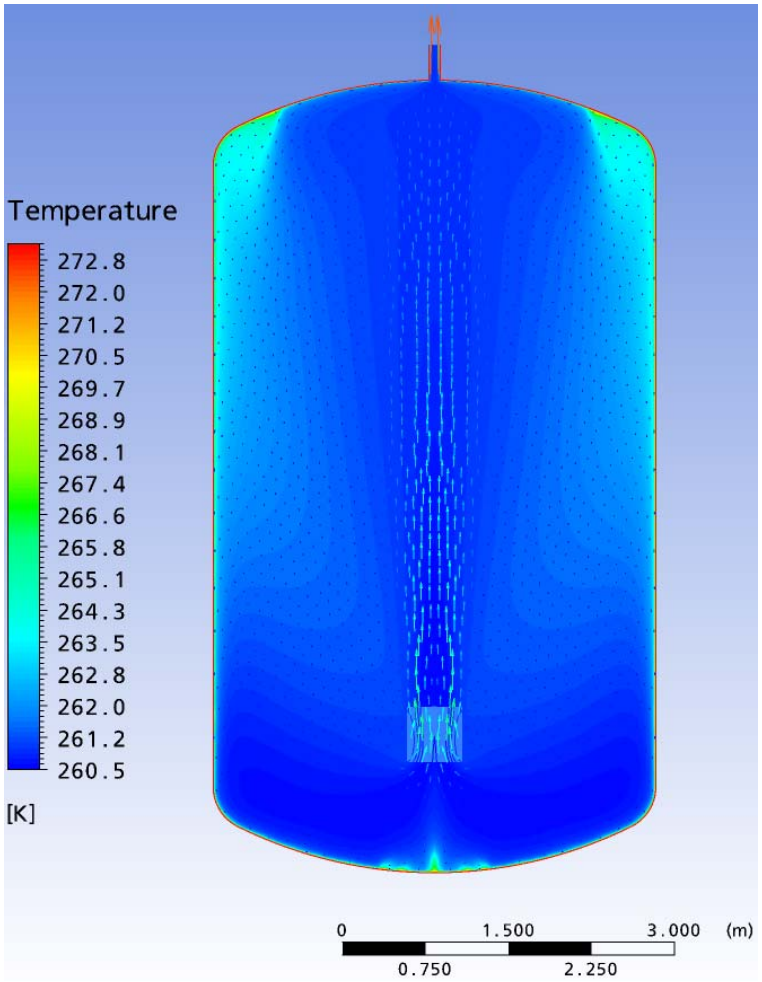
1) Overview of AIDA campaign IN11 (Nov. 07)
2) Testing a new parameterisation of sulphuric acid aerosol freezing by means of the process model MAID



PART 1

Overview IN11

Objectives

- Investigate the relationship between hygroscopic/CCN properties and ice nucleation ability of coated and uncoated soot particles.
- Investigate the effect of carrier gas Argon or Nitrogen on GfG soot properties

Participants

FZ Karlsruhe, AIDA team: AIDA, NAUA
IfT Leipzig, Silvia Henning, Markus Ziese. LACIS field, CCN counter
FZ Jülich, T. Mentel, C. Spindler, A. Buchholz: AMS, HTDMA, CCN
Univ. Manchester, Ian Crawford, Johnny Crosier, James Dorsey : AMS, SP2, CPI
LaMP Clermont-Ferrand, Vincent Michaud, Marie Monier: VHTDMA
ETH Zürich, P. Amsler: HOLIMO
A. Trimborn (Aerodyne Research Inc): AMS

Aerosols examined:

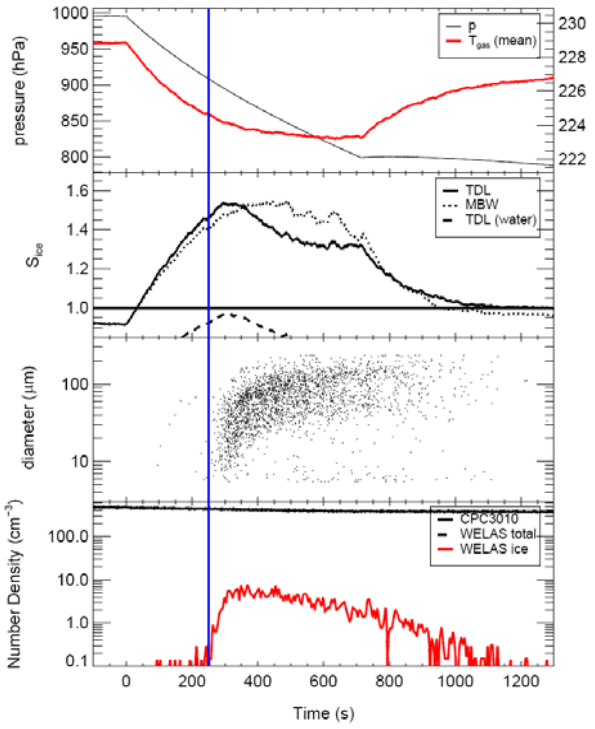
- Soot aerosol from spark discharge generator (Ar and N)
- Soot aerosol (GfG Ar) coated by succinic acid
- Flame soot aerosol (CAST, different ratio C/O)
- Flame soot aerosol (CAST, different ratio C/O) coated by sulphuric acid

