Karlsruhe Institute of Technology

Campus-Alpin
IMK-IFU: Atmosphärische Umweltforschung

Chemical composition of PM in a residential area of Beijing, China

R.R. Shen[1], K. Schäfer[1], P. Suppan[1], N. Schleicher[2,3], U. Kramar[3], S. Norra[2,3], J. Schnelle-Kreis[4], L.Y. Shao[5], J. Wang[5], J.Y. Wang[5], K. Cen[6], Y.S. Wang[7], S. Schrader[1,2]

[1]Institute of Meteorology and Climate Research (IMK-IFU), Karlsruhe Institute of Technology (KIT), 82467 Garmisch-Partenkirchen, Germany
[2]Institute of Geography and Geoecology (IGG), Karlsruhe Institute of Technology (KIT), 76128 Karlsruhe, Germany
[3]Institute of Mineralogy and Geochemistry (IMG), Karlsruhe Institute of Technology (KIT), 76128 Karlsruhe, Germany
[4]Joint Mass Spectrometry Centre, Comprehensive Molecular Analytics, Helmholtz Zentrum München, 85764 Neuherberg, Germany
[5]Department of Resources and Earth Sciences, China University of Mining and Technology (CUMTB), 100083 Beijing, P. R. China
[6]School of Earth Sciences and Resources, China University of Geosciences (CUGB), 100083, Beijing, P.R. China
[7]Institute of Atmospheric Physics (IAP), Chinese Academy of Sciences (CAS), 100029, Beijing, P. R. China

OBJECTIVES

Emission reduction measures were performed to improve air quality during the Olympic Summer Games in 2008: cut down mainly coarse particles.

Question: PM still a problem?

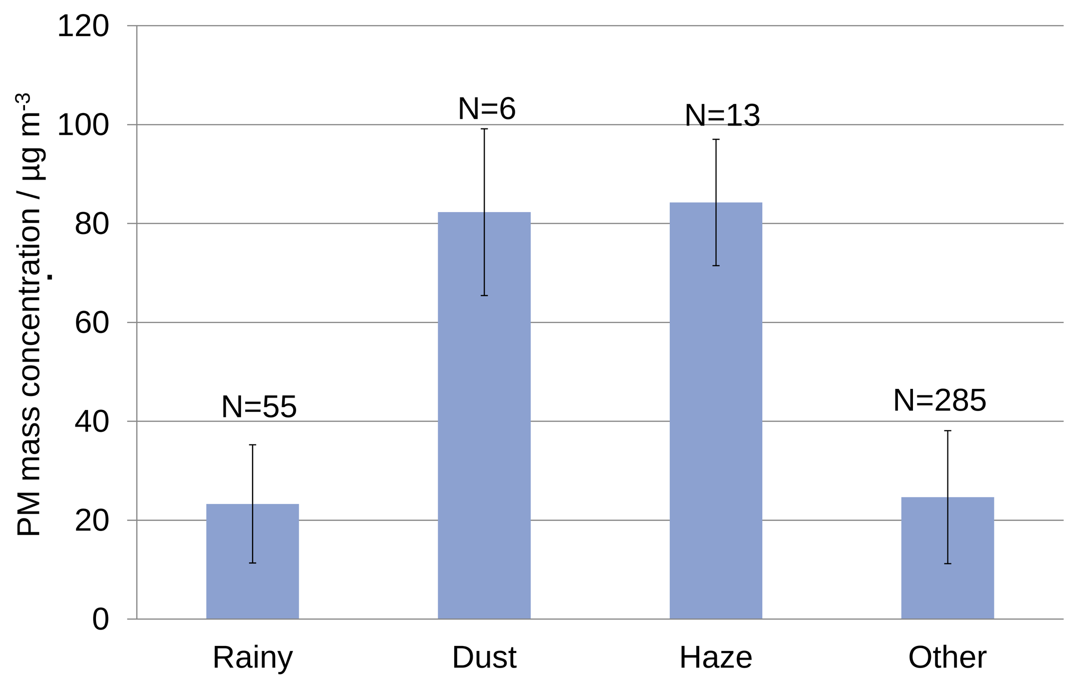
Objectives: Chemical composition of PM, source identification and special case studies during haze and dust events.

