Characteristics of wildfires in Thailand observed from satellite imageries

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1. Introduction

Fires are one of the main elements of the deforestation in the tropical and the sub-tropical region. Occurrence of an excessive fires caused by human activity exerts various influences on both a global and a local scale. Therefore, it is expected to find fires at the early stage, and to extinguish them promptly.

The satellite remote sensing is thought to be an effective method in detecting a forest fire because of its features such as periodicity and ability to measure the thermal infrared spectral region. Although AVHRR data has long been used for fire detection activities, more efficient sensor like MODIS is developed, and the accuracy improvement of the fire detection is expected. However, since the many detection errors are generated in Southeast Asia when applying a present MODIS fire detection algorithm, it's difficult to use the results in fire control. It's important to improve the accuracy of the fire detection using the satellite data in this research. As a preliminary study, we analyzed the feature of fires using MODIS datasets and ALOS/AVNIR-2 imageries.

2. Data and methods

The study area is whole Thailand, and the area of 78×96 km in the west of Chiang Mai, Thailand was selected as a focused observation area.

Imageries of AVINIR-2 instruments onboard the ALOS were used for the dates of March 7 and 27, 2007. The MODIS Thermal Anomalies products (MOD14/MYD14) were used for the dates from January 1 to April 30, 2007 and 2008. The MODIS Land Cover products (MOD12) were also used. Fire information around Chiang Mai which includes fire location, dates, and burning area, provided by local fire service were used for validation data.

We made true- and false-color imageries of AVNIR-2 and detected the smoke plumes by visual check. We made time series of hotspots and real fires obtained from MOD14/MYD14 and fire information. Then we analyzed the land cover classes in which hotspots and real fires were included. At last, we validated the daytime MODIS/Terra hotspots using fire data and AVNIR-2 imageries and counted the number of commission and omission errors. We also compared which land covers had the most errors by computing the performance indexes (Cuomo et al. 2001).

3. Results and discussion

In order to detect the smoke plume by the ALOS/AVNIR-2 imageries, channel 1 (0.42 - 0.50μm) proved to be effective, because true-color imageries were much easier to find smoke plumes visually than false-color imageries.

The numbers of hotspots reached peak at the beginning of March 2007, and at the end of March 2008. Similar tendency was observed in fires around Chiang Mai. Hotspots and real fires were most occurred in the forest class in the six major land cover classes in this area.

Many fires were undetected by MODIS because these fires are small and do not emit sufficient radiation to penetrate the canopies, so it's difficult to distinguish fire pixels from non-fire background pixels by current algorithms.

By comparing the performance indexes for "Evergreen Broadleaf Forest" class and "Woody Savannas" class which occupy the most land covers in study area, the latter result was worse than the former, because the latter global index showed negative value of -0.23 which indicates that the number of false alarms exceeds the detected fires. On the other hand, the former global index showed positive value of 0.29, yet it's still not a good result.

To improve the accuracy of the fire detection using MODIS, it's important to take the difference of land covers into account and choose the optimal threshold correspond to small fires.