9 April 2009 Case Study: Current Analysis

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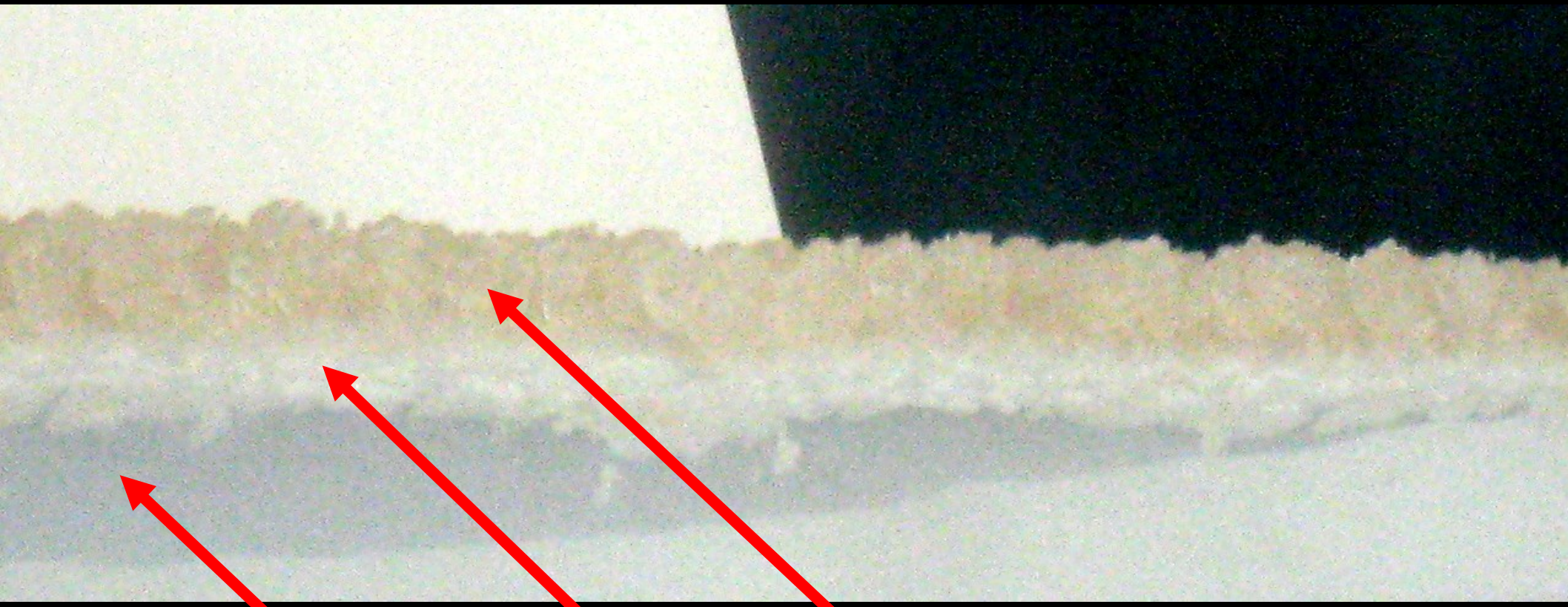
9 April 2009 Picture 13:32 UTC

9 April 2009 ~13:32 UTC

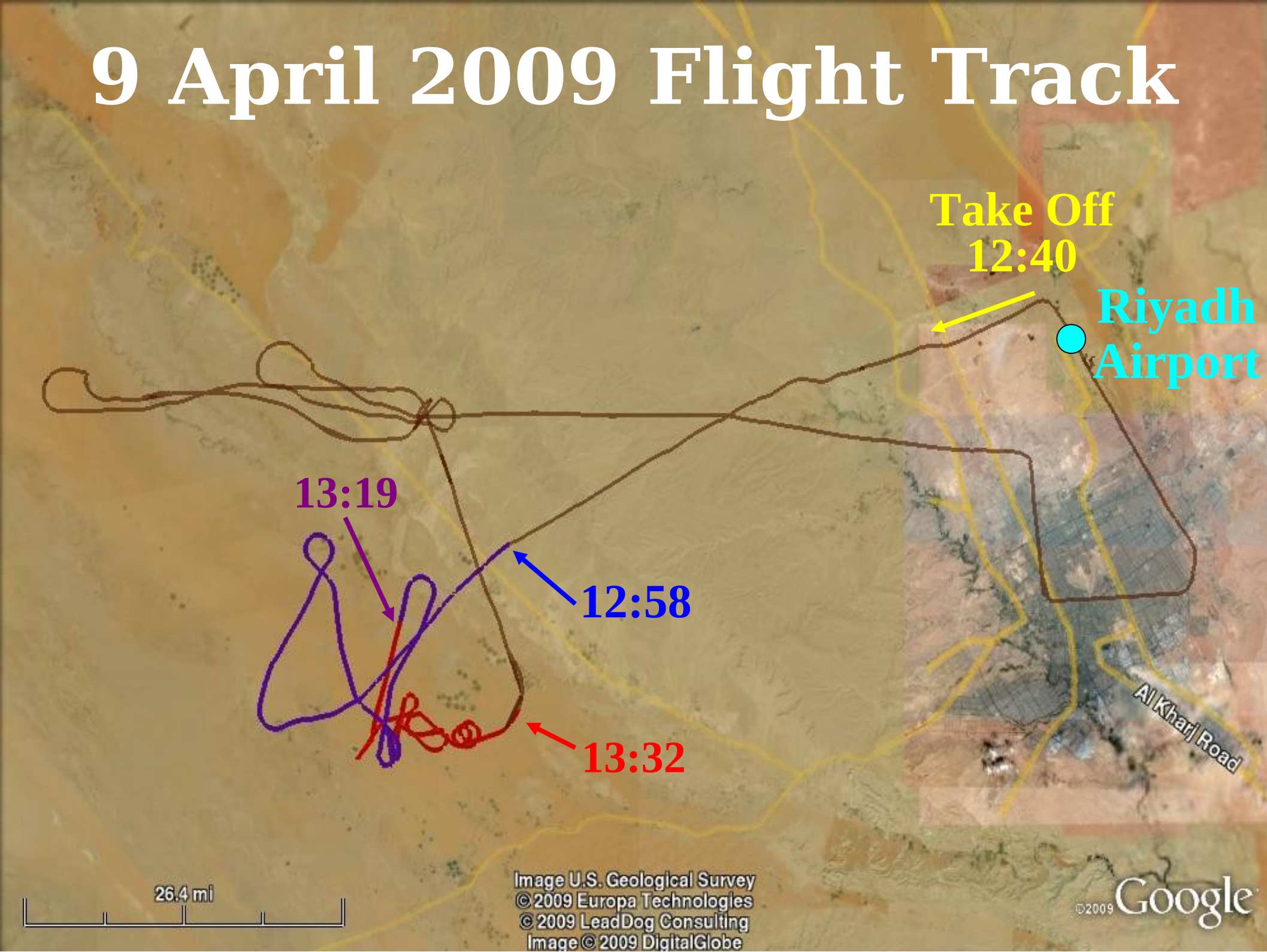


9 April 2009 Case Study

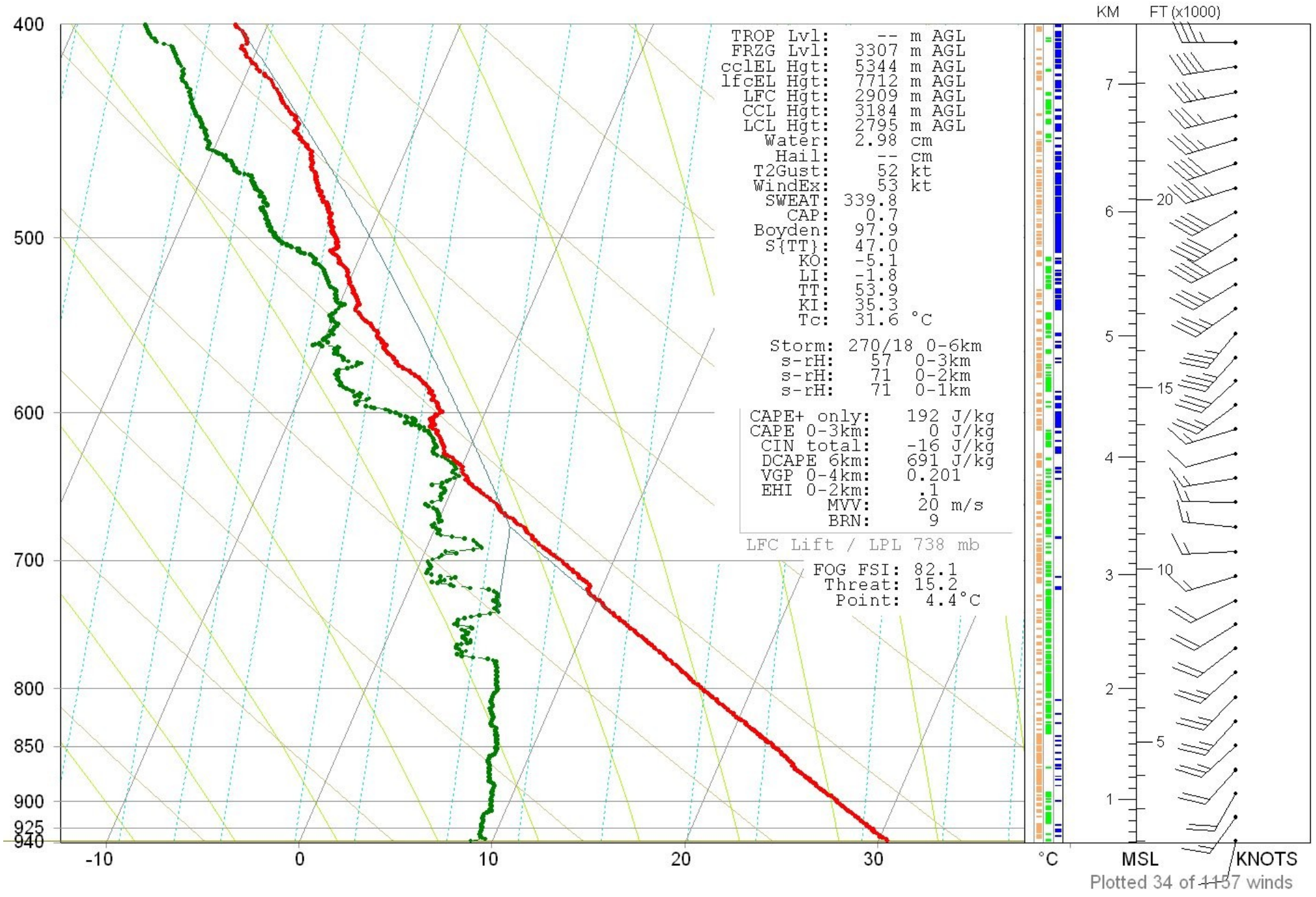
Observation: Ice accumulation on the unprotected leading edge of the aircraft's wing show a color change from white to brown.

