7 SouthEast Asian Studies (7-SEAS)

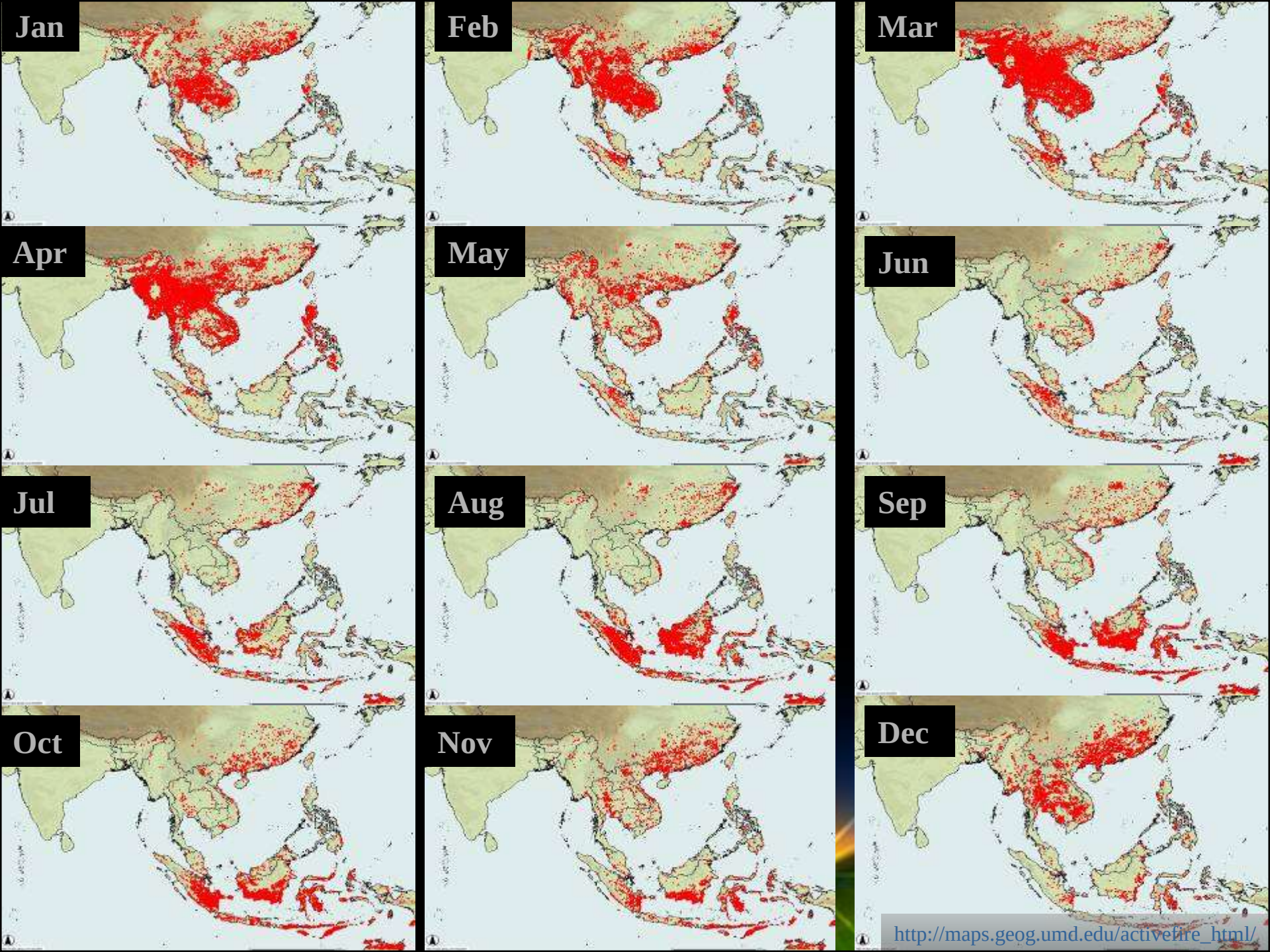
- Background and data briefing

George Lin, National Central U.,

Si-Chee Tsay, Brent Holben, Christina Hsu, NASA/GSFC

Jeff Reid, Naval Research Lab,

7-SEAS team of TH/TW/VN


Jan
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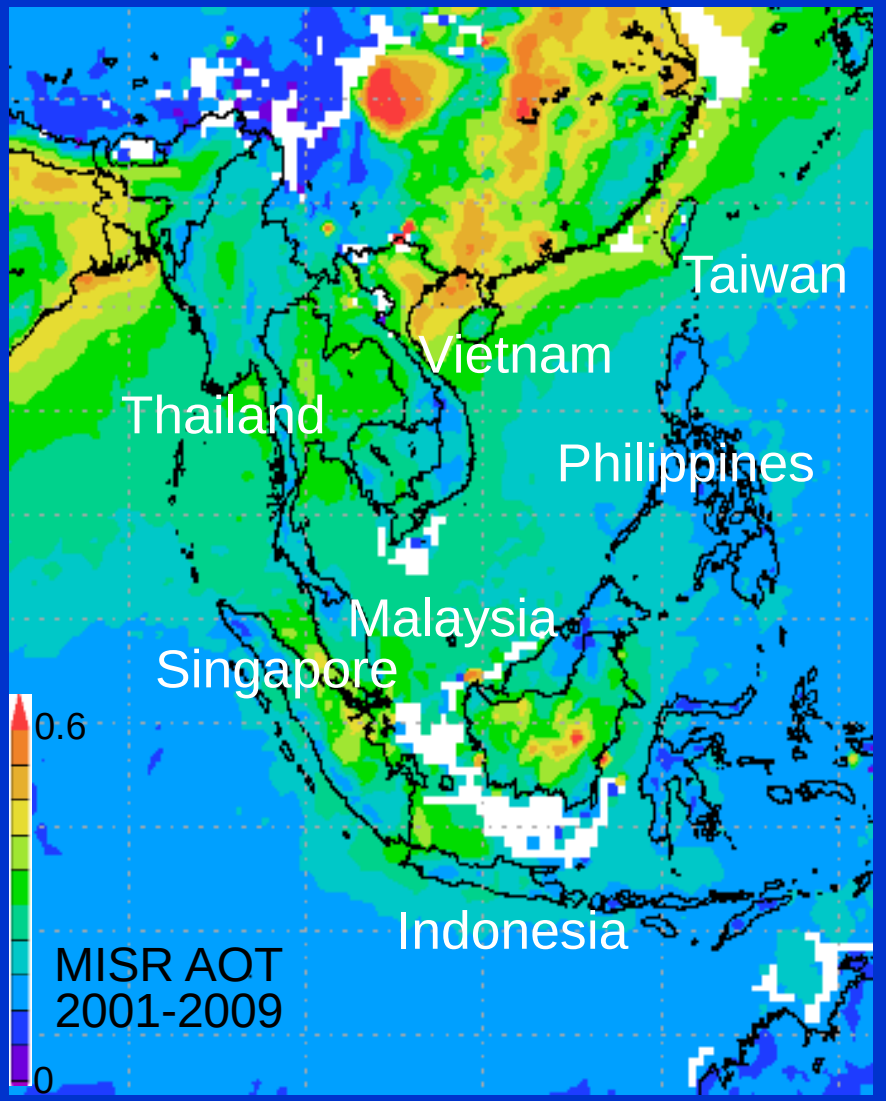
http://maps.geog.umd.edu/activefire_html/

