CHARACTERISTICS OF INORGANIC IONS OF $PM_{2.5}$ IN PENINSULAR MALAYSIA

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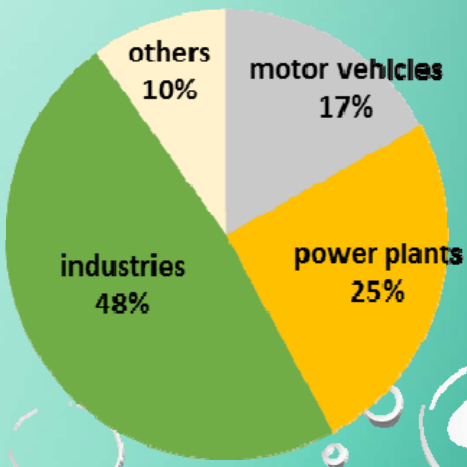
INTRODUCTION

- IN SOUTHEAST ASIA, PARTICULATE MATTER IS A MAJOR CAUSE OF AIR POLLUTION.
- MALAYSIA IS ONE OF THE COUNTRIES HAVING PM POLLUTION FROM MANY SOURCES (LOCAL URBAN AND TRANSBOUNDARY SOURCES).

- TOTAL PM EMISSIONS IN MALAYSIA WERE 2,700 TON
  - (SOURCE CONTRIBUTION: MOTOR VEHICLES = 17%, POWER PLANTS = 25%, INDUSTRIES = 48%) IN 2010 [DEPARTMENT OF ENVIRONMENT, 2011]



SAMPLING OF $PM_{2.5}$ DATA

- THE SAMPLING SITE WAS UNIVERSITI KEBANGSAAN MALAYSIA (UKM) LOCATED IN BANGI, SELANGOR, MALAYSIA.
- PM2.5 AND TSP SAMPLES WERE COLLECTED AT THE ROOF IN UKM.
- LENGTH OF OBSERVATION : 13 – 24 SEPTEMBER 2013

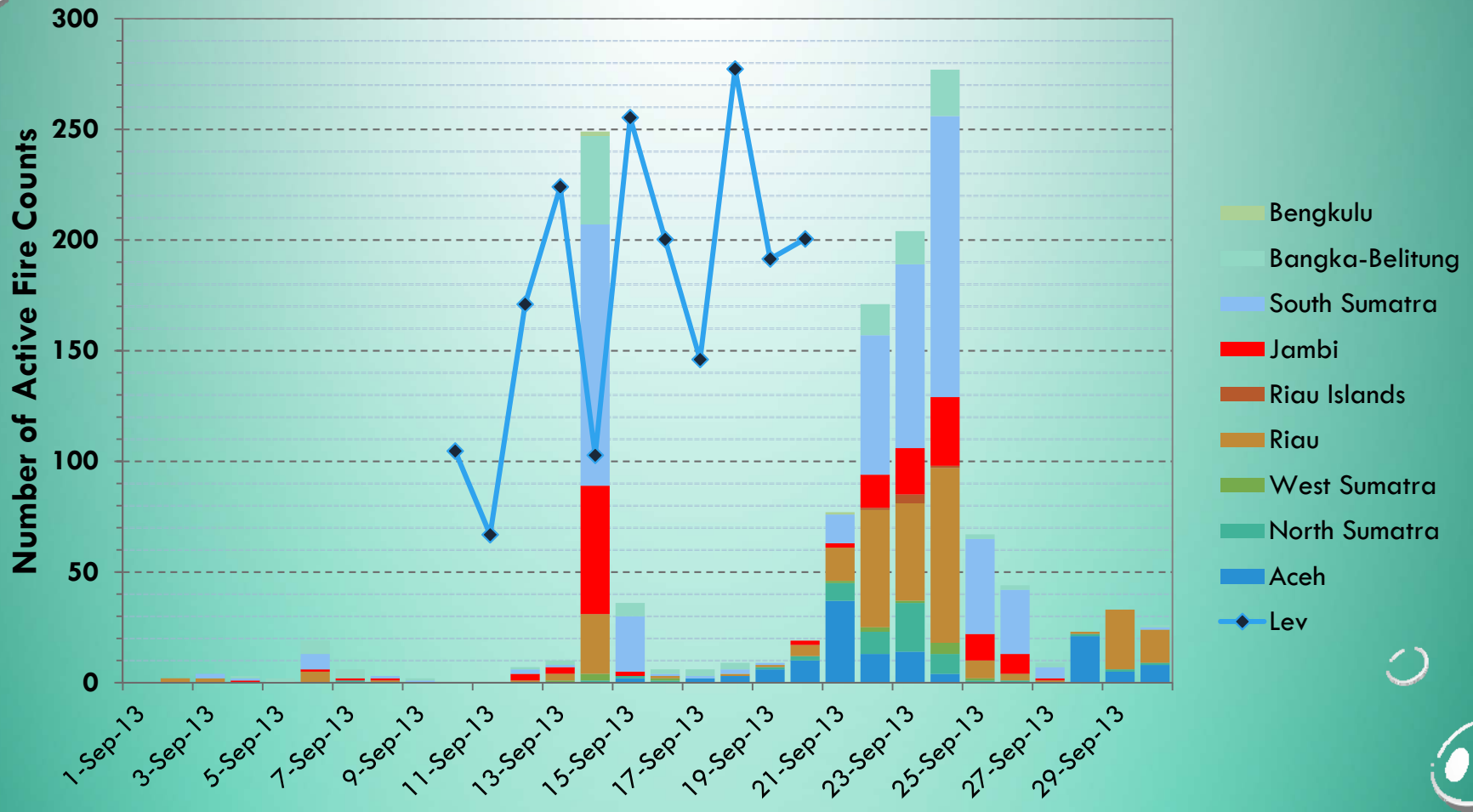
LOCATION OF UKM

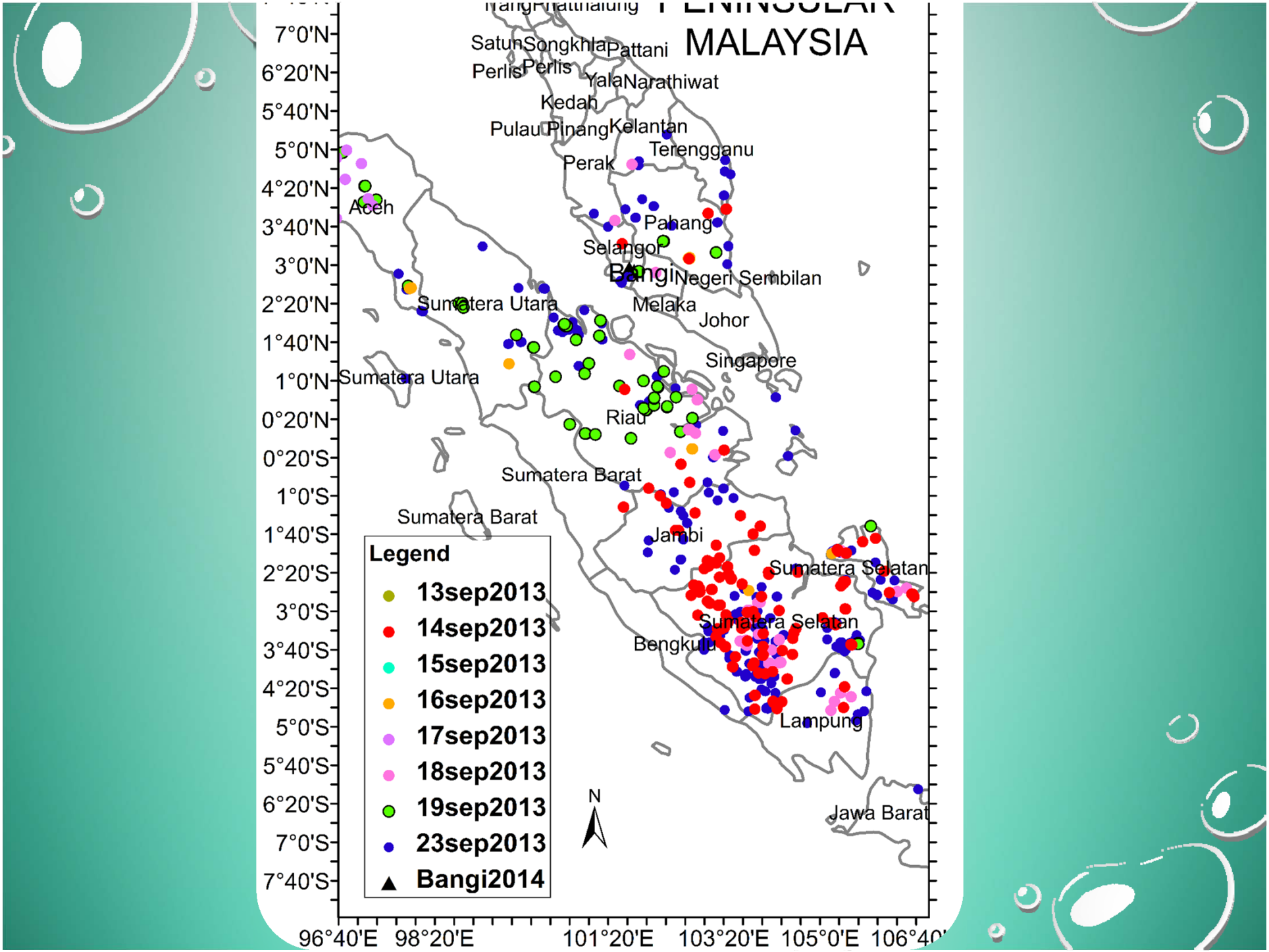

Bangi
Industrial
Estate
UKM
Image © 2015 DigitalGlobe
2147 m

ChemComb model 3500 speciation sampling cartridge, Thermo)

