# Air Pollution Regional Research Network (AIRPET): planned activities and major findings

AIRPET website: http://serd.ait.ac.th/airpet

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# Highlights

- Asian Regional Air Pollution research network (AIRPET)

  Sponsored by Sida, coordinated by AIT

  Phase 1: 2001-2003

  Phase 2: 2004-2007

- Planned activities in phase 1 and phase 2
- Major findings

# AIRPET Team

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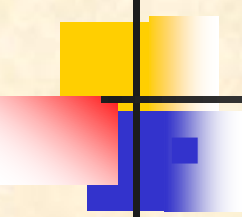**Jl. Ganesha No. 10**
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Project website http://www.serd.ait.ac.th/airpet/
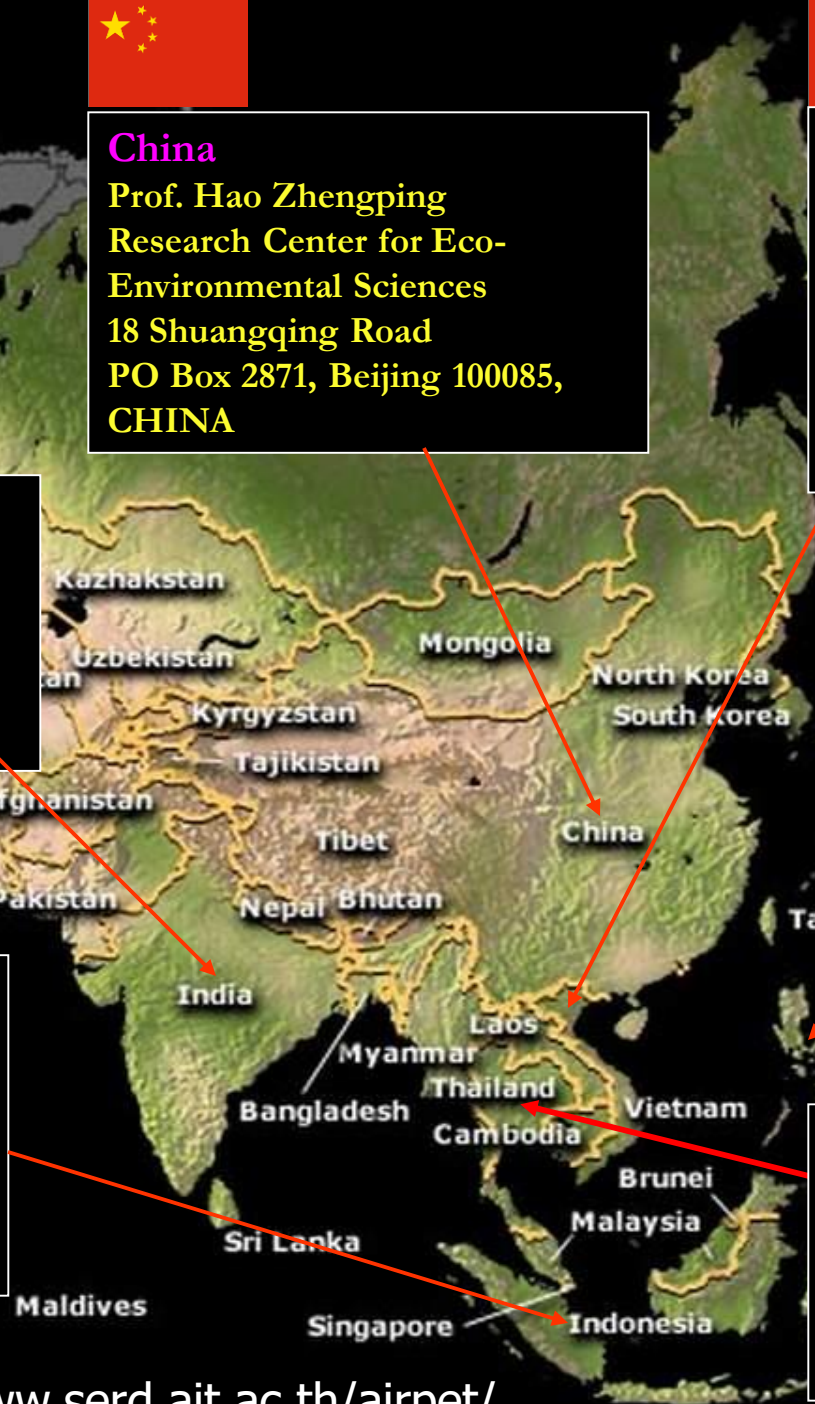
# AIRPET phase 1 & phase 2 Objectives

- To develop a comprehensive assessment of air quality in the region based on long term monitoring

- To develop appropriate control technologies for developing countries

- To use modelling tools for regional air quality management

- To apply integrated air quality management to reduce air pollution from target sources as the demonstration case.
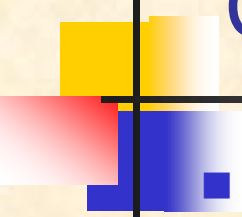
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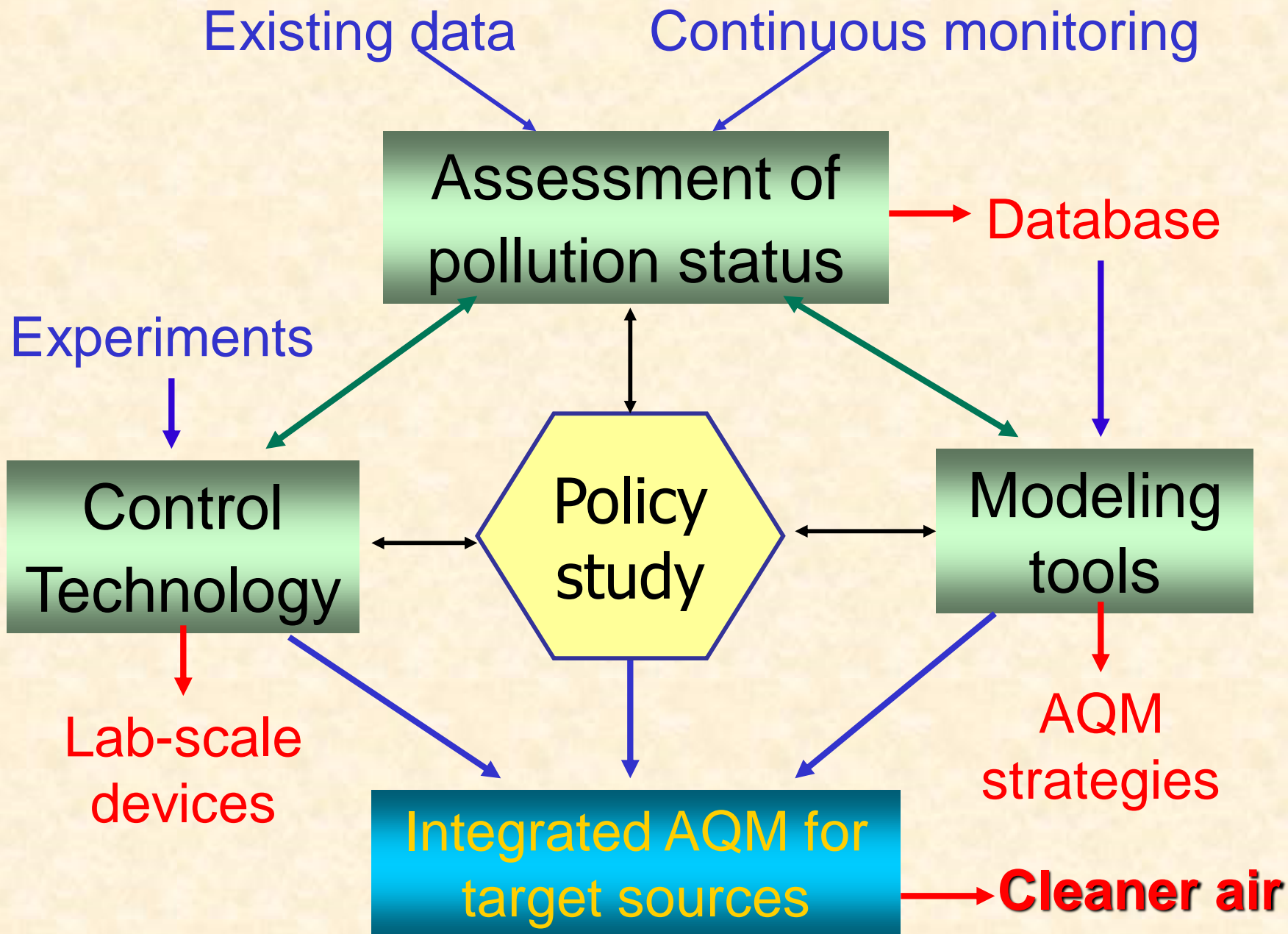
# AIRPET Planned Activities, phase 2

