Comparison of three AMS measurements during Hill Cap Cloud Thuringia 2010 (HCCT 2010)

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Introduction

Impact of clouds on the local aerosol chemical composition was investigated during the Hill Cap Cloud Thuringia 2010 (HCCT-2010) field campaign which took place in autumn 2010 at the Mt. Schmücke in the Thuringia forest (Germany). Three sampling stations were equipped (Figure1): One on the top of Mt. Schmücke, where clouds were samples, and two valley stations located upwind and downwind to the summit of the mountain.

A total of 4 Aerodyne ToF-AMSs were deployed during the campaign. One at each valley stations and 2 at the summit station (one connected downstream of a Cloud Virtual Impactor (CVI) for droplet residuals and one connected to an interstitial inlet measuring interstitial particles). Both valley stations were equipped with PM_1 PILS and a PM_{10} MARGA was deployed at the upwind valley station.

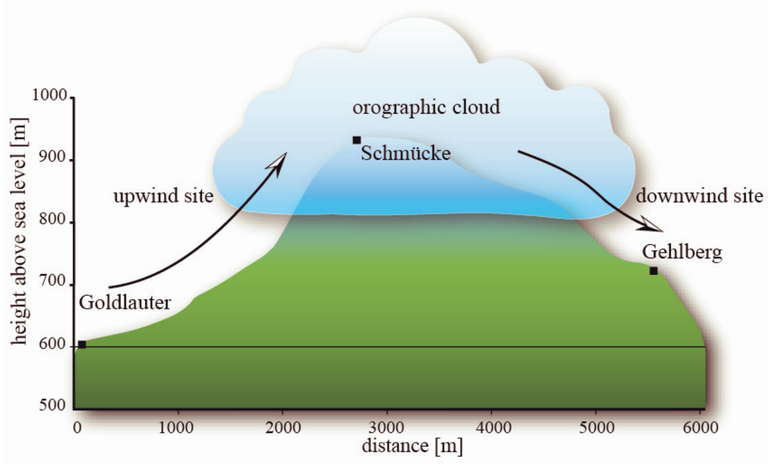


Figure 1: Scheme of the HCCT-2010 sampling site and the general philosophy of cloud passage experiment HCCT-2010

Experimental approach

To investigate the impact of cloud chemistry to the aerosol chemical composition and size distribution, several specific meteorological criteria are required (*e.g.* specific wind direction and wind speed, presence of cloud at the summit station but not at the two valley stations and an absence of precipitation). However, it is crucial to know if instruments provide similar results during non-cloud events prior to study cloud interaction. Therefore several periods with a connected air mass flow between the three stations but without any cloud at the summit station were selected. The first results of the comparison between the AMS measurements performed at the 3 stations during dry overflow periods are presented.

Dry overflow between the 3 stations

Periods with a dry overflow between each station were selected regarding the meteorological conditions at each station. To analyze the connected flow between each station a study using ozone as nearly inert tracer and cross-correlation analysis have been performed. An example of the ozone concentration and corresponding cross correlation during dry connected and un-connected overflow periods is presented in Figure 2.