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

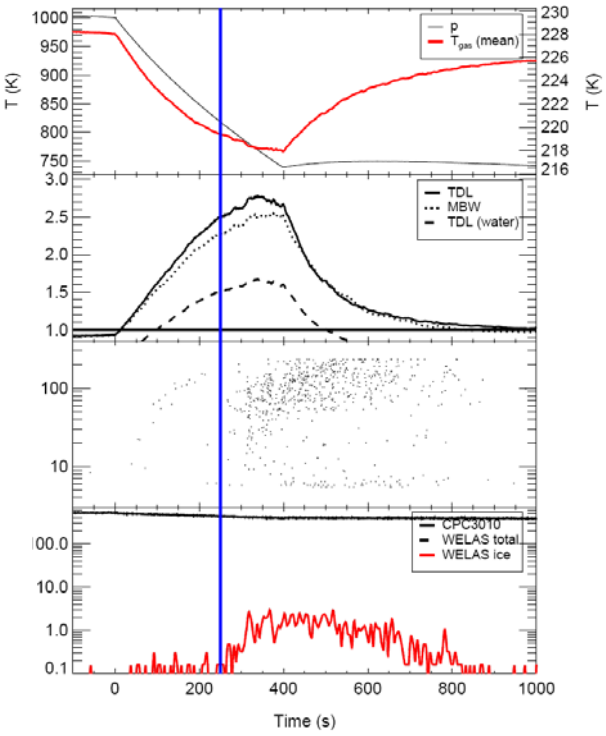
Min OC (C/O: 0.28) Med OC (C/O: 0.39) Max OC (C/O: 0.54)

