25 September 2012
DC3 Science Team Telecon

Mary Barth

Overview Comments on DC3

Students and young scientists involved in DC3

34 undergraduate students (OU: 17)

77 graduate students (OU: 9, CSU: 9, CU: 8)

30 post-doctoral young scientists

Overview of DC3 Cases

The three regions have different types of thunderstorms.

- ***Colorado storms*: high shear and high cloud bases resulting in ice-dominated storms.**
- ***Central Oklahoma and West Texas*: shear-driven thunderstorms with large convective available potential energy (CAPE) producing strong, severe storms.**
- ***Northern Alabama storms*: low shear with moderate CAPE creating short-lived storms.**
- ***Mesoscale Convective System* (MCS) sampled on June 11: both high shear and CAPE.**

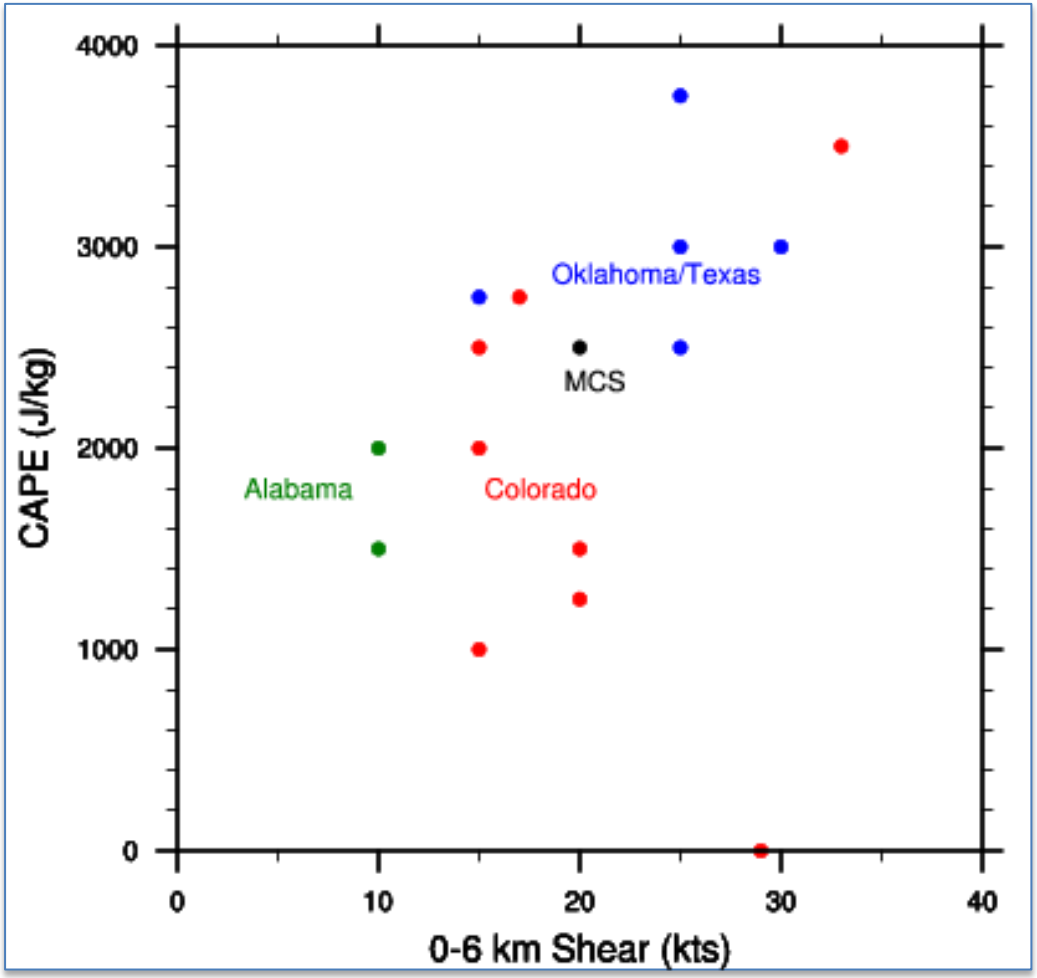
Overview of DC3 Cases

Method:

- NCAR WRF Forecasted CAPE and 0-6 km shear. Values are taken ~1 hour before convection occurred in the region. NCAR WRF forecasts by Weisman, Barth, Manning, Wang, Bela.

- Plan to redo these calculations using the pre-storm environmental soundings

Overview of DC3 Cases



NCAR WRF Forecasted CAPE and 0-6 km shear. Values are taken ~1 hour before convection occurred in the region.

Overview of DC3 Cases

The three regions have different chemical environments.

Northeast Colorado:

- ***Agricultural region often influenced by the Denver plume***
- ***Isoprene and biogenic VOC emissions are low because of the lack of trees in the region***

Central Oklahoma and West Texas:

- ***Agricultural with 100s of gas and oil wells***
- ***Influenced by Dallas – Ft. Worth and Oklahoma City plumes***

Northern Alabama:

- ***Forested region with high isoprene and biogenic VOC emissions.***
- ***Industrial activity***

MCS:

- ***Mixture of high biogenic and anthropogenic air composition in southern Missouri and Arkansas***

Overview of DC3 Cases

Method:

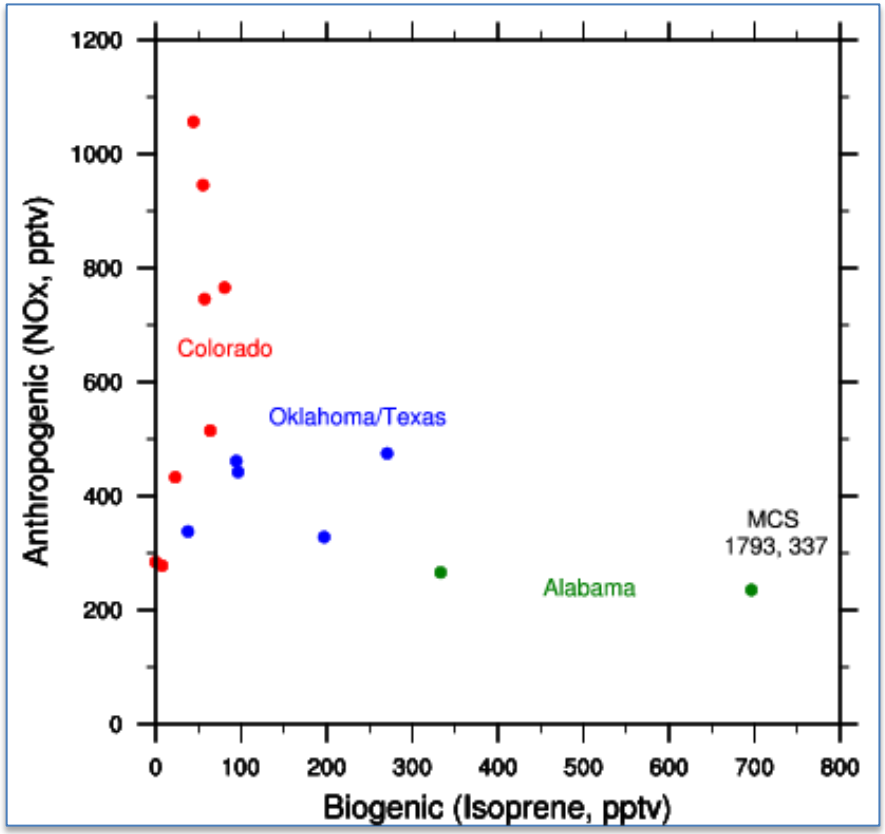
- Use preliminary data from DC-8, except for June 27, 28 cases when only the GV flew
- Average concentrations within 2 km of the ground in the sampling regions
- Color coded by the sampling region.

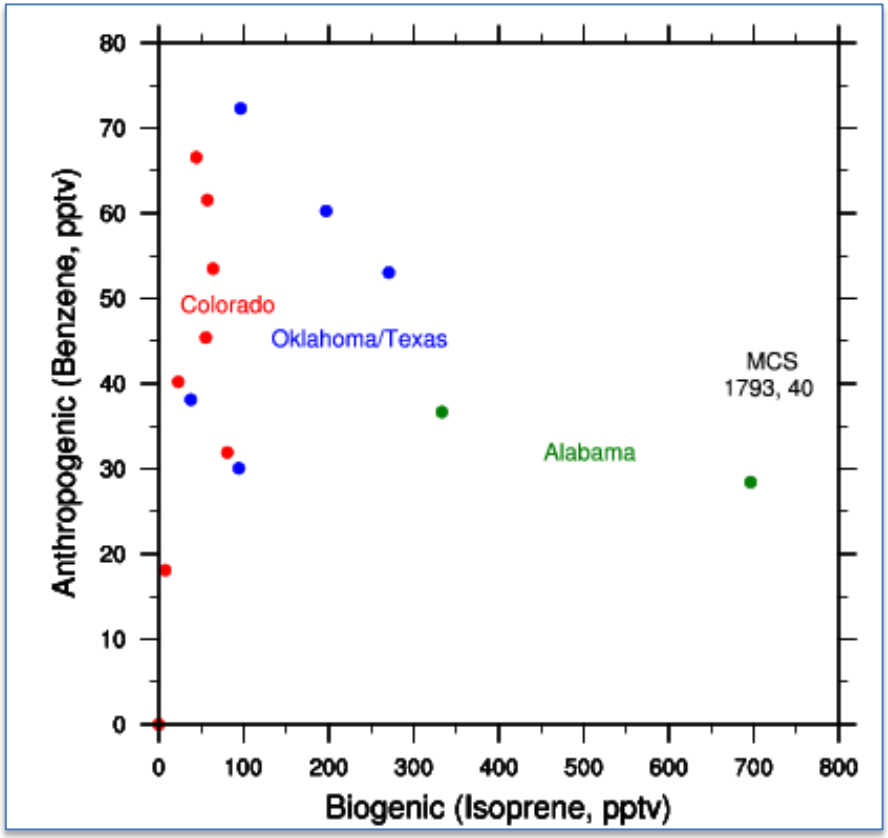
  Colorado: lon < 100W ; lat > 39N

  OK/TX: lon < 95W ; lat < 37.5N

  Alabama: lon > 90W ; lat < 36.5N
- The MCS is the June 11 case where a Mesoscale Convective System occurred over Missouri-Arkansas.

Overview of DC3 Cases





Preliminary Data of average concentrations within 2 km of the ground color coded by the sampling region. The MCS is the June 11 case where a Mesoscale Convective System occurred over Missouri-Arkansas. All points are from DC-8 data except the June 27, 28 storms in Colorado.

Heidi Huntrieser

DLR Falcon

DLR

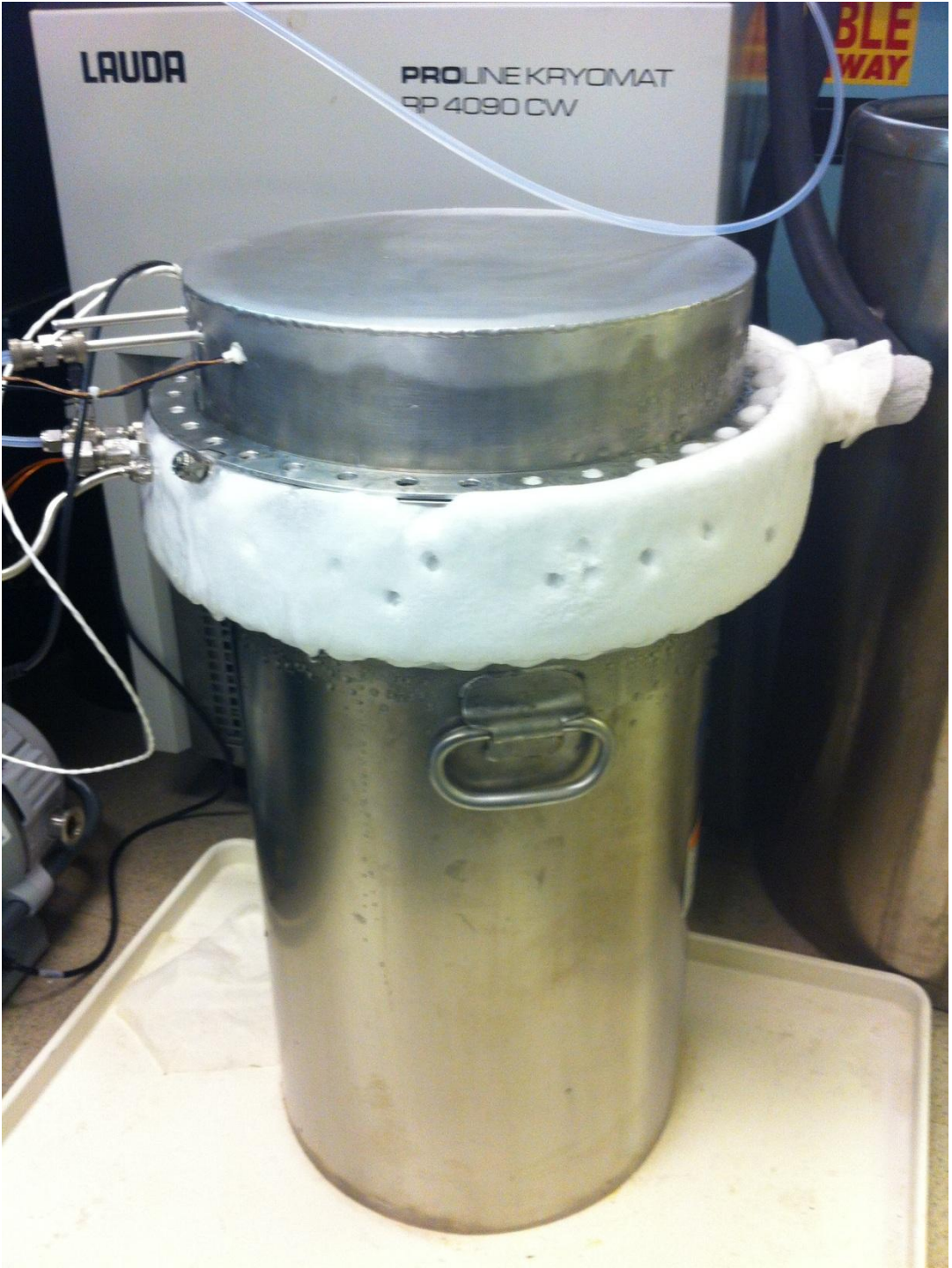
News from the German DLR-Falcon Team:

- extended Falcon flight reports in process (met. situation, detailed flight description, few QLs) → DC3 Field Catalog "Missions" in September/October
- DLR-DC3-Topics: 1) fresh/aged LNOx and O3-production 2) fresh/aged biomass burning/ black carbon plumes
- first preliminary Falcon data in November
- AMS-Conference (Huntrieser, Weinzierl)

DLR-Falcon flight tracks during DC3

Josh DiGangi

Water Vapor Measurements (GV VCSEL)



