

# Ammonia observation and modeling simulation 4

IASI data and GEOS-Chem simulation

2020.11

- Accomplished:
  - 1. calculate the total column concentration of GEOS-Chem output
  - 2. simulating the GEOS-Chem from 2008-2018
  - 3. regrid the IASI from  $1^{\circ} \times 1^{\circ}$  to  $4^{\circ} \times 5^{\circ}$
- Ammonia Data:
  - IASI total columns,  $1^{\circ} \times 1^{\circ}$ , monthly
    - Reanalyzed IASI/Metop-A (2008-2018) L3
  - GEOS-Chem simulation,  $4^{\circ} \times 5^{\circ}$ , daily
    - column concentration (2010)
- Ongoing:
  - 1. seasonal mean distribution of GEOS-Chem over 2008-2018
  - 2. seasonal trend distribution of GEOS-Chem over 2008-2018

# total column concentration

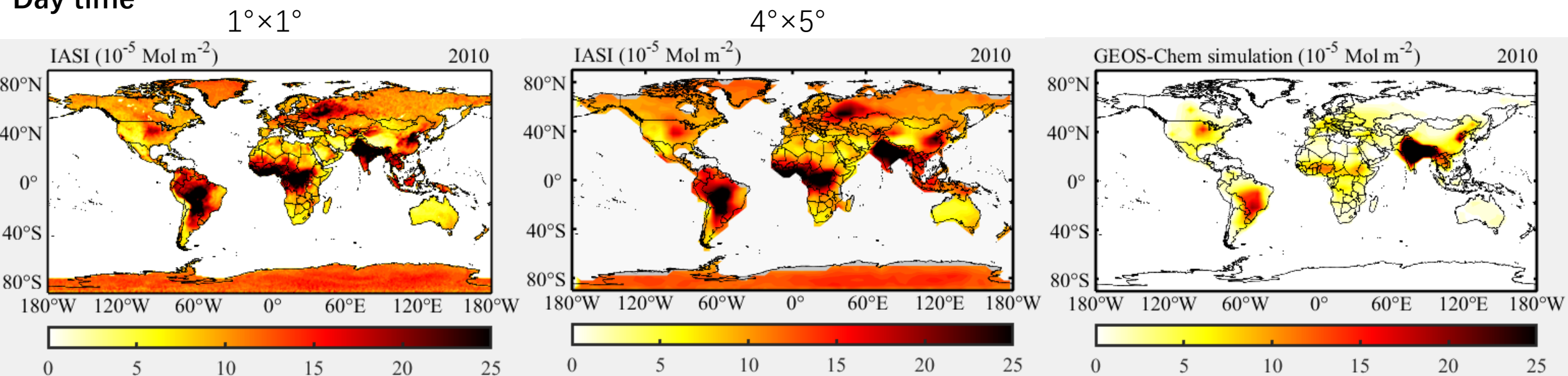
- $\Omega = \sum_{i=1}^{47} c_i \times rho_i \times h_i \times k$ 
  - $\Omega$ : total column concentration, [mol/m<sup>2</sup>]
  - $c_i$ : 'IJ-AVG-\$\_NH3', mixing ratio for each level, [ppbv] to [v/v] (\*1E-9)
  - $rho_i$ : 'TIME-SER\_AIRDEN', air density for each level, [molecules/cm<sup>3</sup>]
  - $h_i$ : 'BXHGHT-\$\_BXHEIGHT', grid box height for each level, [m] to [cm] (\*100)
  - $k$ : 1/6.02214179E19, multiplication factor to convert [molecules/cm<sup>2</sup>] to [mol/m<sup>2</sup>]

# Regrid 180x360 to 46x72

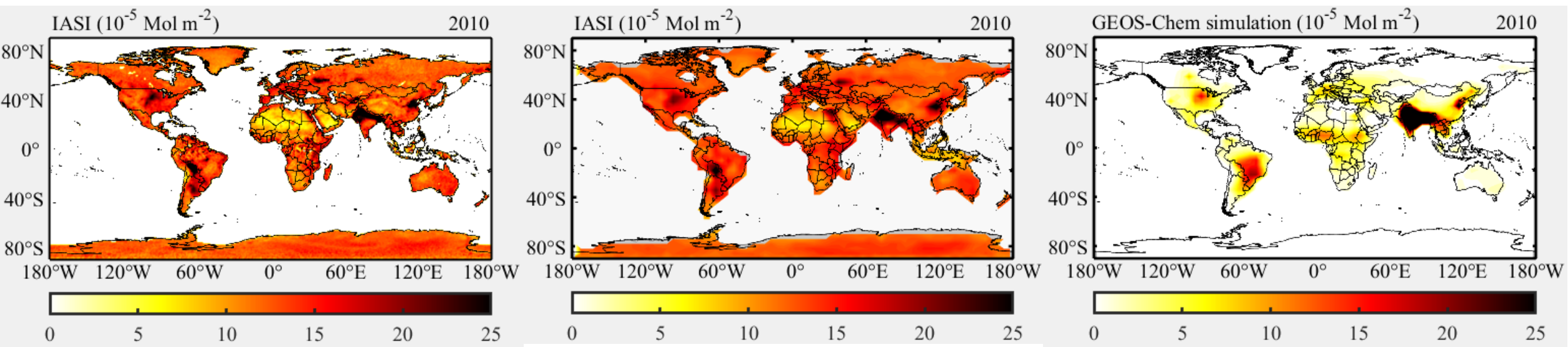
- Latitude: 46 degrees
  - 88°-90°: 2x5 to 1x1, 2 degrees
  - 0-88°: 4x5 to 1x1, 44 degrees
- Method:
  - Step1: mask ocean, set as NaN
  - Step2: calculate mean value in each upscaling grid

