NO_x emissions from power plants in China: bottom-up estimates and satellite constraints

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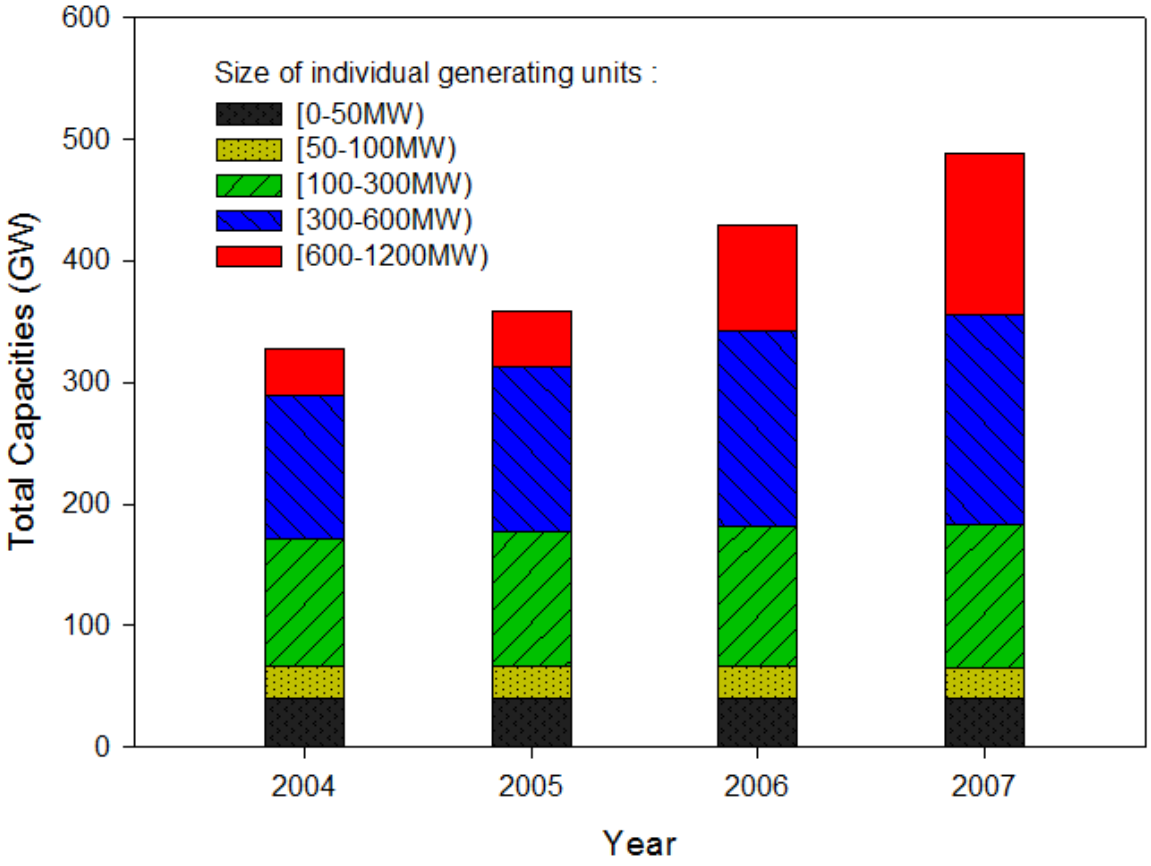
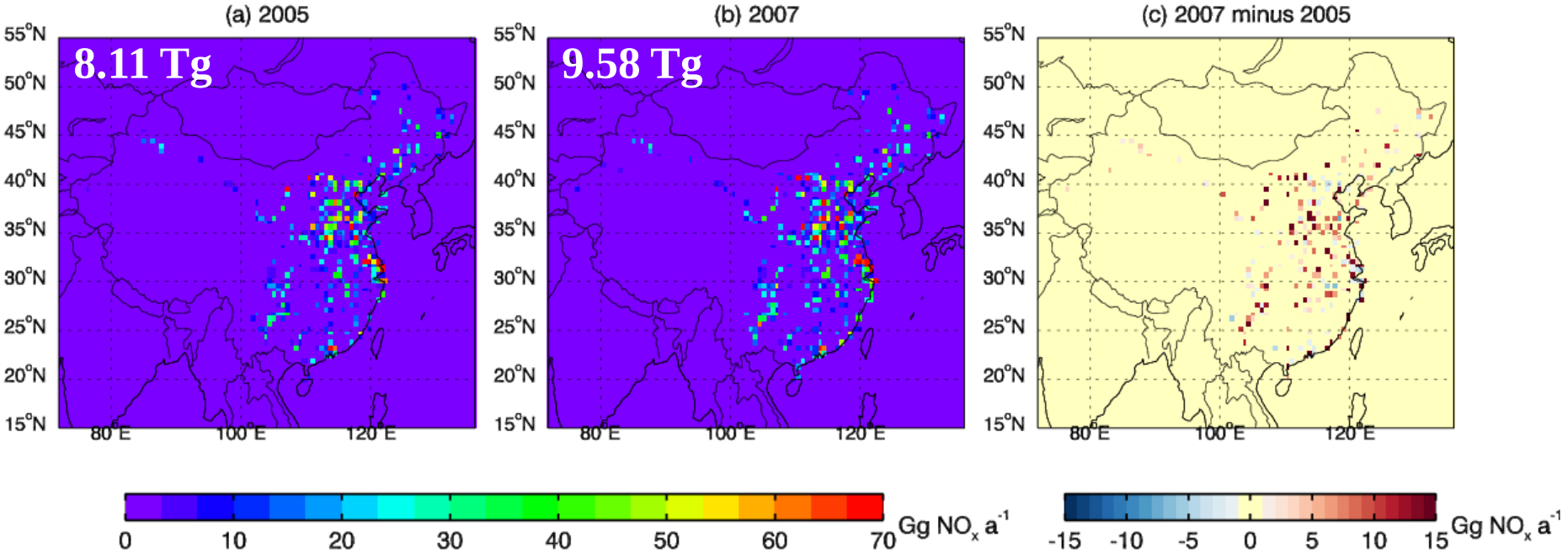
Dramatic increase of thermal generation capacities in 2005-2007