The setting on the Rooftop of the Faculty

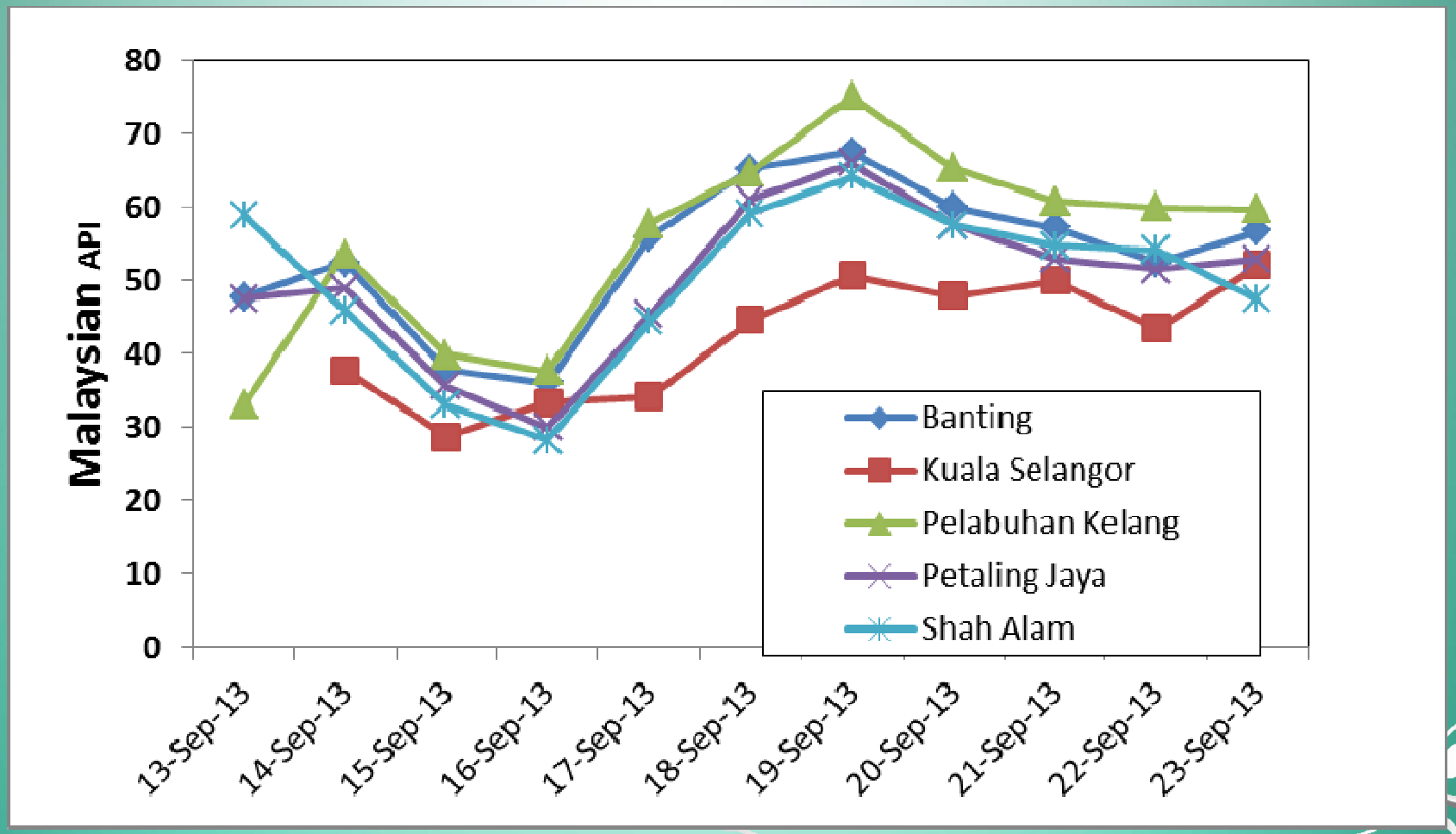
ACTIVE FIRES IN SUMATRA : SEPTEMBER 2013



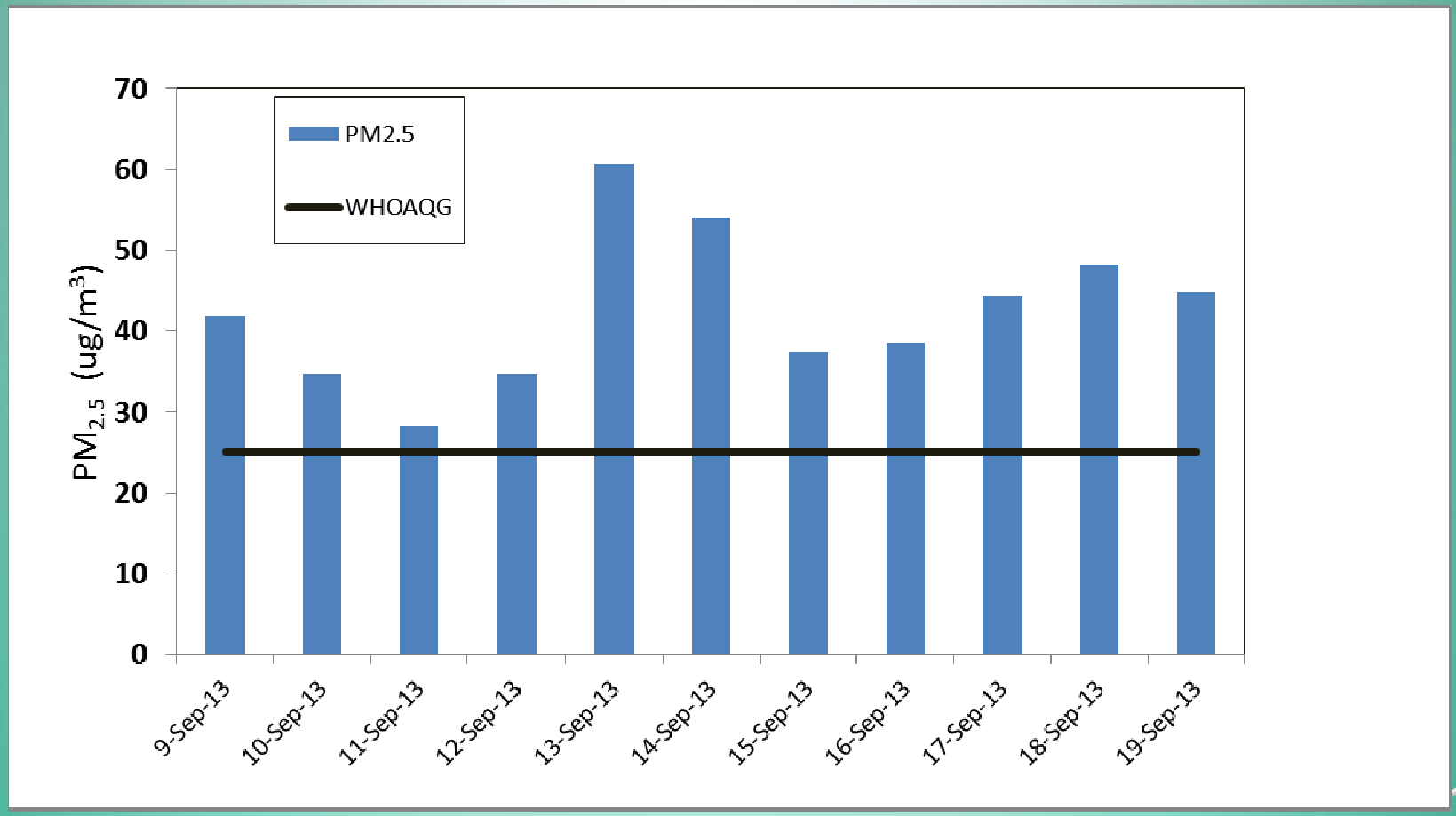

PENINSULAR
MALAYSIA
Satun
Songkhla
Pattani
Perlis
Perlis
Yala
Narathiwat
Kedah
Pulau Pinang
Kelantan
Terengganu
Perak
Aceh
Pahang
Selangor
Bangi
Negeri Sembilan
Sumatera Utara
Melaka
Johor
Singapore
Sumatera Utara
Riau
Sumatera Barat
Sumatera Barat
Jambi
Sumatera Selatan
Sumatera Selatan
Bengkulu
Lampung
Jawa Barat
N
Legend
13sep2013
14sep2013
15sep2013
16sep2013
17sep2013
18sep2013
19sep2013
23sep2013
Bangi2014
7°0'N
6°20'N
5°40'N
5°0'N
4°20'N
3°40'N
3°0'N
2°20'N
1°40'N
1°0'N
0°20'N
0°20'S
1°0'S
1°40'S
2°20'S
3°0'S
3°40'S
4°20'S
5°0'S
5°40'S
6°20'S
7°0'S
7°40'S
96°40'E
98°20'E
101°20'E
103°20'E
105°0'E

