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Author(s)	Yulianti, Nina
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DISSERTATION ABSTRACT

博士の専攻分野の名称 博士（工学） 氏名 NINA YULIANTI

学 位 論 文 題 名

Title of dissertation submitted for the degree

The influence of precipitation patterns on recent peatland fires in Indonesia

(インドネシアの泥炭火災に及ぼす降雨パターンの影響)

In August 2010, Indonesia formally admitted to producing about 2.1 billion tonnes of CO₂, which is a very high amount (the United States produced about 5.2 billion tonnes), mostly as a result of peatland fires and deforestation. Indonesia has now been requested to reduce not only carbon emissions from peatland fires but also air pollution, which is related to deforestation and is caused by haze.

Hotspot data captured by MODIS (Moderate Resolution Imaging Spectroradiometer) from 2002 to 2012 was analyzed to better comprehend the problems associated with fires in Indonesia, Kalimantan, and Sumatra. Due to Indonesia's size and number of islands, various grid sizes utilizing latitude and longitude angles from $1^{\circ} \times 1^{\circ}$ to $0.01^{\circ} \times 0.01^{\circ}$ were used for various analysis purposes. Precipitation data was mainly analyzed to explain fire activities in several regions in Kalimantan and Sumatra, simply because precipitation was a common weather data for all the major weather stations in Indonesia. The NOAA (National Oceanic and Atmospheric Administration) definition of El Nino events and their SST anomaly values were also used to analyze their relationship with precipitation and fire activities.

Preliminary analysis using a 1° ($1^{\circ} \times 1^{\circ}$) grid cell was carried out to locate the most fire-prone areas in Indonesia. Analysis results clearly identified that among the approximately 500 cells covering Indonesia, there were 11 fire-prone cells where the annual average hotspot density exceeded $0.081 \text{ hotspots/km}^2$ (= 1,000 hotspots). The top 11 fire prone cells were located solely in Kalimantan and Sumatra; one region (5 adjacent cells) in south Kalimantan, another region (5 adjacent cells) in north Sumatra, and one area (1 cell) in south Sumatra.

Detailed analyses using $0.5^{\circ} \times 0.5^{\circ}$ grid cells and precipitation data were carried out to understand the seasonal and spatial fire occurrence in Kalimantan and Sumatra more clearly. Most data were tallied every 10 days, enabling a detailed understanding of the seasonal and spatial fire occurrence and precipitation trends. Results of detailed analyses clearly show the number of fire-prone cells with an annual average hotspot density exceeding $0.129 \text{ hotspots/km}^2$ (= 400 hotspots) to be 11 for Kalimantan and 12 for Sumatra. Two severe fire

regions (7 adjacent cells) were identified in the MRP (Mega Rice Project) region in Kalimantan, and in the Dumai region in Sumatra, followed by the Sampit area in Kalimantan and the Palembang area in Sumatra (with 2 adjacent cells). Most fire-prone regions in Kalimantan and Sumatra are located on the peatland and its vicinity. Fire occurrence tendencies in fire-prone regions are mostly explained using the two different precipitation patterns of the region: the summer dry season pattern (S) and the winter and summer dry season pattern (WS). The southern part of Kalimantan and Sumatra, which are located in the southern hemisphere and belong to the S pattern, show severe fire activities over a relatively longer dry season over a few summer months. The northern part of Sumatra, which is located in the northern hemisphere and accords with to the WS pattern, shows separate periods of fire activities, due to two dry seasons in both winter and summer months. From a comparison of fire activities in several areas on both islands, it is evident that the most severe peat fires occur in the southern part of Central Kalimantan, due to the relatively longer dry season (of more than 3 months under El Nino) compared with other areas. Considering this information, a method for forecasting and preventing future fires in Kalimantan and Sumatra was proposed. This method involves three factors: the observation of warning fire occurrence by MODIS, the assessment of drought conditions using the accumulated precipitation curve from around early June, and the use of El Nino information from NOAA.