| NRIs | Monitoring (PM,organic, exposure) | Control | Modeling | | Integrated AQM |
|---|---|---|---|---|---|
| | | | PM Rec. | Disper. | |
| AIT | √ | | √ | √ | √ |
| China | √ | √ | √ | | √ |
| India | √ | √ | √ | | |
| Indonesia | √ | √ | √ | | √ |
| Philippines | √ | | √ | √ | |
| Vietnam | √ | | √ | √ | √ |

# **Monitoring Issue**

- PM: monitoring – levels of fine and coarse PM for dry and wet seasons

- Composition: anions, cations, elements, black carbon/organic carbon,

- Organic pollutants:  PCB, Pesticides, PAHs in gas & PM phase

# Design and Conduct Monitoring for Consistency and Uniformity with QA/QC

- Site selections:
  - Different site types: traffic, residential/mixed, commercial site, industrial, background/upwind (remote site)

- Monitoring period/times: cover seasonal variations (dry and wet)

- Sampling equipment for coarse/PM10 & PM2.5 using dichot and available equipment

- Analytical methods: existing equipment

# Achievements monitoring issue

Assessment of AQ status

- NRI country secondary database collected and updated: meteorology, geography, energy consumption, emission sources

- Monitoring: levels & composition of PM, POPs, VOC

- QA/QC:
  - Standard Reference Materials (GBW 08401) for PM composition analysis
  - Co-located samplers (with dichot, FRM) for PM mass conc. and composition cross-checking
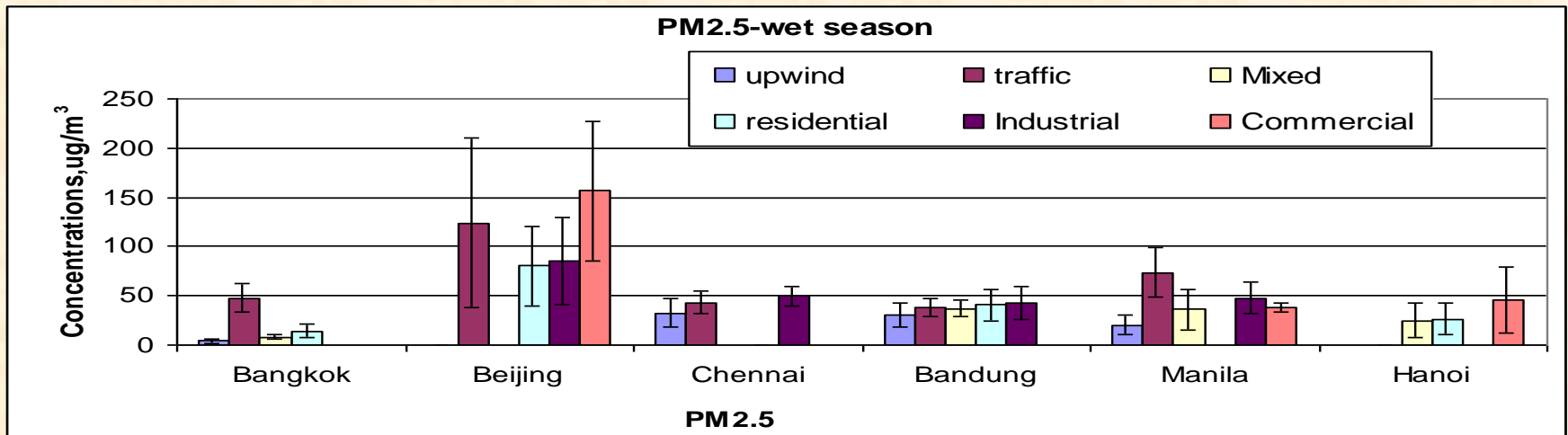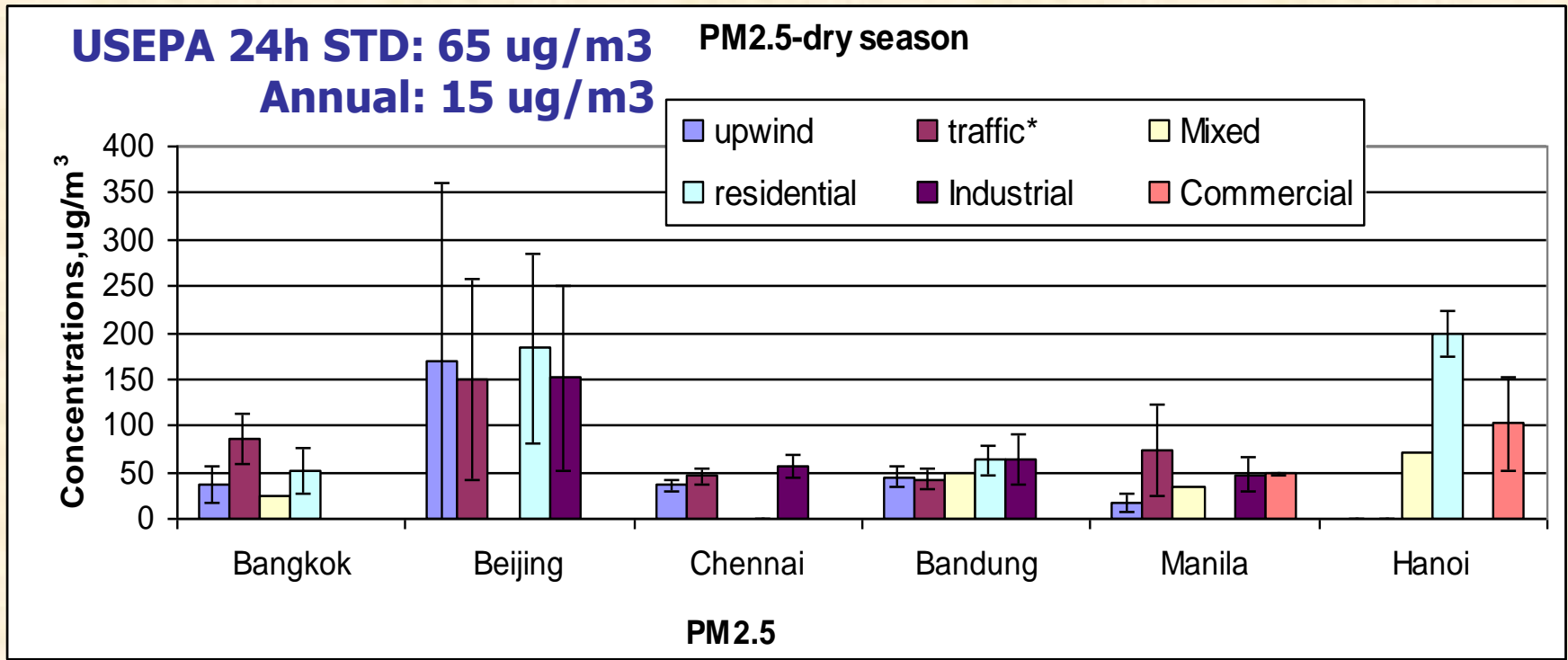  - QC samples

