

Stratospheric water vapor measurements at Thule, Greenland, by means of a new 22 GHz spectrometer

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A new 22 GHz water vapor spectrometer, VESPA-22 (water Vapour Emission Spectrometer for Polar Atmosphere), was installed in July 2016 at the Thule High Arctic Atmospheric Observatory (THAAO) located at Thule Air Base (76.5° N, 68.8° W), Greenland, and participated in the intensive measurement campaign of the Study of the water VApour in the polar AtmosPhere (SVAAP) project. After the campaign VESPA-22 has continued to carry out measurements in an autonomous mode and has now obtained more than 6 months of data.

VESPA-22 was designed and built at the Istituto Nazionale di Geofisica and Vulcanologia (INGV) and measures the 22.235 GHz water vapor emission line with a bandwidth of 500 MHz and a frequency resolution of 31 kHz. The collected spectra are inverted using an optimal estimation algorithm in order to retrieve water vapour vertical profiles from about 26 to 72 km with a vertical resolution varying from 4 to 7.5 km. The spectrometer can produce 2 to 4 vertical profiles a day, depending on season and weather conditions.

VESPA-22 also measures the atmospheric optical depth at 22 GHz and can therefore provide an estimate of precipitable water vapor (PWV) with a temporal resolution of few minutes. The instrument is calibrated every 30 minutes using noise diodes and tipping curves, and requires a calibration with liquid nitrogen (LN2) only once every few months.

We will present water vapor stratospheric profiles over Thule obtained during an almost complete yearly cycle. The retrieved profiles have been compared with the Aura/MLS H₂O dataset. During autumn 2016 the two datasets show a mean difference of less than 5% and a correlation coefficient of about 0.9 at all altitudes between 26 to 60 km.