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Top-down emission inventory development for fine resolution simulation in East Asia

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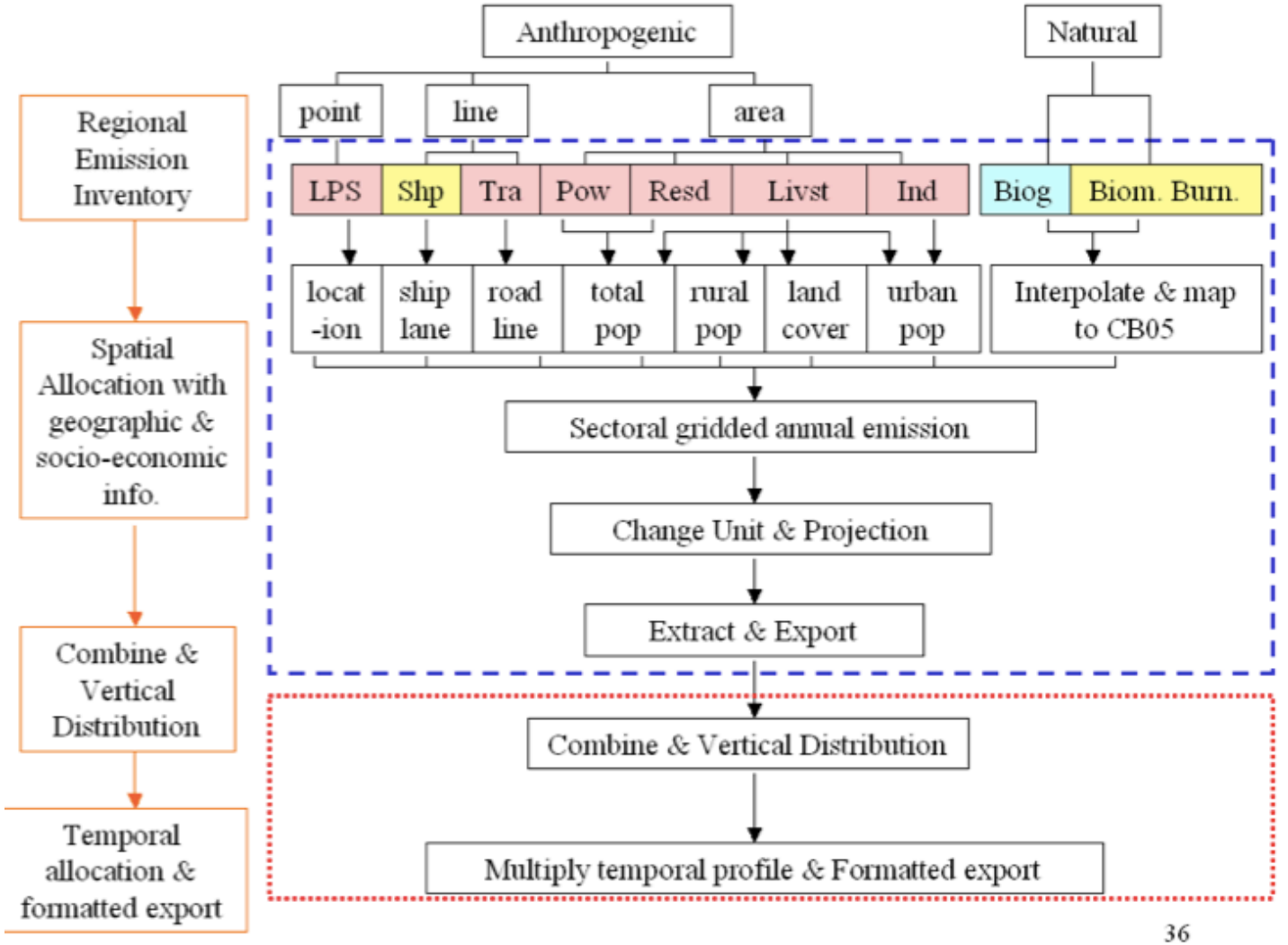
Objectives

1. To apply a new methodology to allocate industrial emissions under the top-down approach
2. Evaluate the performance of this approach under the fine resolution results.

Introduction

- Top-down method for the emission processing has been a popular method for the developing countries
  - Lacking of local emission inventories
  - Change quickly (spatially) during the development
- In general, top-down method categorizes the overall anthropogenic emissions into 7-10 sectors
  - Point source (LPS, Pow)
  - Mobile source (Tra, Shp)
  - Area source (Livst, Ind, Resd)

Top-down Summary



Flow Chart of Emission Process

Anthropogenic

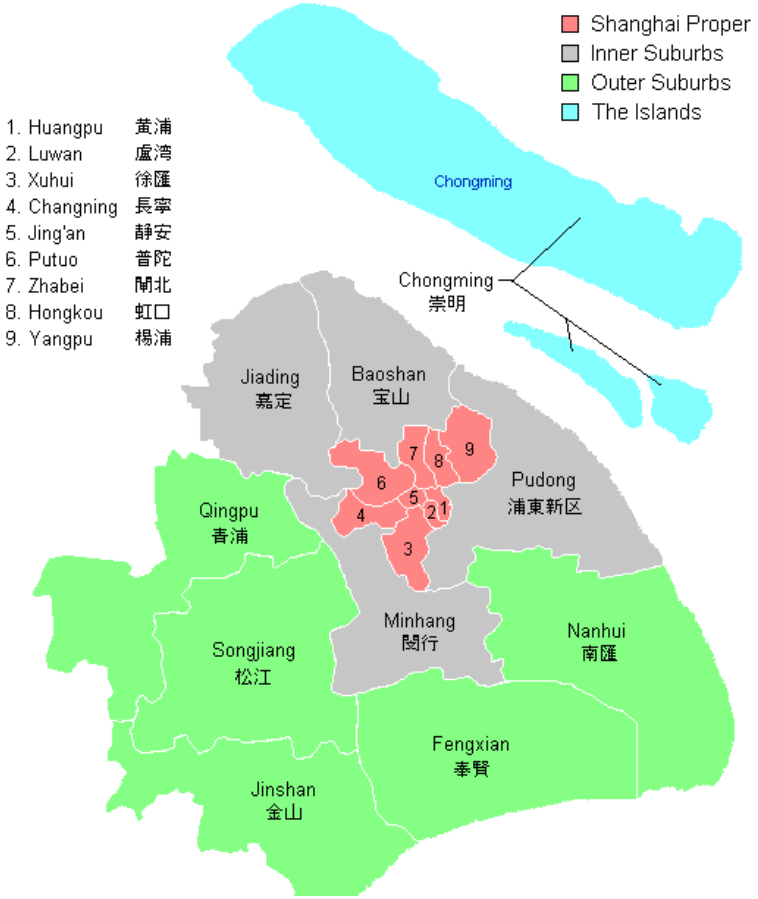
- Population/ Local GDP
- Road network/shipping routes
- Location of LPS

