Overview of the Spring 2009 Field Program and Summary of Key Results

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Project Objective

- Characterize the aerosol and cloud micro-physics in Saudi Arabia.
- Characterize the type of spring time precipitation that develops in the Riyadh, Saudi Arabia region.

King Air 200
Saudi Arabia
Spring 2009

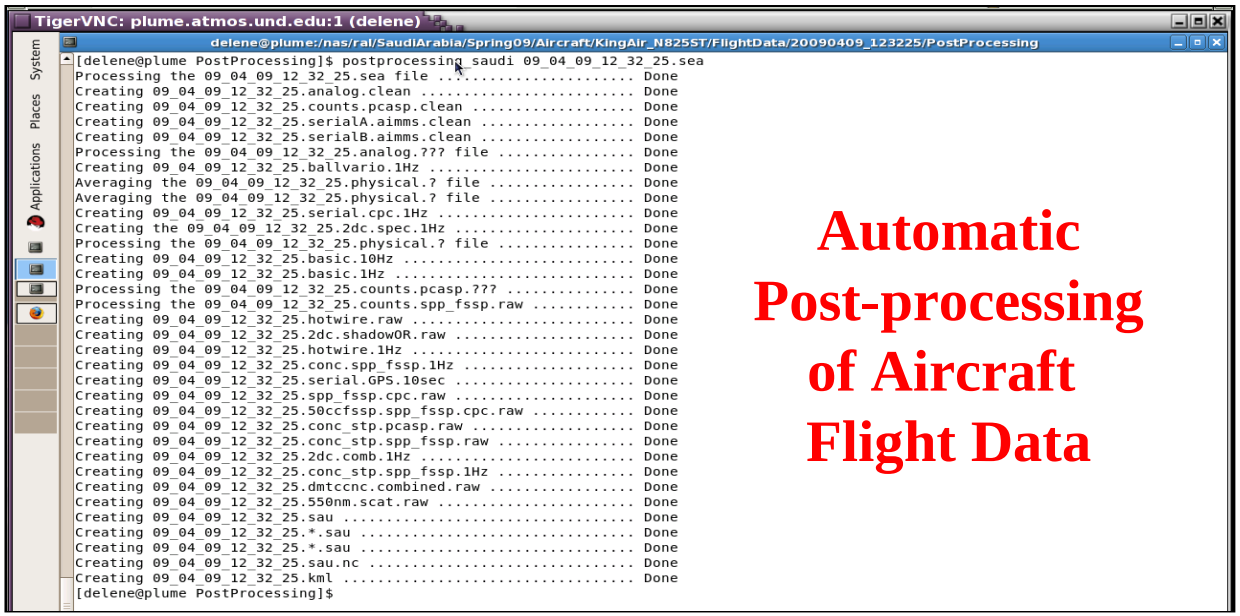
Airborne Data Set

Quality Control - The process of conducting tests to check that measurements are being made correctly and accurately.

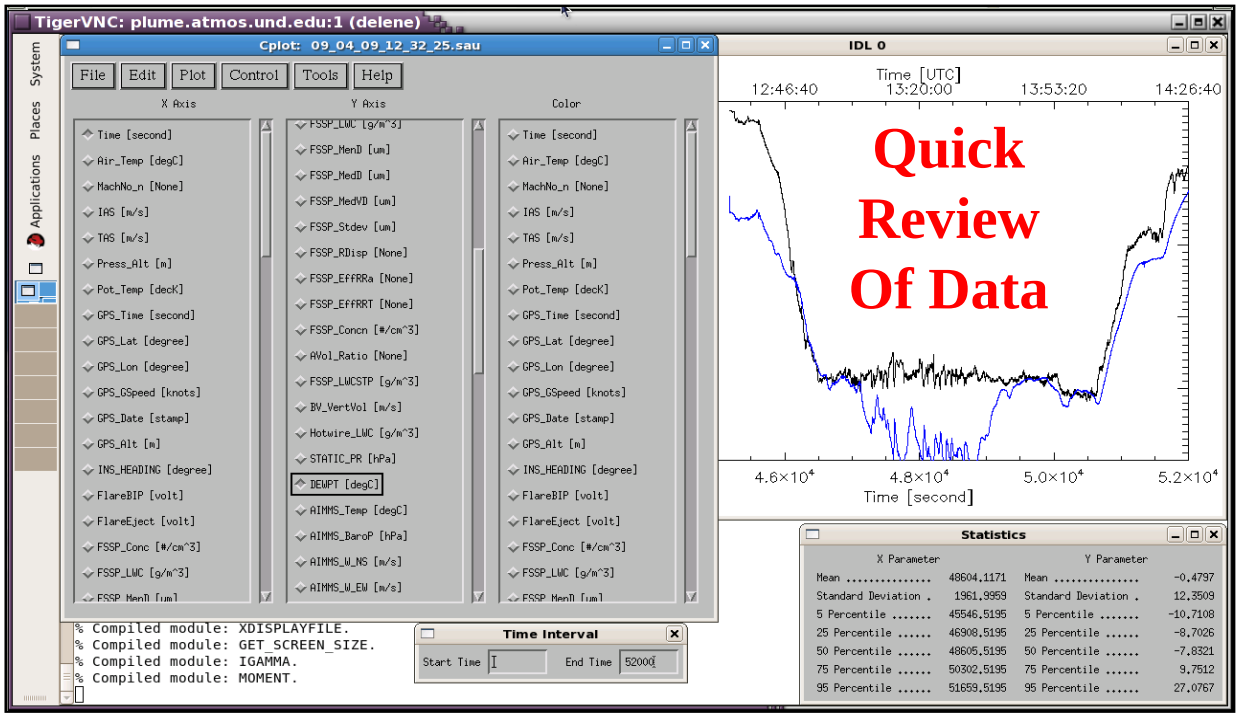
Quality Assurance - The process of reviewing a data set to eliminate measurements that are invalid due to known problems.

