Supplementary Information for "Upper tropospheric CH_4 and CO affected by the Indian summer monsoon during OMO"

by
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Table S1: Uncertainty for CO and CH_4 for all flights during OMO.

flight no.	date	CO uncertainty [%]	CH_4 uncertainty [%]
8	7.21.2015	3.52	0.33
9	7.25.2015	3.47	0.34
10	7.28.2015	3.23	0.33
11	8.1.2015	3.41	0.23
12/13	8.6.2015	19.42	0.26
14	8.8.2015	4.64	0.24
15/16	8.9.2015	4.08	0.19
17/18	9.10.2015	3.78	0.21
19	8.13.2015	7.89	0.34
20	8.15.2015		0.19
21	8.18.2015	5.26	0.21
22	8.23.2015		0.20
23	8.25.2015	3.61	0.31
24	8.27.2015		0.23

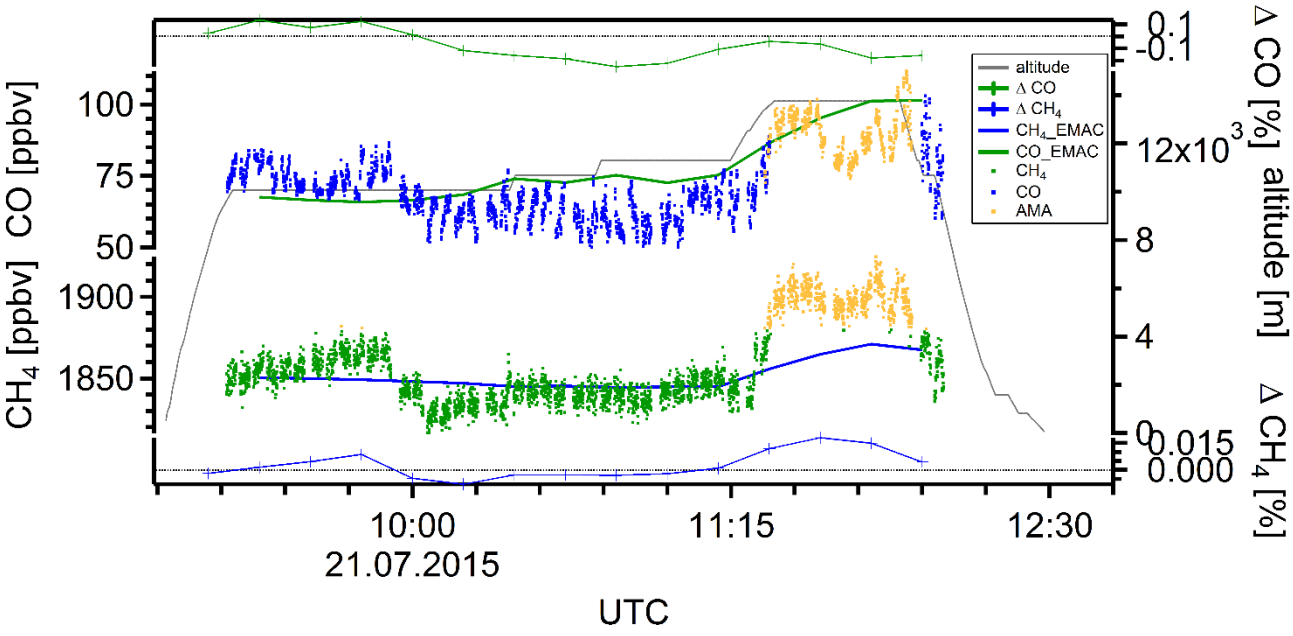
Detailed overview of all OMO flights for p>300 hPa:

a) CO and CH_4 in situ and EMAC data along the flight track. The AMA is color coded due to c[CH_4]>=1879.8 ppb (yellow). Further the deviation between EMAC and in situ data are shown for CO and CH_4. Additionally, the flight altitude is in grey.

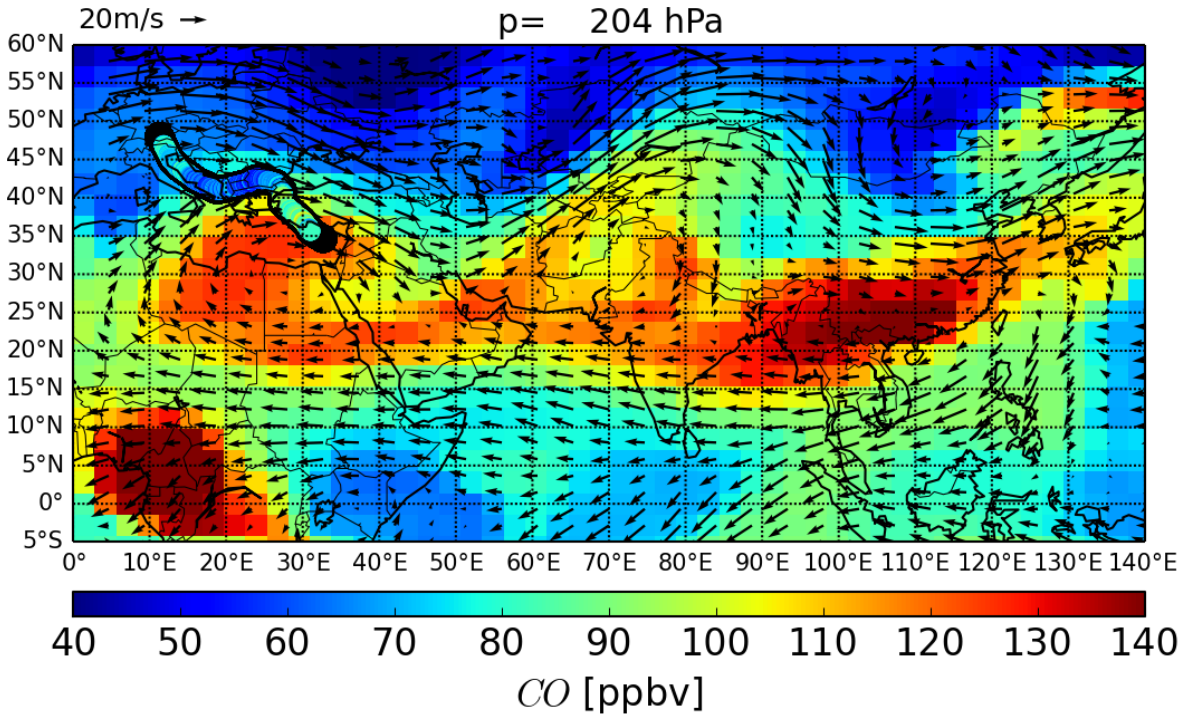
b) 204 hPa EMAC data for CO and wind field and in situ CO along the flight track.

c) 204 hPa EMAC data for CH_4 and wind field and in situ CH_4 along the flight track.

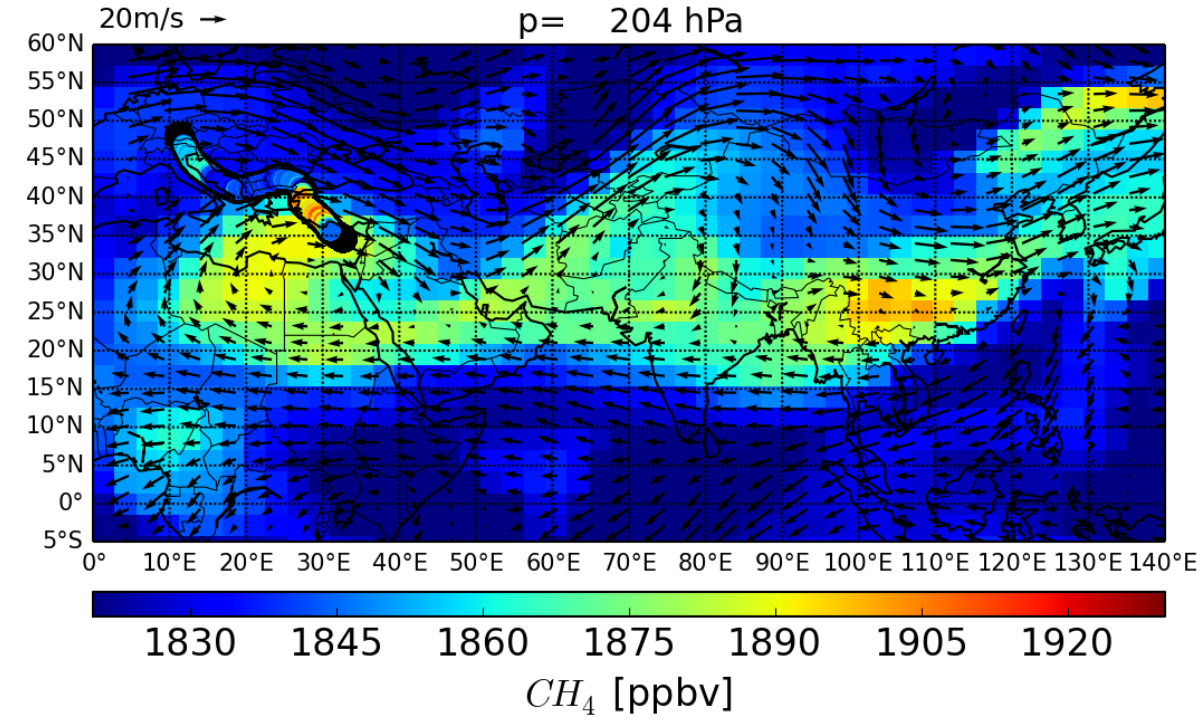
d) 10-day back centroid trajectories for 10 min releases along the flight track (black); color coded is the altitude in hPa.


altitude
Δ CO
Δ CH4
CH4_EMAC
CO_EMAC
CH4
CO
AMA
CH4 [ppbv] CO [ppbv]
Δ CO [%] altitude [m] Δ CH4 [%]
100
75
50
1900
1850
0.1
-0.1
12x10^3
8
4
0
0.015
0.000
10:00
21.07.2015
11:15
12:30
UTC

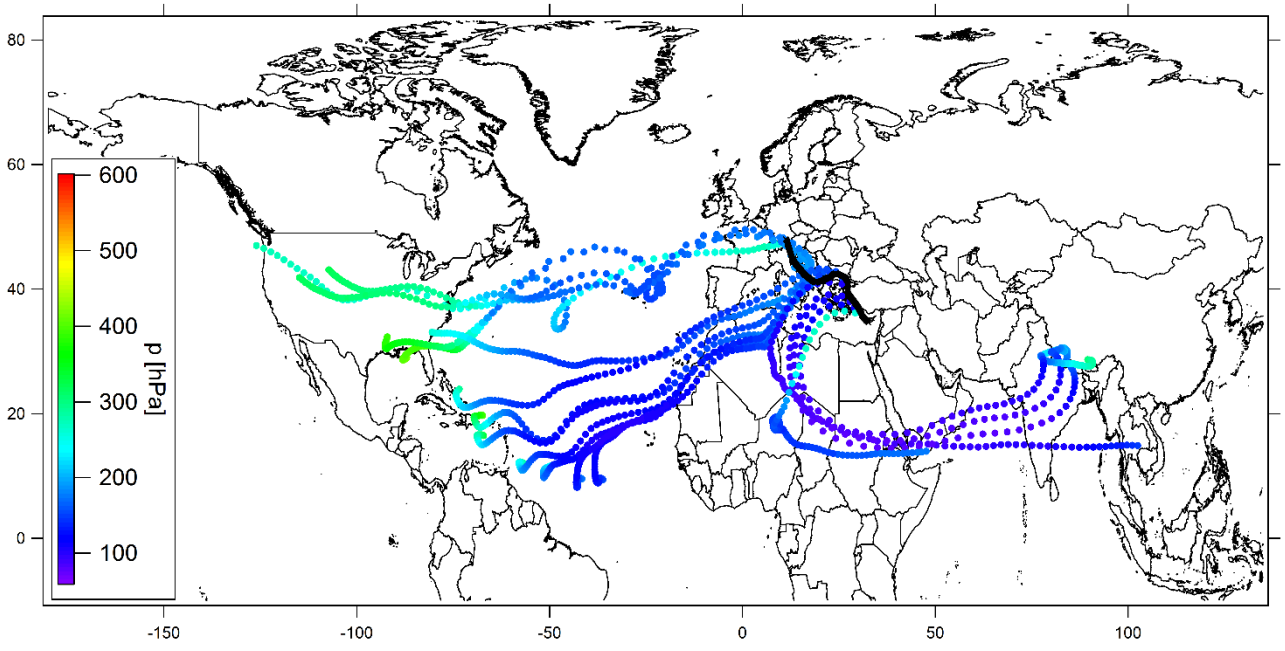
a)


20m/s
p= 204 hPa
60°N
55°N
50°N
45°N
40°N
35°N
30°N
25°N
20°N
15°N
10°N
5°N
0°
5°S
0° 10°E 20°E 30°E 40°E 50°E 60°E 70°E 80°E 90°E 100°E 110°E 120°E 130°E 140°E
40 50 60 70 80 90 100 110 120 130 140
CO [ppbv]

b)

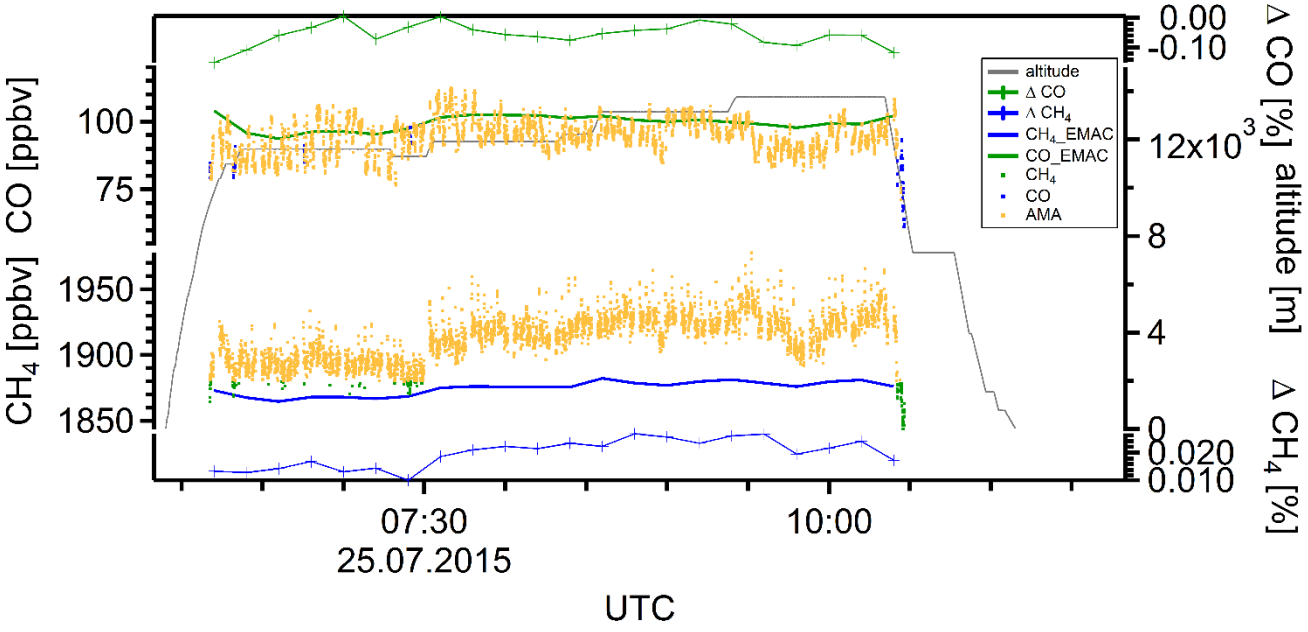


c)

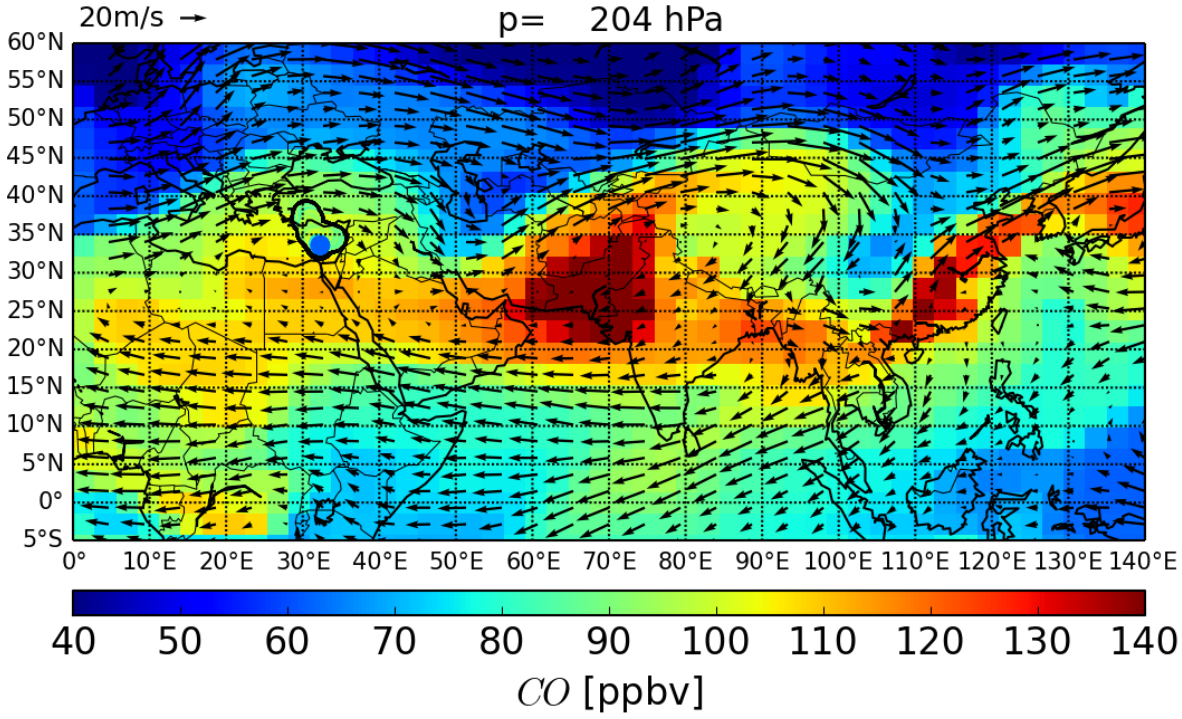


d)

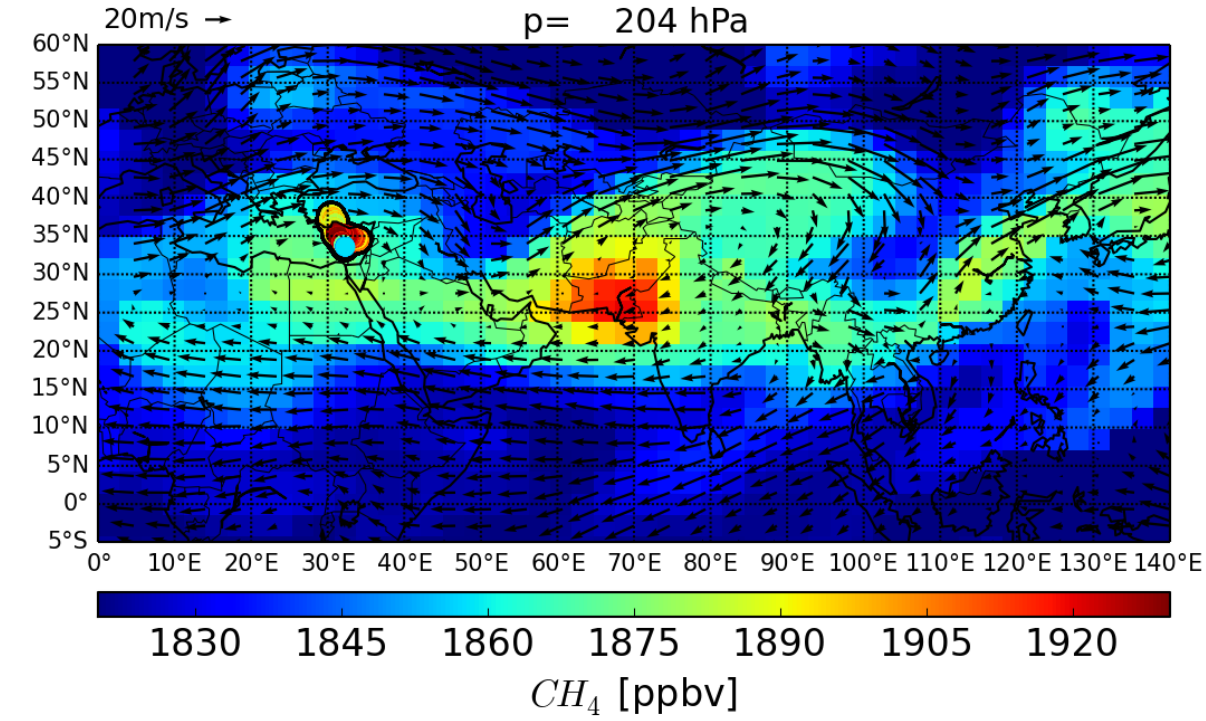
Figure S2: Flight 08 (07.21.2015): transfer flight from Oberpfaffenhofen to Paphos.


