



Transboundary Aerosol from Biomass-burning: Influence on Public Health

Jariya Boonjawat

*Southeast Asia START Regional Center (SEA
START RC), Chulalongkorn University*

E-mail jariya@start.or.th

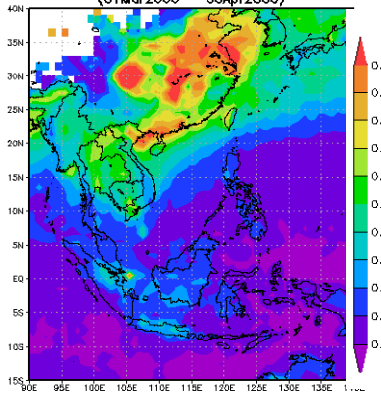
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Key messages

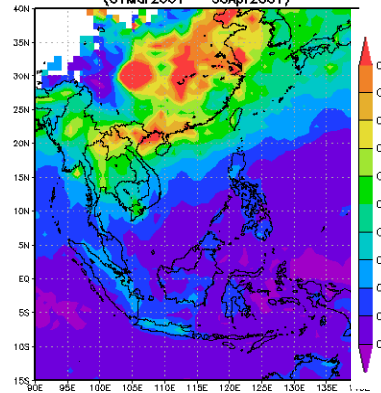
- A large fraction the aerosol particles originate from emissions at the Earth's surface caused by the incomplete combustion of fossil fuels and biofuels (biomass). Biomass-burning has been a regular practice for land conversion and land clearing in many countries in Southeast Asia.
- The most serious health impacts of particles associated with biomass-burning [biomass-burning aerosol/ Atmospheric Brown Clouds (ABC)] include cardiovascular and pulmonary effects leading to chronic respiratory problems, hospital admissions and deaths.

Satellite Images of Aerosol Optical Depth (AOD₅₅₀ nm) – MODIS Fire Map (2000-2007)

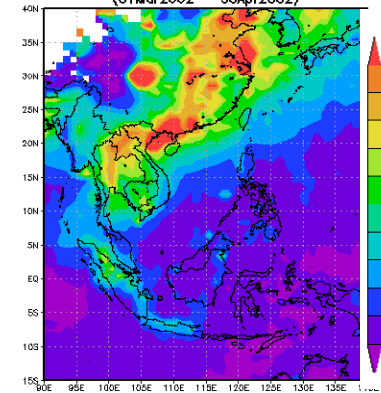
MOD08_D3.005 Aerosol Optical Depth at 550 nm [unitless]
(01Mar2000 – 30Apr2000)



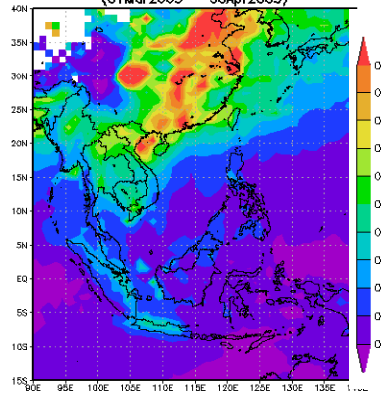
MOD08_D3.005 Aerosol Optical Depth at 550 nm [unitless]
(01Mar2001 – 30Apr2001)



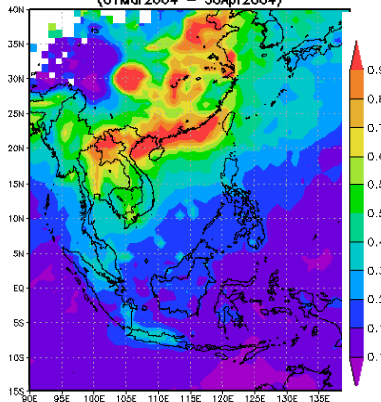
MOD08_D3.005 Aerosol Optical Depth at 550 nm [unitless]
(01Mar2002 – 30Apr2002)



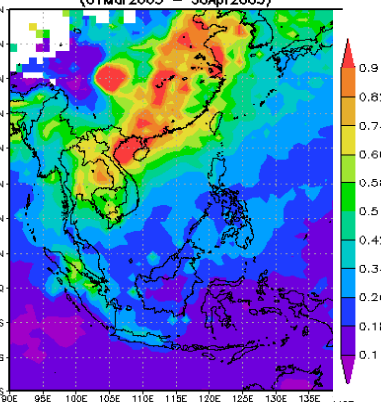
MOD08_D3.005 Aerosol Optical Depth at 550 nm [unitless]
(01Mar2003 – 30Apr2003)



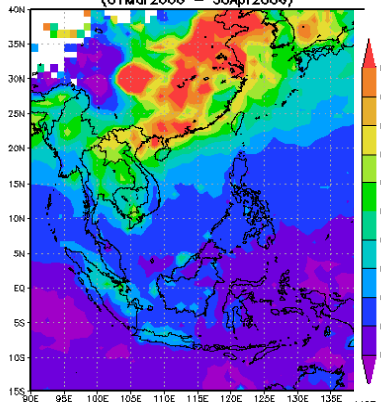
MOD08_D3.005 Aerosol Optical Depth at 550 nm [unitless]
(01Mar2004 – 30Apr2004)



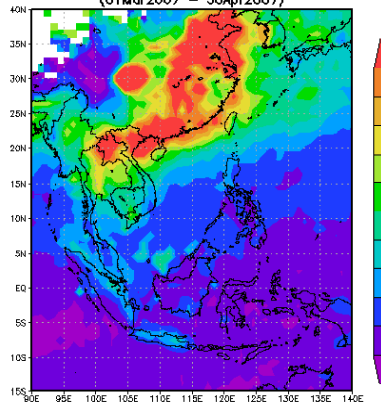
MOD08_D3.005 Aerosol Optical Depth at 550 nm [unitless]
(01Mar2005 – 30Apr2005)



MOD08_D3.005 Aerosol Optical Depth at 550 nm [unitless]
(01Mar2006 – 30Apr2006)

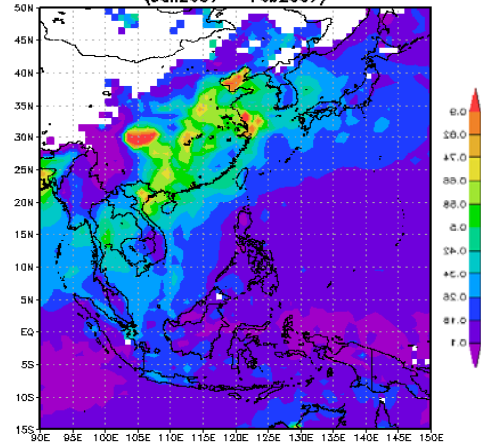


MOD08_D3.005 Aerosol Optical Depth at 550 nm [unitless]
(01Mar2007 – 30Apr2007)

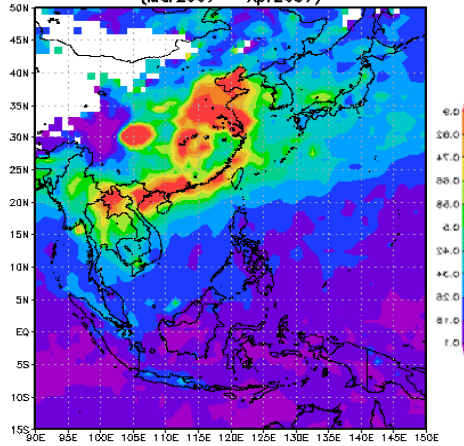


Seasonal variation (2007) observed by MODIS

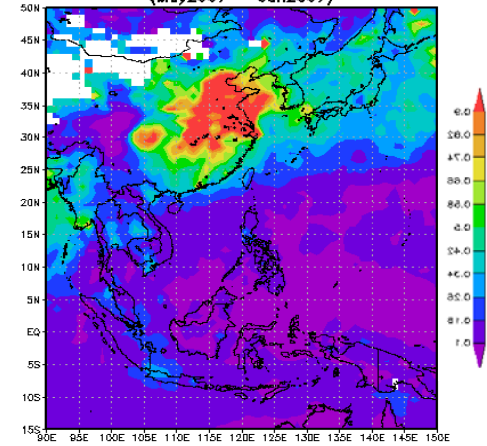
MOD08_M3.005 Aerosol Optical Depth at 550 nm [unitless]
(Jan2007 - Feb2007)



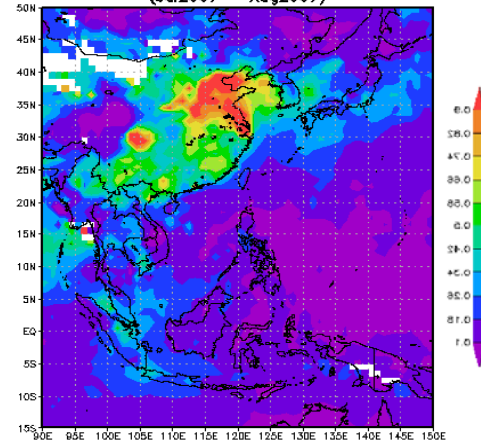
MOD08_M3.005 Aerosol Optical Depth at 550 nm [unitless]
(Mar2007 - Apr2007)