T = -45°C

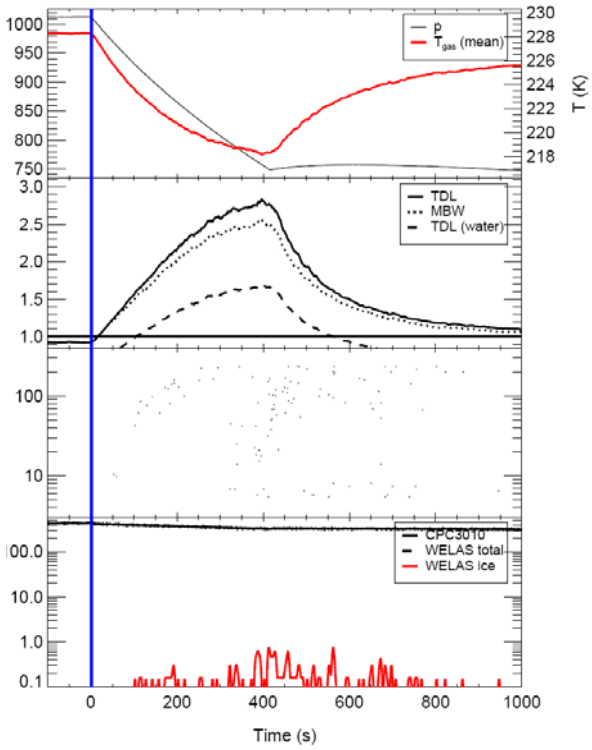
IN11-22, P2 40%



IN11-39, P2 95%



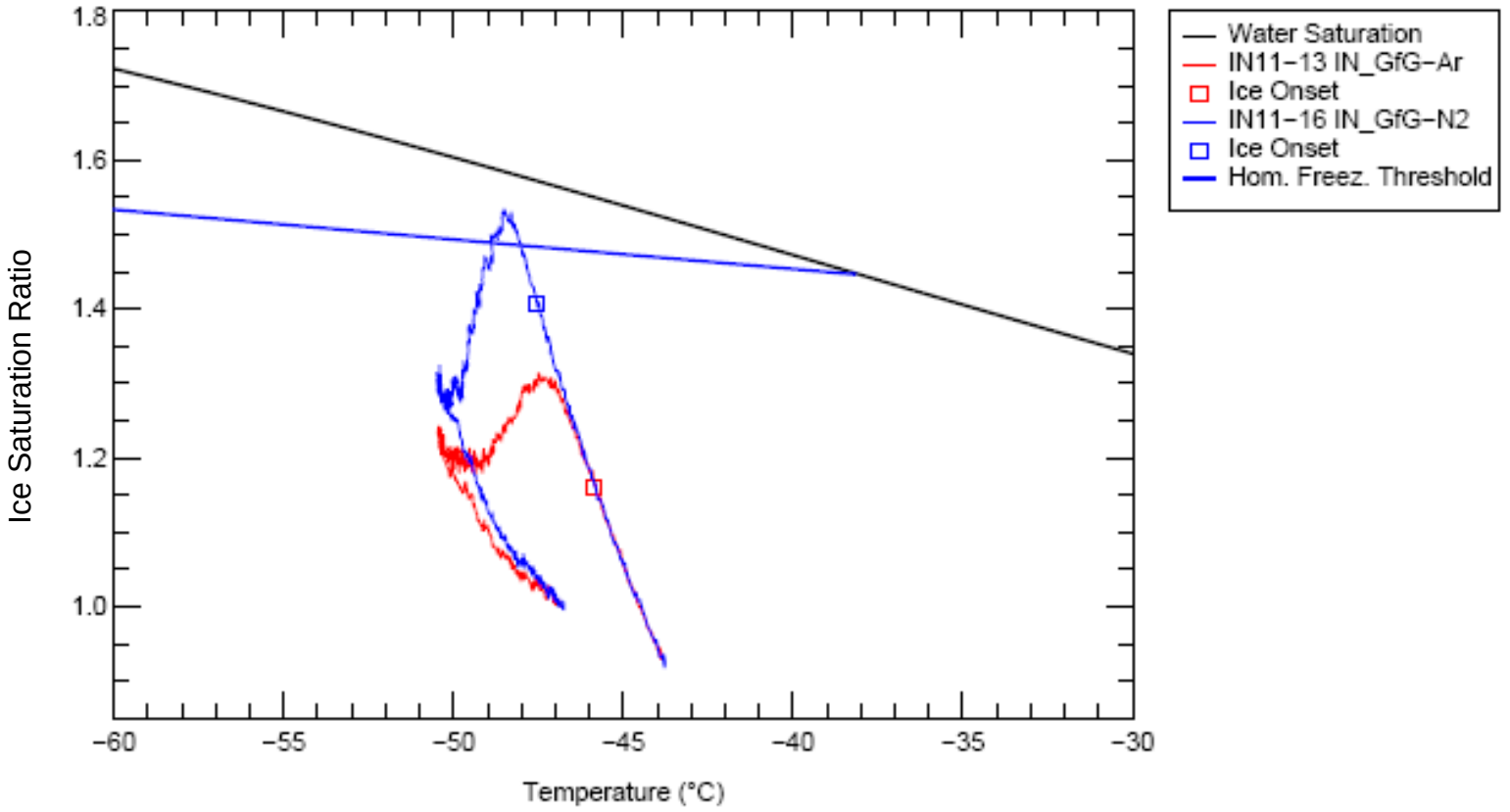
IN11-28, P2 90%



Organic carbon content

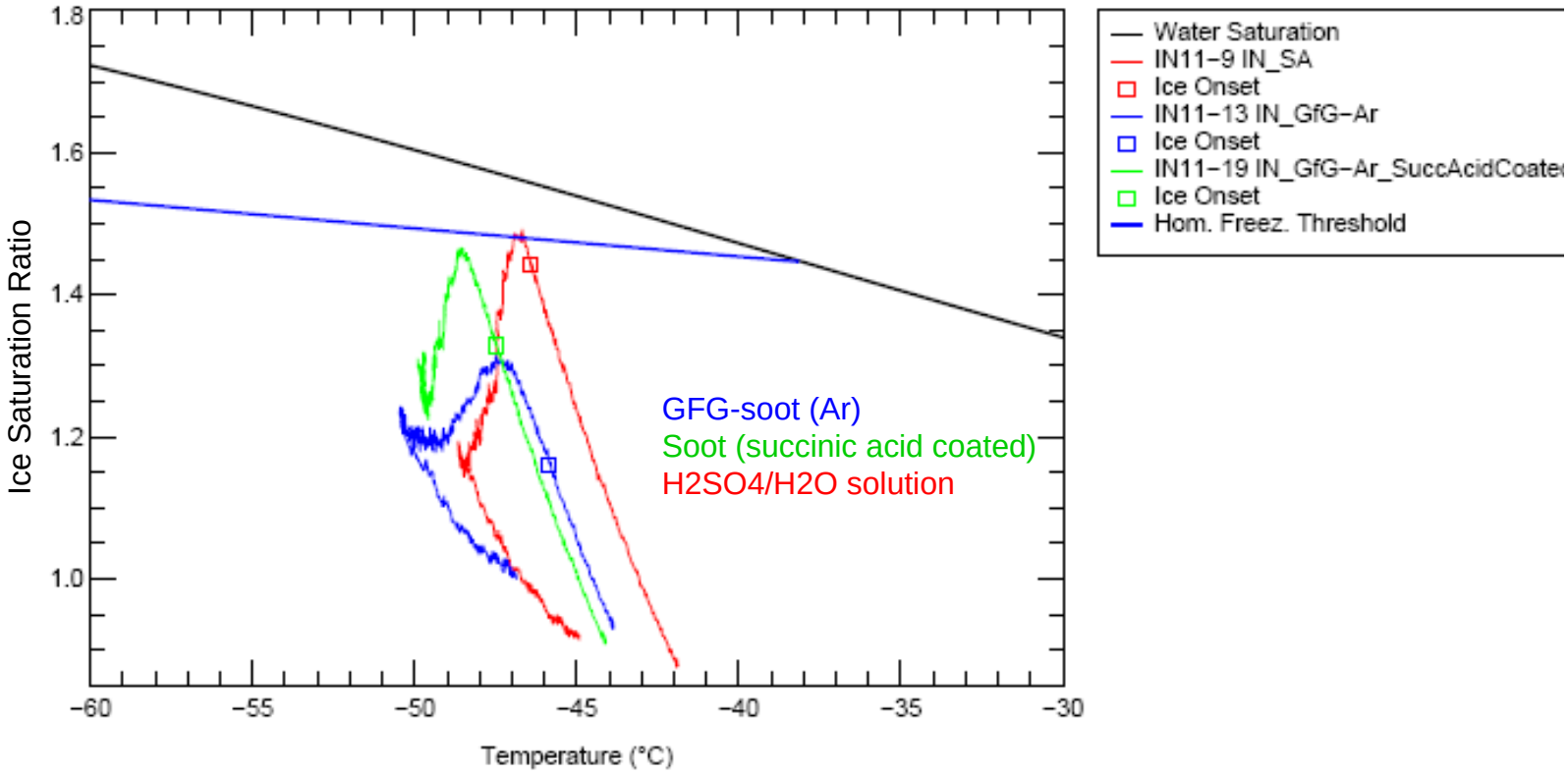
Ice nucleation activity

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

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)

