Comparisons of HALOE, SAGE-II, ACE, and MLS

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+
a long list of people involved with all the instruments

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Version 1.5 Level 2 and data quality description document.

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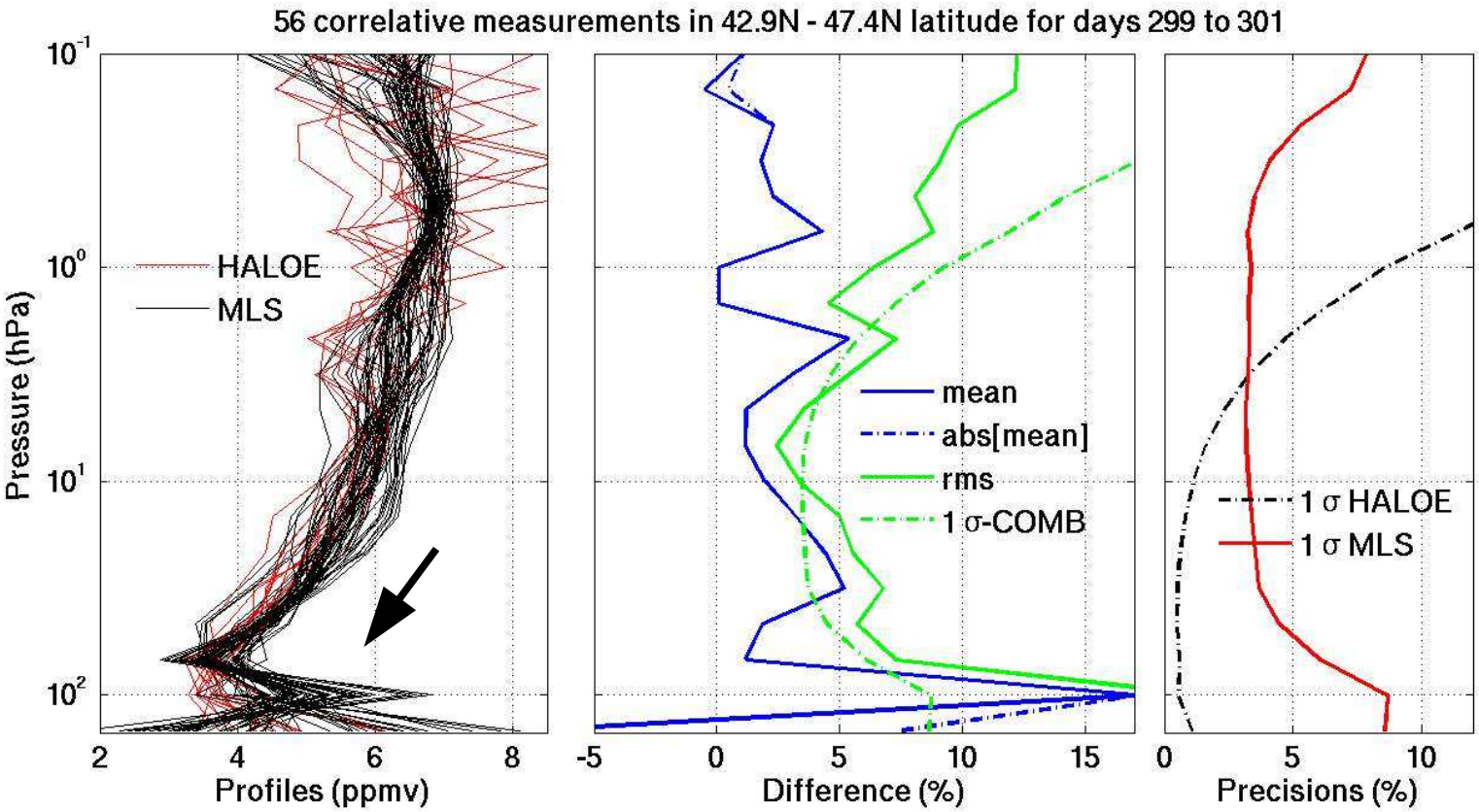
Stability

Monthly averages

L. Froidevaux et al., Early validation analyses of atmospheric profiles from EOS MLS on the Aura satellite, IEEE TGRS, 2005.

(3) Summary

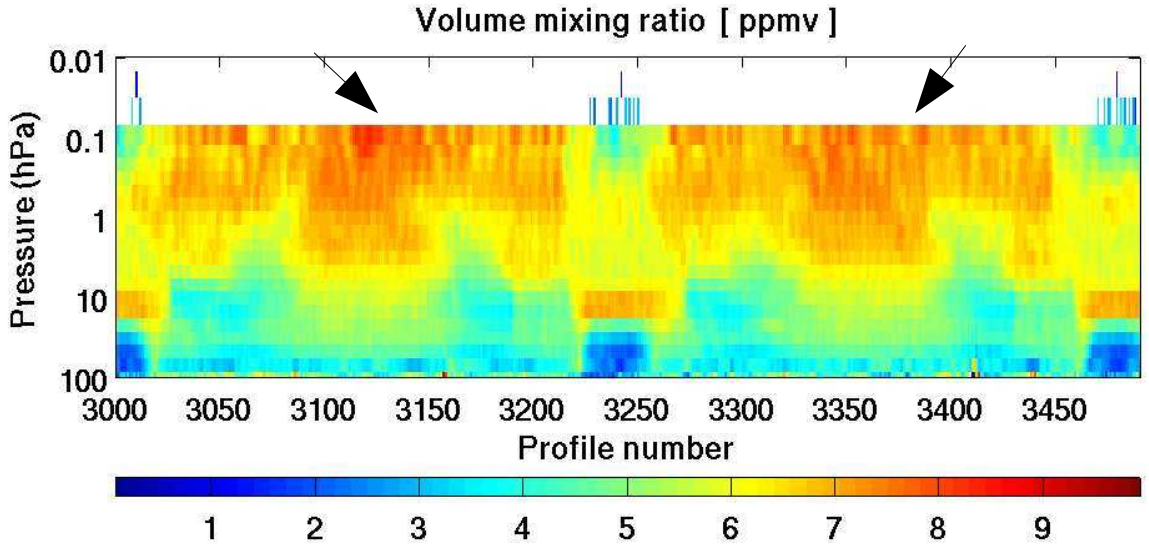
Retrieval issues [stratosphere]



