MLS HCl comparisons versus

HALOE, ACE, PAVE (ASUR), AVE(CIMS)

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+ team members from above measurement systems

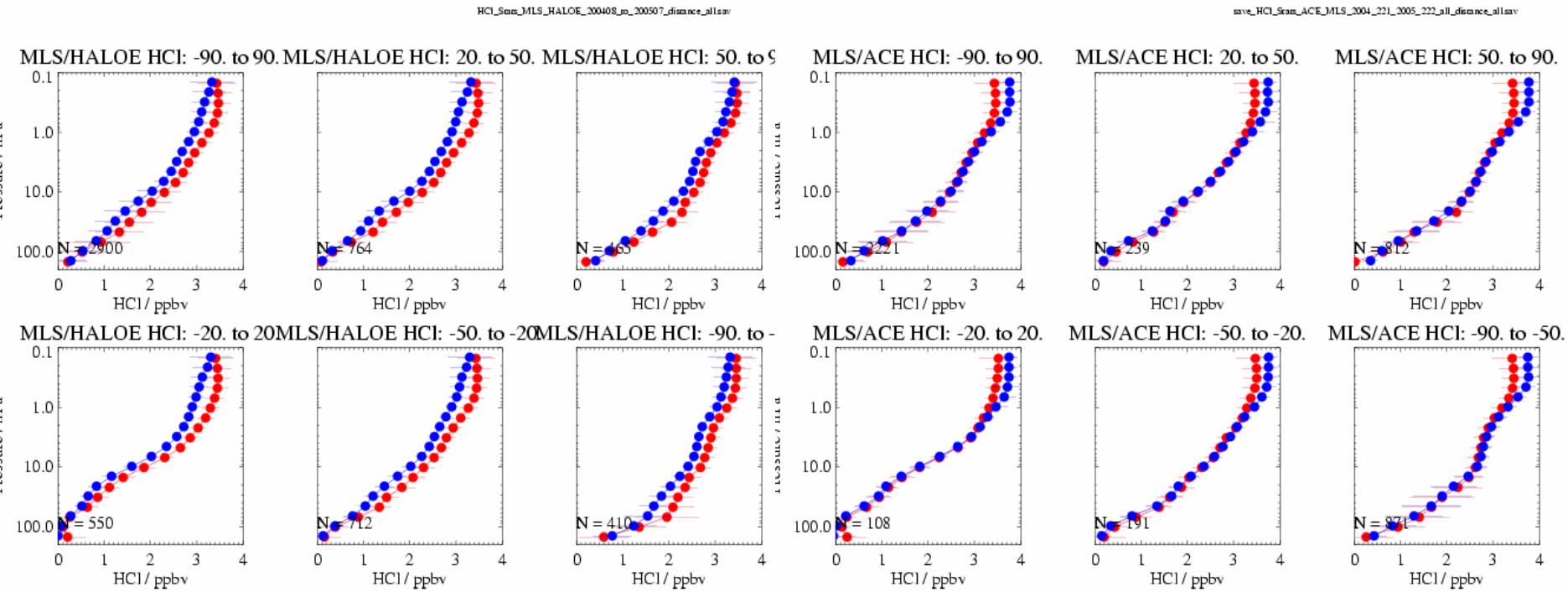
♦ Compare > 2000 coincident profiles (147 hPa to ~ 0.1 hPa) for MLS & HALOE (Aug. 04 – Jul. 05) and MLS & ACE (Aug. 04 – Aug. 05).

- find closest MLS profile in range ΔLat = ± 2 deg., ΔLon = ± 8 deg., ΔLat = ± 12 hr (same day).

ACE has more high latitude coverage than HALOE; HALOE has more coverage in the tropics.

- Avg. profiles for 6 lat. bins shown below (90S-90N, 20-50 N & S, 20S - 20N, 50 – 90N & S).

MLS (V1.5) vs HALOE (V19) MLS (V1.5) vs ACE (V2.2)



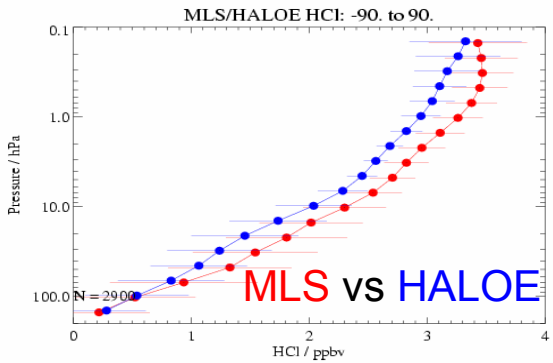
As noticed previously (Dec. 04 AGU; Froidevaux et al. IEEE paper, submitted)
MLS HCl > HALOE HCl and MLS HCl is close to ACE HCl, except in lower mesosphere where ACE HCl > MLS HCl.

