NH3 concentration trend

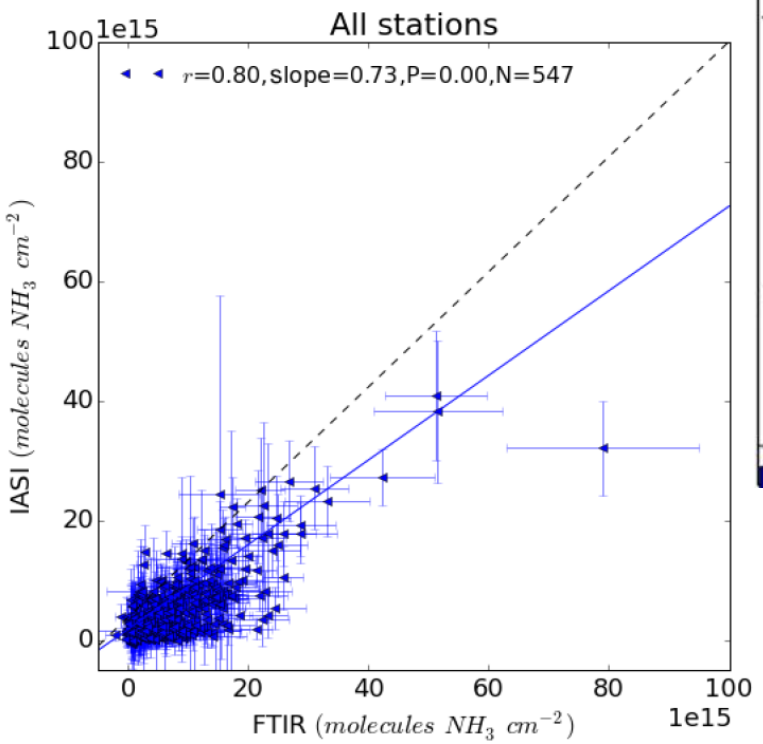
Zhenqi Luo 2021.6

Progress

- validation of IASI NH3 data
  - ground-based measurements
  - airborne data sets

Analysis

- FTIR measurements
  - 9 locations
  - N_obs: 547
- MRD (Mean Relative Difference): -32.4 ± (56.3) %
- Correlation: 0.8
- Slope: 0.73



Atmos. Chem. Phys., 16, 10351–10368, 2016
www.atmos-chem-phys.net/16/10351/2016/
doi:10.5194/acp-16-10351-2016
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Atmospheric Chemistry and Physics
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An evaluation of IASI-NH_3 with ground-based Fourier transform infrared spectroscopy measurements

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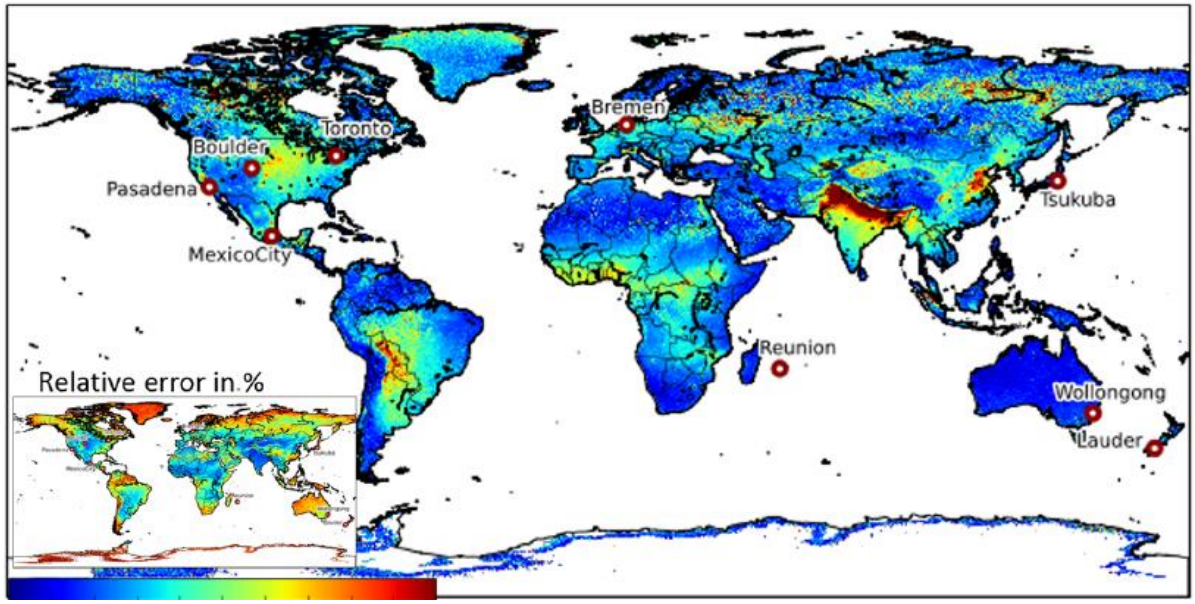

