CAST 2014 NO_x and O_3 data from BAe 146

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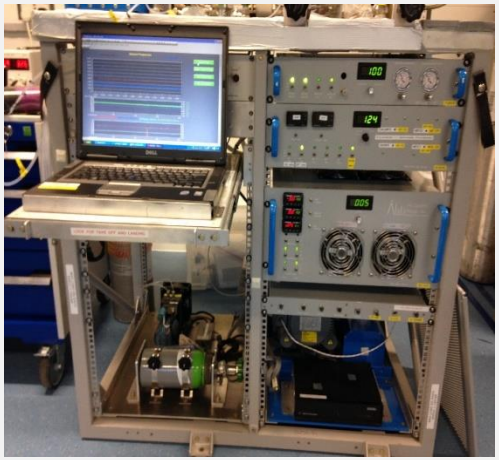
Presentation Content

- AQD NO_x Chemiluminescence Instrument
- NO_2 issue
- First look at O_3 and NO data
- Trajectory analysis
- Comparison of NO and O_3 to GEOS-Chem model

AQD NO_x Chemiluminescence Instrument

- Dual Channel Architecture
- Quantification of NO via Chemiluminescence reaction with O_3
- Quantification of NO_2 via blue light conversion (395nm) to NO, subsequent Chemiluminescence Reaction with O_3
- Independent quantification of NO and NO_2 mixing ratios / ppt
- System CAST LOD's
  - NO: 4 ppt/10 second data
  - NO_2: 15 ppt/ 10 second data



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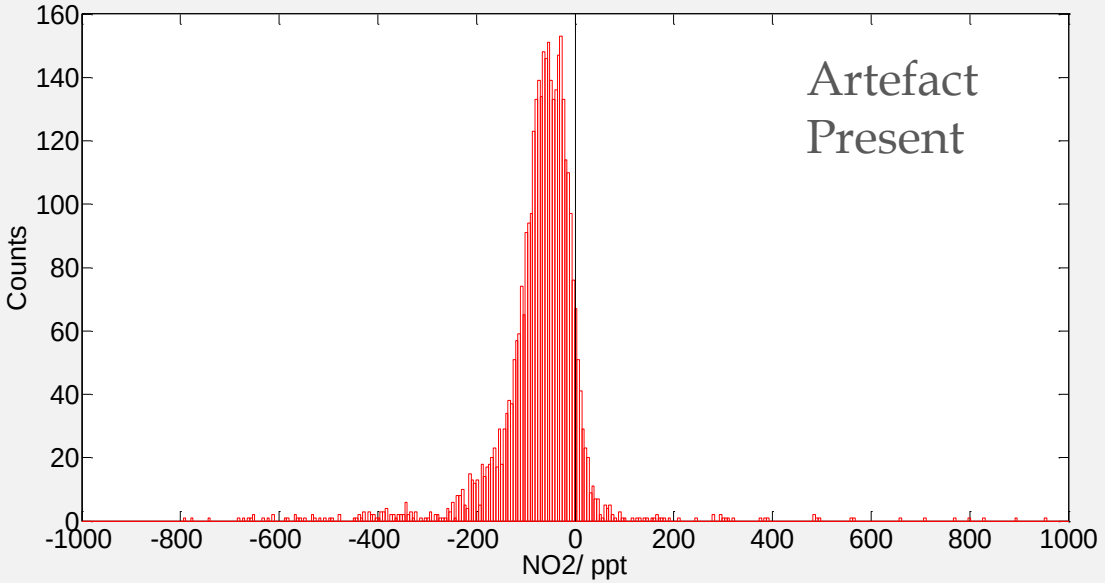
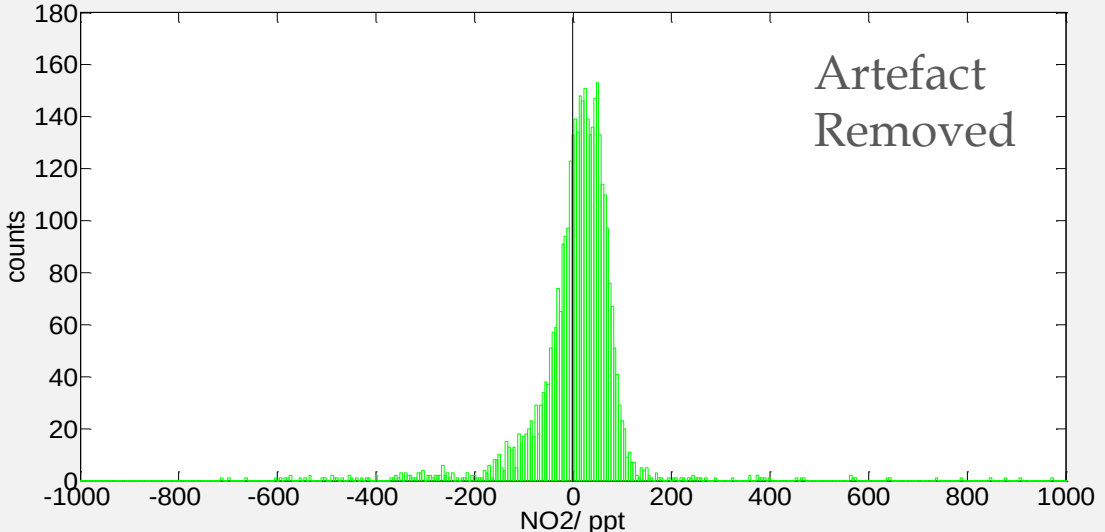
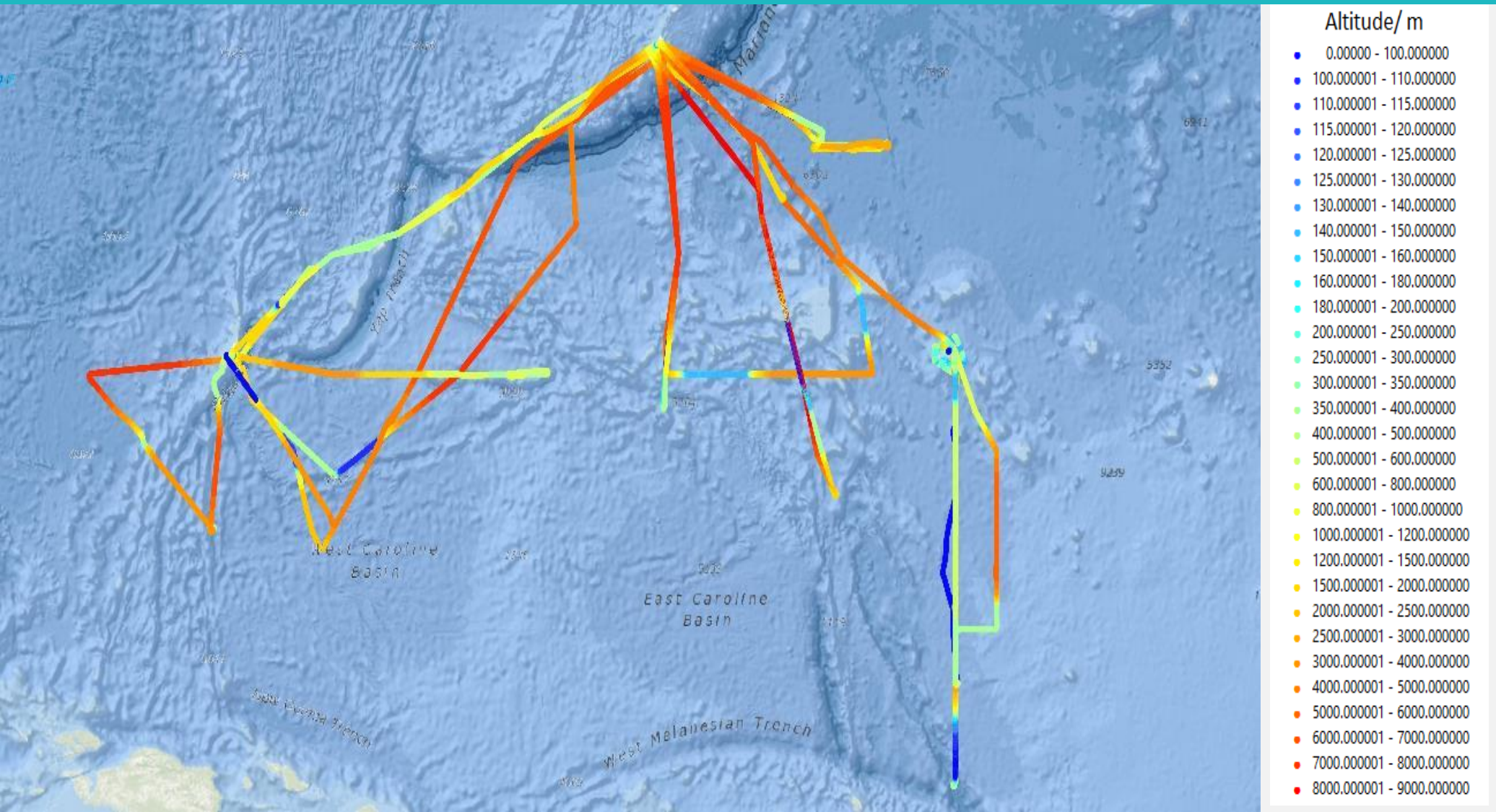
NO_2

- Zero air added to sample inlet pre and post flight
  - Highly negative artefact
  - Zero air analysis not viable (changing artefact in flight)
- Data collected between -200 to 50 ppt
- Negative data still present after removal
- Not confident in NO_2 data