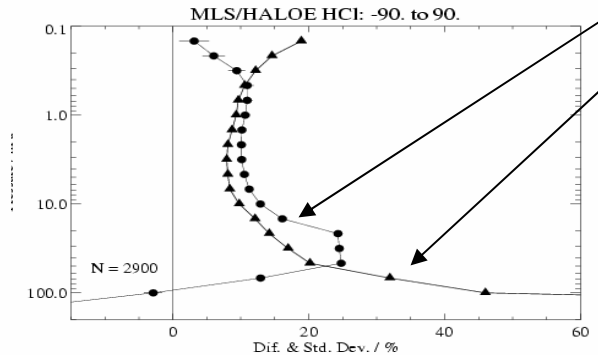
Global Profile Averages

Percent Differences

0.1 hPa

100 hPa

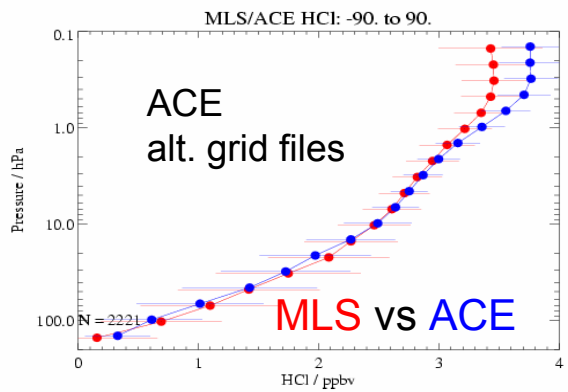


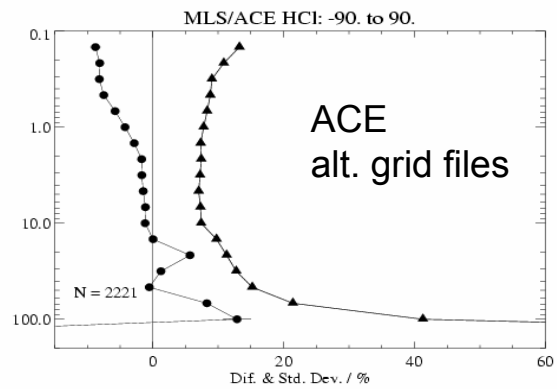


0 20 40 60

0.1 hPa

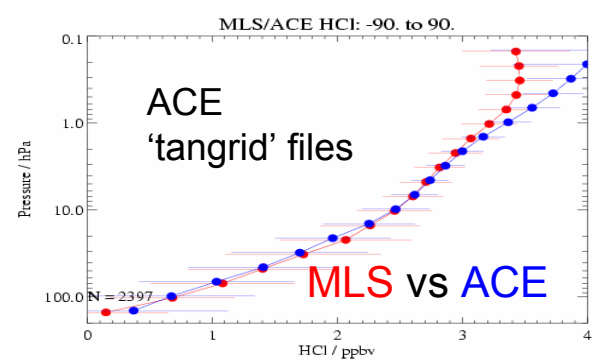
100 hPa

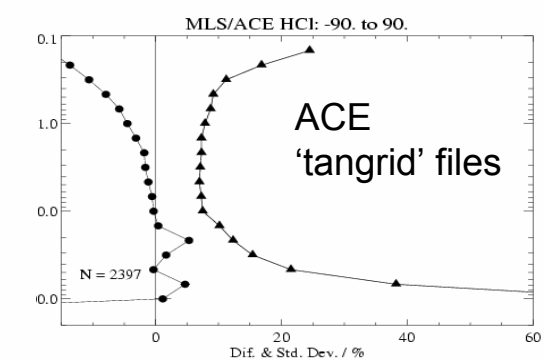




0.1 hPa

100 hPa



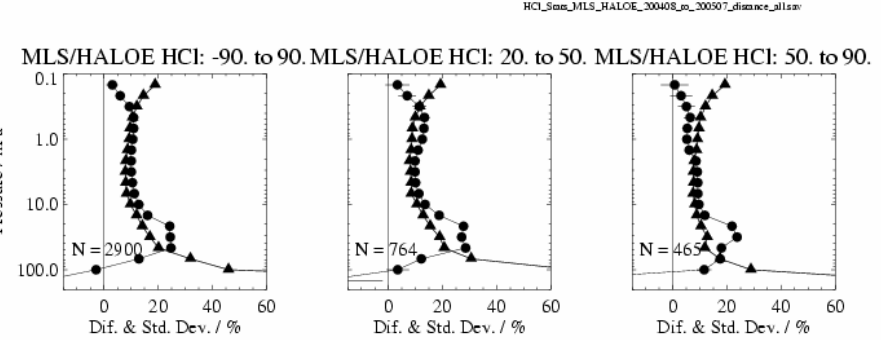


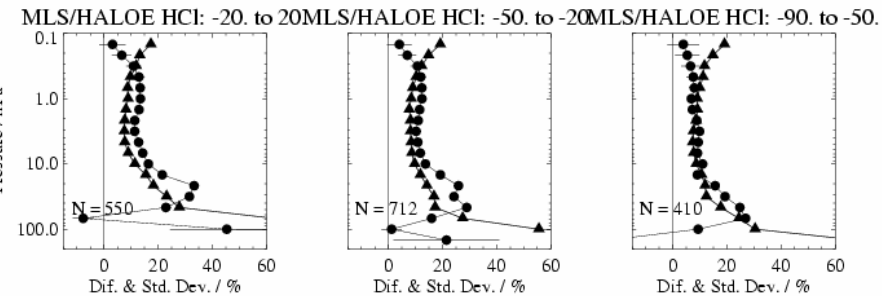
Dots: Mean Difs. (%) [& 2xerror in mean]
Triangles: Std. dev. of difs.

For strat. HCl, on avg.
- MLS > HALOE by ~ 10 - 20%.
- MLS within ~ 5% of ACE.

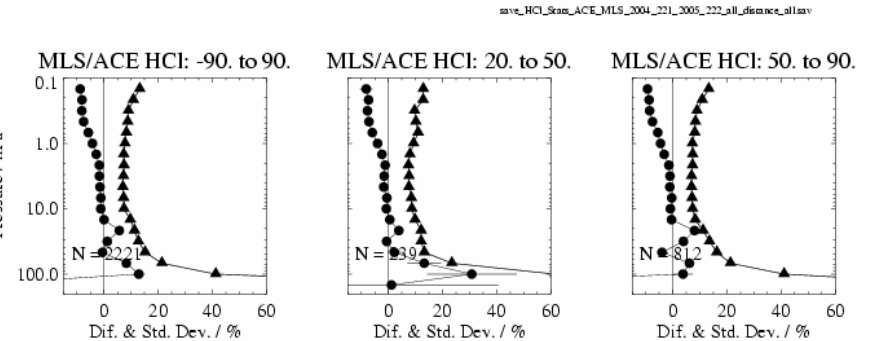
In lower mesosphere:
- MLS HCl peaks and starts to come down.
- HALOE HCl shows no peak.
- ACE values become > than MLS; 'tangrid' files appear to do so even more (flag these?)
> ACE retrieval tests being done.
> Will double-check MLS sensitivity also, for mesosphere.

