

# Results from the September 2005 Aura Validation Balloon Flight

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# Flight Details

- 5 Instruments on one gondola.
  - FIRS-2 Far Infrared thermal emission FTS
  - MkIV Solar Occultation FTS
  - SLS Submillimeter SIS Heterodyne Spectrometer
  - BOH Terahertz OH Heterodyne Spectrometer
  - In situ Ozone UV photometer
- Location: between Ft. Sumner, NM and Parker, AZ
- 19 hours at float: before local solar noon on 9/20/05 to after sunrise on 9/21/05
- Float altitude between 38 km (early) to 26.5 km (late).
- All instruments worked well during the flight.
- TES was not on during this flight.

# Observed Molecules

- FIRS-2:  $O_3$ ,  $H_2O$ ,  $HDO$ ,  $H_2^{17}O$ ,  $H_2^{18}O$ ,  $OH$ ,  $HO_2$ ,  $H_2O_2$ ,  $NO_2$ ,  $HNO_3$ ,  $N_2O_5$ ,  $HNO_4$ ,  $HCl$ ,  $HOCl$ ,  $ClNO_3$ ,  $HBr$ ,  $HOBr$ ,  $N_2O$ ,  $CFC-11$ ,  $CFC-12$ ,  $HF$ ,  $OCS$ ,  $CO_2$ ,  $HCN$ ,  $CH_4$ , Acetone,  $SF_6$ ,  $CCl_4$ ,  $HCFC-22$ .
- MkIV:  $O_3$ ,  $H_2O$ ,  $HDO$ ,  $H_2O_2$ ,  $NO_2$ ,  $NO$ ,  $HNO_3$ ,  $N_2O_5$ ,  $HNO_4$ ,  $HCl$ ,  $HOCl$ ,  $ClNO_3$ ,  $N_2O$ ,  $CFC-11$ ,  $CFC-12$ ,  $HF$ ,  $CO_2$ ,  $OCS$ ,  $HCN$ ,  $CH_4$ ,  $SF_6$ ,  $CCl_4$ ,  $CH_3CN$ ,  $CO$ ,  $H_2CO$ ,  $COF_2$ ,  $CF_4$ ,  $CH_3Cl$ ,  $HCFC-22$ ,  $C_2H_2$ ,  $C_2H_6$ .
- SLS:  $ClO$ ,  $O_3$ ,  $HCl$ ,  $HOCl$ ,  $HO_2$ ,  $BrO$ ,  $CH_3CN$ ,  $HOONO$ .
- BOH:  $OH$ ,  $O_3$ .
- In situ:  $O_3$ .

$MLS$ ,  $TES$ ,  $HIRDLS$ ,  $OMI$ , Multiple Aura instruments

# Submillimeterwave Limb Sounder -2

P.I. Robert Stachnik, Jet Propulsion Laboratory



- **A ‘next-generation’ 600 GHz heterodyne radiometer using a 4K SIS junction mixer** (liquid helium cooled) developed at Caltech for use at the CSO.
- **Radiometric sensitivity > 20 times that of the former uncooled Schottky receiver based SLS** enables e.g., measurement of the ClO 649 GHz lines with S/N > 10 in 100 ms
- **‘in flight’ frequency tunable from 600 GHz to 690 GHz.** Local oscillator generated with a programmable synthesizer and multiplier chain.
- **Lightweight (70 kg), compact (volume < 0.25 m<sup>3</sup> )**

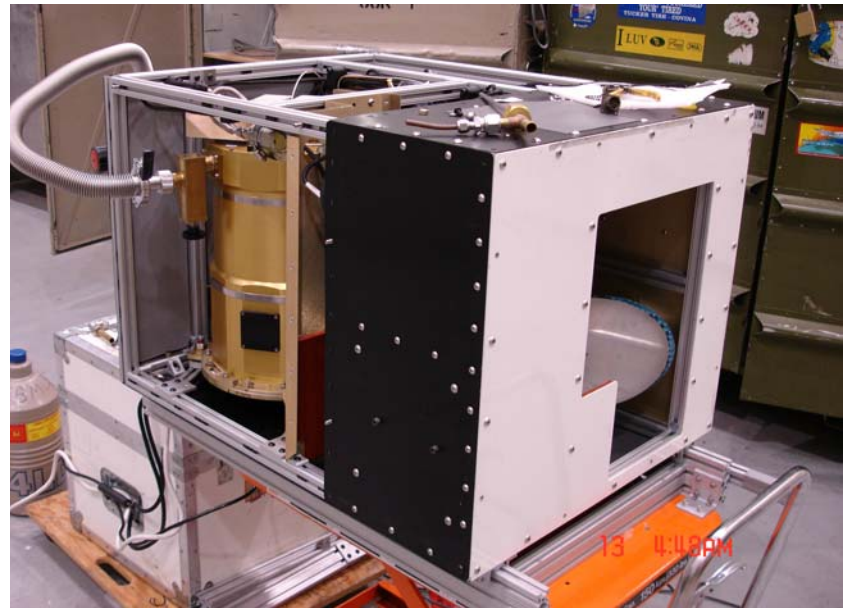


Photo of the SLS-2 at Ft. Sumner NM. (some panels removed)

