Chemical characterization of mineral dust at Dushanbe, Tajikistan

K. Wadinga Fomba*[1], K. Müller[1], J. Hofer[1], D. Althausen[1], H. Herrmann[1]
A. Makhmudov[2], S.Abdullaev[2]

1 Leibniz-Institute for Tropospheric Research, Leipzig, Germany
2 *Academy of Sciences of Republic of Tajikistan, Physical-technical institute, Department of Physical atmosphere*

Central Asian Dust EXperiment
2014-2016 CADEX Tajikistan
38°33'N, 68°51'E, 864 m a.s.l.
vertical + column + meteorological measurements

TROPOS
Leibniz Institute for Tropospheric Research

Member of the Leibniz Association

Introduction

Mineral dust is a significant source of ambient pollution. At Duschanbe, mineral dust originating from Desert regions such as Karakum, Dawir, Lut is often observed at relatively high concentrations. During the CADEX experiment, the chemical composition of mineral dust was characterized to determine the sources and mass concentration levels of important aerosol chemical components such as, aerosol trace metals, elemental and organic carbon, inorganic and organic ions. Furthermore, the effect of the changing mineral dust composition on the mineral dust radiative properties was also investigated.

Fig.1: *Measurement site with high volume sampler*

Methods and Measurements

Aerosol samples were collected in a 48 h routine using a high volume sampler (Digitel DHA-80) on quarz fiber filters. The samples were analyzed for soluble ions (via IC), elemental and organic carbon (thermal desorption) as well as trace metals (via Total Reflection X-ray Flourescence, TXRF).

Results

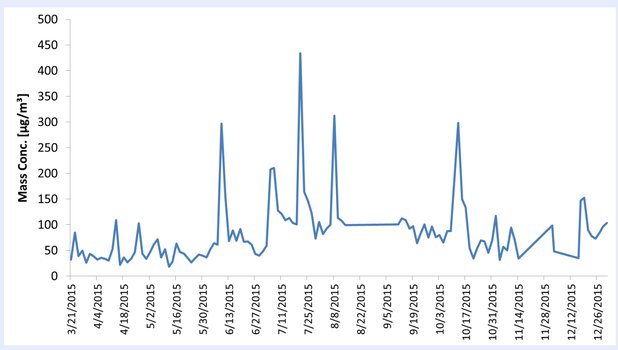

Fig. 2: *Mass concentration variation at Dushanbe from March to December 2015.*

Strong variation in aerosol mass concentration was observed with 48 h average concentrations ranging from 20 to 425 µg/m³. Spikes indicate days of strong dust influence on aerosol loadings. Westerly air masses led to high conc. while air masses from the south led to lower mass conc.

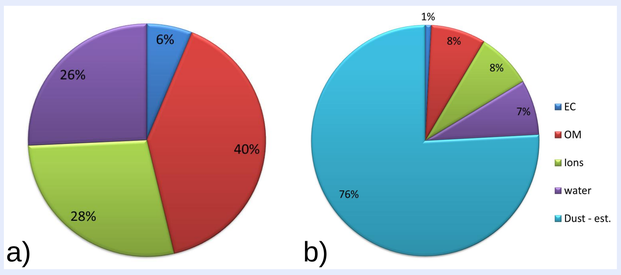

Fig. 3: *Aerosol chemical composition during days of a) less dust (31.03-02.04) and b) high dust (29.04.2015) loadings*

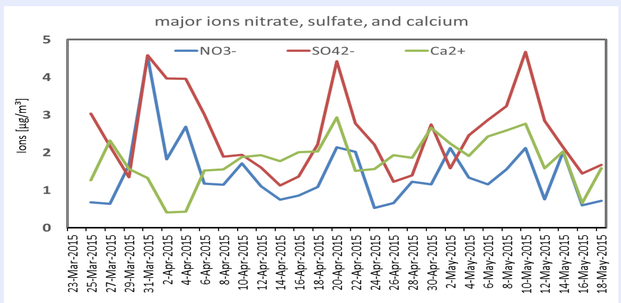

Fig. 4: *Temporal variation of nitrate, sulfate and calcium between March and May 2015*

Anions concentrations were similar to those observed at other sites in Germany. Often, good correlation was observed between nitrate and sulfate.

Conclusions and Outlook

- Strong air mass influence on aerosol loadings observed
- Coal combustion, traffic and metallurgical industry are main sources or local emissions
- Mineral dust at Dushanbe is more Ca and Fe-rich in comparison to Saharan dust
- Correlation of mineral dust composition and radiative effects in progress

Results

a)

	Max	Min	Average	Stdev
DUST (µg/m³)	77	3	26	17
Ca	6526	191	2312	1570
Fe	2610	106	862	588
Al	1953	29	761	496
K	1222	255	564	218
Zn	792	29	244	185
Ti	140	3	49	32
Pb	78	8	31	18
Mn	62	10	24	13
Cr	6.4	0.8	2.7	1.4
V	5.7	0.2	2.1	1.3
Cu	5.4	0.9	2.6	1.2
As	4.1	0.0	0.7	0.7
Ni	3.7	0.7	1.7	0.9
Co	3.5	0.0	0.7	0.8
Se	0.7	0.1	0.3	0.1

b)

