National Aeronautics and Space Administration

Validation of MLS upper tropospheric ozone observations

Nathaniel Livesey + MLS Team

Jet Propulsion Laboratory, California Institute of Technology

TES, DIAL, NOAA Photometer Teams

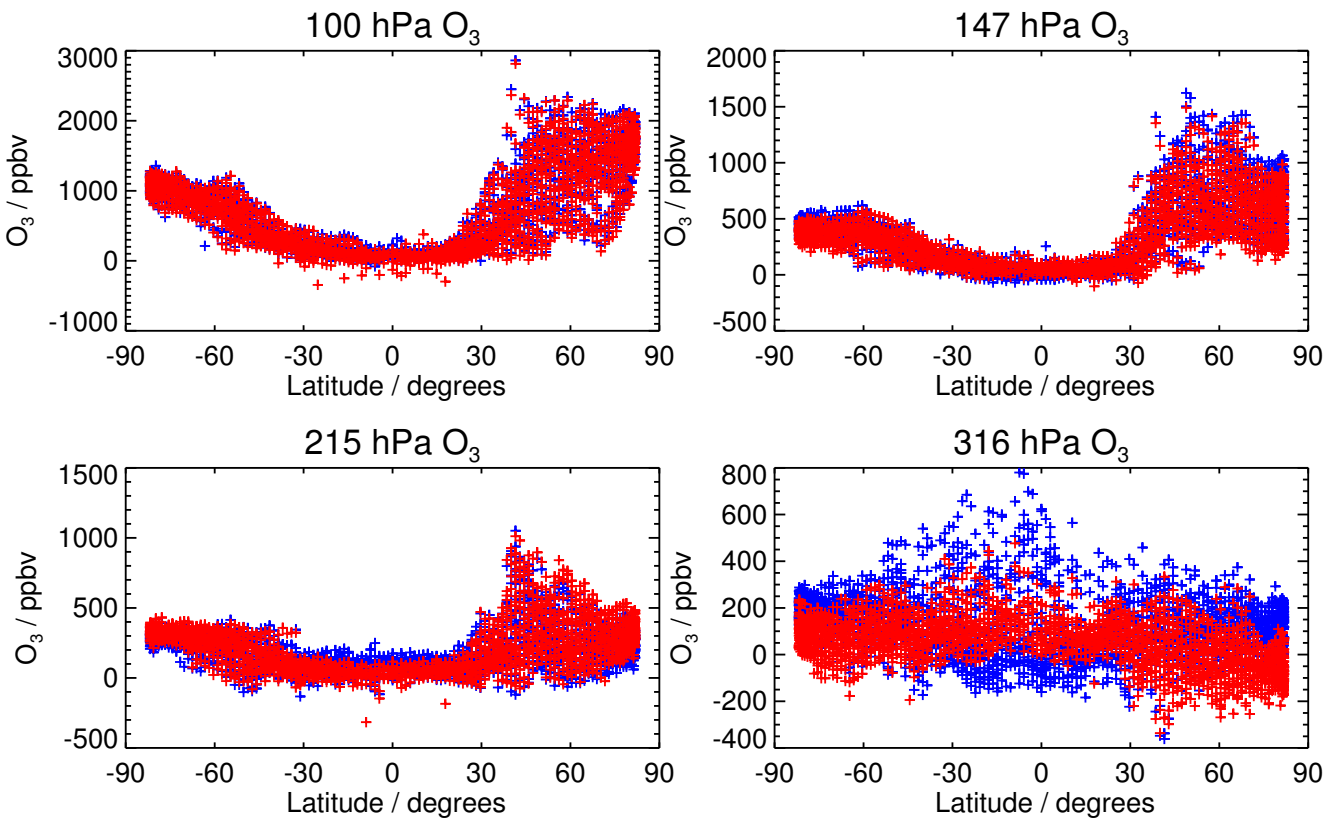
Aura Science and Validation Team Meeting

