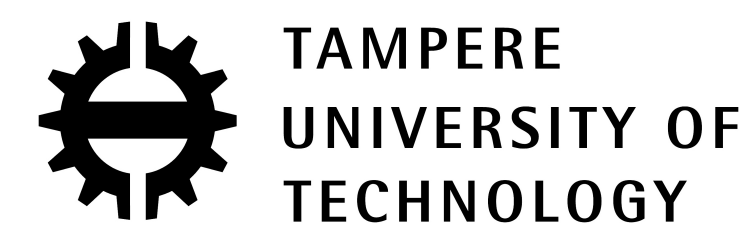


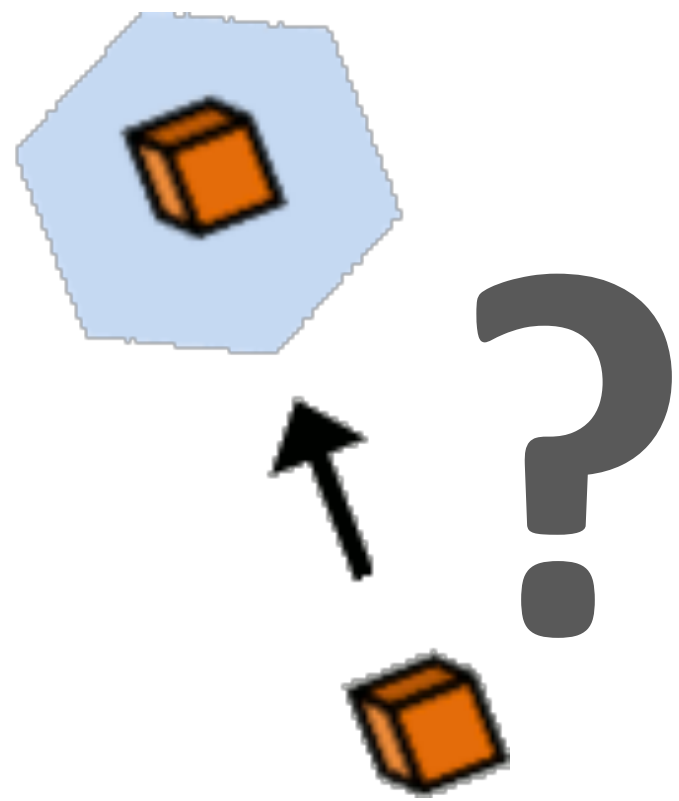


# ICINA



## Ice Clouds and Ice Nucleation in Arctic

ARKTINEN TUTKIMUSOHJELMA  
ARCTIC RESEARCH PROGRAMME



FROM AEROSOLS  
TO ICE IN CLOUDS

### AFFECTING THE ARCTIC CLIMATE

Wintertime Arctic atmosphere has two typical states:

