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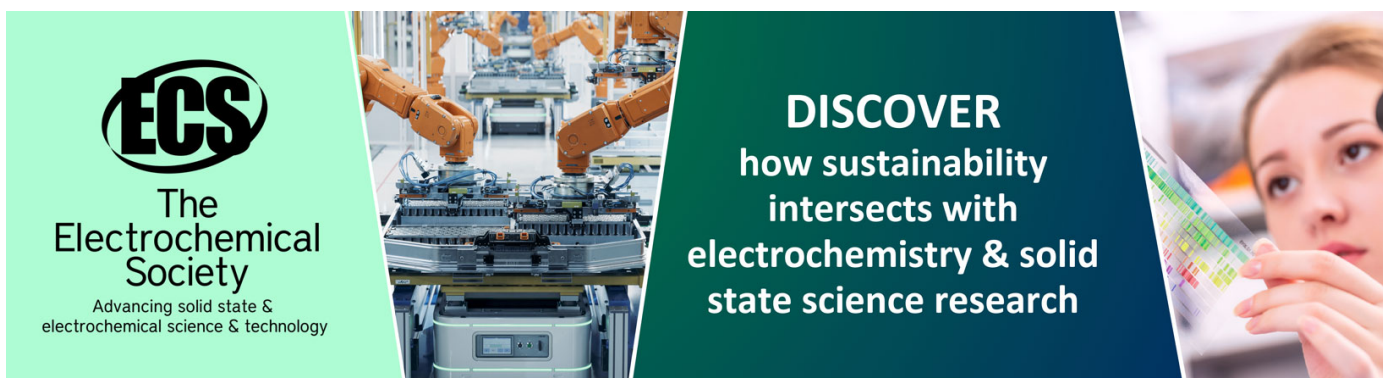
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Detection of frequently-burn locations using multi-temporal Terra/Aqua MODIS fire product (MOD14) in Oudomxay province, Laos

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Abstract. Wildfire is natural and man-made disaster that relates to global warming and climate change. Wildfire is prominent disaster that destroys natural resources, and causes enormous danger to human life and property. The study on the spatial and temporal distribution of wildfire is significant to understand wildfire occurrence and behavior. In the past, people usually study on the pattern of wildfire and open-space burning according to the daily number of active fire detected by MODIS sensor onboard of Terra and Aqua satellites for a particular area at the time of satellite over pass. However, there is no study that focused on the active fire that frequently occurred at the same location for a given period of time. Therefore, in this paper, the authors has focused on the study of frequently-burn locations in Oudomxay province of Laos, which has the 3rd highest active fire number in burning season of year 2007-2009 using spatial and statistical analysis of the active fire distribution and occurrence by time and space. The results of the study show that the highest number of burning frequency is 6 and 7 times within the study period and these numbers are located at 3 districts. One is Xai district which has the highest frequently-burn location for 7 times during the study period at the coordinate of N20.72° and E101.88°. The second districts are Beng and Nga districts which has the 2nd highest frequently-burn location for 6 times during the study period at the coordinate of N 20.28°, E101.68°, and N20.17°,E102.02°, respectively. The obtained information on frequently-burn locations in the province would be useful to identify the repeat burning activity by the local people occurred in the same location and allows the forestry and agricultural officers understand the wildfire distribution pattern

1. Introduction

Since the automatic near real-time MODIS Fire Product processing system in Geoinformatics Center, Asian Institute of Technology, Pathumthani, Thailand was released to the public through the internet in July 2006, the active fire and thermal anomalies phenomenon in South and Southeast region have been observed regularly for 6-8 times per day including day and night, which can be applied to observe in different period of time such as daily, weekly, monthly and yearly. According to the observation by the system for many years, we found that during the dry season in Southeast Asia, Laos is one of the top countries, which have huge amount of active fire locations. Therefore, based on this reason, it is necessary to monitor the spatial distribution of the active fire, which lead to understand the

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characteristics of the fire and biomass burning phenomenon, that related to slash-and-burn and shifting cultivation activities in the country. Moreover, only monitoring the spread of active fire may not sufficient to understand the biomass burning activities of local people. From the observation to the detected active fire and based on the characteristics of shifting cultivation, the burning activity could occurred repeatedly at the same location. Therefore, this study will show the potential use of remote sensing technology to detect the frequent-burn locations in a northern province of Laos, which is Oudomxay province. The result will be used as basic information and bring great benefit to the Ministry of Agriculture and Forestry (MAF) of Laos.

2. Objectives of the study

The purpose of this study is to apply MODIS Fire product to detect the frequently-burn locations in Oudomxay province, which is one of 10 provinces in northern part of Laos, that wild fire is highly detected using Earth observation satellite sensor MODIS installed onboard Terra and Aqua satellites. Table 1 shows the total amount of active fire detected by MODIS in dry season (January - April) of year 2007, 2008 and 2009 for 5 provinces in Northern part of Laos.

