

anthropogenic emissions

Zhenqi Luo 2021.4

progress

$$\hat{E} = \frac{\Delta M_{NH_3}}{\tau_{mod}} + E_{mod}$$

- ΔM_{NH_3} : the NH_3 mass difference between observation and simulation in each atmospheric box
- E_{mod} : GEOS-Chem emission

• 1. Uncertainty analysis

• Lifetime

- IASI total columns concentrations
 - relative error
 - standard deviation
- Export
 - transport (-)
- Deposition
 - standard deviation

• Modelled concentrations

- standard deviation

• Transportation (+)/emission ratio: 0/0.5/0.8/**1**/1.2/1.5/2

• Number of retrievals: 0/15/25/**30**/35/40/50

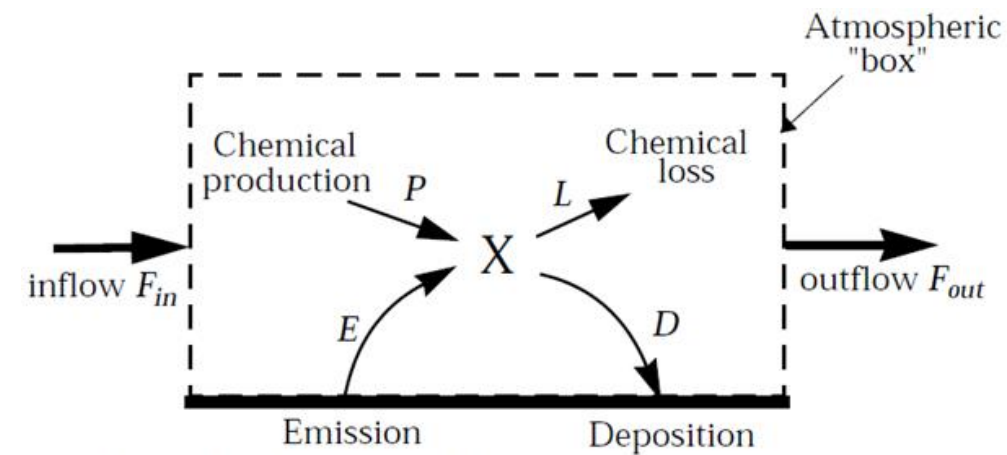


Figure 3-1 One-box model for an atmospheric species X

(Jacob, 1999)

$$\tau = \frac{M}{F_{out} + L + D}$$

- M : NH_3 mass
- F_{out} : NH_3 mass rate of export
- L : NH_3 mass rate of chemical reaction
- D : NH_3 mass rate of deposition, including the wet deposition and the dry deposition