CH4 [ppbv] CO [ppbv]
100
75
1950
1900
1850
0.00
-0.10
12x10^3
8
4
0
0.020
0.010
Δ CO [%] altitude [m] Δ CH4 [%]
altitude
Δ CO
Δ CH4
CH4_EMAC
CO_EMAC
CH4
CO
AMA
07:30
25.07.2015
10:00
UTC

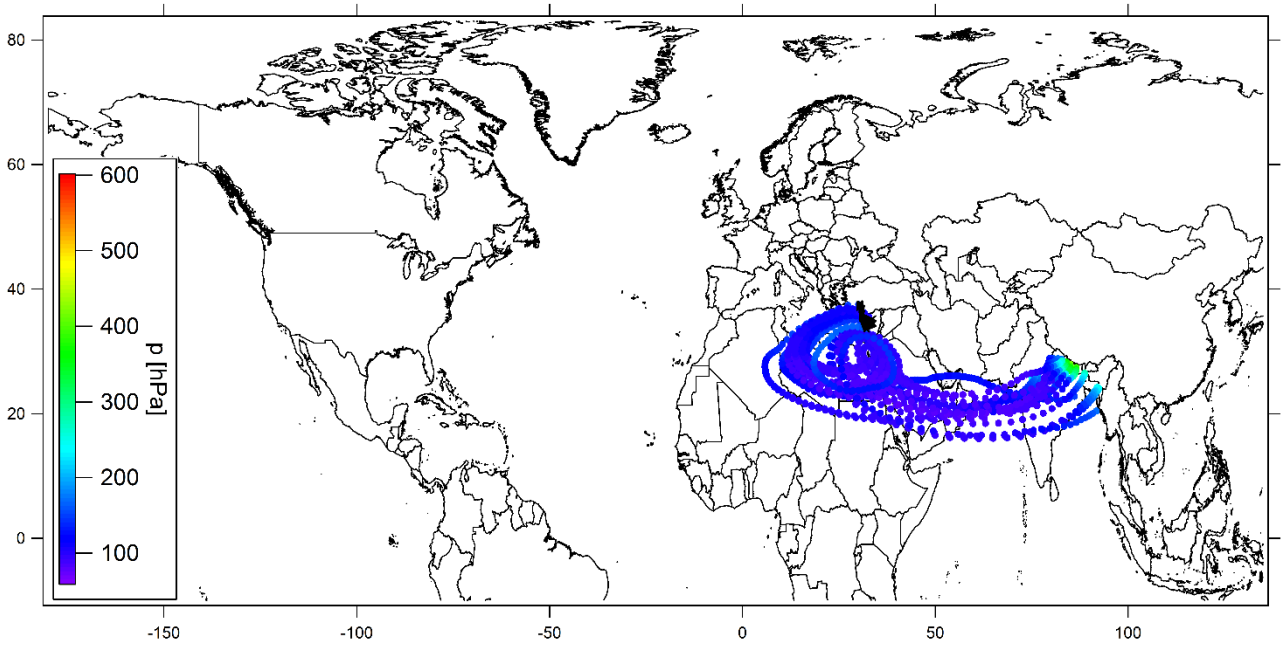
a)


20m/s
p= 204 hPa
60°N
55°N
50°N
45°N
40°N
35°N
30°N
25°N
20°N
15°N
10°N
5°N
0°
5°S
0° 10°E 20°E 30°E 40°E 50°E 60°E 70°E 80°E 90°E 100°E 110°E 120°E 130°E 140°E
40 50 60 70 80 90 100 110 120 130 140
CO [ppbv]

b)

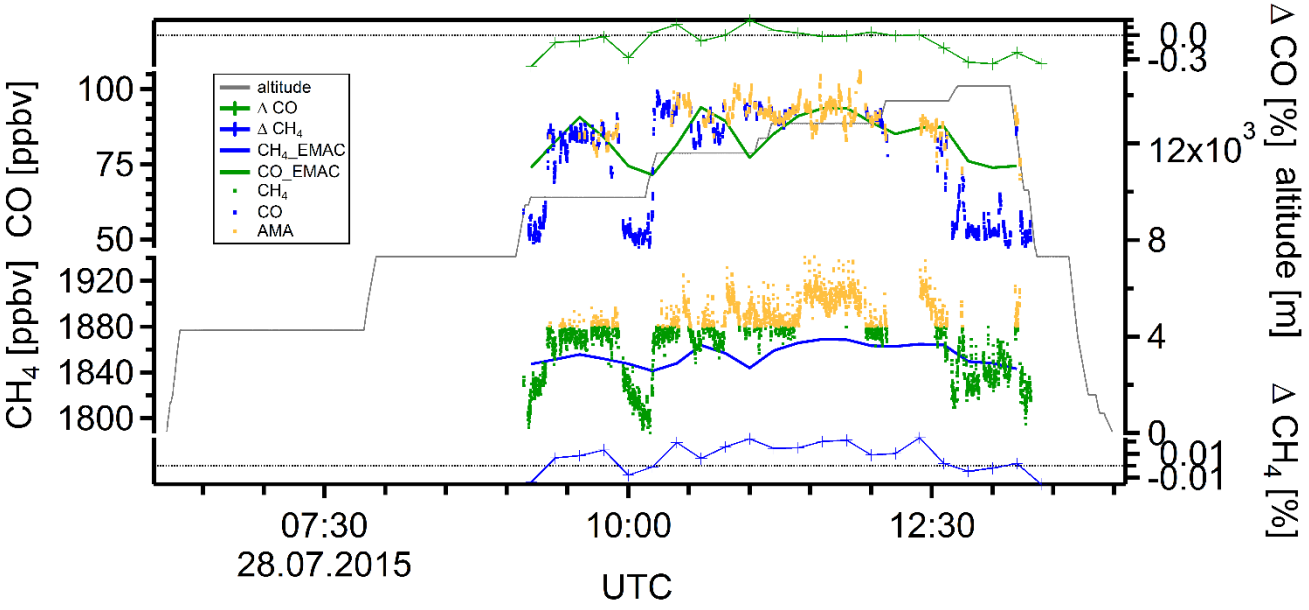


c)

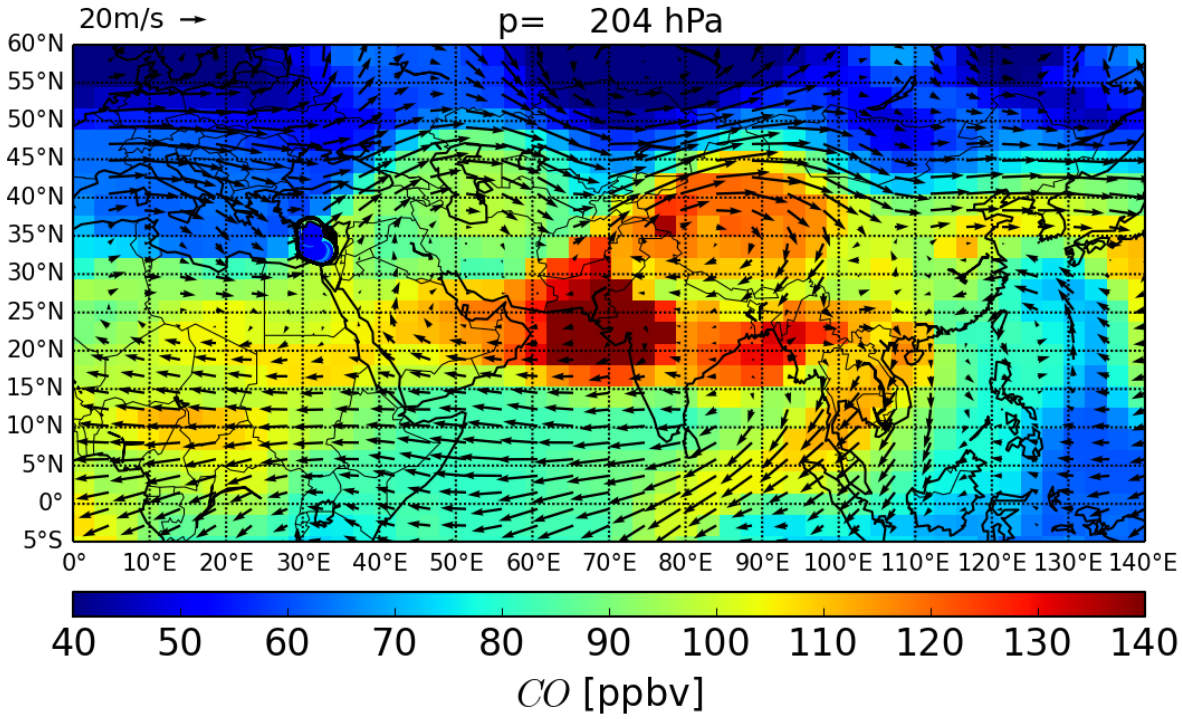


d)

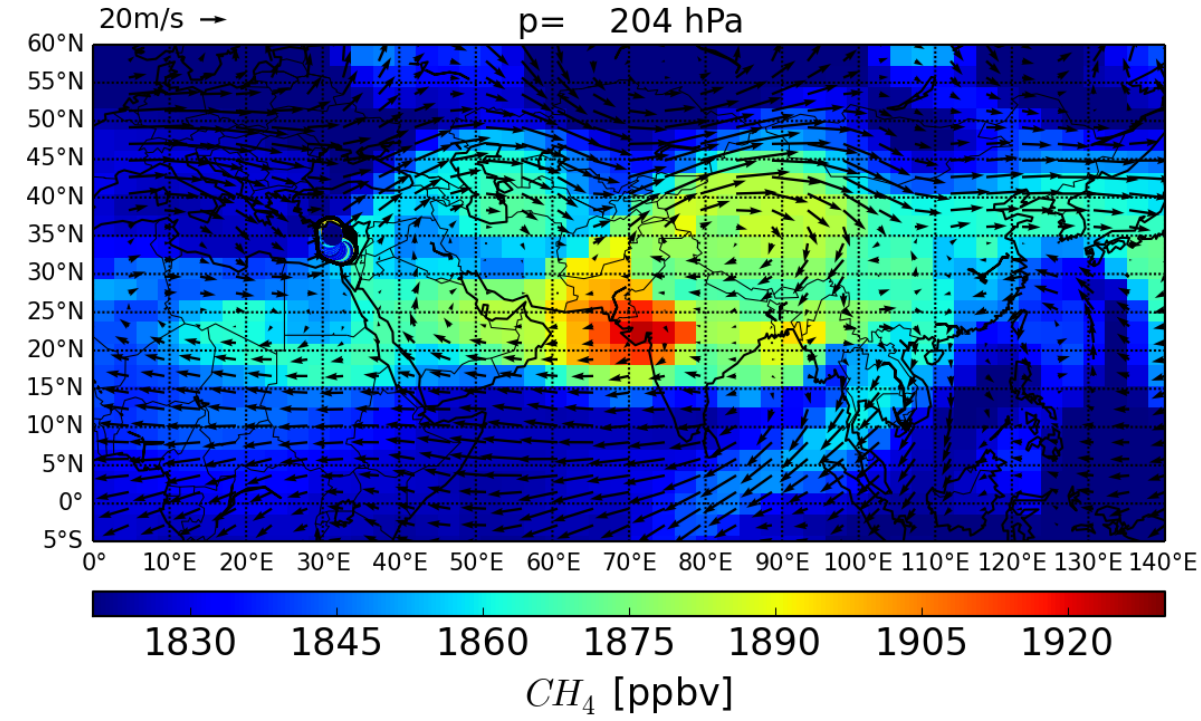
Figure S2: Flight 09 (07.25.2015): measurement flight from Paphos to Paphos over Cyprus.


altitude
Δ CO
Δ CH4
CH4_EMAC
CO_EMAC
CH4
CO
AMA
CO [ppbv]
CH4 [ppbv]
Δ CO [%]
altitude [m]
Δ CH4 [%]
12x10^3
07:30
28.07.2015
10:00
12:30
UTC

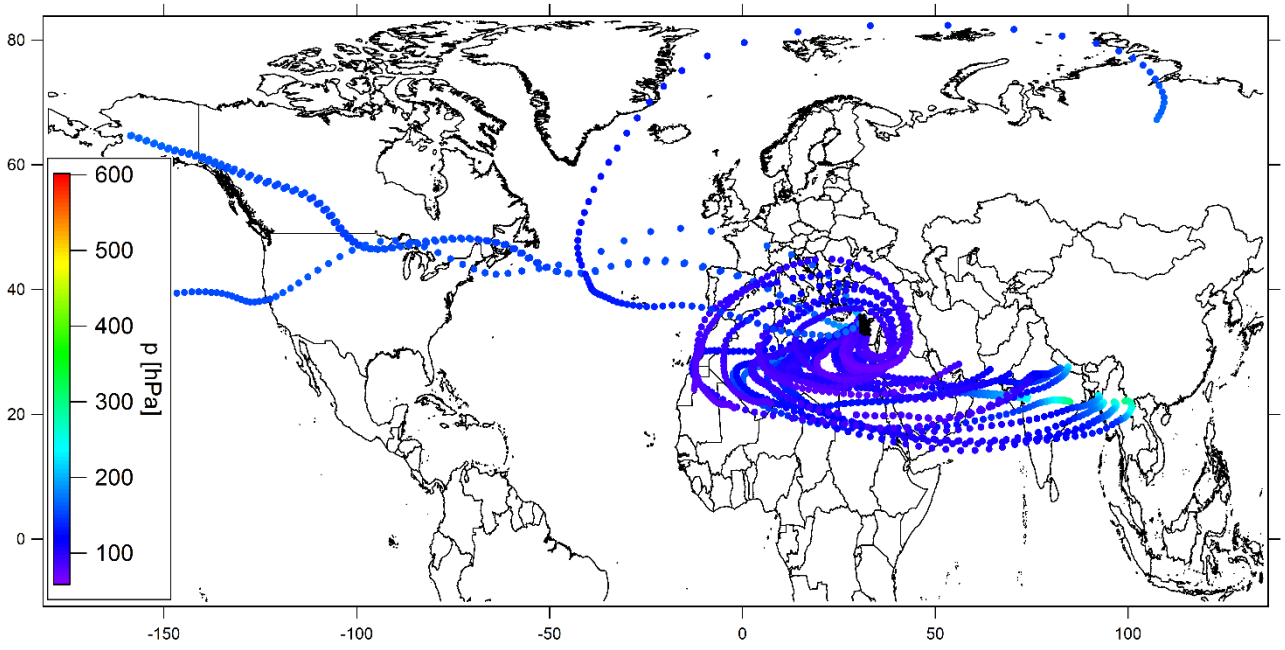
a)


20m/s
p= 204 hPa
60°N
55°N
50°N
45°N
40°N
35°N
30°N
25°N
20°N
15°N
10°N
5°N
0°
5°S
0° 10°E 20°E 30°E 40°E 50°E 60°E 70°E 80°E 90°E 100°E 110°E 120°E 130°E 140°E
40 50 60 70 80 90 100 110 120 130 140
CO [ppbv]

b)

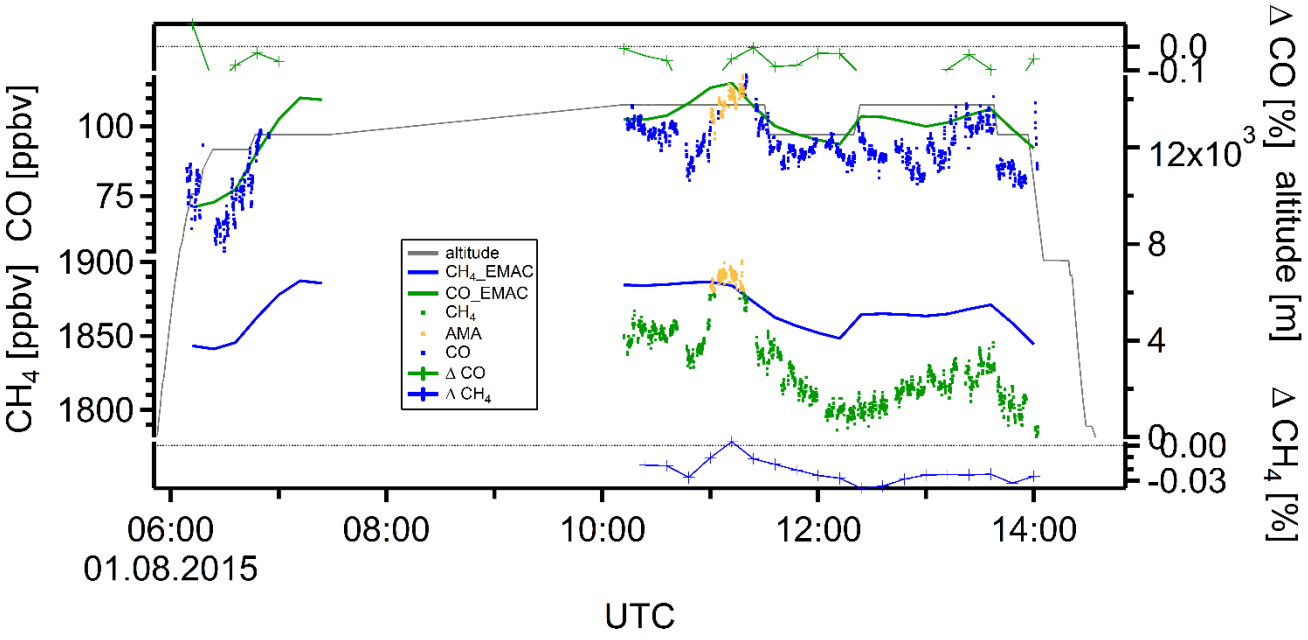


c)

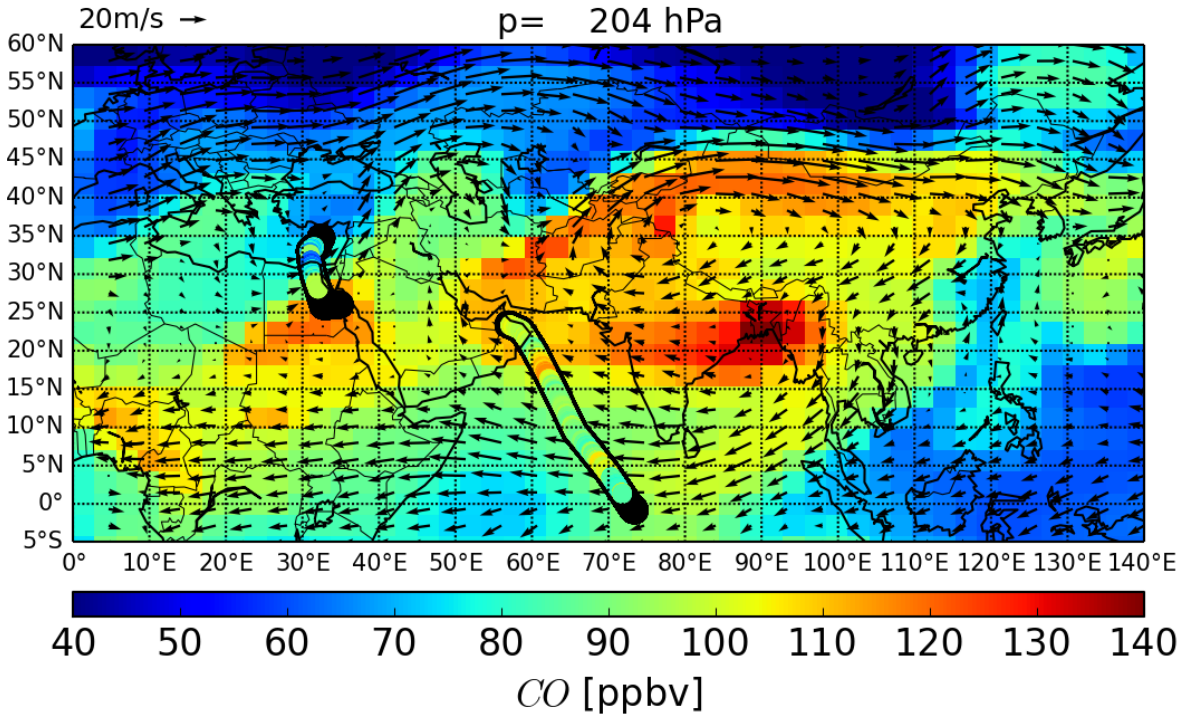


d)