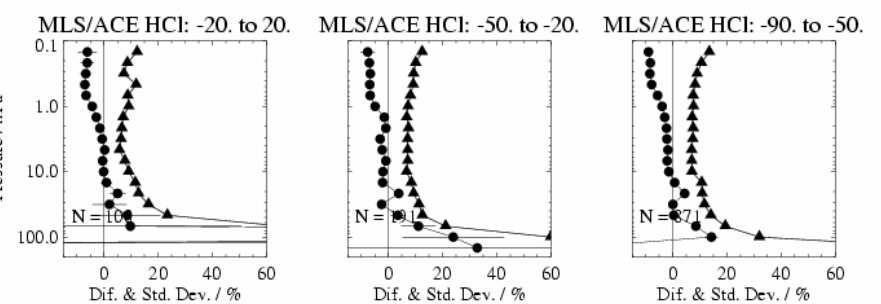
HCl percent differences





MLS vs HALOE in various lat. bins

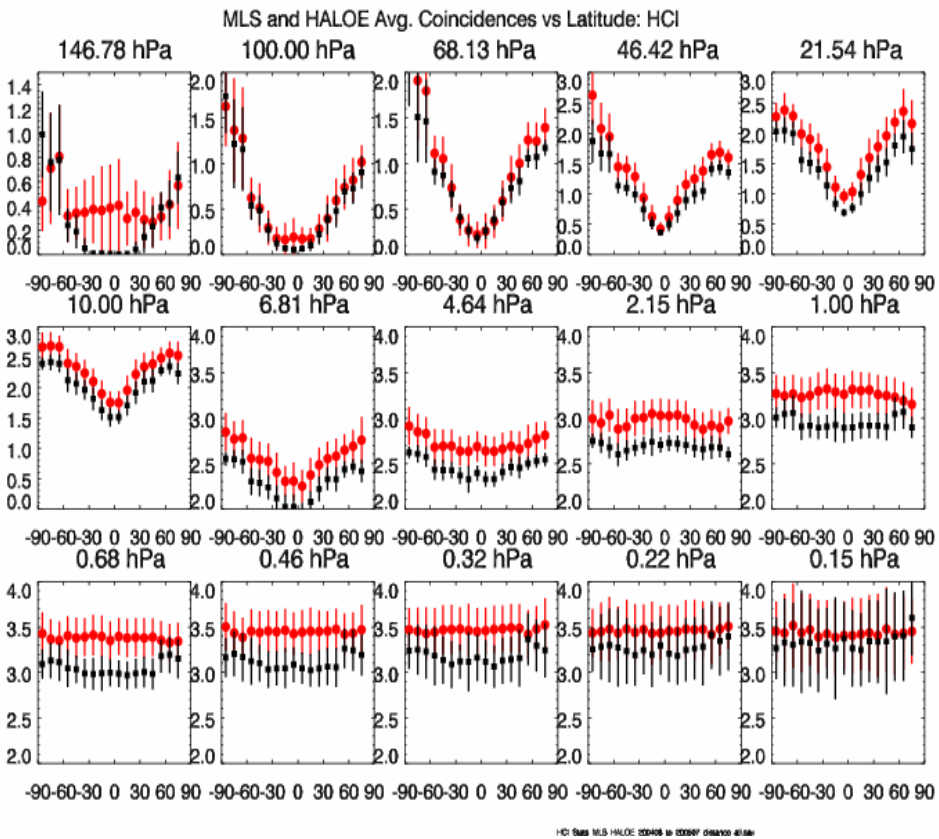




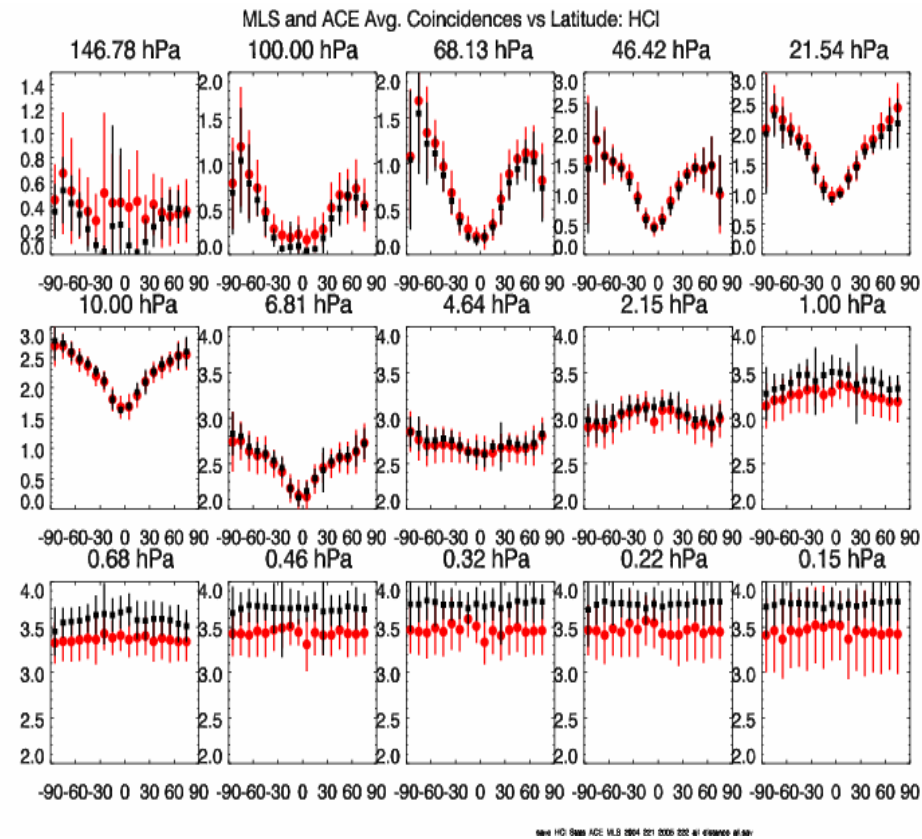
MLS vs ACE in various lat. bins

Variation of HCl differences versus latitude

MLS vs HALOE



MLS vs ACE

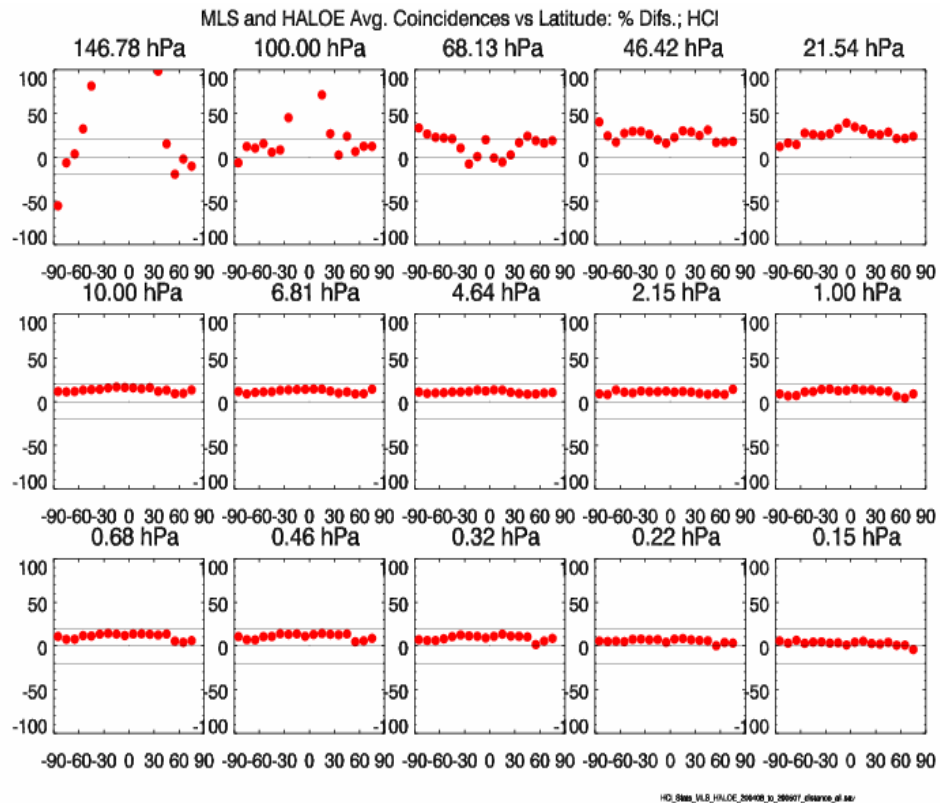


MLS values at 147 hPa appear too large, mainly equatorword of ~ 40° lat.