DAILY MALAYSIAN API

Daily MAPI < 100, indicates moderate air quality



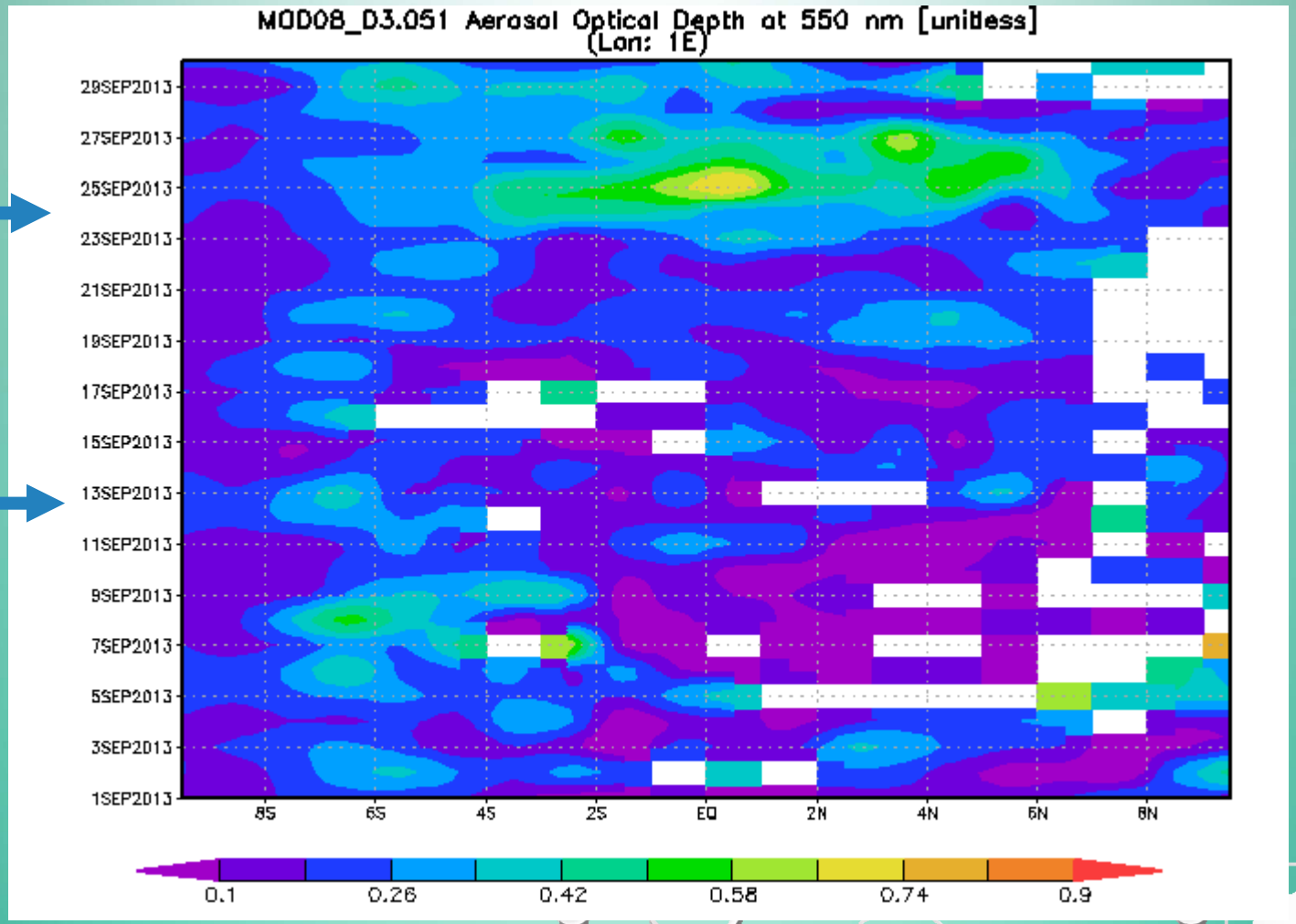
PM 2.5 LEVELS: ABOVE DAILY WHOAQG



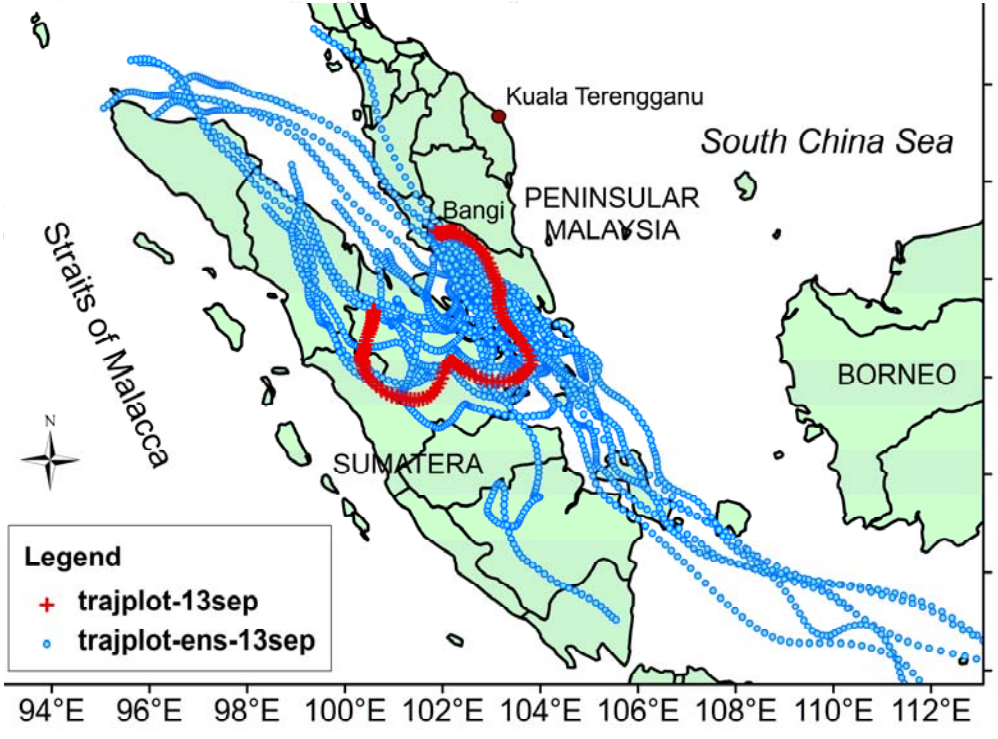
The daily $PM_{2.5}$ mass concentrations during the sampling period was 44.5 ± 8.52 µg m^{-3} at high level compared to the average concentrations in September (2006–2009) had exceeded the national air quality standard of 35 µg m-3 for 24-hour PM2.5 established by the U.S. Environmental Protection Agency.

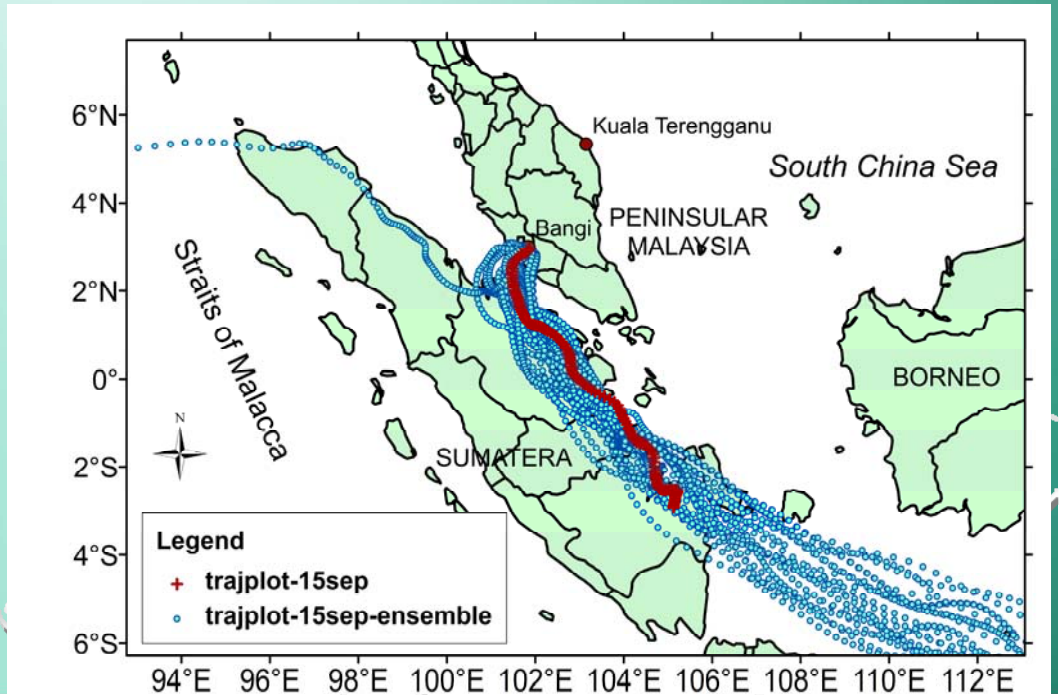
	Range (min–max)	Average
	$PM_{2.5}$ mass [μg m^{-3}]	
$PM_{2.5}$	34.6–59.5	44.5
	Carbonaceous components [weight % of $PM_{2.5}$]	
OC	14.9–40.6	24.4
EC	6.45–13.5	9.41
	Ions [weight % of $PM_{2.5}$]	
Oxalate	7.83–17.2	12.6
Chloride	N.D.–0.0575	–
Nitrate	0.0122–0.251	0.101
Sulfate	7.42–17.8	10.6
Sodium	0.282–1.05	0.620
Ammonium	1.25–5.10	2.44
Potassium	1.01–2.99	1.99

AOD AT 550 NM (AQUA)

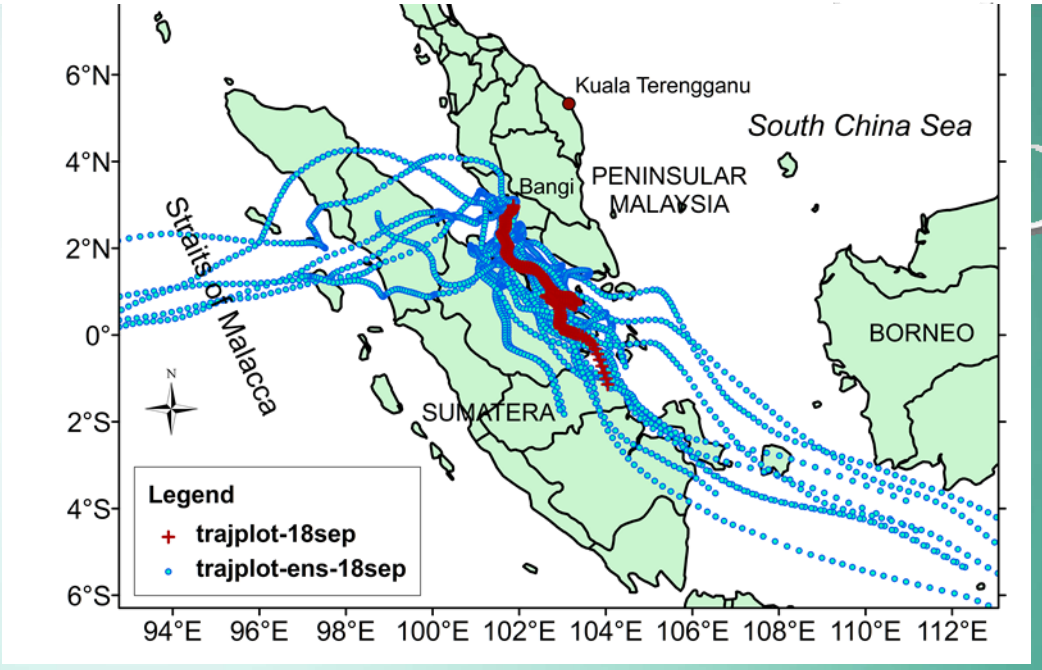


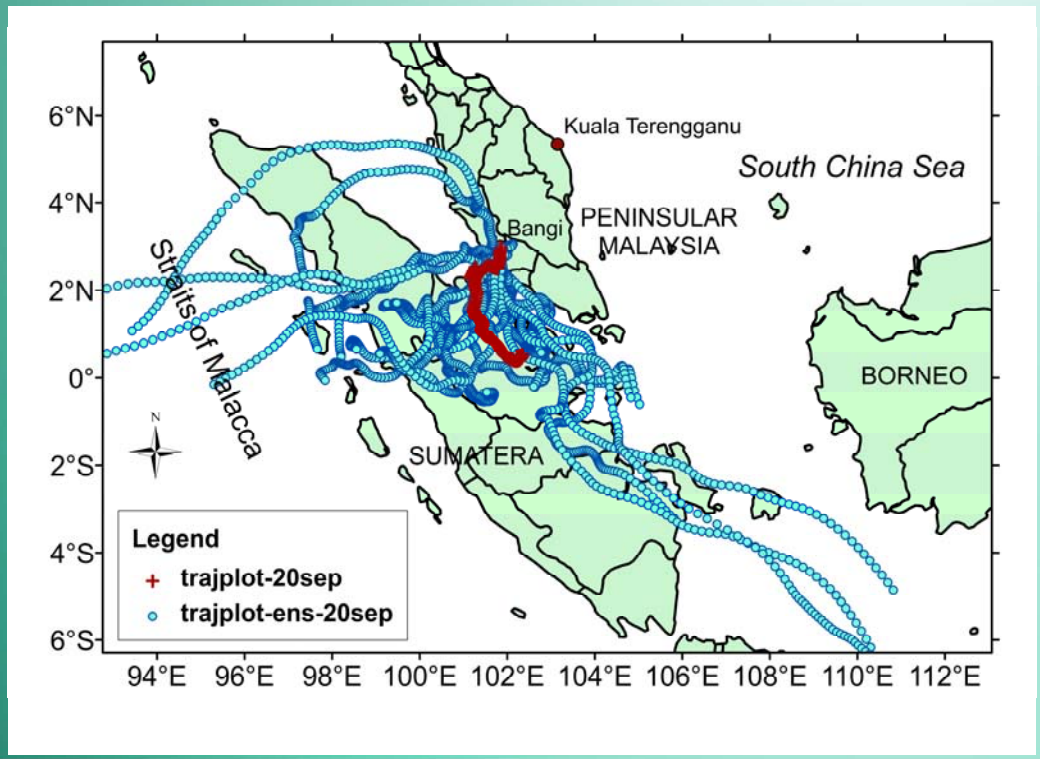
5 DAY BACKWARD TRAJECTORIES 13 SEP & 15 SEP