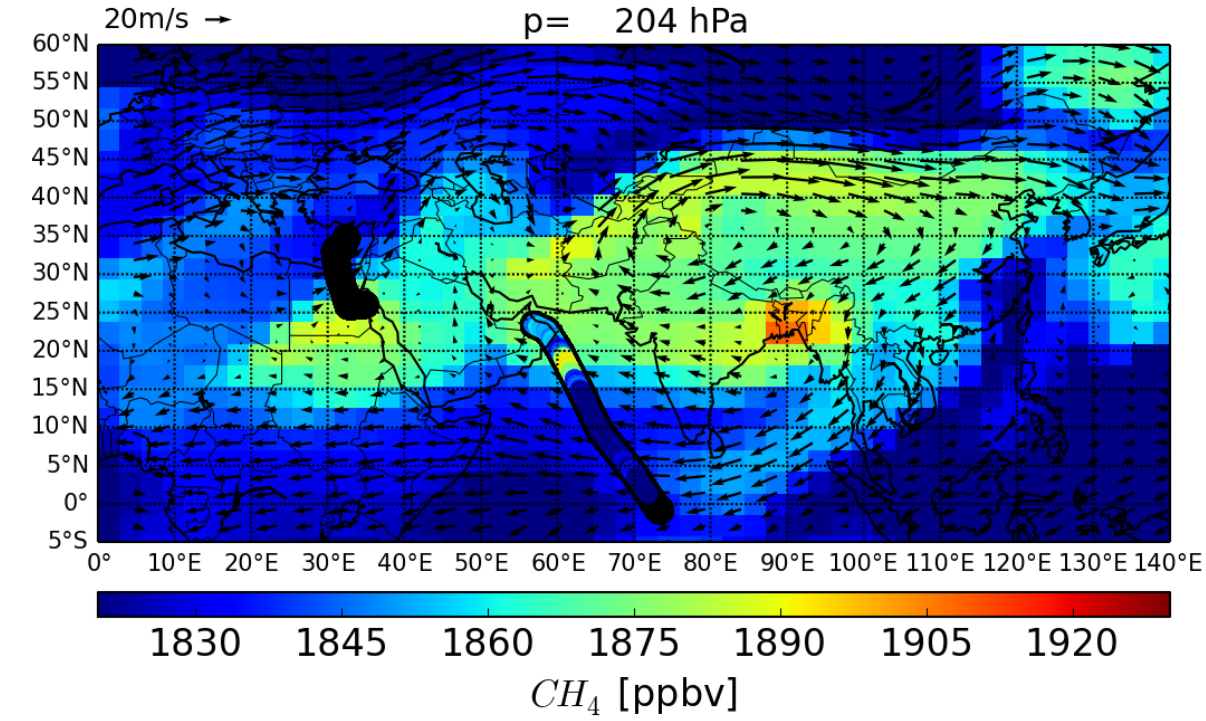
Figure S3: Flight 10 (07.28.2015): measurement flight from Paphos to Paphos over Cyprus.


CH4 [ppbv] CO [ppbv]
Δ CO [%] altitude [m] Δ CH4 [%]
altitude
CH4_EMAC
CO_EMAC
CH4
AMA
CO
Δ CO
Δ CH4
100
75
1900
1850
1800
0.0
-0.1
12x10^3
8
4
0
0.00
-0.03
06:00
01.08.2015
08:00
10:00
12:00
14:00
UTC

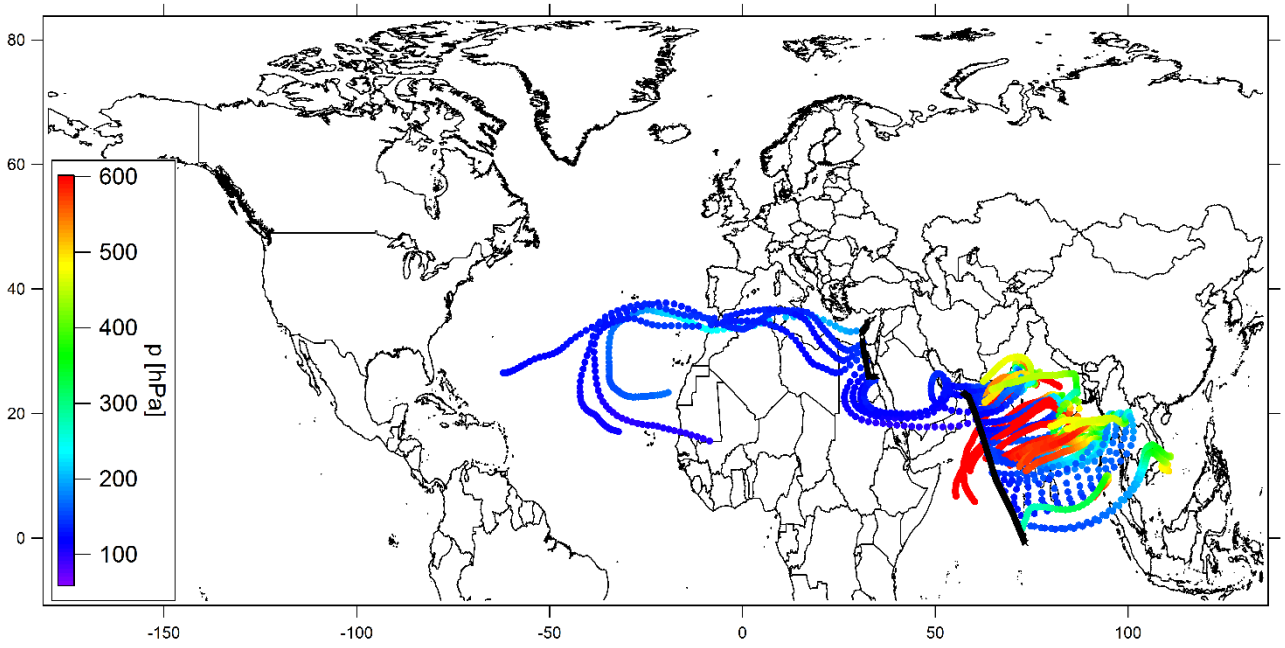
a)


20m/s
p= 204 hPa
60°N
55°N
50°N
45°N
40°N
35°N
30°N
25°N
20°N
15°N
10°N
5°N
0°
5°S
0° 10°E 20°E 30°E 40°E 50°E 60°E 70°E 80°E 90°E 100°E 110°E 120°E 130°E 140°E
40 50 60 70 80 90 100 110 120 130 140
CO [ppbv]

b)

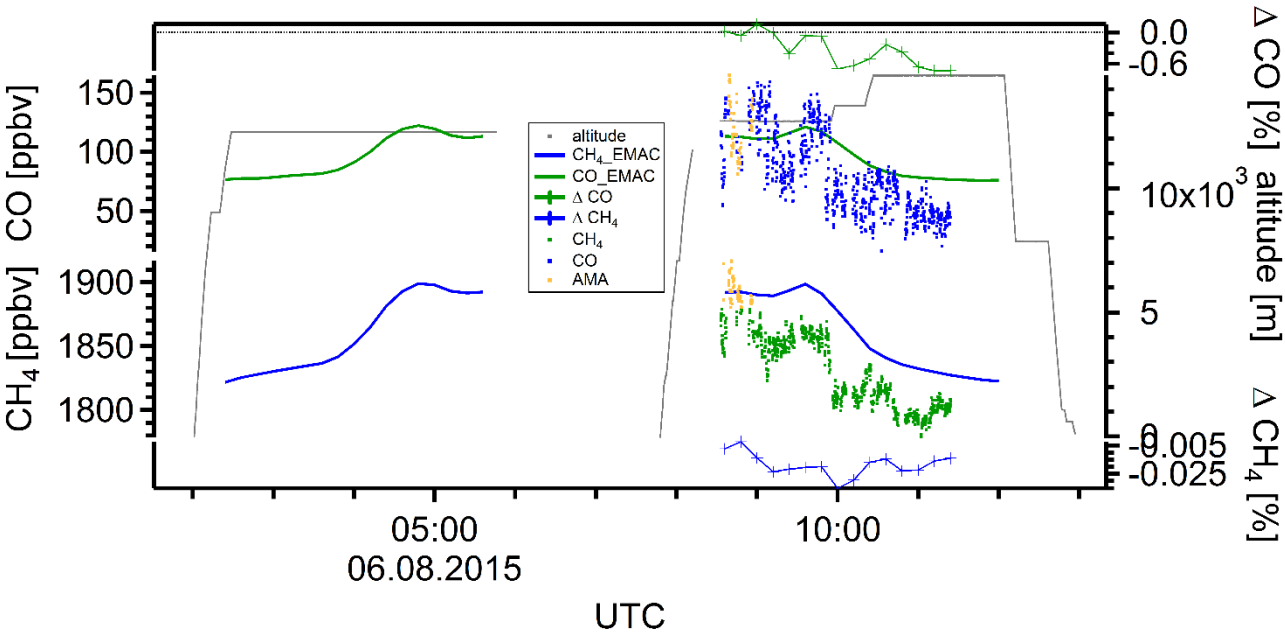


c)

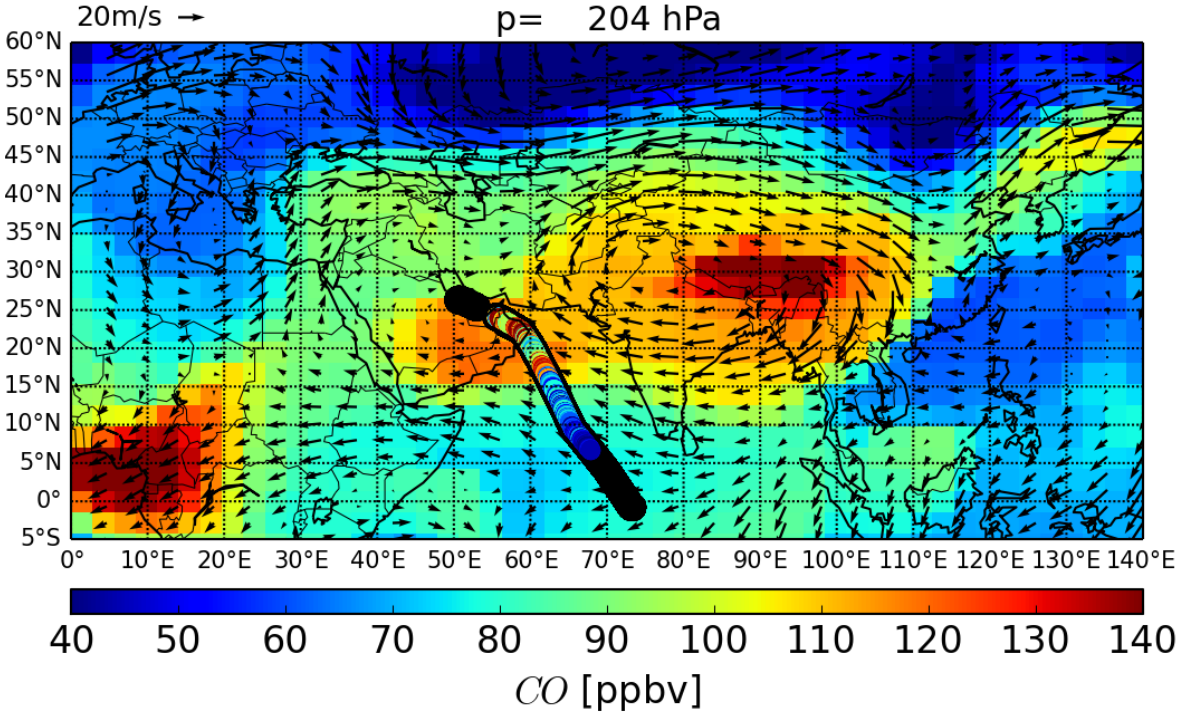


d)

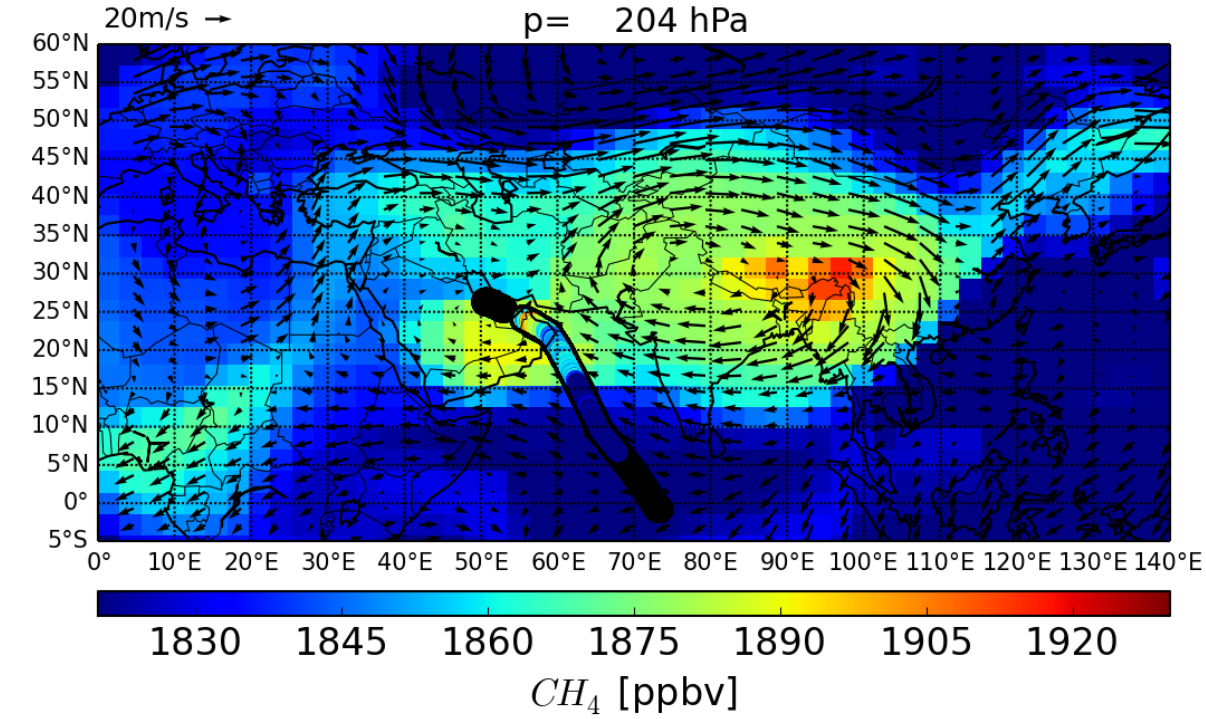
Figure S4: Flight 11 (08.01.2015): transfer flight from Paphos to Gan.


CH4 [ppbv] CO [ppbv]
150
100
50
1900
1850
1800
altitude
CH4_EMAC
CO_EMAC
Δ CO
Δ CH4
CH4
CO
AMA
0.0
-0.6
10x10^3
5
0
-0.005
-0.025
Δ CO [%] altitude [m] Δ CH4 [%]
05:00
06.08.2015
10:00
UTC

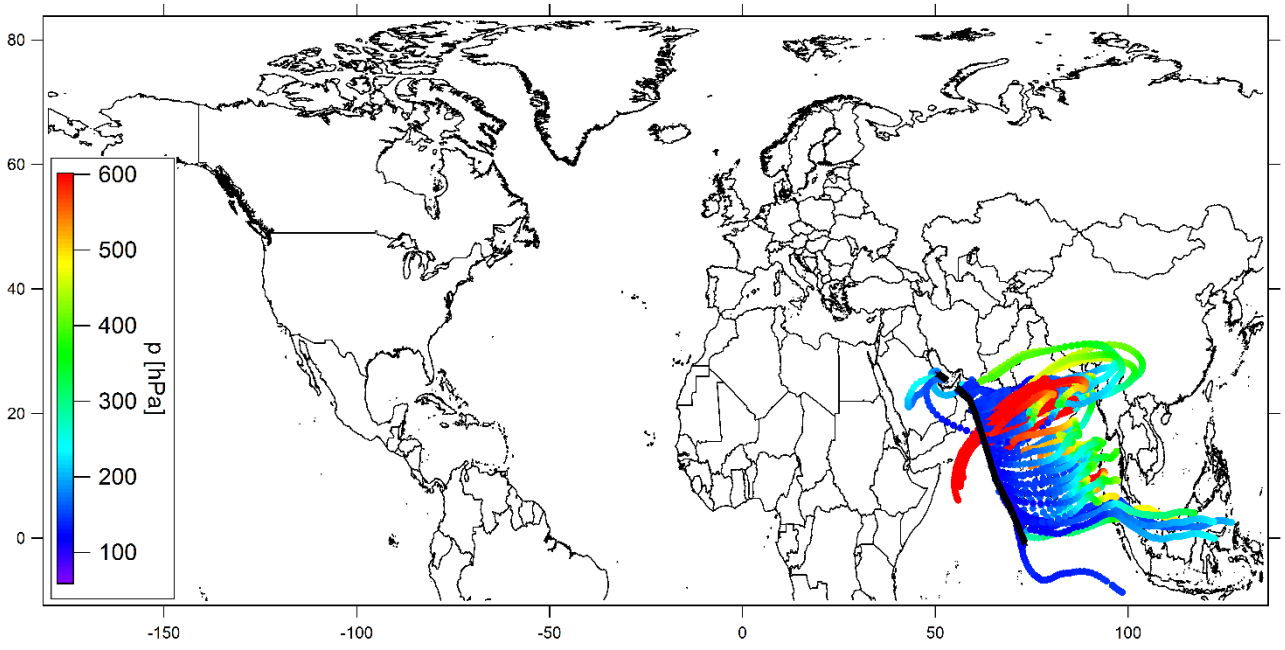
a)


20m/s
p= 204 hPa
60°N
55°N
50°N
45°N
40°N
35°N
30°N
25°N
20°N
15°N
10°N
5°N
0°
5°S
0° 10°E 20°E 30°E 40°E 50°E 60°E 70°E 80°E 90°E 100°E 110°E 120°E 130°E 140°E
40 50 60 70 80 90 100 110 120 130 140
CO [ppbv]

b)

