Continuous Flow Diffusion Chamber (CFDC) Measurements of IN Concentration

Concentrations of Ice-Nucleating Aerosol (IN) as a function of Temperature and %Supersaturation

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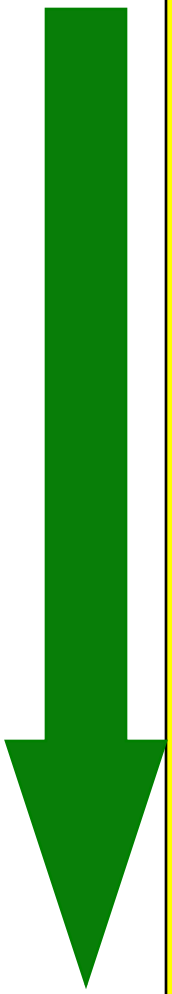
Archived CFDC Data Flights April 8 through end of ISDAC

… CFDC operating conditions vary



Date	Flight Num
20080331	Flight 08
20080401	Flight 09 & 10
20080404	Flight 11 & 12
20080405	Flight 13 & 14
20080408	Flight 15, 16 & 17
20080413	Flight 18 & 19
20080414	Flight 20 & 21
20080418	Flight 22
20080418	Flight 23
20080419	Flight 24, 25, 26
20080424	Flight 27
20080424	Flight 28 & 29
20080426	Flight 30 & 31
20080427	Flight 32
20080428	Flight 33 &34

Concentration of Ice-Nucleating Aerosol (IN)

