LPDM footprints, atmospheric signals, model exploration

Eric Kort et al.

Atmospheric modeling component of ORCAS

- STILT: Stochastic Time-Inverted Lagrangian Transport model
- Use wind fields (forecast, reanalysis, modeled) to drive. Release air parcels (100s – 1000s) which stochastically sample turbulence and can move forwards or backwards in time.
- Been used extensively in regional aircraft campaigns & quantifying fluxes (over land)
- Key feature: links atmospheric observation with upwind sources/sinks

How will this be used for ORCAS

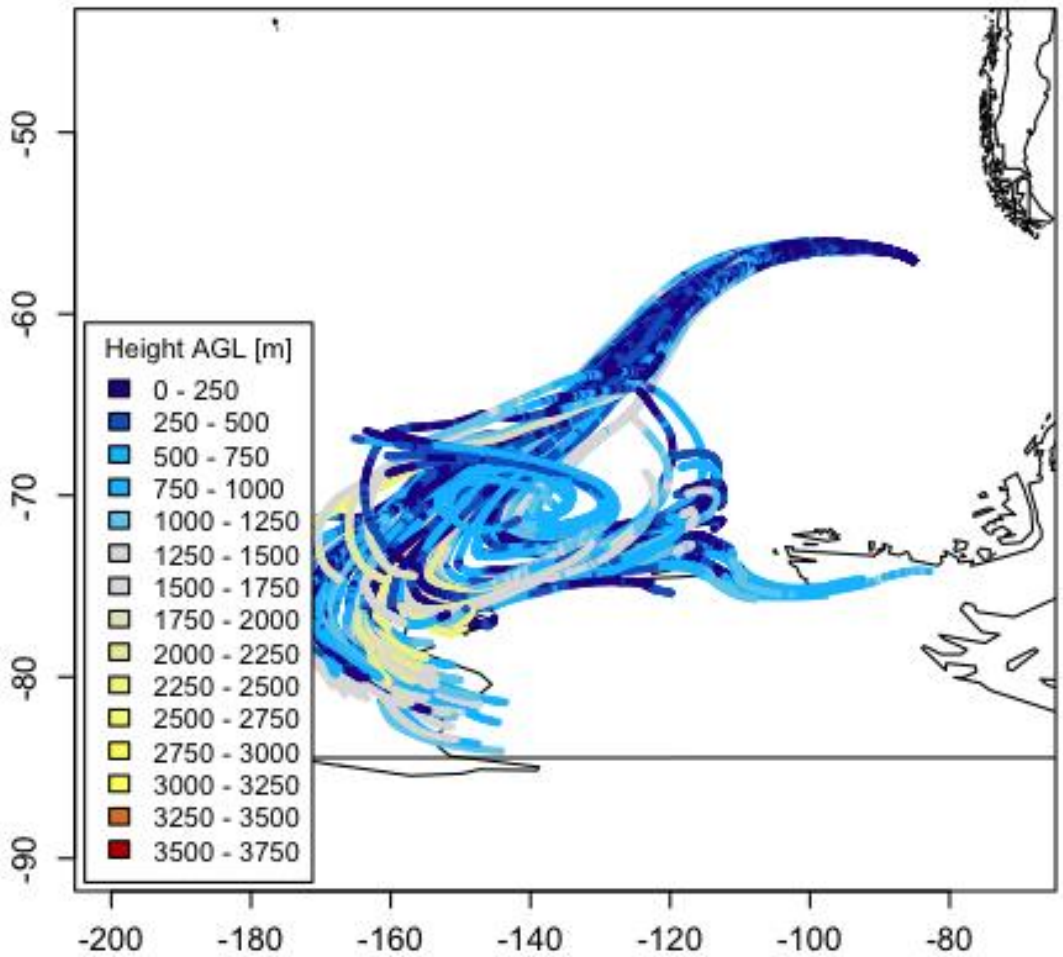
- 2 Modes
  - Flight Planning, possibilities
    - Lagrangian Flight strategies
    - Determine Air Origin/surface regions of influence
    - Predict Location of specific events
  - Post-mission analysis
    - Link observations with Fluxes (and Flux drivers)

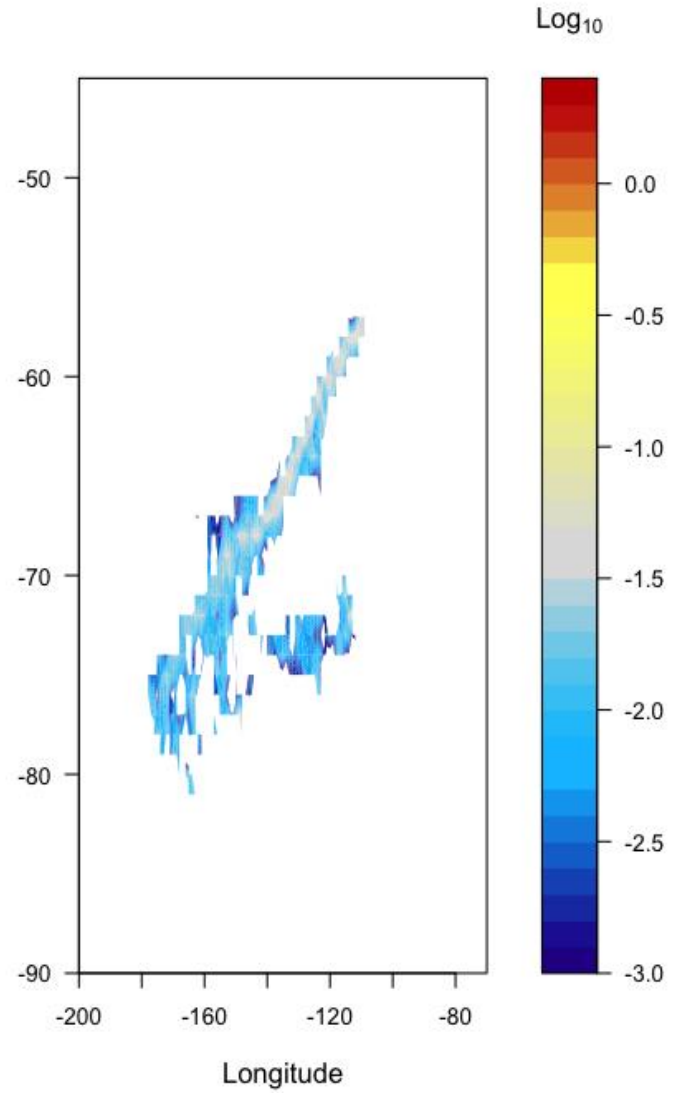
Differences from Land

- No topography
- Higher winds

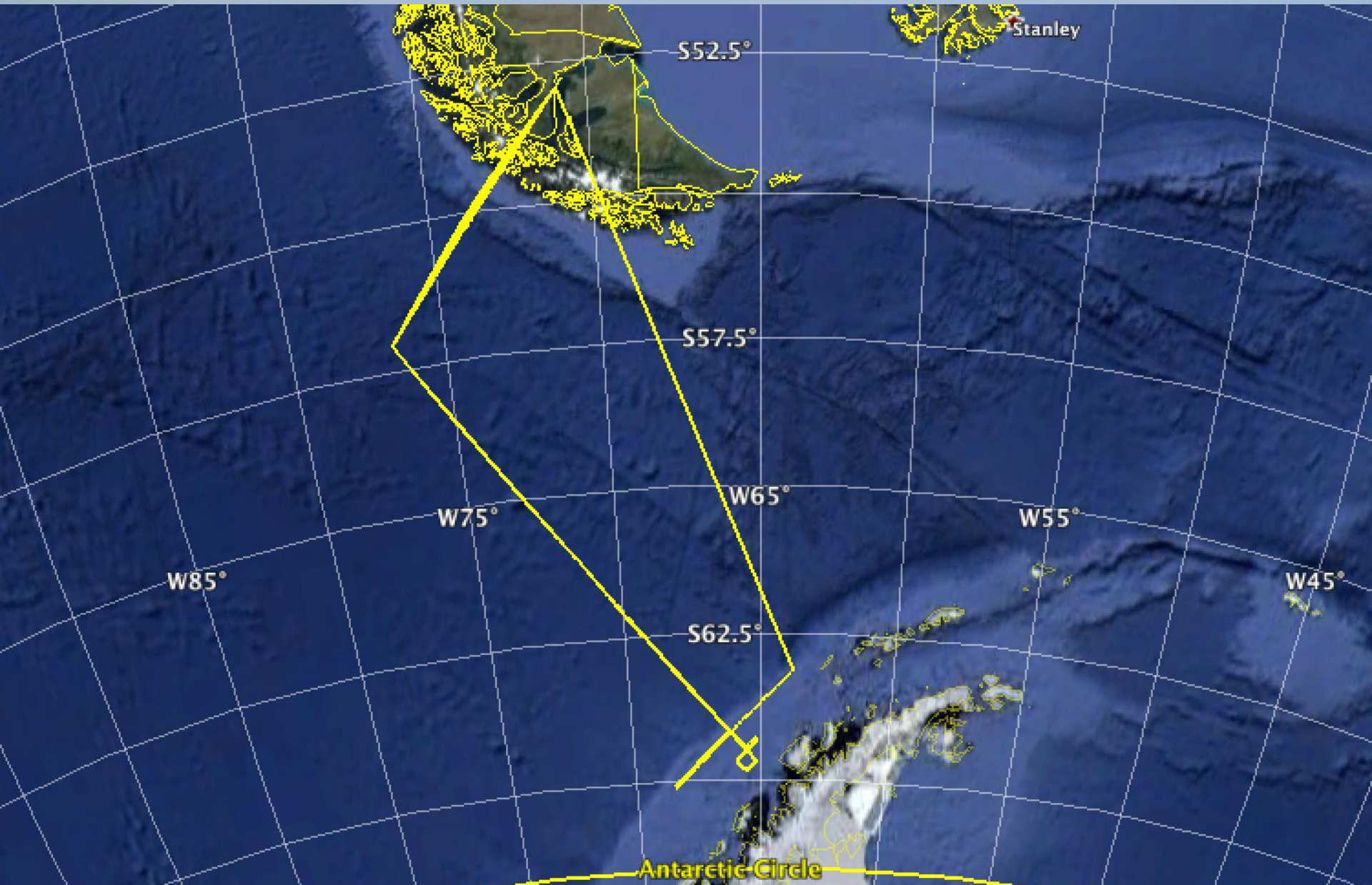
- Regions of interest/influence less well defined

