Co-funded by the
Erasmus+ Programme
of the European Union

TowardanOpenResourcesUsingServices

Modeling impacts of emission reduction measures on air quality, health, crop and climate forcing in Southeast Asia

Prof. N. T. Kim Oanh
Dr. Didin Agustian Permadi
Asian Institute of Technology

Co-funded by the
Erasmus+ Programme
of the European Union

Highlights

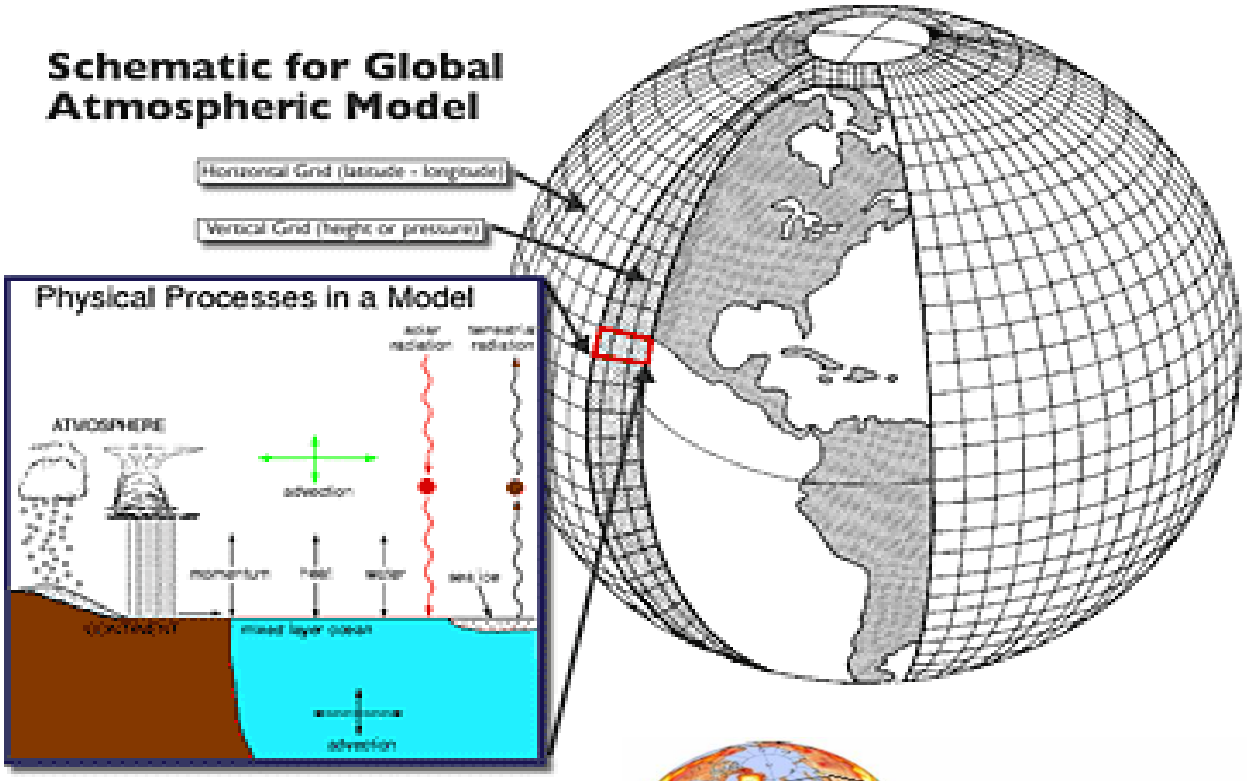
- About atmospheric “modelization”
- Modeling air quality, climate forcing and impacts in Southeast Asia by AIT
- AIT planned activities within TORUS projects

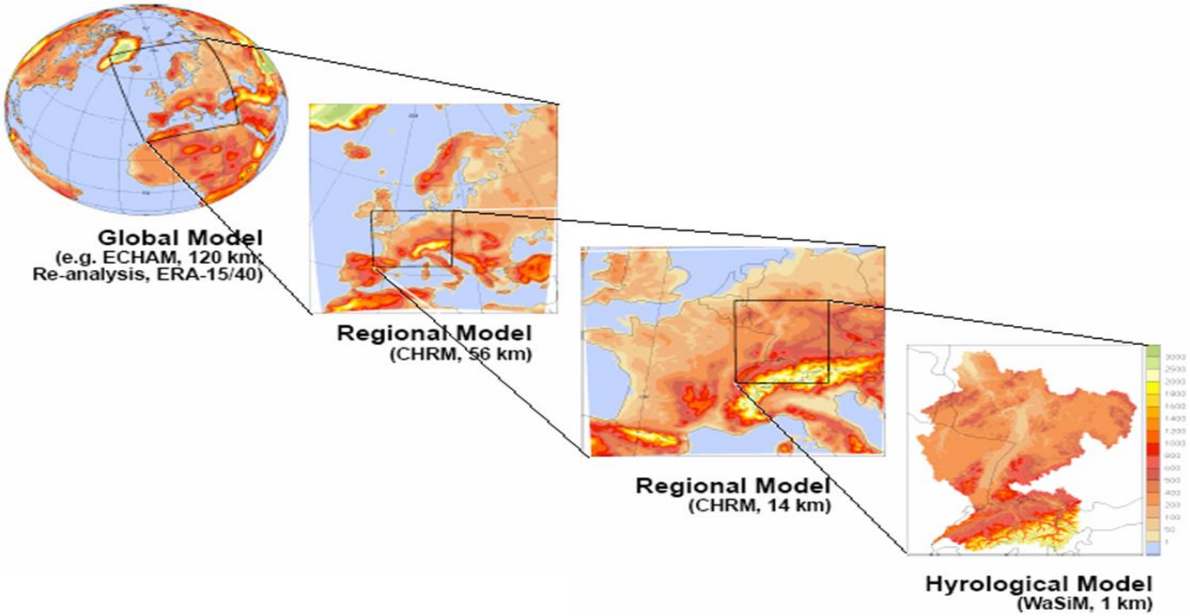
Co-funded by the
Erasmus+ Programme
of the European Union