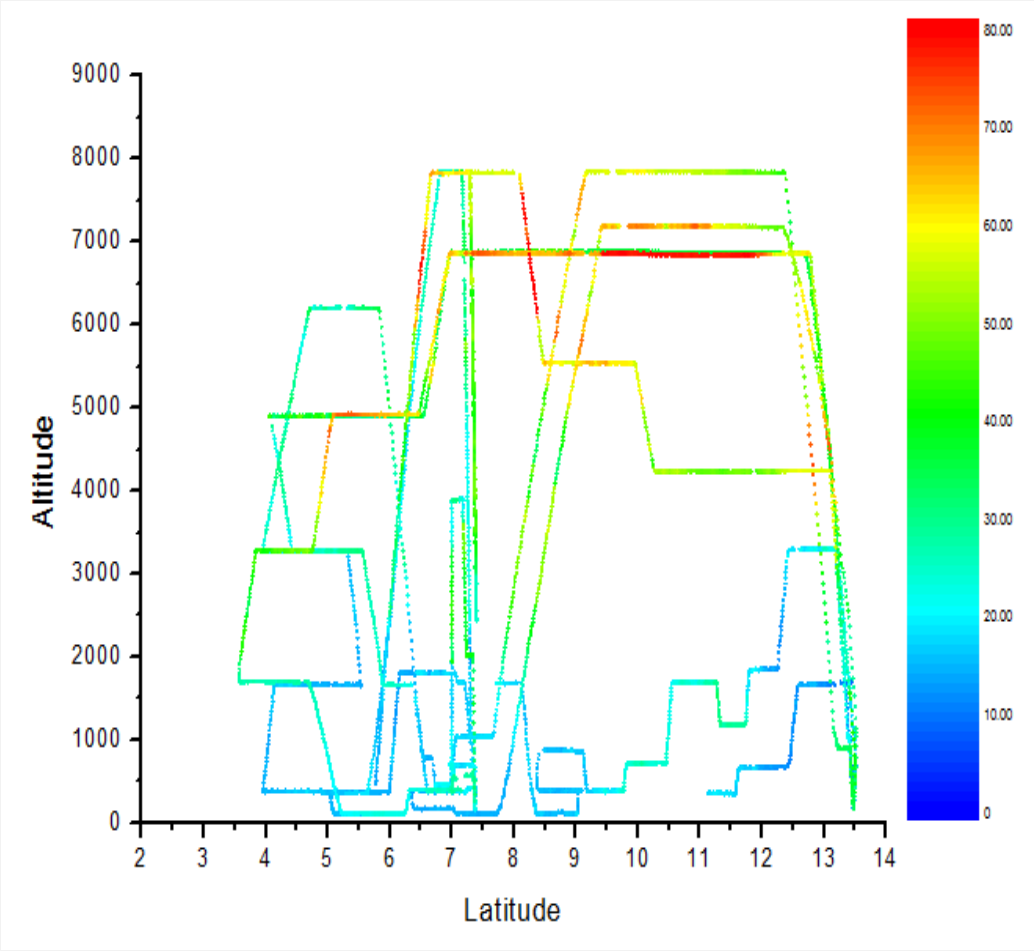


All CAST Flight Altitudes

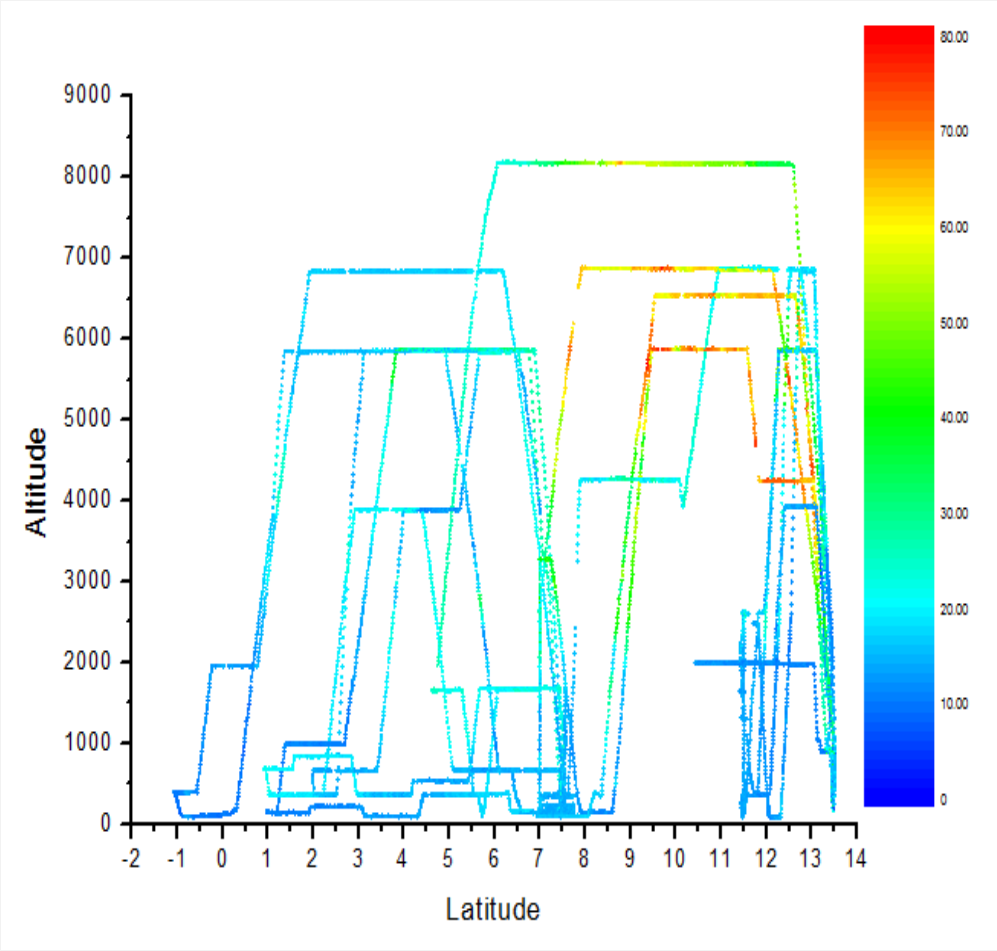


CAST flights O3 data

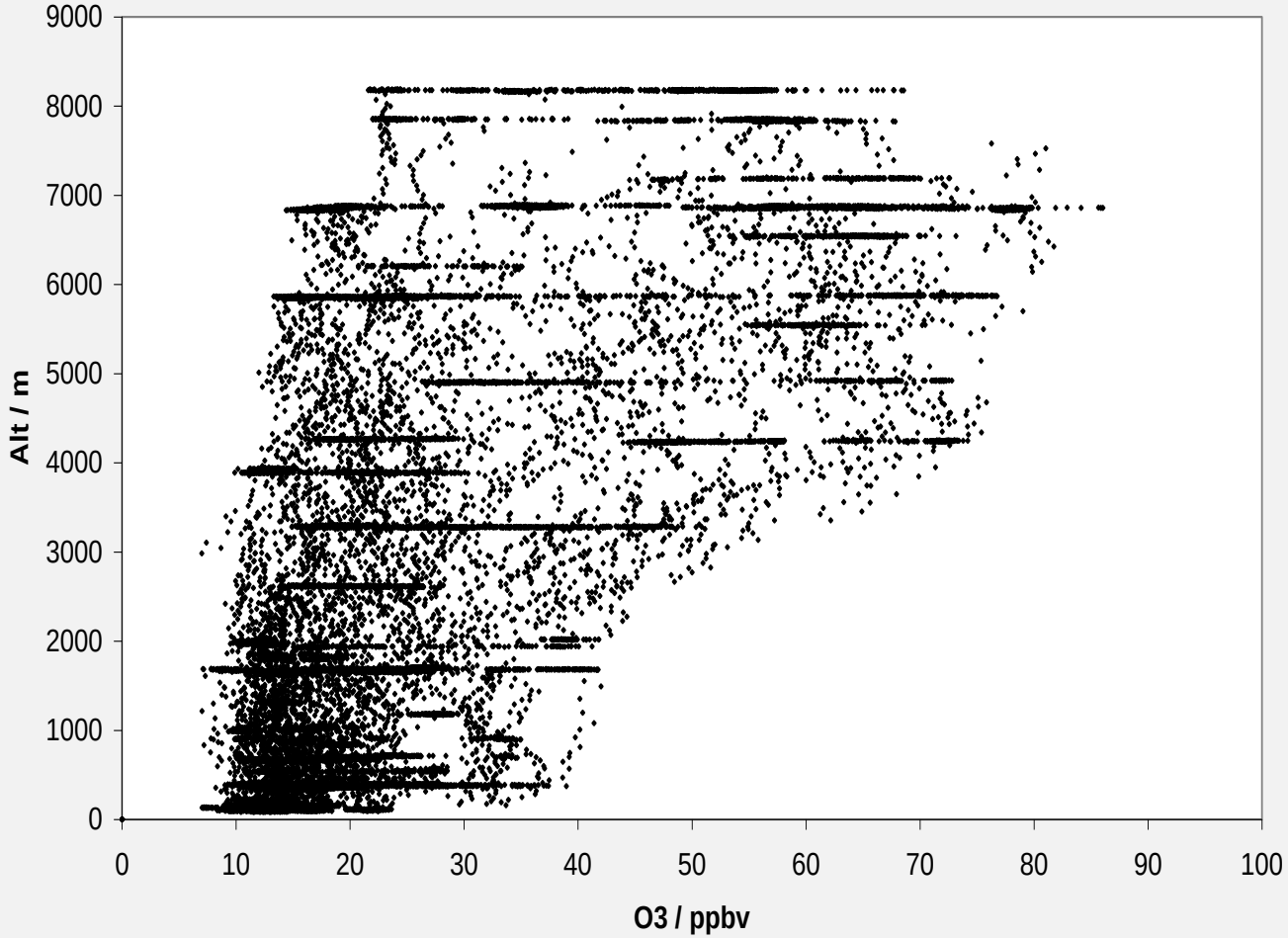
West O3



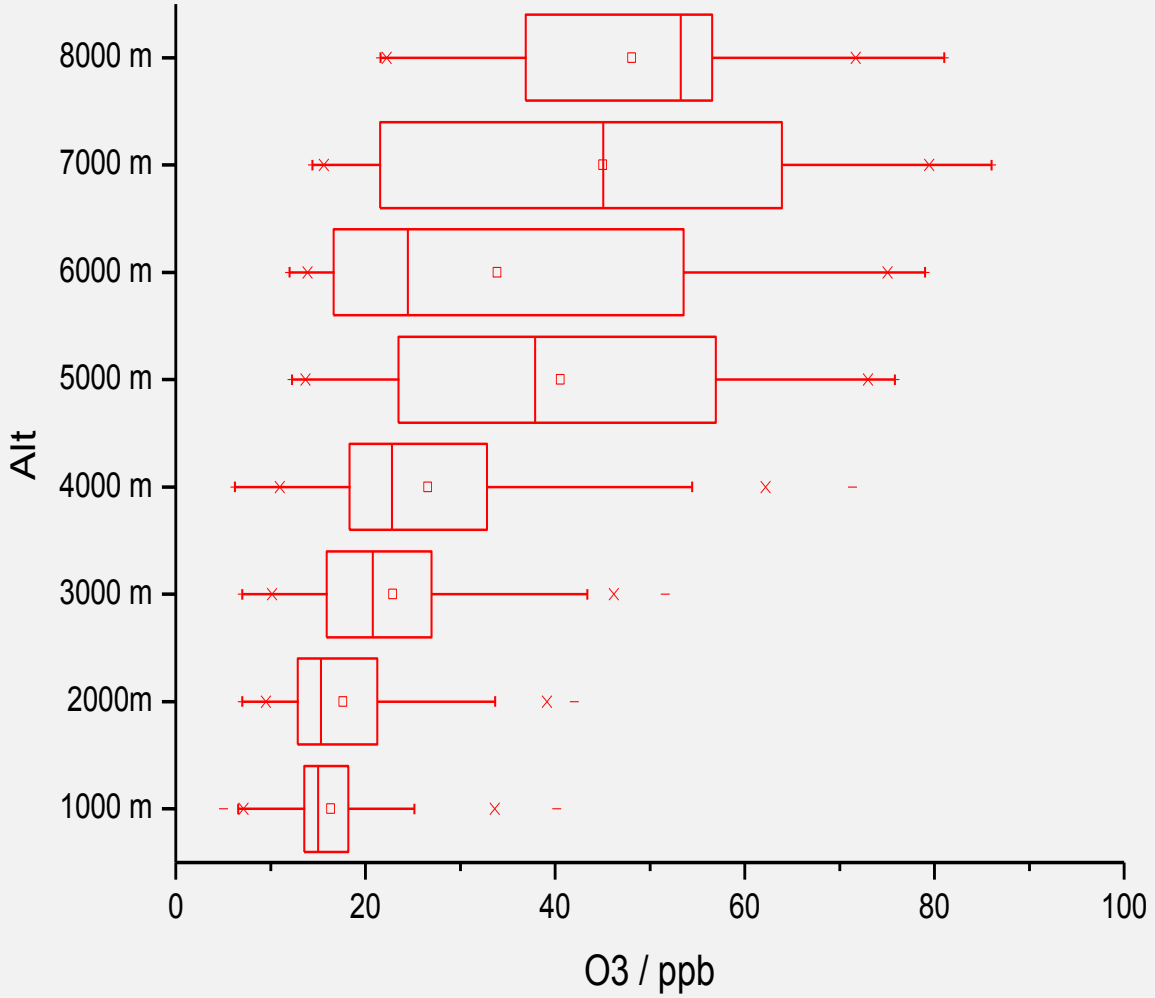
East O3



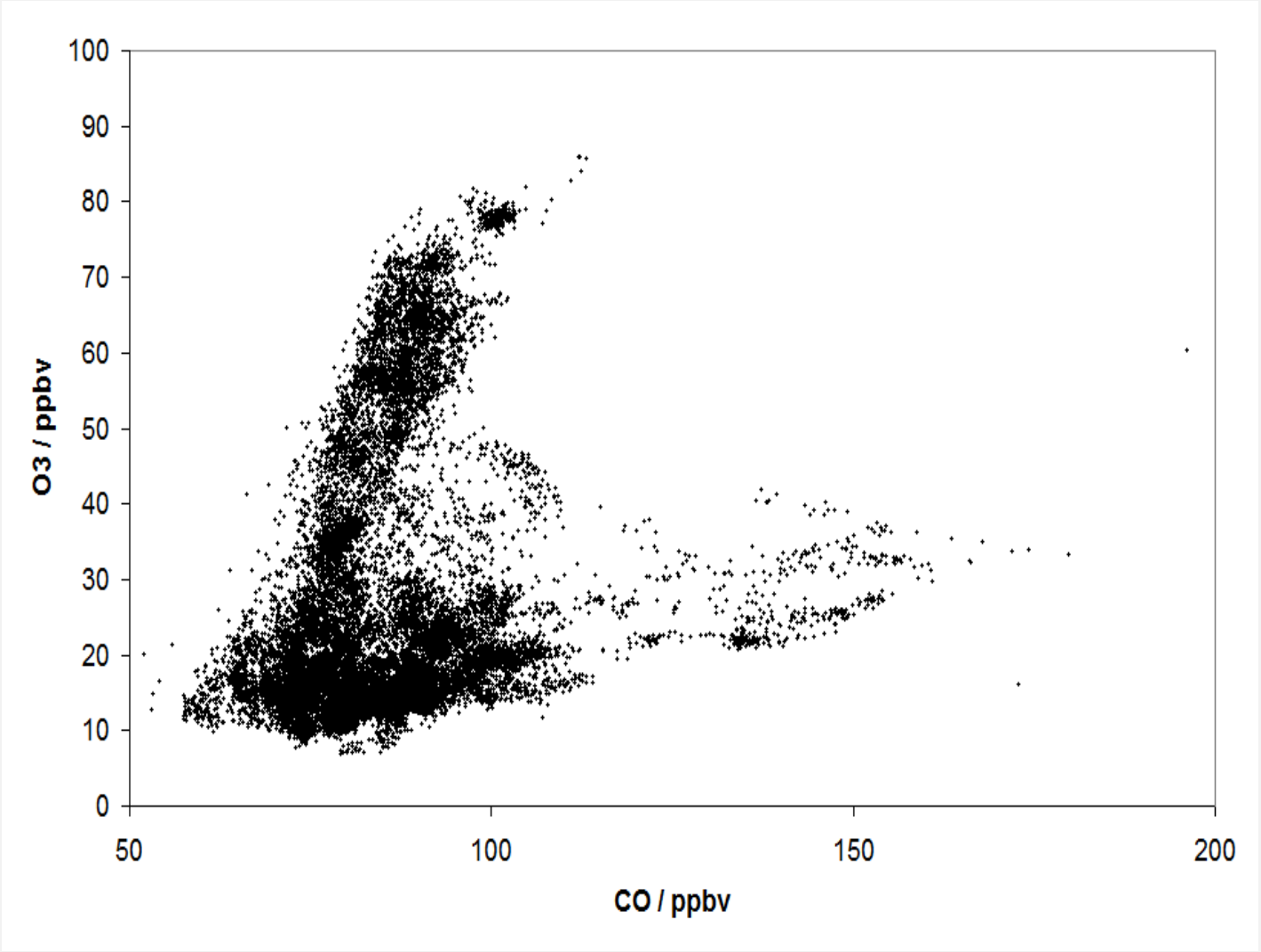
O3 mixing ratio



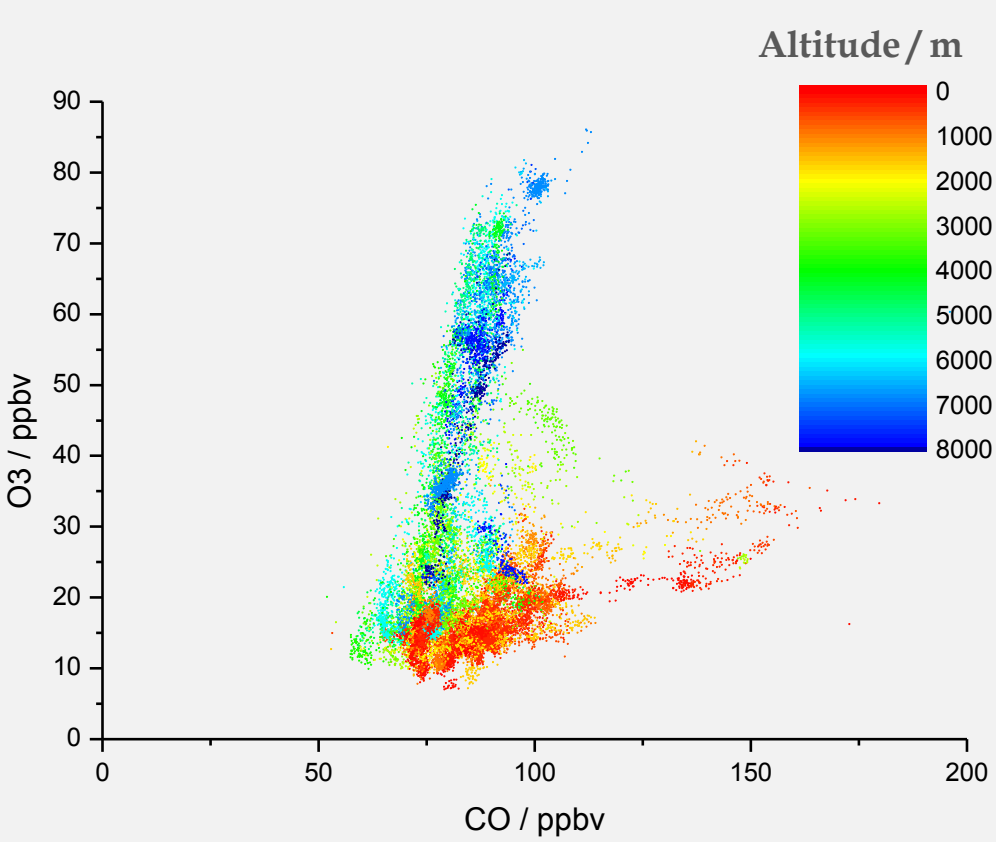
Ozone data

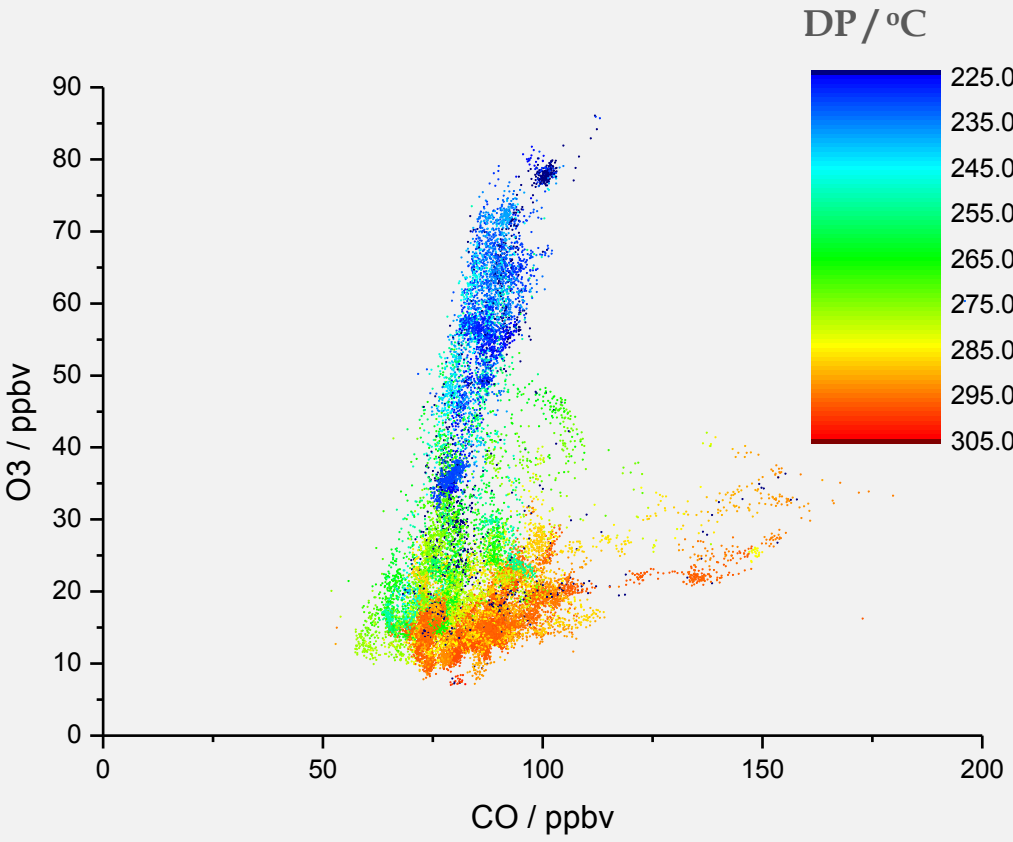

8000 m
7000 m
6000 m
5000 m