# Ammonia spatial distribution

## Day time



## Night time

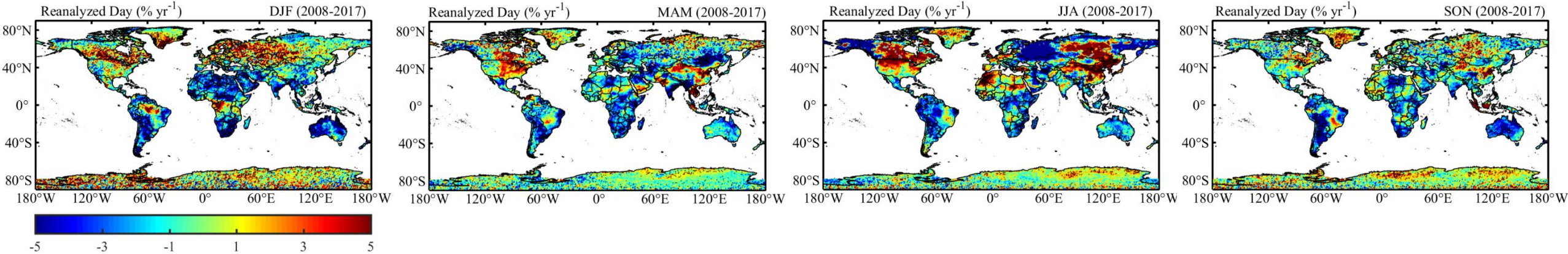




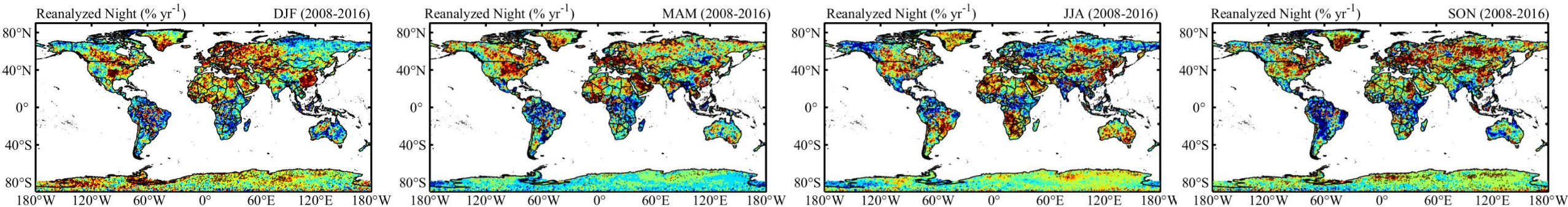


# Spatial distribution of ammonia observations trend/mean

(a) day

