

Discussion of UIUC PLOWS microphysics research

David Plummer

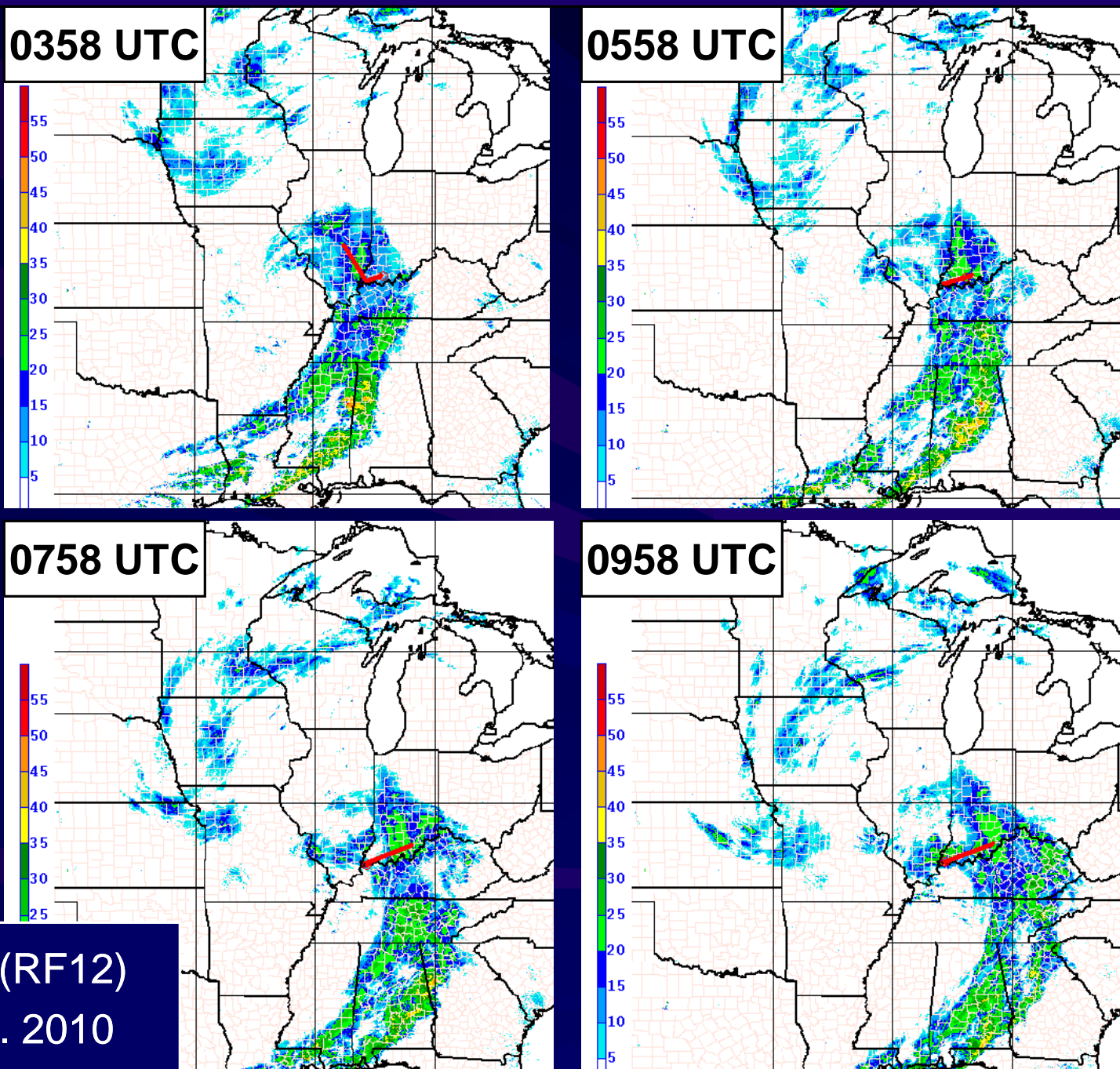
PLOWS science meeting
20 July 2010

Overview

- Currently concentrating on C-130 based measurements
- Characterizing cyclones' microphysical structure from two general perspectives: IOP-19 (RF12) cyclone
 - Large-scale, vertical variation
 - Horizontal variation with respect to banded structures, supercooled water
- Briefly examine effects of particle shattering on number concentrations