4000 m
3000 m
2000m
1000 m
Alt
0
20
40
60
80
100
O3 / ppb

O_3 vs CO



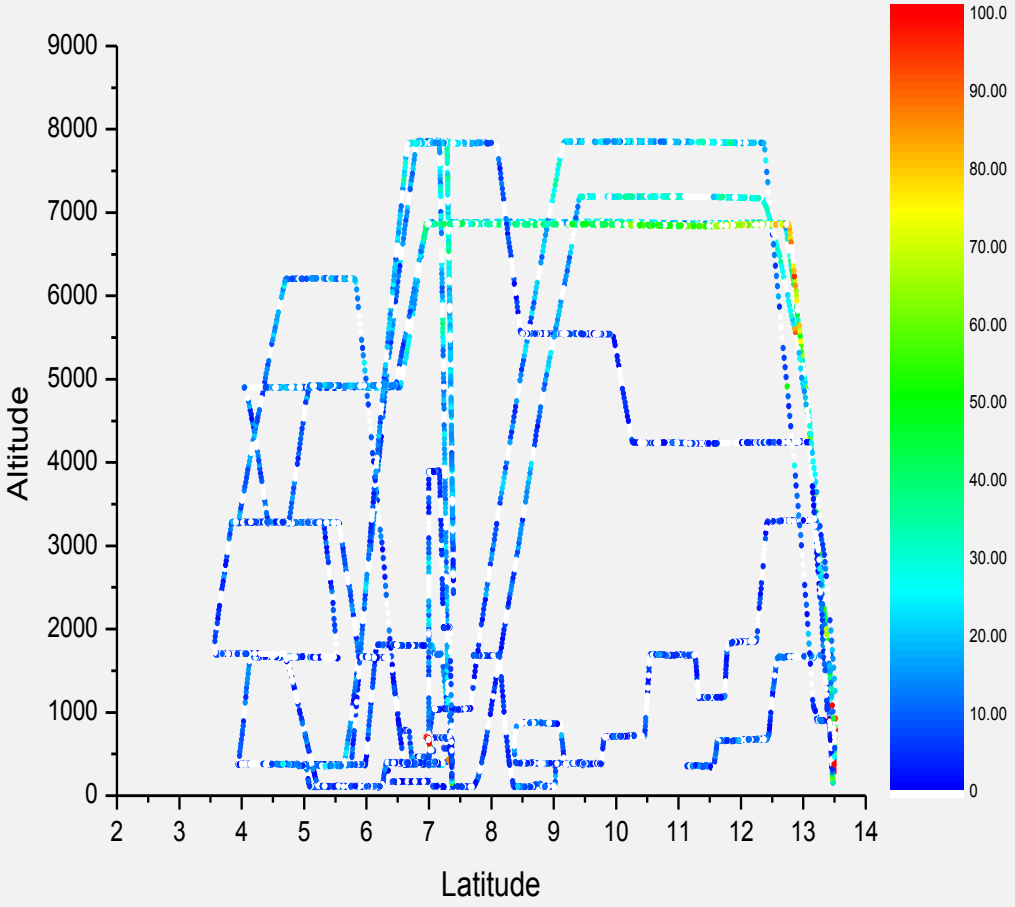
O_3 vs CO


Altitude / m
0
1000
2000
3000
4000
5000
6000
7000
8000
O3 / ppbv
CO / ppbv
0
10
20
30
40
50
60
70
80
90
0
50
100
150
200

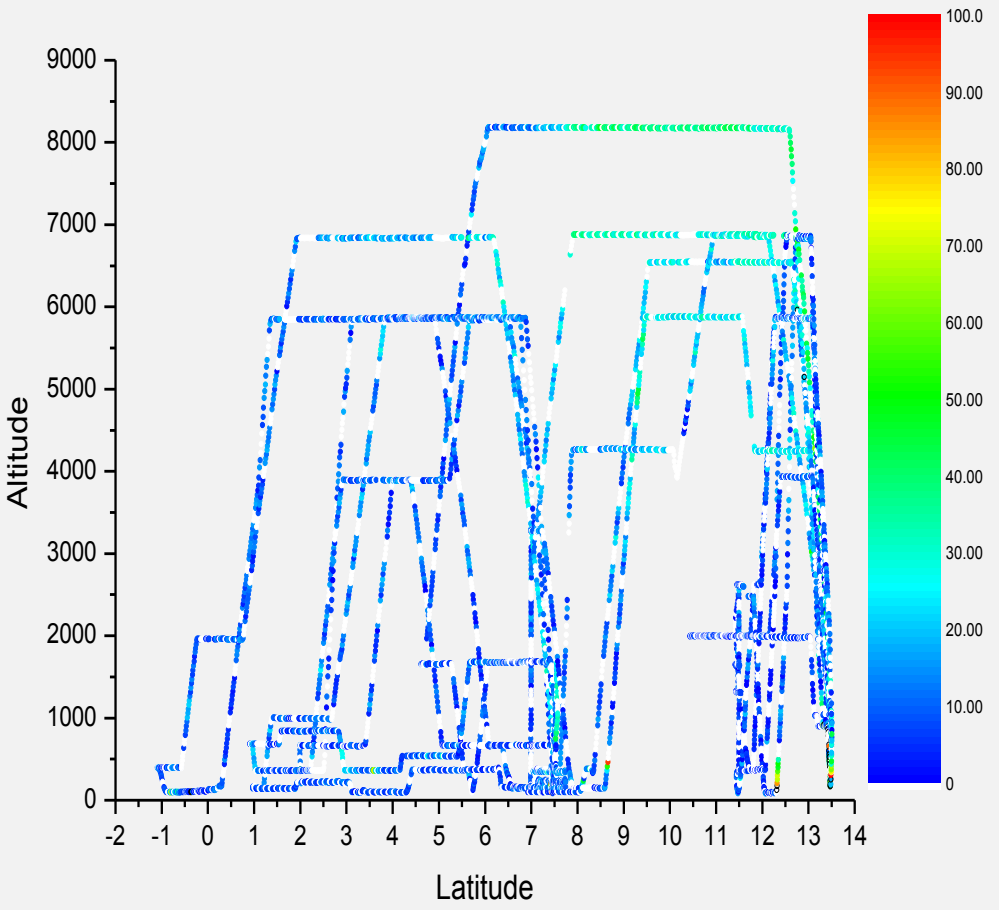

DP / °C
225.0
235.0
245.0
255.0
265.0
275.0
285.0
295.0
305.0
O3 / ppbv
CO / ppbv
0
10
20
30
40
50
60
70
80
90
0
50
100
150
200