DC3 VCSEL Hygrometer Data Quality Status

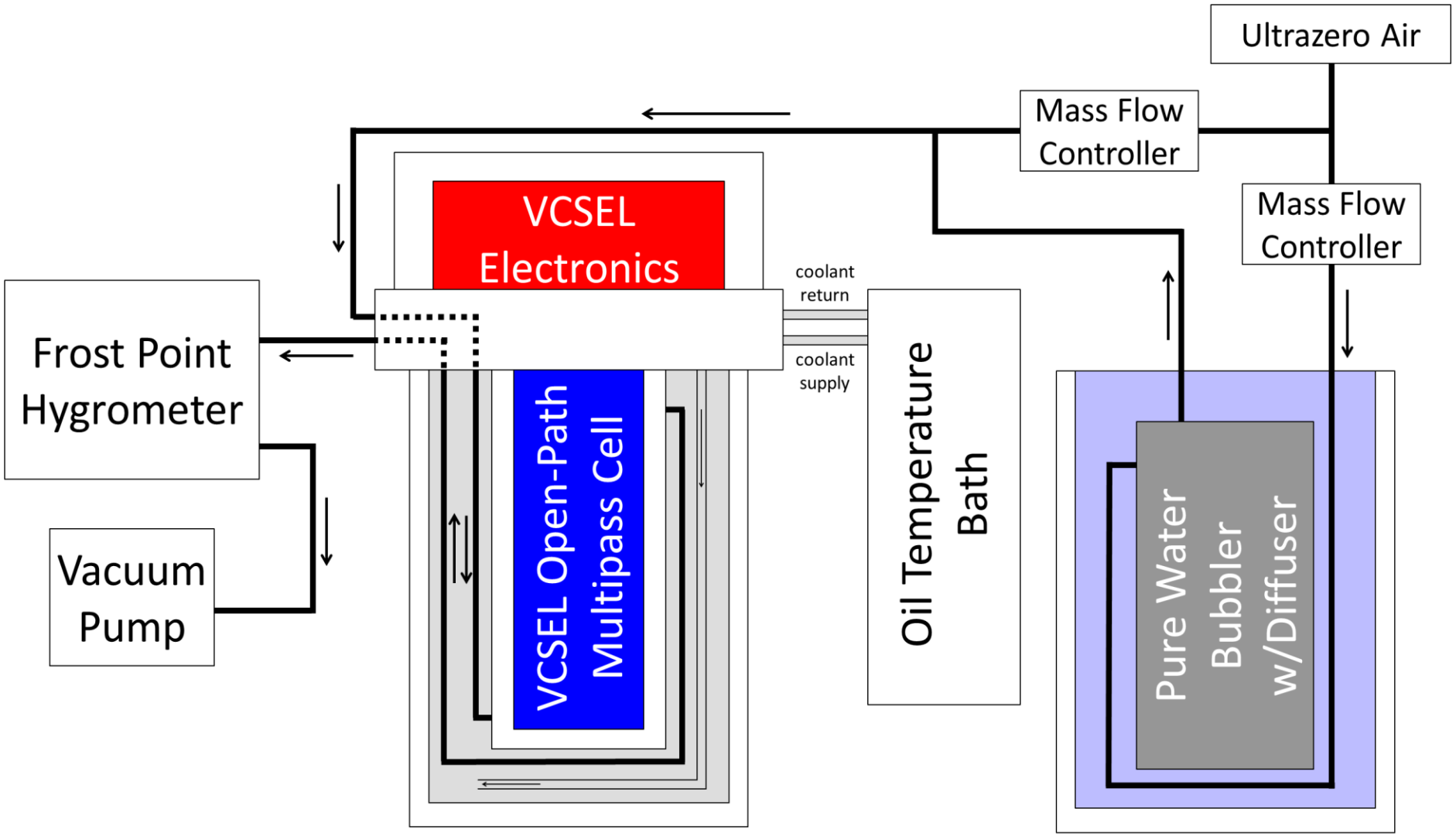
Josh DiGangi
Zondlo Group

DC3 Science Meeting
09/25/12

DC3 Data Quality Issues

- Grounding
  - Significant noise in signal during test flights
  - Also affected absolute calibration
- Multiple spectral/acquisition modes
  - Low, mid, and UT/LS modes
- Previously unforeseen signal gain dependency

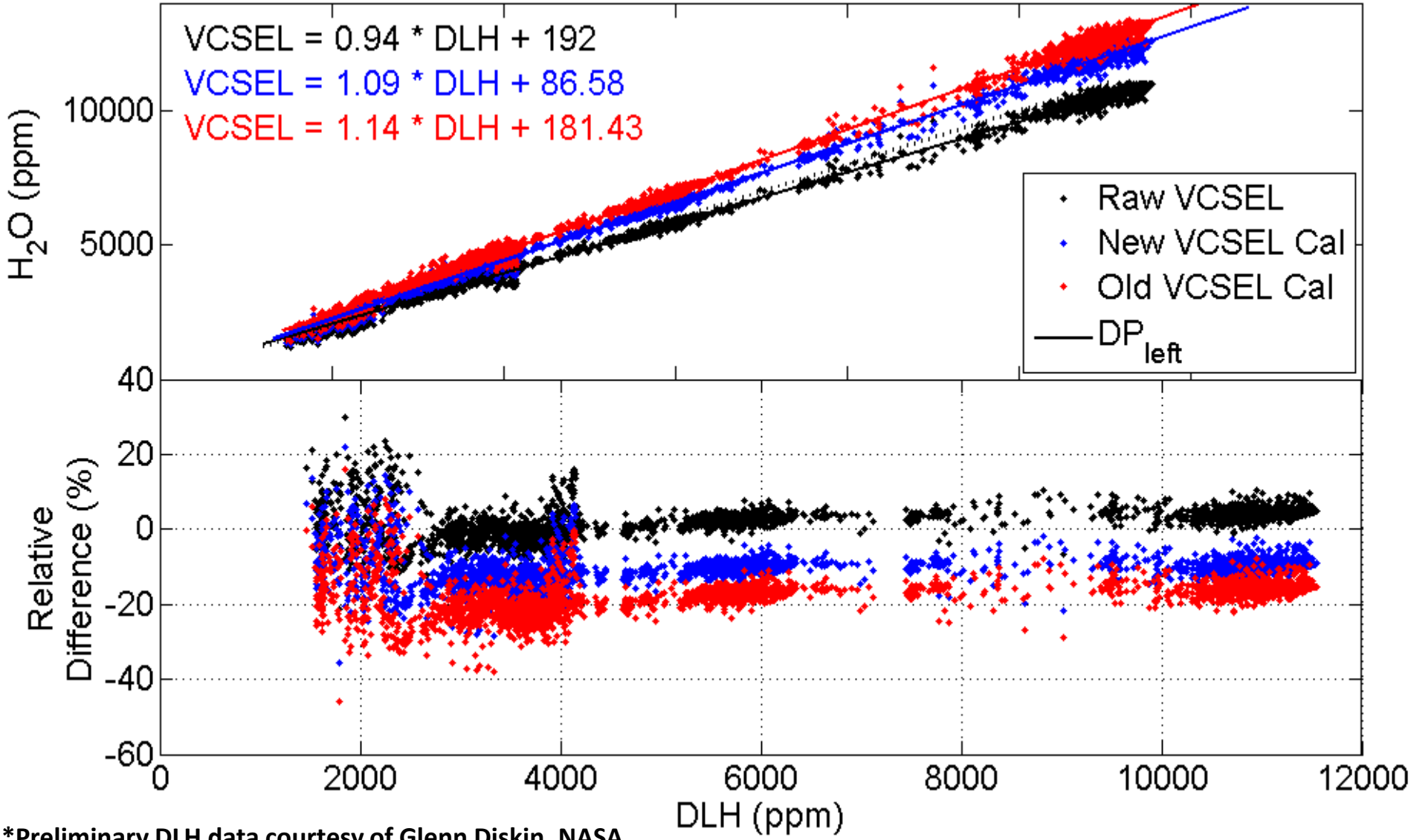
Experimental Approach



Multiple Source Intercomparison

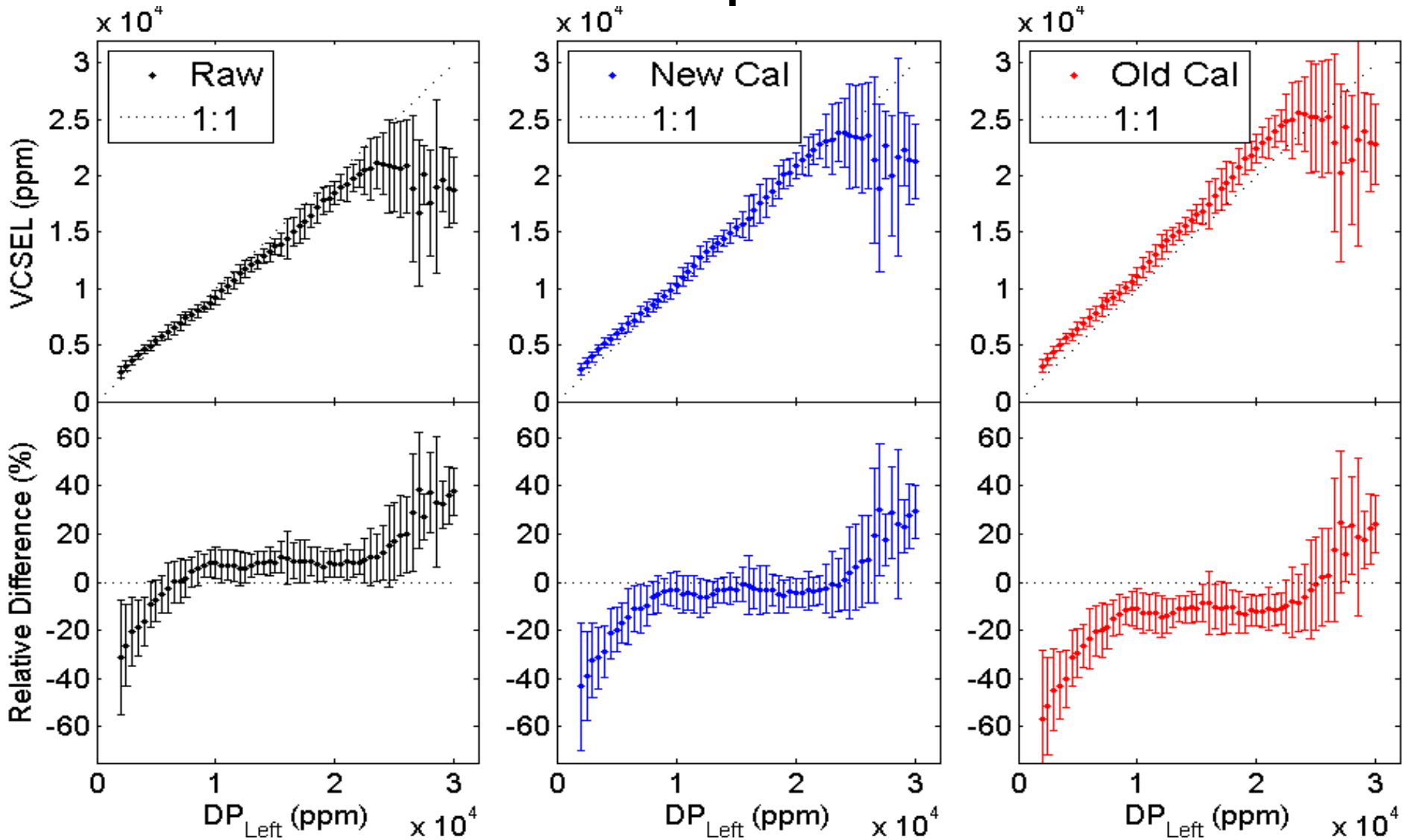
- Source
  - Static experiments
  - Oil bath ice/water saturator
  - Water slush bubbler
  - Chemical slush bath ice saturator
  - H_2 -> H_2O via Pt catalyst oven
- Validation
  - Frost point hygrometer

