Ice nucleation by glaciogenic dust and cloud climate feedbacks

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Although most of the dust present in the atmosphere originates from low-latitude arid deserts, it has been increasingly recognised that there are significant sources of High-Latitude Dust (HLD) in locations such as Iceland, Greenland, North American Arctic or North Eurasia. The emission, transport and deposition of HLD can interact with the atmosphere, cryosphere and the marine ecosystem in several ways. Particularly, HLD has the potential to act as significant source of atmospheric Ice-Nucleating Particles (INP), competing with other sources such as dust and other INP types from lower-latitude arid sources. INPs are the fraction of aerosol particles that can trigger ice-formation in supercooled water droplets, that otherwise would remain unfrozen until temperatures of about -36 °C.

Ice formation initiated by the presence of INPs dramatically affects the amount of solar radiation reflected by clouds containing both liquid water and ice, known as mixed-phase clouds. However, ice-related processes in mixed-phase clouds such as the INP concentration are commonly oversimplified in most climate models, which leads to large discrepancies in the amount of water and ice that the models simulate at mid- to high-latitudes. These present-day divergences in simulated mixed-phase clouds lead to a large uncertainty in the cloud climate feedback. This feedback is associated to the fact that mid- to high-latitude mixed-phase clouds dampen a part of the of the global temperature rise associated with greenhouse gases.

Here we will explain the importance of understanding the chemical and ice-nucleating properties of HLD, as well as how it is emitted, transported and deposited for the cloud climate feedback. We will present new results from aircraft studies of the ice nucleating ability of HLD as well as modelling work which shows that this dust can be transported to altitudes and regions where it has the potential to influence mixed-phase clouds and climate.