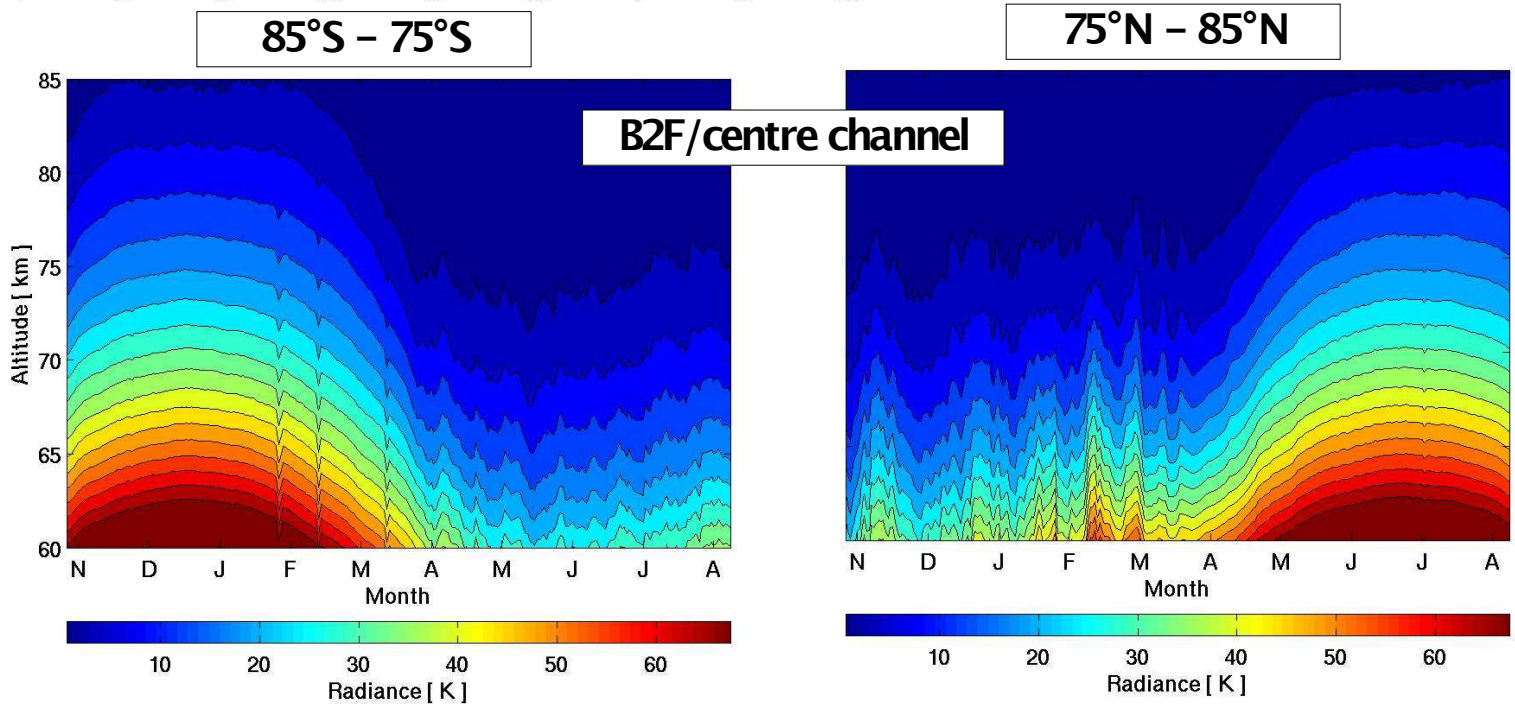
- Some vertical oscillations in the lower stratosphere, related to difficulties to fit the radiances in the upper troposphere-lower stratosphere.

- Improvements expected in the next version of the data.

Retrieval issues [mesosphere]

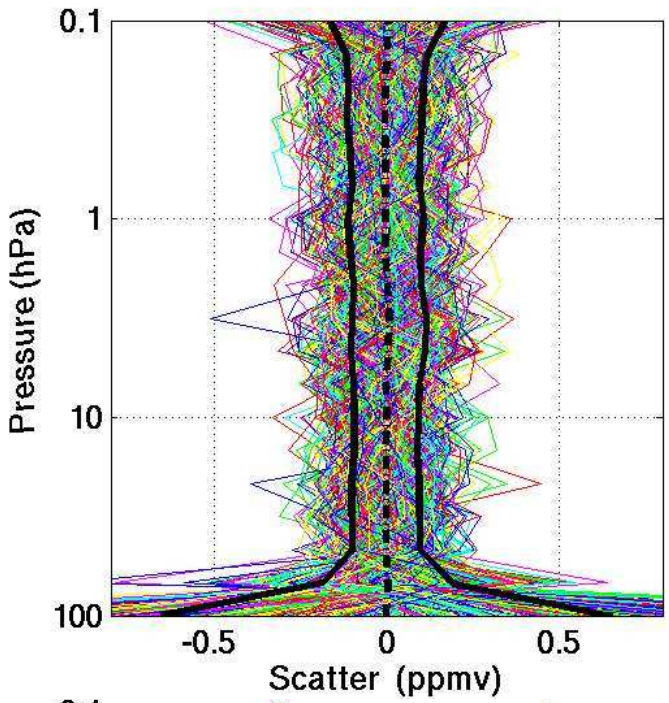


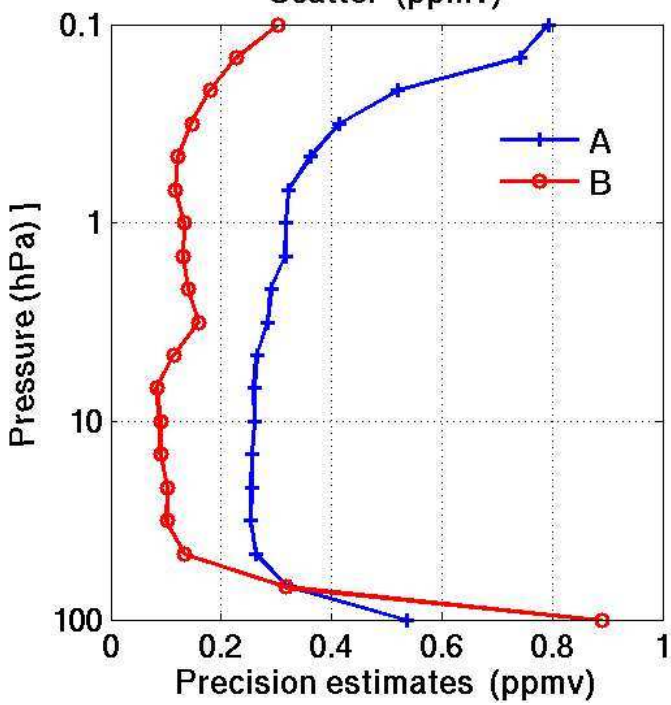
- Data flagged as no usable in the upper mesosphere as the retrievals indicate that the instrument / algorithms fail to provide useful information there.