Determining air origin

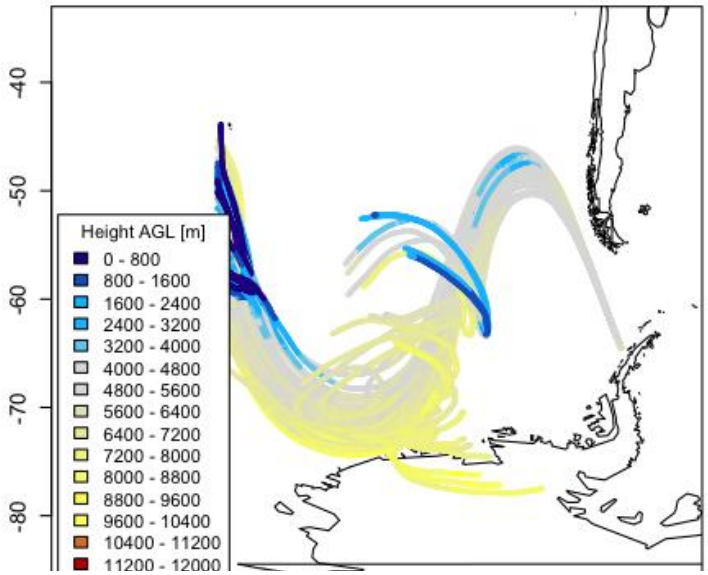


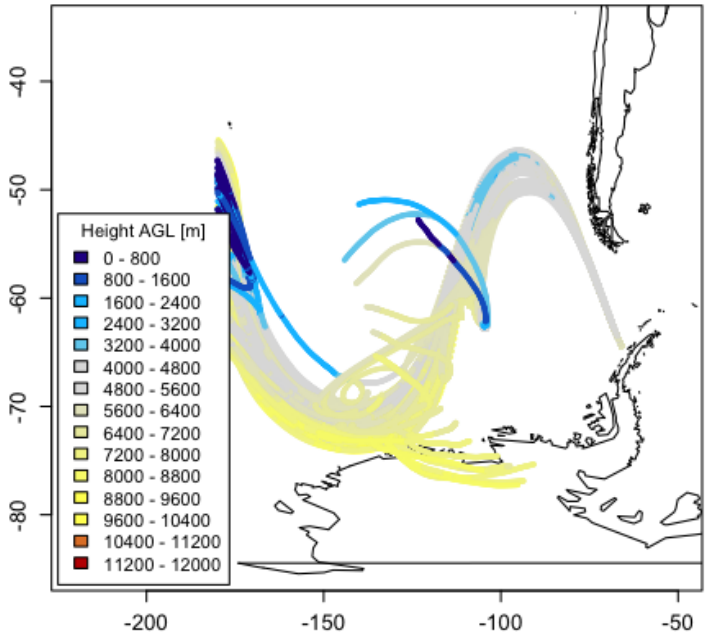


Peninusla Downwind Flight



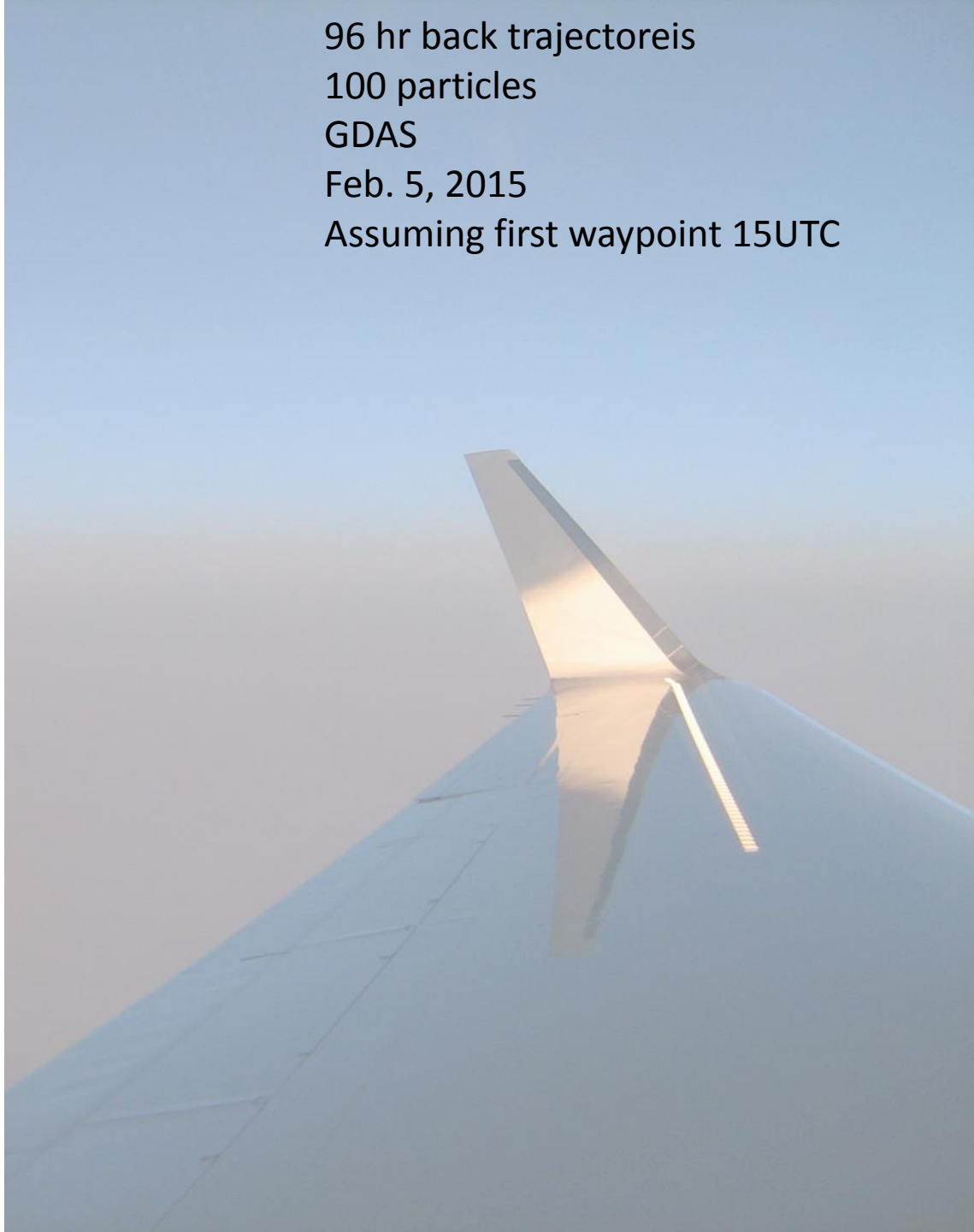
6096m



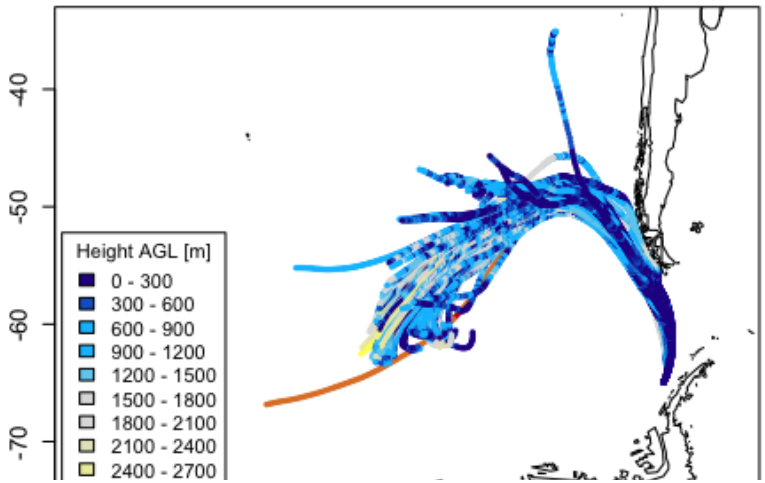


Harvard University

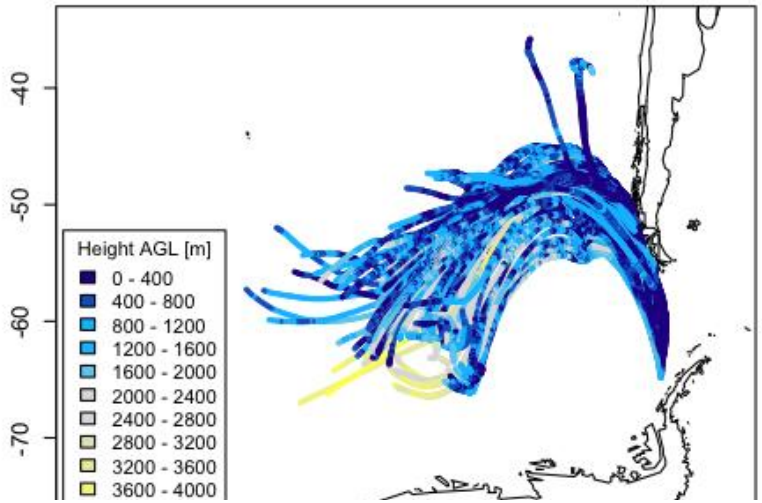
96 hr back trajectoreis
100 particles
GDAS
Feb. 5, 2015
Assuming first waypoint 15UTC

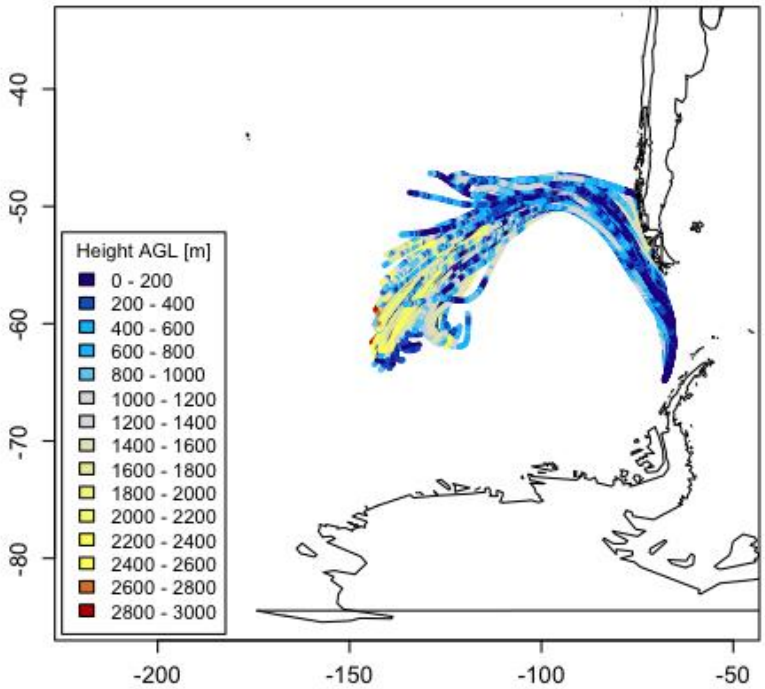


152 m



1524 m





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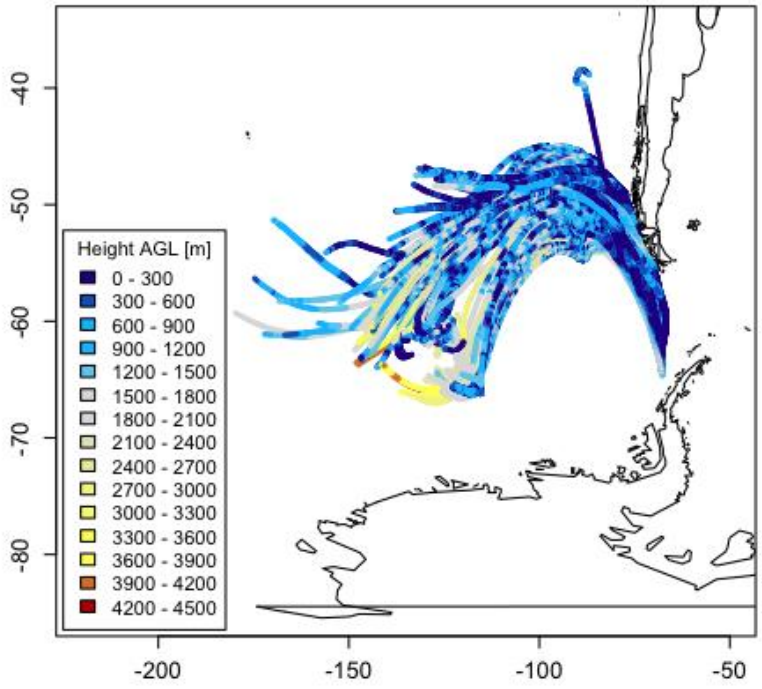

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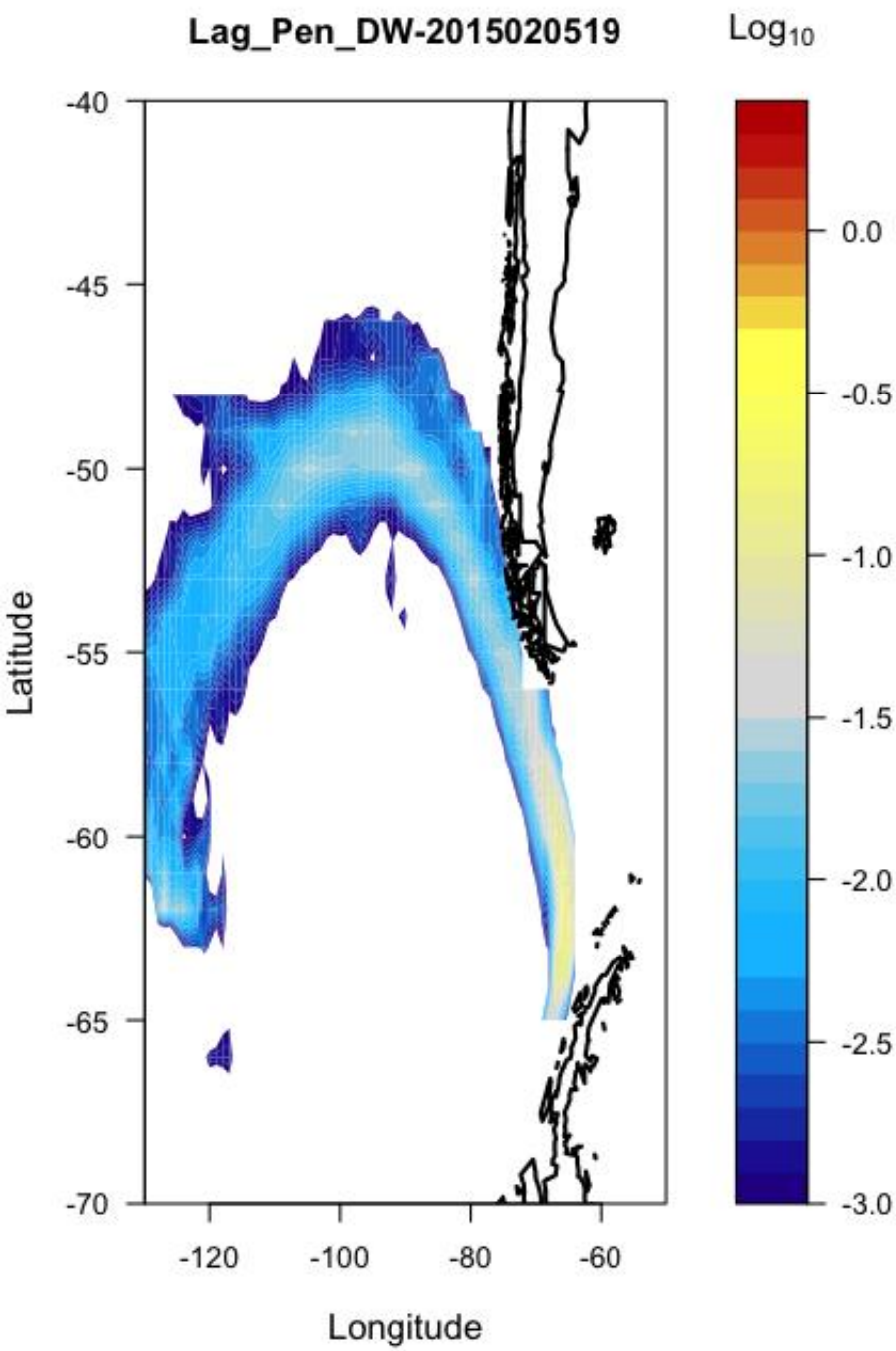
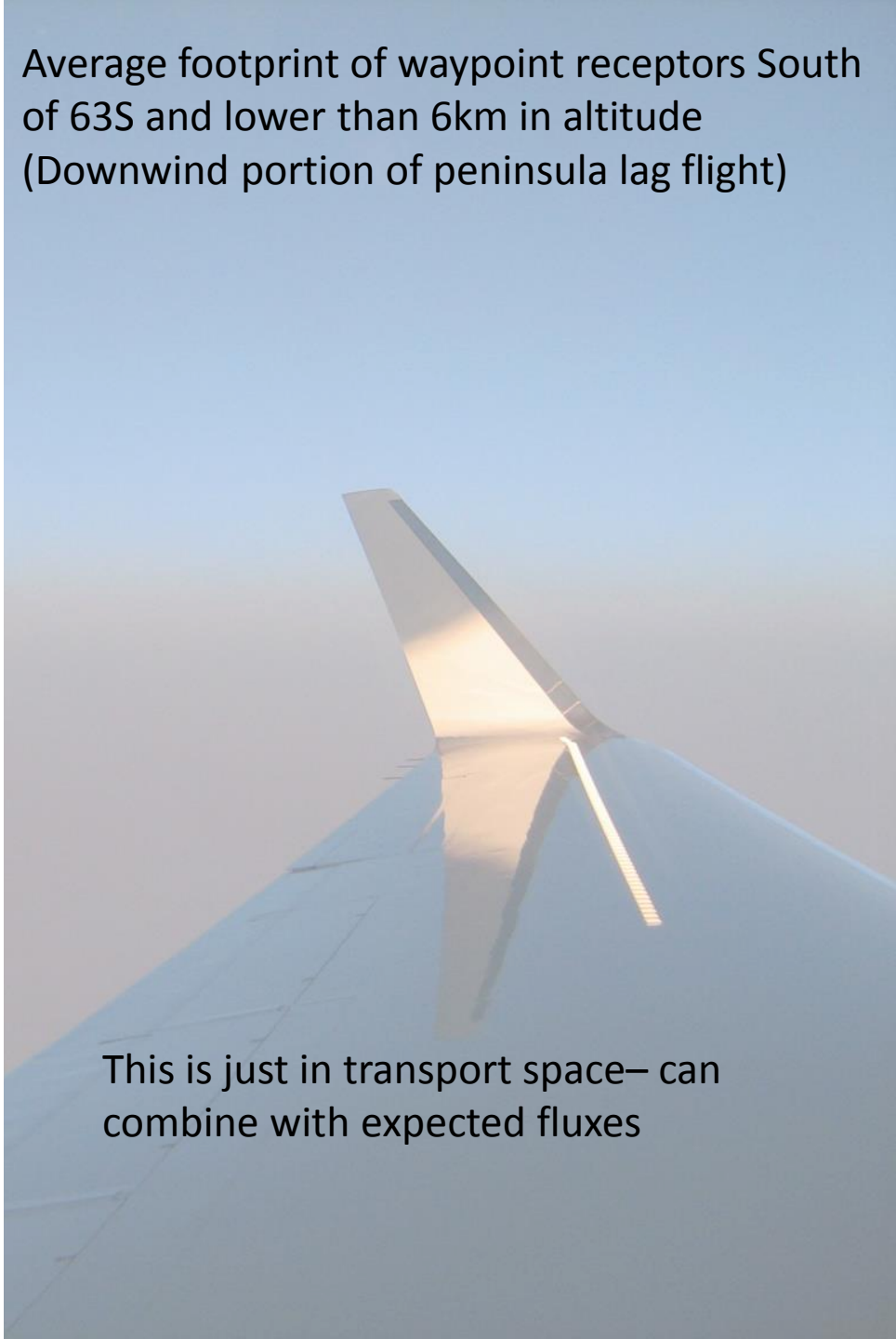
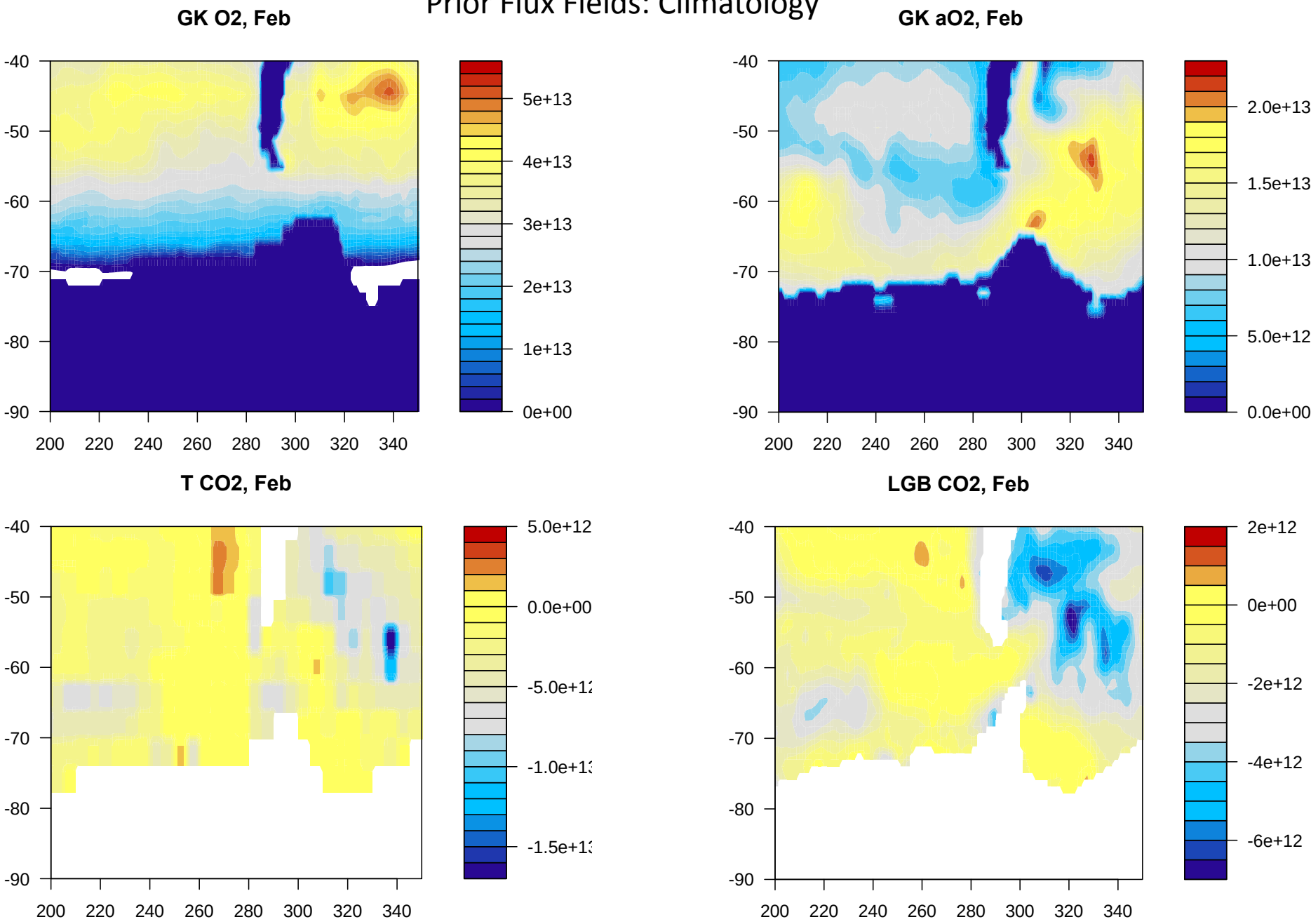