Airborne Data Processing and Analysis (ADPAA) Software Package

- Quality control and quality assurance of data sets requires a great deal of time.
- Robust software tools are essential but time consuming to build and have limited users.

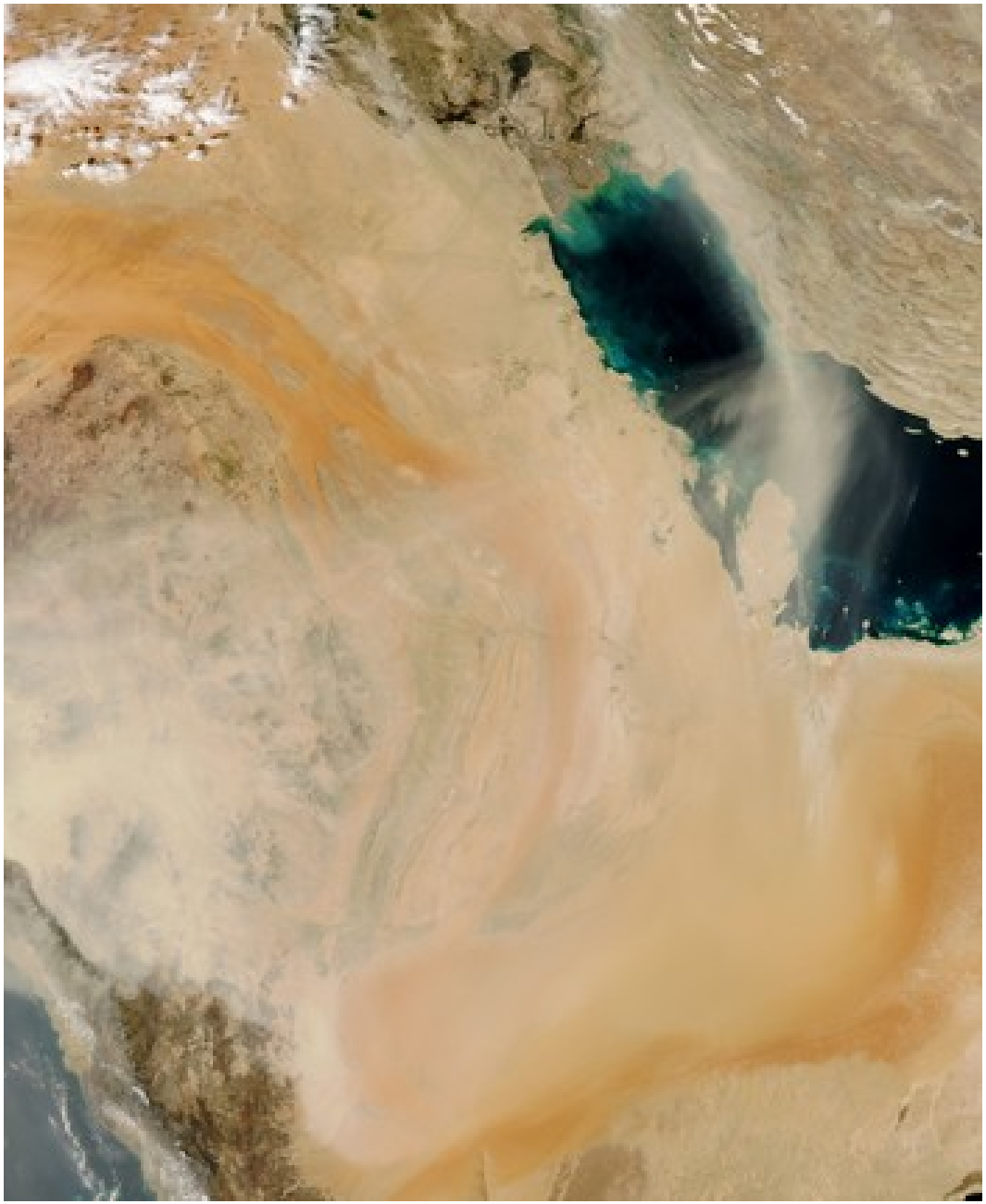


Automatic Post-processing of Aircraft Flight Data



Quick Review Of Data

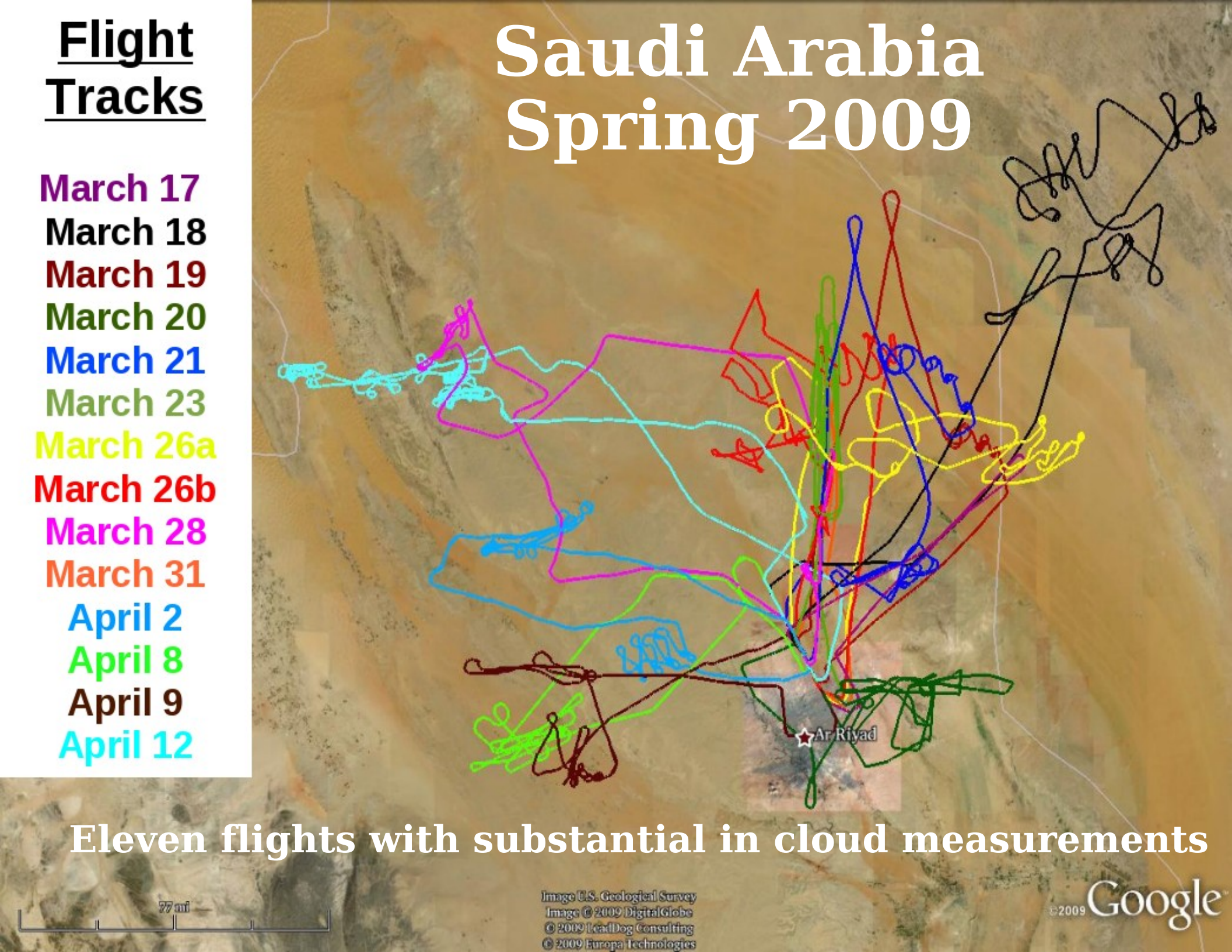
Quality Control and Saudi Arabia Dust



MODIS Image 11 March 2009

