UNH Soluble Acidic Gases and Aerosol (SAGA) during INTEX Phase A

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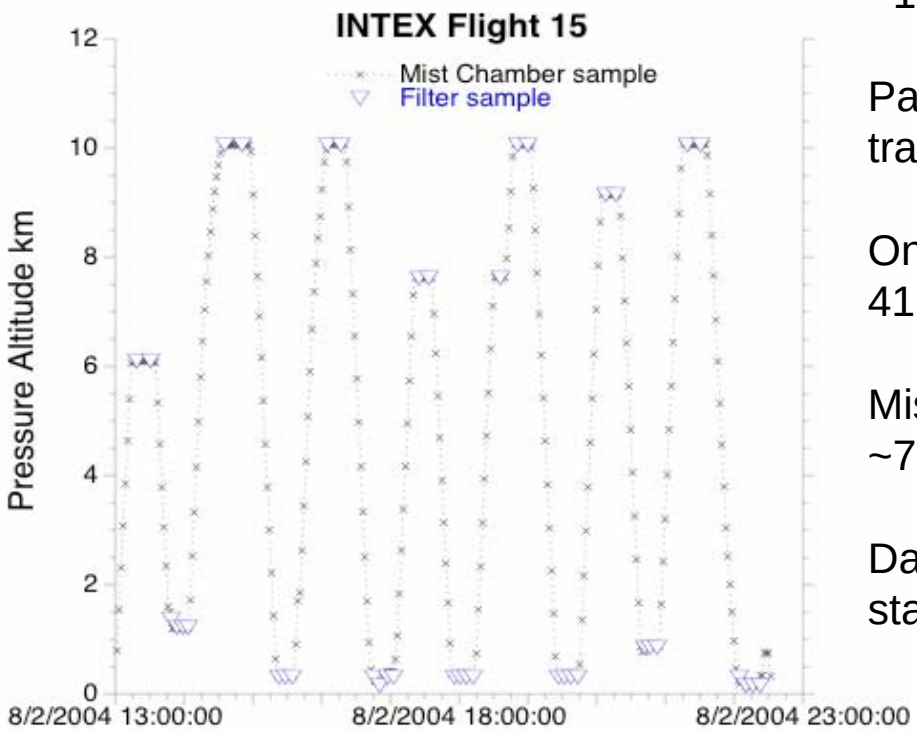
With Thanks to the INTEX Science Team



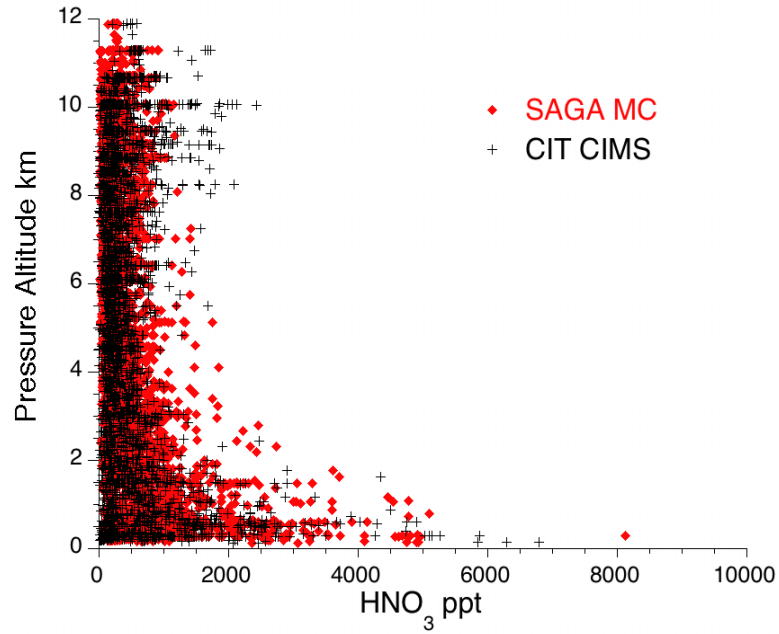
HNO_3 and fine $SO_4^=$ in MC every ~106 seconds.

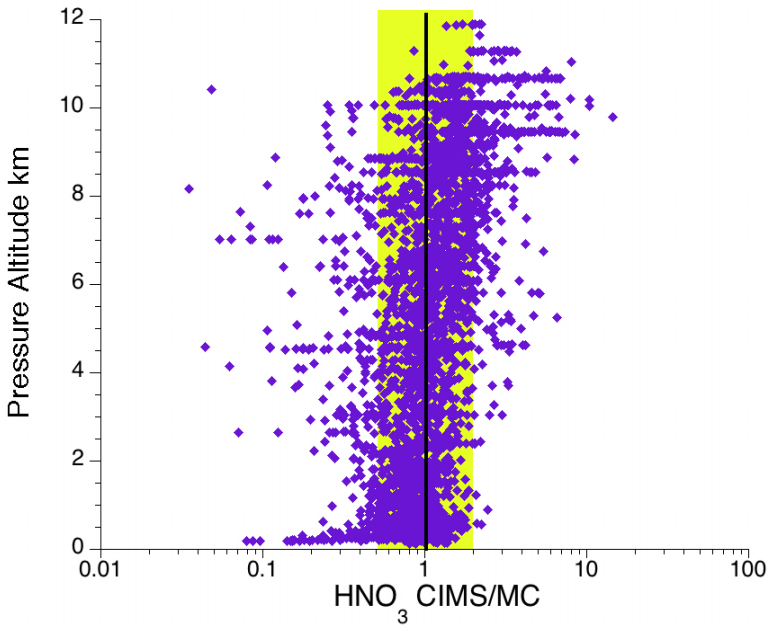
Paired filter samples (ions and radionuclide tracers) on level legs.

On this example flight 323 MC samples, 41 filter samples.

Mission totals: ~ 5000 MC samples, ~700 filters.

Data “final” except for ^{210}Pb (analysis will start soon).