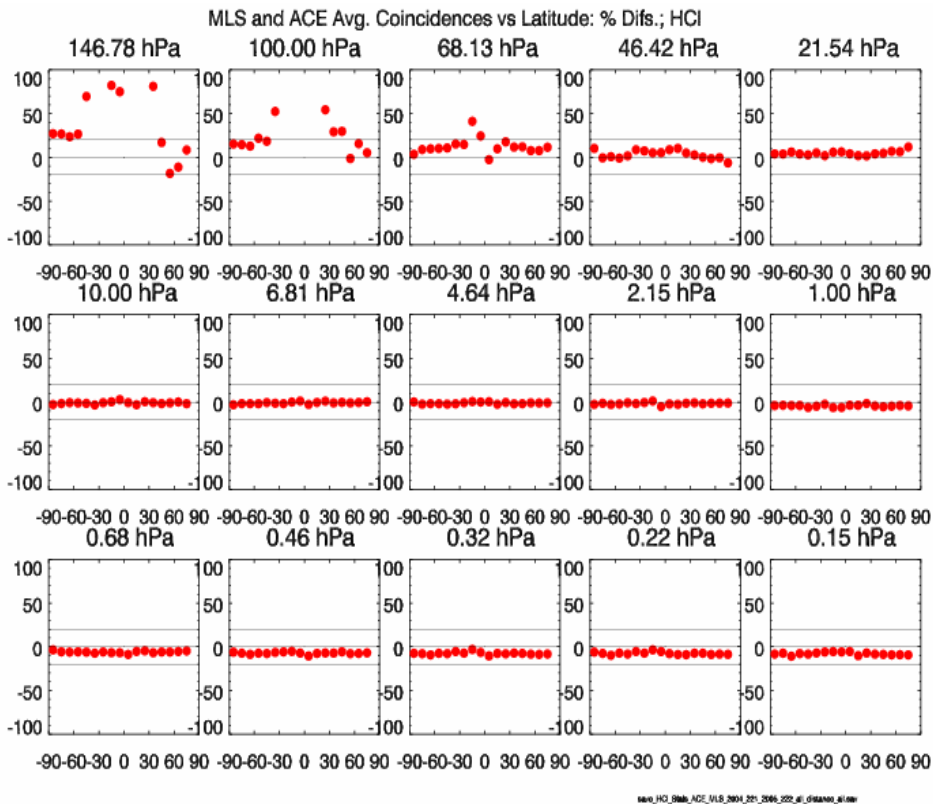
- not currently recommended for use.