$$\tau_{mod} = \frac{M_{NH_3}}{D_{NH_3} + D_{NH_4^+}}$$

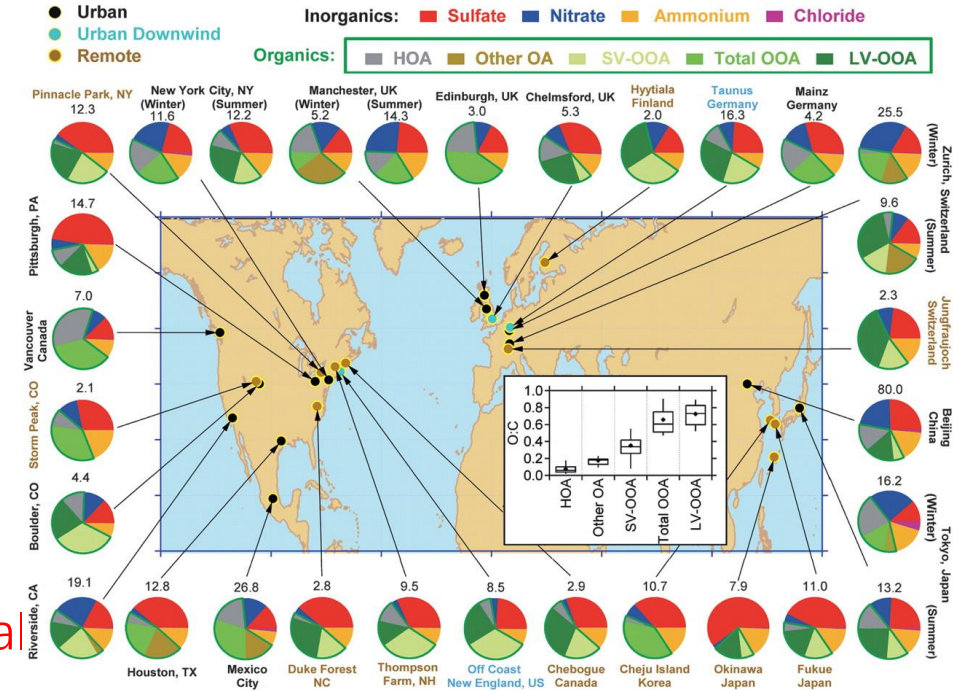
Analysis & Plan

- Parameter uncertainty
- Relative uncertainty of emission

litreature

CEDS_GBD-MAPS inventory

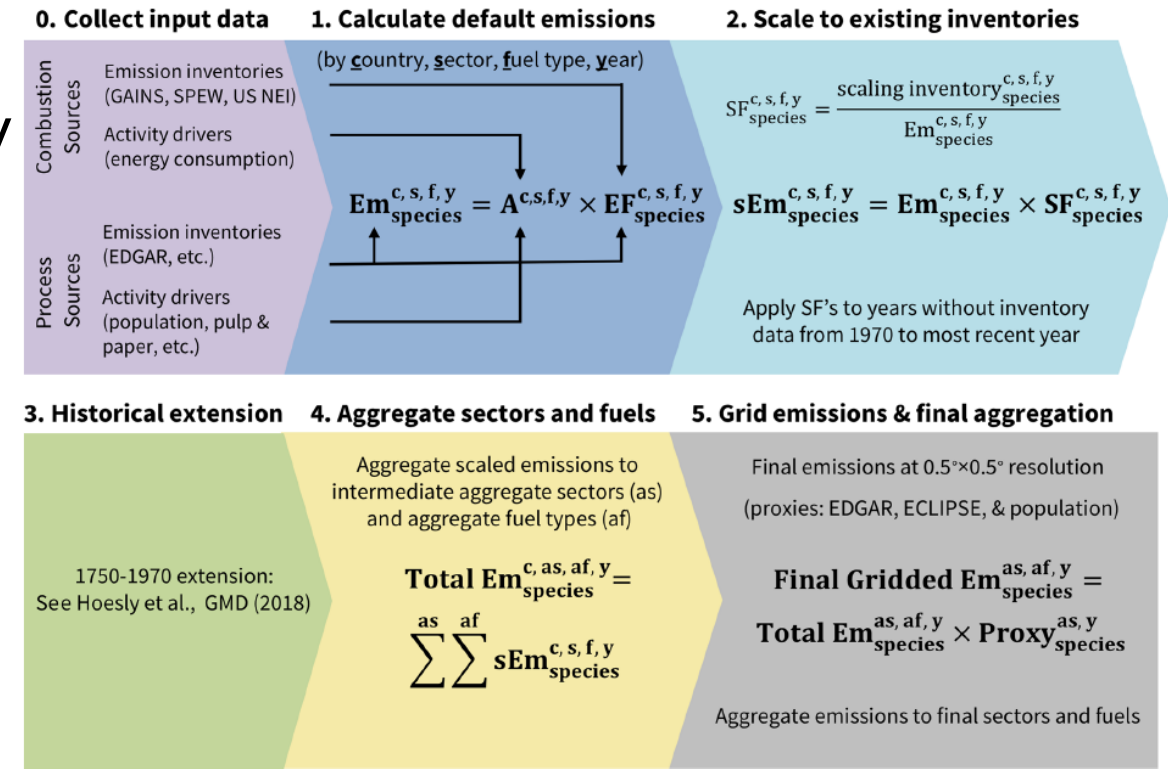
- Particle emissions——(PM 2.5)
 - OC
 - BC
 - SO₂
 - NO
 - VOCs
 - NH₃——agricultural activities——continuous increases in global
 - animal husbandry
 - fertilizer application
- Functions
 - understand the range of emission impacts——inputs in CTM
 - develop effective strategies for pollution mitigation
- Bottom-up inventories
 - EDGAR——European Commission Joint Research Centre
 - ECLIPSE——Greenhouse Gas–Air Pollution Interactions and Synergies (GAINS) model at the International Institute for Applied Systems Analysis (IIASA)
 - CEDS——Joint Global Change Research Institute at the Pacific Northwest National Laboratory and University of Maryland——CEDS_GBD-MAPS (1970-2017)
 - 11 detailed emission source sectors
 - four fuel groups



