Recent changes of NO_x for China observed from OMPS

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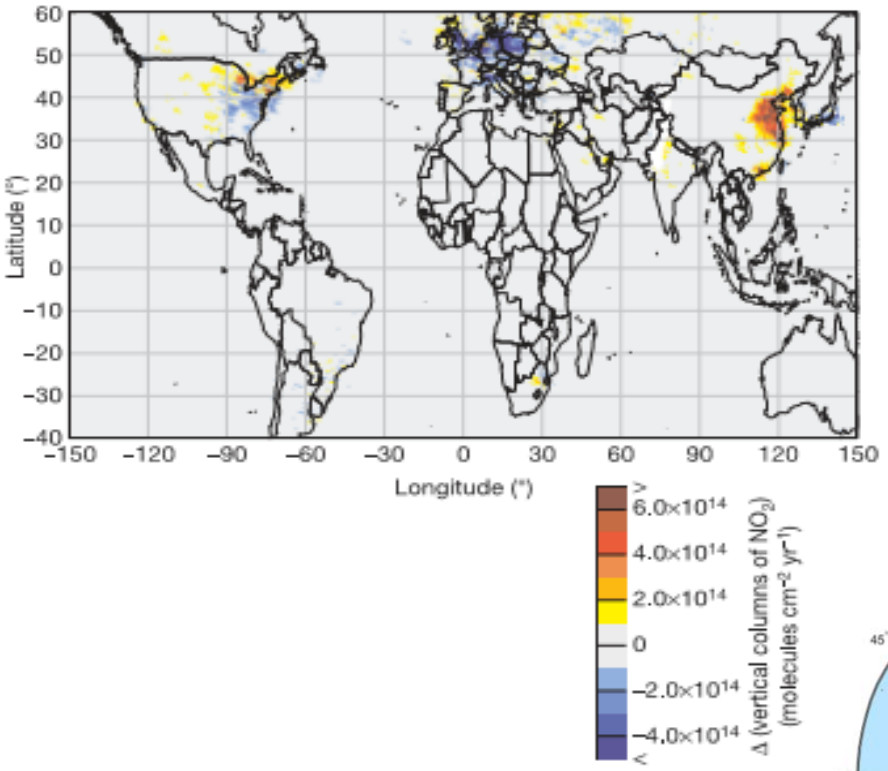
Past trends of NO_2 in China from satellite

