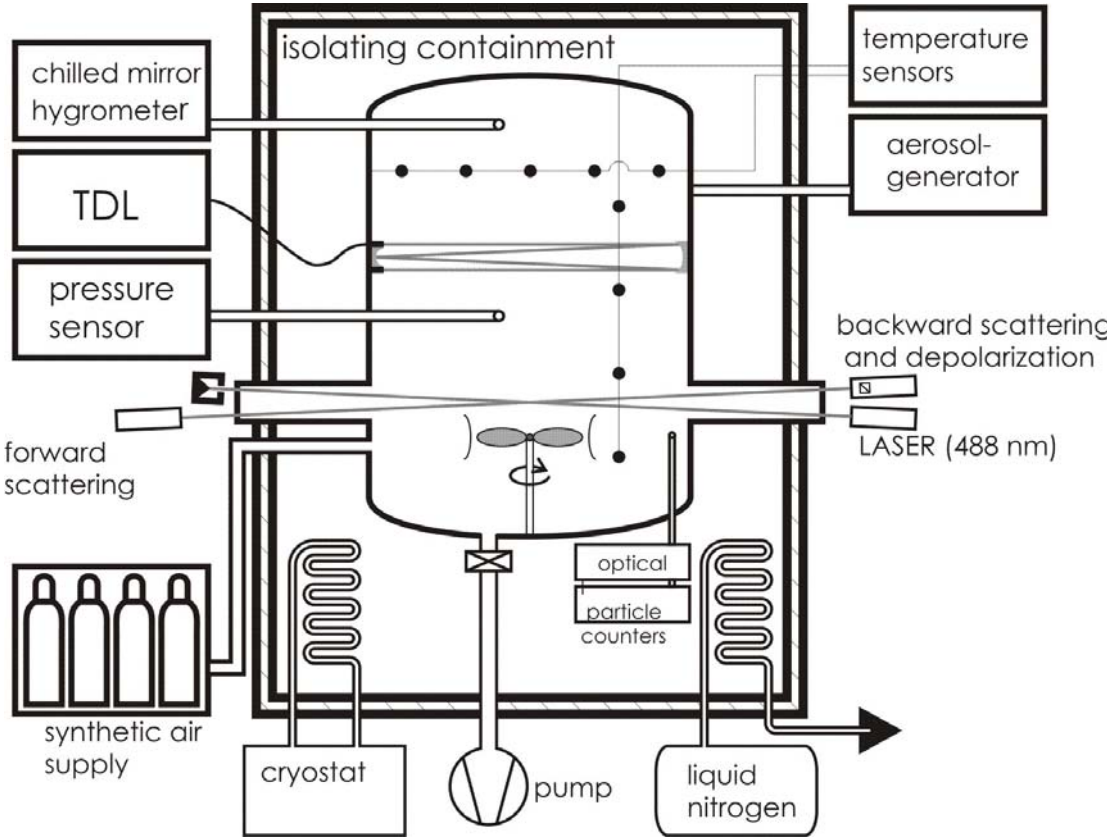
IN11 – First Results from AIDA IN Experiments

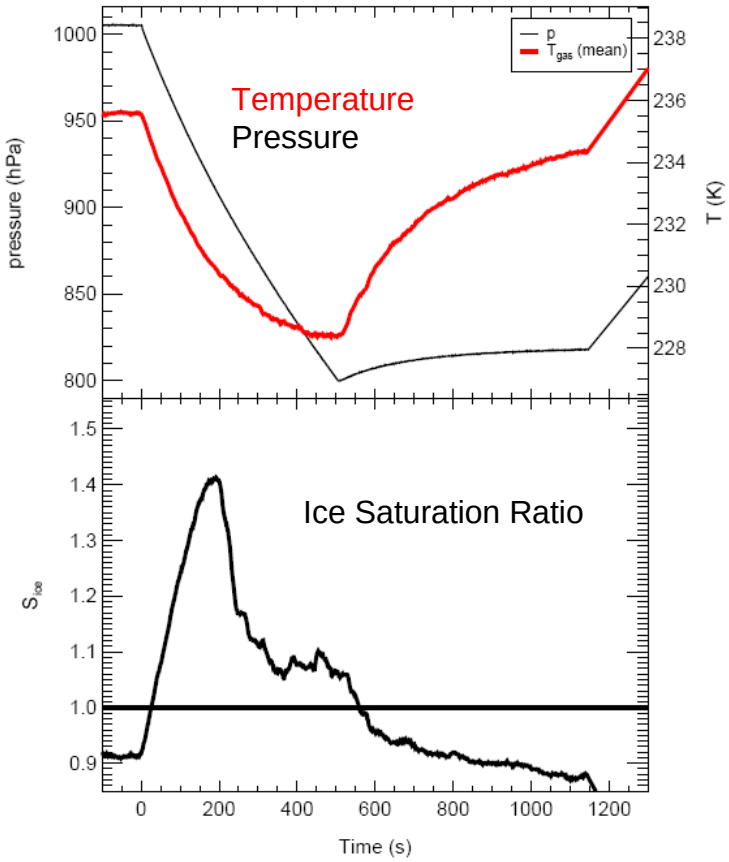
Overview

1. AIDA – Experimental methods
2. IN on soot from spark generator GfG-1000 (carrier gas Ar and N,
   coating by succinic acid)
3. IN on flame soot aerosol (CAST) with low, medium and high content of organic carbon + coating of sulphuric acid

