

Global Lightning Climatology from TRMM LIS and OTD

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Acknowledgements:

- LIS/OTD Science Teams, support from NASA TRMM
- GHRC- hosting the LIS data

Documentation of Dataset

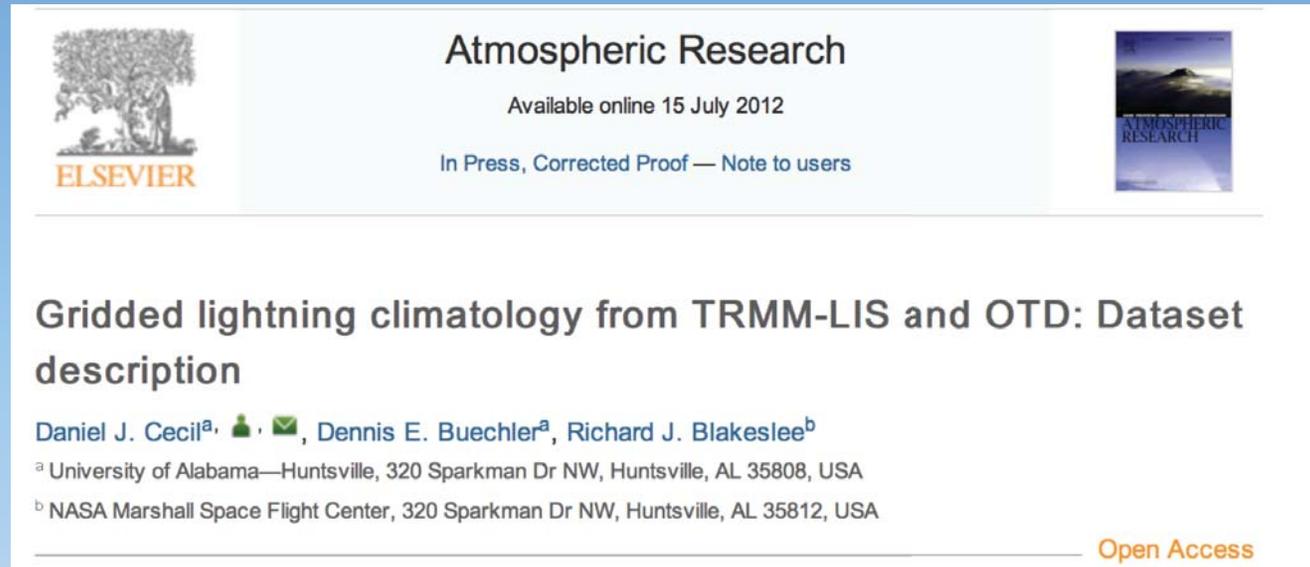
<http://dx.doi.org/10.1016/j.atmosres.2012.06.028>

Description of all gridded LIS-OTD climatology products in Cecil et al (2014) Atmospheric Research

Dataset subsequently updated through 2013

Detection efficiency as a function of diurnal cycle is accounted for

Variable sampling duration as a function of latitude is accounted for



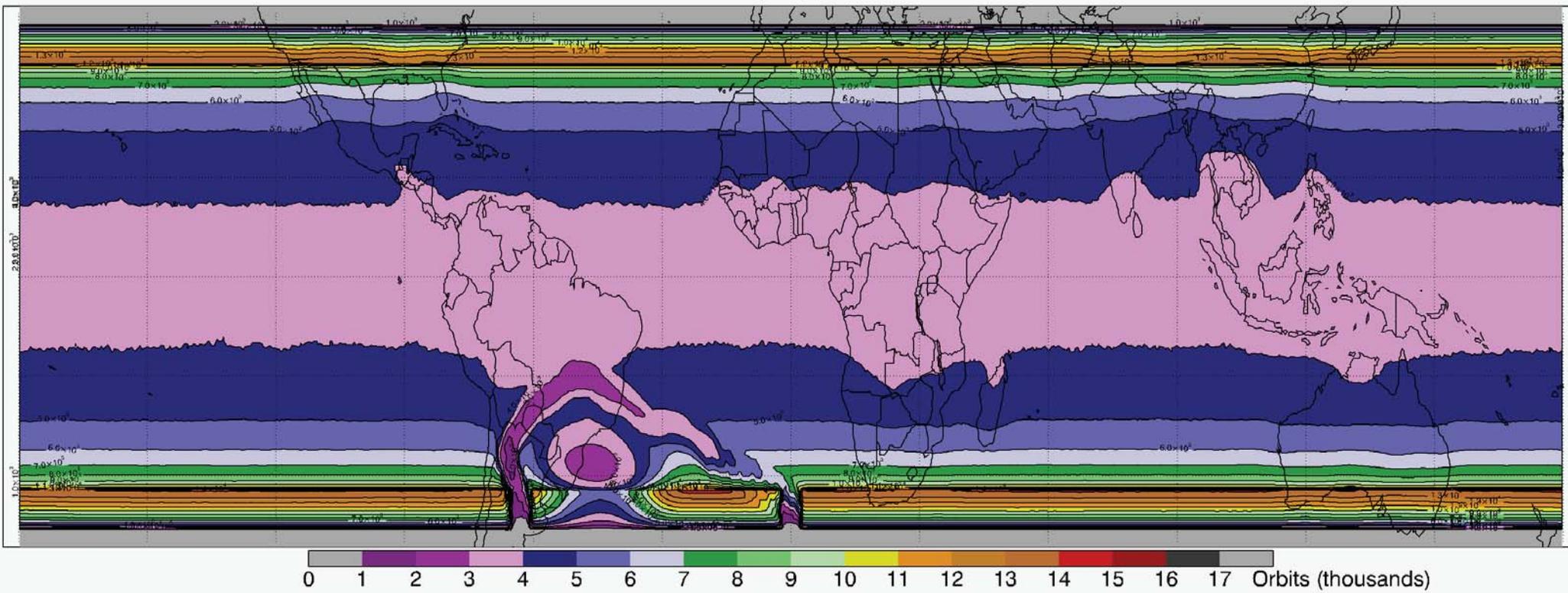
The screenshot shows the journal page for 'Atmospheric Research'. It features the Elsevier logo on the left, the journal title 'Atmospheric Research' in the center, and a cover image on the right. Below the journal information, the article title 'Gridded lightning climatology from TRMM-LIS and OTD: Dataset description' is displayed. The authors listed are Daniel J. Cecil, Dennis E. Buechler, and Richard J. Blakeslee. Their affiliations are provided: Cecil is from the University of Alabama—Huntsville, Buechler is from the University of Alabama—Huntsville, and Blakeslee is from NASA Marshall Space Flight Center. An 'Open Access' badge is visible in the bottom right corner of the page.

