

# 7H.29: Sub-micrometer Aerosol Measurements from a Cabin Window Location on a King Air 200 Aircraft

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## Objective

A Raytheon Beechcraft King Air 200 aircraft has been used to obtain Condensation Particle Counter (CPC) and Cloud Condensation Nuclei Counter (CCNC) measurements on research flights in Saudi Arabia. To minimize cost and aircraft modification time, the front cabin window location was used for the rear facing, stainless tube inlets. An inlet characterization flight was conducted on March 31, 2009 to determine if this inlet location is contaminated by engine exhaust.

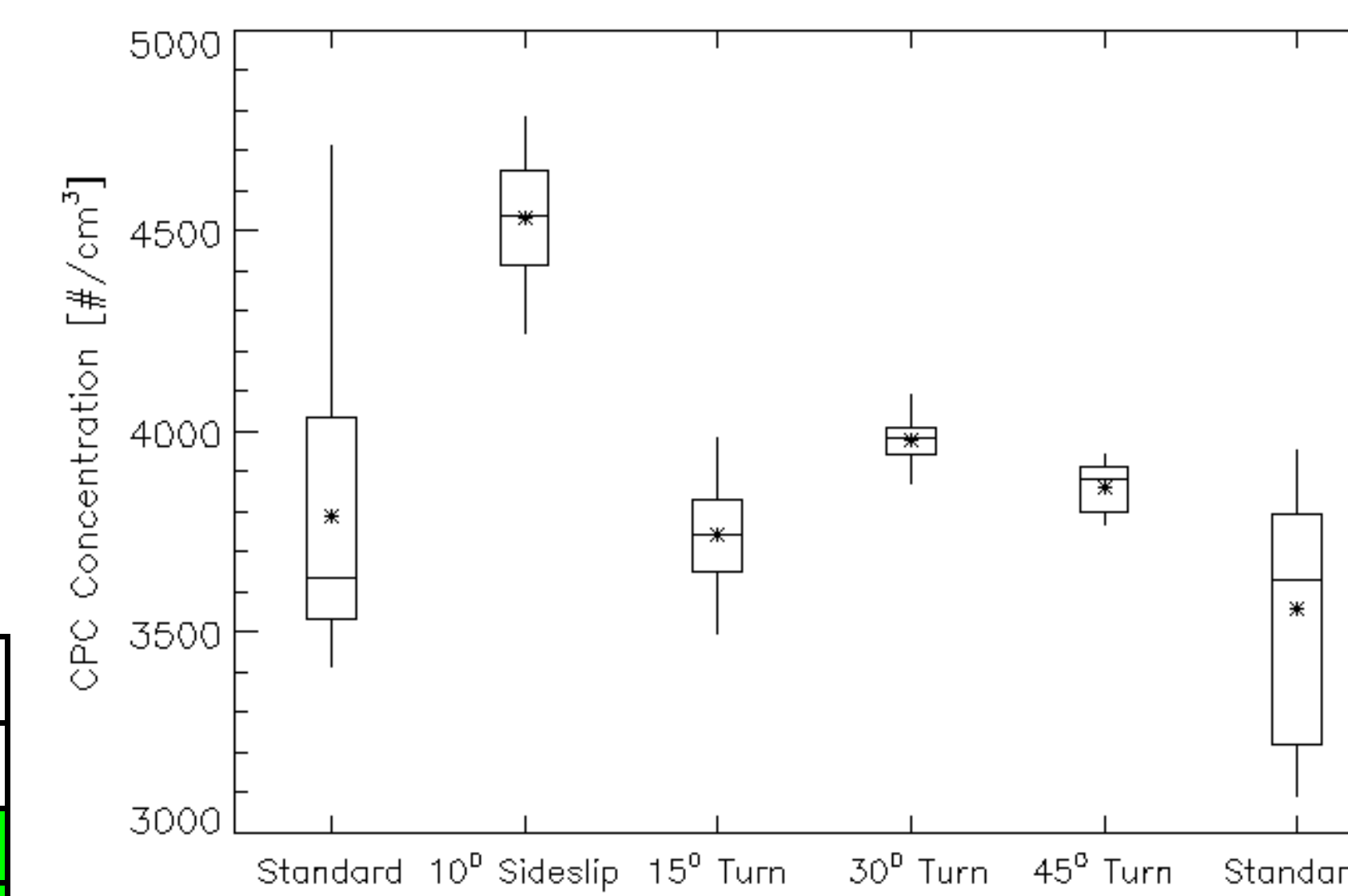
The rear facing, unheated aerosol inlets allow sampling of interstitial cloud aerosols by the CPC and CCNC. The April 12, 2009 flight in Saudi Arabia is one of several flights where high (9,000 – 12,000 #/cm<sup>3</sup>) spikes in CPC concentration were observed inside of growing cumulus clouds.



