

# Long-lead prediction of the 2015 fire and haze episode in Indonesia

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*Dumai, Riau (March 2015)*

## Support

NASA Precipitation Measurement Missions Science Team

NASA Modeling, Analysis and Prediction Program

NASA Atmospheric Composition Modeling and Analysis Program



National Aeronautics and Space Administration  
Goddard Institute for Space Studies  
New York, N.Y.

Quezon City, May 29, 2018

# Office of Climate Change and Land & Forest Fire for Sumatra Region, Ministry of Environment and Forestry

Sumatra (10 -from 34 provinces) – fire prone area



Indonesia





# Zero Fire & Haze for Asian Games Event

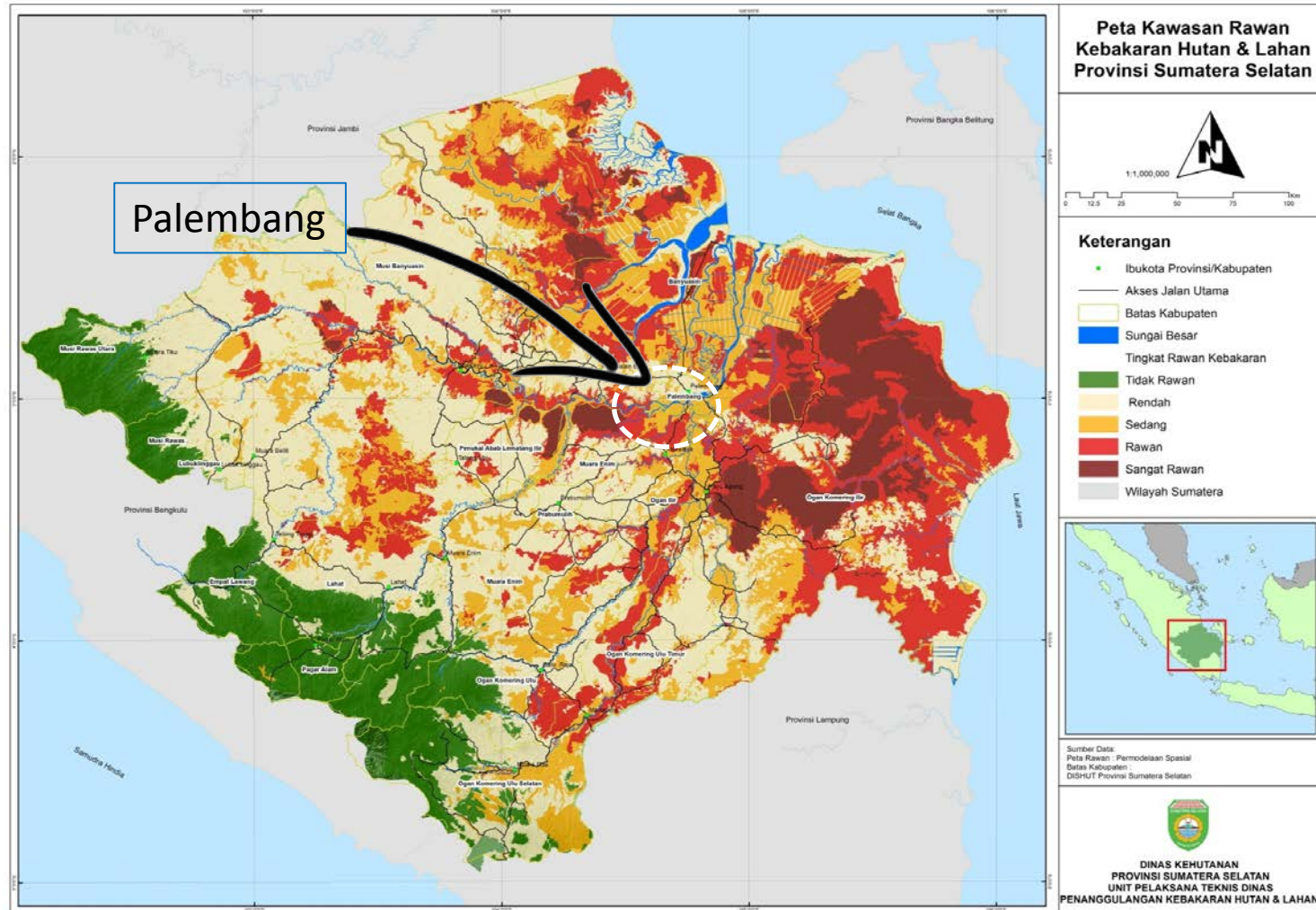
Aug 18 – Sep 2, 2018

ASIAN GAMES | 2018  
Jakarta Palembang

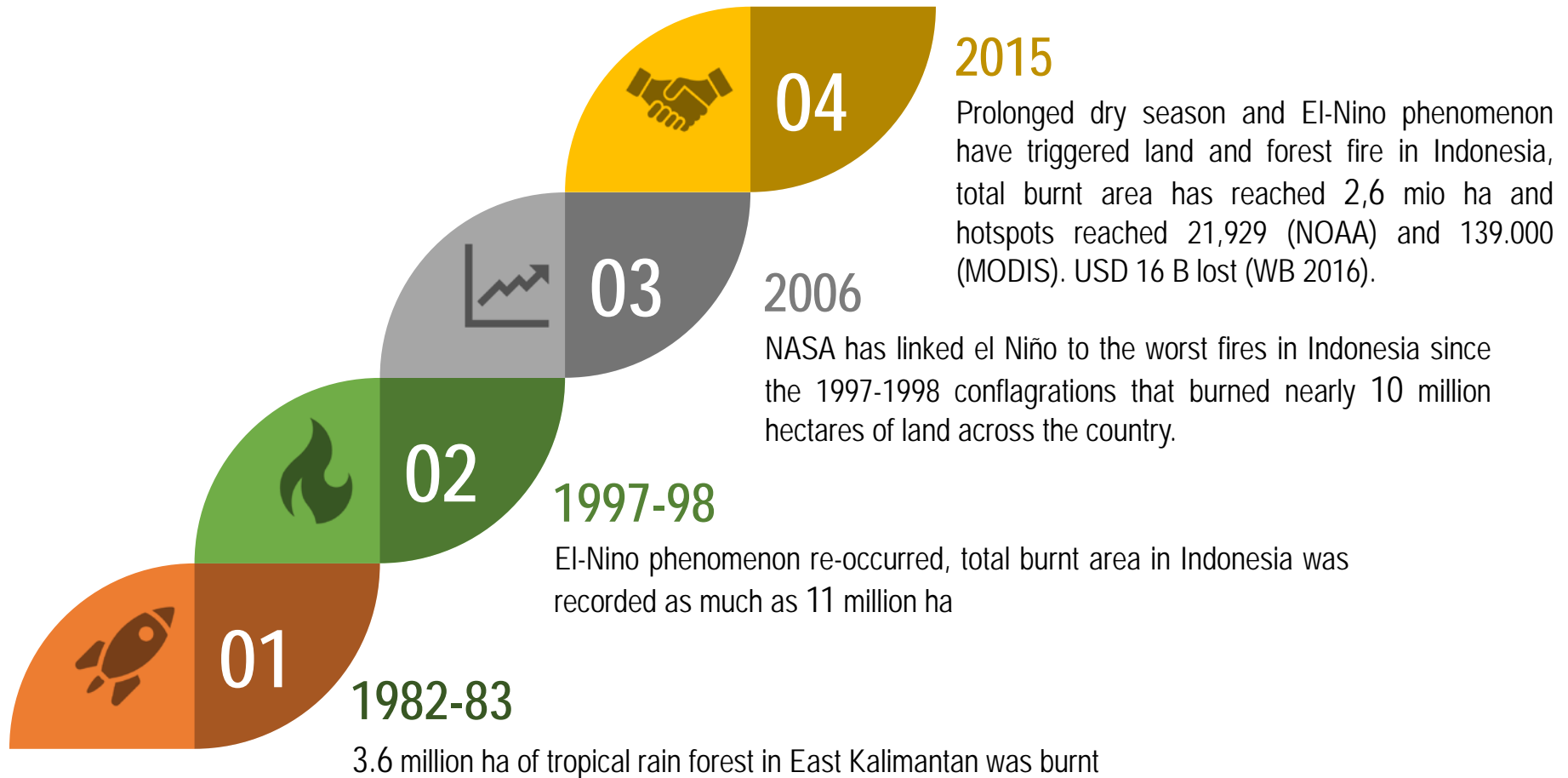
733

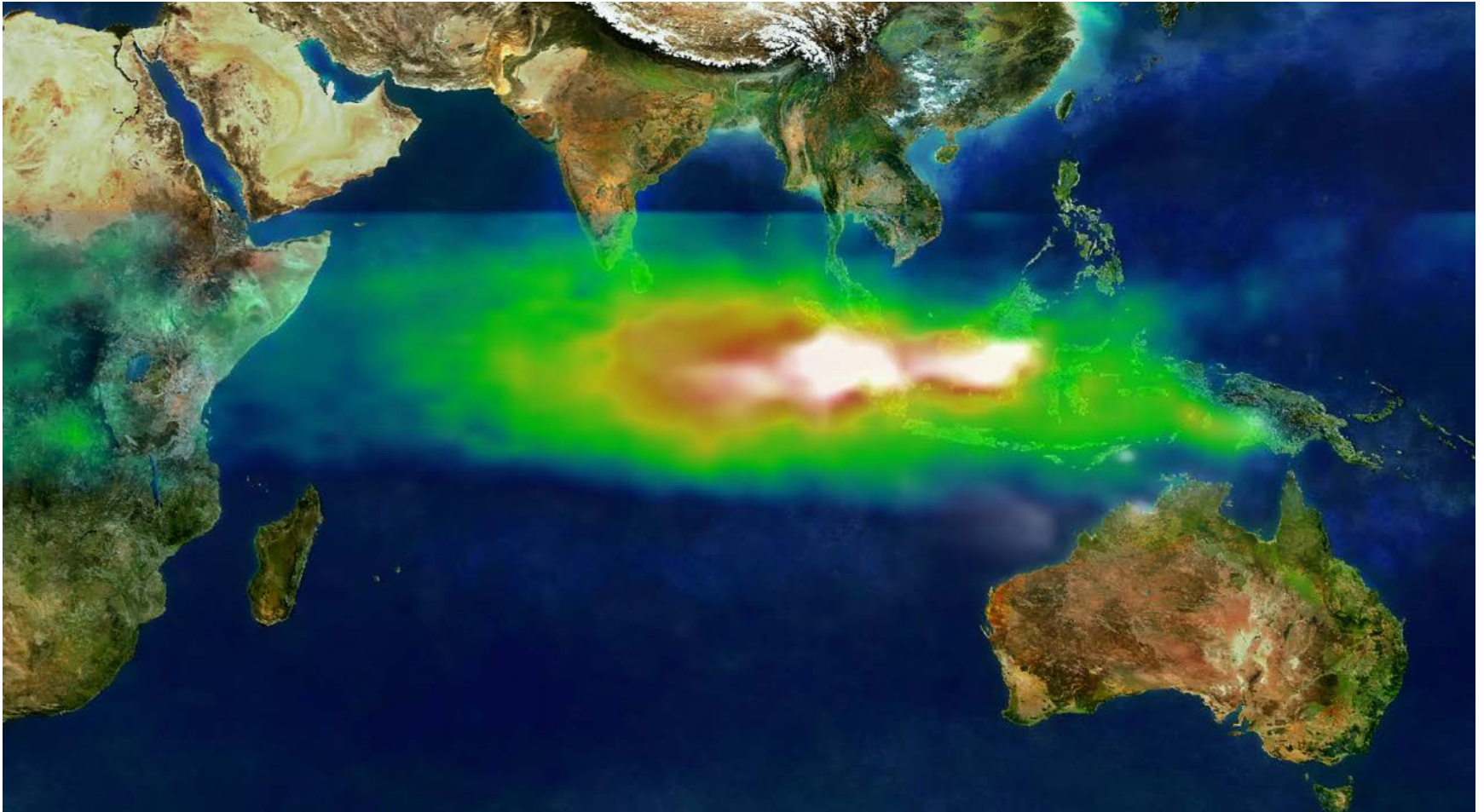
Fire prone villages

Ogan Kemiring Ilir  
Musi  
Banyuasin  
Banyuasin  
Muara Enim



# The enormous land and forest fire in Indonesia



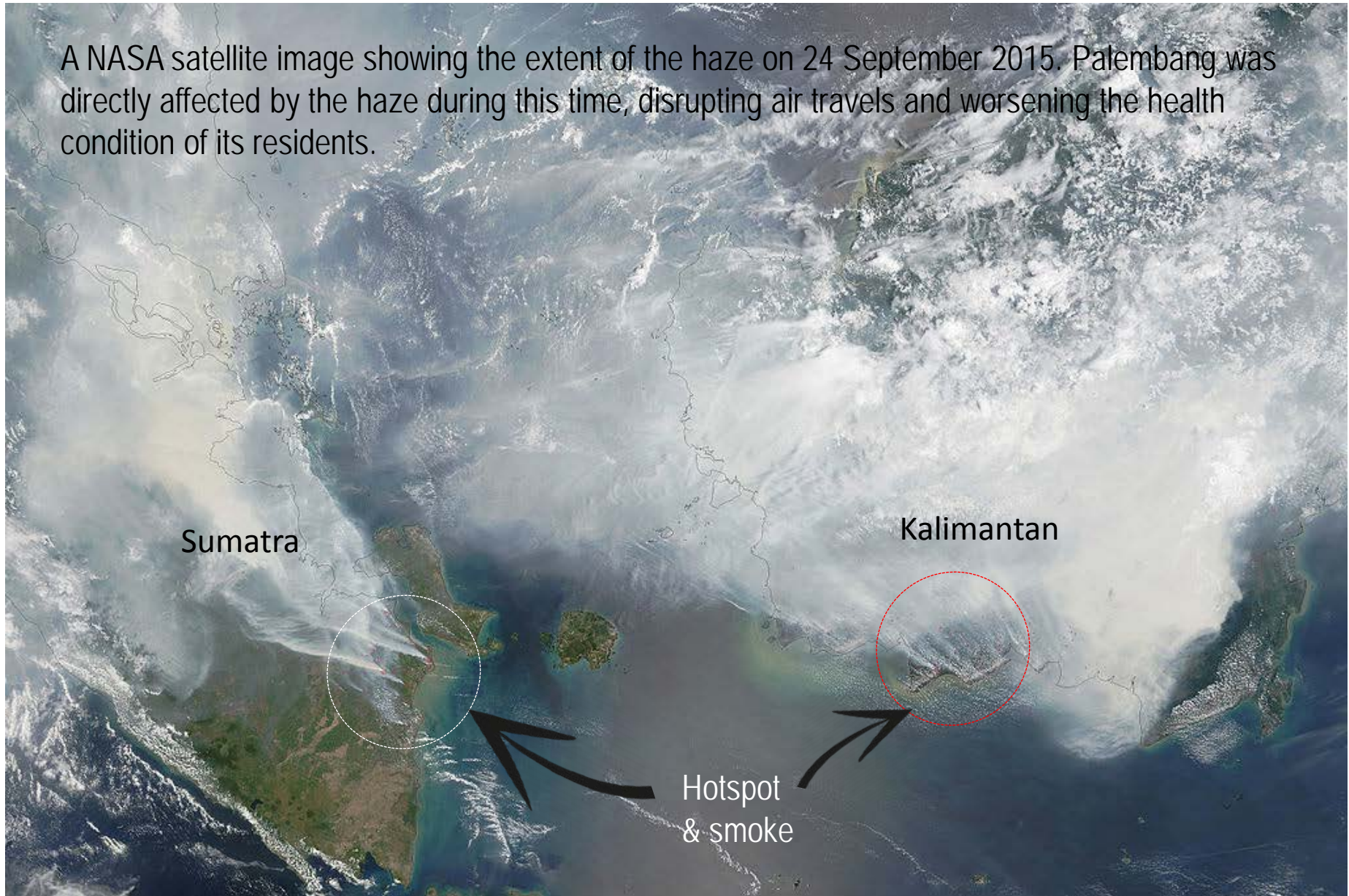