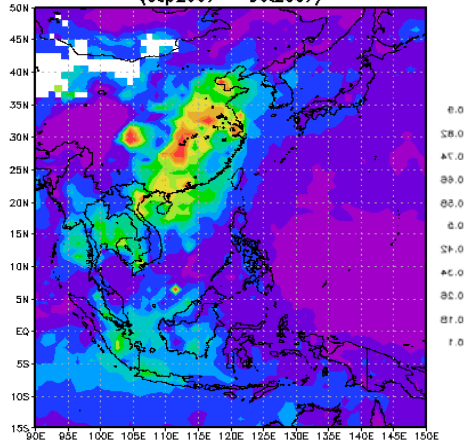
MOD08_M3.005 Aerosol Optical Depth at 550 nm [unitless]
(May2007 - Jun2007)



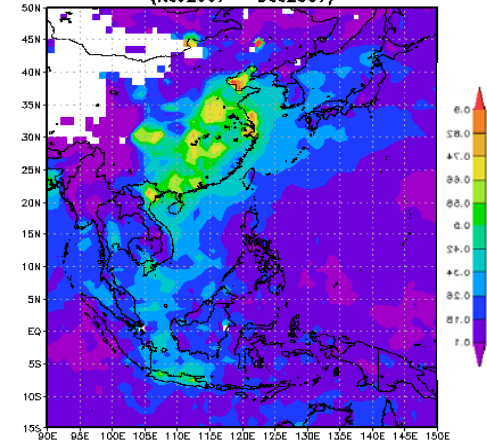
MOD08_M3.005 Aerosol Optical Depth at 550 nm [unitless]
(Jul2007 - Aug2007)



MOD08_M3.005 Aerosol Optical Depth at 550 nm [unitless]
(Sep2007 - Oct2007)



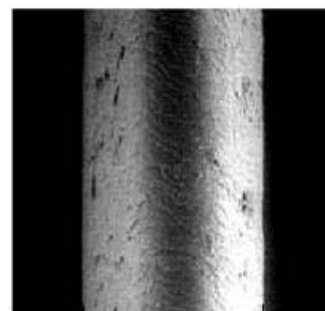
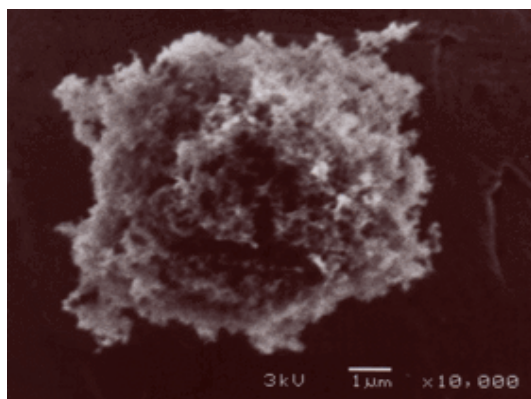
MOD08_M3.005 Aerosol Optical Depth at 550 nm [unitless]
(Nov2007 - Dec2007)



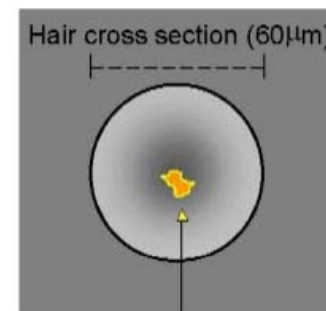
Key Messages Cont.

- Review of the available evidence indicates that there are likely to be very significant public health impacts from biomass-burning aerosols.
- In India and China, increases in anthropogenic $PM_{2.5}$ concentrations of $20 \mu\text{g}/\text{m}^3$ were used to estimate the potential effect of biomass-burning aerosols on mortality. It is inferred that 337,000 excess death per year can result from inhalation of biomass-burning aerosols or atmospheric brown clouds (ABC)...**UNEP Summary Atmospheric Brown clouds: Regional Assessment Report with Focus on Asia, Ramanathans et als. 2008**

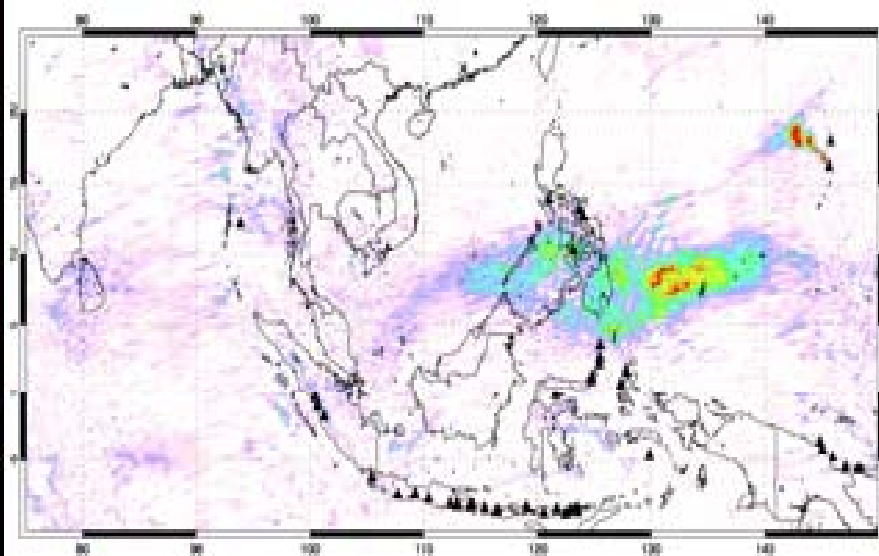
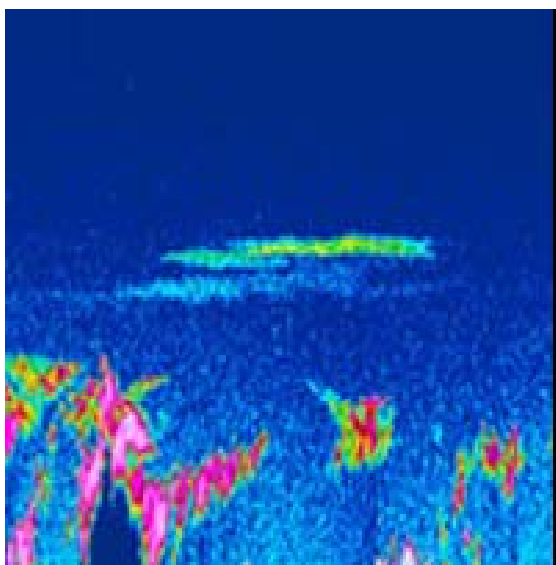
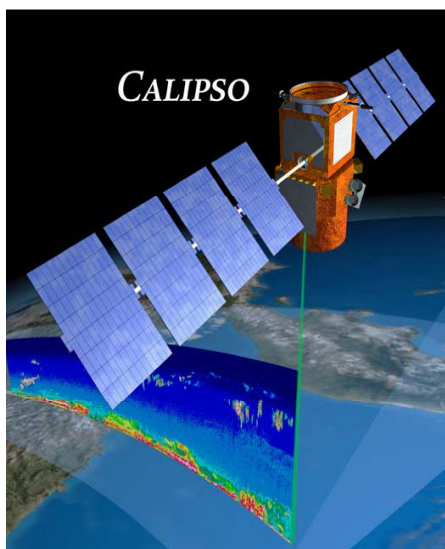
Size of Soot particle and sulfur dioxide plume over Indonesia originated from volcanic activity of Soufriere in the Caribbean(June 6-8,2006)



Human Hair
(60 μm diameter)



Particulate matter
such as a soot particle
(10 μm)