Type	Start Time	End Time	Leg	Roll Angle
	[HH/MM/SS]	[HH/MM/SS]	[#]	[degrees]
Standard	12:41:25	12:45:49	1	1.3284
Sideslip	12:46:00	12:47:59	1	10.7845
15° Turn	12:50:30	12:52:09	1	16.0007
30° Turn	12:52:57	12:53:44	1	29.2789
45° Turn	12:54:28	12:54:49	1	45.4605
Standard	12:55:52	12:57:31	1	1.4209
Standard	12:57:32	12:59:09	2	1.1236
Sideslip	13:00:18	13:01:39	2	11.0590
15° Turn	13:03:25	13:05:04	2	15.8106
30° Turn	13:05:22	13:06:11	2	30.9984
45° Turn	13:07:07	13:08:00	2	45.4242
Standard	13:09:10	13:10:49	2	0.6172

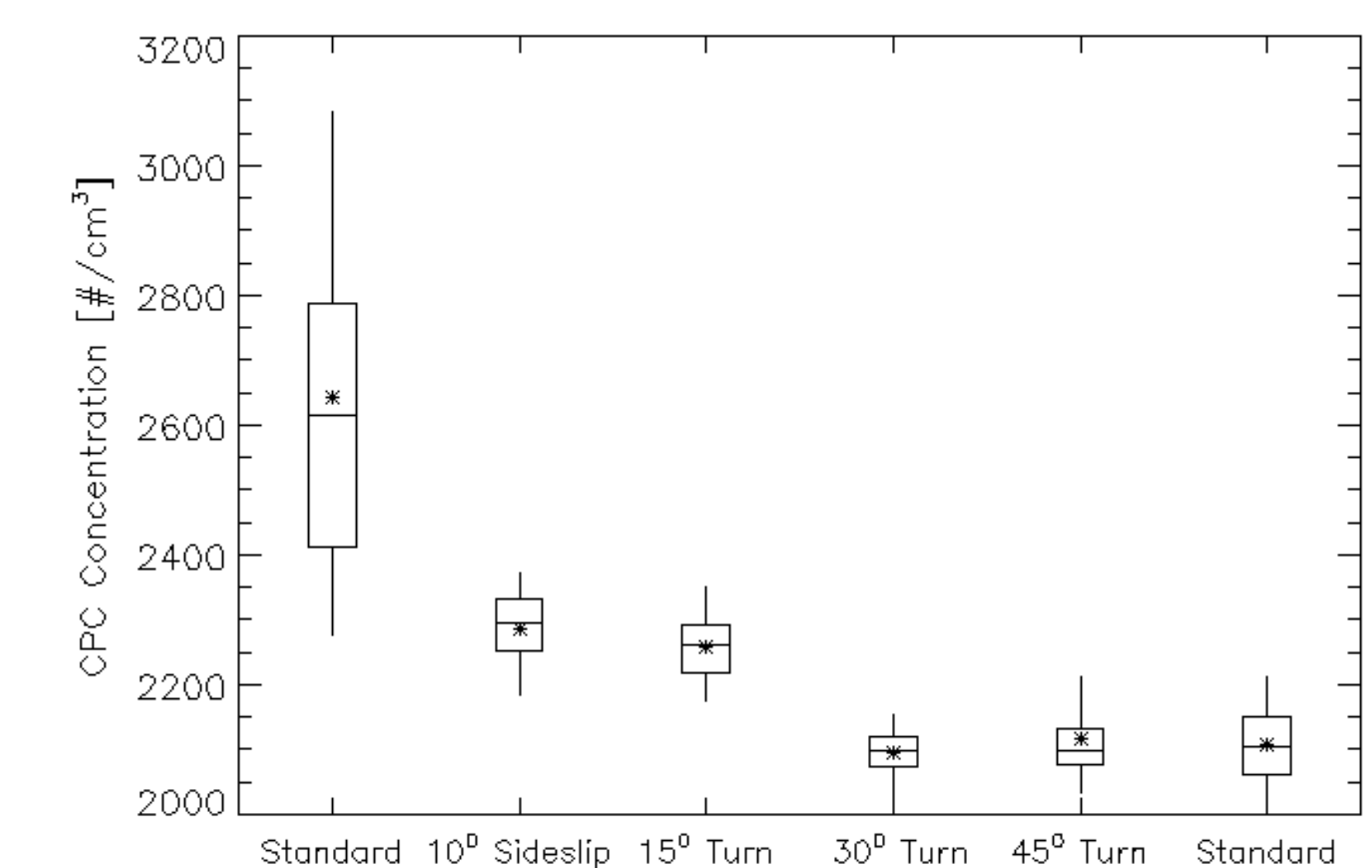
## Inlet Characterization Flight

### Leg 1 - Window Inlet



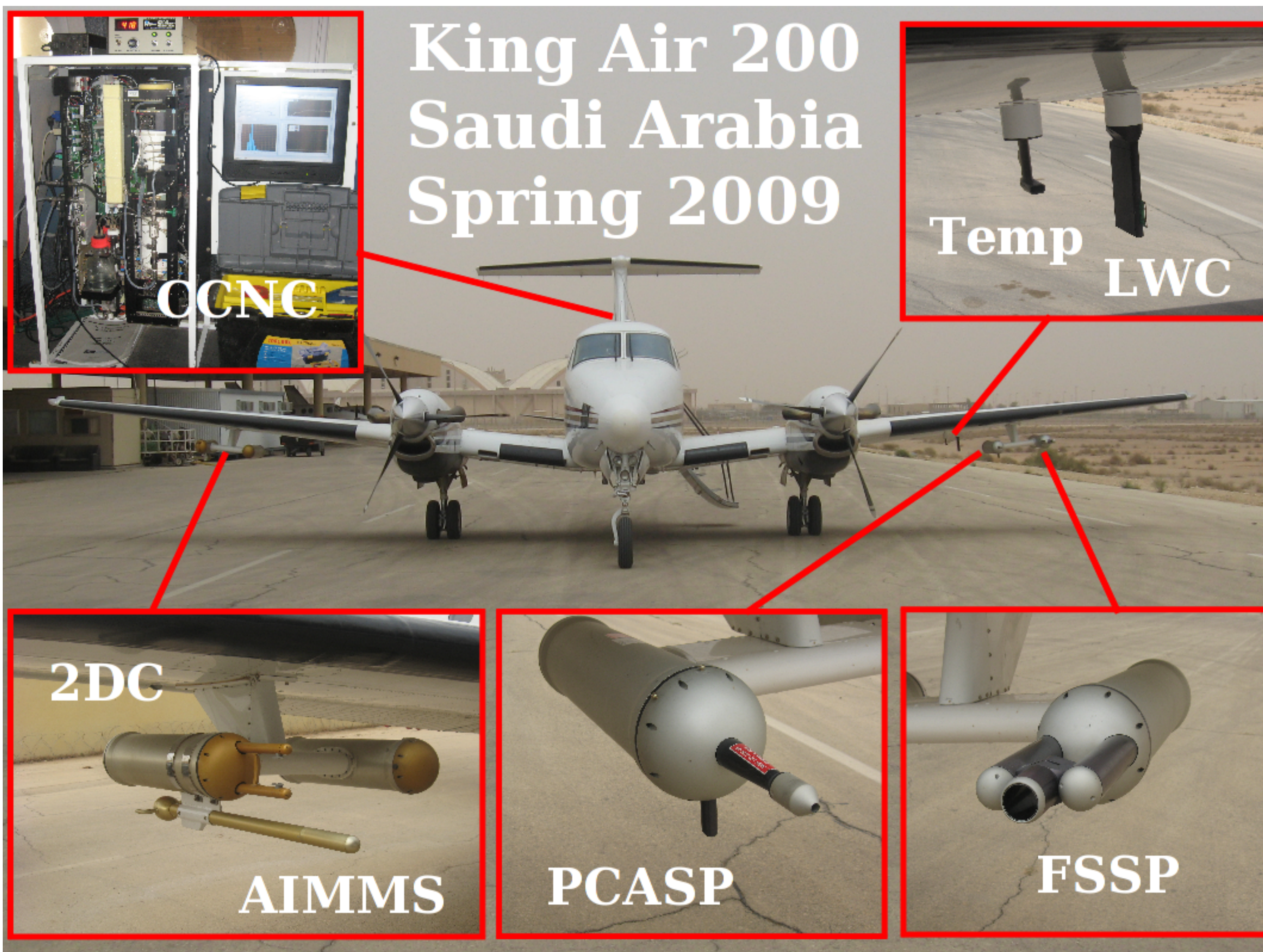
Statistical distribution of 1 Hz CPC measurements obtained during aircraft maneuvers designed to direct exhaust towards the window inlet. The 5, 25, 50, 75, and 95 percentiles are given by the box-and-whiskers, while the stars denotes the mean values. Exact time intervals during the March 31, 2009 flight are given in the table to the left.

