Vertical profiles of the aerosol effective radius in the marine boundary layer over the Baltic Sea

P. Makuch[1], T. Petelski[1], P. Markuszewski[1], M. Cisek[1], T. Zieliński[1], T. Stacewicz[2], S. Sitarek[3]

[1]Institute of Oceanology Palish Academy of Sciences, Sopot, 81-712, Poland
[2]Institute of Experimental Physics, Facu;ty of Physics, Warsaw University, Warsaw, 01-093, Poland
Maksymilian Pluta Institute of Applied Optics, Warsaw, 03-805, Poland
Keywords: aerosol, effective radius, lidar
Presenting author email: makuch@iopan.gda.pl

The aim of this research is to recognize the aerosol particle size distribution and particle vertical profiles over the southern Baltic Sea in different meteorological conditions. We also considered factors which determine the size of the aerosol effective radius. Very interesting for us is the impact of the emission of aerosols from the sea surface on vertical profiles of aerosol size distribution over the Baltic Sea.

We organized simultaneous cruise of our ship S/Y Oceania and a measurement campaign on the coast.

On the ship we made the measurements using the following equipment:

1. Laser particle counter PMS CSASP-100HV (range: 0.5 μm to 47 μm in 45 measurement channels),
2. Laser aerosol spectrometer (LAS 3340) TSI (range: 0.09 μm to 7 μm in 99 measurement channels),
3. Condensation particle counter (CPC 3771) TSI (range: 0.01 μm to 3 μm).

On the coast, less than 50 m from the sea (54.803 N, 18.396 E) we had installed a mobile laboratory with a multichannel lidar. We used a lidar working on laser Nd:YAG made by Quantel Brilliant. This laser emits three wavelengths: 1064, 532 and 355 nm. Energy of the impulse is respectively 100, 60 and 40 mJ, repetition rate is 10 Hz and pulse duration is 6 ns. Measurements made with the lidar were performed in winter 2014/2015.

Lidar was directed at an angel of 13 degrees from the horizontal so we could get the data from 200 to 1100 m above sea level. Data from counters from the S/Y Oceania were collected from 8 to 20 m above sea level.

Effective radius is one of the parameters of aerosol size distribution that synthetically speaks of the scattering of electromagnetic waves on the aerosol. It is defined as the ratio of average volume to average area of the particles:

$$r_{eff}(z) = \frac{\int r^3 n_{opt}(r,z)dr}{\int r^2 n_{opt}(r,z)dr}$$

To calculate effective radius from the lidar data we used the method described by Jagodnicka at al. (2009). While to calculate this parameter for data from the ship we used aerosol particle size distribution from the connection data from all particle counters.

In Figure 1 we present average effective radius from the data from the ship measured in February 2015. We show effective radius for three heights above sea level depending on wind speed.

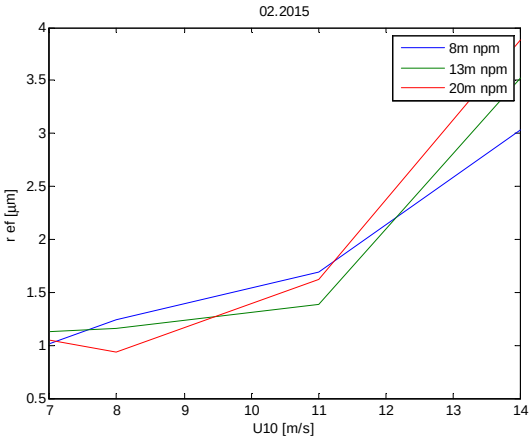

Figure 1. Average effective radius for three heights depending on wind speed.

On the x axis we show wind speed at 10 m above sea level and on the y axis an effective radius in μm is presented. Different colours mean different height above sea level.

This work was supported by the project “Satellite Monitoring of the Baltic Sea Environmental –SatBałtyk” funded by European Regional Development Fund contract No. POIG 01.01.02-22-011/09.

Jagodnicka A.K., Stacewicz T., Karasinski G., Posyniak M., Malinowski S.P. (2009) *Particle Size Distribution Retrival from Multiwavelenght Lidar Signals for Droplet Aerosol* , Applied Optics.