Land Use Change Research Projects in Malaysia

Mastura Mahmud
Earth Observation Centre
Universiti Kebangsaan Malaysia

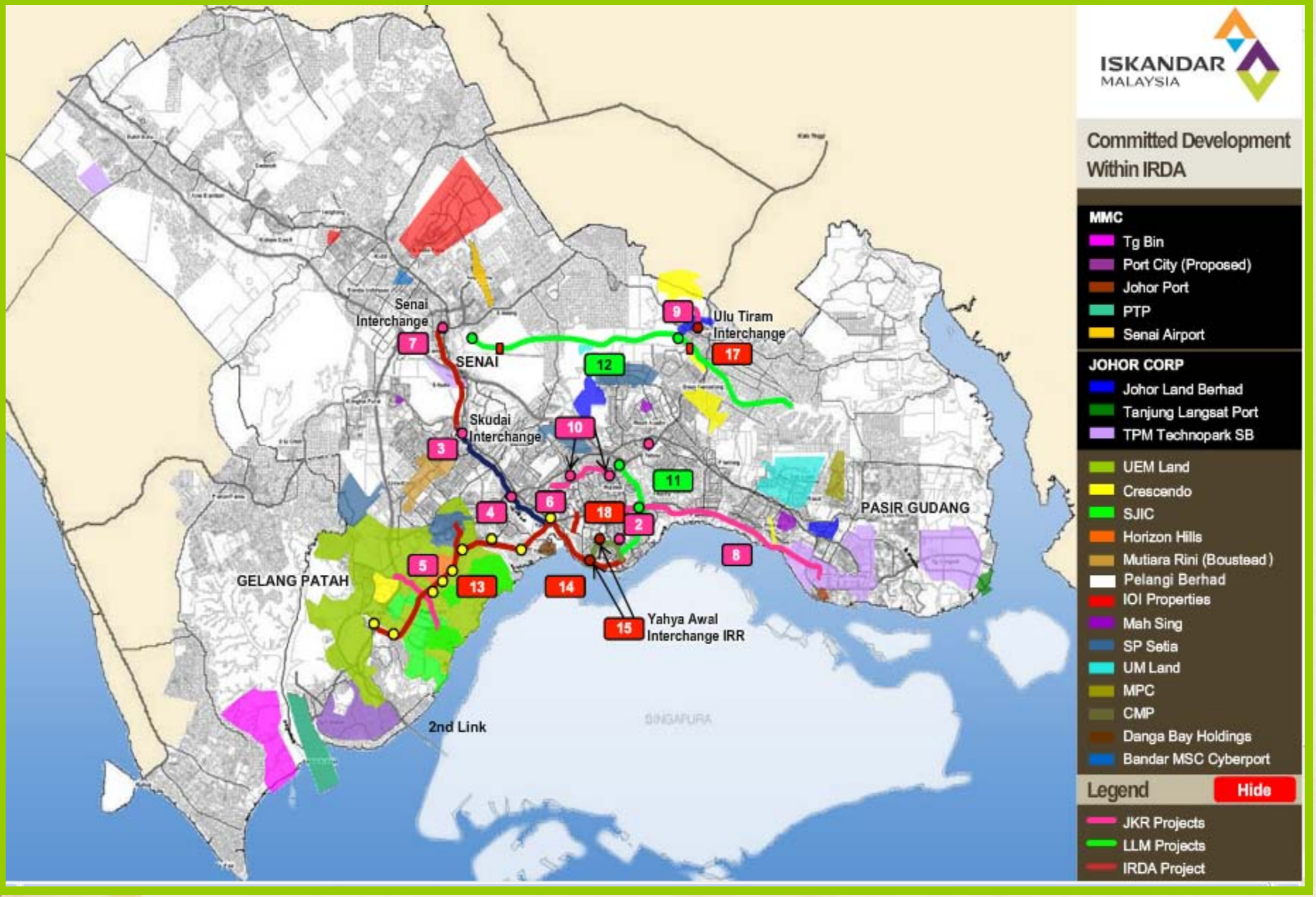
NASA-LCLUC Science Team Joint Meeting with MAIRS, GOFC-GOLD and SEA START Programs on Land-Cover/Land-Use Change Processes in Monsoon Asia Region, January 12-17, 2009 in Khon Kaen, Thailand

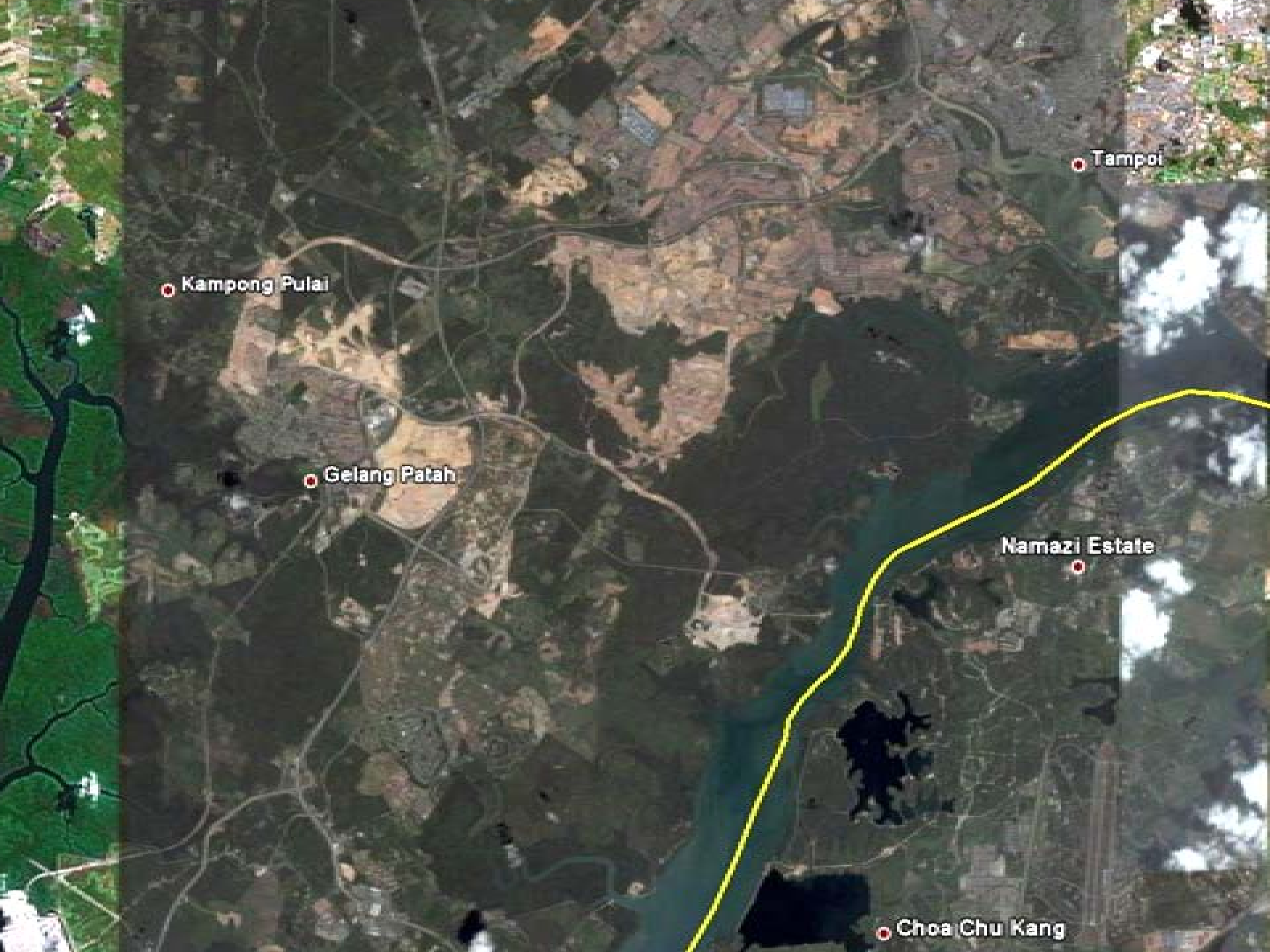
Outline of presentation

- Large Development Regions
- Landslide Issues
- Biomass Burning and Impacts

South Johor Development Area

- Iskandar Malaysia covers 221,634.1 hectares (2,216.3 km²) of land area within the southern most part of Johor.
- The development region encompasses an area about 3 times the size of Singapore.
- Iskandar Malaysia covers the entire district of Johor Bahru (including the island within the district), Mukim Jeram Batu, Mukim Sungai Karang, Mukim Serkat, and Kukup Island in Mukim Ayer Masin, all within the district of Pontian.


ISKANDAR
MALAYSIA
Committed Development
Within IRDA
MMC
Tg Bin
Port City (Proposed)
Johor Port
PTP
Senai Airport
JOHOR CORP
Johor Land Berhad
Tanjung Langsat Port
TPM Technopark SB
UEM Land
Crescendo
SJIC
Horizon Hills
Mutiara Rini (Boustead)
Pelangi Berhad
IOI Properties
Mah Sing
SP Setia
UM Land
MPC
CMP
Danga Bay Holdings
Bandar MSC Cyberport
Legend
Hide
JKR Projects
LLM Projects
IRDA Project
Senai Interchange
SENAI
Skudai Interchange
Ulu Tiram Interchange
PASIR GUDANG
GELANG PATAH
Yahya Awal Interchange IRR
2nd Link
SINGAPURA
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
17
18


Tampoi
Kampong Pulai
Gelang Patah
Namazi Estate
Choa Chu Kang


Gelang Patah

- Five Flagship Zones are proposed as key focal points for developments in the Iskandar Malaysia. Four of the focal points will be located in the Nusajaya-Johor Bahru-Pasir Gudang corridor (Special Economic Corridor -(SEC)). The flagship zones would strengthen further existing economic clusters as well as to diversify and develop targeted growth factors.

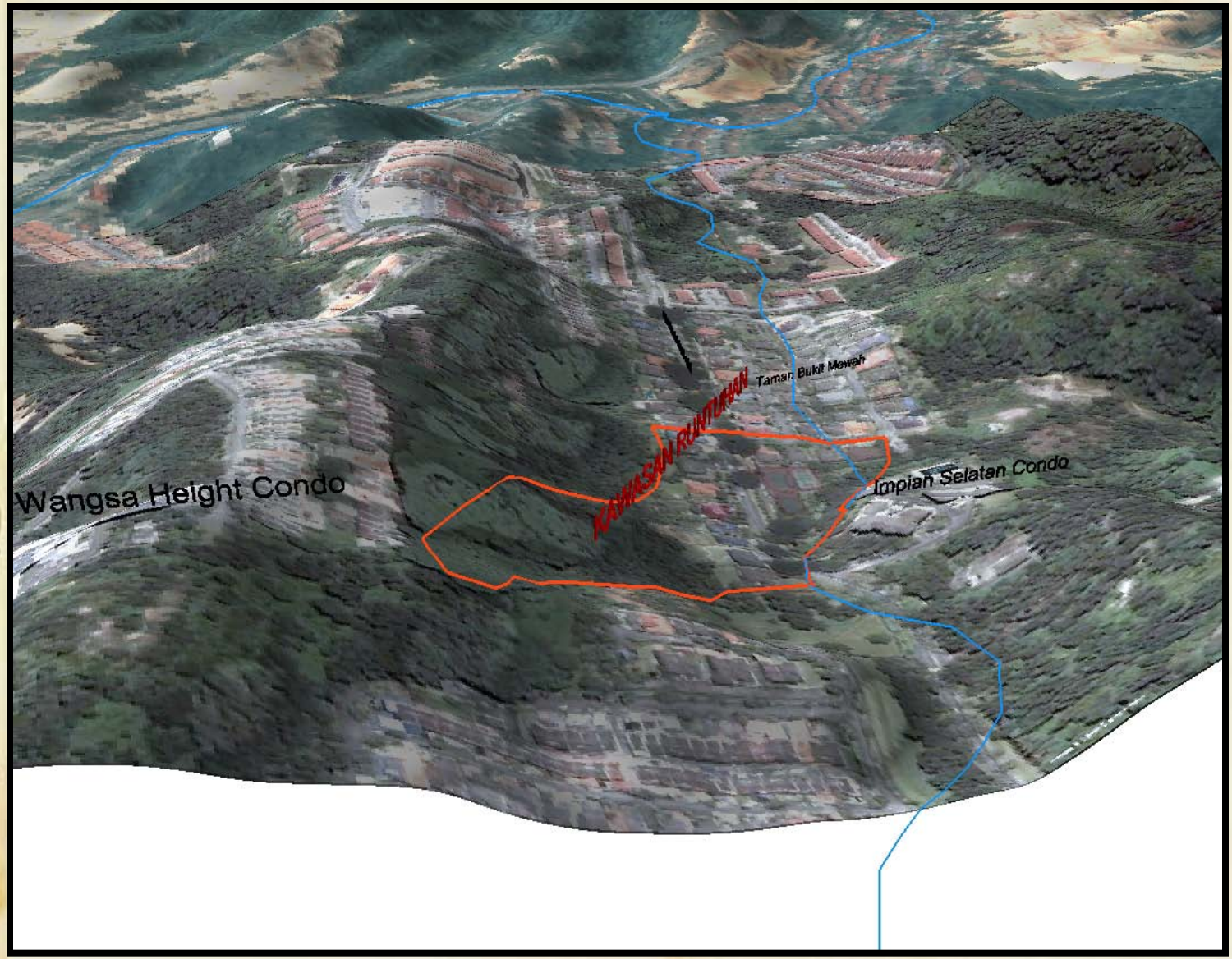
- **Flagship Zone A – Johor Bahru City Centre(**New financial district , Central business district , Danga Bay integrated waterfront city , Tebrau Plentong mixed development , Causeway (Malaysia/Singapore)
- **Flagship Zone B - Nusajaya (**Johor state administrative centre , Medical hub , Educity , International destination resort , Southern Industrial logistic cluster)
- **Flagship Zone C - Western Gate Development (**Port of Tanjung Pelepas , 2nd Link (Malaysia/Singapore) , Free Trade Zone , RAMSAR World Heritage Park , Tanjung Piai)
- **Flagship Zone D - Eastern Gate Development (** Pasir Gudang Port and industrial zone , Tanjung Langsat Port , Tanjung Langsat Technology Park, Kim-Kim regional distribution centre).
- **Flagship Zone E - Senai-Skudai (** Senai International Airport , Senai cargo hub , Skudai knowledge hub , Senai multimodal , entre , MSC Cyberport city

