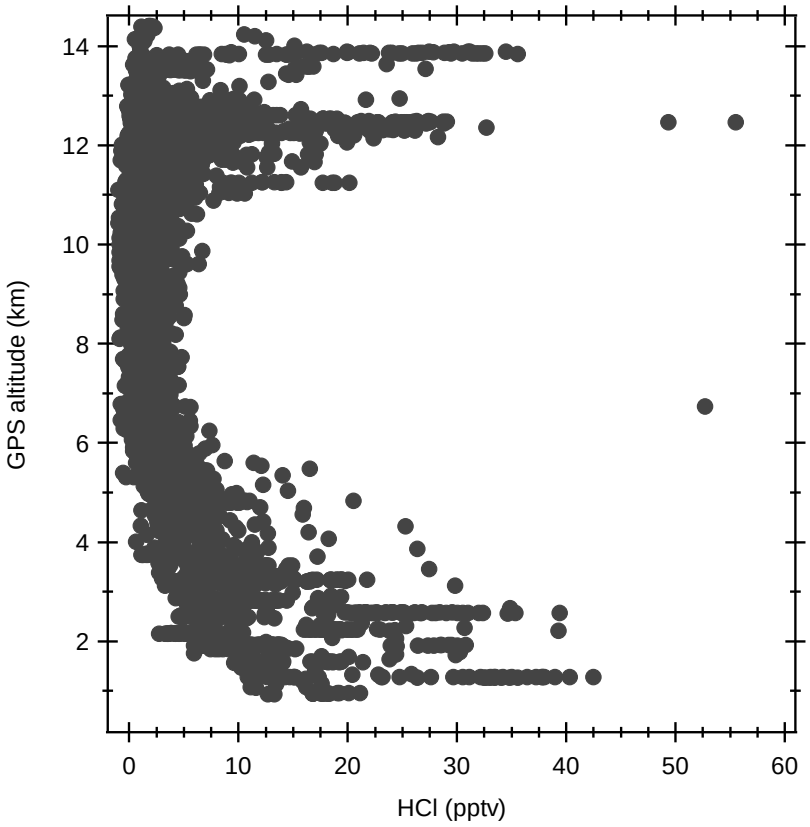
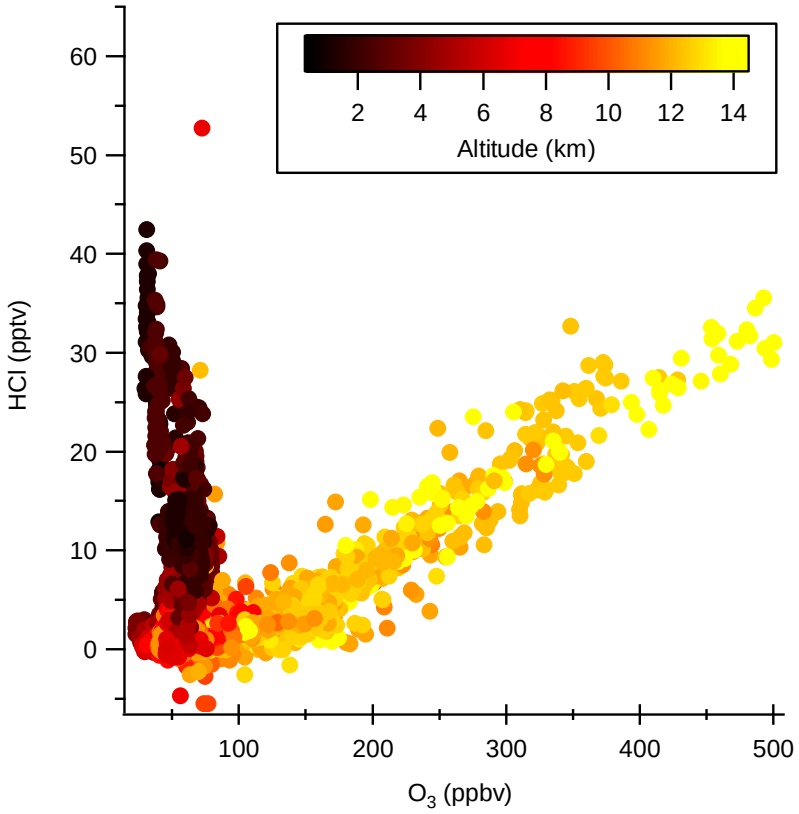
Halogens during DC3

Contributions from:

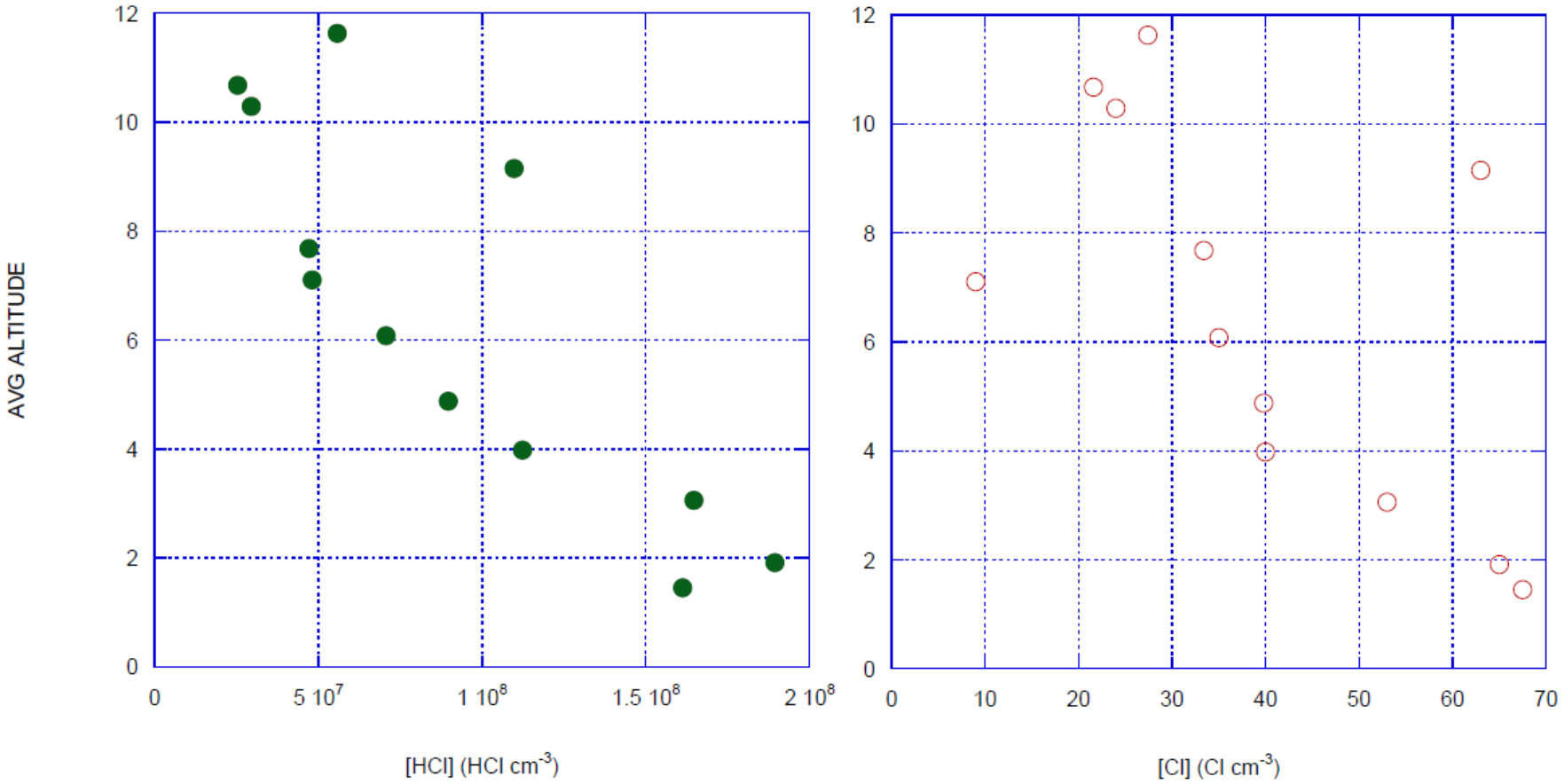
Blake Group, Wingenter, TOGA, GT, CU - AMS

