4 DIBi+2.5 IEF), TUD (1.5) | | |

**Objectives**

- To gather supporting data on forest carbon inventories for bottom-up modelling, inverse modelling and the CDAS, and constrain their estimates through a backcasting exercise
- To develop methods for integration of georeferenced data from heterogeneous, distributed data sources by utilising neural networks and fuzzy techniques
- To establish a network for compilation of soil carbon data for all major land use types in continental Europe

**Description of work**

**Task 4.2.1:** A detailed representation of European scale forest inventory data (partly based on Camels; 1x1 km resolution, but updated and refined) will be built for the CDAS providing online linkage possibilities to the bottom-up modelling (4.5) and the inverse modelling activity (4.4). This will yield age class distributions, tree species distributions, increment and stem wood growing stock per pixel.

**Task 4.2.2:** A co-operation framework will be developed between JRC and national soil carbon monitoring experts. The network will integrate information from previous and ongoing research projects (e.g., IP Ecosystem Component, GREENGRASS, CARBOINVENT, CARBOAGE, FORCAST, other domestic projects) and from COST 627, COST E21, ECCP sink groups, and GTOS/TCO. A major data pillar consists of UNECE forest monitoring activities and the European Soil Information System (EUSIS)

**Task 4.2.3:** A review of suitable methods and algorithms for the integration of georeferenced data (land carbon inventories) by using neural networks and fuzzy techniques will be performed. Out of this a concept of the methods to be applied in the second phase of the project will be developed.

**Task 4.2.4:** A study of methods for "Bottom Up" calculation of carbon budgets on plot level (georeferenced) for Kyoto Protocol Art. 3.3. and 3.4 following the acceptance of IPCC Good Practise Guidance for LULUCF.

**Deliverables**

4.2.1 Detailed database of gridded forest carbon inventories ready for use by the modelling activities (Month 8)

4.2.2 Co-operation framework established by JRC and national soil carbon monitoring experts (Month 12)

4.2.3 Review on methods terminated (Month 18)

4.2.4 Draft on methods compendium (Month 18)

4.2.5 Evaluation report of methods for implementing land carbon inventories (regarding the GPG LULUCF) **JR IEF**

**Milestones and expected result**

Month 18 Decision on methodological concept for data integration

**WP 4.3 Inverse atmospheric model development, evaluation and application**

| Work package number | WP4.3 | Start date or starting event: | Month 1 |
|---|---|---|---|
| Activity type | RTD | | |
| Participant id (Person-months) | CEA-LSCE (6), MPI-BGC (6), MET-OFFICE (6), VU-A (6), SRON (6), NERI (6) | | |

**Objectives**

To develop and apply nested mesoscale modelling systems to infer from atmospheric $CO_2$ concentration measurements surface sources and sinks and their uncertainty over the European continent with a spatial resolution of 100 km and a weekly temporal resolution for 1998 to 2003

**Description of work**

**Task 4.3.1:** Continue and improve the European inverse modelling initiated in the Aerocarb project (FP5) and provide critical analysis of flux estimates and their uncertainties at the regional level and on a monthly basis.

**Task 4.3.2:** Implement a new inverse set up to infer fluxes at high spatial ("Eurogrid") and temporal (weekly) resolution. Carbon fluxes and their year to year variations will be estimated for the 1998-2003 period. Critical and comparative analysis will assess the power of continuous data to better resolve the different terrestrial fluxes.

**Task 4.3.3:** Conduct a series of network representativity and optimization studies to evaluate the resolving power of the existing atmospheric observation network and of the planned new measurement sites in the Atmosphere Component . These studies will also investigate the sampling frequency and quality requirements of the observations and their impact on the inferred regional sources..

**Task 4.3.4:** Implement multi-species simulations for a subset of the different transport models in a forward mode (prior to a multi-species inversion). Simulated isotopic composition of CO2 ($^{14}C$, $^{13}C$, and $^{18}O$) and $O_2/N_2$ ratio will be compared at ground station as well as CO and $CH_4$ concentrations using existing chemical modules in the atmospheric models.

**Deliverables**

4.3.1 Report with assessment of spatial and regional variability of the European carbon balance 1998-2003 based on the top-down approach (Month 18)

4.3.2 Report on the representativity and optimal design of the atmospheric observation network (Atmosphere Component).

**Milestones and expected result**

Month 18 Assessment of spatial (1000km x 1000km) and temporal (monthly) variability of the European carbon balance 1998-2003 by the top-down approach based on the atmospheric observations obtained in the FP5 projects (Aerocarb, Chiotto, Tcos-Siberia) and other agencies (a/o. NOAA/CMDL).