Animations of Mean Flash Rate over annual cycle and diurnal cycle shown in that paper, with updates at:

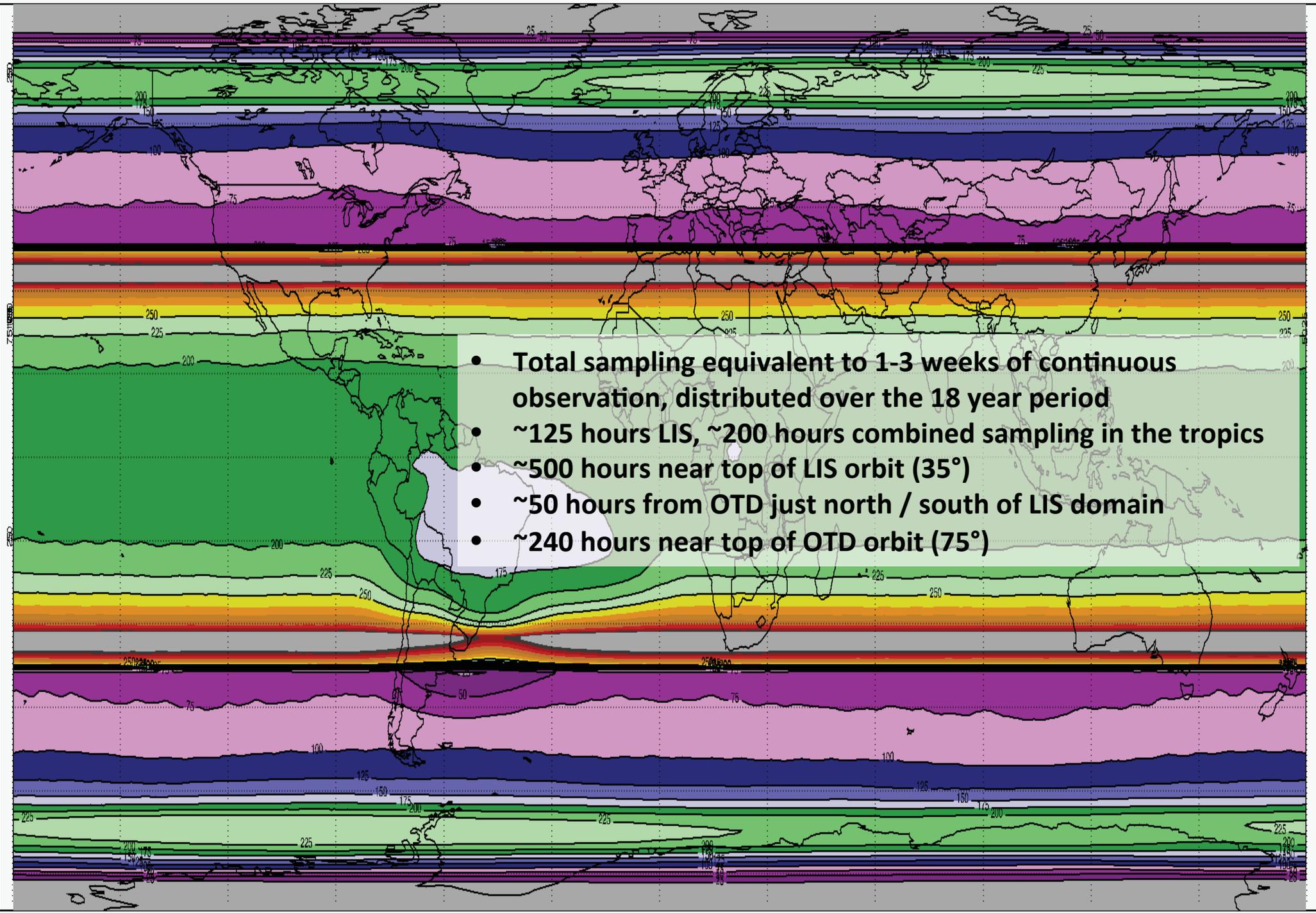
http://lightning.nsstc.nasa.gov/data/data_lis-otd-climatology.html

