Balloon Borne Cryogenic Frostpoint Hygrometer Measurements in Support of Aura Water Vapor Validation

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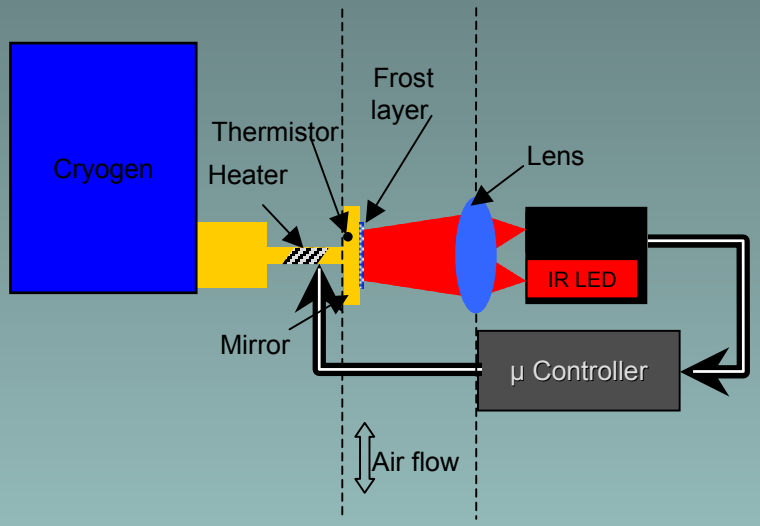
MLS Team for their great instrument and data products

Overview: Validation with version 2.2

- Individual comparison examples
- Summary by geographic region
- Correlation between CFH and MLS
- Summary

Cryogenic Frostpoint Hygrometer (CFH)

- Absolute measurement
- Vertical Range: surface to ~28 km
  (surface to ~25 km on ascent)
- Uncertainty: troposphere: > 4% MR
  stratosphere: ~ 9 %
- Microprocessor control
- Phase sensitive detector:
  electronic sunlight filter
- Weight: ~ 400 gr
- Payloads carry ECC ozone sonde and Vaisala RS80
- ~ 280 soundings so far



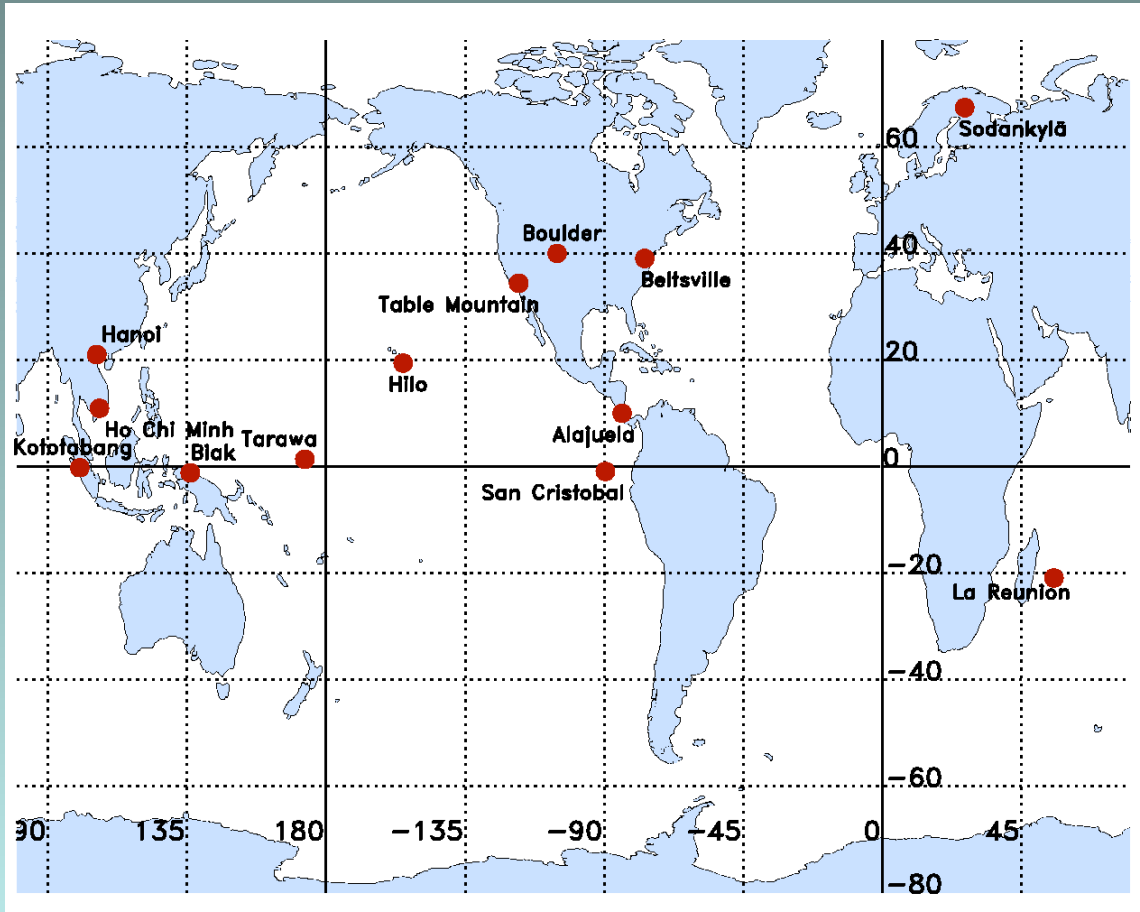
Sounding locations

47 matched soundings within 6 hours and 300 km of Aura/MLS overpass

Campaigns:

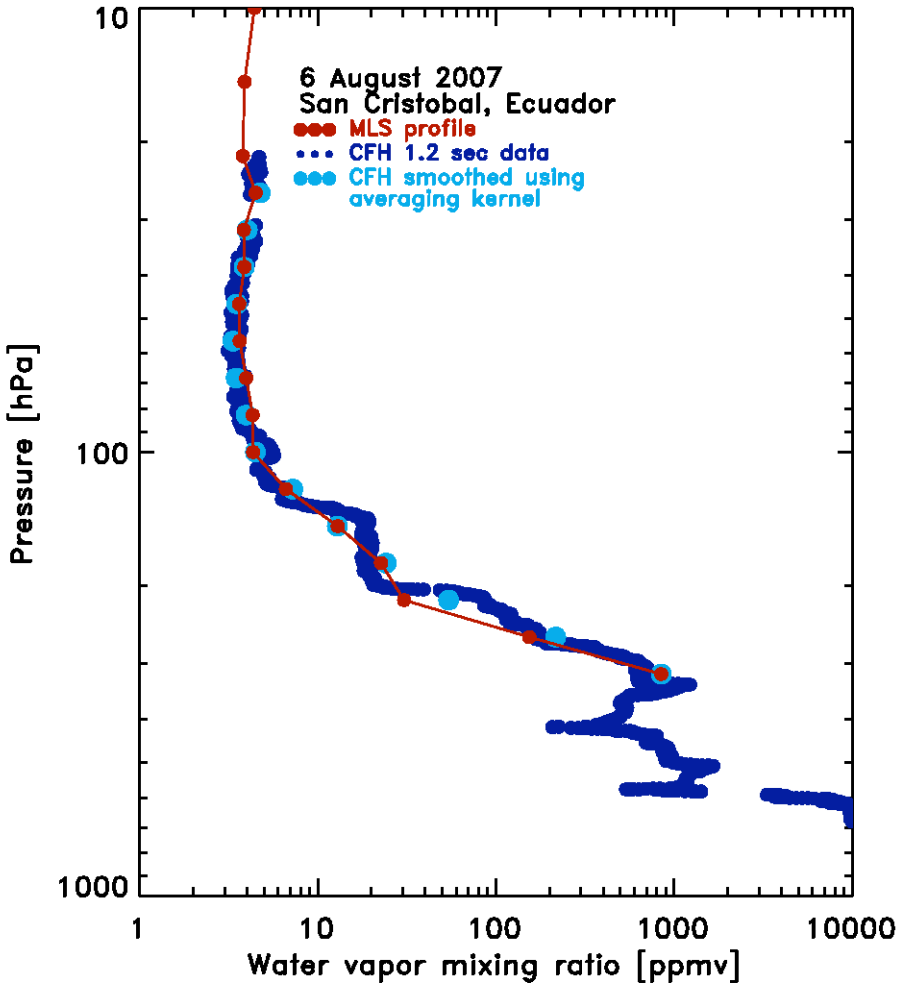
TCSP, July 2005
CR-AVE, Jan/Feb 2006
TC4, Jul/Aug 2007
WAVES, Jul 2006, Jul 2007
MOHAVE, Oct 2006
SOWER, Jan 2006, Jan 2007