Objective: Test the hypothesis that the observation of brown ice build up on the aircraft wings were the result of the ingestion of a large concentration of aerosols by the cloud and document the differences in cloud properties between the brown ice cloud and a typical cloud.

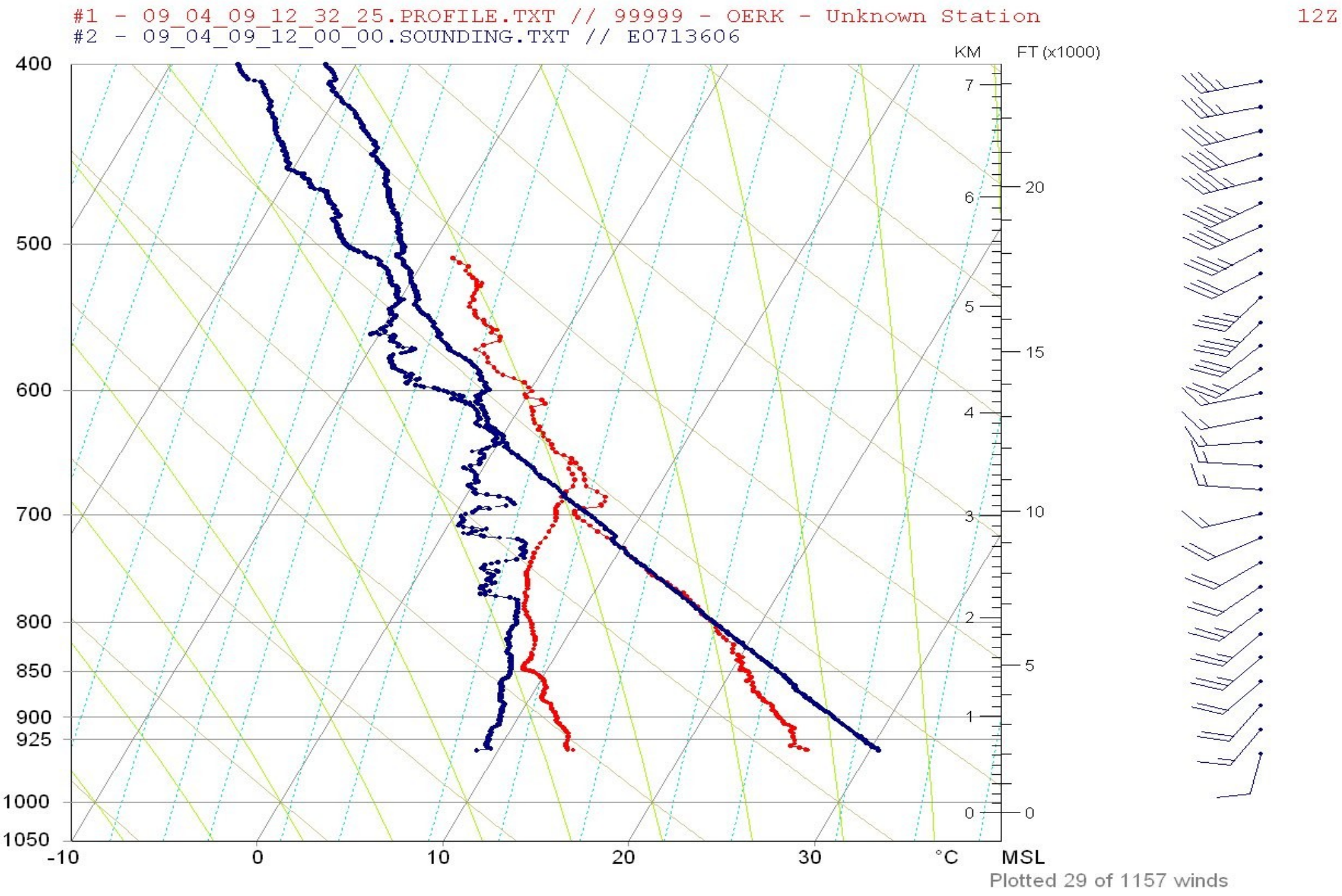
9 April 2009 Flight Track



9 April 2009 Riyadh Sounding



Riyadh Sounding Comparisons