Analysis

- Surface measurements
  - 6 networks
  - Slope: low
  - Intercept: high
- Airborne observations
  - Correlation: 0.8
    - retrieval error < 100%
    - mistime < 3h

Atmos. Meas. Tech., 8, 1575–1591, 2015
www.atmos-meas-tech.net/8/1575/2015/
doi:10.5194/amt-8-1575-2015
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Atmospheric Measurement Techniques Open Access

Towards validation of ammonia (NH_3) measurements from the IASI satellite

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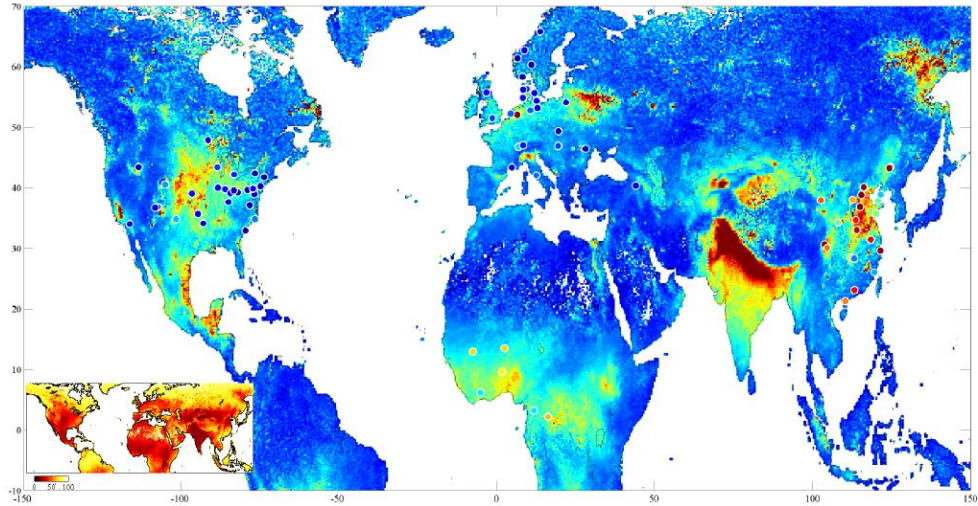
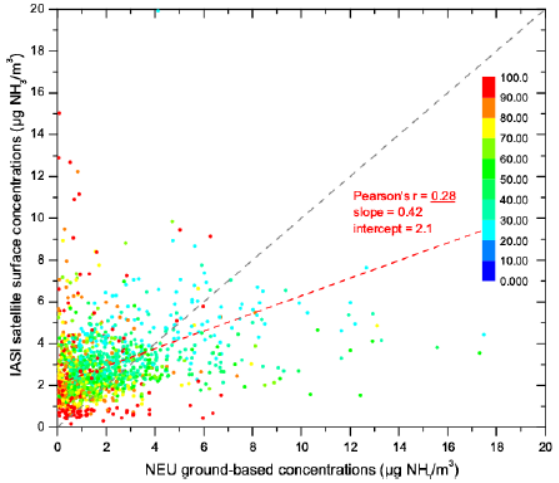
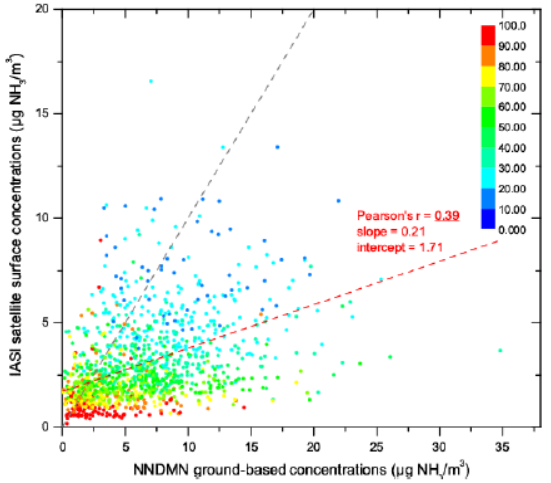
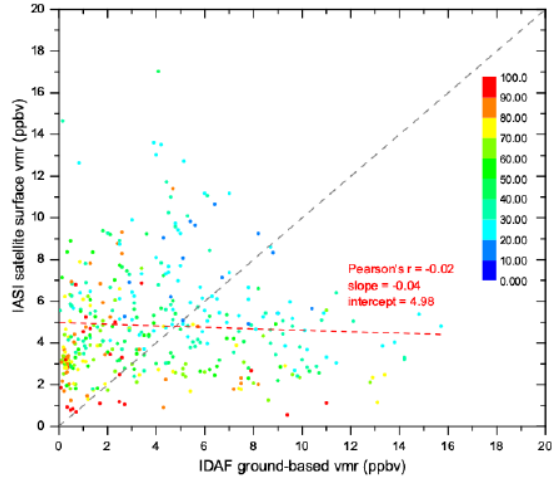








