

Biomass Burning and Air Quality in the equatorial Southeast Asia

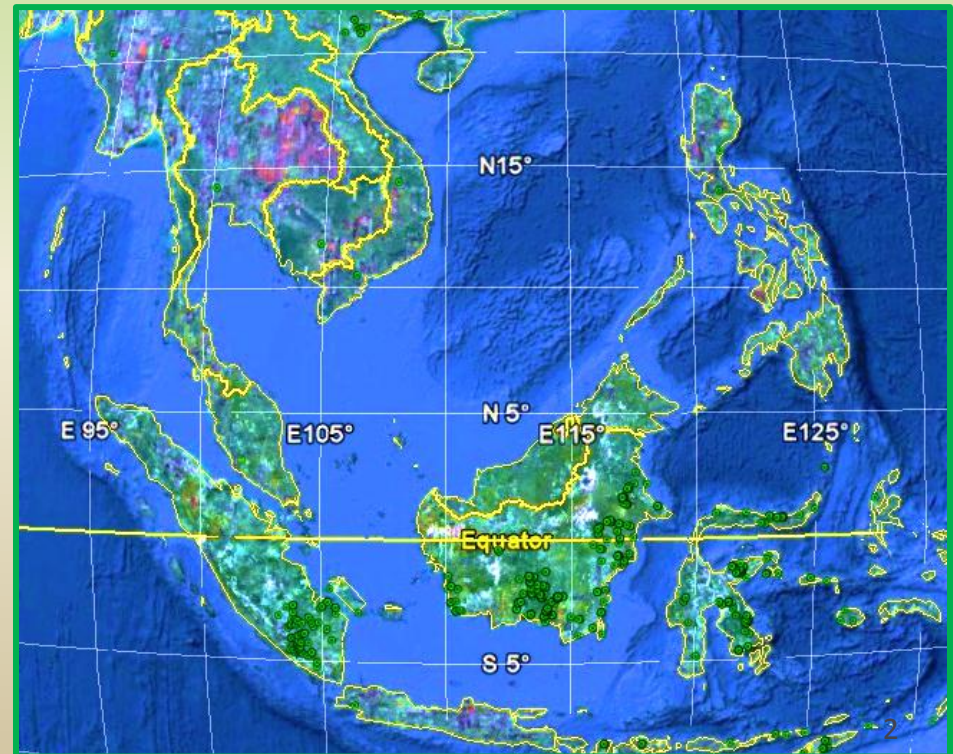
Mastura Mahmud
Universiti Kebangsaan Malaysia

Workshop on Inventory, Modeling and Climate Impacts of Greenhouse Gas emissions and Aerosols in the Asian Region, June 26-28 2013, Tsukuba Japan

Introduction

- The recurring biomass burning activities deteriorate the air quality and impact the health of the public.
- The equatorial maritime continent is characterised by light monsoon winds and calm conditions where smoke is poorly dispersed and cause transboundary haze between countries.

The 1997 El Nino event caused anomalous weak wind conditions over the equatorial Pacific and Indian Oceans, which further degraded the air quality in Sumatra and Borneo during the fire events.

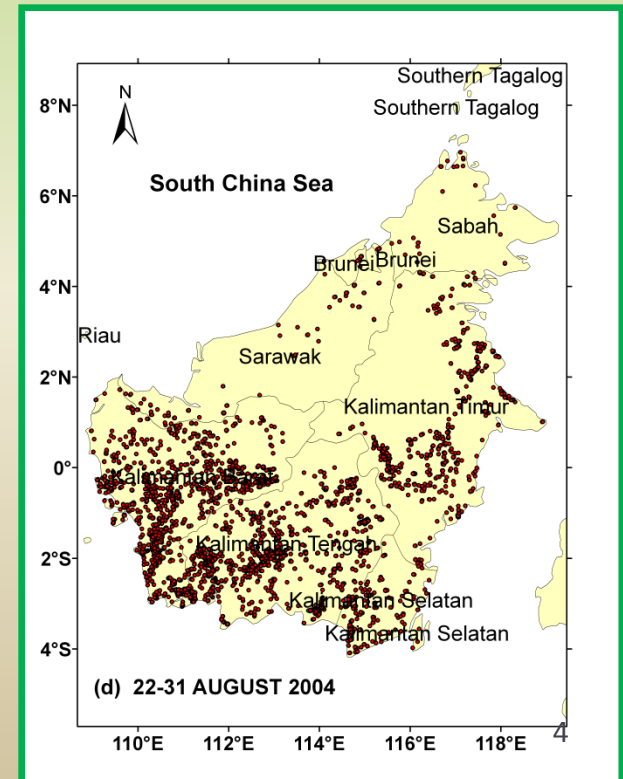
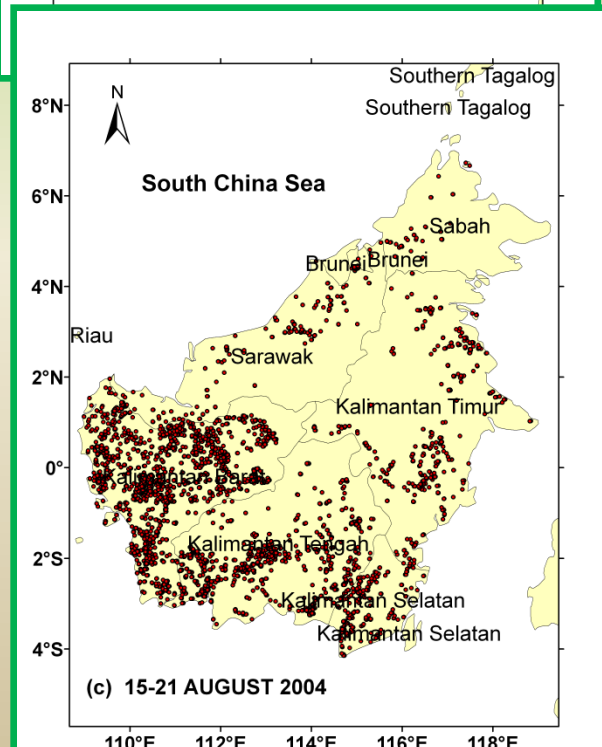
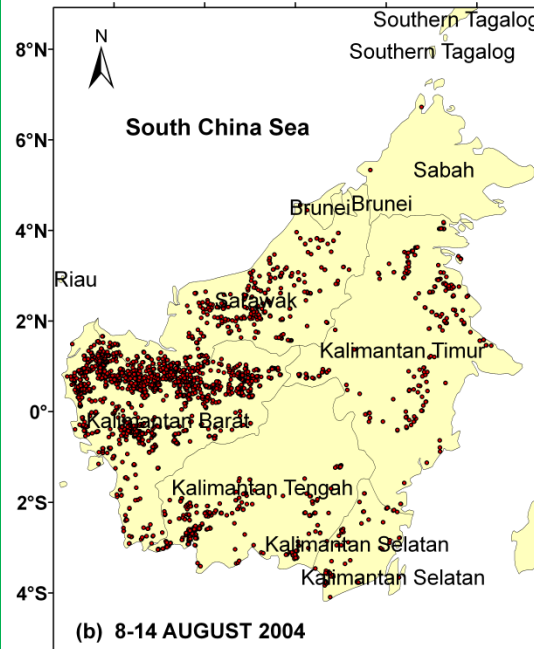
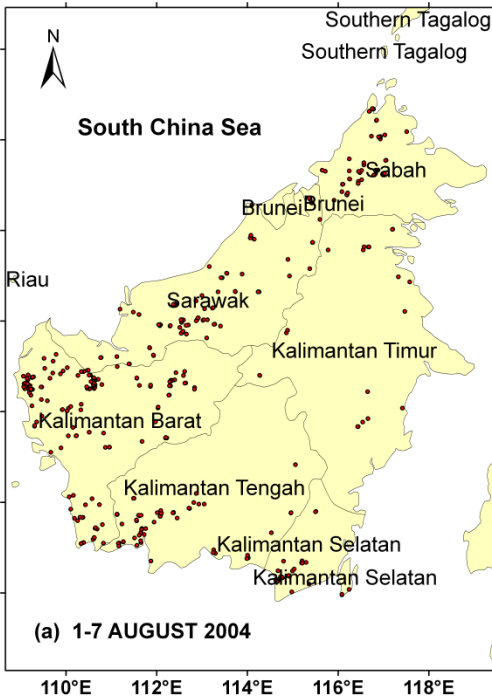


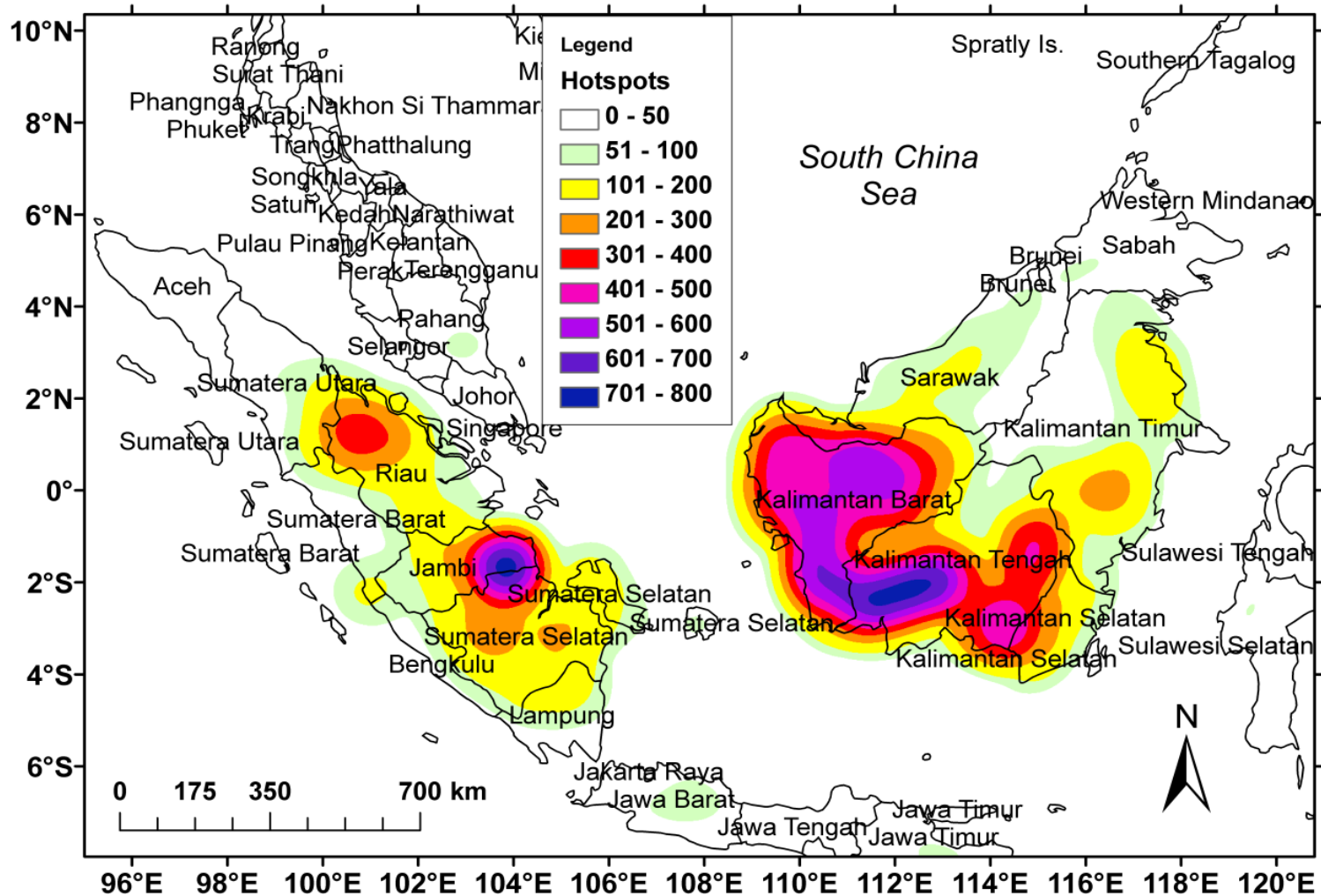
Outline of presentation

- Spatial analysis distribution of the active fire counts
- Trajectory analysis
- Air quality analysis
- Dispersion analysis

Case study: Fire events during August 2004.

