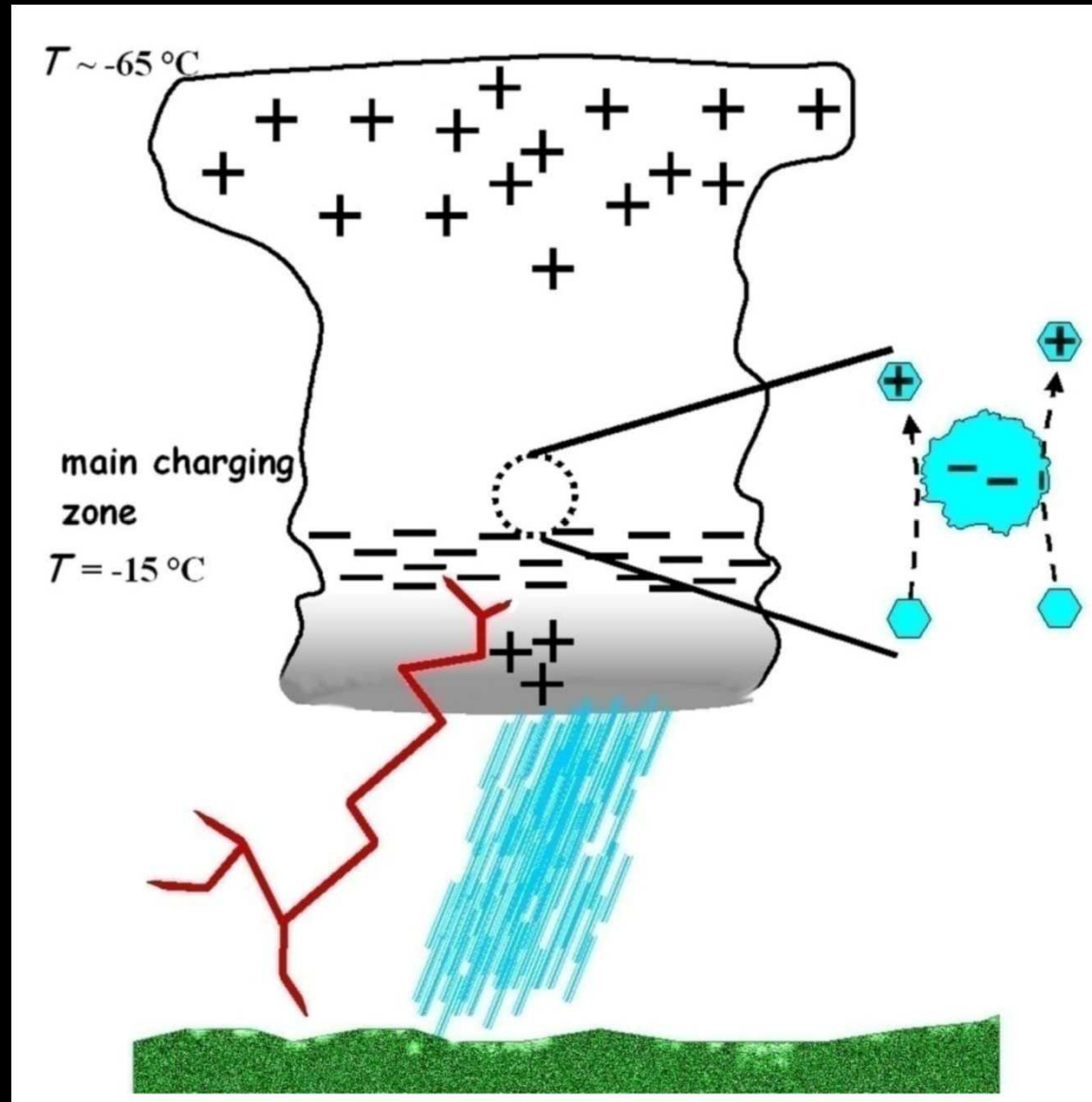


Lightning NO_x Production

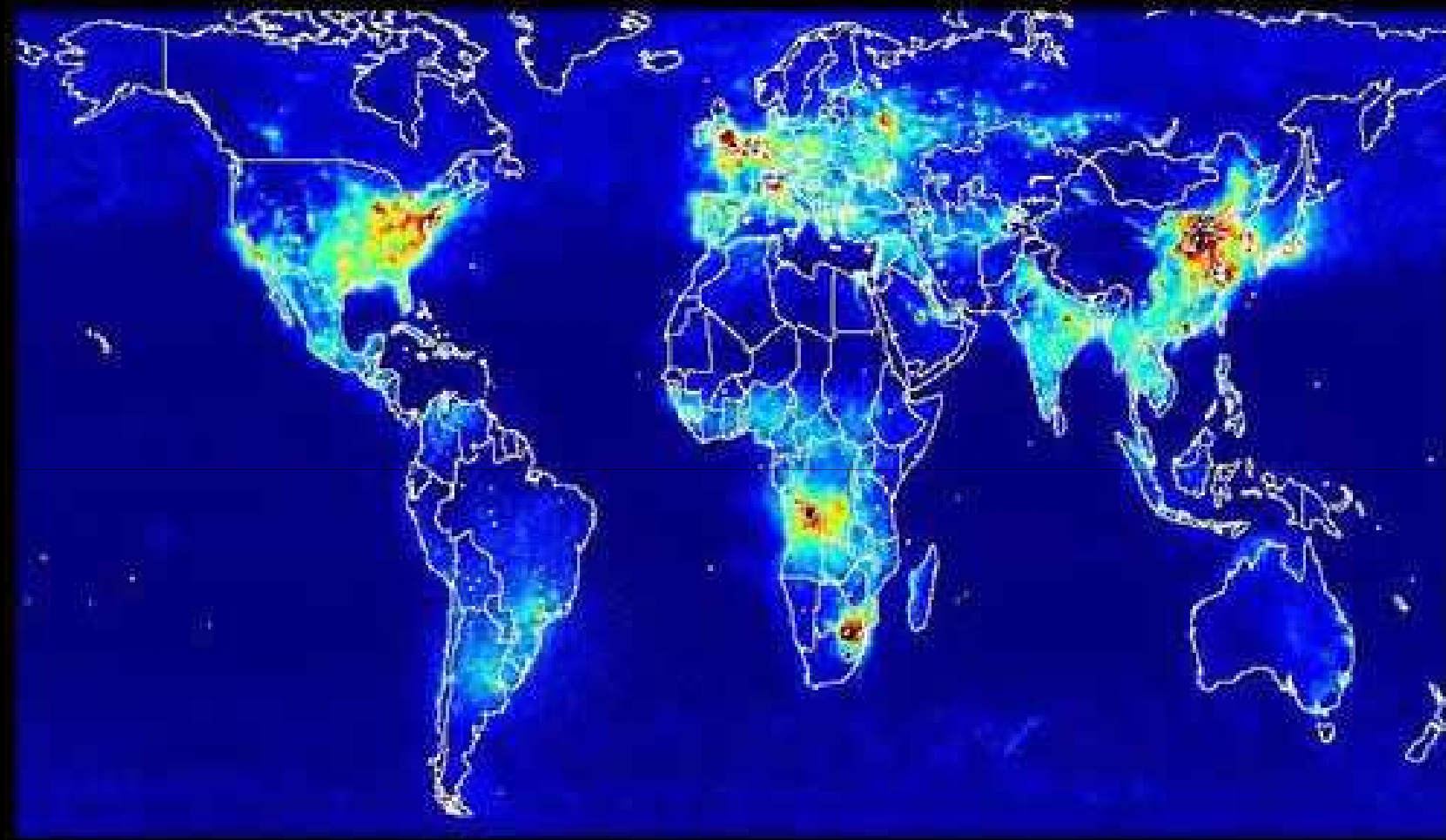


Megan Bela

Lightning Makes NO from N₂ and O₂



Is the lightning NO_x source significant?



2006 Tropospheric NO_2 vertical column densities [10^{16} molecules / cm^2]

