Entwicklung und Erprobung eines Integrierten Regionalen Klimaanpassungsprogramms für die Modellregion Dresden

REG KLAM

Assessment of changes in PM composition in Dresden as a basis for predictions

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1. Introduction

Global warming is supposed to have an influence on the composition as well as on the mass concentration of tropospheric aerosol particles, but the involved effects have not been investigated or quantified yet. The aim of our work, which is part of the interdisciplinary REGKLAM project, is thus to give an estimation of the future load of particulate matter (PM) in an urban area in Saxony on the basis of today's emissions, especially considering climate changes. The collected data will be used for the initialisation of transport models too.

Size-segregated PM samples are collected with low-pressure five-stage Berner impactors. Samples are taken at an urban and a rural site:

Dresden (DD): The city of Dresden has around 517,000 inhabitants. The sampling site is located in a residential area which is representative for the urban background [1] of Dresden. The site is part of the governmental air quality monitoring network and is not affected by nearby particle sources.

Melpitz (M): The IfT Research Station in Melpitz, around 100 km northwest of Dresden (Fig. 1), is situated in a rural environment. The Melpitz site has been proved to be representative for the regional background of the Saxony region [2].

The influence of the urban background is quantified by comparing values measured in Melpitz with those measured in Dresden. This allows to distinguish local and regional sources of particulate matter.

A measurement is started using weather forecasts, as a constant air mass origin and dry weather conditions are needed during the 24 hour sampling period. The sampled air volume is 108 m³ in each case. Aerosol samples are analysed for mass, main ions (sulfate, nitrate, chloride, ammonium, sodium, potassium, magnesium, calcium), organic carbon, elemental carbon and various single organic compounds such as long-chain n-alkanes and PAHs.