The above image shows the pollution over Indonesia and the Indian Ocean on October 22, 1997. White represents the aerosols (smoke) that remained in the vicinity of the fires. Green, yellow, and red pixels represent increasing amounts of tropospheric ozone (smog) being carried to the west by high-altitude winds.

Credit : NASA

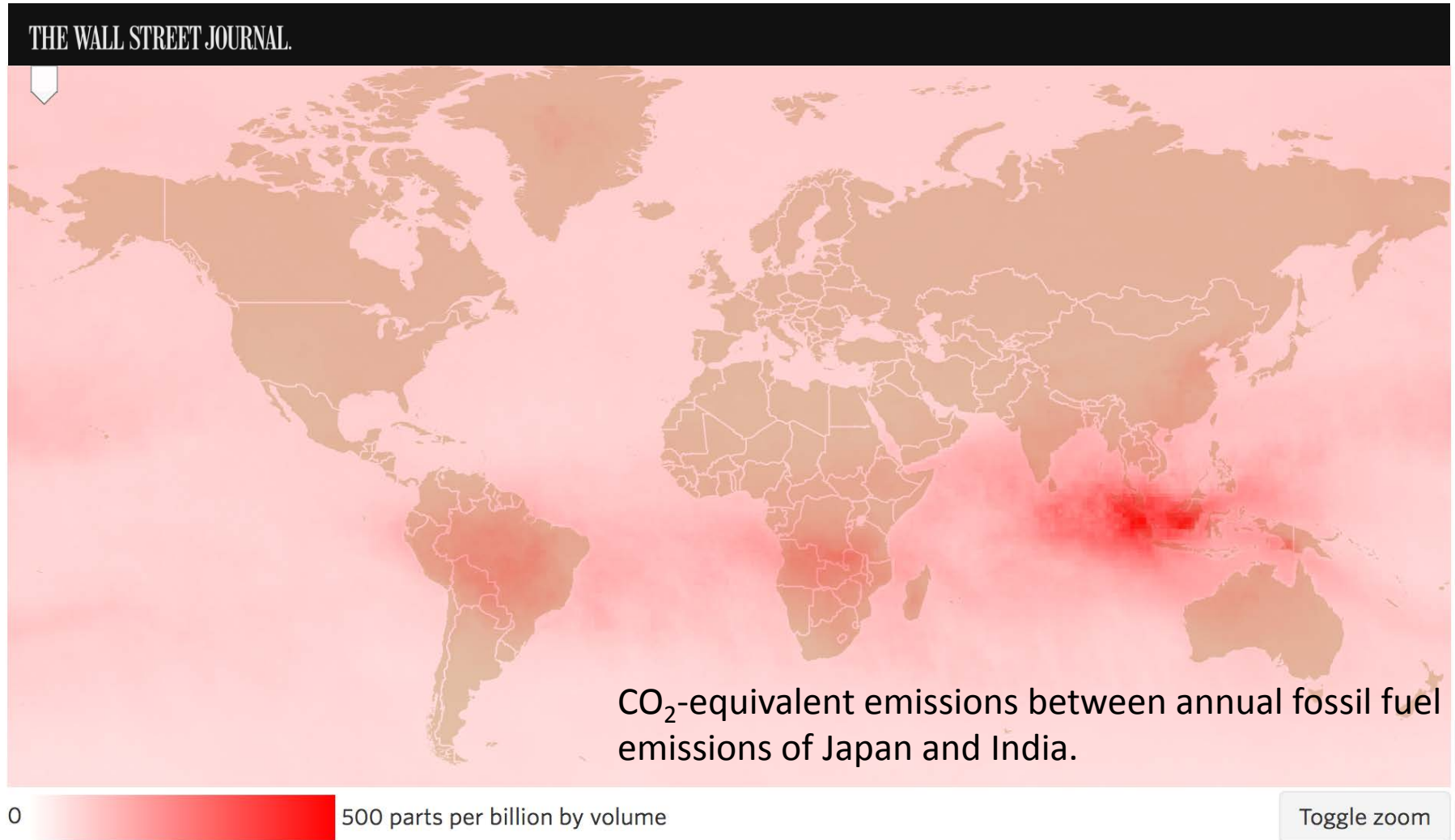


A NASA satellite image showing the extent of the haze on 24 September 2015. Palembang was directly affected by the haze during this time, disrupting air travels and worsening the health condition of its residents.



