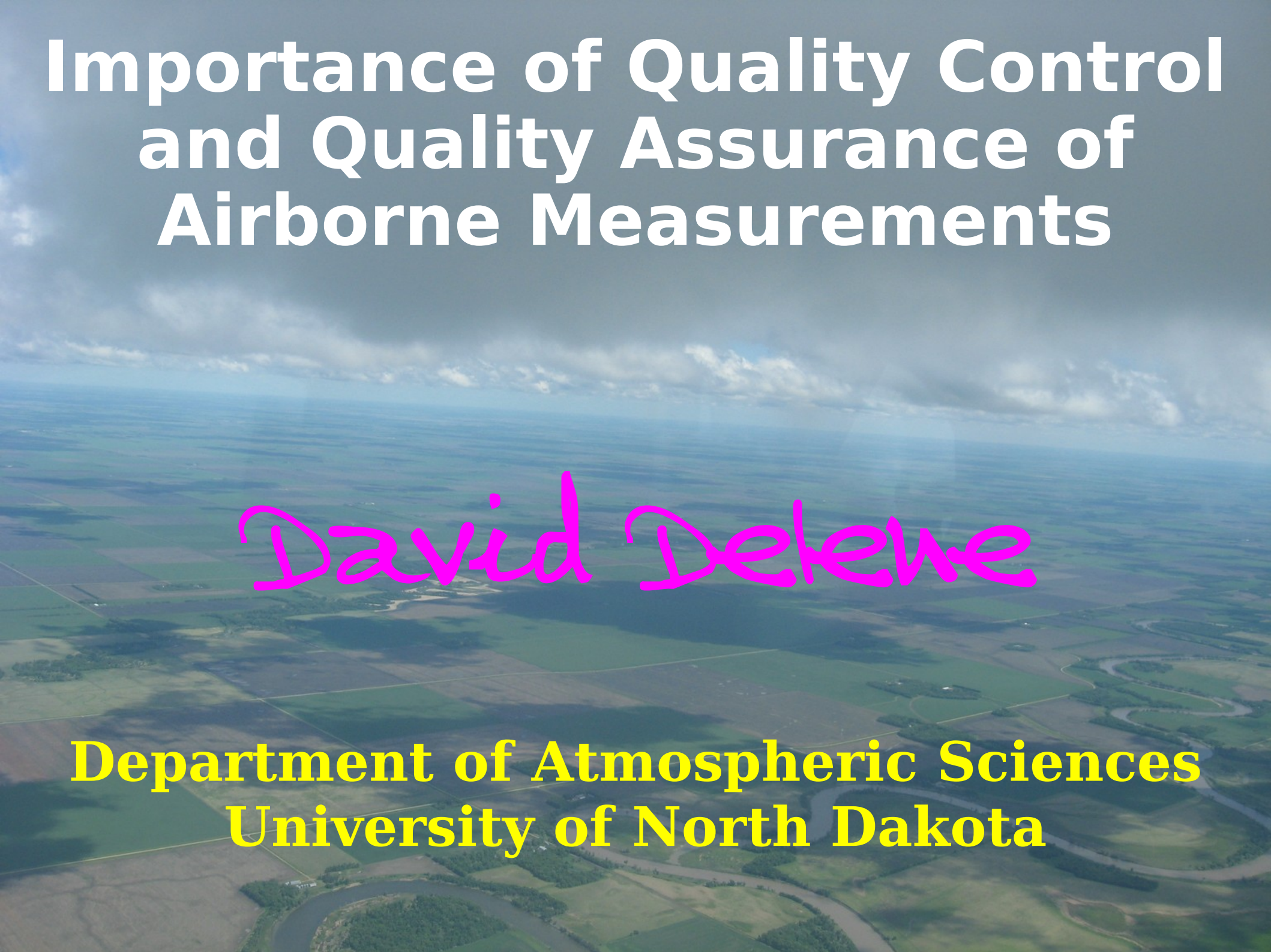
Importance of Quality Control and Quality Assurance of Airborne Measurements



David Delene

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University of North Dakota

Motivation

A scientific method consists of the collection of data through observation and experimentation, and the formulation and testing of hypotheses - *Merriam-Webster Dictionary*.

Thesis: Airborne data set that are not quality controlled and quality assured result in the belief and formation of incorrect hypotheses.

June 13, 2008 Flight

July 7, 2008 Flight

Objective

- Illustrate the process and tools used in creating airborne data sets.
- Provide examples of how poor airborne data sets can result in inaccurate scientific conclusions
- Demonstrate the importance of high quality data sets for scientific progress.

Definition

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 (replace with missing value codes) measurements that are invalid due to known problems.