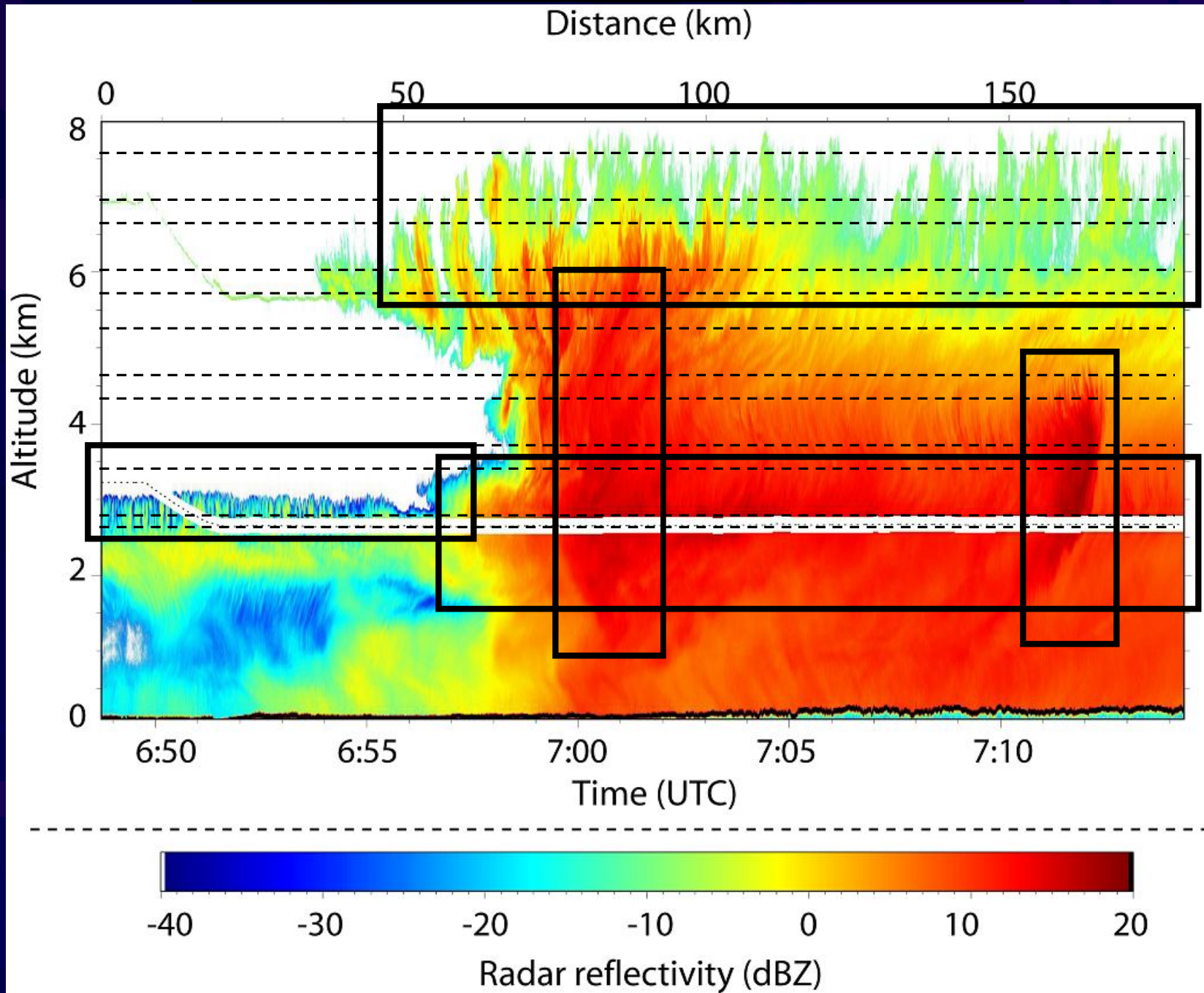


NEXRAD composite radar reflectivity and C-130 flight track

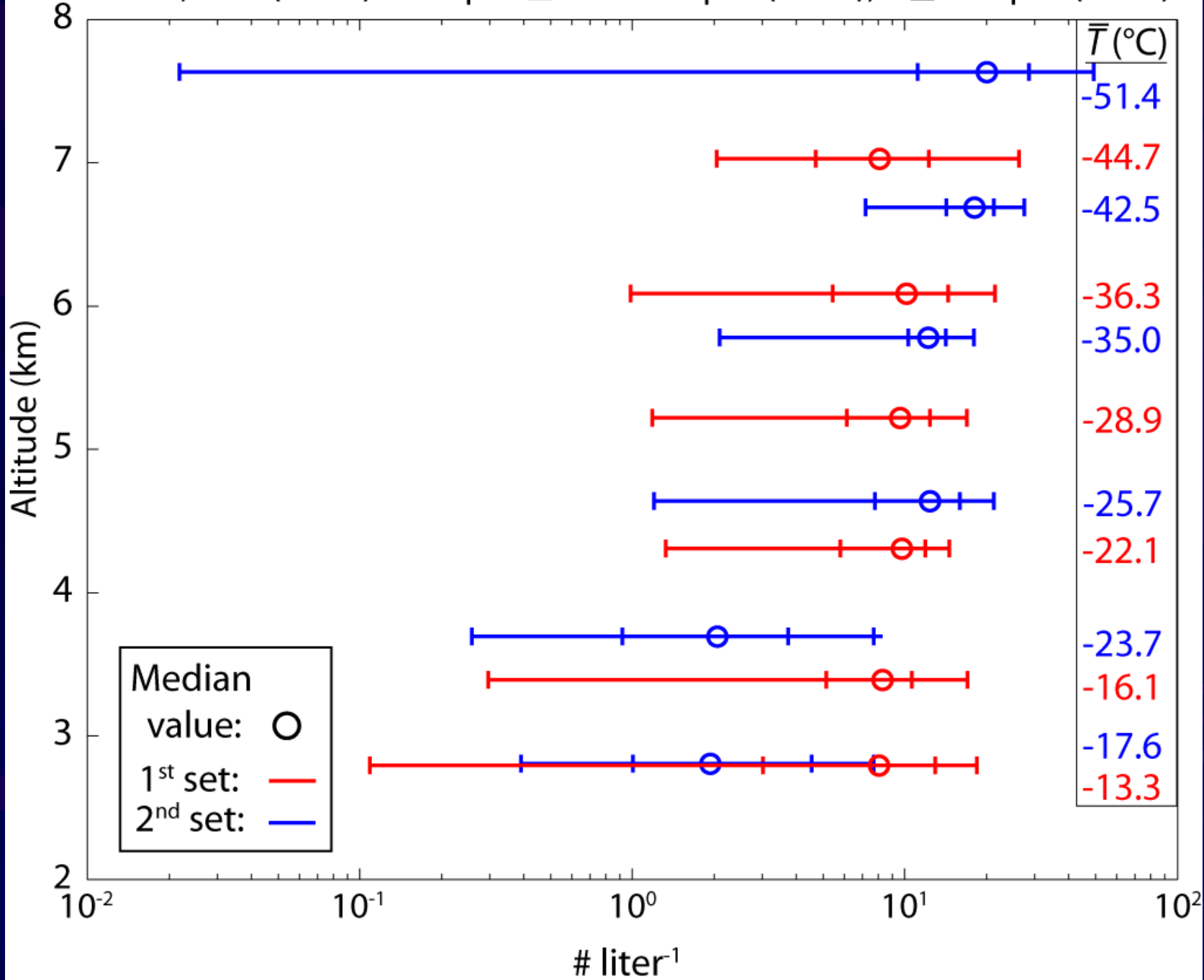


IOP-19 (RF12)
15 Feb. 2010

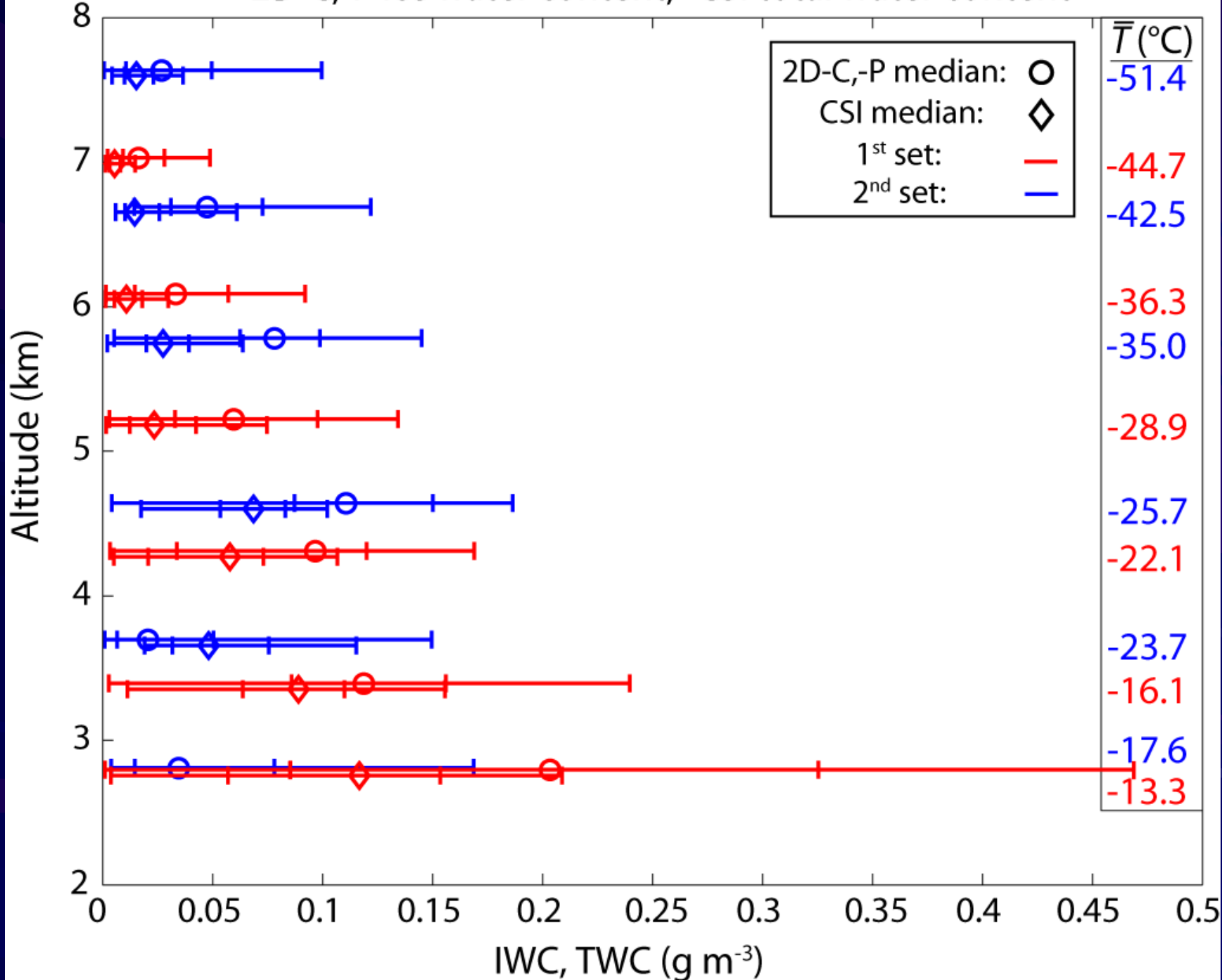
Typical structure as observed by WCR



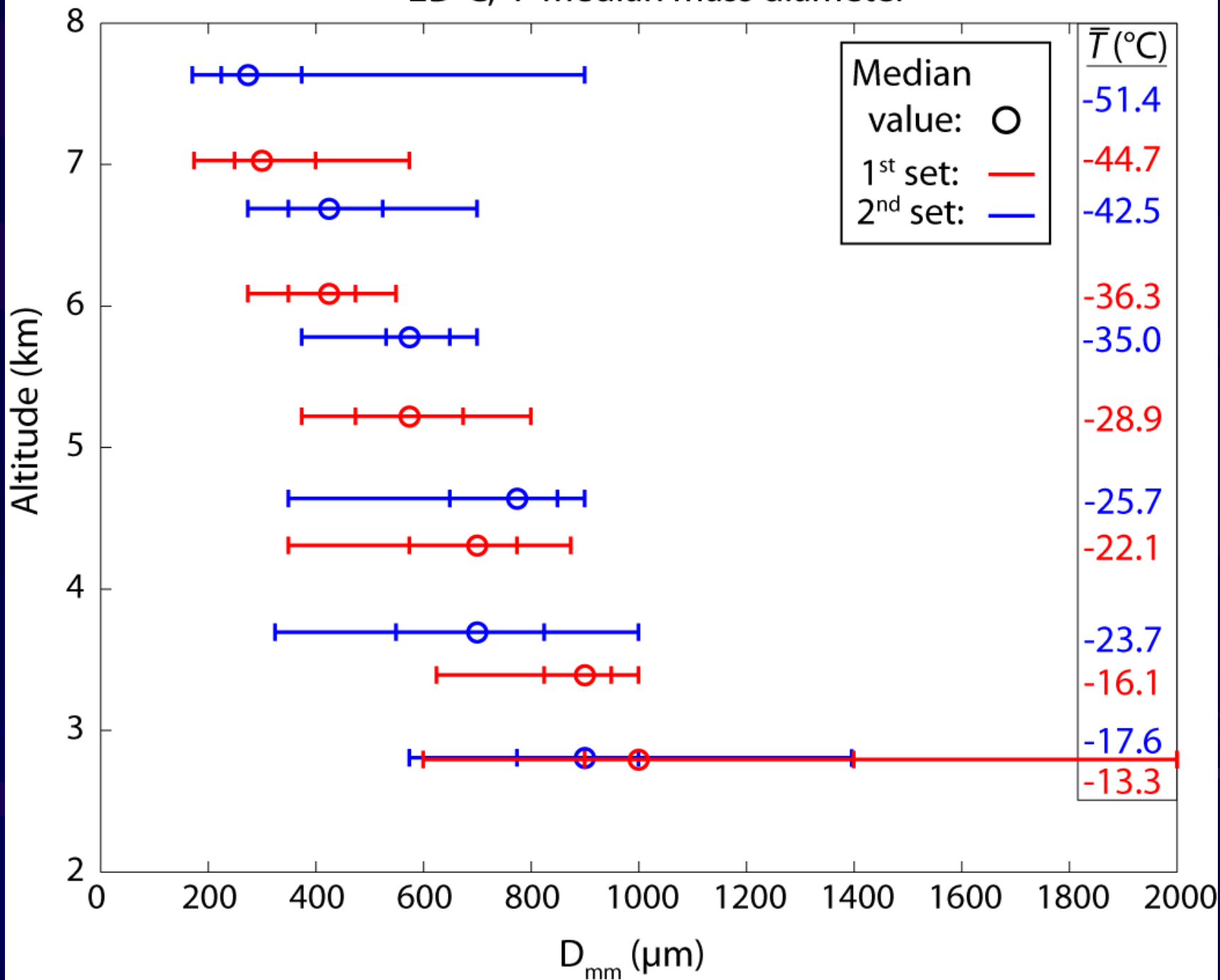
2D-C, -P N (liter⁻¹): 150 μm ≤ D < 900 μm (2D-C); D ≥ 900 μm (2D-P)



2D-C,-P ice water content; CSI total water content



2D-C, -P median mass diameter



Raw 2D-C images

\bar{Z} (km)

7.6

7.0

6.7

6.1

5.8

5.2

4.6

4.3

3.7

3.4

2.8

2.7



\bar{T} (°C)