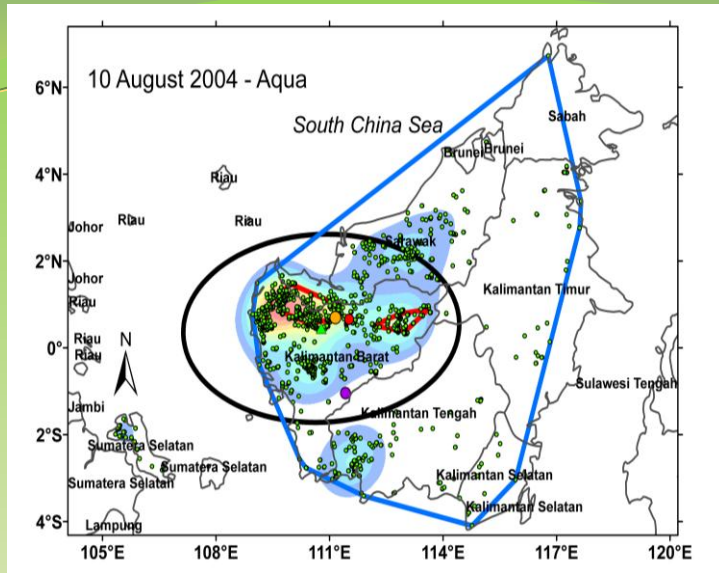
Spatial Distributions of the Weekly Active Fire Counts from MODIS



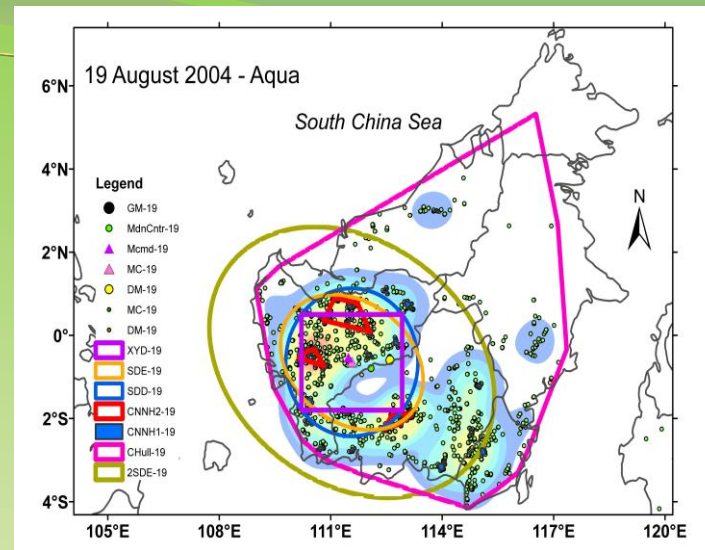


The Kernel density of the total active fire counts (MODIS) in Sumatra and Borneo during August 2004

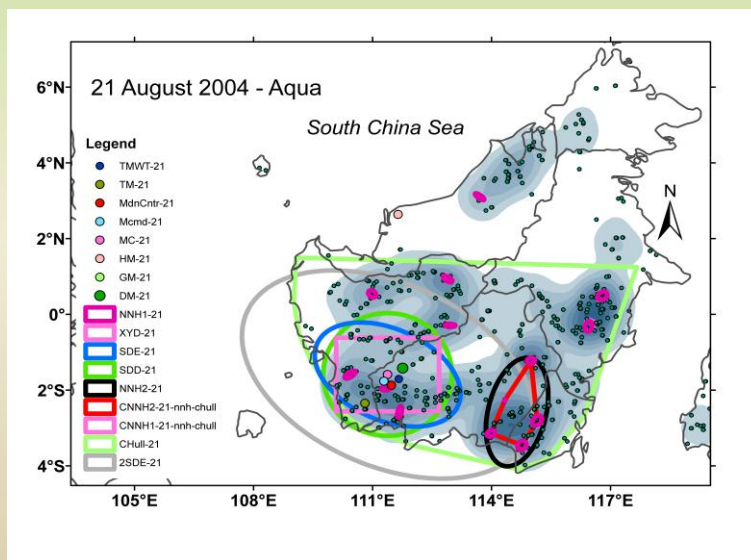
(a) 10 August 2004



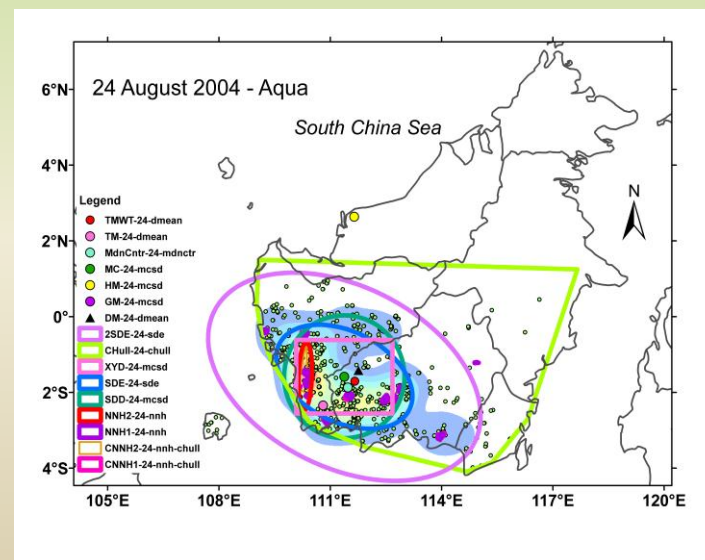
(b) 19 August 2004



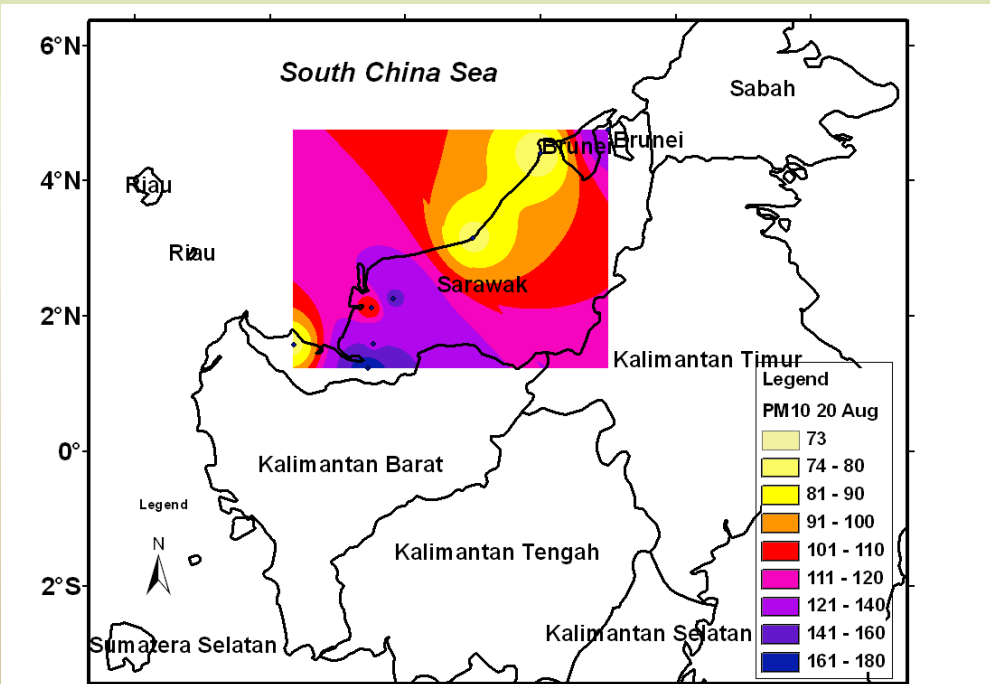
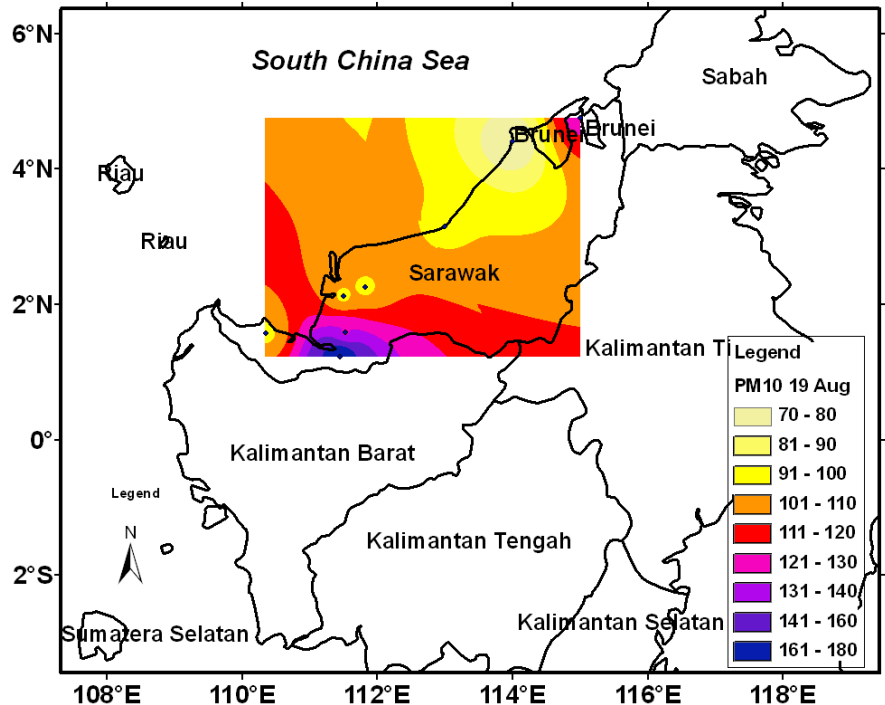
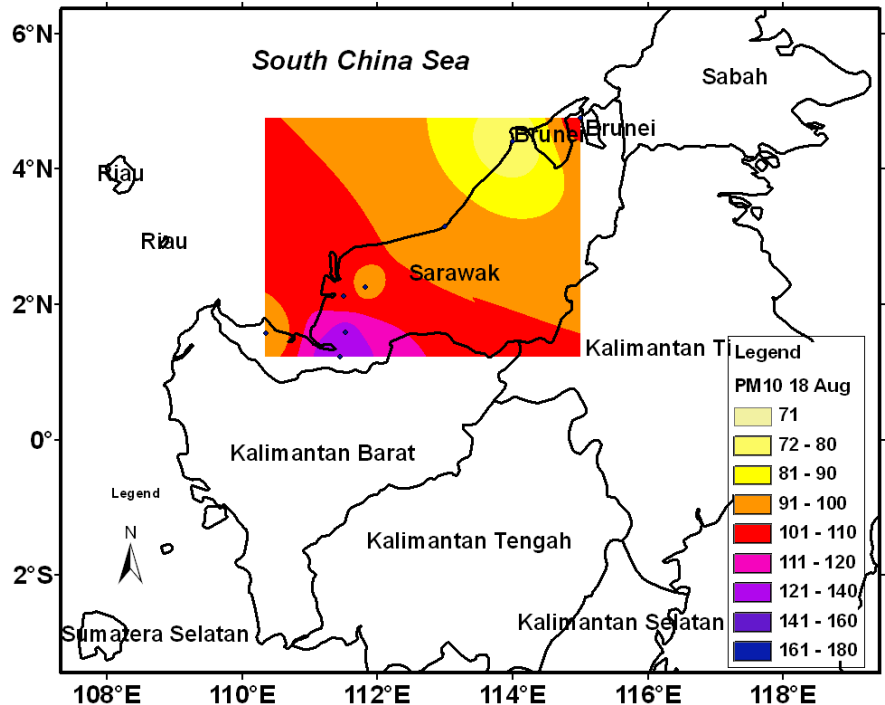
(c) 21 August 2004