CAST flights NO data

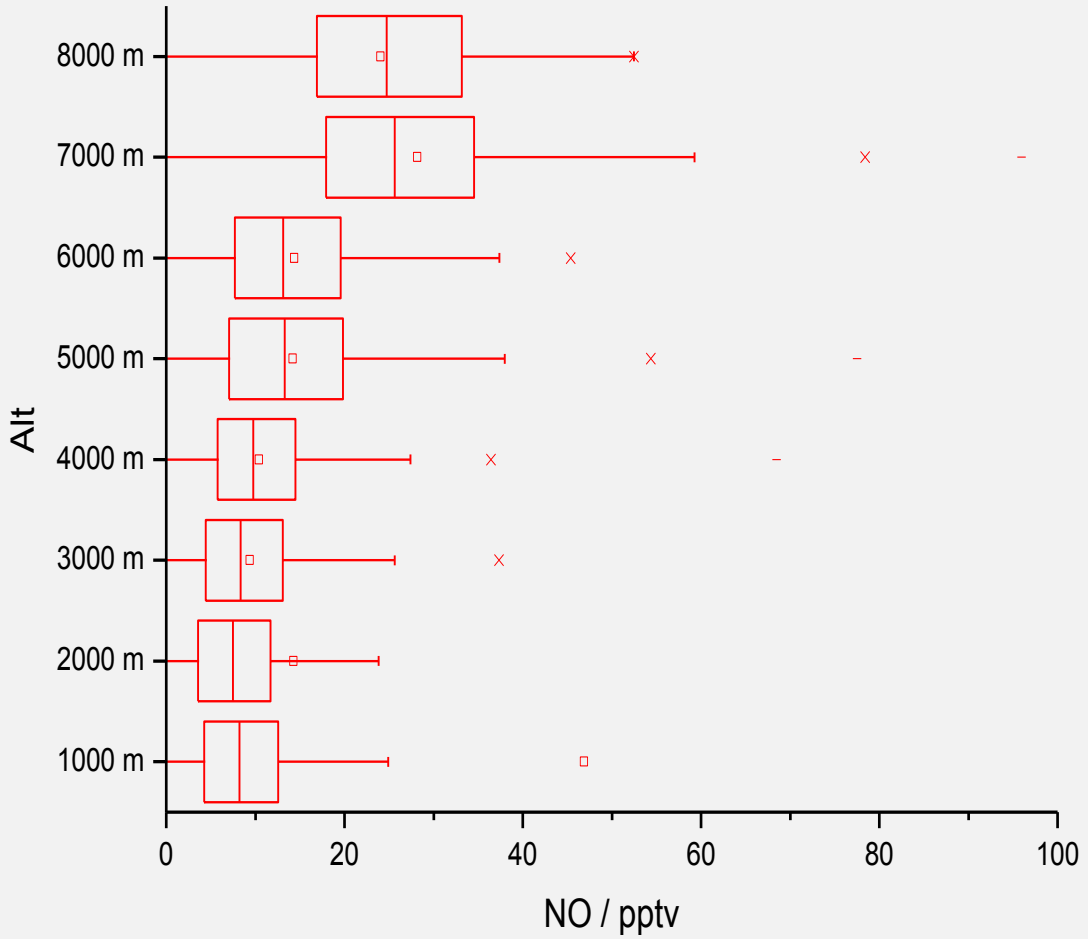
West NO



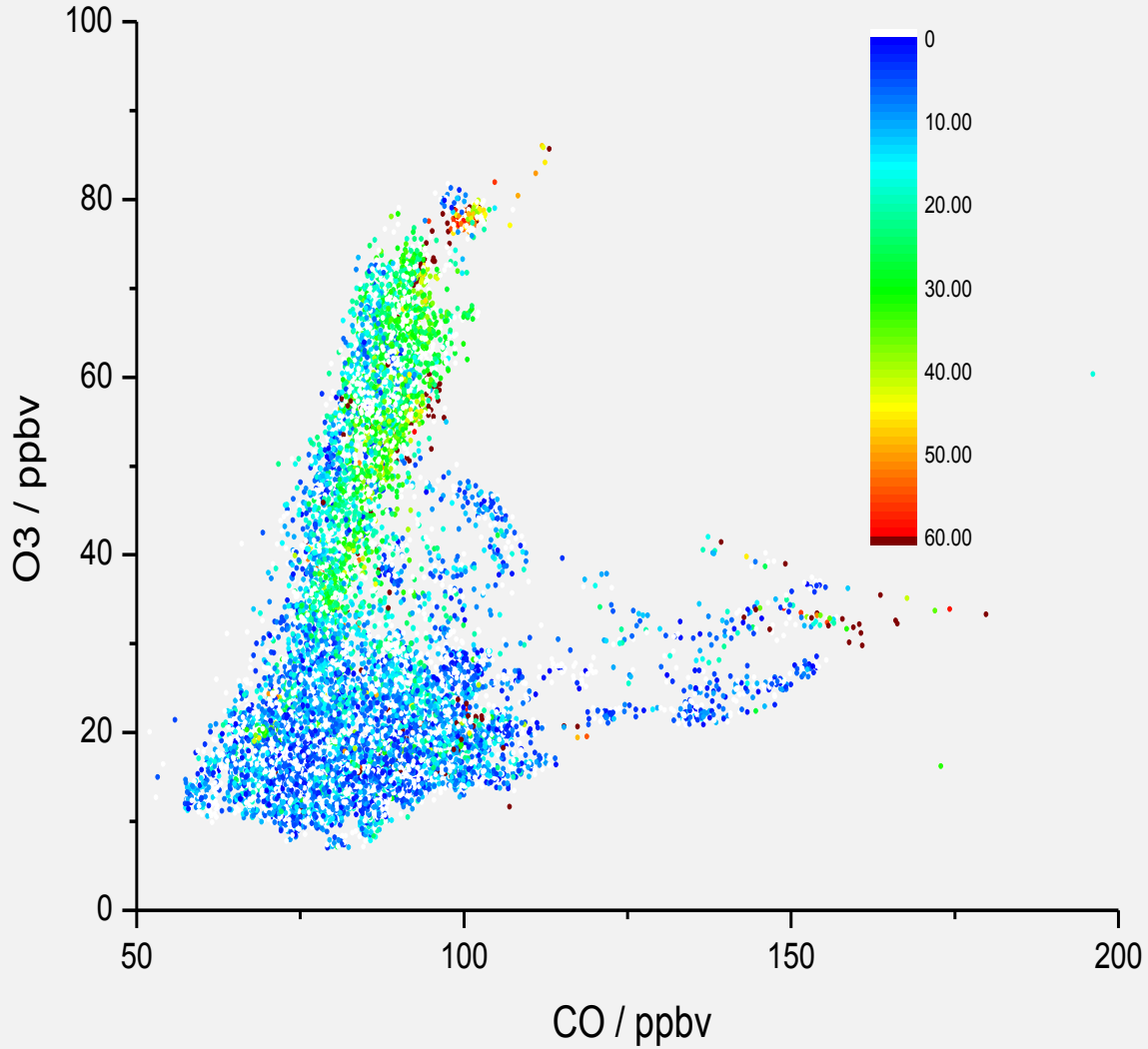
East NO



NO data


Alt
8000 m
7000 m
6000 m
5000 m
4000 m
3000 m
2000 m
1000 m
0
20
40
60
80
100
NO / pptv

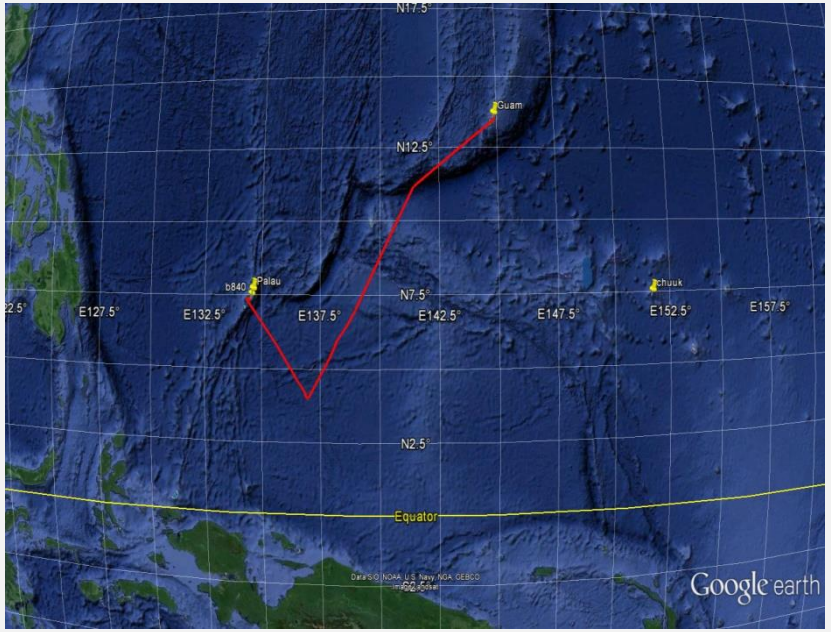
O3 vs CO with NO

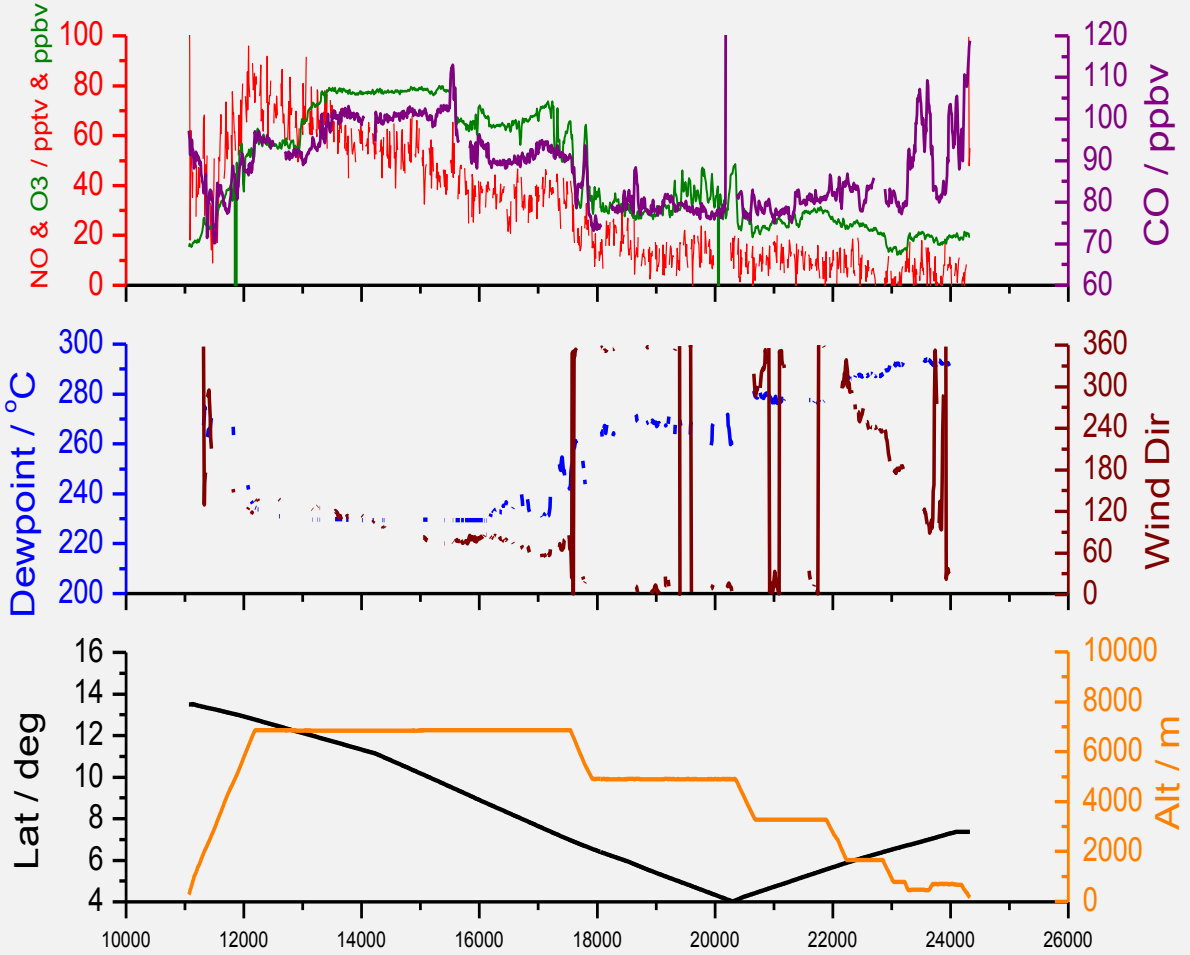


NOAA HYSPLIT - Analysis

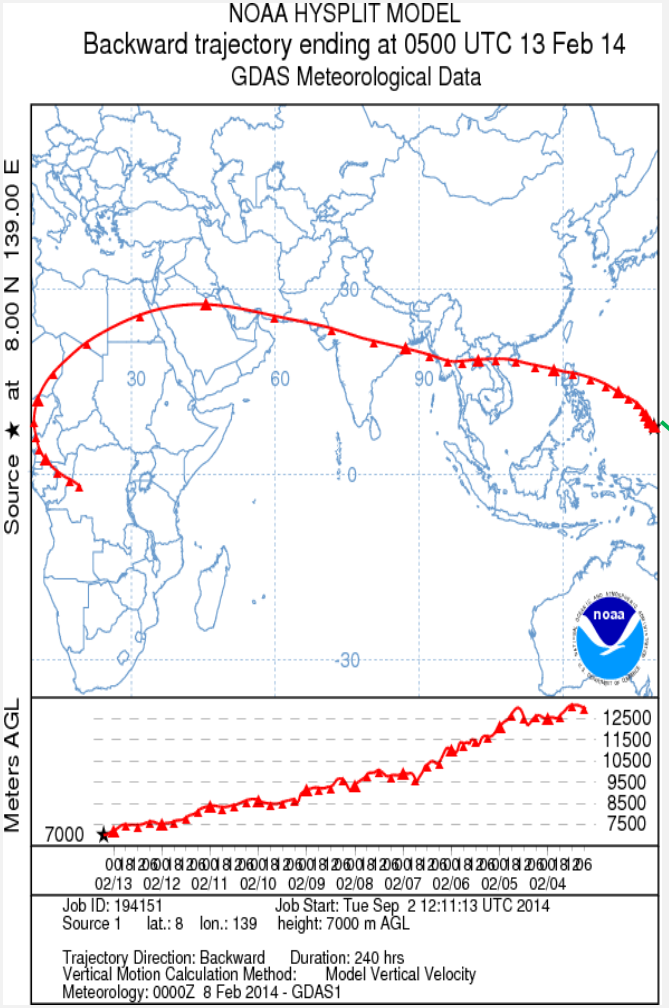
- Flight Analysis for B840, B844/845 & B836
- 10 day back Trajectory Model
- Comparison of NO, O_3, CO & Dew Point

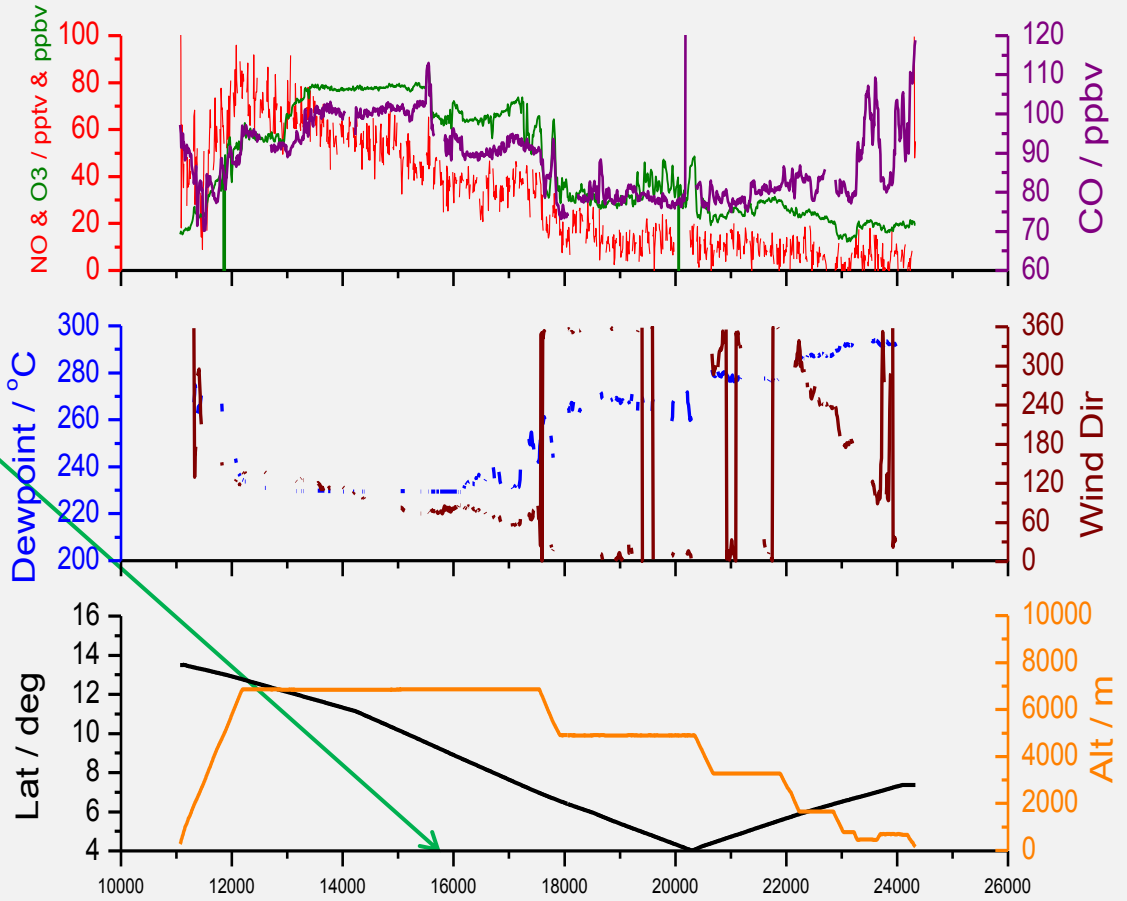
B840 – Guam to Palau (13/02/2014)



