Assessing Transport Pathways during HIPPO using Chemical Tracers

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HIPPO Workshop
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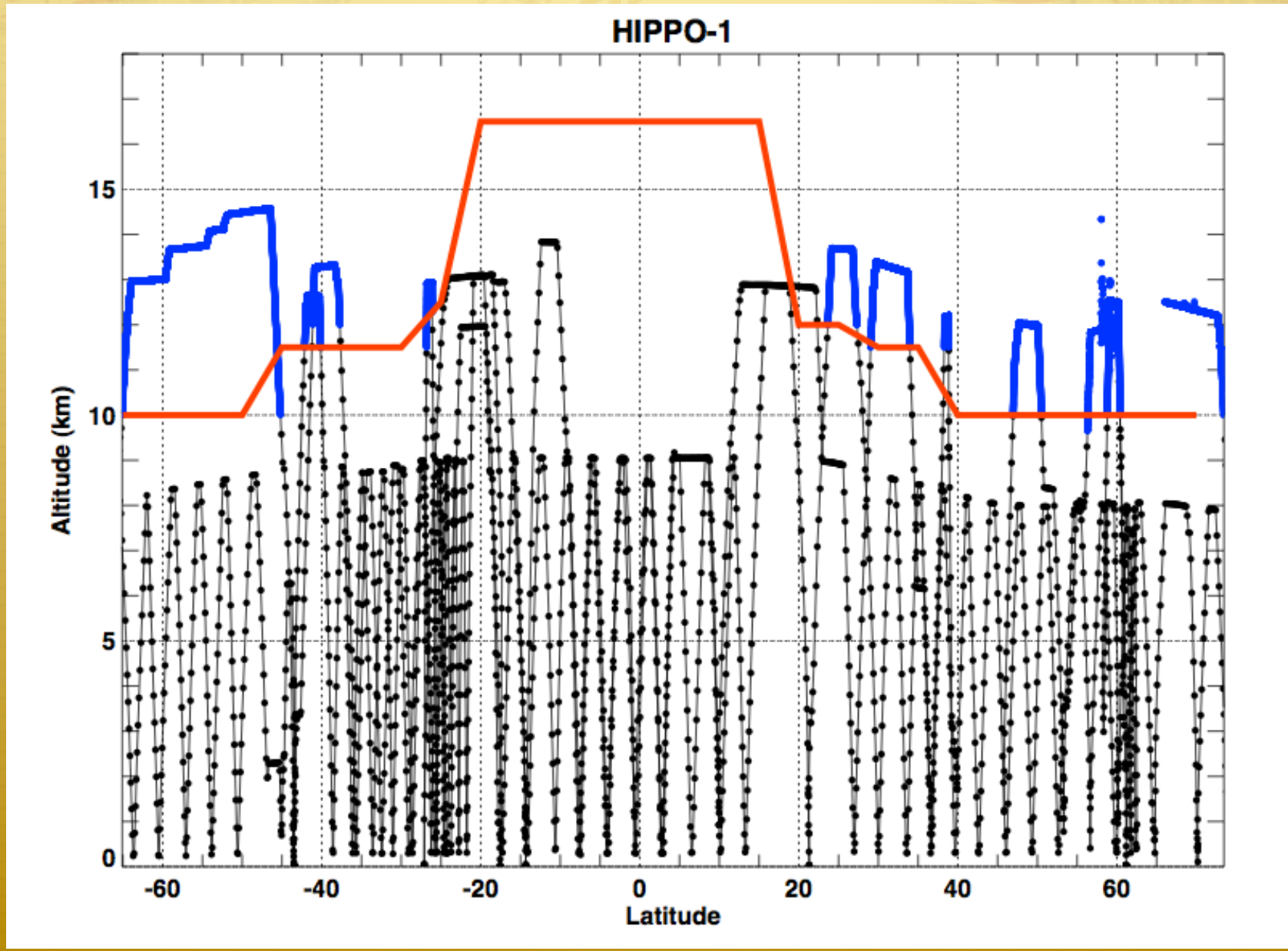
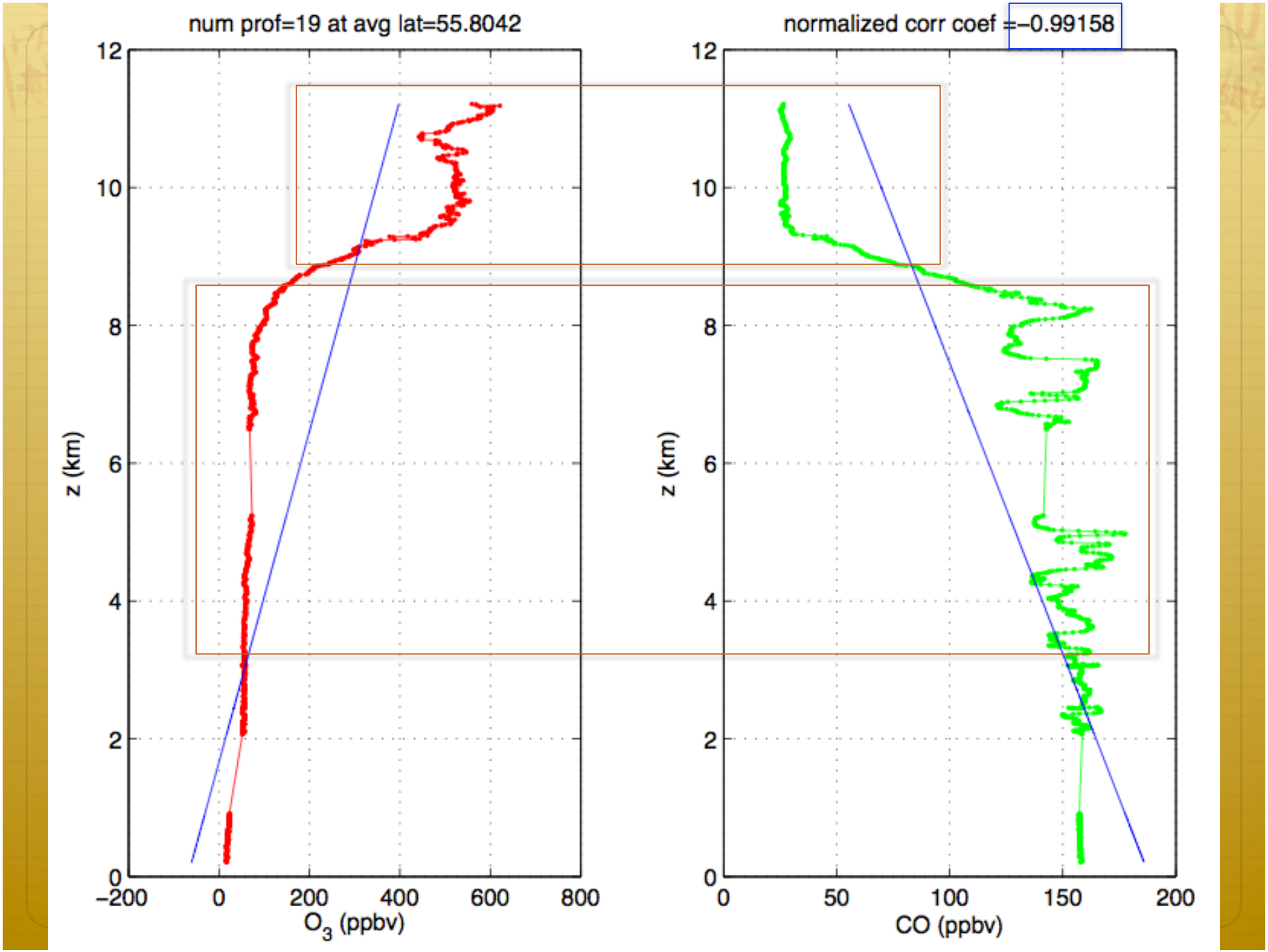
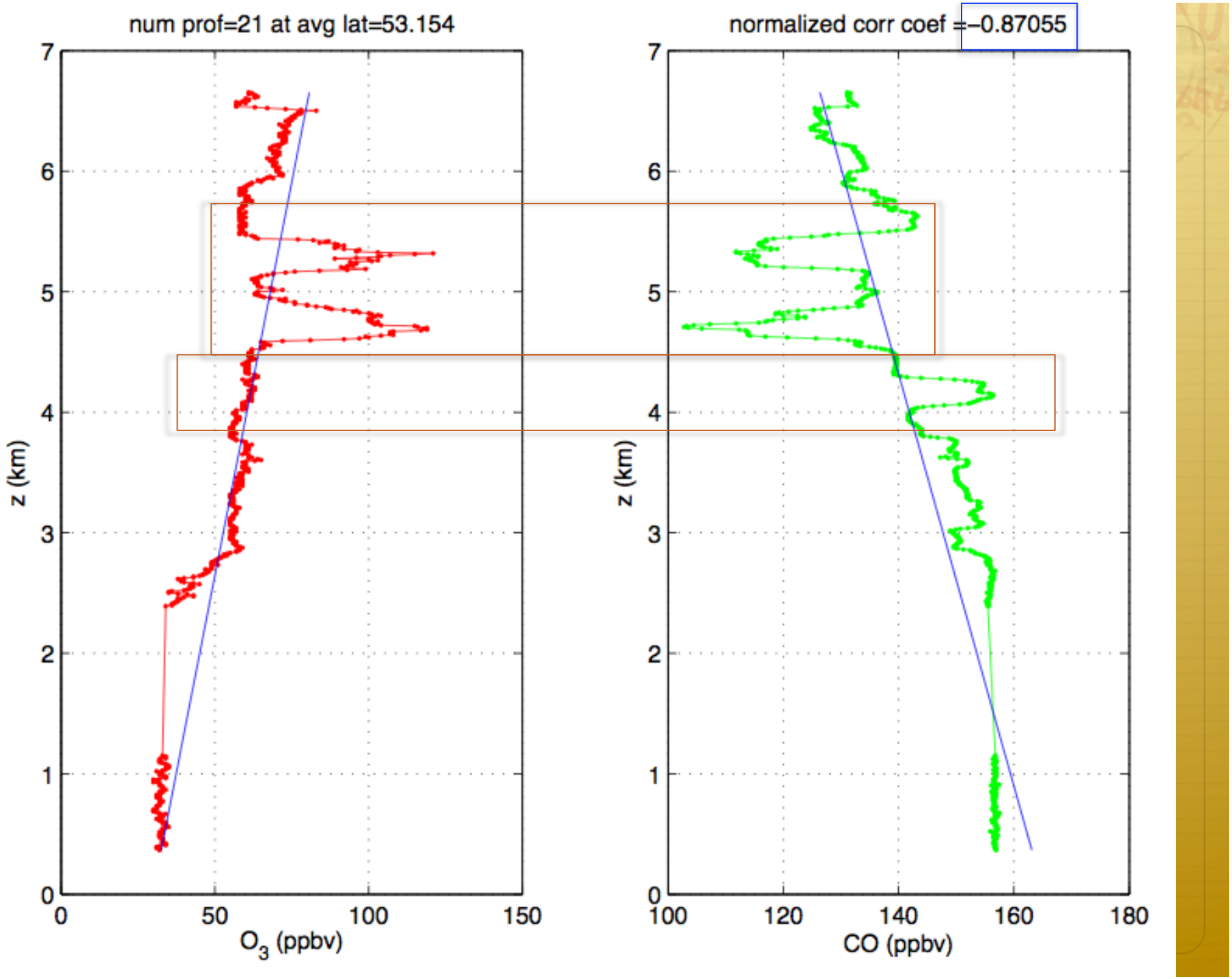
Outline