Deforestation Issues

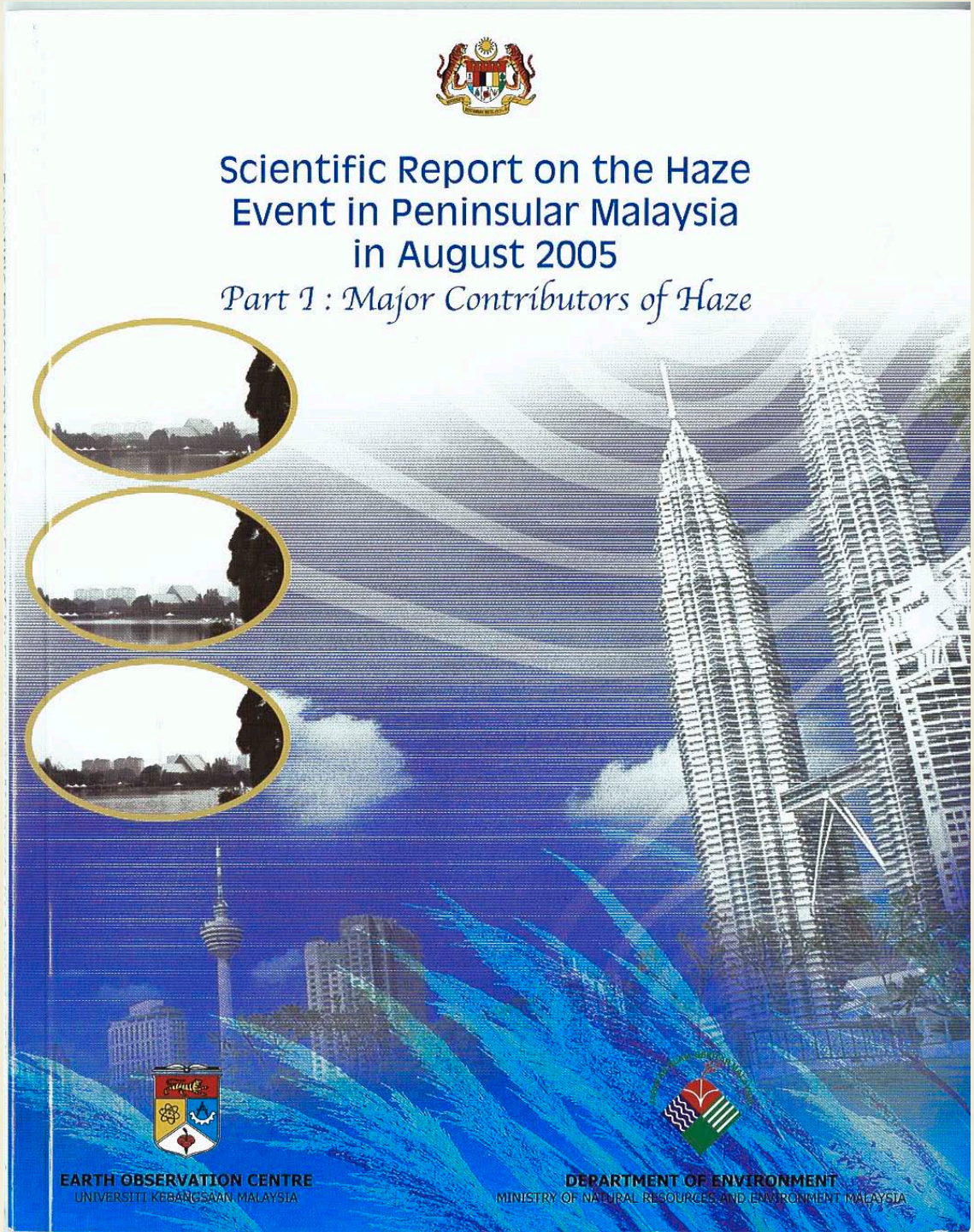
- Nusajaya Project (23,875 acres)
- 7000 acres of the presently oil palm and rubber plantations will be cleared to make way for the development plans.
- One of the EOC's (UKM) project is to calculate the carbon loss from the clearing of the palm oil/rubber plantations.

Impacts of Development: Landslide


Jalan Bukit Antarabangsa
Taman Bukit Mewah
KAWASAN RUNTUHAN
Impian Selatan Condo
Wangsa Height Condo
N
W
E
S
Legend
Sungai Klang
runtuhan
0
30
60
120 Meters


Wangsa Height Condo
KAWASAN RUNTUHAN
Taman Bukit Mewah
Impian Selatan Condo


Jalan Bukit Antarabangsa
KAWASAN RUNTUHAN



A Study on the Main Contributors of the Transboundary Haze in Peninsular Malaysia in August 2005

Background

- The haze emergency state declared on 11 August 2005 in the districts of Klang and Kuala Selangor was one of the worst haze episode that occurred in Peninsular Malaysia since the past decade.

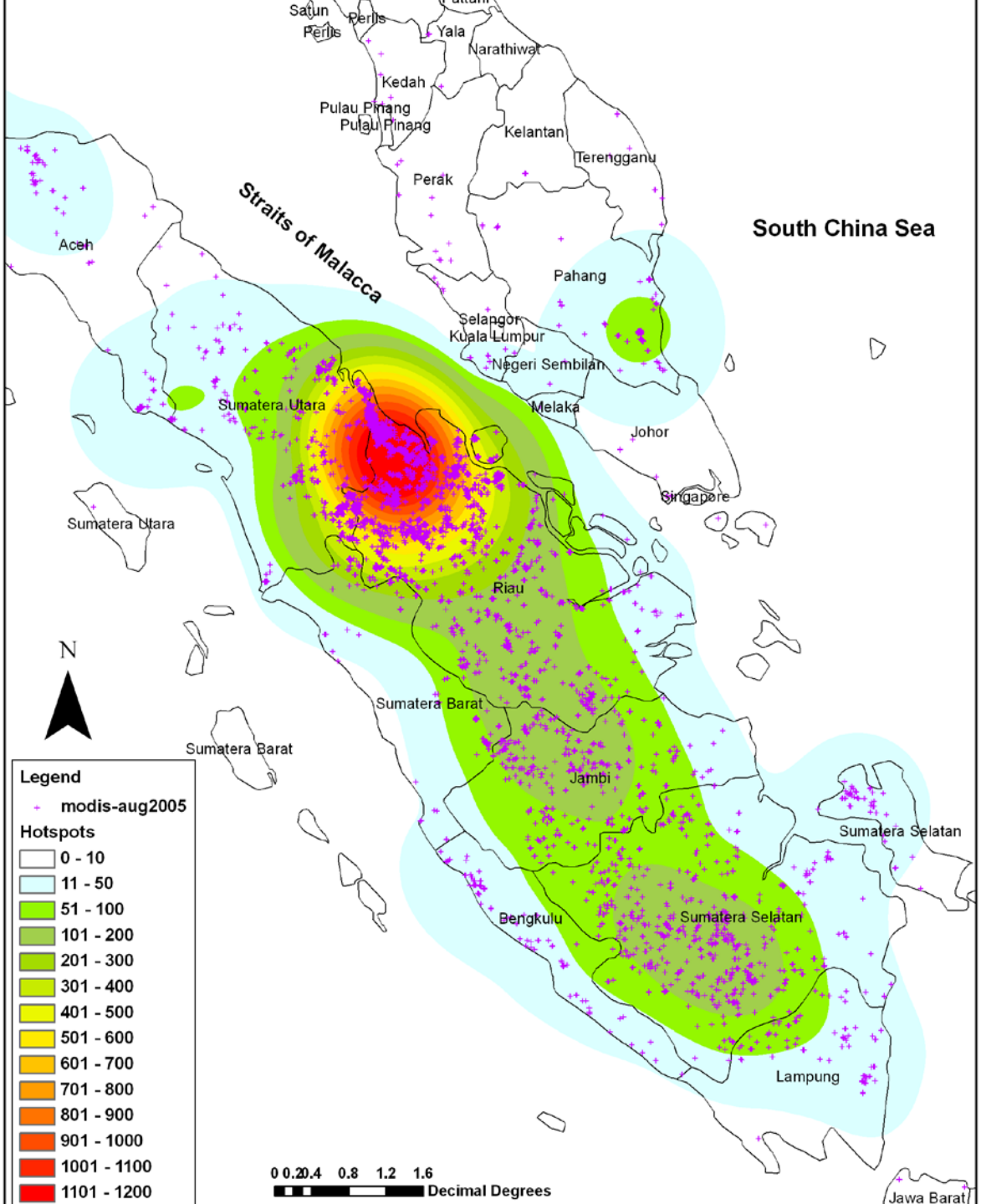
- The unprecedented event of the haze that can be considered an environmental disaster where the air pollutant index indicated hazardous levels of air quality that is harmful to the health of the public.

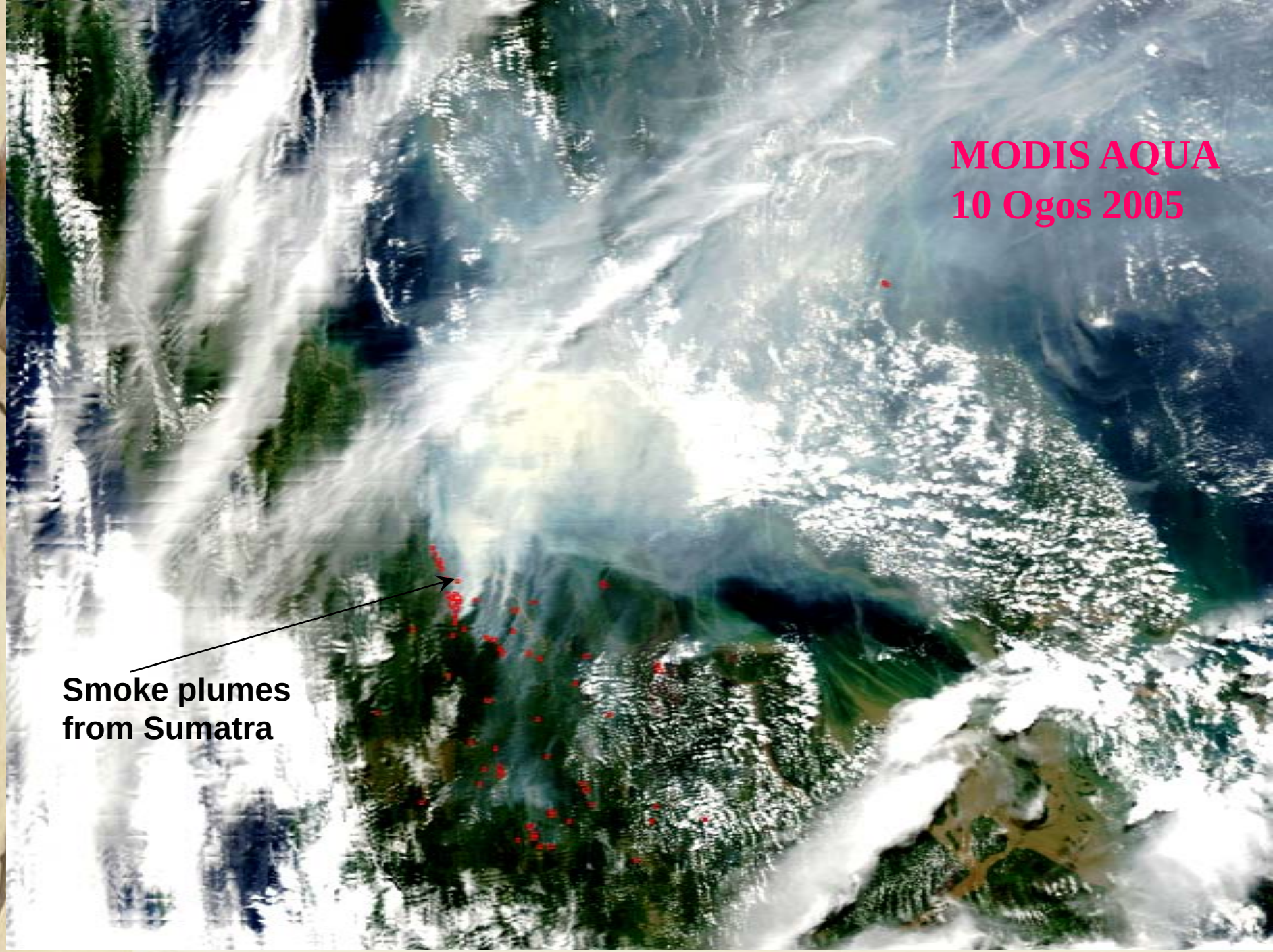
- The main contributors of the haze that affected the state of Selangor, which was mainly instigated by the vegetation fires in Riau, Sumatera during the height of the burning activities will be the topic of this presentation.