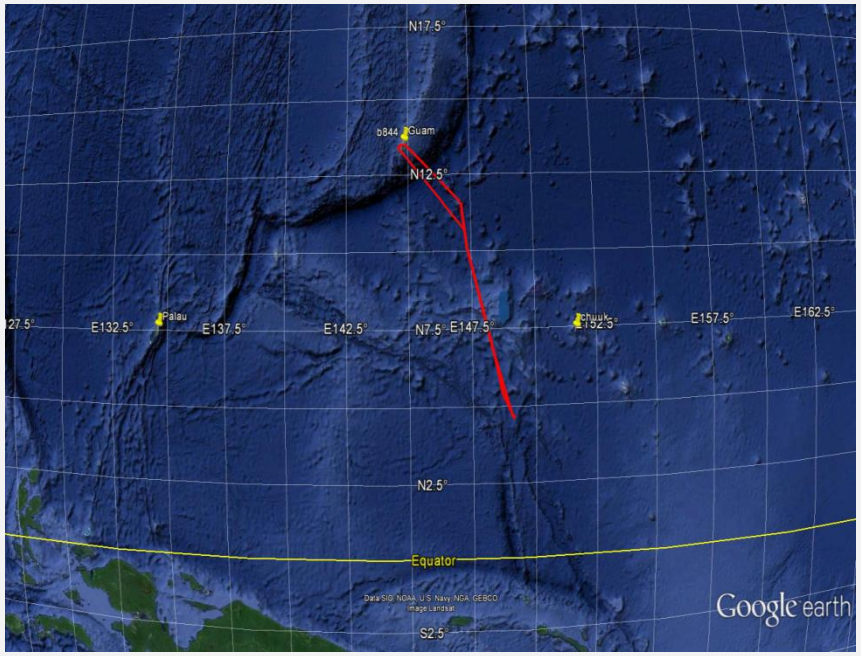


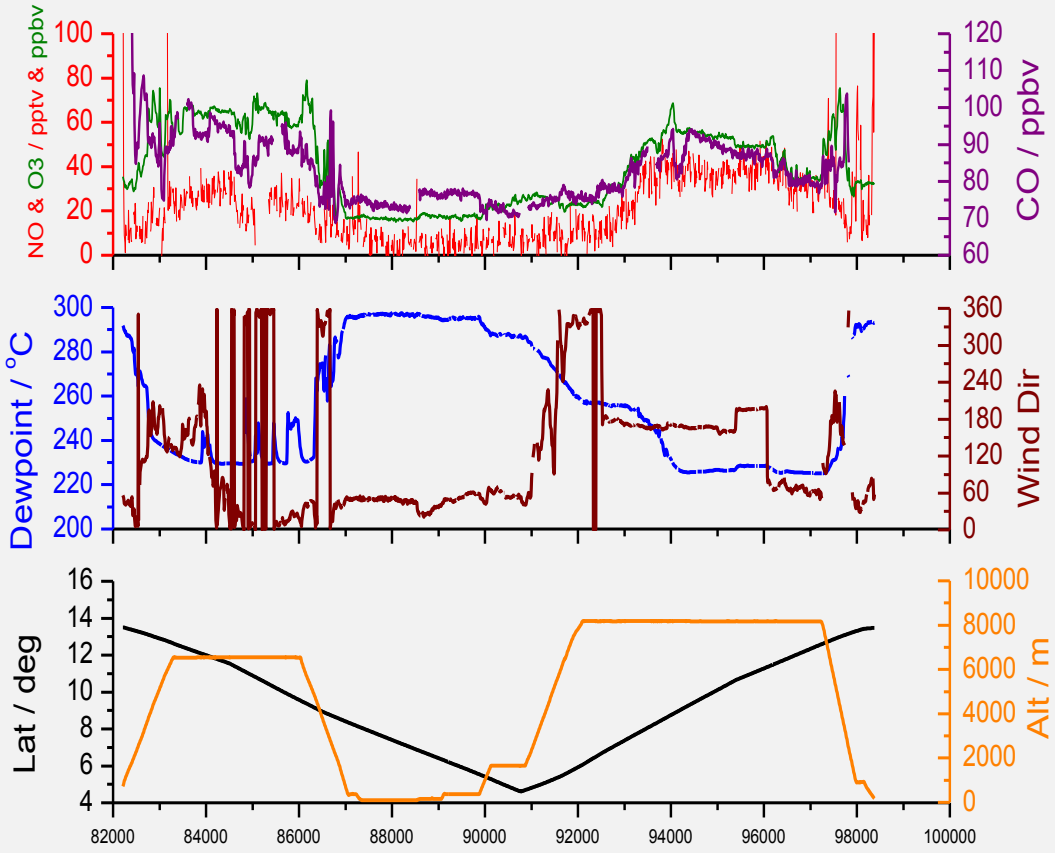
B840 - 10 day back trajectories



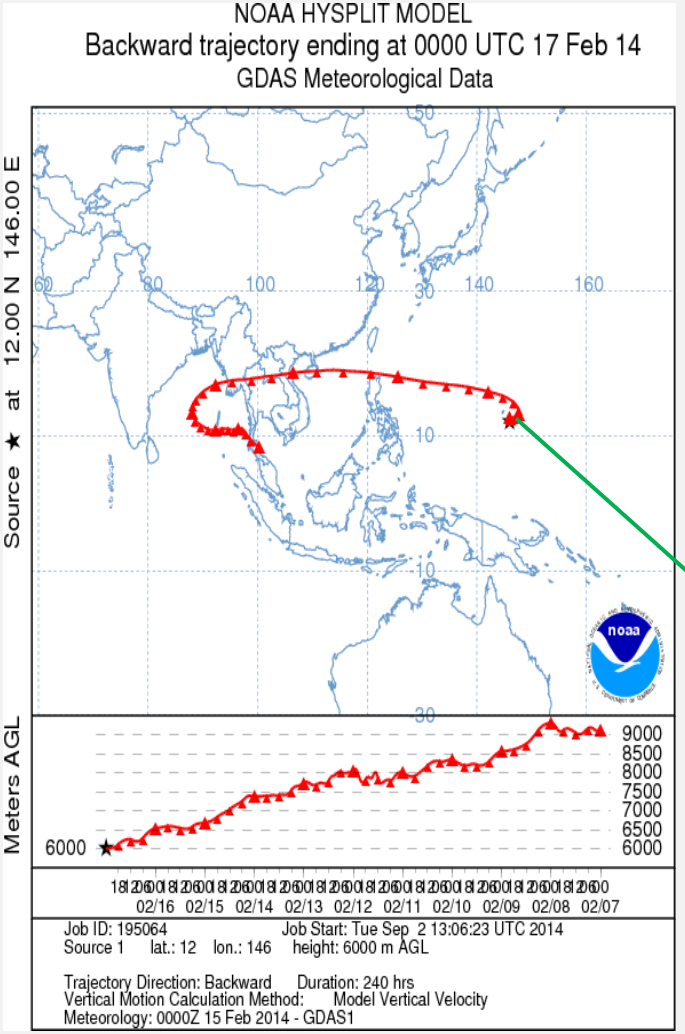


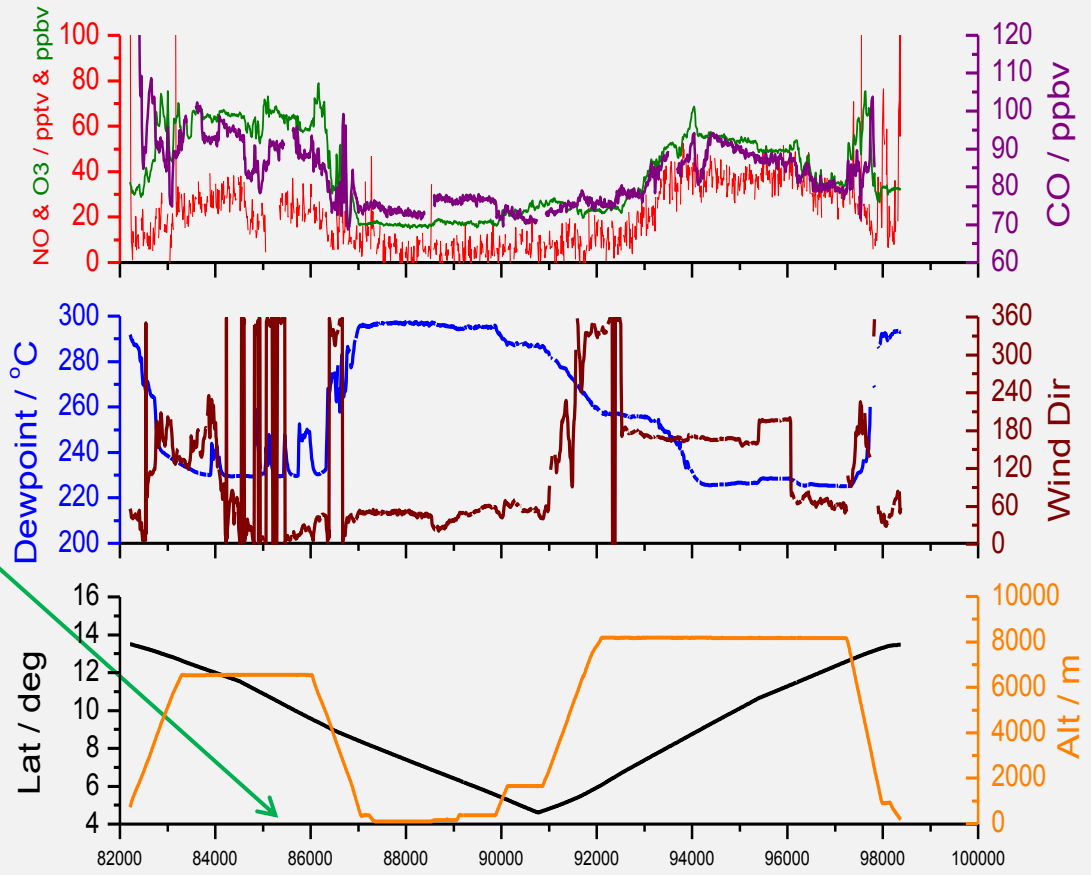
B844 – Guam – Guam (17/2/14 am)