Analysis

- In Situ Measurements
  - California (2013)
  - Colorado (2014)
- Mean deviation: 0.17 E16 molecules/cm2
- Standard deviation: 1.3 E16 molecules/cm2
- Slope: 1±0.2
- Correlation: 0.57

JGR Atmospheres

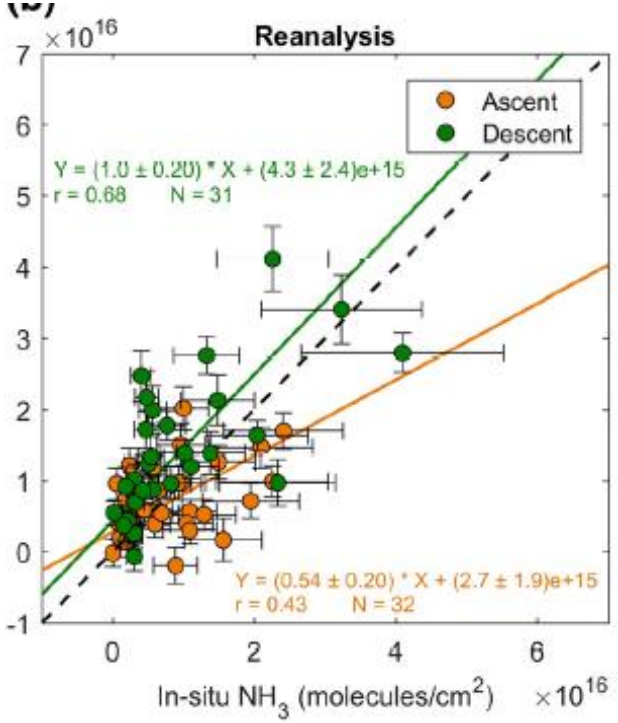
RESEARCH ARTICLE
10.1029/2020JD033475

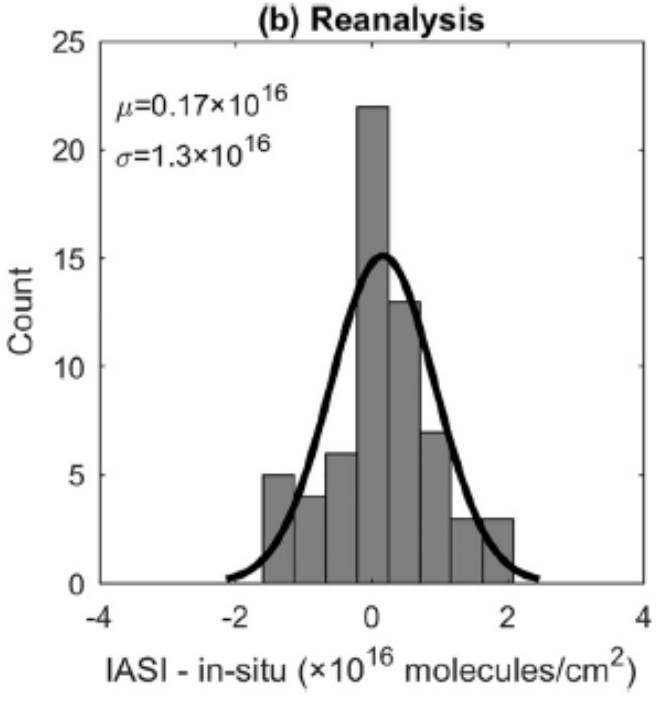
Key Points:

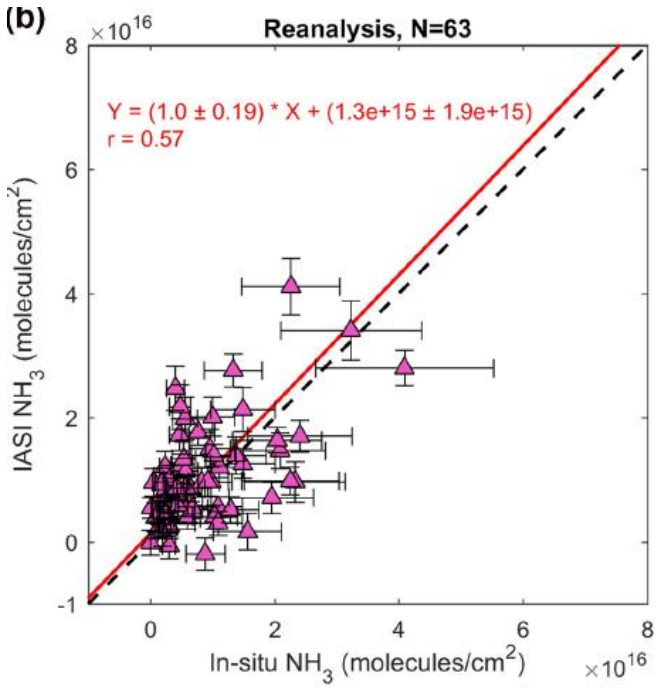
- Infrared Atmospheric Sounding Interferometer NH_3 columns agree well with those derived from boundary layer, in situ measurements with no significant biases at the pixel scale
- Validation in a hotspot region shows best agreement at narrow spatiotemporal scales on the order

Validation of IASI Satellite Ammonia Observations at the Pixel Scale Using In Situ Vertical Profiles

Xuehui Guo[1], Rui Wang[1], Da Pan[1], Mark A. Zondlo[1], Lieven Clarisse[2], Martin Van Damme[2], Simon Whitburn[2], Pierre-François Coheur[2], Cathy Clerbaux[2,3], Bruno Franco[2], Levi M. Golston[1,4,22], Lars Wendt[1,5], Kang Sun[1,6,22], Lei Tao[1,7], David Miller[1,8,22], Tomas Mikoviny[9,10,11,22], Markus Müller[12,13,22], Armin Wisthaler[12,11], Alexandra G. Tevlin[14,15,22], Jennifer G. Murphy[14], John B. Nowak[16,17,22], Joseph R. Roscioli[16], Rainer Volkamer[18,19,20], Natalie Kille[18,19,20], J. Andrew Neuman[19,21], Scott J. Eilerman[22], James H. Crawford[17], Tara I. Yacovitch[16], John D. Barrick[17], and Amy Jo Scarino[17]