# Gondola and Crew



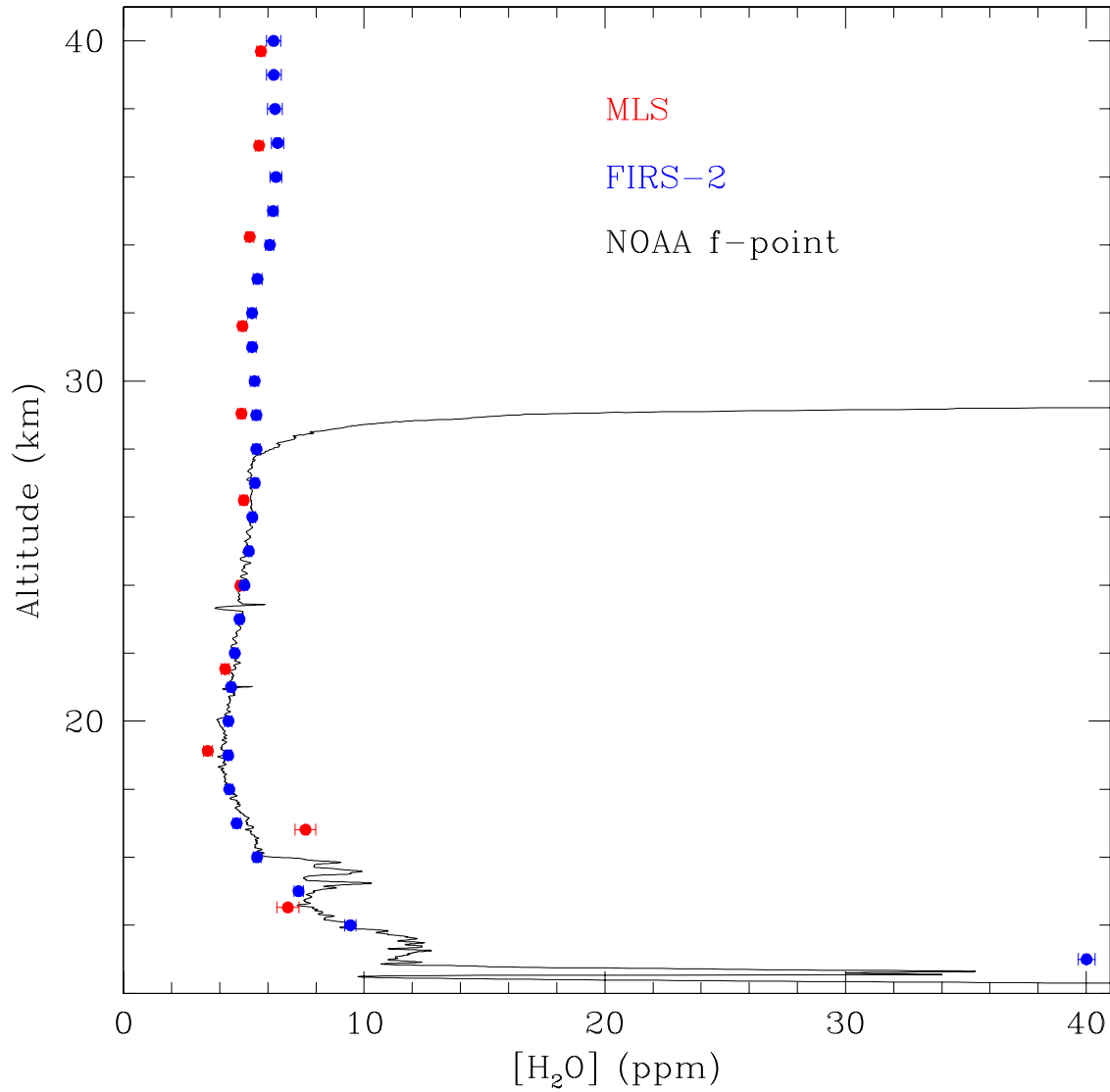


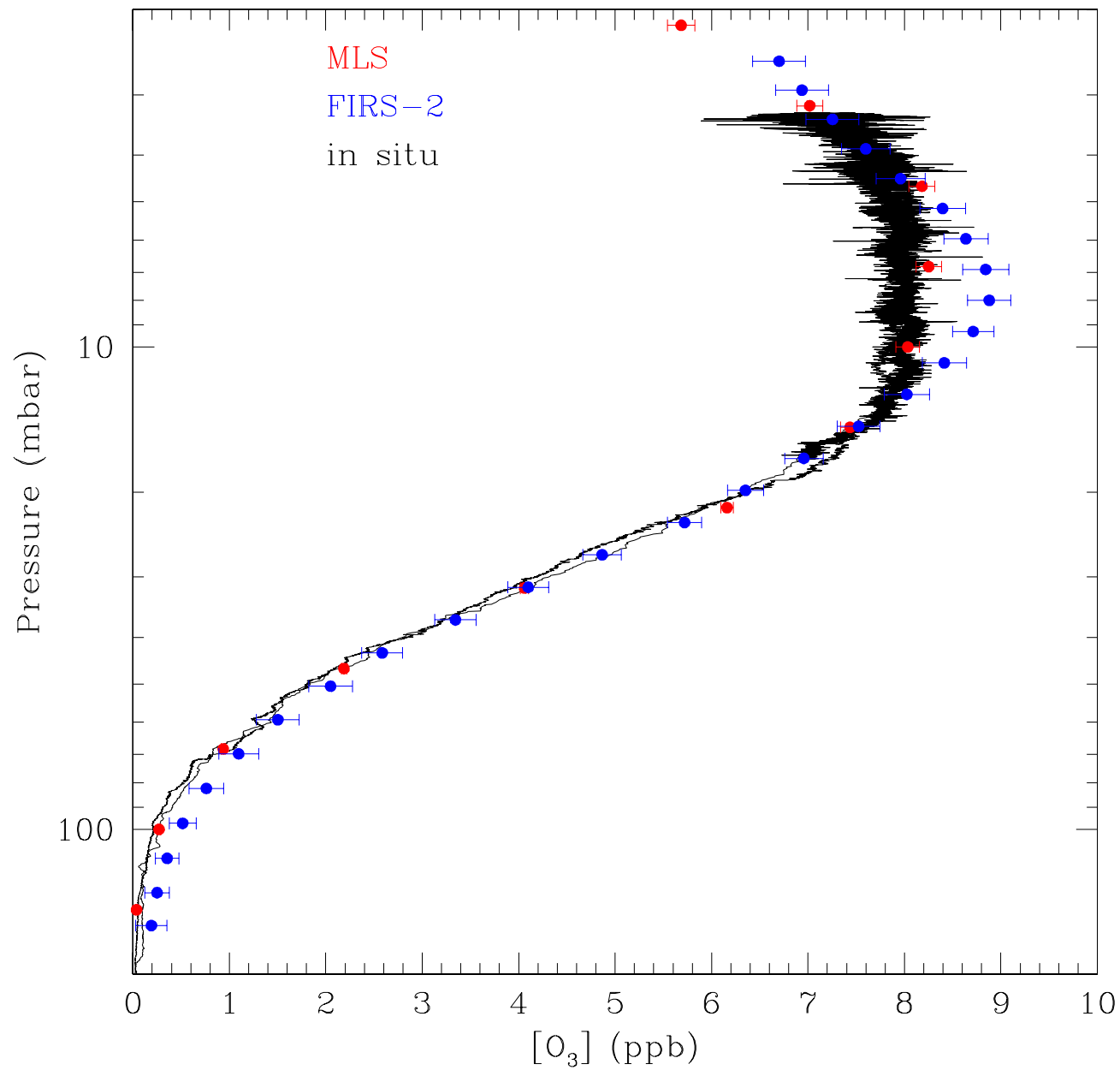
# Flight's Start and Finish



# Some