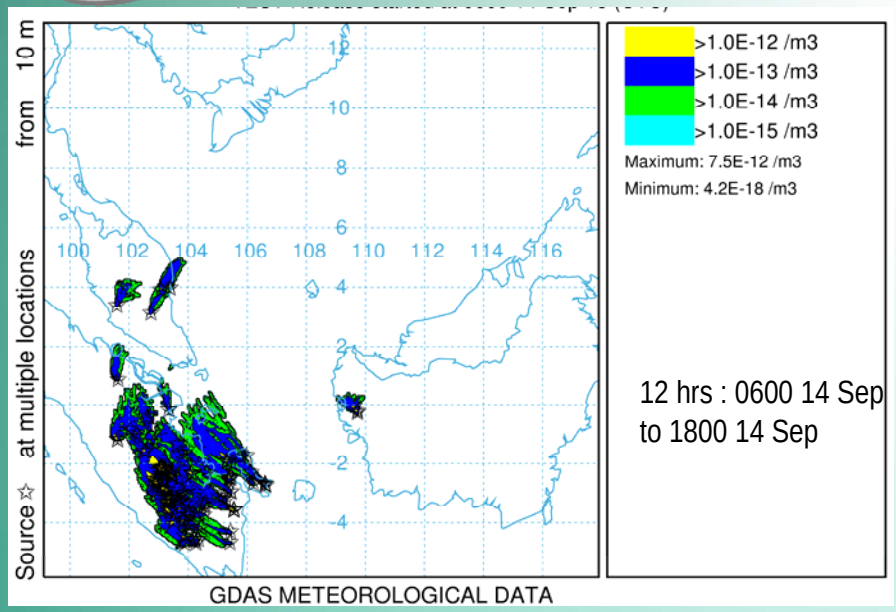
18 SEP & 20 SEP 2013



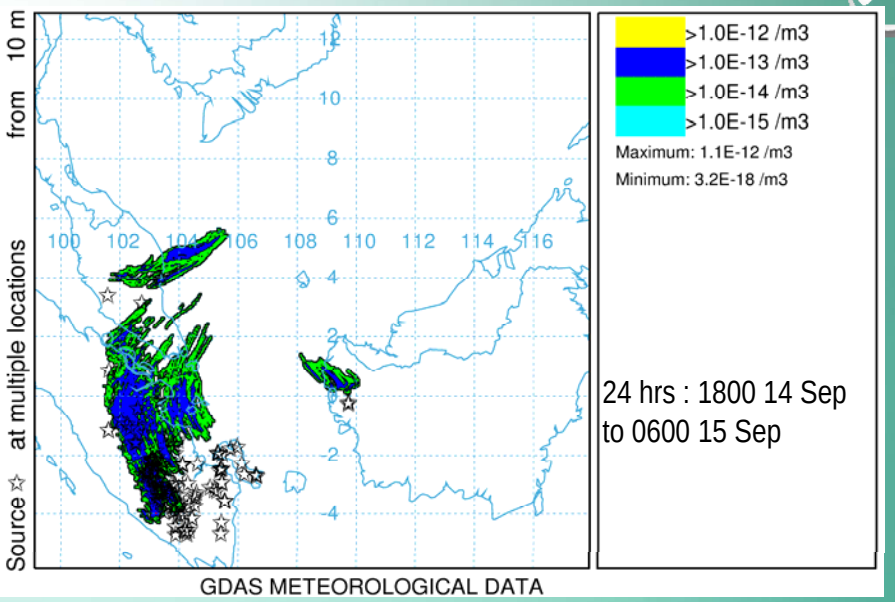


Air particles originate from Sumatra

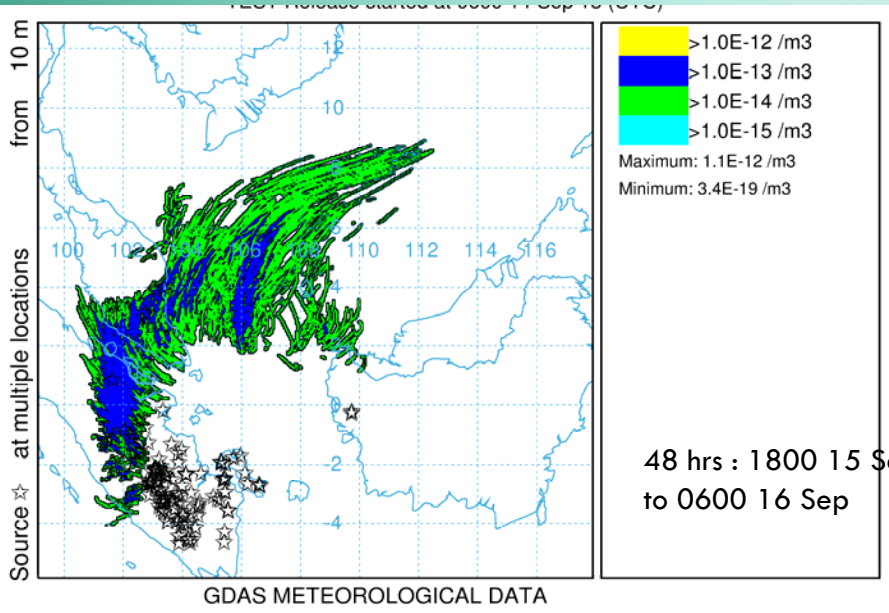
DISPERSION: 14 SEP 2013 (149)