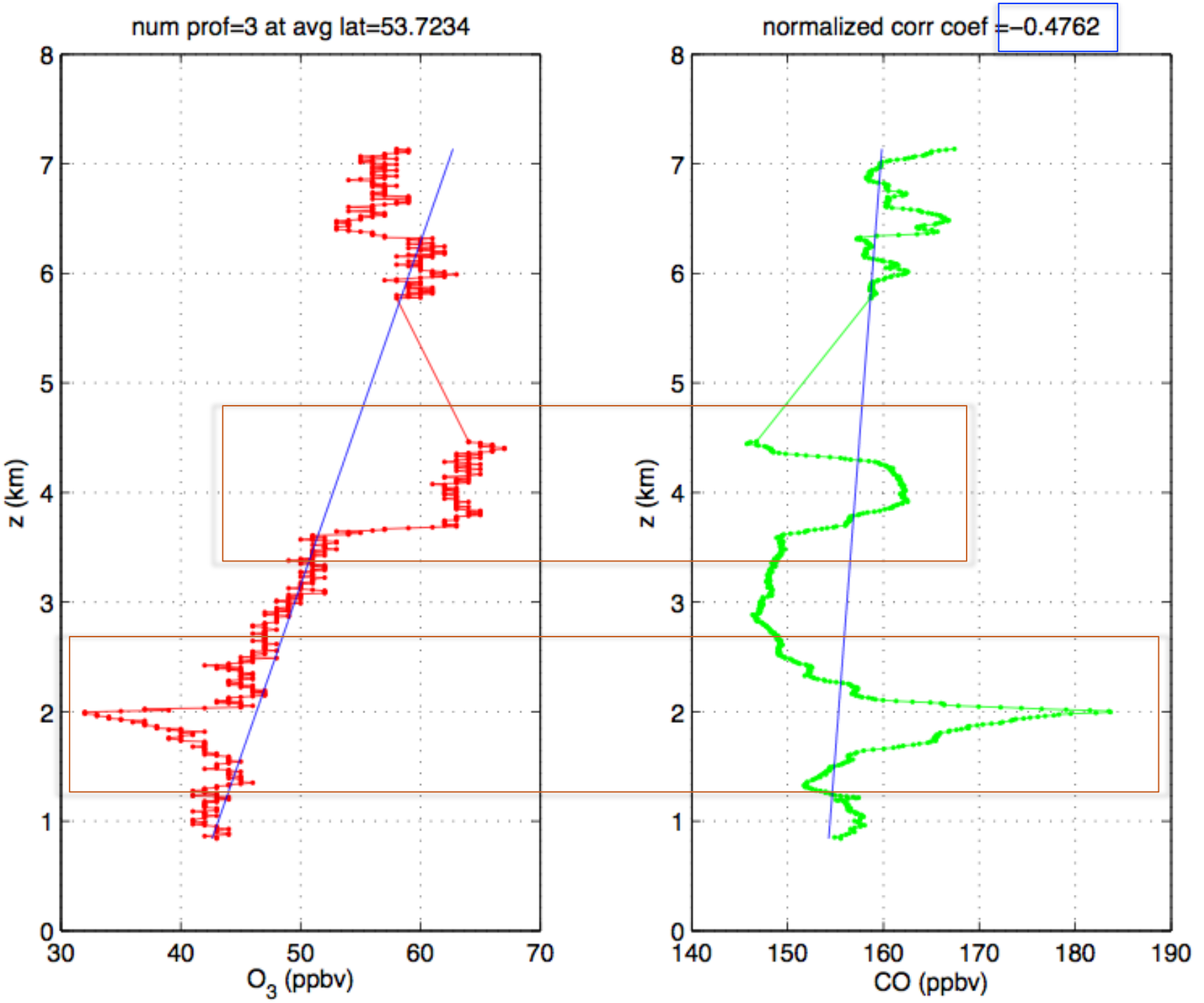
- Examine O_3 / CO correlations throughout troposphere and UT/LS:
  - O_3 -> tracer of stratospheric origin
  - CO -> tracer of tropospheric origin
- Map preferred regions of positive and negative correlations
- Characterize the observed correlations as a function of underlying transport, photochemical processes, hemispheric asymmetry, and seasonal dependence