Average footprint of waypoint receptors South of 63S and lower than 6km in altitude (Downwind portion of peninsula lag flight)



This is just in transport space– can combine with expected fluxes

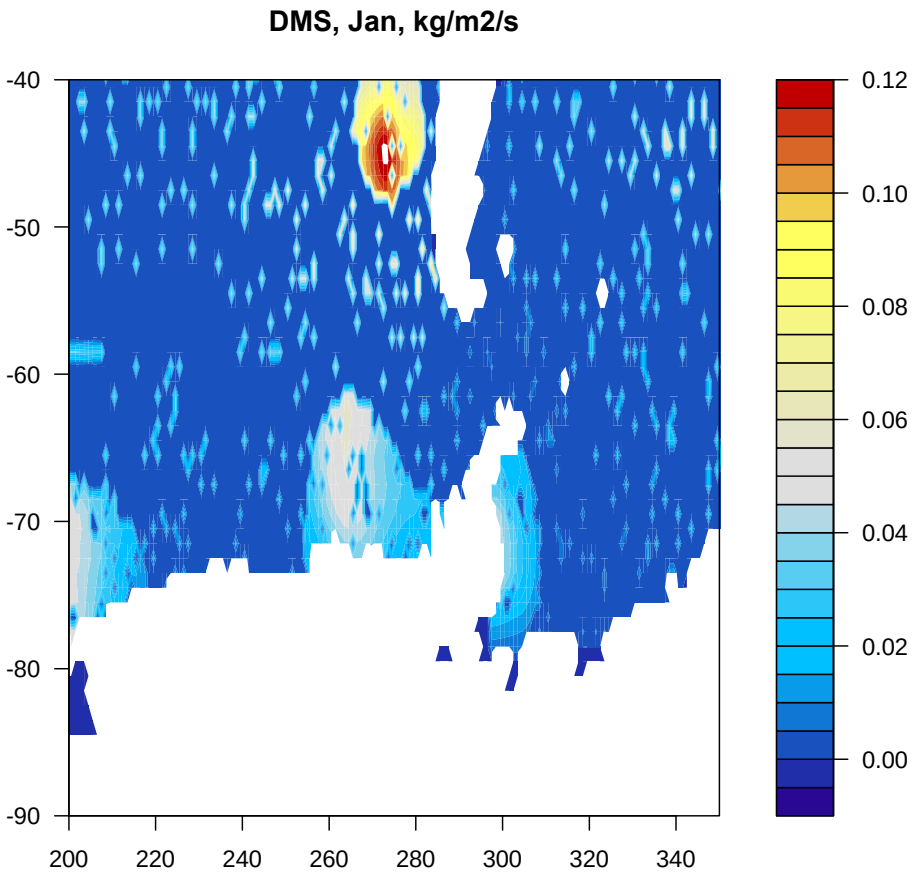
Prior Flux Fields: Climatology

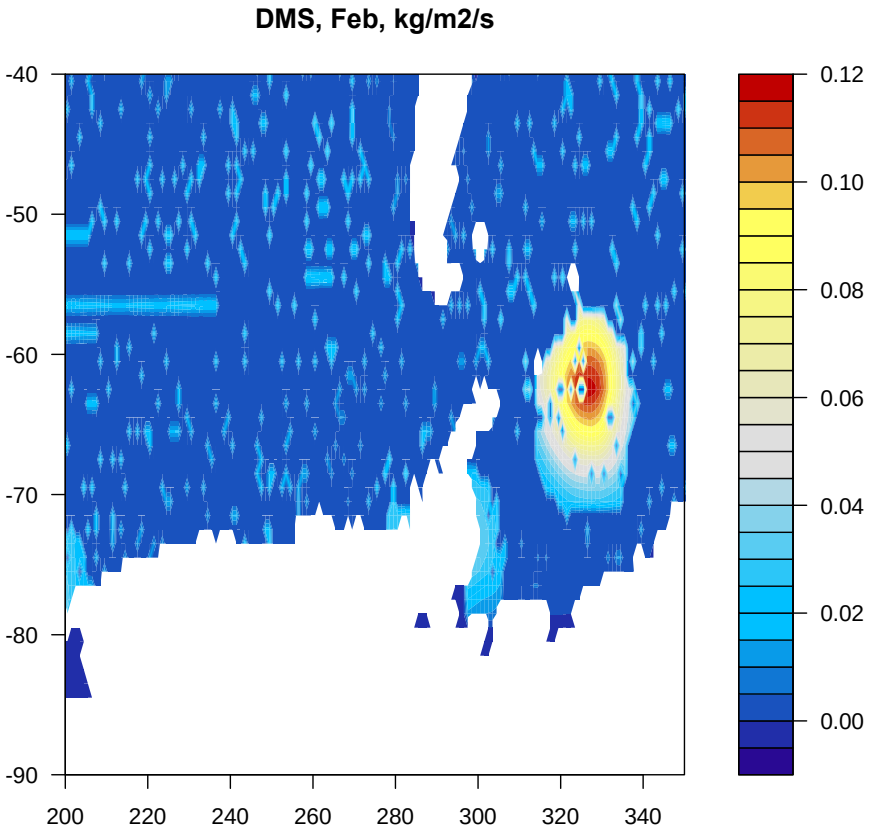


Prior Flux Fields: Climatology

DMS

Lifetime ~days

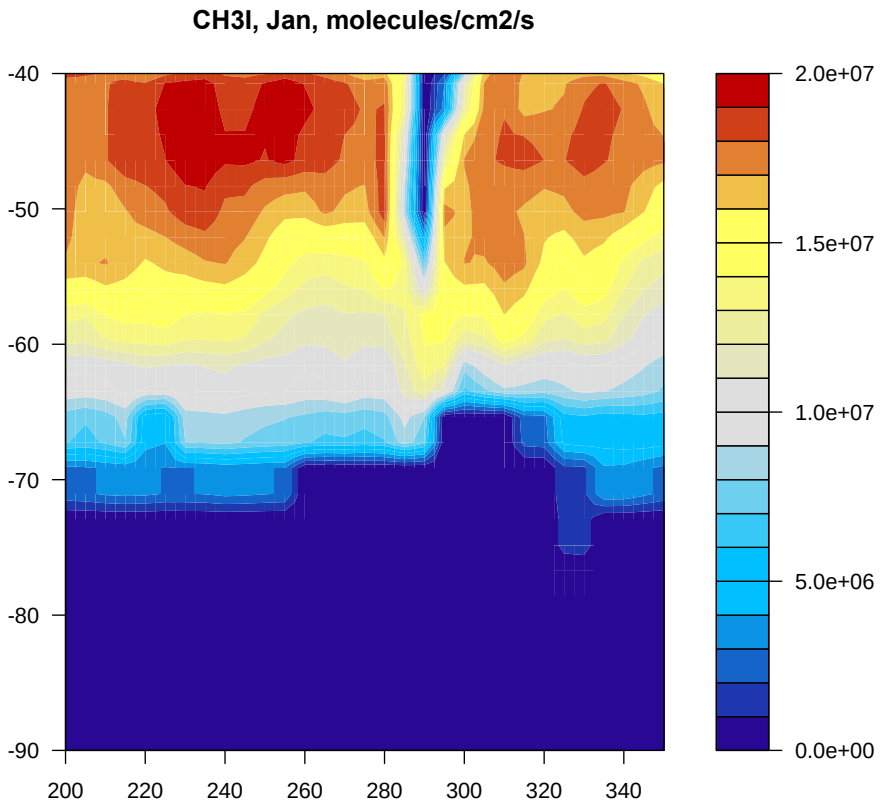


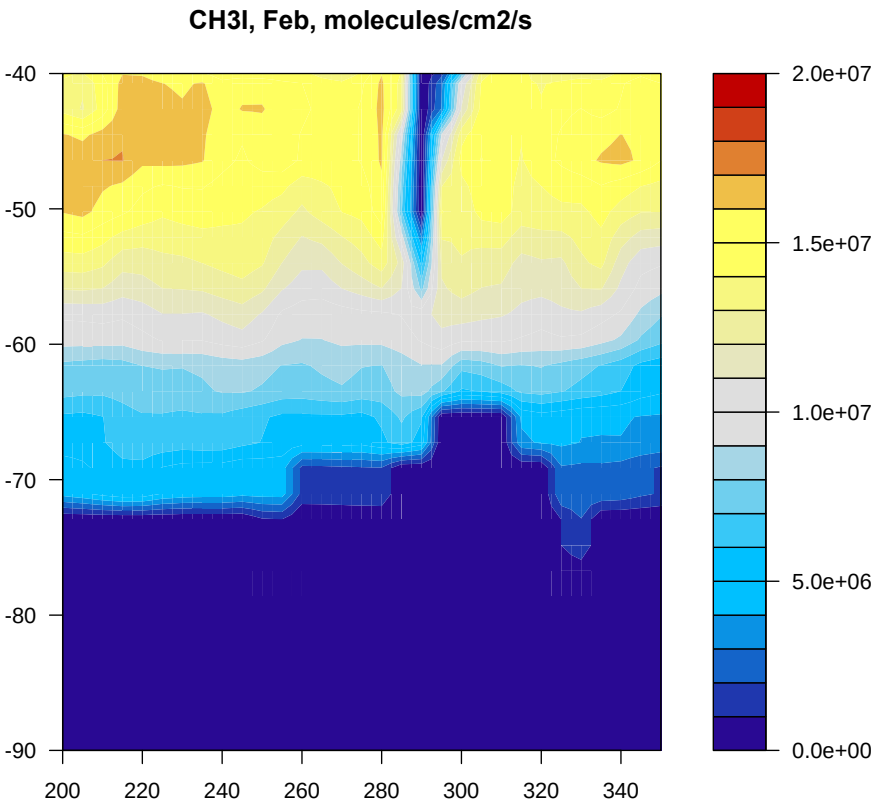


Prior Flux Fields: Climatology

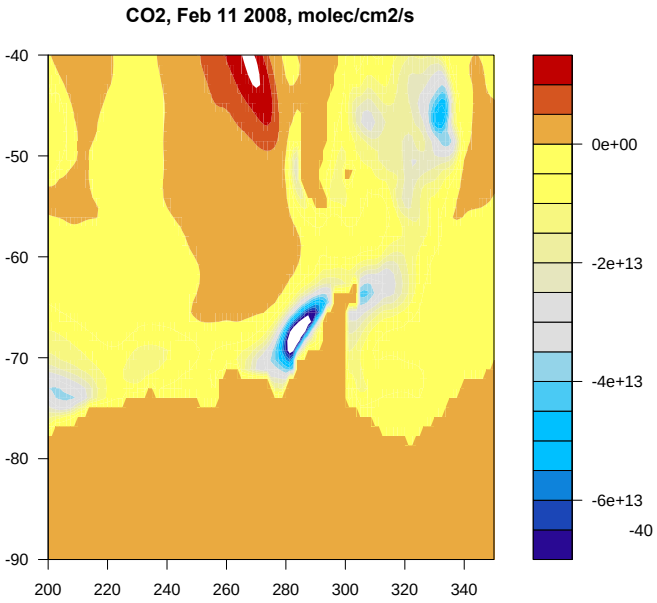
Methyl Iodide

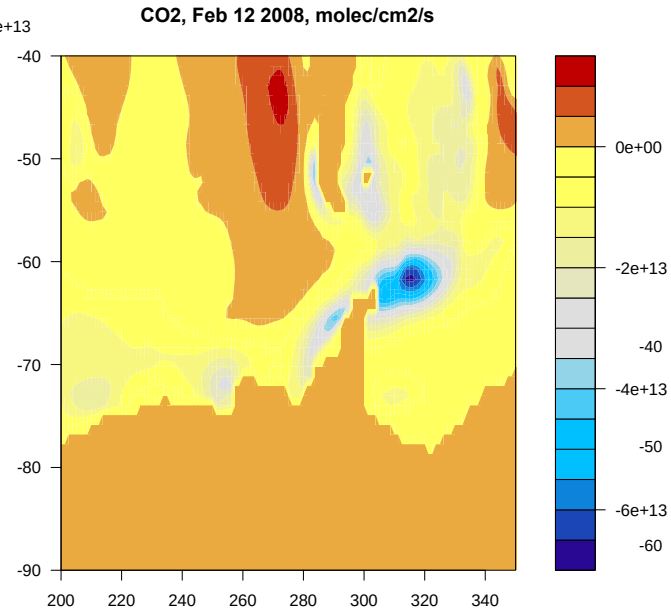
Lifetime ~days

