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Aerosol concentration at Russia monitoring sites of the Acid deposition monitoring Network in East Asia

There are three Russian monitoring sites of EANET in Baikal region: at urban site – Irkutsk, a rural one – Listvyanka, and a remote one – Mondy. There is another site Primorskya, that is located in Primorye on the way of pollutants long-range transport through Asian part of Russia towards the Pacific. Aerosol concentration monitoring has been run more than last 10 years, at Mondy site - from 1998, in Lisvyanka and Irkutsk – from 1999, at Primorskaya site – from 2002. Usually, studying the ground air aerosol concentration, we search for some difference between measurement parameters.

Our main task is to find out some similarity of ionic composition ofsoluble of aerosol that was sampled in different physical-geographical conditions. As a basis we have taken the monitoring measurement data of 10 ions concentration of soluble aerosol fraction– *x* (μg/m^3). Ion concentration differs a lot from sample to sample. It means that the concentration may vary two or three times even through the samples would be taken from the same places but in different years.

To make following analysis the situation requires applying logarithms or a geometric mean, not an arithmetical mean value of concentrations. This promotes to ease the significant concentration difference of the ions during the correlation analysis, for example SO_4^{-2} and NH_4^+, and is less influencing on correlation coefficient. Let's compare ionic composition of aerosols that we've got from all the stations at the same time all year round during the observation period. The results that we've got you can see on the figure1.

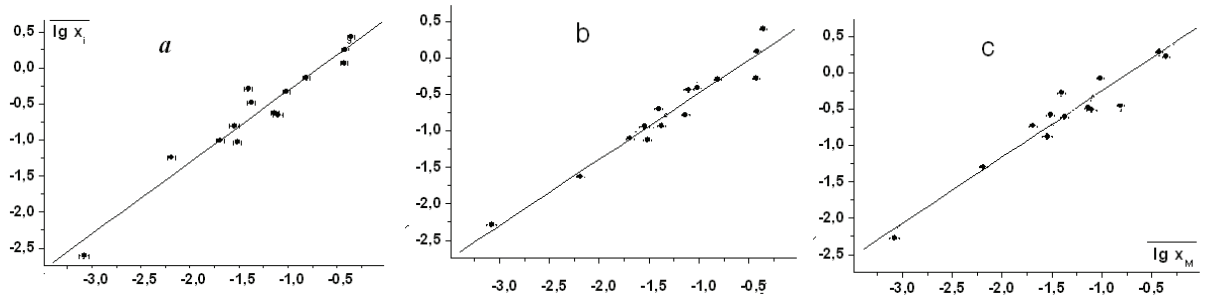

Fig. 1. Comparison of the average logarithms of ions concentration of soluble fraction of atmospheric aerosol at Irkutsk site (a), at Listvyanka site (b) and at Primorskaya site(c) and some data from remote Mondy site.

The X-line is the mean value of logarithm of ionic concentrations at Mondy's research center *lg* x_m, the Y-line is lg x_i at another sites and its mean square deviations $\Delta lg\ x_m$ and $\Delta lg\ x_i$.

The difference between the concentration logarithms on the diagrams substantially surpasses the mean square errors. There is a clear and systematic sequence of distribution of ions over concentrations logarithms in natural pread of points. High coefficients of linear correlation r≥0.94 identify connections $\overline{\lg x_i}$ and $\overline{\lg x_M}$ (Table 1).

Table 1. Coefficients *r, k*±Δ*k* and *b*±Δ*b*.

Sites	*r*	*k*	Δ*k*	*b*	Δ*b*
Mondy-Irkutsk	0.97	0.99	0.08	0.67	0.11
Mondy-Listvyanka	0.97	0.90	0.06	0.42	0.09

Mondy-Primorskaya	0.96	0.91	0.07	0.66	0.11
Irkutsk-Listvyanka	0.96	0.87	0.07	-0.22	0.07
Irkutsk- Primorskaya	0.96	0.88	0.08	0.02	0.07
Listvyanka - Primorskaya	0.94	0.95	0.10	0.19	0.10

Coefficients *k*, subject to the mean square errors Δk, are closely approximated to 1. It means that not only between logarithm values $\overline{\lg x_i}$ and $\overline{\lg x_M}$ linear connection, but the geometric mean ion concentrations at different sites are close too. The difference of the coefficient *b* from 0 means that the general ion concentration is not similar at different research stations. The values of geometric mean concentrations $\bar{x}$, their logarithms $\overline{\lg x}$ and mean square errors $\overline{\Delta \lg x}$ are cited in the table 2. They could be qualified as peculiar "clarkes" for ground air.

