

# TRMM LIS Climatology of Thunderstorm Occurrence and Conditional Lightning Flash Rates

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## Diurnal Cycle of Thunderstorm Occurrence (Fraction of TRMM Overpasses with Lightning in 2.5° Grid Box)

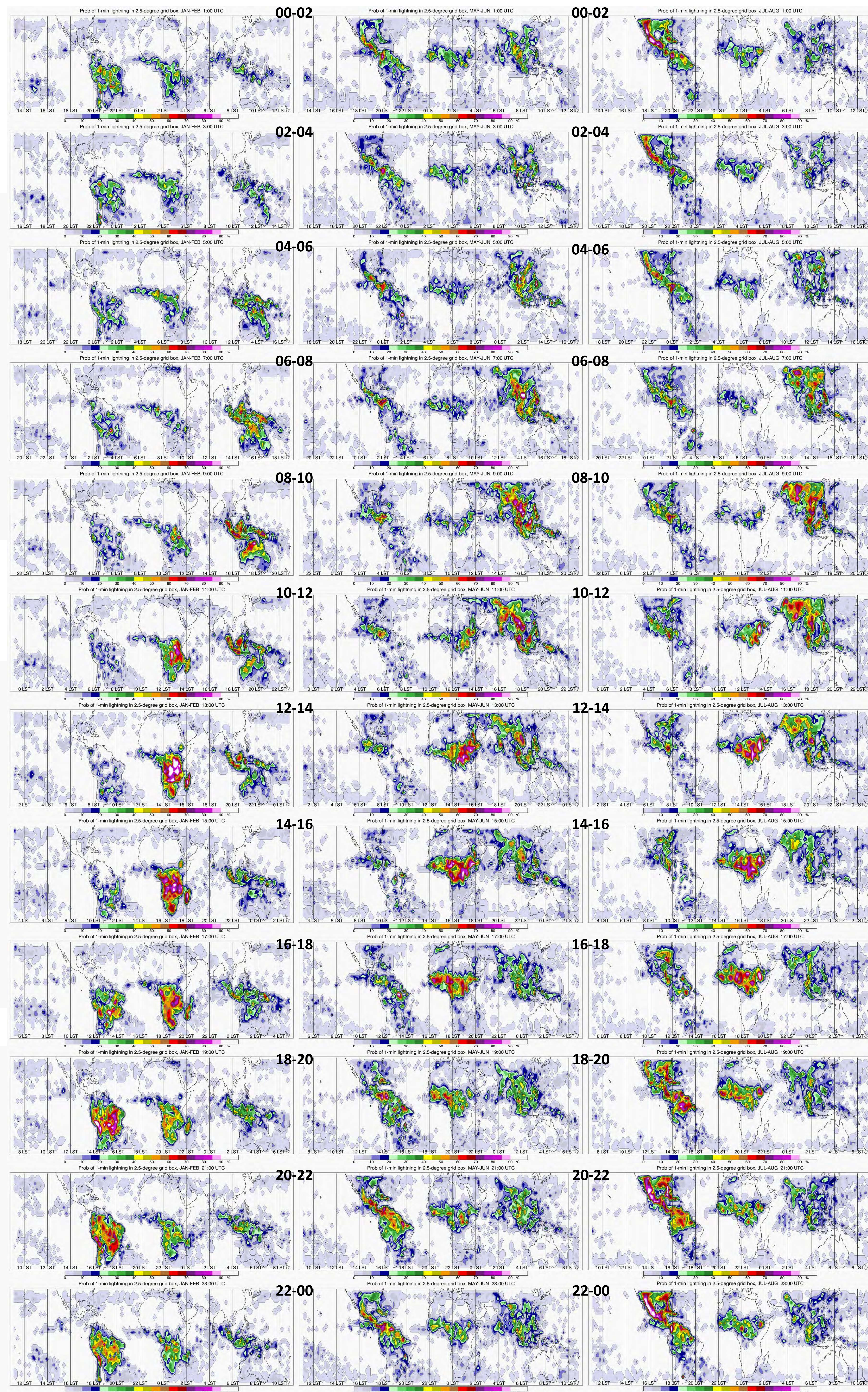
Varying during the year

Map Times are UTC, with vertical (longitude) lines marking Local Time

January-February

May-June

July-August



The TRMM Lightning Imaging Sensor (LIS) collected total lightning (in-cloud plus cloud-to-ground) data from Dec. 1997 until April 2015. Quality-controlled (QC) data files are available from 1 Jan 1998, with QC currently incomplete for 2014-15. Gridded lightning climatology files (HDF, images, and animations) of mean lightning flash rate are available for the period 1998-2013. Cecil et al. (2014 *Atmos. Res.*) describe the gridded climatologies.