Variation of HCl differences versus latitude

MLS vs HALOE



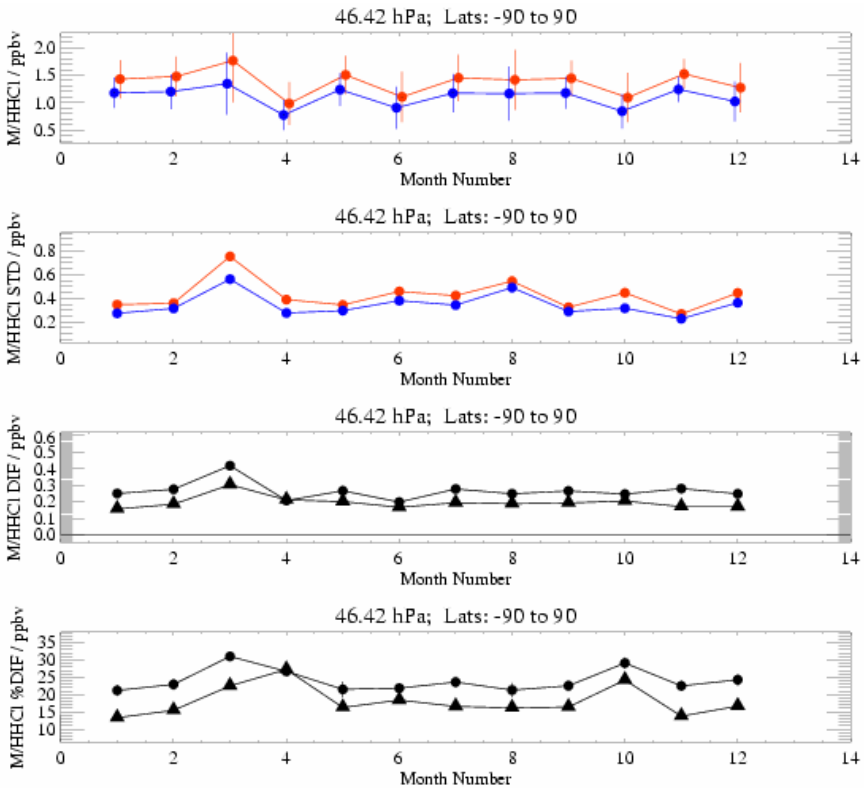
MLS vs ACE



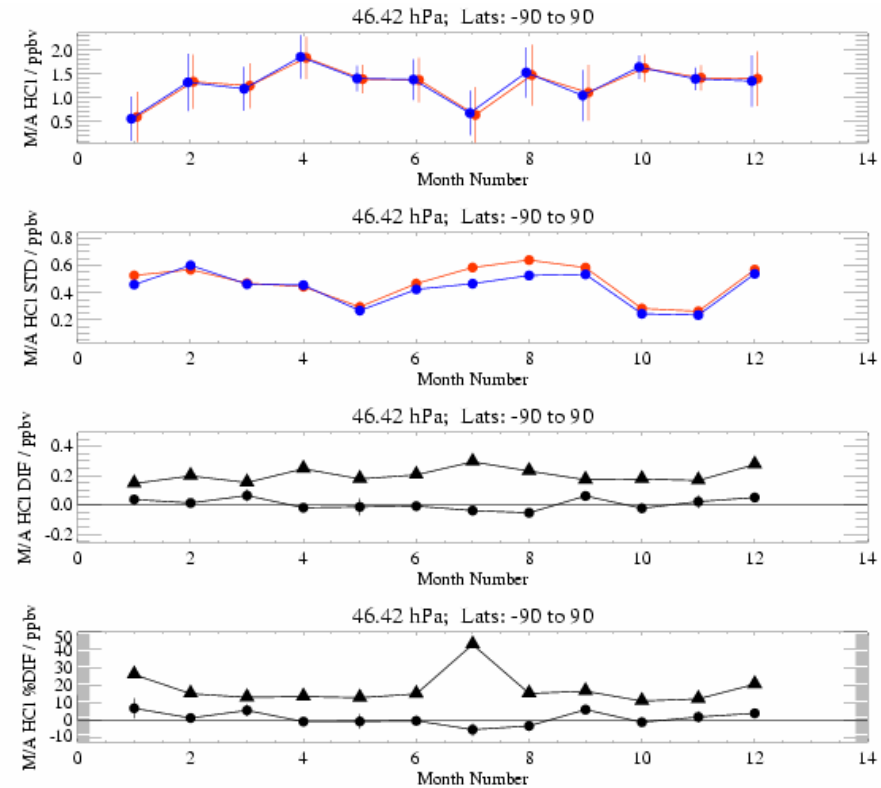
> Differences (for whole year of data) seem quite constant vs latitude.
> MLS vs ACE difs. may be a bit more stable than MLS vs HALOE difs. (e.g., at 22 hPa).

Variation of HCl differences versus time: 46 hPa

MLS vs HALOE



MLS vs ACE



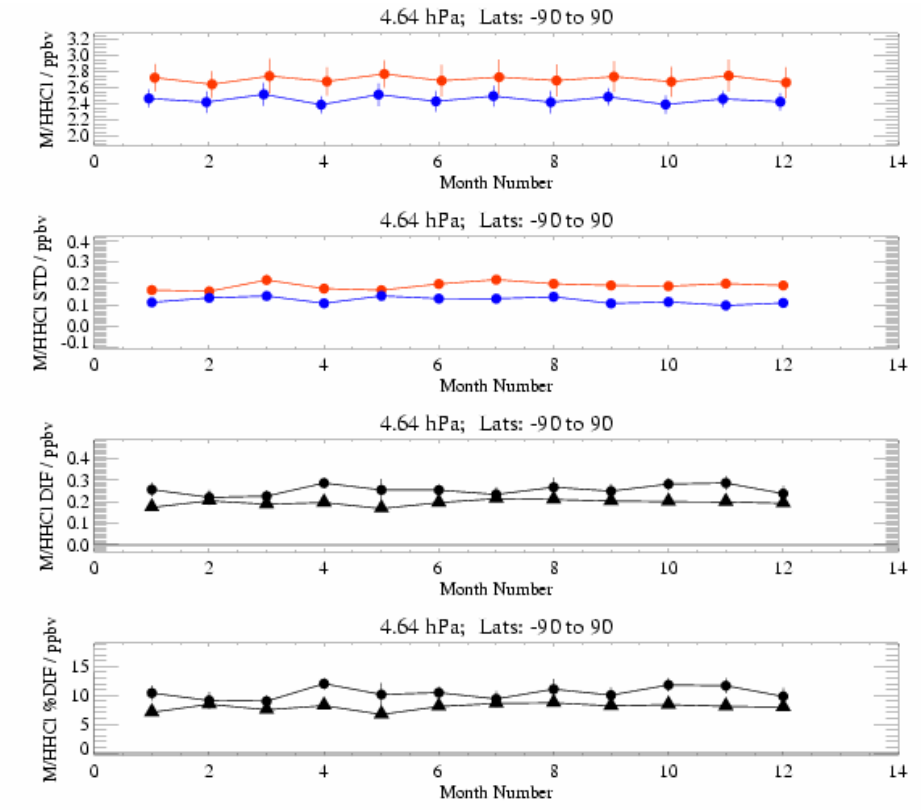
Row 1: Avg. monthly values (Aug. 04 to Jul. 05), for global average coincidences
Row 2: Std. dev. of values within each month
Row 3: Mean Dif. *(dot)* [+ error in mean dif.] & std. dev. of difs. *(triangle)*
Row 4: Same as row 3, but for % Dif. (vs correlative data)

> Monthly avgs. & variability <u>within each month</u> (row 2) track quite well.

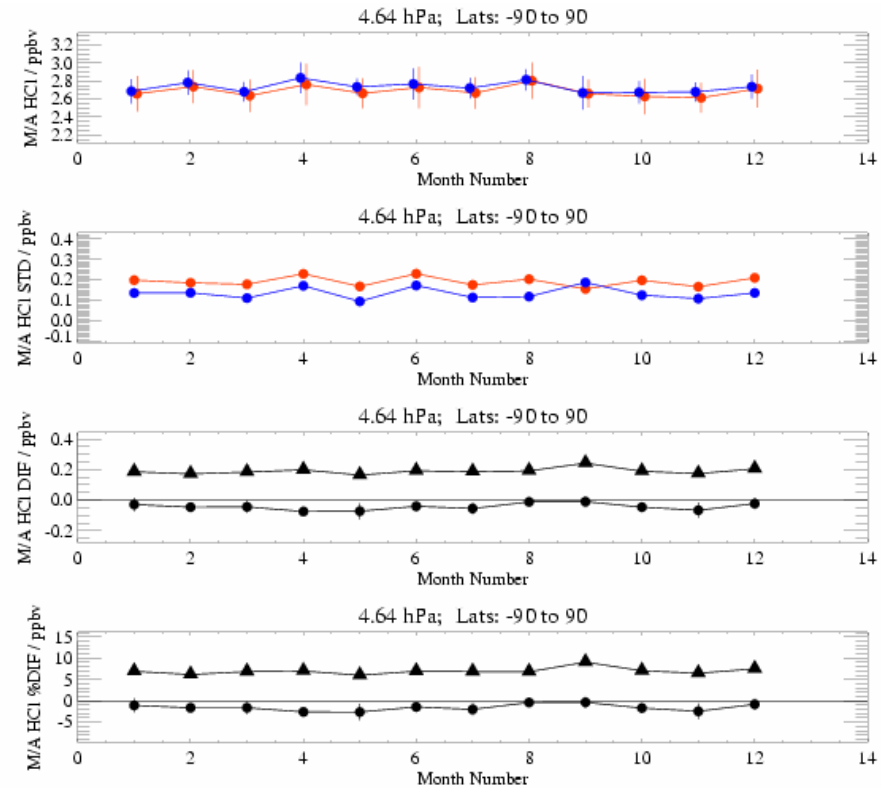
- may seem a bit more stable for MLS/ACE than for MLS/HALOE (see also next 2 slides).

