HOW I MET (YOUR MOTHER) AIR WATER

The influence of air humidity on optical properties of aerosol particles

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INTRODUCTION

Atmospheric aerosols are suspension of solid or liquid particles in the air. They affect the Earth´s climate **directly** (scattering and absorption of radiation) and **indirectly** (changes in lifespan and albedo of clouds).[1]

One of the key parameters influencing the optical properties of aerosols is an **ambient relative humidity (RH)**.[2]

The hygroscopicity of aerosol particles is their ability to bind RH. An interaction with air humidity changes their shape, size, chemical composition, phase behaviour (thus affecting the ability of particles to become cloud condensation nuclei), their optical properties, global climate change and human health. [3]

The hygroscopicity is estimated by the growth factor (GF) of particles:

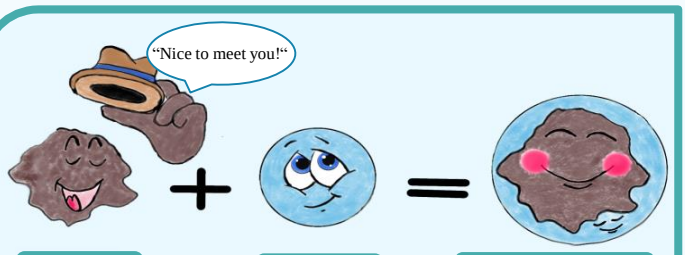
$$GF = \frac{D_p(\%RH)}{D_p(dry)},$$

where D_p (%RH) is the particle diameter of aerosol at specific RH, and D_p (dry) is a particle diameter of aerosol at dry conditions.

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]

OBJECTIVES

- What is the hygroscopic behavior of particles with different mixing states generated in the laboratory (under defined conditions) and in the ambient air?
- How different aerosol sources influence the hygroscopicity of aerosols?
- How aerosols from various aerosol sources interact with incoming solar radiation?



METHODS

Field Experiments
National Atmospheric Observatory Košetice
Ambient Aerosol

Laboratory Experiments
Institute Of Chemical Process Fundamentals Prague
Generated Aerosol

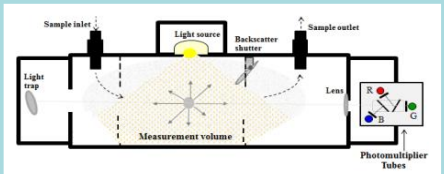


Fig. 3. Nephelometer

Fig. 4. Aethalometer

Fig. 2. National Atmospheric observatory Košetice (NAOK)

Fig. 1. The location of institutions

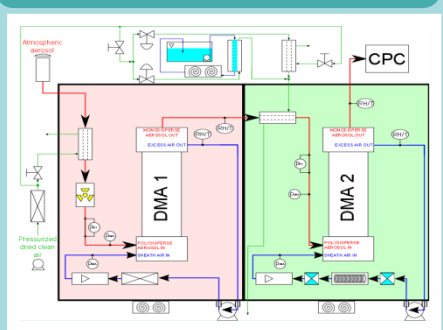


Fig. 3. Hygroscopic Tandem Differential Mobility Analyzer (HTDMA)

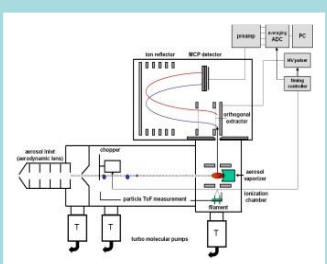


Fig. 7. Aerosol Mass Spectrometer (AMS)

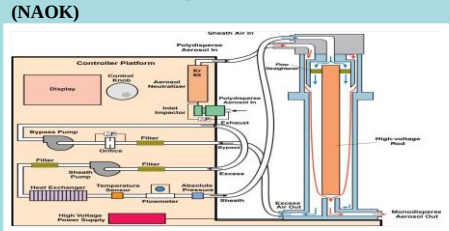


Fig. 5. Scanning Mobility Particle Sizer (SMPS)

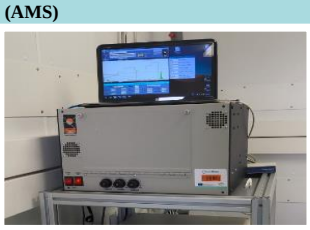


Fig. 6. EC/OC Analyzer

Hygroscopicity HTDMA

Scattering of light Nephelometer

Absorption of light Aethalometer

Size distribution SPMS

Chem. Composition AMS + EC/OC

Generation of aerosol particles of known composition and size relevant to atmospheric aerosols.

After laboratory experiments, the hygroscopicity of aerosol sources will be indirectly analysed at NAOK.

Direct cooling effect of aerosols on the climate.

Measurement of scattering and backscattering coefficients.

Direct warming effect of aerosols on the climate.

Measurement of absorption coefficient.

Important knowledge: different sizes and chemical composition cause different hygroscopic and optical behaviour.

FROM THE ACTIONS TO THE RESULTS

Study of **growth factor** of generated aerosols at defined conditions and ambient aerosols	→	Comparison of hygroscopic behaviour Understanding of aerosol relationship with RH
Study of **optical properties** (scattering and absorption of light) of ambient aerosols	→	Understanding of optical properties relationship with RH
Analysis of long-term data set of **light scattering, light absorption, size distribution, and chemical composition** of aerosols	→	The complex information on temporal aerosol distribution, optical properties, and sources at the background site
Study of **different aerosol sources** with their optical, chemical, and physical properties at the background site	→	Better understanding of the influence of aerosols on the air quality and climate change

→ **Improvement of air quality policies**

→ **More precise estimation of the radiative forcing of aerosols in climate models**

REFERENCES: IPCC; 1. Climate Change 2013: The Physical Basis, 2013. 2. Cheng, Y. F. et al.; Atmos. Environ. (1994) 2008, 42 (25), 6373–6397. 3. Bouzidi, H. et al.; Atmos. Environ. 2020, 229 (117481), 117481.

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