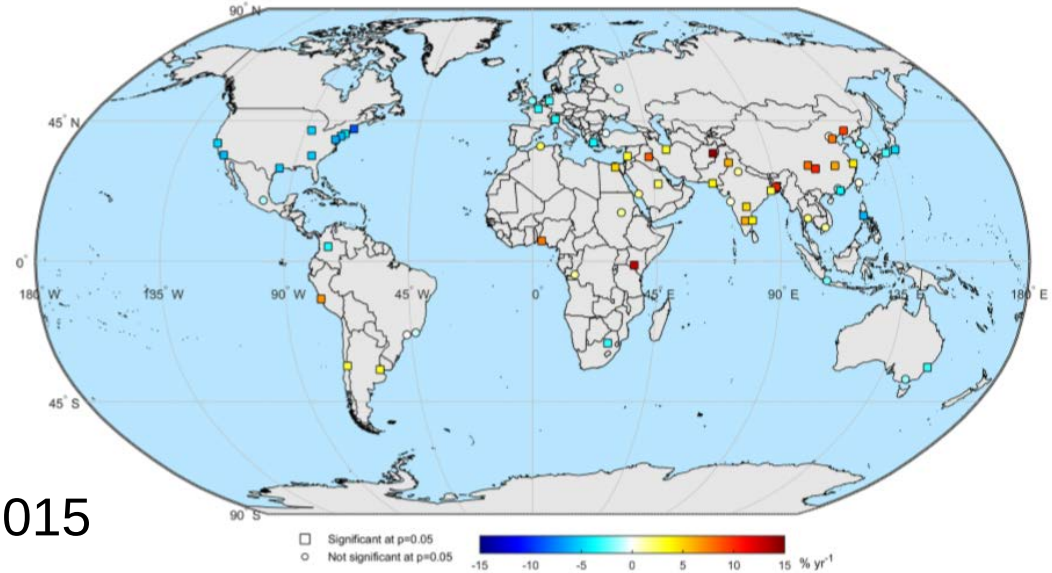
GOME 1996-2002



Richter et al., Nature, 2005

Prior to 2012, NO_2 was growing rapidly in eastern China, in contrast to declining in the US and Europe.

SCIAMACHY 2002-2012

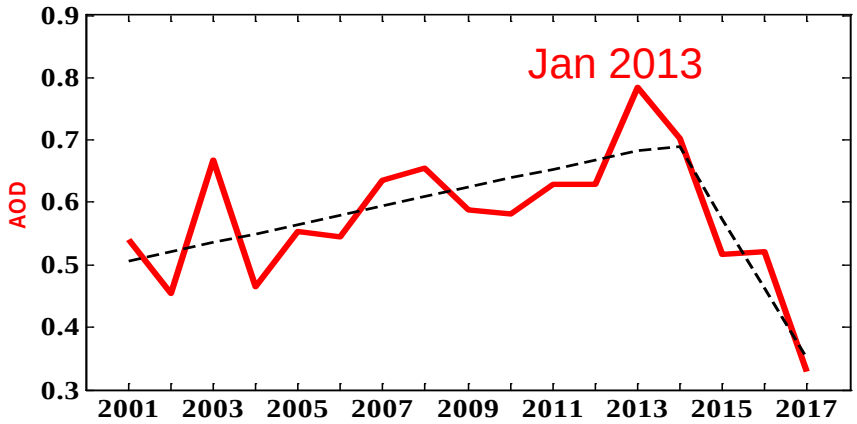


Schneider et al., ACP, 2015

What about NO_2 trend after 2013?

- January 2013: (1) **AQ monitoring network** established in China and has been releasing data since; (2) Documented **severe winter haze** in North China -“Airpocalypse” (Beijing had more than 15 days with PM2.5 > 300 *u*g/m^3)
- September 2013: China implemented the **Action Plan on Prevention and Control of Air Pollution** for eastern China

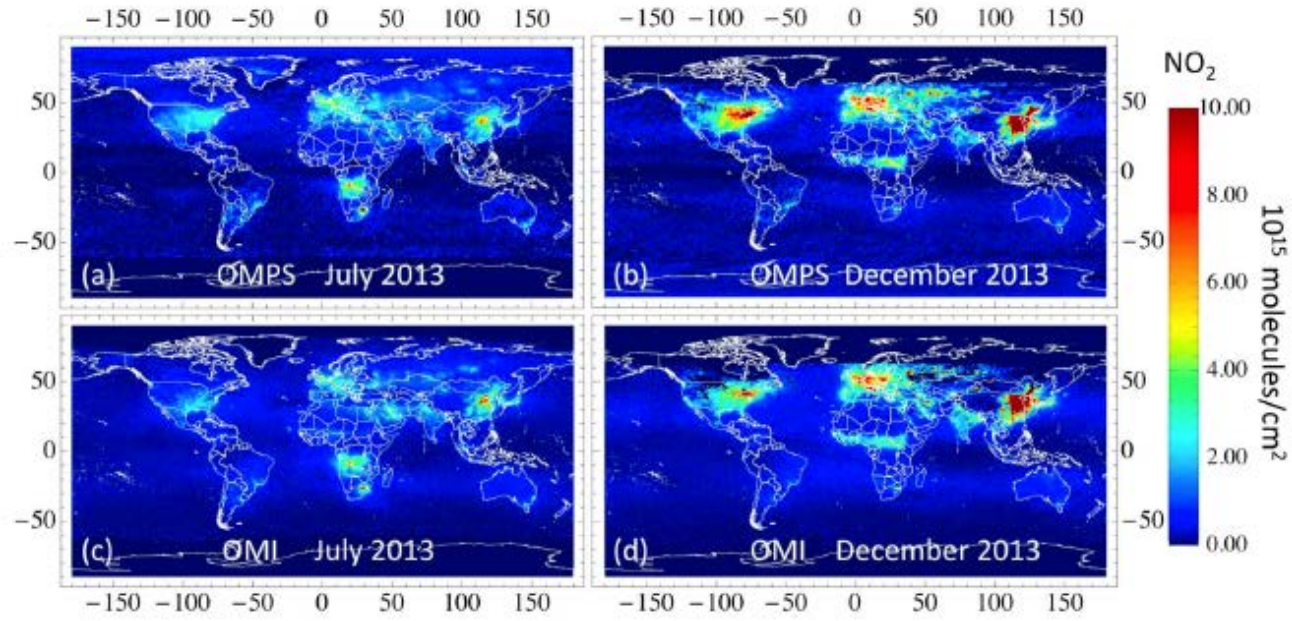
Winter Mean AOD from MODIS (North China)

