Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

MSD05-01 Room:106 Time:May 20 09:00-09:15

Small satellite for stratosphere-mesosphere science

SUZUKI, Makoto[1*], SANO, Takuki[1], SHIOTANI, Masato[2], Doug Degenstein[3]

[1]ISAS, [2]RISH, [3]Univ. Saskatchewan

Since the Numbus-7 satellite in 1978, various nadir looking Vis-UV backscattering observation and limb observations (Solar occultation, limb emission and limb scattering) have been supporting the studies of dynamics and chemistry of stratosphere and mesosphere.

Today, there have been working more than 10 instruments onboard the satellites such as, Aura, TIMED, NPP, Envisat, SciSAT-1, and Odin. In Japan, there had been strato-mesospheric observations using EXOS-C/LAS, EXOS-C/BUV, ADEOS/ILAS, ADEOS-II/ILAS-II and ISS/JEM/SMILES. But, there exists strong concern, among scientists who have been working on the limb observation1), atmospheric science community in general (WCRP/SPARC, SPARC measurement requirements WG), as well as UN/UNEP2), on the future continuation of various limb observations of stratosphere/mesosphere after the current satellite operations (other than operational OMPS-limb scattering observation after the NASA-NOAA JPSS-2 satellite).

This paper reports the preparation status on the international limb observation proposal including SMILES follow-on mission and other limb scattering, limb emission measurements.

SMILES had demonstrated high sensitivity of 4 K cooled SIS detector system, and its extraordinary usefulness for the chemistry of the stratosphere and mesosphere. But, we now clearly faced up to the limitations of ISS/JEM/SMILES as the demonstration mission as well as limitations of existing stratospheric-mesospheric observations. The basis of the description of phenomena in the stratosphere-mesosphere is 3D fields of temperature and O3 which confine chemistry, radiation, and dynamics, but we found that both the measurement precisions, and the spatial-temporal sampling are not sufficient for the requirements of atmospheric sciences. To overcome this situation, we should have a new satellite platform with combination of best instruments available (for precisions and accuracies) and multiple horizontal IFOV to improve spatial and temporal sampling.

SMILES follow-on mission should have following improvements, such as; (1) better temperature sensitivity using O2 emission line, (2) observations of lower-stratosphere and upper troposphere using the 200-300 GHz frequency region, (3) measurement of tracer and source species, such as H2O, N2O, CO, HCN, CH3Cl, etc, (4) optimization of observation frequencies for BrO etc, and (5) smaller vertical IFOV, shorter observation interval, as well as tomography retrieval.

In addition to the SMILES follow-on instrument, there should be observations of (a) daytime limb scattering and nighttime airglow observation (Odin/OSIRIS follow-on or a follow-on instrument of SCIAMACHY limb observation), (b) IR limb emission of temperature and O3 (similar to the TIMED/SABER, but using uncooled detector technology), (c) GPS occultation measurement (stratospheric temperature, ionospheric electron density).

Sience observation described above can be carried out by the ISAS small science satellite program, which can carry up to 200 kg science payload for the 450-500 km and 50-64 degree inclination orbit. (SMILES follow-on: 130 kg, OSIRIS follow-on: 20 kg = 10 kg x 2 IFOVs, uncooled IR limb sounder: 20 kg = 10 kg x 2 IFOVs, GPS occultation: 10 kg, Mission Data Processor: 5 kg, and two fine Star Sensors: 10 kg)

We will seek this satellite proposal through international collaboration, to the ISAS small science satellite program (#3 or later launches).

References

1) Minutes of 5th International Limb Atmospheric Science Conference, Helsinki, Nov. 2009.

2) UNEP, Satellite Networks, page 7 of Recommendations of the eighth meeting of the Ozone Research Managers of the Parties to the Vienna Convention, UNEP/OzL.Conv.9/6, Nov. 2011.

Keywords: stratosphere, mesosphere, Limb onservation, O3, sub-mm, Limb scattering