-51.4

-44.7

-42.5

-36.3

-35.0

-28.9

-25.7

-22.1

-23.7

-16.1

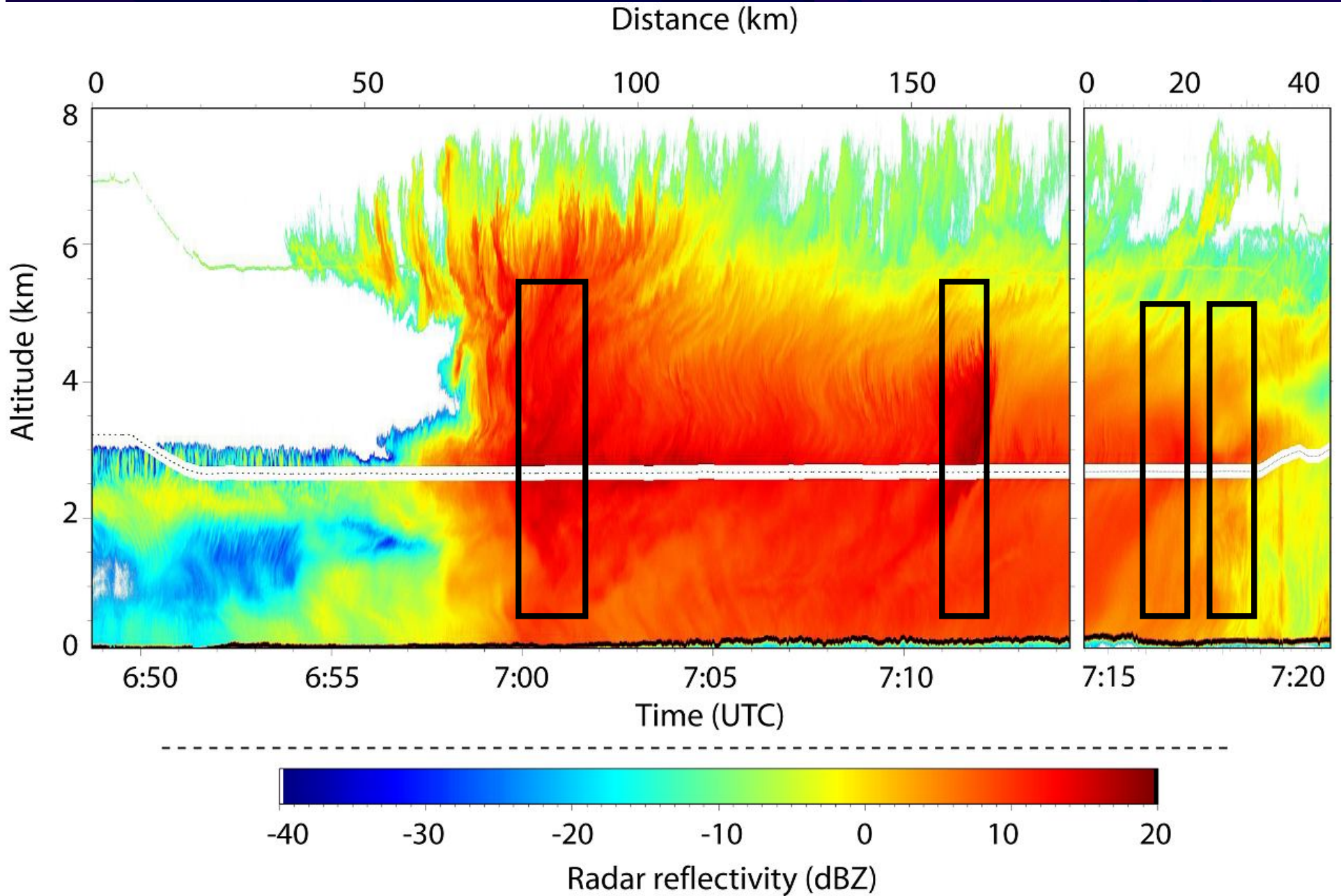
-17.6

-13.3

} 1.6 mm

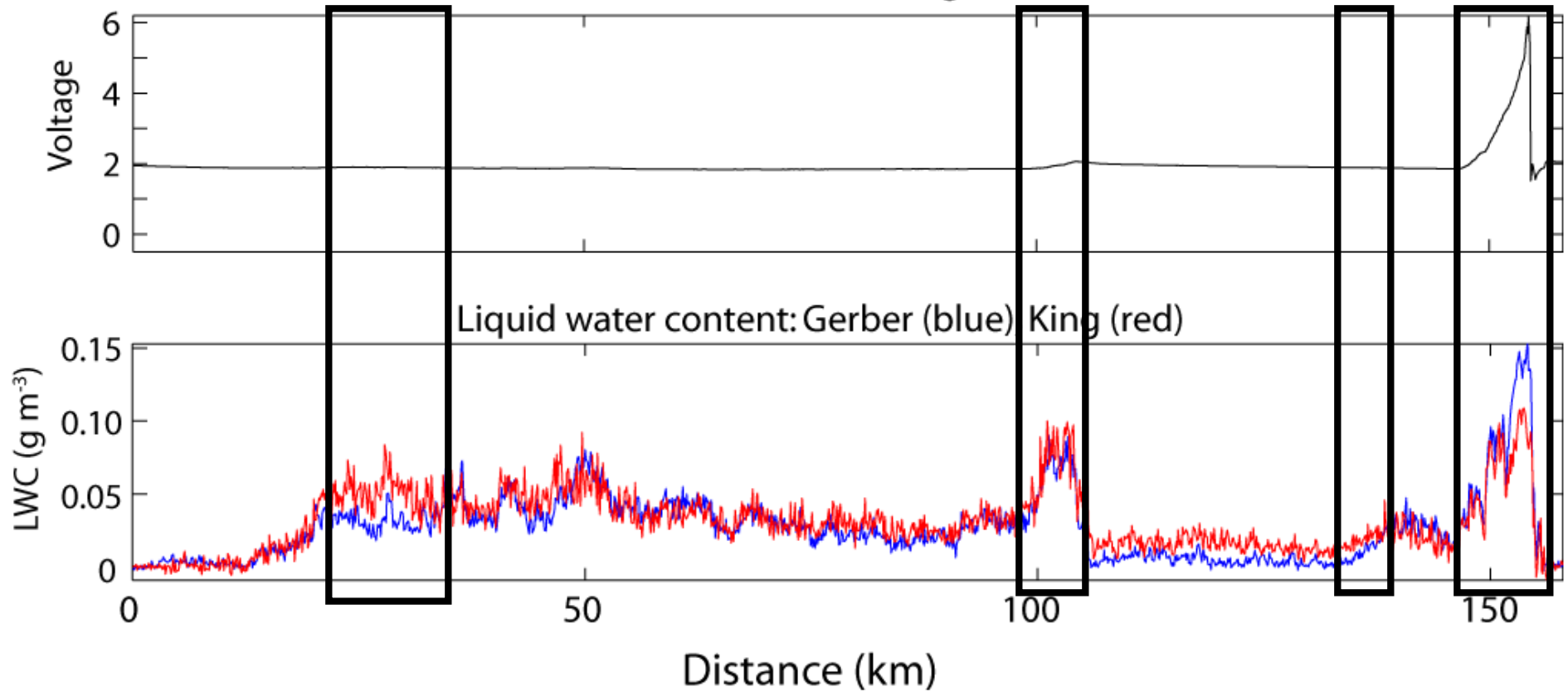
WCR reflectivity