preliminary profile comparisons

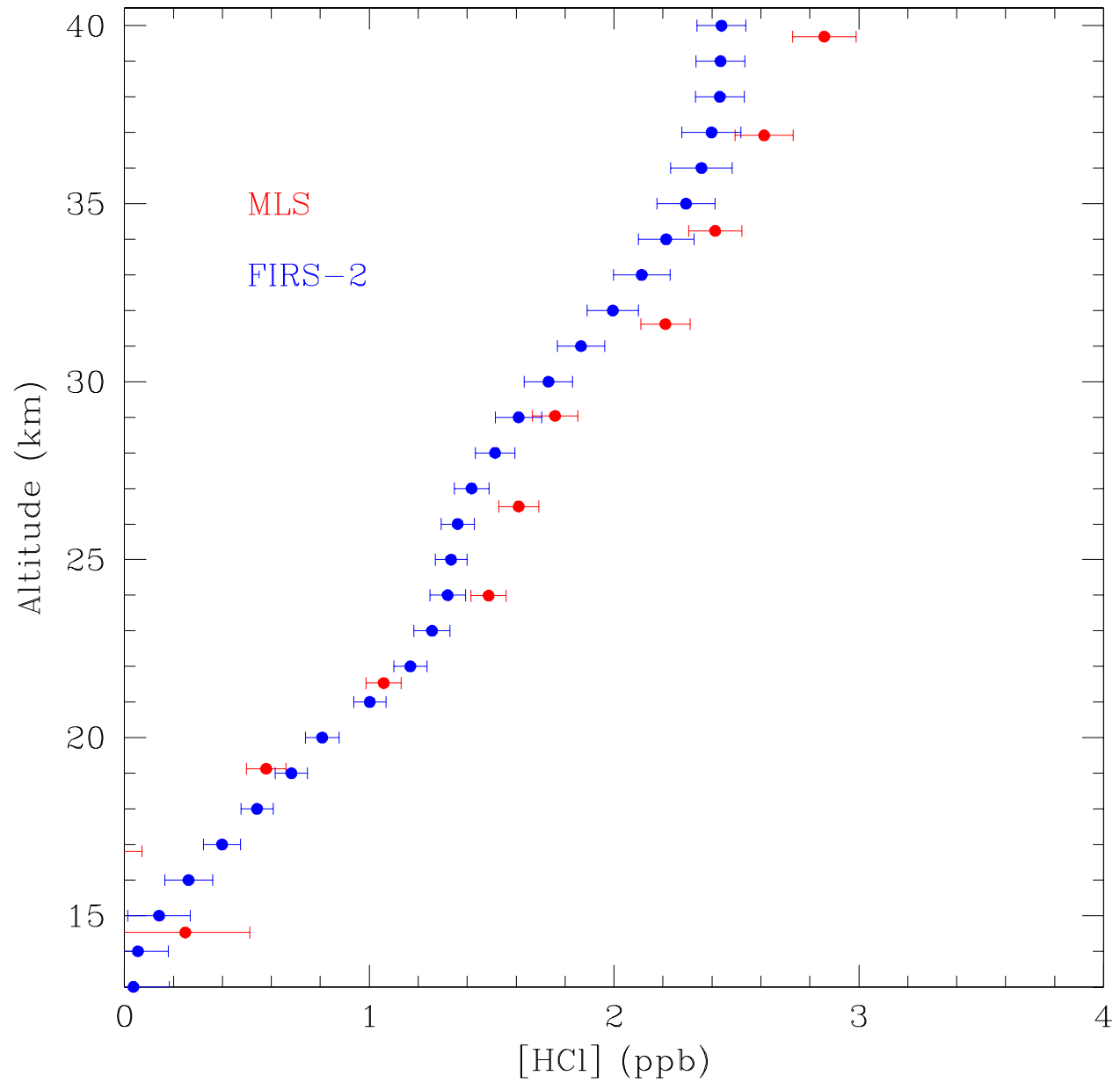
MLS vs. FIRS2 H<sub>2</sub>O for 9/20/05, 36.15°N 250.55°W