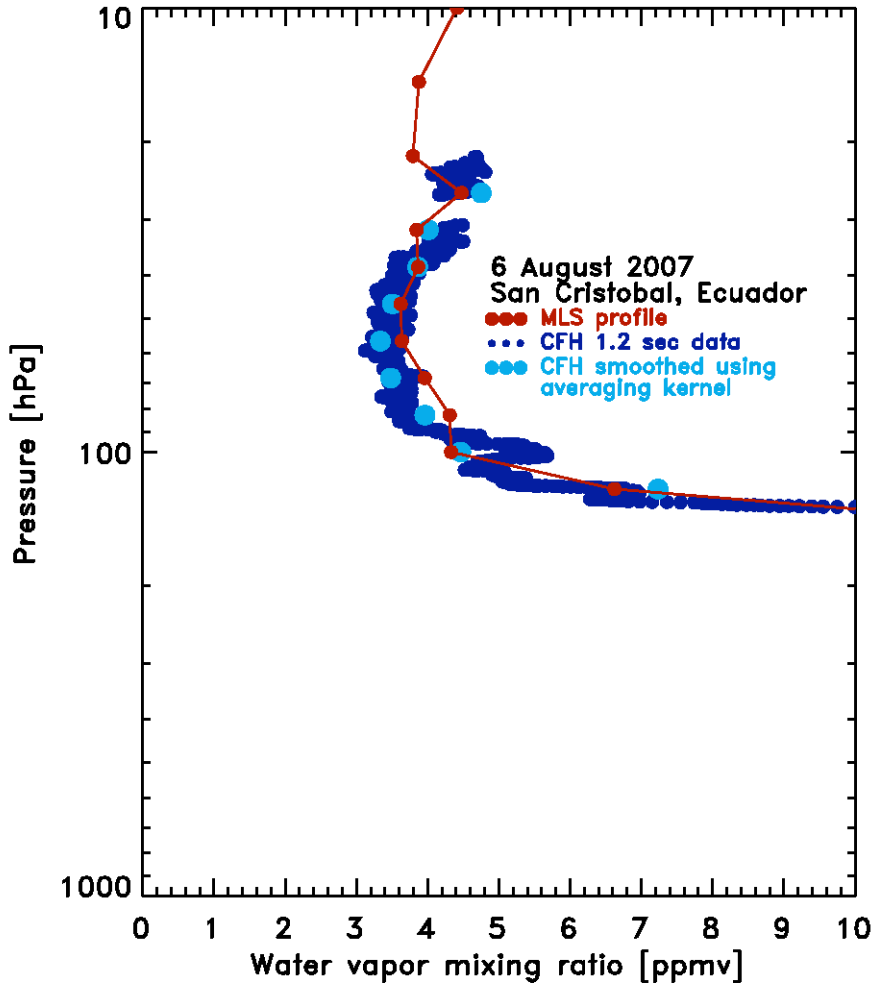
Plus several other unnamed campaigns



MLS water vapor profile version 2.2
Examples

Satellite profile





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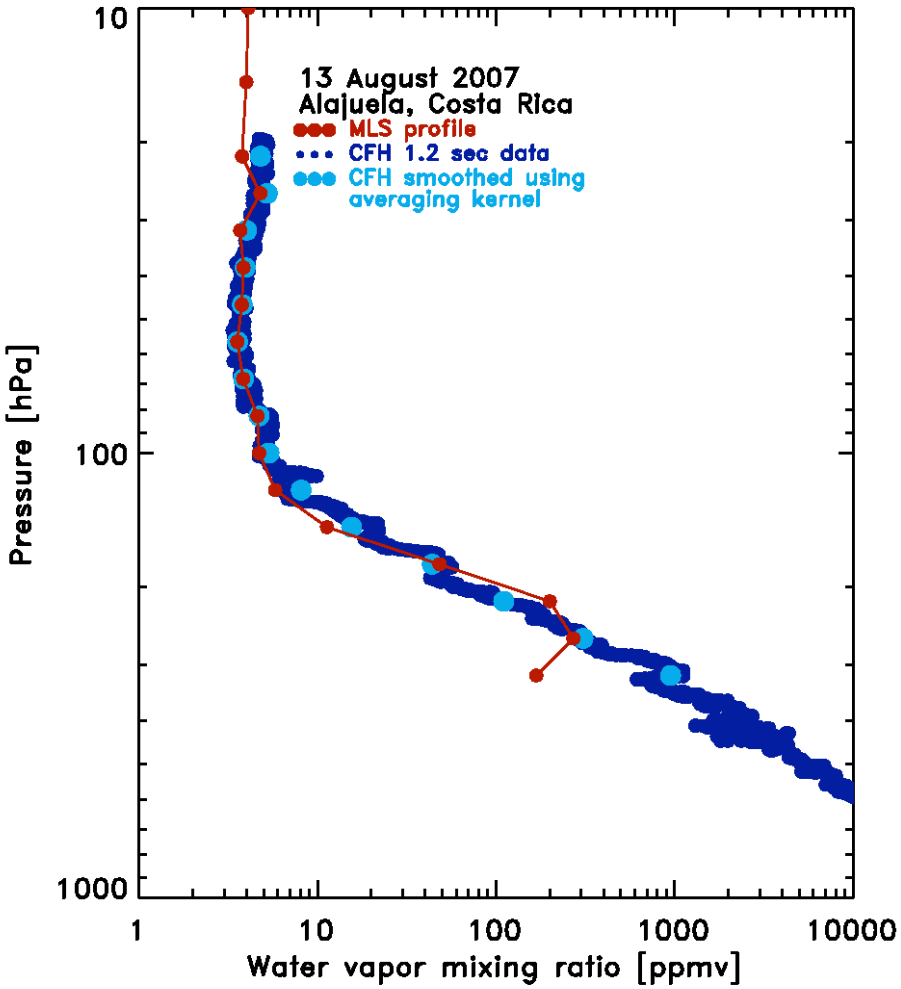

