Global PM and OC emission inventory

Global emissions of PM and OC from 77 major sources were estimated for a period from 1960 to 2009. Regression models and a technology split method were used to estimate country and time specific emission factors, resulting in a new estimate of PM and OC emission factor variation among different countries and over time. PM and OC emissions in 2007 were spatially resolved to 0.1° × 0.1° grids based on a newly developed global high-resolution fuel combustion inventory (PKU-FUEL-2007). The global total annual emission of TSP, PM10, PM2.5, and OC in 2007 were 155.7 Tg (118.4-217.0 Tg as IQR), 97.2 Tg (78.2-127.9 Tg), 77.3 Tg (63.3-99.2 Tg) and 10.27 Tg (excluding Wildfire), respectively. South, East, and Southeast Asia were the regions with the highest PM and OC emission densities, contributing more than of 35% of the global total PM emissions and about 61% of global anthropogenic OC emission.

Global PM and OC Emission Inventory

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Where are emissions from?

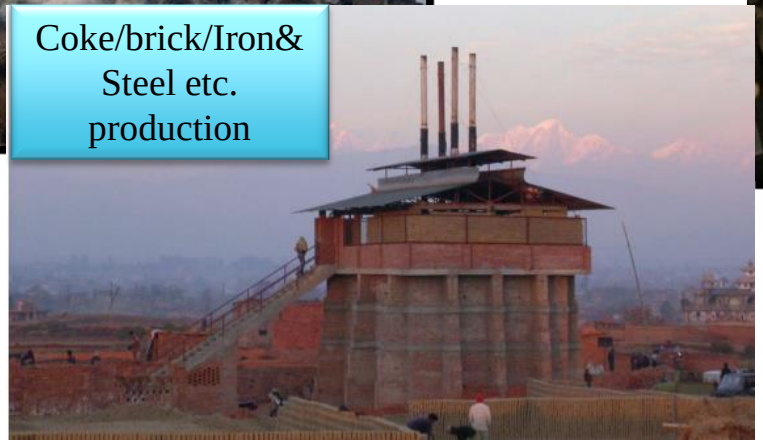
Power plant/industry boilers

Residential fossil fuel consumption

Waste burning

Indoor biomass burning

Coke/brick/Iron& Steel etc. production



How to estimate emission

- General Methodology

$$E_{i,y,z} = \sum_{j}\sum_{k} A_{i,j,k,z}\left[\sum_{m} X_{i,j,k,m,z} F_{j,k,m,y,z}\right]$$

i: represents the country or region

j: represents the economical sector

y: represents the pollutant

z: represents the year

A: represents the activity rate (Fuel consumption or material production)

m: represents the type of combustion or process technology

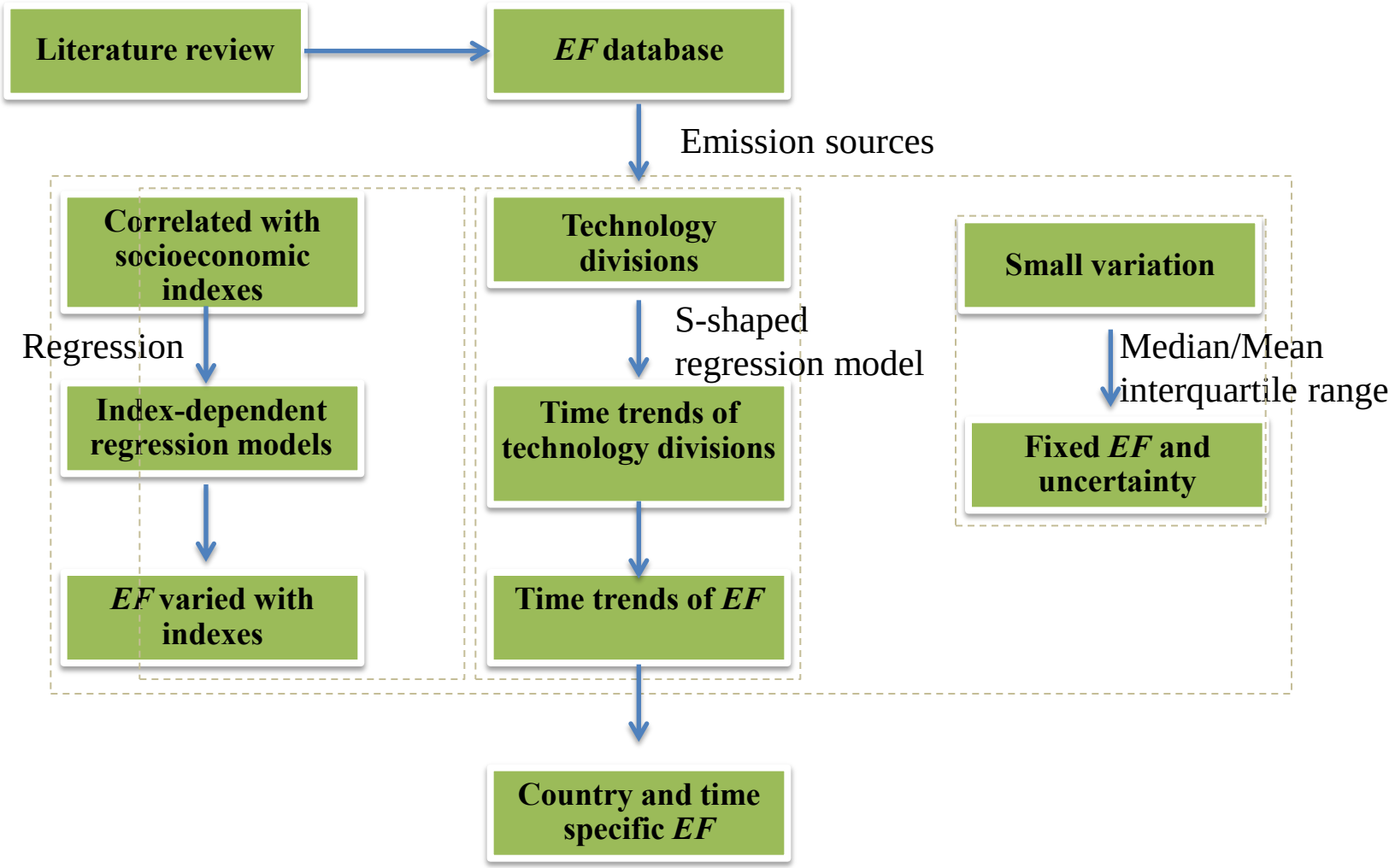
X: represents the fraction of fuel(material) consumed (produced) in a specific technology

F: represents the EF for a specific technology

How to estimate emission？
------Activity Rates

- Fuel Consumption
  - PKU-fuel for 2007
  - IEA, UNdata… …
- Material Production
  - Mineral product
  - Metal product
  - Chemical product

How to estimate emission？
------Emission Factor



How to estimate emission？
------Emission Factor

Regression Model: a example (Wang12)