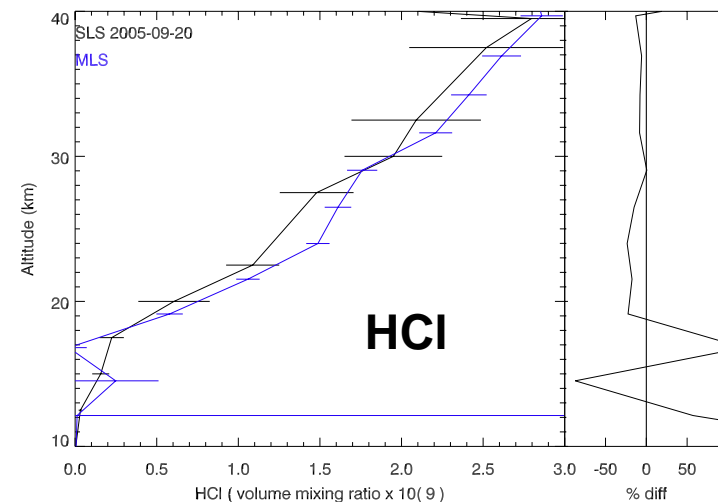
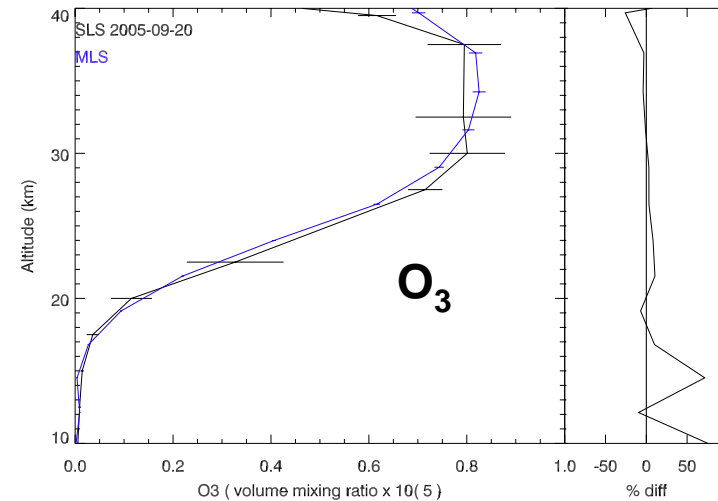
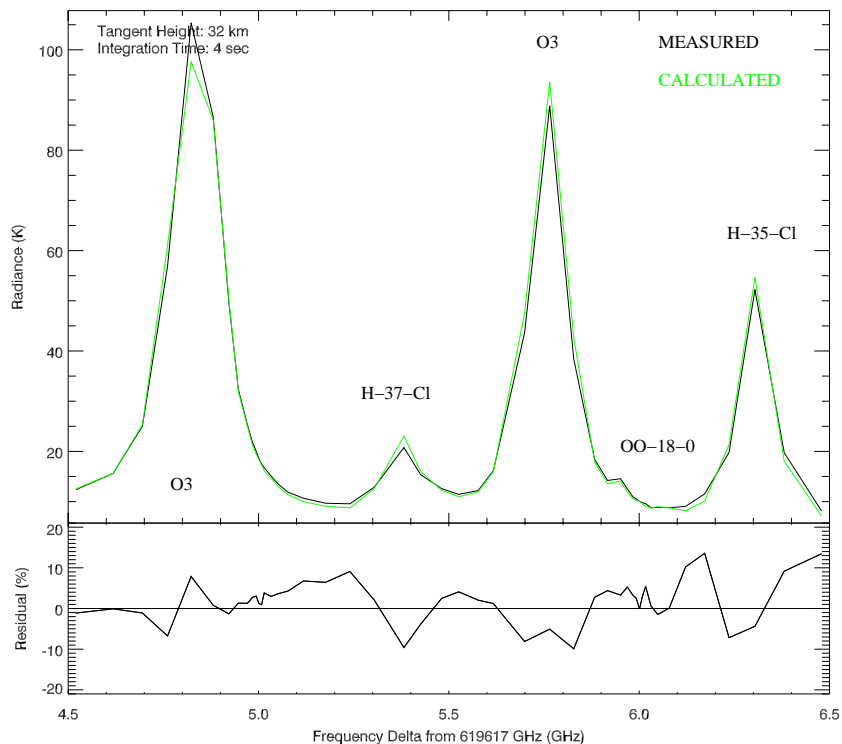
MLS vs. FIRS2 HCl for 9/20/05, 36.15°N 250.55°W



