Ground-Based Microwave Observations of Stratospheric Trace Gases at the Tropical Mérida Atmospheric Research Station (MARS) in Venezuela

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Overview

The joint Venezuelan and German project of a high altitude tropical station for atmospheric research is being established on Pico Espejo (8.51° N, 71.06° W, 4765 m asl) in the vicinity of Mérida, Venezuela. A small building on the top of Pico Espejo has been used for atmospheric research in the 70's and has now been reconstructed for future use as atmospheric research station. One advantage of this high altitude location is the good accessibility by the worlds highest cable car. Figure 1 shows the view over Pico Espejo with the building for the measuring instruments.

Figure 1: View over Pico Espejo with the building for the measuring instruments.

This site provides excellent conditions for ground-based observations due to its low total column water vapor content. Long-term data suggest, that nearly year-round measurements even at 278 GHz will be feasible. Figure 2 shows the atmospheric transmission at 278 GHz calculated from 1958–1997 NCEP/NCAR data on a 2.5°x 2.5°grid for different altitudes in the region of Mérida. A transmission in excess of ∼0.7 allows the measurement of weak signatures like ClO.

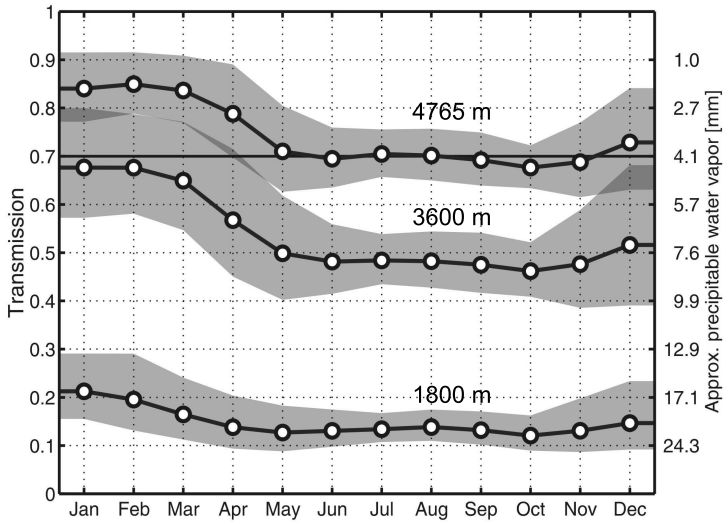

Figure 2: Atmospheric transmission at 278 GHz for different altitudes in the region of Mérida. The shaded areas are the variations calculated for the 1958–1957 time span.

Instruments

The installations on Pico Espejo will include two ground-based microwave radiometers. One of these instruments is the millimeter-wave radiometer MIRA 2, which has been developed at the Forschungszentrum Karlsruhe. MIRA 2 covers the frequency range 268–280 GHz and is capable to measure ozone, ClO, HNO_3, and N_2O. A detailed description of this instrument is given in [1]. This radiometer is well validated and tested during several arctic measurement campaigns since 1996 (e.g. see [2]). Figure 3 shows MIRA 2 with the acousto-optical spectrometer (AOS) and PC control rack.

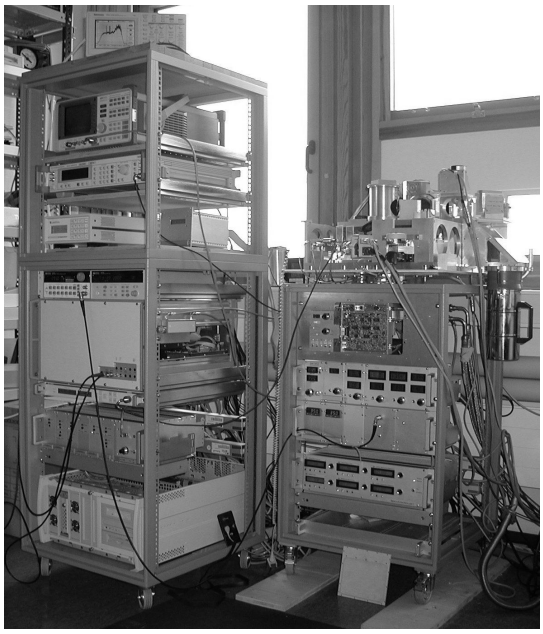

Figure 3: MIRA 2 with the acousto-optical spectrometer (AOS) and PC control rack on the left.

The water vapor radiometer for atmospheric measurements WARAM 2 is developed by

the University of Bremen and measures the H_2O line at 22 GHz. It is based on a similar instrument in operation at the Arctic primary NDSC station at Ny-Ålesund, Svalbard [3]. MIRA 2 and WARAM 2 will share the same acousto optical spectrometer and PC control. Figure 4 shows the frontend of WARAM 2 with the horn antenna and the mirror for calibration and the adjustment of the elevation angle.

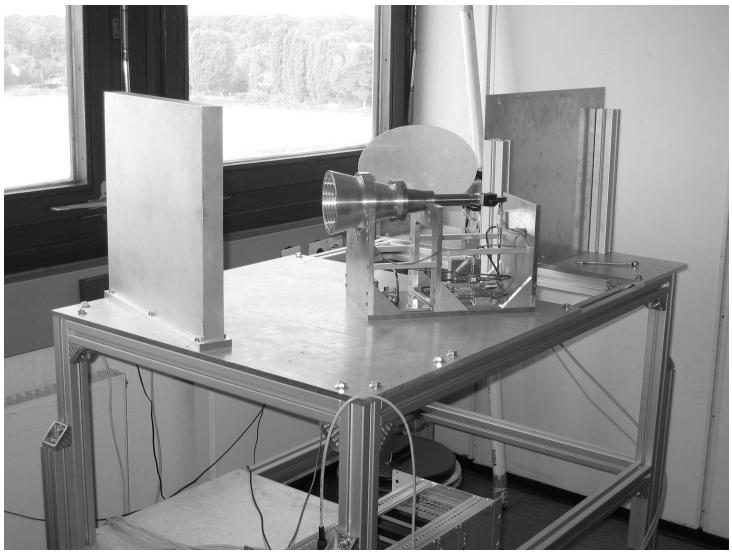

Figure 4: Frontend of WARAM 2 with the horn antenna. The rotatable mirror behind the horn antenna is used for calibration and the adjustment of the elevation angle.

Measurements

Table 1 gives an overview over the trace gases that will be measured by the microwave radiometers on Pico Espejo. Also given are the altitudes, in which the instruments are sensitive, and the accuracy of the retrieved vertical profiles.

Constituent	**Altitude range**	**Accuracy**
O_3 (MIRA 2)	17–55 km	0.5 ppmv
ClO (MIRA 2)	17–55 km	0.4 ppbv
HNO_3 (MIRA 2)	17–55 km	1.0 ppbv
N_2O (MIRA 2)	17–55 km	30 ppbv
H_2O (WARAM 2)	25–55 km	0.3 ppmv

Table 1: Constituents that will be measured by MIRA 2 and WARAM 2 on Pico Espejo. The second and third column give the expected altitude range and accuracy of the retrieved profiles.

In a first phase, the vmr-profiles measured by both instruments will be used for validation of the SCIAMACHY instrument aboard ENVISAT. Due to the very favorable conditions offered by this site for ground-based measurements and the fact, that a number of additional sensors will soon be added also in or near Mérida, it is planned to propose Mérida as the first tropical primary NDSC station.

Acknowledgement

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References

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