http://smiles.tksc.jaxa.jp

Early verification of L2 products derived from 4K cooled submm limb sounder ISS/JEM/SMILES

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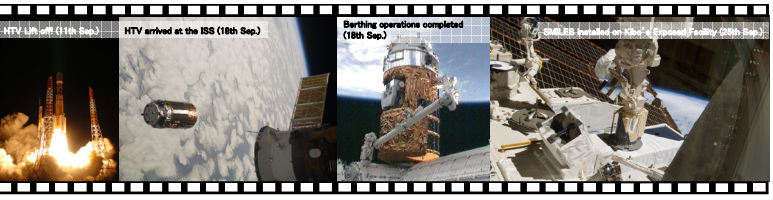
1. Introduction

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). SMILES was successfully launched and attached to the Japanese Experiment Module (JEM) on the International Space Station (ISS) on September 25, 2009. 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 (O_3, HCl, ClO, HO_2, HOCl, BrO, O_3 isotopes, HNO_3, CH_3CN, etc), contributing to the atmospheric sciences. Here we compare the SMILES level 2 products (O_3, HCl and HNO_3) by coincident observationswith other satellite data to determine average biases and related statistics.



2. SMILES observations

The ISS has a 51.6° inclined orbit with 93 minutes period. In order to measure high-latitude regions, the antenna beam is tilted 45° left from the direction of orbital motion, enabling SMILES to observe latitudes from 38° S to 65° N. The antenna is scanned in elevation at a period of 53 sec; about 1600 points per day. However, note that the measurement density is lower at low latitudes because of the inclination of the SMILES orbit and, therefore, we have significantly fewer coincidences available in the tropics. Figure 1 shows the SMILES (band A) observation points for one day on 24 October 2009.

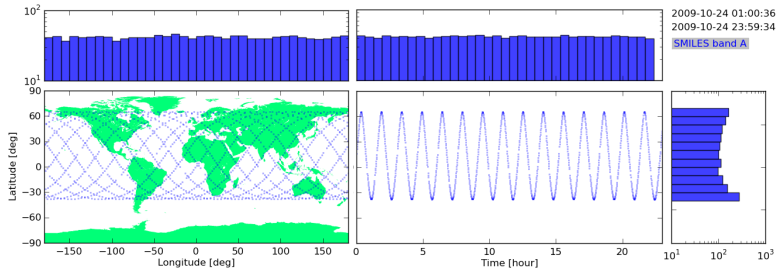


Figure 1 Observation points and their histogram in each latitude and longitude bins

3. Coincidence analysis

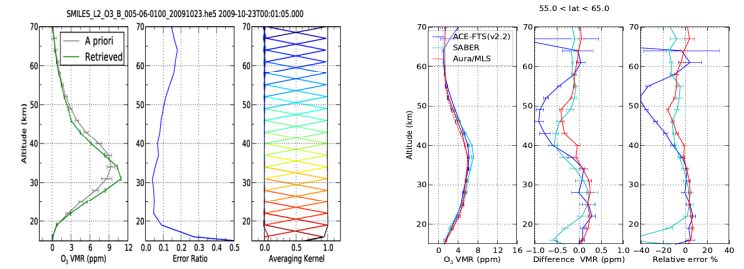
The SMILES level 2 products (O3 HCl and HNO3) are compared with coincident observations from other satellite data by analyzing volume mixing ratio profiles. Common coincidence criteria of temporal (< | 1 | hour) and spatial (< 200 km) are used to search for correlative SMILES observations to compare with the other satellite products. The vertical profiles shown on the right side are comparisons of matched profiles. When we derive comparison results, zonal means and standard deviations are calculated with latitude band width of 10 deg and coincidence events having outliers (> 3σ) are excluded. Then the vertical resolution are matched with that of SMILESusing smoothing function derived from averaging kernel.

