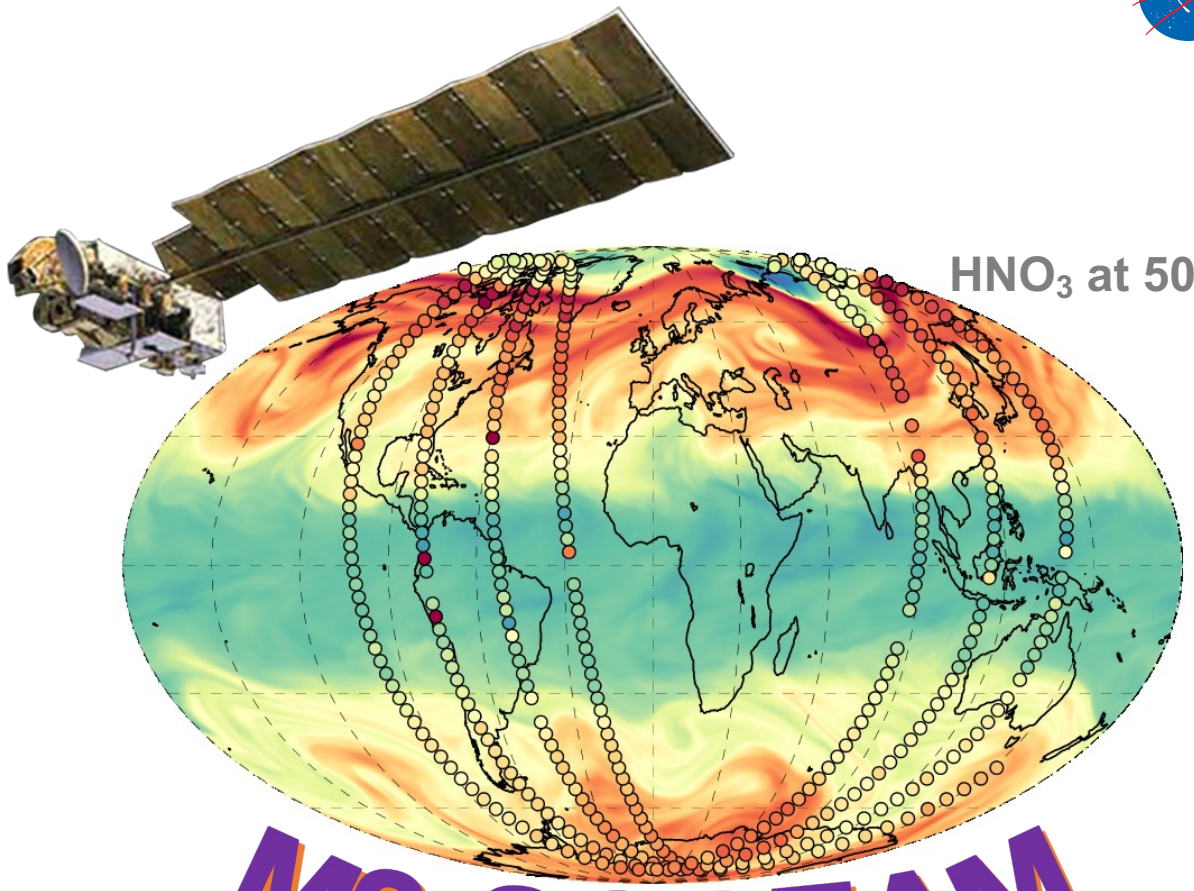
GEOS-SCREAM: A Stratospheric Composition REanalysis of Aura MLS