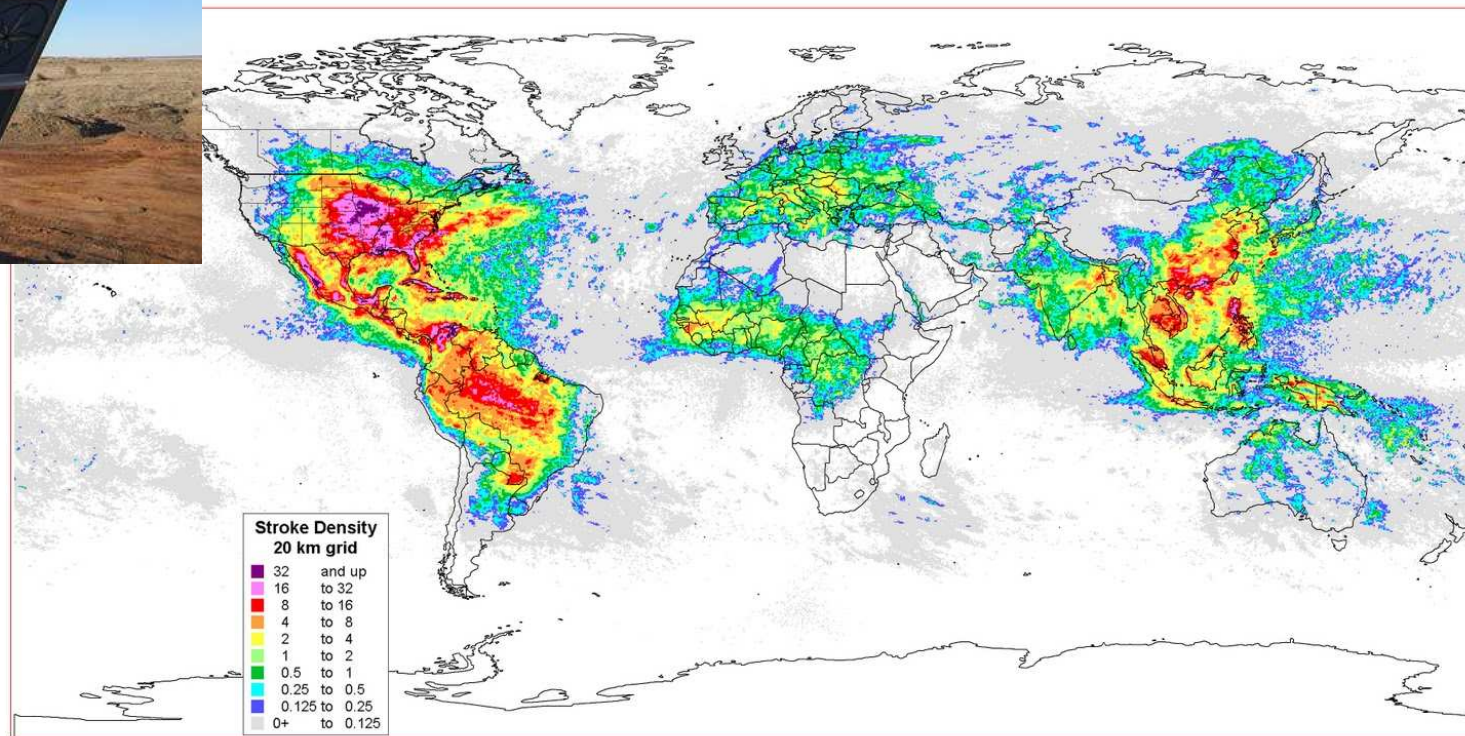


http://disc.sci.gsfc.nasa.gov/Aura/data-holdings/OMI/omno2g_v003.shtml

Lightning is measured from the ground



Cloud-to-ground (CG) only
250-500m (US), 10 km (global)
95% detection (US), 10-50% (SH)