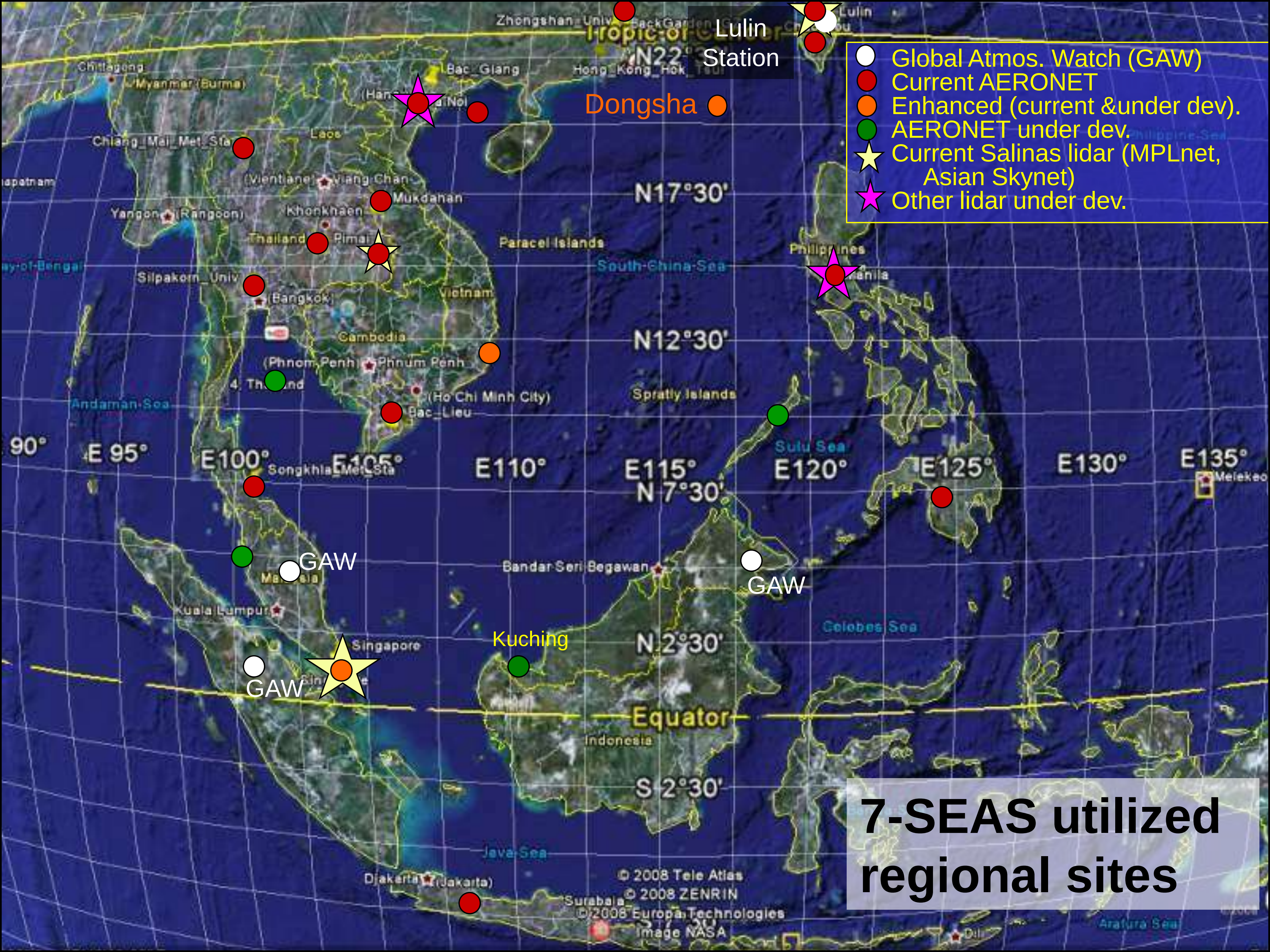
Seven South East Asian Studies
7-SEAS

Investigate the impacts of aerosol particles on *weather and the total SE Asian environment*

In order to do this, we need input from seven science areas:

- Aerosol lifecycle and air quality
- Tropical meteorology
- Radiation and heat balance
- Clouds and precipitation
- Land processes and fire
- Oceanography (phys. and bio.)
- Verification, analysis and prediction





7-SEAS utilized regional sites
Global Atmos. Watch (GAW)
Current AERONET
Enhanced (current &under dev).
AERONET under dev.
Current Salinas lidar (MPLnet, Asian Skynet)
Other lidar under dev.
Lulin Station
Dongsha
GAW
GAW
GAW
Kuching
N17°30'
N12°30'
N 7°30'
N 2°30'
S 2°30'
E 95°
E100°
E105°
E110°
E115°
E120°
E125°
E130°
E135°
Equator
South China Sea
Paracel Islands
Spratly Islands
Sulu Sea
Celebes Sea
Java Sea
Andaman Sea
Philippines
Vietnam
Cambodia
Thailand
Laos
Indonesia
Singapore
Kuala Lumpur
Bandar Seri Begawan
Chiang_Mai_Met_Sta
Mukdahan
Khonkhaen
Pimai
Silpakorn_Univ
(Bangkok)
Bac_Giang
Hong_Kong_Hok
Zhongshan_Univ
Yangon (Rangoon)
(Vientiane) Viang Chan
(Phnom Penh) Phnum Penh
(Ho Chi Minh City)
Bac_Lieu
Songkhla_Met_Sta
Djakarta (Jakarta)
Surabaia
© 2008 Tele Atlas
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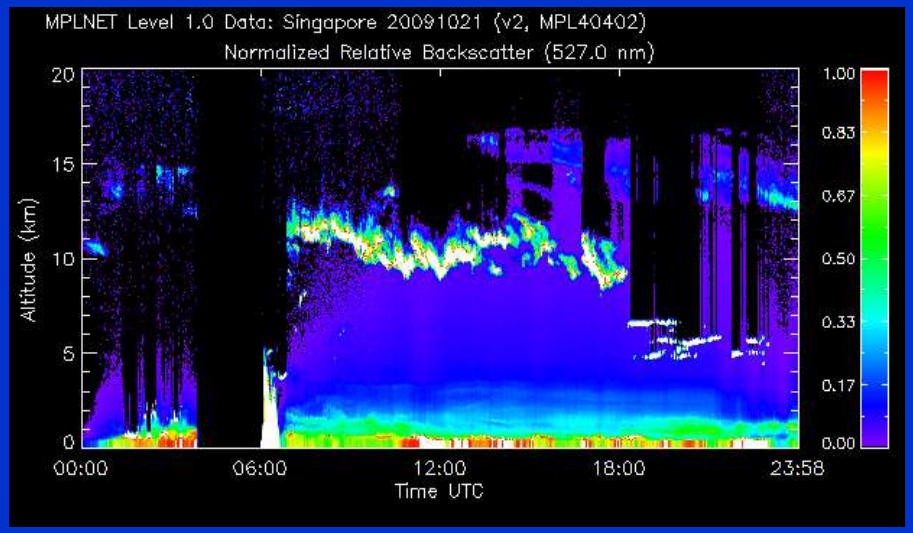
Image NASA

Southeast Asian Lidar Network for Atmospheric Studies (SALiNAS)/ 7 Southeast Asian Studies (7-SEAS)



- South China Sea region renown for complicated vertical distribution of cloud and aerosol layers
- Lidar measurements are necessary to constrain vertical scattering and extinction profile and assess efficacy of concurrent passive observations
- Integration of NASA CALIOP satellite-borne polarization lidar observations (ESA/JAXA EarthCARE?)
- Partners: Japan, Singapore, Taiwan, Philippines, and Vietnam.

Unprecedented coverage for active-profiling on lands surrounding the South China Sea, with support from NASA MPLNET/AERONET and Asian SKYNET.

