



# Integrated Project CarboEurope-IP

## Assessment of the European Terrestrial Carbon Balance

What is the role of the European continent in the global carbon cycle?

To advance our understanding in a multidisciplinary and integrated way, more than 60 research centres from more than 15 countries have joined forces for a 5-year EU-funded research project started in January 2004.

### Rationale

The present concentration of carbon dioxide ( $\text{CO}_2$ ) in the atmosphere is higher than in the past 420,000 years or maybe even in the past 20 million years, and it continues to rise. The primary causes are fossil fuel combustion and deforestation. Globally, the land biosphere (excluding the part subject to deforestation) takes up 30% of the fossil fuel emissions and thus is presently reducing the speed of anthropogenic climate change. This carbon sink is mainly located north of the Tropics, yet its partitioning between Europe, North America, and Asia is uncertain. So is our understanding of its controlling mechanisms and its vulnerability to changes in climate and land management. Coupled climate models indicate that, in the near future, carbon (C) release from existing C pools in the biosphere could be large enough to offset any attempts of technical  $\text{CO}_2$  emission reduction. Meeting the scientific challenge of establishing the full carbon budget of a continent with acceptable accuracy has also high political relevance because the Kyoto Protocol includes carbon sources and sinks in the terrestrial biosphere.

### Overarching Aim

To understand and quantify the present terrestrial carbon balance of Europe and the associated uncertainty at local, regional and continental scale.

### Objectives

#### 1. "The European Carbon Balance"

To determine the carbon balance of the European continent, its geographical patterns, and changes over time

#### 2. "Processes and Mechanisms"

To understand 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.

#### 3. "Detection of Kyoto-relevant changes in carbon"

To design and develop an observation system to detect changes of carbon stocks and carbon fluxes related to the European commitments under the Kyoto Protocol.

### Approach

#### 1. "The European Carbon Balance"

- A strategically focussed set of surface based ecological measurements of carbon pools and  $\text{CO}_2$  exchange
- Further enhancement of an atmospheric high precision observation system for  $\text{CO}_2$  and other trace gases
- A regional high spatial resolution experiment
- Integration of these components by means of innovative data assimilation systems, bottom-up process modelling and top-down inverse modelling

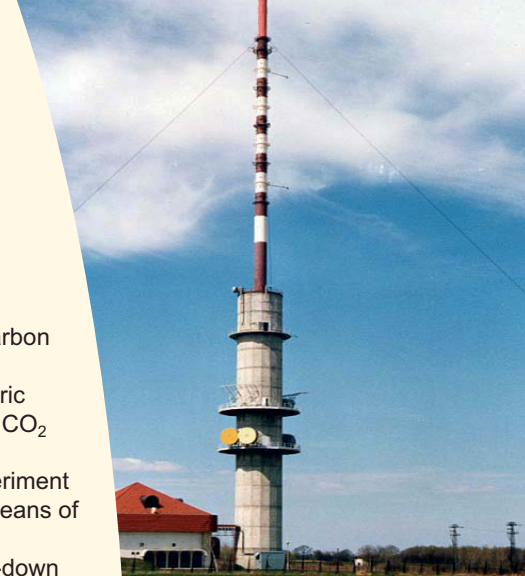
The key innovation of the CarboEurope-IP is in its conception as to apply single comprehensive experimental strategy, and its integration into a comprehensive carbon data assimilation framework (Figure 1). The observational and modelling program will run at unprecedented spatial and temporal resolution. This will allow for the first time a consistent match of bottom-up and top-down estimates of the regional variation in carbon sources and sinks.

#### 2. "Processes and Mechanisms"

- Partitioning of carbon fluxes into their constituent parts (assimilation, respiration, fossil fuel burning), at local, regional and continental scales
- Quantification of the effects of management on net ecosystem carbon exchange based on data synthesis
- Development, evaluation and optimisation of ecosystem process models

#### 3. "Detection of Kyoto-relevant changes in carbon"

- Atmospheric measurements and a modelling framework to detect changes in atmospheric  $\text{CO}_2$  concentrations during the time frame of a Kyoto Commitment Period
- Outline of a carbon accounting system for the second Kyoto Commitment Period based on measuring carbon fluxes and stock changes by soil and biomass inventories, vegetation properties by remote sensing, and atmospheric concentrations
- Consider a framework for the protection of existing C pools in the biosphere



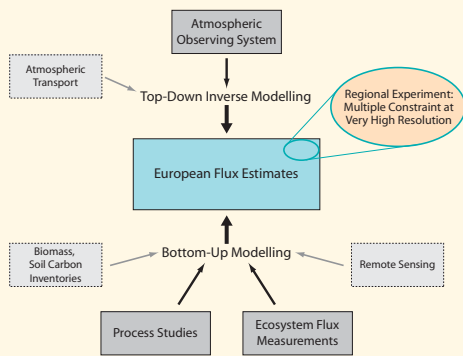


Figure 1 Logic of the flow of data and knowledge in the multiple constraint approach of CarboEurope-IP

### Project Components

The project consists of four "Components":

1. Ecosystem level measurements
2. High precision continental scale atmospheric measurements
3. A regional experiment aimed at reducing uncertainties in scaling
4. Continental Integration merges the various data streams into a comprehensive assessment of the European carbon balance.

All these Components interact and require additional cross-cutting information. The joint aim is to estimate the European carbon balance in the recent past and present.

### History

CarboEurope emerged as a cluster of European projects in 2000. Since then, it consolidated an interdisciplinary research community in the fields of different ecosystems, atmosphere, measurements and modelling. The CarboEurope-IP bundles and expands on these earlier projects and allows for the first time a harmonised and consistent gathering of data and integration of space and time scales. Its duration is from January 2004 to December 2008.

### Key finding of the previous CarboEurope Cluster

In Europe, the biosphere probably absorbs 7-12% of the European anthropogenic emissions. This small net sink results from a strong carbon uptake in forest, which is largely compensated by carbon losses from cropland and peat use. However, the estimate is highly uncertain (I. A. Janssens et al., 2003, Science 300, 1538, Figure 2).

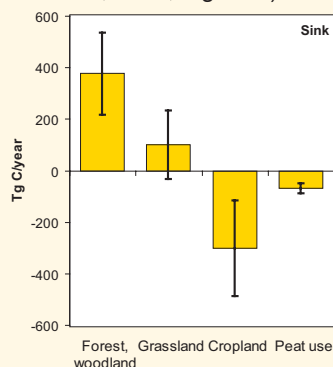


Figure 2 Best estimate of the carbon fluxes in European ecosystems with their uncertainties (Janssens et al., 2003)

### Resources

The project is supported by the European Commission, Directorate-General Research, Sixth Framework Programme, Priority Global Change and Ecosystem. The budget includes 16.3 million Euro from the European Commission and about 30 million Euro from national funding.

### Partners

The consortium consists of 61 Contractor Institutes from 17 European countries (Figure 3), plus about 30 Associated Partners within Europe and further Collaborating Institutes outside Europe. The Max-Planck-Institute for Biogeochemistry, Germany, is project co-ordinator. CarboEurope-IP is open to associate further partners.

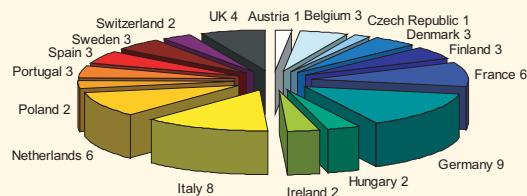


Figure 3 Nationalities of Contractor Institutes

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