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Monitoring of Particles in the Artic Atmosphere – Why we do it!

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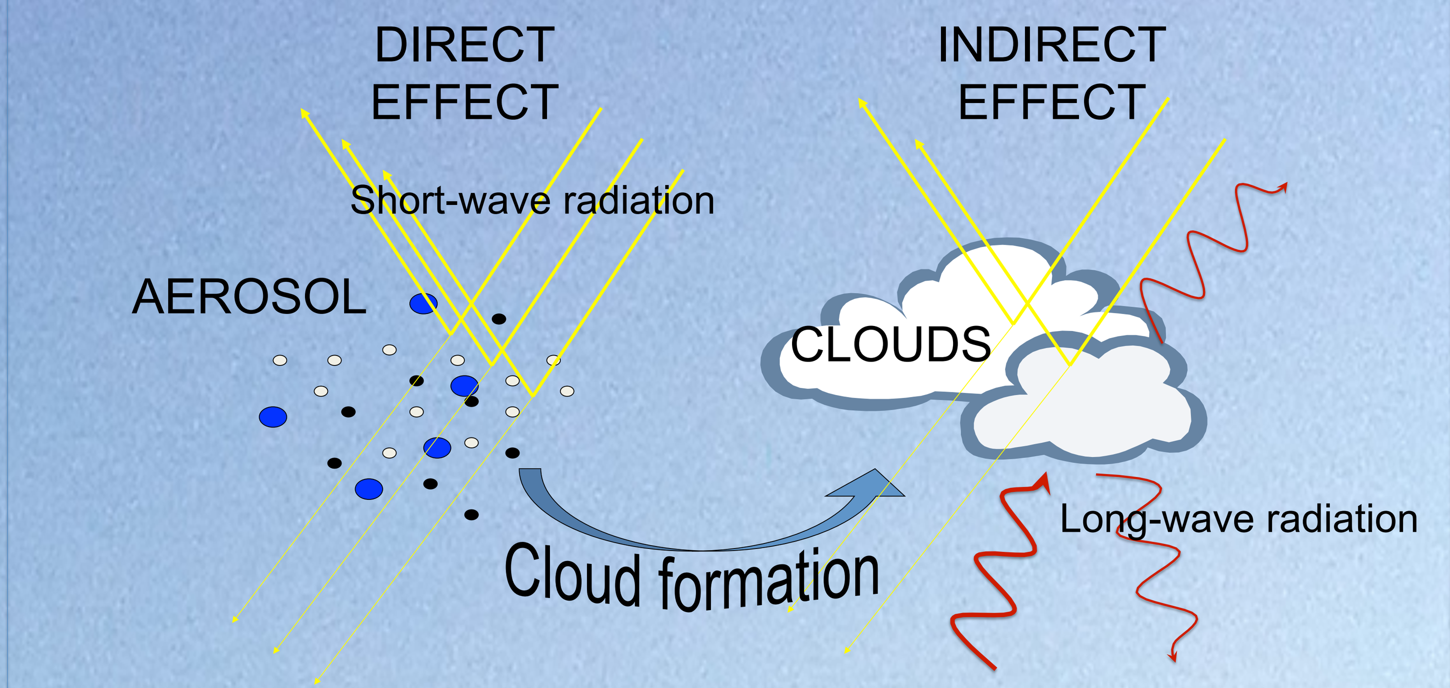
The Arctic environment is well known to be particularly sensitive to perturbation of the radiative budget, and during the past century the temperature increase in the Arctic has been two times larger than the global average (IPCC, 2007). Aerosols play an important role for the radiative budget of the atmosphere. Depending on abundance and composition, as well as meteorological parameters, aerosols may result in a net cooling or a net heating of the lower atmosphere. We want to understand what levels of particles we have in the Arctic, where they come from how the particles are deposited and how this picture may change in the future.

Long-term observations, accompanied by studies of air mass transport as well as numerical modeling provide the basis for this work. ITM has performed monitoring of aerosol microphysical properties at Mt Zeppelin, Svalbard (78° 56'N, 11°53'E, 474m a.s.l.), since 2000. Today, this dataset constitute one of the longest time series of size resolved aerosol properties in this environment.