7-SEAS activities since 2007

- 10 workshops and training courses
- 2007 VBBE (Virtual BB Experiment)
- 2012 Cruise mission in southern SE Asia

In-situ Experiments in northern SE Asia:

Phase I (2010-2012)

- 2010 Dongsha Experiment
- 2011 Son La Campaign I
- 2012 Son-La Campaign II

Phase II (2013-2015)

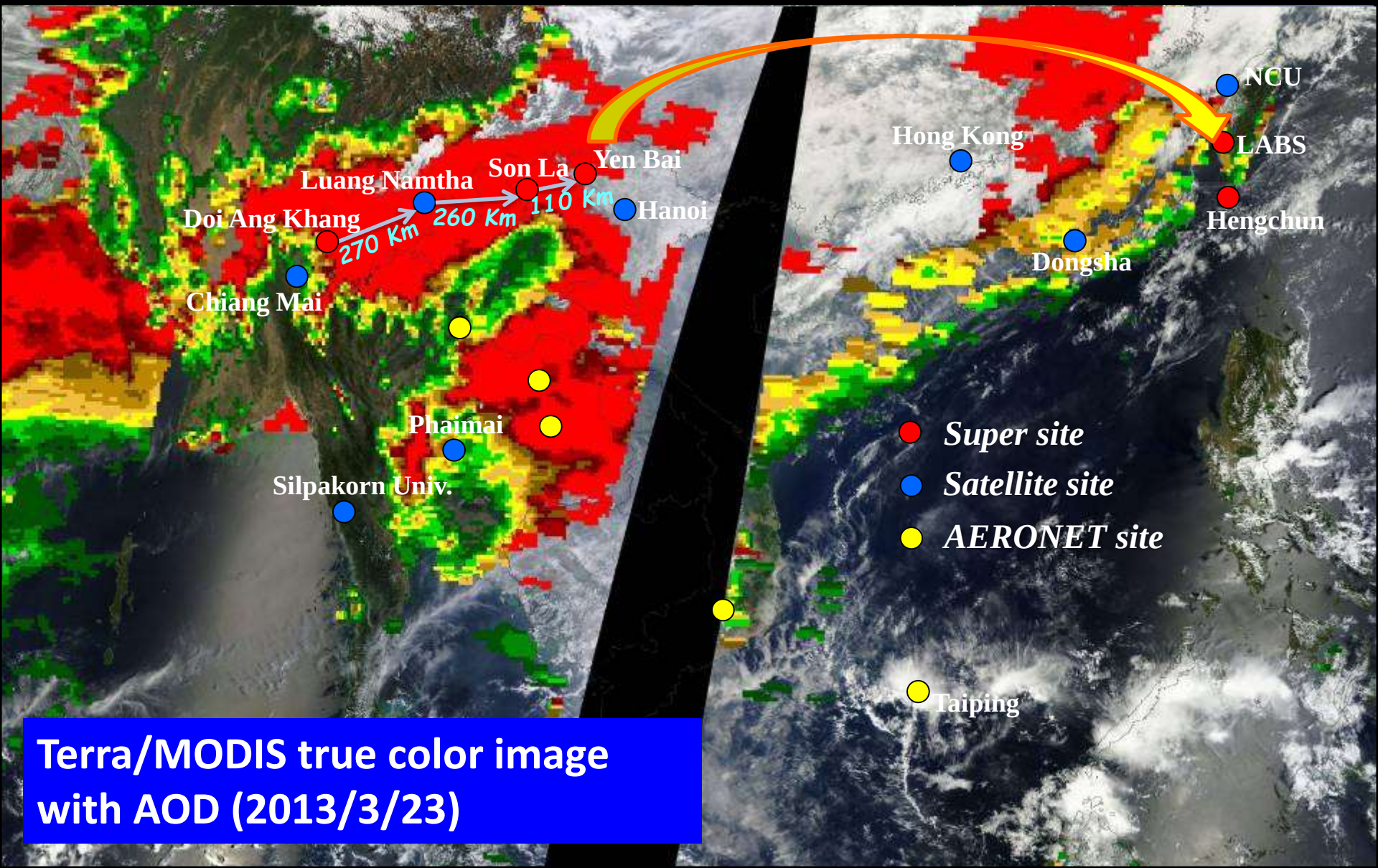
- 2013 BASELInE I
- 2014 BASELnE II
- 2015 BASELInE III

Phase III (2016-2018): Data and network

What are the scientific issues of biomass-burning aerosol and related pollutants in SE Asia we concern about, particularly for Springs?

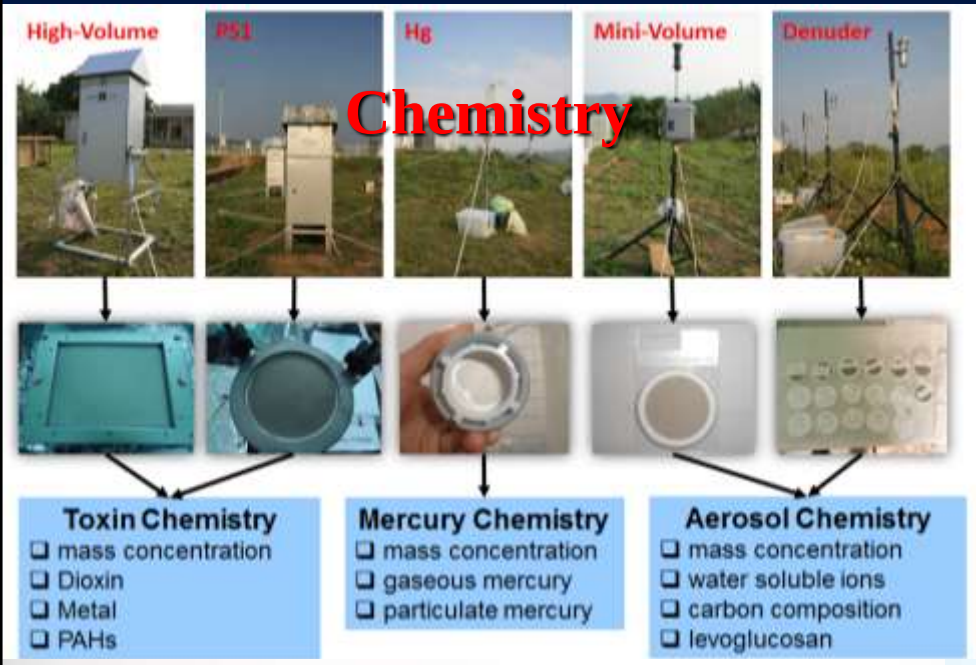
- Source/receptor BB characterization
- Environment and climate impact
- Health effects

7-SEAS Spring field campaigns



Terra/MODIS true color image with AOD (2013/3/23)