- But raw radiances show that there is information for the retrievals to extend the range of usable pressures in the mesosphere, working on a better choice of regularization parameters for next version.

Precision [tropical scattering]





- Measuring true precision by observing the **scattering** in regions with little atmospheric variability, such as the **tropical stratosphere**, for H2O.

- As the radiance errors provided to the retrieval formulas are inflated, an overestimation of the retrieval precision is likely to happen.

- Observing the scattering in the tropics confirm this.

Standard deviation of de differences between consecutive profiles in tropical region 5S-5N

A Estimated precision by retrieval algorithm (combination of radiance and a priori uncertainties)

B Standard deviation of profiles in tropical region 5S-5N (estimation of error from radiance terms)

Accuracy

- Comparisons with other **satellite data** sets:

HALOE [v19]
SAGEII [v6.20]
ACE [v2.2]

- Comparisons done for **Sep 2004 – Aug 2005,** coincident pairs between MLS and correlative measurements extracted by:

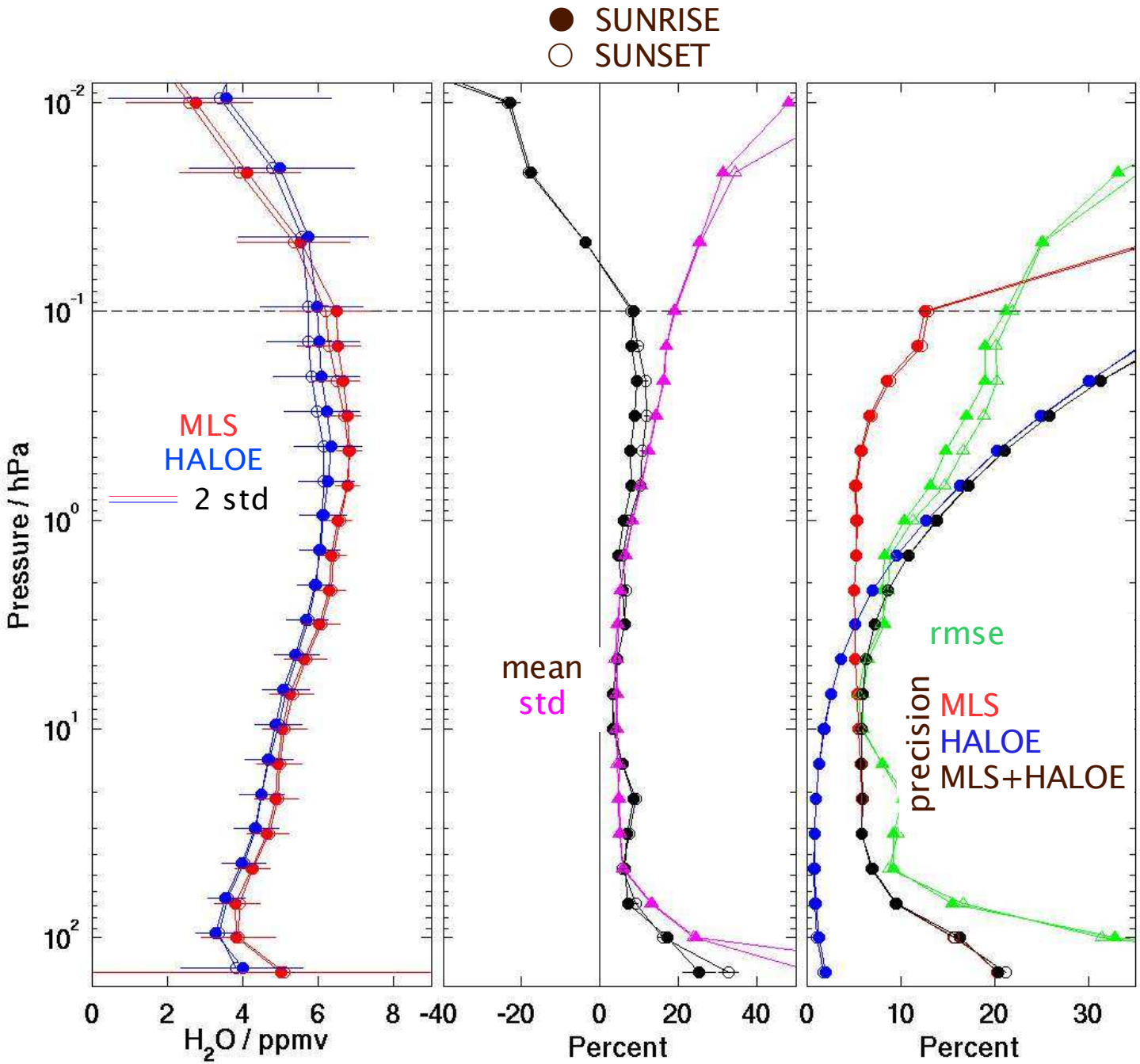
▲ latitude = ± 1 ° ▲ longitude = ± 12 ° ▲ time = ± 12 hours

then selecting the best match based on a **"closest-in-distance"** criteria.

- Differences calculated as:

$$\frac{\textbf{MLS} - \textbf{OTHER}}{\textbf{OTHER}}$$

with other instrument interpolated to MLS retrieval grid.