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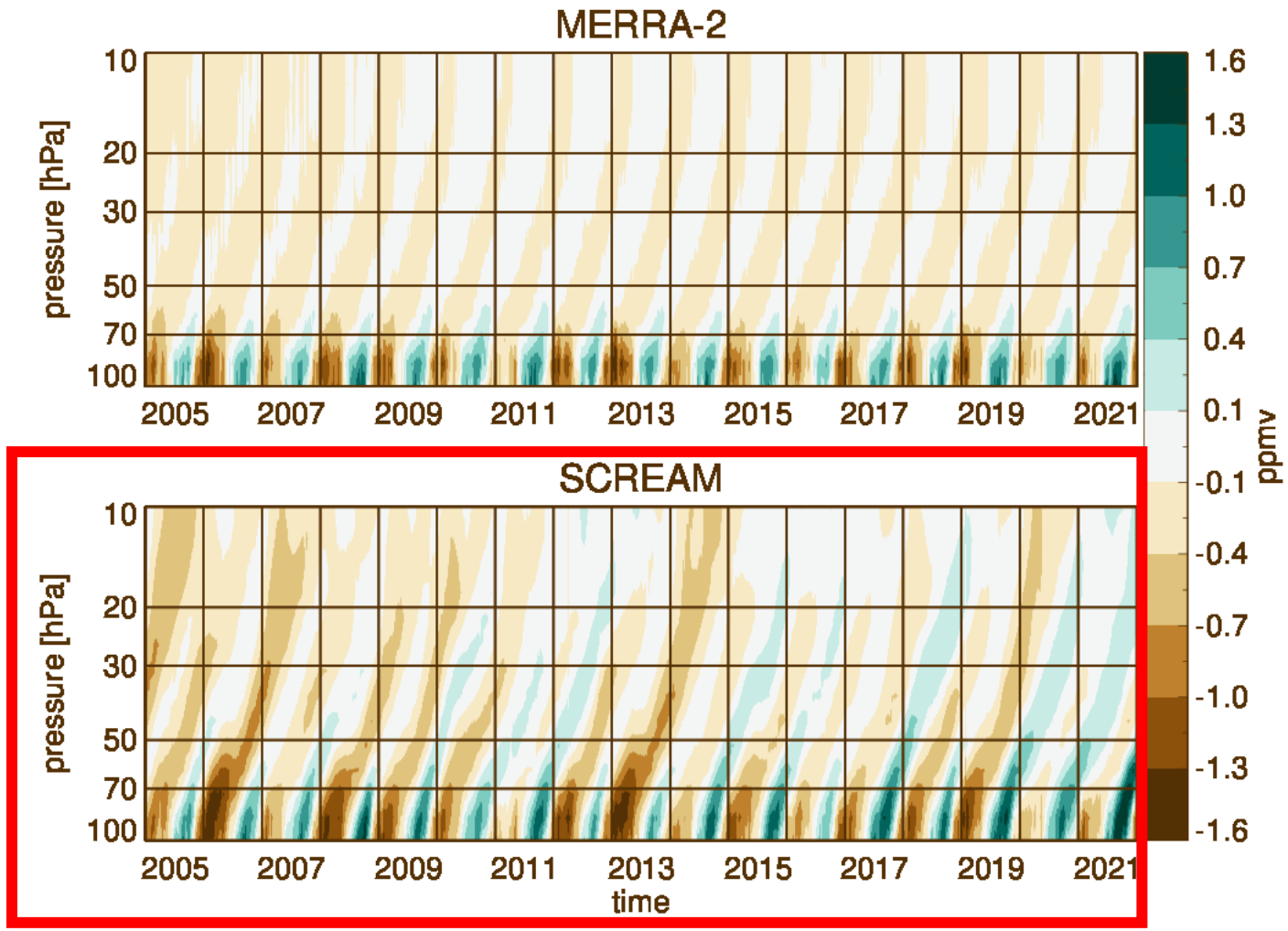
Funded by NASA Modeling, Analysis, and Prediction

Stratospheric Composition Reanalysis of Aura MLS

Mission-long reanalysis of MLS observations of selected species 2004–present

- Assimilating **O_3, H_2O, HCl, HNO_3**, and **N_2O** from MLS and total ozone from OMI with GEOS Constituent Data Assimilation System (CoDAS).
- Meteorology constrained by MERRA-2
- Stratospheric chemistry model
- Resolution: H: 50 km, V: 1–2 km
- **Purpose: variability and trends in stratospheric composition and transport**

