Report on the Polarimetric Cloud Analysis and Seeding Test 2 (POLCAST²)

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Measurement Modification

- The Polarimetric Cloud Analysis and Seeding Test 2 (POLCAST^2) experiment is a continuation of the original 2006 field program.
- The 2008 project focuses on a continuation of sampling with the University of North Dakota (UND) polarimetric doppler weather radar and in situ sampling with airborne instrumentation.

June 13, 2008 Flight

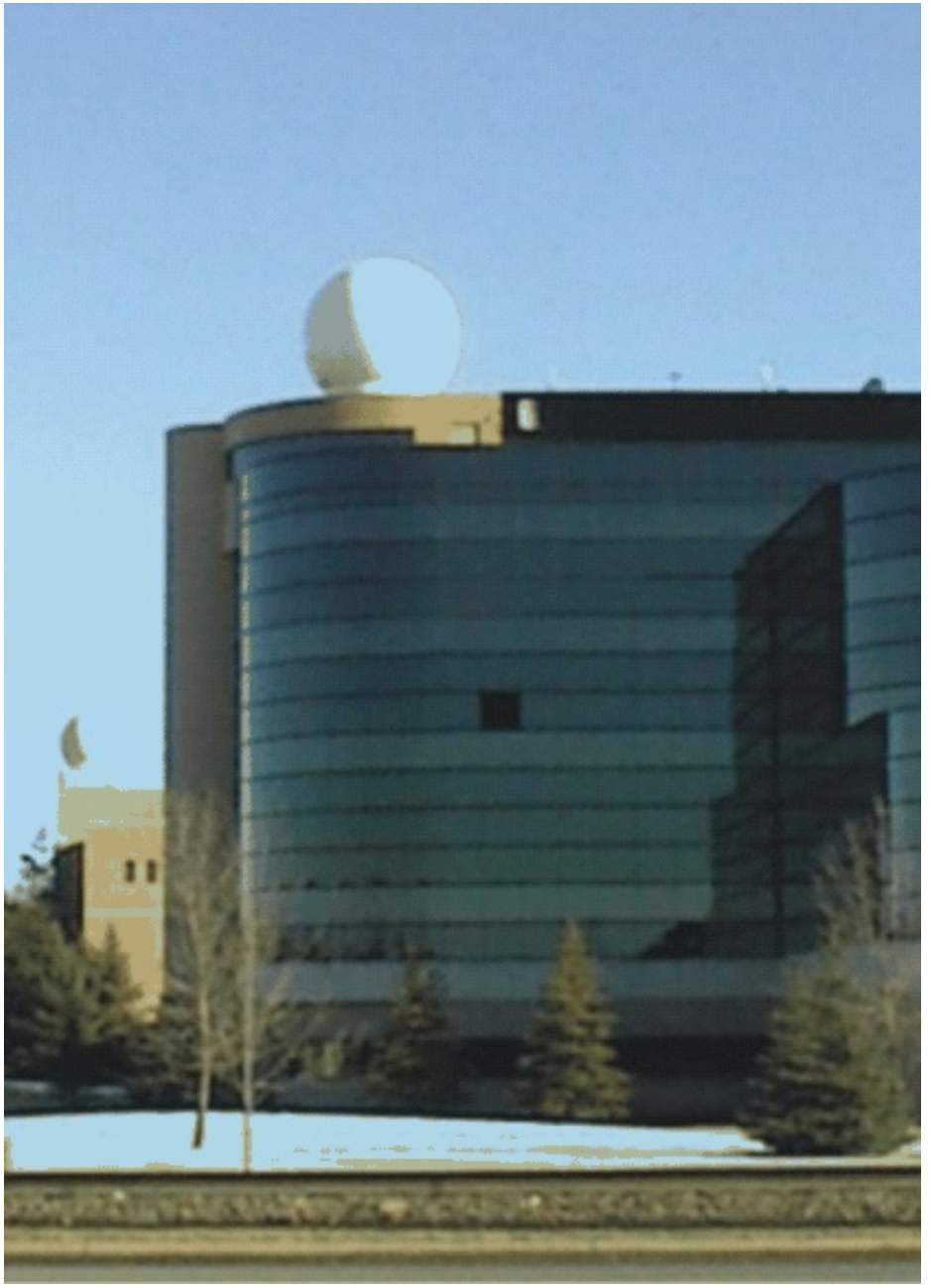
July 7, 2008 Flight

Research Objectives

- To better understand the effects of cloud base hygroscopic seeding of convective clouds in North Dakota.
- Determine identifiable signatures of hygroscopic seeding in polarimetric observables or derived fields.
- Characterization of hygroscopic seeding effects stratified by aerosol and CCN concentrations.
- Characterization of the cloud droplet size distributions for seeded and non-seeded clouds.

UND NorthPol Radar

- C-band (5 cm wavelength) Doppler radar
- Dual-polarized Antenna Mounted Receiver
- 28 m Antenna Above Ground
- SIGMET IRIS and TITAN Analysis Software
- Operated Mostly in Full-Volume Mode during POLCAST[2]