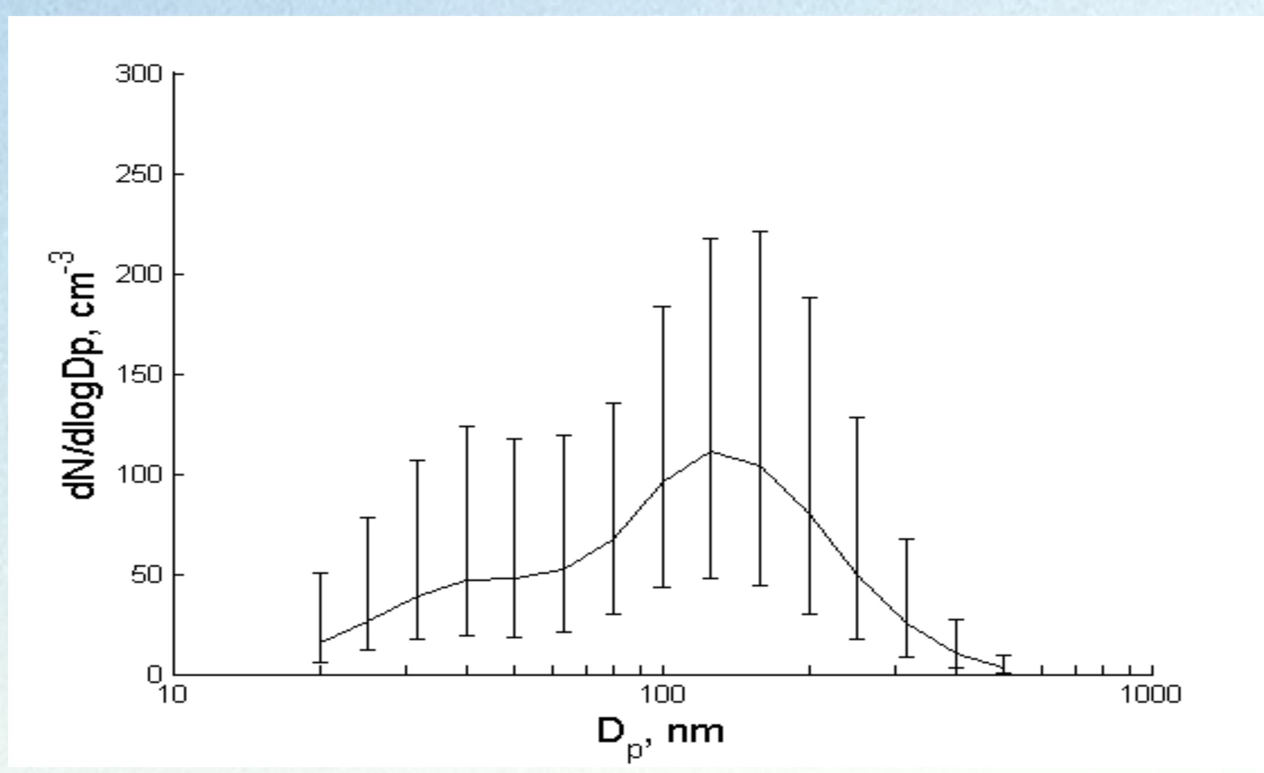
Over all, the aerosol concentration observed at Svalbard is low compared to continental conditions. However, the Arctic environment cannot be considered as pristine. Regular and episodically occurring events bring air with elevated aerosol concentration to the Arctic environment. One of the most prominent features of the environment is the Arctic haze, reoccurring on annual basis every spring, typically March-May. The haze period is characterized by comparably high levels of aerosol number, mass and surface. The haze is transported from lower latitudes, with strong source contribution from especially Eurasia. Low frequency of precipitation, and therefore low rate of wet deposition, and characteristic transport mechanisms pave way for the Arctic haze. Figures the below show the annual variation of aerosol mass and surface concentration and a visual comparison between comparably clean conditions with a record pollution event during 2006.

Of special importance is the transport of absorbing material into the Arctic basin, particularly soot. When deposited on snowy surfaces, the soot reduce the albedo, increasing the absorption of shortwave radiation in the snow and ice, thereby increasing rate of melting. Thus, not only what is in the air, but also what is deposited determines the future evolution of the Arctic cryosphere. At ITM, we have monitored, alongside with aerosol number size distribution, both scattering and absorbing properties of the aerosol for more than 10 years.