METHODOLOGY

Particulate concentrations: Daily PM filter sampling on quartz fibre filters with 2 High-Volume Samplers DHA80 (Digitel) by KIT/IMK-IFU from 2010.06.21 on for one year with CUMTB at the entrance of CUGB in 20 m distance to Mini-Volume Sampler (weekly $PM_{2.5}$ samples) of KIT/IMG.

Meteorological data from IAP and ZBAA (http://weather.uwyo.edu/upperair/sounding.html).

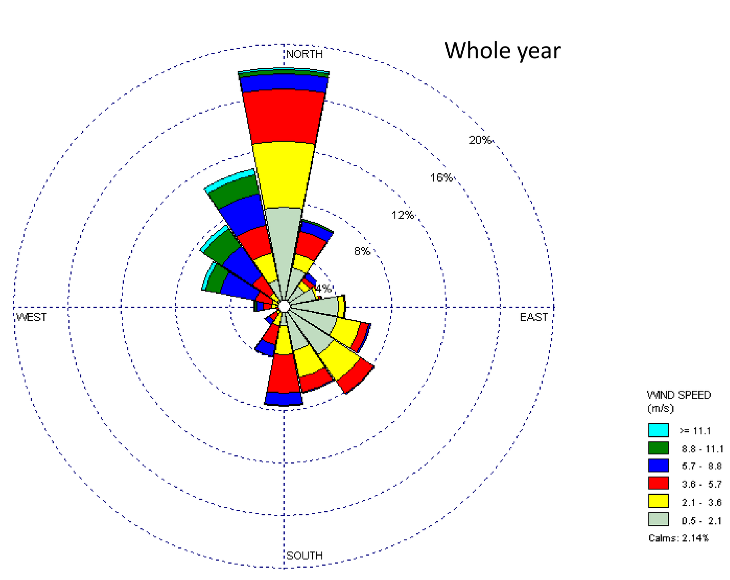
Particle composition: Main and trace elements analysed by PEDXRF (Polarized energy dispersive X-ray fluorescence) from KIT/IMG.



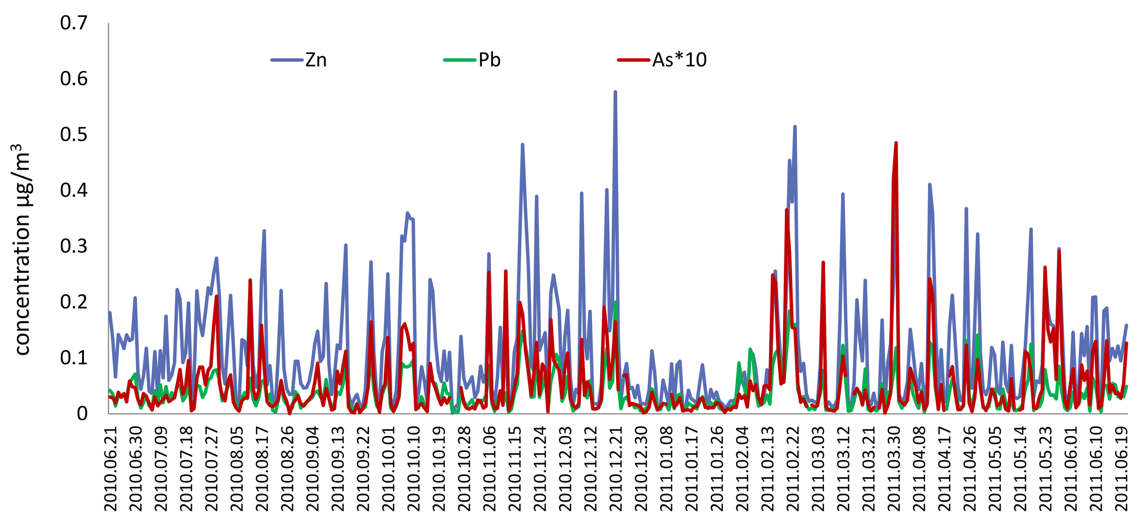
PM mass concentration during different weather conditions

