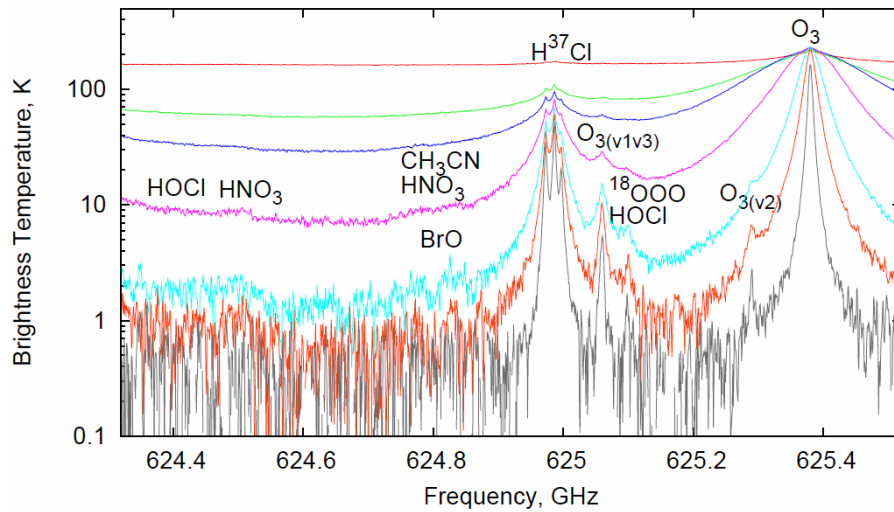


ISS/JEM/SMILES operational Data products by ISAS/JAXA

Makoto SUZUKI¹, Chikako TAKAHASHI², Chihiro MITSUDA²,
Koji IMAI³, Naohiro MANAGO¹, Yoshitaka IWATA¹, Takuki
SANO¹, Masahiro TAKAYANAGI¹, Hiroo HAYASHI⁴, Masato
SHIOTANI⁴, and SMILES mission team^{1,5}

1: ISAS/JAXA, 2: FUJITSU FIP , 3:TOME R&D, 4:Kyoto Univ., 5: NICT

Level 2 Data Processing

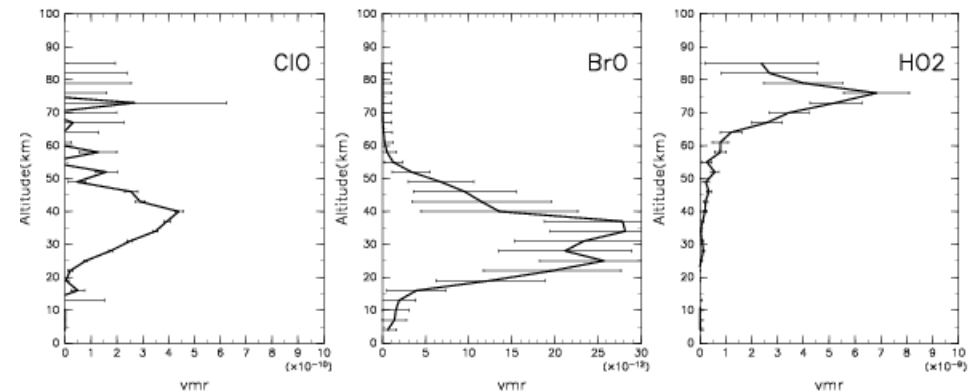
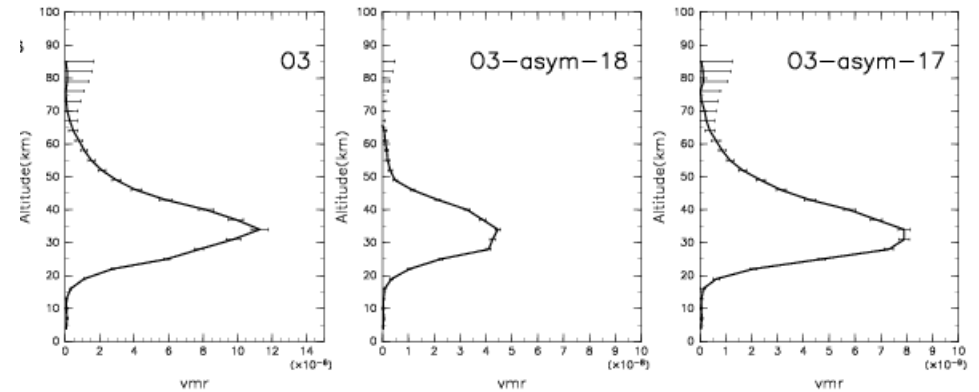


Level 1B data

(Calibrated Brightness Temperature)

Level 2 data

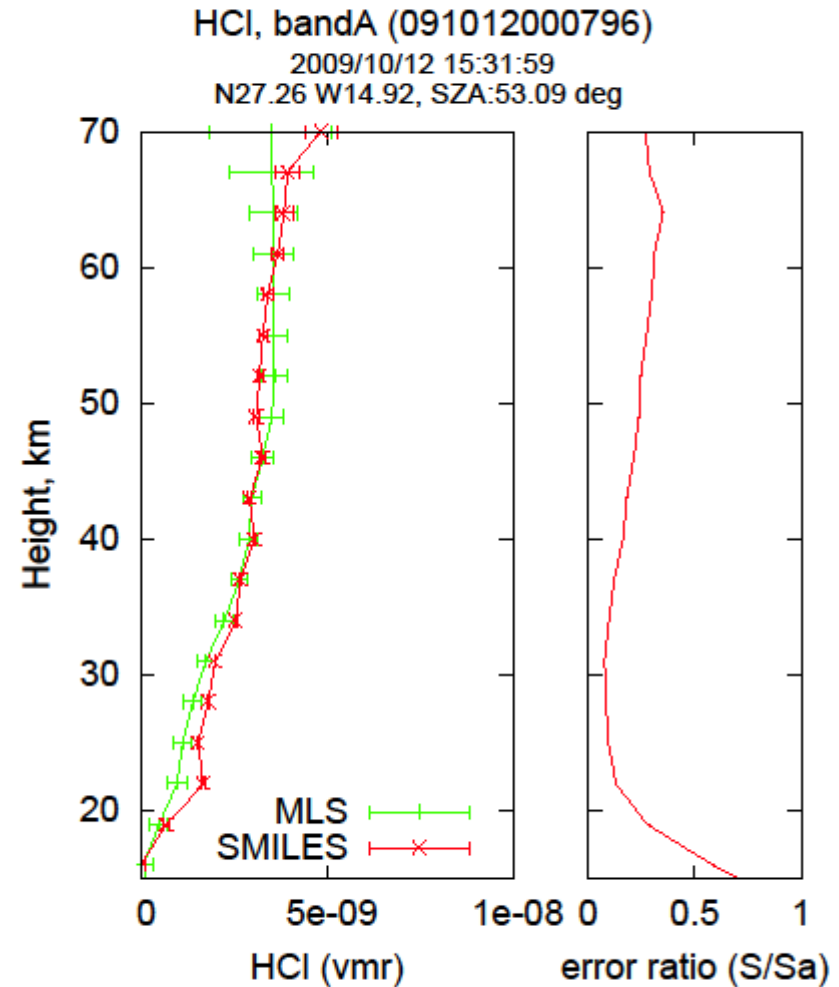
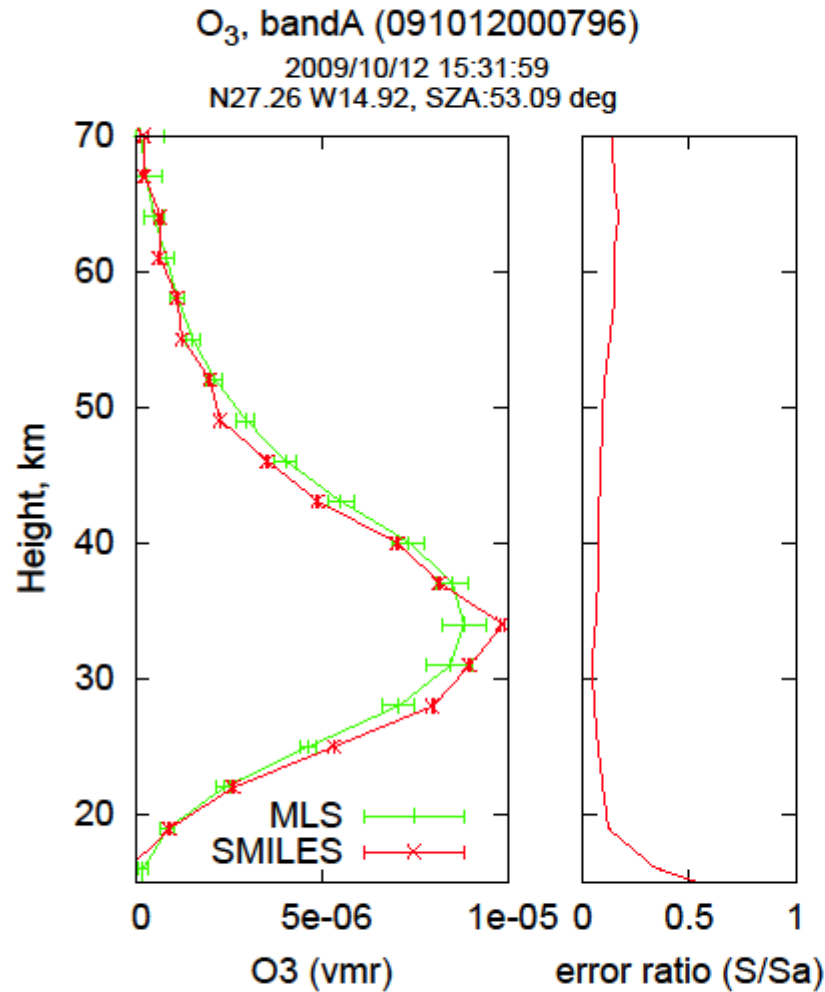
(molecular profiles at point)



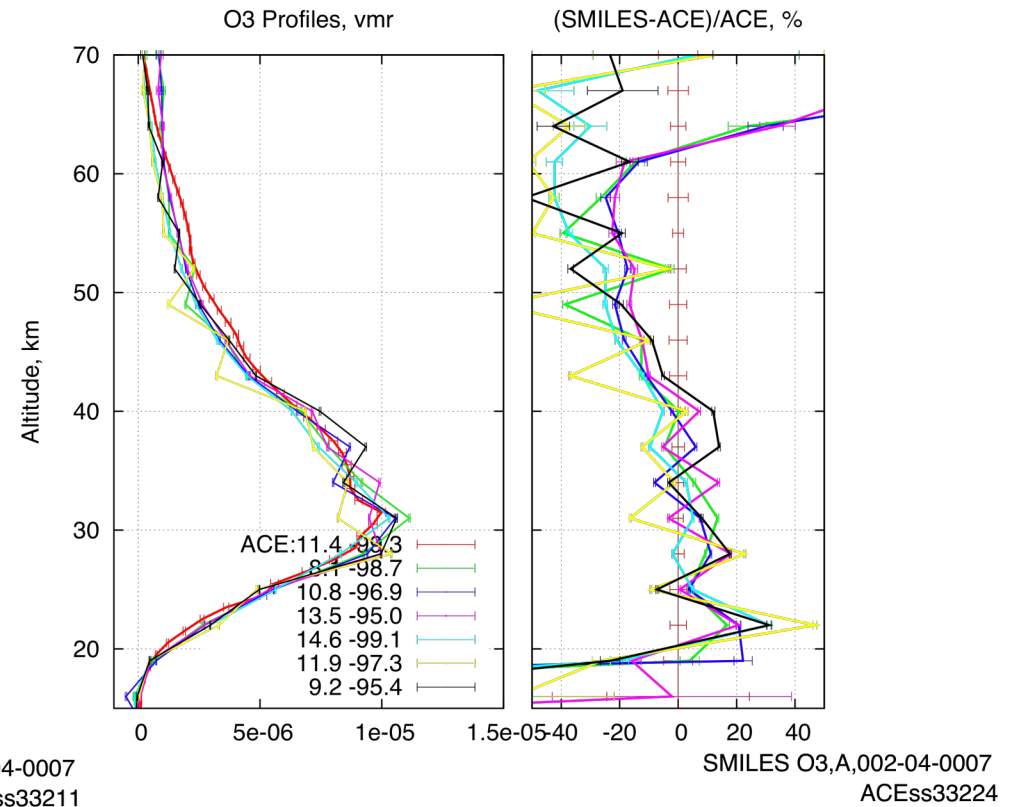
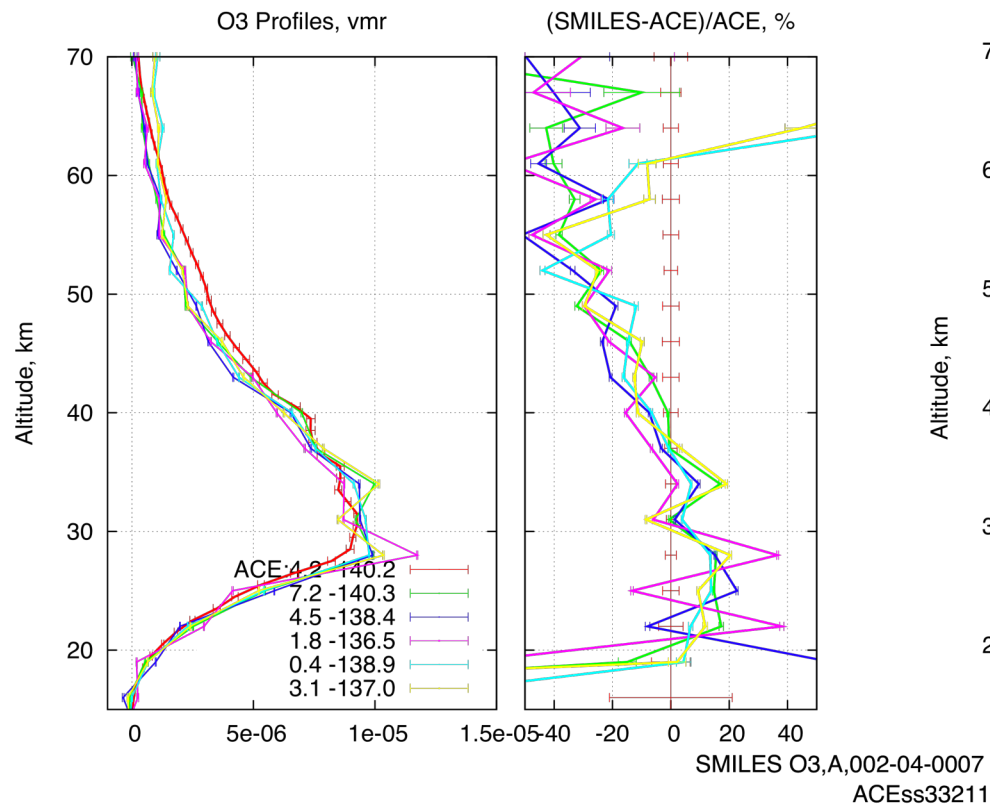
L2 Products

