ChiNorBC project
Emission Workshop Summary

9th December 2020

The establishment of a BC/OC inventory is an important output in the Chinese-Norwegian Project on Emission, Impact, and Control Policy for Black Carbon and its Co-benefits in Northern China (ChiNorBC) project. An Emission Workshop (WS) with international participation was therefore held already back-to-back with the Kick-off meeting of the project on December 9th 2020. This report constitutes the proceeding from the WS. It contains a short summary of the WS as well as the meeting agenda and the presentations given.

BC/OC emissions data in northern China have been published by different institutions and are often inconsistent in total emission or specific sectors due to substantial differences in the emission factors chosen, activity levels recognized, and methodologies applied. These inconsistent results often lead to misunderstanding and confusion and add difficulty to identify major emissions sources and formulate policy. For this reason, a more comprehensive and convincing BC/OC emissions inventory should be developed for northern China to provide scientific data support for the formulation and implementation of policies by incorporating new emissions factors derived from measurements, investigated activity levels, and improved methodology. According to available literature, residential and mobile source sectors are among the most important sectors in emissions and uncertainty, which calls for an intensive study on these two sectors.

The ChiNorBC project was established between China and Norway to specifically addressed these two sectors. This project focuses on improving the knowledge and capability of China to conduct scientific assessments that co-benefit air pollution control and climate change and to provide support in policy making for reducing BC/OC emissions from multiple aspects (emissions inventories, air quality, climate change, health, and policies). The project results will significantly contribute to improve the Chinese Govenrment's capacity for environmental management. Furthermore, developing a strategy for BC/OC co-control will greatly benefit reductions in regional and national air pollutant emissions and improve air quality. To read more about the ChiNorBC project please have a look at the project web site, http://chinorbc.net/

On December 9th, 2020, the kick-off meeting of the international cooperation project Chinese-Norwegian Project on Emission, Impact, and Control Policy for Black Carbon and its Co-benefits in Northern China (ChiNorBC) was held. More than 20 experts and governmental officials from the competent departments and project group of both China and Norway attended the meeting. After the kick-off meeting, an Emission WS was held. Experts from within the project and outside experts from Tsinghua University and IIASA introduced the current status of BC emissions in China and relevant research results. These experts pointed out the adverse impacts of black carbon on air pollution and climate change and showed how different control strategies could reduce the emissions (WS agenda attached). The experience of Norway and Europe to control black carbon will serve as a reference in the project for China to carry out relevant scientific and policy research. After this workshop, more data, including emission factors and activity levels, will be investigated and a BC/OC emission inventory of northern China will be developed. For northern China, the emission inventory will be given a higher temporal/spatial resolution.

Photos from the virtual kick-off meeting and the Emission WS

Attachment: Workshop Agenda

<table>
<tr><td colspan="3">Part 2: Technical workshop on emission inventories for China and co-benefits of black carbon mitigation
Time: 17:25-19:30 / 10:25-12:30</td></tr>
<tr><td colspan="3">Moderator: Vigdis Vestreng, Time keeper: Tor Skudal (NEA), Rapporteur: CRAES</td></tr>
<tr><td>17:30-19:10/
10:30-12:10</td><td>Perspectives on emission inventories for China and co-benefits of black carbon mitigation</td><td>17:25-17:30,Welcome and purpose of WS. Dr. Vigdis Vestreng, NEA
1.17:30-17:50, Black carbon emissions in China – opportunities for mitigation and co-benefits. Mr. Zbigniew Klimont, Senior Researcher, IIASA
2.17:50-18:10, Anthropogenic emission trend of black carbon in China.
Dr. Xing Jia, Tsinghua University
3.18:10-18:25, Asian air pollution levels simulated with the CEDS and ECLIPSEv6 emission inventories”.
Dr. Marianne Tronstad Lund, Senior Researcher, CICERO
4.18:25-18:40, Estimates of health impacts of air pollution in China in the ECLIPSEv6 scenarios, Dr. Shilpa Rao, Senior Researcher, NIPH
5.18:40-18:55: On the UNEP-China SLCPs report. Prof. Zhi Guorui, CRAES
6.18:55-19:10, Diesel engine/vehicle emission prevention and control in China. Prof. Wang Yanjun, CRAES</td></tr>
<tr><td>19:10-19:30 /
12:10-12:30</td><td>Discussion and summing up</td><td>Vigdis Vestreng, NEA / Meng Fan, CRAES</td></tr>
<tr><td></td><td>Dinner</td><td></td></tr>
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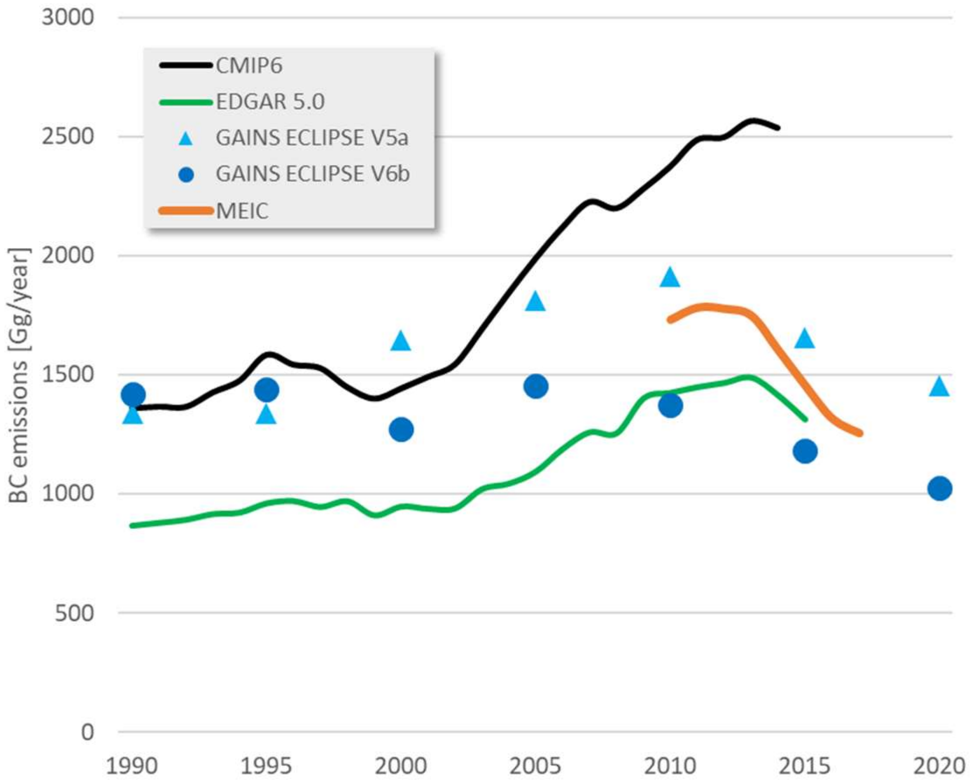
Black carbon emissions in China

Opportunities for mitigation and co-benefits

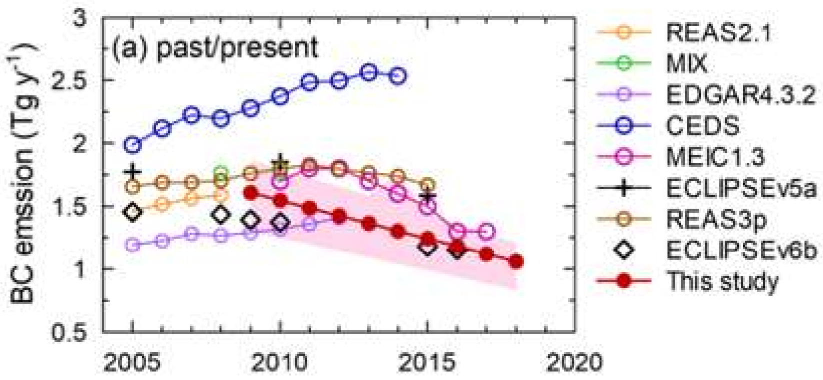
Zbigniew Klimont
International Institute for Applied Systems Analysis (IIASA)

Chinese-Norwegian Project on Emissions, Impacts, and Control Policy for Black Carbon and its Co-benefits; kick-off meeting, December 9, 2020

Comparison of China BC emission estimates

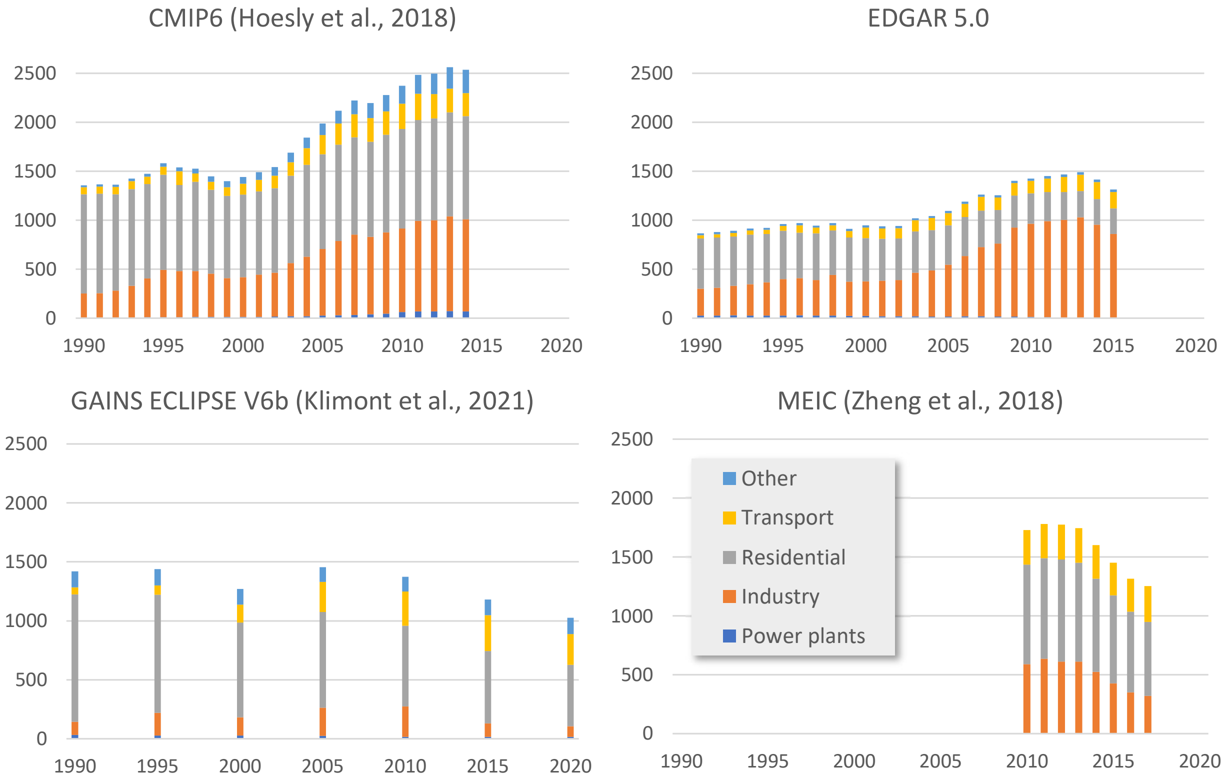


CMIP6 (Hoesly et al., 2018); MEIC (Zheng et al., 2018);
EDGAR 5.0 (https://edgar.jrc.ec.europa.eu/overview.php?v=50_AP);
ECLIPSE V5a (Klimont et al., 2017) – residential coal (MEIC);
ECLIPSE V6b (Klimont et al., 2021) – residential coal (IEA)



Kanaya *et al.* (2020) Rapid reduction of black carbon emissions from China based on 2009–2019 observations from Fukue Island, Japan

Comparison of China BC emission estimates (2) [Gg/year]

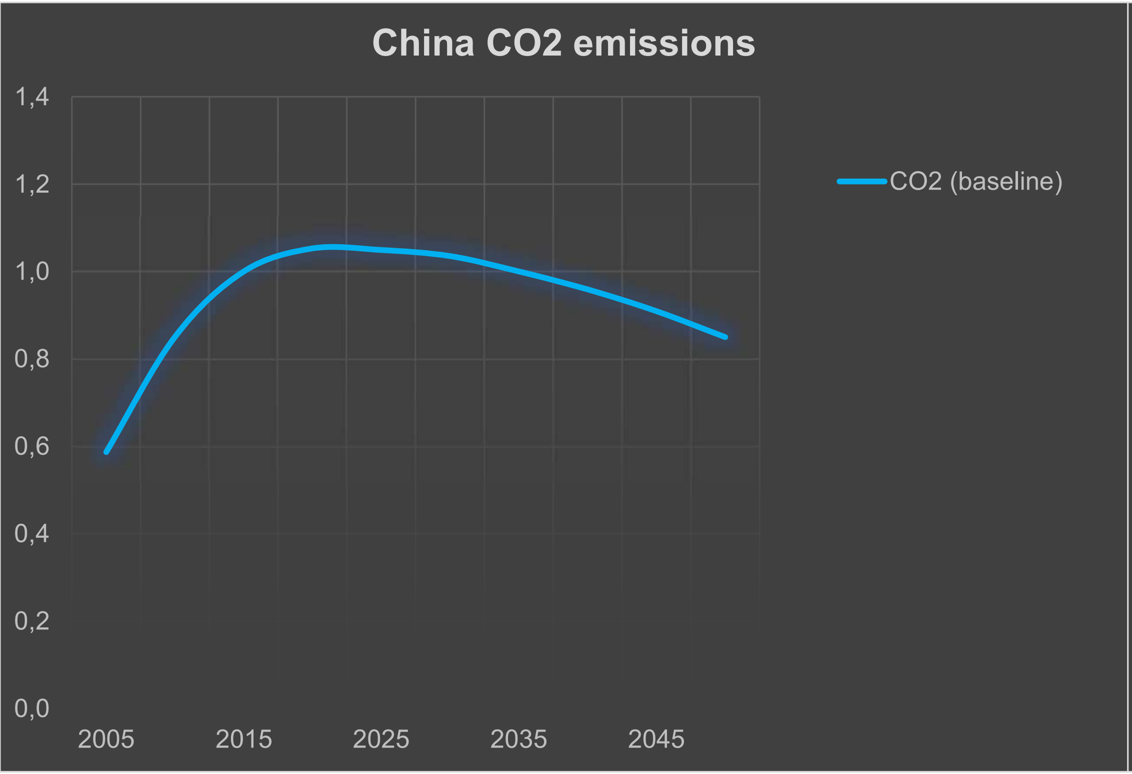


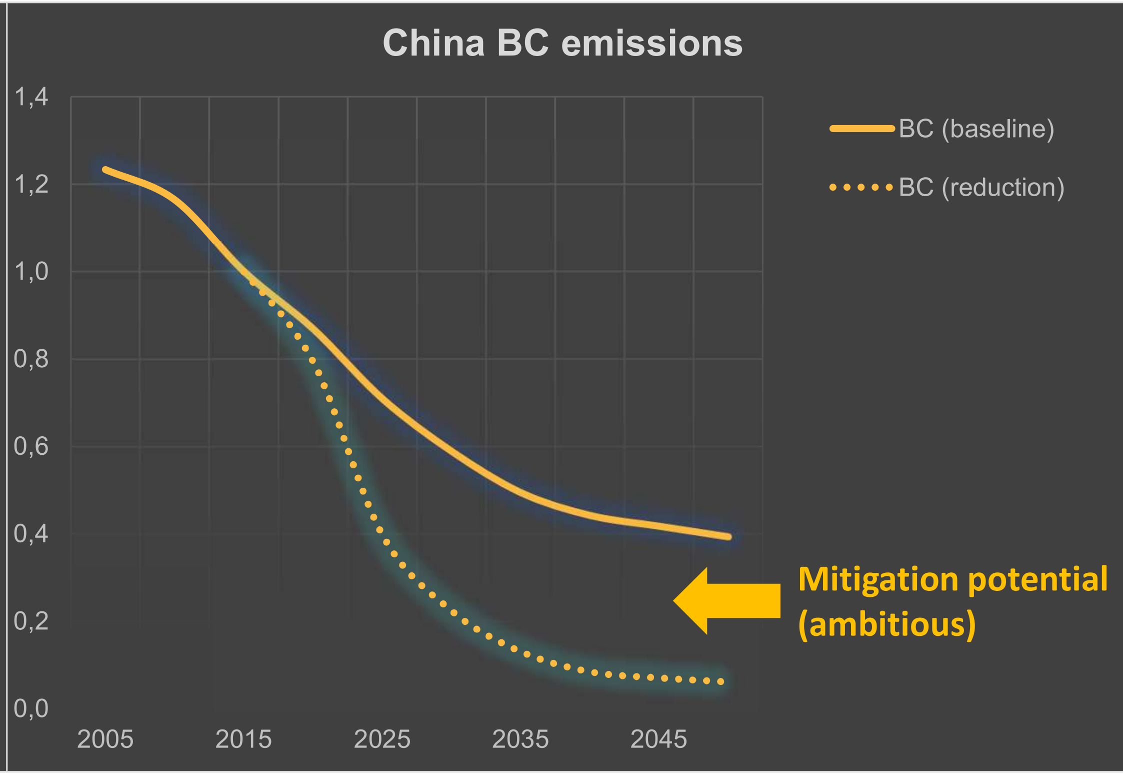
….at least transport looks fairly consistent!

Issues:

- Industry
  - Coke ovens emission factors
  - Small coal boilers emission factors
  - Industrial coal use in recent years
- Residential coal and wood statistics
- Inclusion and activity for waste burning

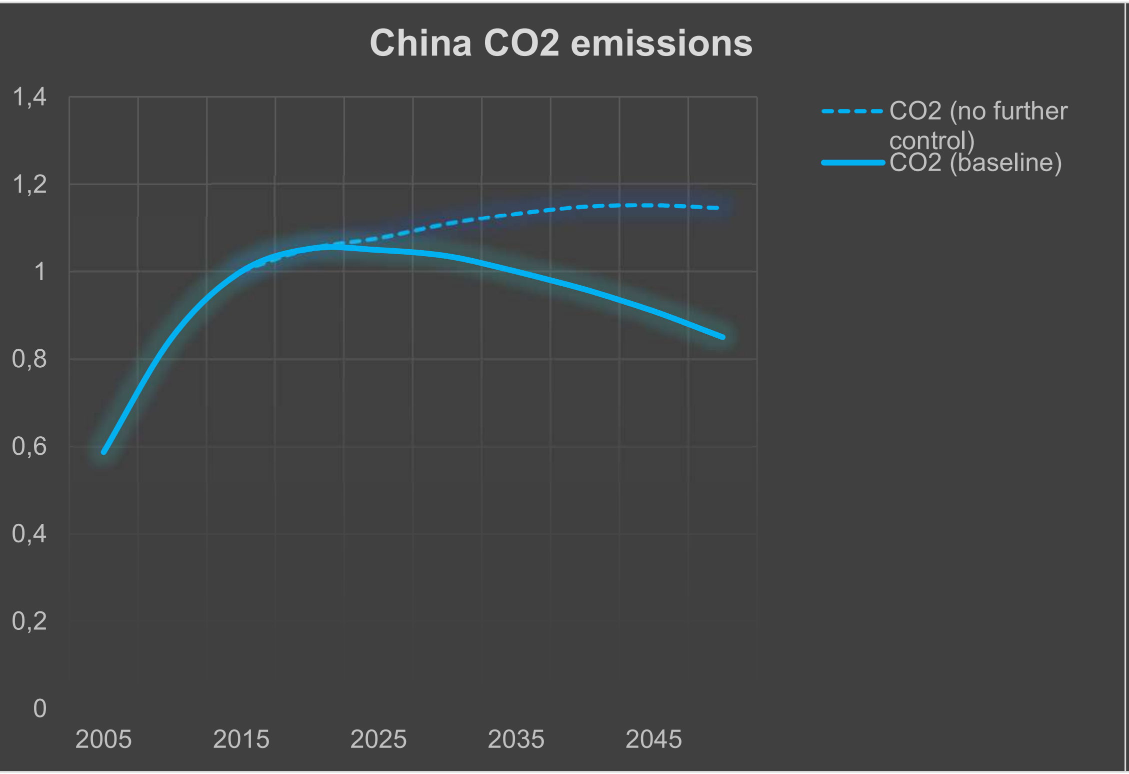
Emission projections and mitigation potential;
(Changes relative to 2015)

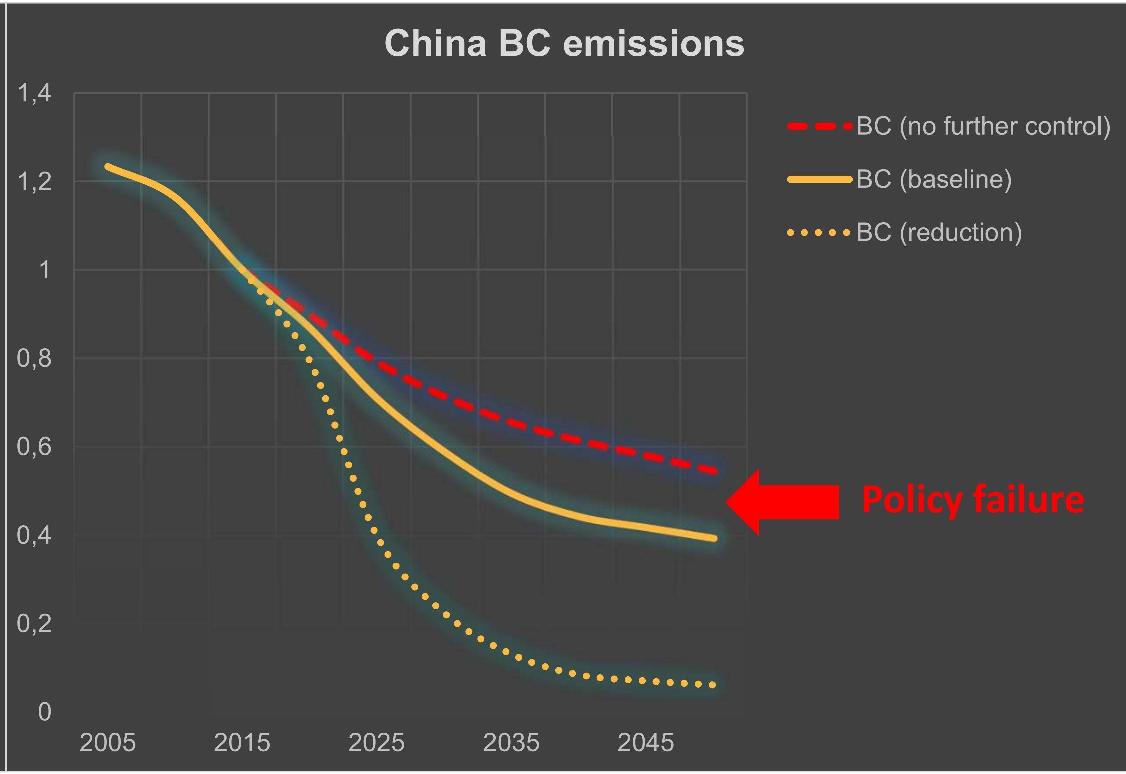




Source: GAINS model (IIASA); scenario: ECLIPSE V6b (CLE, MFR); Klimont et al. (2021)

Emission projections and mitigation potential
(Changes relative to 2015)

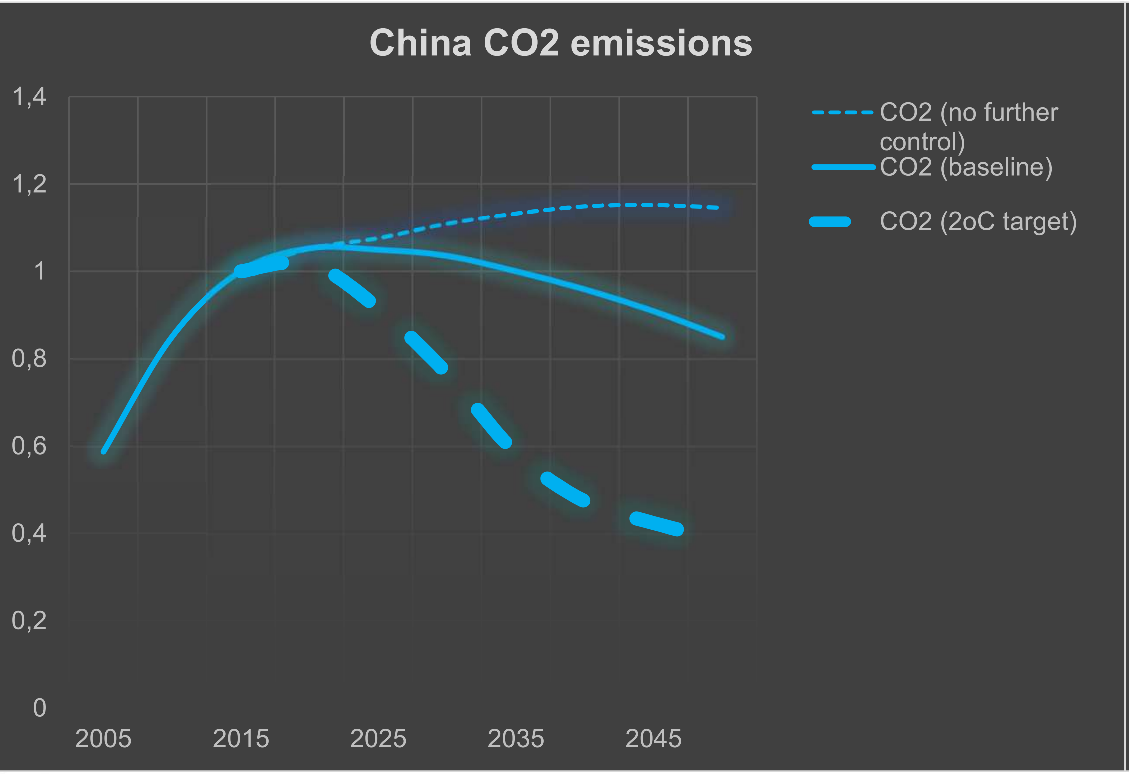


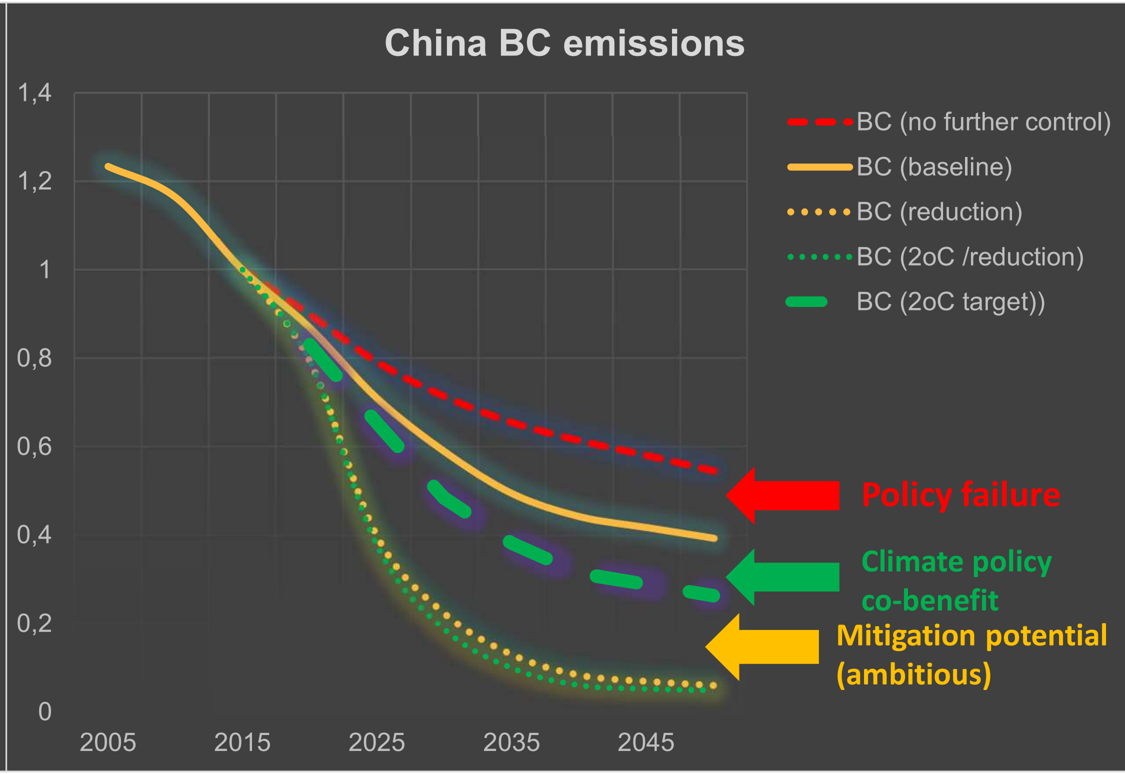


Source: GAINS model (IIASA); scenario: ECLIPSE V6b (CLE, NFC, MFR); Klimont et al. (2021)

Emission projections and mitigation potential

(Changes relative to 2015)





Source: GAINS model (IIASA); scenario: ECLIPSE V6b (CLE, NFC, MFR, SDS, SDS-MFR); Klimont et al. (2021)

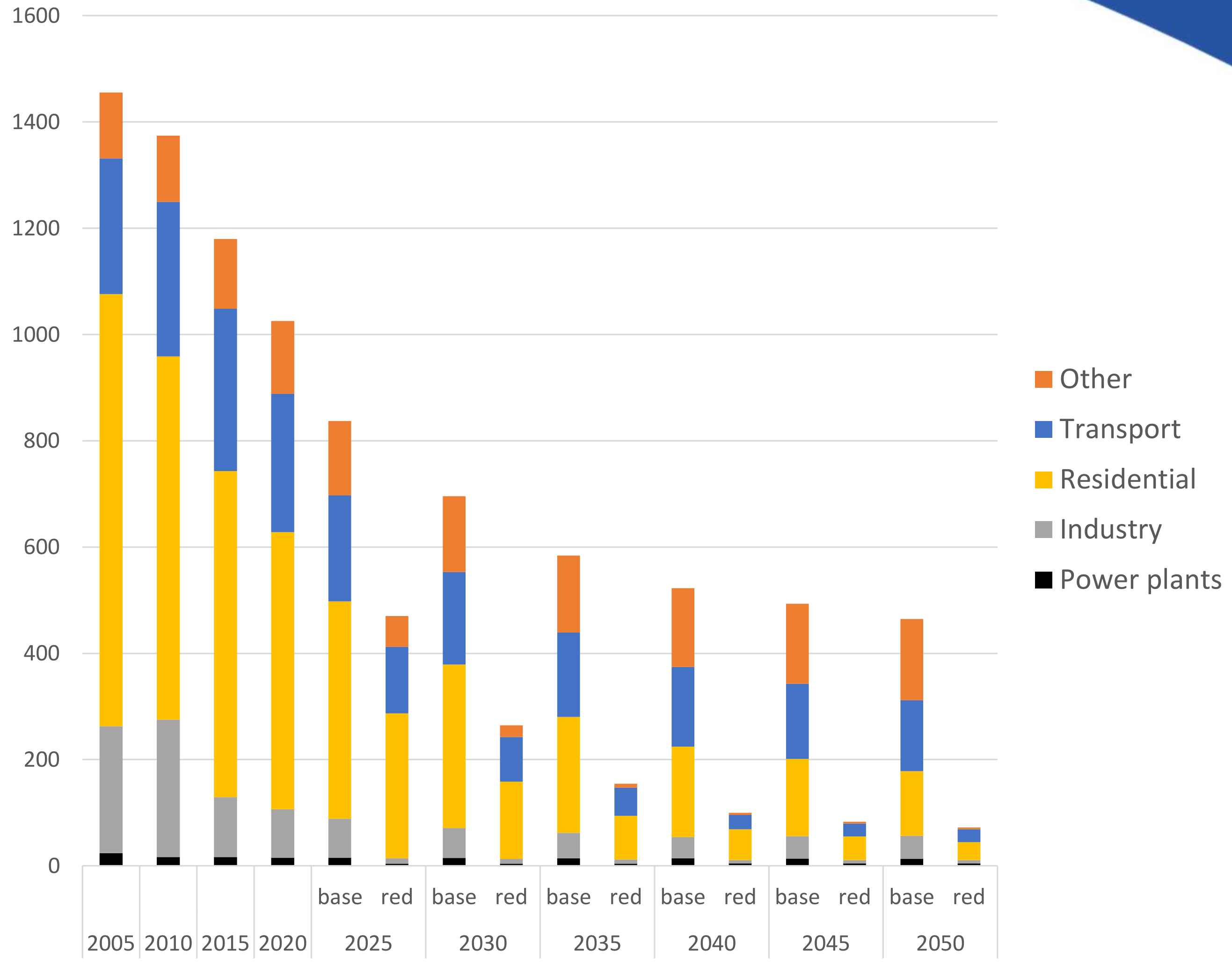
Emission projections and mitigation potential [Gg]

Baseline *(base)*

- Continued reduction in residential and transport
- Waste sector lags behind and becomes a major source

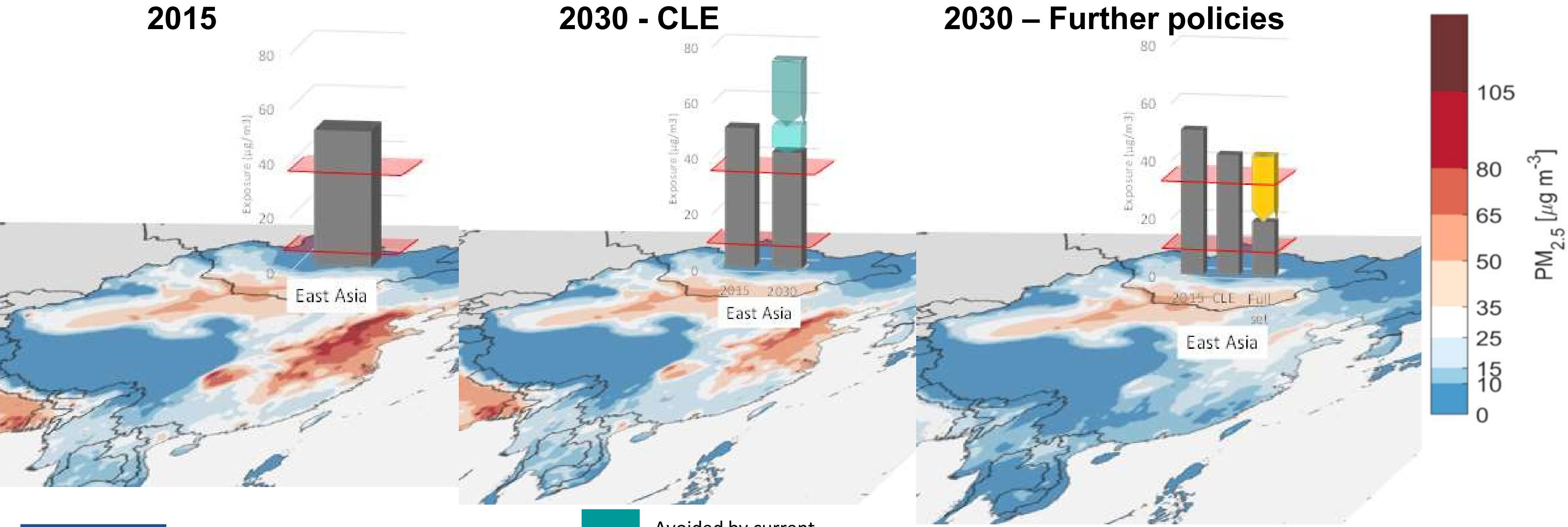
Mitigation *(red)*

- Strict polices in waste sector
- Further strengthening and enforcement in transport
- Accelerated reductions in use of solid fuels for heating and cooking



Source: GAINS model (IIASA); scenario: ECLIPSE V6b (CLE, MFR); Klimont et al. (2021)

PM2.5 concentrations and mean population exposure in East Asia



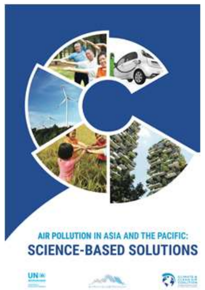
Avoided by current measures

Avoided through recent legislation

Residual/actual concentrations

Potential for further improvements

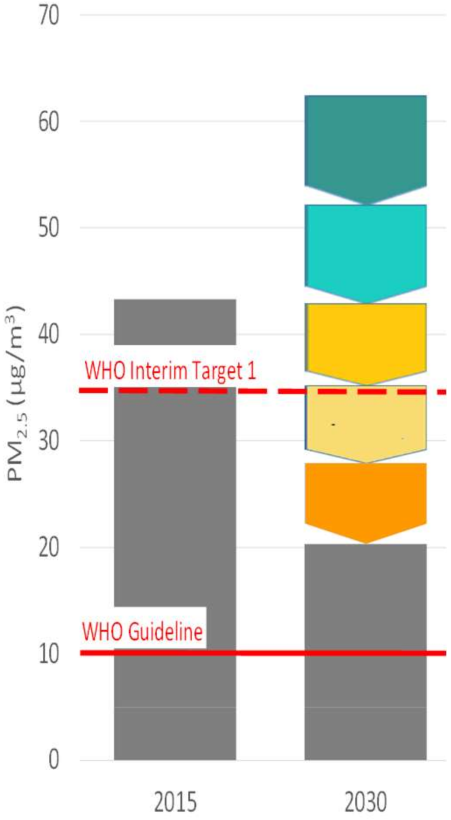
Residual/actual concentrations



Source: GAINS model (IIASA); "Science-based solutions, UNEP/CCAC, 2018"

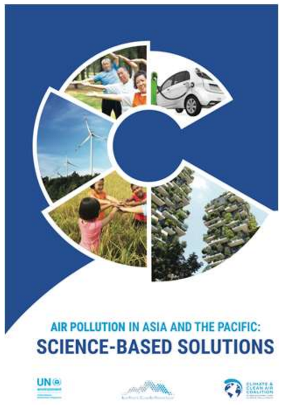
BC reduction shall be part of policies addressing energy efficiency, air pollution, SDGs, resulting in multiple benefits

Mean population exposure to PM2.5



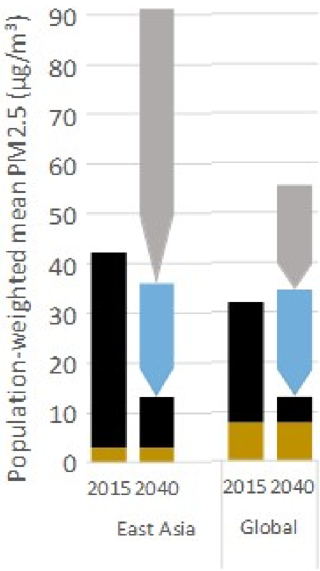
	Climate forcers			SDG benefits
	CO_2	CH_4	BC	
Current legislation relative to 2015*)	*+16%*	*+17%*	*-24%*	
Conventional controls relative to 2030 baseline	0%	0%	-8%	
'Next-stage' measures relative to 2030 baseline	0%	-29%	-56%	
Development priority measures relative to 2030 baseline	-19%	-44%	-72%	

Source: GAINS model (IIASA); "Science-based solutions, UNEP/CCAC, 2018"

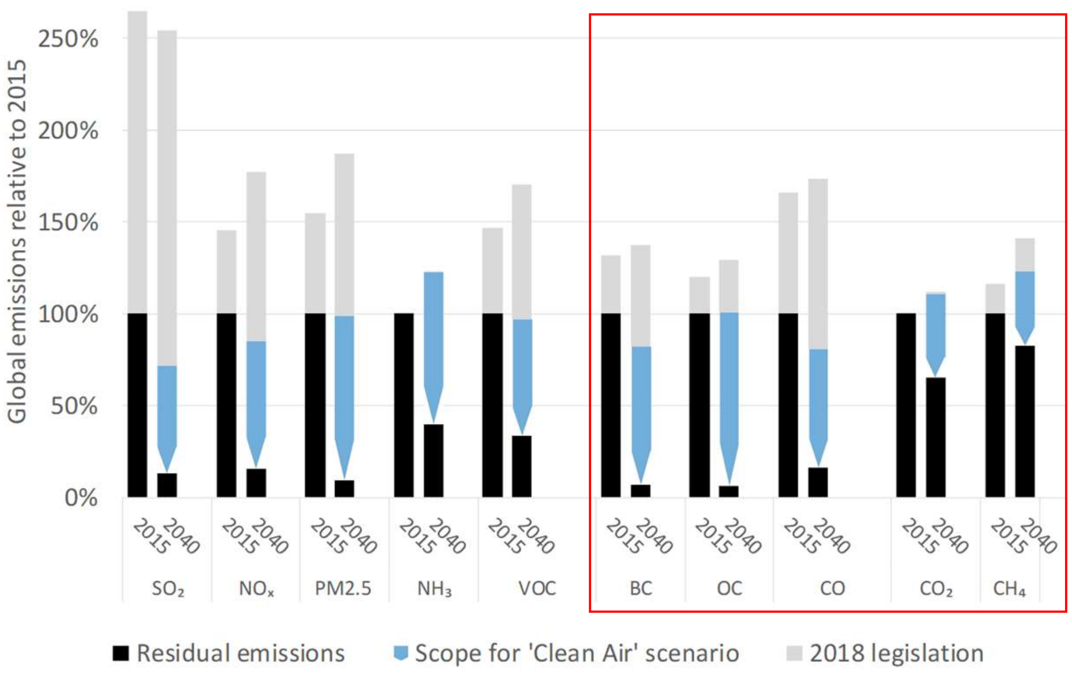


Global Perspective:
Multi-sectoral solutions to achieve clean air will deliver a wide range of benefits on multiple development priorities

