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Approaches to determine the contribution of natural sources to PM_{10} concentrations in North-West Germany

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The 1st EU daughter directive on air quality [Council 1999] includes an exemption from the obligations to draw up action plans if exceedence of the PM_{10} limit value is due to non-anthropogenic influence of natural sources. Moreover, the revised directive [Directive 2008] allow the reporting of contributions by natural sources to PM_{10} concentrations. The reported values will be taken into account if limit values are exceeded. In North-West Germany such influence can predominantly be expected from sea salt advection, soil resuspension and Saharan dust events [see also Bruckmann *et al*., 2008].

Measurements of PM_{10} and PM_1 concentrations and their chemical composition are carried out for more than one year (Feb 2008-March 2009) at two locations in the regional background (site a, mountainous area, ca. 570 m asl) and in urban background, (site b, ca. 40 m asl), respectively. Samples are taken every second day. $PM_{2.5}$ is sampled additionally every third day. Preheated quartz fiber filters (Munktell MK 360) are used, PM_{10} is also sampled on cellulose ester filters (Sartorius) to allow for silicon analyses. To characterise transport effects, back-trajectories based on the NOAA Hysplit model are used [Air Resources Laboratory, 2008].

First measurements and analyses results are directed towards the identification of sea salt contributions. NaCl concentrations and PM_{10} levels are shown in Fig. 1. Characteristic meteorological parameters derived from back-trajectories are presented in table 1.

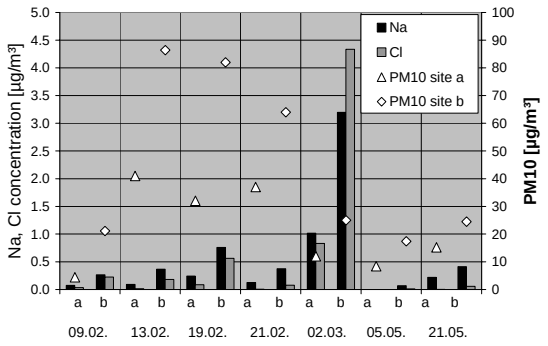

Fig. 1 Concentration of Na, Cl (left y-axis) and PM_{10} (right y-axis), site a: regional b: urban background

Table 1 Meteorological indicators obtained from back-trajectories (evaluated period: -24 h to -48 h)

	wind direction [degrees]		mean velocity [km/h]		mean height of air mass [m agl]		Land index	
site	a	b	a	b	a	b	a	b
09.02.	66	74	32	30	1608	1540	0.90	0.92
13.02.	76	74	16	19	771	1395	1.00	0.98
19.02.	307	307	19	46	492	921	0.47	0.22
21.02.	255	256	18	17	603	584	0.78	0.63
02.03.	272	272	53	64	275	745	0.00	0.00
05.05.	64	61	20	21	1056	1208	0.85	0.79
21.05.	53	40	19	21	390	780	0.82	0.76

Sea salt concentrations do not correlate with PM_{10} and were mostly low, except for the 02.03.08. This corresponds well with the meteorological indicators: low sea salt concentrations are observed at easterly wind directions, low wind speeds and high land index, while on 02.03. westerly wind with high wind speed and 100% residence over sea (zero land index) led to high sea salt concentration. With all samples analysed we will demonstrate the use of a multivariate model connecting trajectory-derived indicators with sea salt concentrations. Further, a method to attribute Saharan dust events will be shown. For this task, various approaches will be needed as recently demonstrated [Bruckmann et al., 2008].

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Air Resources Laboratory, HYSPLIT 4.8 (Feb. 2008) http://www.arl.noaa.gov/HYSPLIT.php

Bruckmann, P.; Birmili, W.; Straub, W.; Pitz, M.; Gladtke, D.; Pfeffer, U.; Hebbinghaus, H.; Wurzler, S.; Olschewski, A. *Gefahrstoffe-Reinhaltung der Luft* 11/12-2008, 490-498

Council Directive 1999/30/EC of 22nd April 1999 to limit values for sulphur, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air. *Official Journal* L 136 from 29.06.1999, p. 41-60.

Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe. *Official Journal* L152 from 11/06/2008