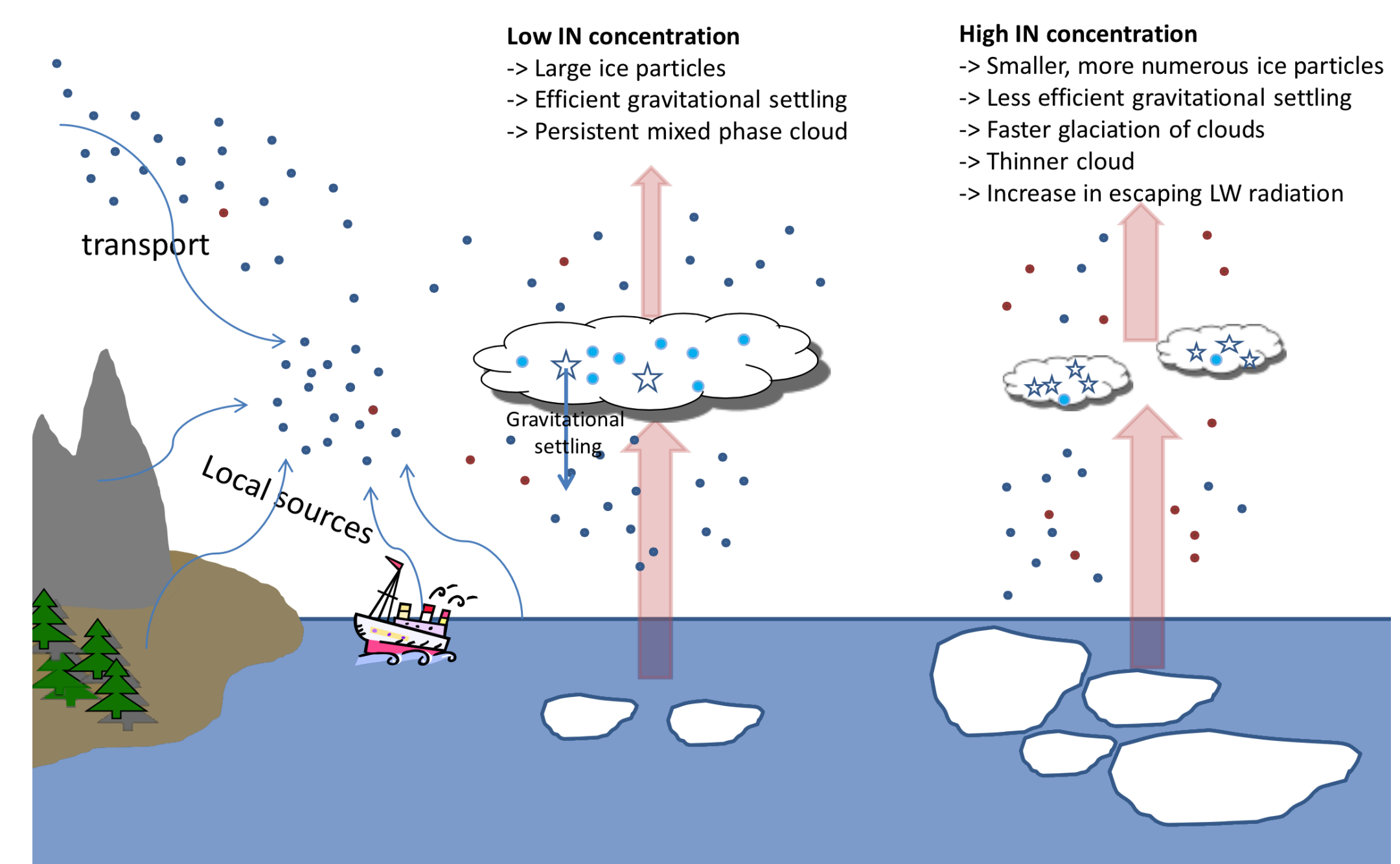
- mixed phase clouds (thick cloud cover, warming)
- radiatively clear state ( $\sim 40\text{-}60 \text{ W/m}^2$  more LW radiation out)

How aerosols are affecting the cloud phase?

What are the radiative properties of Arctic atmosphere?