~ 3800 coincidences

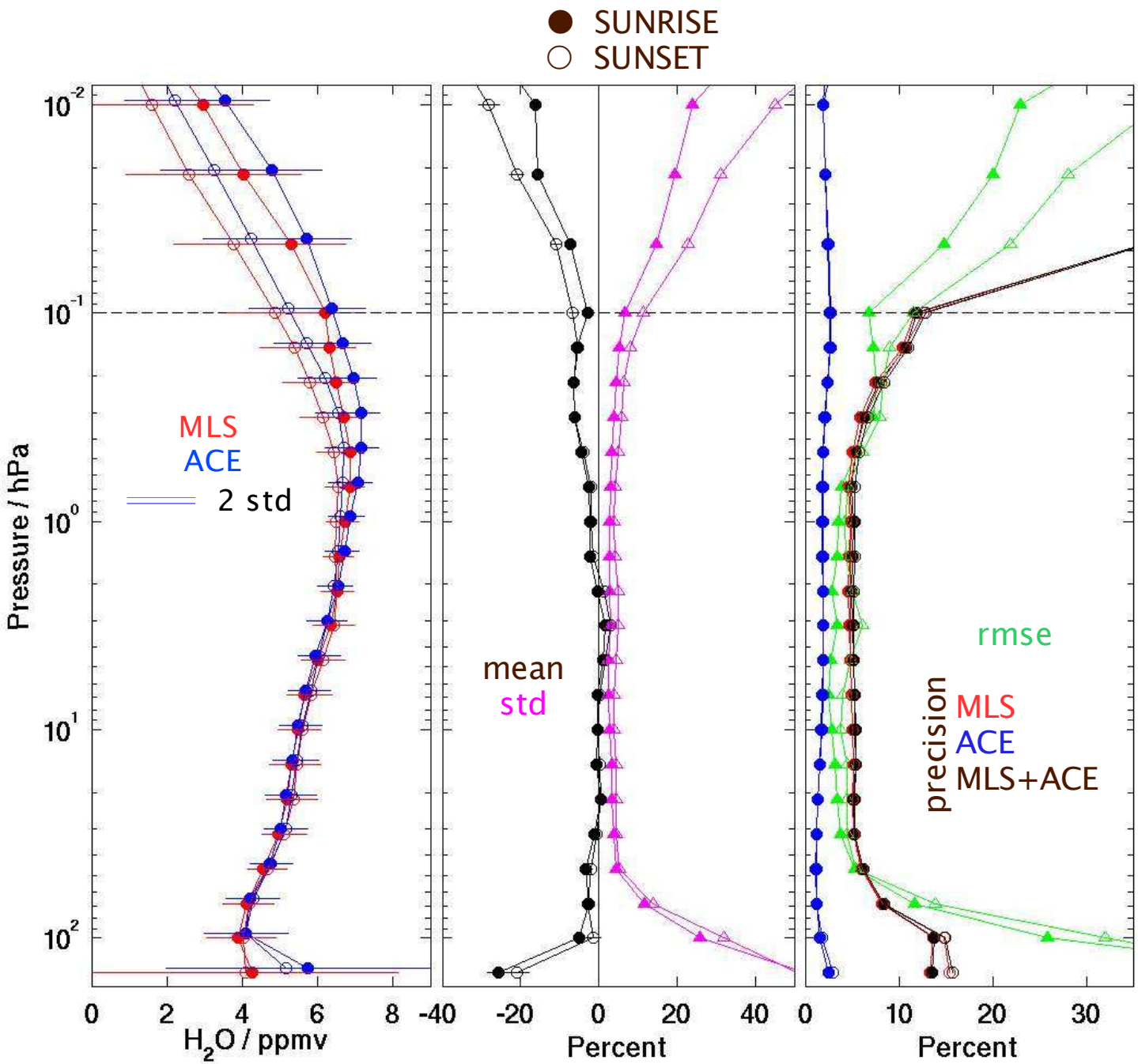
Stratosphere

- MLS consistently wetter than HALOE, 5–10% bias.
- Biases get larger toward the lower strato.
- Reasonable agreement between rmse and combined precision, though rmse gets larger in the lower strato.

Mesosphere

- Lower mesos, MLS also wetter than HALOE, 10–15% bias, with some slight difference between sunset and sunrise.
- Upper mesos [data not recommended] seems to have a dry bias.
- Combined precision gets larger than rmse, suspected overestimation of HALOE precision.

Accuracy [annual averages]



~ 2400 coincidences

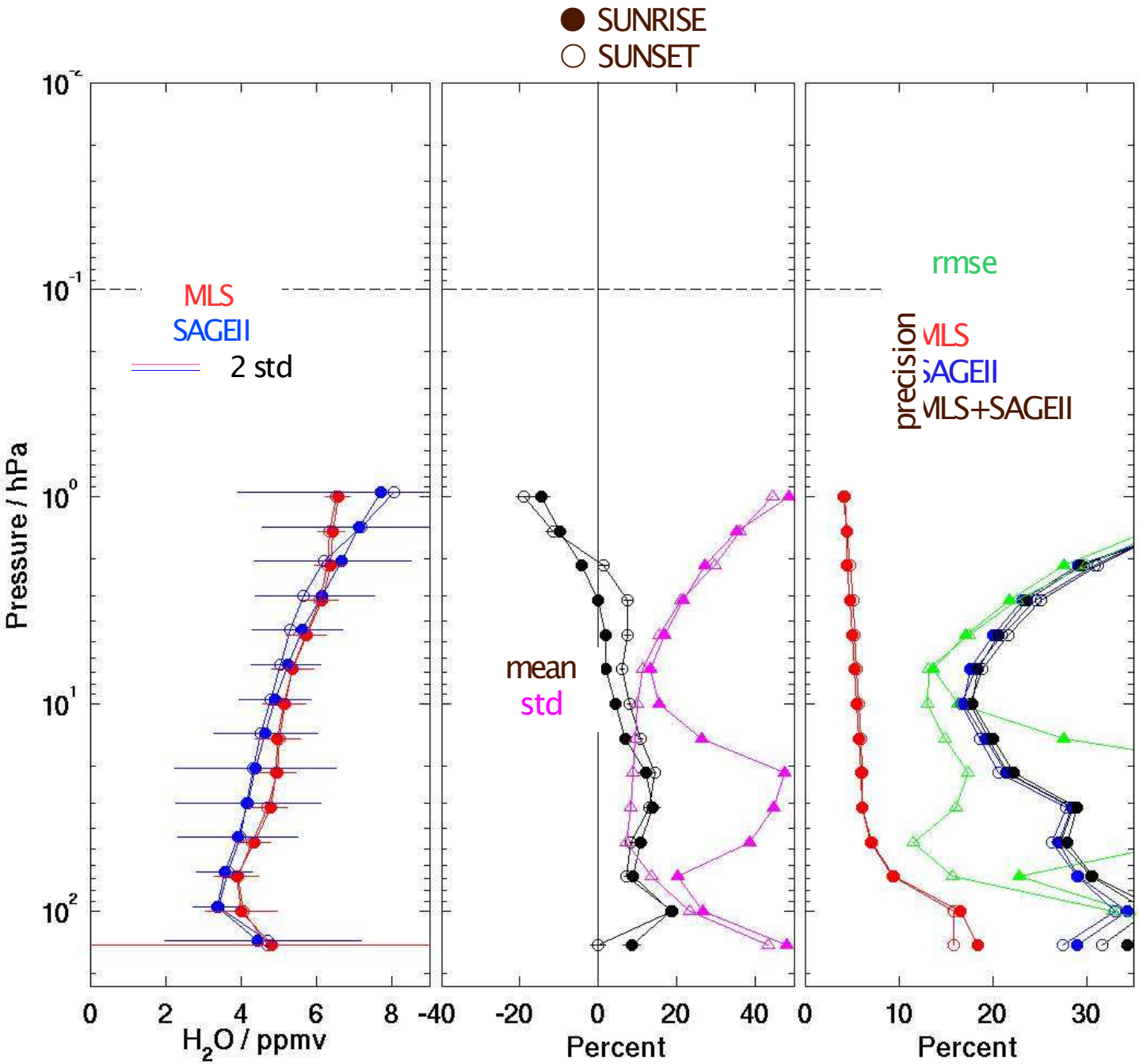
Stratosphere

- Biases of only a few percent, smaller than with HALOE.
- Dry larger bias in the very lower strato, MLS-HALOE showed a wet bias.
- No significant sunrise-sunset differences.
- Reasonable agreement between rmse and combined precision.