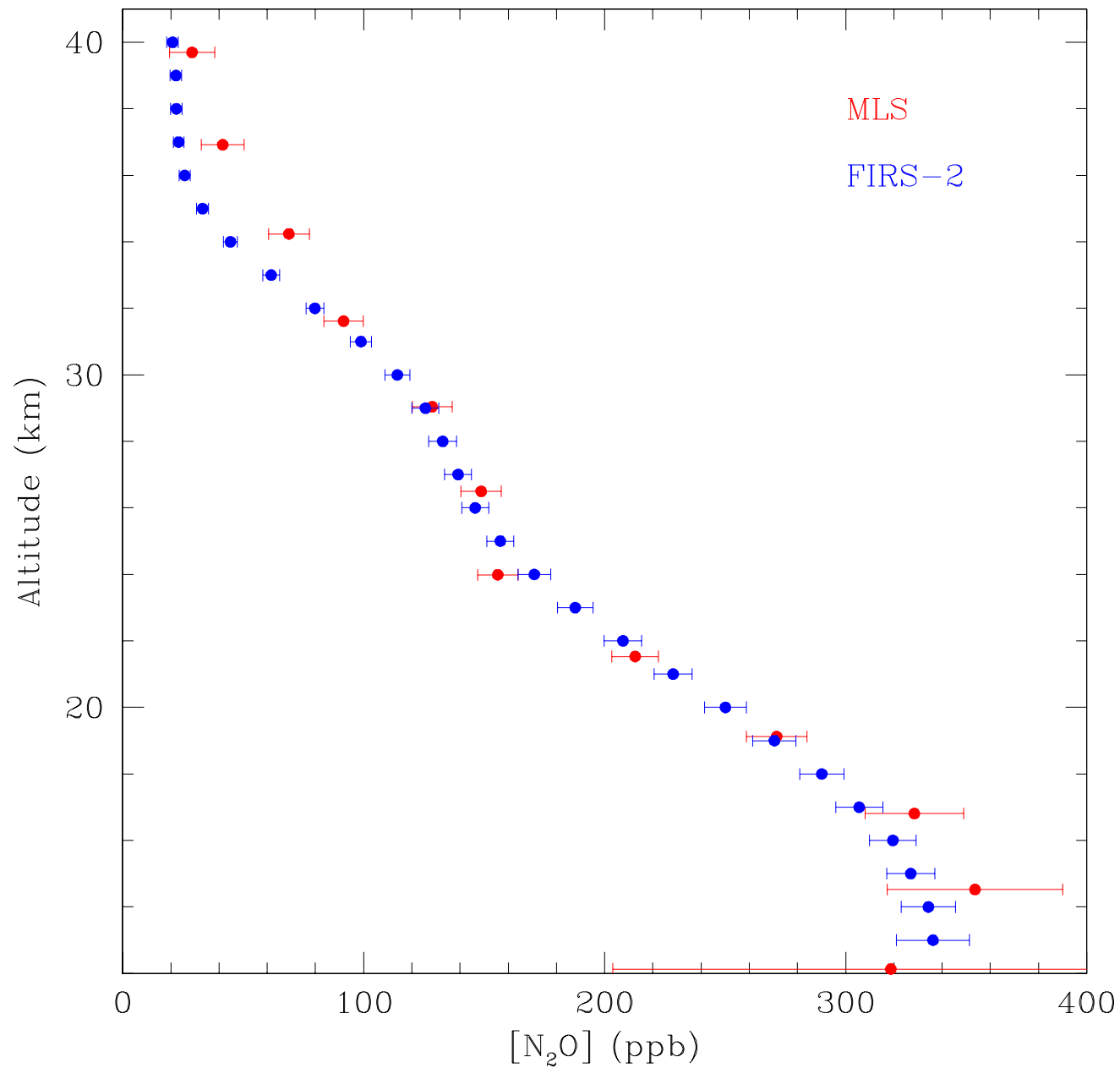
# Submillimeterwave Limb Sounder-2



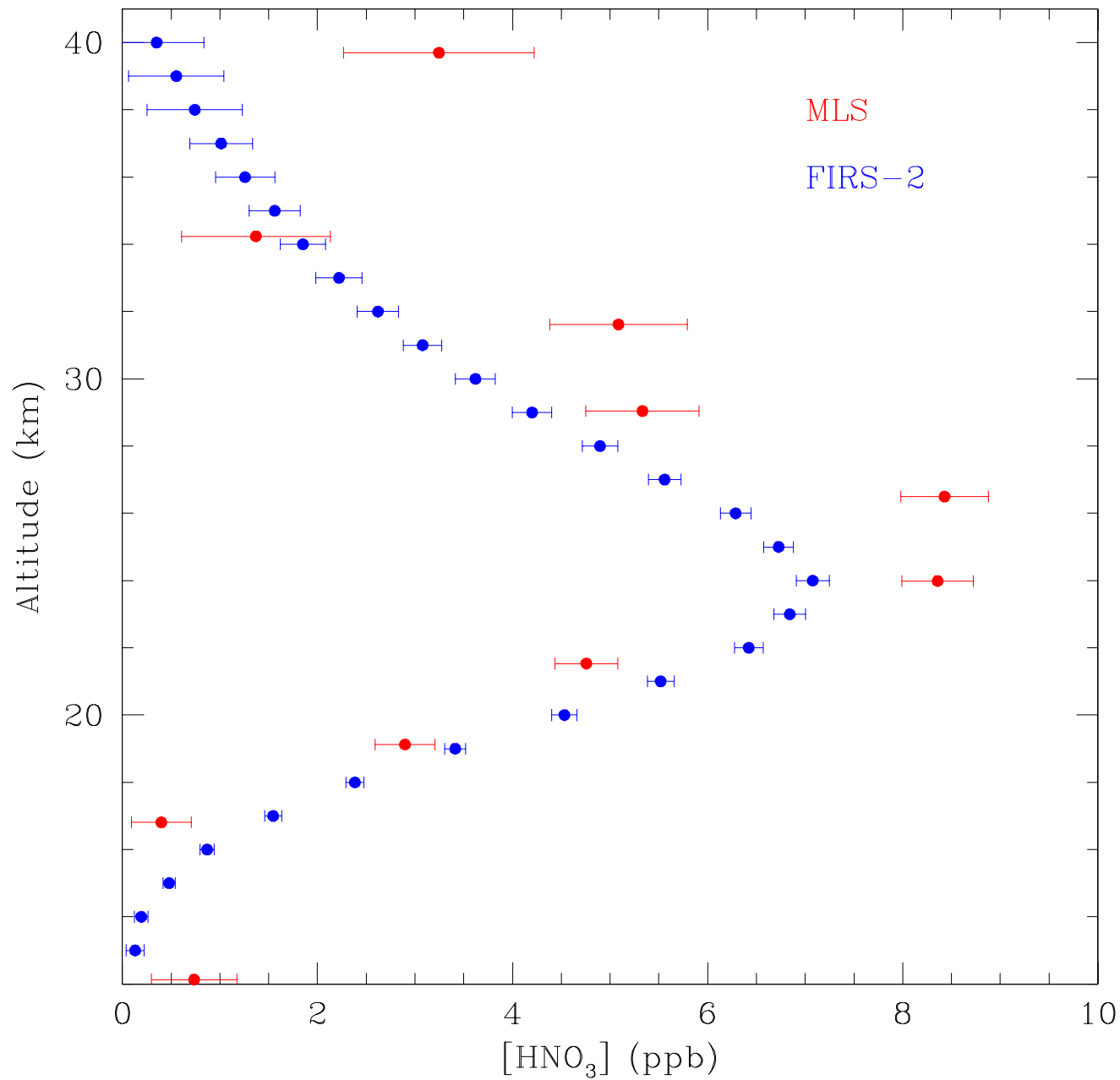
- **Preliminary Results** for O<sub>3</sub> and HCl from the 2005-09-20 balloon flight
- Example measured and calculated spectra (tanh 32 km) for O<sub>3</sub> and HCl (below)
- Retrieved O<sub>3</sub> and HCl profiles compared with Aura MLS (at right)