Temperature: 228 K

AIDA – Aerosol and Cloud Chamber

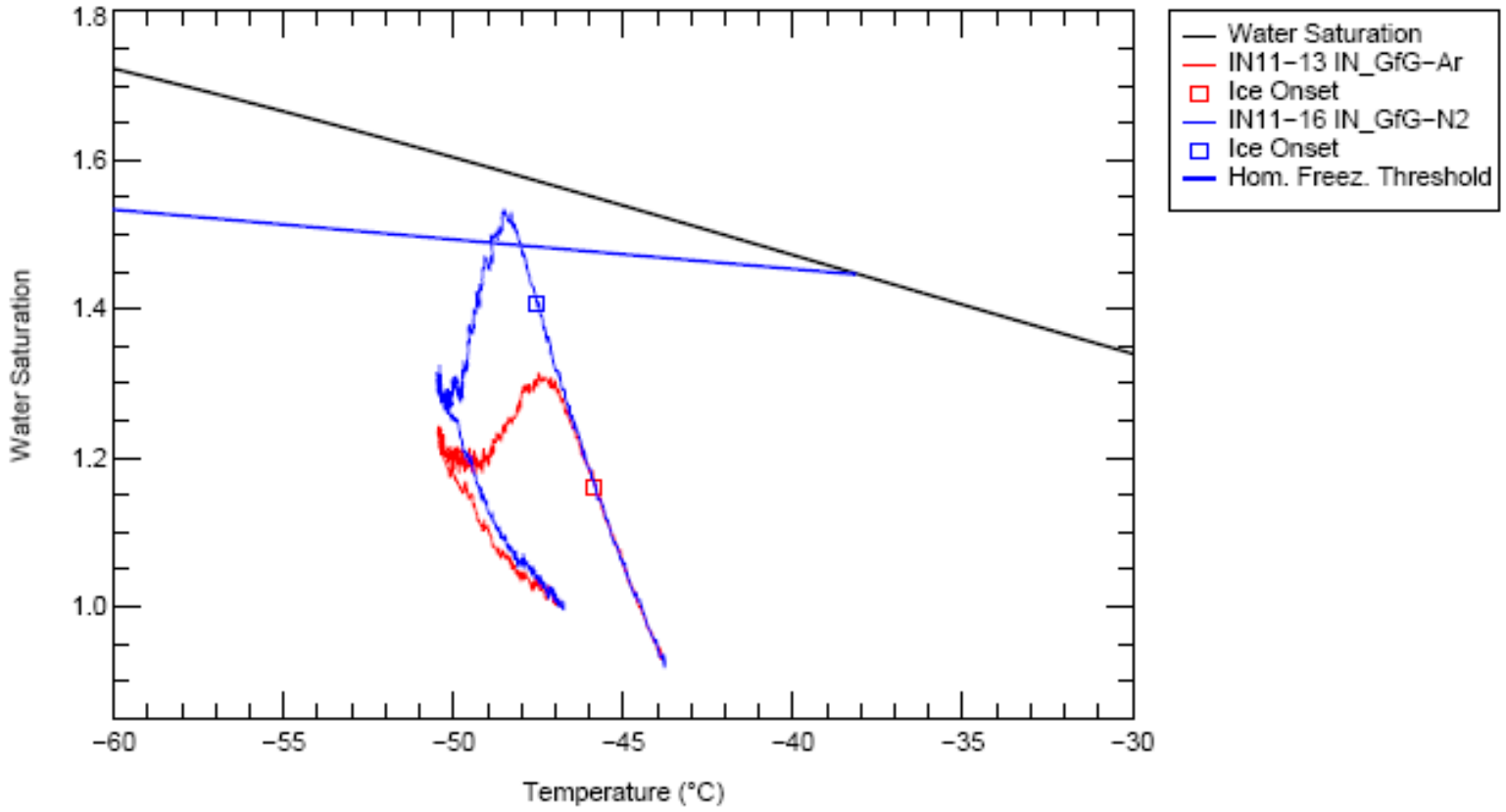




$V = 84m^3$

$-90°C < T < 30°C$

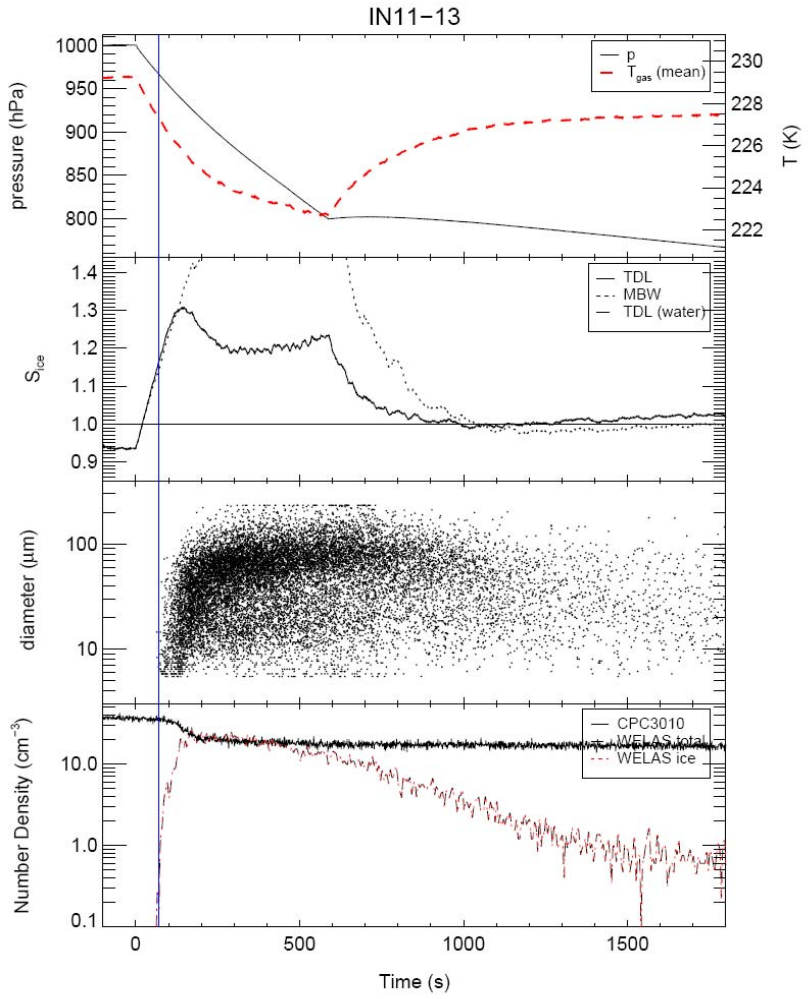
Does the carrier gas of the PALAS discharge generator (GfG1000) affect the properties of the soot particles ?

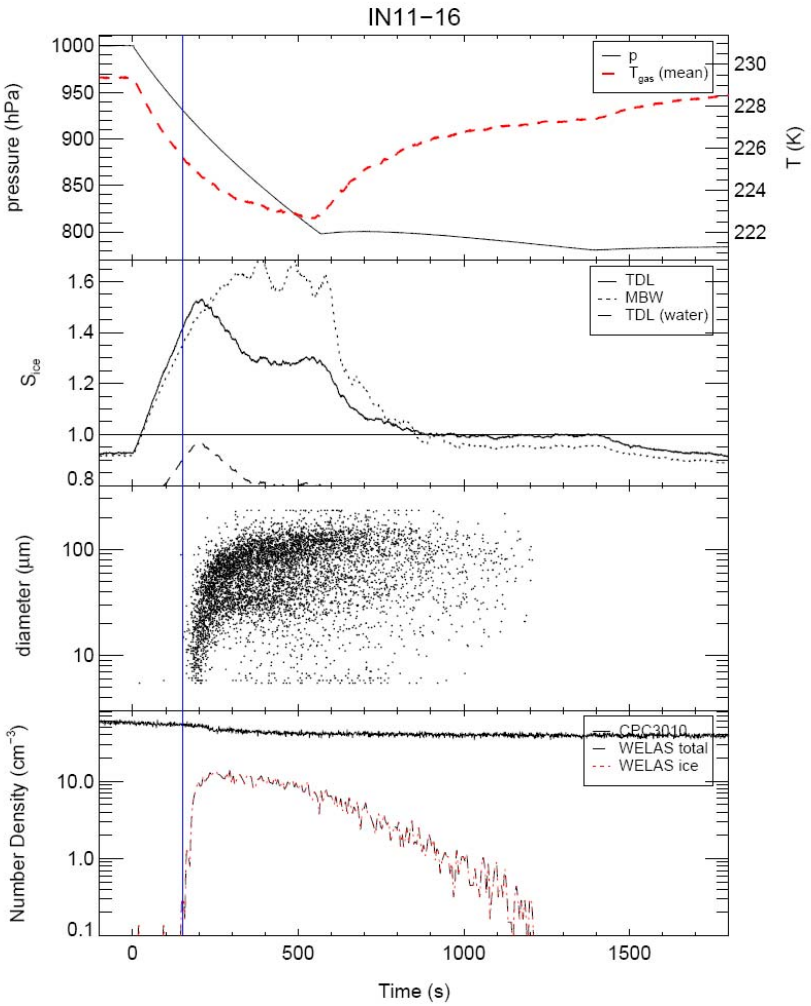


AIDA experiments are showing clearly the influence of the used carrier gas on IN properties of GfG-soot aerosol