$Z_{avg} = 2.8 \text{ km}$, $T_{avg} = -13.3^\circ\text{C}$

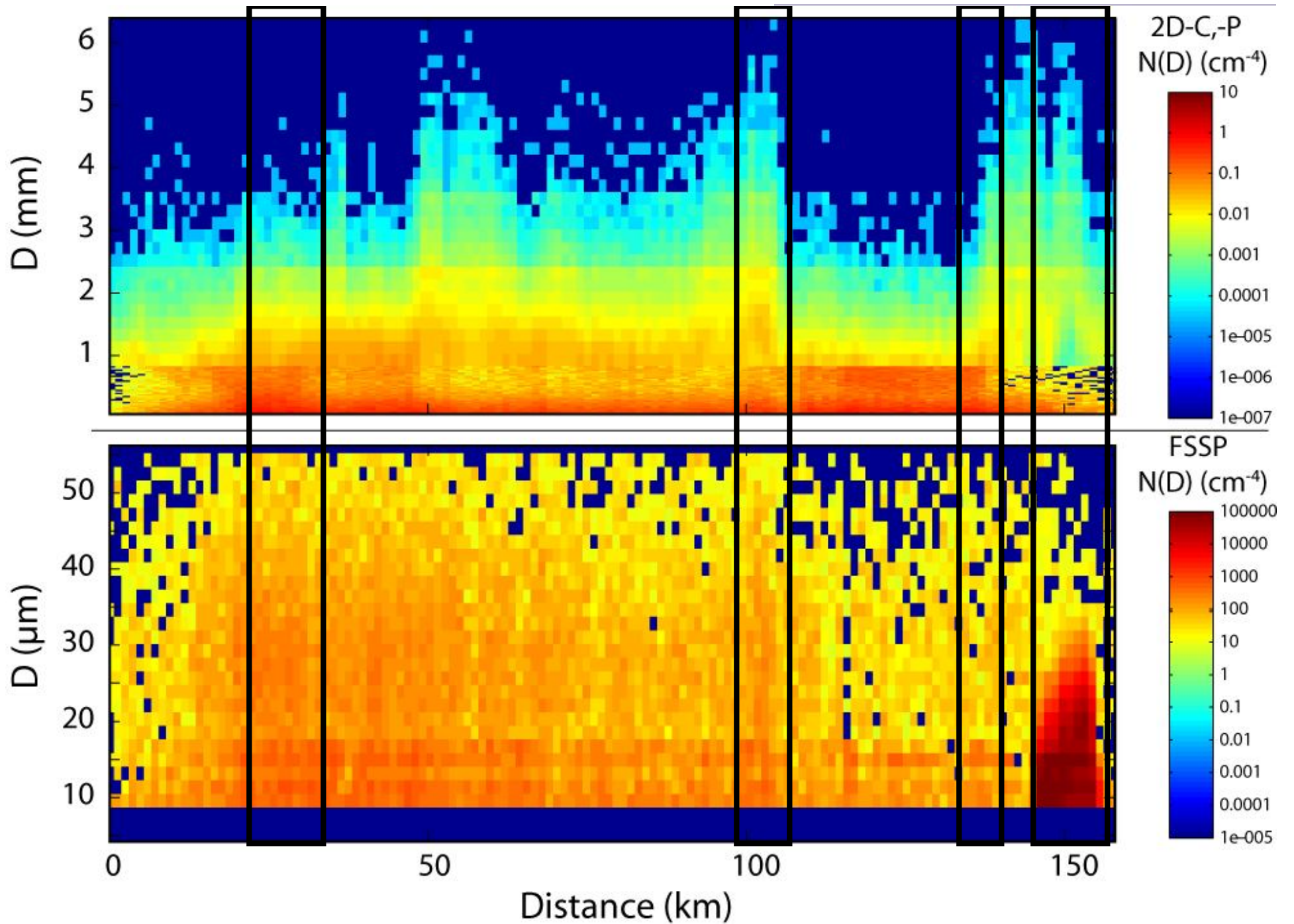


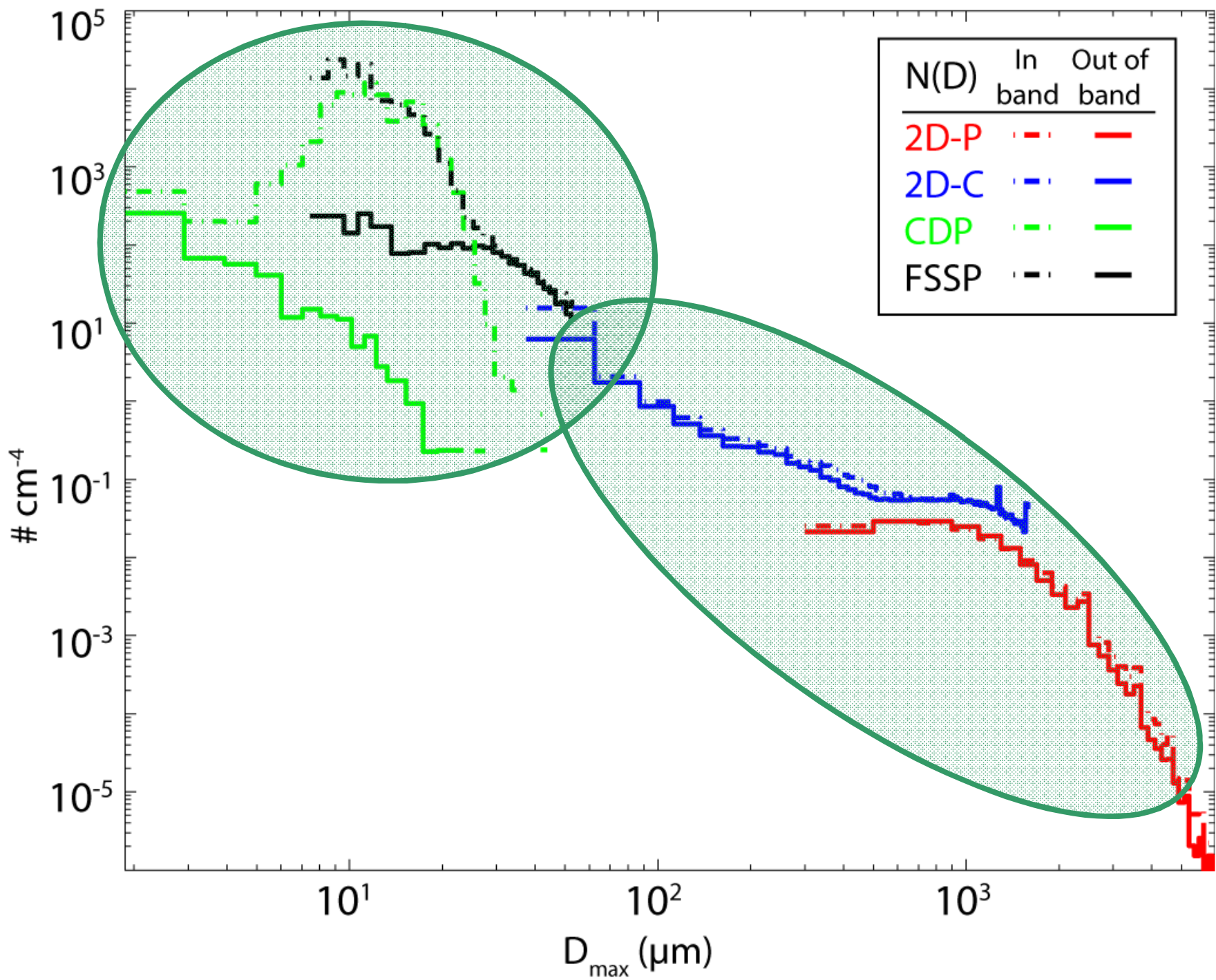
First three bands
predominantly ice-phase

