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International Workshop on LCLUC and Air Pollution in Asia

S-12 project and Regional Emission Inventory in Asia (REAS)

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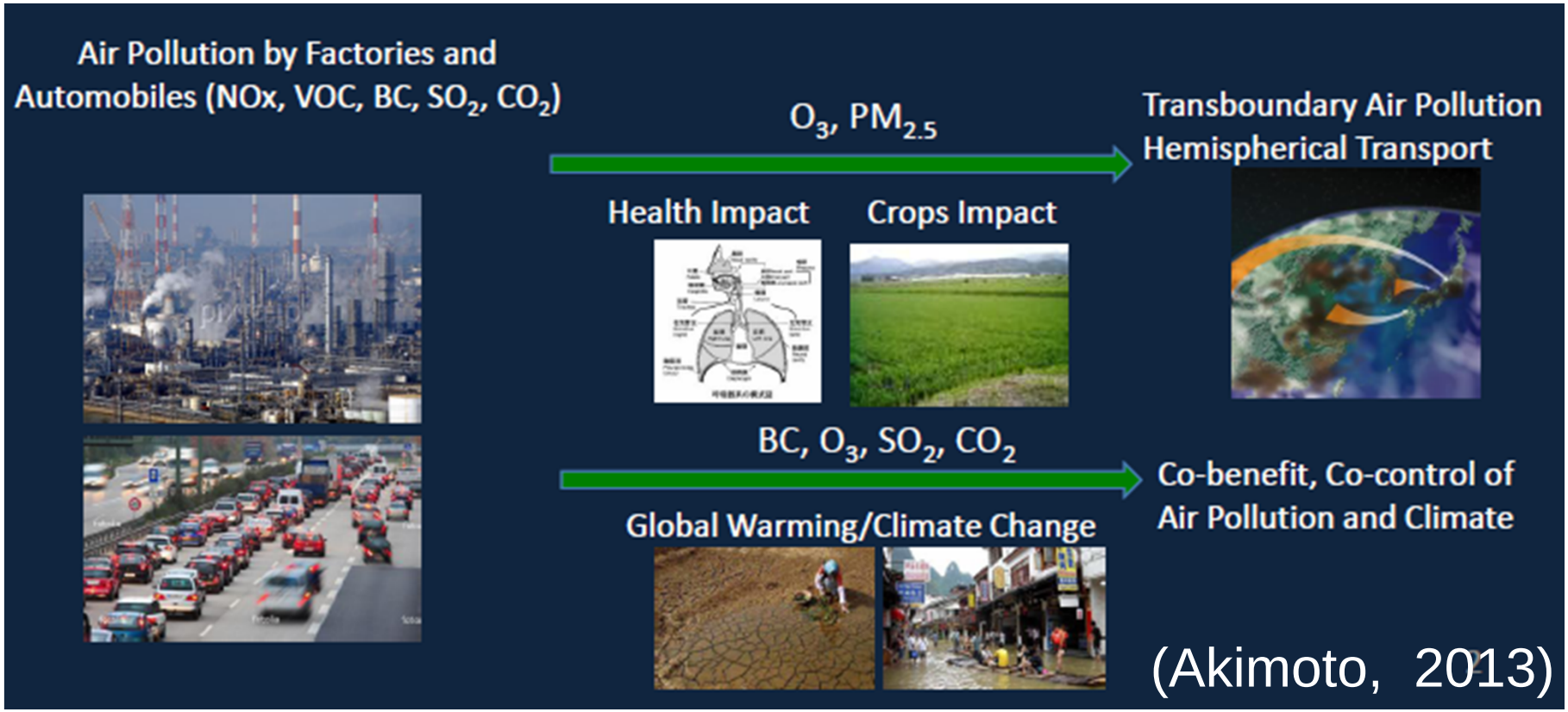
4. Summary

What is SLCPs (Shout-lived Climate Pollutants)

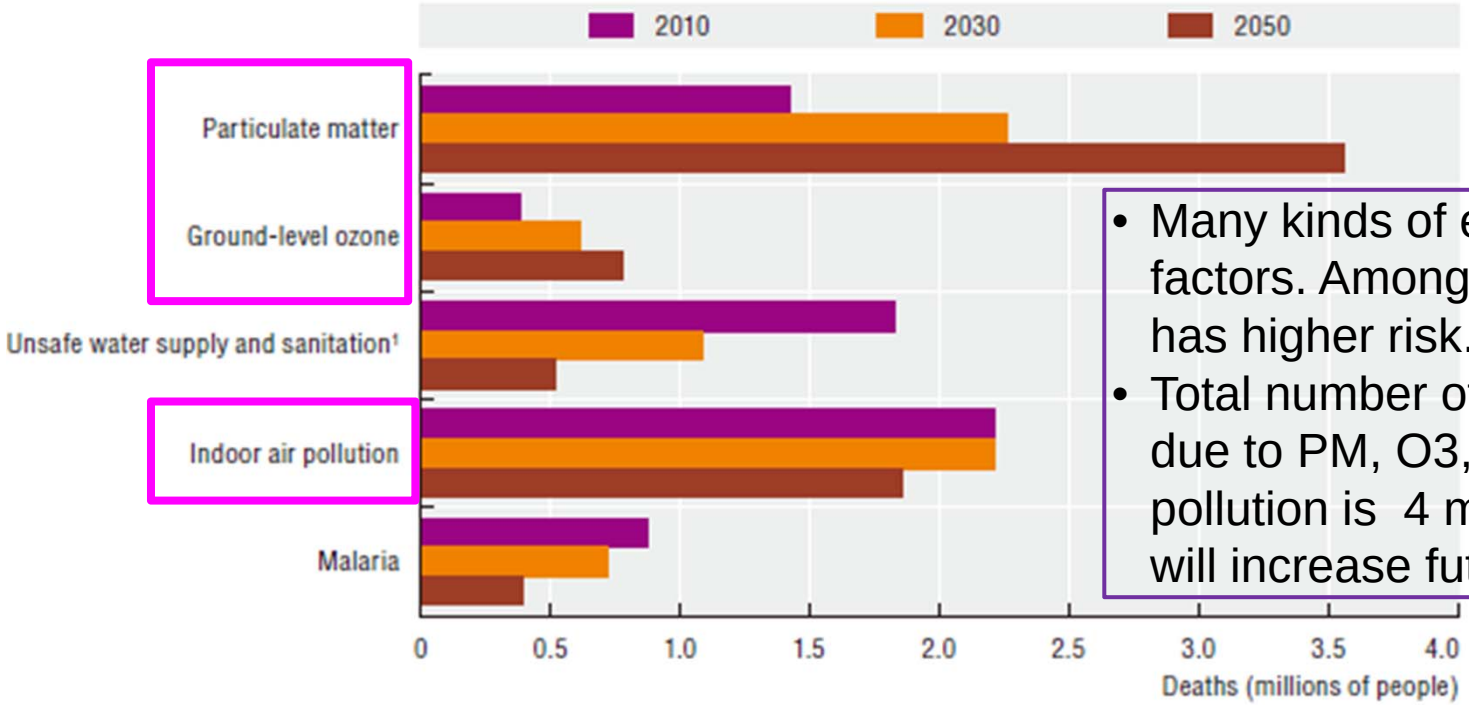
1. Tropospheric ozone: Its precursors: CH_4, NOx/VOC
2. Black carbon (BC)