11–15 September 2006

Boulder CO

Introduction, v2.1 vs. v1.51 MLS UT O_3

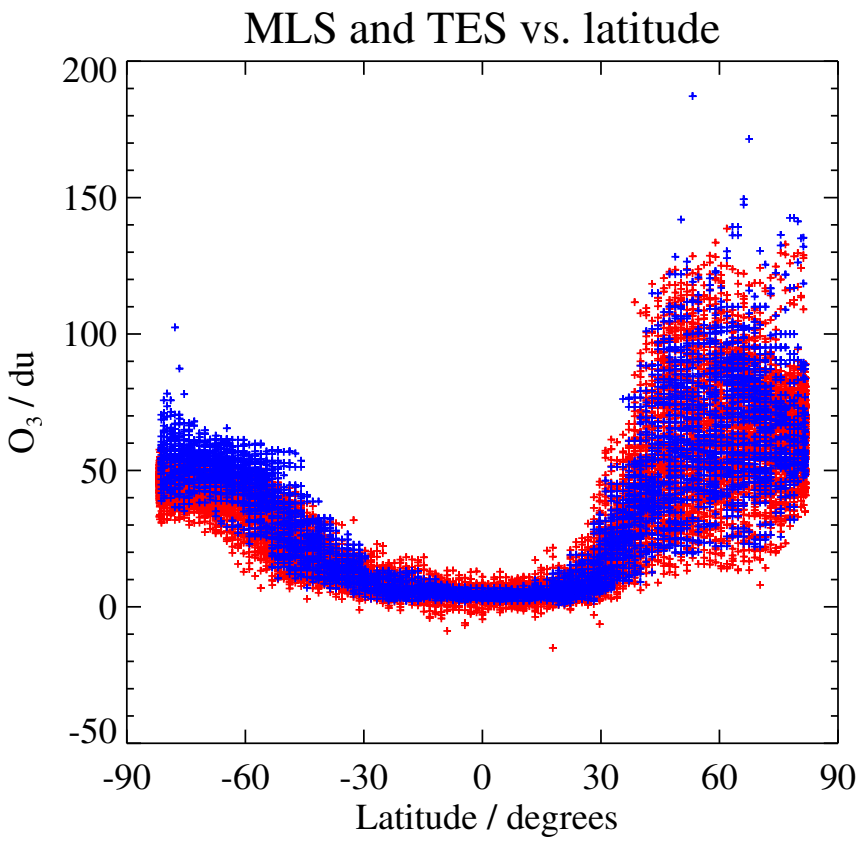
- V2.1 (red) U.T. O_3 data are broadly similar to version 1.5 (blue)
- Single profile precision is 30–50 ppbv
- Vertical resolution is ~3 km