Sample Size – LIS 1998-2013

Number of Orbits Sampling Grid Box At Least 80 s



- All locations in Deep Tropics have been sampled by 3000-4000 orbits, typically around 90 seconds each orbit
- ~6000 orbits have sampled locations at $\pm 26^\circ$ (e.g., Tampa)
- ~13000 orbits have sampled locations at $\pm 33^\circ$ (Phoenix, Dallas, Atlanta), with rapid decrease beyond that
- South Atlantic Anomaly prevents complete sampling in Southern Brazil, Paraguay, Uruguay, Argentina. Many orbits there have only partial sampling (< 80 s)

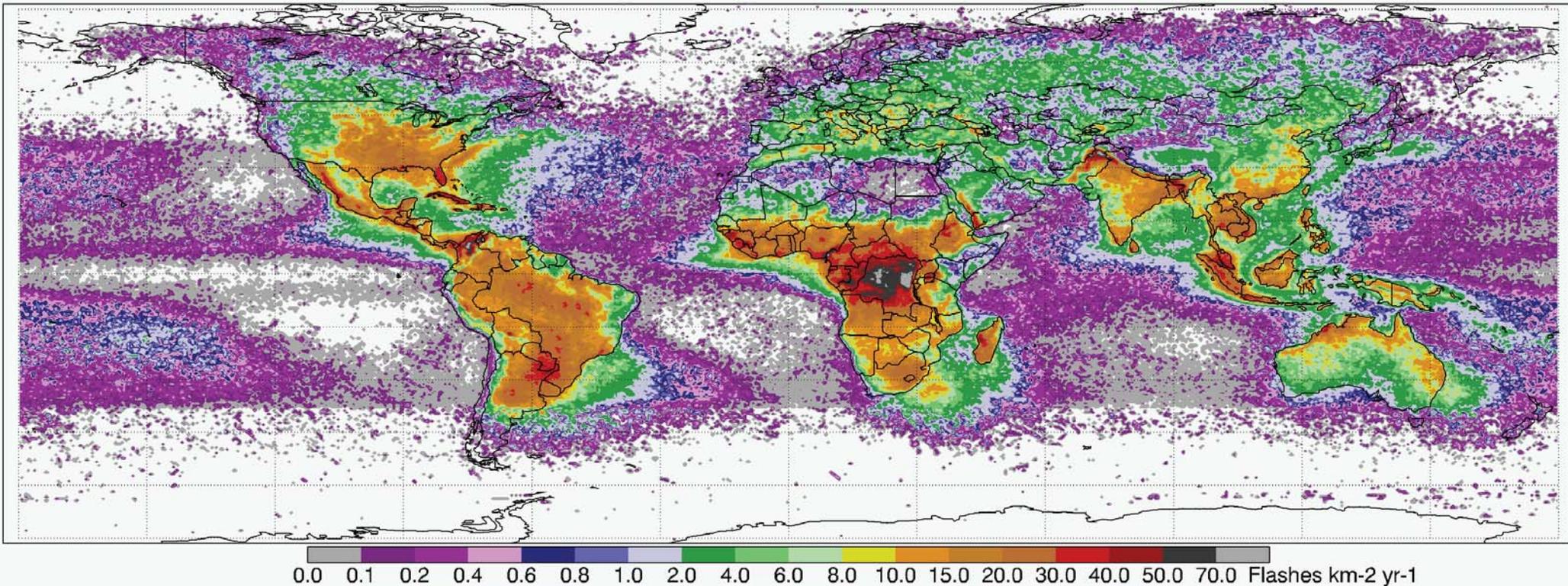


- Total sampling equivalent to 1-3 weeks of continuous observation, distributed over the 18 year period
- ~125 hours LIS, ~200 hours combined sampling in the tropics
- ~500 hours near top of LIS orbit (35°)
- ~50 hours from OTD just north / south of LIS domain
- ~240 hours near top of OTD orbit (75°)