1. Air pollution reduction
2. Climate change mitigation

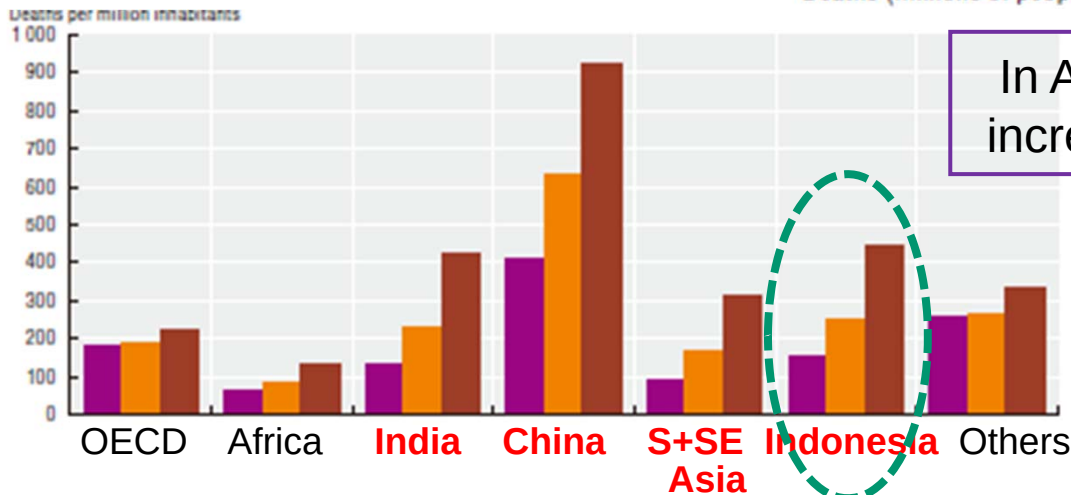
Global premature deaths from environmental risks from 2010 to 2050 (Baseline scenario)

OECD Environmental Outlook to 2050 (2012)



- Many kinds of environmental risk factors. Among of all air pollution has higher risk.
- Total number of premature death due to PM, O3, and indoor air pollution is 4 millions in global and will increase future.

Number of premature deaths per million inhabitants **due to PM**



In Asian countries, the increasing is remarkable.

Why SLCP mitigation now?

(Akimoto, 2013)

(1) Climate Policy Side

CO_2 control can mitigate climate change only after 2050 for grand and grand-grand children generation, but the present climate change is more urgent issue and mitigation in mid-term future (2030-2050) should also be concerned for our own and our children generation.

SLCP control must be useful to accomplish the near future mitigation of climate change.

(2) Air Pollution Policy Side

Present situation of health and vegetation impact by surface ozone and PM is serious from human health and economic damage point of view.

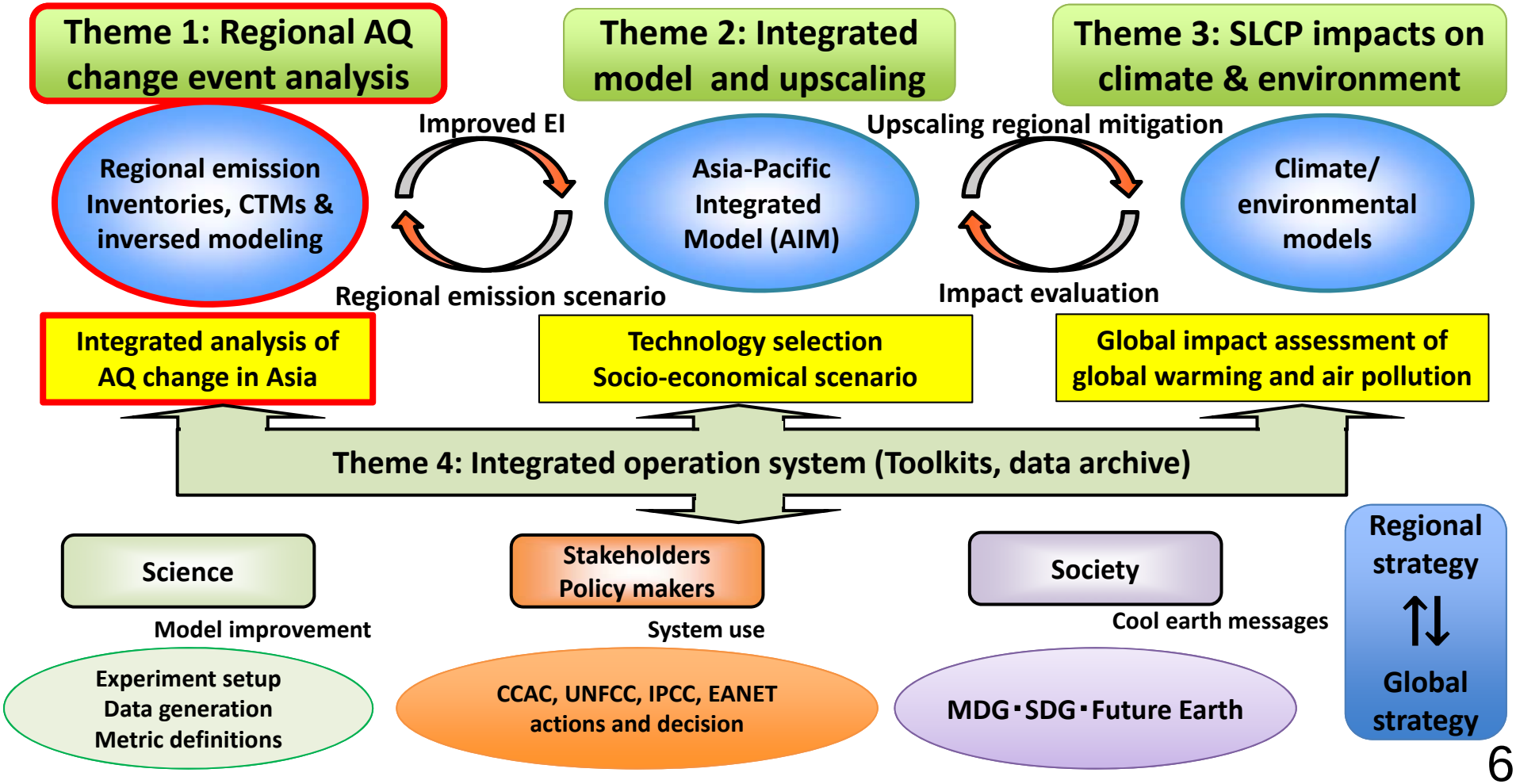
This is particular so in Asia!