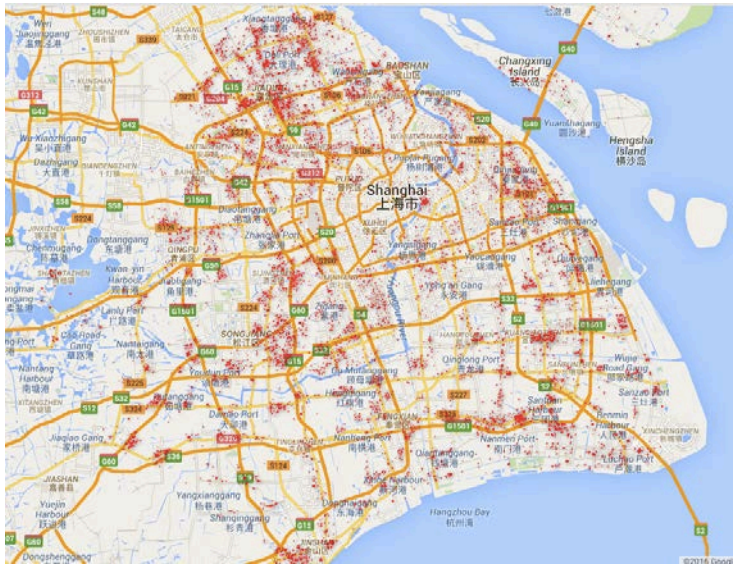
Source: Du (2008), UTK

General Ideas

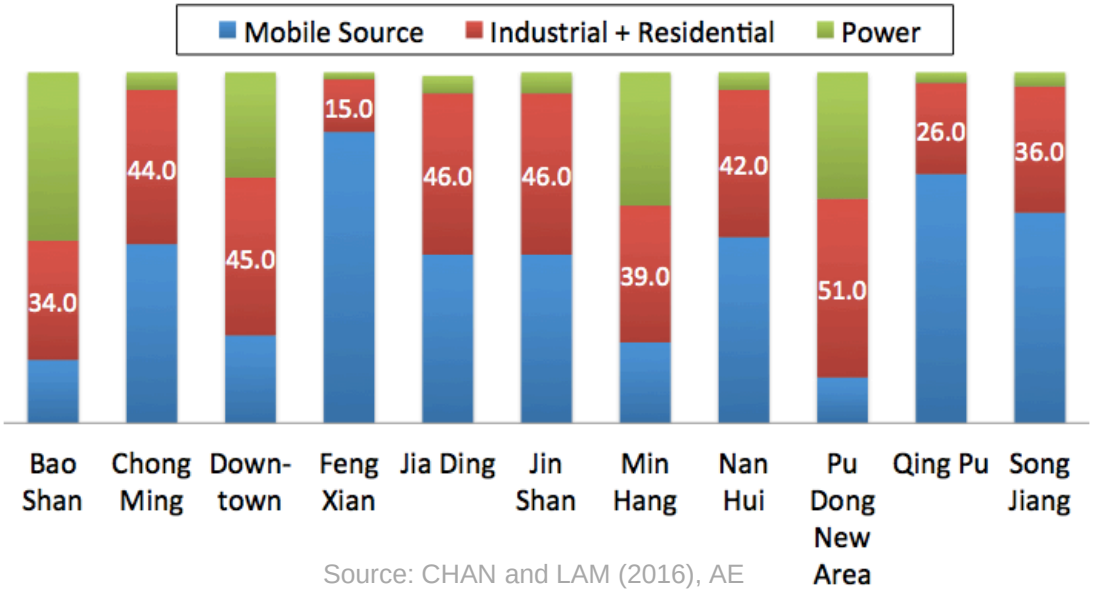
- The current top-down approach is only sufficient to handle grid resolution up to ~10 km
  - Unable to go fine resolution (i.e., 3-5 km) due to lack of effective emission surrogate
  - Particularly for industrial and area sources
- The existing methodology using population density is not the best
  - People no longer living next to the factory
  - Public transportation has become convenient. People can travel around 6-8km within an hour.

Interested Area/Example





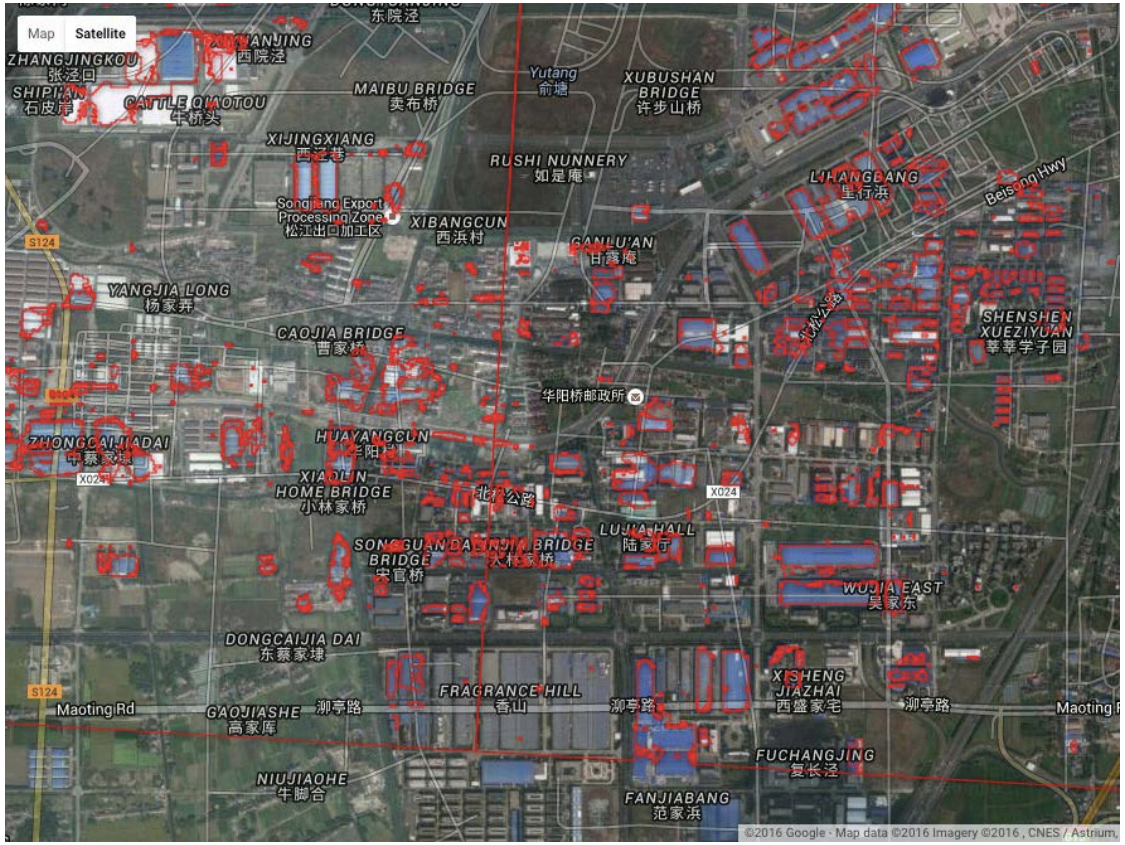
Summary of Emission Inventory (NOx)