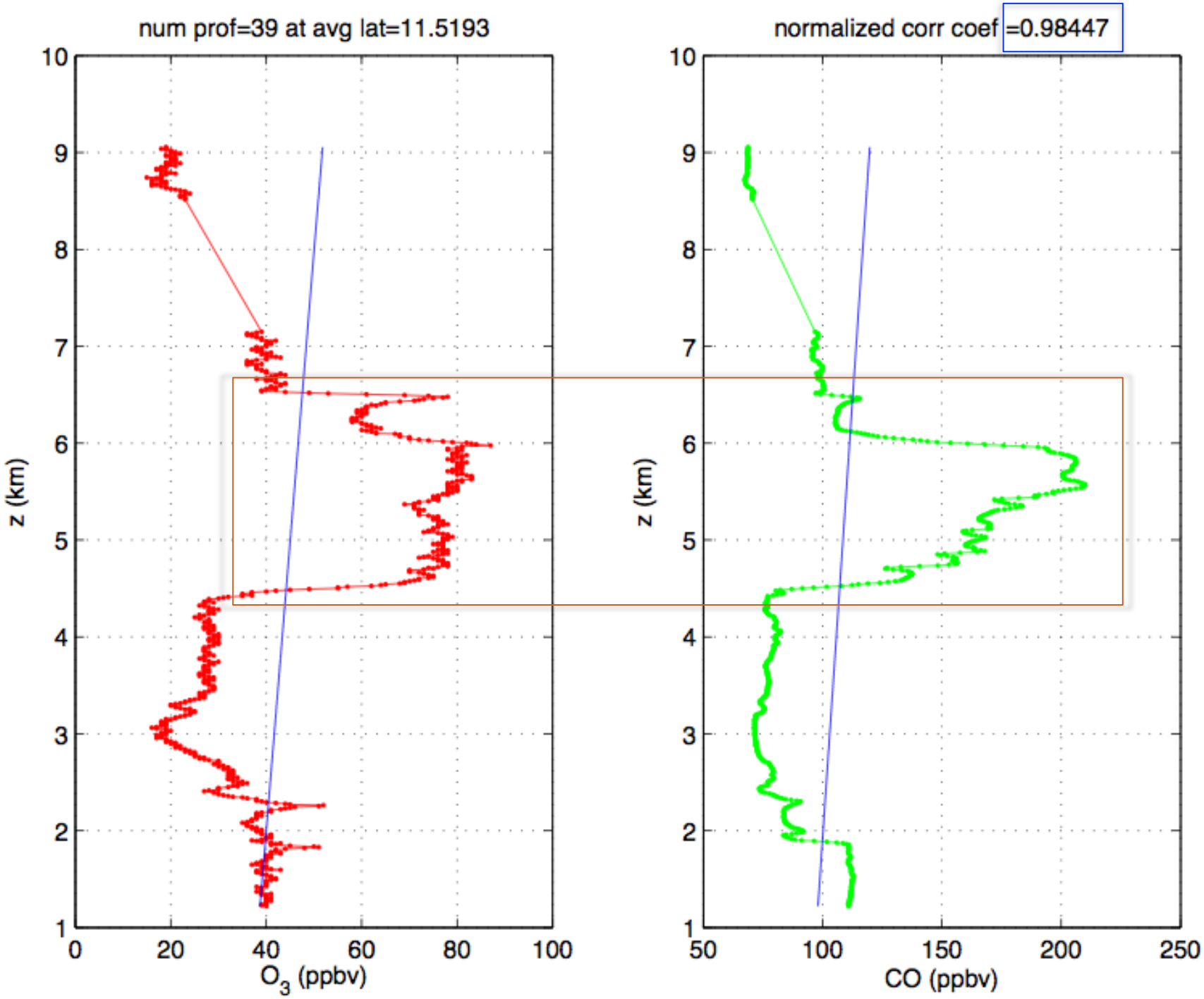
HIPPO Flight Tracks




num prof=19 at avg lat=55.8042
normalized corr coef =−0.99158
z (km)
O_3 (ppbv)
CO (ppbv)
0
2
4
6
8
10
12
−200
0
200
400
600
800
50
100
150


num prof=21 at avg lat=53.154
normalized corr coef =−0.87055
z (km)
O3 (ppbv)
CO (ppbv)
0
1
2
3
4
5
6
7
0
50
100
150
100
120
140
160
180