Representation of clouds in global models

Feedback mechanisms relevant for the Arctic climate

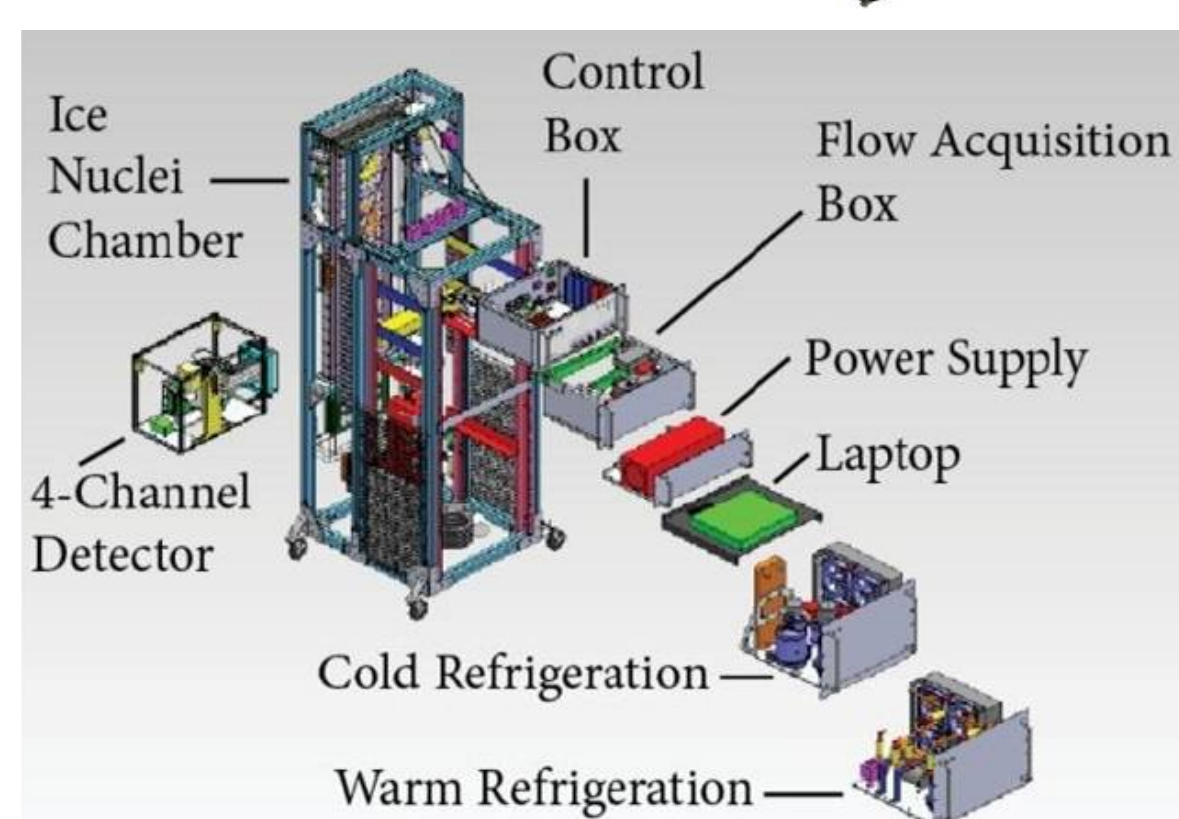


### ICE NUCLEATION EXPERIMENTS

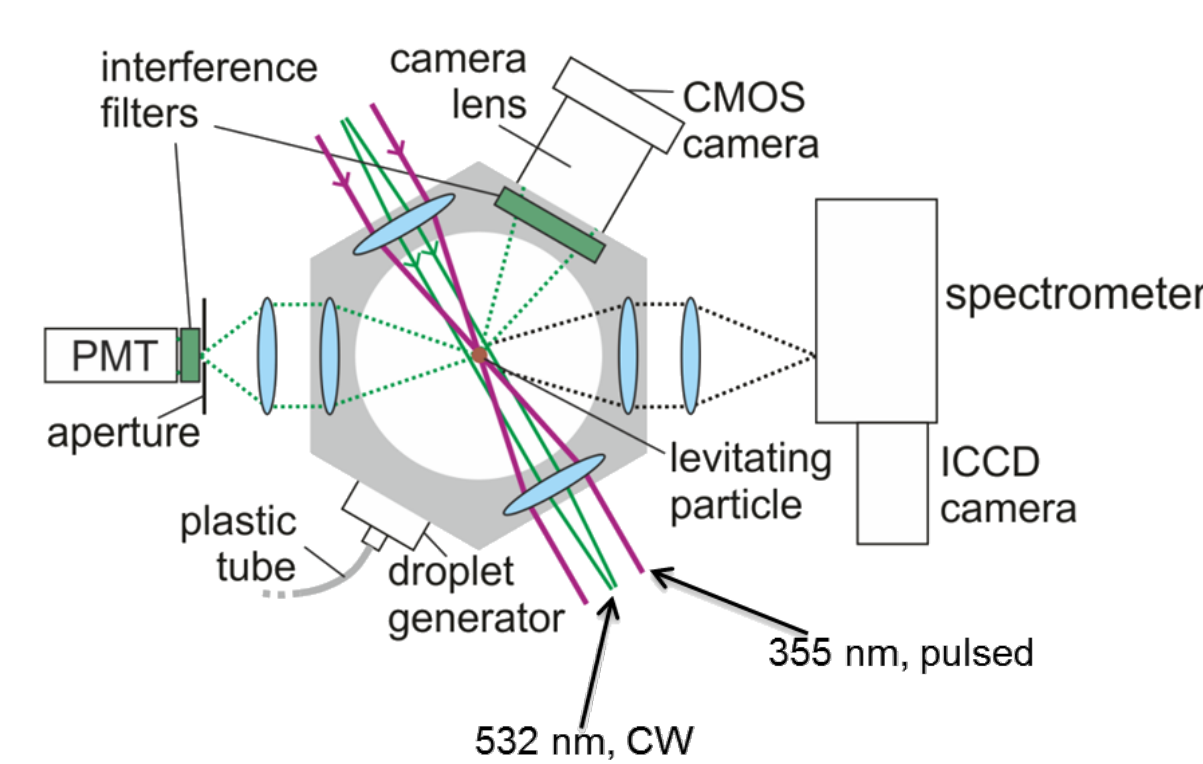
Determining the ice nucleation activity of the most important aerosol types in the Arctic, studying how condensation and aging affects properties, determining particle composition, comparison to theory for simple test systems