Atmospheric modeling

- Global models
  - General circulation models (GCMs)
  - Global climate models: GCMs + CTM (e.g. GHGs, black carbon, etc.)
- Regional and urban scales
  - Meteorology models for weather research and to drive air quality models
  - Air quality modeling for estimation of ambient air concentrations
- Integrated modeling framework: GCMs + CTM + impact models (air quality, health, ecosystem, etc.)

Global climate models





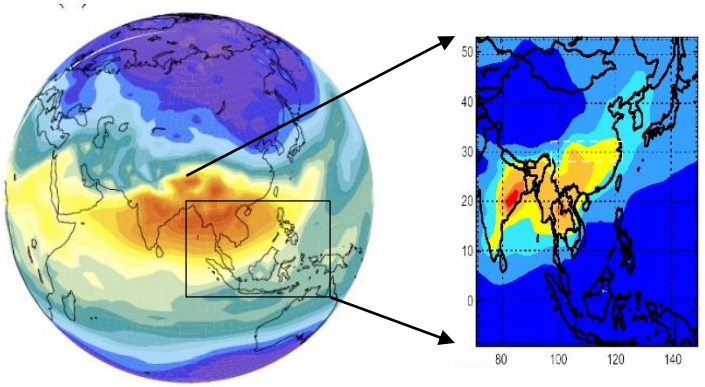
Dynamic downscaling of GCM model results (~1º x 1º)

Source: NASA website

Air Quality Modeling

- Air quality model
  - Input: Emission and Meteorology
  - Output: 3D conc. of air pollutants (hindcast, nowcast, forecast)