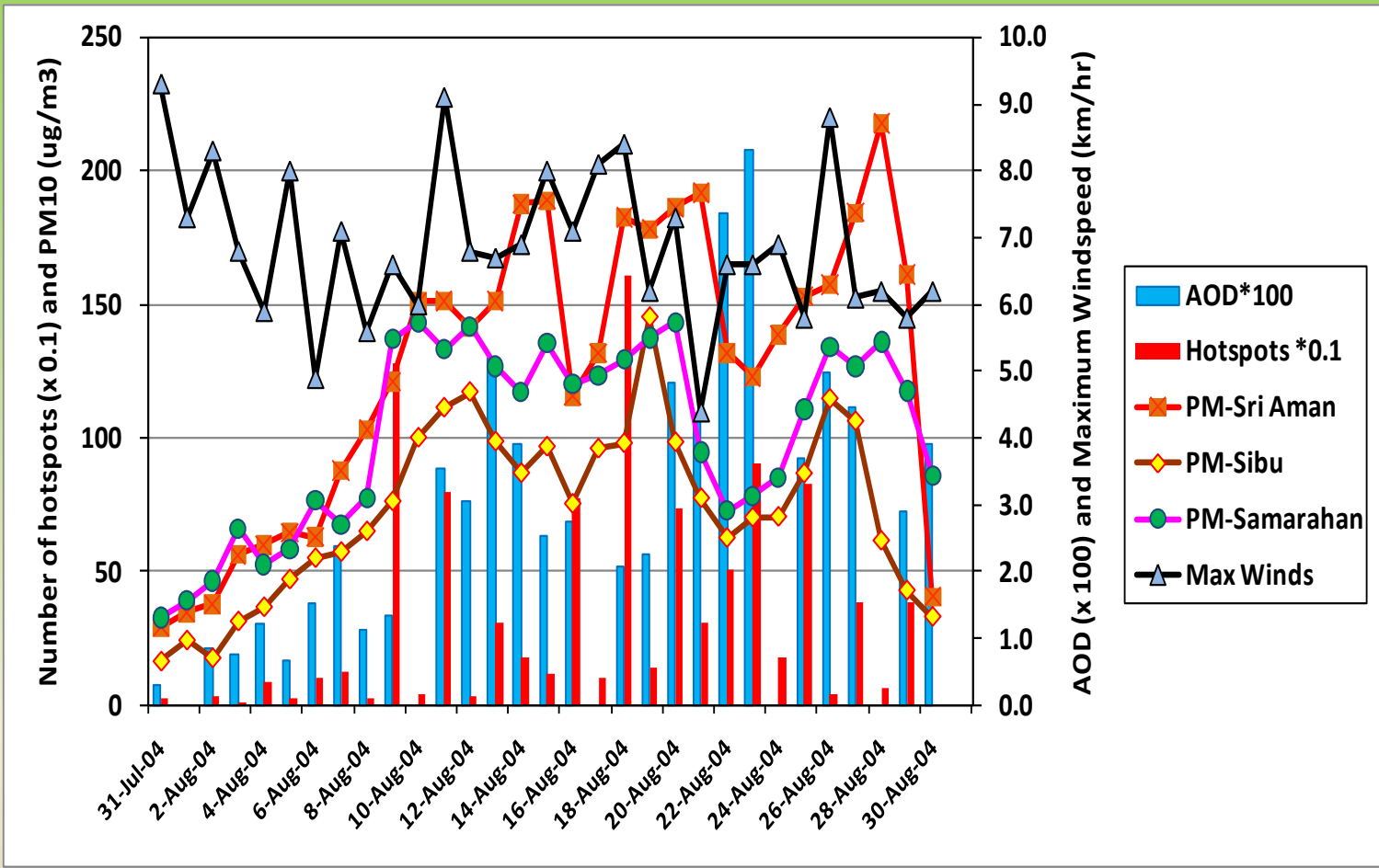
(d) 24 August 2004



The distribution of active fire count densities across Sumatra, Peninsular Malaysia and Borneo on 4 separate dates a) 10th, (b) 19th, (c) 21st and (d) 24th of August 2005.

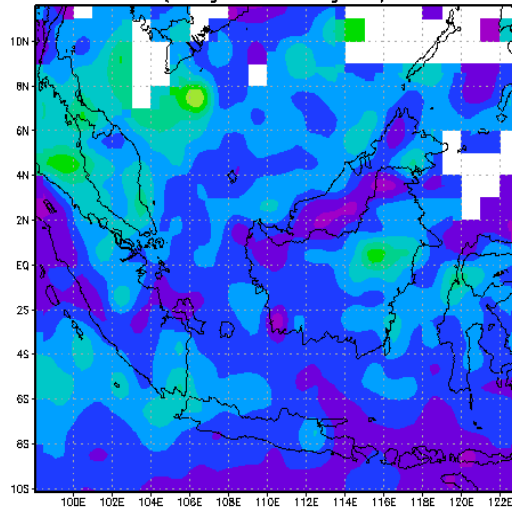


The distribution of PM₁₀ Concentrations on 10th, 19th and 20th August 2004

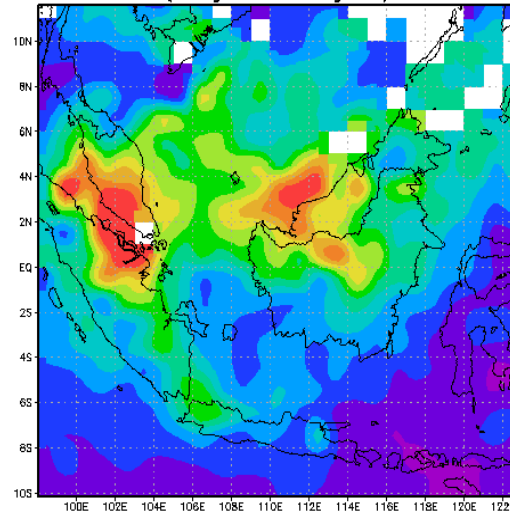


The daily AOD, PM₁₀ concentrations, and maximum wind speed at Sri Aman, Sarawak. The active fires counts are the total for Borneo, while PM₁₀ concentrations are also included for the Kota Samarahan and Sibu air quality stations.

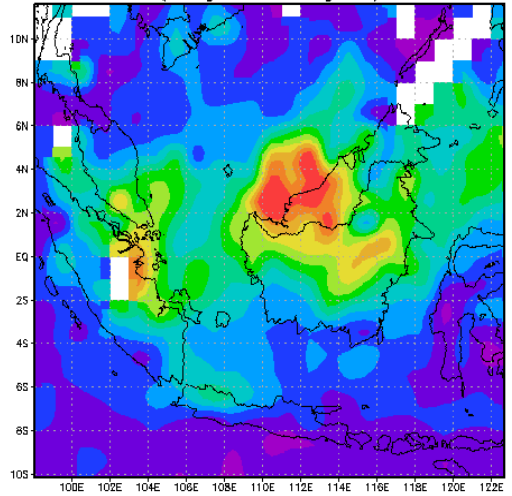
MOD08_D3.005 Aerosol Optical Depth at 550 nm [unitless]
(01Aug2004 - 07Aug2004)



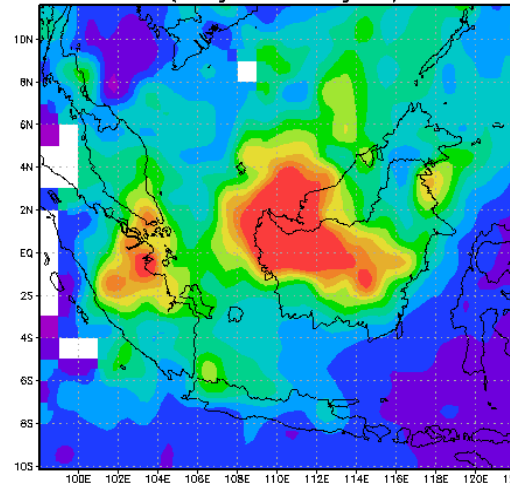
MOD08_D3.005 Aerosol Optical Depth at 550 nm [unitless]
(08Aug2004 - 14Aug2004)



MOD08_D3.005 Aerosol Optical Depth at 550 nm [unitless]
(15Aug2004 - 21Aug2004)



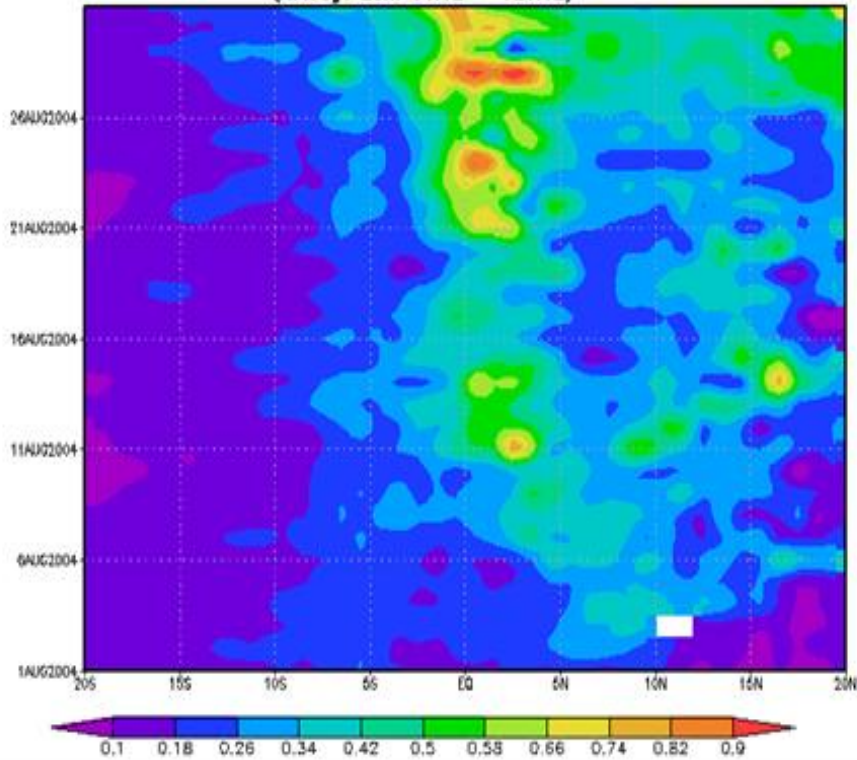
MOD08_D3.005 Aerosol Optical Depth at 550 nm [unitless]
(22Aug2004 - 31Aug2004)



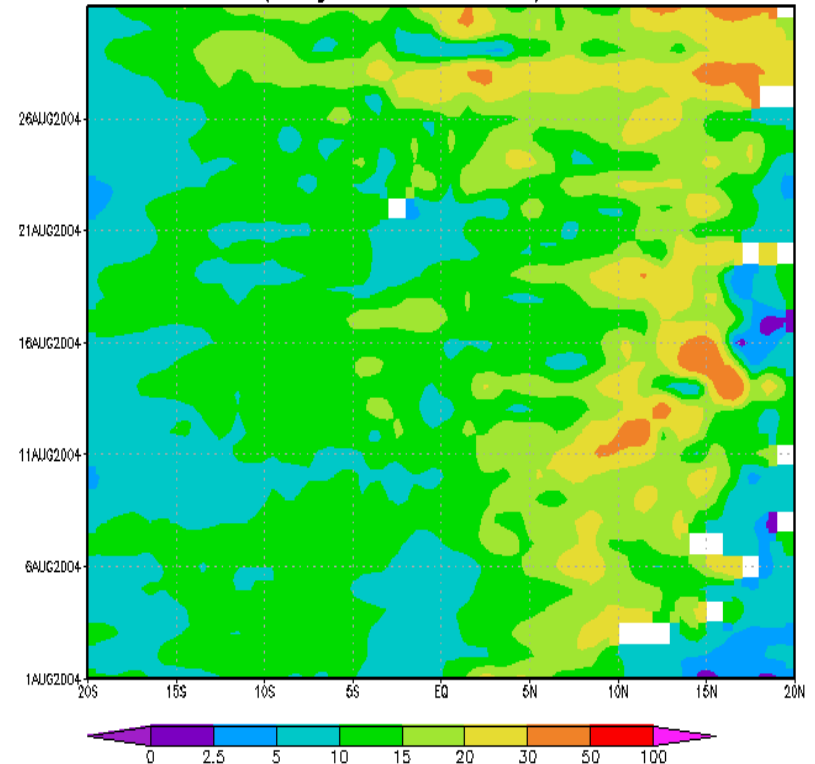
Using Remotely Sensed Information to monitor the events

Weekly aerosol AOD distributions over equatorial Southeast Asia from (a) 1 to 7 August, (b) 8 to 14 August, (c) 15 to 21 August, and (d) 22 to 31 August 2004.

