A new method of correcting Nevzorov measured ice water content in cirrus layer of DCS (MC3E)

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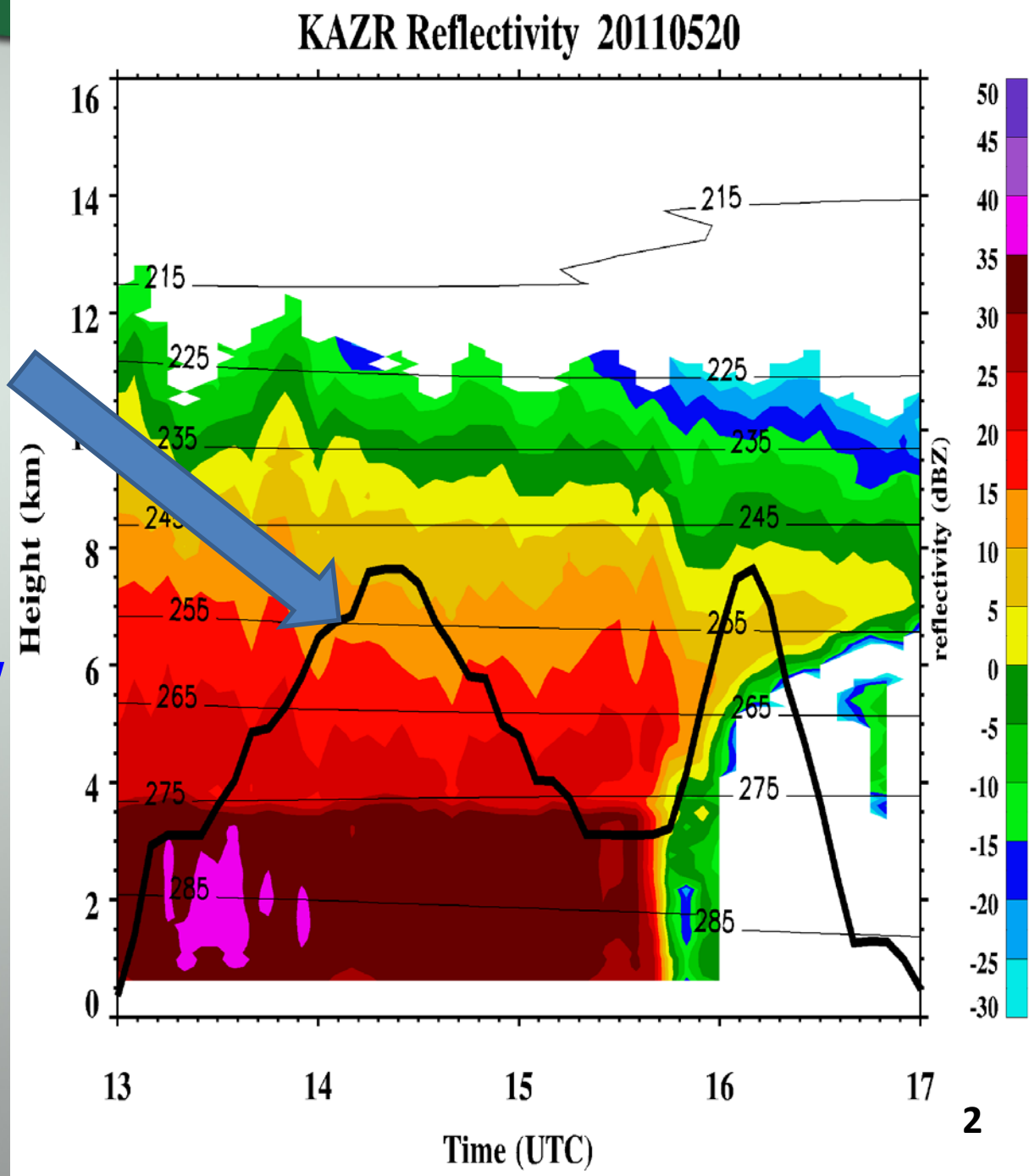
Outline

1. Motivation
2. Determining pure-ice-phase layer of DCS
3. Calculating the correct IWC with a new method
4. Conclusion



Motivation: Nevzorov hot-wire underestimated IWC because it can only measure D<900 um

	Condition on which Nevzorov has high accuracy	Conclusion	$\frac{True\ IWC}{Nevzorov\ IWC}$
Korolev and Nevzorov et al. (1998)	The median volume diameter was approximately 20 um	The TWC measurement for small frozen droplets to an accuracy of 10%-20%	1
Korolev et al. (2013)	The maximum size of ice particles did not exceed 4 mm	TWC sensor was approximately three times lower than that measured by the other three techniques	3

One possible solution to make up the underestimated part of IWC is to determine a ratio of true IWC to Nevzorov IWC.

Motivation: Nevzorov hot-wire underestimated IWC because it can measure D<900 um only

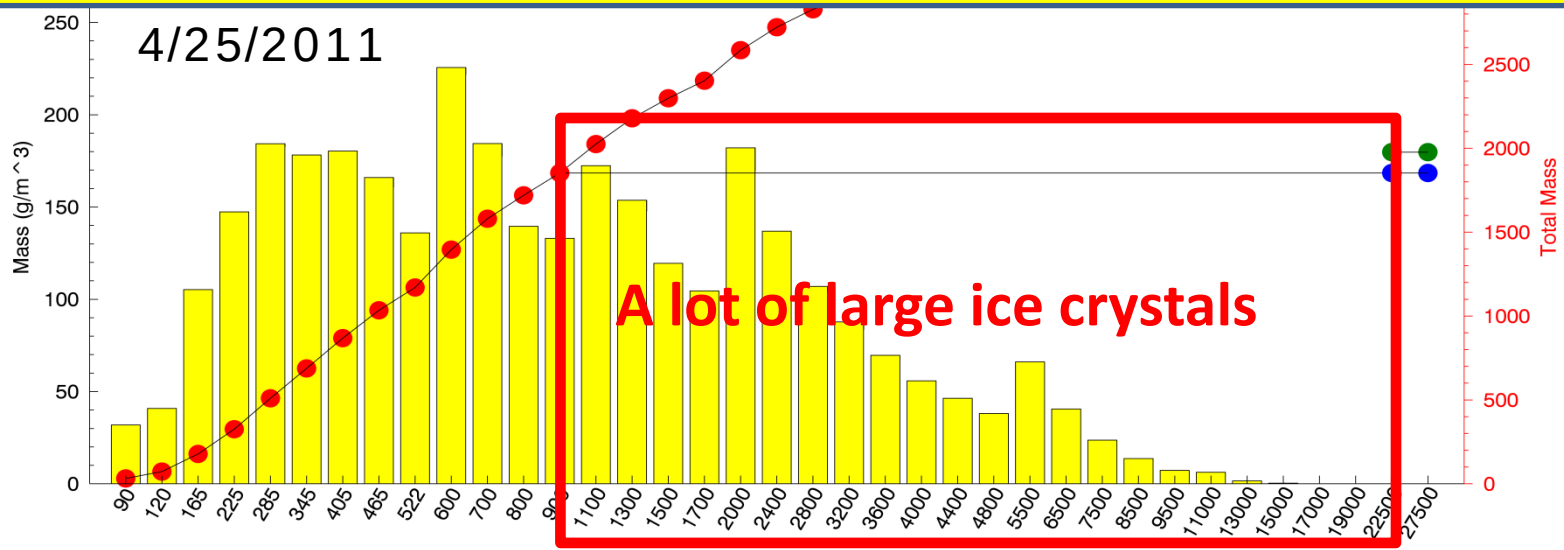
The maximum measurable diameter of ice particle is 1000 um

Nevzorov

➔Due to particle bouncing, pooling and subsequent shedding of water from the sensor, and previous studies, a 900 um size threshold was proposed for the MC3E experiment.