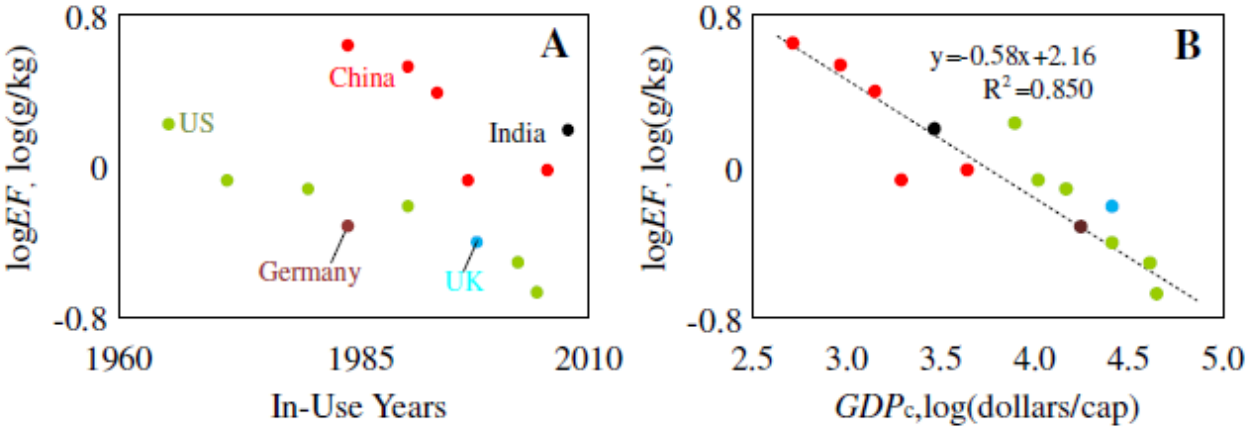
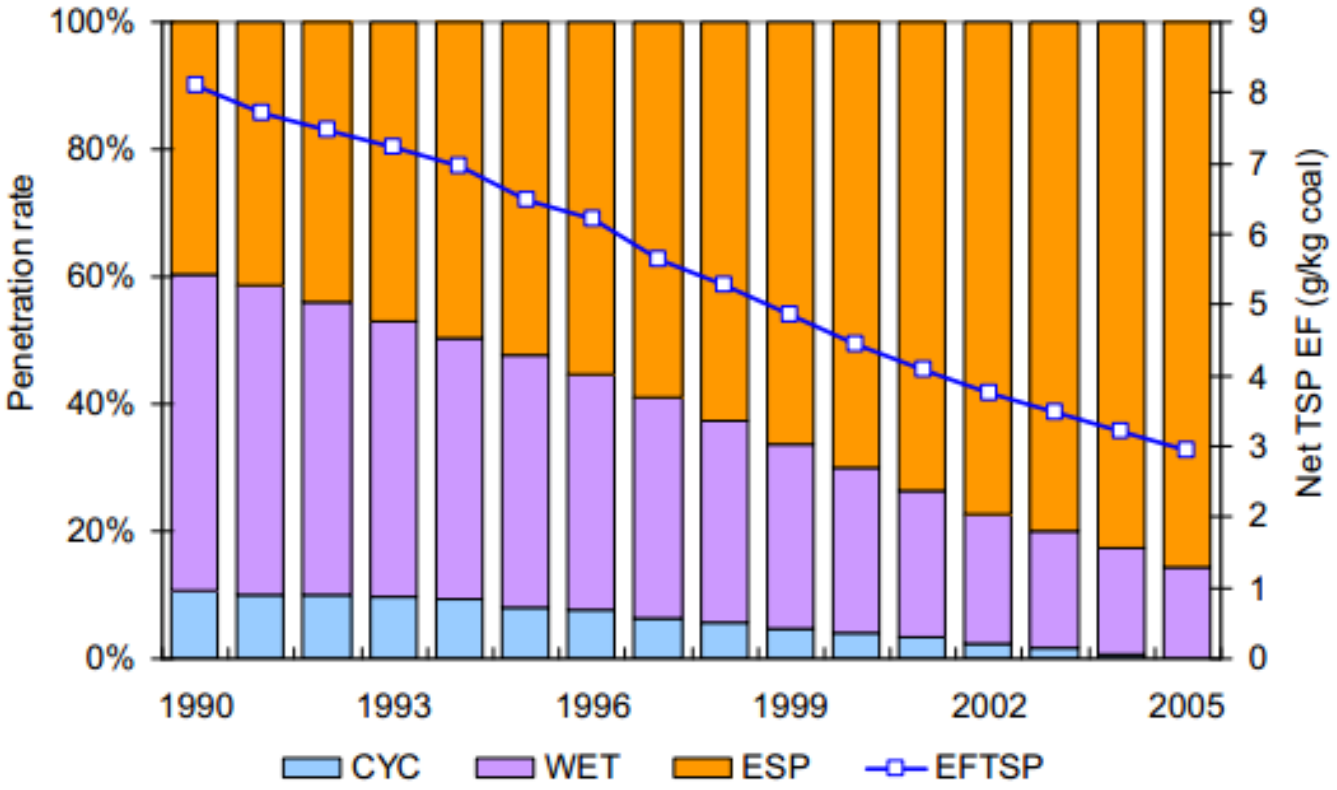


Fig. S2. Regression model of emission factors of fine particle (EF_{PM}) in recovery battery coking. **A**: Relationship between log-transformed EF_{PM} (log EF_{PM}) and in-use year for different countries. **B:** Regression model between logEF_{PM} and per-capita gross domestic product (*GDP*c) of the country where the EF_{PM} were reported. EF_{PM} were collected from the literature[8,9,59-63].

How to estimate emission？
------Emission Factor

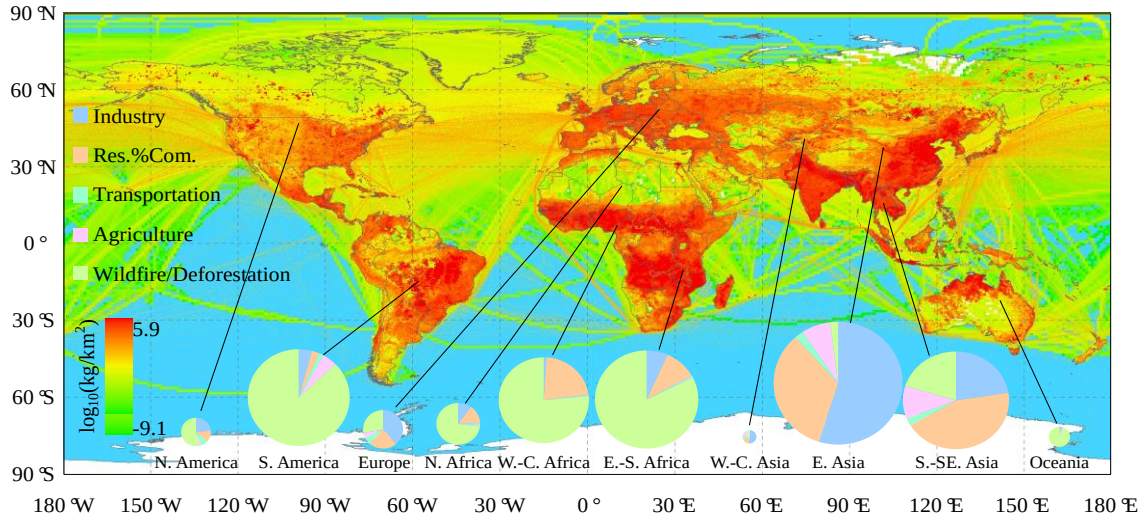
Technology Distribution: a example (Lei11)