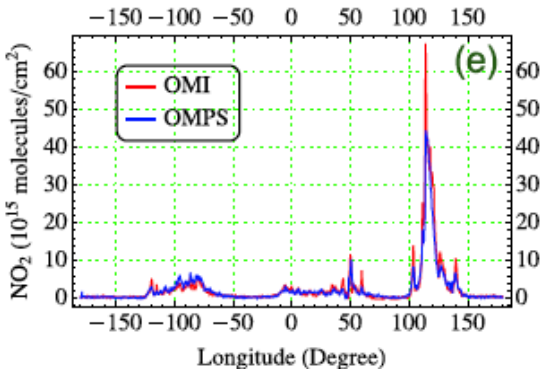


Jia, Wang, et al., in revision

OMPS Nadir Mapper from Suomi NPP

- OMPS (Ozone Mapping and Profiler Suite) NP onboard Suomi NPP launched Oct 2011
- Producing NO_2 products Jan 2012 – present; 1:30 pm equator crossing time, close in time to OMI observations
- Same OMPS instrument will be flown on JPSS-1 and JPSS-2
- Comparisons show good agreement with Aura OMI tropospheric NO_2 data

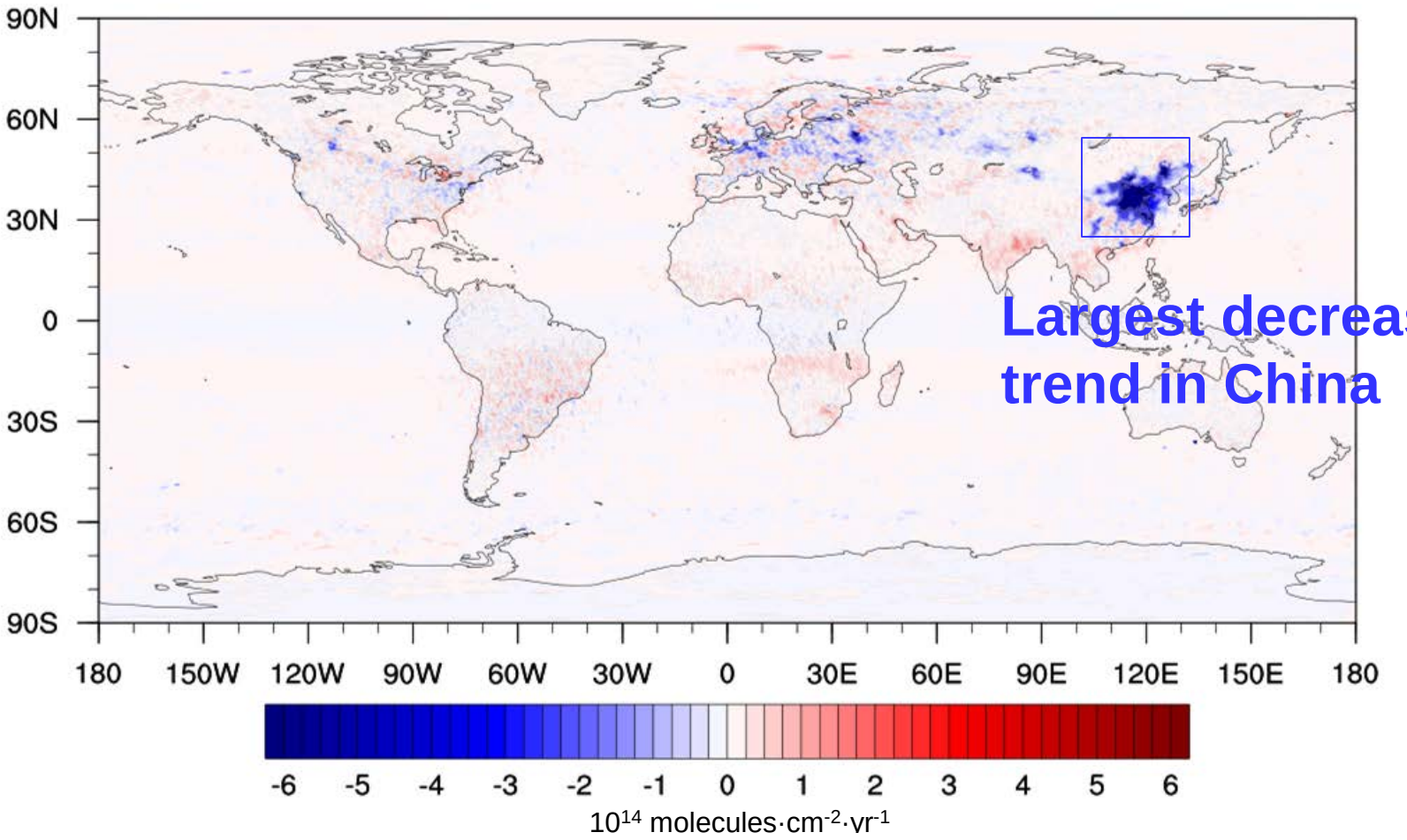




Yang et al., 2014

https://disc.gsfc.nasa.gov/datasets/OMPS_NPP_NMNO2_L2_2/summary

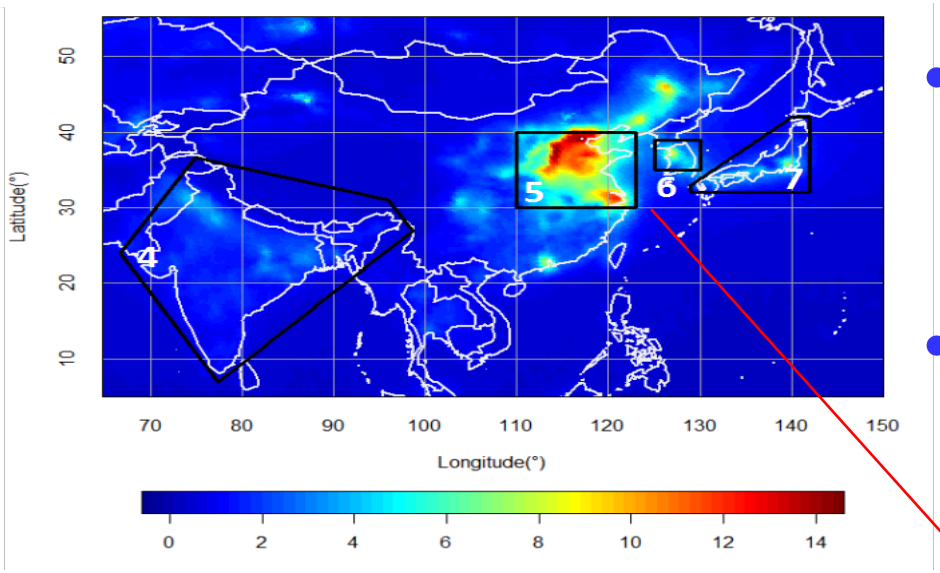
Global NO_2 trends (2012-2016) from OMPS