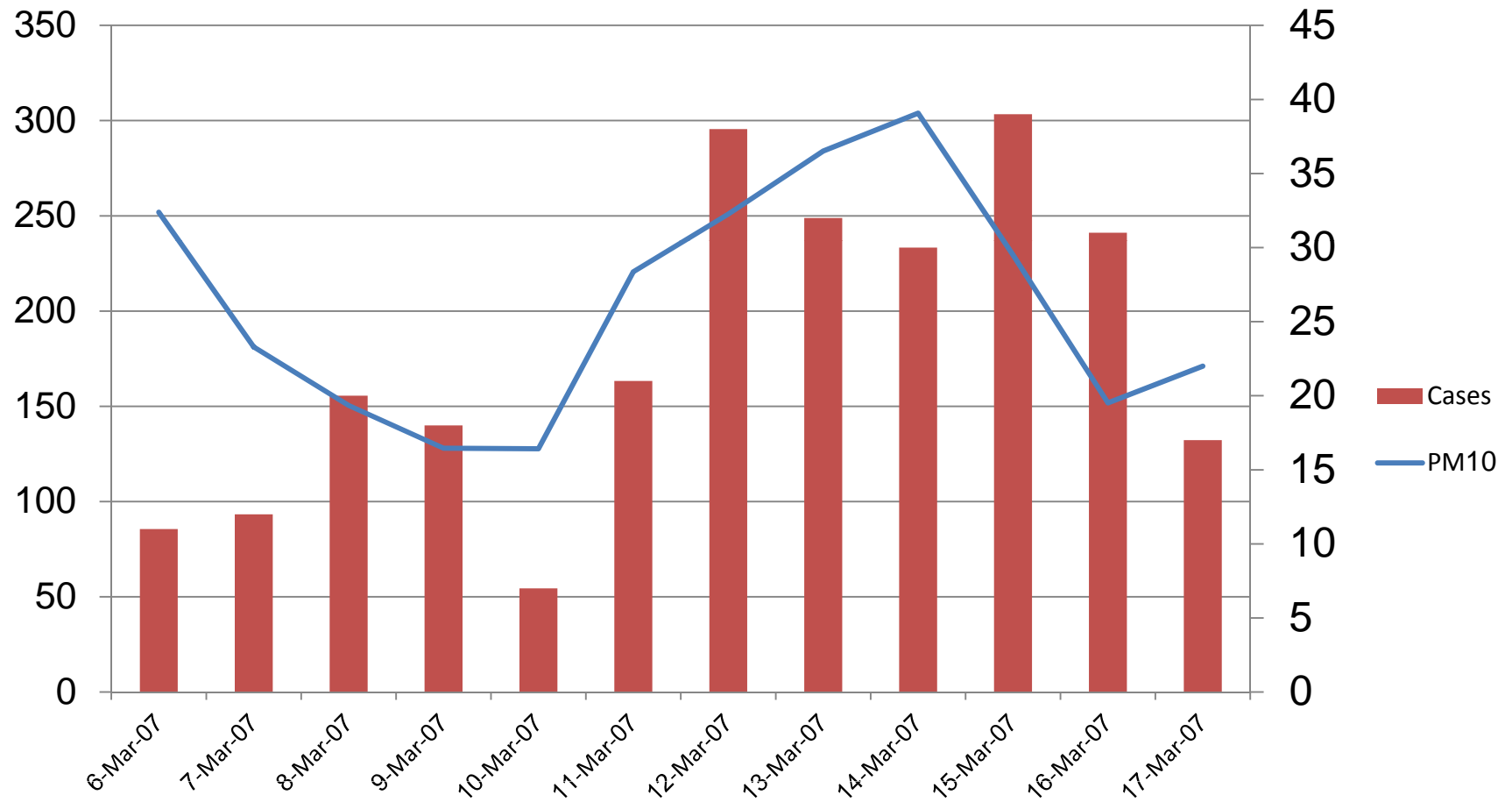


PM10 and incidence of respiratory illness in Chiang Mai during March 2007 [Stoch Environ Res Risk Assess (2008) 22: 437-440]

- In Thailand daily PM10 level in Chiang Mai were from the Pollution Control Department (PCD) measured at the Government Center, Mae Rim, where the overall incidence of respiratory illness in Chiang Mai were derived from the reported registry data of Mae Jam Community hospital with the permission of the hospital administrator.

Correlation between PM10 and incidences of respiratory illness in Chiang Mai, March 2007

Wiwanitkit V. Stoch Environ Res Assess, 2008

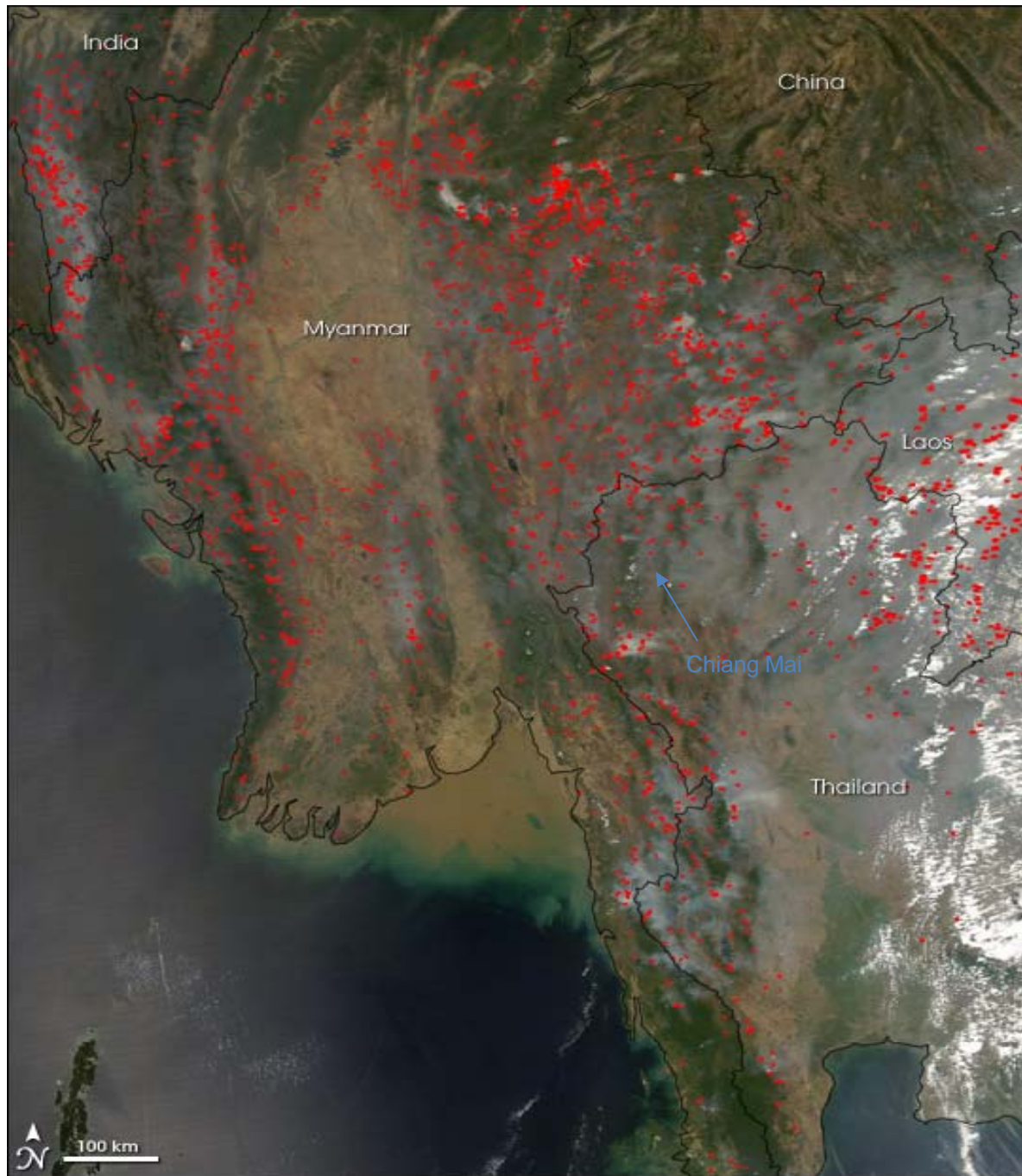


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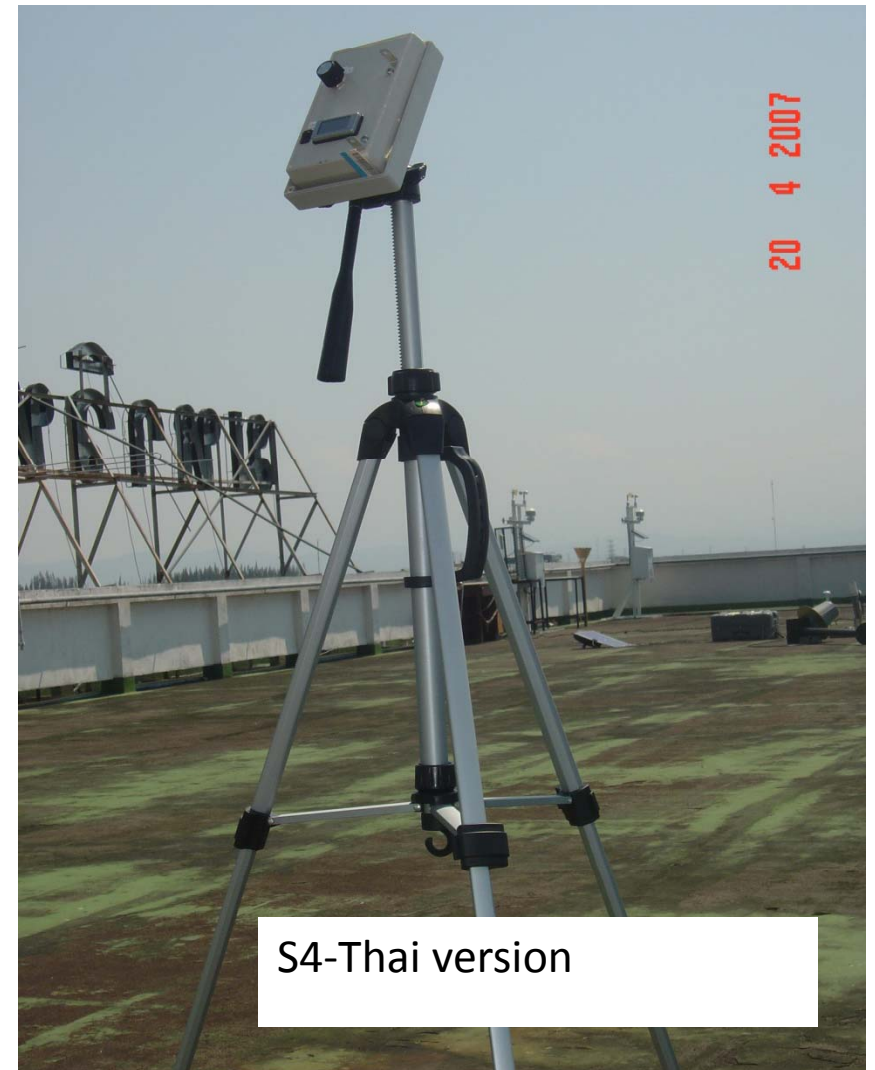
March 18, 2007