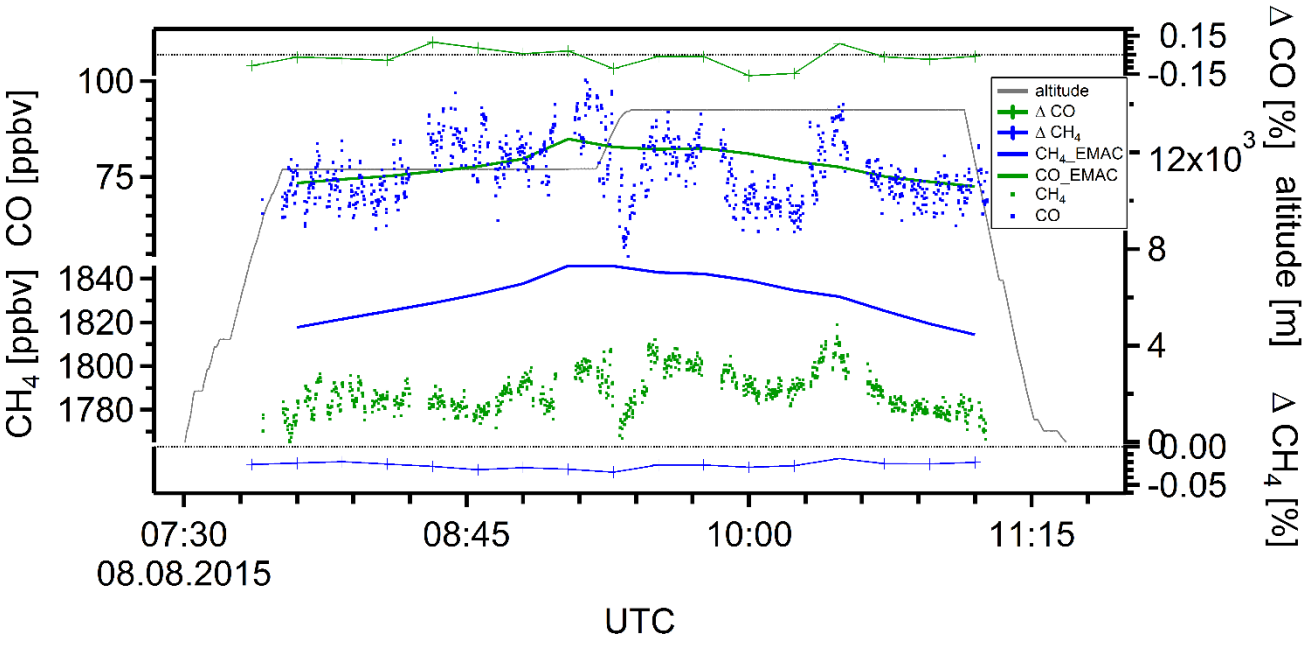


c)

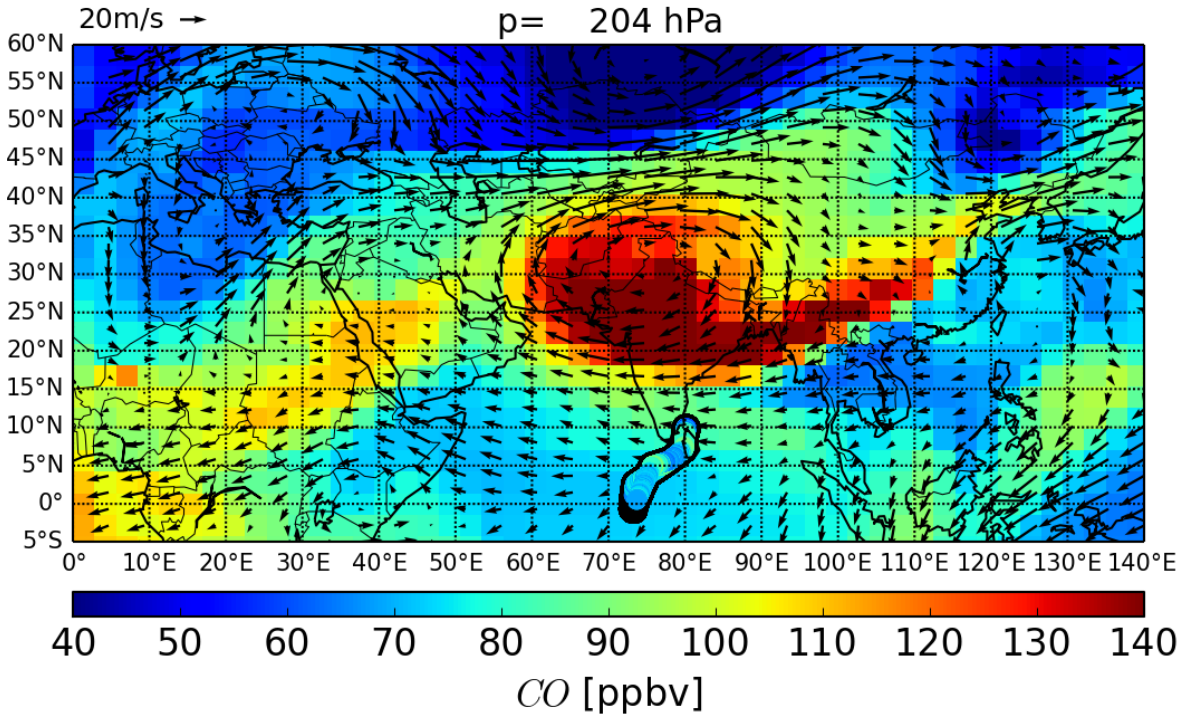


d)

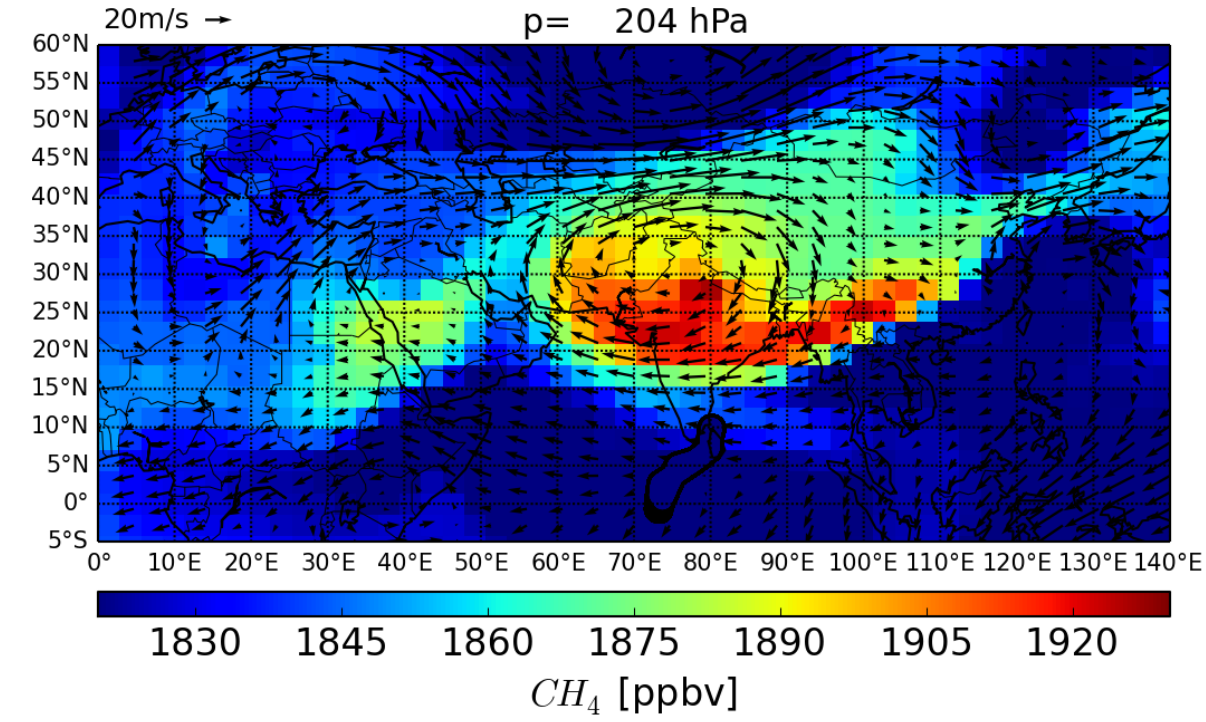
Figure S5: Flight 12/13 (08.06.2015): measurement flight from Gan to Bahrain and return to Gan.


CH4 [ppbv] CO [ppbv]
Δ CO [%] altitude [m] Δ CH4 [%]
altitude
Δ CO
Δ CH4
CH4_EMAC
CO_EMAC
CH4
CO
100
75
1840
1820
1800
1780
0.15
-0.15
12x10^3
8
4
0
0.00
-0.05
07:30
08.08.2015
08:45
10:00
11:15
UTC

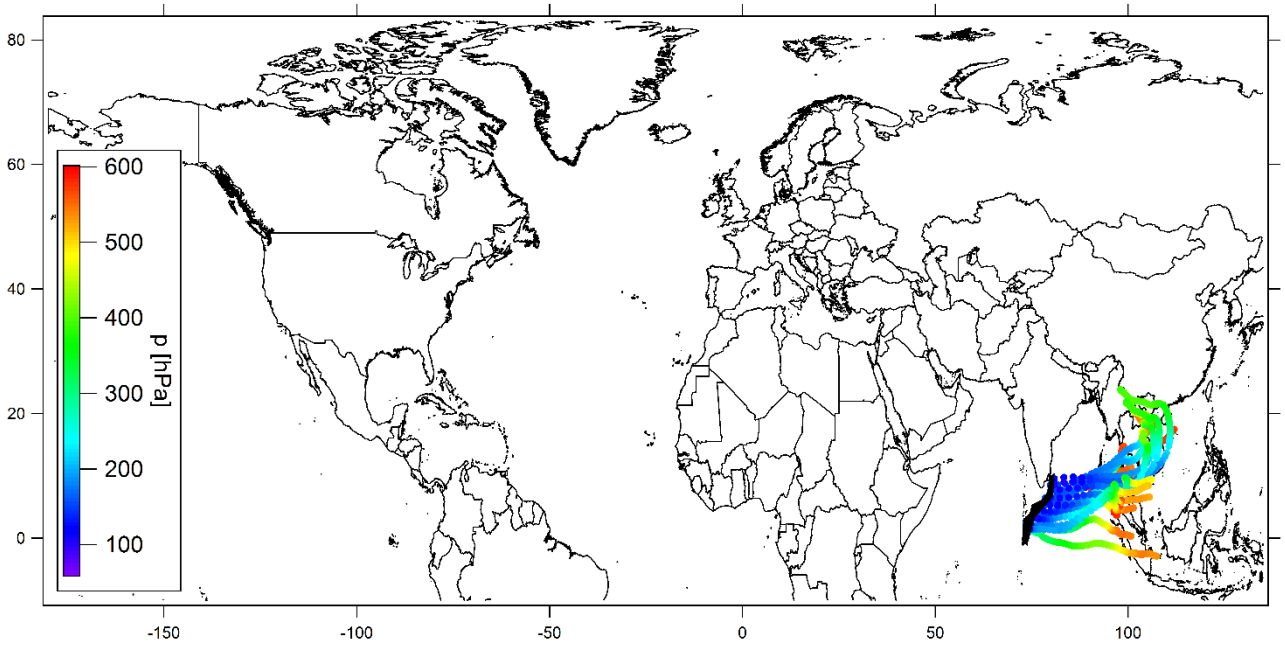
a)


20m/s
p= 204 hPa
60°N
55°N
50°N
45°N
40°N
35°N
30°N
25°N
20°N
15°N
10°N
5°N
0°
5°S
0° 10°E 20°E 30°E 40°E 50°E 60°E 70°E 80°E 90°E 100°E 110°E 120°E 130°E 140°E
40 50 60 70 80 90 100 110 120 130 140
CO [ppbv]

b)

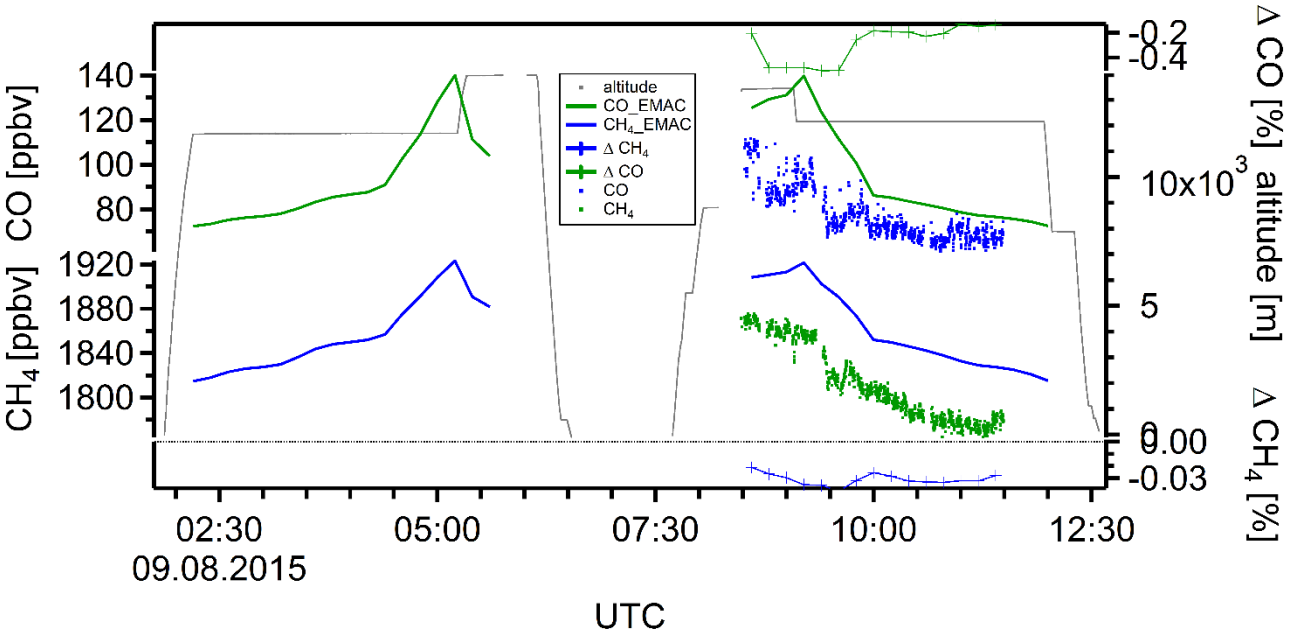


c)

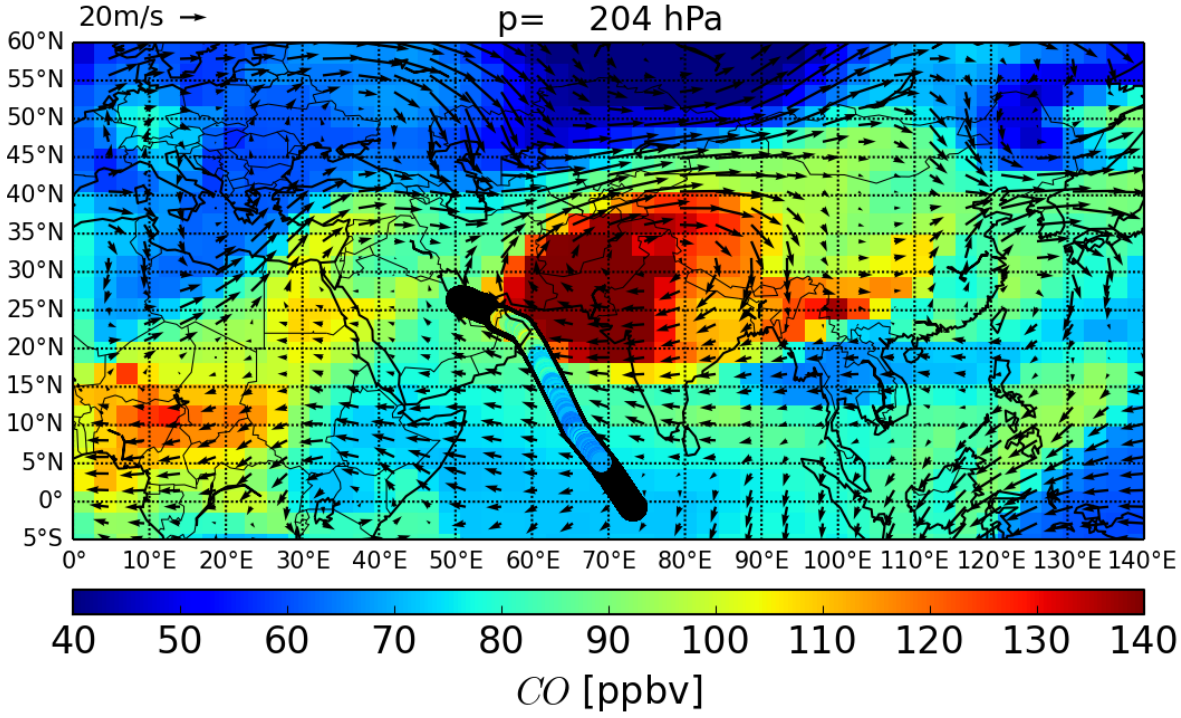


d)

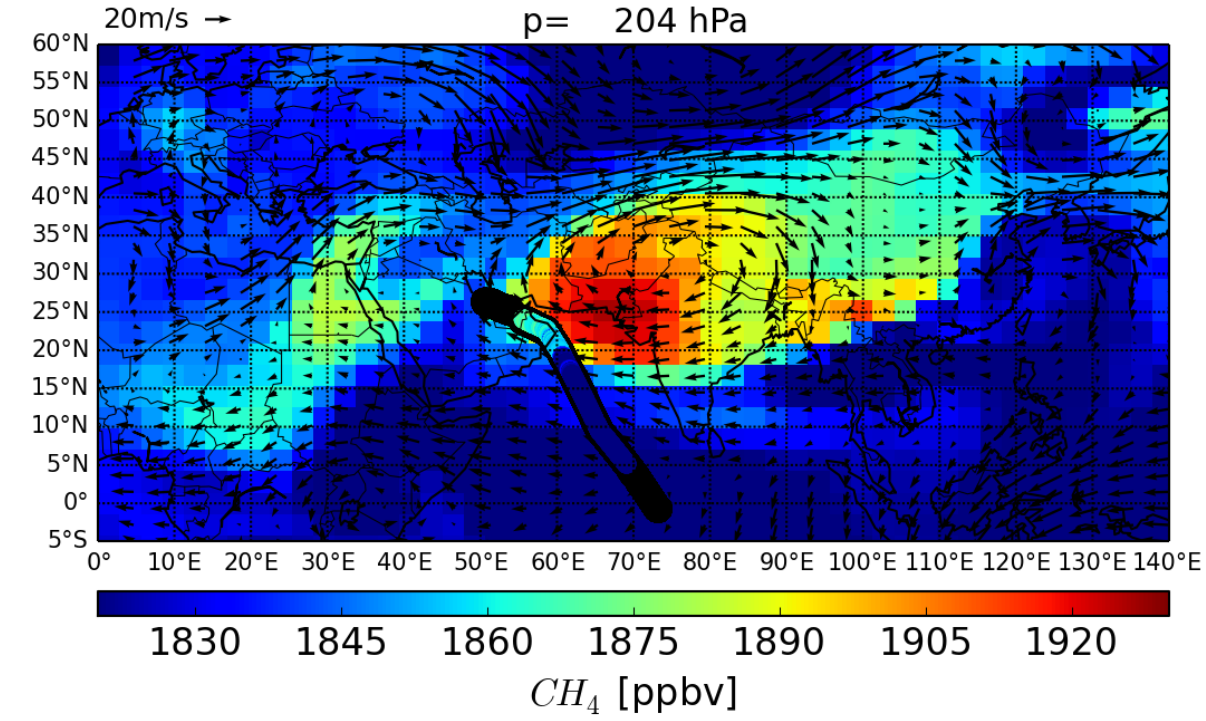
Figure S6: Flight 14 (08.08.2015): measurement flight from Gan to Gan towards Sri Lanka.


altitude
CO_EMAC
CH4_EMAC
Δ CH4
Δ CO
CO
CH4
CH4 [ppbv] CO [ppbv]
Δ CO [%] altitude [m] Δ CH4 [%]
10x10^3
02:30
09.08.2015
05:00
07:30
10:00
12:30
UTC