Lightning Flash Rate products include Mean Annual Flash Rate (the first map below, labeled HRFC\_LIS\_FR), Mean Annual Cycle (monthly and daily), Mean Diurnal Cycle (hourly), combined Annual-Diurnal Cycle (2-hourly means for each day of year), and Time Series (smoothed daily and monthly values sequentially from 1998-2013).

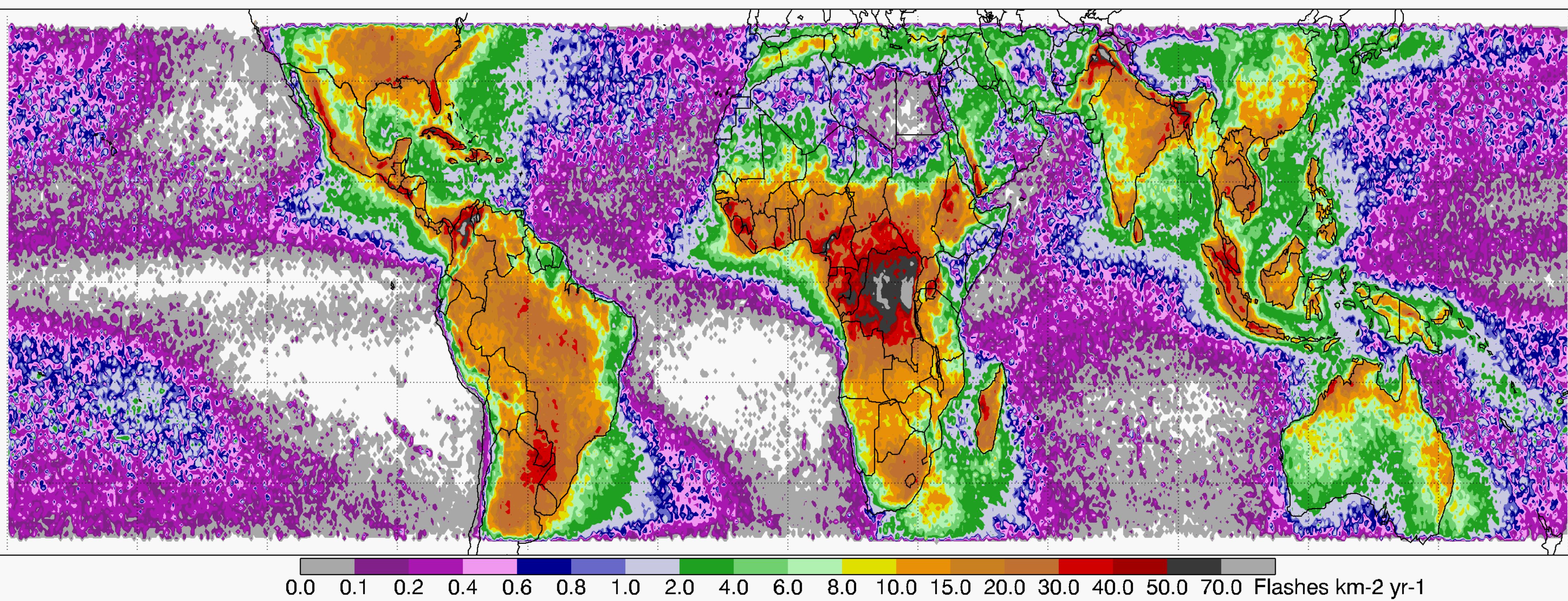
Cecil et al. (2015 *J. Climate*) describe additional fields to be added to the lightning climatology grids after QC is complete for 2014-15, besides the mean flash rate that is already included:

- Fraction of Overpasses With Lightning (i.e., fractional thunderstorm occurrence for a grid box). LIS views a location for about 90 seconds during an overpass.
- Conditional Mean Flash Rate (mean flash rate excluding the times that have zero lightning)

All images on this poster use TRMM LIS data from 1998-2013. These and others are shown in Cecil et al. (2015 *J. Climate*); open access at: <http://dx.doi.org/10.1175/JCLI-D-15-0124.1>.

