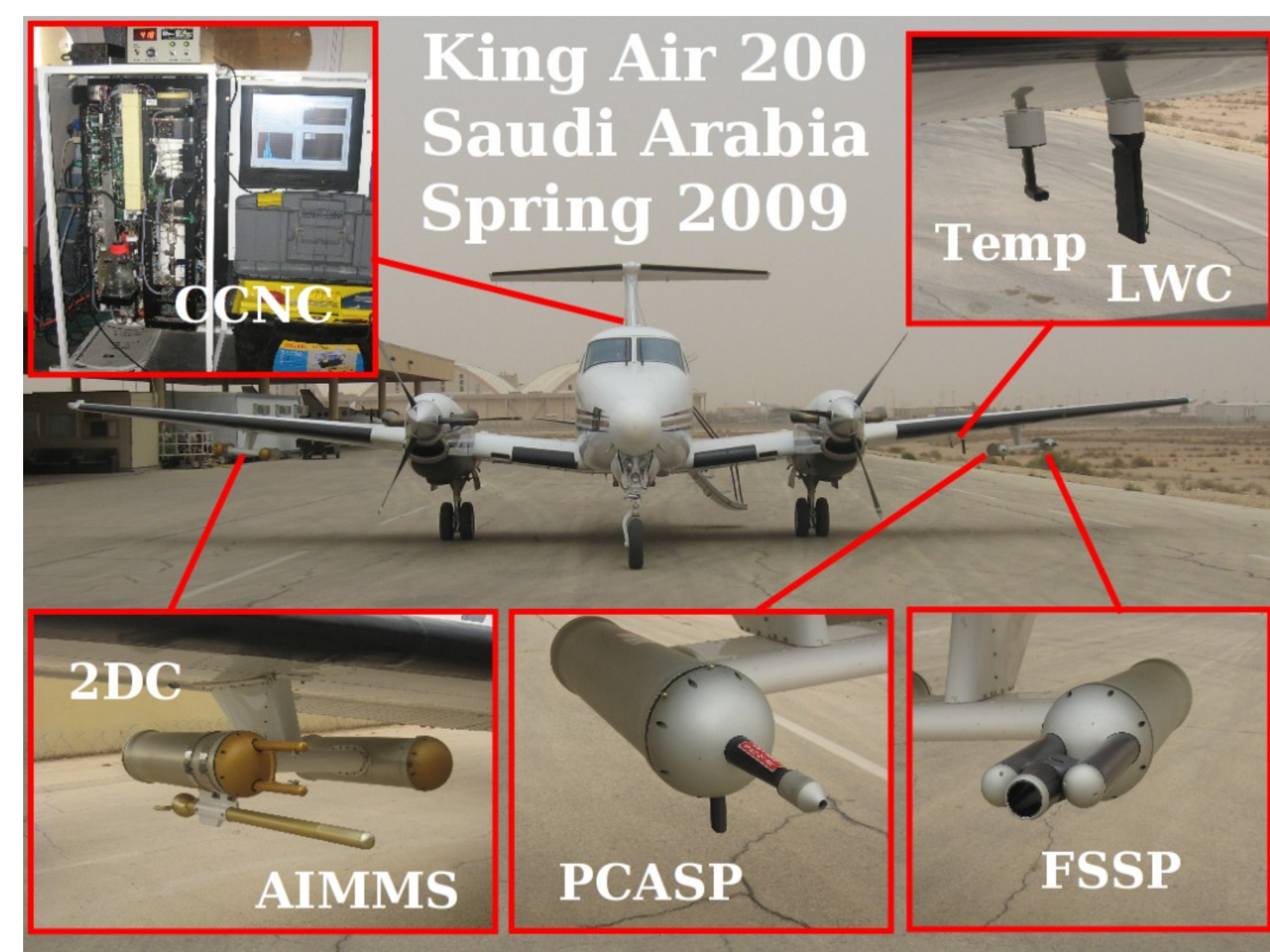


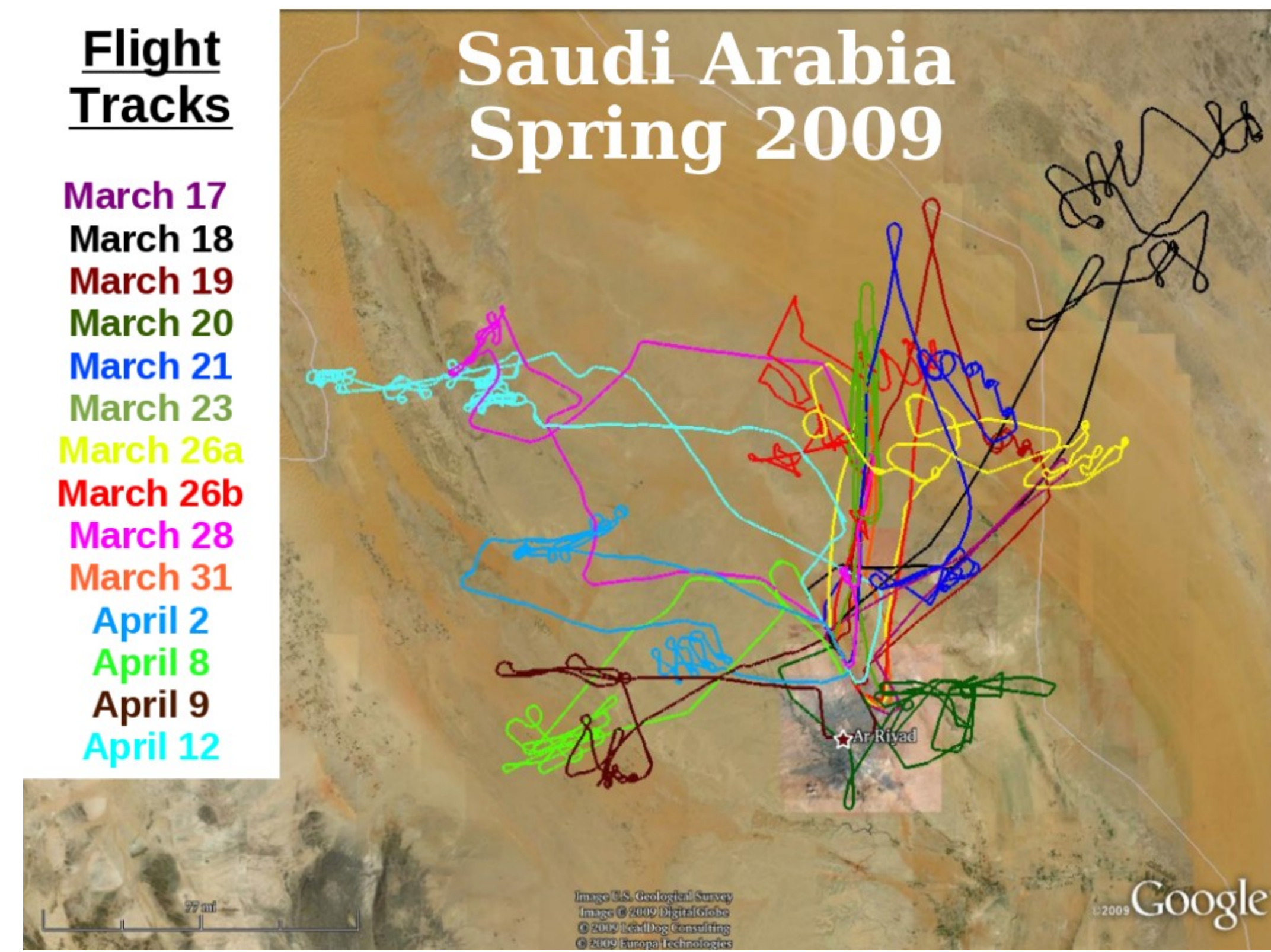
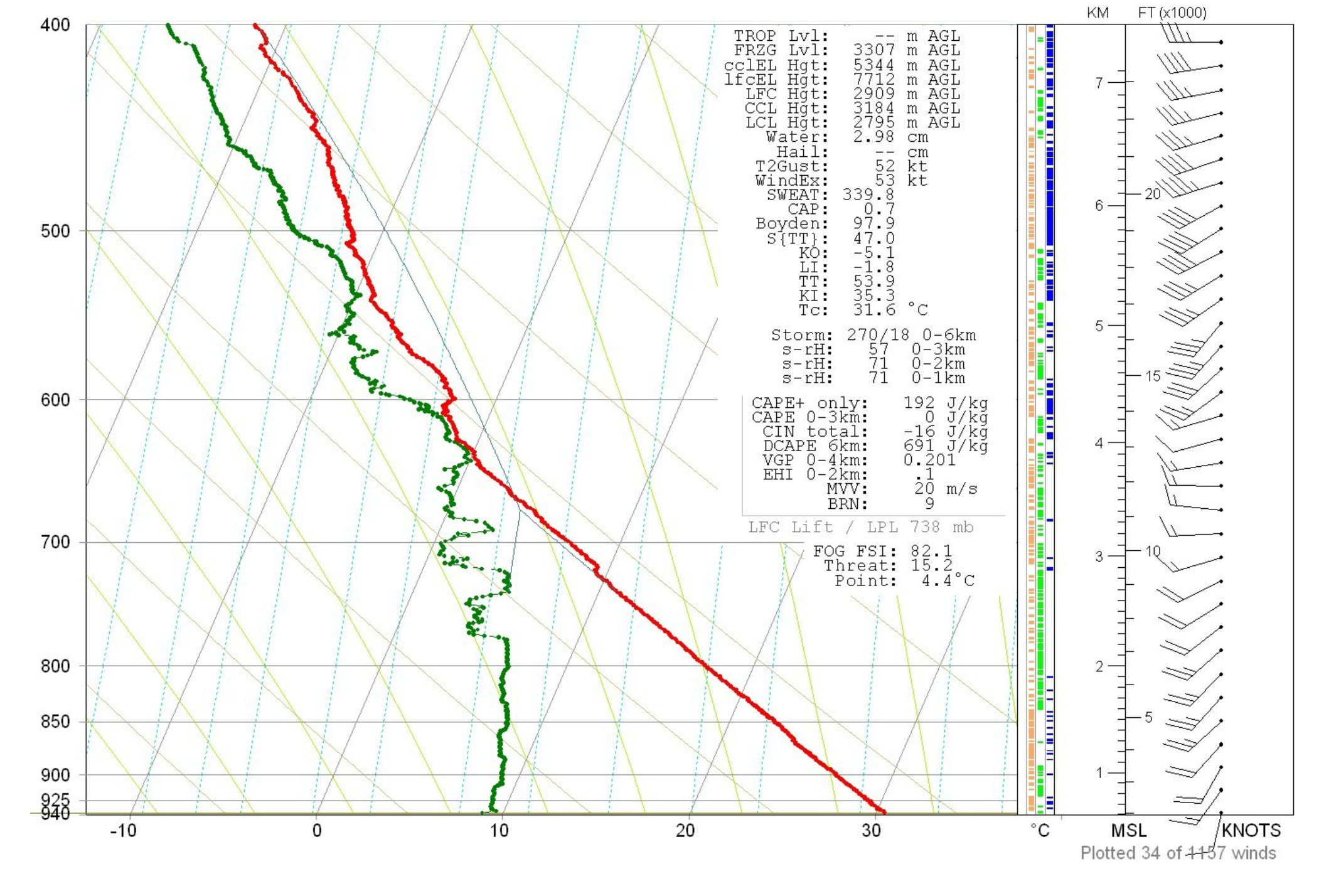
A13B-0215: Case study of the 9 April 2009 ‘brown’ cloud: Observations of unusually high cloud droplet concentrations in Saudi Arabia, David J Delene, University of North Dakota (delene@aero.und.edu; <http://aerosol.atmos.und.edu>)