Mesosphere

- Dry bias, 0-10% in the lower mesos, MLS-HALOE showed a wet bias.
- Upper mesos [data not recommended] seems to have a dry bias, in agreement with MLS-HALOE.
- Combined precision larger than rmse, overestimation of MLS precision-underestimation of ACE?

Accuracy [annual averages]

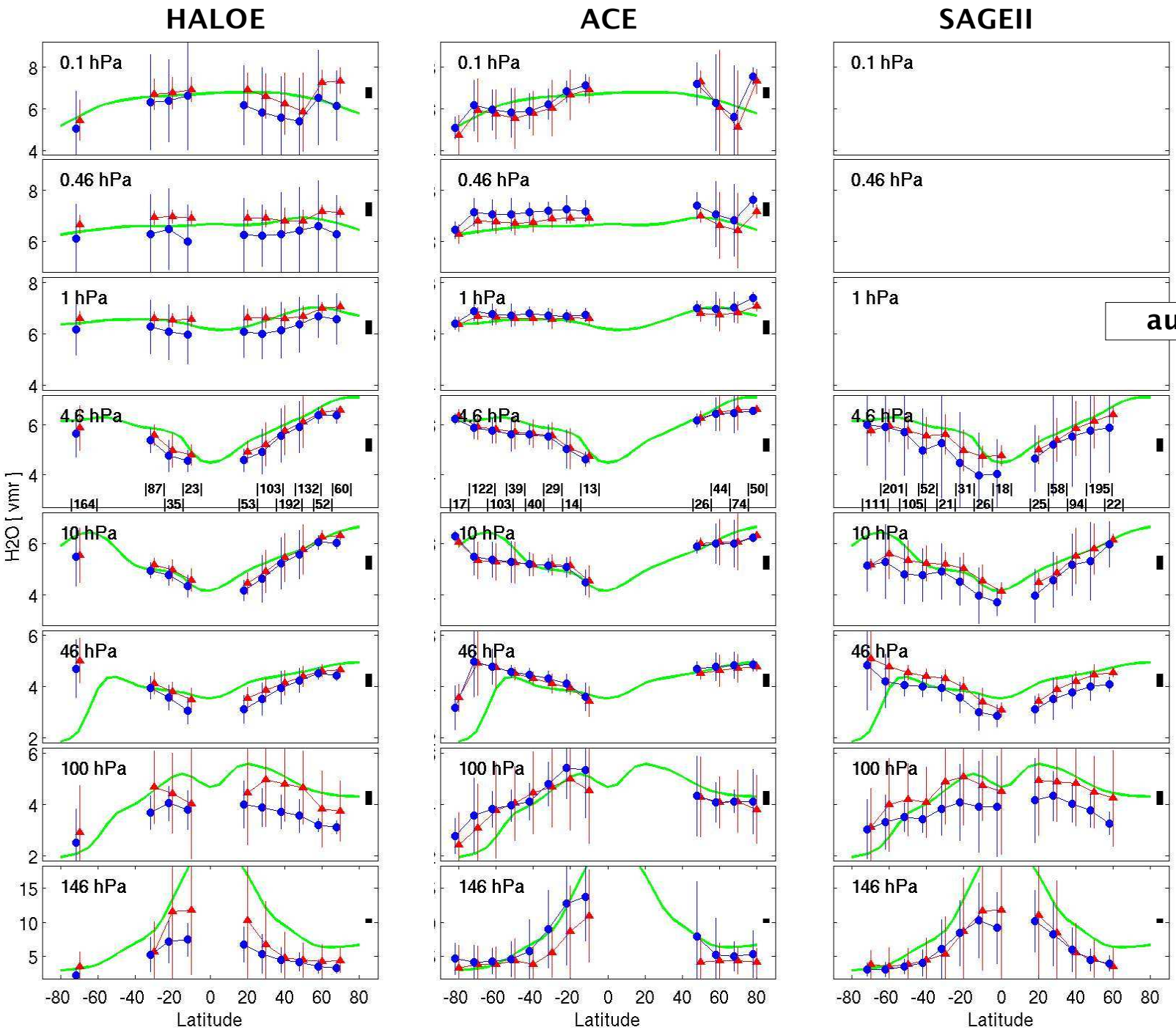


~ 3700 coincidences

Stratosphere

- MLS wetter than SAGEII in the lower–middle strato, bias changing sign towards the upper strato, 10–15% biases.
- Significant sunrise–sunset differences, larger variability in the differences for the sunrise occultations.
- SAGEII precisions dominate the combined precision, reasonable agreement between rmse and combined precision.

Accuracy [zonal averages] MLS– [HALOE,SAGEII,ACE]



