

Measurement Comparisons during DC3

Chris Cantrell

GV, DC-8, & Falcon Teams

Species	GV	DC-8	Falcon
O ₃	O ₃ (CL)	CL, DIAL	UV abs
NO	NO (CL)	CL	CL
NO ₂	NO ₂ (CL)	CL, LIF	
HNO ₃	GT-CIMS	SAGA, GT-CIMS, CIT-CIMS	
NO _y		CL	CL
PANs		CIMS	CIMS
HNO ₄	GT-CIMS	GT-CIMS	
HCHO	CAMS, TOGA	DFGAS, ISAF	
CH ₃ CHO	TOGA	PTR-MS, WAS	
CO	UV Fluor.	DACOM	UV Fluor.
CO ₂	PICARRO	AVOCET	PICARRO
CH ₄	PICARRO	DACOM	PICARRO
CH ₃ CN	TOGA	PTR-MS	
HCN	TOGA	CIT-CIMS	
VOC, CHX, OVOCs	TOGA	PTR-MS, WAS	canisters

Species	GV	DC-8	Falcon
Actinic flux	HARP	CAFS	
Irradiance	RAF UV, SW, IR	Solar, IR	
H ₂ O vapor	VCSEL, RAF-EDPC	DLH	
SO ₂	GT-CIMS	GT-CIMS	
HCl	GT-CIMS	GT-CIMS	
Part # > 10 nm	CN	CN	
Part # > 10 nm, heated		CN heated	CPC
Particle size	SMPS	SMPS	
Particle size	UHSAS	UHSAS x 2	UHSAS-A, PCASP
Cloud particle size	CDP	FCDP	FSSP-300
Winds	RAF-WINDS	MMS	X
Temperature	RAF-ATX	MMS	X
Pressure	RAF-PSXC	MMS	X
Dew Point	RAF-DPX	X	

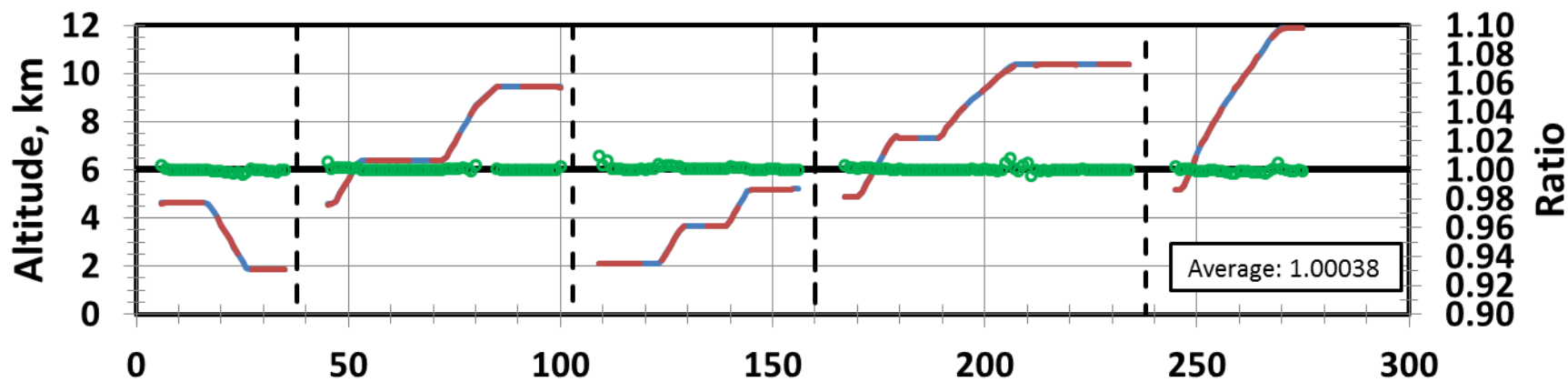
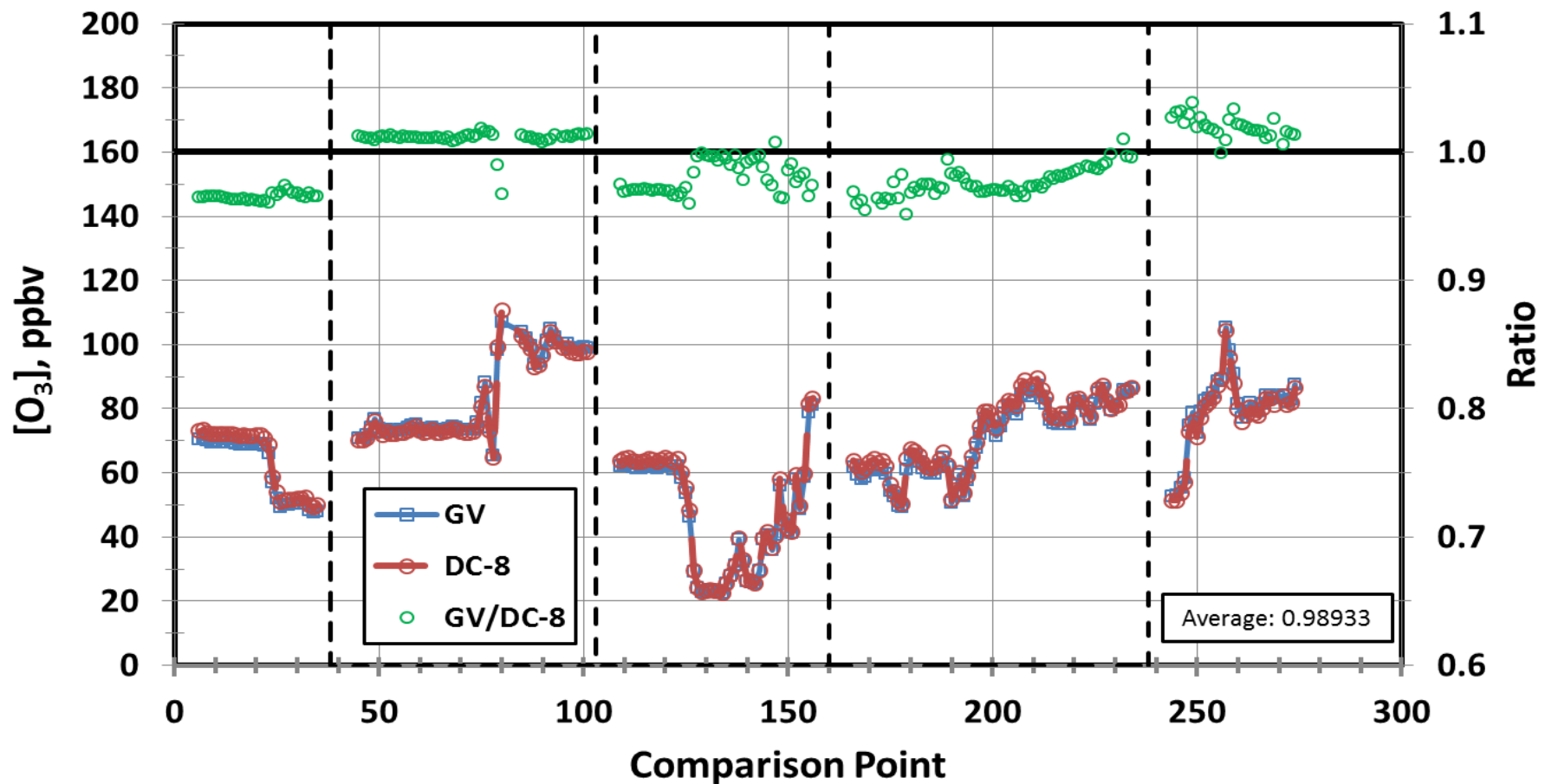
Methodology