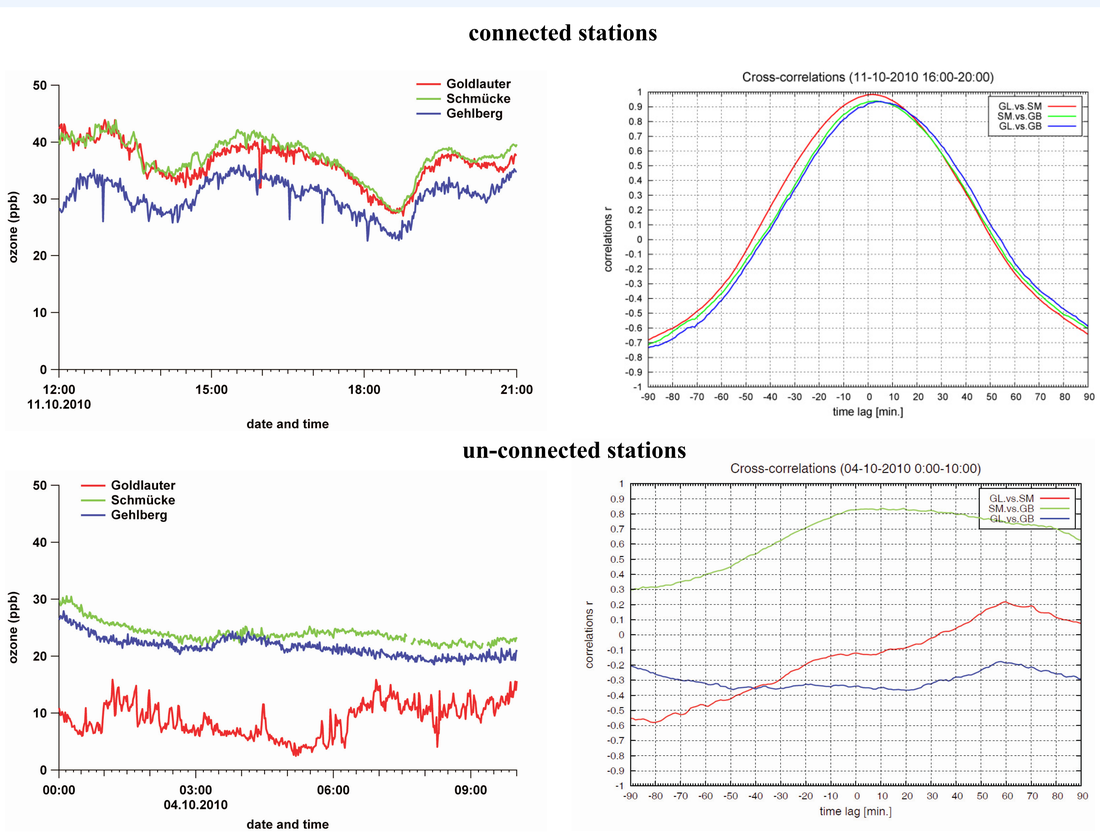
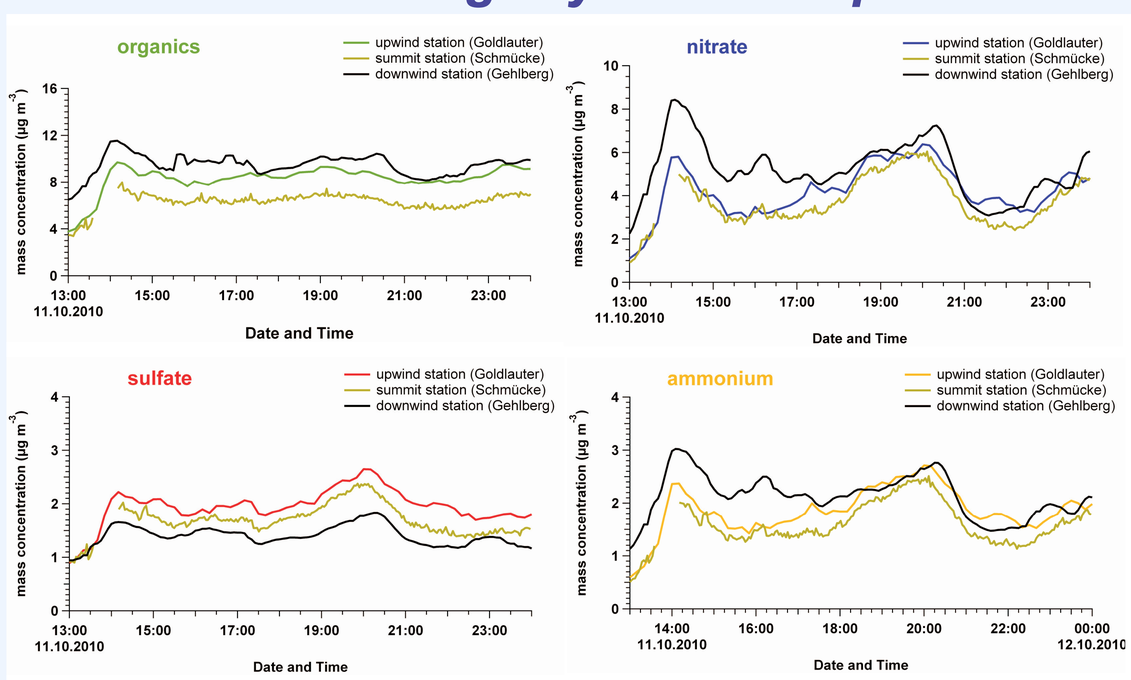


Figure 2: Example for connected (dry overflow, top) and un-connected (bottom) flow conditions

Time series during dry overflow periods



	Reference station							
	Goldlauter				Schmücke			
	Schmücke		Gehlberg		Goldlauter		Gehlberg	
	slope	r^2	slope	r^2	slope	r^2	slope	r^2
organics	0.75	0.98	0.98	0.94	1.32	0.98	1.35	0.96
nitrate	0.84	0.95	1.07	0.81	1.13	0.94	1.21	0.76
sulfate	0.81	0.93	0.54	0.77	1.15	0.93	0.63	0.82
ammonium	0.84	0.96	0.93	0.75	1.14	0.96	1.06	0.80
chloride	1.32	0.70	0.68	0.57	0.53	0.70	0.44	0.51

Figure 3: Time series of organics, nitrate, sulfate, ammonium and chloride measured at each station during the dry overflow period of 11.10.2010. The table presents the linear regression slope and r^2 values for all the different dry-overflow periods using the upwind valley station (Goldlauter) and the summit station (Schmücke) as references