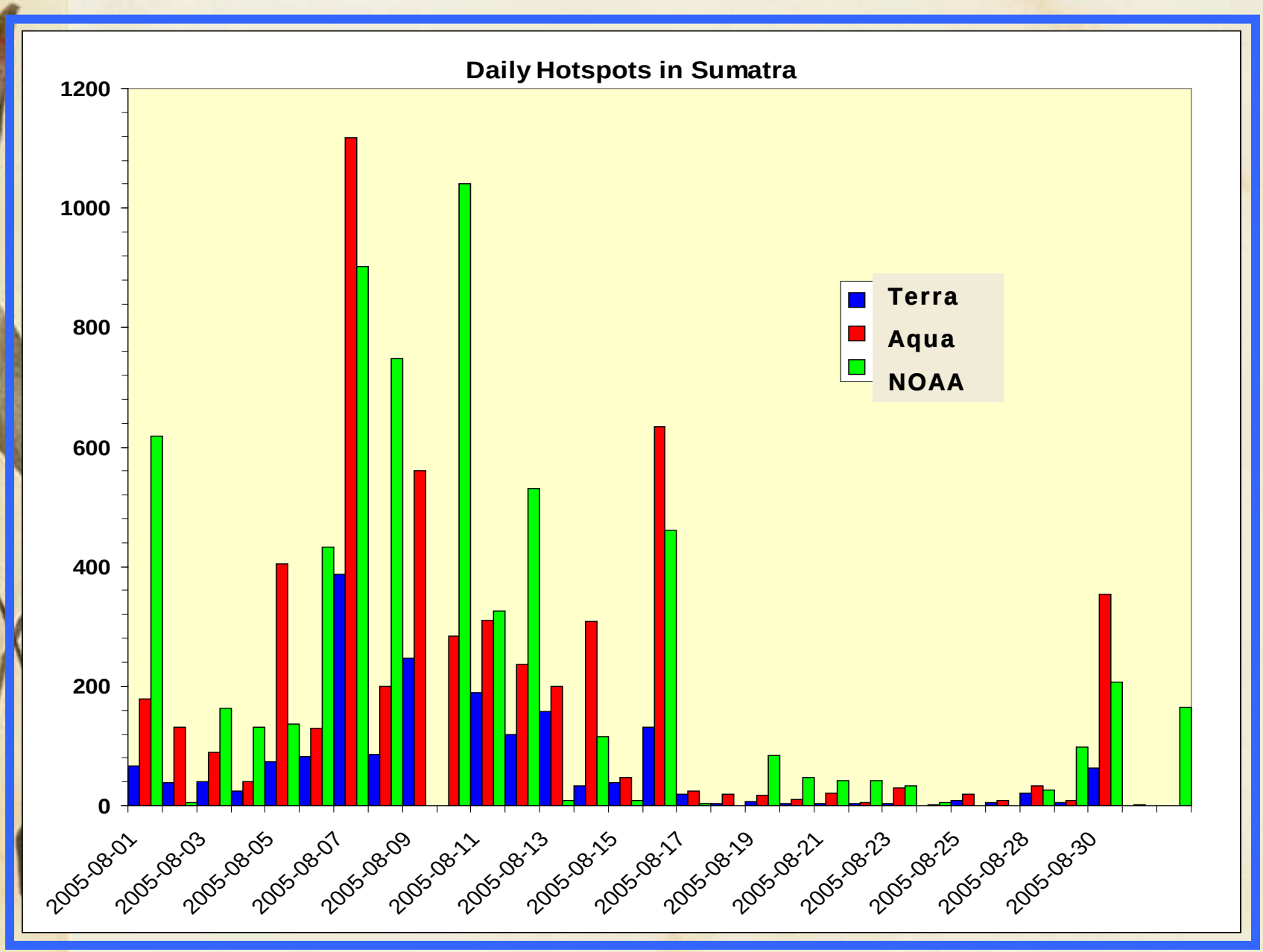
Outline of presentation

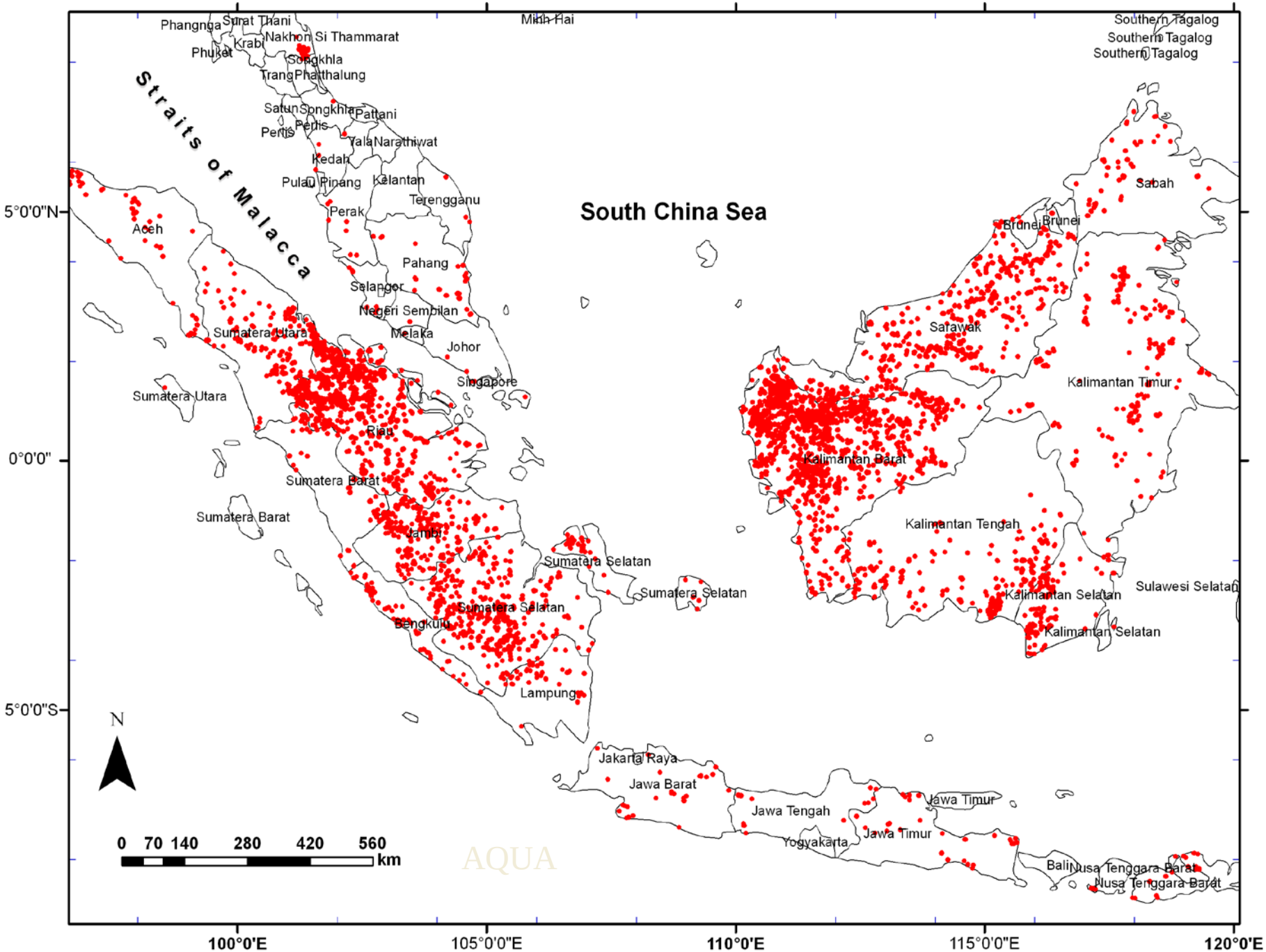
- Satellite data of hotspots
- Spatial analysis distribution of the active fire counts
- Trajectory analysis
- Air quality analysis
- Dispersion analysis