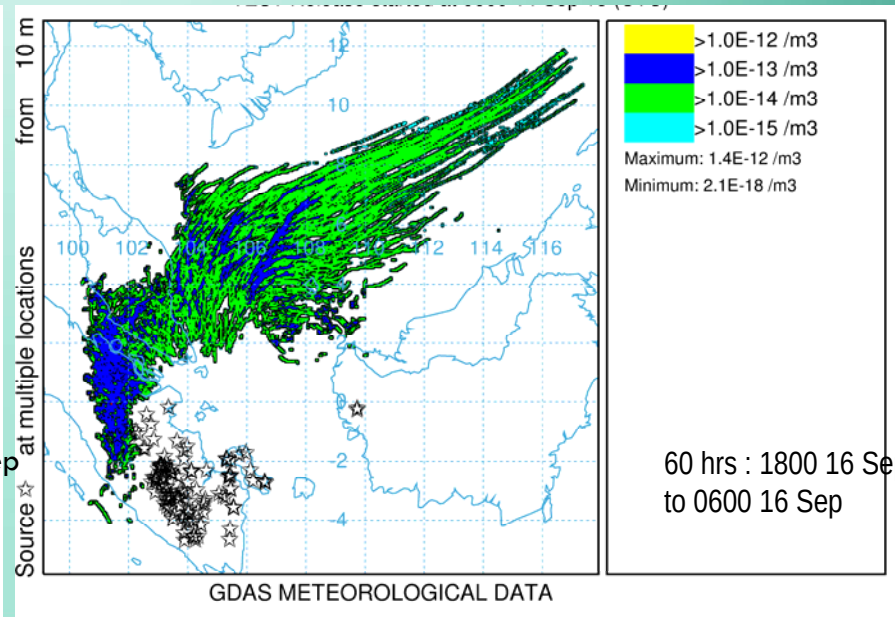
12 hrs : 0600 14 Sep to 1800 14 Sep



24 hrs : 1800 14 Sep to 0600 15 Sep

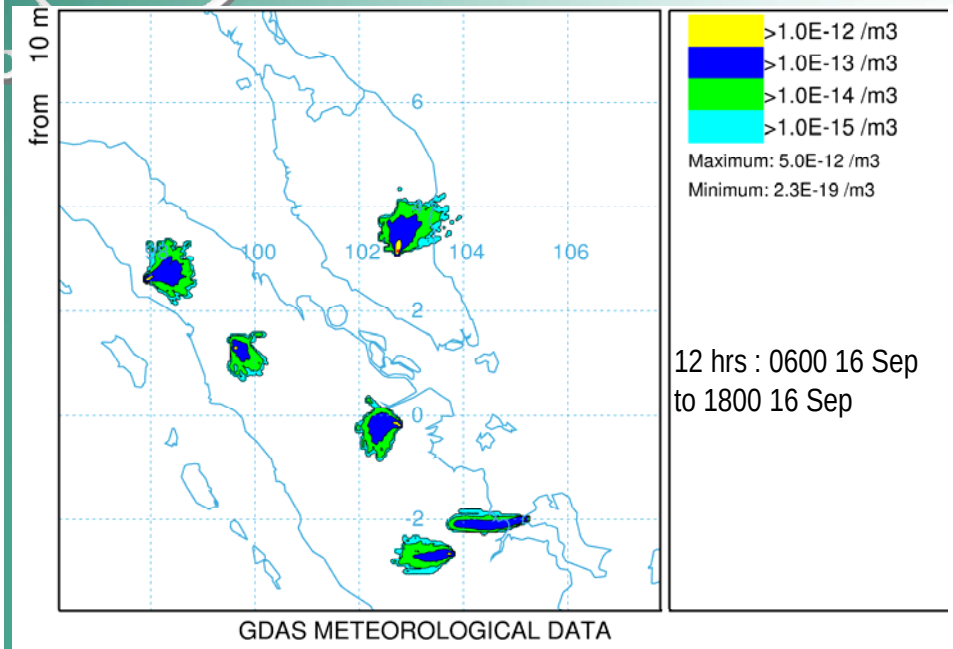


48 hrs : 1800 15 Sep to 0600 16 Sep

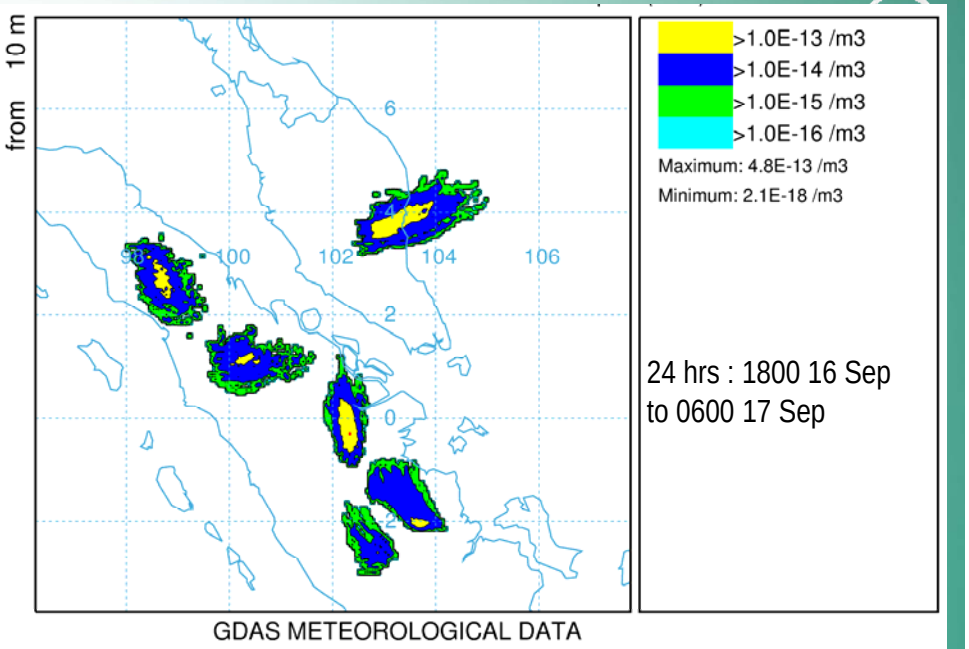


60 hrs : 1800 16 Sep to 0600 16 Sep

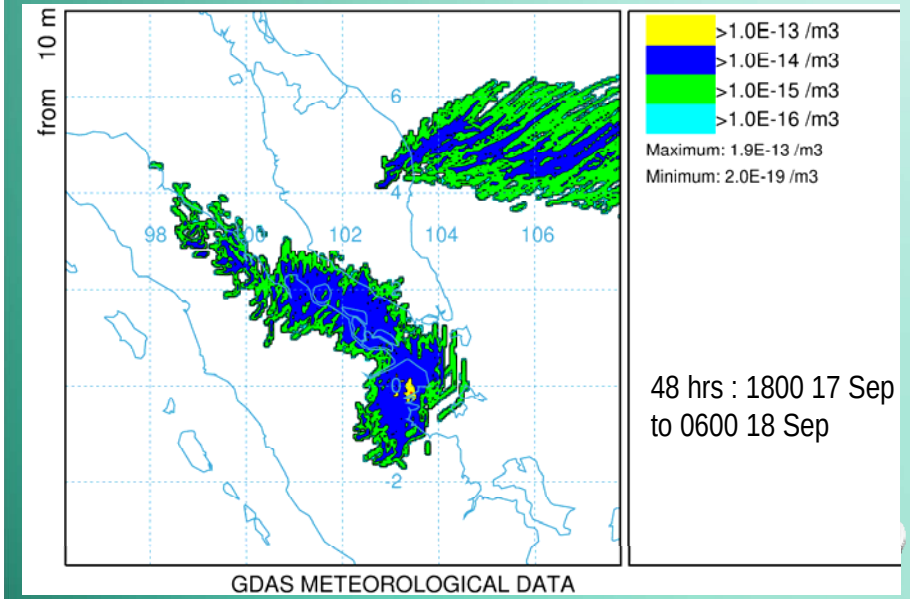
DISPERSION 16 SEP 2013



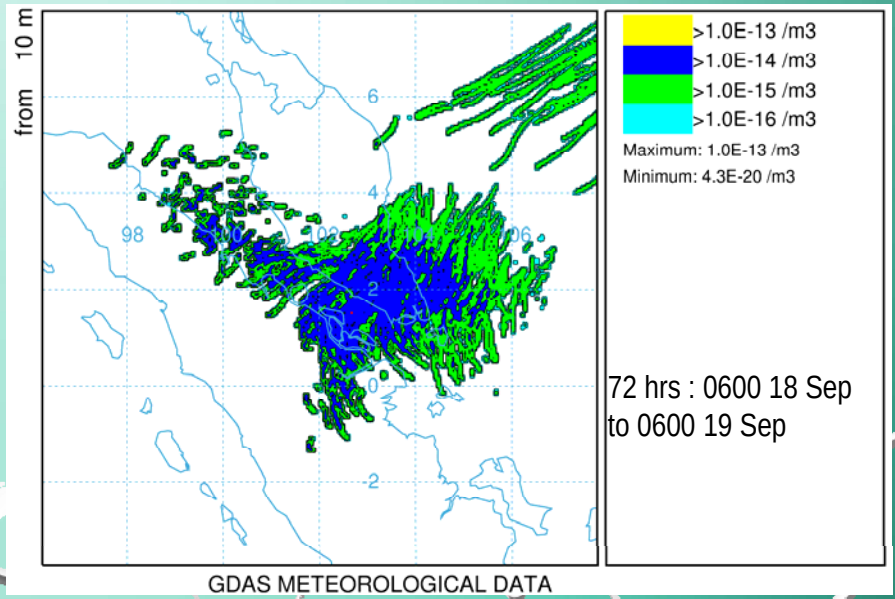
12 hrs : 0600 16 Sep
to 1800 16 Sep



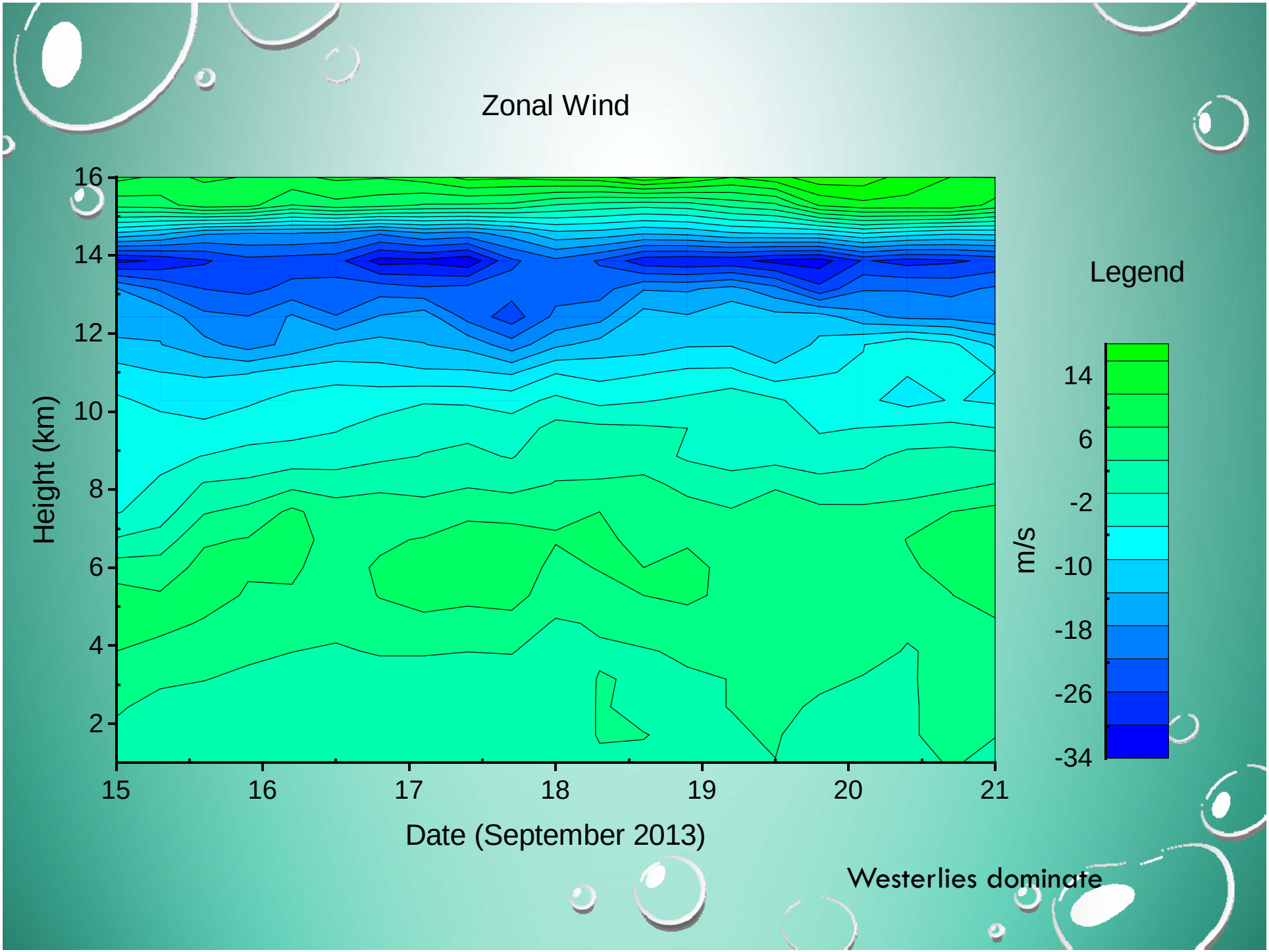
24 hrs : 1800 16 Sep
to 0600 17 Sep



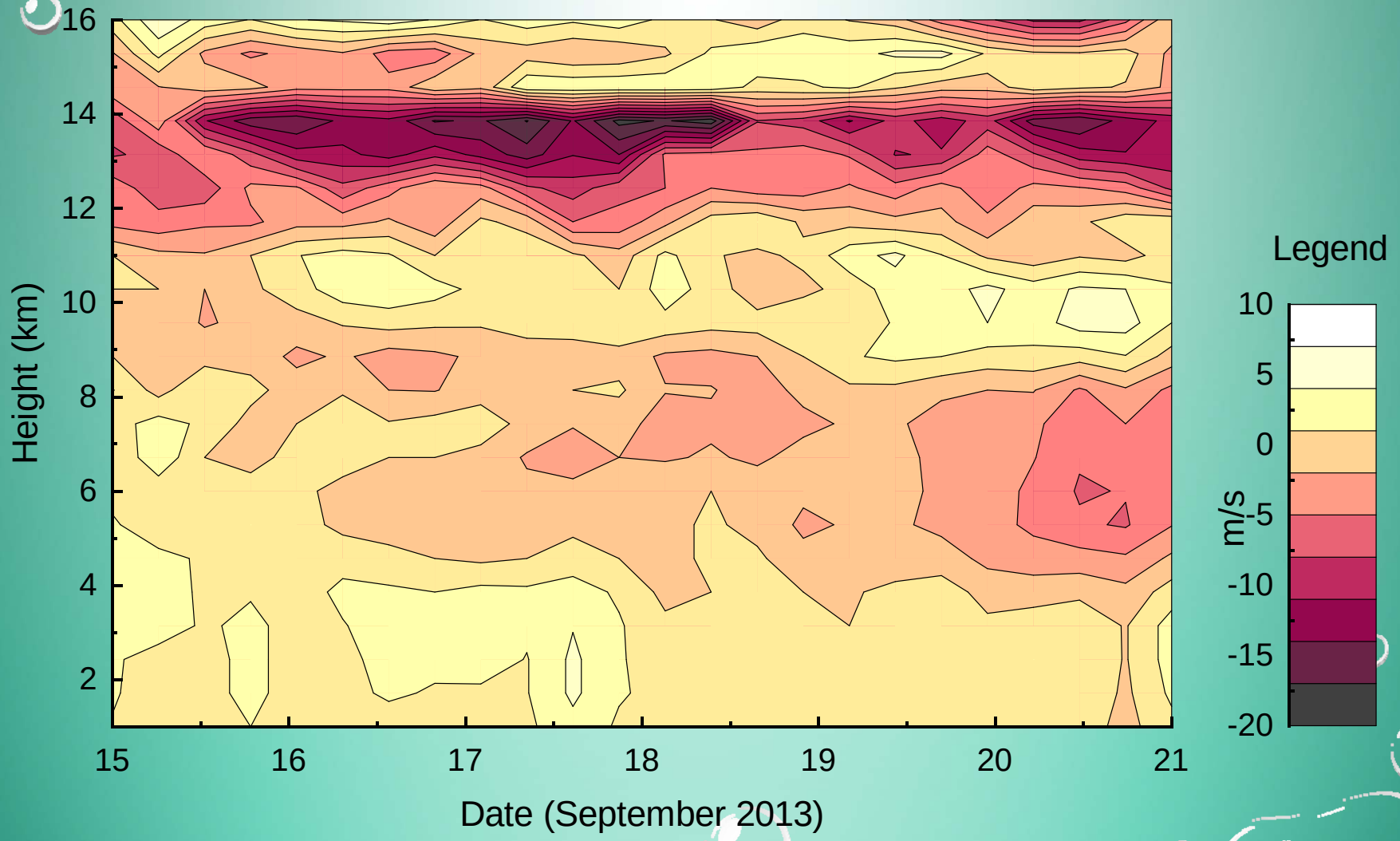
48 hrs : 1800 17 Sep
to 0600 18 Sep



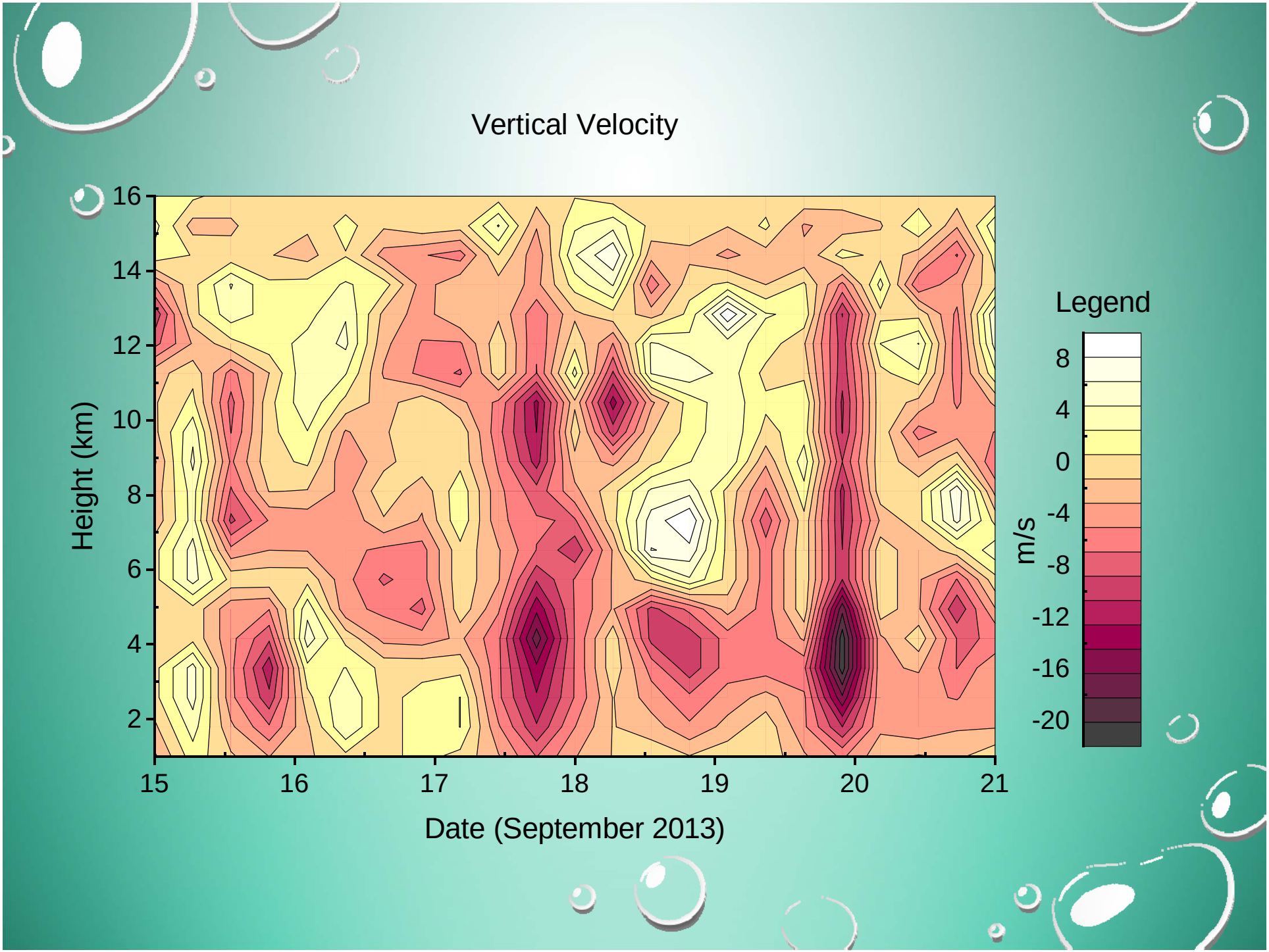