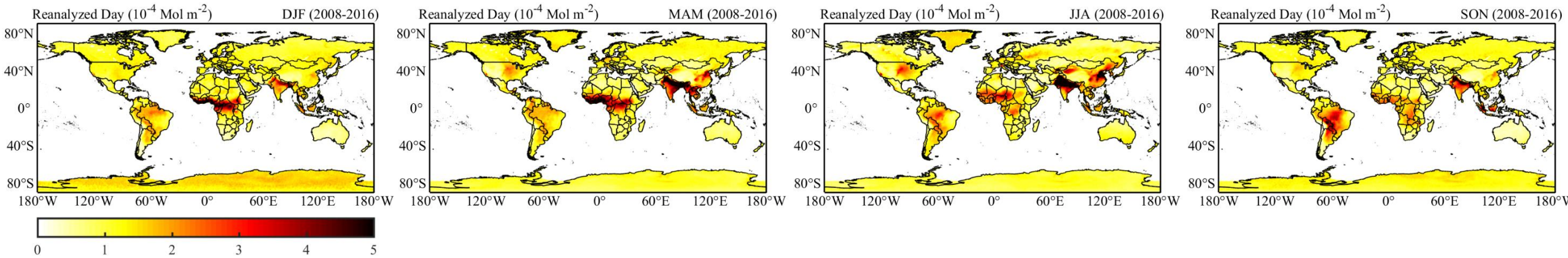


(b) night

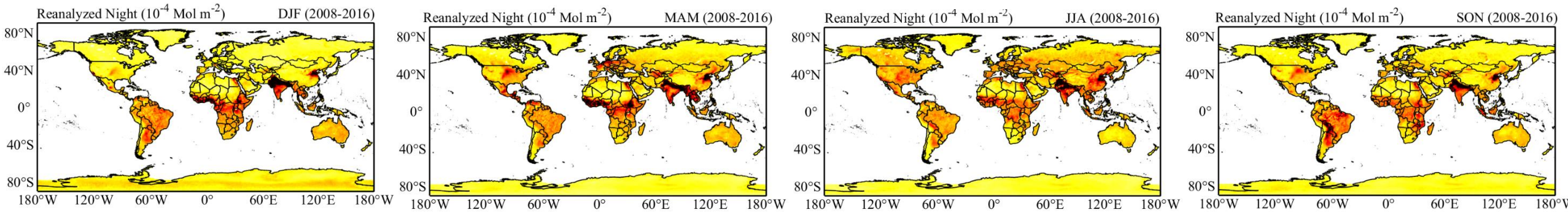


# Spatial distribution of ammonia observations mean

(a) day

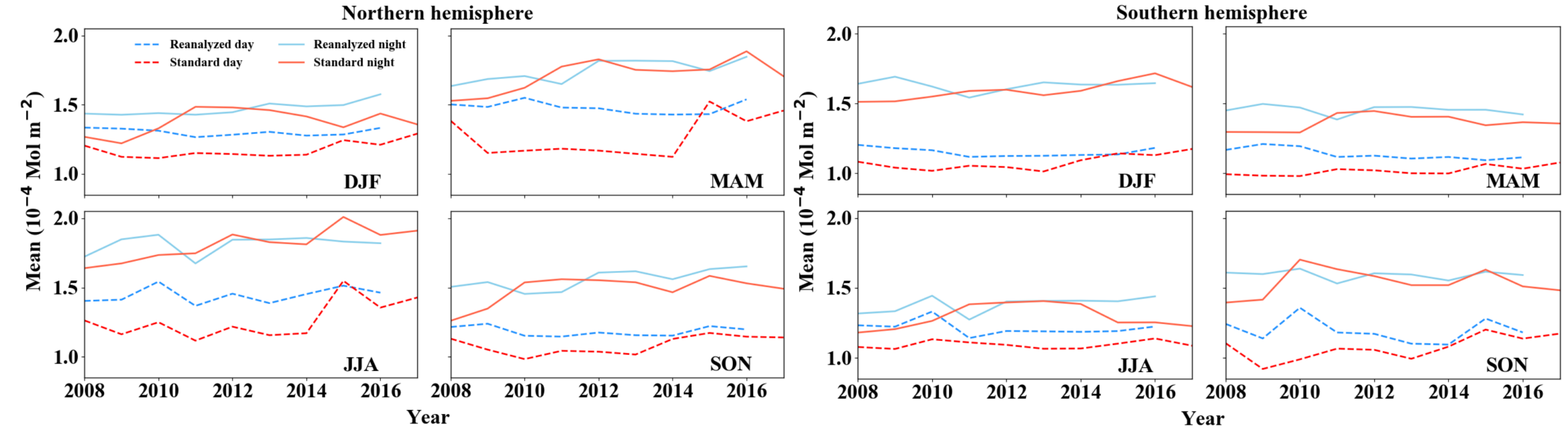


(b) night