Source: CHAN and LAM (2016), AE

Simulation Domains

Methodology



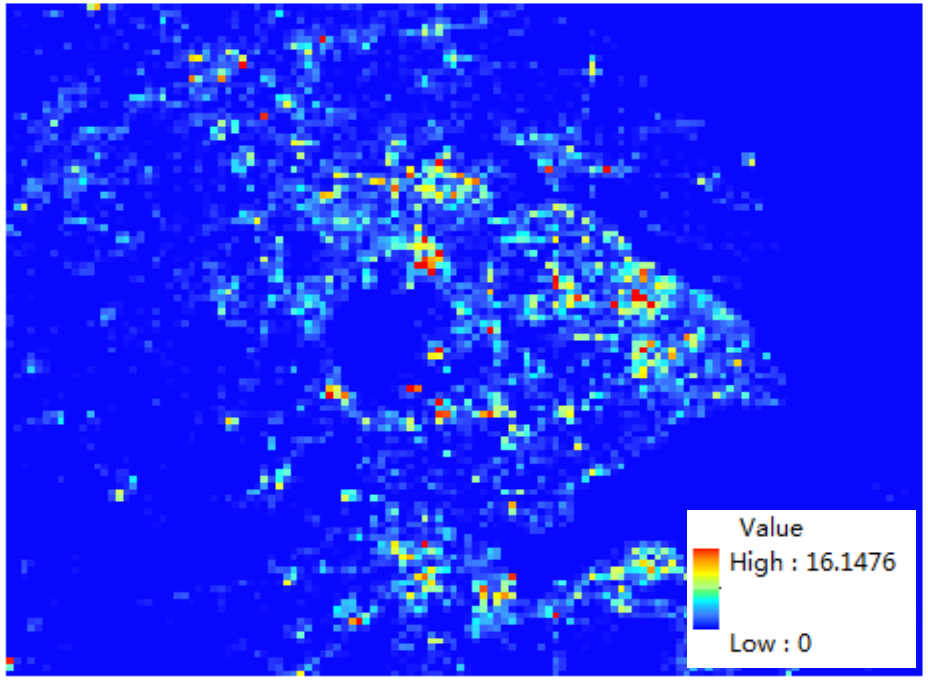
Based on the idea of blue-roof (pink & green roof)

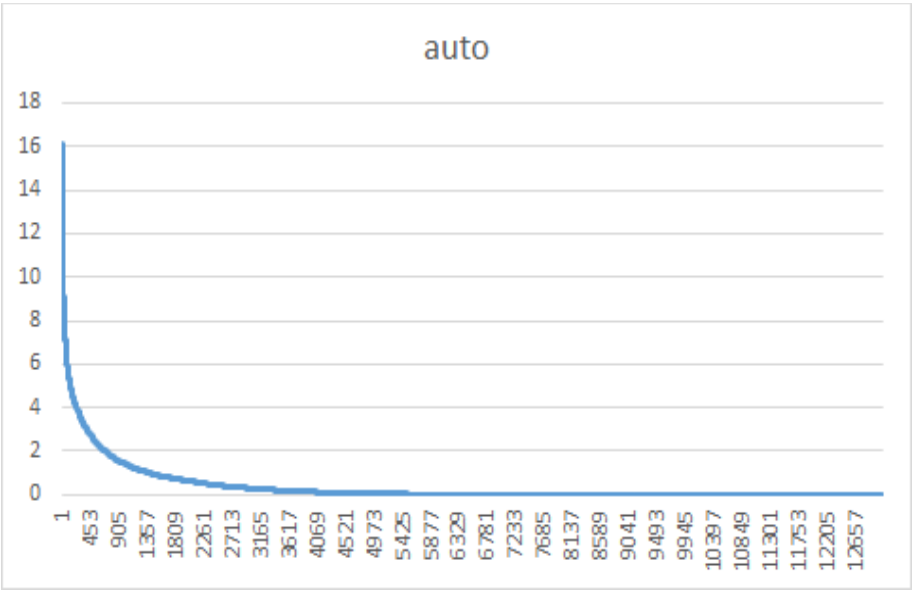
- Factories tend to use zinc/metal for roofing.
- Coating with a layer of epoxy to against corrosion
- Selected colors give a relatively confortable feeling.
- Town house - light red High-rise building - grey

