Radiometer Programs in Europe

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ABSTRACT

There are many groups in Europe actively engaged in microwave radiometry. Large progress has recently been made in appplications related to atmospheric physics, meteorology and in developing new receivers at sub-mm wave length. The review will briefly consider groundbased and airborne sensors and then concentrate on European space programs for the nineties.

INTRODUCTION

In Europe quite a large activity exists in Microwave Remote Sensing (MRS). There are groups covering many areas of application such as Radio Astronomy, Meteorology, Atmospheric Physics and the investigation of the earth surface. Sensors are used on the ground, in airplanes, and are being developed for space applications. The following sections will concentrate on ongoing and future programs for applications commonly related to "remote sensing". Therefore radio astronomy programs are excluded, they will be discussed elsewhere in this session.

Groundbased and airborne sensors are mainly used in an experimental fashion, and only recently groundbased sensor to monitor stratospheric ozone have been implemented in monitoring programs. A large research and technical effort is put into developing spaceborne sensors by the European Space Agency (ESA) and by national research organizations.

GROUNDBASED AND AIRBORNE RADIOMETRY

Groundbased MRS has been used very successfully to study stratospheric and mesospheric Ozone (1,2). MRS is very attractive because it offers a number of advantages, such as providing Ozone profiles over the entire middle atmosphere 15 to > 80 km. These measurements are only slightly affected by clouds, day and night observations are possible, and sensor operation and Ozone profile retrieval can be fully automated (3).

In geodesy a number of laboratories are using ground based MRS to determine tropospheric water vapor and liquid water content for path length correction when using the Global Positioning System (GPS)(3).

Airborne sensors are used to perform atmospheric measurements which require observing altitudes above the troposphere in frequency bands where tropospheric attenuation is too high, e.g. water vapor profiles using the strong 183 GHz water vapor line (4) or measurements at sub-mm wavelength (5). In the near future a scanning radiometer to observe the ocean surface will be implemented in an operational airborne sensor system to detect oil spills (6). Furthermore microwave instruments for meteorological applications are tested on research aircraftes for later use on spacecrafts.

SPACEBORNE RADIOMETRY

Spaceborne microwave sensors are used operationally since many years on polar orbiting satellites to determine temperature profiles in the troposphere and stratosphere, e.g. the MSU (Microwave Sounding Unit) on board the NOAA-satellites. For the next generation of polar weather satellites (advanced Tiros) the UK Meteorological Office takes the lead in developing the AMSU-B (Advanced Microwave Sounding Unit B) for retrieving atmospheric water content over land and to obtain water vapor profile information . A first launch is planned for July 1994 (Tiros-K) and subsequent launches for June 1996 (Tiros-L) and February 1997 (Tiros-M).

For atmospheric research a limb sounding instrument MAS (mm-wave atmospheric sounder) has been developed in Europe with US-collaboration to be flown on the NASA ATLAS-missions. MAS will measure Ozone, Water vapor, ClO temperature and pressure using frequencies from 60-200 GHz. A first flight of MAS is presently scheduled for early 1992 (7). Scientists from the UK have also contributed to the Microwave Limb Sounder (MLS) on UARS (Upper Atmospheric Research Satellite) (8). The advanced MAS (AMAS) is presently in a phase B study and is expected to be launched on the German Environmental Satellite ATMOS by 1996. In addition to the paramters measured by MAS, AMAS will also provide high precision (1 %) Ozone profiles in the stratosphere and mesospheric CO profiles (9).

For the first NASA polar platform (EOS-A), the European space agency ESA is developing the MIMR (Multifrequency Imaging Microwave Radiometer). MIMR will allow measurements with high spatial

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resolution. Over ocean atmospheric water content, sea ice, sea surface temperature and wind stress will be determined. Over land MIMR will give information on parameters like snow cover and soil moisture (10).

CONCLUSION

In Europe large emphasis is put on spaceborne applications of MRS. A number of instruments will be launched in the nineties by European investigator teams for a wide area of applications ranging from oceanography to meteorology and atmospheric physics. Two directions for future activities can be distinguished, one is toward operational sensors, examples are AMSU and MIMR, and the second is toward the last not yet explored spectral region, the sub-mm range (300-3000 GHz). These frequencies have a great potential in atmospheric physics because virtually all molecules of interest in photochemical processes in the middle atmosphere can be investigated by sub-mm radiometry.

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