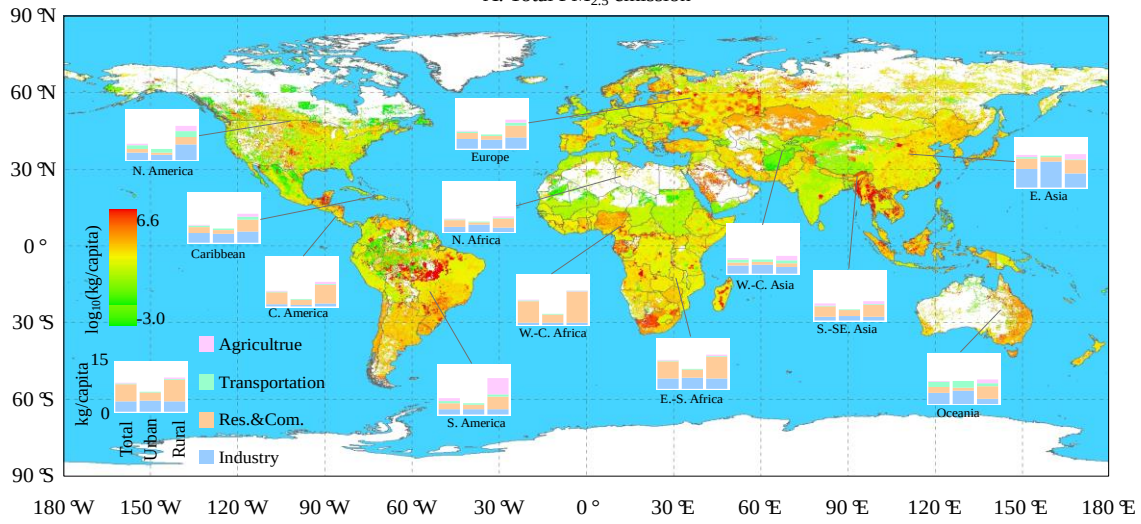
Result-1

- Global PM emission inventory
  - High resolution emission map in 2007
  - Historical emission from 1960-2009

