Quantifying the relative contribution of different aerosol types over Eastern Mediterranean: A decadal high resolution satellite view

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Satellite observations from MODIS have been extensively used in combination with observations from other satellite sensors or model simulations to quantify the optical properties of different aerosol types at a global as well as regional scale. Based on the pioneer results of Kaufman *et al* (2005) and a number of other studies that used a similar approach, Bellouin *et al* (2008) presented an algorithm that combines aerosol optical depth (AOD) and fine-mode ratio (FMR) at 550 nm from MODIS, Aerosol Index from TOMS and surface wind speed over oceans from SSM/I. This algorithm is capable of distinguishing the anthropogenic (fossil fuel and biomass burning) AOD from the corresponding sea salt and dust AOD on a daily basis. However, this is possible over oceans only, since, the FMR retrieval is not considered reliable over land. Over land they used regional anthropogenic fractions as derived from five global models that participated in the AEROCOM project (Bellouin *et al*, 2005). A similar approach was also used in a recent paper by Bellouin *et al* (2012) with data from MACC aerosol reanalysis. The fraction of different aerosol types to the total AOD is crucial for the calculation of the radiative forcing of each type separately (Quaas *et al*, 2008; Jones *et al*, 2009).

A common characteristic is that all the studies referenced above are focused on global observations using daily 1^ox1^o gridded level-3 MODIS data. Since the methodologies are now well established, we have to go a step further and investigate the relative contribution of different types of aerosols at a regional scale taking into account the special characteristics of each region. Here, we focus on Eastern Mediterranean [30^oN-$45N^o$, 17.5^oE-37.5^oE], a region subject to aerosol contributions from a variety of sources. Human activities, like industry and transport (anthropogenic aerosols), occasional Saharan dust intrusions (dust particles), sea spray (marine aerosols) and agricultural fires in Southeastern and Eastern Europe as well as occasional fire events in the region (biomass burning aerosols) contribute to the total aerosol burden. Hatzianastassiou et al (2009) used 1^ox1^o MODIS and TOMS monthly data to investigate the existence of anthropogenic and natural aerosols over Eastern Mediterranean but at a qualitative way rather than a quantitative one. In this work, the relative contribution of different aerosol types over the region is presented at a high resolution of 0.1^ox0.1^o on a daily basis along with the corresponding uncertainties. MODIS TERRA and AQUA level-2 datasets (10 km resolution at nadir) that span from 3/2000 and 7/2002 respectively are used for the compilation of two 0.1x0.1 degree gridded datasets that consist of 30000 grid cells each (see Georgoulias and Kourtidis, 2012 for more details). The use of these datasets in conjunction with Aerosol Index data from Earth Probe TOMS and OMI satellite sensors and wind field data from ERA-interim reanalysis within an algorithm similar to Bellouin *et al* (2008) allows for the calculation of the aerosol type fraction per grid and day. The seasonal and interannual variability of the relative contribution of each aerosol type is discussed while a Fourier-based method is used for the calculation of the trend (and its statistical significance) of AOD_{550} for each aerosol type.

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