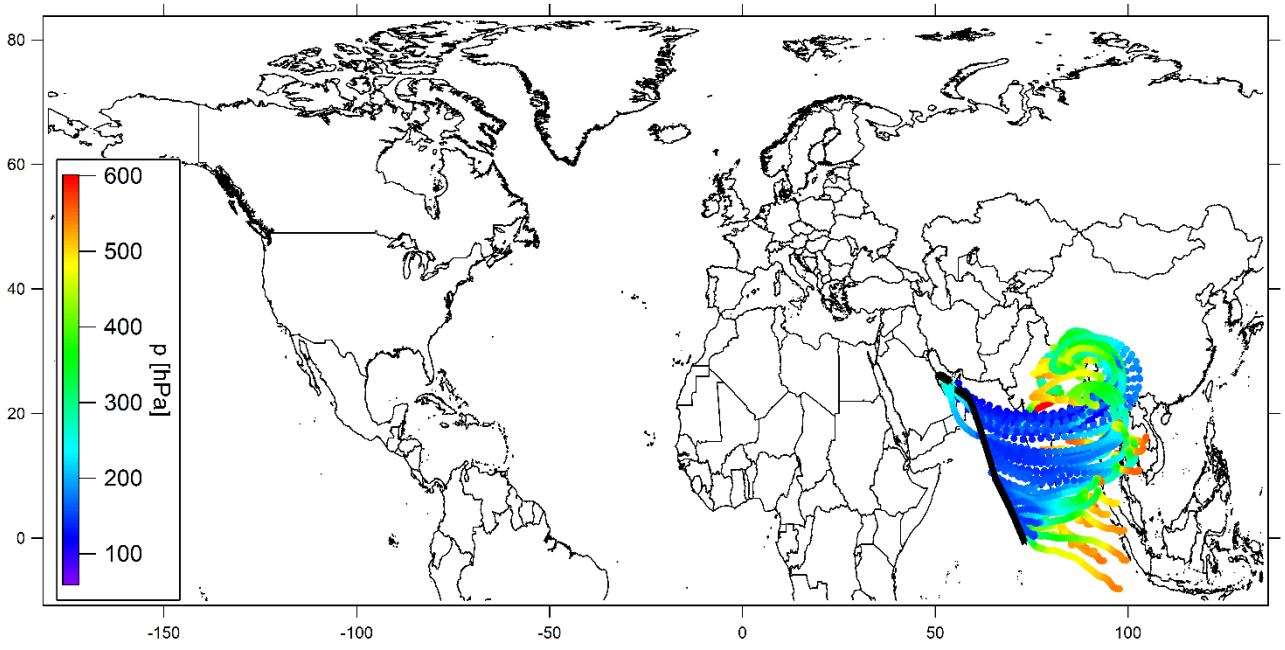
a)


20m/s
p= 204 hPa
CO [ppbv]

b)

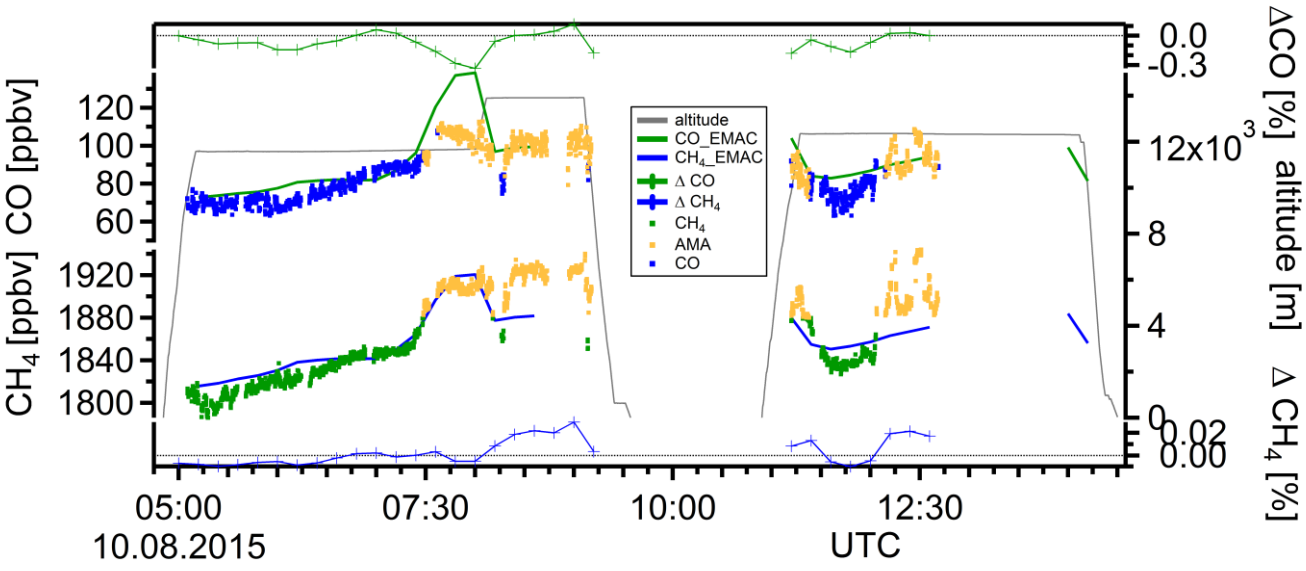


c)

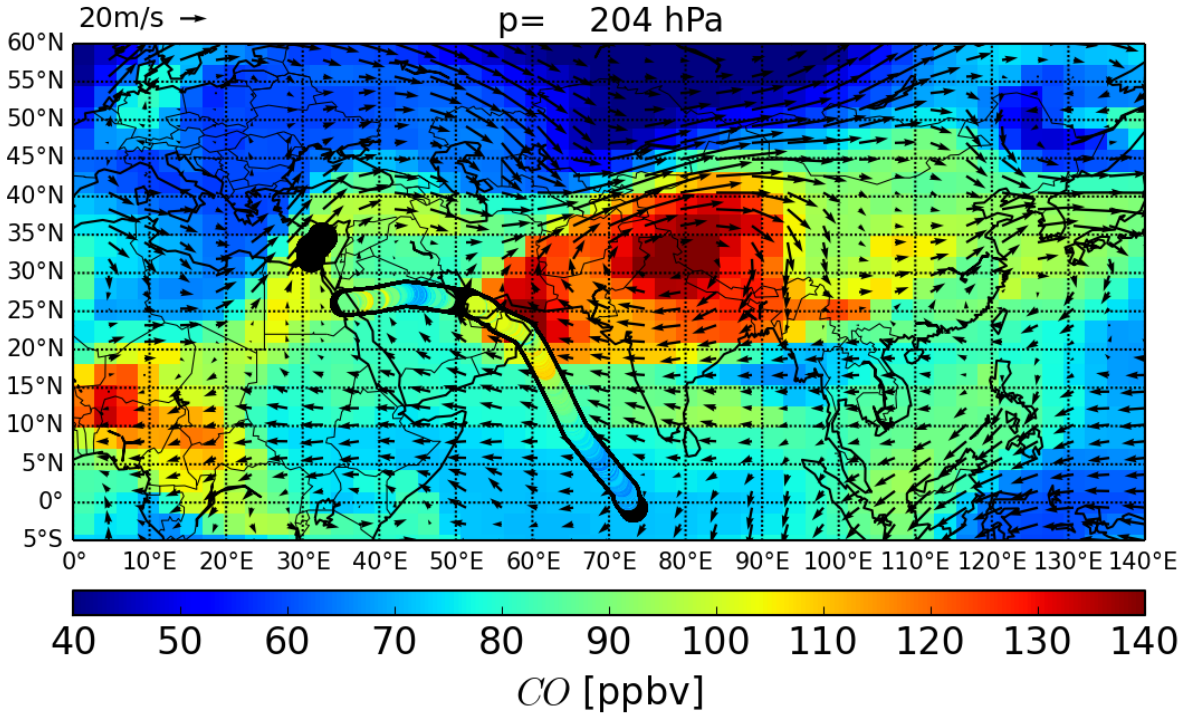


d)

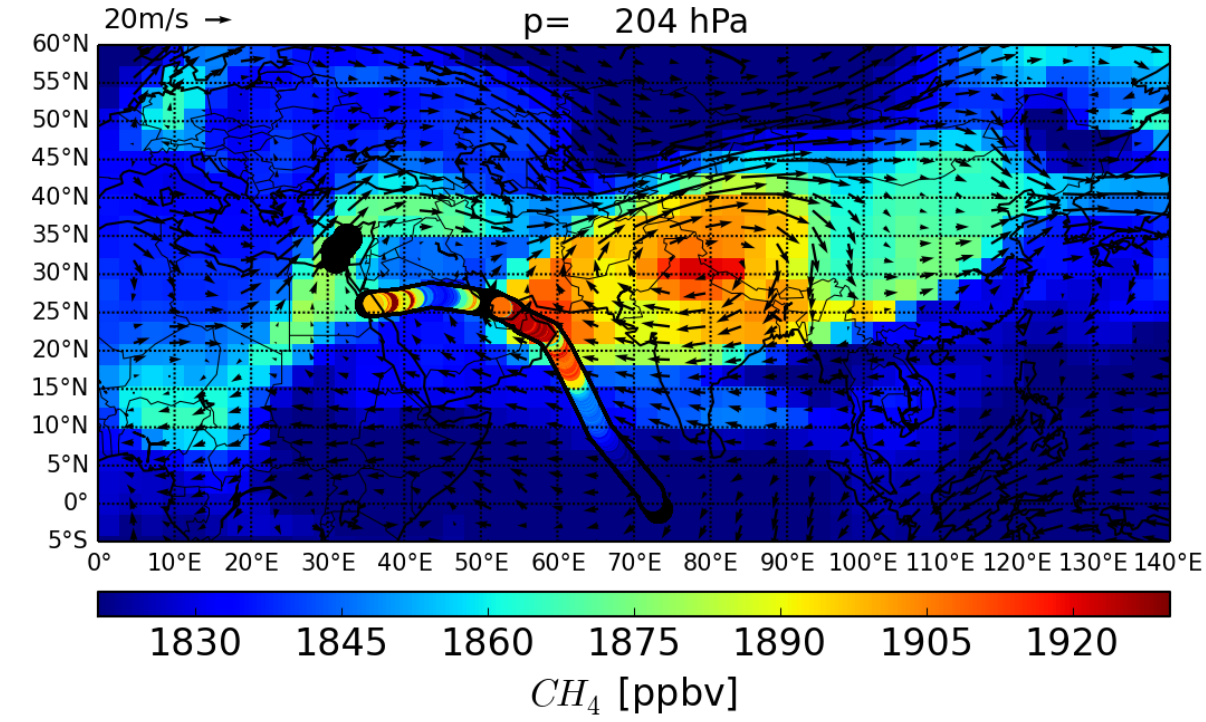
5 **Figure S7: Flight 15/16 (08.09.2015): measurement flight from Gan to Bahrain and return to Gan.**


altitude
CO_EMAC
CH4_EMAC
Δ CO
Δ CH4
CH4
AMA
CO
CH4 [ppbv] CO [ppbv]
ΔCO [%] altitude [m] Δ CH4 [%]
05:00
10.08.2015
07:30
10:00
12:30
UTC

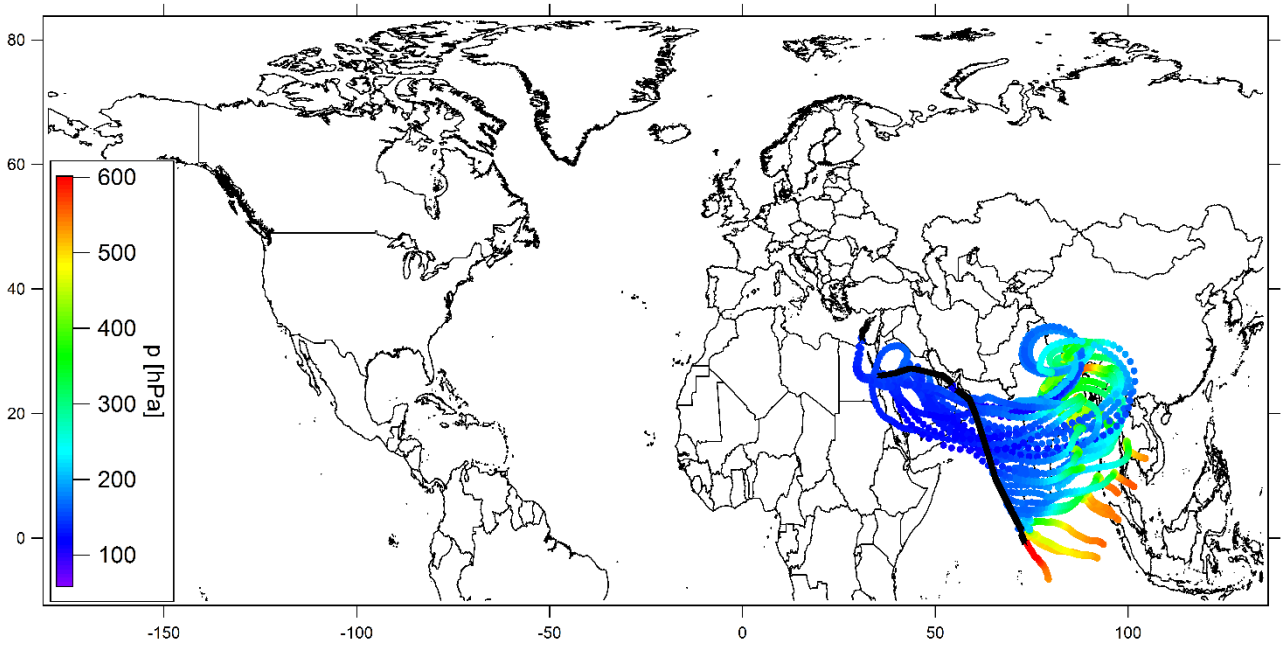
a)


20m/s
p= 204 hPa
CO [ppbv]

b)

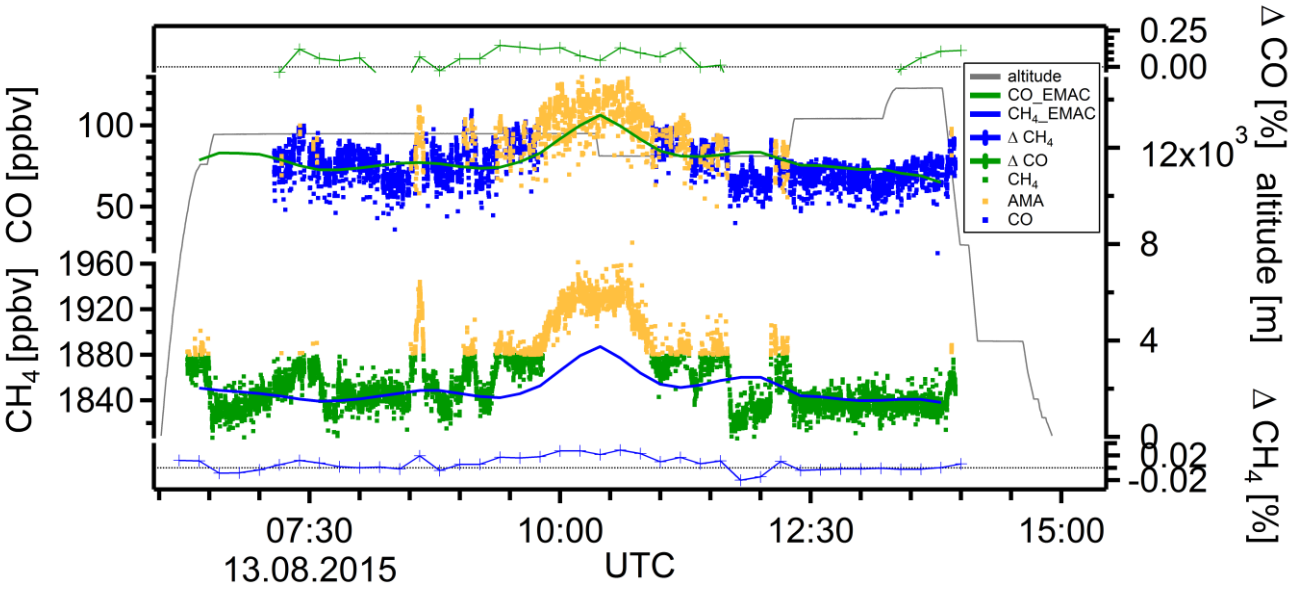


c)

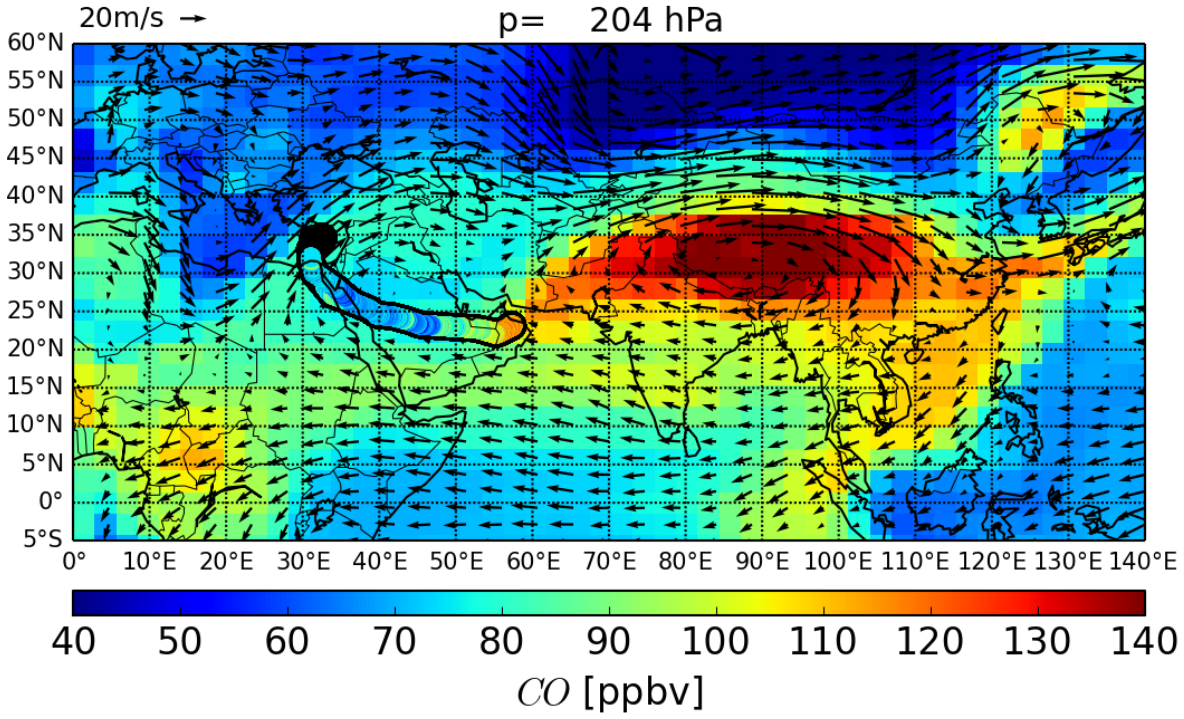


d)

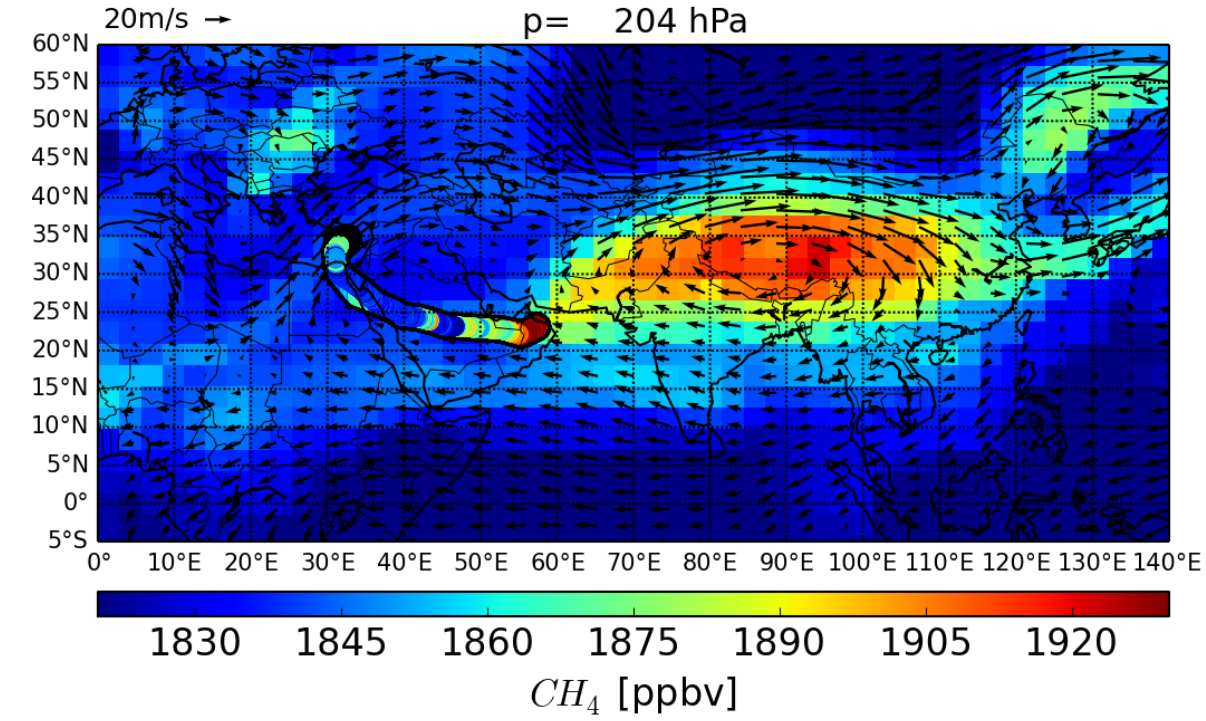
Figure S8: Flight 17/18 (08.10.2015): transfer flight from Gan to Paphos via refuelling stop in Bahrain.