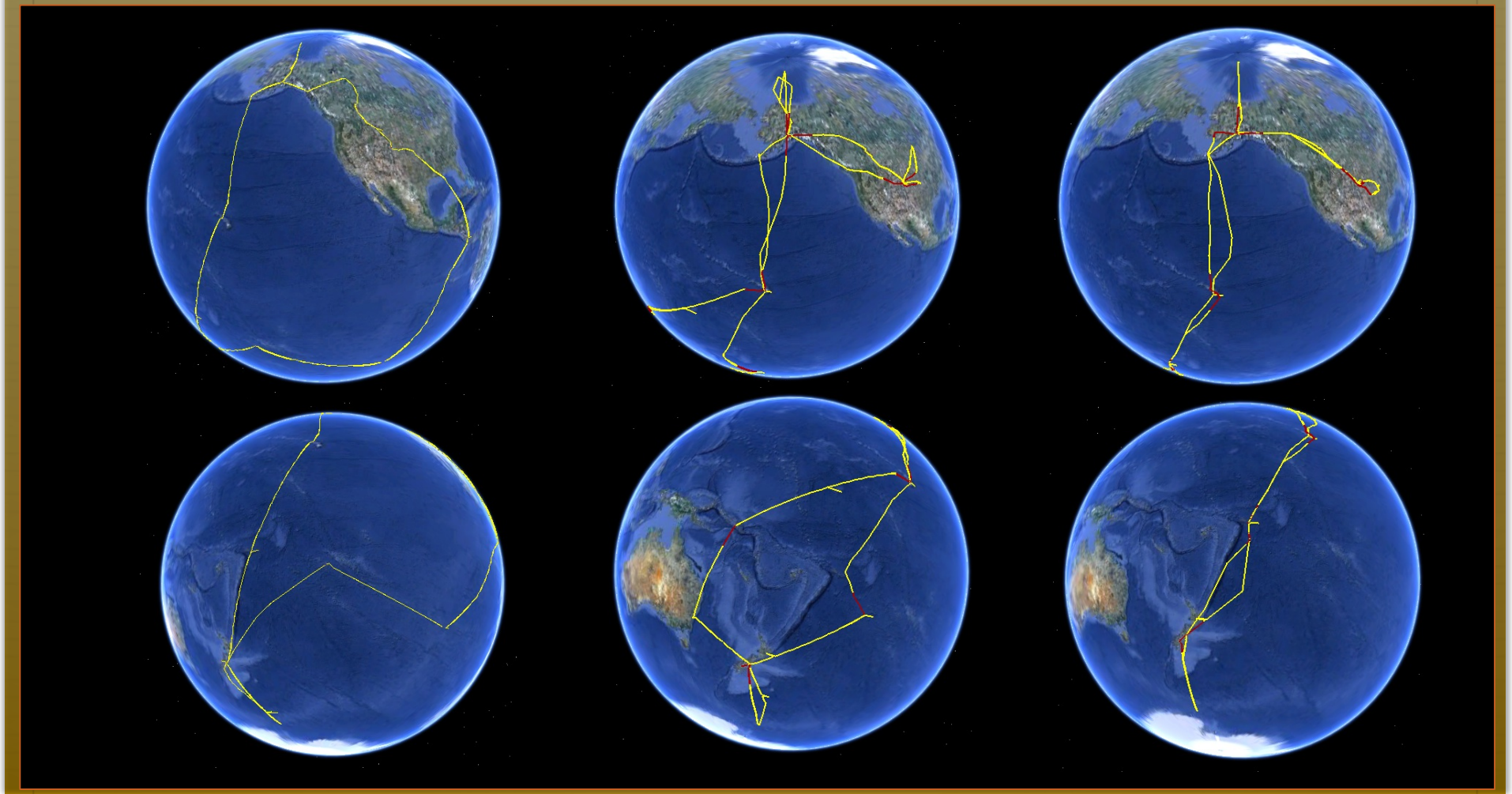

num prof=3 at avg lat=53.7234
normalized corr coef =−0.4762
z (km)
O_3 (ppbv)
CO (ppbv)
0
1
2
3
4
5
6
7
8
30
40
50
60
70
140
150
160
170
180
190


num prof=39 at avg lat=11.5193
normalized corr coef =0.98447
z (km)
O_3 (ppbv)
CO (ppbv)
0
20
40
60
80
100
50
100
150
200
250
1
2
3
4
5
6
7
8
9
10

