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The Integrated Carbon Observation System in Germany

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Due to the strong anthropogenic disturbance of the global carbon cycle, carbon dioxide and other greenhouse gases increase in the atmosphere and contribute to climatic change. Currently, the ocean and the land biosphere still sequester parts of this anthropogenically emitted carbon dioxide. However, the sustainability of these sinks is not guaranteed. Measures to reduce emissions of greenhouse gases are depending on our ability to monitor atmospheric concentrations of greenhouse gases and changes in the environment with high precision. Understanding the complex interactions between the climate system and biosphere, hydrosphere as well as atmosphere must, therefore, be based on long-term precise and internationally comparable measurements. An infrastructure that provides these observations is the best investment for reducing uncertainties and for avoiding future surprises.
In order to develop a long-term perspective for a European monitoring system for greenhouse gases the Integrated Carbon Observation System (ICOS) has been approved by the European Council of Research Ministries as an important research infrastructure and will be established officially as a European Research Infrastructure Consortium (ERIC) in 2013. ICOS will be organized as a decentralized research infrastructure with the observational networks run by national programs. The German component, ICOS-D, consists currently of a consortium of 13 research institutions, contributes to all monitoring networks and will provide the Central Analytical Laboratory (CAL), consisting of a Flask and Calibration Laboratory (FCL) and a Central Radiocarbon Laboratory (CRL) in Jena and Heidelberg, respectively, as central facilities for the entire ICOS Research Infrastructure (ICOS RI).
In the Atmospheric Program continuous and grab sample measurements of trace gas concentrations as well as their isotopic composition will be conducted at tall-tower stations. In combination with transport models, these measurements will enable the researchers to calculate the European carbon fluxes with a resolution of 10 km. The ICOS-D Atmospheric Observational Network for Germany, when fully established, will comprise 9 atmospheric sites.
In the Ocean Program, volunteer observing ships (VOS) plying regular routes in the Atlantic Ocean and the Baltic Sea will be instrumented to make autonomous observations of physical and biochemical parameters (temperature, salinity) and sea surface fugacity of CO_2 (fCO_2). In addition, two ocean observatories at the Cape Verde Islands and Svalbard ('Hausgarten') will be part of the long-term research infrastructure.
The Terrestrial Ecosystem Program will provide continuous measurements of trace gas fluxes between ecosystems and the atmosphere. The measurements will be conducted in forests, grasslands, croplands and wetlands and will partly build on sites that have been run for a decade or more in the framework of EU-projects such as CarboEuropeIP. The Terrestrial Ecosystem Program will be designed in 5 – 6 clusters. A cluster is a group of sites at close range but under different land use. This will ensure high representativeness for climate, soils properties and regional land use criteria.
The CAL will provide calibration gases for the entire network in order to minimize offsets and calibration uncertainties between the measurements at different stations. It will further provide a centralized analysis of grab samples taken within the whole ICOS RI network for additional trace gases and isotope ratios, including radiocarbon which provides an independent method to quantify regional fossil fuel emissions.