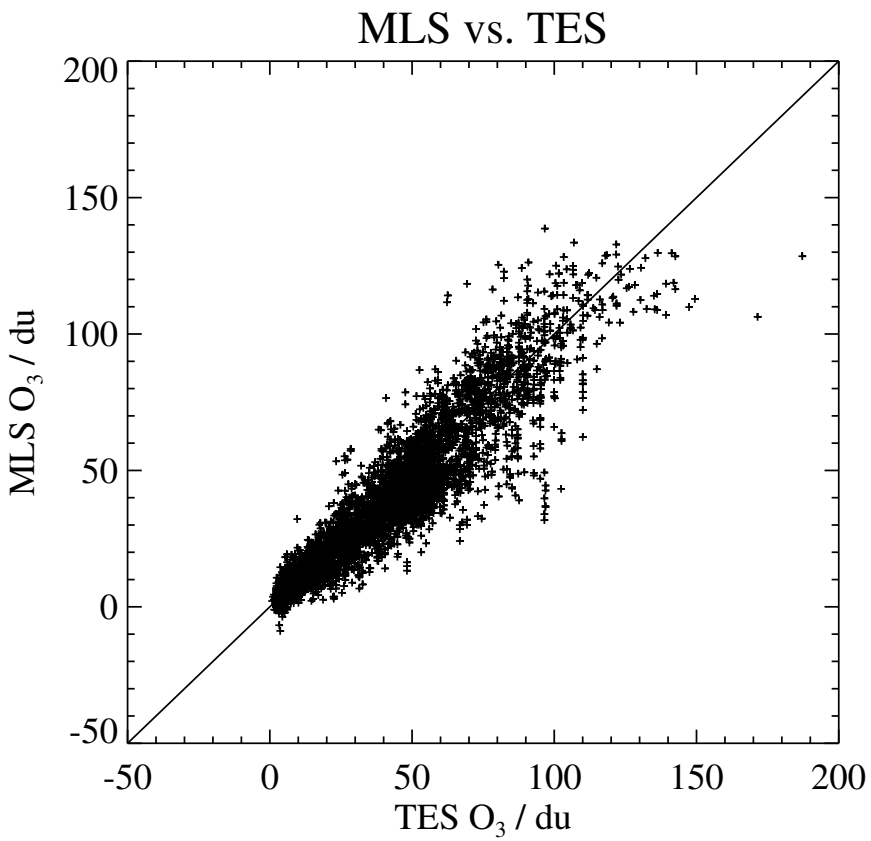


- The previously observed high bias at 215 hPa may be somewhat reduced
- The 316 hPa data are less noisy due to tightening of the *a priori* constraint.
- The 316 hPa O_3 quality will be investigated further for the validation paper

Comparing MLS and TES 215–100 hPa column

- 5 days of version 2.1 MLS data (red) compared with TES matches (blue)
- The agreement is very encouraging, but a thorough consideration of precision and/or smoothing errors is needed for a complete study



