Research Service Facility
Gas Analytics

The scientific understanding of the global budgets of greenhouse gases and their increase in the atmosphere are core research questions at the institute. Experimental evidence is obtained by measurements of the atmospheric concentrations of CO_2, CH_4, and N_2O at representative locations. The reliability of scientific conclusions derived from these datasets crucially depends on data quality. Hence the main task of GasLab is to assure the precision and accuracy of these measurements.

Measurements of the atmospheric air composition provide key information on changes of greenhouse gas budgets and help to understand the underlying natural and anthropogenic driving forces. One fundamental aspect is the long-term perspective: many of the relevant biogeochemical changes in the climate system evolve slowly, implying that the air composition has to be recorded over decades in order to detect these changes. Equally important is the global coverage of the monitoring network that must represent all geographic areas that significantly contribute to the global carbon cycle. This global monitoring network is operated by many institutions; some of the important continuous long-term observatories (*e.g.,* at Cape Verde, in Siberia and in Namibia) are run by our institute. On the European level the currently existing observational network is being expanded within the course of the construction of the Integrated Carbon Observing System (ICOS). This new European research infrastructure for studies on the European carbon budget has evolved from the CarboEurope project that had been coordinated at our institute. ICOS has been designed with major input from MPI scientists.

The time horizon and geographic dimension entail high requirements in detecting small systematic differences in the trace gas concentrations. The reliability of scientific findings crucially depends on data quality. The major task therefore is to ensure that atmospheric observations performed by us yield long-term consistent data that are compatible with those supplied by other laboratories involved in the global monitoring network.

Specific tasks of GasLab

1. Production of reference gases

Analyzers at observatories have to be calibrated for atmospheric monitoring using reference gases. These reference gases are produced at the institute using dried, natural ambient air, and are targe-

Portrait of the Leader

Armin Jordan is in charge of the GasLab at the Max Planck Institute for Biogeochemistry since it started operating in 1999. He has participated in many research projects on atmospheric greenhouse-gas measurements funded by the European Commission in recent years. Within the ICOS Preparatory Phase project he was member of the executive board with the responsibility for the design of the Central Flask and Calibration Laboratories. Armin Jordan is member of the Scientific Advisory Group for Greenhouse Gas Measurements of the WMO Global Atmosphere Watch program. ***contact: ajordan@bgc-jena.mpg.de***

ted in their composition by spiking or scrubbing specific trace gases. The traceability to the international accepted calibration scales is achieved by thorough analysis using precise instruments that are themselves calibrated with standard gases from the global Central Calibration Laboratory. GasLab has served as calibration laboratory within the framework of European research projects also for partner institutions in recent years. Presently, the ICOS Flask- and Calibration Laboratory is being set-up in Jena with funds from the German Ministry for Research and Education. This laboratory will then take over the role as the central service laboratory for greenhouse gas measurements in the European observation network.

As part of a research project on atmospheric hydrogen GasLab has developed a procedure for precise mixing of hydrogen in air in order to obtain reference mixtures. Reference gases produced by this method have been accepted by the World Meteorological Organization (WMO) as international calibration scale and GasLab has been assigned the role of the WMO Central Calibration Laboratory (CCL) for molecular hydrogen in air.

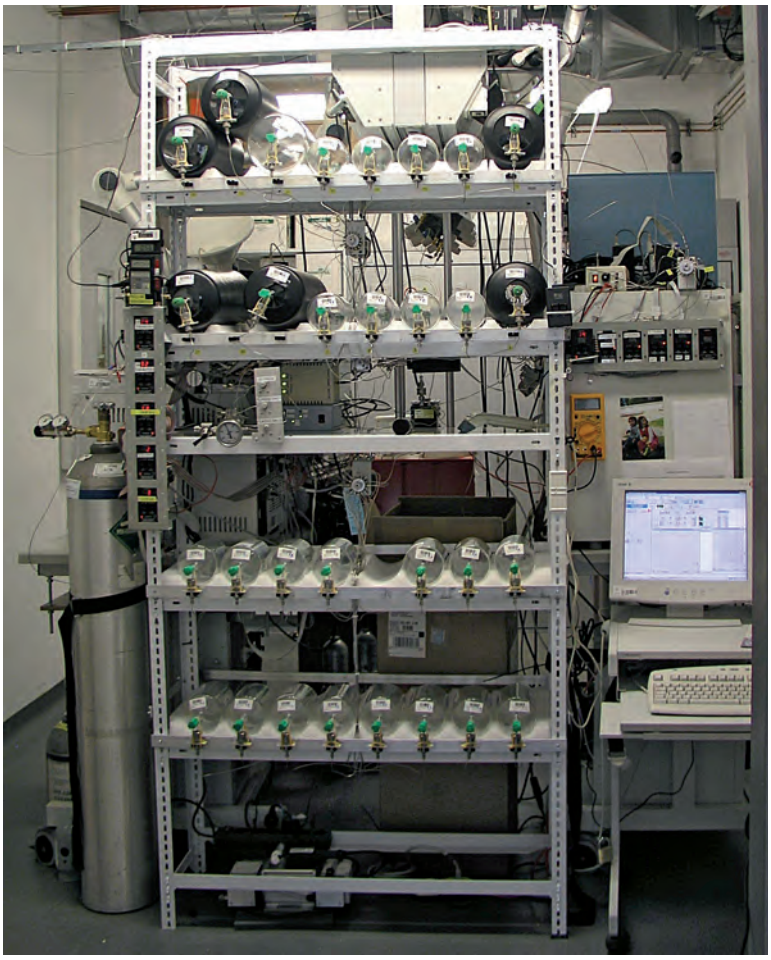
For these measurements we run several different analytical instruments. Many analyzers operate based on spectral photometric techniques like non-dispersive infrared absorption spectroscopy (NDIR), cavity ringdown spectroscopy or vacuum UV fluorescence resonance spectroscopy.

2. Trace gas analysis of grab air samples

Some 3000-4000 discrete air samples collected in glass flasks are analyzed for greenhouse gas mole fractions and supplement tracers (including their isotopic composition), that provide ancillary information on the fate of the air mass that has been sampled. Parameters that are analyzed in GasLab are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), carbon monoxide (CO), hydrogen (H_2), and sulfur hexafluoride (SF6).

Some of these samples originate from monitoring stations contributing to the long-term observations of the background atmosphere. Others are collected as part of measurement campaigns and also serve various research questions. Examples are soil air analysis regularly taken at different ecosystem sites as well as air samples from chamber experiments that allow the investigation of plant or soil respiration. These process studies help understanding the mechanisms that control greenhouse gas fluxes in natural ecosystems.

Analysis of flask air samples are performed using gas-chromatographic techniques as these only consume small amounts of sample. The employed detecting principles are flame ionization detection (CH_4, CO_2), electron capture detection (N_2O, SF6), HgO-reduction detection (CO, H_2), and pulsed discharge detection (H_2).



Gas chromatographic system for trace gas analysis of air samples