VCSEL/DLH Low Troposphere Intercomparison

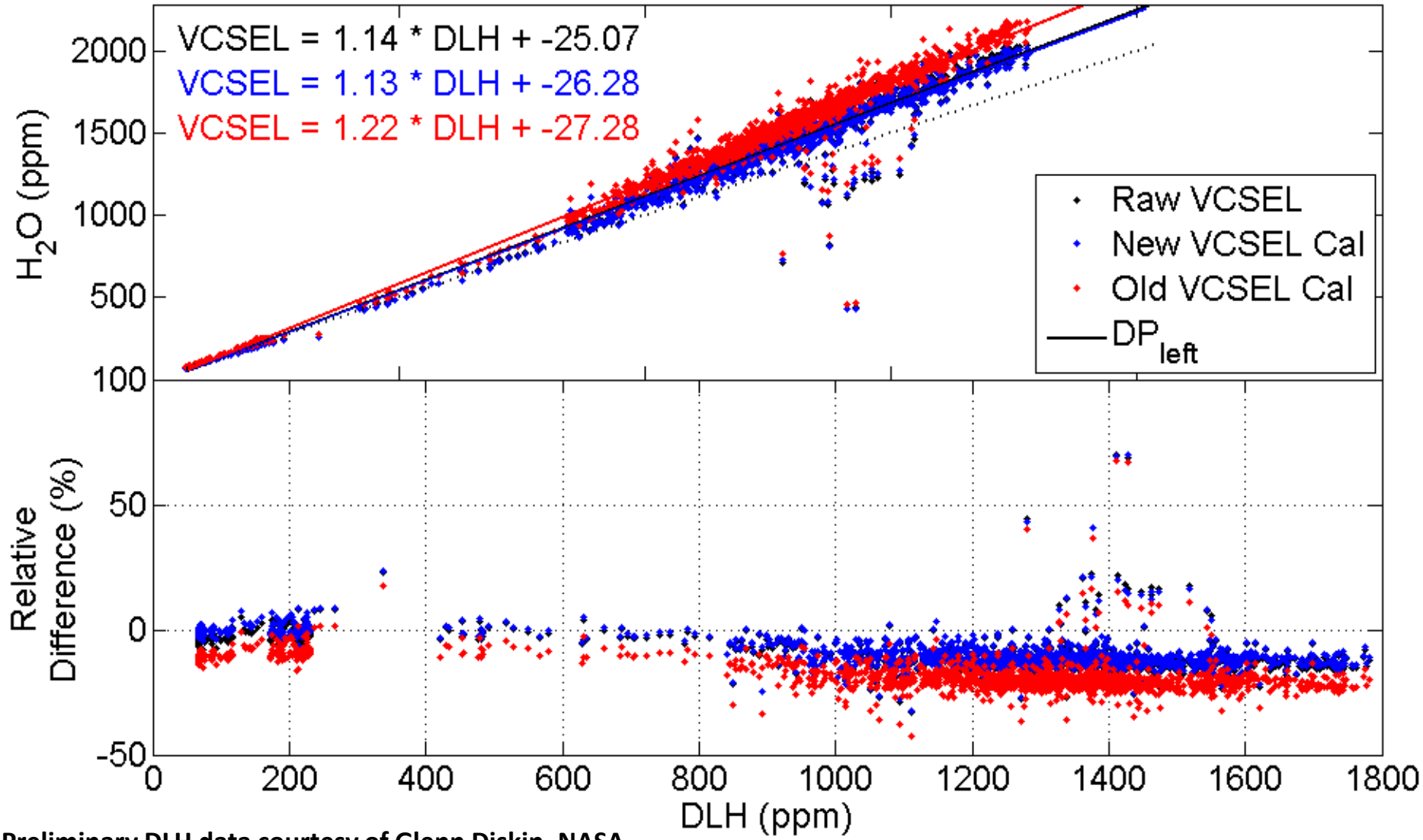


***Preliminary DLH data courtesy of Glenn Diskin, NASA**

VCSEL/Dewpointer Low Troposphere Intercomparison

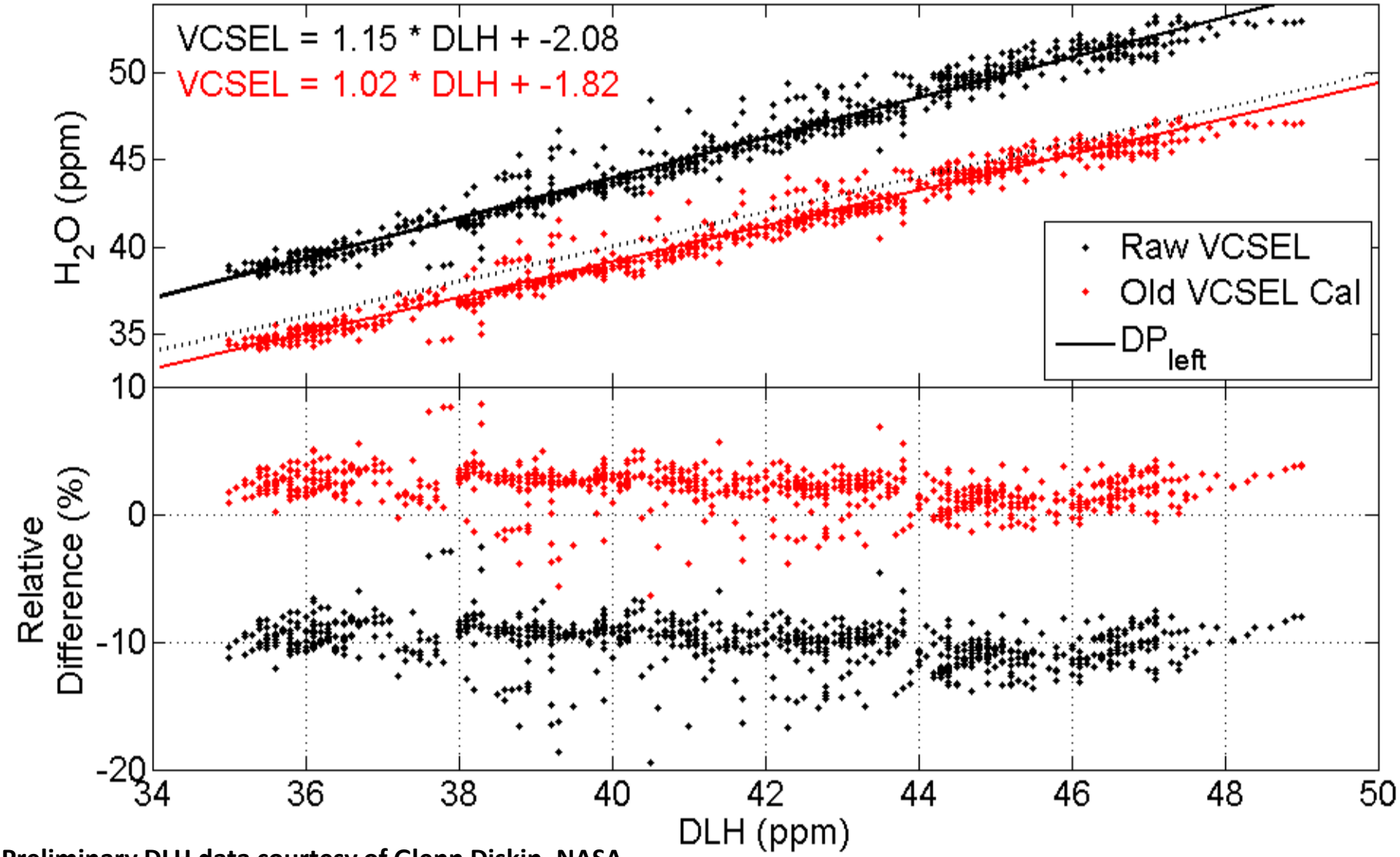


VCSEL/DLH Mid-Troposphere Intercomparison



***Preliminary DLH data courtesy of Glenn Diskin, NASA**

VCSEL/DLH UT/LS Intercomparison



*Preliminary DLH data courtesy of Glenn Diskin, NASA

Next Steps

- Compare results with Pt catalyst source and chemical slush bath
- Finalize calibrations and resubmit by the end of October
- Continue scientific analysis

Acknowledgements

- Zondlo Group
  - esp. Anthony O'Brien, Chris Hamm, Qiushi Zhang
- NCAR Research Aviation Facility
  - esp. Stuart Beaton
- DC3 Science Team

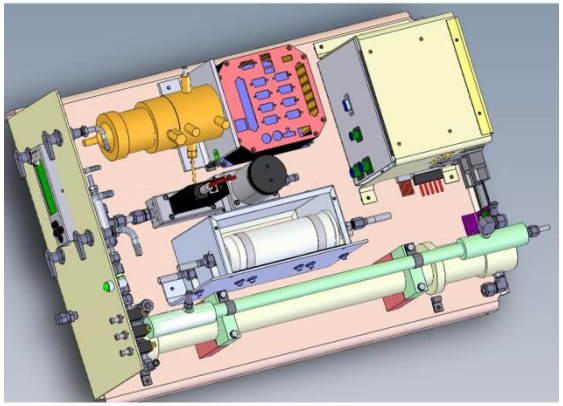
Jim Smith

Aerosol Measurements (GV SMPS)

GV Scanning Mobility Particle Sizer (SMPS)

Jim Smith (NCAR/ACD)
John Ortega (NCAR/ACD)
Dave Rogers (NCAR/RAF)

1. A nanometer Differential Mobility Analyzer (nano-DMA) to size-select aerosols for counting by a Condensation Particle Counter (CPC).
2. One complete size distribution (**diameter range of ~7 – 200 nm**) in **1 min**.
3. Size distribution overlaps with UHSAS, resulting in a overall size distribution from **7 nm to 1 μm**.
4. First campaign with instrument (ran successfully during DC3-Test).
5. Still need to complete some tests of CPC counting efficiency and HIML transmission to arrive at final concentrations – for the moment we show concentrations in "arbitrary units."



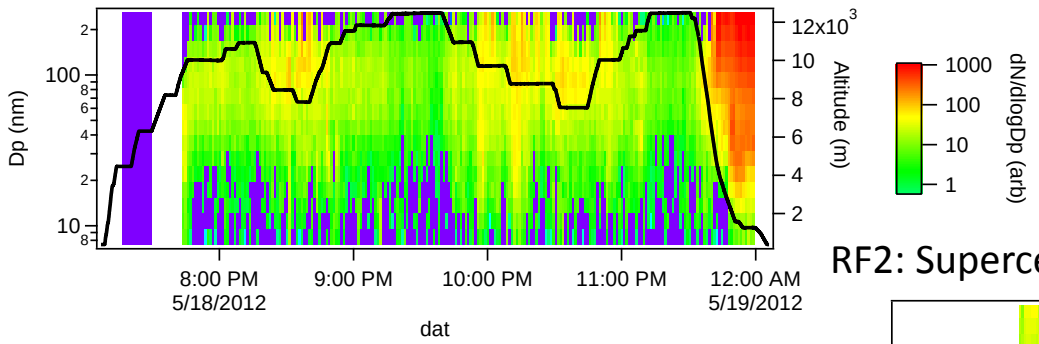
"Our" DC3 science question:

What is the role of deep convection on **aerosol formation, transformations, and transport**?