Fig. 1: *Location of the sampling sites in Germany (shown in red).*

2. Categorisation

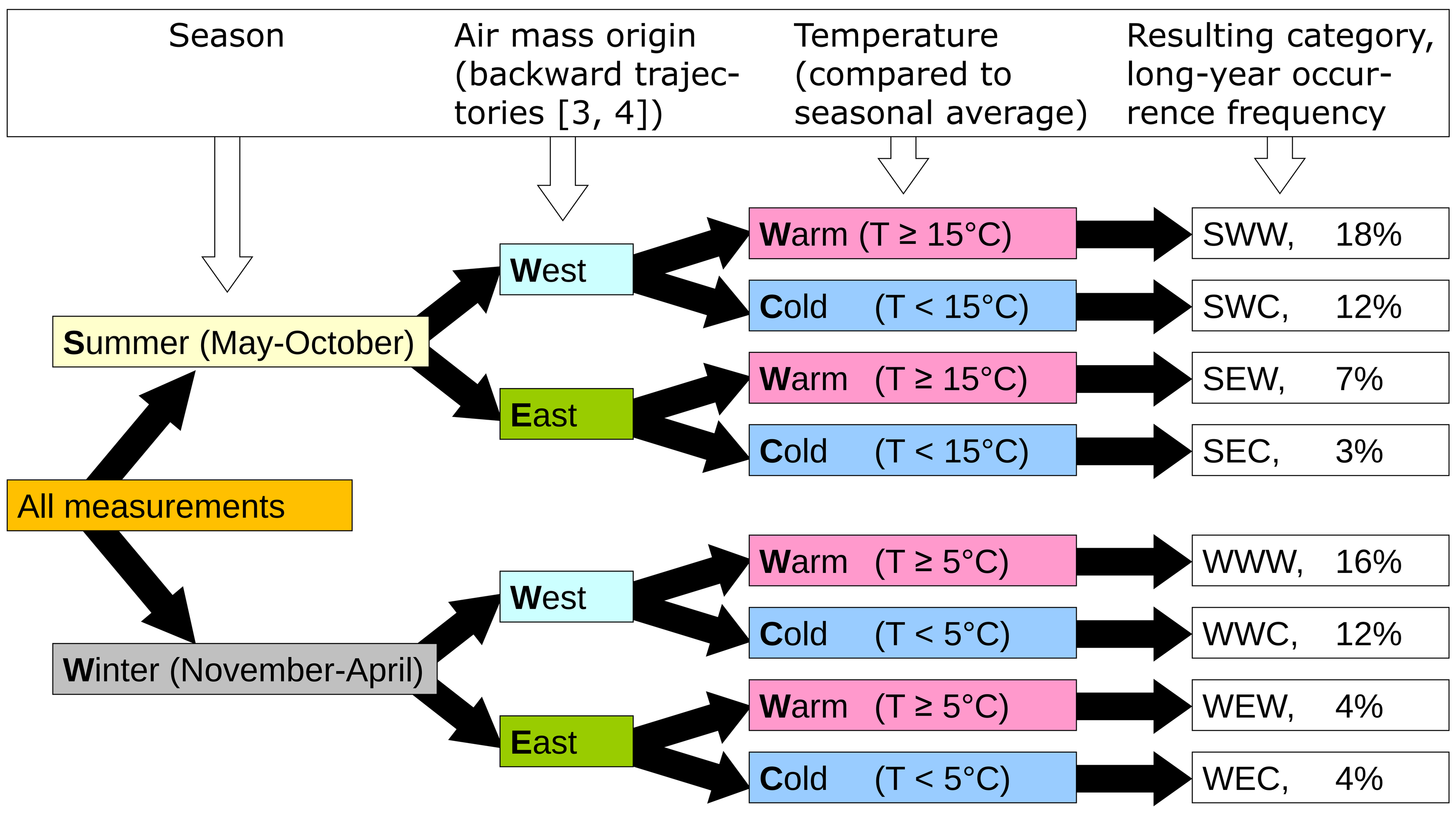

Fig. 2: *Categorisation of sampling events*

3. Observations

Influence of the category:

- Season: PM loads in summer categories are smaller than those in the winter categories, due to fewer emissions (e.g., less domestic heating) and evaporation of volatile particle constituents (e.g., ammonium nitrate).
- Air mass origin: PM loads are higher for eastern categories, which might be due to the fact that western air masses are partly maritime and therefore only lightly loaded.
- Temperature: For the same reasons as described above under 'Season', PM loads are higher on cold days than on warm days.

Influence of the sampling site:

The weighted average PM load in Melpitz is about 77% of the value in Dresden, which indicates that an important amount of Dresden's aerosol comes from distant sources that influence both Melpitz and Dresden. However, the values in Dresden exceed the values in Melpitz, which hints at urban particle generation.

Conclusion:

From these observations, we can conclude that the three chosen parameters (air mass origin, season and temperature) are important factors influencing Dresden's PM load. This is confirmed by long-term observations in Melpitz [2].