Variation of HCl differences versus time: 5 hPa

MLS vs HALOE



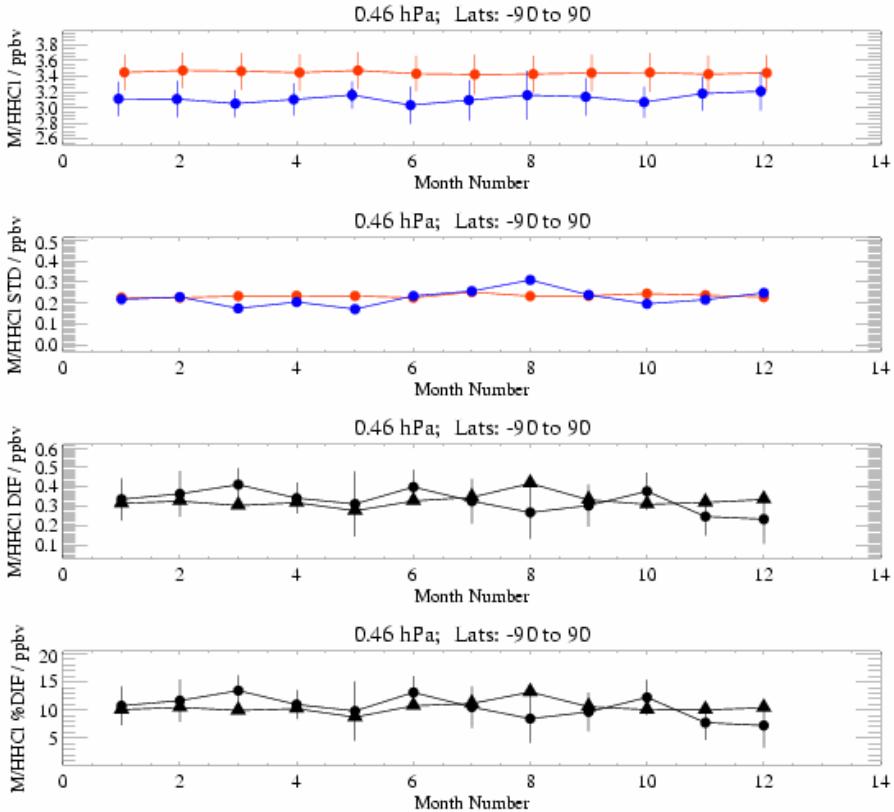
MLS vs ACE



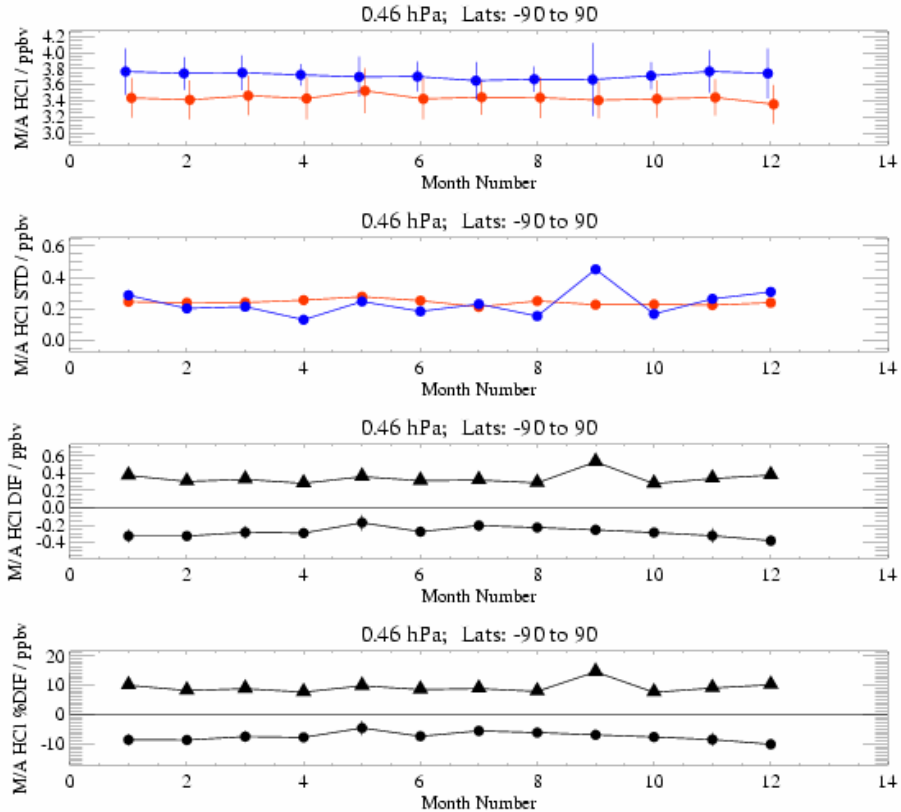
Row 1: **Avg. monthly values (Aug. 04 to Jul. 05), for global average coincidences**
Row 2: **Std. dev. of values within each month**
Row 3: **Mean Dif. *(dot)* [+ error in mean dif.] & std. dev. of difs. *(triangle)***
Row 4: **Same as row 3, but for % Dif. (vs correlative data)**

