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Data Set Description:

PI:	Dr. Jerome de La Noe
Instrument:	Ozone millimeter wave radiometer
Site(s):	Bordeaux Observatory
Measurement Quantities:	Ozone VMR profile

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Reference Articles:

Lezeaux, O., J. de La Noe and P. Ricaud, "Strato-mesospheric ozone measurements at mid-latitudes during the winter 1996-1997", Proceedings of the Fourth European Symposium on Polar Stratospheric Ozone, Schliersee, Germany, 22-26 September 1997, EUR 18032 EN, 212-215, 1998.

de La Noe, J., O. Lezeaux, G. Guillemin, R. Lauque, P. Baron, and P. Ricaud, "A ground-based microwave radiometer dedicated to stratospheric ozone monitoring", Journal of Geophysical Research, 103, 22,147-22,161, 1998.

Lezeaux, O., "Mesures micro-ondes d'ozone strato-mesospherique a partir du sol : restitution de profils verticaux, validation et interpretation geophysique des resultats", these, Univerite Bordeaux 1, 1999.

Instrument Description:

The ozone microwave radiometer detects an ozone emission line at the transition frequency of 110.836 GHz. The instrument consists of a quasi-optical system, a millimeter wave receiver and a dual filterbank spectrometer, controlled by a DEC/Vax computer. Atmospheric signals enter the quasi-optical system

and, thanks to two dual beam interferometer type diplexers, only the ozone line and local oscillator signals enter the millimetre wave cooled Schottky mixer. The ozone line is down converted to 1.5 GHz along with broadband emission of a cold load at 20 K in the image band. The mixer uses a Schottky diode located inside the Dewar vessel and cryogenically cooled down to 20 K by a CTI refrigerator. The cooled receiver has a single side band noise temperature of about 500 K. The local oscillator is a Gunn diode whose frequency is phase-locked to 109.336 GHz.
The intermediate frequency signal then undergoes an additional down-conversion and, after amplification, the 150-MHz carrier frequency is processed in two parallel filter banks consisting of 256 channels of 100-kHz bandwidth and 256 channels of 500-kHz bandwidth, having total bandwidths of 25.6 and 128 MHz, respectively.
Since March 1996, a phase scrambler has been installed in the quasi-optical system in order to remove baseline ripples on spectra. A mirror istranslated back and forth by a quarter wavelenght that put ripples of two consecutive spectra on opposite phase.
The observation procedure uses the beam switching technique. For this radiometer, the signal beam (S) is directed towards an adjustable low elevation (ranging from 10° to 20° depending on atmospheric conditions) while the reference beam (R), is directed towards a fixed high elevation, typically 55°, using a movable flat mirror controlled by a stepping motor. In order to balance the atmospheric emission at low and high elevations, an absorber (10, 15 or 18 mm thickness Plexiglas sheets) is placed within the (R) beam.
Measurements are carried out in 60 cycles of 10 s duration, alternating between (S) and (R) directions, which are integrated over a total observing time of about 10 mn. The resulting (S)-(R) differential spectrum is then stored. Observations are made as often as possible since the data acquisition software has been written to make automatic measurements using ancillary information (rain detector, outdoor temperature and relative humidity).
In order to convert the output value (S)-(R) into intensity units, usually given as brightness temperature in millimeter wave spectrometry, spectra are calibrated with a hot load at ambient temperature and a cold load at liquid nitrogen temperature, once a day.
Since October 1998 hourly automatic relative calibrations have been implemented in the observation procedure.

<u>Summary:</u>
110.836 GHz microwave radiometer
Located at Bordeaux, 45N / 0.5W, 73 m. a.s.l.
2 filter-bank spectrometer of 256 channels each.
Spectral resolution 100 kHz and total bandwidth 128 MHz
SSB noise temperature 500 K (cooled 20 K)
Single spectra integration time of 10 min.
Fully operational since January 1995

Preprocessing: 2 hour integration time for one retrieval
Composite spectrum from both spectrometer (->456 channels)
Reduction of channels (456->74 channels)

Forward model: JPL/HITRAN spectral database

Validation of forward models by participating to the EMCOR intercomparison
Use of actual NMC T and P profiles and O3 CIRA86 profiles

Database: 12 profiles (max) per day, NASA Ames format
1 file per month (BXO3YYMM.DJM)
Data from January 1995 to May 1999

Retrieval algorithm:

Optimal estimation method with 2 iterations

Retrieval grid from 0 to 100 km with a layer thickness of 5 km

Complete analysis of retrieval error + retrieval optimisation by error assessment (de La Noe et al., 1998 and Lezeaux, 1999)

A priori covariance matrix: variability from 30% (stratosphere) to 100% (mesosphere) and ~5 km vertical correlation

Expected Precision/Accuracy of Instrument:

Alt [km]	P [%]	A [%]	R [km]
20	8	20	20
25	6	10	10
30	6	10	10
35	6	10	11
40	6	10	12
45	8	11	12
50	10	12	13
55	15	16	13
60	20	20	14
65	25	25	15
70	30	30	16
75	30	30	18

Validation of profiles for the period 1995-1998 (Lezeaux, 1999): comparison with mm-wave radiometer (GROMOS) at Bern, with the ozone lidar at OHP, with MLS and HALOE instruments aboard the UARS satellite, and with SAGE-II instrument aboard the ERBS satellite.

<u>Instrument History:</u>

Operational since January 1995

March 1996: implementation of the phase scrambler

October 1998: implementation of automatic relative calibrations