MODIS Hotspots in August 2005

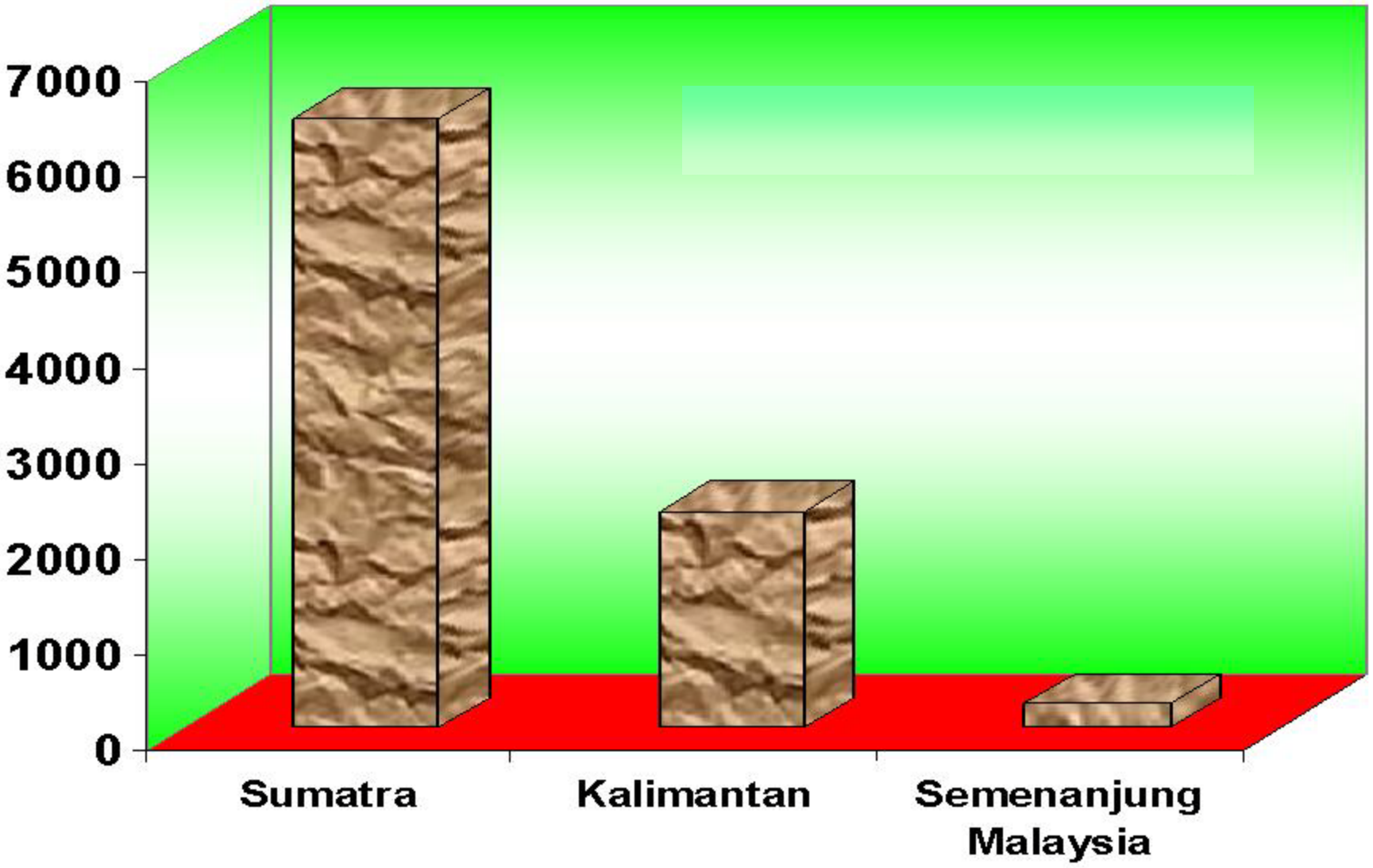



MODIS AQUA
10 Ogos 2005
Smoke plumes
from Sumatra

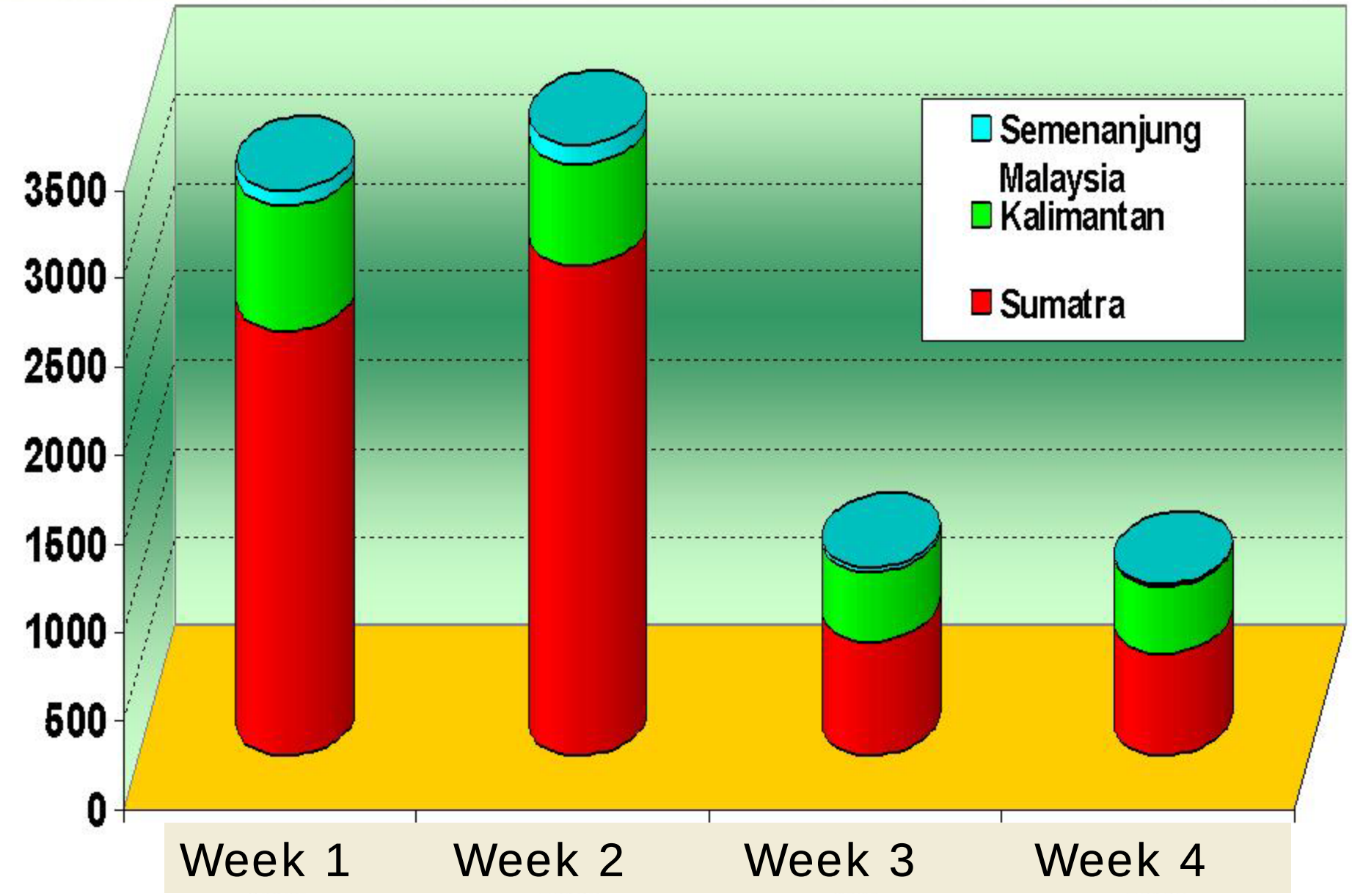

Daily Hotspots in Sumatra
1200
1000
800
600
400
200
0
Terra
Aqua
NOAA
2005-08-01
2005-08-03
2005-08-05
2005-08-07
2005-08-09
2005-08-11
2005-08-13
2005-08-15
2005-08-17
2005-08-19
2005-08-21
2005-08-23
2005-08-25
2005-08-28
2005-08-30

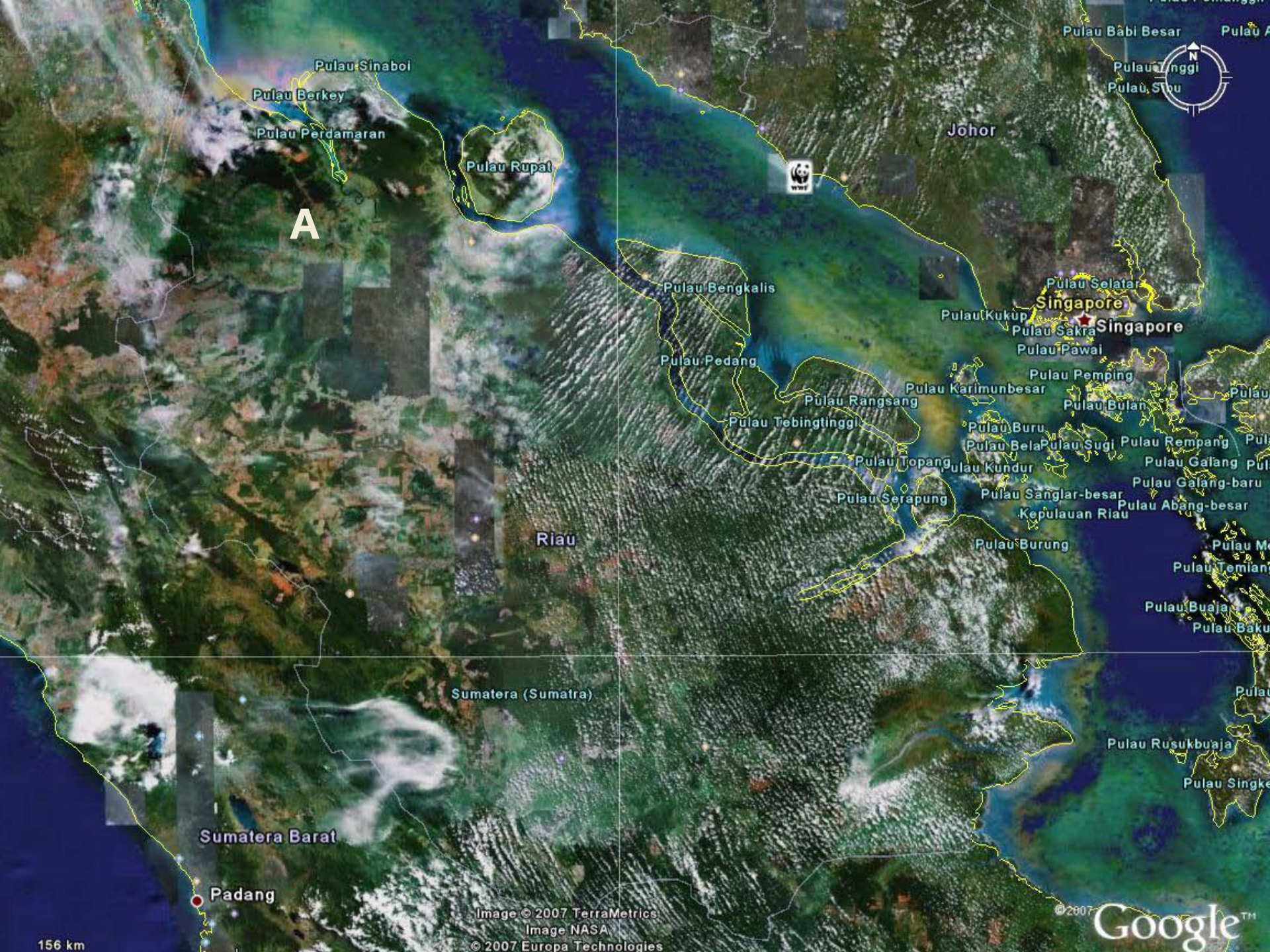

Phangnga
Surat Thani
Nakhon Si Thammarat
Krabi
Phuket
Songkhla
Trang
Phatthalung
Satun
Songkhla
Pattani
Perlis
Perlis
Yala
Narathiwat
Kedah
Pulau Pinang
Kelantan
Terengganu
Perak
Straits of Malacca
Aceh
Pahang
Selangor
Negeri Sembilan
Sumatera Utara
Melaka
Johor
Singapore
Sumatera Utara
Riau
Sumatera Barat
Sumatera Barat
Jambi
Sumatera Selatan
Sumatera Selatan
Sumatera Selatan
Bengkulu
Lampung
South China Sea
Mindanao
Southern Tagalog
Southern Tagalog
Southern Tagalog
Sabah
Brunei
Brunei
Sarawak
Kalimantan Timur
Kalimantan Barat
Kalimantan Tengah
Kalimantan Selatan
Kalimantan Selatan
Sulawesi Selatan
Jakarta Raya
Jawa Barat
Jawa Tengah
Jawa Timur
Yogyakarta
Jawa Timur
Bali
Nusa Tenggara Barat
Nusa Tenggara Barat
5°0'0"N
0°0'0"
5°0'0"S
100°0'E
105°0'0"E
110°0'E
115°0'0"E
120°0'E
N
0 70 140 280 420 560
km
AQUA

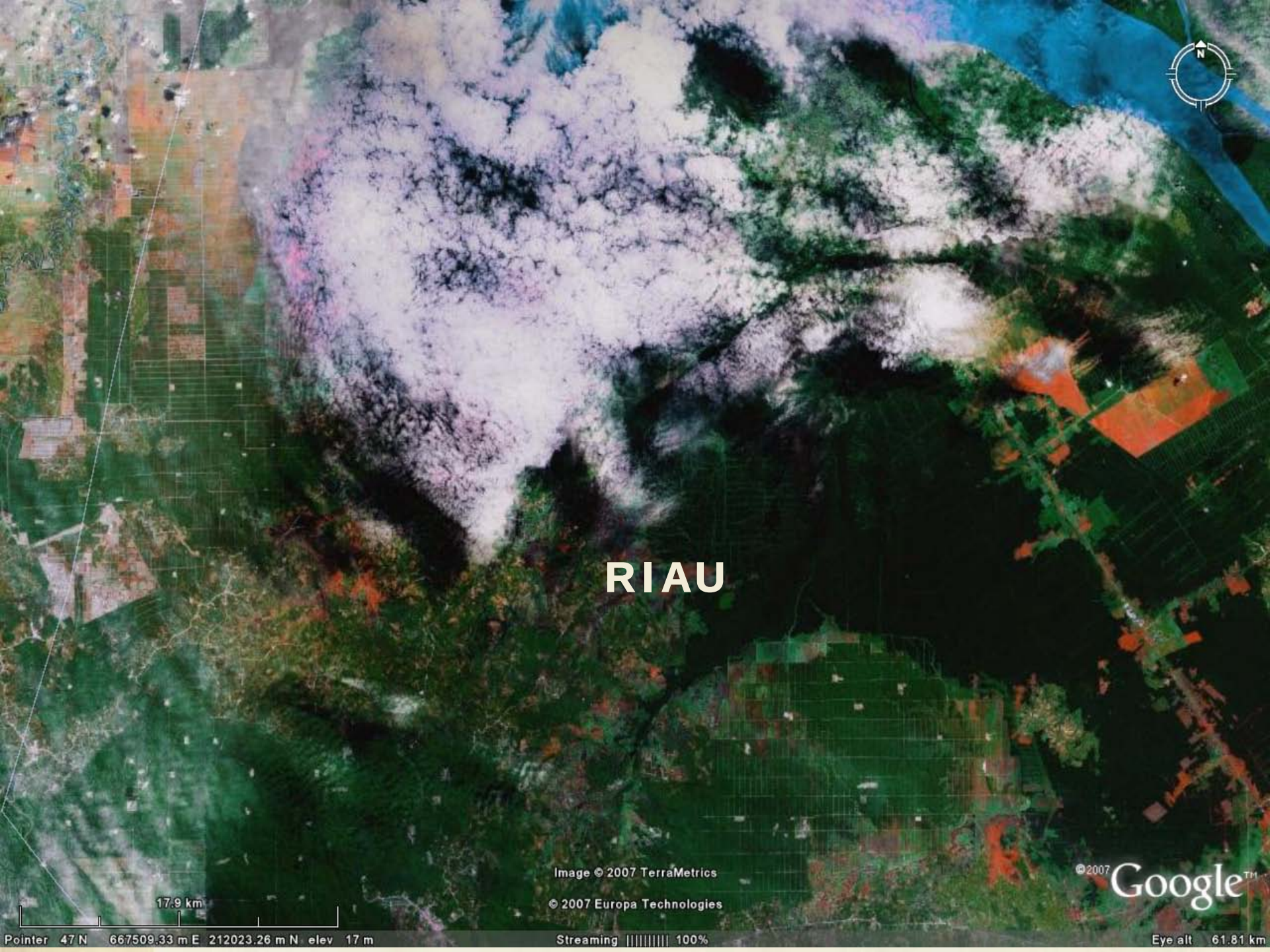
Total Hotspots in August 2005



Total hotspots according to weeks




Pulau Sinaboi
Pulau Berkey
Pulau Perdamaran
Pulau Rupat
A
Pulau Bengkalis
Pulau Pedang
Pulau Rangsang
Pulau Tebingtinggi
Pulau Topang
Pulau Serapung
Riau
Pulau Bâbi Besar
Johor
Pulau Selatar
Singapore
Pulau Kukup
Pulau Sakra
Singapore
Pulau Pawai
Pulau Pemping
Pulau Karimunbesar
Pulau Bulan
Pulau Buru
Pulau Bela
Pulau Sugi
Pulau Kundur
Pulau Rempang
Pulau Galang
Pulau Galang-baru
Pulau Sanglar-besar
Pulau Abang-besar
Kepulauan Riau
Pulau Burung
Pulau Temian
Pulau Buaja
Pulau Baku
Sumatera (Sumatra)
Pulau Rusukbuaja
Pulau Singke
Sumatera Barat
Padang
156 km
Image © 2007 TerraMetrics
Image NASA
© 2007 Europa Technologies
©2007
Google™


RIAU
Image © 2007 TerraMetrics
© 2007 Europa Technologies
©2007 Google™
17.9 km
Pointer 47 N 667509.33 m E 212023.26 m N elev 17 m
Streaming 100%
Eye alt 61.81 km

Spatial Analysis

- There exist tendencies of sustained burning from mid-morning through to late evening as revealed by the NOAA, Terra, and Aqua satellites.