Global $PM_{2.5}$ emission in 2007

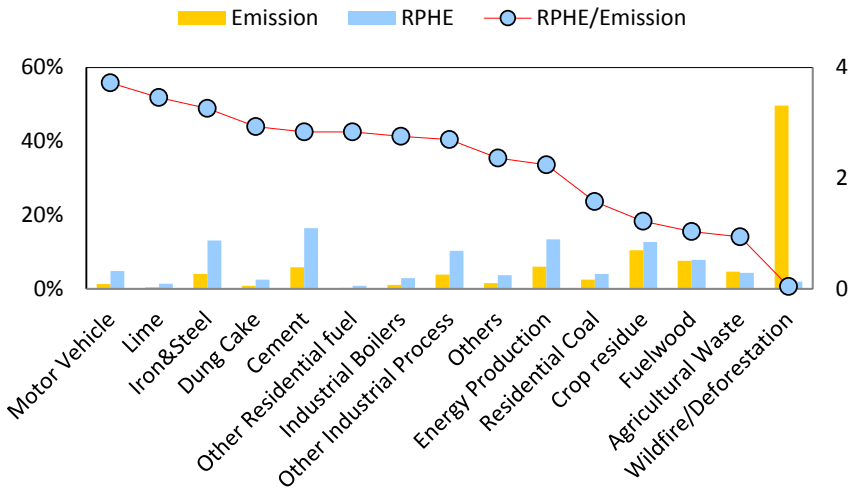


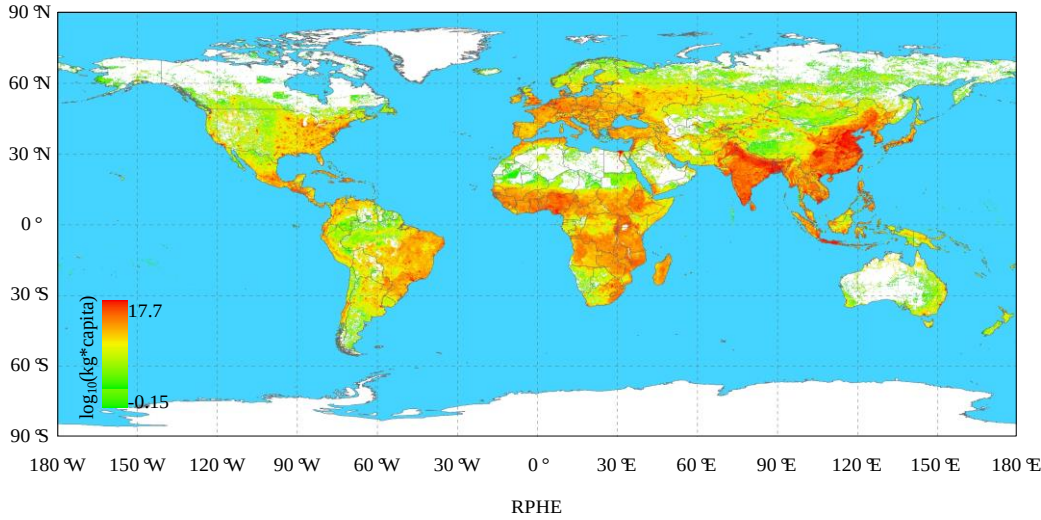
A. Total $PM_{2.5}$ emission



B. Per capita $PM_{2.5}$ emission

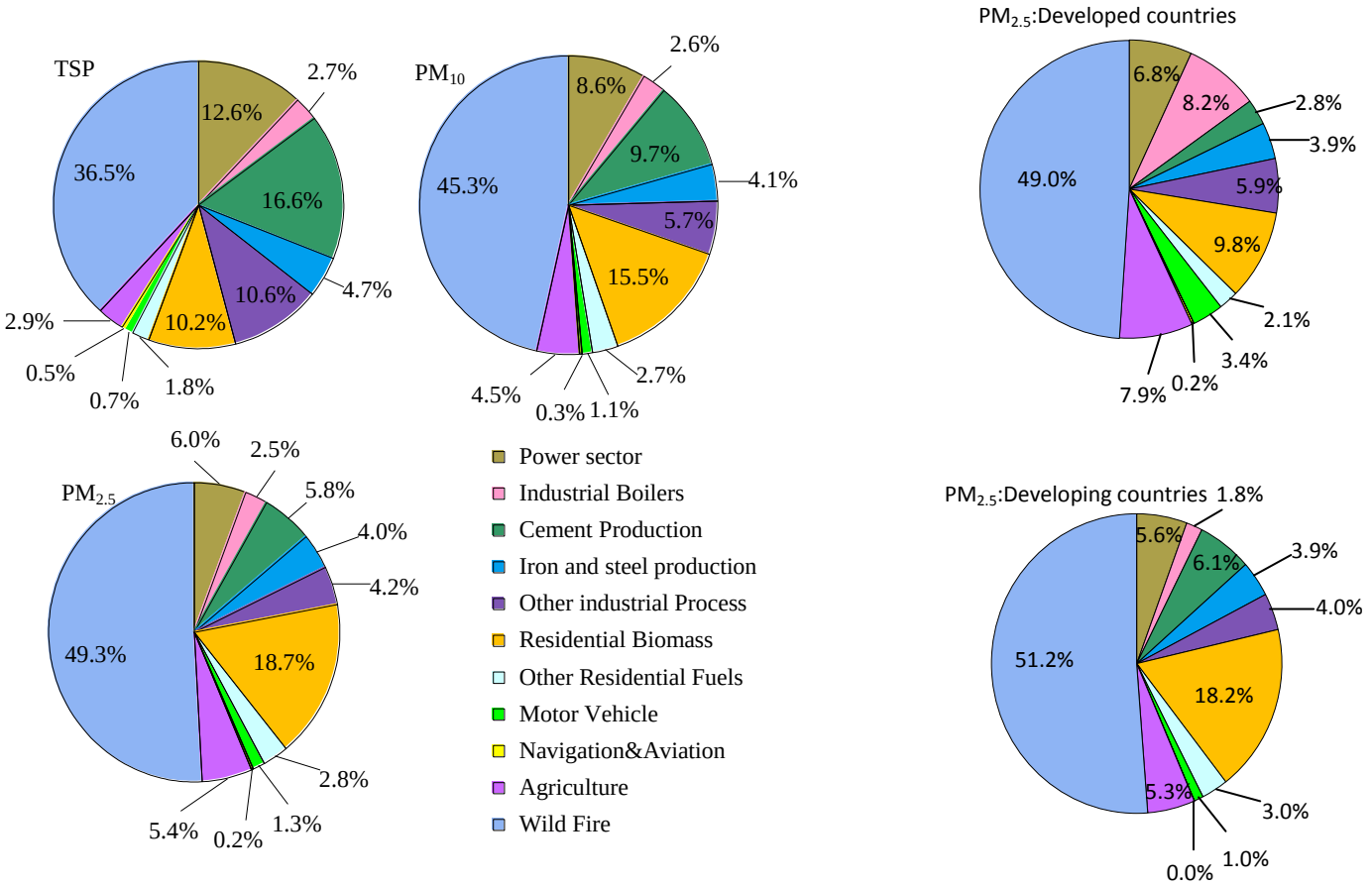
Relative Potential Health Effect（RPHE）



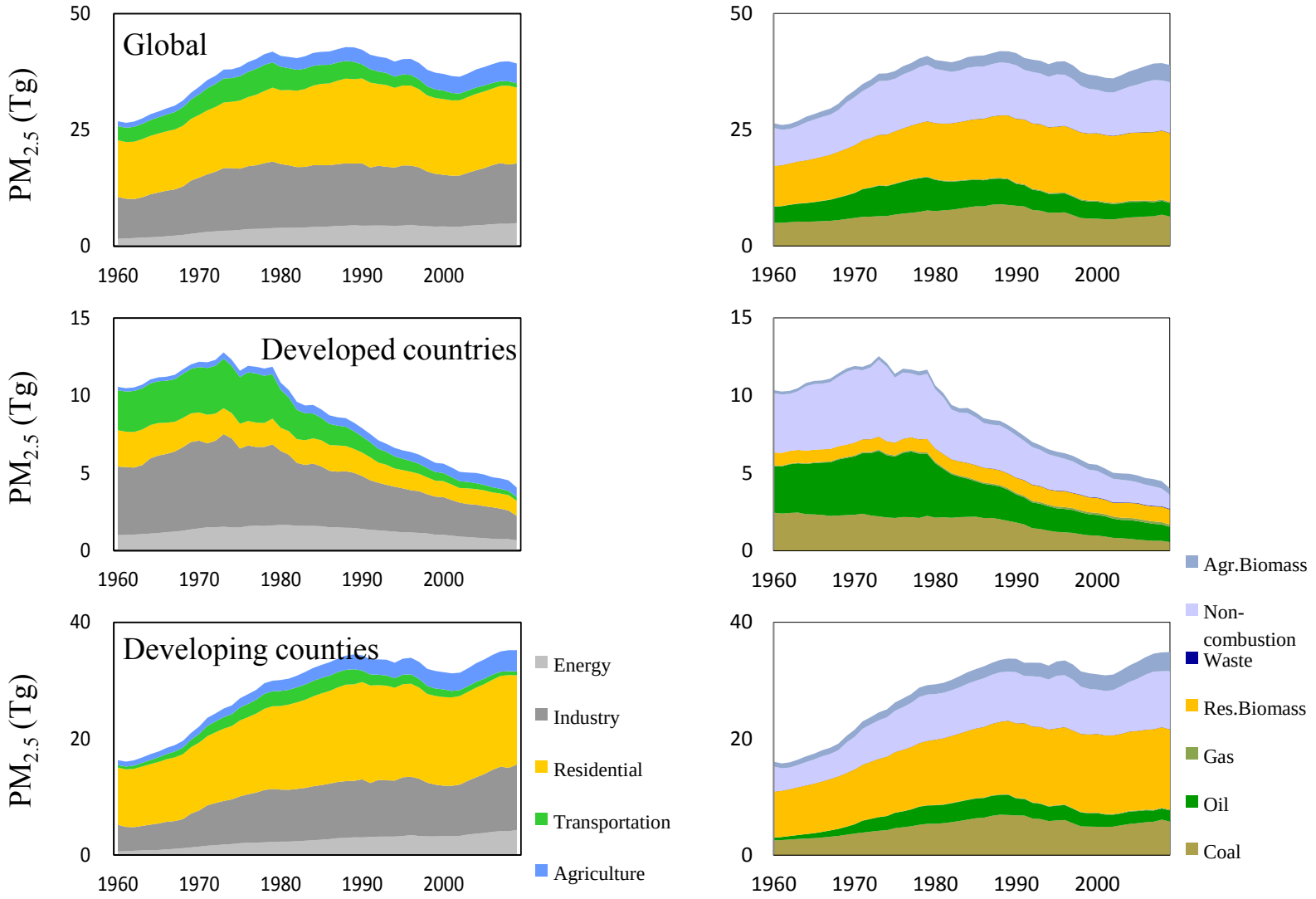


Assume that health effect of $PM_{2.5}$ emitted from a given grid (0.1° ×0.1°) was quantified as the effects on the emissions grid and the 24 surrounding grids. The effect on each receiving grid within this area was proportional to the total emissions of the source grid and total population of the receiving grid and inversely proportional to the distance (1 for the source grid itself, 1/4 for the 8 grids immediately adjacent to the source grid, and 1/9 for the other 16 grids) between the emissions and receiving grids.