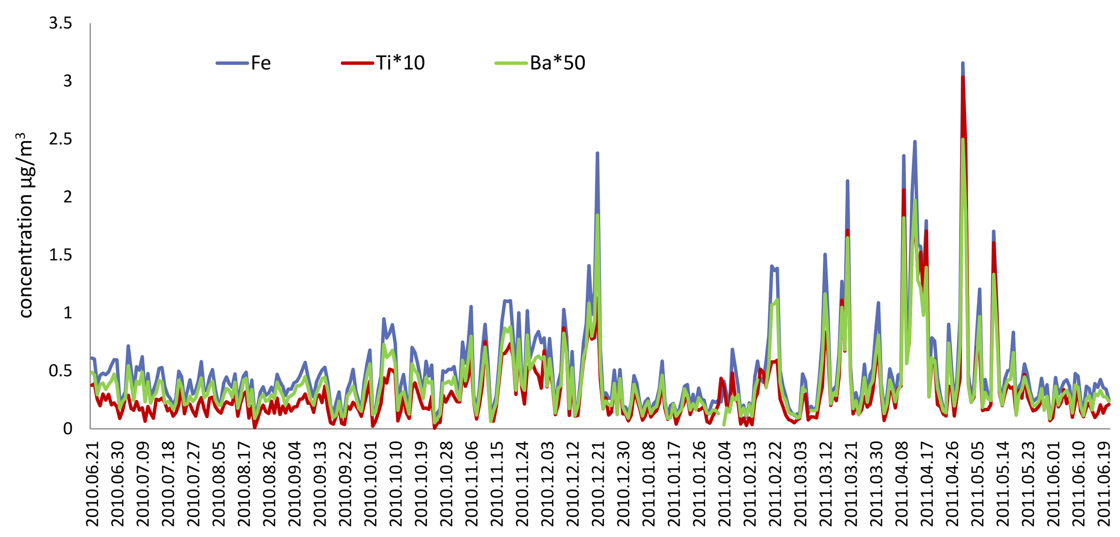
Comparison of PM mass concentration during different weather conditions: **haze days** highest PM mass concentration, followed by **dust days.**

Dust days - most coarse particles.
Haze days influenced by human activities - most secondary particles in fine mode.