72 hrs : 0600 18 Sep
to 0600 19 Sep

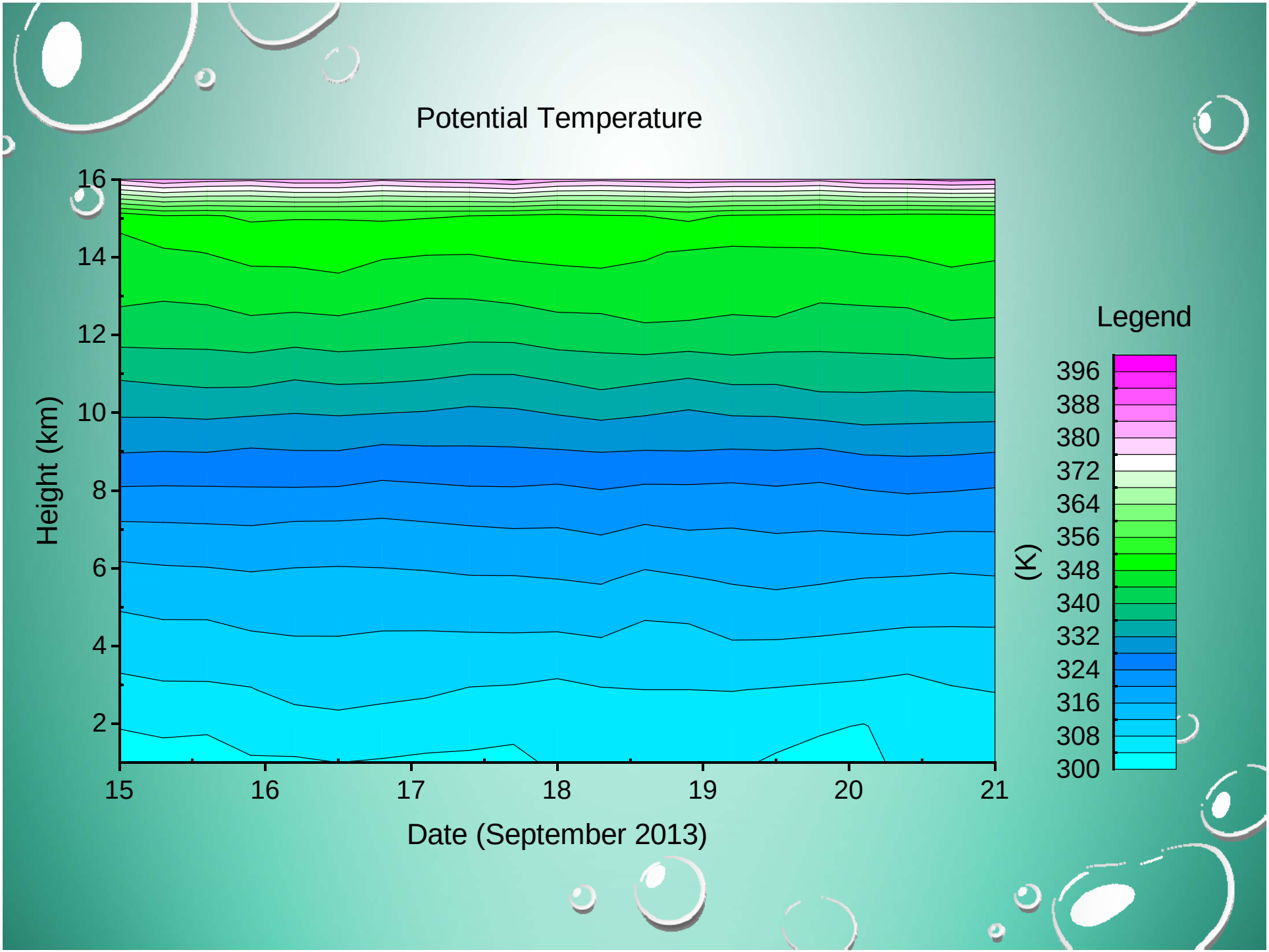

Zonal Wind
Height (km)
16
14
12
10
8
6
4
2
15
16
17
18
19
20
21
Date (September 2013)
Legend
m/s
14
6
-2
-10
-18
-26
-34
Westerlies dominate

Meridional Profile



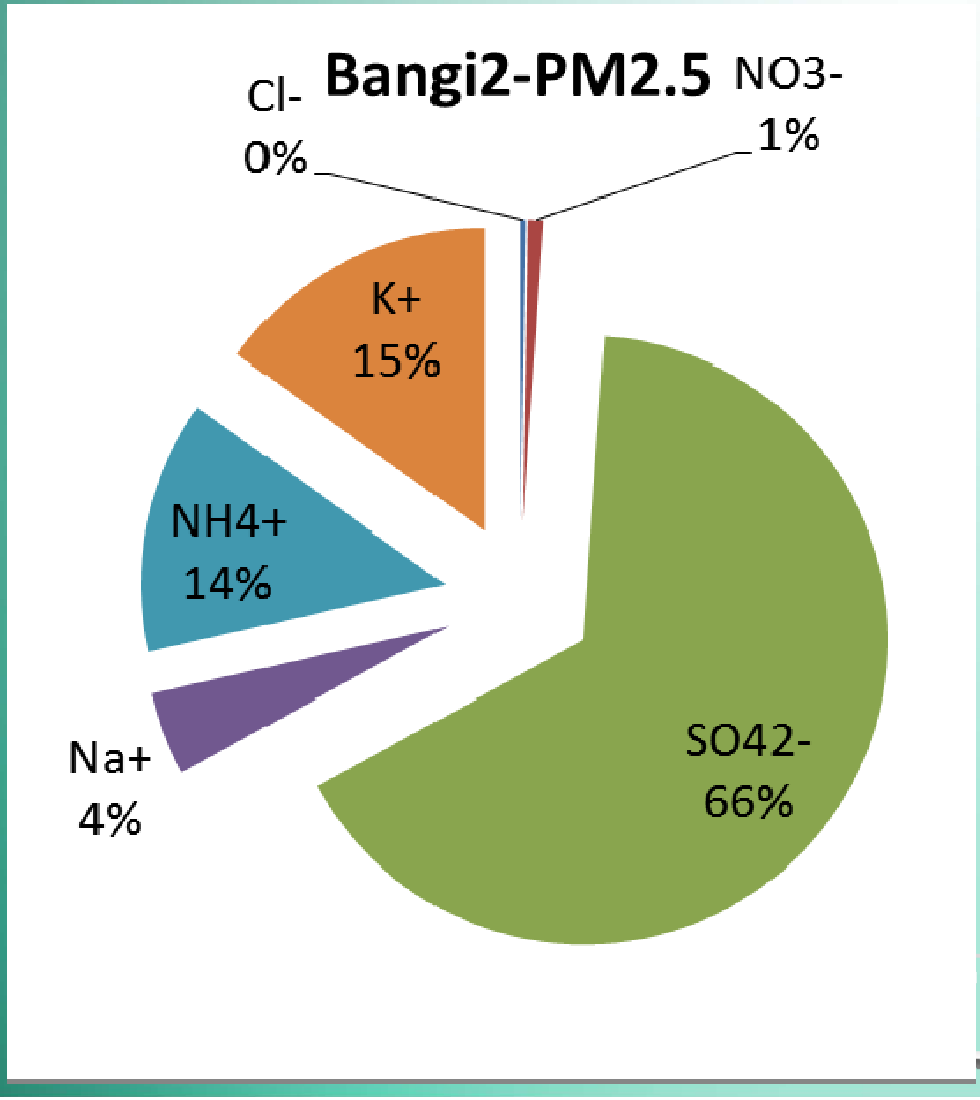
Southerlies dominate


Vertical Velocity
Height (km)
16
14
12
10
8
6
4
2
15
16
17
18
19
20
21
Date (September 2013)
Legend
m/s
8
4
0
-4
-8
-12
-16
-20


Potential Temperature
Height (km)
16
14
12
10
8
6
4
2
15
16
17
18
19
20
21
Date (September 2013)
Legend
(K)
396
388
380
372
364
356
348
340
332
324
316
308
300