- Consequence of the fast economic growth and electricity shortage in the early of 2000s
- Increase rates differ in size
  - 92.2% of the increased capacities in 2005-2007 are from generator units ≥ 300 MW
- Proportion of the generator units < 300 MW decreased to 37.6% at the end of 2007



The unit-based power plant NO_x emission inventory

- Time period: 2005-2007
- Time resolution: Monthly
- Database: ~5,700 individual units (data from MEP)
- Data: Location, capacity, boiler type, technology, coal consumption, the month when unit came into operation



Model and Satellite data

- **GEOS-Chem**
  - v8-02-01; Nested-Grid (0. 5°x 0.667°); GEOS-5; 47 vertical levels
  - Period: 2005-2007
  - Anthropogenic NO_x emissions: unit-based power plant inventory + others use the same methodology in *Zhang et al*. (2007)
  - Two scenarios: GC_S0 --- with all emissions

    GC-S1 --- remove emissions from new generator units (units came into operation between 2005 and 2007)

- **We used OMI tropospheric NO_2 columns (DP_GC) developed by Lamsal *et al*. (2010)**
  - Based on DOMINO NRT products (version 1.0.2, collection 3)
  - The cross-track bias in tropospheric slant column densities was corrected following the approach described by *Celarier et al*. (2008)
  - **We use nested-grid *a priori* NO_2 profiles (0.5°x 0.667°) to calculate the AMF**