- Direct health benefits on health, particularly in urban areas (SDG 3, SDG 11)
- Significant cuts of global emissions of SLCFs and CO_2 (SDG 13)
  BC (-90%), CH_4 (-30%), CO_2 (-40%)
- Improve further energy efficiency and access to clean energy (SDG 7)
- Improved nitrogen use efficiency contributes towards reducing malnutrition and several environmental impacts and enables responsible consumption and production (SDG 2, SDG 14, SDG 15, SDG 12)



Emission changes to 2040



Source: Amann et al (2020). *Phil. Trans. R. Soc. A*

Final remarks

- BC emission estimates remain uncertain
- Declining trend of BC emissions in China appears robust
- Enforcement of current policies important to deliver significant further reductions; nearly 30% of total potential
- Further mitigation potential exists and could be achieved with known and proven technologies/transformations
- BC measures are among the top priority measures for air quality improvements in Asia
- Co-benefits of climate policy are smaller than often believed and might result in unnecessary delay in BC mitigation
- BC reduction shall be part of policies addressing energy efficiency, air pollution, and several SDGs resulting in multiple benefits

Anthropogenic emission trend of black carbon in China

Jia Xing, Fenfen Zhang, Haotian Zheng, Shuxiao Wang

Tsinghua University

Outline

- Overview of ABaCAS-EI
- BC and its impacts during 2013-2017
- Future emission prediction to 2035

Summary of current emission inventories

Air Benefit and Cost and Attainment Assessment System-Emission Inventory (ABaCAS-EI)
- 2005-2017 China anthropogenic emissions of air pollutants by country and on spatial grid
- 1 km x 1 km

http://abacas-dss.com

Emissions Database for Global Atmospheric Research (EDGAR v4.3.2)
- 1970-2010 global past and present day anthropogenic emissions of greenhouse gases and air pollutants by country and on spatial grid
- 0.1 degree x 0.1 degree

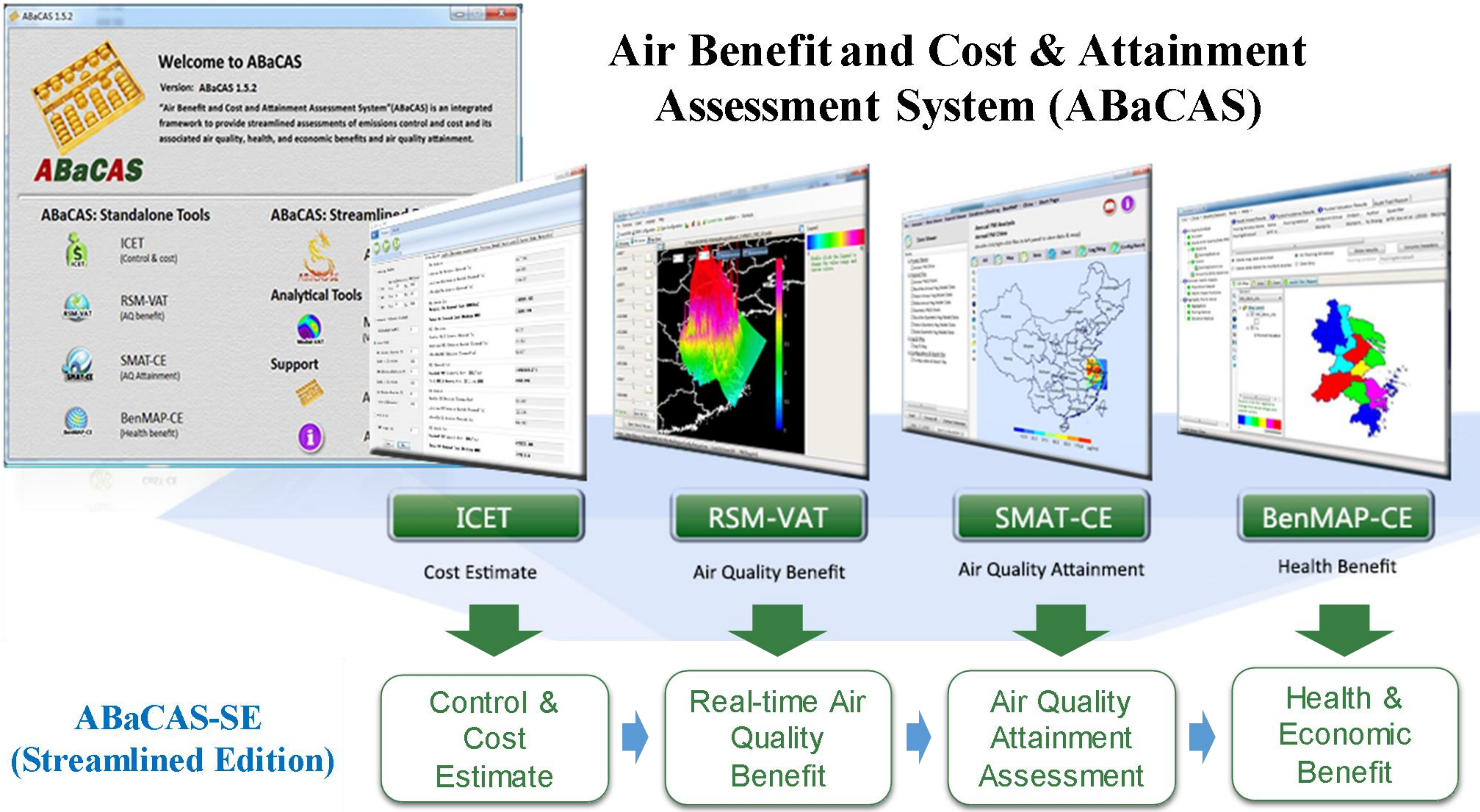
Regional Emission inventory in ASia (REASv3.1)
- 1950-2015 Asia anthropogenic emissions of air pollutants by country and on spatial grid
- 0.25 degree x 0.25 degree

The ECLIPSEv5a emission dataset from GAINS-Asia (IIASA)
- 1990-2015 Asia anthropogenic emissions of air pollutants by country and on spatial grid
- 0.25 degree x 0.25 degree

Multi-resolution Emission Inventory for China (MEICv1.3)
- 2008-2016 China anthropogenic emissions of air pollutants by country and on spatial grid
- 1 degree x 1 degree

MIX Asian emission inventory (MIXv1.1)
- 2008 and 2010 Asia emissions of air pollutants by country and on spatial grid
- 0.25 degree x 0.25 degree
- Integrating latest MEIC, REAS2, PKU-NH3, and CAPSS emission inventories

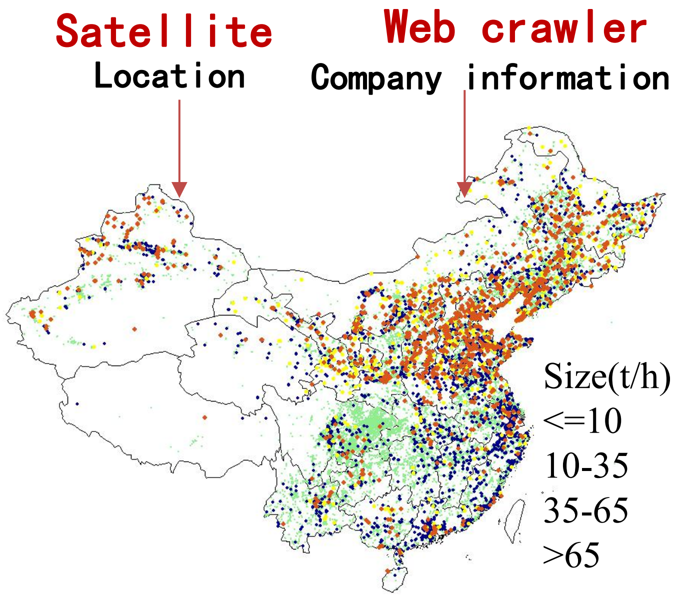
ABaCAS: a scientifically sound decision support system



Xing, J. *et al*. ABaCAS: an overview of the air pollution control cost-benefit and attainment assessment system and its application in China. *The Magazine for Environmental Managers - Air & Waste Management Association* **2017**, April.

ABaCAS-EI: a bottom-up emission inventory in China

Unit-based industrial emission

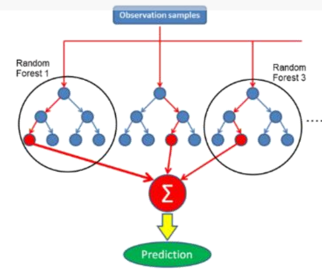


Pollutants	SO_2、NOx、PM、VOCs、NH_3、HCl/PCl、Hg
Time	2005-2017
Region	China, key regions and cities
Spatial resolution	~1km×1km
Time resolution	1 hour
Components	Local PM2.5 and VOC profiles

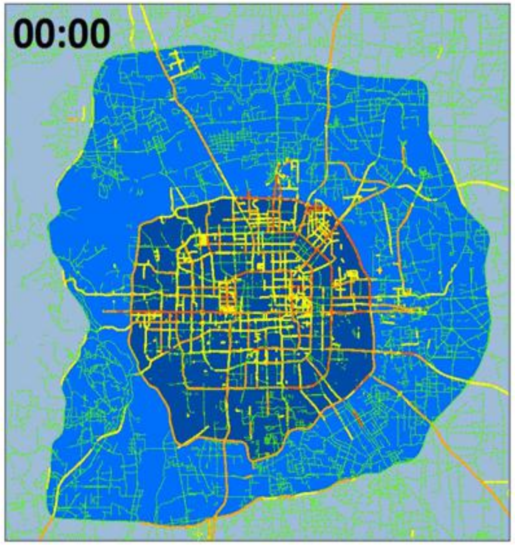
Vehicle emission based on AI

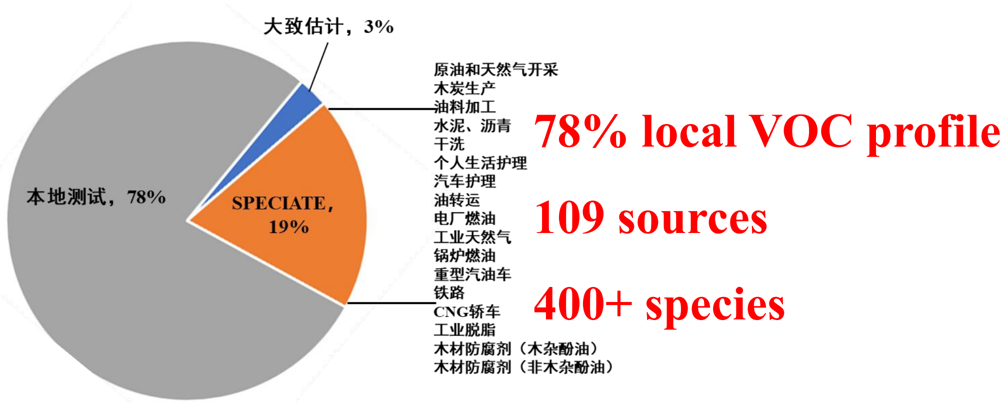
Traffic big data

Machine learning



Resolution: 100m-1hour

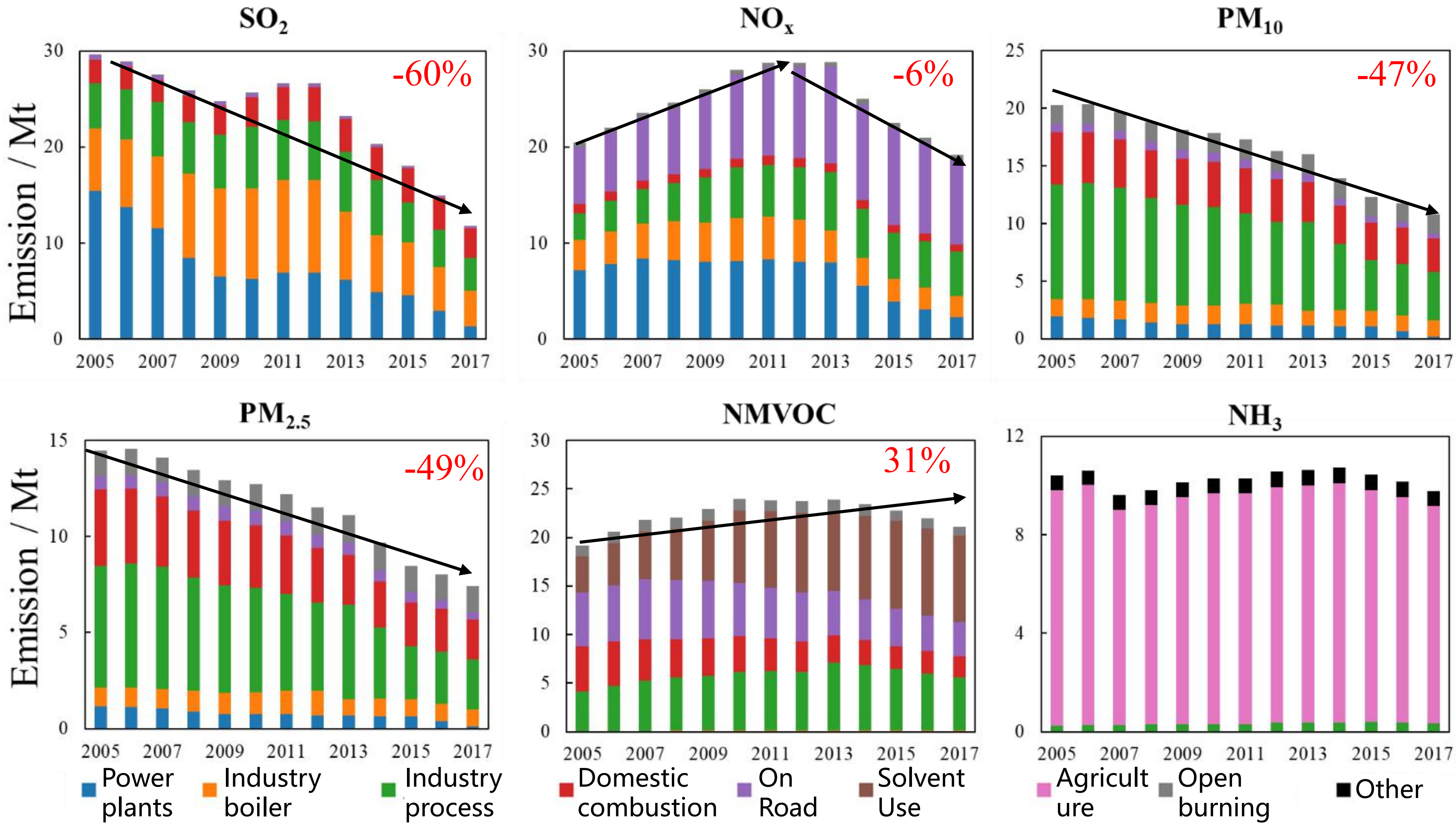




VOC speciation

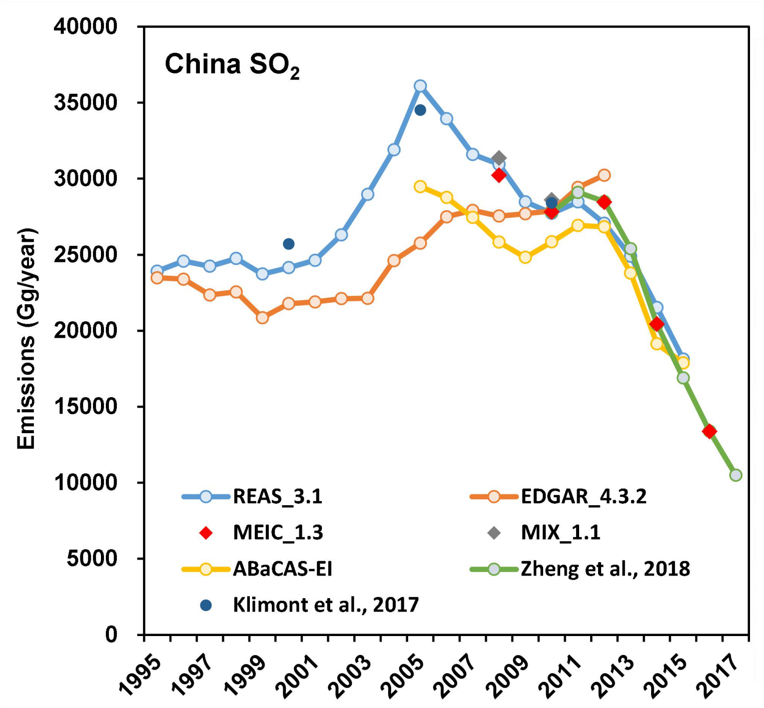
Anthropogenic emissions in China (2005-2017)

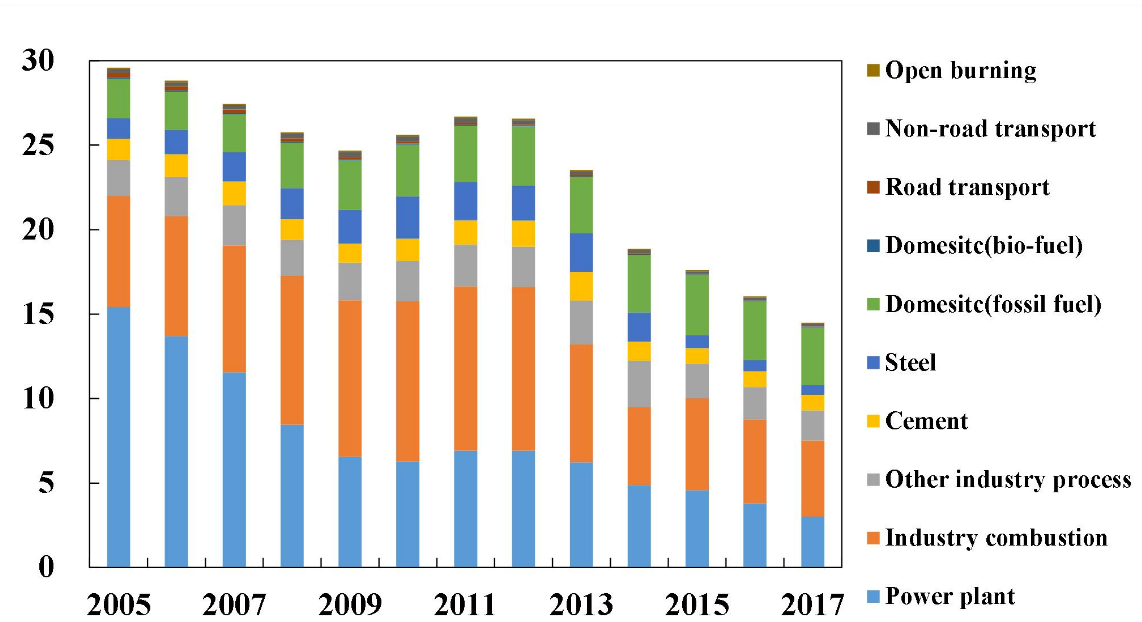
With inner-consistent method



Zheng et al., EI, 2019

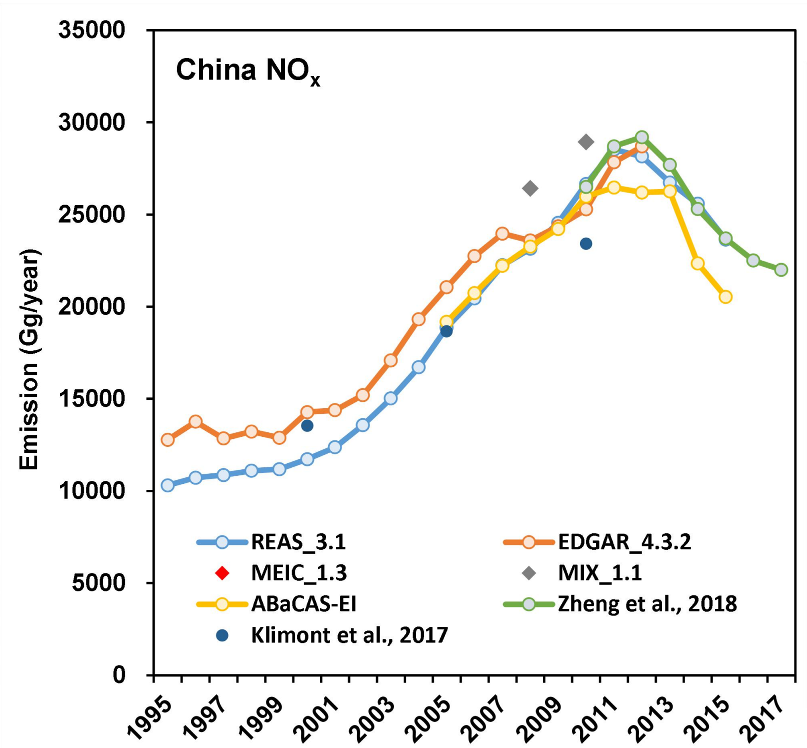
ABaCAS-EI: SO_2

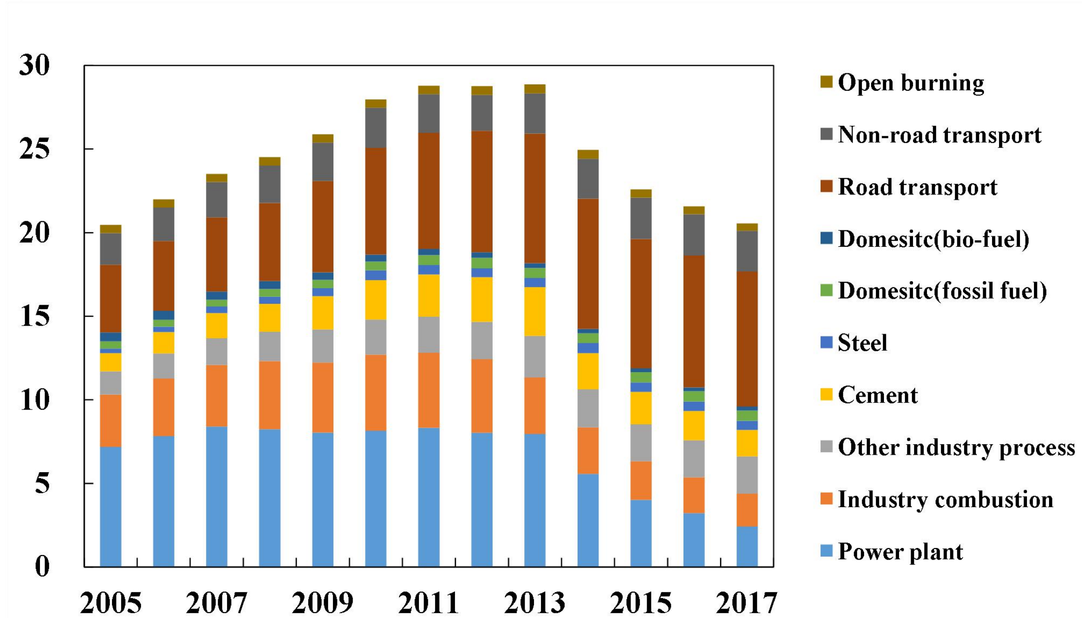




- During 2005-2017, SO_2 emissions were reduced by **51%**, with the largest contributor was power plants (80%) and industrial combustion (32%).

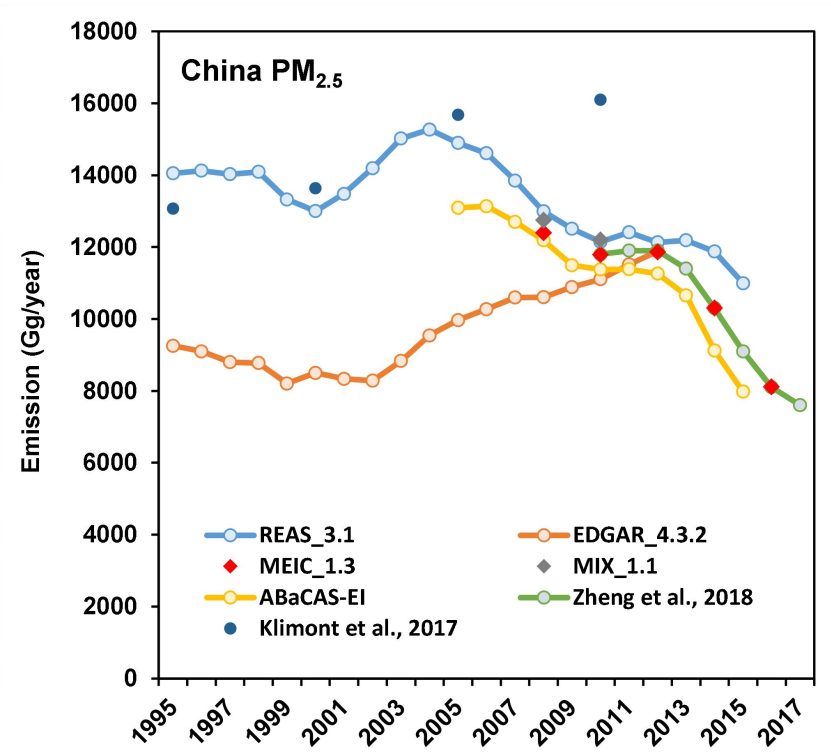
ABaCAS-EI: NO_X

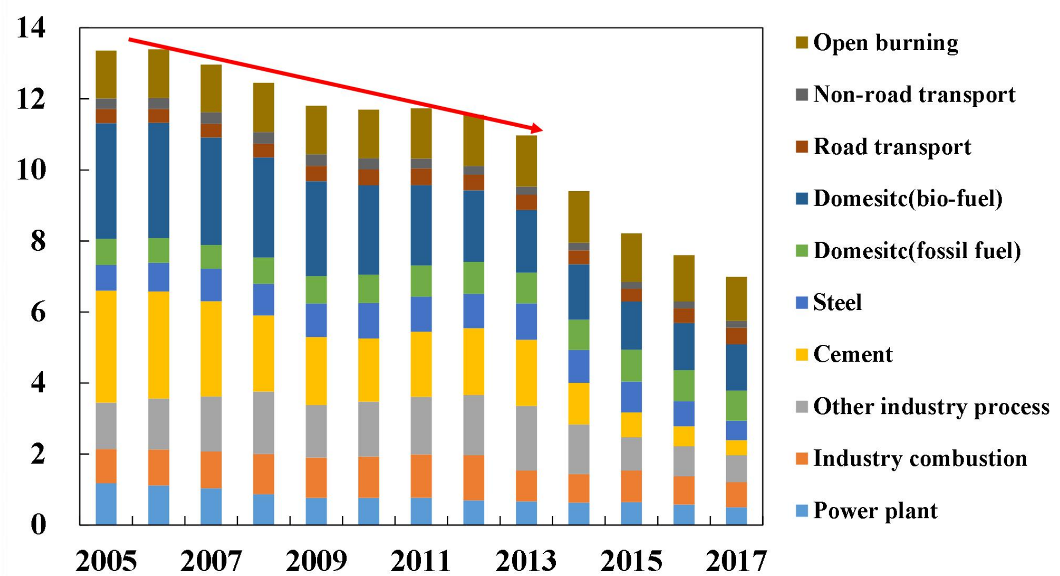




- During 2005-2017, NOx emissions first increased and then decreased, emissions from power plants and industrial combustion significantly decreased, emissions from steel, cement and industrial processes increased, and emissions from road transport doubled.

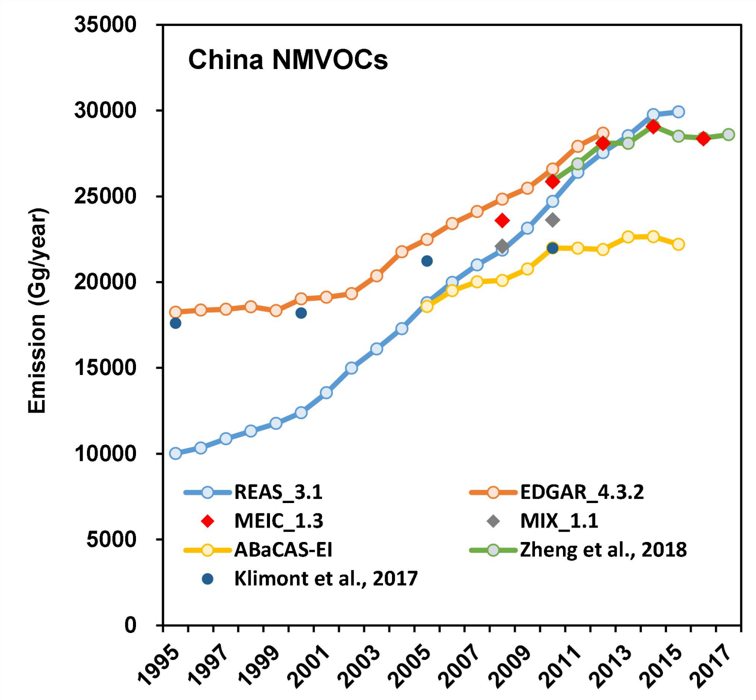
ABaCAS-EI: $PM_{2.5}$

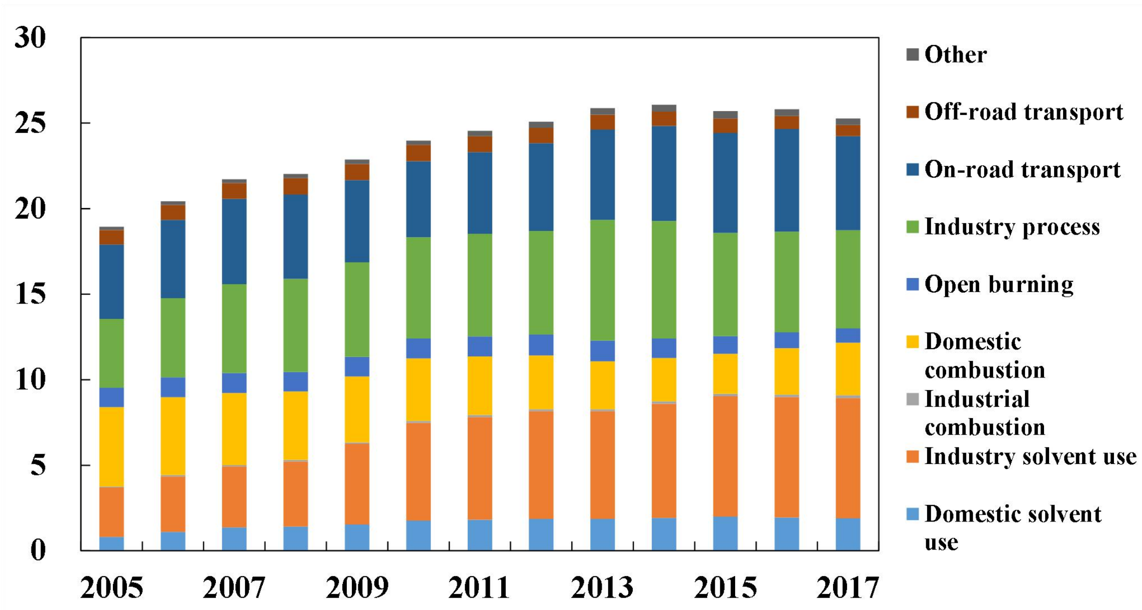




- During 2005-2017, $PM_{2.5}$ emissions decreased by 48%, with the largest contributor was cement (80%), power plants (57%) and domestic biomass combustion.

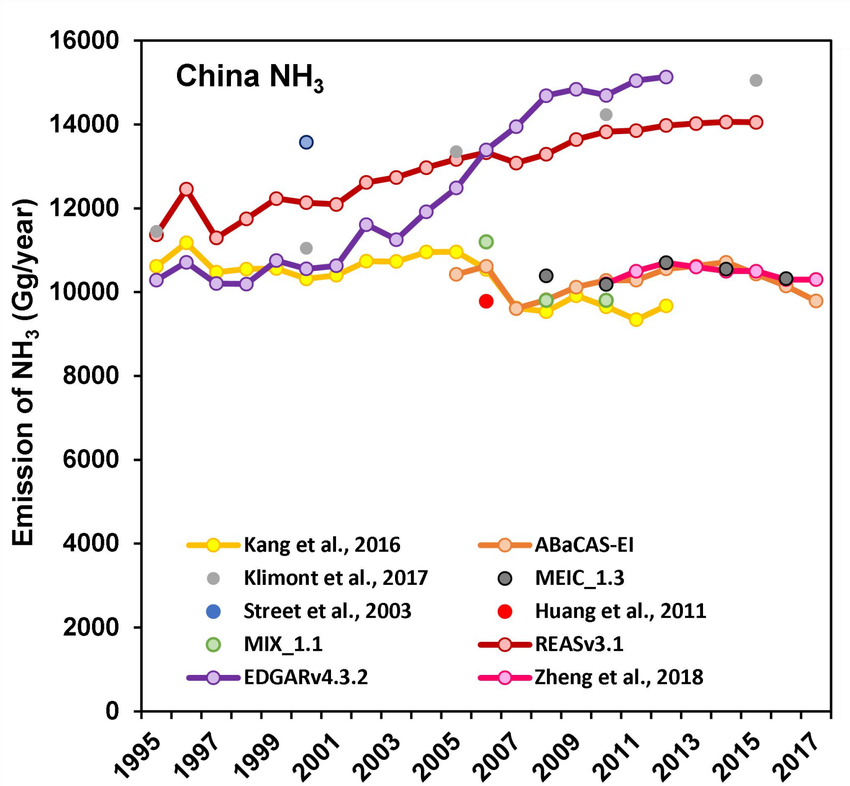
ABaCAS-EI: NMVOCs

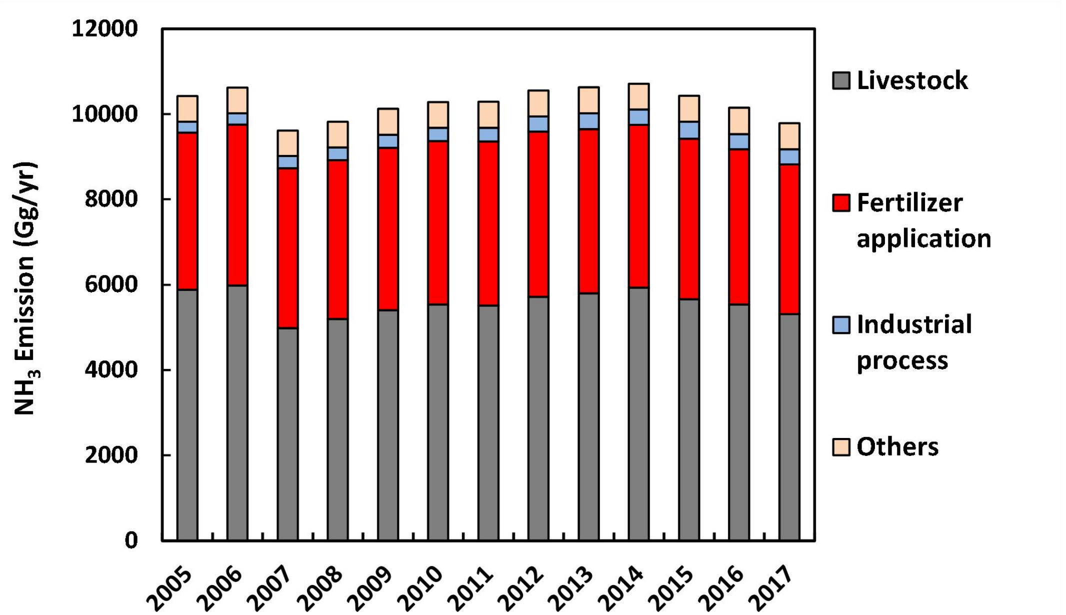




- During 2005-2017, NMVOC emissions increased by 14%, with the largest increases sector was solvent use, industrial processes and traffic sources.

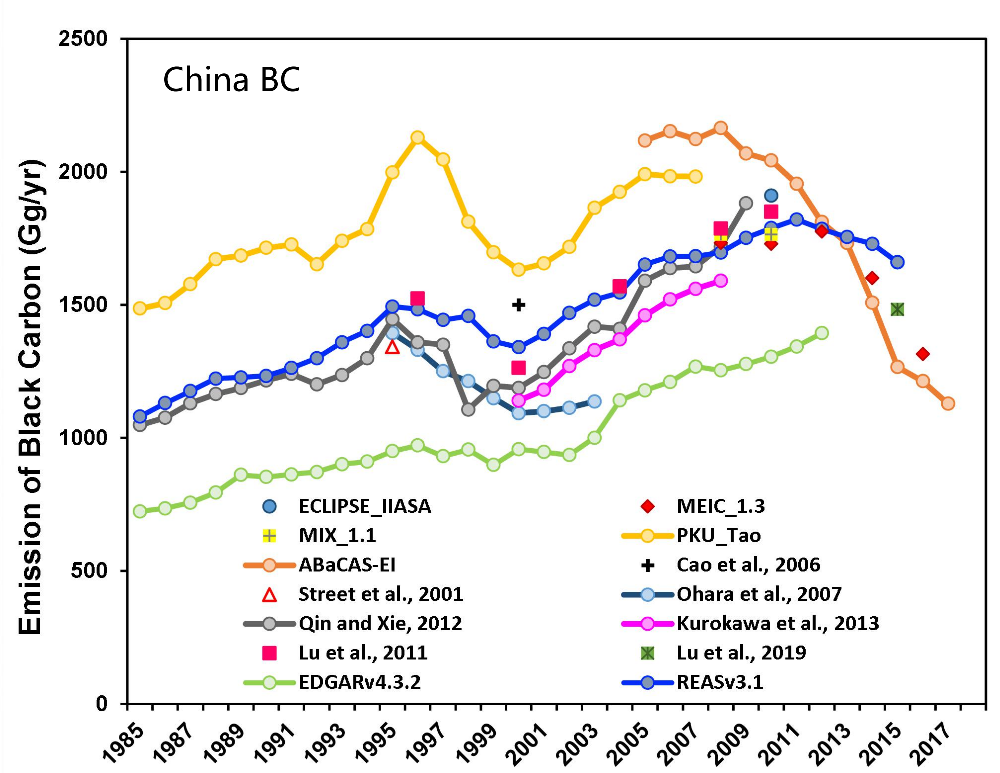
ABaCAS-EI: NH_3

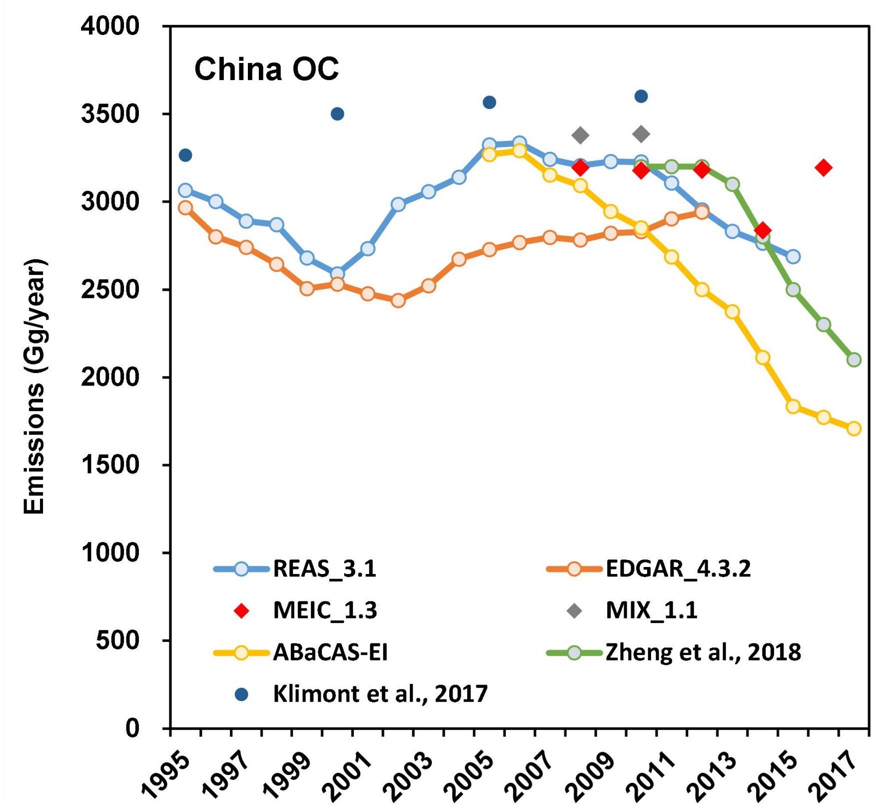




- During 2005-2017, the NH_3 emissions decreased by 6.1%, with the most contributor was livestock and fertilizer application, which totally contributed up to 90%.