$$Y_t = A + BX_t + C\sin(DX_t + E) + \delta U_t + N_t$$

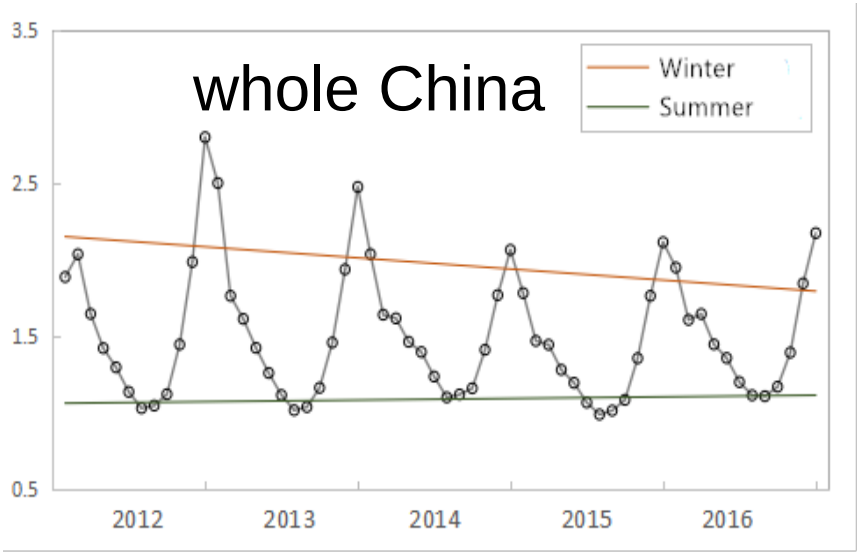
(0.25° × 0.25°)

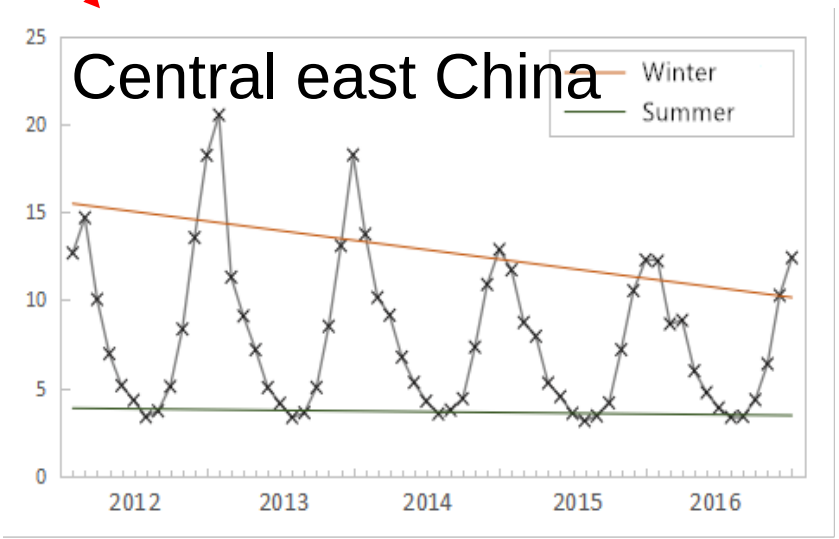
OMPS observed trop. column NO_2 in China



- China trend: -0.8±0.28 x 10^{14} molecules·cm^{-2}·yr^{-1} (-3.0±1.4%/yr)
- Decreasing is largest in winter and over central East China