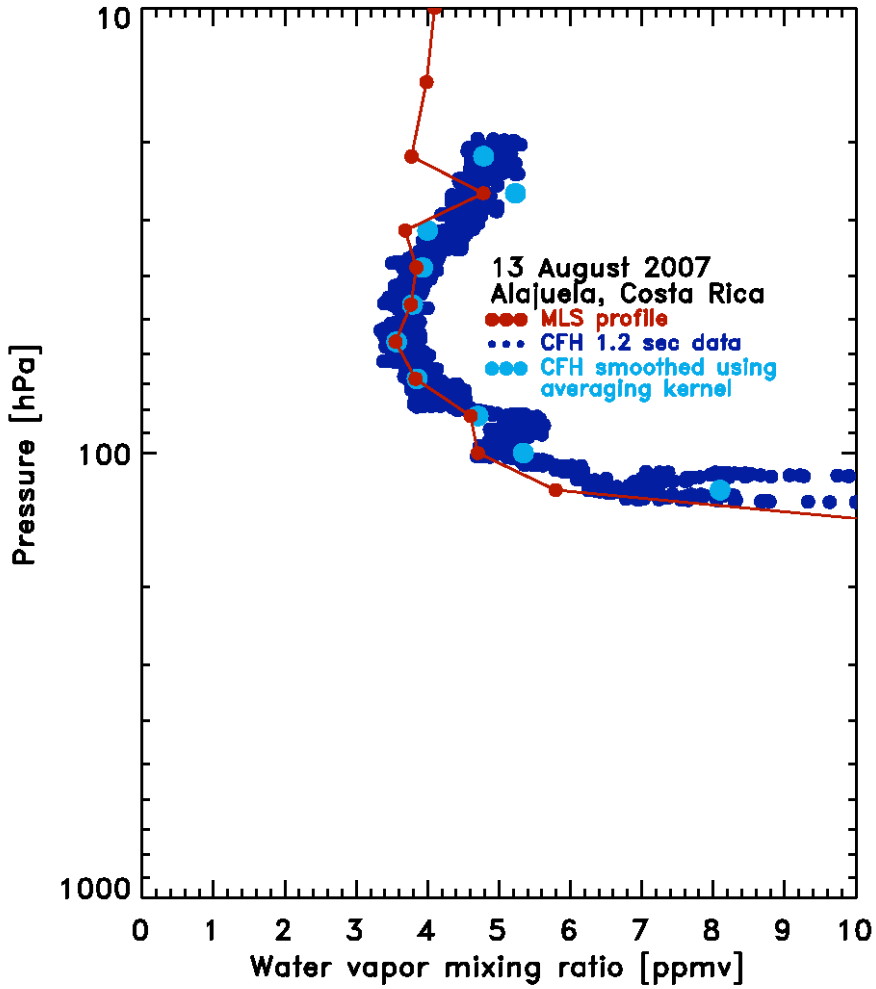

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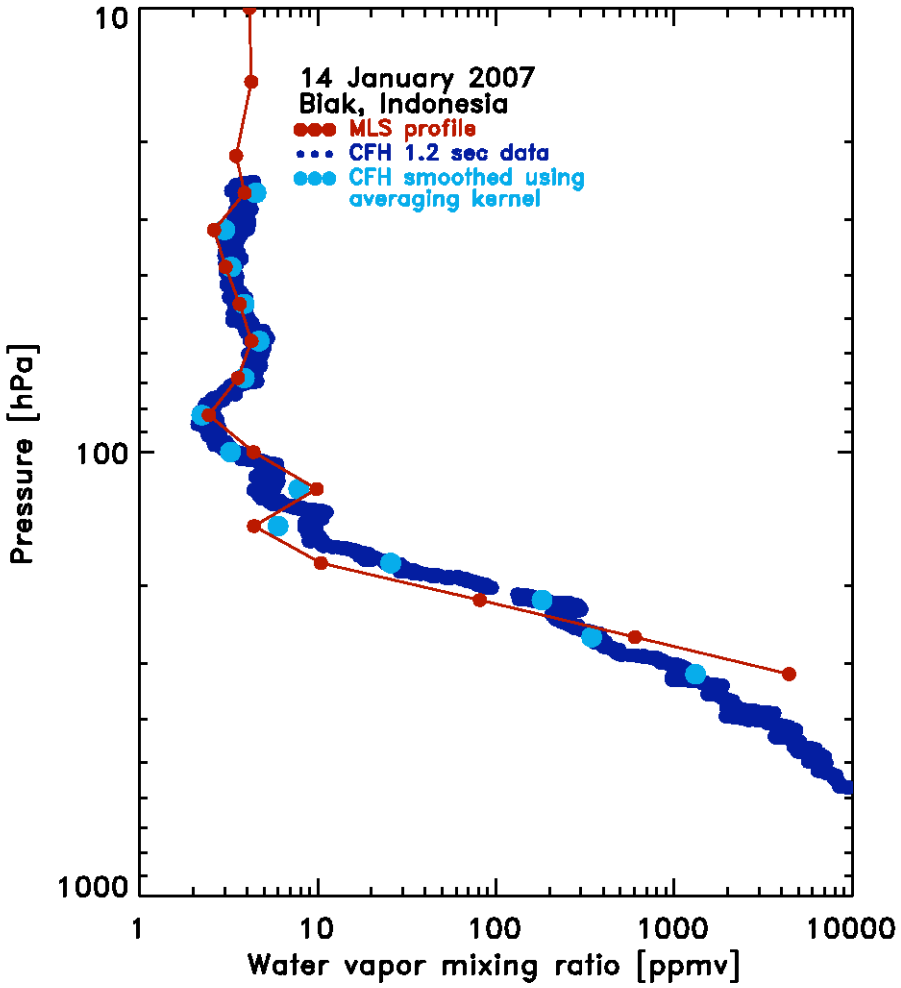
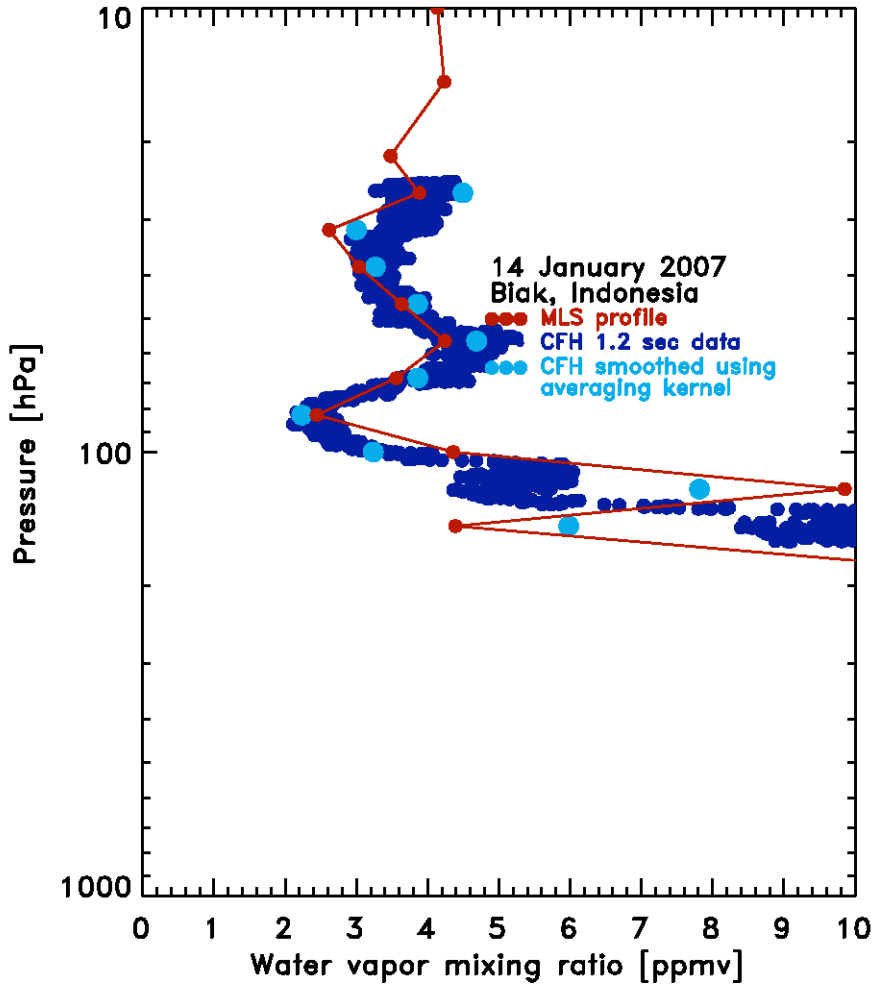
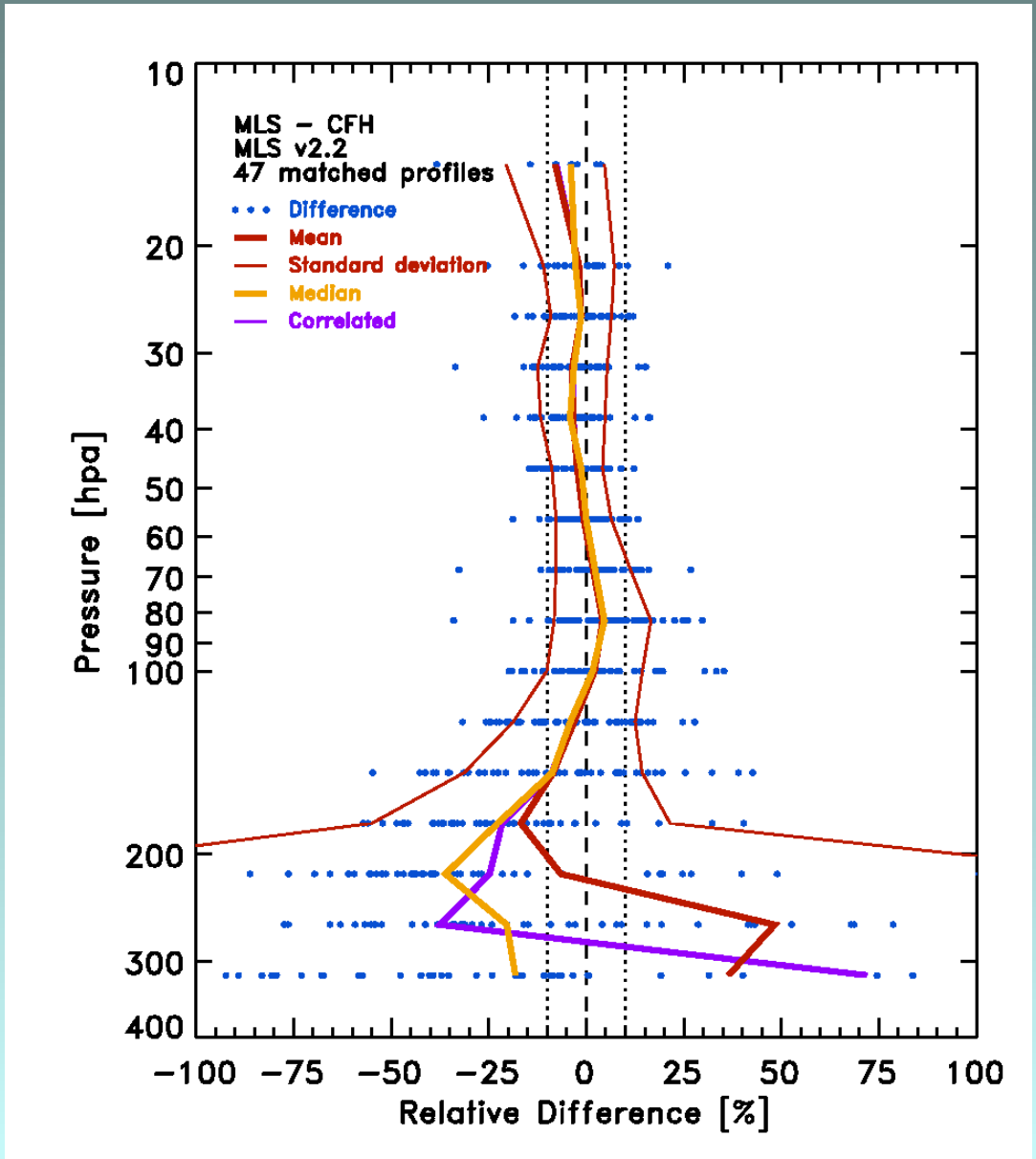




