

Observing Supersaturation of Water in the Upper Troposphere and Lower Stratosphere Using a Vertical Cavity Surface Emitting Laser Hygrometer

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Water vapor detection in the upper troposphere and lower stratosphere (UT/LS) impacts weather and climate prediction and our understanding of atmospheric dynamics. Our instrument is a vertical cavity surface emitting laser (VCSEL) spectrometer operating at about 1854 nm. Mounted onboard the NSF Gulfstream V research aircraft during the Stratosphere-Troposphere Analyses of Regional Transport 2008 (START08) field campaign, the VCSEL hygrometer measured water vapor concentration *in situ* using an open cell. The VCSEL is promising because it operates at the wide range of temperatures, pressures and humidities seen in the UT/LS. It also has a finer resolution than the chilled mirror hygrometer and does not suffer from hysteresis problems found in enclosed tunable diode laser instruments, both of which are also onboard the aircraft and are common in water vapor detection. We are analyzing our data along with the campaign's other atmospheric measurements to first investigate the extent and degree of ice supersaturated regions in the UT/LS. The conditions required to achieve relative humidities with respect to ice greater than 100% are poorly understood. However, this appears to occur more frequently than expected. This influences cloud formation and, consequently, the greenhouse effect caused by water vapor. Preliminary analyses suggest that supersaturated regions were observed on all flights with some instances exceeding 150% humidity. An examination of the circumstances under which supersaturation is observed during the flights will include noting aerosol and trace gas concentrations and atmospheric temperature and pressure.