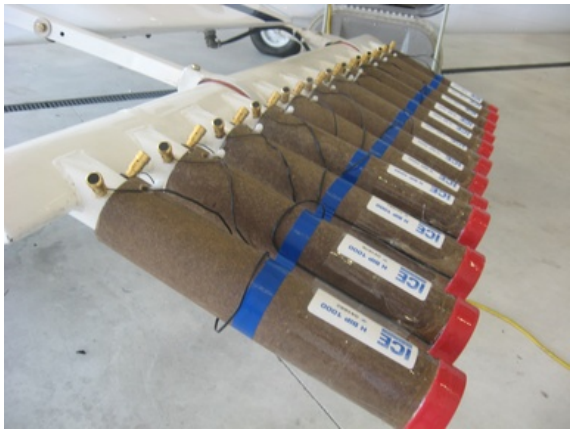


Cessna 340 Equipment

CCN Counter

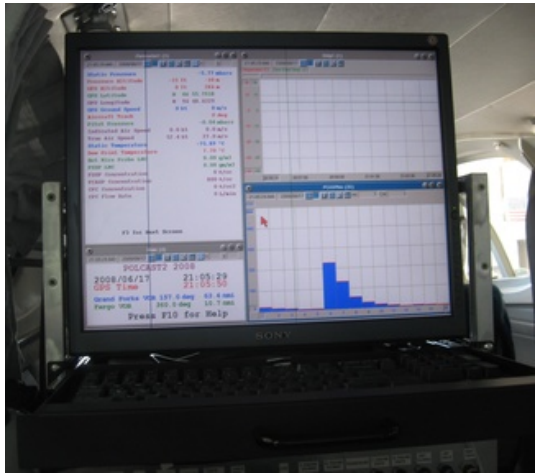
FSSP

Flare Rack



PCASP

M300 Display



Temperature and Hot Wire Probe

Dew Point Temperature Sensor Head

Randomized Hygroscopic Seeding Targets

- A set of seed/no seed decisions (50/50 split) were compiled prior to start of the field program.
- Upon deciding on a seeding candidate, the flight scientist talked to the operation center and the decision on whether to seed or not to seed was relayed to the aircraft.
- Decisions are kept secret and opened one at a time as needed.

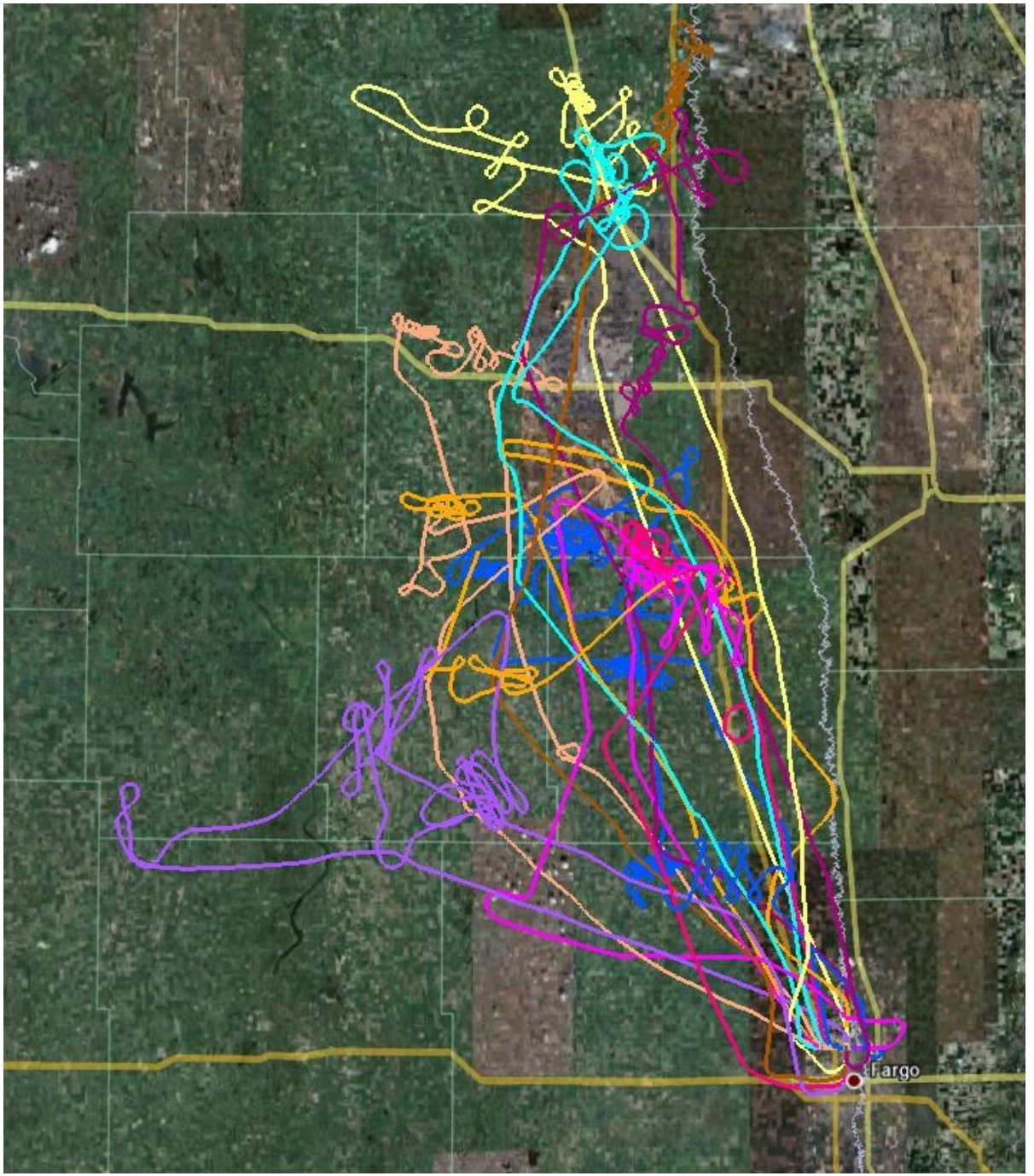
Aircraft Flight Summary

A total to 12 aircraft flights (24.83 hours of measurements) were conducted between June 10 and July 11, 2008.