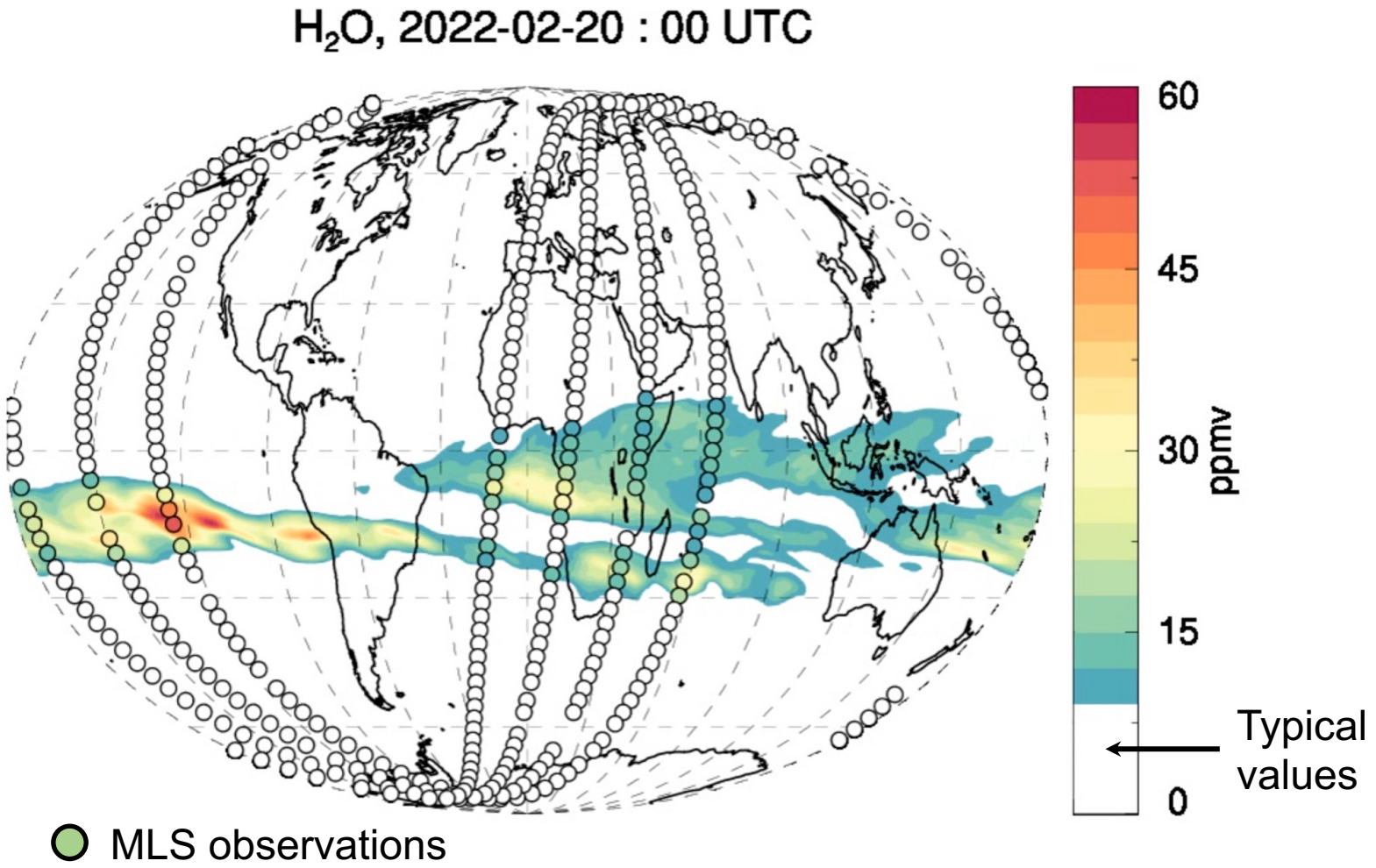
MLS: Microwave Limb Sounder;
OMI: Ozone Monitoring Instrument