Particle size distribution

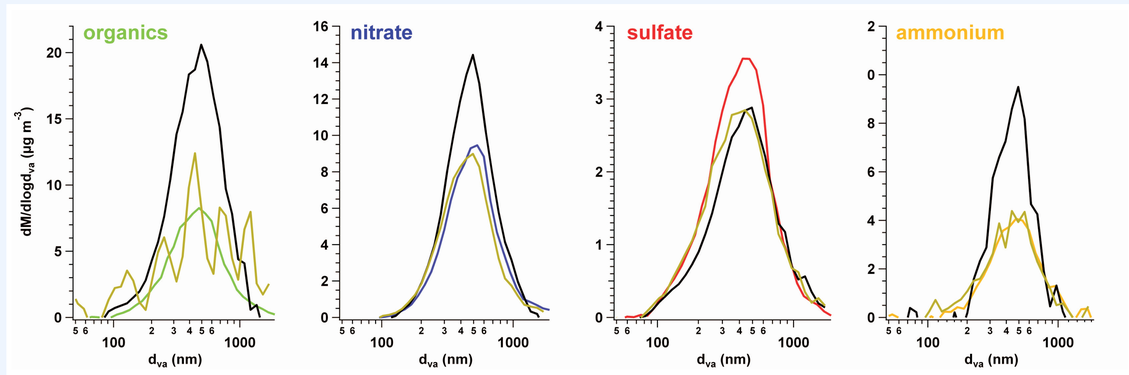


Figure 4: Size resolved chemical concentration during the dry overflow period of the 11.10.2010 using similar color code than in Figure 3

As illustrated in Figure 4, the size resolved chemical concentration measured during the different dry overflow periods show a similar pattern within uncertainties in diameter estimated around 10 to 15%.

A case of un-connected stations

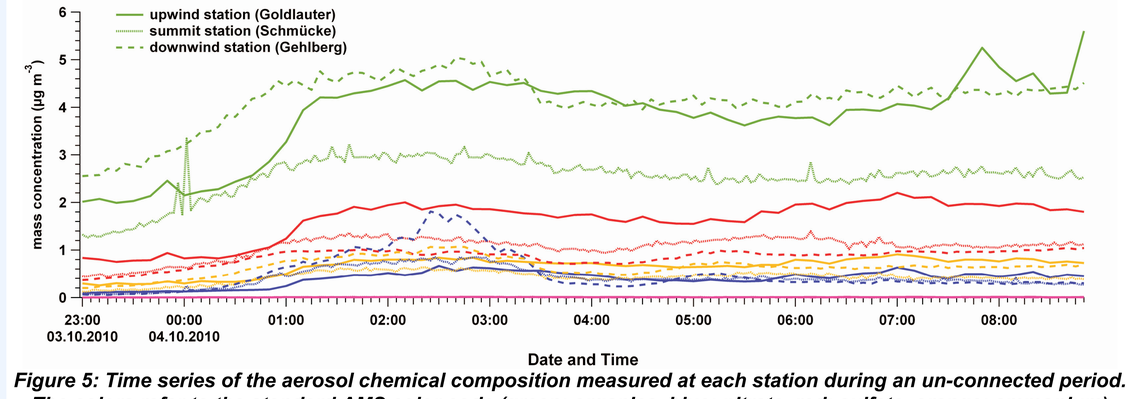


Figure 5: Time series of the aerosol chemical composition measured at each station during an un-connected period. The colors refer to the standard AMS color code (green: organics, blue: nitrate, red: sulfate, orange: ammonium)

Conclusion

The comparison of the AMS measurements performed at each station during different dry overflow periods, shows similar time series and particle size distribution. The small differences in term of absolute concentration observed may be attributed to instrumental uncertainties as well as possible particle lost and/or dilution effect during the air mass transport between the three stations. Therefore regarding the main target of the HCCT-2010 campaign, the comparison of the AMS measurements performed at the 3 stations during cloud event periods could be directly used to investigate aerosol cloud interaction during HCCT-2010.

Companion HCCT-2010 presentations:

- D. van Pixteren, Hill Cap Cloud Thuringia 2010 (HCCT-2010) Overview and first results, Talk, Section 7B: Aerosol-Cloud Interaction 3, 7B1-386
- J. Schneider et al., Microphysical and chemical characterization of cloud droplets, cloud droplet residuals, and interstitial aerosol particles during a hill-cloud field experiment in Central Europe, Talk, Section 7B: Aerosol-Cloud Interaction 3, 7B2-577
- A. Roth, Analysis of cloud and aerosol particles by single particle mass spectrometry during a hill-cloud field experiment in Central Europe, Poster, 4P274-350
- I. George, et al., The impact of clouds on radical concentrations. Observations of OH and HO2 during HCCT-2010, Poster, 8P74-486