### Leg 2 - Top Inlet



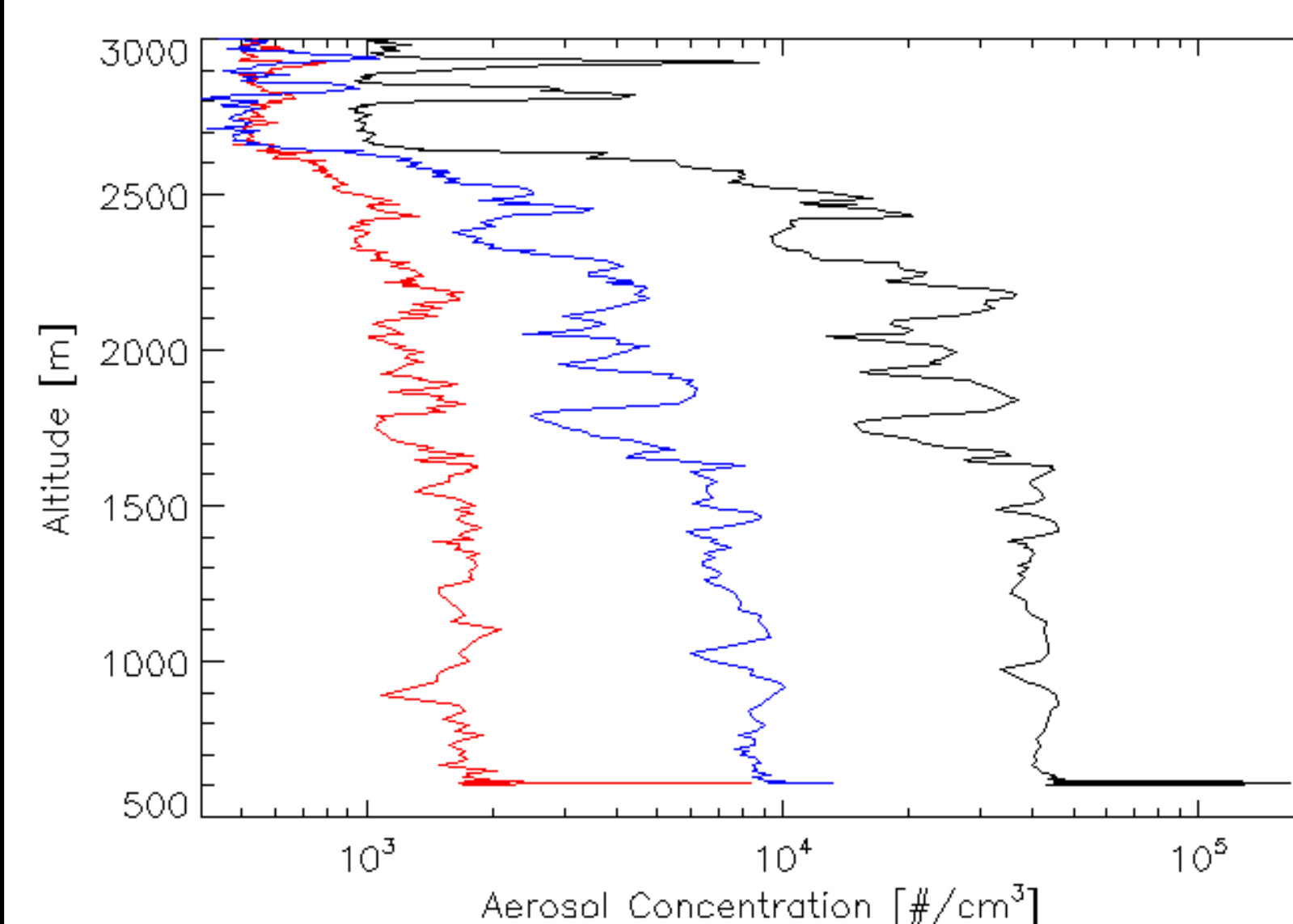
Statistical distribution of 1 Hz CPC measurements similar to the plot on the left. During Leg 2, the CPC was switched to sampling from the top of the aircraft inlet instead of the side window location. The 5, 25, 50, 75, and 95 percentiles are given by the box-and-whiskers, while the stars denote the mean values.