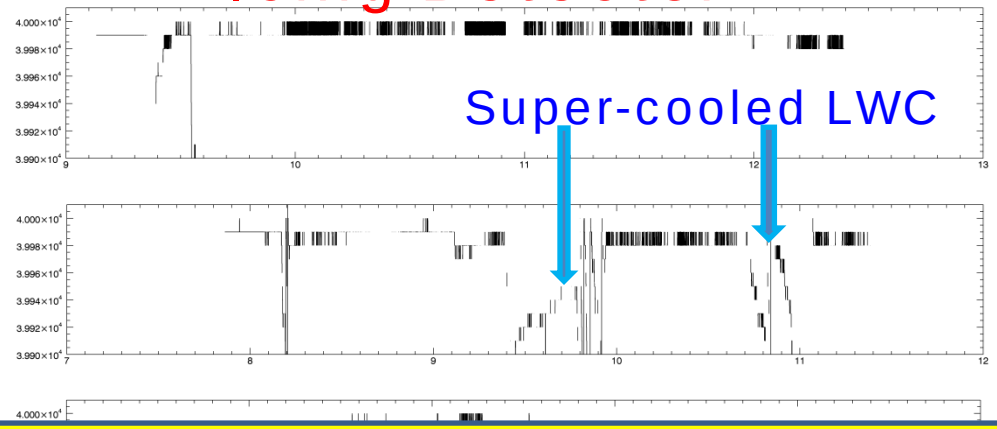
Motivation: Nevzorov hot-wire underestimated IWC because it can measure D<900 um only

The ratio (true IWC/Nev IWC) is not fixed because it depends on how many large particles (>900 um).

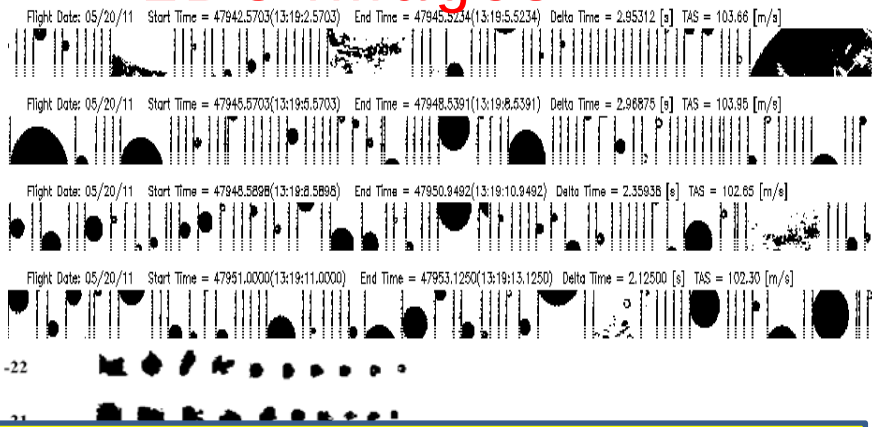


2. Determination of temperature threshold of pure ice phase layer of DCS

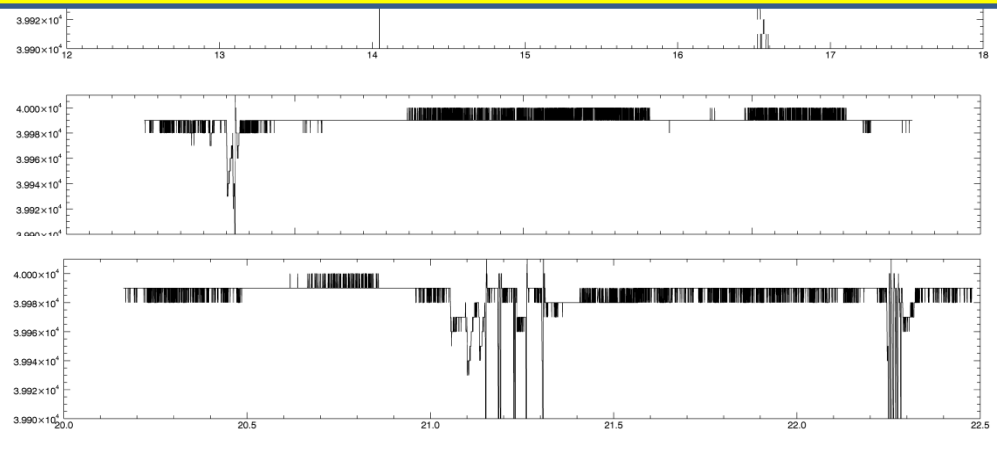
Icing Detector

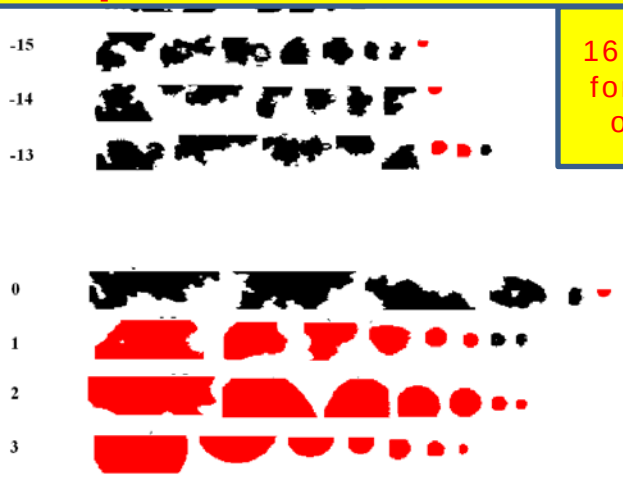


2DC images



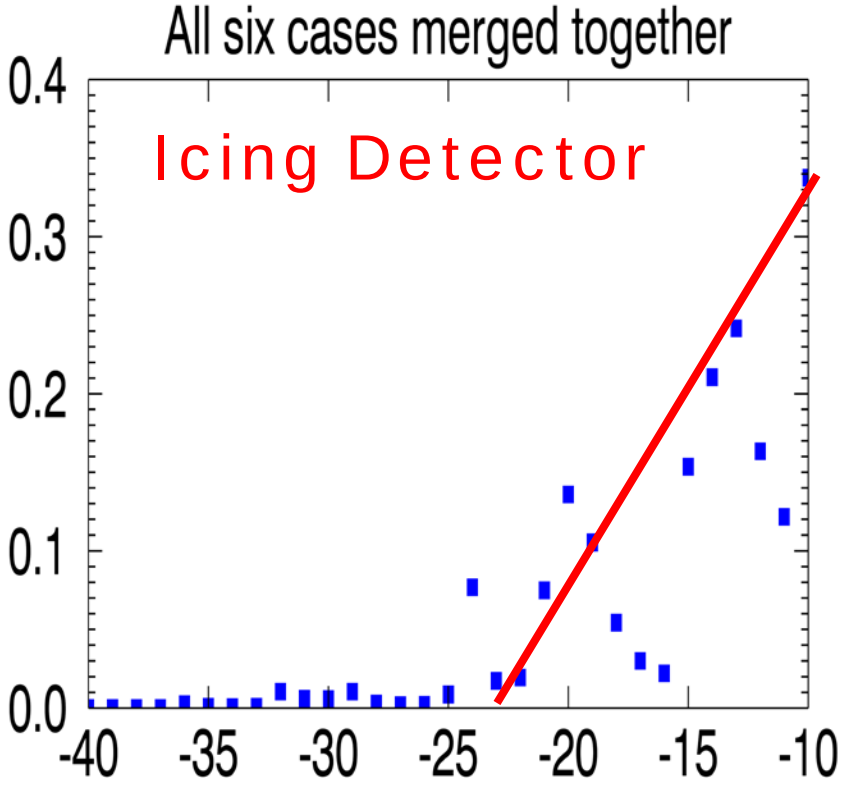
We need to quantitatively estimate the frequency of supercooled liquid water vs. cloud temp.