MODIS- Aqua

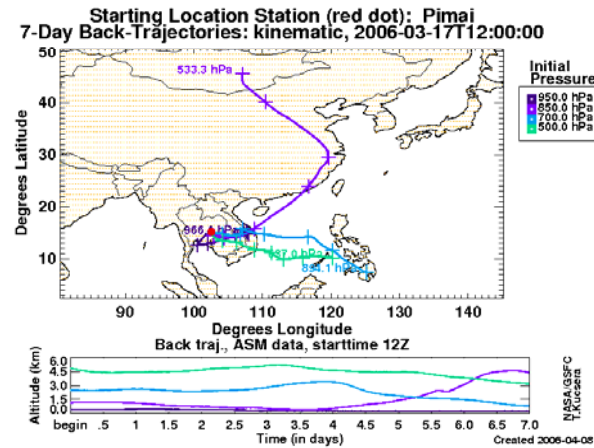
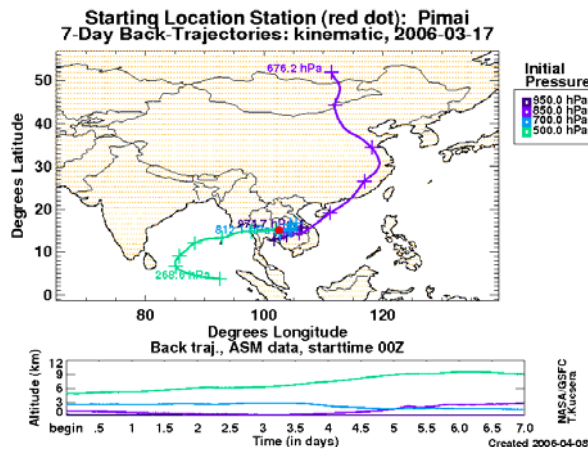
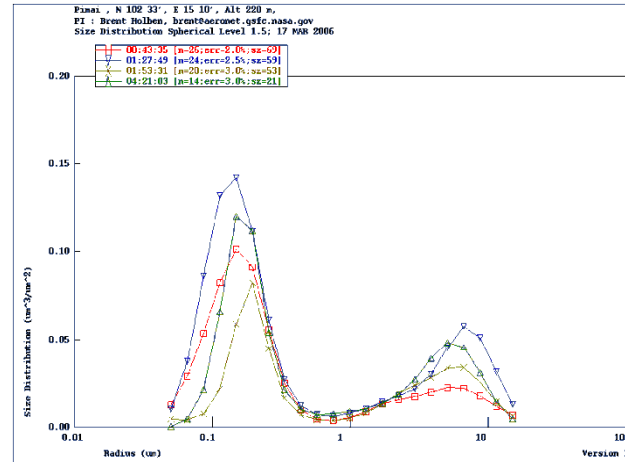
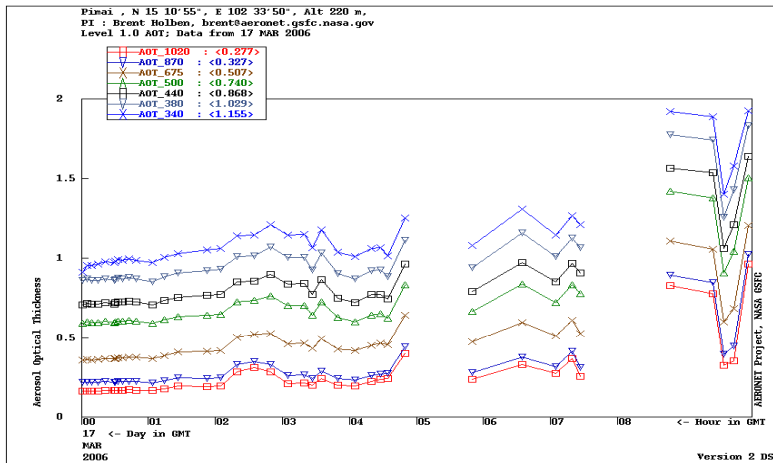
แผนที่ไฟจากภาพถ่าย
ดาวเทียม Aqua-MODIS
วันที่ 18 มีนาคม 2550



3 Generations of sunphotometers

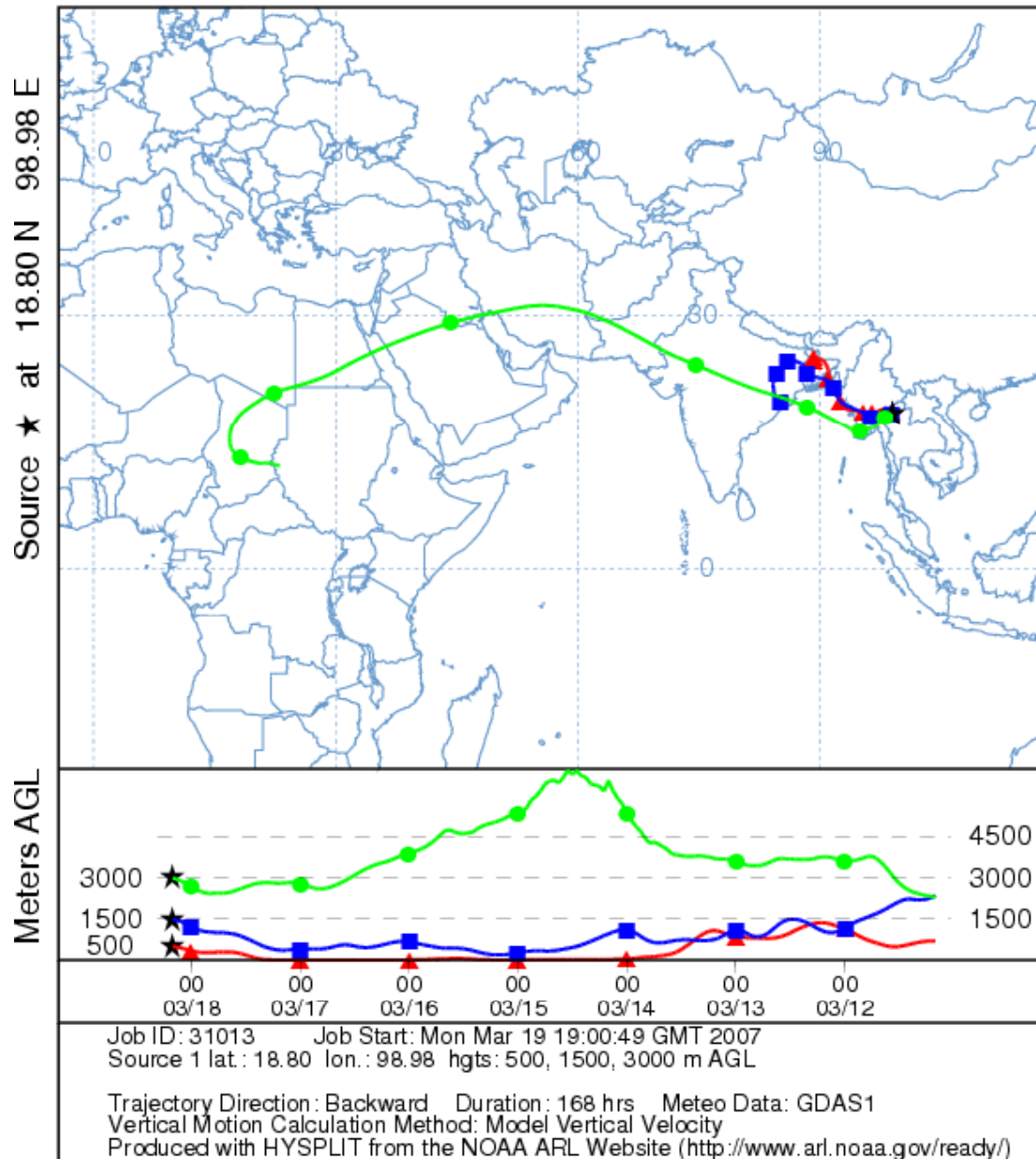


Aerosol optical thickness, AOT



7-day Back trajectory analysis

NOAA HYSPLIT MODEL
Backward trajectories ending at 04 UTC 18 Mar 07
GDAS Meteorological Data