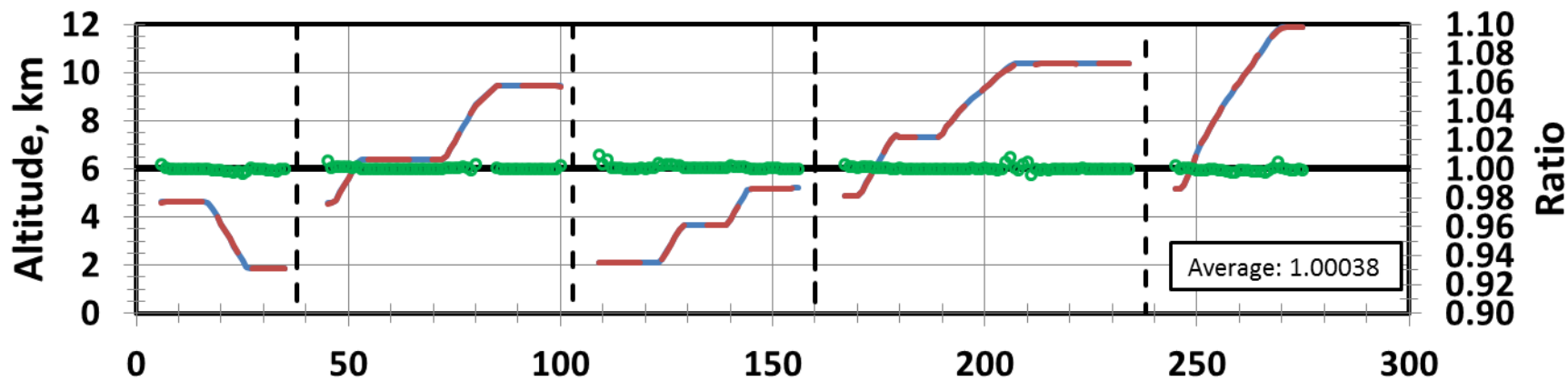
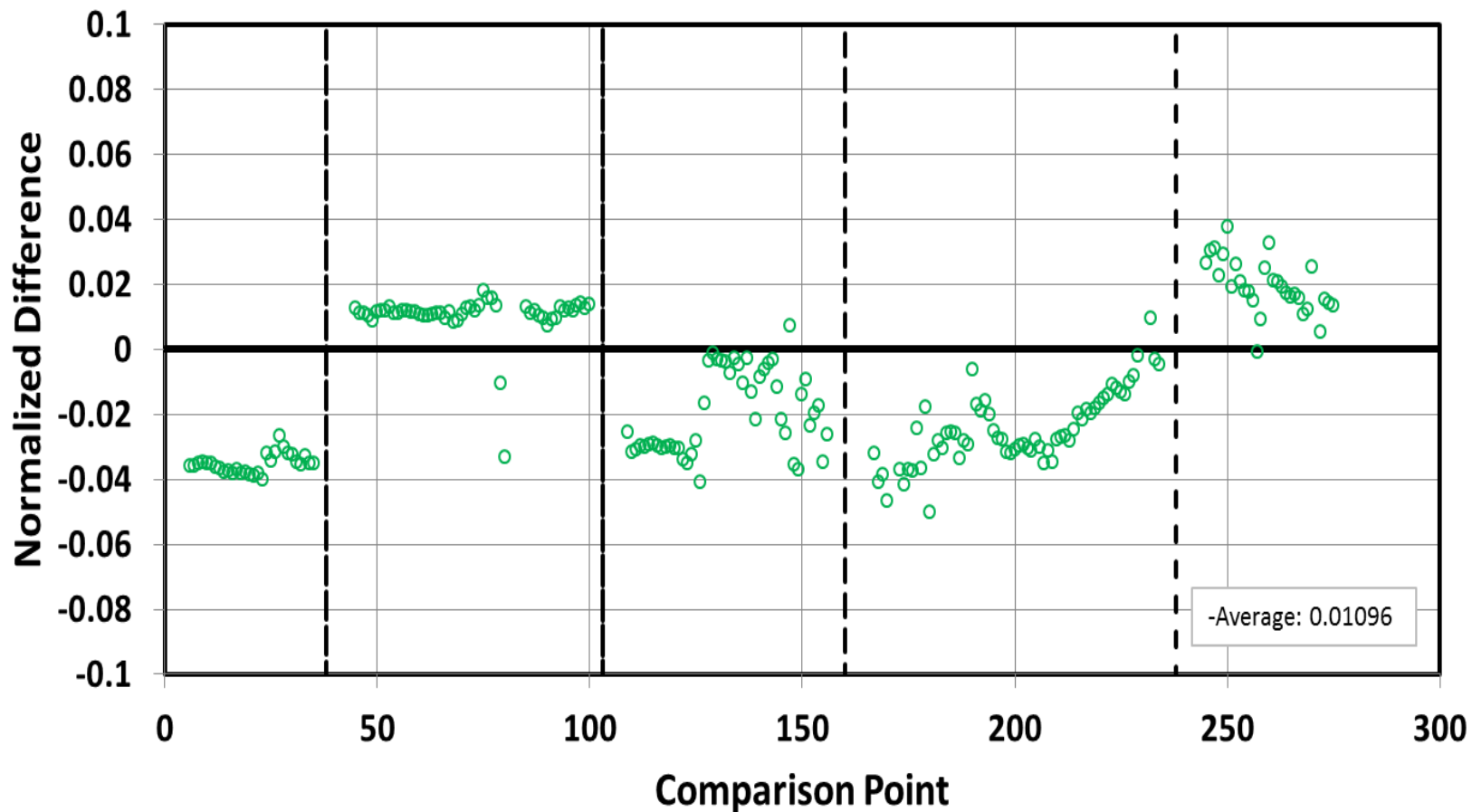
- Measurement ratios ($[X_1]/[X_2]$)
- Normalized differences ($([X_1]-[X_2])/avg([X_1],[X_2])$)
- Bivariate linear fit of $[X_1]$ vs $[X_2]$
 - Slope, intercept, r^2
- Examine distribution of these parameters
- Examine these parameters versus:
 - Time
 - Altitude
 - Other parameters