Summary of AIDA results IN11

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

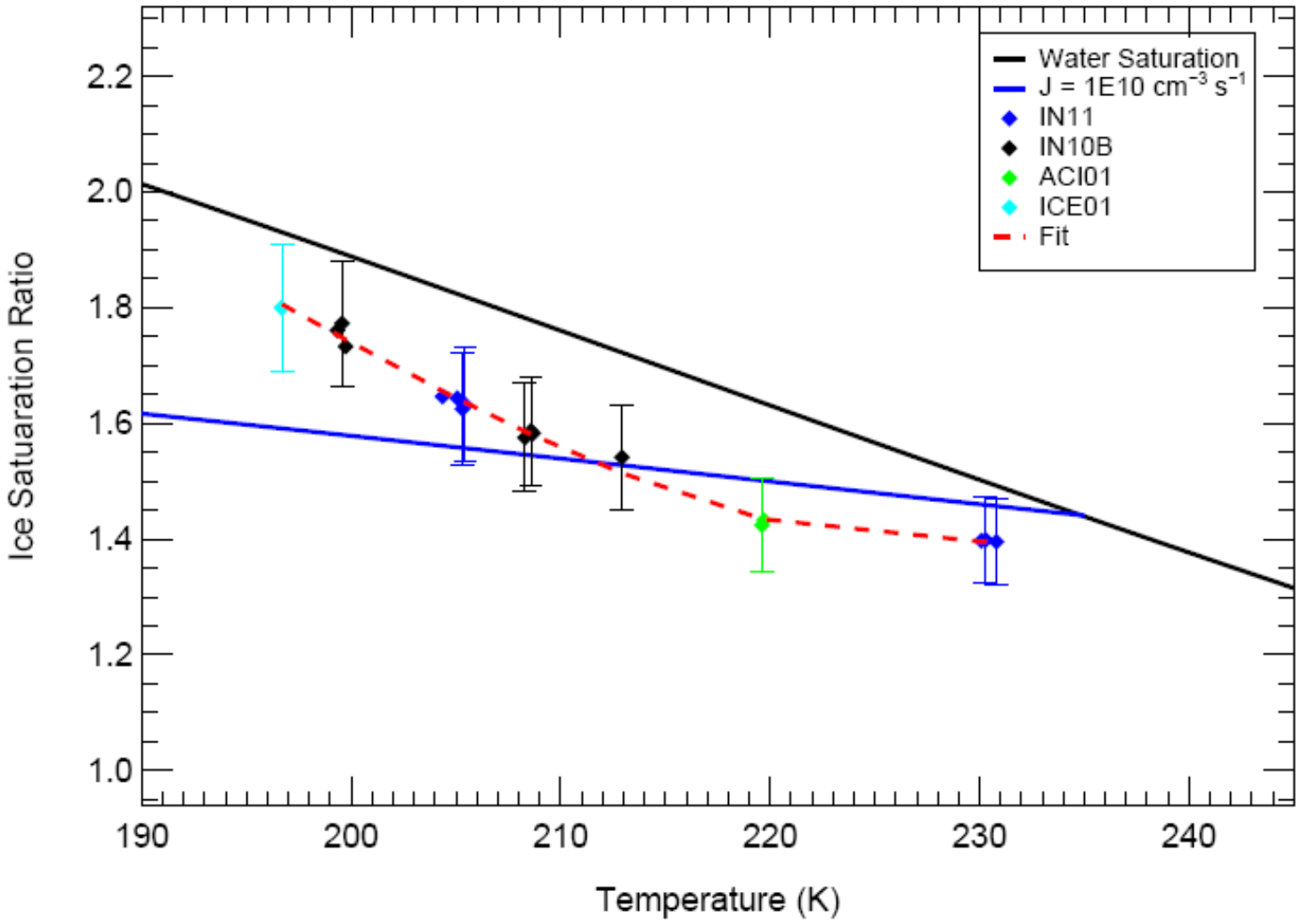
Soot from spark discharge generator GfG-1000

