

Is the growth rate of N₂O increasing?

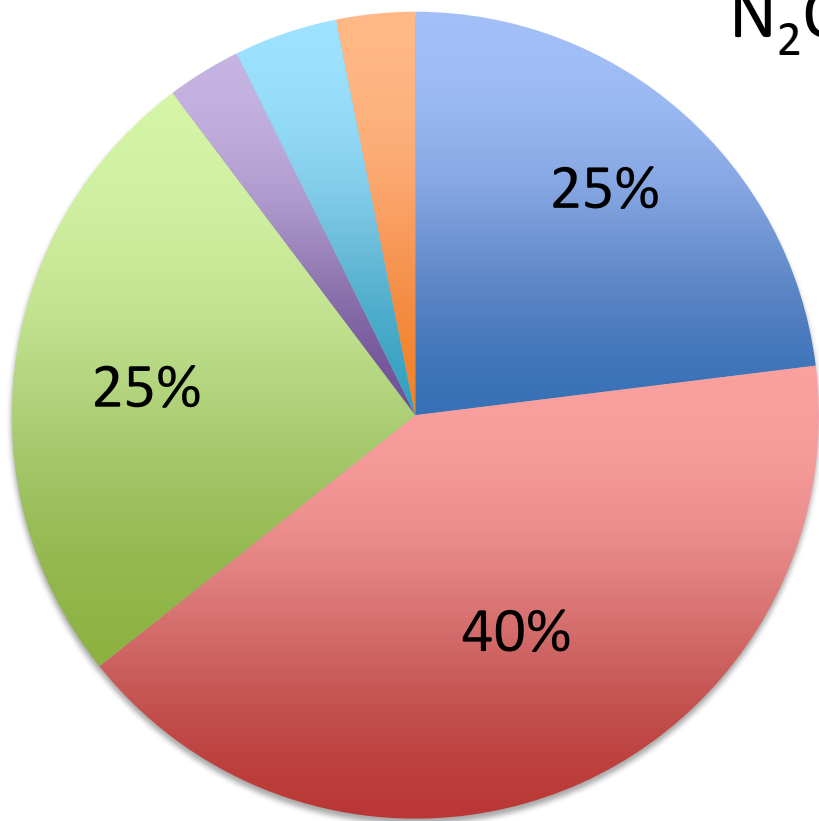
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Patricia Lang¹, Andrew Croswell², James Elkins²**

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2015 Global Monitoring Annual Conference, Boulder, CO

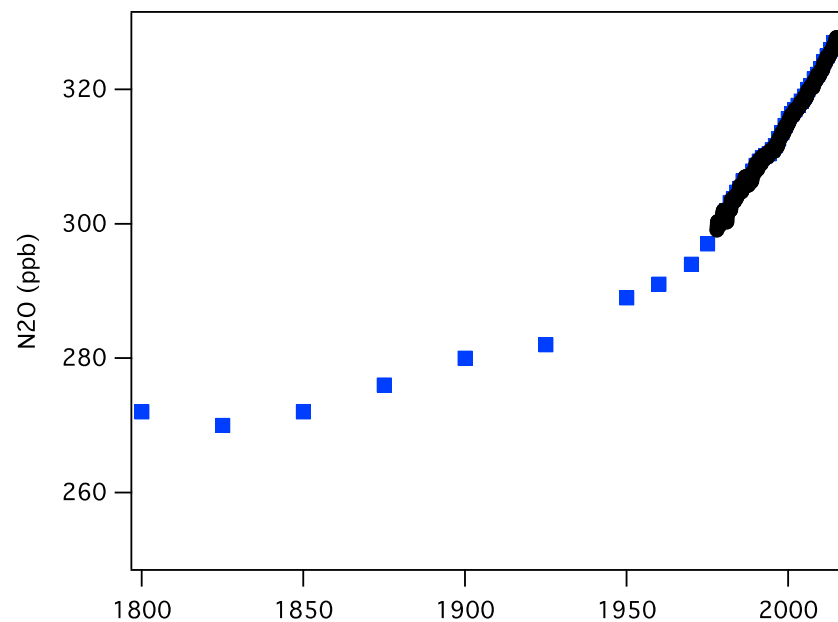
N₂O Source Distribution



- agricultural soils
- natural soils
- ocean
- industry
- biomass burning
- other

Total source
~17 Tg-N yr⁻¹

Total sink
~13 Tg-N yr⁻¹



Interannual Variability

- Thompson et al, 2013
- Ishijima, et al, 2009
- ENSO, QBO
- soil moisture
- temperature

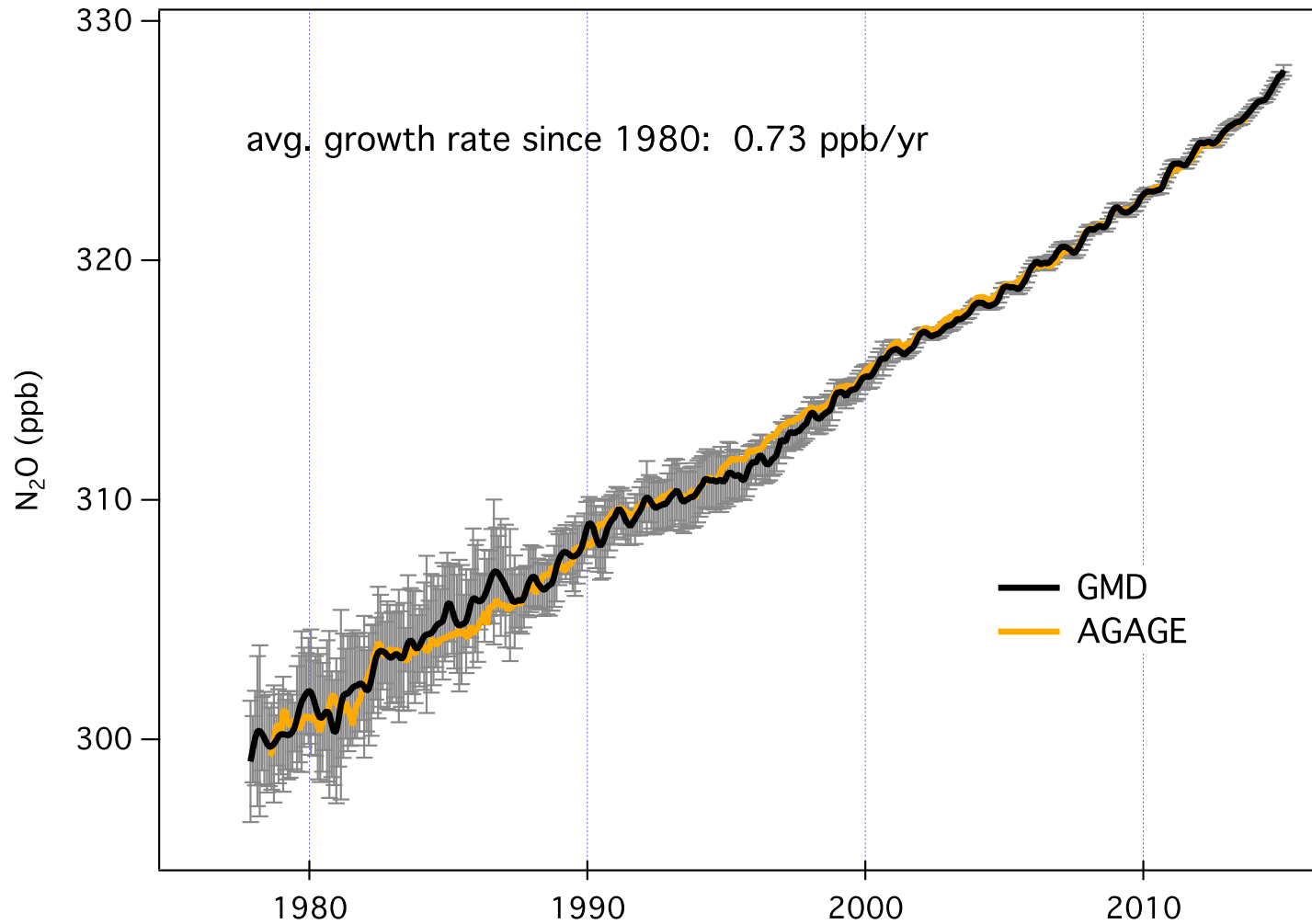
Seasonal Cycle

- Nevison et al, 2011
- Hamilton and Fan, 2000
- STE
- ocean exchange (thermal)

Global Emissions (inverse model, ecosystem model)