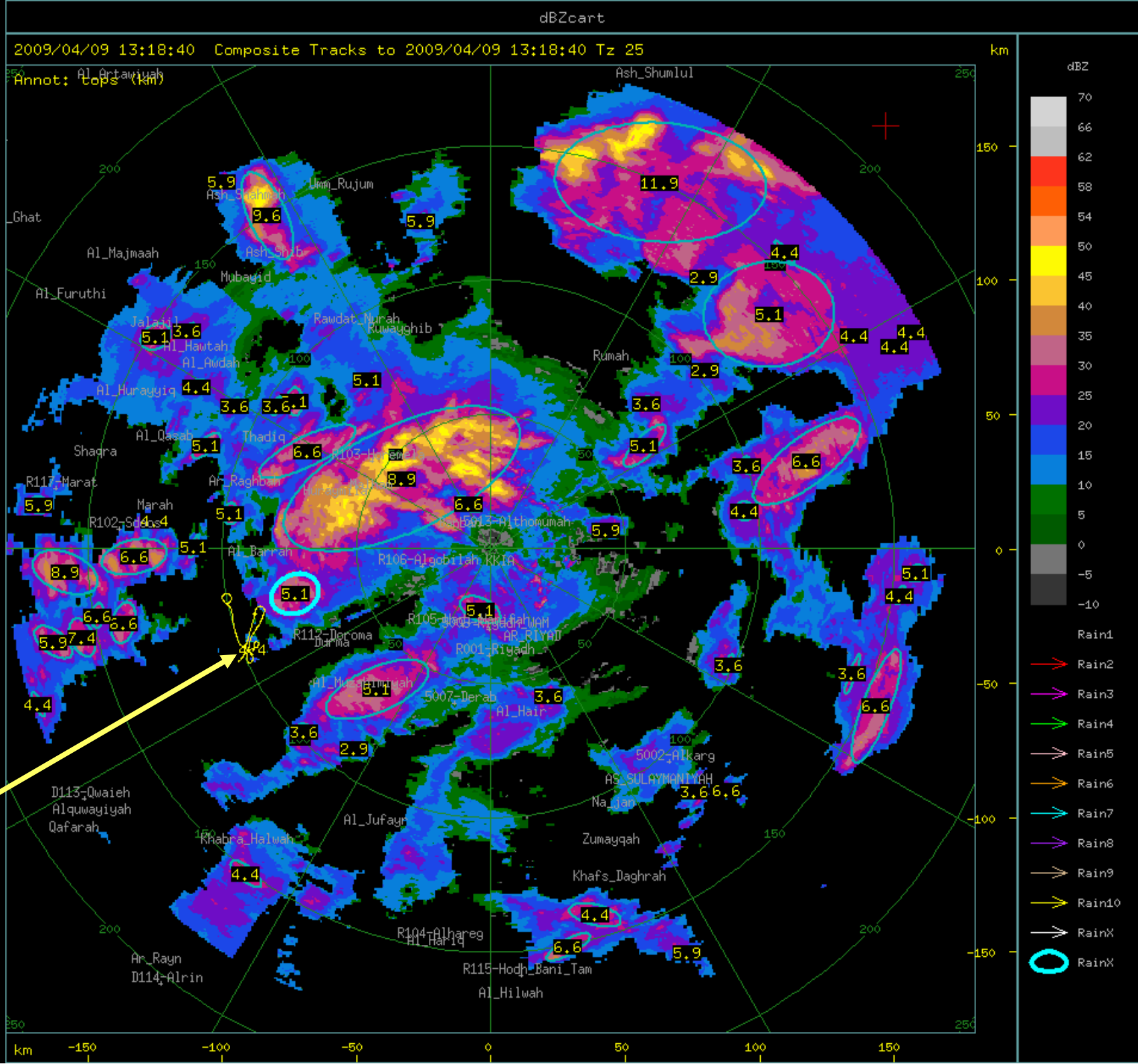


TITAN Radar Display

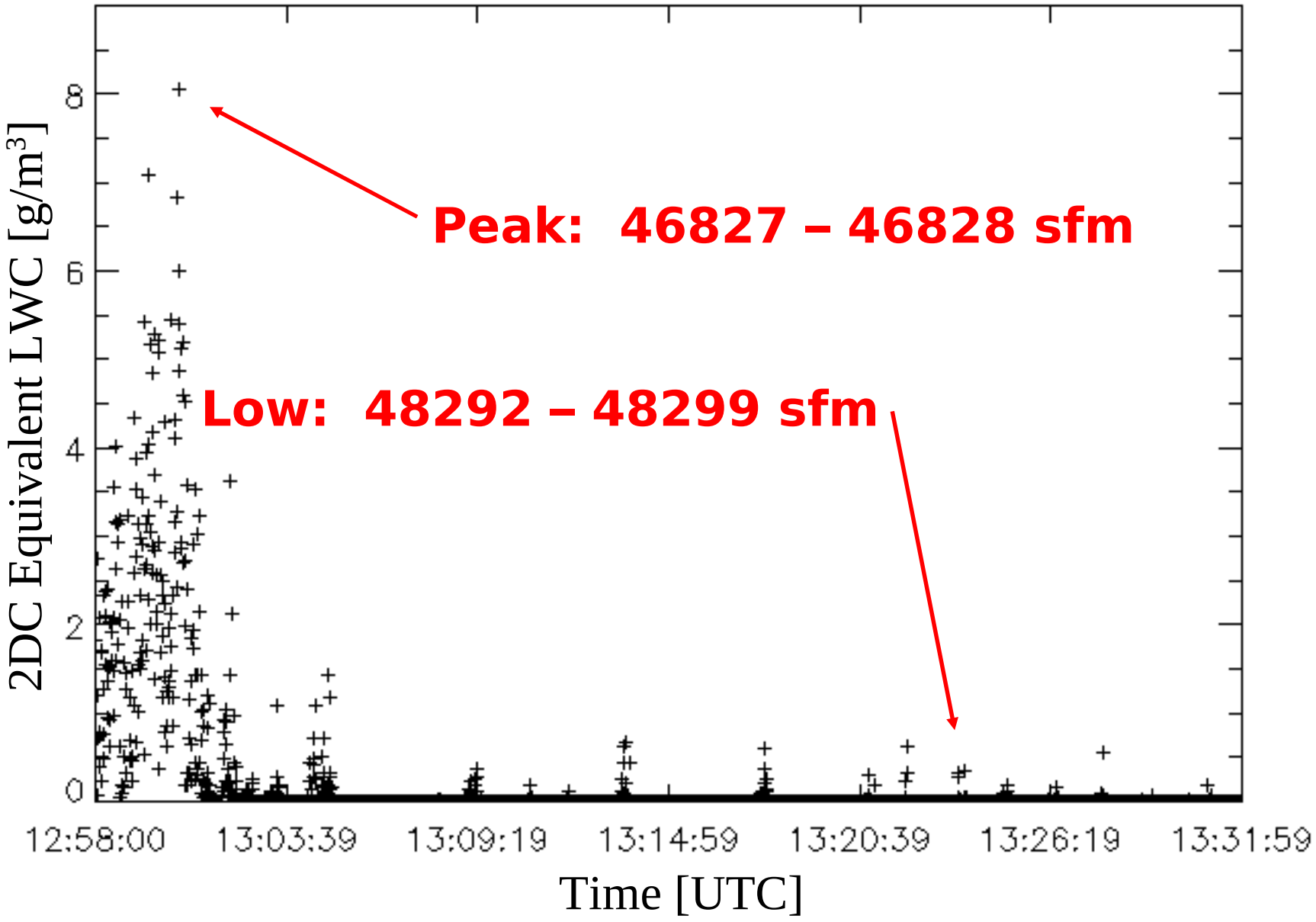
Riyadh Saudi Arabia

9 April 2009 13:19:40

Aircraft Track

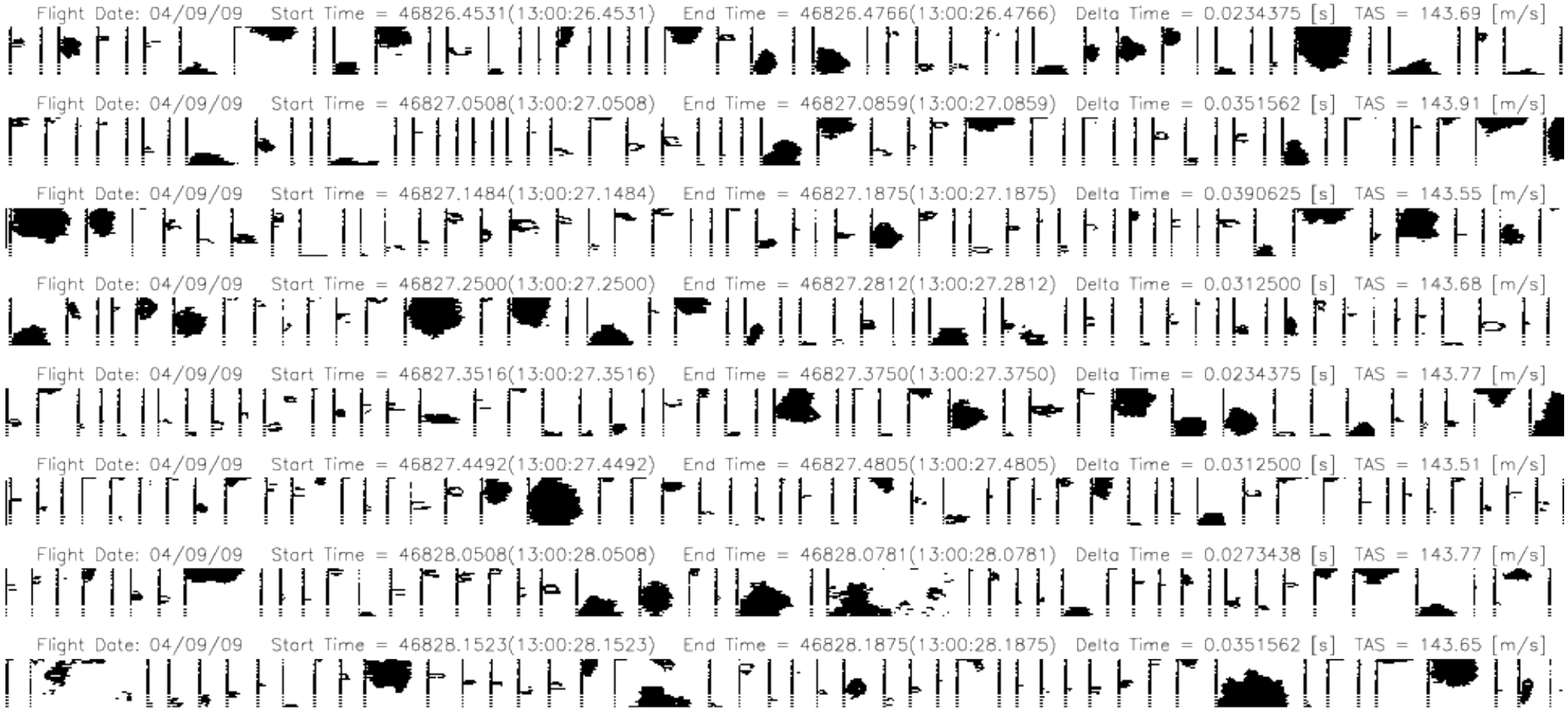


9 April 2009 Flight



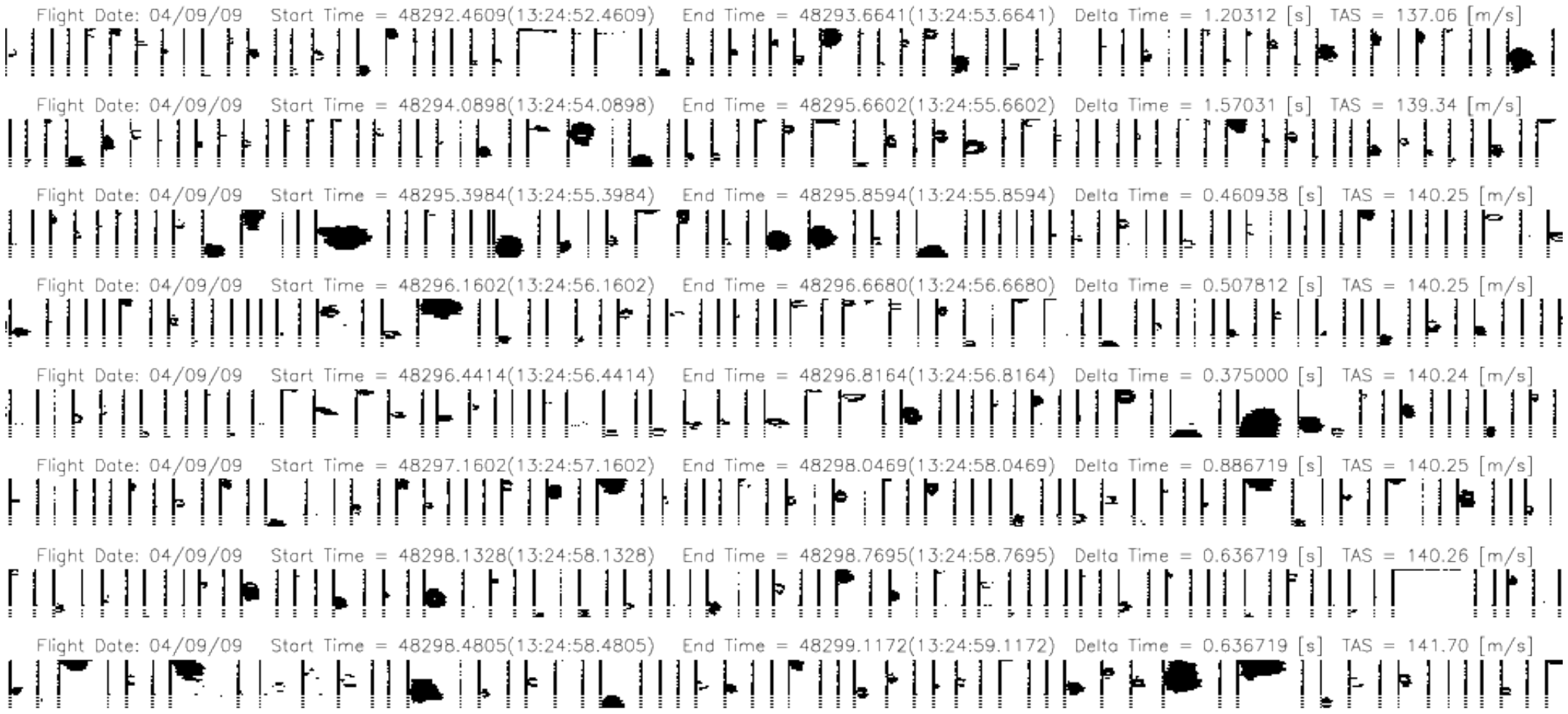
Liquid water content equivalent (1 Hz data) at 18,000 ft measured by 2-DC probe on a research flight in Saudi Arabia.