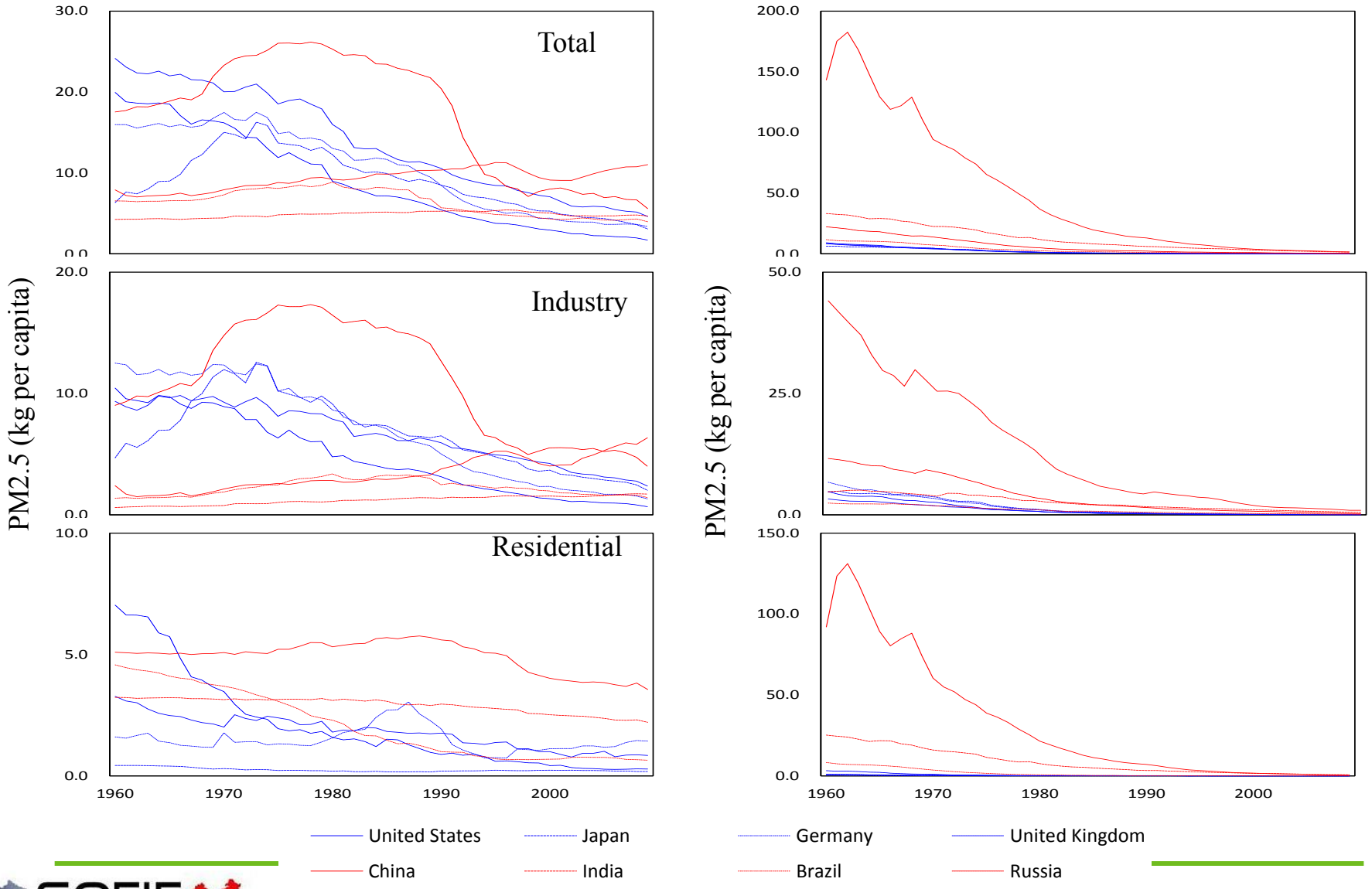
Source Profile of PM



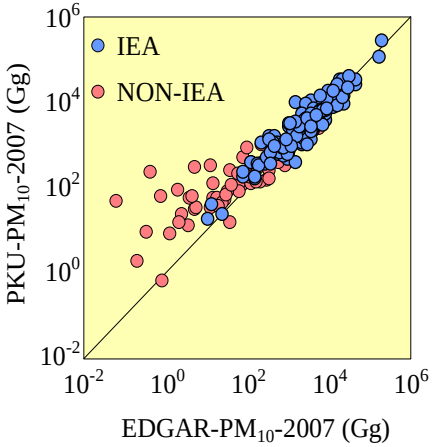
Historical Emission of Anthropogenic $PM_{2.5}$

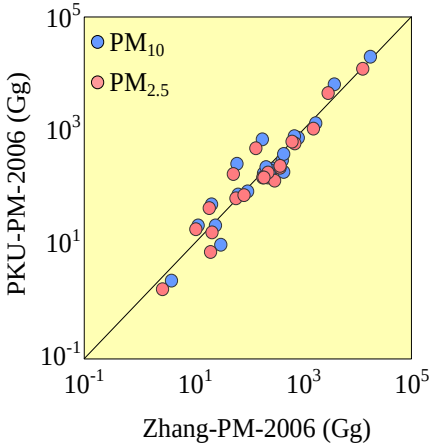


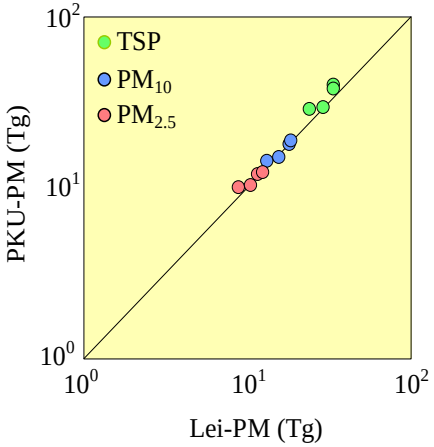
Time trends of per capita PM2.5 emissions and PM2.5 emission intensities