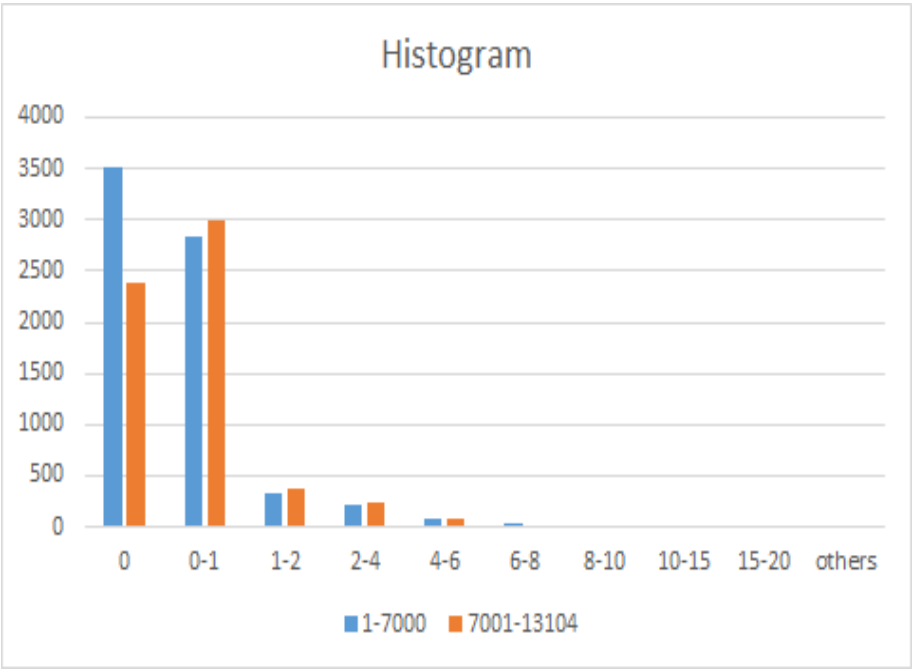
Preprocessing (Image processing)

Name	Hit Rate	Miss Rate	False Rate
Beijing	98%	30%	2%
Shenzhen	95%	10%	5%
Jiaozuo	92%	10%	8%

Preprocessing Results

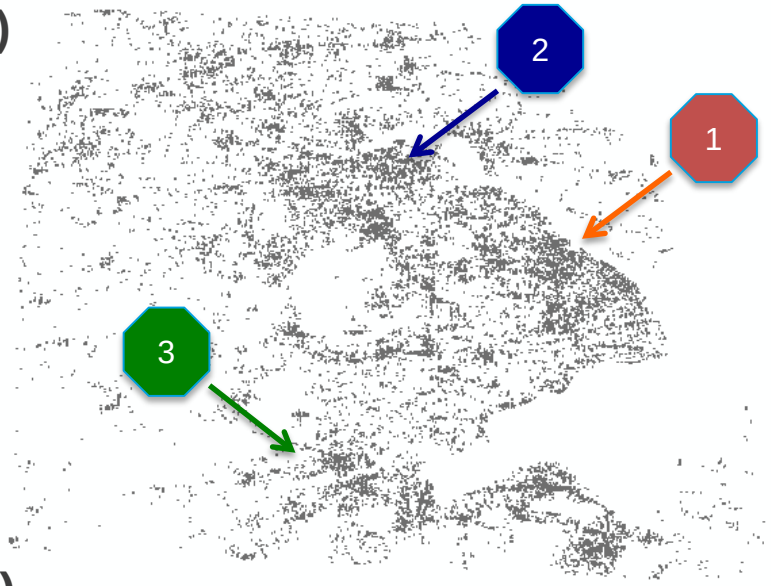




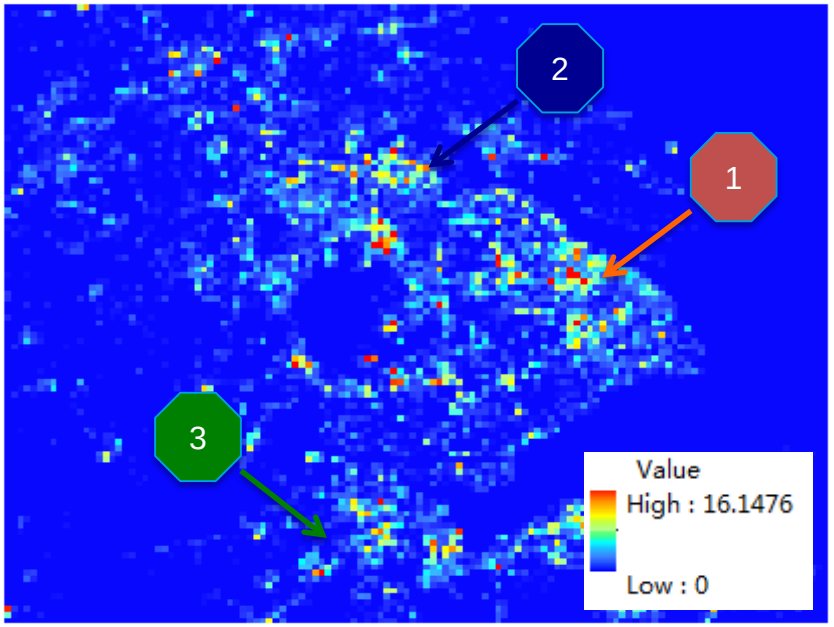


Count:	13104
Minimum:	0
Maximum:	16.14764
Sum:	4872.243369
Mean:	0.371813
Standard Deviation:	0.993305
Nulls:	0

a)

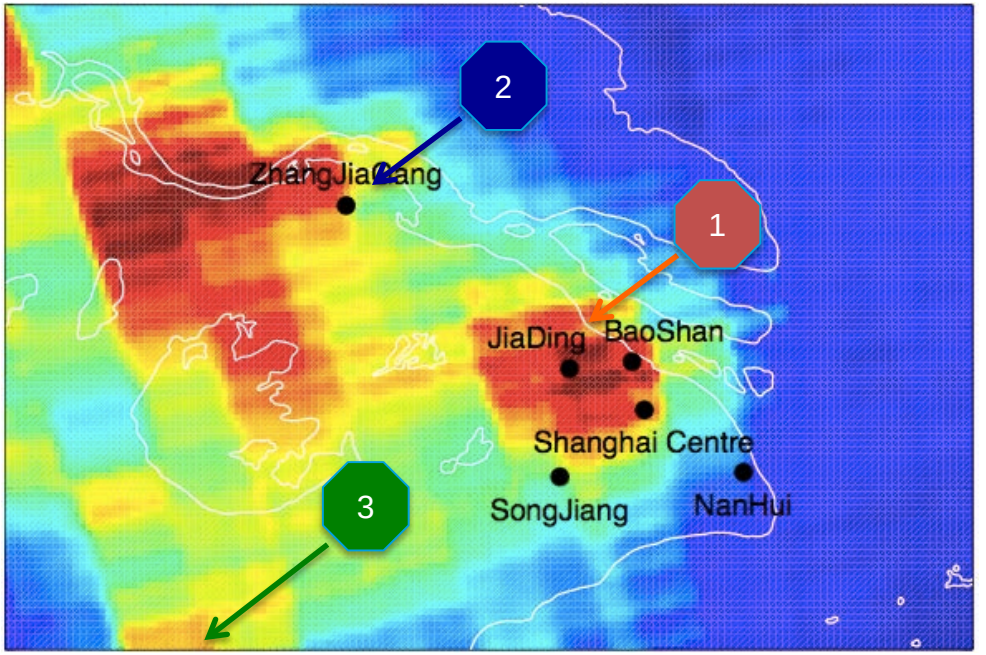


b)