9 April 2009 Flight



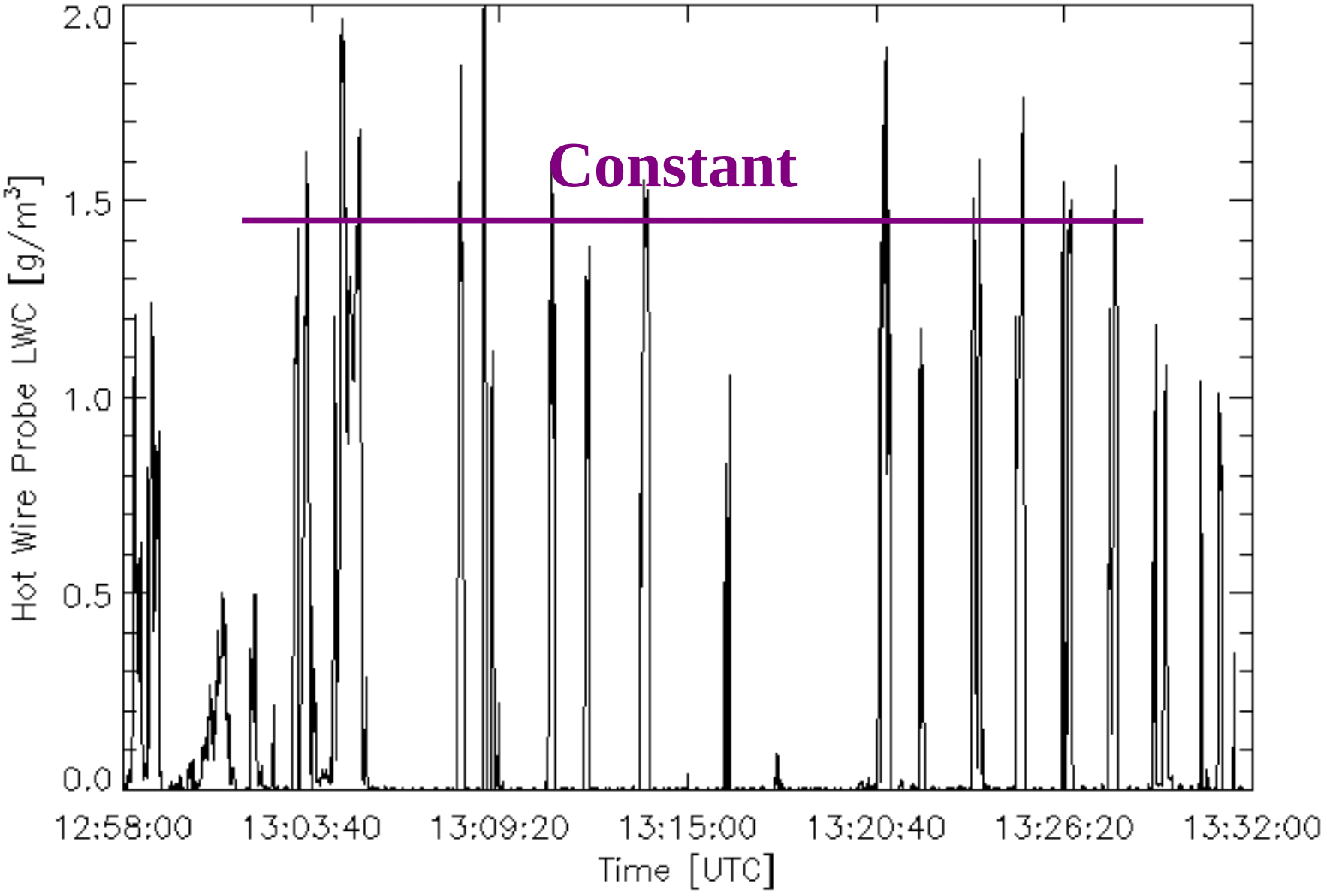
Images from the 2-DC between 13:00:26.45 and 13:00:28.19 (less than 2 seconds total) which correspond to the maximum liquid water content equivalent (1 Hz data) measured by 2-DC probe between on 9 April 2009 research flight in Saudi Arabia.

9 April 2009 Flight



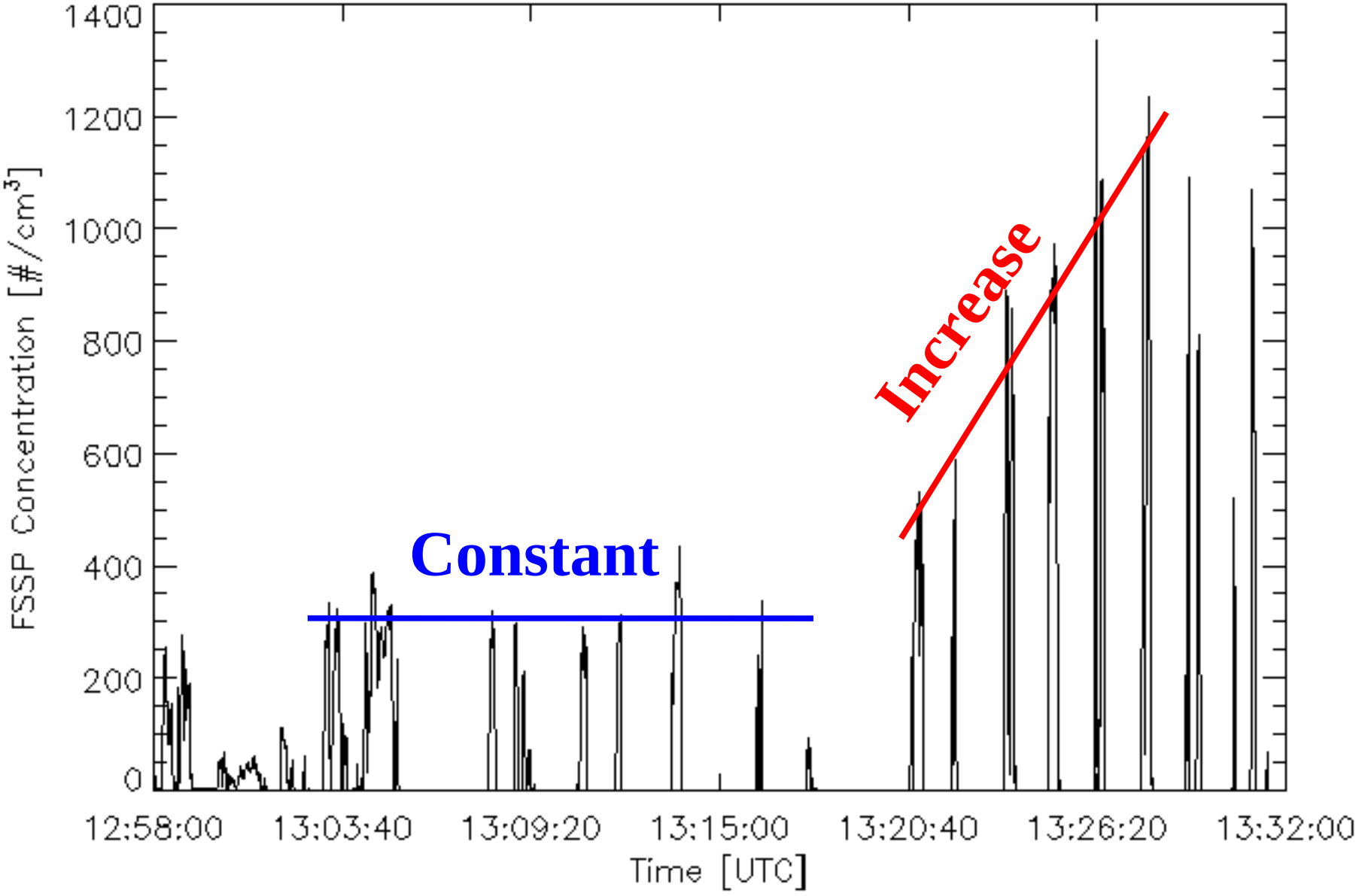
Images from the 2-DC between 13:24:52.46 and 13:24.59 (9 seconds total) which correspond to the low liquid water content equivalent (1 Hz data) measured by 2-DC probe on 9 April 2009 research flight in Saudi Arabia.