Order of SO42->NO3->Cl- and NH4+>K+>Na+

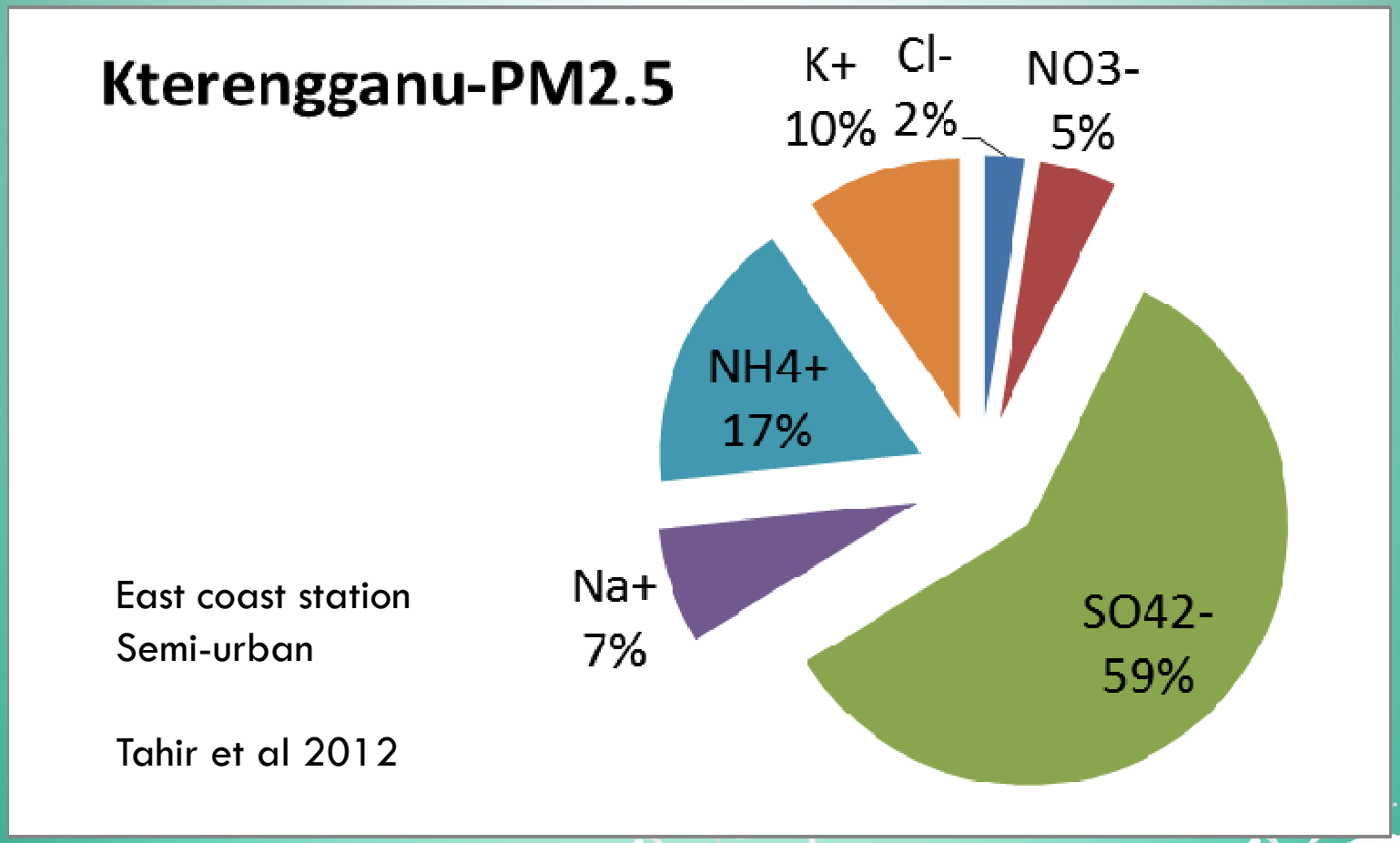
PM2.5 (NON-HAZE)



Total PM2.5 ions concentrations were 7.22 ± 3.20 μg m^{-3} and the most abundant inorganic ion was sulfate of 67% of total inorganic ionic mass concentration.

The average concentrations of individual anions and cations decreased in the order of $SO4^{2-}$ > NO3- > Cl- and $NH4^{+}$ > K^{+} > Na^{+}.

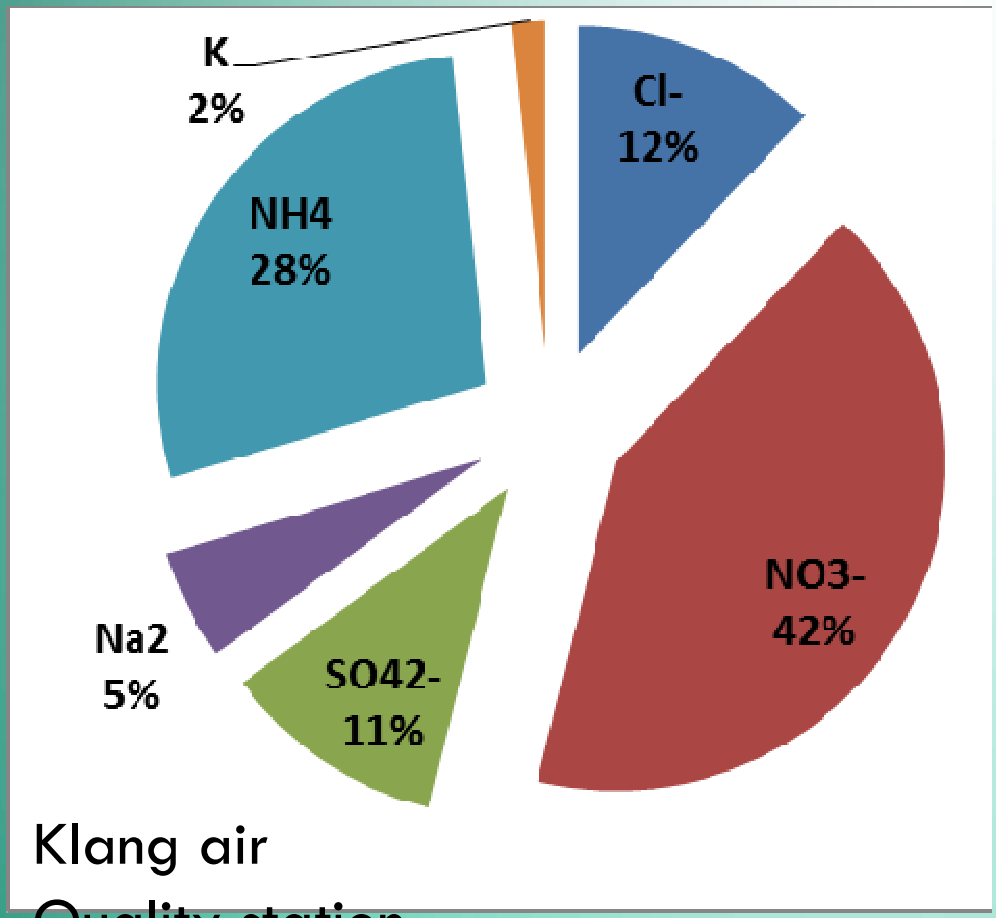
KUALA TERENGGANU (2006-2009)