Factors which impact IN concentration

1. CFDC operating conditions:

Temperature

%Supersaturation with respect to ice

% Supersaturation with respect to water

2. Aerosol properties:

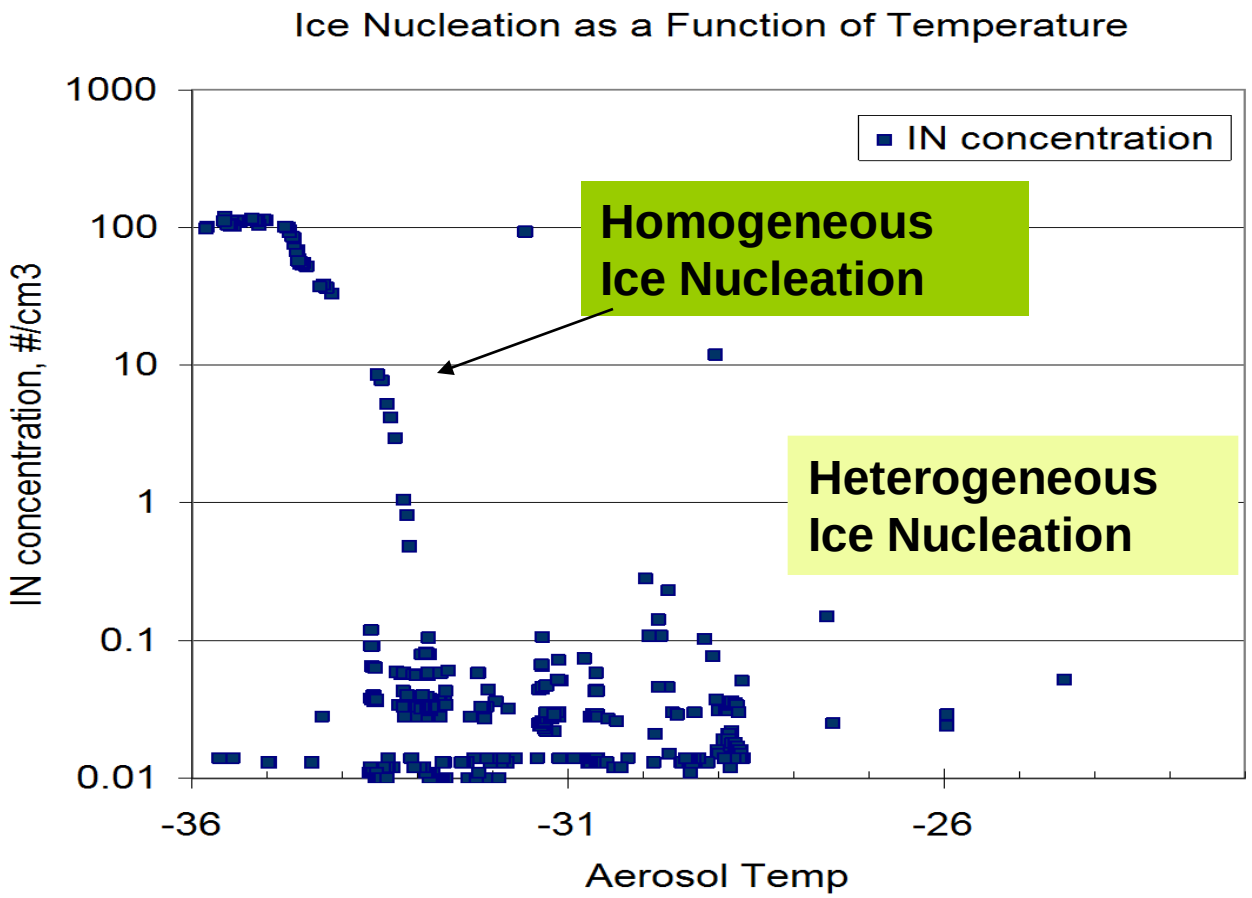
Source

Composition

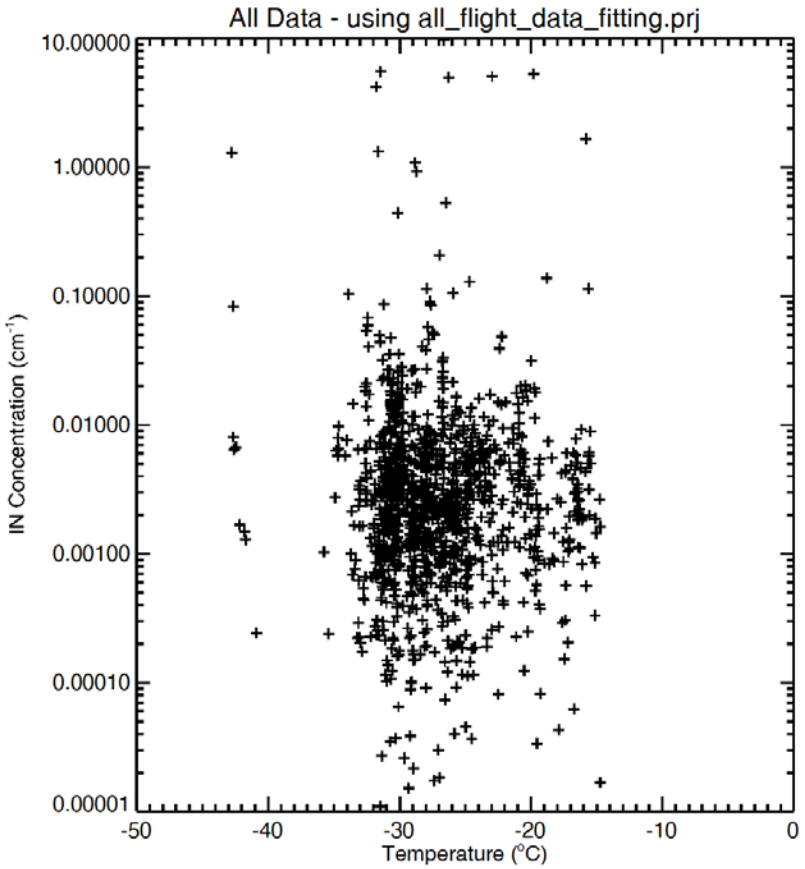
Size

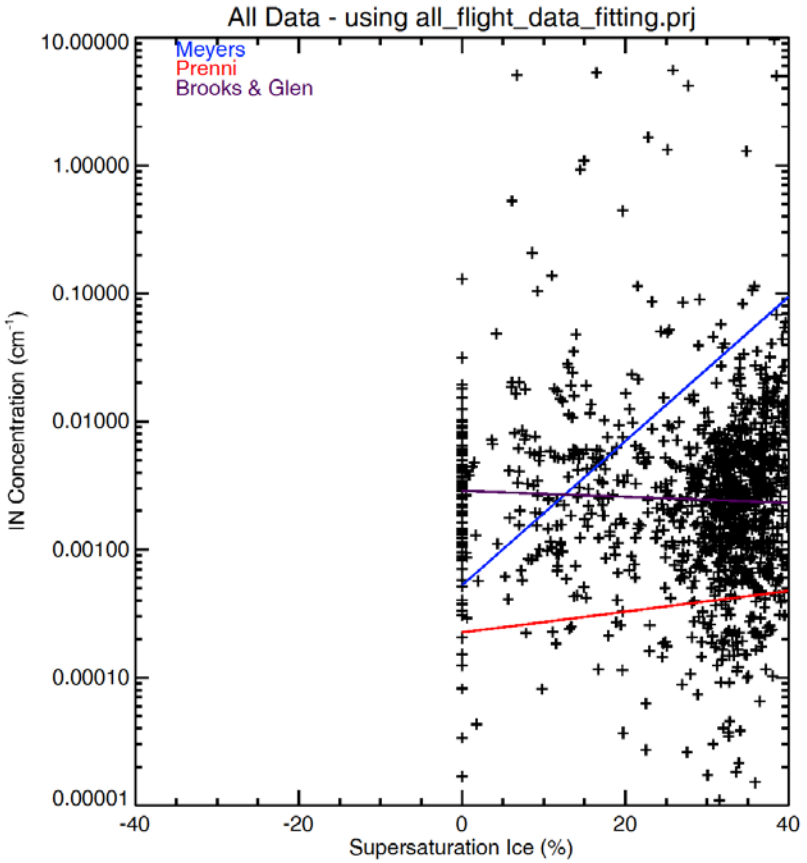
When aerosol conditions are constant, such as during the transit flight on April 28 , we can