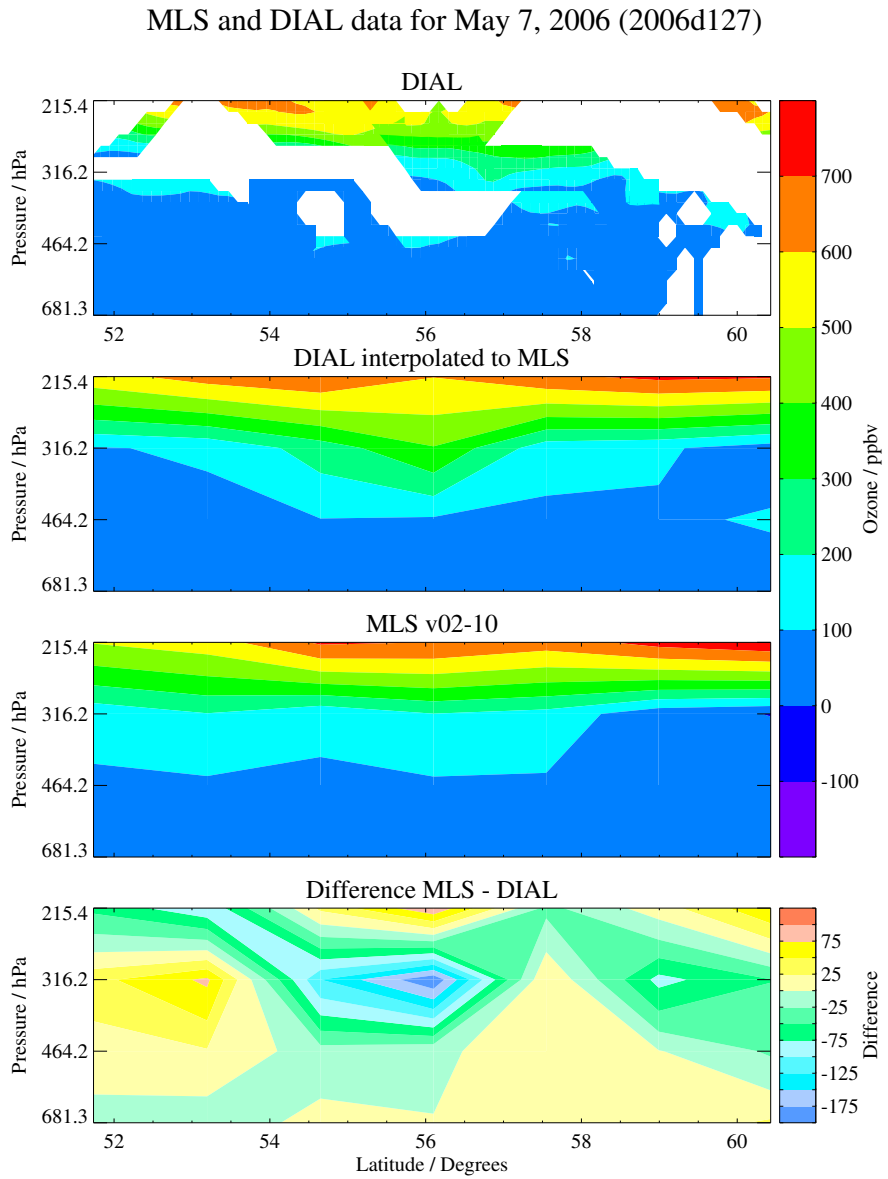


Approach to aircraft comparisons

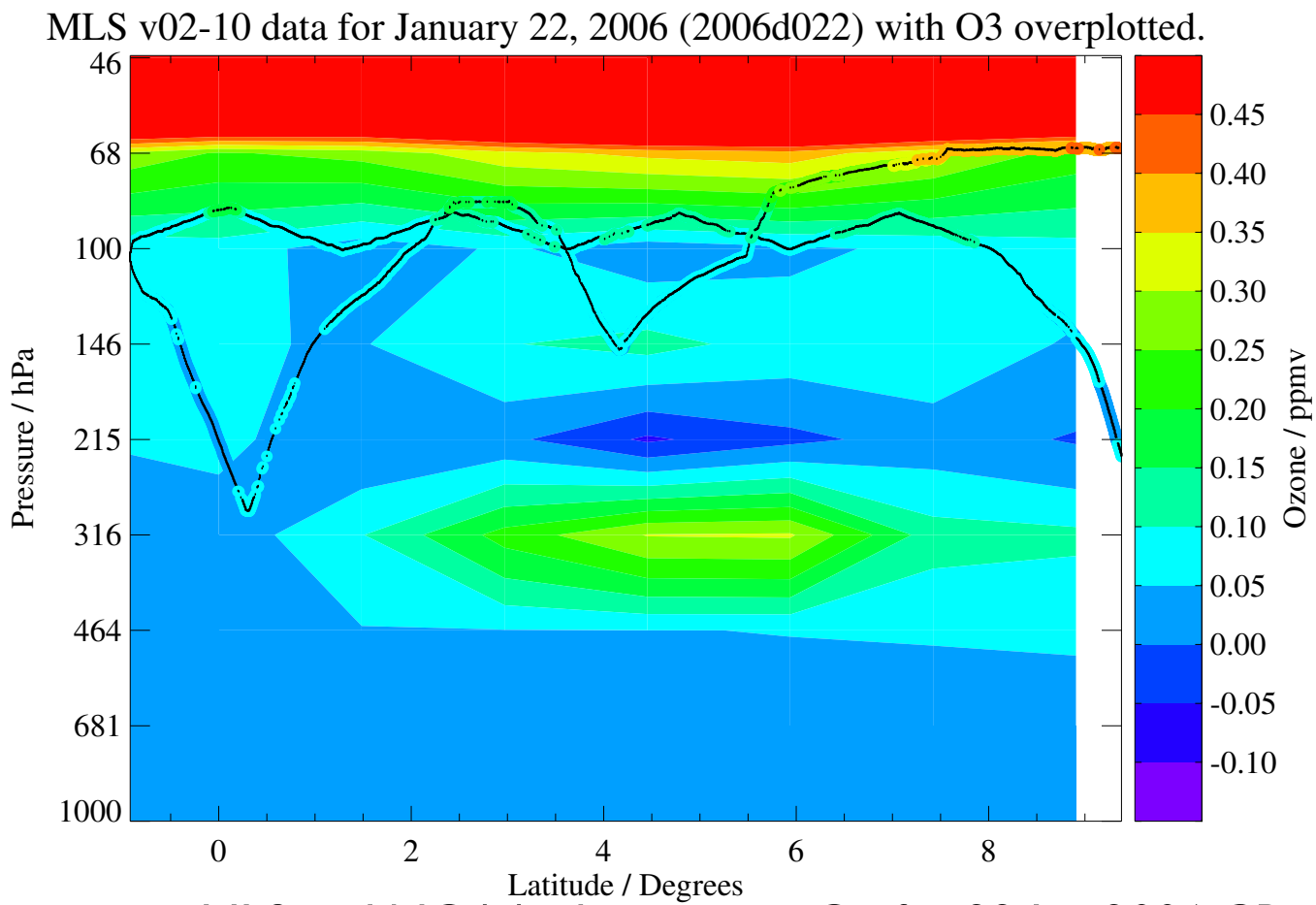
- The MLS data give a piecewise-linear representation of the atmospheric fields
- To get an MLS estimate for an in-situ location, simply interpolate
  - ⇨ linearly in —log pressure
  - ⇨ linearly in horizontal distance along the orbit (doing it in latitude is good enough in most cases)
- Computing the field MLS should report given in-situ observations is a little more complicated
  - ⇨ First a least squares fit of the in situ data to the MLS grid is needed
  - ⇨ Additionally, depending on the circumstances, the averaging kernel can be applied
  - ⇨ For the LIDAR comparisons shown here, we will only consider the least-squares fitting

