

SPARC Water Vapor Assessment: Measurements of water vapor in the upper troposphere and lower stratosphere with CIMS during the 2011 MACPEX mission

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Concentrations of water vapor in Earth's upper troposphere and lower stratosphere (UT/LS) are typically low (< 10 ppmv) yet water in this region is a significant driver of climate. Significant discrepancies have repeatedly been observed between multiple in situ precision measurements of water vapor at these low values. During the NASA Mid-latitude Airborne Cirrus Properties Experiment (MACPEX) mission in March and April of 2011, measurements of water vapor in the UT/LS were made using the NOAA chemical ionization mass spectrometer (CIMS) integrated on the NASA WB-57 based out of Ellington Field, TX. This was the first aircraft deployment of this CIMS instrument designed to measure water vapor. The CIMS carried a unique calibration system using two independent water vapor standards that were in excellent agreement throughout the campaign. Other high precision water vapor instruments including the Harvard Water Vapor and FISH Lyman- α hygrometers were also on the WB-57 during MACPEX. Balloon soundings of the NOAA frost point hygrometer (FPH) were coordinated with final descents of some of the flights. Here we present preliminary CIMS data from the mission and compare the measurements made with CIMS to those made with the other instruments. In general, better agreement between these instruments is observed than has been observed on many previous campaigns while some systematic differences persist below 10 ppm. From the intercomparison of these instruments, we highlight the excellent agreement between some of the measurements, and examine the systematic differences that exceed the combined instrumental uncertainties at water vapor mixing ratios below 10 ppmv.