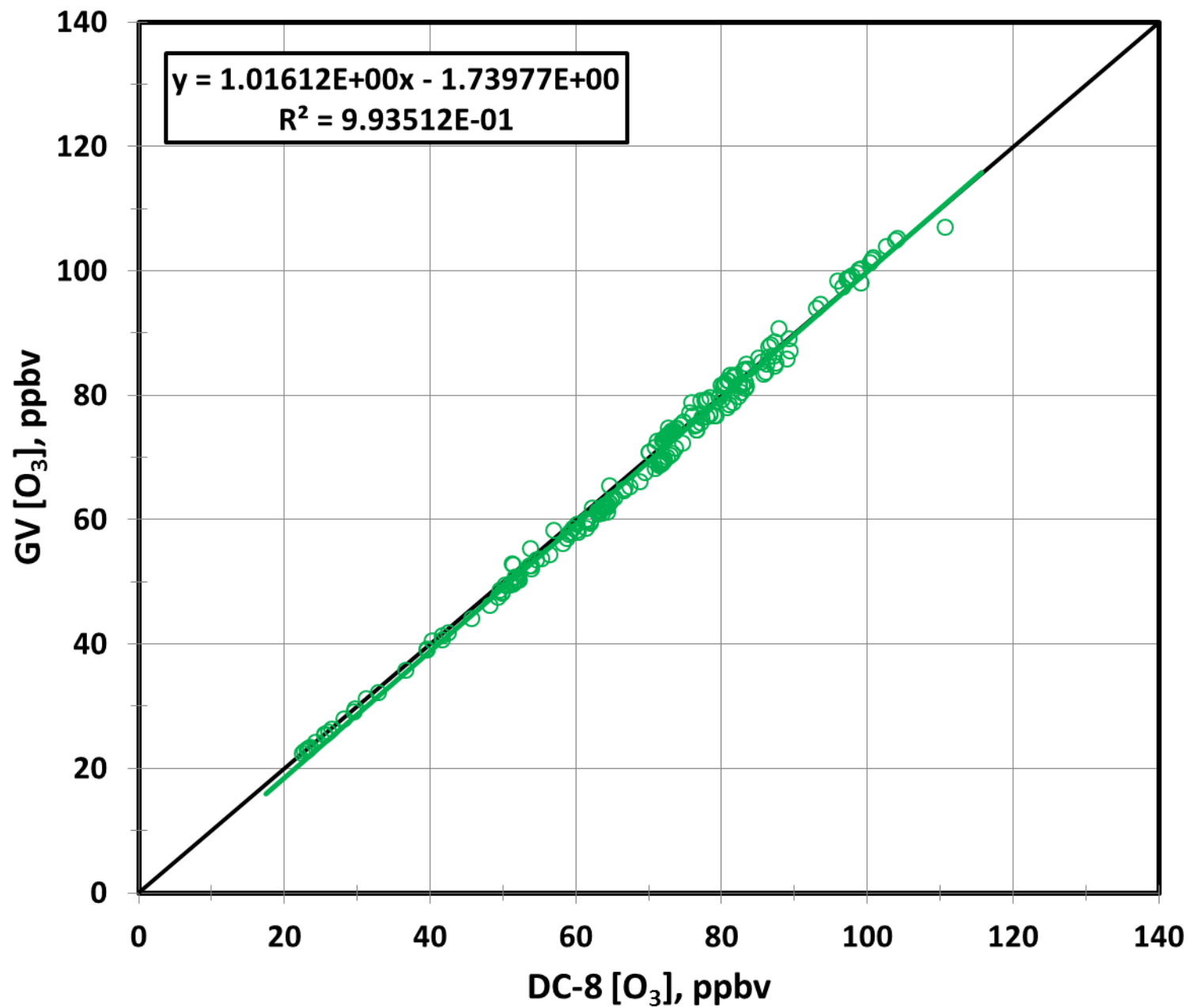
GV – DC-8 Comparison Periods

IC Period #	Date	Start (secs)	End (secs)	Total time
1	25 May 2012	75150	76890	1740 s
2a	30 May 2012	68610	70710	2100 s
2b	30 May 2012	71010	71970	960 s
3	1 June 2012	72750	75570	2820 s
4	5 June 2012	73590	77670	4080 s
5	17 June 2012	83070	84870	1800 s
				3.75 hrs

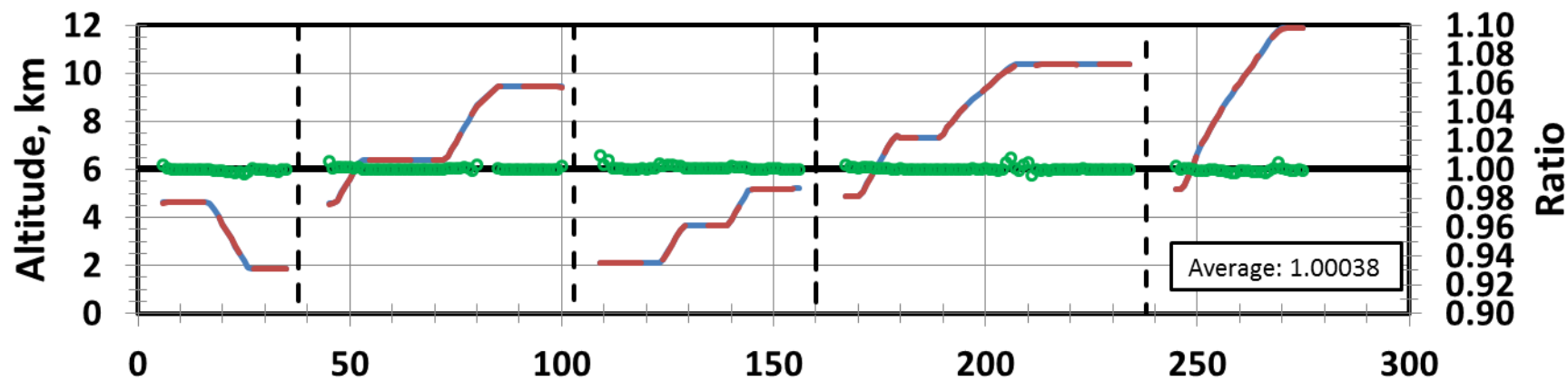
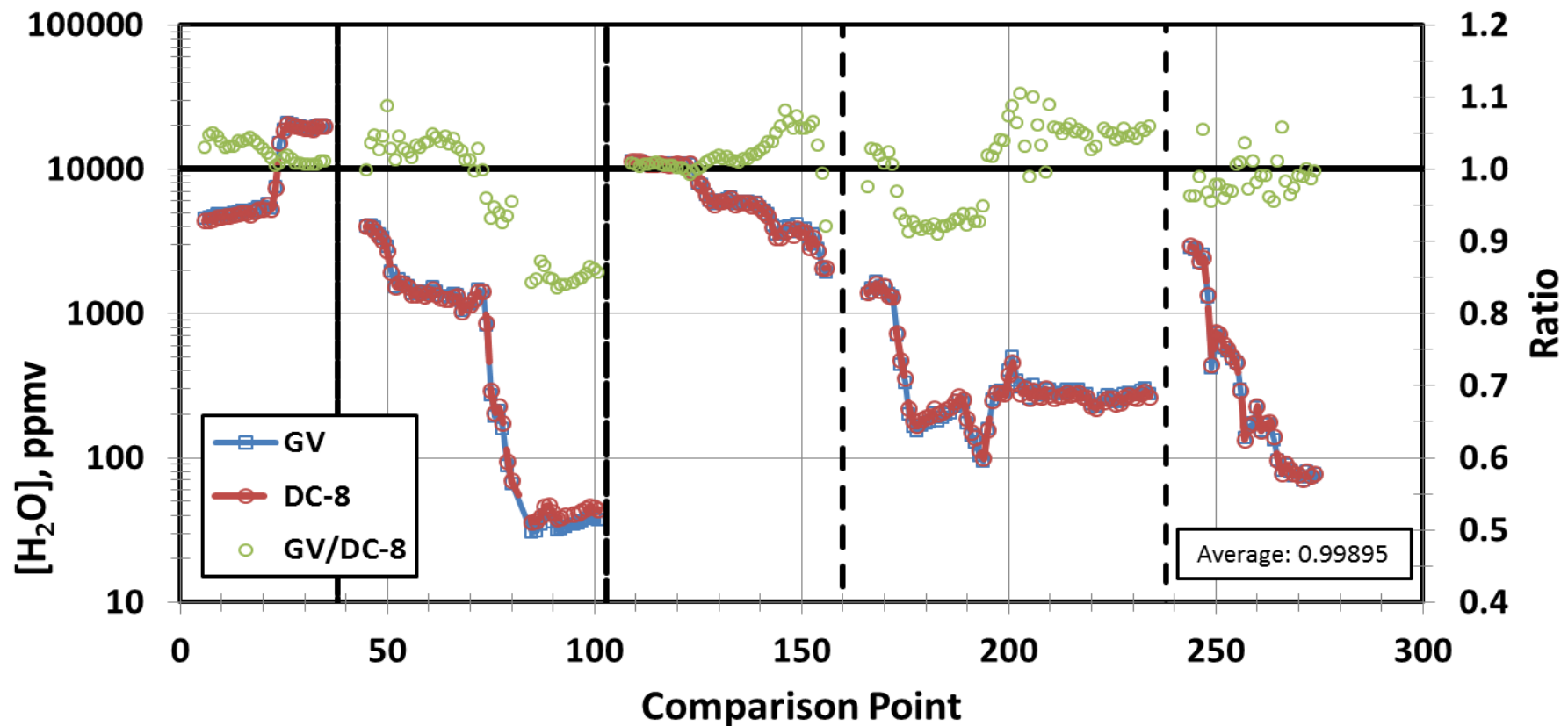
GV & DC-8 Ozone