demonstrate the relationship between IN concentrations and operating temperature.

Data collected on April 28 shows the dependence of IN concentration on CFDC operating temperature.



The April 28 case is not representative of IN concentrations observed during sampling of various air masses during ISDAC

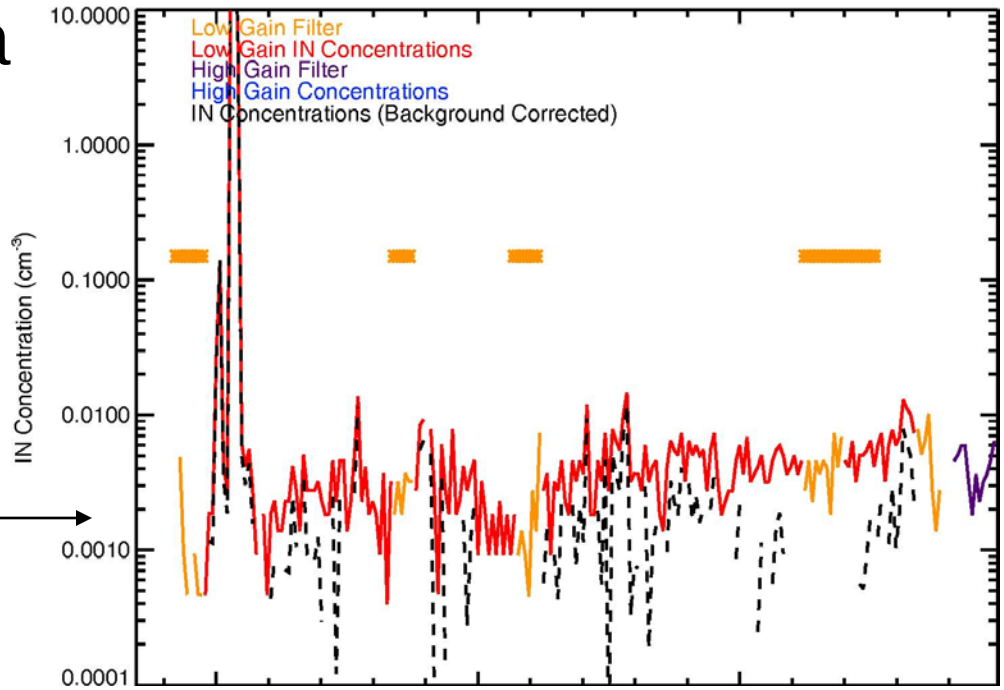




Overall, no clear trend in IN concentration with temperature or saturation.