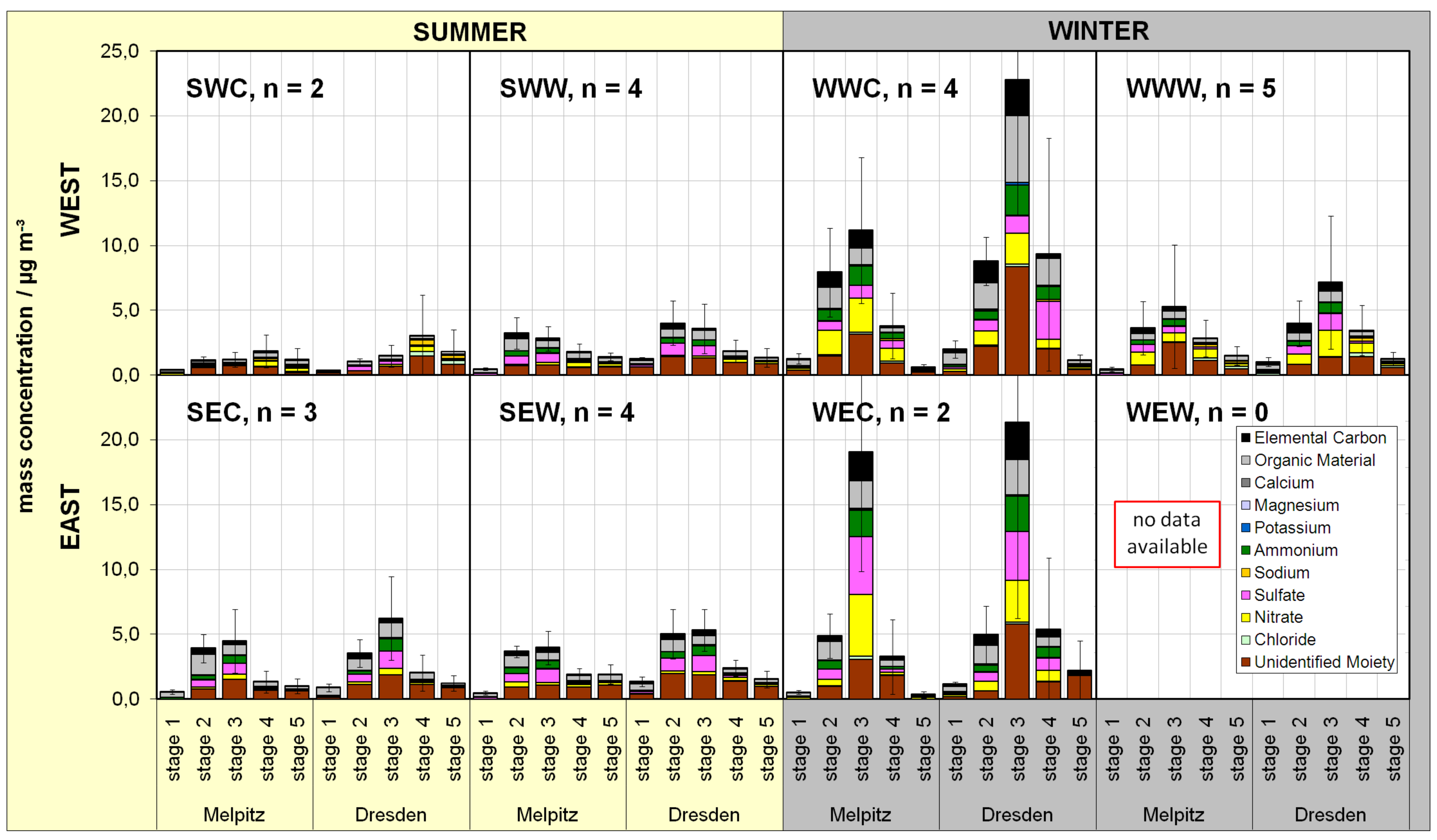

Fig. 3: *Size-segregated aerosol particle composition for the eight categories in Melpitz (rural) and Dresden (urban). n is the number of samples for each category. In total, 25 measurements have been taken. Organic Material = 1.8 x Organic Carbon. Upper cutoff diameters: 0.14 µm, 0.42 µm, 1.2 µm, 3.5 µm, 10 µm.*

4. Assessment

Thanks to this simplified model, an assessment of changes in size-segregated PM mass concentration due to climate changes can be given. The occurrence frequencies of the different categories are likely to change. As an example, warm categories might become more prevalent due to rising temperatures, and the air mass transport pattern is likely to alter as well. Estimates from climate models will be used for a quantification of these effects, the corresponding data being provided by the REGKLAM network. These data will consider different possible scenarios of climate developments.

Assuming constant particle sources, Dresden's future PM load as well as the size-segregated chemical composition of PM can then be calculated for each scenario.

5. References

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Partner

Verortung in REGKLAM

Teilprojekt 2.2 (Regionalisierte Projektion von atmosphärenchemischen Kenngrößen) ist Teil des Moduls 2 (Regionalisierte Szenarien). Es beschäftigt sich mit der Modellierung und Messung von Partikeln und Luftschadstoffen. Das hiesige Poster bezieht sich auf TP 2.2b (Abschätzung der größenaufgelösten Partikelkonzentration und -zusammensetzung anhand wetterlagenorientierter experimenteller Messungen).

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