

Report on 1998–1999 Sabbatical Leave

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This short report begins with a restatement of my objectives for this sabbatical, as stated in the sabbatical leave proposal dated February 14, 2005, and then summarizes the activities conducted during the sabbatical and resulting outcomes related to these objectives.

Objectives

I had two broad objectives for this sabbatical, both related to the PICO-NARE atmospheric station on Pico mountain in the Azores Islands, Portugal.

1. to work toward the development of a permanent atmospheric station building on the current MTU-owned PICO-NARE station, and
2. to develop new scholarly works based on analyses of measurements made at that station.

Activities

Activities related to objective 1 included the following.

- I travelled to the University of the Azores, Terceira Island, to meet with Prof. Paulo Fialho to plan the development of the Pico station, to visit his marine boundary layer station, and to discuss the development of an integrated Azores atmospheric monitoring system composed of the two stations together (August 2005).
- I travelled to Ponta Delgada (São Miguel Island) to meet with Mr. K. G. Moore, U.S. Vice Consul to the Azores, to discuss the coordination between the University of the Azores, the Regional Government of the Azores (RGA), and the Portuguese Institute of Meteorology (IM) that is required for successful station development (August 2005).
- I participated in a video conference to discuss the station transfer, which also included Dr. André Bradford, Advisor to the President, RGA; Diamantino Henriques, IM, K. G. Moore, Vice Consul, American Consulate Ponta Delgada; Dr. Paulo Fialho, University of the Azores (September 2005).

Activities related to objective 2 included the following.

- I met with Dr. G. Pfister (NCAR) to discuss her simulations of the transport and evolution of boreal fire plumes transported to the PICO-NARE station, conducted using the MOZART global chemical transport model (GCTM). Dr. Pfister travelled to Houghton for this purpose and to present a seminar.
- I participated in the Gordon Research Conference on Atmospheric Chemistry (Big Sky Montana, September 2005). There, I discussed with Q. Li (NASA JPL) a joint proposal and future research collaborations involving his use of the GEOS-CHEM global chemical transport model in conjunction with analyses of measurements at the PICO-NARE station, in order to study the photochemical evolution of low-altitude North American pollution outflow.

- I participated in the Fall 2005 meeting of the American Geophysical Union and held extended meetings with Dr. Detlev Helmig (University of Colorado) to discuss analysis of his non-methane hydrocarbon (NMHC) measurements at the PICO-NARE station and collaborations on future proposals and research.
- I worked on data analysis and interpretation, paper writing and review, and proposal development.

Outcomes

- **Progress toward development of a permanent Pico atmospheric station.** As a result of the activities noted above, the Regional Government of the Azores, the University of the Azores, and the Portuguese Institute of Meteorology have agreed to work together to create a new, permanent station on Pico mountain, and to start by taking over the PICO-NARE station. A formal ceremony at which the station will be donated to the University of the Azores by Michigan Tech is scheduled to take place June 29, 2006. This ceremony is being coordinated by the U.S. Consulate to the Azores. At this ceremony, RGA and IM will document their commitment to support the development and operation of a permanent station.

The PICO-NARE station is unique as a free tropospheric station in the central North Atlantic region, where aged North American pollution can be frequently sampled. For this reason, if these Portuguese entities are successful at developing and operating a Pico station, this work will have contributed to a significant long-term resource for studies of atmospheric composition and change and for the evaluation of global chemical transport models used to evaluate human impacts on the global atmosphere. As an indication of the importance assigned to this development, the national director of the NOAA Climate Program is currently planning to attend the transfer ceremony.

- **New scholarly works and proposals.** The following publications, presentations and proposals were completed or are based largely on work completed during this sabbatical.

Publications

- R. C. Owen, O. Cooper, A. Stohl, and R. E. Honrath, An analysis of transport mechanisms of North American emissions to the central North Atlantic, *J. Geophys. Res.*, in press, 2006.
- K. Lapina, R. E. Honrath, R. C. Owen, and M. Val Martín, Evidence of significant large-scale impacts of boreal fires on ozone levels in the midlatitude Northern Hemisphere free troposphere, *Geophys. Res. Lett.*, in press, 2006.
- J. Kleissl and R. E. Honrath, Analysis and application of Sheppard's airflow model to predict mechanical orographic lifting and the occurrence of mountain clouds, *J. Appl. Met.*, in press, 2006.
- P. Fialho, M. C. Freitas, F. Barata, B. Vieira, A. D. A. Hansen, and R. E. Honrath, Aethalometer calibration and determination of iron concentration in dust aerosols, *J. Aerosol Sci.*, in press, 2006.
- The occurrence of upslope flows at the Pico mountain observatory: a case study of orographic flows on small, volcanic islands, J. Kleissl, R. E. Honrath, R. C. Owen, M. Val Martin, and M. P. Dziobak, *J. Geophys. Res.*, to be submitted by May 31, 2006.