Cheyenne II: Bamako, Mali 2007

CCN Counter

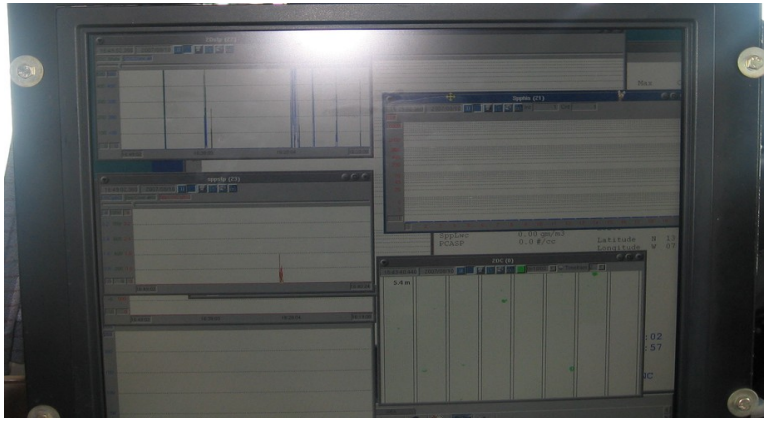
Ejectable Rack

FSSP

PCASP

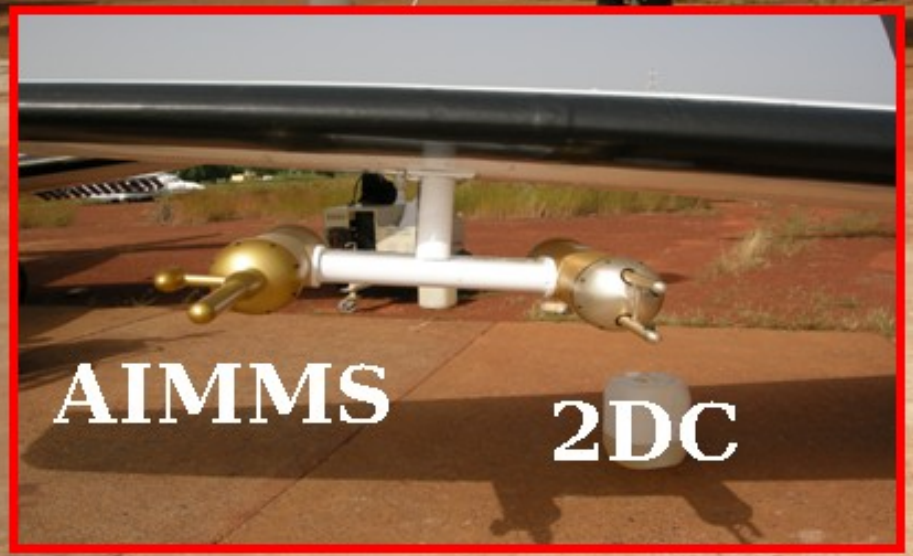
Flare Rack

2D-C



M300 Display

King Air 200
Bamako, Mali
2008 Season

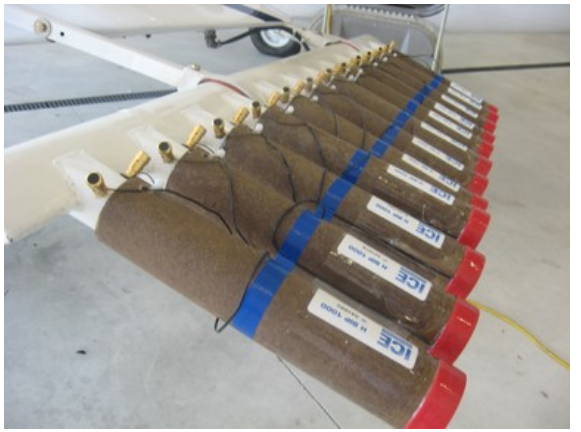


Cessna 340: North Dakota 2008

CCN Counter

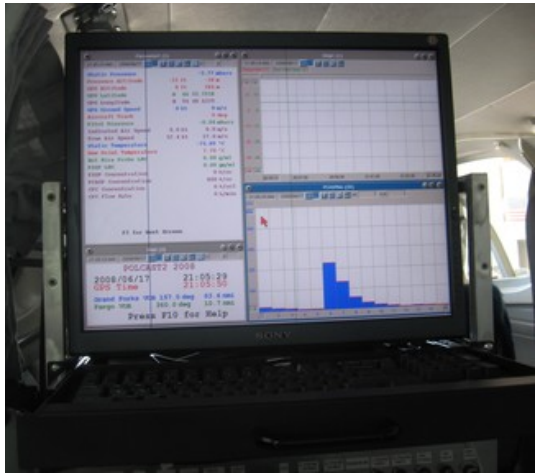
FSSP

Flare Rack



PCASP

M300 Display

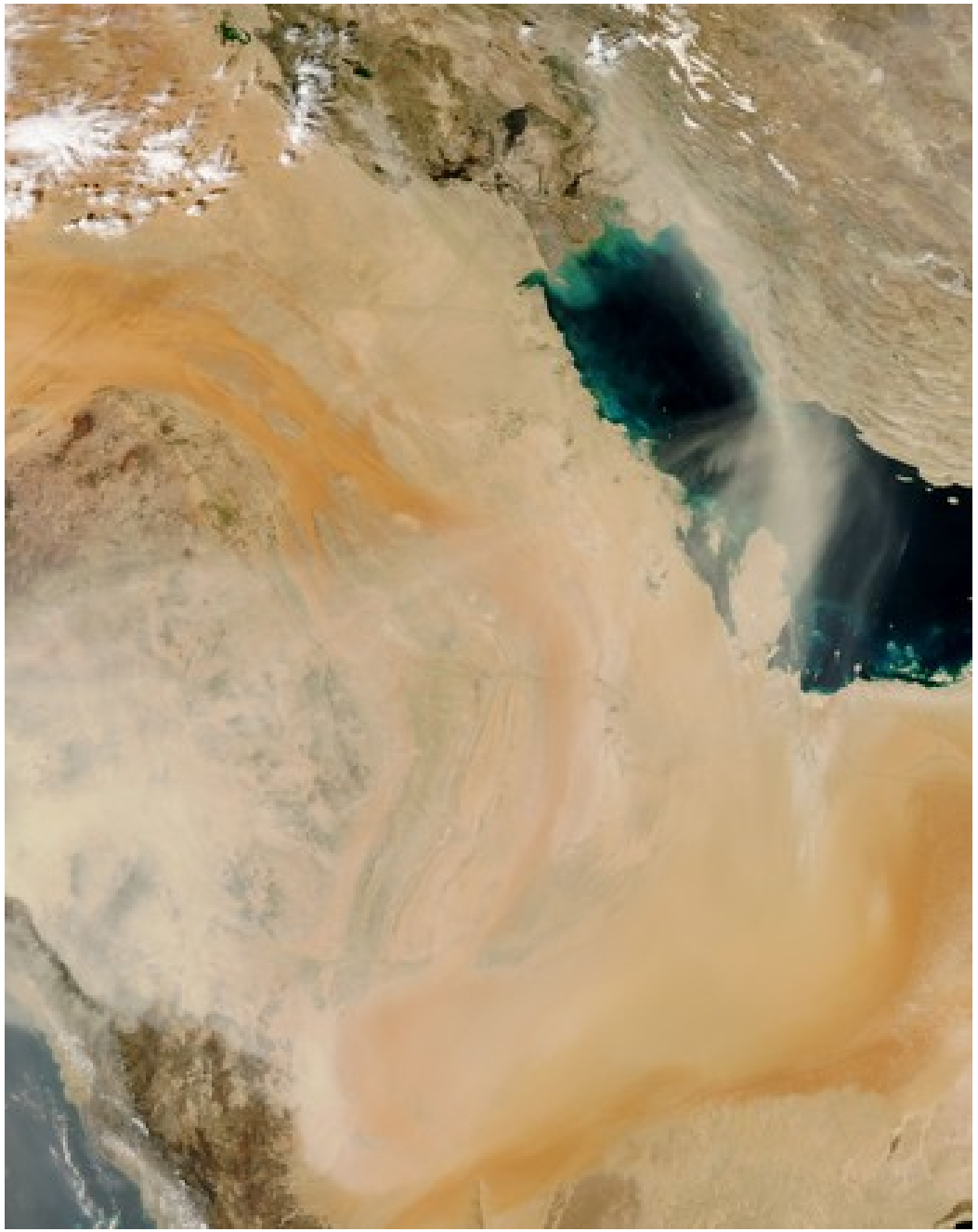


Temperature and Hot Wire Probe

Dew Point Temperature Sensor Head

King Air 200
Saudi Arabia