MOD08_D3.005 Aerosol Optical Depth at 550 nm [unitless]
(Average Lon: 80.0E - 120.0E)

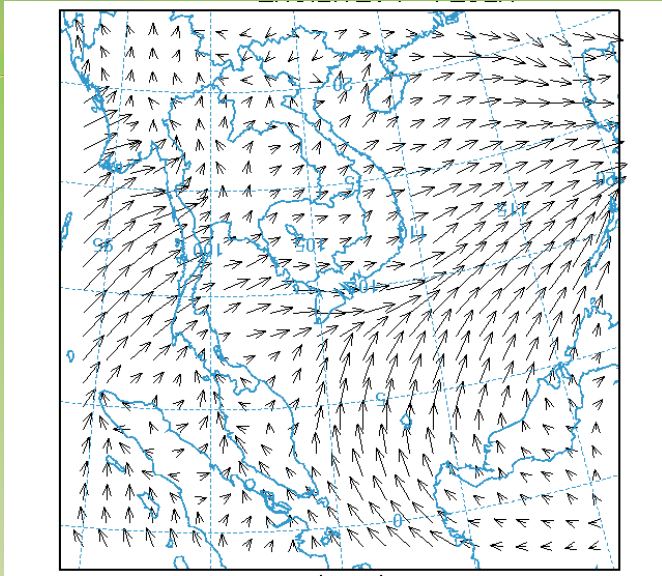


MOD08_D3.005 Mass Concentration - Ocean (QA-w) [$\mu\text{g}/\text{cm}^2$]
(Average Lon: 80.0E - 120.0E)

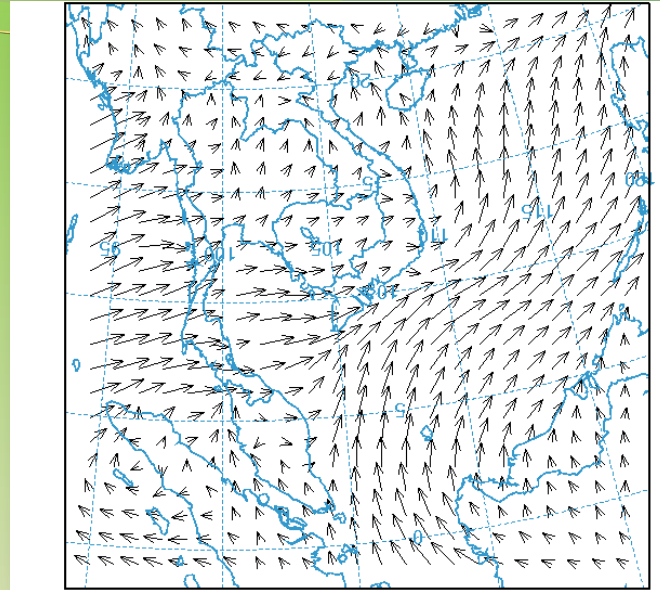


The Hovmoller representation of the (a) AOD and (b) oceanic mass concentrations ($\mu\text{g}/\text{cm}^2$) over the averaged longitude of 80°E to 120°E during August 2004.