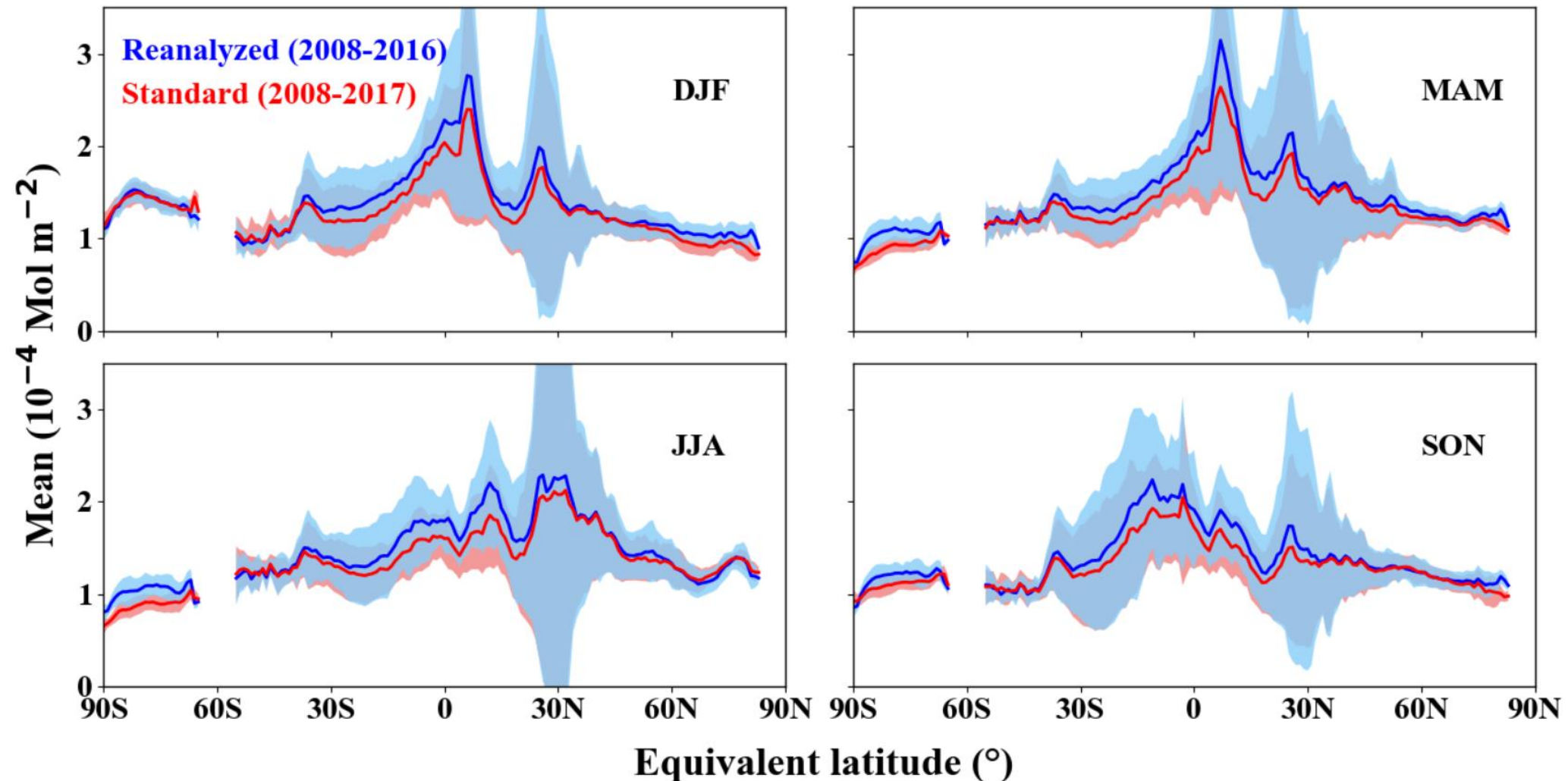


# Seasonal change for NH and SH (day and night)



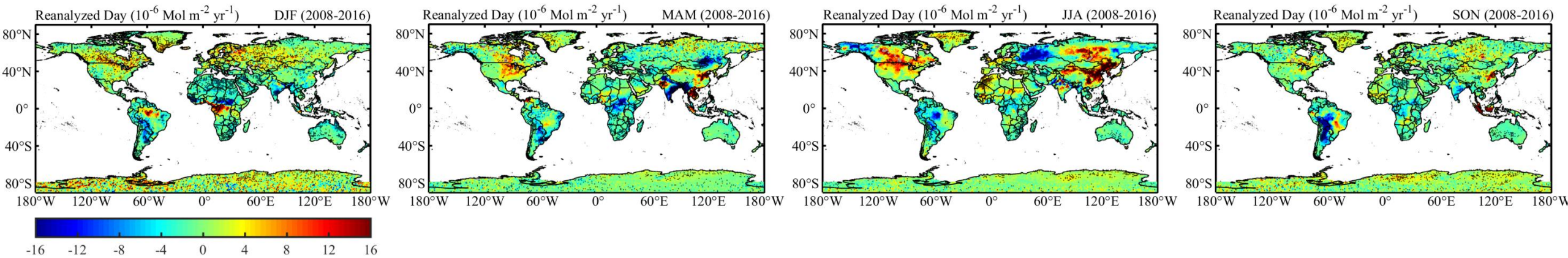
# Seasonal mean of Land for equivalent latitude (within 1 sigma standard deviations)