7-SEAS 2010-2015 *in-situ* instrumentation




CCN

Lidar


Meteorological data

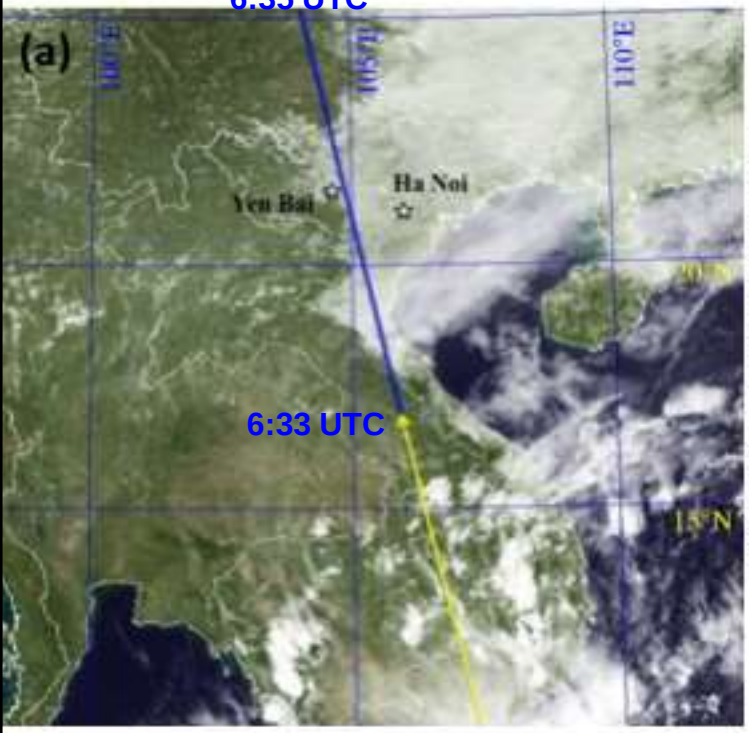
AOD · Radiation

氣膠吸光及散光係數

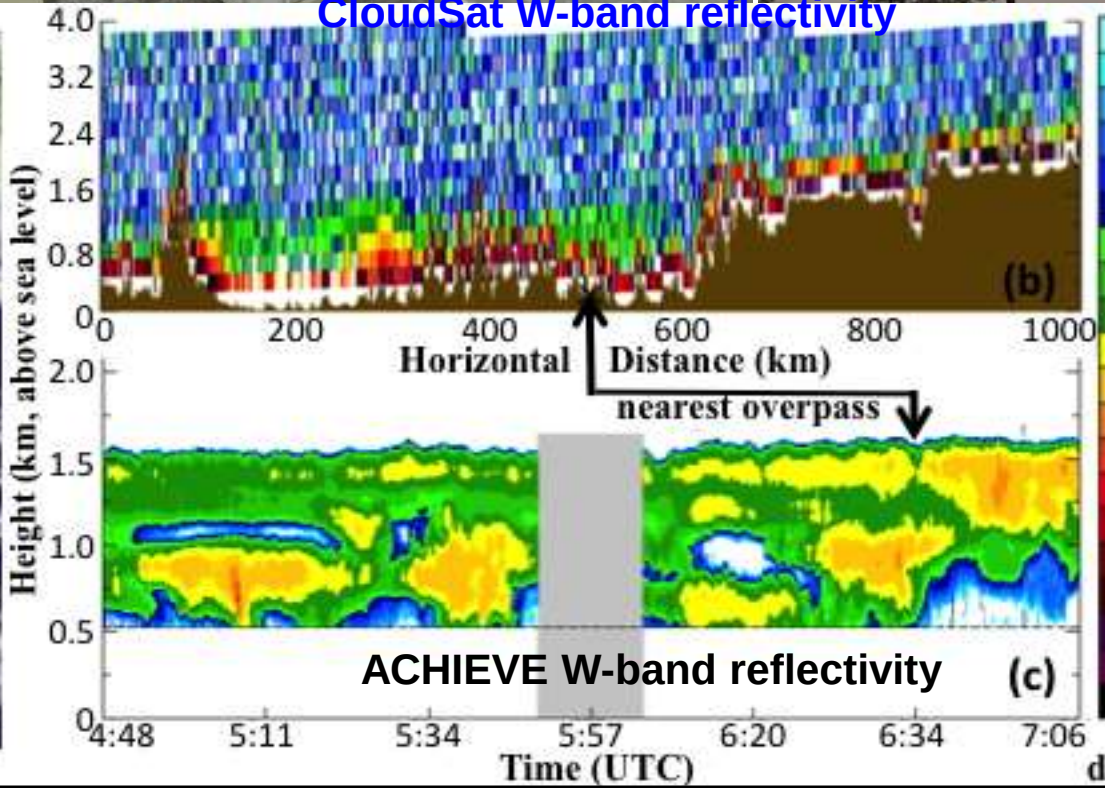
NASA COMMIT- Dongsha, Son La
NASA ACHIEVE Yen Bai
NCU mobile 1 - Doi Ang Khang
NCU mobile 2 – Hengchun
NCU Mt. Lulin Dongsha supersites

Air quality mobile - Hengchun

6:35 UTC



CloudSat W-band reflectivity



ACHIEVE W-band reflectivity

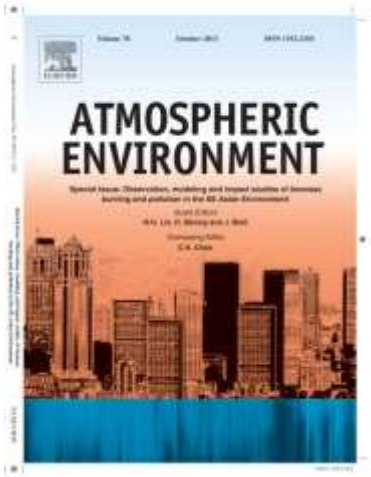
2010 Dongsha Experiment

- A pre-study of 7-SEAS
- Capacity building
- To characterize aerosol chemistry and physics over BB source/receptor sites in northern SE Asia: TH-VN-TW

Atmospheric Environment

2013 Nov (78) special issue on:

"Observation, Modeling and Impact Studies of Biomass Burning and Pollution in the SE Asian Environment – From BASE-ASIA and Dongsha Experiment to 7-SEAS"



Guest Editors:

George Lin, NCU (nhlin@cc.ncu.edu.tw)

Hal Maring, NASA

Jeff Reid, NRL

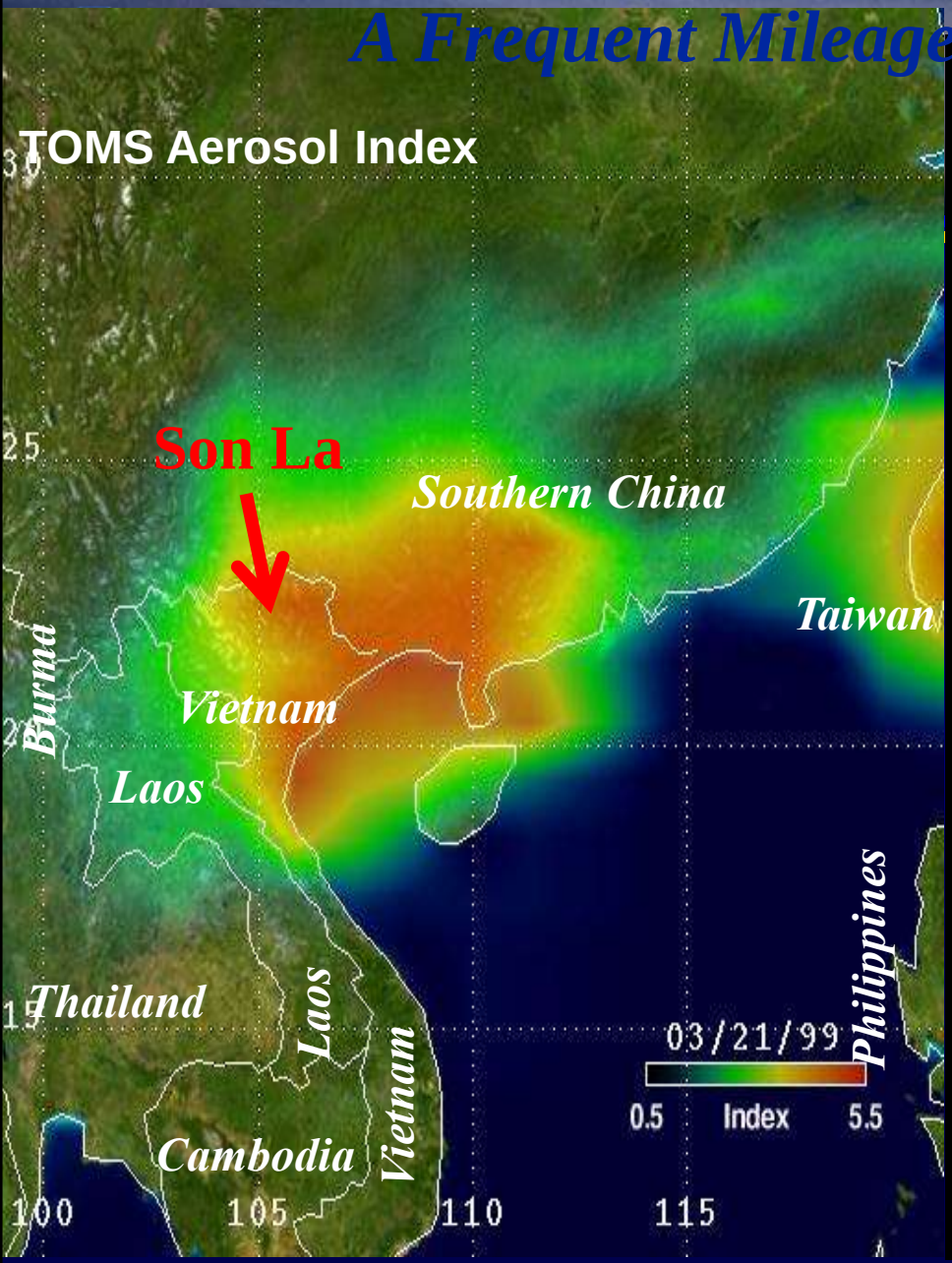
28 papers – overview, aerosols/gases/toxics, remote sensing, modeling and impact studies.