Objective

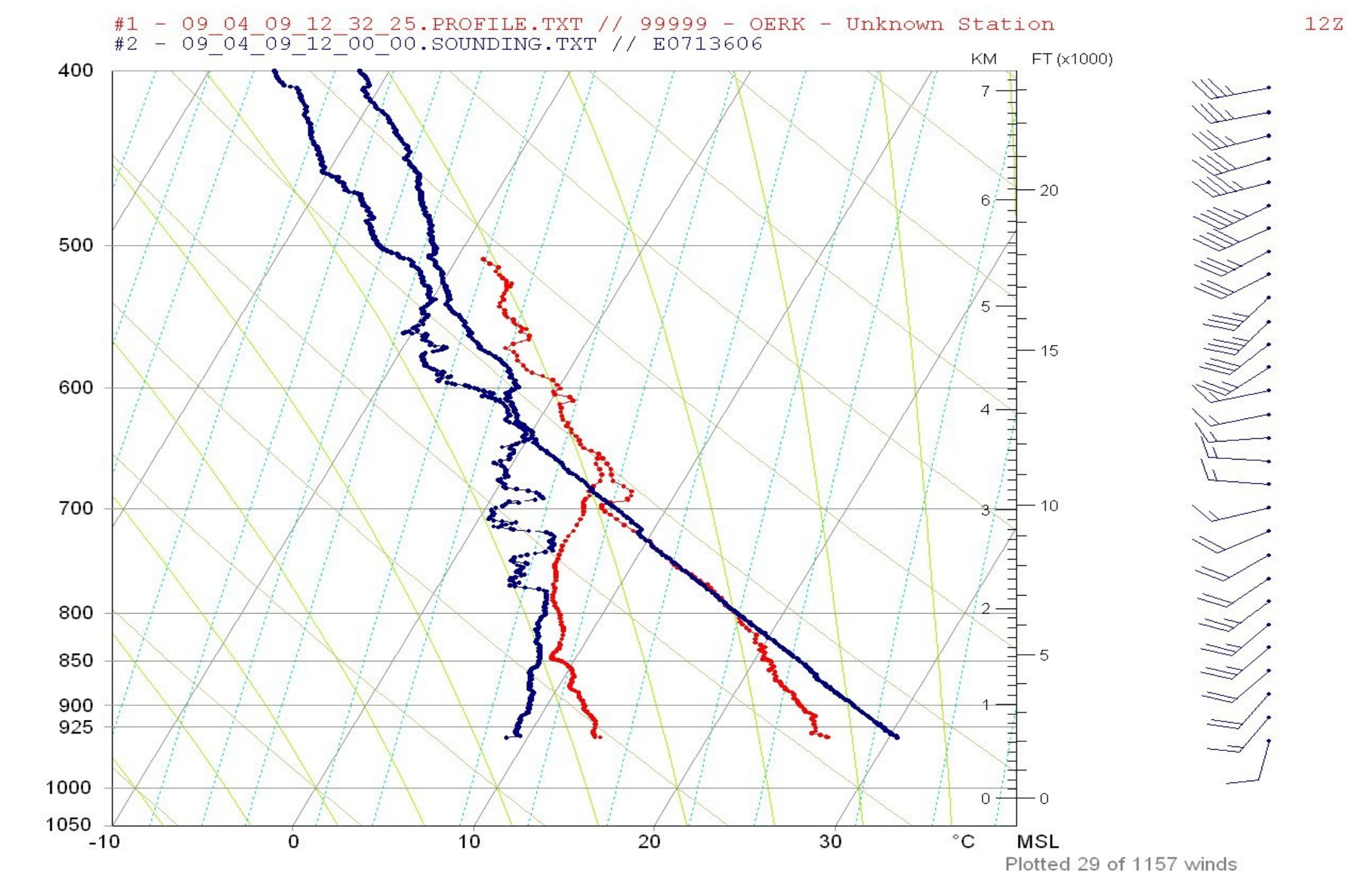
Photographs of ice accumulation on the unprotected leading edge of the aircraft’s wing during the 9 April 2009 research in Saudi Arabia show a color change, from white during the time of low droplet number concentration, to brown during the time of high droplet number concentration. The hypothesis that 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 is investigated and the changes in cloud properties are documented.



A King Air 200 aircraft was used for airborne measurements that has two PMS cans mounted under each wing. The aircraft had an Aircraft-Integrated Meteorological Measurement System (AIMMS), 2DC, PCASP, FSSP, Cloud Condensation Nuclei Counter (CCNC), Liquid Water Content (LWC) probe, and a Temperature (Temp) probe.



Flight tracks for research flights conducted near Riyadh, Saudi Arabia during the spring 2009 field project.



Riyadh 12Z balloon sounding and aircraft sounding comparison on 9 April 2009. The red line in the sounding comparison is for the aircraft ascent to the southwest starting at 12:40.