Chemistry Transport Model

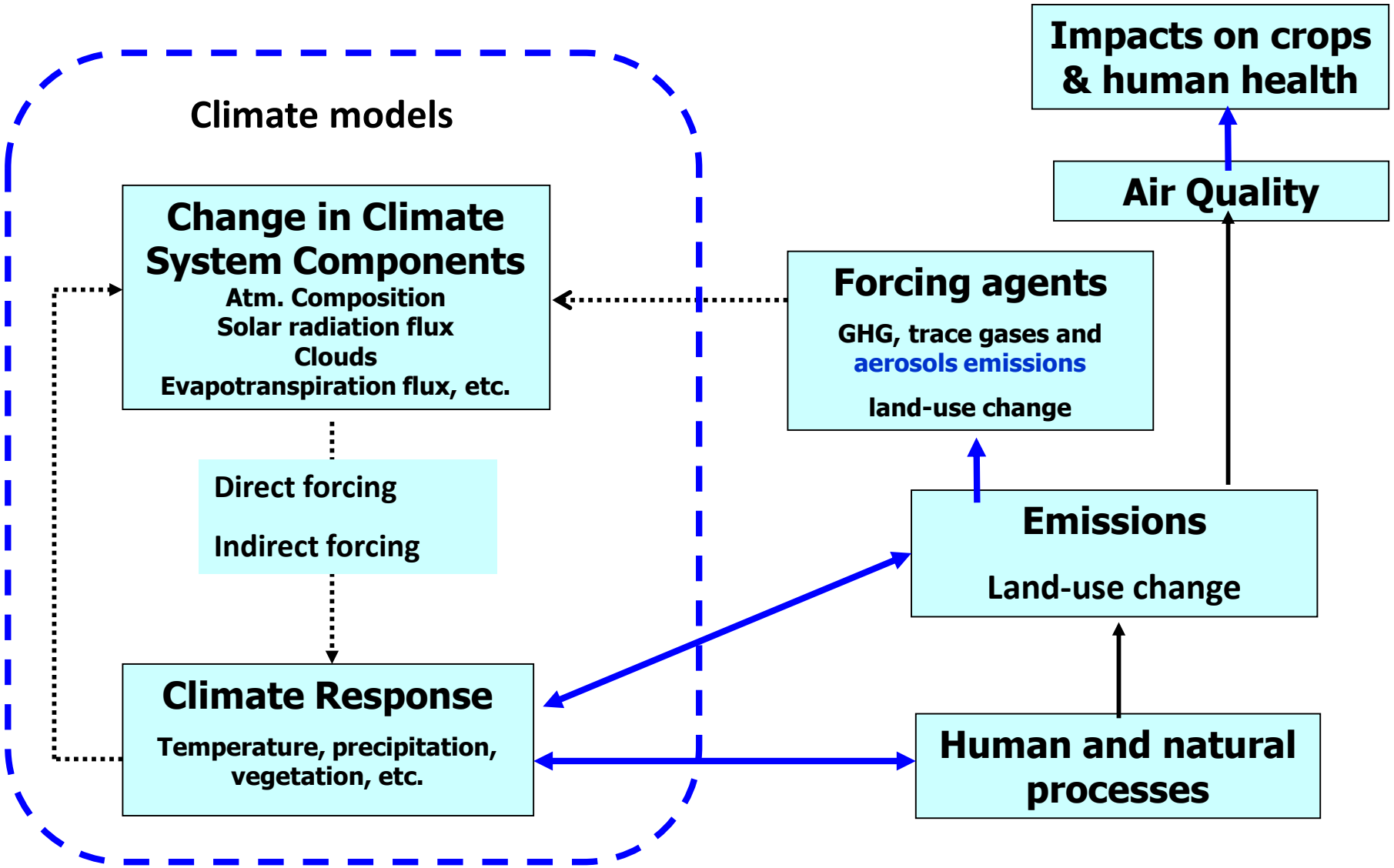


Global Regional

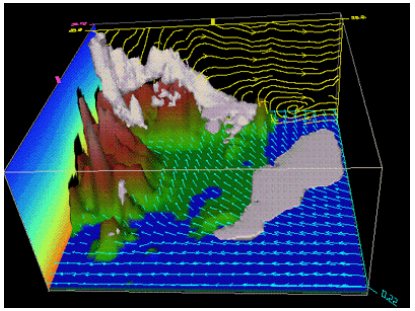
- Use of AQ model results
  - Pollutant conc. ➔ current impacts on health, crops, etc.
  - Scenarios of emission ➔ impacts of emission reduction measures
  - Scenarios of future climate ➔ affect emission and dispersion ➔ effects on air quality

➔ Development of co-control strategies, e.g. for SLCPs

Integrated air quality and climate modeling: interaction between air quality and climate

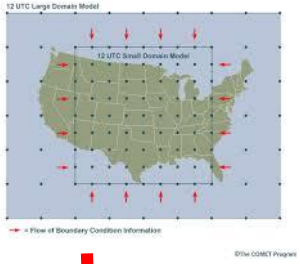


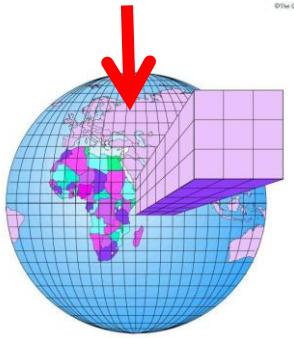
AIT activities: Air Quality Modeling for Southeast Asia

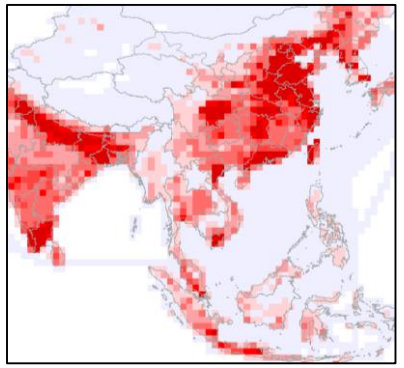


3D- Meteorology model (WRF, MM5)

Boundary conditions



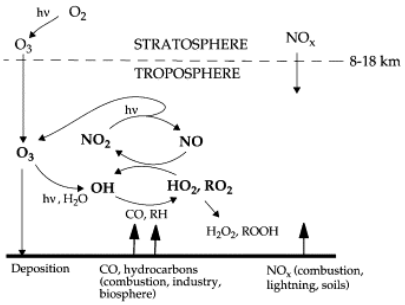




Emission inventory

Chemistry Transport (CHIMERE, CAMx, CMAQ)

Chemistry Mechanisms



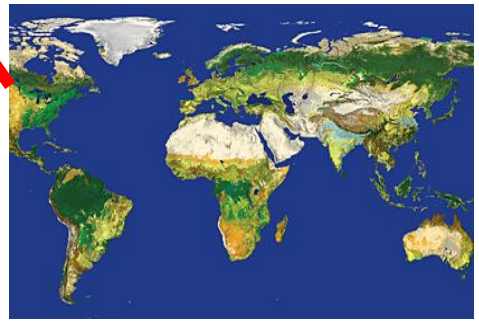
Atmospheric Concentration

AODEM (forcing)