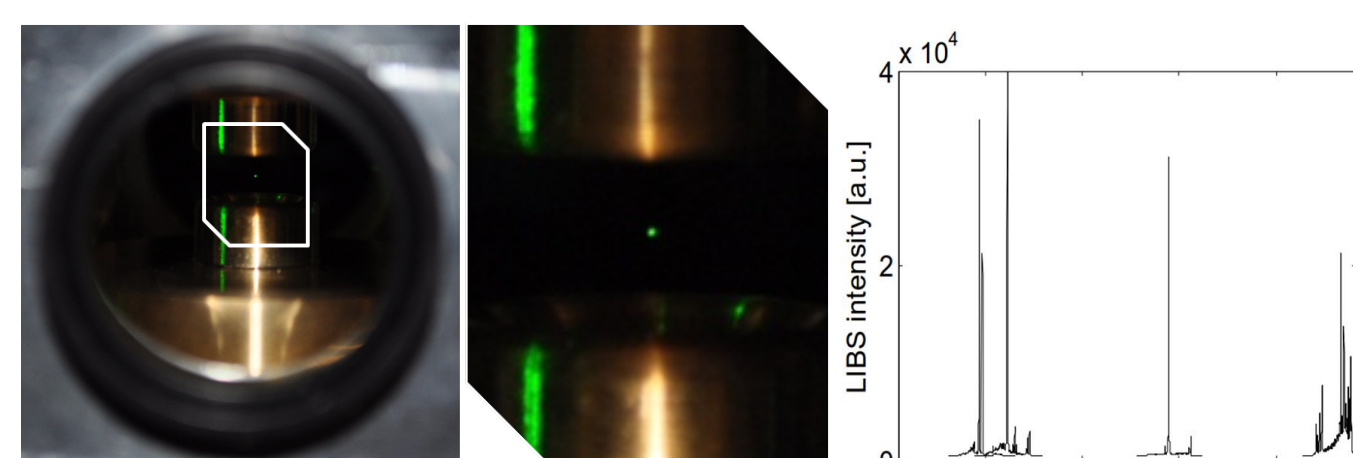
SPIN: a portable ice nucleus counter, based on a continuous flow diffusion chamber – laser, two light-scattering detectors and two polarized light detectors allow discrimination of ice particles from other particles



Developing a portable combined airborne LIF (Laser Induced Fluorescence) and LIBS (Laser Induced Breakdown Spectroscopy) measurement system within the project