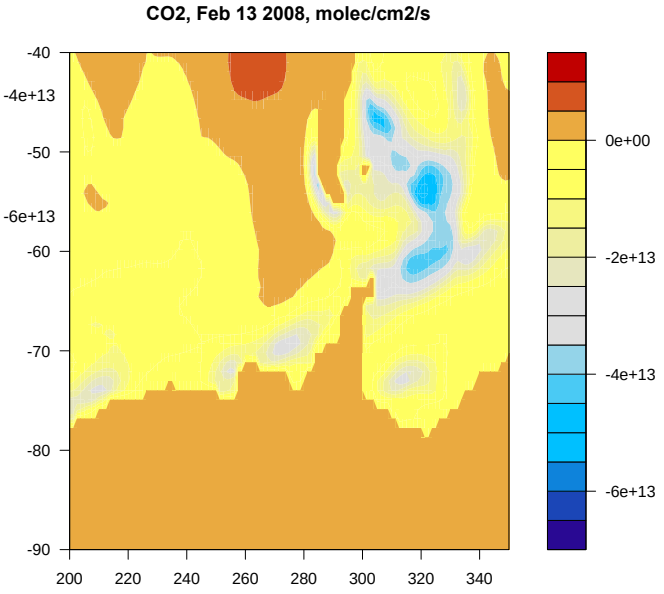




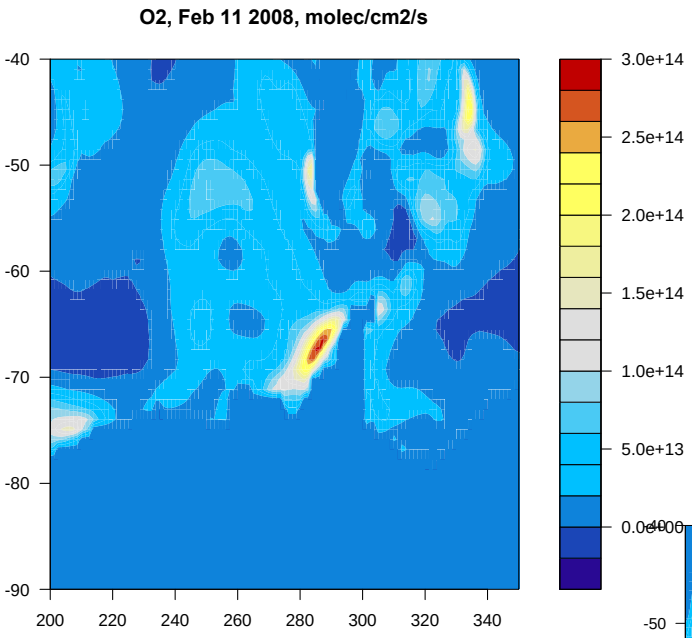
Prior Flux Fields: CESM daily model

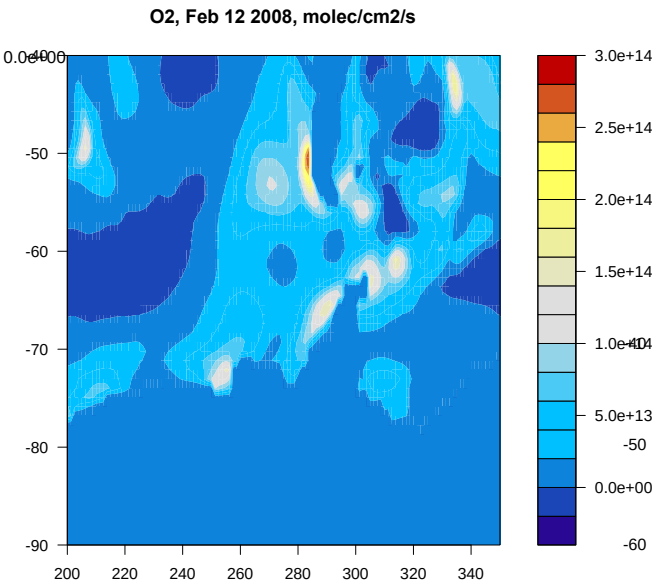


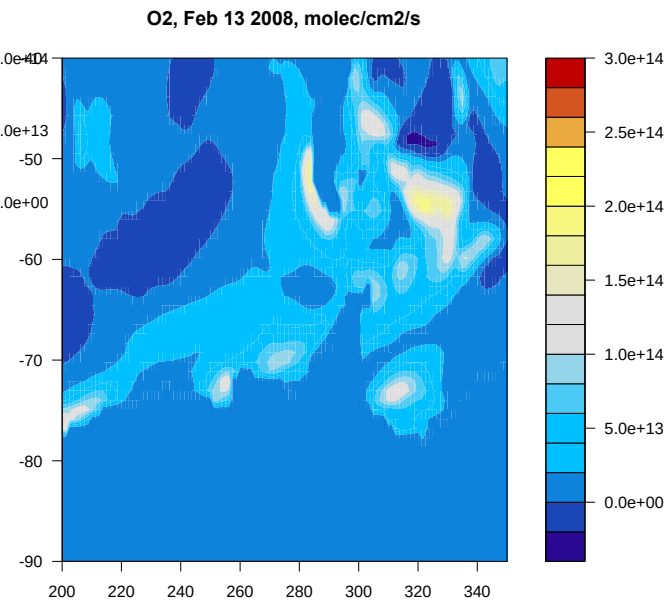


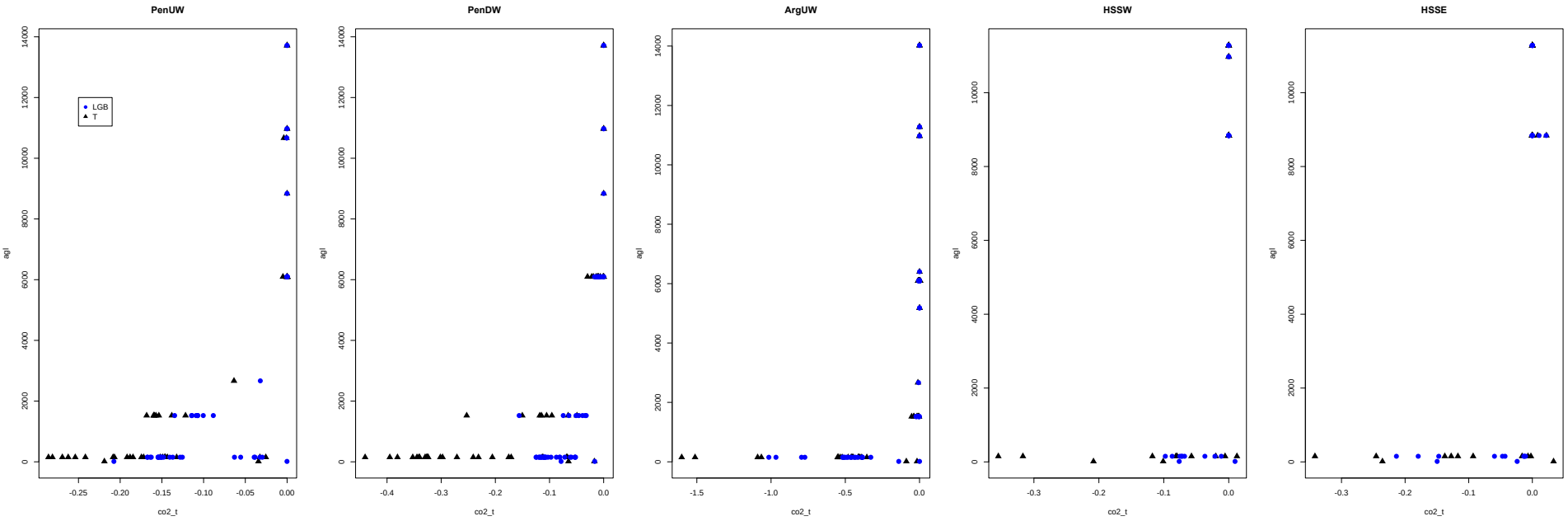


Prior Flux Fields: CESM daily model





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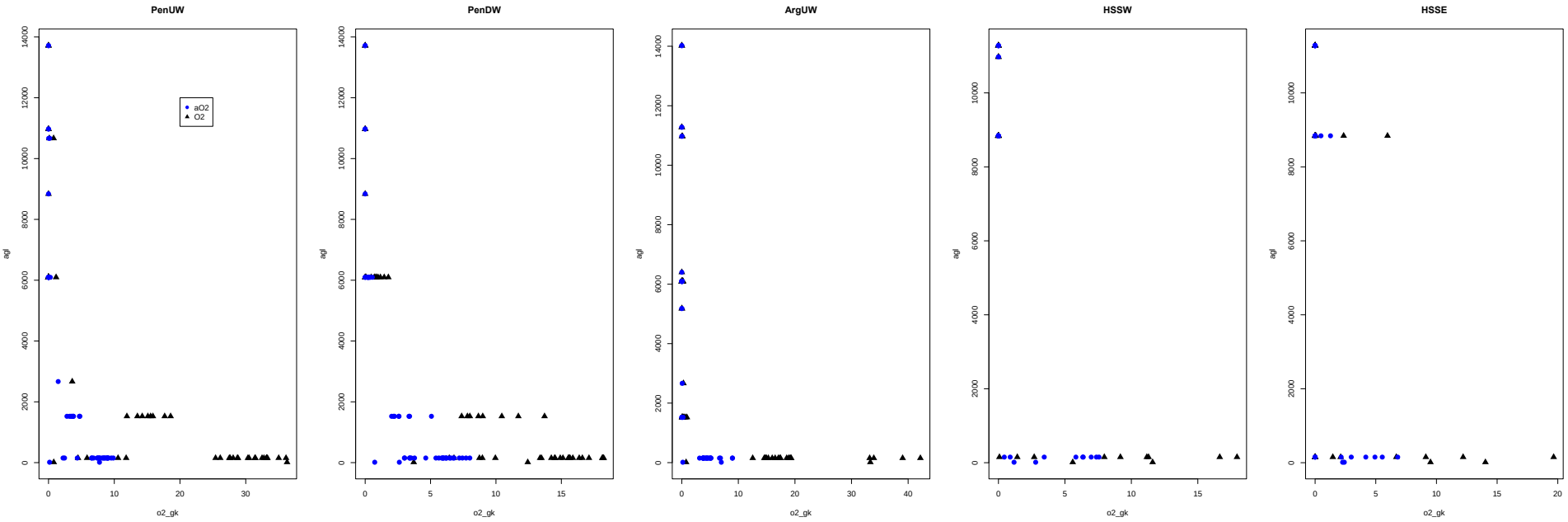
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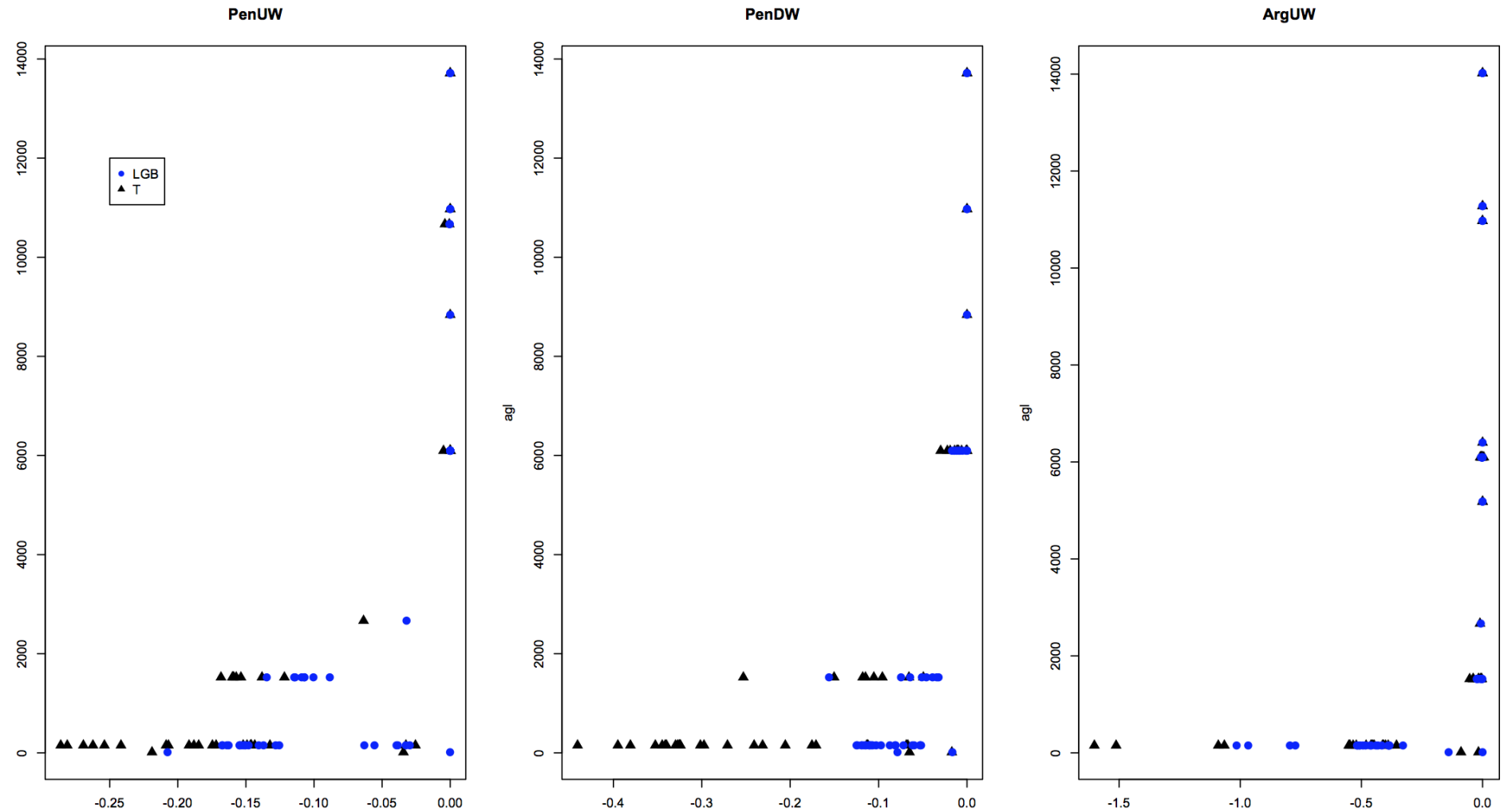
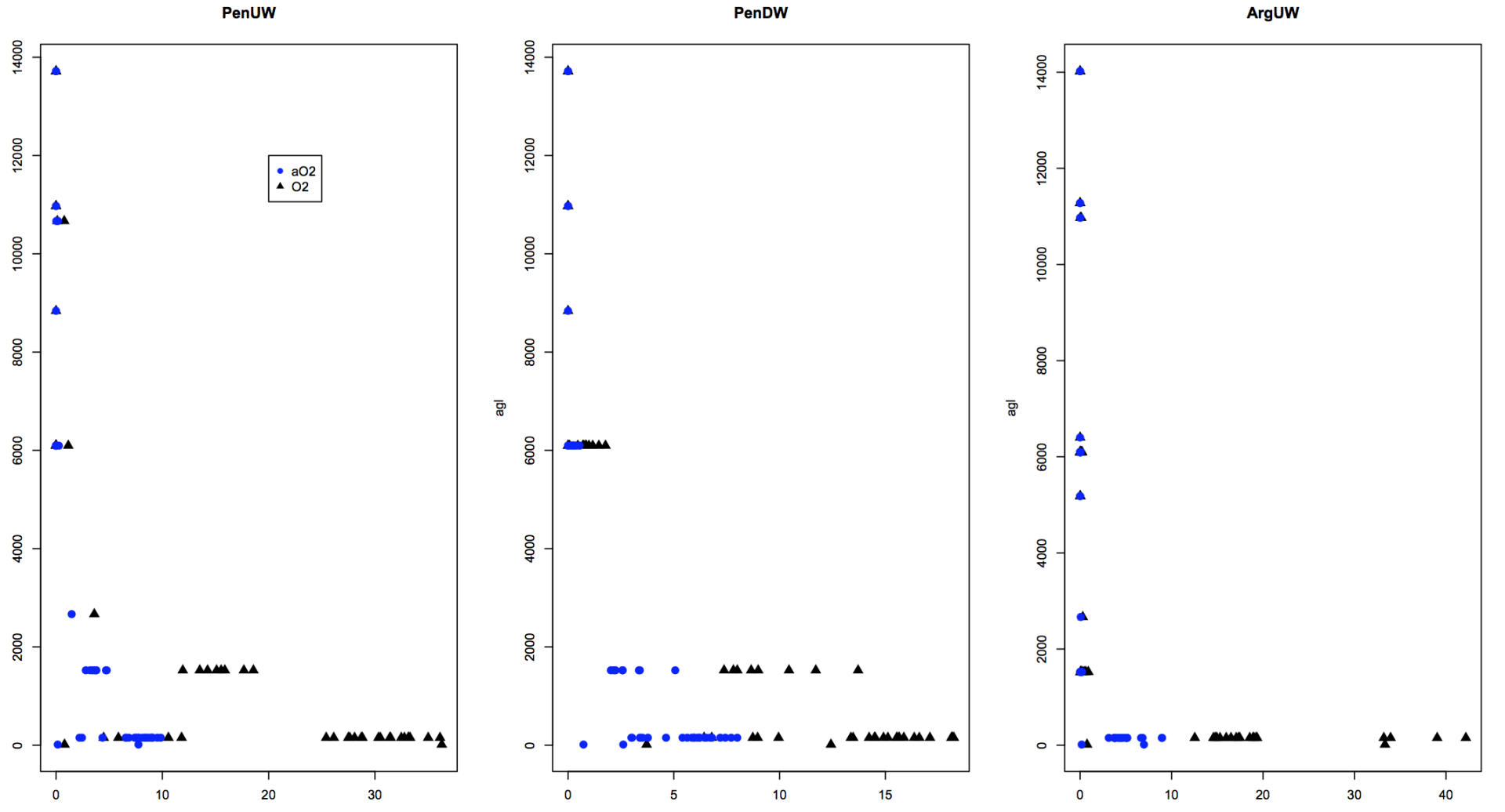
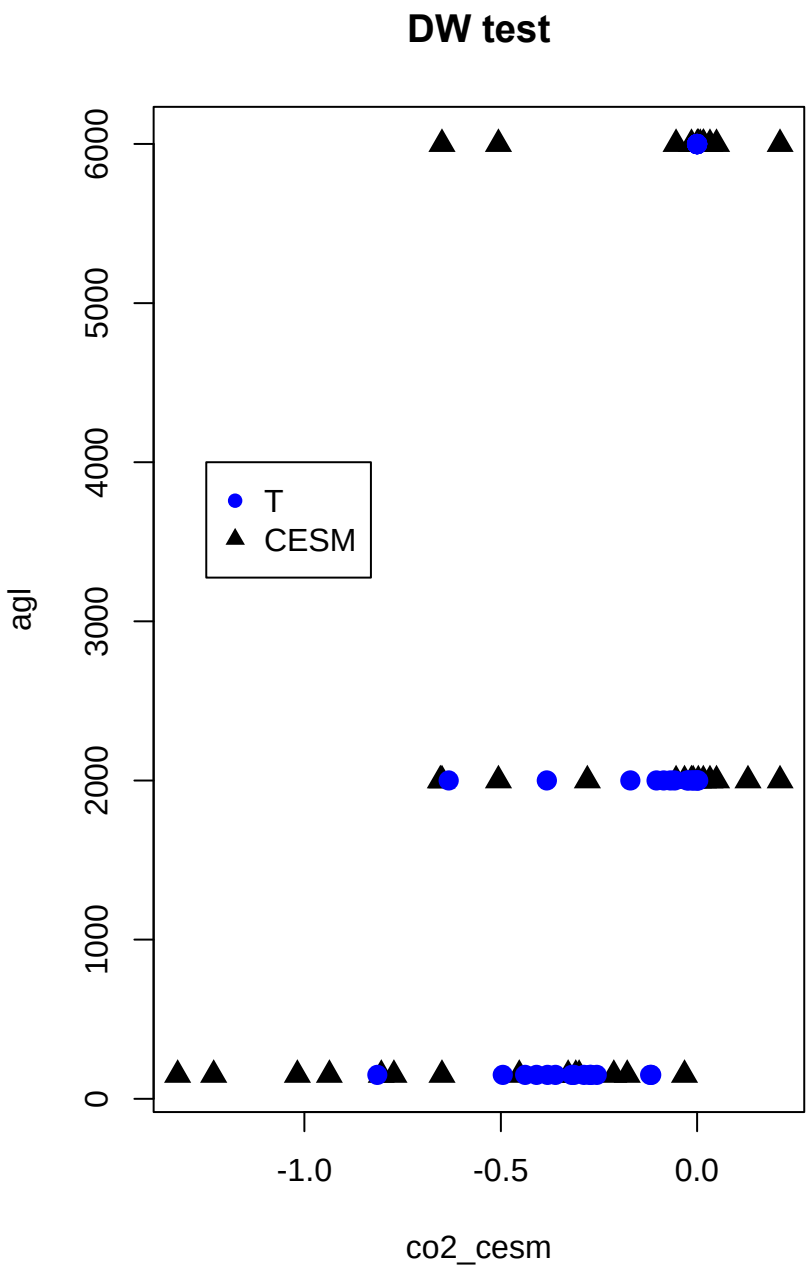
CO2 vertical profiles for sample flights



