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Atmospheric aerosols affect the Earth's climate in many important ways. Aerosols interact with the sunlight and cause radiation forcing. The direct radiation effect of aerosols includes scattering and absorption of radiation, the indirect effect includes changes in lifespan and albedo of clouds.[1]

One of the key parameters affecting the optical properties is ambient relative humidity (RH). Under dry conditions, particle number size distribution (PNSD) is the most important, followed by aerosol concentration, relative refractive index, and then particle shape. Many aerosol components are hygroscopic and adsorb or absorb water as a function of RH.[2]

The hygroscopicity of aerosol particles is their ability to bind air humidity under environmental conditions and is the key factor for the atmospheric lifetime of aerosols, gas-to-particle partitioning, and heterogeneous chemical transformations.[3] Humidification causes the growth of particles in the visible light scattering range and thus increases light scattering and particles' ability to act as cloud condensation nuclei.[4]

This hygroscopic behavior of aerosols, combined with the ability of particles to modulate the formation of clouds and albedo, represents one of the biggest uncertainties in the prediction of climate change models.[1]

The main objective of this thesis is to study the hygroscopicity of aerosols both in the laboratory and in the atmosphere, to look for the estimation of the physico-chemical behaviour of aerosol mixtures at different levels of relative humidity (RH) and to investigate optical properties of dry and wet particles. Another objective is to better understand the influence of different types of aerosol on the radiation forcing and improve our knowledge in this field.

In the laboratory, aerosol particles of known composition will be generated and their hygroscopicity will be studied using an HDTMA (Hygroscopic Tandem Differential Mobility Analyser). Atmospheric aerosols will be studied at the National Atmospheric Observatory

Košetice (NAOK) by several aerosol instruments with emphasis on the relationship to radiation in the ambient air, mainly: optical properties as absorption and scattering by aethalometer and integrating nephelometer in both dry and wet modes; size distribution by SMPS (Scanning Mobility Particle Sizer), chemical composition determined by c-TOF-AMS (The Compact Time-of-Flight Aerosol Mass Spectrometer) and carbonaceous content in aerosol by EC/OC Analyzer.

References

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