Spatial and temporal variations in trace gases and aerosols from biomass burning in Southeast Asia as measured from space

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1.Introduction

Southeast Asia is well known as one of largest burnt fields areas in the world. Recently, the region has a problem that deforestation and air pollution caused by the repeated burnings without sufficient interval for the recovery of vegetation.

Carbon monoxide (CO) generated by the biomass burning is one of the precursors of tropospheric ozone. It is thought that the ozone generated by biomass burning over the area has caused significant air pollution [Zhang et al., 2003]. In addition, the black carbon emitted from biomass burning has greenhouse warming potential. Detailed investigation of the biomass burning is required to understand not only the air quality but also the radiation balance of the earth.

Satellite observations provide information on temporal and spatial distribution of atmospheric constituents. The purpose of this research is to make the spatiotemporal variation of the aerosols and gases by the data observed from satellite over Southeast Asia. We examined the aerosol data obtained by Ozone Monitoring Instrument (OMI) and the CO data obtained by Measurement of Pollution in the Troposphere (MOPITT), and then compared them with the hotspot data derived from Moderate Resolution imaging Spectrometer (MODIS).

2.Data

Fire event

We analyzed the data of fire hot spot derived from thermal anomaly data from Moderate Resolution imaging Spectrometer (MODIS) [Takeuchi et al.,2005].We archived the number of the fire events in the grid of 0.25°×0.25°

Aerosol

Aerosol data are from OMI onboard the Aura satellite. The aerosol types are classified into three types. In this study, the products of the aerosol index, the aerosol optical depth, and the aerosol type were analyzed.

CO Mixing Ratio

CO data were from MOPITT onboard the Terra/Aqua satellite. In this study, the product of ver4 of CO mixing ratio at 900hPa was analyzed.

3.Spatial distribution of fire hotspot, aerosol and CO

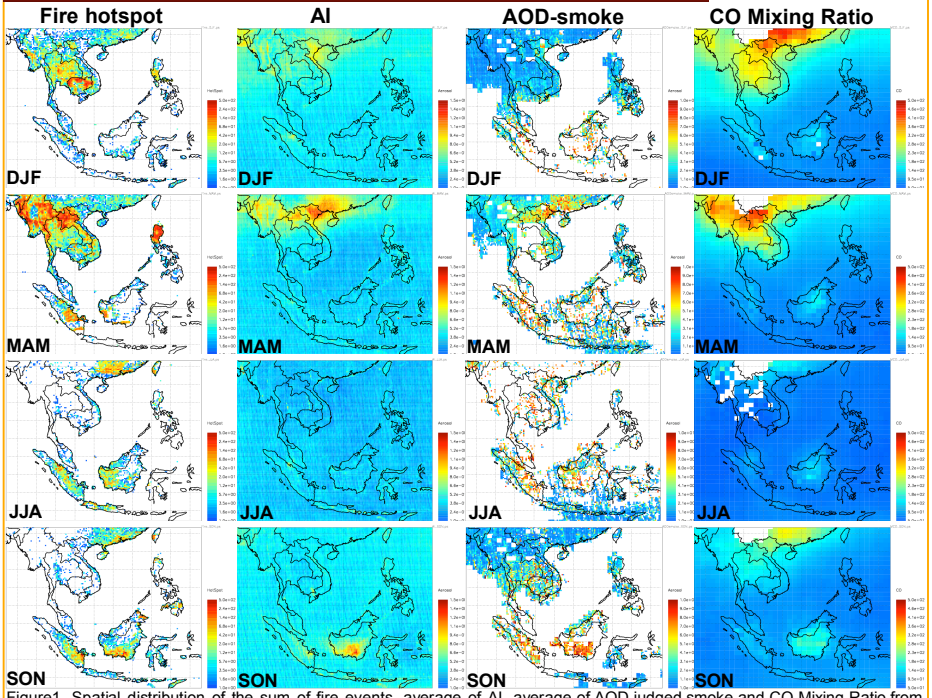

Figure1. Spatial distribution of the sum of fire events, average of AI, average of AOD judged smoke and CO Mixing Ratio from 2004 to 2008

Many burning events happened in the mountain area of Myanmar, Laos, Thailand, Sumatra, and Kalimantan. In those areas, AI and CO Mixing Ratio data were also high. At Hanoi in Vietnam and South China area, AI is high although there is few fire hot spot data