In order to facilitate mitigation of air pollution, SLCP control by co-benefit approach must be useful particularly in developing countries giving more incentives.

Much need of SLCP mitigation in Asia

MOEJ-S12: Active evaluation of SLCP impacts and seeking the optimal pathway (2014-2018) *PI: Terry Nakajima*

- Reduction of SLCP is easier than that of LLGHG due to their short lifetime, but the effects are very complex.
- Therefore, search for optimum mitigation paths is important for society.
- It is needed to develop an active evaluation system for LLGHG and SLCP mitigation policy, by overarching emission inventory, integrated models, and climate models.



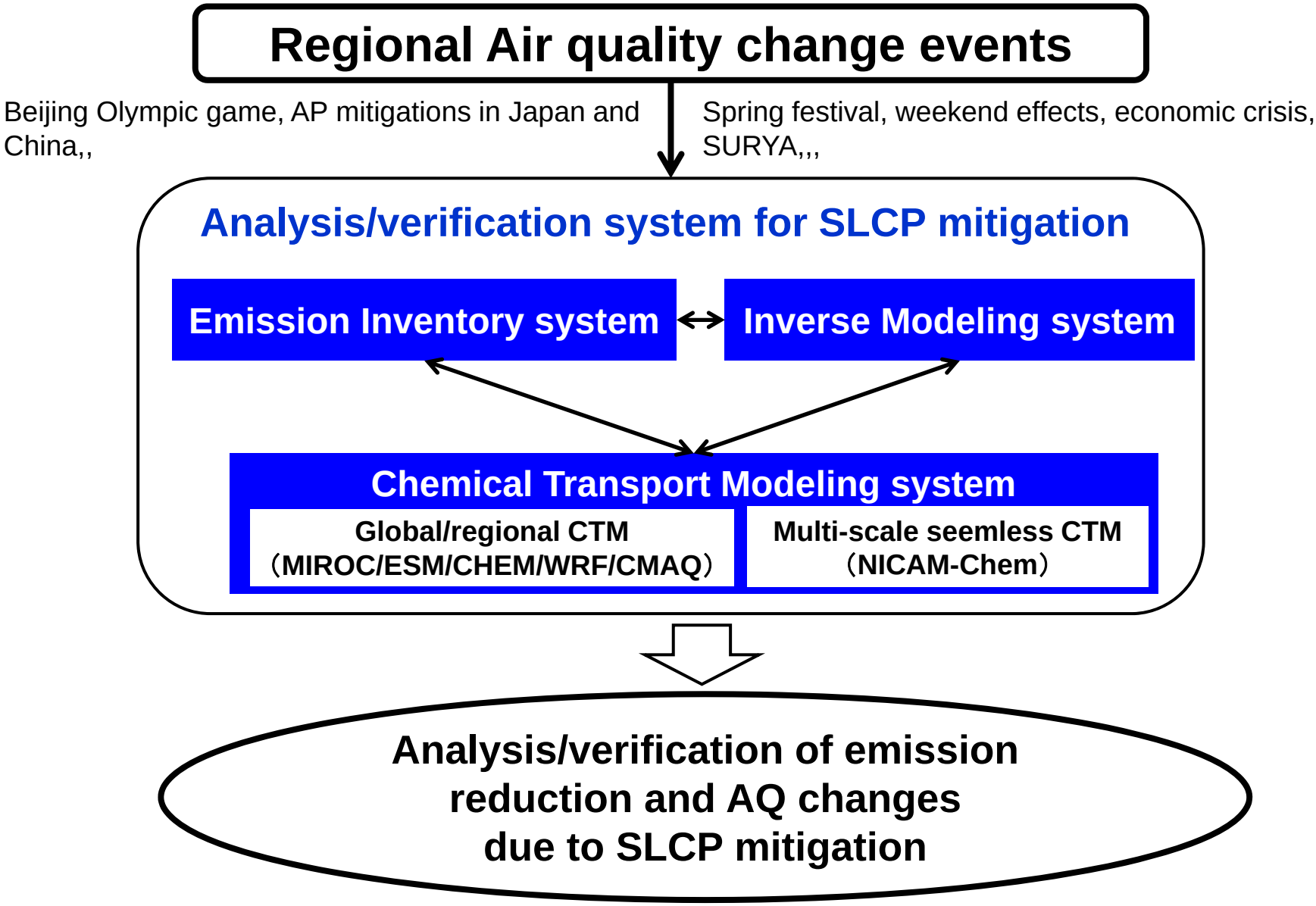
Aim of Theme 1 of S12

(1) The **air quality change events caused by air pollution control and socioeconomic variations**, which are considered to be social experiments of SLCP mitigation, are analyzed by means of regional/global chemical transport modeling (CTM), inverse modeling (IM) and regional emission inventory (EI).

