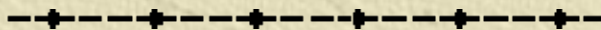


# INFLUENCE OF SIBERIAN CITIES WITH DIFFERENT INDUSTRIAL LOADING ON CHEMICAL AND DISPERSIVE COMPOSITION OF ATMOSPHERIC AEROSOL

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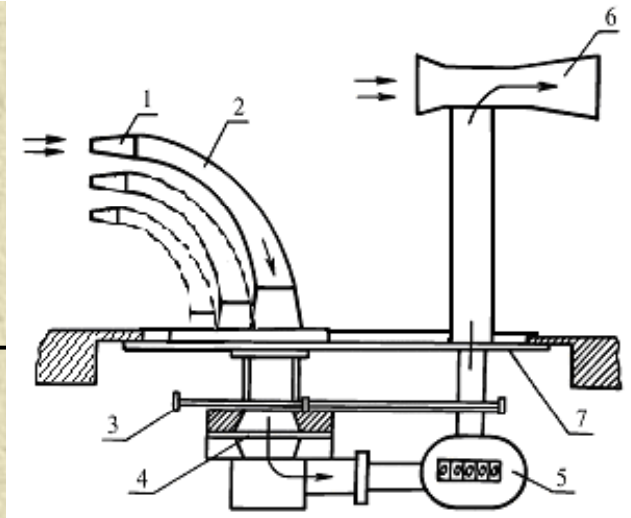
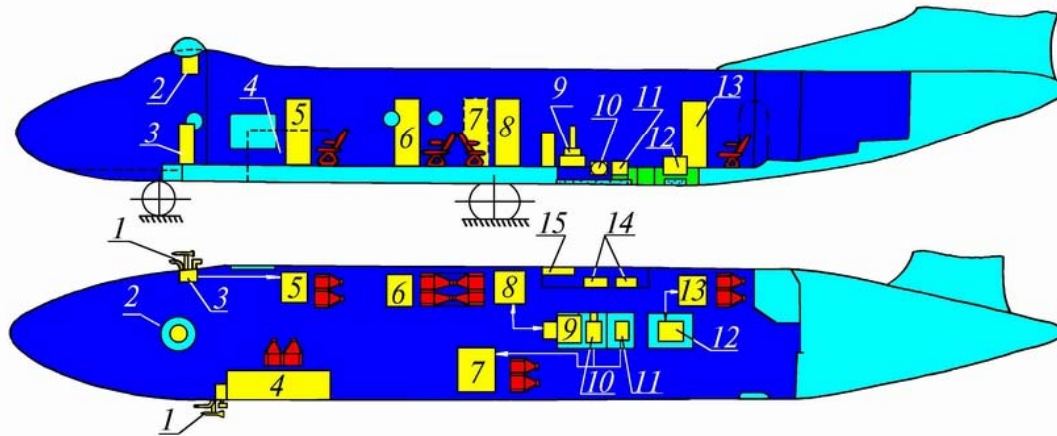


# Purpose of the study:

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- ✦ To investigate influences of cities with different industrial loading on dispersive and chemical (contents of ions and elements) composition of atmospheric aerosol

# Means

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- ✦ The measurements in the atmosphere of urban and suburban areas by means of both aircraft-laboratory and (mobile) stations, including synchronous surface measurements at two sites - the background and nearby the city.



c) Sampler on Kireevsk site, April 2001

a) Aircraft-Laboratory "Optic-E"  
 (a) based on "Antonov-30" includes 1- air intake, and 3 – air sampler for aerosol sampling on Petryanov's filters (b) with particle counters AZ-5 (12 canals in 0.4- >10  $\mu\text{m}$  range), disposed under them.

In case of synchronous campaigns both surface measurement complexes included two similar samplers (photo - c) and AZ-5.

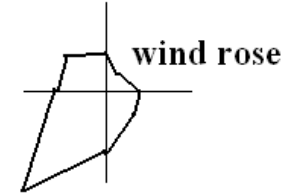
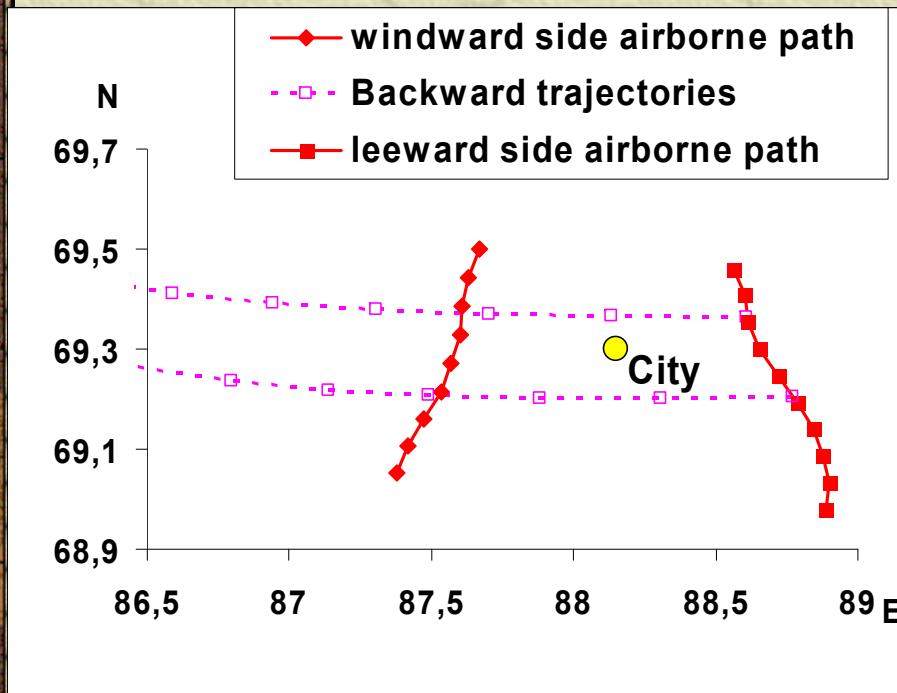
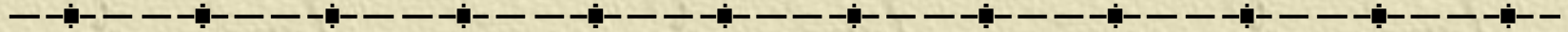
## Detection thresholds of the methods used for analysis of the atmospheric aerosol sampled on Petryanov's filters

Components	Method for determination	DTh, $\mu\text{g}/\text{filter}$	Error, %
$\text{NO}_3^-$ , $\text{SO}_4^{2-}$	Ion chromatography	0,6	8
$\text{Cl}^-$	Ion chromatography	0,1	12
$\text{F}^-$ , $\text{NH}_4^+$ , $\text{NO}_3^-$	Ionometry	0,2	10
Al, Co, Cr, Mo, Ni, Ti, Zn, B, Si	Atomic emission spectroscopy (AES)	0,02	20
Ag, Ba, Cu, Pb, Sn, V, Mg, Mn	Atomic emission spectroscopy (AES)	0,01	20
Fe, Ga, W	AES	0,1	20
Ca, Cd	AES	0,2	20
$\text{Na}^+$ , $\text{K}^+$	Atomic absorption	0,2	10