**Observational seasonal mean**

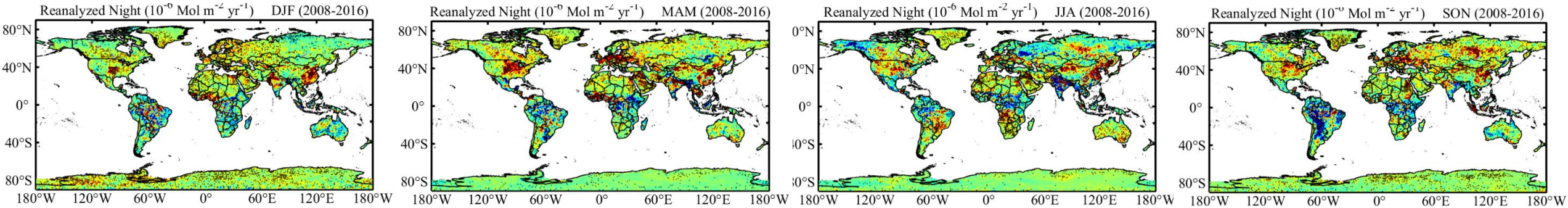


# Spatial distribution of ammonia observations trend

(a) day



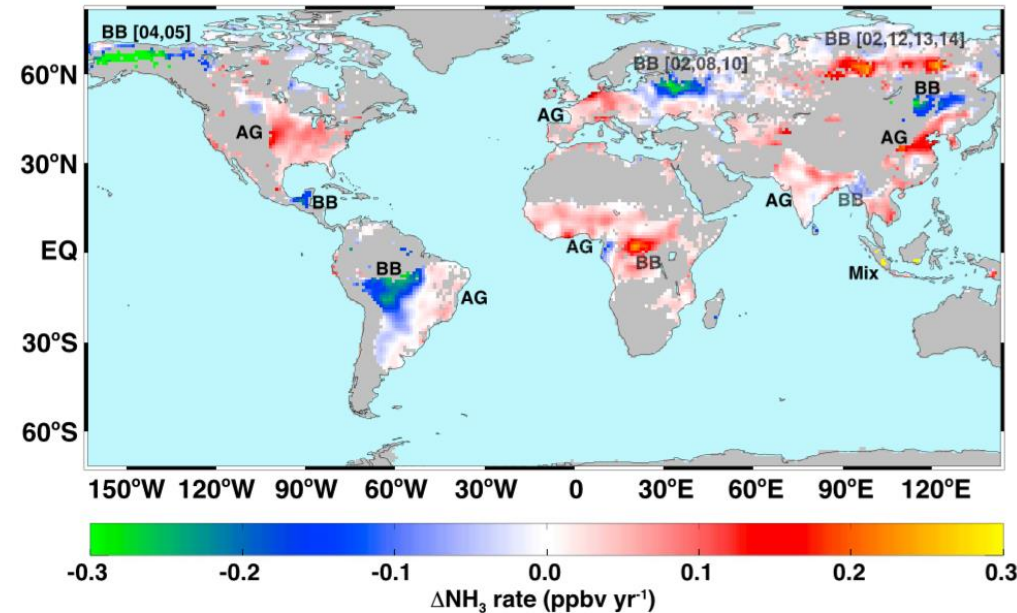
(b) night



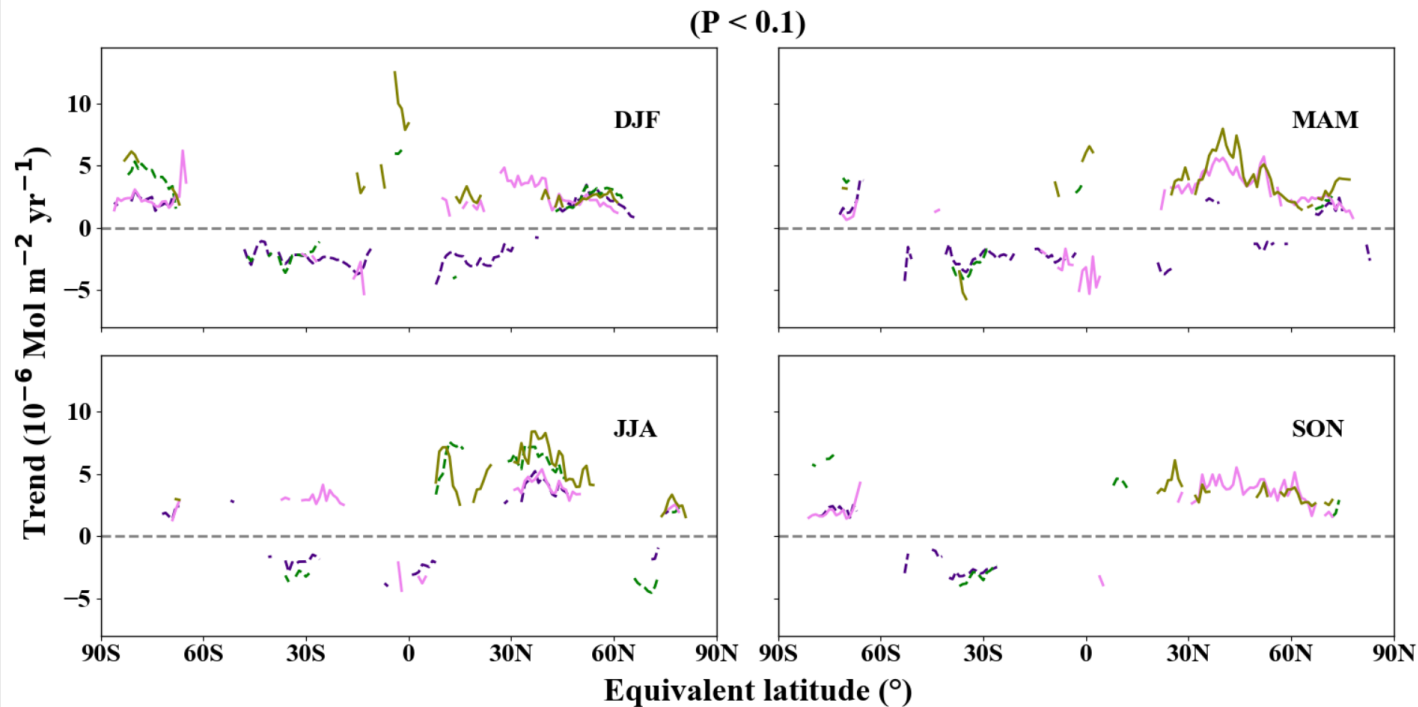
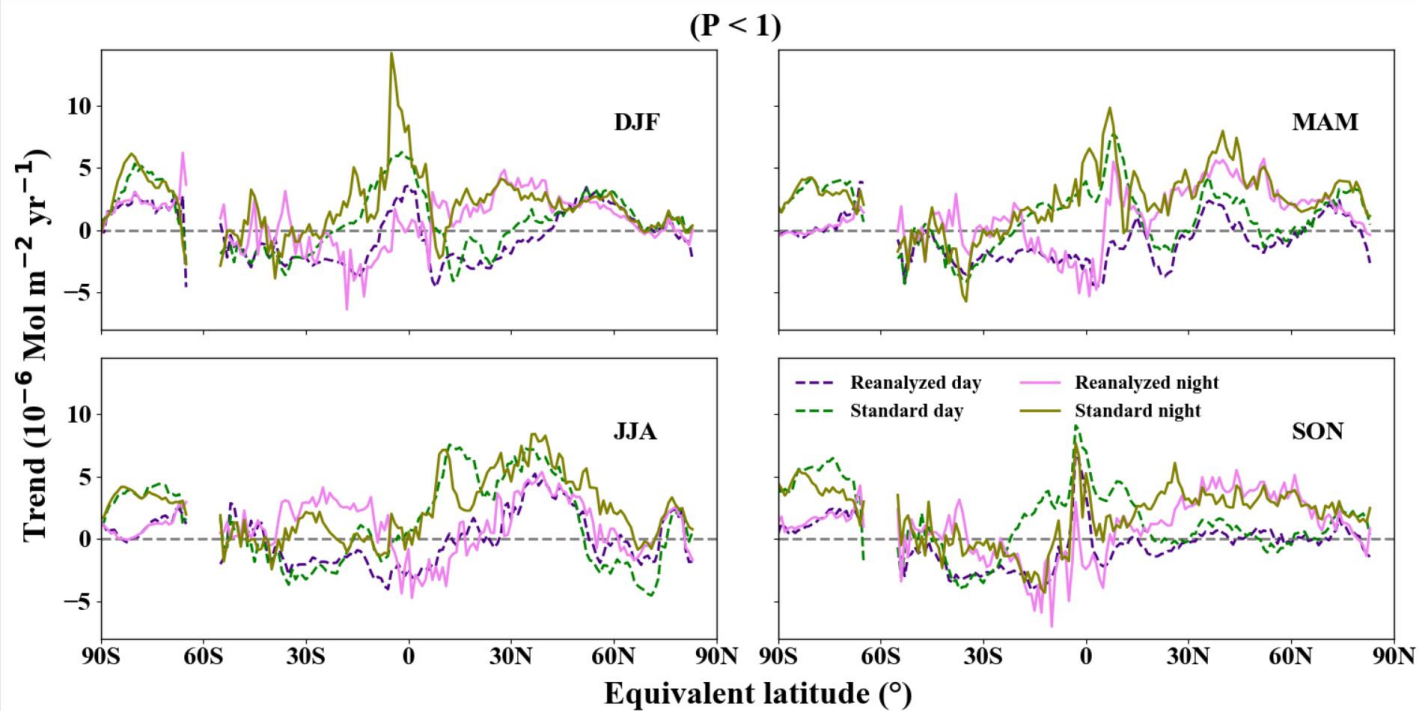


# Increased atmospheric ammonia over the world's major agricultural areas detected from space

- provides evidence of substantial increases in atmospheric ammonia ( $\text{NH}_3$ ) concentrations (14year) over several of the world's major agricultural regions
- The rate of change of  $\text{NH}_3$  volume mixing ratio (VMR) in parts-per-billion by volume (ppbv) per year computed
  - BB: biomass burning
  - AG: agricultural