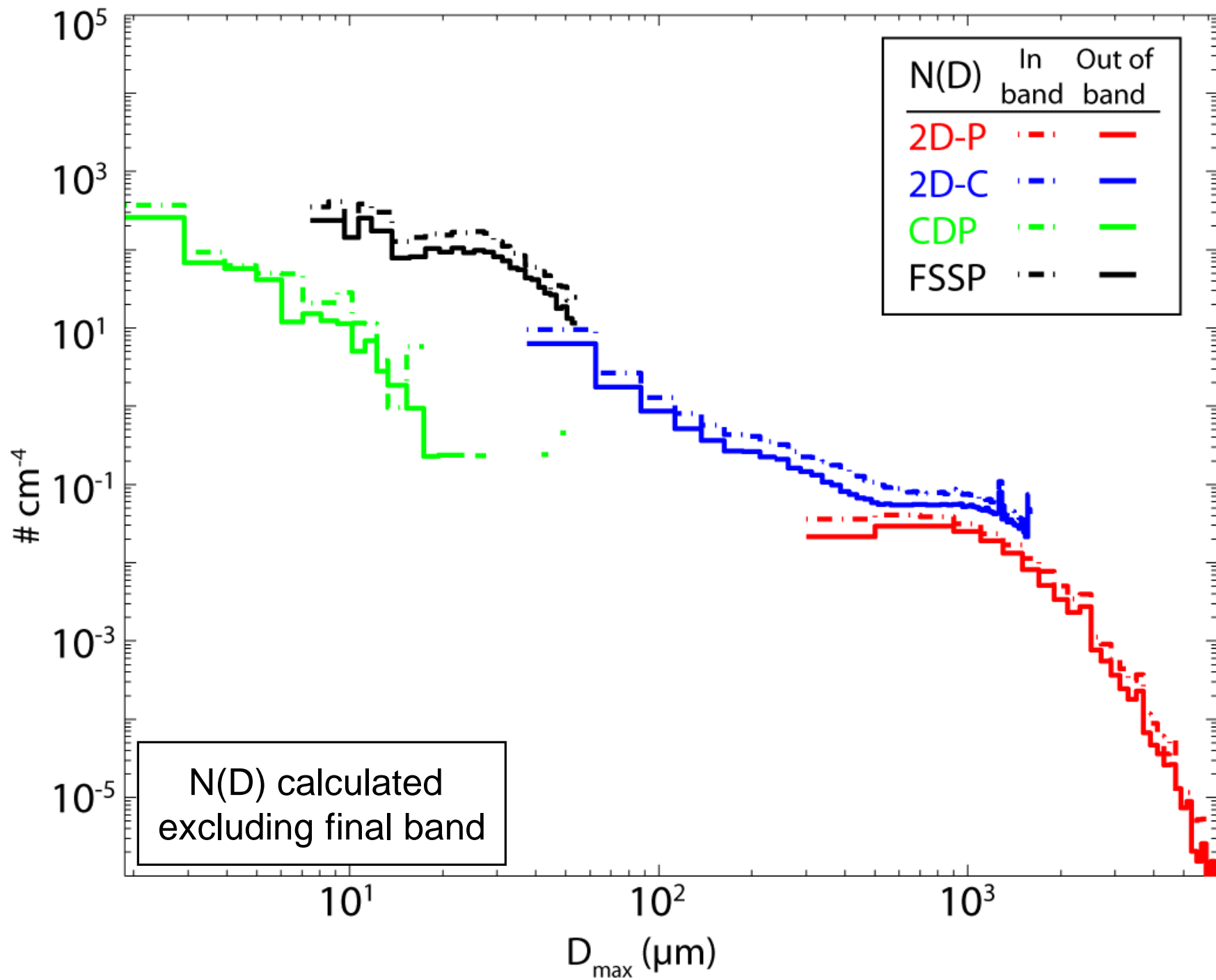
Rosemount voltage

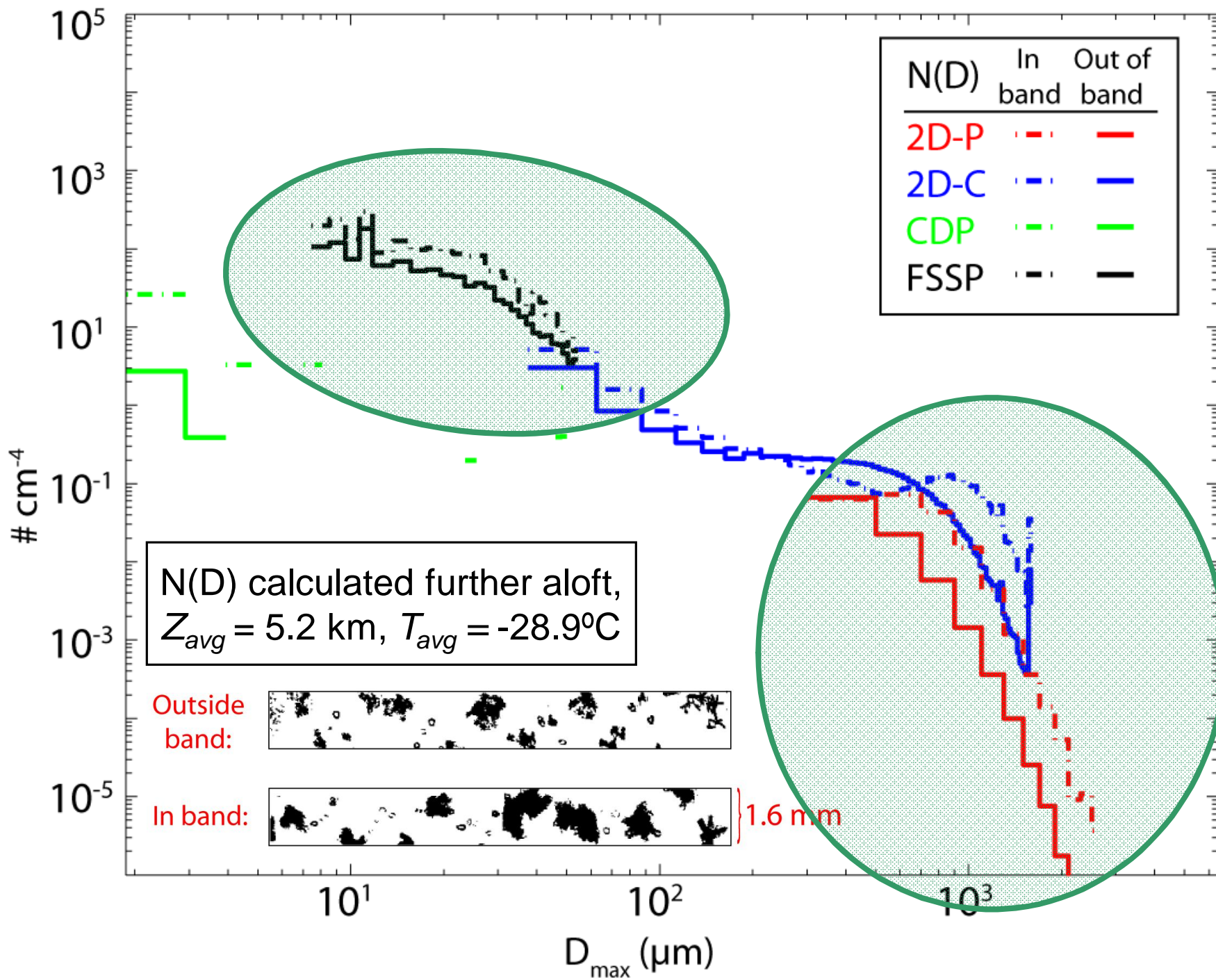


Supercooled water most
apparent in fourth
precipitation band



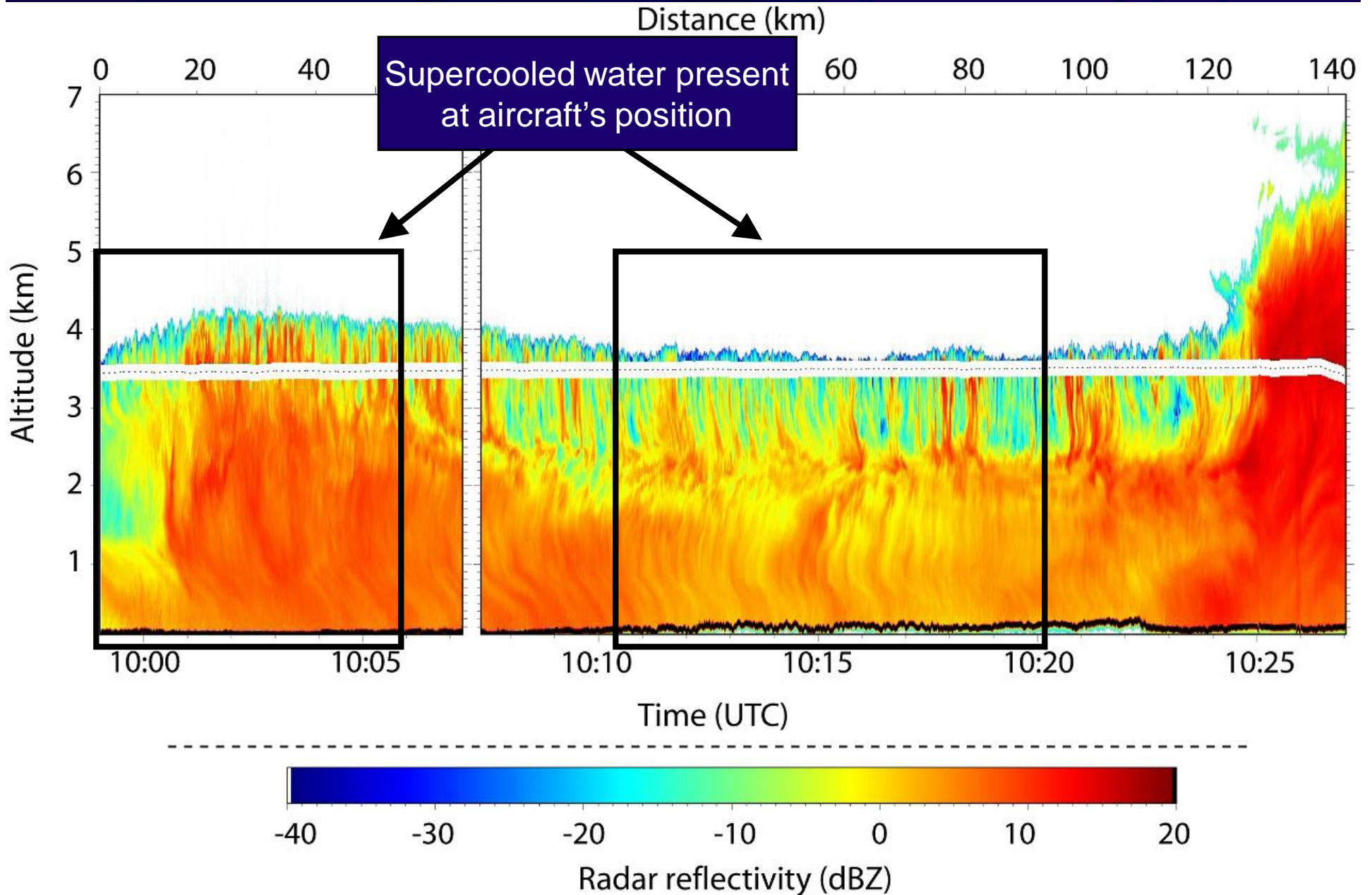