Need to look at data for individual cases:

IN concentrations

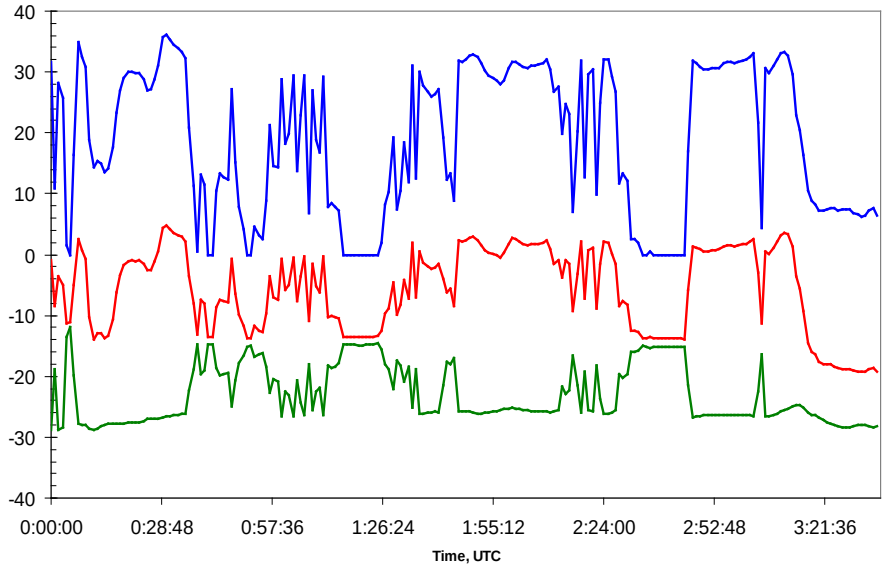


CFDC operating conditions

Supersaturation_ice, %

Supersaturation_water, %

Temperature, ^{o}C



Observed IN concentrations are highly variable
Why?

Highly IN-active aerosols sampled during ISDAC?

or

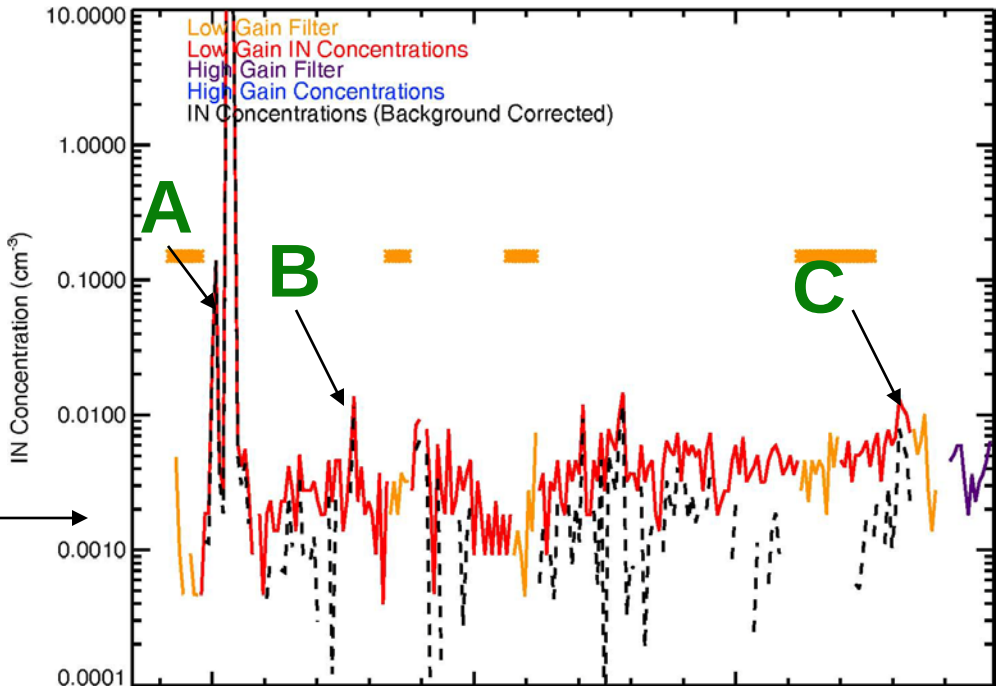
Are we overcounting IN?

-IN mixed phase could the CFDC counting droplets as IN?

-Are we counting large soot particles from biomass burning as IN?

