Scientific Targets of Superconducting Submillimeter-Wave Limb-Emission Sounder (SMILES)

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The Superconducting Submillimeter-Wave Limb-Emission Sounder (SMILES) was designed to be aboard the Japanese Experiment Module (JEM) on the International Space Station (ISS) as a collaboration project of Japan Aerospace Exploration Agency (JAXA) and National Institute of Information and Communications Technology (NICT). Mission Objectives are: i) Space demonstration of super-conductive mixer and 4-K mechanical cooler 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 observations of atmospheric minor constituents in the stratosphere (O3, HCl, ClO, HO2, HOCl, BrO, O3 isotopes, HNO3, CH3CN, etc), contributing to the atmospheric sciences.

Not only in the polar latitudes, but also in the mid- and lower latitudes, ozone depletion is critical whole the globe. Recovery of the ozone hole over the Antarctica is estimated around 2060- 2070, but there is very big uncertainty in association with the Cl and Br chemistries (WMO, 2006). Since the SMILES mission is distinguished as that focusing on the detailed halogen chemistry related to ozone destruction, we will aim at the following scientific targets.

[Bromine budget]
Limited BrO measurements so far suggest that in addition to long-lived source gases (halons and methyl bromide), very short-lived (less than 6 months) source gases likely contribute to Bry by about 5 pptv. This difference can be important for O3 concentrations in the lower stratosphere (Salawitch et al., 2005). BrO measurements by SMILES will provide further constraints to Bry level, which affects O3 chemistry in the lower stratosphere.

[Inorganic chlorine chemistry]
Partitioning within Cly in the upper stratosphere: Inclusion of the reaction (ClO+OH==HCl+O2) results in a better agreement with observed [ClO]/[HCl] ratio and O3 trend in the upper stratosphere. SMILES [ClO]/[HCl] measurements can be utilized further systematic test on Cly partitioning.

HOCl Production: There is a factor of 2 uncertainty in the rate constant for the reaction (ClO+HO2==HOCl+O2). It directly affects HOCl levels, while it does not affect ClO and HO2 levels. ClO+HO2 cycle can be the most efficient O3 loss process within the cycles involving ClO in the lower stratosphere, and then important for O3 trend. SMILES HOCl measurements with ClO and HO2 can be used to assess importance of the ClO+HO2 cycle.

Global ClO distribution: The background ClOx level is important to quantify the in-situ O3 loss at mid-latitudes, though its global distribution with high precision has not been known yet. SMILES will make much more accurate measurements on the global ClO distribution. Also measurements of ClO, HCl, HOCl, and HO2 can provide important insights into the Cly chemistry.

In Summary SMILES will make measurements on several radical species crucial to the ozone chemistry with high-sensitivity observations. SMILES will be scheduled for the launch using H-II Transfer Vehicle (HTV) in 2009 summer.