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PII: S0169-8095(16)30592-0
DOI: doi: 10.1016/j.atmosres.2017.07.019
Reference: ATMOS 4014

To appear in: *Atmospheric Research*

Received date: 8 November 2016
Revised date: 6 June 2017
Accepted date: 18 July 2017

Please cite this article as: H. Lihavainen, M.A. Alghamdi, A. Hyvärinen, T. Hussein, K. Neitola, M. Khoder, A.S. Abdelmaksoud, H. Al-Jeelani, I.I. Shabbaj, F.M. Almehmadi , Aerosol optical properties at rural background area in Western Saudi Arabia, *Atmospheric Research* (2017), doi: 10.1016/j.atmosres.2017.07.019

AEROSOL OPTICAL PROPERTIES AT RURAL BACKGROUND AREA IN WESTERN SAUDI ARABIA

H. Lihavainen[1], M. A. Alghamdi[2], A. Hyvärinen[1], T. Hussein[3], K. Neitola[1], M. Khoder[2], A. S. Abdelmaksoud[2], H. Al-Jeelani[2], I. I. Shabbaj[2] and F. M. Almehmadi[2]

[1]Finnish Meteorological Institute, Finland

[2]Department of Environmental Sciences, Faculty of Meteorology, Environment and Arid Land Agriculture, King Abdulaziz University, P. O. Box 80208, Jeddah 21589, Saudi Arabia

[3]University of Helsinki, Department of Physics, Finland

ABSTRACT

To derive the comprehensive aerosol in situ characteristics at a rural background area in Saudi Arabia, an aerosol measurements station was established to Hada Al Sham, 60 km east from the Red Sea and the city of Jeddah. The present sturdy describes the observational data from February 2013 to February 2015 of scattering and absorption coefficients, Ångström exponents and single scattering albedo over the measurement period. The average scattering and absorption coefficients at wavelength 525 nm were 109 ± 71 Mm^{-1} (mean ± SD, at STP conditions) and 15 ± 17 Mm^{-1} (at STP conditions), respectively. As expected, the scattering coefficient was dominated by large desert dust particles with low Ångström scattering exponent, 0.49 ± 0.62. Especially from February to June the Ångström scattering exponent was clearly lower (0.23) and scattering coefficients higher (124 Mm^{-1}) than total averages because of the dust outbreak season. Aerosol optical properties had clear diurnal cycle. The lowest scattering and absorption coefficients and aerosol optical depths were observed around noon. The observed diurnal variation is caused by wind direction and speed, during night time very calm easterly winds are dominating whereas during daytime the stronger westerly winds are dominating (sea breeze). Positive Matrix Factorization mathematical tool was applied to the scattering and absorption coefficients and $PM_{2.5}$ and coarse mode (PM_{10}- $PM_{2.5}$) mass concentrations to identify source characteristics. Three different factors with clearly different properties were found; anthropogenic, BC source and desert dust. Mass absorption efficiencies for BC source and desert dust factors were, 6.0 m^2 g^{-1} and 0.4 m^2 g^{-1}, respectively, and mass scattering efficiencies for anthropogenic (sulphate) and desert dust, 2.5 m^2 g^{-1} and 0.8 m^2 g^{-1}, respectively.

1. INTRODUCTION

Atmospheric aerosol particles are recognized as one of the most variable components in the Earth's atmosphere. They affect the Earth's radiative balance and climate directly by scattering and absorbing solar radiation (Charlson et al., 1992; Haywood and Shine, 1995), and indirectly changing the microphysical properties of clouds (Kaufman et al., 2005). The uncertainties in various climate effects of aerosols continue to be the largest uncertainty in the total, global radiative forcing estimate (IPCC, 2013). Aerosols are also known to cause adverse health effects (e.g. Schwarze et al., 2006).