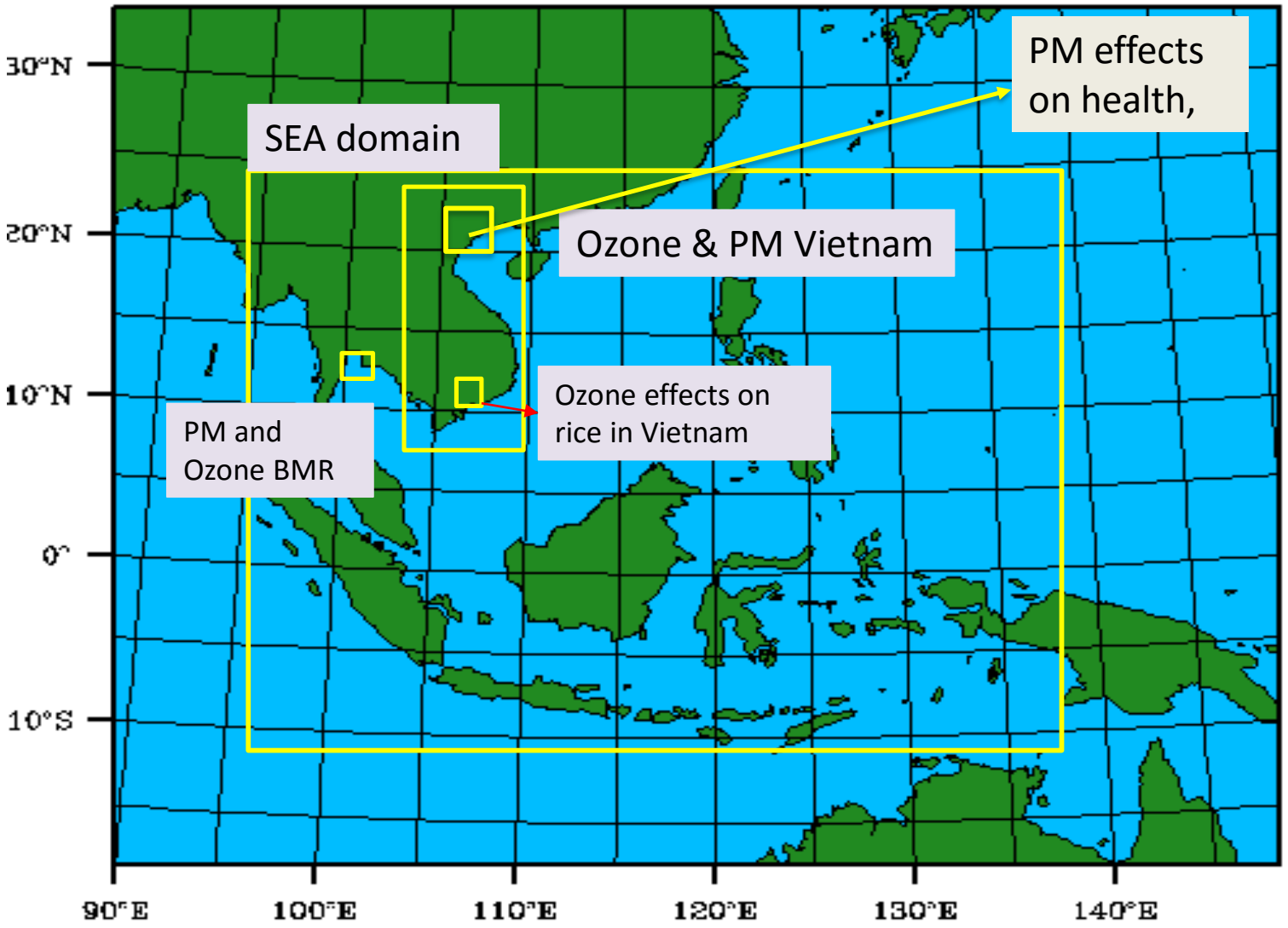
DO3SE (crop impacts)

Scenario study

Land cover data

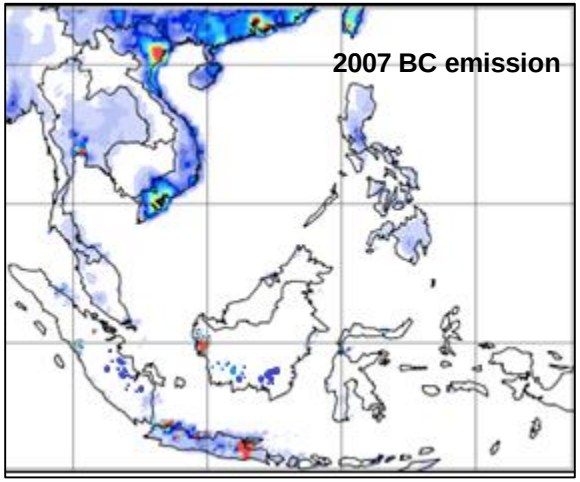


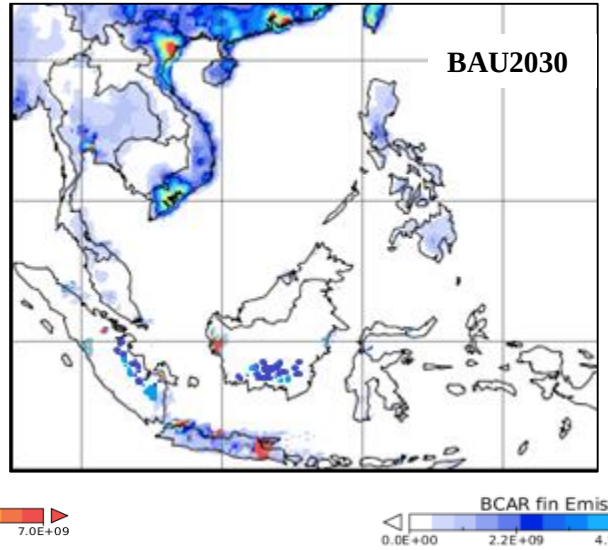
SEA modeling domains

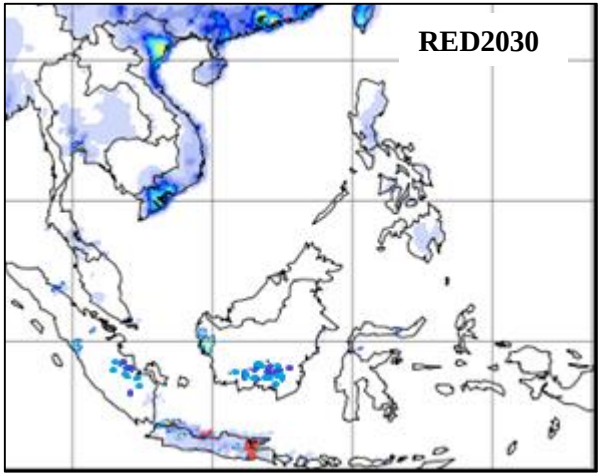


Co-funded by the Erasmus+ Programme of the European Union

Emission: black carbon in SEA







Scenario 1: Business as usual (BAU2030)