Spring 2009

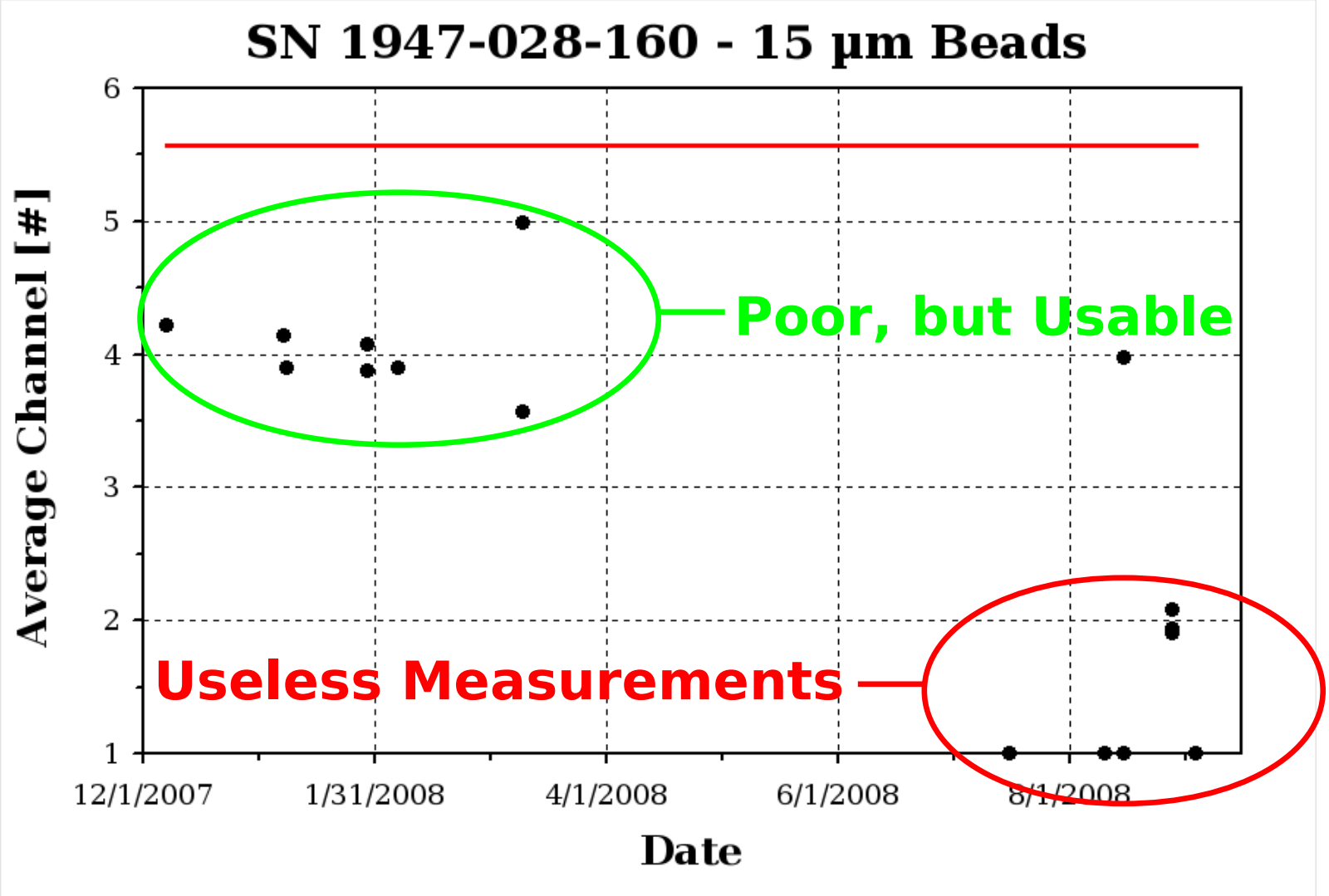
Saudi Arabia Dust



MODIS Image March 11, 2009

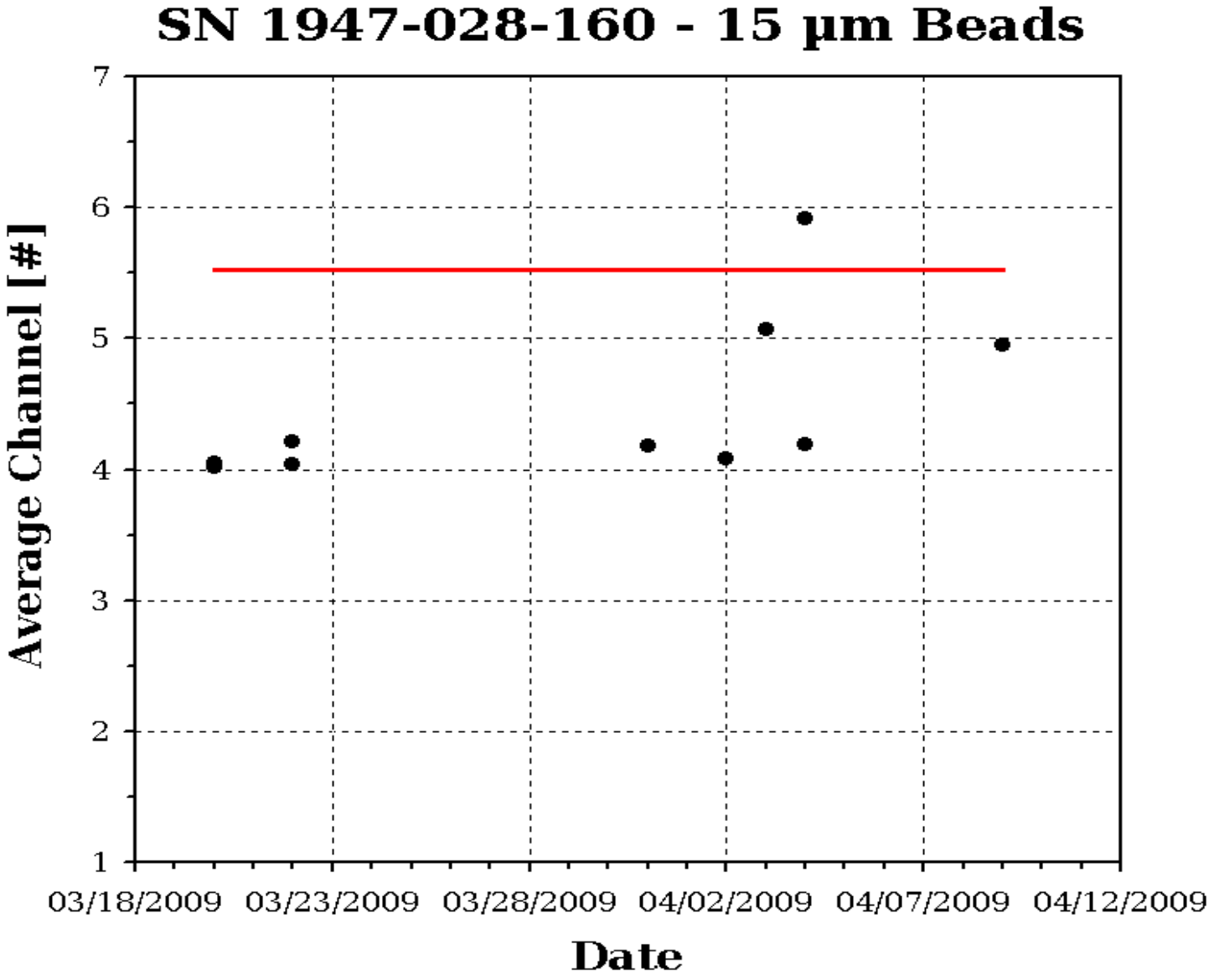
Al Faisaliyah Center

FSSP Performance Checks



Average channel values for the FSSP from performance checks conducted during the 2007/2008 field project. All checks were performed in Saudi Arabia while the FSSP was on the research King Air 200 aircraft. The solid horizontal line indicates the “standard” average channel value where 15 µm beads theoretically should be measured.