### Mean Annual Flash Rate, 0.5° grid

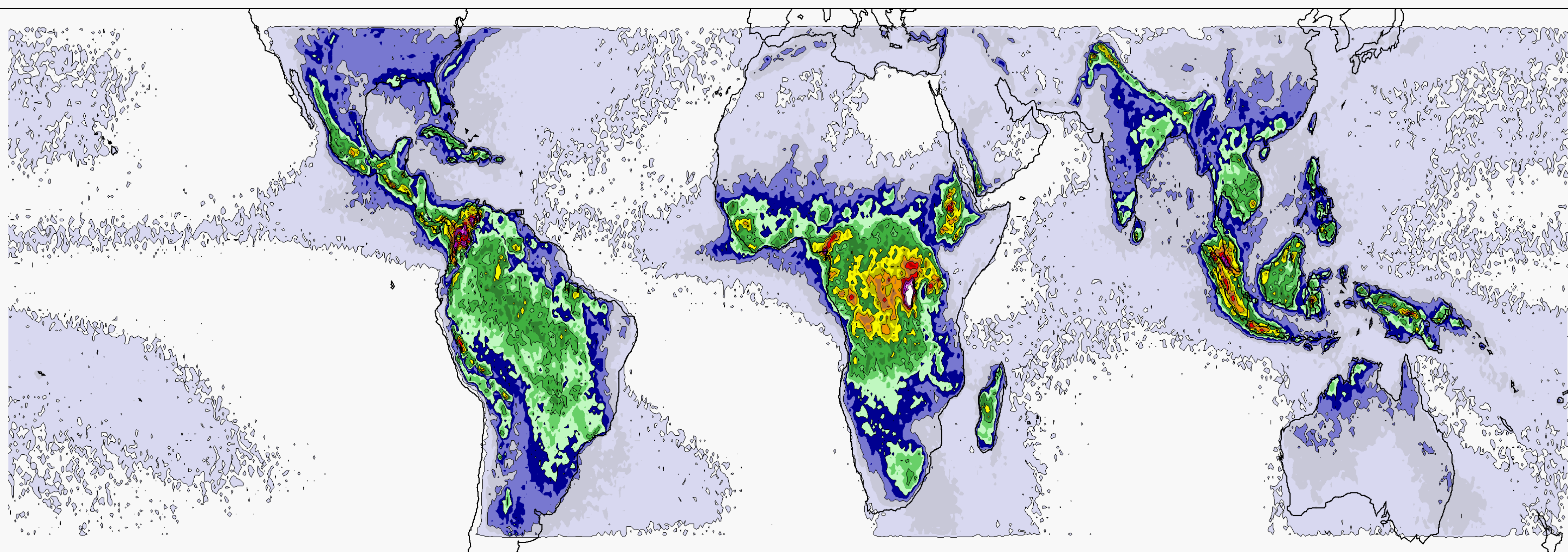
HRFC\_LIS\_FR



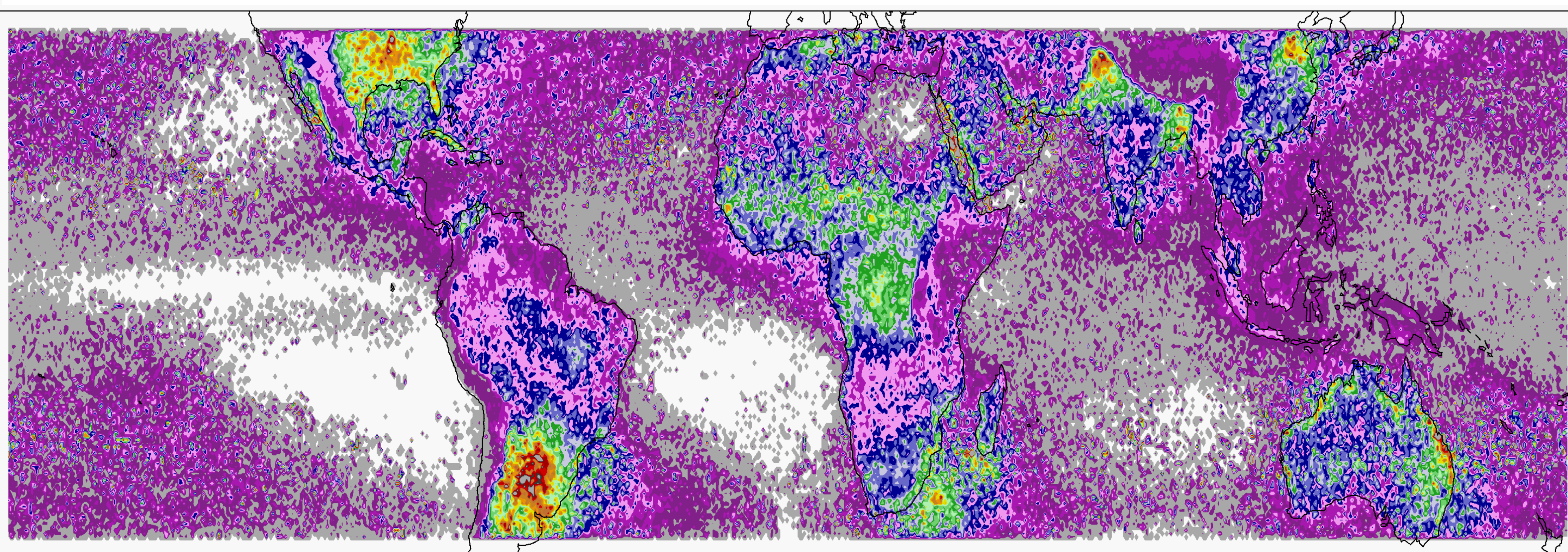
**Above: Mean Annual Flash Rate, 0.5° grid.** The highest value (188 Flashes km<sup>2</sup> yr<sup>-1</sup>) is over Lake Maracaibo, Venezuela. Central Africa (far eastern Dem. Rep. Congo) ranks close behind. At coarser grid scales, Central Africa has the highest flash rates. Other regions with very high values (~100 Flashes km<sup>2</sup> yr<sup>-1</sup>) include other parts of Central Africa and the Northern Andes, Northern Pakistan (foothills of the Hindu Kush Mountains), and the Cameroon-Nigeria border. Most generally, we see the familiar result that “lightning loves land”.

**Below: Fraction of TRMM Overpasses With Lightning (fractional thunderstorm occurrence for a 0.5° grid box).** The far eastern DRC has thunderstorms most often (about 10% of TRMM overpasses), followed by Lake Maracaibo and the Northern Andes, and the Malacca Strait between Malaysia and Sumatra. More generally, tropical land regions and mountain chains stand out with high frequency of occurrence for thunderstorms.