- Standard Products (L2, by ISAS/JAXA)
 - O₃, HCl, ClO
 - CH₃CN, HOCl, HNO₃, O₃ isotopes
 - HO₂, BrO
- Research Products (L2R, by NICT)
 - to be presented by P. Balon

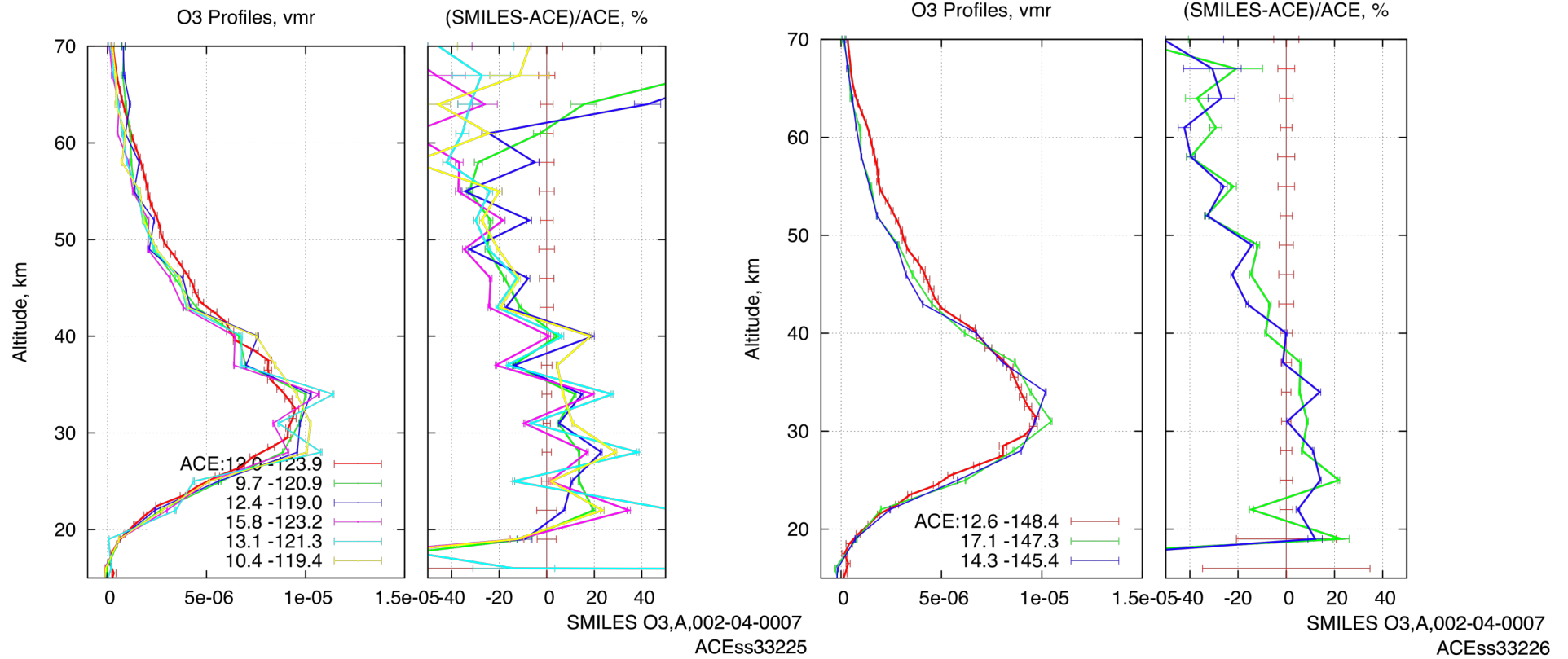
Preliminary results: O_3 , HCl vs. AURA/MLS Climatology



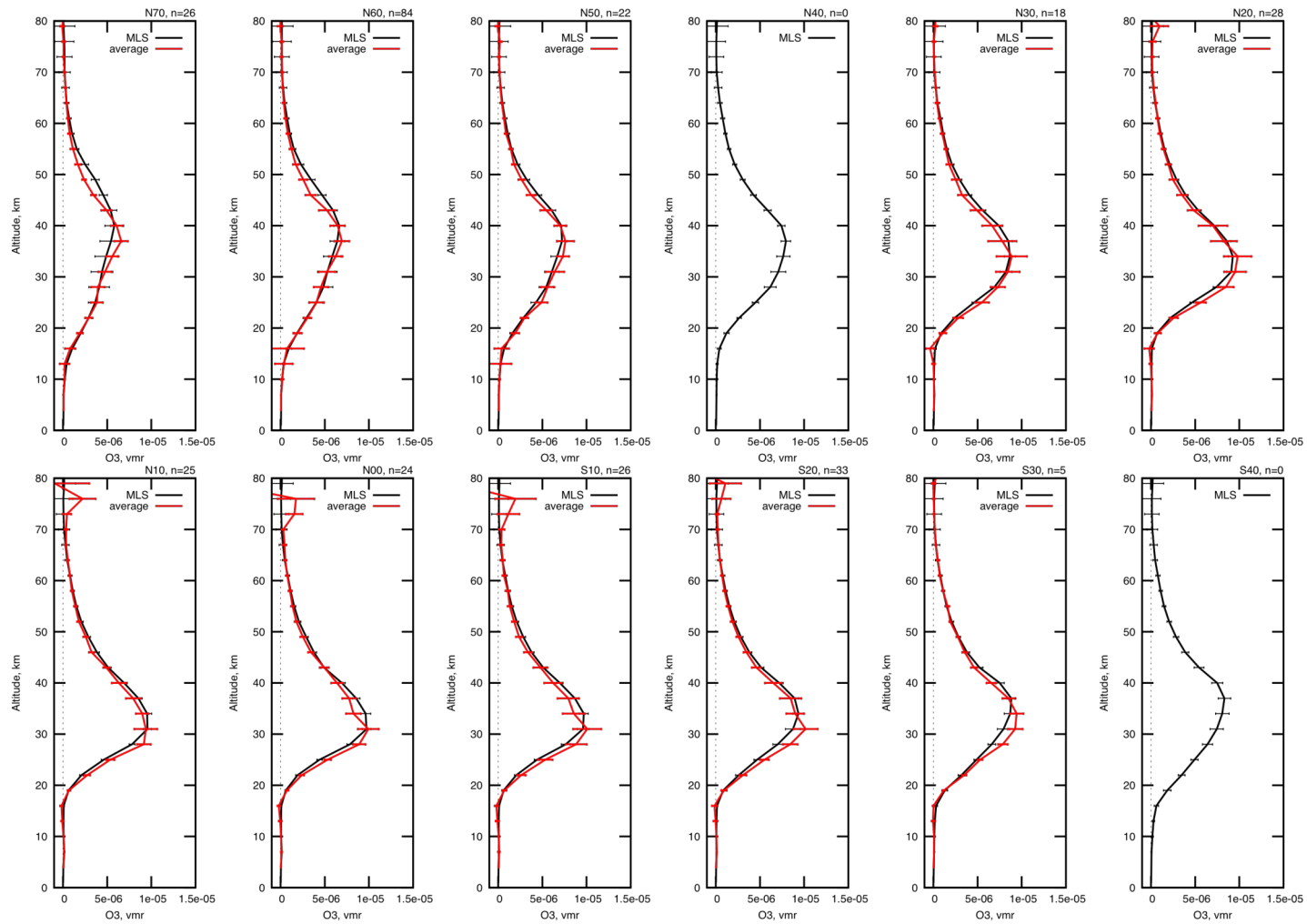
ACE-FTS, Coincidences: O₃



ACE-FTS, Coincidences: O₃

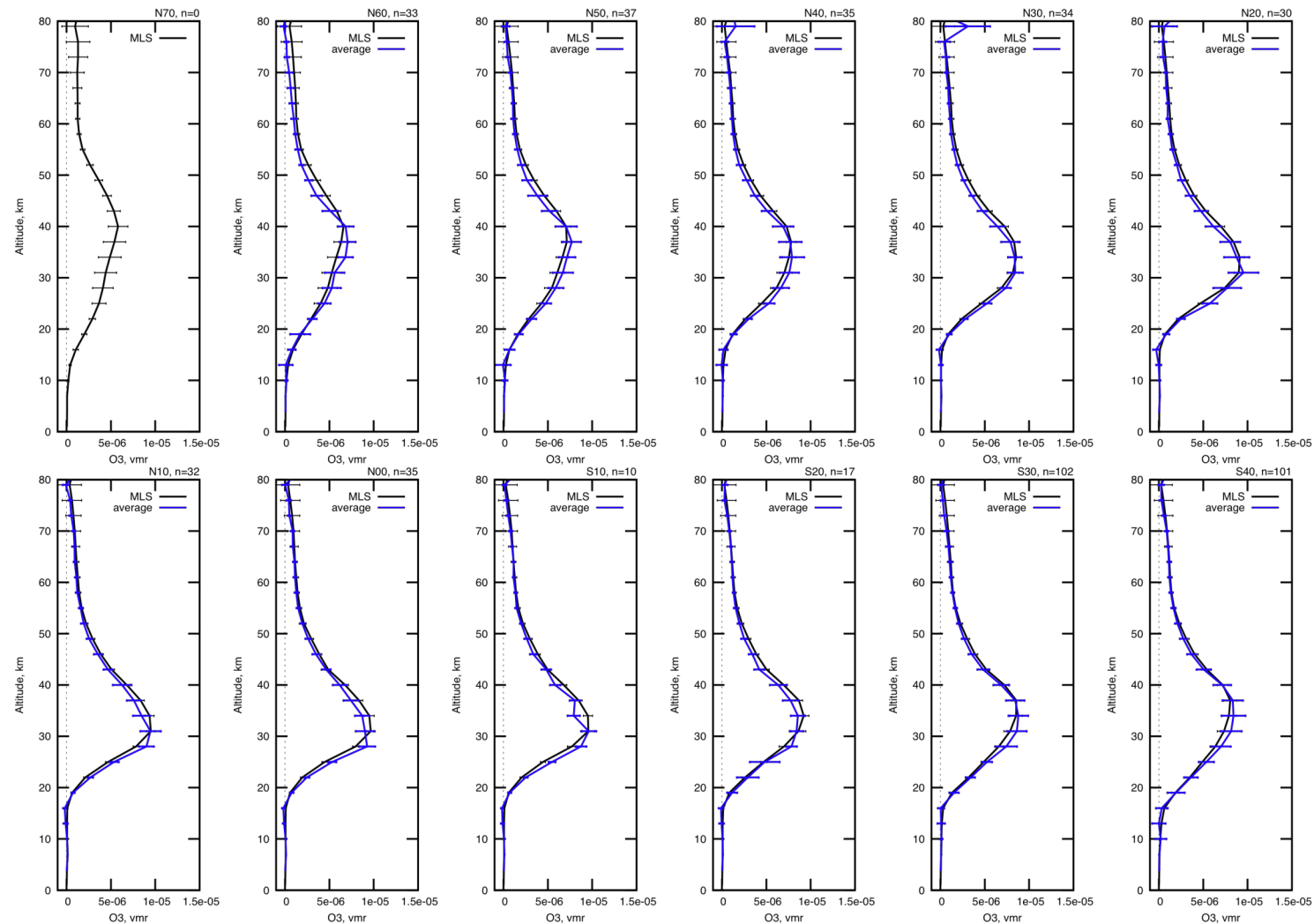


Daytime Zonal mean O_3 : SMILES (Oct. 12th) vs. MLS (ver. 2.2, 2005-2007, Oct.)