ABaCAS-EI: BC and OC





- During 2005-2017, BC and OC emissions decreased by 46.7 % and 47.7 %, respectively.
- The largest contributor was industrial processes, transportation and domestic sectors.

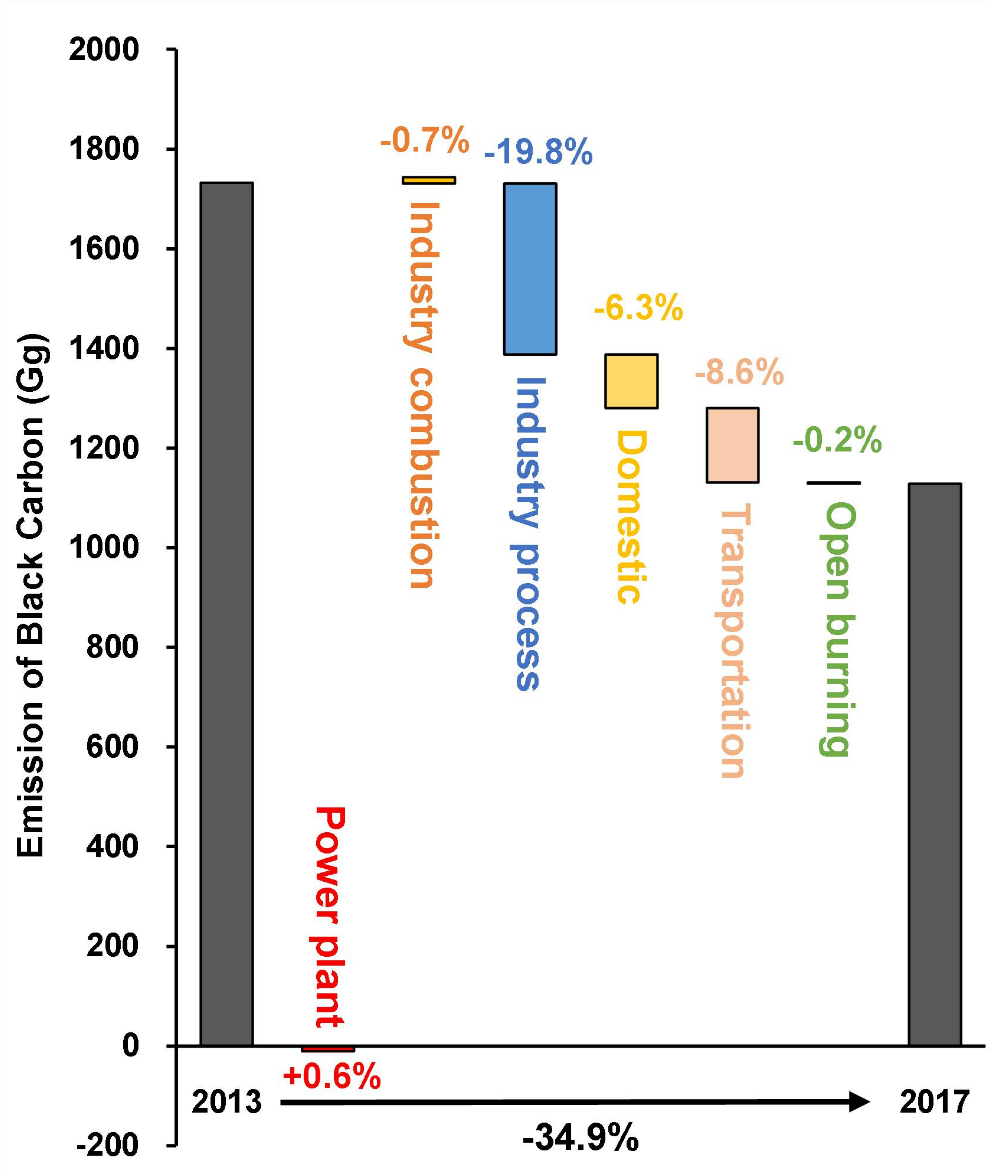
Outline

- Overview of ABaCAS-EI
- BC and its impacts during 2013-2017
- Future emission prediction to 2035

Reduction of BC emissions during 2013-2017

- Emission of BC during 2013-2017
  - In 2013: 1732.4 Gg
  - In 2017: 1128.5 Gg
  - Reduction: - 34.9 %

- Reduction of BC emissions in different sectors
  - Power plant: + 0.6 %
  - Industry combustion: - 0.7%
  - Industry process: - 19.8%
  - Domestic: - 6.3%
  - Transportation: - 8.6%
  - Open burning: - 0.2%



WRF-CMAQ model configuration

Domain

– 27 km X 27 km

Modeling period

– Jan/Jul in 2013

– Jan/Jul in 2017

Scenarios

- Sim_no feedback (nf)
- Sim_feedback (sf)
- Sim_no BC emissions with feedback (noBC_sf)
- Sim_no BC emissions without feedback (noBC_nf)

WRF-CMAQ coupled model

–WRF3.8: NCEP/NCAR Reanalysis data with 2.5 degree spatial and 6-hour temporal resolution; NCEP ADP Operational Global Surface/ Upper Air Observations with 6 hour intervals, MODIS land-use type, RRTMg radiation scheme, ACM2 (Pleim) PBL, PX LSM.

–CMAQ5.2: CB06-AERO6 chemistry, inline photolysis.

–Emission: ABaCAS-EI (years of 2013 and 2017, Tsinghua University), other regions (IIASA)

–Boundary Condition: derived from hemispheric WRF-CMAQ simulations

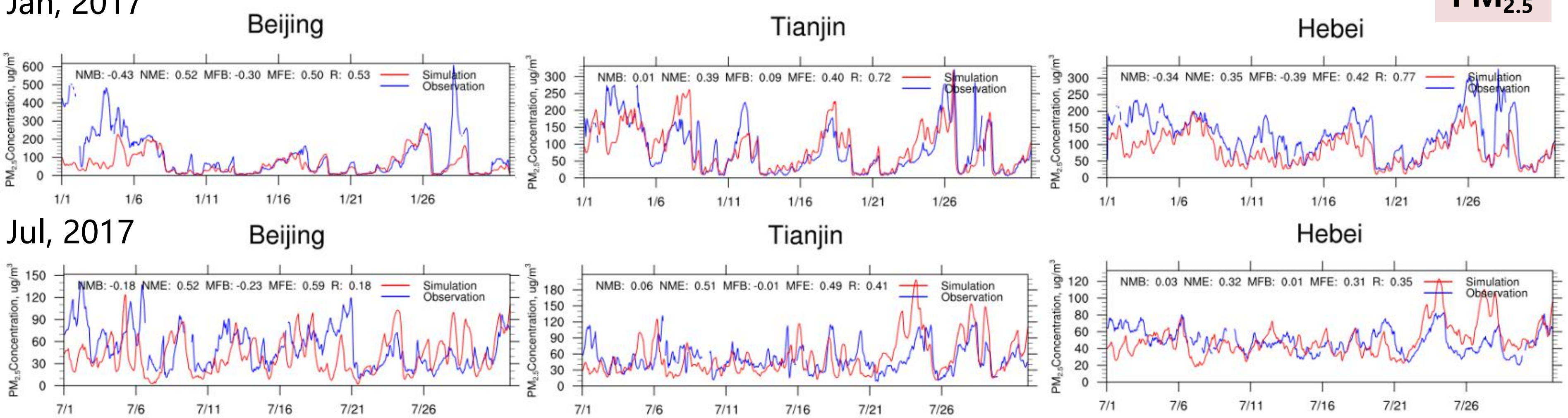
Zhang et al., in preparation

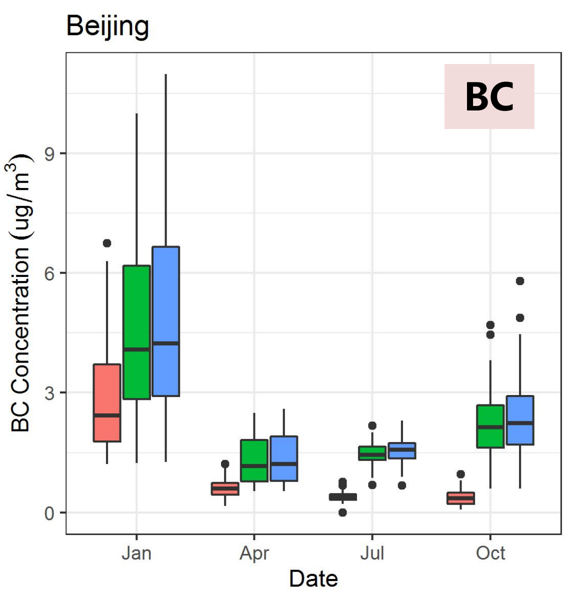
Model performance in simulating $PM_{2.5}$

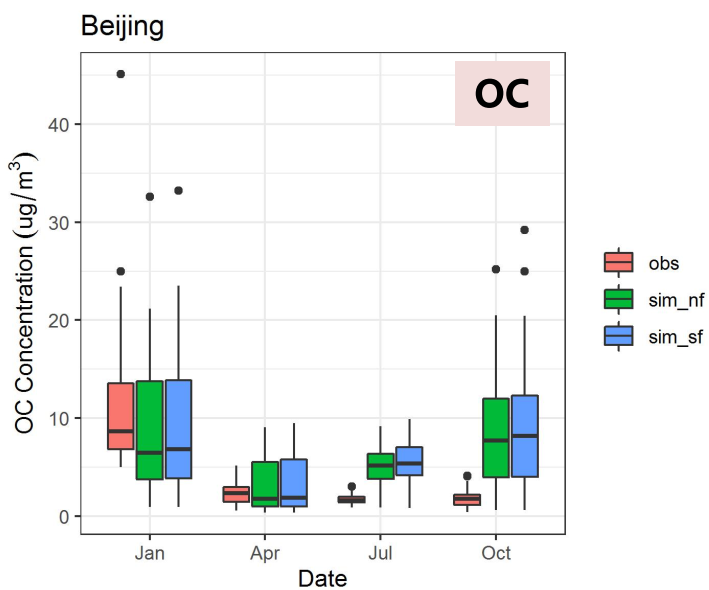
$PM_{2.5}$

Jan, 2017

Jul, 2017







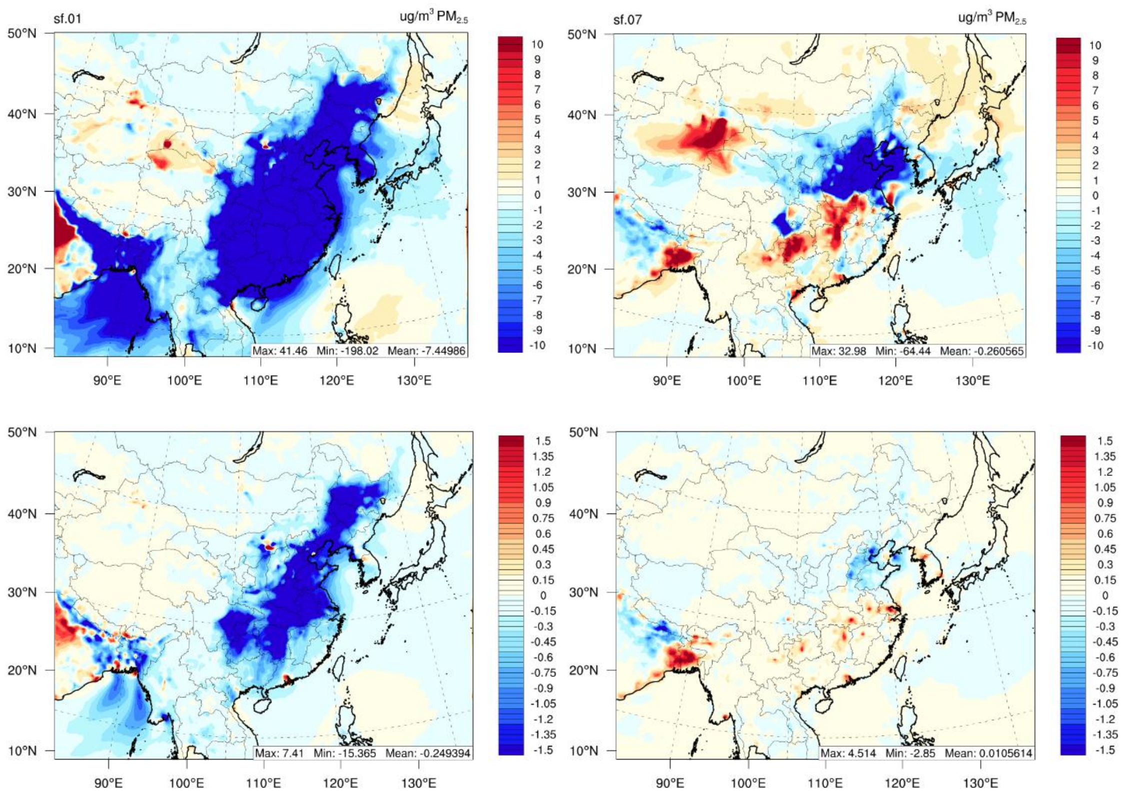
Model tends to overestimate BC and OC, and in Oct

Simulated $PM_{2.5}$ & BC changes

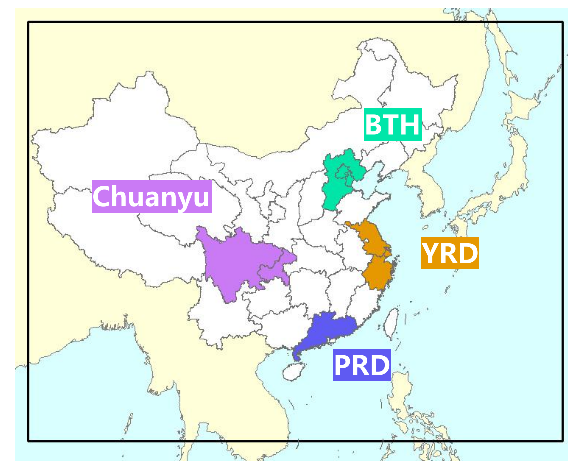
Jan Jul

$PM_{2.5}$

BC



- BTH： -54.9 ug/m^3
- YRD: -29.6 ug/m^3
- PRD: -6.4 ug/m^3
- Chuanyu: -65.6 ug/m^3

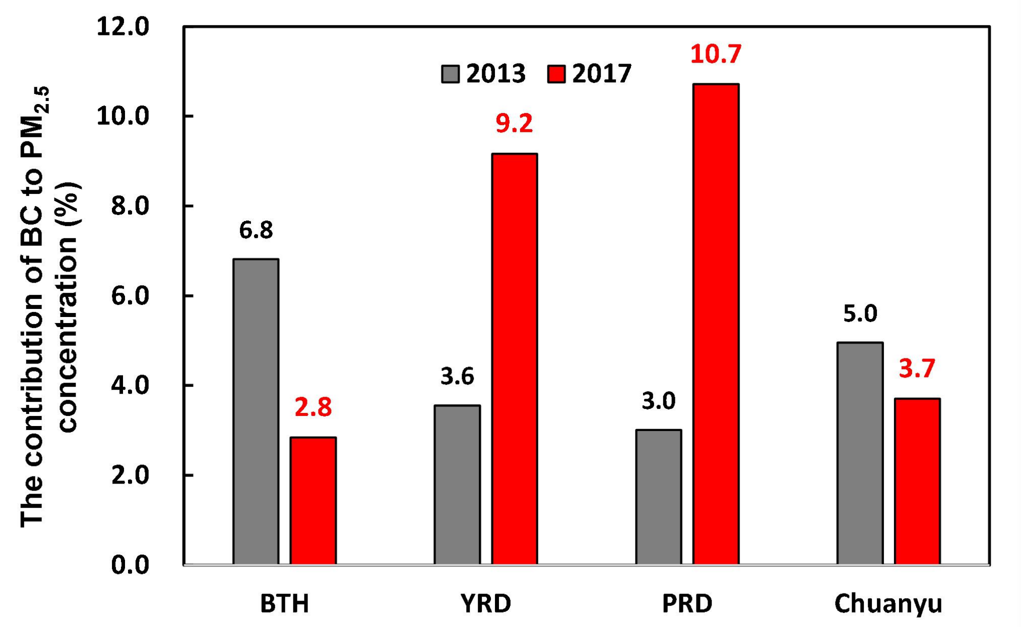


The emission controls lead to a substantial reduction in $PM_{2.5}$ concentrations, mostly in BTH and ChuanYu

The proportion of BC in $PM_{2.5}$

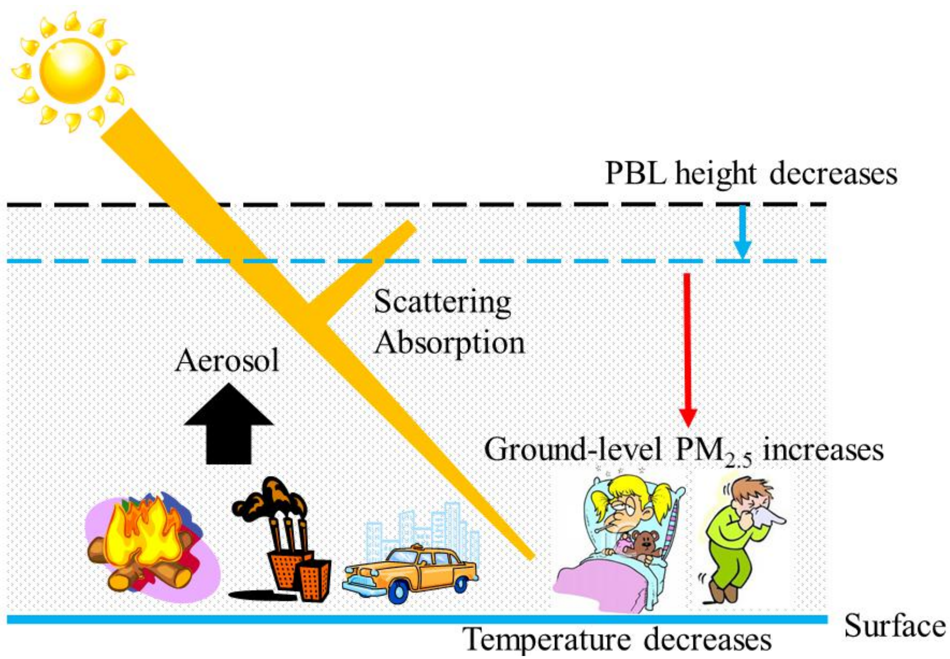
- The proportion of BC in total $PM_{2.5}$ concentration is **7.4% in China** during 2013-2017

- ✓ BC proportions are larger in YRD and PRD than that in BTH and ChuanYu
- ✓ From 2013 to 2017, BC proportions are decreased in BTH and ChuanYu but increased in YRD and PRD

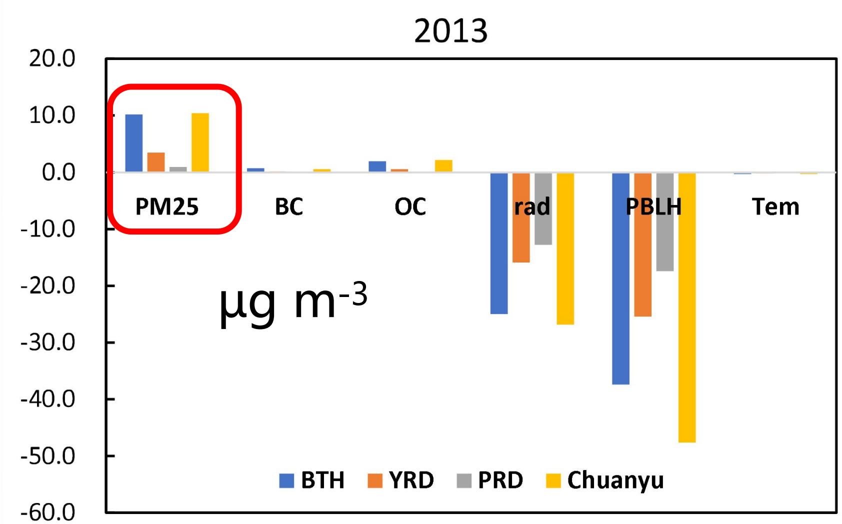


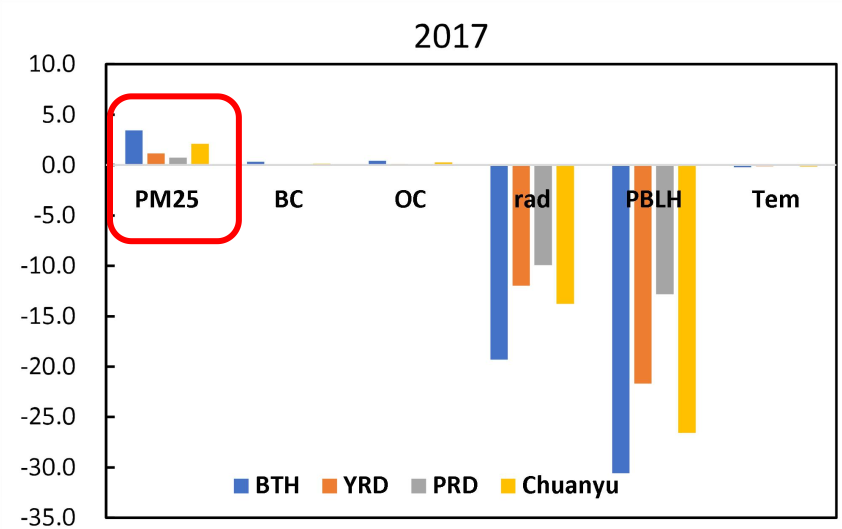
- ✓ BTH: Beijing-Tianjin-Hebei
- ✓ YRD: Yangtze-River-Delta
- ✓ PRD: Pearl -River-Delta
- ✓ Chuanyu: Sichuan and Chongqing

Impacts of the aerosol direct effects (ADE)



ADE reduces surface radiation, PBL height and ground temperature, thus enhances $PM_{2.5}$ concentration





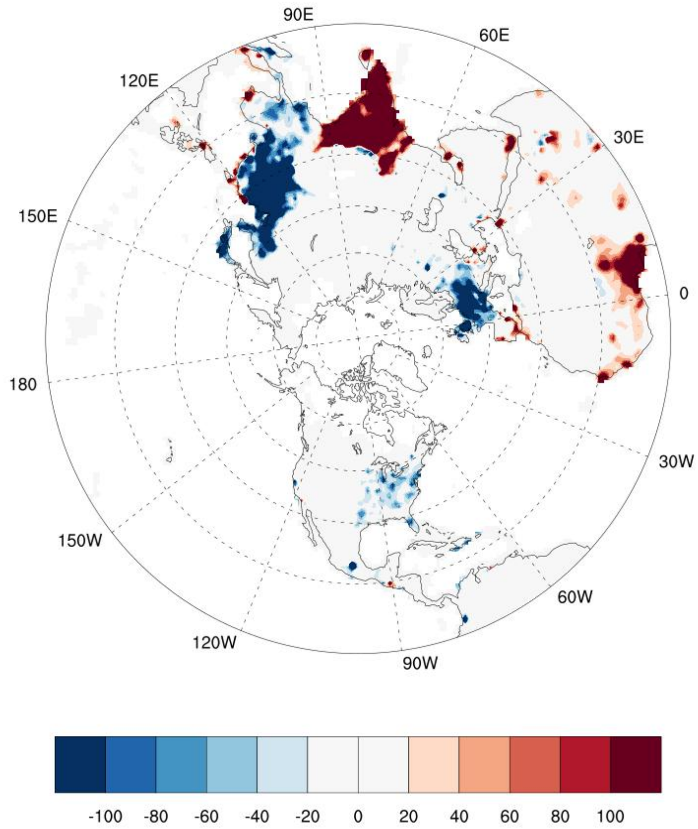
Extra benefits in reducing ADE

Xing et al, ES&T (2016)

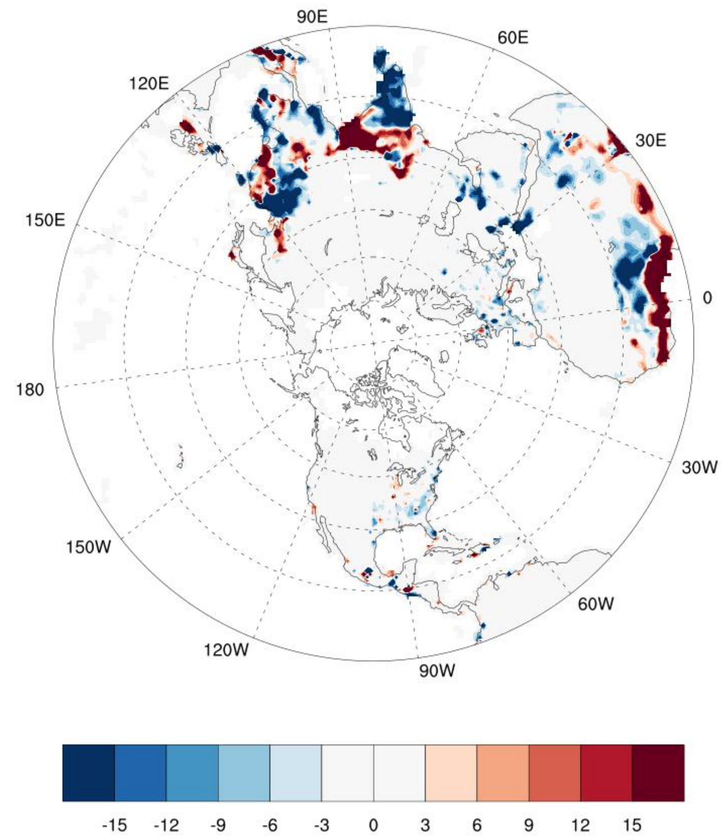
Changed $PM_{2.5}$ mortality due to ADE

2017-2013

Δ $PM_{2.5}$ mortality



Δ $PM_{2.5}$ mortality due to ADE



- ADE deaths in India increased from 77,866 to 93,575 while in China it reduced from 59,529 to 40,470 during 2013-2017

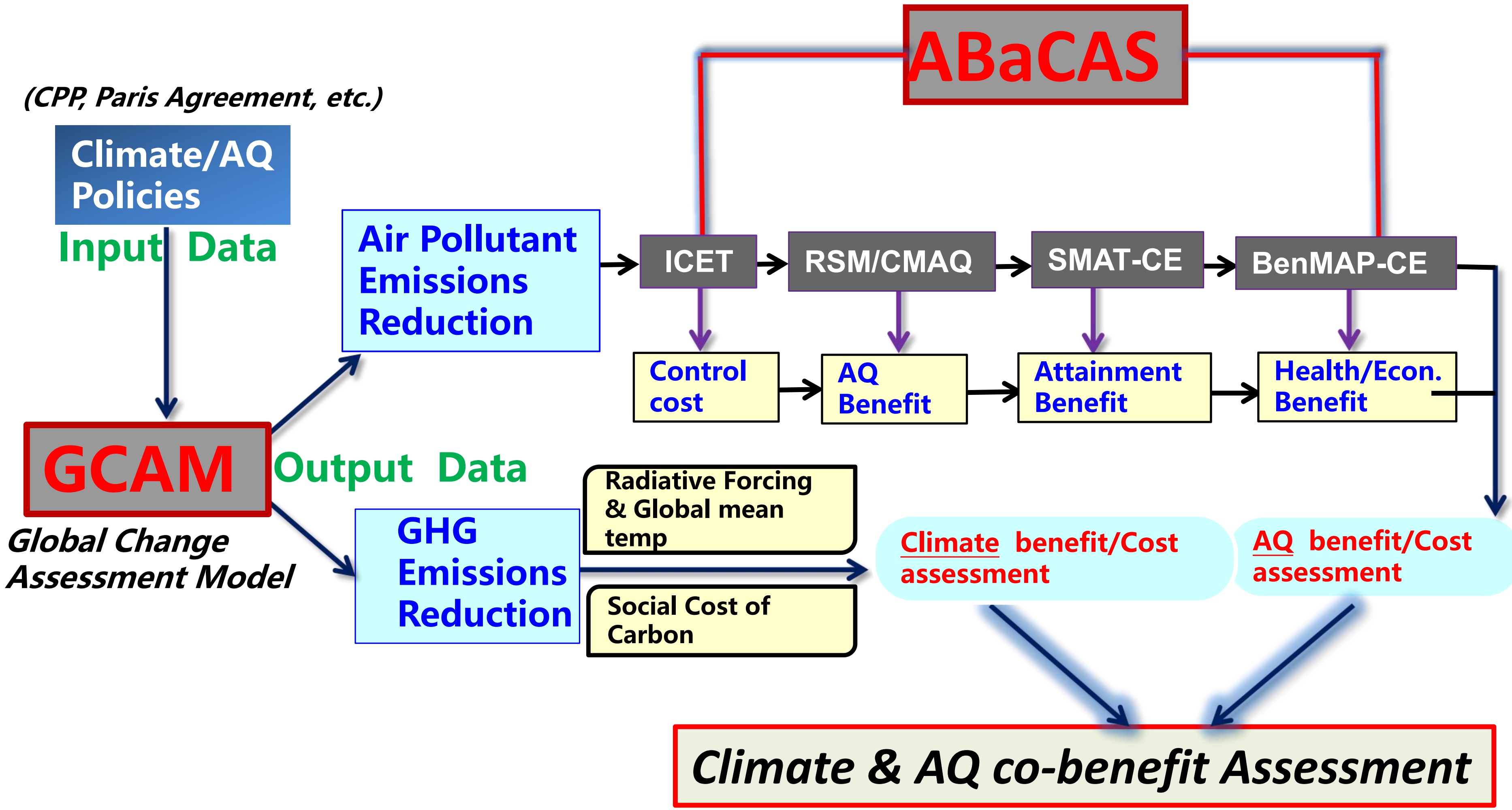
Sahu et al, Chemosphere (2020)

Outline

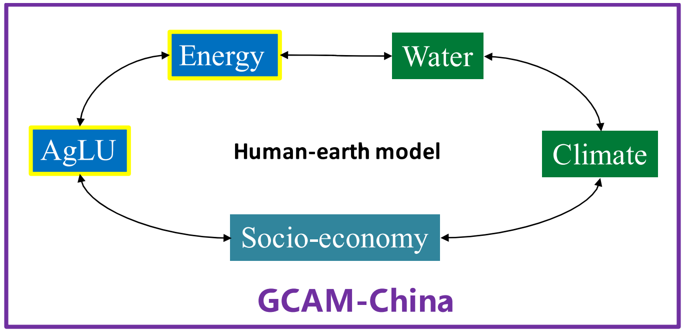
- Overview of ABaCAS-EI
- BC and its impacts during 2013-2017
- **Future emission prediction to 2035**

Future projection with GCAM-ABaCAS

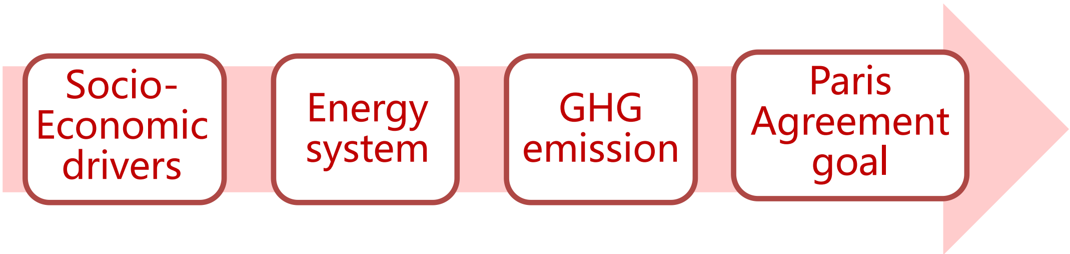
Integrating dual goals of climate and air pollution control



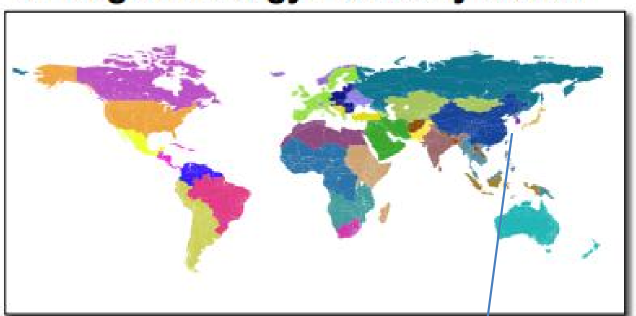
Downscale GCAM to China 31 provinces



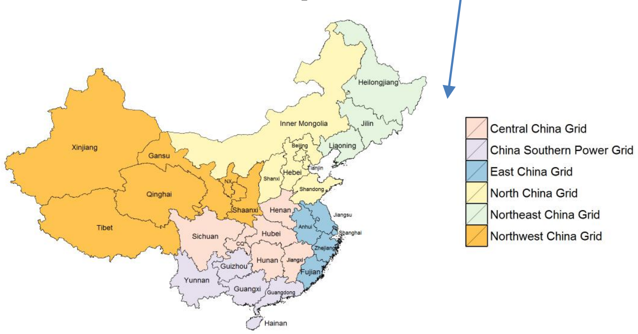
Source: PNNL, GCAM wiki



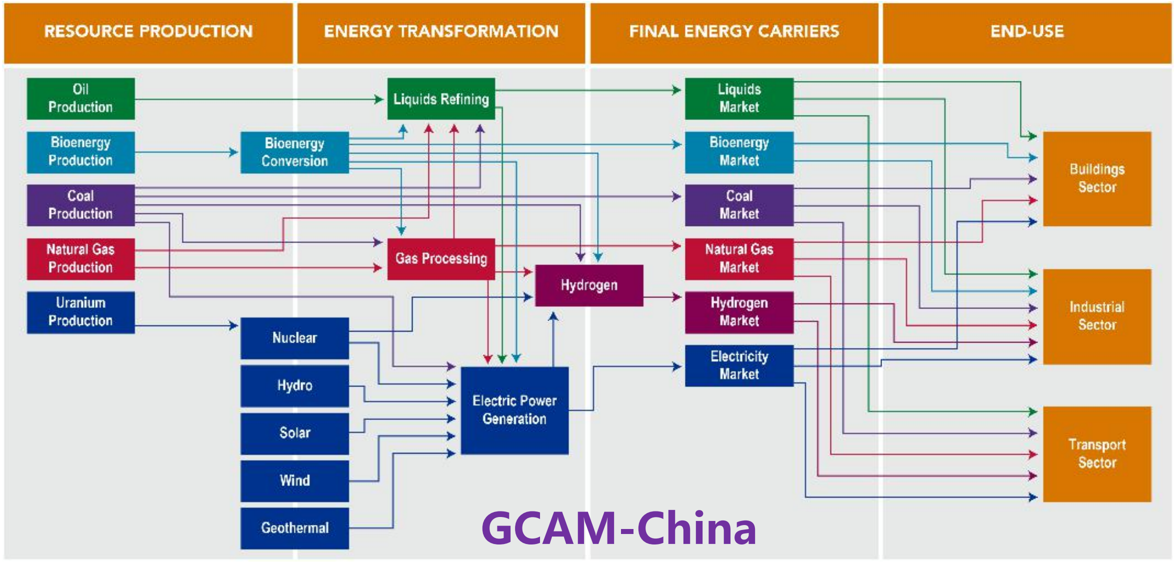
32 Region Energy/Economy Model



GCAM-China: 31 provinces



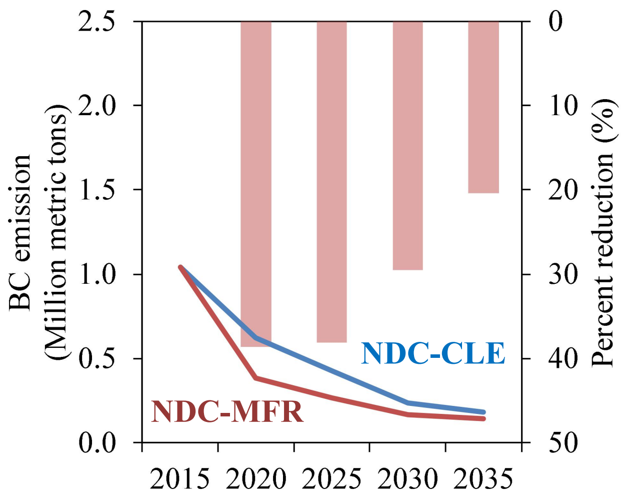
- ✓ Calibrate 31-province energy and economic system
- ✓ Incorporate non-CO_2 emission and control market



Co-Benefits of energy policy in reducing CO_2 / pollutants

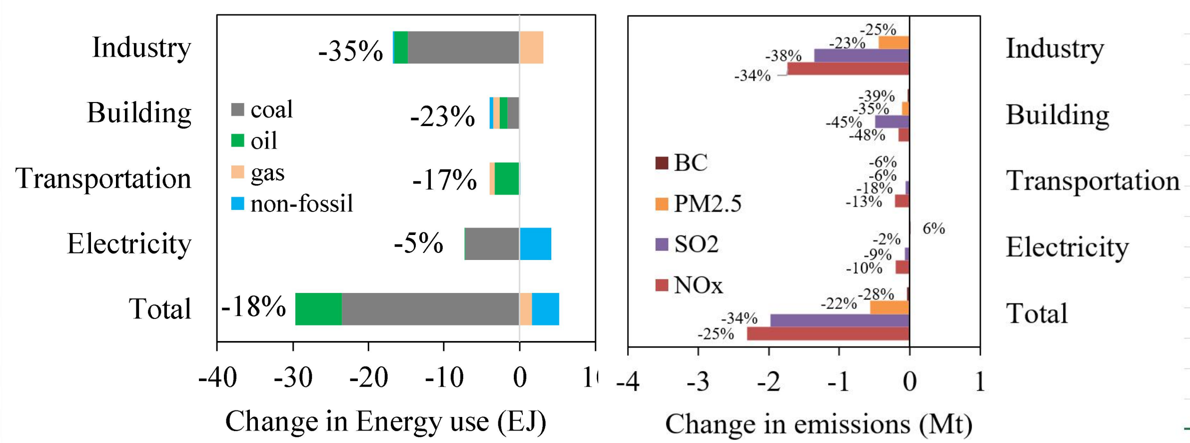
Pathway	Energy scenario	End-of-pipe control levels
(1) NDC-CLE	Baseline scenario which considers only CO_2 intensity reduction to meet the Paris Commitment	Current legislation (CLE)
(2) NDC-MFR	Same as energy scenario in NDC-CLE.	maximum-feasible-reduction (MFR)
(3) CBE-MFR	Co-benefit energy scenario with implementation of low carbon policies related to energy conservation (e.g., improvement of energy efficiency)	maximum-feasible-reduction (MFR)

Impacts of end-of-pipe controls on BC emissions



EOP is quite limited in future

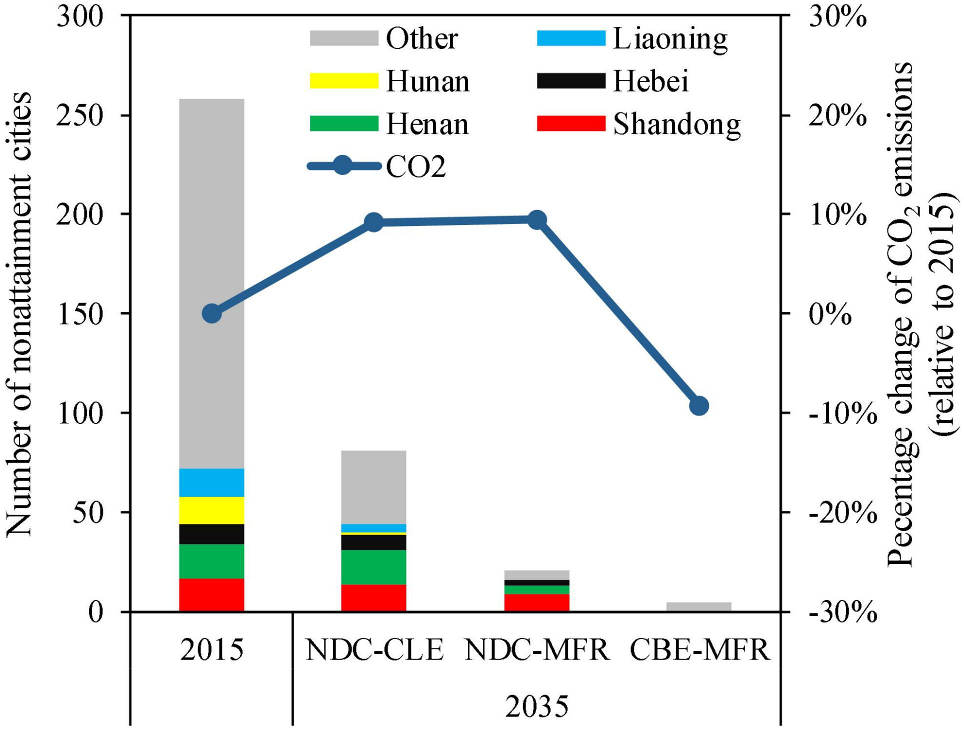
Changes in energy use and emissions in CBE scenario compared to the NDC scenario in 2035



Large co-benefits from energy policies

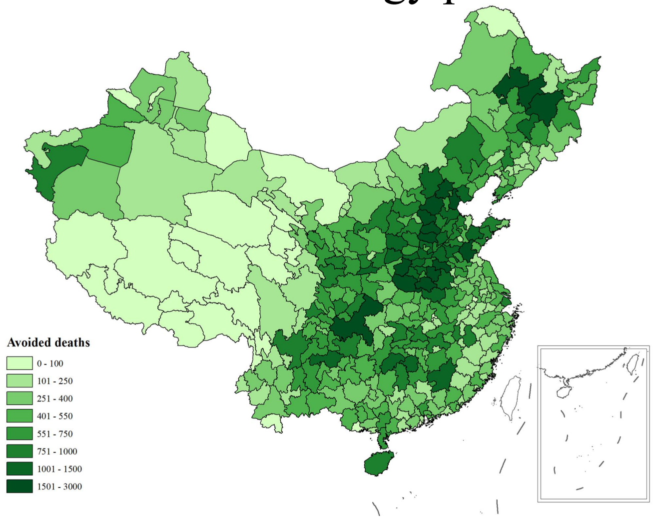
Energy policy is crucial for dual attainment

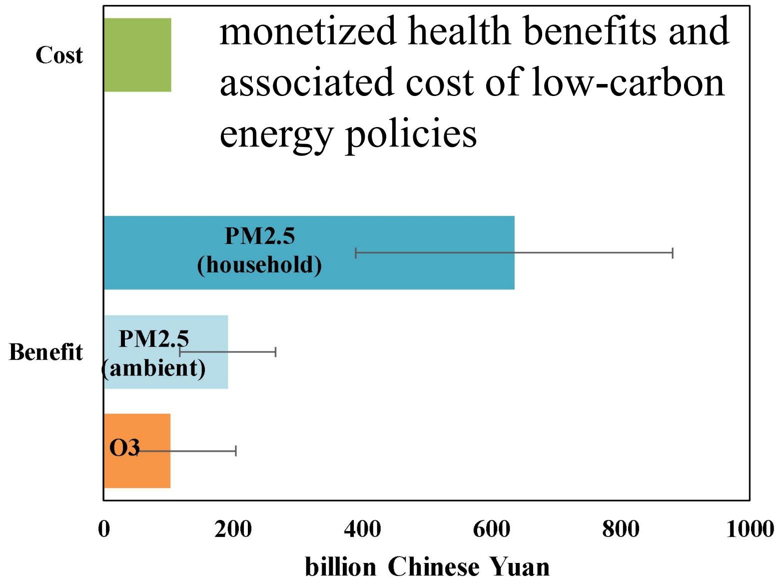
- the NDC scenarios cannot ensure China to fully attain the ambient $PM_{2.5}$ standards even with the most stringent end-of-pipe controls



- Stronger low-carbon energy policies bring greater health benefits than the associated costs

Avoided $PM_{2.5}$-related premature death due to low-carbon energy policies





Xing et al, PNAS (2020)

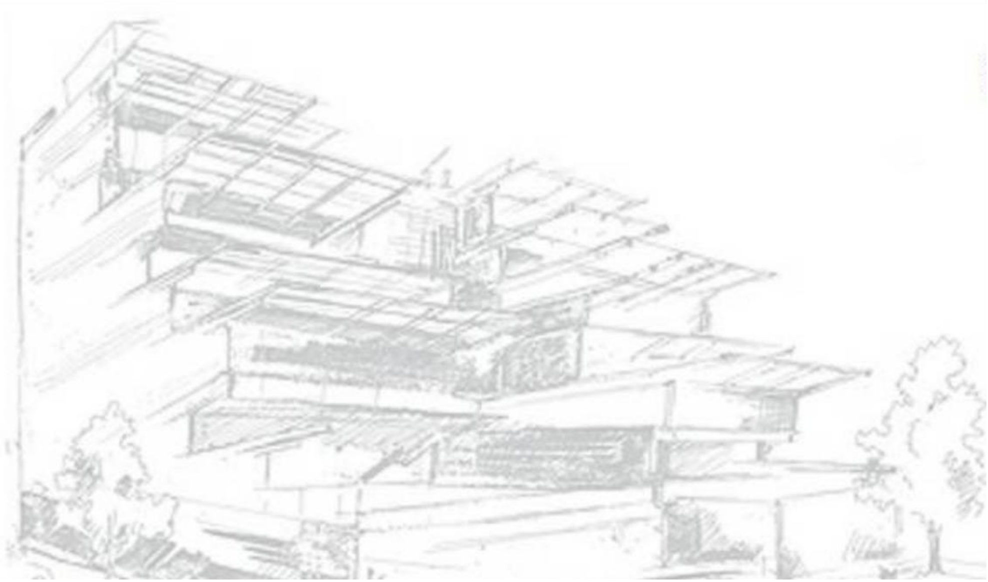
Future Work

- Update ABaCAS-EI to 2018, 2019
- Validation of BC emissions with more observations
- Improve BC-aging process in CMAQ
- Evaluate the BC control benefits on human health, climate and ecosystem

Tsinghua University

School of Environment

Thank you very much!



