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Characteristics of correspondence between MODIS/Terra orbiter AOT measurements and AERONET network depending on cloud parameters

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We analysed the data of aerosol optical thickness of the atmosphere (AOT) measurements at a wavelength of 550 nanometres obtained from the MODIS orbital spectrometer installed on the Terra satellite from 23 points of the terrestrial network of spectrophotometers AERONET, differing in the level of aerosol loading and located in different regions of Europe, Asia and Africa and in different physiographic zones. MODIS/Terra measurements were compared (col. 6.1, level 3, variable AOD_550_Dark_Target_Deep_Blue_Combined_Mean, 1x1 degree resolution) with daily mean AOT data of the AERONET network (data level 1.5); ground-based measurements were considered as reference), and the correlation parameters of ground and satellite data were calculated depending on the cloudiness parameters (variable Cloud_Fraction_Day_Mean, hereafter CFDM) determined from MODIS measurements. For most stations, it is found that when the cloudiness parameter decreases, the matching characteristics of cloud and ground data improve.

In this paper, we used MODIS data filtering on the Cloud_Fraction_Day_Mean variable with 0.1 steps ranging from 1.0 (unfiltered data) to 0.1 to investigate the effect of cloud parameters on the fit characteristics of satellite and ground data (correlation coefficient, slope coefficient, and free term of linear regression).

At most of the stations located in continental temperate regions (10 out of 13), a significant increase in the correlation coefficient (R) with decreasing cloudiness score was found (on average for the 10 stations R increased from 0.79 (for unfiltered data, CFDM ≤ 1.0) to 0.84 for CFDM ≤ 0.5 and 0.88 (for CFDM ≤ 0.2). At the 3 remaining ones, the improvement of the mentioned parameter is less pronounced. At 1 out of 4 stations located in the coastal zones of the tropical and subtropical belt, the similar effect of the increase in the correlation coefficient is clearly expressed, at the other 3 - less markedly. Among the stations located in the desert, the described effect is well expressed at 1 out of 7 stations, at one more it is weakly expressed, and at the remaining 5 desert stations the similar effect is not noted. The effect of improvement of other fit parameters (slope coefficient and free term of the linear regression) is mainly for stations located in continental temperate regions; no effect of improvement of these parameters was observed at tropical coastal and desert stations (values of k and a fluctuate in the range of the same values).

To improve the quality of MODIS data (by AOT) over continental regions, we propose filtering by cloudiness CFDM ≤ 0.5, which increases the representativeness of Level 3 measurements, while slightly reducing the amount of experimental information (up to 70-80% of the total amount of unfiltered data).