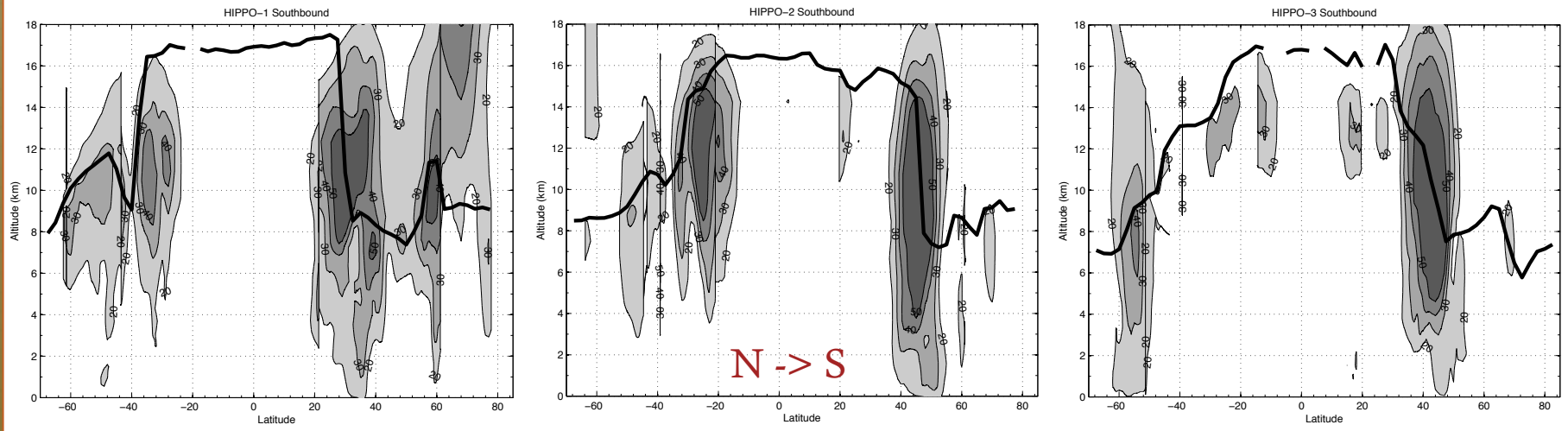
HIPPO-1
January 2009

HIPPO-2
Oct/Nov 2009

HIPPO-3
Mar/Apr 2010



HIPPO-1 HIPPO-2 HIPPO-3

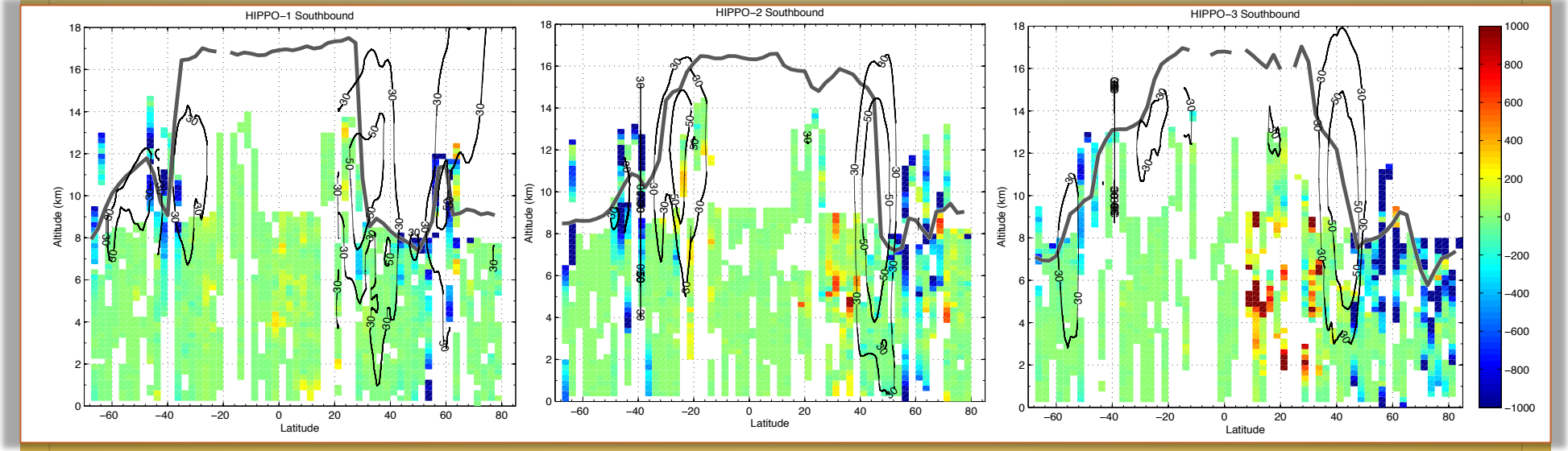


Winds

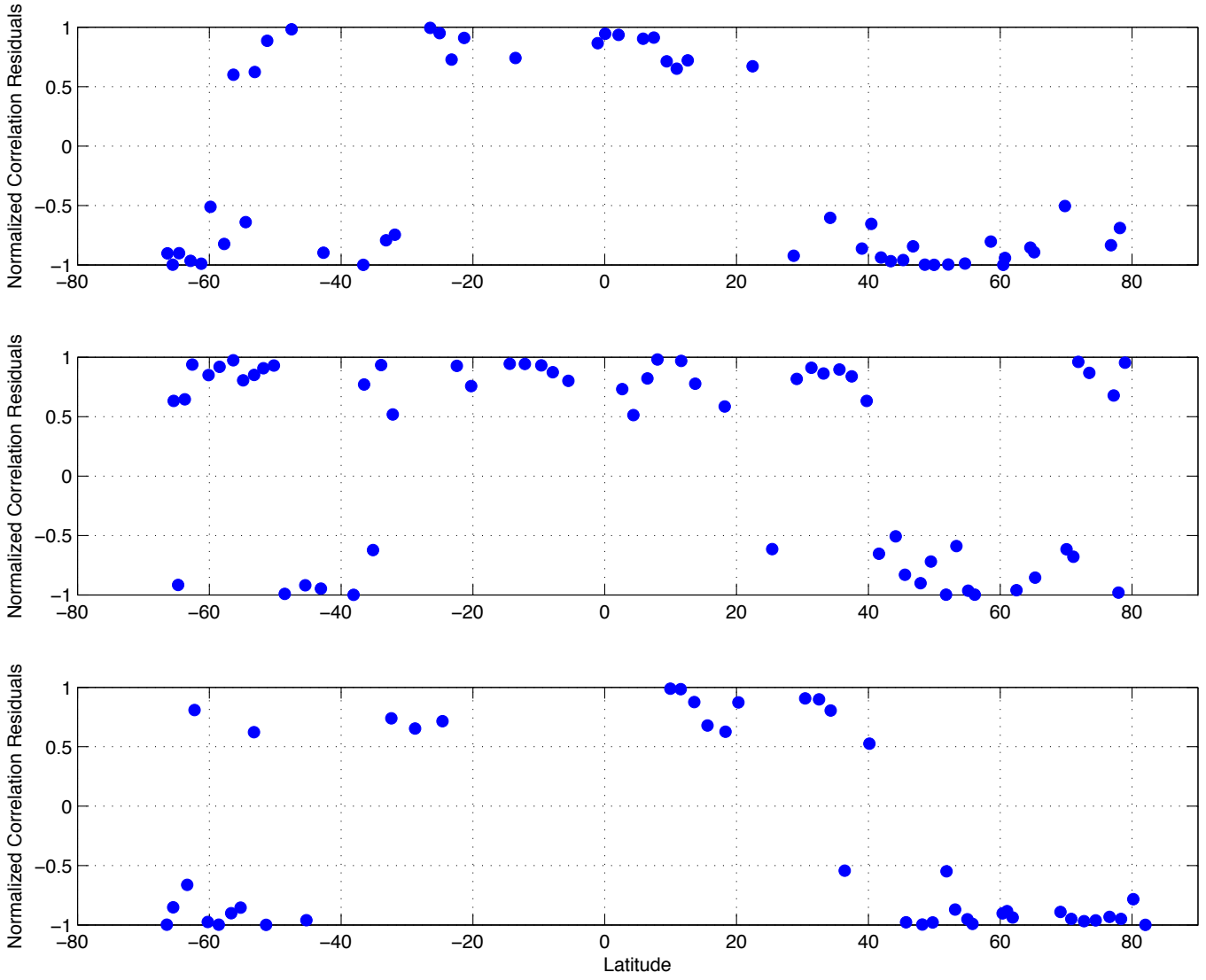
HIPPO-1
142 profiles

HIPPO-2
141 profiles

HIPPO-3
124 profiles



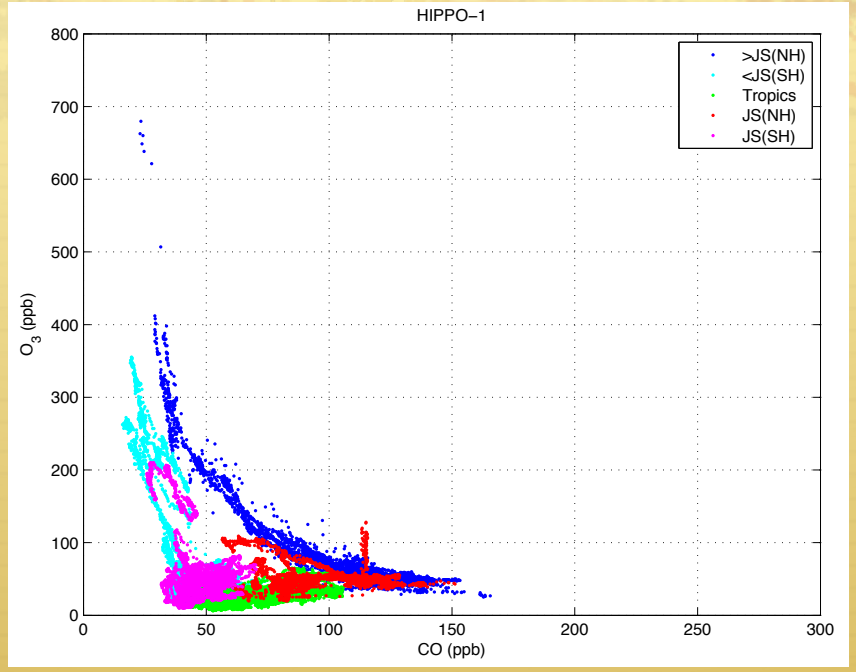
Southbound Legs

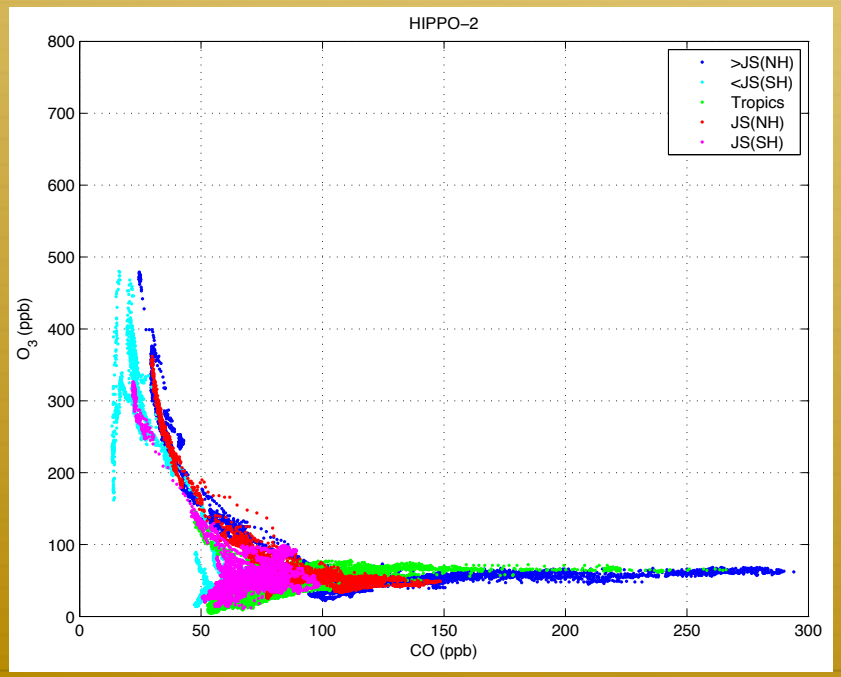


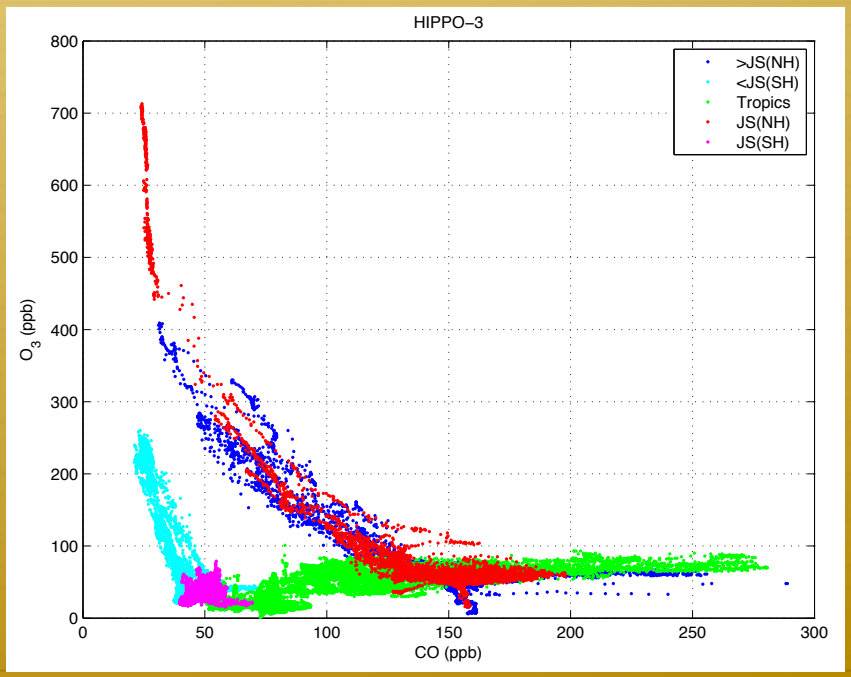
HIPPO-1

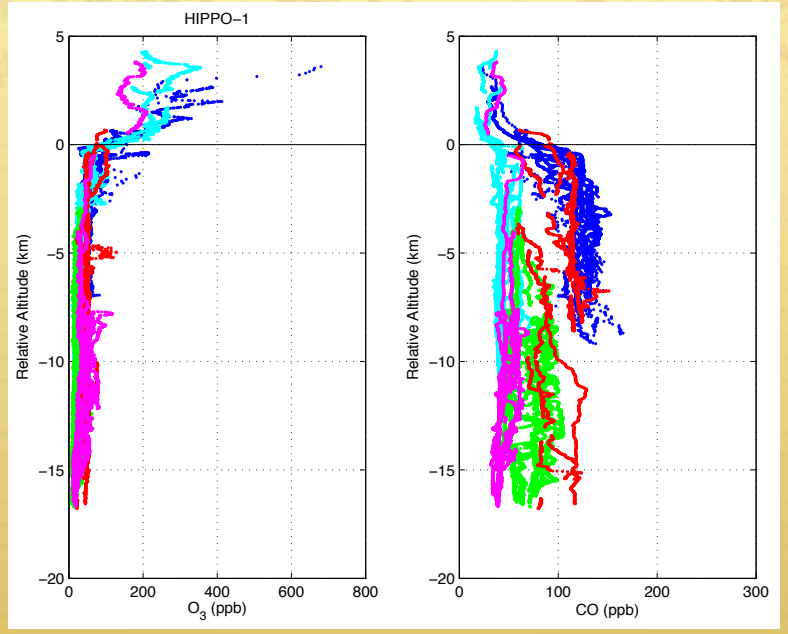
HIPPO-2

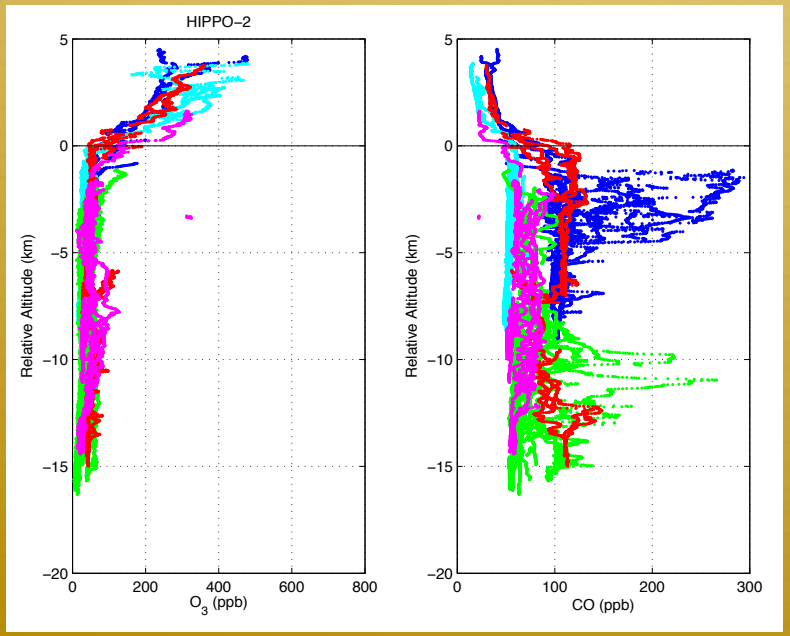
HIPPO-3

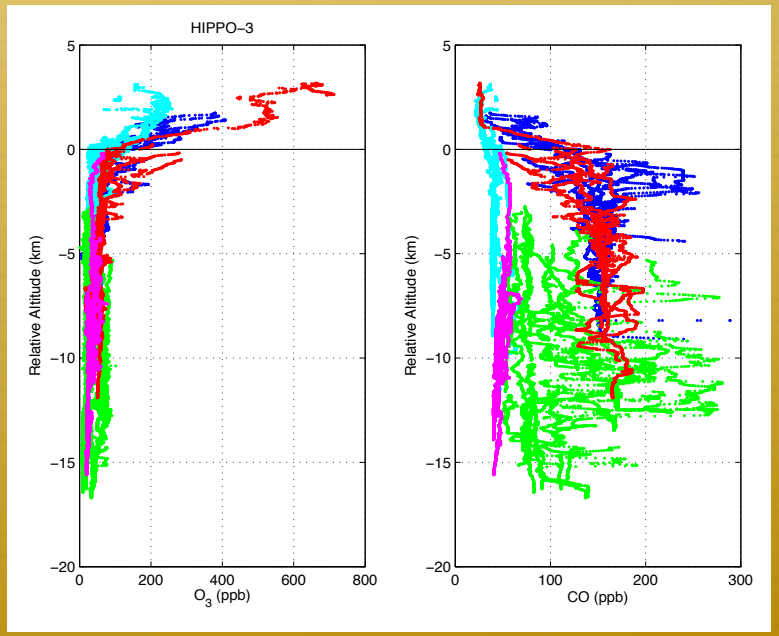

