Seasonal variability of atmospheric aerosol characteristics over Birtamode using Microtops II sunphotometer observations and validation of MODIS aerosol products

Sishir Dahal[1], Ram Kumar Sharma[2]

1 Department of Civil Engineering, Pulchowk Campus, IOE, Tribhuvan University, Nepal

2 Department of Applied Sciences, Pulchowk Campus, IOE, Tribhuvan University, Nepal

dahalsishir2072@gmail.com

Abstract

•Aerosol optical depth (AOD) is measured for the first time in Birtamode (eastern Nepal).

•Average AOD is found to be 0.68±0.39 (0.13-1.93) over the sampling period (October 2018-February 2019); post- monsoon (October-November) season (0.74±0.43); winter (December-February) season (0.60±0.32).

•Angstrom exponent (α) for post- monsoon and winter are found to be 1.08±0.099 and 1.11±0.16 respectively.

•More than 47% of the instantaneous AOD_{500} values, during the monitoring period, are above 0.6.

•AOD values obtained from MODIS instrument onboard Aqua satellite show high linear correlation (R^2> 0.8) with ground truth for the study duration.

•The Deep Blue (DB) algorithm shows better performance over Dark Target (DT) algorithm.

Introduction

•Aerosol optical depth (AOD/τ) is a measure of attenuation of direct solar radiation by aerosols.

•Bouger-Lambert-Beer law:

$I = I_0 e^{-\tau(\lambda)m}$ ..Eqn.1

•Angstrom's power law:

$\tau(\lambda) = \beta\lambda^{-\alpha}$ ..Eqn.2

$\ln[\tau(\lambda)] = -\alpha\ln(\lambda) + \ln(\beta)$ ..Eqn.3

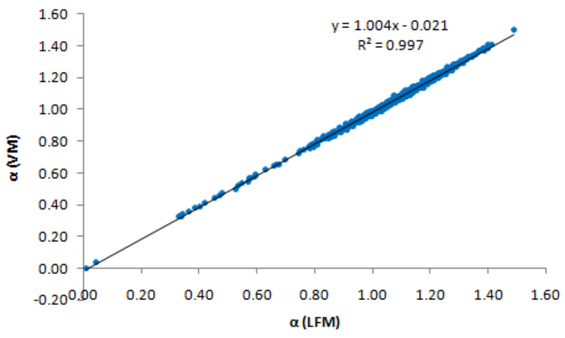
Methodology and Data Analysis

•A base station for AOD measurement was selected in Birtamode region (26.65˚N, 88˚E, 137 m).

•Ground- based spectral AOD measurements were carried out at an interval of 30 minutes from 6:30 am to 4:30 pm with Microtops II Sunphotometer.

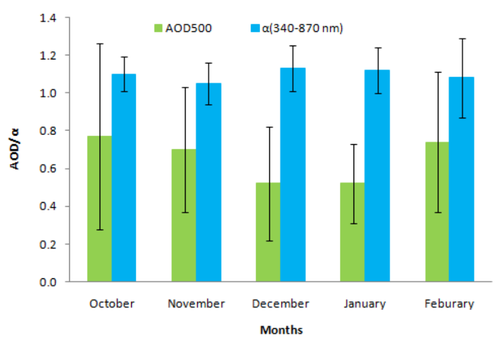
•Daily AOD data (Level 2, Collection 6.1) over Birtamode acquired with the MODIS instrument of Aqua satellite were retrieved from the LAADS DAAC data platform of NASA.

•The AOD values corresponding to Deep Blue (DB) and Dark Target (DT) algorithms with the resolution of 10 km were retrieved.