Table 1. Active fire locations detected by MODIS in 2007-2009 for January – April [1].

No	Province name	Number of detected active fire points
1.	Louang Phrabang	11691
2.	Xaignabouli	9453
3.	Oudomxai	8020
4.	Phongsali	6231
5.	Louang Namtha	5192

2. Study area

Oudomxay is a province of Laos, located in the northwest of the country as shown in Figure 1. The province capital is Muang Xai. The province is divided to 7 districts which are Beng, Houn, La, Nam, Nga, Pakbeng and Xai. Oudomxay Province covers an area of 15,370 square kilometres. The province borders China to the north, Phongsali Province to the northeast, Luang Prabang Province to the east and southeast, Xaignabouli Province to the south and southwest, Bokeo Province to the west, and Luang Namtha Province to the northwest. The topography of Oudomxay is mountainous, between 300–1,800 metres above sea level. Approximately 40,000 hectares of land are cultivated in Oudomxay, with rice being the main crop. Besides rice, important crops are corn, soybeans, fruits, vegetables, cassava, sugarcane, tobacco, cotton wool, tea and peanuts. In 2004, approximately 10,000 tons of sugarcane and 45,000 tons of corn were produced. [2]

3. Data used and methodology

The data used in this study are the MODIS active fire product which is NASA standard product as shown in Figure 2. The data represents as pixels, that identify the location of active fire detected by MODIS sensor and has the spatial resolution of 1 km by 1 km. The methodology of the study is shown in Figure 3. First, at step 1 as indicated in the flowchart, the active fire data from MODIS fire product (MOD14) for Laos were prepared for the duration of 2007-2009. These data contains various physical parameters defined by NASA. The most important parameters that are used in this study are date and GMT time of active fire detection, fire confidence in percentage (0 – 100%) and geographic locations of detected active fire in latitude and longitude. The selected fire confidence used in this study is in the range of 71-100% which belongs to high confidence category. These data were filtered to get only those that located in the province and its districts. At step 3, the filtered data were spatially analysed using GIS system to extract only the data with the same geographic locations within the period of 2007-2009, and finally the obtained data in step 3 were grouped for the same district, and finally overlay these district data to the map. At this stage, instead of still traditional map, we use Google Earth for displaying the spatial distribution of the obtained frequent-burn active fire locations, which is efficiently used for visualization of the obtained results.

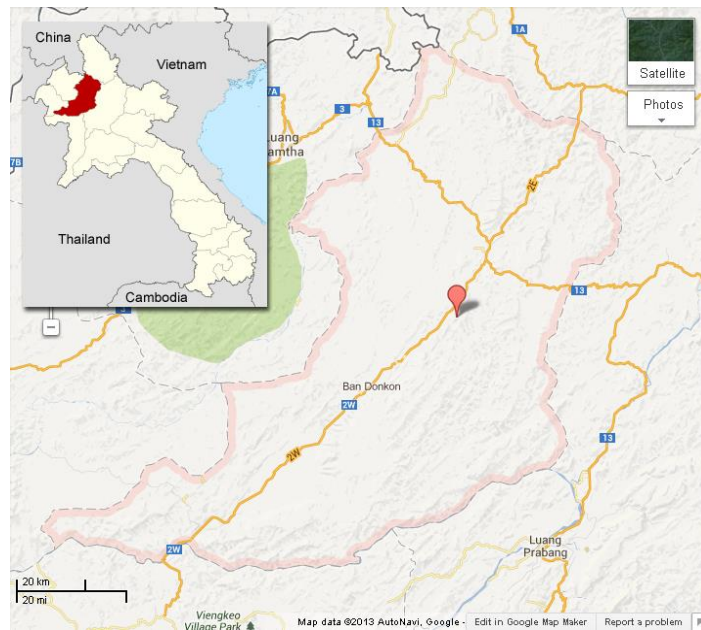


Figure 1. Oudomxay province with its boundary marked in red.