Impacts of new power plant NO_x emissions on NO_2 profiles

- Shangdu:

  rural area

  (a) at 0. 5°x 0.667°

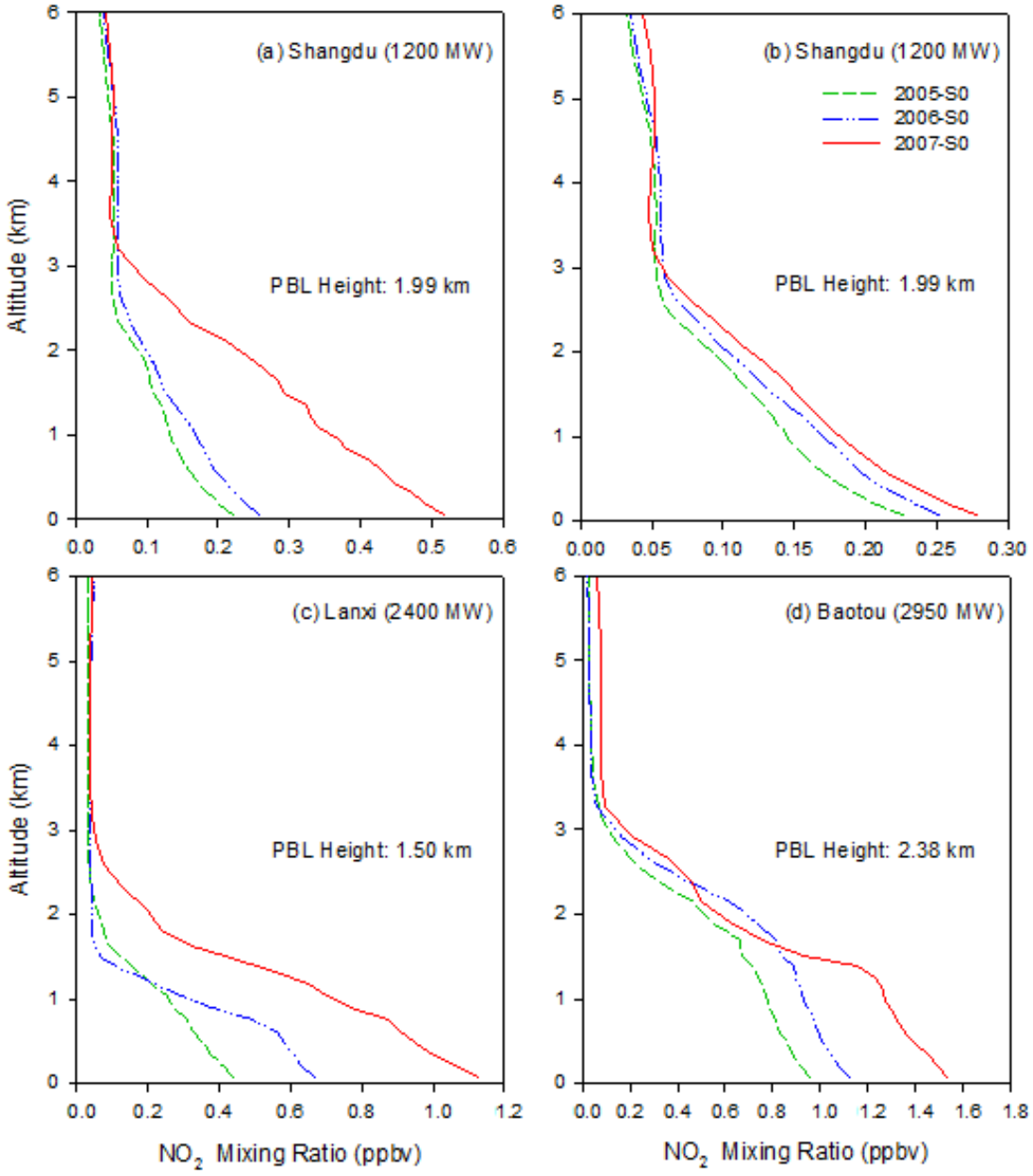
  (b) at 2°x 2.5°
- Lanxi:

  small town

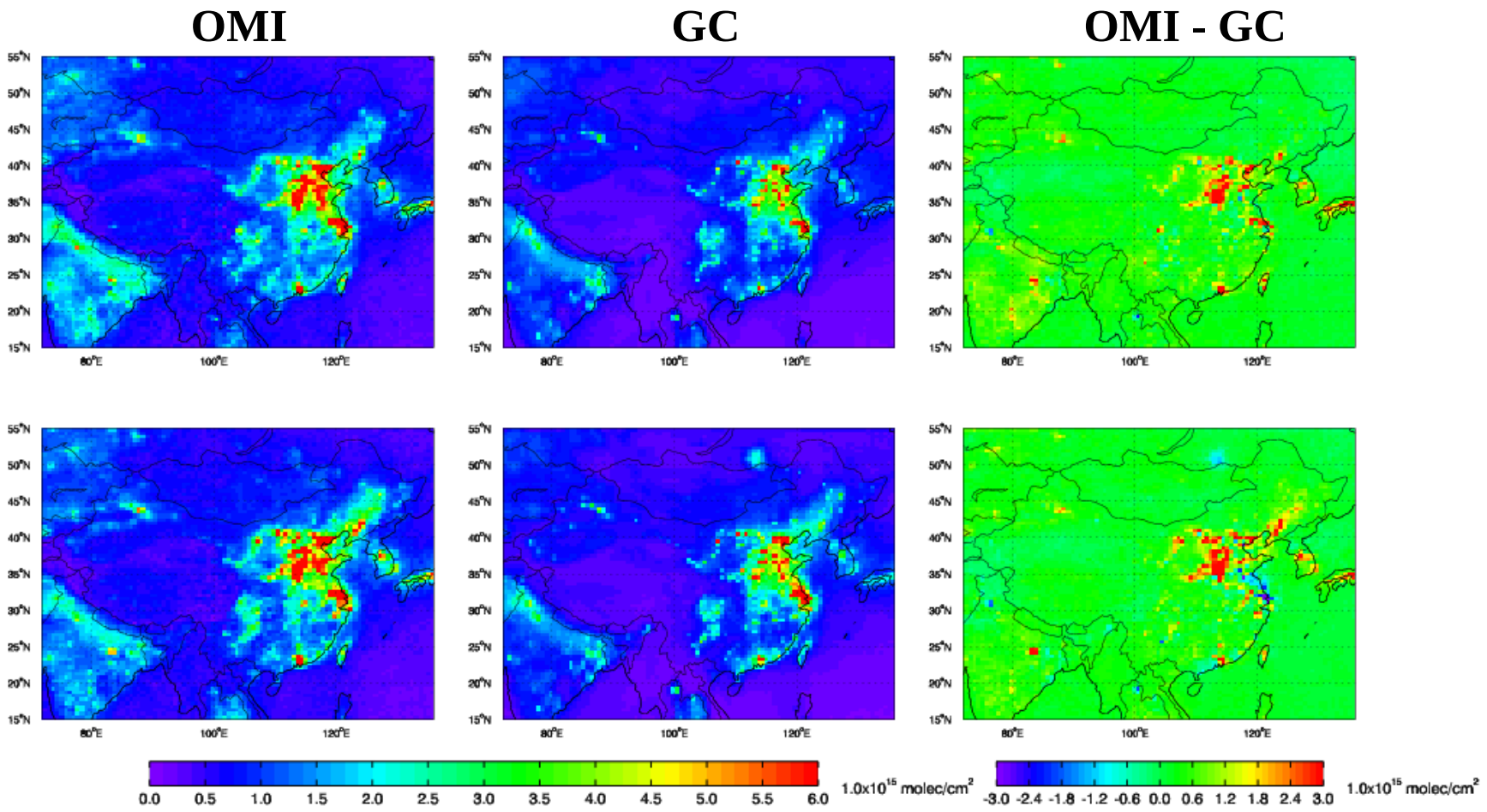
  (c) at 0. 5°x 0.667°
- Baotou:

  urban

  (d) at 0. 5°x 0.667°



Comparison of the OMI and GC tropospheric NO_2 columns for summers (JJA) of 2005 and 2007