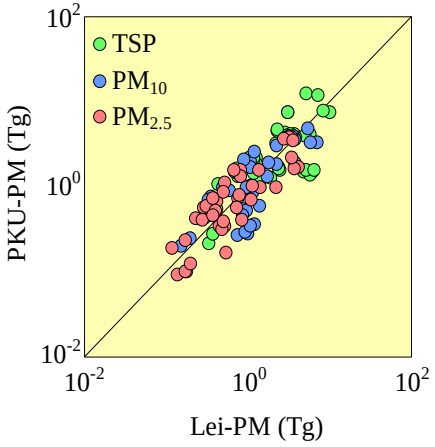


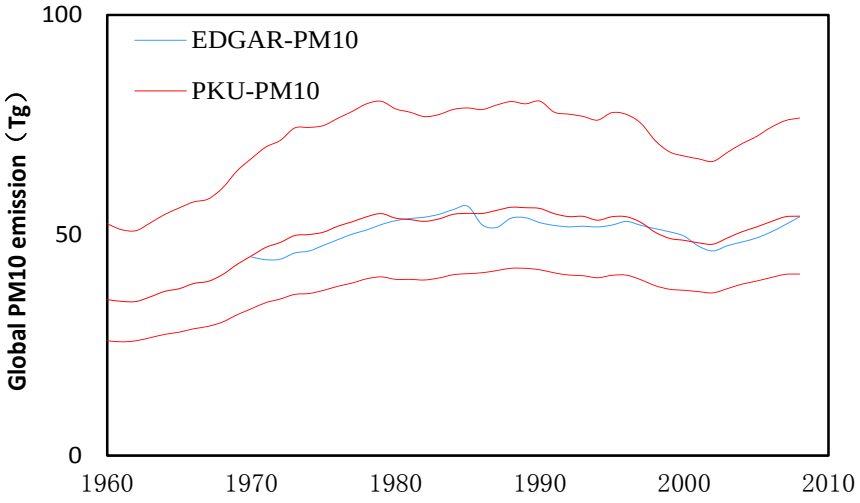
Compared with previous studies

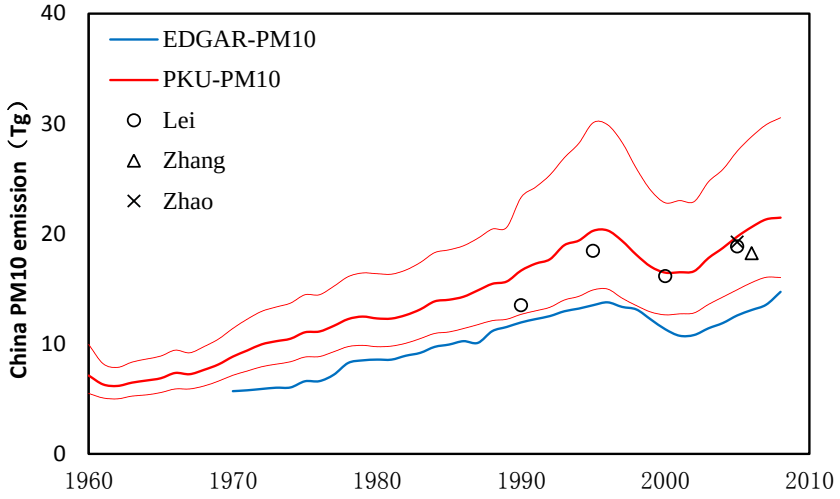








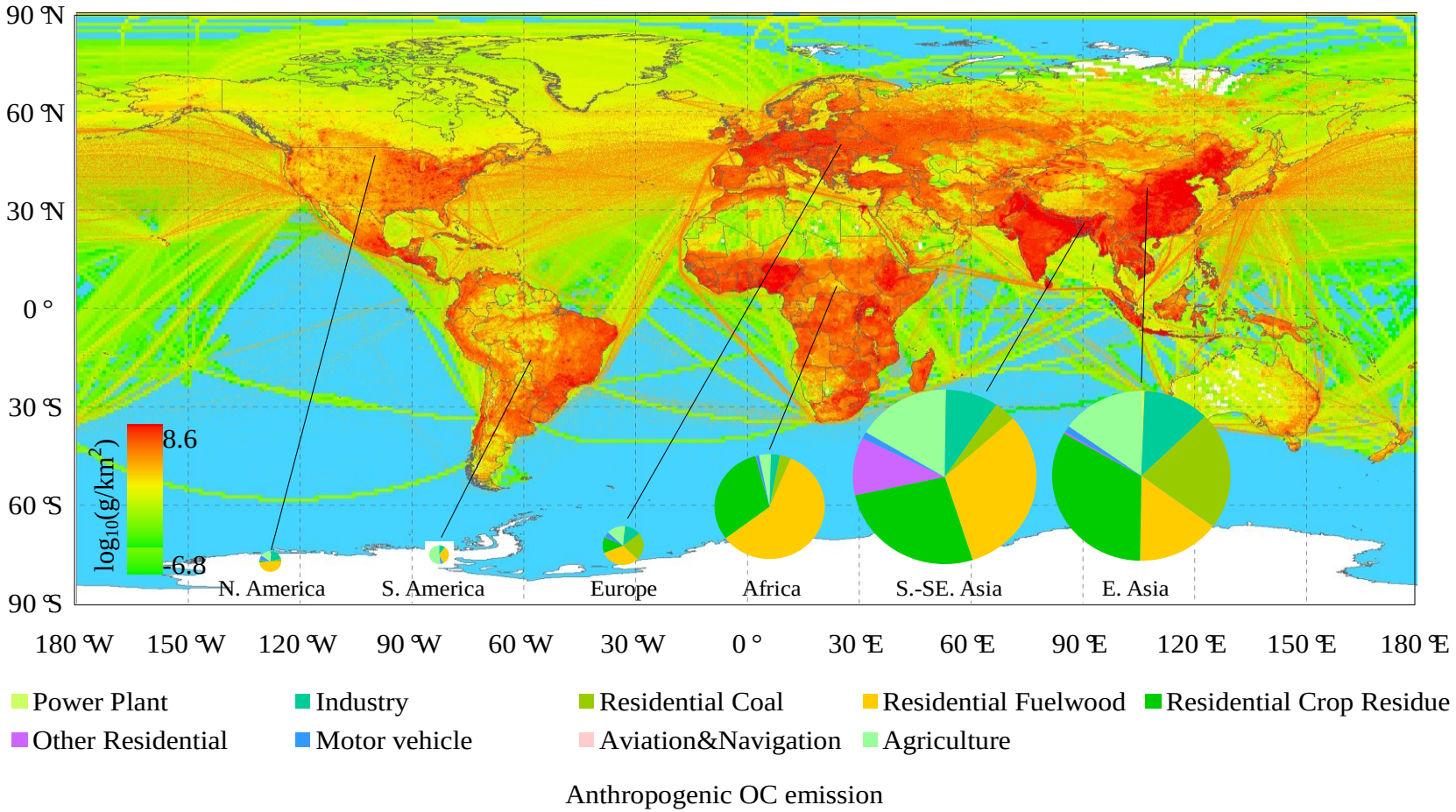




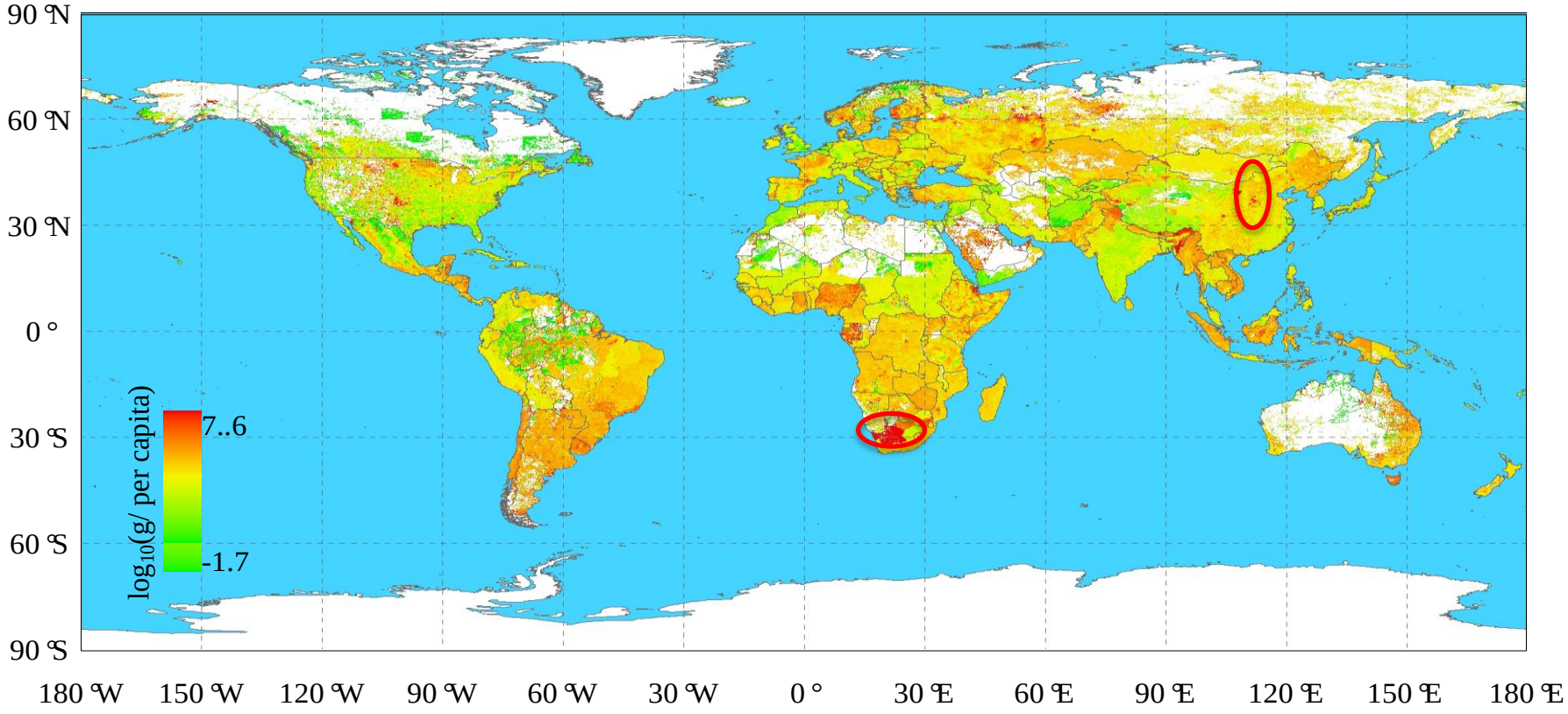
Result-2

- Global OC emission inventory
  - High resolution emission map in 2007
  - Historical emission from 1960-2009