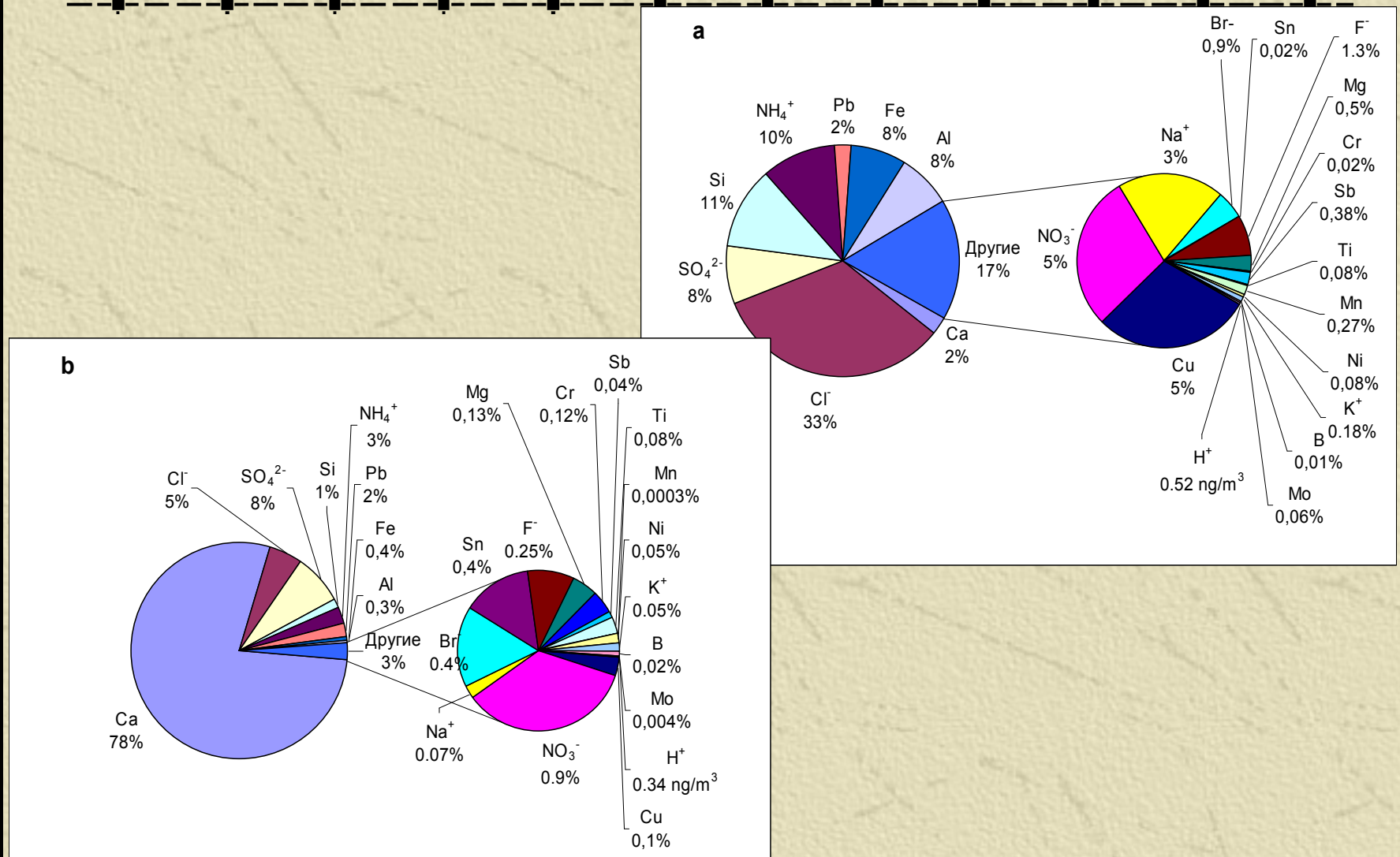
# Investigating influences of cities

1) free atmosphere

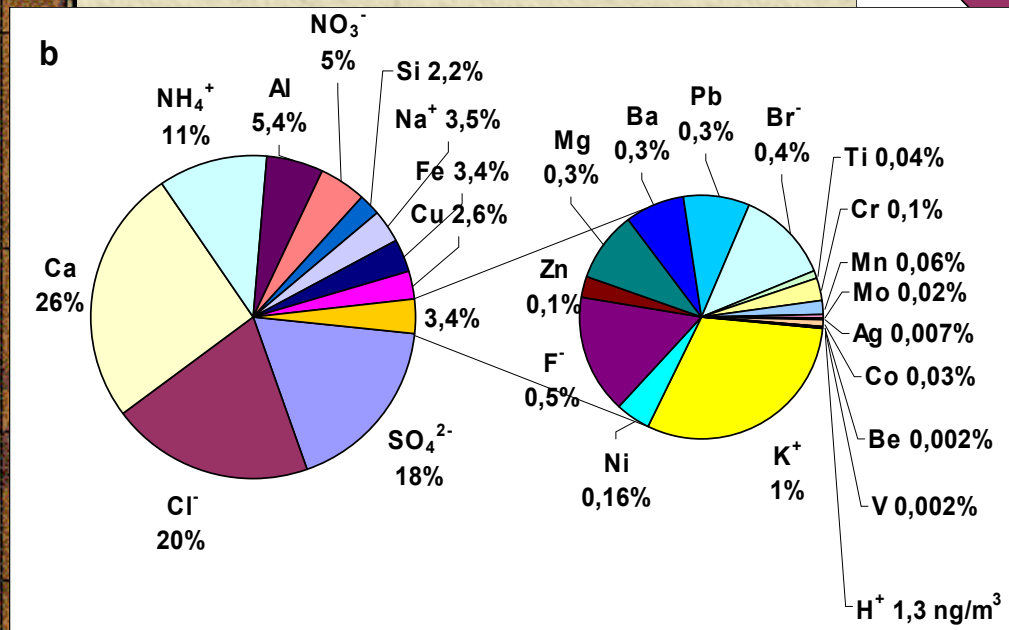
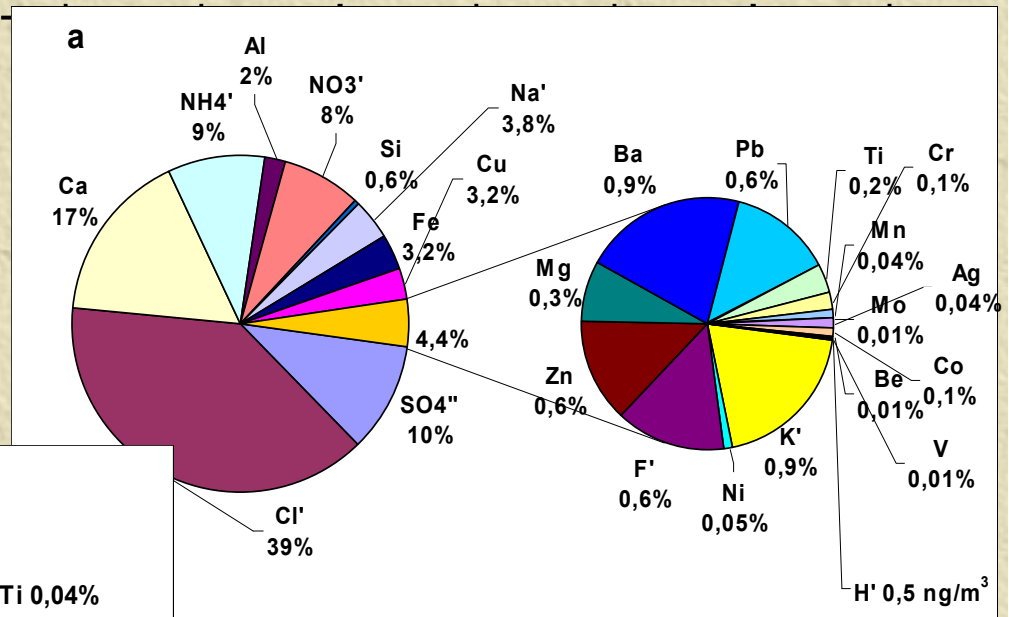
2) surface layer



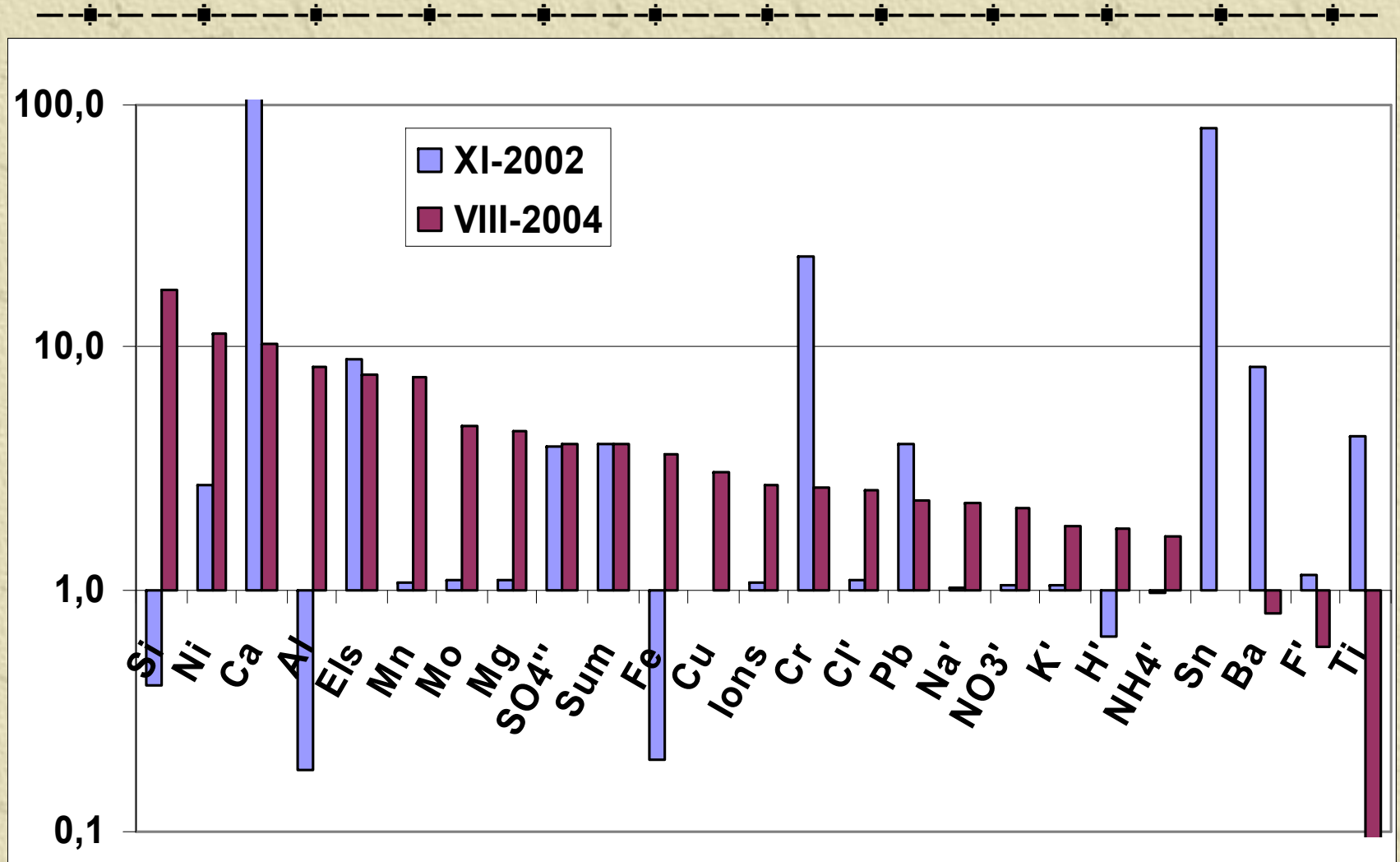
# 1) Relative chemical composition of aerosol on windward side (a – 11,3 $\mu\text{g}/\text{m}^3$ ) and leeward side (b – 45,4 $\mu\text{g}/\text{m}^3$ ) in 400-1000 m atmospheric layer of Norilsk industry region in November 2002



