## OASIS Barrow Field Intensive Spring 2009

The OASIS (Ocean-Atmosphere-Sea Ice-Snowpack) field campaign was designed to provide a detailed study of atmosphere-cryosphere exchange processes occurring in the Arctic in late winter / early spring and the impact these exchange processes have on the oxidizing capacity of the remote Arctic atmosphere, with an eye toward the understanding of how these processes will evolve in a changing climate.

The field campaign, led by Paul Shepson (Purdue University) and Harry Beine (UC-Davis), was successfully carried out from late February to mid-April, 2009. NCAR scientists successfully deployed eleven instruments / instrument suites during the study, as summarized in Table 1 below, thus forming the backbone of the gas-phase component of the study. In addition to the instruments deployed by NCAR, complementary gas-phase measurements were carried out by colleagues at Georgia Tech (PI L.G. Huey, various inorganic halogen species, including BrO), Purdue University (PI P. Shepson, ClO and BrO radicals), the University of Colorado (PI D. Helmig, tethered balloon operation and ozone flux measurements), the University of Toronto (PI J. Abbatt, oxygenated organic compounds), Environment Canada (PIs A. Steffen and R. Staebler, measurements of Hg, and meteorological data), and the University of Wuppertal (PI U. Friess, BrO), while complementary measurements of snowpack chemical, physical and optical properties were conducted by scientists at LGGE-Grenoble, UC-Davis, McGill University, Villanova University and Royal Holloway, University of London.

NCAR scientists have also been heavily involved in campaign planning, organization and logistics (including pre- and post-campaign activities), and thus acted in an appropriate role as facilitators of this University-led campaign. Among the organizational activities carried out by NCAR were the following:

- Hosted the pre-campaign organizational workshops (Boulder, July 9-10, 2007; June 9-10, 2008).
- Acted as lead coordinators of the field site design and layout, including acting as liaisons between scientists and logistics support entities before, during and after the missions.
- Provided and installed some of the infrastructure used in the study, including the two flux towers and sampling lines and associated hardware used by some campaign participants (e.g., NCAR, University of Colorado, Environment Canada, University of Toronto).
- Helped with organization of post-campaign data workshop (held in Davis, Dec. 2009).
- Helped with organization of special session at AGU Fall Meeting, Dec. 2009.
- Provided post-mission data coordination and support, including data merging and archiving services.
- Coordinating delivery of field data to a publicly accessible location.

**Data Collection, Merging and Analysis:**

The following gives a summary of the data obtained, and related sampling details. The majority of the gas-phase instrumentation was housed in two temporary buildings, located about 150m southeast of the Barrow Arctic Research Center, northeast of Barrow AK (see photo #1). Reactive radical species (OH, $HO_2$, BrO, ClO, other inorganic halogen species) were sampled from specialized inlets at a single height (≈5 ft above the snow surface). Data for many of the more stable species (e.g., $O_3$, NO, $NO_2$, $NO_y$, PANs, organic compounds, including oxygenates and halocarbons) were obtained at multiple heights on a tower (≈2, 6 and 18 ft.) and, when available, from a tethered balloon (operated by D. Helmig of CU, at heights of 150, 300 and 450 ft). Typically, sampling was done for a 5 min time interval at each height on the tower and/or tethered balloon, with all instruments sampling in unison from common lines. Thus, the data can be used in conjunction with meteorological data obtained on two towers and from the sodar system (operated by Environment Canada, PI R. Staebler) to examine gradients and possibly fluxes of various species from the snowpack. Aerosol number density and other aerosol physico-chemical

parameters were obtained from a suite of instruments deployed in a building about 400 m northwest of the temporary buildings.

Please see the Google Earth / location files and photographs for further reference.

**TABLE 1:** Instruments deployed by NCAR scientists during the OASIS field mission.

| Instrument / Technique | PI | Other Investigators | Compounds / Parameters Measured |
|---|---|---|---|
| Actinic Flux | Sam Hall | Kirk Ullmann | Photolysis rates for all photo-active species. |
| IR Laser Absorption | Alan Fried | Petter Weibring, Jim Walega | Formaldehyde ($CH_2O$) |
| Trace Organic Gas Analyzer (TOGA, Fast GC-MS) | Eric Apel | Alan Hills Dan Riemer (U. Miami) | VOCs, including oxygenated and halogenated species |
| PAN Thermal-Decomposition CIMS | Frank Flocke, Wengang Zheng | | PAN, $CH_3C(O)OONO_2$ and analogs (e.g, PPN, PBN, etc.) |
| $NO_x$, $NO_y$, $O_3$ Chemiluminescence | Frank Flocke, Andy Weinheimer | David Knapp Denise Montzka Steve Gabbard | NO, $NO_2$, $NO_y$, $O_3$ |
| CIMS, OH | Lee Mauldin | Ed Kosciuch, Josh McGrath (U. Colorado) | OH, $H_2SO_4$, MSA |
| CIMS, OH Reactivity | Lee Mauldin | Ed Kosciuch, Josh McGrath (U. Colorado) | OH Reactivity |
| CIMS, $HO_2$ | Chris Cantrell | Rebecca Hornbrook | $HO_2$, $RO_2$ radicals |
| Aerosol physical and chemical properties, various instruments | Jim Smith | Steve Sjosted, Jon Abbatt (U. Toronto) | Number concentration, size distribution, hygroscopicity, volatility, bulk composition |
| Cartridge samples, GC-MS analysis | Alex Guenther | Jim Greenberg, Andy Turnipseed | Alkyl halides |
| 3D anemometer | Alex Guenther | Jim Greenberg, Andy Turnipseed | Turbulence, vertical wind |

**Photos #1 and 2:** Site of the OASIS field experiment, NE of the city of Barrow, AK. Photos show research trailers from which the majority of the gas-phase measurements were made. Photo on left also

shows the tethered balloon (operated by Detlev Helmig and Patrick Boylan, University of Colorado), from which gradients of some species were measured.

All data received have been finalized, and are available to the public through the National Snow and Ice Data Center.