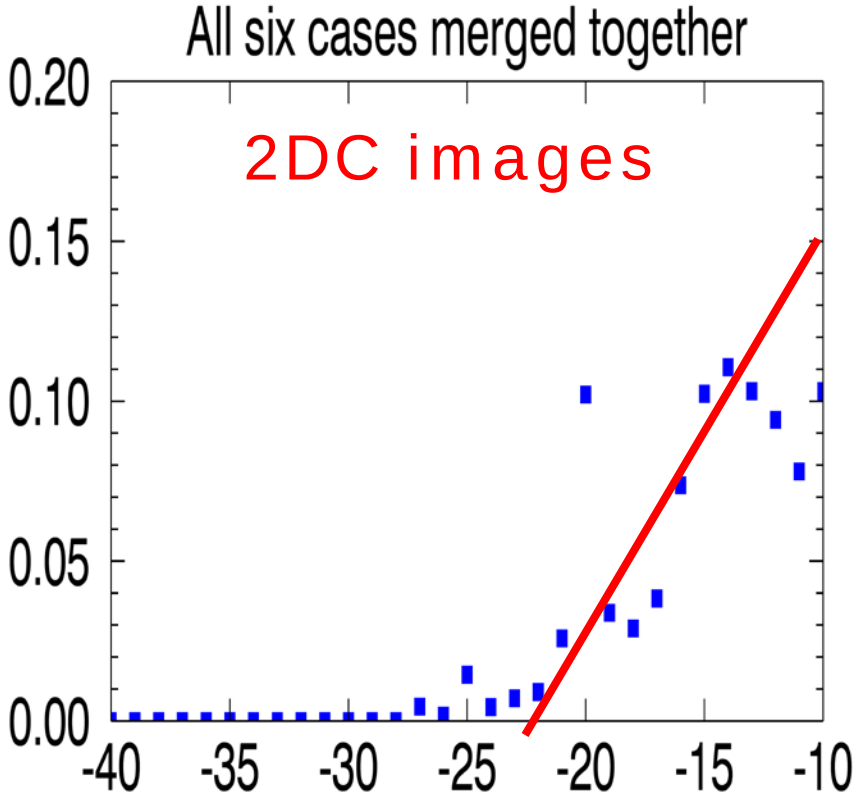




16,000 images for each case on average

2. Determination of temperature threshold of pure ice phase layer of DCS

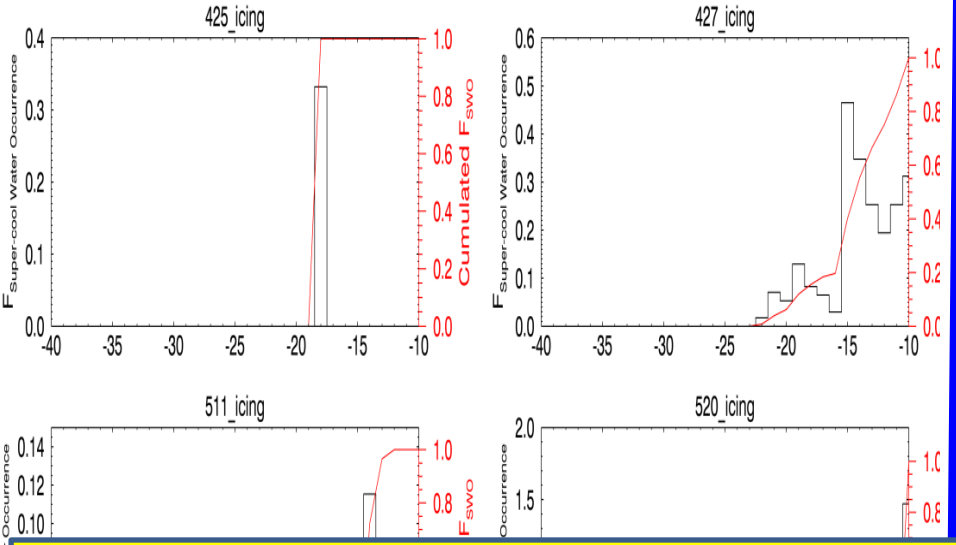




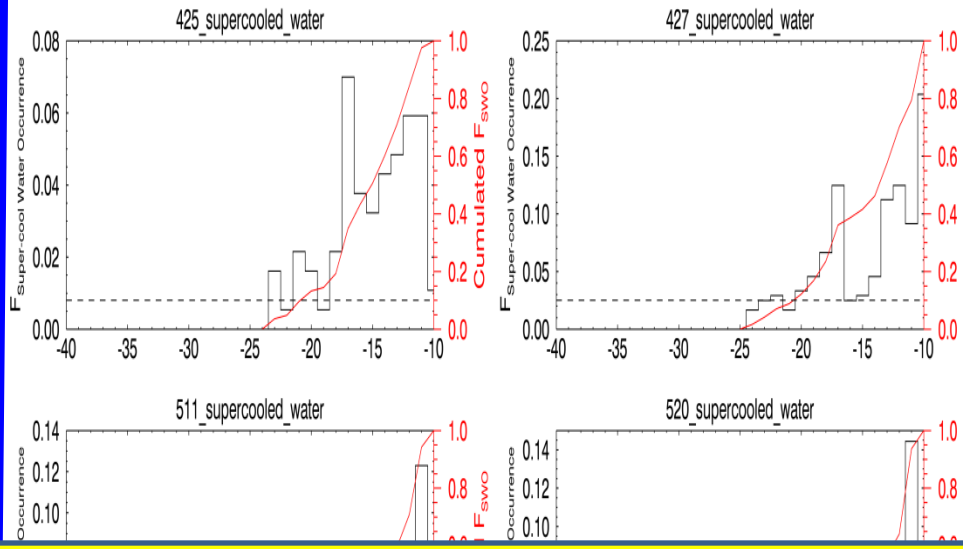
Both icing detector and 2DC image reading provided the same trend of the super-cooled liquid water vs. temp; pure ice occurred at ~ - 22 ^{o}C