Argon

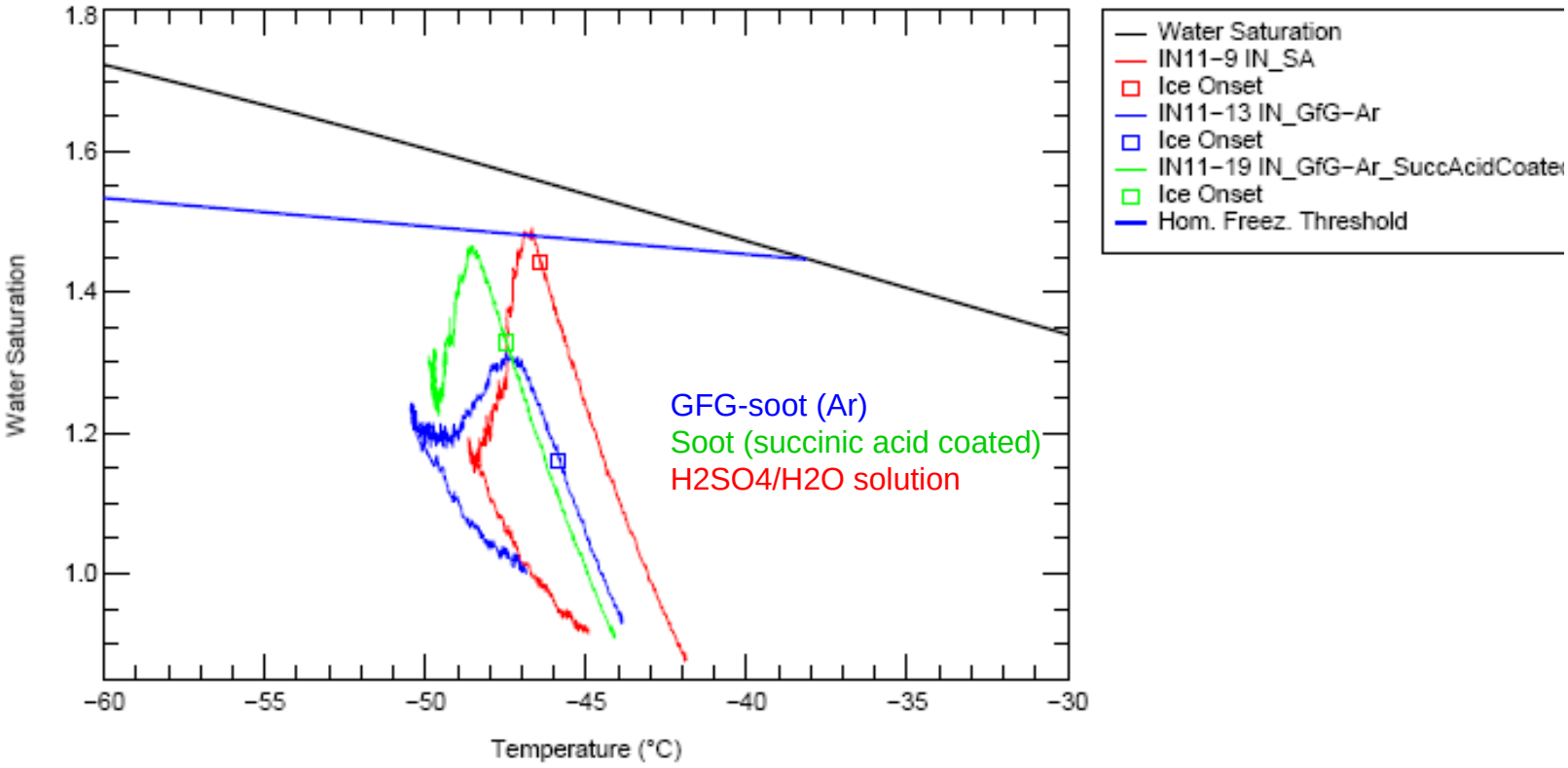
Nitrogen





Fraction of ice activated particles: 100% 25%

Effect of coating the soot aerosol by succinic acid



Coating of GfG-soot aerosol with succinic acid increases onset value of S_{ice} for freezing markedly

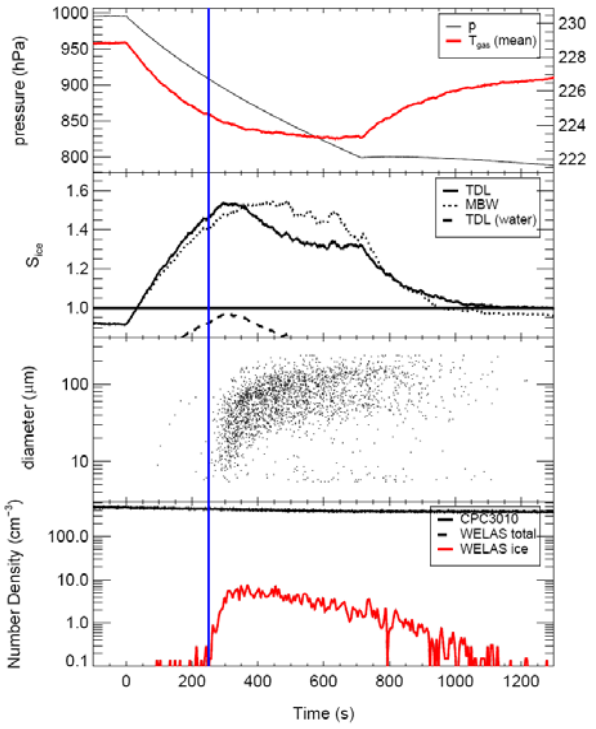
(same effect was found for sulphuric acid coating, published in Möhler et al, JGR 2005)

Ice nucleation on flame soot (CAST) of different organic carbon content

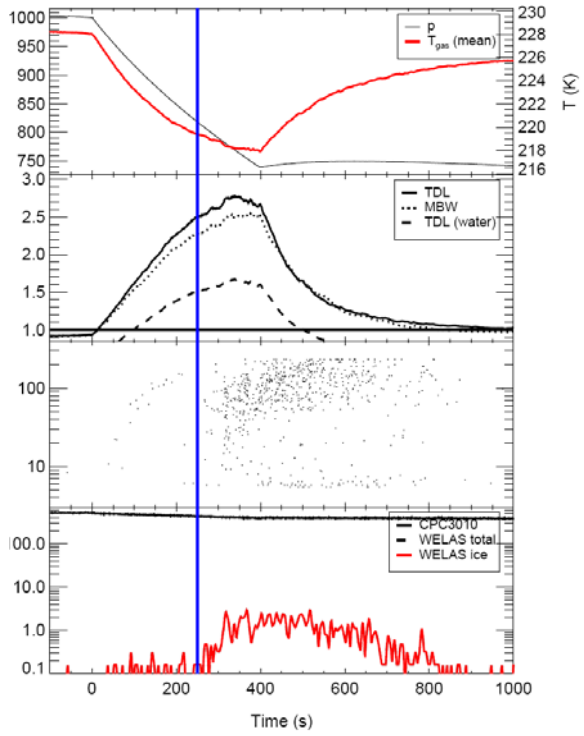
Min OC (C/O: 0.28) Med OC (C/O: 0.39) Max OC (C/O: 0.54)

