Observation of Venus and Martian atmospheres by Telescope Observatory for Planets on Small-satellite (TOPS)

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1. Introduction

Telescope Observatory for Planets on Small-satellite (TOPS) is a next small satellite mission of the Japan Aerospace eXploration Agency (JAXA) proposed by the TOPS working groups. TOPS will be useful for monitoring observation of planetary atmospheric phenomenon since the whole disk of planet can be observed for a long period without receiving the influence of the Earth's atmosphere. In this presentation, we talk about scientific goal at the observation of Venus and Martian atmospheres and surfaces by using TOPS.

2. Observation of Venus

Venus surface is covered by the thick cloud layer composed of sulfuric acid. Recently, Venus atmosphere below the cloud layer and the surface can be observed by using near infrared radiation and the 'window' wavelength radiation is also useful for observation by TOPS. The major scientific problems of Venus atmosphere and surfaces which can be treated by using TOPS are followings; (1) vertical cloud structure, (2) thunder lightning in cloud, (3) sulfate cycle between atmosphere and surface. These observations will be performed complementary to the Venus Climate Orbiter mission which will be launched by JAXA in 2010.

(1) Vertical cloud structure: Upper cloud is observed by using ultra-violet and visible radiation, and middle to lower clouds are observed by using the 'window' near-infrared radiation. Combining these observation results, vertical structure of Venus cloud layer will be revealed. In addition to, time development of the vertical cloud structure will be also examined by frequent observation of Venus disk.

(2) Thunder lightning in cloud: Whether the thunder lightning occurs in Venus cloud or not is not confirmed, in spite of many radio and optical observations has been performed. Therefore, by using 777 nm band radiation which is expected as the wavelength of the lightning by laboratory experiments. The lightning in Venus cloud is explored specifying quantitative criterion.

(3) Sulfate cycle between atmosphere and surface: The spectrum of surface minerals can be observed by near infrared radiation and analysis of these spectrum may give constraints on component of surface materials. By using the constraints, behaviors of gas components (for example, SO_2, CO_2 and OCS) which are assumed to be chemical equilibrium between the surface and atmosphere are examined.

3. Observation of Mars

Our knowledge of Martian atmosphere and surface environment greatly increases by recent space craft observations. These space crafts, however, can not observe whole disk for a long period owing to its orbit. On the other hand, it is difficult to keep a long observation time of the Habble Space Telescope (HST) which don't have such constraint. These difficulties don't emerges in the case of TOPS observation, and the scientific problems of Martian atmosphere which can be treated by using TOPS are followings; (1) visualization and tracking of atmospheric tracers, (2) monitoring of dust storm.

(1) Visualization and tracking of atmospheric tracers: Martian atmospheric tracers which can be observed by TOPS are water ice cloud, water vapor and ozone. By using distribution of ice cloud, and those of column abundance of water vapor and ozone, the atmospheric circulation patterns from synoptic to planetary scale are examined.

(2) Monitoring of dust storm: Regional and planet-encircling dust storms are monitored and when, where and how the dust storm occurs are eaxmined. Information on local time when the dust storm occurs has not been obtained by previous space craft observations.