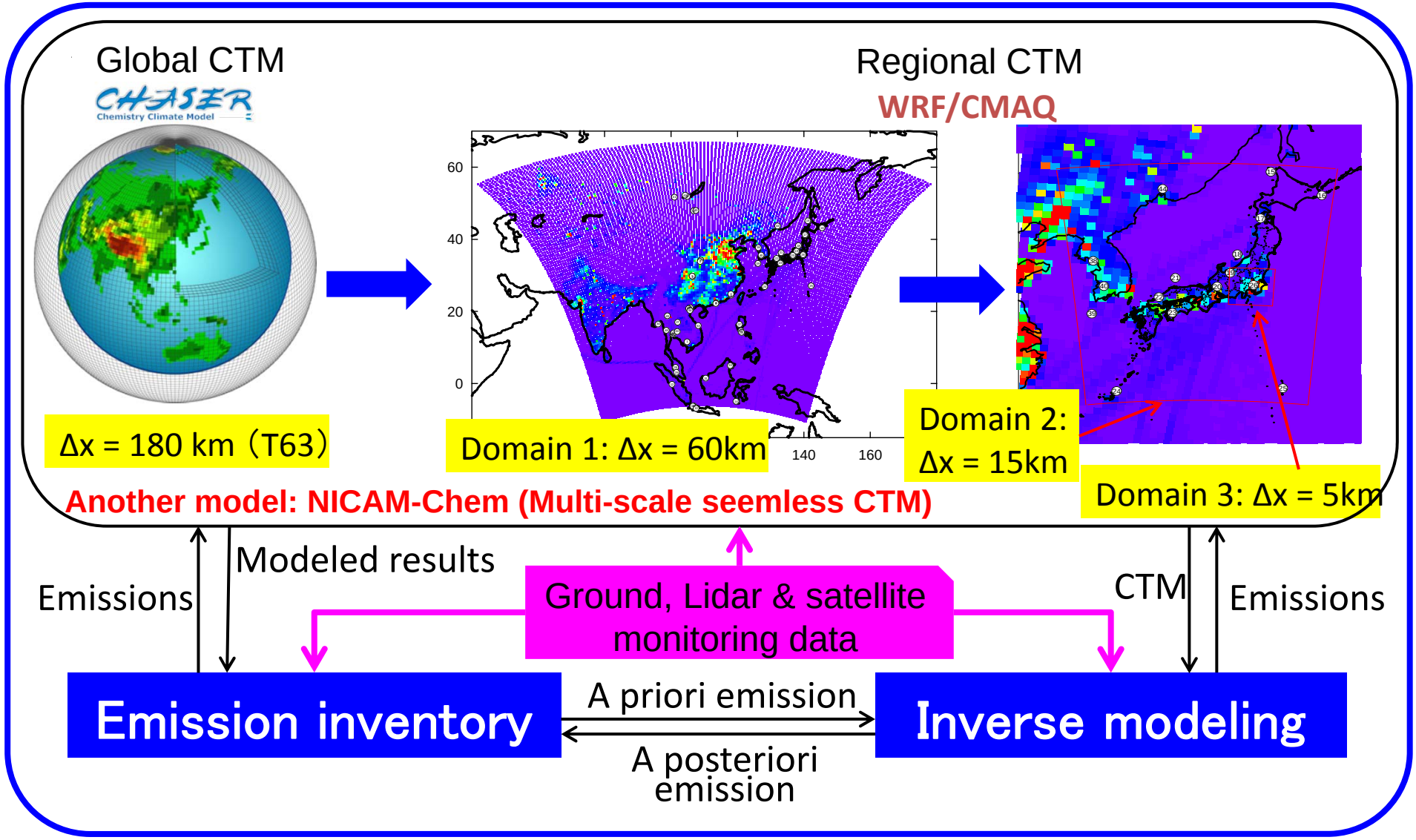
(2) CTM, IM, and EI are integrated as an **analysis/verification system** for quantifying the emission reduction and air quality improvements due to SLCP mitigation. The system is validated by the analysis of air quality change events.

(3) The system is applied to **assessment for SLCP mitigation** policy and future emission scenario.

Schematic diagram of our approach



Structure of analysis/verification system for regional air quality changes

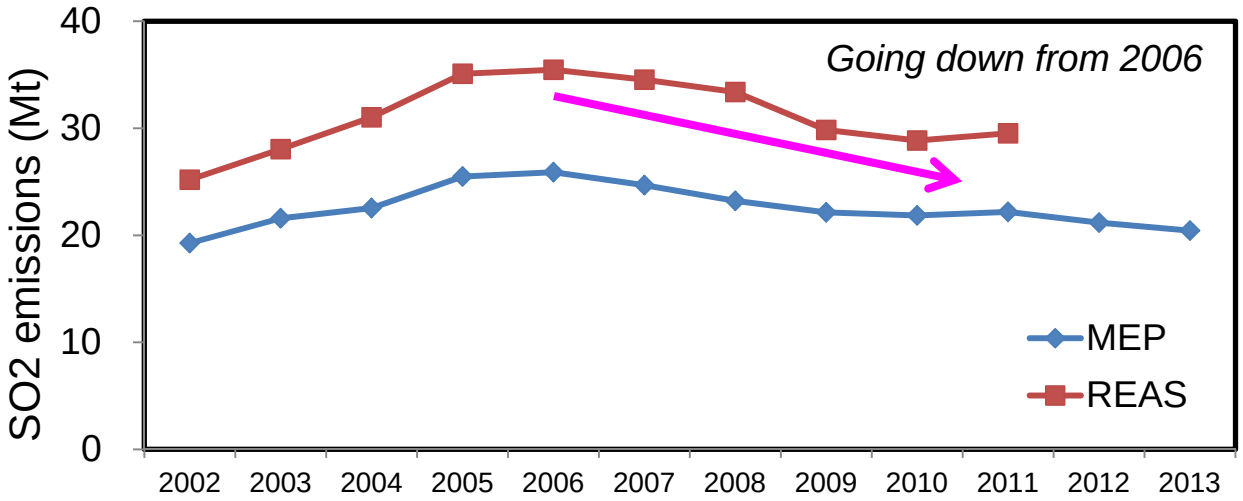


Summary of air quality change events in Asia

		Events	Targeted compounds	Time scale	Spatial scale
Japan	Long-term measures	SOx, NOx Vehicle emissions Evaporative VOC	SOx, NOx NOx, PM, VOC VOC	Decade(s)	Urban - National
	Socio-economical	Weekend effects Fukushima accident	NOx, VOC, PM Many comp.	Years	Urban - National
China	Long/mid-term meas.	**SOx,** NOx Urban pollution 12nd five years plan	SOx, NOx Many comp. Many comp.	Decade	Urban - National
	Short-term measures	Beijing Olympic Shanghai Expo. Guangzhou Asian game	Many comp. Many comp. Many comp.	Months	Urban - Regional
	Socio-economical	Spring festival	Many comp.	Weeks	National
SE Asia	Measures	Bio-energy in Thailand Open burning	Many comp. PM, VOC	Years	National
Others	Social experiments	Surya etc.	BC	Years	Local