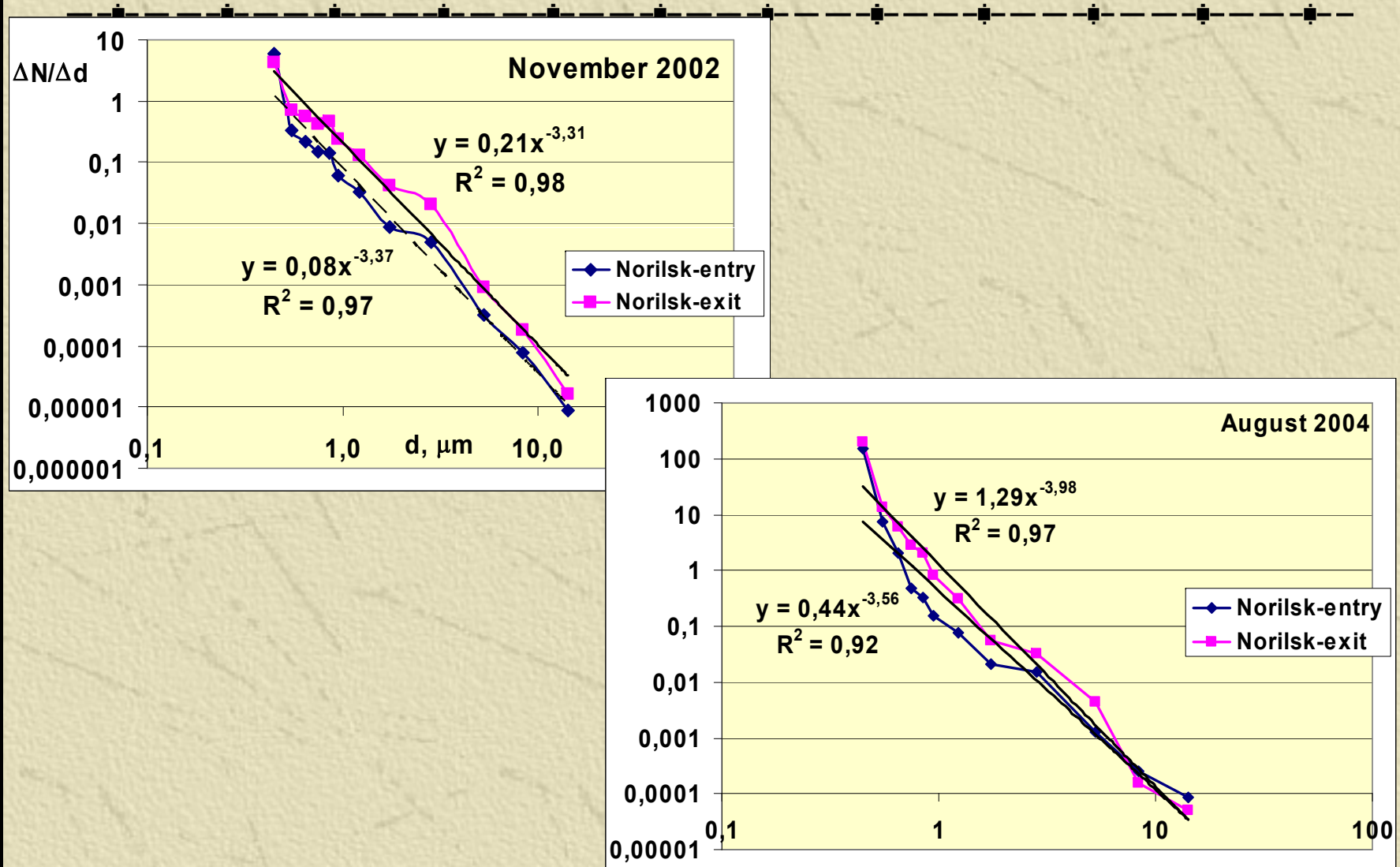
# Relative chemical composition of aerosol on windward side (a – 8,8 $\mu\text{g}/\text{m}^3$ ) and leeward side (b – 31,8 $\mu\text{g}/\text{m}^3$ ) in 500-2000 m atmospheric layer of Norilsk industry region in August 2004

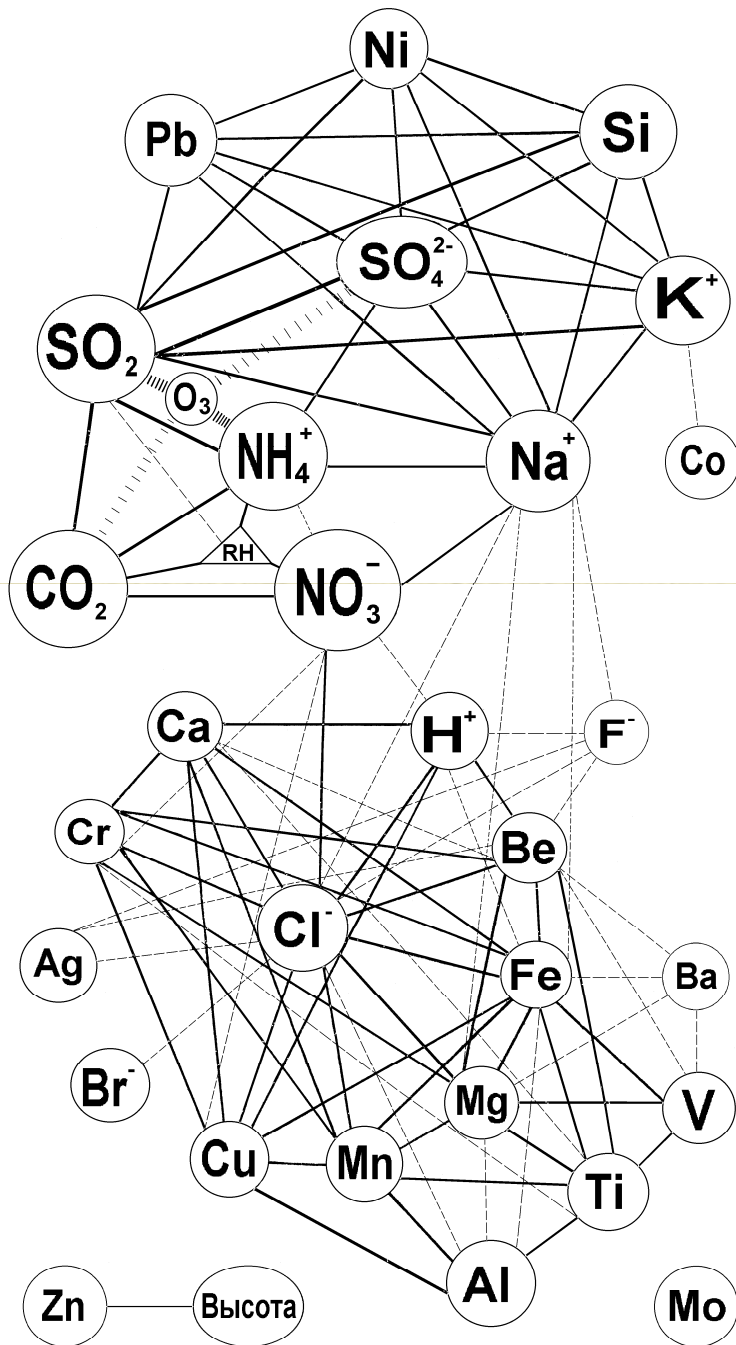


# Enrichment of inorganic chemical component into aerosol matter in passing air mass over Norilsk industry region

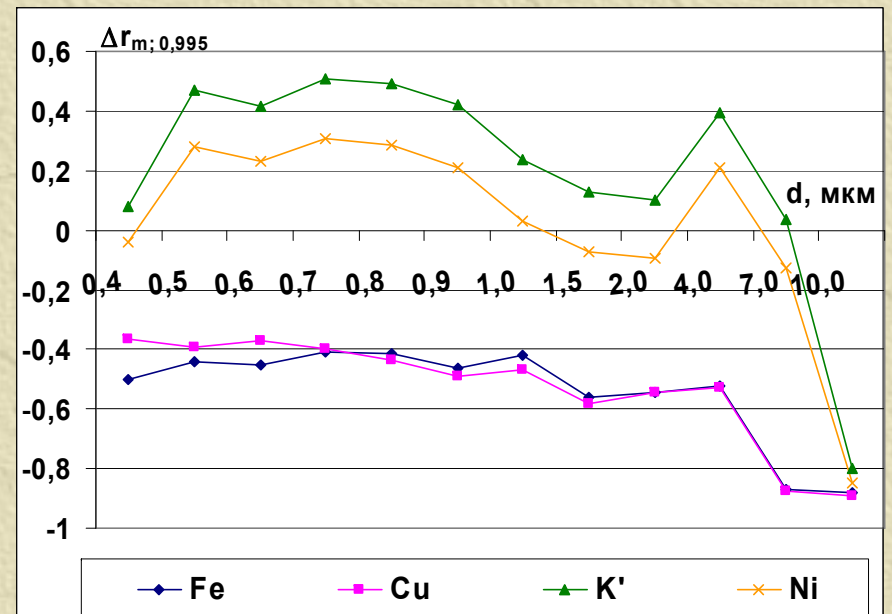
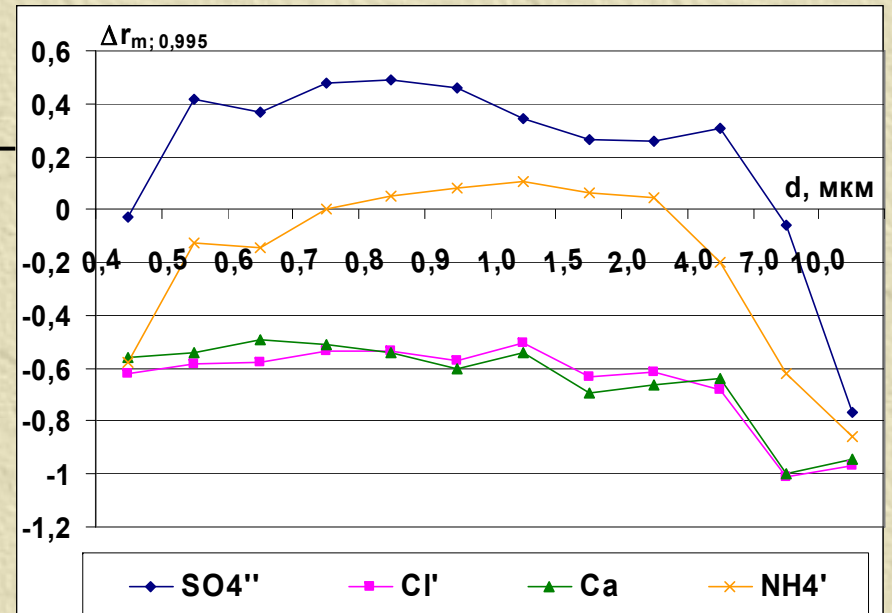