Month 18 First multi-species forward simulations performed by the atmospheric models and comparison with existing ground station data.

**WP 4.4 Bottom-up model development, evaluation and application**

| Work package number | WP4.4 | Start date or starting event: | Month 1 |
|---|---|---|---|
| Activity type | RTD | | |
| Participant id (Person-months) | MPI-BGC (6), UBT-PE (18), CEA-LSCE (6), MET-OFFICE (6) UNITUS (?) | | |

**Objectives**

- To develop and apply a neural network based sectorial models for the European forests for the baseline year 2001.
- To develop and apply a high resolution process-based stand model for the baseline year 2001.
- To implement and apply process based terrestrial ecosystem models (TEMs) on the Eurogrid spatial scale and compute the evolution of the 20th century carbon balance of Europe with special emphasis on the target time period 1998-2003.

**Description of work**

**Task 4.4.1:** The neural network model $NETWORK_{NEE}$ will be used to estimate NEE fluxes for the forest sector. $NETWORK_{NEE}$ has the advantages that the neural network approach 1) may be applied with a minimum of driving variables (even in the absence of driving variables known to influence particular processes), 2) efficiently summarises observations, and 3) allows rapid re-application to new data sets, e.g., permits a time efficient summary of flux studies from multiple sites.

**Task 4.4.2:** Driver data sets from MODAPS for radiation, temperature and humidity will be extrapolated to several individual Eurogrid pixel in daily time steps and through estimation with standard functions for hourly time steps. Precipitation from the Global Precipitation Climate Project will similarly be extrapolated to the grid on a daily basis. Soil properties are taken from the Joint Research Council European soils map. Land cover and LAI at 1 $km^2$ scale will be taken from MODIS remote sensing products. These input datasets will be used to run the high resolution process-based stand model $PROXEL_{NEE}$ (Process-Pixel for NEE) for the baseline year 2001 and/or BEPS or derived radiation use efficiency based formulations, depending on simulation time constraints.

**Task 4.4.3:** Several process based terrestrial ecosystem models (TEMs) that have been developed in previous CarboEurope and related projects (e.g. ATEAM), will be implemented and used for the simulations on the Eurogrid spatial scale over the entire European continent. These models include LPJ, ORCHIDEE, BETHY, Biome-BGC, and Triffid. In this activity these models will be run off-line subject to the prescribed climate data and land use history compiled in Activity 4.3. Several of these models dispose also of special modules to describe agriculture and certain land management practices (e.g. forestry). The models will be initialised up for a prescribed climate and land use state representative for the 19th century and then run in a transient mode over the 20th century using a methodology similar to the one described in McGuire et al., (2001). The computed carbon balance of Europe for the time period of 1998-2003 will be compared with the upscaled carbon balance with the methods described in task 1 and 2, and with the top-down estimates obtained in Activity 4.4.

**Deliverables**

4.4.1 Report describing the bottom-up and top-down assessment of the European carbon balance and it's constituent fluxes for the target time period 1998-2003 (Month 18)

**Milestones and expected result**

Month 12 $NETWORK_{NEE}$ and $PROXEL_{NEE}$ based models implemented and driver data compiled.
Month 12 TEM models implemented on Eurogrid and driver data ready.
Month 18 First simulations of the 20th century simulations with all TEMs completed.

**WP 4.5 Development of a carbon data assimilation system**

| Work package number | WP4.5 | Start date or starting event: | (Month 24) |
|---|---|---|---|
| Activity type | RTD | | |
| Participant id (Person-months) | MET-OFFICE (-), MPI-BGC (-), CEA-LSCE (-) | | |

**Objectives**

To develop a Carbon Cycle data assimilation system (CCDAS) which optimally combines data and models to produce operational estimates of the European carbon balance and its constituent contributions

**Description of work**

This activity will build on the work of the Camels FP5 project, utilising and building on the prototype carbon data assimilation system (CDAS) which Camels will deliver. In the Camels approach coarse grid global atmospheric models with a grid size of typically 200-400km coupled to global terrestrial ecosystem models of similar resolution are optimised using the observations from the global observational networks. In CarboEurope-IP beyond Camels the very much enhanced observational datasets over the European domain will be used for constraining surface fluxes on a much finer spatial and temporal scales (Eurogrid, daily-weekly) using the same methodology as in Camels. Thereby it is envisaged to also use the nested atmospheric mesoscale models which are also used in the inverse modelling activity 4.4, in order to better represent (1) the atmospheric transport over the continent, and (2) the local prevailing climate and weather as driver for the TEMs in the simulation.