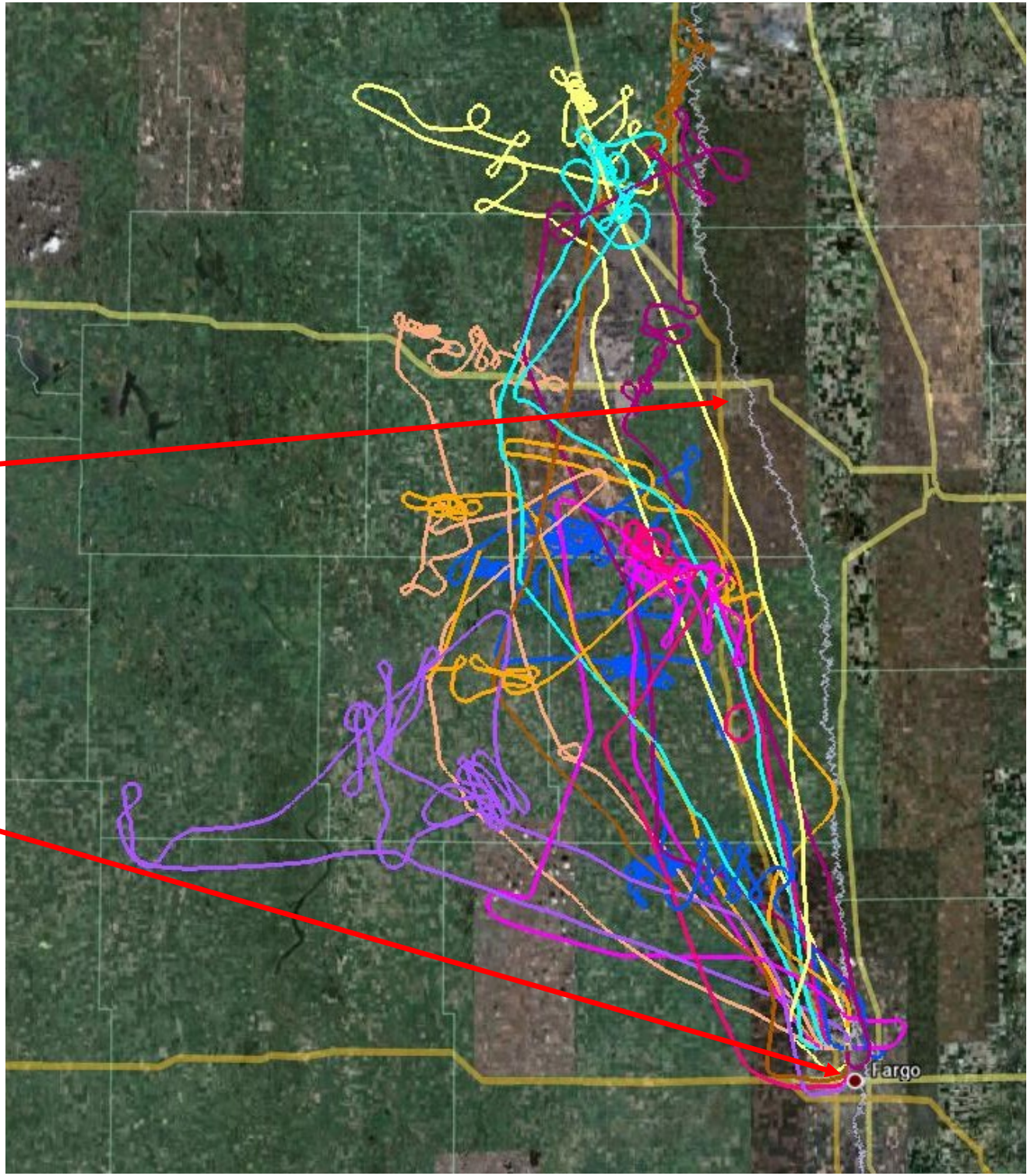
FSSP Performance Checks



Average channel values for the FSSP from performance checks conducted during the Spring 2009 field project. The solid horizontal line indicates the “standard” average channel value where 15 µm beads theoretically should be measured. Analysis performed by Matt Clegg.

Observations POLCAST2 Flights

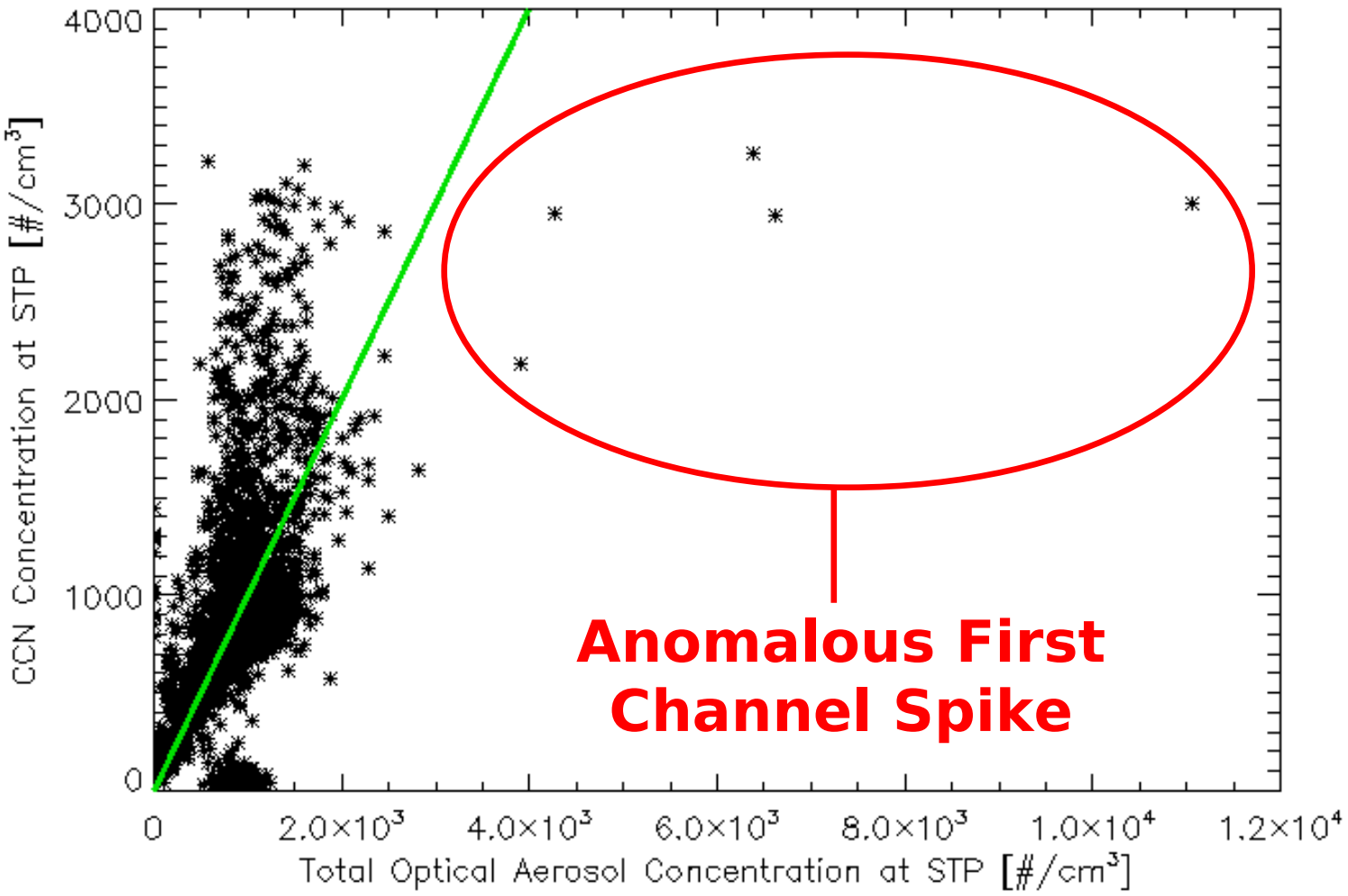
- Targets within coverage of the UND radar.
- Flights were launched out of Fargo, North Dakota.
- Targets within North Dakota.
- Obtained 7 seed cases and 6 no seed cases.