Mean Annual Flash Rate

HRFC_COM_FR

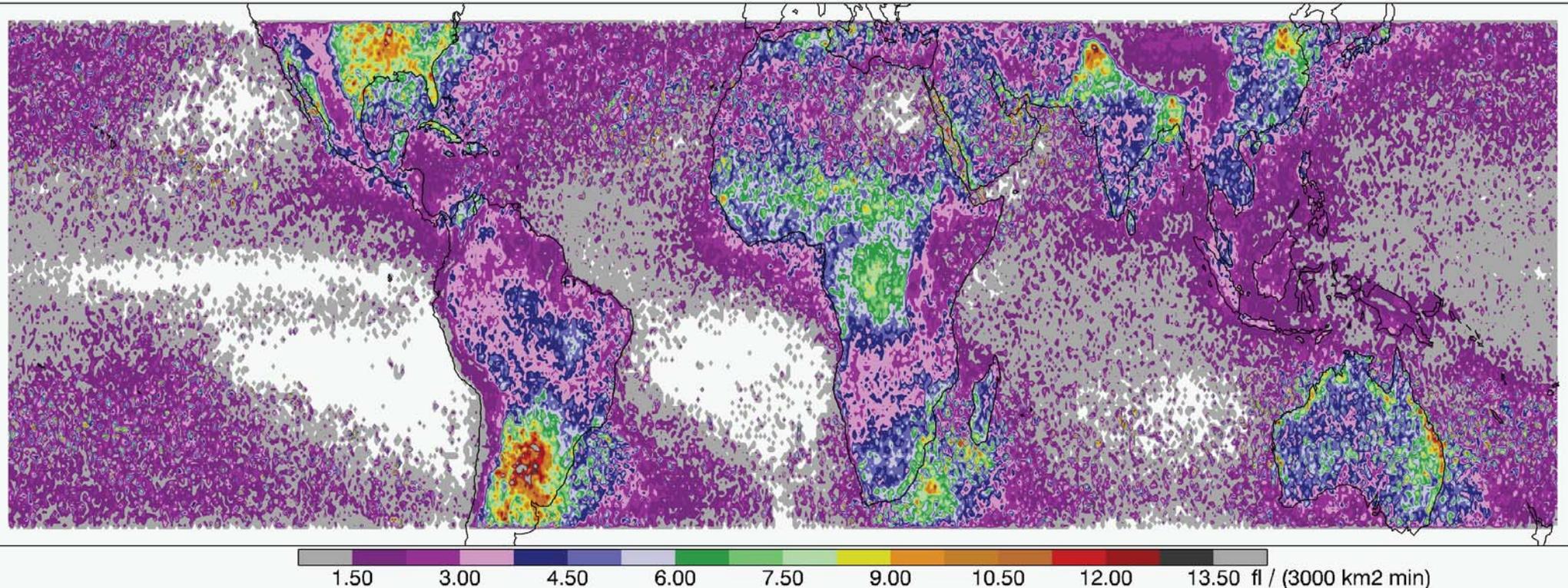


Combined OTD (1995-2000, with high latitudes) and LIS (1998-2013, +/-38°)

- Peak: ~ 160 fl $\text{km}^{-2} \text{yr}^{-1}$ in eastern Congo
- Higher resolution study (Albrecht) shows peak near Lake Maracaibo, Venezuela
- Other peaks in Maritime Continent, Bangladesh / East India, Pakistan, N. Argentina / Paraguay, west coasts of Mexico and Arabia
- Huge land-ocean contrast

Conditional Mean Flash Rate

Conditional Mean Flash Rate



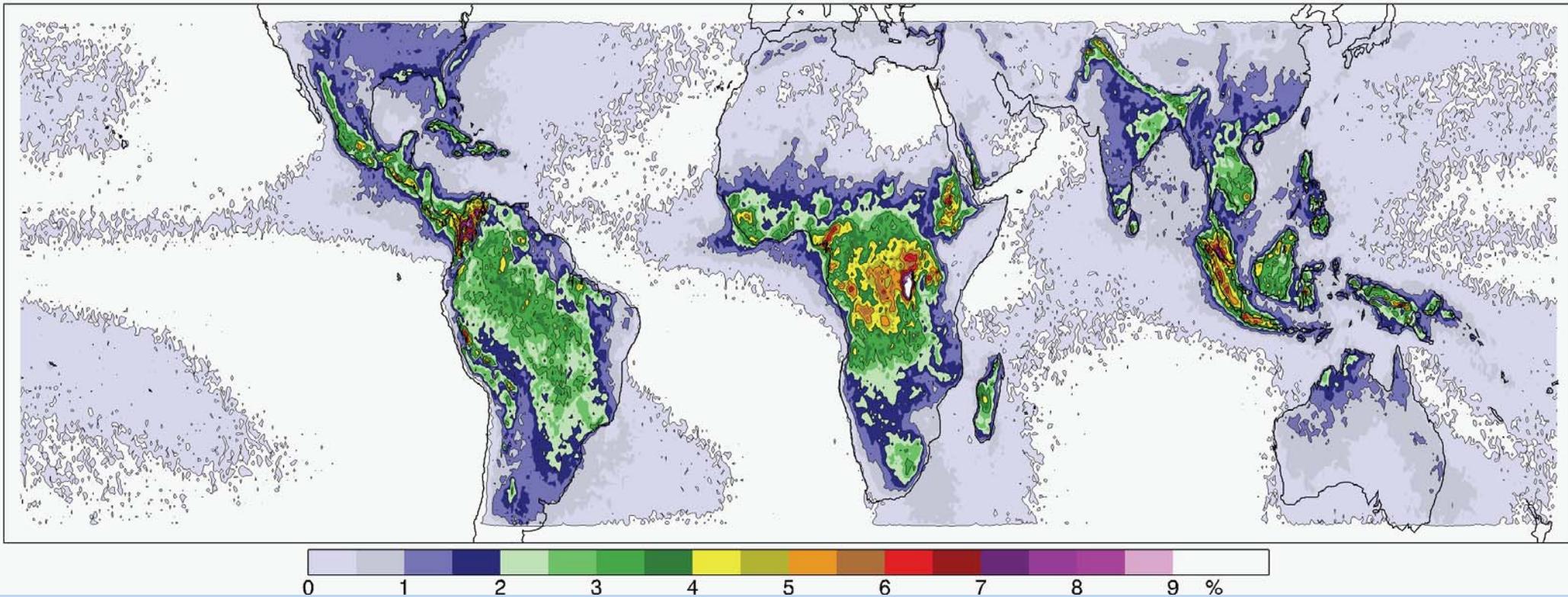
Annual Flash Rate depends on:

- (a) *How often thunderstorms occur, and*
- (b) *How active those thunderstorms are*

- Central Africa has sharp East-West gradient between frequent low-flash-rate storms (east), and less frequent higher-flash-rate storms (west)
- Highest flash rates in Argentina (> 10 flashes per minute mean, on 0.5° grid)
- East of Rockies, southern US has 6-10 flash per minute mean
- Subtropical hotspots have greater flash rates than tropical hotspots

Fraction of LIS Orbits w/ Lightning in 0.5° Box

Prob of 1-min lightning in 0.5-degree grid box

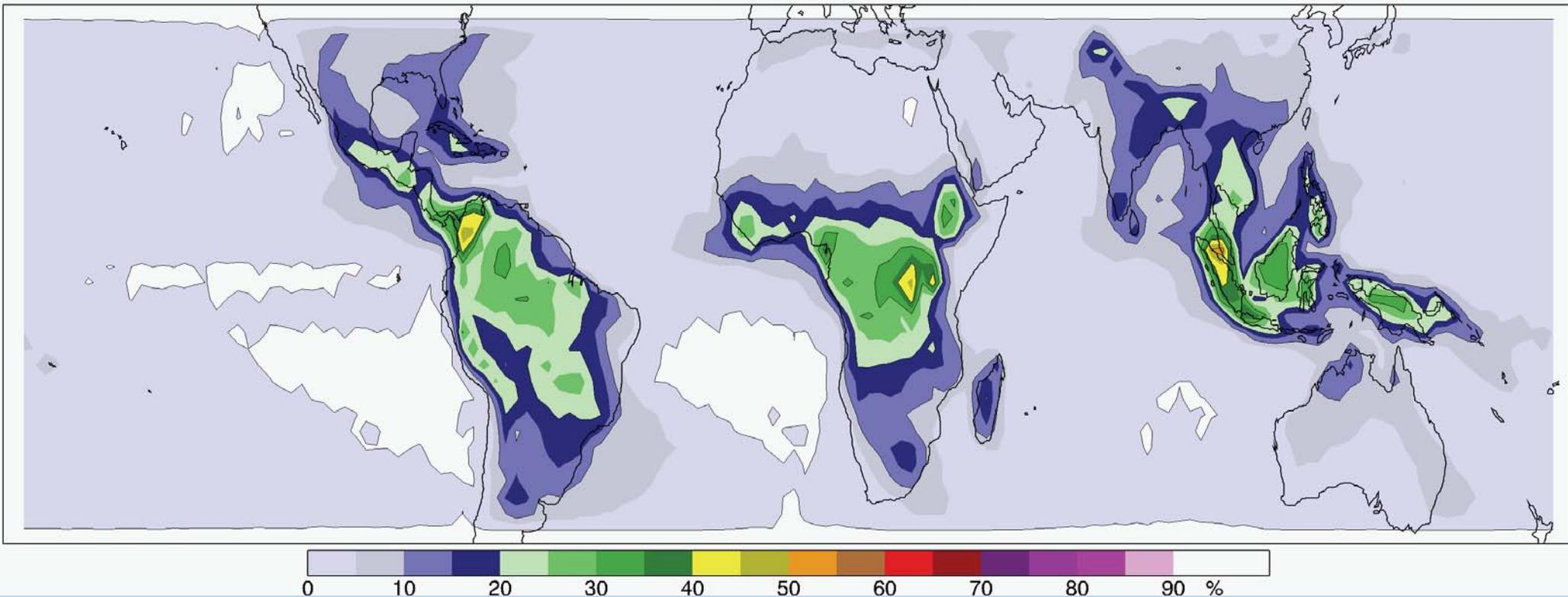


What is the chance there is any lightning within a $\sim 50 \times 50$ km box, over ~ 90 seconds?