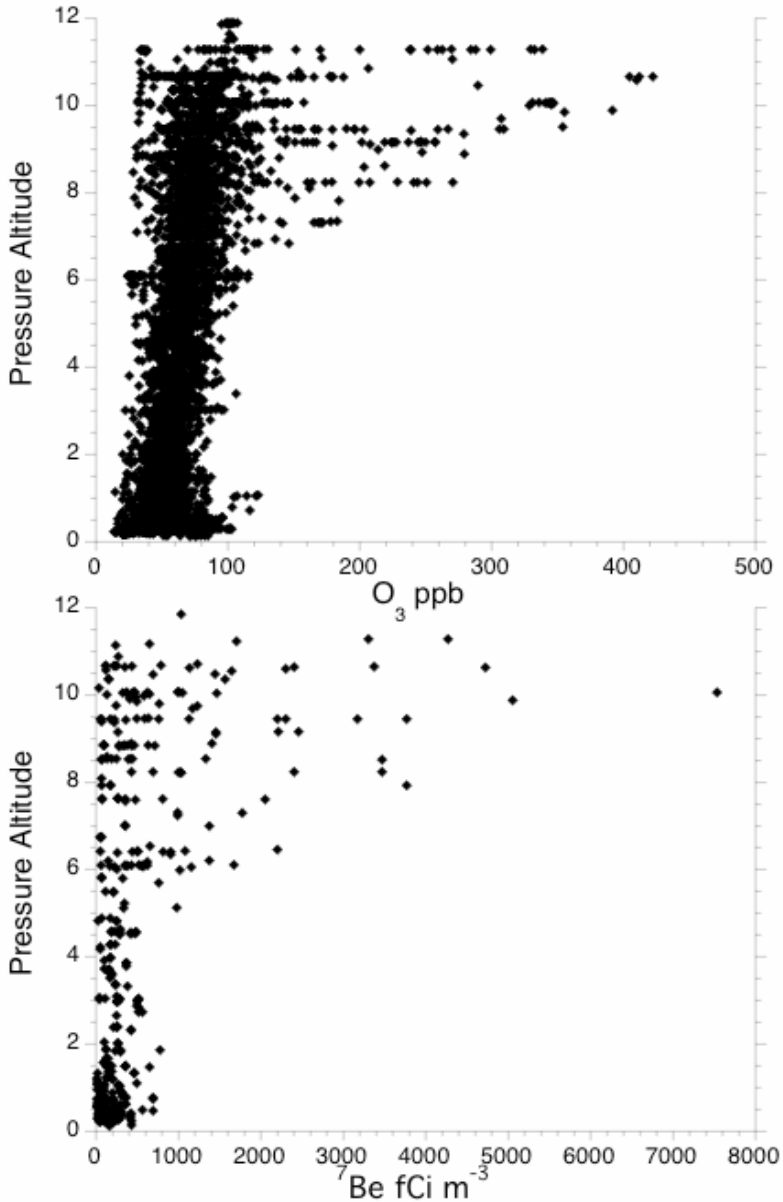
Two different measurements of HNO_3 on the DC-8.

Agreement between the SAGA MC and CIT CIMS is reasonable at first glance.

For the 3156 overlapping samples in the MC merge the mean value of the ratio CIMS/MC was 1.30±0.98, with median of 1.07.

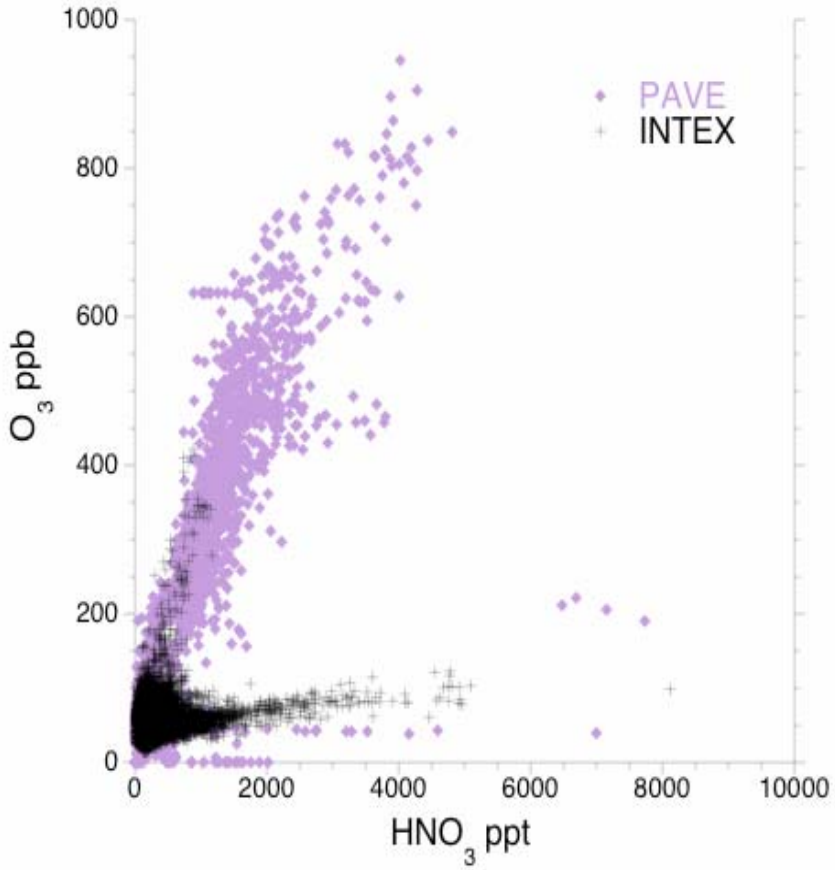
However, there is substantial scatter, and an apparent trend in the ratio with altitude.

There is a poster with more details, see John Crounse if you are interested but missed it last night.



In the field we all noted that O_3 was pretty low in the troposphere. High O_3 in stratospheric parcels was encountered, but did not seem that frequent or important as a source of tropospheric O_3.

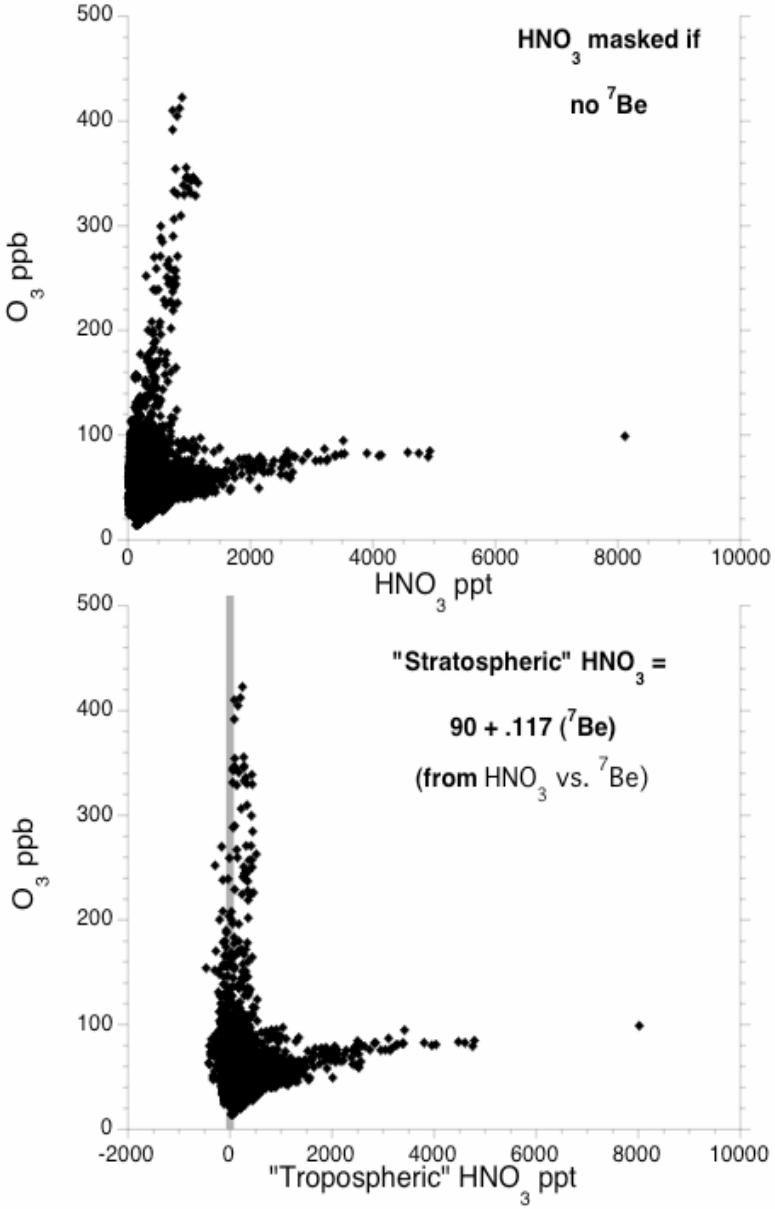
Altitude distributions of O_3 and ^7Be suggest strat influence may have been significant above 6-7 km.