MLS
OTHER
CLIMATOLOGY

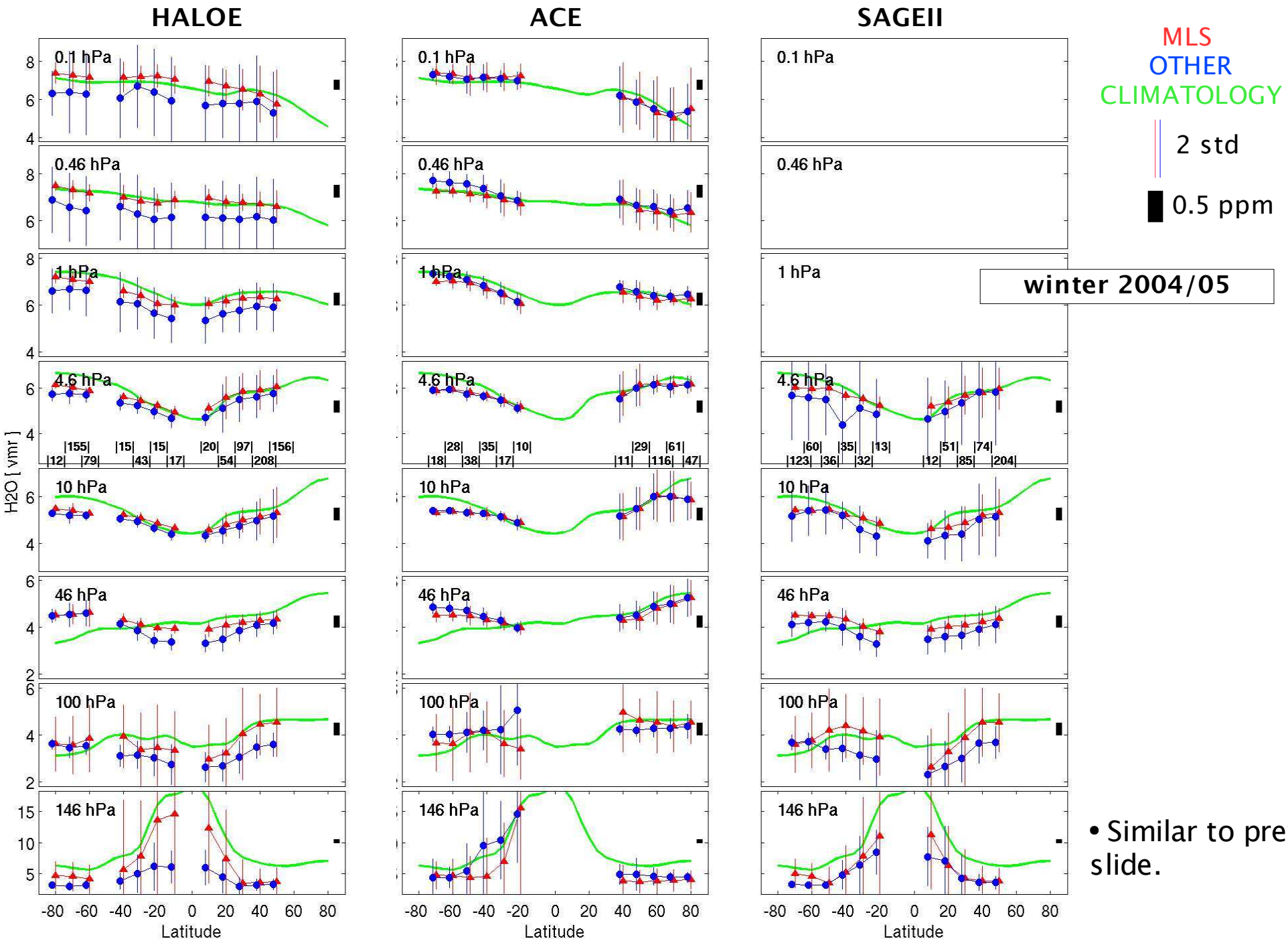
2 std

0.5 ppm

autumn 2004

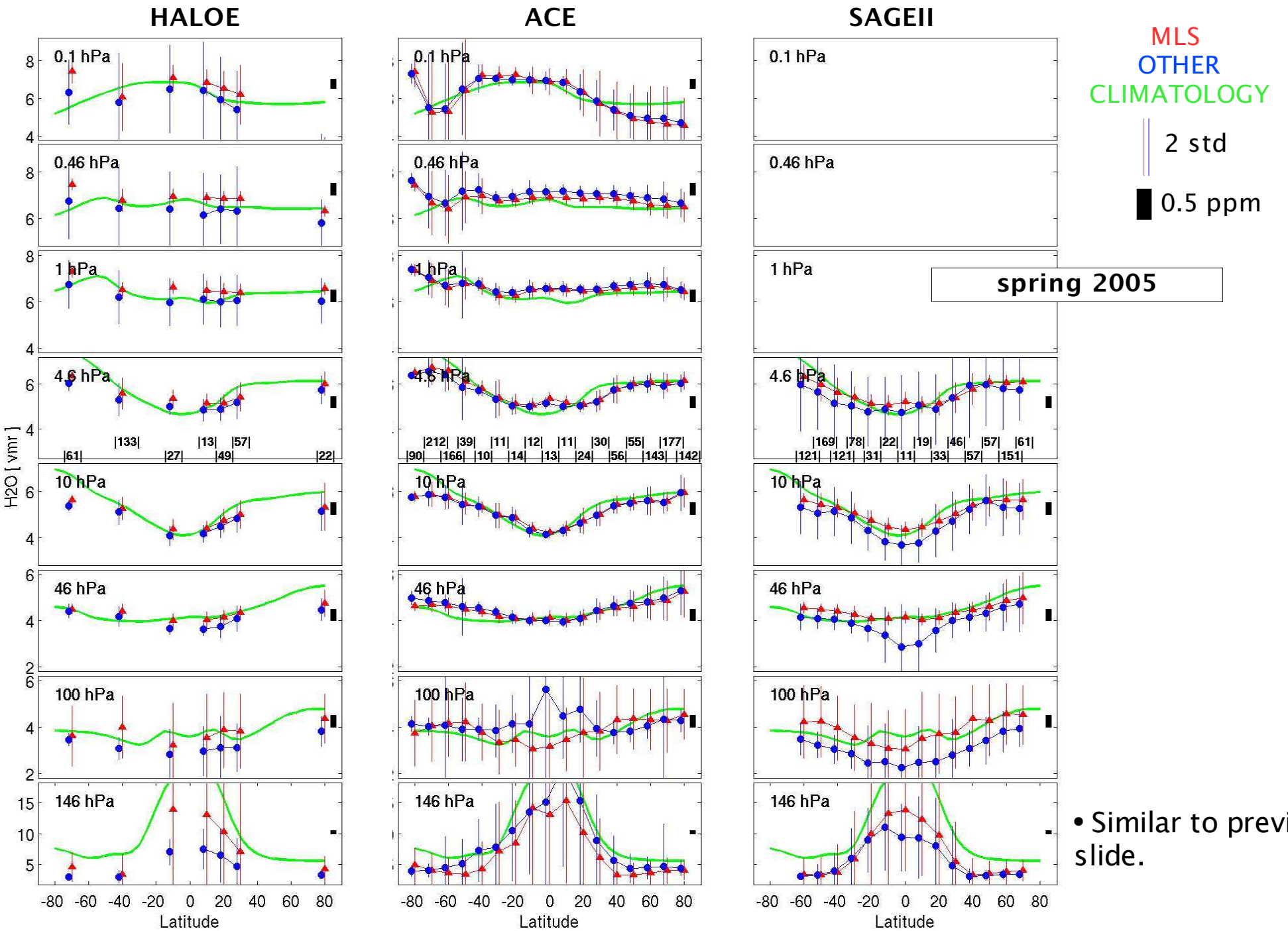
- Presenting zonal averages for different seasons at different pressures.
- In general, similar tracking of latitudinal variations among the instruments.
- Observed biases are consistent with the biases presented in the annual averages.

