Level 2 Product Ver. 1.3 (006-06-0200) Release Notes

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1. Descriptions

- The version 1.3 is a fourth test retrieval version to verify L1B and L2 data processing.

    ➢ The version numbers for previous products have also been renamed, "1.0" for former 005-06-24, "1.1" for 005-06-0032, "1.2" for 005-06-0150.

- We request that the version 1.3 data should be used very cautiously for scientific purposes, under the condition that you know characteristics of the data well.

- The period of coverage of this version is from October 12, 2009 to April 20, 2010.

    ➢ From November 30 to December 15, 2009, the ISS Solar Paddle stopped just in front of the SMILES IFOV due to the maintenance reason of the Port Solar Power Module elements of the ISS.

    ➢ From February 25 to March 5, 2010, the number of L1B data is only around 10% of ordinary condition, due to trouble of communication system of ISS/JEM (not according to SMILES itself).

- There are two types of products. The one is consisted of minimum information (*L2Product_G_RA*, 0.8 MB/file), which is identical with the product of previous version. In addition of it, the other has detailed information, such as the status flag from L1B and averaging kernels (*L2Product*, 8MB/file). Refer to the Product Guide for details.

- The pointing direction for determining tangent altitudes (geometrical) is calculated by using SMILES scan mirror angle and ISS position. However, since the pointing accuracy heavily would affect to error of tangent altitude determination, an average altitude within single scan is retrieved with using the Star Sensor of SMILES in L2 processing. In case that sunlight or moonbeam enters in the FOV of SMILES Star Sensor, positioning information cannot be obtained, so it will be estimated from the information of 50 scans around the scan in such cases.

- The tangent altitude for L2 data is retrieved as an elevation angle offset of antenna.

- For the retrieval of Band C, a priori value of the tangent altitude is provided from Band A or B. (There are operational modes with Band A+C and Band B+C.)

- This version of L2 product includes some profiles which is inadequate for scientific use. In using these products, it is strongly recommended to pick up usable profiles

according to the following conditions:

> The L2 product might include the data of scan in case of antenna FOV interference with ISS solar paddles, whose number is about a few of all scans in the product. We encourage to exclude the scans, which is under condition that *fovInterference* > 0, from any data analysis. However, there is no forecast data for FOV interference in about 7% of "antenna FOV interference" scan, so it is difficult to exclude these scan data.

> The converged profiles can be picked up with the condition of *NumIterPerform* > 3. The criterion is the most credible quality information,.About 85% of data for band A, 75% for band B, and 50% for band C satisfy this criterion.

> The nearly converged profiles can be picked up with the condition of *Convergence* < 10. About 70% of data for band C meet this condition. However, a few scans of abnormal data per day might be included in each product.

- L2 products includes altitude range not usable for validation and/or science. If the *L2Precision* is more than 50% compared to the *AprioriError*, it is probable that L2 algorithm is just answering *a priori*. In this case, the value of *L2Precision* has been turned into negative. (*L2Precision* and *AprioriError* are defined as HDF EOS5 names in the SMILES L2 products.)

- Preliminary "status flag" has been newly added from this version.

- Condition of vertical correlation is not introduced in the retrieval of all species except temperature, according to the result of vertical correlation study.

2. Improvements

- L1B data have been updated from version 005 to 006. The retrieved profiles from the scans near "FOV interference" were improved by referring "the flags indicating FOV disturbance." For details of L1B data update, see the document "Level 1 Product Release Notes (Ver.006)".

- Standard temperatures for Lorentz width of absorption lines of O_3, HNO_3, HO_2 and ozone isotopes have been corrected from 300K to 296K. The effect for this correction is around a few percent.

- In correcting the tangent height on the observation point, it is introduced that the antenna elevation offset is retrieved from the average of altitude offset within one scan. According to this change, O_3 and HCl above 50km increase a few percent.

- Antenna movement within the time to acquire a spectrum for single height is taken into account with the antenna pattern. This improvement causes a few percent increase of ozone at the peak height (lower stratosphere).

- In order to make better fitting of the curved baseline of brightness temperature, the uncertainty of absorption coefficient is fitted with 2-dimensional function instead of 1-dimensional. As a result, residue of the baseline has been decreased to about a half in comparison with the previous version.
- Regularization of status vectors in the inversion model with a priori error have been introduced. According to this improvement, 2-dimensional term of the absorption coefficients with small number of digits can be retrieved.
- The grids of retrieval altitude have been adjusted 2, 3 or 4 km depending on species, band and altitude, instead of uniformly 3km in the previous version. In adjusting the altitude grid, the information of altitude resolution is referred. As a result of this modification, the species with high sensitivity (such as O_3 and HCl) can be retrieved with more precise altitude grid, and the one with low sensitivity (such as BrO and HO_2) can be retrieved with wider altitude range.
- The altitude correlation of 10km has been introduced for all products except O_3 from band A and B.
- The information of convergence, FOV interference and observation altitude are stored in the *status* field. For details, see the format sheet in the Product Guide of version 1.3.
- In order to evaluate the residue of spectrum, the cost function for all species and all altitudes are stored in the *CostFunctionY* and *CostFunctionYAll* fields in the products.
- Bugs in the *AveragingKernel*, *InformationValue* and *VerticalResolution* fields have been fixed.

3. Remaining Issues after ver. 1.0(0024)/1.1(0032)/1.2(0150)
- Correction factors of on-orbit AOS response function are experimentally obtained from the retrieval result of temperature profiles. The new on-orbit measurement data for AOS response function were obtained in January of 2011, and these data are now under analysis. [Continuing from ver. 1.2]
- HOCl, HNO_3 (in band A) and BrO data (in band A) look not usable. [Continuing from ver. 1.0]
- We recommend zonal mean processing on using CH_3CN, BrO (in band C), HNO_3 (in band C) and HO_2 data.
- Checking of O_3 isotope products have not been sufficiently done yet. [Continuing from ver. 1.0]

4. Newly Found Issue in ver. 1.3

- Non-linearity of brightness temperature is not compensated in the version 006 of L1B data, but the effect of this non-linearity seems to be serious. For example, a few Kelvin of temperature in the stratosphere, and 10% of ozone amount, can be decreased with the compensation. We recognize this issue as the most important problem. We continue our investigation in cooperation with SMILES instrument team.

- According to the change of retrieval altitude grid, altitude grids of the species in single product are not uniform. In the future, we consider to apply the pressure grids uniformly among the species. In addition, we are studying some improvements of L2 retrieval algorithm.