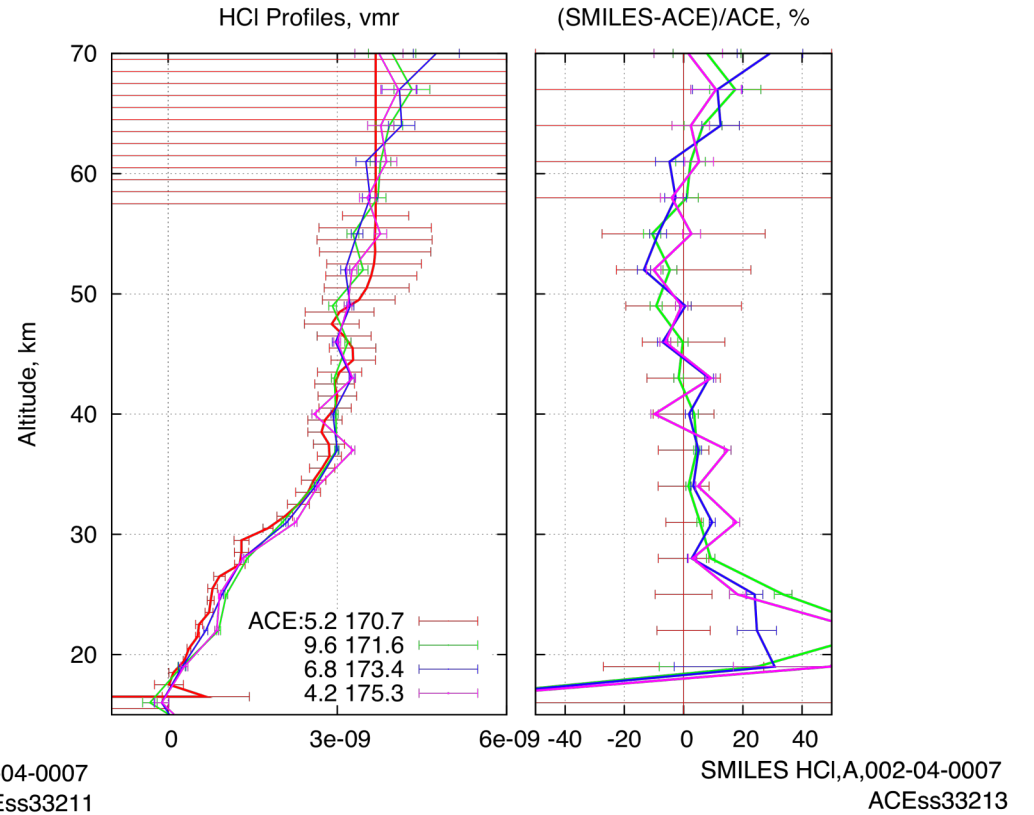
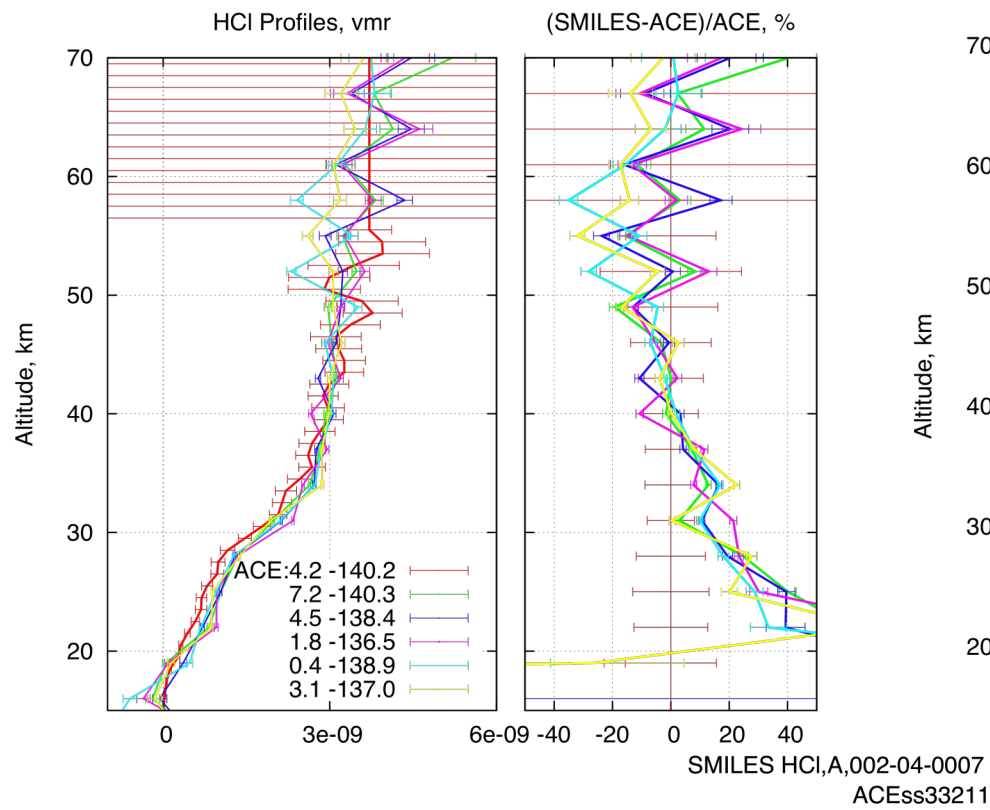


SMILES_L2_O3_A_003-04-0010_20091012_day

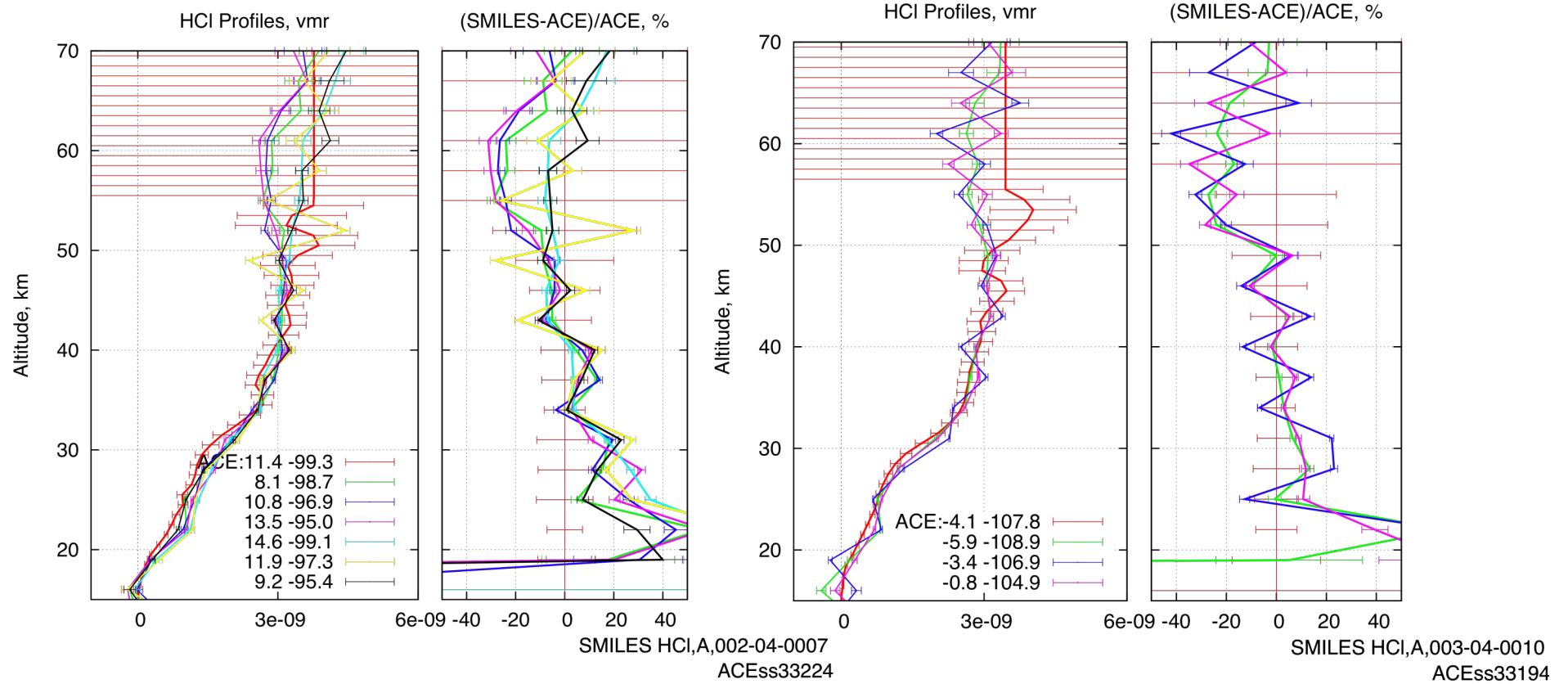
Nighttime Zonal mean O_3 : SMILES (Oct. 12th) vs. MLS (ver. 2.2, 2005-2007, Oct.)



