IGACtivities Newsletter
of the International Global Atmospheric Chemistry Project

Issue No. 24
August 2001

In this Issue

A Note From the IGAC Chair: *Guy Brasseur*

Towards a Second Phase of IGAC

When IGAC was created in the late 1980's, clear scientific objectives were established with the purpose of solving important issues related to global atmospheric chemistry and global change. At that time, very little information on the global budgets of chemical species was available, and the global distribution of key compounds in the troposphere was virtually unknown. The photochemical theory for the lower atmosphere, especially in remote environments, had not been tested *in situ*, and chemical transport models were in their infancy. In fact, most of the efforts by the scientific community in the 1980's had focused primarily on issues related to stratospheric ozone; time had come to investigate how changes in the chemical composition of the *troposphere* would affect the Earth system. The importance of biosphere/atmosphere interactions was soon identified as a priority for the Project, and the role of aerosols became another important IGAC focus. Several field experiments were organized under the IGAC umbrella in various parts of the world, with superb results published in different special issues of professional journals. The two most recent experiments endorsed by IGAC are ACE-Asia (supported by NSF in the United States as well as agencies in several Asian countries) and TRACE-P (supported by NASA), both in the western Pacific and with a strong international participation.

The major success of IGAC is probably that a large international scientific community with focus on global atmospheric chemistry has been formed and has become very active. International scientific conferences sponsored by IGAC (with various partners) have presented exciting results on several occasions. A synthesis of many efforts conducted by this community is nearing completion and will appear in a few months in a volume prepared by a large group of experts. It has been reviewed extensively and can be considered as a first international assessment on global tropospheric chemistry. This integration/synthesis document is a major milestone in IGAC history, and it will conclude the first phase of the Project.

Time has therefore come to start defining the scientific objectives and an organizational structure for a new phase of IGAC. This second phase is expected to begin in , 2003. A "transition team" to guide preparation of the new phase of IGAC is being formed now and will be co-chaired by Mary Scholes (South Africa) and Tim Bates (United States). Both are world-class scientists who have contributed very substantially to IGAC's science. The task of the transition team will be to establish new priorities for research in atmospheric chemistry on the regional to global scale. Issues like upper troposphere/lower stratosphere processes, long-range transport of pollutants, multiphase chemistry, cloud-chemistry interactions and chemistry-climate couplings are examples of topics that the new IGAC will have to consider. A workshop will be held in Sweden late this year or early in 2002 to develop scientific themes and priorities for the next 10 years. Because of the breadth of the new themes for IGAC in the future, it is hoped that, in addition to IGBP and CACGP, the two parent organizations of IGAC, stronger links will be established with other related programs, in particular the World Climate Research Programme (WCRP) and its SPARC Project.

The Azores Islands: A unique location for ground-based measurements in the MBL and FT of the central North Atlantic

Contributed by **R.E. Honrath** (reh@mtu.edu), *Michigan Technological University, Houghton, USA, and* **Paulo Fialho** (paulo.fialho@angra.uac.pt), *Universidade dos Açores.*

The Azores Islands—the only islands in the central North Atlantic that are distant from all surrounding continents—have historically been important for studies of the North Atlantic atmosphere. Prior to the advent of satellite observations, they provided weather data critical to the accuracy of forecasts of European weather. Today, they provide a unique base for observations of the impacts on atmospheric composition of emissions from the surrounding continents. As part of the NARE program, ground-based measurements of CO and O_3 [Parrish *et al.*, 1998] and NO_Y [Peterson *et al.*, 1998], as well as ozone sondes [Oltmans *et al.*, 1996] were made in 1993 on the island of Terceira. The Azores have also served as a base for airborne studies (e.g., those described by Law *et al.*, this issue) and shipboard studies [e.g., Huebert *et al.*, 1996]. Here, we briefly discuss Azores ground-based measurements, with an emphasis on a new mountaintop site designed to probe the free troposphere.