HCl Observations DC3



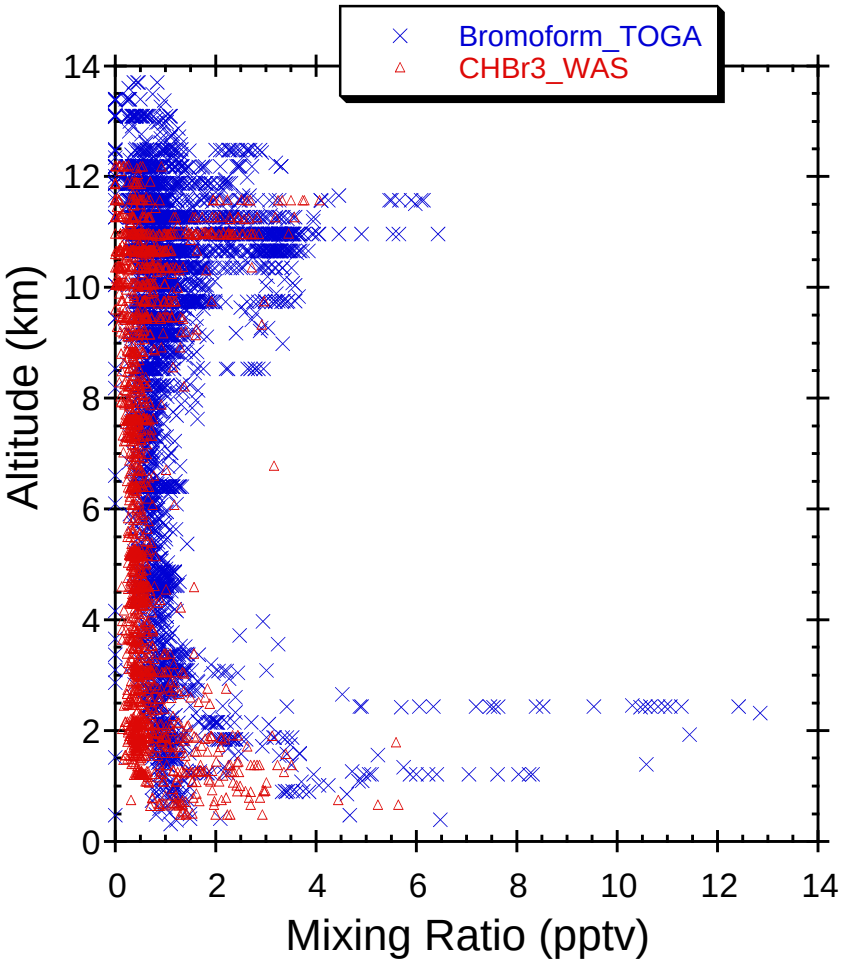


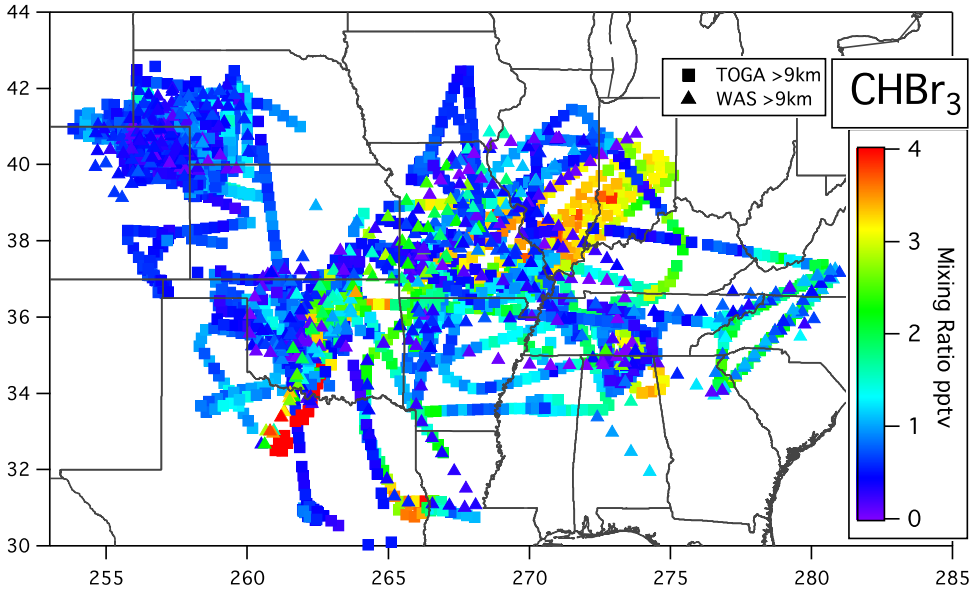
DC3 Convective flights (1, 8, 9, 10, 11, 14, 18) from Colorado