- Peak: Lightning occurs somewhere in a 0.5° box for about 13% of all ~ 90 s periods, in eastern Congo
- Highest lightning probabilities mostly associated with terrain features
- Most of US has lightning within a 0.5° box 1-2% of the time (for 90 s periods)
- Huge land-ocean contrast

Fraction of LIS Orbits w/ Lightning in 2.5° Box

Prob of 1-min lightning in 2.5-degree grid box

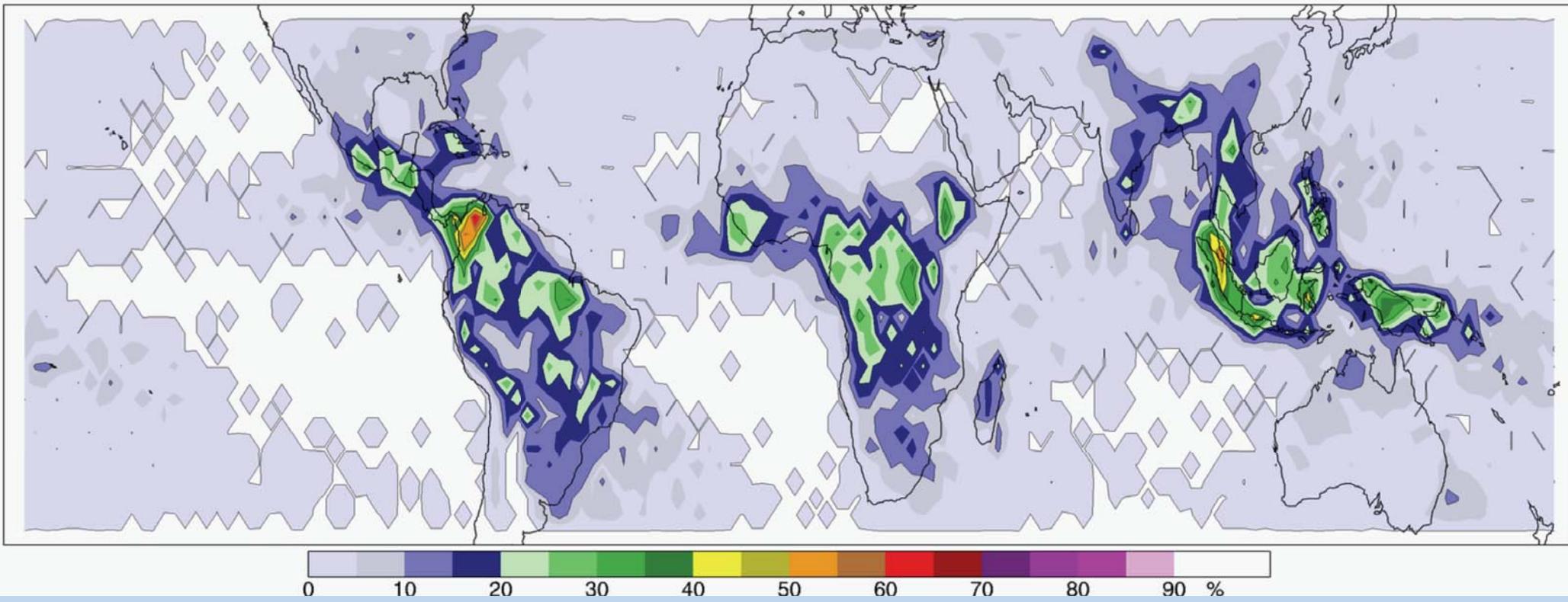


What is the chance there is lightning within a $\sim 250 \times 250$ km box, over ~ 90 seconds?

- Peak: Lightning occurs somewhere in a 2.5° box for $> 40\%$ of all ~ 90 s periods, in eastern Congo, Colombia, Sumatra
- Most tropical land locations have lightning within 2.5° box $> 20\%$ of the time