# Monitoring: Number of Samples in phase 1

| NRIs | TSP | PM$_{10}$ or Coarse PM | PM$_{2.5}$ | Total PM | Organics |
|---|---|---|---|---|---|
| AIT | - | 257 | 257 | 514 | 55 POP 80 VOC |
| China | 187 | 221 | 190 | 598 | |
| India | - | 190 | 190 | 380 | 50 (VOC) |
| Indo | 85 | 144 | 144 | 288 | 32 PAH |
| Phil | - | 188 | 773 | 961 | - |
| VN | 102 | (180+197) | 118 | 597 | 16 PAH |
| Total | 374 | 1377 | 1672 | 3338 | 233 |

# Number of Samples collected in phase 2

| NRIs | TSP | PM10* | PM2.5 | Total PM | Others |
|---|---|---|---|---|---|
| AIT | 36 | 102 | 102 | 240 | 34 (BTEX)<br>34 (gas)<br>36 POPs |
| China | - | 140 | 291 | 431 | - |
| India | - | 101 | 101 | 202 | 104 ($SO_x$)<br>104 ($NO_x$) |
| Indo | - | 64 | 64 | 128 | - |
| Phil | - | 18 | 18 | 36 | - |
| VN | - | 181 | 232 | 413 | - |
| Total in 2005 | 36 | 606 | 808 | 1450 | 312 |
| Total planned | 200 | 1335 | 1460 | 3495 | 500 |

# PM2.5 in Six AIRPET Cities



PM2.5-dry season

USEPA 24h STD: 65 ug/m3
Annual: 15 ug/m3

PM2.5-wet season

# PM10 in Six AIRPET Cities



**US 24h STD: 150 ug/m3**
**Annual: 50 ug/m3**

PM10-dry season

Legend: upwind, traffic*, Mixed, residential, Industrial, Commercial

Y-axis: Concentrations, ug/m³ (0–600)
X-axis cities: Bangkok, Beijing, Chennai, Bandung, Manila, Hanoi
PM10

PM10-wet season

Legend: upwind, traffic*, Mixed, residential, Industrial, Commercial
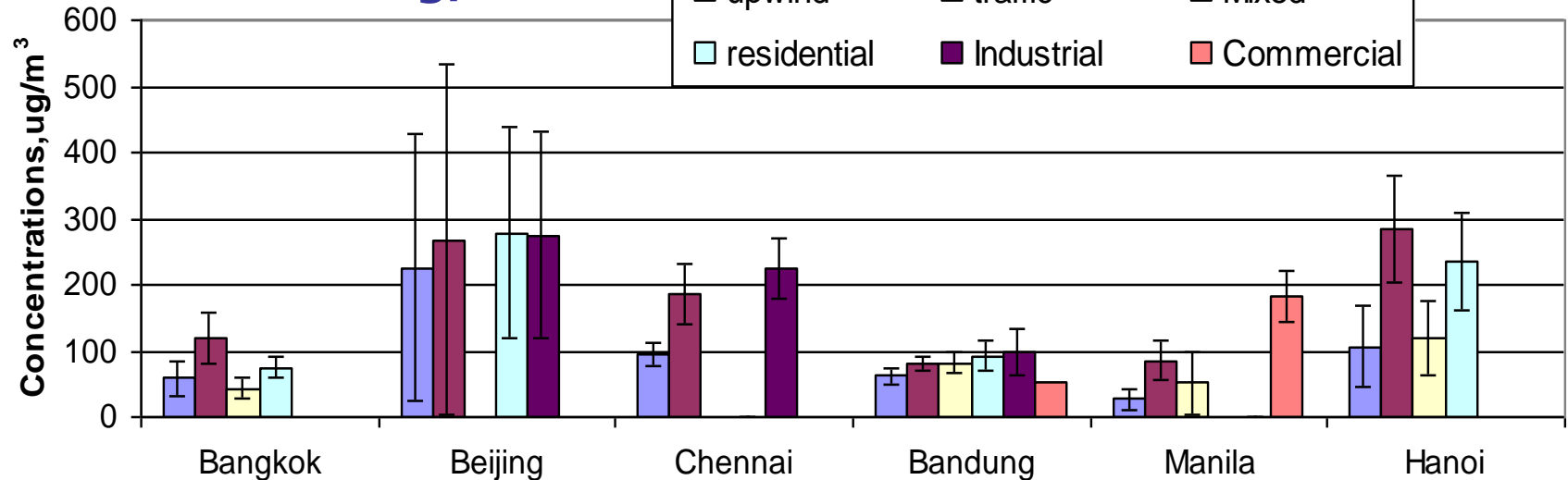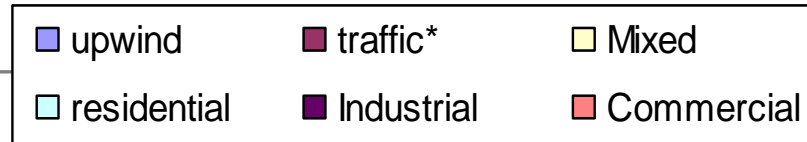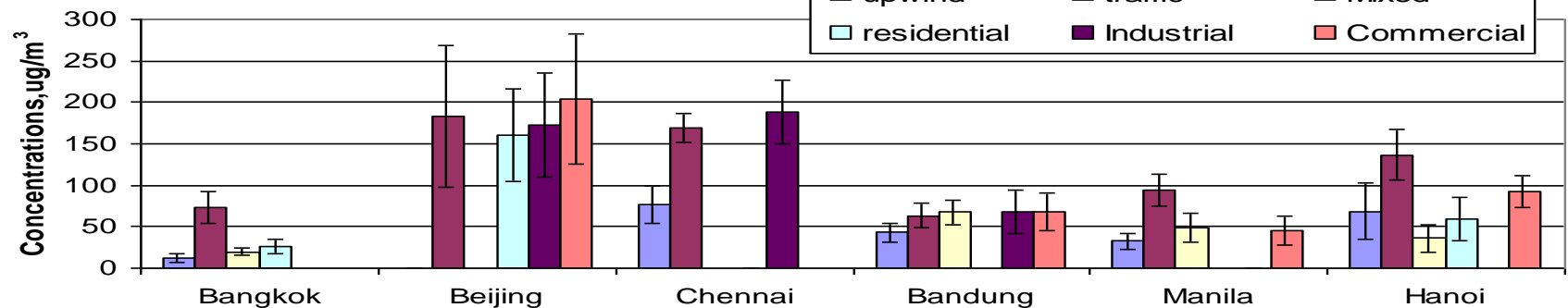
Y-axis: Concentrations, ug/m³ (0–300)
X-axis cities: Bangkok, Beijing, Chennai, Bandung, Manila, Hanoi
PM10