Variation of HCl differences versus time: 0.5 hPa

MLS vs HALOE



MLS vs ACE



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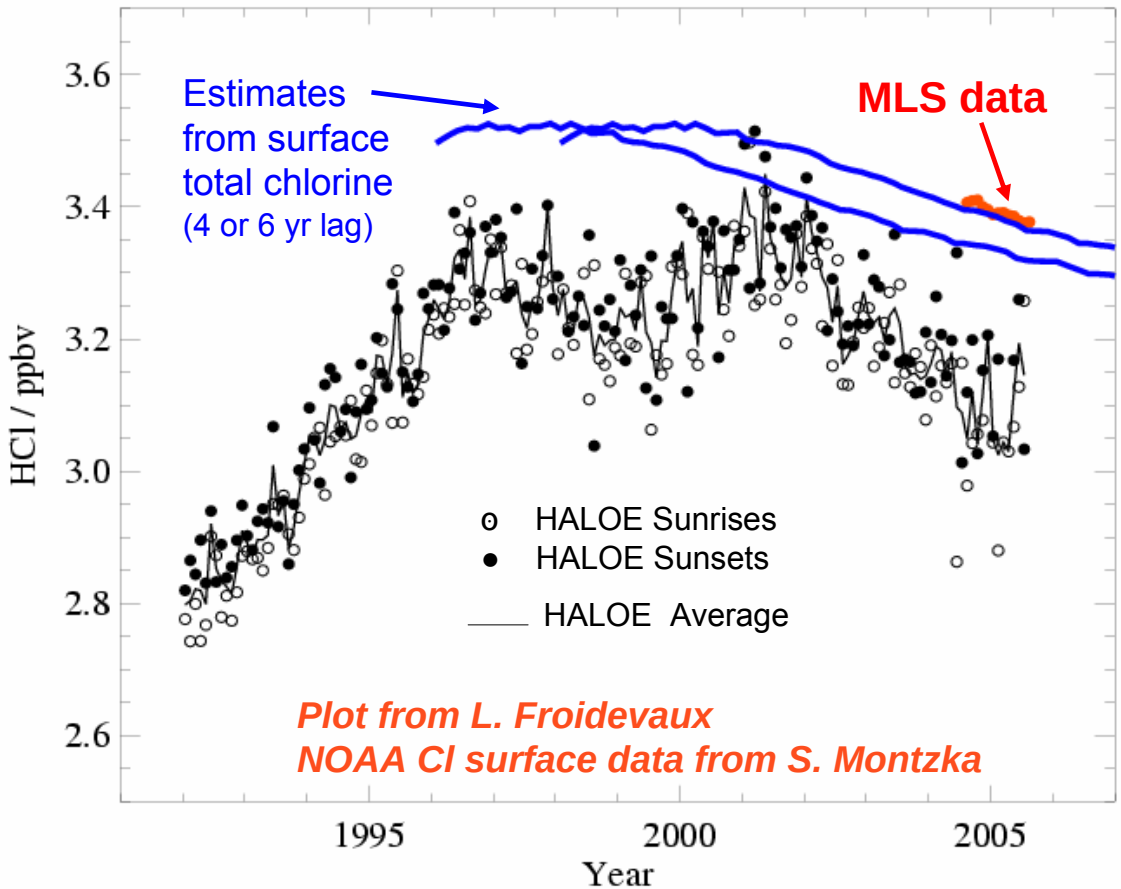
HCl variations at 50-60 km



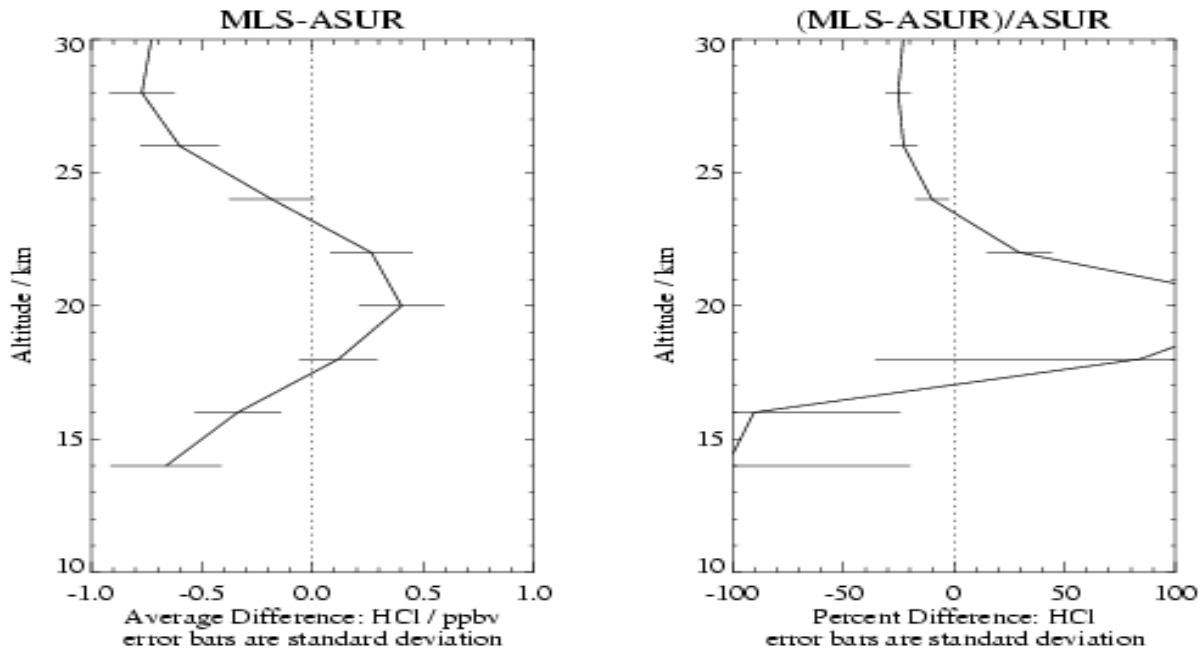
60S-60N averages for HALOE and MLS data

More to be done to reconcile all data (+ models)
- see also work by R. Salawitch et al.

> Error in monthly means is within dot size for MLS
- large num. of profiles sampled daily, regularly, and globally by MLS.

> MLS HCl slope seems to be consistent with expectations from ground-based data (with simple time lag).
- absolute agreement for MLS seems good also (given that there are assumptions and error bars…).

MLS HCl versus PAVE (ASUR) HCl



> 65 profiles were chosen as ‘close coincidences’ during several PAVE flights.

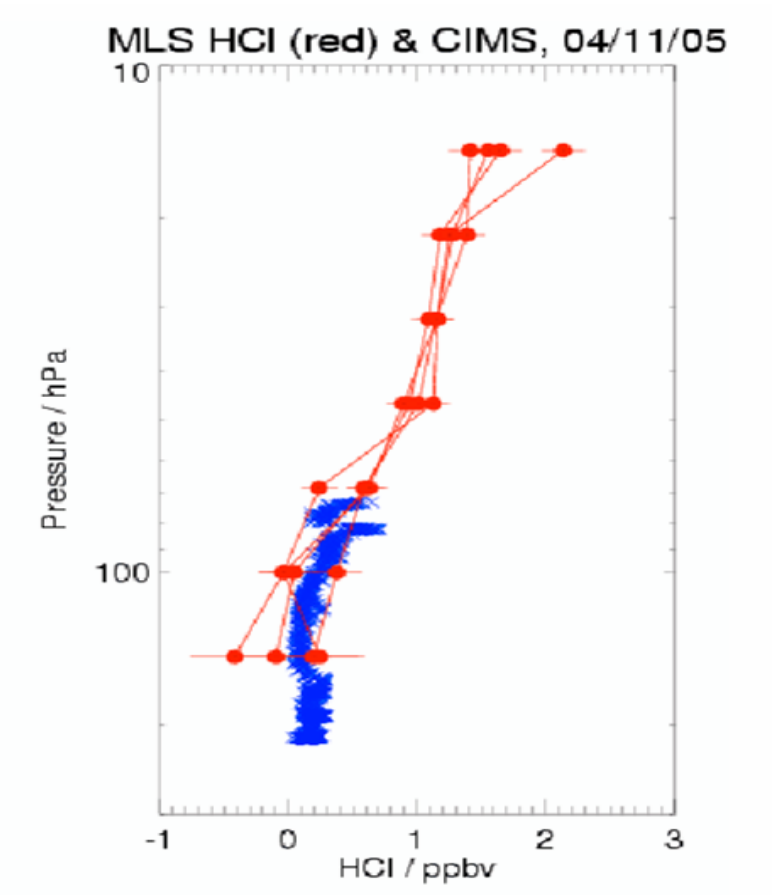
> Average results are shown here (per study by M. Santee and N. Livesey)

> ASUR and MLS disagree in shape of profile (even with averaging kernel smoothing).