## King Air 200 Saudi Arabia Spring 2009

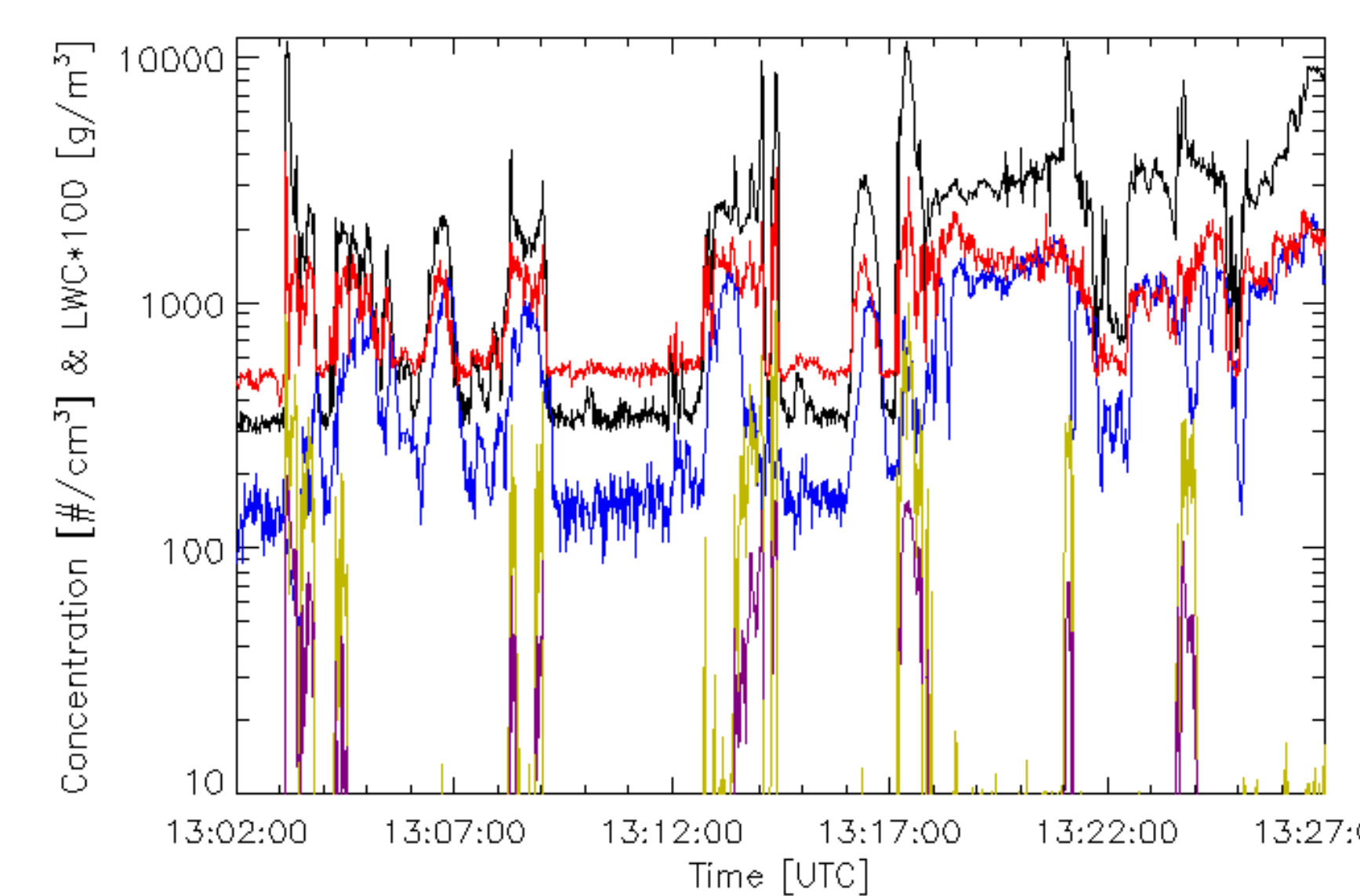


During the Spring 2009 field project, a King Air 200 aircraft was used for airborne measurements that has two PMS cans mounted under each wing. The aircraft had an Aircraft-Integrated Meteorological Measurement System (AIMMS), 2 dimensional cloud Imaging Probe (2DC), Passive Cavity Aerosol Spectrometer Probe (PCASP – 0.1 to 3.0 μm), Forward Scattering Spectrometer Probe (FSSP – 3.0 to 50 μm), Cloud Condensation Nuclei Counter (CCNC), Condensation Particle Counter (CPC), Liquid Water Content (LWC) probe, and an Aircraft Temperature (Temp) probe.