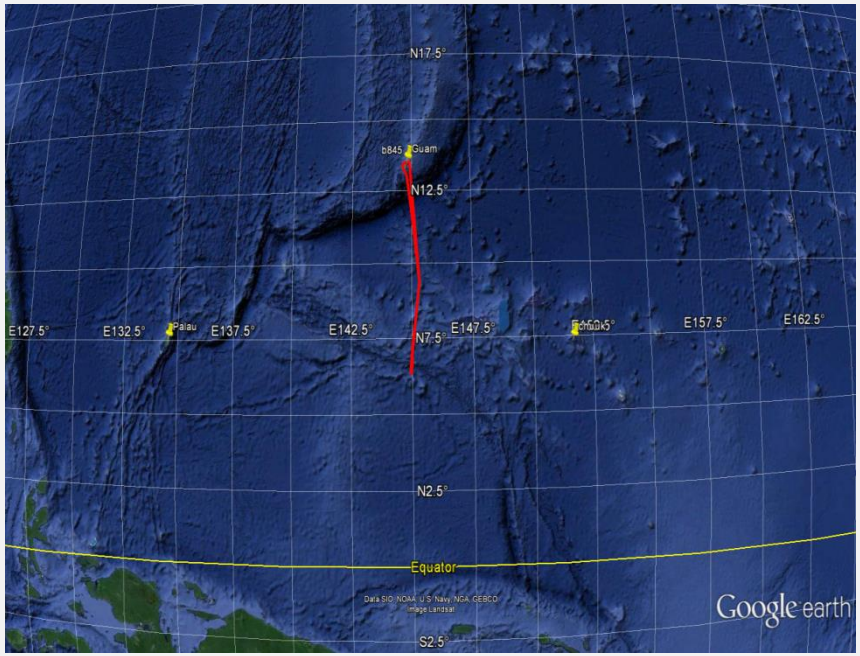


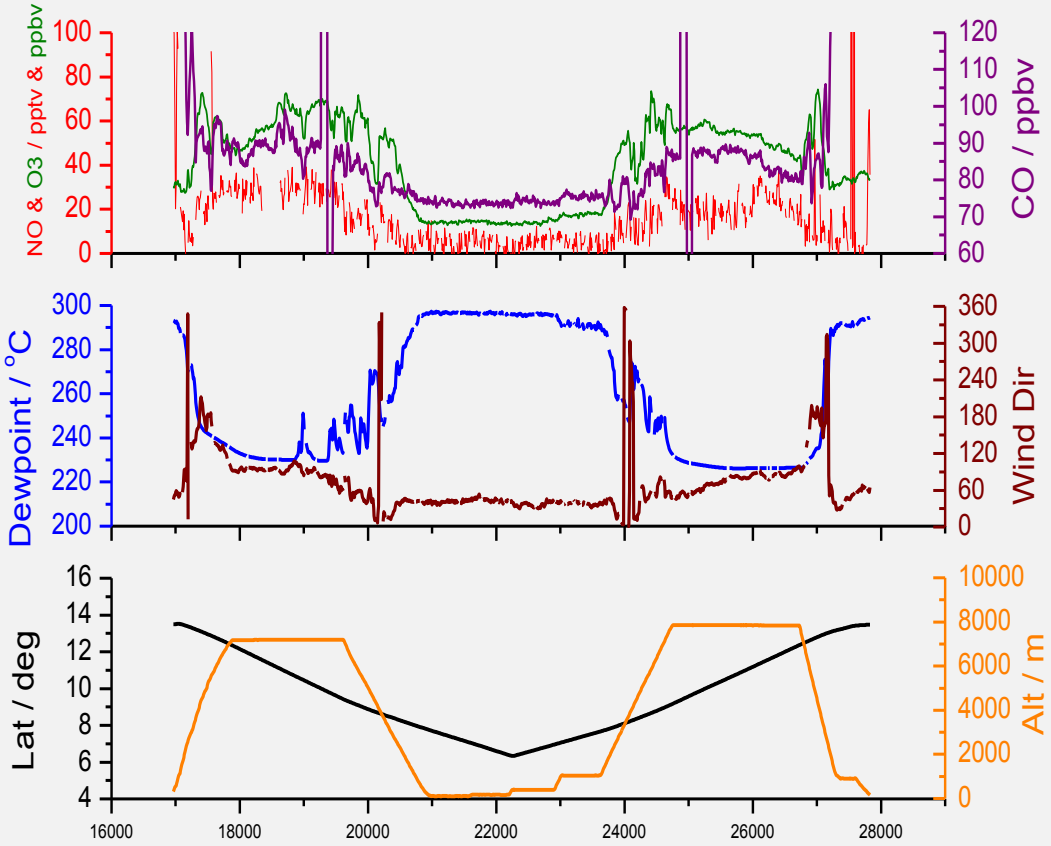
B844 - 10 day back trajectories



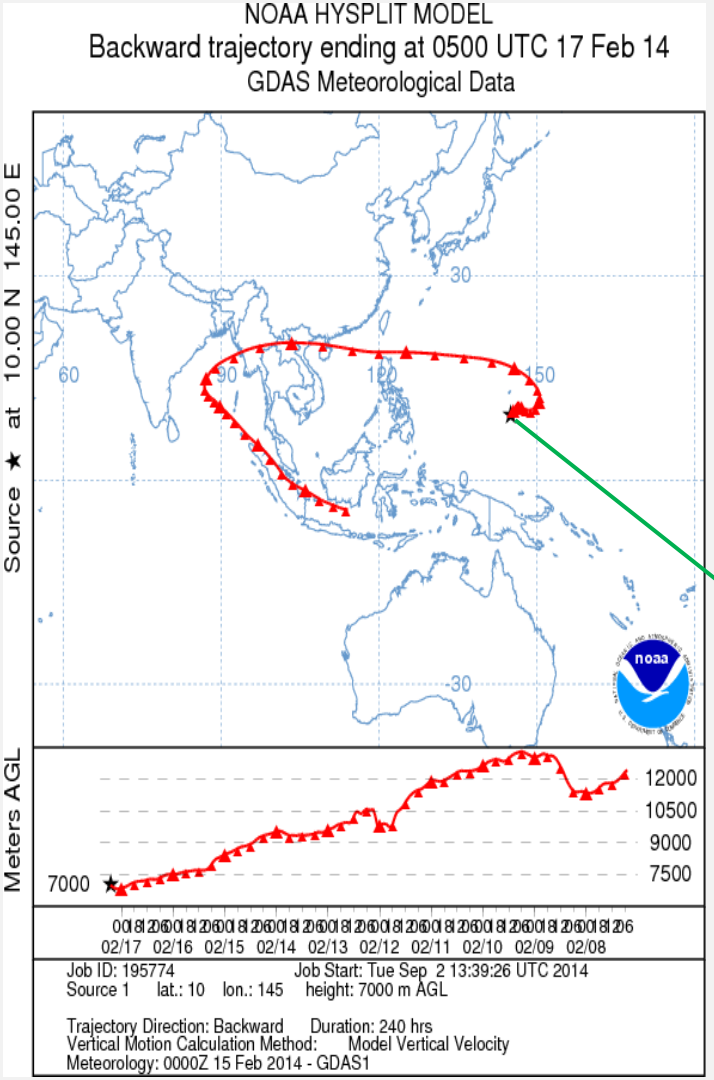


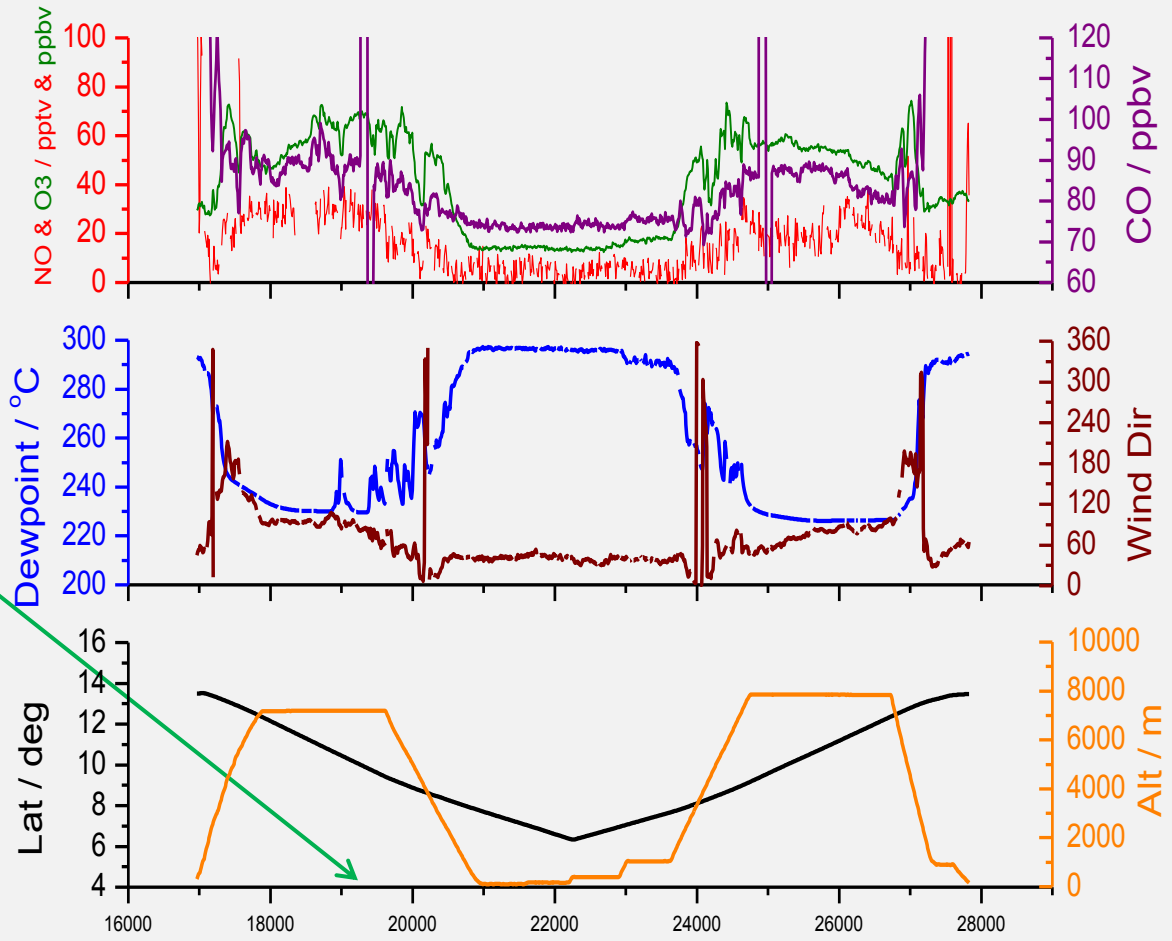
B845 – Guam – Guam (17/2/14 pm)