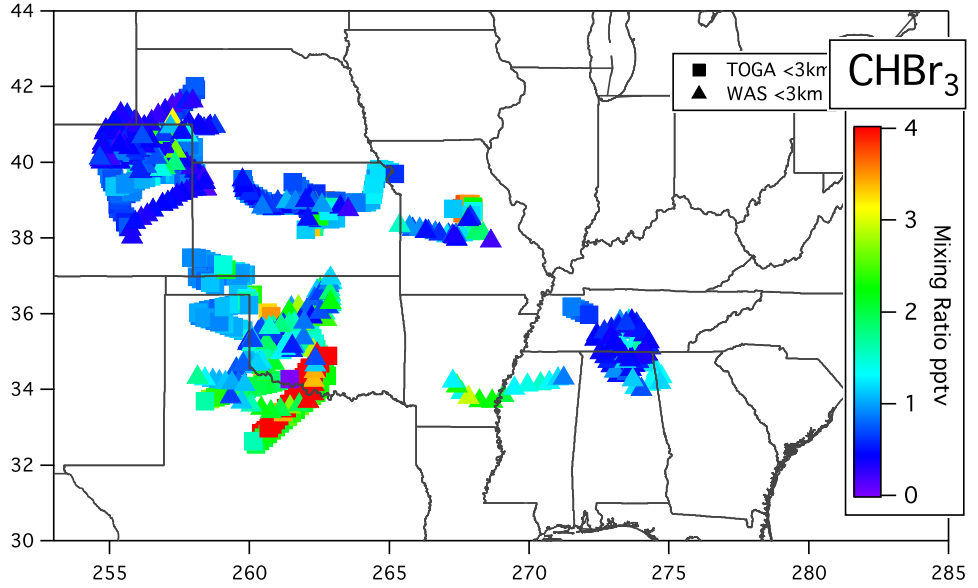


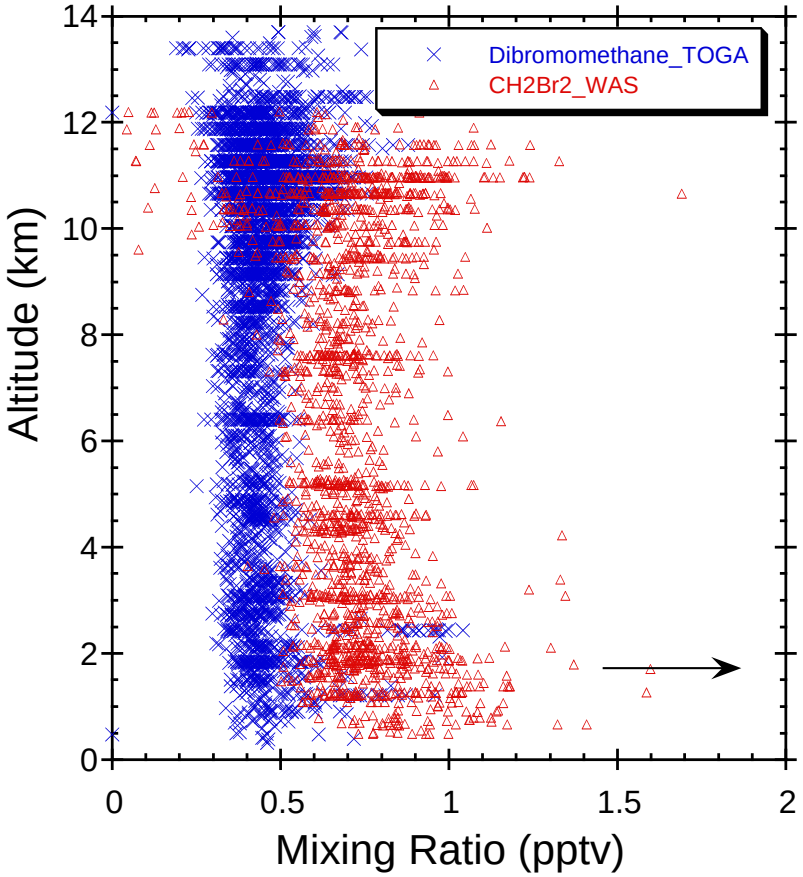
[Cl] were estimated using a Photochemical Steady State model (Wingenter et al, 2005). to match measured [HCl]. Errors for [Cl] are about a factor of 2.

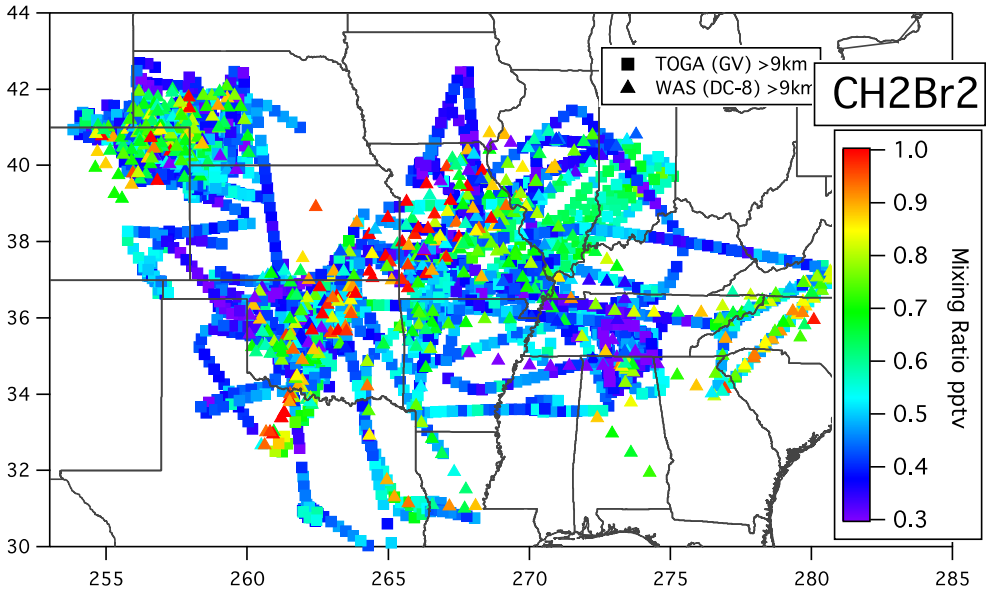
The low amounts of Cl had a 0.0 to 0.2 % impact on O_3 tendency.