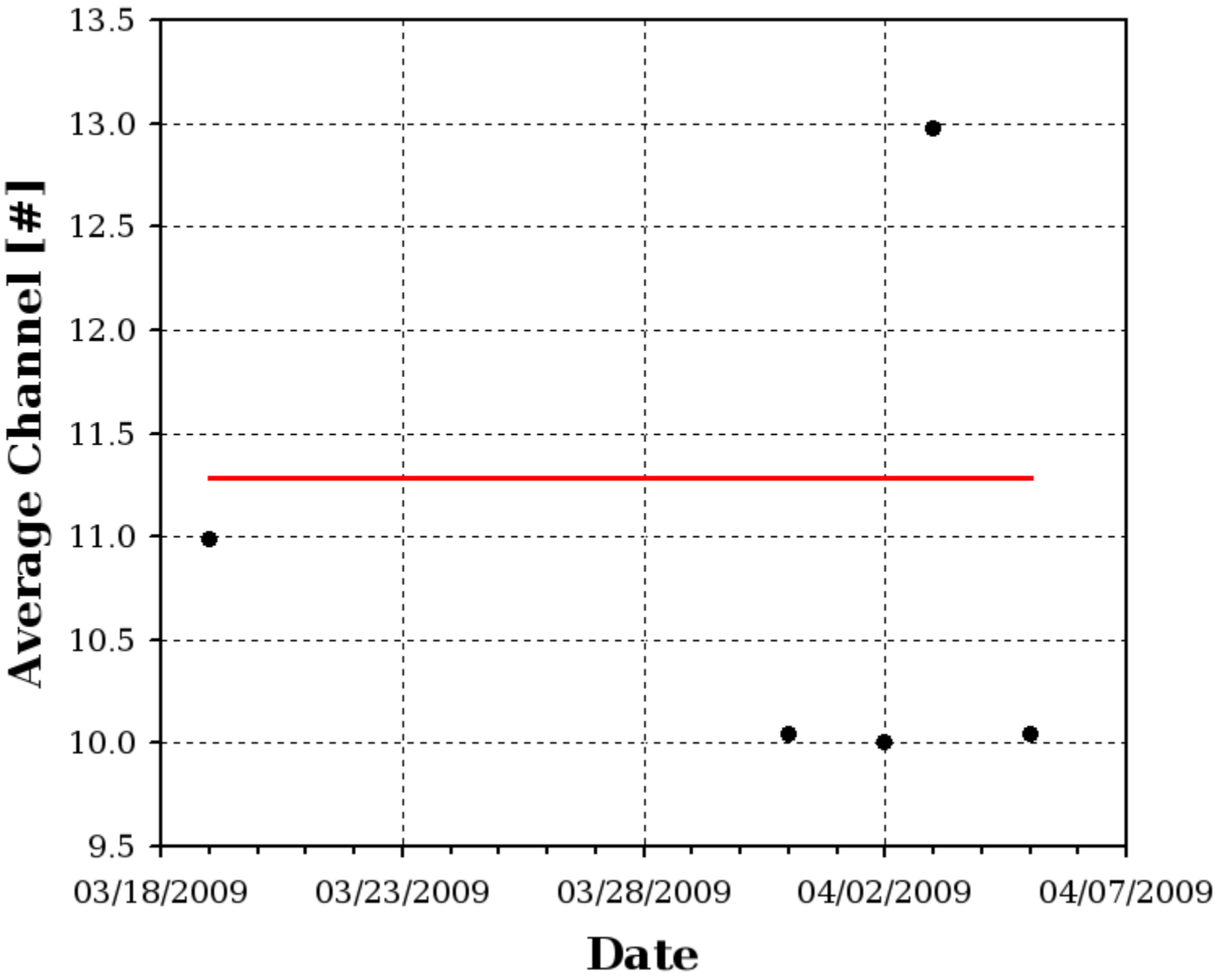
Al Faisaliyah Center

Saudi Arabia Spring 2009

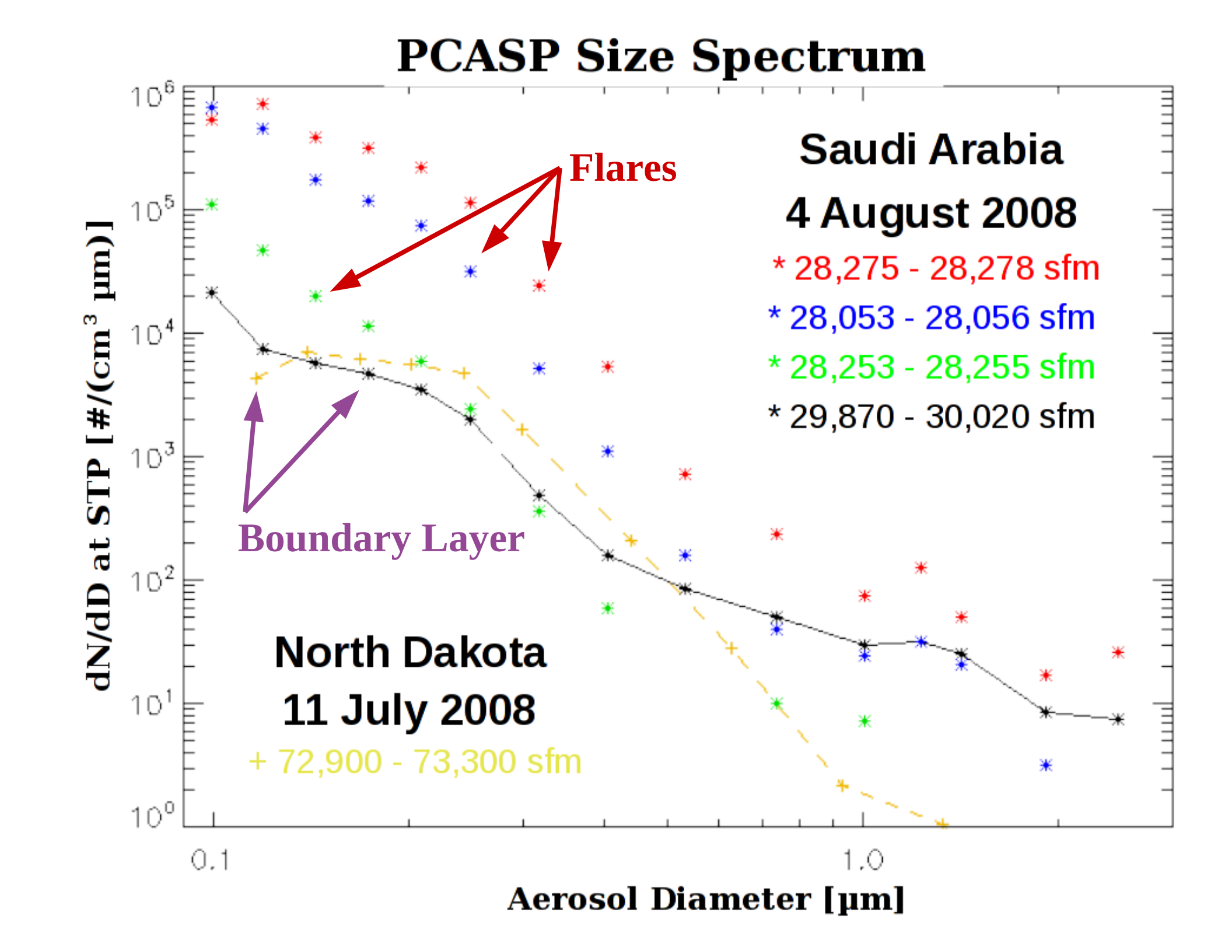


Eleven flights with substantial in cloud measurements

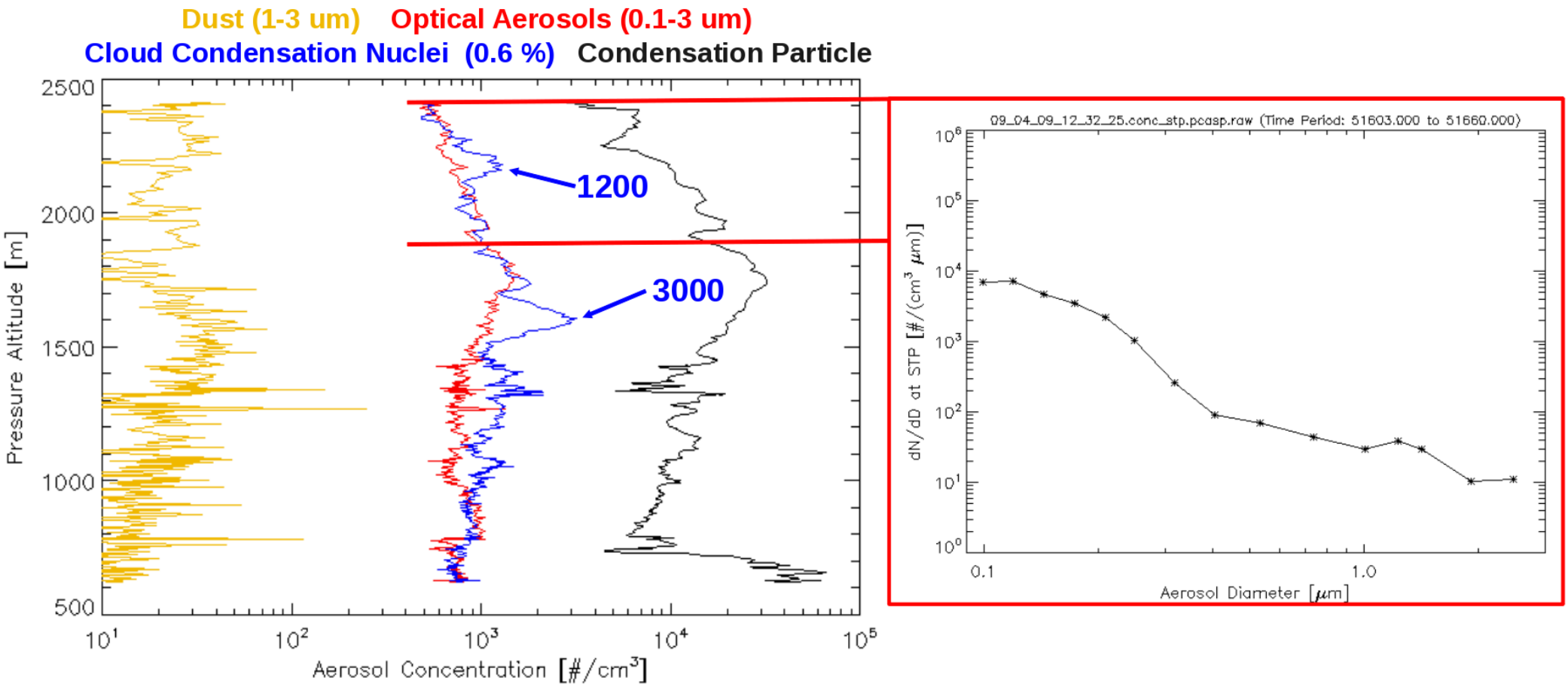
FSSP Performance Checks



Average channel values from valid performance checks conducted on the FSSP during spring 2009 IOP using 30 µm beads. The solid horizontal line indicates the “standard” average channel value.