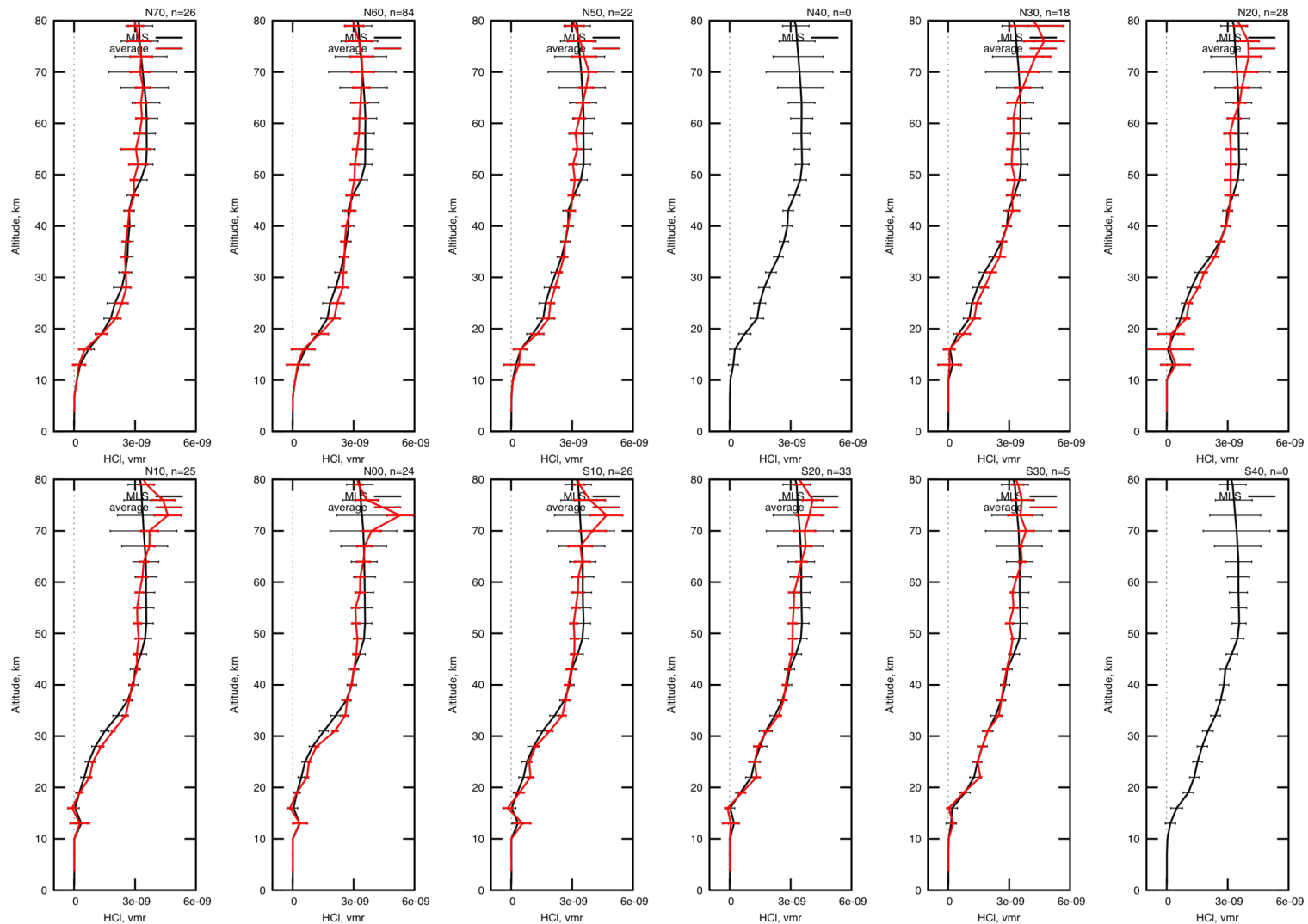
ACE-FTS, Coincidences: HCl



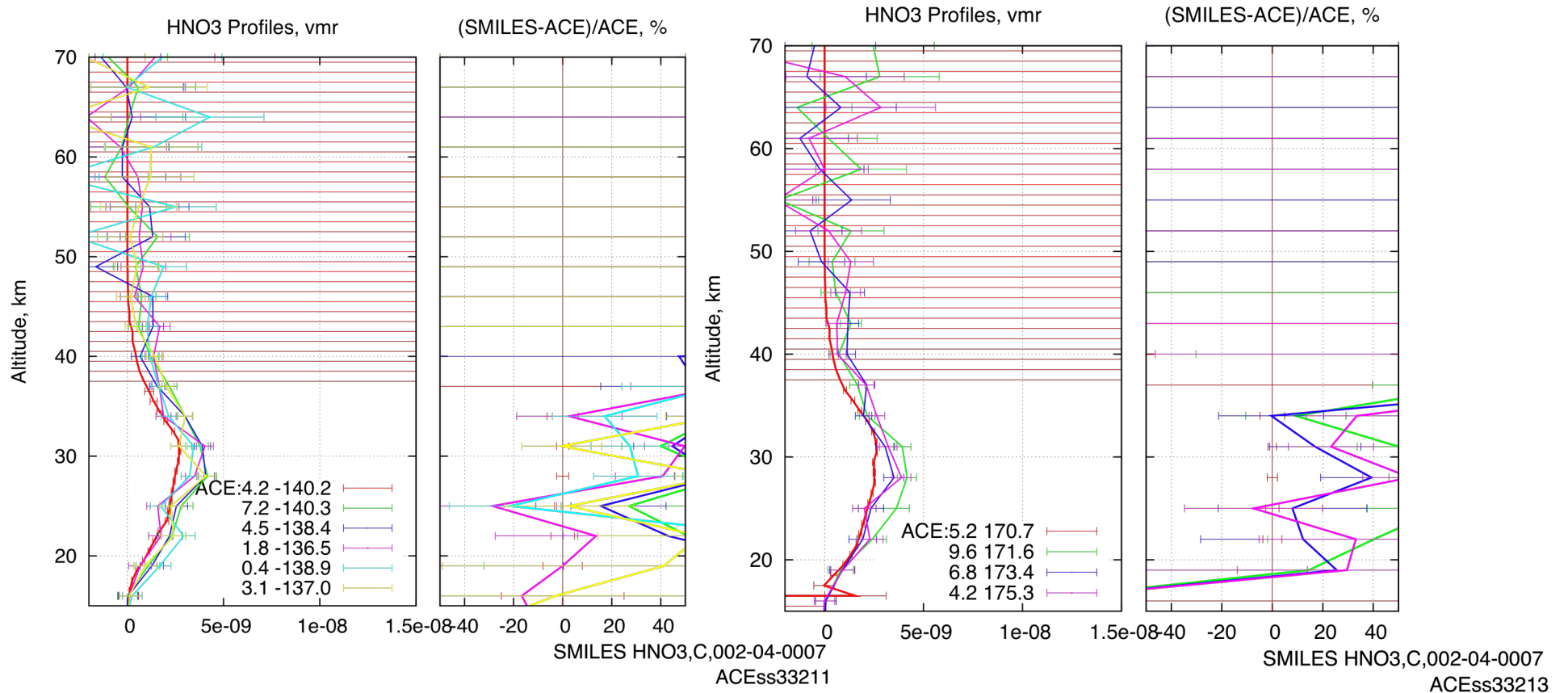
ACE-FTS, Coincidences: HCl



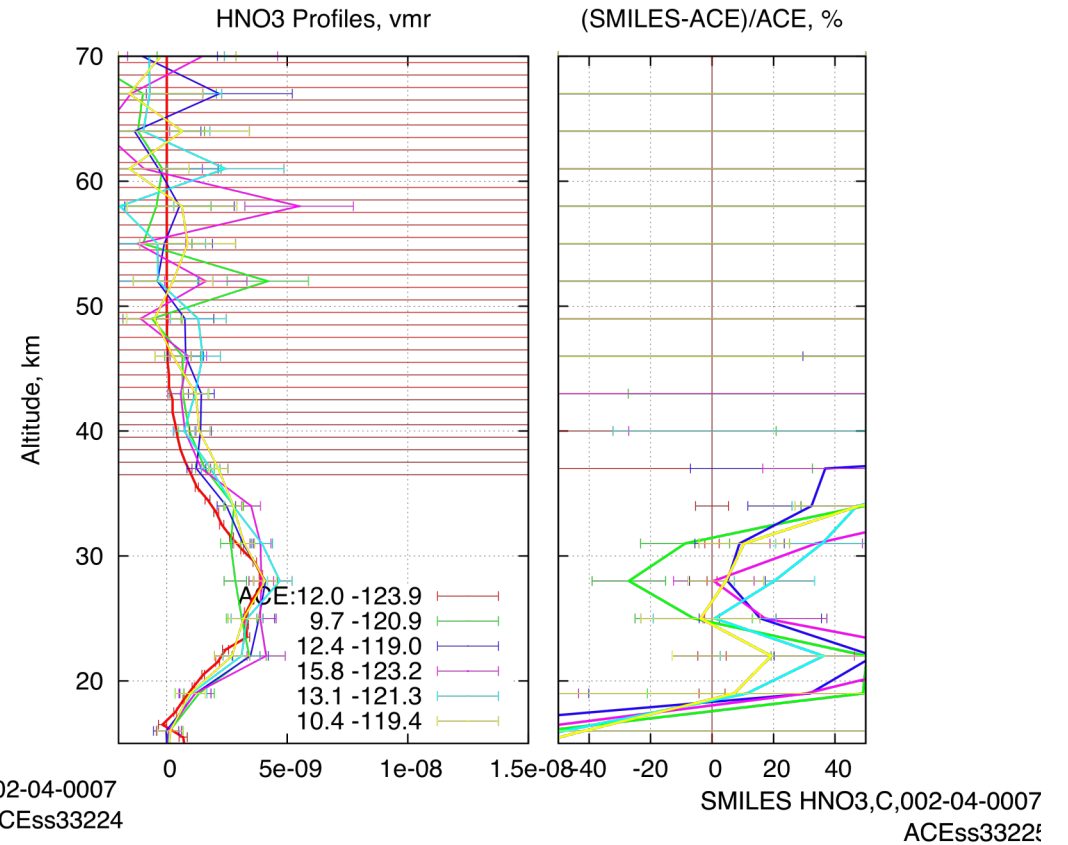
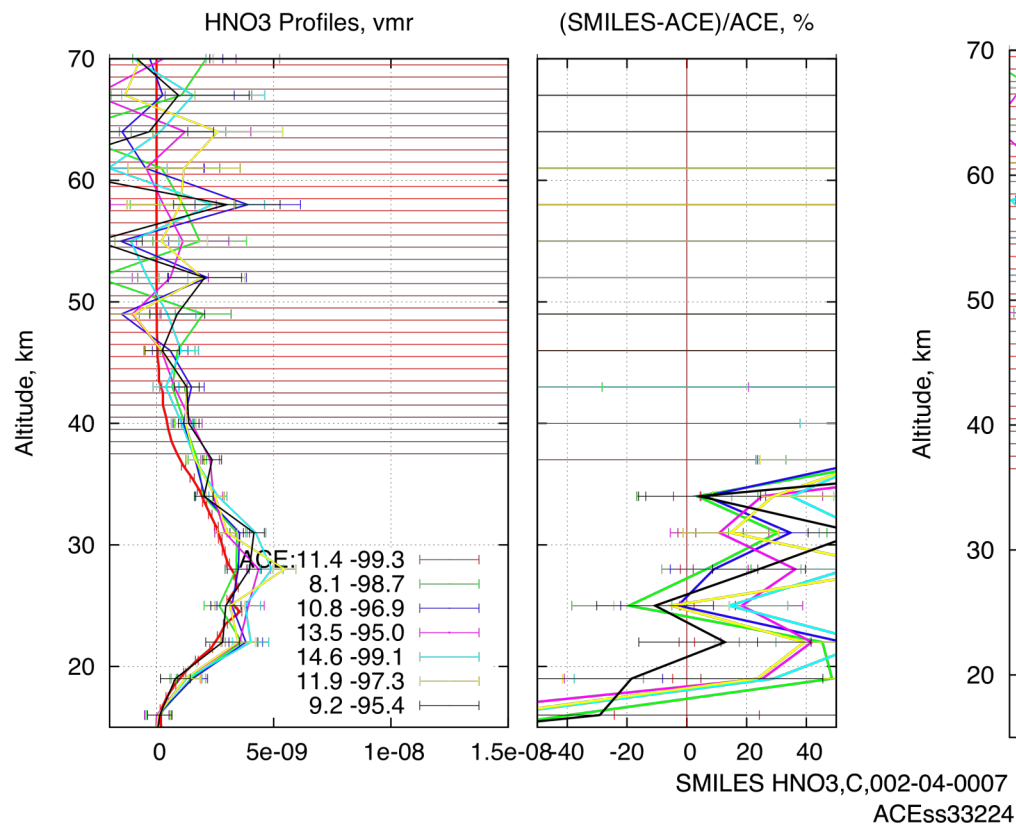
Zonal Mean HCl: SMILES (Oct. 12) vs. MLS (ver 2.2, 2005-2007, Oct. average)