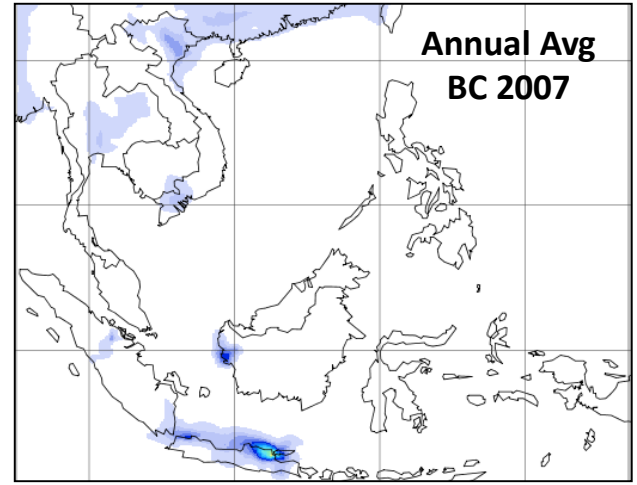
- Simple regression statistical analysis → 7-10 years historical activity data
- Emission projected to 2030
- EFs used were similar to BY2007

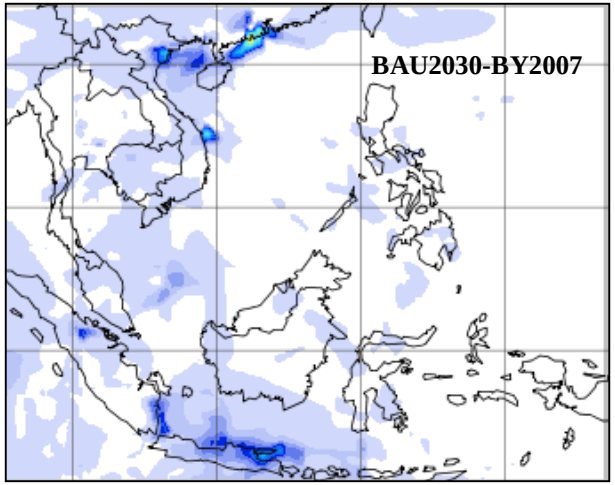
Scenario 2: Emission reduction (RED2030)

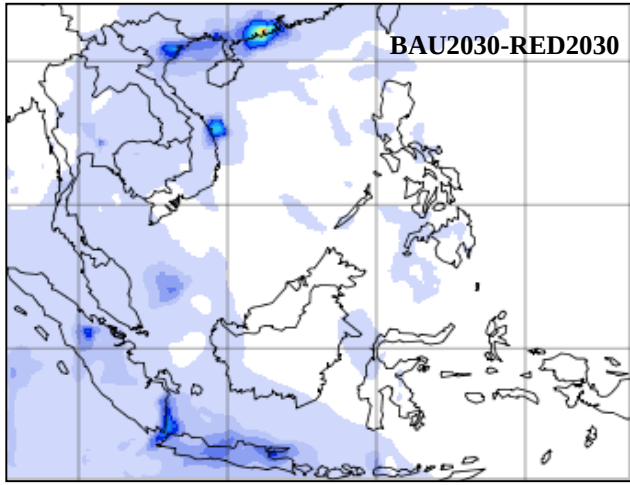
- Measures in 4 sectors: on-road transport, residential, industry, biomass OB
- Implemented for Thailand and Indonesia
- Other countries follow RCP8.5 scenario

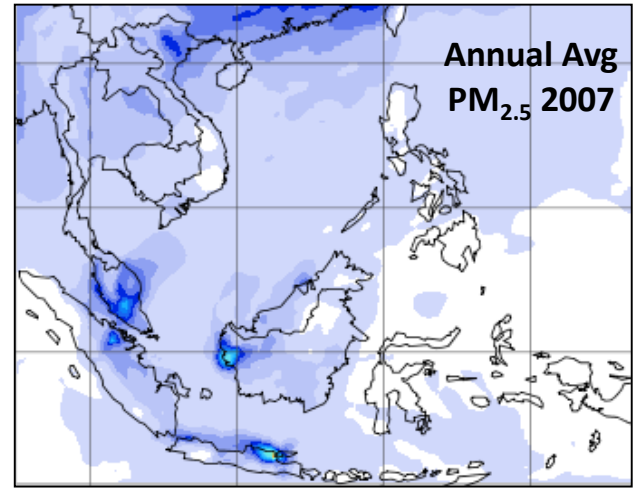
Co-funded by the Erasmus+ Programme of the European Union

