

Ozone Measurements during HIPPO

Ru-Shan Gao, Ryan Spackman



*Chemical Sciences Division
NOAA Earth System Research Laboratory
and
CIRES, University of Colorado
Boulder, Colorado*



NOAA CSD Ozone Data Summary

- Final data have been submitted for all 5 deployments
- NOAA O₃ Classic instrument performed well:
 - 1 s data were not recorded for the last part of RF02 and entire RF03 of HIPPO-1 and HIPPO-4
 - 1 s data at every 10 s are available for these 4 flights
- Instrument accuracy: 5%
- Precision: 1.5×10^{10} molecules/cm³ (approximately 1 ppb at 5 km, 2 ppb at 10 km)
- The instrument has not been changed for a long time. No future modifications are planned.

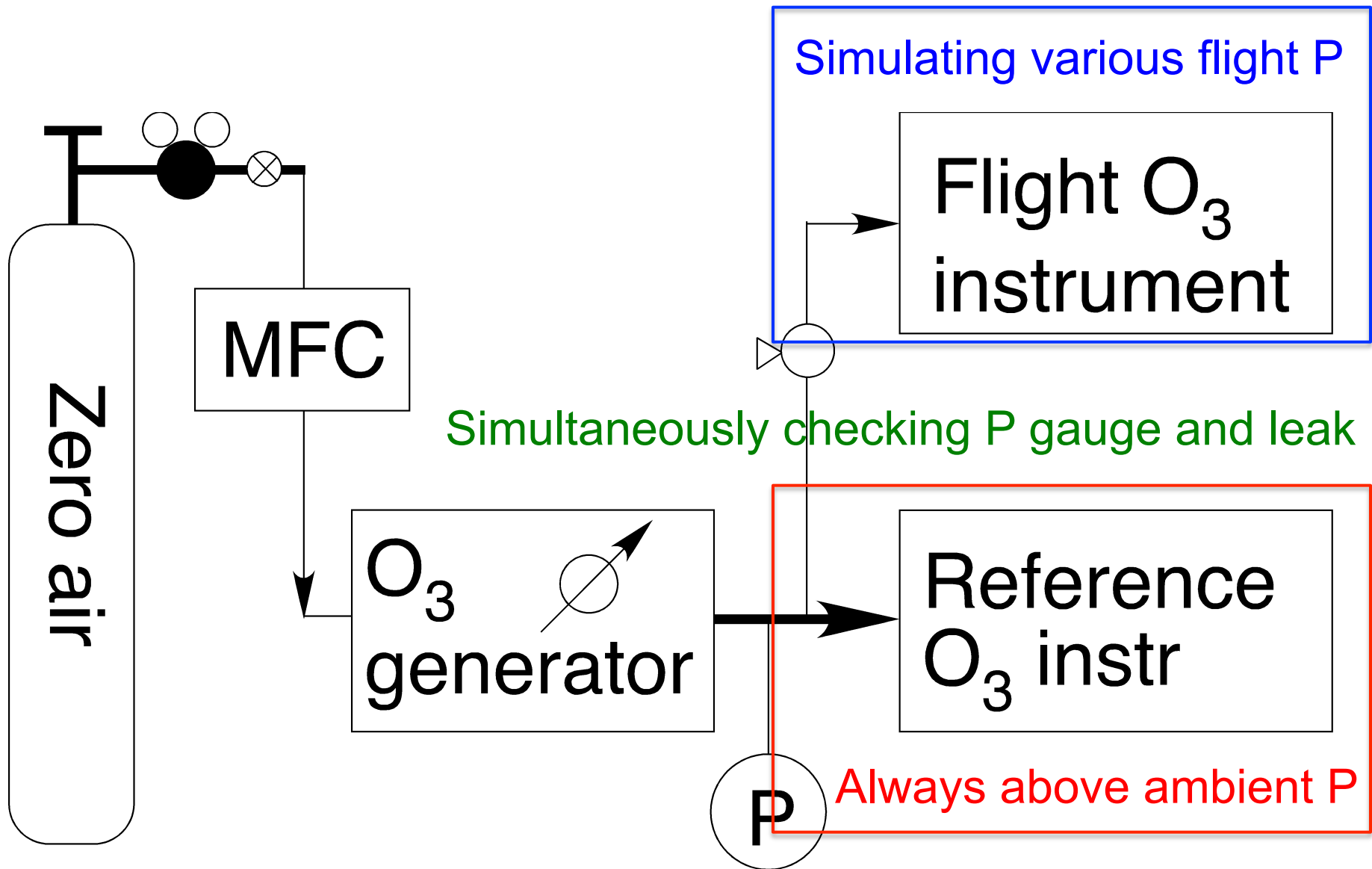
Ozone Instrument Intercomparison

- NOAA O₃ Classic instrument is based on O₃ UV differential absorption technique and is theoretically absolute
- Direct calibration is difficult and is not performed in our lab
- This type of instrument is usually validated through intercomparisons with other O₃ instruments
- O₃ Classic has been intercompared with at least one other O₃ instrument before every deployment (NOAA UAS O₃, two TECOs)
- Rigorous leak checks have been performed in the lab and and also before the de-installation at the end of HIPPO-1