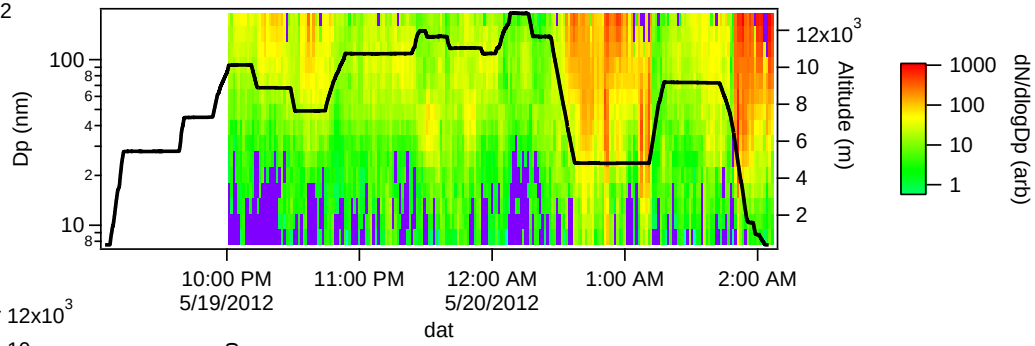
Ortega et al., ATM, in preparation

May 18 - 25

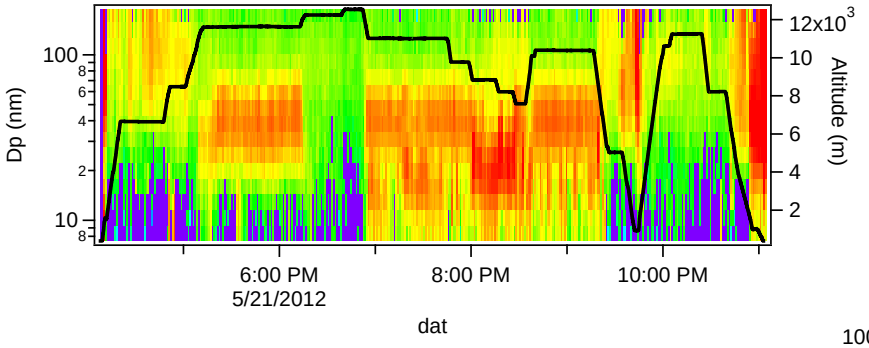
RF1: Flight to storms in CO



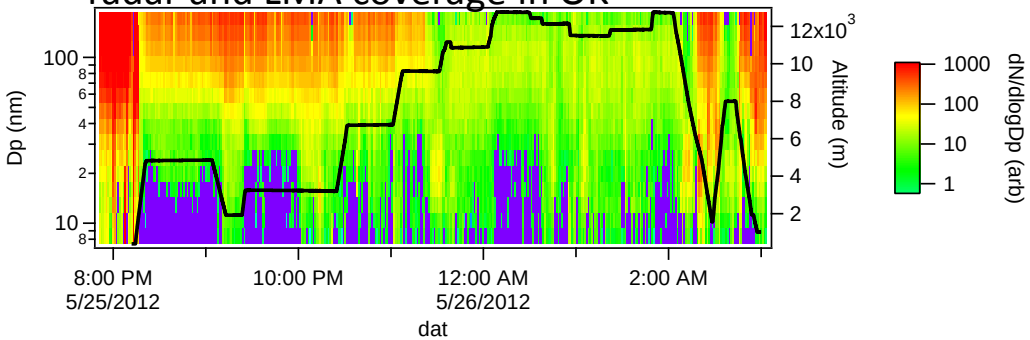
RF2: Supercell-like convection in W. OK



RF3: Extensive convection in TN and AL

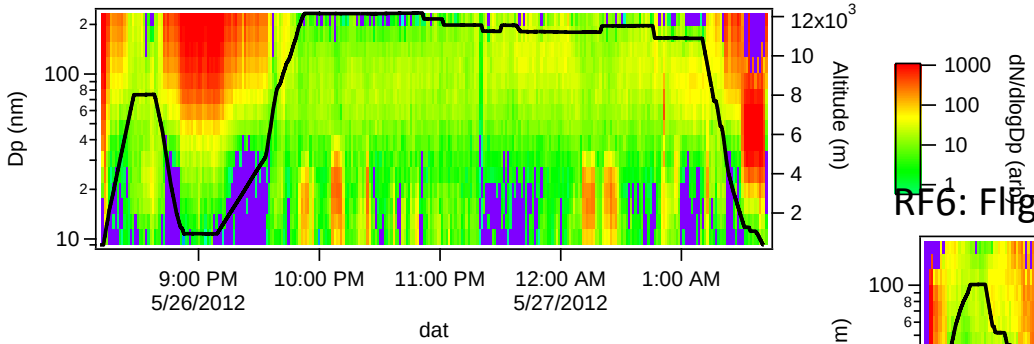


RF4: Convection in a region with radar and LMA coverage in OK

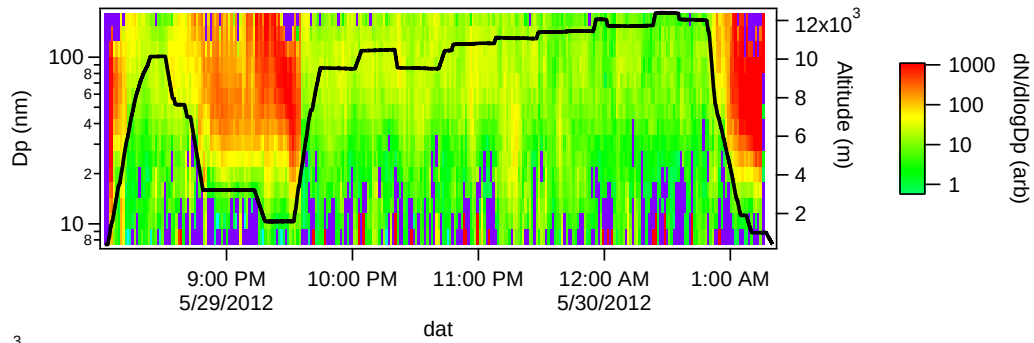


May 26 – June 1

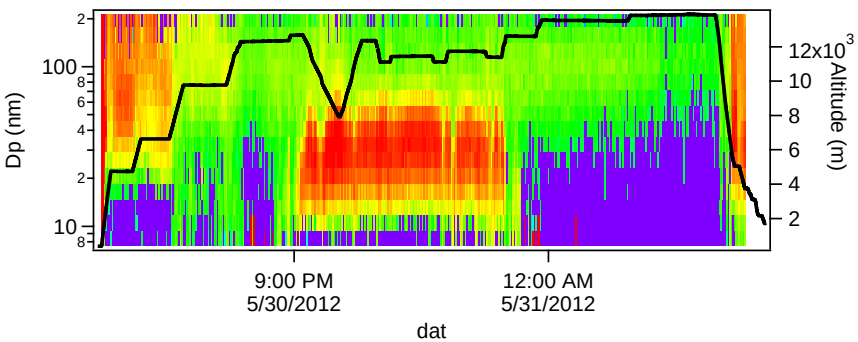
RF5: Downwind flight to Midwest



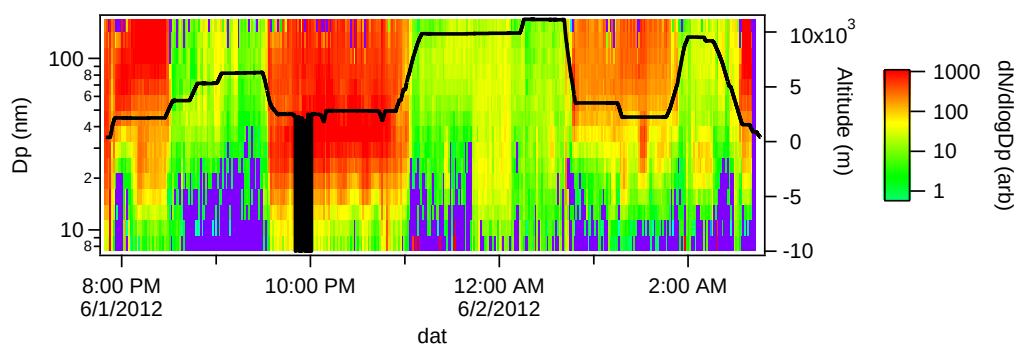
RF6: Flights in LMA/radar region



RF7: Downwind flight to Southern Appalachia

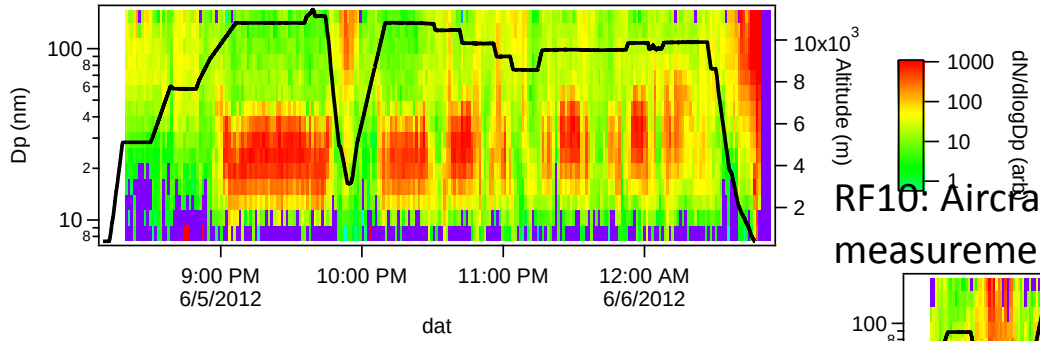


RF8: Source Characterization and W TX Convective Storm

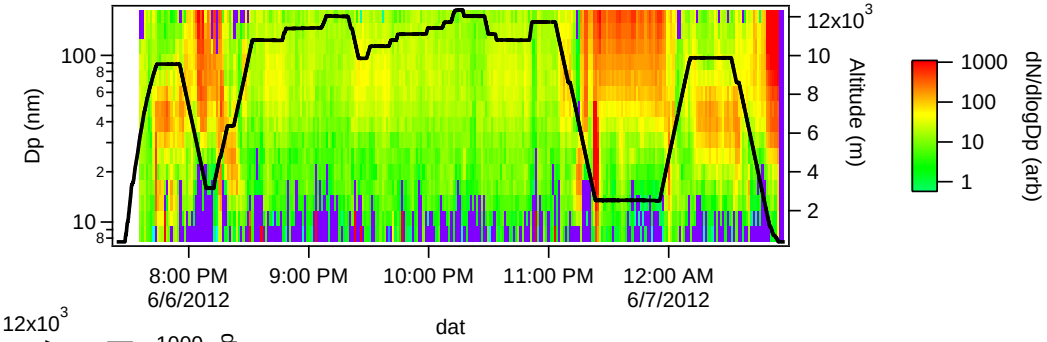


June 5 - 11

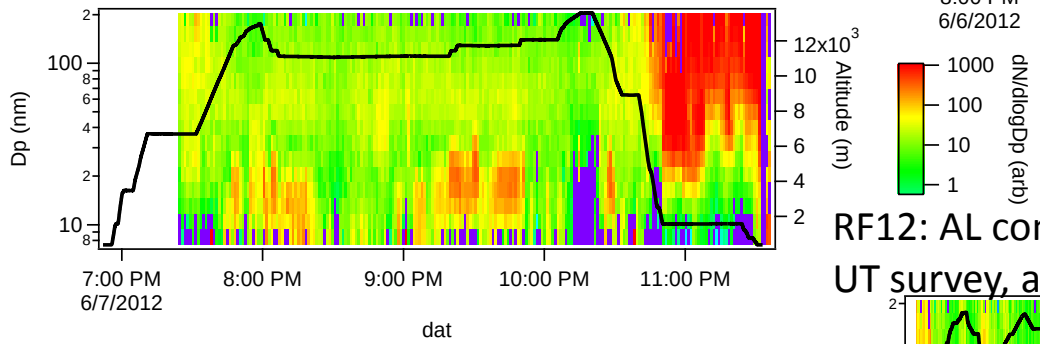
RF9: CO Convective Storm



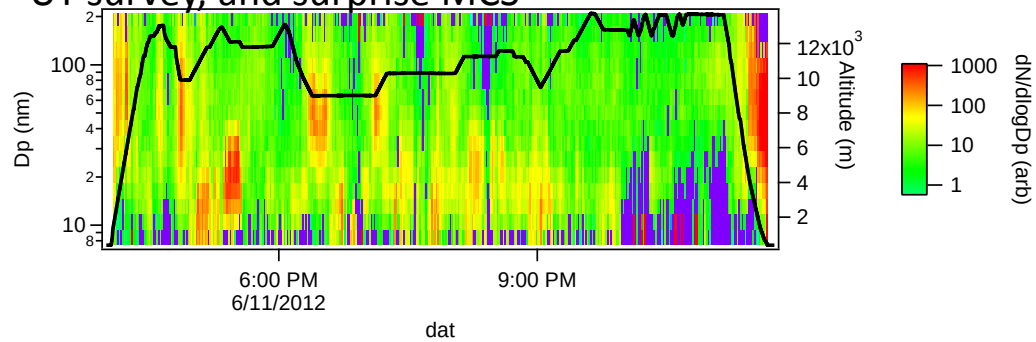
RF10: Aircraft and radar measurements in the CO domain



RF11: Downwind flight to MO region

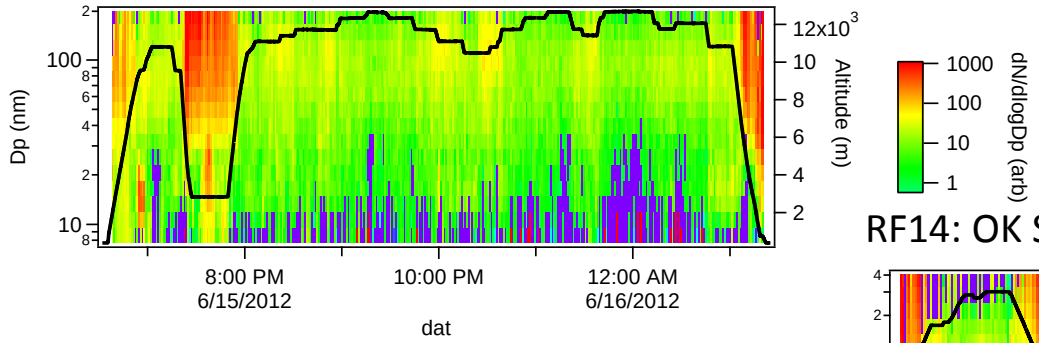


RF12: AL convection, UT survey, and surprise MCS

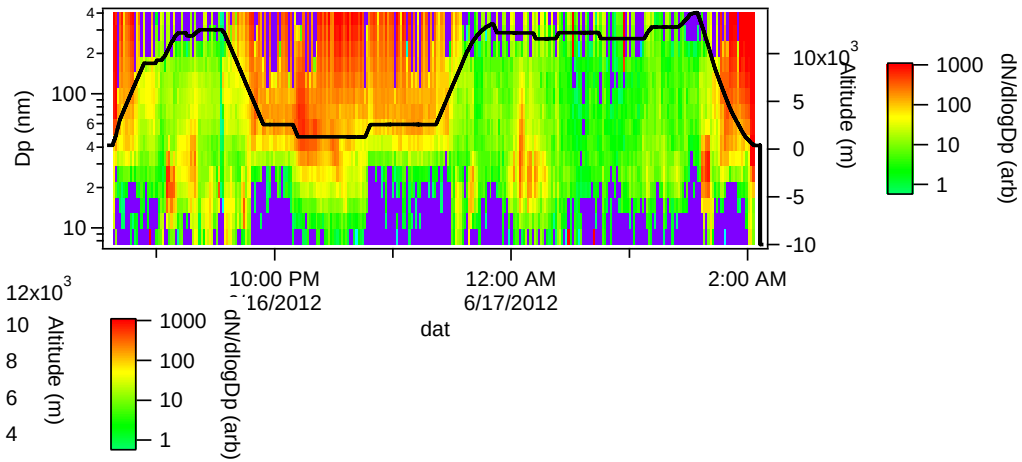


June 15 - 21

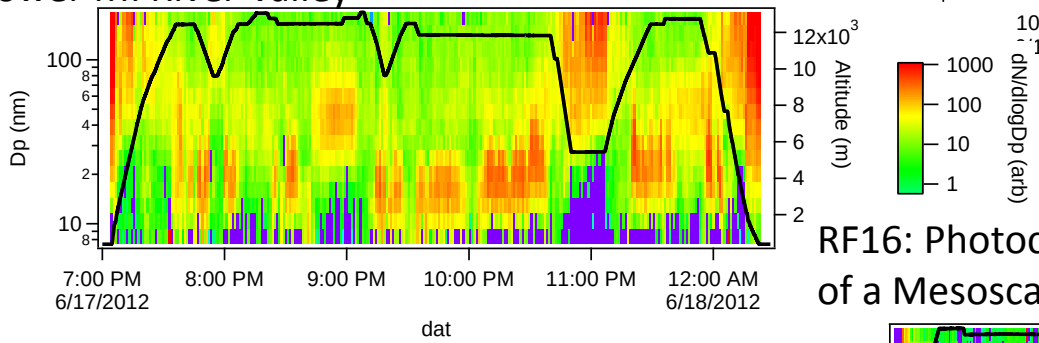
RF13: CO Convective Storm



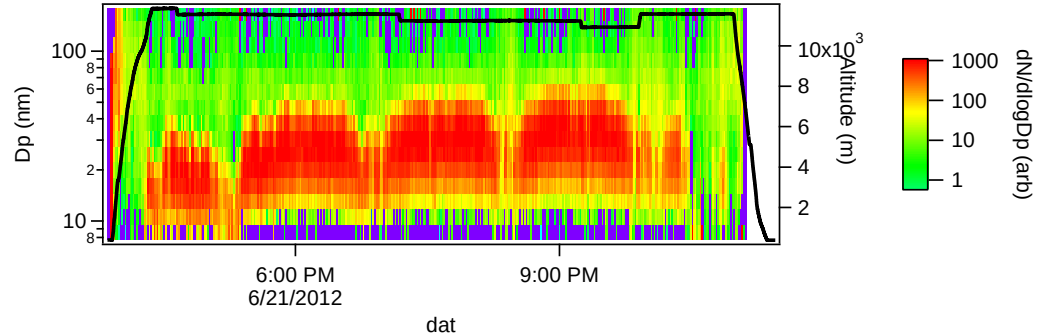
RF14: OK Storm Study



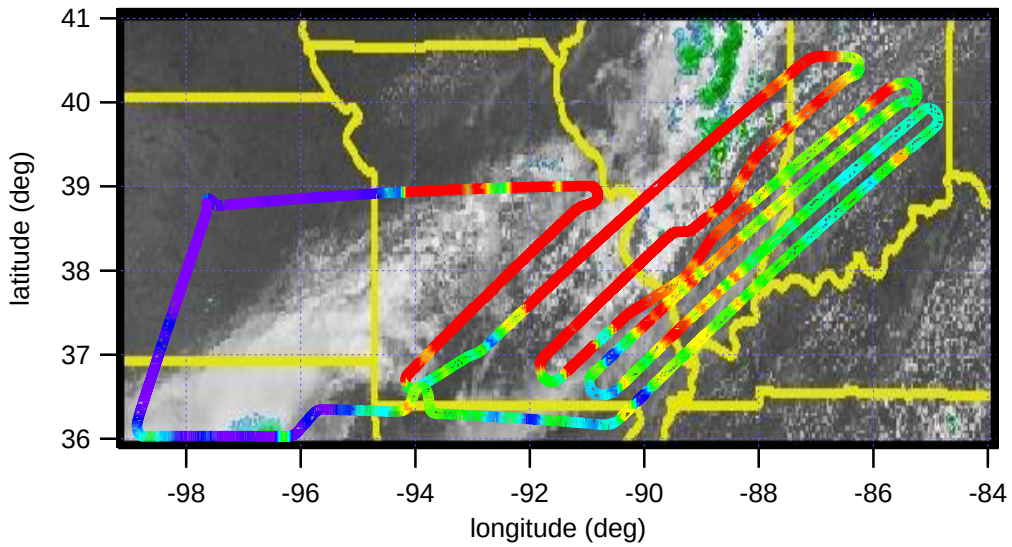
RF15: Downwind Flight to Lower MI River Valley



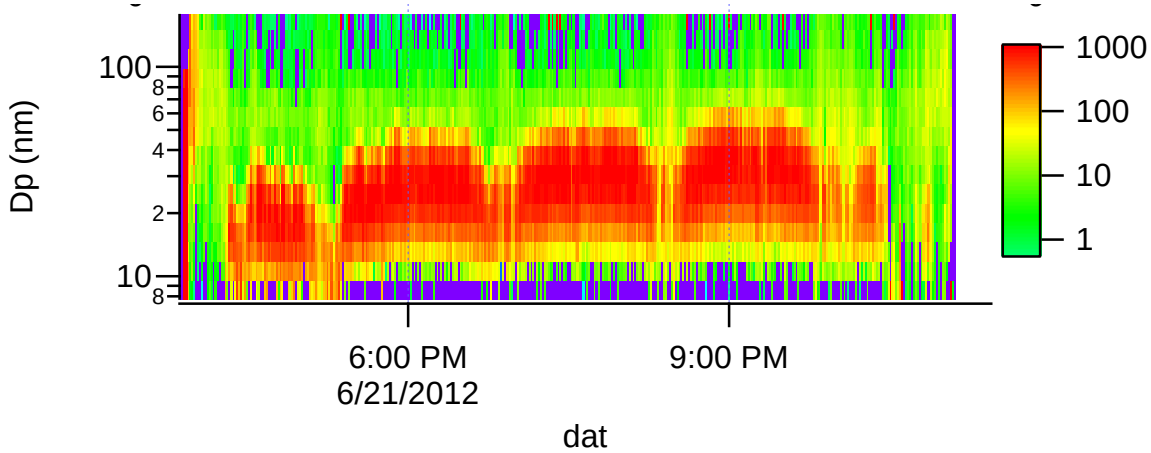
RF16: Photochemical Aging of a Mesoscale Convective System