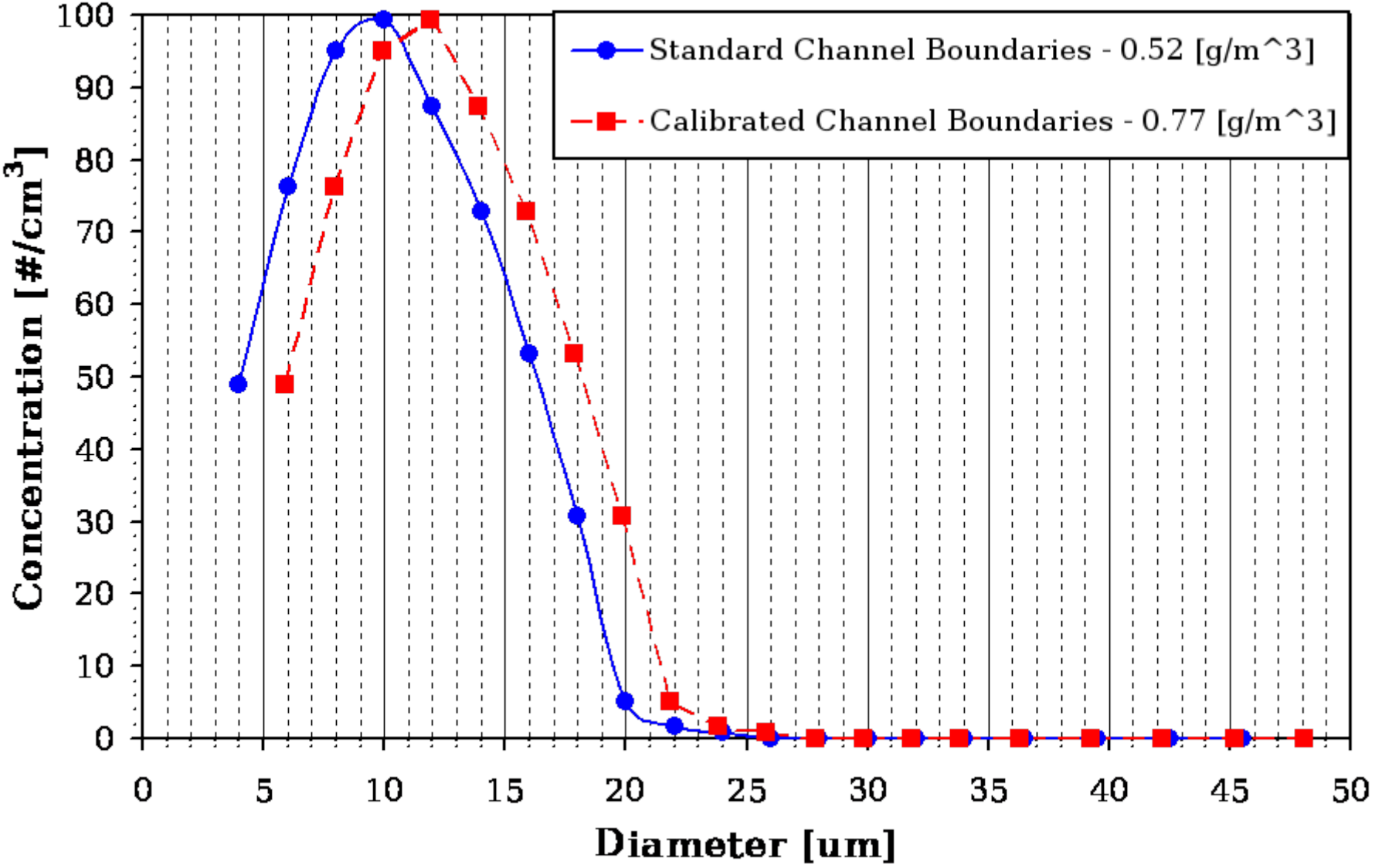
Start Date	Start Time	End Time	Total Time	Cloud Base Height	Cloud Base Temp
YYMMDD	HH:MM:SS	HH:MM:SS	Hours	Meters	Celsius
080610	22:46:47	23:27:30	0.68	1150	4
060612	19:24:43	20:33:37	1.15	1750	4
080612	21:52:43	23:55:21	2.04	2100	3
080613	18:19:08	21:32:41	3.23	1600	6
080614	20:24:45	22:32:19	1.58	2400	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

POLCAST² Flights

- Flights took off from Fargo, North Dakota.
- Targets with in coverage (100 km) of the UND radar.
- Targets with in North Dakota.
- Obtained 7 seed cases and 6 no seed cases.
- Aircraft measurements on all flights.