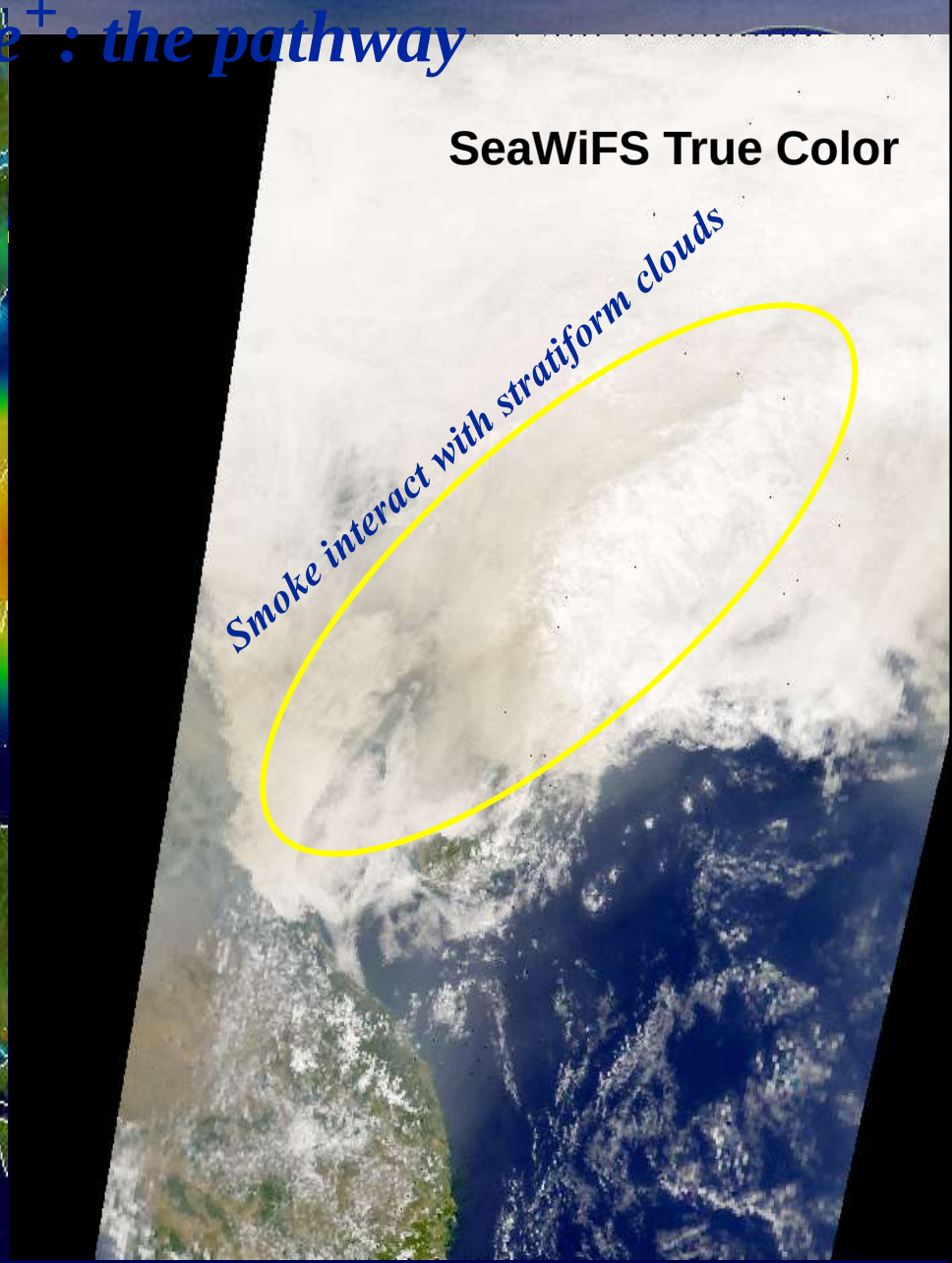
7-SEAS/Son La Experiments in northern Vietnam

- **2011 3/18-4/6: A pilot study of aerosol chemistry near biomass-burning source regions in northern Vietnam**

- **2012 3/13-4/9: Comprehensive *in-situ* and vertical profiling measurements**

A Frequent Mileage^{+} : the pathway





Event on 21 March 1999

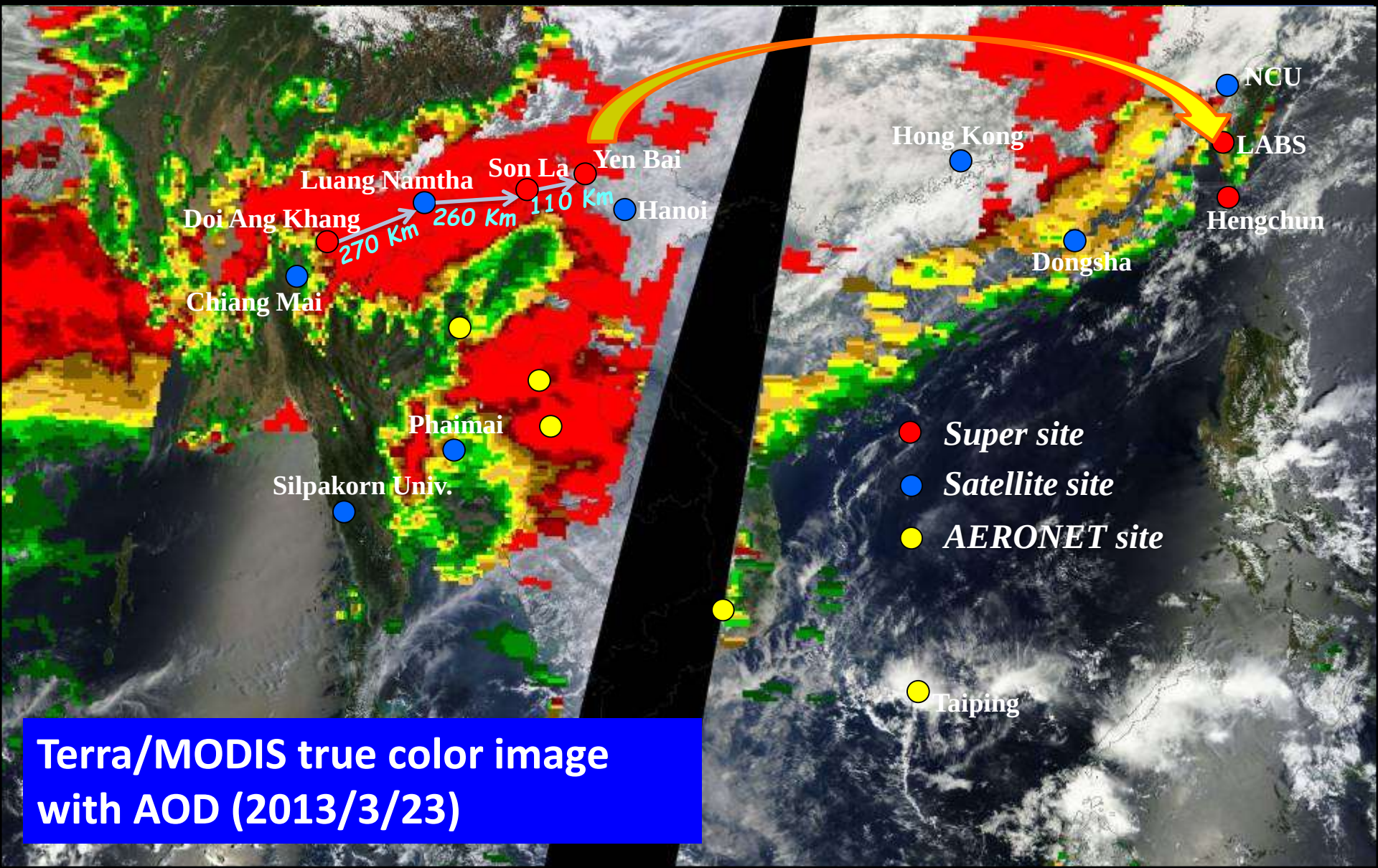
(Provided by Christina Hsu, NASA)