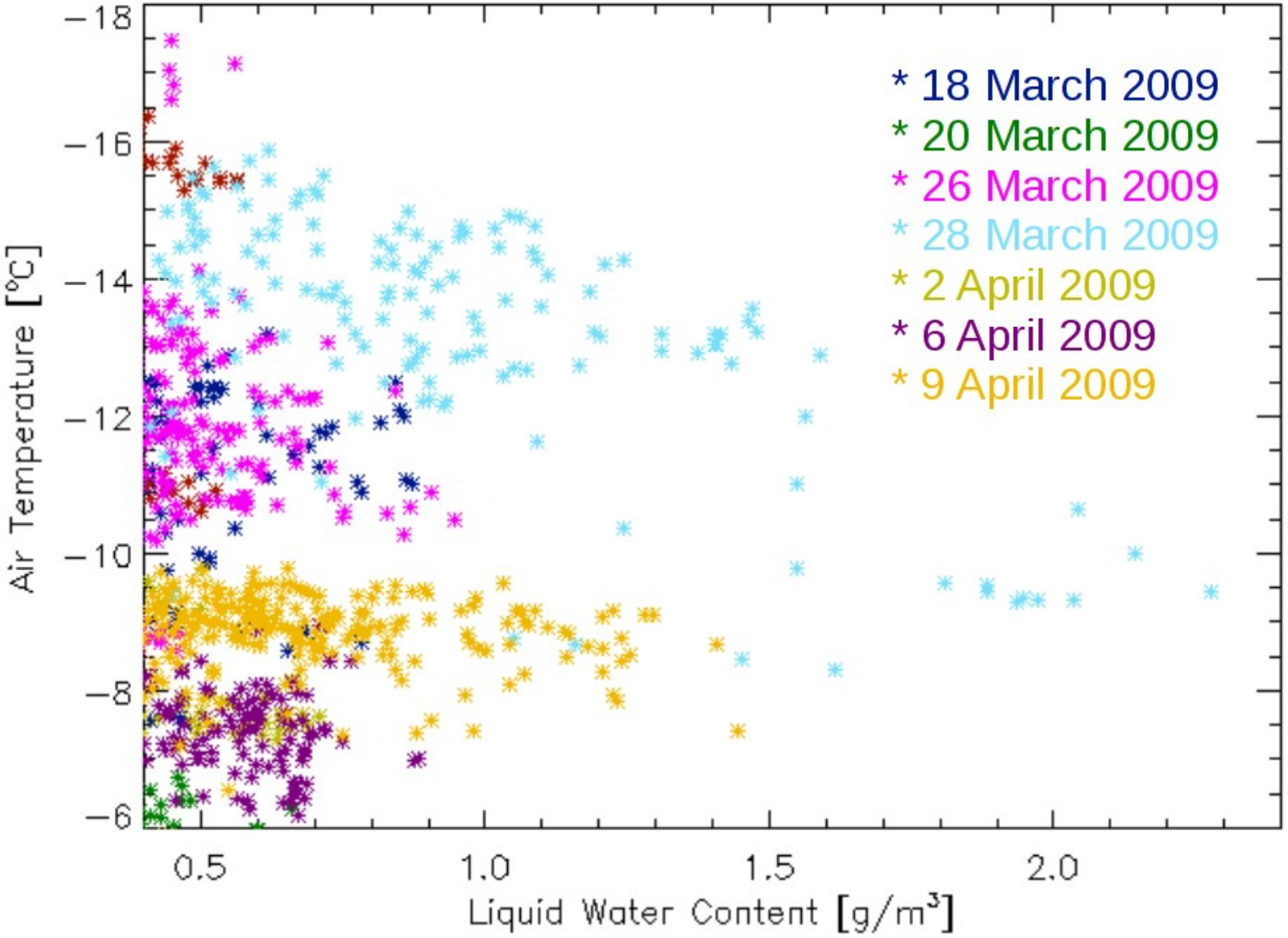

PCASP Size Spectrum
Flares
Saudi Arabia
4 August 2008
* 28,275 - 28,278 sfm
* 28,053 - 28,056 sfm
* 28,253 - 28,255 sfm
* 29,870 - 30,020 sfm
Boundary Layer
North Dakota
11 July 2008
+ 72,900 - 73,300 sfm
dN/dD at STP [#/(cm3 µm)]
Aerosol Diameter [µm]
0.1
1.0