RF16: Photochemical Aging of a Mesoscale Convective System

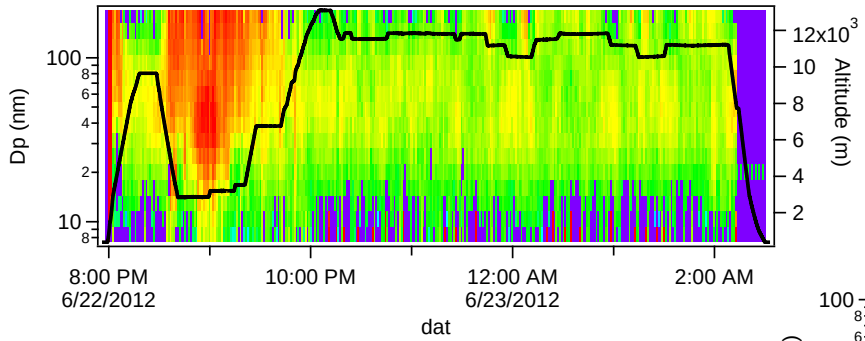


GOES vis4km and nexrad composite at 18:00 GMT

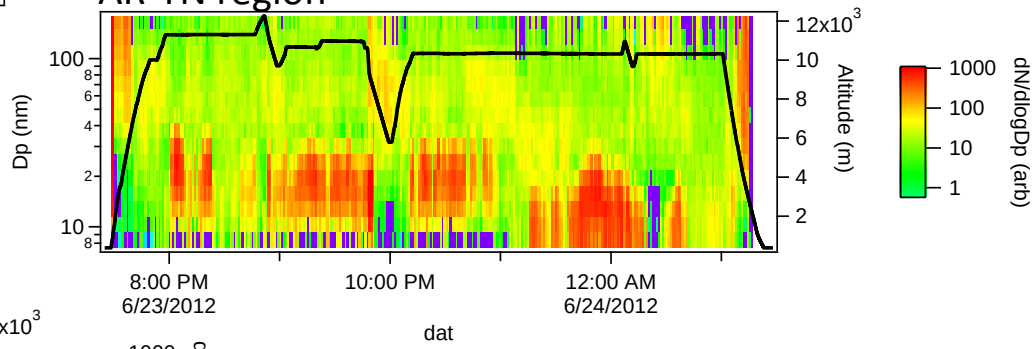


June 22 - 27

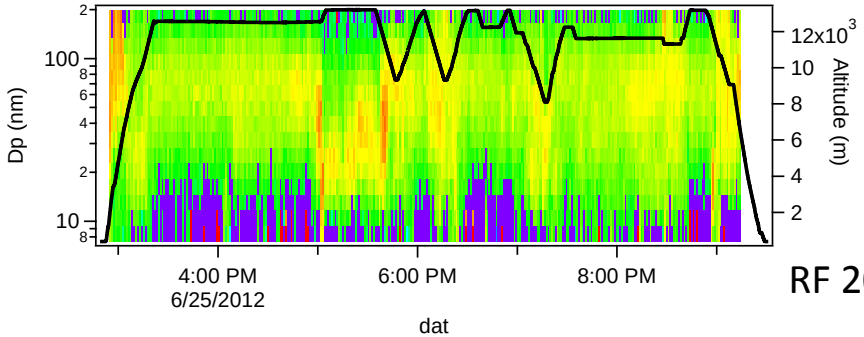
RF17: CO convection



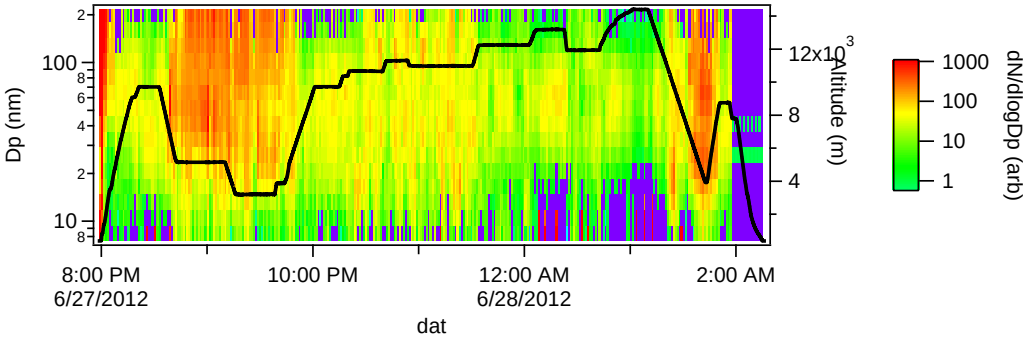
RF18: Downwind flight to AR-TN region



RF19: UT Survey of Gulf of Mexico

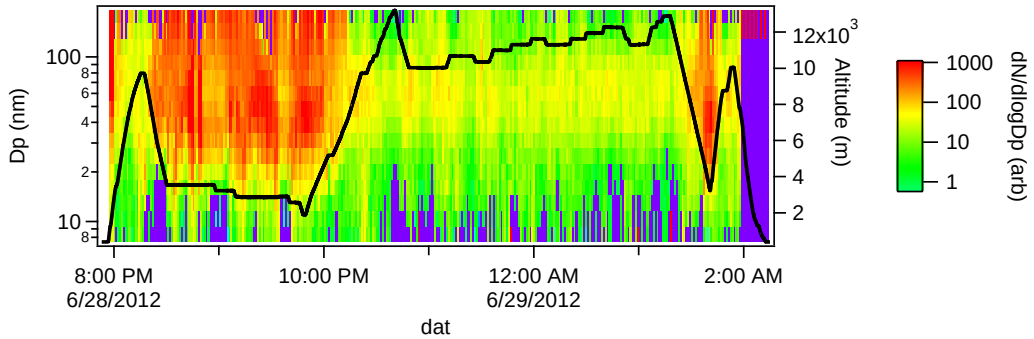


RF 20: CO Convective Storm

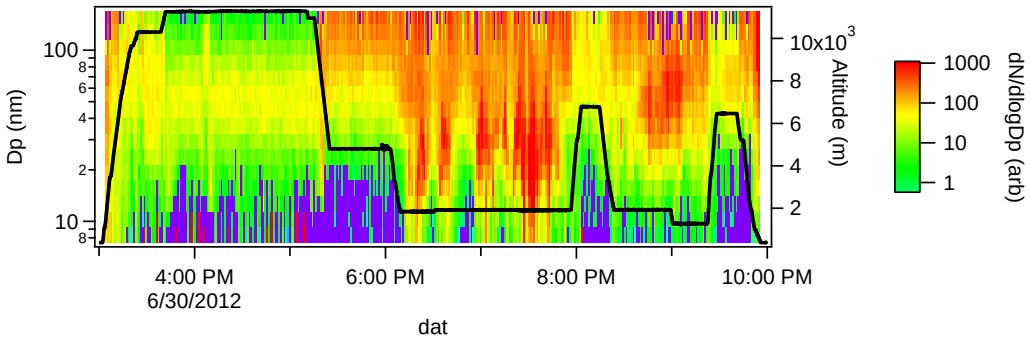


June 28 - 30

RF 21: Colorado Convective Storms



RF 22: Calibration Flight



Concluding remarks

GV SMPS seems to work well … still need to quantify efficiencies for sampling and detection.

GV SMPS measurements during DC3 show high concentrations of sub-100 nm particles associated with convective transport over the USA.

My current favorite RF's (from the viewpoint of small particles):

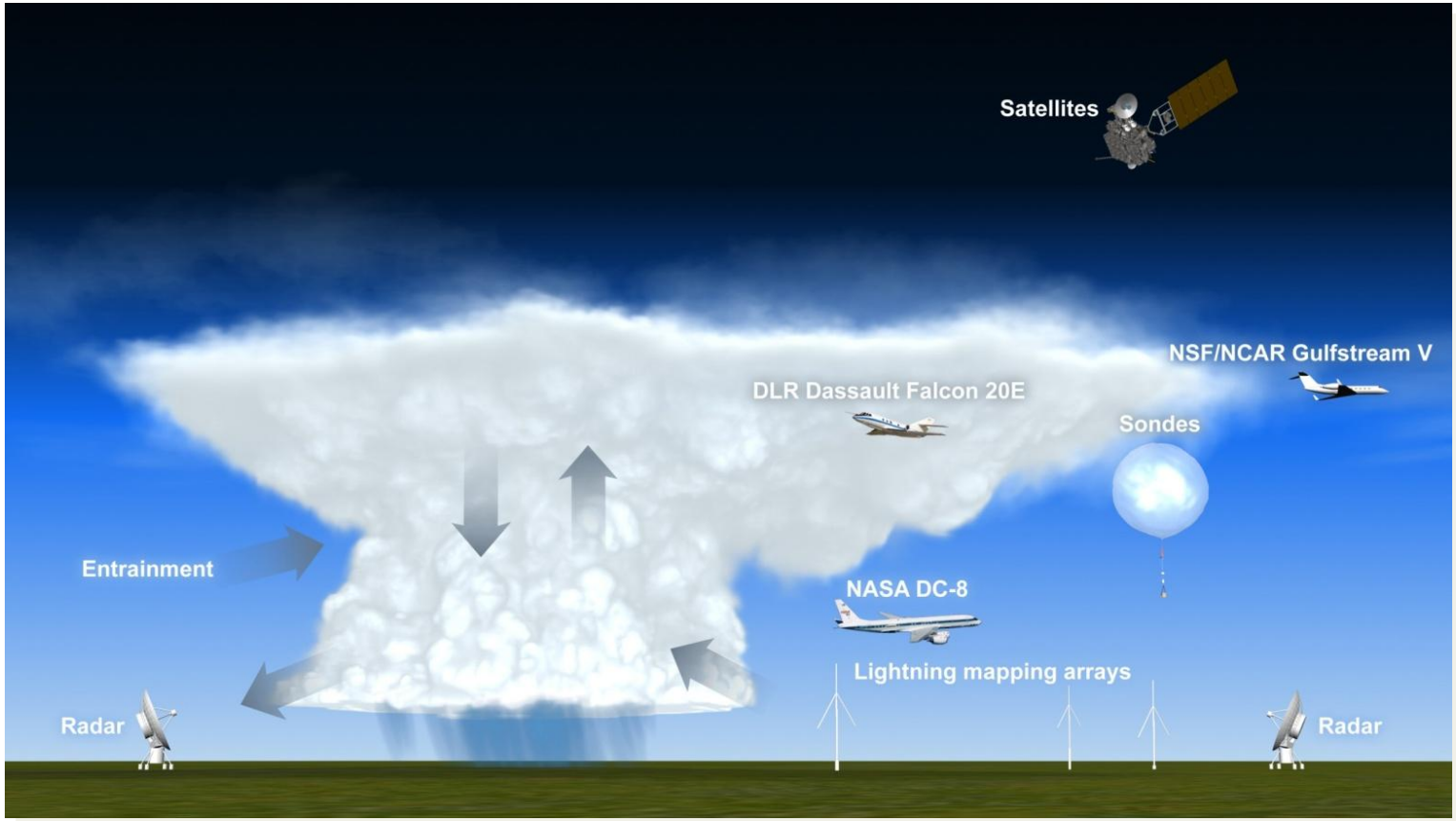
- 7 (30 May): a lot of small particles in aged outflow
- 9 (5 Jun) CO convection … signs of condensational growth
- 16 (21 Jun): a lot of small particles in aged outflow, signs of growth … really nice!
- 18 (23 Jun): nucleation of small particles @ 10km

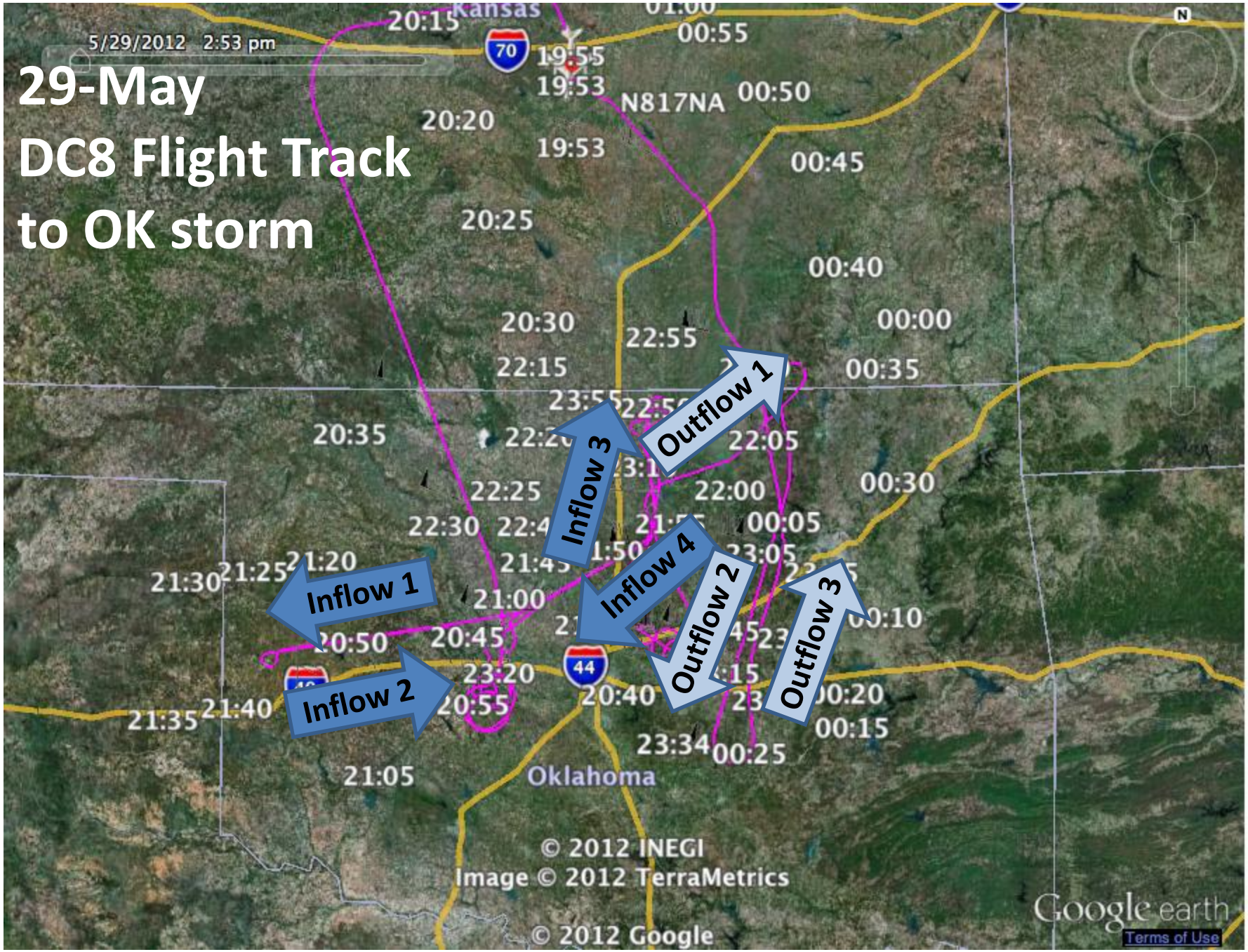
Eric Apel / Becky Hornbrook

VOC Measurements (GV TOGA)

DC3 Deep Convective Clouds and Chemistry

PIs: Barth, Cantrell, Rutledge, Brune




29-May
DC8 Flight Track
to OK storm
5/29/2012 2:53 pm
Kansas
Oklahoma
N817NA
Inflow 1
Inflow 2
Inflow 3
Inflow 4
Outflow 1
Outflow 2
Outflow 3
© 2012 INEGI
Image © 2012 TerraMetrics
© 2012 Google
Google earth
Terms of Use