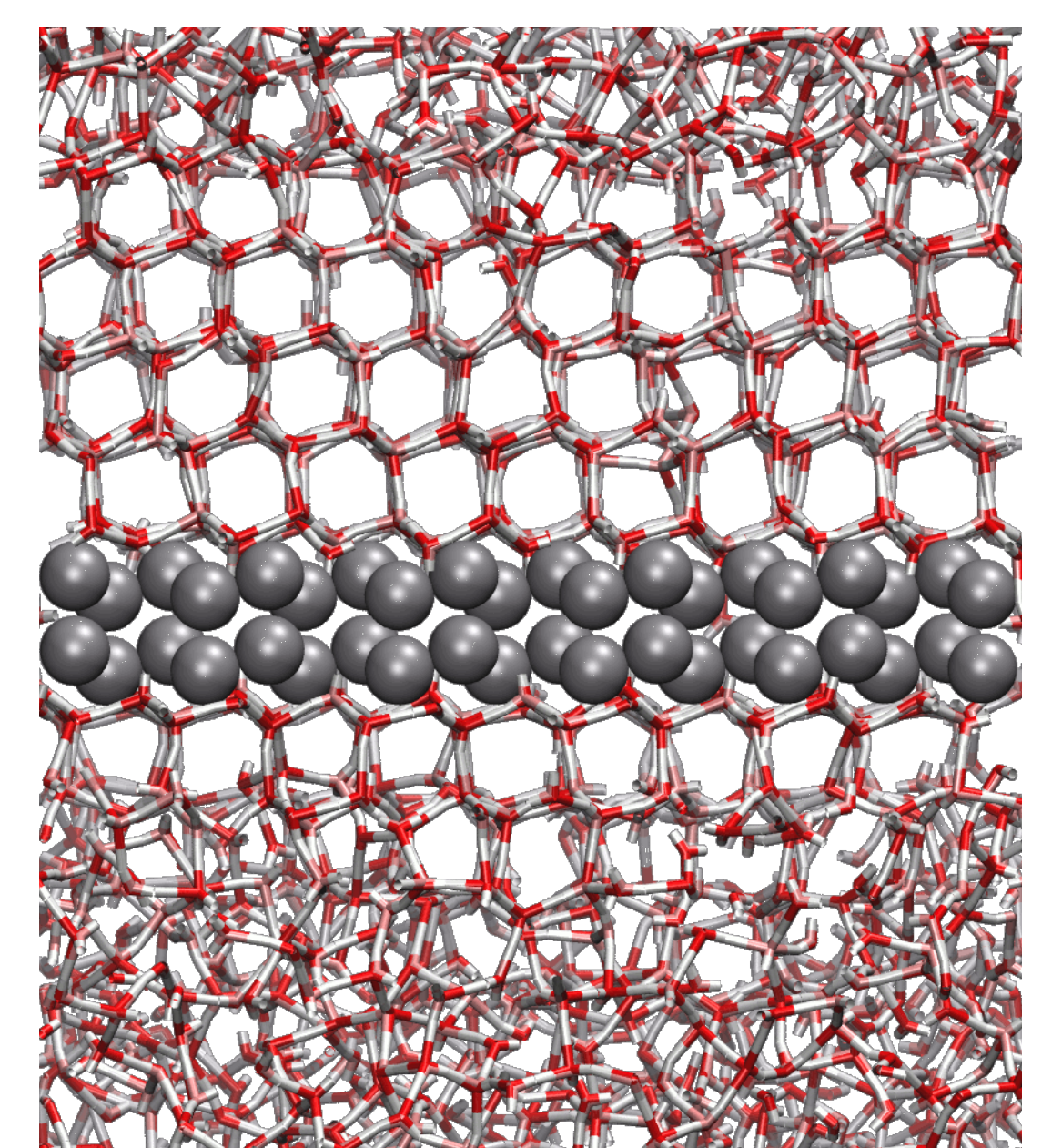


EDB levitation of aerosol particle for laser induced spectroscopy (left)  
LIBS spectrum of airborne Bacillus licheniformis bacteria (right)



### MODELLING ICE NUCLEATION

State-of-the-art molecular level modelling tools to gain fundamental understanding on ice nucleation and to construct a molecular level theoretical framework describing the ice nucleation processes