Relationship between HNO_3 and O_3 clearly indicates distinct “strat” and “trop” populations in the INTEX data set.

The INTEX “strat” relationship is very similar to what we found on PAVE in Jan-Feb, 2005.

Also, measurements by Fahey from the WB-57 during AVE Houston (Oct, 2004) show the same trend.

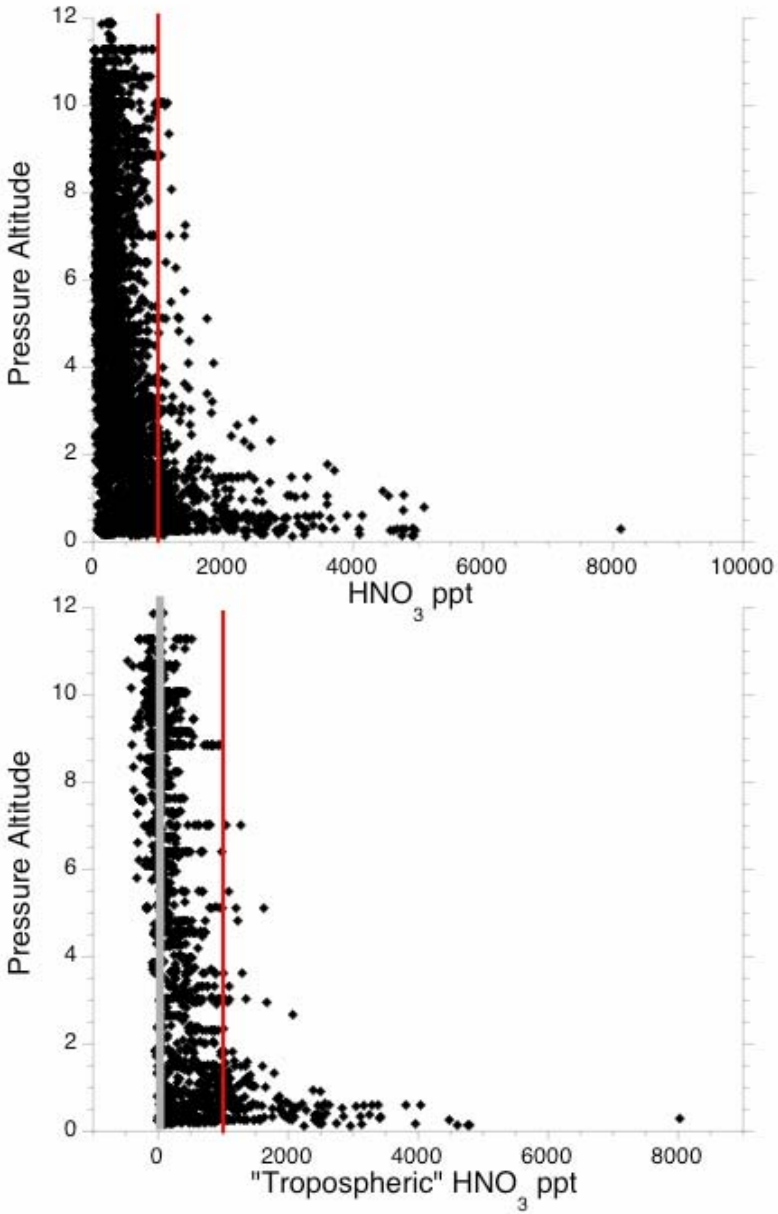


Can the stratospheric influence be filtered out?

Choosing thresholds of O_3 or ^7Be problematic near the vertex of the two “arms” of the distribution.

The correlation between HNO_3 and ^7Be in the clearly “strat” influenced airmasses can be used to estimate “strat” HNO_3, hence “trop” HNO_3 as the residual.

Encouraging, but, we only have ^7Be on level legs!



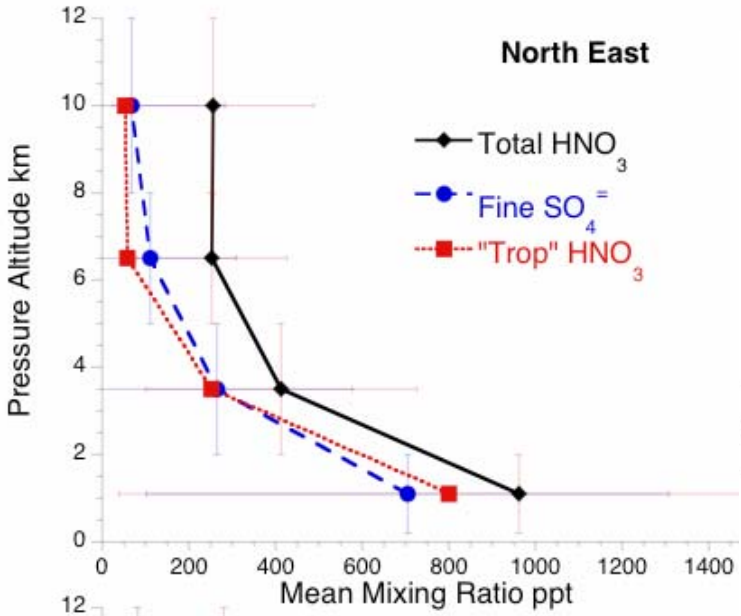
Estimated “trop” HNO_3 nearly an order of magnitude lower than total in UT/LS, and 2.5 times lower in mid troposphere.

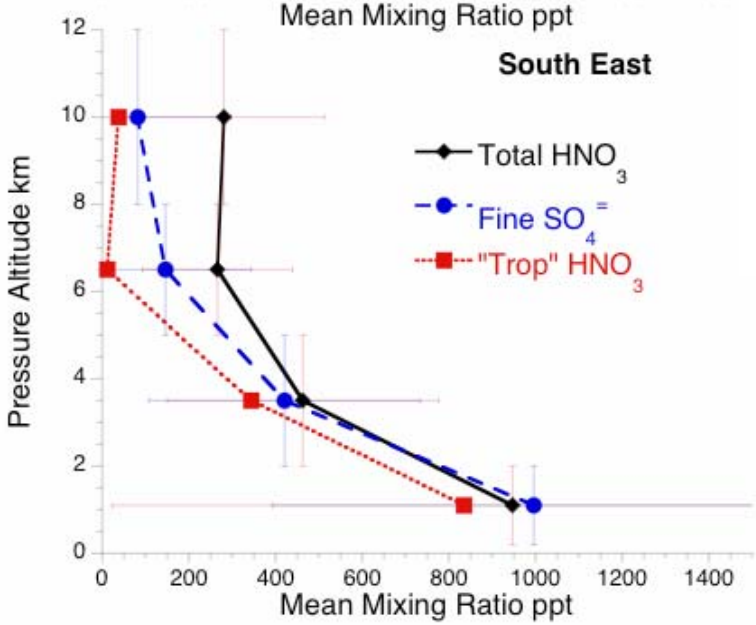
Above 8 km mean = 232 ppt
(1464 samples)