Stroke Density Map - 20 km grid

6 Months, May - Oct 2010

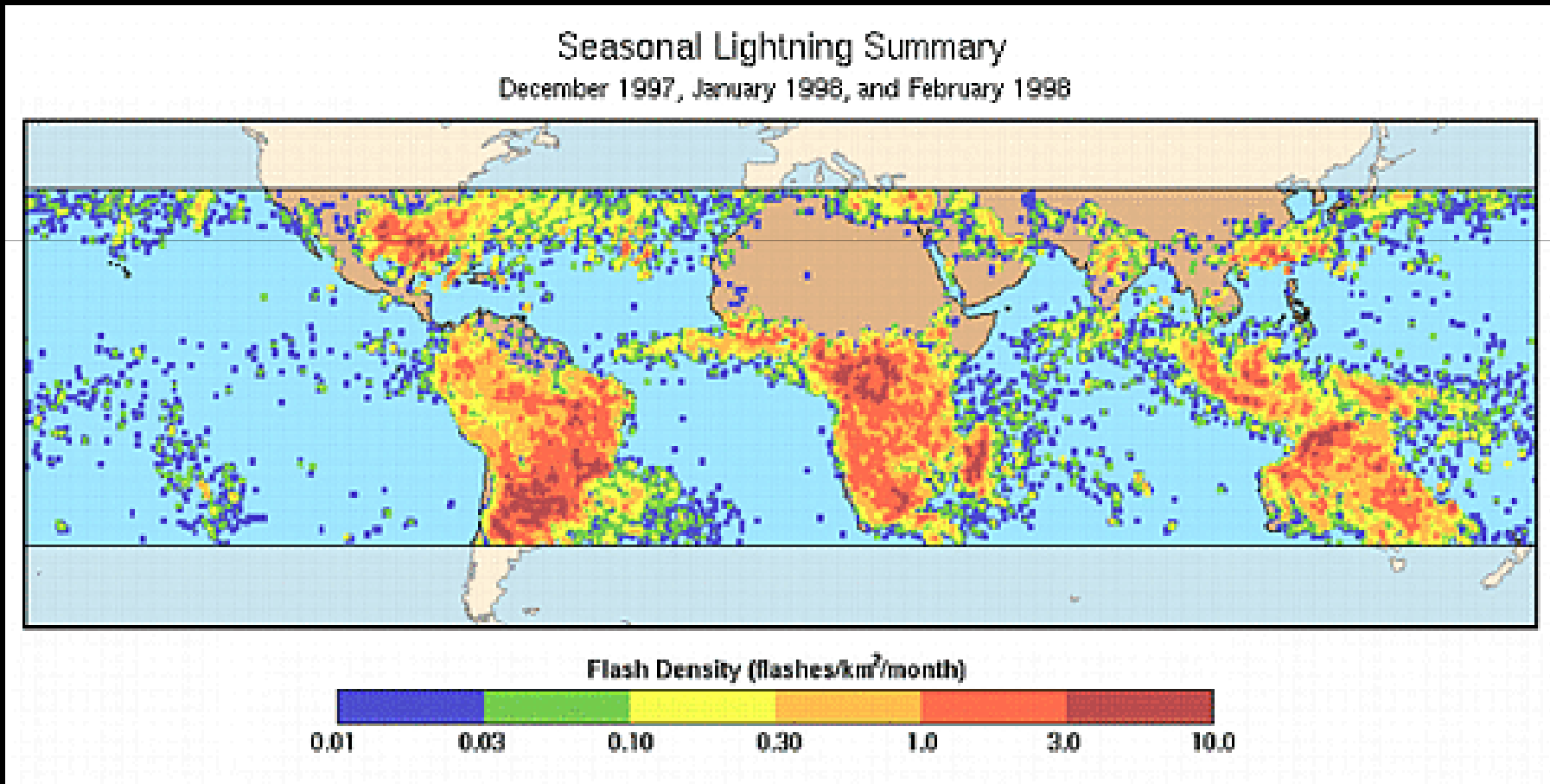
GLD360 data

Lightning is measured from space

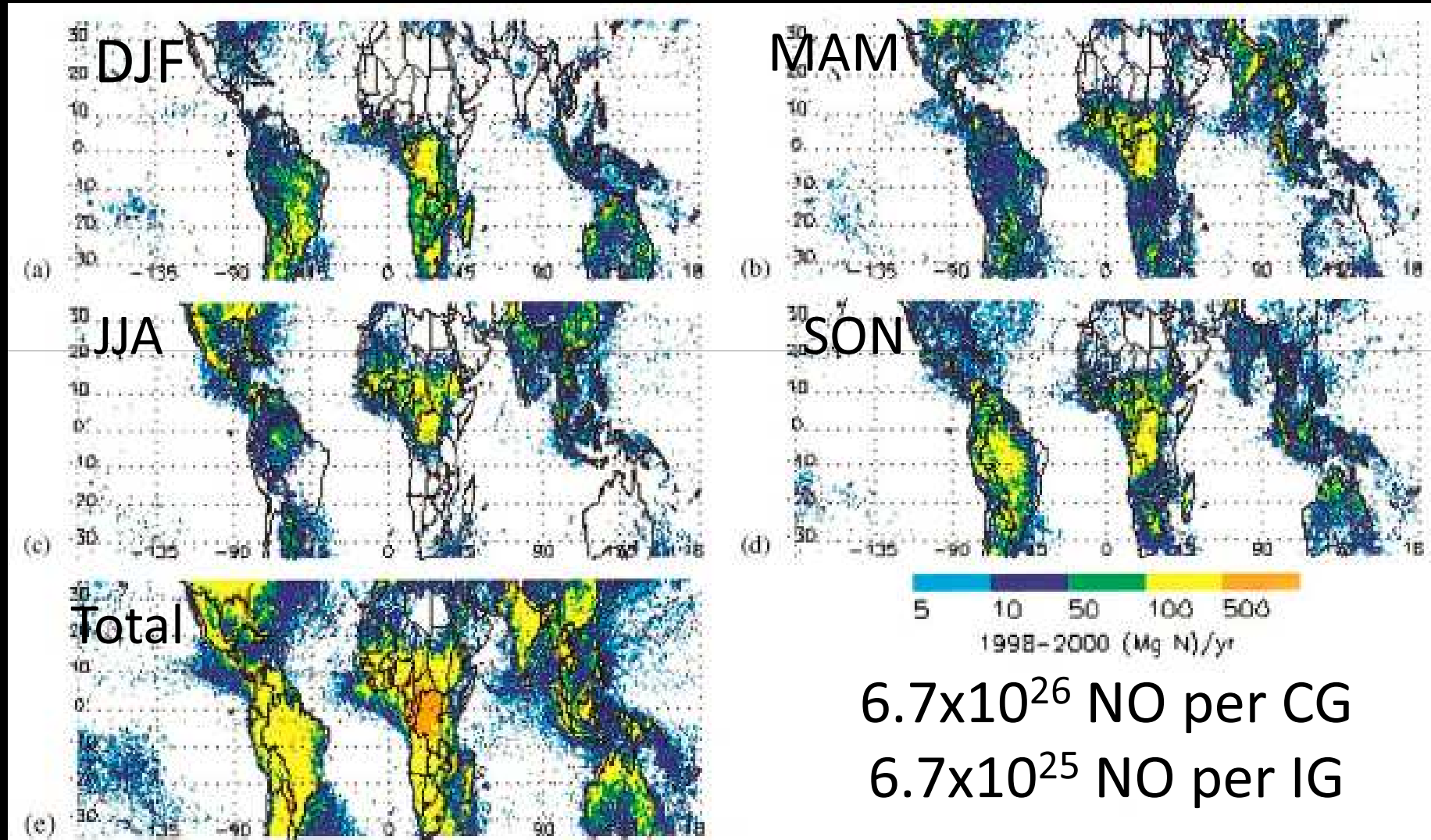
Lightning Image Sensor (LIS)