CFDC Measurements April 26, Flight 31

A closer look at cases of high IN concentration

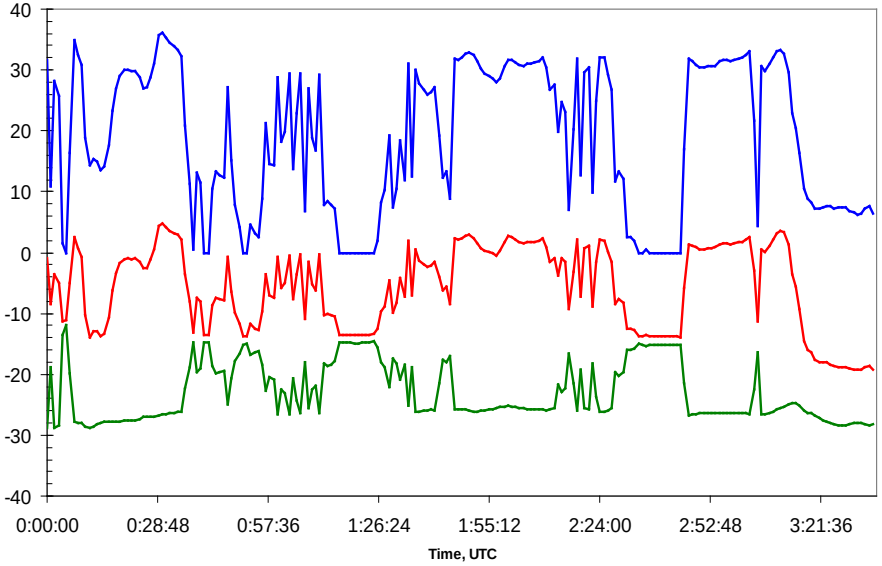


CFDC operating conditions

Supersaturation_ice, %

Supersaturation_water, %

Temperature, °C

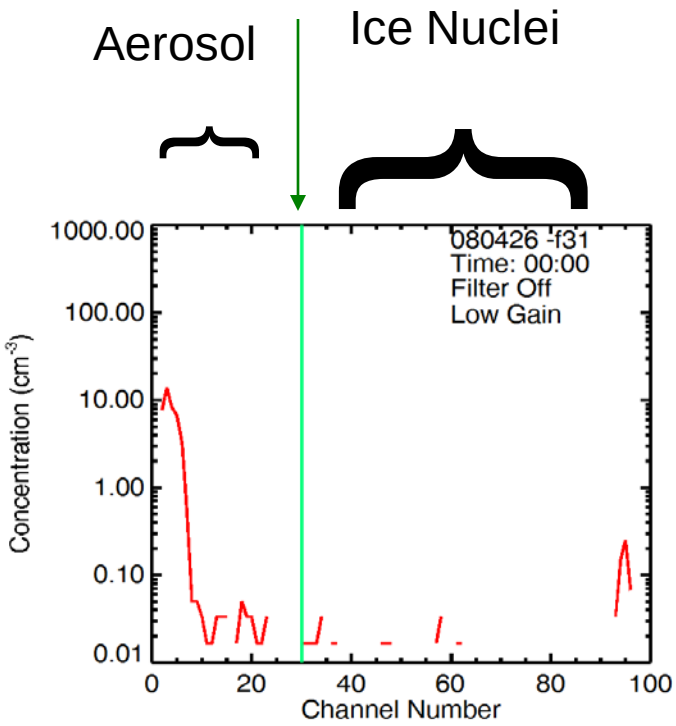


Case A

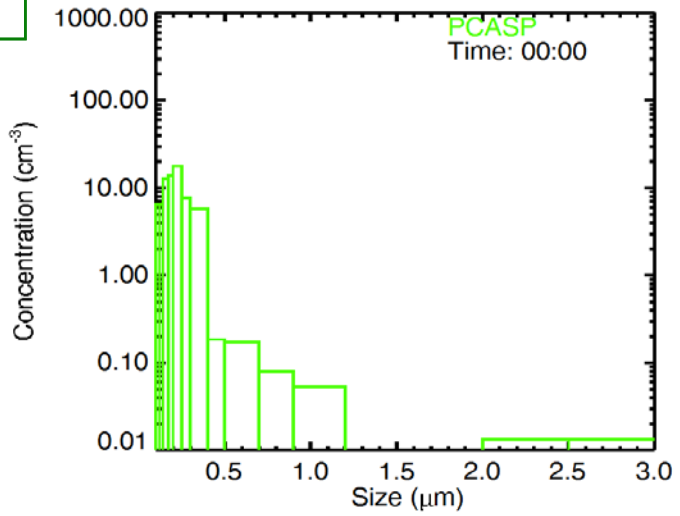
Comparing
CFDC detection of aerosols and ice nuclei to PCASP aerosol size distributions

Here we see
1. Agreement between non-nucleating aerosol in CFDC and PCASP aerosol
2. Large aerosols are not falsely counted as IN.