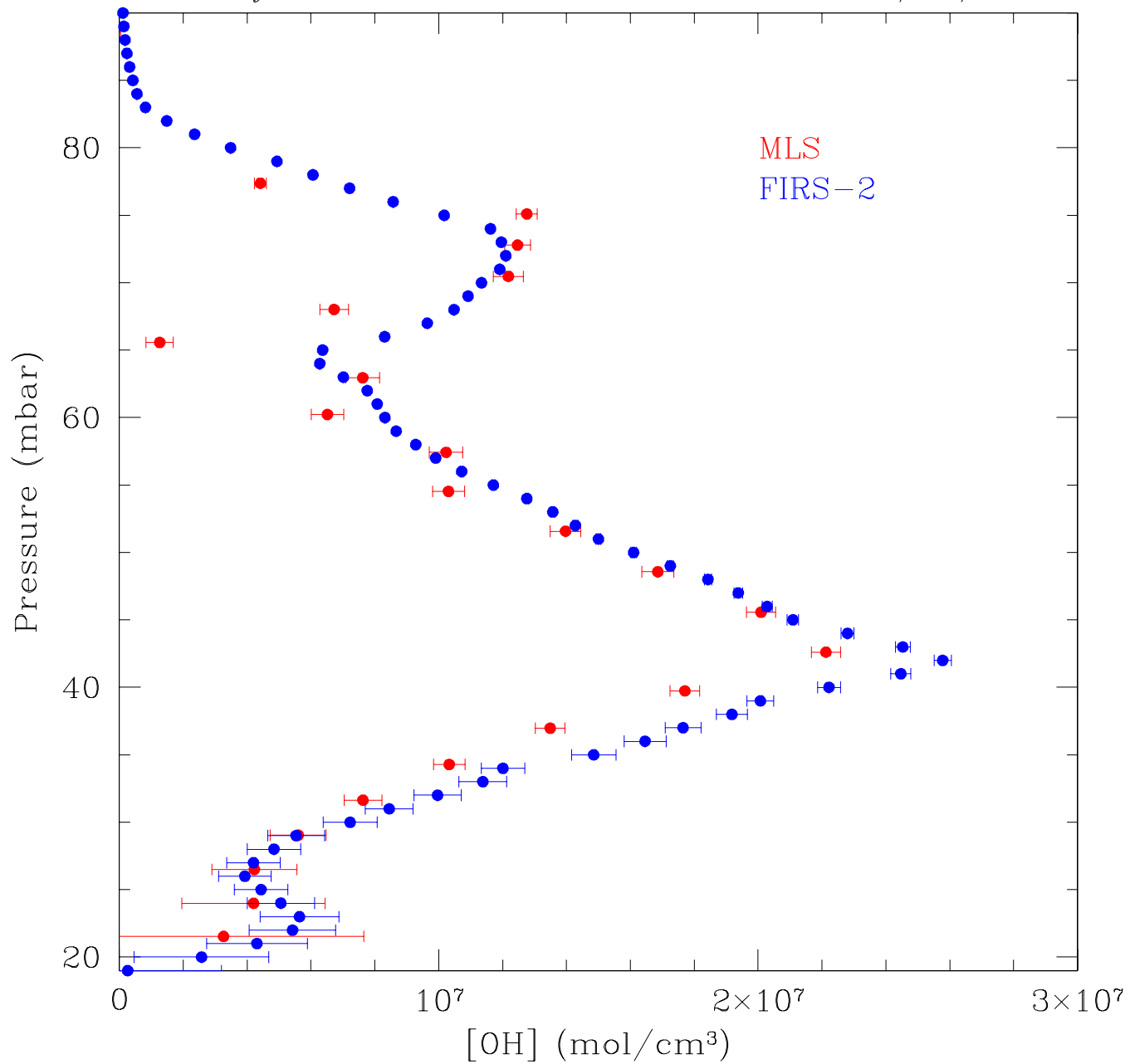
MLS vs. FIRS2 N<sub>2</sub>O for 9/20/05, 36.15°N 250.55°W



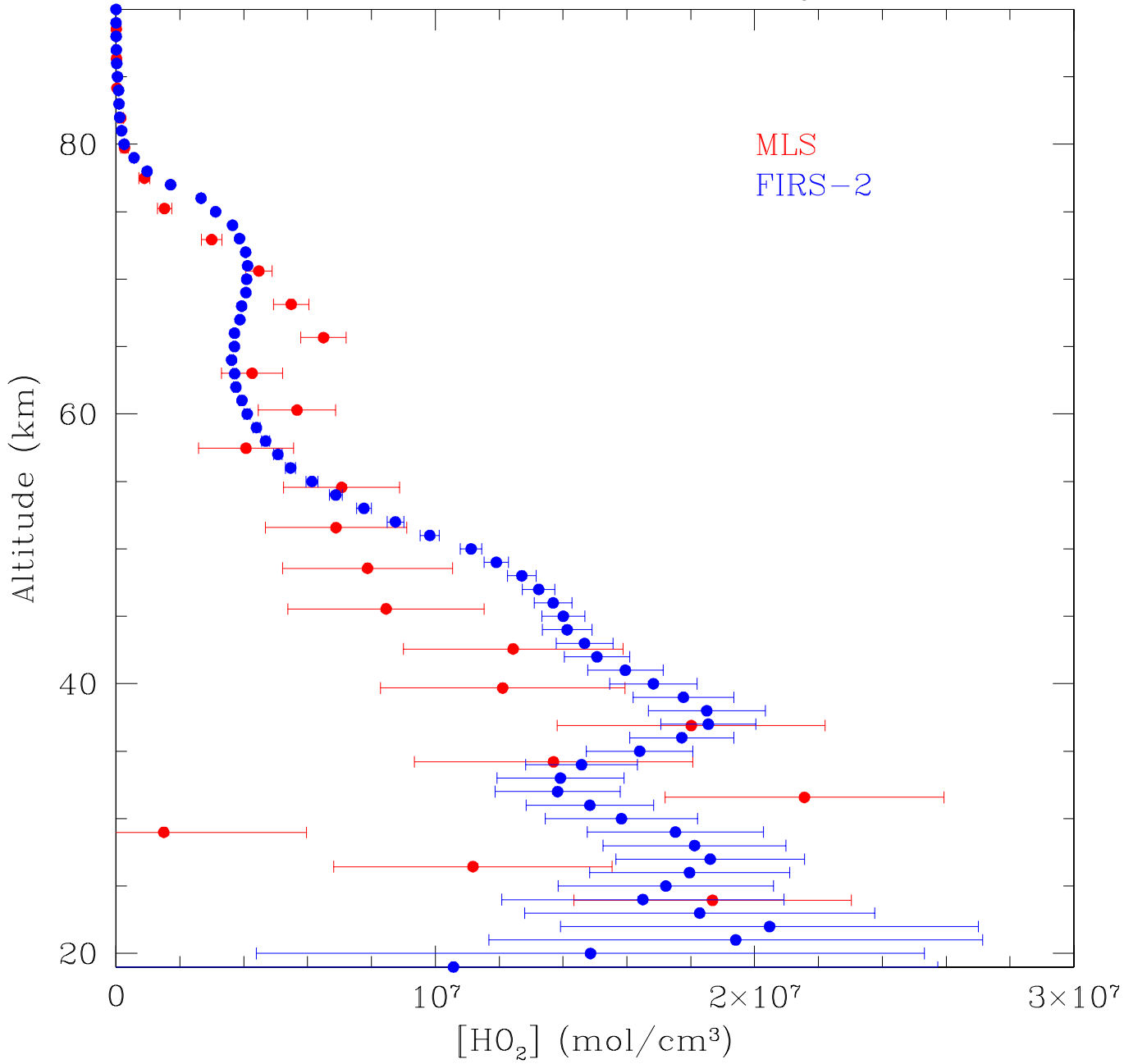
MLS (1-day) vs. FIRS2 HNO<sub>3</sub> for 9/20/05, 36.15°N 250.55°W