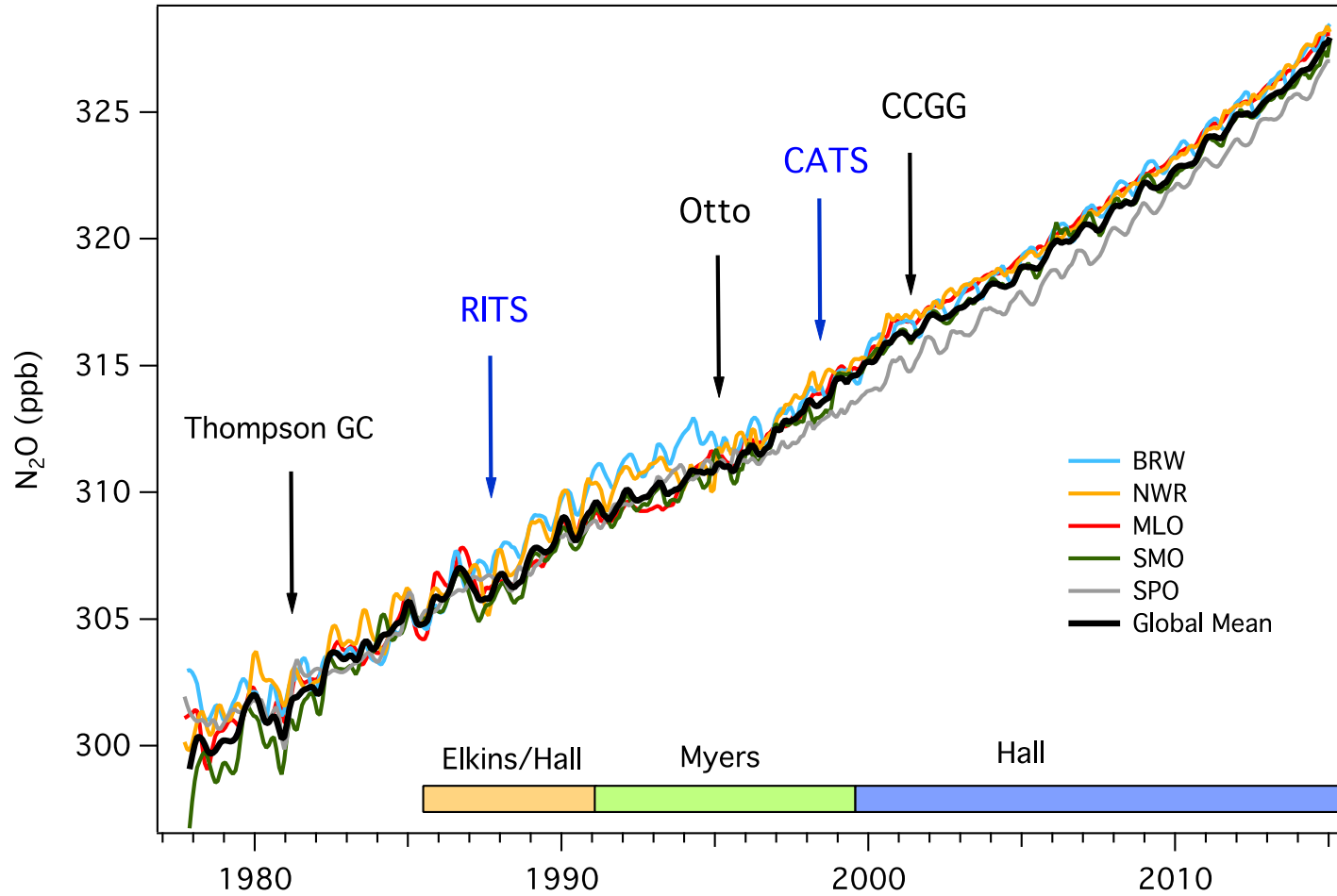
- Thompson et al, 2014
- Saikawa et al, 2014
- Huang et al, 2008
- Tian et al, 2015