Spatial distribution of anthropogenic OC emission

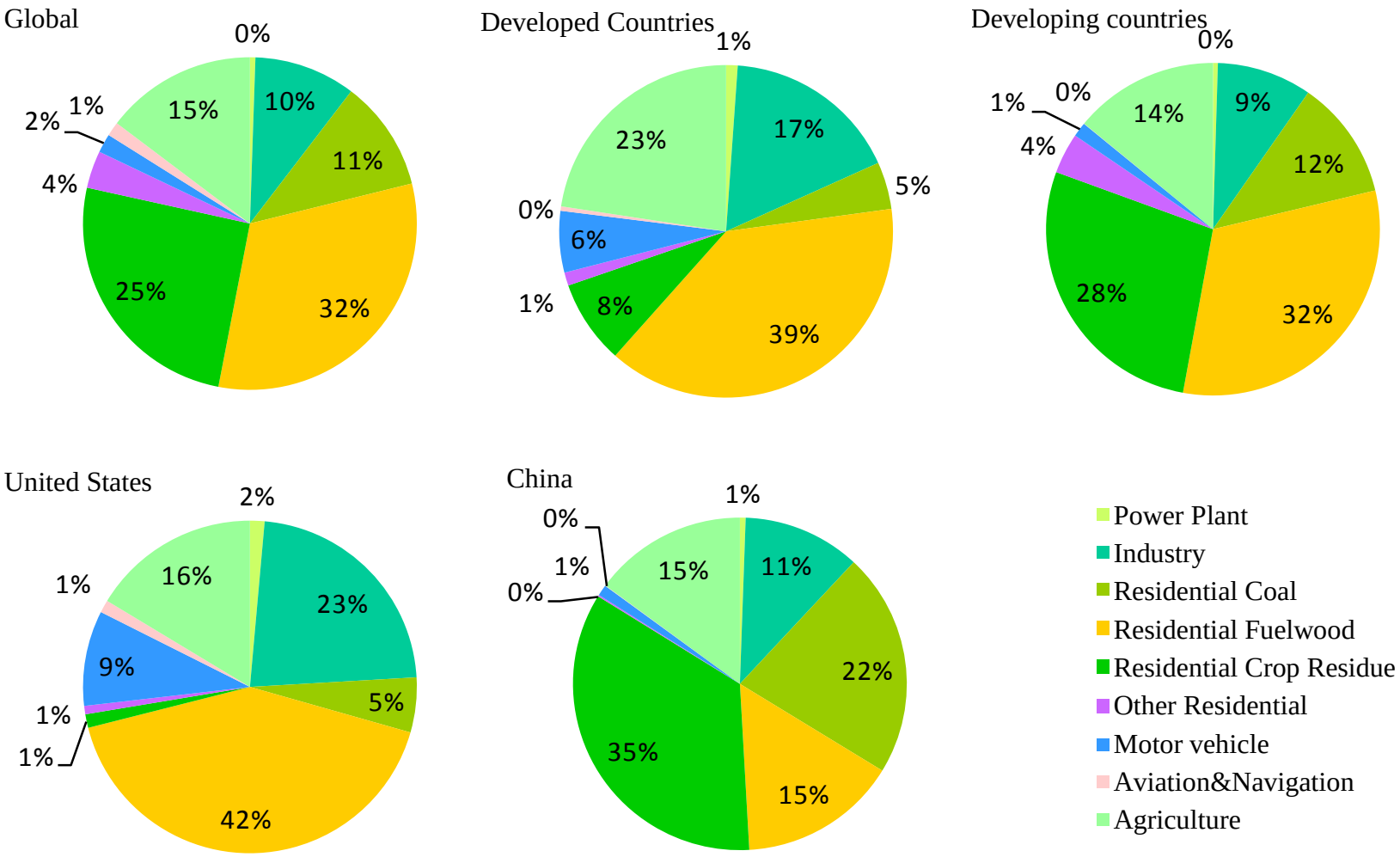


Spatial distribution of anthropogenic OC emission per capita

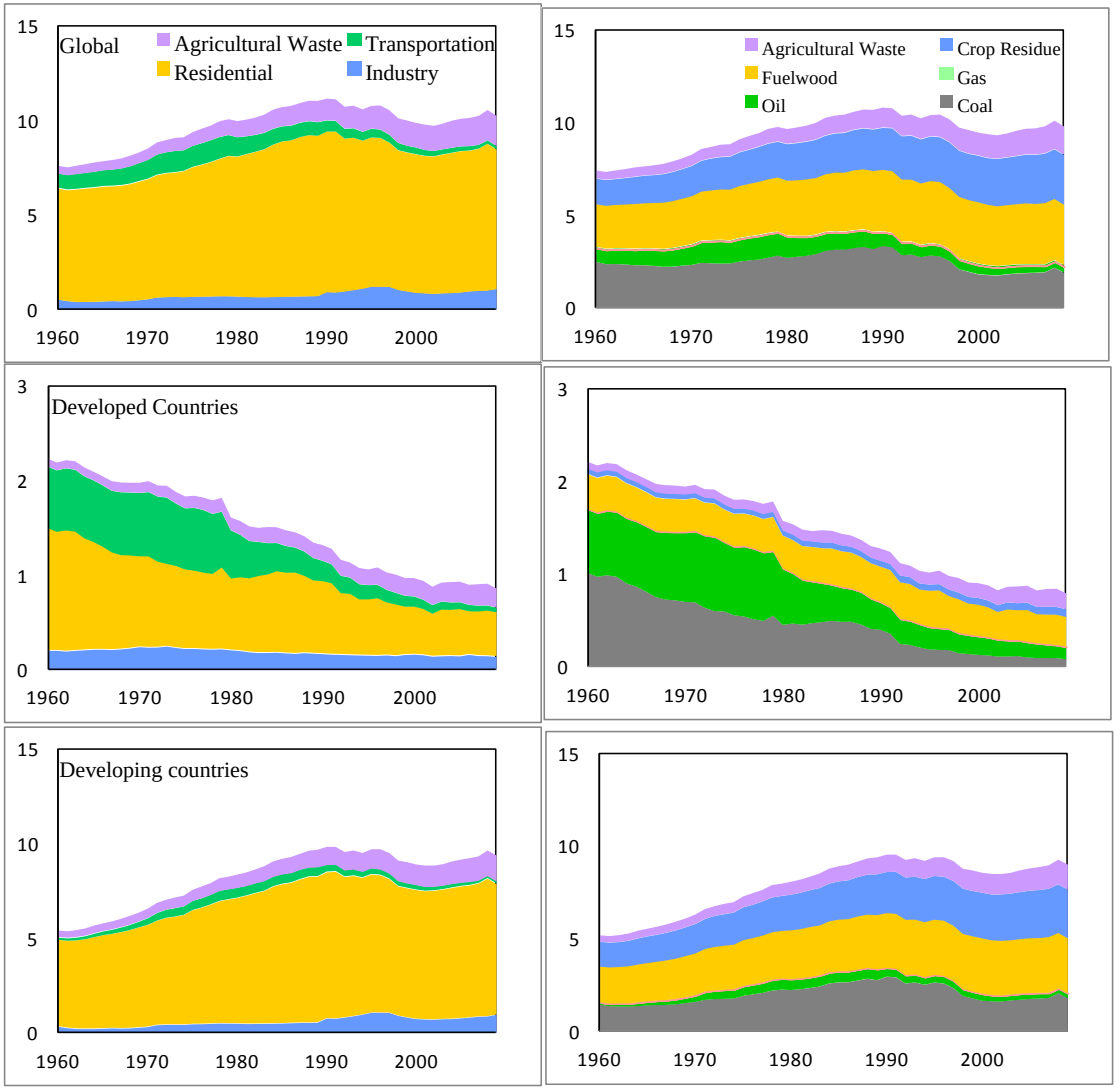


Anthropogenic OC emission per capita