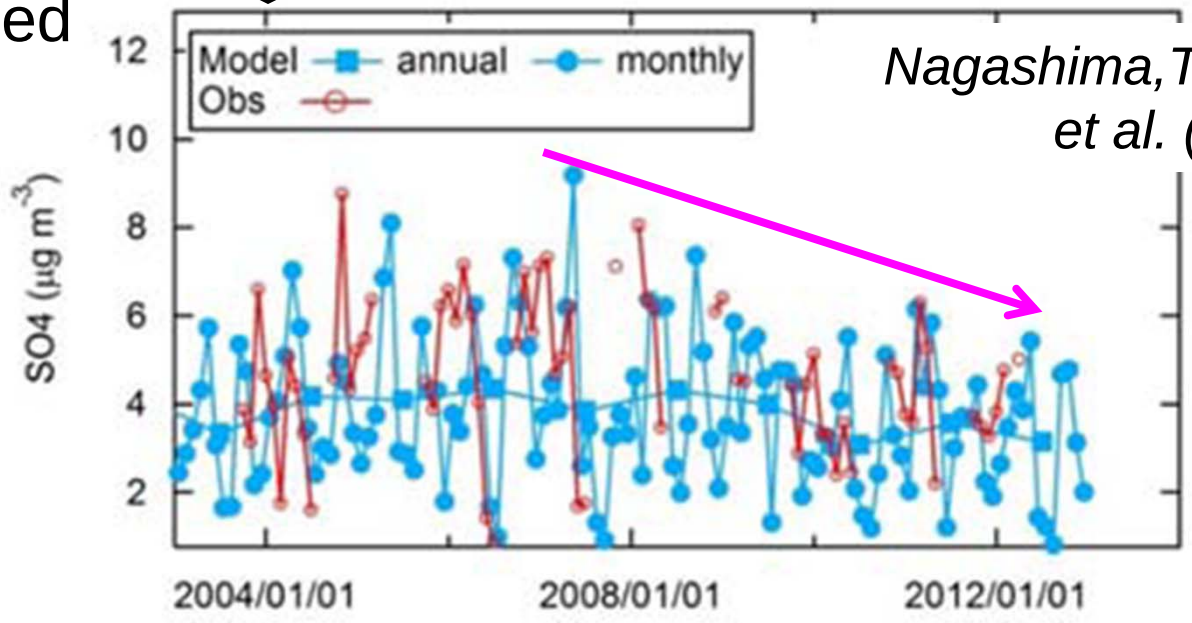
Impact of Chinese emission control on AQ in Japan

SO_2 emissions in China



This declining may cause AQ improvement in Japan.

Measured & modeled SO_4^{2-} at Okinawa (Cape Hedo)

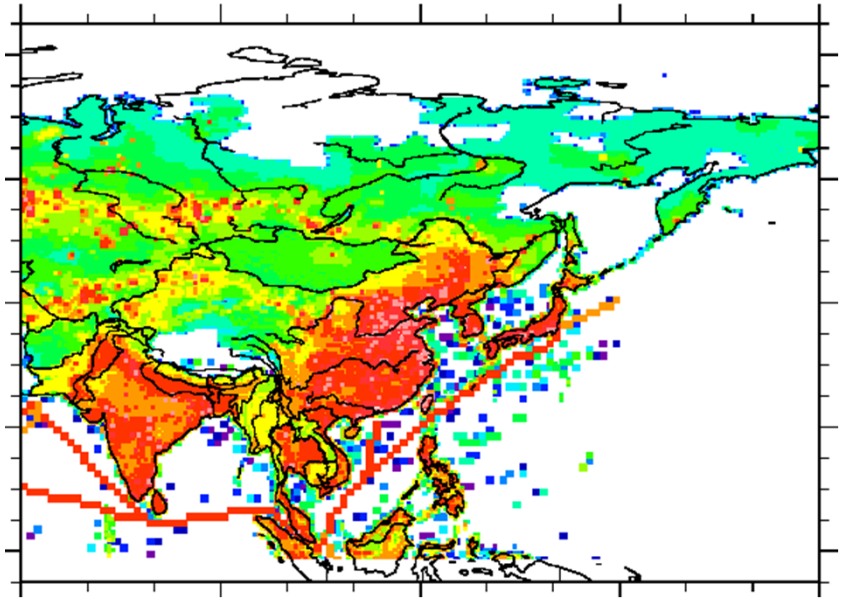


Nagashima, Takami et al. (2015)

Evidence of the impacts of Chinese emission control on AQ in Japan.

Regional Emission inventory in ASia (REAS)

[Ver.1] Ohara et al. (2007) ACP; [Ver.2] Kurokawa et al. (2013) ACP



Item	Description
Emission sources	Anthropogenic
Areas	E, SE, and S Asia + Russian & Central Asia
Years	2000-2008
Spatial Resolution	0.25 x 0.25 degree
Temporal Resolution	Monthly

	SO_2	NO_x	CO	PM_{10}	$PM_{2.5}$	BC	OC	NMV	NH_3	CH_4	N_2O	CO_2
Fossil Fuel Biofuel	●	●	●	●	●	●	●	●	●	●	●	●
Industrial Process	●		●	●	●	●	●	●	●		●	●
Fertilizer use		●							●	●	●	
Livestock									●	●	●	
Others								●	●	●	●	