Global mean N₂O

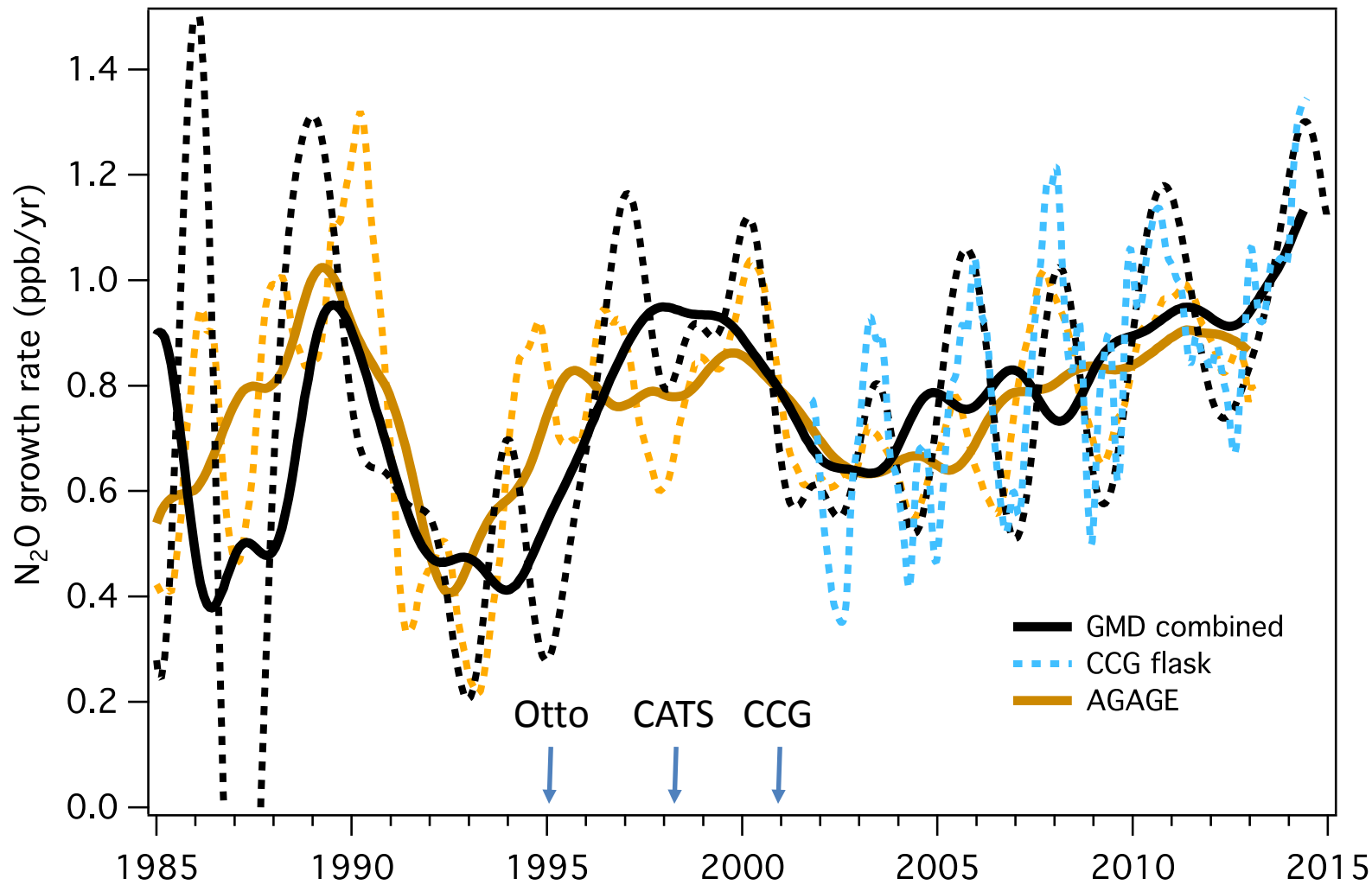


AGAGE data: <https://agage.mit.edu/data/agage-data>

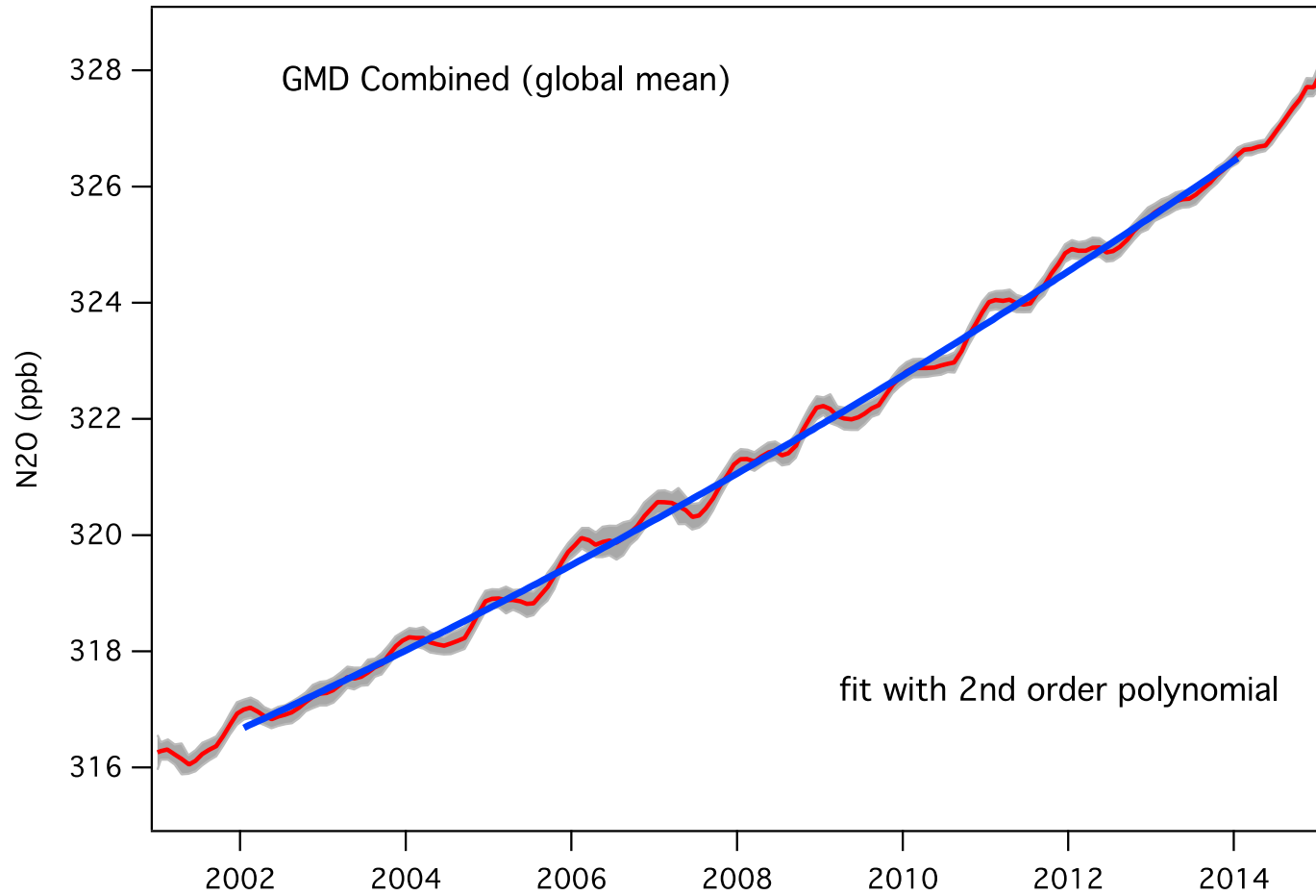
Instrumentation/Methods/Programs



N₂O growth rate

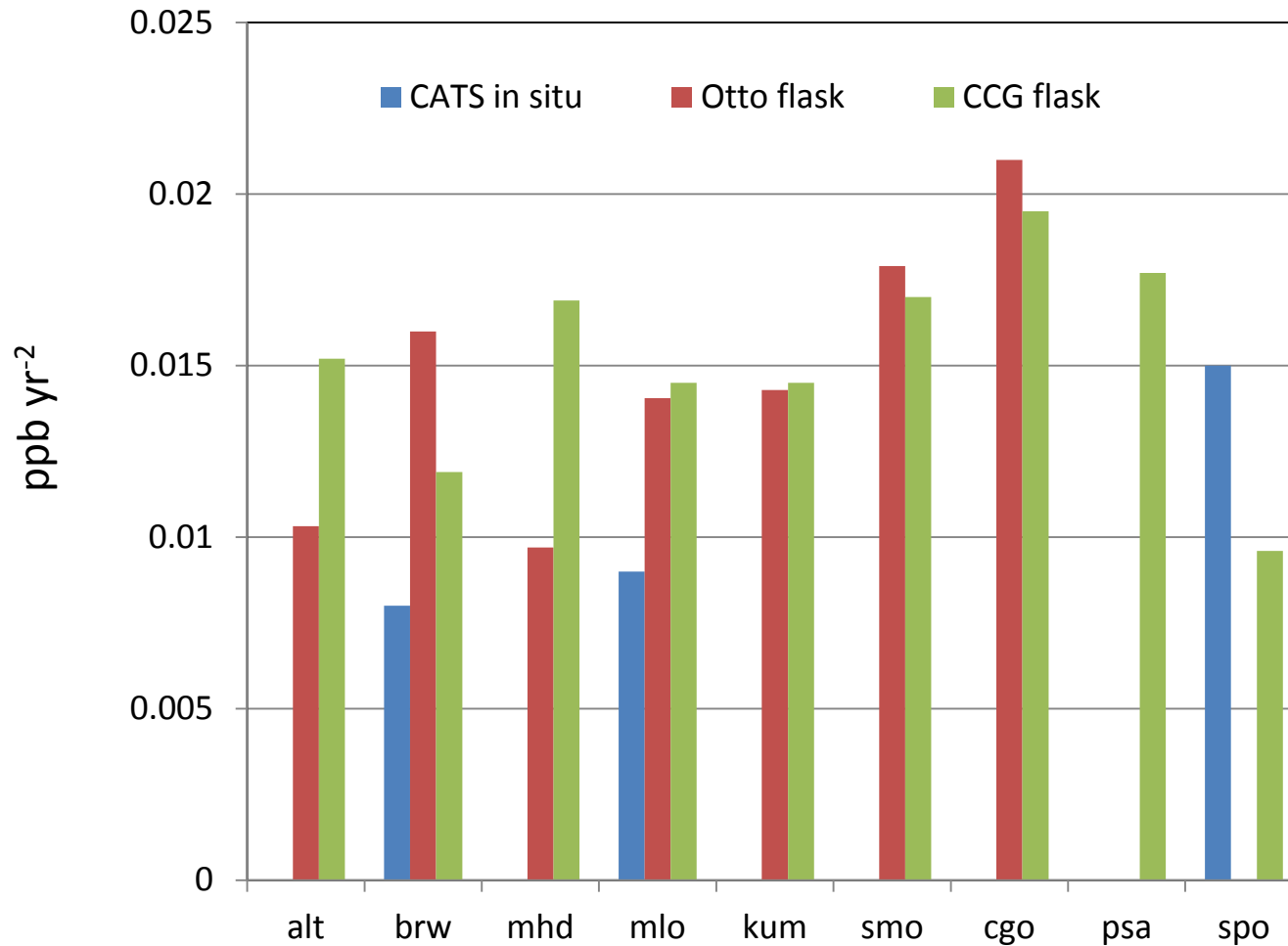


Focus on 2002-2013: Expanded global coverage, improved instrumentation



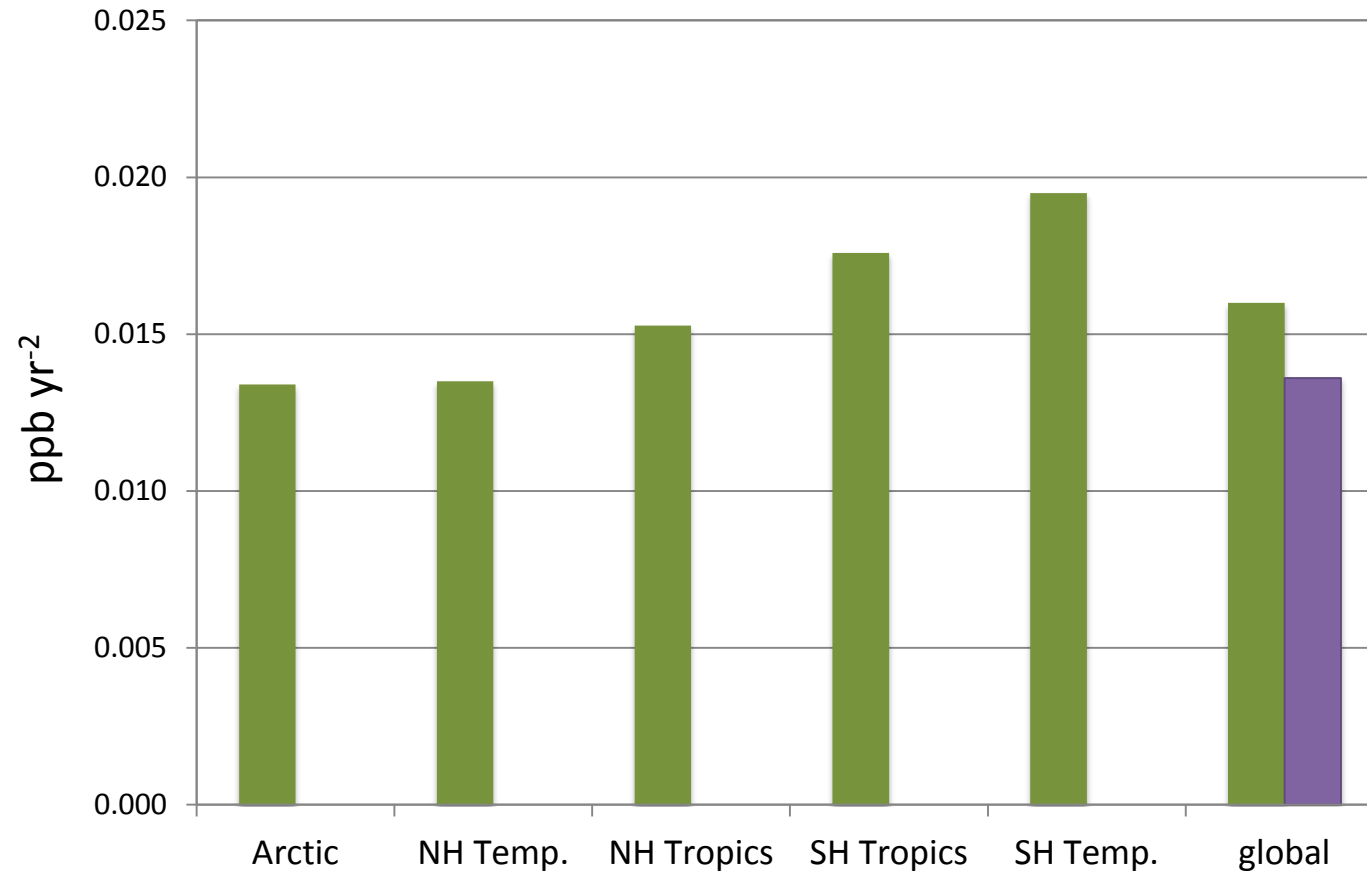
2ND Order Term, least squares fit: ppb yr⁻² (2002-2013)