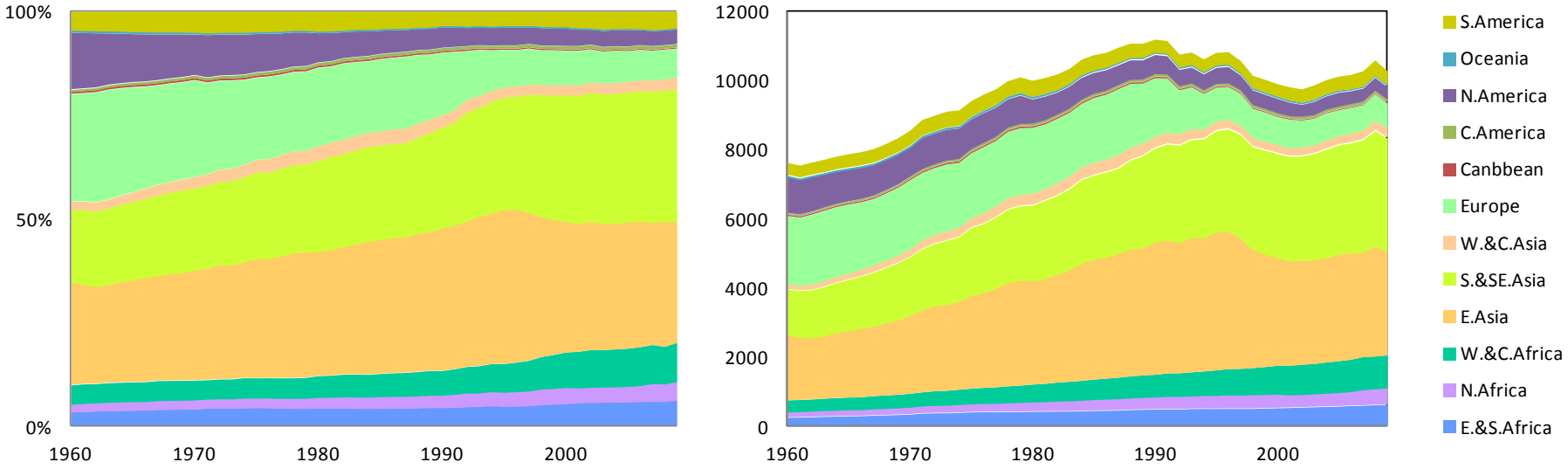
Source Profile of OC



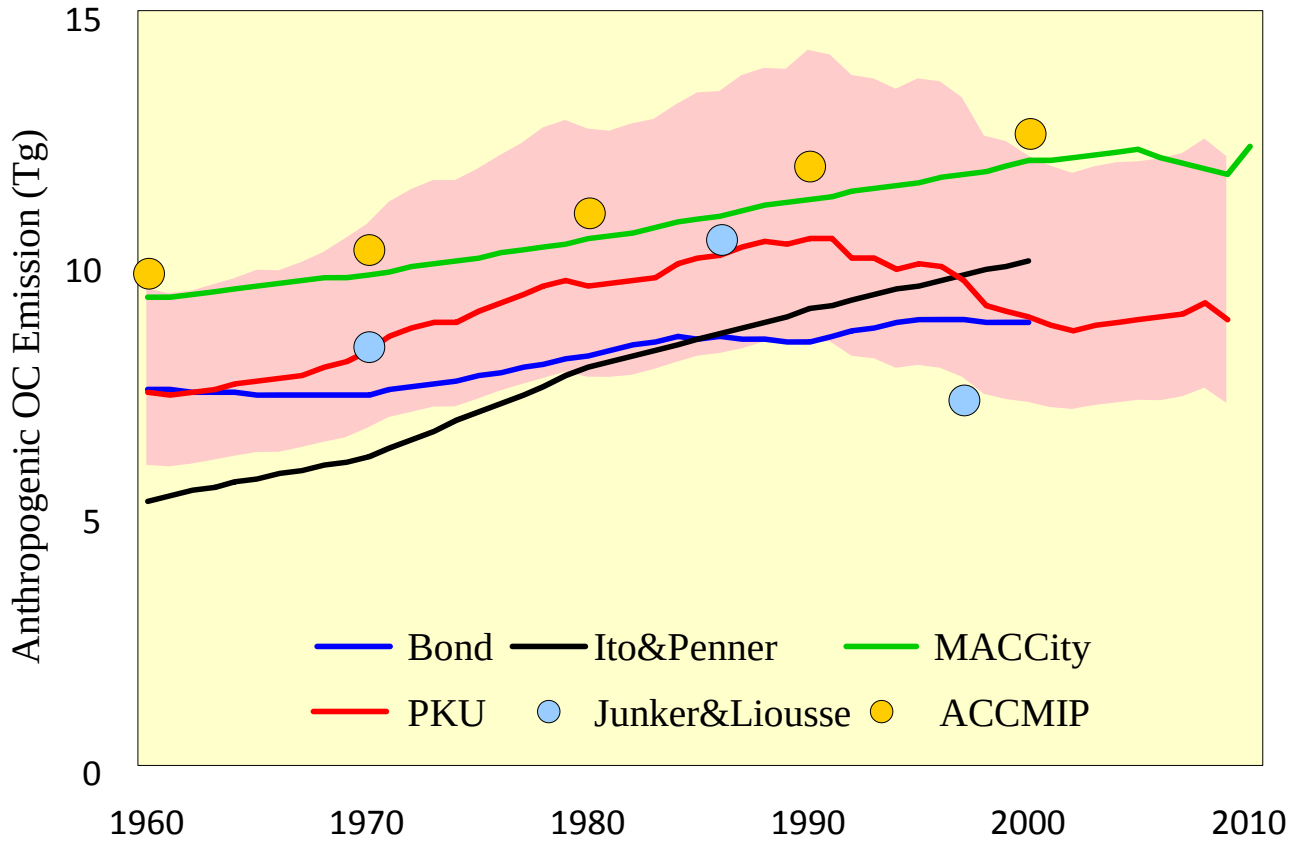
Historical OC Emission



Historical emission for different regions



Compared with previous studies



Thank you!