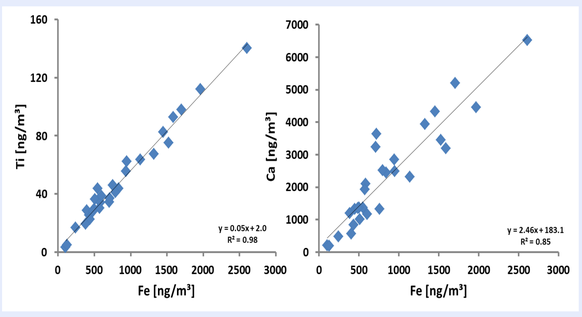

Fig. 5: *a)Trace metal and mineral dust concentration between March and May 2015 and b) good correlation between iron, calcium and titanium indicating strong influence of mineral dust*

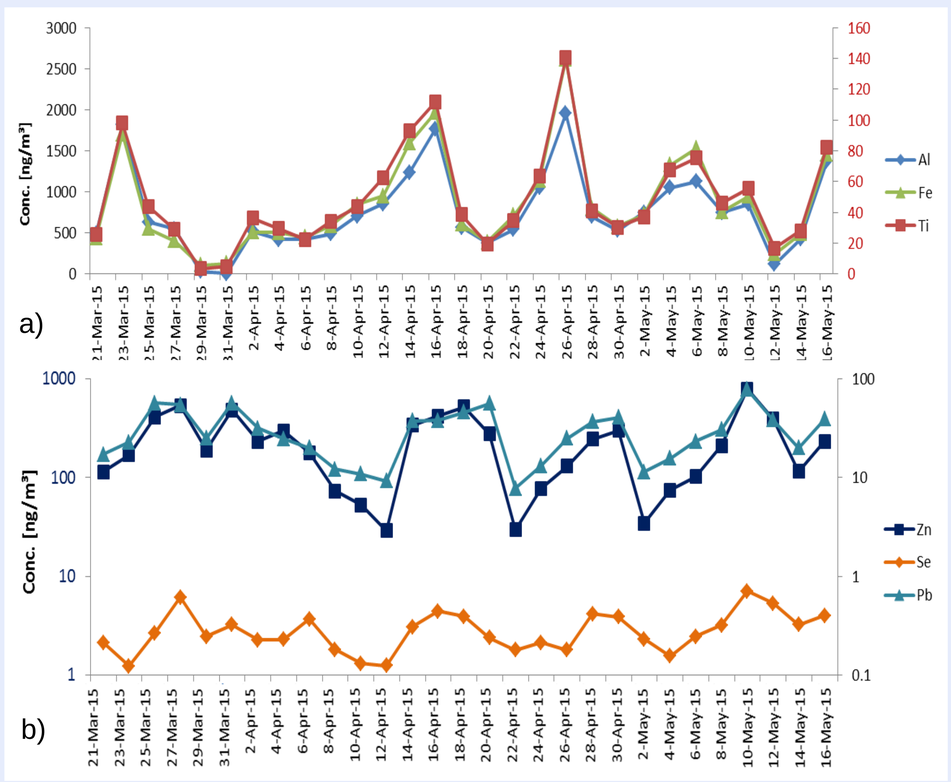

Fig. 6: *Temporal variation of a) mineral dust and b) anthropogenically emitted trace metals between March and May 2015. Spikes indicate days of high dust and local pollution influence*

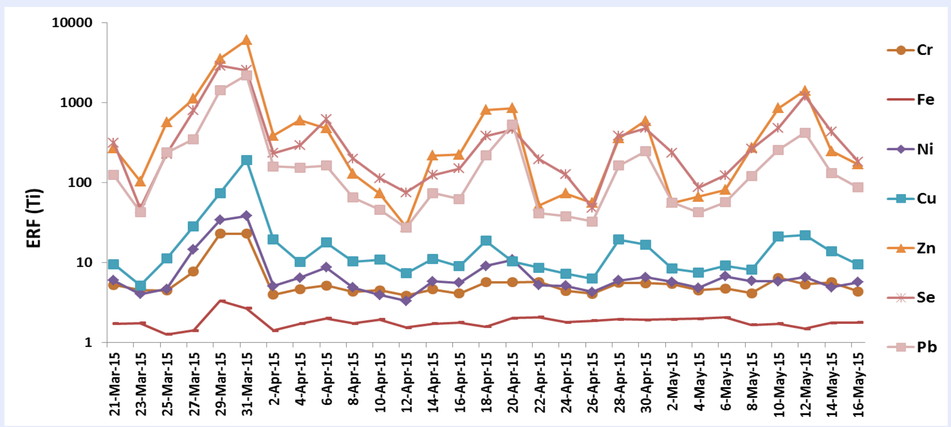

Fig. 7: *Temporal variation of enriched anthropogenic trace metals indicating different dominant sources such as metalurgicall industry, traffic and combustion sources*

Z/Ti	CVAO Cape Verde	Dushanbe
Fe	10.84	18.3
Ca	12.2	47.5
Mn	0.25	0.46
Co	0.02	0.016

Asian dust at Dushanbe shows higher iron and calcium content than Saharan dust observed at Cape Verde