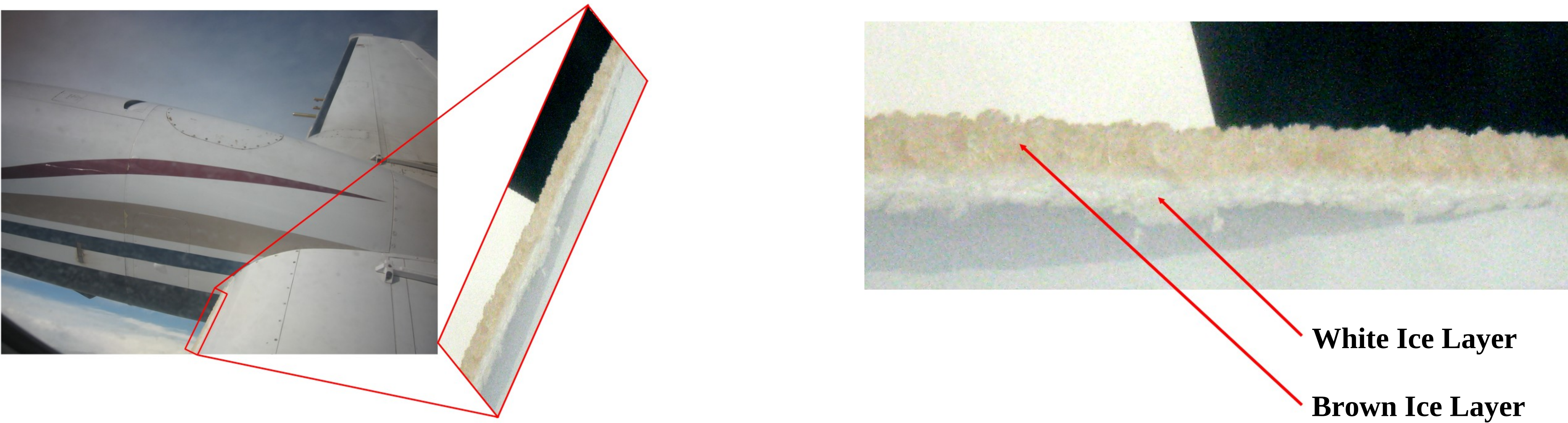