9 April 2009 Flight



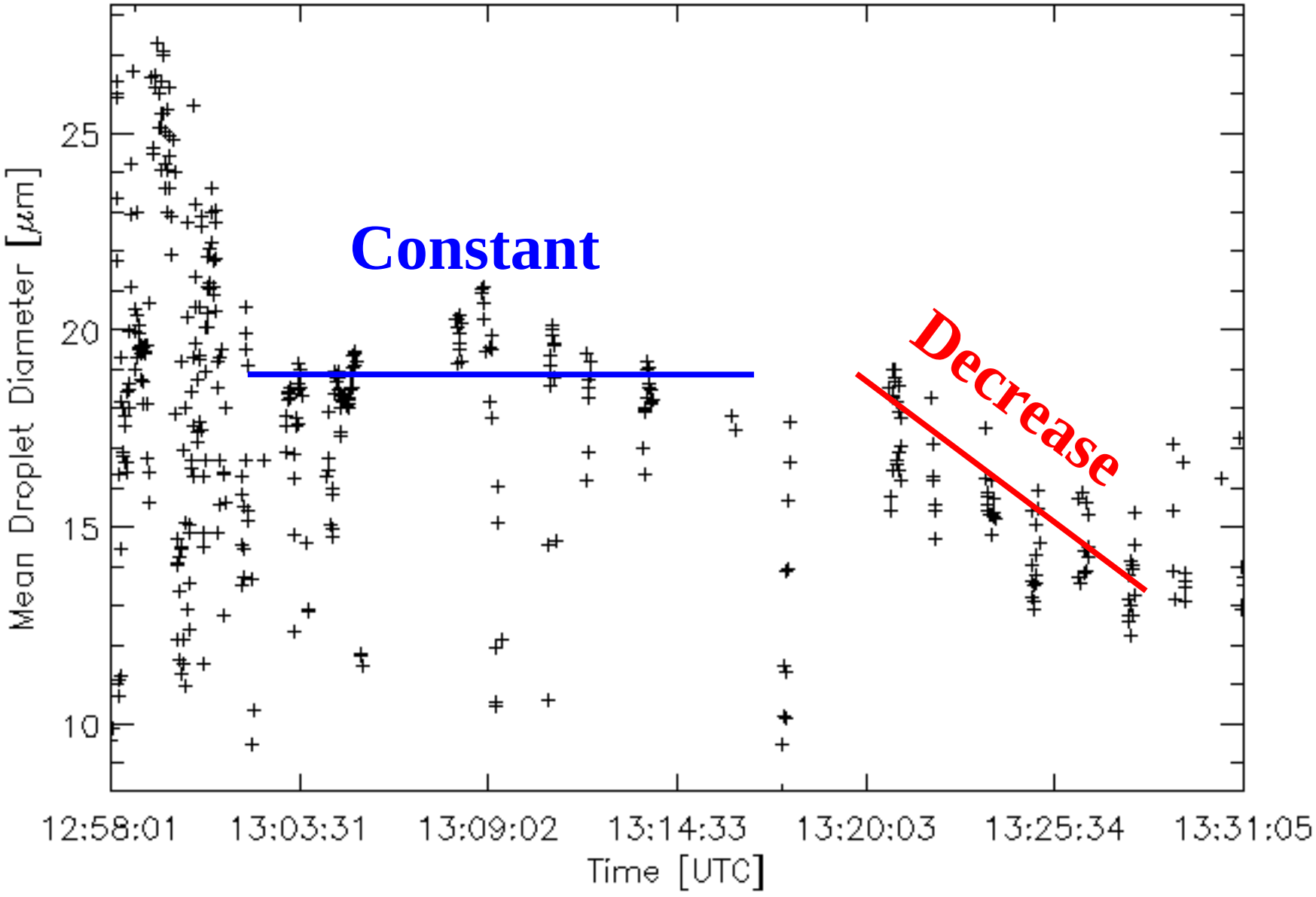
Liquid water content at 1 Hz measured by a DMT Hot Wire Probe on the 9 April 2009 research flight in Saudi Arabia.

9 April 2009 Flight



Time serial of cloud droplet concentration (1 Hz average) at 18,000 ft measured by an FSSP on the 9 April 2009 Saudi Arabia flight.

9 April 2009 Flight

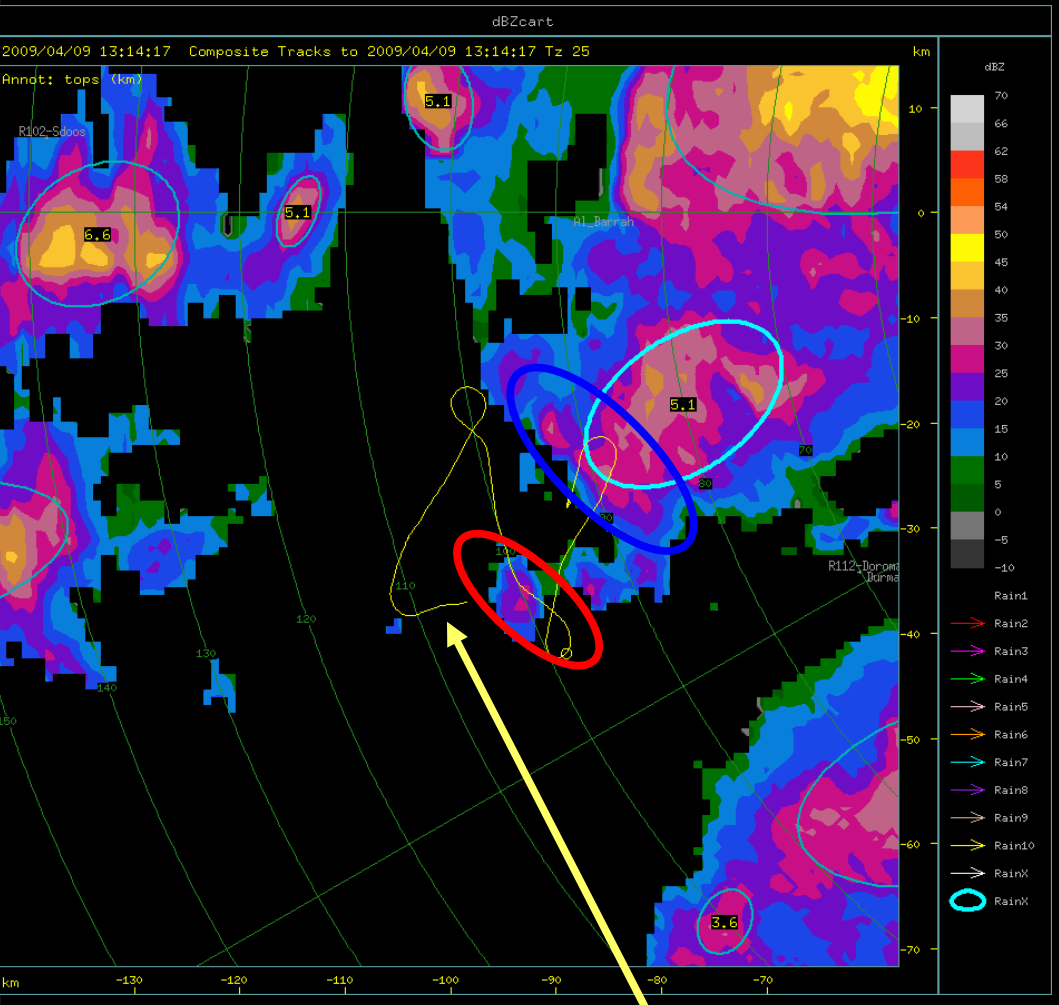


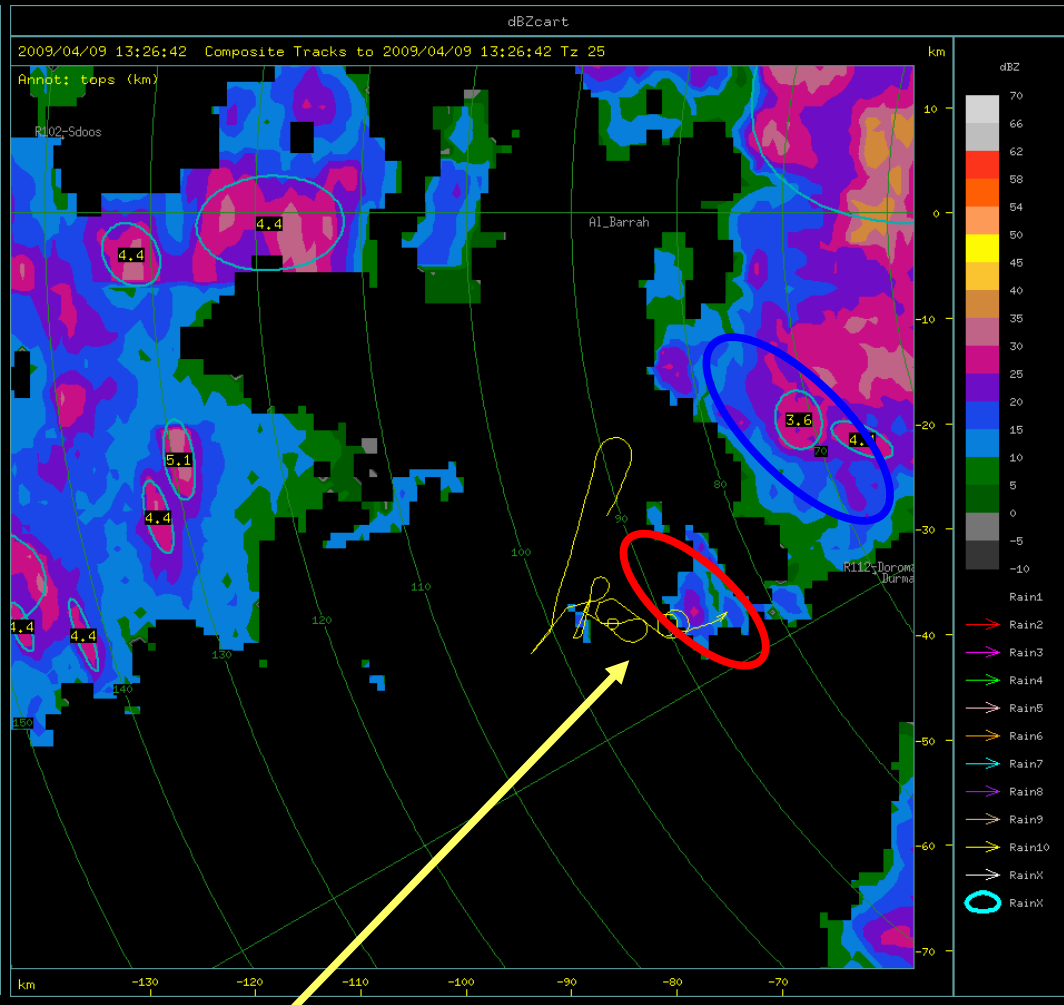
Time series of mean droplet diameter (1 Hz data) at 18,000 ft measured by an FSSP on the 9 April 2009 Saudi Arabia flight.