CC/IC/CG

600 x 600 km, 4-7 km pixel -> 90 s per location



Lightning is an important source of NO_x , especially in the tropics

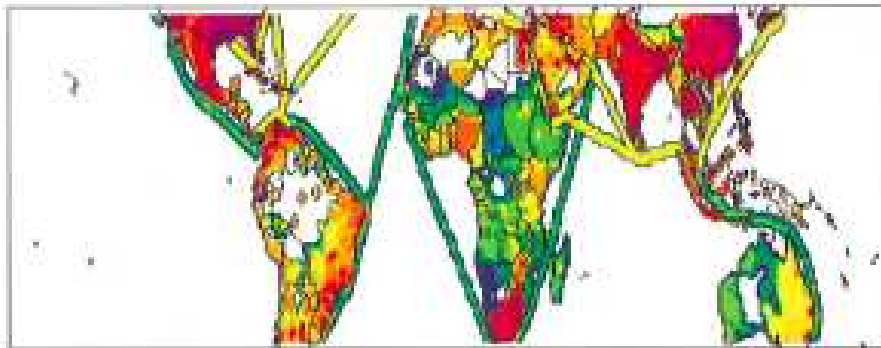


6.7×10^{26} NO per CG

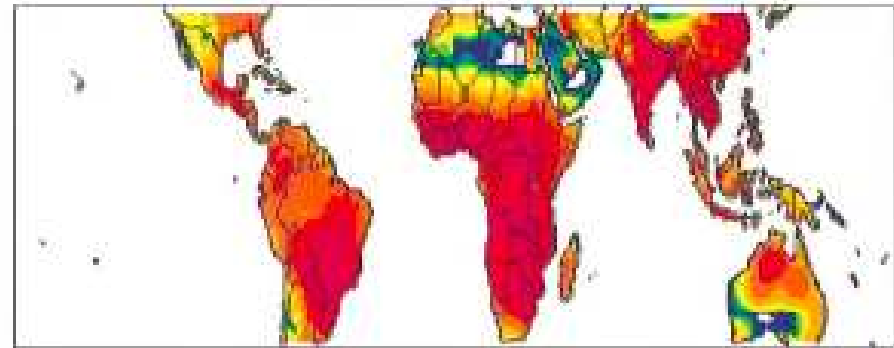
6.7×10^{25} NO per IG

Bond et al. (2002)

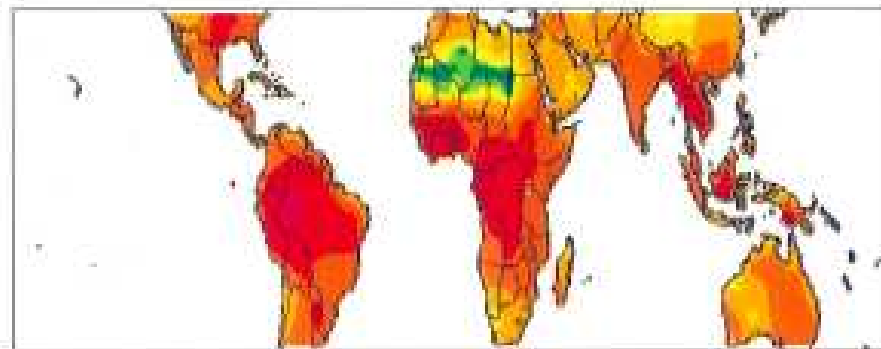
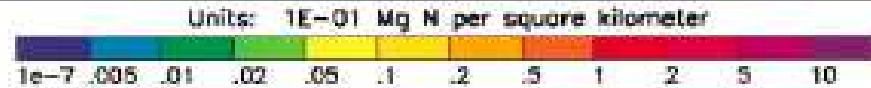
Lightning NO_x is comparable to other sources in the tropics