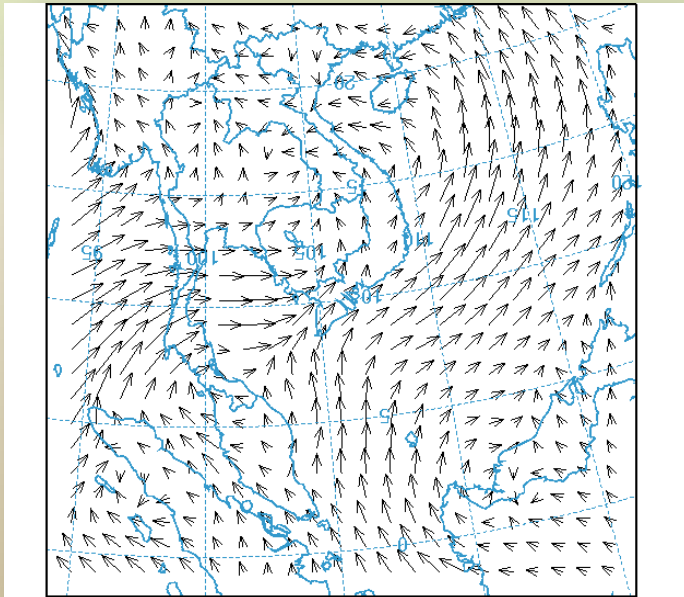
a) 10 August 2004



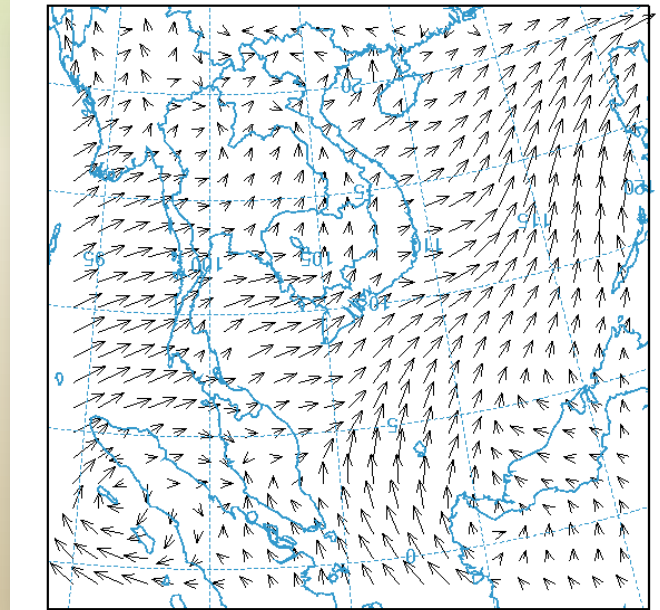
(b) 19 August 2004



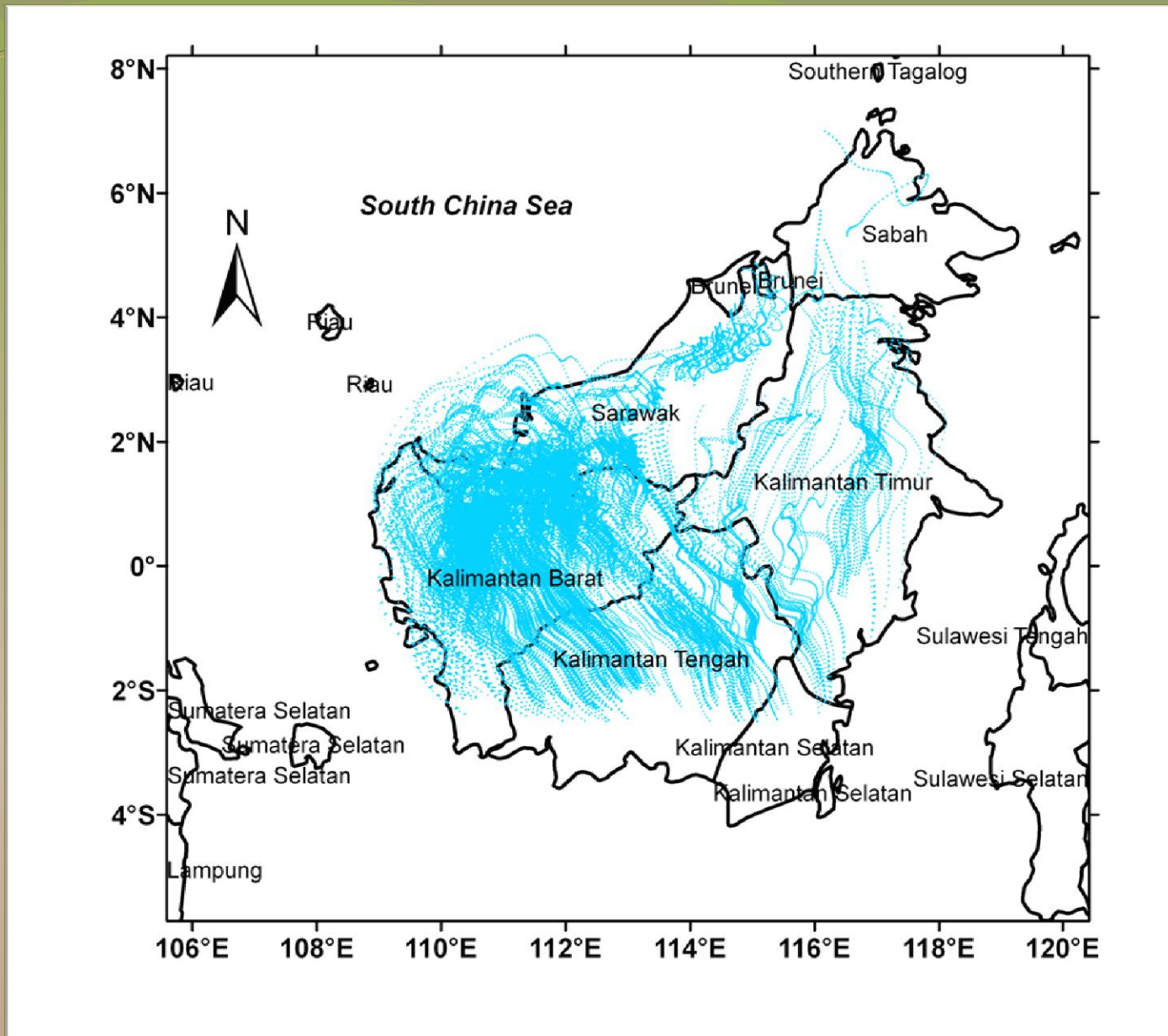
(c) 21 August 2004



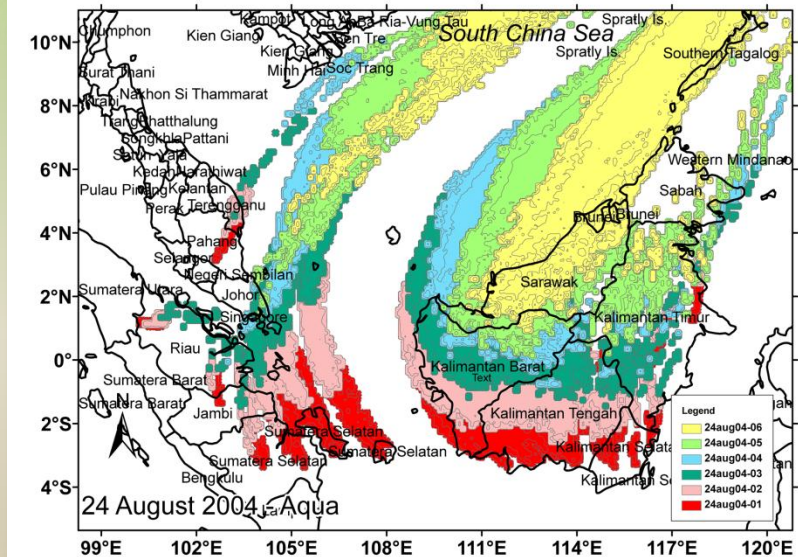
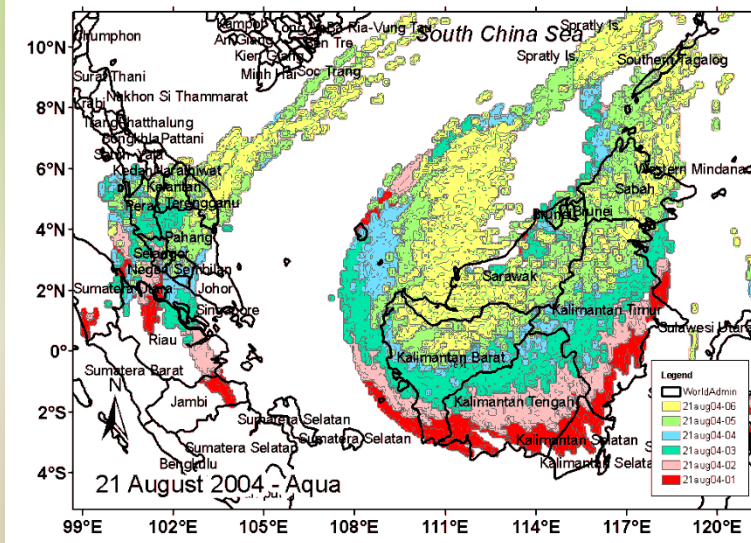
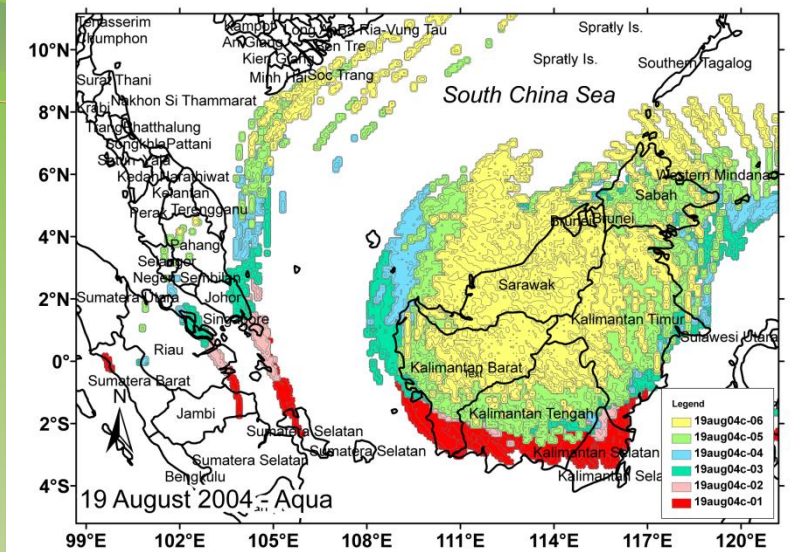
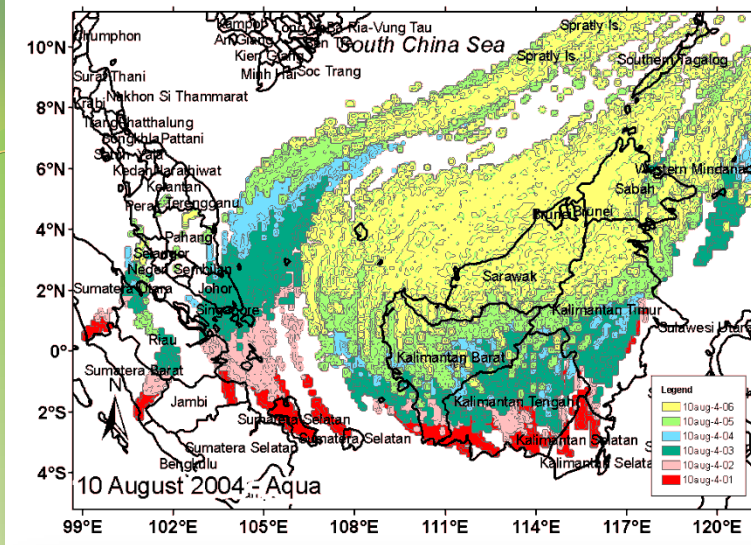
(b) 23 August 2004



**Southwest
Monsoon
Winds over
The
Region
Indicating
Weak winds
Over the
Equator**



Trajectories from sources of active fire counts on 19 August 2004

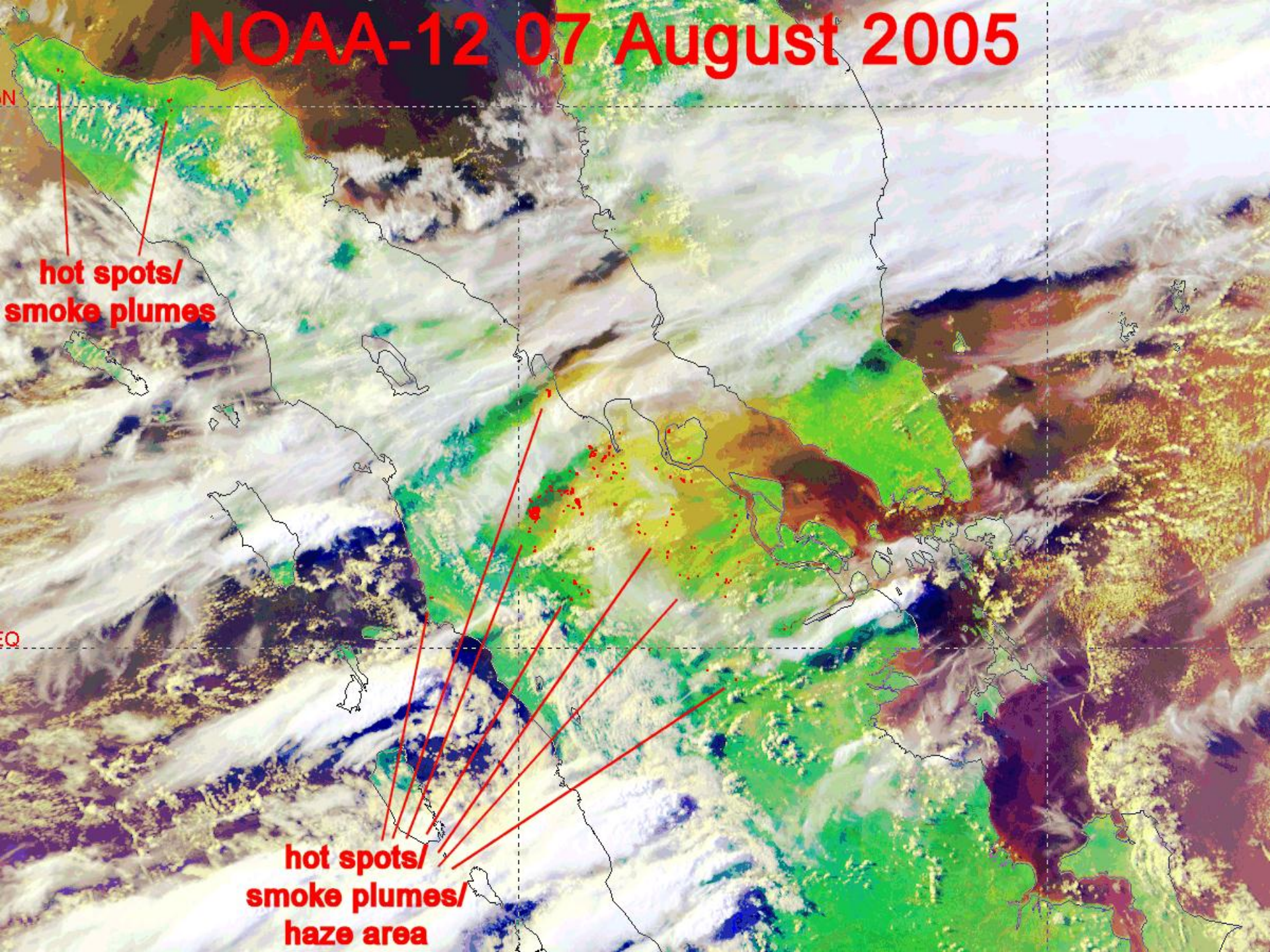


Dispersion of plumes at every 12 hours starting from 12 hours until 72 hours for selected days on (a) 10 August, (b) 19 August, (c) 21 August and (d) 24 August 2004.

Comparison: 2005 event

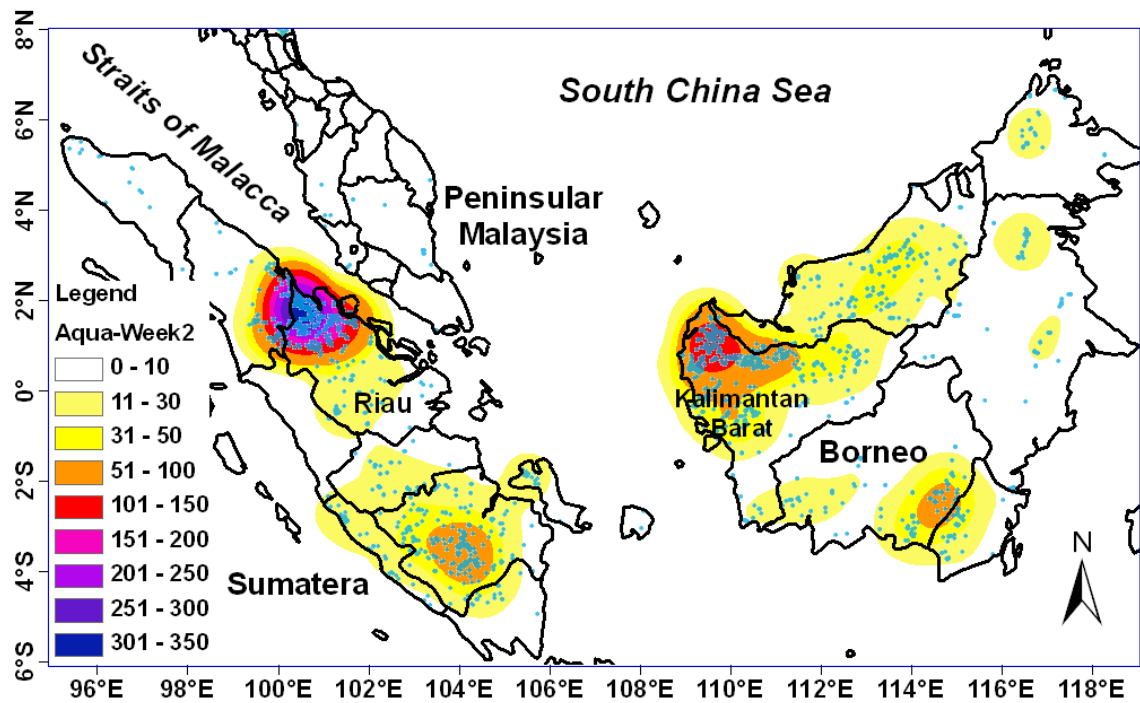
Haze emergency at 2 locations on the western coast of Peninsular Malaysia

