UNIVERSITY OF NAIROBI

SIMULATION OF RADIATIVE FORCING DUE TO AEROSOLS OVER SOME COUNTIES IN KENYA

BY

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Declaration

This dissertation is my original work and has not been presented for the award for any degree in this University or any other academic institution.

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Dedication

This dissertation is dedicated to my father, Wilfred Daniel Owino and My Mother, Fridah Owino for their prayers and unwavering support during my course work.

Abstract

Anthropogenic emissions of aerosols and their precursors contribute to a reduction of solar radiation at the surface. The Coupled Ocean and Atmosphere Radiative Transfer (COART) model was used to solve a radiative transfer equation using aerosol optical thickness data derived from Moderate Resolution Imaging Spectroradiometer (MODIS) spanning 2000 to 2015.

Trajectory modeling was carried out using Hybrid Single Particle Langrangian Model (HYSPLIT) to trace the possible sources of aerosols. Integrated fluxes were generated from COART model and their spatial and temporal patterns specified. Counties investigated are Mombasa, Lamu, Nairobi, Kakamega, Bungoma, Nyeri, Meru, Machakos, Turkana, Tranzoia, Baringo, Nakuru, Narok, Kisumu, Kisii, Nyamira and Busia. Simulation of future warming was also done using Model for the Assessment of Green House Gas-Induced Climate Change, A Regional Climate SCEnario GENerator (MAGGICC SCENGEN).

Results of the spatial characteristics of aerosols revealed that Turkana, Garrisa, Mombasa and Lamu Counties had higher aerosol optical depth while Kisii County had low aerosols ‘optical depths respectively across all seasons. It was also observed that aerosol loading was highest during the JJA season. Results from the temporal characteristics of aerosols showed that Garrissa County had the highest interannual variability of aerosols. The study indicated that aerosol loading across all Kenyan Counties is reducing and that long distance transport and dispersion of aerosols was facilitated by low level winds.

Results from spatial variation of radiative forcing due to aerosols revealed that Kisii County had high radiative forcing while Marsabit, Wajir, Mombasa, Lamu and Turkana Counties had relatively lower radiative forcing. Results from temporal analysis revealed that forcing over Kenya is reducing and is in the range of -0.187 to -0.05 w/m^2.

Model simulation results revealed a warming of 0.17 ^{0}C, 0.45 ^{0}C, and 2.96 ^{0}C by the year 2000, 2015 and 2100 respectively, due to aerosols. Results also reveal sulphates-induced warming of 0.1 ^{0}C and 0.25 ^{0}C under reference and policy scenarios respectively. Detailed investigation of dominant radiative processes corresponding to individual aerosols in each county is recommended.

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