Detection and characterization of fire activity and burned area over Central Kalimantan peatland area under the influence of drought from satellite observation

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Background

- Equatorial Asia is one of the most extremely vulnerable tropical rainforest area in the world that is directly affected by ENSO cycle. As a consequence, it will experience reduction in precipitation during El-Niño episode, following the severe droughts during the dry season.
- Drought conditions are favorable for fire and haze occurrence, especially when normally moist fuels are drying out, leading to potentially flammable and thereby susceptible to fires.
- Pulang Pisau district (Central Kalimantan province), is one of the most severely affected district in the 2015 forest fire event under the influence of drought induced by 2015 El-Nino episode, which are mostly in the ex-site of megarice project (drying peatlands).
- The locations of the fires and the progression of the fire season in 2015 was resembled in the same place and it is interesting to compare the fire activity and burned area on past events
- This study aims to evaluate and characterize the impact of long-term climate variability on fire activity in Pulang Pisau district to understand the drought and fire conditions under which they occurred.

Result and Discussion

- It was noted, that in 2009 was the largest burned area in comparison with 2015 and 2002 events (Fig. 5a), even though the amount of hotspot in the 2009 event was only the third highest after 2015 and 2006 events, in the cluster of Kalimantan analysis (Fig. 1c).
- We found significant negative correlation between precipitation and different indicators of fire over Pulang Pisau district (Fig. 4a-c). There is a consistent bi-linear relationship between dry season precipitation and the different indicators of fire (Fig. 5a-c).
- The strong El-Niño event induced drought condition during the dry season, and there was a significant decrease of rainfall in the El-Niño years (Fig. 4 and 5). Simultaneously, high carbon emission, large burned area and the high number of hotspots in El-Niño years are evident from September to November (Fig. 5a-c).
- Fire activity does not increase with El-Niño strength in every case. The difference in fire impacts may be partly attributed to different patterns of anthropogenic factors. This study only analyzes drought as the precondition to the fire occurrences.

Area Clustering and Identification of Fire Occurrences

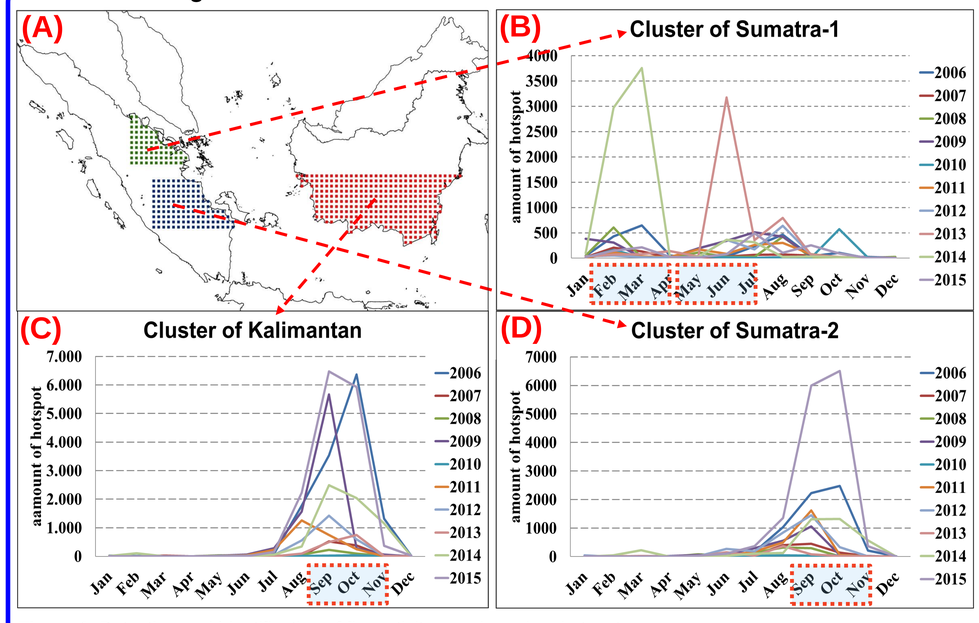


Figure 1. Detection and Identification of fire activity area based on hotspot occurrences