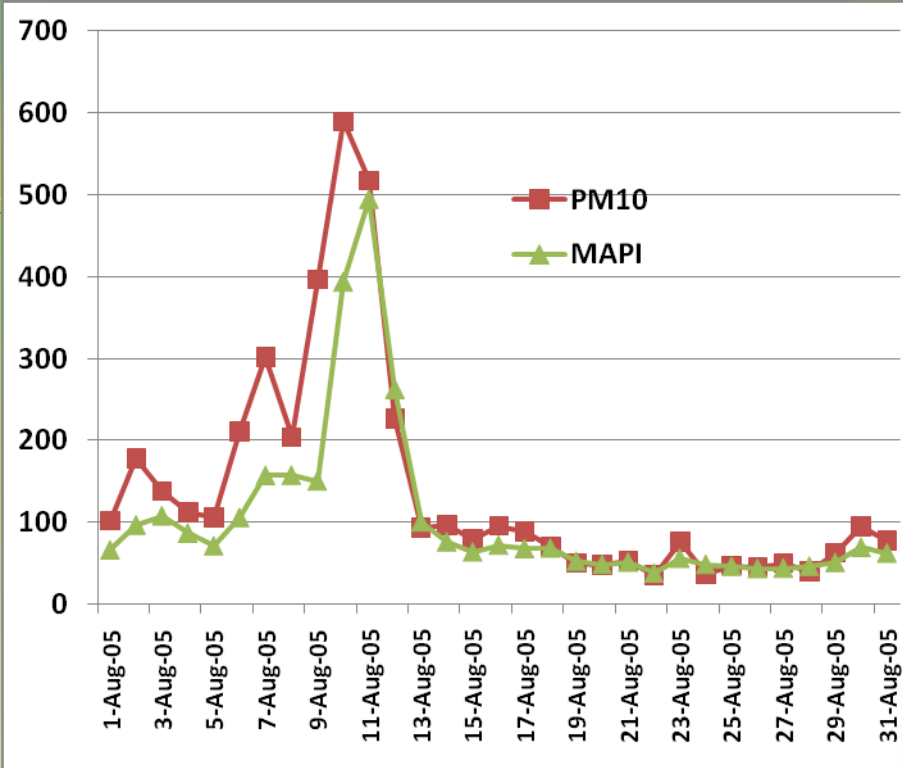
NOAA-12 07 August 2005



**hot spots/
smoke plumes**

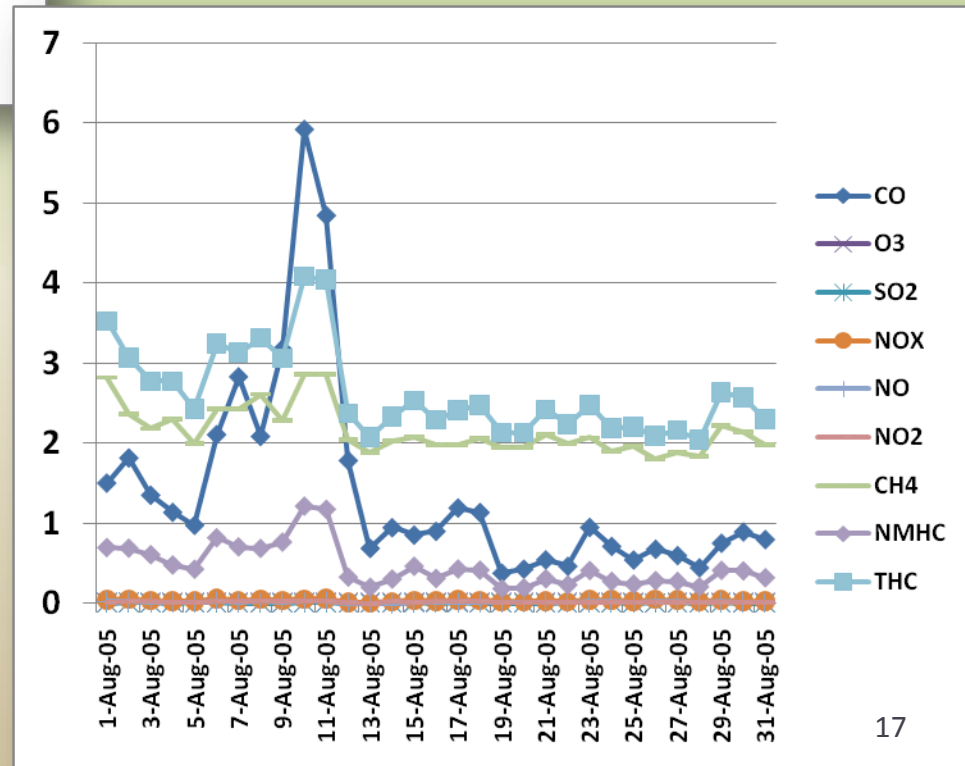
**hot spots/
smoke plumes/
haze area**





Air quality at Klang station during August 2005

Emissions of biomass burning estimated from Sumatra during the August 2005 showed a significant amount of greenhouse gases such as CH₄ and CO as well as the O₃ precursors released to the atmosphere.

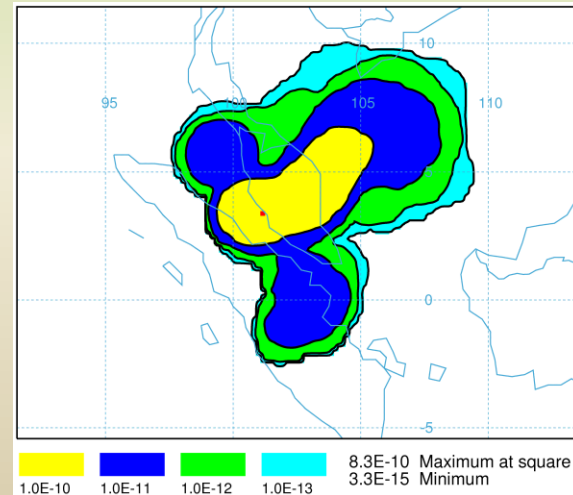
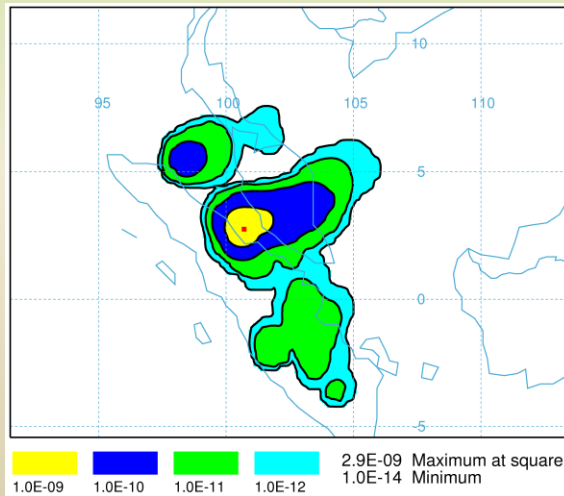
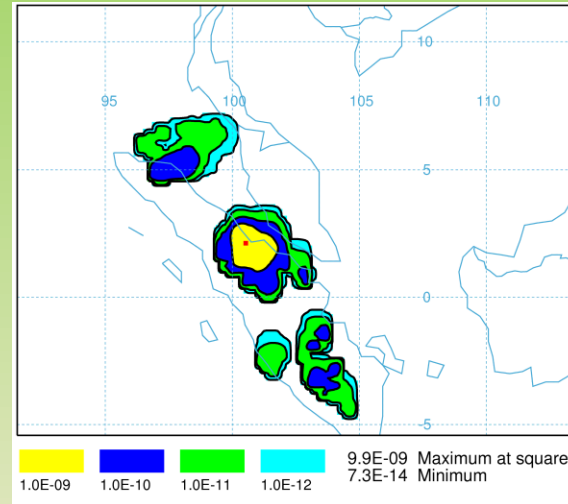
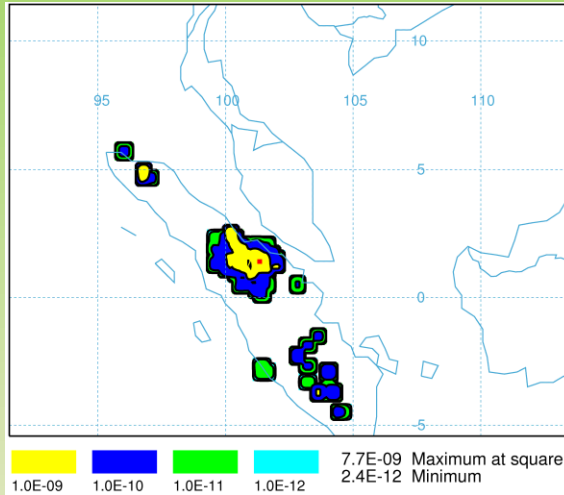


Estimates of pollutants from Sumatera during August 2005



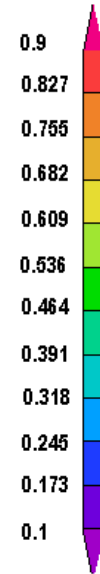
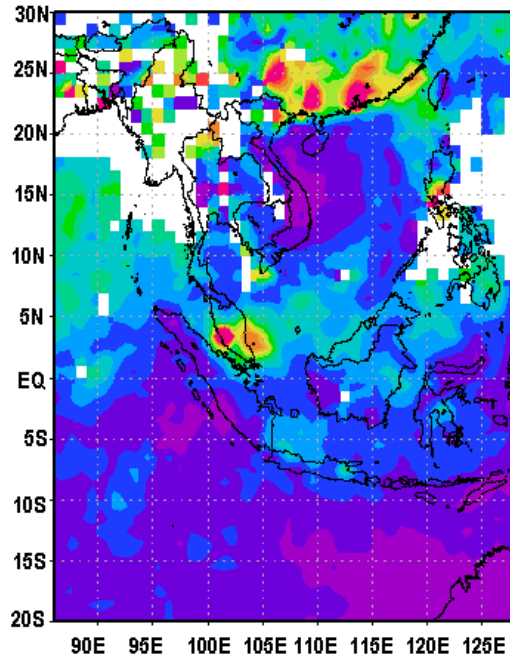
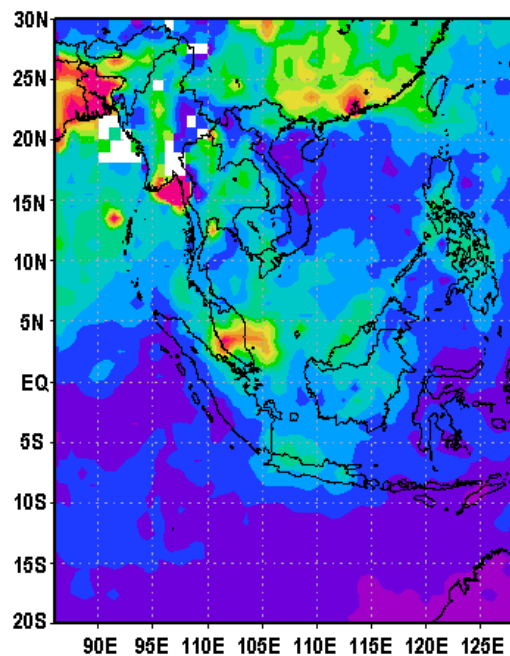
Provinsi	TSP (tons)	CO (tons)	NMHC (tons)	NOx (tons)	SOx (tons)	TSP (<2.5µm) (tons)
Aceh	115431.1	45828.64	7141.081	916300.2	7140.073	164816.2
Bengkulu	522836.7	207598.1	32346.58	4150301	32340.45	746522.1
Jambi	196911.7	78176.7	12181.72	1563100	12180.12	281156.9
Lampung	81481.94	32364.18	5041.916	646800.3	5040.13	116342.1
Riau	10456661	4151061	646860.3	83006011	646804.1	14930365
Sumatera Barat	81481.14	32354.26	5041.13	646800.2	5040.077	116341.2
Sumatera Selatan	1317267	522918.1	81486.98	10456601	81480.47	1880838
Sumatera Utara	1880843	746673.7	116352.6	14930302	116340.9	2685529
Total	14652913	5816975	906452.3	1.16E+08	906366.3	20921910

The dispersion analysis, which shows the merging of several puffs after a period of 48 hours from integration on 10 August 2005 (NOAA active fire counts)