# Receptor Modeling for Source Apportionment  by all NRIs

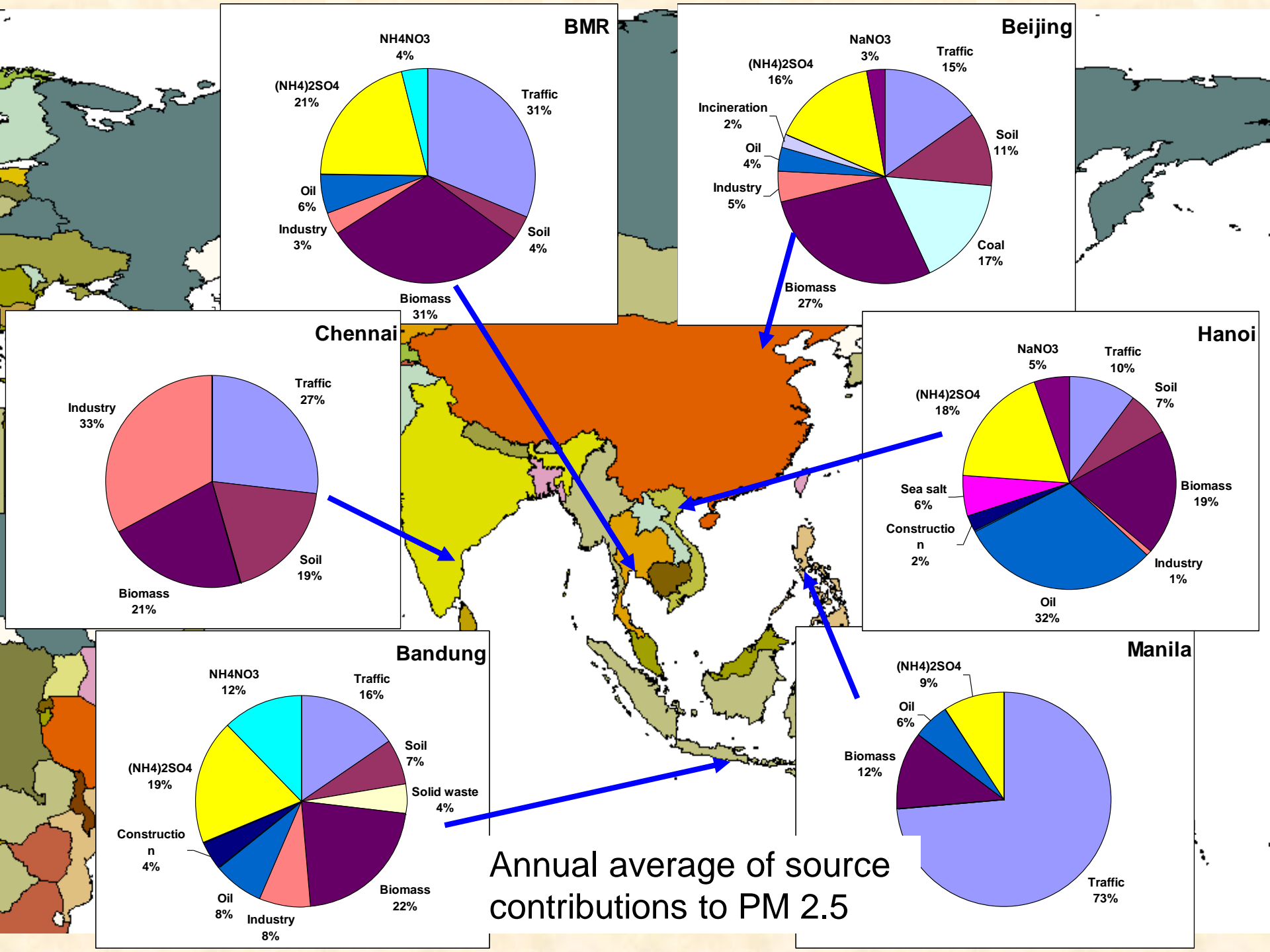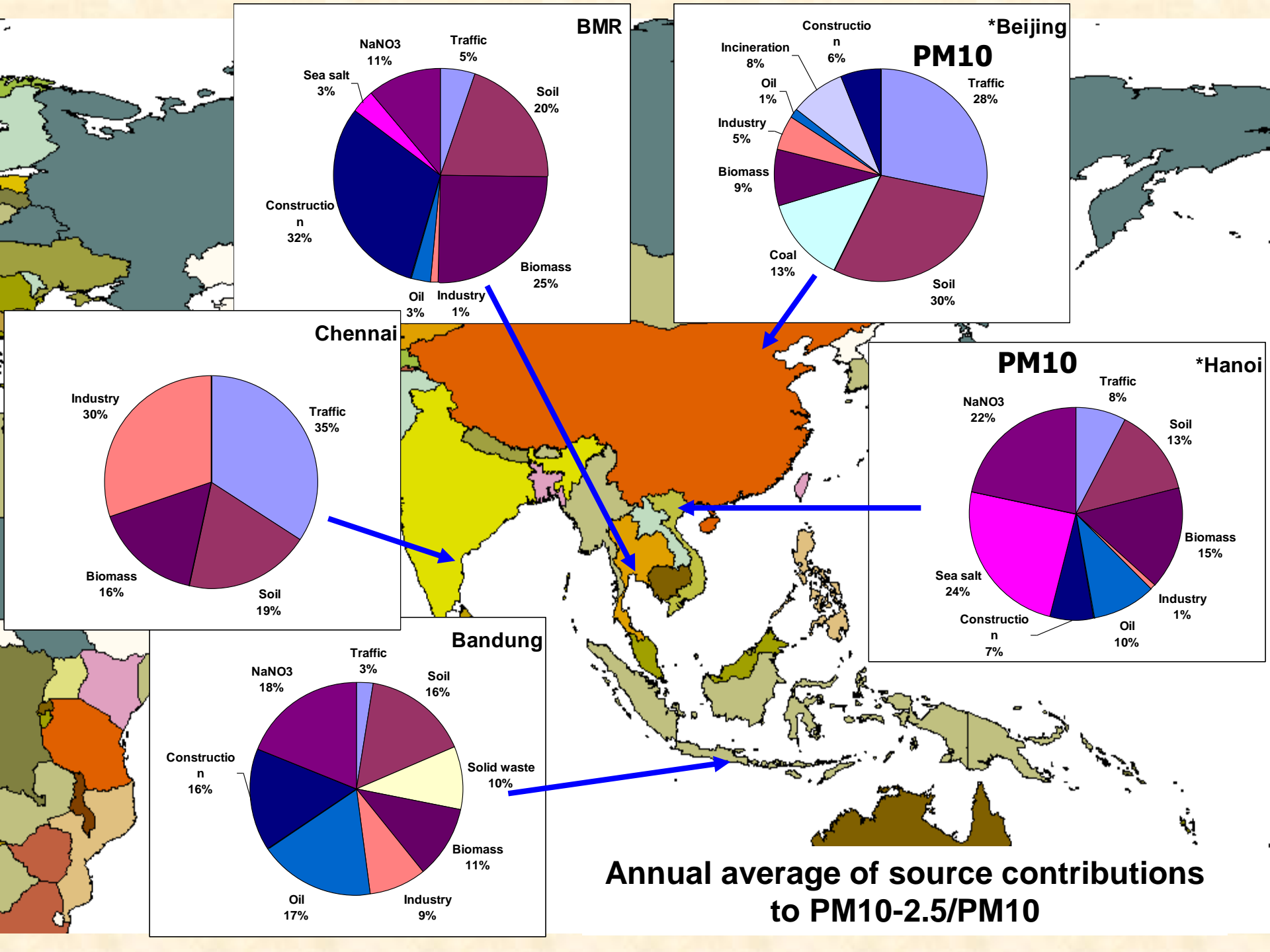- Applied Chemical Mass Balance Model (CMB8)