Phase II: 2013-2015 7-SEAS/BASELInE

Biomass-burning
Aerosols &
Stratocumulus
Environment:
Lifecycles and
Interactions
Experiment

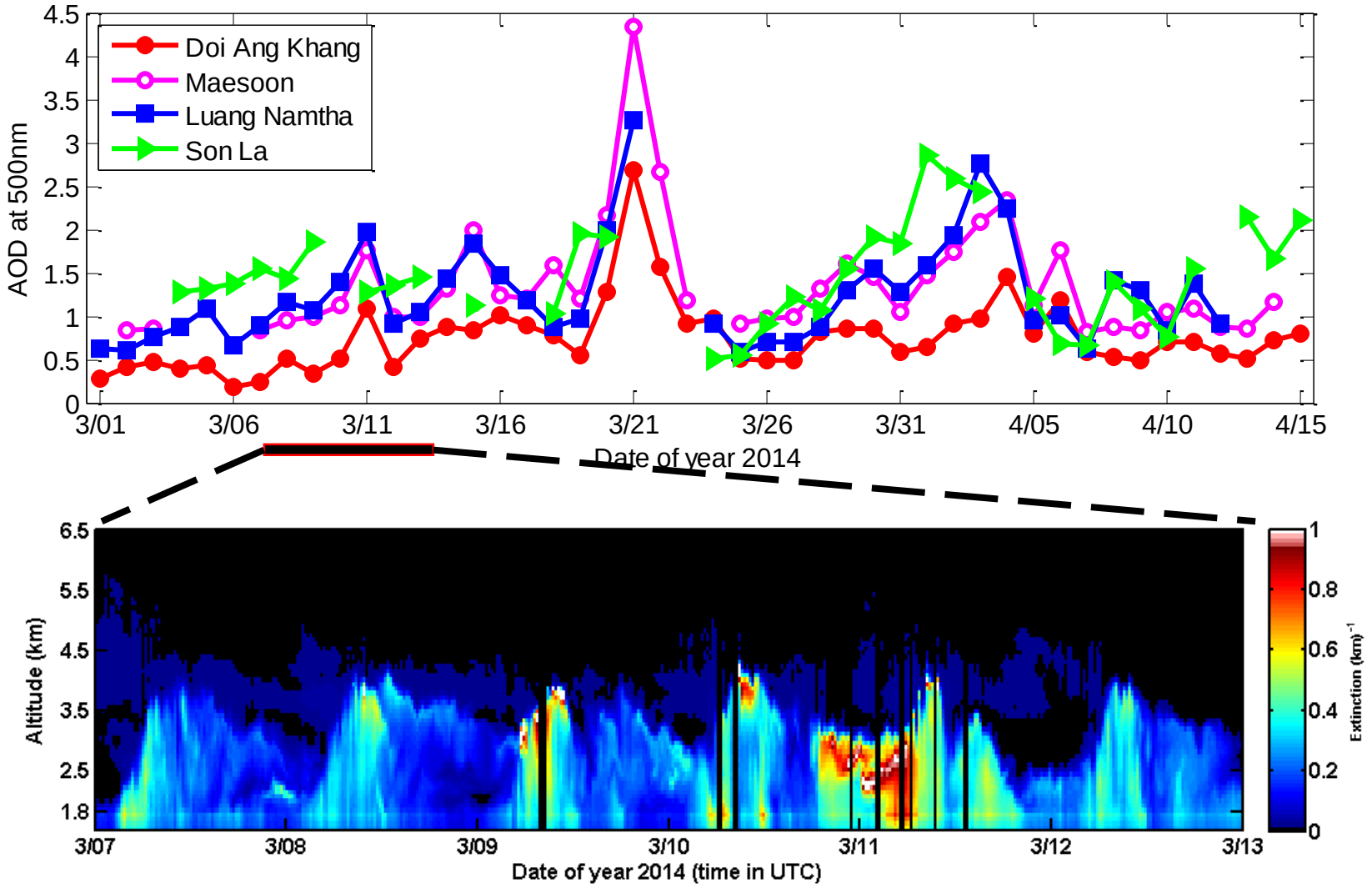
- **Lifecycle of biomass-burning aerosols from source to receptor regions in springtime northern SE Asia**
- **Aerosol-cloud interaction**

7-SEAS/BASELInE spring campaigns



Terra/MODIS true color image with AOD (2013/3/23)

Regional biomass-burning smoke haze



Doi Ang Khang supersite (DAK)

1,534 m MSL
northern Thailand

Radiation

Air quality and aerosol in-situ

Chemistry sampling

Aerosol micro-physical measurements at Doi Ang Khang

NCU instruments

- PSAP (Radiance Research, BC)
- SMPS (TSI 3936, 0.3 lpm, fine PSD)

- CCNC (DMT 100, 0.5 lpm, CCN conc.)

S.S.: 0.15%, 0.3%, 0.45%, 0.6%, 0.75%

$$\frac{N_{CCN}}{N_{CN}} \times 100\%$$

- CPC (TSI, 3010, 1.0 lpm, CN conc.)

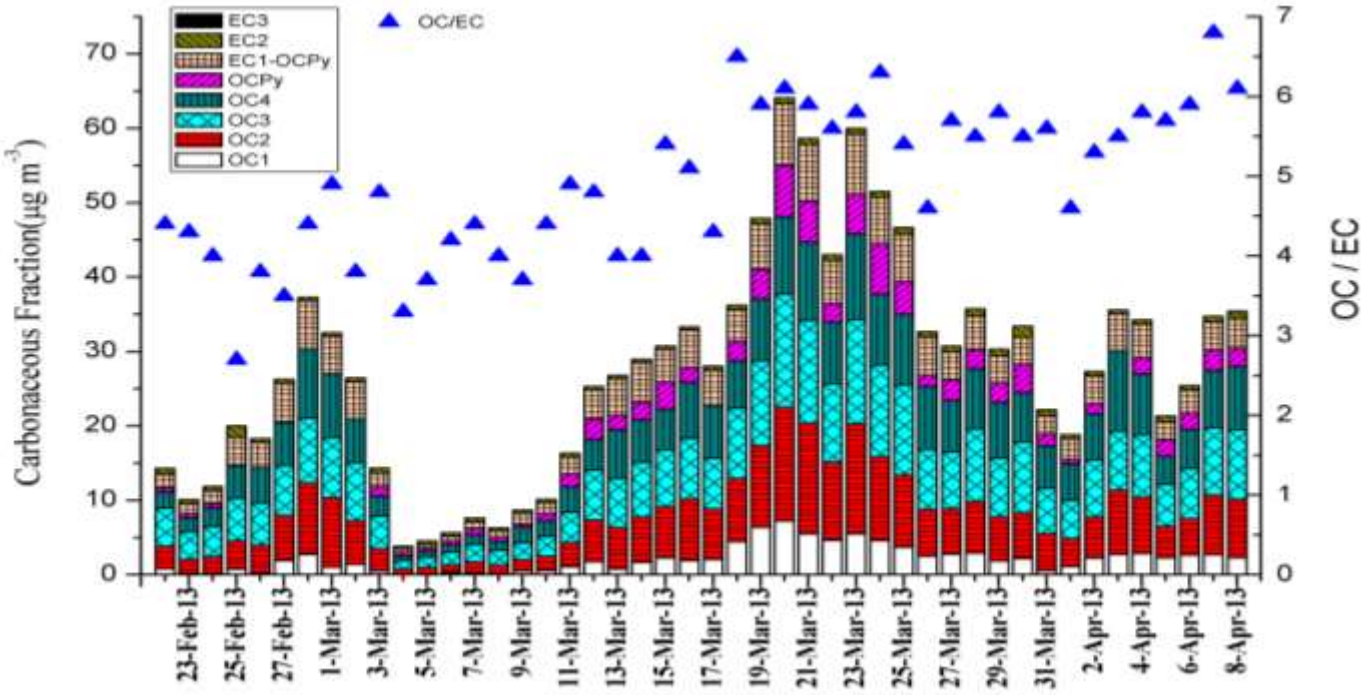
- Aerotrak (TSI 9000, 2.5 lpm, Alv. S.A. conc.)