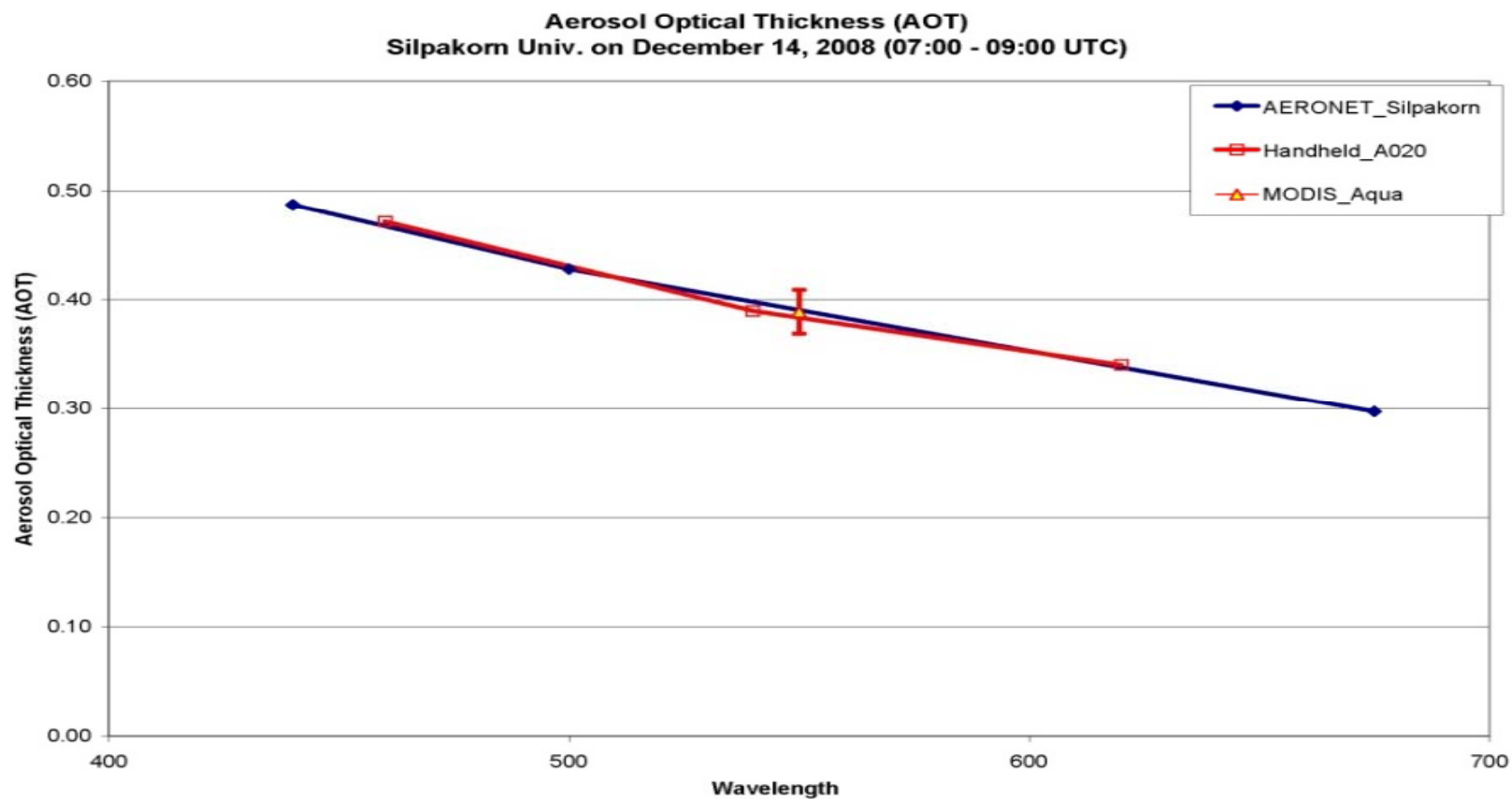
7-Day Back
Trajectory to
Chiang Mai

March 18, 2007

การเคลื่อนที่ของมวล
อากาศจากอินเดีย ผ่าน
พม่าเข้าสู่ เชียงใหม่

วันที่ 18 มีนาคม 2550

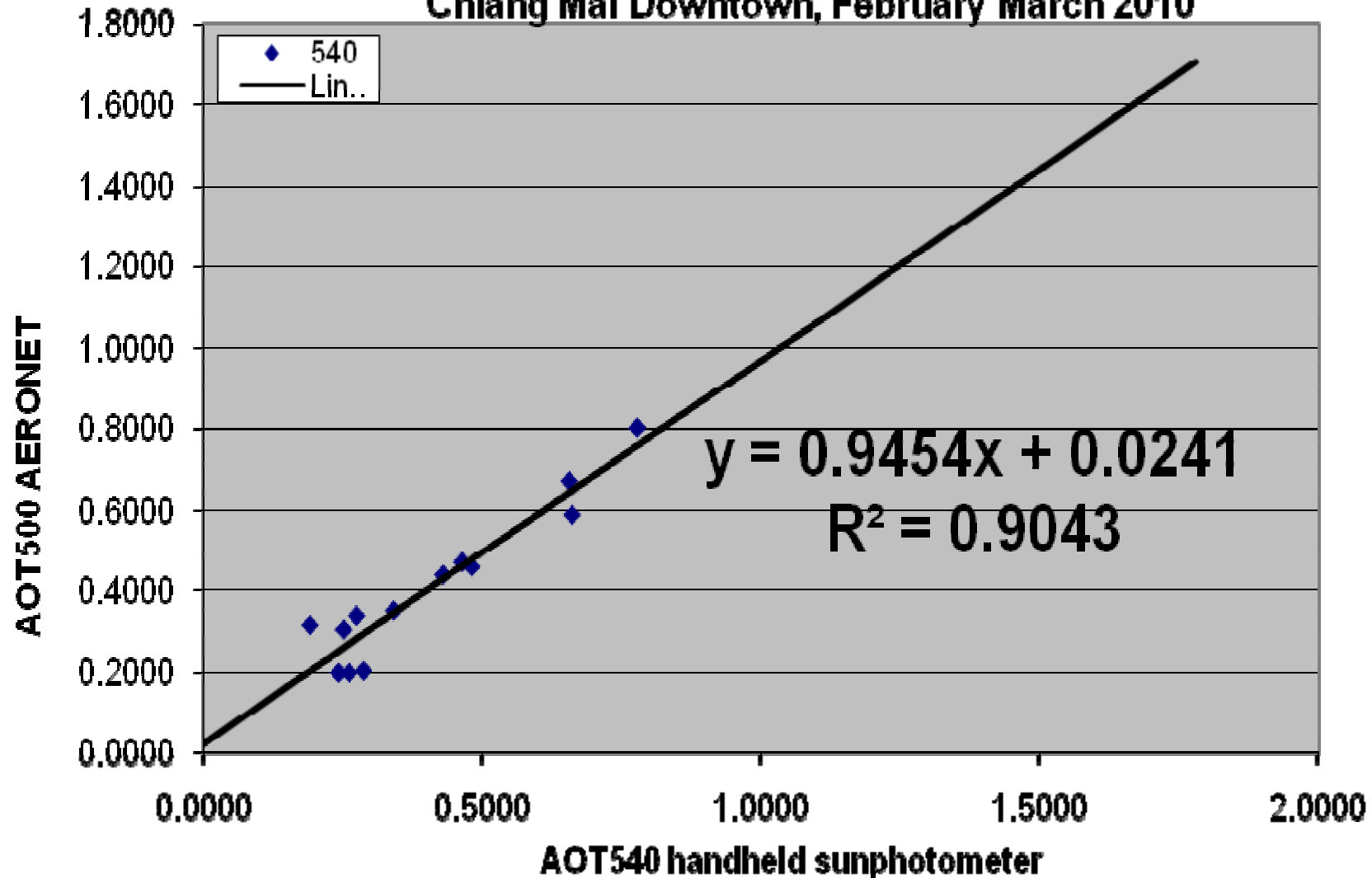
Good agreement among Handheld sunphotometer (HSP), AERONET and MODIS AOT