4.Emission data

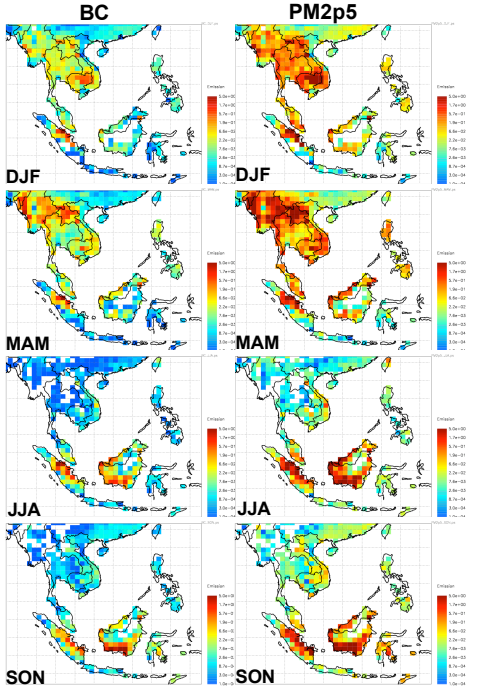

Figure2-1. Integrated value of the aerosol amount emitted from the biomass burning origin taken from the Emission inventory database, Global Fire Emission Database (GFED).

This GFED database is the emission inventory, which is available on the website (http://daac.ornl.gov/). There is good agreement between the spatial distribution of the GFED emission data from biomass burning and the fire number, Aerosol Index, and CO Mixing Ratio shown in Fig.1.

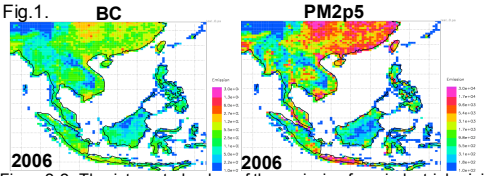

Figure2-2. The integrated value of the emission from industrial origin taken from Intercontinental Chemical Transport Experiment-Phase B(INTEX-B).

The INTEX-B is inventory database of air pollutant emissions in Asia in the year 2006(biomass burning is excluded), and is available on the website (http://www.espo.nasa.gov/intex-b/). Over Hanoi in Vietnam and South China area, there is emission source from industrial activity. On the other hand, there is no source of the industrial activity over Sumatra, Kalimantan.

5.Temporal variation

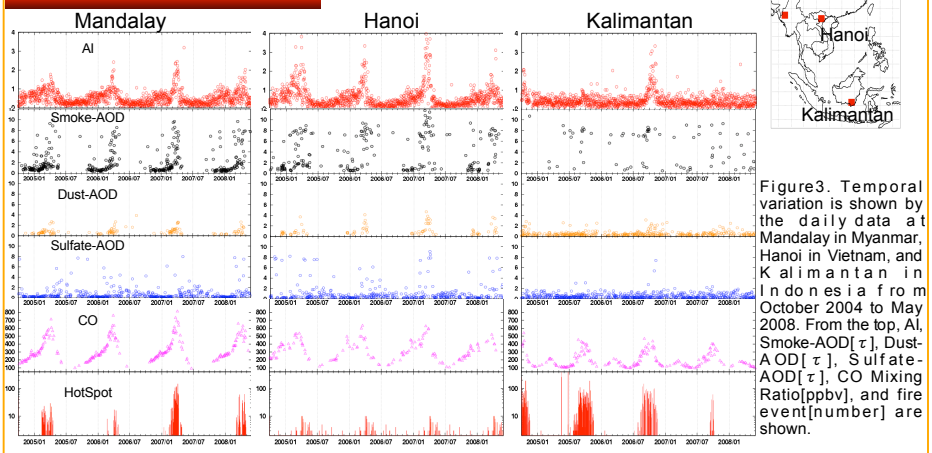

Figure3. Temporal variation is shown by the daily data at Mandalay in Myanmar, Hanoi in Vietnam, and Kalimantan in Indonesia from October 2004 to May 2008. From the top, AI, Smoke-AOD[τ], Dust-AOD[τ], Sulfate-AOD[τ], CO Mixing Ratio[ppbv], and fire event[number] are shown.

At Mandalay fire event data show a strong enhancement around March-April every year. Corresponding to the fire events, both of the aerosol and CO data show a outstanding maximum at around the same time. At Kalimantan hotspot data show a strong enhancement around September-November every year. Both the aerosol and CO data show also a clear maximum around the same time. In the season of biomass burning most of aerosols are classified as smoke.

6.Summary

We tried to clearly that air pollution in Southeast Asia by using satellite data.The data of satellite observation revealed that considerable amount of the aerosols and CO is emitted from the burn agricultural area.

Hanoi may be influenced by biomass burning from burn agriculture area because temporal variation at Hanoi shows similar variation to that at burn agriculture area nevertheless there is an urban area.