Table 1 Selection criteria

	ACE-FTS	Aura/MLS	TIMED/SABER	Envisat/MIPAS
Product Version	2.2	2.2	1.07	V4O_HNO3_201 V4O_O3_202
Temporal Difference	< | 3 | hour	< | 1 | hour < |12| hour ※1		
Spatial Difference	< 500 km	< 200 km		
Solar Zenith Angle	---	< | 2 | deg ※1		
Time Period	Oct/12/2009 – Nov/30/2009	Oct/12/2009 – Apr/22/2010		Oct/12/2009 – Oct/14/2010

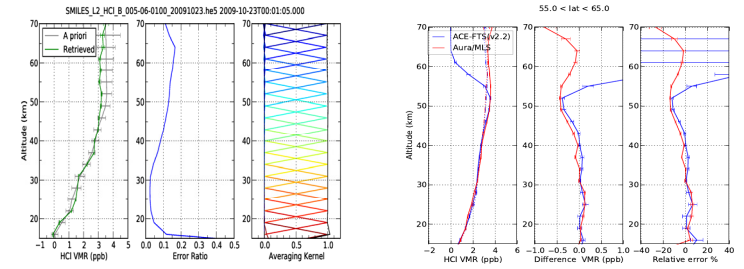
※1 Selection criteria for dirnal products (ClO)
The products are also divided by using solar zenith angle (sza), 0 < sza < 90 for daytime and 90 < sza < 180 for nighttime, respectively.

3-1. O_3



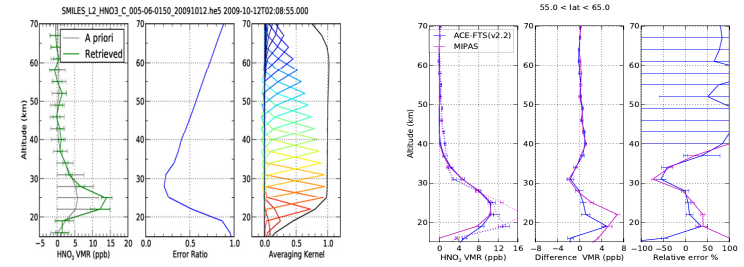
For the O_3 data products, the SMILES values are good agreement around the peak (25～35 km) with those of other data. However the SMILES values are 5 ～ 40 % lower at higher altitude (> 40 km).

3-2. HCl



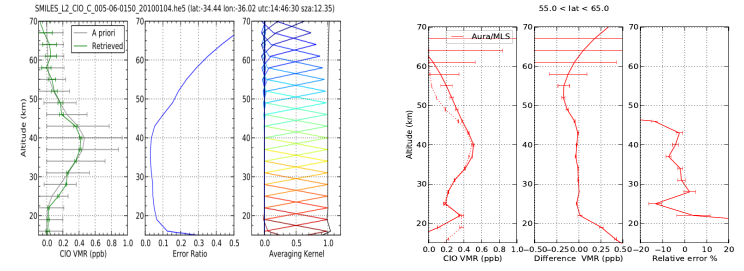
The SMILES HCl products show similar results as in the case of ozone. The SMILES values are good agreement at lower altitude(< 40 km). However they are < 20 % lower at higher altitude (> 40 km).

3-3. HNO_3



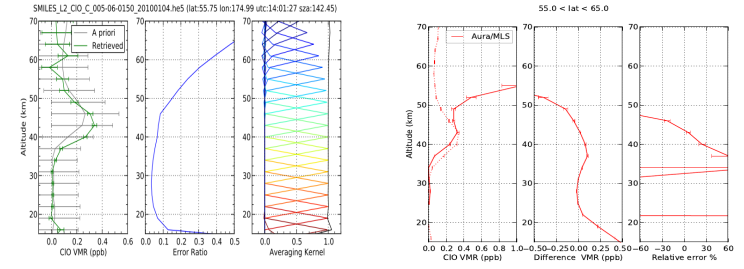
The SMILES HNO3 products show a good agreement in a narrow altitude range (20 – 30 km).

3-4. ClO (day)



The SMILES ClO products of daytime are good agreement around the peak (30 ～45 km) with those of Aura/MLS. However the SMILES values are differ in the other altitude range.

3-5. ClO (night)



For the SMILES ClO products of nighttime, the SMILES values are differ in the all altitude range with those of Aura/MLS.