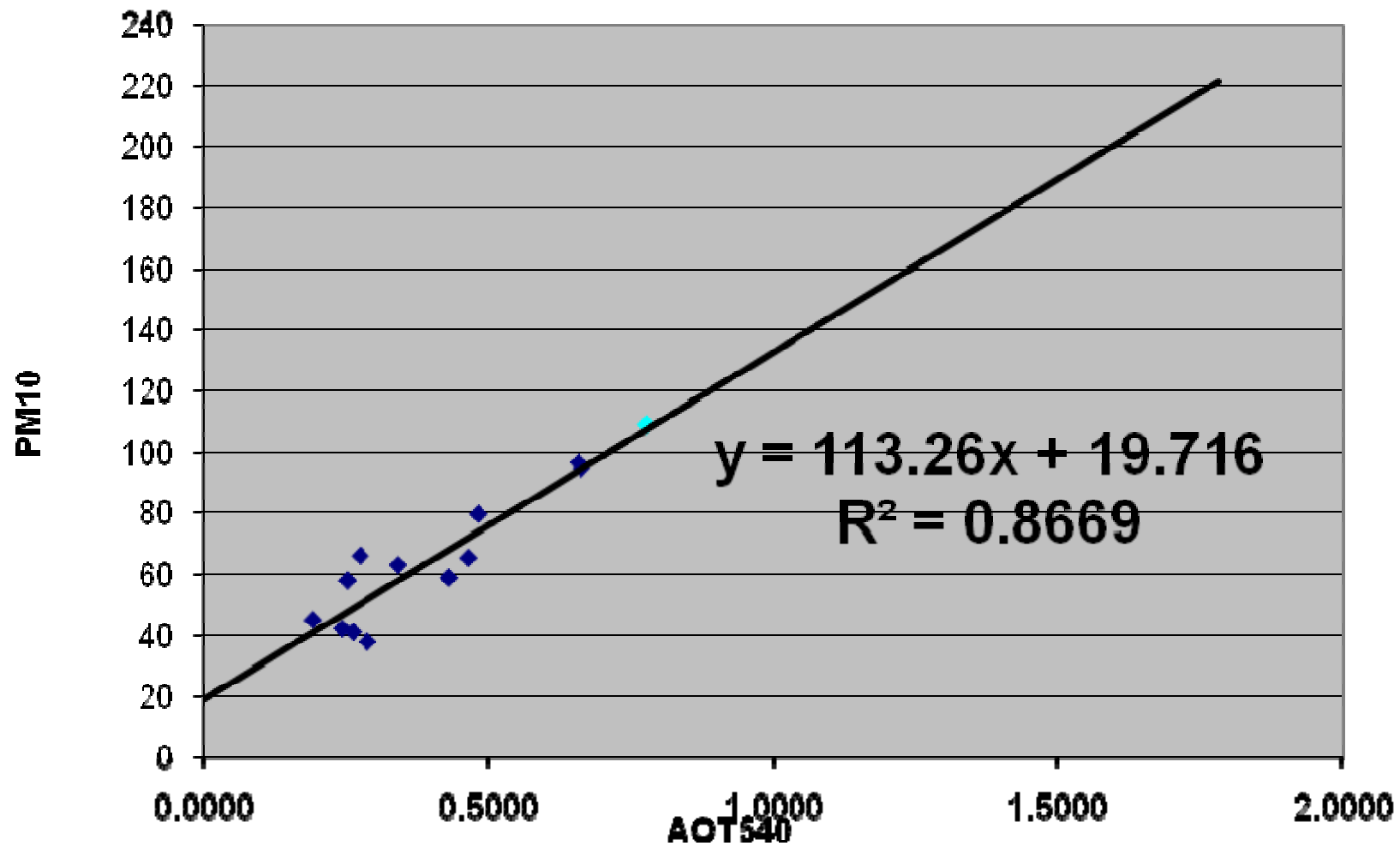
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Correlation between AOT540 HSP and AOT500 AERONET (Daily Average)

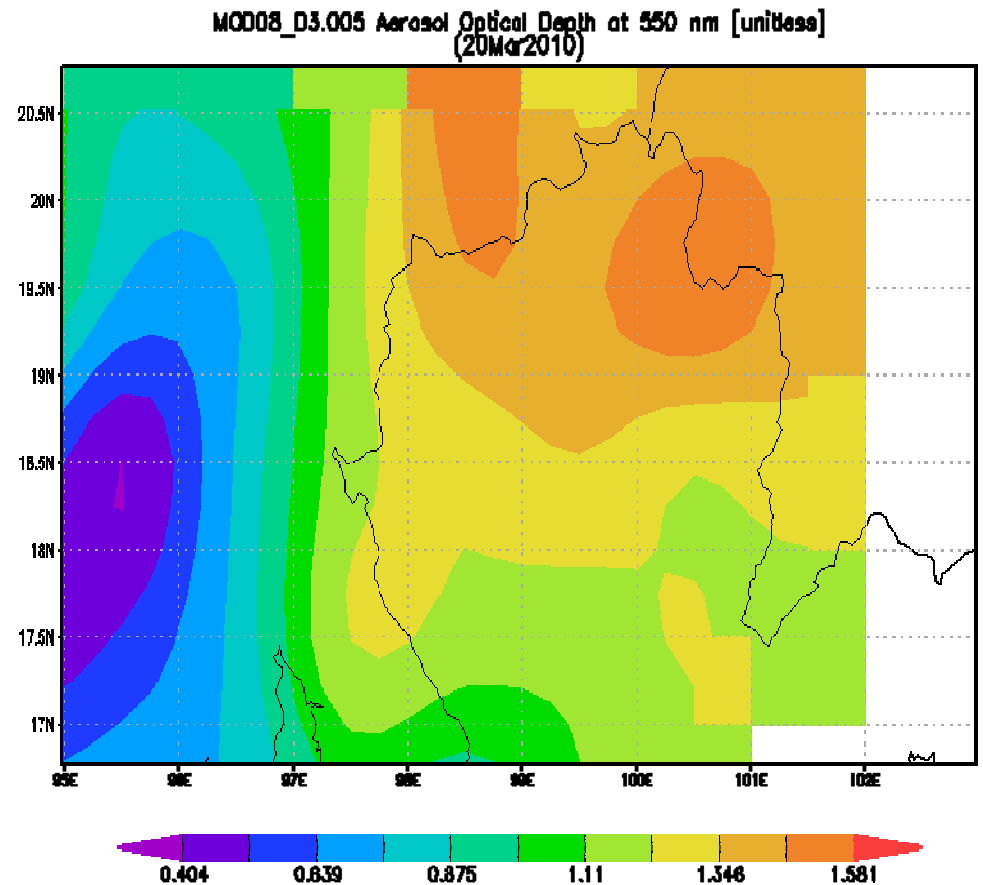
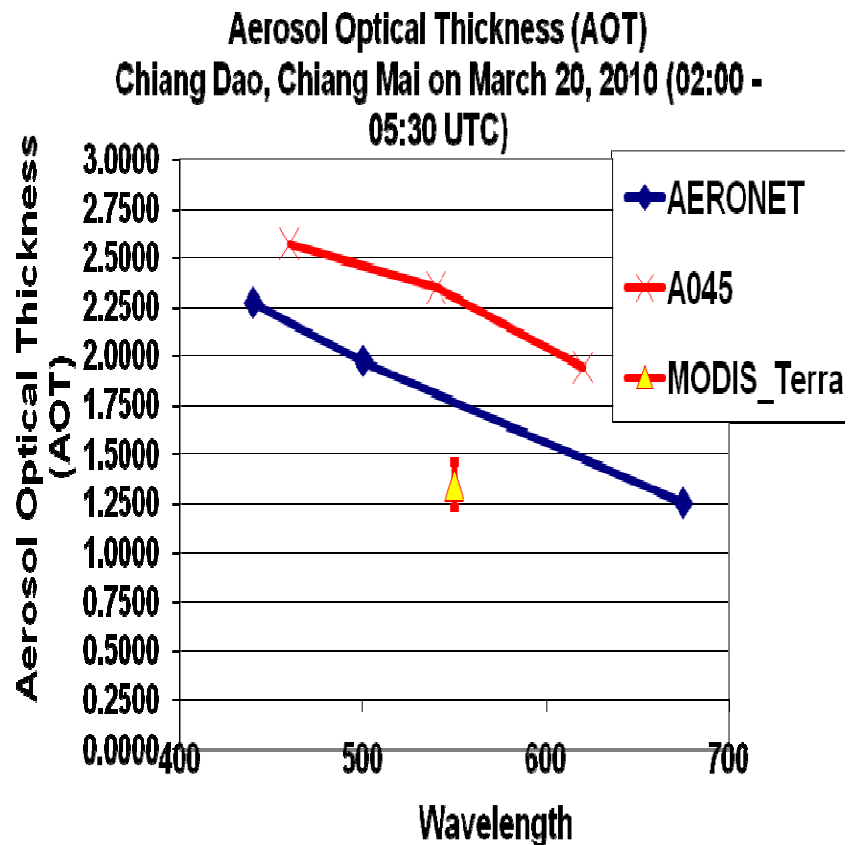
Chiang Mai Downtown, February March 2010



