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A plan of an Earth observation satellite for the middle atmosphere dynamics and chemistry

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The Superconducting Submillimeter-Wave Limb-Emission Sounder (SMILES) aboard the Japanese Experiment Module (JEM) of the International Space Station (ISS) made atmospheric measurements of minor species in the stratosphere and mesosphere for about six months from October 2009 to April 2010 (Kikuchi et al., 2010). The unprecedented high sensitivity measurements using the 4-K cooled submillimeter limb sounder provided new insights into the physics and chemistry of the middle atmosphere such as the diurnal variation in stratospheric ozone (Imai et al., 2013; Sakazaki et al., 2013).

On the basis of the technology employed for SMILES, we propose a plan of an Earth observation satellite for the middle atmosphere dynamics and chemistry. Particular emphasis is placed on high sensitivity temperature measurement that was not implemented in SMILES and wind field measurement that was demonstrated by SMILES (Baron et al., 2013). We expect the mission life time for about 3 years to provide global data promoting sciences in the middle atmosphere and the lower thermosphere. Those measurements are essential to constrain advanced chemical transport models for future projection of the ozone layer.

Scientific targets using the data are as follows: 1) Clarification of heat budget and momentum budget in the middle atmosphere on the basis of high precision temperature measurements with accuracy ~1K up to 100km. Wind fields should be also derived by Doppler shift of spectral lines at least for line-of-sight. Data assimilation can be used to derive the horizontal wind filed. Characteristics of atmospheric tides in the mesosphere can be clarified. 2) Transport processes of tropospheric air into the stratosphere based on high accuracy observations of ClO and BrO that are important to ozone budget. Measurements of tracers such as H_2O and N_2O are also performed for quantitative argument of the meridional circulation. 3) Effects of solar activity on the upper atmosphere. Solar proton events in addition to periodic variations associated with the solar activity can be captured.

References:
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