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°CICERO

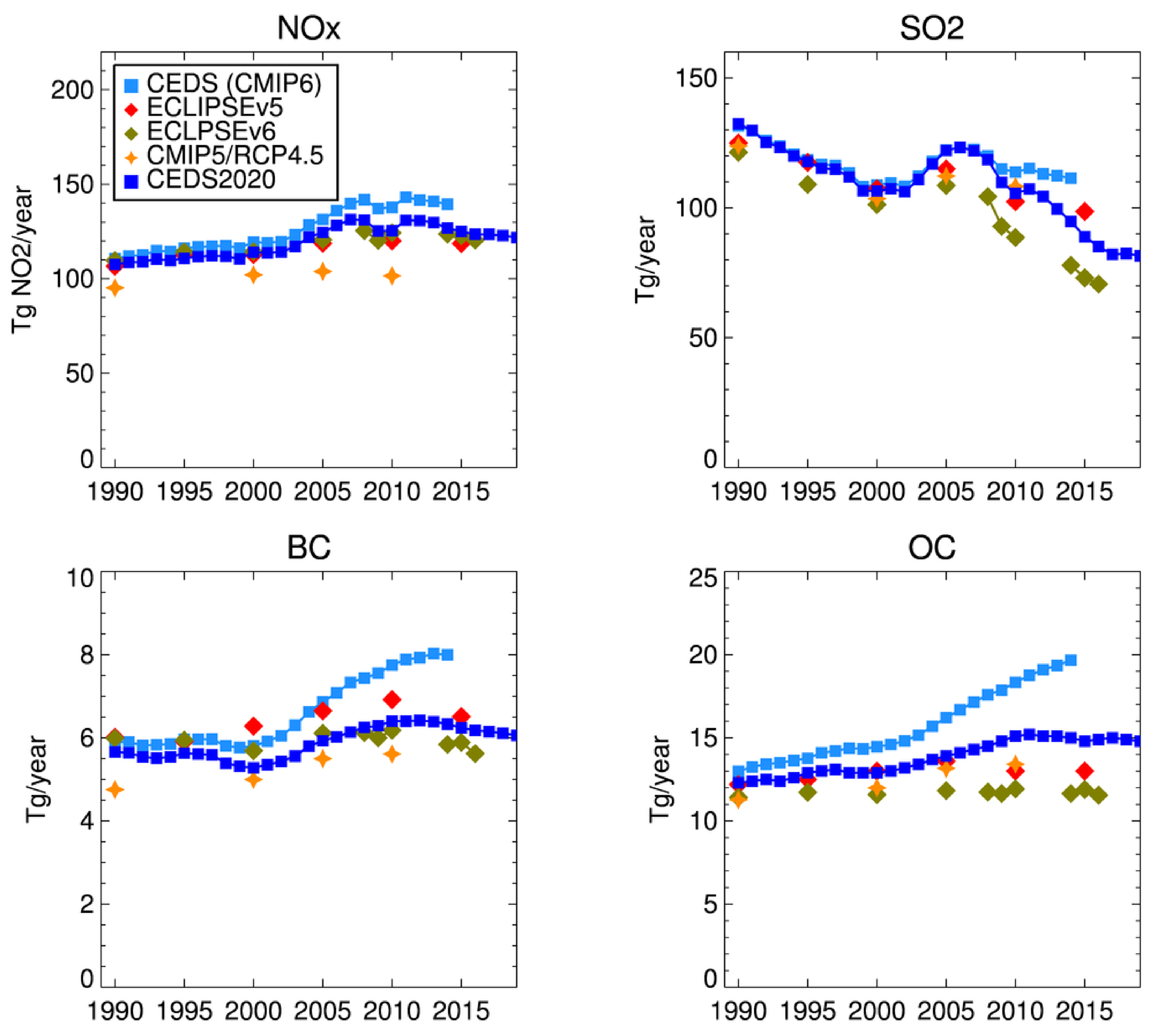
Asian air pollution levels simulated with the CEDS and ECLIPSEv6 emission inventories

Marianne T. Lund, senior researcher CICERO
Project kick-off, 12/09/20

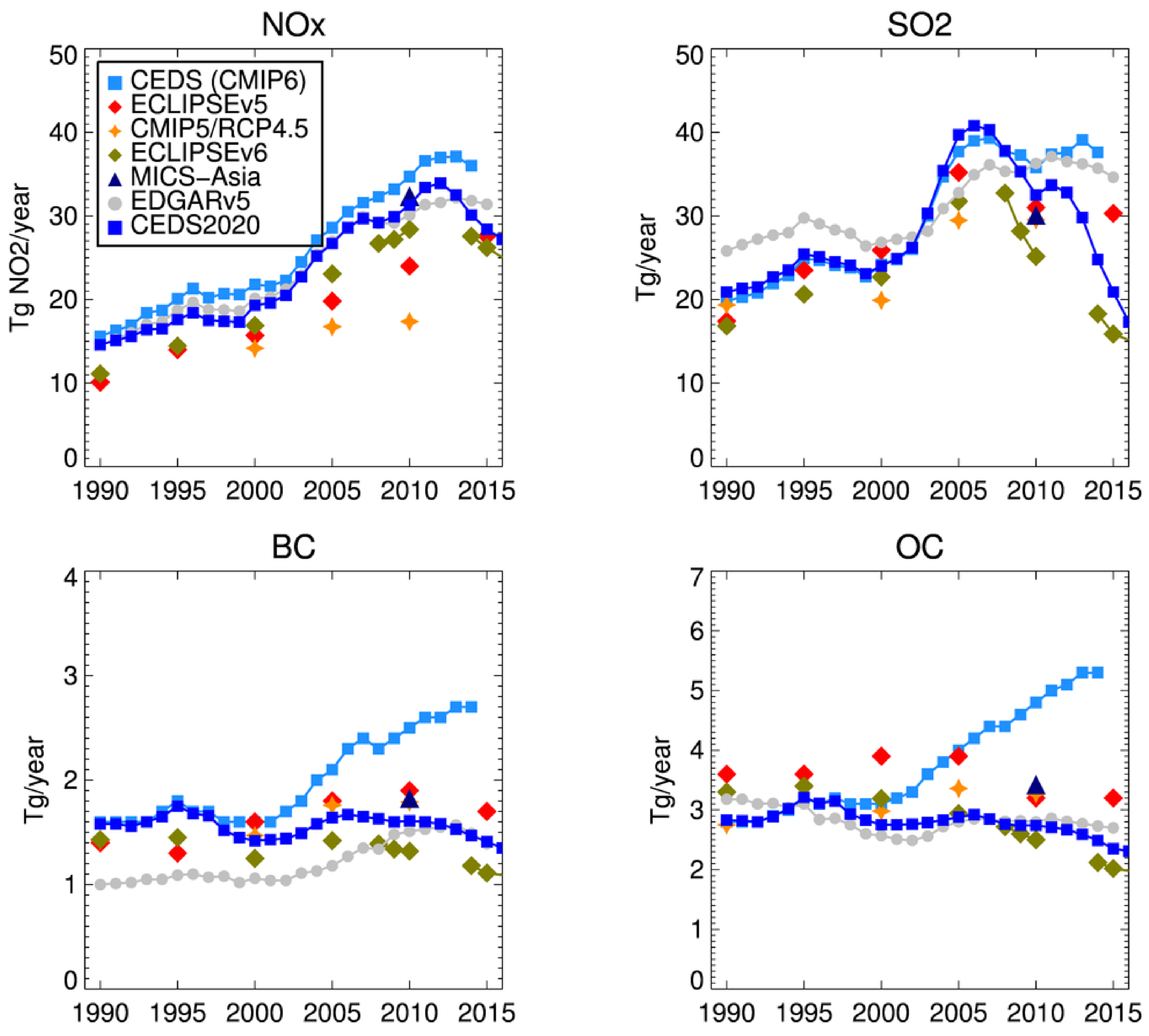
Significant differences between emission inventories

NB! Preliminary work

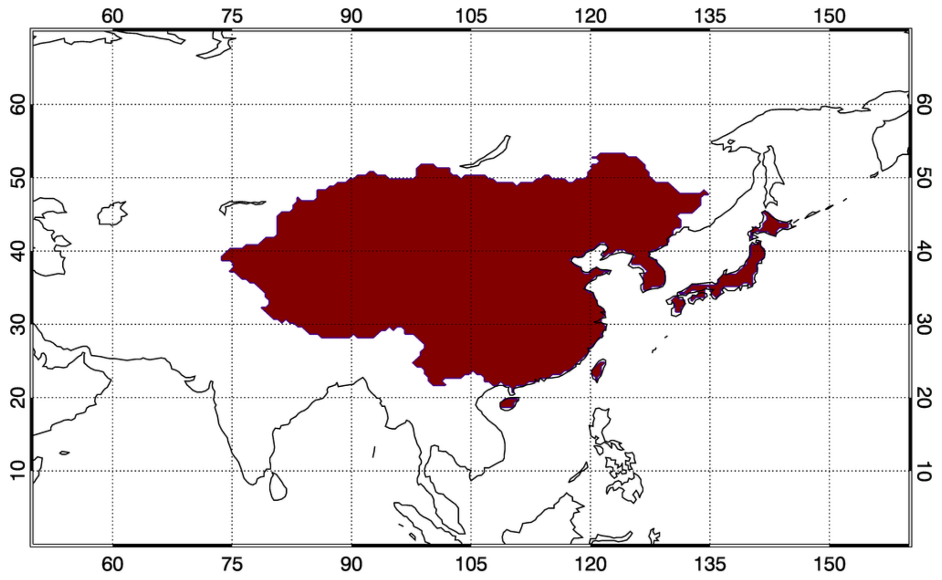
Total year 2014 emissions of NOx, SO_2, BC and OC **globally**



Total year 2014 emissions of NOx, SO2, BC and OC **in East Asia**

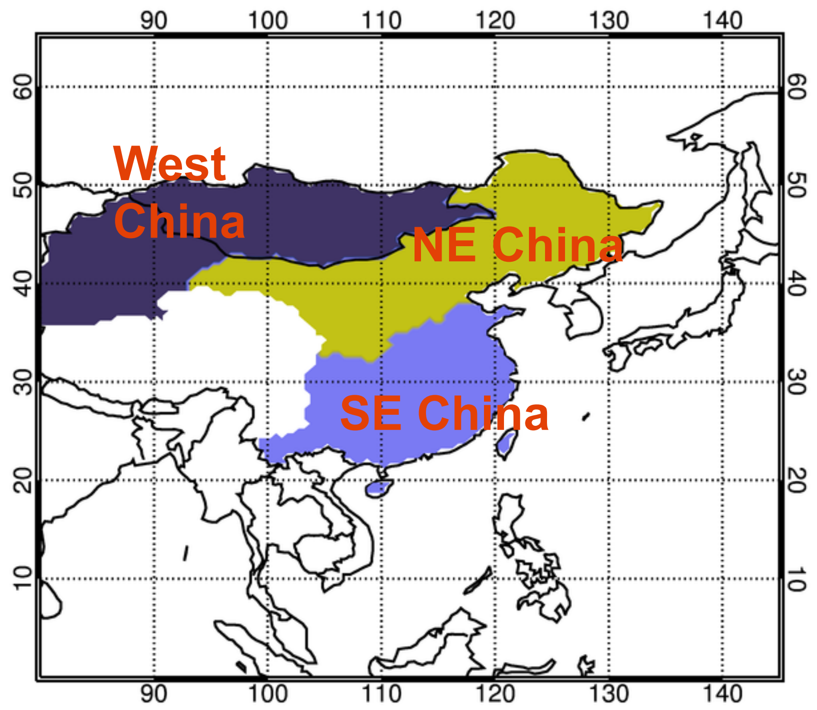


East Asia



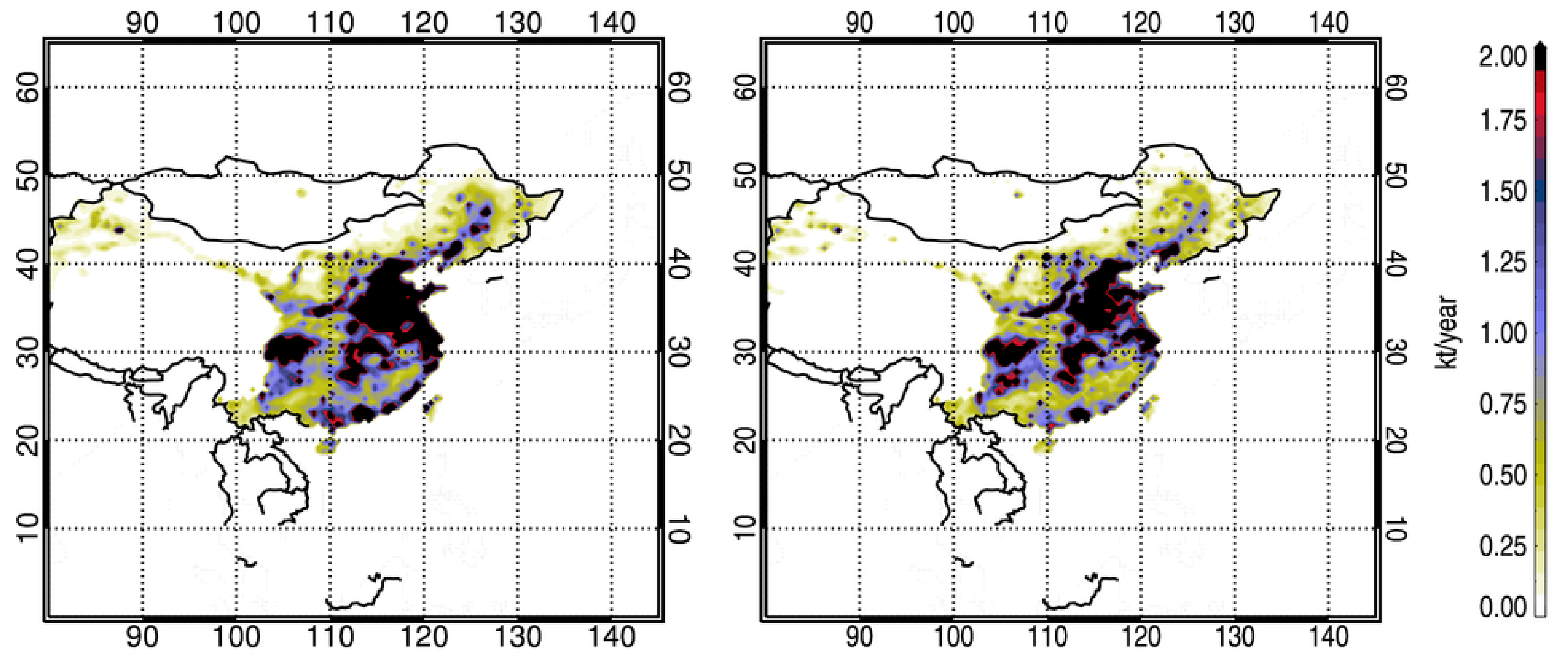
CEDS: Hosely et al. 2018; var Maarle et al. 2018. CMIP5/RCP45: Lamarque et al. 2020; Clarke et al. 2007. EDGARv5: Crippa et al. 2019. MICS-Asia: Li et al. 2017. ECLIPSEv5: Klimont et al. 2017. ECLIPSEv6: Zig Klimont, personal communication.
CEDS2020: A Community Emissions Data System (CEDS) for Historical Emissions | Joint Global Change Research Institute (umd.edu)

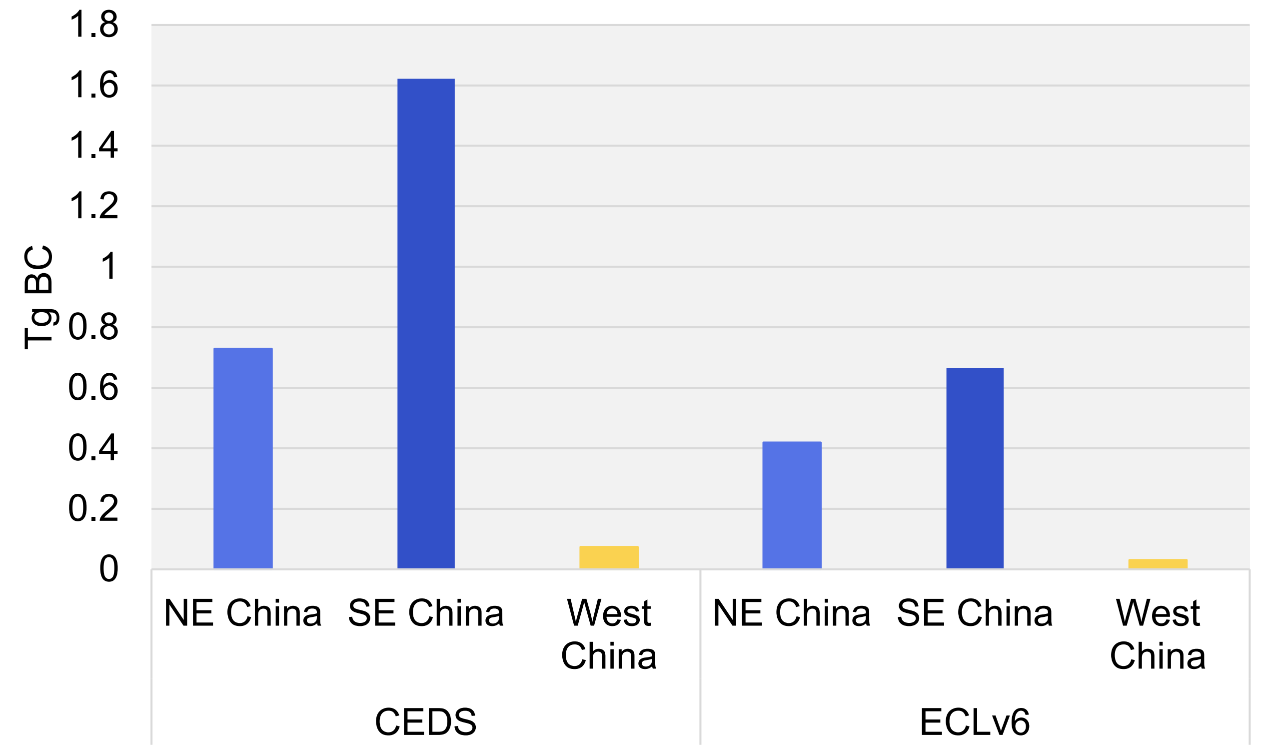
Significant differences between emission inventories – cont.



Year 2014 BC emissions

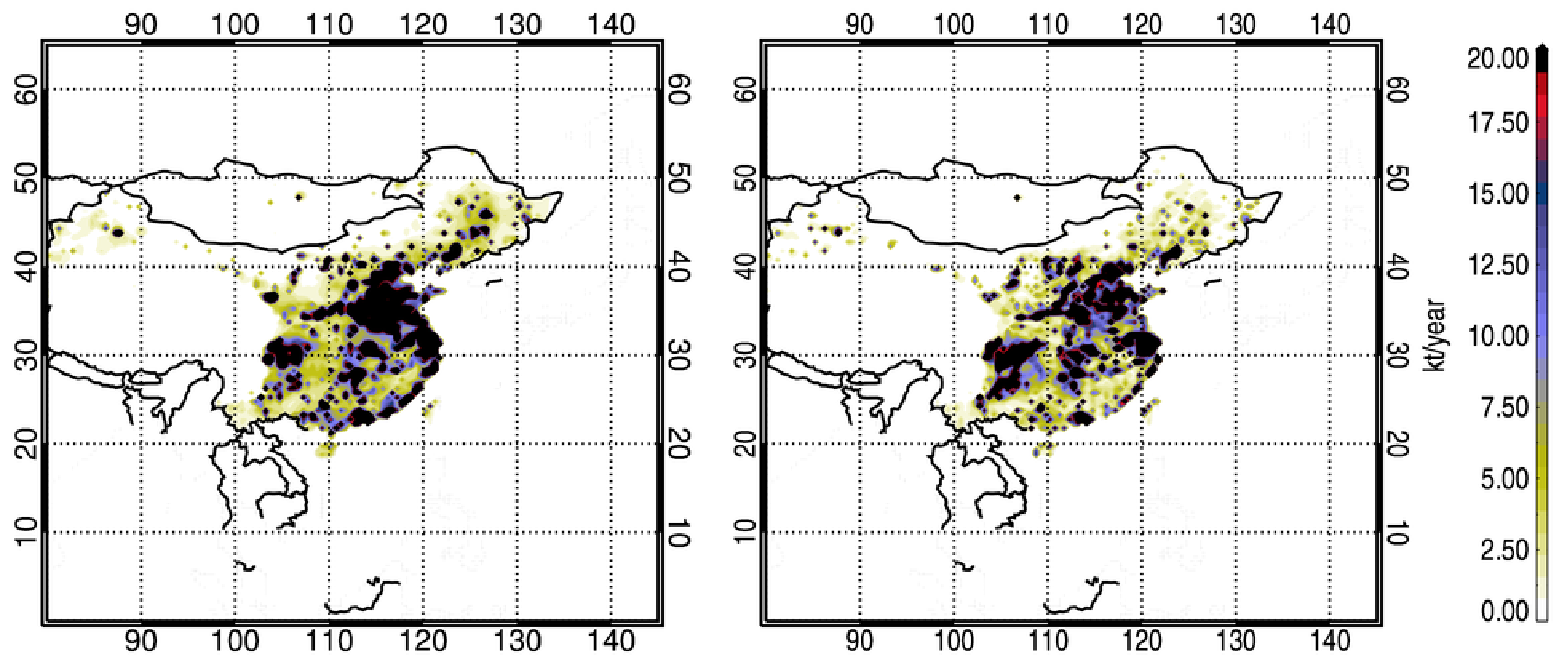
CEDS ECLIPSEv6

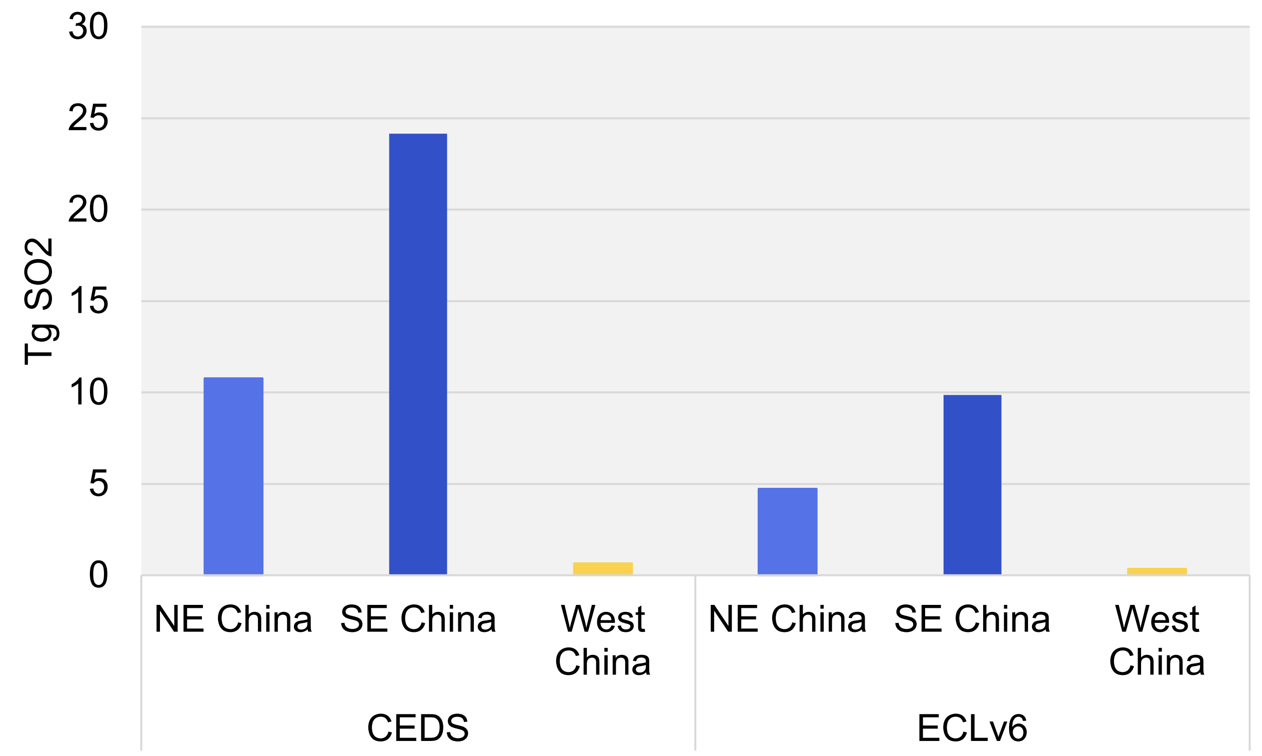




Year 2014 SO2 emissions

CEDS ECLIPSEv6





CEDS: Hosely et al. 2018; var Maarle et al. 2018. ECLIPSEv6: Zig Klimont, personal communication.

NB! Preliminary work

How does this difference translate to model simulations of air pollution and its radiative forcing?

Method:

Global chemical-transport model OsloCTM3 (https://www.cicero.oslo.no/en/osloctm3) with year 2014 meteorological data and emissions from:

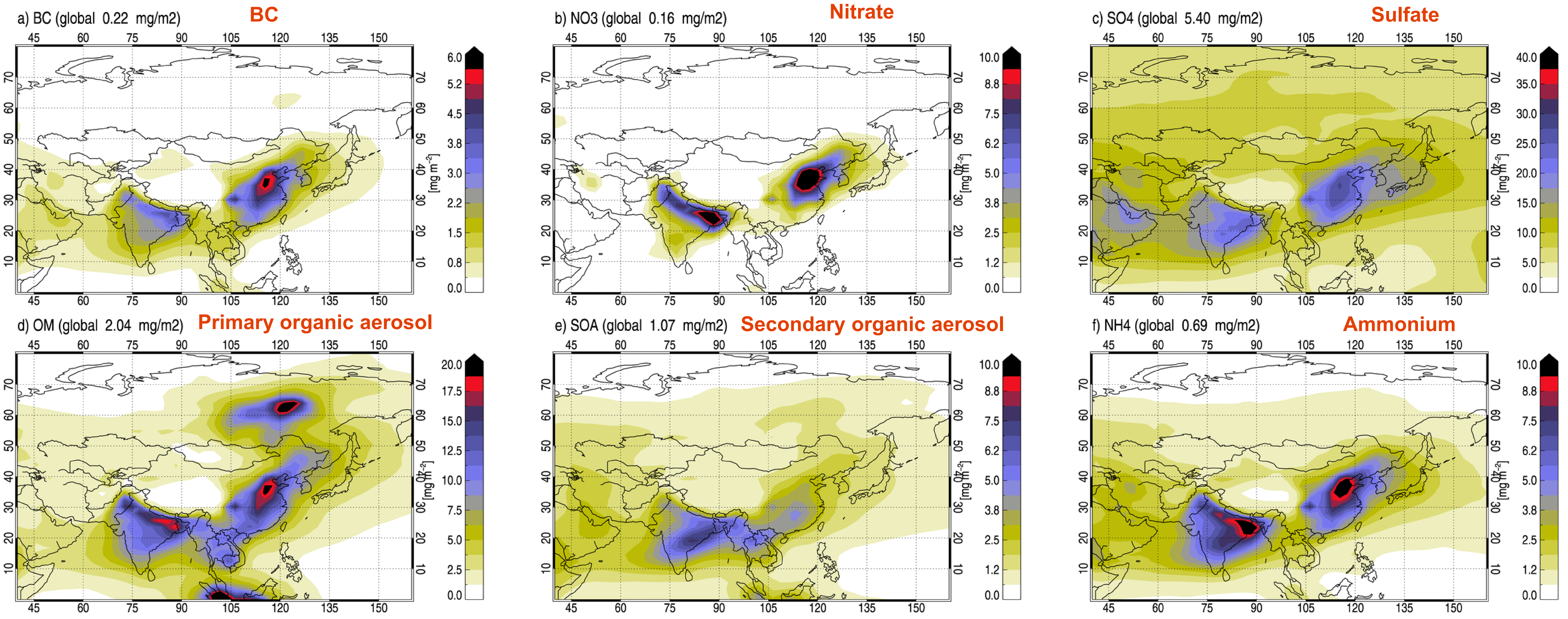
1) CEDS (Community Emission Data System) inventory
2) CEDS emissions in East Asia replaced with ECLIPSEv6

Species: BC, OC, SO2, NOx, CO, nmVOCs, NH3

 NB! Preliminary work

Baseline modeled particle concentrations

Baseline annual mean atmospheric burden of air pollutants



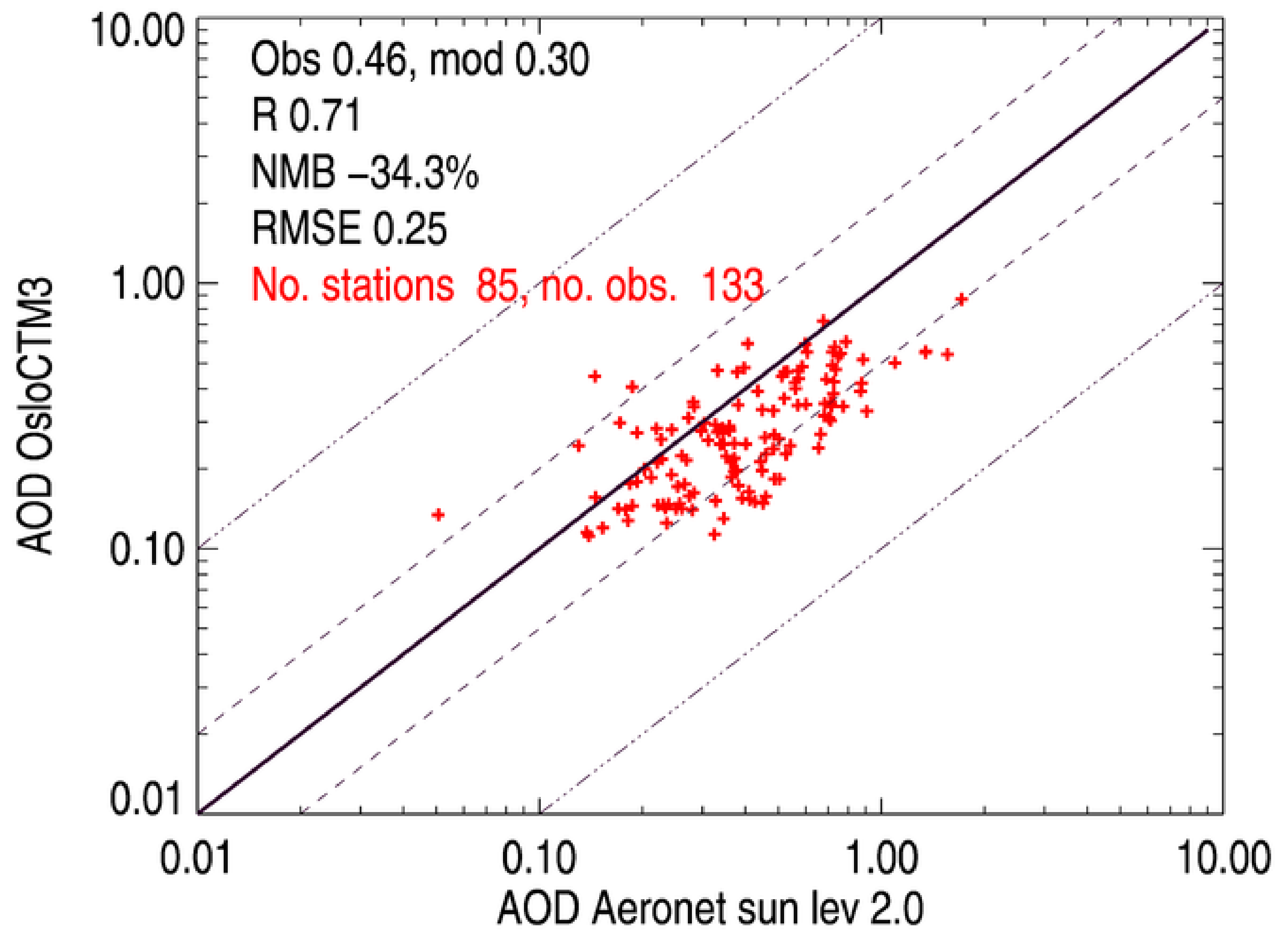
NB! Preliminary work

Previous model–observation comparison shows quite good performance – implications for new results?

Concentrations and radiative forcing of anthropogenic aerosols from 1750 to 2014 simulated with the Oslo CTM3 and CEDS emission inventory

Marianne Tronstad Lund[1], Gunnar Myhre[1], Amund Søvde Haslerud[1], Ragnhild Bieltvedt Skeie[1], Jan Griesfeller[2], Stephen Matthew Platt[3], Rajesh Kumar[4,5], Cathrine Lund Myhre[3], and Michael Schulz[2]

Total aerosol optical depth over China



Relative aerosol composition

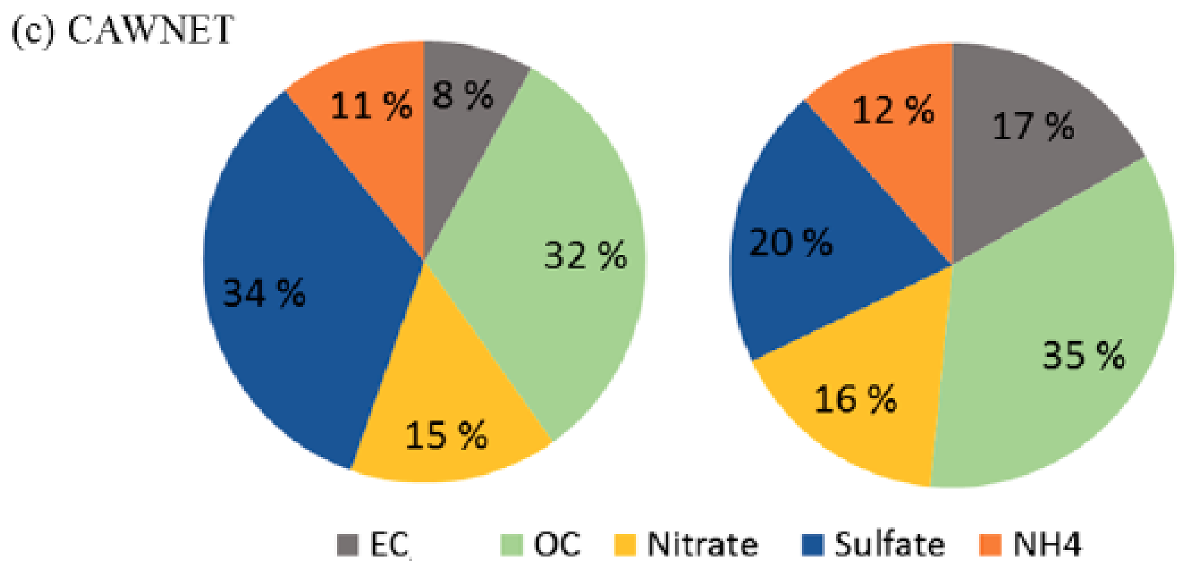


Figure 2. Aerosol composition (fraction of total aerosol mass) derived from the IMPROVE, EMEP–ACTRIS, and CAWNET networks (left column) and corresponding Oslo CTM3 results (right column).