CFDC

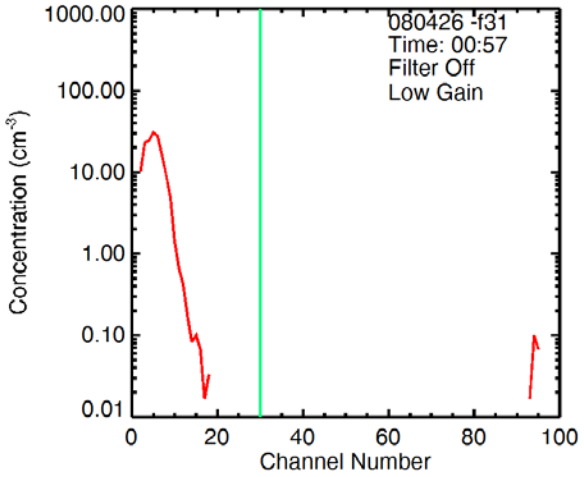


PCASP

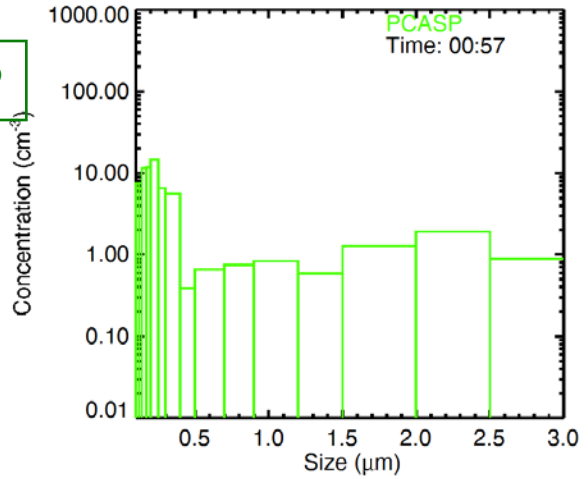


Case B
Droplets and Ice Nuclei

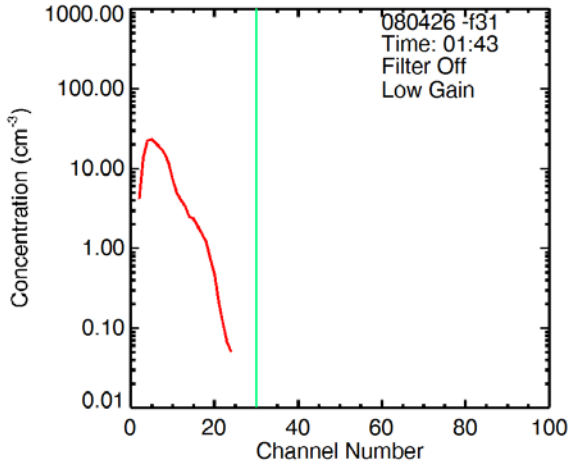
CFDC

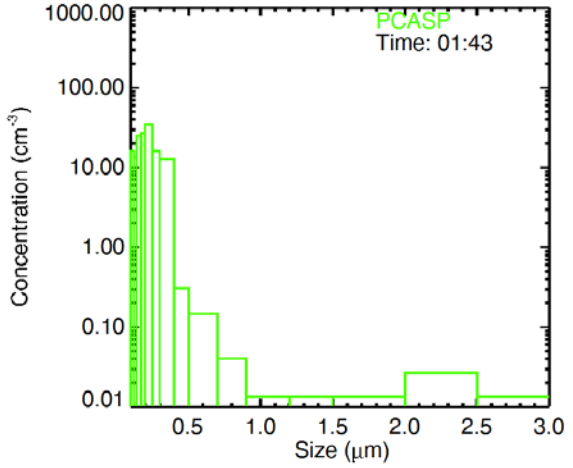


PCASP



For comparison:
Case of droplets, and zero IN



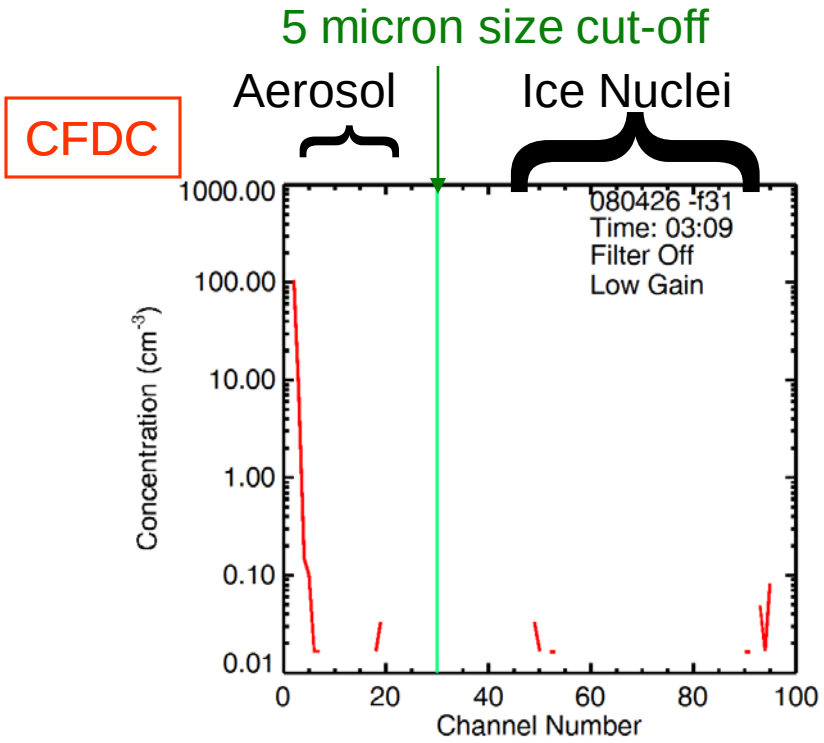


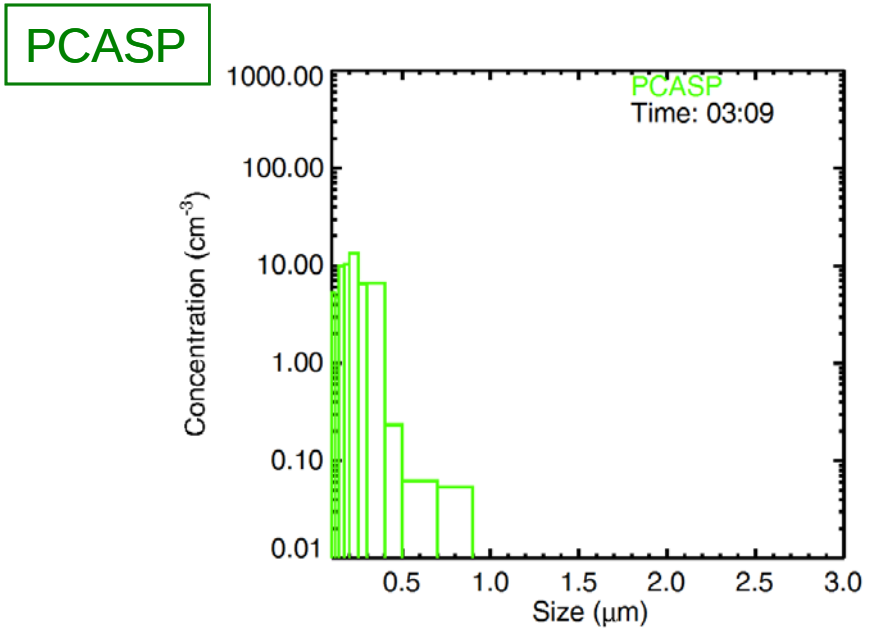
Droplets are not falsely counted as IN under ISDAC sampling conditions

Case C

Very high concentrations of both submicron IN-active aerosols

and IN





Conclusions

Observed CFDC IN concentrations – highly variable

IN concentrations must be considered in the context of other parameters

Next steps:

Correlations with aerosol composition

Correlations with aerosol size and ice crystal size

Nucleation Mechanisms