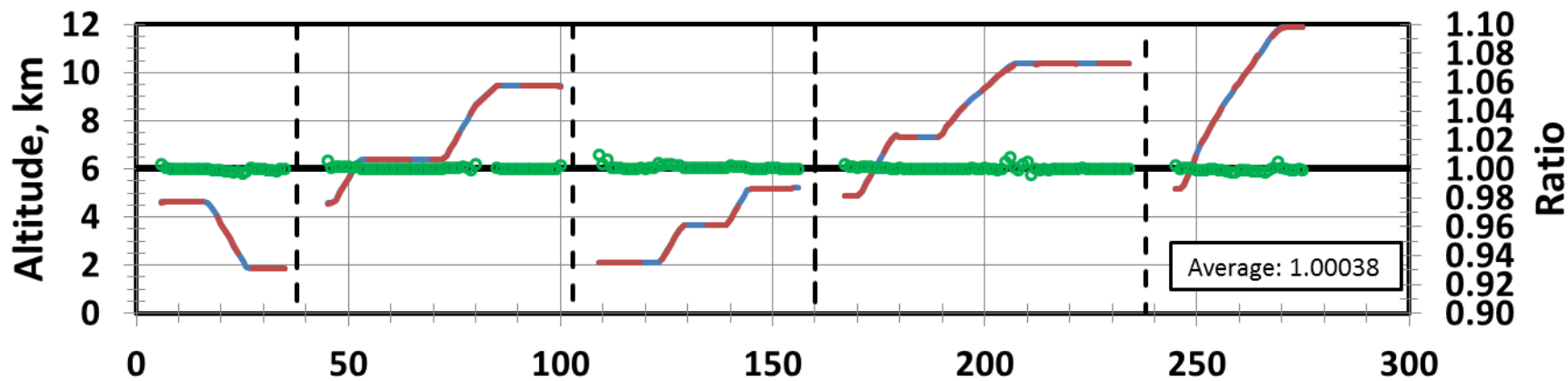
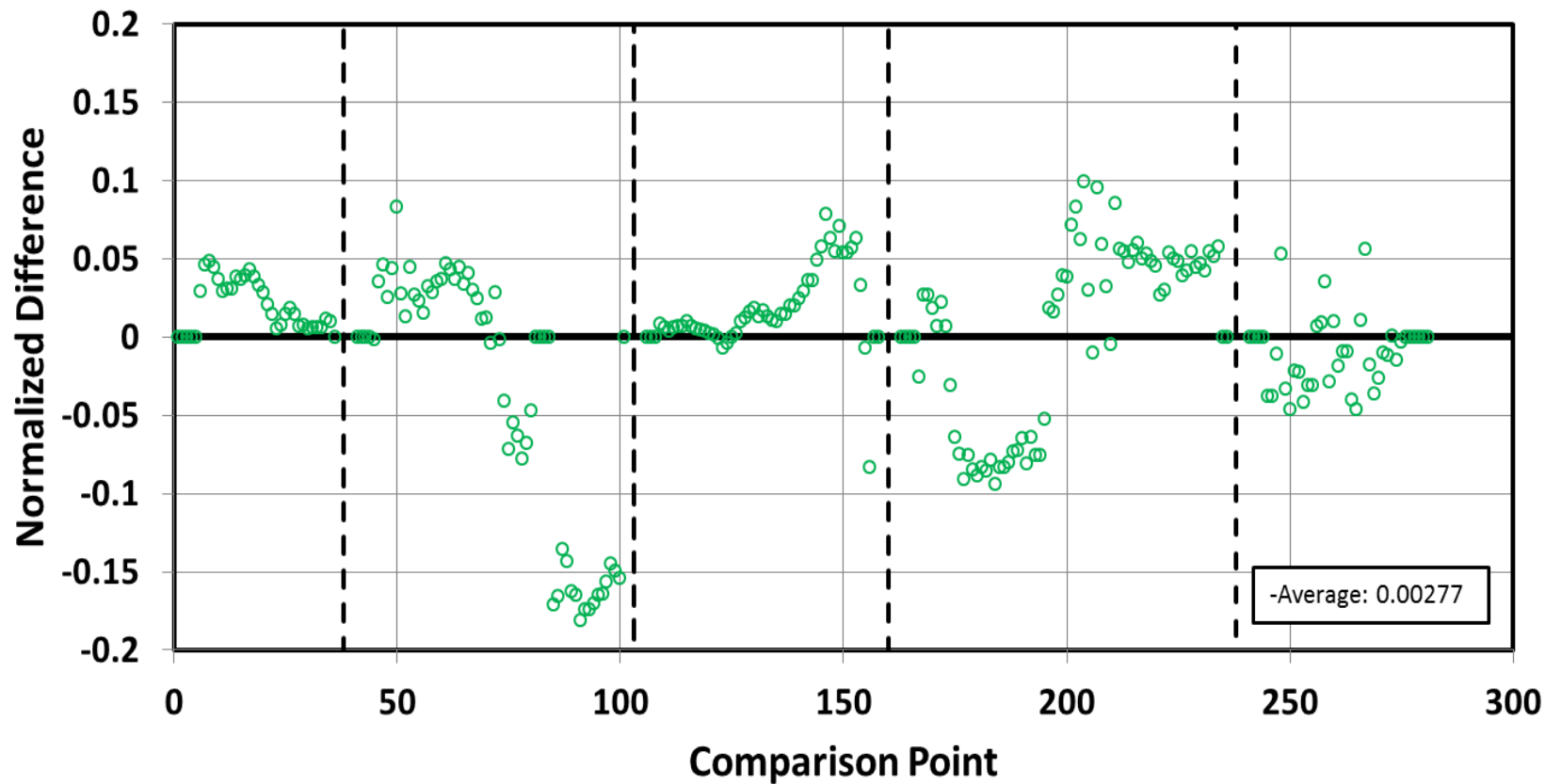