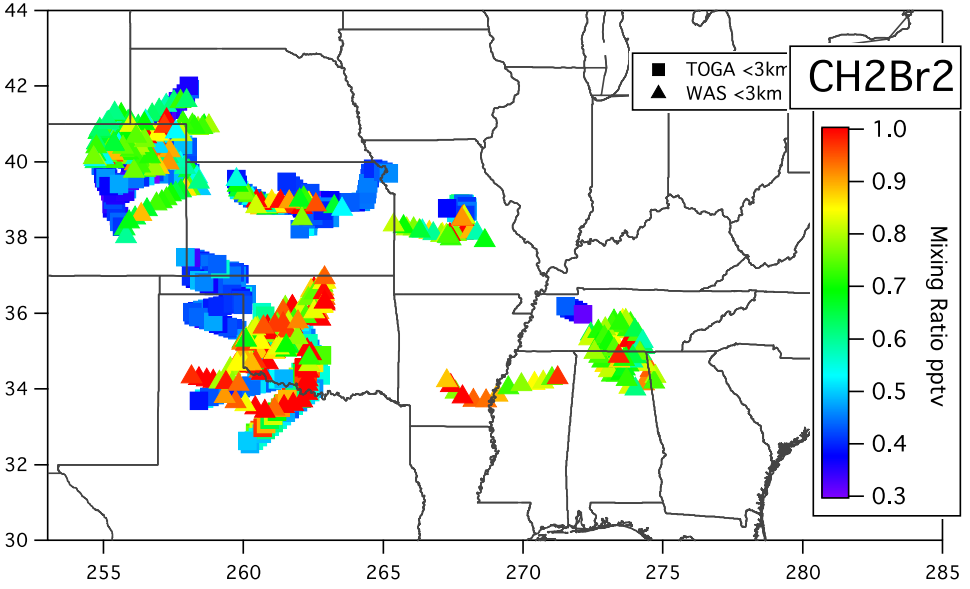

Bromoform_TOGA
CHBr3_WAS
Altitude (km)
Mixing Ratio (pptv)
0
2
4
6
8
10
12
14

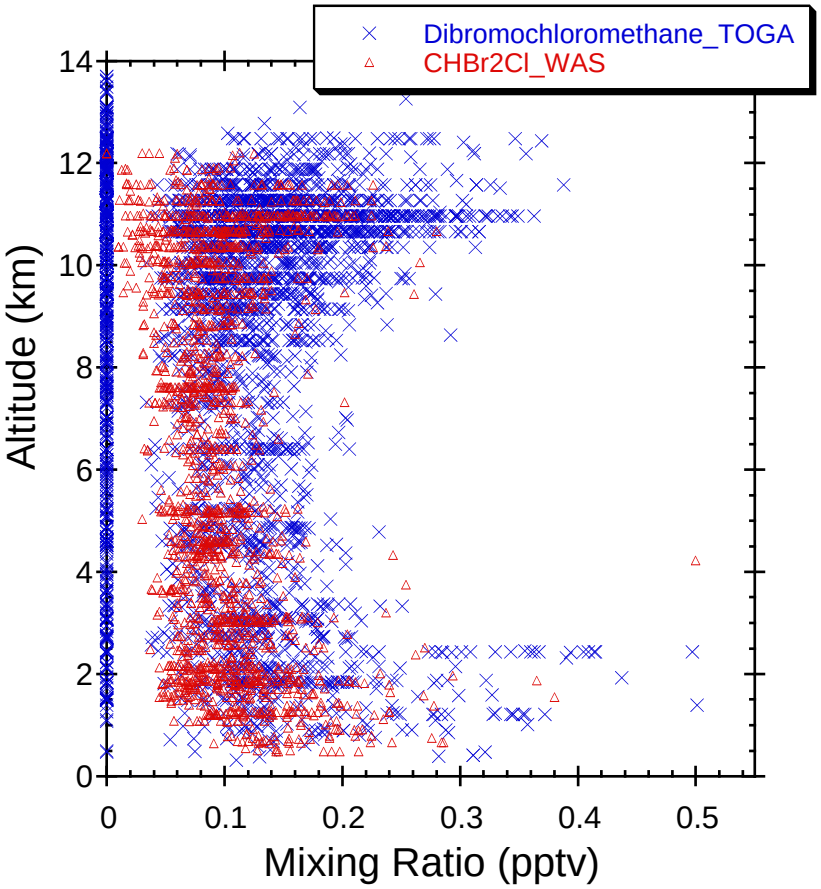

TOGA >9km
WAS >9km
CHBr3
Mixing Ratio pptv
0
1
2
3
4
30
32
34
36
38
40
42
44
255
260
265
270
275
280
285

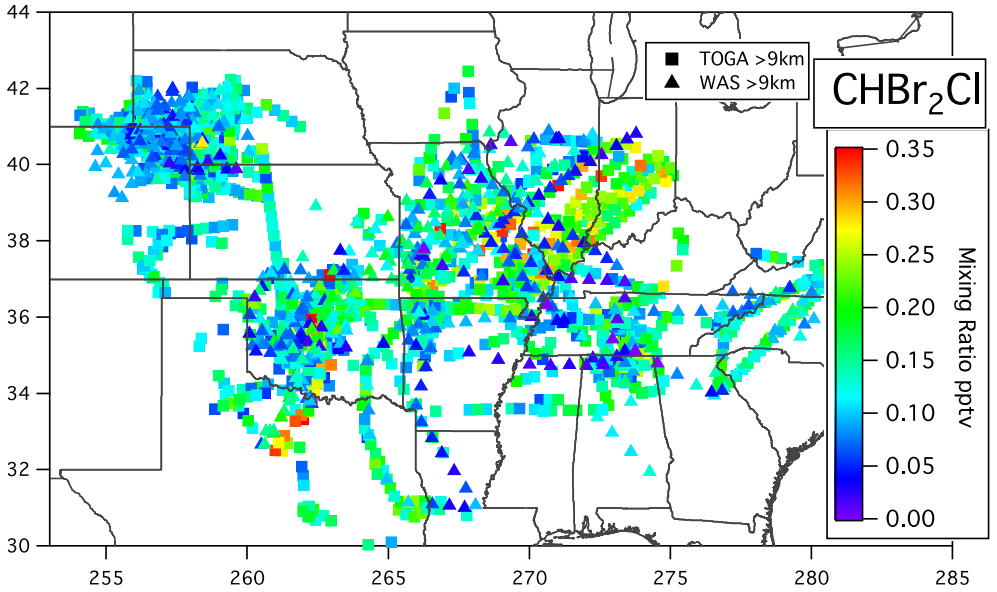

TOGA <3km
WAS <3km
CHBr3
Mixing Ratio pptv
0
1
2
3
4
30
32
34
36
38
40
42
44
255
260
265
270
275
280
285

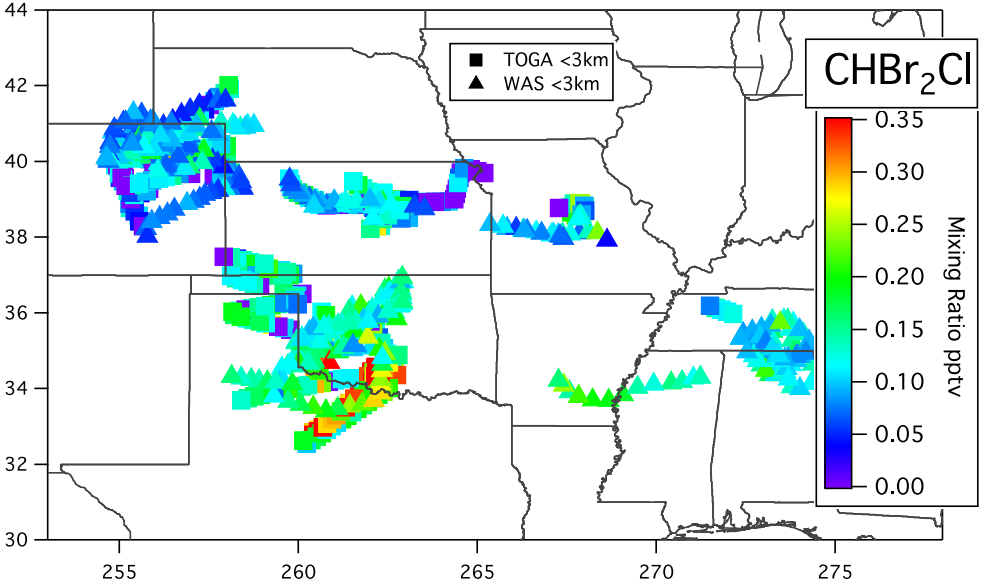

Dibromomethane_TOGA
CH2Br2_WAS
Altitude (km)
Mixing Ratio (pptv)
0
2
4
6
8
10
12
14
0
0.5
1
1.5
2