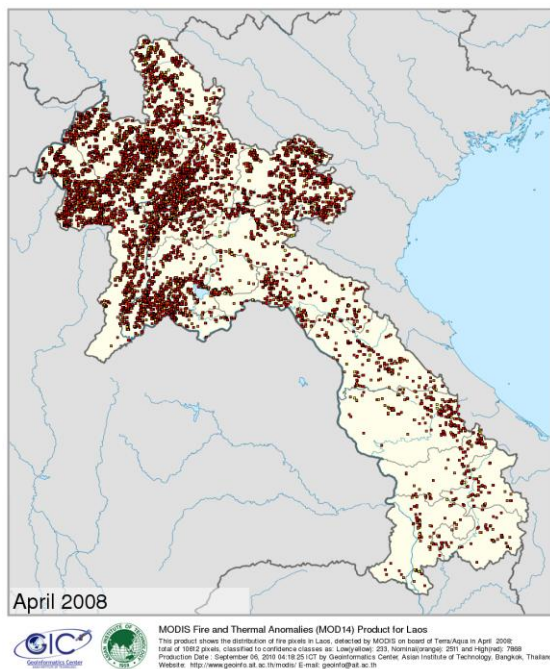


Figure 2. MODIS active fire product (MOD14), detected in Laos in April 2008.

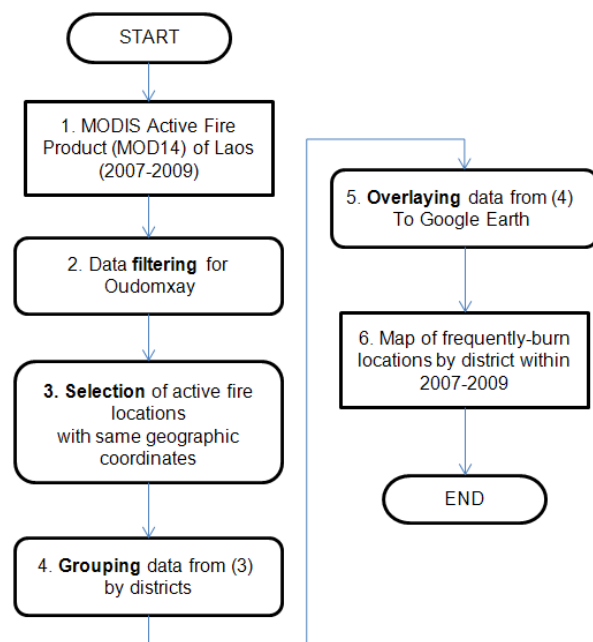


Figure 3. Flowchart of the methodology.

4. Results and discussions

Based on the implementation of the methodology above, we obtained the list of districts in Oudomxay province with the frequent-burn locations of 2, 3, 4, 5, 6 and 7 times within the study period. The number of frequent-burn locations represents the repeating time of burning activities within the time period of the study at the same location. Table 2, 3 and 4 shows some examples of the frequent-burnt locations of 4, 5 and 6 times in Beng, Xai and Beng districts, respectively. Figure 4 shows the spatial distribution of frequent-burn locations in the whole province. Figure 5 shows the spatial distribution of

frequent-burn locations in Beng district. The Google Earth's placemarks with numbers identify the number of frequent-burn at the specific location, identified by the placemark. From the obtained result, we can see that the active fire in the same locations occurred repeatedly from 3 to 7 times with the study period in many districts of the provinces. These results can be used to identify the burning activities of the local people in the province. The high frequent-burn number shows that the local people access to the area very often to burn the biomass for preparing the land for agricultural activities, while the area with low frequent-burn number shows that the area has not much burning activities. The information could be used for the local officers to understand the burning activities of the local people in each district, and could be useful to apply for shifting cultivation management and planning in district level.

Table 2. Frequent-burnt locations of 4 times within the study period in Beng district, Oudomxay.

ID	Date	GMT Time	Latitude	Longitude	Fire confidence	District	Province
01	26/03/2007	06:17	20.50	101.97	100	Beng	Oudomxay
02	31/03/2007	06:35	20.50	101.97	100	Beng	Oudomxay
03	08/04/2008	05:58	20.50	101.97	100	Beng	Oudomxay
04	21/04/2009	06:39	20.50	101.97	100	Beng	Oudomxay

Table 3. Frequent-burnt locations of 5 times within the study period in Xai district, Oudomxay.

ID	Date	GMT Time	Latitude	Longitude	Fire confidence	District	Province
01	31/03/2007	06:35	20.72	101.87	99	Xai	Oudomxay
02	03/04/2007	04:01	20.72	101.87	96	Xai	Oudomxay
03	20/03/2009	06:39	20.72	101.87	100	Xai	Oudomxay
04	20/03/2009	06:39	20.72	101.87	86	Xai	Oudomxay
05	21/04/2009	06:39	20.72	101.87	86	Xai	Oudomxay

Table 4. Frequent-burnt locations of 6 times within the study period in Beng district, Oudomxay.