- The small mean near neighbourhood distances that ranged between 3.5 km to 10.6 km during the first week of August 2005 displayed the relationship of an occurrence of a fire closer to its neighbours than would be expected based on chance.

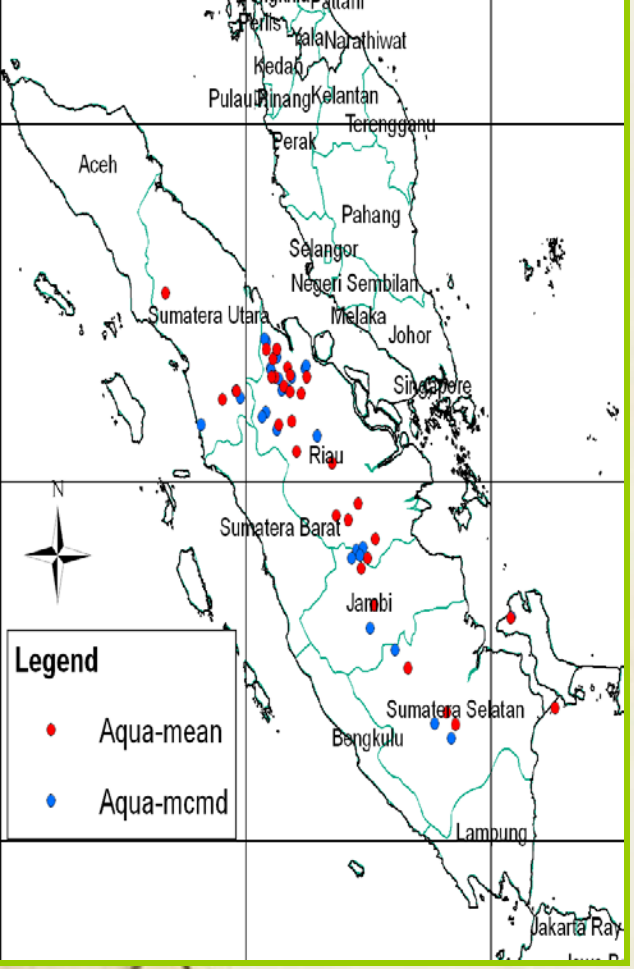
- Intense burning activities during this short period aggravated the transboundary haze conditions, causing the air quality to deteriorate in the neighbouring western coast of Peninsular Malaysia, particularly the states of Selangor and Negeri Sembilan, less than 200 km away from the province of Riau.