2. Determination of temperature threshold of pure ice phase layer of DCS

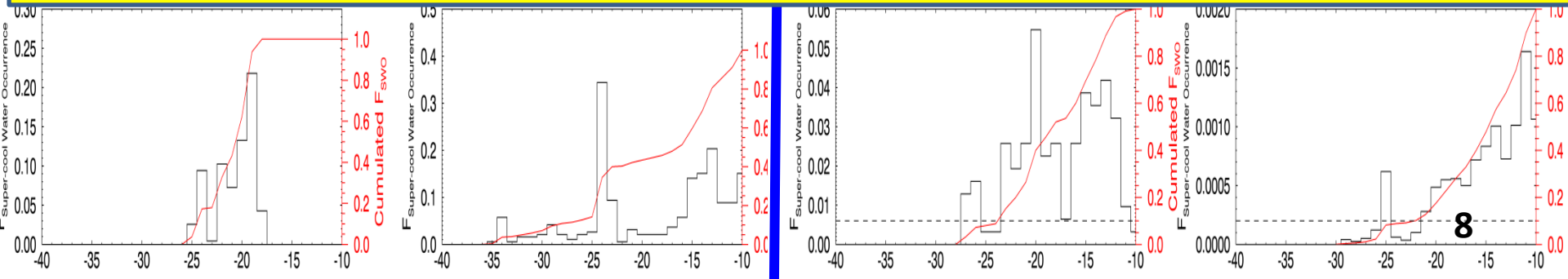
Icing Detector



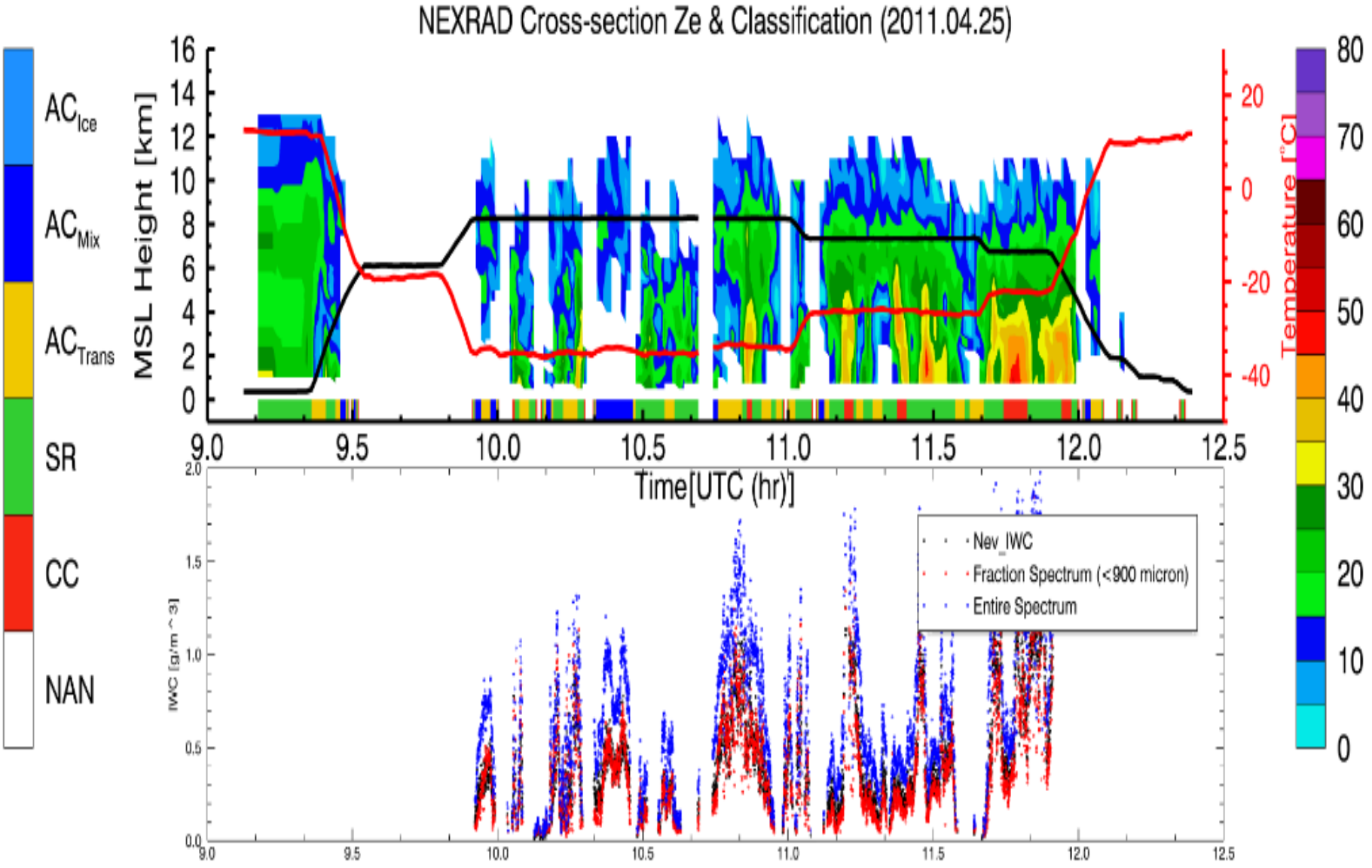
2DC images



However, the temp threshold (-22°C) changed case by case from -19 to -24 °C.



3. Calculating the correct IWC with a new method



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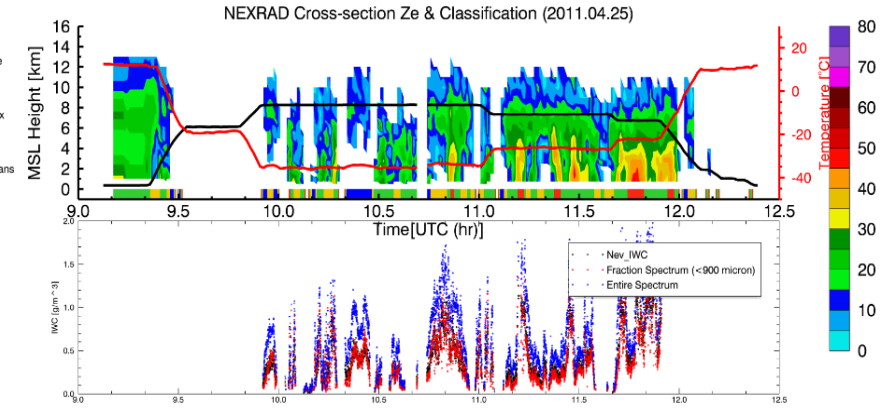