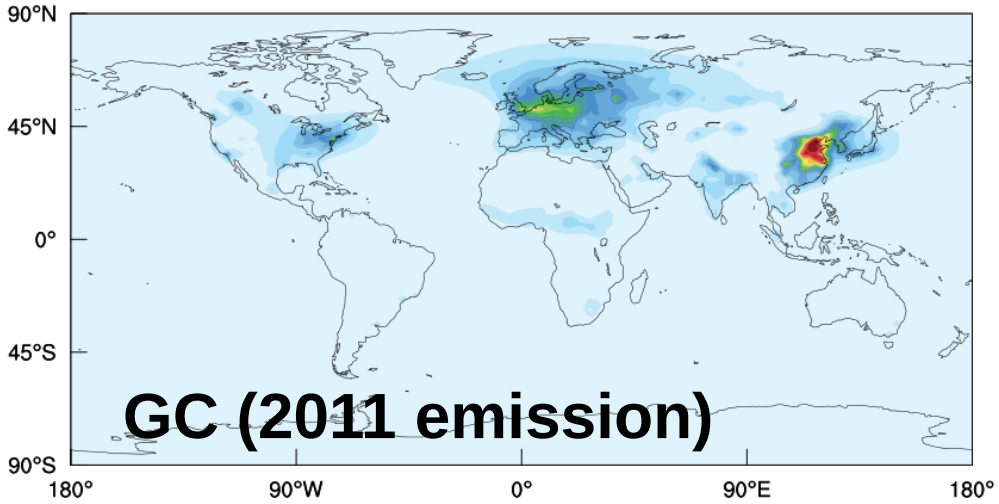
10^{14} molecules·cm^{-2}

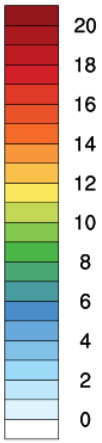




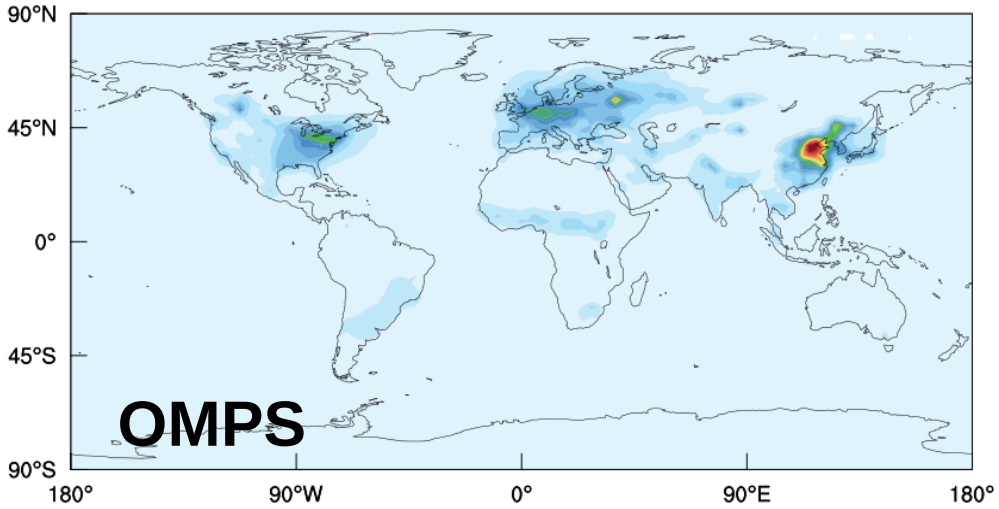
Use GC to simulate effects of meteorology

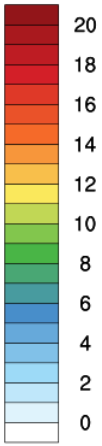
Winter Trop NO_2 vertical column density
2012-2016 (Jan and Feb)