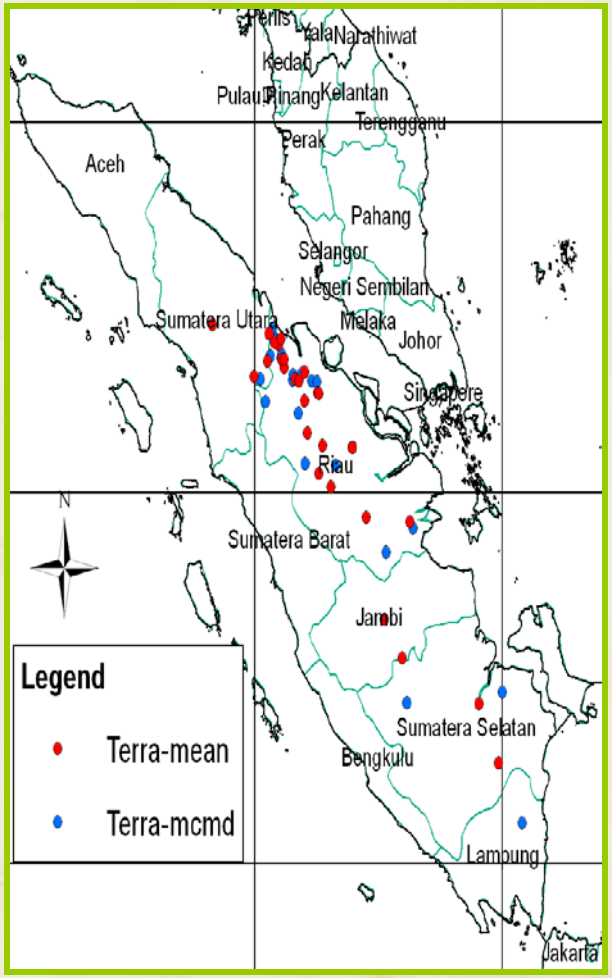
Centrographic analysis

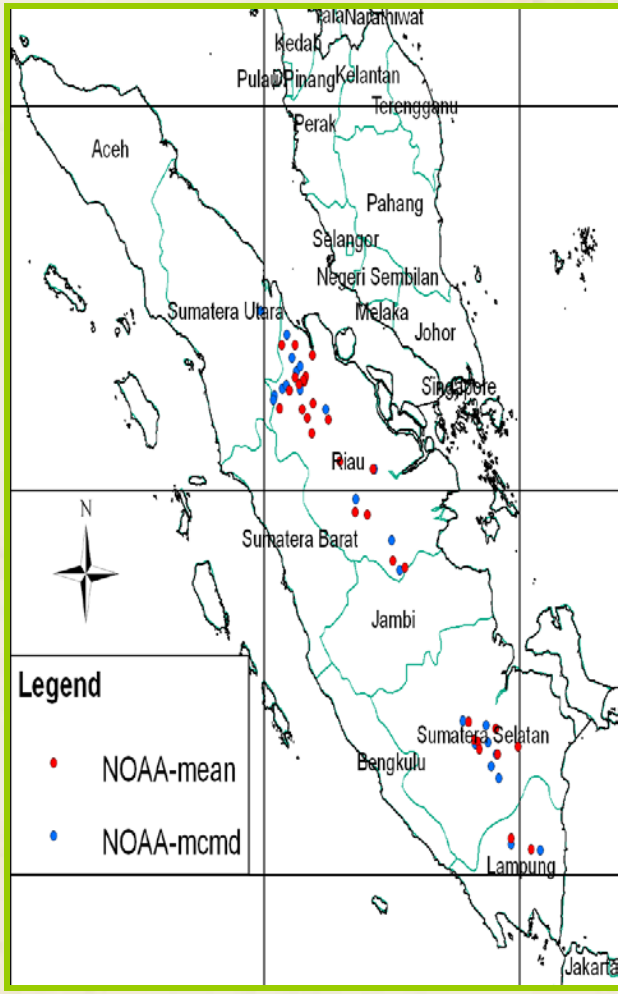
Daily Mean Centre

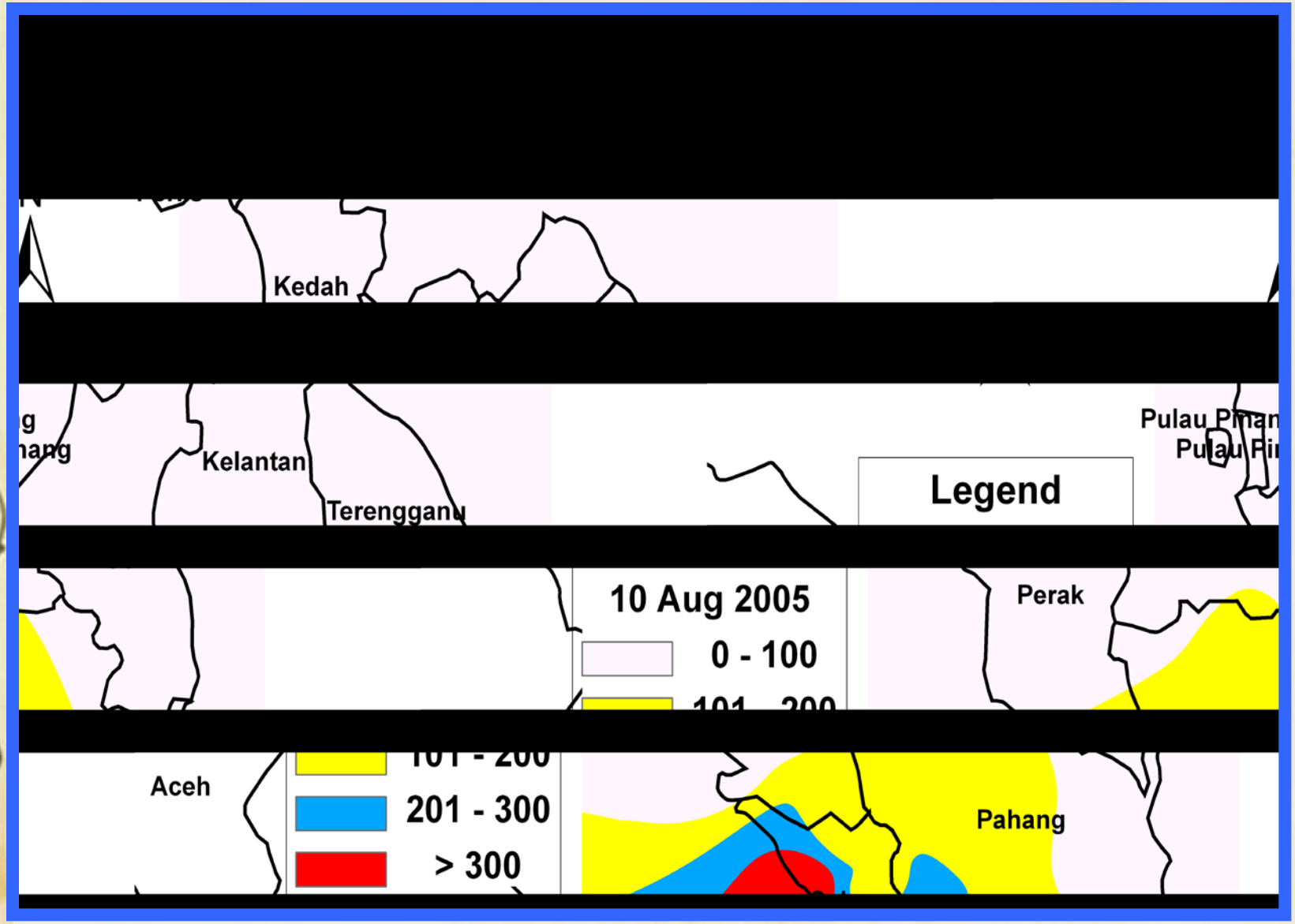
Red: Aqua, Green: Terra,

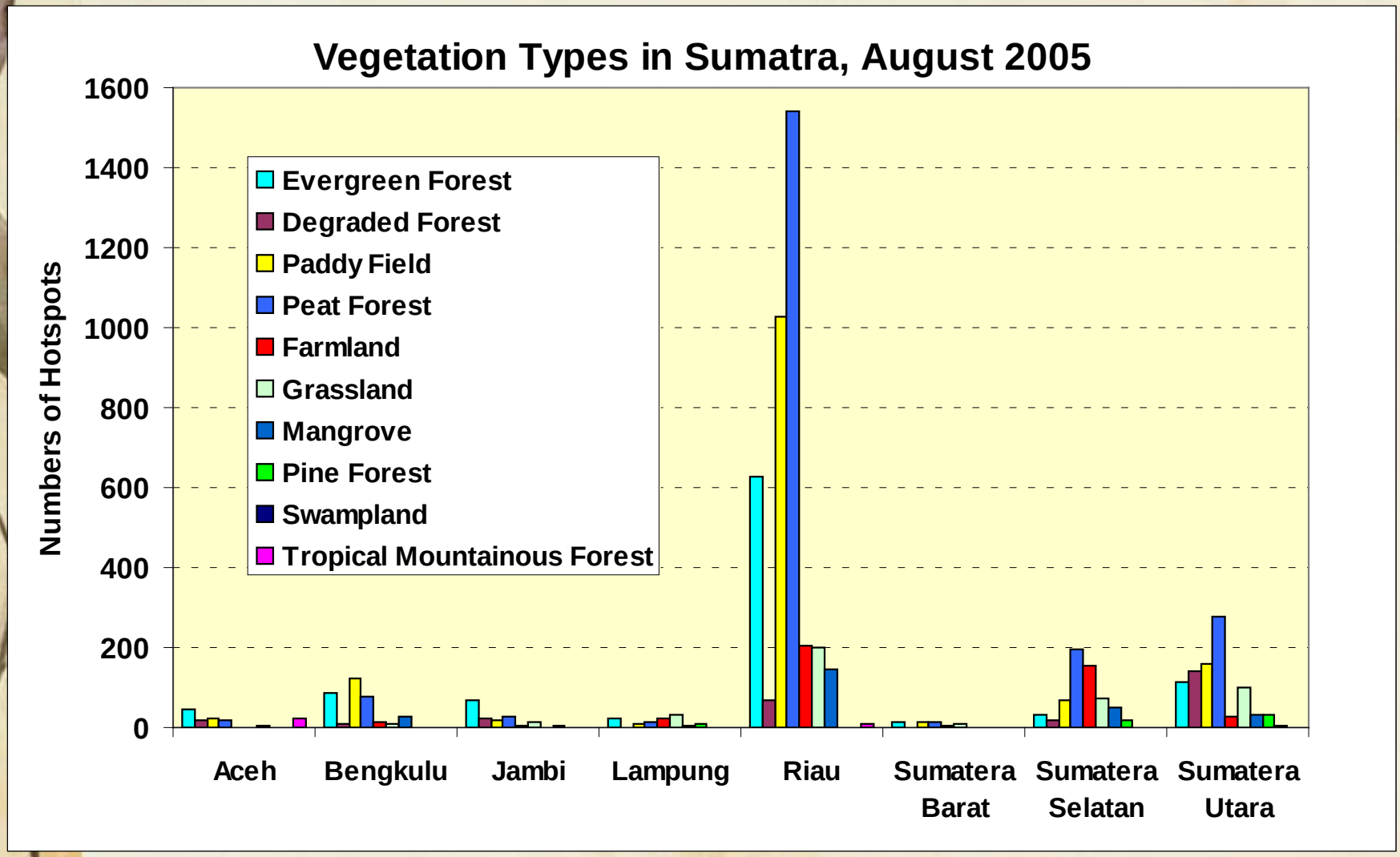
Blue: NOAA


Perlis
Yala
Narathiwat
Kedah
Pulau Pinang
Kelantan
Terengganu
Perak
Aceh
Pahang
Selangor
Negeri Sembilan
Sumatera Utara
Melaka
Johor
Singapore
Riau
Sumatera Barat
Jambi
Sumatera Selatan
Bengkulu
Lampung
Jakarta Ra
N
Legend
Aqua-mean
Aqua-mcmd


Perlis
Yala
Narathiwat
Kedah
Pulau Pinang
Kelantan
Terengganu
Perak
Aceh
Pahang
Selangor
Negeri Sembilan
Sumatera Utara
Melaka
Johor
Singapore
Riau
Sumatera Barat
Jambi
Sumatera Selatan
Bengkulu
Lampung
Jakarta
N
Legend
Terra-mean
Terra-mcmd


Yala
Narathiwat
Kedah
Pulau Pinang
Kelantan
Terengganu
Perak
Aceh
Pahang
Selangor
Negeri Sembilan
Sumatera Utara
Melaka
Johor
Singapore
Riau
Sumatera Barat
Jambi
Sumatera Selatan
Bengkulu
Lampung
Jakarta
N
Legend
NOAA-mean
NOAA-mcmd


Kedah
Kelantan
Terengganu
Pulau Pinan
Legend
10 Aug 2005
0 - 100
101 - 200
201 - 300
> 300
Perak
Aceh
Pahang


Vegetation Types in Sumatra, August 2005
Numbers of Hotspots
1600
1400
1200
1000
800
600
400
200
0
Evergreen Forest
Degraded Forest
Paddy Field
Peat Forest
Farmland
Grassland
Mangrove
Pine Forest
Swampland
Tropical Mountainous Forest
Aceh
Bengkulu
Jambi
Lampung
Riau
Sumatera Barat
Sumatera Selatan
Sumatera Utara

Emissions Analysis

- Biomass burning emissions in Sumatera released a significant source of greenhouse gas such as carbon dioxide (CO_2) and methane, as well as ozone precursors such as non-methane hydrocarbons and nitrogen dioxides (NOx).

- Total emissions of methane, CO, CO_2, NOx, particulate matters and a suite of other gases from biomass burning were emitted from forests, degraded forests, peat land areas and agricultural waste burning.

- The combination of greenhouse gases, smoke particulates and hazardous gases in the transboundary haze is of concern especially to the neighbouring countries that are directly affected due to their close proximity to the source of the burning.

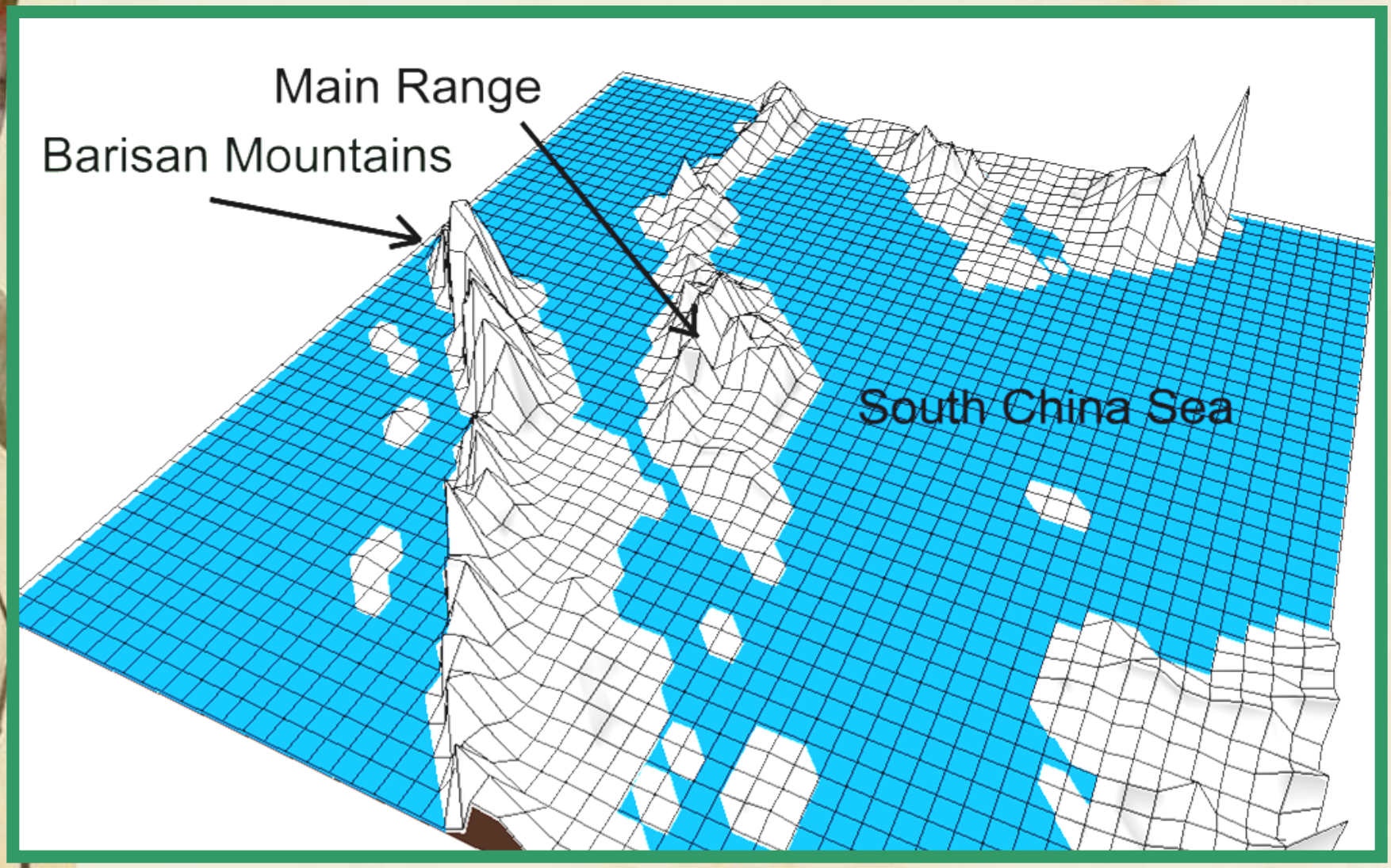
Estimates of pollutants from Sumatera during August 2005

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

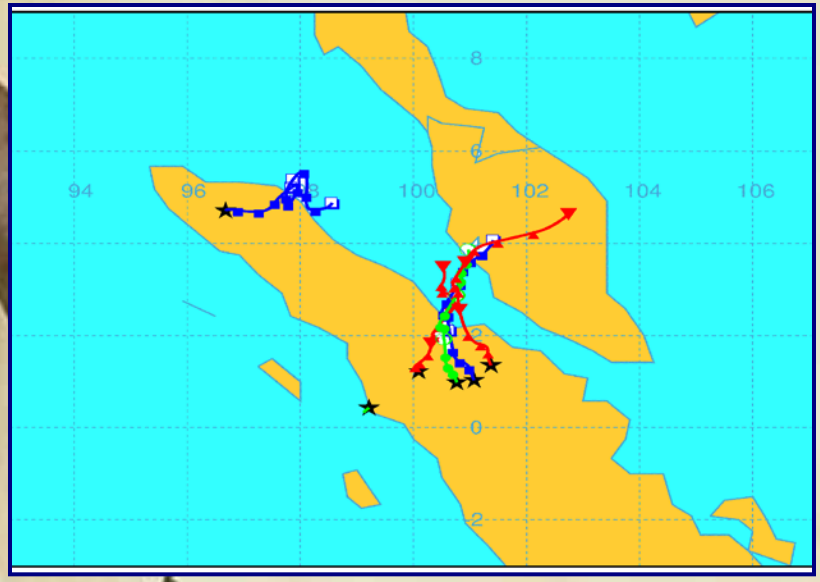
Trajectory Analysis

- The topographical setting of the landform that encompasses the Sumatera Island and Peninsular Malaysia is one of the factors that disfavour efficient dispersion and diffusion of pollutants during the haze episodes.

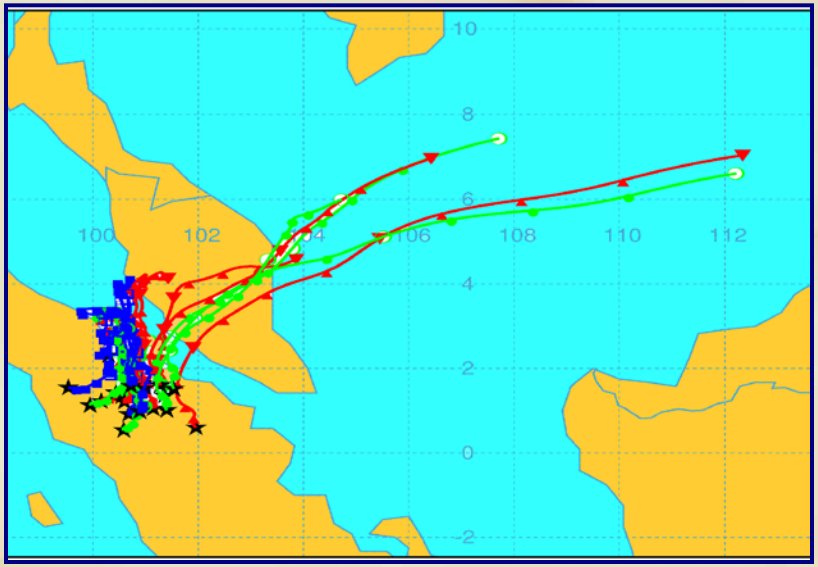
- The air trajectories showed evidence that the air was near-stagnant during the first two weeks of the month of August 2005.