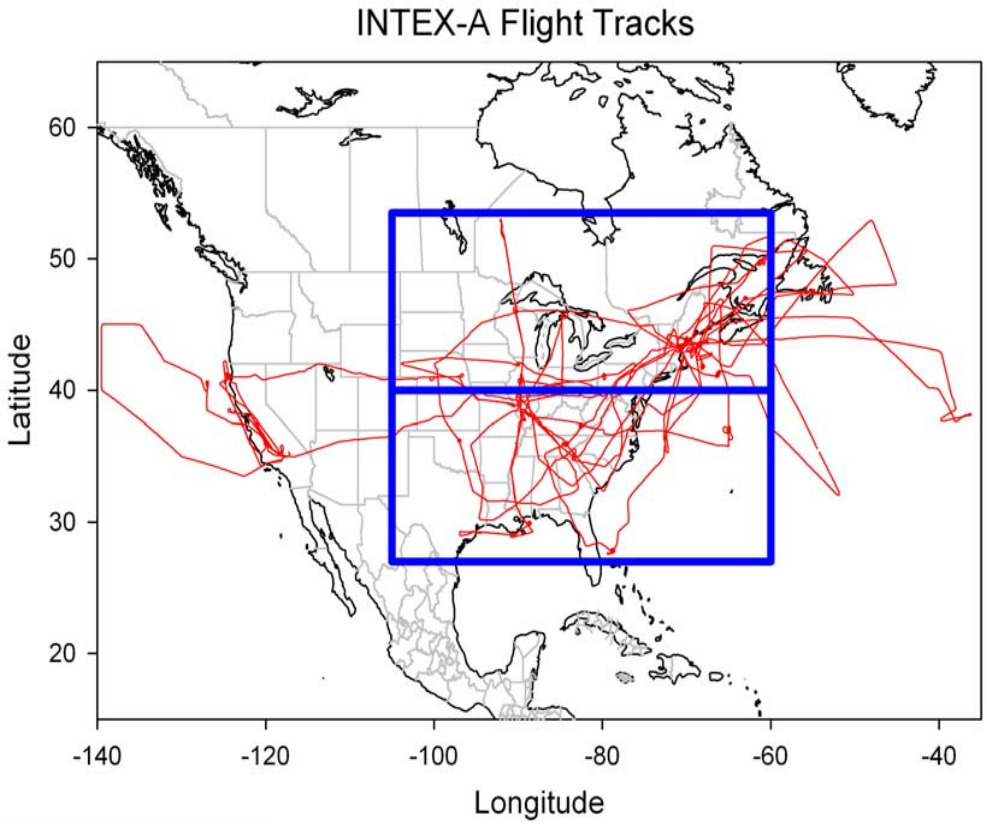
5-8 km mean = 267 ppt
(975 samples)

Above 8 km mean = 25 ppt
(825 samples)

5-8 km mean = 101 ppt
(393 samples)

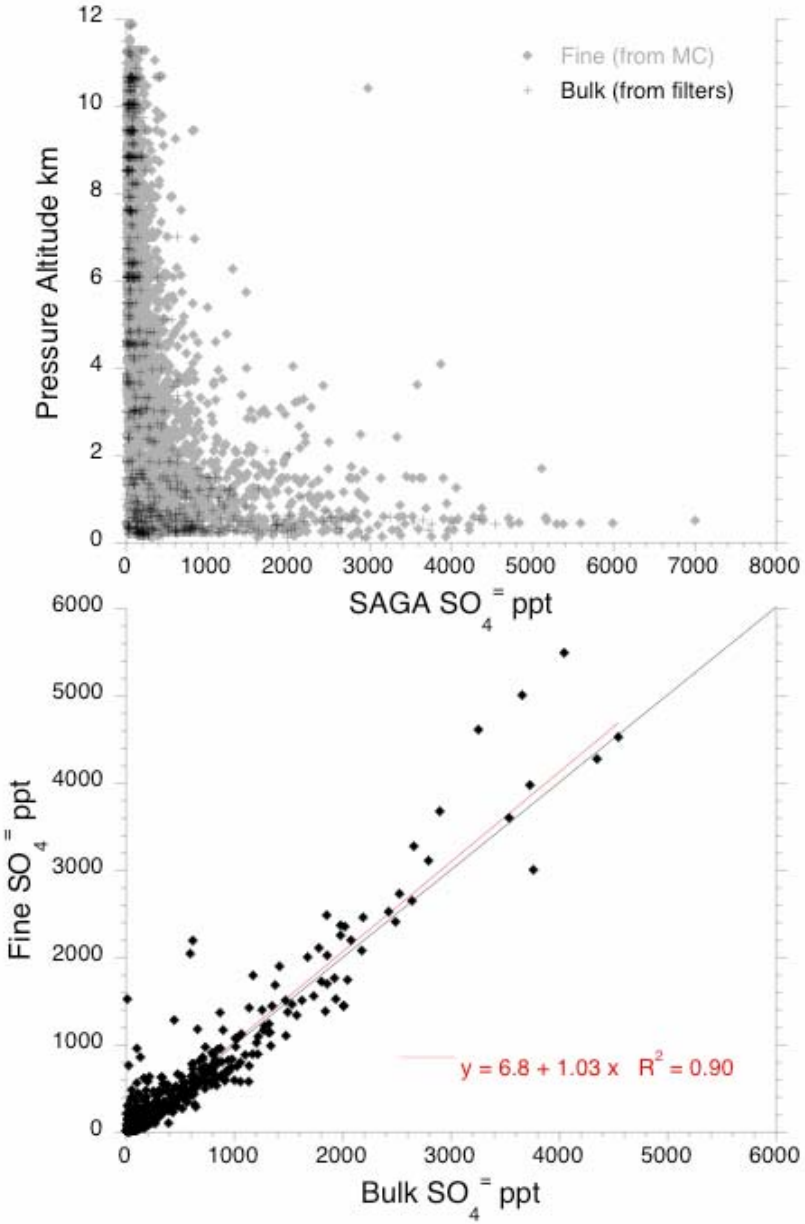






Suggested (during mission and at AGU) that enhanced HNO_3 in UT could reflect convection.

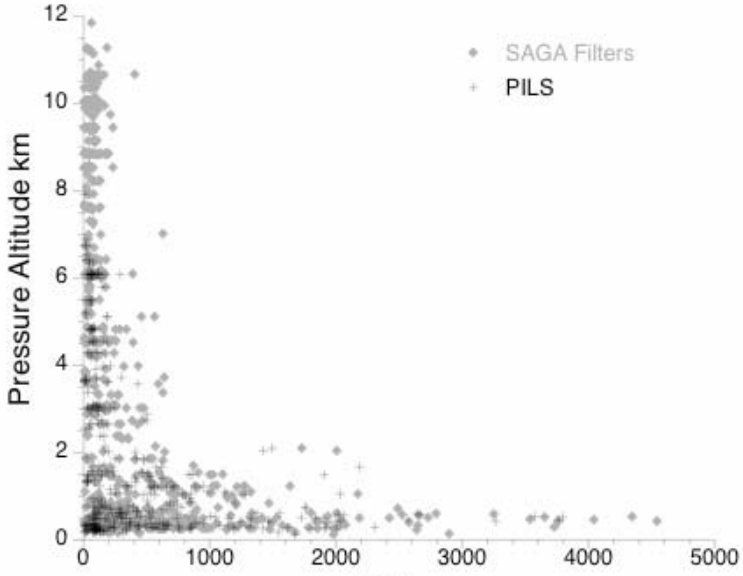
May still be true, remember the ^{7}Be filter excludes many samples taken on ascents/descents.