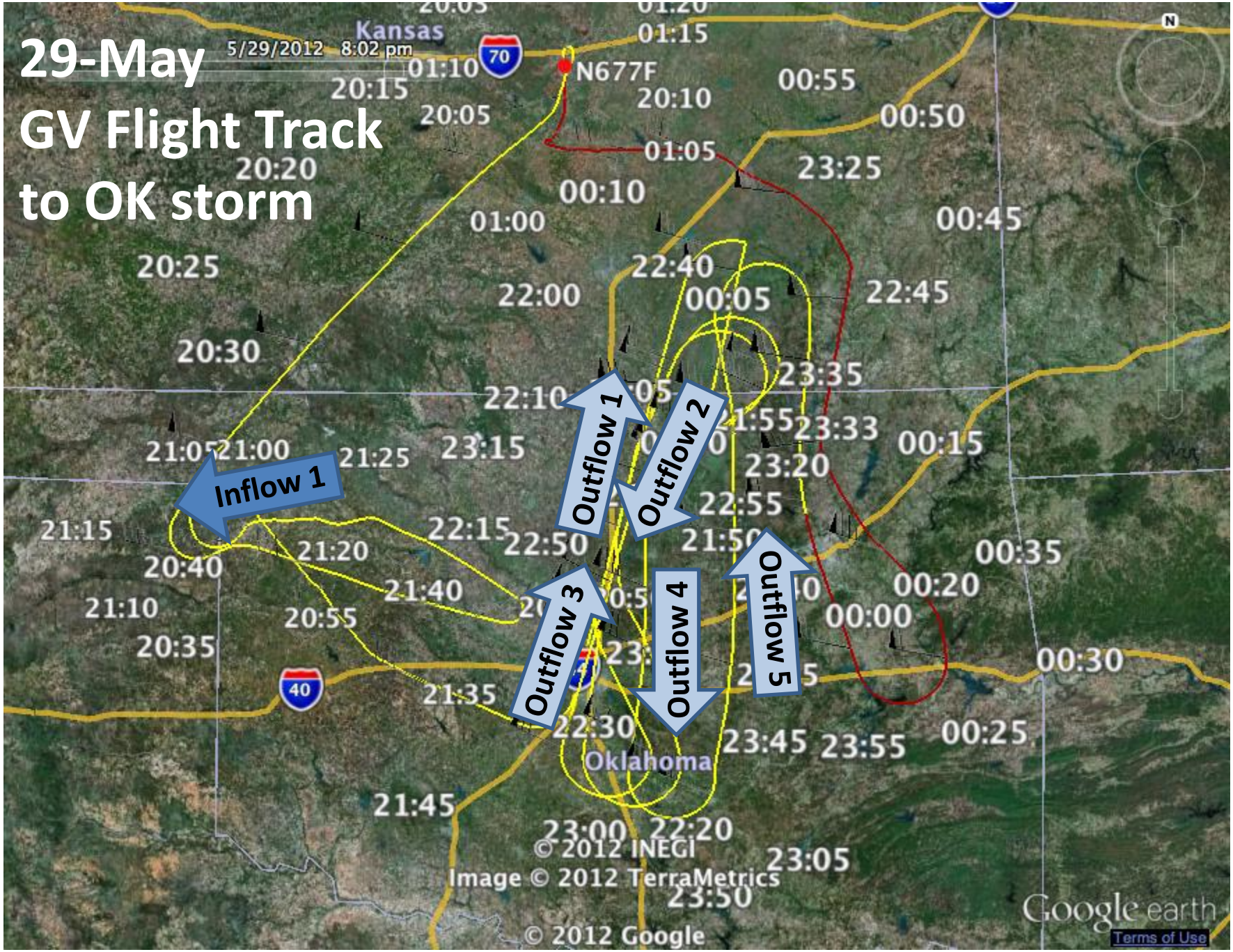

29-May
GV Flight Track
to OK storm
5/29/2012 8:02 pm
Kansas
N677F
Oklahoma
Inflow 1
Outflow 1
Outflow 2
Outflow 3
Outflow 4
Outflow 5
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Image © 2012 TerraMetrics
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Google earth
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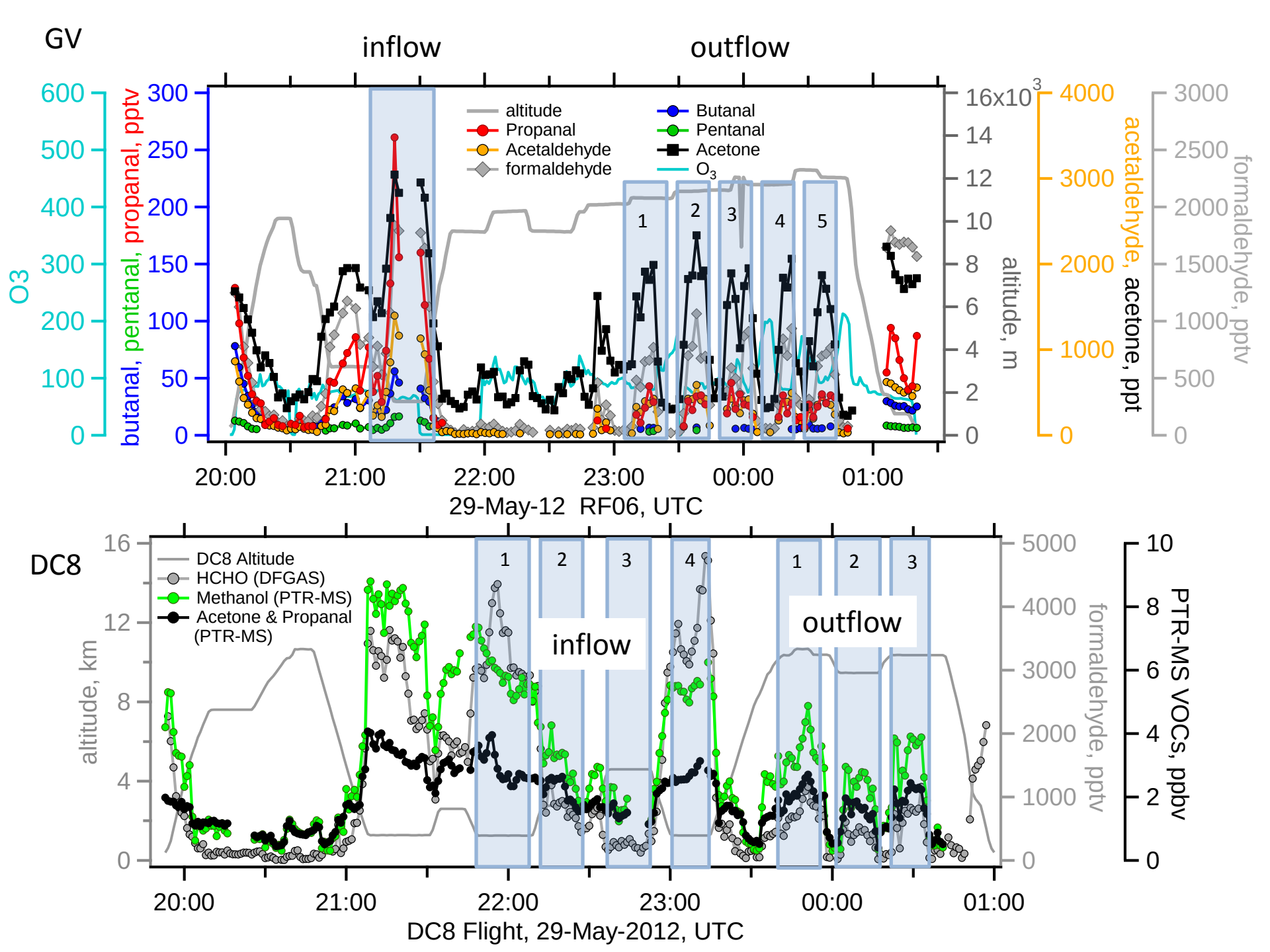
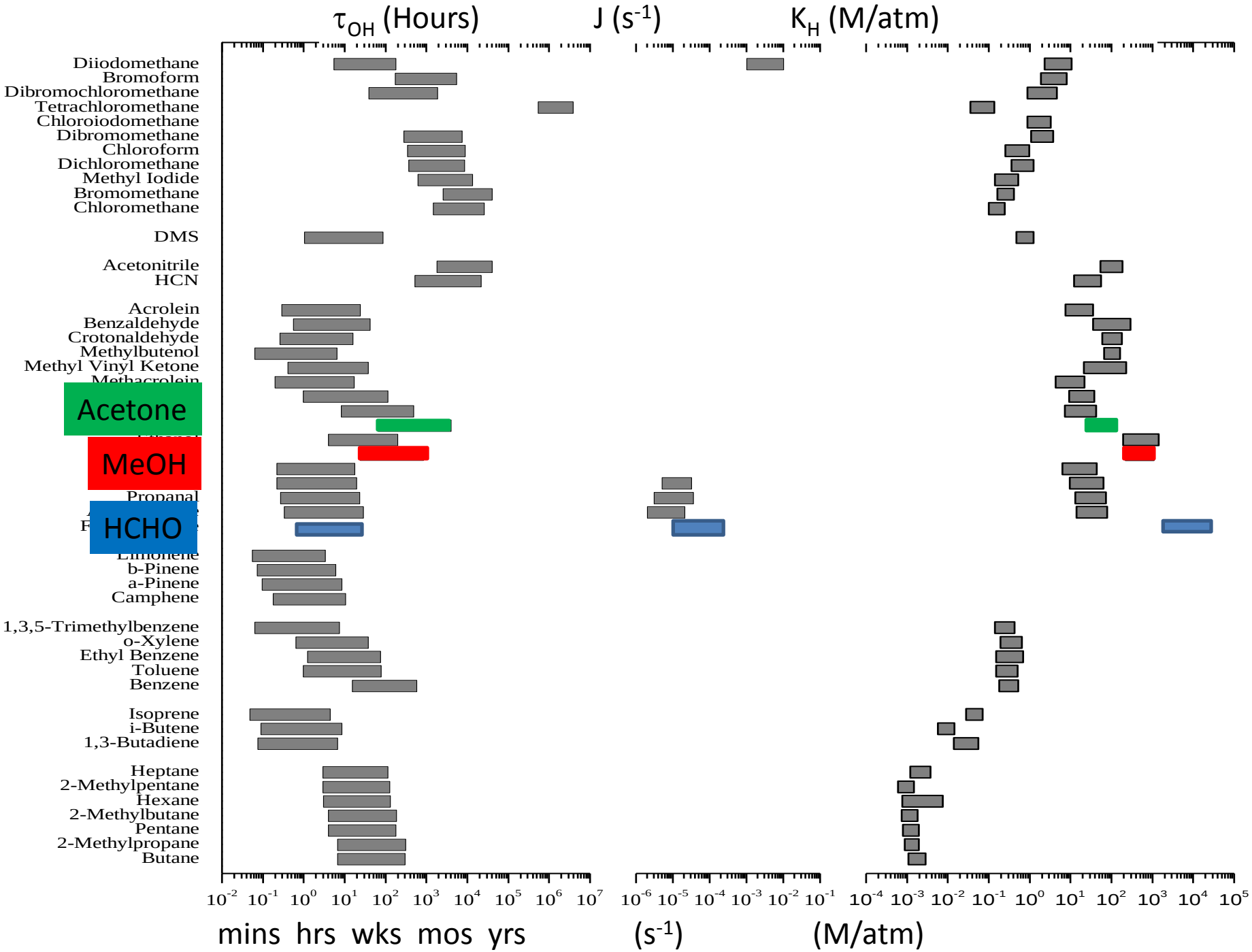
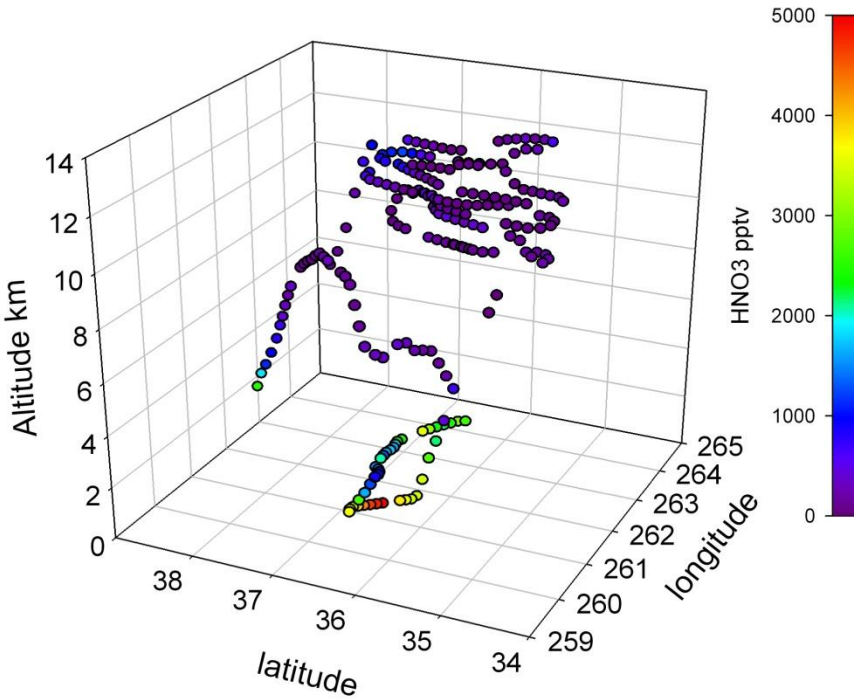
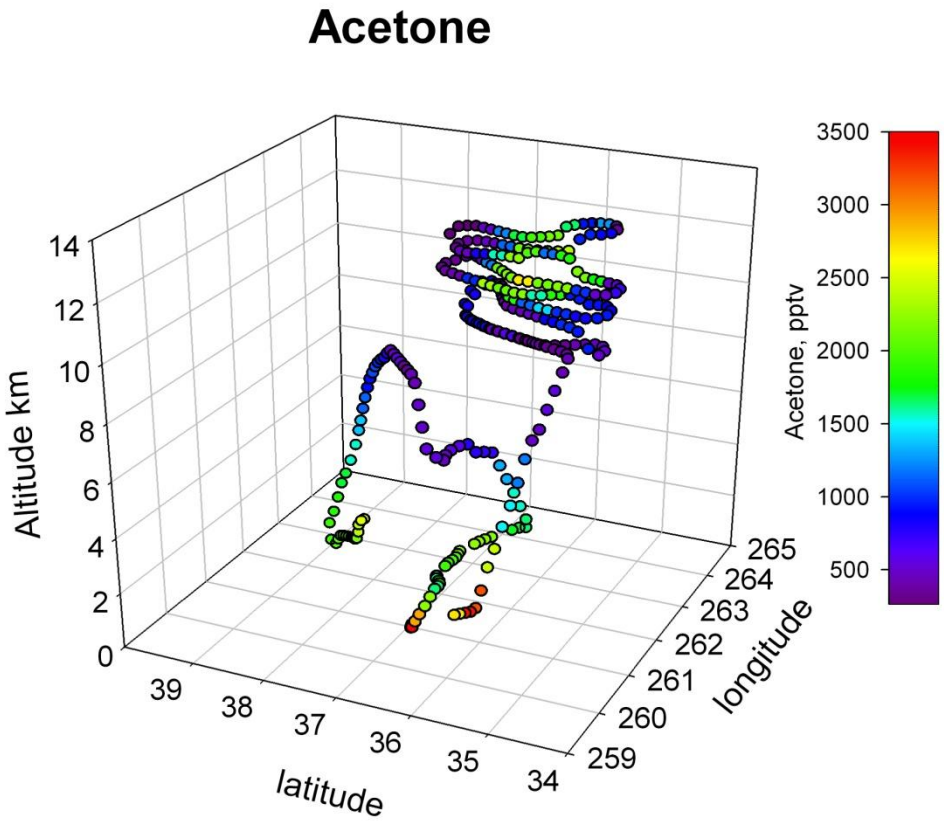

