Temporal variations of the predominant aerosol type during a 20-year period in Thessaloniki, Greece

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Introduction

Atmospheric aerosols are typically rather diverse. Their chemical composition and optical properties may vary significantly depending on the contributing sources (e.g. urban and industrial environements, arid regions and deserts, wildfires, oceans). Identifying the predominant aerosol species in the atmospheric column is important in order to associate them proprly with a emmission source. In this study, we analyze the temporal variations of the predominant aerosol type that is observed within the urban center of Thessaloniki, Greece (40.52N, 22.96E) based on columnar optical aerosol properties during the period 1997 – 2017.

Methods

The methodology of Siomos et al., 2018 can be applied to columnar Aerosol Optical Depth (AOD) and Single Scattering Albedo (SSA) measurements in the spectral region 320 – 360 nm in order to identify the predominant aerosol combonent in the atmospheric column (Fine Non Absorbing, Polluted Dust, Black Carbon, or Dust) using a cluster analysis based on the Mahalanobis distance. With this technique we have clasified aerosol cases using Brewer spectrophotometer measurements in the period 1997 – 2017. The instrument is located in the Laboraty of Atmospheric Physics in Thessaloniki at 60m a.s.l. and the products applied for the cluster analysis were calculated with the methodology of Fountoulakis et al., 2018. The hourly classification flags are applied in order to calculate the daily occurrence ratio which equals to the number of times per day a flag appeared devided by the total number of measurements within the same day. This approach is necessary as multiple filters (e.g. clouds, solar zenith angle) have been applied the Brewer products to ensure a high quality product (Fountoulakis et al., 2016) resulting in a variable number of hourly flags per day. The annual occurrence ratios are produced from the correpsonding daily values if more than 2 days are are available per week, 2 weeks per month, 1 month per season and 2 seasons per year. This criteria assures more representative annual averages.

Conclusions

A reduction in the occurrence of fine non absorbing aerosols in favor of black carbon and polluted dust mixtures can be seen after 2006 in Fig. 1. This can be attributed either to a decrease in their concentration levels or to an increase of the local dust and/or black carbon levels. Dust dominant cases are rarely encountered, which is expected due to the strong urban background of Thessaloniki. Their occurrence ratio seems constant through the years. In the future, these flags will be used along with optical productts from Brewer and other remote sensing instruments in order to facilitate the source apportionment procedure.

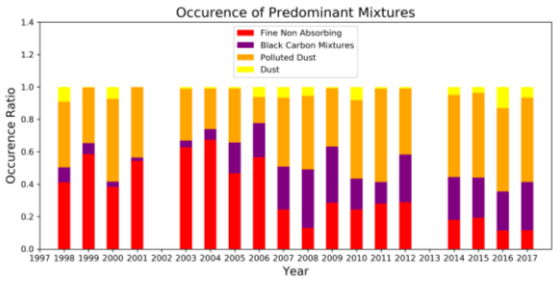

Figure 1. Timeseries of the annual occerence ratio of the predominant columnar aerosol mixtures in the period 1997 - 2017

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