POLCAST2 Flight Summary

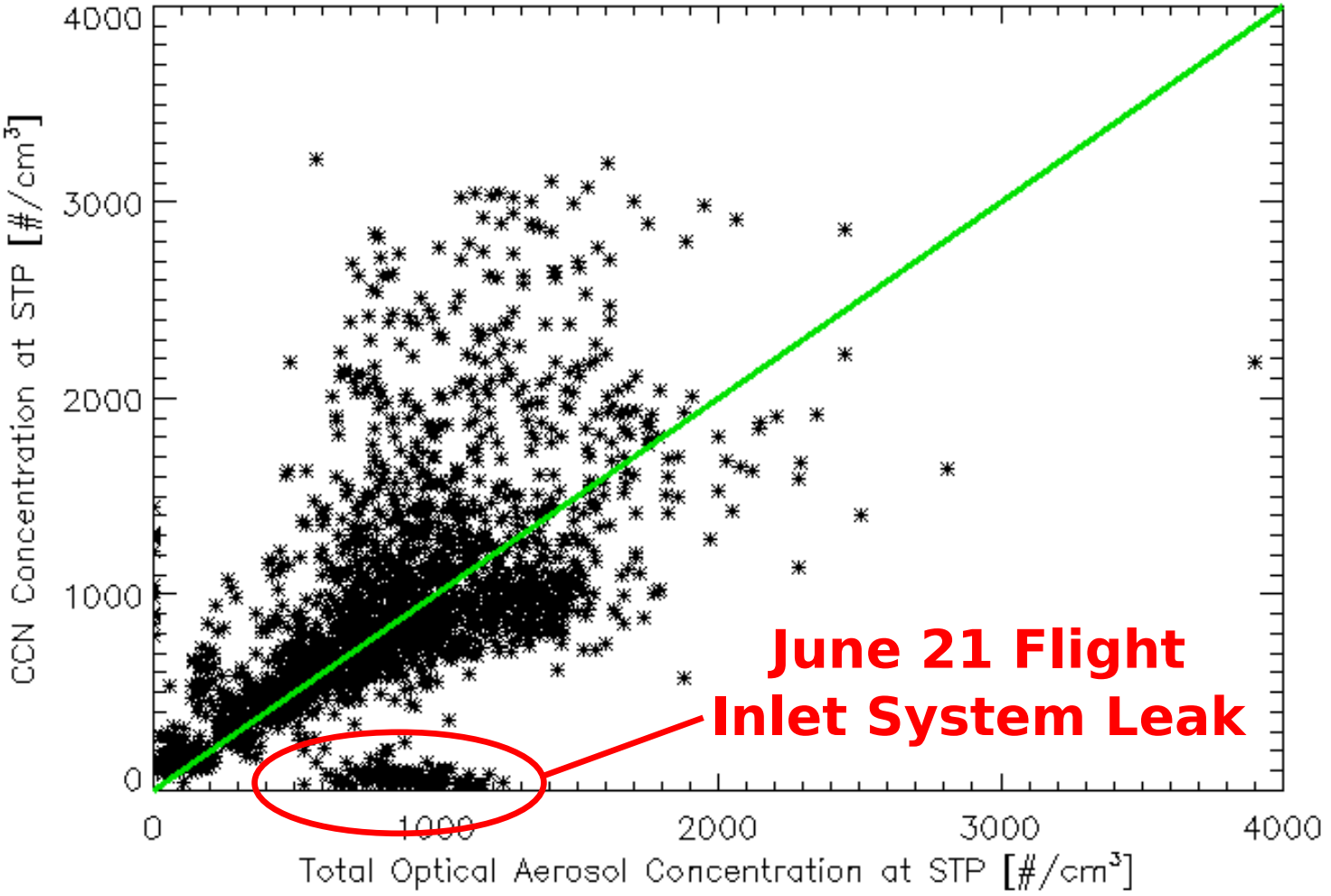
Start Date	Start Time	End Time	Total Time	Cloud Base Height	Cloud Base Temp
YYMMDD	HH:MM:SS	HH:MM:SS	Hours	Meters	Celsius
080610	22:46:47	23:27:30	0.68	1150	4
060612	19:24:43	20:33:37	1.15	1750	4
080612	21:52:43	23:55:21	2.04	2100	3
080613	18:19:08	21:32:41	3.23	1600	6
080614	20:24:45	22:32:19	1.58	2400	4
080619	21:19:54	22:42:50	1.38	2100	8
080621	20:57:32	22:53:01	1.95	2200	4
080626	21:57:00	00:24:42	3.46	2250	9
080701	22:41:52	01:02:48	2.39	1650	10
080707	22:45:17	00:55:28	3.17	1400	9
080709	19:41:54	21:25:18	1.74	2200	7
080711	19:10:58	21:15:20	2.07	950	22

Preliminary POLCAST2 Data



The 1 Hz averaged total (0.1 – 3.0 μm in diameter) aerosol concentration measured by the Passive Cavity Aerosol Spectrometer Probe (PCASP) at the time corresponding to samples made be the University of Wyoming Cloud Condensation Nuclei (CCN) counter (1% Supersaturation). The solid green line is the one-to-one line. All valid out of cloud measurements (FSSP total number concentration less than 50 # cm^{-3}) obtained during the POLCAST2 field project are presented. Both the PCASP and CCN Counter concentrations have been adjusted to standard temperature and pressure.

Preliminary POLCAST2 Data



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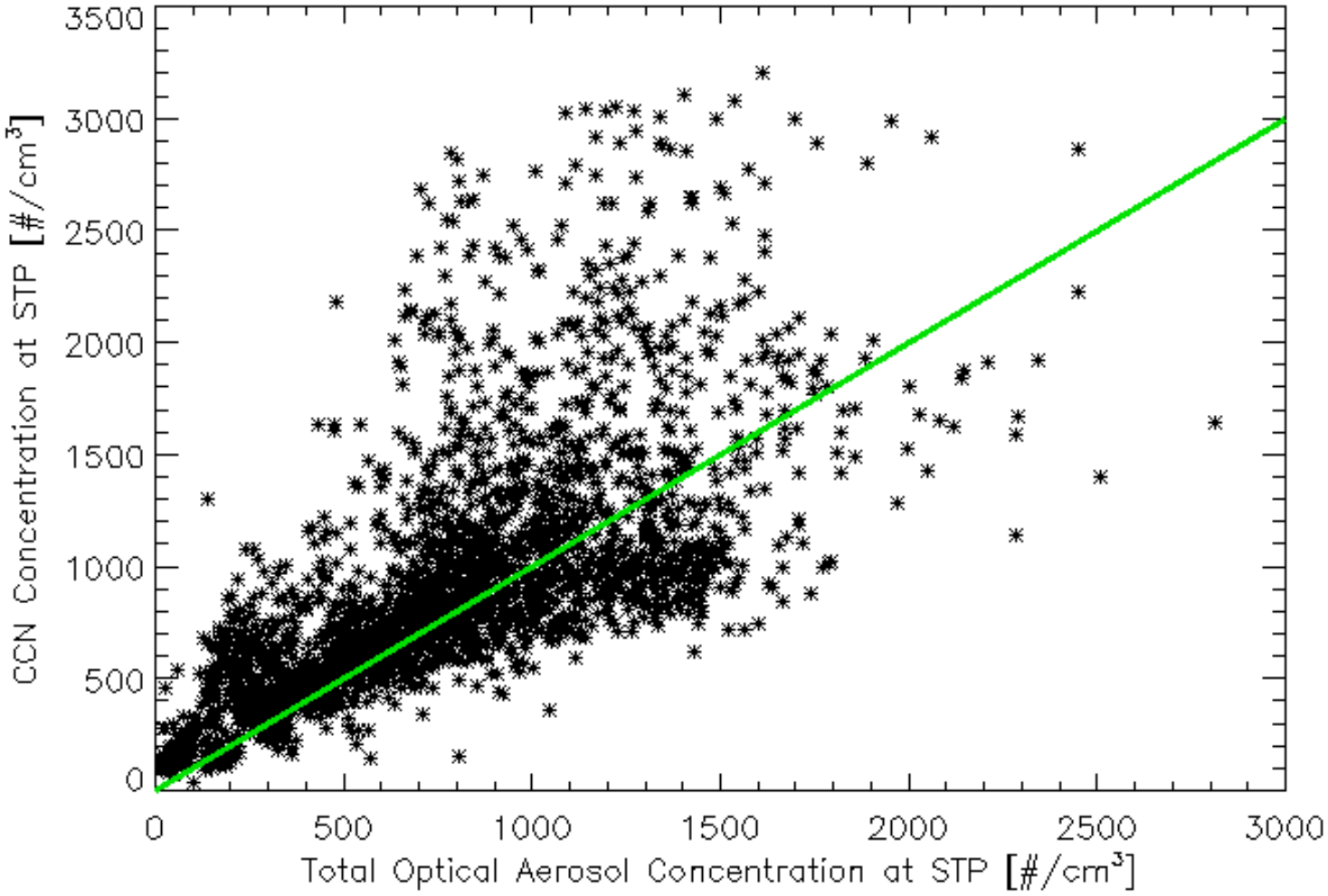
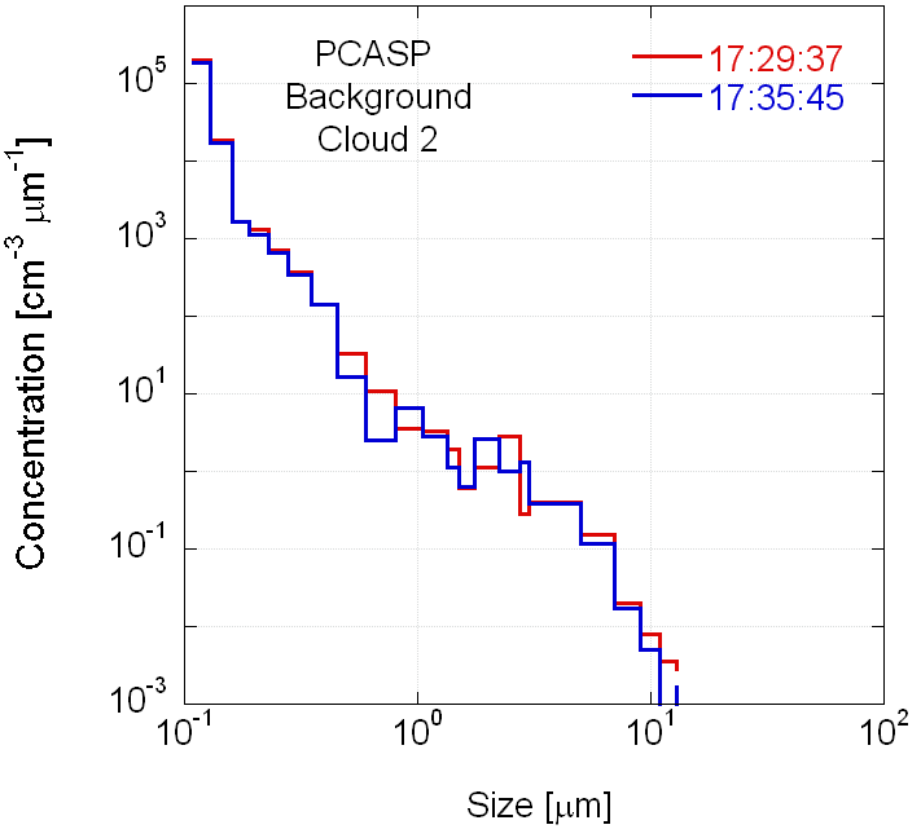
Quality Assured Data



