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Retrieval of aerosol optical properties from the synergy of polar nethelometer, aethalometer, multifilter rotating shadowband radiometer and ceilometer data.

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We present a method to obtain aerosol optical properties from in-situ and remote sensing observations performed during the field campaign in Sopot (Poland) in 2011. Surface aerosol properties were measured using the three wavelength Aurora 4000 polar nephelometer and the seven wavelength AE-31 aethalometer. The Aurora 4000 was configured during this experiment to measure the intensity of scattered radiation in four following sectors (10-170o, 40-170 o, 70-170 o, and 90-170 o). Based on the in-situ observations we retrieved the aerosol extinction coefficient, the single scattering albedo and the asymmetry parameter as well as aerosol size distribution. In addition, profile of the aerosol extinction coefficient was obtained from the synergy of three different measurement techniques (in-situ, passive and active remote sensing). For this purpose we used the CHM-15K Jenoptik ceilometer operated at 1064 nm, the Multifilter Rotating Shadowband Radiometer (MFR-7) as well as the Aurora 4000 and AE-31 Aethalometers. Profile of the extinction coefficient was retrieved from the standard backward Klett-Fernald-Sasano method. In this technique the lidar ratio is constant with altitude and adjusted with an integrated ceilometer extinction coefficient profile to the total aerosol optical thickness from the MFR-7. Active remote sensing provided the opportunity to estimate the aerosol optical thickness during the night which cannot be measured with sun photometers or the MFR-7. For this purpose we developed a method to estimate aerosol optical thickness at 1064 nm to provide its diurnal cycle. In this case the forward technique is used to solve lidar equation with boundary condition taken from the in-situ surface observations. The overlap correction was estimated from a horizontal observation during homogenous conditions. It allowed to reduce the overlap from the original 650 m to 250 m. This method required the estimation of the cailometer/lidar calibration coefficient which was obtained using the ceilometer auto-calibration technique applied for low level stratocumulus clouds. The calculated profile of the aerosol extinction coefficient from the forward method has been applied for the aerosol optical thickness estimation.