# Aqua AIRS Carbon Monoxide @ 500 hPa

## October 13-26, 2015



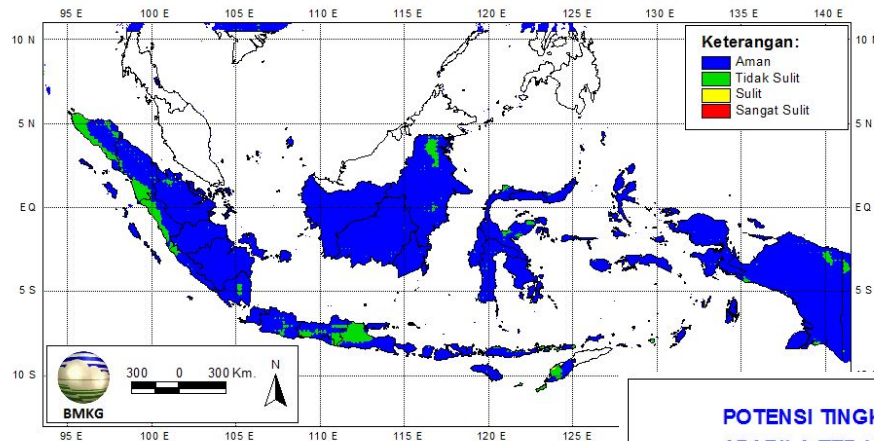
Source: NASA's Atmospheric Infrared Sounder and Jet Propulsion Laboratory



**POTENSI TINGKAT KESULITAN PENGENDALIAN  
APABILA TERJADI KEBAKARAN HUTAN DAN LAHAN**

**Fire Weather Index**

Berlaku untuk: 28 Mei 2018 ----- Wilayah Indonesia



Sub Bidang Peringatan  
Sumber Data : Data Pra

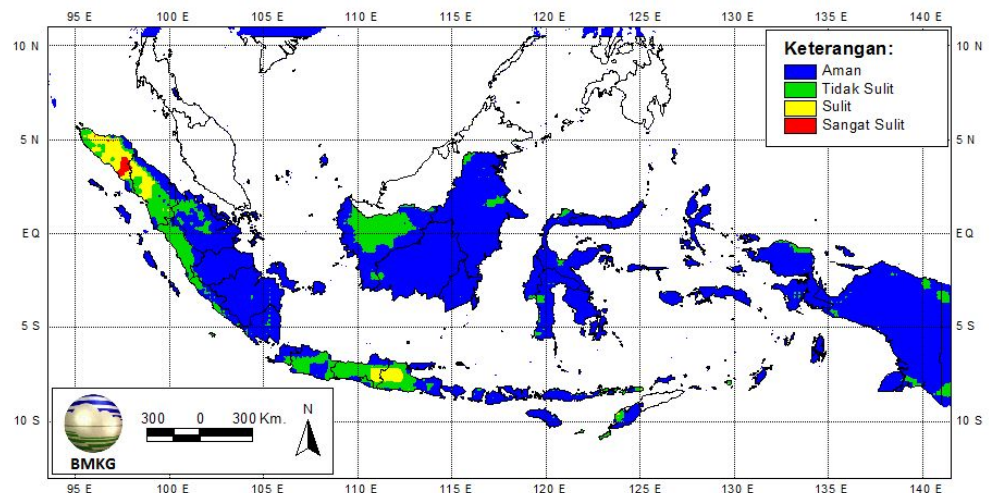
1-day prediction

6-day prediction

**POTENSI TINGKAT KESULITAN PENGENDALIAN  
APABILA TERJADI KEBAKARAN HUTAN DAN LAHAN**

**Fire Weather Index**

Berlaku untuk: 03 Juni 2018 ----- Wilayah Indonesia



Sub Bidang Peringatan Dini Cuaca BMKG  
Sumber Data : Data Prakiraan (MODEL WRF)

Long-lead prediction?



# How far ahead could severe conditions have been predicted?

(Shawki et al., 2017, *Geophys. Res. Lett.*)