T = -45°C

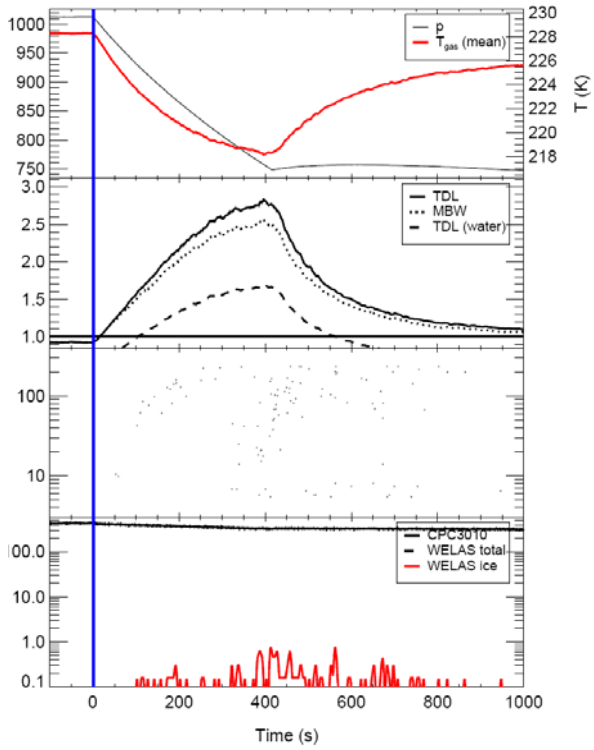
IN11-22, P2 40%



IN11-39, P2 95%



IN11-28, P2 90%

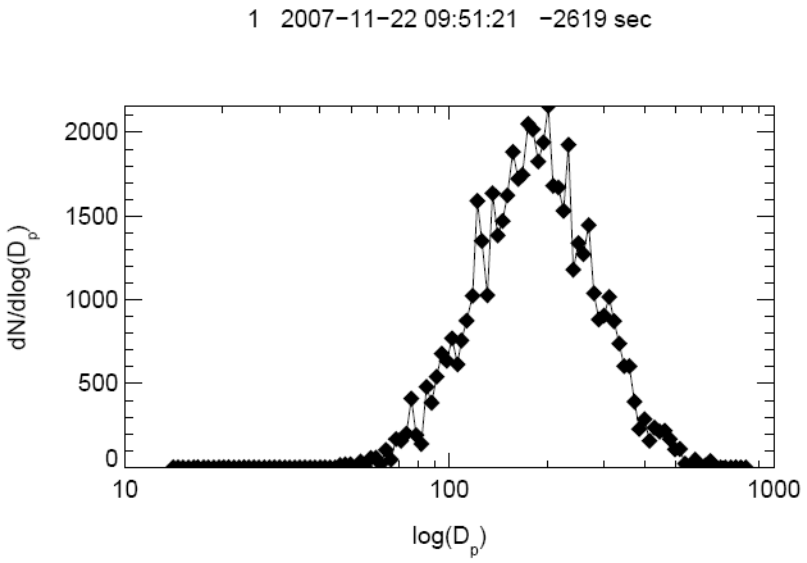


Organic carbon content

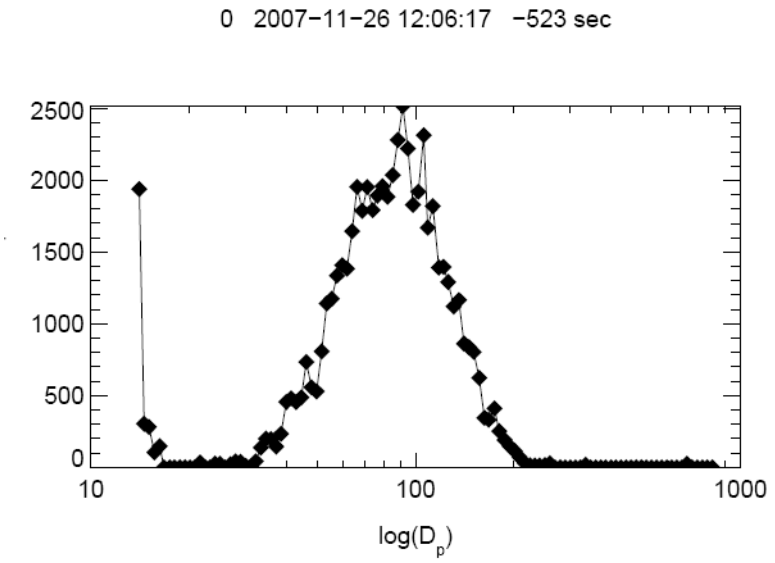
Ice nucleation activity

Size Distributions of CAST soot (SMPS measurement)

IN11-20 (low OC)

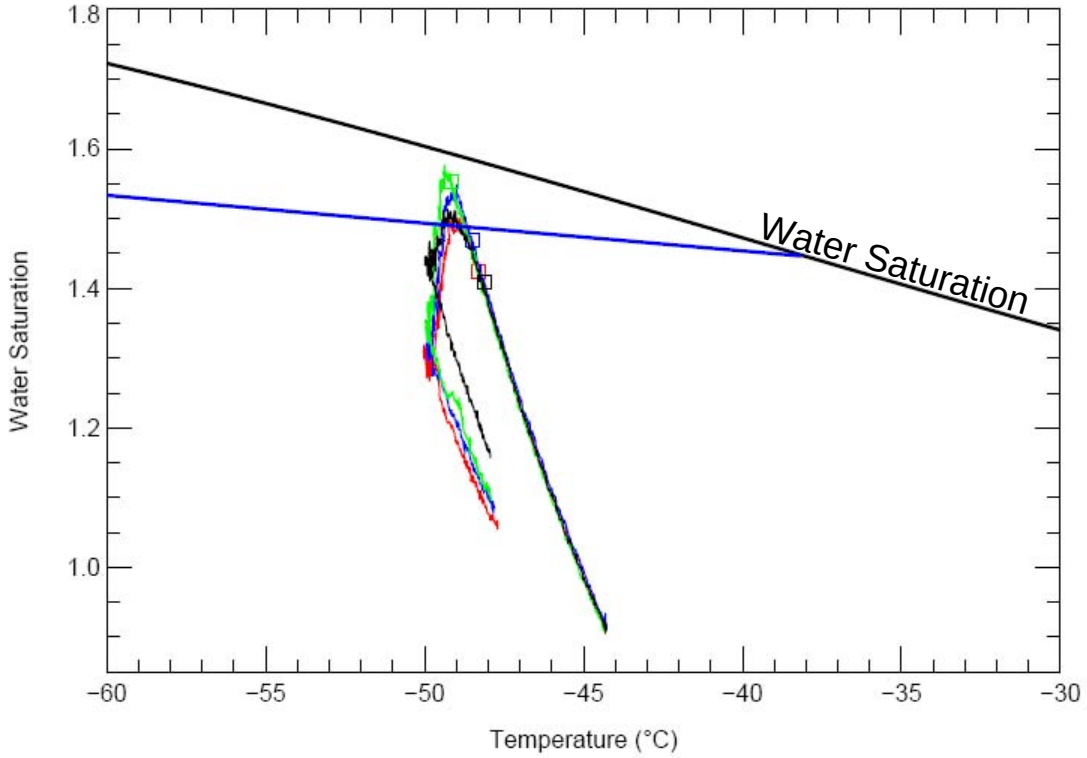


IN11-37 (high OC)



Möhler et al., 2005: “ … increasing amount of OC condensing on the soot particles causes the initial aggregate structure to collapse to more compact particles with smaller mobility equivalent diameter … ”