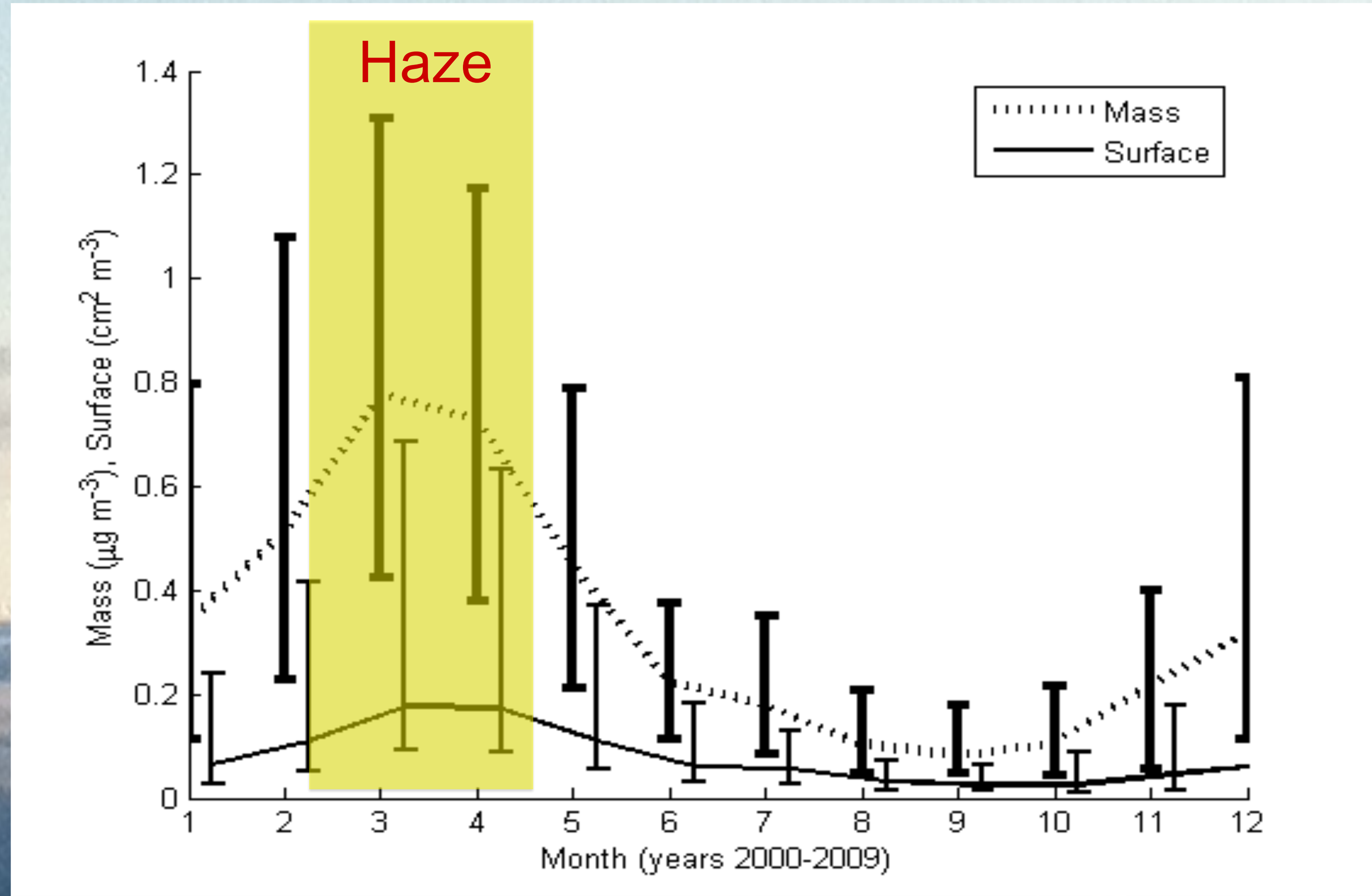
Aerosols and climate



Aerosol particles are believed to perturb the radiative balance of the Arctic environment in numerous ways: Directly scatter and absorb incoming short wave radiation, influence microphysics and lifetime of clouds, and influence surface albedo of snow and ice. Assessment of these effect requires knowledge of the aerosol number size distribution.



The aerosol number size distribution give information of how the aerosol particles are distributed over a certain size range. This information is crucial in order to determine both direct and indirect climate effect of particles in the atmosphere. The picture above shows the grand annual average of the aerosol size distribution as observed at Svalbard.



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