Diurnal Cycle of Lightning Probability in 2.5° Box

Prob of 1-min lightning in 2.5-degree grid box, 0:00 Local Solar Time

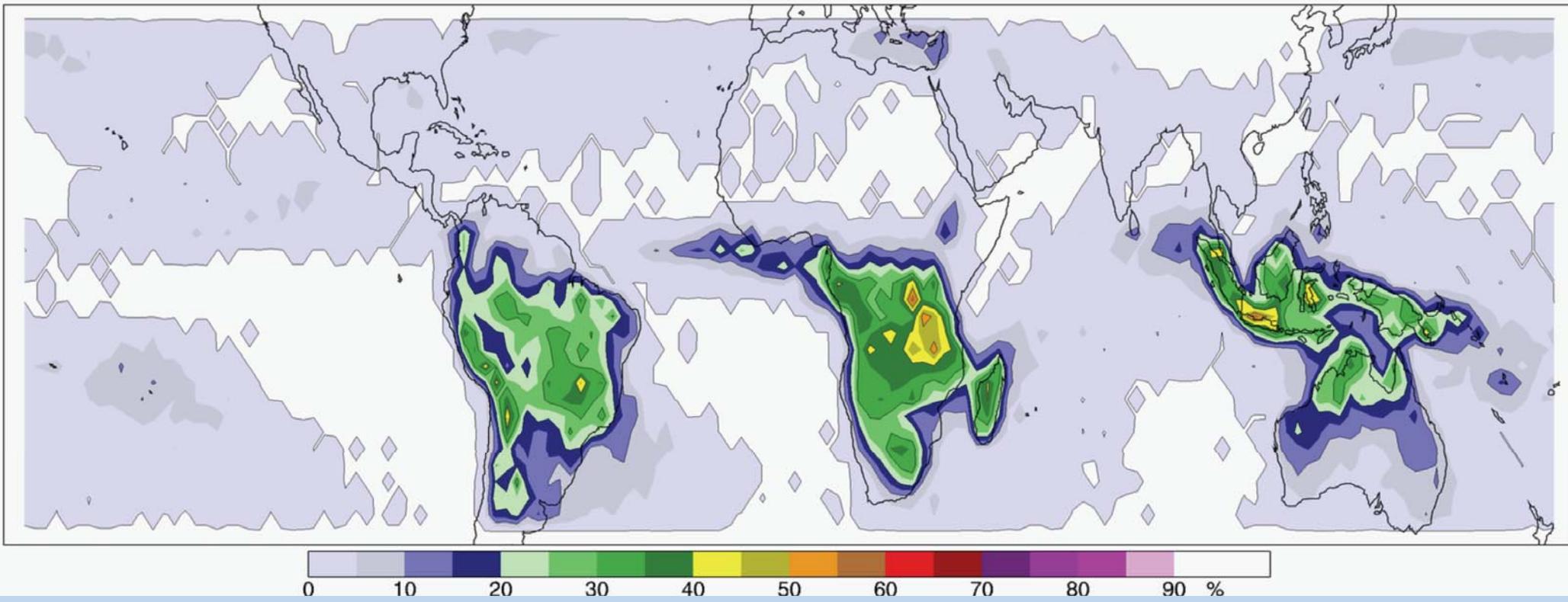


What is the chance there is lightning within a ~250x250 km box, over ~90 seconds?

- During afternoon, > 90% of orbits have lightning in eastern Congo
- > 20% for parts of SE US and southern Rockies
- Offshore max near 6 AM, onshore max in mid-afternoon for coastal areas