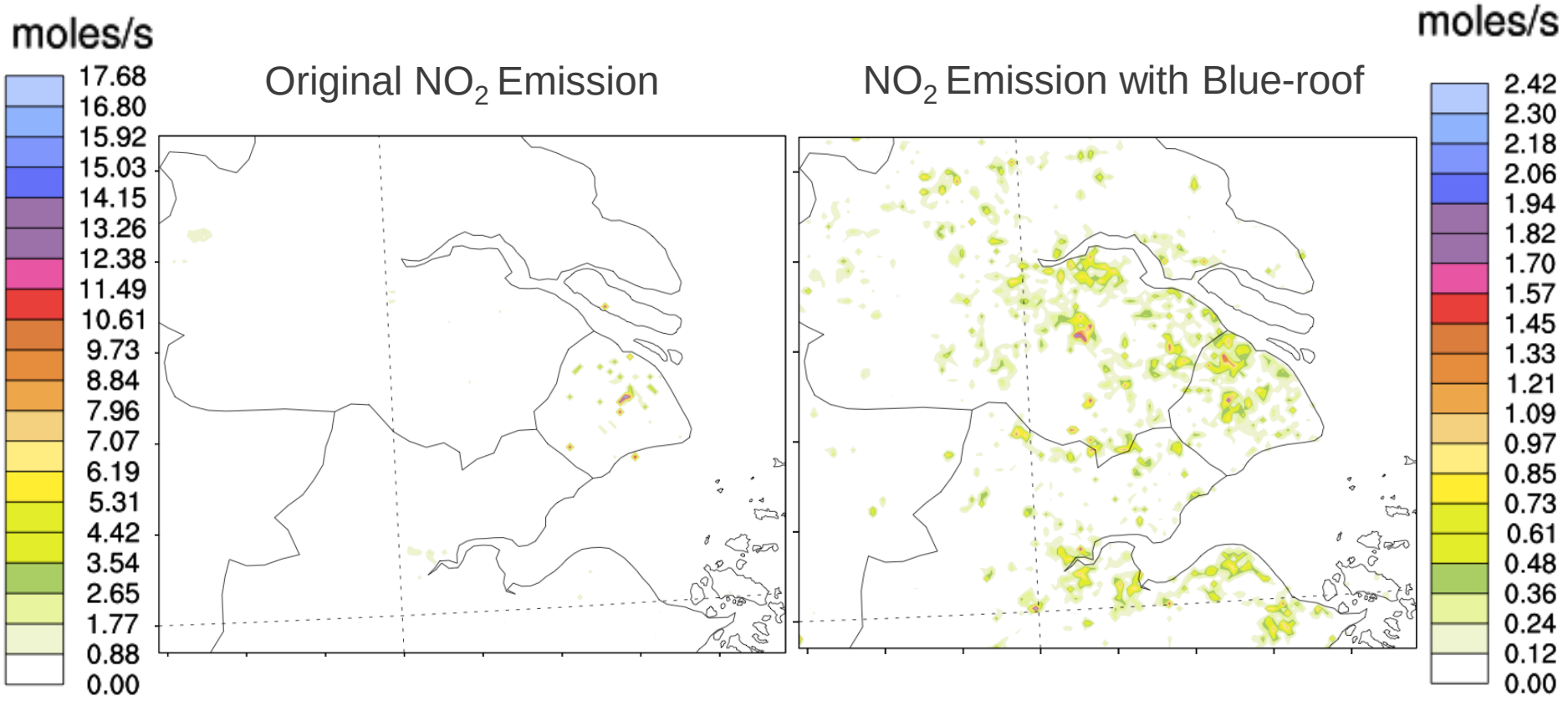


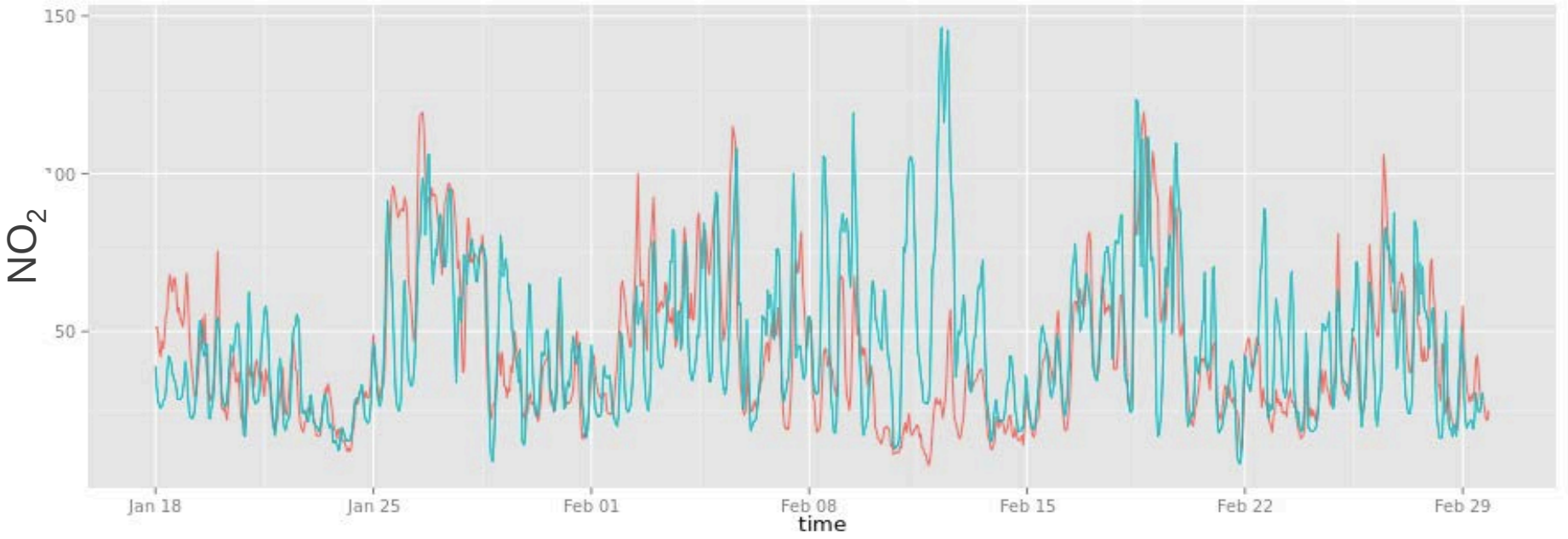
c)