1 day zonal mean MLS vs. FIRS2 OH for 9/20/05

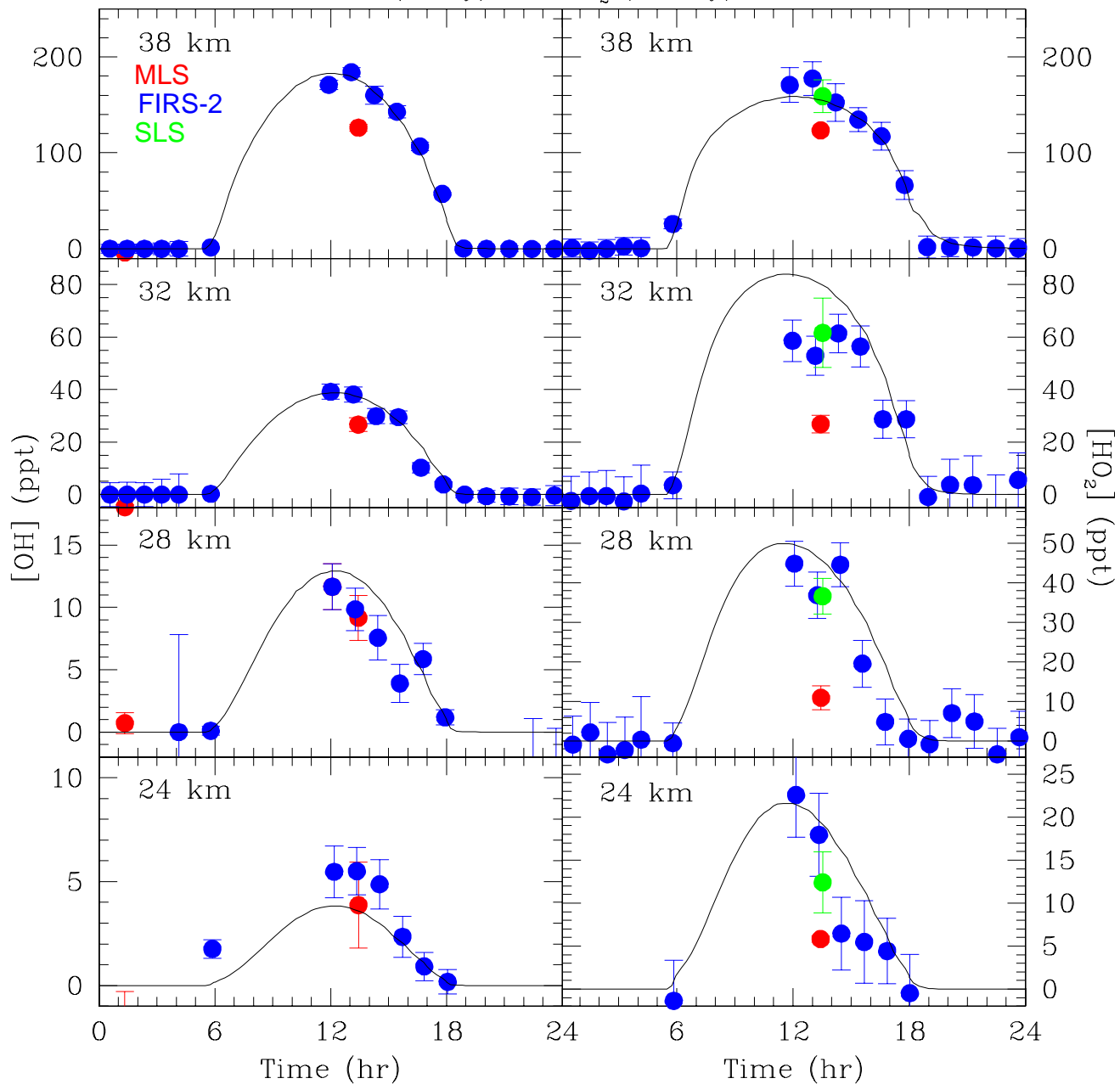


15 day zonal mean MLS vs. FIRS2 HO<sub>2</sub> for 9/20/05





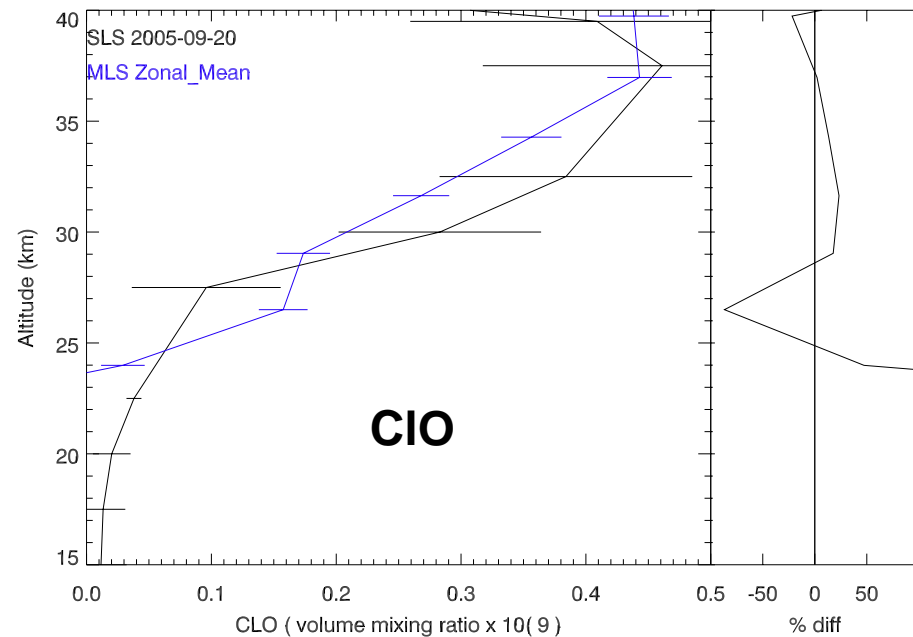
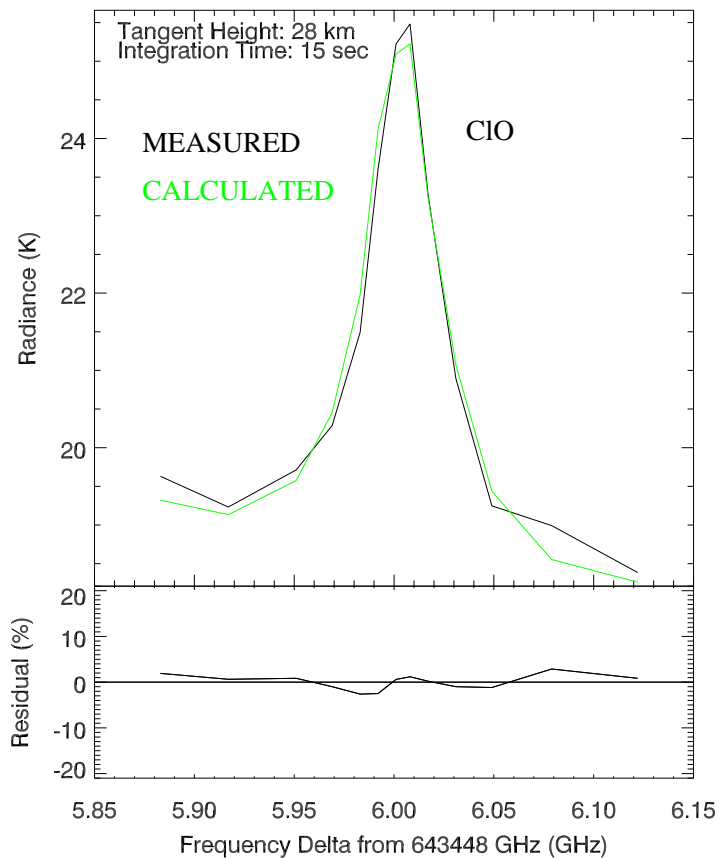
FIRS-2 and MLS OH (1 day) and HO<sub>2</sub> (15 day) vs. local solar time