Annual Cycle of Lightning Probability in 2.5° Box

Prob of 1-min lightning in 2.5-degree grid box, JAN

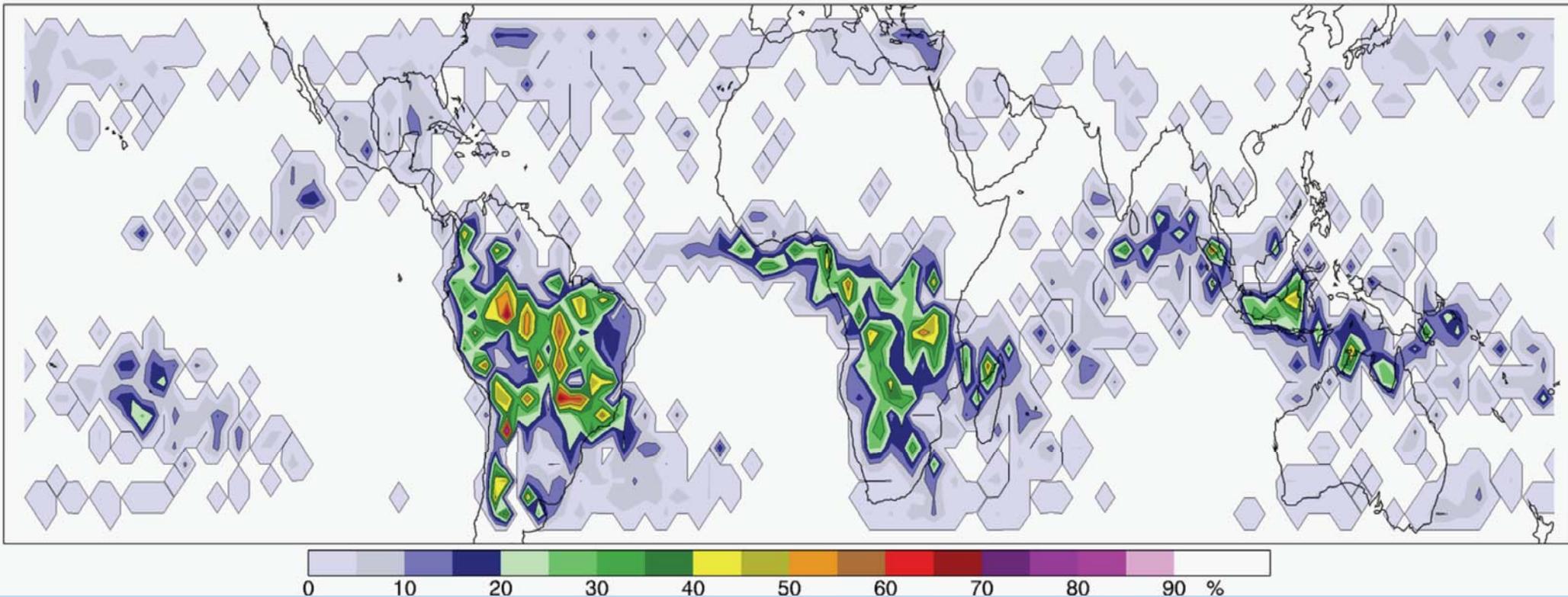


What is the chance there is lightning within a $\sim 250 \times 250$ km box, over ~ 90 seconds?

- Seasonality as expected, with peaks generally in summer
- Want to combine this with diurnal cycle (next slide), but limited sampling makes it noisy

Annual Diurnal Cycle of Lightning Probability, 2.5° Box

Prob of 1-min lightning in 2.5-degree grid box, JAN-FEB 1:00 UTC



What is the chance there is lightning within a ~250x250 km box, over ~90 seconds?

- Times are in UTC, for my convenience using previous software
- Don't focus on noisy details, the sampling is not robust
- Work in progress (very, very early!)

LIGHTNING AND ATMOSPHERIC ELECTRICITY RESEARCH AT THE GHCC

HDF files of gridded climo available

Google-Earth interface for querying data

Home



Need help?
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The GHCC Lightning Team

A Lightning Primer

Dataset Information

Space Research and Observations

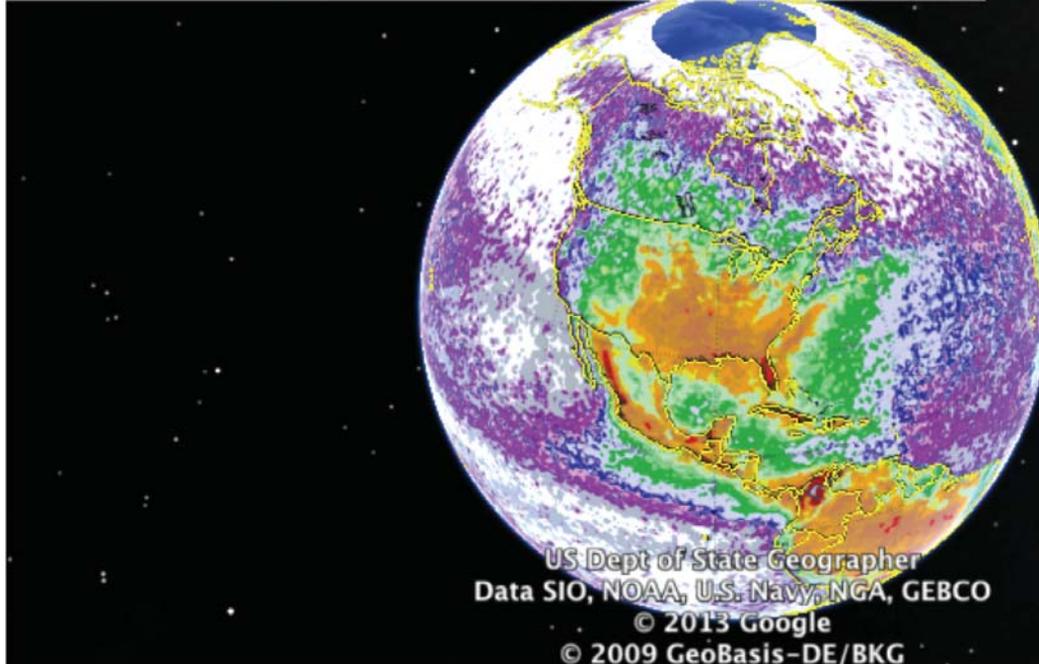
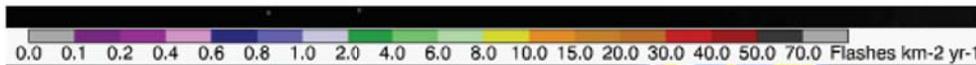
Field Campaigns and Ground Validation

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Summary and Notes

- LIS/OTD gridded total lightning climatology products (*mean flash rates*) have been updated through 2013
- Various products are available
 - Hi (0.5°) and Low (2.5°) resolution
 - Monthly, Annual, Daily, Diurnal
- Most of what was shown here (fraction of orbits with lightning; conditional mean flash rates) is not included in the current climatology products
- This was proof-of-concept, for consideration in future releases
- Feedback wanted – should these be included in the standard LISOTD climo files, included as separate files, or not at all?
- Annual Diurnal Cycle product is in UTC, not LST – would switching that introduce a problem for users?