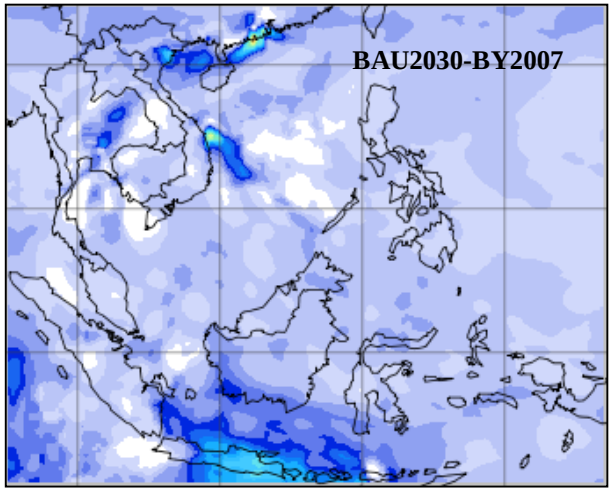
WRF-CHIMERE output: BC and $PM_{2.5}$

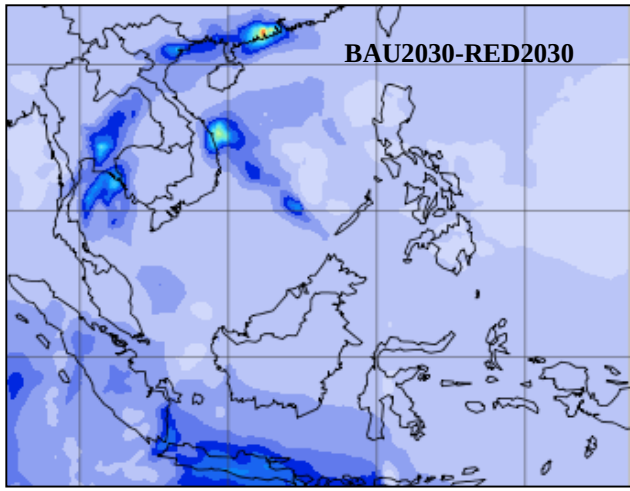




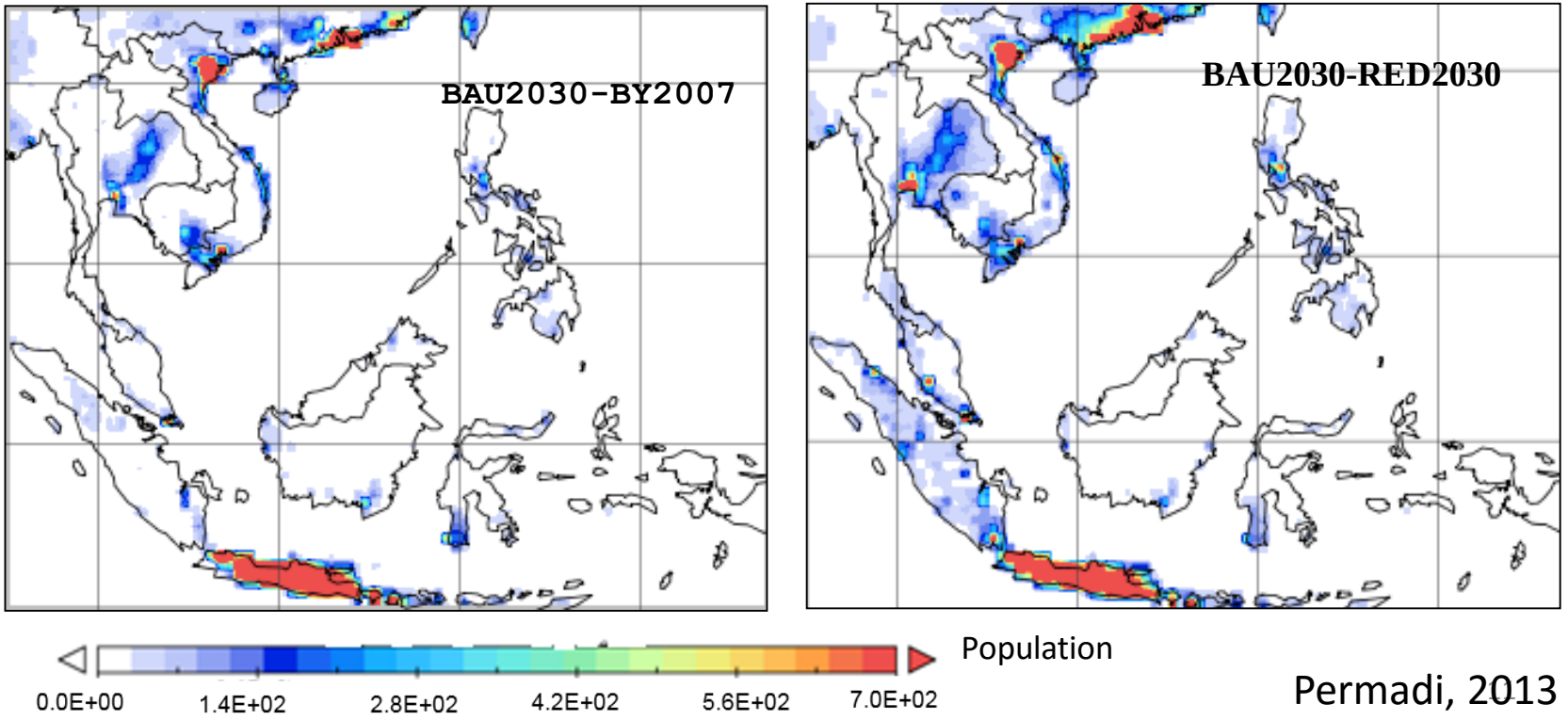








Health effects: premature deaths

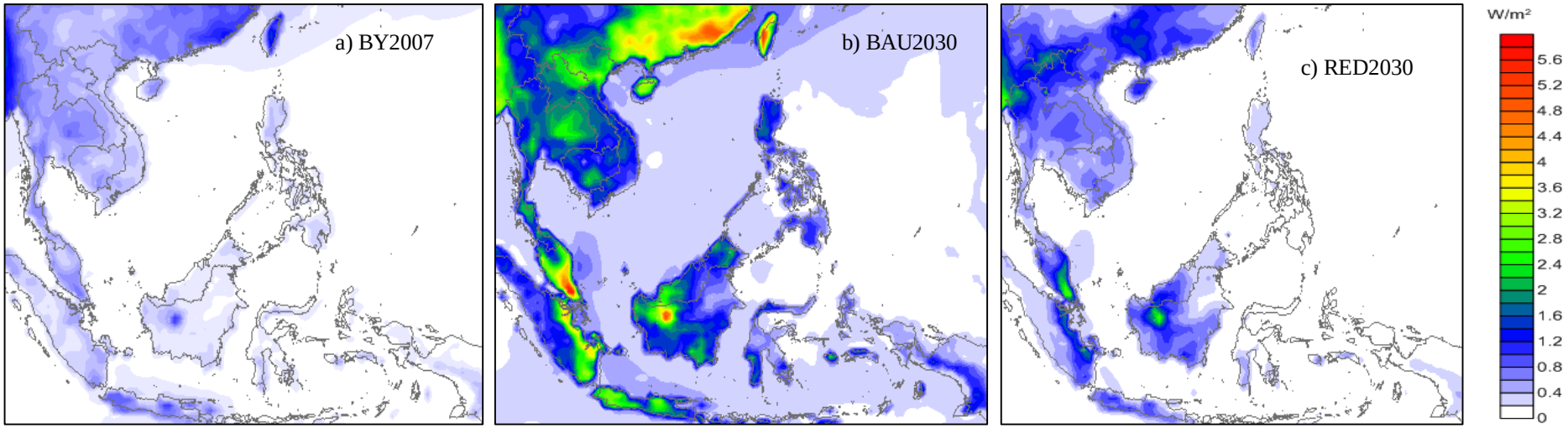


Permadi, 2013