Radar Reflectivity Composite
9 April 2009

13:14:17

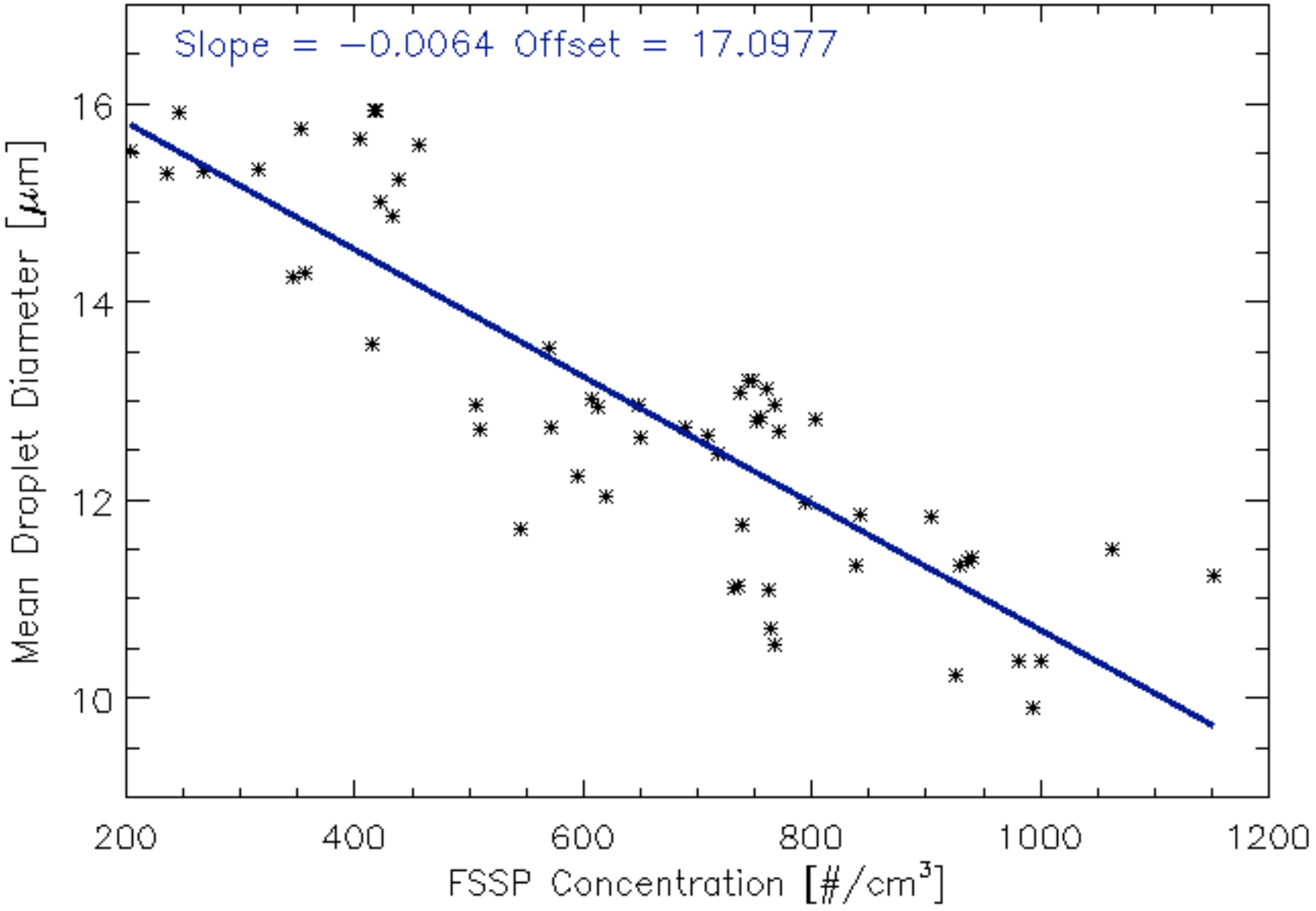
13:26:42





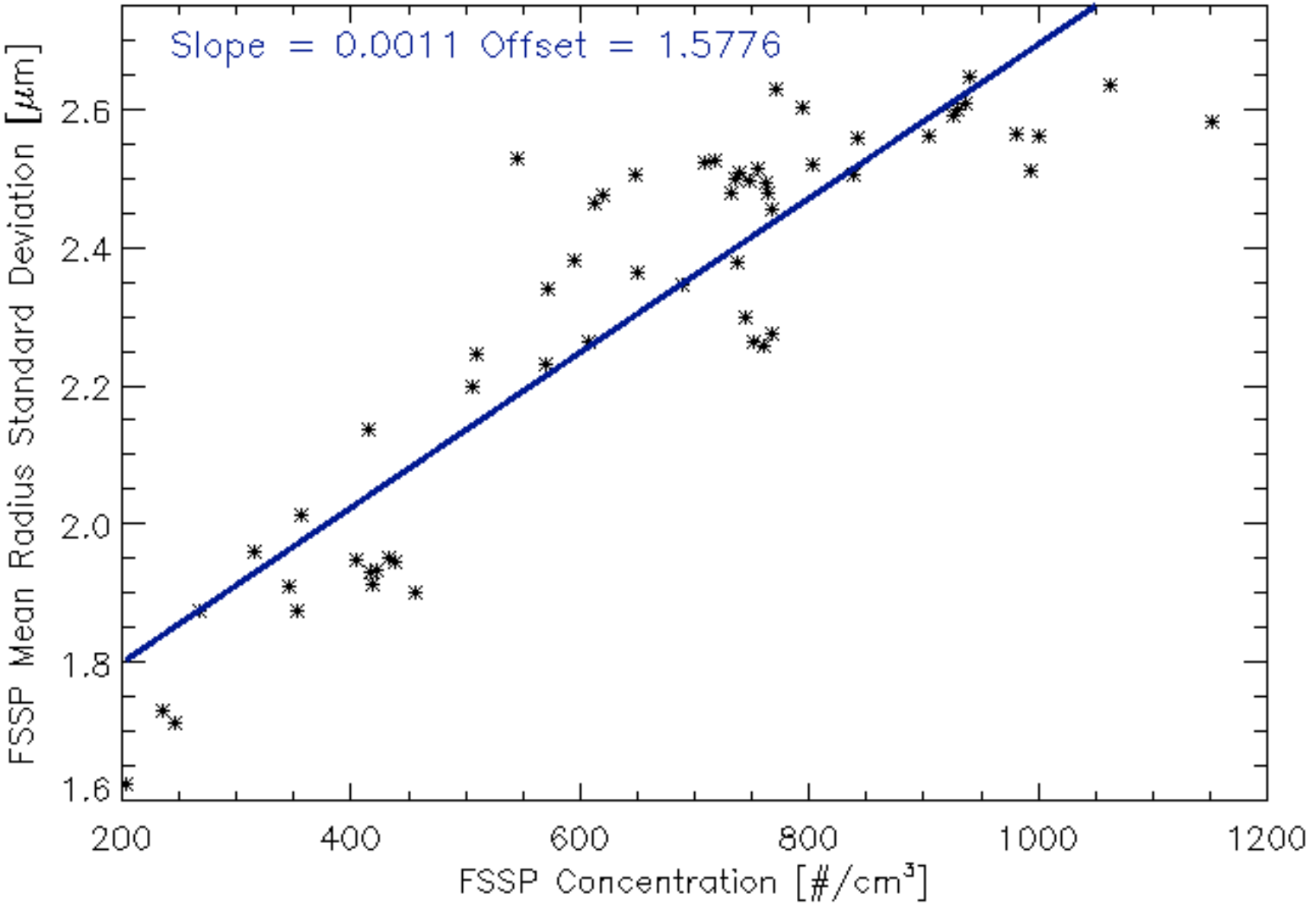
Aircraft Track

9 April 2009 13:20 - 13:28



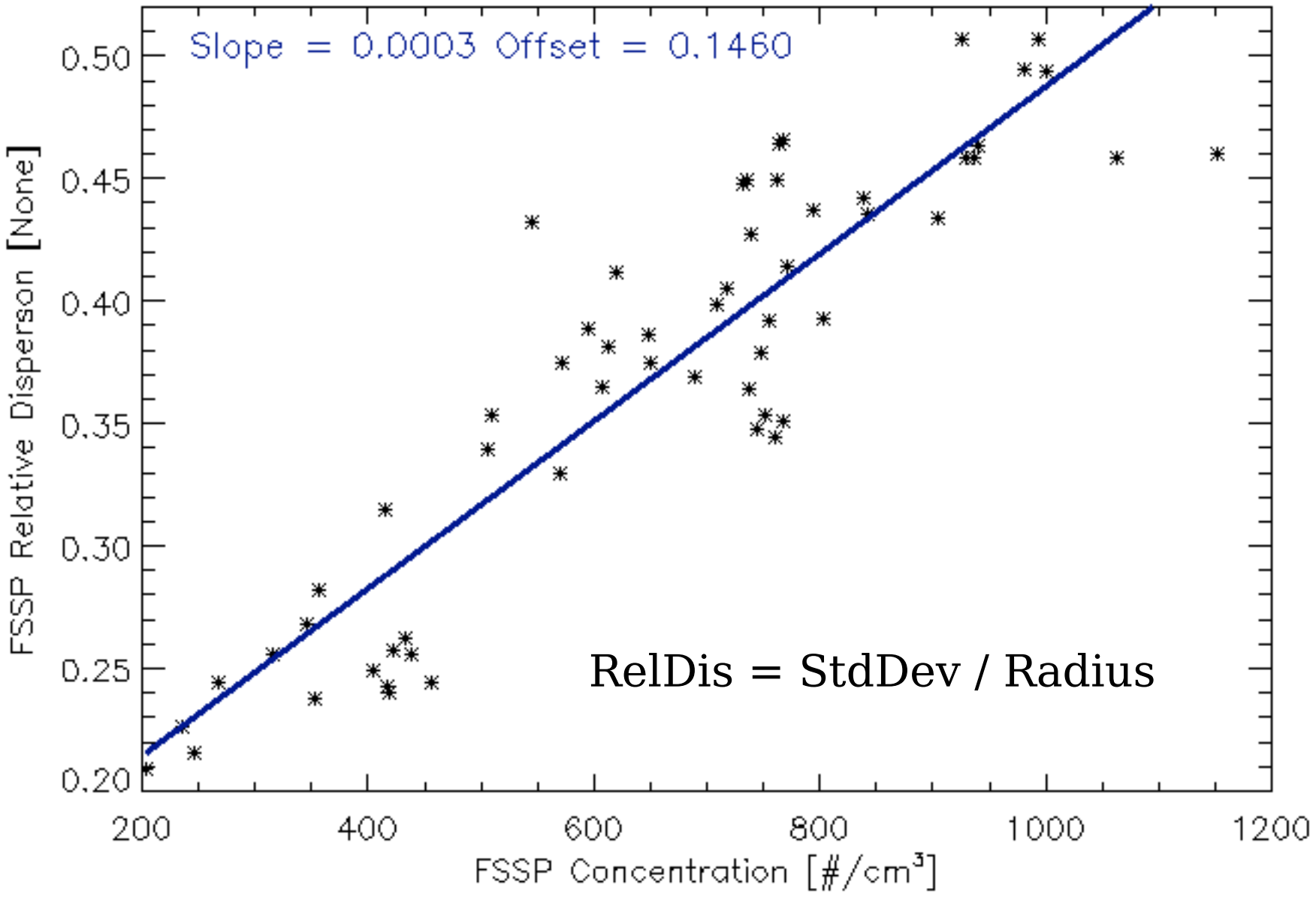
Only 1 Hz measurements with DMT Hot Wire liquid water content above 1.0 g/m^3 are included.