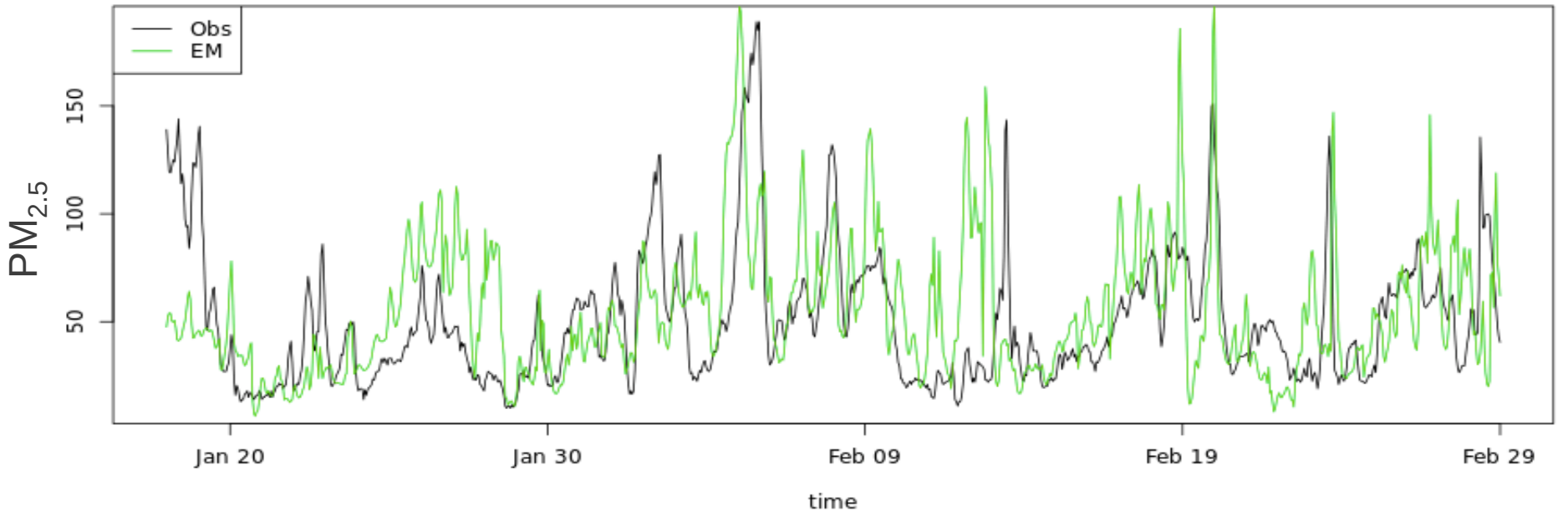
Sept 2009 - OMI Trop NO_2 VCD (10^{16} molec/cm^2)



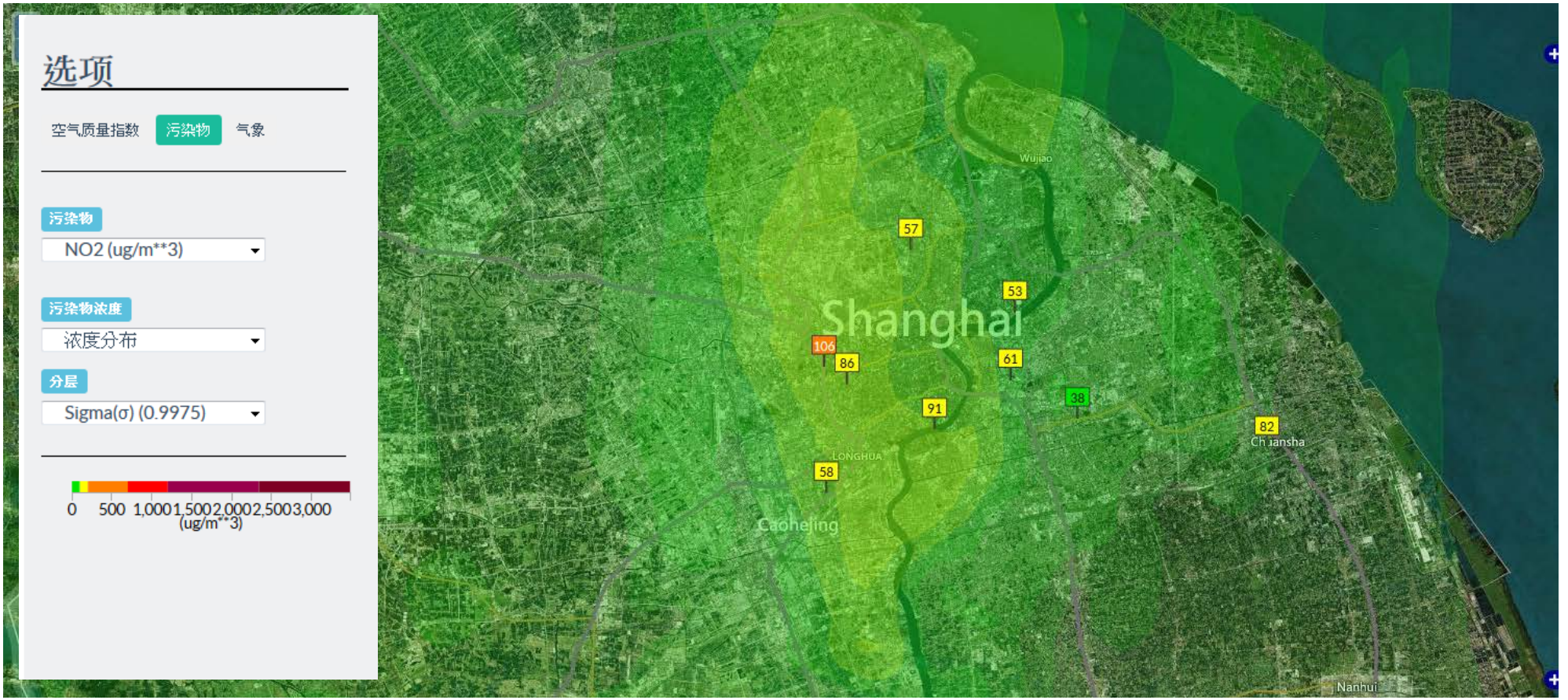
Emission Redistribution (NO_2)



