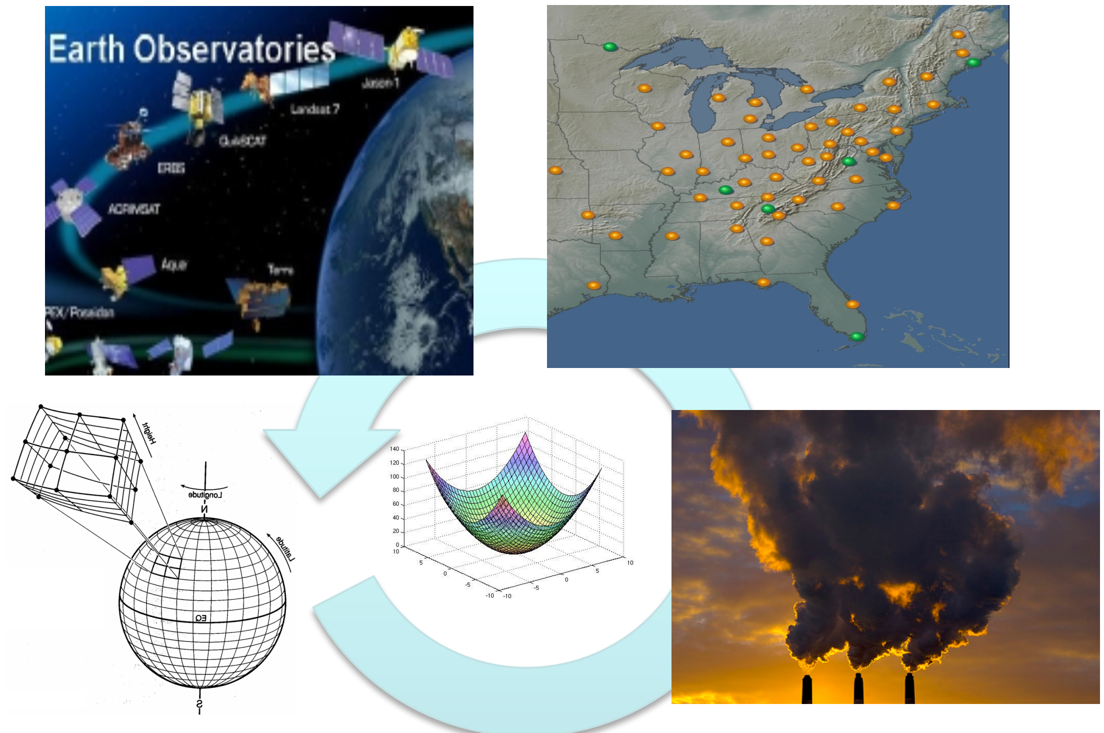
Top-down trends in NO_x – recent changes and impacts on O_3



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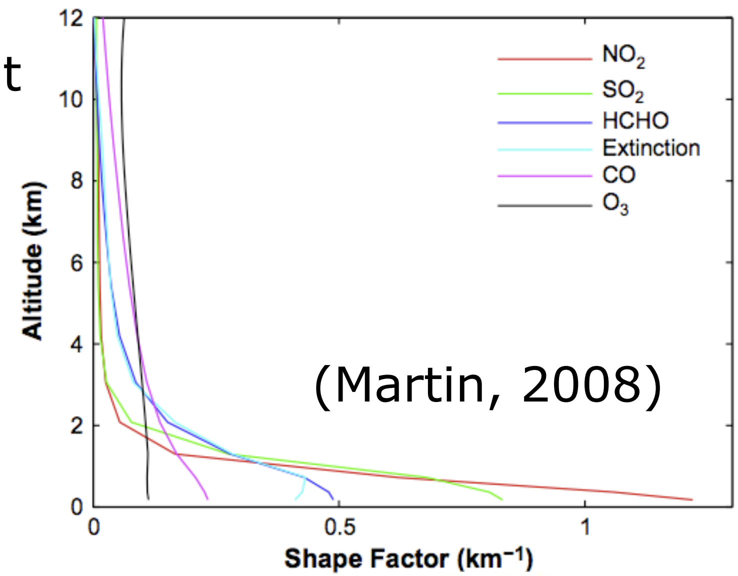
Remote sensing constraints on NO_x emissions

NO_2 observations provide insight into NO_x emissions magnitudes and trends, e.g. recent studies over China:

- Jin and Holloway, 2015
- Krotkov et al., 2016
- Cui et al., 2016
- Duncan et al., 2016
- Fioletov et al., 2016
- Xia et al., 2016
- van der A. et al., 2016
- Qu et al., 2017
- Souri et al., 2017
- de Foy et al., 2016



(Martin, 2008)

Ratio of observed to modeled column concentrations (Ω) is proportional to emissions: $(E / E_{model}) \sim (\Omega_{sat} / \Omega_{model})$

Proportionality impacted by chemistry and transport; treated to varying degree of rigor.



vs

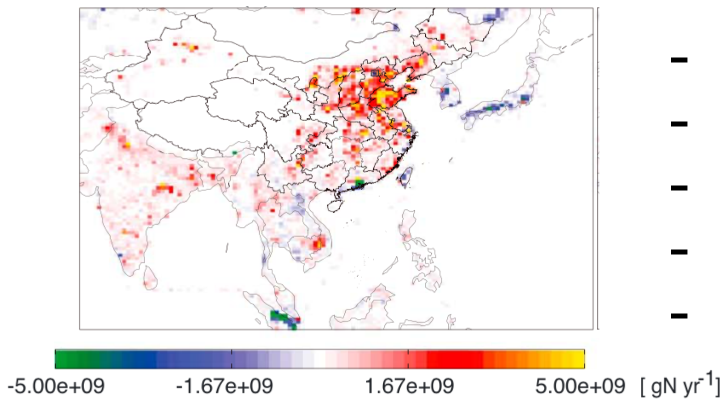


Our team applies methods for quantitative yet computationally expedient constraints on emissions from remote sensing data
(Turner et al., 2012; Cooper at al., 2017; Qu et al., 2017)

Trends & impacts feed Tiger Team assessments

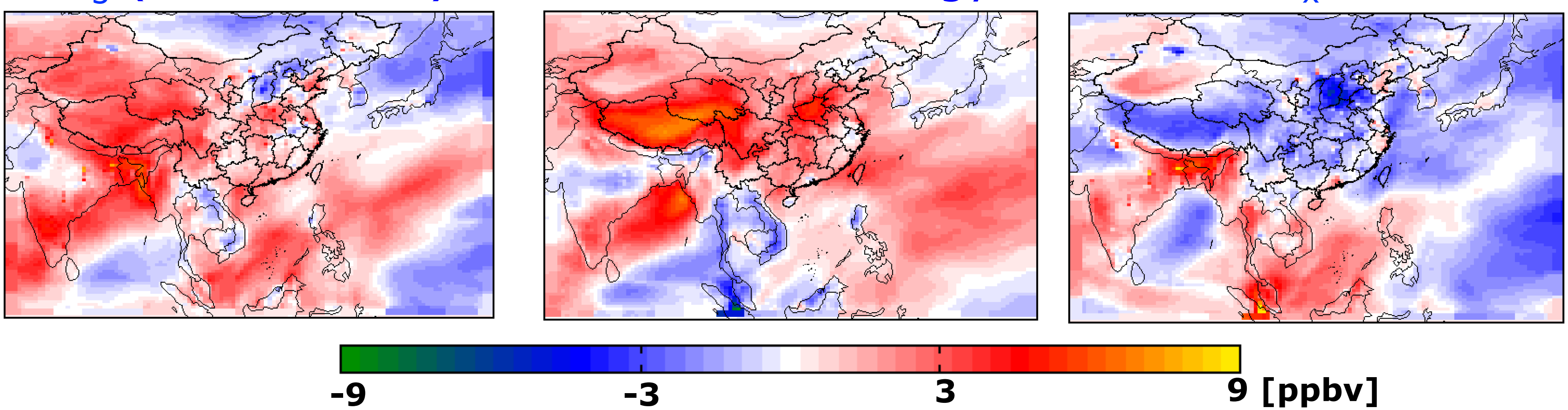
NO_2 trends in East Asia

ΔNO_x emissions (2012 – 2005) from Qu et al. (2017)



- Hybrid 4D-Var / Mass Balance
- OMI NASA SP NO_2 & GEOS-Chem
- Mostly increases 2005 to 2010
- Some decreases 2010 to 2012
- What are the impacts on O_3?

ΔO_3 (2012 – 2005) | From meteorology | From ΔNO_x emissions



- O_3 increase caused by meteorology, decrease by NO_x saturation
- Saturation dominated in Beijing, Hebei and Shanxi (e.g., Jin et al., 2017)