altitude
CO_EMAC
CH4_EMAC
Δ CH4
Δ CO
CH4
AMA
CO
CH4 [ppbv] CO [ppbv]
Δ CO [%] altitude [m] Δ CH4 [%]
07:30
13.08.2015
10:00
UTC
12:30
15:00

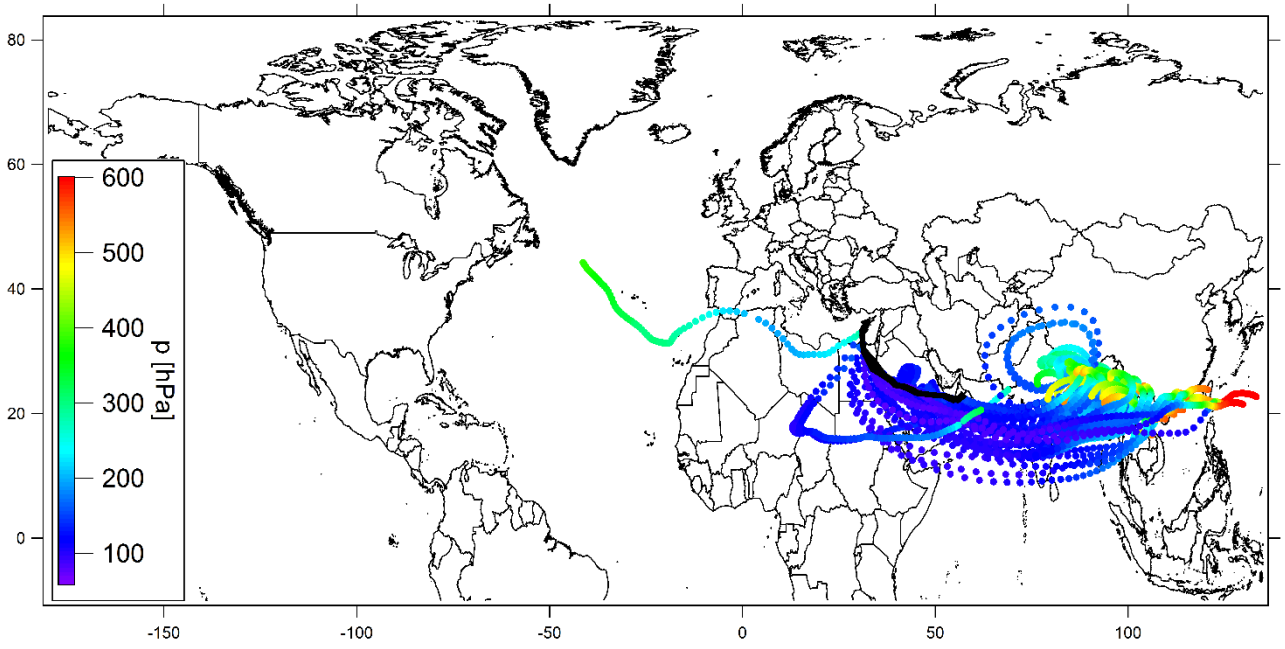
a)


20m/s
p= 204 hPa
CO [ppbv]

b)

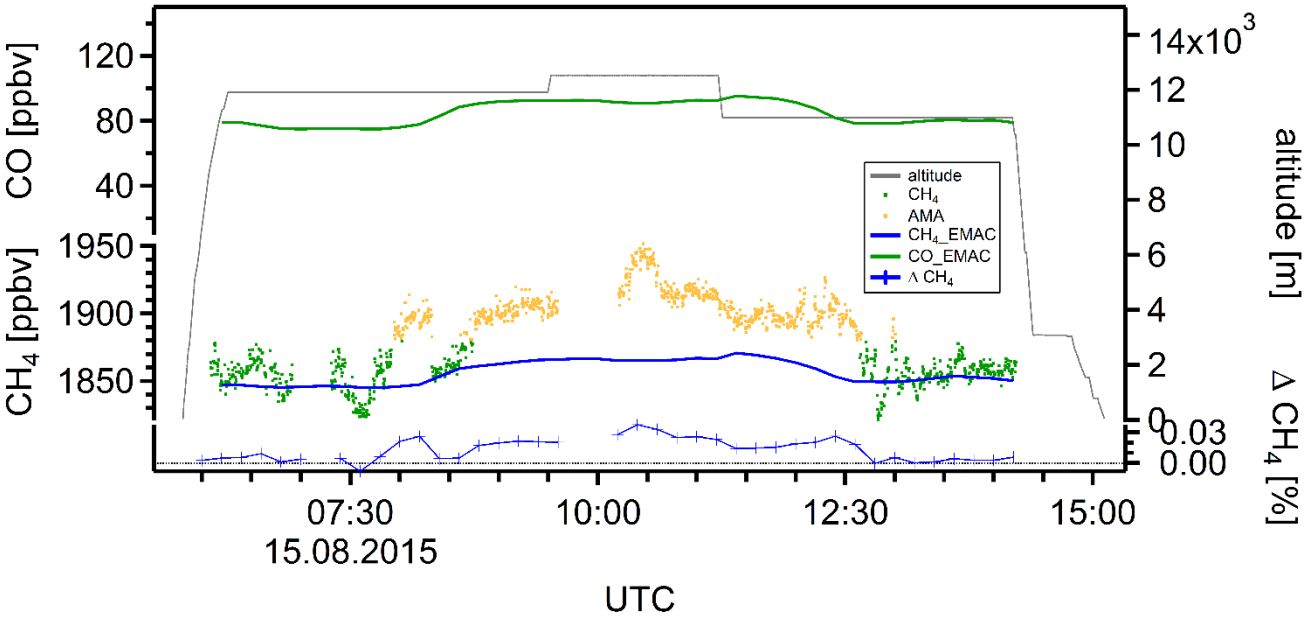


c)

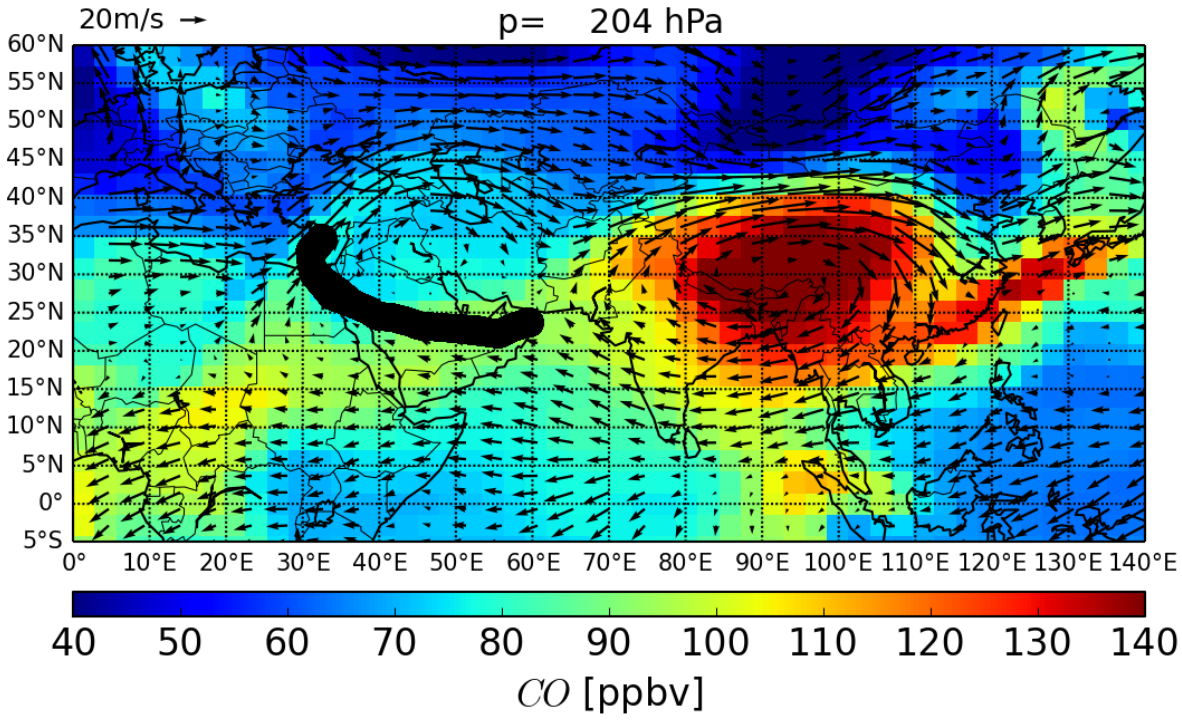


d)

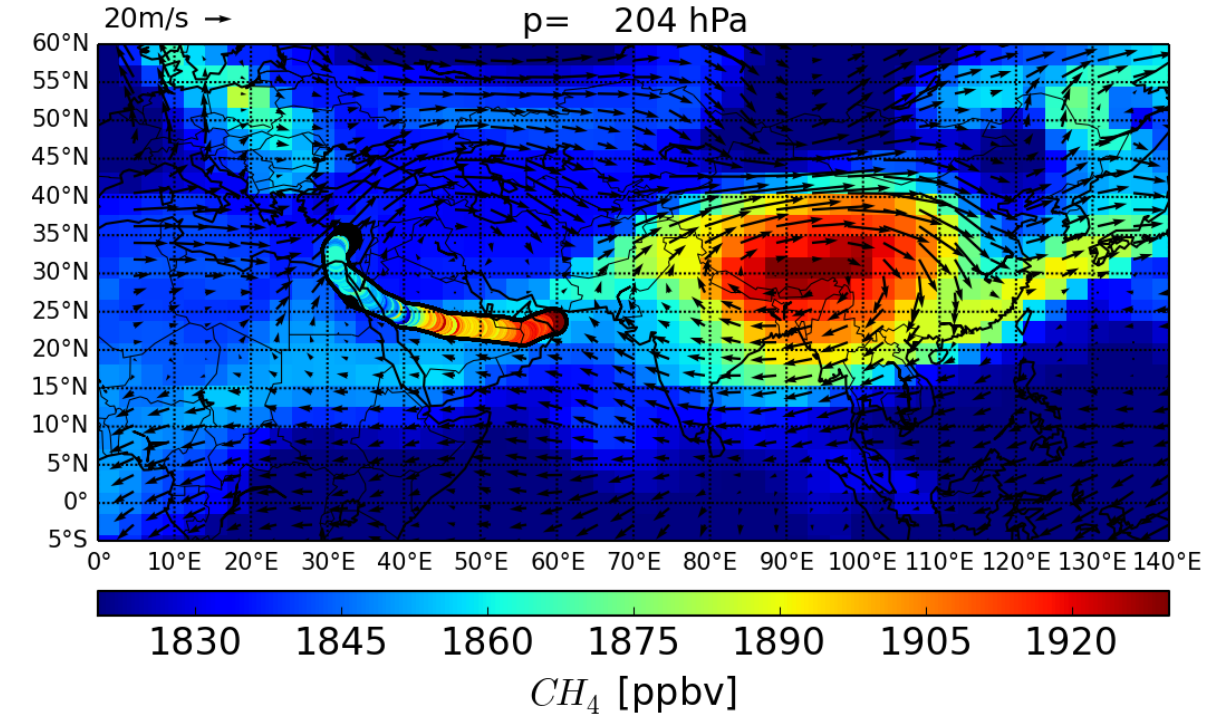
Figure S9: Flight 19 (08.13.2015): measurement flight from Paphos to Paphos towards Oman.


CO [ppbv]
CH4 [ppbv]
altitude [m]
Δ CH4 [%]
14x10^3
altitude
CH4
AMA
CH4_EMAC
CO_EMAC
Δ CH4
07:30
15.08.2015
10:00
12:30
15:00
UTC

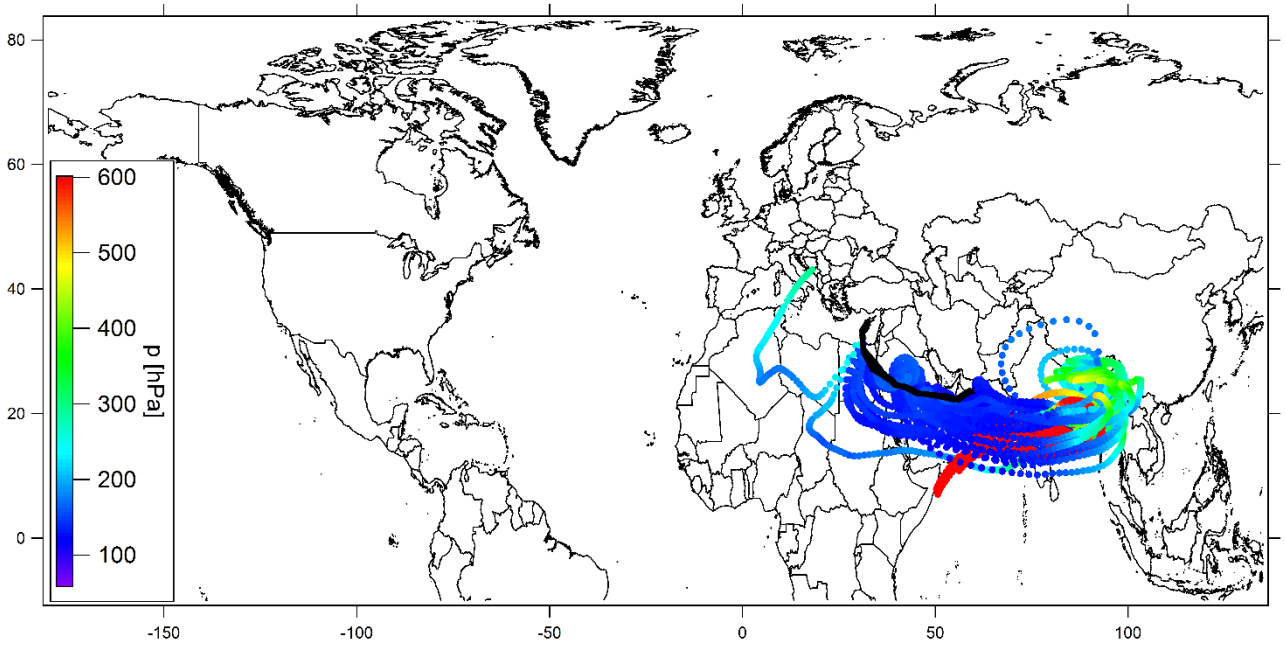
a)


20m/s
p= 204 hPa
60°N
55°N
50°N
45°N
40°N
35°N
30°N
25°N
20°N
15°N
10°N
5°N
0°
5°S
0° 10°E 20°E 30°E 40°E 50°E 60°E 70°E 80°E 90°E 100°E 110°E 120°E 130°E 140°E
40 50 60 70 80 90 100 110 120 130 140
CO [ppbv]

b)

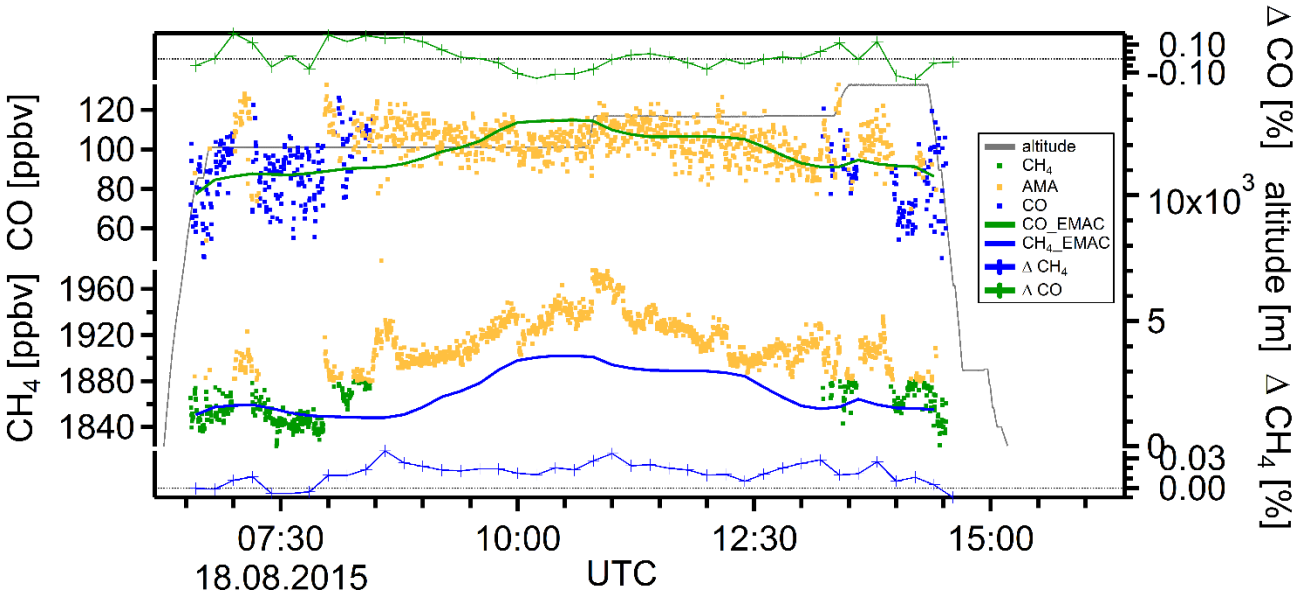


c)

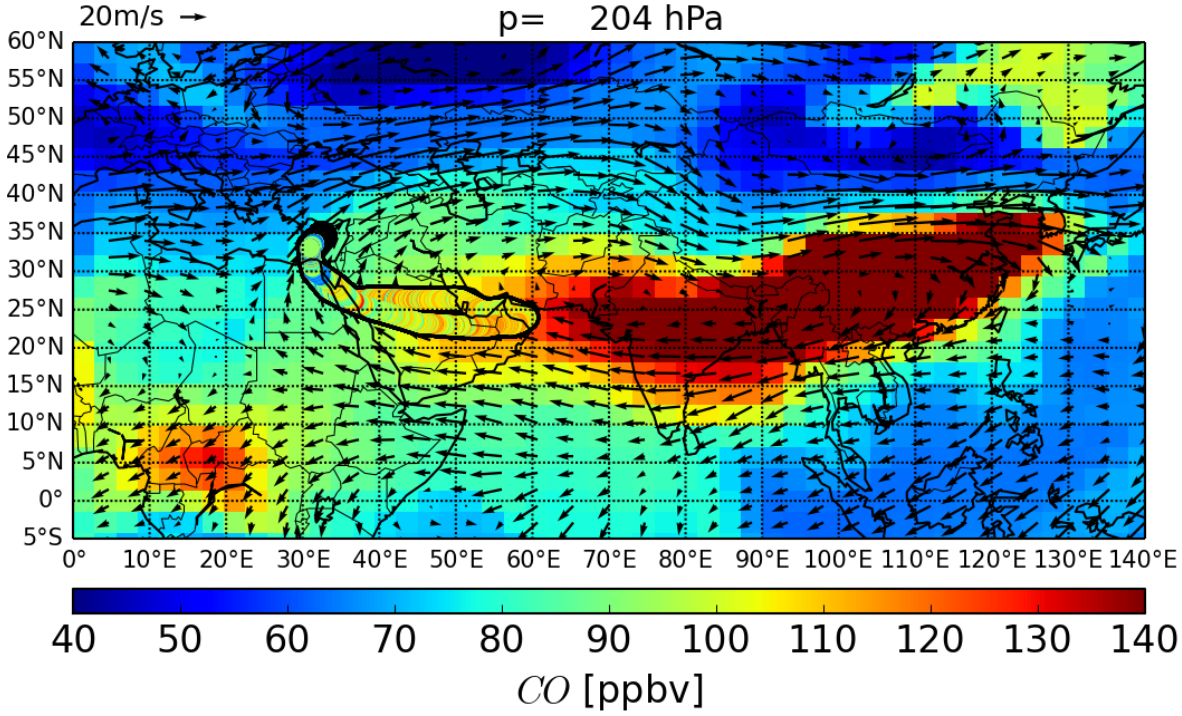


d)