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

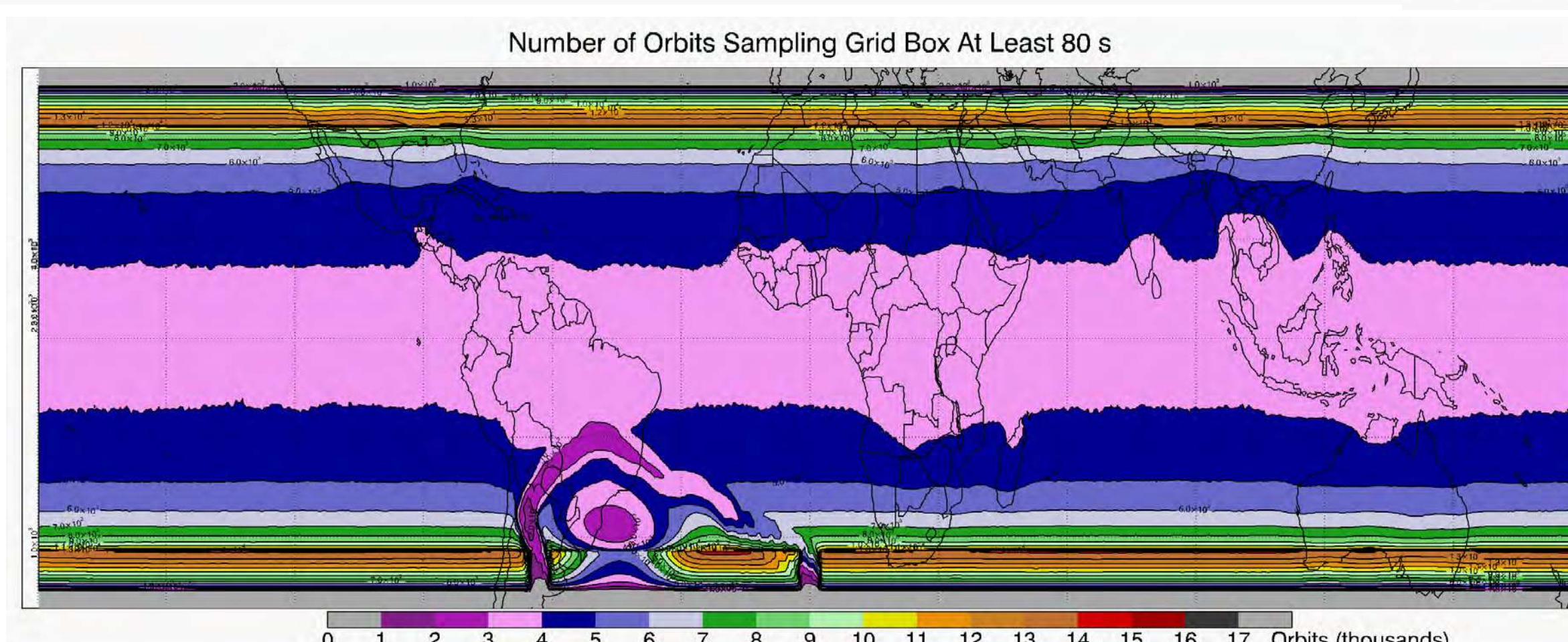


**Below: Conditional Mean Flash Rate.** This is the Mean Annual Flash Rate (top) divided by the Fraction of Overpasses With Lightning (Middle), with the units re-scaled to be appropriate for the size of a grid box and length of an individual observation. Subtropical land regions stand out as having the highest flash rates *when thunderstorms do occur*. Northern Argentina, Paraguay, Central and Southeast U.S., Northern Pakistan, East India / Bangladesh, Eastern China, Coastal Australia, and offshore South Africa have the highest values. The Maritime Continent and most of tropical South America have notably low values – frequent storms, not terribly strong.



### Conditional Mean Flash Rate, 0.5° grid

**Right: Number of TRMM orbits sampling each 0.5° grid box for at least 80 seconds.** Distortion near Uruguay is due to South Atlantic Magnetic Anomaly, which introduces noise and sometimes renders the instrument temporarily “blind” for practical purposes.



Gridded LIS climatology data is available from: [http://lightning.nsstc.nasa.gov/data/data\\_lis-otd-climatology.html](http://lightning.nsstc.nasa.gov/data/data_lis-otd-climatology.html)

Besides the HDF data files, images, and animations, that web page includes a Google Earth Interface for viewing the imagery. Some parts of the interface are not intuitive, so this tutorial may help: [http://lightning.nsstc.nasa.gov/data/lis\\_otd\\_tutorial.m4](http://lightning.nsstc.nasa.gov/data/lis_otd_tutorial.m4)

### Acknowledgments

This research benefits from over two decades of work by past and present members of the lightning team associated with NASA MSFC. In particular, the gridded climatologies were updated using source code originally developed by Dennis Boccippio. Sponsorship and support for the OTD and LIS data is from the NASA Earth Observing System and the Tropical Rainfall Measuring Mission. LIS and OTD data, including the gridded climatologies produced here, are distributed by the NASA EOSDIS Global Hydrology Resource Center DAAC, Huntsville, AL, USA, <http://lightning.nsstc.nasa.gov>.

Cecil, D.J., D. Buechler, and R. Blakeslee. 2014b. LIS/OTD/Gridded Lightning Climatology Data Collection. Data set available online [\[http://ghrc.nsstc.nasa.gov/pub/lis/climatology\]](http://ghrc.nsstc.nasa.gov/pub/lis/climatology) from the NASA EOSDIS Global Hydrology Resource Center Distributed Active Archive Center Huntsville, Alabama, U.S.A. doi: <http://dx.doi.org/10.5067/LIS/LIS-OTD/DATA311>