A-1.3.3 Laboratory Study on Measurement Techniques of and Physical Processes of Stratospheric Aerosols (Final Report)

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Abstract In order to quantitatively evaluate the effects of Polar stratospheric clouds (PSCs) on the mechanism of ozone depletion, laboratory studies are very important. In this subject, experimental equipments and techniques have been developed for laboratory study using the model particles of PSCs. For analysis of the physical processes of the model particles, an experimental chamber was constructed where the conditions of gases was well-managed and where levitation techniques by ultrasonic wave and electrodynamics balance was applied. For a measurement of model particles, our in-situ measurement system by dynamic / static light scattering methods was improved, for applying for moving, low-concentrationed particles with high accuracy. For an electrodynamics measurements, electric chargers and DMA-FC system for low temperature particles were also designed and made.

Key Words Ozone depletion, PSCs, Aerosol physics, Aerosol measurement

1. Introduction

It is known that the aerosols called polar stratospheric clouds play the important roles on ozone depletion. In order to quantitatively evaluate the effects of PSCs, analysis of physical processes of PSCs is important similar to chemical processes. Laboratory study using "particles" is very valuable to analyze these processes, but those studies have hardly be done because of the difficulty of the experiments. Especially, measurement is difficult because almost measuring equipment is not available for these low-temperature aerosol particles. The measurement for those particles is not only needed for but also important for observation of real PSCs. If using model particles, there is a possibility to evaluate an accuracy of measurement.

In this subject, we have developed experimental equipments and techniques including measuring systems for laboratory study using the model particles of PSCs.

2. Development of experimental chamber for model particles

For analysis of the physical processes of the model particles, an experimental chamber was constructed in which temperature, pressure, air flow are well controllable. The spec of this chamber is as follows; temperature -80 - -20 C, pressure: 50Torr - 1atm, size: ID 250mm x H 300mm, with 30 port for probe.

Levitation equipments by ultrasonic wave and electrodynamics balance was developed and set in this chamber, in order to observe the condensation growth for a long time. By 100kHz ultrasonic wave, particle> 10um can be hold. By electrodynamics balance using

triple ring electrode, 5um < d < 40um can be hold.

3. Improvement of light scattering measurement system for model particles

For a measurement of model particles, our in-situ measurement system by dynamic / static light scattering methods was improved, for applying for moving, low-concentrationed particles with high accuracy.

In order to apply the photon correlation spectroscopy method to fine aerosol particle growing in flow as an in-situ measurement method, autocorrelation function was investigated theoretically and an new signal analyzing system was designed and developed based on the above investigation. As the results of an theoretical investigation, it became clear that effects by flow and concentration fluctuation. It is shown that accuracy of sizing is improved using this new measurement system.

4. Development of charging and electrodynamics measurement system for model particles

In order to control the electric charge on particles, the neutralizer and the unipolar charger whose walls were cooled in order to apply to the model (ice) particles. It is not only for measurement, but for levitation by electrodynamics balance.

For an electrodynamics measurements, DMA(Differential Mobility Analyzer)-FC(Faraday Cup) system for low temperature particles were also designed and made.