- Other models (Positive Matrix Factorization (PMF), Constrained Physical Receptor Model (COPREM), ME, etc.) for the sites with large numbers of samples

Annual average of source contributions to PM 2.5

**BMR**
- Traffic 31%
- Soil 4%
- Biomass 31%
- Industry 3%
- Oil 6%
- (NH4)2SO4 21%
- NH4NO3 4%

**Beijing**
- Traffic 15%
- Soil 11%
- Coal 17%
- Biomass 27%
- Industry 5%
- Oil 4%
- Incineration 2%
- (NH4)2SO4 16%
- NaNO3 3%

**Chennai**
- Traffic 27%
- Soil 19%
- Biomass 21%
- Industry 33%

**Hanoi**
- Traffic 10%
- Soil 7%
- Biomass 19%
- Industry 1%
- Oil 32%
- Construction 2%
- Sea salt 6%
- (NH4)2SO4 18%
- NaNO3 5%

**Bandung**
- Traffic 16%
- Soil 7%
- Solid waste 4%
- Biomass 22%
- Industry 8%
- Oil 8%
- Construction 4%
- (NH4)2SO4 19%
- NH4NO3 12%

**Manila**
- Traffic 73%
- Biomass 12%
- Oil 6%
- (NH4)2SO4 9%

**BMR**

NaNO3 11%
Traffic 5%
Sea salt 3%
Soil 20%
Construction 32%
Biomass 25%
Oil 3%
Industry 1%

**PM10** *Beijing

Construction 6%
Incineration 8%
Oil 1%
Industry 5%
Biomass 9%
Traffic 28%
Soil 30%
Coal 13%

**Chennai**

Industry 30%
Traffic 35%
Biomass 16%
Soil 19%

**PM10** *Hanoi

NaNO3 22%
Traffic 8%
Soil 13%
Biomass 15%
Industry 1%
Oil 10%
Construction 7%
Sea salt 24%

**Bandung**

NaNO3 18%
Traffic 3%
Soil 16%
Construction 16%
Solid waste 10%
Biomass 11%
Oil 17%
Industry 9%

**Annual average of source contributions to PM10-2.5/PM10**

# Control Devices (lab scale) Developed and Tested

| NRIs | Phase I | Phase II |
|------|---------|----------|
| AIT | Diesel exhaust pipe extension | - |
| China | PM trap-Catalytic soot oxidizer | Catalytic oxidation of VOCs |
| India | Biofilter : VOC emission | NOx, SOx removal with $O_3$ oxidation |
| Indo | Photocatalytic Reactor for NOx (red) | NOx Multiplate Reactor |

# Control Devise Issue

Indonesia: A Multi Plate Reactor

India: Photo catalytic Reactor

*China: Monolith Catalytic Materials  Used for VOCs*

# Dispersion Modeling Tool for Air Quality Management

| NRIs | Dispersion model |
|------|------------------|
| AIT | ■ Photochemical smog modeling: using UAM, CHIMERE, CAMx, CMAQ/MM5 for urban scale (BKK, Hanoi) and regional scale (Southeast Asia to assess the impacts on crops) ■ Other models: Climatological model, Mixing height calculation, ISC, etc |
| PHIL | ISC3: LT & ST for SPM in Manila |
| VN | ISC3 for SPM, UAM and CAMx for ozone in Hanoi |