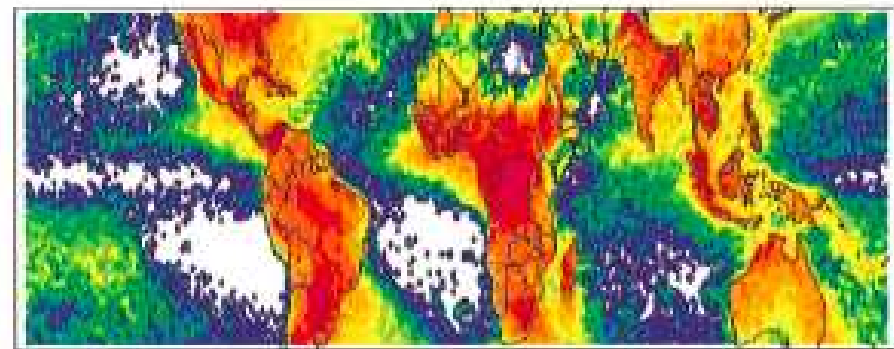
Anthropogenic Activity



Biomass Burning

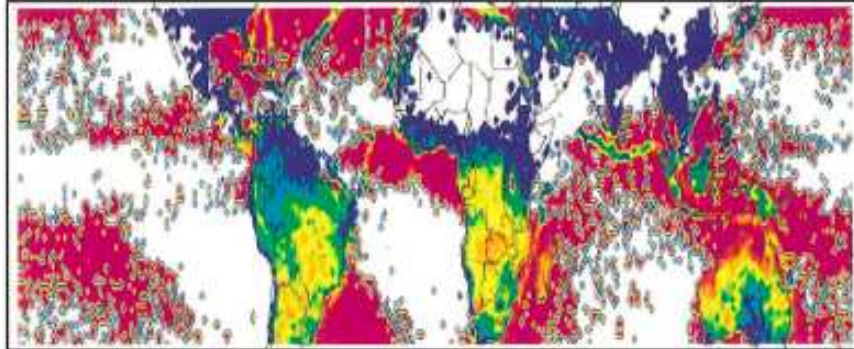


Soil Release

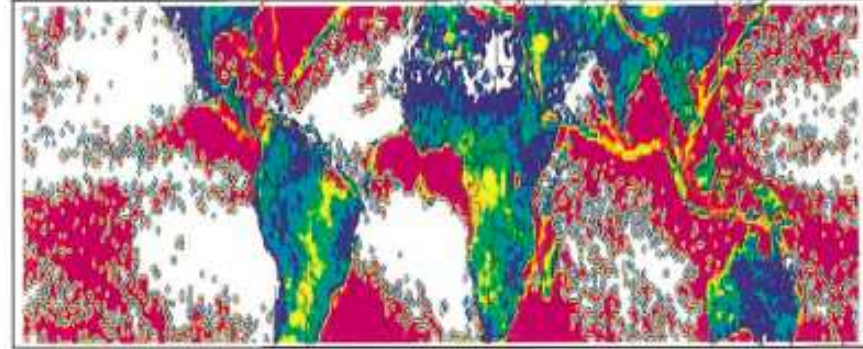


Lightning Discharges 1998-2000 average

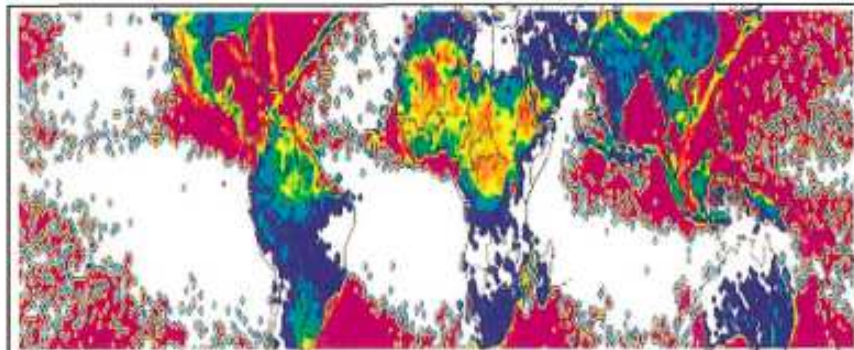
Lightning is the primary NO_x source over the ocean