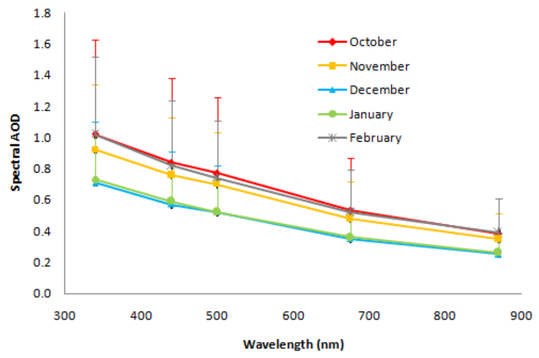


Correlation between α values obtained by Linear Fit Method and Volz Method

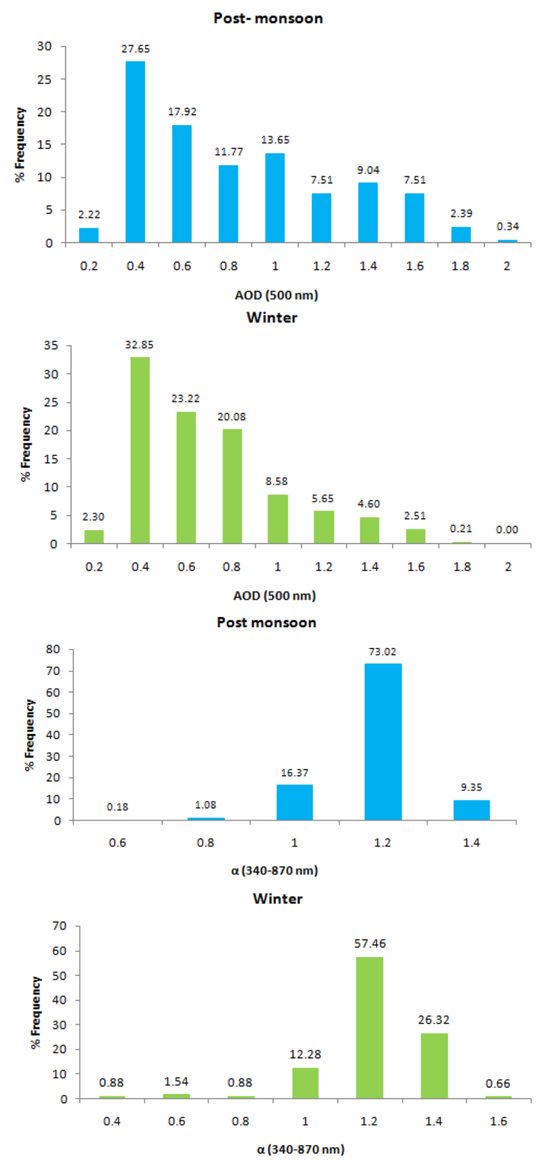
Results



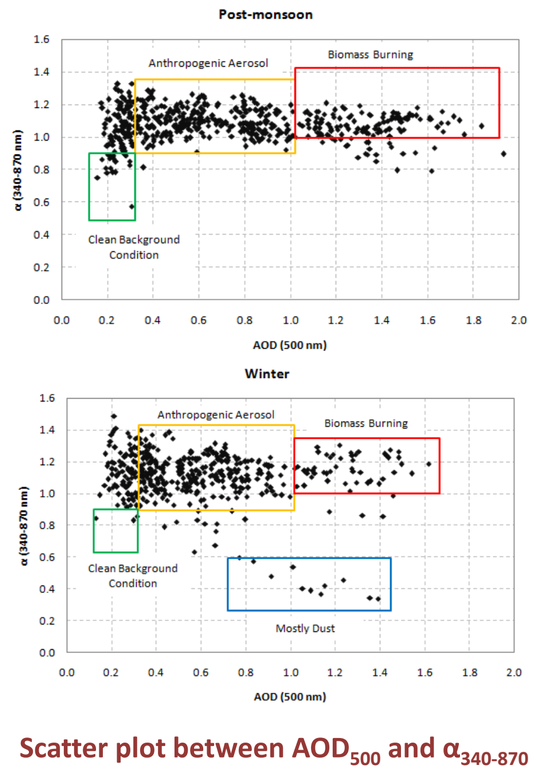
Variation of monthly mean AOD and α



Monthly spectral AOD distribution

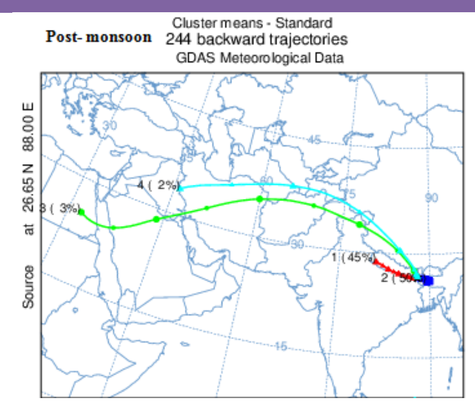


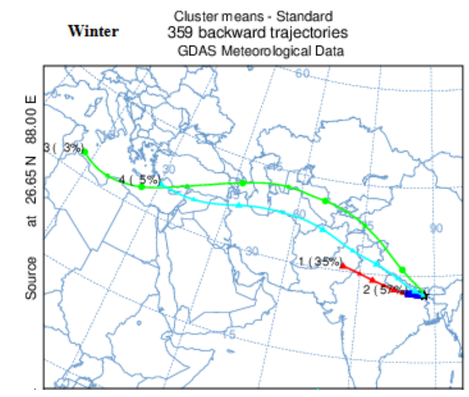
Frequency distribution of AOD_{500} and $\alpha_{340-870}$



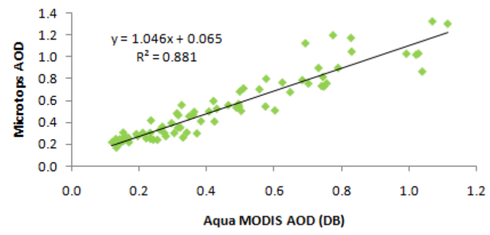
Scatter plot between AOD_{500} and $\alpha_{340-870}$

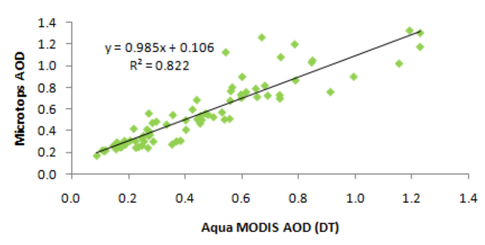
Results

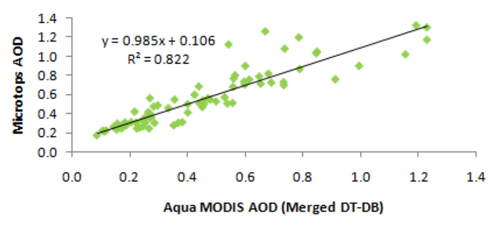




5- day air mass back trajectories at 500m above Birtamode







Scatter plot between Microtops AOD and MODIS AOD

Inter-annual variation of MODIS AOD

Conclusions

•Atmospheric condition of Birtamode is comparable to that of Lumbini (in 2013- 2014) and Kanpur (in 2005- 2010).

•The contribution of anthropogenic aerosol type is highest among all others, which is followed by biomass burning emission.

•The MODIS AOD values show good correlation (R^2>0.8) with ground truth obtained from Microtops.

•DB algorithm show better correlation for Birtamode although the number of collocations is slightly lower compared to DT and merged DT- DB.

•The rate of increase of AOD is comparable to other sites in South Asia.

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