CAST soot (low organic content), coated by sulphuric acid



Uncoated: red + blue

Coated: green + black

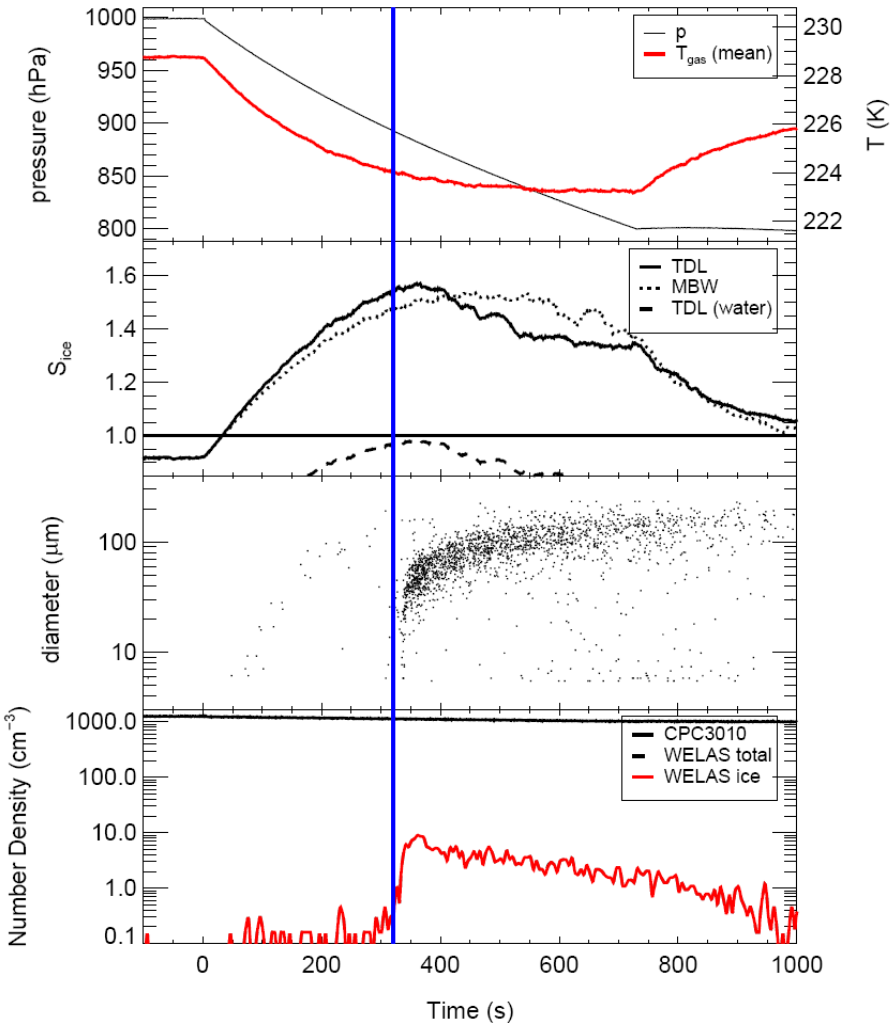
Identical pumping rate (P2 40%)

IN11-24: C = 1260 cm^{-3} , ice active fraction: 0.5%, Ice onset: T = -49.1°C/S_{ice}= 1.55

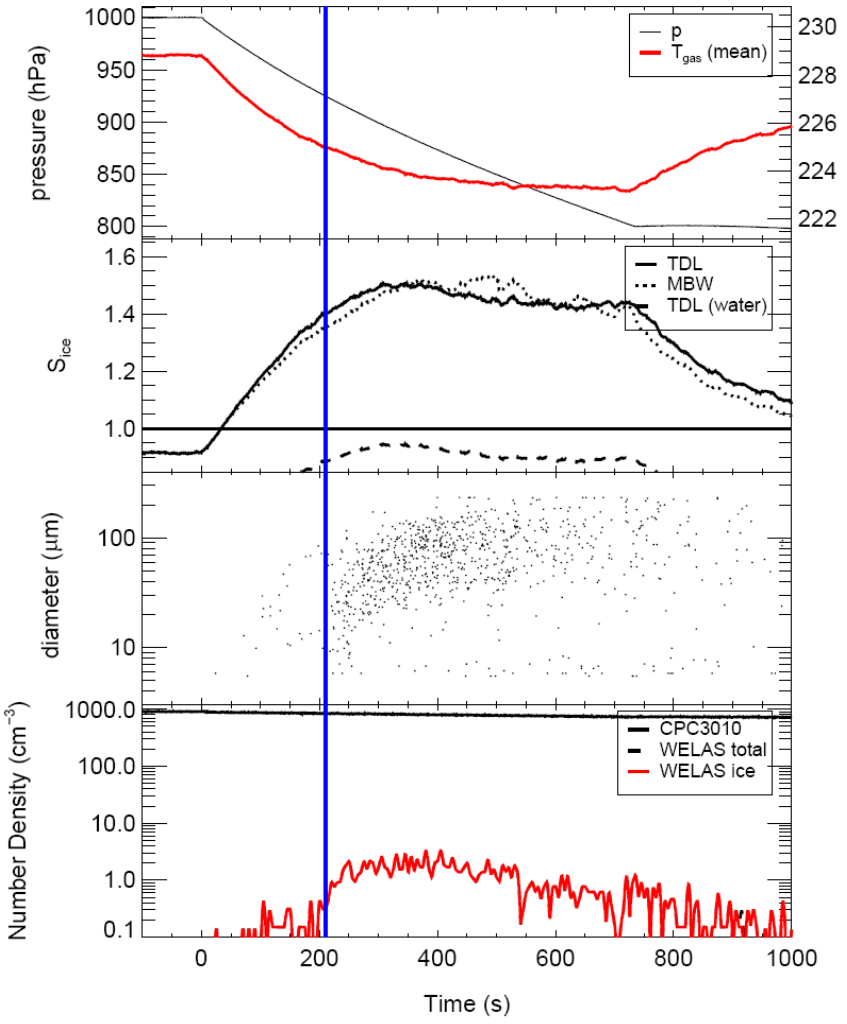
IN11-25: C = 910 cm^{-3}, ice active fraction: 0.2%, Ice onset: T = -48.1°C/S_{ice} = 1.40

Comparison reveals no clear picture of whether soot particles act more effective as IN in the deposition or immersion mode

