

# The IMECC project: A bridge for an Infrastructure of European Carbon Cycle Monitoring

The Earth's atmosphere is warming, driven largely by rapid increases in concentrations of anthropogenic greenhouse gases (mainly CO<sub>2</sub>). Natural uptakes remove half the CO<sub>2</sub> humans add to the atmosphere each year but these uptakes are poorly understood. Improved knowledge underpins any sound climate mitigation policy. The first step is accurate mapping of CO<sub>2</sub> fluxes and the processes that control them. The set of these measurements constitutes a distributed infrastructure. Efficient research and robust monitoring requires that the measurement infrastructure is coordinated, harmonized and accessible.

In Europe, these measurements are mainly made by national bodies. The EU funded the IMECC project (<http://www.imecc.org>) to improve the coordination, harmonization, and development of this infrastructure. IMECC links not only measurements made in different countries but of different types, aiding an integrated view of the carbon cycle. Some of the know-how obtained by IMECC is illustrated below.

Links to space-based measurements: New

satellites measure CO<sub>2</sub> globally through the depth of the atmosphere, providing unprecedented spatial coverage. Such measurements are linked to surface data by ground-based remote-sensing of the atmosphere, supported by direct aircraft measurements. IMECC supported the building of two such ground-based observatories in France and Poland and calibration campaigns to ensure that European sites were calibrated to the same scale as existing global networks.

Europe is leading the way towards routine measurement of greenhouse gases in the atmosphere. IMECC prototyped the provision of in-situ data to this effort as well as allowing global researchers fast access to data.

Until now, different parts of ecosystem function have been measured in different places. IMECC designed a standard package with a common suite of measurements throughout the range of climate and land-use in Europe.

The research challenges to respond to climate change issues are global. IMECC provided new global standards to ensure isotopic

measurements from around the world could be used together. It also provided the first freely available software processing suite for CO<sub>2</sub> flux measurements; already taken up by the global leaders in providing flux measurement instruments.

The number of different players in carbon-cycle research makes development of a coordinated infrastructure difficult. IMECC built a publicly-available tool (<http://imecc.ccdas.org/>) to evaluate the impact of new measurement sites and thus to support the design of an integrated observational network.

European carbon-cycle research is evolving rapidly with many new players. IMECC TransNational Access linked emerging groups to established facilities, providing a shortcut to world class measurement capability.

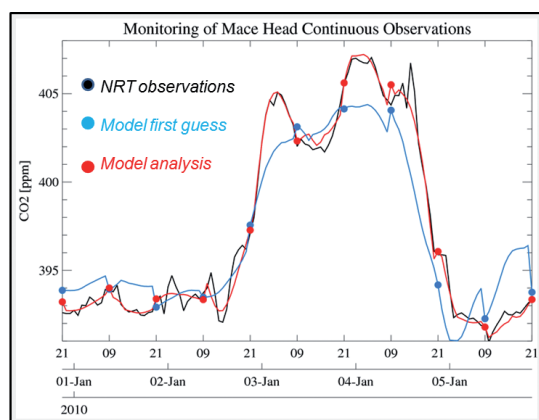
Finally, IMECC has helped kick-start the long-term ICOS infrastructure (<http://www.icos-infrastructure.eu>), providing a training ground, a technical foundation and a prototype of many of the concepts. The recent InGOS project will extend IMECC's work to non CO<sub>2</sub> greenhouse gases.



- Measurements from the IMECC infrastructure:**
- CO<sub>2</sub> exchange between the vegetation and the atmosphere and components of the ecosystem function
  - CO<sub>2</sub> concentrations in the atmosphere
  - Sunlight absorbed by the CO<sub>2</sub> molecules (spectrometers)
  - CO<sub>2</sub> concentrations in the atmosphere



*Comprehensive ecosystem measurement site in Norunda, Sweden. The tower measures the amount of CO<sub>2</sub> exchanged between the forest and the atmosphere.*



Assimilation of IMECC Near Real Time data in the EU funded MACC project (<http://www.gmes-atmosphere.eu/>). The assimilation of these data allows the model to fit very well the observations. Courtesy of Dr. R. Engelen, ECMWF, Reading, UK.

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