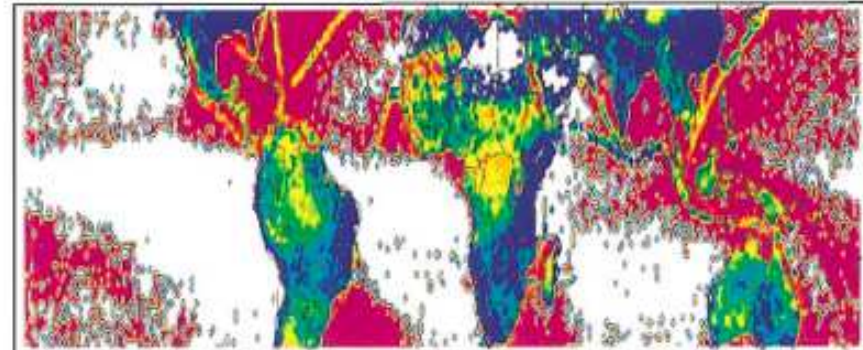
DJF



MAM



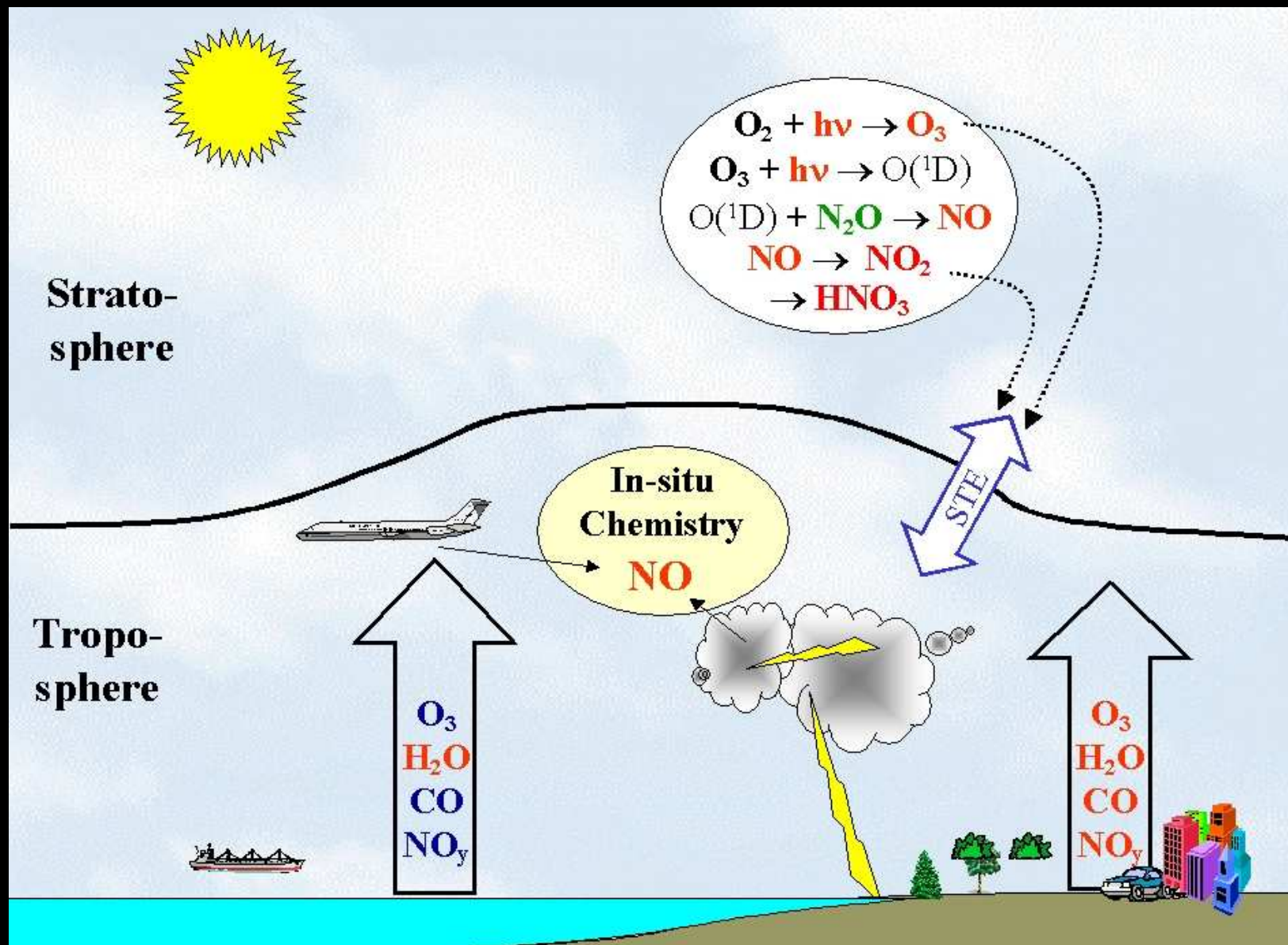
JJA



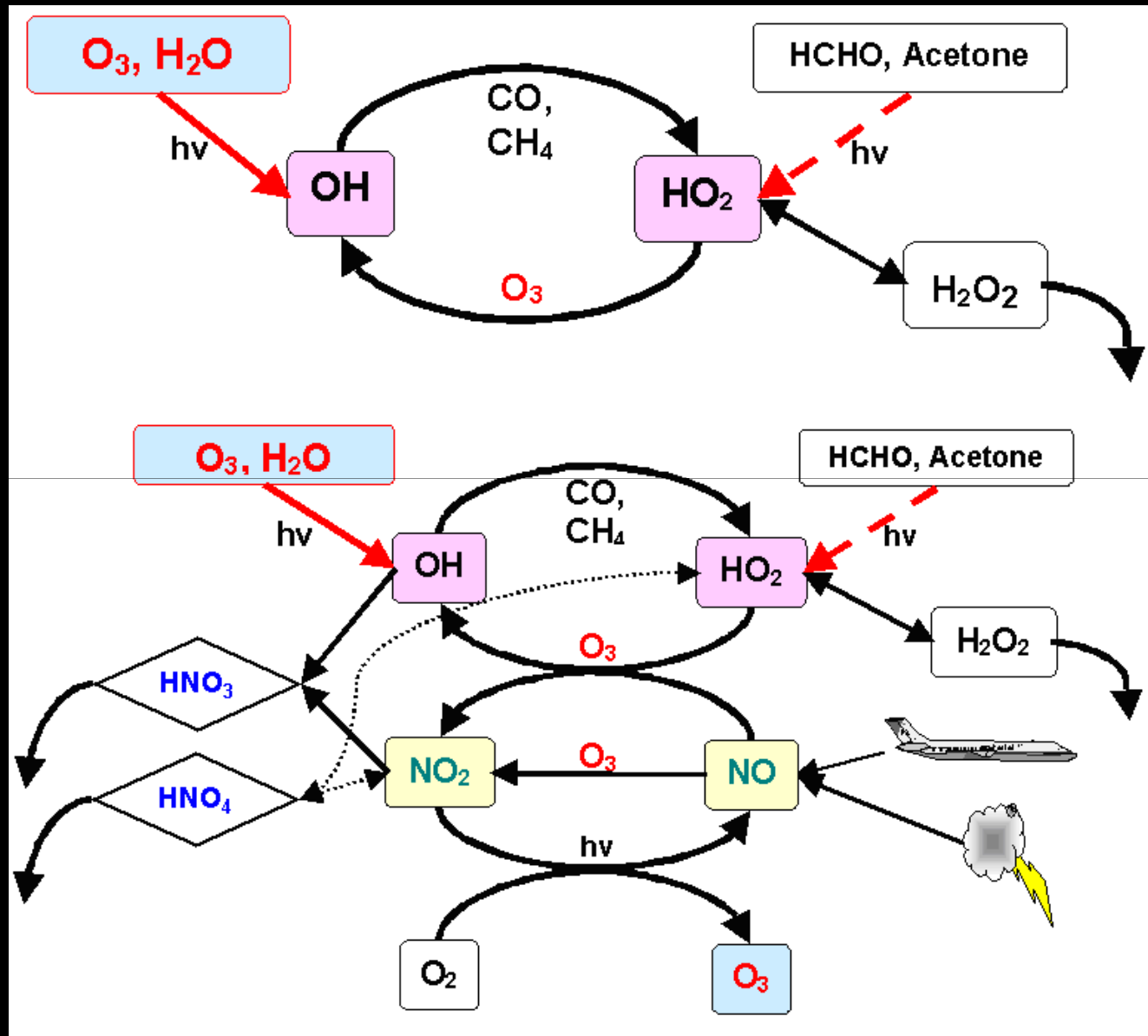
SON

1998-2000 average

Vertical distribution matters for chemistry



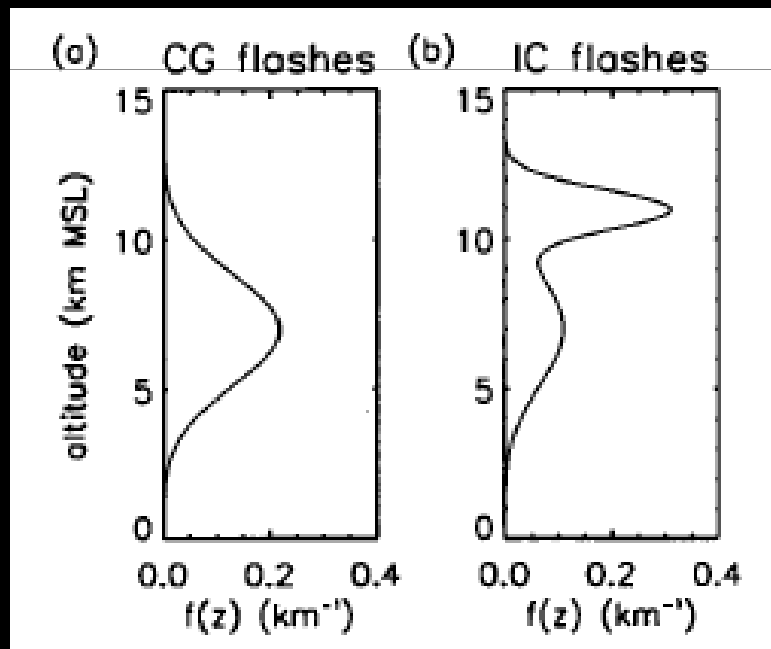