- Top row: 2005; Bottom row: 2007
- Modeled columns are lower than OMI measurements in city corridors in Shanxi-Shaanxi-Inner Mongolia region

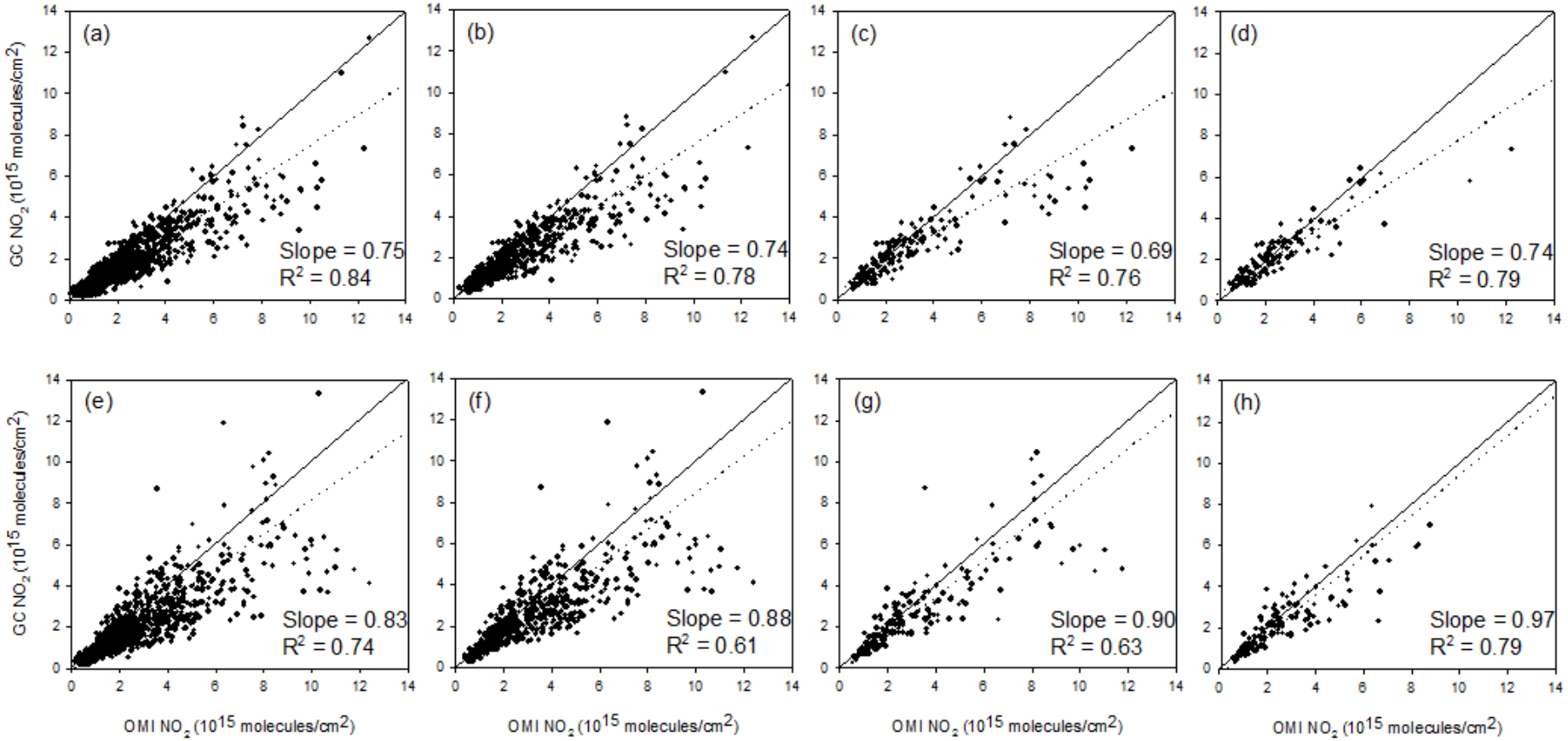
Correlations of summer NO_2 columns over power plants (PP)

