The variation of the total aerosol particle number concentration in fog in southern and south-eastern regions of the Baltic Sea

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The objective of this study was to determine the effect of air masses and meteorological conditions on the variation of total aerosol particle number concentration in marine boundary layer and simultaneously at the coastal site (Preila Environmental pollution research station, Lithuania) during the fog in the spring and autumn.

Measurements were performed during three cruises of r/v "Oceania" (Institute of Oceanology of PAS) in 2008 – 2010 mostly in southern and south-eastern parts of Baltic Sea. The total aerosol particle number concentration over open sea and at the Preila station was measured by using CPC (cut-off size 4.5 nm). Additionally, at the Preila station was measured aerosol size distribution by SMPS for the range 9 – 840 nm. To analyze transport pathways of air masses arriving at investigation sites (open sea and Preila station) the 72 hours air mass backward trajectories at 50, 500, 1000, 2000 and 2500 m heights above the sea or ground levels were calculated using the HYSPLIT-4 model, developed by NOAA/ARL (http://www.arl.noaa.gov/ready.htm, 2008). Meteorological parameters (air temperature, wind speed and direction, relative humidity) were measured at the Preila station and by the on-board system.

The analysis of data showed, that the variation of the total aerosol particle number concentration both in marine boundary layer and coastal zone (Fig. 1B) was smallest during evaporation fog, which was created by cold Polar air passing over warmer sea water. This type of fog is the most localized form (Heo *et al*, 2010) and was observed in Gulf of Gdansk during cruise on 26 September 2009. On the same time at the coastal site aerosol particle number concentration was typical of clean polar air mass. During the cruise on 22 – 23 September 2008, when fog was observed in more polluted polar continental air arriving from north-eastern directions and entering coastal site and the marine boundary layer, the aerosol particle number concentration over the open sea was similar to the case of 2009 but with higher variation of the concentration. However, at the same time at the aerosol particle number concentration at the Preila station was similar to the open sea concentration but with smaller variations in time (Fig. 1A).

The long continuous advection fog (~15 hour), which occurred when warm air mass from south-eastern direction passed over a cool water surface (Baltic Sea), was observed during cruise on the 7 – 8 April 2010 (Fig. 1C). The fog was observed simultaneously over open sea and coastal site causing the similar variations of aerosol particle number concentrations (the values of correlation coefficient were 0.79 and 0.82). Especially interesting phenomena is that during fogs, which were formed in calm anticyclone weather conditions, the total aerosol particle number concentrations over open sea during all cruises were about 4000 cm^{-3} level and may be conditioned by the specific environment of the Baltic Sea (e.g., 7‰ water salinity, typical amount of various phytoplankton (Chl-a (algal biomass) concentration varied from 3 to 30 mg m^{-3})) as a source of particles condensation nuclei in marine boundary layer.

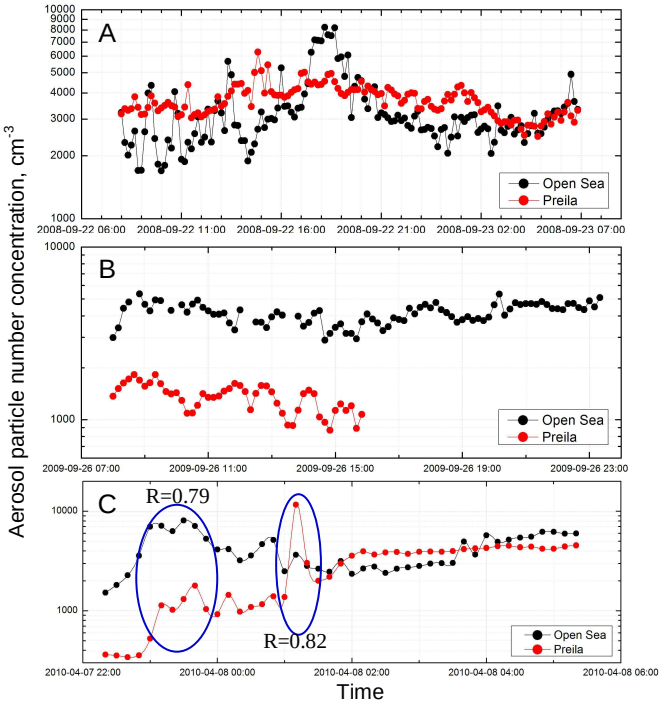

Figure 1. Variations of total aerosol number concentration during fog in marine boundary layer and at the coastal site in 2008 – 2010.

Heo, K.-Y., Ha, K.-J., Mahrt, L. and Shim, J.-S. (2010) *Atmospheric research* **98**, 426-437.