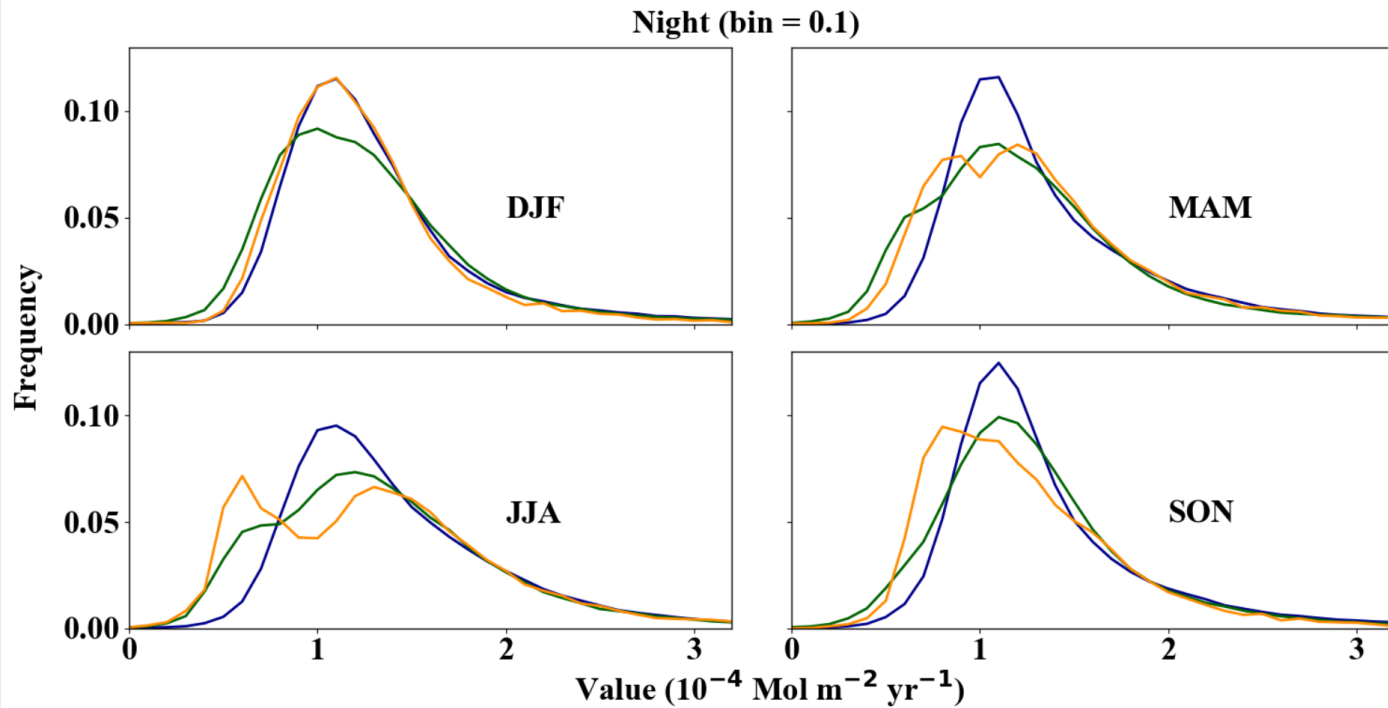
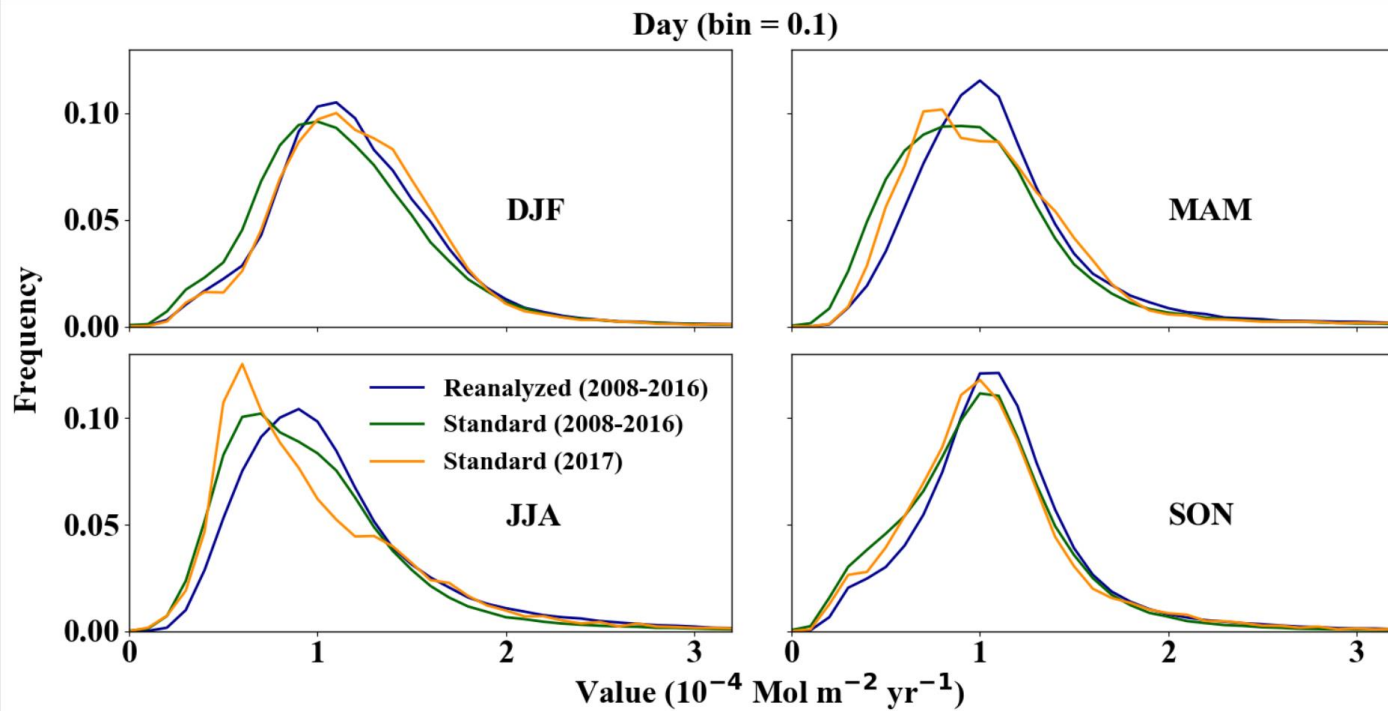


