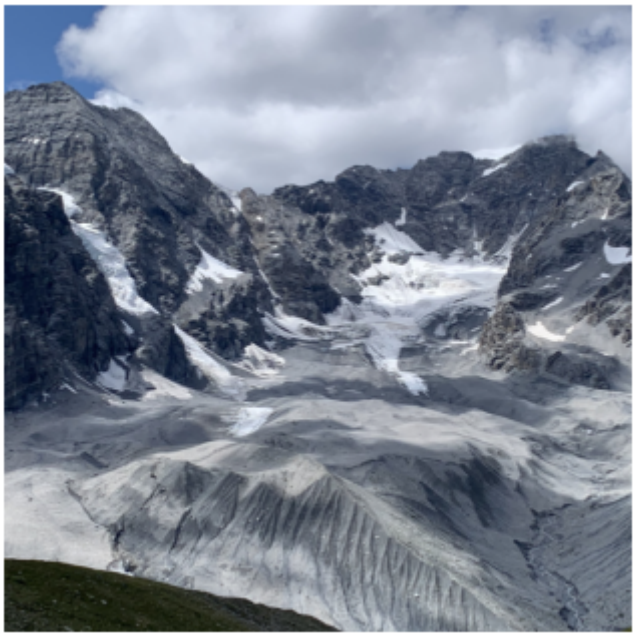
Project GEOCARBON

Operational Global Carbon Observing System

adaptation | climate change | carbon cycle | greenhouse gas | mitigation

PROJECT DESCRIPTION



Having data and observations on the carbon cycle and other greenhouse gases, such as methane (CH4), is becoming increasingly important to understand the current situation, predict future trends (including possible consequences), propose and implement mitigation measures necessary to reduce emissions or increase absorptions and limit their consequences through adaptation to climate change. Despite the recent and important progress, many uncertainties still remain in the area of understanding and forecasting the greenhouse gas cycle, and there are still many aspects to be improved and developed in the currently used monitoring systems, which do not have a global coverage (many important regions and continents, such as Africa, are underrepresented) and often use different methods and incompatible formats, limiting their usefulness for a global picture of the situation. With the purpose of facing this situation, which intrinsically links science and politics, GEOCARBON set the objective to develop a coordinated and **integrated global system of observation and analysis of the carbon cycle** (*Global Carbon Observation and Analysis System*), aimed at contributing to the "climate" goal of GEO (*Group on Earth Observations*, www.earthobservations.org) towards the construction of a Global Earth Observation System of Systems (GEOSS) for carbon.

OBJECTIVES

To achieve this, the specific objectives of the project were to: 1 - provide an aggregated and harmonized set of carbon data and information (CO2 and CH4) at a global level, integrating the terrestrial, oceanic, atmospheric and anthropogenic components; 2 - develop better systems for assimilating carbon data (CCDAS - *Carbon Cycle Data Assimilation Systems*); 3 – give a more reliable estimation of the annual CO2 and CH4 balance; 4 - improve regional carbon budgets with a focus on the Tropics (Amazonia and tropical Africa); 5 - define the specifications for the operational functioning of a global carbon observation system; 6 - assess the economic value of an enhanced global carbon observation system; 7 - strengthen the link between science and politics in terms of exchange and use of data and information.

PROJECT PHASES

The project was divided into eight different components, which worked partly in sequence and partly simultaneously, carrying out the following activities: CMP1 - Collecting, harmonizing and summarizing the observations globally available on carbon; CMP2 – Integrating global observations on carbon into an improved system of assimilation of carbon cycle data; CMP3 - Establishing the requirements for an integrated global carbon observation system and evaluating the obtained results; CMP4 - Creating a specific observatory for the carbon cycle in the tropical areas of Amazonia and Africa; CMP5 - Estimating the global and regional annual carbon budgets, including related uncertainties; CMP6 – Enhancing knowledge about methane sources and sinks over the last decade and setting up a specific monitoring system; CMP7 - Assessing the economic value of an enhanced global carbon

observation system, including the estimation of costs and savings in terms of emissions; CMP8 - Disseminating the results of the project, strengthening the link between the scientific community and GEO and producing relevant information for decision-makers in the *climate* field.