**Task 4.5.1: Model validation and Uncertainty Analysis**

Will utilise local flux and inventory data to improve process representation in TEMs, and to define Probability Distribution Functions (PDFs) of the key internal model parameters.

**Task 4.5.2: Development and application of a Carbon Cycle Data Assimilation System**

Will assemble all information on land-biosphere processes and observational datastreams into a common Carbon Data Assimilation framework (CDAS), which can estimate carbon sources and sinks over land at a spatial resolution of 50km and a temporal resolution of 1 day.

This work will be performed after the completion of Camels, i.e. in 2006-2008.

**Deliverables**

None (part of FP5)

**Milestones and expected result**

None (part of FP5)

Central Database

| Work package number | DATA | Start date or starting event: | Month 1 |
|---|---|---|---|
| Participant id | MPI-BGC (18). | | |
| Person-months per participant | | | |

**Objectives**

- To design and to maintain the IT structure and data exchange protocol of the distributed database
- To analyse the data formats of providers and the needs of users/modellers, to create and to maintain the database of project data
- To define uniform meta-data terminology (clearinghouse)
- To support data quality assessment, standardisation, harmonisation, georeferencing and final archiving

**Description of work**

**Task DATA.1:** The data formats of providers and the data needs of users/modellers will be carefully analysed under guidance of the Data Management Committee, to create the final structure of the central project metadatabase. The database is intended to allow centralised data retrieval from distributed databases, to mirror access rules and protocols of the individual databases, to allow full tracing of data downloads, to guarantee a permanent dialogue between data-provider and data-user.

**Task DATA.2:** A uniform meta-information terminology will be established under supervision of the Data Management Committee and in close collaboration with the 4 Component data managers and of the dissemination activities. Standards will be founded upon international protocols and current European activities (e.g., INSPIRE, EFIS)

**Task DATA.3:** A uniform protocol in the IP will be organised with regard to measurement data (data quality assessment, standardisation, harmonisation) and to internal and external spatial data. Standard setting for spatial data includes georeferencing, projecting, aggregating to the Eurogrid, as well as rules for extrapolating from point data to areas, and for application of spatial statistics.

**Deliverables**

DATA.1 Protocol of meta-data terminology and catalogue of spatial data products (Month 12)
DATA.2 Bluebook of standard formats for measurement data and spatial data (Month 18)
DATA.3

**Milestones and expected result**

Month 6 Updated version of the Carbodata database and information system ready, providing published data of related projects in a relational and searchable database.
Month 12 Final structure of the IP database on the web.

**Demonstration activities**

| **Work package number** | **DEMO** | **Start date or starting event:** | **Month 1** |
|---|---|---|---|
| **Activity type** | Demonstration | | |
| **Participant id** | MPI-BGC (0), TLWJF (12) | | |
| **Person-months per participant** | | | |

**Objectives**

- To demonstrate the feasibility of identifying human-induced carbon stock changes at the state forest level for carbon trading under the Kyoto Protocol

**Description of work**

It is planned to update the inventory of the State forest of Thuringia for the period 2000 to 2004 and to support the intent of TLWJF to demonstrate human-induced changes in carbon pools, which should be merchantable under the Kyoto Protocol. This is the first Demonstration activity of this type in Europe.

Tasks:

- to provide test areas for detailed verification of C- changes
- to enlarge the soil observation network by establishing new soil pits in conditions that are presently underrepresented. The need for new observation points will come from CarboEurope scientists
- to implement the database of the BWI (German Federal Forest Inventory) as basis for carnon assessments in a 5-year observation cycle as required by the Kyoto agreement
- to establish multiple links with CarboEurope Scientists who need regional test areas.
- try to find industrial buyers for C- storage

**Deliverables**

DEMO1 Enhanced observing system and database established (Month 18)

**Milestones and expected result**

Month 12 Consultations with federal and UNFCCC authorities, consultation with forest land owners

Month 12 regional information about age structure of Norway spruce in Thuringian state forest, regional focus areas of spruce, structure and regional focus areas of promoting mix with other tree species

**Dissemination activities**

| **Work package number** | **DISS** | **Start date or starting event:** | **Month 6** |
|---|---|---|---|
| **Activity type** | Management | | |
| **Participant id (Person-months)** | MPI-BGC (0), CEA-LSCE, UNITUS, MET-OFFICE, JRC-IES, UNIABDN, ALTERRA, JR (all 0) | | |