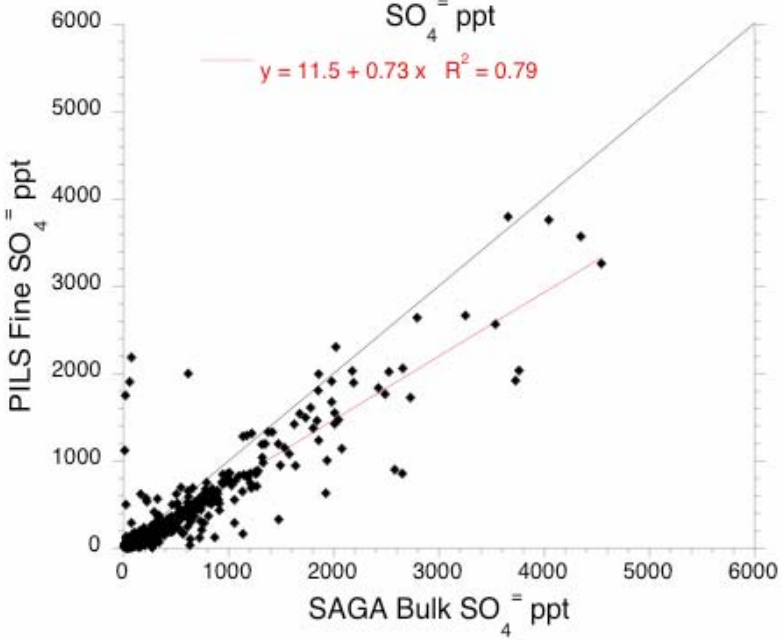


Three different measurements of $SO_4^=$ in aerosol on the DC-8.

The SAGA MC data on fine (< 2.5 micron) $SO_4^=$ agrees closely with the SAGA filter-based data.

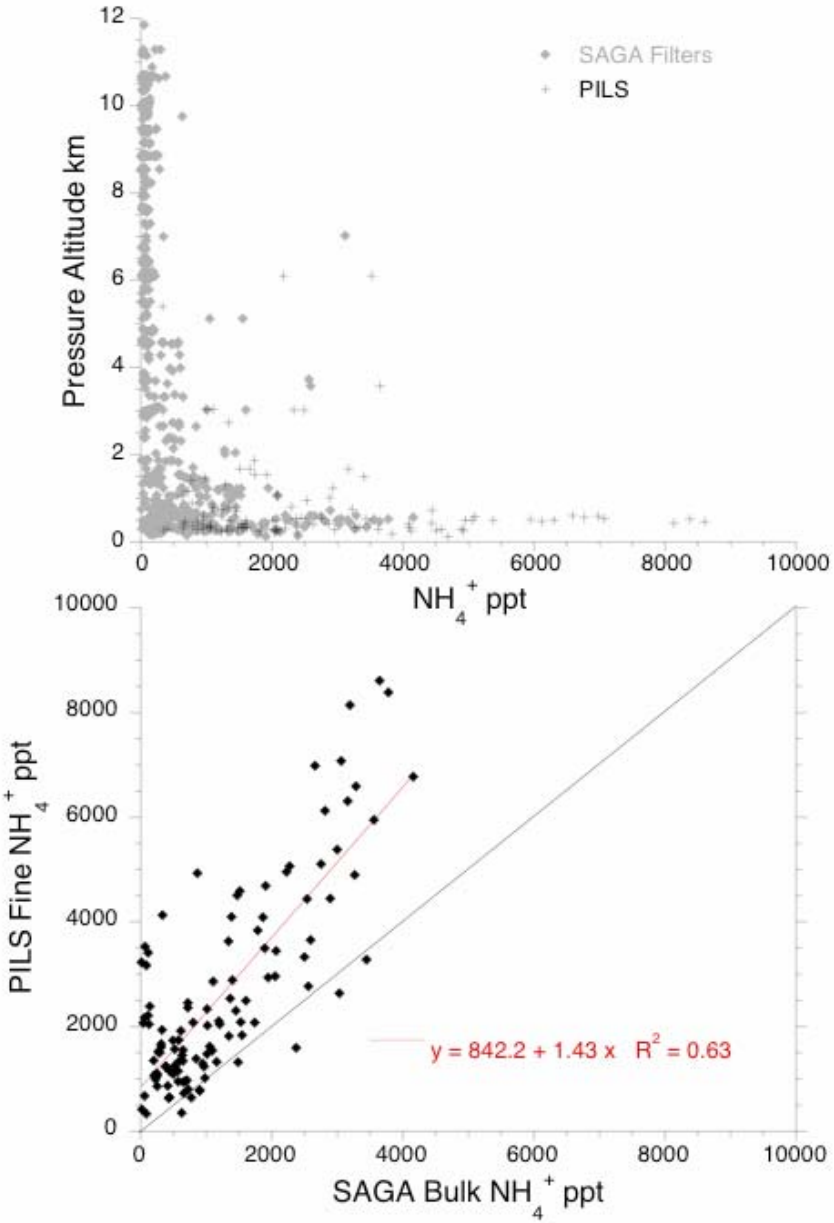
Differences between the two techniques should generally fall below the 1:1 line if there is any coarse $SO_4^=$, so the agreement is a little “too good”.





SAGA bulk $SO_4^=$ was generally > PILS sub-micron $SO_4^=$.