ID	Date	GMT Time	Latitude	Longitude	Fire confidence	District	Province
01	17/03/2007	06:23	20.28	101.68	95	Beng	Oudomxay
02	28/03/2007	06:04	20.28	101.68	100	Beng	Oudomxay
03	29/03/2007	06:47	20.28	101.68	100	Beng	Oudomxay
04	09/04/2008	06:40	20.28	101.68	100	Beng	Oudomxay
05	06/03/2009	06:27	20.28	101.68	96	Beng	Oudomxay
06	13/03/2009	06:33	20.28	101.68	89	Beng	Oudomxay

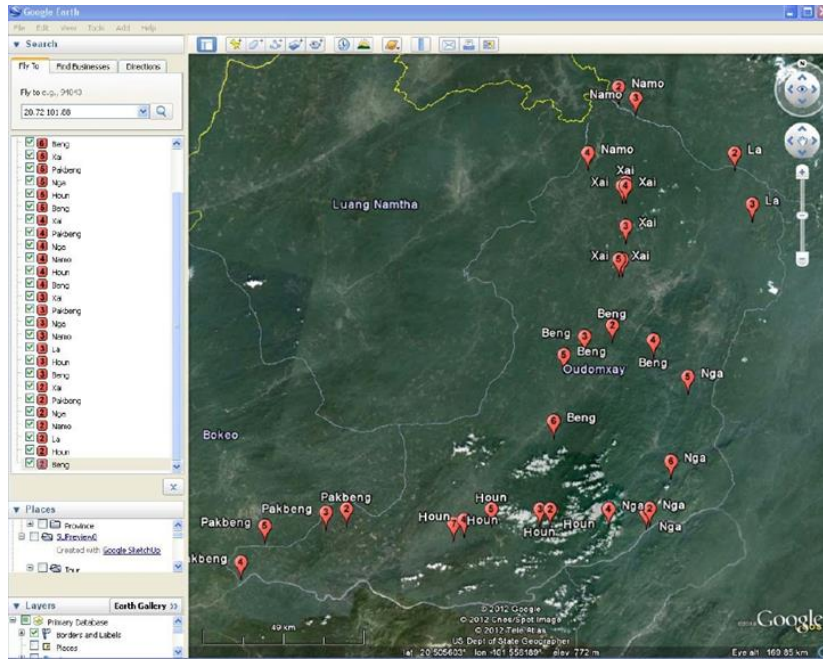


Figure 4. Spatial Distribution of Frequent-burn Locations in Oudomxay province.

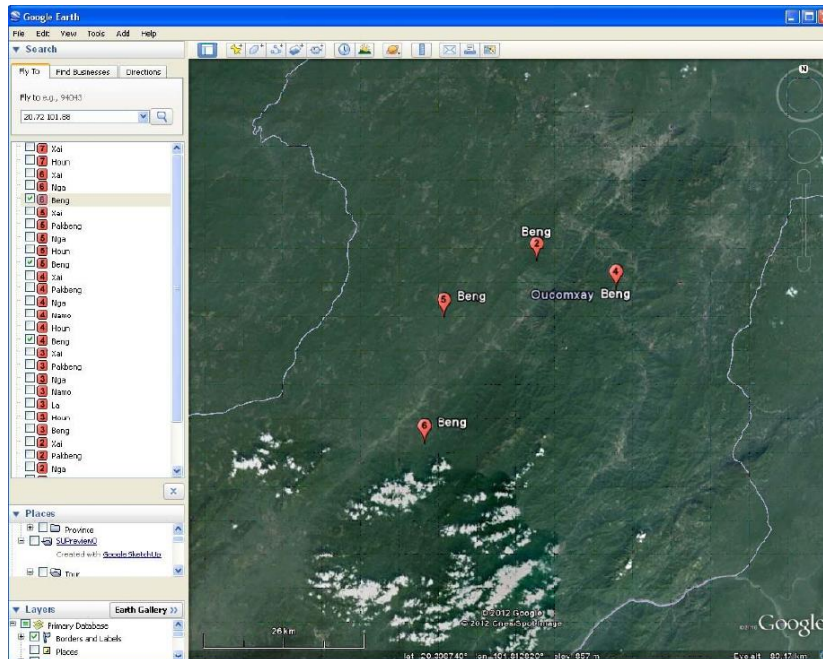


Figure 5. Spatial Distribution of Frequent-burn Locations in Beng district.

5. Conclusions

The fire information generated from daily MODIS data are useful for the wildfire monitoring and biomass burning in Southeast Asian region as well as in the specific countries where the wildfire has becoming environmental problem that causes smoke and haze and climate change. It would be very efficient to detect also the locations in the region where the burning activities occur more than one times in the period of many years. This phenomenon can be identified by the number of frequent-burn locations which shows the accessibility of the local people to prepare the land for agriculture, wildlife hunting, illegal logging and other possible purposes. The fire information of frequent-burn locations are given in district level and could be provided to local officers to have better management and control of the shifting cultivation in the province.

6. References

- [1] Oudomxay Province. Wikipedia website. Last opened June 29, 2013
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