Tropical tape recorder: M2-SCREAM reproduces interannual variability not captured by MERRA-2

Eruption of Hunga Tonga in January 2022

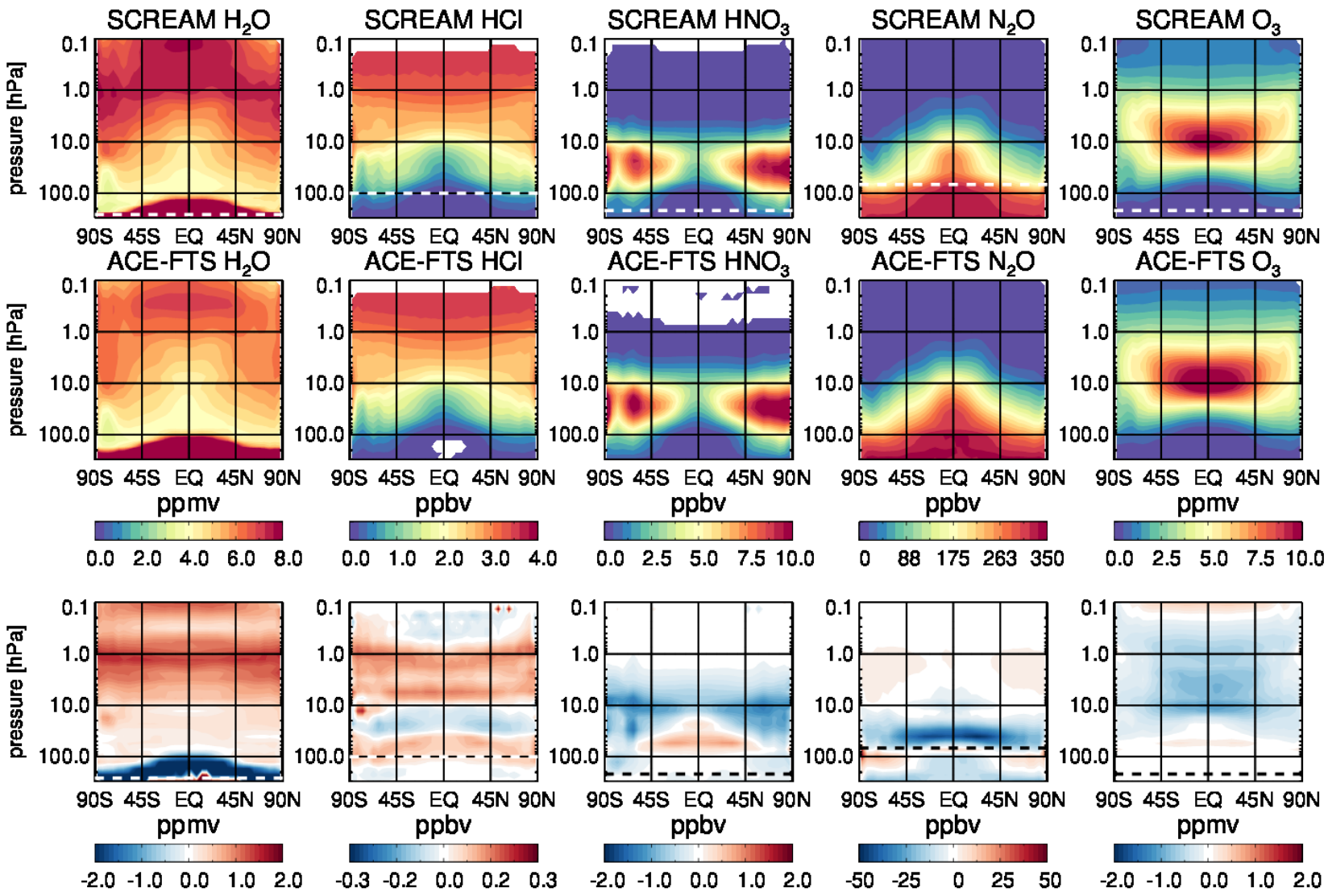
- Record amount of water vapor injected into the stratosphere
- Maximum mixing ratios an order of magnitude larger than climatology
- Reanalysis provides a dynamical view of the plume, consistent with observations