The 1 Hz averaged total (0.1 – 3.0 μm in diameter) aerosol concentration measured by the Passive Cavity Aerosol Spectrometer Probe (PCASP) at the time corresponding to samples made be the University of Wyoming Cloud Condensation Nuclei (CCN) counter (1% Supersaturation). The solid green line is the one-to-one line. All valid out of cloud measurements (FSSP total number concentration less than 50 # cm^{-3}) obtained during the POLCAST2 field project are presented. Both the PCASP and CCN Counter concentrations have been adjusted to standard temperature and pressure.

Bamako, Mali Aerosol Pollution



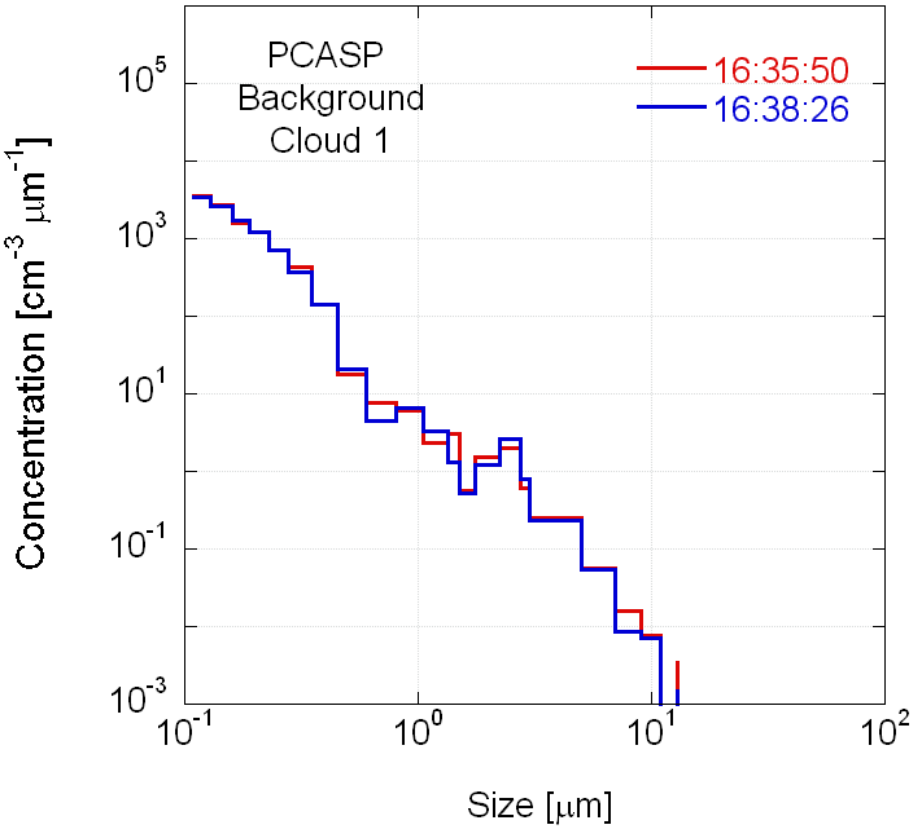
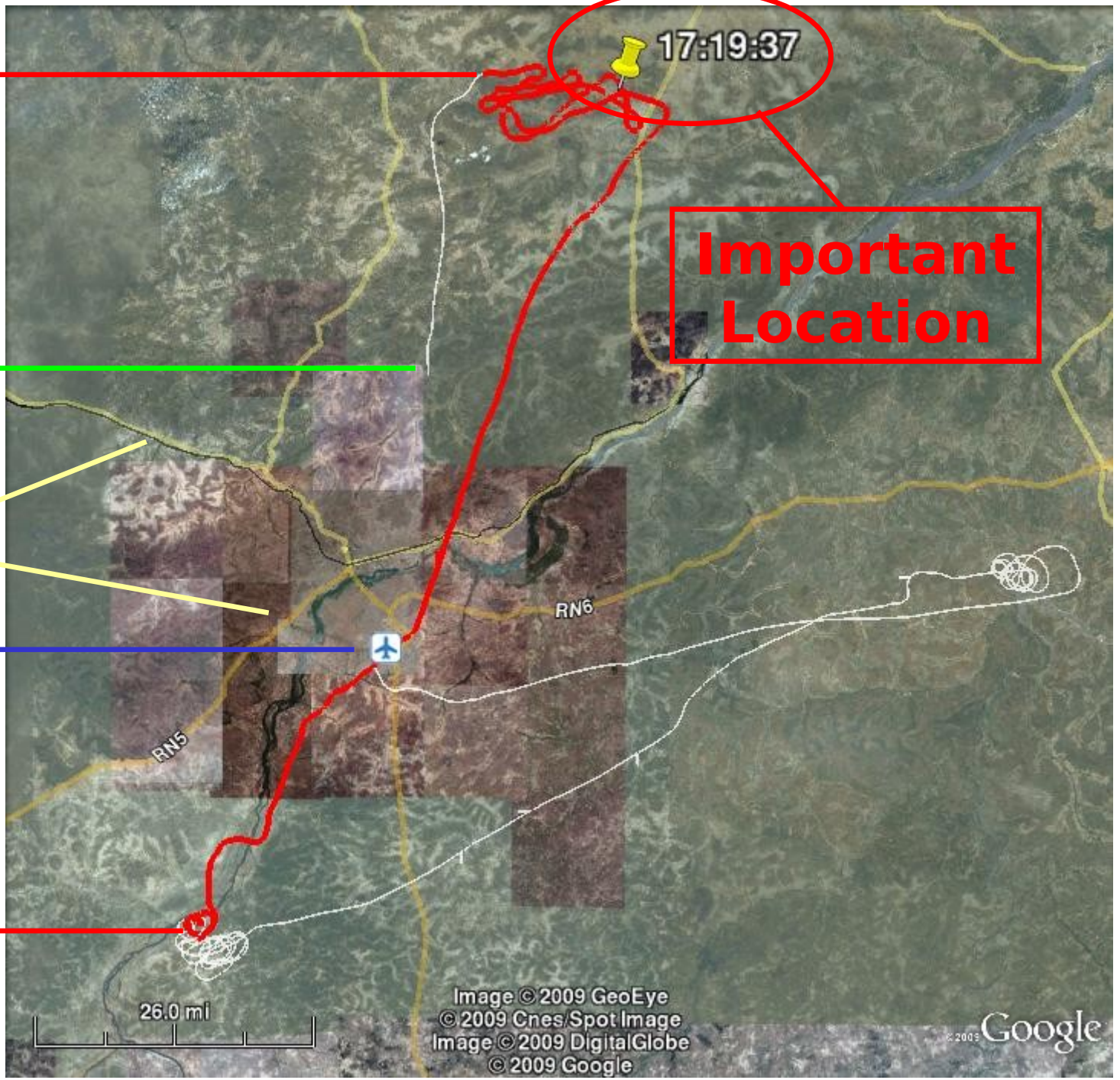


Figure 5.4: Aerosol size distributions measured downwind of Bamako and upwind from Bamako on 18 August 2006.