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

PART 2

Onset of homogeneous ice nucleation in sulphuric acid aerosol in AIDA experiment

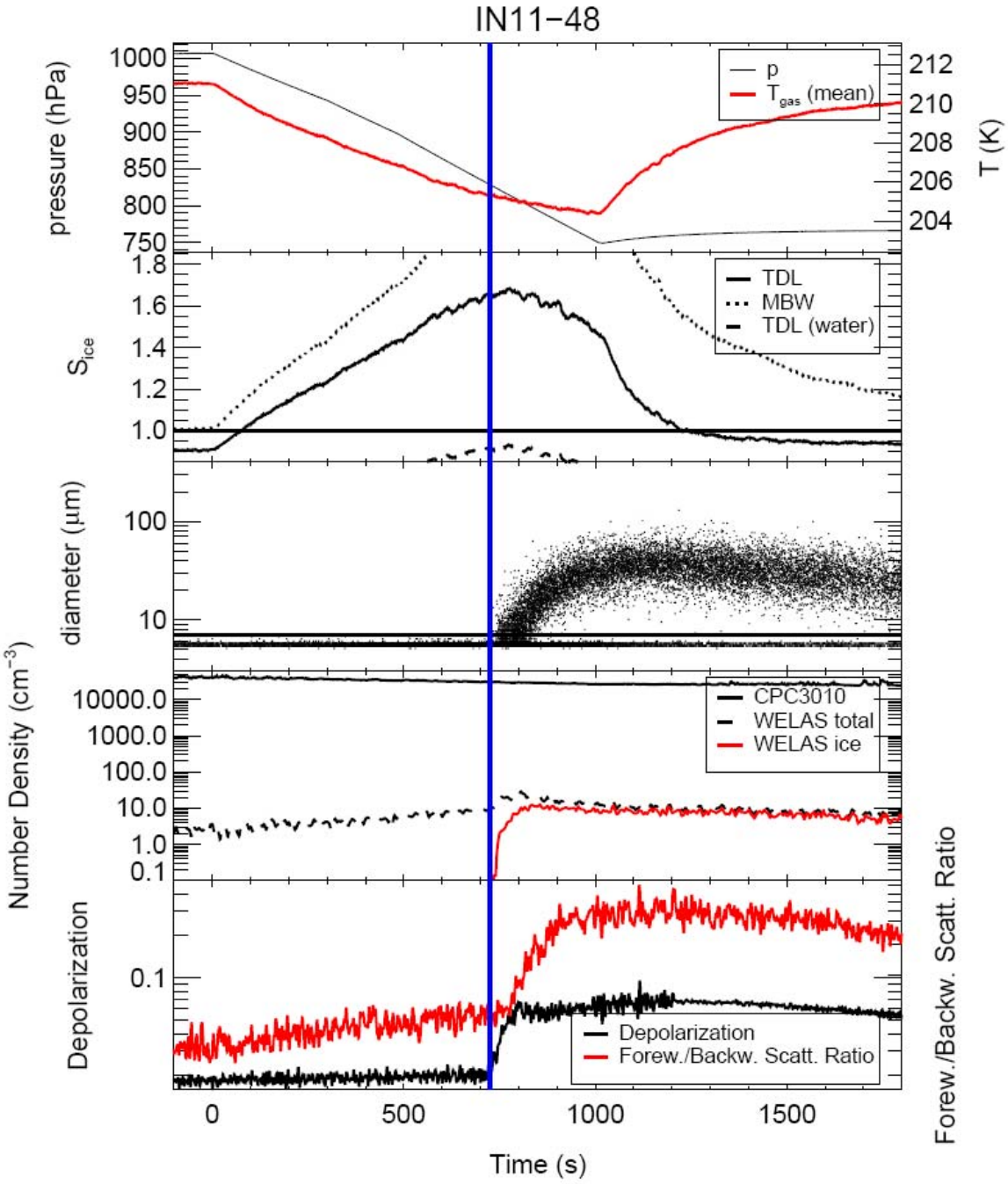


Pressure/Temperature

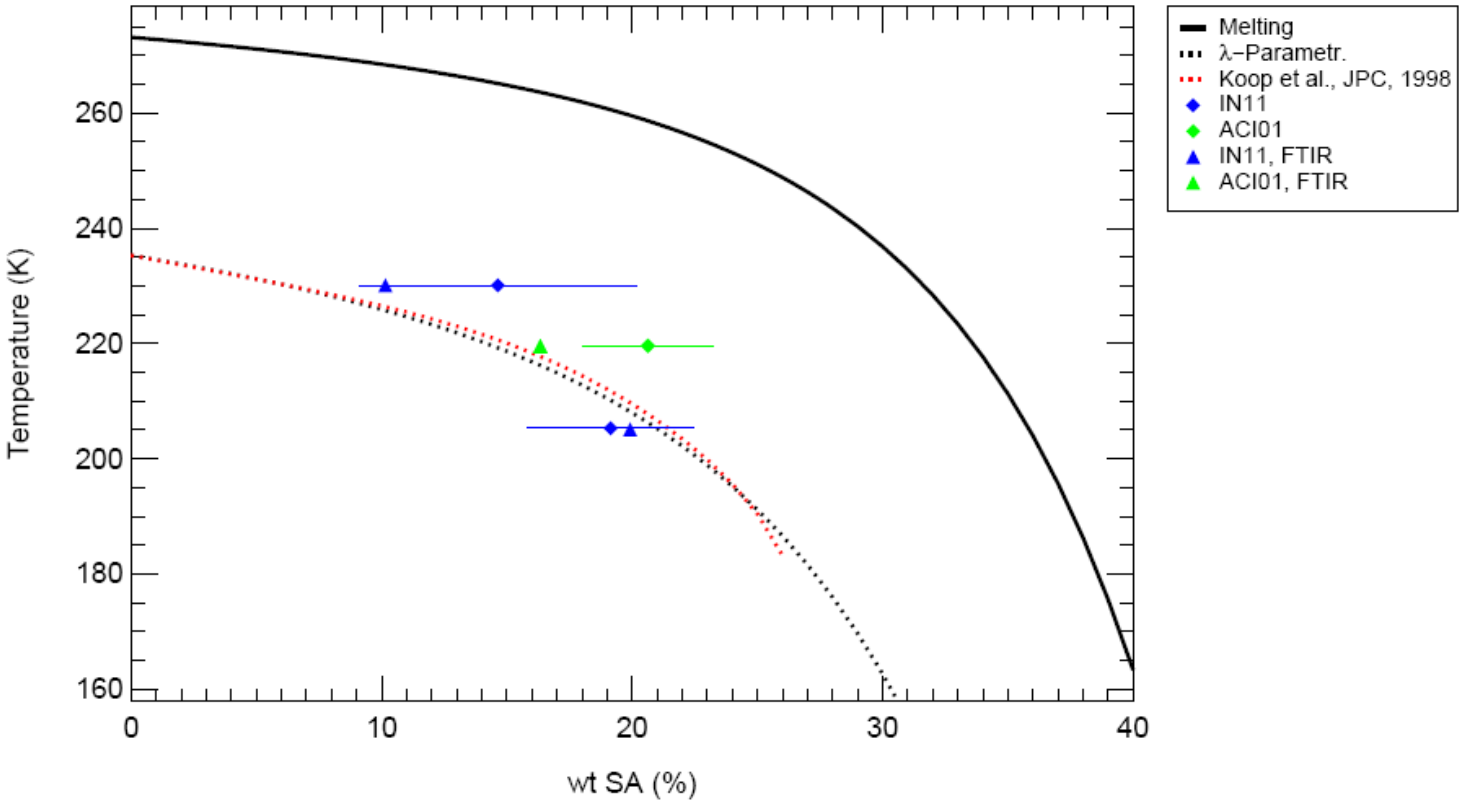
Ice Saturation Ratio

WELAS OPC

SIMONE

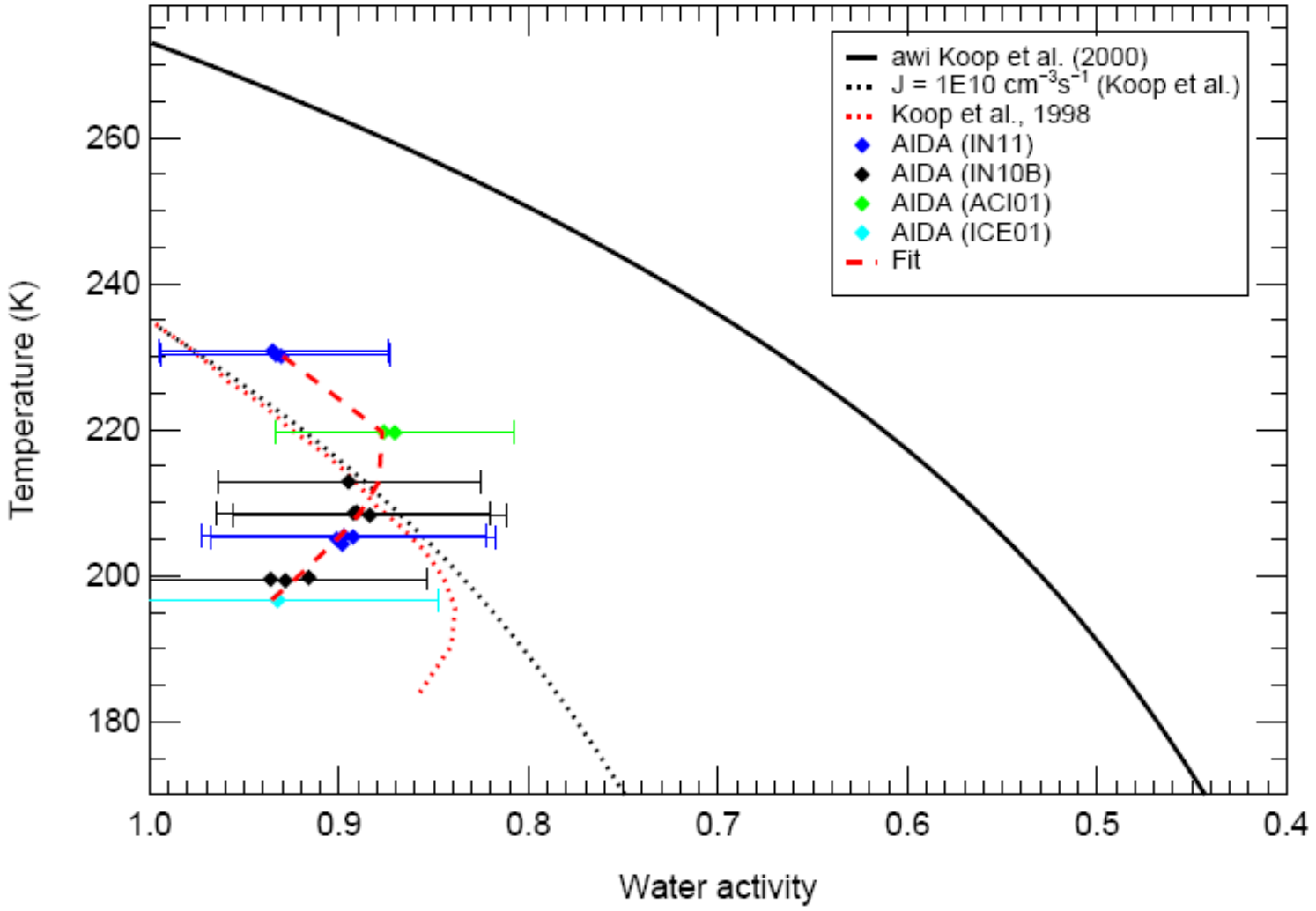