Main Range
Barisan Mountains
South China Sea

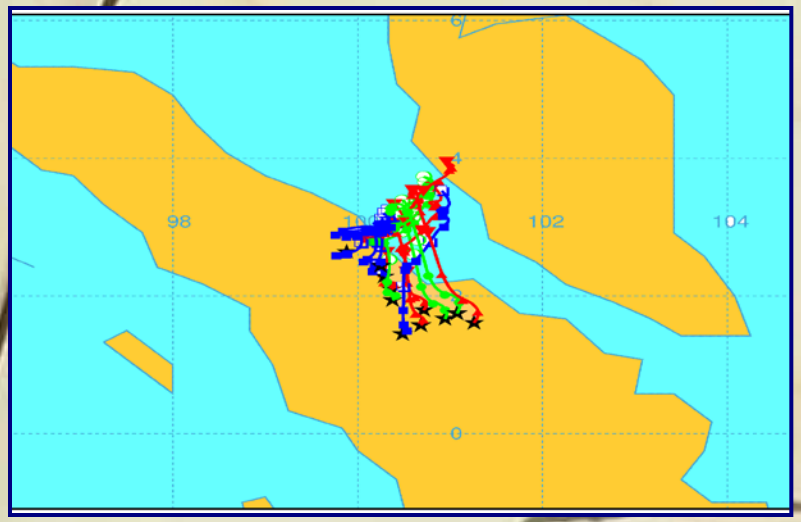
6 August 2005



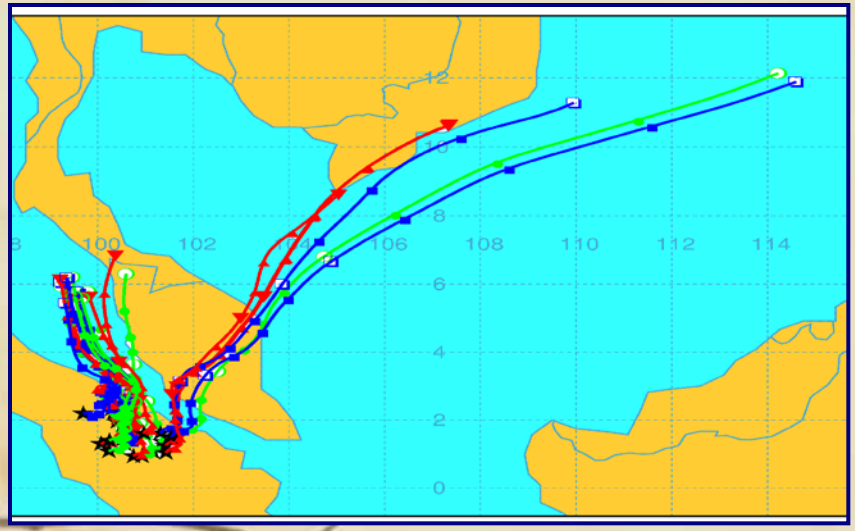
7 August 2005



8 August 2005



10 August 2005



Trajectory Analysis from 8 to 11 August 2005

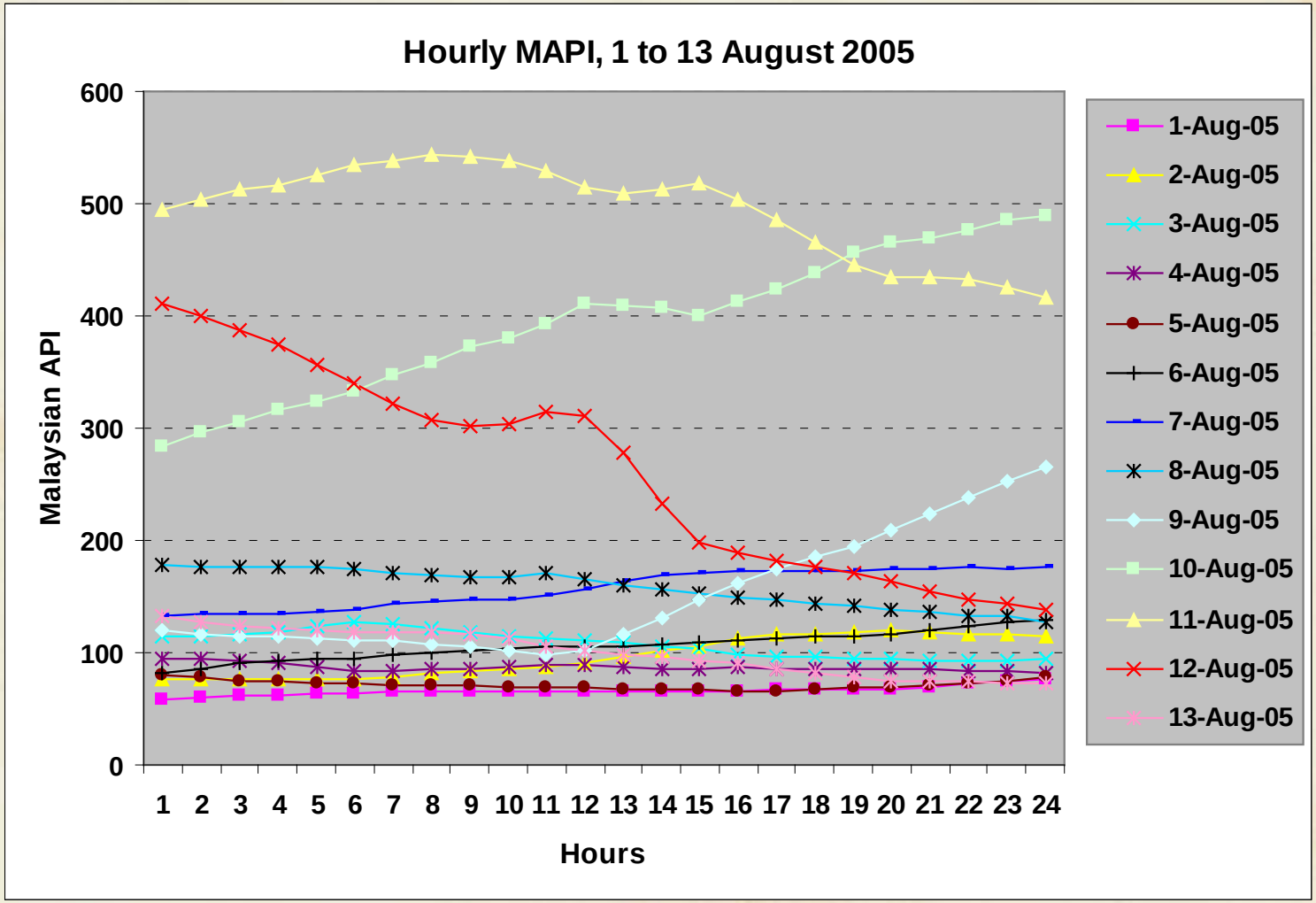
EOC
EARTH OBSERVATION CENTER
UNIVERSITI KEBANGSAAN MALAYSIA

AIR QUALITY ANALYSIS

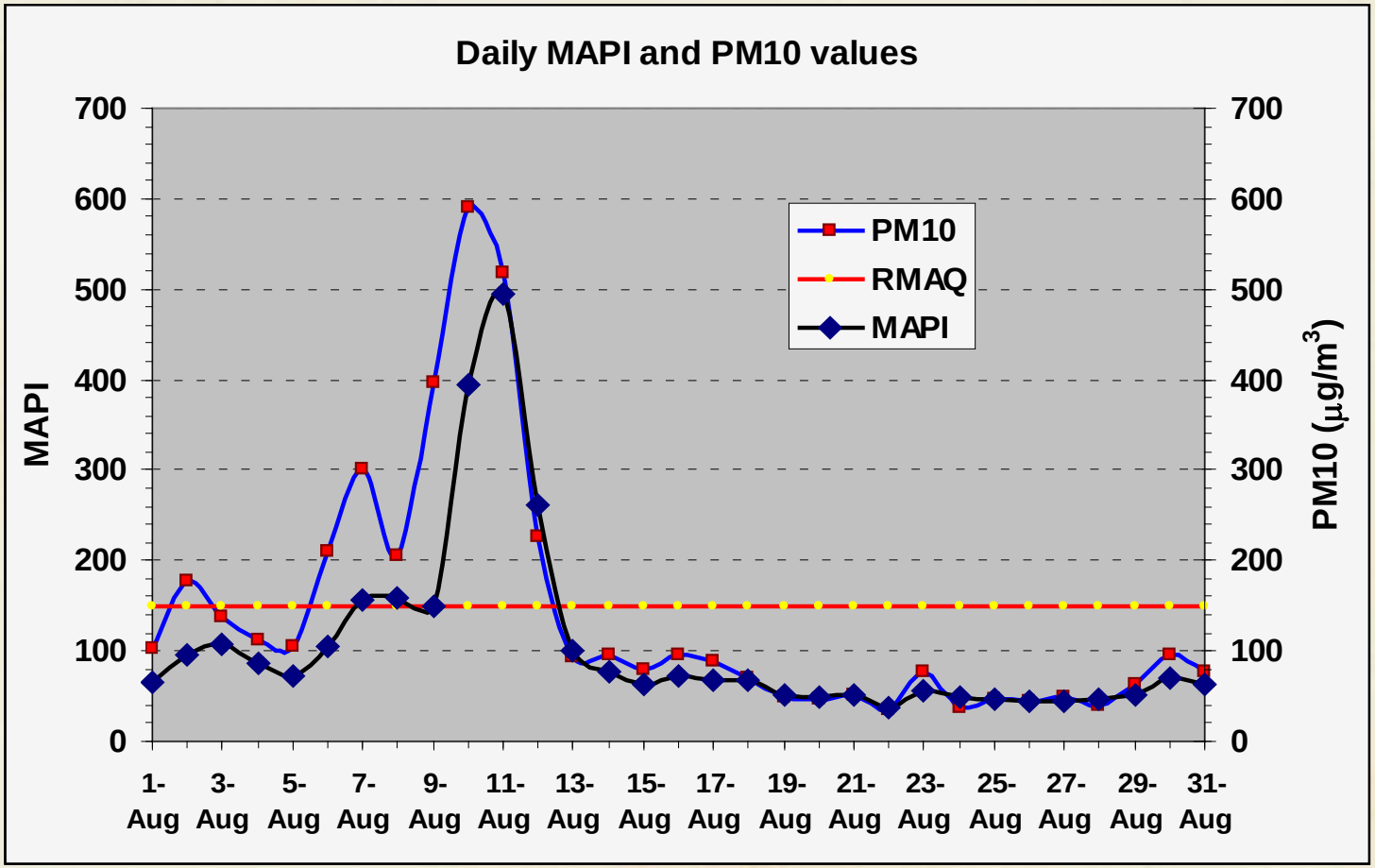
- The Malaysian Air Pollutant Index (MAPI) exceeded the 300 levels during the early morning of 10 August 2005 in the districts of Klang and Kuala Selangor. The air quality then improved when the MAPI levels reached below 300 by midday of 12 August 2005.

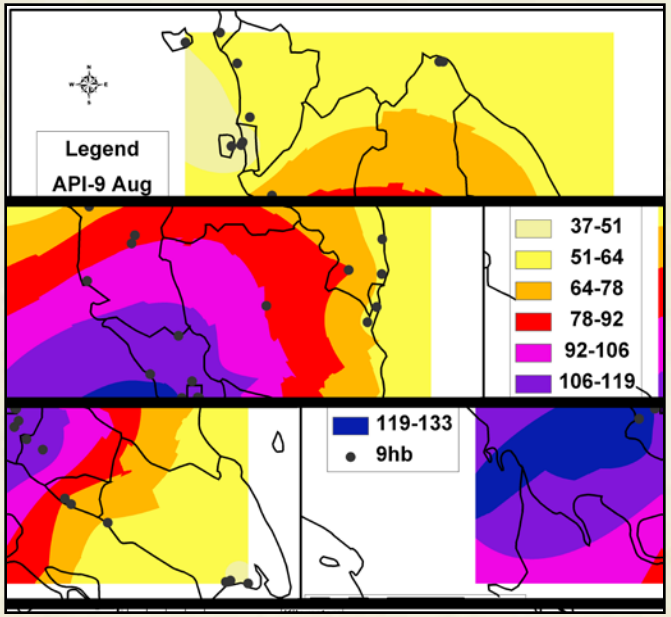
- This period coincided with the intense burning activities concentrated in the provinces of northern Riau and southern Sumatera Utara. The correlation between the hotspots in Riau and the PM10 concentrations recorded in the Raja Zarina School in Klang was moderate at 0.7.