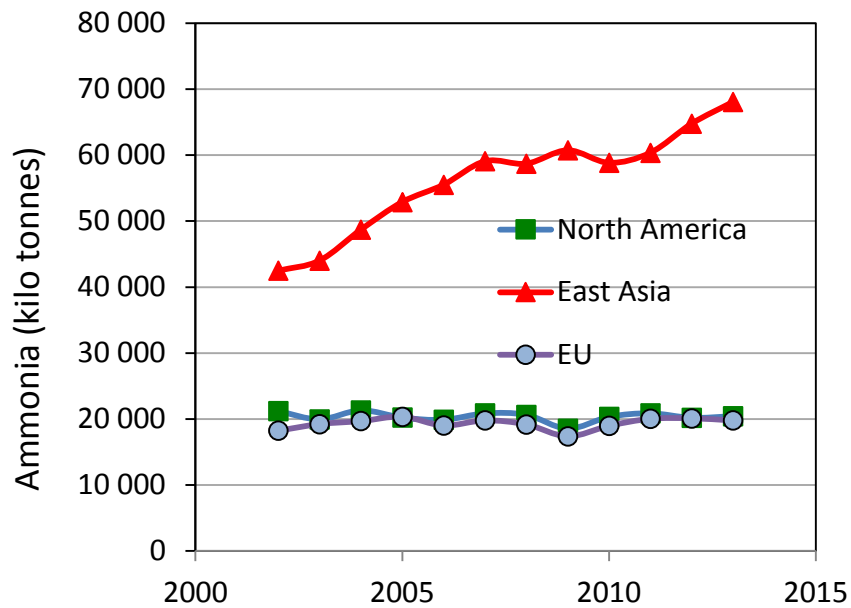
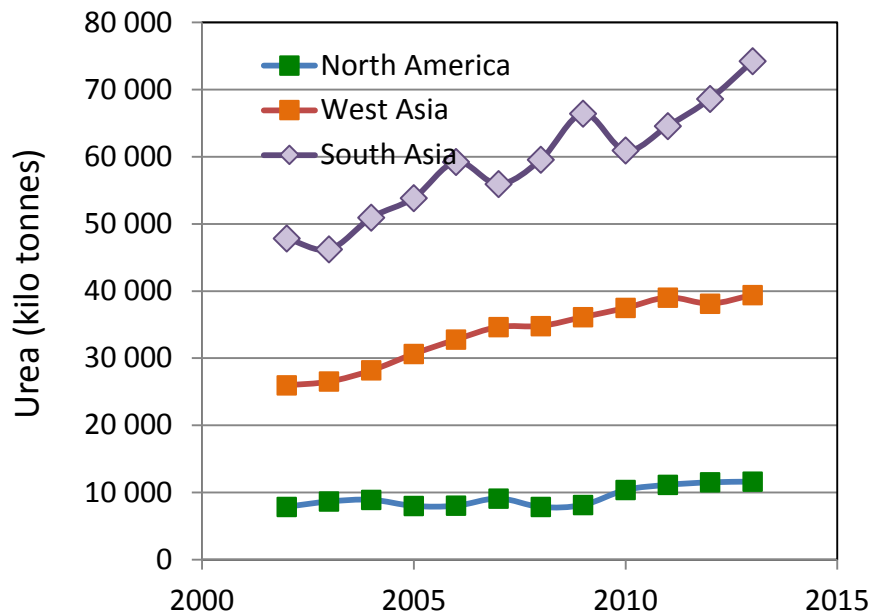
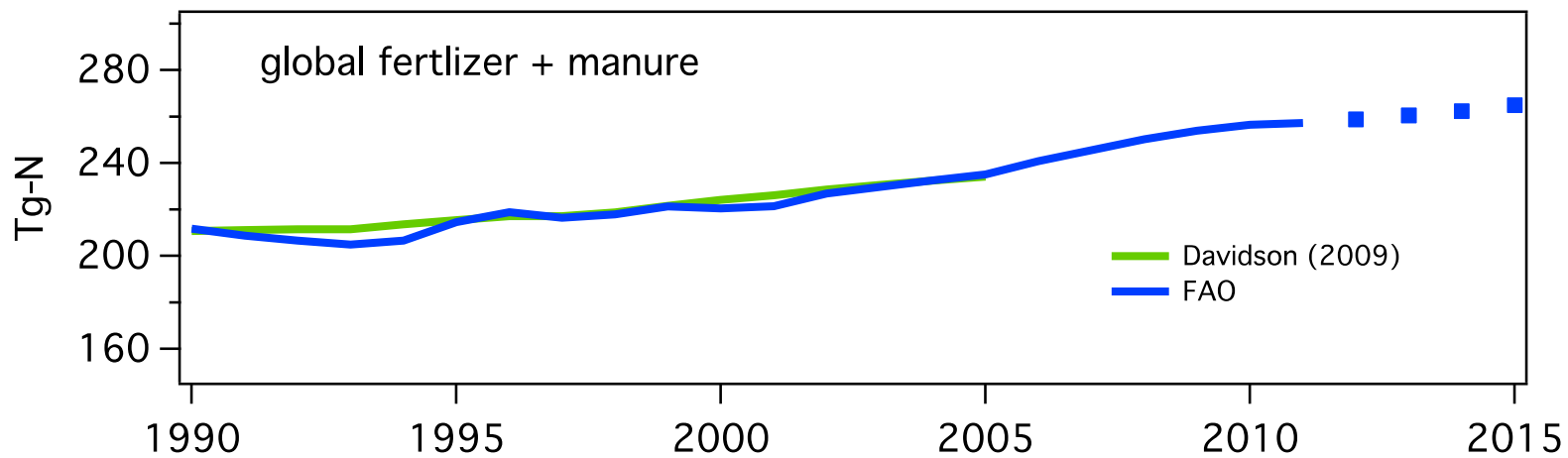
Individual programs at select measurement sites



2ND Order Term, least squares fit: ppb yr⁻² (2002-2013)