# Dispersivity of background and industry aerosol in different seasons in Norilsk region





## Aerosol chemical matrix of Norilsk region

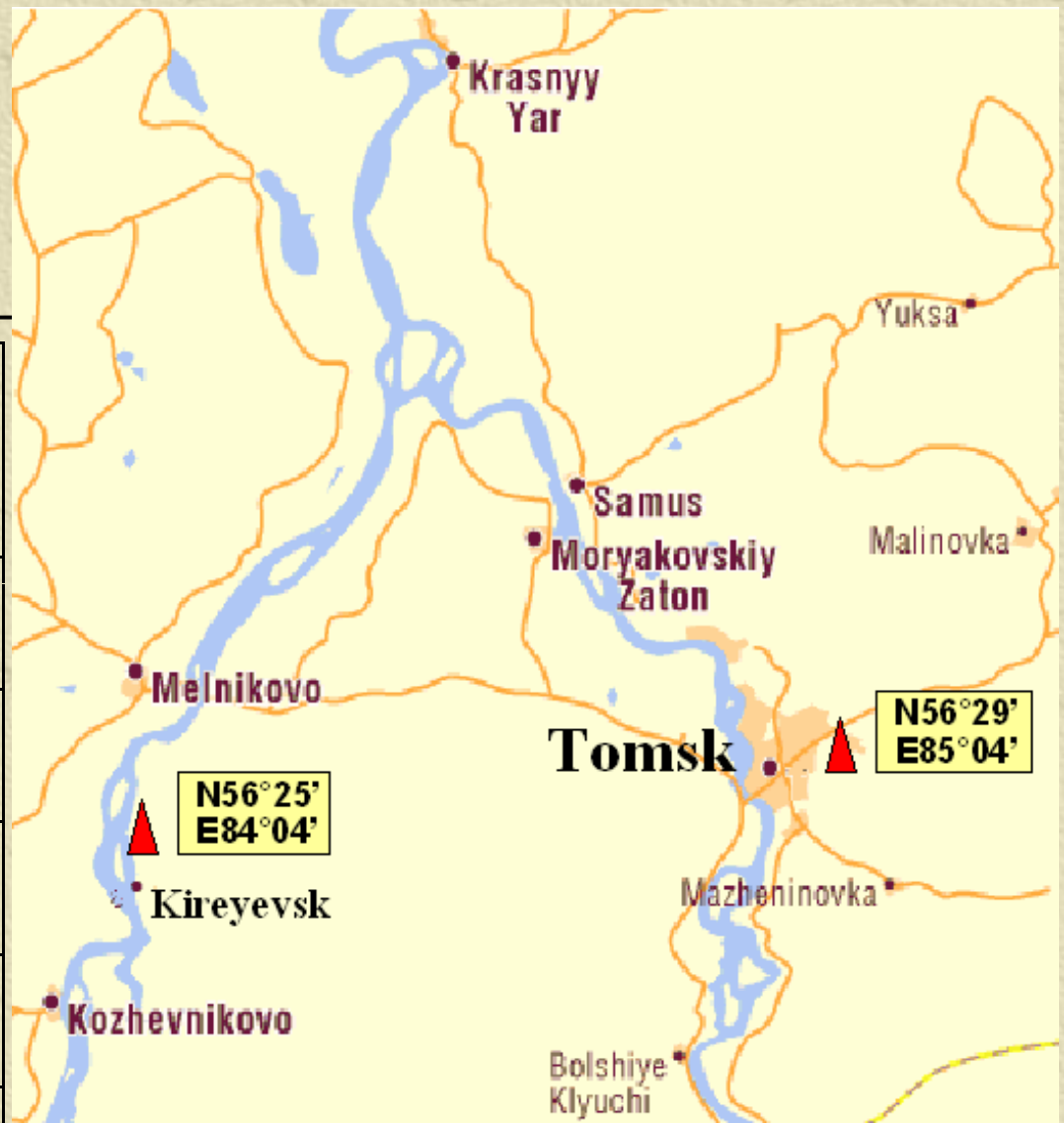


# Conclusion 1

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- ✦ The aerosol field over a big enough city with high industrial loading are determined by character of manufacture in significant degree.

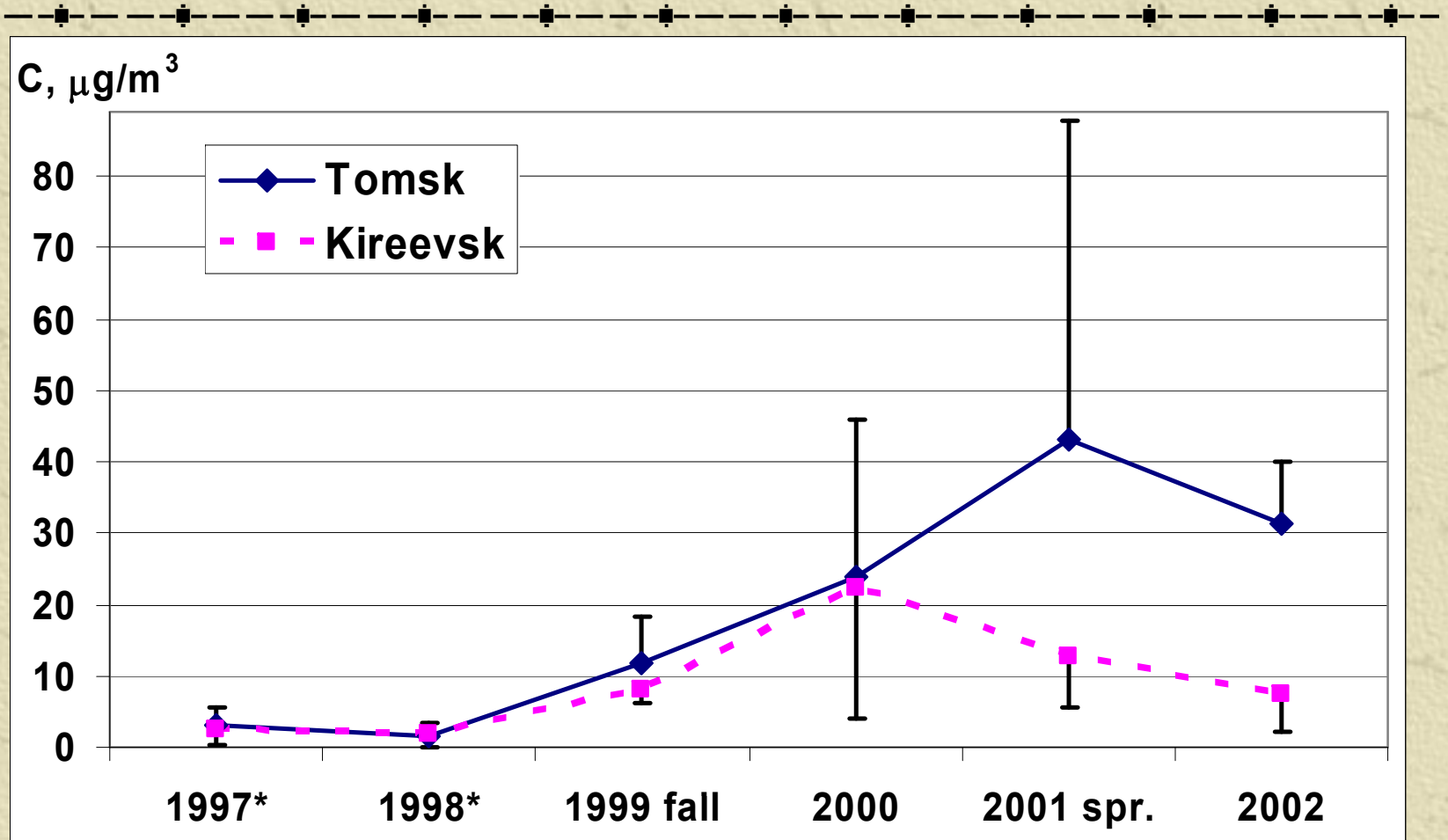
## 2) **Sites**, periods and statistics of synchronous sampling:

Periods of synchronous sampling	The number of sample pairs
31.07 - 24.08. 1997	25
15.07 - 25.08. 1998	28
22.10 - 15.11. 1999	7
29.06 - 27.06. 2000	15
07.03 - 26.04. 2001	43
8 - 27.08. 2002	6



Synchronous measurements at two sites, the background one in the rural area of Tomsk region (nearby Kireevsk), and an urban one near the city of Tomsk (Akademgorodok)

## Behaviour of mean-run sum of defined aerosol components.



\* - without matrix element Al, Si; T – standart deviation for the run

[Tomsk]/[Kireevsk] ratios for inorganic components in aerosol matter

	1997 summer	1998 summer	1999 autumn	2000 summer	2001 spring	2002 summer
<b>Sum</b>	1,11	0,75	1,42	1,03	3,64	3,17
Na <sup>+</sup>	0,97	1,82	0,62	0,18	1,54	1,63
K <sup>+</sup>	0,85	0,45	1,17	1,30	2,45	0,95
Ca	1,13	0,33	0,94	1,16	1,66	3,09
Br <sup>-</sup>	0,70	-	0,70	1,32	1,35	6,75
Mg	0,85	2,73	1,11	0,96	3,57	2,97
Cl <sup>-</sup>	0,56	2,31	2,16	1,74	1,24	6,71
Cr	0,14	3,76	0,16	0,70	0,19	3,48
Ba	1,07	3,16	2,40	1,41	0,56	-
Ti	1,92	4,11	1,04	1,31	-	2,73
Si	-	-	1,03	1,28	5,11	3,21
Fe	2,56	0,14	1,18	0,81	1,43	7,95
Al	-	-	0,93	0,62	1,09	10,22
Mo	0,69	0,99	0,29	0,76	1,09	-
V	1,65	1,38	0,11	1,26	0,53	-
Cu	0,82	0,05	0,22	2,35	2,49	0,19
SO <sub>4</sub> <sup>2-</sup>	1,18	0,92	2,33	1,12	0,91	0,90
NO <sub>3</sub> <sup>-</sup>	1,67	1,03	1,54	1,07	1,16	4,26
NH <sub>4</sub> <sup>+</sup>	9,16	-	-	1,39	0,96	0,58
Ni	0,43	3,34	0,05	0,60	6,62	1,23
Pb	1,07	5,00	1,81	1,45	1,68	1,68
F <sup>-</sup>	1,90	0,91	-	0,77	2,29	17,82
Mn	0,91	1,73	0,67	1,11	2,35	33,48