Plan

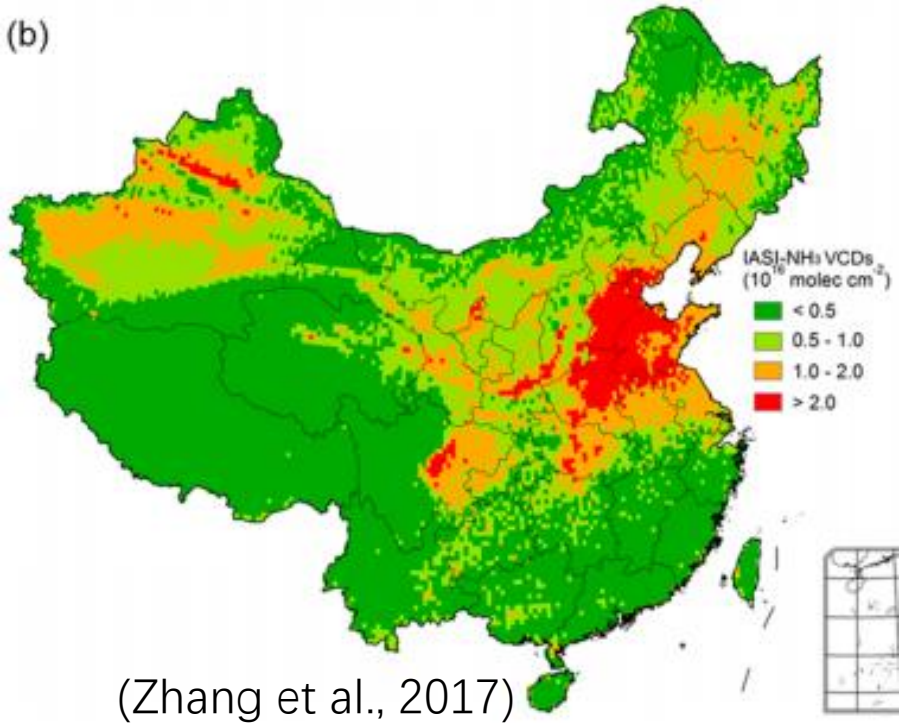
- Comparison of NH3 emissions with other published results
  - Top down
  - Bottom up

litreature

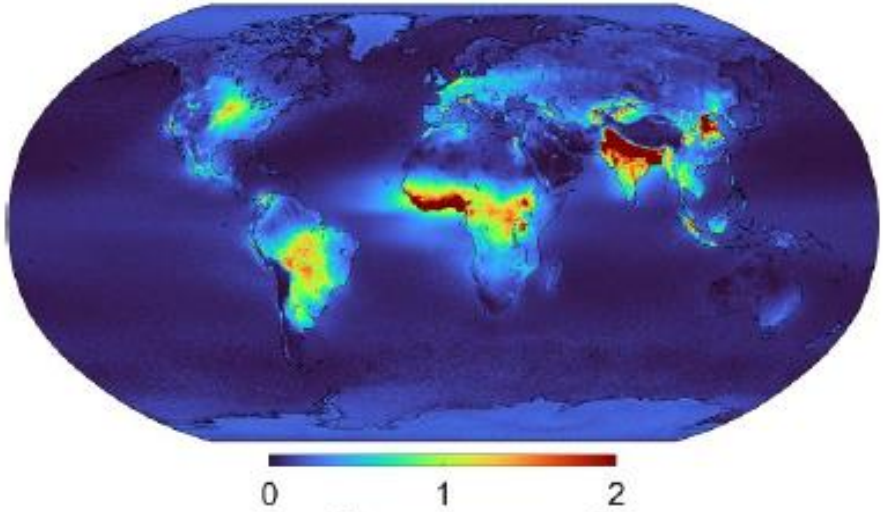
Global, regional and national trends of NH3, 2008-2018

