MICROWAVE RADIOMETRY OF STRATOSPHERIC TRACE GASES IN TROPICAL LATITUDES AT THE MÉRIDA ATMOSPHERIC RESEARCH STATION (MARS)

G. Hochschild, IMK, Forschungszentrum Karlsruhe, D-76344 Eggenstein, Germany, hochschild@imk.fzk.de
P. Hoffmann, Faculty of Science, Universidad de los Andes (ULA), Mérida, Venezuela, hoffmann@ciens.ula.ve
K. Kunzi, IUP, Physics, University of Bremen, D-28334 Bremen, Germany, e-mail: kunzi@uni-bremen.de
M. Peñaloza, Faculty of Science, Universidad de los Andes (ULA), Mérida, Venezuela, e-mail: mpenaloa@ciens.ula.ve
A. Richter, IUP, Physics, University of Bremen, D-28334 Bremen, Germany, e-mail: Andreas.Richter@iup.physik.uni-bremen.de

MARS is a joint project by the Institute of Environmental Physics, University of Bremen and the Forschungszentrum Karlsruhe both in Germany, and the Universidad de los Andes, Mérida, Venezuela. Operation of the station is expected to start in early 2002.

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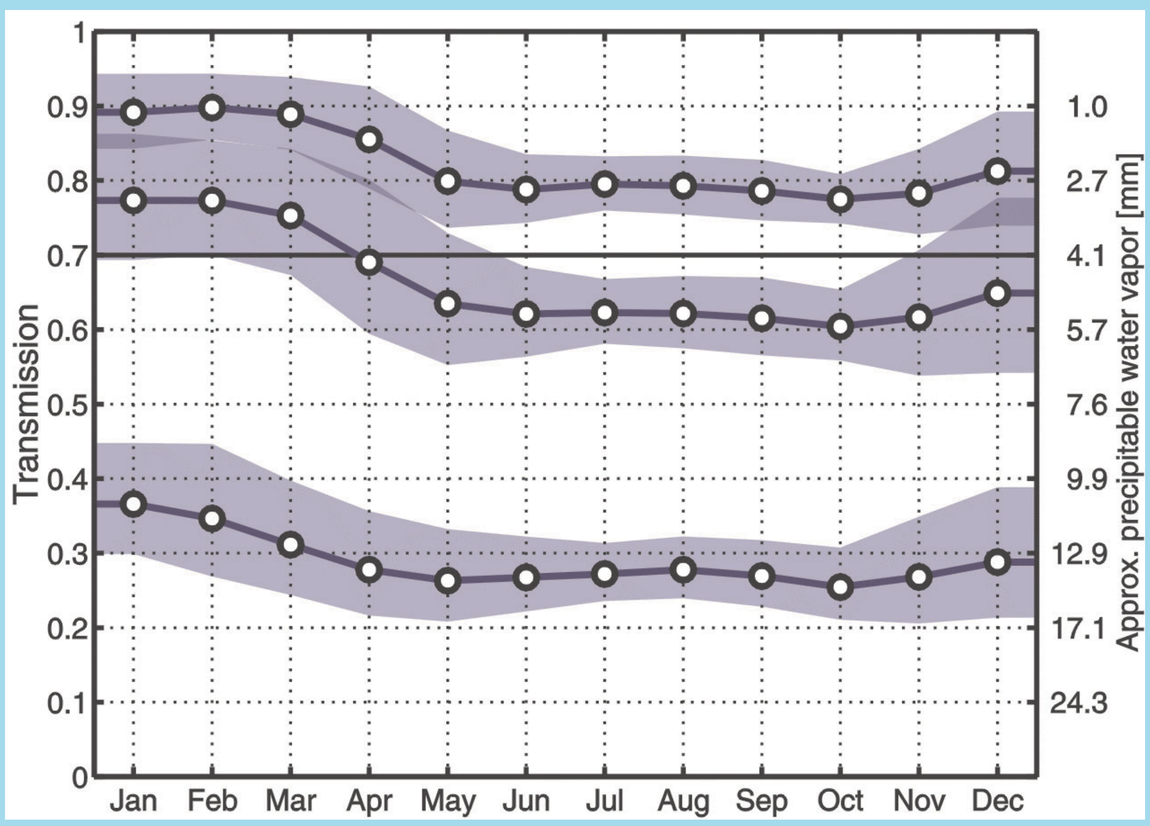
Institute of Meteorology and Climate Research

MARS will be established near the city of Mérida, Venezuela (8N, 71W, see map) in cooperation with the University of Mérida, Physics Dept. **MARS** will take advantage of a high altitude site, the *Pico Espejo* at 4765 m for the microwave sensor. *Pico Espejo* is accessible with the world highest cable car. Additional instruments (LIDAR, FTIR and UV-A/B spectrometers) will also be deployed at the nearby *Instituto Astrofisico* at 3600 m altitude by the Alfred-Wegener-Institut, Bremerhaven, Germany.



Expected performance (figure on left) of a microwave radiometer operating near 270 GHz at tropical latitudes. The *solid line* at 0.7 transmission gives the lower detection limit for successful measurements for species with a small VMR such as ClO. The top curve is for an observing altitude of 4765 m, and the lower two lines are for 3600 m and 1800 m respectively. The shaded area is the calculated variation for the 1958-1997 time span. For these calculations reanalyzed NCEP/NCAR data on a 2.5º×2.5º grid have been used.

In addition to the profiling microwave instrument an optical instrument operating in the DOAS mode will be installed. This sensor measures the absorption of visible and near-ultraviolet sunlight scattered in the atmosphere allowing to perform quasi-continuous observations of several atmospheric species during day time. The determination of column abundance of molecules such as ozone, and a number of additional constituents is possible (see table below). These gases are key compounds in both the troposphere and the stratosphere, and several of them are not measurable by other means. The data retrieval will be performed by combined radiative transfer modeling and the well-known Differential Optical Absorption Spectroscopy (DOAS) method. Some profile information will be obtained by using two viewing directions near the horizon in addition to the zenith pointing.

Building for the MARS station in the foreground. The Cable Car Station can be seen in the background.

Constituent	Altitude range [km]	Accuracy	Instrument Name or type
H_2O	25-55	0.3 ppm or 20%	WARAM
O_3	17-55	0.5 ppm or 10 %	MIRA-2
ClO	17-55	0.4 ppb or 20 %	MIRA-2
HNO_3	17-55	1 ppb or 20 %	MIRA-2
N_2O	17-55	30 ppb or 15 %	MIRA-2
O_3	Columns (free Troposphere and Stratosphere)	< 2%	DOAS
NO_2		< 5 %	DOAS
OClO		$1*10^{13}$ molec/cm^2 or 15 %	DOAS
IO		$1*10^{13}$ molec/cm^2 or 30 %	DOAS
BrO		$1*10^{13}$ molec/cm^2 or 10 %	DOAS
HCHO		$1*10^{15}$ molec/cm^2 or 20 %	DOAS
H_2O		$1*10^{23}$ molec/cm^2 or 4 %	DOAS

NOTES

Estimated performance for microwave radiometers operating in the frequency range 268 to 280 GHz, and 22.2 GHz for water vapour at approximately 4700 m altitude in the tropics. Vertical resolution will be 8 to 10 km in the lower and 10 to 12 km in the upper stratosphere.

The DOAS observes total columns above the observing site. Viewing directions near the horizon gives information about trace gases in the free troposphere.

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