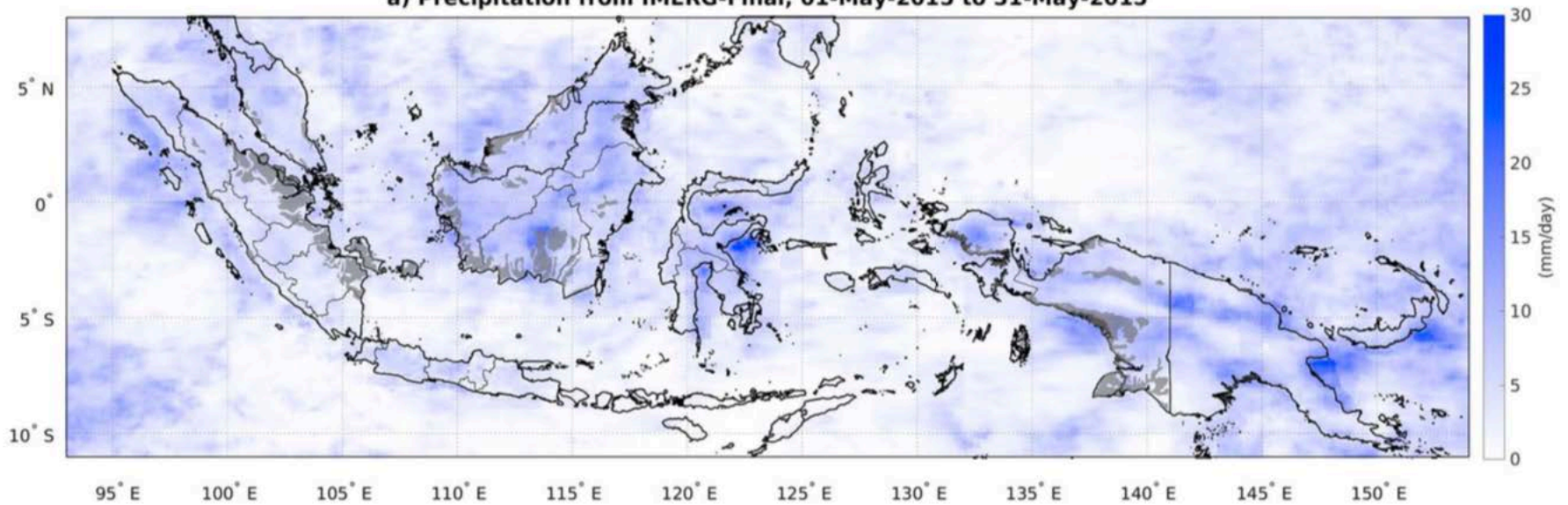


## Methods

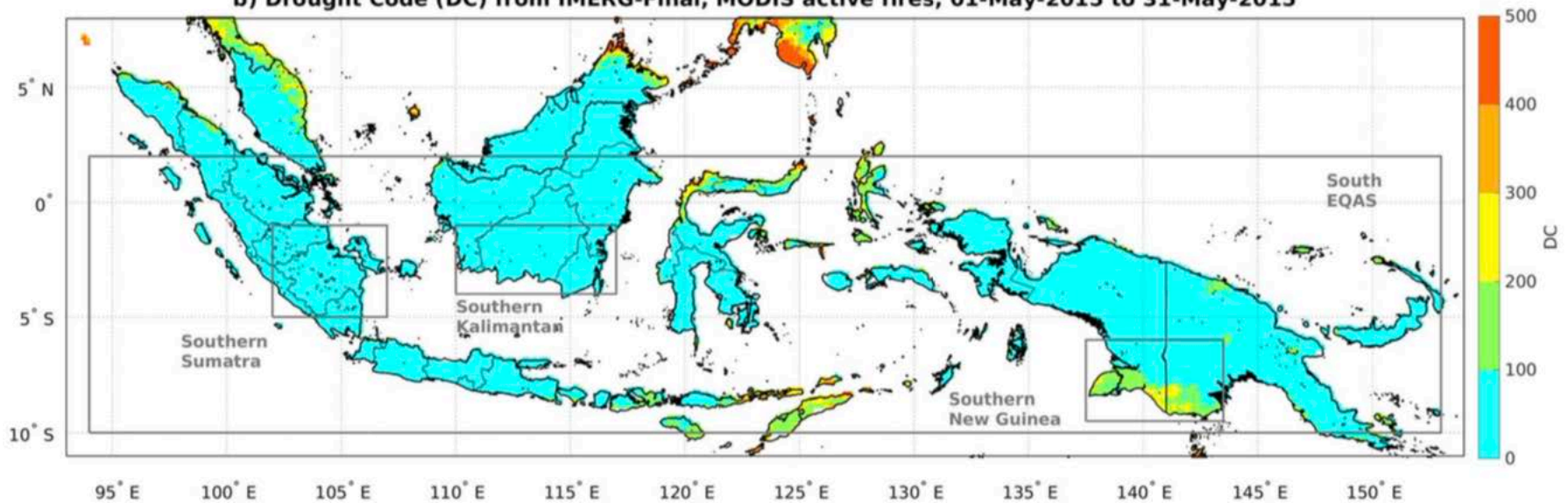
- 6 month DC forecasts over Indonesia using T and precipitation forecasts from NCEP CFSv2
- DC forecasts computed for the subsequent 6 months using the forecasts of daily surface temperature and total precipitation. Each DC forecast is initialized with the observed DC value for that day using data available from the Global Fire Weather Database Modern-Era Retrospective Analysis for Research and Applications ver 2 (MERRA2)
- The study focus was on the forecasts leading up to the severe 2015 haze, using the wet and largely fire-free dry season of 2016 for comparison.
- DC forecasts evaluated over the whole of Southern Equatorial Asia (South EQAS)
- Considered the severe burning regions of Southern Sumatra, Southern Kalimantan.
- DC forecasts examined made in May, which correspond to a 3 month lead time prior to the onset of severe burning in mid-August 2015 and are similar to the lead time examined for previous fire episodes over Kalimantan.

# Discussion

a) Precipitation from IMERG-Final, 01-May-2015 to 31-May-2015

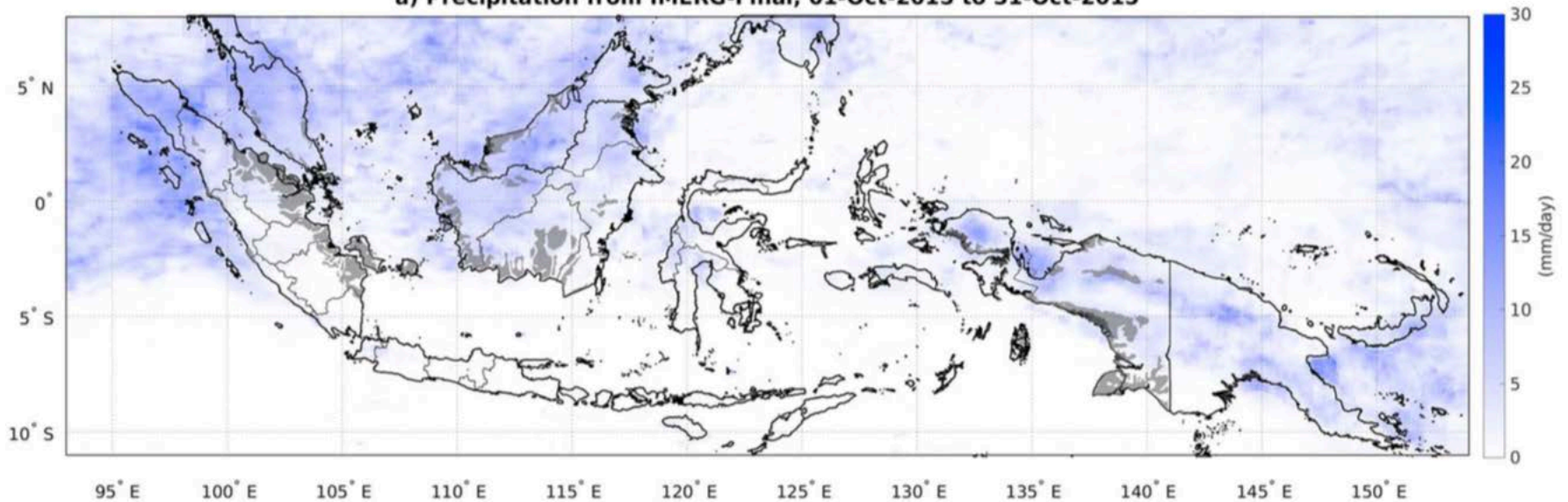


b) Drought Code (DC) from IMERG-Final, MODIS active fires, 01-May-2015 to 31-May-2015