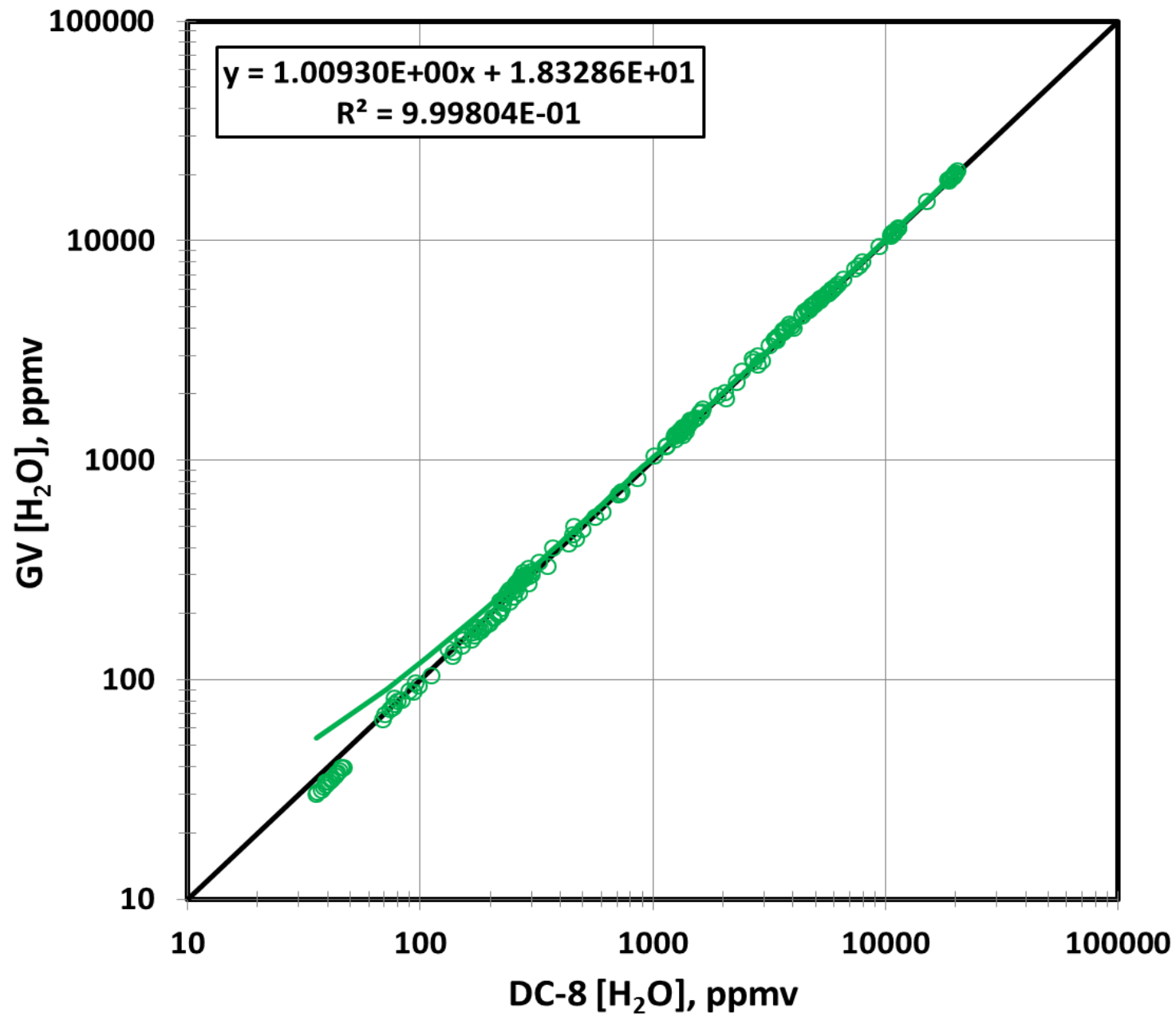


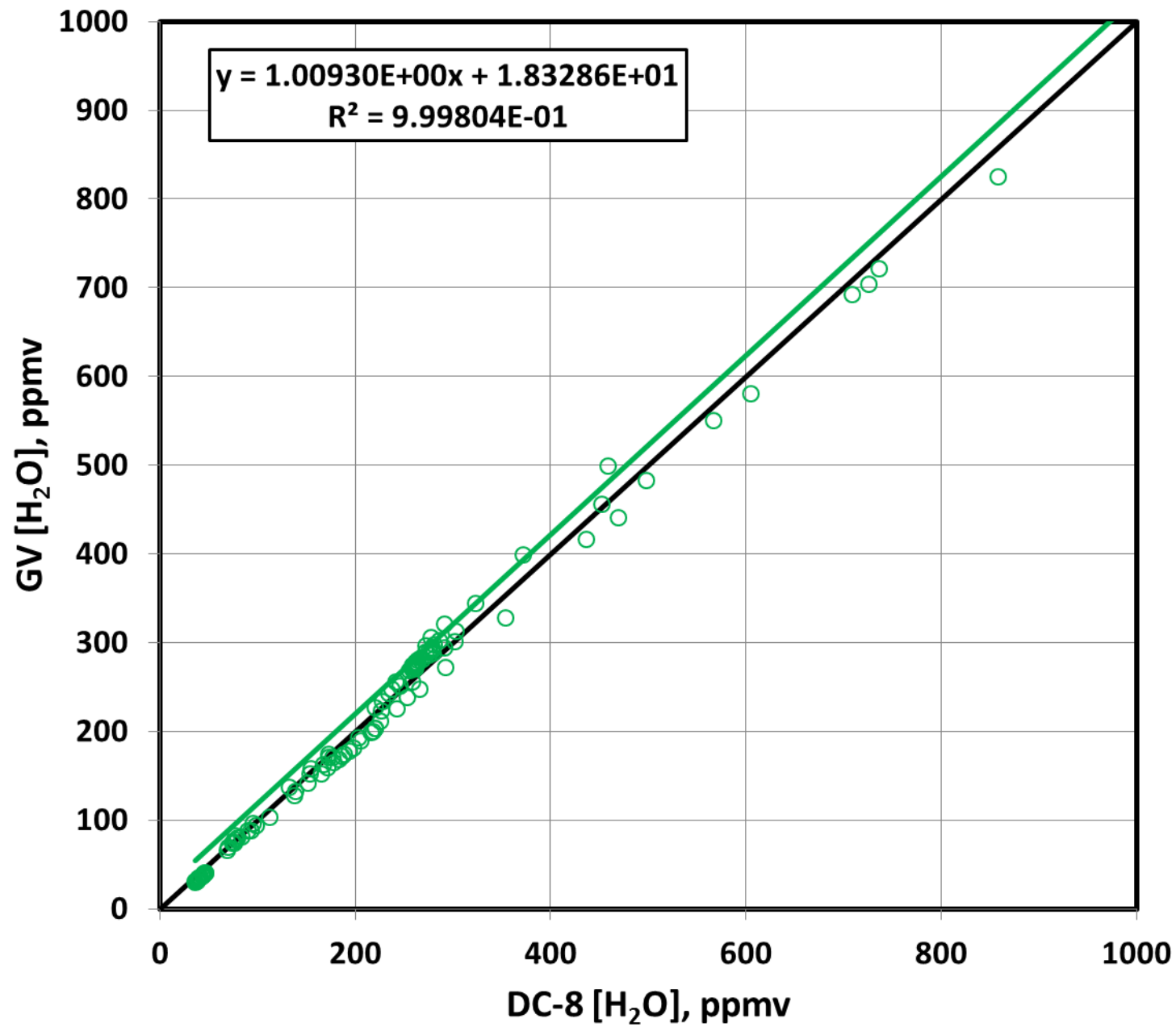


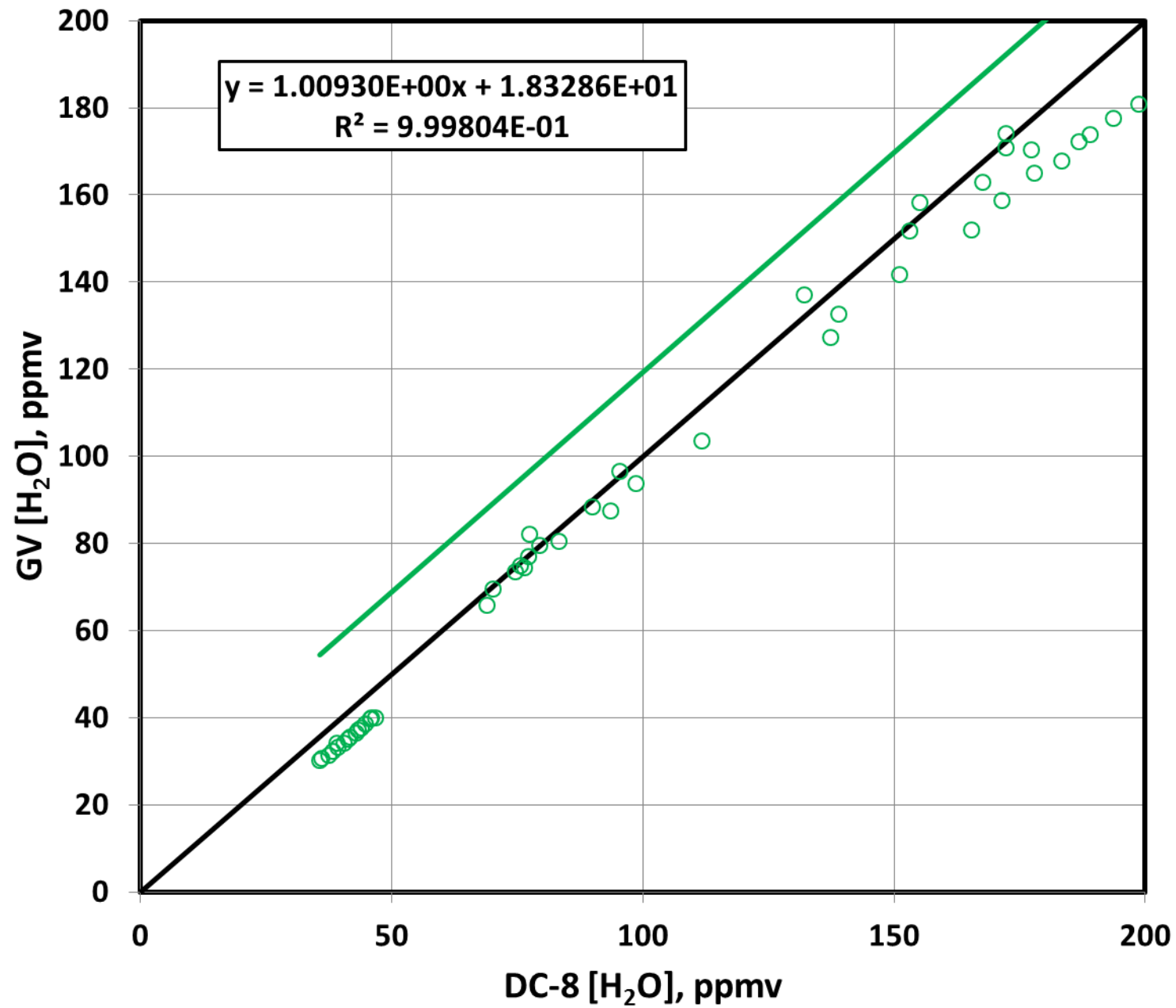
GV & DC-8 H₂O Vapor





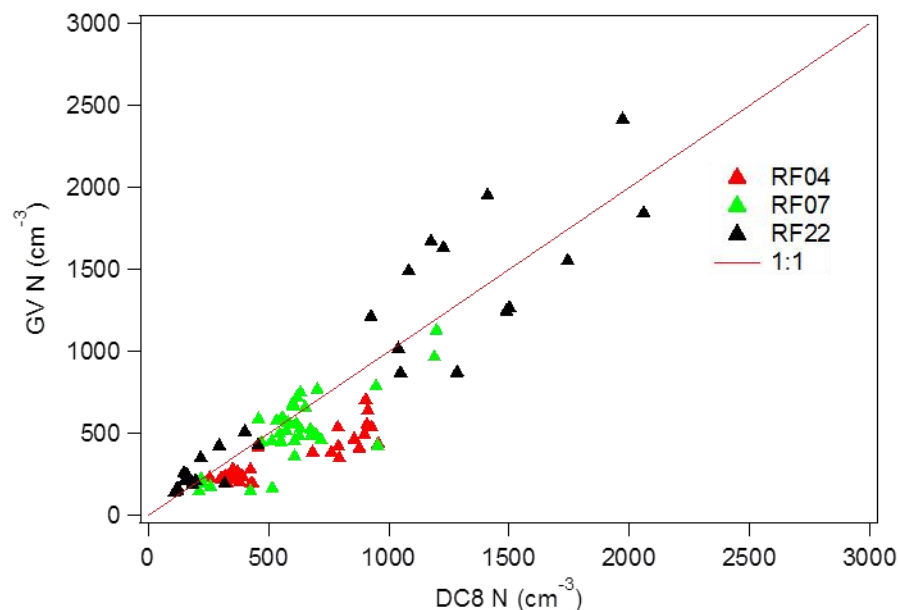






Scanning Mobility Particle Sizer Intercomparison