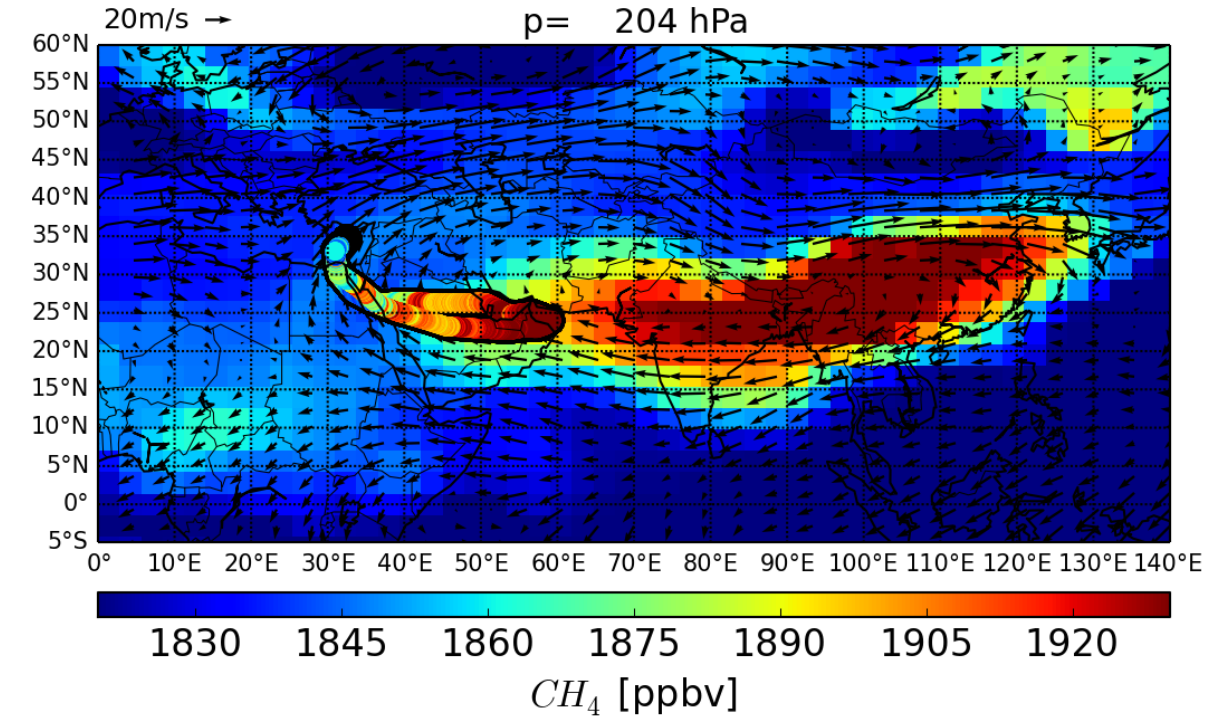
Figure S10: Flight 20 (08.15.2015): measurement flight from Paphos to Paphos towards Oman.


CO [ppbv]
CH4 [ppbv]
altitude [m]
Δ CO [%]
Δ CH4 [%]
altitude
CH4
AMA
CO
CO_EMAC
CH4_EMAC
Δ CH4
Δ CO
07:30
18.08.2015
10:00
12:30
15:00
UTC

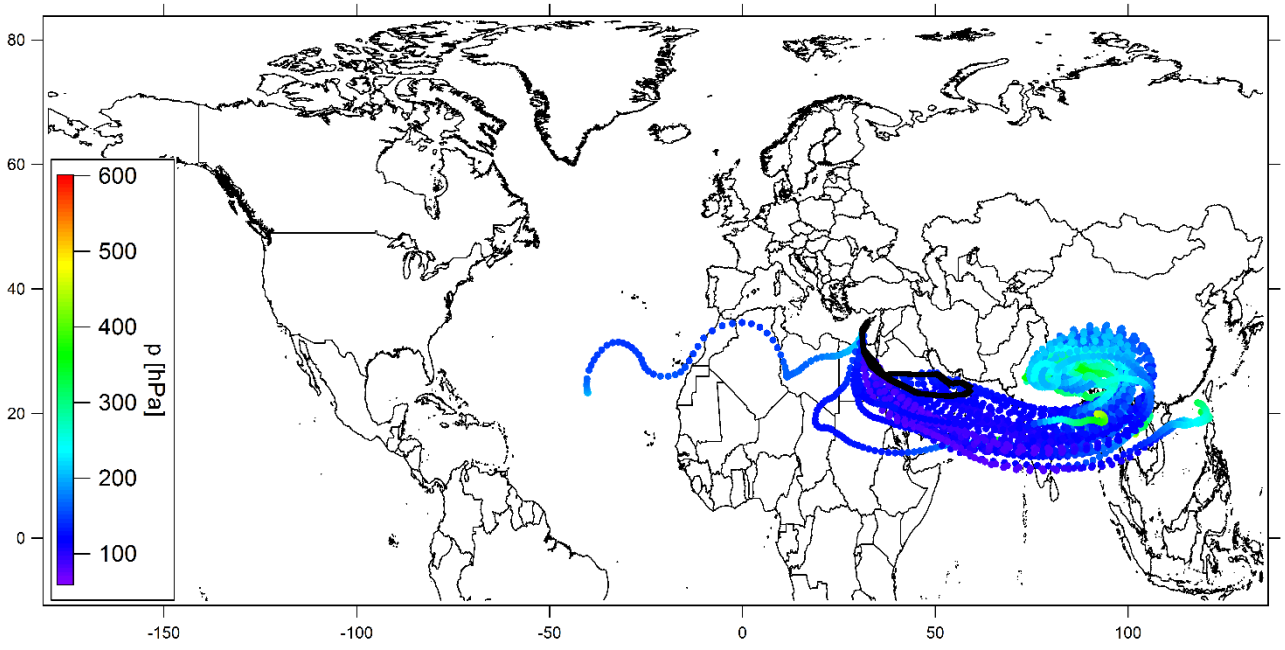
a)


20m/s
p= 204 hPa
CO [ppbv]

b)

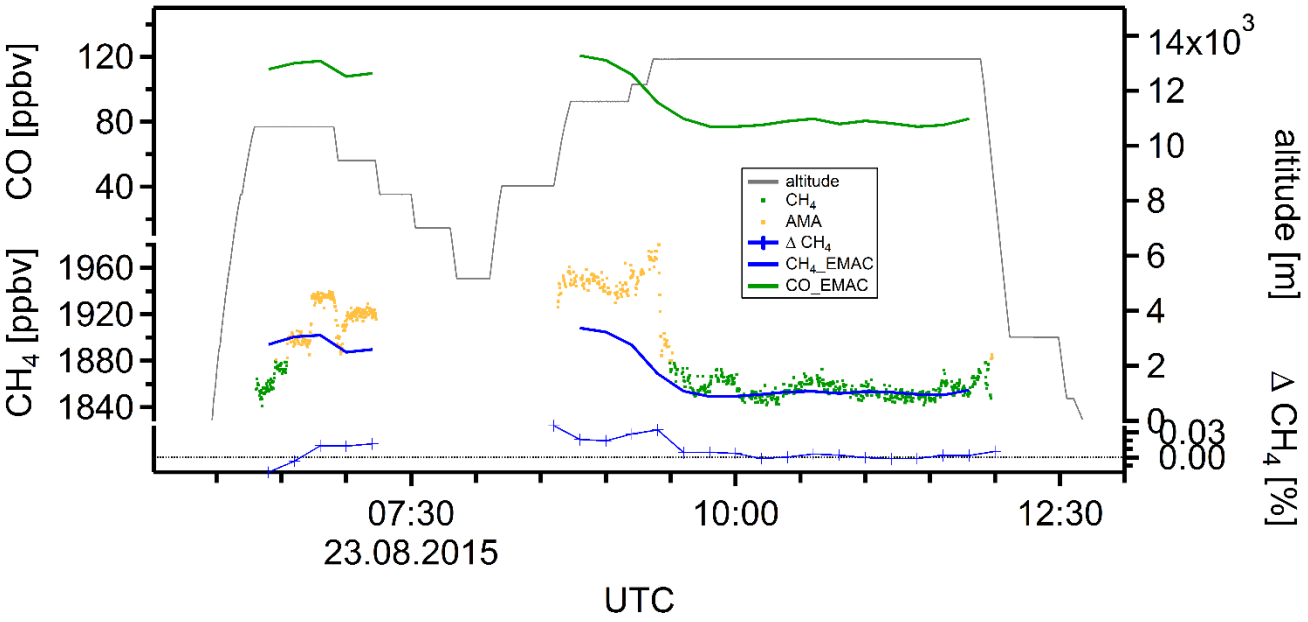


c)

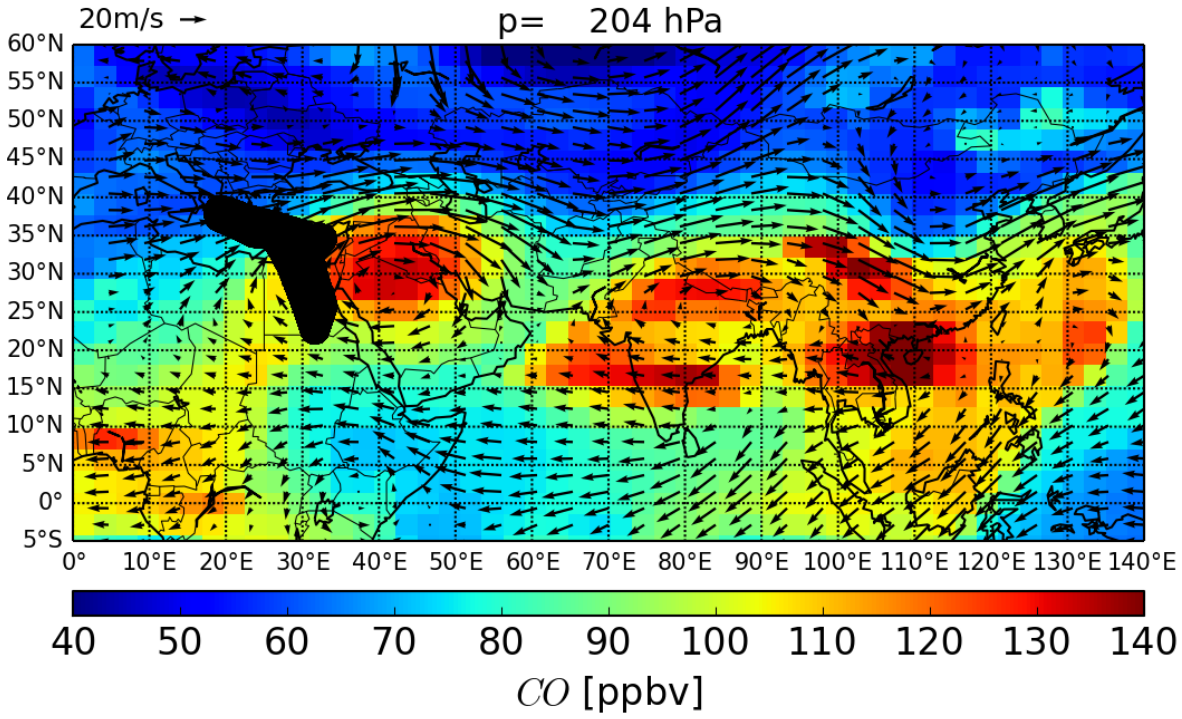


d)

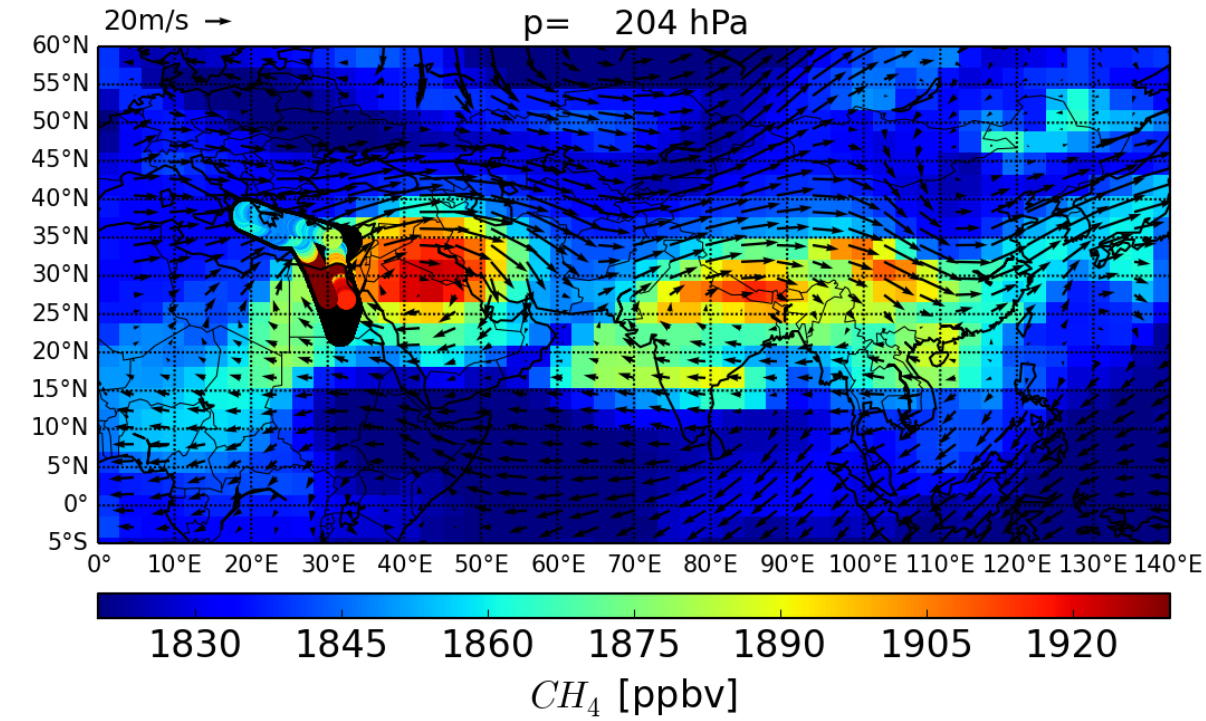
Figure S11: Flight 21 (08.18.2015): measurement flight from Paphos to Paphos towards Oman.


CO [ppbv]
CH4 [ppbv]
altitude [m]
Δ CH4 [%]
altitude
CH4
AMA
Δ CH4
CH4_EMAC
CO_EMAC
07:30
23.08.2015
10:00
12:30
UTC

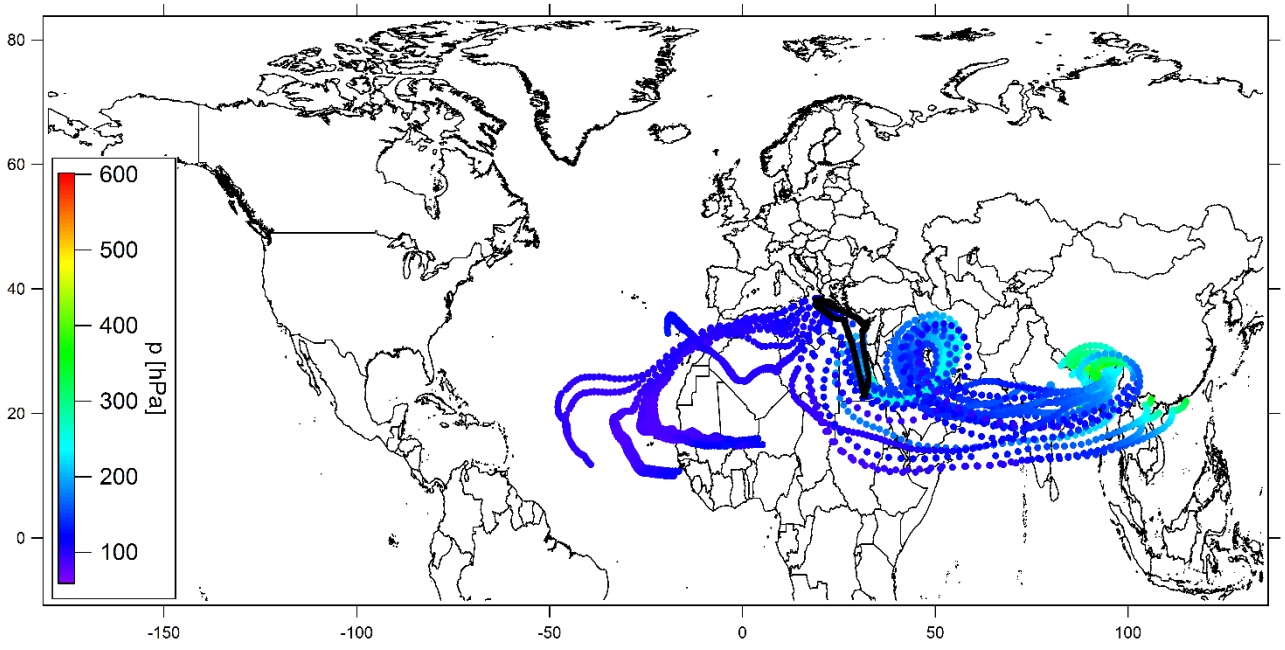
a)


20m/s
p= 204 hPa
CO [ppbv]

b)

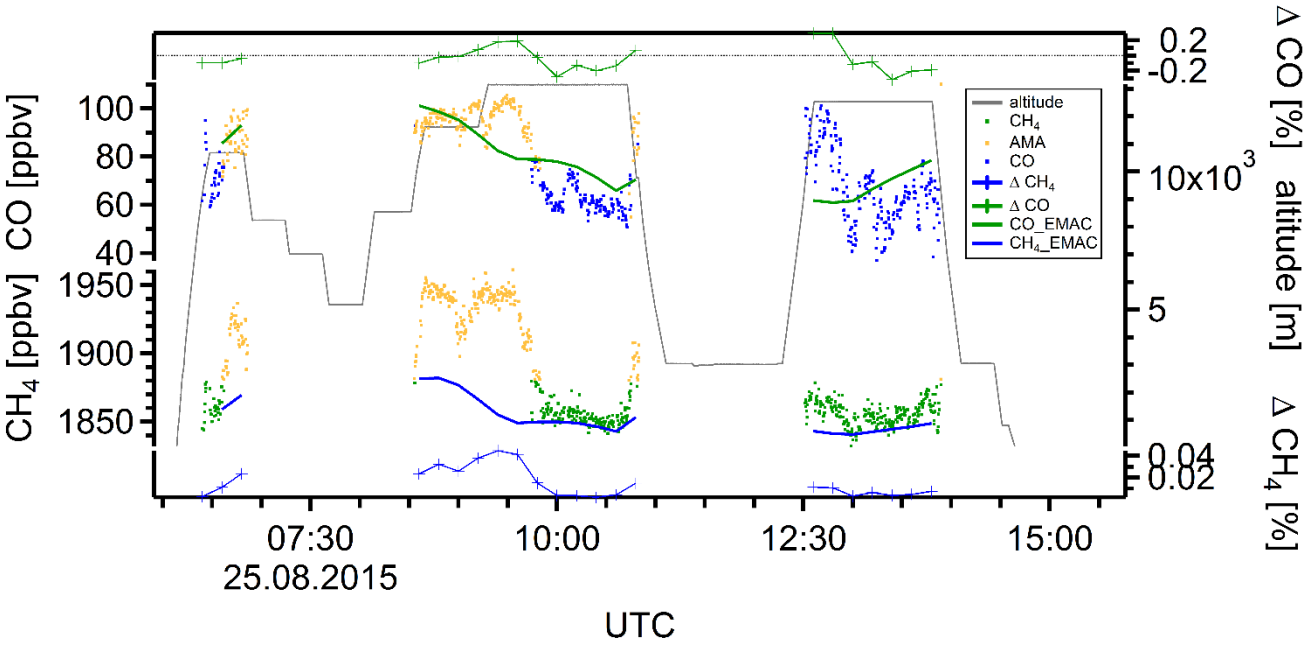


c)