Table 2. Average values of concentration logarithms $\overline{\lg x}$, mean square errors $\overline{\Delta \lg x}$ and geometric mean concentrations $\bar{x}$, μg/m^3.

	Mondy			Irkutsk			Listvyanka			Primorskaya		
	$\overline{\lg x}$	$\overline{\Delta \lg x}$	$\bar{x}$	$\overline{\lg x}$	$\overline{\Delta \lg x}$	$\bar{x}$	$\overline{\lg x}$	$\overline{\Delta \lg x}$	$\bar{x}$	$\overline{\lg x}$	$\overline{\Delta \lg x}$	$\bar{x}$
H^+	-3.08	0.05	$8.3\cdot 10^{-4}$	-2.61	0.03	$2.5\cdot 10^{-3}$	-2.28	0.02	$5.2\cdot 10^{-3}$	-2.27	0.03	$5.4\cdot 10^{-3}$
HCO_3^-	-0.81	0.04	0.16	-0.13	0.03	0.74	-0.29	0.03	0.51	-0.45	0.07	0.35
SO_4^{2-}	-0.41	0.03	0.39	0.25	0.02	1.8	0.09	0.02	1.2	0.49	0.02	3.1
NO_3^-	-1.40	0.04	0.039	-0.29	0.03	0.51	-0.70	0.03	0.20	-0.27	0.04	0.53
Cl^-	-1.54	0.05	0.029	-0.80	0.03	0.16	-0.94	0.04	0.12	-0.88	0.04	0.13
NH_4^+	-1.01	0.04	0.097	-0.33	0.02	0.47	-0.41	0.02	0.39	-0.08	0.02	0.84
Na^+	-1.69	0.04	0.020	-1.01	0.02	0.098	-1.10	0.02	0.079	-0.73	0.02	0.19
K^+	-1.52	0.04	0.030	-1.03	0.02	0.094	-1.12	0.03	0.075	-0.58	0.03	0.26
Mg^{2+}	-2.19	0.04	0.006 5	-1.24	0.03	0.058	-1.62	0.02	0.024	-1.29	0.03	0.051
Ca^{2+}	-1.37	0.04	0.043	-0.48	0.02	0.33	-0.93	0.03	0.12	-0.61	0.03	0.25

As it was expected, minimal ion concentration in ground air is found out at Mondy research site. That matters that we may qualify the site as a background site.

Let's determine the average contribution of each ion (t_k) to their summary concentration – $t_K = \overline{x_K} \Big/ \sum_K \overline{x_K}$ (Table 3).

Table 3. Coefficient t_k

Ion	Mondy	Irkutsk	Listvyanka	Primorskaya	$\overline{t_K}$
H^+	0.001	0.001	0.002	0.001	0.001
HCO_3^-	0.196	0.174	0.187	0.061	0.141
SO_4^{2-}	0.478	0.422	0.441	0.543	0.469
NO_3^-	0.048	0.120	0.073	0.093	0.079
Cl^-	0.036	0.038	0.044	0.023	0.034
NH_4^+	0.119	0.110	0.143	0.147	0.129
Na^+	0.025	0.023	0.029	0.033	0.027
K^+	0.037	0.022	0.028	0.046	0.032
Mg^{2+}	0.008	0.014	0.009	0.009	0.010
Ca^{2+}	0.053	0.077	0.044	0.044	0.053

Thus, the relative concentration distribution of ions can be considered as a universal model approximation fit for evaluating calculation of average ion composition of ground air under quite diverse weather conditions of East Siberia and Far East.