Upper troposphere NO_x creates O_3



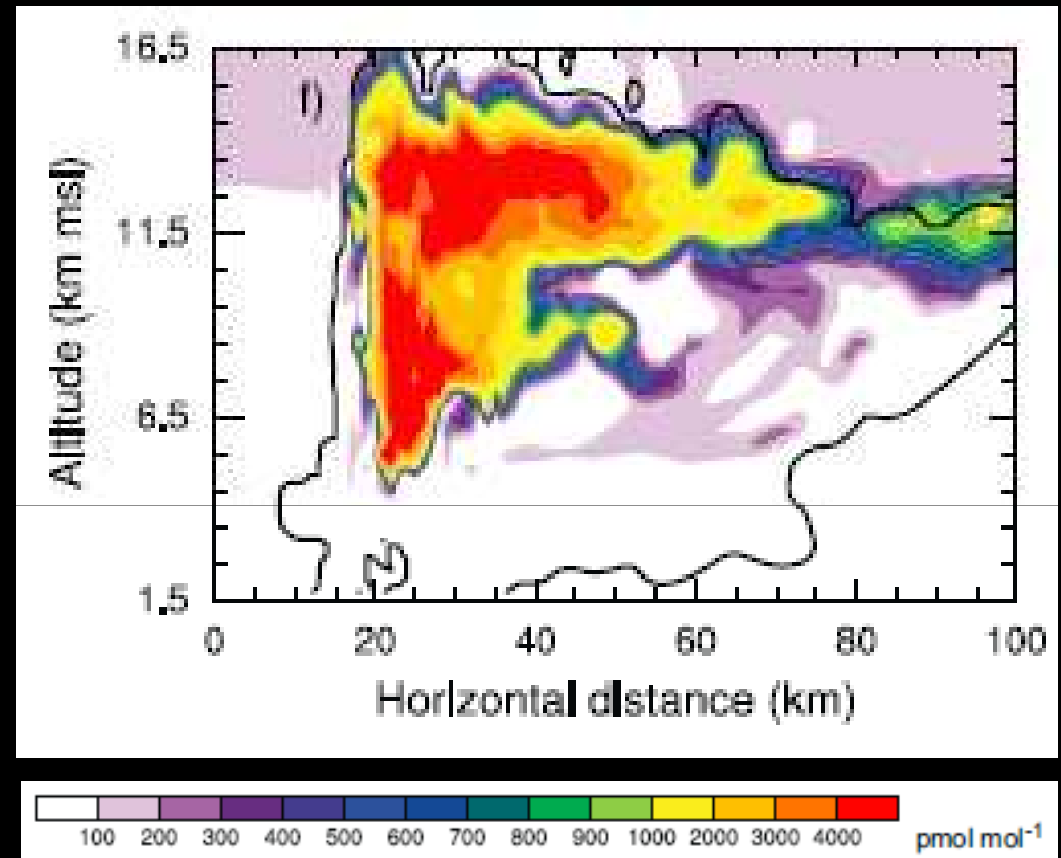
<http://www2.fz-juelich.de/icg/icg-2/mozaic/background>

Lightning NO_x is parameterized in models

Which cells have lightning?
Flash rate and location?
NO per flash?
Where to put NO?