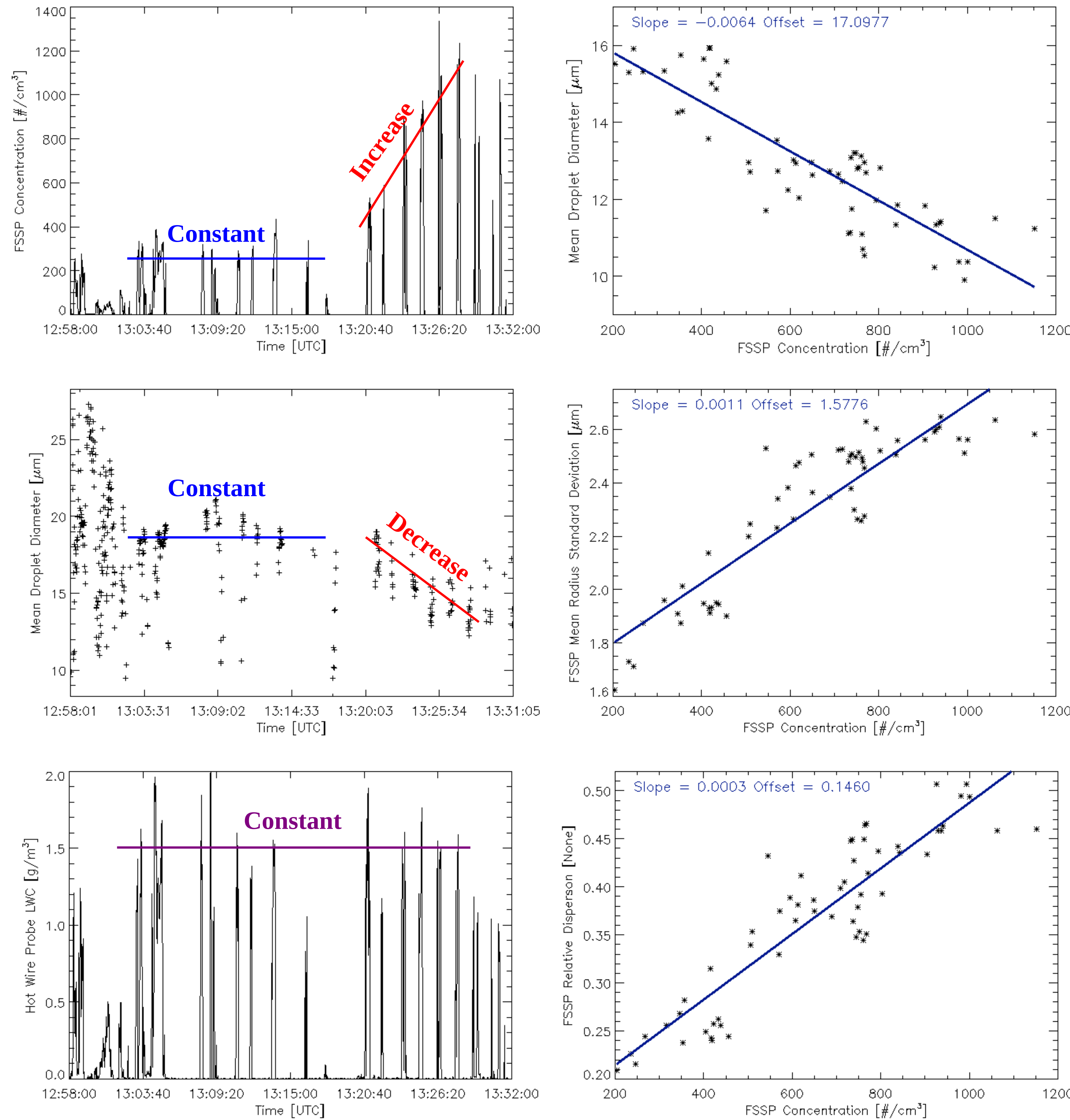
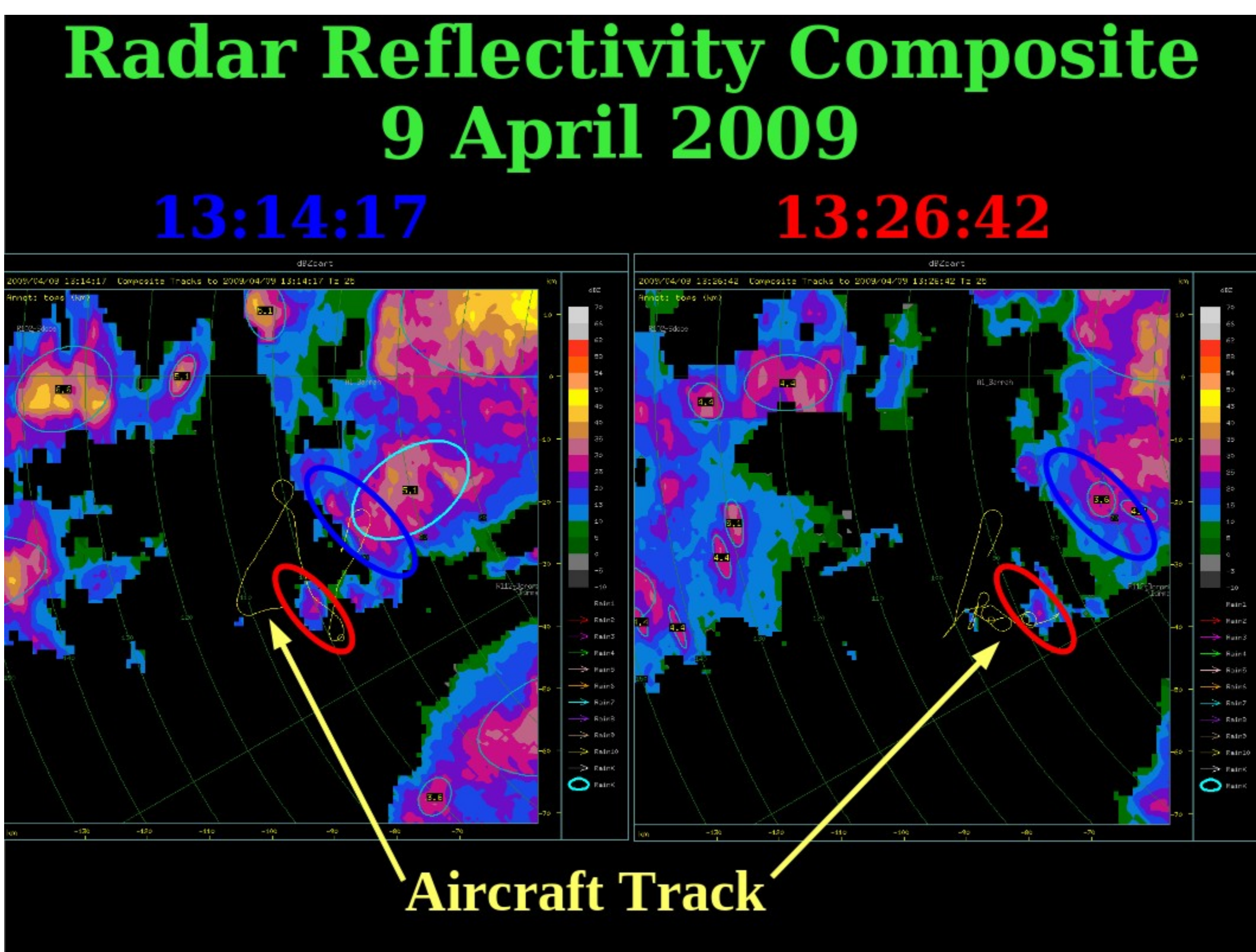