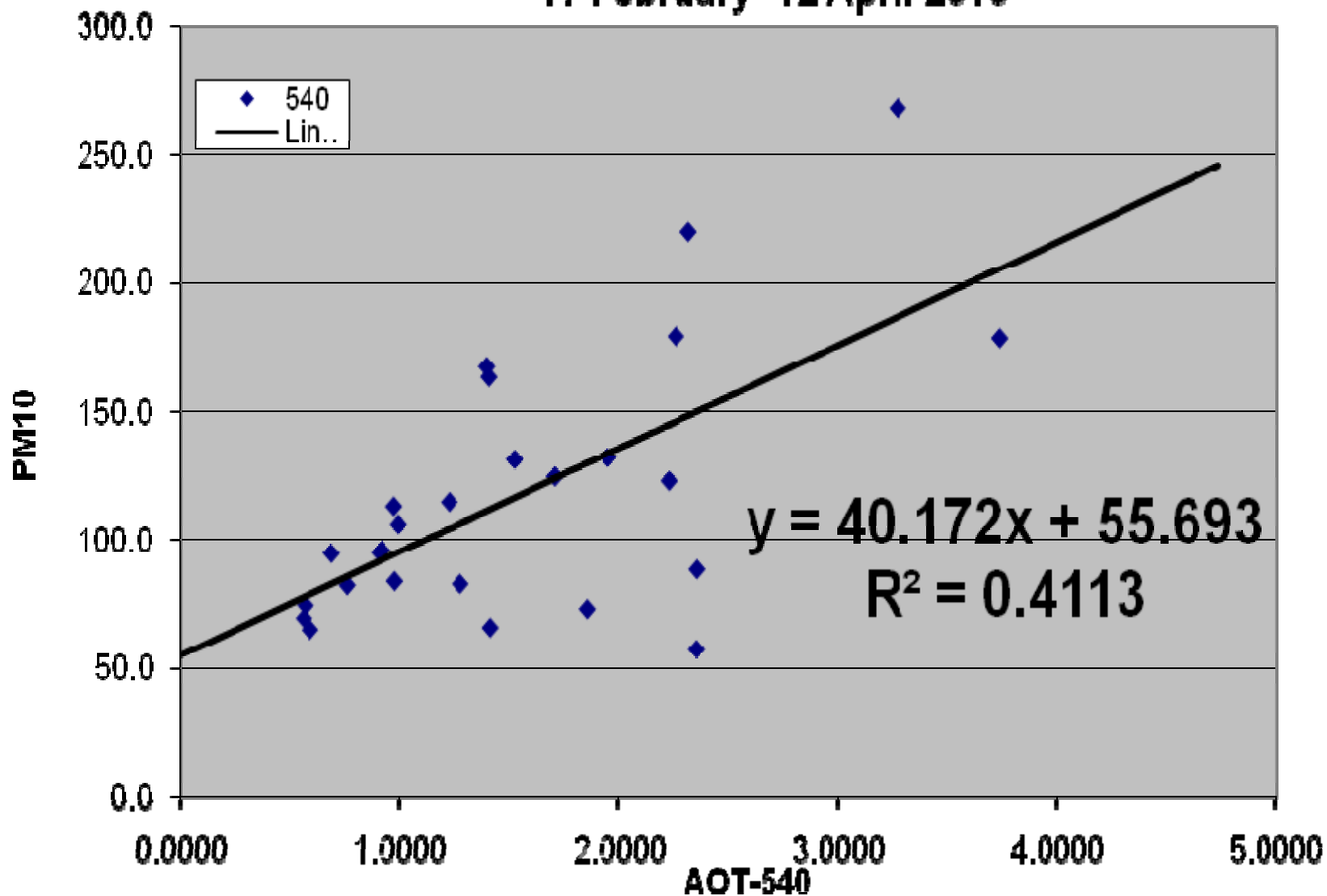
Correlation between AOT540 and PM10(daily average) Chiang Mai, February, March 2010



Smoke haze from forest fire on March 20, 2010 as measured by HSP in Chiangdao, 70 km from Chiang Mai downtown compared with AERONET and MODIS - 550 nm



Correlation between AOT 540 at Chiang Dao and PM10 - Salaklang (Daily Average) 17 February -12 April 2010

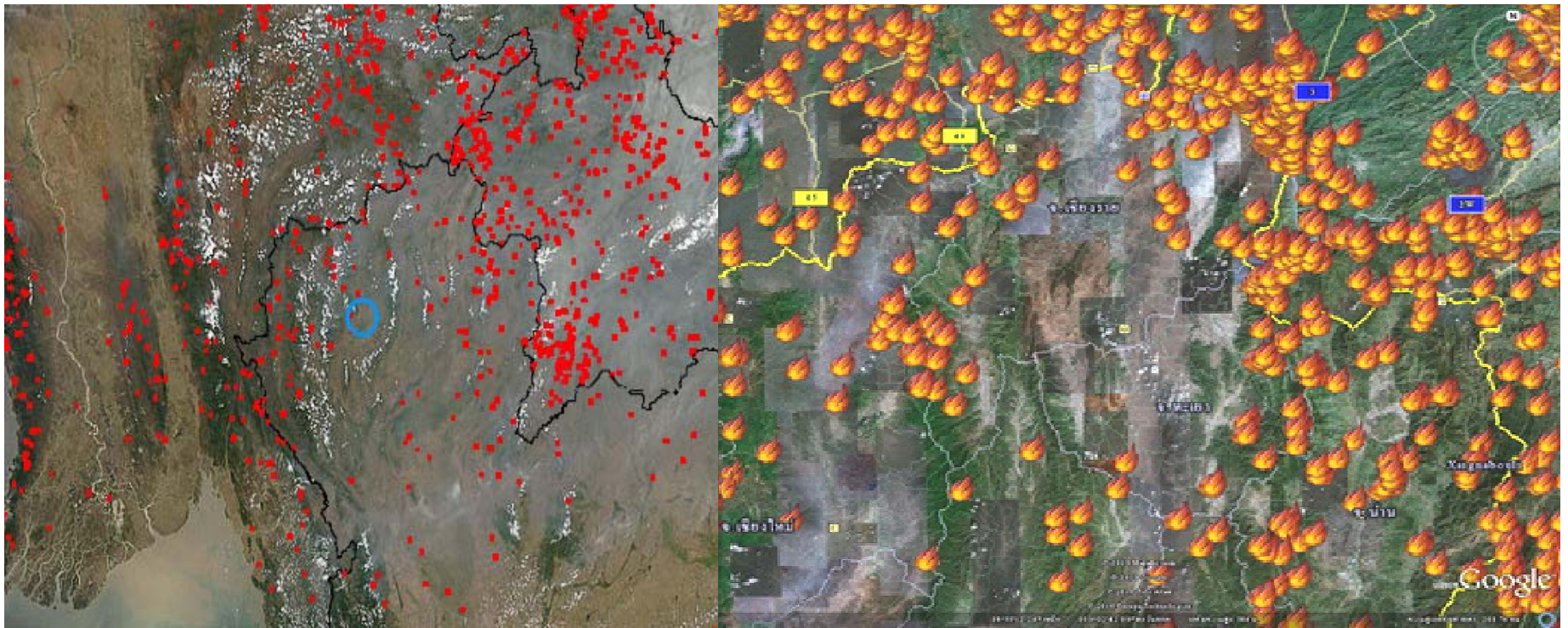


Smoke haze in Chiangdao 12-13 April 2010



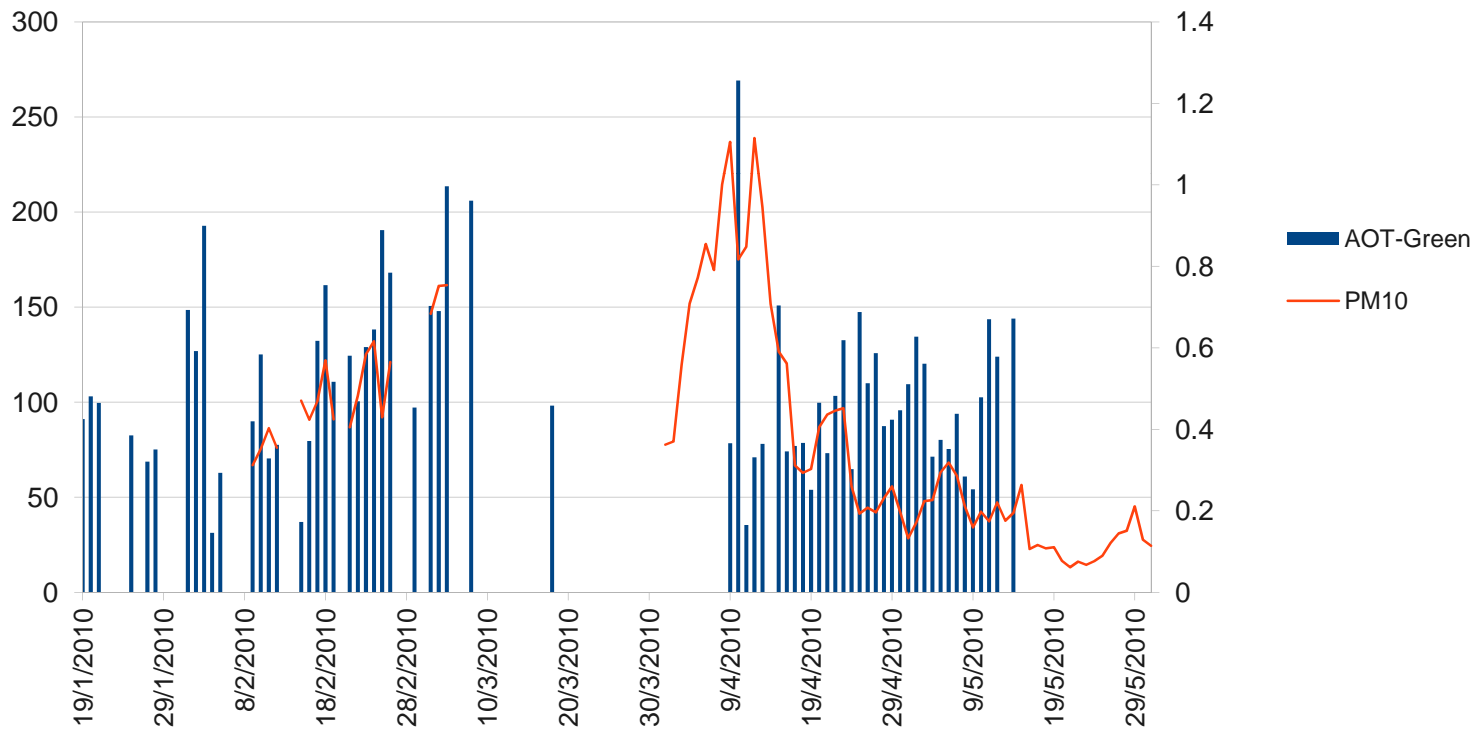
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MODIS fire map and KML-Google map of hotspot in the northern part of Thailand, showing fire also in Myanmar and Lao PDR Date 13 April 2010