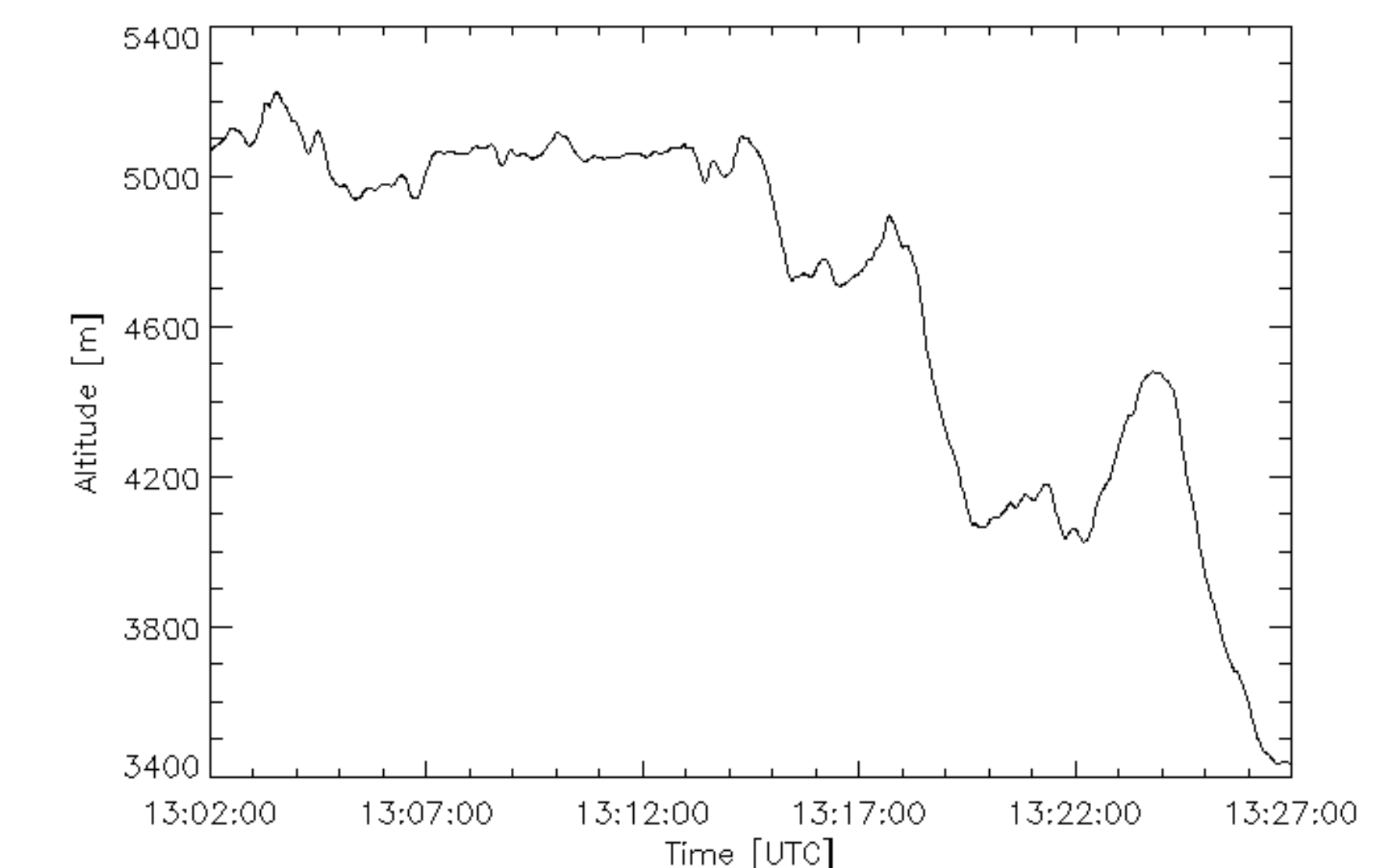
## Interstitial Cloud Aerosol Sampling



Vertical profile of 1 Hz frequency aerosol concentration during aircraft ascent on the 12 April 2009 Saudi Arabia flight. The black line is the CPC concentration. The blue line is the CCN concentration at an ambient supersaturation of 0.46 %. The red line is the total PCASP concentration.



Time series of aerosol concentrations (colors similar to vertical profile on the left) during cumulus cloud penetration on the 12 April 2009 Saudi Arabia Flight. The dark yellow line is the super-micrometer size particles (droplets) and the purple line is the liquid water content multiplied by 100 measured by a hot wire probe.



Time series of aircraft altitude during the cloud penetrations given to the left. The aircraft turned during this time period so that the same cloud was sampled several times. The air temperature varied between -10 and +3 °C during this time period. The aircraft true air speed was approximately 100 m/s.

## Conclusions

- Tests of the side window inlet location indicate no major contamination; furthermore, there were no time series CPC spikes that would indicate contamination.
- The interstitial CPC concentration spikes were sometimes 10 times higher than the out of cloud CPC concentrations. The fact that the spikes were approximately the same magnitude as below cloud base CPC measurements indicates recent transport of the air parcel from below cloud base by updrafts.