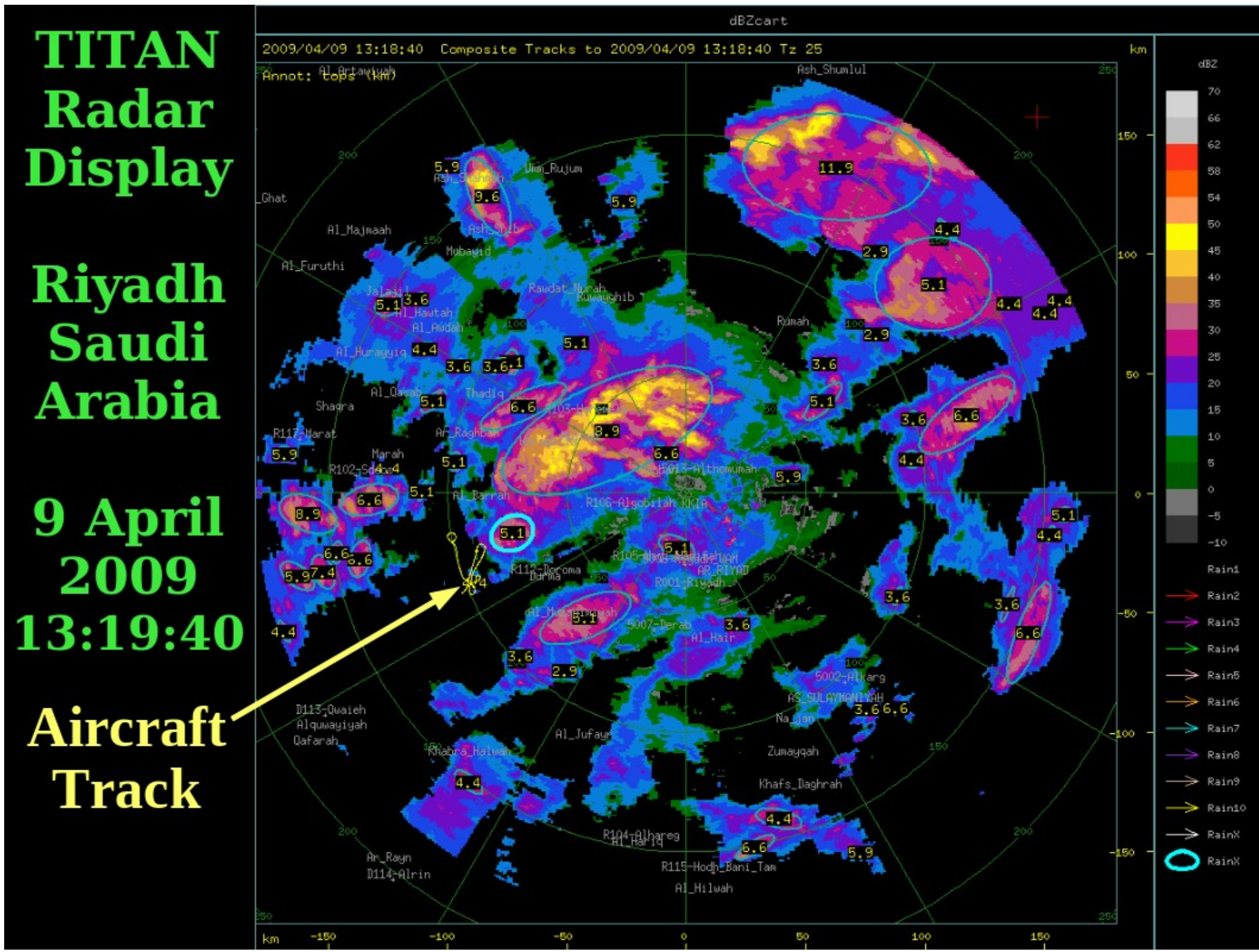