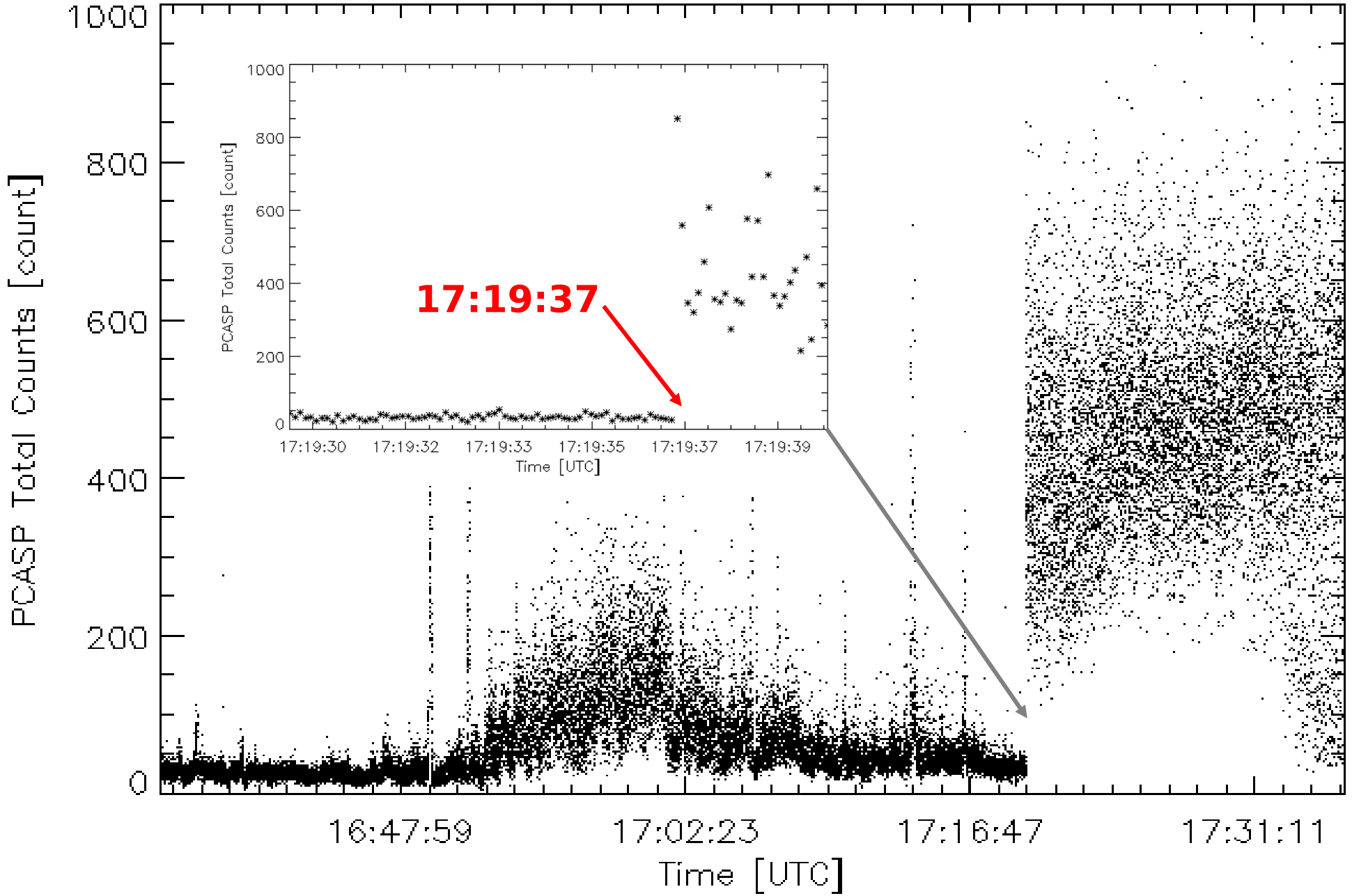
"Although the concentrations of larger particles are very similar upwind and downwind of Bamako, the concentrations of smaller particles dramatically increase downwind of Bamako most probably due the city pollution evident. While the total concentrations of aerosols upwind of Bamako ranged between 200 and 400 cm^{-3}, the total concentrations of aerosols in the size range 0.1 to 3 μm diameter increased to between 4000 and 5000 cm^{-3}."

Quoted from "Feasibility Study for the Augmentation of Rain in Mali" 2006 NCAR report.