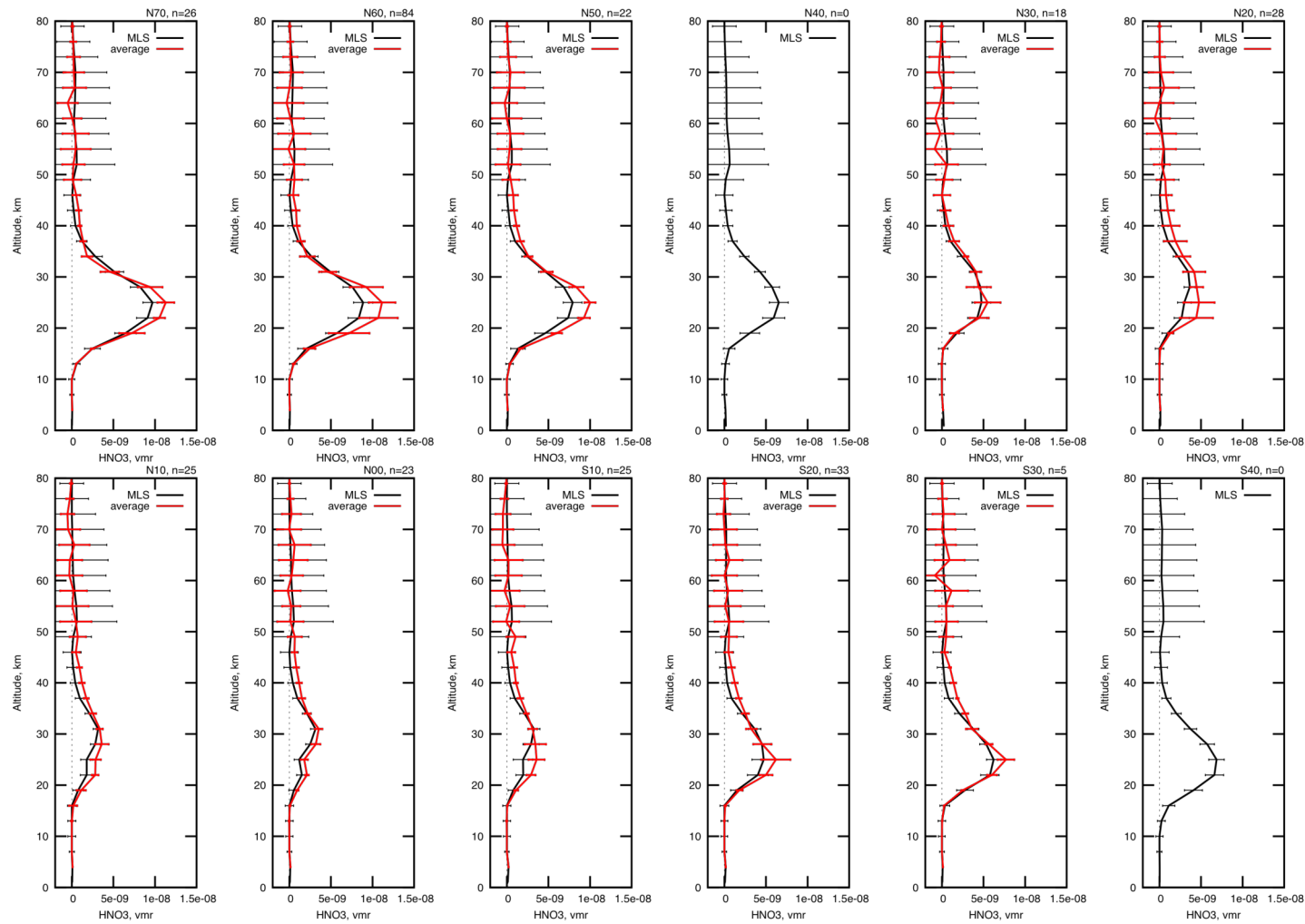
ACE-FTS, Coincidences: HNO₃



ACE-FTS, Coincidences: HNO₃

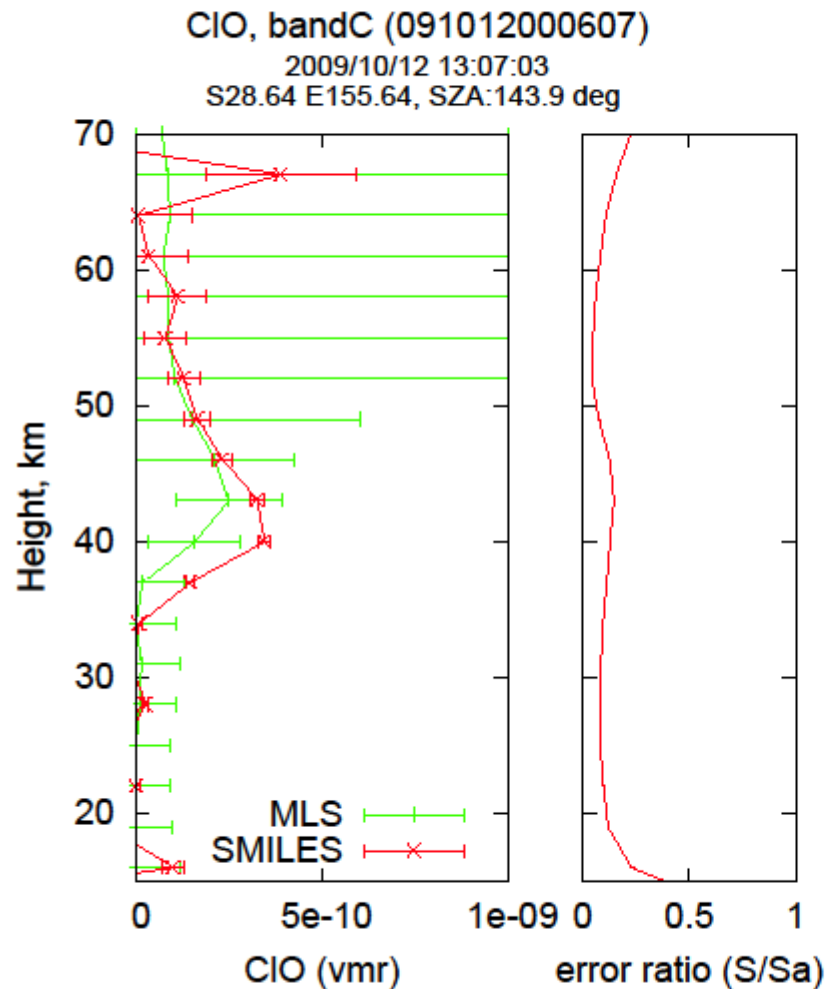
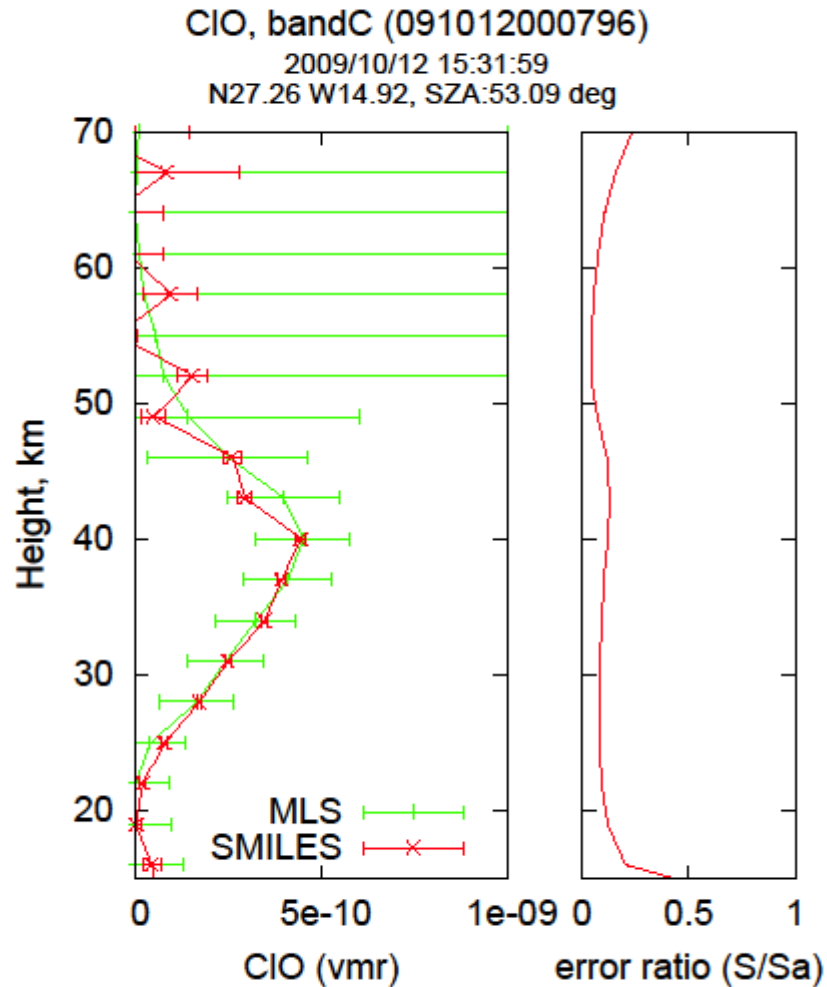


HNO3: SMILES Zonal Mean (Oct. 12) vs MLS (ver 2.2, 2005-07 Oct. average)

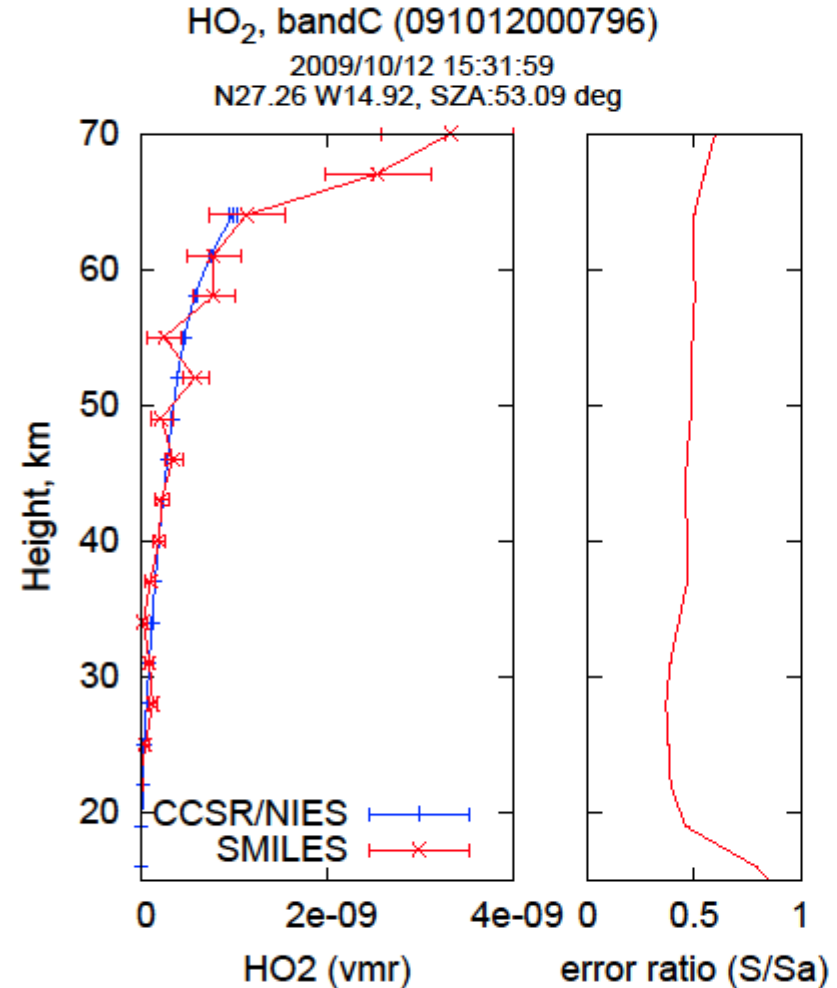
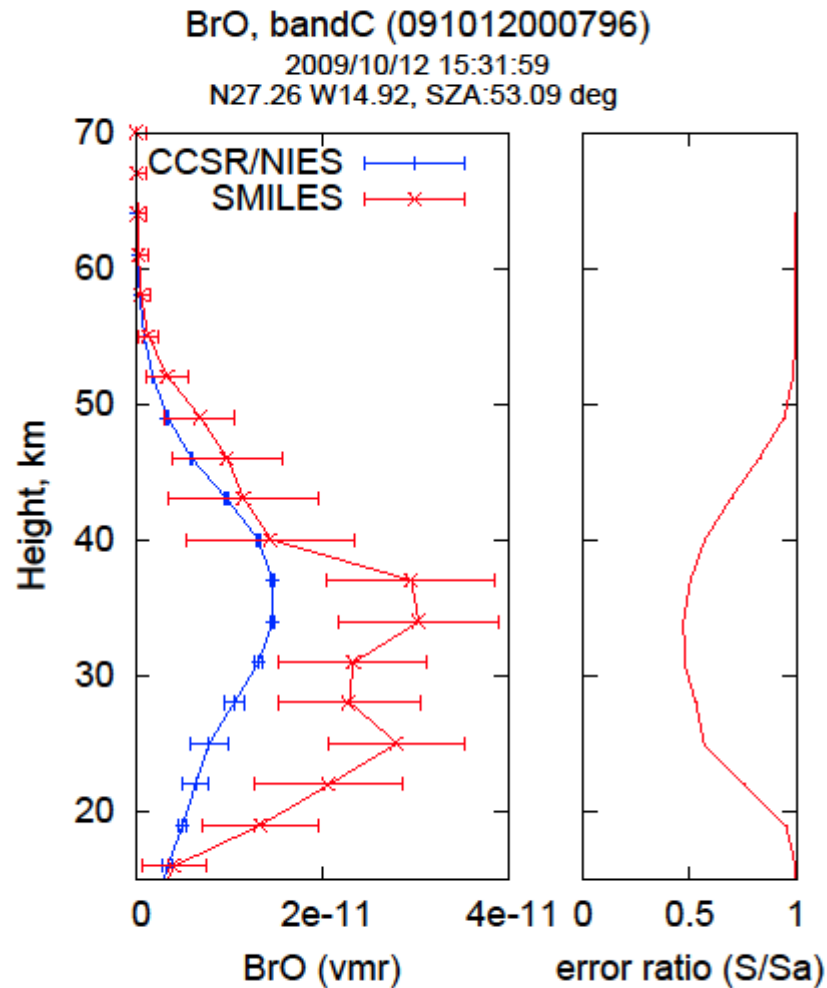


SMILES_L2_HNO3_C_003-04-0010_20091012_day

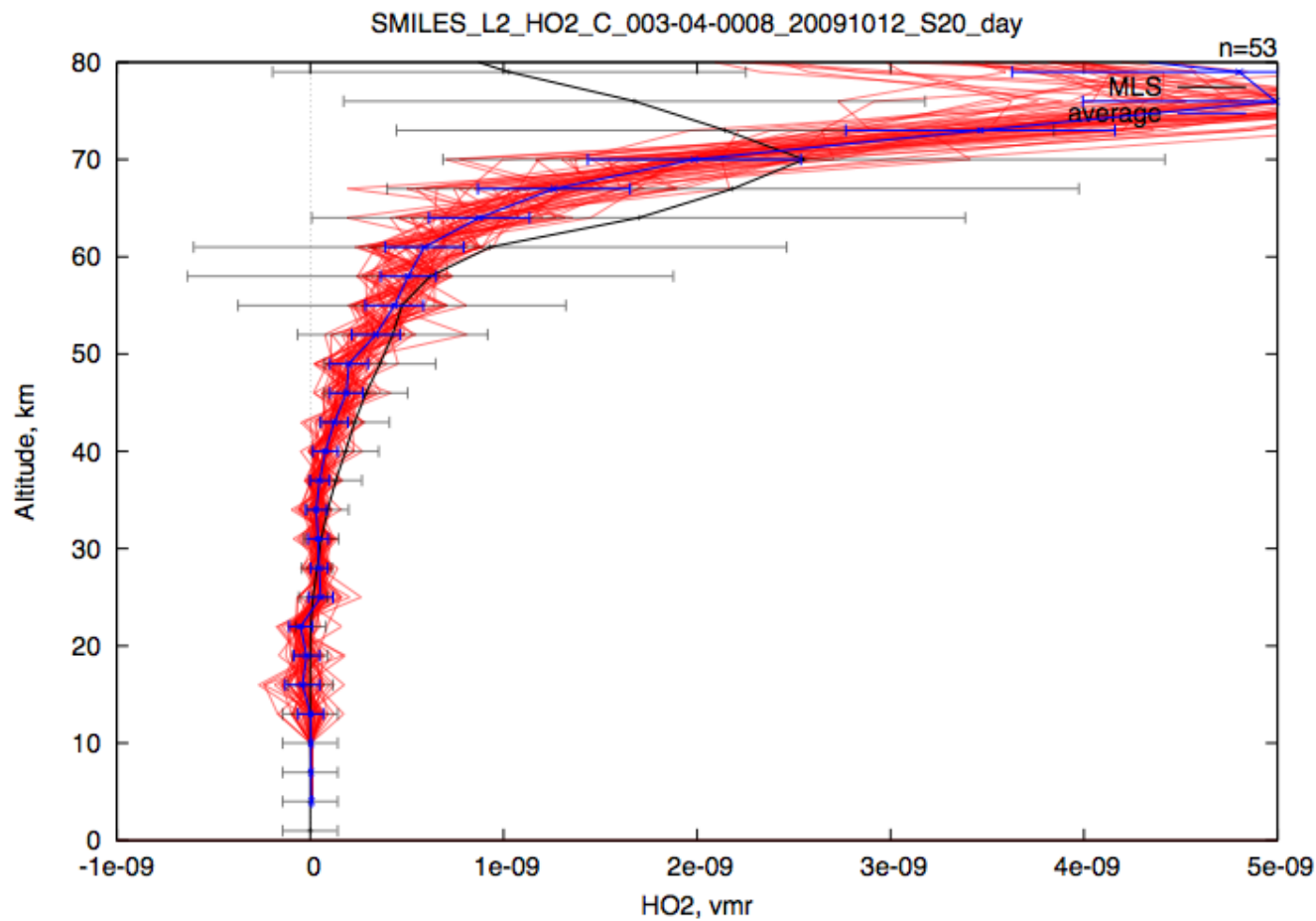
Preliminary results: ClO vs. AURA/MLS Climatology



Preliminary results: HO₂, BrO vs. CCSR/NIES Climatology (provided from Akiyoshi)

