# EUROCHAMP

*Integration of European Simulation Chambers for Investigating Atmospheric Processes – an integrated infrastructure initiative (I3)…*

To understand climate change and related problems such as atmospheric composition change, scientists need to study the chemistry of the atmosphere. One way to do this is through controlled experiments, by fitting analytical instruments to large boxes, cylinders or air balloons, so-called simulation chambers. Europe has more than 20 of these atmospheric test chambers, and the EUROCHAMP project aims to help European researchers to make better use of them. With €3.9m from the Integrated Infrastructure Initiative (I3) of the Sixth Framework Programme, EUROCHAMP is providing transnational access to researchers from all disciplines, improving existing experimental facilities and planning new ones.

As climate change has moved high onto the political agenda, the rarefied topic of atmospheric chemistry has taken on a new urgency. The bulk constituents of air – oxygen and nitrogen – were central to the work of pioneering scientists including Priestley, Lavoisier and Cavendish. In the last few decades, however, the focus has been on scarcer gases that control acid rain, smog, and the effects of radiation from the sun. These include sulphur dioxide, nitrogen oxides, carbon dioxide, water vapour, methane, ozone, fluorocarbons and volatile organic compounds (VOCs).

Atmospheric chemistry is a complex subject that draws on chemistry, physics, meteorology, computer modelling, oceanography, geology and volcanology. Like many other fields of natural science, it is studied in three main ways: by observing the natural world; by carrying out controlled experiments; and through mathematical simulation.

Important instruments for investigating the quite complex atmospheric chemical processes are 'so-called' atmospheric simulation chambers. By using these simulation chambers, it is possible to simulate real world atmospheric conditions without the underlying effect of transport processes, which occur in the natural atmosphere. In these chambers, which are quite often also called 'smog chambers', pure synthetic air is polluted with the pollutant of interest, which is then photolysed by natural sunlight.

*Atmospheric inversion layer in the City of Cologne, Germany*

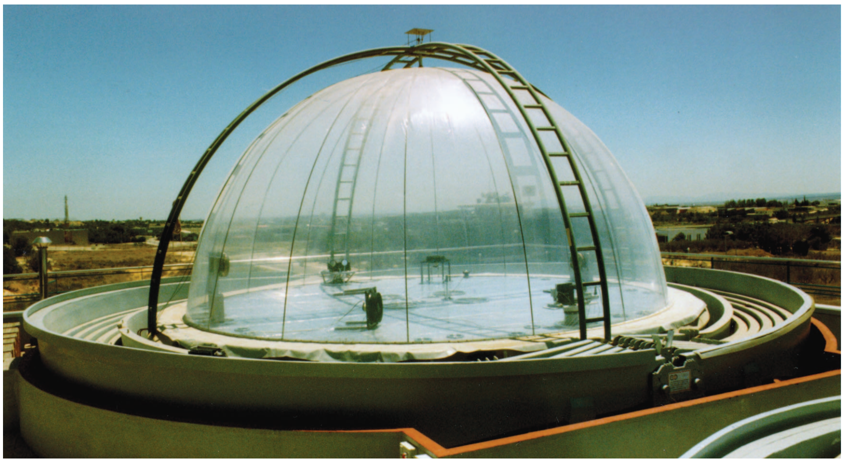
*Air pollution in the megacity of Cairo, Egypt*

Controlled experiments are essential in helping to understand real world observations and calibrate computer models.

But how can a box of air accurately mimic what goes on in the vast atmosphere, especially the freezing temperatures and intense radiation that characterise its upper regions? A particular problem is the tendency of gas molecules to stick to the walls of the box.

Given a big enough box, most of the molecules zooming around inside will rarely hit the walls, so experimental observations reflect fairly accurately the open conditions of the real atmosphere. Europe has more than 20 of these boxes, otherwise known as atmospheric simulation chambers, and many of them are certainly big. They range from cylinders and spheres of a few hundred litres in volume to a massive cube measuring more than six metres on each side.

The chambers fall into three basic types: outdoor and indoor photoreactors, plus 'dark chambers'. Photoreactors, illuminated by the sun or artificial ultraviolet lights, are especially important in the study of ozone and smog formation, while dark chambers reveal how atmospheric chemistry changes at night or during the polar winter.



*The European Photoreactor (EUPHORE) at CEAM, Valencia, Spain*

Of course, there is more to the average atmospheric reaction chamber than a box of air. The box itself is generally made of inert materials, such as glass, stainless steel, Polytetrafluoroethylene (PTFE), or other fluorocarbon polymers. It may have lamps, temperature control, and vacuum pumps for simulating conditions above sea level. Most importantly, it typically has a large array of spectrometers, particle counters and other sensitive instruments.

By analysing the chemical processes with various ultra-sensitive measurement techniques, it is possible to obtain information about the connection between photo smog formation and primary emissions, which are then combined with meteorological processes in so-called chemistry transport models (CTM) to describe the atmosphere.

EUROCHAMP aims to make better use of these expensive facilities by breaking down boundaries between national research institutions and opening up access to a wider range of researchers. The project has been a success story from its beginning in June 2004. A huge database on environmental chamber experiments has been developed, which is also currently being used by many scientists from outside the consortium for the development and improvement of chemical mechanisms describing the degradation of atmospheric pollutants.

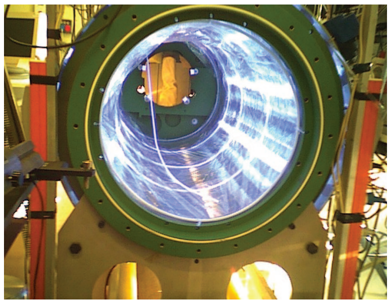
Furthermore, within the frame of the project, several novel analytical techniques for the detection of trace gases and particulates in the atmosphere have been developed and will be deployed in the future in field experiments. In addition, a great number of peer reviewed publications resulted from the project.

The success story will continue. On 1st May 2009, the EUROCHAMP-2 project will be launched with a slightly modified consortium, which will continue the prosperous work for at least the next four years.

Partner institutions include:

- Bergische Universität Wuppertal (BUW), Germany (co-ordinator);
- Joint Research Centre Ispra (EC-JRC), Italy (not participating in EUROCHAMP-2);
- Forschungszentrum Jülich GmbH (FZJ), Germany;
- Fundación Centro des Estudios Ambientales del Mediterráneo (CEAM), Spain;
- Universität Bayreuth (UBAY), Germany;
- University College Cork (UCC), Ireland;
- Centre National de la Recherche Scientifique (CNRS-ICARE), France;
- Paul-Scherrer-Institut (PSI), Switzerland;
- Forschungszentrum Karlsruhe GmbH (FZK), Germany;

*The SAPHIR simulation chamber at Jülich Research Centre, Germany*



*Inner view of a smaller atmospheric simulation chamber with artificial sunlight*

- University of Leeds (LEEDS), United Kingdom;
- Technical Research Institute of Sweden (SP), Sweden;
- Centre National de la Recherche Scientifique (CNRS-LISA), France;
- Leibniz-Institut für Troposphärenforschung (IFT), Germany;
- University of Copenhagen (UCPH), Denmark (new EUROCHAMP-2 partner);
- University of Manchester (UMAN), United Kingdom (new EUROCHAMP-2 partner).

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