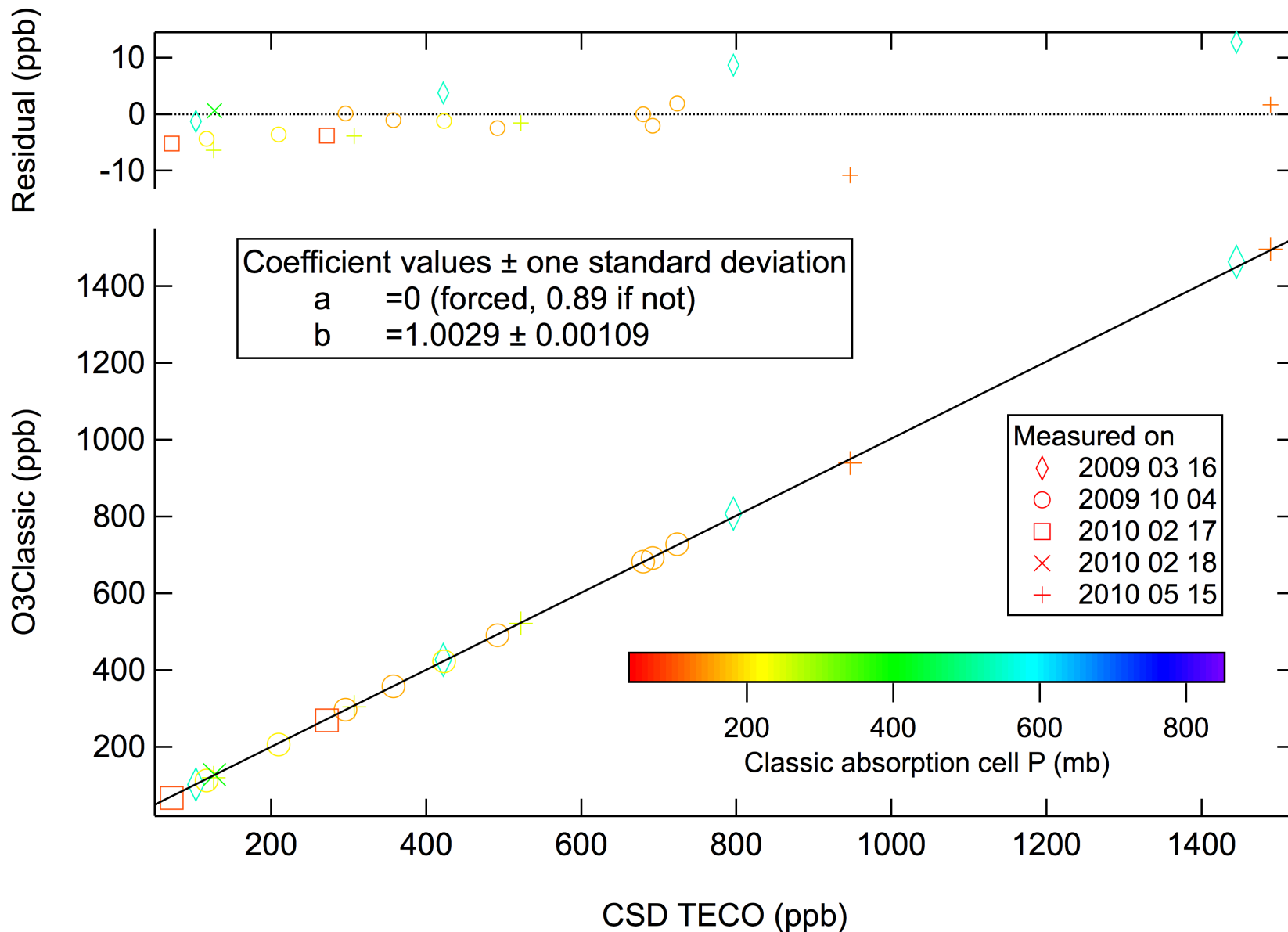
Science Plan

- Measurement-Model intercomparison
 - Harvard GEOS-CHEM, NOAA RAQMS, ...
- O₃/N₂O correlations in the stratosphere
 - Try to see if there is a change from 90's
 - Also include GloPac and ATTREX data