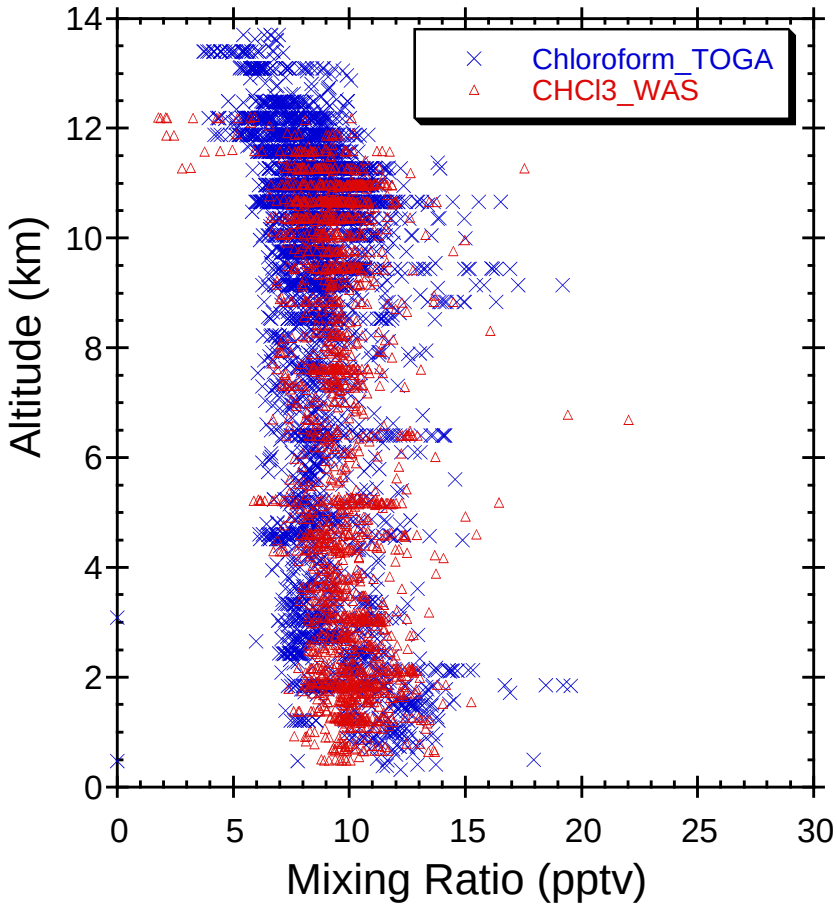

TOGA (GV) >9km
WAS (DC-8) >9km
CH2Br2
Mixing Ratio pptv
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
30
32
34
36
38
40
42
44
255
260
265
270
275
280
285

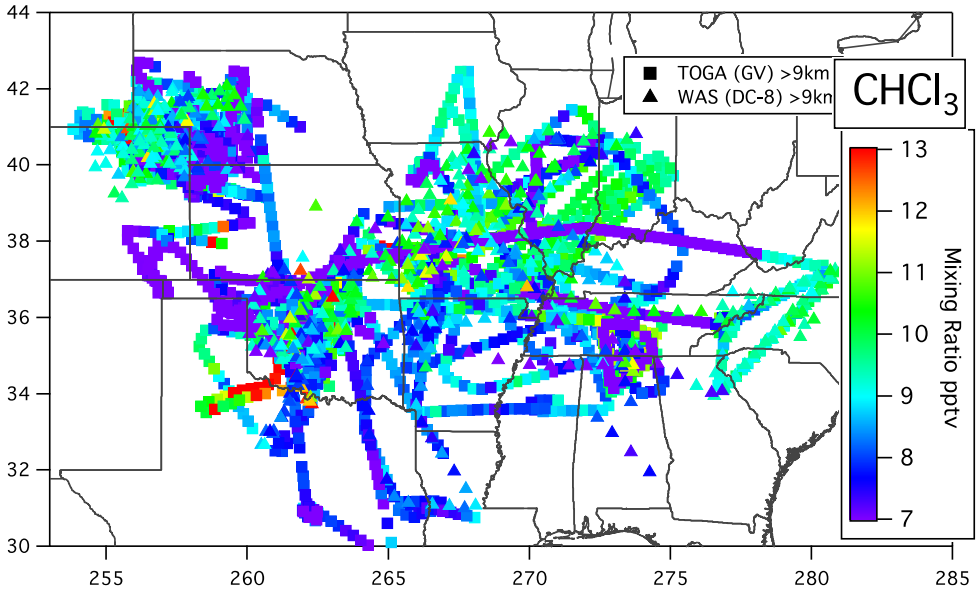

TOGA <3km
WAS <3km
CH2Br2
Mixing Ratio pptv
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
30
32
34
36
38
40
42
44
255
260
265
270
275
280
285

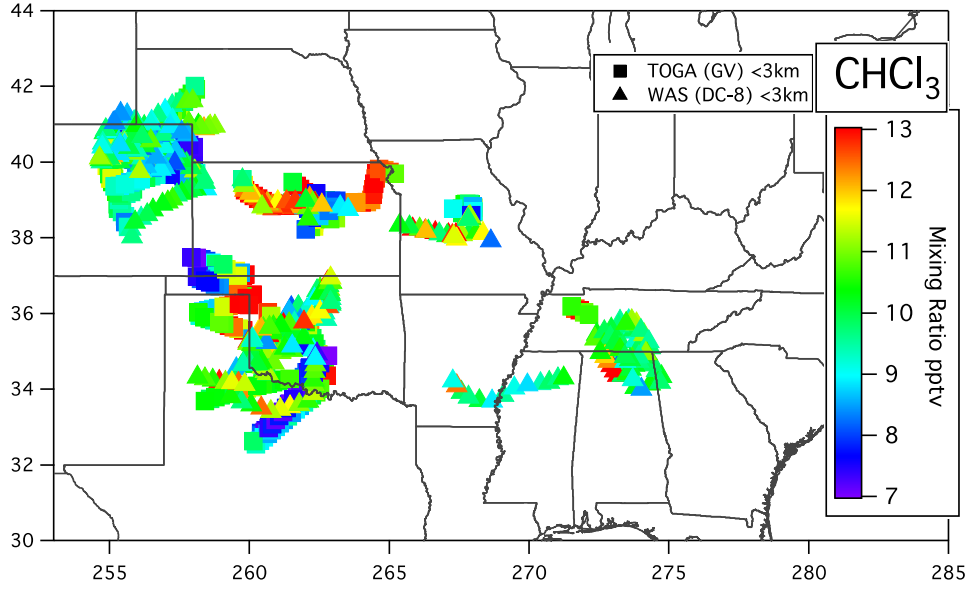

Dibromochloromethane_TOGA
CHBr2Cl_WAS
Altitude (km)
Mixing Ratio (pptv)
0
2
4
6
8
10
12
14
0
0.1
0.2
0.3
0.4
0.5