Descent Profile 9 April 2009

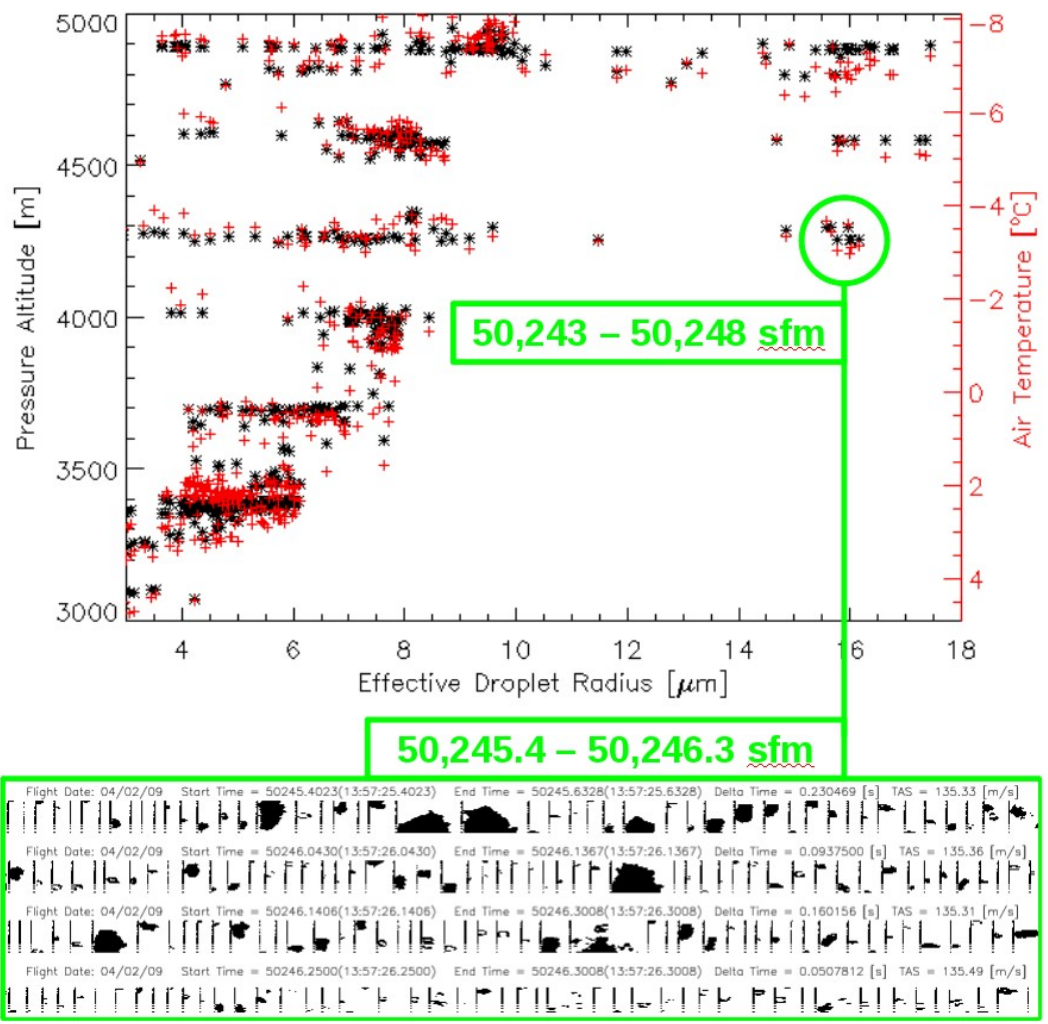


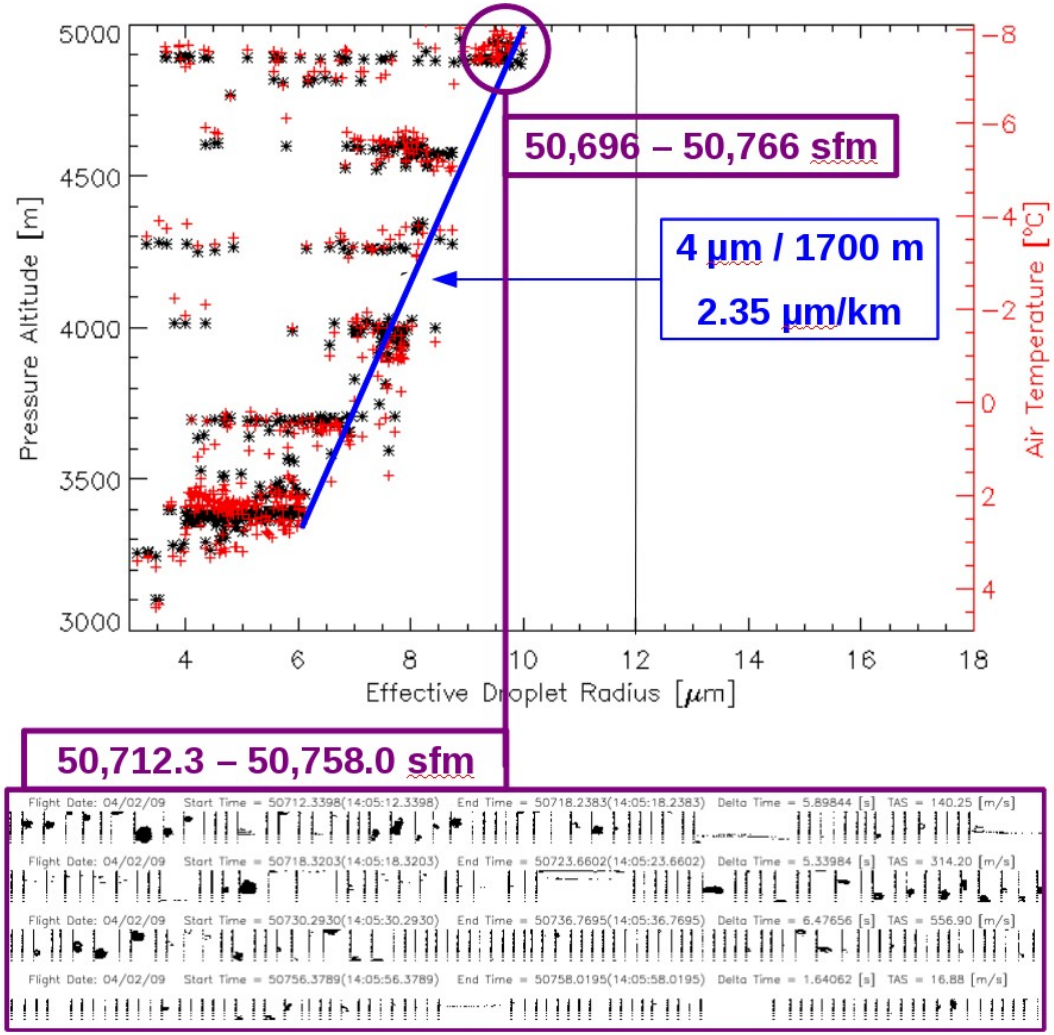
Descent aerosol profile (left panel) for 9 April 2009 flight in Saudi Arabia. The blue labels of 1200 and 3000 indicate cloud condensation nuclei (CCN) concentrations increase where the optical aerosol concentration does not increase. The PCASP spectrum (red box on right) is for the upper (1900 to 2400 m) of the profile.