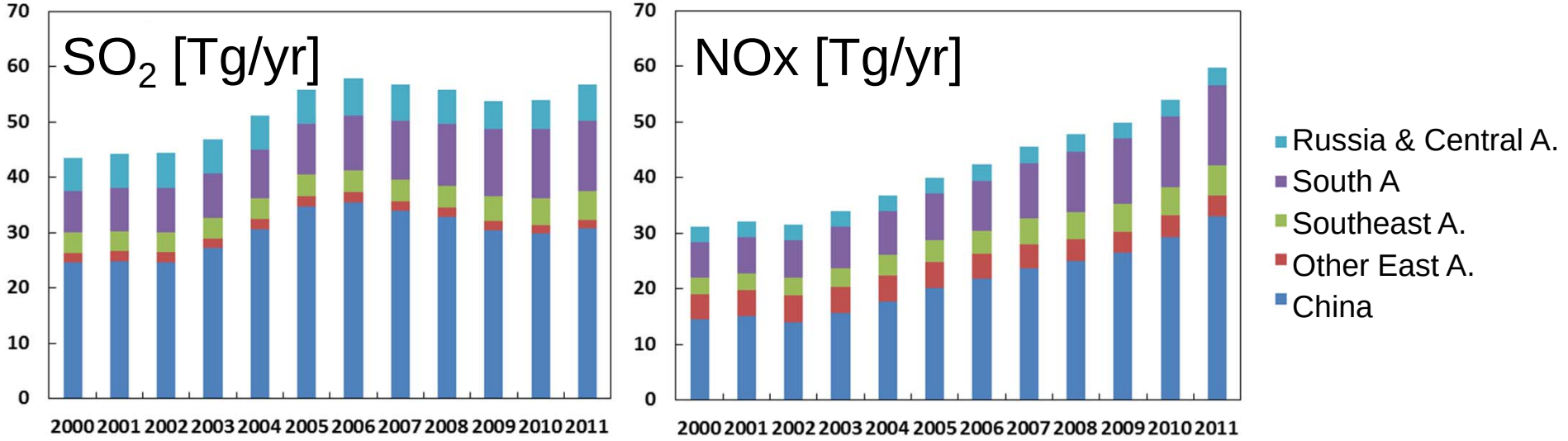
Recent progress of REAS update

- ✓ Developing emission inventory system
- ✓ Update for recent years (2000 – 2011)
- ✓ Historical emissions (1950 – 2011)
- ✓ Collaboration with inverse modeling

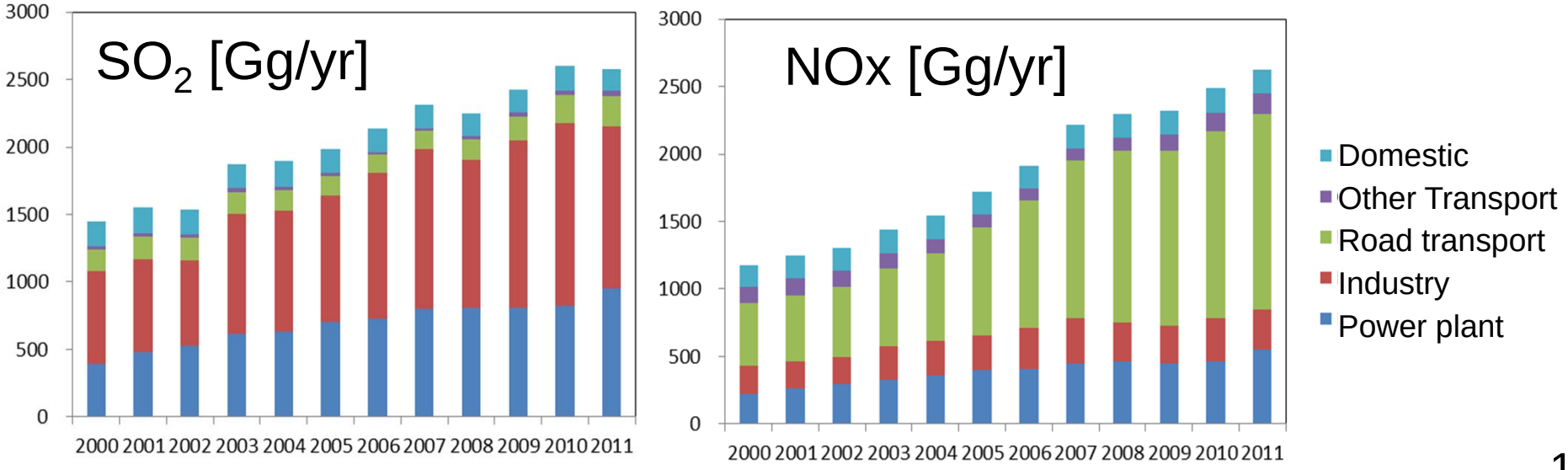
Anthropogenic emissions for recent years (2000 – **2011**)

Kurokawa (2015)

Asia (by region)

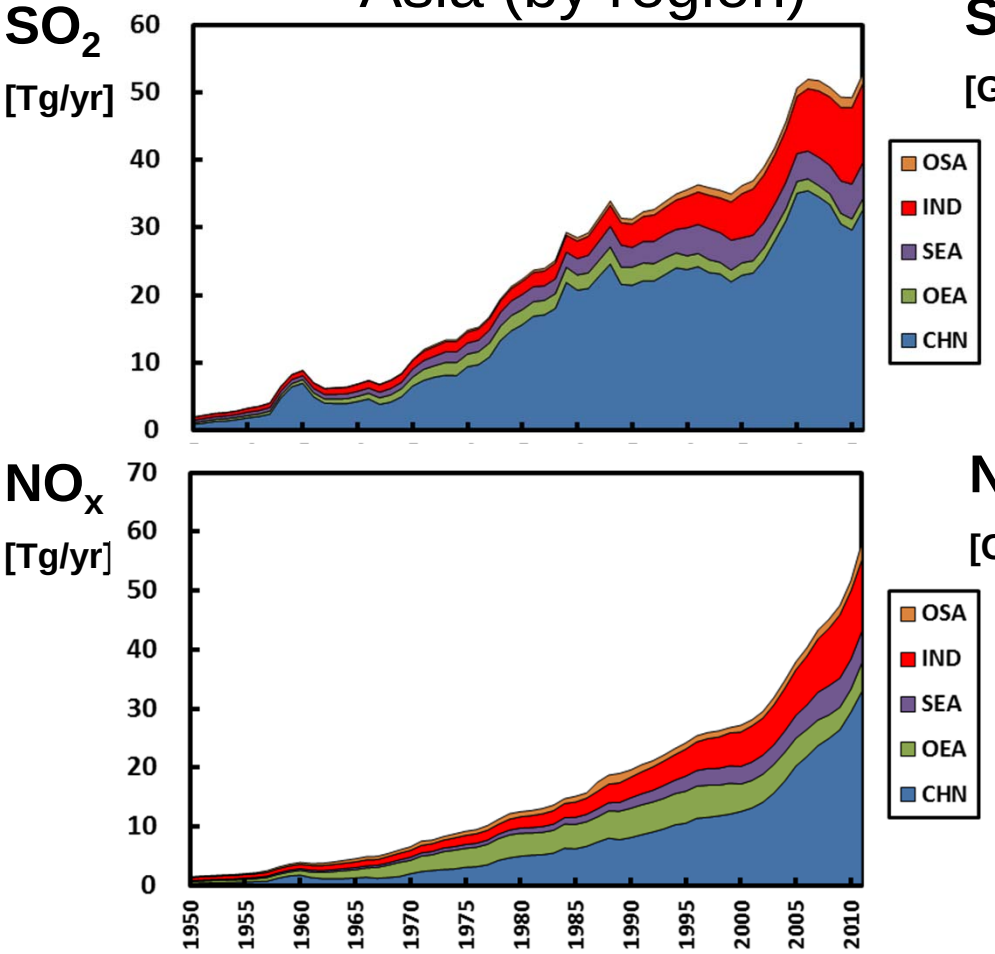


Indonesia (by sector)