Composition of freezing SA aerosol particles inferred from FTIR spectra (by Robert Wagner) and from WELAS, TDL + AIM model

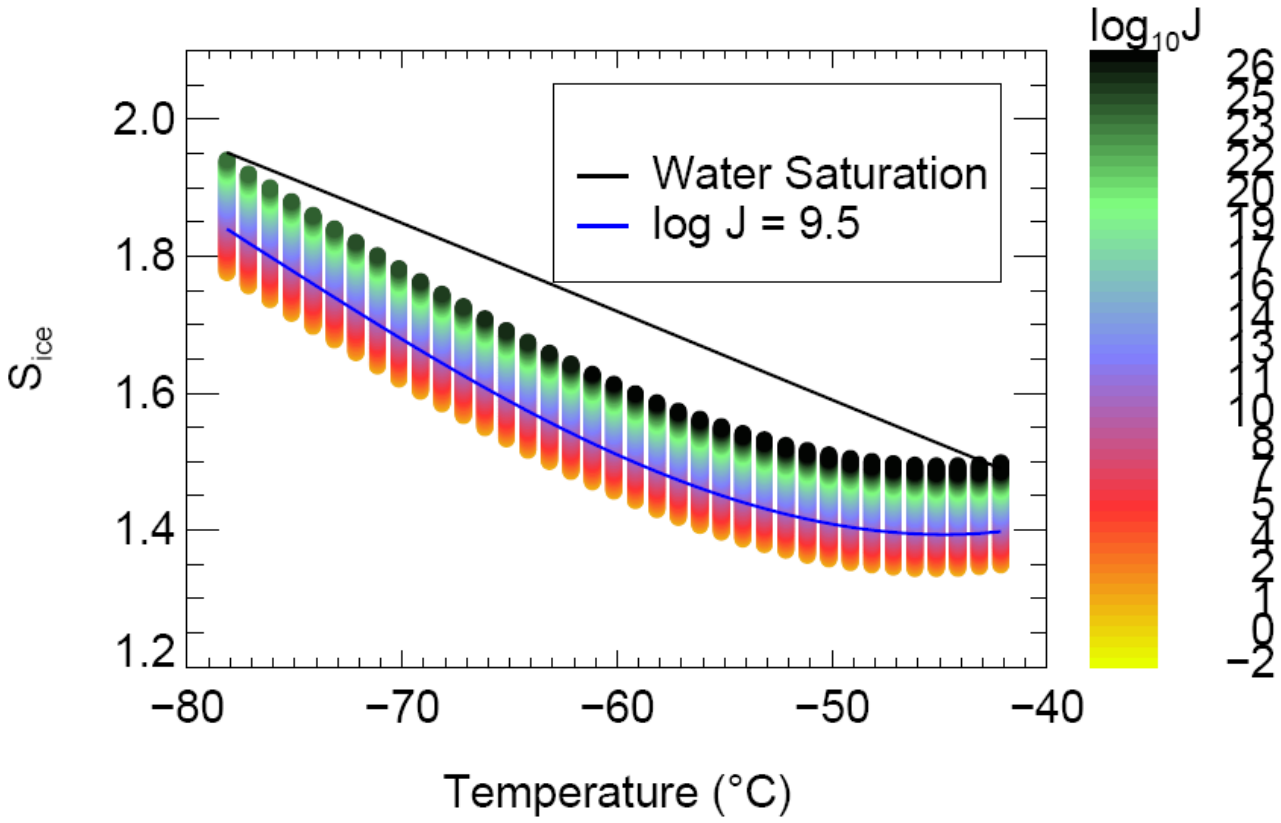


R. Wagner et al., "Infrared Optical Constants of Highly Diluted Sulfuric Acid Solution Droplets at Cirrus Temperatures" **Phys. Chem. A, 2008**