Surface measurements

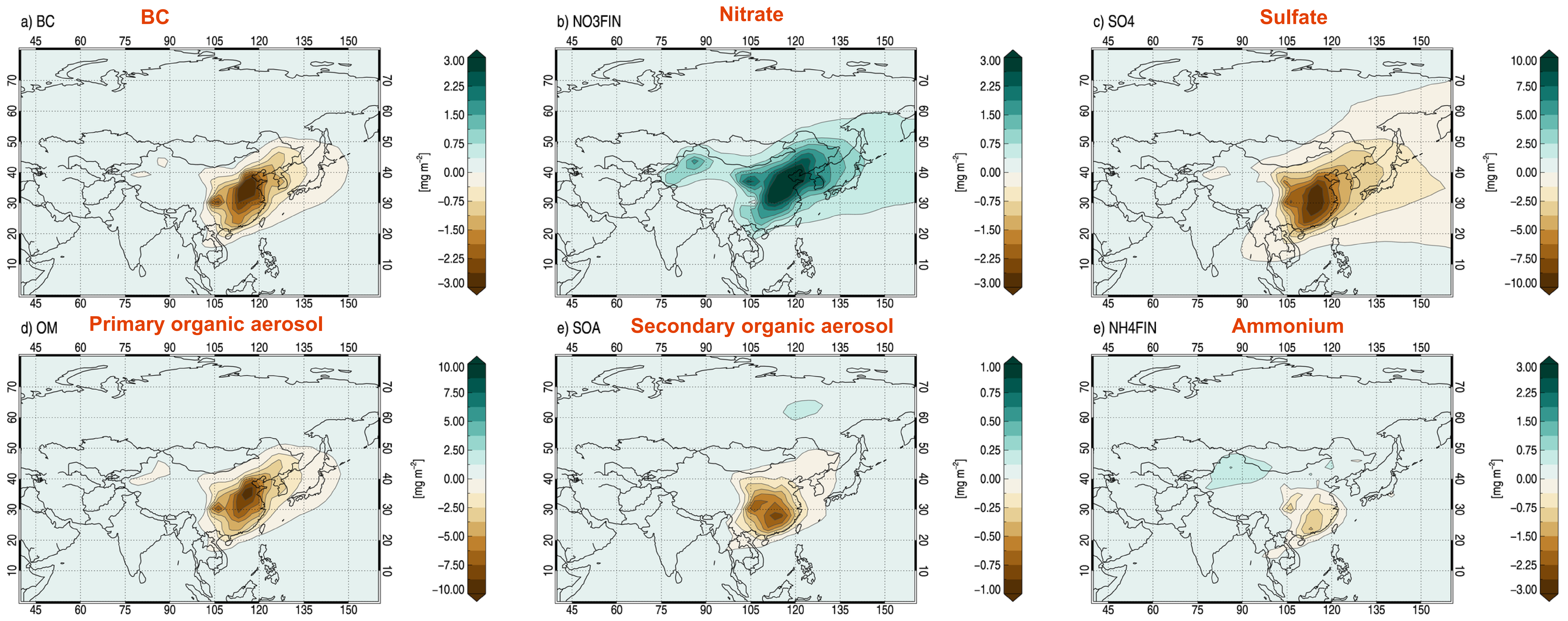
Table S2: Summary of bias, error and correlation of modeled against measured surface concentrations by region/network.

		China (CAWNET) (*Zhang et al.*, 2012)
EC	RMSE	3.1
	NMB	-18
	R	0.66
OC	RMSE	16
	NMB	-58
	R	0.49
Nitrate	RMSE	8.1
	NMB	-58
	R	0.74
Sulfate	RMSE	21
	NMB	-76
	R	0.89

NB! Preliminary work

Results - particles

Difference in annual mean atmospheric burden of air pollutants between ECLIPSEv6 and CEDS simulation



Results - particles

NB! Preliminary work

Ratio of average atmospheric air pollutants levels between ECLIPSEv6 and CEDS simulation

	Global average	
	Burden	Surface concentration
BC	0.89	0.81
POA	0.96	0.90
SOA	1.01	0.99
SO4	0.94	0.93
NO3	1.27	1.02
NH4	1.001	0.94

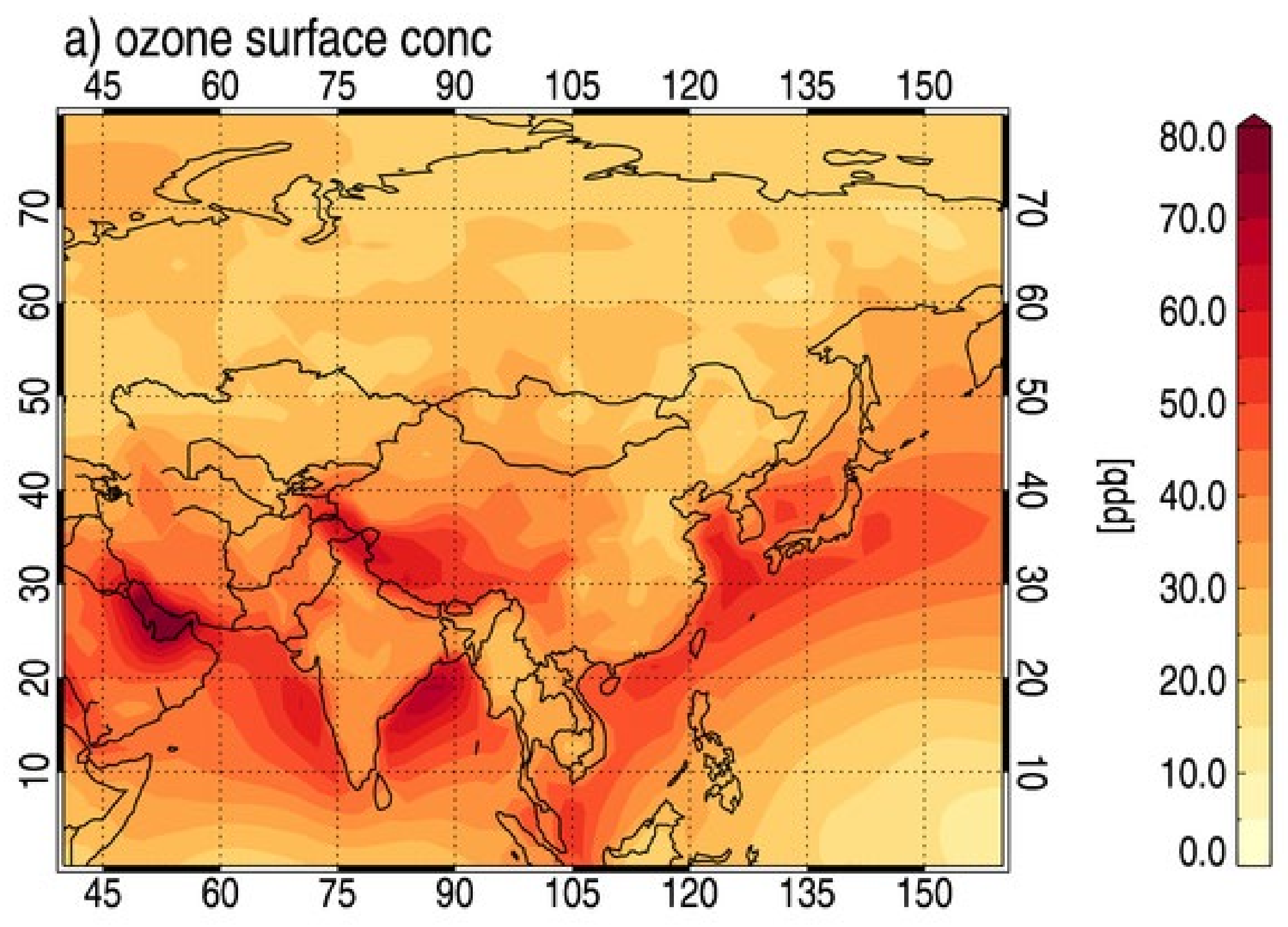
	EAS average	
	Burden	Surface concentration
BC	0.52	0.43
POA	0.71	0.54
SOA	0.93	0.86
SO4	0.76	0.67
NO3	1.47	1.03
NH4	0.97	0.78

NB! Preliminary work

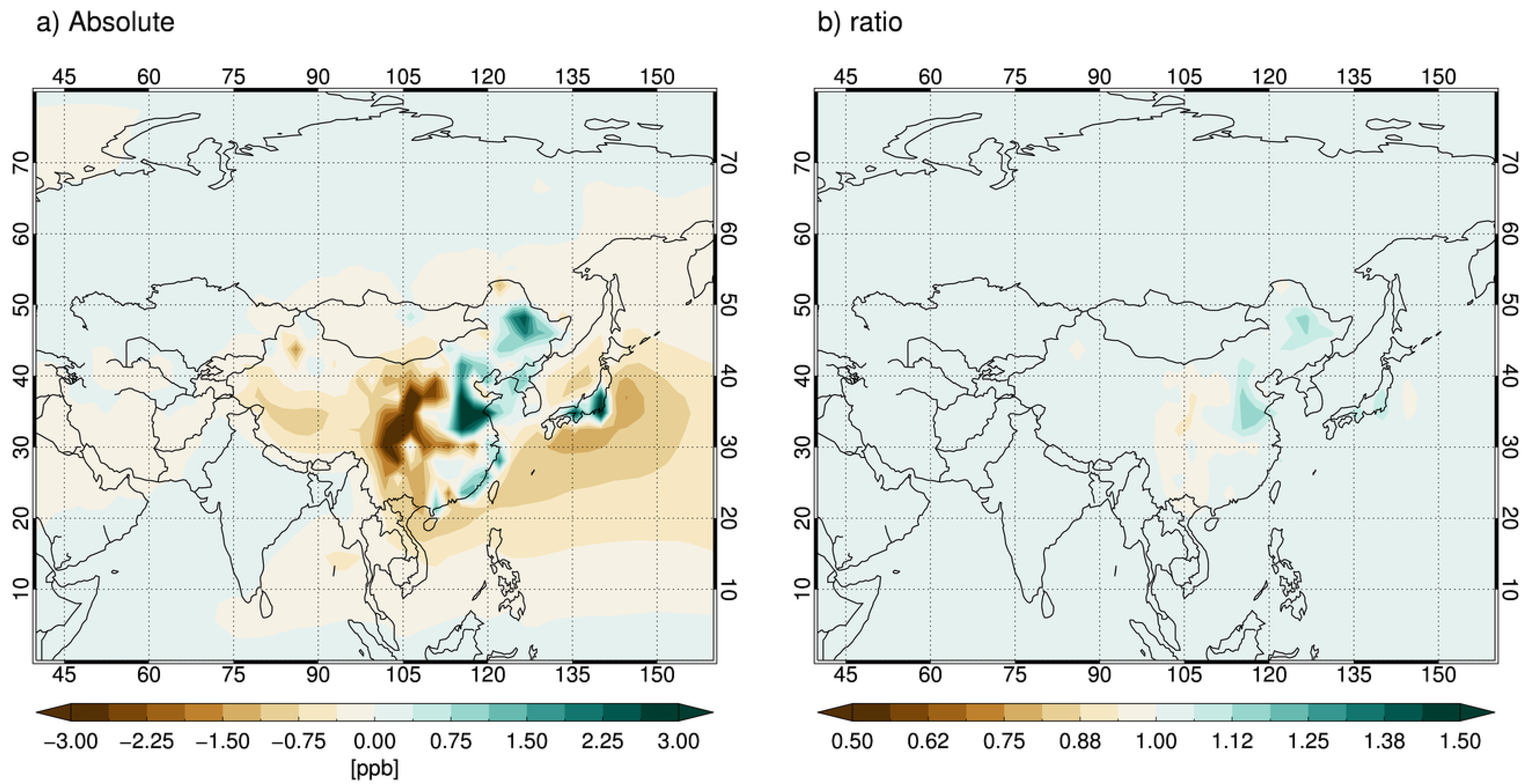
NB! Preliminary work

Results - ozone

Baseline ozone surface concentration



Difference in annual mean surface ozone between ECLIPSEv6 and CEDS simulation



Next steps:

What do these differences mean for:

1) Model performance compared to observations

2) Air quality/health impact assessment

3) Radiative forcing

NB! Preliminary work

°CICERO

Thanks!

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Norwegian Institute of Public Health

Health Impacts of Air Pollution in China

Review and estimates using the ECLIPSE v6 scenarios

Shilpa Rao, Norwegian Institute of Public Health

Kick-off meeting of the Chinese-Norwegian Project on Emission, Impact, and Control Policy for Black Carbon and Its Co-benefits in Northern China

09.12.2020

Main goals

- i) Review published epidemiological and toxicological studies in China and globally and evaluate the different main exposure sources, the association between exposure to PM2.5 and BC, and health effects.
- ii) Conduct a statistical analysis to describe the relationship between exposures and their impacts on health outcomes.
- iii)Perform a health risk assessment and disease burden analysis in China using the published dose-response of PM2.5 and BC.

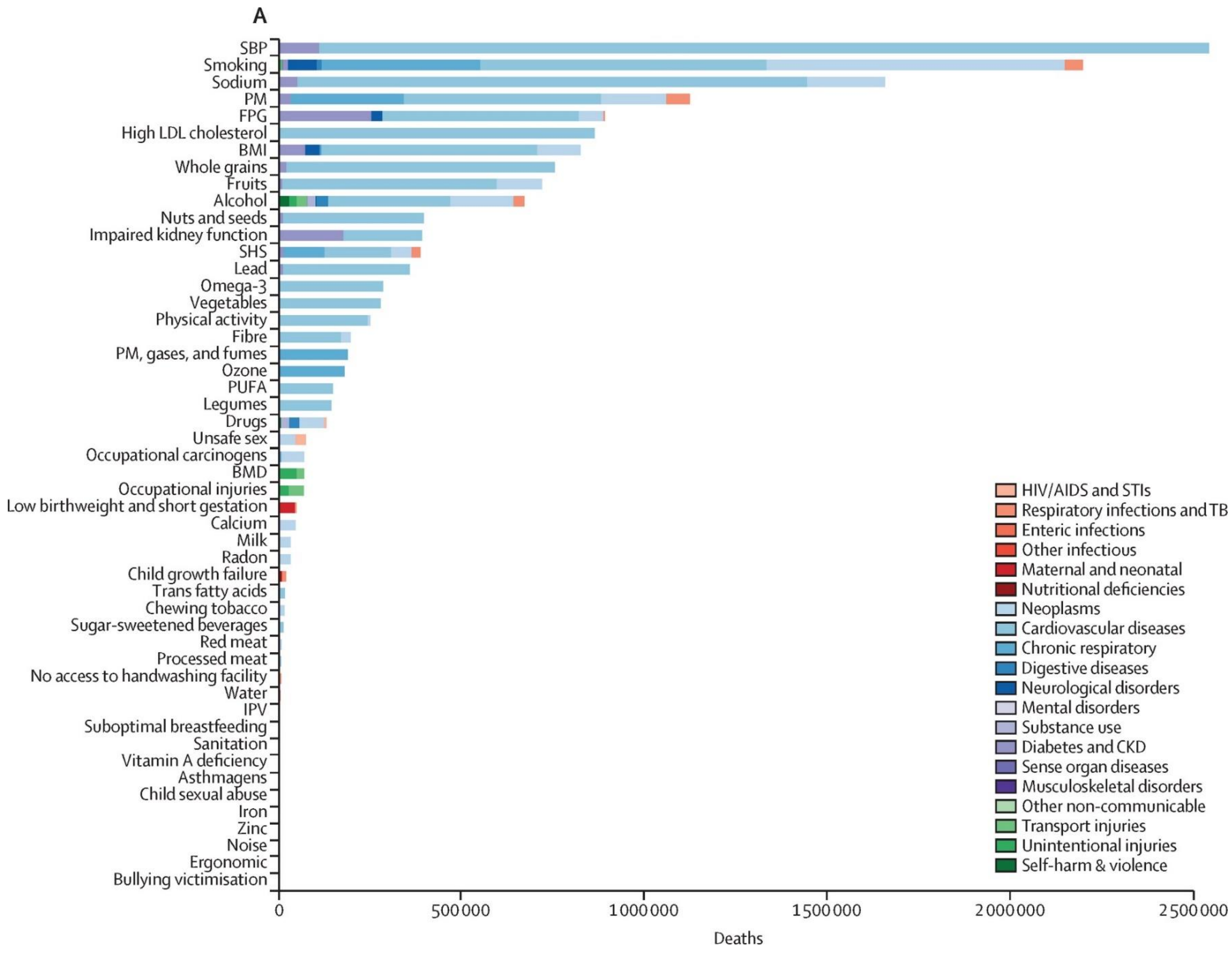
Output 4: Health Impacts of BC, Task 4.3, Chinese-Norwegian Project on Emission, Impact, and Control Policy for Black Carbon and Its Co-benefits in Northern China

Top 25 causes of DALYs in China, 1990–2017

Leading causes 1990	Leading causes 2017	Percentage change in number of all-age DALYs	Percentage change in all-age DALYs per 100 000 population	Percentage change in age-standardised DALYs per 100 000 population
1 Lower respiratory infections	1 Stroke	46·8 (38·1 to 53·9)	24·4 (17 to 30·4)	–33·1 (–37·4 to –29·8)
2 Neonatal disorders	2 Ischaemic heart disease	125·3 (109·4 to 138·5)	90·9 (77·5 to 102·1)	4·6 (–3·3 to 10·7)
3 Stroke	3 COPD	–24·2 (–28·9 to –12·9)	–35·8 (–39·7 to –26·2)	–66·4 (–68·4 to –61·2)
4 COPD	4 Lung cancer	140·3 (117·2 to 157·7)	103·6 (84·1 to 118·3)	13·1 (2·3 to 21·2)
5 Congenital birth defects	5 Road injuries	–3·8 (–13·9 to 5·2)	–18·5 (–27·1 to –10·9)	–25·0 (–32·5 to –18·8)
6 Road injuries	6 Neonatal disorders	–64·8 (–70 to –58·8)	–70·2 (–74·6 to –65·1)	–60·8 (–66 to –55·3)
7 Ischaemic heart disease	7 Liver cancer	43·5 (31·3 to 60·3)	21·6 (11·3 to 35·9)	–28·3 (–34·4 to –19·9)
8 Drowning	8 Diabetes mellitus	102·5 (93 to 112·3)	71·6 (63·5 to 79·9)	4·8 (–0·6 to 10)
9 Self-harm	9 Neck pain	81·1 (71·6 to 91·1)	53·4 (45·4 to 62)	2·6 (–1·3 to 6·6)
10 Diarrhoeal diseases	10 Depressive disorders	36·5 (29·3 to 43·9)	15·7 (9·6 to 21·9)	–12·5 (–14·7 to –10·3)
11 Liver cancer	11 Age-related hearing loss	81·3 (77·7 to 84·7)	53·6 (50·6 to 56·5)	–2·6 (–4·1 to –1·3)
12 Stomach cancer	12 Stomach cancer	5·4 (–2·4 to 12·5)	–10·7 (–17·3 to –4·6)	–50·3 (–54 to –47)
13 Tuberculosis	13 Low back pain	23·2 (14·7 to 31·4)	4·4 (–2·8 to 11·3)	–23·2 (–26·9 to –19)
14 Lung cancer	14 Alzheimer's disease	157·0 (138·4 to 170·3)	117·8 (102·1 to 129·1)	–7·5 (–13·8 to –3·1)
15 Depressive disorders	15 Other musculoskeletal	60·8 (50·6 to 72·1)	36·3 (27·7 to 45·8)	–1·2 (–5·4 to 2·1)
16 Drug use disorders	16 Headache disorders	36·2 (31·8 to 41·5)	15·4 (11·7 to 19·9)	–0·2 (–2·5 to 2·2)
17 Low back pain	17 Falls	51·9 (8·4 to 74·1)	28·7 (–8·1 to 47·6)	3·8 (–25·6 to 18·6)
18 Cirrhosis	18 Drug use disorders	–5·0 (–12·8 to 2·8)	–19·5 (–26·1 to –12·9)	–21·2 (–28·1 to –14·9)
19 Diabetes mellitus	19 Blindness	74·9 (70·9 to 79·2)	48·2 (44·8 to 51·8)	–7·3 (–9 to –5·9)
20 Headache disorders	20 Congenital birth defects	63·4 (–68·5 to –58·1)	–69·0 (–73·3 to –64·5)	–55·4 (–61 to –48·8)
21 Neck pain	21 Chronic kidney disease	15·5 (8 to 21·3)	–2·1 (–8·5 to 2·8)	–36·1 (–40·6 to –32·9)
22 Age-related hearing loss	22 Hypertensive heart disease	18·3 (6·7 to 39·1)	0·3 (–9·6 to 17·9)	–48·6 (–53·8 to –39·4)
23 Chronic kidney disease	23 Cirrhosis	–12·5 (–23·8 to 24·6)	–25·9 (–35·4 to 5·6)	–53·9 (–59·9 to –34·9)
24 Other musculoskeletal	24 Oesophageal cancer	9·5 (0·7 to 17·8)	–7·2 (–14·6 to –0·1)	–50·1 (–54·1 to –46·4)
25 Hypertensive heart disease	25 Lower respiratory infection	–88·6 (–89·8 to –86)	–90·3 (–91·3 to –88·2)	–88·6 (–89·9 to –86·4)
26 Oesophageal cancer	26 Self-harm			
27 Falls	28 Drowning			
28 Blindness	34 Tuberculosis			
29 Alzheimer's disease	37 Diarrhoeal diseases			

Communicable, maternal, neonatal and nutritional
Non-communicable
Injuries



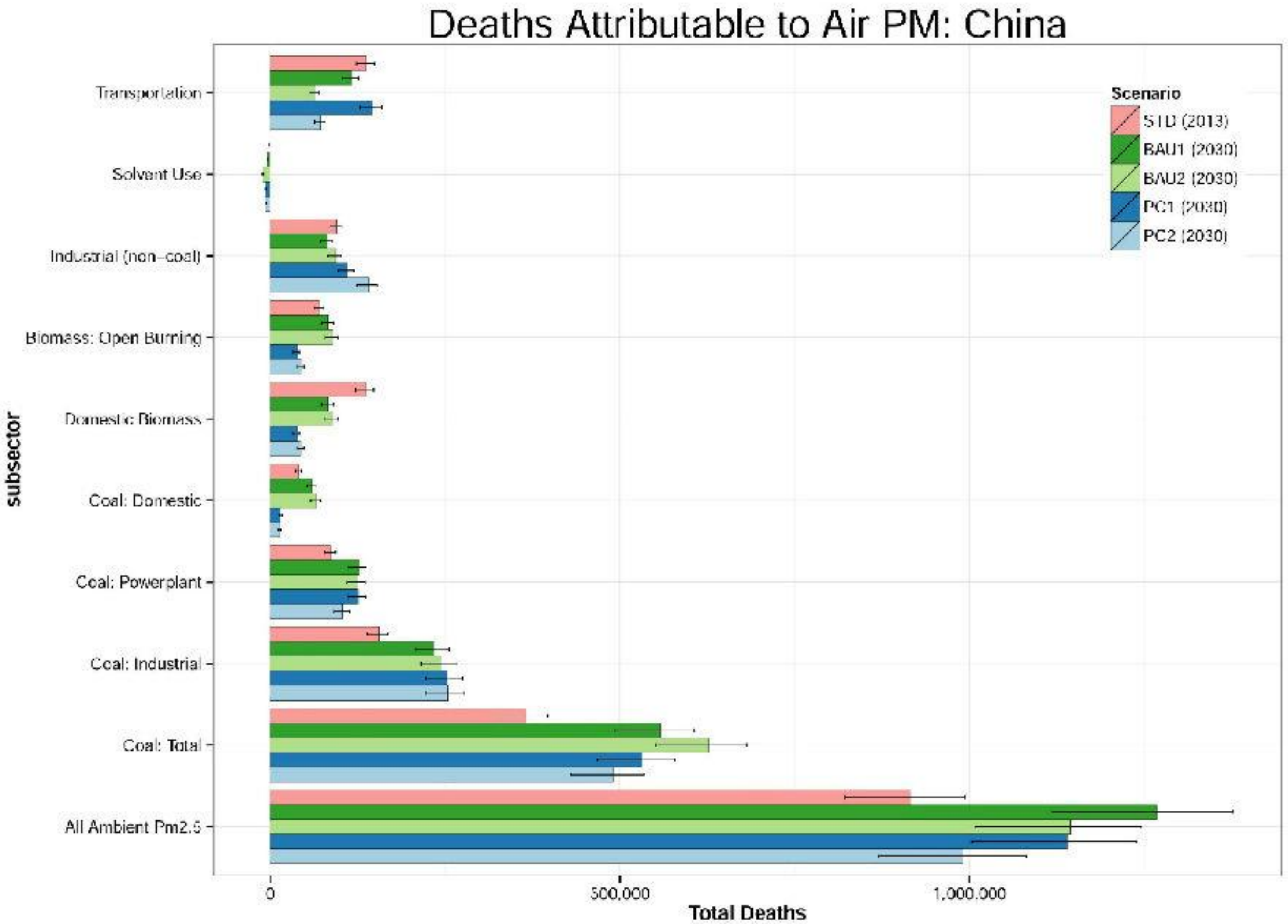



Number of deaths and percentage of DALYs related to the leading level risk factors in China in 2017

-	City	Study period	Study design	ER (%) of total non-accidental mortality (95%CI)	ER (%) of mortality due to CVD (95%CI)	ER (%) of mortality due to RD (95%CI)
PM10						
Chen et al. (2010)	Anshan	2004–2006	Case-crossover	0.24(-0.03.0.51)	0.67(0.29.1.04)	0.21(-0.82.1.24)
Yang et al. (2013)	Beijing	2009–2010	Time-series	0.25(0.17.0.33)	0.24(0.12.0.35)	0.29(0.03.0.54)
Dong et al. (2013)	Beijing	2007–2008	Case-crossover	–	0.36(−0.07.0.78)	–
Zhang et al. (2012)	Beijing	2008–2009	Time-series	0.15(0.05.0.24)	0.14(0.00.0.28)	0.29(0.02.0.58)
Xue et al. (2012)	Beijing	2005–2009	Time-series	0.13(0.08.0.17)	0.14(0.00.0.27)	0.12(0.06.0.19)
Zhang et al. (2012)	Beijing	2004–2008	Time-series	–	0.20(0.01.0.39)	–
Zhang et al. (2011)	Beijing	2003–2008	Time-series	–	0.16(0.14.0.18)	0.1(0.06.0.15)
Yang and Pan (2008)	Beijing	2003	Time-series	–	0.40(0.20.0.60)	–
Yu et al. (2012)	Guangzhou	2006–2009	Time-series	1.26(0.86.1.66)	1.79(1.11.2.47)	0.93(0.03.1.83)
Huang et al. 2012)	Guangzhou	2004–2008	Time-series	0.94(0.79.1.09)	1.23(0.98.1.48)	0.97(0.62.1.32)
Ren et al. (2007)	Hangzhou	2002–2004	Case-crossover	–	0.61(0.28.0.94)	–
Wong CMWong et al. (2012)	Hong Kong	1985–1995	Time-series	0.09(-0.12.0.30)	-0.26(-0.67.0.18)	0.02(-0.33.0.36)
Wong et al. (2010)	Hong Kong	1996–2002	Time-series	0.53(0.26.0.81)	0.61(0.11.1.10)	0.83(0.23.1.44)
Wong et al. 2002)	Hong Kong	1995–1998	Time-series	–	0.30(−0.20.0.80)	0.80(0.10.1.40)
Tsai et al. (2003)	Kaohsiung	1994–2000	Case-crossover	0.00(-0.81.0.82)	−0.44(−2.16.1.32)	0.34(−2.76.3.56)
Zhang et al. (2011)	Lanzhou	2004–2007	Time-series	0.69(0.28.1.10)	–	–
Chen et al. (2013)	Shanghai	2001–2008	Time-series	0.15(0.07.0.23)	–	–
Wong et al. (2010)	Shanghai	2001–2004	Time-series	0.26(0.14.0.37)	0.27(0.10.0.44)	0.27(-0.01.0.56)
Huang et al. (2009)	Shanghai	2004–2005	Time-series	0.14(0.02.0.26)	0.24(0.08.0.40)	0.22(−0.08.0.52)
Song et al. (2008)	Shanghai	2002	Time-series	0.57(0.18.0.96)	1.08(0.33.1.83)	1.23(0.40.2.06)
Jia et al. (2004)	Shanghai	2000–2002	Case-crossover	0.70(0.30.1.10)	0.70(0.20.1.20)	–
Kan and Chen (2003)	Shanghai	2000–2001	Time-series	0.30(0.10.0.50)	0.30(0.00.0.60)	0.50(−0.1.1.10)
Yang et al. (2010)	Suzhou	2002–2007	Time-series	–	−1.38(−1.69,−1.07)	–
Tsai et al. (2010)	Taichung	1993–2006	Time-series	0.39(0.19.0.58)	–	–
Yang et al. 2004)	Taipei	1994–1999	Case-crossover	−0.16(-0.93.0.63)	−0.38(−1.88.1.10)	−0.45(−3.09.2.30)
Zhang et al. (2008)	Taiyuan	2004	Time-series	–	4.80(0.20.9.60)	–
Wang et al., (2013)	Tianjin	2006–2010	Time-series	0.01(-0.40.0.42)	1.02(0.48.1.56)	–
Li et al., 2013)	Tianjin	2006–2009	Time-series	0.42(0.26.0.58)	0.41(0.21.0.62)	0.76(0.29.1.23)
Zhang et al. (2010)	Tianjin	2005–2007	Time-series	0.45(0.21.0.69)	0.60(0.29.0.91)	0.82(0.04.1.61)
Liu et al. 2012)	Wuhan	2005–2006	Case-crossover	–	–	0.50(0.40.0.60)
Wong et al. (2010)	Wuhan	2001–2004	Time-series	0.43(0.24.0.62)	0.57(0.31.0.84)	0.87(0.34.1.41)
Combined estimate				0.36(0.26.0.46)R	0.36(0.24.0.49)R	0.42(0.28.0.55)R
PM2.5						
[288]	Beijing	2007–2008	Case-crossover	–	0.78(0.07.1.49)	–
Li PLi et al. 2013)	Beijing	2004–2009	Time-series	–	–	0.69(0.54.0.85)
Venners et al., (2003)	Chongqing	1995	Time-series	0.00(-0.72.0.68)	–	–
Yang et al. (2012)	Guangzhou	2007–2008	Case-crossover	0.90(0.55.1.26)	1.22(0.63.1.68)	0.97(0.16.0.79)
Geng et al. (2013)	Shanghai	2007–2008	Time-series	0.57(0.12.1.01)	0.78(0.10.1.43)	0.07(-1.29.1.38)
Chen et al. (2013)	Shanghai	2001–2008	Time-series	0.17(0.02.0.35)	–	–
Huang et al. (2009)	Shanghai	2004–2005	Time-series	0.30(0.06.0.54)	0.39(0.12.0.66)	0.71(0.05.1.37)
Song et al. 2008)	Shanghai	2002	Time-series	0.85(0.32.1.39)	1.54(0.37.2.72)	2.02(1.14.2.91)
Ma et al. (2011)	Shenyang	2006–2008	Case-crossover	0.49(0.19.0.79)	0.53(0.09.0.97)	0.97(0.01.1.94)
Huang et al. (2012)	Xi’an	2004–2008	Time-series	0.20(0.07.0.33)	0.27(0.08.0.46)	0.19(-0.20.0.59)
Combined estimate				0.40(0.22.0.59)R	0.63(0.35.0.91)R	0.75(0.39.1.11)R

Meta review of mortality related risk factors in different locations in China

Feng Lu, Dongqun Xu, Yibin Cheng, Shaoxia Dong, Chao Guo, Xue Jiang, Xiaoying Zheng, Systematic review and meta-analysis of the adverse health effects of ambient PM2.5 and PM10 pollution in the Chinese population,Environmental Research, Volume 136, 2015, Pages 196-204, ISSN 0013-9351, https://doi.org/10.1016/j.envres.2014.06.029.



Health Effects Institute and Tsingua University, **2016**

Review from the Health Impacts of BC

- BC is a universal indicator of a variable mixture of particulate material from a large variety of combustion sources and it is always associated with other substances from combustion sources, such as organic compounds.
- Recent studies increasingly indicate a wide range of outcomes associated with long-term exposure to black carbon including cardiovascular and respiratory outcomes; allergic respiratory diseases, diabetes, obesity; and cognition among others
- Due to significant uncertainties in the health effects of BC, WHO, 2012 recommended that PM2.5 should continue to be used as the primary metric in quantifying human exposure to PM and the health effects of such exposure, and for predicting the benefits of exposure reduction measure.
- Jensen et al (2015) suggest that BC is a valuable additional air quality indicator to evaluate the health risks of air quality dominated by primary combustion particles and is associated with a higher health risk as compared to PM2.5

Review of studies on BC related health impacts in China

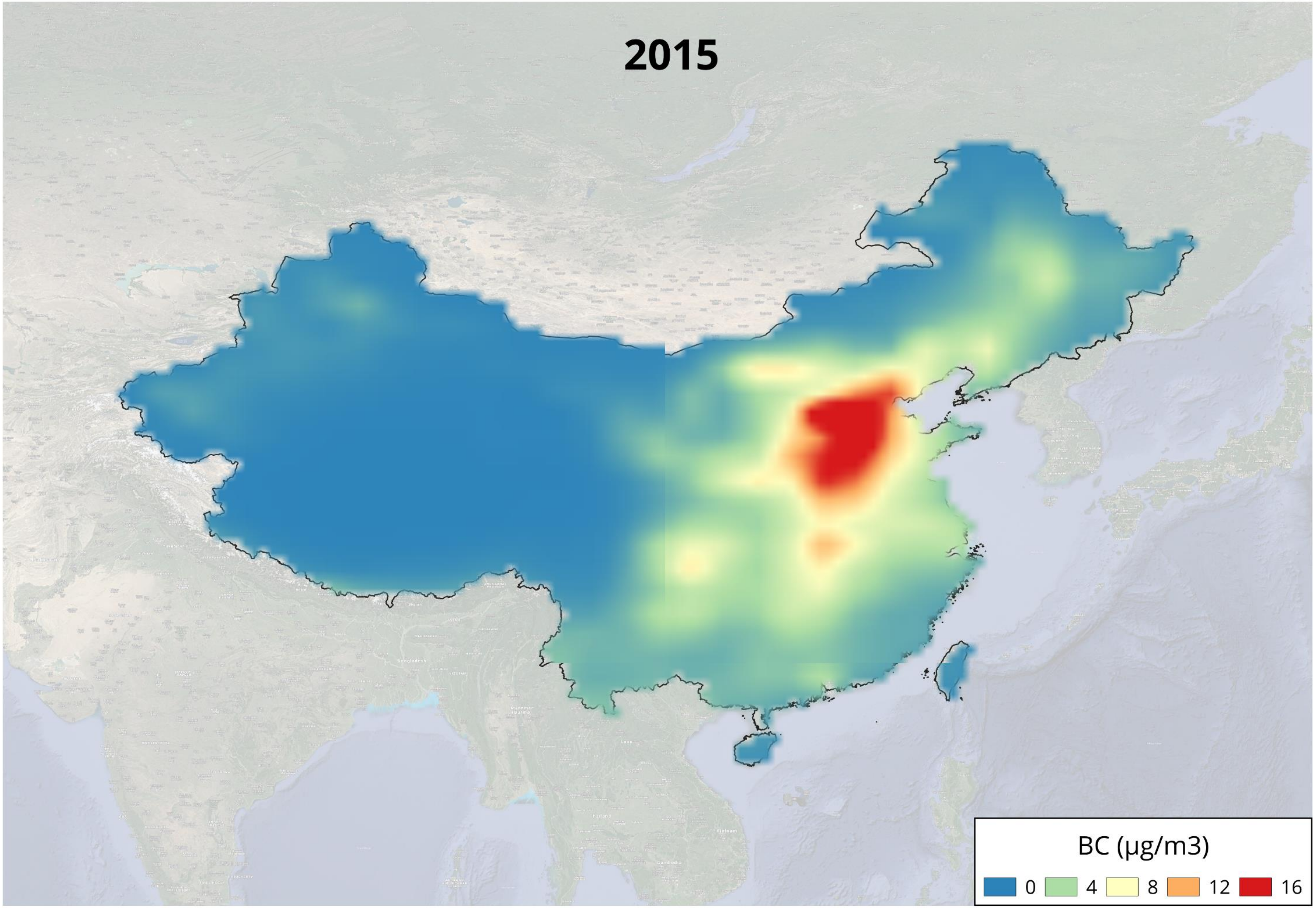
- **Baumgartner et al. 2014** suggest that BC from combustion emissions is more strongly associated with blood pressure than PM mass, and that BC's health effects may be larger among women living near a highway in rural China and with greater exposure to motor vehicle emissions.
- **Zhao et al. 2014 : Personal Black Carbon Exposure Influences Ambulatory Blood Pressure**
- **Chen et. Al. 2020, Characteristics and toxicological effects of commuter exposure to black carbon and metal components of fine particles ($PM_{2.5}$) in Hong Kong:** importance of commuter exposures and their toxic effects, urging effective mitigating strategies to protect human health.
- **Li R, et al. 2019:** BC derived from three main emission sources (residential coal combustion, biomass burning, and diesel engine exhaust) in China was subjected to physiochemical characterization and its oxidative potential (OP) was tested. Coal consumption in China contributes to the highest amount of BC mass emission, but result indicates that diesel exhaust BC has the greatest OP. An emission inventory based on health impacts is urgently needed to control air pollution sources in the future.
- **Zhou et al. 2020 panel study** among elderly adults aged 60–69 years old in Jinan, China. Strong correlations were found between personal and ambient BC concentrations. Aside from ambient concentration, meteorological conditions, education level, individual activities such as using air purifiers were significant determinants of personal exposure to BC among elderly adults in urban area.