Accuracy [zonal averages] MLS- [HALOE,SAGEII,ACE]



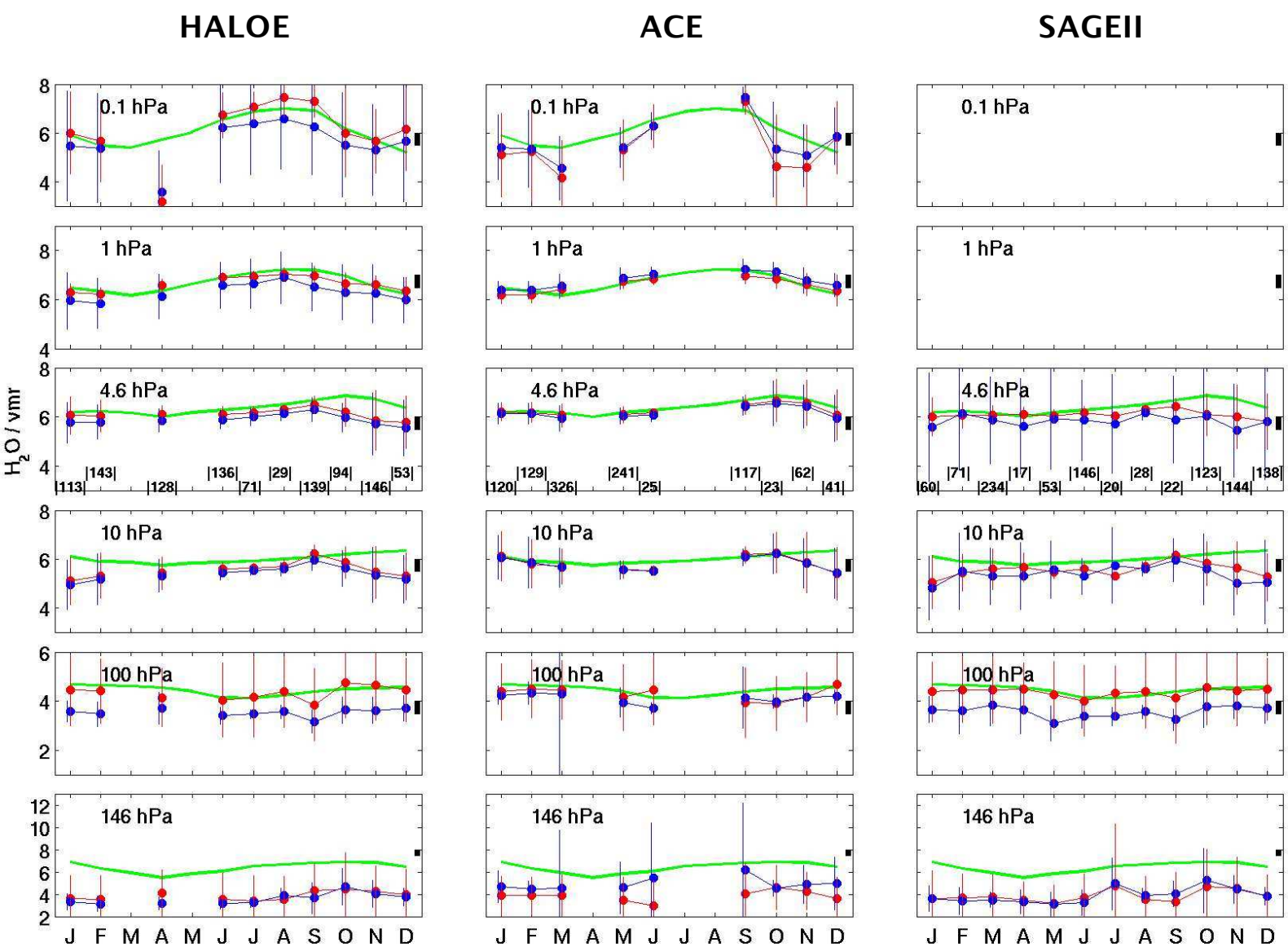
- Similar to previous slide.

Accuracy [zonal averages] MLS– [HALOE,SAGEII,ACE]



- Similar to previous slide.

Stability [time averages] MLS– [HALOE,SAGEII,ACE]