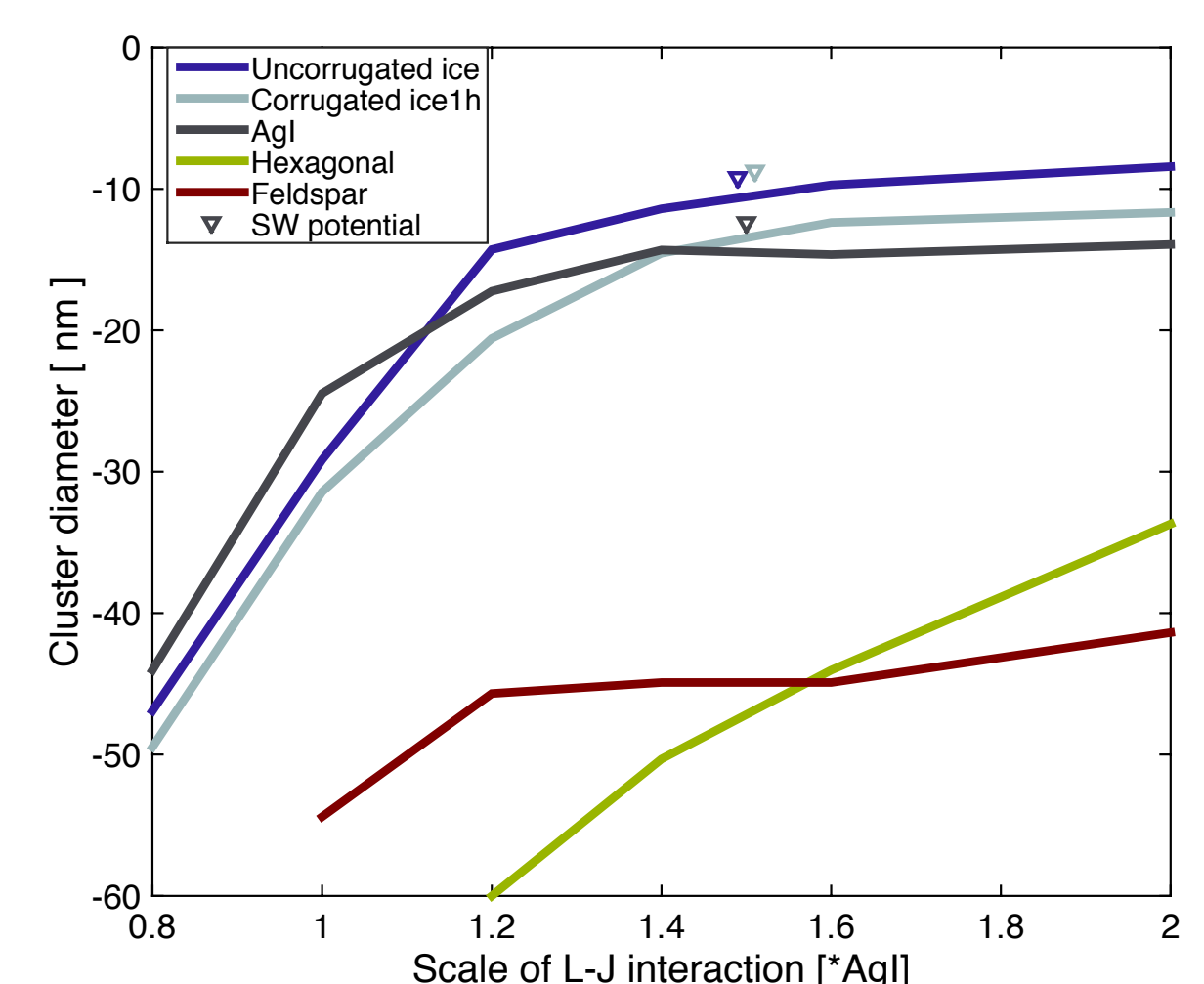


QM/MM method development

Direct comparison to laboratory experiments for simple test substances and for more complex atmospherically relevant aerosols

Bridging the gap between all-atom simulations and macroscopic models, such as CNT

Generating a realistic description of the ice nucleation process for global models