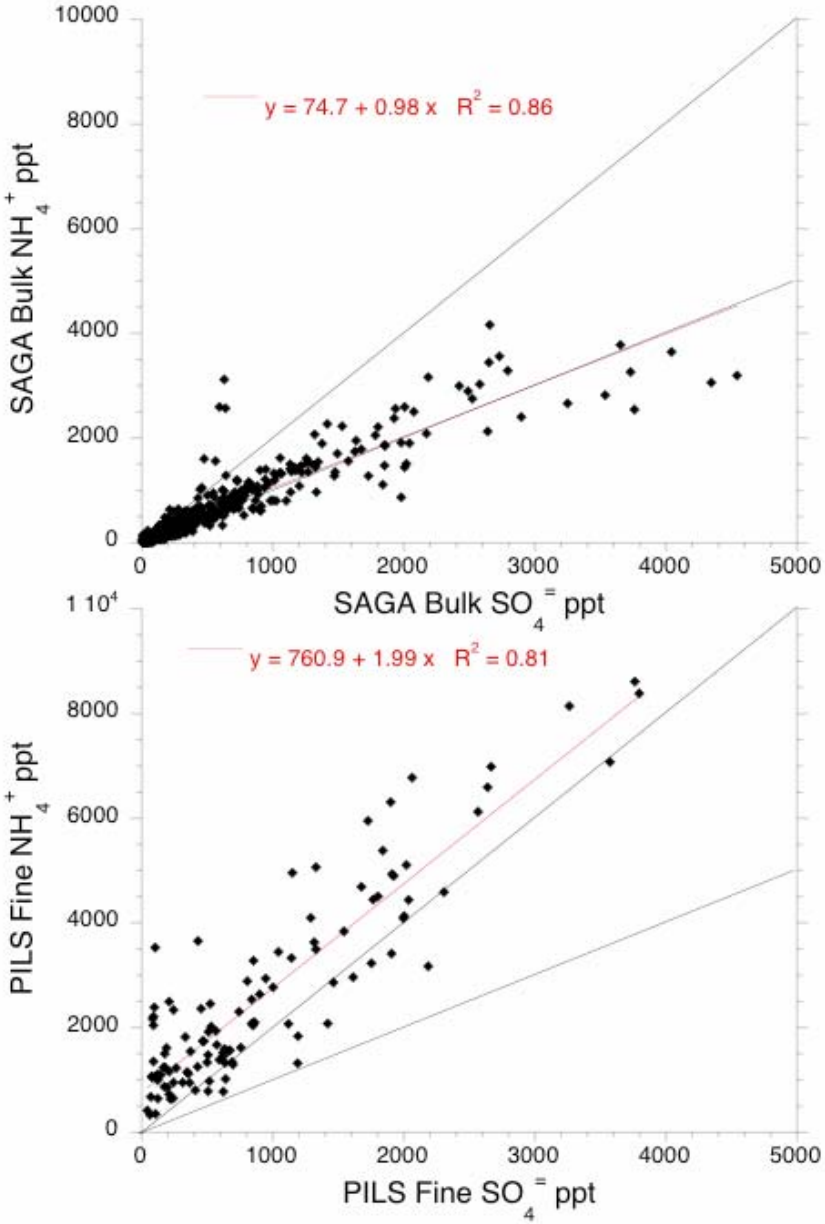
(This is very much as expected, but still good news!)



SAGA measurements of NH_4^+ were usually much less than those by PILS.

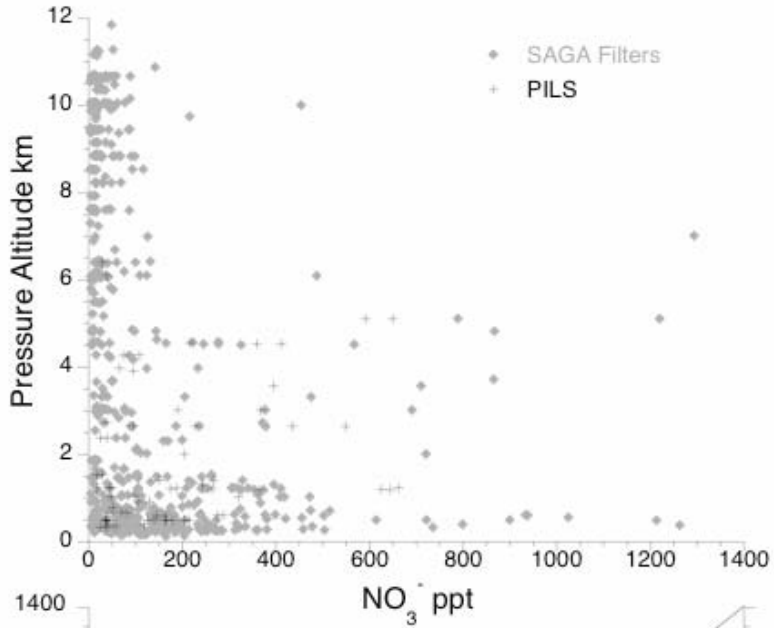
Different size cuts of the two techniques should not impact these data (most of the NH_4^+ is submicron).

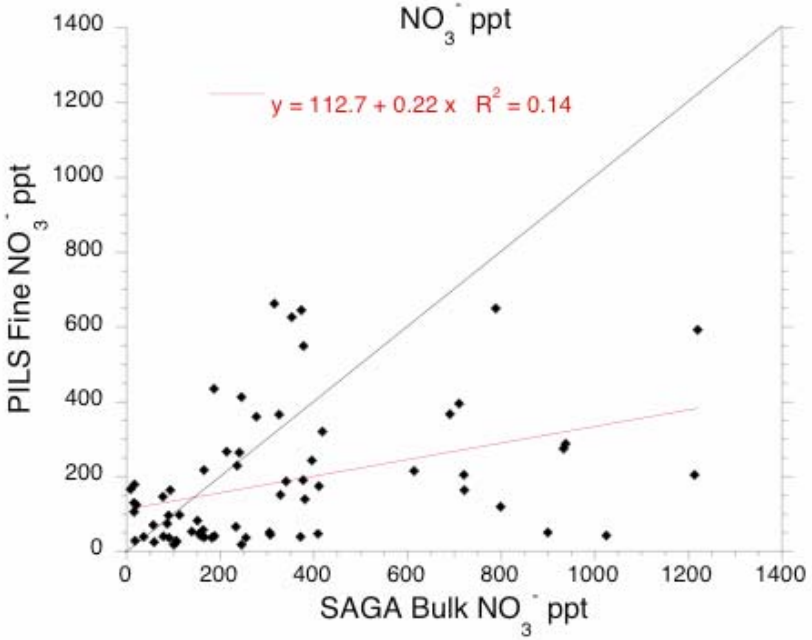
Analytical, or blank, issues seem to be responsible for these differences.



Given that SAGA $SO_4^=$ exceeded PILS $SO_4^=$, while the reverse was true for NH_4^+, large differences in $NH_4^+/SO_4^=$ should not be surprising.

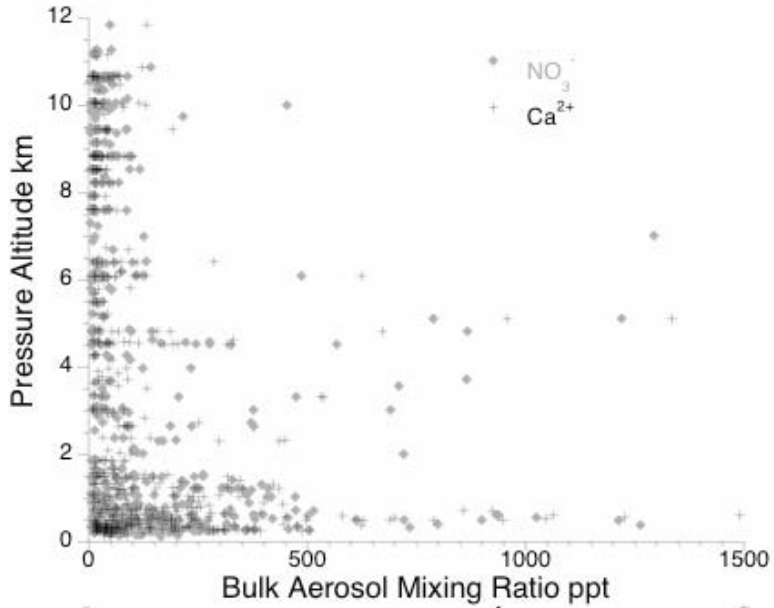
SAGA observations suggest the inorganic aerosol was dominated by NH_4HSO_4, while PILS data suggest that NH_3 was generally abundant enough to more than fully neutralize $SO_4^=$.