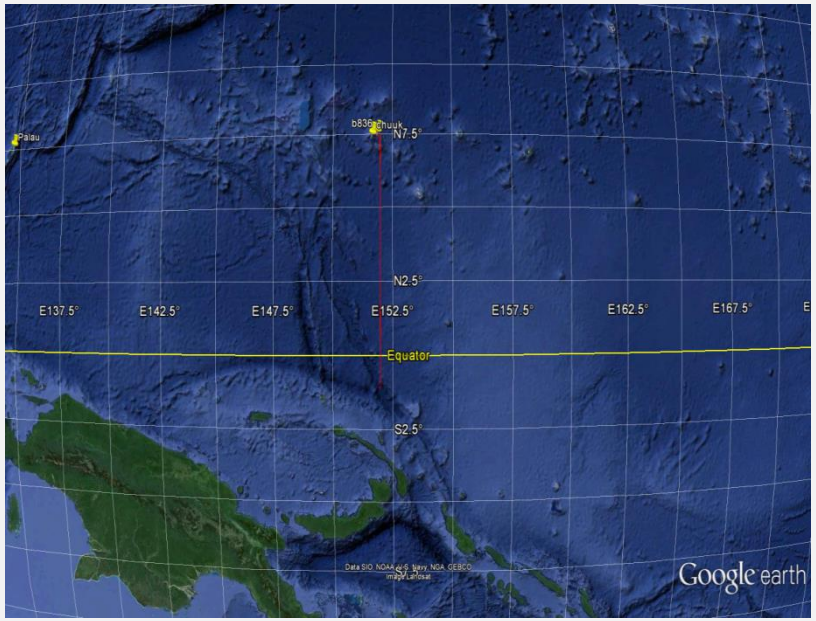


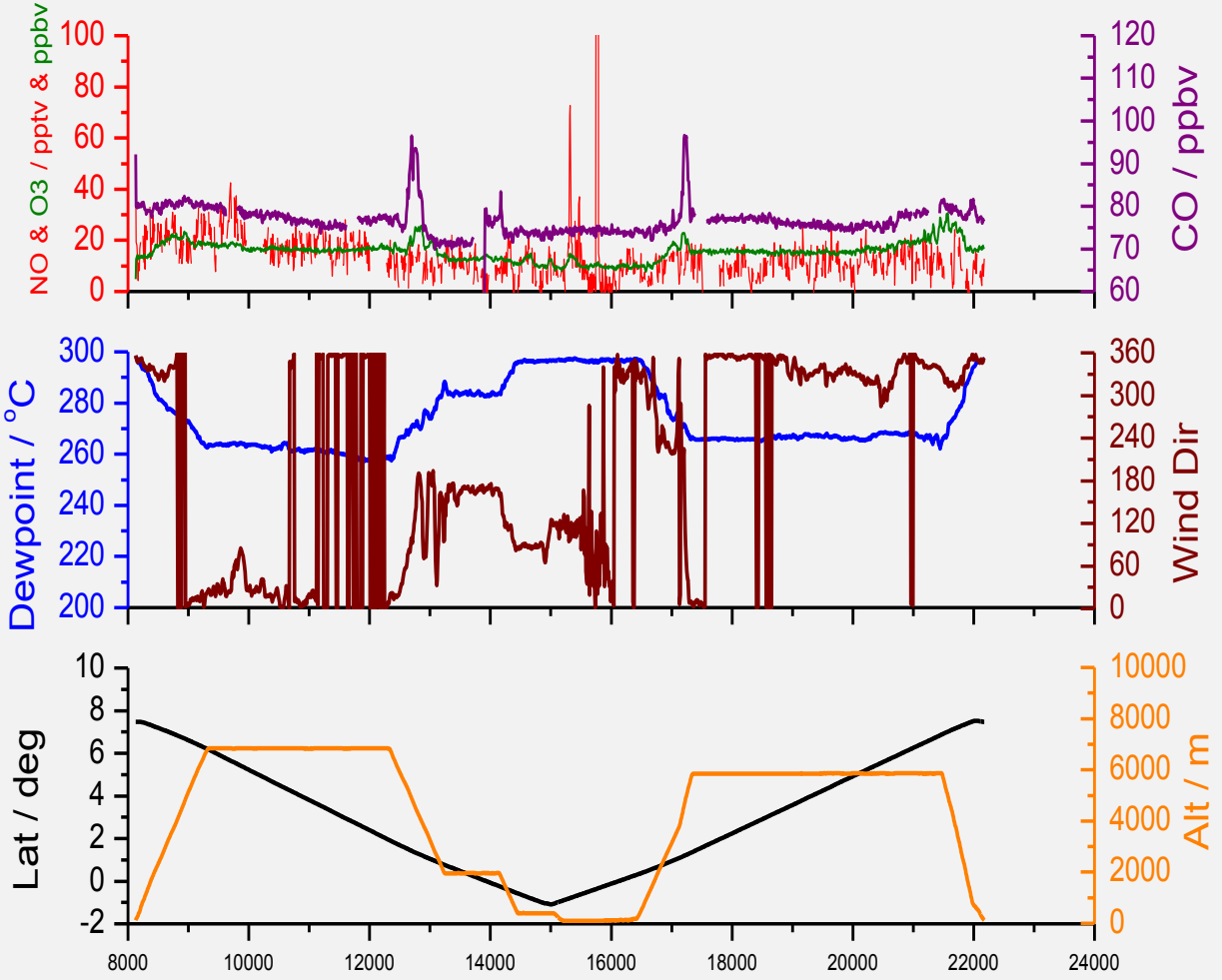
B845 - 10 day back trajectories



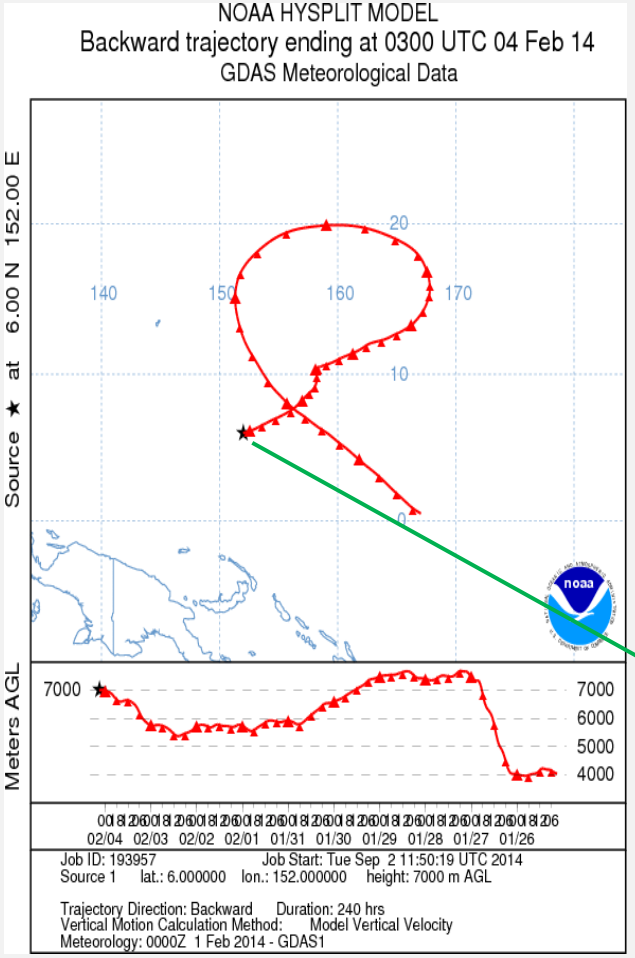


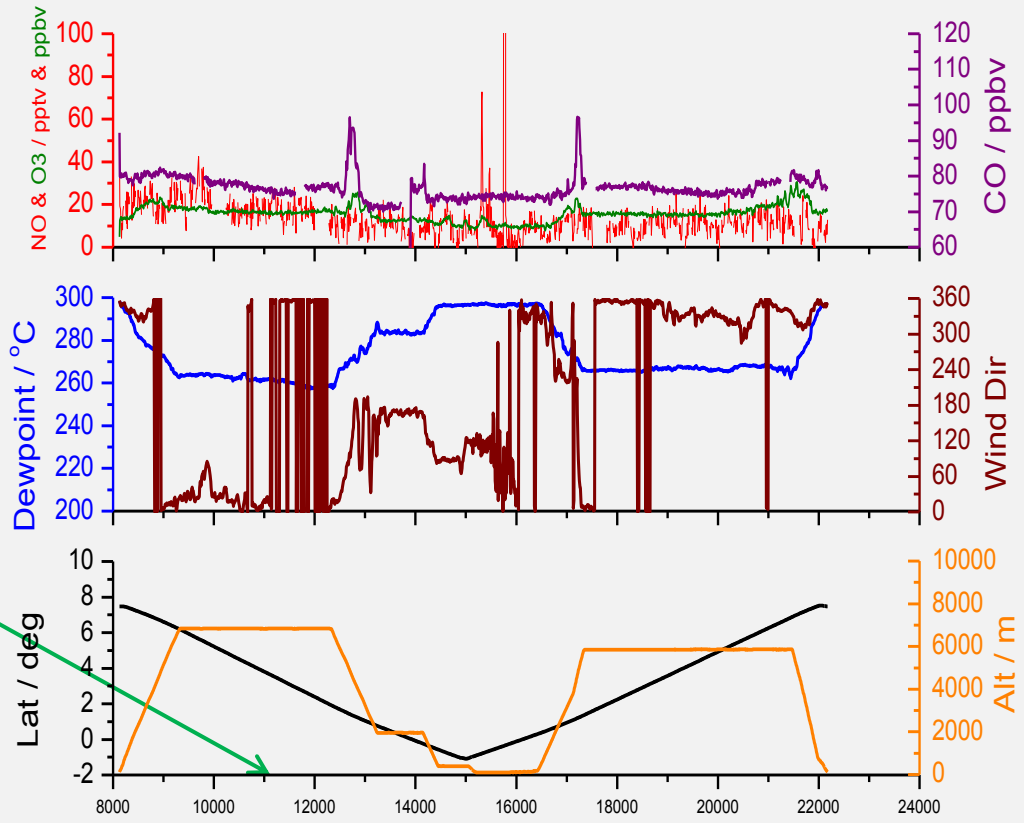
B836 – Chuuk – Chuuk (4/2/14)





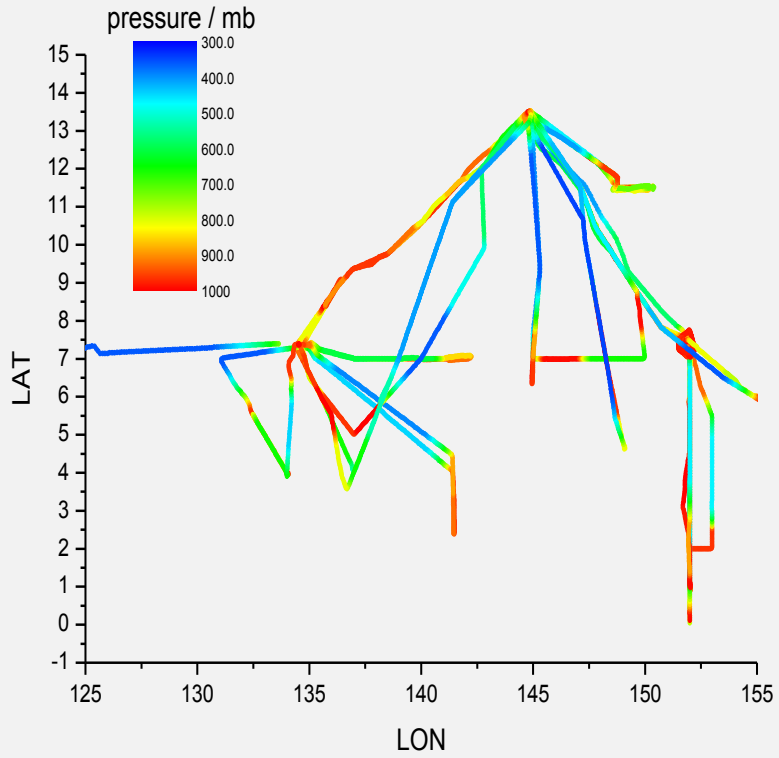
B836 - 10 day back trajectories



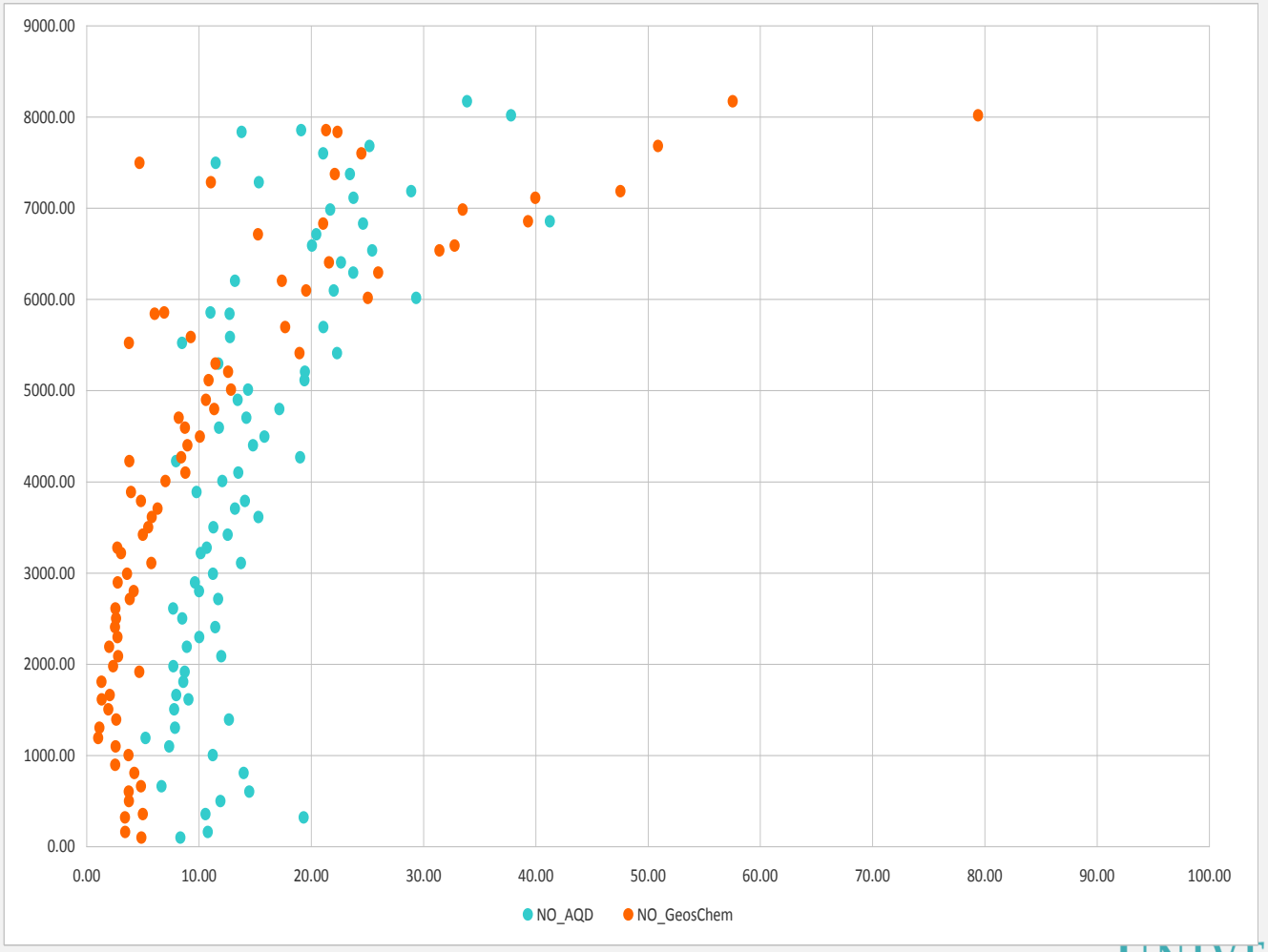


GEOS-Chem model comparison

- 4° x 5° resolution
- Run along BAe 146 flight tracks



Altitude Comparison – NO/ppt



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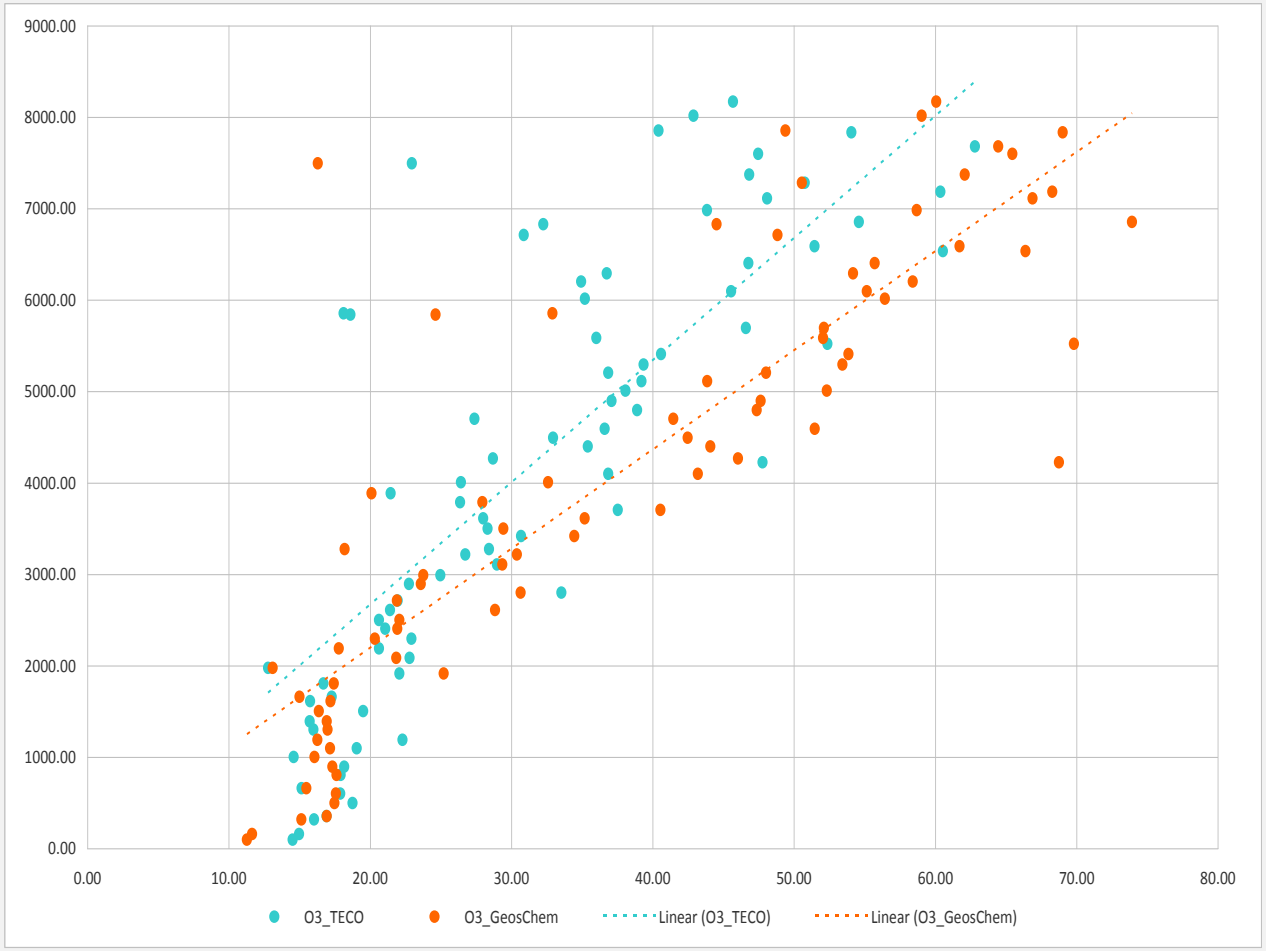
Altitude Comparison – O_3