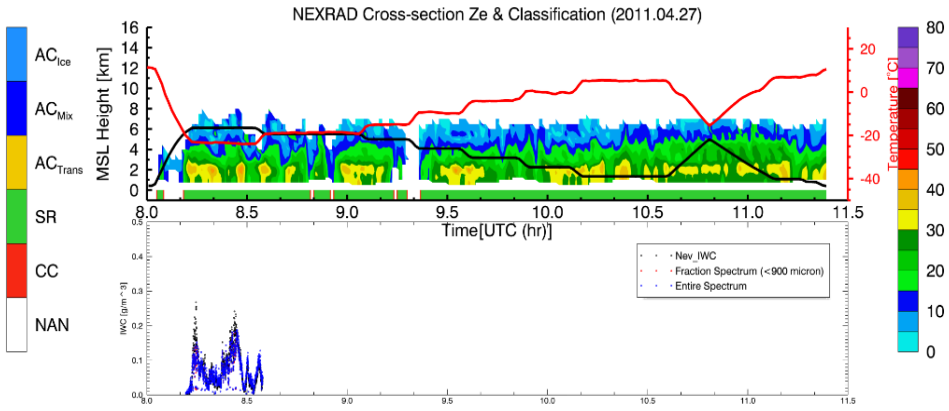

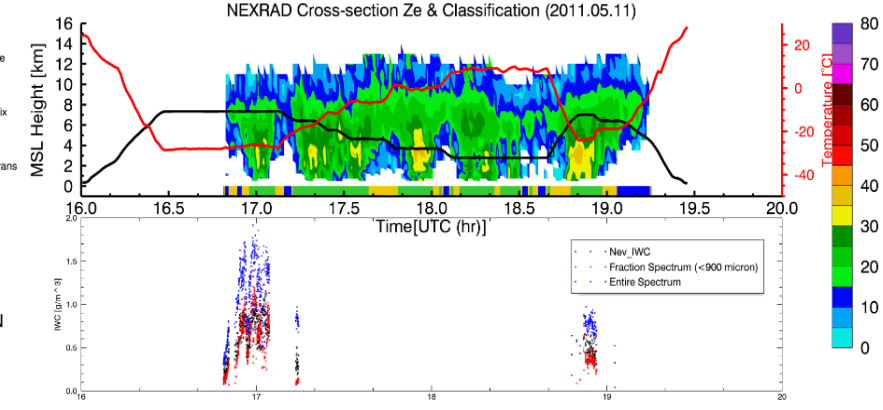

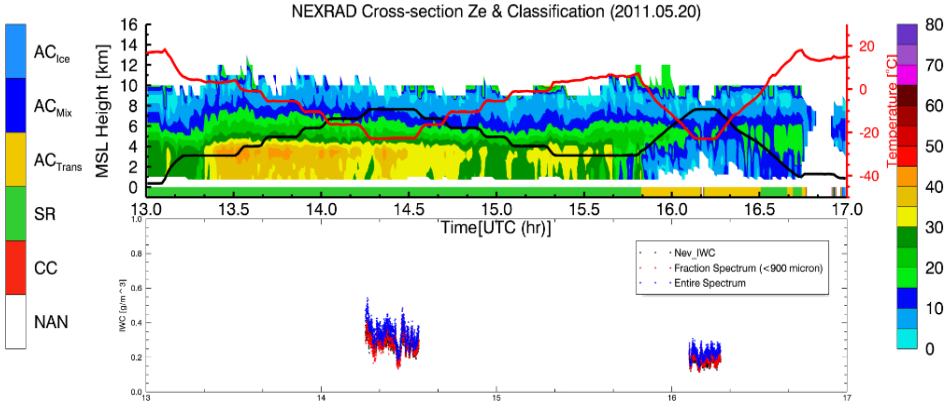

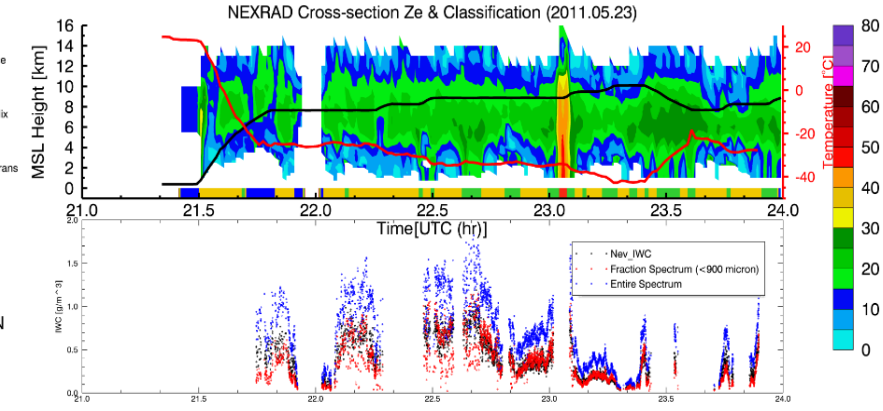

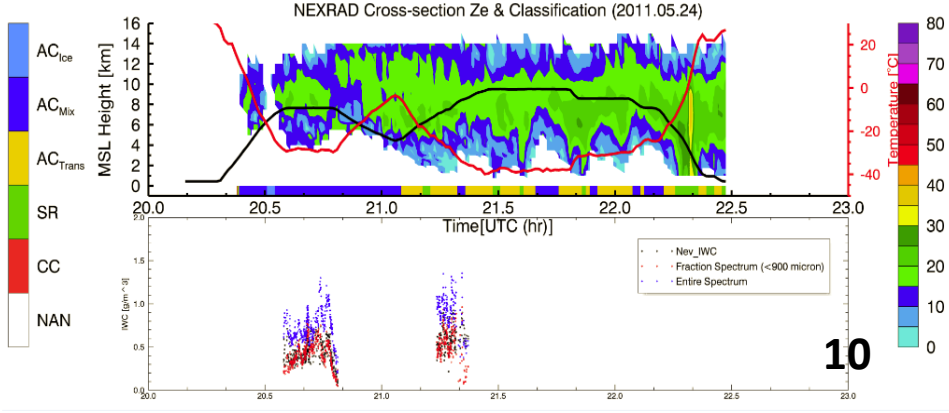

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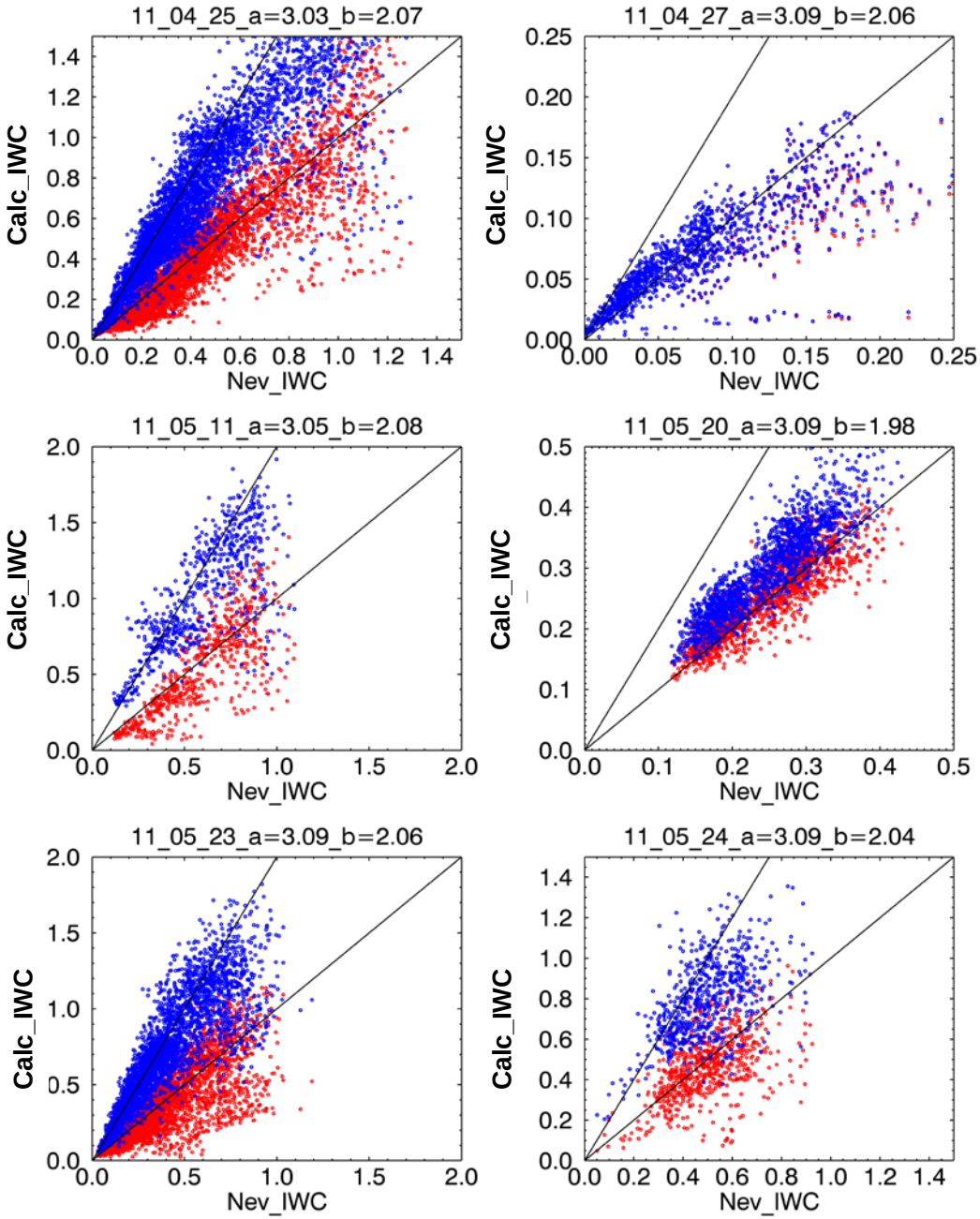


X-Axis is NEV_IWC, Y-axis are calculated IWCs from 2DC and HVPS with D<900 um (red dots) and a full range of particle sizes (blue dots).