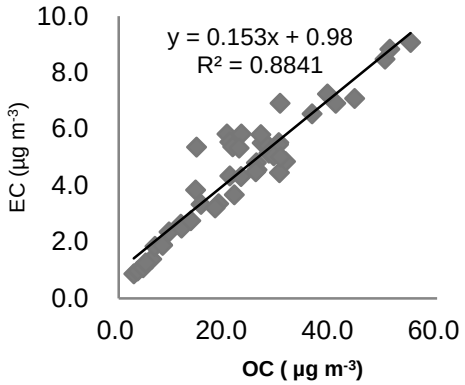
- Aerosol Inlet
  - APS (TSI 3321, 5.0 lpm, course PSD)

- Aerosol Inlet ($d_{p,a}$<2.5μm)
  - TEOM (RP 1400, 16.7 lpm, PM2.5 mass conc.)

(TC Hsiao)

$PM_{2.5}$ – OC/EC at Doi Ang Khang





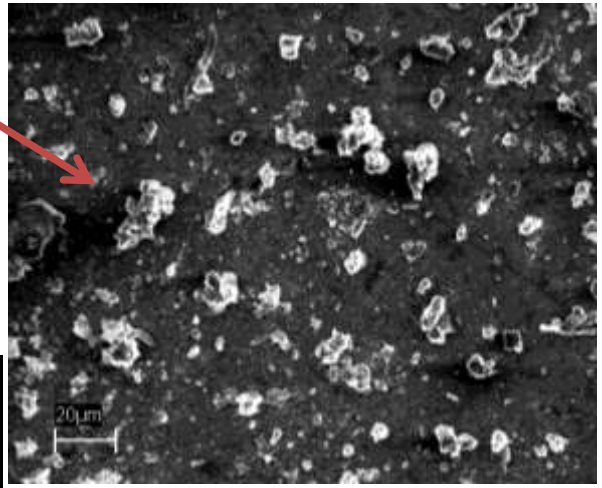
OC (μg m^{-3})	23.2 ± 12.9
EC (μg m^{-3})	4.5 ± 2.1
TC (μg m^{-3})	27.7 ± 14.9
OC/EC	**4.9 ± 0.9**

- **OC/EC can be used to identify sources** (Chow et al., 2004; Cao et al., 2005), for instance, 1.1 for mobile source and 2.7 for coal burning (Watson et al., 2001), **5.1 for forest fire** in (Pio et al., 2008).
- OC and EC are highly correlated with R^2=0.88.

(Provided by CT Lee)

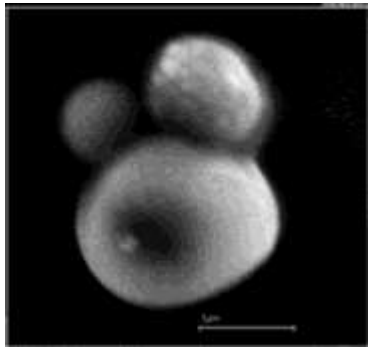
STRUCTURE of SMOKE

SEM/EDX INDIVIDUAL PARTICLE ANALYSIS



Olga

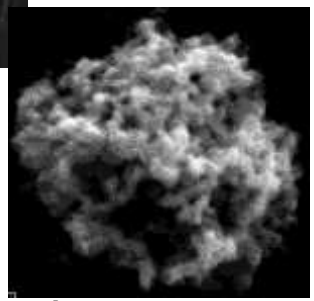
Dust/Soil

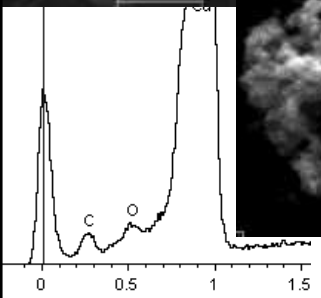


aluminum silicates mixed with K, Fe

Organic/tar

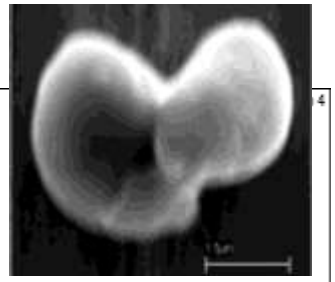
soot



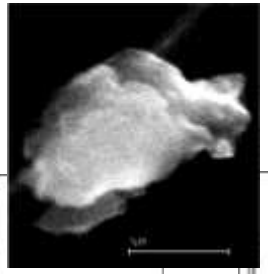


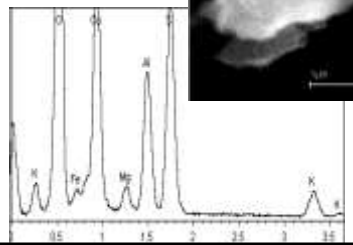
Fly Ash

K chlorides

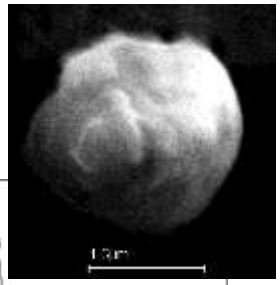


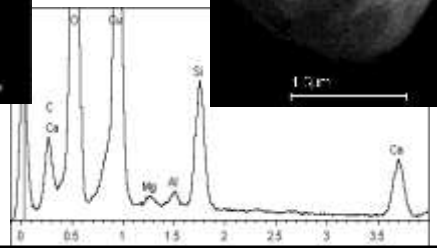
Fe - rich



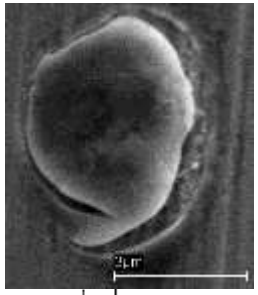


Ca - rich





Sulfates

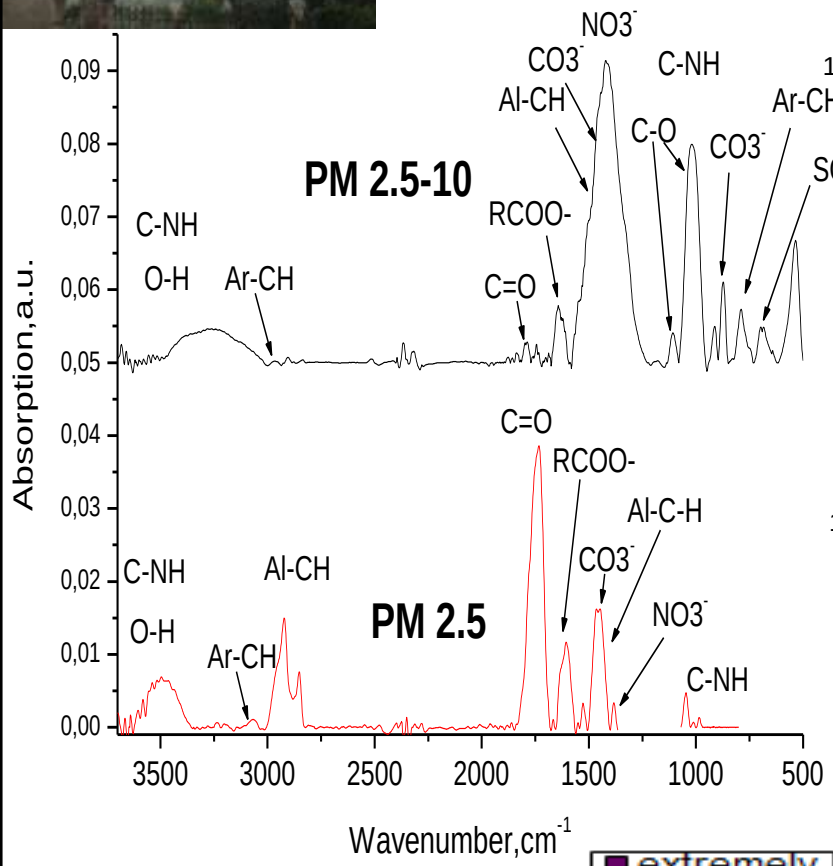


FTIR ORGANIC/INORGANIC COMPOSITION

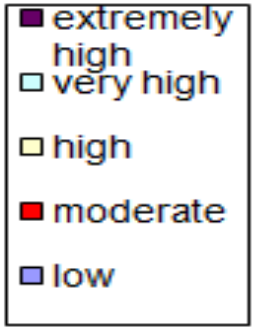
Size Distribution of Functionalities in Smoke Aerosols