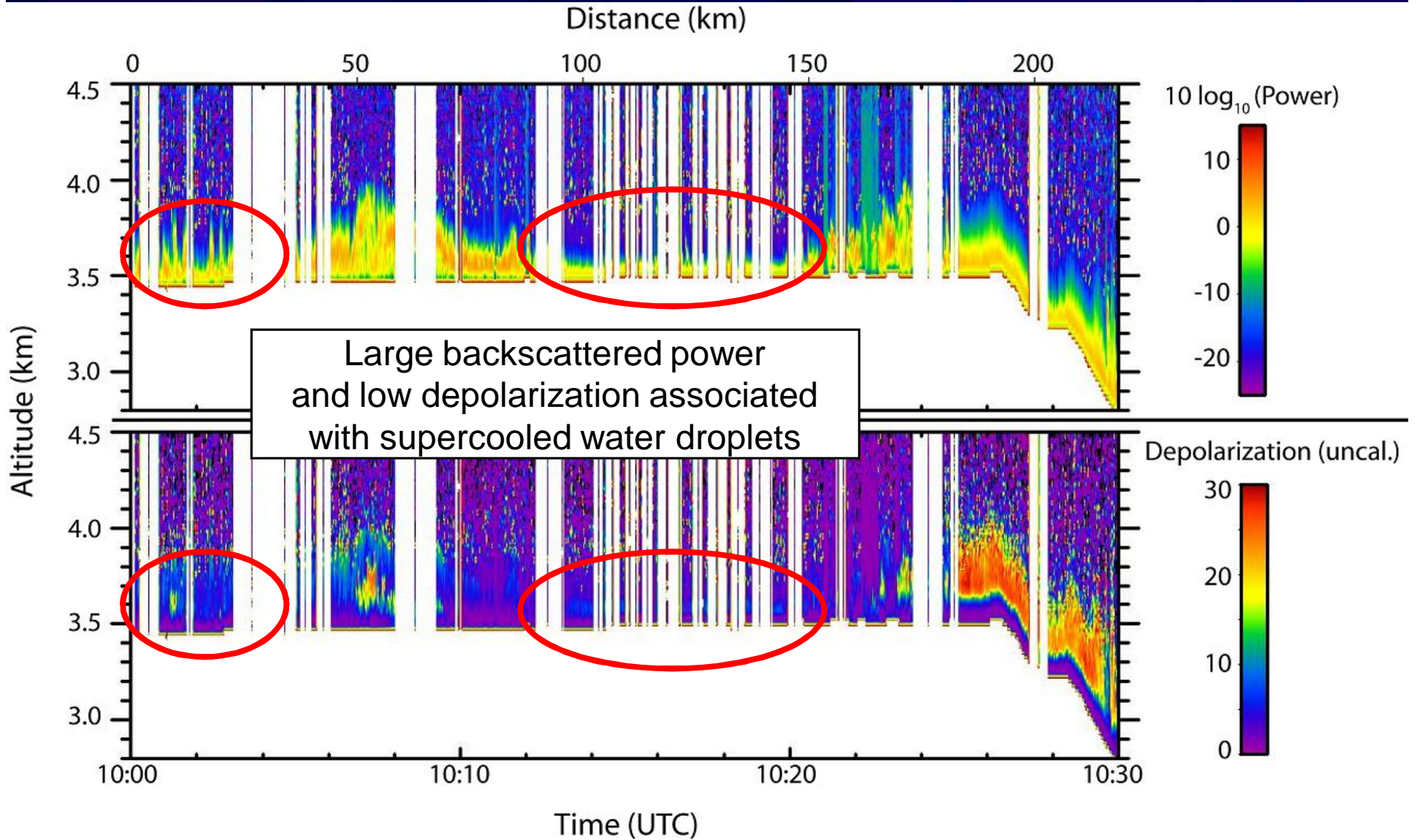


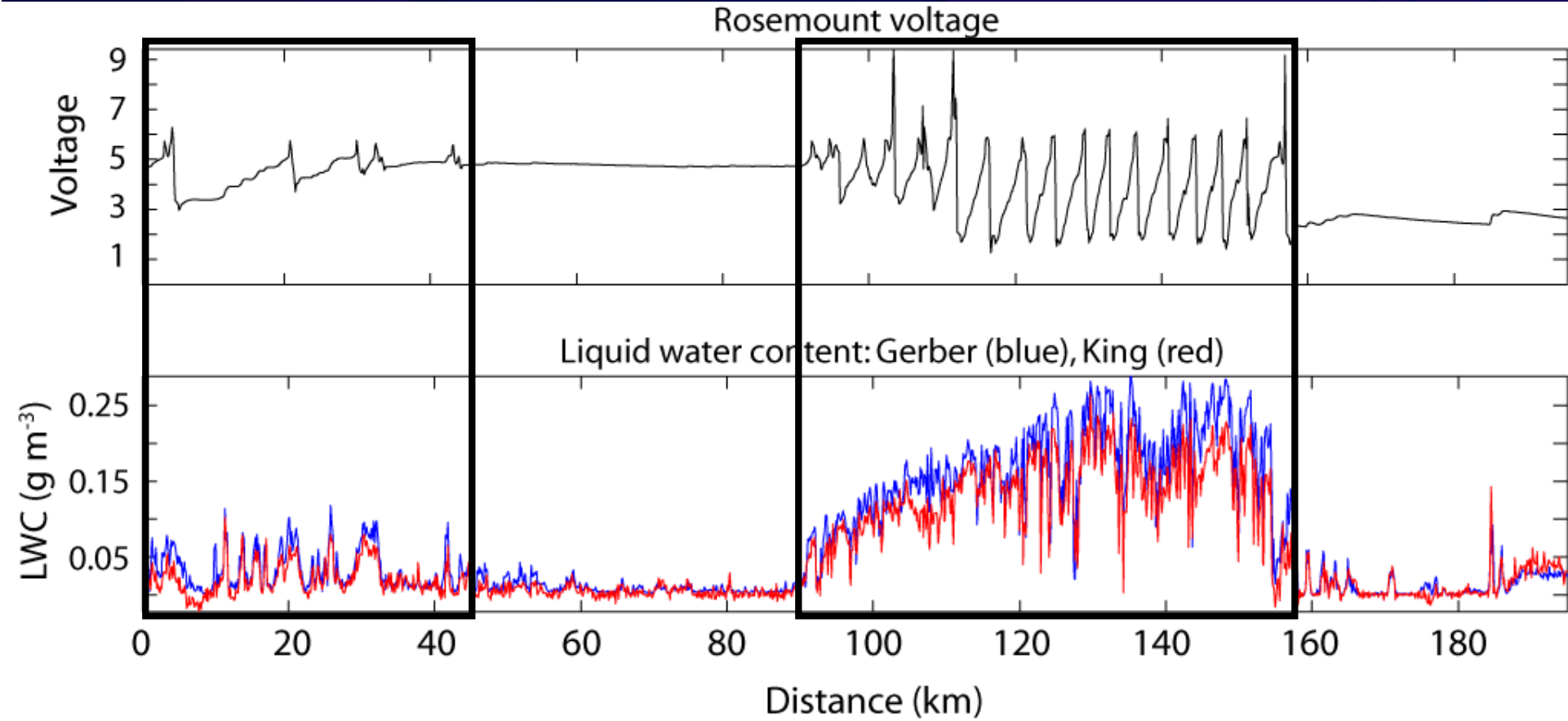
WCR reflectivity

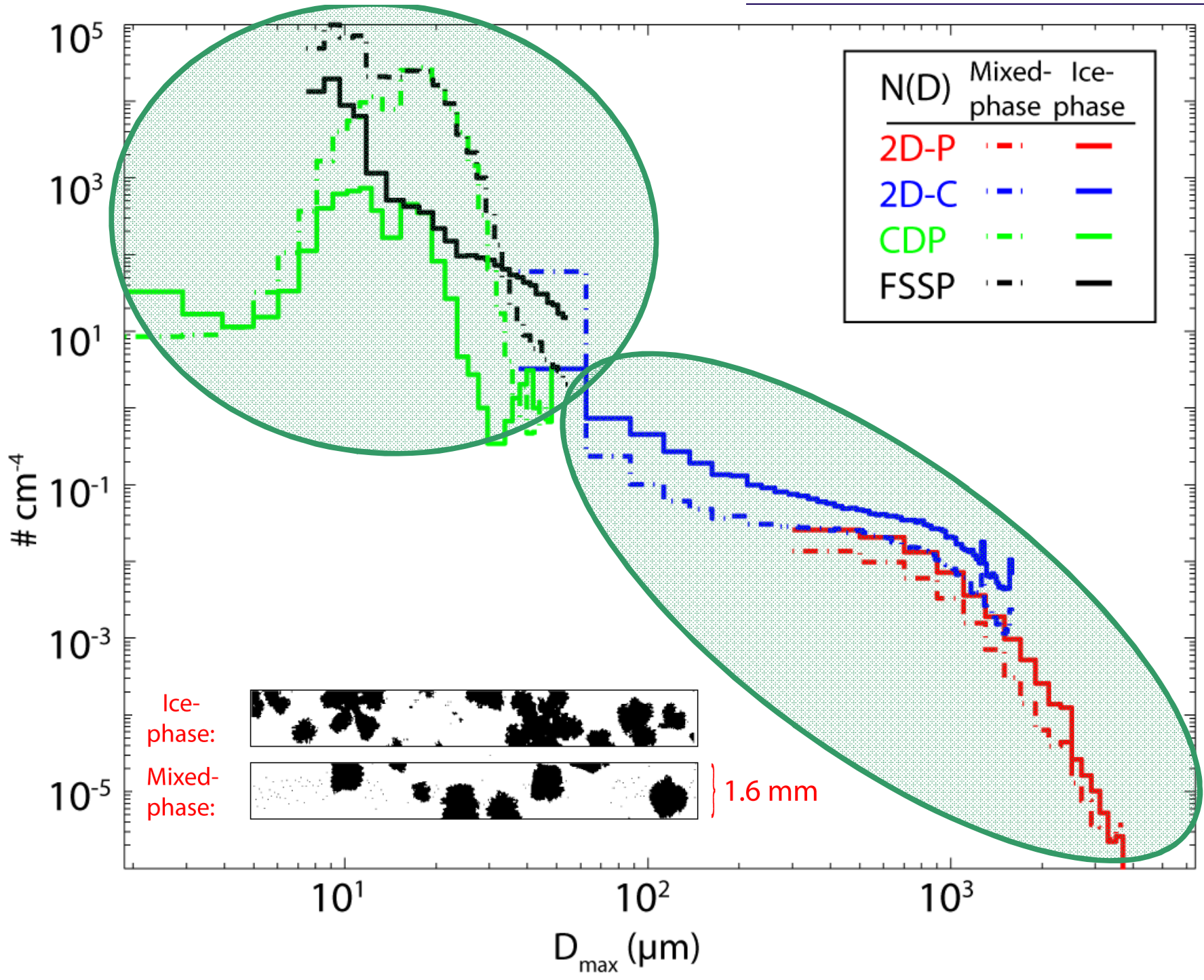
$Z_{avg} = 3.7$ km, $T_{avg} = -23.7^{\circ}\text{C}$



