Empirical orthogonal function computation and analysis of aerosol optical depth from MODIS data over Northern India

Manoj Kumar Singh[a] and P. Venkatachalam[b]

[a] Research Scholar, CSRE, Indian Institute of Technology Bombay, India; Tel: 9320047005; E-mail: manojks@iitb.ac.in

[b] Professor, CSRE, Indian Institute of Technology Bombay, India; E-mail: pvenk@iitb.ac.in

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ABSTRACT: Summer monsoon and water runoff from the Himalaya are two key parts in the livelihood of millions of people of northern India. By modulating heat budget and altering microscopic properties of clouds, atmospheric aerosols disrupt summer monsoon and Himalayan snow cover. Clearer interaction of atmospheric aerosols with summer monsoon and the Himalayan climate need to be understood. Measurement of aerosols at synoptic spatial scale and at greater frequency in time domain is a key milestone in understanding above mentioned climate and aerosols relationship. Aerosol optical depth (AOD) is a measure of aerosols present in the atmosphere. Satellite sensors such as MODIS and MISR provide synoptic and frequent measurement of AOD. Different algorithms were in use to retrieve AOD data from different sensors. It is difficult to retrieve AOD data over areas with cloud cover, deserted and snow covered areas. Therefore, satellite AOD products have many missing values. Empirical orthogonal function (EOF) is a tool quit frequently used in climate data analysis. EOF analysis on data field with too many missing values may not give proper modes and principle components. Many times missing values overestimates amplitude of EOF. Interpolation can be done to fill out missing values. But interpolation generally smoothen the spatial and temporal fields and thus reduces the signals in EOF modes.

In this paper we have used a method for filling missing values based on eigenvalue-eigenvector decomposition. The method involves Markov chains of eigenvalues and eigenvectors. We have further analyzed the EOF modes and principle components obtained from this process to study the behavior of aerosols in the northern India.