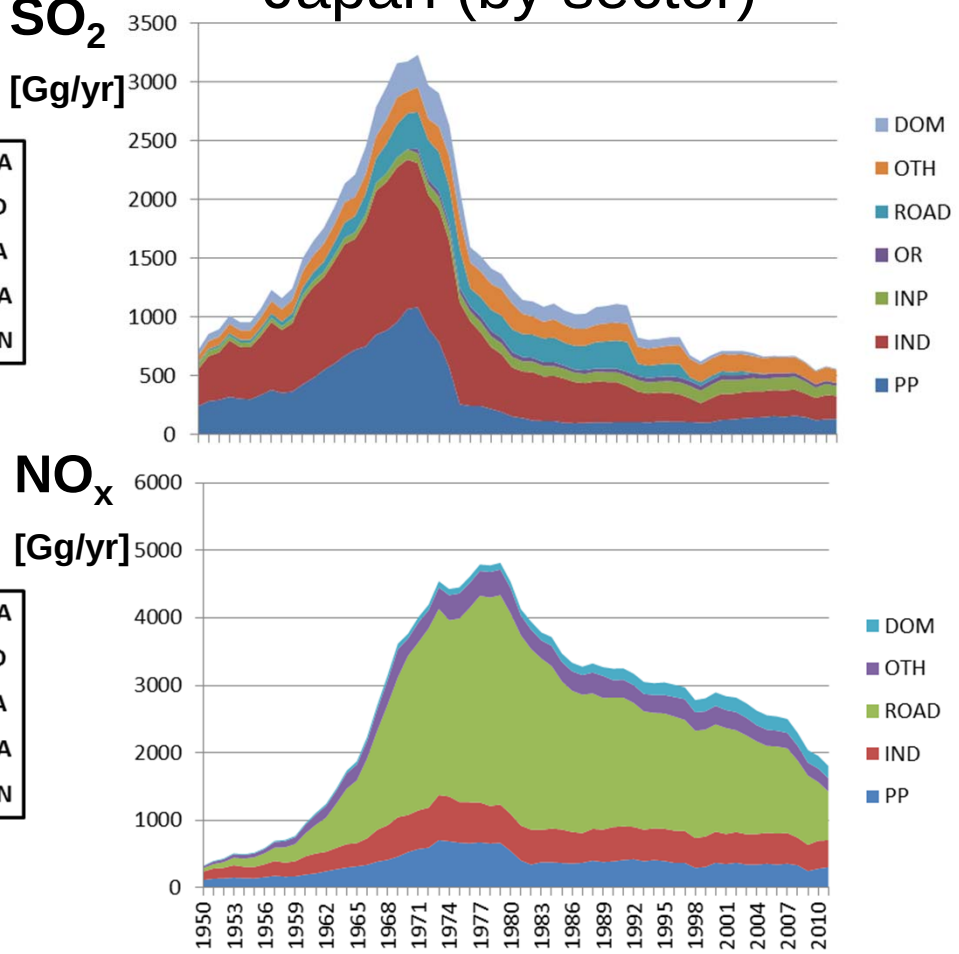


Historical emissions in Asia during 1950-2011 (preliminary results)

Asia (by region)



Japan (by sector)



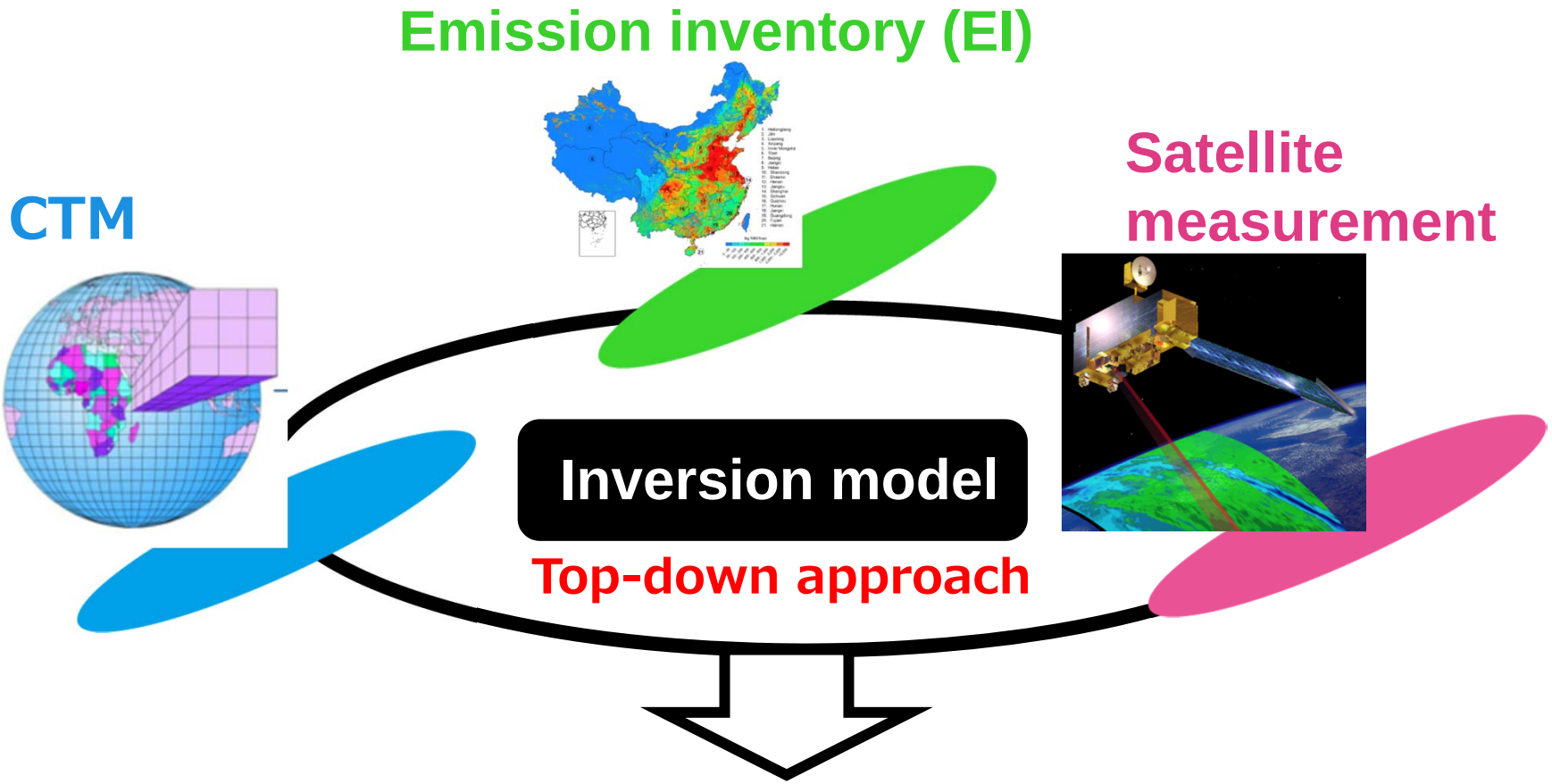
- Asian emissions were going up in the last half century.
- 1970 - : SO2 and NOx emissions gradually increased.
- 2000 - : The increasing speed was accelerated.
- Recently: SO2 is fluctuating and NOx is still going up.

