The comparison of the light scattering coefficient measured in urban and coastal environments

V. Dudoitis, V. Ulevicius, K. Plauškaitė and G. Mordas

Center for Physical Sciences and Technology, Savanoriu av. 231, LT-02300, Vilnius, Lithuania
Keywords: light scattering, angstrom exponent, nephelometer
Presenting author email: vadimas.dudoitis@ftmc.lt

Atmospheric aerosols affect the Earth's climate directly through absorbing and scattering the solar radiation. The light scattering coefficient is depended on the aerosol particle chemical composition and is different in various environments. In this work, we determined and compared light scattering coefficients for urban and coastal environments. The most common component of coastal aerosol is sea-salt, which has a significant influence on the light scattering properties Chamaillard *et al* (2006). One of such property is a wavelength dependence of the optical thickness described by the Ångström wavelength exponent α. According to Smirnov *et al* (2002) average α values estimated for marine environments were in range from 0.3 to 0.7.

Table 1. Monthly observations of aerosol light scattering coefficients.

	AVG, Mm^{-1}	MAX, Mm^{-1}	MIN, Mm^{-1}	25‰, Mm^{-1}	50‰ Mm^{-1}	75‰, Mm^{-1}
Vilnius city						
σ_{sp}^{450}	30.5	369.1	8.9	16.8	23.9	37.8
σ_{sp}^{550}	20.2	276.2	5.6	10.9	15.7	24.9
σ_{sp}^{700}	12.8	194.6	3.5	6.7	9.7	15.8
Environment Pollution Research station in Preila						
σ_{sp}^{450}	109.6	279.4	13.2	61.6	96.2	158.1
σ_{sp}^{550}	84.5	223.5	9.3	49.1	71.9	119.4
σ_{sp}^{700}	61.7	167.5	7.7	36.2	52.5	85.0

An integrating nephelometer TSI 3563 was used to measure the light scattering coefficient during the whole measurement campaign. Measurements were performed in Preila (55°22'39.24", 21°1'54.34"; coastal area; 2012 December) and Vilnius (54°38'36.31", 25°10'58.81"; urban-background area; 2012 July).

The statistical analysis (Table 1) revealed that almost all total scattering coefficient values were higher in Preila than in Vilnius. Though exceptionally high (MAX) values in Vilnius were reported during the Saharan dust event Mordas *et al* (2013). However, such event is not common for this area and doesn't correctly represent the monthly variations. Thus, the comparison of 99th percentile shows that the aerosol scattering coefficient in Preila is 2.4 times higher than in Vilnius.

Klaipėda meteorological station data and HYSPLIT4 air mass backward trajectories, were compared with α values in Preila and in Vilnius. Preila wind directions can be combined in two categories: from the sea (SW, W, NW, N) and from the land (NE, E, SE, S). Lowest α values were reported from the sea directions, except from the North. In this case, average Ångström values were in range: α_1 = 0.46 – 0.79; α_2 = 0.24 – 0.25; α_3 = 0.42 - 0.58. On the contrary, the wind direction from the land resulted in higher Ångström values, which can be classified as continental aerosol. Average α values for land directions were in range: $\alpha_1=\alpha_2=\alpha_3$=1.32 – 1.48.

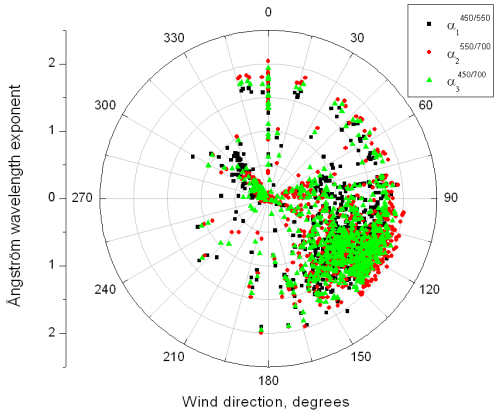

Fig. 1. The dependence of Ångström wavelength exponent α on the wind direction in Preila.

This work was supported by the Lithuanian-Swiss cooperation programme "Research and development" project AEROLIT (Nr. CH-3-ŠMM-01/08).

Chamaillard, K., Kleefeld, C., Jennings, S.G., Ceburnis, D. and O'Dowd, C.D. (2006), J. Quant. Spectrosc. Radiat. Transfer **101**, 498–511.

Smirnov, A., Holben, N. B., Kaufman, Y. J., Dubovik, O., Eck, T. F., Slutsker, I., Pietras, C. and Halthore, R. N. (2002), *J. Atmos. Sci.* **59 (3)**, 501–523.

Mordas, G., Prokopciuk, N. and Ulevicius, V. (2013 in press), *Boreal Env. Res.*