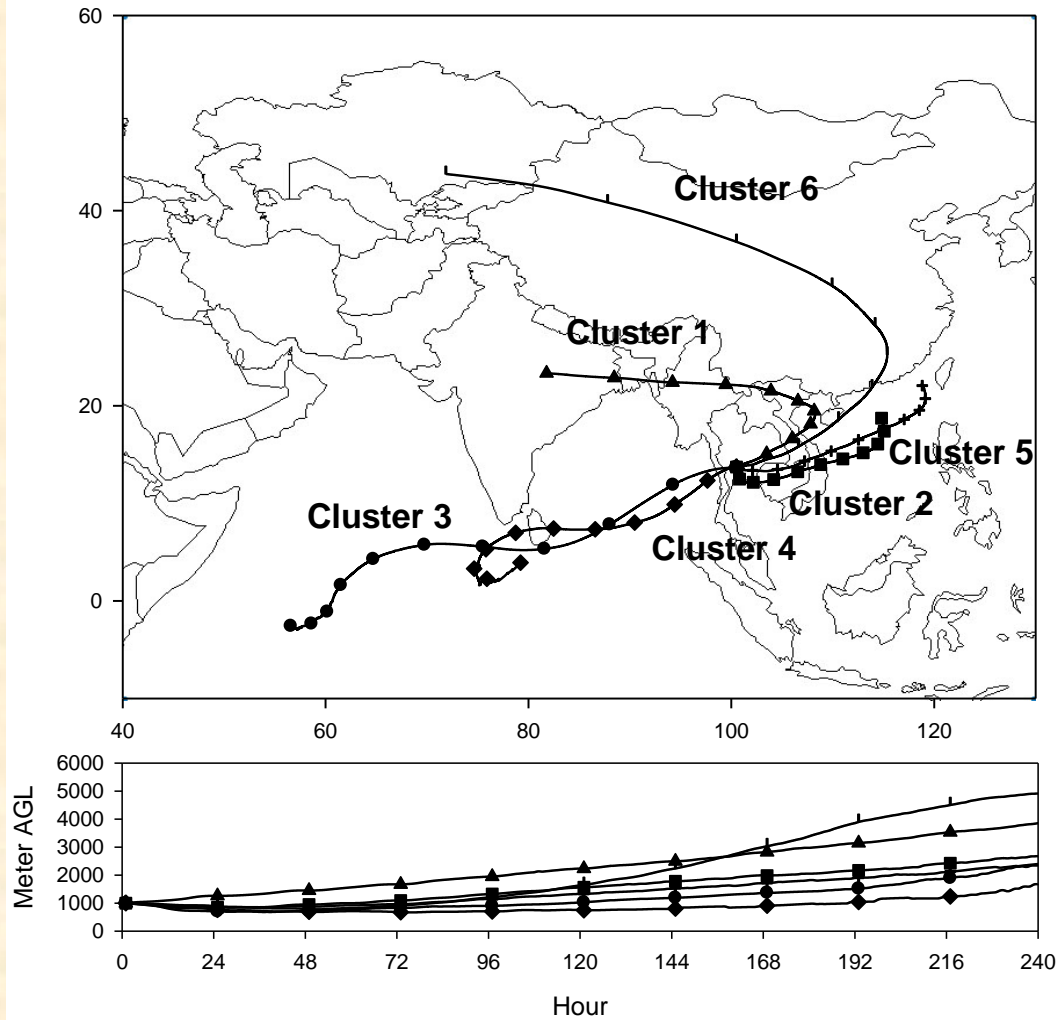# Sensitivity of $O_3$ formation in Bangkok, UAM-V/SAIMM
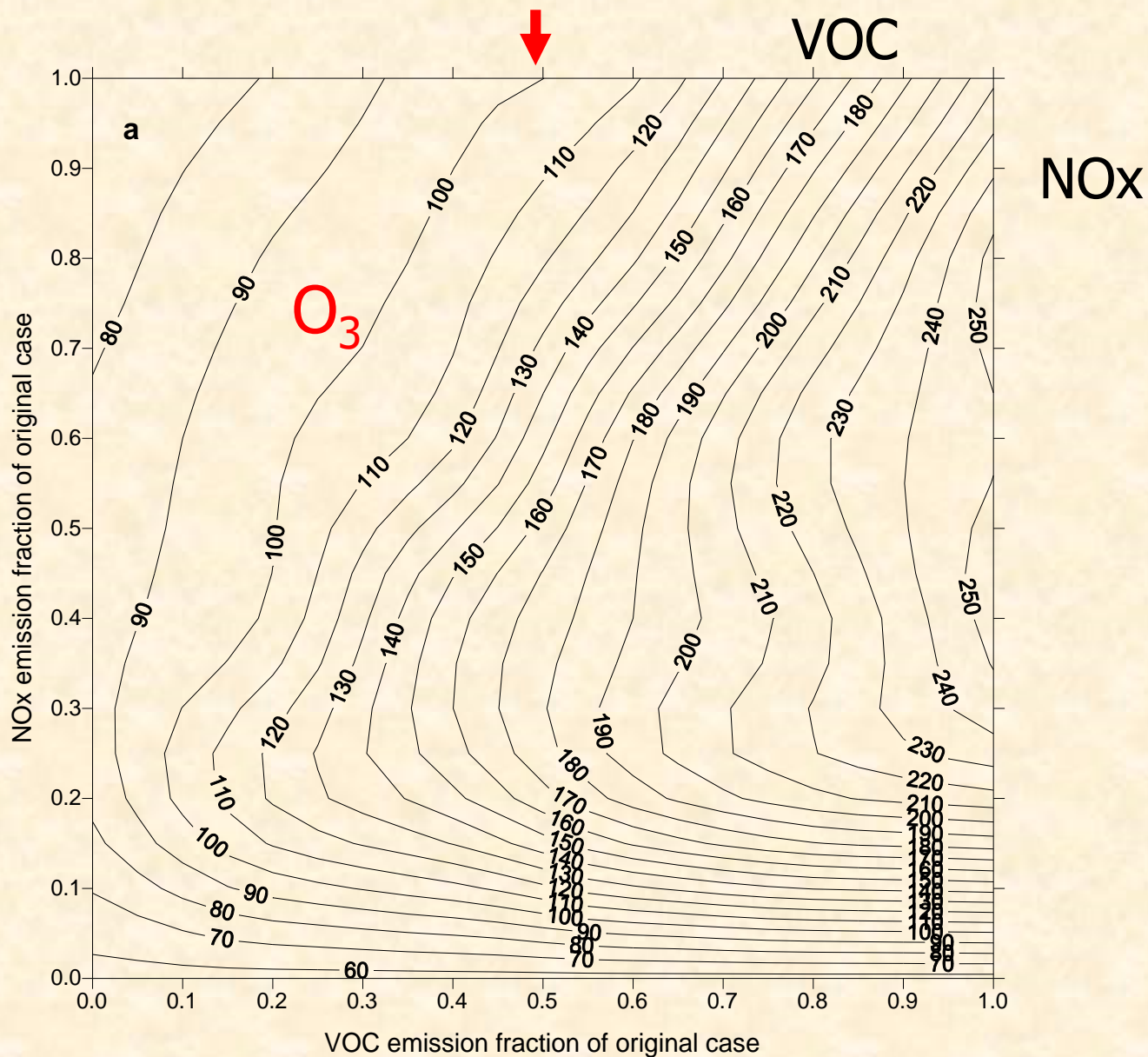
# Impact of Management Strategies on Peak 1-hr O$_3$ in Bangkok (UAM-V)
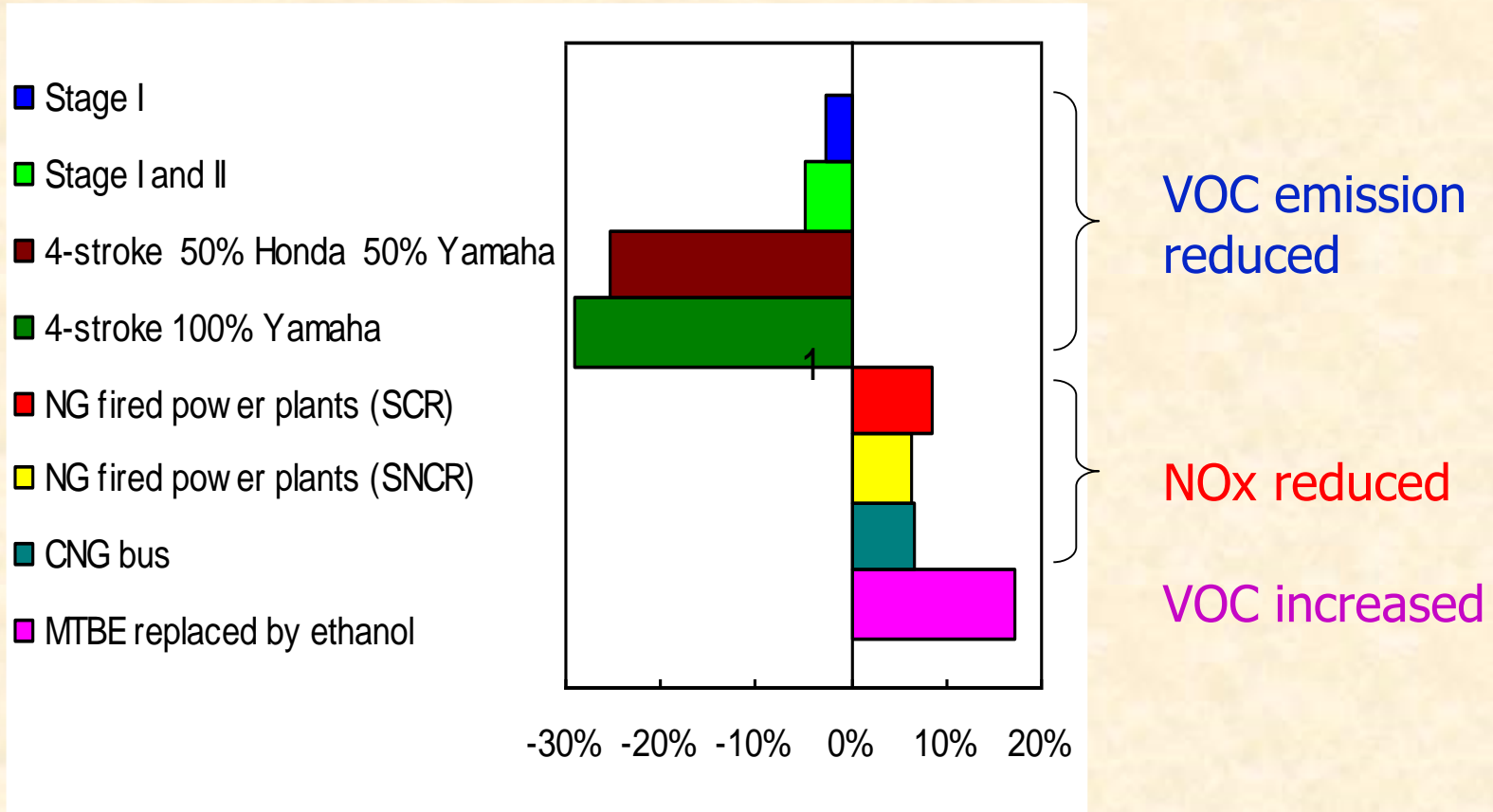
# Modeling O$_3$ concentration over SEA, CMAQ-MM5