Water vapor on the 600-K theta surface (~30 km) one month after the eruption

Comparisons against ACE-FTS (2005–2021)

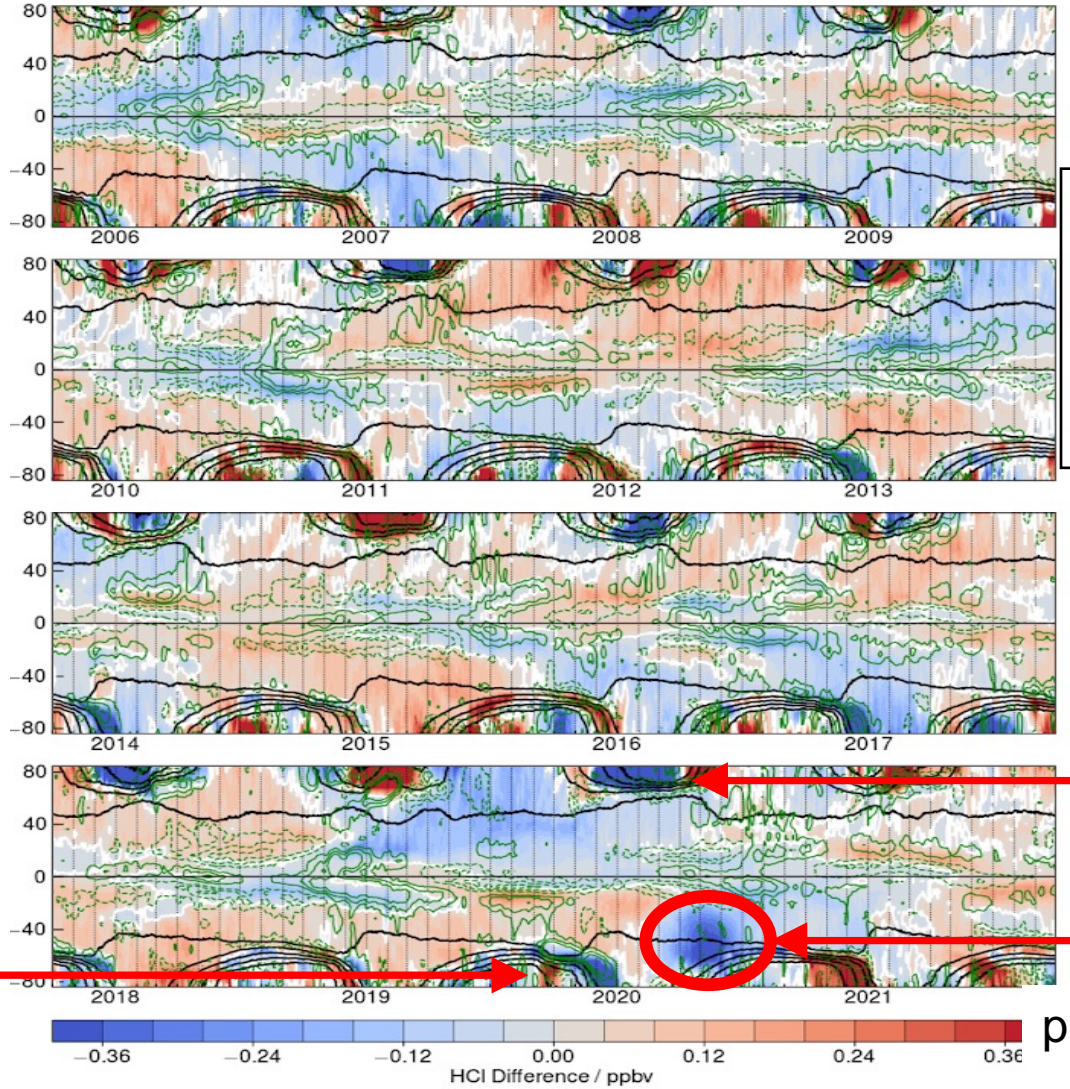
- Good agreement with independent observations from The Atmospheric Chemistry Experiment Fourier Transform Spectrometer for all five species (zonal mean)
- Differences reflect relative bias between MLS and ACE-FTS
- Standard deviation of the differences (not shown) small compared to variability