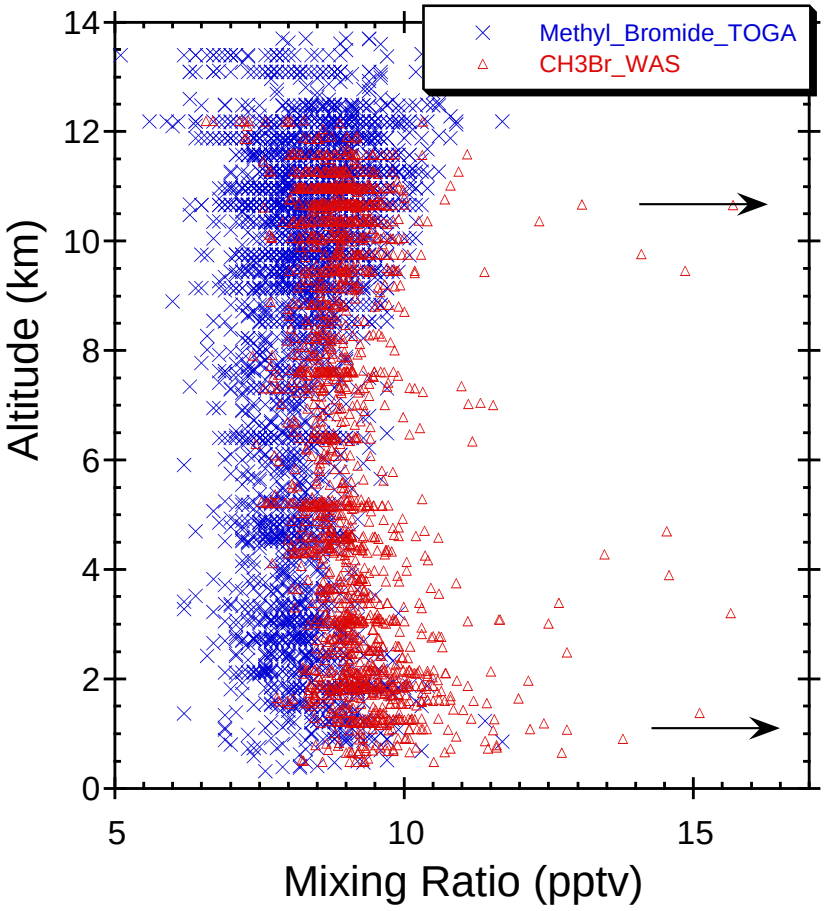

TOGA >9km
WAS >9km
CHBr2Cl
Mixing Ratio pptv
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
30
32
34
36
38
40
42
44
255
260
265
270
275
280
285

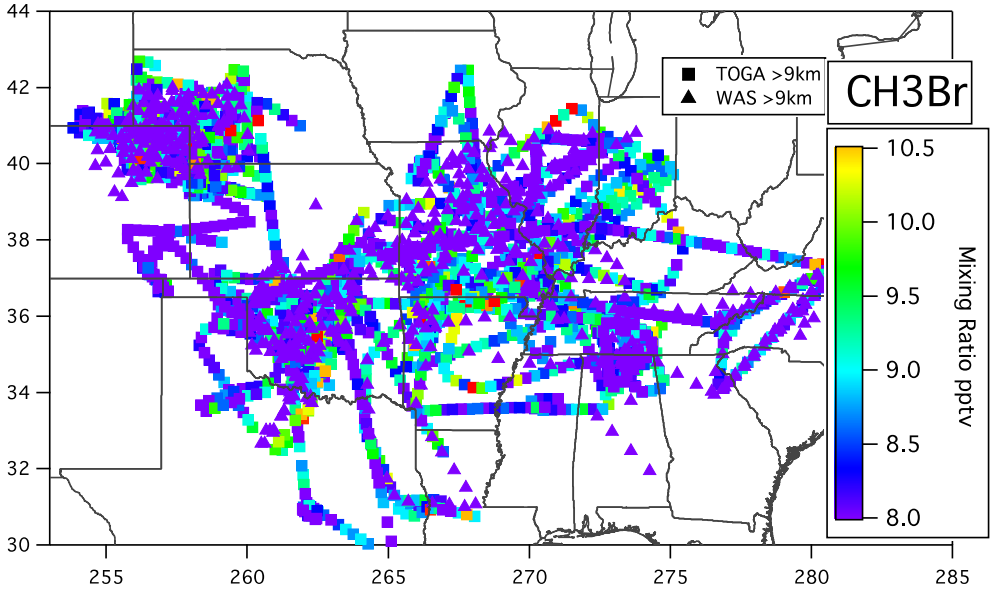

TOGA <3km
WAS <3km
CHBr2Cl
Mixing Ratio pptv
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
30
32
34
36
38
40
42
44
255
260
265
270
275

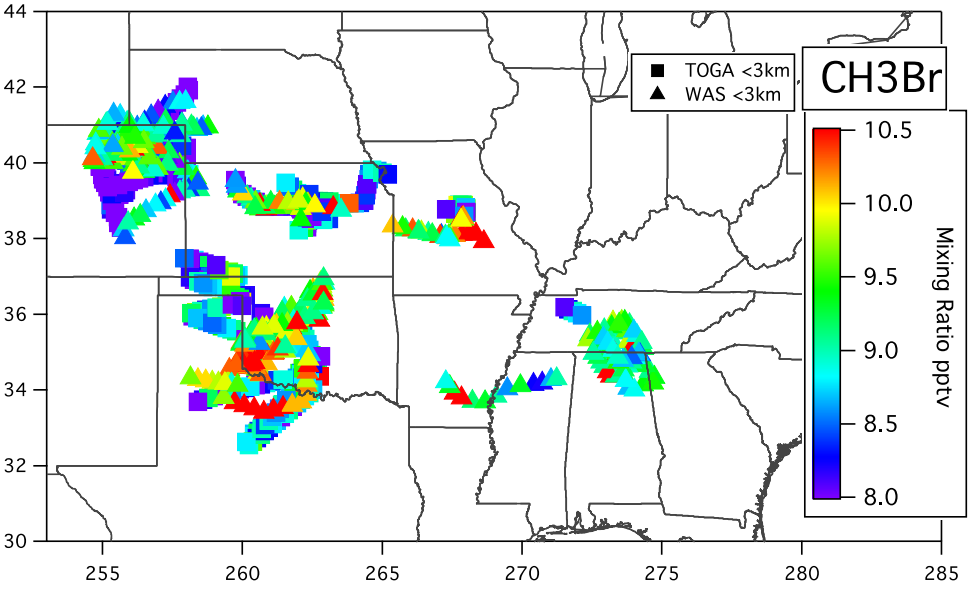

Chloroform_TOGA
CHCl3_WAS
Altitude (km)
Mixing Ratio (pptv)
0
2
4
6
8
10
12
14
0
5
10
15
20
25
30

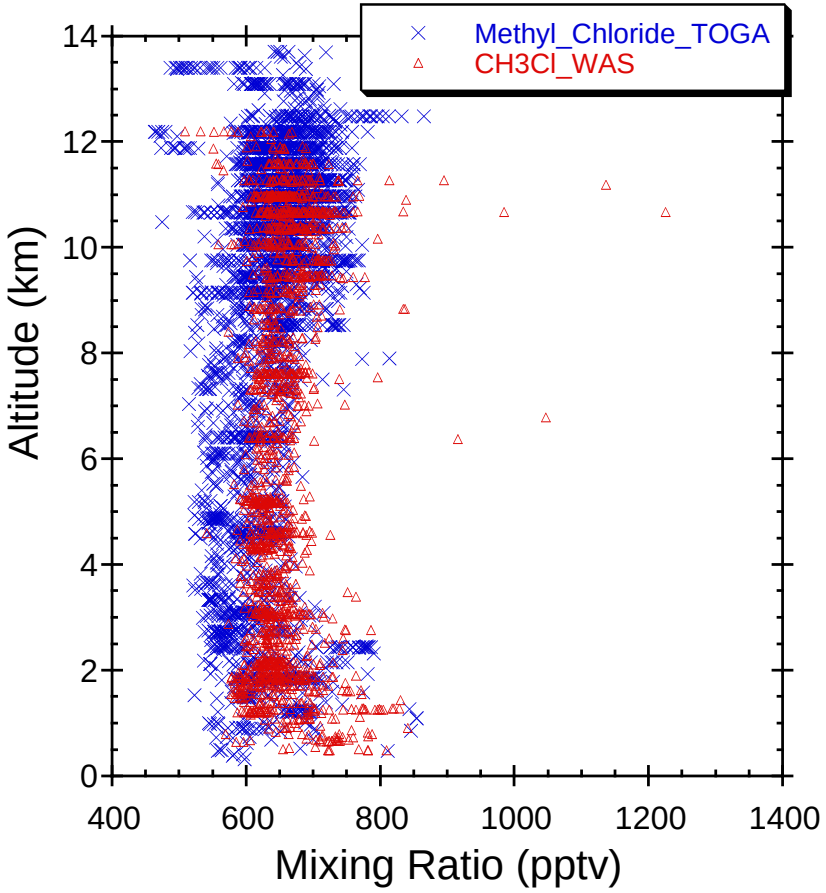

TOGA (GV) >9km
WAS (DC-8) >9km
CHCl3
Mixing Ratio pptv
7
8
9
10
11
12
13
30
32
34
36
38
40
42
44
255
260
265
270
275
280
285