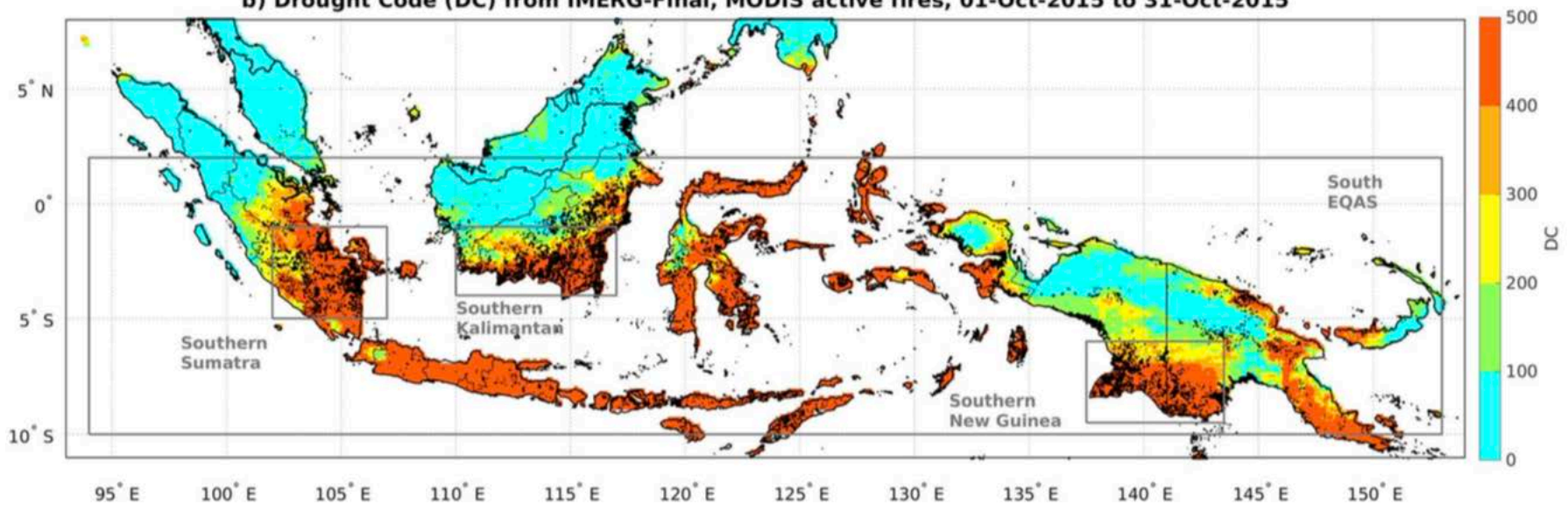




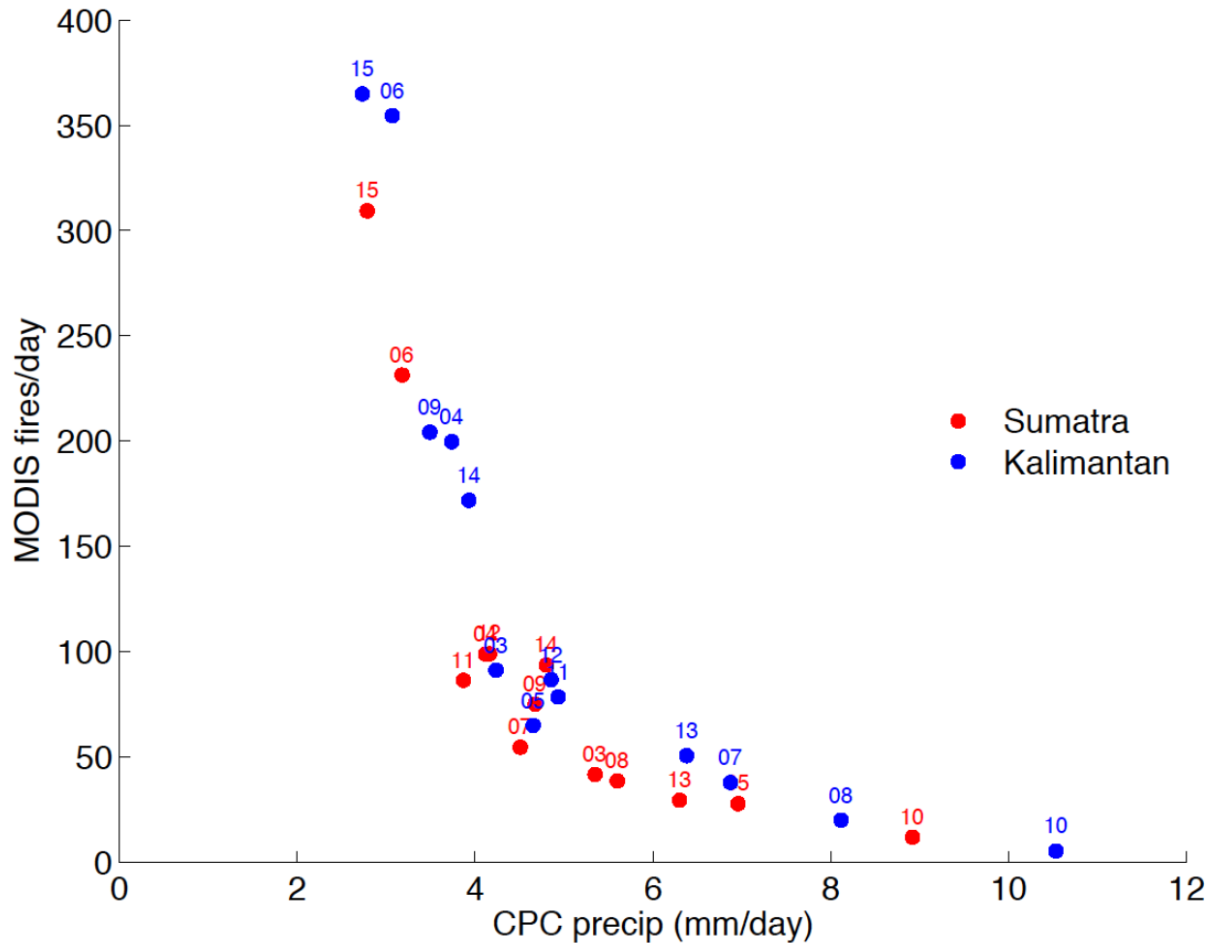
**a) Precipitation from IMERG-Final, 01-Oct-2015 to 31-Oct-2015**



**b) Drought Code (DC) from IMERG-Final, MODIS active fires, 01-Oct-2015 to 31-Oct-2015**



2015 the most severe fire event in Indonesia during EOS era.  
Drought is a very strong control on fire and haze.



Similarly for:  
MODIS AOD  
OMI aerosol index  
MOPITT CO  
AIRS CO  
MLS CO



# > 90% of emissions are from peat burning

(Levine et al., 1999, *Geophys. Res. Lett.*; Page et al., 2002, *Nature*)



