NCAR

UPDATES

National Center for Atmospheric Research • Office of the Director • P.O. Box 3000 Boulder, Colorado 80307

1990-41 October 16, 1990

NCAR Scientists Involved in Stratospheric Aerosol Sulfate Layer Studies

A group of NCAR scientists, led by Alan Fried of the Atmospheric Chemistry Division (ACD), is studying the chemistry of and potential perturbations to the stratospheric aerosol sulfate layer. The layer, also know as the Junge layer, is comprised of sulfuric acid–water aerosol particles and surrounds the earth 18 to 23 kilometers from the surface. The aerosols are in the exact size range to efficiently scatter ultraviolet and visible radiation.

Volcanic eruptions and anthropogenic emissions of long-lived sulfur gases such as carbonyl sulfide (OCS) and its precursor carbon disulfide are believed to be the primary vehicles in sustaining the Junge layer. Enhancing the layer over the long term from such anthropogenic emissions may significantly influence the earth's radiation budget and climate through increased solar scattering and aerosol absorption. The destruction of ozone on a global scale may also be enhanced through heterogeneous chemical reactions on aerosols similar to those that destroy ozone in the Antarctic. Model calculations made by ACD scientists have shown that the destruction of ozone by chlorofluorocarbons could be significantly enhanced by the presence of aerosols, especially after a large volcanic eruption.

These heterogeneous reactions between gas-phase species and polar stratospheric clouds (frozen water aerosols) are now known to be important in the catalytic destruction of ozone in the Antarctic. Such reactions on the background Junge layer may also be important on a global scale. However, the rates of such reactions, know as reaction probabilities, are poorly determined.

Fried and his NCAR colleagues Bruce Henry and Jack Calvert, in collaboration with Michael Mozurkewich, formerly of NCAR and now at York University in Ontario, are carrying out laboratory heterogeneous studies of dinitrogen pentoxide and chlorine nitrate on sulfuric acid–water aerosols to determine these important reaction probabilities. In these studies, submicron aerosols representative of those in the midlatitude stratosphere are generated, and the resultant gas-phase products and residual reactants are measured with a highly sensitive and selective infrared tunable diode laser absorption system (TDLAS). The system was developed by Fried and colleagues at NCAR in collaboration with James R. Drummond at the University of Toronto. Under cosponsorship of NSF and NASA, reaction probabilities are being measured as a function of temperature and relative humidity, the results of which will be employed in stratospheric models.

In addition to laboratory heterogeneous studies, the TDLAS has been employed in a number of other studies by Fried and colleagues including: 1) high precision measurements of ambient OCS; 2) OCS fluxes in bog ecosystems measured in collaboration with Lee Klinger at NCAR; 3) measurements done at the Colorado Department of Health of OCS in motor vehicle exhaust as a function of converter technology, fuel sulfur, and driving conditions; and 4) carbon monoxide intercomparison studies with David Parrish of NOAA's Aeronomy Laboratory. The results of the last two studies are currently being prepared for publication.

Update Contact: Joan Vandiver Frisch, NCAR Director's Office (303) 497-8720