HIPPO–1
>JS(NH)
<JS(SH)
Tropics
JS(NH)
JS(SH)
O3 (ppb)
CO (ppb)
0
100
200
300
400
500
600
700
800
0
50
100
150
200
250
300


HIPPO–2
>JS(NH)
<JS(SH)
Tropics
JS(NH)
JS(SH)
O3 (ppb)
CO (ppb)
0
100
200
300
400
500
600
700
800
0
50
100
150
200
250
300


HIPPO–3
>JS(NH)
<JS(SH)
Tropics
JS(NH)
JS(SH)
O3 (ppb)
CO (ppb)
0
100
200
300
400
500
600
700
800
0
50
100
150
200
250
300


HIPPO–1
Relative Altitude (km)
O_3 (ppb)
CO (ppb)
>JS(NH)
<JS(SH)
Tropics
JS(NH)
JS(SH)


HIPPO–2
Relative Altitude (km)
O_3 (ppb)
CO (ppb)


HIPPO–3
Relative Altitude (km)
O_3 (ppb)
CO (ppb)

Summary

- Correlation residuals from O_3 / CO vertical profiles provide a tool to illustrate transport and photochemical processes during HIPPO.
- O_3 / CO anti-correlations provide evidence of stratospheric air in the UT (at higher latitudes and around the jet stream) and of boundary layer pollution.
- O_3 / CO positive correlations could be explained by in situ photochemical production, mainly found throughout the tropics.
- Seasonal variability in transport and photochemical processes is evidenced by changes in the distribution of these trace gases.