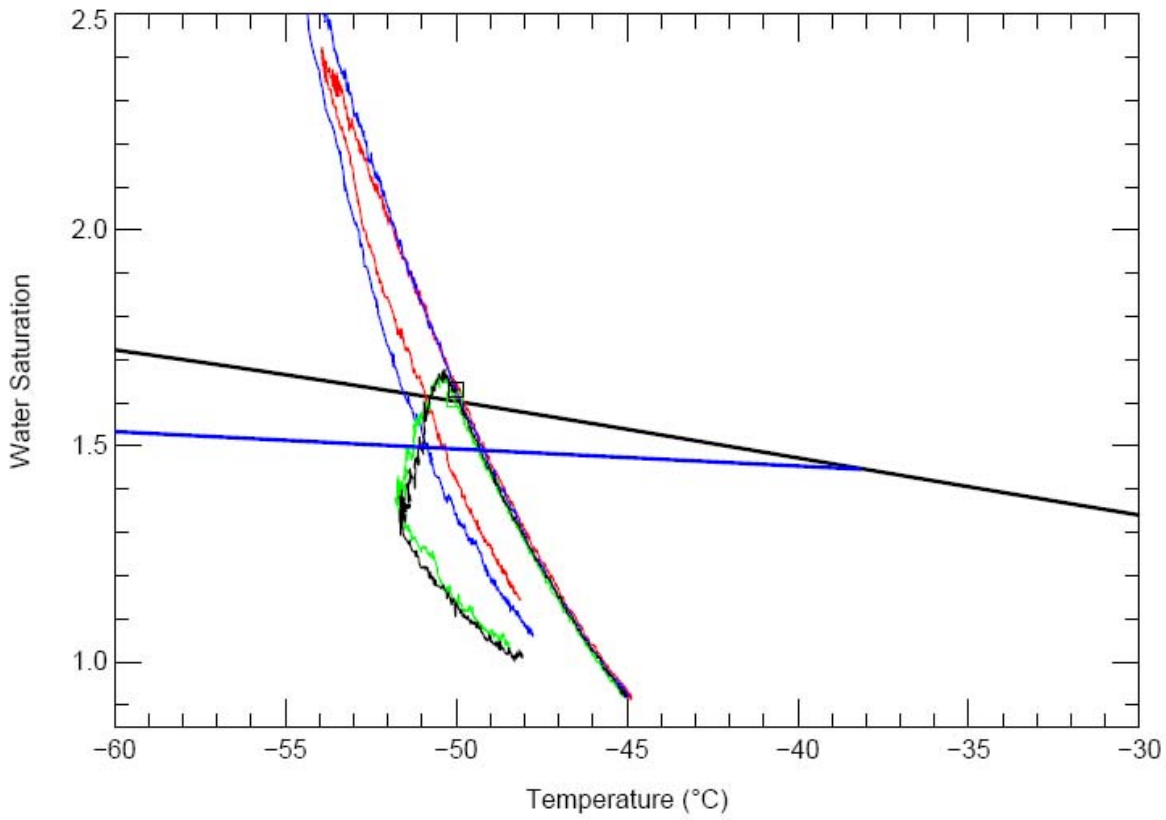
IN11-24



IN11-25



CAST soot (medium organic content), coated by sulphuric acid



Uncoated: red + blue

Coated: green + black

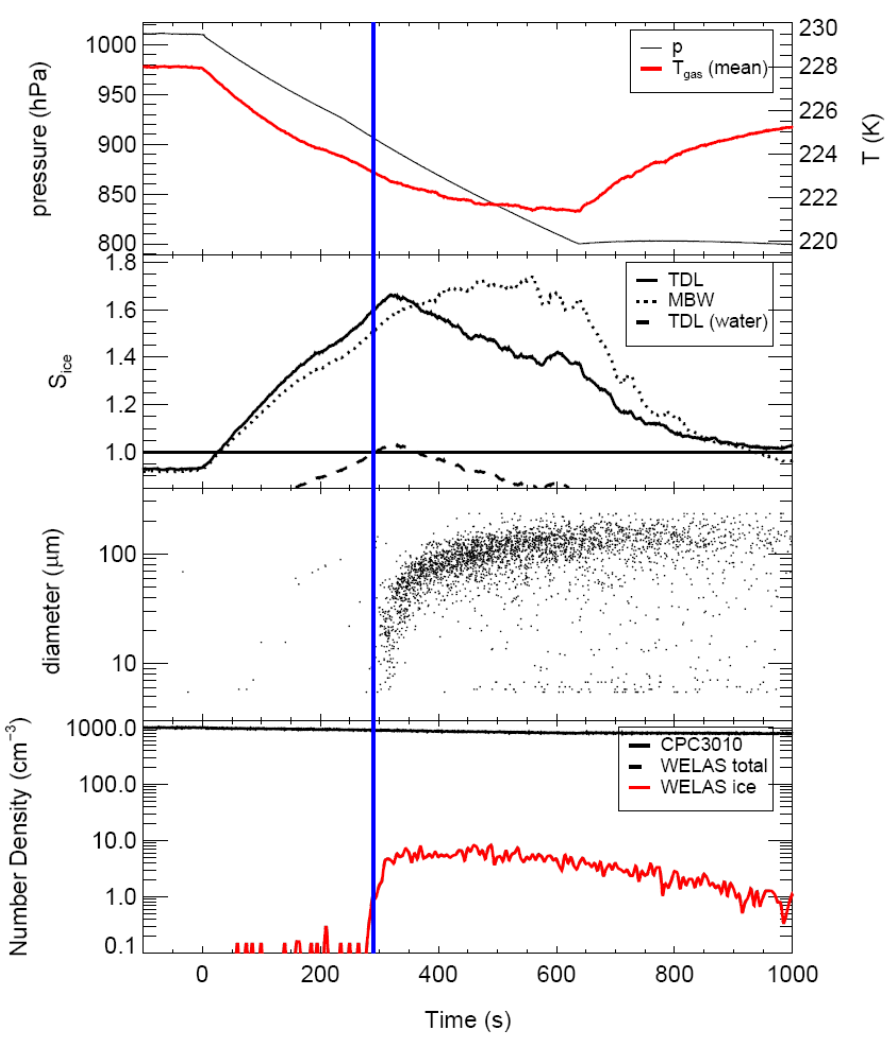
First Experiment: P2 40%

Second Exp.: P2 50%

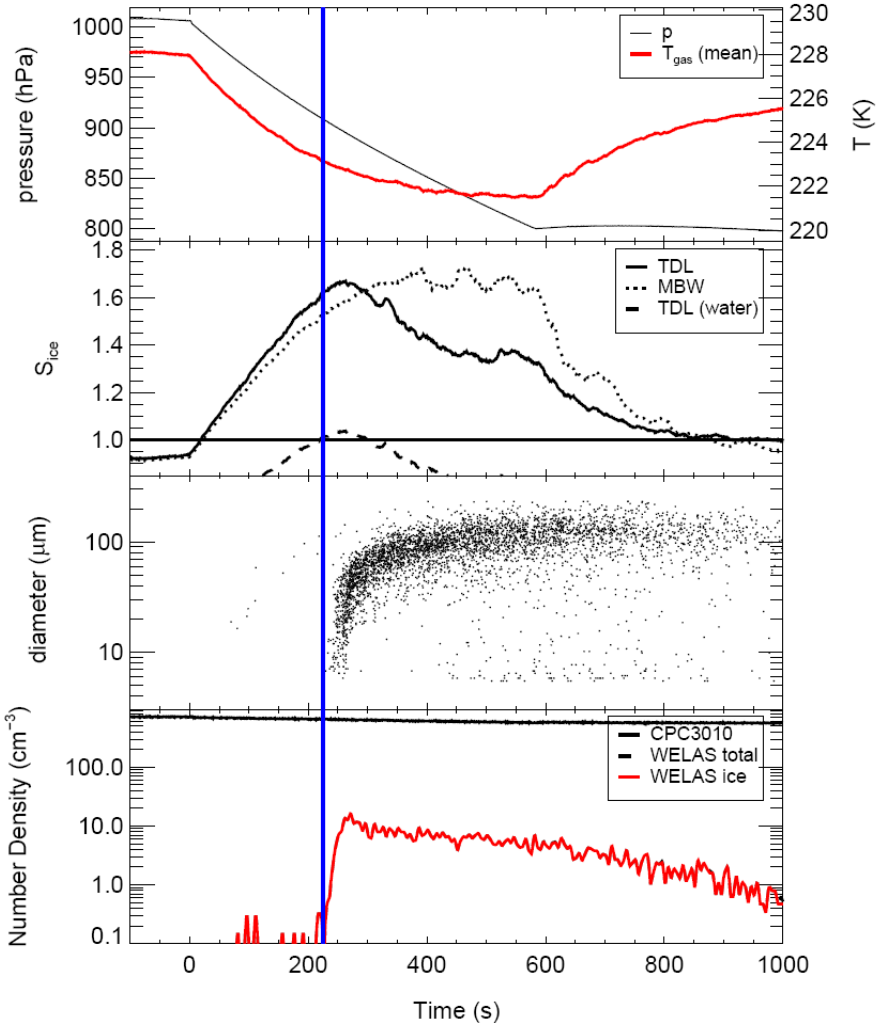
IN11-34: C = 1000 cm^{-3} , ice active fraction: 0.6%, Ice onset: T = -50.0 °C/$S_{ic\ e}$= 1.60

IN11-35: C = 720 cm^{-3}, ice active fraction: 1.2%, Ice onset: T = -50.0 °C/S_{ice} = 1.62