The 1993 measurements were made at 1000 m on the island of Terceira. This was low enough that the air sampled originated in the surrounding marine boundary layer (MBL), with the exception of short periods of active vertical mixing due to frontal passages. Periods of correlated variations in CO and O_3 were observed during spring, indicating significant impacts from pollutant transport [Parrish *et al.*, 1998]. However, this signature of long-range transport was much weaker during summer. NO_Y measurements were made during August only, and were similarly unaffected by long-range transport [Peterson *et al.*, 1998].

Interpretation of measurements in the MBL to identify impacts of long-range transport is not straightforward for three reasons. First, the structure of the near-shore boundary layer over oceans and other large water bodies is largely determined by land-water temperature differences, and this can result in the lofting of continental emissions above the MBL and a disconnection between surface-air composition and that of the air above [Angevine *et al.*, 1996; Honrath *et al.*, 1997]. This process restricts North American pollutant export into the Atlantic MBL during summer. Second, pollutant lifetimes in the MBL are shorter than those in the free troposphere (FT), as a result of the presence of the ocean-water surface, high concentrations of water vapor and therefore of OH radical, and elevated aerosol levels. This reduces the spatial scale of impacts from long-range transport in the MBL, relative to that of transport in the overlying FT. Finally, in remote midlatitude marine regions like the central North Atlantic, MBL composition and structure are largely determined by subsidence from the FT. For this reason, concentrations in the MBL of compounds like O_3, nitrogen oxides, and CO are determined by a balance between the source from the FT (which depends on concentrations in the FT) and the sink in the MBL. Events of changing concentrations in the overlying FT, which may be caused by long-range transport, are therefore reflected by changing concentrations in the MBL, but the magnitude and timing of these changes is different for each compound because of differences in their lifetimes in the MBL. The result is that interspecies correlations in the MBL must be interpreted with caution [Peterson *et al.*, 1998]. Nevertheless, ground-based measurements can be an extremely valuable complement to aircraft studies. In particular, the opportunity for continuous observations for an extended period of time allows determination of the frequency and duration of pollutant transport events and calculation of the distribution of concentrations in background air.

The Pico International Atmospheric Chemistry Observatory (PICO-NARE) was developed with these issues in mind to provide information on the frequency and duration of events carrying O_3 and O_3 precursors to the lower FT of the Azores region, and to determine regional background levels of these compounds for comparison with global model predictions. PICO-NARE is the result of a collaboration between Michigan Tech and the University of the Azores, and was set up in July 2001 on the summit of Pico mountain on the Azores island of Pico. At an altitude of 2225 m, this is the only location in the central North Atlantic high enough for ground-based observations frequently in the FT. (Water vapor soundings deployed from the adjacent island of Terceira indicate that the MBL height during August typically ranged from 1 to 2 km [Oltmans *et al.*, 1996], and the summit of Pico is often observed above the MBL-capping cloud layer.)

Measurements on Pico mountain are logistically difficult, as the nearest road ends 1000 m below the summit, and the mountain is a restricted area for both environmental and safety reasons. Equipment on the mountaintop is limited to a 2 by 2.5 by 2 m instrument enclosure and instrument inlets. The system is powered by a small diesel generator located 1000 m lower in elevation, via a 2.5 km power cable. All instruments are fully automated and are controlled and accessed via a GSM (cellular) internet connection. The regional government of the Azores has granted permission for 2 years of operation.

Measurements during the first year will focus on the relatively simple and reliable observations of O_3 and the combustion tracers CO and aerosol black carbon, plus standard meteorological parameters and automated sampling of whole air for determination of non-methane hydrocarbons. However, the site was designed with capacity for a limited number of additional measurements, and it is our hope that the potential value of PICO-NARE as a platform for observations of the impacts of continental emissions on the lower FT and MBL of the central North Atlantic region will be fully realized. Scientists wishing to conduct collaborative research during Year 2 (June 2002–2003) and those desiring additional information on

PICO-NARE may contact the project's web site for additional information (www.cee.mtu.edu/~reh/pico).