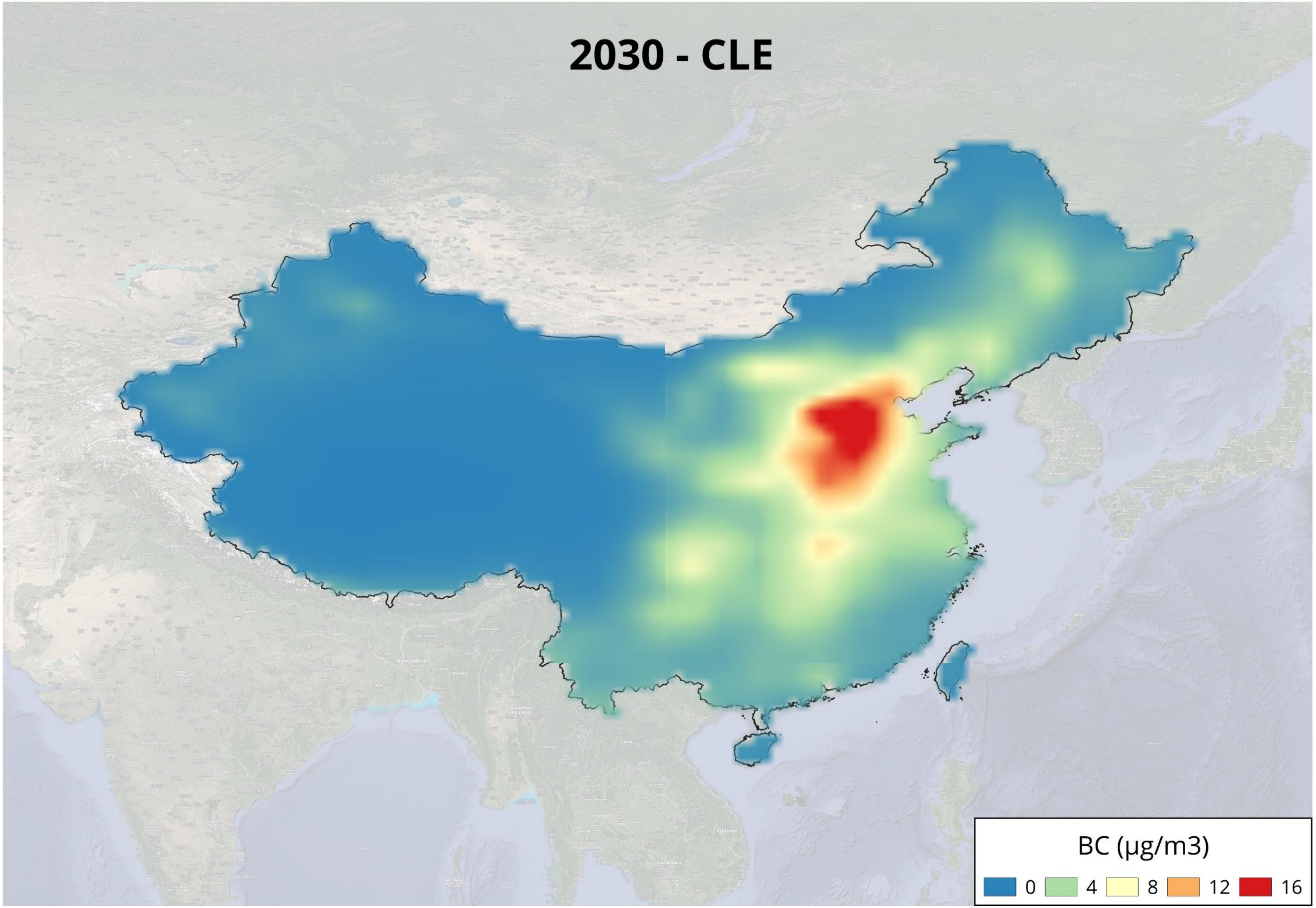
Published articles on the health impacts of pollution policies in China

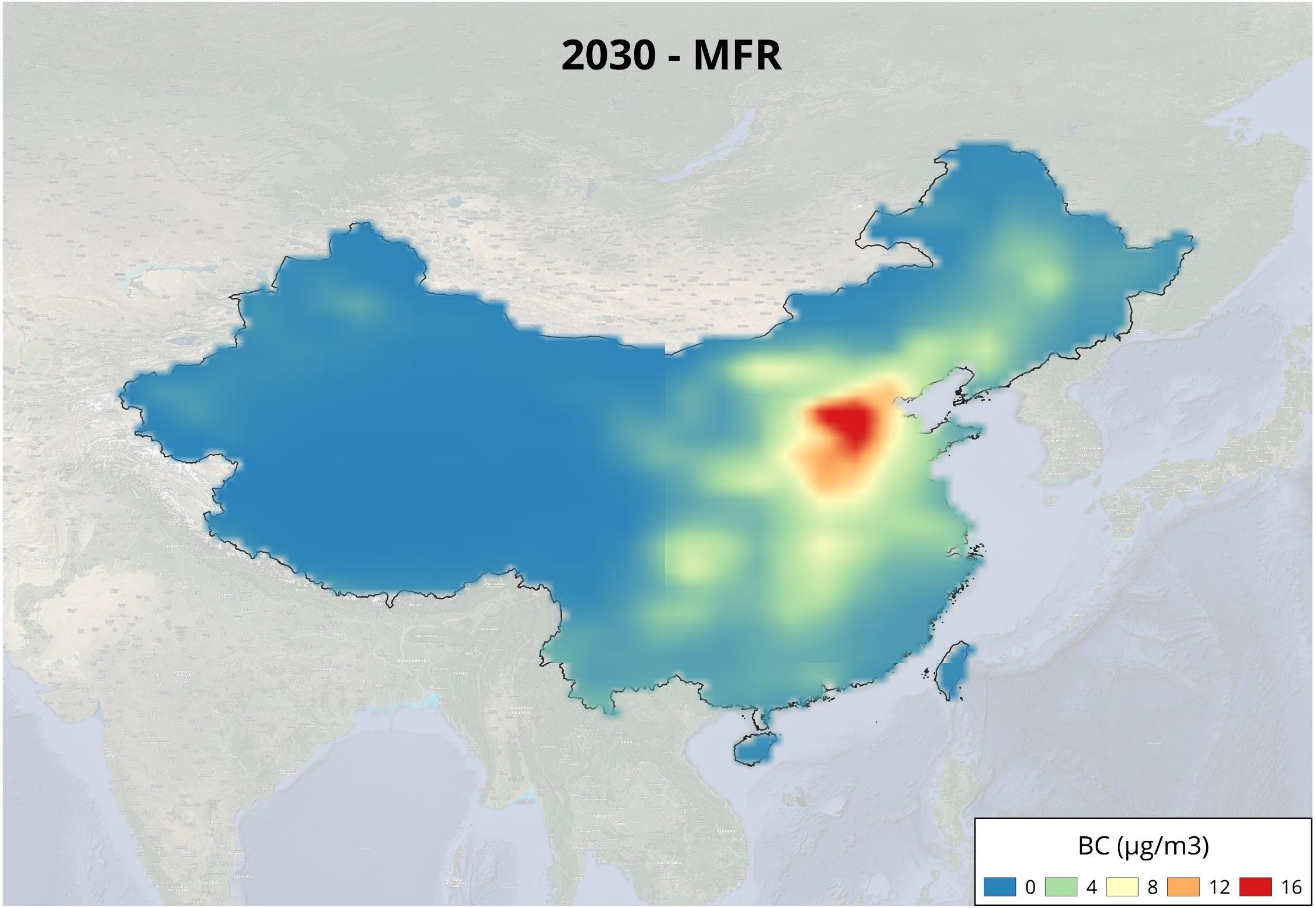
- **Wang et al., 2019** investigated premature deaths associated with $PM_{2.5}$ across China on the basis of air quality scenarios proposed by the expert group involved in the formulation of the 13th Five-Year Plan for Eco-Environmental Protection
- **Yue et al. 2020, Stronger policy required to substantially reduce deaths from $PM_{2.5}$ pollution in China** Chinese government implemented the Air Pollution Prevention and Control Action Plan (APPCAP) from 2013 to 2017
- **Maji , 2020** Substantial changes in $PM_{2.5}$ pollution and corresponding premature deaths across China during 2015–2019 (Total $PM_{2.5}$-related nonaccidental deaths decreased by 383 thousand to 1755 thousand (28%)

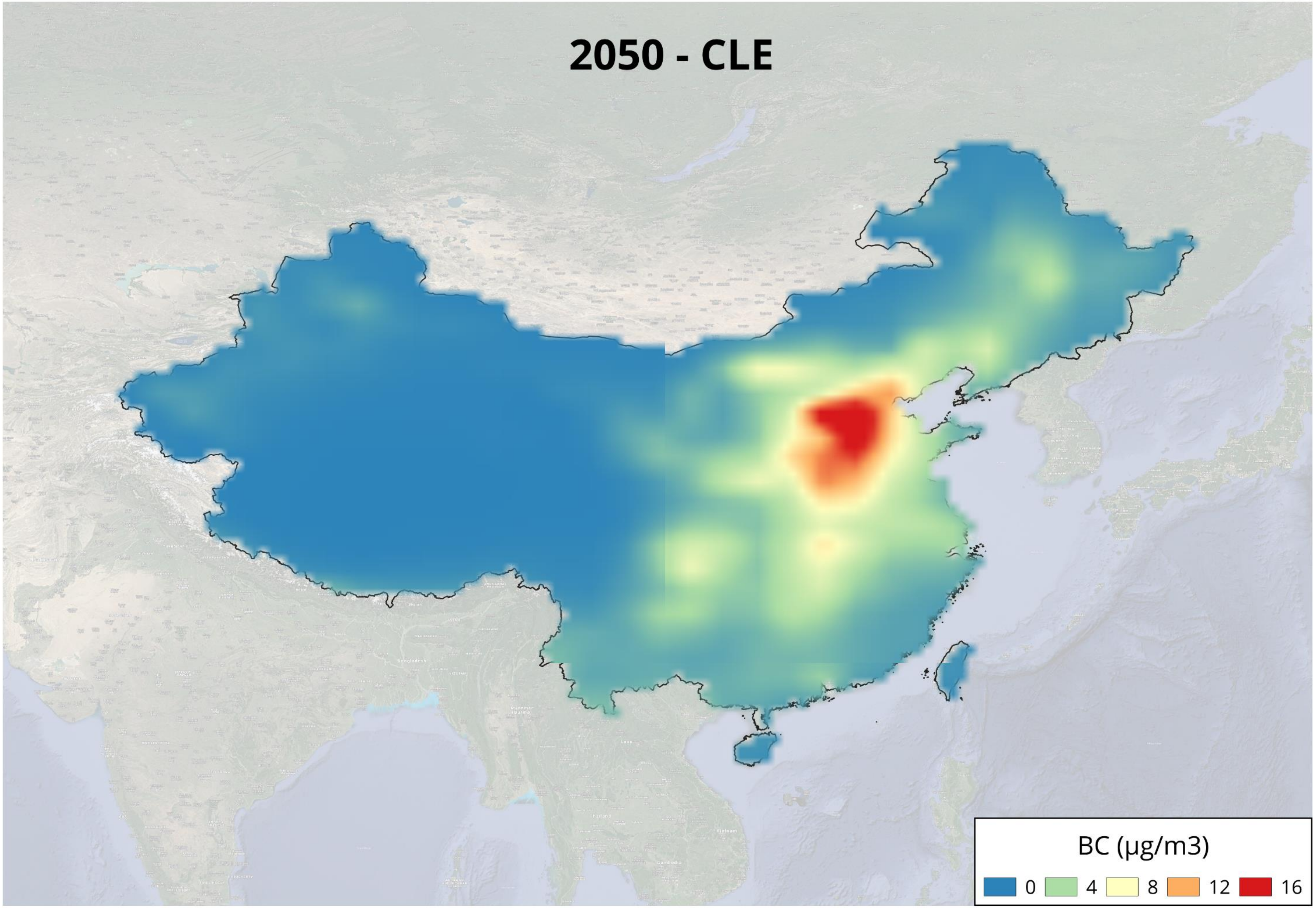
Estimation Global Mortality burdens in the ECLIPSE scenarios in the AMAP SLCP group

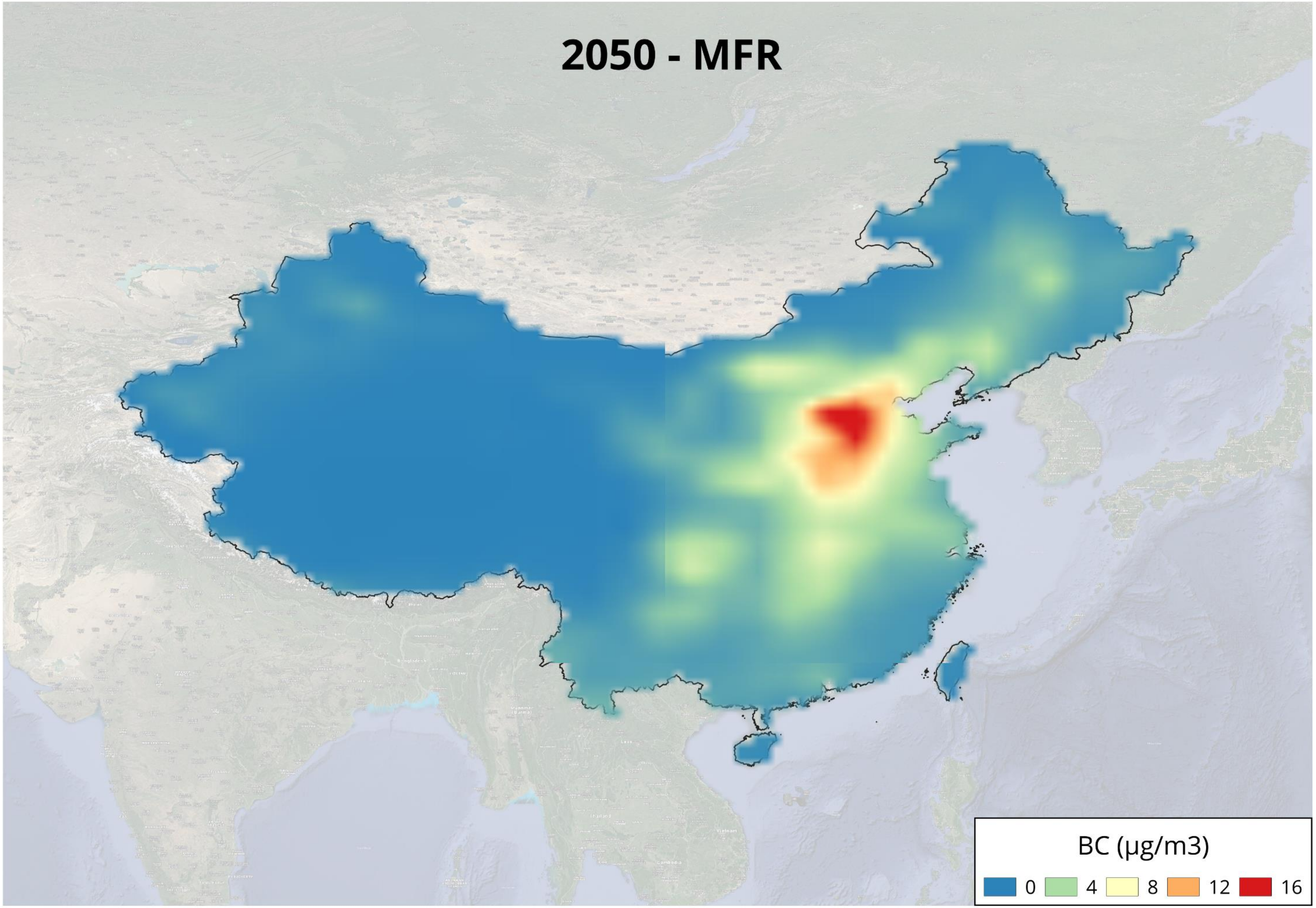
- In order to examine the impacts of PM2.5 and BC on health, we use a set of emission scenarios developed by Klimont et al. (GAINS model) that include energy projections from the International Energy Agency (IEA)
- Air pollution control policies:
  - **CLE** – current legislation: efficient implementation of air pollution policies (including emission standards) committed before 2018
  - **MFR** – maximum technically feasible reduction: implementation of best available technologies defined in the GAINS model.
- PM2.5 and BC concentrations are simulated by multiple atmospheric models (relatively coarse resolution of air quality)
- Population scenarios are based on the Shared SocioEconomic Pathways of the Integrated Panel on Climate Change
- Risk functions for PM2.5 and BC are derived from the literature and based on the Global Burden of Disease (GBD) and other sources


2015
BC (μg/m3)
0
4
8
12
16

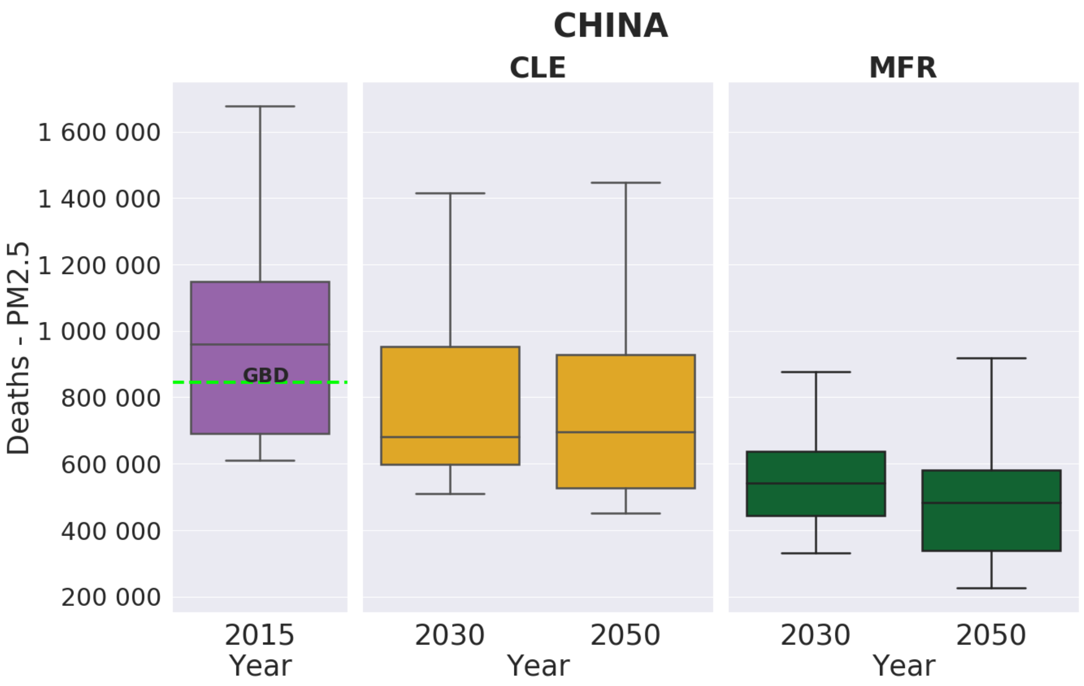

2030 - CLE
BC (μg/m3)
0
4
8
12
16

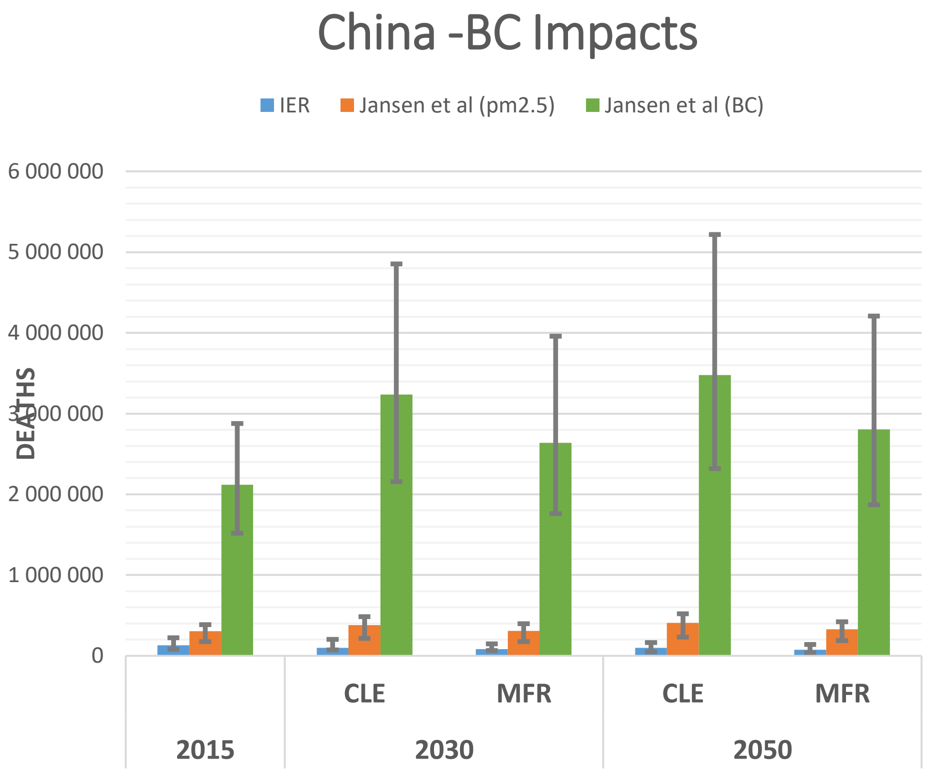

2030 - MFR
BC (μg/m3)
0
4
8
12
16


2050 - CLE
BC (µg/m3)
0
4
8
12
16


2050 - MFR
BC (µg/m3)
0
4
8
12
16

PM2.5 related mortality in China in the AMAP ECLIPSE scenarios





- ➢ Current policies do not account clearly for the differences in health risks from different sources and do not account for all possible health outcomes.
- ➢ Health benefits induced by air quality improvements could be offset by the effect of the population increasing in size and ageing.

This work is ongoing and under review . Please do not quote or distribute,

Summary

- Current air pollution legislations in China are effective in reducing PM2.5 emissions over the next few decades and result in corresponding reductions in related mortality (30-50%).
- Large uncertainties exist in estimates of BC related risk functions and mortality.
- Current policies do not account clearly for the differences in health risks from different sources and do not account for all possible health outcomes.
- Health benefits induced by air quality improvements could be offset by the effect of the population increasing in size and ageing
- Uncertainties associated with mitigating BC from different sources and its contribution to health effects must be accounted for while estimating inventories and planning mitigation policies.

中 国 – 挪 威 合 作 中 国 北 方 地 区 黑 碳 排 放 、 影 响 、 控 制 对 策 及 其 协 同 效 应 研 究 项 目 启 动 会
Chinese-Norwegian Project on Emission, Impact, and Control Policy for Black Carbon and its Co-benefits in Northern China Kick-off Meeting

从《UNEP短寿命气候污染物中国报告》谈起

On the *UNEP-China short-lived climate pollutants (SLCPs) Report*

支国瑞
ZHI Guorui

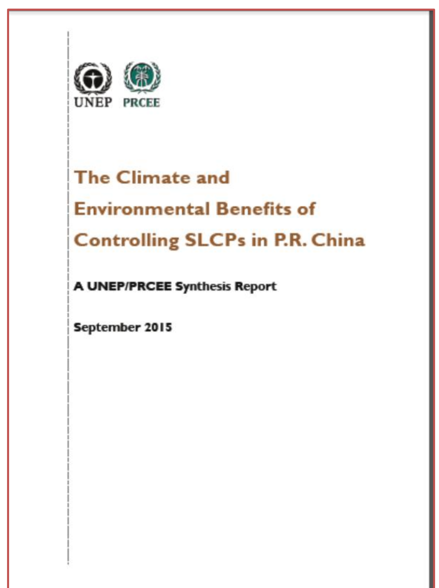
中国环境科学研究院
Chinese Research Academy of Environmental Sciences (CRAES)

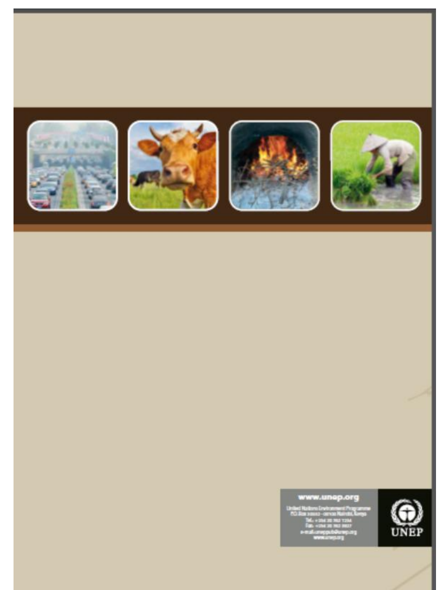
Beijing, China 2020.12.09

2013 年，在中国环境保护部的支持下，联合国环境规划署和环保部环境与经济政策研究中心开展了“短寿命气候污染物”的相关合作。《中国控制短寿命气候污染物的环境和气候效益》报告是联合国环境规划署首次与中国开展“短寿命气候污染物”方面的政策研究合作成

In 2013, UNEP started the collaboration with Policy Research Center for Environment and Economy (PRCEE) of Ministry of Environmental Protection (MEP) on Short-Lived Climate Pollutants (SLCPs) with the support of MEP.

This is the first time that UNEP collaborated with China on SLCPs policy study with the report on “The Climate and Environmental Benefits of Controlling SLCPs in China”.





Outline报告提纲

- 为什么是中国

  Why chose China for SLCPs assessment

- 《UNEP-中国SLCPs报告》简介

  Brief introduction of the *UNEP-China SLCPs Report*

- 中挪双边黑碳项目：做出新贡献

  China-Norwegian bilateral BC project: new contribution

Why chose China for SLCPs assessment为什么是中国

(WMO GHG Bulletin 2010温室气体公报2010)

CO_2 是长寿命气体，非常稳定，即使停止排放，在大气中的历史累积依然会带来气温继续上升

The warming effect of CO_2 will continue to a long time due to CO_2's long lifetime even no CO2 is newly released into atmosphere

为什么是中国Why chose China for SLCPs assessment

Nobel Laureate诺贝尔奖获得者
Maria Molina

(WMO GHG Bulletin 2010温室气体公报2010)

建议针对短寿命的气候开展快速行动防止危险气候变化

Propose rapid action on short-lived climate pollutants(SLCPs)

to prevent dangerous climate change

甲烷（Methane）

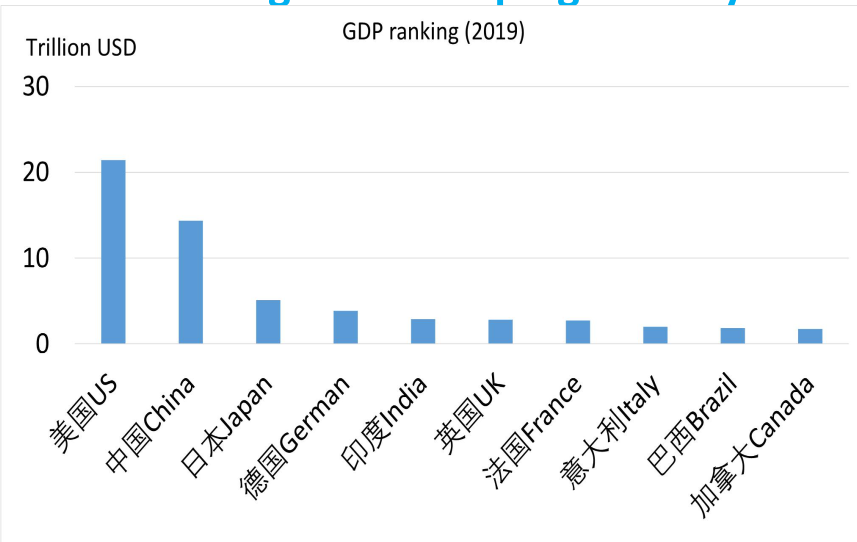
对流层臭氧（O_3）

黑碳（BC）

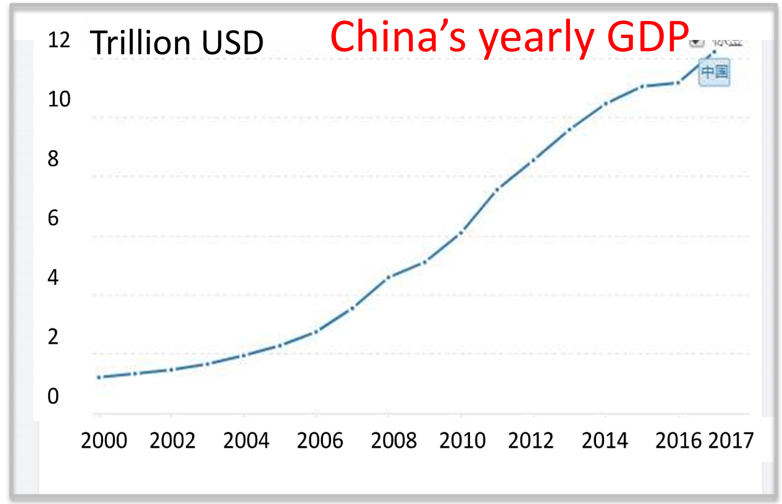
氢氟碳化物（HFCs）

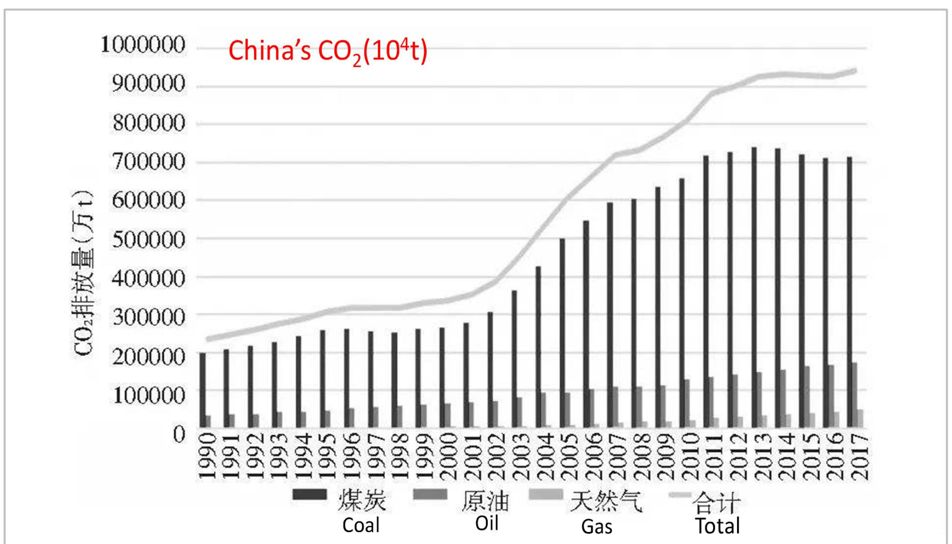
为什么是中国Why chose China for SLCPs assessment

中国是最大的发展中国家
China is the largest developing country



中国的GDP快速增长，能源消耗也在增长
China's GDP and energy consumption on rise



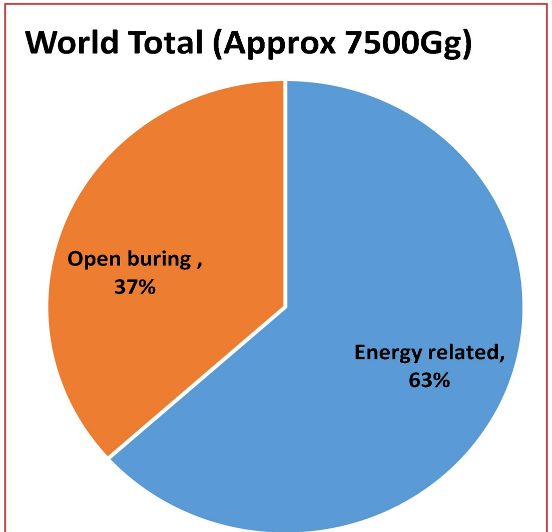


◆**2015年11月20日的巴黎气候大会，习近平主席在“国家自主贡献”中提出将于2030年左右使二氧化碳排放达到峰值并争取尽早实 现**

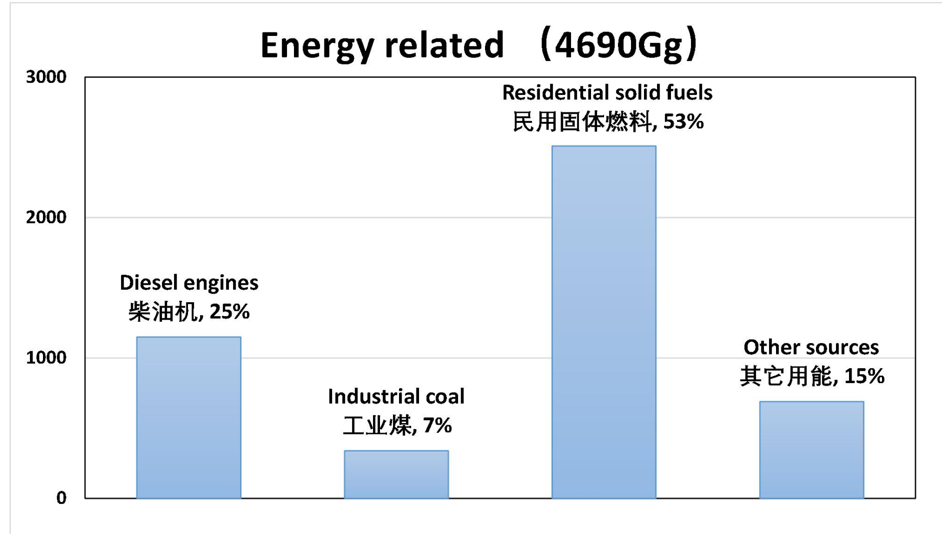
◆In November 20, 2015, President Xi Jinping described China's Intended Nationally Determined Contributions. China pledges to peak CO_2 emissions by around 2030 and strive to achieve it as early as possible.

为什么是中国Why chose China for SLCPs assessment

(Bond et al., 2013)

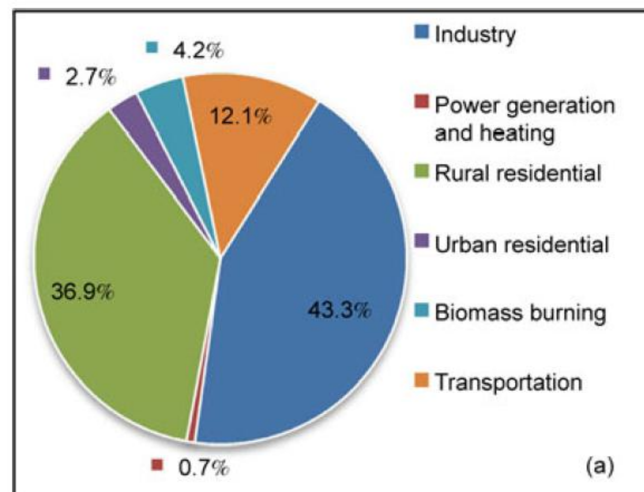


(GAINS, Bond et al., 2013)



China (Approx. 1500Gg)

Year	Industry	Power	Residential	Biomass burning	Transportation	Total
2008	695.0	11.6	636.0	67.7	194.6	1604.9
2000	88.9	6.8	780.7	112.4	59.8	1048.6
2000	99	18	938		38	1093
2005	610	10	700		190	1510
2006	575	36	1002		198	1811
2007	529	13	651	104	145	1399
2007	646	50.7	988	77.7	188	1957
2008	510	19	888	110	259	1787



(Zhang Nan et al., 2013)

为什么是中国Why chose China for SLCPs assessment

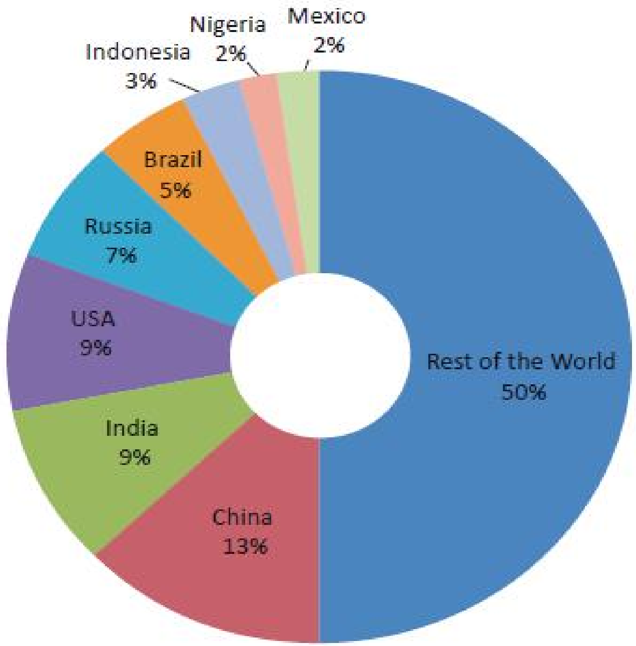


Figure 4.1a. Global methane emission in 2010
Source: Brink et al. (2013)

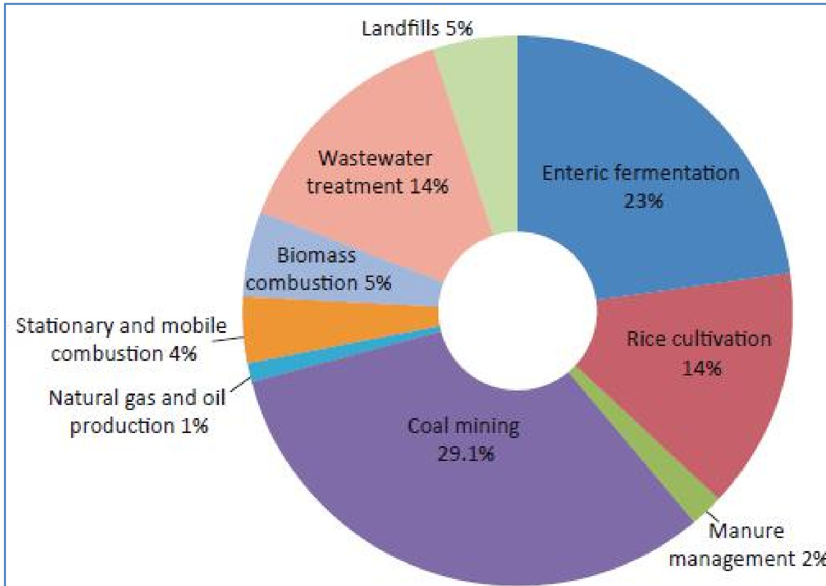


Figure 4.1c. China's methane emission by sector in 2010
Source: Brink et al. (2013)

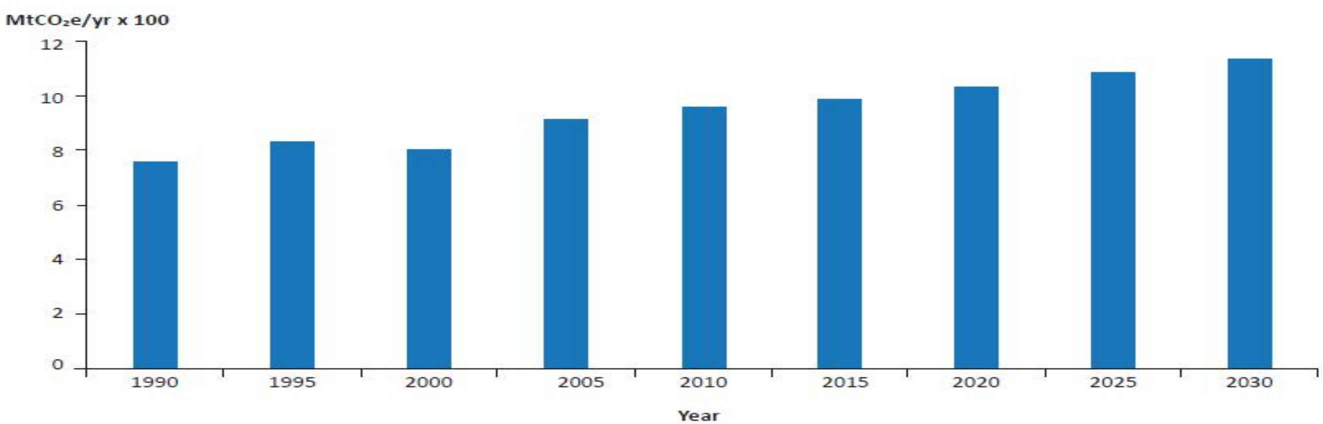
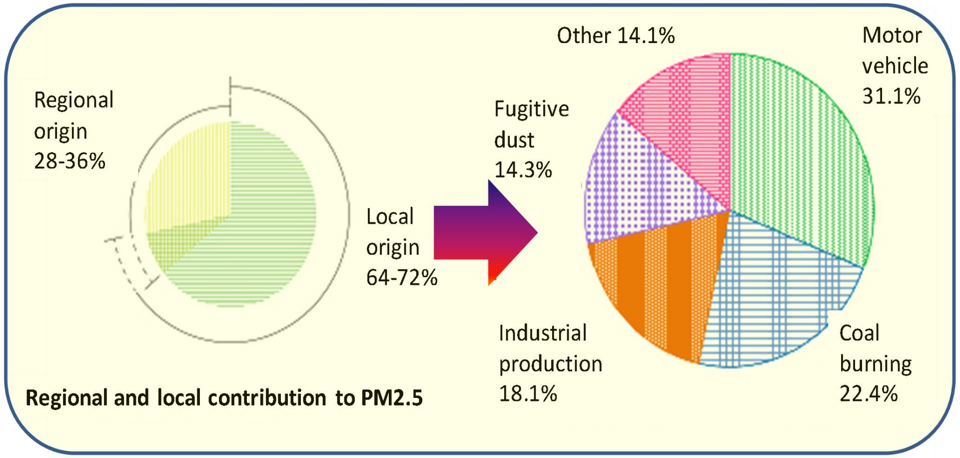


Figure 4.2. Trend and Projection in China's total methane emission, 1990 to 2030
Source: USEPA (2012)

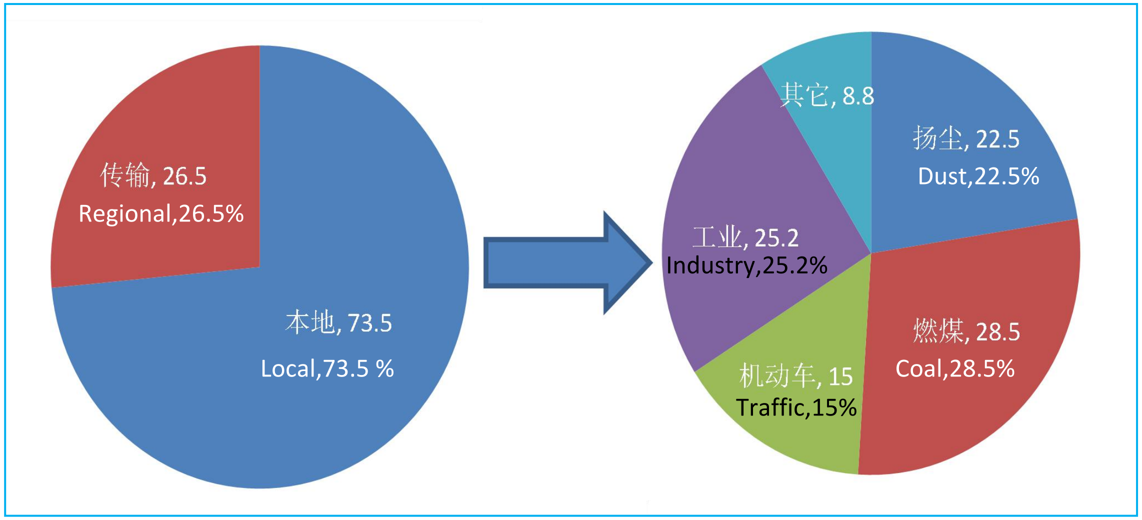
为什么是中国Why chose China for SLCPs assessment

黑碳控制与中国的大气空气污染控制的手段相一致
Win-win measures in China

北京Beijing



石家庄Shijiazhuang



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2013.6.19 首次会议，初步交流
First meeting, information exchange

2013.6.19 分配撰写任务
Division of Chapters

2014.2.18 汇总和内审
Compilation and Internal check

2014.2.18 国际专家外审
Global Expert review

2014.7.21 作者会议
Authors' Meeting for response

2014.12.1 发布会取消
Canceled Launch Ceremony

2015.9.18 结题和发布
Project completion and report launch

《UNEP-中国SLCPs报告》简介Brief introduction

16位作者：主要为中国本地专家

16 authors: Mainly Chinese local experts

按姓氏字母排序（ Alphabetical order of last names ）

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朱彤（北京大学）	
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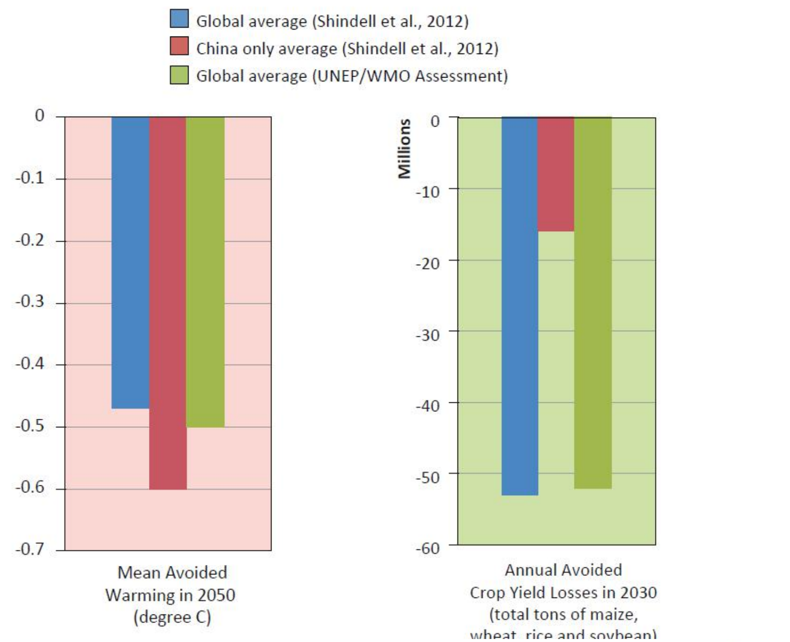
《UNEP-中国SLCPs报告》简介Brief introduction

第一章前言Chapter 1 Introduction

论述了为什么开展评估，强调了通过减排短寿命污染物能够实现的各种收益。这些收益对中国的发展很重要。目前，中国的相关政策尚未加以整合，未来需要进一步推进一体化管控，在相关领域实现更大的可持续发展收益，在国家、区域和全球层面实现多方共赢。

This chapter discusses why we carries out an assessment, highlights the opportunity for achieving benefits from mitigating SLCPs. Whilst these benefits have been shown to be substantial in China, work on SLCPs has not featured in an integrated manner on the policy agenda in China; yet such an approach could yield substantial sustainable development benefits at the national, regional, and global levels.