Step1:
All grids in China

Step2:
Grids with PP

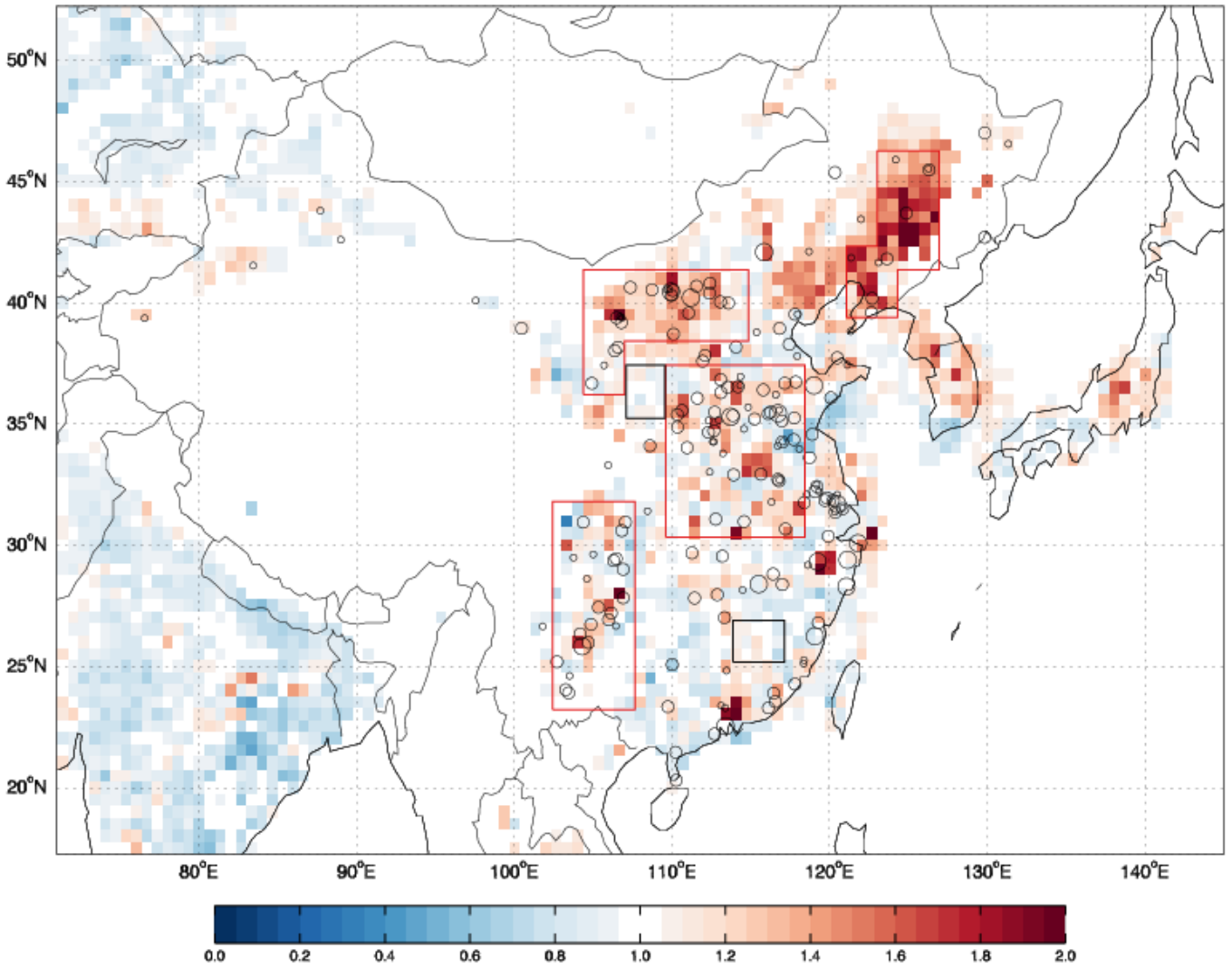
Step3:
PP emissions > 60%

Step4:
PP emissions > 60%
Urban pop.< 0.5 million



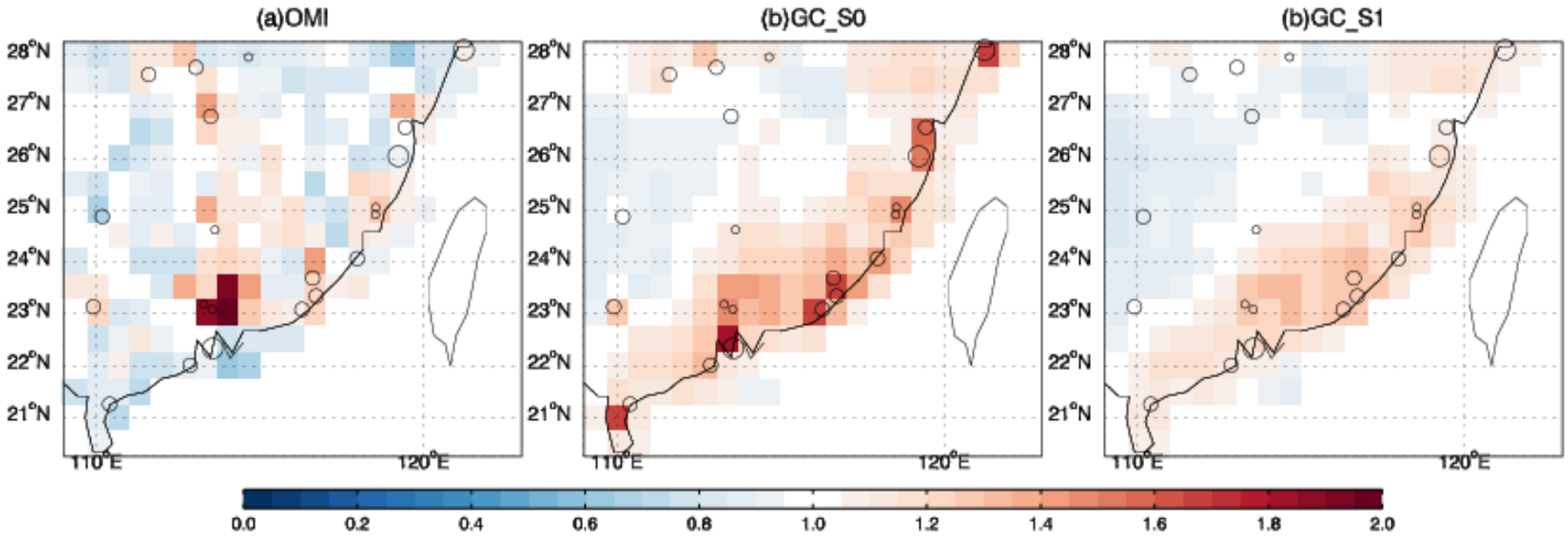
- Top row: 2005; Bottom row: 2007

Increase ratio of summer NO_2 columns (2007 to 2005) detected by OMI



- Circle dots indicate the locations of new power plants during 2005-2007

Increase ratio of summer NO_2 columns (2007 to 2005) from OMI and GC model: coastal areas