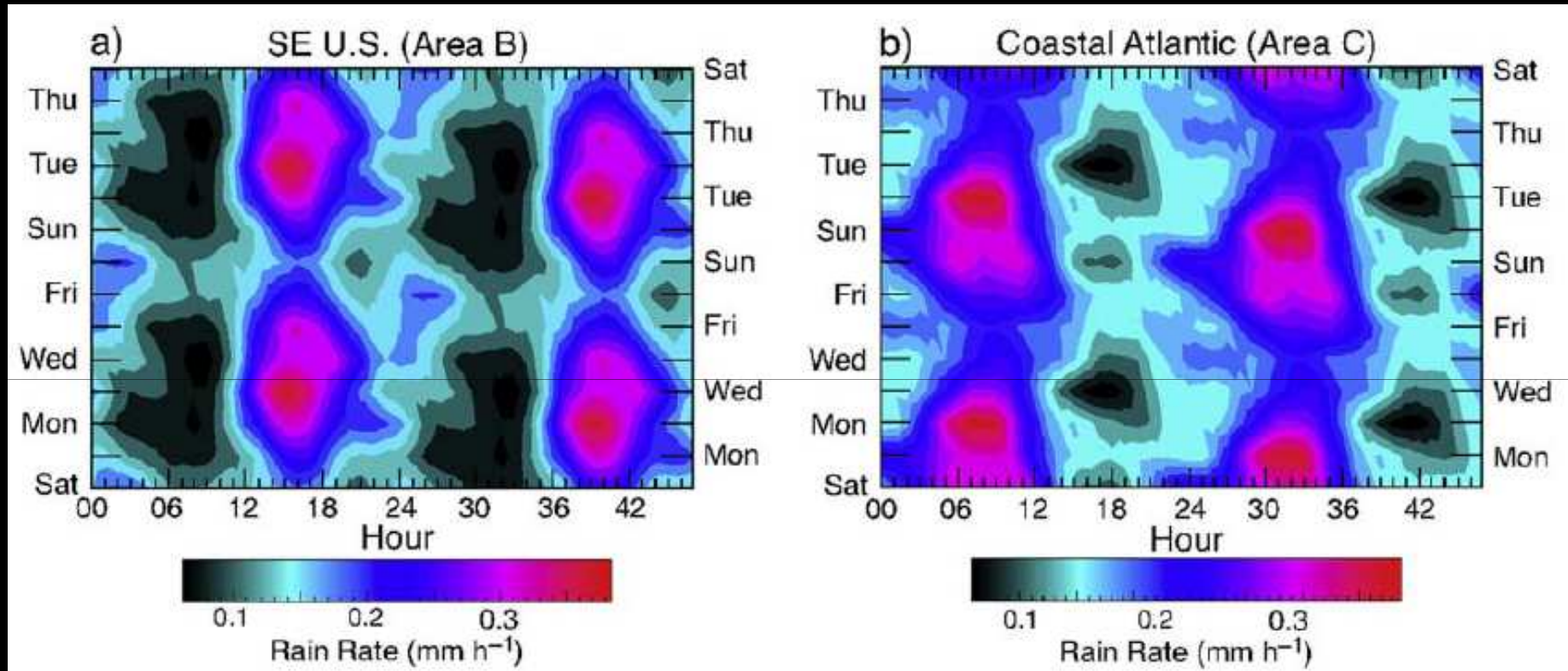
Decaria et al. (2000)



10 July 1996 STERAO storm
(NE Colorado) 2h

Barthe and Barth (2008)

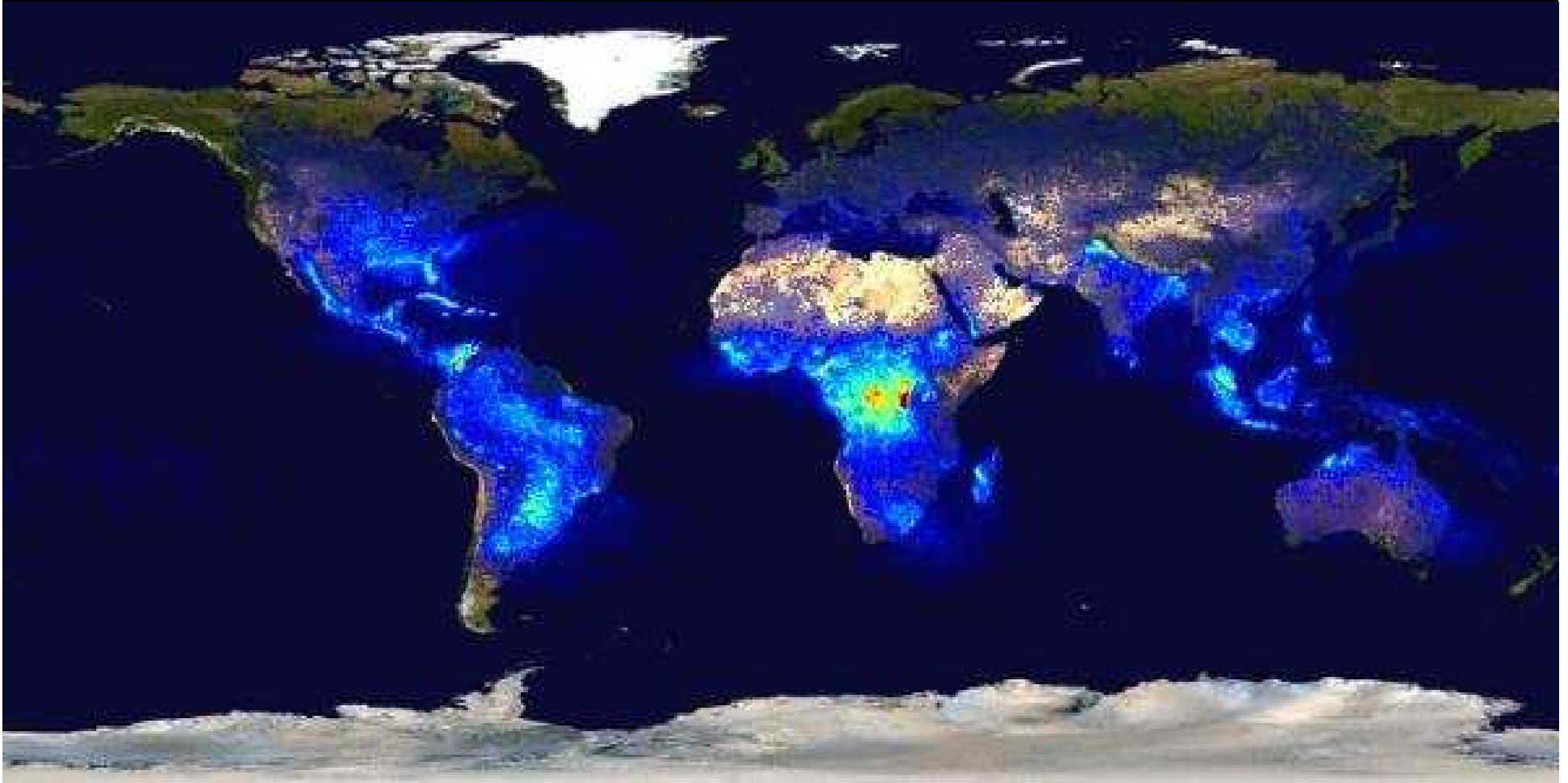
Anthropogenic effects on lightning?



TMI-estimated 4-hr average rain rate
June-August 1998-2005

Bell et al. (2008)

Questions?



<http://www.sciencedaily.com/releases/2009/10/091030100022.htm>