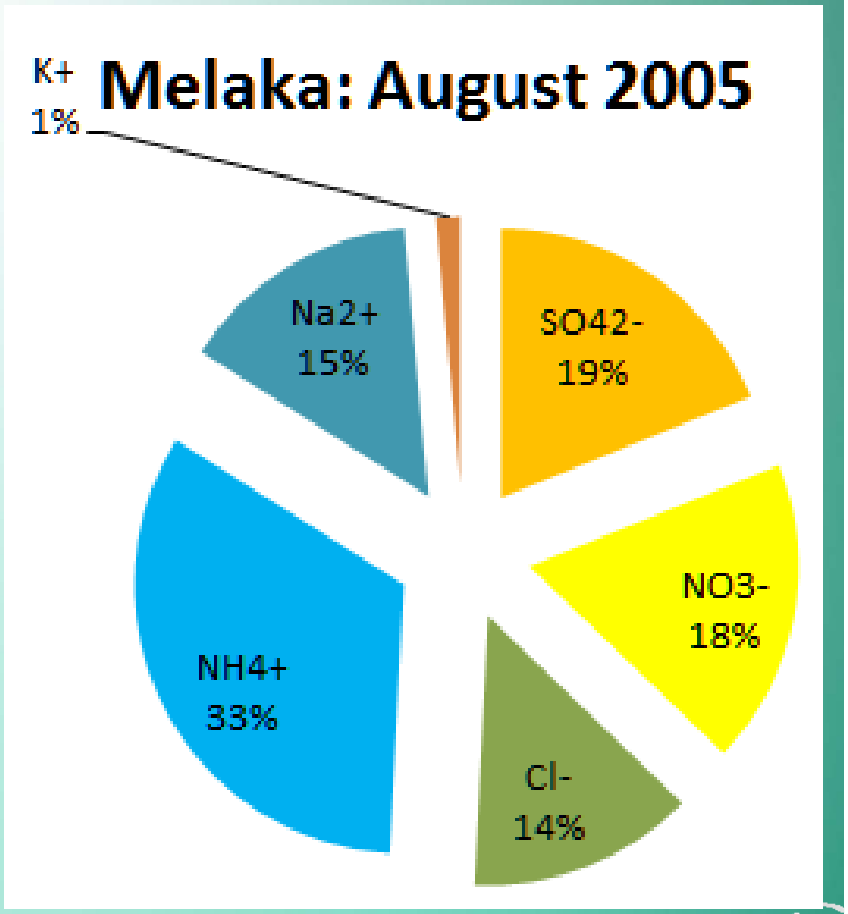
East coast station
Semi-urban

Tahir et al 2012

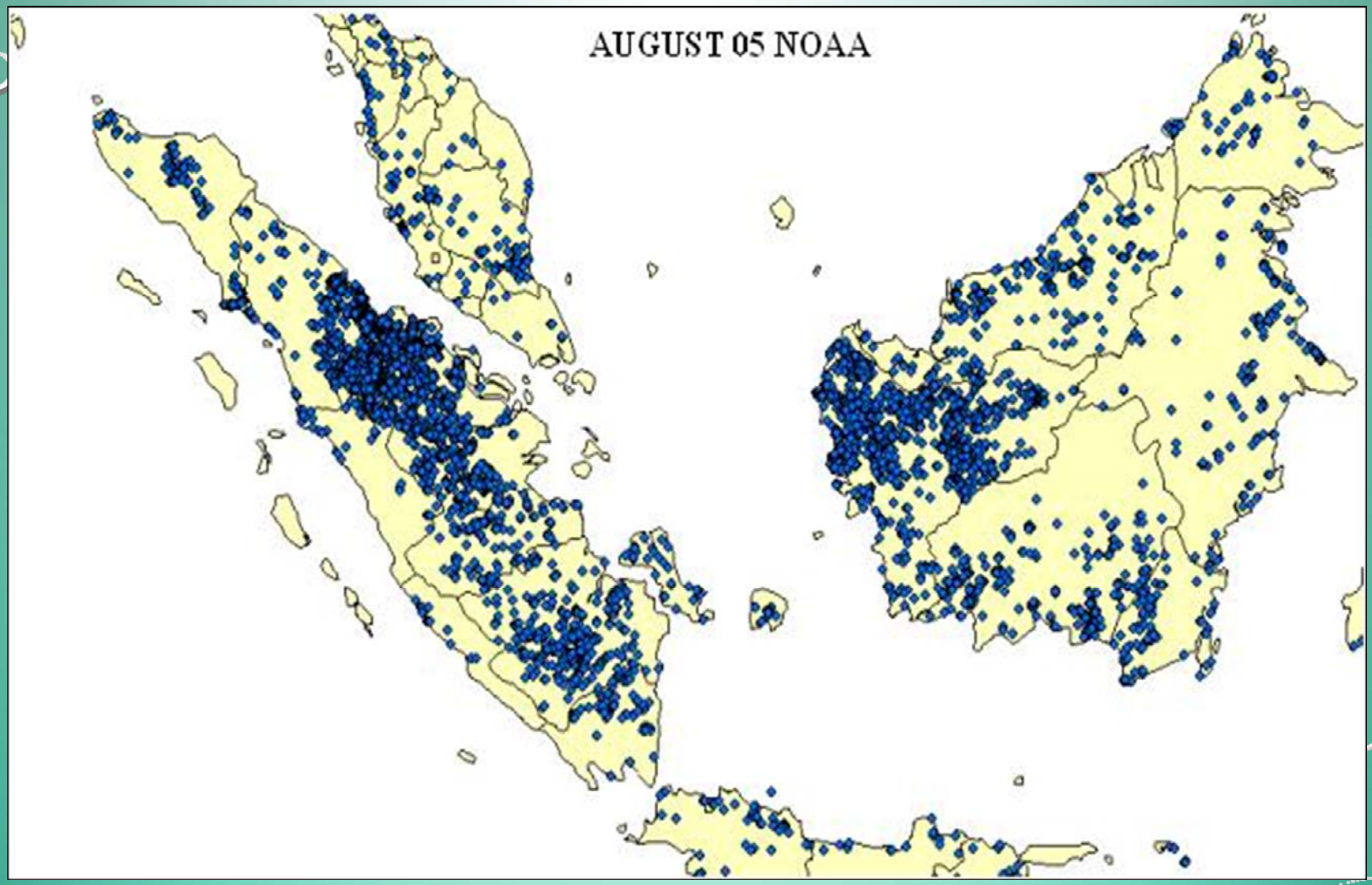
PM_{10} MONTHLY VALUES: AUG 2005

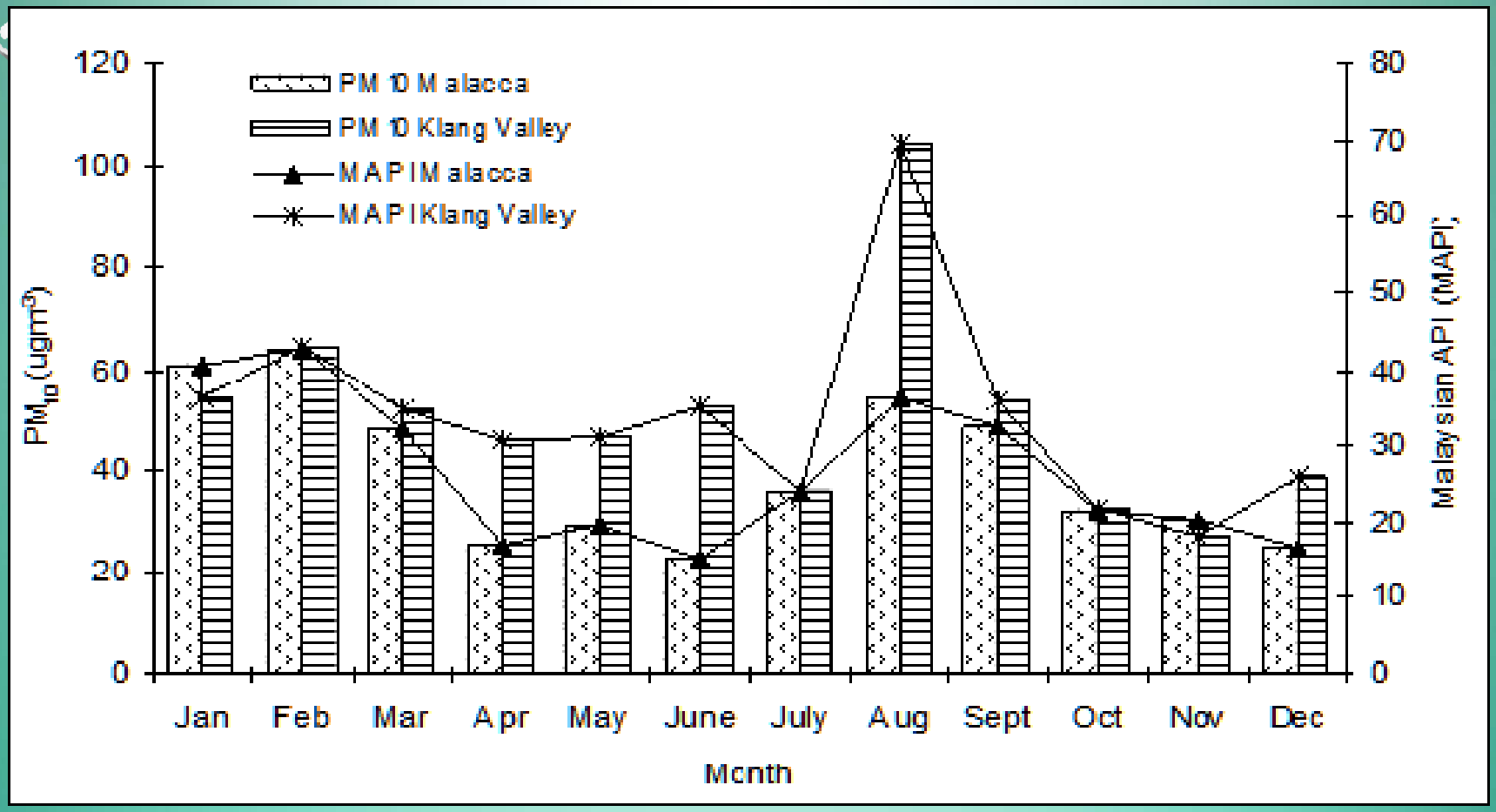


Klang air Quality station (Sulaiman et al 2013)

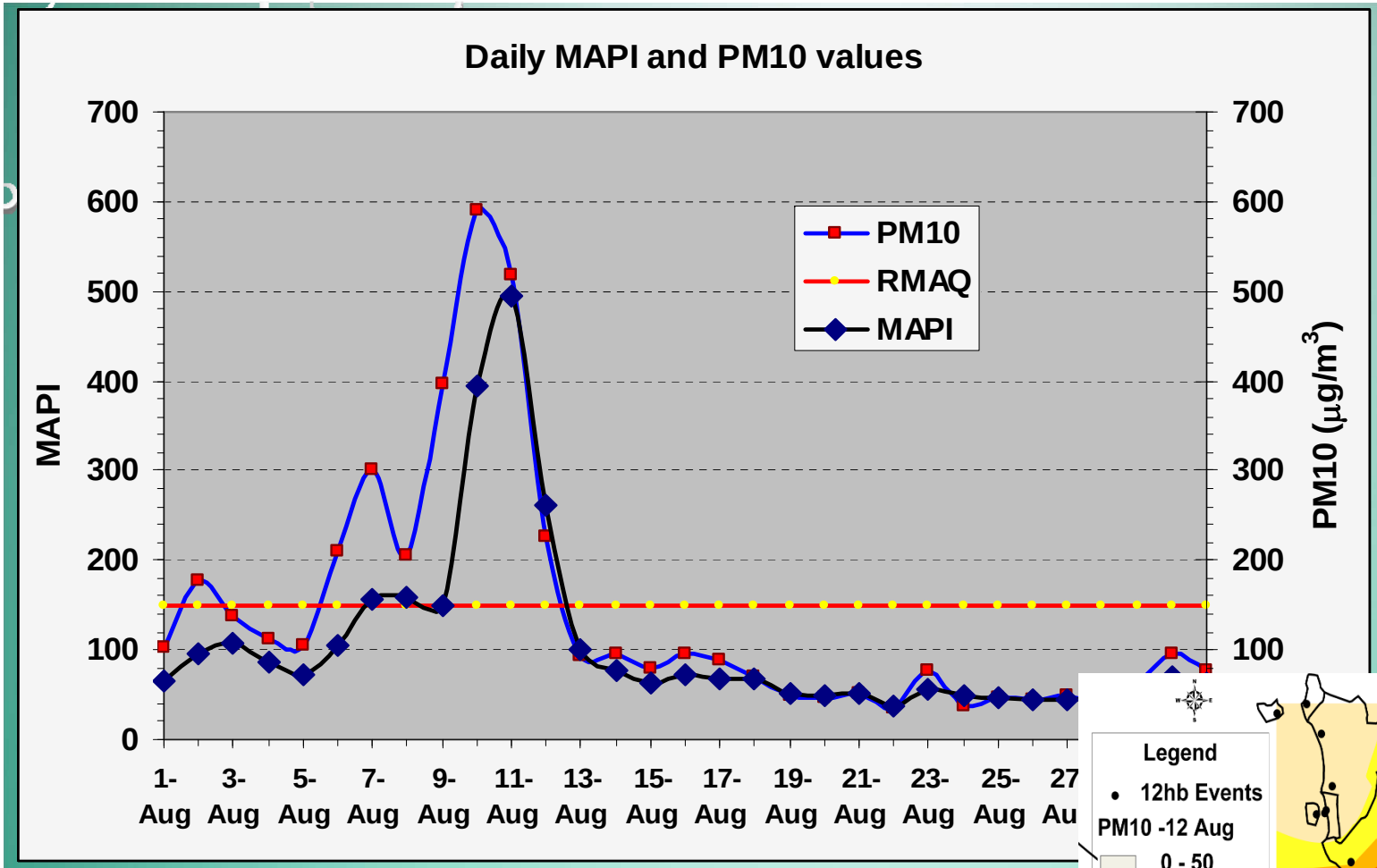


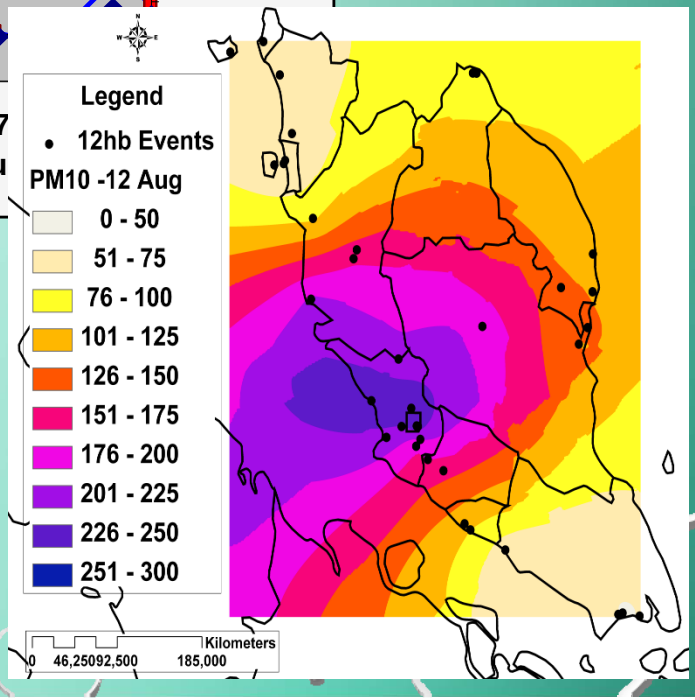
Nitrates, sulphates, chloride anions, Ammonium, sodium, potassium cations


AUGUST 05 NOAA



(Sulaiman et al 2013)


Daily MAPI and PM10 values
MAPI
PM10 (µg/m3)
PM10
RMAQ
MAPI
0
100
200
300
400
500
600
700
1-Aug
3-Aug
5-Aug
7-Aug
9-Aug
11-Aug
13-Aug
15-Aug
17-Aug
19-Aug
21-Aug
23-Aug
25-Aug


Legend
12hb Events
PM10 -12 Aug
0 - 50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 175
176 - 200
201 - 225
226 - 250
251 - 300
Kilometers
0 46,250 92,500 185,000

(Mahmud, 2009)

CONCLUSION

- INORGANIC IONS IN $PM_{2.5}$ WERE COMPOSED OF SULFATE ION (66% OF TOTAL IONS MASS) IN 2013.
- PARTICULATE SULFATE EXISTS IN THE FORM OF MIXTURES OF AMMONIUM (61%), POTASSIUM (24%), AND SODIUM SULFATES (15%) IN THE ATMOSPHERE.
- SULFATE AND POTASSIUM WERE IN THE $PM_{2.5}$ SIZE RANGE AND THE COARSE FRACTION WAS NEGLIGIBLE.

TERIMA KASIH