**Objectives**

- To organise a science conference together with the first annual meeting of the CarboEurope-IP as a whole
- To collaborate with researchers involved in the North American Carbon Program (NACP) towards an integrated and optimised carbon observing system, co-ordinated efforts in modelling (future projections, assimilation methods), interpretation, and future data acquisition strategies, enhanced georeferenced Carbon Cycle data availability and quality; and common assessment methods and state-of-the-art reports
- To run the European support office of GCP
- To advise policy makers about the terrestrial Carbon Cycle related to the implementation of the Kyoto Protocol

**Description of work**

The first CarboEurope science conference will be organised together with the first annual meeting of the CarboEurope-IP. It will eventually be organised jointly with the science conference of the FP5 project CarboEurope-GHG Concerted Action.

Collaboration with the NACP will include

- Set up a joint participation to planning meetings every year between CarboEurope and NACP.
- Organise joint scientific sessions at the EGS and AGU annual meetings
- Facilitate the intercomparison of inverse models through the TRANSCOM-3 programme
- Establish a data policy for frequent exchange of data between EU and US groups
- Define the participation of European scientists from CarboEurope in future assessment of the Carbon Cycle

The European support office of GCP (UNITUS, MPI-BGC, MET-OFFICE) is maintained and funded by the FP5 project CarboEurope-GHG Concerted Action for the first 18 months.
The science/policy interface is performed and funded by the FP5 projects CarboEurope-GHG Concerted Action and Camels for the first 18 months.

**Deliverables**

DISS 1 First CarboEurope-IP conference (Month 13)
DISS 2 Cross participation to meetings between CarboEurope and NACP (e.g., Month 14)
DISS 3 Data-policy for exchanging data between CarboEurope and NACP (Month 9)
DISS 4 Joint Science sessions at EGS and AGU conferences (Month 12)
DISS 5 Broad international contacts via GCP (Month 12)
DISS 6 Active science/policy interface (Month 12)

**Milestones and expected result**

Month 6 Data policy document for exchange of data between CarboEurope and NACP
Month 12 first joint session at wintertime AGU
Month 13 First CarboEurope-IP conference

**Innovation activity**

| **Work package number** | **INNOV** | **Start date or starting event:** | **Month 6** |
|---|---|---|---|
| **Activity type** | Innovation | | |
| **Participant id (Person-months)** | UEDIN (0) | | |

**Objectives**

To stimulate innovation related to CarboEurope-IP

**Description of work**

- Yearly innovation report: a synthesis of scientific and technological innovation achieved in the workpackages of the CarboEurope-IP, as well as a list of innovation ideas which could facilitate the achievement of the IP´s research goals
- Contacts with innovation fora at national and European level, e.g. with the Environmental Technology Action Plan (ETAP) of the European Commission
- Links to parallel and evolving projects
- Brainstorming workshops to stimulate scientific and technical innovation
- Contacts to interest groups and potential public and private investors (SMEs, industries) to exploit results, e.g. for an operationalisation of carbon monitoring, or the certification and verification of carbon sequestration projects.

**Deliverables**

INNOV 1 First innovation reports to be distributed and discussed at the Steering Committee and placed on the web site (Month 12)
INNOV 2 Network of contacts outside the CarboEurope community, including the private sector and the forestry agencies in the Partner countries (Month 18)
INNOV 3 First brainstorming workshop to identify new measurement techniques and emerging technologies (Month 12)
INNOV 4 Contacts with private sector and interesting private investors in carbon-related issues (Month 18)
INNOV 5 Links with related and evolving projects in Europe and elsewhere (Month 18)

**Milestones and expected result**

Month 12 First innovation report
Month 18 Brainstorming workshop
Month 18 Dissemination of network of contacts and links with private sector

**Training activities**

| **Work package number** | **TRAIN** | **Start date or starting event:** | **Month 1** |
|---|---|---|---|
| **Activity type** | Training | | |
| **Participant id (Person-months)** | IBIMET-CNR (1), MPI-BGC (0), VU-A (0), FUSAGx (0), ETH (0), KVL (0); SAUG (6) | | |

**Objectives**

- To train activities PhD students and young PostDocs in carbon science
- To produce a basic set of educational resources for secondary schools in the IP website
- To involve key multipliers to disseminate these resources to a large number of teachers and young people in Europe
- To stimulate direct contacts between CarboEurope researchers and secondary school students

**Description of work**

A one-week **Advanced Training Course in Airborne Flux Measurements** will be organised. It convey both the theory and the practicalities of using Small Environmental Research Aircraft to measure surface fluxes. The course will consist of introductory lectures by leading scientists in this area about the theory of airborne eddy correlation measurements and a field exercise in which the students will conduct short-term airborne flux measurements campaigns. The CarboEurope Sky Arrow platform will be available for those exercises. The field exercise start with planning the mission by the students. The research mission will be conducted also by the support of a specialised SME that has specific experience in conducting aircraft operations. The students will learn how to use software to access aircraft data and calculate the surface fluxes and will become experienced in flux calculations.