- Source
  - agricultural activities——major source (over 80% in Asia, Europe, US)
    - Livestock manure——volatilization
    - Synthetic fertilizer application——loss
  - EDGAR: 49 Tg
    - Agricultural: 86%
    - 20 % increase over 2000-2010
  - GFED:
    - Others: 4.9 Tg
- Reduction in emissions of nitrogen and sulfur oxides——increased NH3
- Satellite measurements: morning overpass IASI/Metop-A——2008-2018
  - A good correlation: in-situ vertical profiles vs IASI-NH3
- Trend method:
  - least squares regression
  - bootstrap resampling
  - global/national

$$\mathrm{NH_3}(t) = ct + \sum_{n=0}^{3}[a_n \sin(2\pi nt) + b_n \cos(2\pi nt)].$$



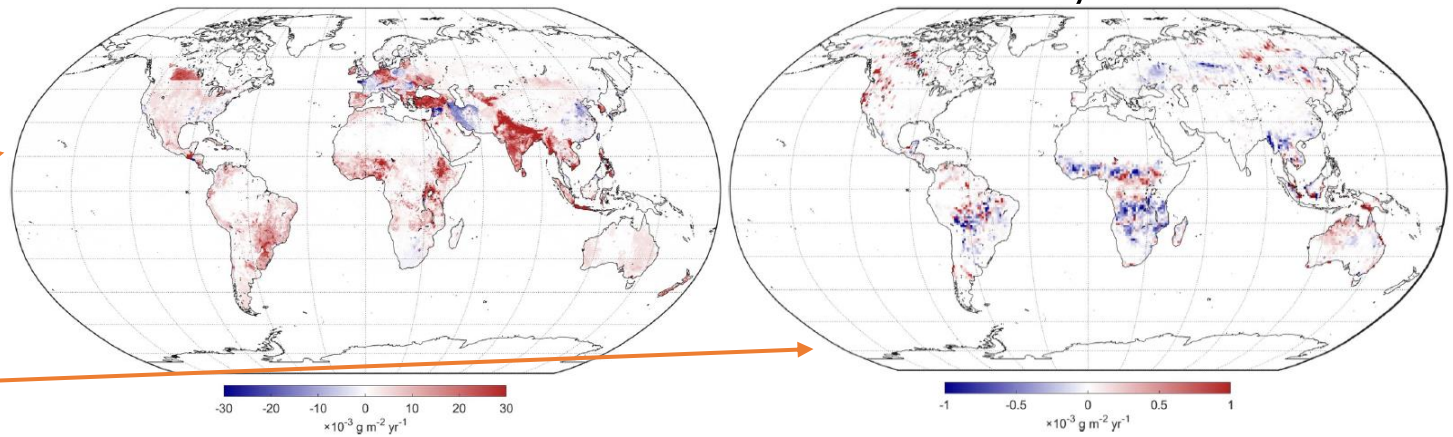
(Zhang et al., 2017)



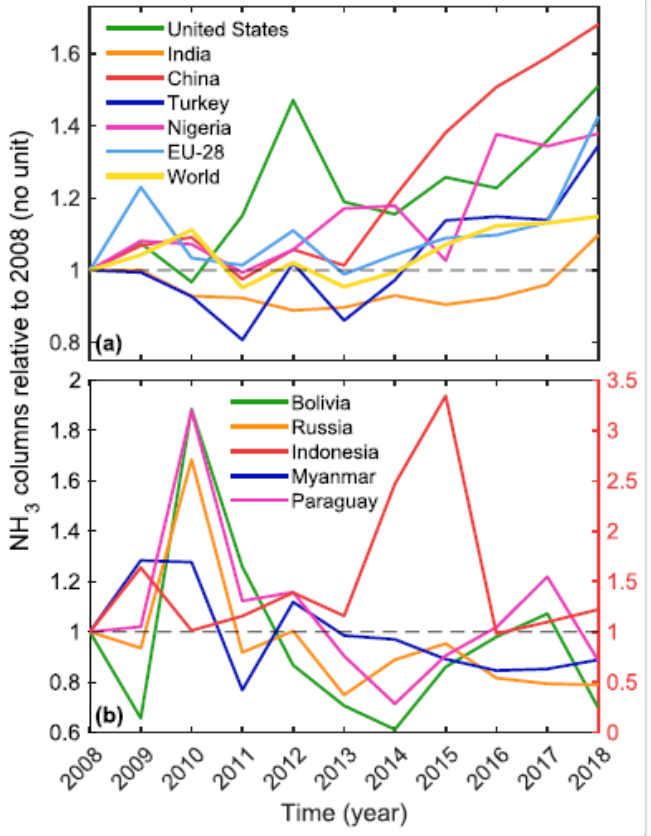
(Van Damme et al., 2021)