(Warner et al, 2016)



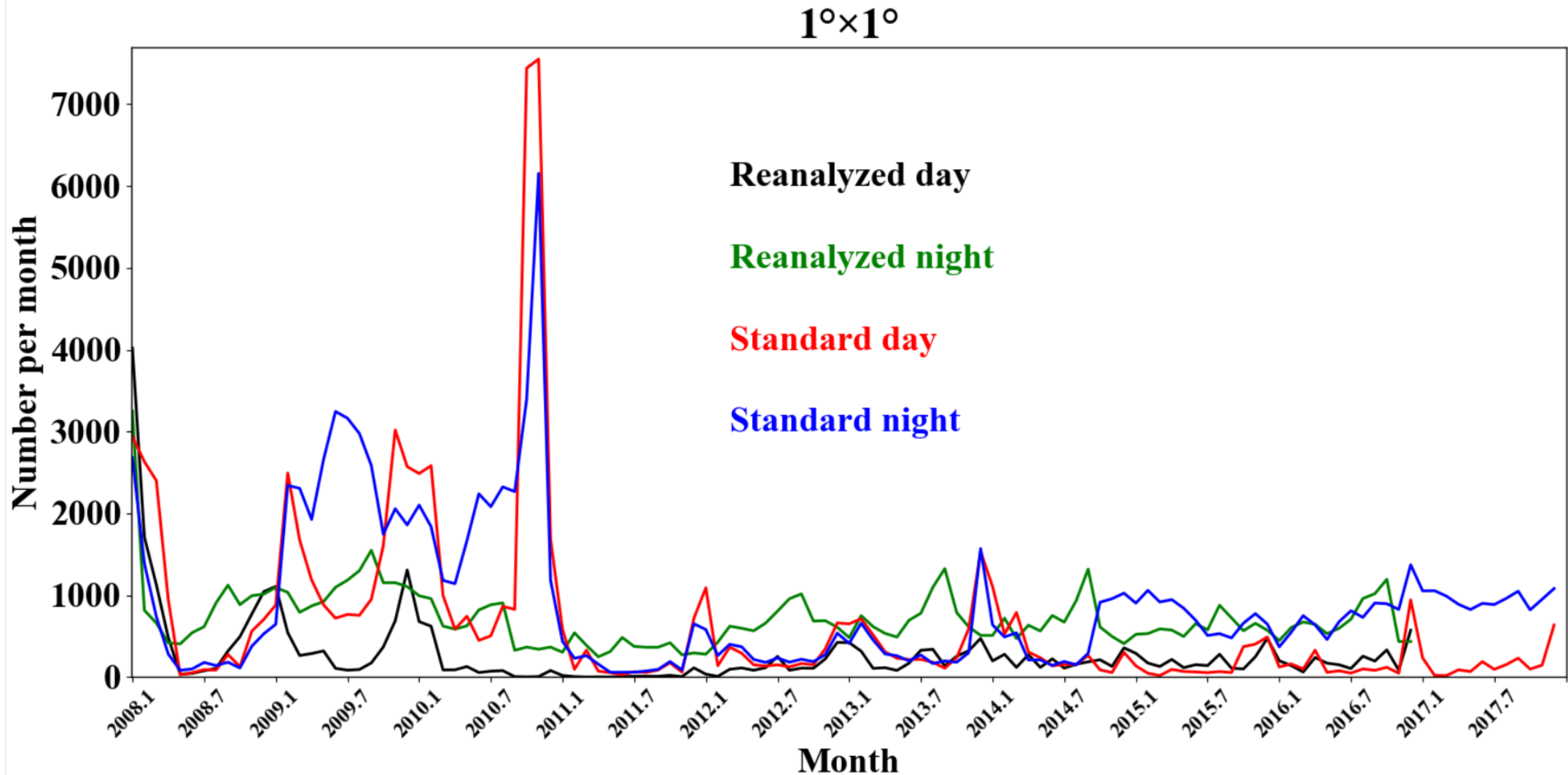
Seasonal trend in the  
equivalent latitude  
over 2008–2016 (day  
and night)





PDF of the 2008-  
2016 and 2017 (day  
and night)

# Missing value of datasets over 2008-2017 (per month)



End