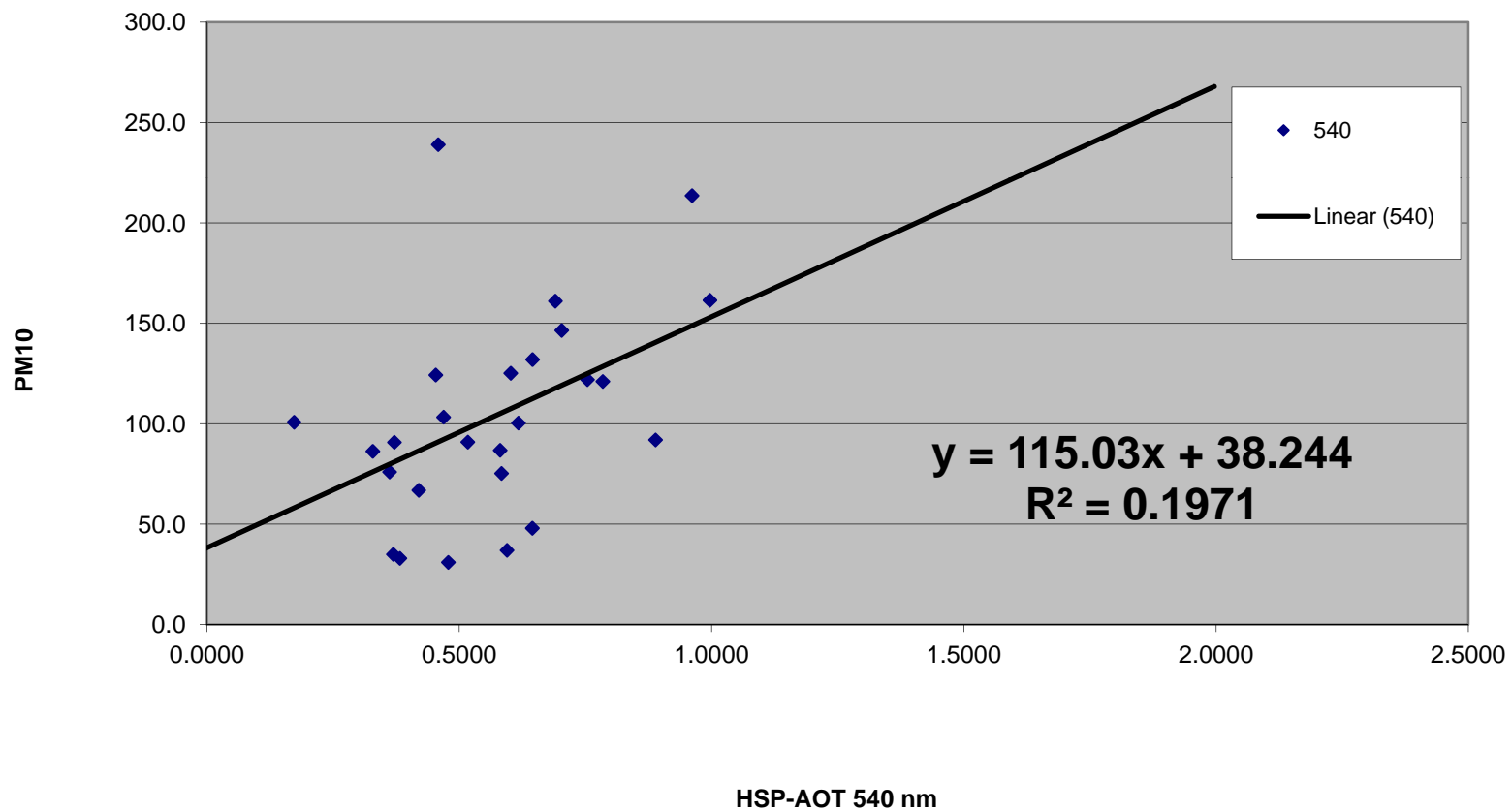
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Comparison between HSP-AOT-540nm measured at Tanthong Withaya School in Pan district and PM10 measured in Chiangrai downtown from Jan-May 2010

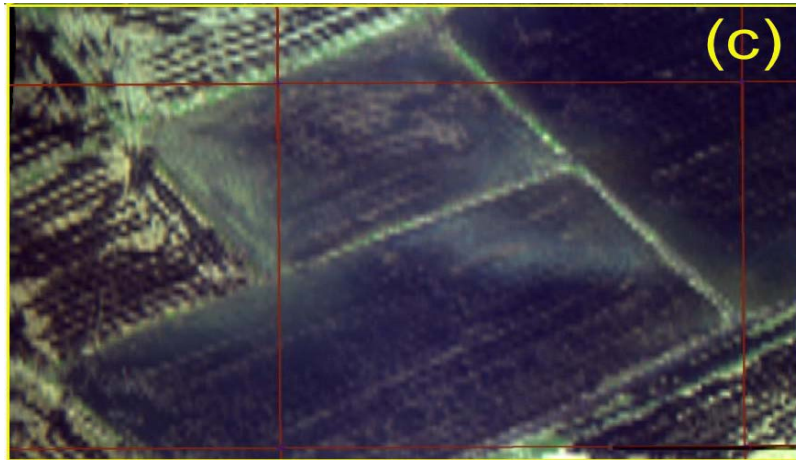


Daily PM10 in Chiangrai: 19° 54' 41''N, 99° 49'27''E AOT540 in Tanthong Witaya School: 19° 42'6.4''N,99° 43'38.5 E

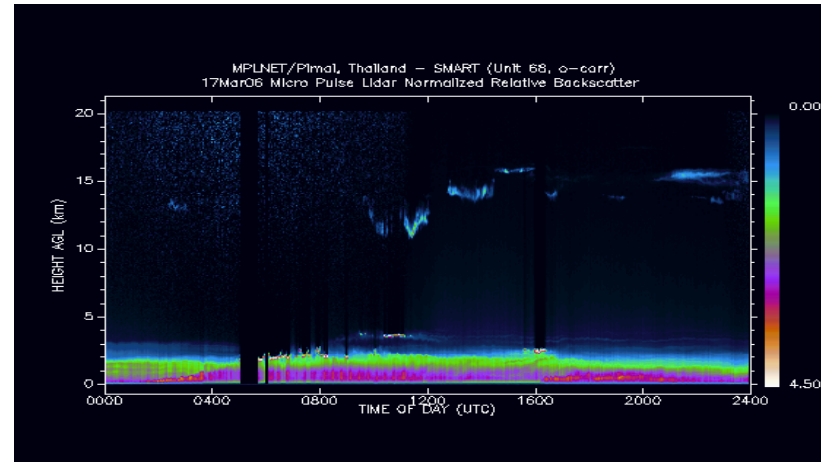
Correlation between AOT540 at Chiangrai-Tanthong witaya and PM10 at Chiangrai downtown
1 November 2009- 18 March 2010



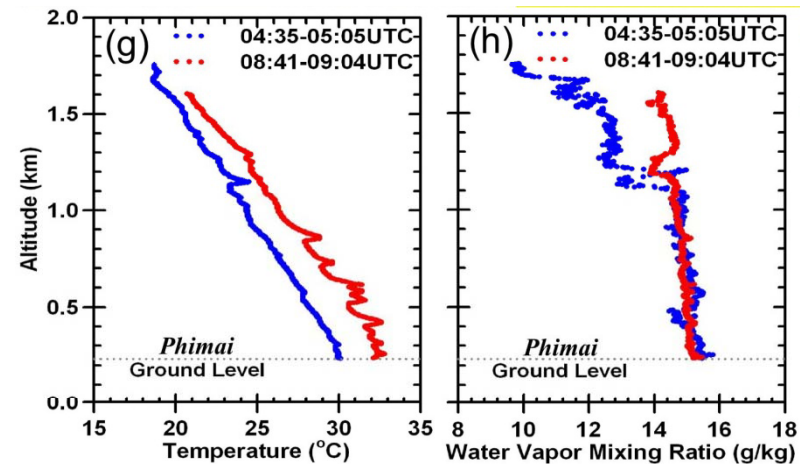
Integrated studies: aircraft, tether balloon and micro-pulse Lidar (17/3/06)



C. Hyperspectral images from CASA 100 aircraft showed smoldering fire



Micro-pulse Lidar showed aerosol layer ~2 km altitude



g. Temperature profiles, blue –morning; red afternoon by tethered balloon

ASEAN Agreement on Transboundary Haze Pollution

- In July 2007, the Ministry of Natural Resources and Environment hold a Workshop on Fire and Haze in the Mekong Sub-Region in Bangkok, and the meeting agreed to set up a Technical Working Group on Fire and Haze in Mekong-Sub-Region (TWG-Mekong) to develop action plan for mitigation of fire and haze pollution.

Health Impact of transboundary biomass-burning aerosols and anthropogenic ozone

- Anenberg et al., 2010 estimated that roughly 3.5 million cardiopulmonary and 220,000 lung cancer mortalities per year are associated annually with anthropogenic PM_{2.5} and 0.7 million per year with anthropogenic ozone.
- The death attributable to PM_{2.5} about 6% of all deaths that occur globally, therefore it is important to assess the health impact of transboundary aerosols, not just regional climate impact.