## Dominating air transport in the region during the measurement (in % on synoptical maps AT-700/850)

	<b>1997</b> summer	<b>1998</b> summer	<b>1999</b> autumn	<b>2000</b> summer	<b>2001</b> spring	<b>2002</b> summer
<b>0</b>	17	25	-	27	10	-
<b>45</b>	7	14	-	-	-	-
<b>90</b>	3	11	-	-	-	-
<b>135</b>	-	-	-	-	-	-
<b>180</b>	3	7	-	7	-	17
<b>225</b>	28	7	29	13	28	33
<b>270</b>	31	25	57	27	53	33
<b>315</b>	10	11	14	27	10	17

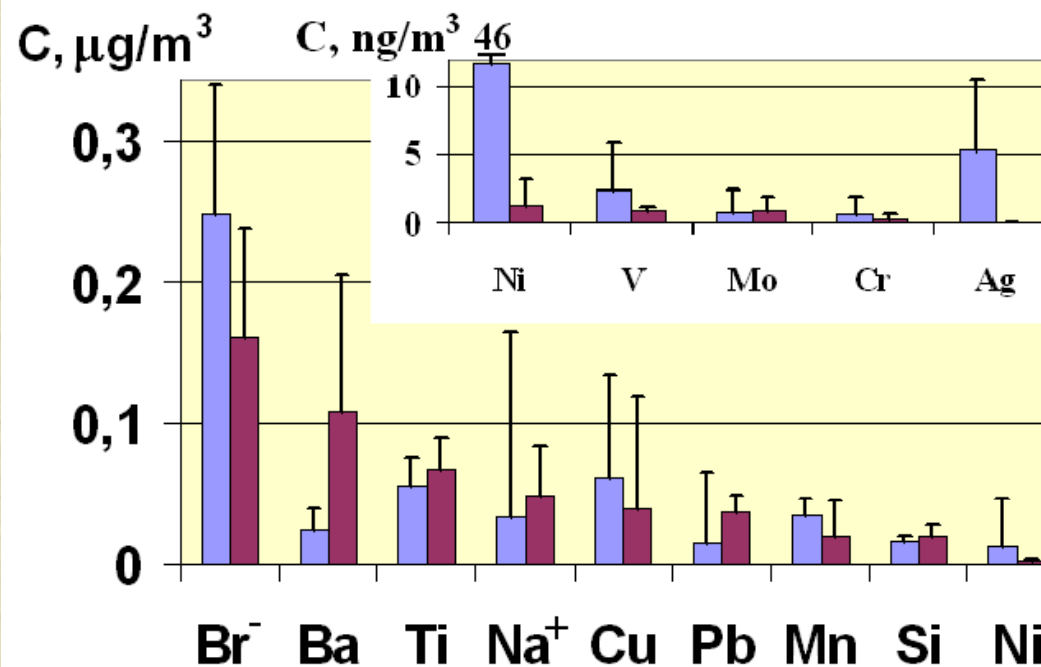
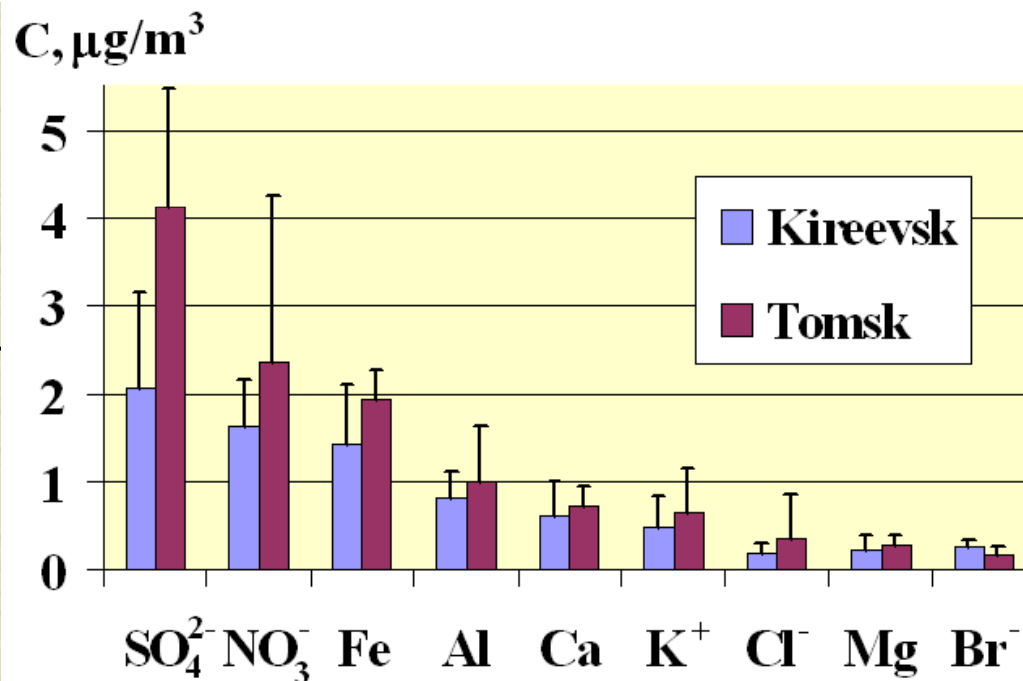


Means, standart deviations for aerosol component concentrations during autumn (22.10-15.11.1999) run

Weather comments:  
20-21.10 – Passage of a number of cold fronts with snow precipitations and intrusion of polar air masses – presence of snow cover during all autumn run.

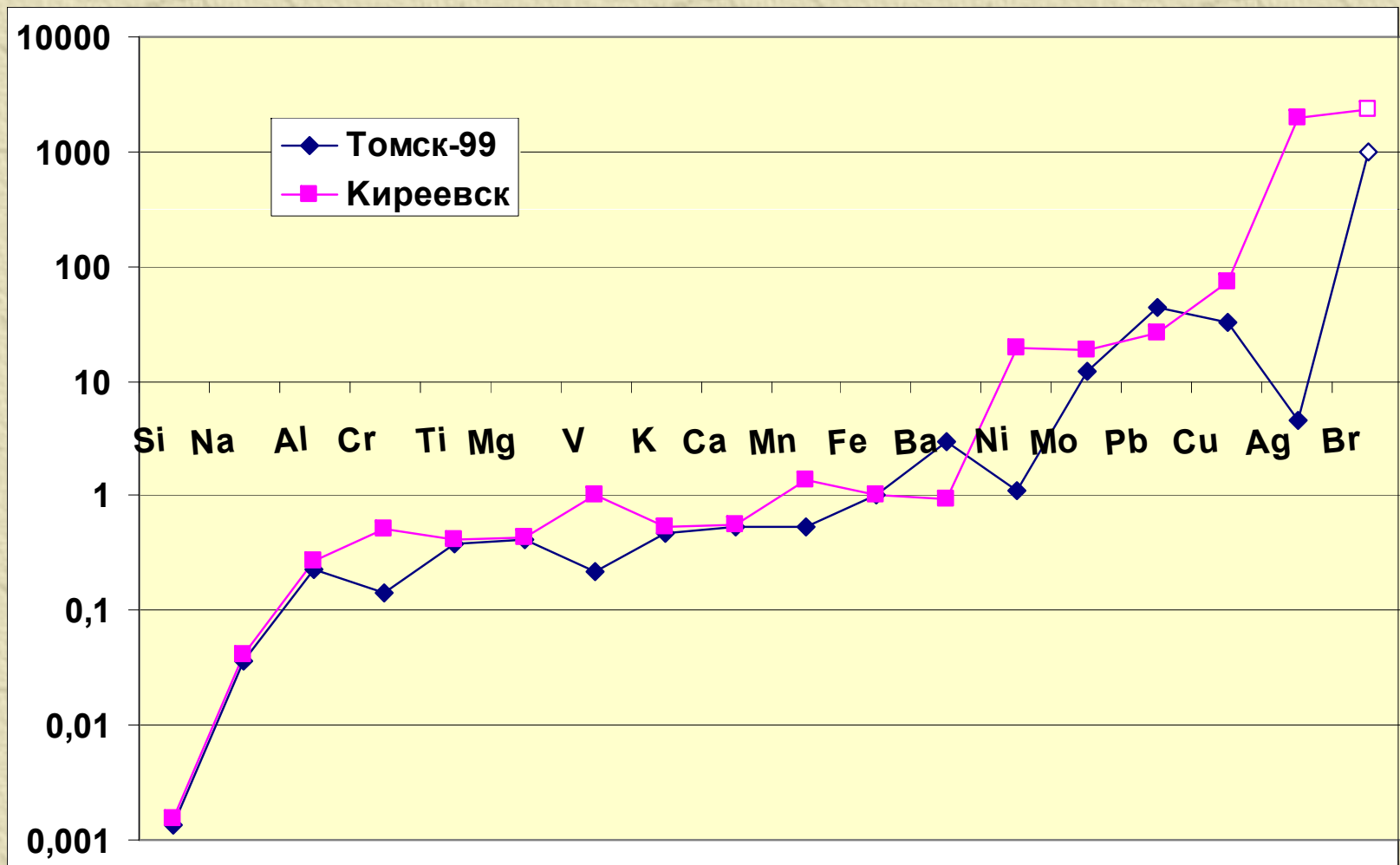
Back behaviour:

Br, Cu, Mn, Ni, V, Ag

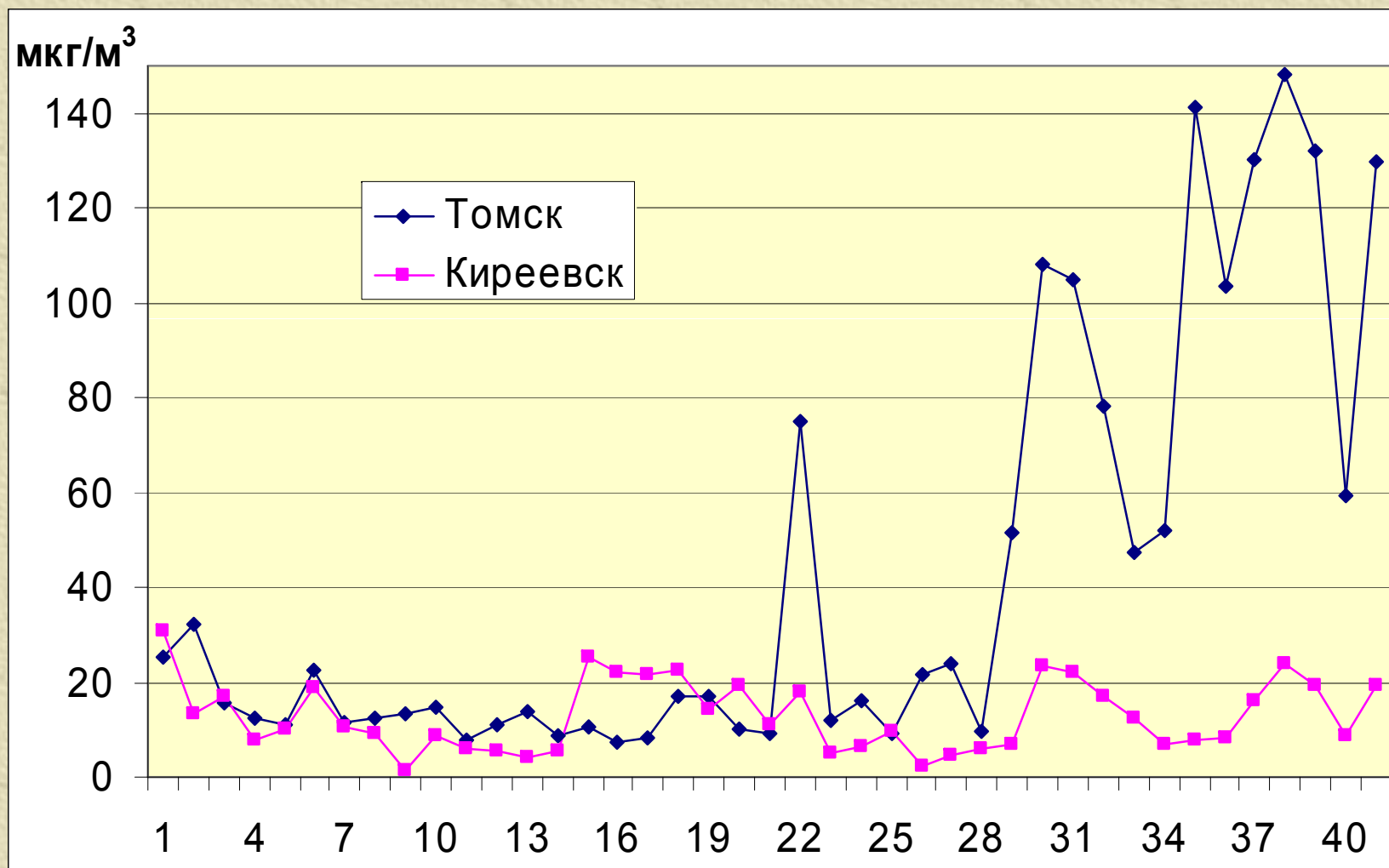


# Ratio of enrichment for aerosol element on Fe

( >10 – antropogenic origin criterium )

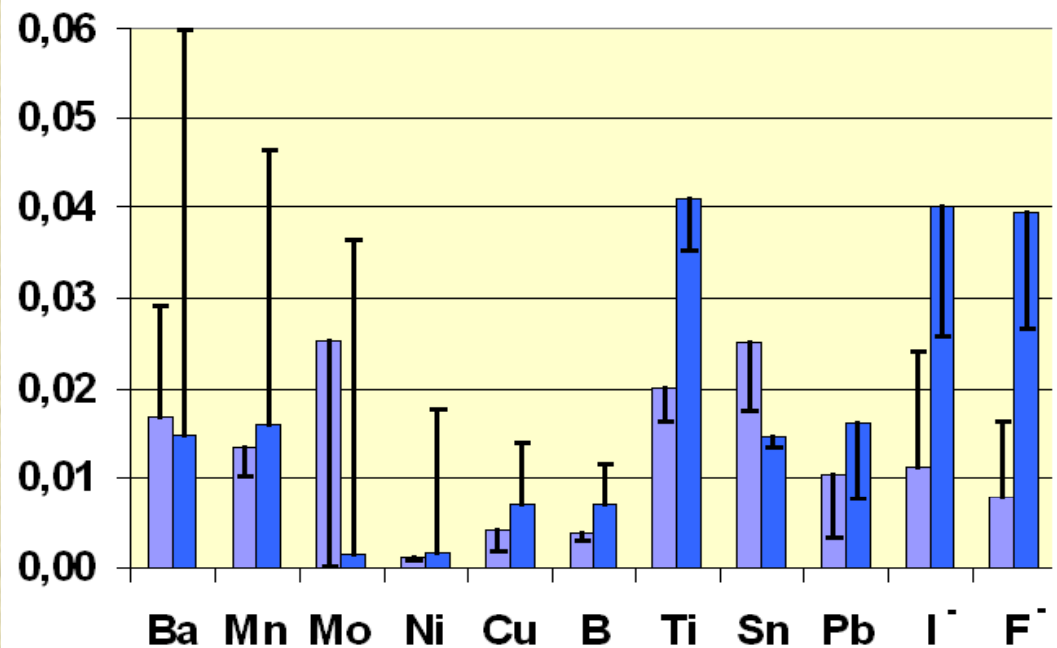
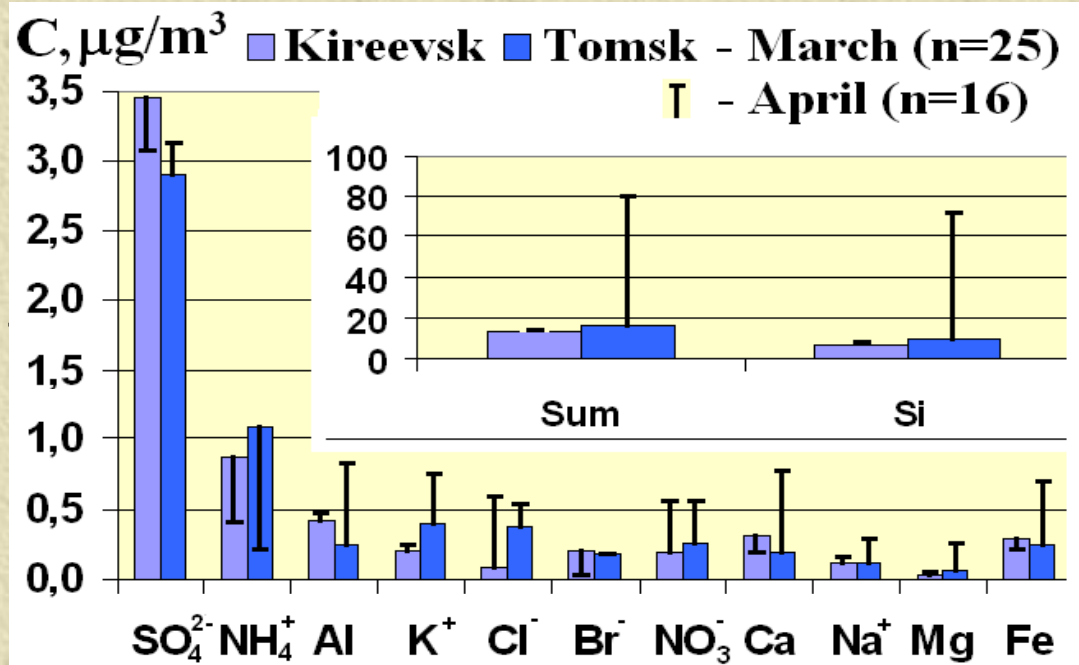