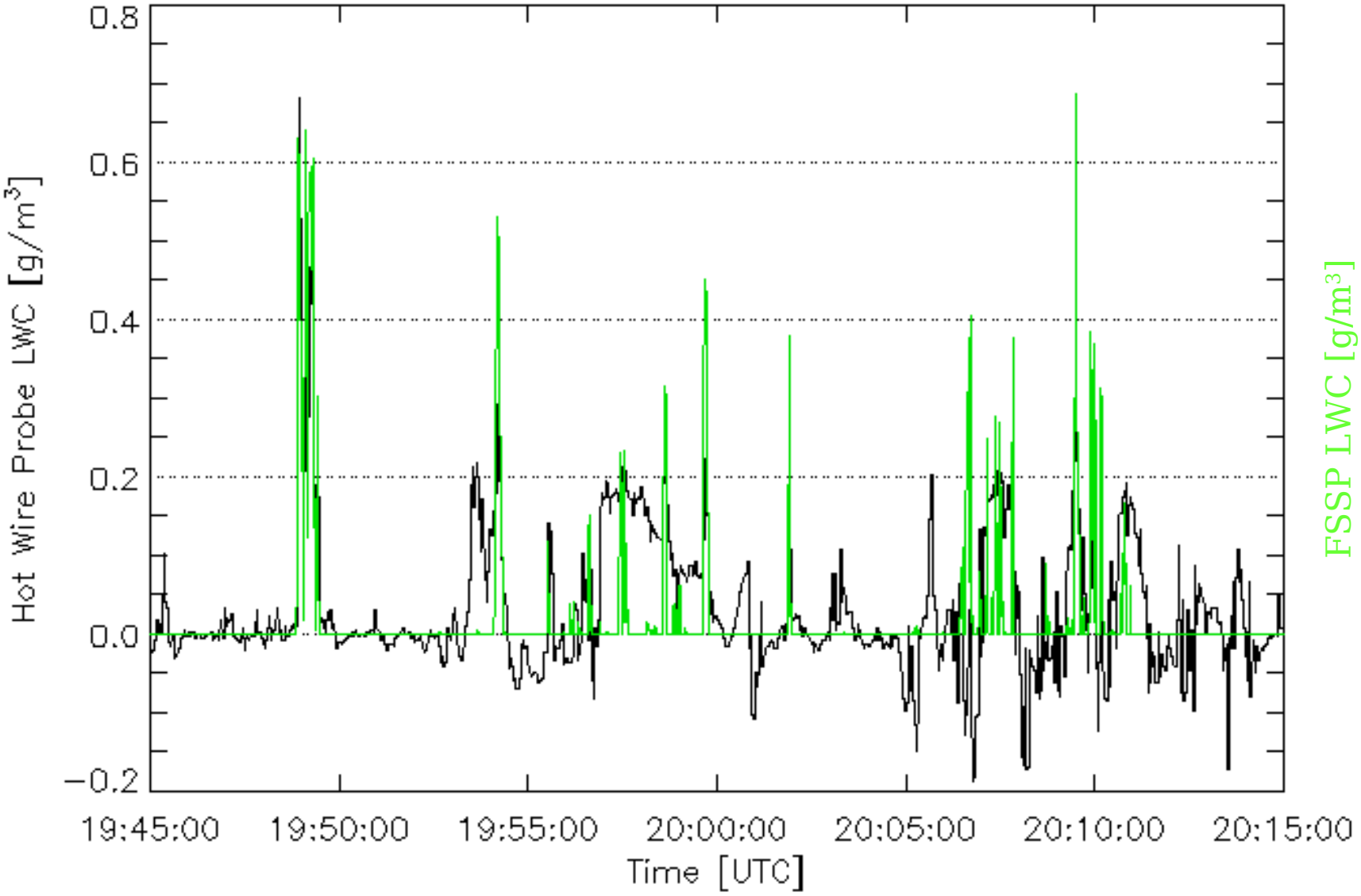


FSSP Liquid Water Content



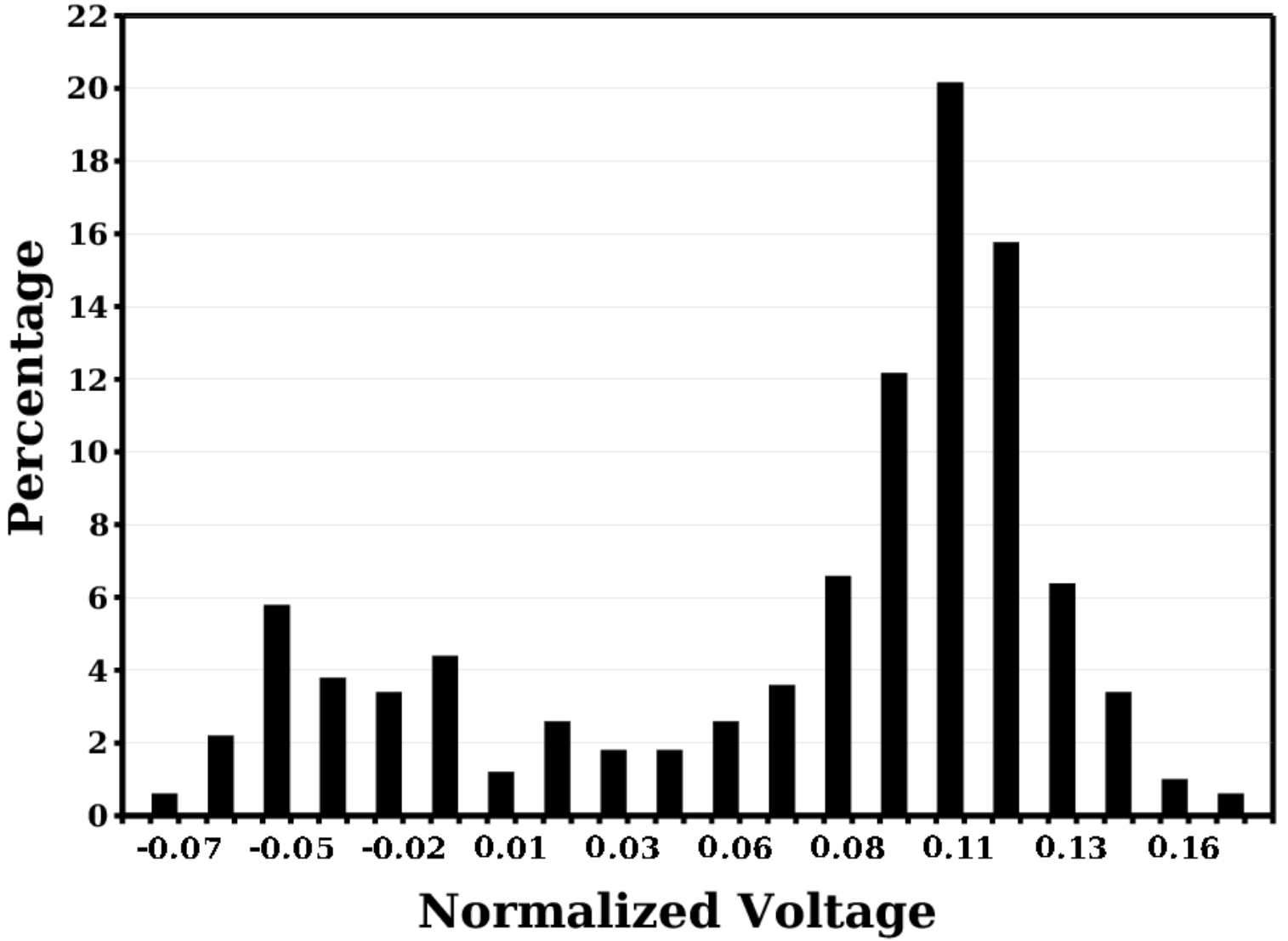
Typical change in the FSSP spectrum between using the standard channel boundaries (blue) and the POLCAST[2] calibrated channel boundaries (red).