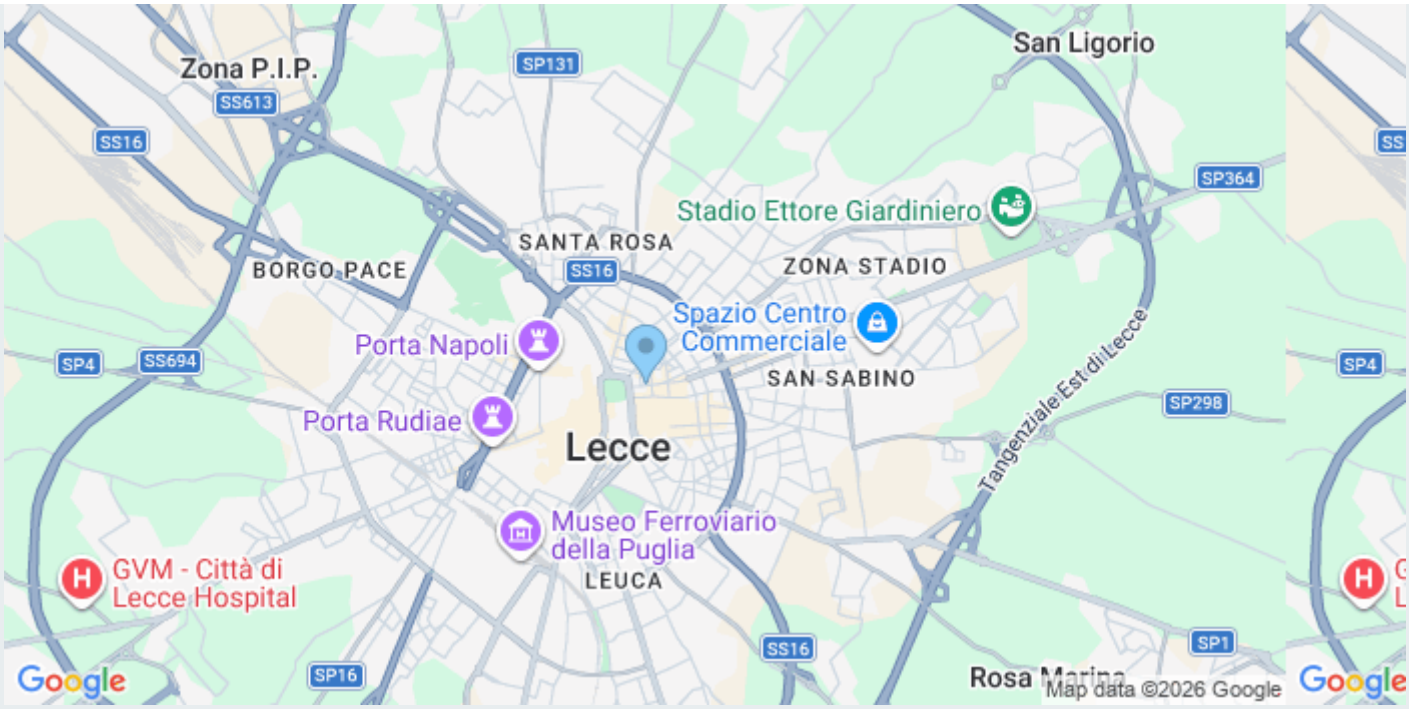
The first phase was the collection of all available datasets, the analysis of their quality and their possible use and the identification of important data to be collected further. Then all these data were organized in a project database and processed through mathematical models, in order to allow their visualization on a global scale and be able to make forecasts. Observations from different monitoring networks (*in situ*, air and satellite) and model results were combined to obtain a complete picture on the global carbon cycle with less uncertainties. In parallel two analyses were conducted: on the requirements that an optimal global monitoring system must have, and another, economic analysis on the costs and benefits of this system. Case studies were carried out in the tropical areas of Africa and South America, to deepen the knowledge on the global carbon cycle in these two key regions. Updates to the *global carbon budget* have been provided annually.

PROJECT RESULTS

GEOCARBON was a very large project, with numerous partners and a wide variety of activities and results, ranging from biogeochemical cycles to economic analysis. Among these results, perhaps the most apparent was the **annual update of the *global carbon budget***. Project closure data showed that anthropogenic CO2 emissions increased by 2.3% in 2014 compared to 2013, leading to an average concentration in the atmosphere of 395.31 ± 0.10 ppm (*Le Quéré et al., 2014*). Emissions from fossil fuels, cement production and land use change were a total of 10.8 ± 0.5 GtC. About half of these have been absorbed by the oceans and terrestrial ecosystems (respectively 27% and 23%), leaving only half of the emissions in the atmosphere. These results show the importance of the role that the oceans and ecosystems play in the carbon cycle and their role in halving the amount of CO2 in the atmosphere. Despite this, however, the greenhouse gases in the atmosphere continue to increase. Other important results achieved by the project were:

- development of new data assimilation and processing systems;
- contribution to the first global estimate of the *methane budget*;
- development of a database collecting data from various environmental domains (atmosphere, seas, terrestrial ecosystems): http://www.bgc-jena.mpg.de/geodb/geocarbon/Home.php
- better comprehension of the role of tropical areas and the impacts that climate change can have on them. It has been confirmed that the Amazonian forest absorbs carbon dioxide (hence the famous "green lung of the planet"), but it has also been shown how, in particular conditions, such as periods of intense aridity, the Amazon itself can become a spring of emissions corresponding to about 0.5 GtC.

As for the socio-economic analysis, the results showed the convenience to invest in a global carbon cycle monitoring system, because despite the high initial costs, there will be positive returns already in the medium term. The results of GEOCARBON were not for their own sake as they are also the basis of the development of a further Italian-led initiative always within GEO, related to the development of a global carbon monitoring system that should be operational within the next decade.



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Acronym
GEOCARBON

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Beneficiary Coordinator
CENTRO EURO-MEDITERRANEO SUI CAMBIAMENTI CLIMATICI

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EU contribution
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Call Year
2011

Start Year
2011

End Year
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