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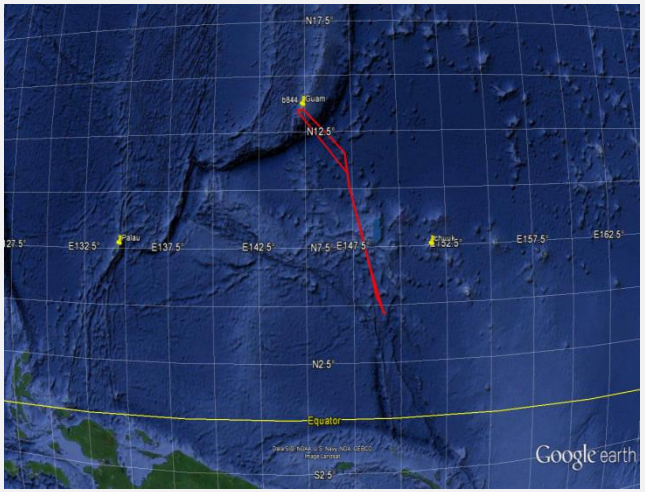
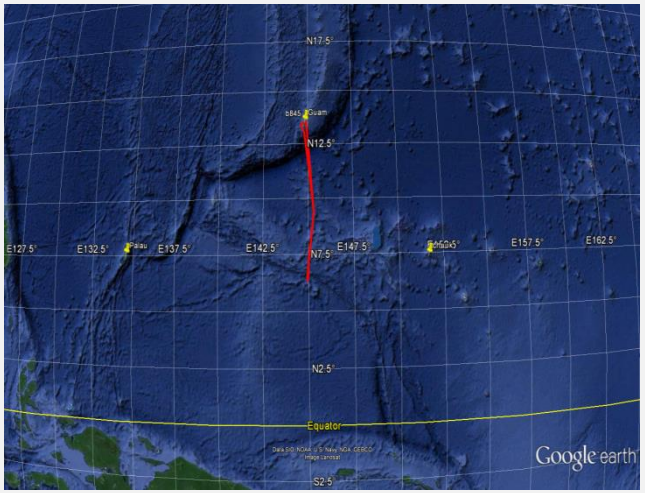
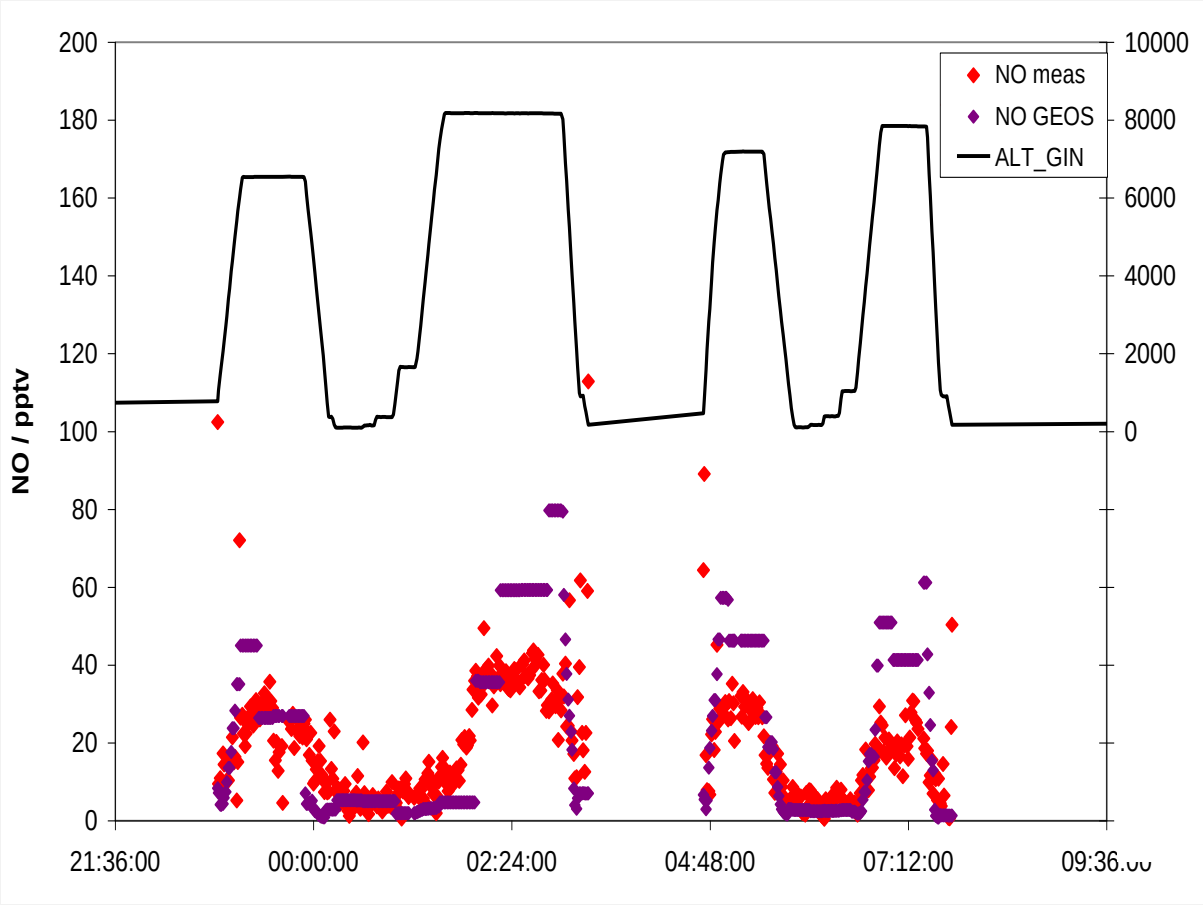
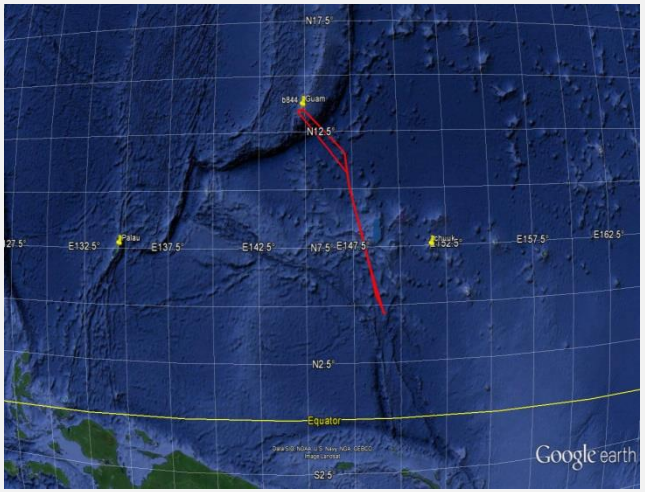
B844 / 845 – NO

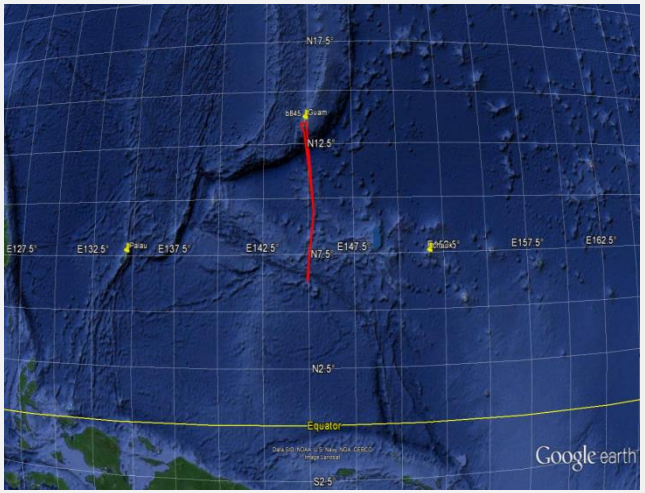

N17.5°
B844 Guam
N12.5°
E127.5°
E132.5°
Palau
E137.5°
E142.5°
N7.5°
E147.5°
E152.5°
E157.5°
E162.5°
N2.5°
Equator
S2.5°
Google earth

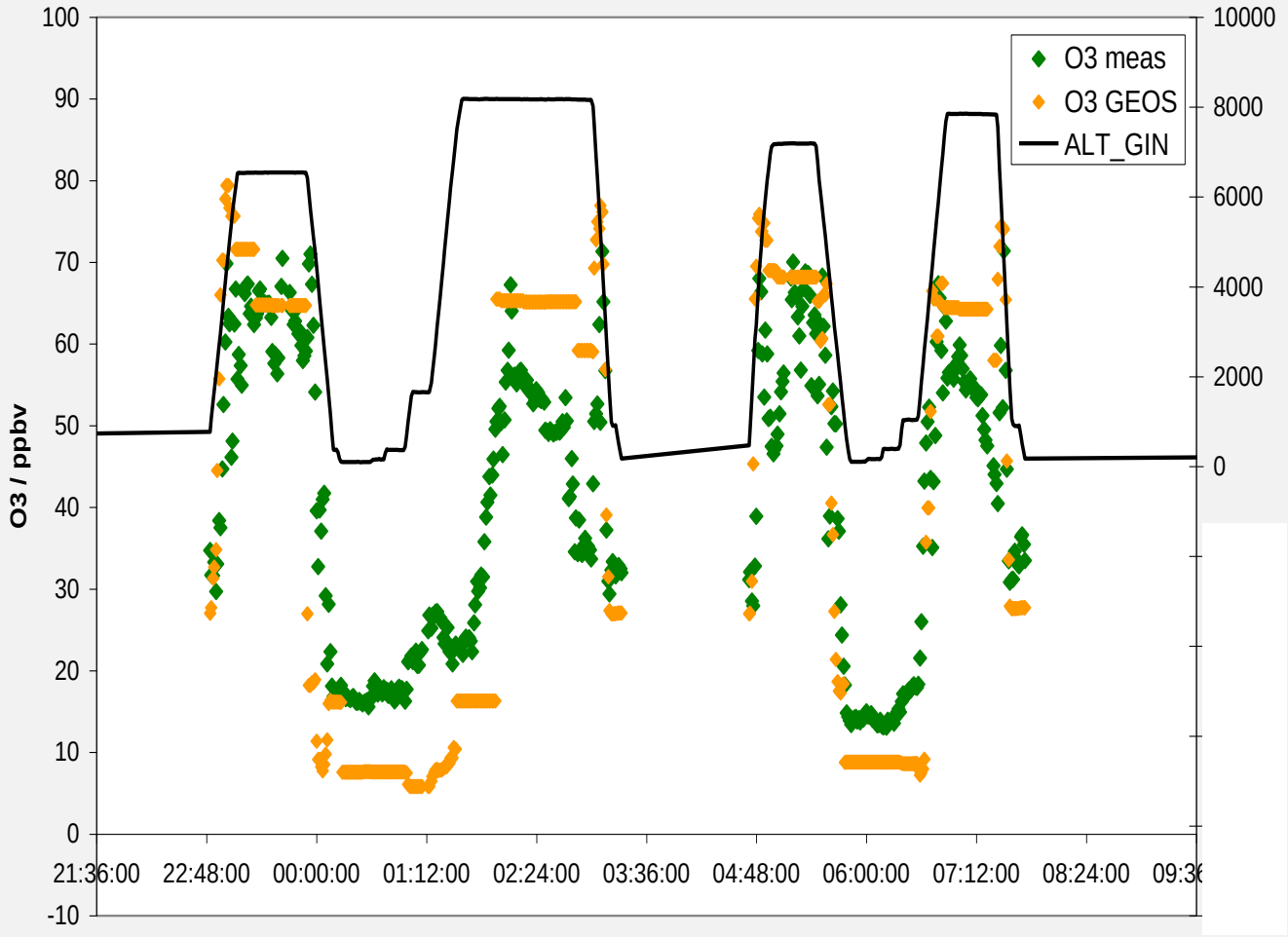

N17.5°
B845 Guam
N12.5°
E127.5°
E132.5°
Palau
E137.5°
E142.5°
N7.5°
E147.5°
E152.5°
E157.5°
E162.5°
N2.5°
Equator
S2.5°
Google earth


NO / pptv
200
180
160
140
120
100
80
60
40
20
0
10000
8000
6000
4000
2000
0
NO meas
NO GEOS
ALT_GIN
21:36:00
00:00:00
02:24:00
04:48:00
07:12:00
09:36:00

B844 / 845 – O3


N17.5
b844 Guam
N12.5
E132.5
Palau
E137.5
E142.5
N7.5
E147.5
E152.5
E157.5
E162.5
N2.5
Equator
S2.5
Google earth


N17.5
b845 Guam
N12.5
E127.5
E132.5
Palau
E137.5
E142.5
N7.5
E147.5
E152.5
E157.5
E162.5
N2.5
Equator
S2.5
Google earth


O3 meas
O3 GEOS
ALT_GIN
O3 / ppbv
100
90
80
70
60
50
40
30
20
10
0
-10
10000
8000
6000
4000
2000
0
21:36:00
22:48:00
00:00:00
01:12:00
02:24:00
03:36:00
04:48:00
06:00:00
07:12:00
08:24:00

Conclusions

- Good instrument performance for NO
- NO_2 artefact problem, not confident in data
- Increased O3 and NO higher at higher altitudes
- HYSPLIT trajectories show potential long range transport / convective uplift / lightning NO_x
- GEOS-Chem model gives similar structure to NO & O_3 measurements, especially in plumes
- Some difference in absolute concentrations