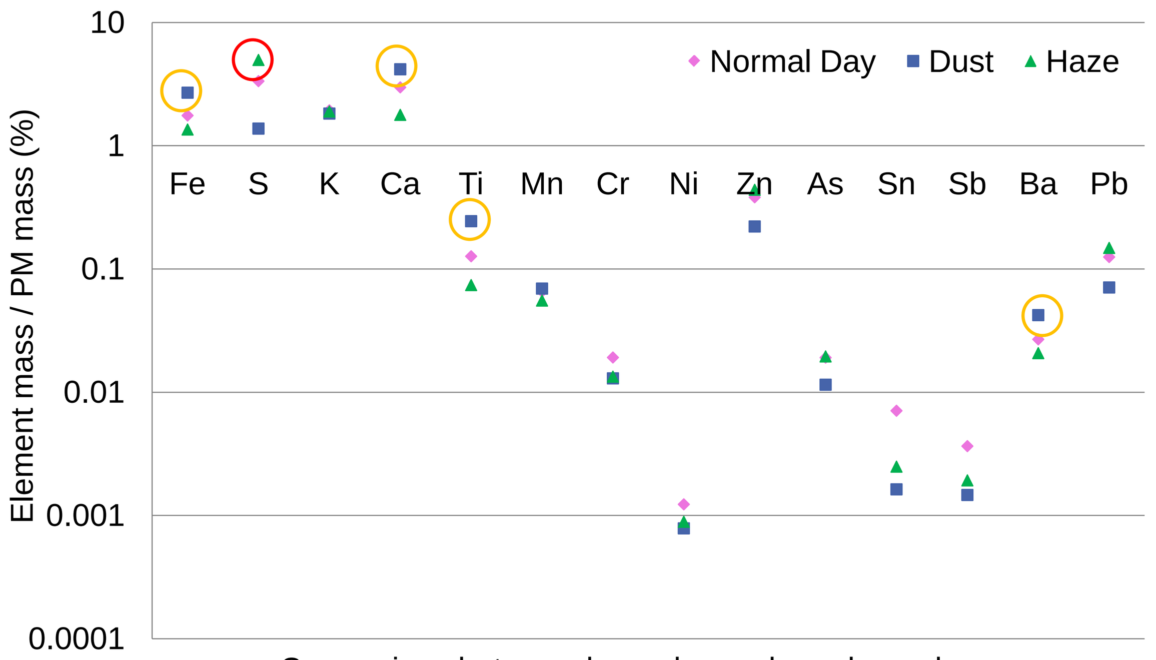


Whole year wind rose in Beijing: prevailing wind direction **north** and **south east**.





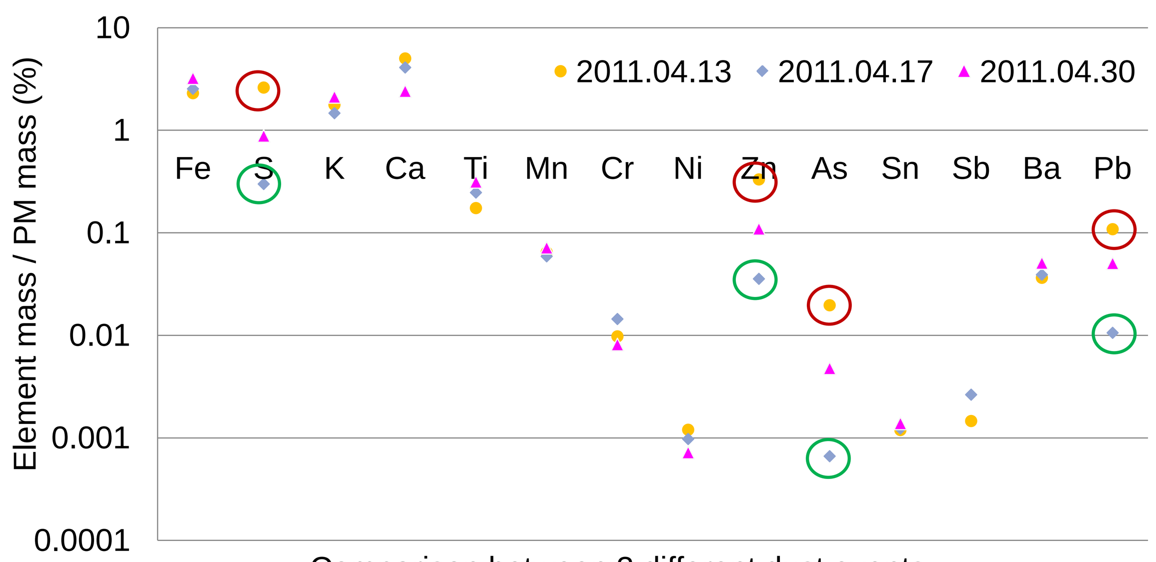
Concentrations of **natural sources** (Fe, Ti and Ba) and **anthropogenic sources** (Zn, As and Pb) in PM: dust storm on 2011.04.30 highest Fe, Ti and Ba concentrations.



Comparison between haze day and non-haze day

Sulfur, Zinc and **Lead** which refer to anthropogenic influences - highest amount during haze days.

Fe, Ti, Ca, Mn, Ba which refer to geogenic sources - highest amount during dust days.