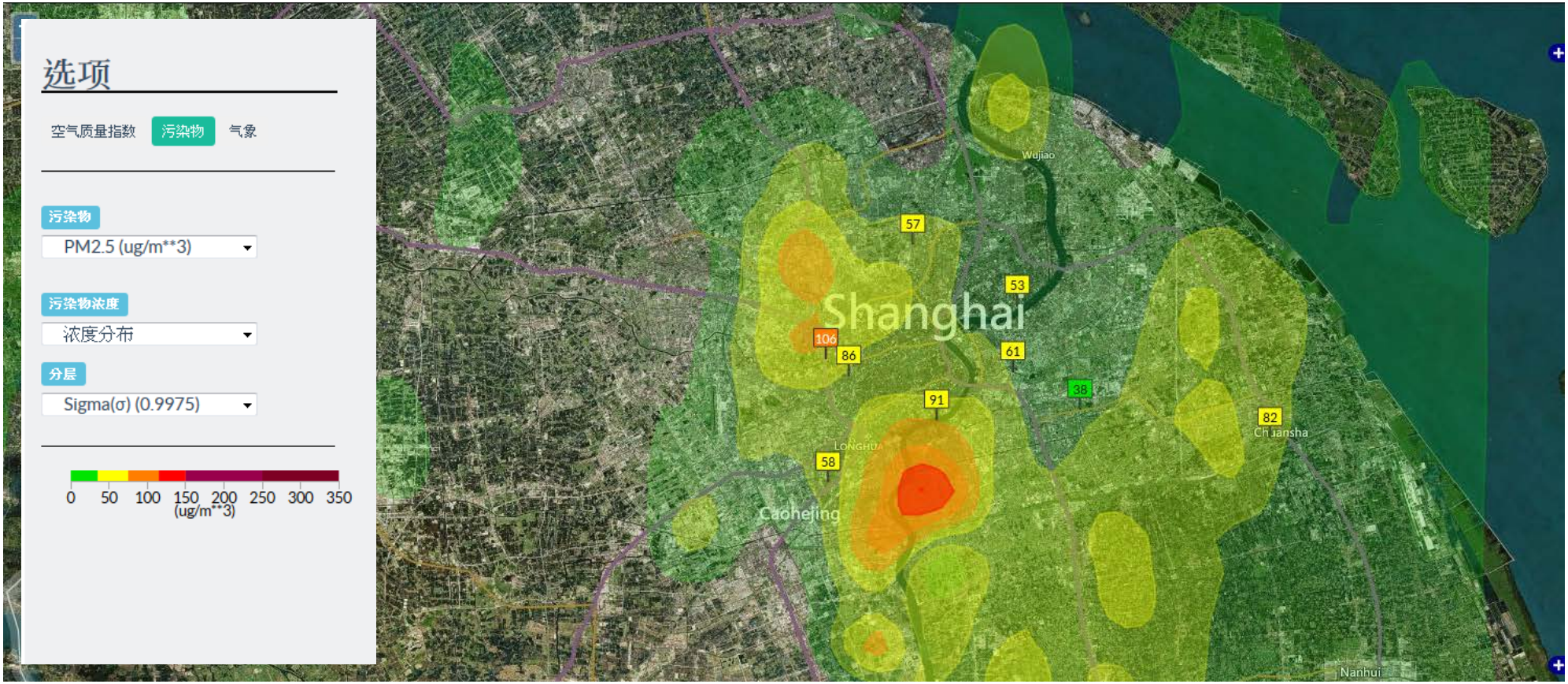

150
100
50
NO_2
Jan 18
Jan 25
Feb 01
Feb 08
Feb 15
Feb 22
Feb 29
time


Obs
EM
150
100
50
$PM_{2.5}$
Jan 20
Jan 30
Feb 09
Feb 19
Feb 29
time

Spatial Patterns (NO_2)



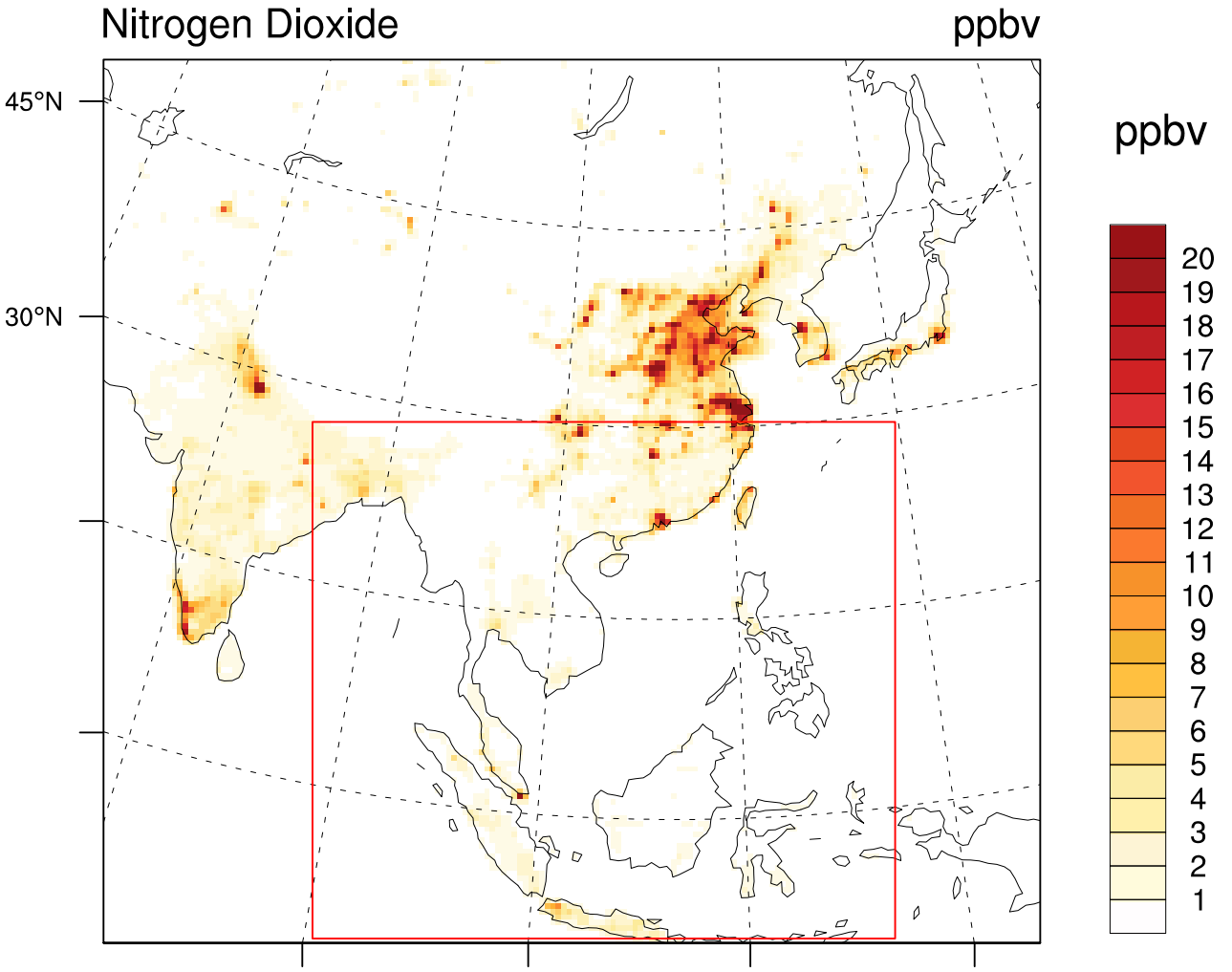
Spatial Patterns ($PM_{2.5}$)