Zonal Means from CCG flask data





Recent Emission Trends from Modeling Studies

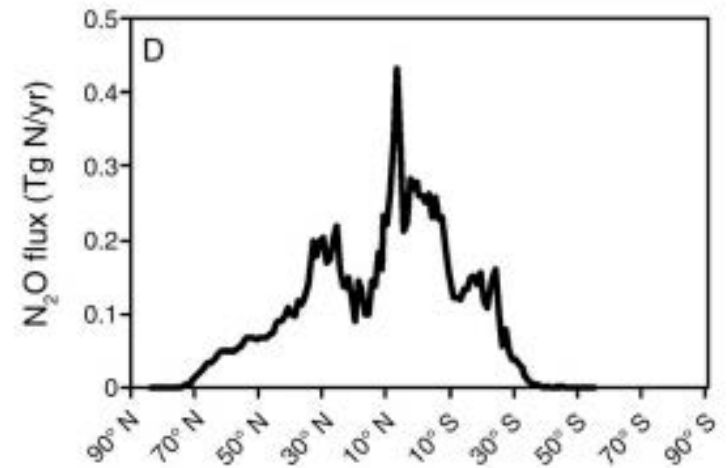
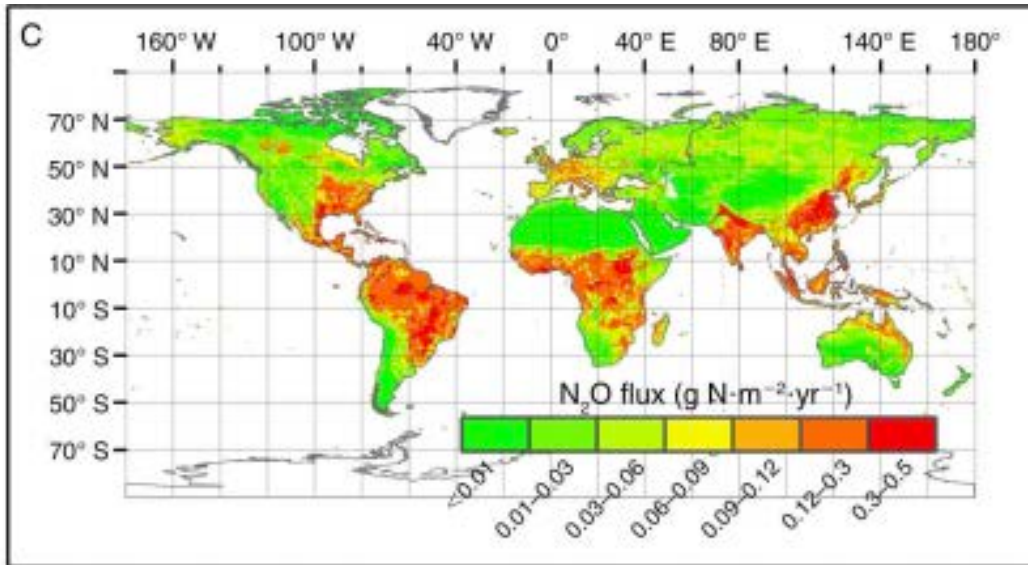
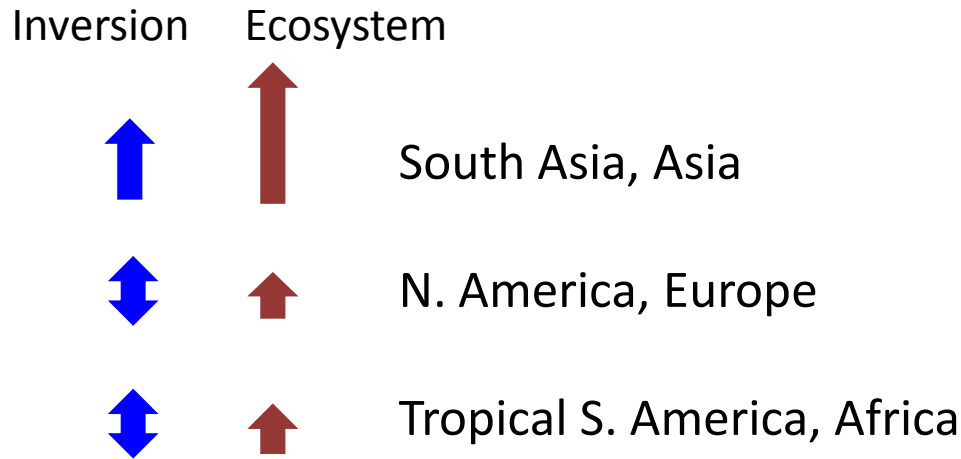
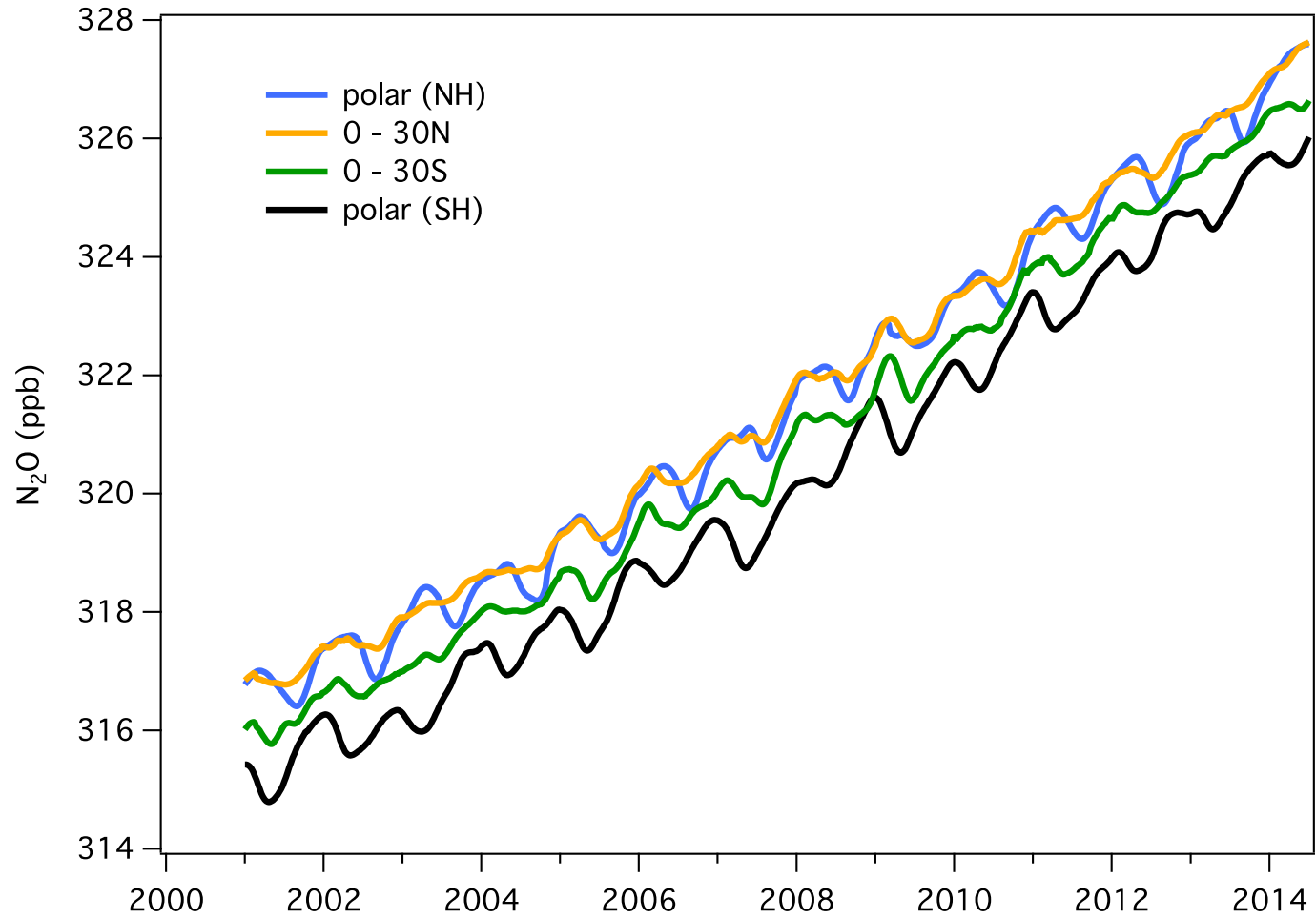
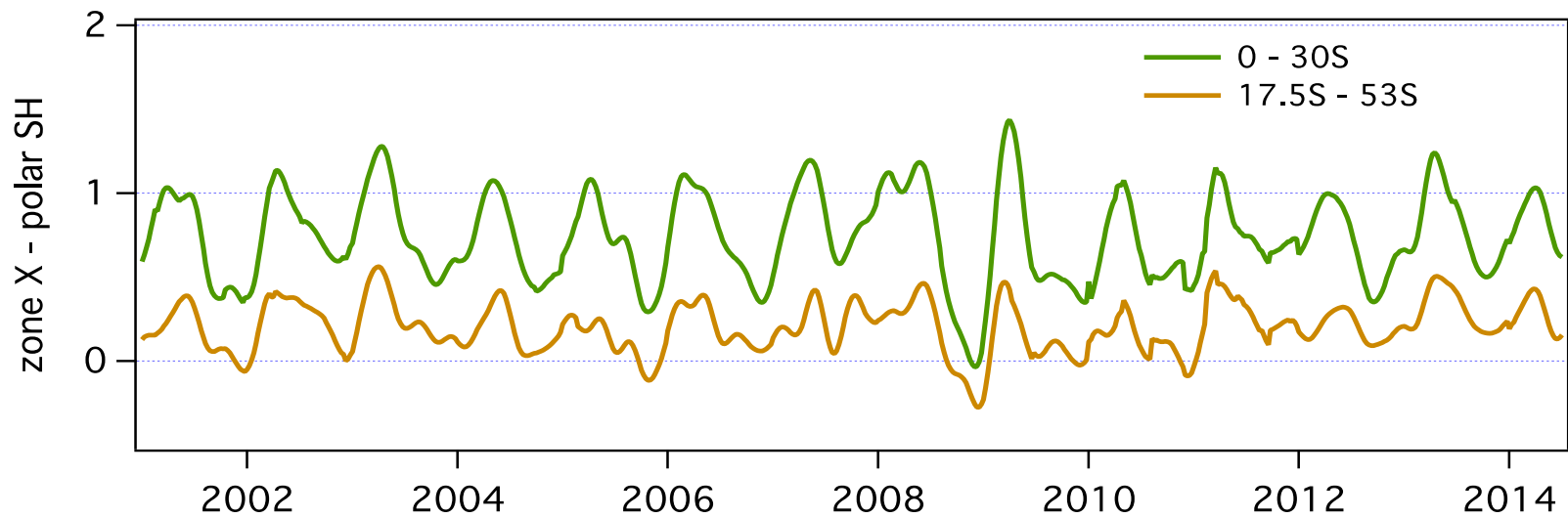
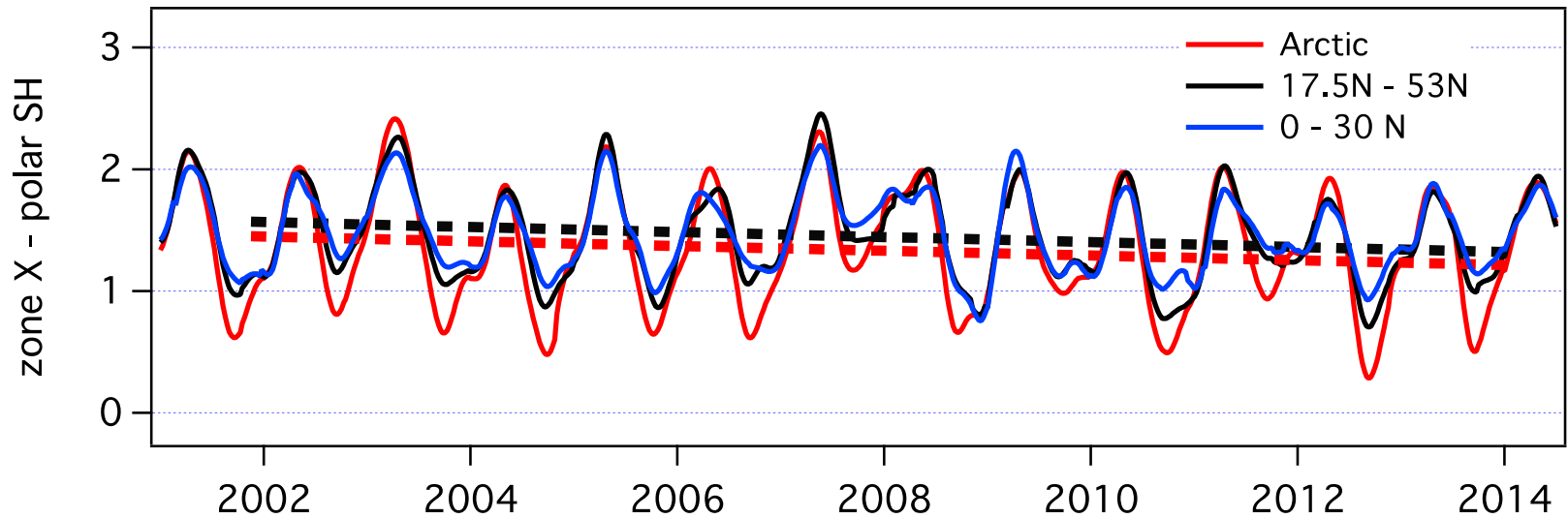