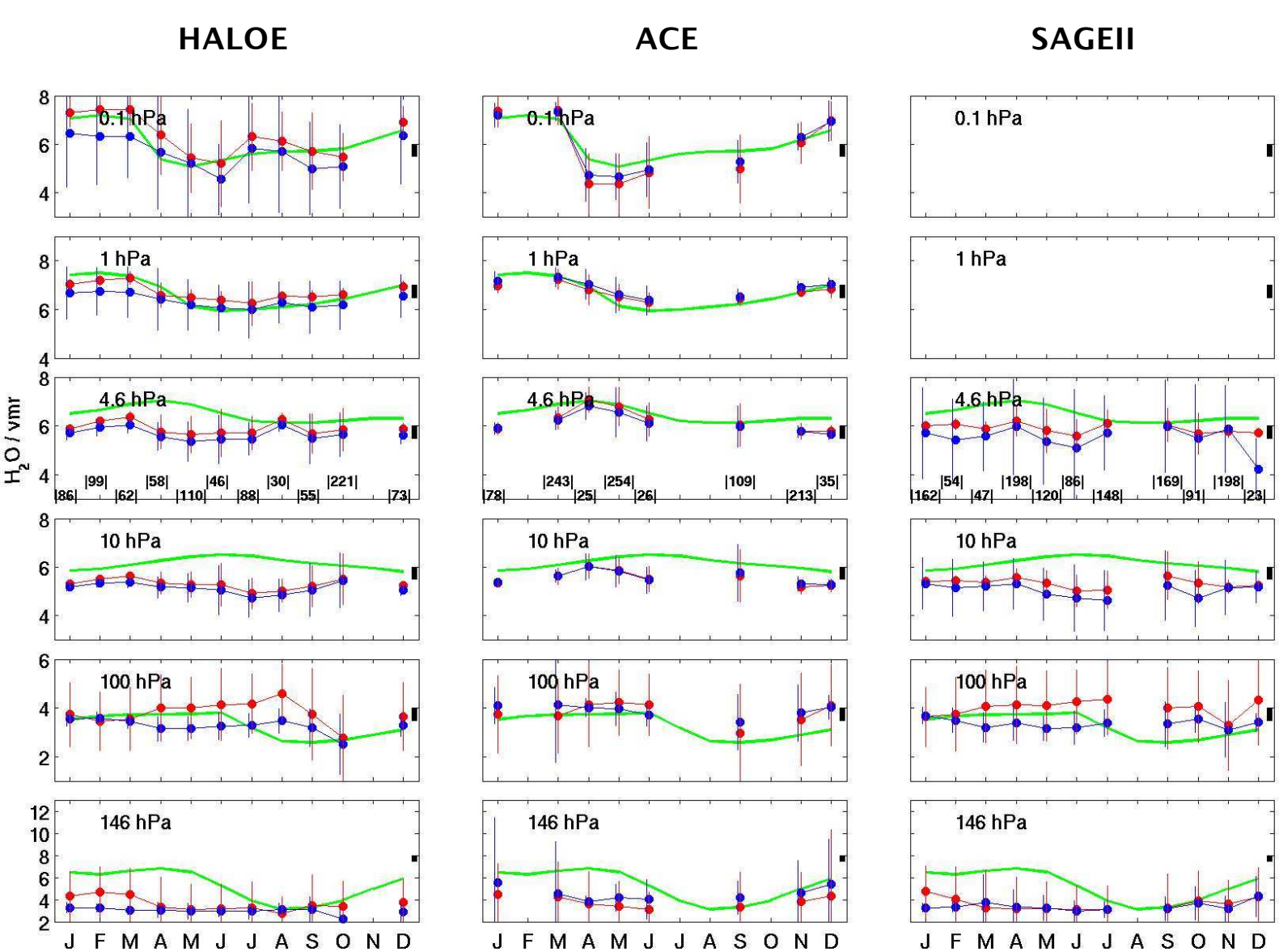
40°N – 85°N

MLS
OTHER
CLIMATOLOGY

2 std

0.5 ppm

- Only one year of MLS data, but trying to start checking possible stability issues by looking at time averages.
- Presenting monthly averages for different latitude bins at different pressures.
- Nothing unusual to report, in general similar tracking of time variations by all instrument, with biases consistent with the annual biases.



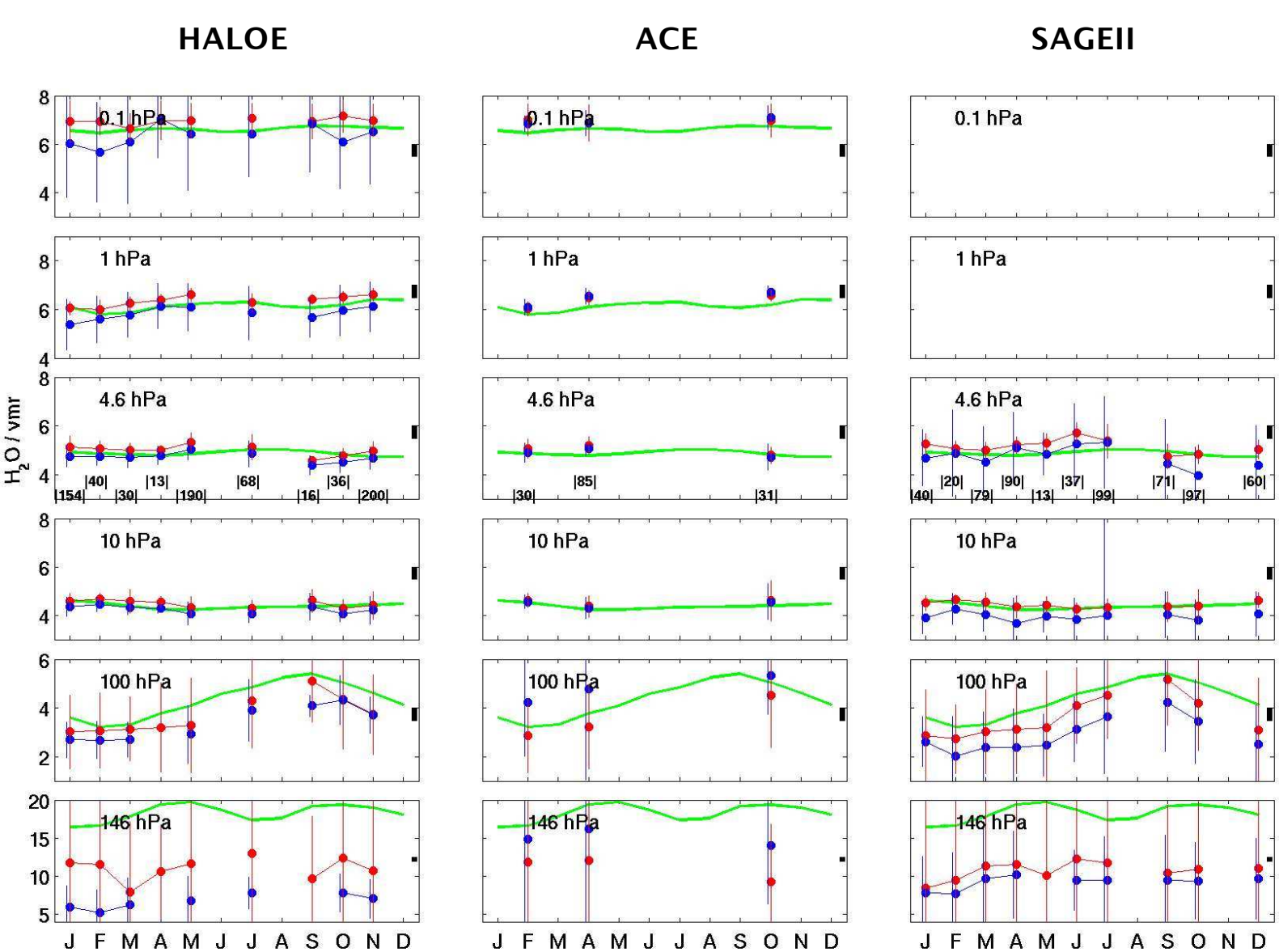
MLS
OTHER
CLIMATOLOGY

2 std

0.5 ppm

- Similar to previous slide.

85°S – 45°S



MLS
OTHER
CLIMATOLOGY

2 std

0.5 ppm

20°S – 20°N

- Similar to previous slide.

Summary

Pressure, hPa	Vertical Resolution, km	"True" Precision, ppmv	Estimated Precision ppmv	Estimated Accuracy Difference HALOE	Difference SAGEII	Difference ACE
0.1	7	0.3	0.8	+10%		−10%
1	5	0.1	0.3	+5%	−15%	−3%
10	4	0.1	0.3	+5%	+10%	−1%
100	3	0.8	0.5	+15%	+5%	−5%

Future plans

- Removing observed **zigzagging** in the lower stratosphere, trying to get better radiance closure in that region.

- Extending **retrieval vertical range** further up into the mesosphere, working towards a better tuning of the smoothing constrains in that part of the atmosphere.

- Further **validation**, updating from the rest of comparisons presented at the meeting.