Total mass concentration and mass fractions
(Jimenez et al., 2009) *Science*

CEDS_GBD-MAPS inventory

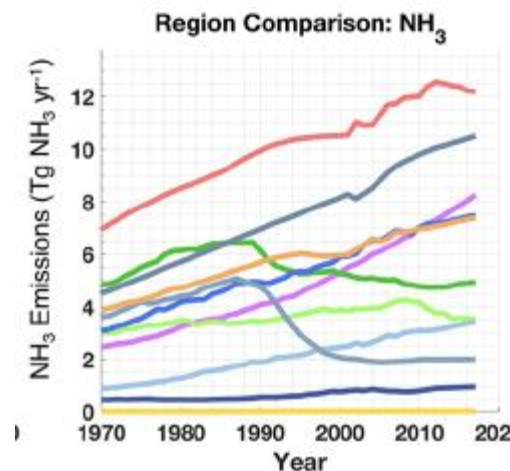
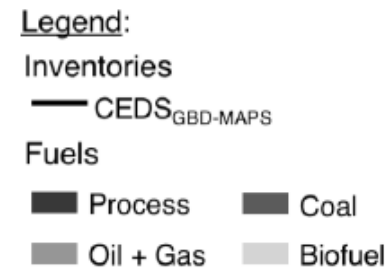
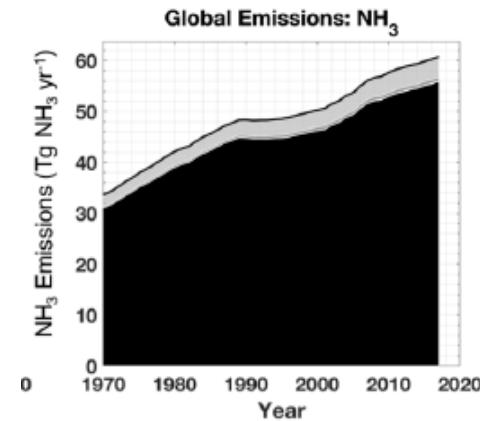
- Step 0: collection of input data
- Step 1: $Em = A * EF$
 - Em: emission estimates
 - A: relevant activity
 - EF: emission factor
- Step 2: scales total emission estimates
 - $SF = \text{scaling inventory } Em / \text{default CEDS } Em$
 - SF: scaling factors
 - extend SFs to fill missing data
- Step 3: extends the scaled emission estimates from 1970 to 1750
- Step 4: aggregates the scaled country-level emissions into gridding sectors
- Step 5: allocate country-level emission estimates onto a 0.5x0.5 grid



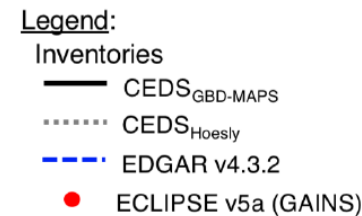
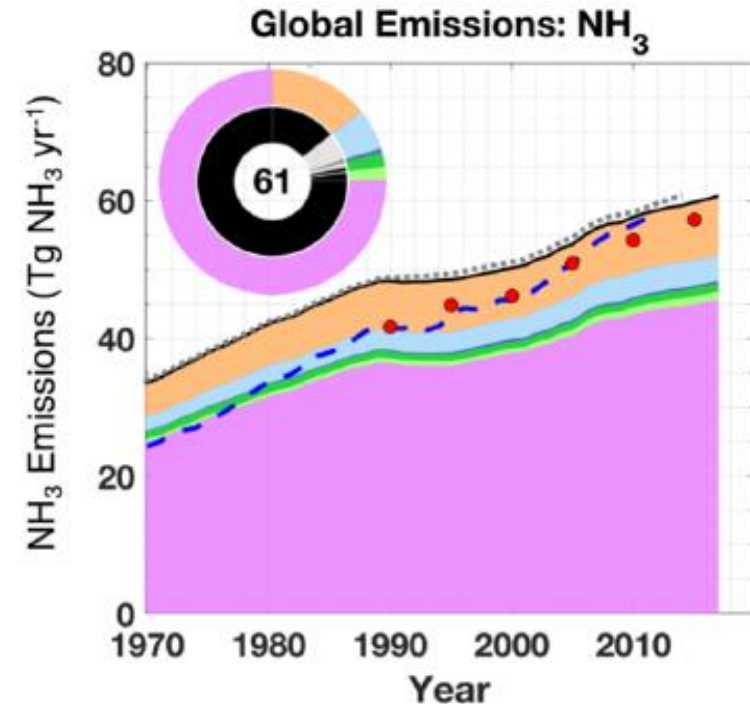
(McDuffiez et al., 2020)

CEDS_GBD-MAPS inventory

- Annual total emissions: time series from 1970–2017
 - Global: agriculture and waste—89%
 - Regions: China—20%, 12 Tg
 - Trend: continuously increase—81%
 - agricultural: 82%
 - waste sector: 77%
- Comparison to global inventories
 - CEDS: unchanged
 - EDGAR: increase rate
 - GAINS: within 15%
- Uncertainties
 - activity data
 - global bottom-up inventories
 - agricultural statistics
 - emission factors
 - regional-level scaling inventories
 - agricultural regions in winter: underestimated
 - sectoral and fuel contributions
 - grid



(McDuffiez et al., 2020)



Questions?