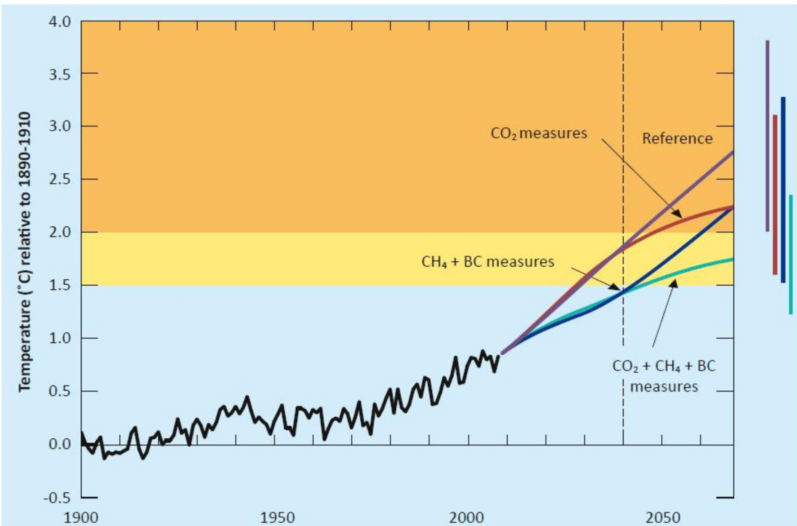


Figure 1.2. Observed deviation of temperature to 2009 and projections under various scenarios

Source: UNEP/WMO, 2011

《UNEP-中国SLCPs报告》简介Brief introduction

第二章中国空气污染和短寿命气候污染物现状

Chapter 2 Air pollution and SLCPs in China

强调短寿命气候污染物和空气污染的关系，并将特别关注中国情况。

This chapter highlights the relationship between SLCPs and Air pollution, esp. in the Chinese context.

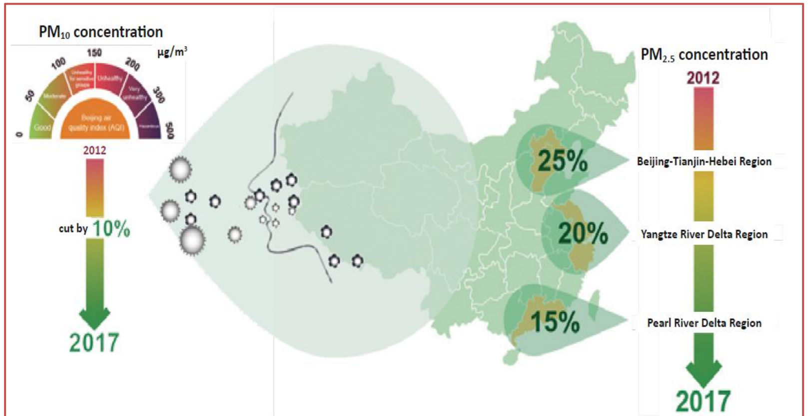


Figure 2.1. Schematic of the chinese airborne pollution prevention and control action plan, 2013
Source: Adapted from China's Daily (http://www.chinadaily.com.cn/china/fightairpollution/2013-09/11/content_16962092.htm)

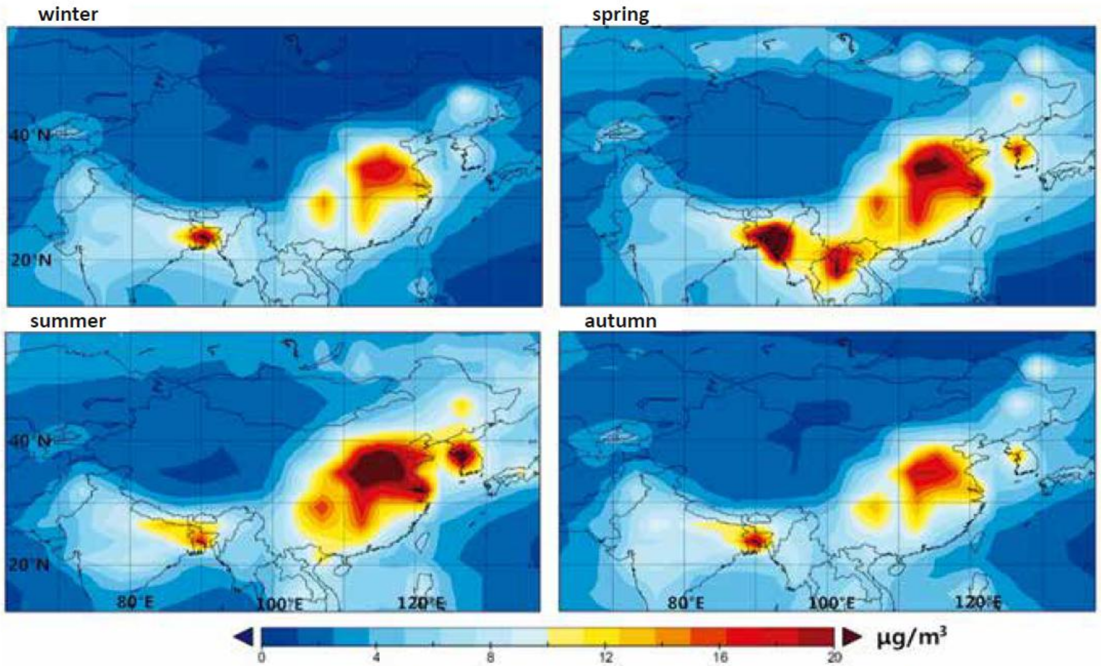


Figure 2.2. Distribution of simulated $PM_{2.5}$ (only including anthropogenic aerosols)
Source: Zhang, et al. (2014)

第三章黑碳及其影响Chapter 3 Black carbon and its impacts

本章深入分析中国黑碳排放源、排放趋势和排放预测，并讨论其相关影响

Chapter 3 looks more closely at black carbon, highlighting its emission sources, trends and projections in China, as well as its impacts.

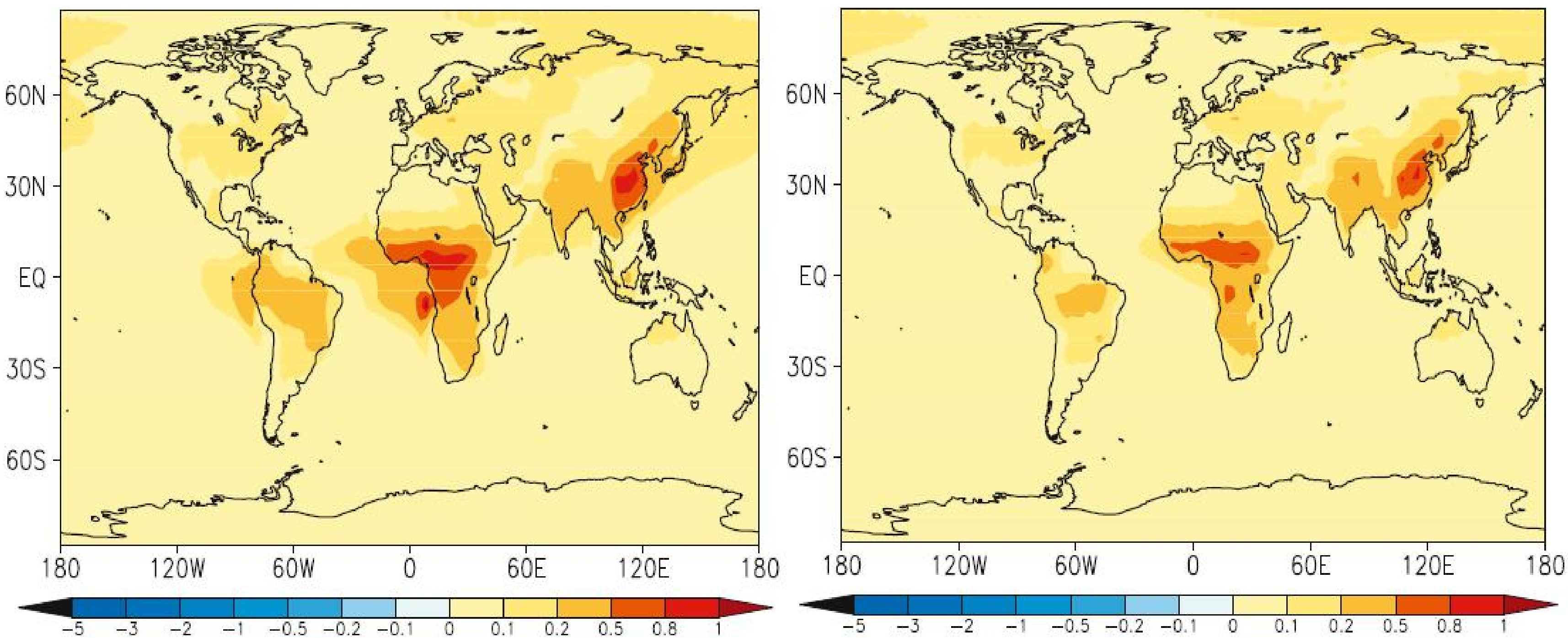


Figure 3.2. Annual mean distributions of the simulated direct radiative forcing (W/m^2) due to black carbon under all sky (left) and clear sky (right) conditions

Source: Zhang et al. 2012.

第四章甲烷及其影响Chapter 4 Methane and its impacts

本章深入分析中国甲烷的排放源、排放趋势和排放预测，并讨论其相关影响

Chapter 4 looks more closely at methane, highlighting its emission sources, trends and projections in China, as well as its impacts.

Table 4.1. The Emission Inventory of Agricultural Activities in China, 2005

Sectors	CO_2 equivalent (eq. Million tons CO_2)	Methane (10^4 tons CH_4)	Nitrous oxide (10^4 tons N_2O)
Rice cultivation	166	792.6	
Agricultural soil	208		67.2
Enteric fermentation	302	1437.9	
Animal manure management	143	286.4	26.6
Total	**819**	**2516.6**	**93.8**

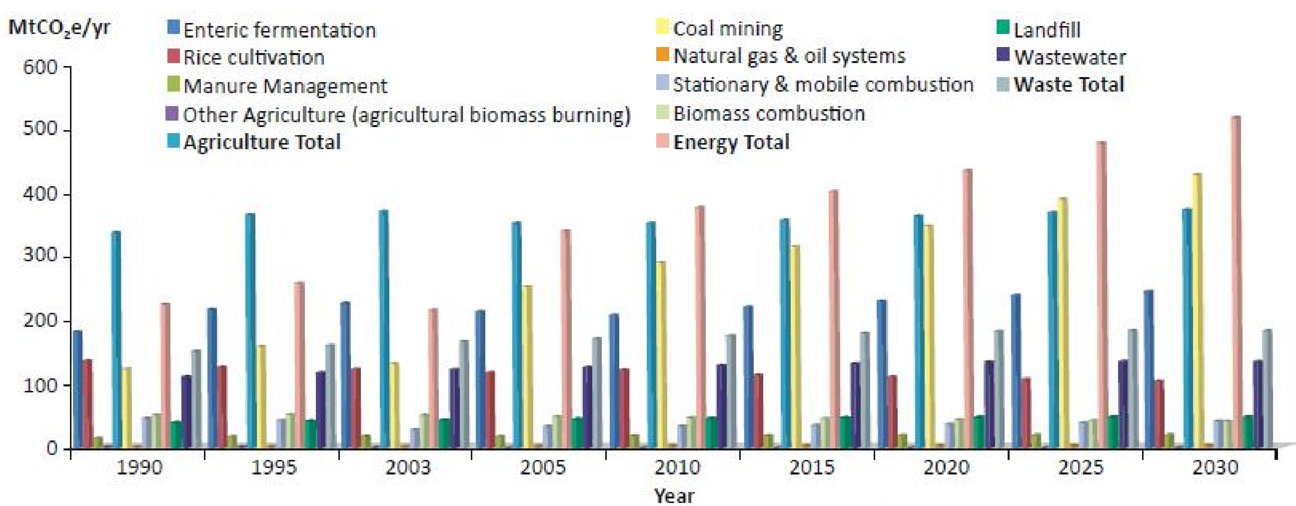


Figure 4.3. Sectoral breakdown of trend and projection of China's methane emission, 1990 to 2030

Source: USEPA (2012)

第五章减排措施Chapter 5 Emission reduction measures

本章讨论黑碳和甲烷减排的各项措施，回顾当前中国的各项减排努力，以及未来政策和行动的推进方向。

This chapter *discusses the various mitigation measures for black carbon and methane, reviewing current mitigation efforts in China and highlighting what more could be done.*

Table 5.1. UNEP/WMO (2011) measures for black carbon emission reduction

Measure[1]	Sector
BC measures (affecting BC and other co-emitted compounds)	
Diesel particle filters for road and off-road vehicles	Transport
Elimination of high-emitting vehicles in road and off-road transport	
Replacing coal by coal briquettes in cooking and heating stoves	Residential
Pellet stoves and boilers, using fuel made from recycled wood waste or sawdust, to replace current wood-burning technologies in the residential sector in industrialized countries	
Introduction of clean-burning biomass stoves for cooking and heating in developing countries[2, 3]	
Substitution of clean-burning cookstoves using modern fuels for traditional biomass cookstoves in developing countries[2, 3]	
Replacing traditional brick kilns with vertical shaft kilns and Hoffman kilns	Industry
Replacing traditional coke ovens with modern recovery ovens, including the improvement of end-of-pipe abatement measures in developing countries	
Ban of open field burning of agricultural waste[2]	Agriculture

《UNEP-中国SLCPs报告》简介Brief introduction

第五章减排措施Chapter 5 Emission reduction measures

Figure 5.4 Coals and stoves used by Zhi et al. (2009)
photo credit: Guorui Zhi

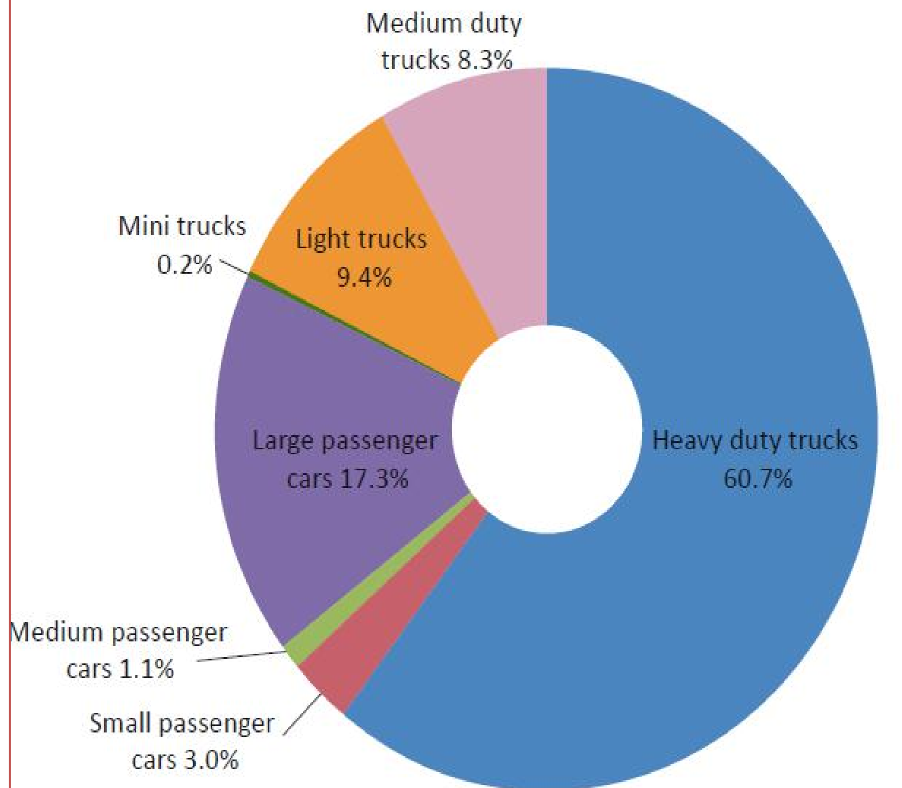


Figure 5.7. Particulate matter emissions from different vehicle types
Source: China Motor Vehicle Pollution Prevention Annual Report (2013)

第五章减排措施Chapter 5 Emission reduction measures

Table 5.3. UNEP/WMO (2011) measures for methane emission reduction

Measure[1]	Sector
Methane measures	
Extended pre-mine degasification and recovery and oxidation of CH_4 from ventilation air from coal mines	Extraction and transport of fossil fuel
Extended recovery and utilization, rather than venting, of associated gas and improved control of unintended fugitive emissions from the production of oil and natural gas	
Reduced gas leakage from long-distance transmission pipelines	
Separation and treatment of biodegradable municipal waste through recycling, composting and anaerobic digestion as well as landfill gas collection with combustion/utilization	Waste management
Upgrading primary wastewater treatment to secondary/tertiary treatment with gas recovery and overflow control	
Control of CH_4 emissions from livestock, mainly through farm-scale anaerobic digestion of manure from cattle and pigs	Industry
Intermittent aeration of continuously flooded rice paddies	

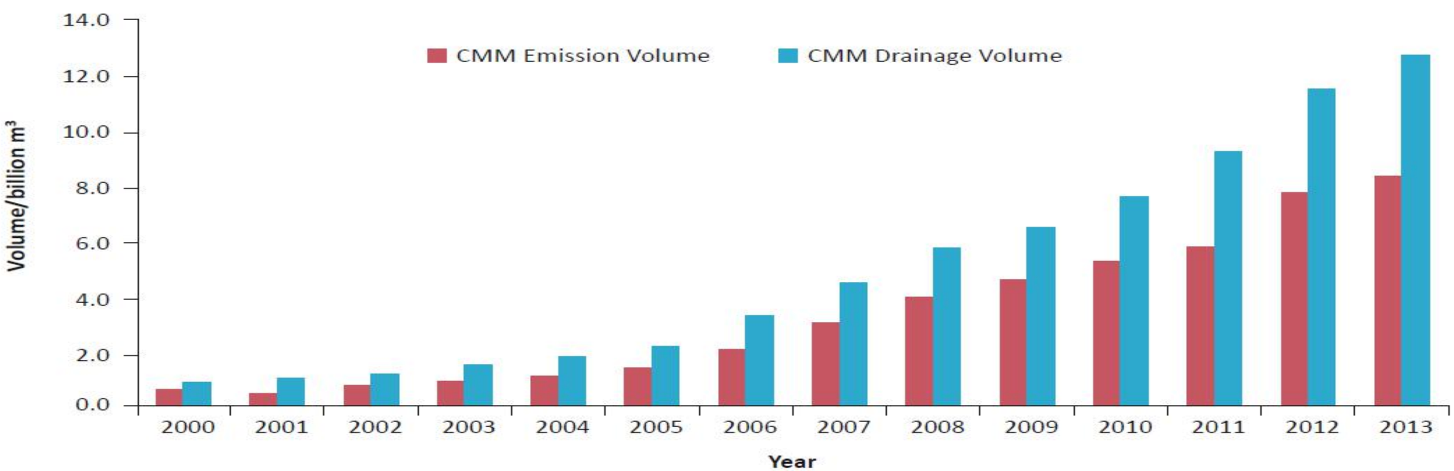


Figure 5.9. Direct emission (unutilized) and drainage volume of CMM in China, 2000-2013

Source: China Coal Information Institute

第六章政策建议Chapter 6 Implications for policy

1 未来行动选择Options for future action

A居民取暖和烹饪Domestic heating and cooking

B工业部门Industry

C交通部门Transport

D露天焚烧Open burning

E农业部门Agriculture

F煤矿瓦斯排放Coal mine emissions

G废弃物管理Waste management

2推动转型Delivering Change

A强化政策制定过程中的数据基础Strengthen the information base for policy formulation

B建立一套SLCPs的管理和计划体系Develop a regulatory and planning systems for SLCPs

C加强国际交流与合作Strengthen international communication and cooperation

3下一步行动Next steps

强调应树立协同控制的理念，并落实于行动中Highlights the co-control mechanism for air pollutants and GHGs and put this conception into practice

Outline报告提纲

- 为什么是中国

  Why chose China for SLCPs assessment

- 《UNEP-中国SLCPs报告》简介

  Brief introduction of the *UNEP-China SLCPs Report*

- 中挪双边黑碳项目：做出新贡献

  China-Norwegian bilateral project on BC: new contribution

黑碳项目：做出新贡献BC project: new contribution

当前进展：方法框架Methodological framework Designed

Collecting existing inventories 收集清单

↓

Deciding which inventory will be based on确定初始排放清单

↓

Analyzing the structure of the inventory based 清单的初始结构和性能分析

- Source classification 源分类体系
- How to obtain emission factors获取EFs方式
- Spatial/temporal resolution 时空分辨率
- How to obtain activity levels 获取ALs方式

↓

- Literature review 文献调查
- Measuring EFs in key sectors重点行业EF测试
- Investigating ALs in key sectors重点行业AL调研

↓

A national inventory
全国大气污染排放清单

- 2018
- Grid:0.25° X0.25°
- 9 pollutants

An inventory for northern China
北方地区排放清单

- 2018
- 0.10° X0.10°
- 9 pollutants

黑碳项目：做出新贡献BC project: new contribution

A)排放因子测试实验:

在河北省唐山市进行不同煤种的排放放因子测试工作

Emission factor measurement: In-door measurement of emission factors of different coals

多指标测试平台: An In-door test system

十余种煤: Various coals

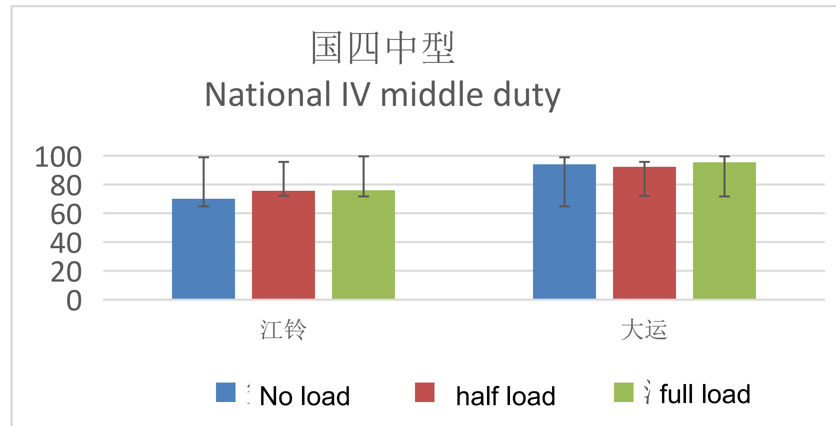
正在对测试过程的各种信息进行处理，最终计算结果将用于校正文献排放因子

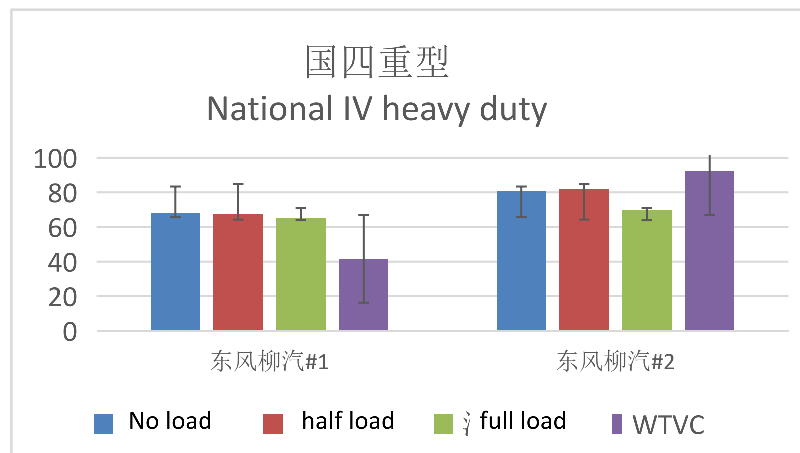
Data of measurements are under processing and the calculated results will help to improve the emission factors extracted from literature

黑碳项目：做出新贡献BC project: new contribution

A)排放因子测试实验:

Emission factor measurement: National IV Emission Level Heavy Vehicles

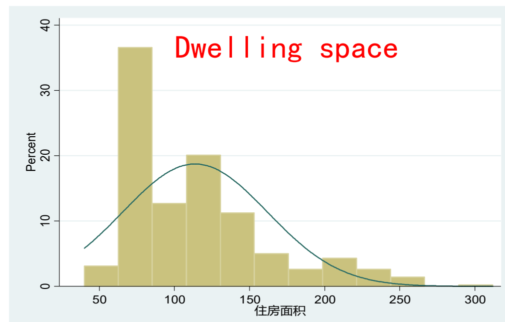


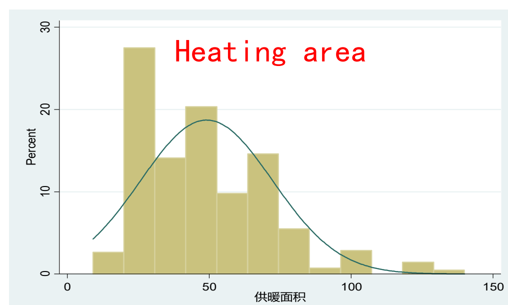


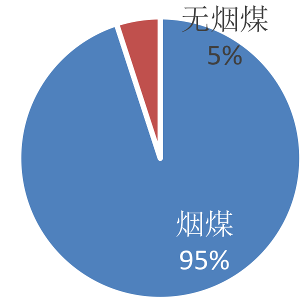
黑碳项目：做出新贡献BC project: new contribution

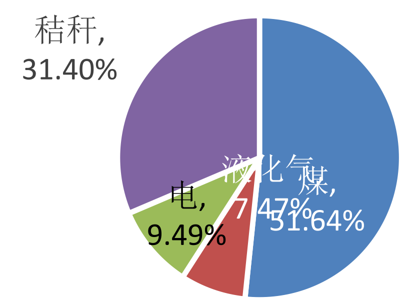
B) 活动水平调研 **The investigation of activity level organized**

第一种方式：入户调查 First manner: into household questionnaires





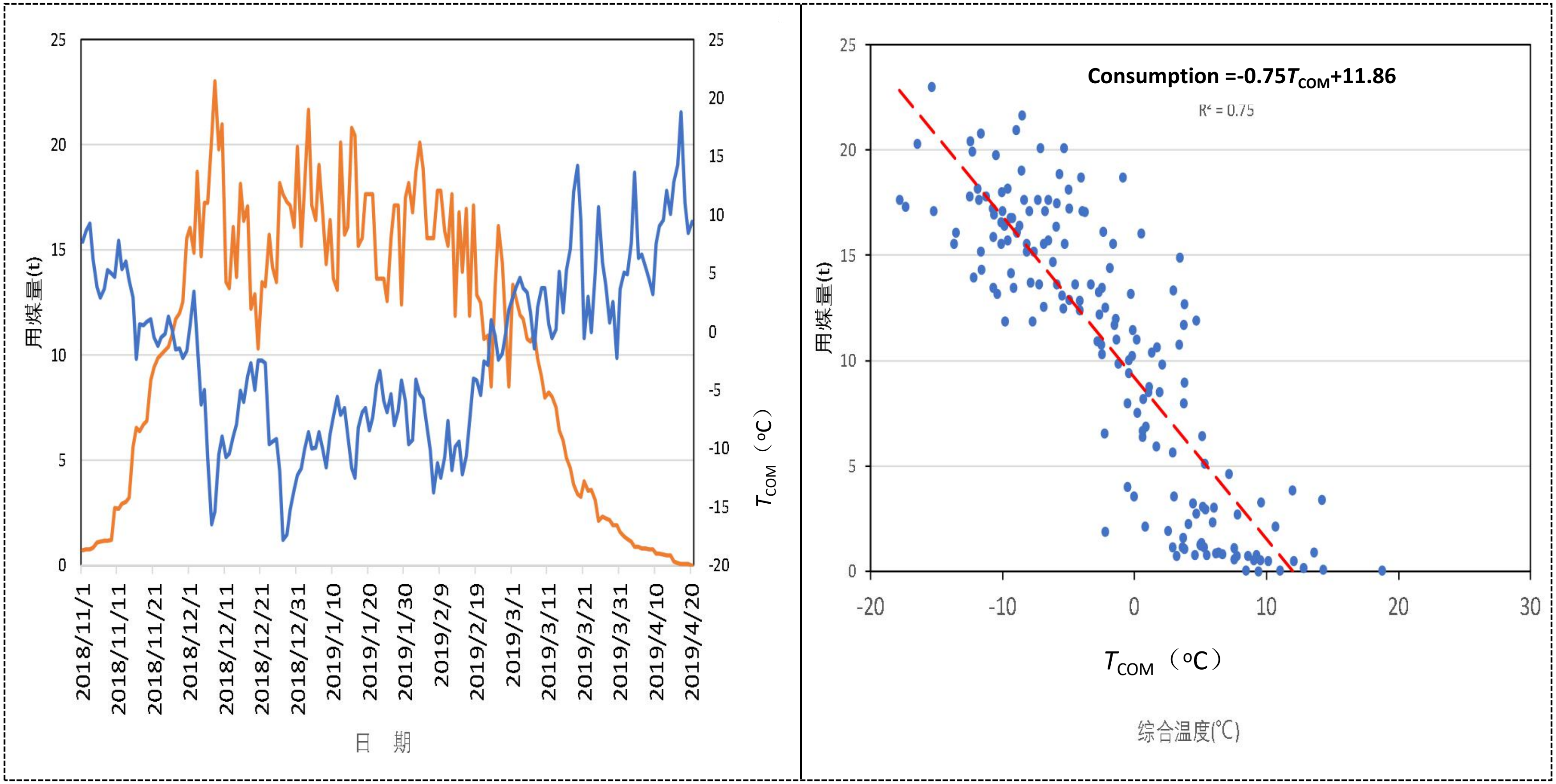




黑碳项目：做出新贡献BC project: new contribution

B) 活动水平调研 The investigation of activity level organized

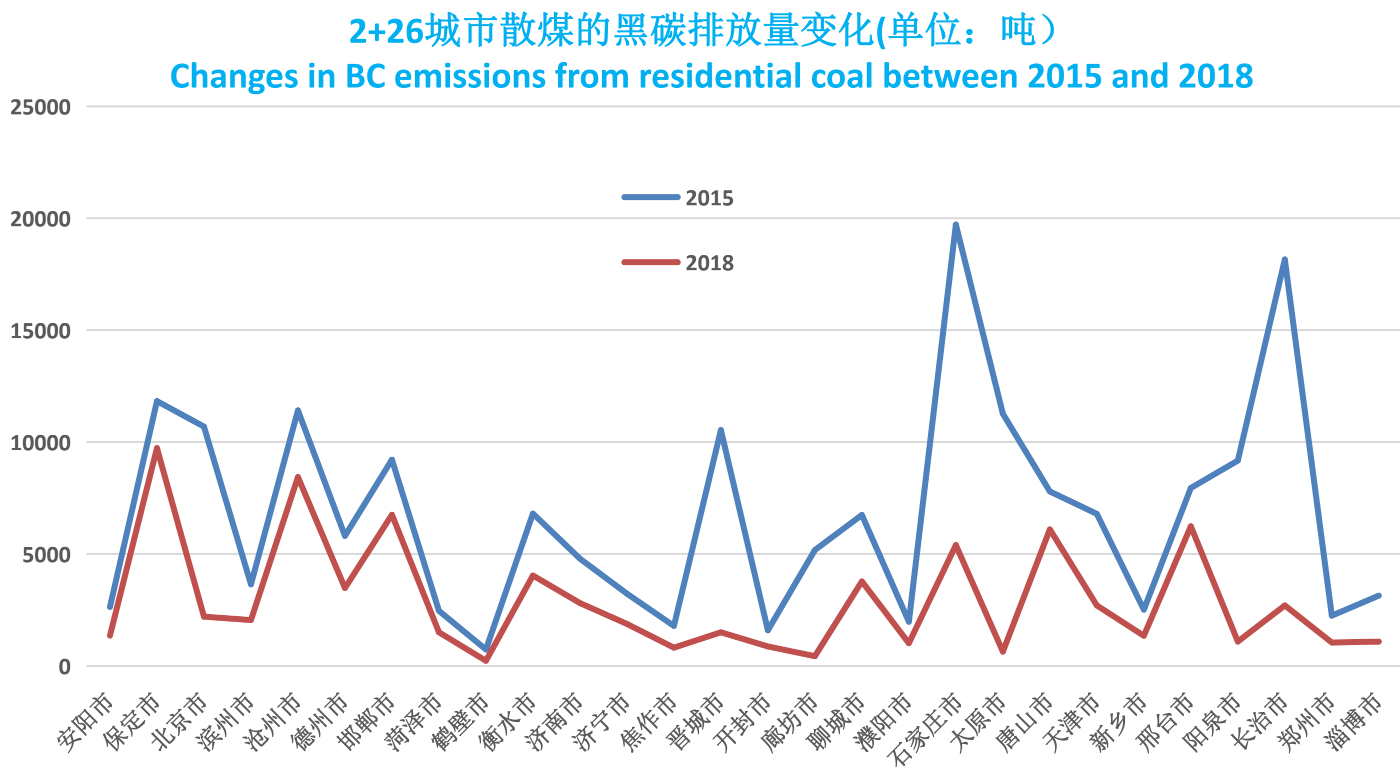
第二种方式：创立算法Second manner: Establish an algorithm



黑碳项目：做出新贡献BC project: new contribution

京津冀及周边散煤黑碳排放在快速降低中

Beijing-Tianjin-Hebei cluster is undertaking a rapid decline in BC emissions due to the promotion of clean energy for coal



谢 谢！

Thank You！


中国柴油机/车排放污染管控措施

王燕军

中国环境科学研究院

2020年12月4日

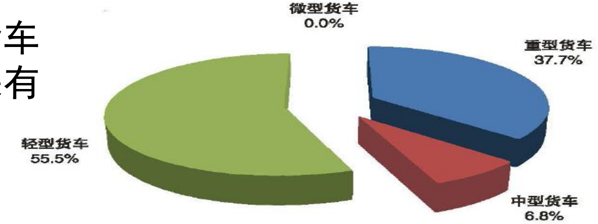
目录

中国柴油机/车排放状况

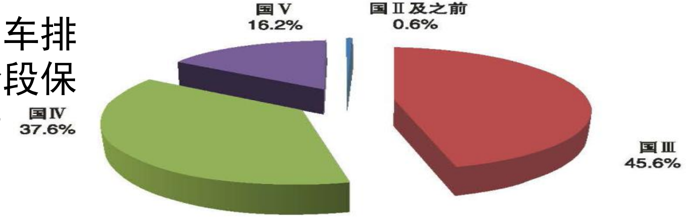
我国柴油车排放状况

- 到2018年底，我国机动车保有量为3.27亿吨，汽车保有量2.4亿辆；柴油车2103万辆，柴油货车1818万辆，占总柴油车的86.4%，占总汽车保有量占比7.9%，2013-2018年柴油货车年均增长率4%左右。

柴油货车分类保有量

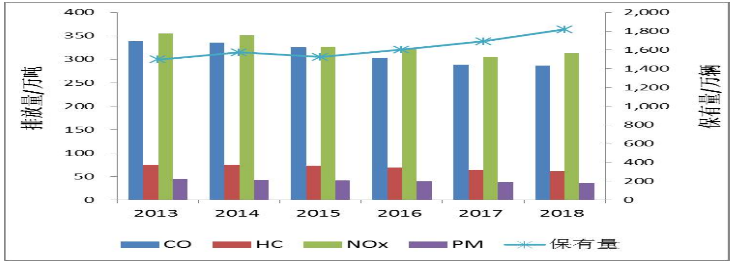


柴油车排放阶段保有量

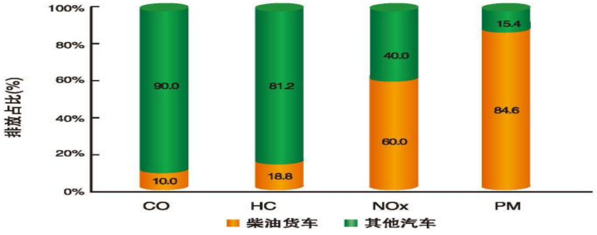


- 2018年柴油货车NOx313.4万吨、PM35.7万吨，分别占汽车排放量的60%和84.6%。 长途货车等营运车辆由于行驶里程数高，维护保养不正规，运行环境恶劣，部分车主劣质油品的使用，造成的污染排放问题十分突出。