O2 vertical profiles for sample flights

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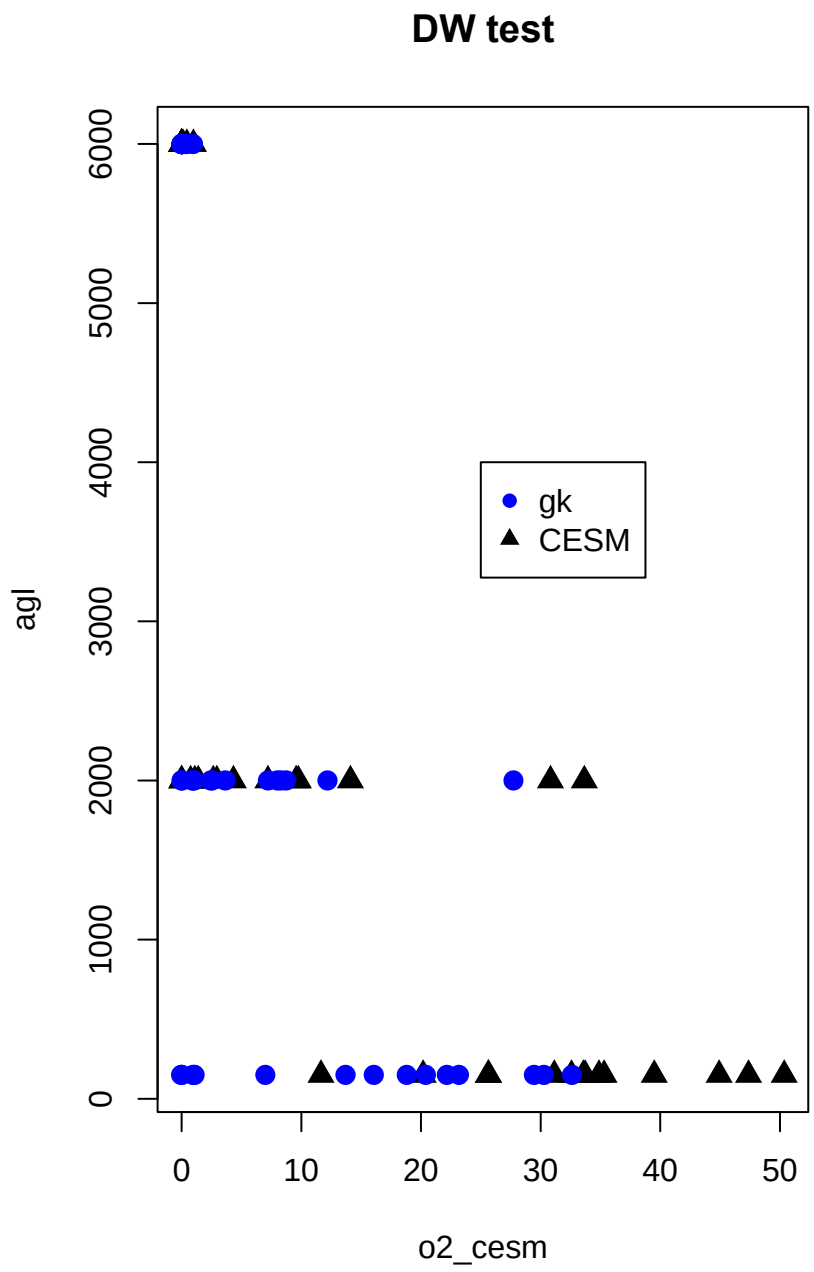
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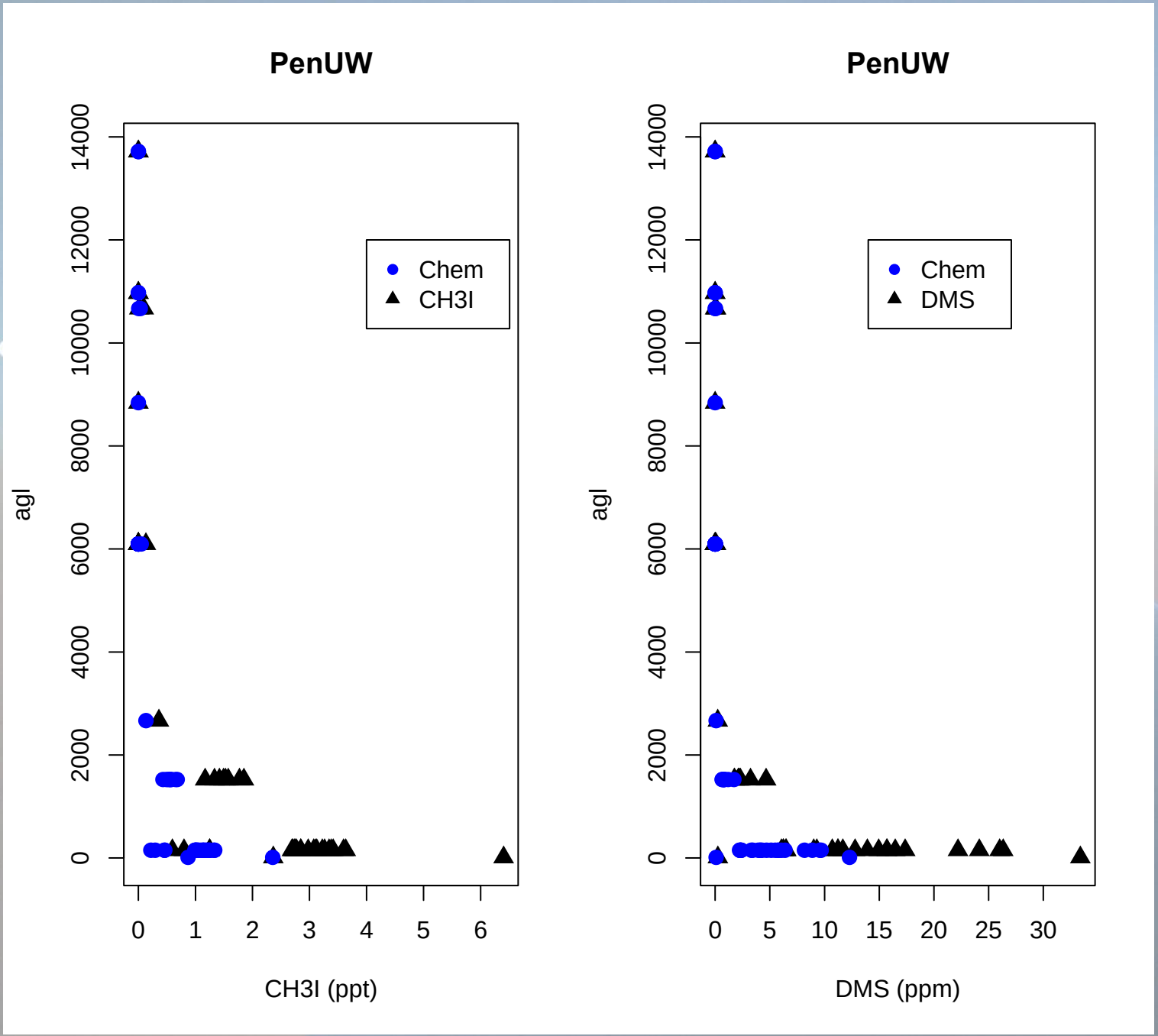
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8000
10000
12000
14000
Chem
CH3I
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1
2
3
4
5
6
CH3I (ppt)
PenUW
agl
0
2000
4000
6000
8000
10000
12000
14000
Chem
DMS
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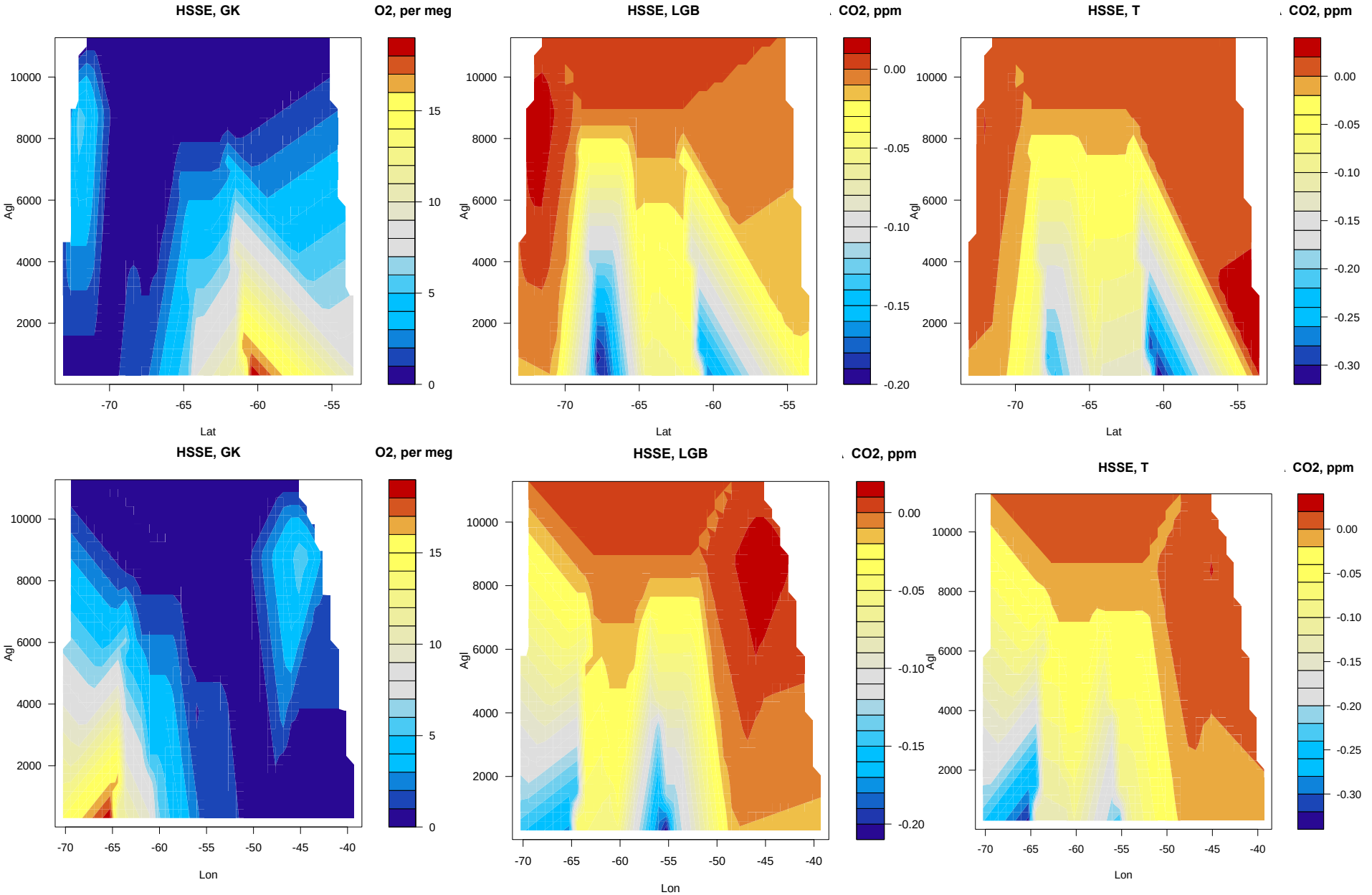
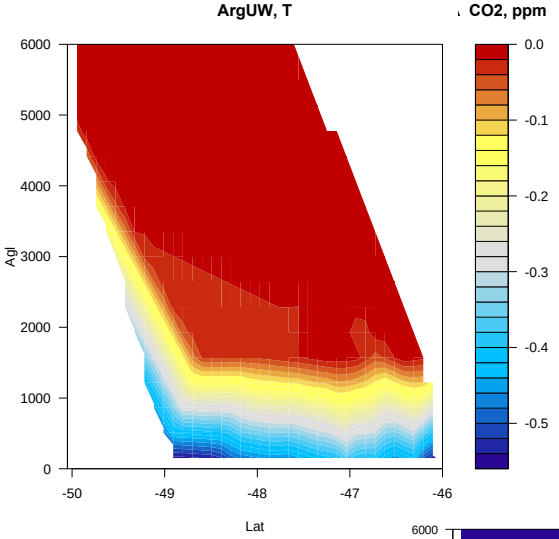
5
10
15
20
25
30
DMS (ppm)