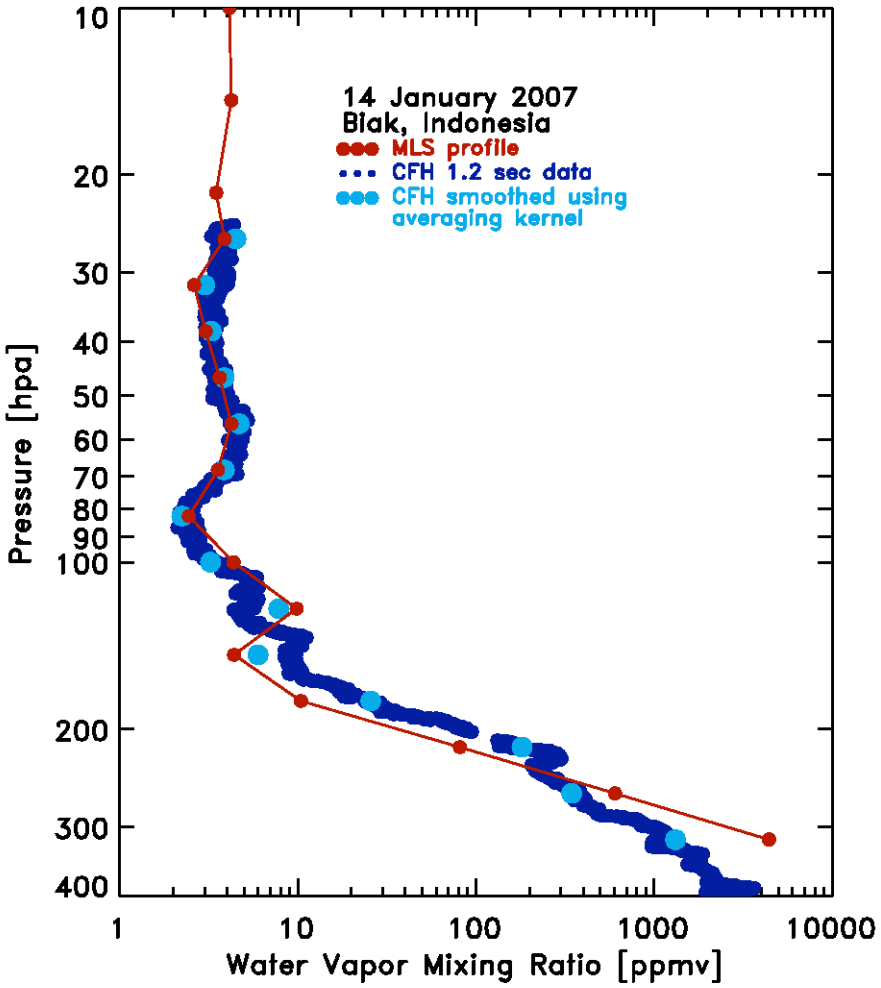
Update on MLS water vapor validation with version 2.2