Fig. 6 from Tian et al, 2015 {doi/10.1890/EHS14-0015.1}

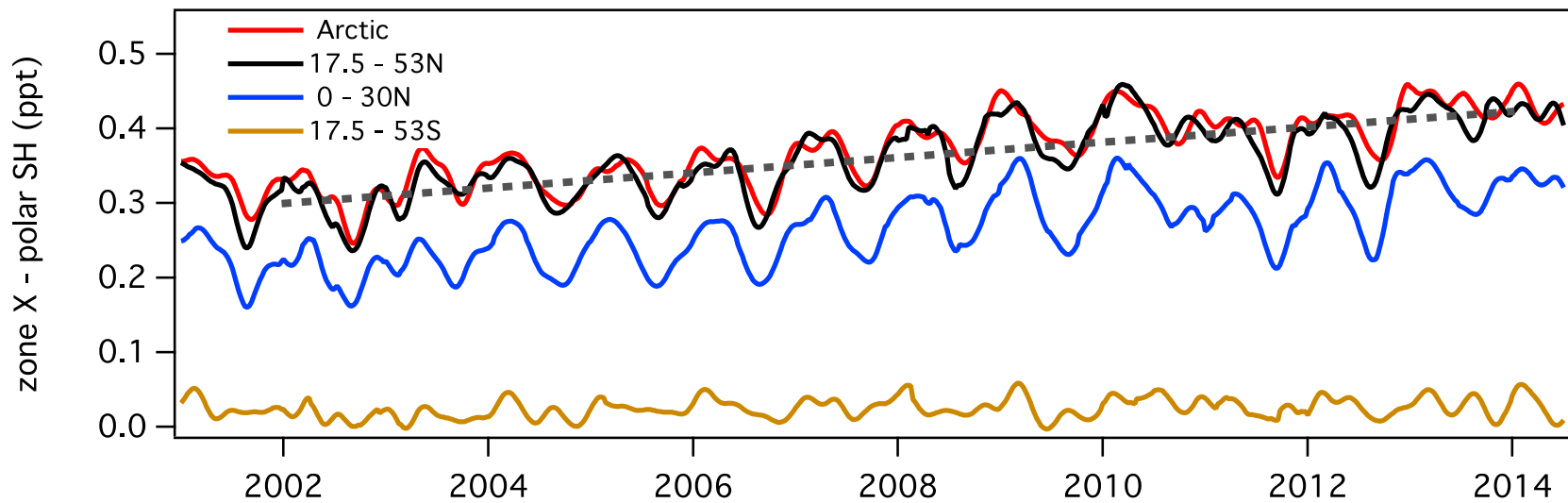
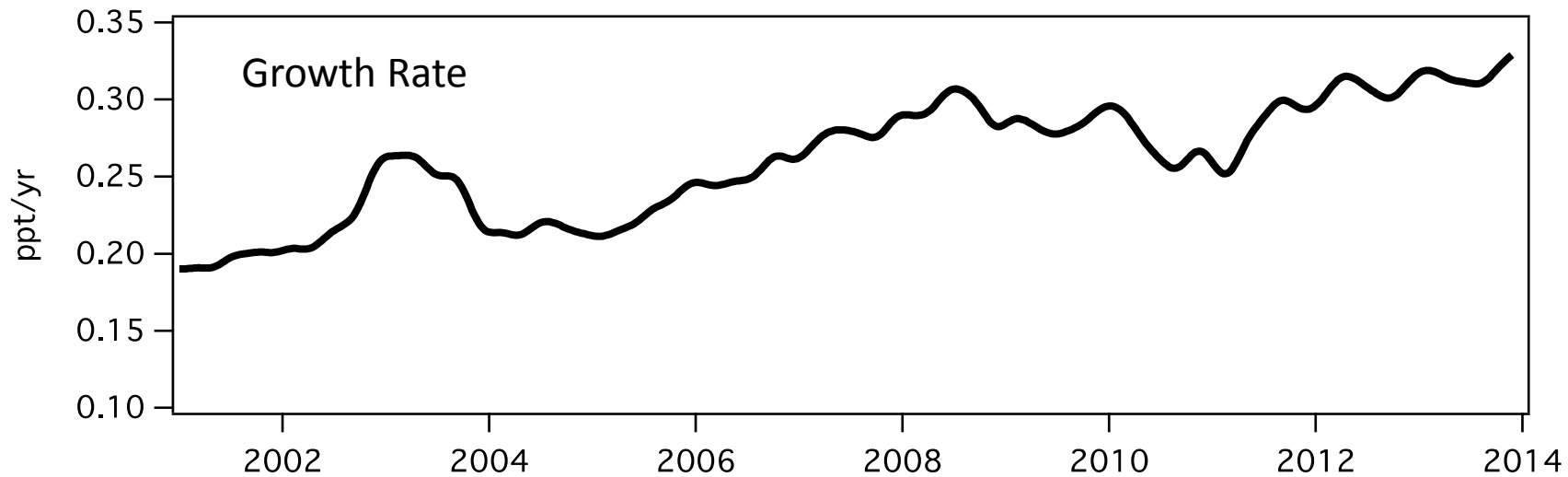
Zonal means: well-resolved gradients



Compare N₂O zonal averages



Compare to SF₆



Summary

- N₂O growth rate increasing since ~2003
 - >> acceleration: 0.014-0.016 ppb/yr²
- observed globally
- higher growth rates in S.H.
- mean growth rate in 2013: ~1 ppb/yr
- inter-hemispheric difference is decreasing
 - >> ~0.15 ppb over 10 years
- influence of climate drivers on tropical S.H. emissions?

