Testing of aerosols in Barentsburg area (Spitsbergen)

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Keywords: aerosols, correlation, share factors, the sum of ions
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In Spring to Summer periods of 2001-2012 (table 1) testing of aerosols air characteristics were conducted on the territory of the Spitsbergen archipelago (western Artic section) in the area of Zonal Hydrometeorological Observatory (ZHO), in Barentsburg (78.1°N 14.2°E, eastern part of the Grenfjord bay of the Greenland sea). Aerosols samples were taken on PTFE filters with 0.8 μm pore size. Chemical composition of aerosols water soluble fraction was done on ion chromatographer ICS-3000 (Dionex, USA).

During testing periods in the area of Barentsburg northern and western (Greenland island side) air mass transports were observed. During Summer seasons higher temperatures and lower wind speeds were observed. In summer it was often that foggy and thick weather was observed. Atmospheric pressure and relative air humidity varied within short ranges.

Mean concentration of ions within aerosols soluble fraction in April-May 2011 was twice higher as compared to their concentration in August. Maximum concentration of ions (5.6 $\mu g \cdot m^{-3}$) was recorded on May 16, and the minimum (0.48 $\mu g \cdot m^{-3}$) was recorded on August 02, 2011. In spring there was significant correlative interrelation of concentrations between the ion pairs NH_4^+–SO_4^{2-}, Na^+–Cl^-, Mg^{2+}–Cl^-, Ca^{2+}–NO_3^- with correlation ratios equal to 0.79, 0.97, 0.96 и 0.90 accordingly. In summer period this interrelation went down (0.68, 0.63, 0.61, 0.58) while higher positive correlation between the other pairs especially cations and nitrate- and chloride ions was indicated.

Mean cumulative ratio of ions in 2012 as compared to the previous testing was one and a half times higher during summer season. Exceeding of concentrations was due to ions of marine origin - Na^+ and Cl^- that together with ions NH_4^+ and SO_4^{2-} prevailed in aerosols composition. To this effect, during summer season higher correlative interrelation of concentrations between ion pairs Cl^- and Na^+, NH_4^+, Mg^{2+}, Ca^{2+} (r = 0,93-0,98) was observed. Comparison of aerosols compositions sampled in Barentsburg in 2011-2012 was indicative of its identity. Although similarity of qualitative composition there were differences in quantitative relation. During spring season number of soluble substances in aerosols composition during both testing years was more or less similar, however, in summer 2012 amount of ions rose three times as compared to 2011. Concentrations of Na^+ were 8.5 times higher, Mg^{2+}- - 3.7 times higher, K^+ and NO_3^- - 2.9 times higher, Cl^- and NH_4^+ - 1.8 times higher, and SO_4^{2-} - 1.6 times higher. During the same period increase of mass concentration of smock black within Barentsburg atmosphere was 1.5 times higher as compared to spring time. Similar increase of smoke black ratio was observed in 2011 when mean values in summer seasons were 3 times higher.

For identifying input of different sources into building chemical composition of aerosols FM_{cont} and FM_{ocean} share factors were used [1]. Relations of K^+, Mg^{2+}, Na^+, Ca^{2+}, Cl^-, SO_4^{2-} concentrations being the main ones both in sea water, and in aerosols. It was found out that prevailing factor of impact on building chemical composition of aerosols is continental. However, in summer season 2012 increase of sea factor input reaches up to 30 %.

This work was supported in part by the Program of Basic Researches No. 23 of the Presidium of the Russian Academy of Sciences «Basic problems of oceanology: physics, geology, biology, ecology».

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Table 1. Mean chemical composition of aerosols in the area of Barentsburg, $\mu g \cdot m^{-3}$

Period	Na^+	NH_4^+	K^+	Mg^{2+}	Ca^{2+}	Cl^-	SO_4^{2-}	NO_3^-
2011								
19.04- 26.05	0,21±0,16	0,29±0,24	0,06±0,03	0,07±0,07	0,13±0,15	0,80±0,65	0,97±0,60	0,19±0,35
26.07 -31.08	0,08±0,04	0,13±0,14	0,07±0,05	0,02±0,01	0,14±0,21	0,30±0,24	0,57±0,53	0,07±0,04
2012								
26.04-06.06	0,33±0,22	0,22±0,28	0,14±0,11	0,02±0,02	0,15±0,18	0,45±0,44	1,18±1,21	0,17±0,53
21.07-25.08	0,70±0,83	0,24±0,26	0,20±0,13	0,06±0,11	0,25±0,25	1,63±1,65	0,90±0,98	0,15±0,55