GV
inflow
outflow
altitude
Propanal
Acetaldehyde
formaldehyde
Butanal
Pentanal
Acetone
O3
1
2
3
4
5
O3
butanal, pentanal, propanal, pptv
altitude, m
acetaldehyde, acetone, ppt
formaldehyde, pptv
20:00
21:00
22:00
23:00
00:00
01:00
29-May-12 RF06, UTC
DC8
DC8 Altitude
HCHO (DFGAS)
Methanol (PTR-MS)
Acetone & Propanal (PTR-MS)
inflow
outflow
altitude, km
formaldehyde, pptv
PTR-MS VOCs, ppbv
DC8 Flight, 29-May-2012, UTC

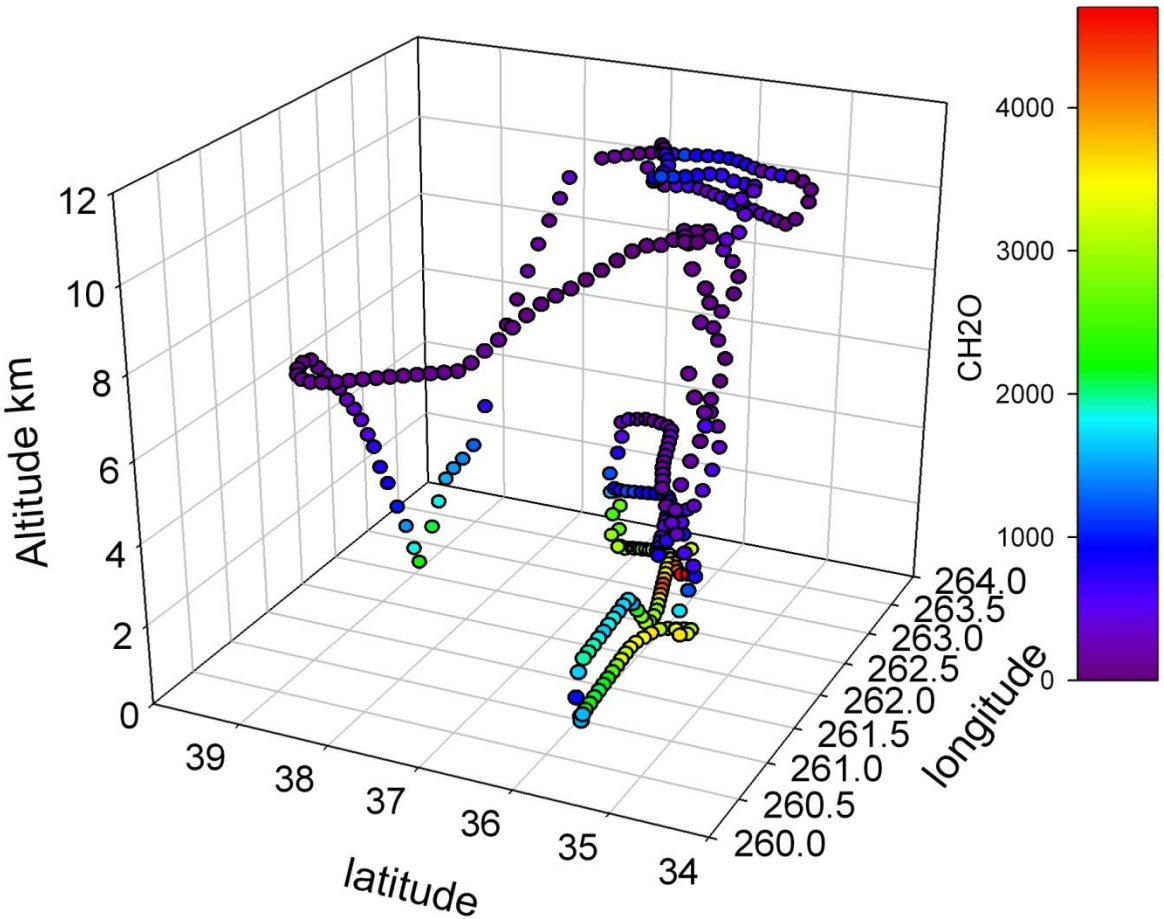

τOH (Hours)
J (s-1)
KH (M/atm)
Diiodomethane
Bromoform
Dibromochloromethane
Tetrachloromethane
Chloroiodomethane
Dibromomethane
Chloroform
Dichloromethane
Methyl Iodide
Bromomethane
Chloromethane
DMS
Acetonitrile
HCN
Acrolein
Benzaldehyde
Crotonaldehyde
Methylbutenol
Methyl Vinyl Ketone
Acetone
MeOH
Propanal
HCHO
b-Pinene
a-Pinene
Camphene
1,3,5-Trimethylbenzene
o-Xylene
Ethyl Benzene
Toluene
Benzene
Isoprene
i-Butene
1,3-Butadiene
Heptane
2-Methylpentane
Hexane
2-Methylbutane
Pentane
2-Methylpropane
Butane
10-2 10-1 100 101 102 103 104 105 106 107
mins hrs wks mos yrs
10-6 10-5 10-4 10-3 10-2 10-1
(s-1)
10-4 10-3 10-2 10-1 100 101 102 103 104 105
(M/atm)