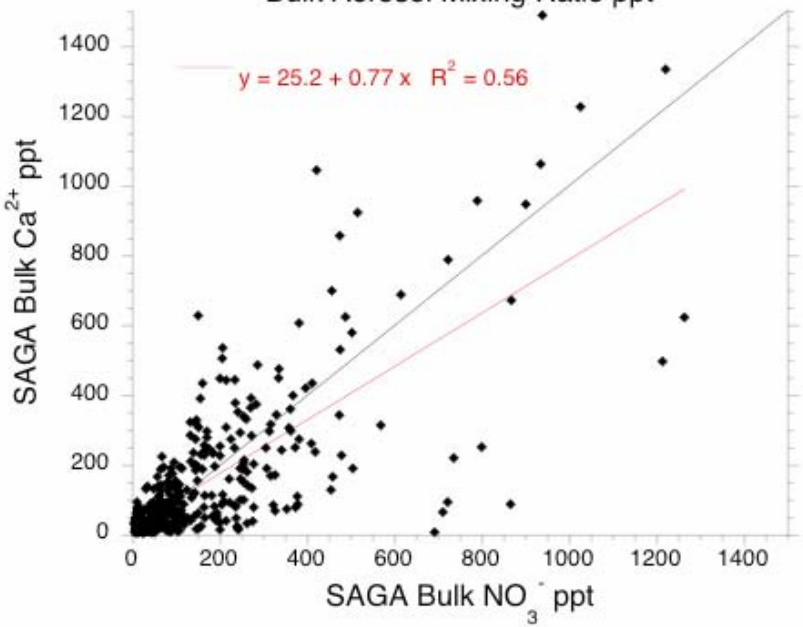




Neither technique found aerosol NO_3^- to be all that high, except in a few plumes.

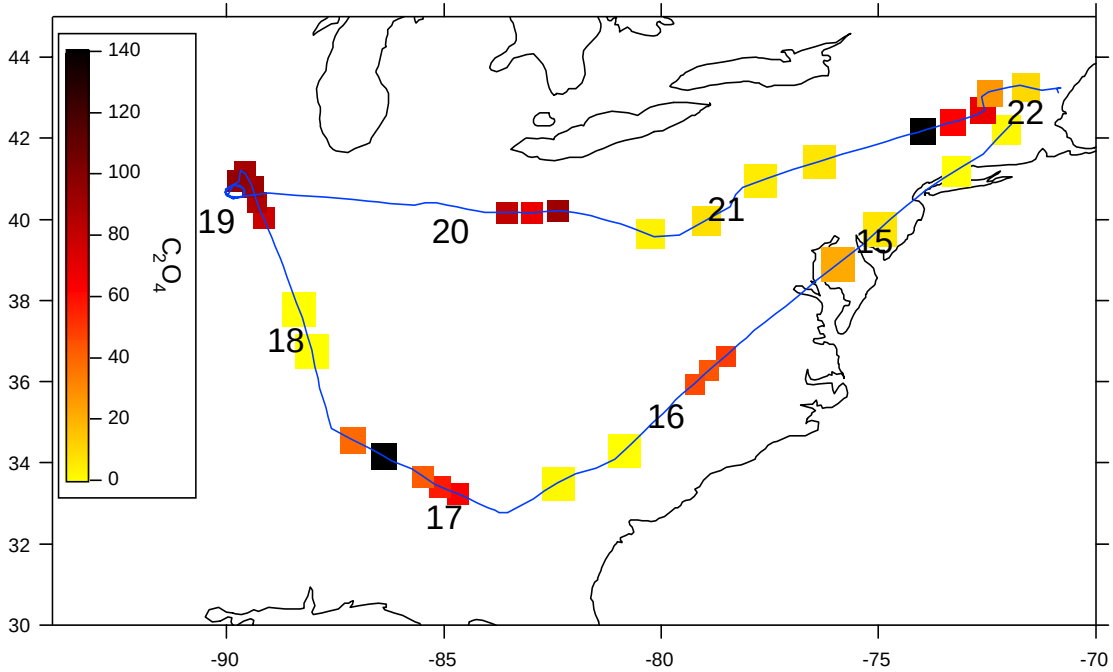
Higher NO_3^- in the SAGA bulk samples than PILS is consistent with much of it being on larger particles (e.g., not NH_4NO_3).

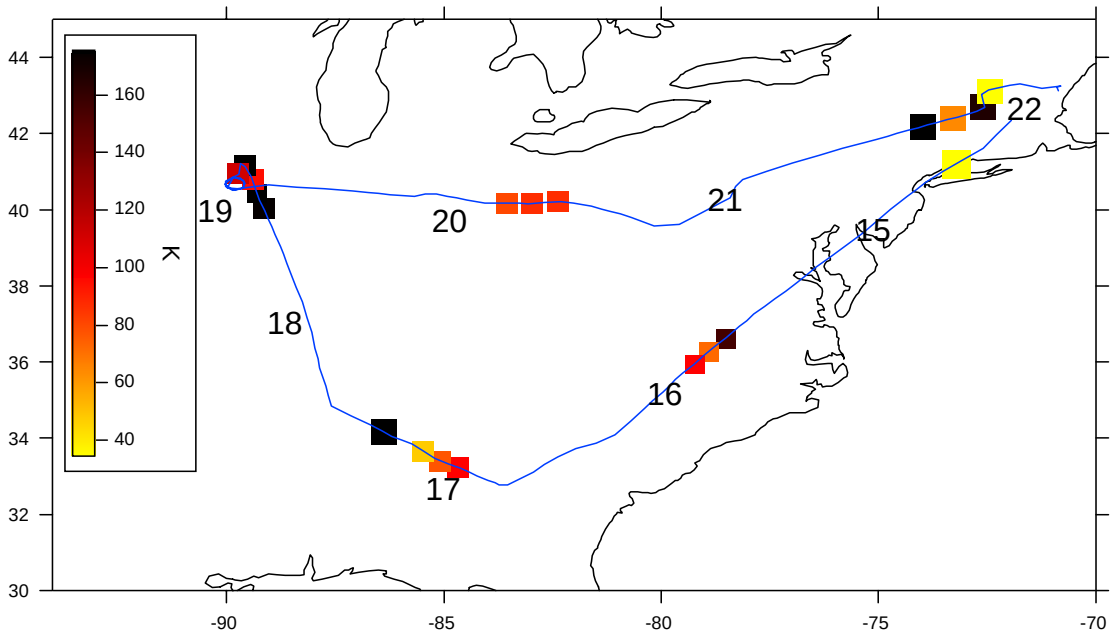




Coarse aerosol NO_3^- can result from HNO_3 reacting with dust and/or seasalt.

Highest NO_3^- mixing ratios in the filter samples often associated with elevated Ca^{2+}.