### ORIGIN AND PROPERTIES OF ARCTIC AEROSOLS

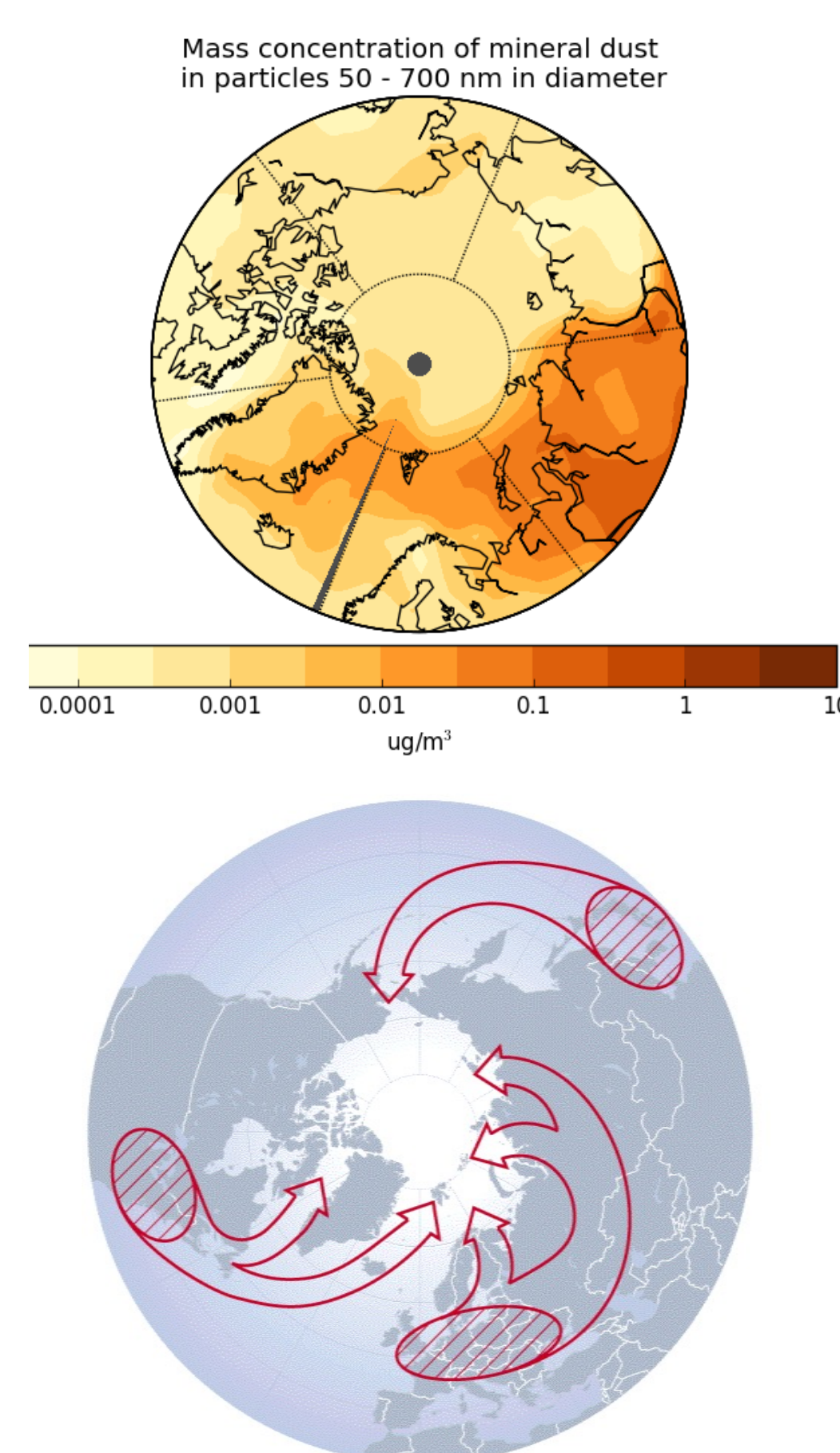
Ground station measurements of ice nuclei (IN) concentrations and types in the Arctic and sub-Arctic

Satellite observations of dust transport into Arctic

Aerosol transport modeling of aerosol origin

Analysis of relative contribution of local sources vs long range transport of IN active particles