CONTOUR MAP OF OZONE OVER CSEA DOMIAN - 15:00 LST MARCH 26, 2004
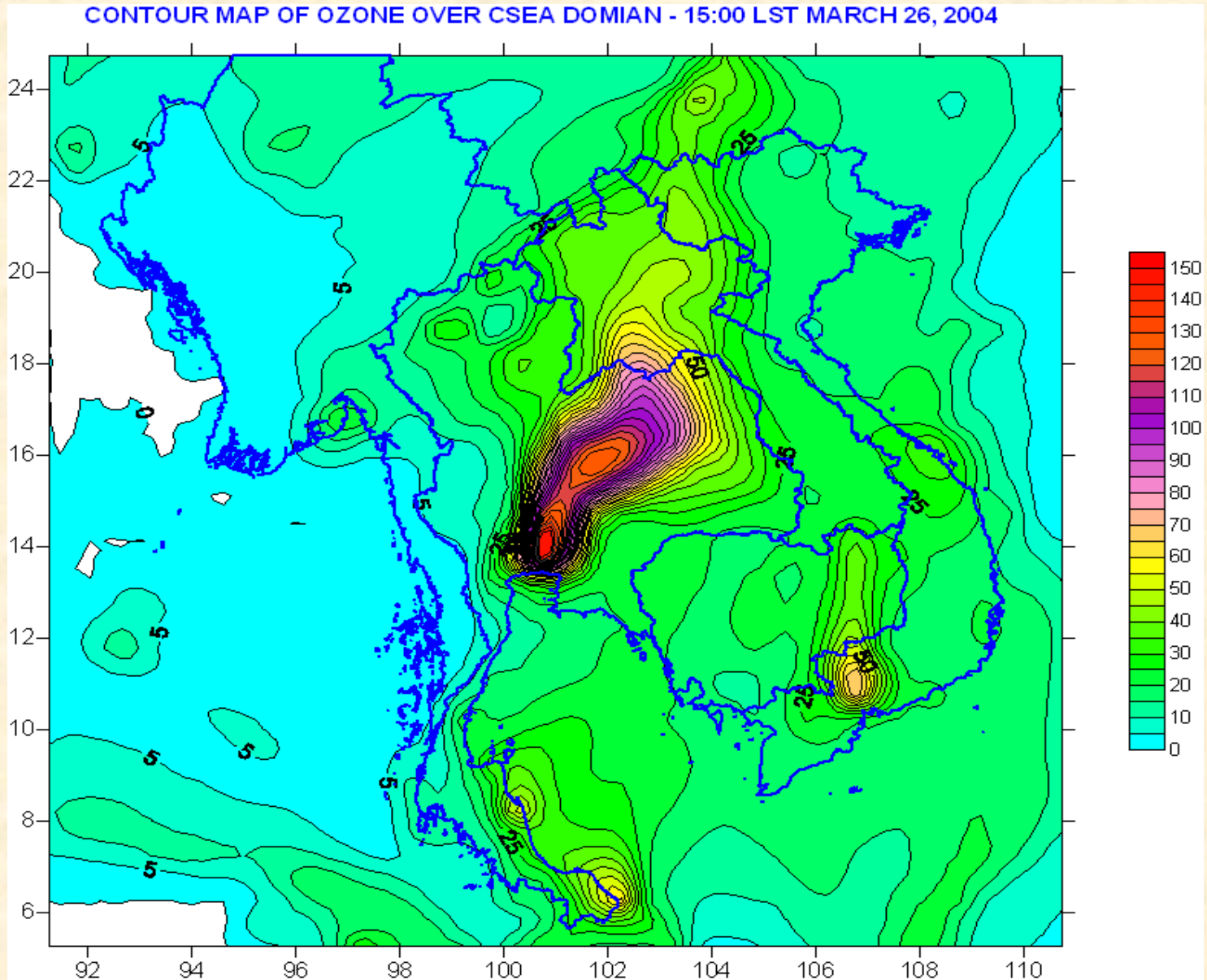
# PM in Long-range Transport
# by trajectory model 2002 - 2004

