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The long term Lampedusa data set of aerosol optical properties based on AERONET and MFRSR measurements

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Measurements of aerosol optical properties are made on the island of Lampedusa (35.5°N, 12.6°E), in the central Mediterranean, since 1999. Seven-band multi filter rotating shadowband radiometers (MFRSR) and a Cimel sunphotometer have been used, with MFRSR and Cimel running in pareallel over extended periods. Four different MFRSRs were operated during the period 1999-2013, and MFRSR measurements are available quasi-continuously since summer 2001. The Cimel sunphotometer was run in a short period in 2000, and over the periods 2003-2006, and 2010-present. A different setup of the cimel channels was used before (with 4 wavelengths) and after 2010. During most of the cimel operation periods also MFRSR measurements are available.

In this study we use the different advantages of the two measurement techniques (high temporal resolution of the MFRSR, allowing for a better cloud screening and larger number of data; smaller field of view allowing for more accurate aerosol optical depth, AOD, measurements for large particles for the Cimel) to produce a well calibrated and consistent multi-wavelength AOD dataset over the 2001-2013 period. The calibration of the two instruments is totally independent and follows different protocols. MFRSR calibration is based on the determination of the extraterrestrial constants from the measurements at Lampedusa, taking advantage of the high number of cloud-free data and the limited diurnal variability of the aerosol. The cimel is calibrated periodically within AERONET, and level 2 data are used in the analysis.

Firstly, silutaneous co-located measurements of AOD in the different bands are compared. AOD measurements agree within the respctive measurements uncertainties for values smaller than about 0.5, while an underestimate by MFRSR is found for larger values. This underestimate is due to the effect of the larger MFRSR field of view, and the influence of forward scattering by large particles, particularly important for desert dust cases which correspond with elevated AODs. A correction of the MFRSR measurements, derived from the comparison of simultaneous observations, was applied. The combined mesurements also allow to identify periods with instrumental problems, incorrect cloud screening, and problematic calibrations.

Secondly, a combined intercalibrated dataset is constructed after careful verification of the avaliable data. The dataset is based on corrected MFRSR measurements, which guarantee high resolution observations and a better cloud screening, and AERONET data in the period when MFRSR measurements are not available.

The evolution of the AOD at Lampedusa during the 2001-2013 period is discussed, in relation with long-term evolution, interannual variability, and seasonal changes. The data series display a very limited long-term change over the investigation period, and a relatively large interannual variability, with minima of the AOD occurring during years 2004, 2006, and 2009. The minimum in 2009, with an annual average of 0.14 against an overall annual average of 0.185, stands as a singularity in the record. The combined Lampedusa dataset will be used for aerosol climatological studies, and for verification of satellite observations and model analyses.