Premature mortality (BAU2030-RED2030)	Indonesia	Thailand
Avoided mortality per 100,000 pop.	**49**	**36**
Shindell et al. (2011)	74	68

Co-funded by the
Erasmus+ Programme
of the European Union

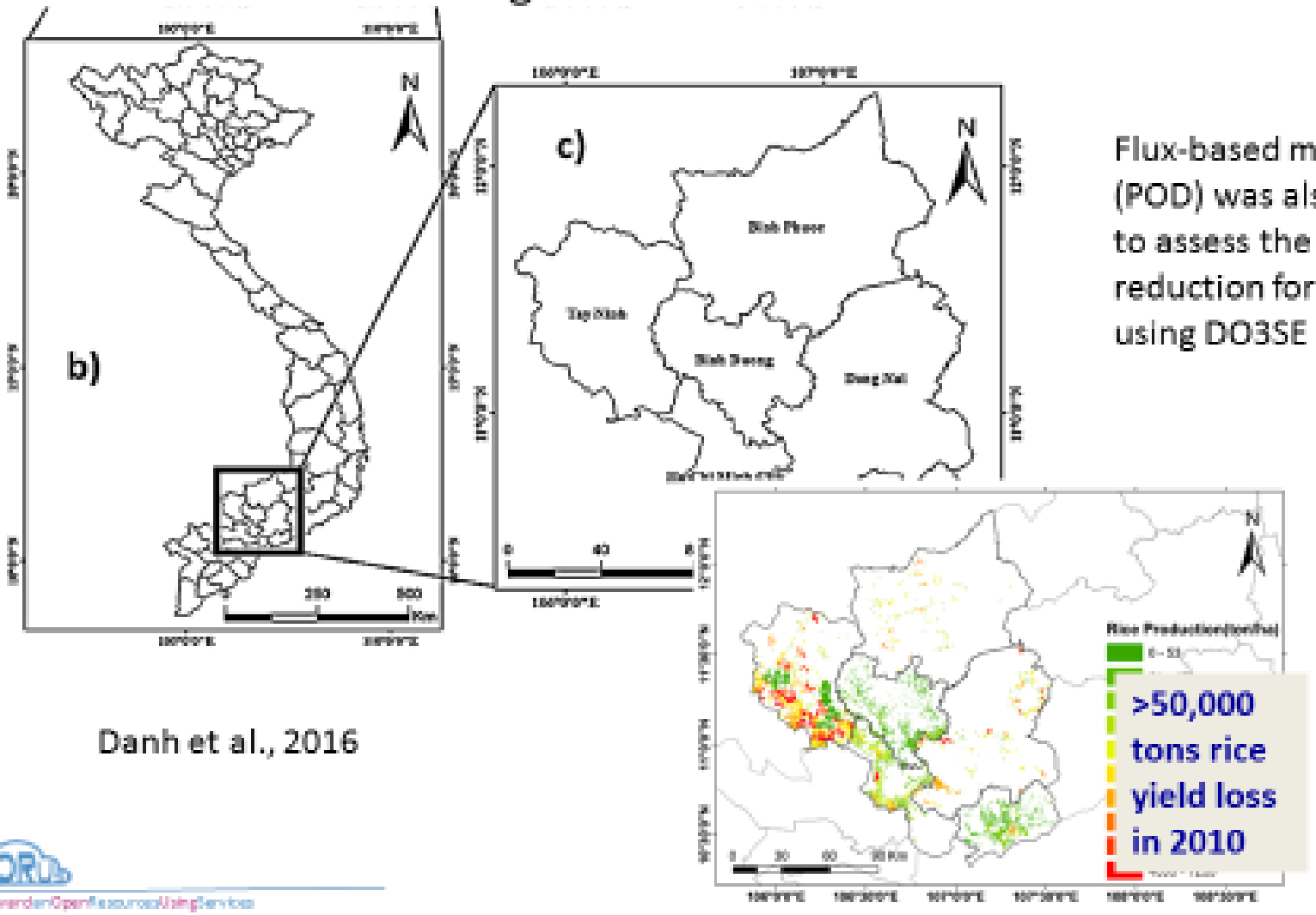
BC Direct Radiative Forcing in Different Emission Scenarios