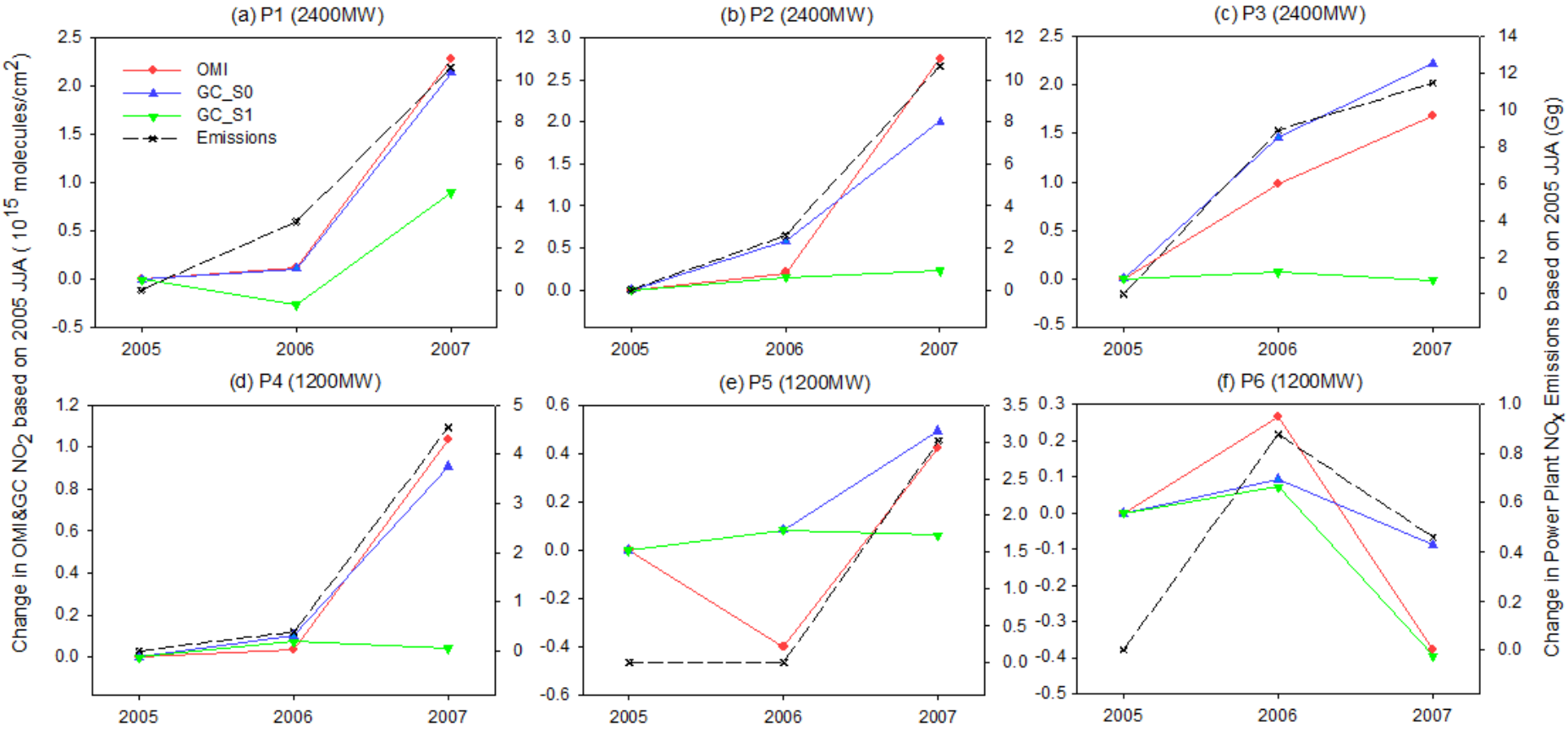
OMI

GC (S0)

GC without new PP (S1)

- Impact of meteorology (monsoon)?
- Impact of a priori NO_2 profile, e.g., under-sample (Hechel, et al., 2011) ?

Temporal evolution of NO_2 columns over individual power plants



- with large new generation capacities (≥1200 MW)
- located in grids with less urban population (< 0.3 million)
- positions of new power plants are nearby the centers or on windward sides in the corresponding model grids
- located in inland

Acknowledgements

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Thank you for your attention!

DP_GC OMI product developed by Lamsal et al. (2010)

- Based on DOMINO NRT products (version 1.0.2, collection 3)
- The cross-track bias in tropospheric slant column densities was corrected following the approach described by *Celarier et al.* [2008]
- GEOS-Chem *a priori* NO_2 profiles (2°x 2.5°)
- Improved performance in summer compared to *in situ* measurements in the United States

Figure 5b in *Lamsal et al.* (2010)

Blue - NASA Standard OMI products

Red - DOMINO OMI products

Green - improved DOMINO OMI products