9 April 2009 13:20 - 13:28



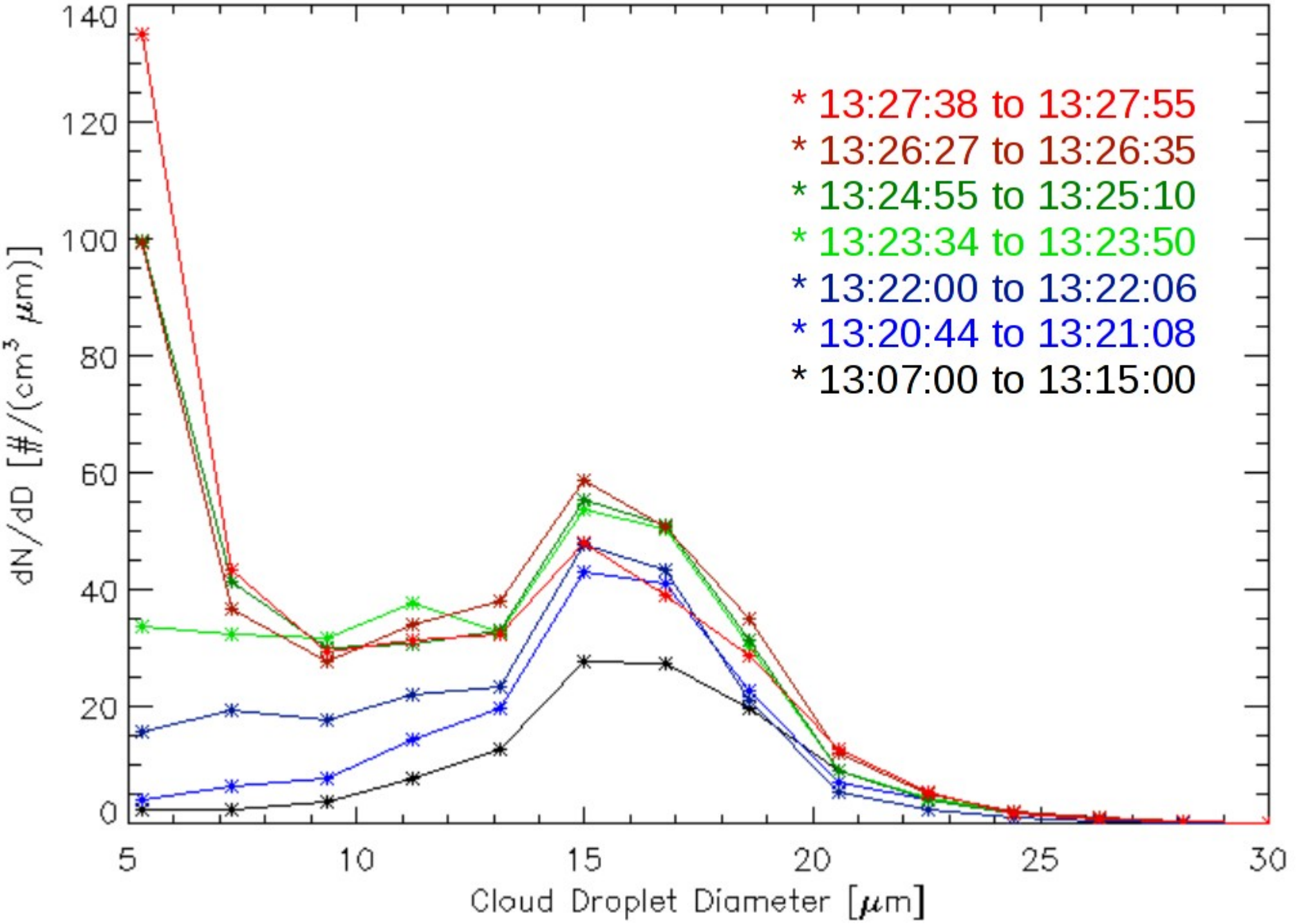
Only 1 Hz measurements with DMT Hot Wire liquid water content above 1.0 g/m^3 are included.