Collaboration for a workshop on agroecosystems in Denmark in 2005 has been offered by KVL in the frame of the training network for the Nordic region on Carbon Dynamics in Managed Terrestrial Ecosystems.

**Training at secondary school level**:

- Pre-identification of relevant educational scopes through review of bibliography, interviews of scientists and discussions during IP kick-off meeting
- Setting up of an informal education advisory group with interested scientists and PhD students
- Early involvement of strategic multipliers in several countries on a mutual interest basis in order to define the scientific focus, contents formats and channels of diffusion
- Short field missions in selected research sites to produce basic resources in English (basically stories, reports and illustrations adapted to secondary school audience)
- List of contact-persons for secondary school teachers in CarboEurope sites and institutions
- Integration of material in the IP website, support to multipliers for adaptations and dissemination.

**Deliverables**

TRAIN 1 Advanced Training Course in Airborne Flux Measurements (Month 8)
TRAIN 2 Educational package for adaptation and dissemination by involved multipliers (Month 18)
TRAIN 3 Educational section for secondary schools on CarboEurope website (Month 18)

**Milestones and expected result**

Month 9 multipliers identified, dissemination agreements concluded, educational focus defined
Month 18 field missions completed, basic educational resources written

**IP co-ordination and management**

| **Work package number** | **CO** | **Start date or starting event:** | **Month 1** |
|---|---|---|---|
| **Activity type** | Management | | |
| **Participant id (Person-months)** | MPI-BGC (36); UNITUS, VU-A, CEA-LSCE (all 0 funded) | | |

**Objectives**

- To perform the legal and administrative management of the Integrated Project
- To perform the scientific co-ordination of the Integrated Project at the level of the entire consortium and of the four Components

**Description of work**

- To prepare, update and manage the consortium agreement between the participants
- Administrative management
- To oversee and review science and society issues, related to the research activities conducted within the project
- To oversee the promotion of gender equality in the project in collaboration with the gender committee
- To execute the financial management
- To co-ordinate at the consortium level the knowledge management and other innovation-related activities
- To prepare the first annual report
- To organise meetings and workshops for the CarboEurope-IP as a whole

**Deliverables**

CO1 Legal management (Month 1)
CO2 Financial management (Month 1)
CO3 Scientific co-ordination of the IP as a whole and of the Components (Month 1)

**Milestones and expected result**

Month 1 Consortium Agreement signed by all partners (Month 2)
Month 3 Kick-off meeting (Month 1)
Month 3 Gender committee established (Month 1)
Month 13 First financial report, including financial audits by all partners (Month 13)
Month 13 First annual scientific progress report (Month 13)
Month 13 Annual meeting of IP (Month 13)

**Gender action plan**

| **Work package number** | **Gender** | **Start date or starting event:** | **Month 1** |
|---|---|---|---|
| **Activity type** | RTD | | |
| **Participant id (Person-months)** | Gender committee (elected) | | |
| **Objectives**<br>- To promote gender equality in the project. | | | |
| **Description of work**<br>**Task Gender.1 Election of gender committee**. The gender committee will be elected during the kick-off meeting.<br>**Task Gender.2 Promotion of female researchers.** The gender committee will initiate and maintain a network of female researchers of the project, stimulate a mentoring programme and overlook the achievements of the female representation target of 20% or more in project-related meetings and decision bodies. It will actively help finding qualified females, and recruiting females, for open jobs in CarboEurope-IP.<br>**Task Gender.3 Annual gender action report** containing an inventory and evaluation of gender equality activities performed at project level and in the main project Components. | | | |
| **Deliverables**<br>Gender.1 Gender committee established<br>Gender.2 Female researchers´ network and mentoring programme established<br>Gender.3 First annual gender action report | | | |
| **Milestones and expected results**<br>Month 1: Election of gender committee<br>Month 3: Female researchers´ network established<br>Month 6: Framework for mentoring programme established<br>Month 14: First annual gender action report published | | | |