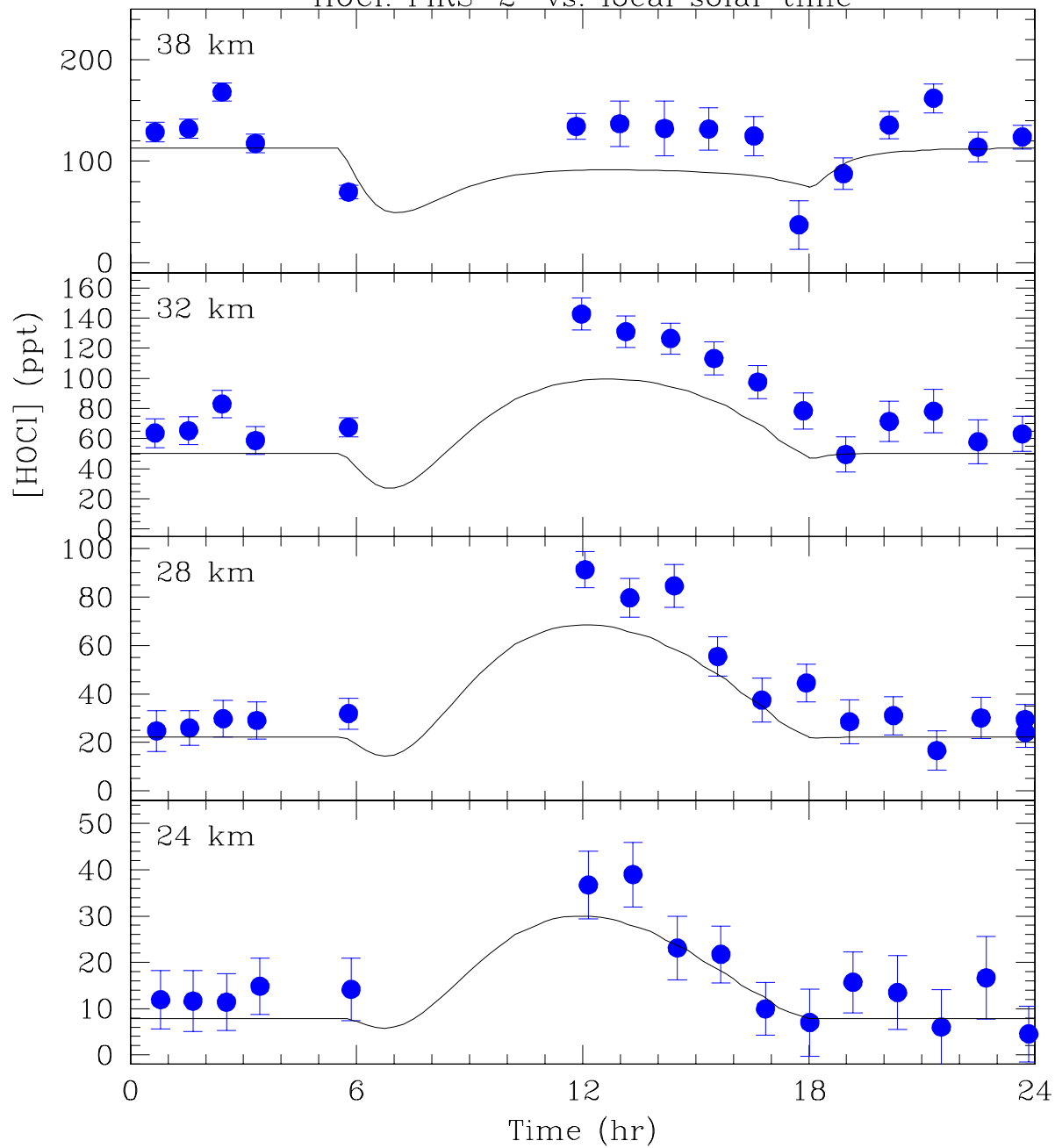
# Submillimeterwave Limb Sounder-2



- **Preliminary Results** for ClO from 2005-09-20 balloon flight
- Measured and calculated (green trace) spectra (tanh 28 km) for ClO (below left)
- Retrieved ClO profile compared to Aura MLS zonal mean (below right)



HOCl: FIRS-2 vs. local solar time



MLS vs. FIRS2 HCN for 9/20/05, 36.15°N 250.55°W