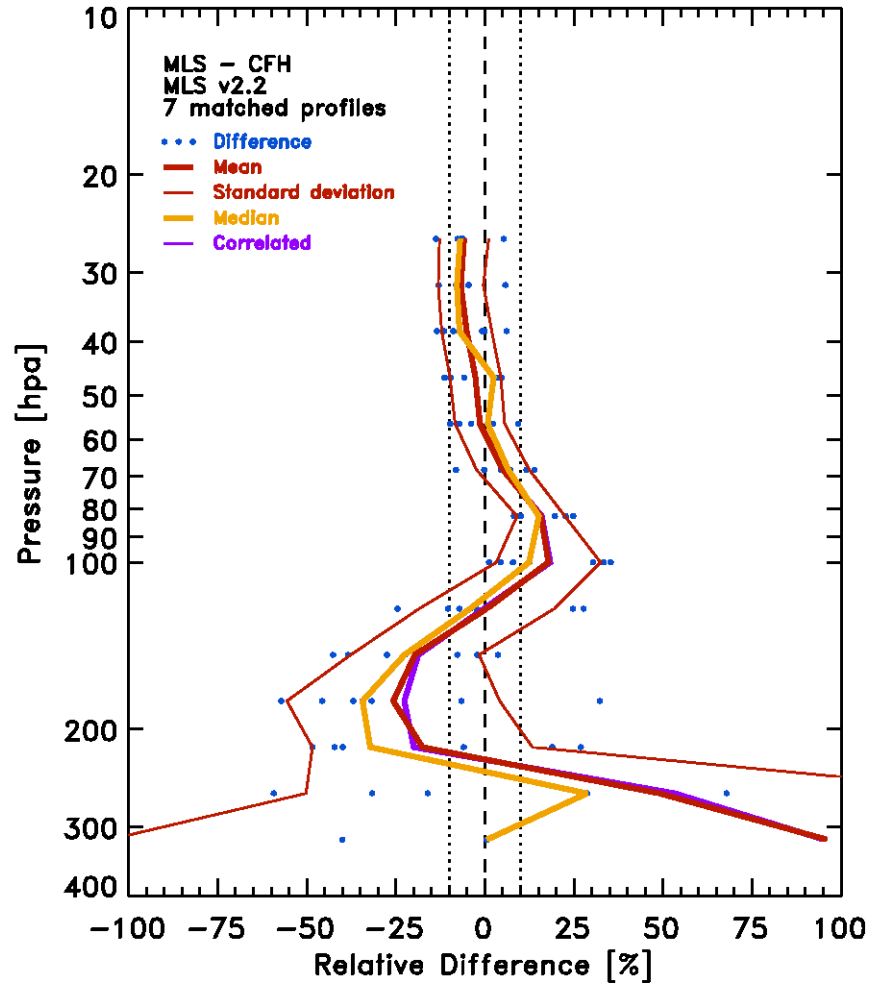
MLS Comparison: All soundings



MLS Comparison: Equatorial

Soundings during Dec/Jan



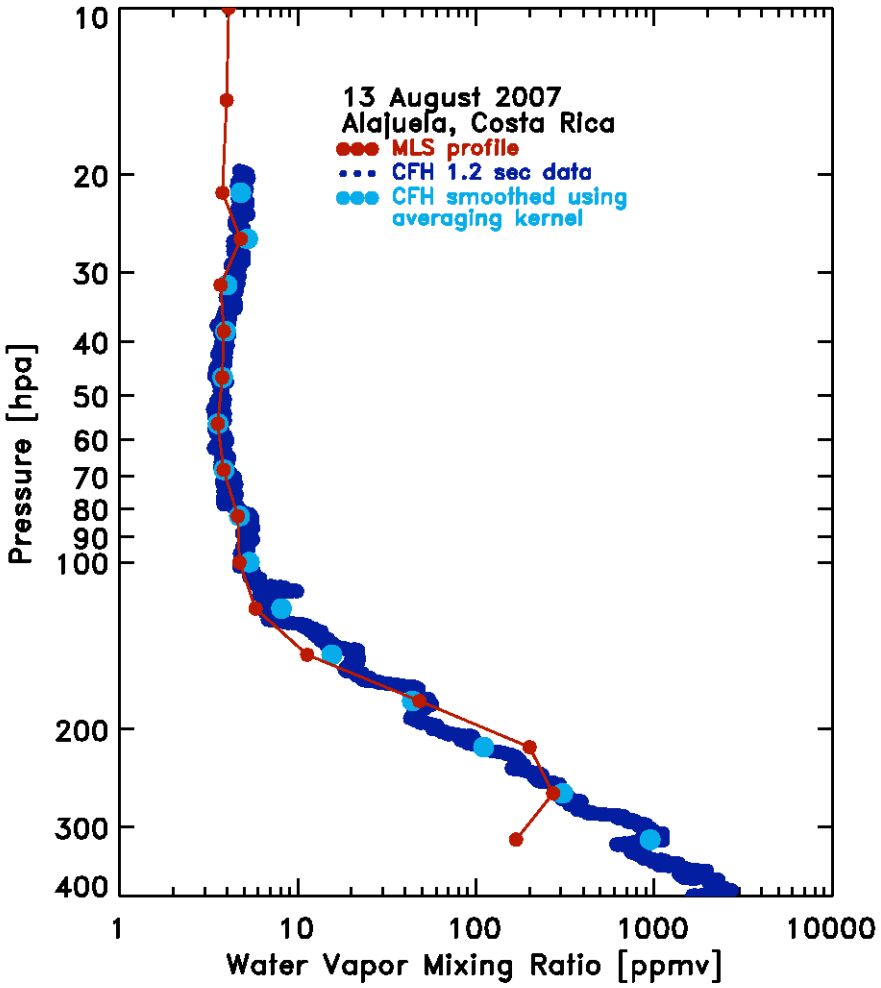


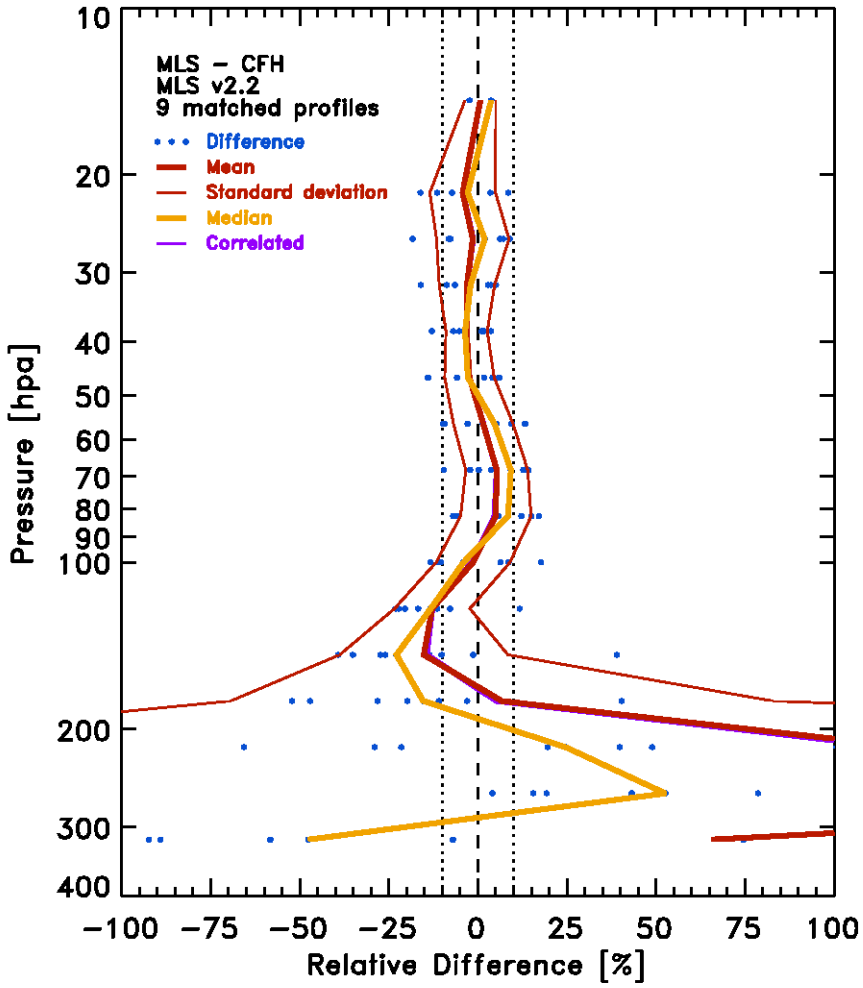
Example

Difference profile

MLS Comparison: Costa Rica

Soundings during Jan-Mar and Jul-Sep

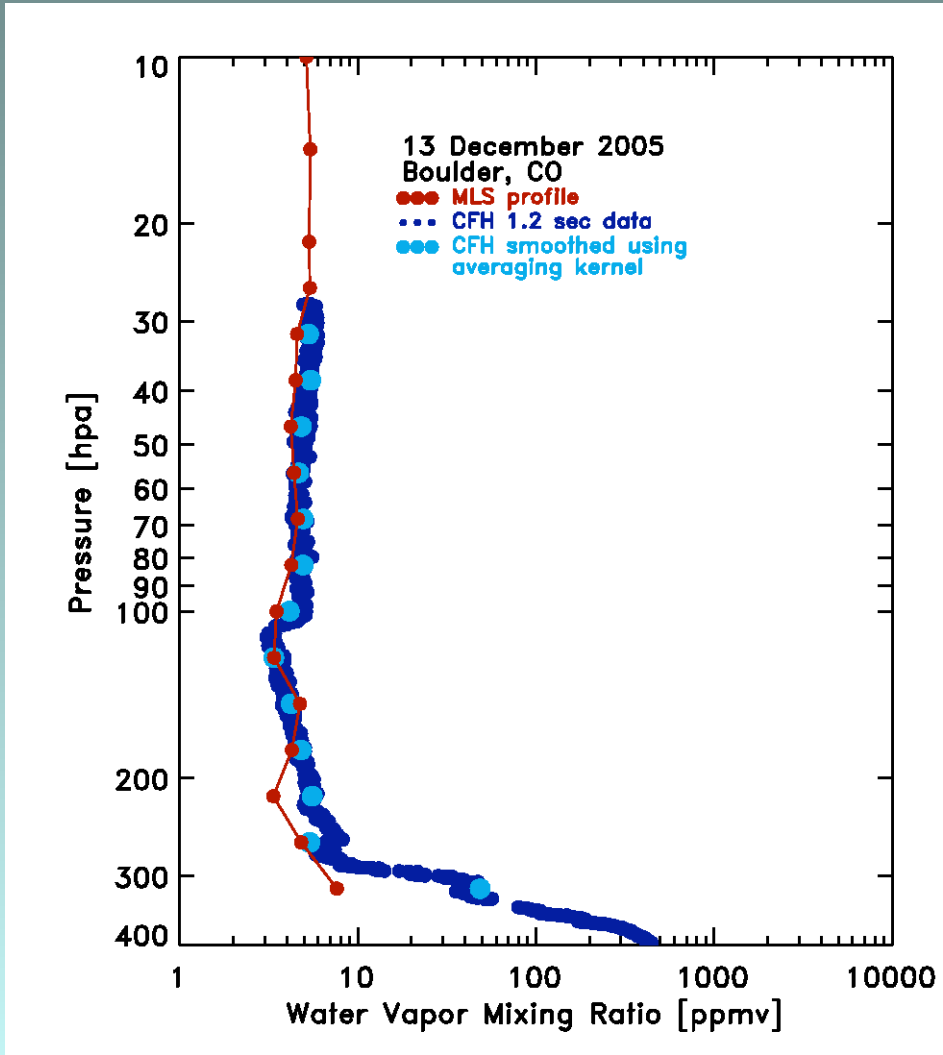


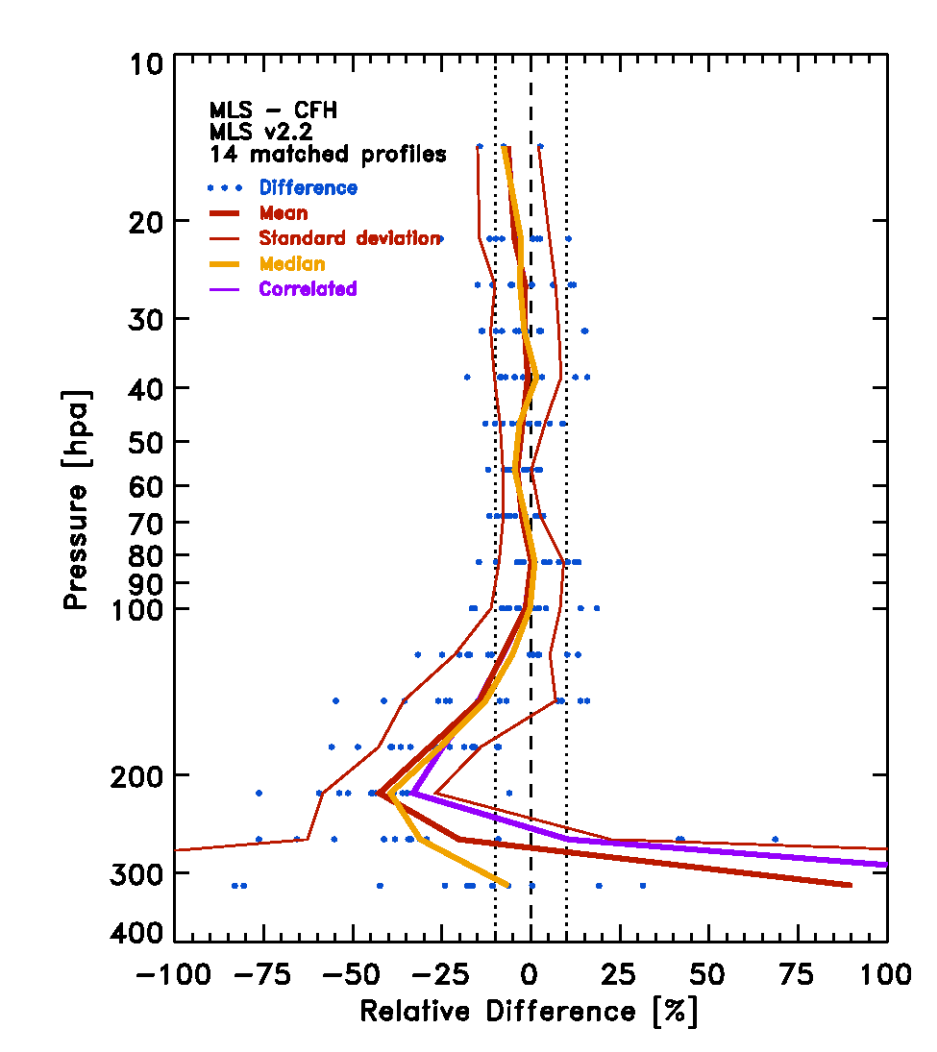