## Temporal course daily-mean ion-elemental sums of aerosol matter during March and April 2001



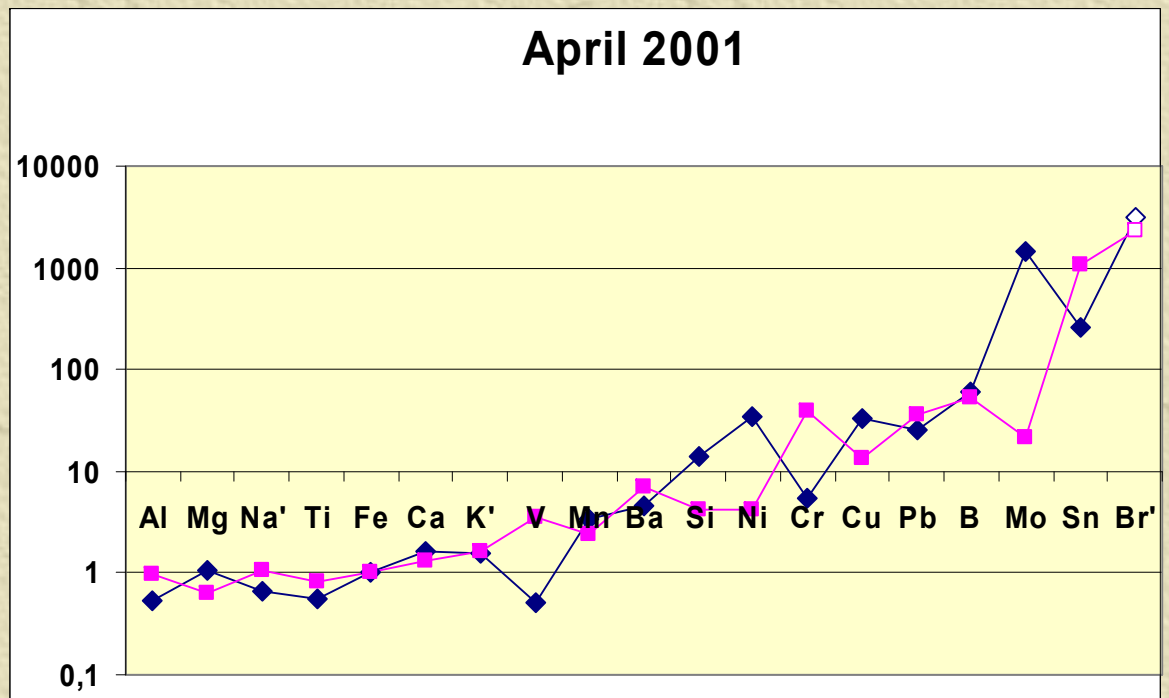
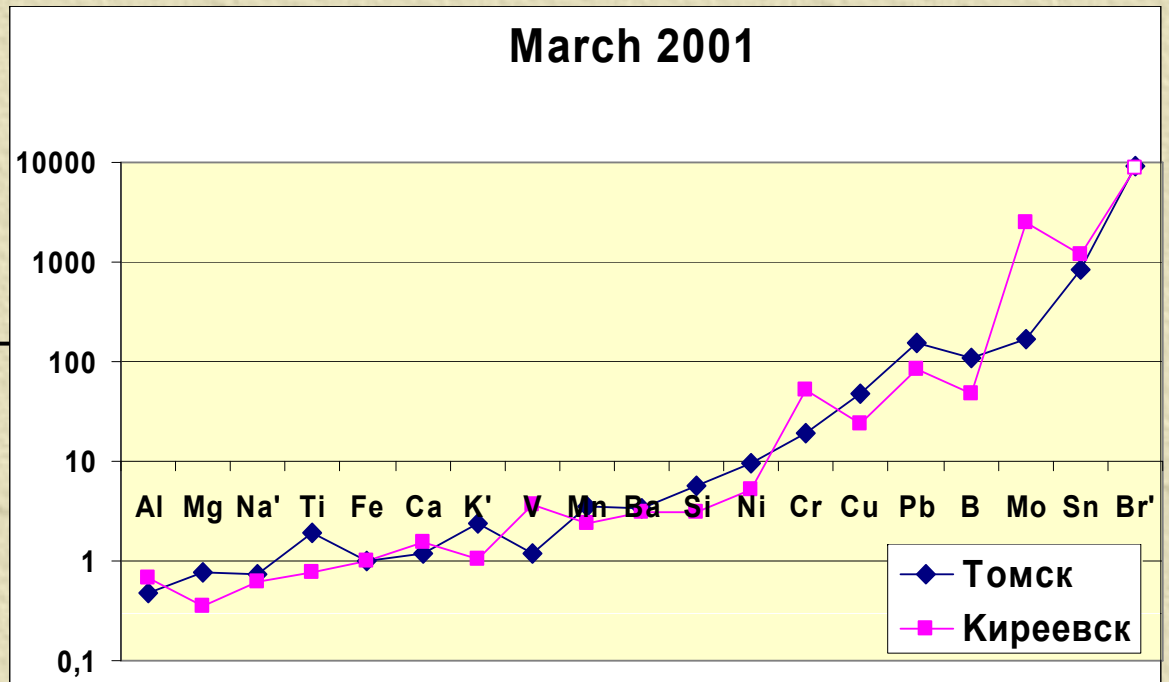
correlation between rows equal 0,314

Average values  
of aerosol  
matter chemical  
component  
during 2  
subperiods of  
2001 spring  
measurement  
runs

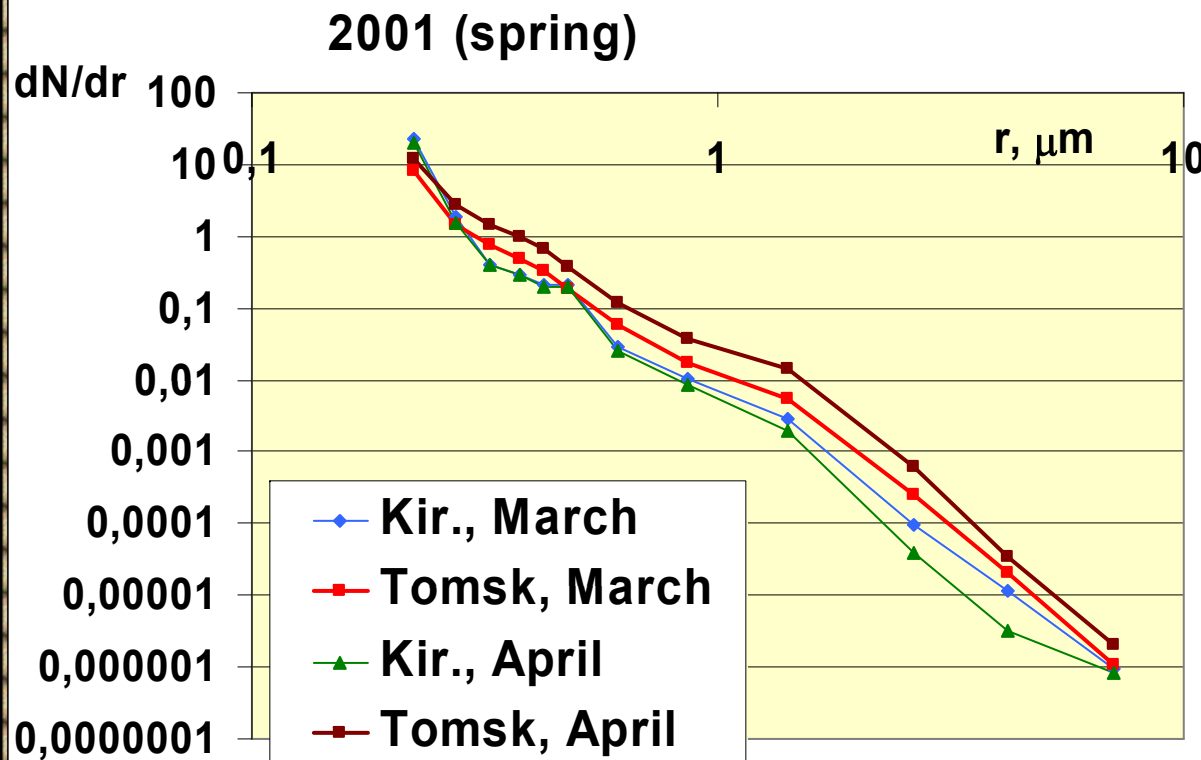
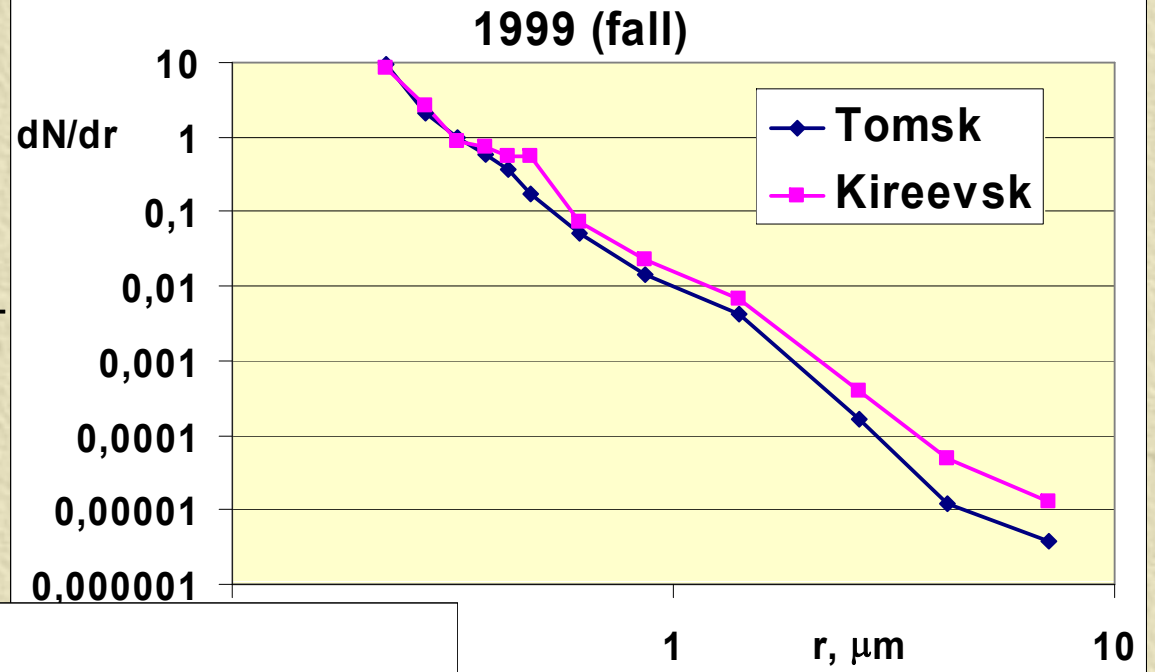
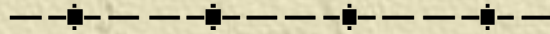