Interannual variability: HCl anomalies

- Example of process-based evaluation
- Year-to-year variability reflects variations in meteorology
- Note variability in polar processing / intensity and timing of chlorine activation and deactivation
- Signature of chlorine repartitioning following the Australian New Year PyroCb events

520-K Eq. Lat. HCl detrended and deseasonalized anomaly

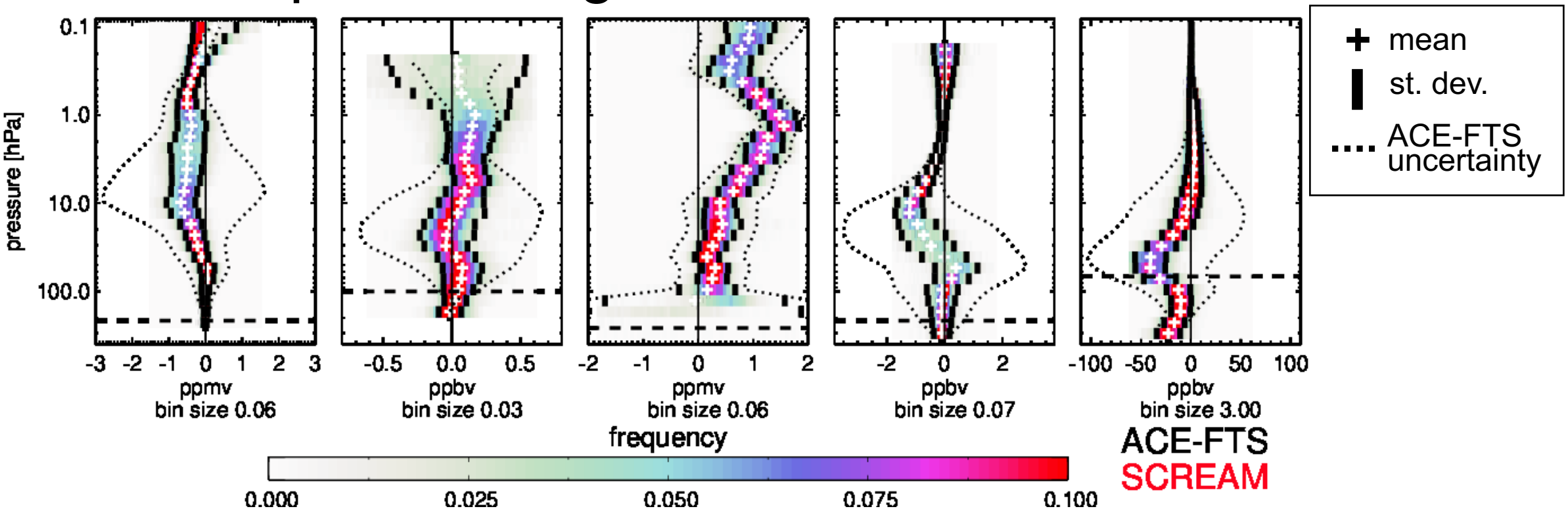


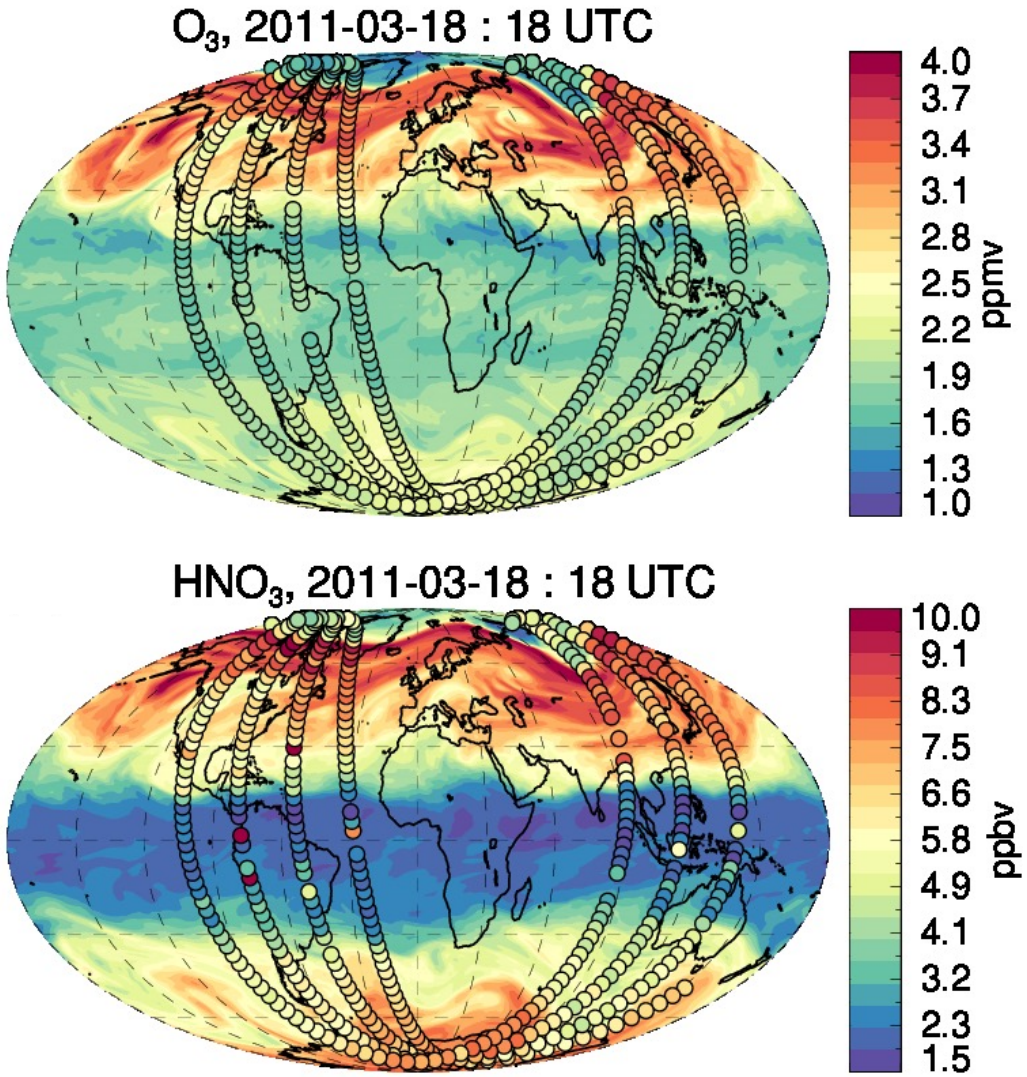
Summary and data availability

- M2-SCREAM: a new reanalysis of stratospheric ozone, water vapor, HCl, HNO_3, and N_2O with MLS observations
- High resolution, 3-hourly global fields
- Compares well with MLS (assimilated) and independent observations
- Meteorological fields and analysis uncertainties provided with the data
- Scientifically useful data: where MLS observations are available; low confidence regions are flagged
- Description and validation: manuscript to be submitted to ESSD
- Access: Will be available on NASA's GES DISC (same as MERRA-2)
- It's important to have multiple reanalyses focused on stratospheric composition (so far there is BRAM2, M2-SCREAM,…)

backup

Comparisons against ACE-FTS: differences




O_3, 2011-03-18 : 18 UTC
4.0
3.7
3.4
3.1
2.8
2.5
2.2
1.9
1.6
1.3
1.0
ppmv
HNO_3, 2011-03-18 : 18 UTC
10.0
9.1
8.3
7.5
6.6
5.8
4.9
4.1
3.2
2.3
1.5
ppbv