Onset conditions for homogeneous ice nucleation in SA aerosol in AIDA experiments



Parameterising the homogeneous ice nucleation rate in sulphuric acid aerosol

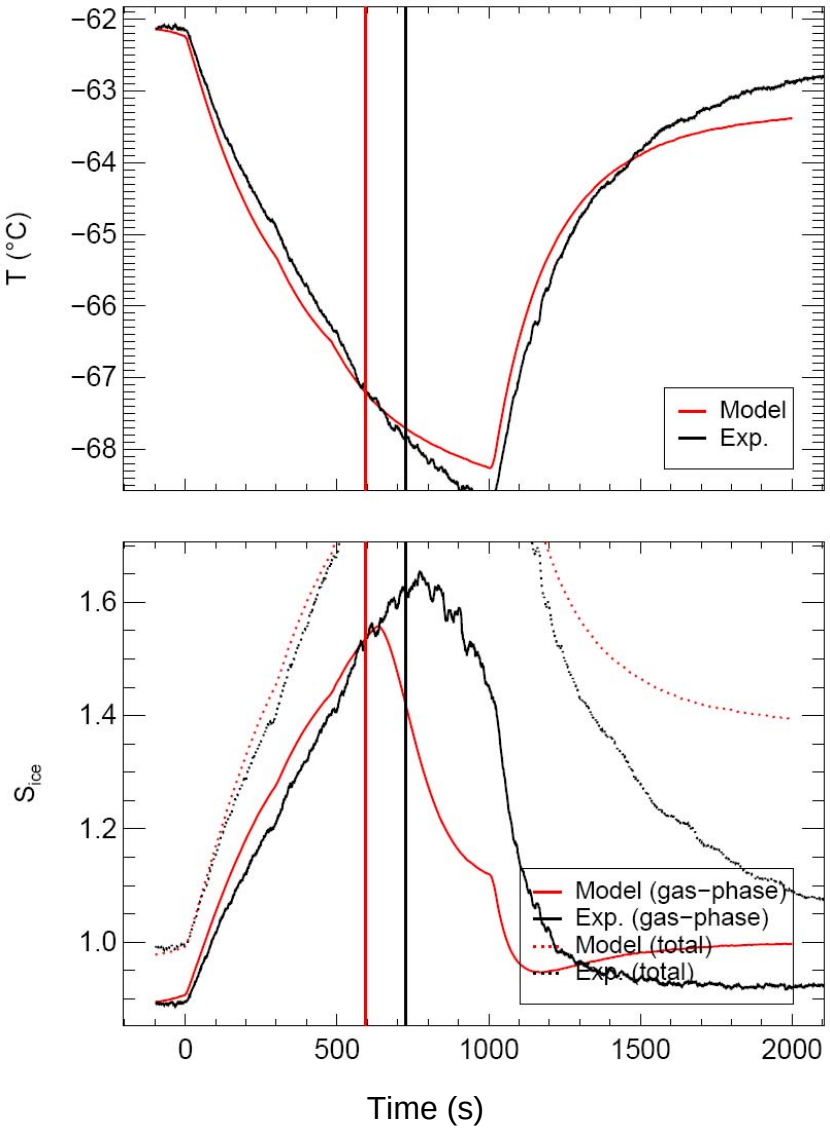


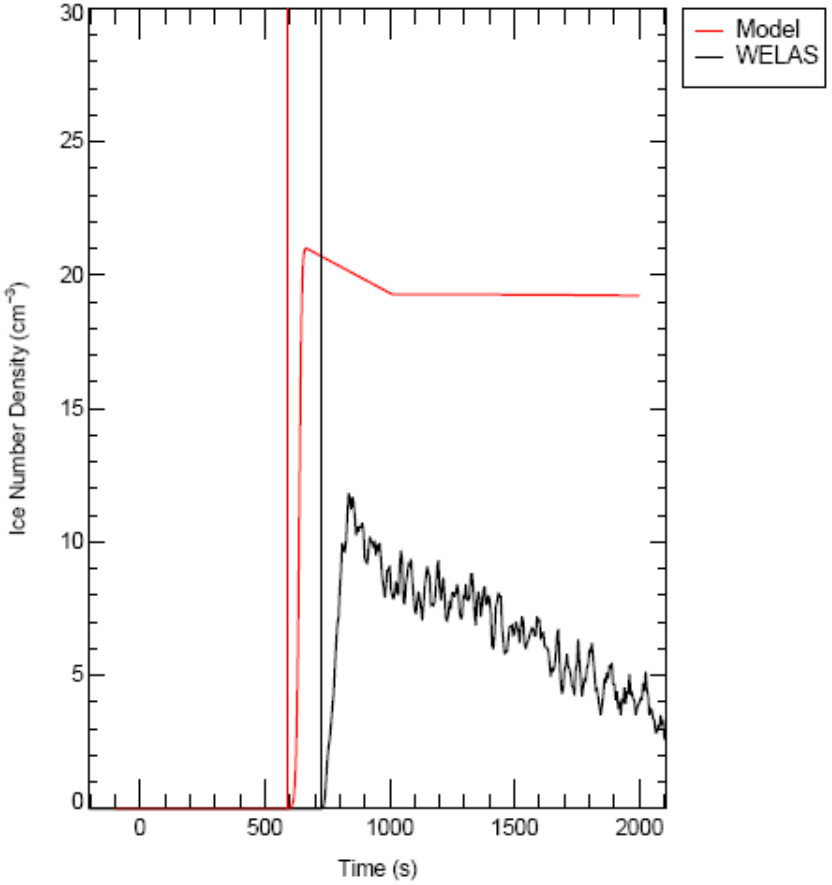
2d polynomial fit to surface provides parameterisation for J with $J=J(T,S_{ice})$ suitable for proving with process model MAID