# Behaviour of enrichment on iron

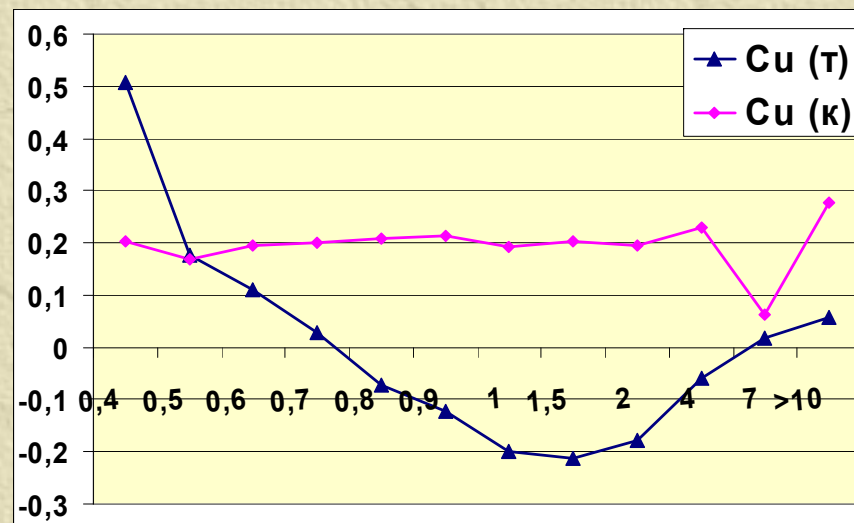
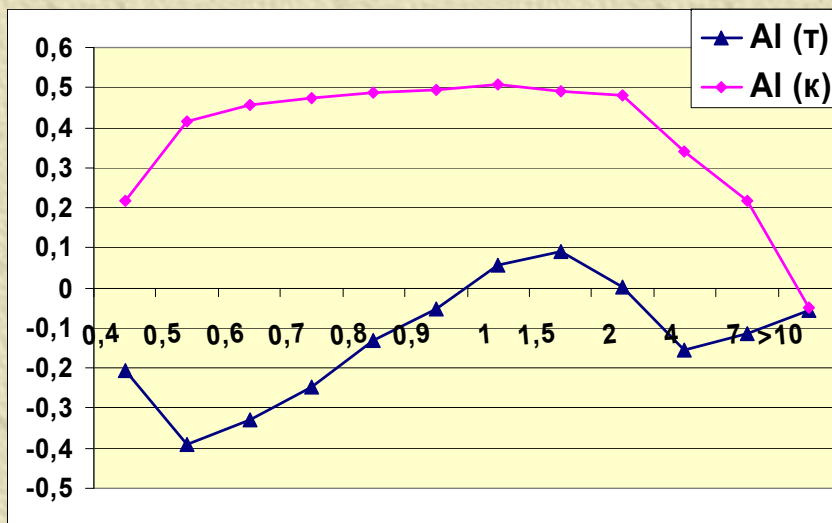
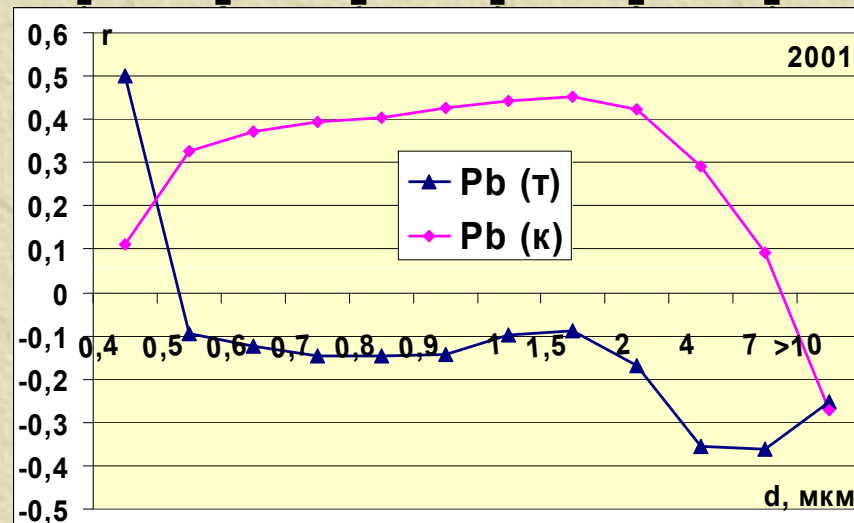
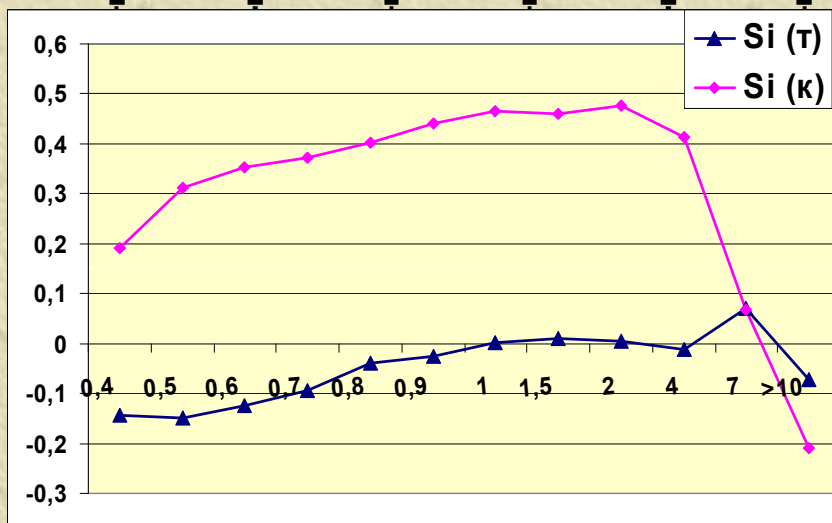
Relative contents of «background» for polar air mass (Ni, Mo) antropogenic elements decrease in Kireevsk, but grow in Tomsk, in which, however, enrichment for Pb (always typical for urban air) falls on order of magnitude.



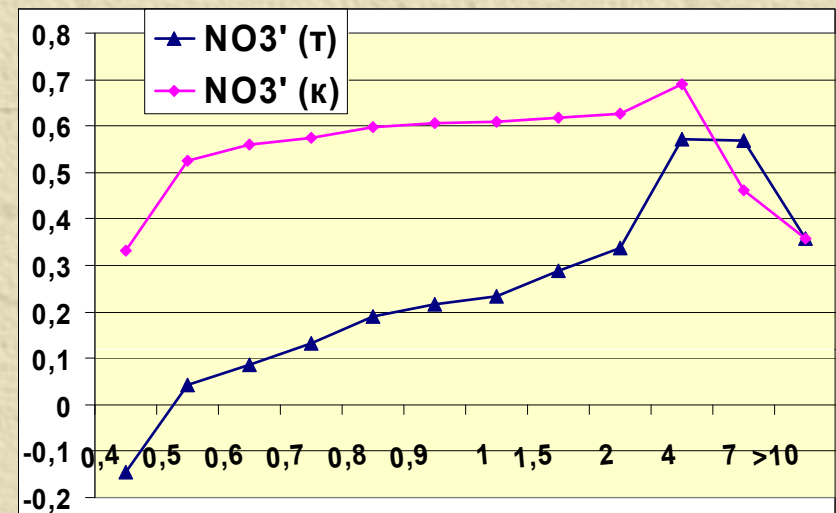
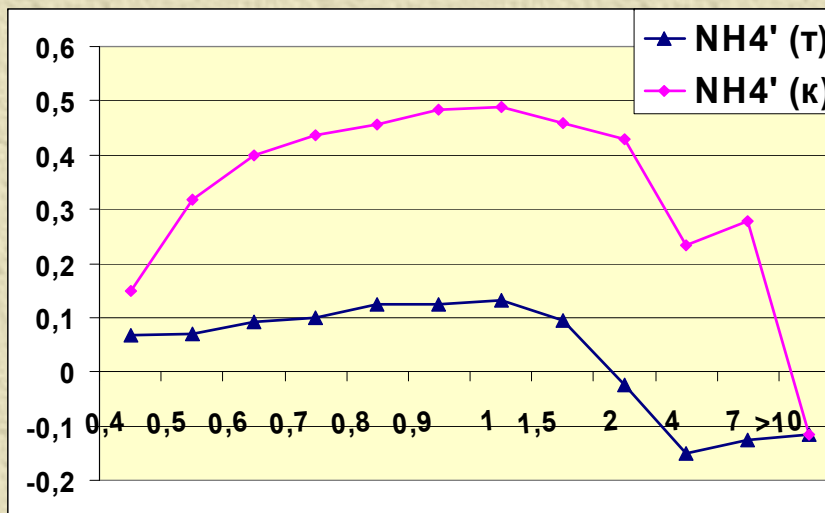
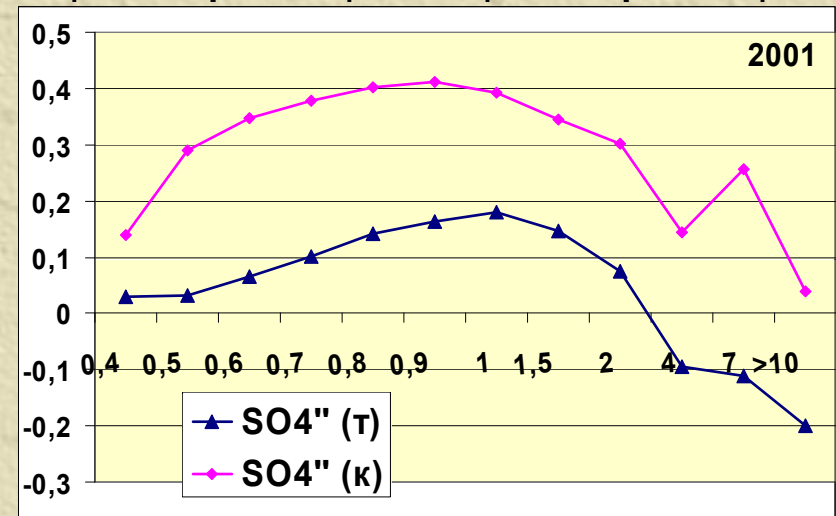
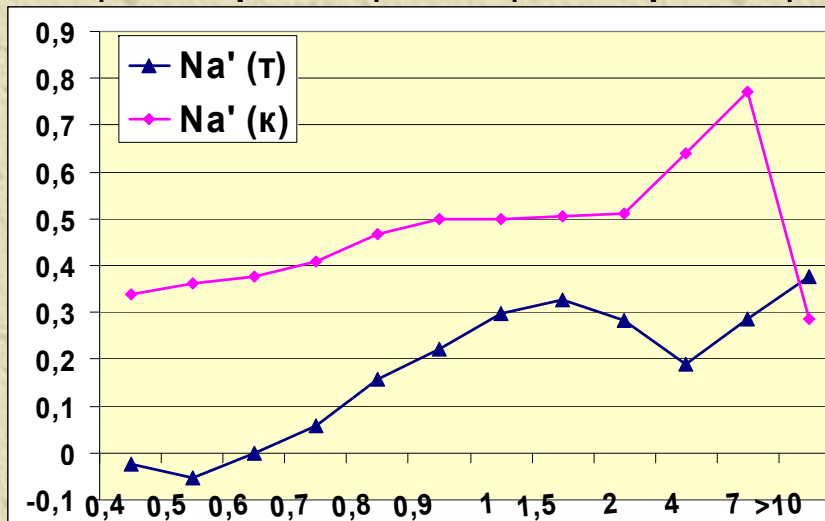
# Dispersive composition of surface aerosol



# Correlation curves of distribution of a number of elements onto different size aerosol particles



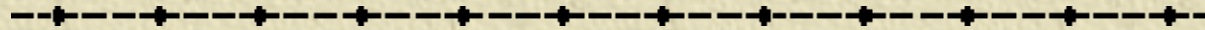
# Correlation curves of distribution of a number of ions onto different size aerosol particles





СПАСИБО

ЗА



ВНИМАНИЕ !