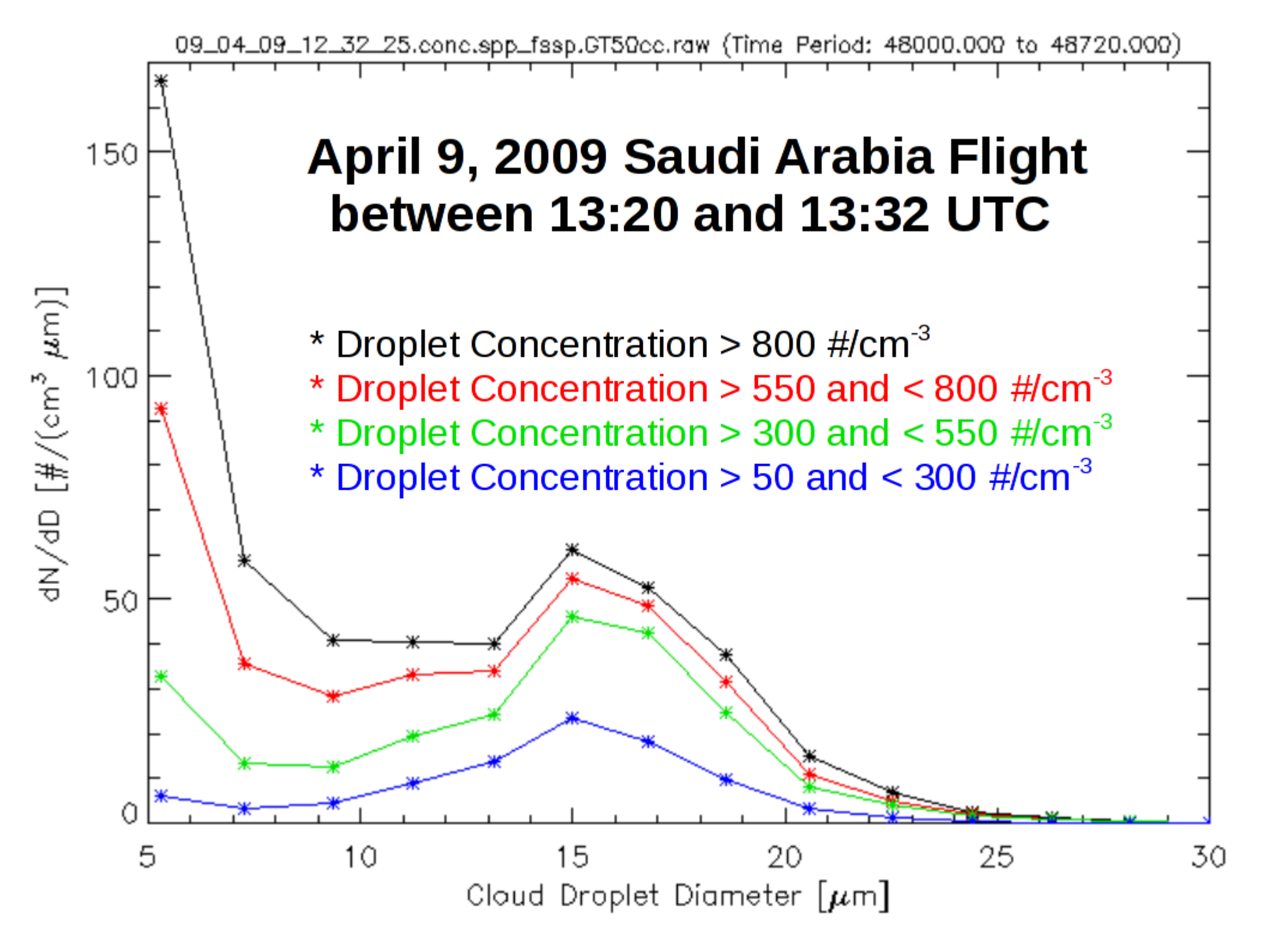
9 April 2009 13:20 - 13:28



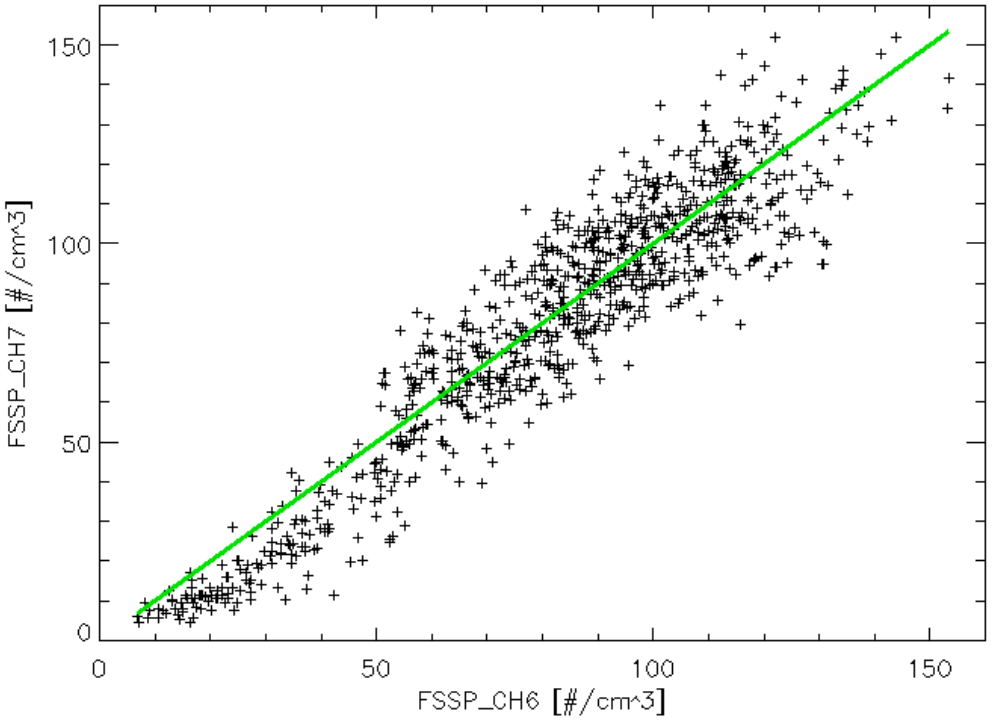
Only 1 Hz measurements with DMT Hot Wire liquid water content above 1.0 g/m^3 are included.

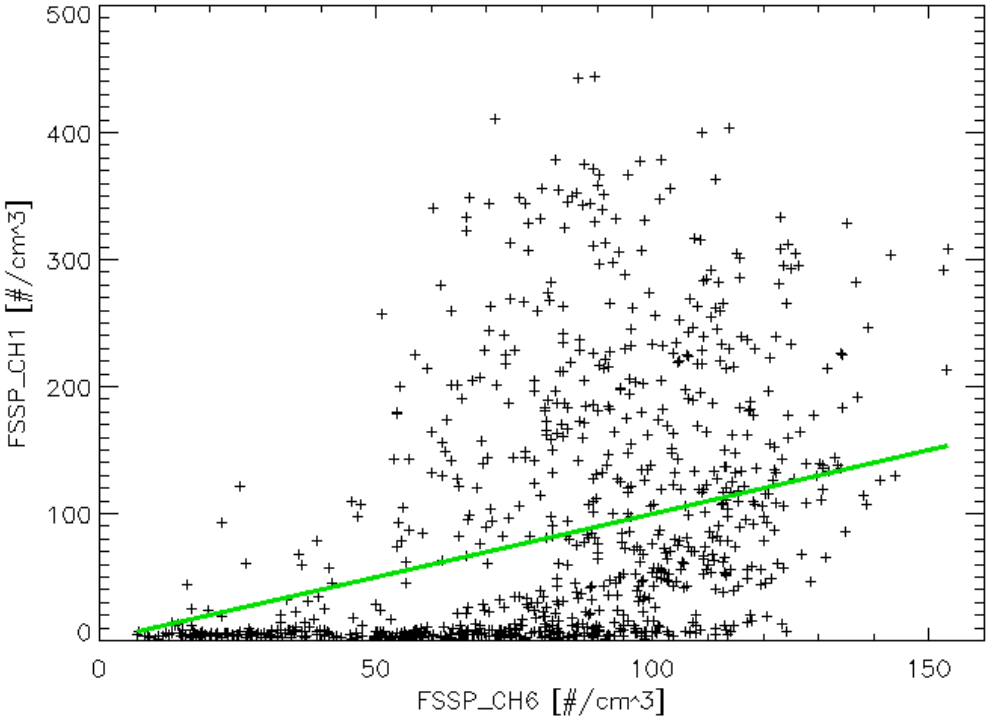
April 9, 2009 Saudi Arabia Flight




09_04_09_12_32_25.conc.spp_fssp.GT50cc.raw (Time Period: 48000.000 to 48720.000)
April 9, 2009 Saudi Arabia Flight
between 13:20 and 13:32 UTC
* Droplet Concentration > 800 #/cm-3
* Droplet Concentration > 550 and < 800 #/cm-3
* Droplet Concentration > 300 and < 550 #/cm-3
* Droplet Concentration > 50 and < 300 #/cm-3
dN/dD [#/(cm3 μm)]
0
50
100
150
5
10
15
20
25
30
Cloud Droplet Diameter [μm]

9 April 2009 13:20 - 13:28



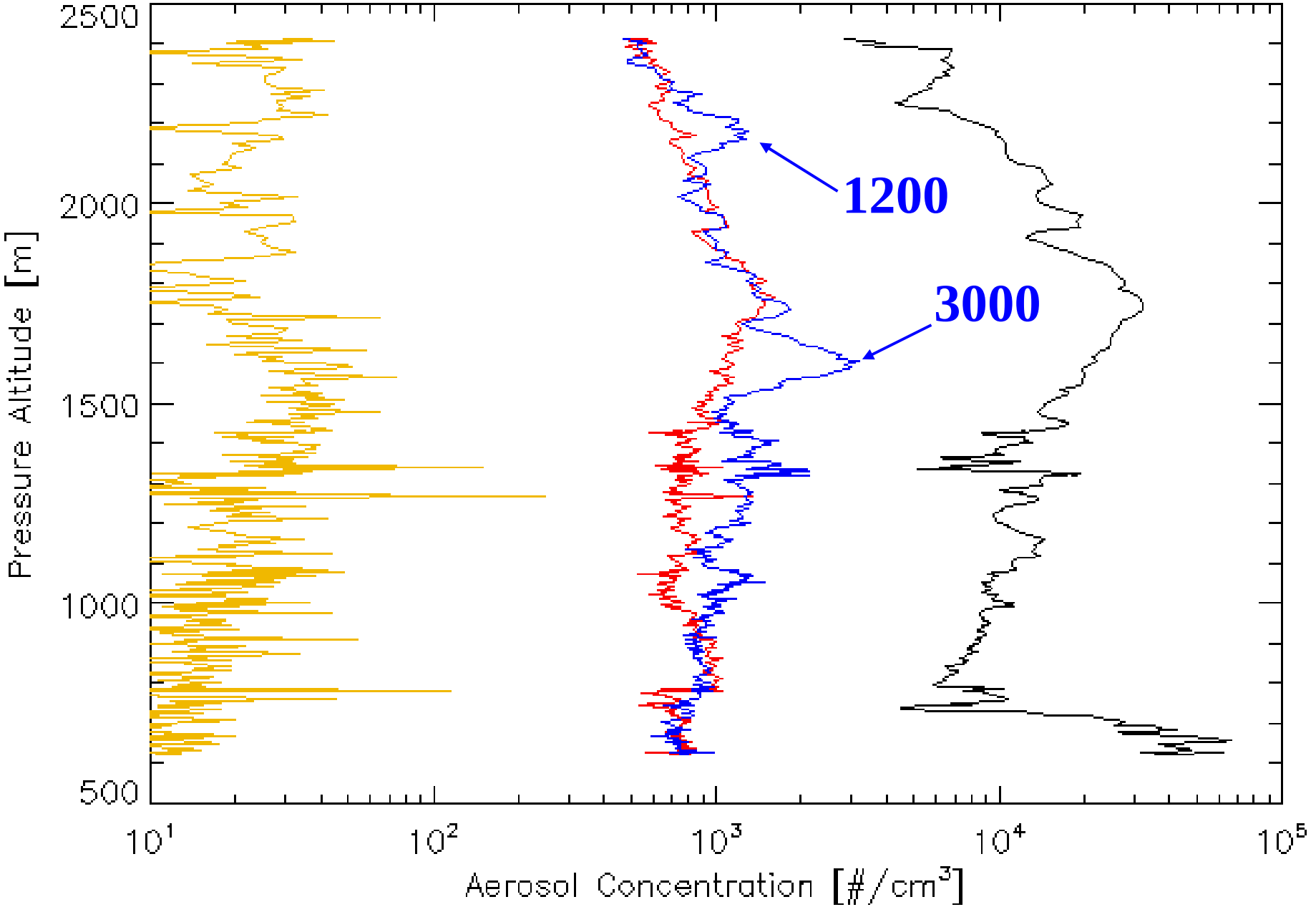


10 Hz FSSP measurements between 13:20 and 13:28 UTC on the 9 April 2009 flight in Saudi Arabia. The green solid line denotes the one to one line.

Descent Profile 9 April 2009

Dust (1-3 um) Optical Aerosols (0.1-3 um)

Cloud Condensation Nuclei (0.6 %) Condensation Particle



Conclusions

- The 'brown' ice cloud cell had very high droplet concentrations (up to 1200 #/cm^3) and reduced average mean droplet diameters compared to a normal cell.
- Cloud base CCN measurements in Saudi Arabia are variable with some very high concentrations.
- The increases in droplet concentration was probably the result of increases in cloud base CCN concentration which may have resulted in the cell's death.

Acknowledgments

The participation of the University of North Dakota in the spring 2009 Saudi Arabia field project was funded by the Kingdom of Saudi Arabia through a contract with Weather Modification Inc (WMI).

Thanks to Terry Krauss, Jeff Tilley, Gökhan Sever and Robert Mitchell for support during the Spring 2009 Saudi Arabia project field project.

Thanks for Listening

Any Questions