# Integrated Air Quality Management Issue

Indonesia: Blood Lead Level Test 2005

Vietnam: Applying simple control device for brick manufacturing

# Integrated AQ management demonstration case

| NRI | source | Task |
|---|---|---|
| AIT | Open agro residue burning (rice straw burning) | Source monitoring<br>Exposure assessment<br>Modeling impacts on air quality<br>Meteorological classification |
| China | VOC emission | collecting data of VOCs emission sources, cost-benefit analysis on some techniques. |
| Vietnam | Brick manufacturing | Survey<br>Stack for monitoring |
| Indonesia | Traffic emission (lead) | Blood Pb testing (BLL test)<br>Policy Development |

# Burning rice field in Pathumthani

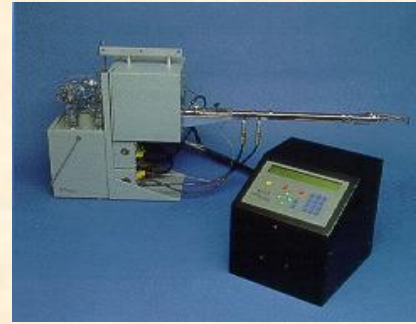# Relationship between hotspot counting in Pathumthani and 24hr-PM10, monthly in 2003-2004



Correlation of hot spot and PM10

Less burning season
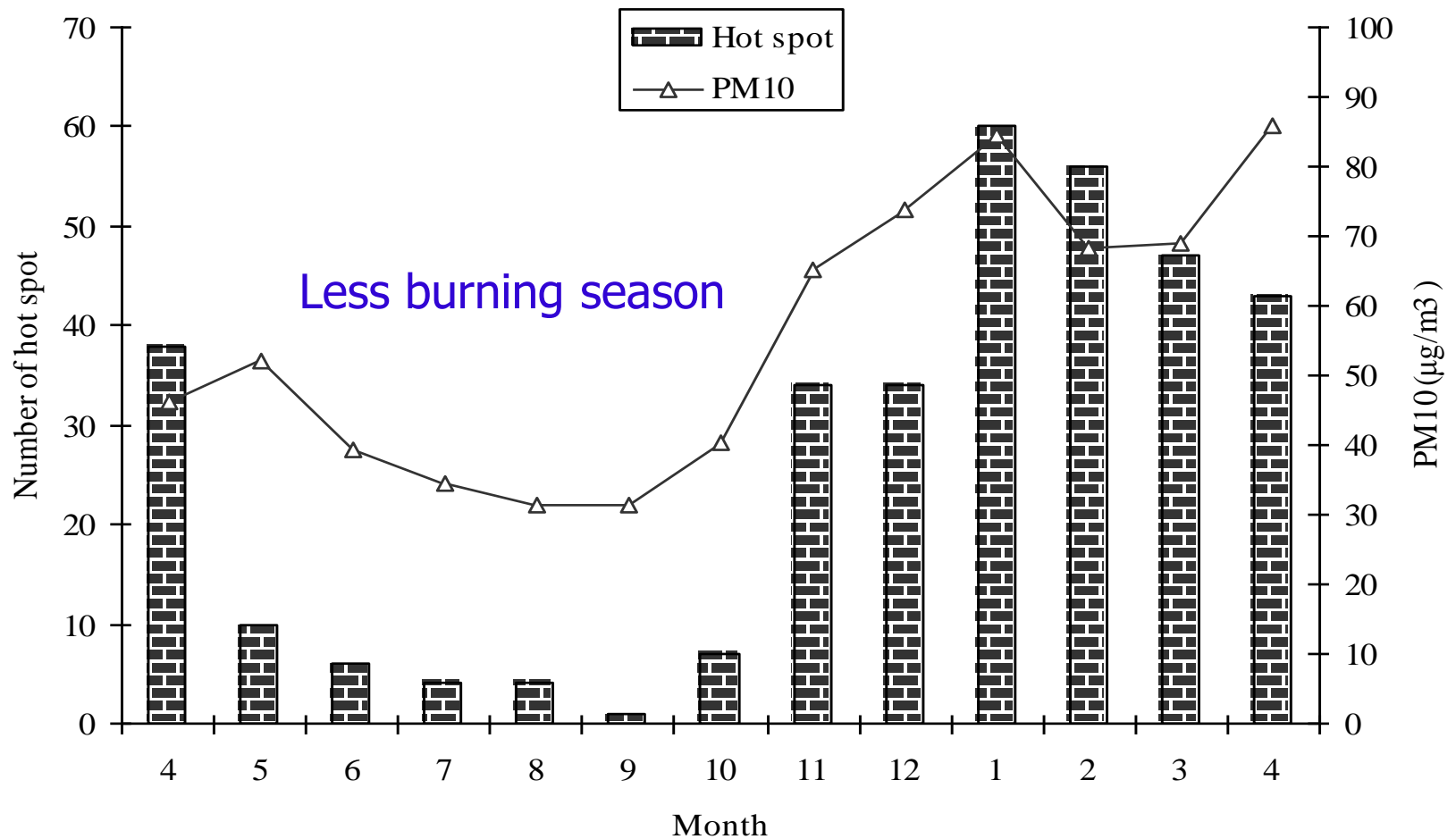
# Rice straw burning, Diesel emission sampling pictures

# Networking

- AIRPET regional workshops: Bandung (2001), Chennai (2002) and Hanoi (2004)
- AIRPET workshop in Bali, 16-18 September 2006
- Mutual scientist visits:
  - From NRIs to AIT for modeling
  - From AIT/NRIs to NRIs
- Information and data sharing: NRI national networks, AIRPET network (E-mail and website)
- Network with other regional project: CAI-Asia, IGAC, etc. .. and UNEP

# Acknowledgement

- Swedish International Development Agency
- AIRPET team at AIT and regional
- Master and Ph D students involved in the network
- Many others who helped in different ways

*Thank s to UNEP for providing this opportunity to present our project profile*

*Thank You!*

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