Liquid Water Content (LWC)



Time series (1 Hz) of liquid water content on July 11, 2008 measured by the DMT Hot Wire probe (black) and derived from the FSSP (green).

Liquid Water Content (LWC)



Histogram showing the normalized hot wire voltage between 72,820 and 72,840 seconds from midnight during the July 11, 2008 flight.

Polarimetric Radar Data

Thunderstorm Identification Tracking Analysis and Nowcasting (TITAN)

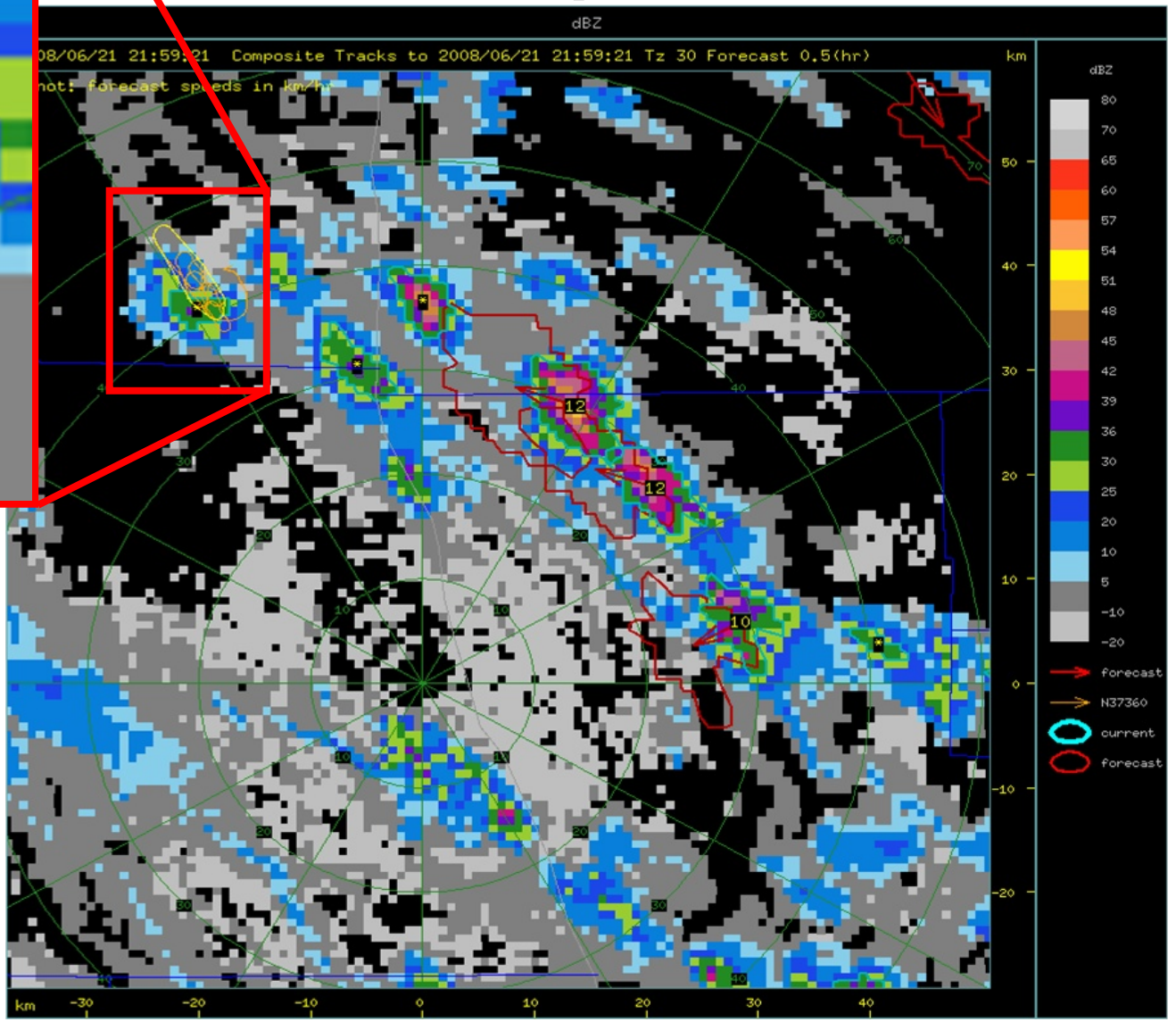
- Rview
- Configurable Interactive Data Display (CIDD)
- Scripts
  - EsdAcIngest
  - AcTrack2Polygon
  - Ctrec
  - AdvectPolygon