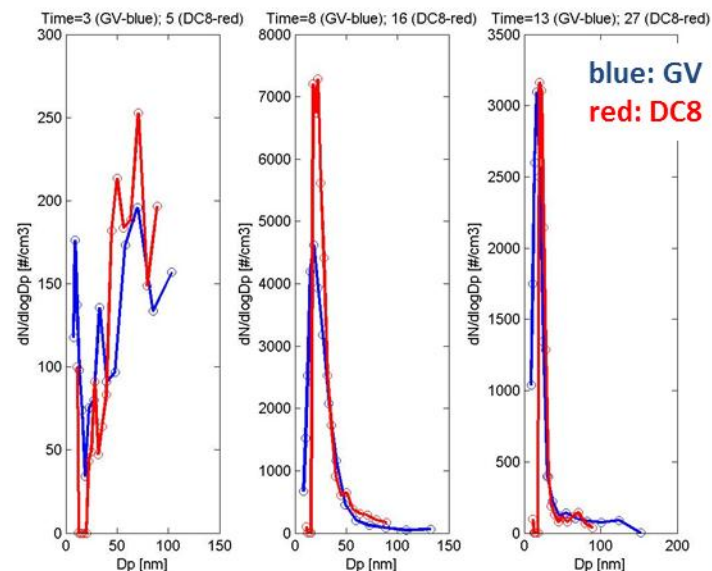
comparison of total integrated number concentration (diameter range: 10-110 nm)



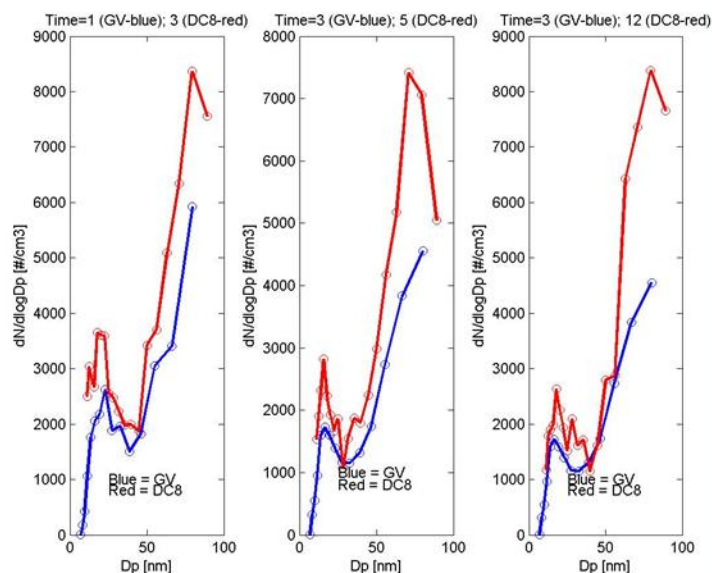
GV: Jim Smith (PI) and John Ortega (NCAR)
DC8: Bruce Anderson (PI) and Luke Ziemba (NASA)