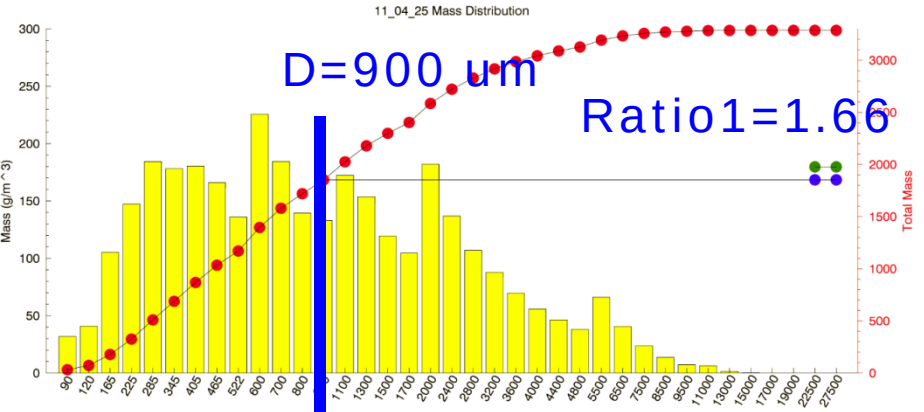
➔The calculated IWCs (D<900 um) agree well with NEV IWCs

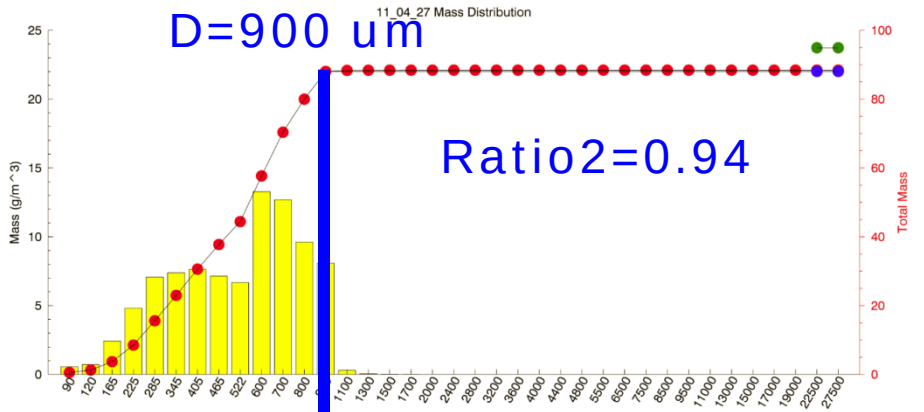
➔The ratios of calculated IWC with a full range to Nev IWC are:

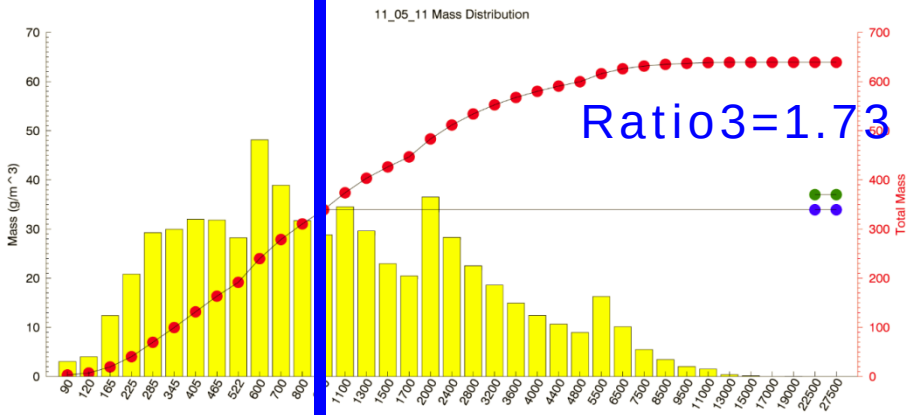
Ratio1= 1.66 for 4/25/2011
Ratio2= 0.94 for 4/27/2011
Ratio3= 1.73 for 5/11/2011
Ratio4= 1.21 for 5/20/2011
Ratio5= 1.78 for 5/23/2011
Ratio6= 1.51 for 5/24/2011

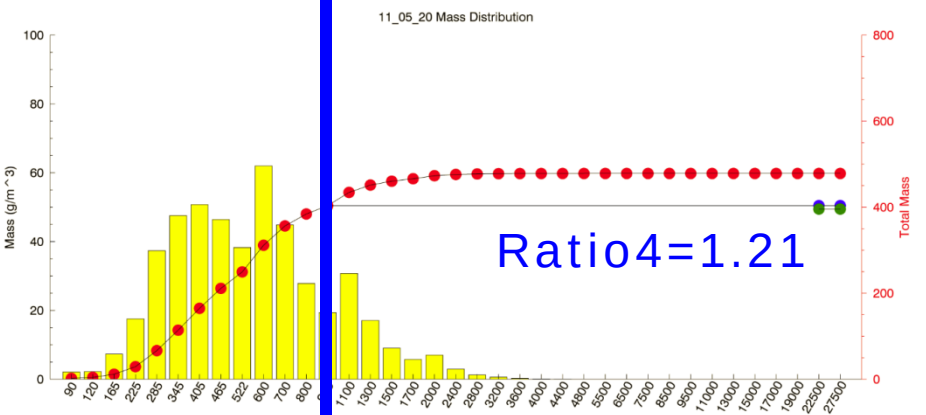
But why their ratios are different?

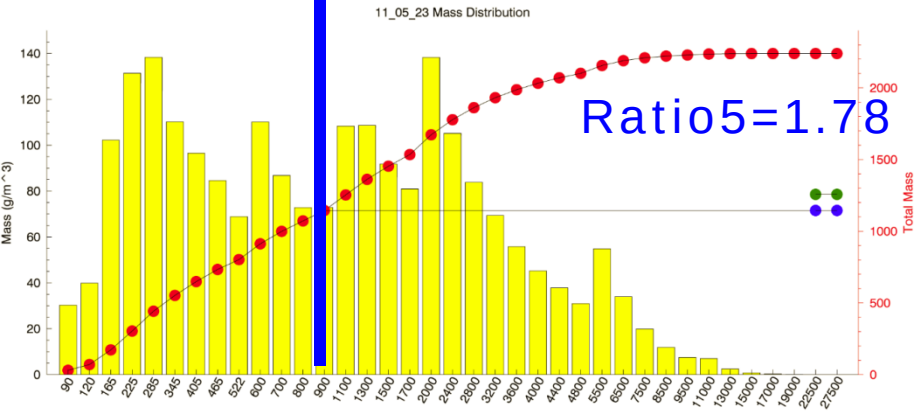
It depends on how many large particles (>900 um).