FSSP Liquid Water Content

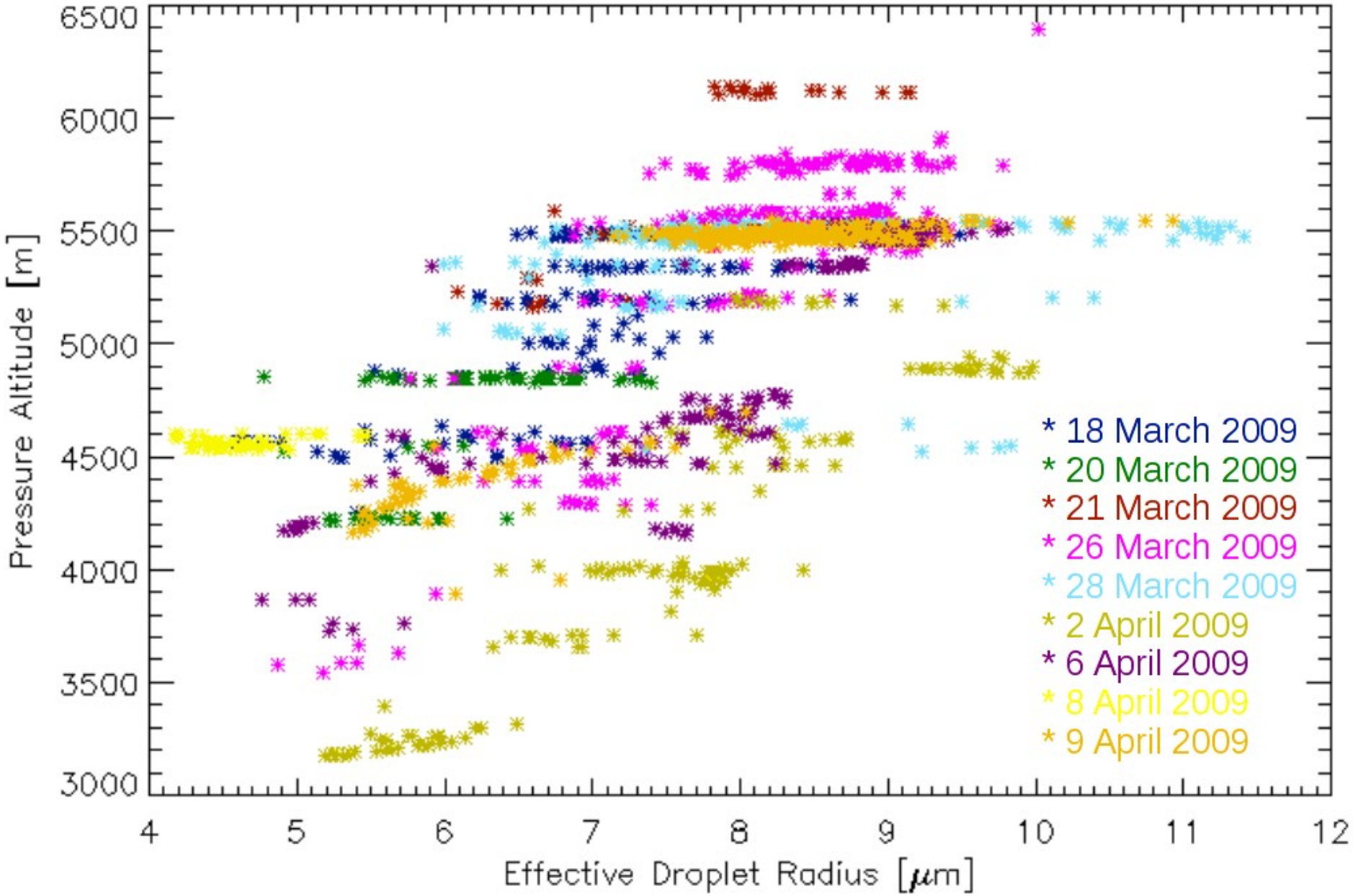


Droplet Effective Radius





Sampling of cloud cell between cloud base and cloud top during time interval 49,100 to 50,800 sfm on 2 April 2008. Left panel shows all observations, while the right panel only includes FSSP concentrations at STP that are greater than 100 #/cm^3. The blue line gives the approximate rate of increase of effective droplet radius with height.



Summary of cloud droplet effective radius measurements in the core (liquid water content > 0.25 g/m^3 , cloud droplet number concentration > 300 #/cm^3, 2DC concentration < 0.1 #/cm^3) of cloud during the spring 2009 field project in Saudi Arabia.

Activity Summary

- Dr. David Delene conducted a total of 34 training activities during the spring 2009 IOP.
- Dr. Jeffrey Tilley conducted 3 days of lectures that were defined and scheduled a month ahead of time.
- A total of 16 research flights with eleven flights obtaining substantial in cloud measurements.
- A quality controlled and quality assured data set was produced and analyzed.

Research Conclusions

- Atmospheric sampling of the seeding plume indicates that 1 µm diameter concentration within a hygroscopic flare plume is similar to concentrations measured within the boundary layer in Saudi Arabia.

- The PCASP measurements in Saudi Arabia indicate that the accumulation mode aerosol size distribution is typically very broad. High CCN concentrations were often observed in below cloud base regions (e.g. 9 April 2009).

- There exists super-cooled liquid water in clouds in the Riyadh region during spring time convection.

- Observations show a natural ice precipitation formation process and a limited warm rain precipitation formation process.

Spring Time Cloud Seed-ability

- Observations show super-cooled liquid water between -8 and -18 C which are targets for AgI seeding.
- Observations show a limit warm rain precipitation formation process with small growth in droplet effective radius with height above cloud base. Therefore, there exists the potential for seeding with hygroscopic flares to increase the formation of large droplets to start the warm rain precipitation process.

Thanks for Listening

Any Questions