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Forecasting the weather
- ensemble techniques
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Aerosol Optical Depth and PM10 trends over Europe in the last decade: Relationship between high resolution satellite data and ground base measurements

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Dimming and Brightening of the Surface Solar Radiation (SSR) has been a subject of a considerable number of studies, especially in the last years. Between 1950s and 1980s the instruments recorded a clear decrease of SSR ("global dimming"); and in the last two decades, a positive trends in SSR signal is present in many locations in Europe and North America ("global brightening"). Since the radiative effect of aerosols still shows significant uncertainties, the study of trends in aerosols concentration actively contributes to quantify the role of aerosols in global climate and in the SSR variability.

Here we analyze Particulate Matter (PM10) mass concentration data from ground stations and columnar Aerosol Optical Depth (AOD) from ground and space-based instruments over central Europe. The aim is to find, quantify and critically discuss the presence of trends in the above-mentioned data during the 2000-2010 decade. The enhanced availability of ground and satellite measurements during this period will provide some constraints on previous studies. Moreover, looking simultaneously at the aerosols surface concentration (PM10) and at the total optical extinction (AOD) will provide additional insights, allowing separation of surface aerosols contribution in the clear-sky SSR trend.

We analyzed the data from the air quality information system maintained by the EEA through the European topic centre on Air and Climate Change (AirBase). We used the Moderate Resolution Spectro-Radiometer (MODIS) data collection 5 Aerosol Optical Depth Over Land And Ocean Level 2.0 product from NASA website, with a spatial resolution of 10x10 km2. In addition, we analyzed the new AOD MODIS MAIAC algorithm with an enhanced horizontal resolution of 1x1 km2. Satellite AOD for the period is validated using data from the Aerosol Robotic Network (AERONET), which provides accurate aerosols information at some selected sites.

These two algorithms present similar performances in accuracy and comparable errors, but the latter has about 35% more valid clear-sky observations than the former. Aerosols daily distributions (PM10 and AOD) are found to be non-normally distributed, so that the frequency and the amplitude of the seasonal signals and the distribution of extreme values are analyzed before applying linear regression to the data. The European picture in the last decade appears quite complex, with a moderate (3-5%) and significant (2-sigma) decrease of the ground PM10 in some countries, due to European air pollution regulations, but non significant in others. Satellite AOD shows also a decreasing trend but does not always reproduce spatially the surface mass signal. Uncertainties on the measured trends are reported and the results are discussed in term of the physical differences between the two variables.

We reckon that this analysis can add significant information on the current studies about the climatological effect of aerosol forcing at a regional and continental level.