INTENT FOR PROJECT PROPOSAL
DURING THE INTERNATIONAL POLAR YEAR (IPY) 2007 / 2008

ATMOSPHERIC NITROGEN PHOTO-CHEMISTRY IN AND ABOVE SNOW SURFACES
“PHOTO-SNOW”

The project idea PHOTO-SNOW is connected to two large international efforts, the IGAC project AICI (Air-Ice Interactions, http://www.igac.noaa.gov/AICI.php), and OASIS.

Following the hugely successful International Polar Sunrise Experiment at Alert 2000 [special issue Atmos.Environ.,36(15-16), 2002], an international group of scientists is planning for a new research campaign on Ocean-Sea Ice-Snowpack-Atmosphere Interaction Research (OASIS). The OASIS processes are very complex [see http://www.chem.purdue.edu/arctic/ArcticWorkshop.html for complete details]. The main objective can be summarized to: Understand solar influence on physical, chemical, and biologically-mediated chemical exchange processes involving halogens, NOx, O3, VOCs, POPs, Hg, S-species and CO2 in the Arctic and links to climate change.

The OASIS field-work is planned to coincide with the International Polar Year (IPY) in 2007 to give the project maximum visibility and to increase the chances for national and European funding. “The 125th, 75th, and 50th anniversaries of the first two International Polar Years (IPYs) and the International Geophysical Year (IGY) will occur in 2007-2008. These milestones have the potential to spark exciting new polar science and research, both engaging the next generation of scientists and illustrating to the public the benefits and challenges still inherent in polar exploration.” (http://dels.nas.edu/prb/ipy/).

Scientific Background of PHOTO-SNOW:

The chemistry of snow and ice controls aspects of boundary layer chemistry over large regions of the world. Photochemical production of HONO and NOx from nitrates in snow surfaces is sufficient to alter the composition of the overlying atmosphere. The possible effects of this reaction cycle are fivefold. 1) Reactivation of nitrate extends the influence of NOx emissions, both spatially and temporally, as NOx may be re-emitted after it has been oxidized to HNO3 and deposited. 2) Resulting emissions of NOx may increase the net rate of tropospheric O3 production in some regions. 3) If some of the released NOx is exported, nitrate deposition to snowpacks may be less than previously believed. 4) In remote regions, the production of OH radicals within the snowpack (directly produced from NO3− photolysis) or from photolysis of released HONO may surpass OH production from O3 photolysis. Very high OH concentrations were observed in Antarctica. 5) Reactivation of NO3− is coupled with oxidation of snowpack organic matter, a process that has been hypothesized to be the source of oxidized compounds such as aldehydes.

Especially #4 relates to global change feedback mechanisms. Sun-lit snow is de-facto a large source for hydroxyl radicals, which clean the atmosphere from anthropogenic pollutants. This is being recognized only now. Climate change and the possibility of less snow and ice cover in midlatitudes and Polar Regions may bring both immediate contamination (e.g. photochemical smog, acid rain) and long-range transport. Currently, however, there is little knowledge about the quantitative extent of this snow driven cleaning mechanism.

The practical work for Photo-Snow is intended to be part of the international program OASIS. C.N.R. – IIA and the Italian Polar communities may be involved in several ways.

1. OASIS field-work is planned for 2007 on an Ice-Island some place north of an existing Arctic infrastructure. No location has been decided yet. Scientific as well as logistic reasons make a strong case that this place be North of Svalbard, either on an ice float in the open Arctic ocean or on an existing natural island off the Svalbard shore.
2. With the purchase of the new NOx instrument and existing instrumentation for HONO we would be able to measure with extremely high accuracy simultaneous fluxes of NO, NO2, and HONO (in collaboration with T. Georgiadis CNR-IBIMET).
3. There are numerous research possibilities for individual Italian groups and researchers for specific polar projects in the frame of OASIS (related to halogens, NOx, O3, VOCs, POPs, Hg, S, etc…).

Our group at IIA has worked in this field since 1999, when NOx emissions from snow surfaces were first discussed. We have contributed to the Polar Sunrise Experiment at Alert 2000, and coordinated the European project NICE 2001 – 2003. Between 2001 and 2004 we have measured various aspects of nitrogen emissions from snow surfaces at Ny-Alesund, Svalbard, Monte Cimone, Italy, and Terra Nova Bay, Antarctica. Some of the scientific questions can be seen in more detail in our recent PNRA proposal ‘CESIP’ (BeineX4, PNRA 2004-06)

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