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Section 2. Sources of Atmospheric and Atmospheric Electricity

The Middle Atmosphere Program (MAP), which is an international attempt to obtain the scientific knowledge of the middle atmosphere extending from the tropopause to approximately 100 km altitude, has started from the beginning of 1982. We cover in the program the measuring of aerosol, ion, ozone, nitrogen oxide and others.

The first MAP aircraft observation in cooperation with several universities and institutes was carried out on 20 October, 1982 by using Merlin IV aircraft. For taking air samples into the pressure cabin special devices were investigated. The flight was for about 3.5 hours including a course over the Japan Sea between the airports of Yao, Osaka Prefecture and Niigata. The maximum altitude was about 7 km. In the flight we measured the densities of nitrogen oxides and aerosols in an almost satisfactory condition.

The equipment for nitrogen oxides has newly developed in our laboratory for the MAP flight. It has a high sensitivity enough to detect the order of 10 ppt and a capacity for sucking the ambient low pressure air samples. The principle of measurement is based on the detection of chemiluminescence in the reaction of NO with supplied O₃, and combination with a NO₂-NO convertor. The measured density of NO_x at 7 km altitude was the order of 0.5 ppb.

The aerosol number density was measured for particles larger than 0.3 μm in diameter by photomultiplier counting of Mie scattering of light due to individual particles. The equipment is basically of the same composition as that so far used for balloon observations. It was set in the unpressured nose luggage area as it was designed to work in the ambient pressure. Several improvements were made in the sucking unit and in calibration of the system for obtaining the better accuracy and sensitivity. The measured density at 7 km was 0.15 to 0.4 cm⁻³ for particles larger than 0.3 μm, and 0.05 to 0.15 cm⁻³ for those larger than 0.5 μm in diameter.

A balloon experiment (B5-114) for aerosol observation was made at Sanriku Balloon Center, Institute of Space and Astronautical Science

on 19 October, 1982, just one day before the Merlin IV flight. The profile obtained for aerosol density larger than $0.3 \mu\text{m}$ in diameter was considerably different from those obtained in last years. A dense aerosol layer was observed in altitudes between 17 and 23 km: the density was about 5 cm^{-3} , which was almost 10 times larger than the values so far observed at Sanriku during the period from 1973 to 1981. The dense layer was perhaps under the influence of the eruption of Mt. El Chichon volcano in April, 1982, the effect of which had been confirmed at various places in the world by in situ and by ground-based observations. The present result at Sanriku demonstrates that the effect had extended to 39°N in half a year after the eruption.

As a powerful tool for the investigation of the middle atmosphere a laser radar system was constructed on the top of institute building for the observation of aerosols and gaseous minor substances such as ozone and nitrogen dioxide. The system has been set about working from the later half of 1982. It will be a great help for us in the MAP to conduct the studies on physical aspects of the stratosphere and the upper troposphere. The preliminary data showed the existence of a dense aerosol layer which corresponded to the balloon observation data. The density and altitude of the layer had changed day by day, wherefore the ground-based observation is recognized to have a big gain in easily following the temporal variations. Specifications of the system is reported in this issue.

Preparations for EXOS-C satellite, by which we are planning to monitor the global distribution of stratospheric aerosol and ozone through the solar occultation measurement, have advanced according to the schedule for the launching in February, 1984.

One of the main subjects in the MAP is the observations in Antarctic region. Equipments designed and manufactured by us for the aircraft and balloon measurements of aerosols and ionization rate have been carried by the members of 24th Antarctic Research Expedition to Syowa Station, and will bring new information on the antarctic stratosphere.

The investigation of the tropospheric environment has also been continued. Aircraft observations of tropospheric aerosols spreading over the sea were made in the altitude range lower than 3 km in March and April, 1982. Equipments on board Cessna 402 measured the behaviors of large and small size aerosols. One flight of them was the continuation of cooperative studies on "yellow sands" with a group from the Meteorological Research Institute.

An observation cruise over the South-west Pacific Ocean was made

for about 2 months from 22 January to 17 March, 1982 by the research vessel, Hakuho-Maru of the Ocean Research Institute, University of Tokyo. About 10 years have passed since our last cruise on the ocean and we were interested in whether there were some secular tendencies in atmospheric electrical properties in the oceanic atmosphere. Observations were carried out on the electric field, electric conductivity, densities of small ion, radon, small and large size particles, and simultaneously for the chemical analysis of large particles by PIXE method to obtain information on the particle origin. The results are still being investigated.

The observation at Sakushima Observatory has been continued on atmospheric electrical and meteorological parameters. Some data were analysed in comparison with the observations by aircrafts and vessel.

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