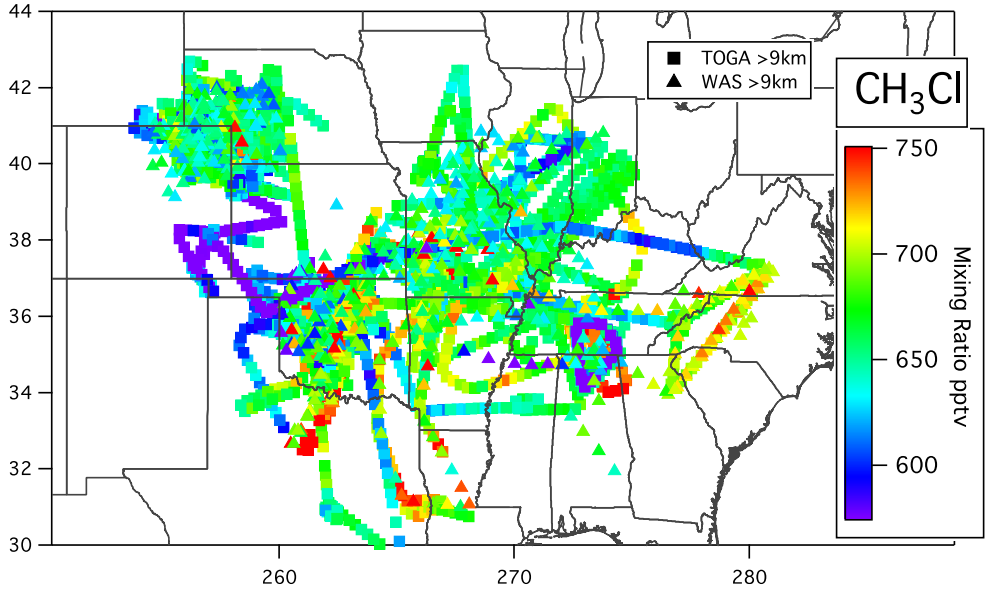

TOGA (GV) <3km
WAS (DC-8) <3km
CHCl3
Mixing Ratio pptv
7
8
9
10
11
12
13
30
32
34
36
38
40
42
44
255
260
265
270
275
280
285

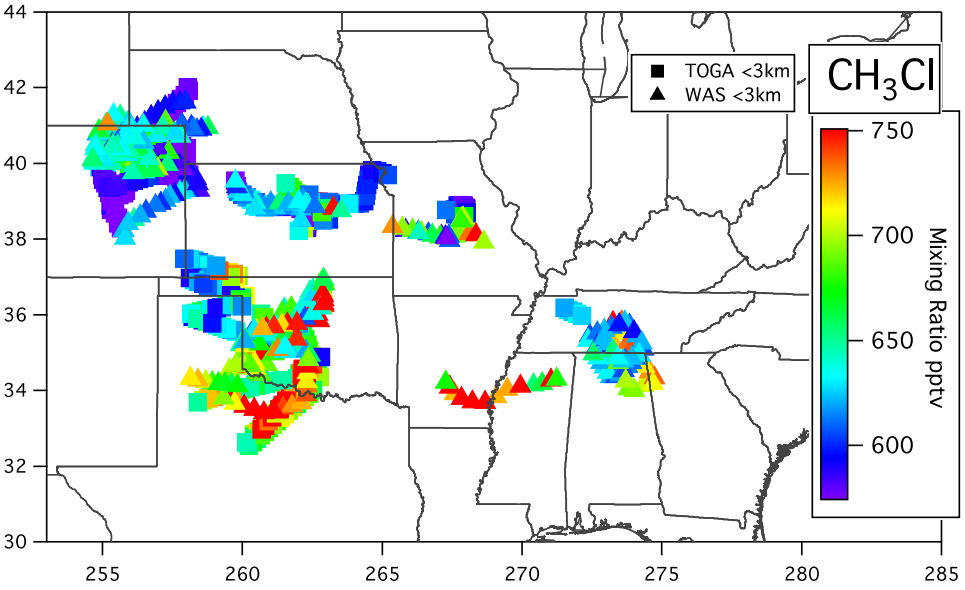

Methyl_Bromide_TOGA
CH3Br_WAS
Altitude (km)
Mixing Ratio (pptv)
0
2
4
6
8
10
12
14
5
10
15


TOGA >9km
WAS >9km
CH3Br
Mixing Ratio pptv
10.5
10.0
9.5
9.0
8.5
8.0
30
32
34
36
38
40
42
44
255
260
265
270
275
280
285

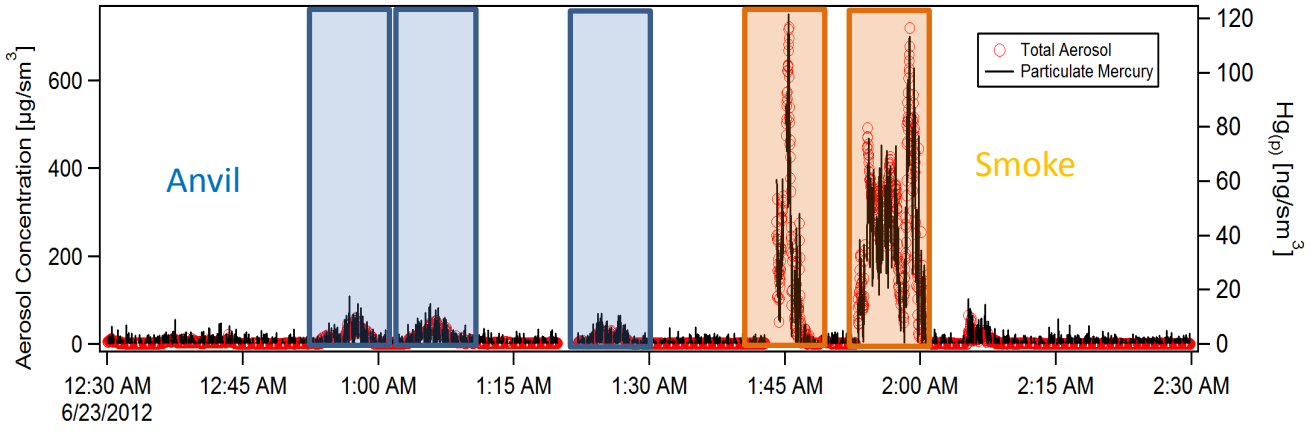

TOGA <3km
WAS <3km
CH3Br
Mixing Ratio pptv
10.5
10.0
9.5
9.0
8.5
8.0
30
32
34
36
38
40
42
44
255
260
265
270
275
280
285


Methyl_Chloride_TOGA
CH3Cl_WAS
Altitude (km)
Mixing Ratio (pptv)
0
2
4
6
8
10
12
14
400
600
800
1000
1200
1400