$$\log J = \sum A_{i,j} T^i S_{ice}{}^j$$

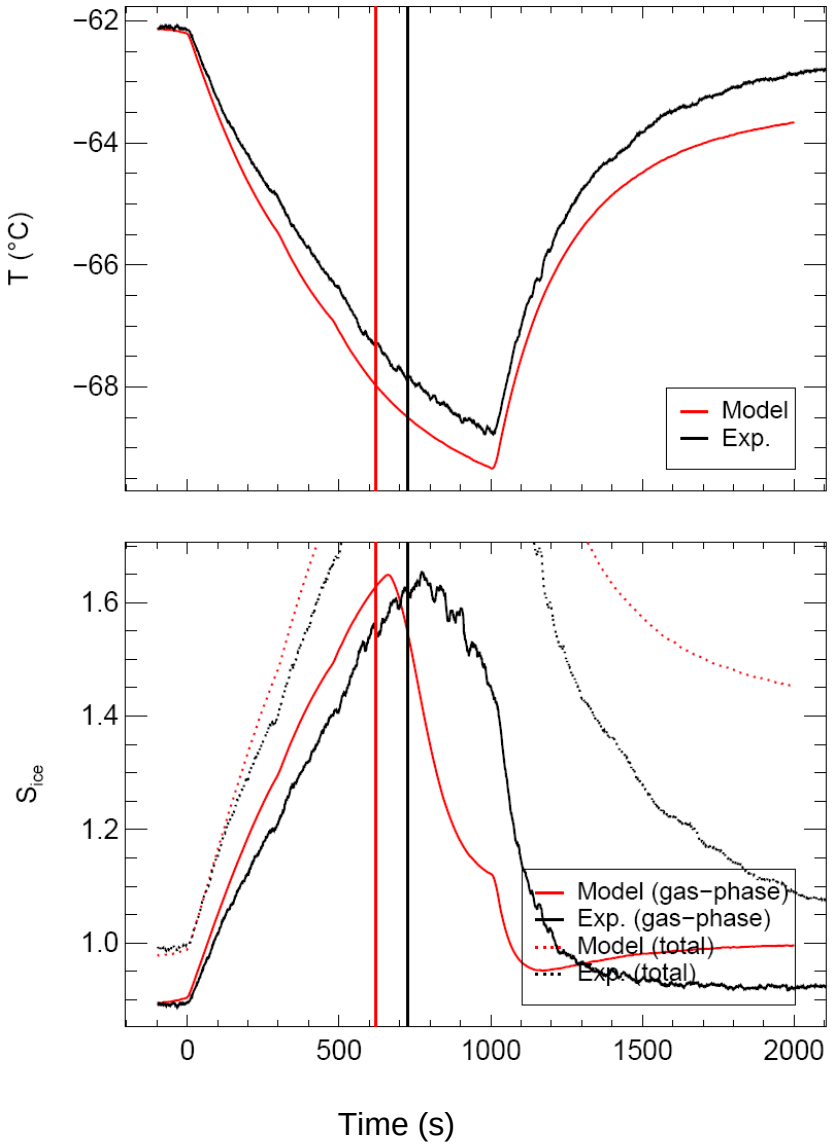
with $A_{i,j} = \begin{pmatrix} -9184.8 & -382.7 & 3194.9 \\ 62.8 & -31.8 & -39.332 \\ -0.0955 & -0.1399 & 0.1151 \end{pmatrix}$

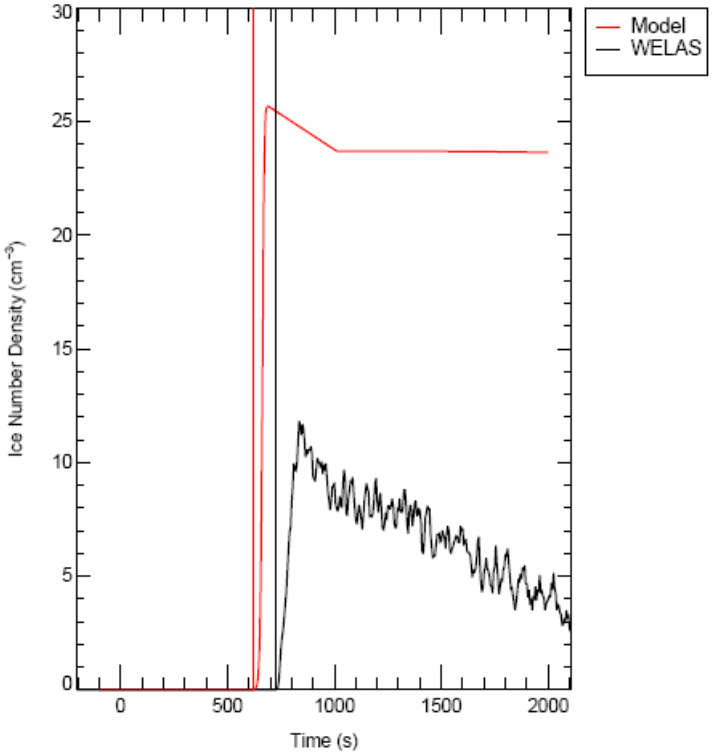
MAID vs. AIDA Exp. IN11-48 (IN parameterisation by T. Koop, Nature 2000)
Freezing of sulphuric acid aerosol ($N_{aerosol}$=12 000 P/cm^3)





MAID vs. AIDA Experiment IN11-48 (New IN parameterisation)
Freezing of sulphuric acid aerosol ($N_{aerosol}$=12 000 P/cm^3)





Summary PART 2

- AIDA freezing experiment with sulphuric acid aerosol show significant differences to literature data (ice onset conditions, ice number density)
- In contrast to data from literature the composition of the freezing particles and the relative humidity could be determined simultaneously and independently in AIDA experiments
- A new IN parameterisations based on AIDA data is currently developed and tested with the aid of the detailed process model MAID