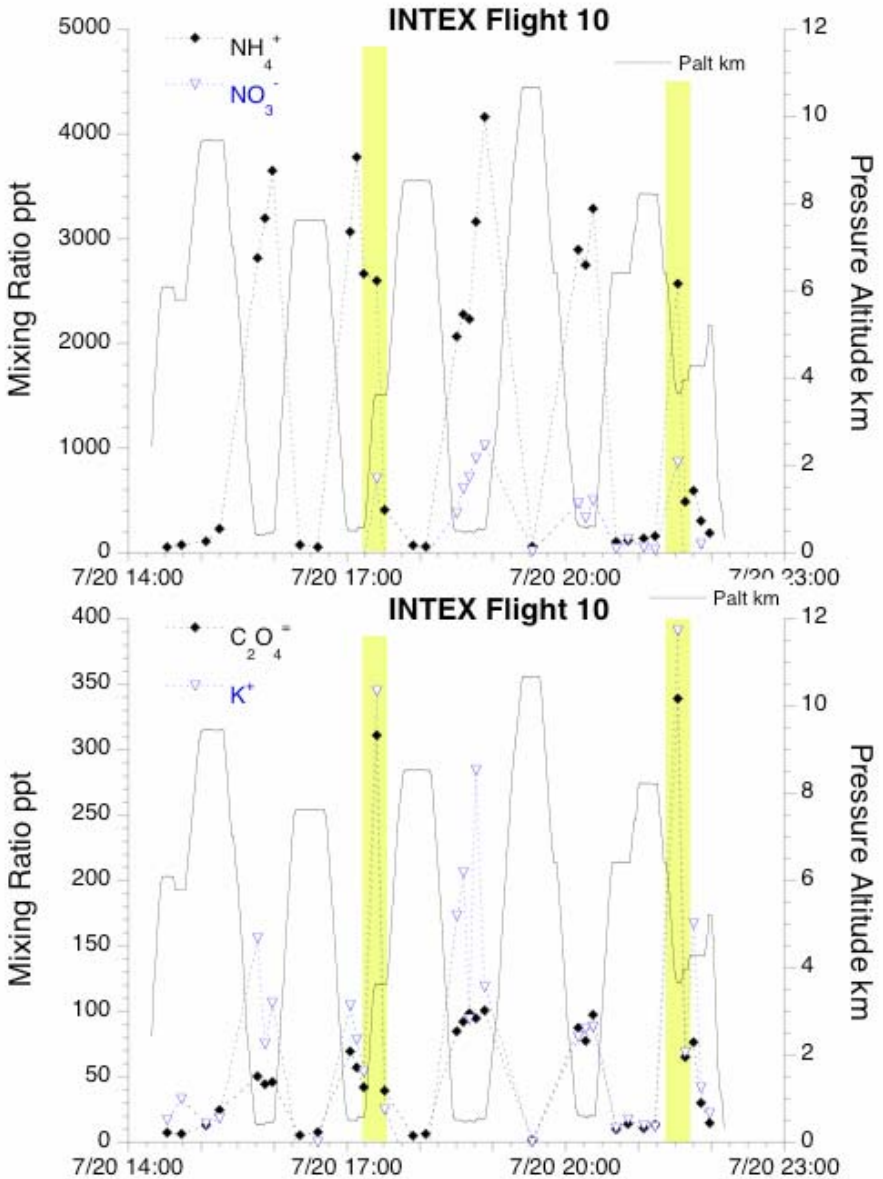
Flight 10, 20 July 2nd Pease Local

Filter sample locations along flight track, color coded by $C_2O_4^{=}$ mixing ratio.

Filter sample locations along flight track, color coded by K^+ mixing ratio.

Smaller symbols represent low altitude. Numbers are hours UTC.

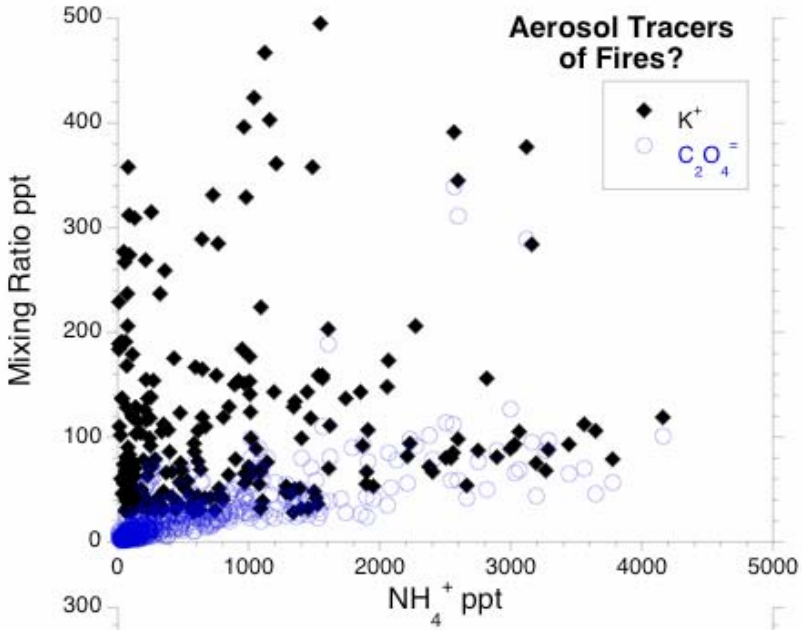
(Thanks Nicola!)

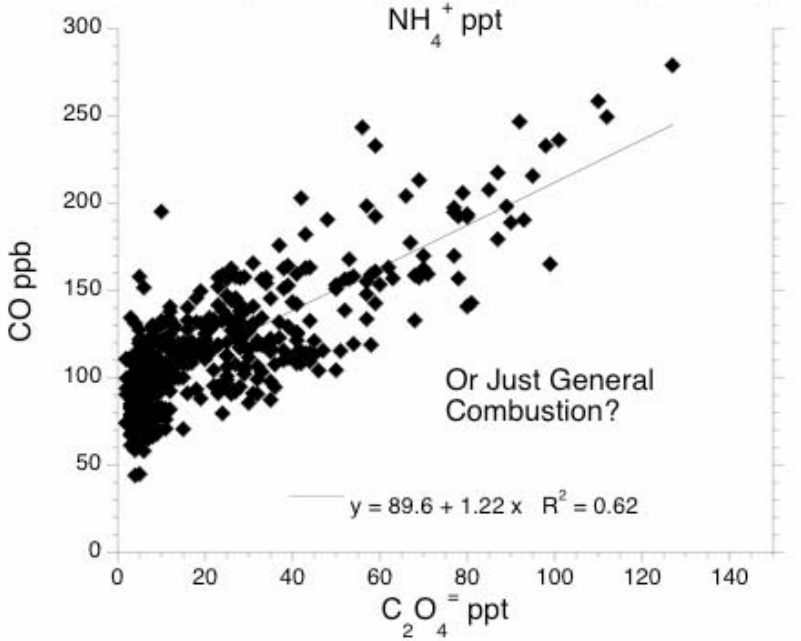


Biomass Burning

Strong enhancements in NH_4^+, K^+ and $C_2O_4^=$ (and to a lesser extent NO_3^-) just above 4 km are consistent with a smoke plume.

Smaller enhancements in the BL could support the suggestion that the smoke was down there too.





It appears that there are too many other sources of NH_4^+, K^+, and $C_2O_4^=$ for any one of them to be unambiguous tracer of biomass burning.

The correlation between NH_4^+ and $C_2O_4^=$ hints that elevated levels of both tracers may be more specific.

However, $C_2O_4^=$ may be a general tracer of combustion.

Multiple tracers likely needed to identify biomass burning plumes in the INTEX data set.