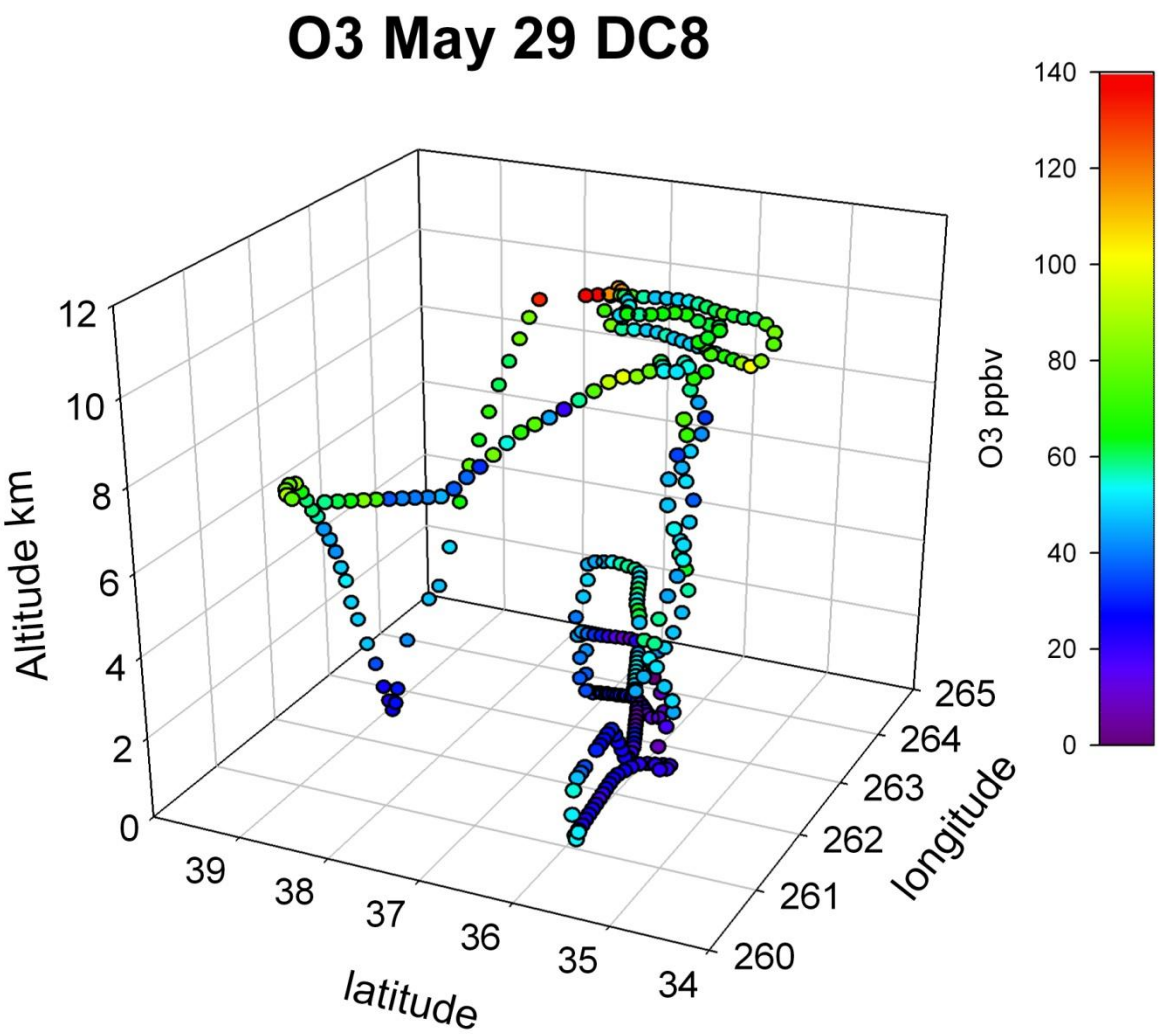
Some GV Data May 29

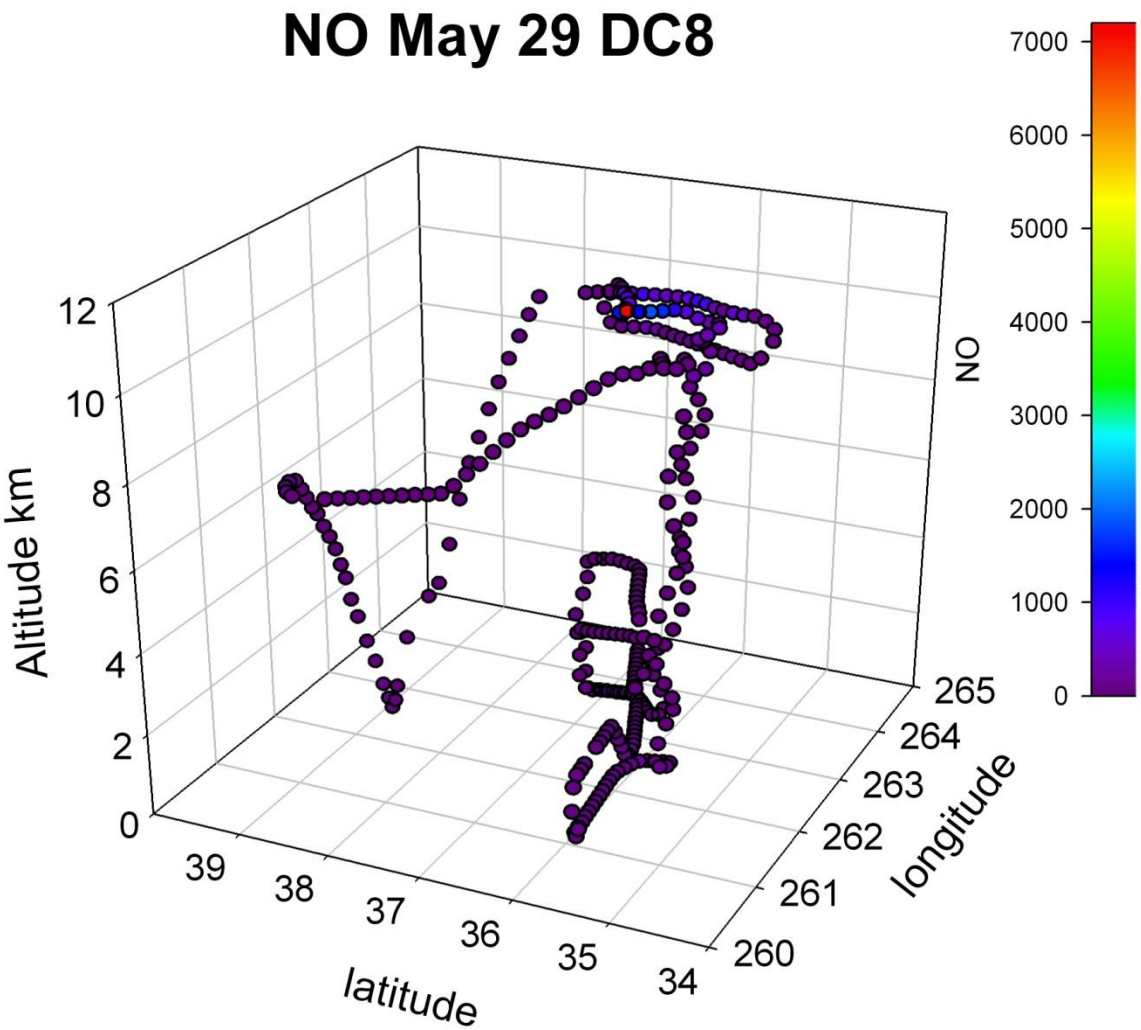


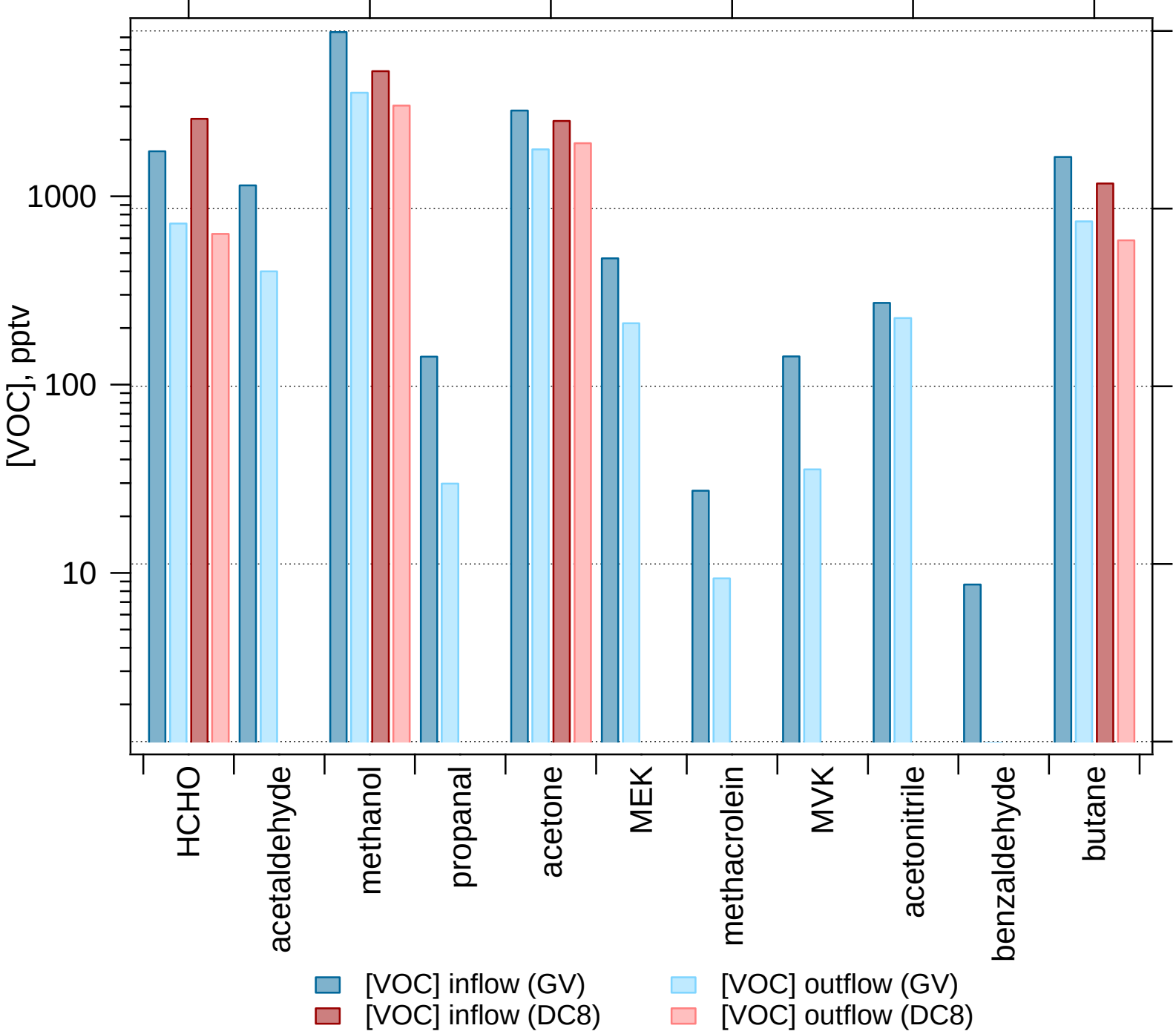


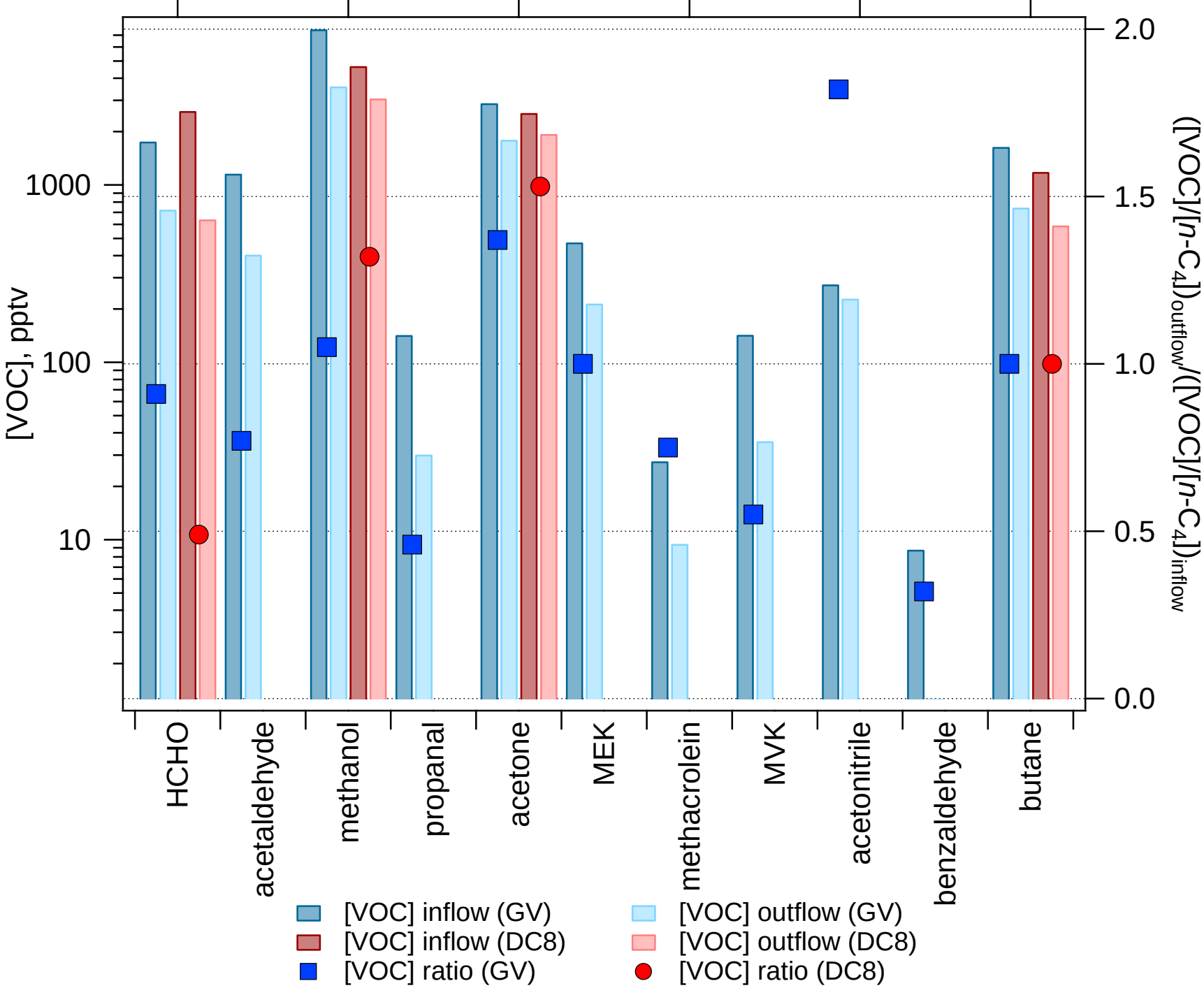
CH2O DFGAS May 29 DC8

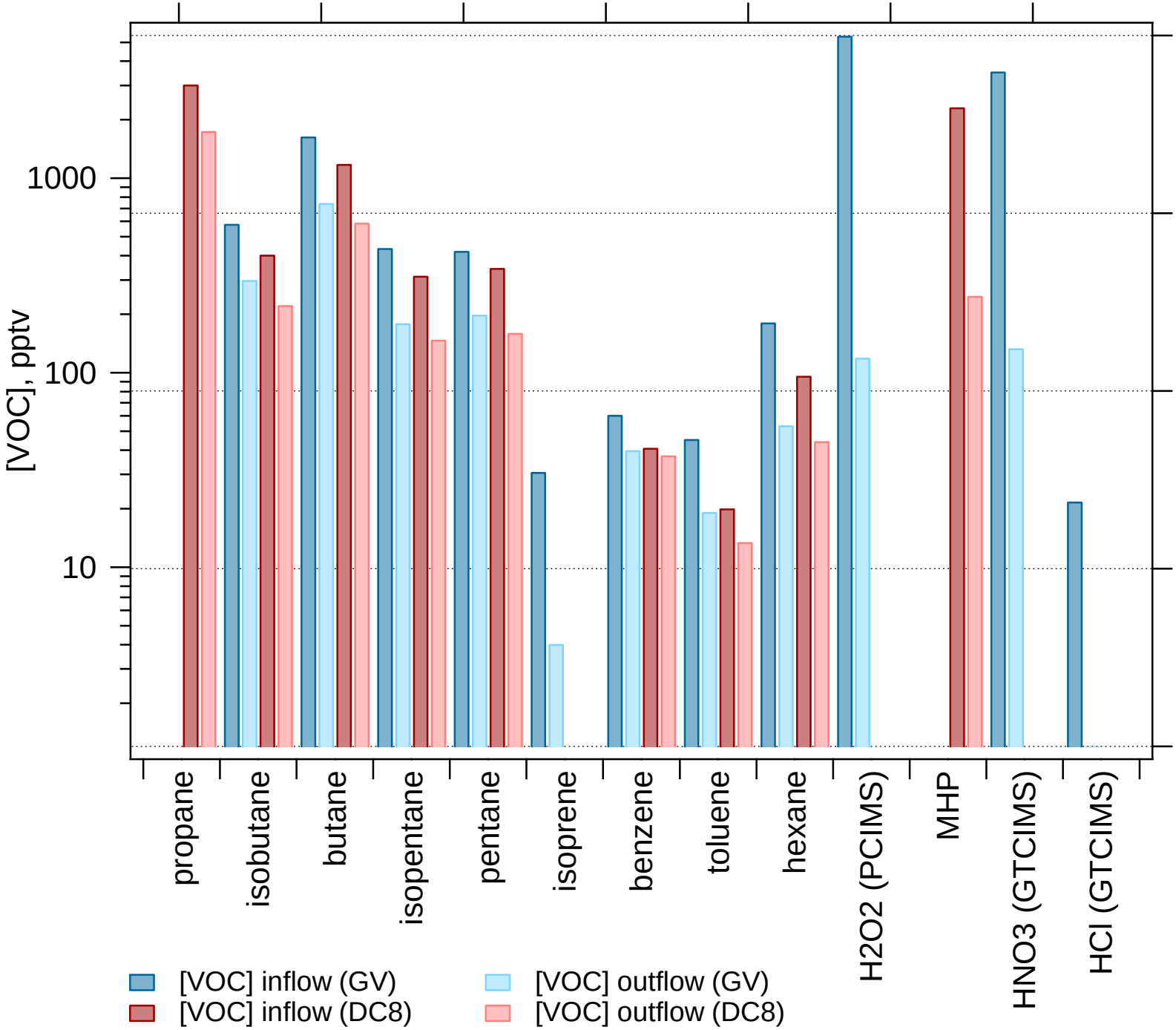


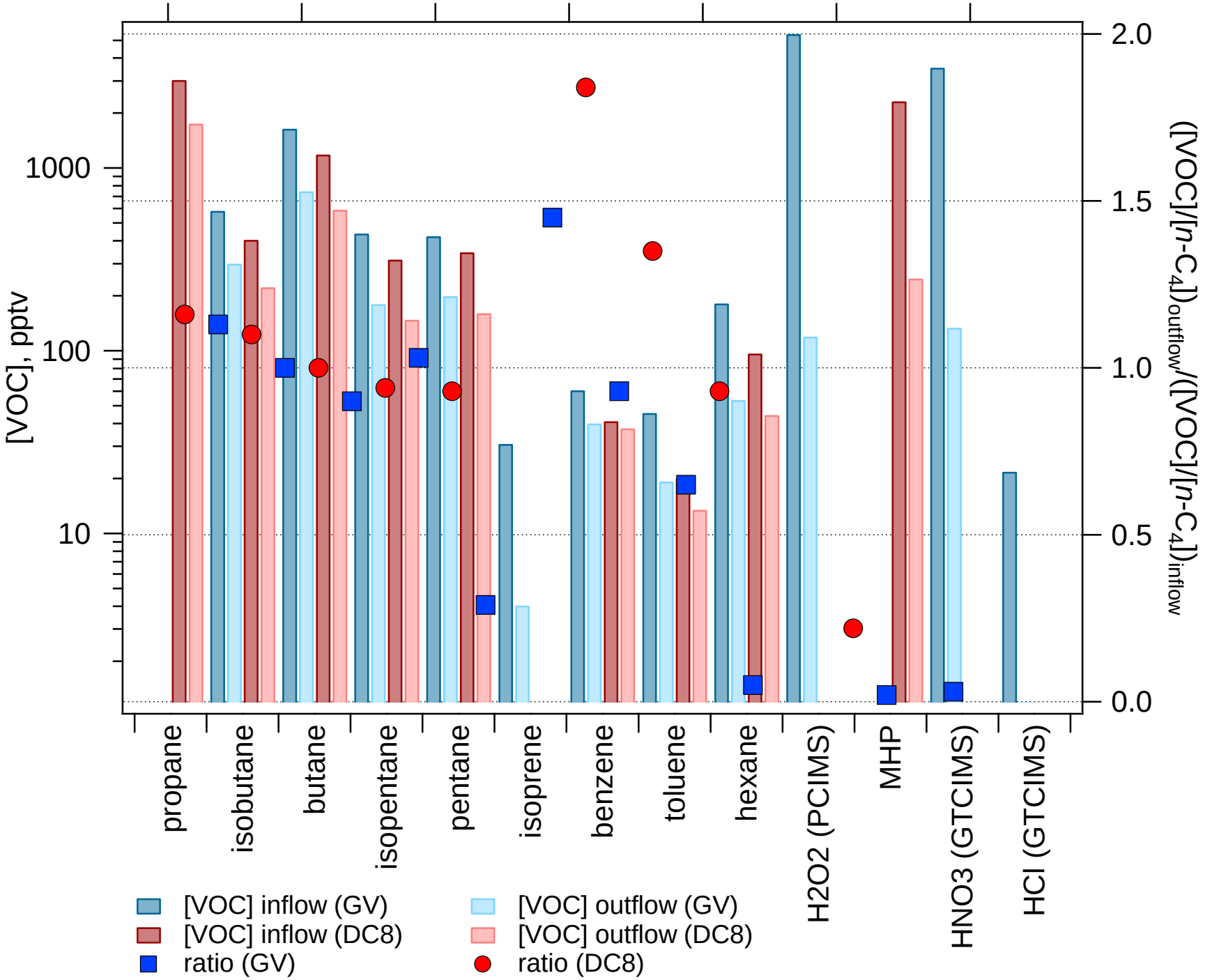

O3 May 29 DC8
Altitude km
0
2
4
6
8
10
12
latitude
39
38
37
36
35
34
longitude
260
261
262
263
264
265
O3 ppbv
0
20
40
60
80
100
120
140


NO May 29 DC8
Altitude km
12
10
8
6
4
2
0
39
38
37
36
35
34
latitude
260
261
262
263
264
265
longitude
NO
7000
6000
5000
4000
3000
2000
1000
0


[VOC], pptv
1000
100
10
HCHO
acetaldehyde
methanol
propanal
acetone
MEK
methacrolein
MVK
acetonitrile
benzaldehyde
butane
[VOC] inflow (GV)
[VOC] inflow (DC8)
[VOC] outflow (GV)
[VOC] outflow (DC8)


[VOC], pptv
1000
100
10
2.0
1.5
1.0
0.5
0.0
([VOC]/[n-C4])outflow/([VOC]/[n-C4])inflow
HCHO
acetaldehyde
methanol
propanal
acetone
MEK
methacrolein
MVK
acetonitrile
benzaldehyde
butane
[VOC] inflow (GV)
[VOC] inflow (DC8)
[VOC] ratio (GV)
[VOC] outflow (GV)
[VOC] outflow (DC8)
[VOC] ratio (DC8)


[VOC], pptv
1000
100
10
propane
isobutane
butane
isopentane
pentane
isoprene
benzene
toluene
hexane
H2O2 (PCIMS)
MHP
HNO3 (GTCIMS)
HCl (GTCIMS)
[VOC] inflow (GV)
[VOC] inflow (DC8)
[VOC] outflow (GV)
[VOC] outflow (DC8)


[VOC], pptv
1000
100
10
([VOC]/[n-C4])outflow/([VOC]/[n-C4])inflow
2.0
1.5
1.0
0.5
0.0
propane
isobutane
butane
isopentane
pentane
isoprene
benzene
toluene
hexane
H2O2 (PCIMS)
MHP
HNO3 (GTCIMS)
HCl (GTCIMS)
[VOC] inflow (GV)
[VOC] inflow (DC8)
ratio (GV)
[VOC] outflow (GV)
[VOC] outflow (DC8)
ratio (DC8)

Science Team Telecons / Events

Tuesday October 23 1:30 pm -- 3:00 pm Mountain Time
Tuesday November 13 1:30 pm -- 3:00 pm Mountain Time

Meet at AGU? and AMS?

** DC3 Science Team Meeting in Boulder February 25-28 **
This will be a 3 1/2 day meeting in Boulder.