Image taken at 13:32 UTC on the 9 April 2009 flight in Saudi Arabia showing the accumulation of two different colors of ice on the unheated leading edge of the wing on the King Air 200 research aircraft.

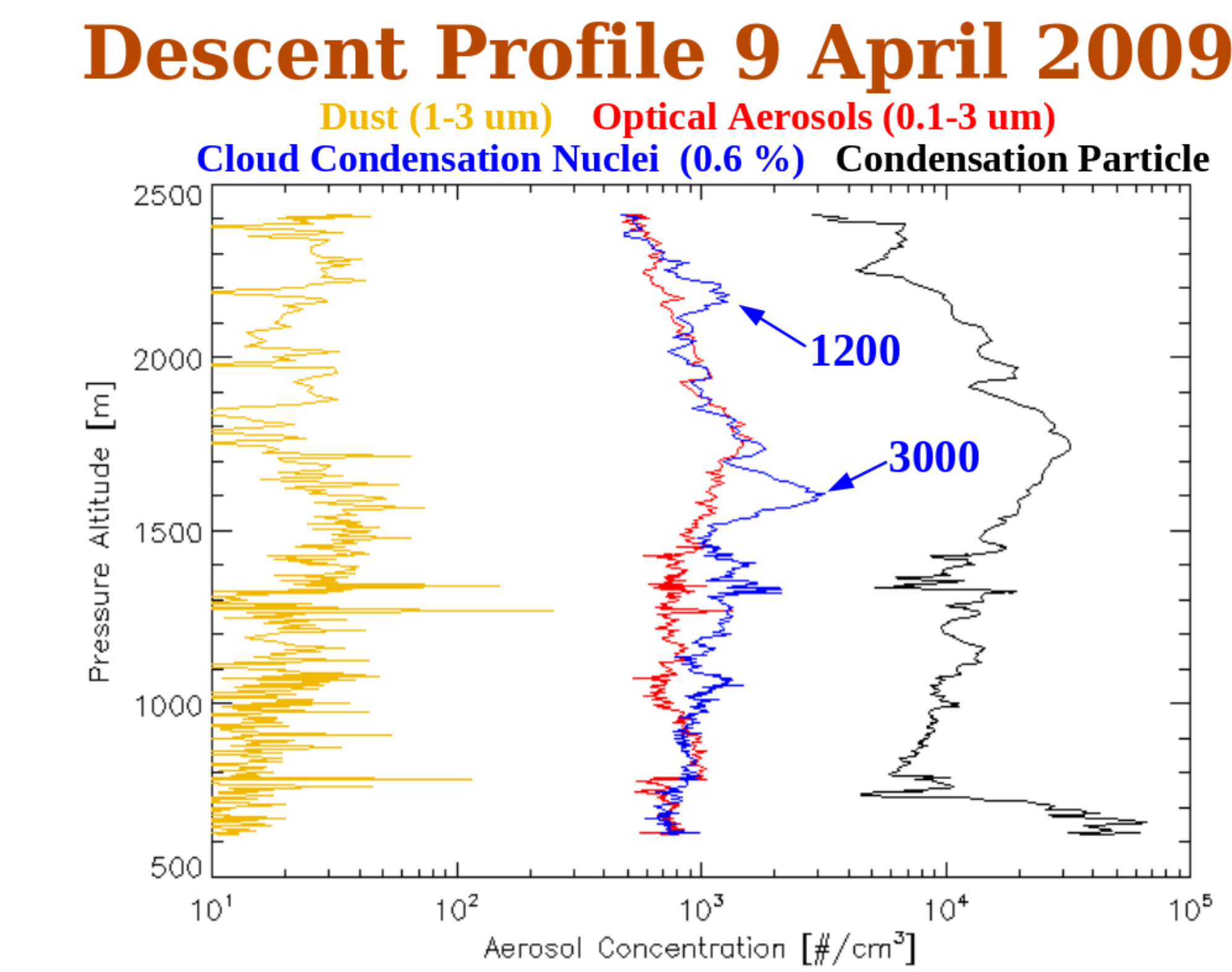


Time series (1 Hz) of cloud properties at 18,000 ft on the 9 April 2009 flight in Saudi Arabia. Droplet concentration and mean diameter are measured with an FSSP, while liquid water content (LWC) is measured with a DMT hot wire probe. The blue and red lines correspond to sampling different cloud cells.

Relationships between cloud droplet concentration and cloud properties between 13:20 and 13:28 on 9 April 2009 flight. Only measurements with 1 Hz hot wire probe liquid water measurements above 1 g/m³ are included in the analysis.



Blue ellipse denotes cell sampled from 13:03 to 13:19, while red ellipse denotes cell sampled from 13:20 to 13:28.



Conclusions

- The 'brown' ice cloud cell had very high droplet concentrations (up to 1200 #/cm³) 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 concentrations was probably the result of increases in cloud base CCN concentration which may have resulted in the cell's death.

Future Work

- Conduct another spring field project in Saudi Arabia to obtain more observations.
- Conduct a series of multiscale simulations of the 9 April 2009 observations using the WRF/WRF-Chem modeling system applied to a hierarchy of nested domains

Acknowledgments

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