Katingan District, Central Kalimantan

Credit: Israr Albar

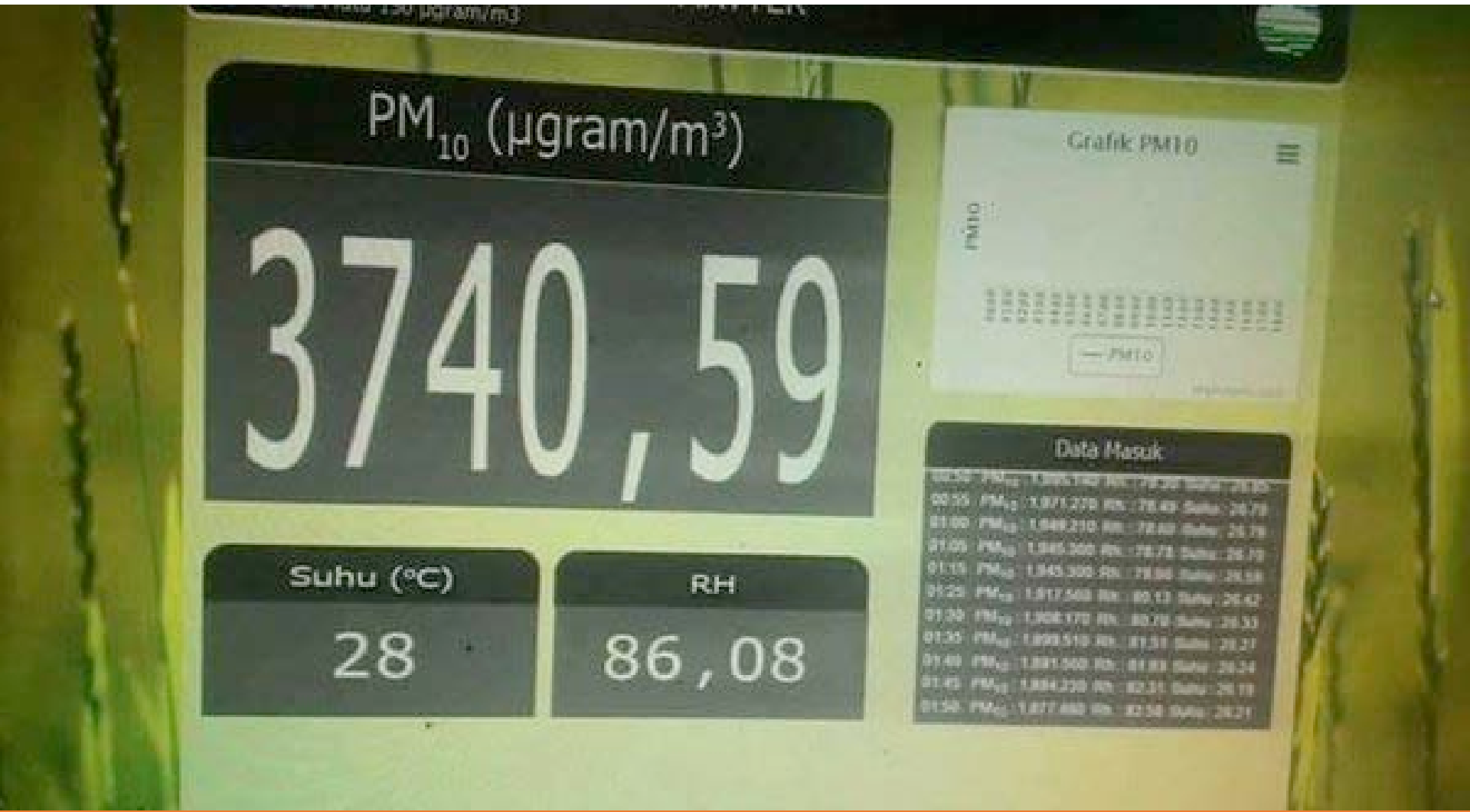


**There was a large-scale response involving thousands of fire-fighters and international assistance.**

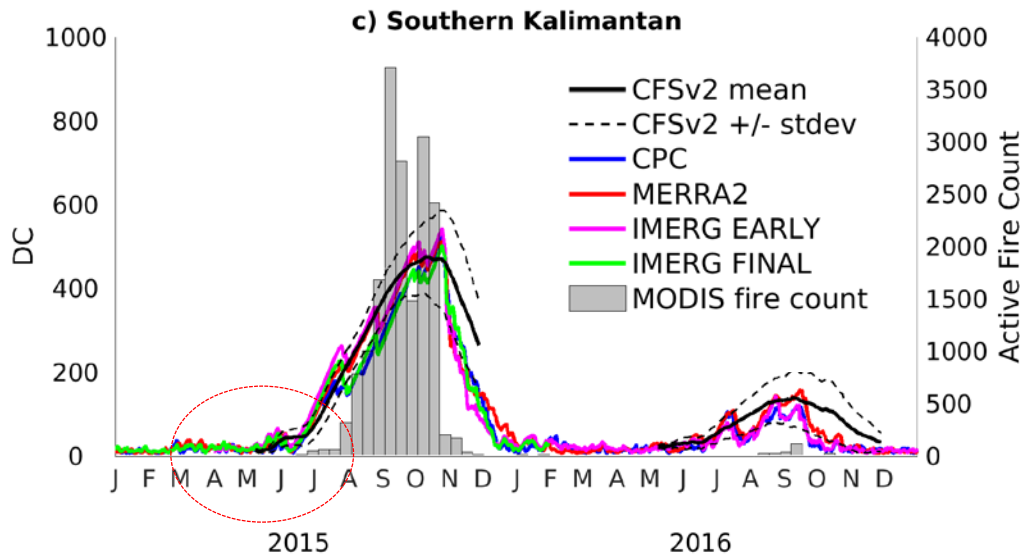


Credit: David Gaveau

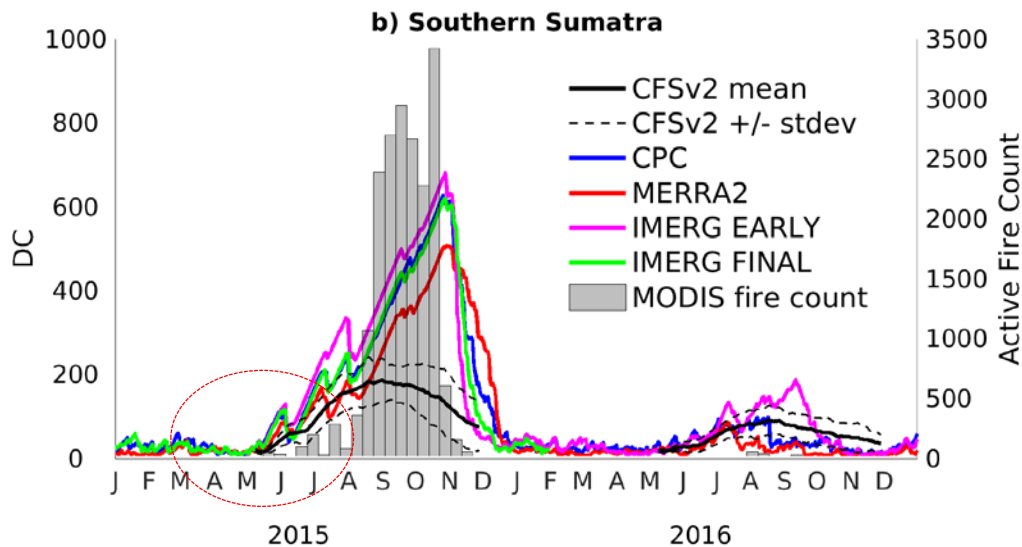
20 October PM<sub>10</sub> in Palangkaraya, Central Kalimantan  
EPA 24-hour standard is 150  $\mu\text{g}/\text{m}^3$   
(David Gaveau, CIFOR)



# NCEP CFSv2 DC forecasts initialized in May



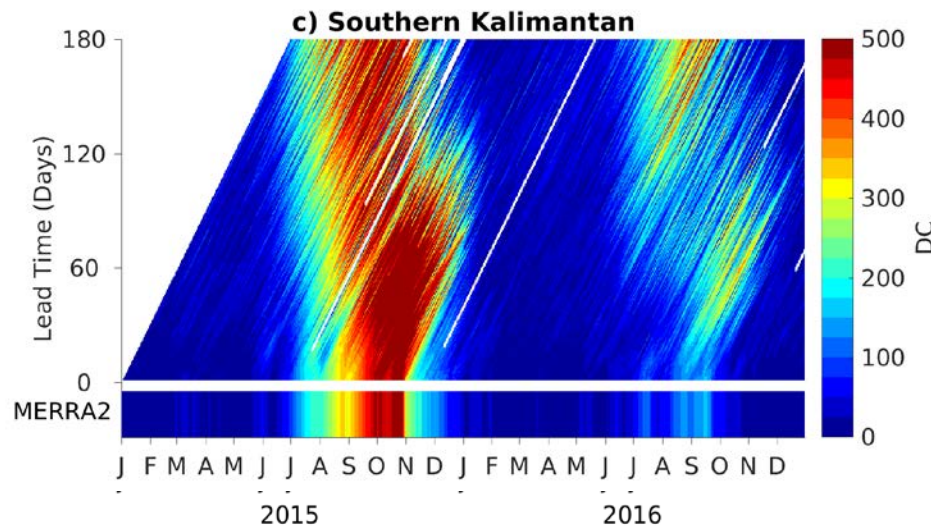
Over Kalimantan, the May forecast accurately predicted high DC in September and October.