MICS-Asia Phase III (since 2013)

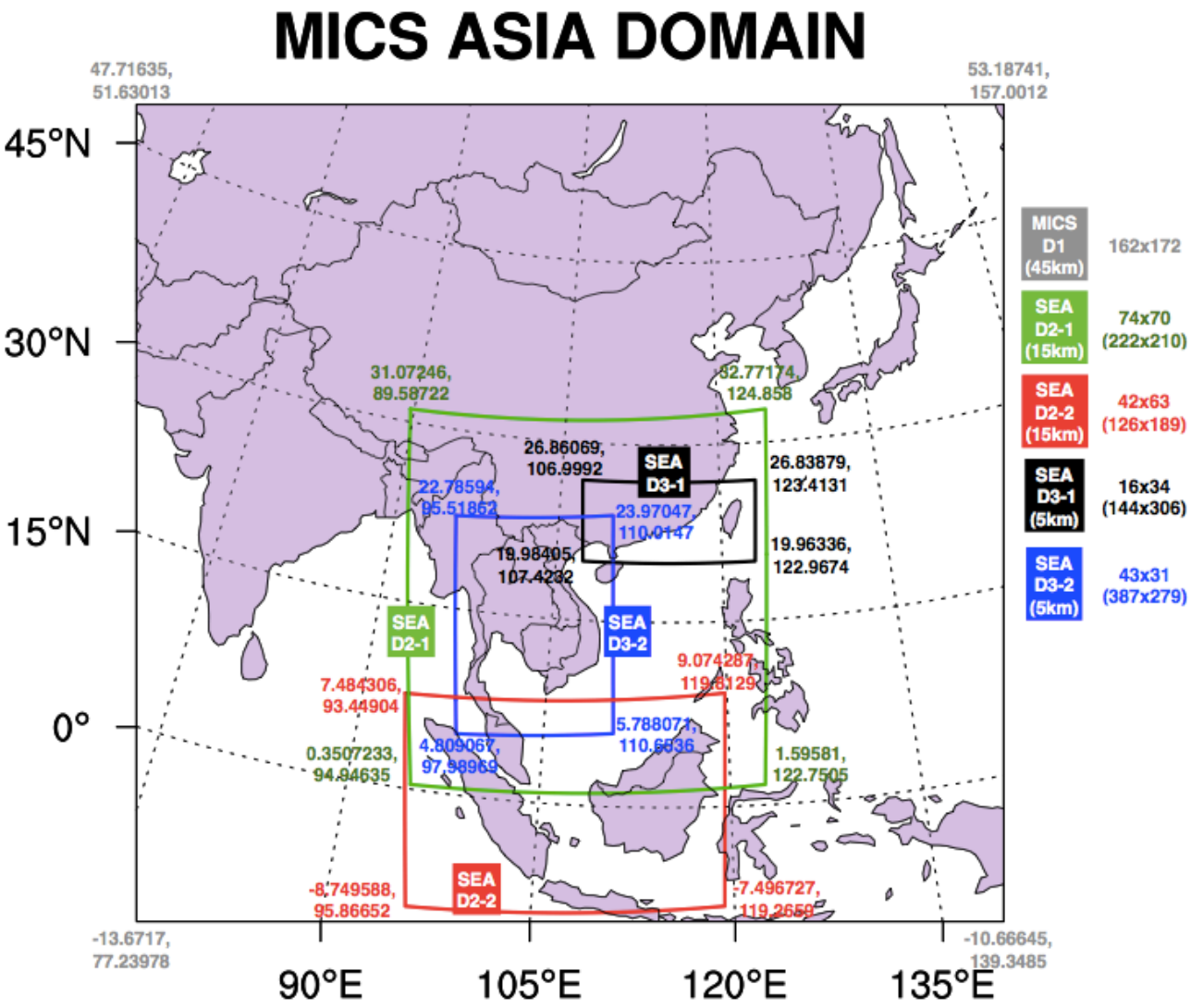
- **Model Inter-comparison**
  - **(Lead by Z. Wang, Yamaji and J. Fu)**
  - Evaluate strengths and weakness of current air quality models and air quality simulation and prediction.
- **Inter-comparison of emission inventory**
  - **(Lead by J. Woo, T. Ohara and Q. Zhang)**
  - Develop regional emission for Asia
- **Air Quality/Weather/Climate Interactions**
  - (**Lead by G. Carmichael, ZW Han, Yafang Cheng)**
  - Understand air quality and climate interactions

MICS-Asia (Southeast Asia sub-group) – REASv2



D1: 45 km; D2: 15 km, and D3: 5 km

MICS-Asia (Southeast Asia sub-group)



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