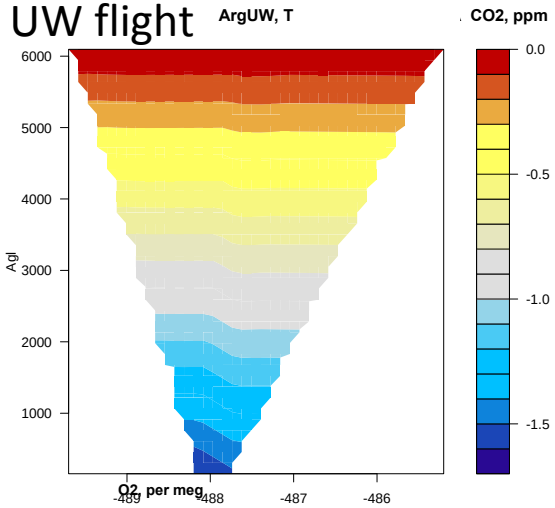
X-sections from sample flights

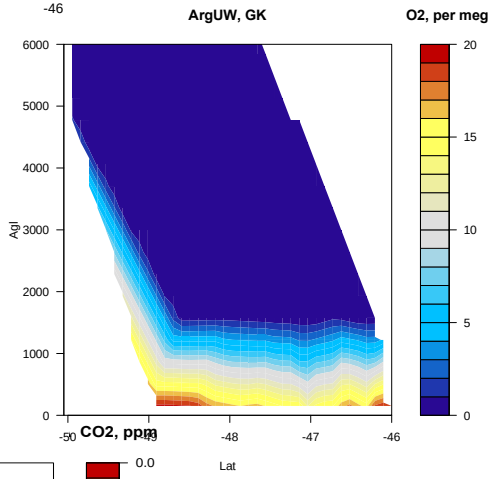


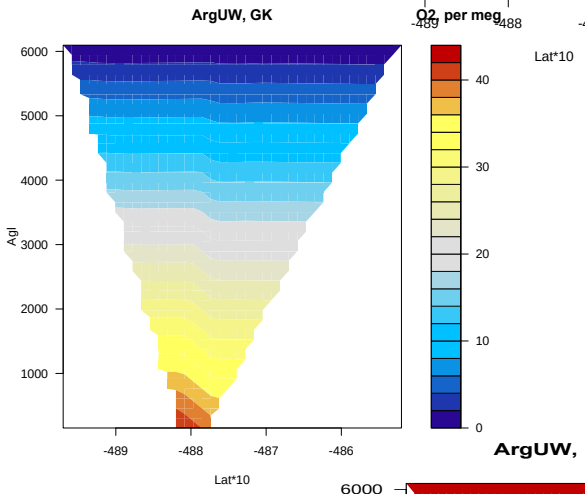
“downwind” leg from UW flight

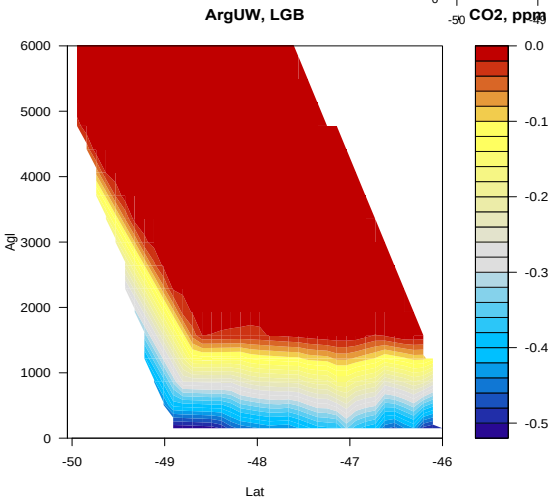
“upwind”

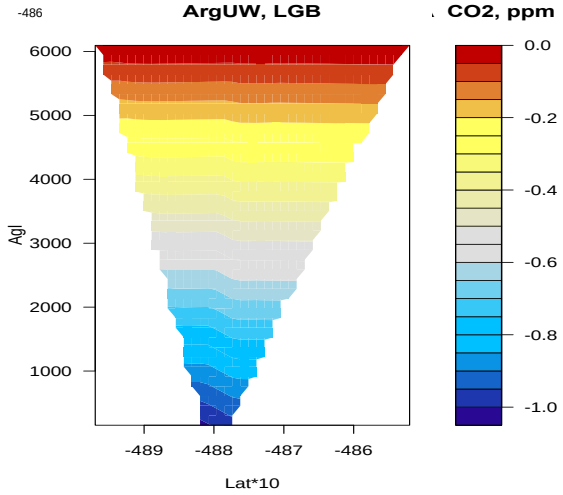




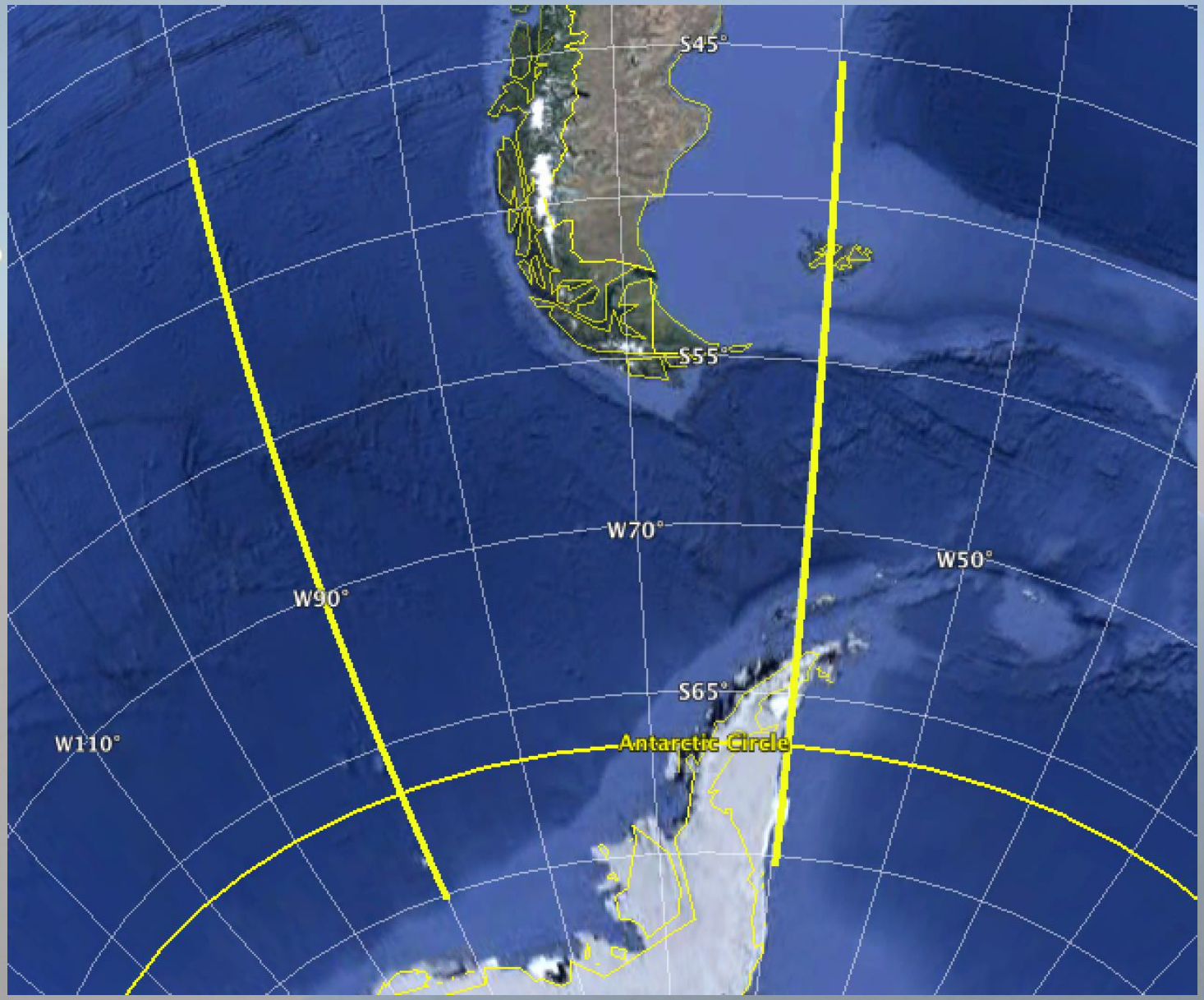


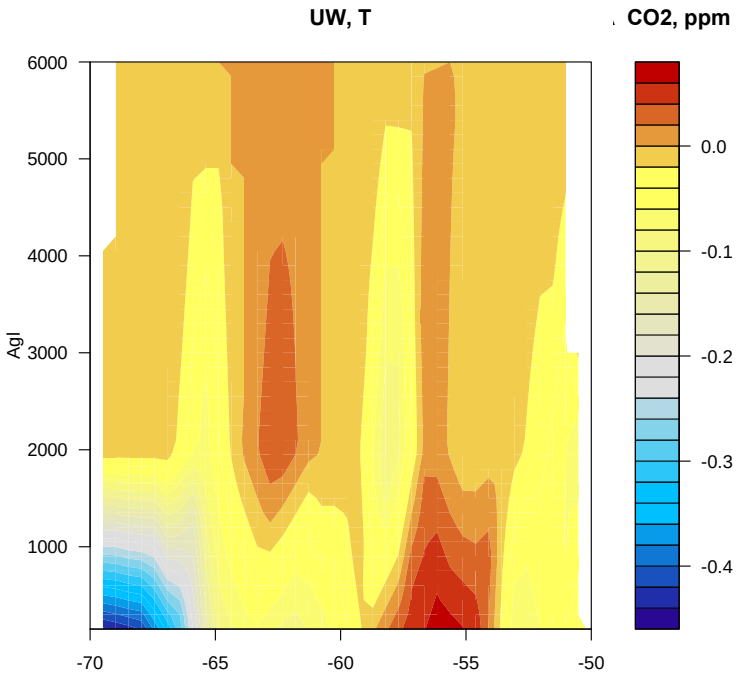






Sample upwind/downwind of Drake Passage. (along –90 and -60)