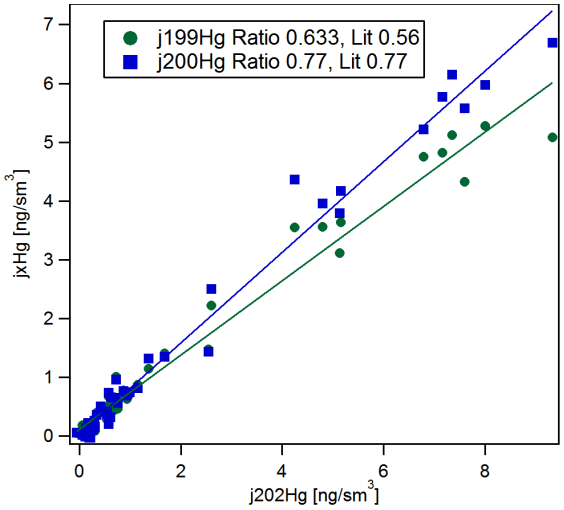

TOGA >9km
WAS >9km
CH3Cl
750
700
650
600
Mixing Ratio pptv
30
32
34
36
38
40
42
44
260
270
280


TOGA <3km
WAS <3km
CH3Cl
750
700
650
600
Mixing Ratio pptv
30
32
34
36
38
40
42
44
255
260
265
270
275
280
285

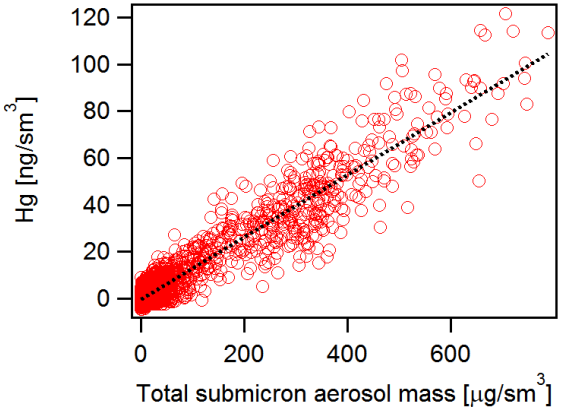
Mercury detection on 6/22 Flight



>100 ng/sm^3 of particulate mercury in the smoke, about 10 ng/sm^3 made it to the anvil at 33 kft



Despite the high organic signal at m/z 202, the isotopic ratios found in the HR fitting of the mass spectra are consistent with mercury

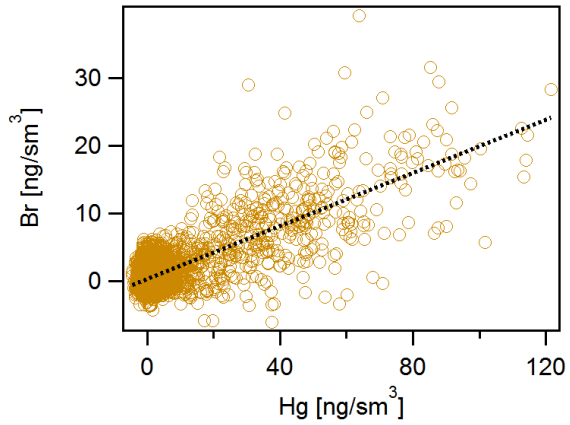


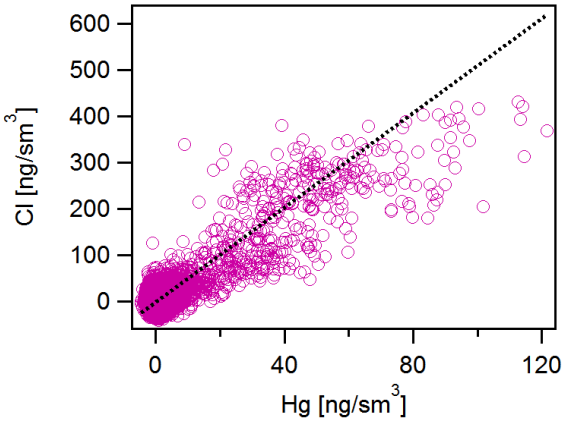
While the overall Hg sensitivity of the AMS needs to be better calibrated, a preliminary analysis leads to about ~100 ppm overall abundance in fresh BBOA

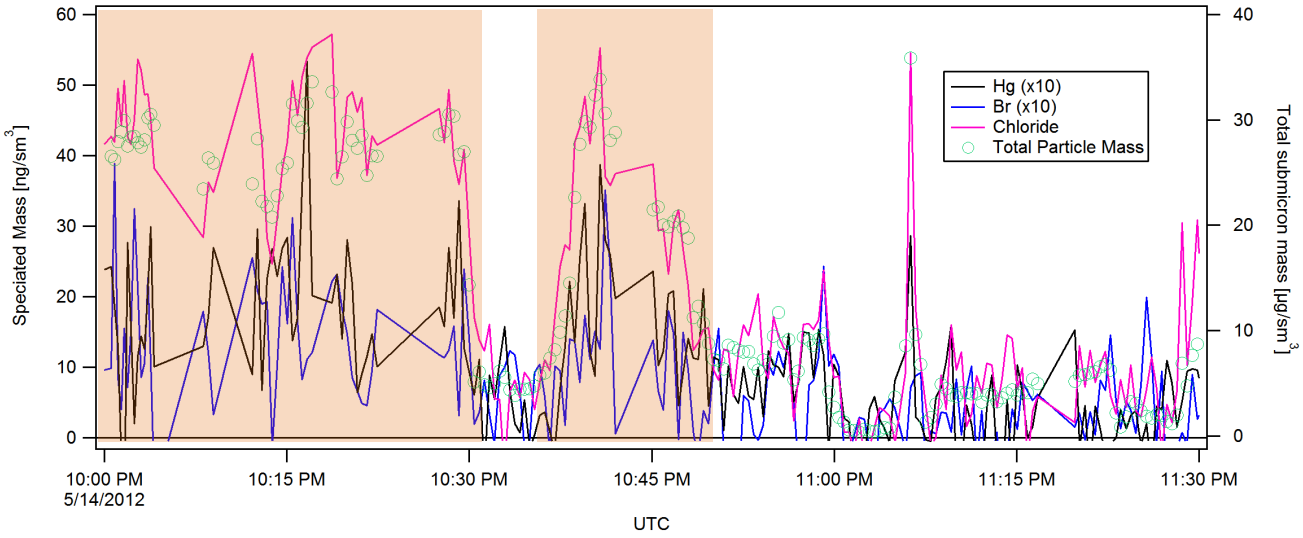
The extent of Hg evaporation in the inlet is unknown, and the overall ionization sensitivity for Hg is probably lower than assumed, so this are lower, conservative estimates.

So this suggests that biomass burning might be a larger source of particulate Hg than currently thought

Hg/X chemistry and the 5/14 Flight







While particulate mercury has often been associated with $HgBr_2$, and bromine was indeed detected during the 6/22 flight, with realistic calibration factors a 1:2 stoichiometry cannot be achieved, so part of the mercury might be bound otherwise (ie there is plenty of chloride present)

The stratospherically transported BBOA detected on the 5/14 flight showed traces of both mercury and bromide (barely above DL).

The ratio of Hg/Total Mass is consistent with the one found for the 6/22 flight