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Synergy of in situ airborne measurements and ground-based passive remote sensing in the quality assessment of the aerosol optical properties derived from POLDER-3/PARASOL (2005-2013) over the western Mediterranean Sea

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The western Mediterranean atmosphere is impacted by a variety of aerosol sources, producing a complex and variable mixture of natural and anthropogenic particles, with different chemical and physical properties. Satellite sensors provide a useful global coverage of aerosol parameters but through indirect measurements that request careful validation. Here we present the results of a long-term regional scale analysis of the full dataset (March 2005 and October 2013) of POLDER-3/PARASOL ocean operational retrievals of the total, fine and coarse aerosol optical depth (AOD, AODF and AODC), Angstrom exponent (AE), and the spherical/non-spherical partition of coarse-mode AOD (AODCS and AODCNS), respectively. The evaluation is performed using data from seventeen coastal and insular ground-based AERONET sites on one side, and airborne vertical profiles of aerosol extinction and number size distribution obtained by the SAFIRE ATR 42 aircraft operated in the area during summer 2012 and 2013 campaigns of the MISTRALS/ChArMEx programme on the other side.
This study provides the first regional evaluation of uncertainties of the POLDER-3 products, and highlights their quality. The POLDER-3 Ångström exponent, representing AOD spectral dependence in link with the aerosol particle size distribution, is biased towards small values. This bias, however, does not prevent using AE for classifying the regional aerosol laden air masses. AODF corresponds to particles smaller than 0.6-0.8 μm in diameter and appears suitable to monitor the aerosol submicron fraction from space. We also provide an original validation of POLDER-3 AODC and its spherical/non-spherical partition, which shows agreement within 25% with AERONET shape retrievals when the aerosol coarse fraction dominates.
This work now serves the dust model validation undergoing in the ERA4CS DustClim project.