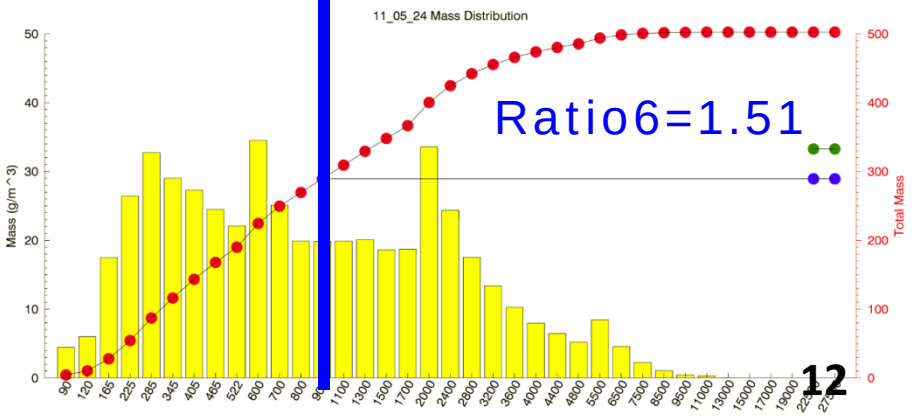










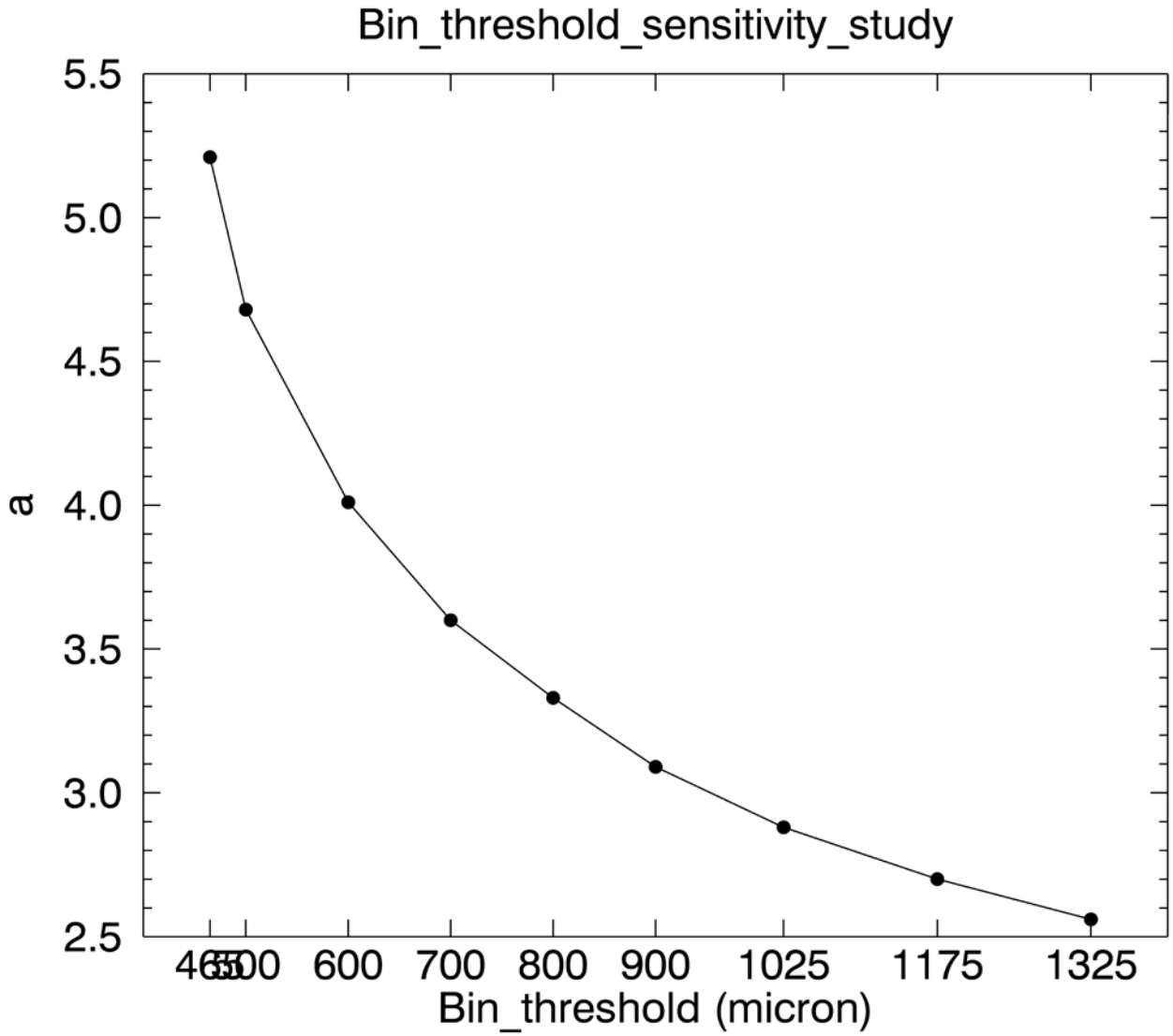


4. Conclusion

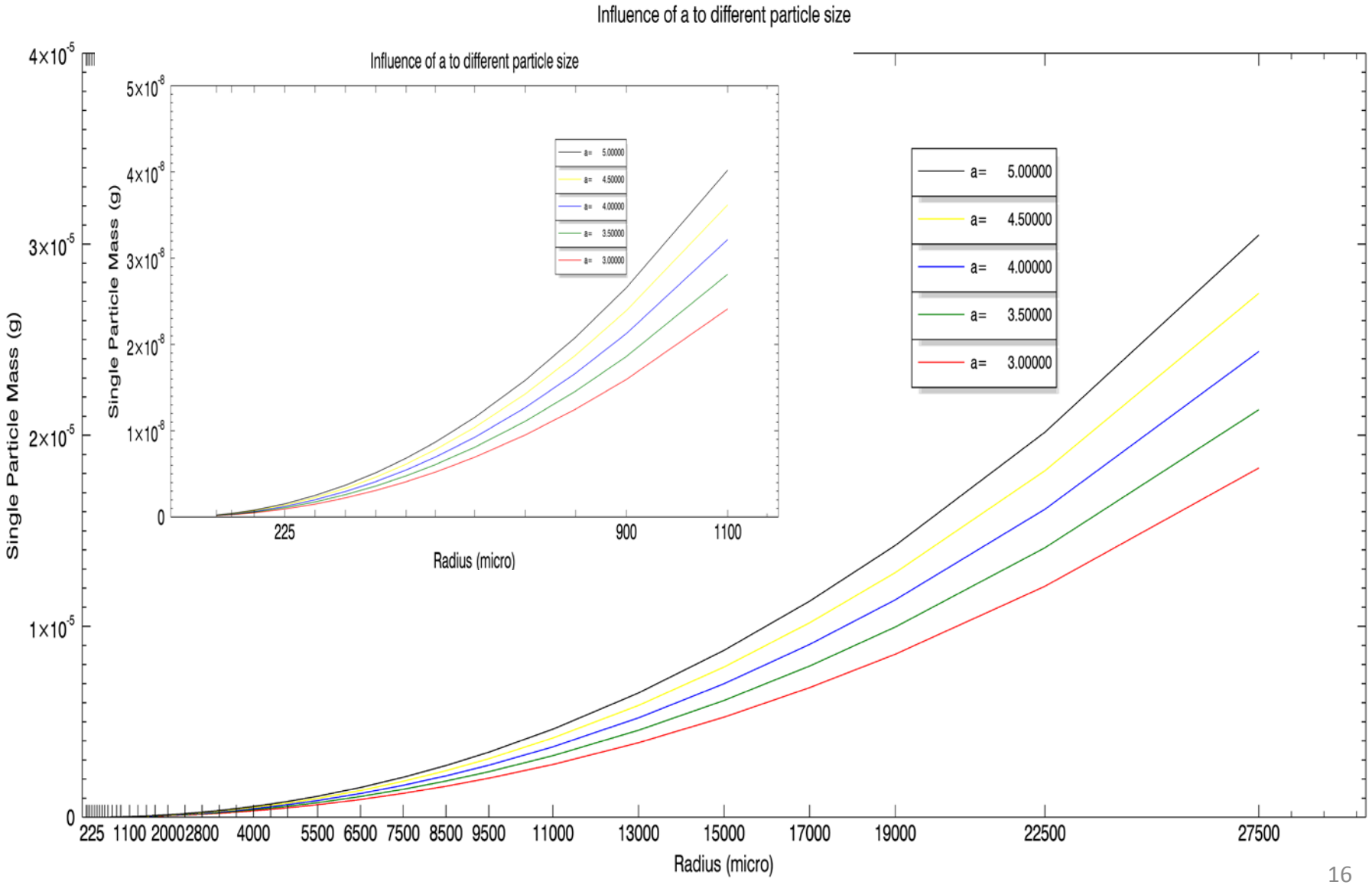
1) Six cases during MC3E have been investigated in this study.
2) The temperature thresholds for pure-ice-phase have a range of -19 ^{o}C to -24 ^{o}C, determined from ice detector and 2DC images reading.
3) The ratio of true IWC to Nev IWC is not fixed because it depends on the number of large particles (>900 um). The ratios for these six cases range from 0.94 to 1.78.