Example

Difference profile

MLS Comparison: Mid Latitudes

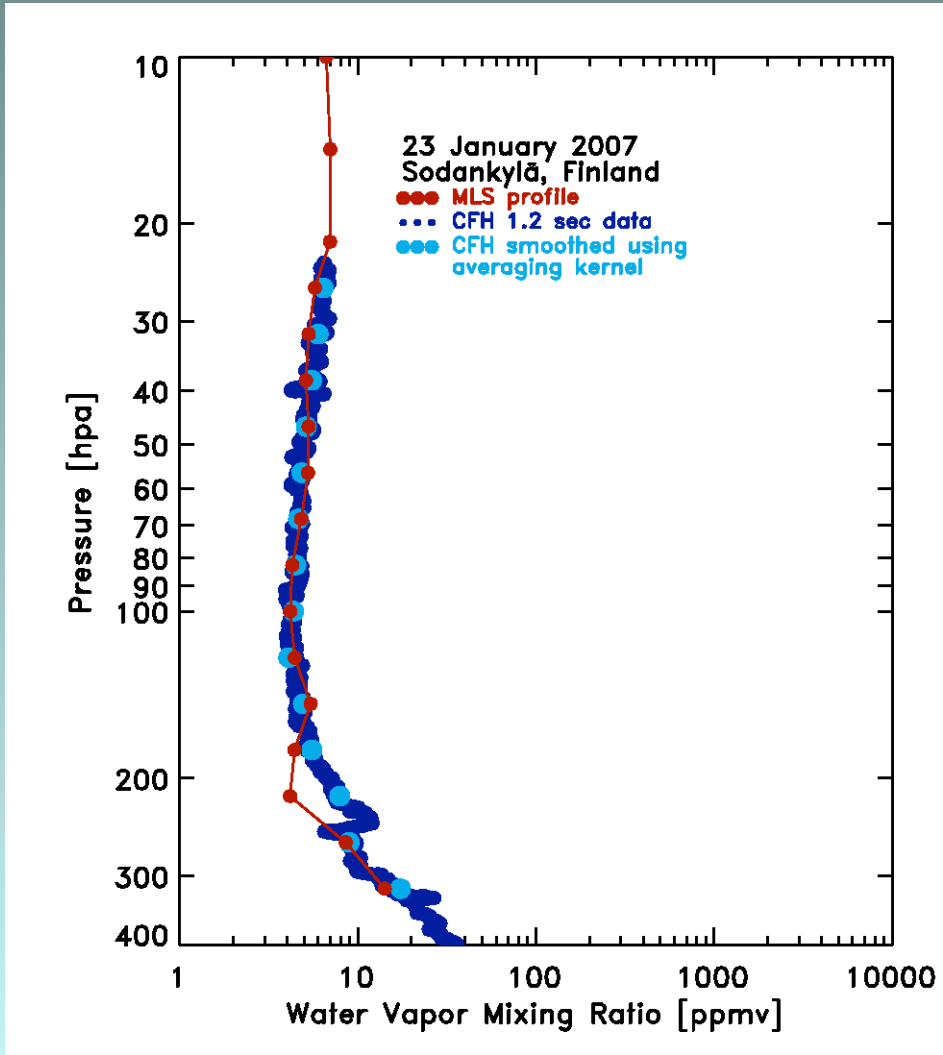


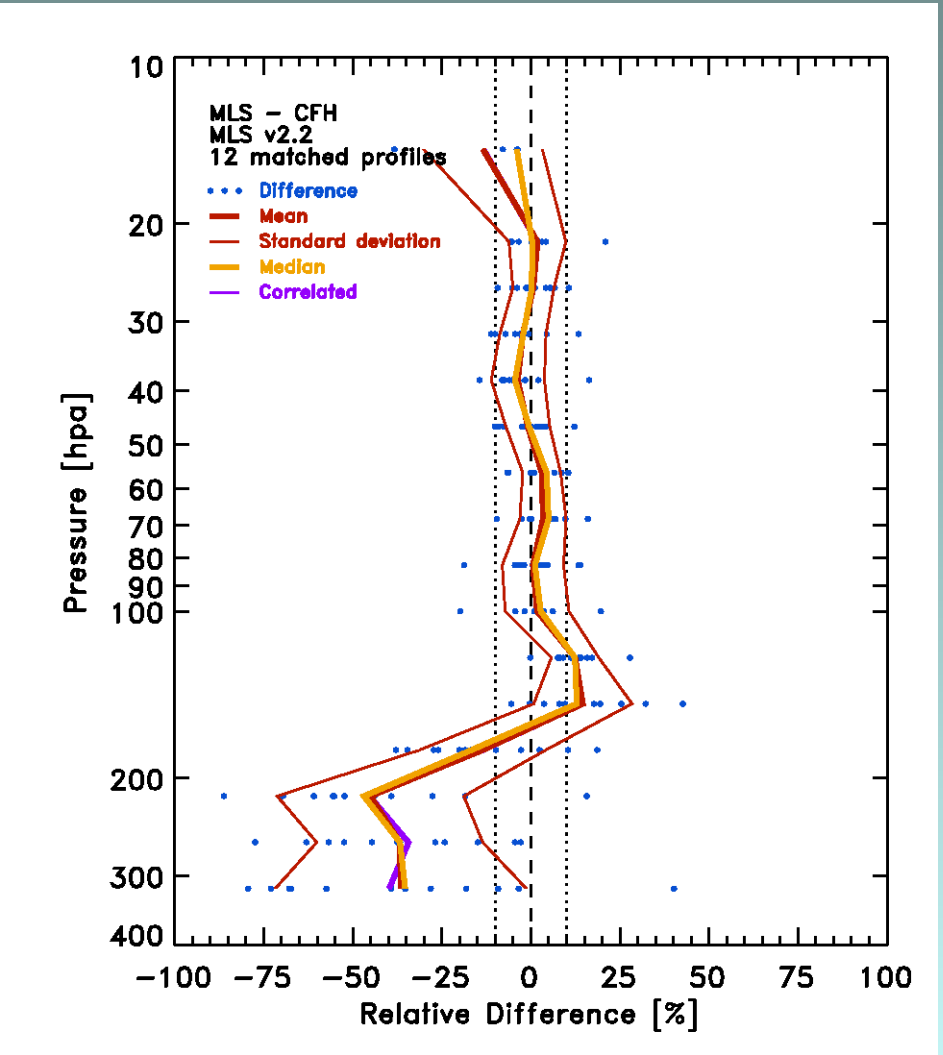


Example

Difference profile

MLS Comparison: Arctic





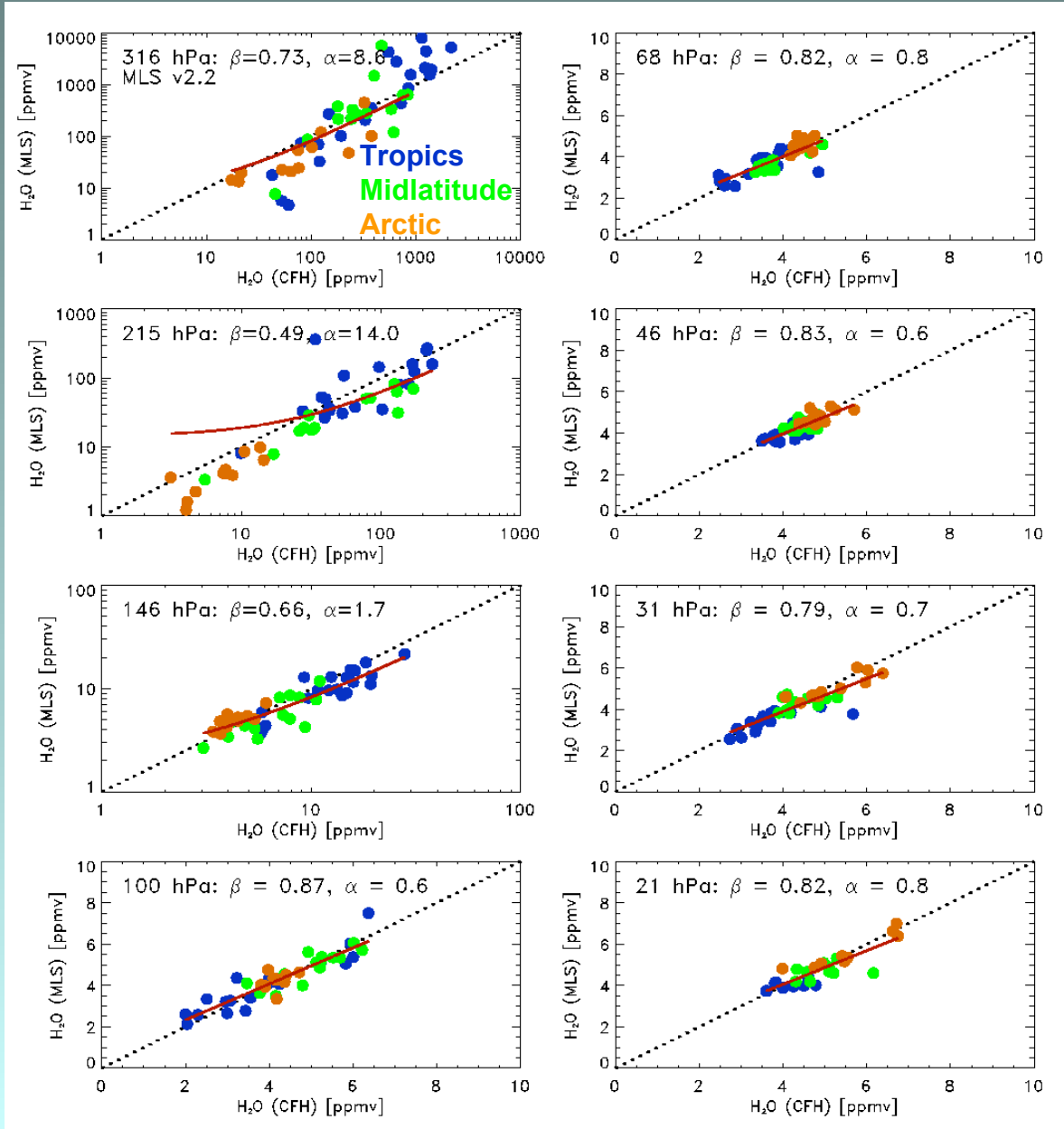
Example

Difference profile

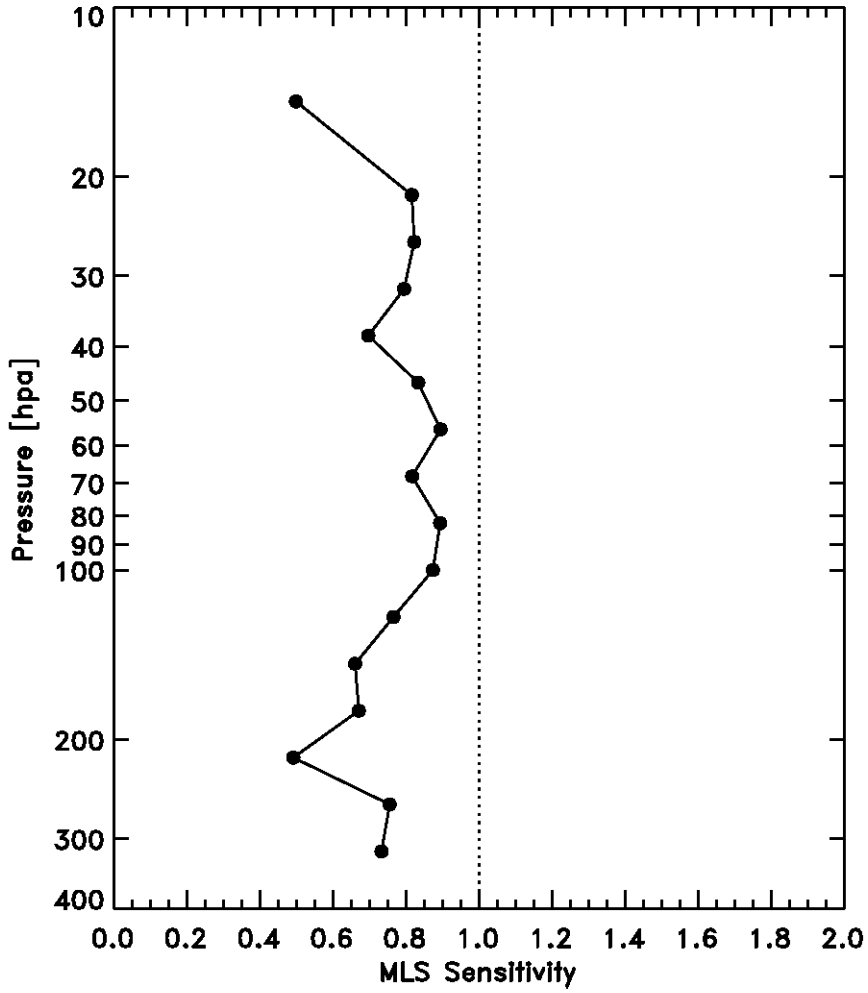
Correlations based on:

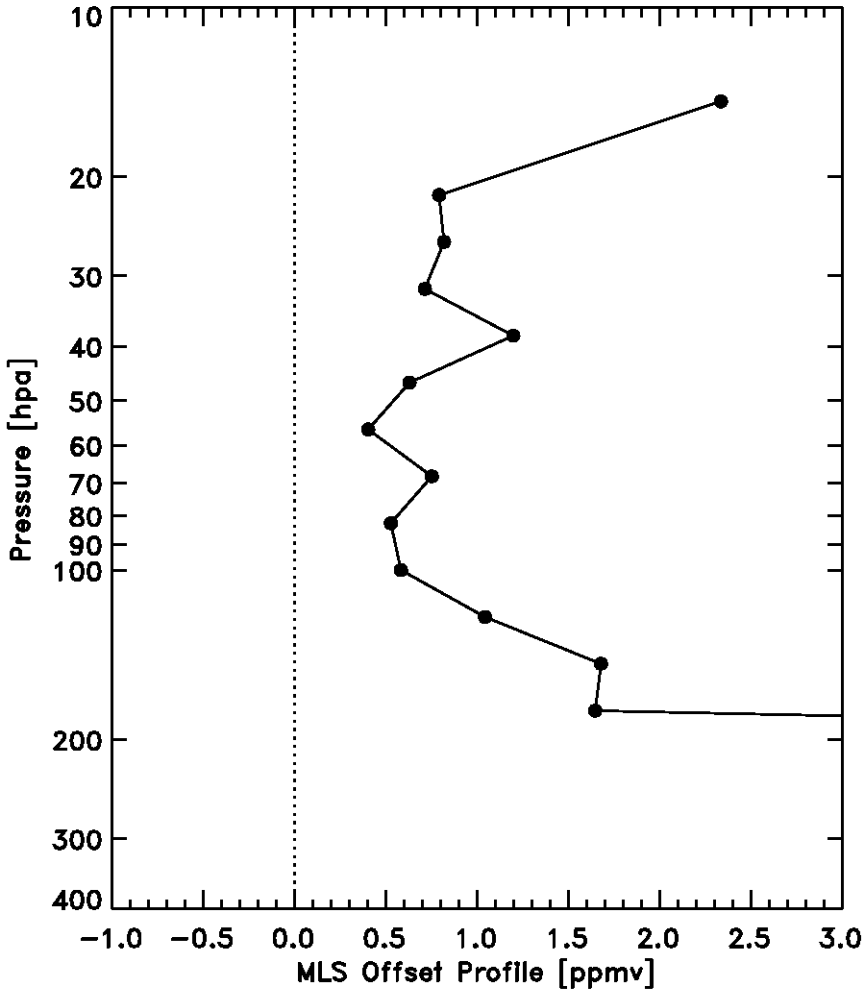
$$q_{i,\,MLS} = \alpha + \beta\, q_{i,\,CFH} + \eta_i$$

Correlation between MLS and CFH



Correlation parameters





Slope β

Offset α

Summary

- On average good agreement between CFH and Aura/MLS in stratosphere, with some bias in the upper tropopshere

- Layer average difficult to interpret in process studies
- Transition from 12 leves/decade to 6 leves/decade creates a spike

- Tropical upper troposphere (P ≥ 216 hPa): MLS wetter than CFH, but very large scatter
- Tropical lower TTL (216 hPa > P > 100 hPa): MLS drier than CFH (-17%±20%)
- Tropical tropopause (100 hPa ≥ P ≥ 82 hPa): MLS wetter than CFH (~ 10%±10%)
- Arctic upper troposphere (P ≥ 216 hPa): MLS drier than CFH (~ -40%±30%)

- MLS sensitivity is lower than CFH (about 80%), compensated by positive offset