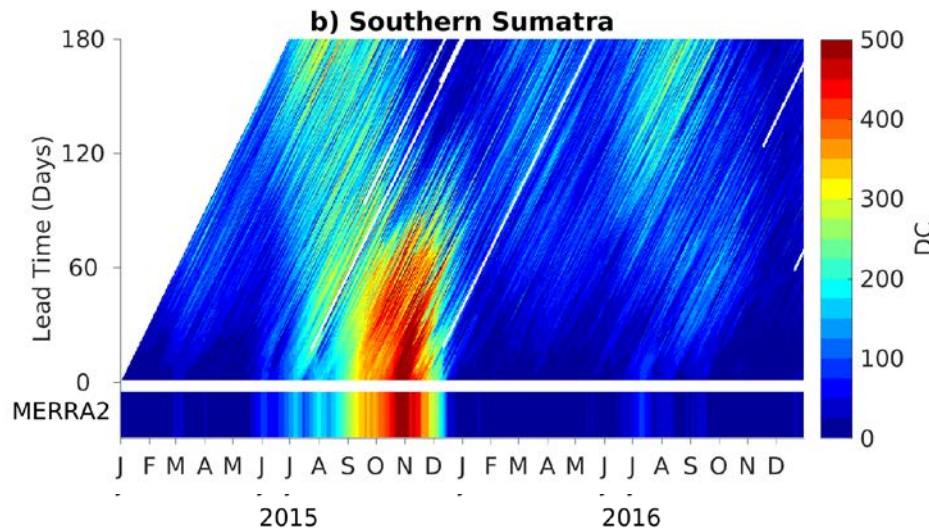
Over Sumatra, the May forecast missed the high DC entirely.



# DC forecasts at different lead times



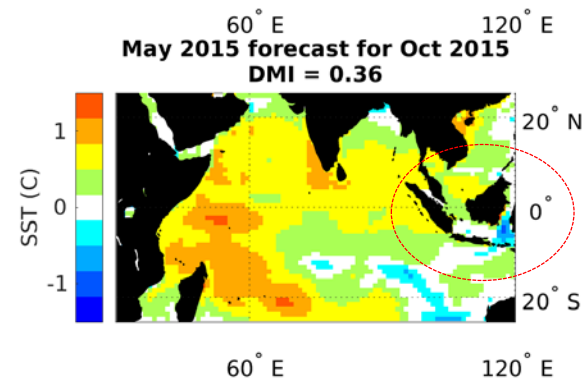
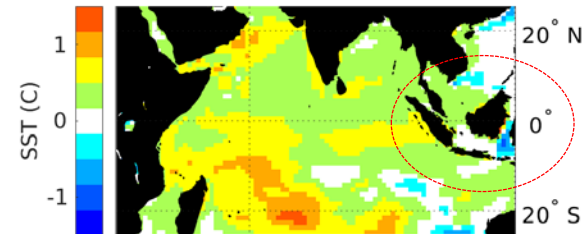
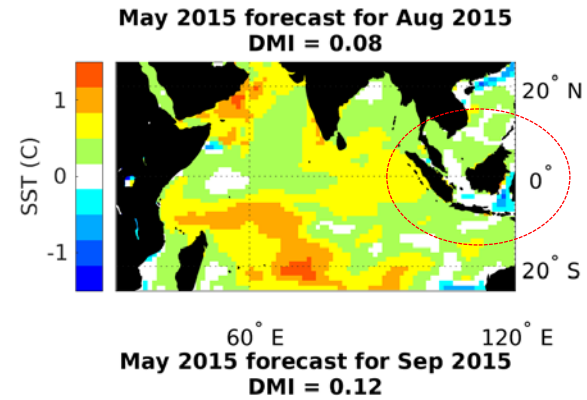
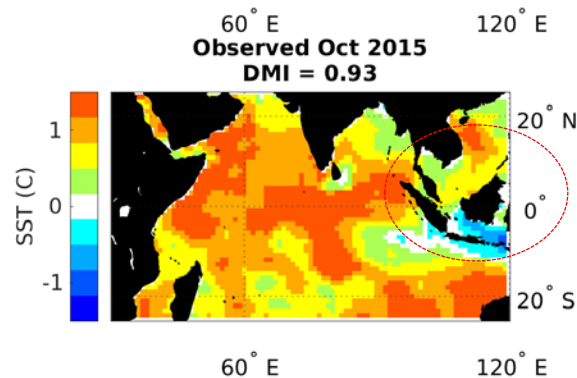
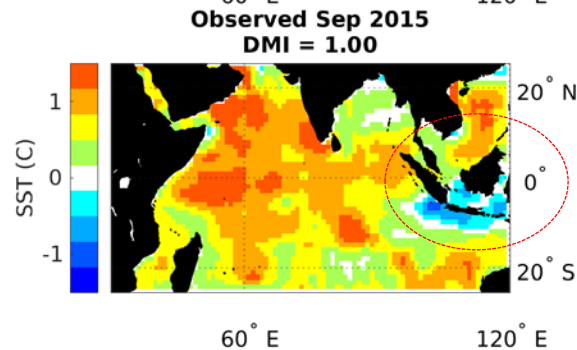
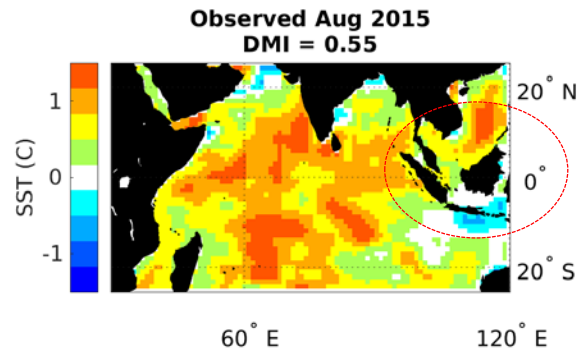
Over Kalimantan, 2015 forecasts were consistently good with 6-month lead times, other than predicting too-long drought at lead times greater than two weeks.



Over Sumatra, the forecasts became accurate with a 2-month lead time.

Dry conditions over Sumatra are associated with positive Indian Ocean Dipole conditions – a decrease in SSTs from west to east – more strongly than Kalimantan.

This gradient was not well-forecast in May.



# Conclusion

- Early warning lead times of high observed DC in September and October 2015 varied considerably for different regions.
- High DC over Southern Kalimantan was predicted with 180 day lead times, whereas Southern Sumatra had lead times of up to only 60 days, which we attribute to the absence in the forecasts of an eastward decrease in Indian Ocean sea surface temperatures.
- This case study provides the starting point for longer-term evaluation of seasonal fire danger rating forecasts over Indonesia.
- NASA GEO GWIS Project - “Enhancements to the Global Wildfire Fire Information System: Fire Danger Rating and Applications in Indonesia” - NASA & Univ. Columbia. Announced Oct 2017 for period 2018-2020.



# Thank you



israralbar



**THE DEPARTMENT OF ATMOSPHERIC SCIENCES**

The School of Earth, Society & Environment  
College of Liberal Arts and Sciences