# Latitudinal Variations of Aerosol Optical Parameters over South Africa Based on MISR Satellite Data

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## ABSTRACT

The latitudinal variation of the relative weight size distribution and optical properties of aerosols over South Africa is presented here. The study uses 10-years of Multi-angle Imaging SpectroRadiometer (MISR) satellite data, collected over South Africa. The results affirm that large areas of South Africa are influenced by "typical anthropogenic pollution" in addition to numerous natural sources of aerosols.

## INTRODUCTION

It is well known that aerosols have a variety of important direct, semi-direct and indirect effects on the Earth's energy budget, the microphysical and radiative properties of clouds, thermal process of the atmosphere and also detrimental effects on human health [Haywood, 2000 and Twomey, 1977]. The fact that one of the greatest challenges in studying the impact of aerosols on the climate is the immense diversity, not only the particle size, composition, and origin, but also their spatial and temporal distribution. They are also unpredictable due to changes in events such as large dust storms and volcanic eruptions. The knowledge of aerosol characteristics at a local and global scale, their temporal change interrelations with other atmospheric parameters and with solar radiation is of great importance for atmospheric research. To study the effects of aerosols in the atmosphere,, improved aerosol climatology will enable more accurate estimations of the direct and indirect aerosol forcing [Masmoudi et al. 2003]. The present work aims at conducting the seasonal climatology and spatial variability of aerosol relative weight size distribution and optical properties variation correlation with meteorological parameters such as rain fall, relative humidity and wind speed and direction over South Africa. In this extended abstract, we shall present the results obtained in terms of latitudinal variations of aerosol optical depth at 555 nm, the Angstrom exponents in visible: VIS (440-670 nm) and near infrared: NIR (670-865 nm) spectral bands and its spectral curvature.

## DATA AND METHODS

We use 10 years of monthly mean optical properties of aerosols (extinction optical depth, single scattering albedo, absorption optical depth) from MISR. These properties were used to determine the sensitivity of the particle extinction efficiency to wavelength using the graphical framework method, which relies on the Angstrom exponent spectral curvature. The above selected optical parameters of aerosols are linked to other meteorological parameters which greatly affect the aerosol load, dispersion, removal mechanisms and physical-chemical behavioral change during transportation and aging processes. Although our aim is to study the seasonal aerosol climatology over South Africa, here only the latitudinal variations are presented.

## RESULTS AND DISCUSSION

Figure-1 illustrates the 10 years (2000-2009) average aerosol optical parameters (aerosol optical depth at 555 nm in the entire particle size mode, Angstrom exponent in the VIS and NIR bands and its spectral curvature) over the latitudinal variations. We have averaged the obtained aerosol optical parameters over longitude. It is understandable from the figure that the overall annual average optical depth latitudinal variation increases from the lower tip of the Western Cape to the upper tip of Limpopo provinces. Based on the observed trend, the overall average optical depth latitudinal increment can be expressed by the exponential function: $AOD = 0.5198e^{0.051L}$,

where L = Lat. + 34.5, (-34.5 ≤ Lat. ≤ -22) with an $R^2$ (Regression coefficient) equal to 0.845.

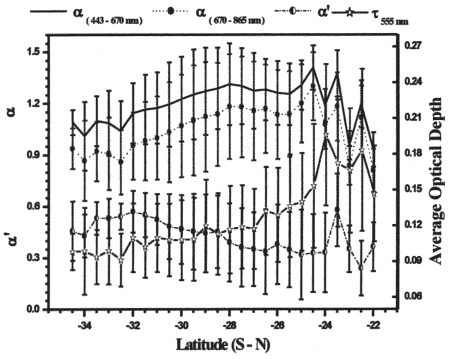


Figure 1: 10 year's monthly average aerosol optical depth, Angstrom exponents in VIS and NIR bands and its spectral curvature latitudinal variations.

The latitudinal variations $\alpha_{(443-670)nm}$, $\alpha_{(670-865)nm}$ and $\alpha'$ (see Figure 1) suggest that regions with lower aerosol burden (Western Cape and the lower parts of Eastern Cape and the Northern Cape lower and central parts) are loaded with bi-modal distribution of accumulation and coarse mode particles with a relatively comparable magnitude. In contrast to the rest of South Africa, higher $\alpha$ values were observed in the VIS and NIR narrow spectral bands ($1.1 < \alpha < 1.7$) together with the near-zero values of $\alpha'$. This indicates bi-modal aerosol size distributions, with significant fine and sub-micron particles and lower concentrations of super micron (radius >1 um) aerosols [Eck et al., 1999]. The exception is the northern regions of the Limpopo province which shows reduced dominance of accumulation-mode particles and a significant contribution of coarse-mode aerosols.

**Summary and Future perspectives**

The upper part of South Africa (26.5S - 22S, 16.5E – 32E) is a "typical pollution" zone with high average extinctions which are ~31.2 % higher than the rest of the South Africa. A significant dominance of submicron particles assures us that there are major local polluted air mass sources over this area.

The extended work, in terms of detailed seasonal variations of aerosol and its relations between background meteorological parameters, is in progress and will be submitted for journal publications in the near future.


## ACKNOWLEDGEMENTS

The authors are greatly thankful to MISR (http://www-misr.jpl.nasa.gov/index.html) for providing satellite data. We are also thankful to the South African Weather Service (SAWS) for providing meteorological data. The work is supported by African Laser Centre and National Research Foundation under the grant (68688), in addition to CSIR-National Laser Centre.


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