representative size distributions

**RF7
(5/30)**

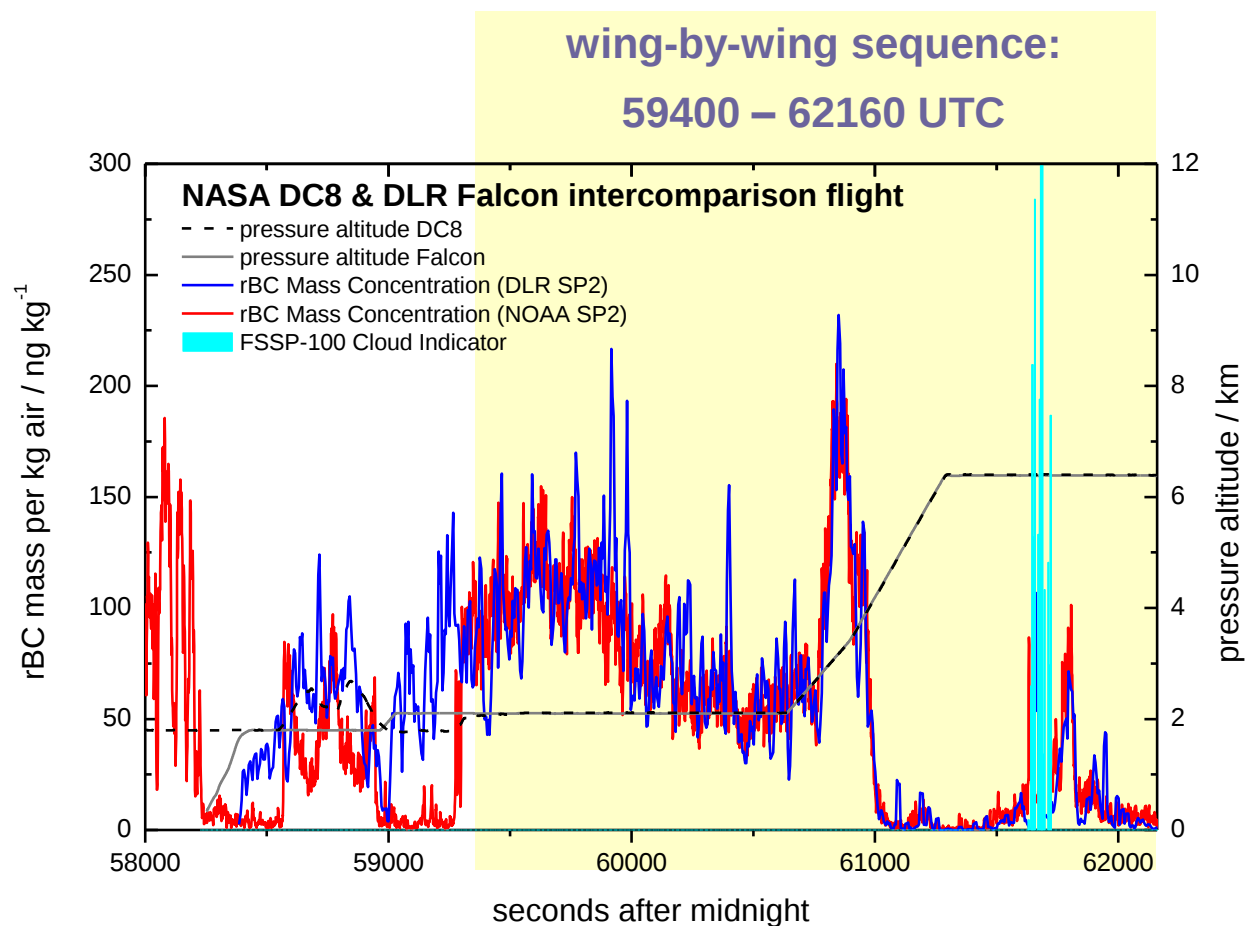
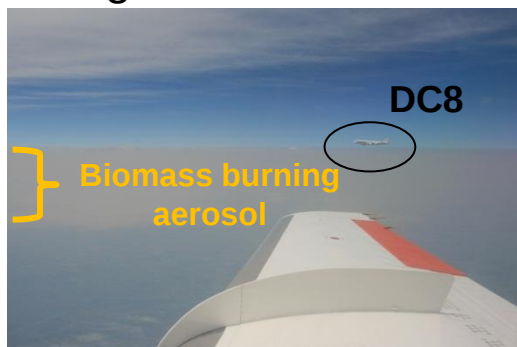


**RF22
(6/17)**



DC3 2012: DC8-Falcon intercomparison flight on 11 June 2012

High Park Fire



NOAA SP2: Milos Markovic, Shuka Schwarz, Anne Perring, Dave Fahey

DLR SP2: Bernadett Weinzierl, Katharina Heimerl

Measurement Ratios

Species	Meas #1	Meas #2	Meas #1 / Meas #2					Minimum Value
			Average	Std Dev	Min	Max	Count	
Altitude	GV	DC-8	1.00038	0.00155	0.9962	1.0096	229	0
Pressure	GV	DC-8	0.99978	0.00166	0.9876	1.0061	229	0
Temperature	GV	DC-8	0.99928	0.00181	0.9938	1.0027	229	0
Wind Speed	GV	DC-8	1.01677	0.07920	0.7683	1.3418	218	5
Wind Direction	GV	DC-8	0.99133	0.03688	0.7117	1.0388	229	0
Dew Point	GV	DC-8	1.00600	0.00879	0.9770	1.0233	210	0
CH ₂ O	GV CAMS	DC-8 DFGAS	1.11167	0.29928	0.4270	2.5864	105	200
	GV TOGA	DC-8 DFGAS	1.44386	0.54913	0.5033	3.0224	118	200
	GV TOGA	GV CAMS	1.37165	0.42026	0.8683	2.0342	22	200
	DC-8 LIF	DC-8 DFGAS	1.04751	0.24676	0.6132	1.8581	49	200
	GV TOGA	GV CAMS	1.35147	0.48940	0.3449	8.293	2595	200
	DC-8 LIF	DC-8 DFGAS	0.98476	0.19042	0.3301	2.8090	2841	200
SO ₂	GV GTCIMS	DC-8	2.54026	2.91993	0.5184	17.319	92	20
HNO ₃	GV GTCIMS	DC-8 SAGA	1.64423	0.92156	0.1920	5.760	163	20
HCl	GV GTCIMS	DC-8 GTCIMS	1.10955	0.47631	0.5212	2.5364	67	2
j(O ¹ D)	GV HARP	DC-8 CAFS	1.11114	0.0419	1.03159	1.2764	229	0
j(NO ₂)	GV HARP	DC-8 CAFS	0.90541	0.00844	0.8481	0.9213	229	0
i-butane	GV TOGA	DC-8 WAS	0.94176	0.13540	0.6990	1.3139	88	20
n-butane	GV TOGA	DC-8 WAS	0.92674	0.11455	0.6242	1.3551	119	20
methyl chloride	GV TOGA	DC-8 WAS	0.91739	0.06879	0.7991	1.0969	177	1
acetaldehyde	GV TOGA	DC-8 WAS	0.86780	0.35158	0.4356	1.4156	22	1
butanone (MEK)	GV TOGA	DC-8 WAS	1.57774	1.65999	0.2030	10.506	135	10
benzene	GV TOGA	DC-8 WAS	1.28491	0.35355	0.4026	2.1558	117	10
CO ₂	GV	DC-8	1.00037	0.00119	0.9970	1.0088	223	0
CO	GV	DC-8	0.98391	0.01165	0.9256	1.0339	204	0
NO	GV CL	DC-8 CL	0.88730	0.43443	0.2903	4.6705	102	20
NO ₂	DC-8 LIF	GV CL	1.82825	0.78377	0.5272	4.2678	75	50
	DC-8 LIF	DC-8 CL	1.20808	0.51473	0.1460	5.3960	610	50
O ₃	GV CL	DC-8	0.98933	0.02156	0.9510	1.0386	224	0
H ₂ O	GV VCSEL	DC-8 DLH	0.99895	0.05774	0.834	1.1044	229	0
CH ₄	GV PICARRO	DC-8	1.00094	0.00322	0.9748	1.0099	221	0