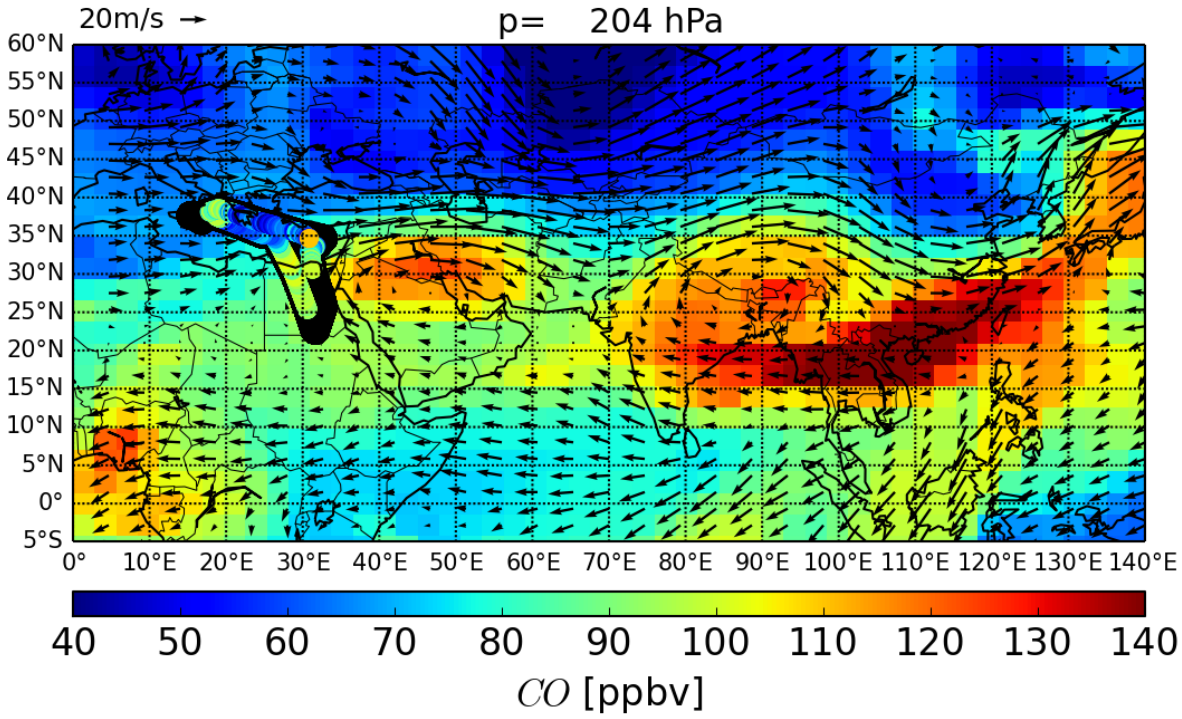


d)

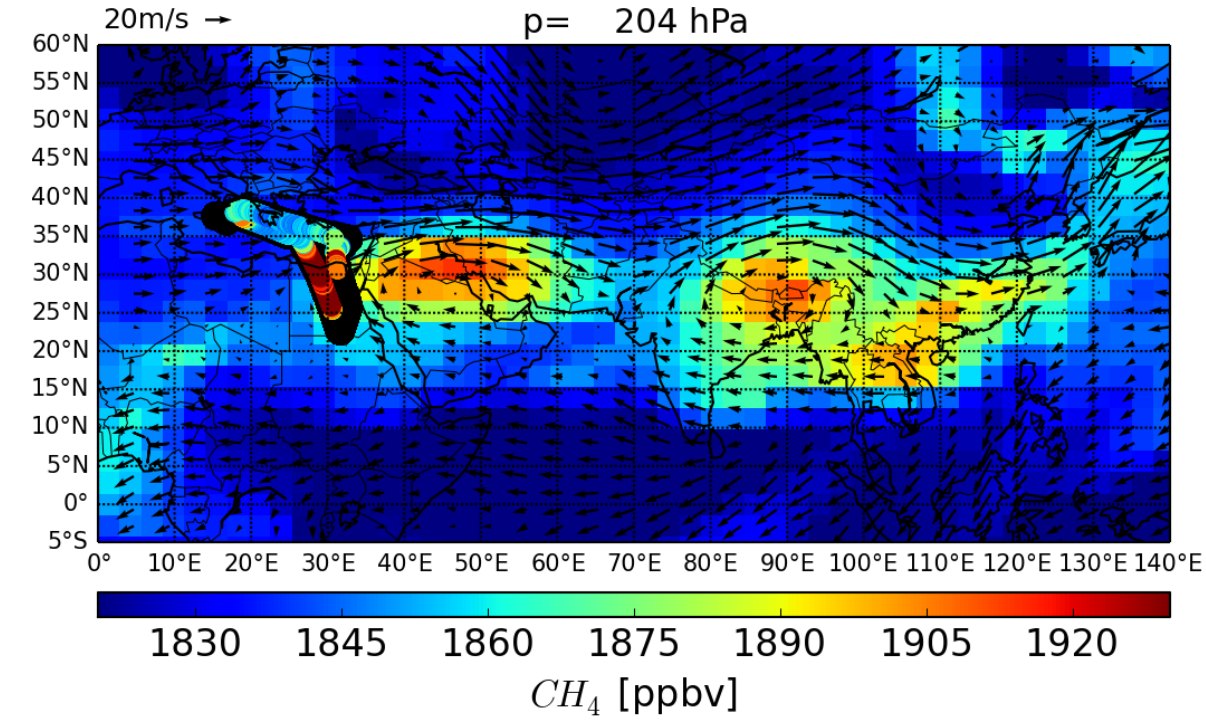
Figure S12: Flight 22 (08.23.2015): measurement flight from Paphos to Paphos over Egypt, Greece, the Mediterranean; with profiles over Egypt.


CH4 [ppbv] CO [ppbv]
Δ CO [%] altitude [m] Δ CH4 [%]
altitude
CH4
AMA
CO
Δ CH4
Δ CO
CO_EMAC
CH4_EMAC
07:30
25.08.2015
10:00
12:30
15:00
UTC

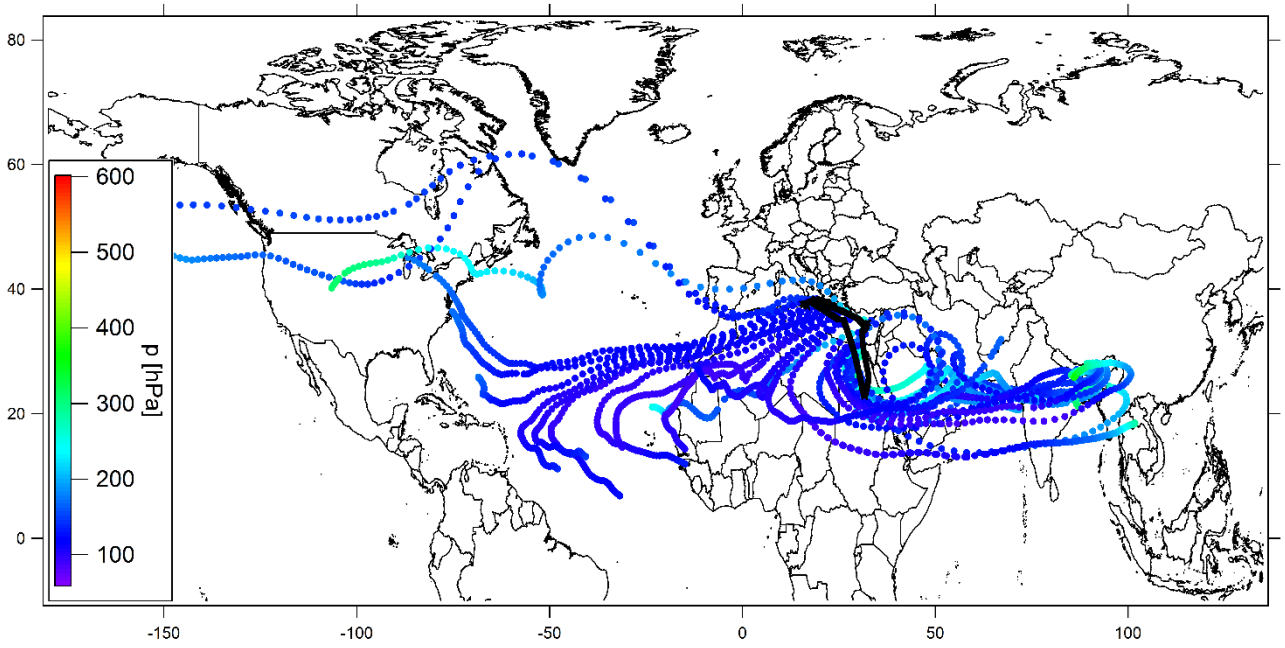
a)


20m/s
p= 204 hPa
CO [ppbv]

b)

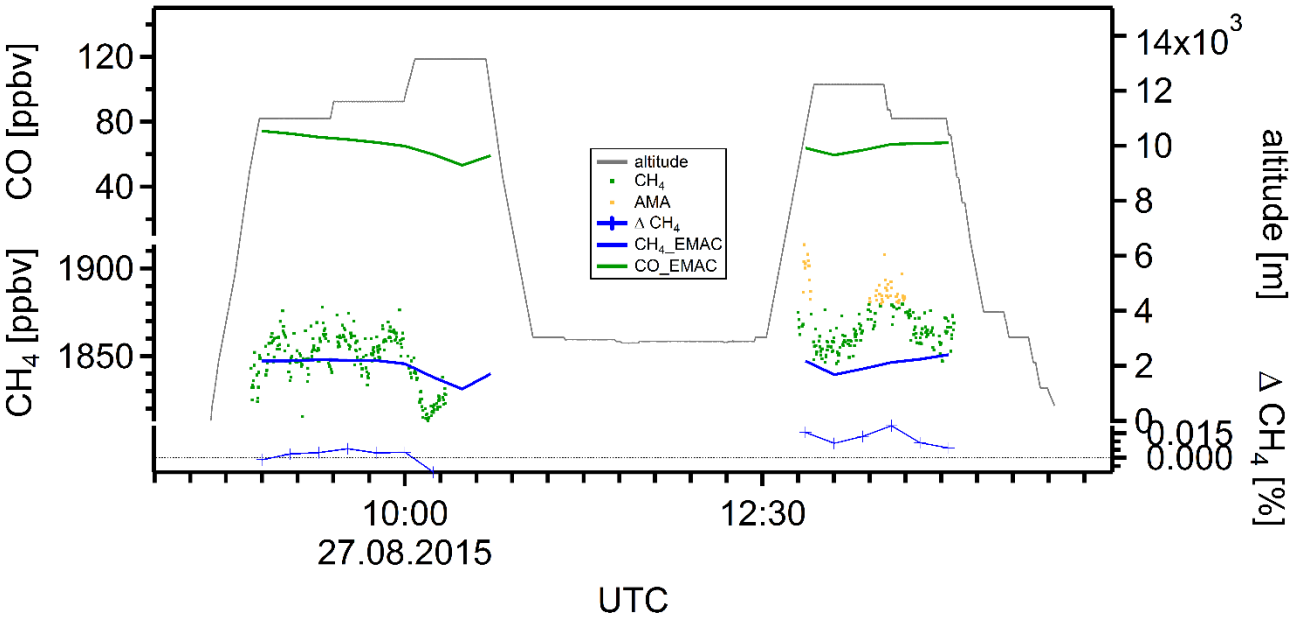


c)

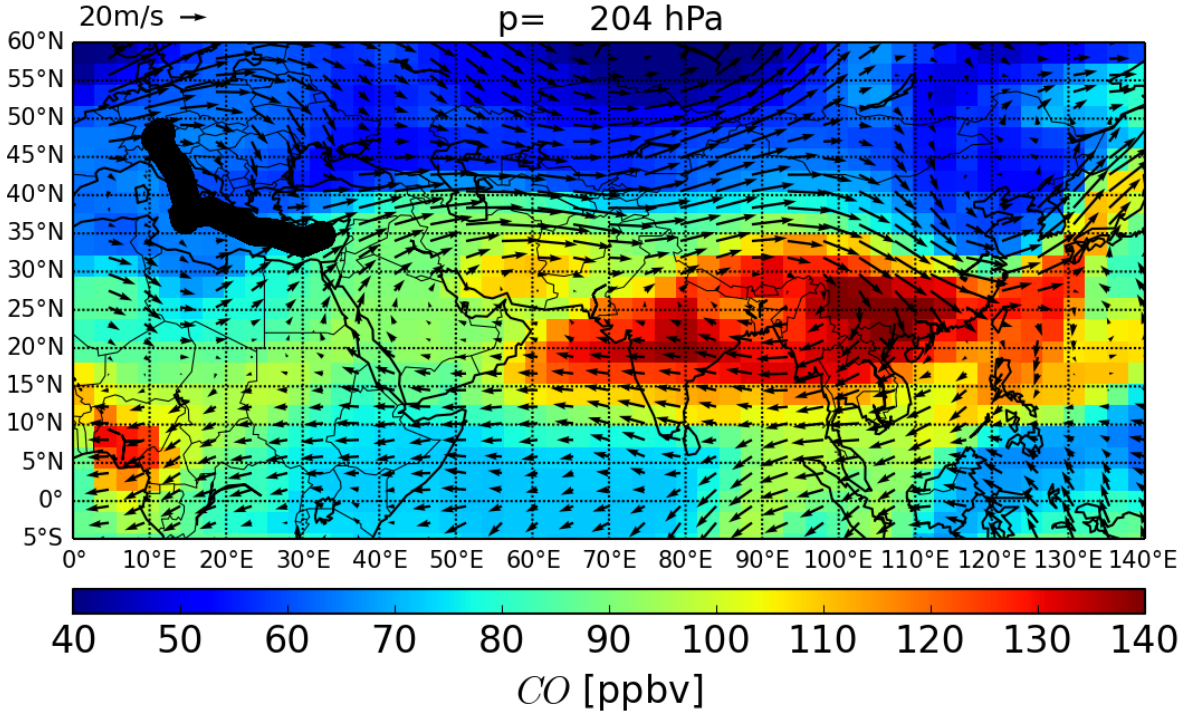


d)

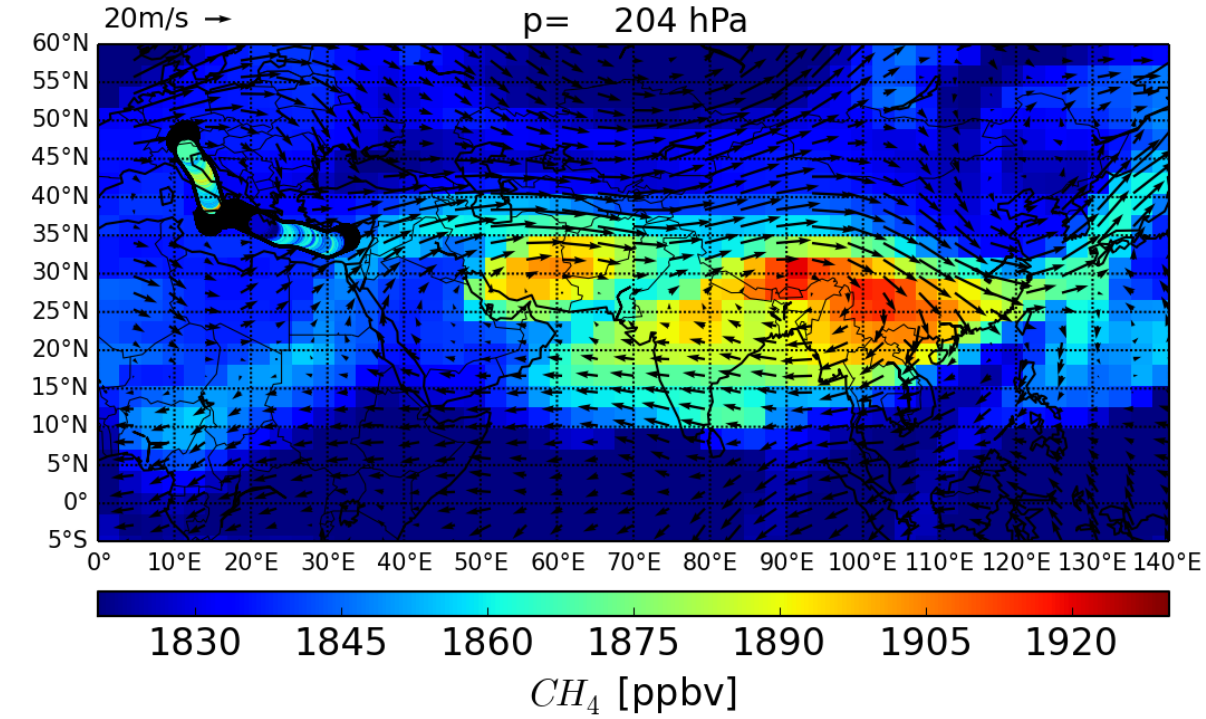
Figure S13: Flight 23 (08.25.2015): measurement flight from Paphos to Paphos over Egypt, Etna, the Mediterranean; with profiles over Egypt and low altitude at the Etna.


CO [ppbv]
CH4 [ppbv]
altitude [m]
Δ CH4 [%]
altitude
CH4
AMA
Δ CH4
CH4_EMAC
CO_EMAC
10:00
27.08.2015
12:30
UTC

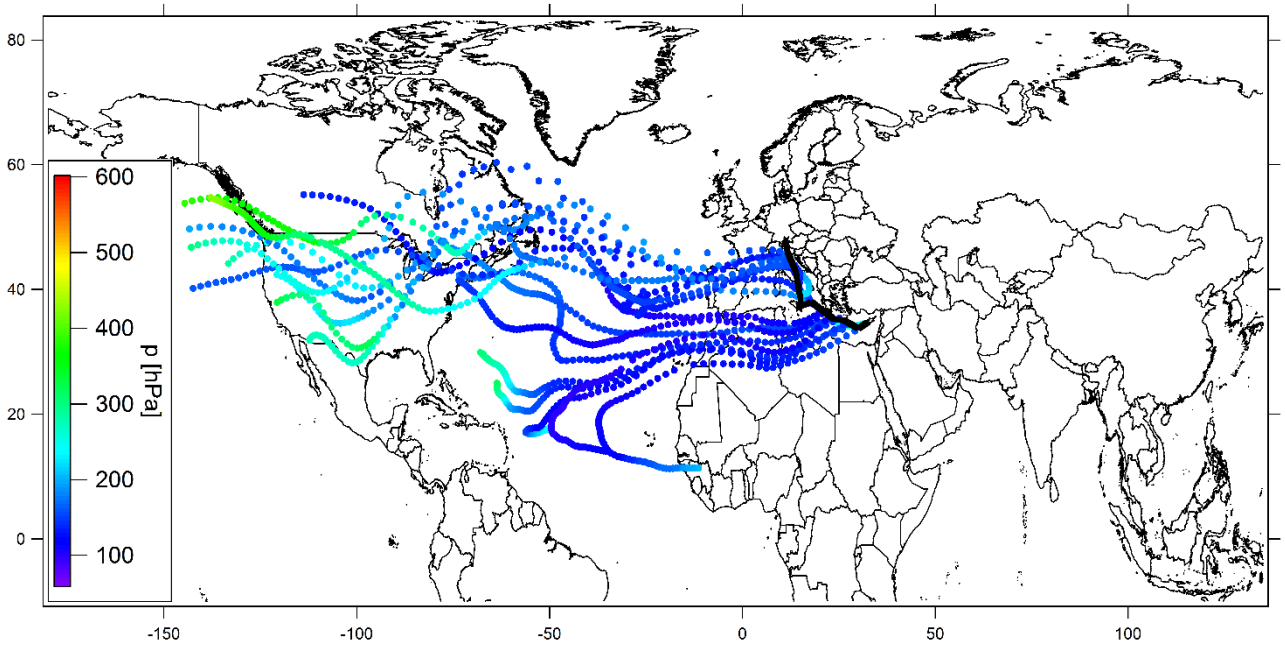
a)


20m/s
p= 204 hPa
CO [ppbv]

b)



c)



d)

Figure S14: Flight 24 (08.27.2015): transfer flight from Paphos to Oberpfaffenhofen via Etna with low altitude.