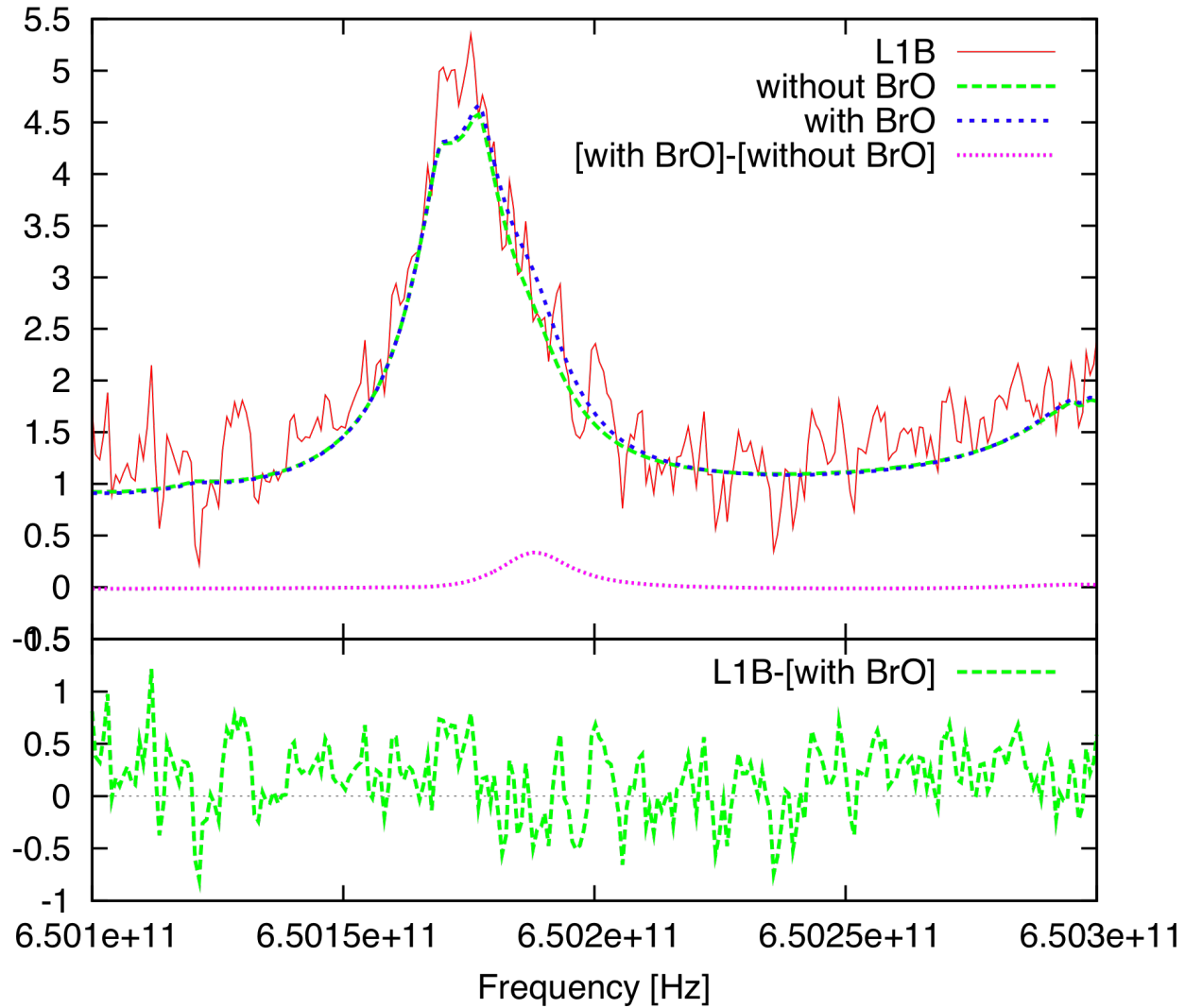


HO2: SMILES vs. MLS (ver 2.2, 2005-2007 Oct. average)

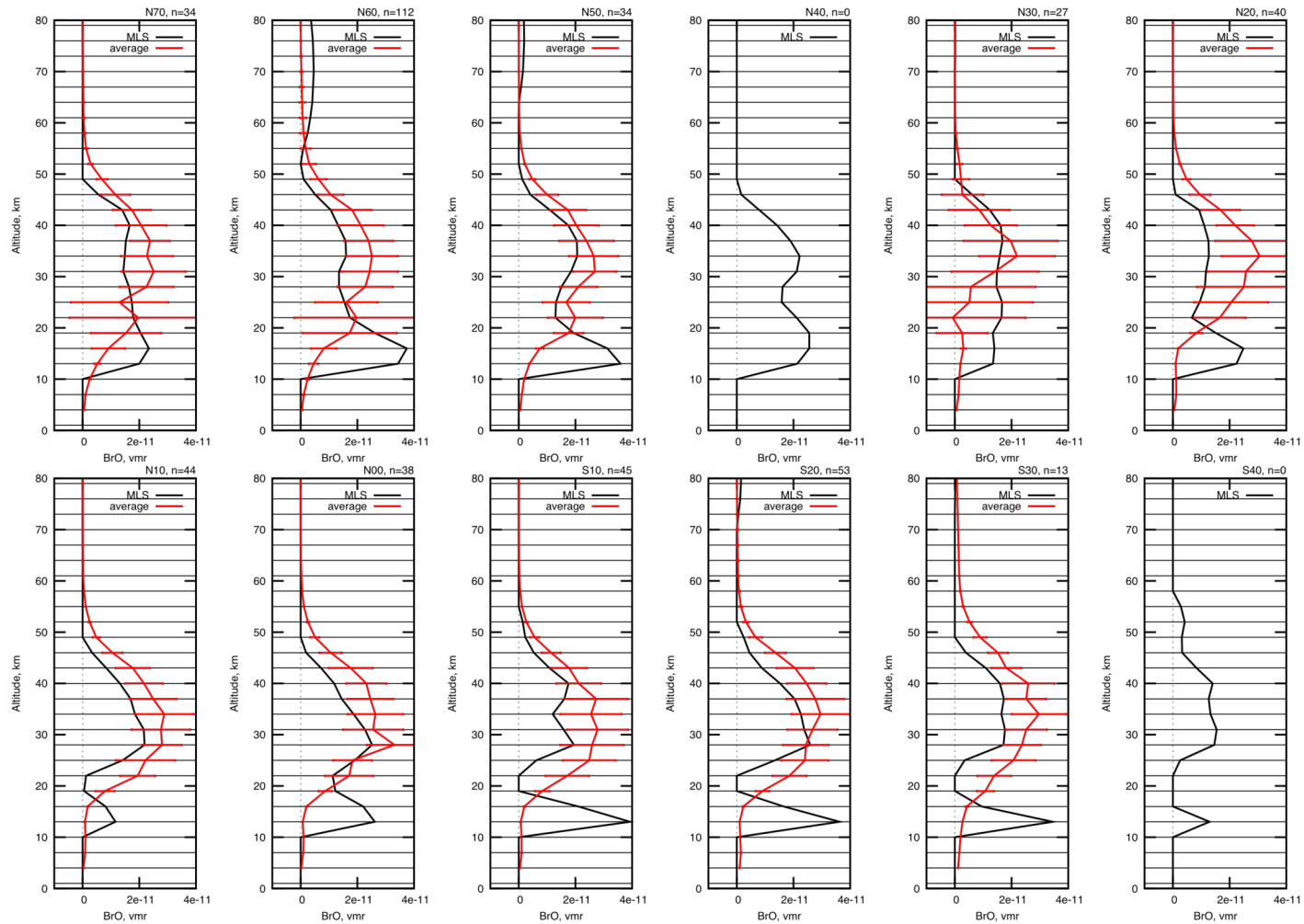


BrO Spectrum fitting

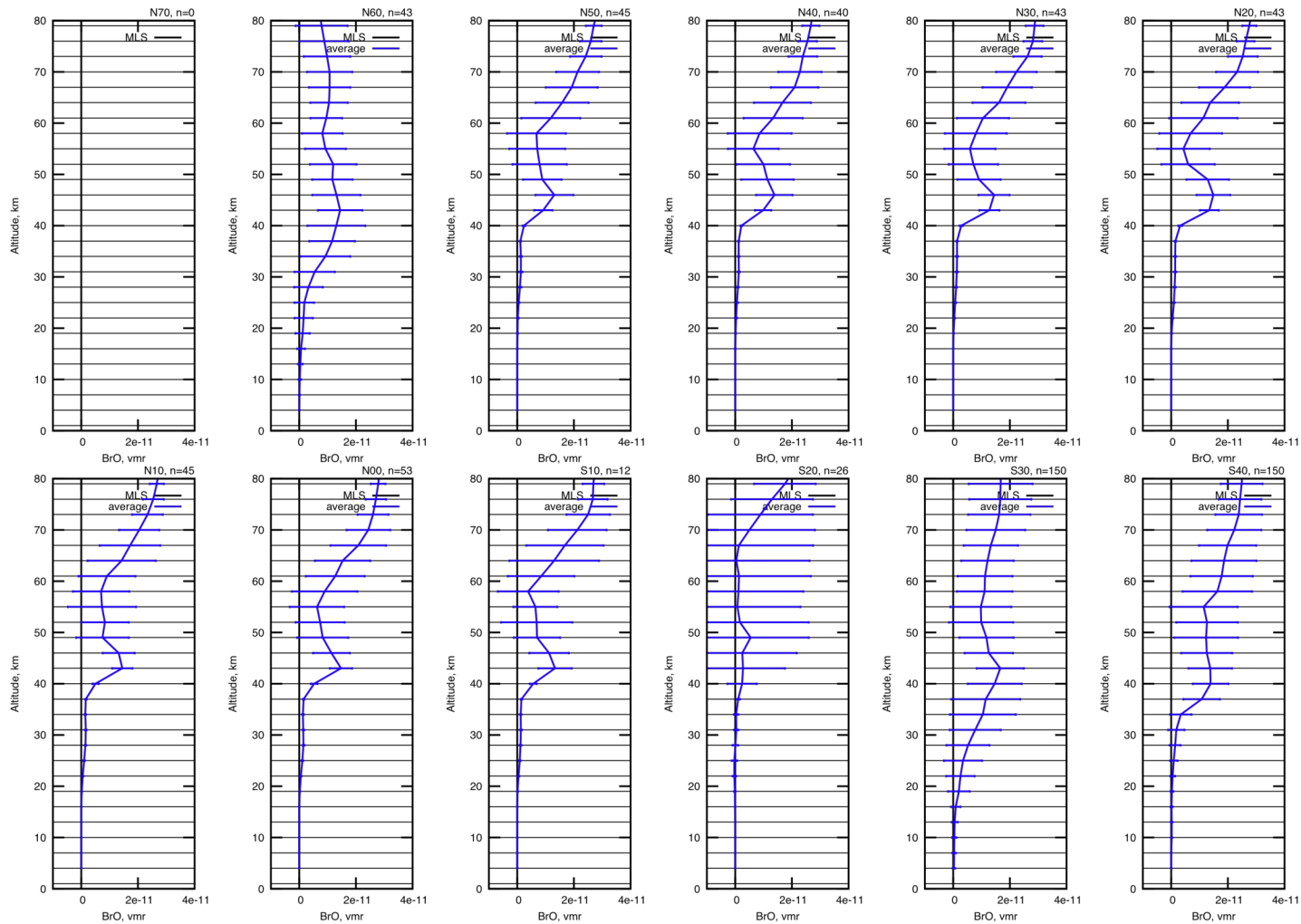
30 km



Zonal mean day time BrO: MLS (Day – Night, ver 2.2, 2005-7 average, Oct.) vs. SMILES (Oct. 12)



Zonal mean night time BrO: SMILES (Oct. 12)