Rview

Polygon

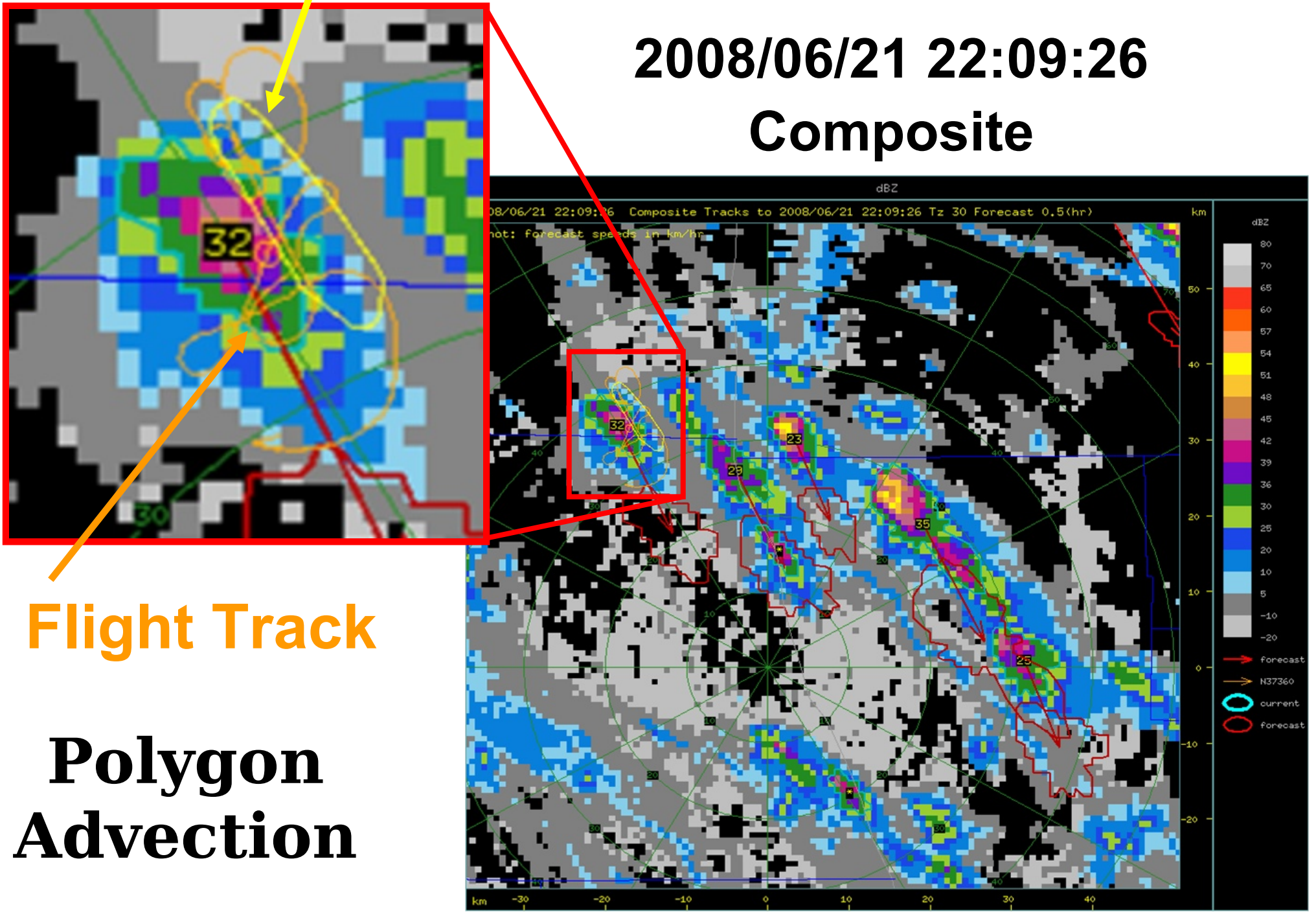
Flight Track

2008/06/21 21:59:21
Composite

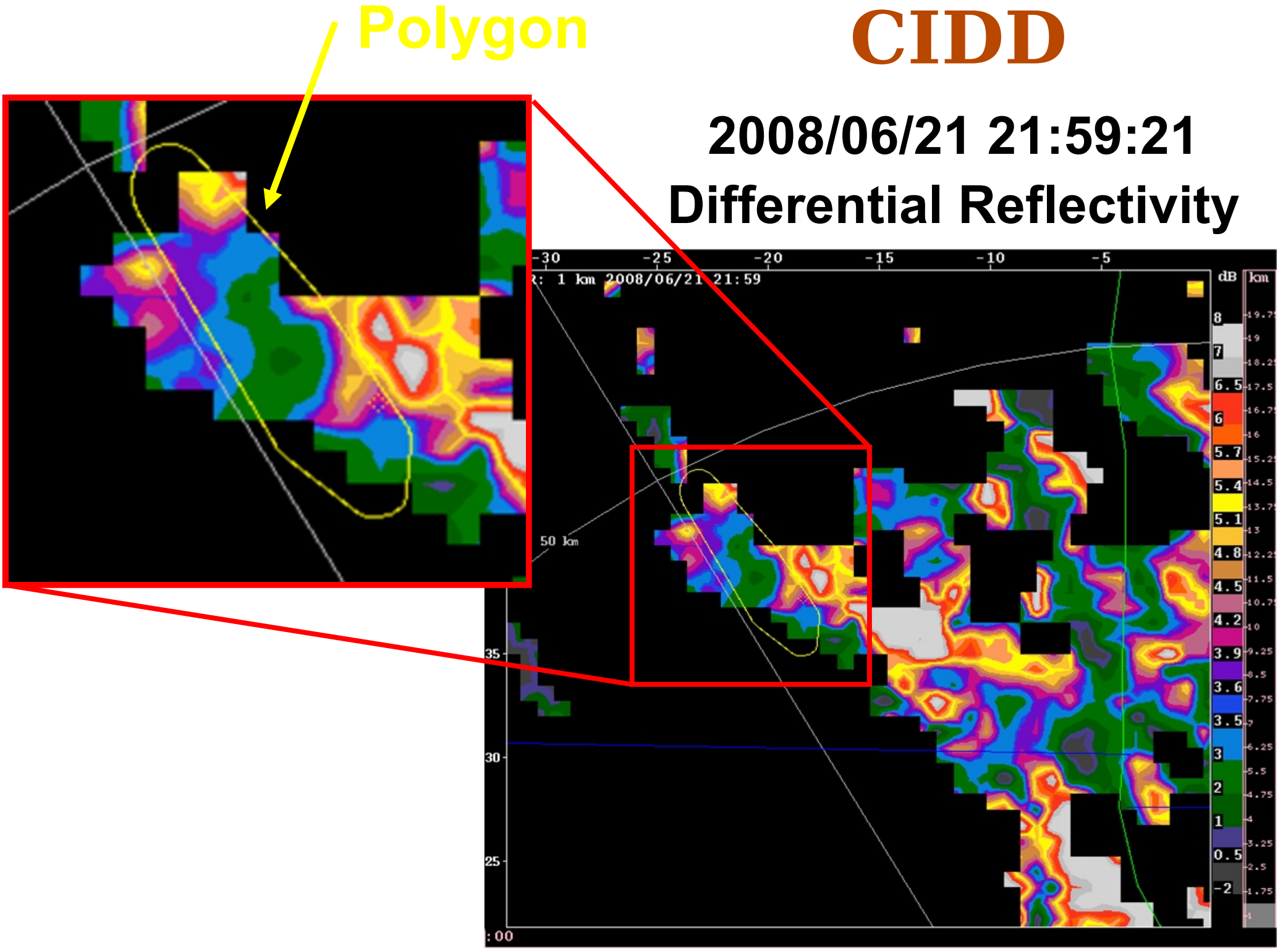


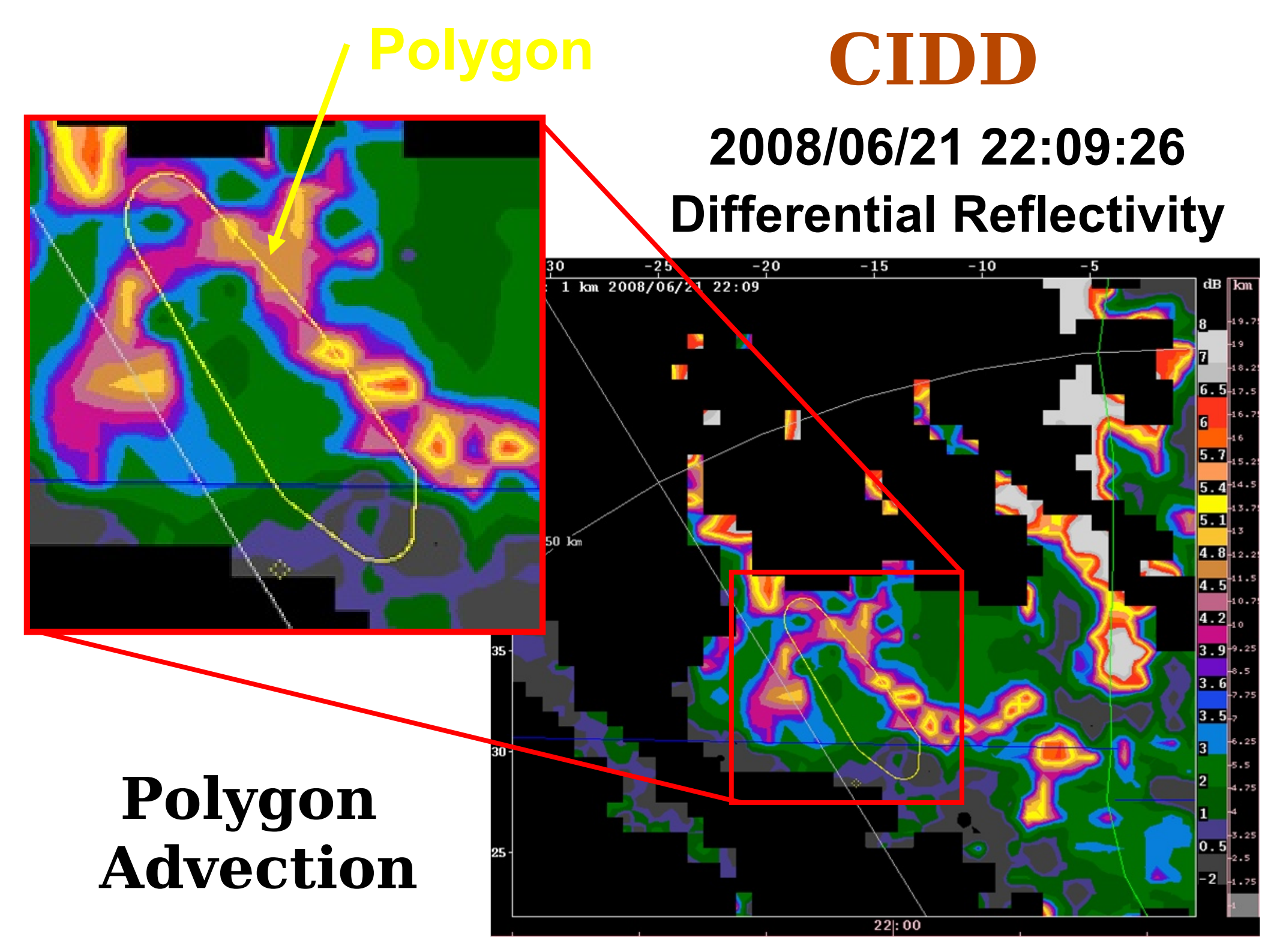
Rview

2008/06/21 22:09:26
Composite



Polygon Advection


Polygon
CIDD
2008/06/21 21:59:21
Differential Reflectivity
-30
-25
-20
-15
-10
-5
1 km 2008/06/21 21:59
50 km
35
30
25
dB
km
8
7
6.5
6
5.7
5.4
5.1
4.8
4.5
4.2
3.9
3.6
3.5
3
2
1
0.5
-2