不同排放阶段柴油车污染物分担率



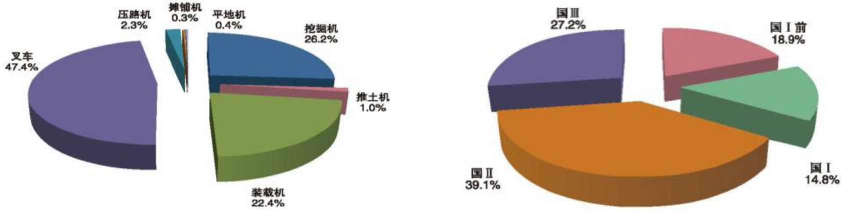
柴油货车占汽车总排放量分担率



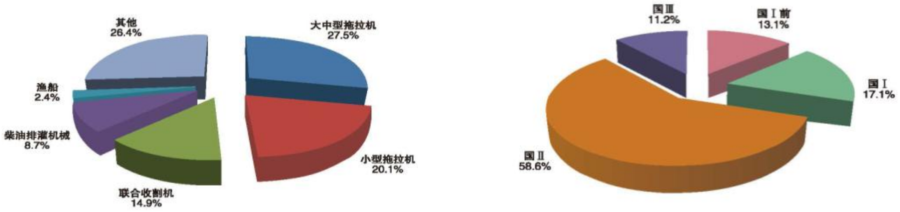
我国非道路柴油机污染问题-1

非道路移动源保有量或活动水平状况

年份	工程机械保有量	农业机械保有量***	农业机械柴油总动力	机动渔船保有量	船舶保有量	铁路机车拥有量	飞机起降架次
	万台	万台	万千瓦	万艘	万艘	万台	万架次
2011	525.5	4983.7	78536.3	301.60	17.9	2.0	598.0
2012	584.8	5112.8	82365.0	348.80	17.9	2.0	660.3
2013	636.5	5099.1	84541.0	374.03	17.3	2.1	731.5
2014	677.6	5158.2	86717.0	399.26	17.2	2.1	793.3
2015	690.8	5205.1	89783.8	416.34	16.6	2.1	856.6
2016	700.0	3960.0	75220.0	433.28	16.0	2.1	923.8
2017	720.0	4020.0	76776.3	460.0	14.5	2.1	1024.9
2018	760	4025	78168.9	490	13.7	2.1	1108.8



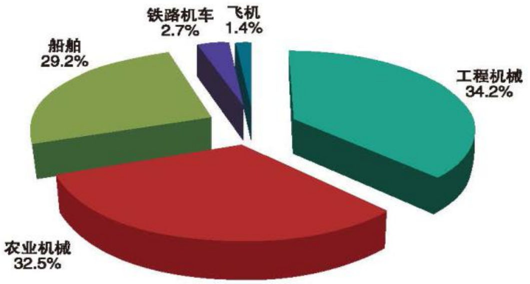
分类、分排放阶段工程机械



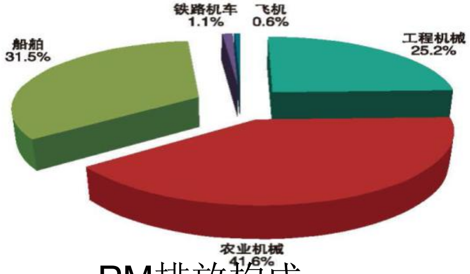
分类、分排放阶段农业机械

我国非道路柴油机污染问题-2

- 2018年，非道路移动源排放二氧化硫（SO2）59.5万吨，碳氢化合物（HC）76.2万吨，氮氧化物（NOx）562.1万吨，颗粒物（PM）44.5万吨；
- 非道路移动机械污染物排放主要贡献者为农业机械和工程机械，冒黑烟的问题突出；
- 船舶燃料（渣油、重油等）含硫量是车用油的100-3500倍，长三角、珠三角及沿海沿江地区船舶港口排放已成为大气污染的重要来源之一，但管控措施还较为薄弱。

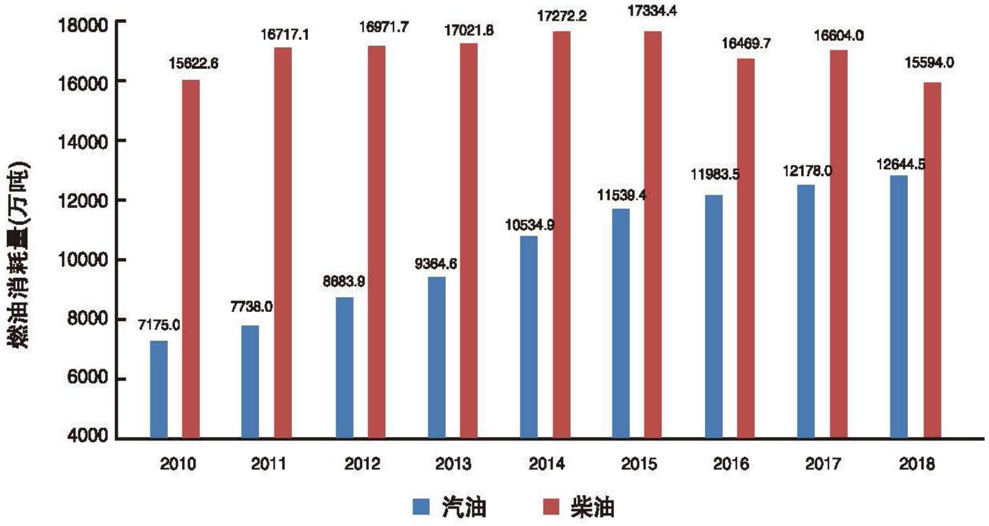


NOx排放构成

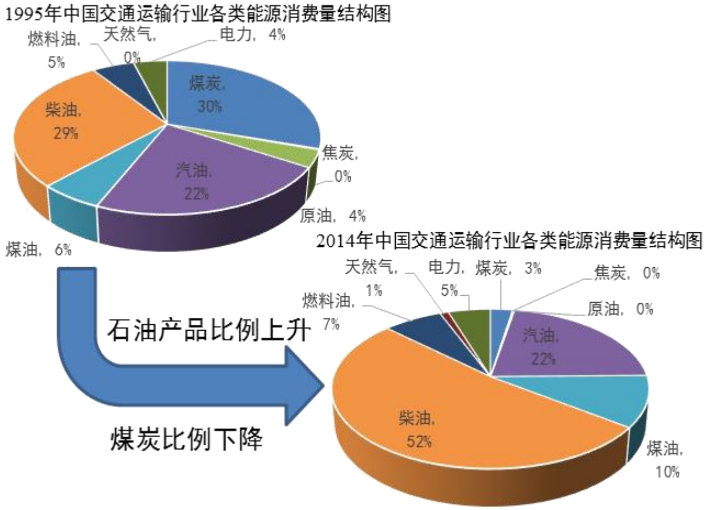


PM排放构成

燃油消耗历年变化情况



2010-2018成品汽柴油消费量



1995年和2014年交通运输行业能源利用变化

- 柴油消费量保持在1.5-1.6亿吨左右；柴油车、非道路移动机械用柴油机各占1/3、1/3。

柴油机/车污染防治法律、制度

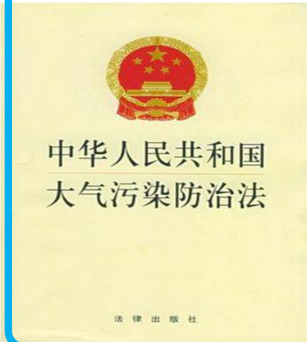
大气法-柴油机排放监管制度

达标排放

第51条

机动车船、非道路移动机械不得超过标准排放大气污染物。

禁止生产、进口或者销售大气污染物排放超过标准的机动车船、非道路移动机械。



信息公开

第52条

机动车、非道路移动机械生产企业应当对新生产的机动车和非道路移动 机械进行排放检验经检验合格的，方可出厂销售。检验信息应当向社会公开。

省级以上人民政府环境保护主管部门可以通过现场检查、抽样检测等方式，加强对新生产、销售机动车和非道路移动机械大气污染物排放状况的监督检查。 工业、质量监督、工商行政管理等有关部门予以配合。

监督检查

第56条

环境保护主管部门应当会同交通运输、住房城乡建设、农业行政、水行政等有关部门对非道路移动机械的大气污染物排放状况进行监督检查，排放不合格的，不得使用。

污染控制装置

第59条

在用重型柴油车、非道路移动机械未安装污染控制装置或污染控制装置不符合要求，不能达标排放的，应当加装或更换符合要求的污染控制装置。

划定限排区

第61条

城市人民政府可以根据大气环境质量状况，划定并公布禁止使用高排放非道路移动机械的区域。

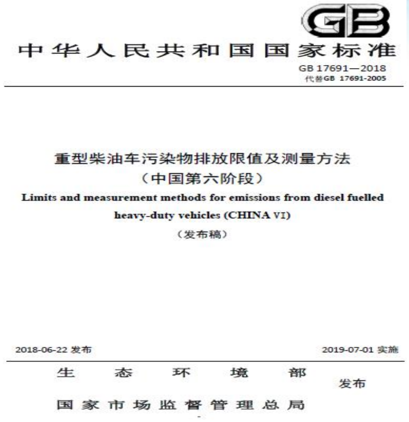
处罚

第109条

违反本法规定，生产超过污染物排放标准的机动车、非道路移动机械的，由省级以上人民政府环境保护主管部门责令改正，没收违法所得，并处货值金额一倍以上三倍以下的罚款，没收销毁无法达到污染物排放标准的机动车、非道路移动机械；拒不改正的，责令停产整治，并由国务院机动车生产主管部门责令停止生产该车型。

新生产柴油车环保达标监管

信息公开证书-车



国六标准

信息公开公告

信息公开证书-机械

- ➢ **严格实施排放标准**
- ➢ **强化机动车环保信息公开**
- ➢ **严厉打击生产销售不达标机动车行为**

信息公开：2018年，74家发动机企业：582个机型；958机动车企业：21321个车型；
随车清单：866家企业，30258077张

排放信息公开制度

中华人民共和国环境保护部
Ministry of Environmental Protection of the People's Republic of China

索 引 号：	000014672/2016-00783	分类：	环境管理业务信息\大气环境管理
发布机关：	环境保护部	生成日期：	2016年08月25日
名　　称：	关于开展机动车和非道路移动机械环保信息公开工作的公告		
文　　号：	国环规大气[2016]3号	主 题 词：	

关于开展机动车和非道路移动机械环保信息公开工作的公告

国环规大气[2016]3号

为贯彻落实《大气污染防治法》，加快推进机动车和非道路移动机械环境管理的系统化、科学化、法治化、精细化和信息化，根据国务院关于简政放权、放管结合、优化服务、便民惠民的决策部署要求，我部决定依法开展新生产机动车和非道路移动机械环保信息公开工作。现将有关要求公告如下：

一、信息公开主体

按照《大气污染防治法》规定，机动车和非道路移动机械生产、进口企业，应当向社会公开其生产、进口机动车和非道路移动机械的环保信息，包括排放检验信息和污染控制技术信息，并对信息公开的真实性、准确性、及时性、完整性负责。

二、信息公开内容

（一）机动车和非道路移动机械生产、进口企业基本信息；

（二）机动车和非道路移动机械污染控制技术信息，具体内容详见附件1；

（三）机动车和非道路移动机械排放检验信息：型式检验、生产一致性检验、在用符合性检验和出厂检验信息，包括

信息公开公告

-国环规大气【2016】3号

信息公开查询

环保信息公开平台

http://www.vecc-mep.org.cn

非道路移动机械（柴油）环保信息

第一部分 机械信息

第二部分 发动机信息

第三部分 检验信息

第四部分 污染控制技术信息

第五部分 制造商/进口企业信息

随车清单

在用符合性检查

- 2000年建立了企业负责、政府监管的汽车环保生产一致性保障制度。企业必须制定汽车环保生产一致性计划，定期报送计划执行情况，声明企业对汽车环保一致性承诺的兑现情况；
- 强化汽车环保一致性监管，生态环境部联合工信、公安、工商、质检等部分建立了机动车环保达标联合监管工作机制，在生产、销售、注册登记、使用等环节强化汽车环保生产一致性监管、处罚、召回等制度；
- 2018年1月，生态环境部对山东凯马汽车制造有限公司、山东唐骏欧铃汽车制造有限公司生产排放超标机动车和污染控制装置弄虚作假行为进行了3800万元处罚；
- 2018年6月，山东省环保厅对德州德工机械有限公司因生产、销售不达标非道路移动机械，机动车进口销售企业青岛奥维俊杉贸易有限公司因未按规定进行环保信息公开，两公司分别被罚款157万元、10万元；

在用车环保检验制度

- 多地已制定实施地方机动车环保法规，多个省市成立了机动车环境管理中心；
- 截止2018年底，全国大陆31个省（自治区、直辖市）均已开展机动车环保定期检验工作，检验机构6678家，参加环保定期检验的汽车约1.76亿辆，占保有量的75%以上；
- 北京等城市划定了低排放区域，对高排放车辆和非道路移动机械实施区域限行；
- 在用柴油车检测方法与限值标准更新；

在用车环保检测线

停放地环保抽测

遥感检测

低排区划定

柴油货车污染治理攻坚行动计划

计划由来

十九大	党的十九大提出着力解决突出环境问题。	2017年10月
中央经济会议	今后3年要重点抓好决胜全面建成小康社会的防范化解重大风险、精准脱贫、污染防治三大攻坚战。	2017年12月
两会	推进污染防治取得更大成效。巩固蓝天保卫战成果。**开展柴油货车超标排放专项治理。**	2018年3月
中央财经1次会议	打好决胜全面建成小康社会三大攻坚战。打好污染防治攻坚战，要打几场标志性的重大战役，打好柴油货车污染治理攻坚战。	2018年4月
环保大会	要把解决突出生态环境问题作为民生优先领域。打好污染防治攻坚战时间紧、任务重、难度大，是一场大仗、硬仗、苦仗，必须加强党的领导。	2018年5月

- 坚持全民共治、源头防治，持续实施大气污染防治行动，打赢蓝天保卫战。
- 打好污染防治攻坚战，要使主要污染物排放总量大幅减少，生态环境质量总体改善，重点是打赢蓝天保卫战，调整产业结构，淘汰落后产能，调整能源结构，加大节能力度和考核，调整运输结构。
- 坚持源头防治，调整“四个结构”，做到“四减四增”。要调整运输结构，减少公路运输量，增加铁路运输量。
- 基本消除重污染天气，还老百姓蓝天白云、繁星闪烁。
- 要抓住重点区域重点领域，突出加强工业、燃煤、机动车“三大污染源”治理，坚决打赢蓝天保卫战。

打赢蓝天保卫战；
打好柴油货车污染防治攻坚战；

指导思想

以习近平新时代中国特色社会主义思想为指引，全面贯彻落实党的十九大精神，坚持**统筹“油、路、车”**治理，以京津冀及周边地区、长三角地区、汾渭平原等重点区域为主战场，以车用柴油和尿素质量达标保障为主攻方向，以货物运输结构调整为导向，以高污染高排放柴油货车为重点，建立健全最严格的机动车全防全控环境监管制度，大力实施清洁柴油车、清洁柴油机、清洁运输、清洁油品行动，全链条治理柴油车超标排放，明显降低污染物排放总量，促进城市和区域空气质量明显改善。

柴油货车污染治理攻坚战行动计划

主要任务

柴油货车污染治理攻坚战

1 清洁柴油车行动

加强新生产柴油货车环保达标监管（一）
加大在用车监督执法力度（二）
强化在用车排放检验和维修治理（三）
加快老旧车辆淘汰和深度治理（四）
推进监控体系建设和应用（五）
推动相关行业集约化发展（六）

2 清洁柴油机行动

（一）严格实施排放标准
（二）加强排放控制区划定和管控
（三）加快治理和淘汰更新
（四）强化监督管理
（五）推动靠港船舶使用岸电

3 清洁运输行动

提升铁路货运量（一）
推广高效货运组织方式（二）
促进运输企业集约化发展（三）
优化运输车队结构（四）

4 清洁油品行动

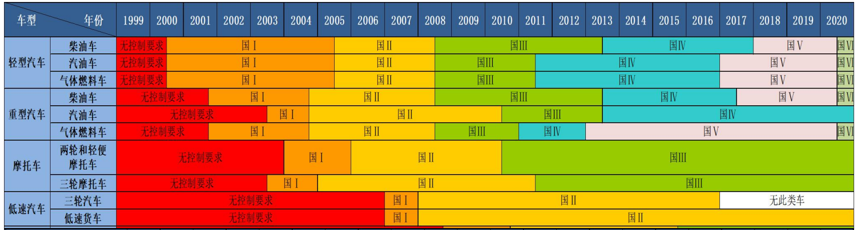
（一）加快提升油气质量标准
（二）健全燃油及清净增效剂车用尿素管理制度
（三）推进油气回收治理
（四）强化生产销售和使用环节监管

工作进展

移动源排放标准升级

- 自2000年我国实施国一标准以来，轻型车、重型车全面实施国五排放标准，新车单车排放量下降了90%以上；
- 轻型车国六、重型车国六排放标准已发布并将逐步实施，移动源排放技术控制水平逐步向发达国家靠近；轻重型柴油车限定了PN排放；
- 国四非道路移动源排放标准（修订版）也将发布，PN的限值要求和OBD远程传输功能也将纳入其中；

新车排放标准



新非道路移动机械排放标准

		基准质量(RM)/(kg)	限值							
			CO/(mg/km)	CO_2/(g/km)	THC/(mg/km)	NMHC/(mg/km)	NOx/(mg/km)	N_2O/(mg/km)	PM/(mg/km)	PN/(#/km)
第一类车	-	全部	500	tbd	100	68	60	tbd	4.5	6.0×10^{11}
第二类车	I	RM≤1305	500	tbd	100	68	60	tbd	4.5	6.0×10^{11}
	II	1305<RM≤1760	630	tbd	130	90	75	tbd	4.5	6.0×10^{11}
	III	1760<RM	740	tbd	160	108	82	tbd	4.5	6.0×10^{11}

轻型车国六排放标准限值

试验	CO (mg/kWh)	THC (mg/kWh)	NMHC (mg/kWh)	CH_4 (mg/kWh)	NO_X (mg/kWh)	NH_3 (ppm)	PM (mg/kWh)	PN (#/kWh)
WHSC 工况 (CI[(1)])	1500	130	—	—	400	10	10	8.0×10^{11}
WHTC 工况 (CI[(1)])	4000	160	—	—	460	10	10	6.0×10^{11}
WHTC 工况 (PI[(2)])	4000	—	160	500	460	10	10	6.0×10^{11}

[(1)]CI=压燃式发动机
[(2)]PI=点燃式发动机

重型车国六排放标准限值

加大在用车监督执法力度

➢ “天地车人”一体化监控体系

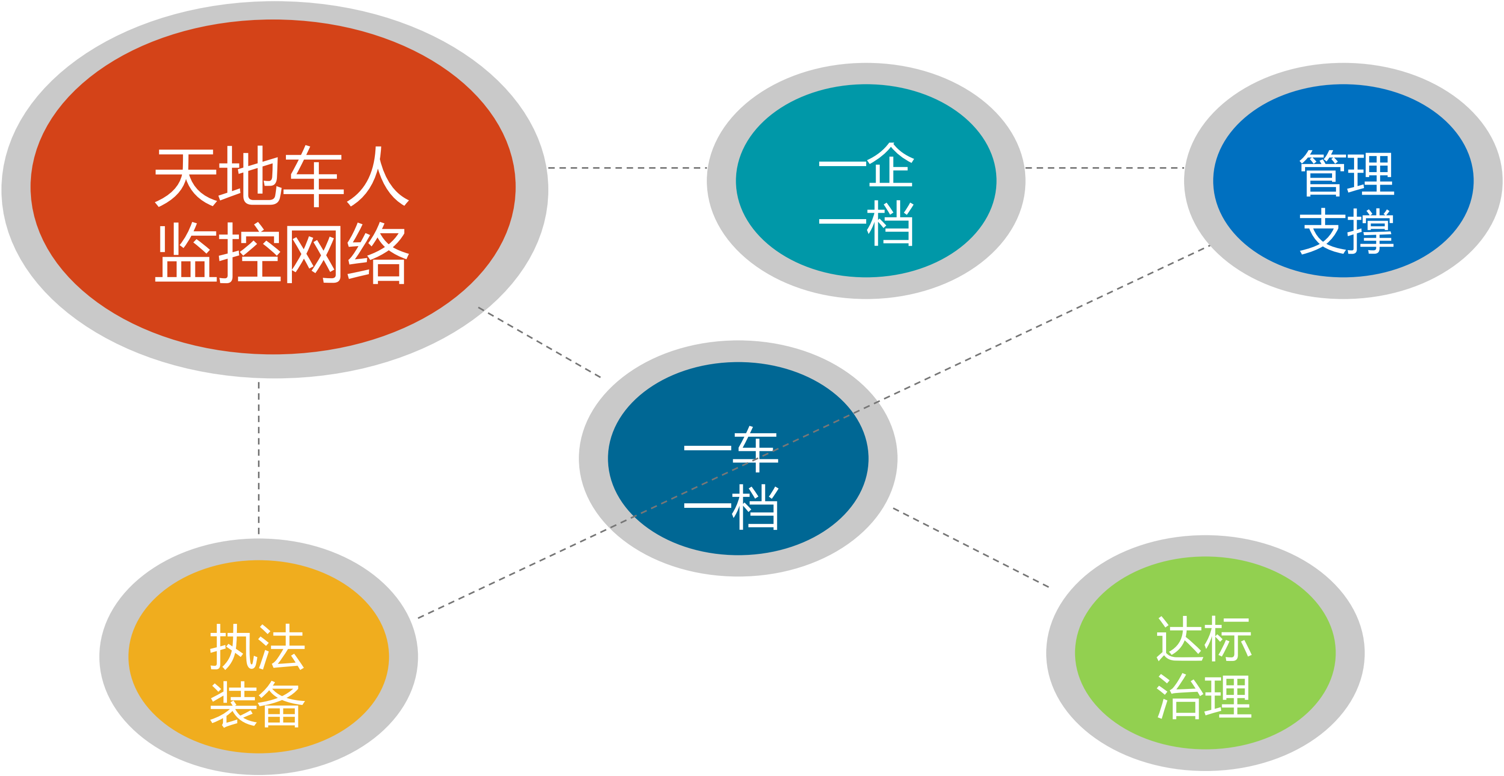
天
道路遥感
黑烟抓拍
企业视频
路边微站

地
机动车环保定期检验
检验机构三级联网

车
单车实施排放监测
卫星精准定位
加油位置监控

人
路检路查
停放地监督抽测

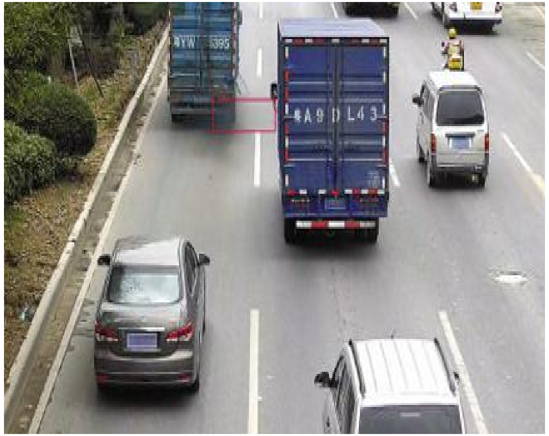
监控思路



道路沿线车辆监管

- 在主要物料输送地、交通道路沿线等地安装车流量视频监控和黑烟抓拍、遥感系统；

遥感系统



遥测与抓拍

HJ

中华人民共和国国家环境保护标准

HJ 845—2017

在用柴油车排气污染物测量方法
及技术要求
（遥感检测法）

Measurement method and specifications for exhaust pollutants from in-use diesel vehicles by remote sensing method

本电子版为发布稿。请以中国环境科学出版社出版的正式标准文本为准。

2017-07-27 发布　　2017-07-27 实施

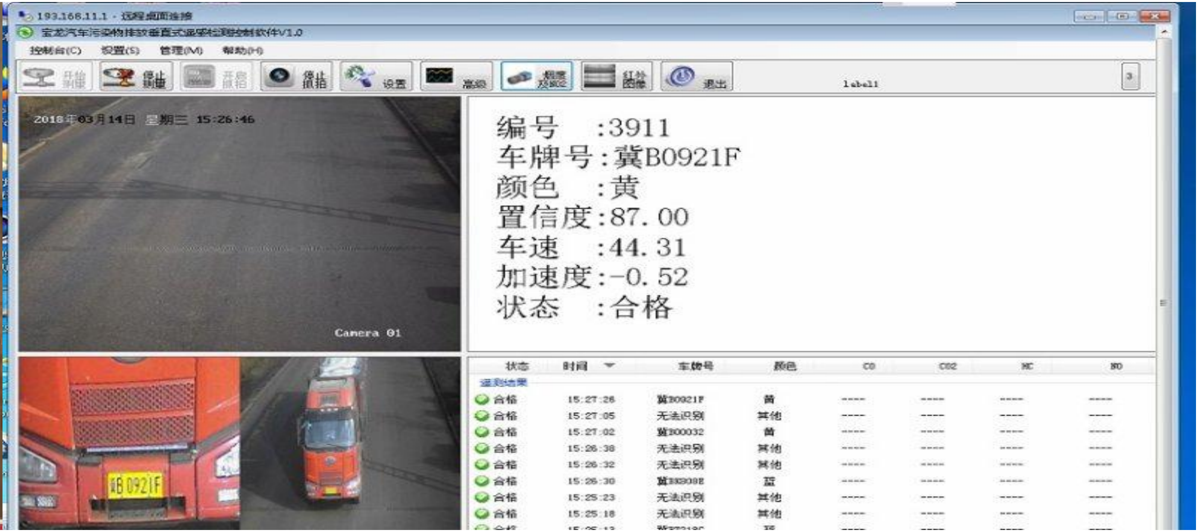
环　境　保　护　部　发布

HJ845-2017（在用柴油车遥感槛车方法及技术要求）

工业企业运输监控

- 对工业企业重型柴油车的运行情况利用高清摄像机进行监控；

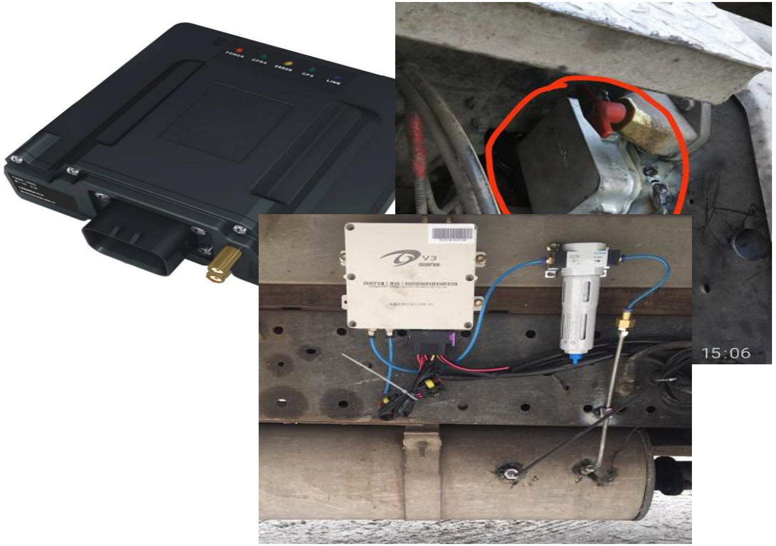
厂门入口



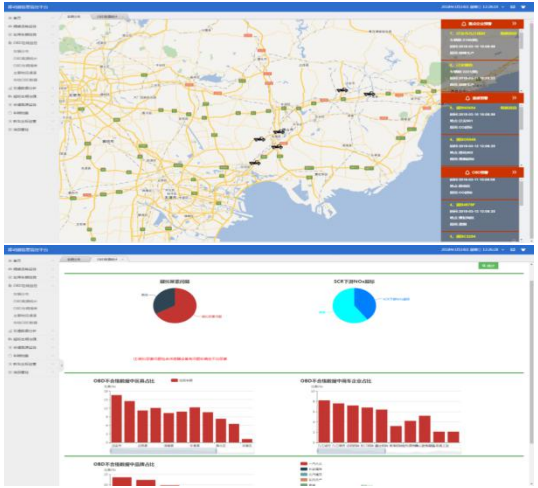
监控系统

车辆远程监控

➤ 构建重型柴油车车载诊断系统远程监控系统，利用OBD车载终端技术了解车辆尾气控制系统是否正常工作（NOx浓度、尿素液位变化等），实现重点车辆实时监控；



OBD系统



远程监控

附件2

HJ

中华人民共和国国家环境保护标准

HJ □□□□.1—20□□

重型车远程排放监控技术规范

第 1 部分：总则

Technical specifications of remote emission supervision system for heavy-duty vehicles

PART1：General principle

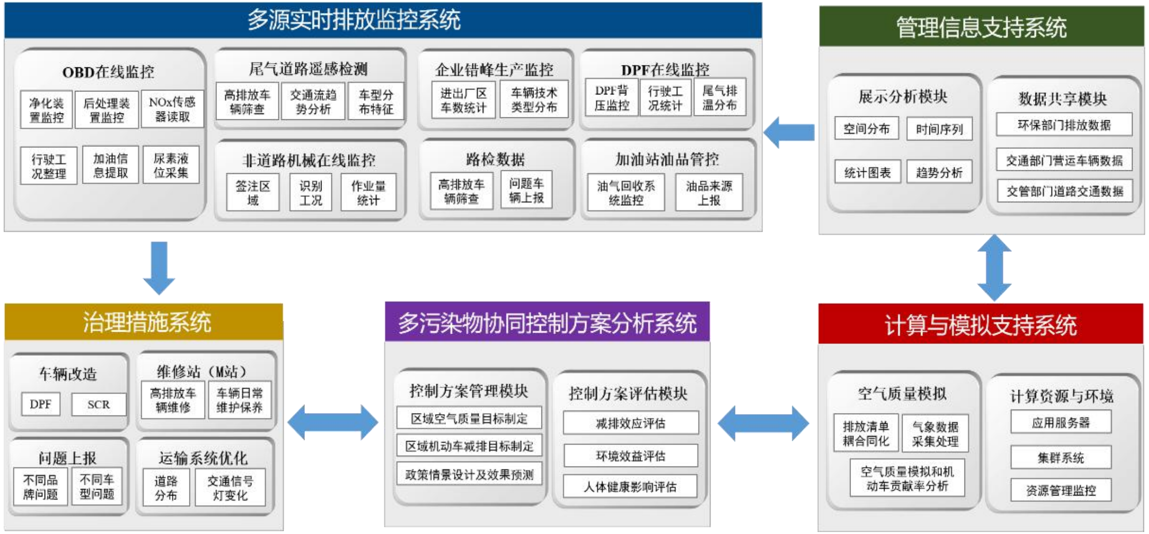
（征求意见稿）

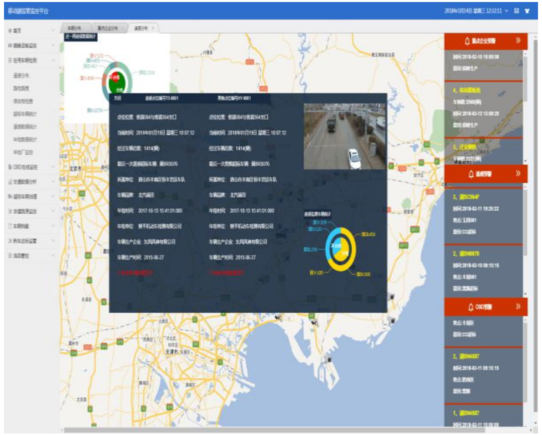
20□□-□□-□□发布　　20□□-□□-□□实施

生 态 环 境 部　发布

技术规范（征求意见稿）

监控平台-大数据用于管理决策



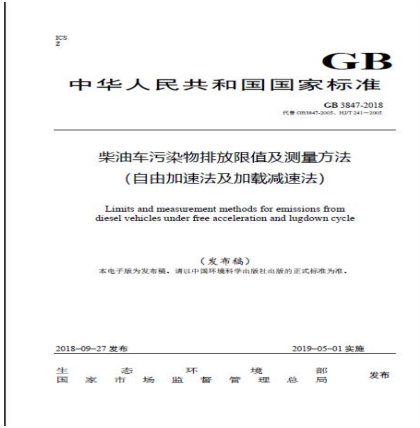


区域、部门联合管控

“监管-治理-评估” 闭环政策控制系统

- 多源实时排放监控系统、治理措施系统、多污染物协同控制方案分析系统、计算与模拟支持系统和管理信息支持系统；
- 结合排放清单、排放测试和微站观测等的综合分析决策平台；
- 研究制定不同的管控措施，支撑大气污染防治的科学决策和精准施策；

强化在用车排放检验和维修治理



ICS
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GB

中华人民共和国国家标准

GB 3847-2018

柴油车污染物排放限值及测量方法
（自由加速法及加载减速法）

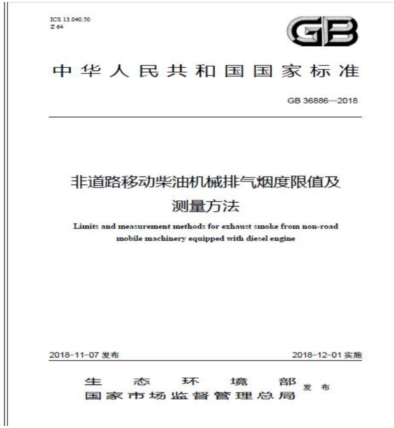
Limits and measurement methods for emissions from diesel vehicles under free acceleration and lugdown cycle

（发布稿）

2018-09-27 发布 2019-05-01 实施

生态环境部
国家市场监督管理总局 发布

GB3847-2018



GB

中华人民共和国国家标准

GB 36886—2018

非道路移动柴油机械排气烟度限值及测量方法

Limits and measurement methods for exhaust smoke from non-road mobile machinery equipped with diesel engine

2018-11-07 发布 2018-12-01 实施

生态环境部
国家市场监督管理总局 发布

GB36886-2018

- **加强排放检验机构监督管理；**
- **建立完善排放检验与维护制度（I/M制度）；**
- **加大维修单位监督管理力度；**

- 生态环境部联合国家认监委对机动车环保检测检测机构开展双随机检查；
- 生态环境部印发在用柴油车、非道路移动柴油机械烟度限值和测量方法；
- 《生态环境部 交通运输部 市场监管总局关于建立实施汽车排放检验与维护制度的通知》（环大气〔2020〕31号）

加快老旧车辆淘汰和深度治理

推进老旧货车淘汰报废

- 重点区域采取经济补偿、限制使用、严格超标排放监管等方式，大力推进国三及以下排放标准营运柴油货车提前淘汰更新，加快淘汰采用稀薄燃烧技术和“油改气”的老旧燃气车辆；
- 各地制定营运柴油货车和燃气车辆提前淘汰更新目标及实施计划。2020年底前，京津冀及周边地区、汾渭平原淘汰国三及以下排放标准营运中型和重型柴油货车100万辆以上；
- 修订《报废汽车回收管理办法》；

柴油车深度治理

➢ 推动高排放车辆深度治理

加装后处理装置

针对颗粒物超标的机动车和非道路移动机械加装颗粒后处理装置。

调整车辆电子控制策略

针对氮氧化物超标的带有电子控制系统的机动车，与车辆生产企业合作调整电子控

按照政府引导、企业负责、全程监控模式，推进高排放老旧柴油车深度治理。对于超标排放且具备条件的柴油车，应依法加装或更换符合要求的污染控制装置，协同控制颗粒物和氮氧化物排放；政府支持的车辆，应安装远程排放监控设备和北斗导航定位系统，并与生态环境部门联网，实时监控油箱和尿素箱液位变化，以及氮氧化物、颗粒物排放情况，确保治理效果。

加强排放控制区划定和管控

- 各城市人民政府依法划定并公布禁止使用高排放非道路移动机械的区域；
- 加强环渤海（京津冀）、长三角、珠三角水域船舶排放控制区管理，调整扩大船舶排放控制区范围；
- 研究探索在船舶排放控制区同步管控船舶硫氧化物、氮氧化物和颗粒物排放；

2018年11月，交通运输部《船舶大气污染物排放控制区实施方案》：明确了控制范围、燃油硫含量、PM和NOx排放控制要求，使用岸电等；

船舶大气污染物排放控制区实施方案

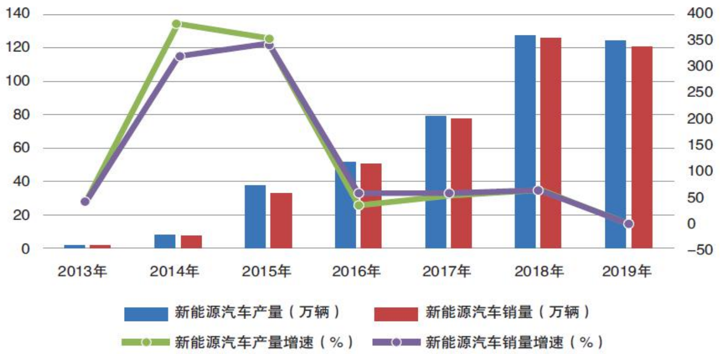
强化非道路移动源排放监管

- 非道路移动机械登记和标记管理制度；
- 新生产、销售的工程机械安装北斗定位系统和实时排放监控装置；
- 进入重点区域城市划定的禁止使用高排放非道路移动机械区域内作业的工程机械，推进工程机械安装实时定位和排放监控装置，建设排放监控平台；
- 对使用排放超标机械的施工单位或工地业主由主管部门处罚制度；
- 强化船舶排放控制区内船用燃料油使用监管；

非道路移动机械治理和淘汰更新

- 加快推进老旧工程机械、农业机械治理。
- 推动促进老旧农业机械、老旧工程机械淘汰报废。
- 加快新能源非道路移动机械的推广使用。
- 加快淘汰港作老旧燃油机械，促进采用新能源或清洁能源。
- 推动内河和江海直达船舶治理，限制高排放船舶使用。
- 推进内河船型标准化，鼓励淘汰使用20年以上的内河航运船舶，依法强制报废超过使用年限的船舶。
- 推广使用纯电动船舶和天然气船舶。

优化车队结构



- 加快推进城市建成区新增和更新的公交、环卫、邮政、出租、通勤、轻型物流配送车辆使用新能源或清洁能源汽车，重点区域使用比例达到80%；
- 重点区域港口、机场、铁路货场等新增或更换作业车辆主要使用新能源或清洁能源汽车；
- 在物流园、产业园、工业园、大型商业购物中心、农贸批发市场等物流集散地建设集中式充电桩和快速充电桩。为承担物流配送的新能源车辆在城市通行提供便利。
- 2019 年，全国新能源汽车产销量分别为124.2 万辆和120.6 万辆，其中，纯电动汽车产销量分别为102.0 万辆和97.2 万辆；插电式混合动力汽车产销量分别为22.0 万辆和23.2 万辆；燃料电池汽车产销量分别为2833 辆和2737 辆。

推广高效货运组织方式

- 推进港口集装箱联运；
- 提高沿海港口集装箱铁路集疏港比例；
- 加快发展多式联运；
- 推进多式联运型和干支衔接型货运枢纽（物流园区）建设；
- 提高铁路运货量；
- 试点开展高铁快运、地铁货运等；
- 优化城市货运和快递配送体系；

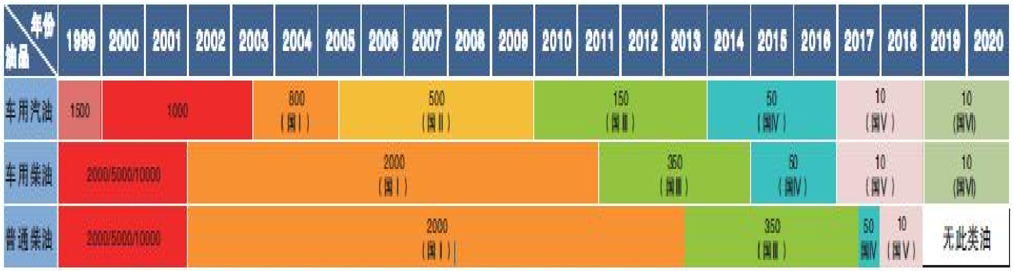
✓2018年9月，国务院办公厅印发《推进运输结构调整三年行动计划（2018-2020年）》；
✓2018年10月，交通运输部、生态环境部等印发《贯彻落实国务院办公厅<推进运输结构调整三年行动计划（2018-2020）>的通知》；
✓2018年7月铁路总公司《2018-2020年货运增量行动方案》；2019年1月，所属18家集团公司与1014家大型企业达成协议货意见：20亿吨，比去年增长30%；

✓ 2018年全国铁路完成货运40.3亿吨，同比增长9.1%；煤炭、矿石等大宗货物和集装箱运量增加12%以上；
✓ 曹妃甸港区：铁路列车8趟，运输铁矿石834.65万吨；

提升油气质量

- 全面供应符合国六标准的车用汽柴油；
- 实现“三油并轨”；
- 制定实施内河部分大型船舶用燃料油标准，
- 修订天然气质量标准；
- 加快制定更加严格的油品质量标准，降低烯烃、芳烃和多环芳烃含量；

- 2018年市场监管总局、国标伟：关于废止《普通柴油》强制性国家标准的公告；
- 2019年1月1日起，全国供应国六车用柴油，取消普通柴油，实现与部分船舶用油三油并轨；



全国车用燃料标准实施进度

下一步工作设想

工作建议

- 推进国六标准和非道路国四标准的实施；
- 深化事前信息公开、事中达标监管、事后环保召回的机动车环保监管体系；
- 利用科技手段提高在用车环保监测监督，落实I/M制度；
- 加强非道路移动机械管理；
- 建立健全船舶等的环保检验制度；

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