Flight Track: 18 August 2006

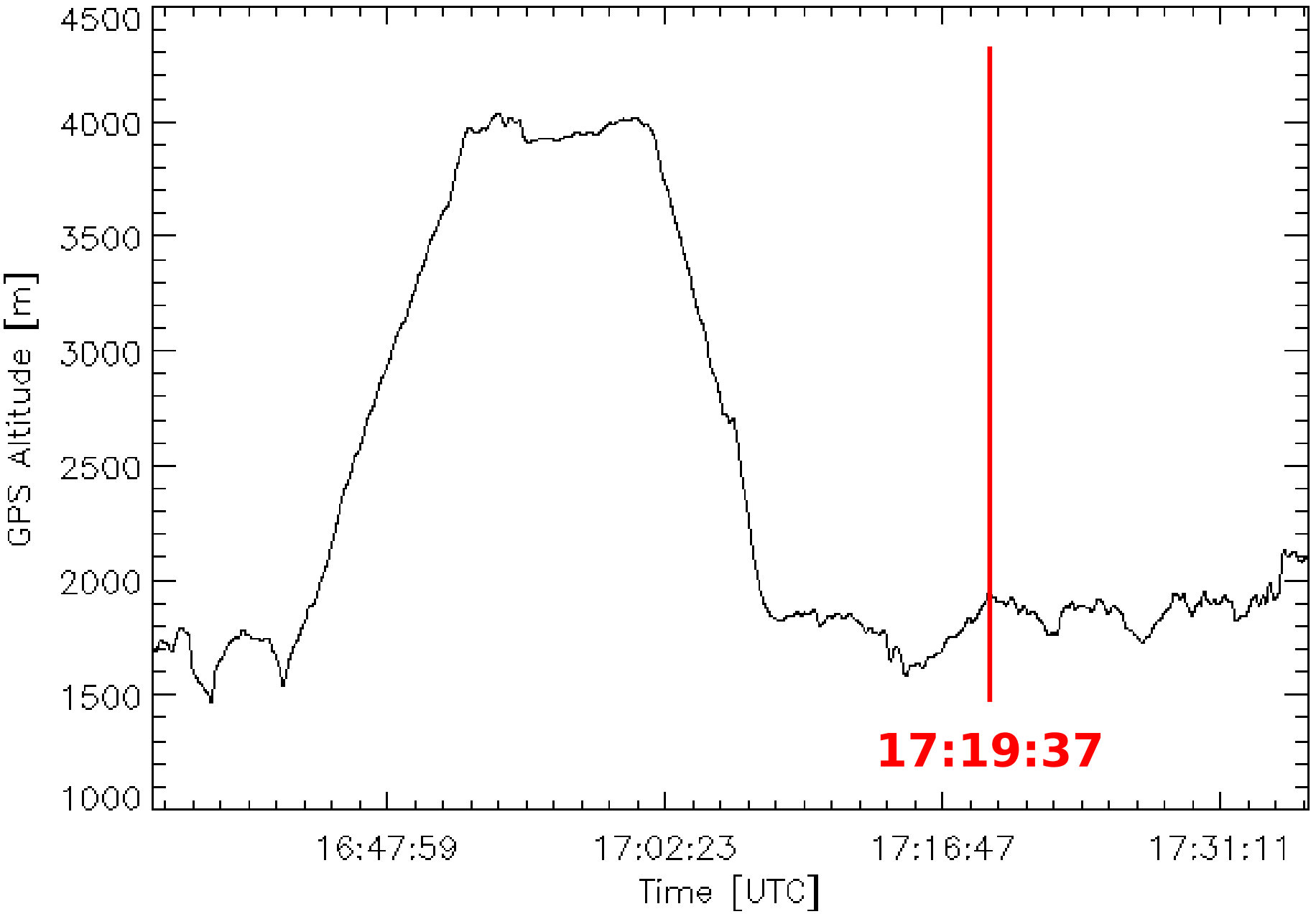


PCASP Counts: 18 August 2006



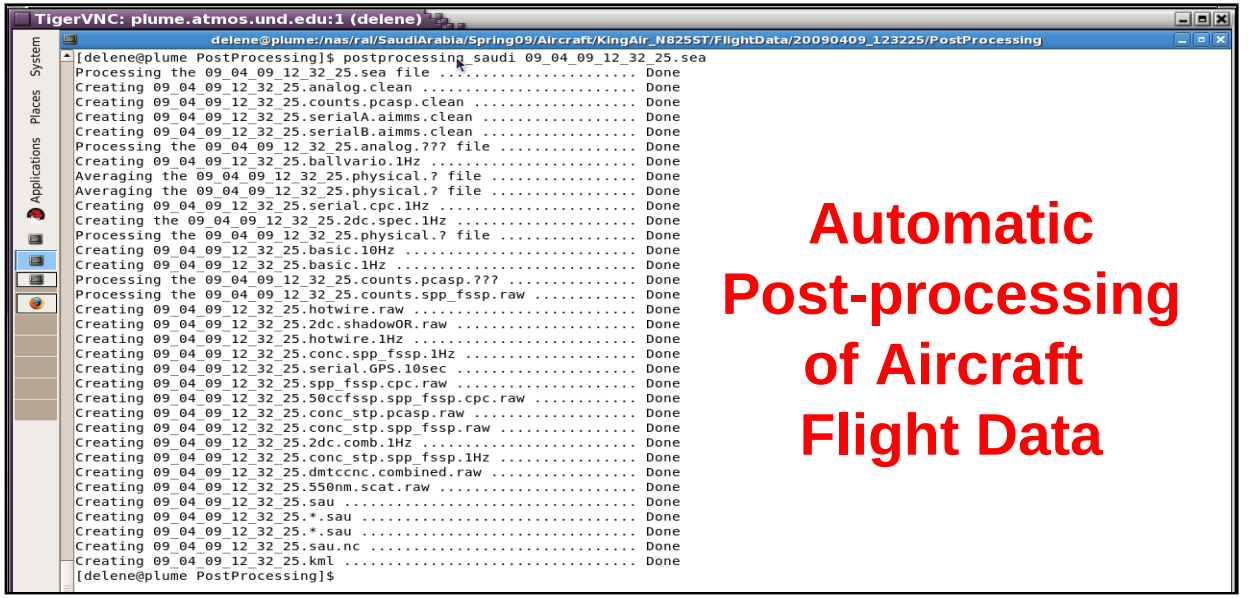
The 10 Hz total (0.1 – 3.0 μm in diameter) aerosol counts measured by the Passive Cavity Aerosol Spectrometer Probe (PCASP).

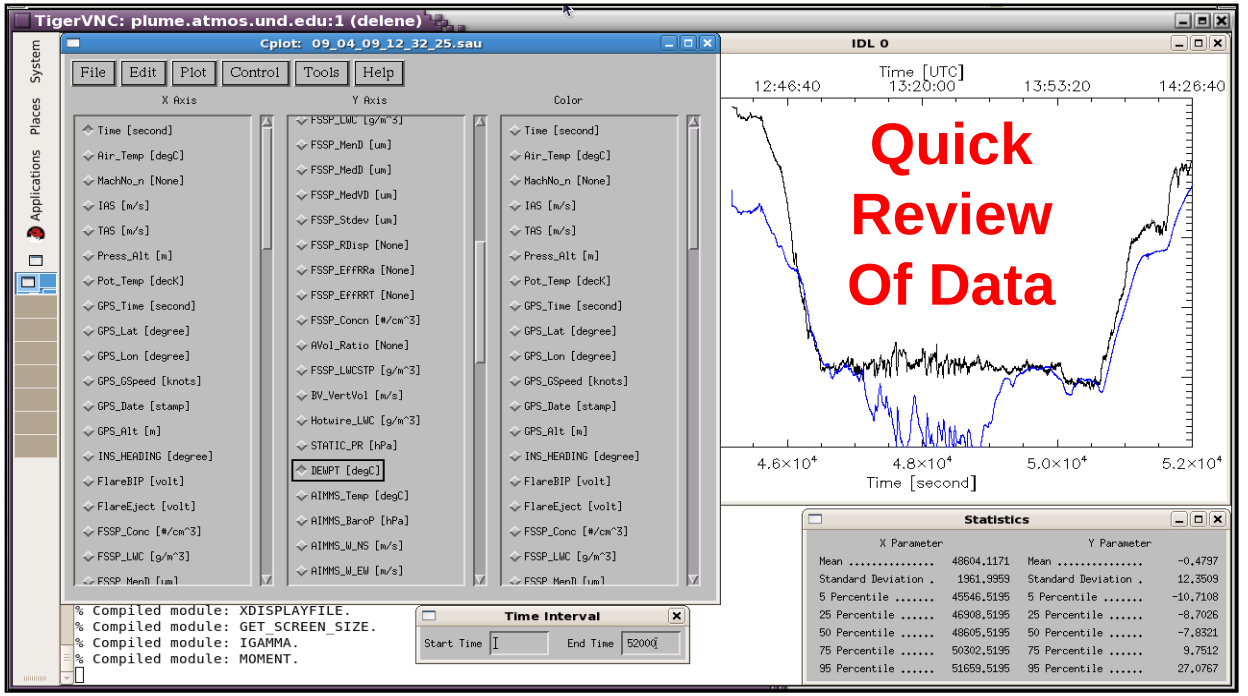
GPS Altitude: 18 August 2006



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.
- Started ADPAA Source Forge project.





ADPAA on Source Forge

http://sourceforge.net/projects/adpaa

- GNU General Public License, Version 3
- Over 170 K lines of code in IDL, Bash/csh Scripts, Perl, FORTRAN, C, and Python
- Subversion Source Code Management
  - Sync Code Between Systems
  - Tracking Coding Activity
  - Revert Changes
- Feature Requests, Bug Tracker and Forum

Conclusions

- Problems can develop during field projects that are only detectable with robust quality control procedures.
- Knowledgeable scientists are required to perform quality assurance of airborne measurements in order to provide scientifically useful data sets.
- Not conducting quality control and quality assurance result in incorrect hypotheses and beliefs.

Thank You Listening

Any Questions


Should You be
Doing That?