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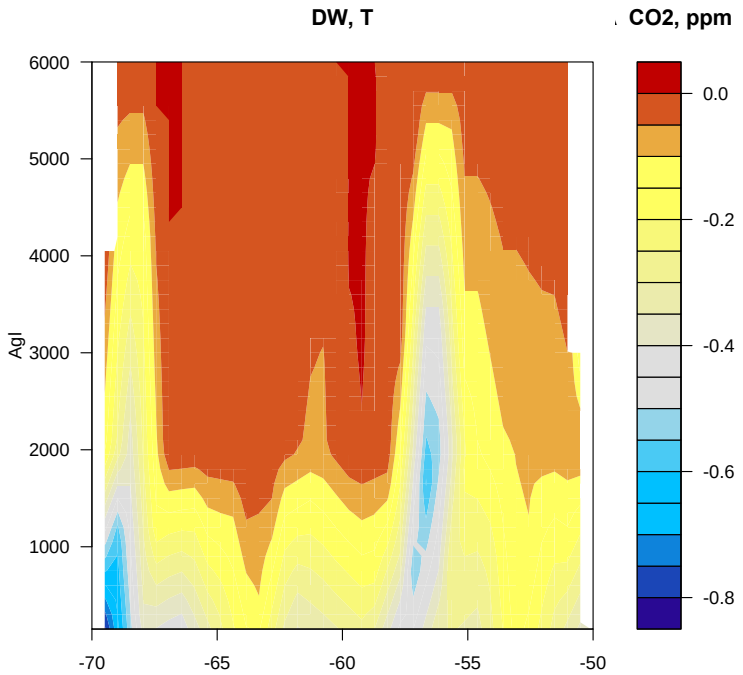
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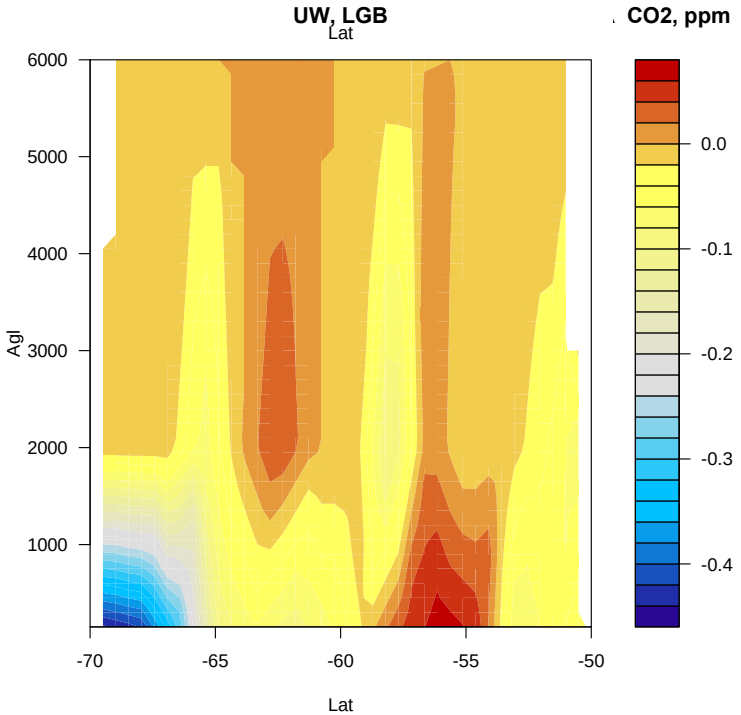
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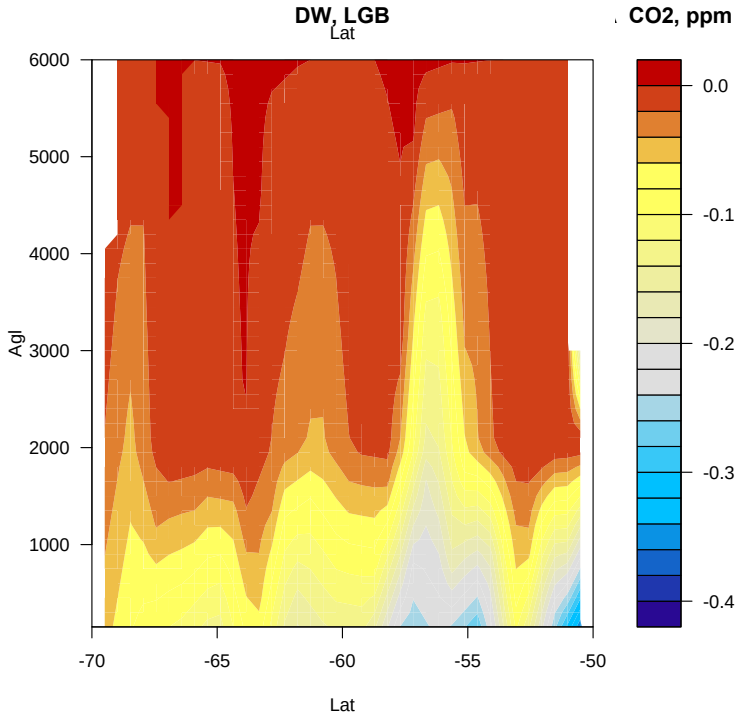
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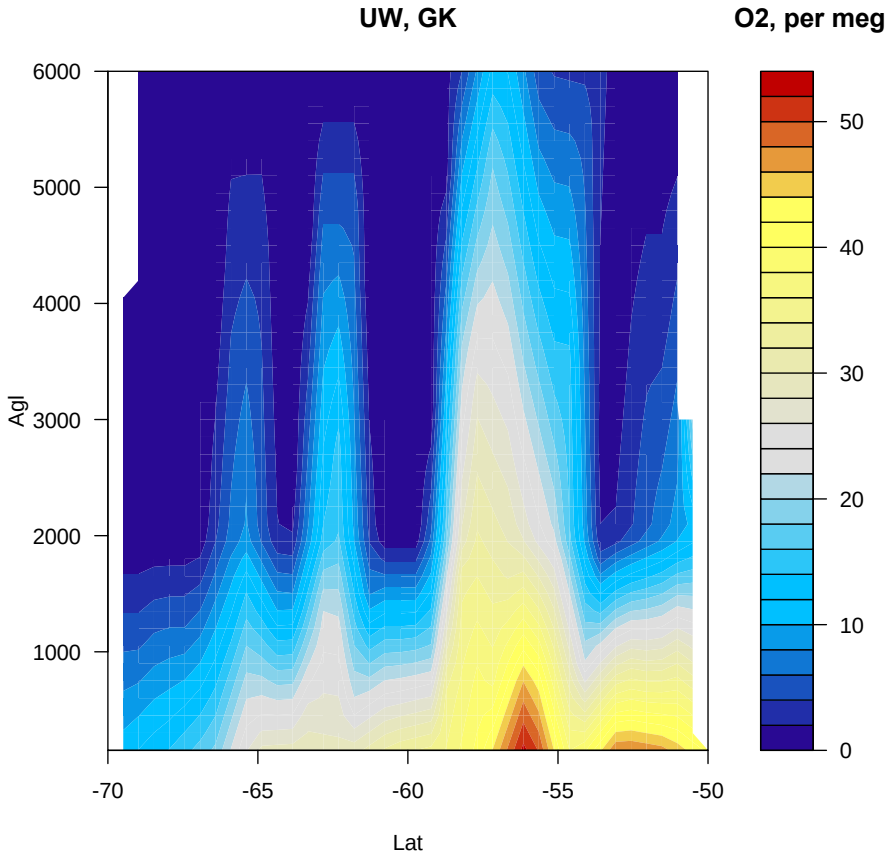
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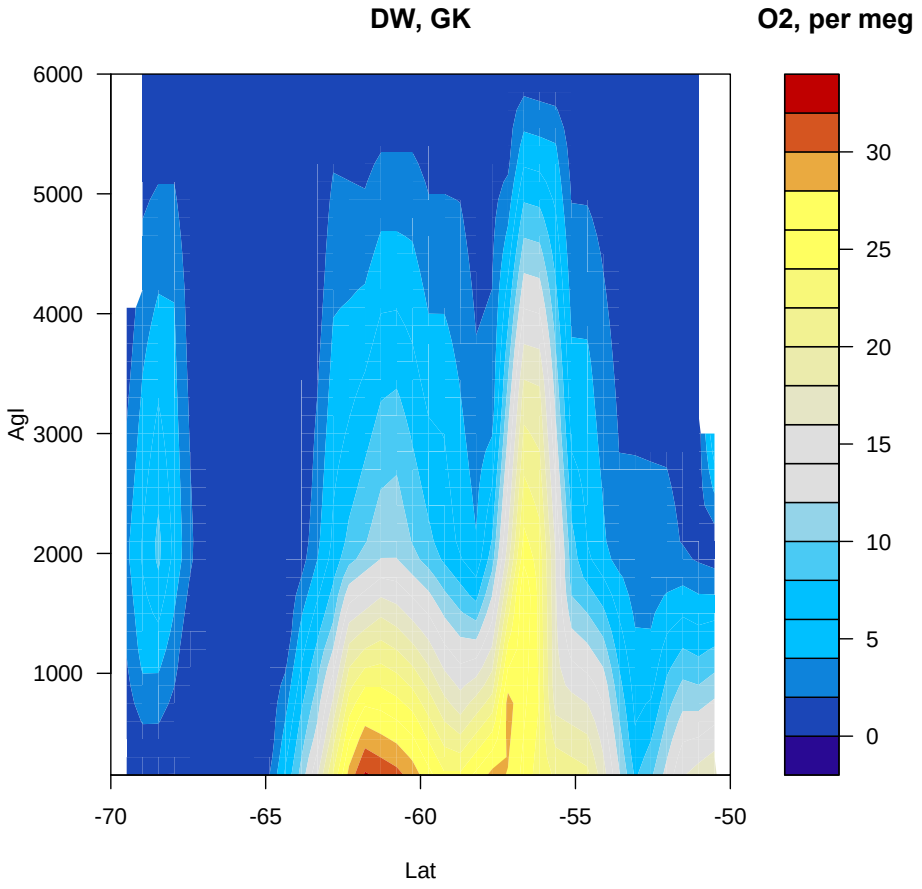
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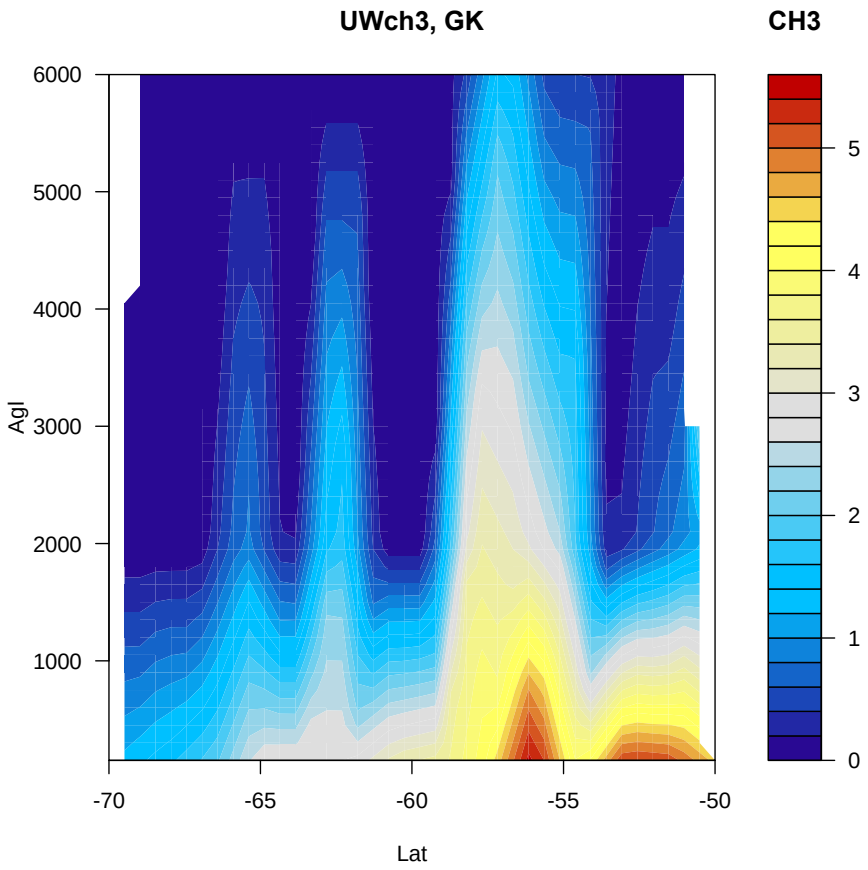
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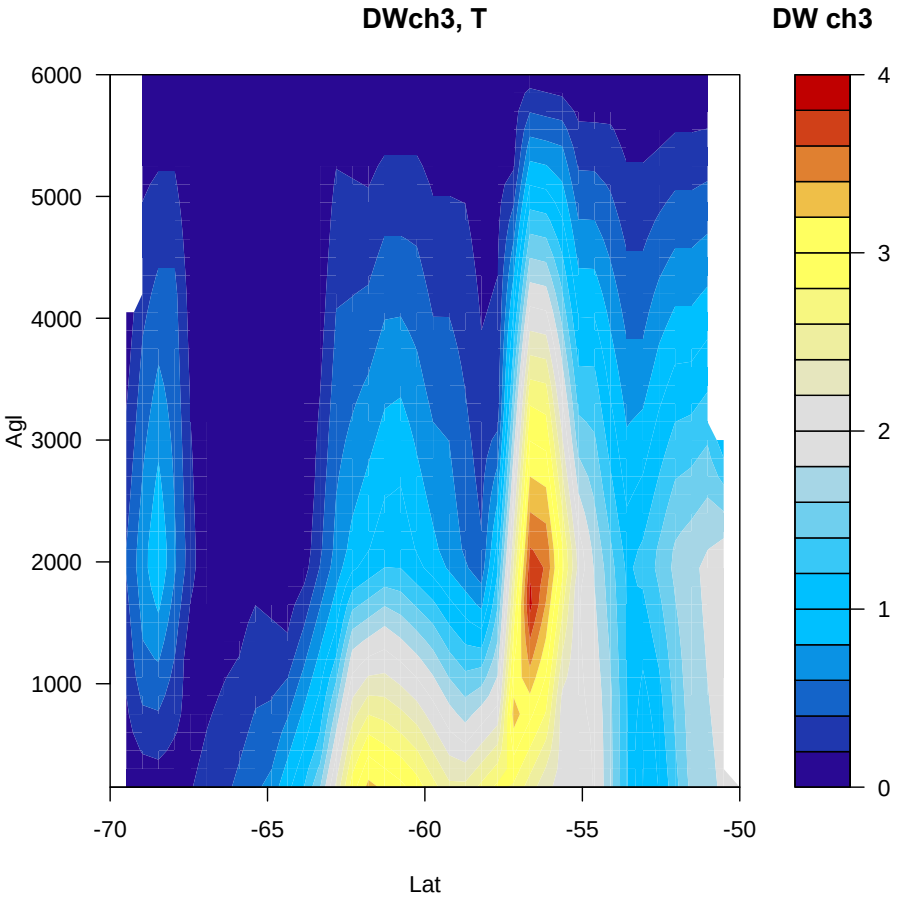
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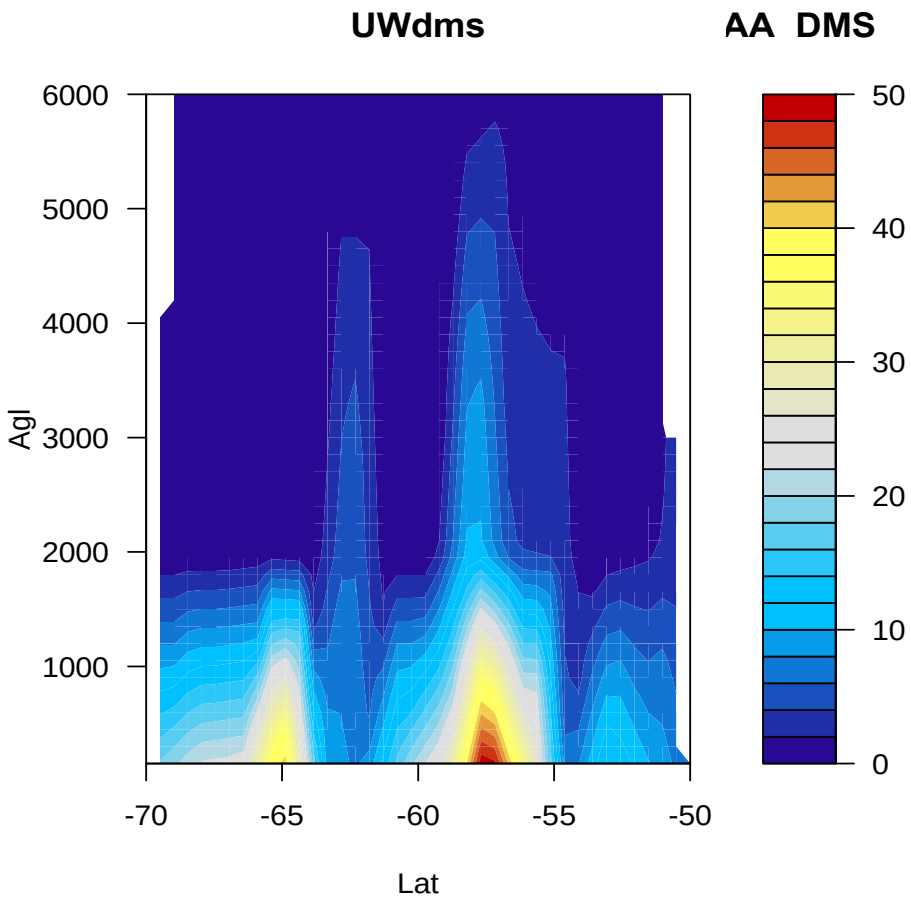
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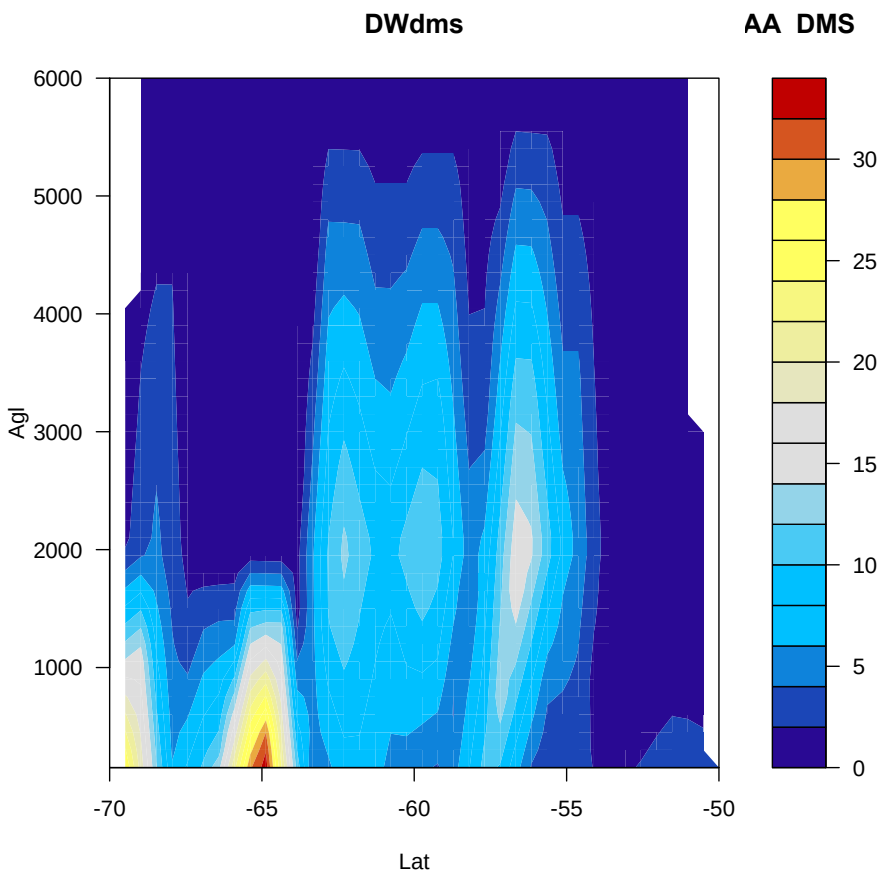
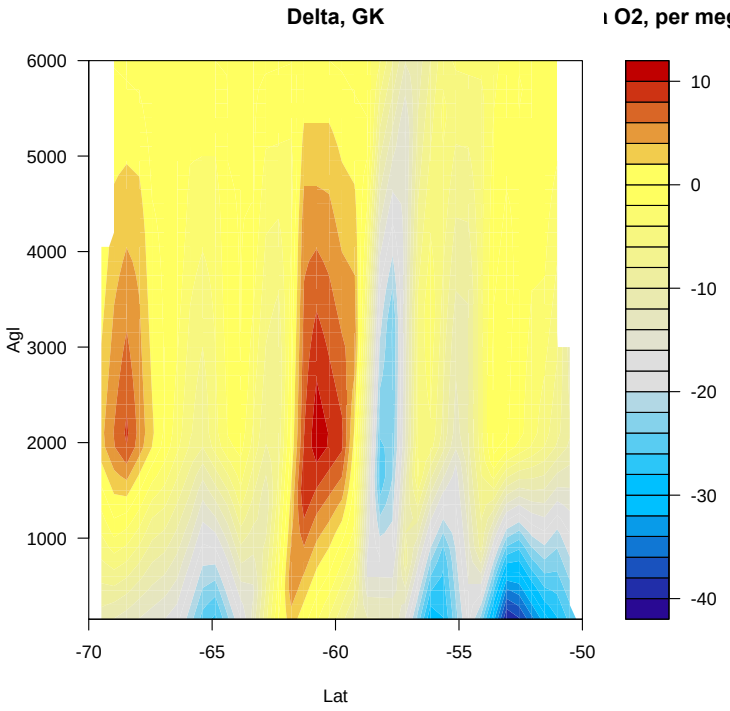
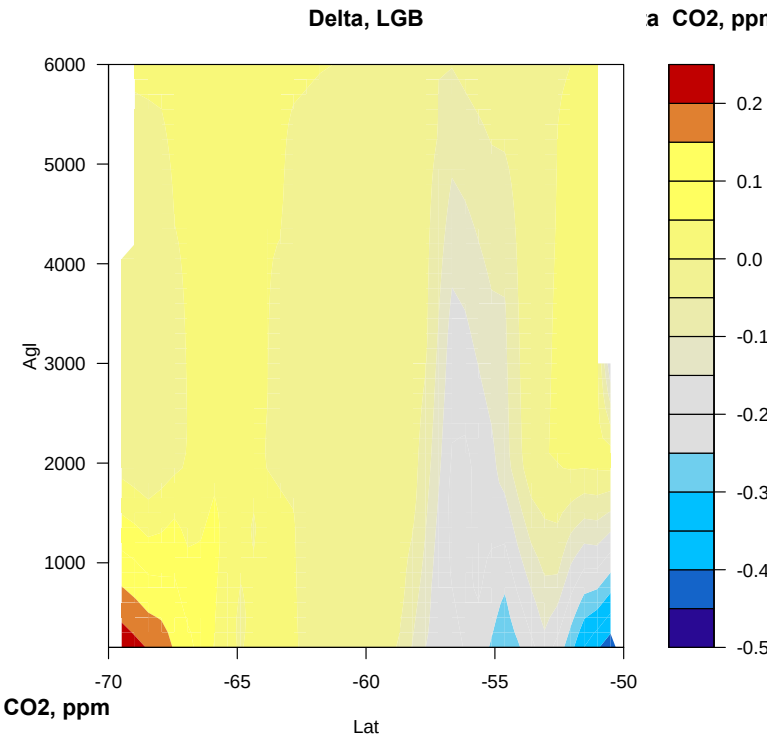
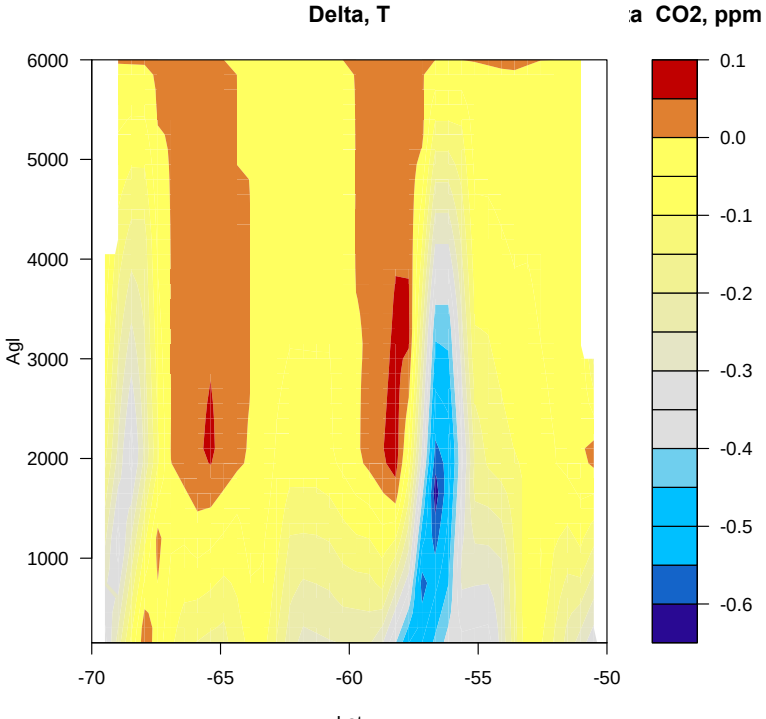
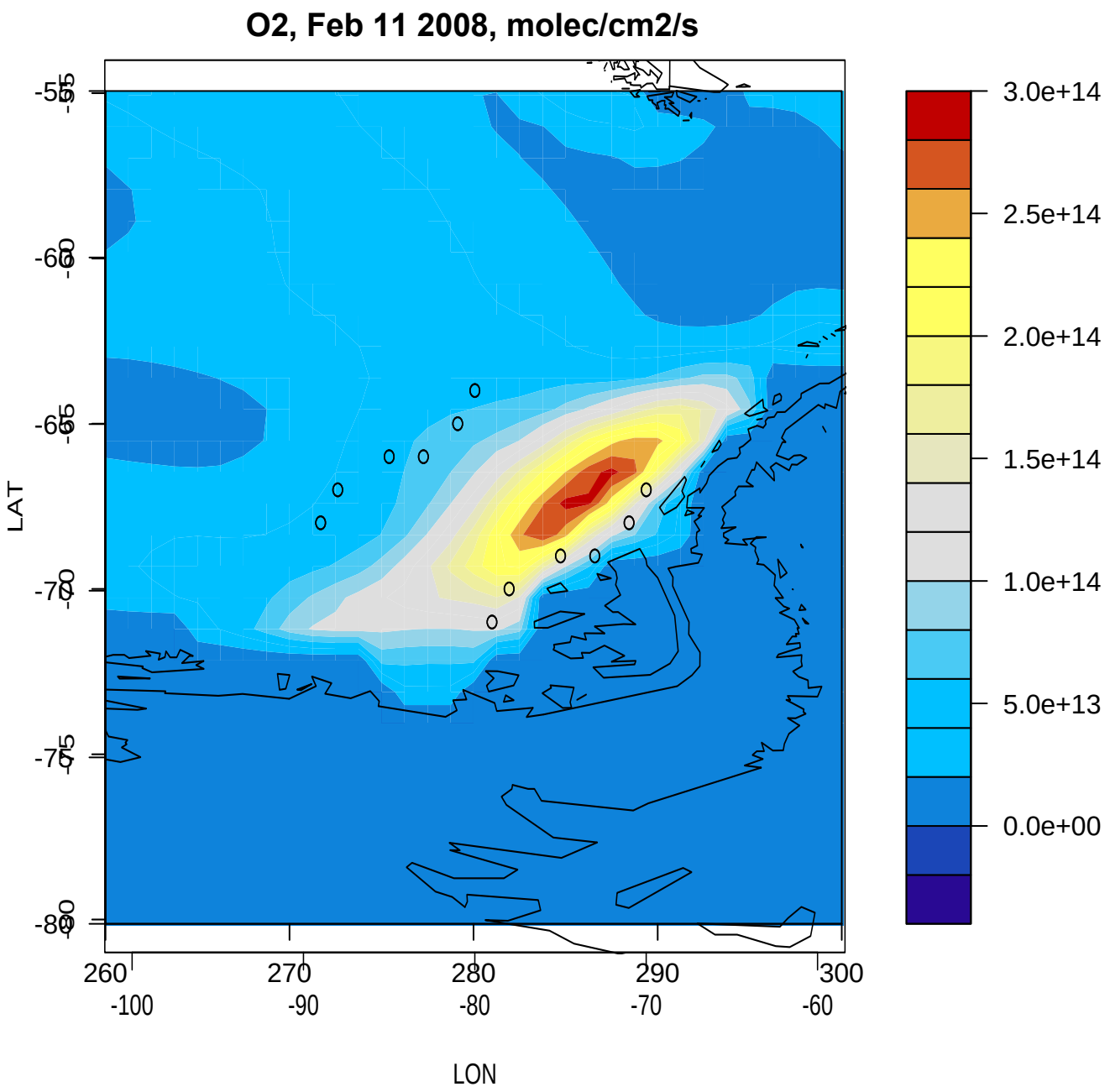
AA DMS
Agl
6000
5000
4000
3000
2000
1000
-70
-65
-60
-55
-50
Lat
50
40
30
20
10
0