Ozone Instrument Intercomparison Approach

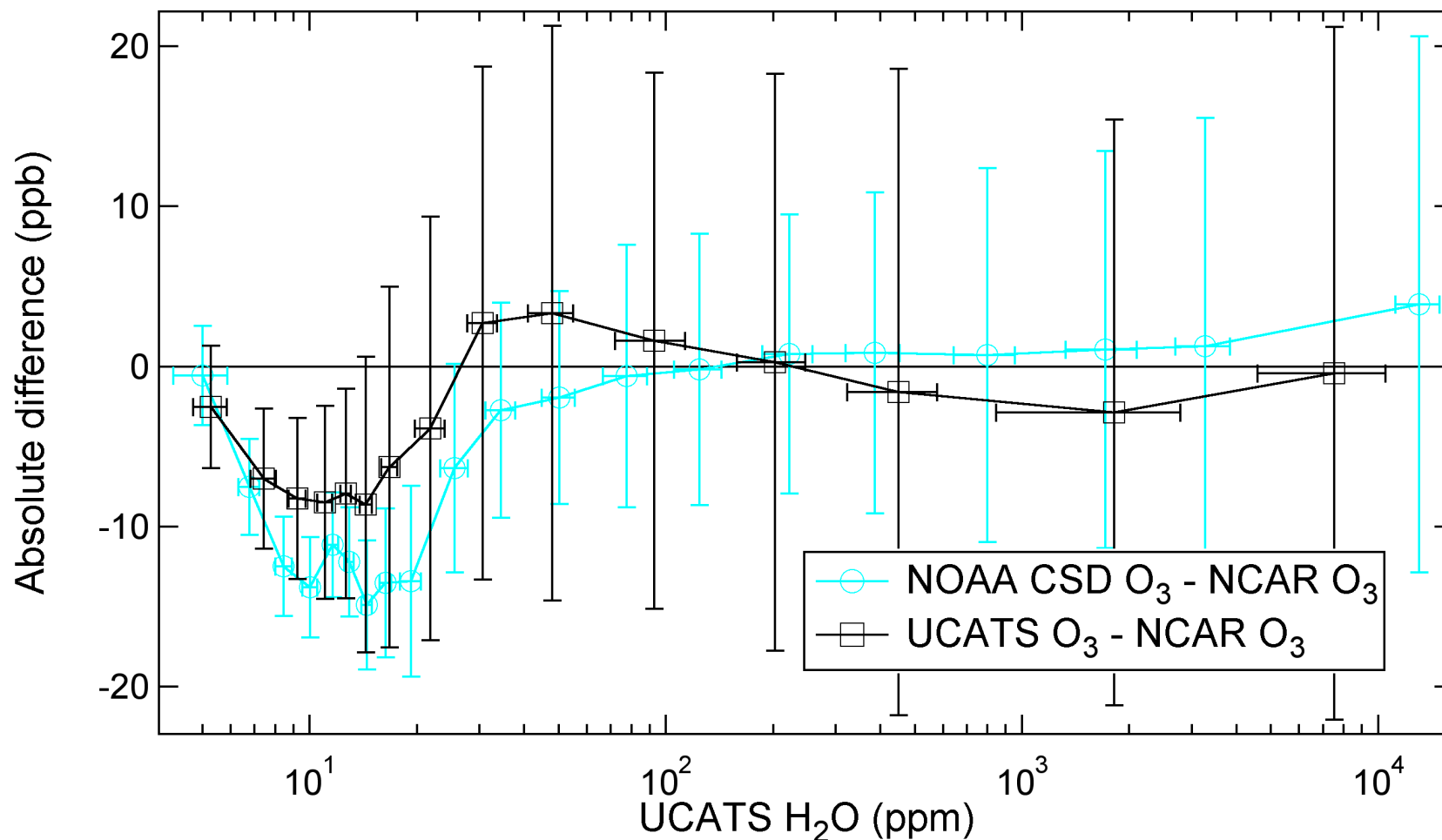


Ozone Instrument Intercomparison Summary



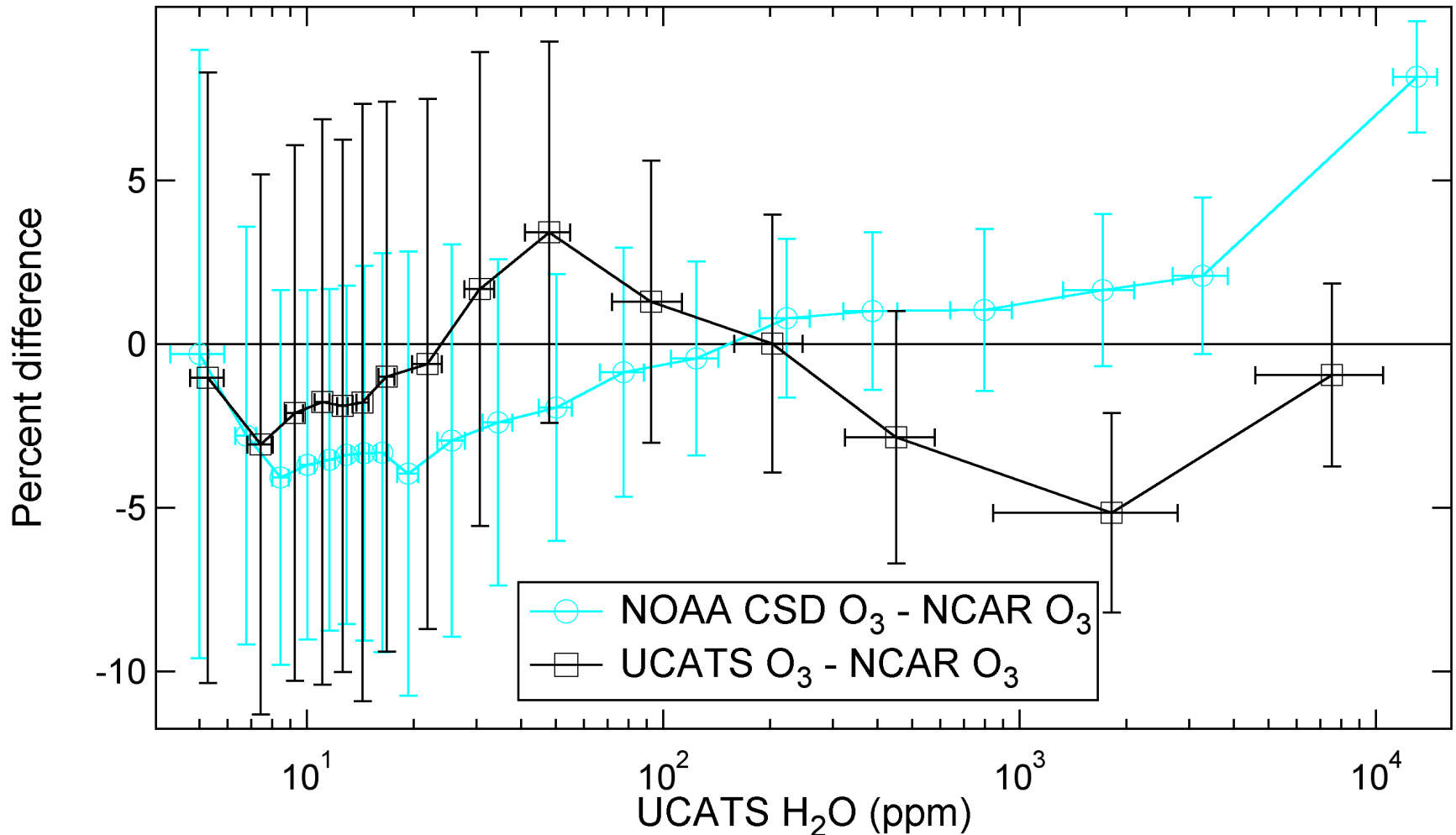
In-Flight Intercomparison from START08

- Largest differences likely from high-to-low H₂O concentration transitions



In-Flight Intercomparison during START08

- All measurements are consistent to within 10% (1σ)



In-Flight Intercomparisons during HIPPO-1

- **HIPPO-1**: NOAA CSD O₃ and UCATS O₃ sometimes did not correlate with each other (CSD O₃ lower by up to 40 ppb):
 - Occurred on ascent from high H₂O environments
 - Happened in 9 out of 11 flights
- Possible CSD O₃ instrument problems during **HIPPO-1**:
 - Pressure and temperature sensor drifts and catalyst degradation:
 - ✓ Ruled out using in situ data and post-mission lab work
 - Leaks in the instrument or in the sample line:
 - ✓ No significant leak was found during post-mission check
- H₂O artifact:
 - ✓ Laboratory tests with H₂O: Possible artifact < 10 ppb
 - ✓ Limited evidence for artifact during START08/Pre-HIPPO and HIPPO-2

In-Flight Intercomparisons during HIPPO-2

- **HIPPO-2:** A different, more systematic disagreement:
 - UCATS O₃ was higher than CSD O₃ in the first half of the mission by 10–40 ppb with the larger differences at higher ambient O₃ mixing ratios
 - After changing a Hg lamp, UCATS O₃ was lower than CSD O₃ in the second half of the mission by 10–30 ppb, with the larger differences at higher ambient O₃ mixing ratios
 - See Eric Hintsa's intercomparison talk on Friday for details
- **HIPPO-3:** no in-flight intercomparisons
- CSD O₃ has not changed its configuration since START08
- In-flight intercomparison with NOAA UAS O₃ will occur in March – April 2011 on NASA WB-57F