MJC Optical Technology

Topics in Particle and Dispersion Science

The EOF method applied to approximate the atmospheric aerosol PSD

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Fig. 1, Fig. 2

Examples of the approximation of the aerosol size distributions with EOFs are given here by using data from a set of 2449 aerosol size distribution profiles measured during the Rough Evaporation Duck (RED) experiment that took place off Oahu, Hawaii, from 26 August to 15 September 2001. The measurements are discussed in detail by, for example, Kuśmierczyk-Michulec J and van Eijk 2006. Each size distribution from this data set is a vector with 25 components corresponding respectively to particle diameters of 0.25, 0.27, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.5, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, and 15 µm. The particle diameter is defined here as the equivalent spherical diameter.

The raw particle size distribution data were obtained with a light scattering-based aerosol particle spectrometer (Particle Measuring System) in the instrument-specific diameter size bins which together covered a diameter range of 0.21 to 42.5 µm. Each raw particle size distribution was smoothed by using the 5-th order polynomial. The smoothed results were used in the EOF calculations.

For this data set, the first eigenvalue accounts for ~99% of the total variance (Eq. 12 in *PSD approximation and analysis with empirical orthogonal functions (EOF)*). Such a large contribution allows one to use only the first eigenvector, h_1 (Fig. 1) and neglect the remaining eigenvectors. Thus, each aerosol size distribution, $n_i(D)$, $i = 1, ..., 2449$, from this data set can be described as follows:

$$n_i(D_j) \cong \langle n(D_j)\rangle + \beta_{i1}\, h_1(D_j) \qquad i = 1, \ldots, 25 \qquad (1)$$

where D is the equivalent spherical particle diameter. Representative size distributions approximated this way are shown in Figure 2. Hence, the i-th particle size distribution of the above data set is represented by a single number β_{i1}, instead of the 25 numbers constituting the vector $n_i(D)$. This significantly simplifies the analysis of the trends in and differences between the size distributions (for example, Kuśmierczyk-Michulec J and van Eijk 2006).

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Kuśmierczyk-Michulec J. 2008. The EOF method applied to approximate the atmospheric aerosol PSD (www.tpdsci.com/Tpc/PsdEofAer.php). In: *Top. Part. Disp. Sci.* (www.tpdsci.com).

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