한국대기환경학회 2006 춘계학술대회 논문집
Proceeding of the 41st Meeting of KOSAE(2006)
Korean Society for Atmospheric Environment

2D1) 시베리아 산림 화재시 CMAQ 모델을 이용하여 추정한 입자광학두께의 분포

Regional Aerosol Optical Depth Distribution Derived by CMAQ Model Simulation Under Siberian Forest Fire Emission

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1. INTRODUCTION

Biomass burning, including forest fires, is a major global source for CO, aerosols and other pollutants. ForMay 2003 a large number of fires were detected along the Russian borders with Mongolia and China between 45 and 60 N with the most intense fire in the regions near Lake Baikal. This boreal forest fire event have drawn attention to the role of wildfires in influencing aerosol concentrations and radiative budget in regional and global scale atmosphere environment (Jaffe et al., 2004; Lee et al., 2005). Jaffe et al. (2004) report the relationshipbetween the annual Russian area burned and background O_3 concentration and CO concentrations in western North America.

In this study, we examined enhancement of aerosol optical depth (AOD) derived by Community Multi-scale Air Quality (CMAQ) model and compare that with Moderate Resolution Imaging Spectroradiometer (MODIS) and ground AERONET sun photometer measurementsto account for the contribution of long-range transported smoke aerosols to the visual environment in the northeast Asia.

2. MODEL DESCRIPTION

We used the CMAQ regional 3-D model with biomass burning emissions of trace gases and aerosols using data from Global Fire Monitoring Center (GFMC) on top of anthropogenic gaseous and primary aerosol emissions compiled by Streets et al. (2003). GFMC estimated 18.9 million hectares burned in 2003, average fuel consumption of 30 tons/hectare and emission factors of 120g CO/kg fuel burned and 1.4g N/kg fuel burned. We allocated the emission spatial-resolved using fire detected by MODIS/TERRA satellite measurement with assumption of vertical well mixing from ground level up to 5km model heights.

We used the general relationship between aerosol extinction optical depth and the aerosol mass loading per unit area (Lacis and Mishchenko, 1994) to describe the AOD distribution which was used for quantify seasonal variations of AOD in global scale (Chin et al., 2002). The aerosol optical properties were based on the Global Aerosol Data Set (GADS; Kopke et al., 1997)

3. RESULTS

Elevated AOD is observed over biomass burning areas and along fire plume pathways (Figure 1). Our analyses show that smokes from fires in Siberia was well resolved comparing with satellite detection in time and space. However, CMAQ derived AOD was underestimated due to the low bias of aerosol mass loading which was attributed to aerosol emission intensity errors in model (Figure

2).

We compare model results of PM10 and CO concentrations at ground level with those observed concentration at surface monitoring sites over south Korea and also validate AOD estimation by comparing with AERONET sun photometer measurements in Beijing, Anmyon, and Gosan sites.

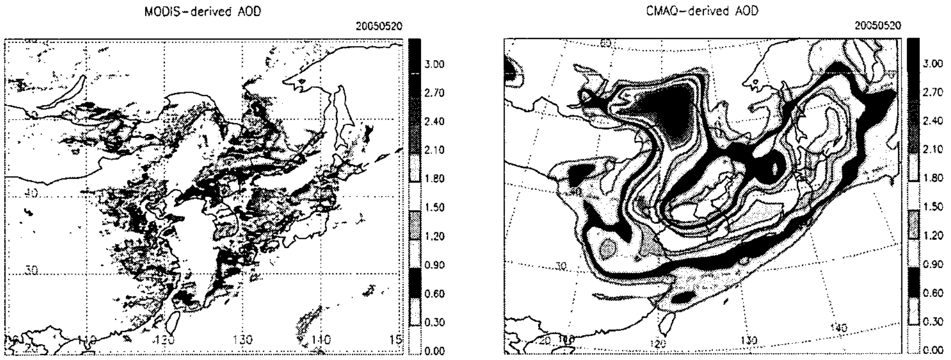

Fig. 1. Spatial distribution of aerosol optical depth retrieved by MODIS (left panel) and derived by CMAQ simulation (right panel) in May 20, 2003.

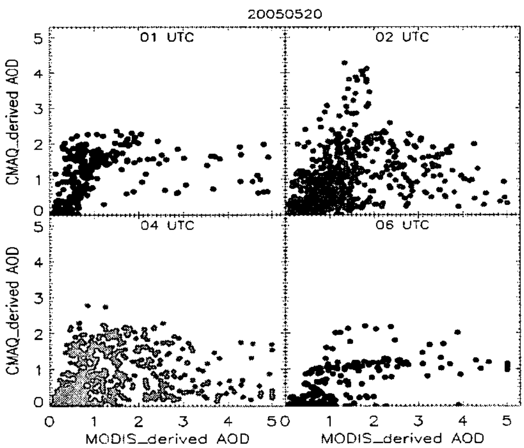

Fig. 2. Scatter plots of aerosol optical depth between retrieved by MODIS and derived by CMAQ simulation at 01, 02, 04, and 06 UTC in May 20, 2003.

ACKNOWLEDGMENTS

This work was supported by the Korea Research Foundation Grant funded by Korea Government (MOEHRD, Basic Research Promotion Fund) (KRF-2005-050-C00013) and by the Climate Environment System Research Center in Seoul National University.

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