MLS and INTEX-B DIAL

- Top panel is DIAL LIDAR O_3 for INTEX-B flight on 7th May 2006
- Next panel has same data least-squares fit to MLS retrieval grid
- Third panel is MLS observations
- Recall, MLS O_3 retrieved at 316 hPa and 215 hPa
- Bottom panel is difference
- At 215 hPa differences are comparable to expected precision
- Differences at 316 hPa are a little larger then expected from noise
- The quality of the 316 hPa data needs further investigation

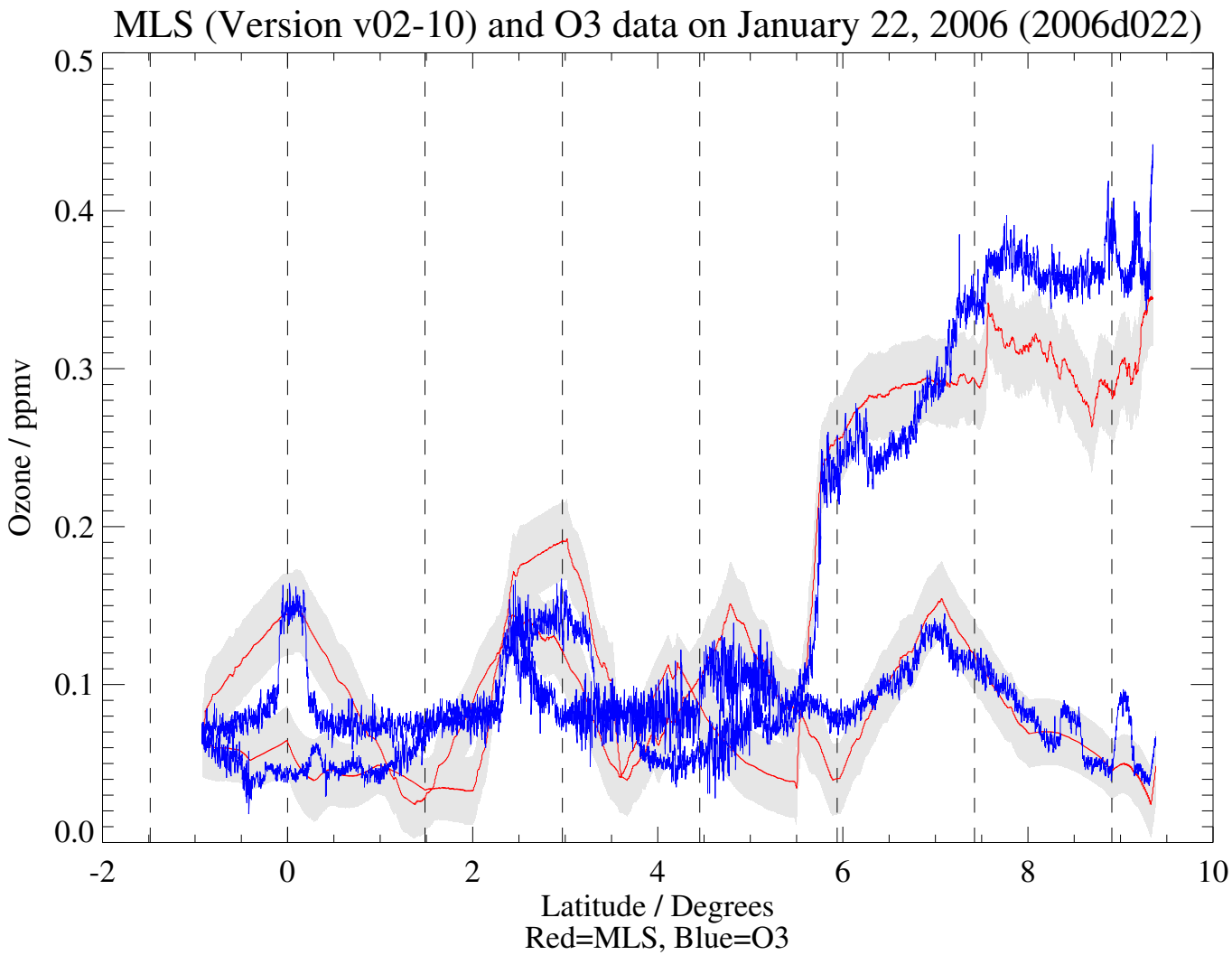


Comparison to CR-AVE NOAA photometer



- Plot compares MLS and NOAA photometer O_3 for 22 Jan 2006 CR-AVE flight
- Colored contours are MLS O_3, dots and colored rings are in situ data
- We see very encouraging levels of agreement

Same comparison as a time series



- This is the same comparison as a time series, MLS in red, NOAA in blue
- Given the MLS precision and resolution this is very good agreement indeed

Summary, plans for the UT O_3 validation paper

- The version 2.1 upper tropospheric ozone product is fairly similar to v1.5
- Data are useful at 215 hPa and lesser pressures
- The quality of the 316 hPa data needs further investigation

- There will be three O_3 validation papers from the MLS team
  1. Stratospheric and mesospheric O_3 *(Froidevaux et al.)*
  2. Upper tropospheric O_3 *(Livesey et al.)*
  3. Comparisons with sondes and ground based remote sensors *(Y. Jiang et al.)*
- For the Livesey et al. paper, we plan to:
  - ⇨ Quantify the impact of the various sources of systematic error
  - ⇨ Ensure consistency of MLS O_3 with observed MLS radiances
  - ⇨ Do more comparisons with satellite datasets (e.g., TES and AIRS)
  - ⇨ Distill in-situ comparisons shown above into summary statistics
  - ⇨ Identify issues to be resolved in later MLS versions