Data and Methods

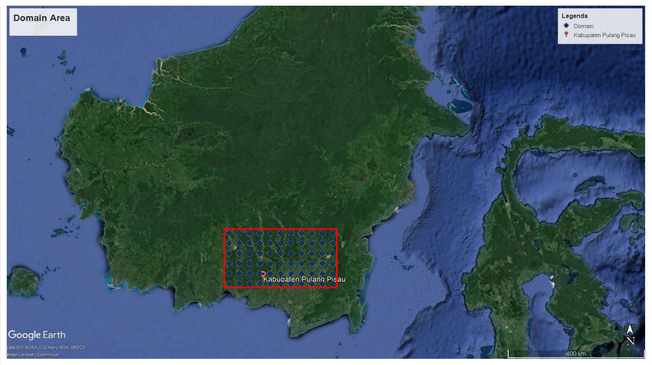


Figure 3. Study Area: Pulang Pisau District (Central Kalimantan, Indonesia)

Dataset:

1. GFED4.1s (1997-2016), variable: burned area and carbon emission
2. Inhouse hotspot (grid) period: 2001-2017, derived from MODIS
3. Precipitation (TMPA Level 3) period: 1998-2018

All of the datasets are with a resolution of 0.25^0x0.25^0 grid size

Methods:

1. Calculate the correlation between precipitation and fire indicators on area average of Pulang Pisau district (Lon 112.5 114.5 and Lat -3.5 -2).
2. Calculate the stepwise regression between precipitation and fire indicators on area average of Pulang Pisau district.

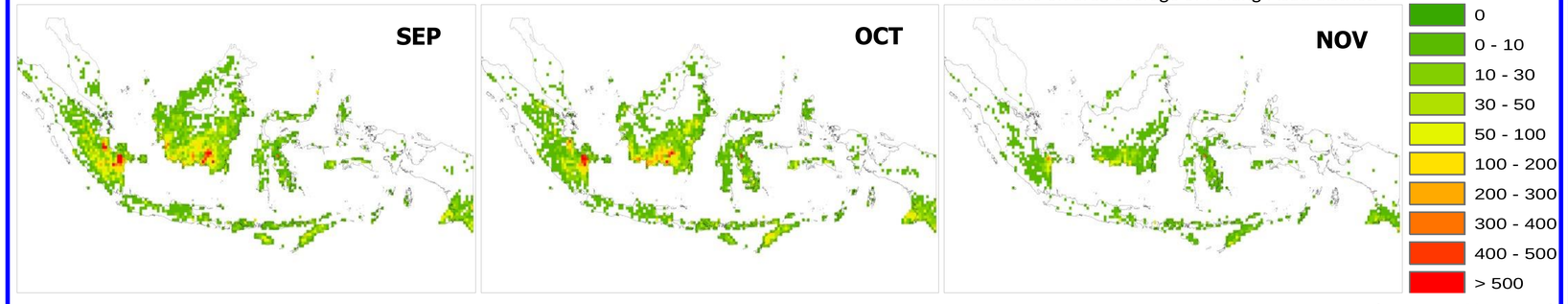
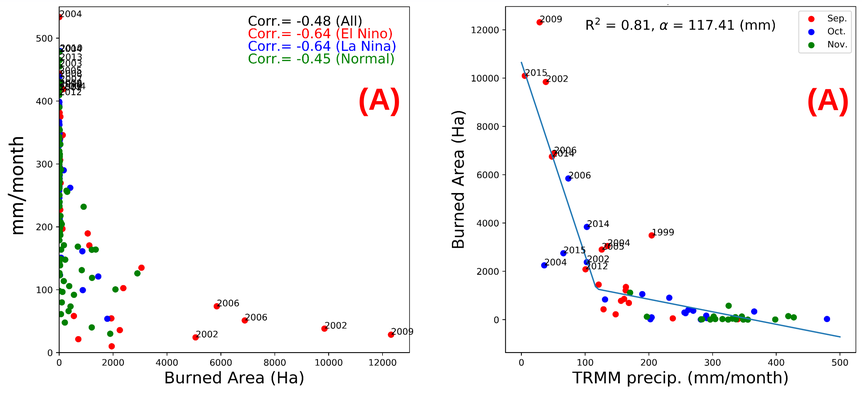
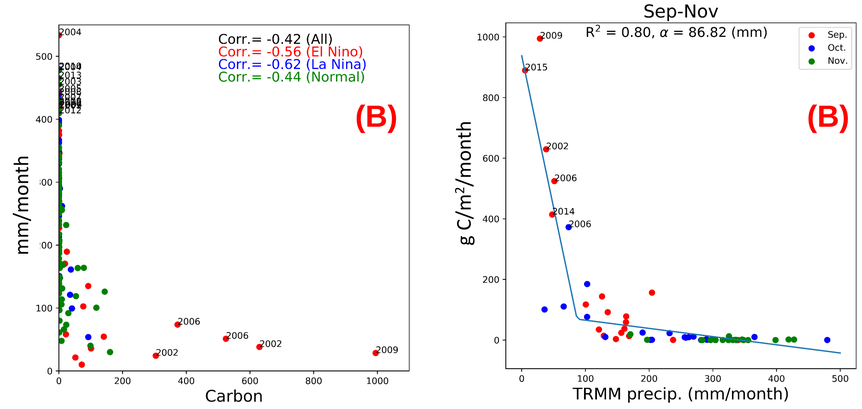


