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Overview and Early Results of the Superconducting Submillimeter-Wave Limb-Emission Sounder (SMILES)

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The Superconducting Submillimeter-Wave Limb-Emission Sounder (SMILES) was developed to be aboard the Japanese Experiment Module (JEM) on the International Space Station (ISS) under the cooperation of the Japan Aerospace Exploration Agency (JAXA) and the National Institute of Information and Communication Technology (NICT). SMILES was successfully launched by the H-IIB rocket with the H-II Transfer Vehicle (HTV) on September 11, 2009, was attached to JEM on September 25, and started atmospheric observations on October 12 (All dates in JST). Mission objectives are: i) Space demonstration of 4-K mechanical cooler and super-conductive mixer for the submillimeter limb-emission sounding in the frequency bands of 624.32- 627.32 GHz and 649.12- 650.32 GHz, and ii) global measurements with its high sensitivity for atmospheric minor constituents in the middle atmosphere (O3, HCl, ClO, HO2, HOCl, BrO, O3 isotopes, HNO3, CH3CN, etc), contributing to the atmospheric sciences.

Now SMILES is in the operational mode and has been performing global observations about 100 points per each track of ISS, except for any restrictions due to the ISS operation. After the data processing, global distributions of about ten kinds of atmospheric minor constituents related to the ozone chemistry have be revealed, which will contribute to various issues of atmospheric science. Since ISS has a circular orbit with an inclination angle of 51.6 degrees, no observation in the polar latitude is available. To measure northern high-latitude regions the antenna beam is tilted 45 degrees left from the direction of orbital motion, enabling SMILES to observe latitudes from 38oS to 65oN. Another important aspect of the SMILES observation is that the ISS orbit is not sun synchronous. Therefore, SMILES can measure distributions of the above mentioned minor species at different local time, and consequently SMILES can provide information on the diurnal cycle of them.

The level 2 processing has been run to retrieve vertical profiles of these species. At the same time we have been conducting preliminary data quality check by comparing the SMILES data with other existing data source. Results from SMILES have demonstrated its high potential to observe the atmospheric minor constituents in the stratosphere and the mesosphere. We hope that these outstanding data from SMILES can make a breakthrough in the middle atmosphere science.

Keywords: satellite observations, International Space Station, stratospheric ozone, middle atmosphere