N91-10486

SUB-VISUAL CIRRUS DETECTION AND CHARACTERIZATION

E. Schmidt, G. Grams, E. Patterson
Georgia Institute of Technology, School of Geophysical Sciences
Atlanta, Ga 30332

Analysis of archived cold optics (COR) radiometer data is yielding useful information on the diurnal, geographic, seasonal and altitude variability of atmospheric background radiance levels in the 11 micron window region. This database is a compilation of Kuiper Infrared Technology Experiment (KITE) and Atmospheric Radiance Study (ARS) observations under a wide variety of conditions. Correlating the measurements from these two studies with the LOWTRAN model code has revealed several important results. First, the 11 micron window appears to be "filled-in," i.e., the troughs on either side of the nitric acid peak are shallower than expected. Second, the amplitude of the background radiances measured exceeds the model predictions by a factor of 2-3 or more. This is thought to be due to the existence of thin, high altitude cirrus clouds (sub-visual cirrus) above the sensor platform. These high background levels are observed under quiescent conditions in the south Pacific (Marshall Islands), as well as over the continental United States (the west coast). In the tropics, there appears to be little diurnal variability, a plausible seasonal variation and a linear dependence between 7.2 and 11.4 micron band data, indicating possible multi-spectral approaches to detection of sub-visual cirrus clouds.

Theoretical analysis of the magnitude of the effects of a sub-visual cirrus cloud on atmospheric background radiances measured by a near-horizontal sensor is in progress. Fine tuning of the radiative transfer calculations requires characterization of sub-visual cirrus cloud properties, specificaly total optical depth, altitude, vertical structure, and persistence. The scattering of thermal emissions from the Earth and low-lying warm clouds by non-spherical

hexagonal ice crystals that are non-randomly oriented is suggested as a possible explanation for the elevated window measurements (emission from the cloud itself is considered.) Calculation of phase functions to specificaly address these conditions requires information on particle size distribution and orientation, as well as shape.

Further efforts underway include work at Wright-Patterson Air Force Base using the 100-inch collimator as the receiver for a powerful lidar system, the "MEGALIDAR." The MEGALIDAR facility will ultimately provide profiles of atmospheric density and temperature up to 100 km. Other experiments planned rely on coordination of lidar techniques with sky background observations. Under a project sponsored by the USAF Summer Research Program, we plan to correlate simultaneous visible and infrared (8-12 micron) spectral sky measurements with lidar observations of altitude, vertical structure, total optical thickness and persistence of sub-visual cirrus at the MEGALIDAR site. This information, along with satellite and rawindsonde support data, should provide a useful "snapshot" of the subvisual cirrus and allow proper analysis of the effects of sub-visual cirrus.

Information on the spatial extent and characteristics of sub-visual and high altitude cirrus clouds will not be available from the planned program; however, it is hoped that useful information might be gathered from the FIRE data and included in our analysis.