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AERONET versus MODIS retrievals at different spatial resolutions over south-east Italy

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The Moderate Resolution Imaging Spectroradiometer (MODIS) sensor onboard both NASA's Terra and Aqua satellites since December 1999, and May 2002, respectively, acquire daily radiance measurements at thirty-six spectral bands ranging from 0.41 μm to 14 μm, to derive worldwide aerosol optical properties at different spatial and temporal resolutions.

In this study we investigate the correlation between AERONET aerosol products, retrieved by sunphotometer measurements performed at the Physics Department of Lecce's University (40º, 20' N, 10º, 6' E), and corresponding MODIS aerosol products retrieved at different spatial resolutions collocated in space and time. The main objective of our study is to understand to what extent the Lecce's AERONET site can be considered representative of a larger area and hence, locally-derived aerosol parameters can be of use in General Circulation and Chemical Transport Models. Most of these models simulate aerosol properties at horizontal resolutions larger than 100x100 km^2.

MODIS and AERONET aerosol retrievals from March 2003 to September 2004 are used for the correlation study. In particular, aerosol optical depths τ_{MODIS} and fine fraction parameters η_{MODIS} retrieved at 550 nm by mean of both the over ocean and over land MODIS algorithm, are used. Then, τ_{MODIS} and η_{MODIS} values calculated by averaging the data of 50x50, 100x100, and 300x300 km^2 boxes centered on the AERONET monitoring site, respectively are correlated to corresponding AERONET retrievals, to identify regional biases of Lecce's AERONET-data and to get an estimate of the Lecce's AERONET-data ability to be representative of the aerosol properties over the south-east Mediterranean basin. We have observed that τ_{MODIS}

and η_{MODIS} averaged values retrieved with the application of the over ocean algorithm are better correlated to corresponding AERONET parameters than τ_{MODIS} and η_{MODIS} averaged values retrieved by mean of the over land algorithm. The scatter plot between $\tau_{AERONET}$ and τ_{MODIS} calculated by the over ocean algorithm and retrieved from observations collocated in space and time, shows that about 70% of all data points fall within the expected uncertainty of $\Delta\tau_{MODIS} = \pm 0.03 \pm 0.05\tau_{MODIS}$. The yearly temporal evolution of τ_{MODIS} retrieved with the application of the over ocean algorithm is also better correlated to the yearly temporal evolution of $\tau_{AERONET}$ than τ_{MODIS} values calculated by the over land algorithm: the latter aerosol optical thicknesses are always overestimated.

We have also observed that the correlation factor between τ_{MODIS} and $\tau_{AERONET}$ data is not affected by the spatial size of the box centered over the AERONET site, at least up to a box area of about 300x300 km^2. Latter results have lead us to assume that $\tau_{AERONET}$ and $\eta_{AERONET}$ values retrieved at Lecce can be considered representative at least of an area of about 300x300 km^2. In conclusion, we believe that the results of our study are of interest since they can provide a more adequate representation of the aerosol properties in climate models applied to the south-east Mediterranean basin and hence can contribute to reduce existing uncertainties due to aerosol effects on climate. Several aerosol studies have focused in the last years on the Mediterranean area: a net direct radiative forcing by sulphate aerosols is predicted to occur in the eastern Mediterranean between Greece and Israel by various models. The east Mediterranean basin represents a unique area in terms of suspended particulate matter. Bounded to the north by the European continent and to the south by North Africa, it is largely affected by anthropogenic aerosols, Saharan dust, and sea spray from the Mediterranean Sea itself.