Figure 2. Hotspot grid distribution 0.25^0x0.25^0 from MODIS (confidence level above 80 %) period 2001-2017

- In the Maritime Continent fires typically occur during the July to October dry season and usually peak on **September and October** mainly in Sumatra and Kalimantan Islands (**Fig. 1 C and D**). Forest fires have occurred periodically in Kalimantan since the 1980s and in Sumatra since at least the 1960s.
- Based on the climatology, from the hotspot grid distribution that was spatially analyzed (**Fig. 2**), the highest population of hotspots were clearly seen in Jambi, South Sumatra, West Kalimantan, Central Kalimantan, South Kalimantan, and East Kalimantan (> 500 hotspots) that occurred in the months during the peak of the dry season (**September and October**).





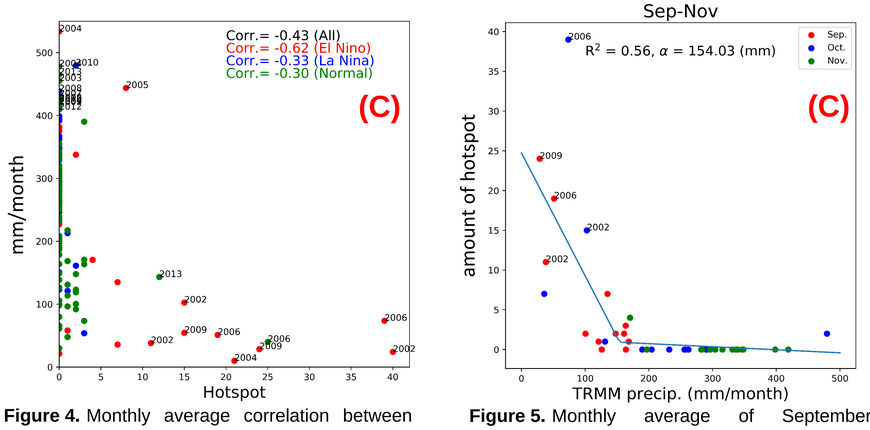


Figure 4. Monthly average correlation between TRMM precipitation and fire indicators classified by ENSO years in Pulang Pisau district.

Figure 5. Monthly average of September-November in relationships between TRMM precipitation and fire indicators in Pulang Pisau district.

Reference

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