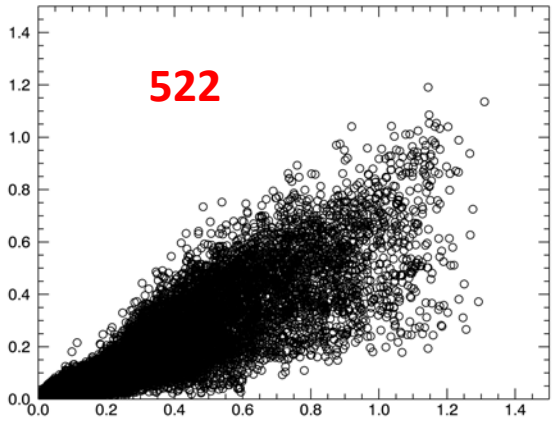

Thanks for Your attention!
Questions?

Fixed b=2.06 changing threshold



Single particle mass with changing a

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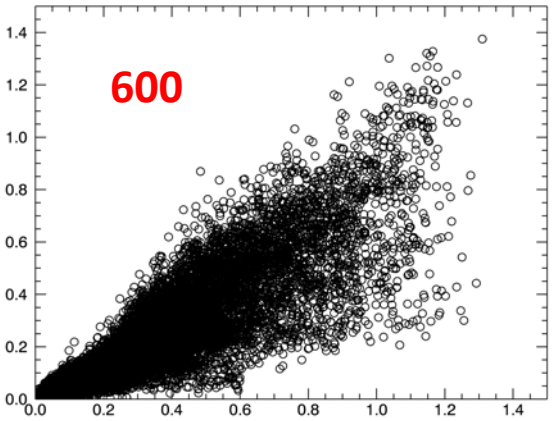
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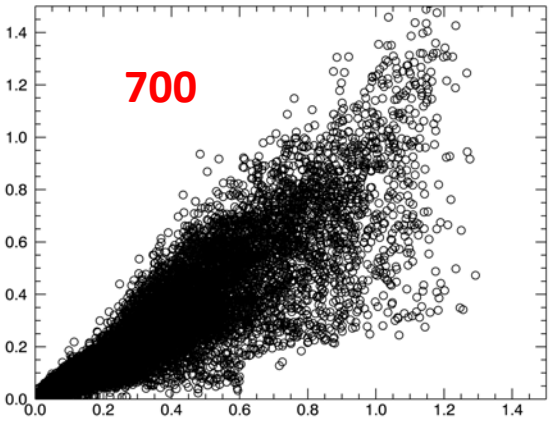
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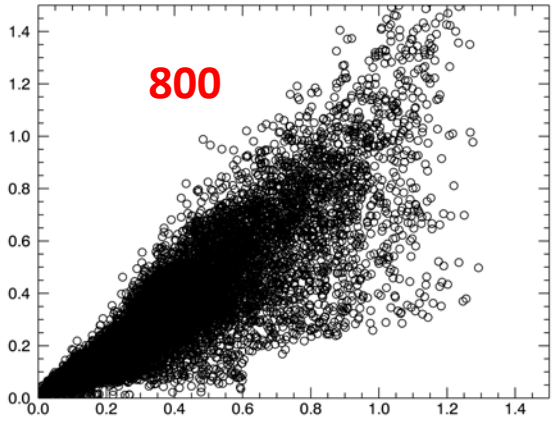
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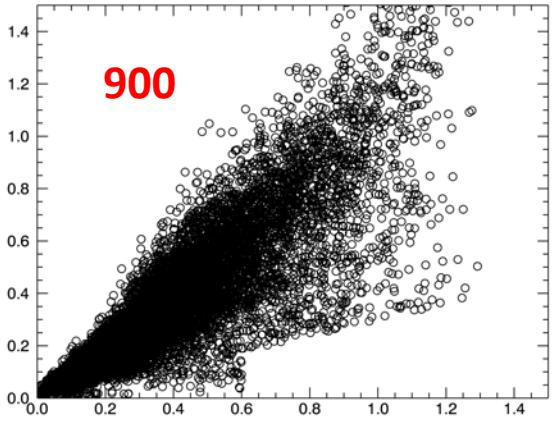
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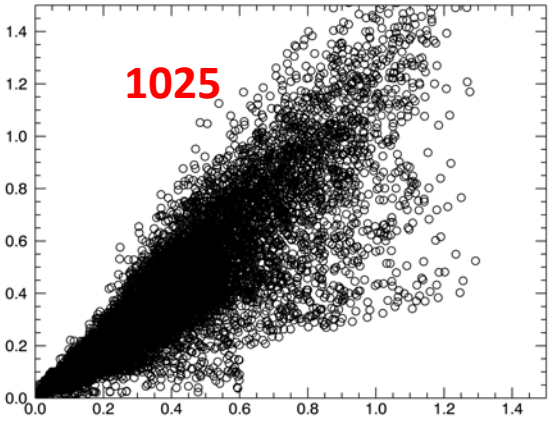
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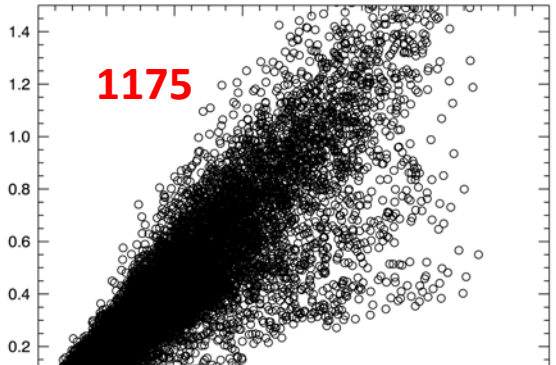
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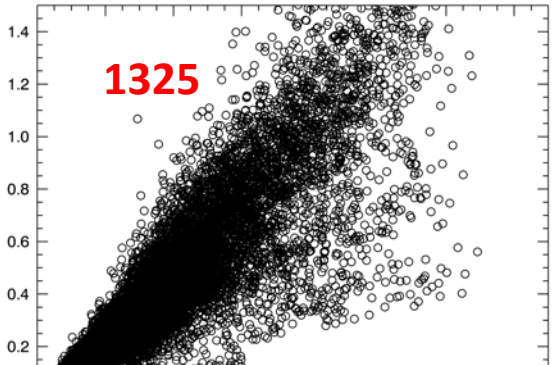
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