Diurnal variation of BrO

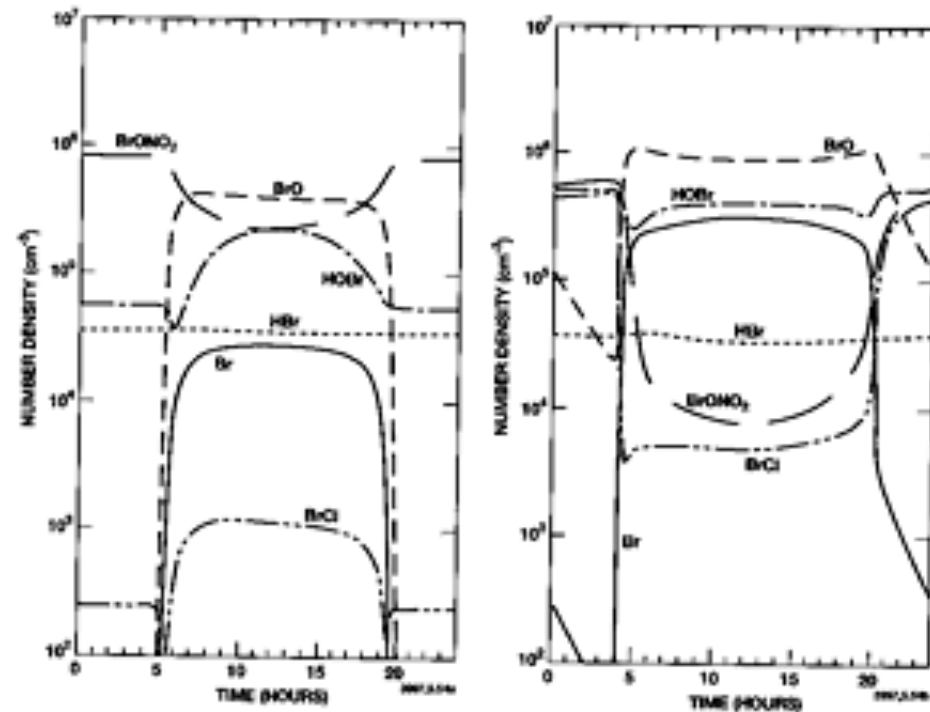
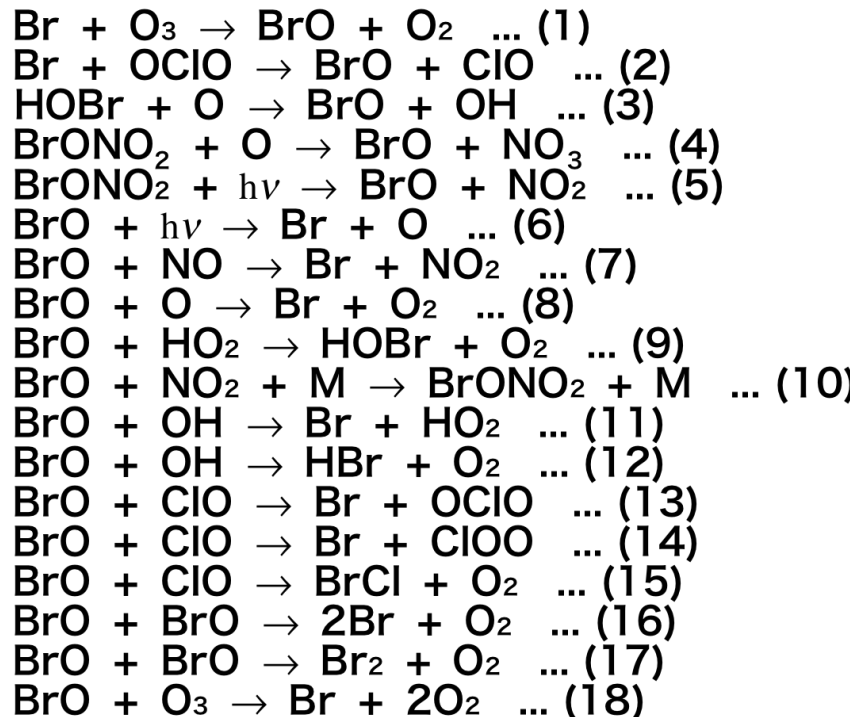
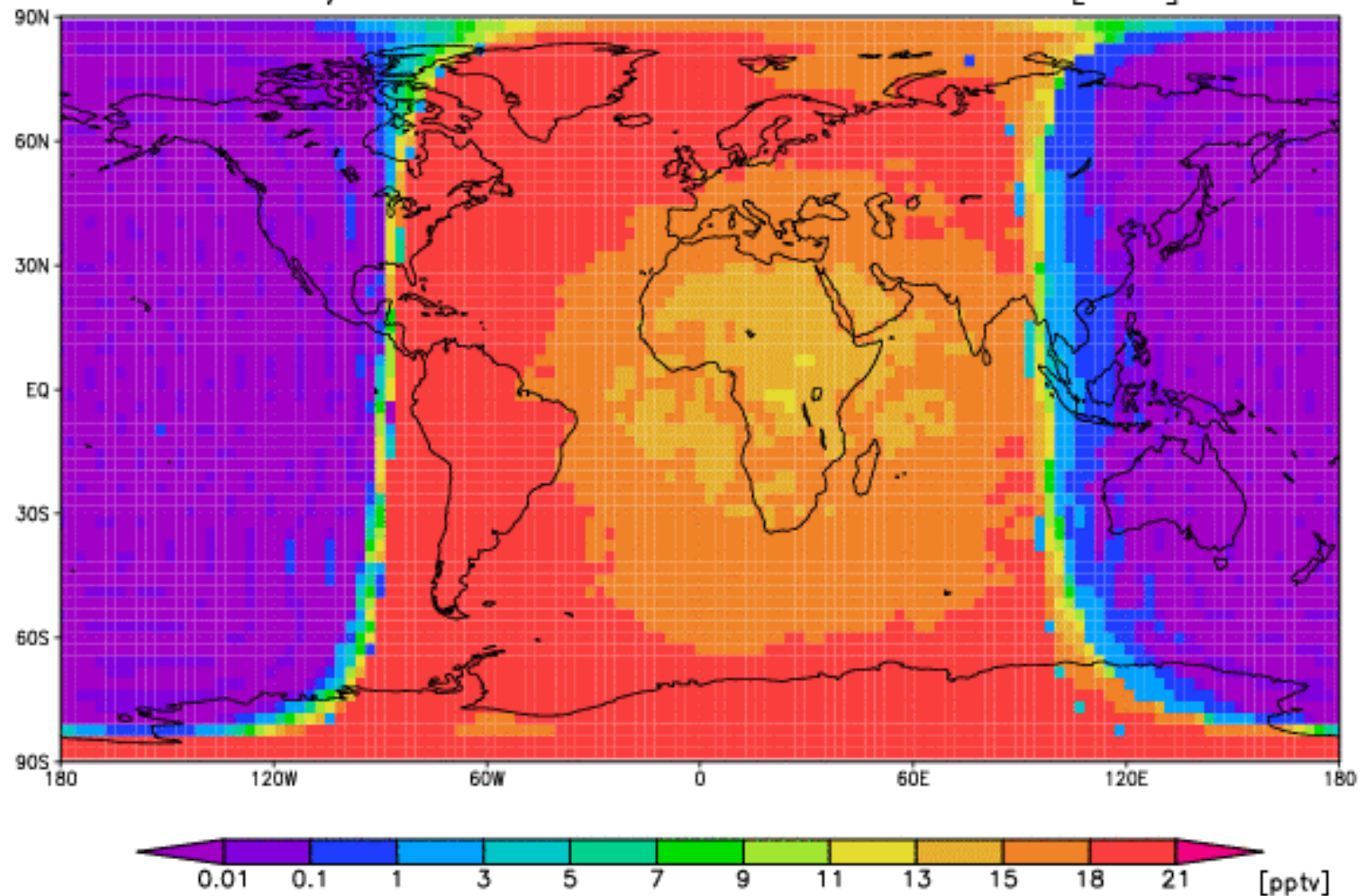


Figure 5.54. Diurnal variation of bromine species calculated for May 10 and 65°N at 20 km (a) and 40 km (b).

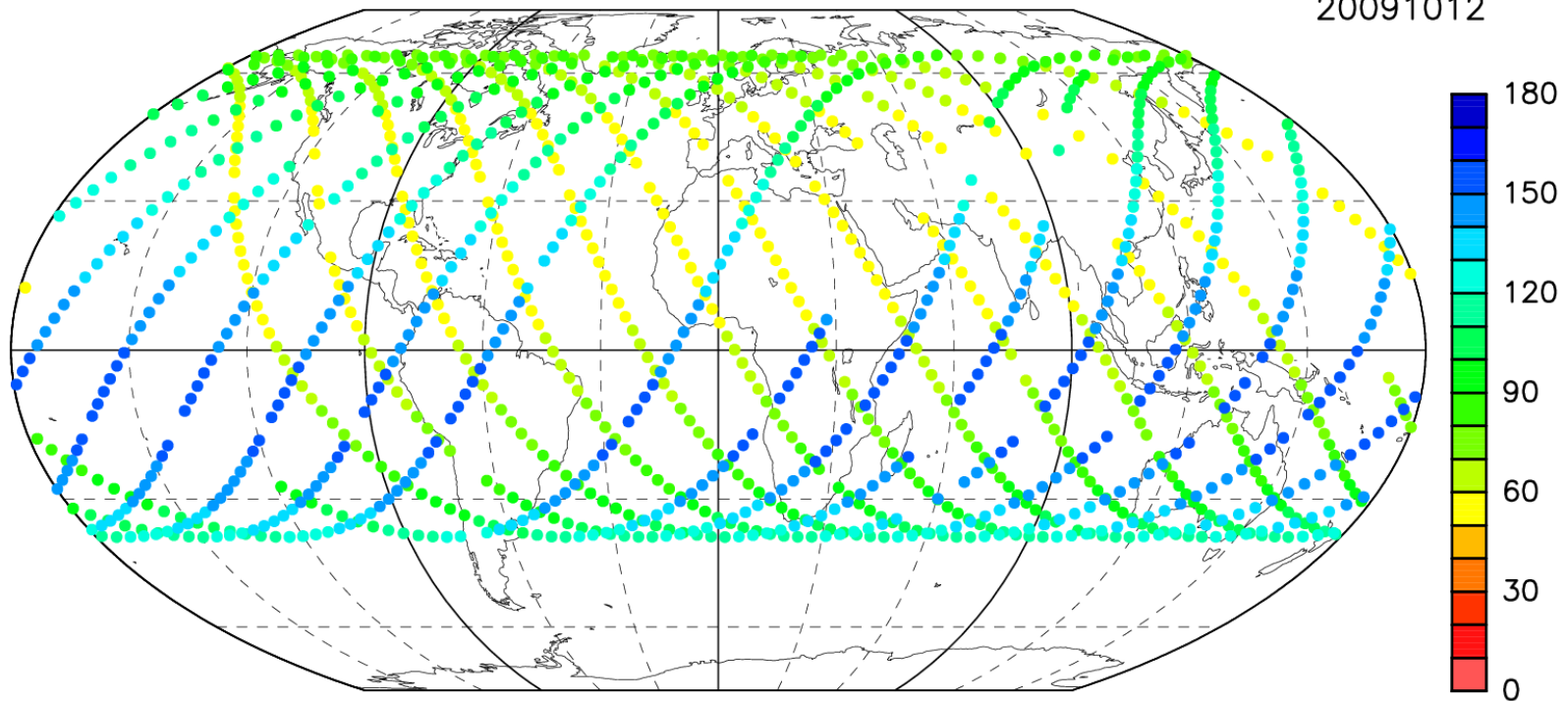
***BrO diurnal variation at 10 hPa caculated by
CCSR/NIES 3D-CGCM (Akiyoshi, NIES)***

CCSR/NIES : BrO : 12Z01OCT2010 : 10 [hPa]

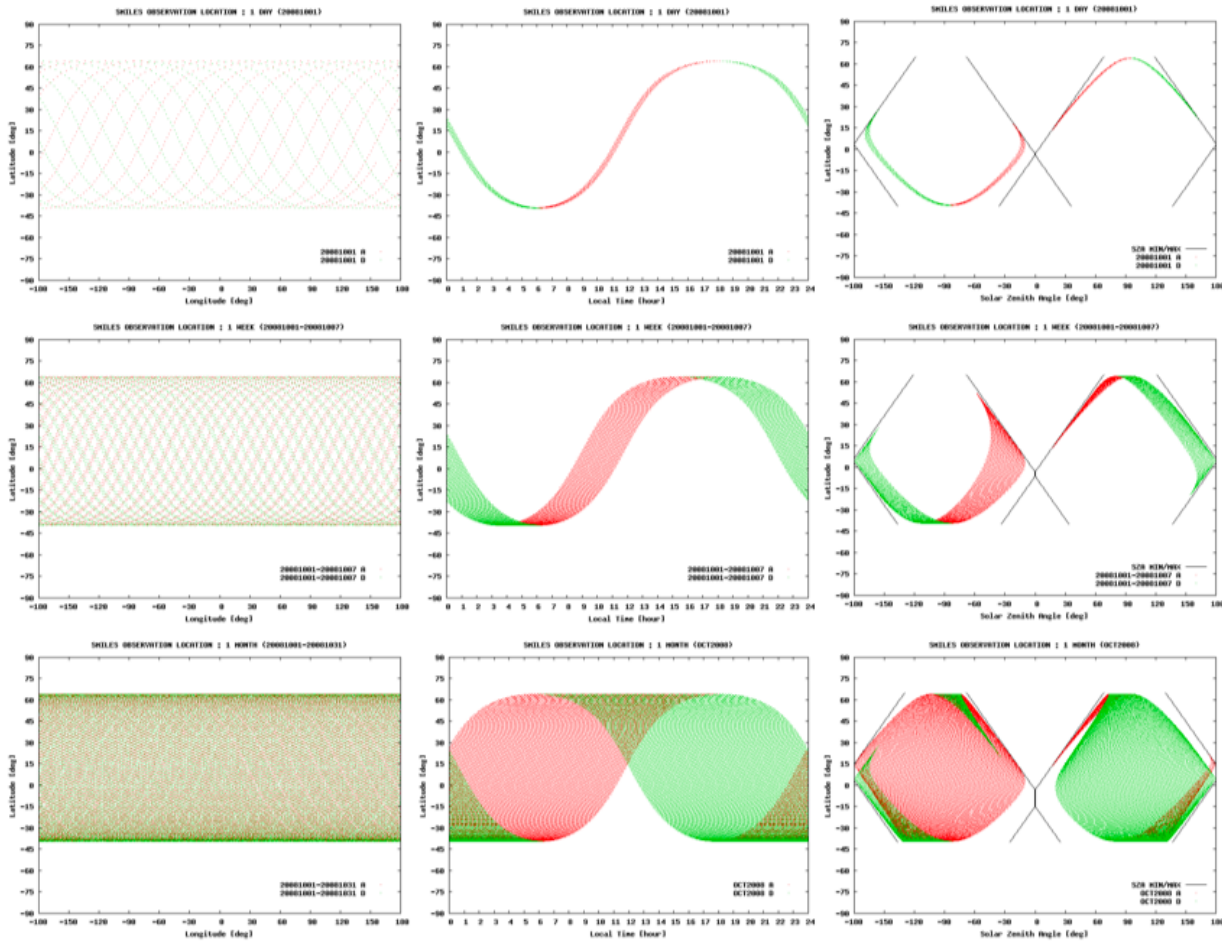


SZA of SMILES diurnal observation

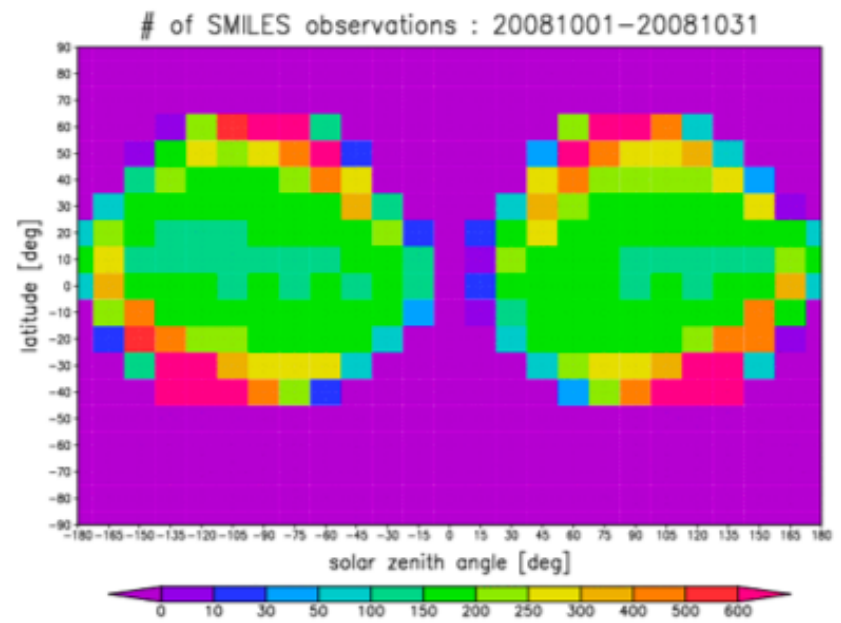
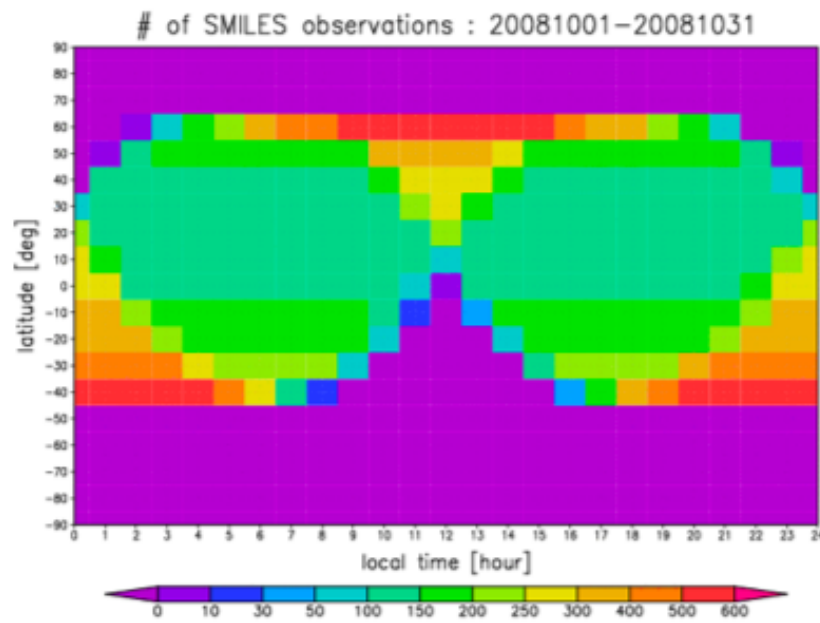
Solar Zenith Angle
20091012