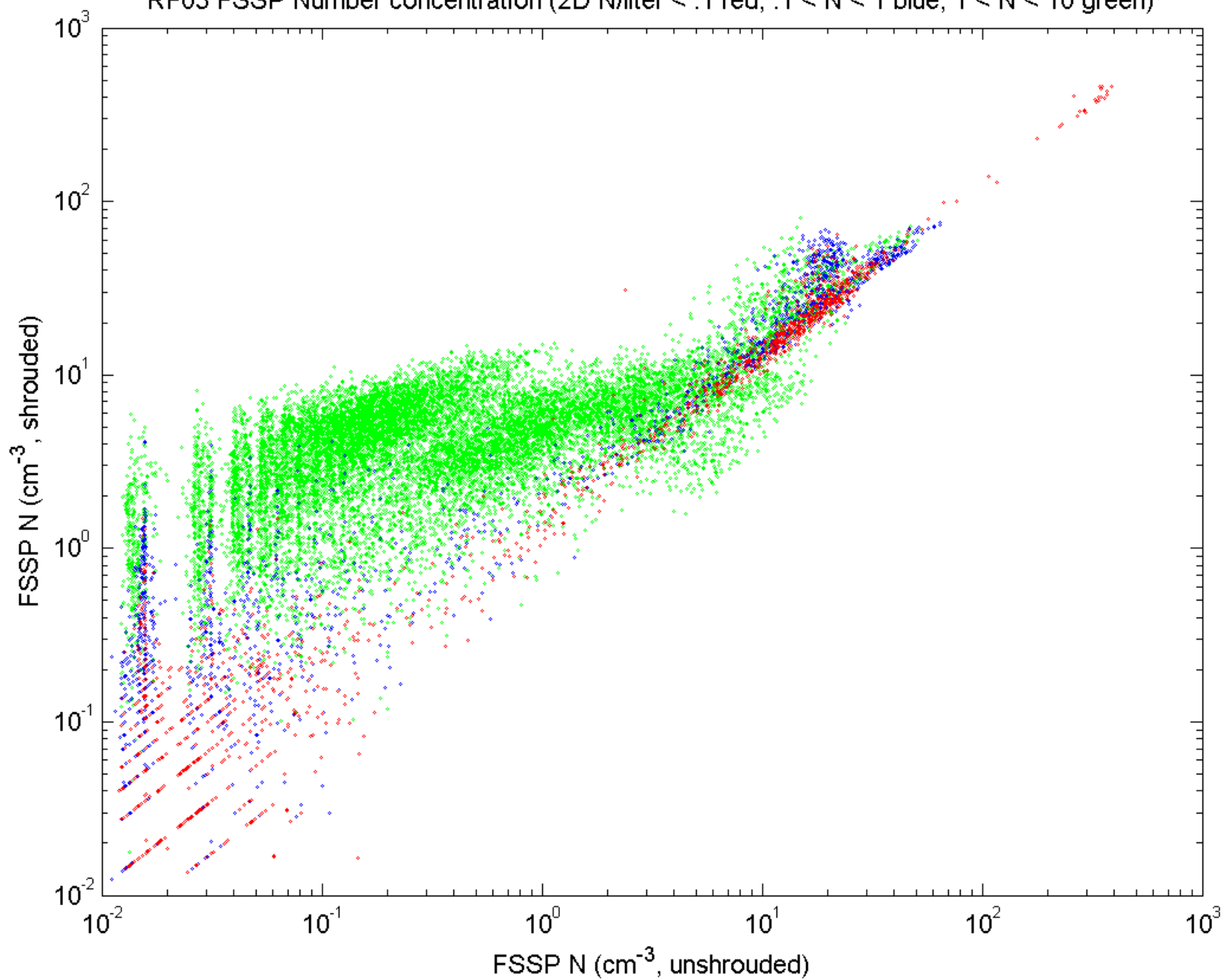
WCL backscattered power/depolarization



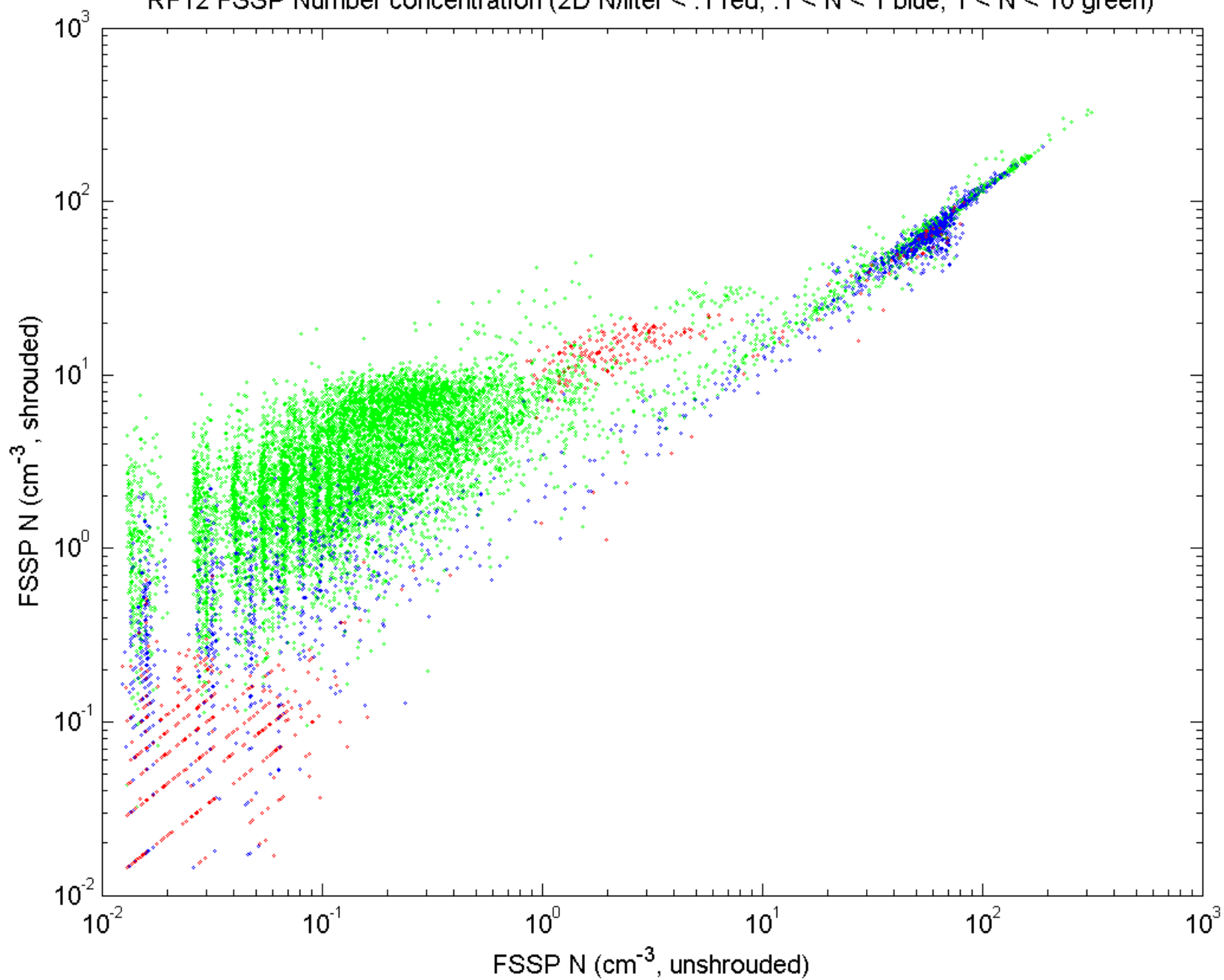




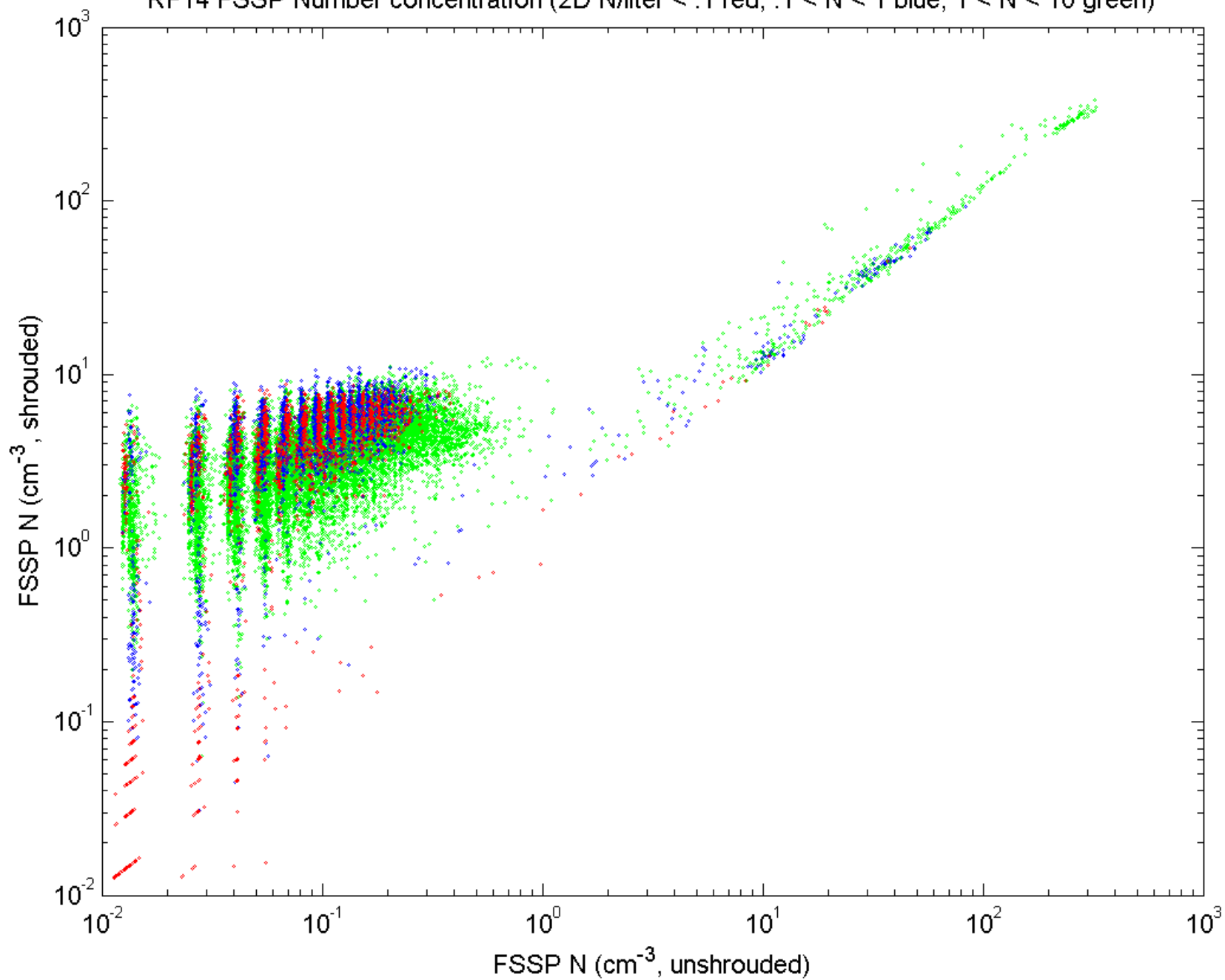
RF03 FSSP Number concentration (2D N/liter < .1 red; .1 < N < 1 blue; 1 < N < 10 green)



RF12 FSSP Number concentration (2D N/liter < .1 red; .1 < N < 1 blue; 1 < N < 10 green)



RF14 FSSP Number concentration (2D N/liter < .1 red; .1 < N < 1 blue; 1 < N < 10 green)



Summary

- Sampled persistent banded structures and convective towers in mid-latitude cyclone
- Vertical characteristics
 - Number concentrations decreased, IWC and D_{mm} increased from cloud top towards lower altitudes
 - Broad transition from small irregular & some rosettes/plates near cloud top to large dendrites & aggregates at lower altitudes
- Horizontal characteristics
 - Higher concentrations and some larger particles associated with enhanced reflectivity in banded structures, particularly aloft
 - 2D-C, -P concentrations lower, particles more compact where supercooled drops most prevalent
 - CDP and FSSP respond consistently to supercooled droplets

Continued work

- Quantitative identification of banded structures
- Statistical analysis of microphysical differences
- Continued analyses of other cases, e.g. RF03, RF04, RF14 (vertical profile), RF07 (horizontal characteristics)
- Continue investigation of particle shattering