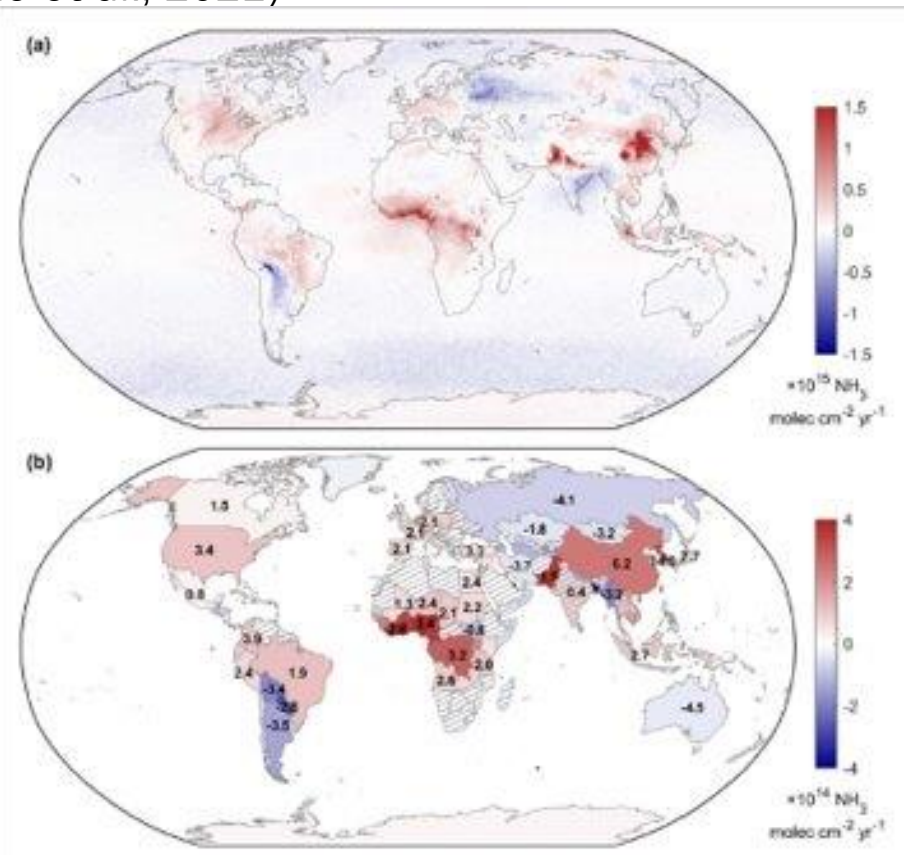
Global, regional and national trends of NH3, 2008-2018

- Inventory Trend:
  - EDGAR: 2008-2015
    - China: a moderately slow decline
  - GFED: 2008-2018
    - southeastern Asia: decrease
- IASI Trend:
  - East Asia: largest increase
  - China: 83.3 ± 7.0 %——longer atmospheric lifetime
  - India:
    - IGP: high upward
    - Southeastern: decreasing
  - EU: increase in 2018
  - Western and central Africa: strong upward
  - South America: small change
  - US: positive



(Van Damme et al., 2021)





Questions?