Olga

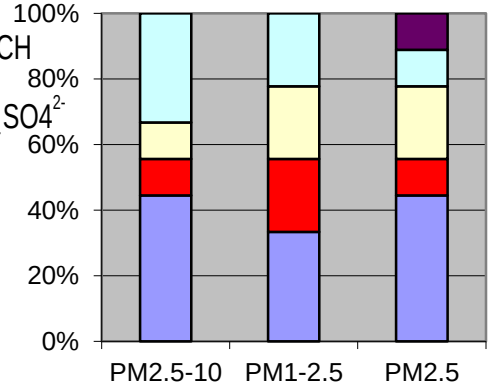
2013.02.26 – 2013.03.20



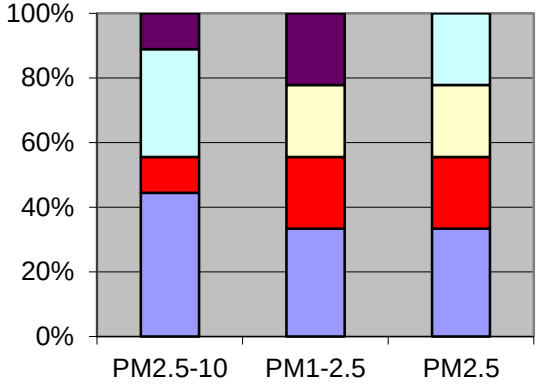
	cm^{-1}
O-H	3600-3100
C-H ar	3100-3000
C-H al	3000-2800
C=O	1850-1650
CO3-	880-860
SO42-	700-680



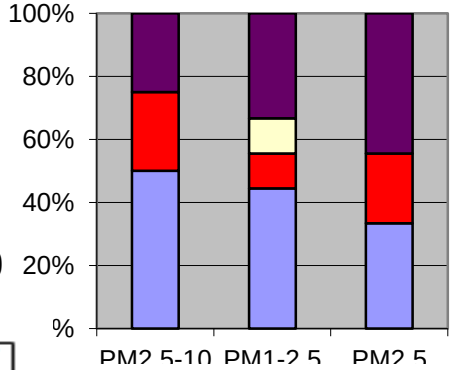
Hydroxyl O-H carbon



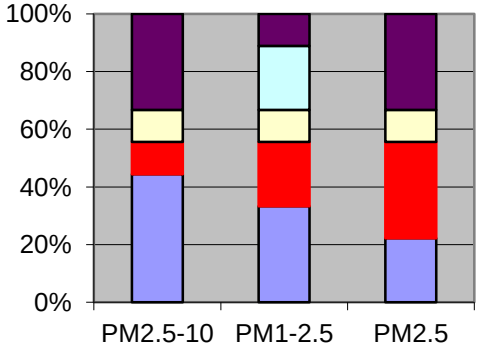
Carbonyl C=O carbon



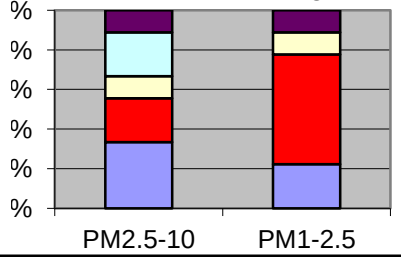
Aromatic C=C-H carbon



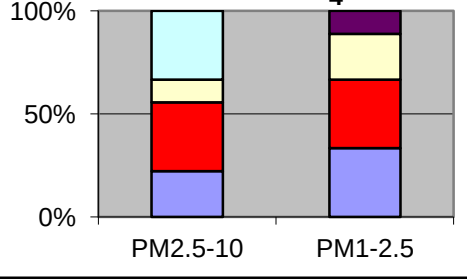
Aliphatic C-H carbon



Carbonate CO_3^{2-}



Sulfate SO_4^{2-}



Aerosol and Air Quality Research

2nd special issue on:

"Aerosol Impact on Physical, Chemical and Biological Processes in Southeast Asia and the Maritime Continent"

Guest Editors:

James Campbell, NRL

Guey-Rong Sheu, NCU

Somporn Chantara, CMU

Published in Nov. 2016

27 papers

7-SEAS/BASELInE Data Products

SMARTLabs/AERONET/MPLNET	Regional Instrumentation
Trace Gas – Column: O_3, NO_2, SO_2, HCHO, CO, H_2O; – ***Surface***: CO, CO_2, O_3, SO_2, NO, NOx/NOy; – ***Profile***: NO_2, (O_3 in progress)	***Organic Carbon*** (OC): OC_1 (120°C), OC_2 (280°C), OC_3 (480°C), OC_4 (580°C), OP (pyrolyzed organic carbon, e.g., anhydrosugars, dicarboxylic acids)
Aerosol Optical Thickness: multi-spectral from UV to shortwave-IR, dust at longwave-IR, and extinction profile	***Elemental Carbon*** (EC): EC_1 (580°C – OP), EC_2 (740°C), EC_3 (840°C)
Aerosol Microphysics/Chemistry: size, mass, type, CCN, hygroscopicity, scattering/absorption/extinction	***Water soluble ions***: Na^+, NH_4^+, K^+, Mg^{2+}, Ca^{2+}, Cl^-, NO_3^-, SO_4^{2-}, nss-SO_4^{2-}, NO^{2-}, F^-
Cloud Optical Thickness: multi-spectral from visible to longwave-IR	***Toxic***: Mercury, PCDD/Fs (dioxin)
Cloud Microphysics: size, liquid-/ice-water content, cloud-base/top/height, thermodynamic phase, Doppler fall-velocity, depolarization and reflectivity profiles	***Metal***: Ti, Mn, Co, Ni, Cu, Zn, Mo, Ag, Cd, Sn, Sb, Tl, Pb, V, Cr, As, Y, Se, Zr, Nb, Ge, Rb, Cs, Ga, La, Ce, Pr, Nd, Sm, Eu, Gd
Radiation Flux: surface solar and terrestrial irradiance	***UV radiation:*** spectral UV (erythemal) irradiance
Meteorology: P, T, RH, wind, mixed-layer height, precipitation, visibility	***Supplementary data***: sounding profile, sky image, particle spectroscopy/morphology, rainfall amount

7-SEAS Phase III for N. SEA Region

- 2016-2018
- Data analysis and modeling
- Regional networking
- 2018 spring campaign
- 2018 fall campaign in collaboration with NASA flight missions of SW monsoon studies in SE Asia
- The 3rd special issue on JGR

7-SEAS 2018 spring campaign

- March - mid-April 2018
- Plume transport observation:
  TH-VN-CN/HK-TW
  Vertical profiling
- Aerosol-cloud interaction in N. VN
- Sources from southern China?
- Impact studies


Welcome you to join 7-SEAS!
Bring your instruments here!
Contact:
nhlin@cc.ncu.edu.tw
Website:
http://aerosol.atm.ncu.edu.tw
THANK YOU!