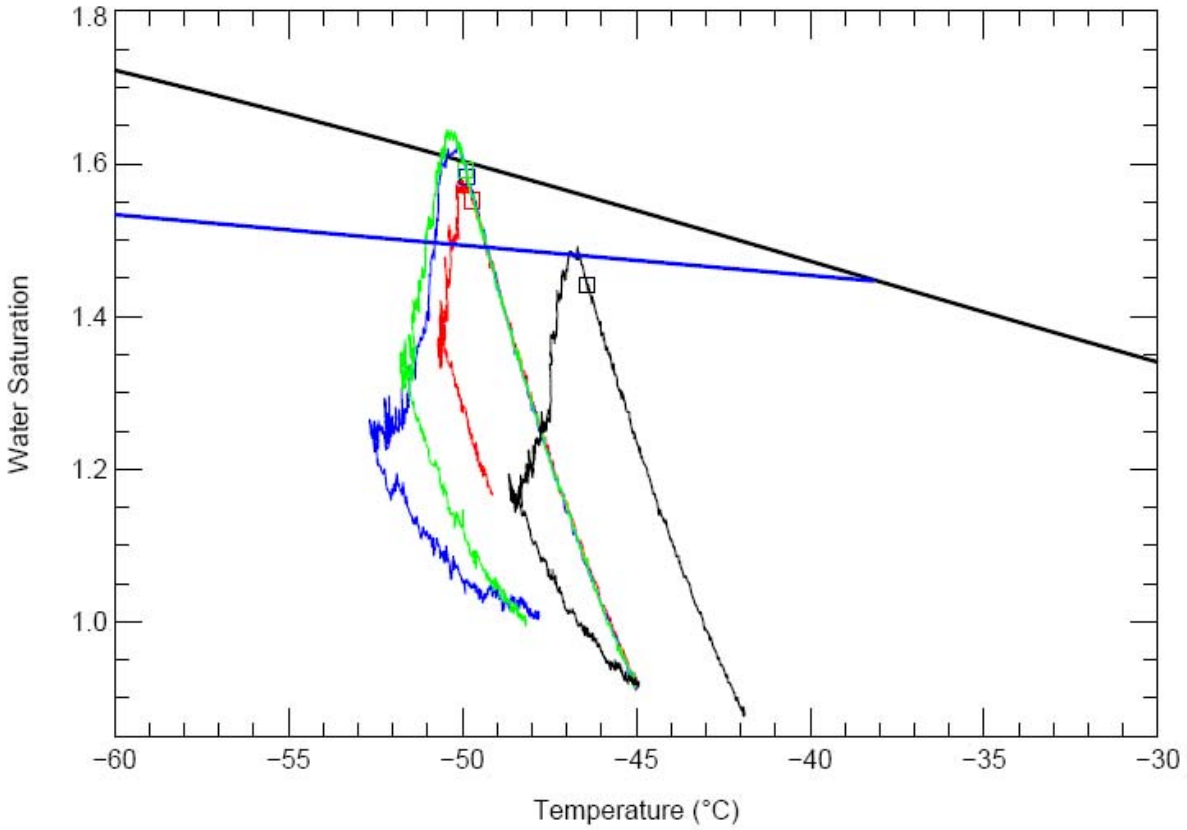
IN11-34



IN11-35



CAST soot (high organic content), coated by sulphuric acid



H_2SO_4-coated soot: red, blue, green

H_2SO_4/H_2O: black

P2 40%

P2 60%

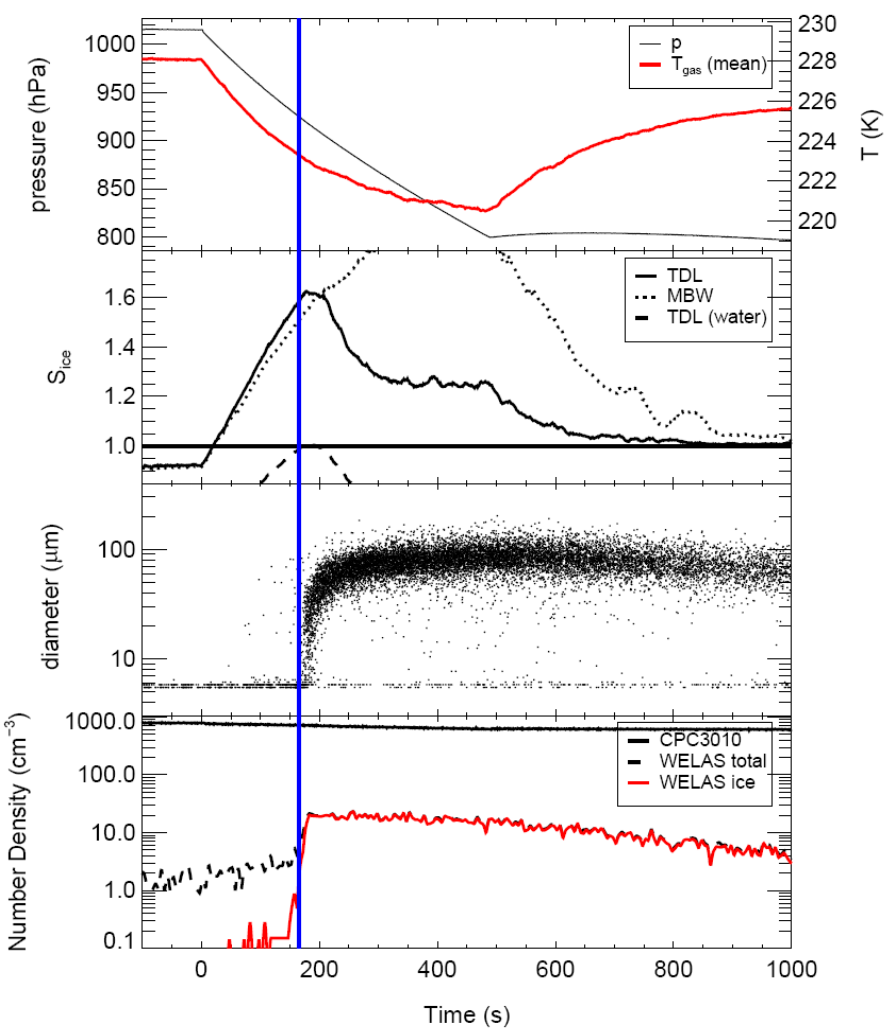
P2 50%

IN11-30: C = 1150 cm-3, ice active fraction: 0.4%, Ice onset: T = -49.7°C/Sice = 1.56