> Results do not agree very well with other comparisons of MLS vs HALOE, ACE, or balloon. ASUR values (z > 23 km) are larger than MLS by ~20% (same as for O_3).

> To be continued / discussed…

MLS HCl versus AVE (CIMS) HCl



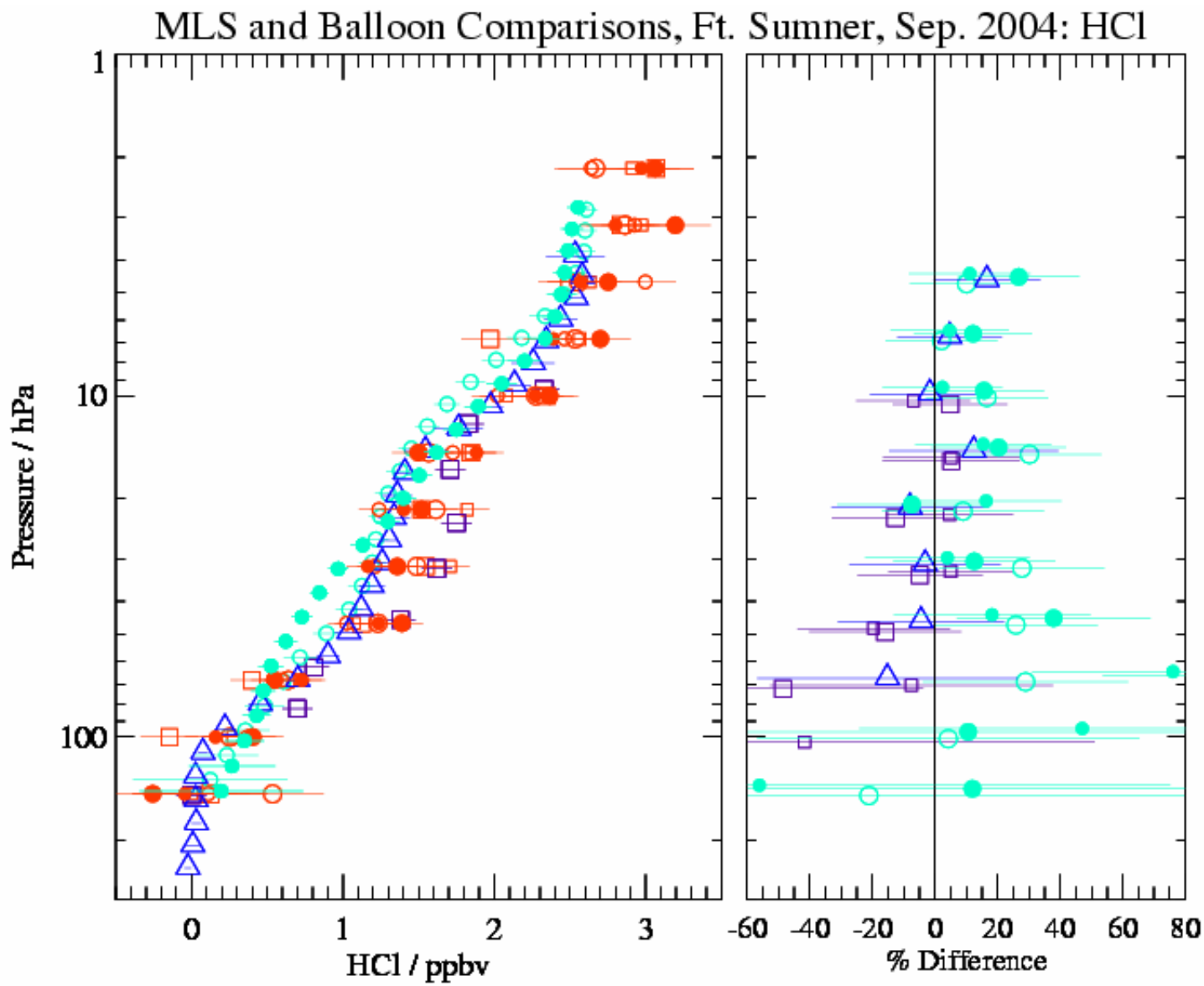
> Profiles from AVE 04 showed agreement with MLS within the error bars, but there may not be enough profiles to come up with a statistically significant comparison.

> T. Marcy showed some nice comparison plots and HCl / O3 correlation plots.

> Worth pursuing and looking at all the AVE flights that are available.

> Tropical campaign measurements could confirm some MLS HCl artifacts low down. [high MLS values at the lowest levels, mainly 147 hPa].

Sample HCl comparison
(MLS in red, CIMS in blue)
for Houston AVE, Nov. 2004.



No clear systematic difference emerges from 1 balloon flight.

See IEEE paper.

Maybe the 2005 flight will help, if get good HCl data from SLS as well as MkIV and FIRS.

Summary and future work

> MLS HCl follows the behavior of HALOE HCl very well, after 1 year of data, except for an offset.

> Latitudinal and temporal changes track well between MLS, HALOE, and AC; poorer at the lowest altitudes (P of 147 hPa not currently recommended for MLS).
- 100 to ~ 0.1 hPa is recommended range for MLS data.

> The MLS HCl offset versus HALOE HCl is 10-25% and is seen globally.
- HALOE values seemed somewhat low (by 10-15%) based on 1996 JGR validation paper for HALOE. ACE comparisons vs MLS seem to confirm this, since MLS HCl agrees with ACE HCl (from 1 year of coincident profiles).
- The ACE values in the mesosphere seem to become too large. The MLS values decrease slightly up high, towards 0.1 hPa (where HALOE data tend to be constant)..

➢Time series of monthly mean MLS data (global, or 60S-60N) shows good agreeement with expectations from ground-based Cly data (shifted by 6 years), for slope of variation and absolute values.

➢ Some limited comparisons vs CIMS (AVE), balloons, ASUR (PAVE); no firm conclusions, but main disagreement is with ASUR (> 20% below 22 km).

> Plan to continue / refine these studies (+ discuss more here).