Normalized Differences

Species	Meas #1	Meas #2	(Meas #1 - Meas #2) / avg(Meas #1, Meas #2)					Minimum Value
			Average	Std Dev	Min	Max	Count	
Altitude	GV	DC-8	0.00038	0.00155	-0.0038	0.0096	229	0
Pressure	GV	DC-8	-0.00022	0.00167	-0.0125	0.0061	229	0
Temperature	GV	DC-8	-0.00072	0.00181	-0.0062	0.0027	229	0
Wind Speed	GV	DC-8	0.01365	0.07628	-0.2620	0.2919	218	5
Wind Direction	GV	DC-8	-0.00946	0.04064	-0.3369	0.0381	229	0
Dew Point	GV	DC-8	0.00594	0.00878	-0.0233	0.0088	210	0
CH ₂ O	GV CAMS	DC-8 DFGAS	0.07227	0.25161	-0.8030	0.8847	105	200
	GV TOGA	DC-8 DFGAS	0.28820	0.34567	-0.6609	1.00557	118	200
	GV TOGA	GV CAMS	0.04253	0.31486	-0.5734	1.1065	90	200
	DC-8 LIF	DC-8 DFGAS	0.01946	0.23180	-0.4796	0.6005	49	200
	GV TOGA	GV CAMS	0.23946	0.30347	-0.9742	1.5695	2595	200
	DC-8 LIF	DC-8 DFGAS	-0.03280	0.18652	-1.0072	0.9498	2841	200
SO ₂	GV GTCIMS	DC-8	0.53372	0.50791	-0.6343	1.7816	92	20
HNO ₃	GV GTCIMS	DC-8 SAGA	0.30169	0.54372	-1.6929	1.4082	166	20
HCl	GV GTCIMS	DC-8 GTCIMS	-0.02534	0.41243	-0.9834	0.8689	72	2
j(O ¹ D)	GV HARP	DC-8 CAFS	0.10455	0.03739	0.0311	0.2428	229	0
j(NO ₂)	GV HARP	DC-8 CAFS	-0.09933	0.00940	-0.1644	-0.0819	229	0
i-butane	GV TOGA	DC-8 WAS	-0.09048	0.17576	-0.6746	0.2713	148	20
n-butane	GV TOGA	DC-8 WAS	-0.10936	0.18931	-1.1189	0.5061	163	20
methyl chloride	GV TOGA	DC-8 WAS	-0.08880	0.07380	-0.2233	0.0924	177	1
acetaldehyde	GV TOGA	DC-8 WAS	-0.21503	0.41214	-0.7863	0.3441	22	1
butanone (MEK)	GV TOGA	DC-8 WAS	-0.15312	0.88704	-1.9158	1.6523	155	10
benzene	GV TOGA	DC-8 WAS	0.33881	0.41103	-0.8519	1.6716	173	10
CO ₂	GV	DC-8	0.00036	0.00118	-0.0030	0.0088	223	0
CO	GV	DC-8	-0.01629	0.01187	-0.0773	0.03337	204	0
NO	GV CL	DC-8 CL	-0.16984	0.24993	-1.1000	1.2946	102	20
NO ₂	DC-8 LIF	GV CL	0.47501	0.42371	-0.6192	1.2407	75	50
	DC-8 LIF	DC-8 CL	0.10042	0.41067	-1.4903	1.3746	610	50
O ₃	GV CL	DC-8	-0.01096	0.02174	-0.0502	0.0378	224	0
H ₂ O	GV VCSEL	DC-8 DLH	-0.00277	0.05993	-0.1810	0.0599	229	0
CH ₄	GV PICARRO	DC-8	0.00093	0.00323	-0.0255	0.0099	221	0

Fit and Correlation

Species	Meas #1	Meas #2	Fit of Meas #1 (y) vs Meas #2 (x)				Minimum Value
			Slope	Intercept	r ²	Count	
Altitude	GV	DC-8	0.99972	0.00354	0.99999	229	0
Pressure	GV	DC-8	0.99959	0.07243	0.99999	229	0
Temperature	GV	DC-8	1.01969	-5.15116	0.99994	229	0
Wind Speed	GV	DC-8	0.94636	0.99824	0.95544	218	5
Wind Direction	GV	DC-8	1.03017	-9.27614	0.97959	229	0
Dew Point	GV	DC-8	1.01463	-2.07445	0.99292	210	0
CH ₂ O	GV CAMS	DC-8 DFGAS	1.10402	-6.25695	0.95814	105	200
	GV TOGA	DC-8 DFGAS	0.97165	189.439	0.91315	118	200
	GV TOGA	GV CAMS	0.90828	113.996	0.90198	90	200
	DC-8 LIF	DC-8 DFGAS	0.99176	21.2665	0.97341	49	200
	GV TOGA	GV CAMS	1.07017	163.037	0.85382	1965	200
	DC-8 LIF	DC-8 DFGAS	0.83922	141.695	0.96352	2841	200
SO ₂	GV GTCIMS	DC-8	1.51398	15.6888	0.63581	85	20
HNO ₃	GV GTCIMS	DC-8 SAGA	1.49851	-4.41863	0.85577	156	20
HCl	GV GTCIMS	DC-8 GTCIMS	1.35078	-1.33181	0.88431	67	2
j(O ¹ D)	GV HARP	DC-8 CAFS	1.10549	-1.59E-9	0.99348	229	0
j(NO ₂)	GV HARP	DC-8 CAFS	0.89954	6.90E-5	0.99584	229	0
i-butane	GV TOGA	DC-8 WAS	0.83470	11.3157	0.99268	88	20
n-butane	GV TOGA	DC-8 WAS	0.90657	1.71266	0.99373	119	20
methyl chloride	GV TOGA	DC-8 WAS	1.0569	-90.942	0.41500	177	1
acetaldehyde	GV TOGA	DC-8 WAS	1.66340	-471.29	0.55361	22	1
butanone (MEK)	GV TOGA	DC-8 WAS	0.74788	126.71	0.54860	48	10
benzene	GV TOGA	DC-8 WAS	0.57153	17.012	0.47243	117	10
CO ₂	GV	DC-8	0.98913	4.4570	0.79901	223	0
CO	GV	DC-8	0.95433	3.18225	0.99570	204	0
NO	GV CL	DC-8 CL	0.99417	-16.522	0.95386	102	20
NO ₂	DC-8 LIF	GV CL	-0.52180	259.03	0.00764	75	50
	DC-8 LIF	DC-8 CL	0.78366	91.4023	0.87355	610	50
O ₃	GV CL	DC-8	1.01612	-1.73977	0.99351	224	0
H ₂ O	GV VCSEL	DC-8 DLH	1.00930	18.329	0.99980	229	0
CH ₄	GV PICARRO	DC-8	1.01453	-25.147	0.96697	221	0

Next Steps

- Finish analyses of all comparable species (multi-platform, same platform)
- Work with PIs to work out any issues
- Recalculate parameters with preliminary and then final data
- Recognize degree of agreement when using data from multiple platforms in addressing DC3 goals