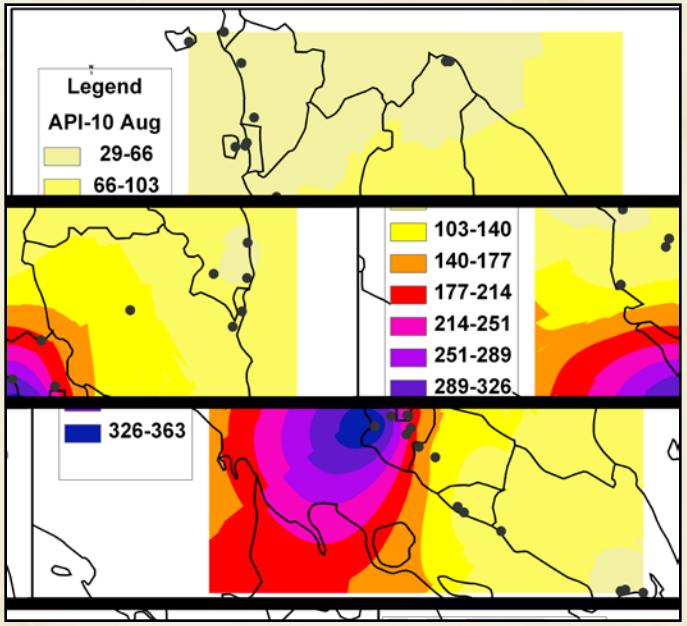
The MAPI

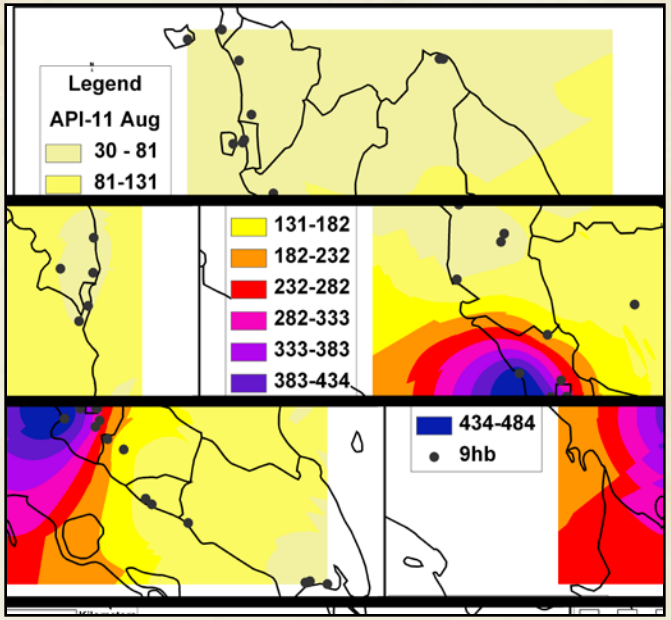

Hourly MAPI, 1 to 13 August 2005
Malaysian API
600
500
400
300
200
100
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Hours
1-Aug-05
2-Aug-05
3-Aug-05
4-Aug-05
5-Aug-05
6-Aug-05
7-Aug-05
8-Aug-05
9-Aug-05
10-Aug-05
11-Aug-05
12-Aug-05
13-Aug-05

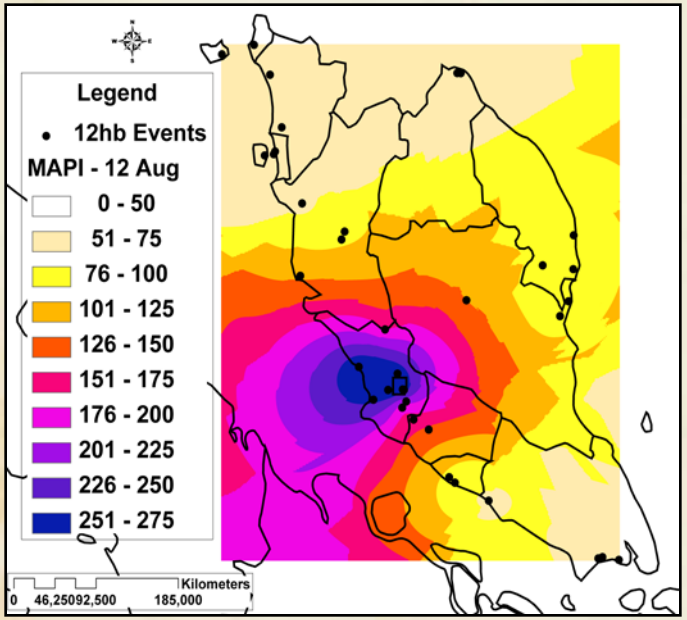
Daily MAPI and PM_{10} concentrations

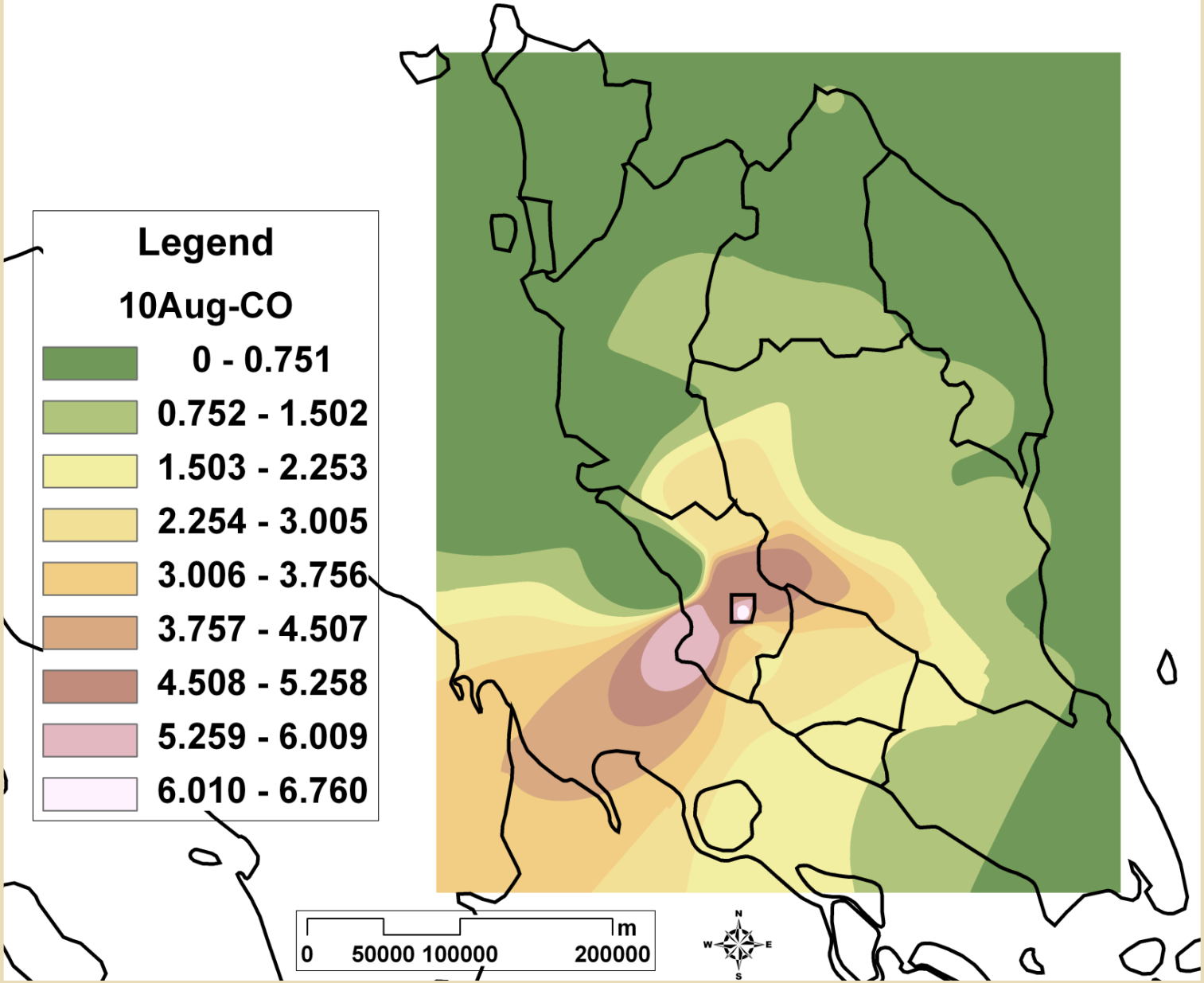



Legend
API-9 Aug
37-51
51-64
64-78
78-92
92-106
106-119
119-133
9hb


Legend
API-10 Aug
29-66
66-103
103-140
140-177
177-214
214-251
251-289
289-326
326-363


Legend
API-11 Aug
30 - 81
81-131
131-182
182-232
232-282
282-333
333-383
383-434
434-484
9hb


Legend
12hb Events
MAPI - 12 Aug
0 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 175
176 - 200
201 - 225
226 - 250
251 - 275
Kilometers
0 46,25092,500 185,000


Legend
10Aug-CO
0 - 0.751
0.752 - 1.502
1.503 - 2.253
2.254 - 3.005
3.006 - 3.756
3.757 - 4.507
4.508 - 5.258
5.259 - 6.009
6.010 - 6.760
0
50000
100000
200000
m
N
W
E
S

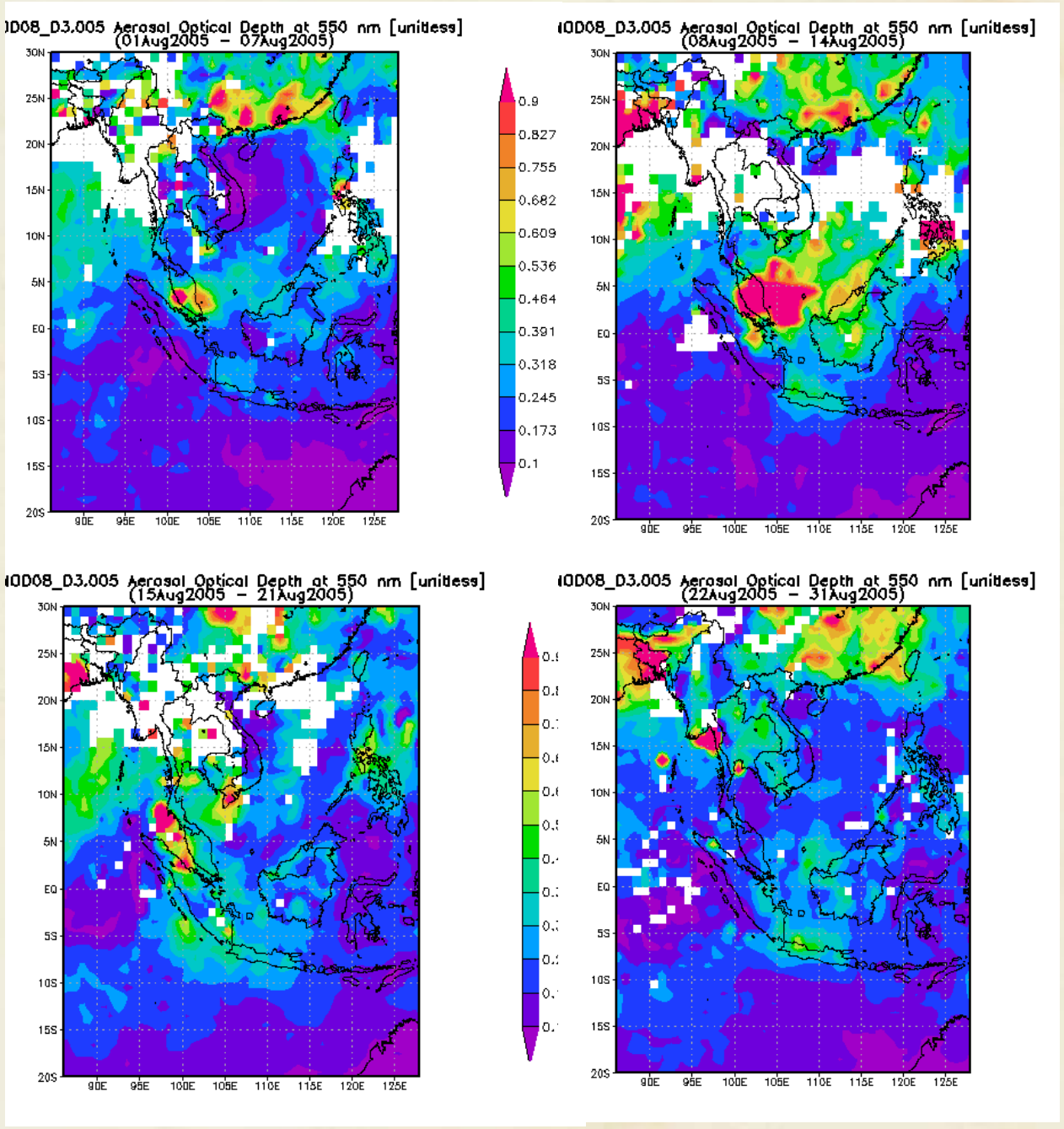
Dispersion Analysis

- The transboundary processes from vegetation burning sources from Sumatera two days prior to the haze emergency period declared in the districts of Klang and Kuala Selangor were successfully simulated in this study.
- Most of the plumes from Riau were directed northeastward by the weak southwesterly monsoon towards the neighbouring states of Selangor.

- Smoke plumes that were generated within 24 hours after emission was by and large a local phenomenon, when the plumes were confined near the locations of burning in Riau.

- Within 36 to 48 hours, the plumes were generally found over the western coast of Peninsular Malaysia, particularly affecting the southwestern half of the Peninsular Malaysia such as Selangor, Pahang, Negeri Sembilan and Melaka.

The dispersion analysis, which shows the merging of several puffs after a period of 48 hours from integration on 11 August 2005. AQUA.


MOD08_D3.005 Aerosol Optical Depth at 550 nm [unitless]
(01Aug2005 - 07Aug2005)
MOD08_D3.005 Aerosol Optical Depth at 550 nm [unitless]
(08Aug2005 - 14Aug2005)
MOD08_D3.005 Aerosol Optical Depth at 550 nm [unitless]
(15Aug2005 - 21Aug2005)
MOD08_D3.005 Aerosol Optical Depth at 550 nm [unitless]
(22Aug2005 - 31Aug2005)
0.9
0.827
0.755
0.682
0.609
0.536
0.464
0.391
0.318
0.245
0.173
0.1
30N
25N
20N
15N
10N
5N
EQ
5S
10S
15S
20S
90E
95E
100E
105E
110E
115E
120E
125E

CONCLUSION

- The recurrence of the large-scale biogenic fires and the resulted transboundary haze is one of the most serious environmental issues facing Southeast Asia today.

- Fires are deliberately set alight to clear forests and land, particularly in Indonesia 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 it brings to the population of the neighbouring countries.

Terima Kasih
Thank You