10^{15} molecules·cm^{-2}

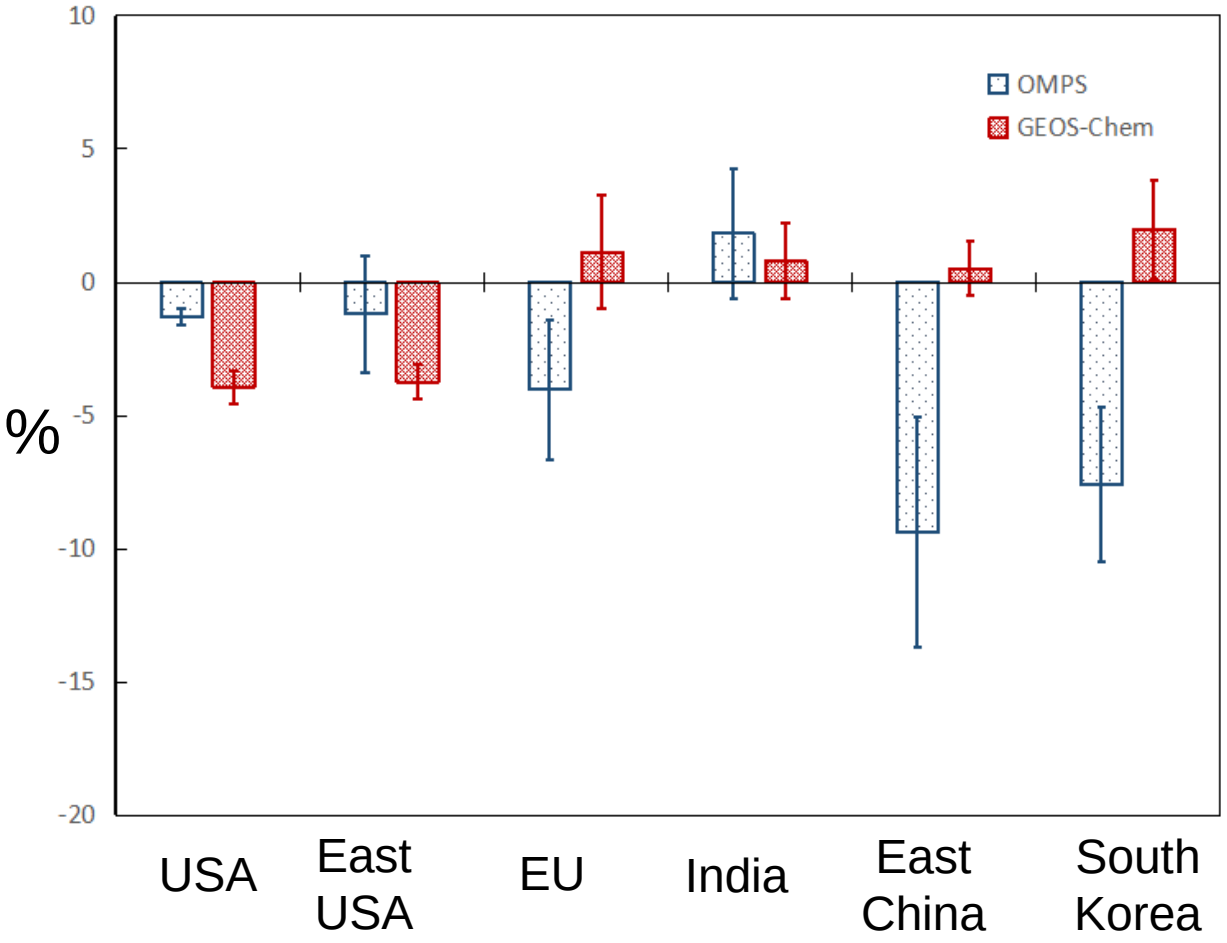




10^{15} molecules·cm^{-2}

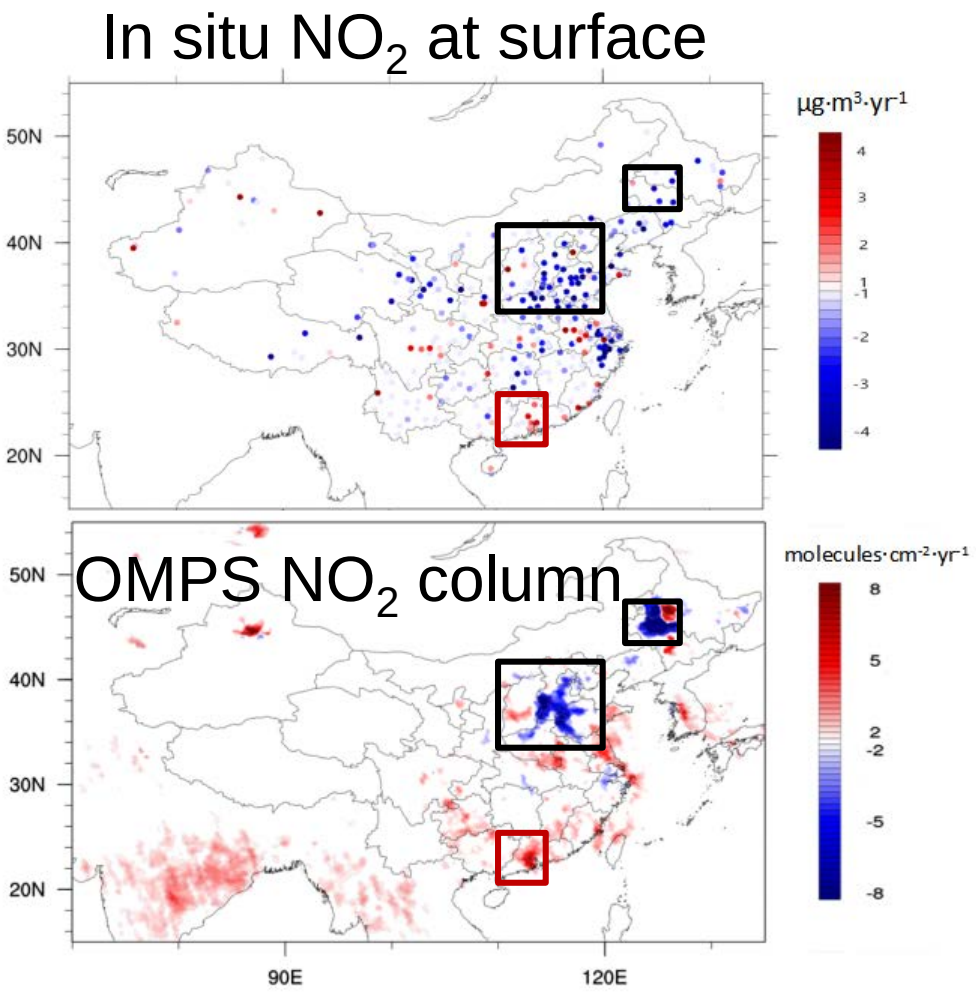
Trop NO_2 trend in China driven by emissions

Winter trend from OMPS and GEOS-Chem (2012-2016)



- Small met effect in China; OMPS trend reflects decreasing emissions
- Meteorology effect dominates for the US
- Possible small decrease of emissions in EU

Validation with surface monitoring data



- Both calculated using annual mean from 2015 to 2017.
- Consistent spatial distributions in trend between the two datasets
- OMPS-observed NO_2 column trend is most likely driven by surface emissions

Summary

- OMPS NP provides consistent records of NO_2 column density observations since 2012
- OMPS derives significant decreasing trend of tropospheric NO_2 over China during 2012-2016, consistent with in situ NO_2 at the surface
- GEOS-Chem simulations indicate emissions drive the decreasing trend of trop NO_2 from OMPS
- NOx emissions ‘turning’ point occurred 2013