Modelling the change in aerosol IN properties during atmospheric aging



### PROPERTIES OF CLOUDS & GLOBAL MODELS

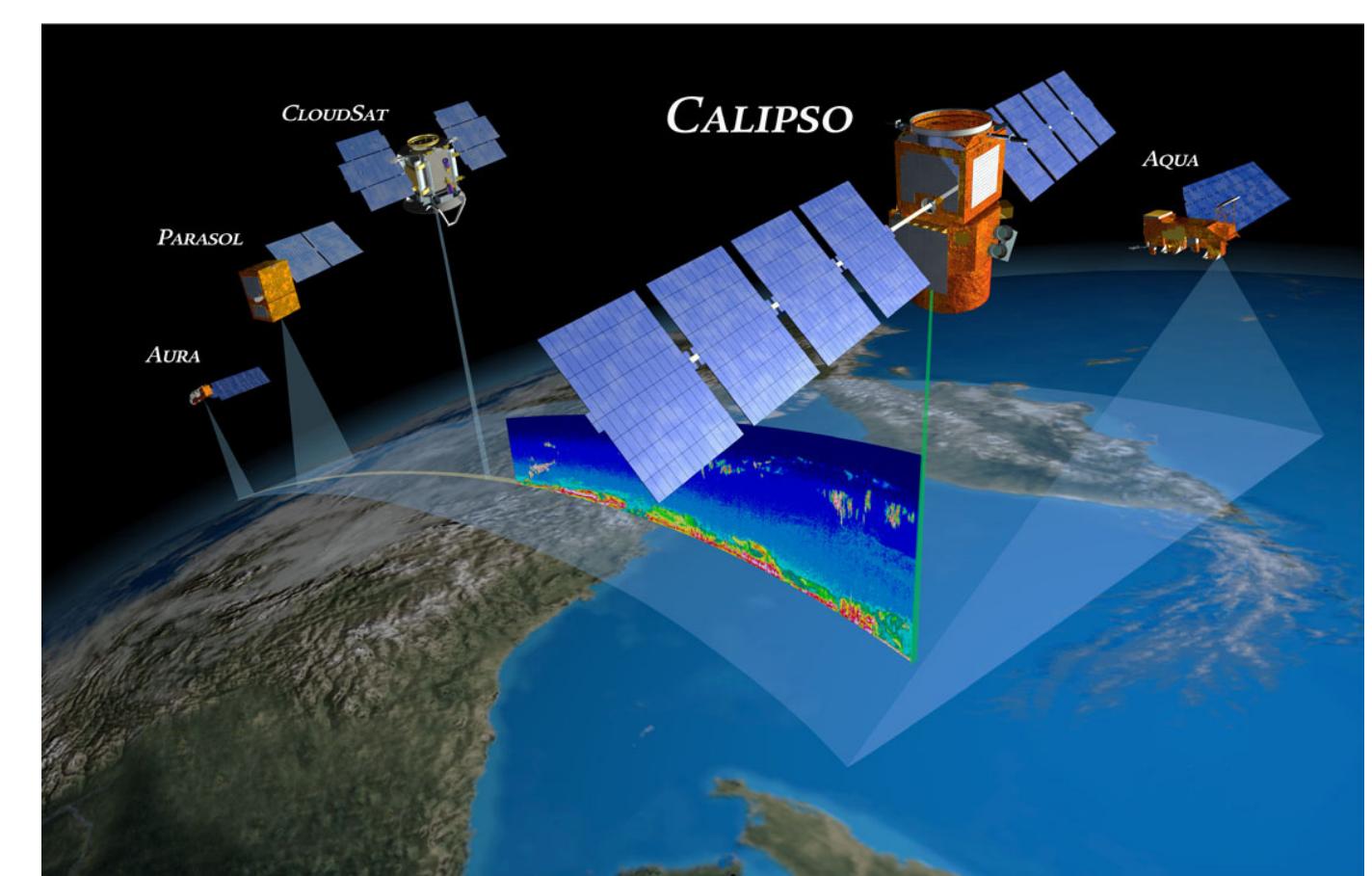
Remote sensing by ground and satellite based LIDARs

Cloud droplet & ice particle residue measurements

Cloud scale process modeling of cloud dynamics

New parameterizations for mixed and ice phase cloud dynamics in global climate model

Better simulations for radiative properties of Arctic atmosphere



NASA Afternoon Train group of satellites with LIDAR equipped CALIPSO

### PROJECT OUTCOMES

New tools for measuring and modelling of key processes related to Arctic ice and mixed phase cloud formation

Predicting how formation and properties of Arctic clouds change in the future

Improving regional climate and air quality predictions, help target climate change mitigation and adaptation

### CONTACTS

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