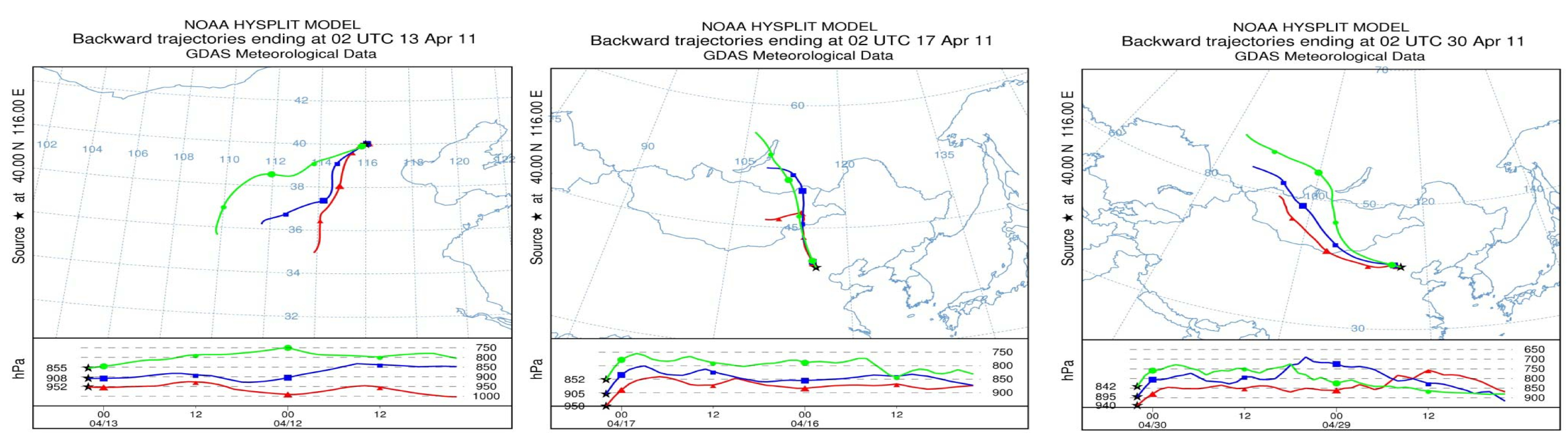


Comparison between 3 different dust events

Sulfur and Zinc highest amount during dust event on 2011.04.13 - influenced by re-suspended dust.

Element	Factor 1	Factor 2	Factor 3
PM	**0.684**	**0.647**	0.129
Fe	**0.944**	0.261	0.107
S	0.009	**0.874**	-0.009
K	**0.620**	**0.653**	0.097
Ca	**0.885**	0.218	0.124
Ti	**0.954**	0.040	0.117
Mn	**0.843**	0.417	0.137
Cr	**0.520**	**0.514**	-0.078
Ni	**0.467**	**0.564**	0.060
Zn	0.367	**0.814**	0.273
As	0.132	**0.677**	0.419
Sn	0.008	0.174	**0.792**
Sb	0.172	0.068	**0.680**
Ba	**0.947**	0.240	0.110
Pb	0.348	**0.850**	0.236

Source apportionment - Factor Analysis:
Factor 1: Geogenic sources
Factor 2: Fossil fuel combustion (oil and coal combustion) and waste incineration
Factor 3: Brake wear



Backward trajectories of 3 different dust events

RESULTS

PM mass concentration:

Highest in April - dust storm, re-suspended road dust.

Lowest in January - low emissions during Spring Festival holiday as well as influenced by wind direction.

Source apportionment by Factor Analysis:

Soil and re-suspended dust (geogenic sources), fossil fuel combustion, waste incineration, and brake wear.

Haze:

S, Zn and Pb - anthropogenic influences - highest contribution to PM and highest mass concentration: relative humidity and wind speed favour formation of secondary aerosols and aggravate pollution level.

Dust:

High PM mass concentration by re-suspended road dust, Mongolian desert and Gobi desert respectively.

CONCLUSIONS

Sources of PM: soil and re-suspended dust (geogenic sources), fossil fuel combustion, waste incineration, and brake wear.

Haze days: highest PM mass concentration from anthropogenic activities, highest sulfur amount.

Dust events: sources different, mainly desert dust, highest Fe, Ti, Ca, Mn, Ba amount.

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