end

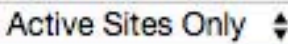
Programs: Carbon Cycle Gases



Popup Detail: Full



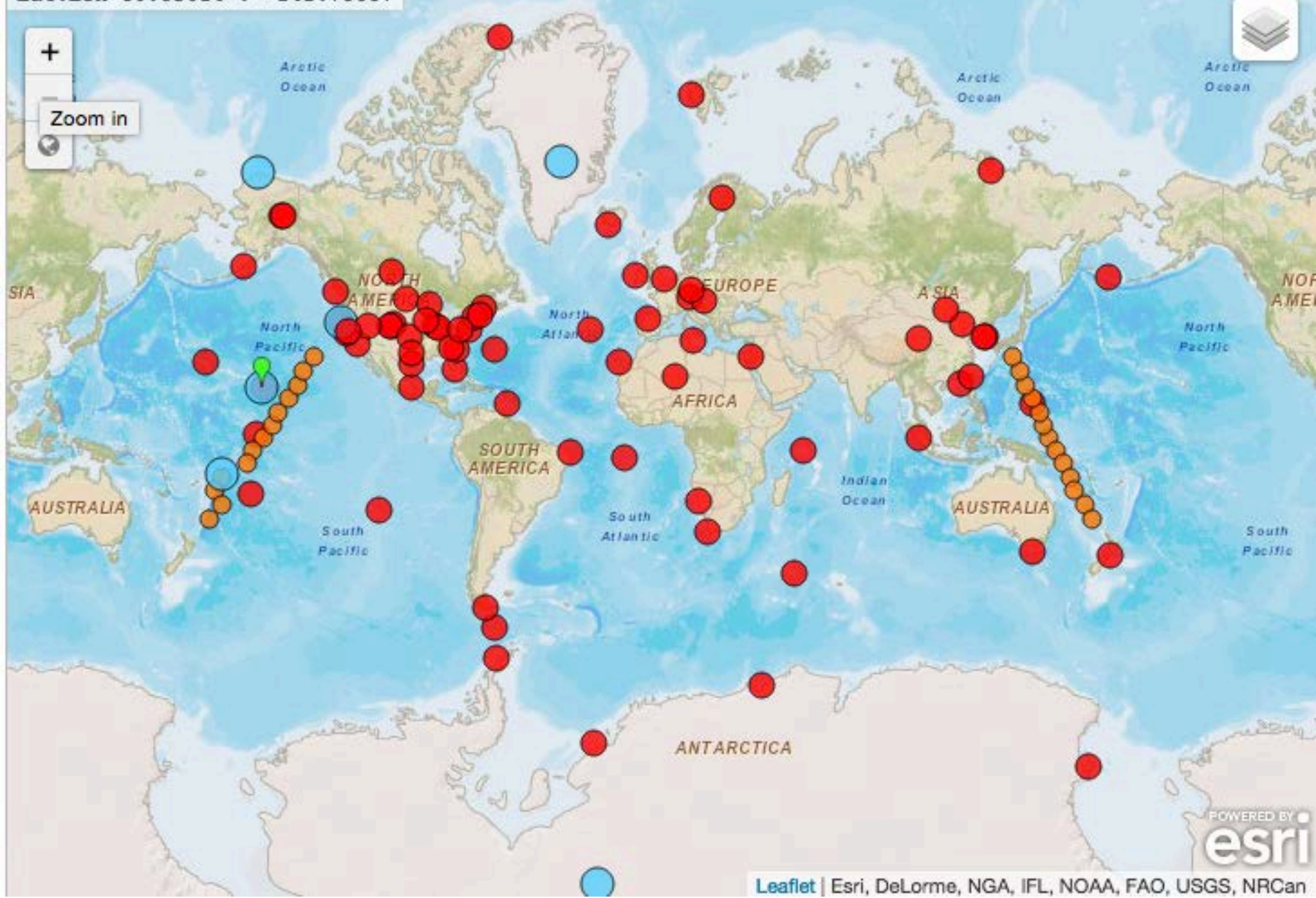
Active Sites: Active Sites Only



Lat:Lon 80.85014 : -242.78687

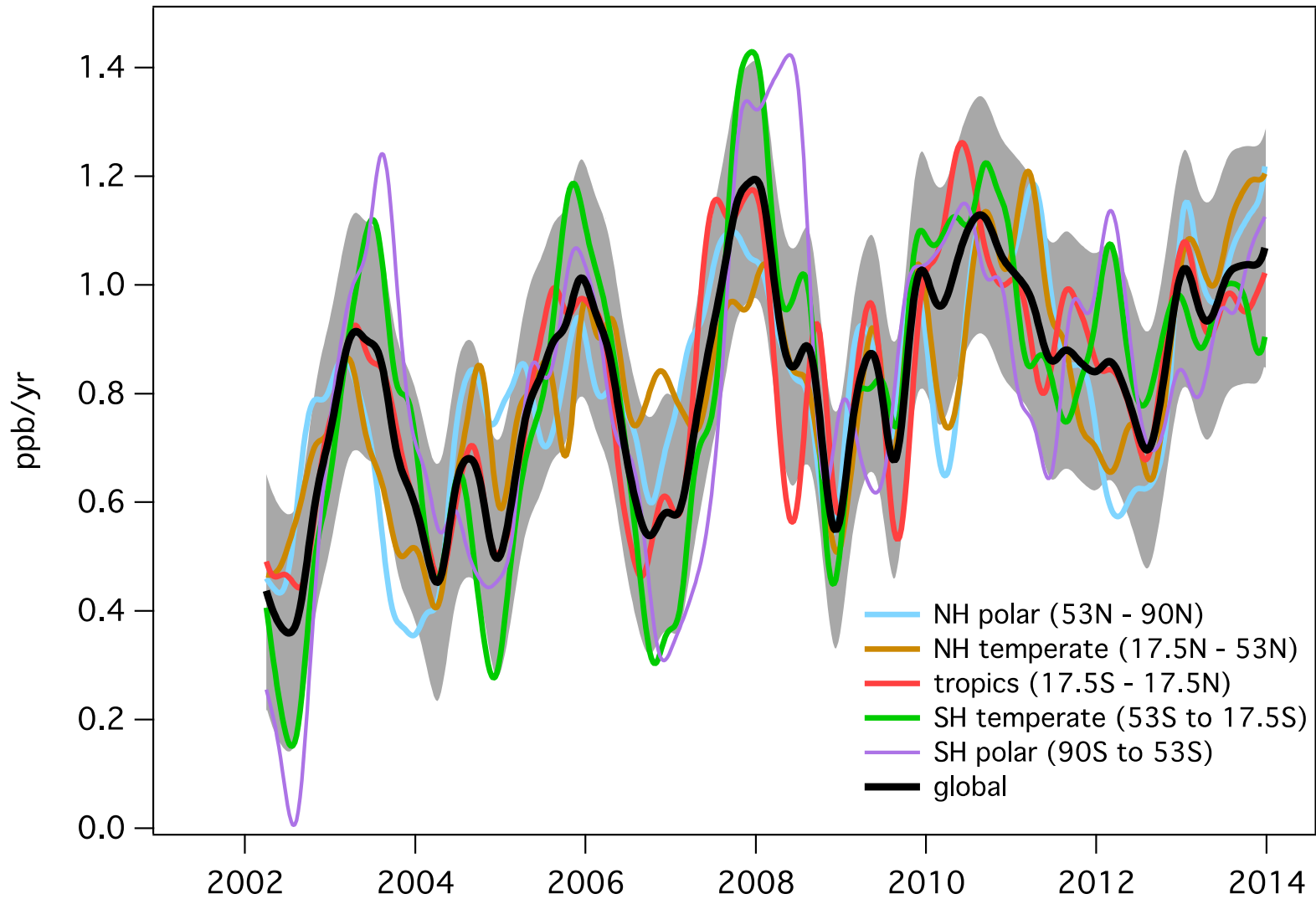
+

Zoom in

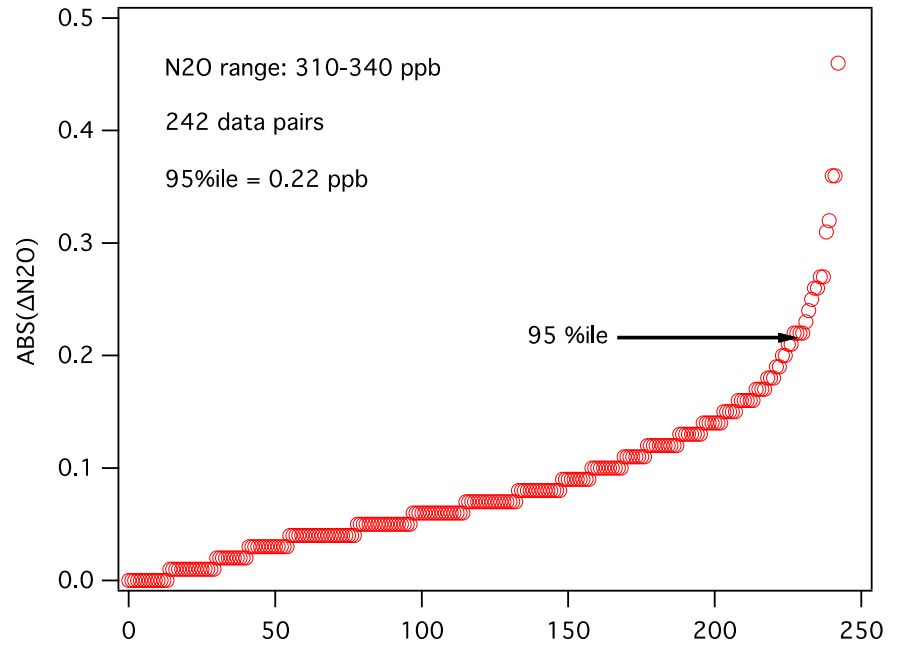
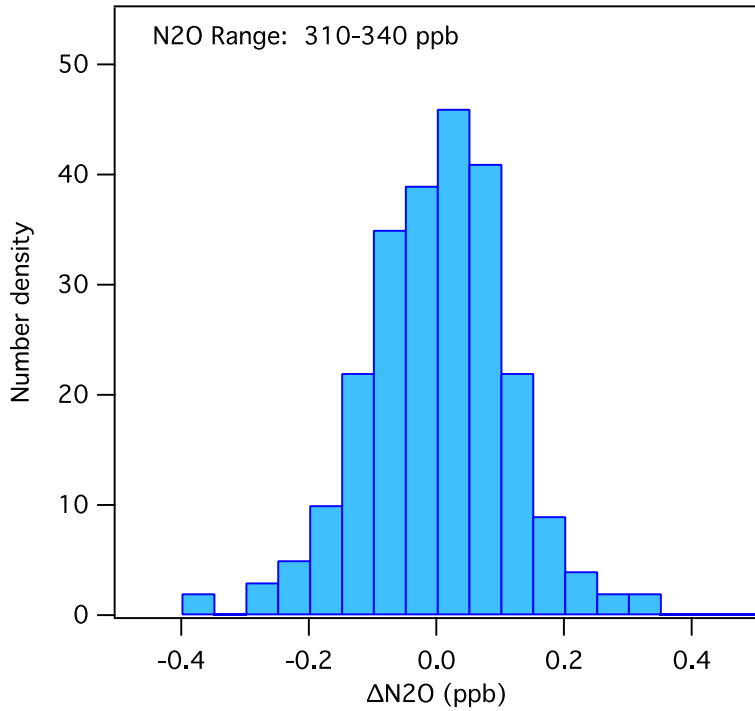


POWERED BY
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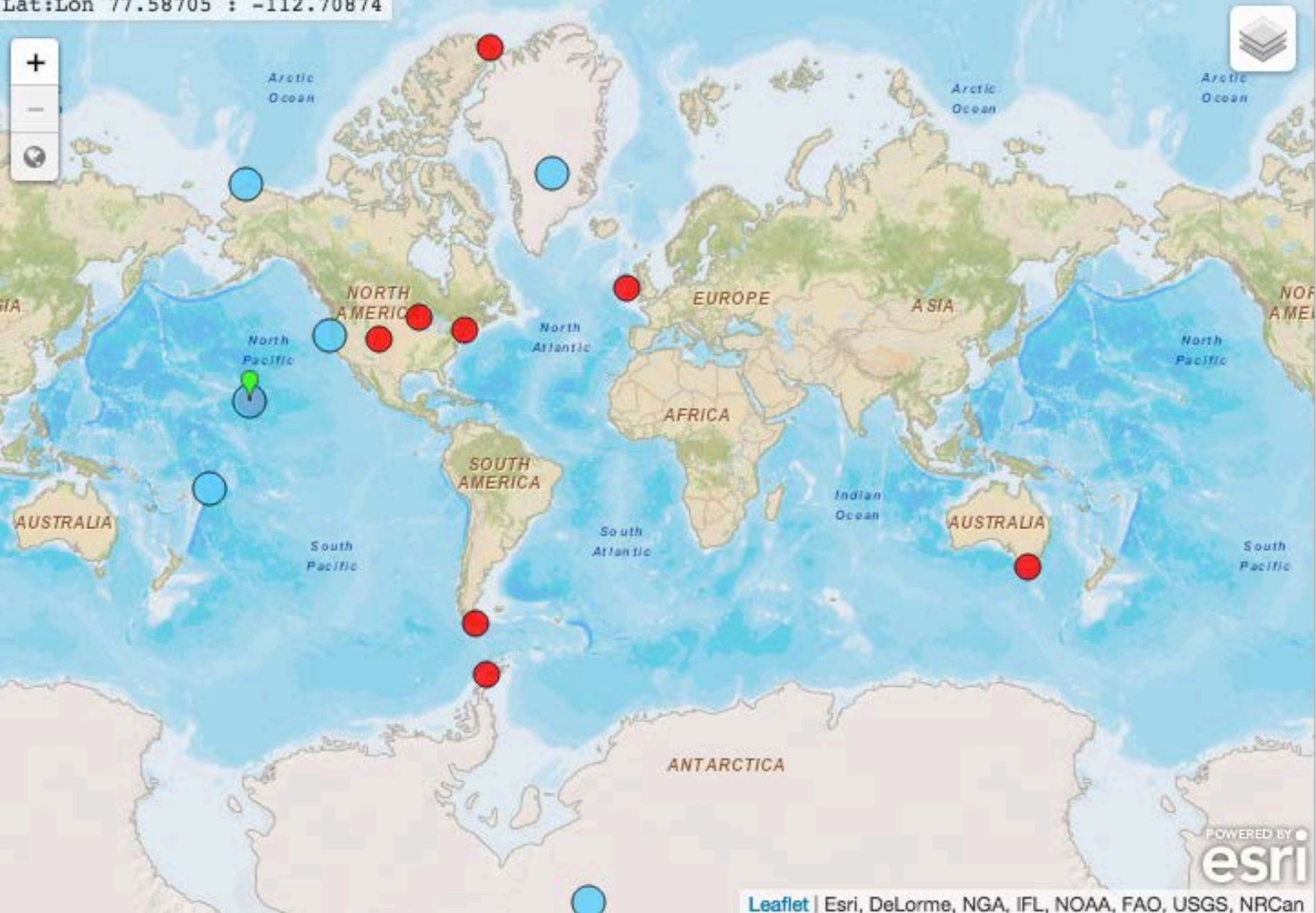
N₂O Growth Rate: 2002-2013 period