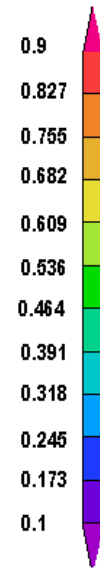
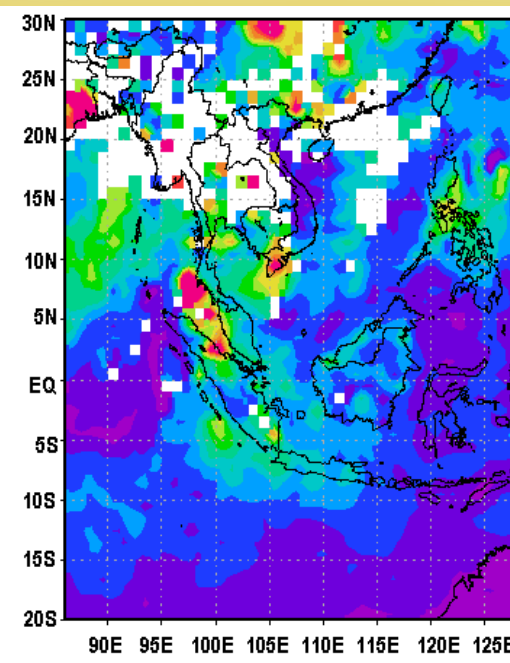
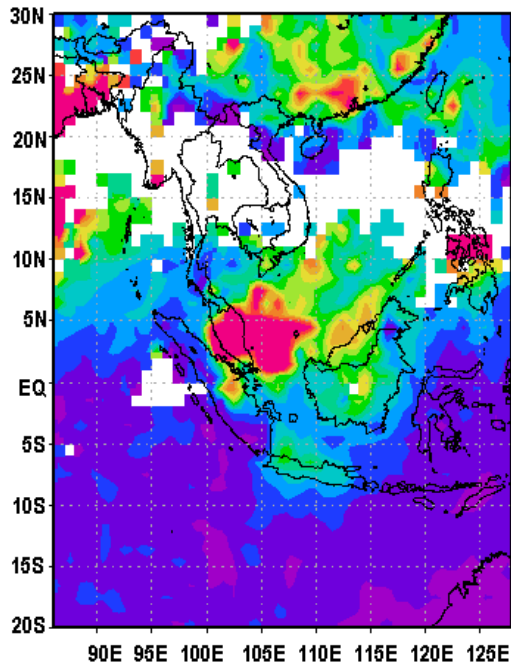
(a) 1 to 31 August 2005

(b) 1 to 7 August 2005



(c) 8 to 14 August 2005

(d) 15 to 21 August 2005



2005 event:

Aerosol optical depths (AOD) from

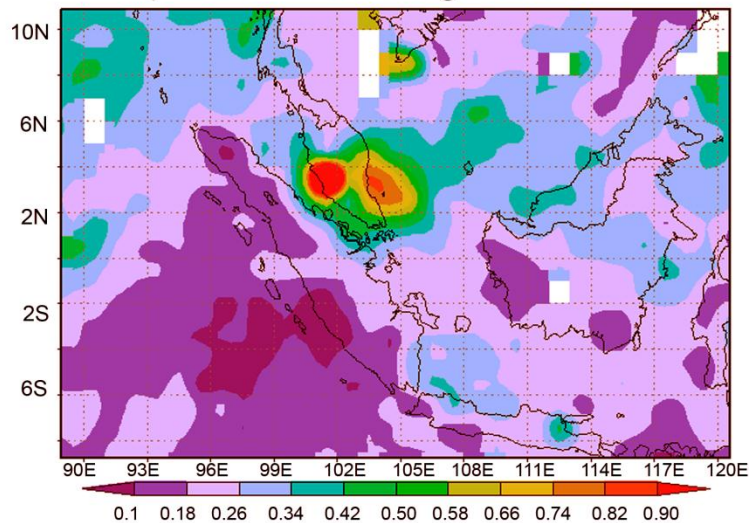
(a) 1-31 Aug,

(b) 1-7 Aug,

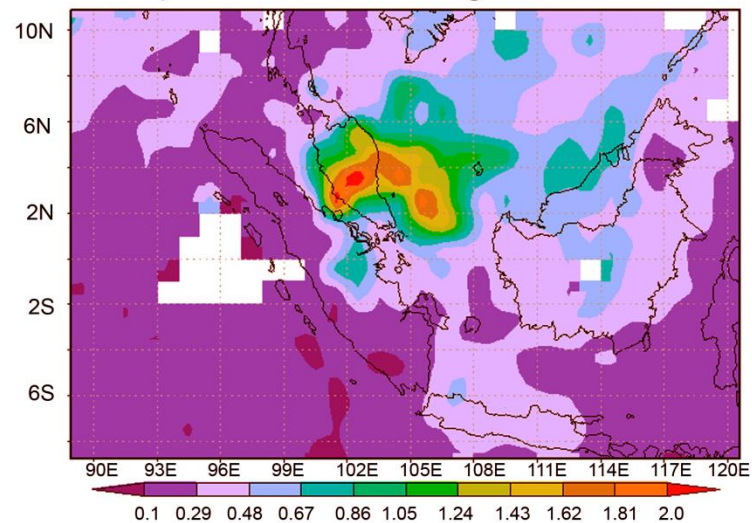
(c), 8-14 Aug,

(d) 15-21 Aug.