Polygon
CIDD
2008/06/21 22:09:26
Differential Reflectivity
Polygon
Advection
-30
-25
-20
-15
-10
-5
1 km 2008/06/21 22:09
50 km
dB
km
8
7
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6
5.7
5.4
5.1
4.8
4.5
4.2
3.9
3.6
3.5
3
2
1
0.5
-2
35
30
25
22:00

Conclusions

- The POLCAST^2 project had 13 hygroscopic seeing targets that were within radar coverage and had corresponding airborne measurements.
- Flight tracks and SIGMET radar data has been imported into TITAN which allows polygons to be automatically created and used for analysis of ZDR and rain rate.
- While the hotwire probe measurement of liquid water content had noise, the FSSP and PCASP probe were well calibrated.

Future Work

- Fully analyze the parameters enclosed by polygons formed from the seeding flight tracks.
- Create summary statistics for the aerosol and cloud measurements and compare with other locations.
- Conduct case study analysis of the most interesting days.
- Fully document what we have learn and how to apply it in the POLCAST^3 field project.

POLCAST² Team

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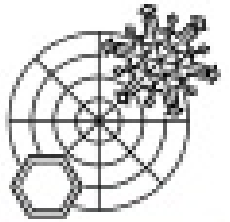

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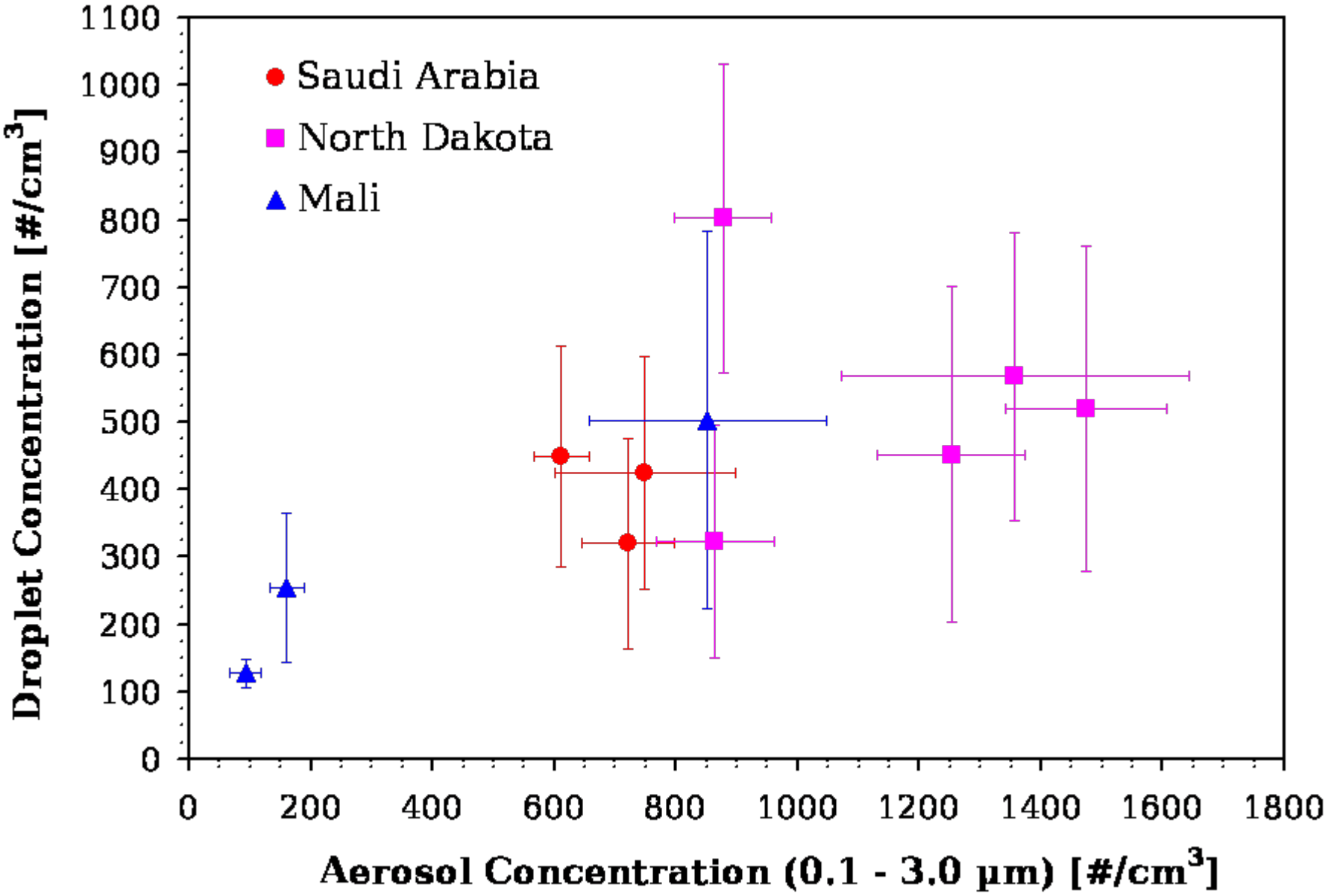
Questions

Future Analysis