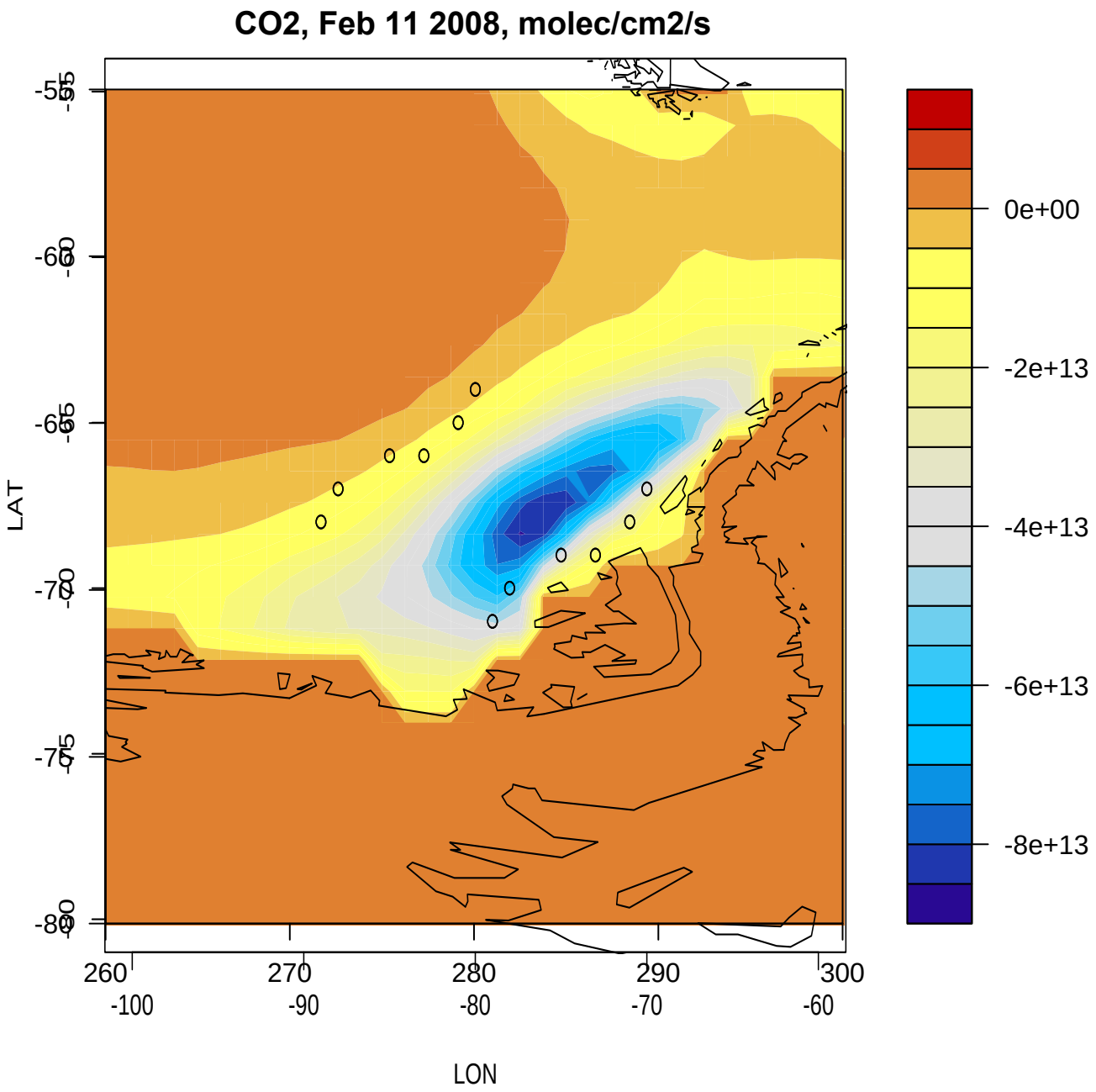

DWdms
AA DMS
Agl
6000
5000
4000
3000
2000
1000
-70
-65
-60
-55
-50
Lat
30
25
20
15
10
5
0

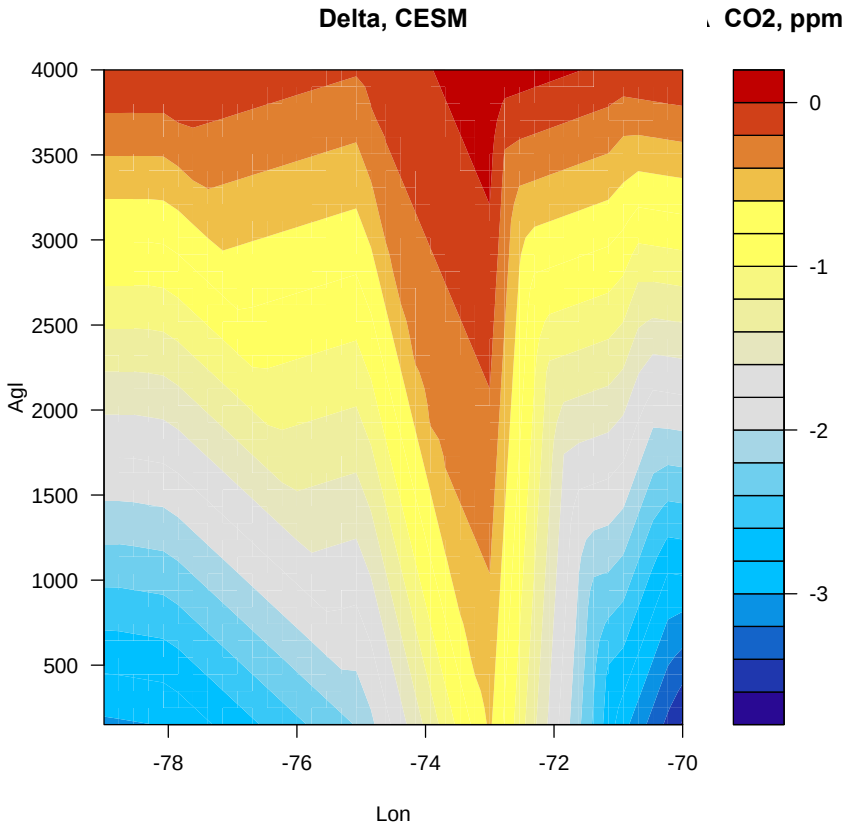

Delta, GK
O2, per meg
Agl
Lat
6000
5000
4000
3000
2000
1000
-70
-65
-60
-55
-50
10
0
-10
-20
-30
-40

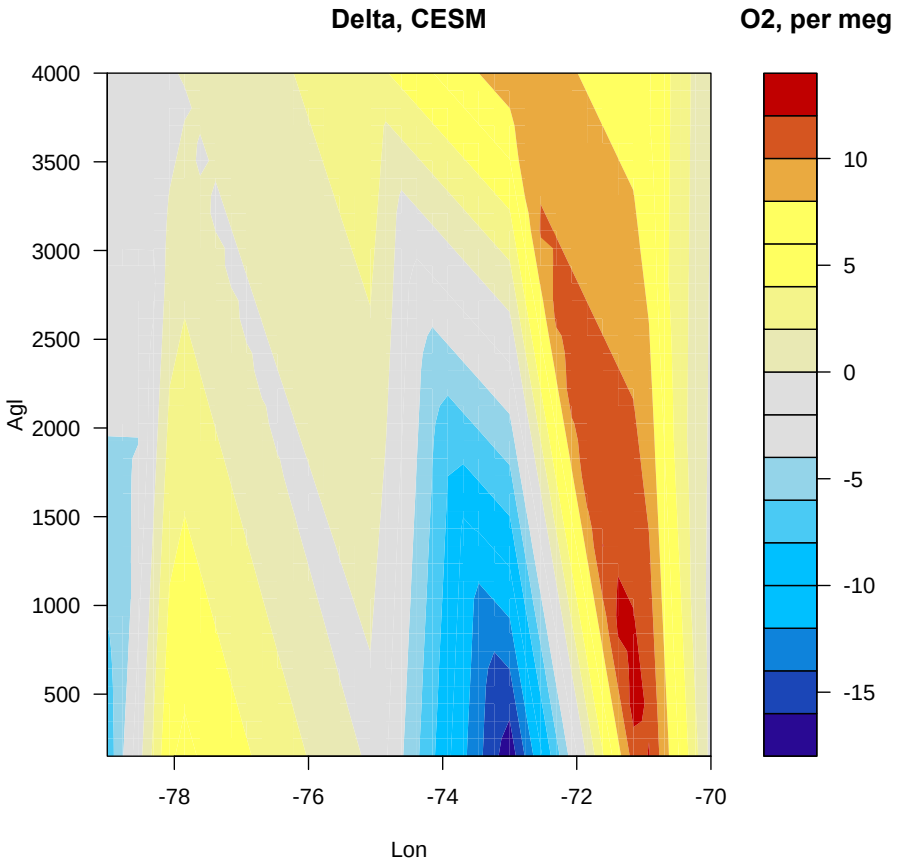

Delta, LGB
CO2, ppm
Agl
Lat
6000
5000
4000
3000
2000
1000
-70
-65
-60
-55
-50
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5


Delta, T
CO2, ppm
Agl
6000
5000
4000
3000
2000
1000
-70
-65
-60
-55
-50
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6


O2, Feb 11 2008, molec/cm2/s
LAT
LON
-55
-60
-65
-70
-75
-80
260
270
280
290
300
-100
-90
-80
-70
-60
3.0e+14
2.5e+14
2.0e+14
1.5e+14
1.0e+14
5.0e+13
0.0e+00


CO2, Feb 11 2008, molec/cm2/s
LAT
LON
-55
-60
-65
-70
-75
-80
260
270
280
290
300
-100
-90
-80
-70
-60
0e+00
-2e+13
-4e+13
-6e+13
-8e+13


Delta, CESM
CO2, ppm
4000
3500
3000
2500
2000
1500
1000
500
Agl
-78
-76
-74
-72
-70
Lon
0
-1
-2
-3


Delta, CESM
O2, per meg
4000
3500
3000
2500
2000
1500
1000
500
Agl
-78
-76
-74
-72
-70
Lon
10
5
0
-5
-10
-15

- Easy to ingest flight plan waypoints and run trajectories.
- Fairly easy to convolve with different prior flux fields and get estimated enhancements

- How do we really want to use. (What flux fields to use a priors in the field?).

Post-mission analysis

- Quantifying fluxes & linking to drivers
  - Using all campaign data
  - Using lagrangian flight data
- Valuable for analysis
  - Upwind values
  - Modeled fluxes
  - Expected drivers for fluxes