- Having a peak around 1975 and then going down.

Kurokawa (2015)

Schematic diagram of inversion modeling system

Yumimoto et al. (2015)



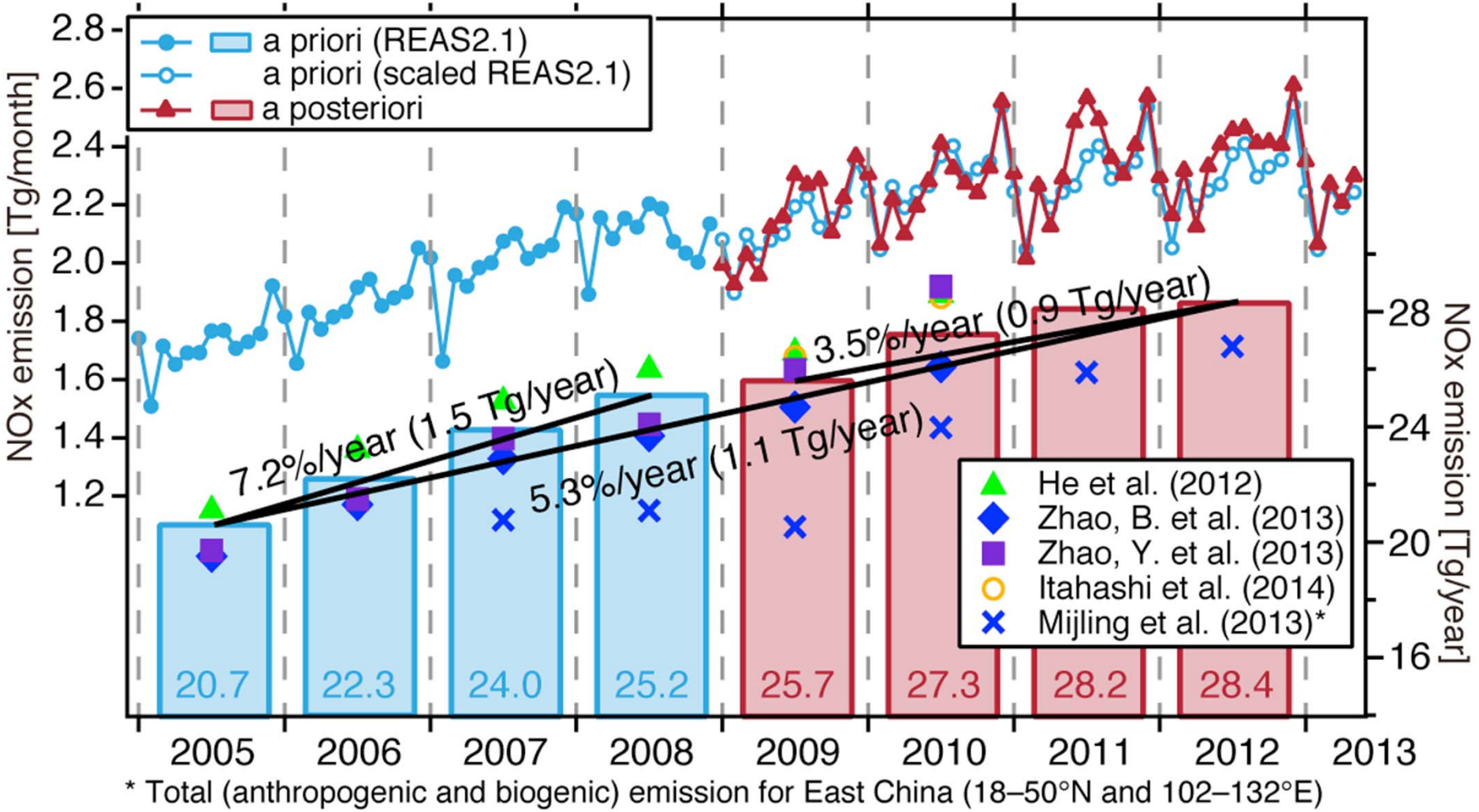
Development of better EI with lower uncertainties

Semi-real time update of EI

Analysis of air quality change events

NOx emission trend in China from top-down and bottom-up approaches

Yumimoto et al. (2015)



By combination of two approaches, we can update emissions with two years lag.

Summary

1. Air pollution, such as O_3 and PM, is a severe environmental issue that make an enormous impact on the human health in Asia. Asian approach for SLCP mitigation should be paid attention to air pollution reduction.
2. S-12 project aims to analysis air quality change events such as emission control and social events and to develop an analysis/verification system for quantifying the emission reduction and air quality improvements due to SLCP mitigation.
3. Regional Emission Inventory in Asia (REAS) are being updated to historical and latest emissions, and improved using top-down approach.