Annual average BC radiative forcing (W/m^2)

Ozone impact on crops

Eastern Region Southern Part of Vietnam



Flux-based metric (POD) was also used to assess the yield reduction for crops using DO3SE model

Danh et al., 2016

Co-funded by the
Erasmus+ Programme
of the European Union

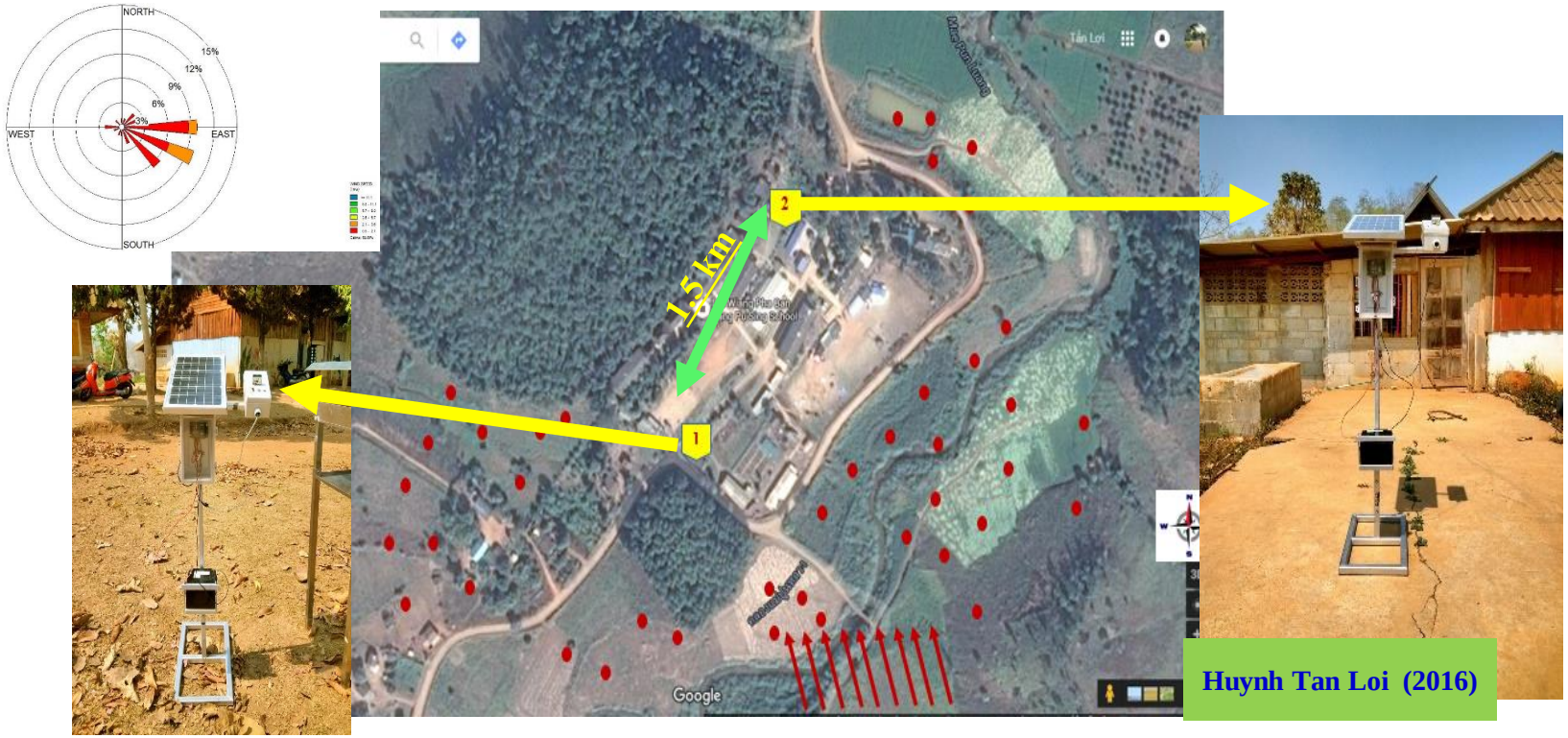
TORUS planned activities at AIT

- Update SEA emission inventory data for 2015
- Use Cloud Computing system to run and handle SEA modeling data
- On-line coupled meteorology-chemistry simulation to get climate output (temp., rainfall)
- Model evaluation using satellite data and wireless sensor monitoring data

Co-funded by the
Erasmus+ Programme
of the European Union

Wireless sensor monitoring at AIT

- Monitor haze in Northern Thailand
- Monitor smoke of rice straw burning smoke in Central Thailand



Co-funded by the Erasmus+ Programme of the European Union

Location Aware Sensing System (LASS) of $PM_{2.5}$ sensor at AIT

Sensors were donated by Academia Sinica, Taiwan

LASS Location Aware Sensing System

Thank you for your attention