TRMM-LIS Lightning Climatology and Time Series

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• LIS/OTD Science Teams, support from NASA TRMM
• GHRC- hosting the LIS data
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°)
ISS LIS to launch in early 2017

54° inclination orbit is nearly ideal for augmenting the previous LIS-OTD sample size

After about a 2-year gap, time series products of lightning flash rate can be resumed
From a simple counting experiment, the total number of flashes observed divided by the total observation duration for each 0.5° grid box
Annual Cycle, Diurnal Cycle, Inter-Annual Variability

As the data volume grows large, we can examine finer details and get robust results:

- Annual Cycle
- Diurnal Cycle
- Diurnal Cycle, as it varies through the year
- Inter-Annual Variability
Mean Annual and Diurnal Cycles from TRMM-LIS and OTD (1995-2014)

Animation of Diurnal Cycle (in UTC), separately for each month

Good data for analyzing this in the tropics already, but ISS-LIS will make characterization of mid-latitudes much more robust
The long record from OTD and TRMM-LIS allows comparisons of different years.

Most of the big percentage anomalies (at right) are for regions / seasons that do not get much lightning climatologically (e.g., deserts, oceans).

Absolute anomalies can also be plotted, which would highlight only the regions / seasons that do get a lot of lightning.

*Time Series products have ~3-month temporal smoothing, 7.5° spatial smoothing*
**Top:** Flash Rate Time Series and Anomalies for a box including **East India and Bangladesh**

*For this region, most years are pretty close to normal in terms of total flash rate.*  2010 was a huge (positive) anomaly.

**Right:** Mean flash rate for **March-April-May 2010**, and percentage anomaly from the March-April-May mean
Top: Flash Rate Time Series and Anomalies for a box including southern Paraguay

For this region, “normal” almost never happens. Most years are either abnormally active or inactive.

Right: Mean flash rate for Oct-Dec 2009 (top right), and Oct-Dec 2011 (bottom right).
**Top:** Flash Rate Time Series and Anomalies for a box including northwestern Australia

For this region, some years have pretty normal lightning flash rates, some years are particularly active or inactive

**Right:** Mean flash rate for Oct-Dec 2009 (top right), and Oct-Dec 2011 (bottom right).
Note the difference in amplitude of annual cycle between Central Asia and Indonesia.
South America

Huge inter-annual variability for Paraguay region, but even the “off season” has a substantial amount of lightning.
Central Africa dominates the maps of mean annual flash rate in part because it remains active all year, every year.
Data available from GHRC, pretty easy to use, lots of ways to look at the datasets

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