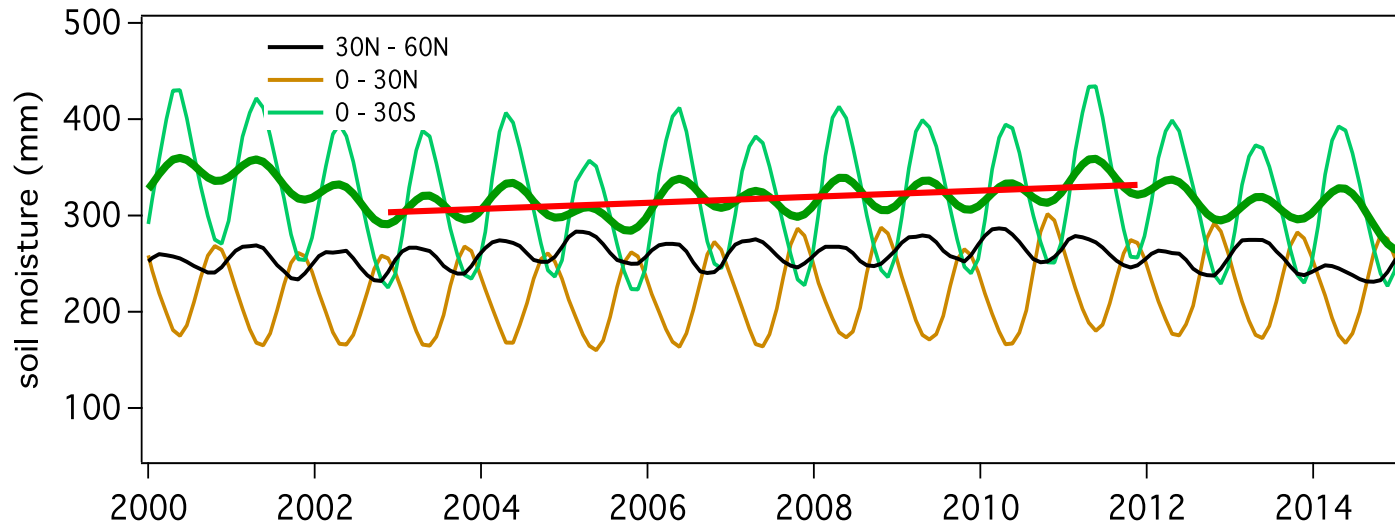
Calibration: Reproducibility ~ 0.1 ppb (1-sigma)

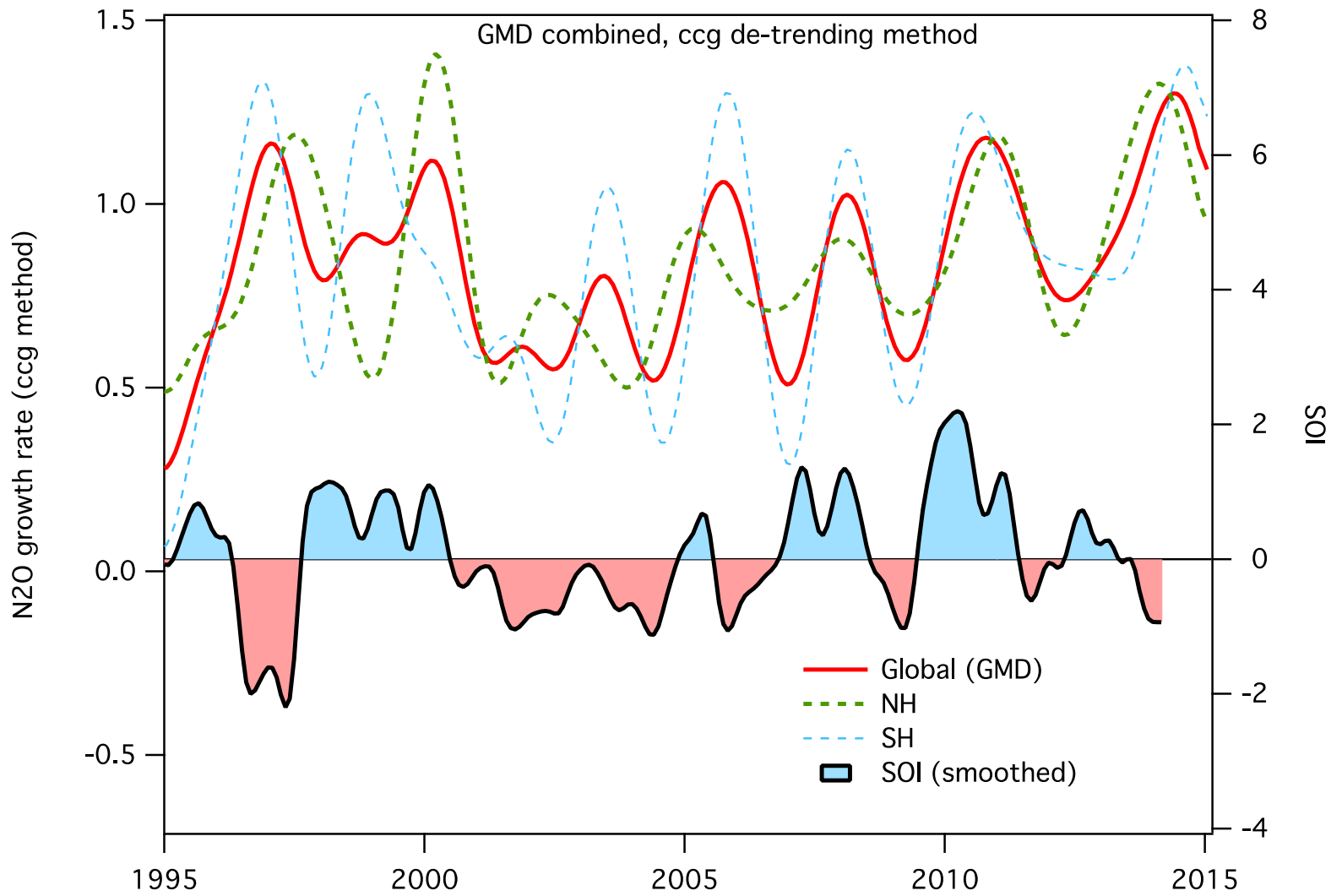


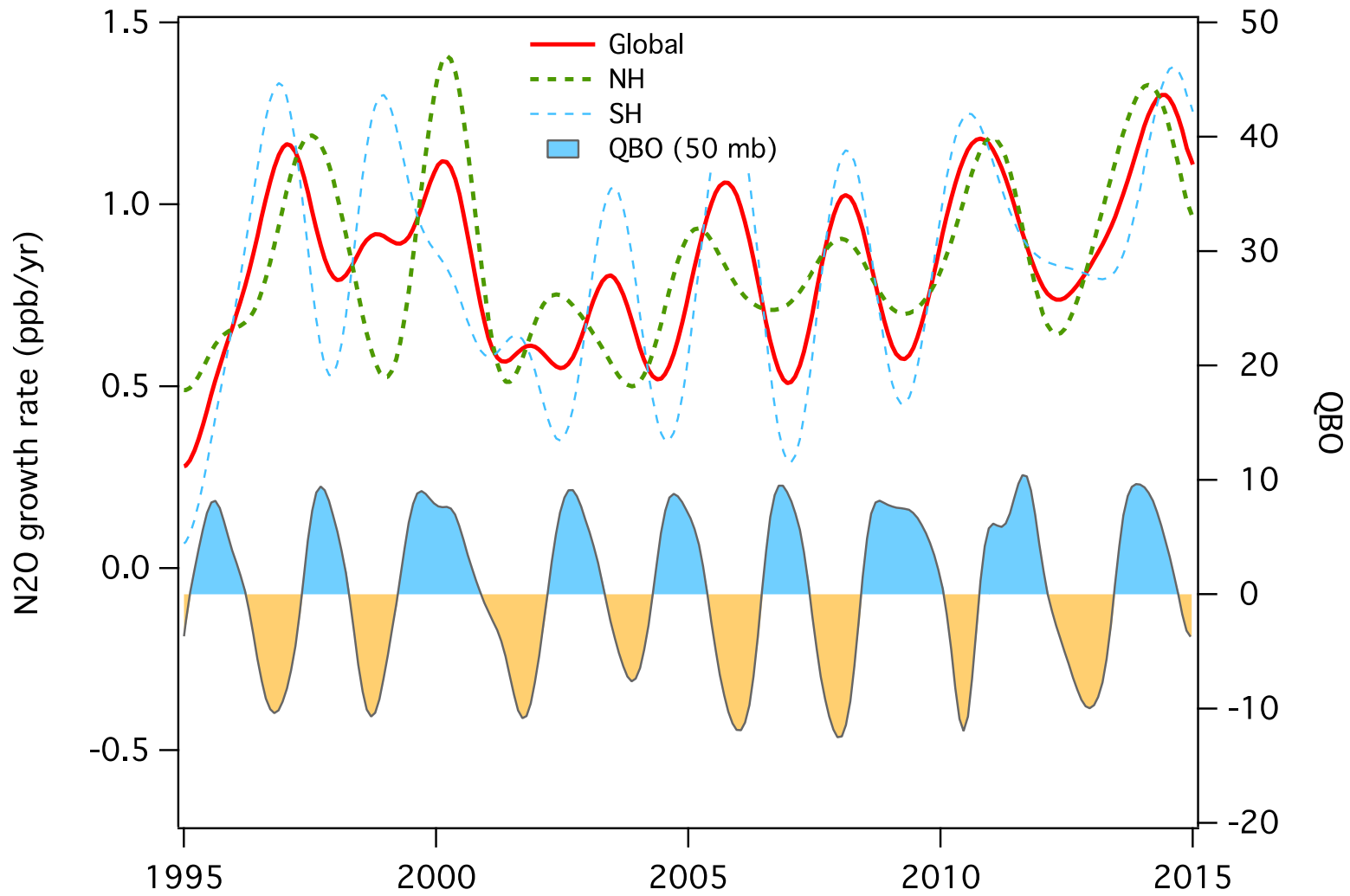
Lat:Lon 77.58705 : -112.70874



Monthly mean soil moisture







N₂O at Barrow, Alaska

