Preliminary Balloon-borne in Situ Water Vapor Intercomparison from Aire-sur-l'Adour, France: September 2022

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Water vapor is Earth's most abundant greenhouse gas and is responsible for about half of Earth's greenhouse effect. Slight variations in the abundance of water vapor in the stratosphere can significantly affect the Earth's radiation budget. Monitoring the abundance of stratospheric water vapor is a crucial aspect of detecting and predicting climate change, as it serves as a significant driver of decadal global surface climate change. In the lower stratosphere, water vapor mixing ratios are less than 10 ppmv. Making accurate measurements of water vapor in the upper troposphere and lower stratosphere remain challenging and few in situ instruments are able to accurately perform this task. For this reason, it is important to have rigorous intercomparisons with stratospheric water vapor instruments with good spatial and temporal matching.

In September 2022, several lightweight hygrometers were flown on different balloons during a one-week intensive intercomparison that took place in Aire-sur-l'Adour, France. The newly developed mid-infrared hygrometer, known as "Pico-Light H_2O," was compared with the NOAA frost point hygrometer (FPH) on three nighttime flights. Two separate Pico-Light instruments were flown on the final night providing an intercomparison between two Pico-Light instruments and the NOAA FPH. The differences were less than 1 ppmv (10%) between 14-22 km. This campaign took place within the framework of the E.U. funded HEMERA project. We also evaluate the performance of the Meteomodem M20 and InterMet Systems iMet-4 radiosondes flown during the campaign with the NOAA FPH.

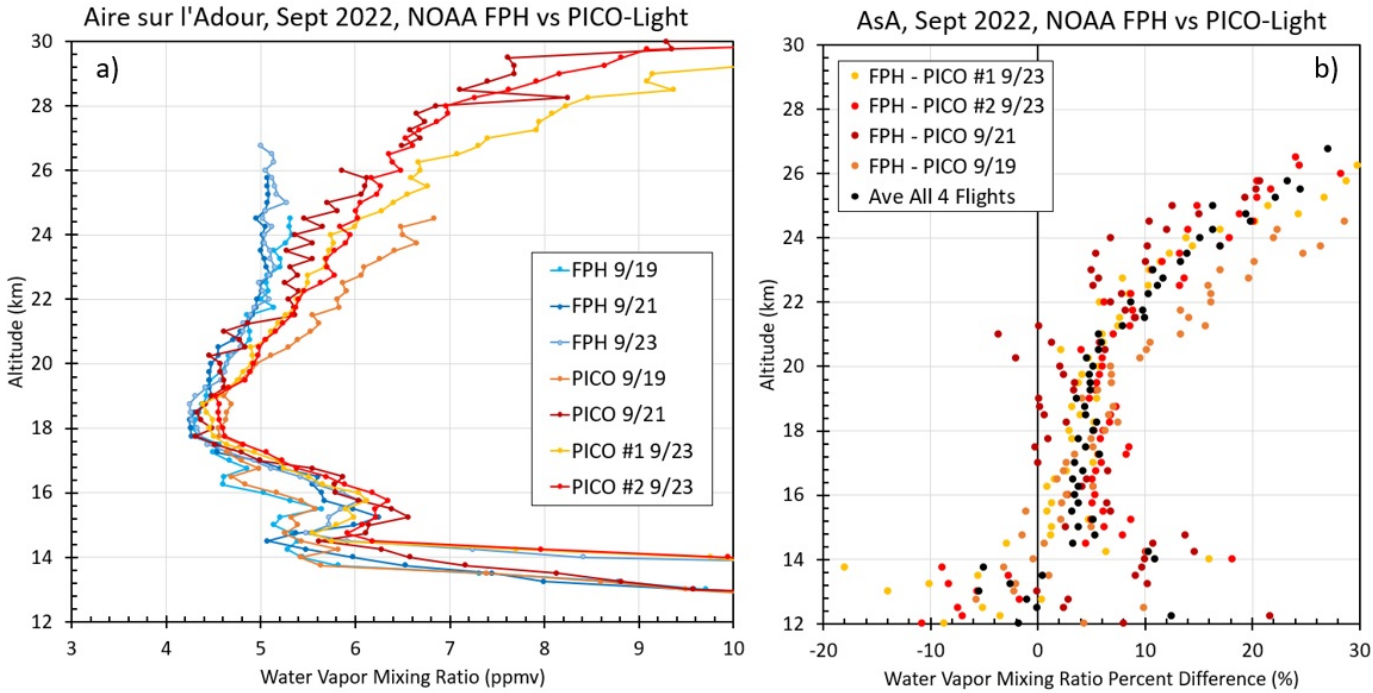

Figure 1. Stratospheric water vapor profiles are shown in panel a) from three-night flights in Aire-sur-l'Adour, France. The percent differences are shown in panel b). Two different Pico-Light instruments were flown on September 23, 2023 launched minutes apart.