- Significant enhancements of nitrogen oxides, ozone and black carbon in the North Atlantic lower free troposphere resulting from North American boreal wildfires, M. Val Martín, R. E. Honrath, R. C. Owen, G. Pfister, P. Fialho, and F. Barata, *J. Geophys. Res.*, to be submitted by May 31, 2006.
- D. Helmig, D. Tanner, R. Honrath and others, Transport and photochemical processing in the lower North Atlantic troposphere as derived from non-methane hydrocarbon analyses at Pico Mountain, Azores, *J. Geophys. Res.*, to be submitted by May 31, 2006.
- G. Pfister, L. K. Emmons, P. G. Hess, J.-F. Lamarque, R. E. Honrath, M. Val Martín, and R. C. Owen, Ozone production from boreal forest fire emissions, *J. Geophys. Res.*, to be submitted by May 31, 2006.

Proposals

- Collaborative Research: Ozone photochemistry in lower-FT anthropogenic and biomass-burning plumes at the PICO-NARE station, NSF. This project is a collaboration using Michigan Tech measurements of CO, O₃, and nitrogen oxides with measurements of NMHC by D. Helmig (U. Colo), MOZART GCTM simulations by P. Hess and G. Pfister (NCAR), and GEOS-CHEM GCTM simulations by Q. Li (NASA JPL).
- NO and NO₂ measurements as part of a study of ozone photochemistry at Summit, Greenland, Univ. Colorado/NSF. This project is a collaboration with D. Helmig (U. Colo), which is an outgrowth of discussions during our meetings in December 2005.

Presentations during the sabbatical

- R. E. Honrath, P. Fialho, D. Helmig, M. Val Martín, R. C. Owen, J. Kleissl, J. Strane, M. P. Dziobak, D. M. Tanner, and F. A. Barata, permanent free tropospheric observatory at Pico summit in the Azores Islands? Past measurements (2001-2005) and future plans, American Geophysical Union Fall Meeting, December 5–9, 2005.
- Val Martín, M., Honrath, R. E., Owen, R. C., Kleissl, J., Fialho, P., Pfister, G., Lapina, K., Large Enhancements of Nitrogen Oxides Over the Central North Atlantic Lower Free Troposphere Resulting From Boreal Wildfires: Observations at the PICO-NARE Station During Summer 2004, American Geophysical Union Fall Meeting, December 5–9, 2005.
- Pfister, G. G., Emmons, L. K., Hess, P. G., Lamarque, J., Edwards, D. P., Thompson, A. M., Wuebbles, D. J., Herman, R. L., Owen, C. R., Honrath, R., Val Martin, M., Sachse, G. W., Avery, M., and Randerson, J. T., Implications of North American Boreal Fires on Air Quality and Composition in Nearby and Remote Regions, American Geophysical Union Fall Meeting, December 5–9, 2005.
- K. Lapina, R. Honrath, C. Owen, M. Val Martín, and J. Strane, Impact of Large-Scale Boreal Fires on Levels of Tropospheric Ozone in the Northern Hemisphere, American Geophysical Union Fall Meeting, December 5–9, 2005.
- J. Kleissl, M. P. Dziobak, and R. E. Honrath, The Influence of Orographic Flows on PICO-NARE Trace-Gas Measurements, American Geophysical Union Fall Meeting, December 5–9, 2005.
- R. E. Honrath, M. Val Martin, J. Kleissl, R. C. Owen, K. Lapina, D. Helmig, and D. Tanner, Large-scale impacts of anthropogenic and boreal forest fire emissions observed in multi-year free tropospheric observations in the Azores, Gordon Research Conference (Atmospheric Chemistry), Big Sky Resort, Big Sky, Montana, Sept. 4–9, 2005.