THE ORA RADIOMETER ON EURECA : MEASUREMENTS OF ATMOSPHERIC MINOR CONSTITUENTS WITH A SATELLITE BORNE RADIOMETER

Principal investigator : Etienne ARIJS, Belgisch Instituut voor Ruimte-Aëronomie (BIRA) Ringlaan, 3, B-1180 Brussel, Tel : +32 2 375.15.79 — Fax : +32 2 374.84.23 — E-mail : POSTMASTER@ATMOS.BE
Participants : D. NEVEJANS, D. FUSSEN, P. FREDERICK, E. VAN RANSBEECK AND C. KOTSIRA
In collaboration with : Prof. F.W. TAYLOR (leading scientist), S. Calcutt, S. Werrett, C. Hepplewhite, T. Pritchard, I. Burchell, C. Rodgers, Atmospheric, Oceanic and Planetary Physics, Oxford University, Clarendon Laboratory, Parks Road, Oxford OX1 3PU, U.K., Tel : +44 865 272903 — Fax : +44 865 272924

The ORA project is a cooperation between the Belgian Institute for Space Aeronomy (BISA) and the Department of Atmospheric, Oceanic and Planetary Physics of the Oxford University, aiming the measurement of vertical profiles of trace gases such as ozone, NO_2, water vapour and aerosols in the Earth's upper atmosphere. For this purpose a small and lightweight radiometer was built and flown on the European Retrievable Carrier from July 1992 until June 1993, where it measured the attenuation of solar radiation during occultation events as observed from the carrier at an altitude of 500 km. The instrument consists of two separate units.

The UV-visible unit containing 8 similar modules, each composed of an interference filter, simple optics to limit the field of view and a photo diode detector, aims to derive profiles of ozone, nitrogen dioxide, water vapour and aerosols in the stratosphere.

The infrared part of the radiometer, designed to measure water vapour and carbon dioxide in the upper atmosphere, consists of two channels and uses the gas correlation technique by switching (with a mirrored rotating chopper) the incoming light (after passage through an interference filter) either directly to a detector or first through a gas cell, containing the gas to be measured.

Whereas the infrared part of the instrument was delivered by the Oxford group, the BISA team was responsible for the UV-visible unit, the complete

electronics (hard and software), the ground support equipment, the qualification tests and management of the project.

The ORA instrument relied upon the pointing capabilities of the carrier itself and therefore had a rather large field of view. Thus the full solar disk is used for the occultation and a limited altitude resolution but high signal to noise ratio is obtained.

During the 11 months of the EURECA mission, the ORA instrument has been measuring almost continuously for about 9 months and data were recorded permanently at BISA. Occultation data in the UV-visible were obtained successfully at each sunrise and sunset, apart from a few occasions where measurements were interrupted for short periods, due to operational requirements of the EURECA satellite itself. The infrared part of ORA has collected data for more than 4 months. In total more than 6000 occultation events have been captured. As a result a huge volume of information concerning the composition of the Earth's atmosphere has been gathered, with a latitudinal coverage from 35° S to 35° N.

Although the conversion from the raw data into scientific results is only in an early stage, the preliminary results look very promising. The continuation of the project will include the full data analysis, involving the development of suitable deconvolution algorithms, setting up of appropriate data bases and validation of the results through comparison with data obtained at the same time by similar instruments on other satellites (Sage II on ERBS, HALOE and ISAMS on UARS).

It is hoped that the results of the infrared experiment will contribute largely to our understanding of the mechanisms controlling the water vapor budget in the mesosphere. The retrieval of the UV-visible data is also expected to result in new information concerning the stratosphere, especially in view of the effects of the Pinatubo volcanic eruption on the ozone and aerosol concentrations, which should be mainly affected in the equatorial regions, where ORA has performed most of its measurements.

References

Nevejans D., Arijs E. and Fussen D. 1989. The electronic and software design of the ORA occultation radiometer, In : Proc. IVth internat. seminar : Manufacturing of scientific space instrumentation, Vol. II, Ed. Balebanov V. M., Academy of Sciences (USSR), Space Res. Institute : 61-73.

Calcutt S. B., Taylor F.W., Werret S.T., Pritchard T.M., Arijs E. and Nevejans D. 1993. Radiometer for the Measurement of Water Vapour in the Upper Atmosphere from Space. Applied Optics 32 : 6764-6776.