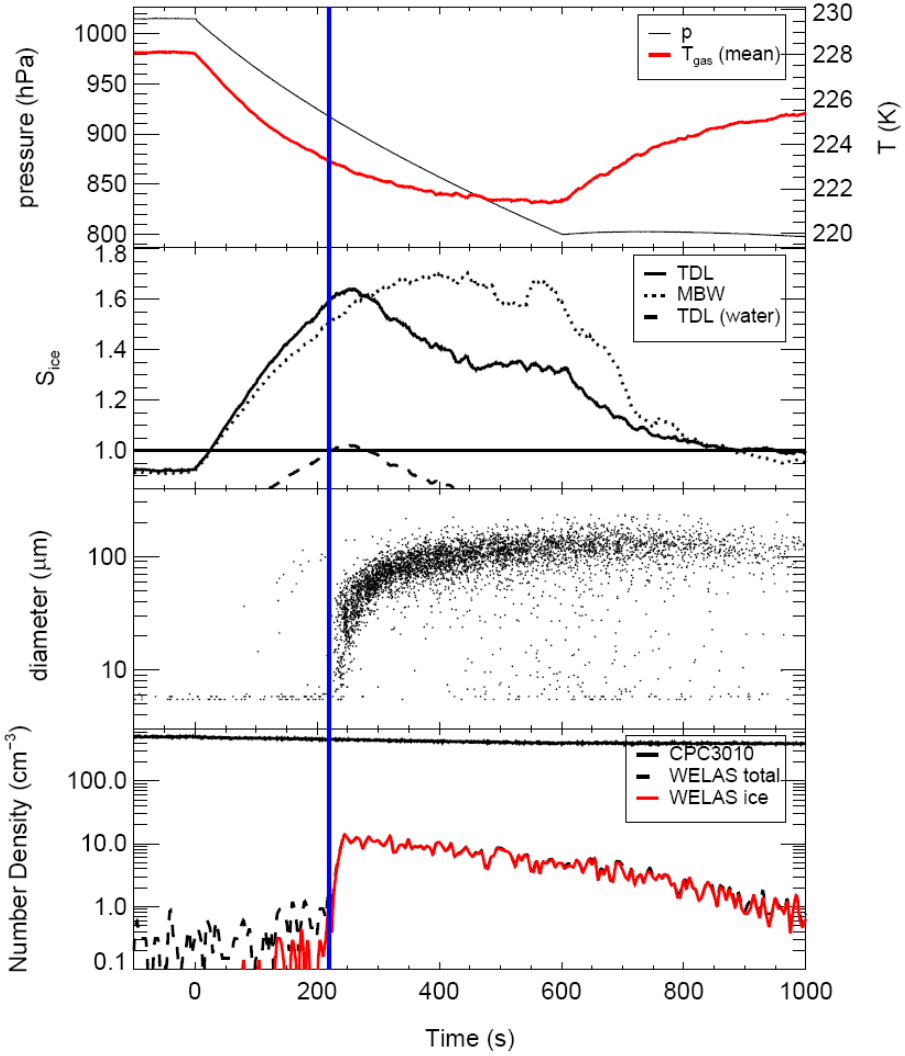
IN11-31: C = 790 cm-3, ice active fraction: 3.0%, Ice onset: T = -49.8°C/Sice = 1.58

IN11-32: C = 510 cm^{-3} , ice active fraction: 2.4%, Ice onset: T = -49.9°C/S_{ice}=1.59

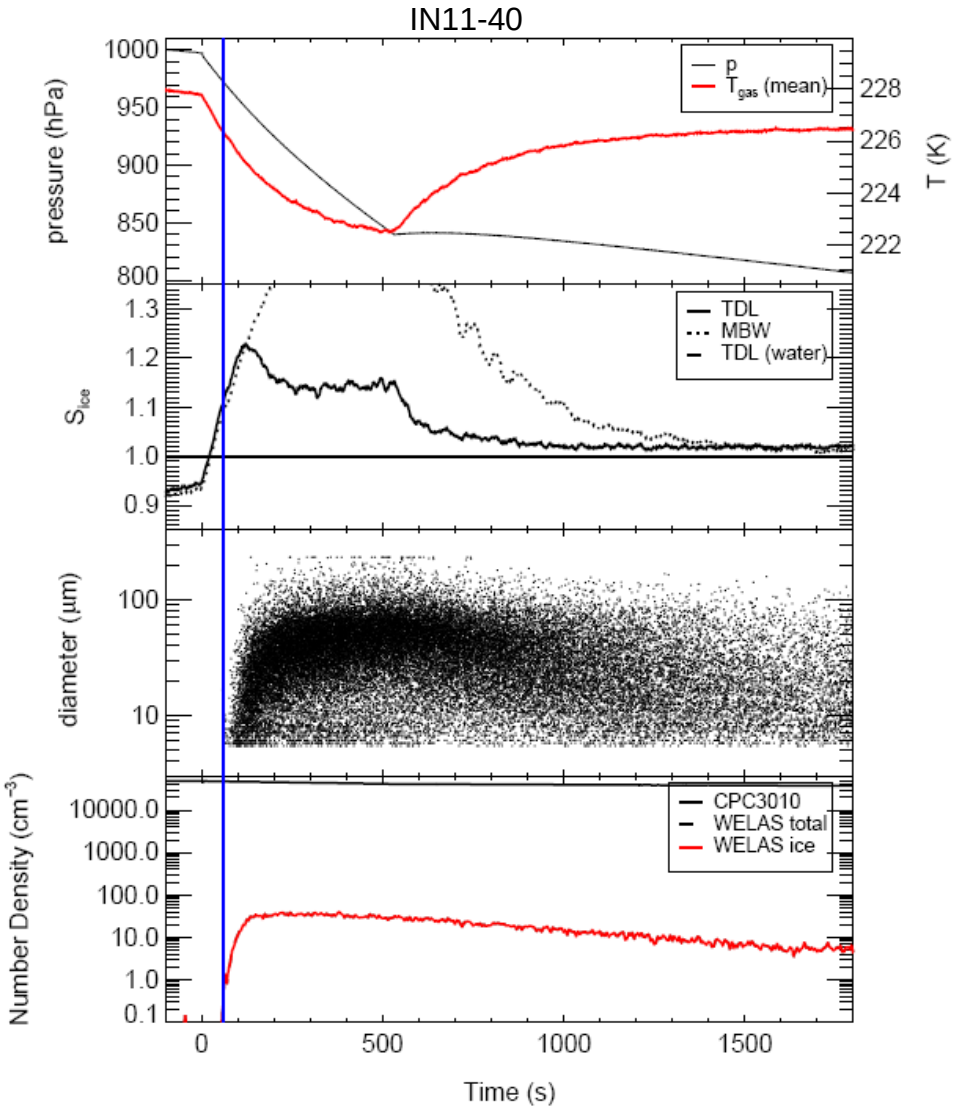
IN11-31



IN11-32

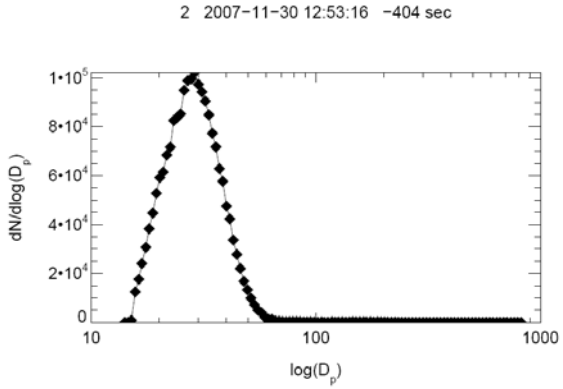


First experiments with oxalic acid (30/11/07)



Synthetic air was passed over Oxalic Acid Dihydrate (heated up to 120°C in a glass tube) and injected into the cold AIDA (time period: 2h)

C = 40 000 P/cm^3



S_{ice} = 1,11
T_{ice} = -46.8°C
f_{ice} = 0.08%

Summary of AIDA results

In two weeks of experiments the IN properties of pure and coated soot aerosol particles were examined :

Flame soot from CAST with different OC/EC ratio

Increasing amount of OC seems to suppress ice nucleation via the deposition mode

Sulphuric acid coating of soot particles with low OC fraction reveals no clear effect on ice nucleation whereas soot particles with higher OC ratio act as IN in the immersion mode near water saturation

Soot from spark discharge generator GfG-1000

Used carrier gas seems to affect the IN properties of spark discharge soot particles (Argon and Nitrogen)

Succinic acid coating of soot particles (Ar) shifts onset value of temperature towards a lower value and of ice saturation ratio to a higher value