SMILES takes 1 month to acquire full diurnal cycle



Occurrence for One Month Product for Local time-Latitude and SZA-Latitude grids



conclusions

- SMILES test observation started in Oct. 12
- Test products, after initial bug fixes, agrees well with MLS 2005-2007 average, ACE-FTS coincidence, and CCSR/NIES CGCM calculation.
- Diurnal cycle in stratosphere/mesosphere can be studied by using one month SMILES data (BrO, HO₂, ClO, and mesospheric O₃)
- We will try to release SMILES L2 to RA team within a month or so.
- Significant improvements in algorithm and validation will be necessary for real science application.

Few more words,

- Strength and Beauty of the SMILES are
 - $T_{\text{sys}} < 400\text{K}$,
 - Frequency stability $< 100\text{ kHz}$,
 - Extremely good calibration.
- But it lacks tangent height stability,
 - Star sensor specifications.
 - Pointing mirror angle resolver specifications.
- We applaud people who imagined and designed the SMILES instrument, especially to Prof. Inatani.
- Many thanks to European science community to support SMILES program over years, especially Prof. Kunzi and his colleagues and DLR.
- Original SMILES proposal was written sometime in 1988 by Prof. Kunzi, Prof. Inatani, and Dr. Masuko, and 2 decades later it really worked very beautifully in space.

- Appendix

JEM/SMILES data sets

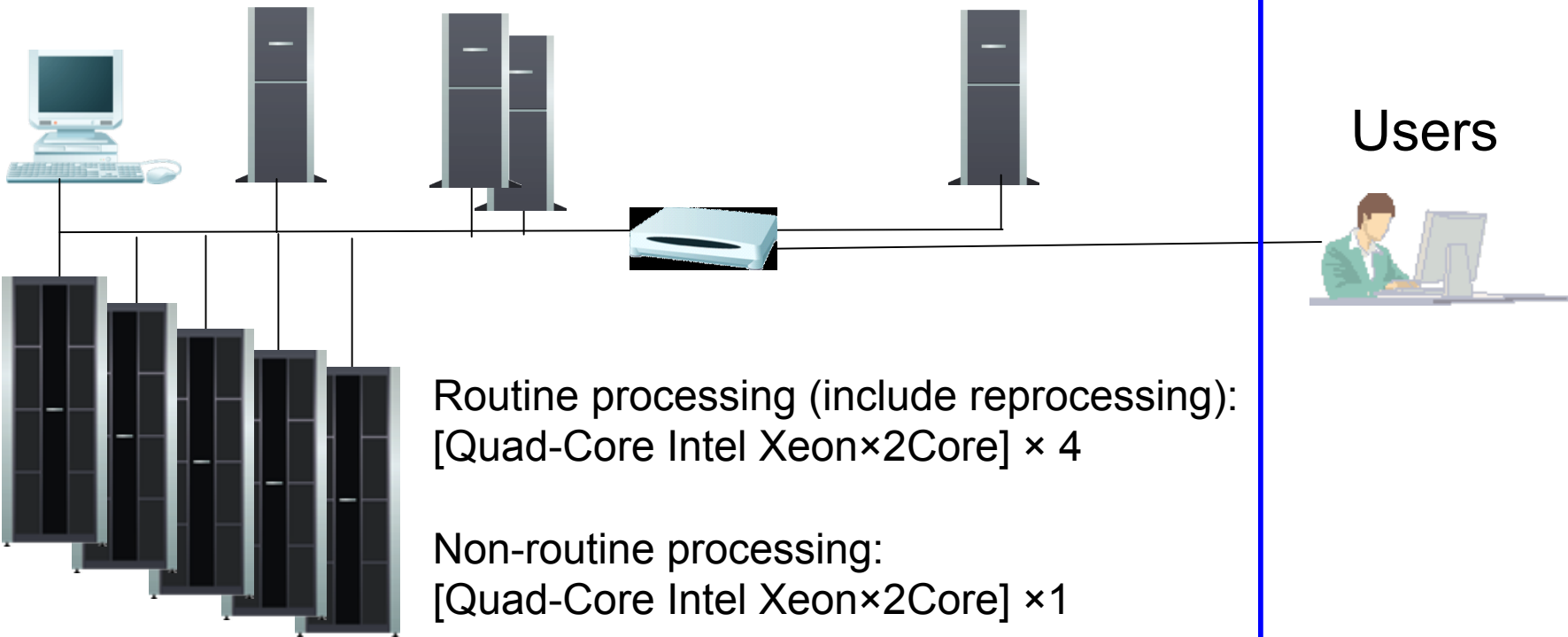
Data Type	Description
RAW	Unprocessed mission data at binary packets
Level 0 (TKSC)	Reconstructed, unprocessed mission data at binary packets
Level 1b (TKSC)	Calibrated instrument radiances and related data
Level 2 (ISAS,NICT)	Derived geophysical variables at the same resolution and location as the Level 1 source data
Level 3 (NICT)	Variables mapped on uniform space-time grid scales, usually with some completeness and consistency

Processing
↓

L2 System configuration

Level2 Data Processing System in JAXA/ISAS

Monitor Operation File Server RAID5×2 (mirroring) Web server



Validation supporting

- Predict appropriate time for the observation

The observation is done at 53 intervals of the second(about 400km).
Because it is prediction result, the error margin is included.

Detail

No.	Time(UTC)	Solar Local Time	Latitude	Longitude	Distance(km)
1	2009-03-18 01:30	2009-03-18 01:30	6.292778	48.382233	362.876656

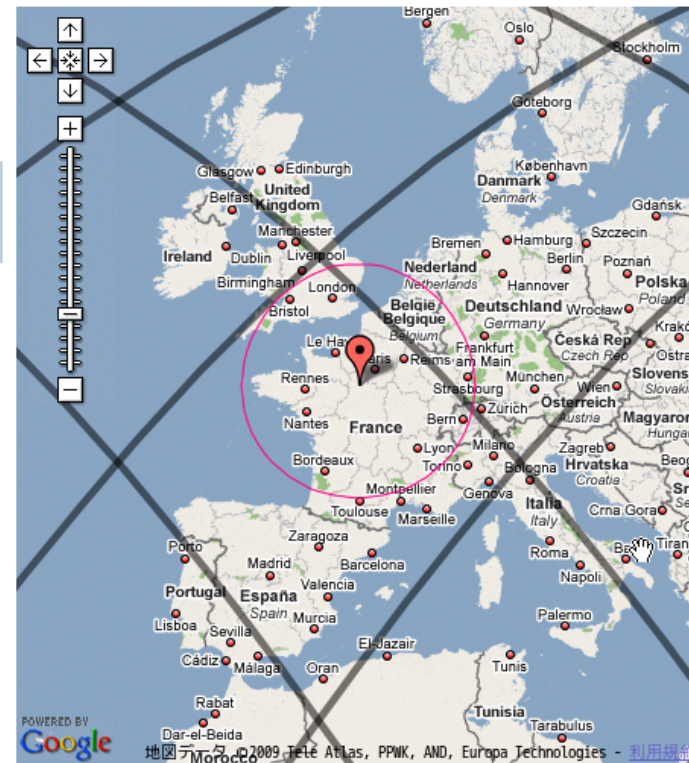
Precondition

Observation Date	2009-03-18
ISS Flight Attitude:Roll	0
ISS Flight Attitude:Yaw	0
ISS Flight Attitude:Pitch	0
Radius from Validation Point	500

TLE Data

Epoch	2009-03-08
Inclination	51.6401
R.A.A.N	100.7608
Eccentricity	0.0010750
Argument of Perigee	98.4284
Semi Major Axis	6733.9869
Mean Anomaly	261.8097

[download](#)



Products of level 2 data

■ Standard Products :

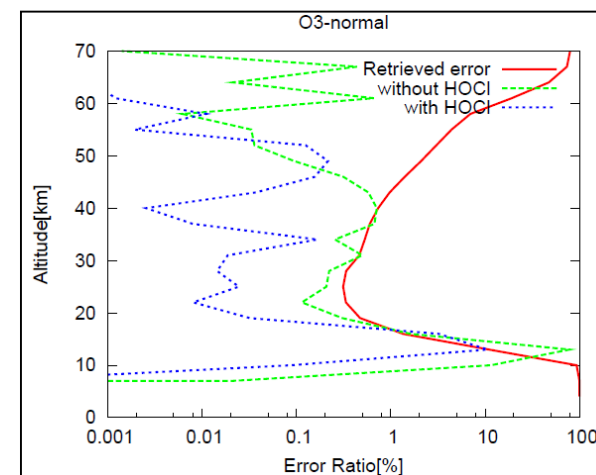
- Routine processing : O₃, HCl, ClO, CH₃CN, O₃ isotopes, HOCl, HNO₃
- Nonroutine Processing : HO₂, BrO

■ Research Products :(These products are outside of this system)

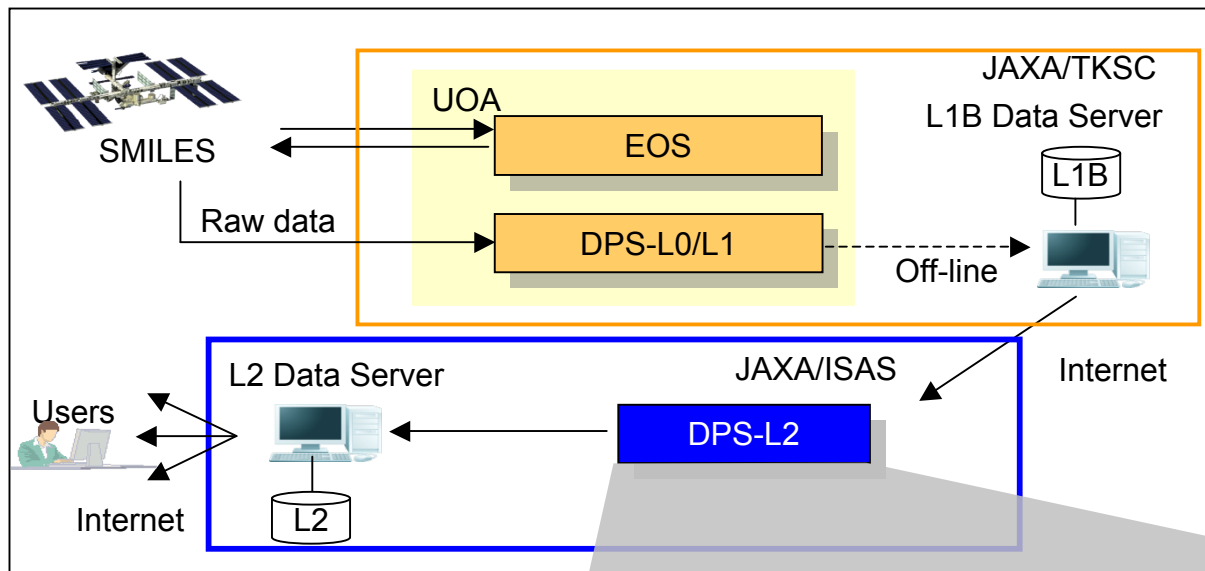
volcanic SO₂, H₂O₂, UTH, Cirrus Clouds

Type	Band A	Band B	Band C
Species retrieved from single-scan data	O ₃ H ³⁷ Cl 18O ₃ HNO ₃ CH ₃ CN HOCl O ¹⁷ O ₂	O ₃ H ³⁵ Cl 18O ₃ O ¹⁷ O ₂ ClO	O ₃ 18O ₃ HNO ₃
Species retrieved from multi-scan data (noisy products)	BrO	HO ₂	BrO HO ₂

Effects from Other Molecules



JEM/SMILES data flow



- Downlinked raw data from the SMILES will be received by the DPS-L0/L1 at User Operation Area (UOA) on Tsukuba Space Center (TKSC).
- The DPS-L0/L1 processes the raw data consisting of house keeping (HK) data and mission data to brightness temperature (level 1B data) in near-real-time.
- The DPS-L2 produces the vertical profiles of target species called level 2 data in near real time and distributes the level 2 data to data users by a Web server.

UOA: User Operation Area,
EOS: Experiment Operations System,
DPS: Data Processing System