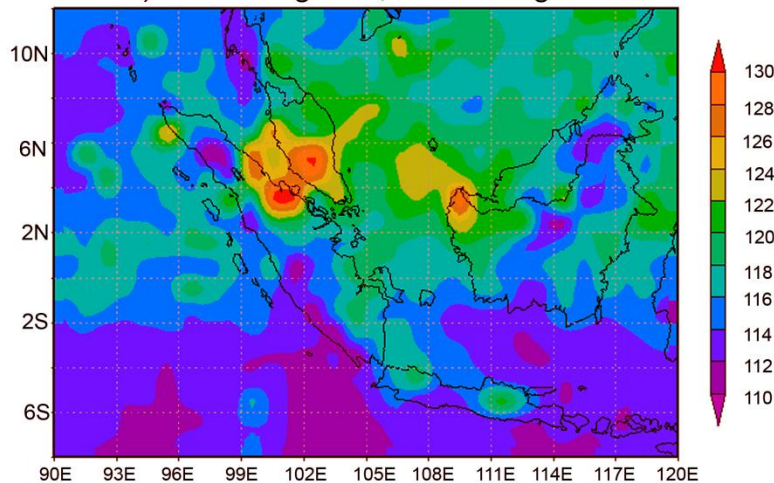
a) AOD from 1 to 7 August 2005



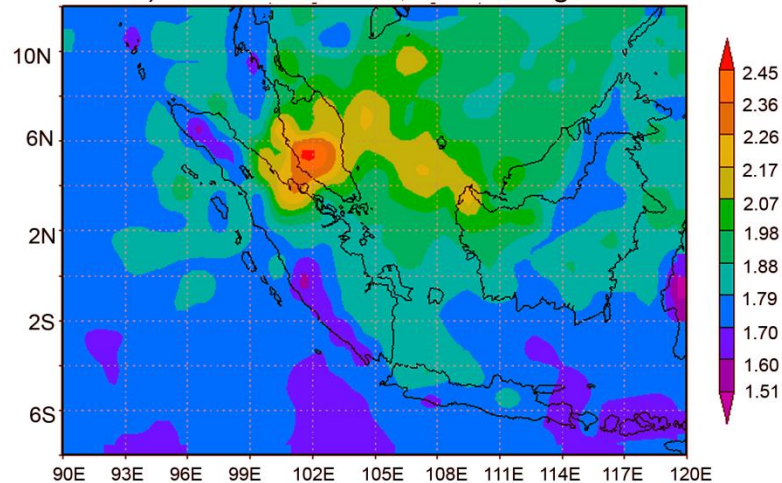
b) AOD from 8 to 14 August 2005



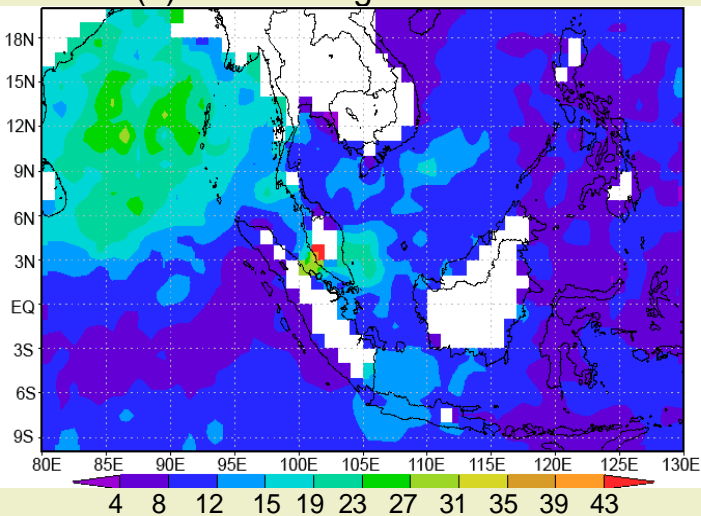
c) CO mixing ratio, 8 to 14 August 2005



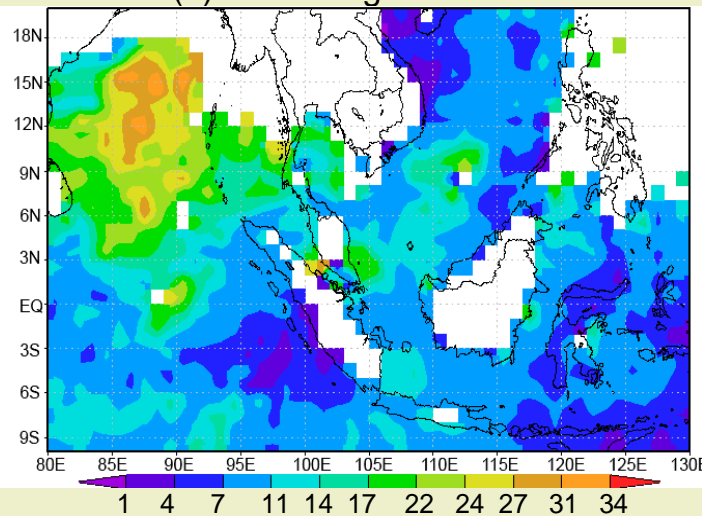
d) Total column CO, 8 to 14 August 2005



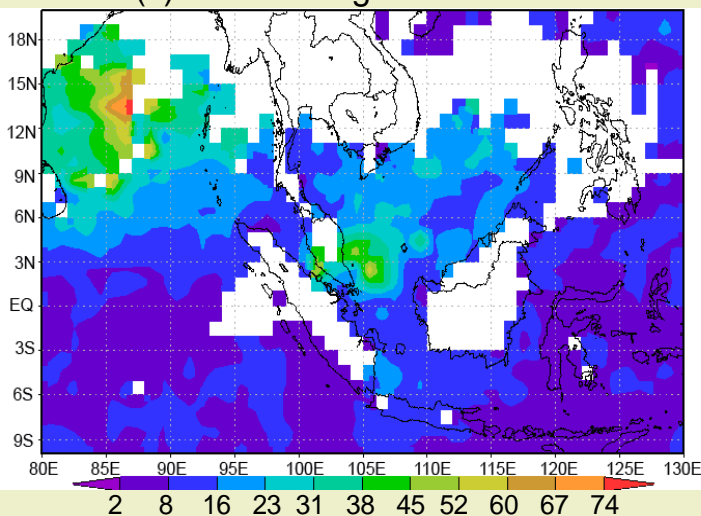
(a) 1 to 31 Aug 2005



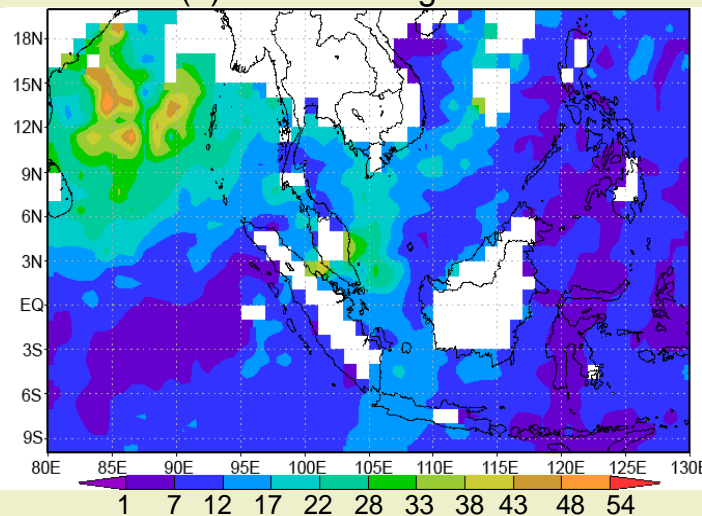
(b) 1 to 7 Aug 2005



(c) 8 to 14 Aug 2005



(d) 15 to 21 Aug 2005

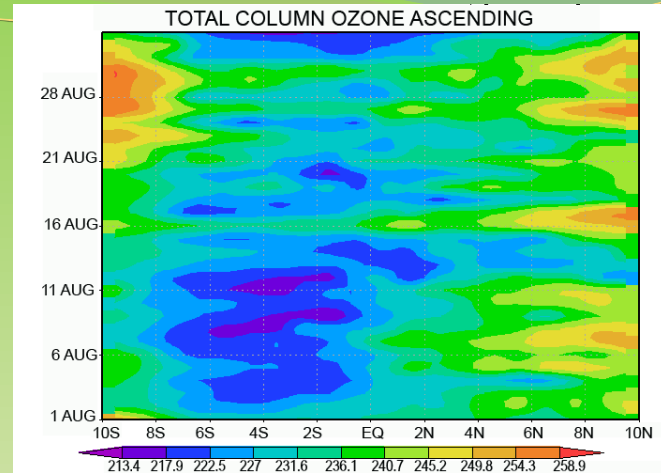
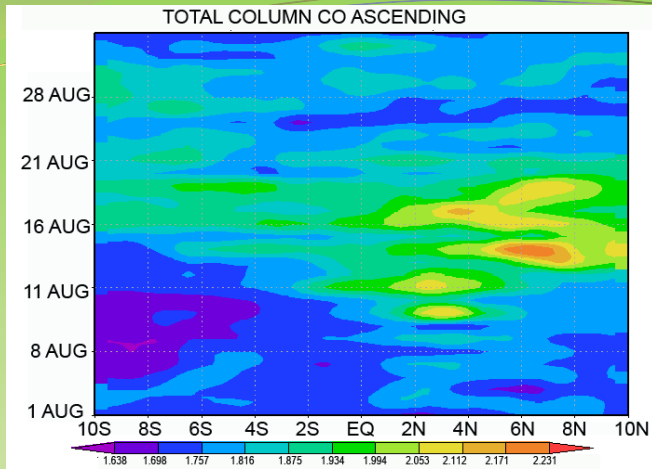


Mass concentrations of aerosols over the ocean of Southeast Asia from

- (a) 1-31 Aug,
- (b) 1-7 Aug,
- (c) 8-14 Aug
- (d) 15-21 Aug 2005.

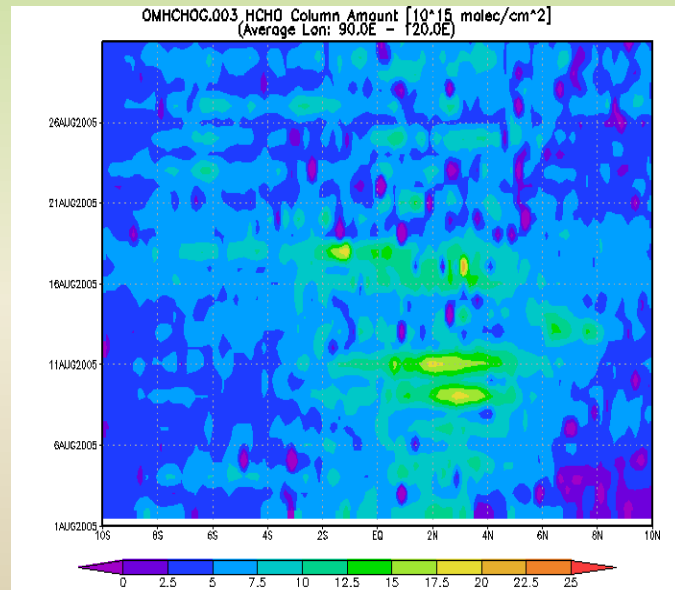
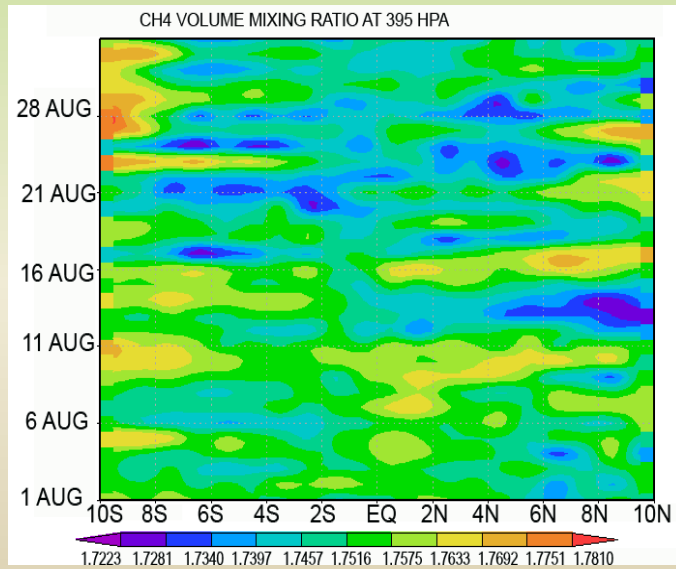
(a) total column CO

(b) total column O₃



(c) CH₄ volume mixing ratio

(d) Tropospheric column HCHO



Haze in June 2013

- Haze emergency declared in the state of Johor, Malaysia (neighbouring Singapore) on 23 June 2013 when the API reached 500 (hazardous).
- API in Muar reached 750 on 22 June 2013 but decreased to 148 on 24 June, while Port Dickson increased to 335.

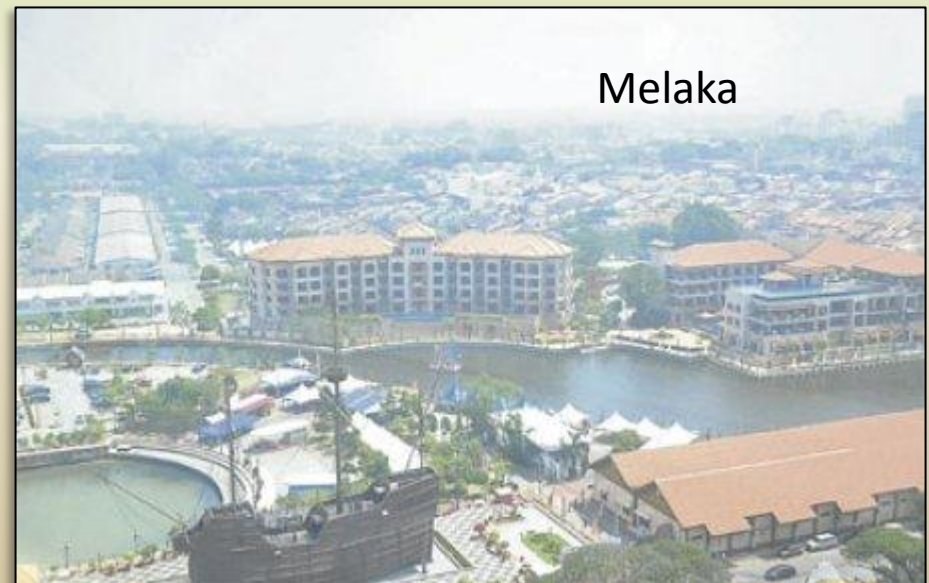
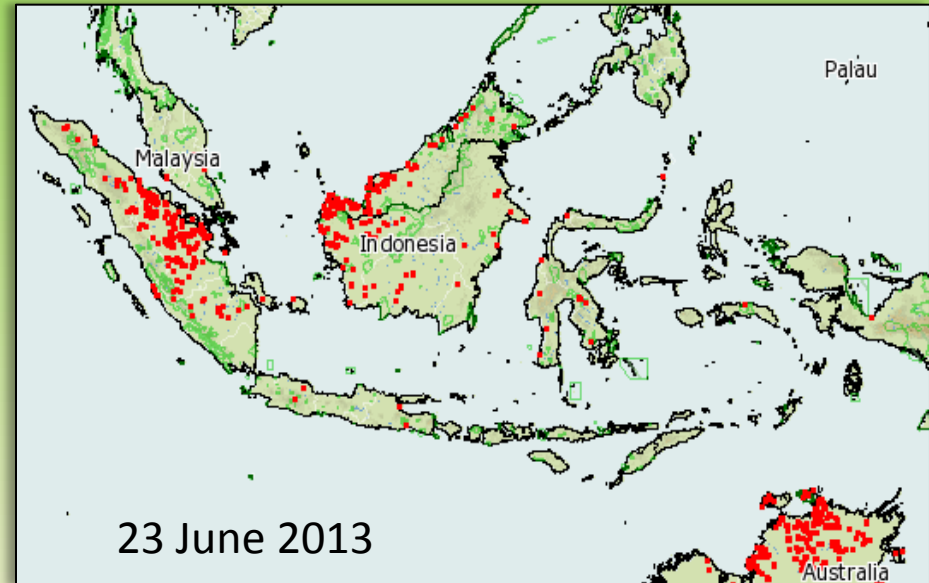
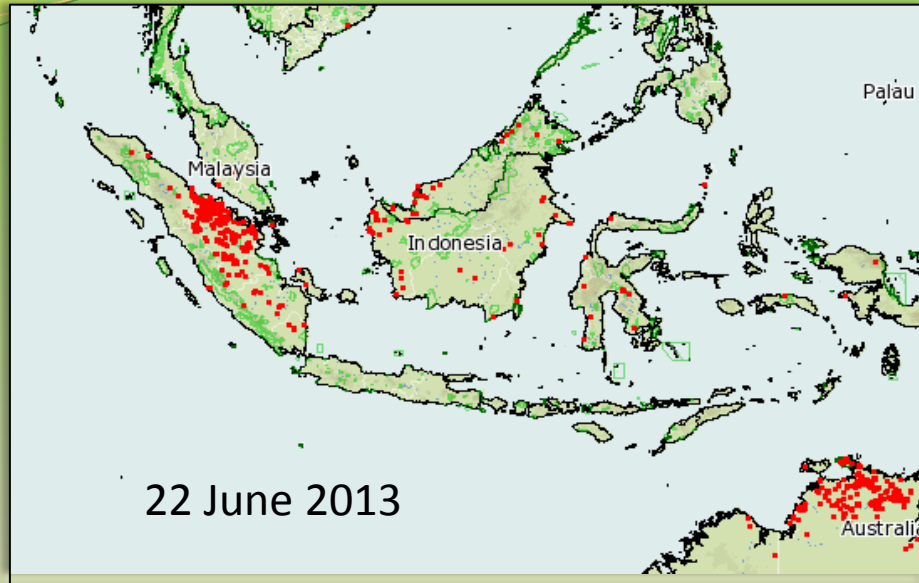


Riau, Indonesia, 23 June 2013



Thick smoke from raging forest fires rise in Pelalawan regency in Riau on June 21, 2013

Haze in June 2013



CONCLUSION

- The recurrence of the large-scale biogenic fires and the resulted transboundary haze is one of the most serious environmental issues facing SEA today.
- Fires are deliberately set alight to clear forests and land, over the last few decades which had led to repeated air pollution episodes within the neighbouring countries such as Malaysia, Singapore and Brunei.
- Clearly the transboundary haze problem must be solved and controlled to cope with the negative impacts to the population of the neighbouring countries.



Terima Kasih
Thank You

