Aerosol Classification Using Multiparameter Retrievals from Remote Measurements on Space and Other Platforms


Abstract

Over the past several decades, due to the development of truly global aerosol measurements by satellites and AERONET, it has proven feasible to assemble a comprehensive dataset of aerosol properties over time. This dataset includes measurements of aerosol optical properties and aerosol type from a wide variety of remote sensing instruments: spaceborne, airborne, and surface-based sensors. To save space, Table 1 focuses on sensors or combinations that produce or access aerosol optical properties. This dataset allows us to explore relationships between aerosol type and aerosol optical properties, and to test the predictive ability of algorithms that classify aerosol type from remote measurements. We demonstrate these capabilities by applying a statistical classification algorithm to the aerosol optical properties retrieved from the MODIS sensor on NPP, the MOOS or MODIS-MAX solar vector, the CALIPSO ceilometer, the MODIS and MSG infrared data, the CALIPSO aerosol optical thickness data, and the MODIS temperature and aerosol optical thickness data. We show that the aerosol optical properties retrieved from MODIS can be used to classify aerosol type with a high degree of accuracy.

3. Examples of parameters available

To illustrate the variety of parameters available, Table 1 lists important aerosol data products produced by selected sensors. The columns describe the type of measurement, the retrieval algorithm(s) used, and the time period over which the data was retrieved. The data are arranged in order of increasing complexity, starting with scalar measurements, and ending with vector measurements. The data are also arranged in order of increasing spatial resolution, starting with scalar measurements, and ending with vector measurements.

3.1. Aerosol Parameters and Classes Used in Our Current Classification Method

We are currently using 6 parameters and 6 aerosol classes (specified clusters), as listed in Tables 2 and 3 and illustrated in Fig. 2. The parameters chosen were those that index the aerosol type and that are likely to be easily obtained from standard optical retrievals. The aerosol classes are those that are likely to be easily grouped into broad aerosol types. This classification is based on the aerosol classification scheme used by the AERONET project. This scheme is defined in Table 3.

3.2. Multidimensional specified clustering and Mahalanobis distances

The aerosol classification scheme used by the AERONET project is represented by a set of multidimensional distances. These distances are defined in Table 3. The classes are defined by the mean and standard deviation of the multidimensional distances. The classes are defined by the mean and standard deviation of the multidimensional distances. The classes are defined by the mean and standard deviation of the multidimensional distances. The classes are defined by the mean and standard deviation of the multidimensional distances. The classes are defined by the mean and standard deviation of the multidimensional distances.

3.3. Specified clustering and Mahalanobis distances

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4. Summary and Conclusions

• Specified clustering and Mahalanobis distances together provide a way of combining several dimensions of optical information to assign aerosols to classes. This is done by computing a Mahalanobis distance from the aerosol optical properties to the mean of each specified cluster.

• We have applied the methods of AERONET Version 2 to data sets using the parameters extinction attenuation exponent (EAE), absorption attenuation exponent (AAE), single scattering albedo (SSA), and scattering ratio (SR). We have also used the methods of AERONET Version 3 using the parameters extinction attenuation exponent (EAE), absorption attenuation exponent (AAE), single scattering albedo (SSA), and scattering ratio (SR), and the MODIS aerosol forcing data.

• Using these AERONET Version 2 data sets, retrieved using the parameters extinction attenuation exponent (EAE), absorption attenuation exponent (AAE), single scattering albedo (SSA), and scattering ratio (SR), and the MODIS aerosol forcing data, we assign aerosols to classes, and the AERONET Version 3 data sets, retrieved using the parameters extinction attenuation exponent (EAE), absorption attenuation exponent (AAE), single scattering albedo (SSA), and scattering ratio (SR), and the MODIS aerosol forcing data, we assign aerosols to classes.

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