TRMM-LIS Lightning Climatology and Time Series

Daniel J. Cecil (1)
Dennis E. Buechler (2)
Richard J. Blakeslee (1)

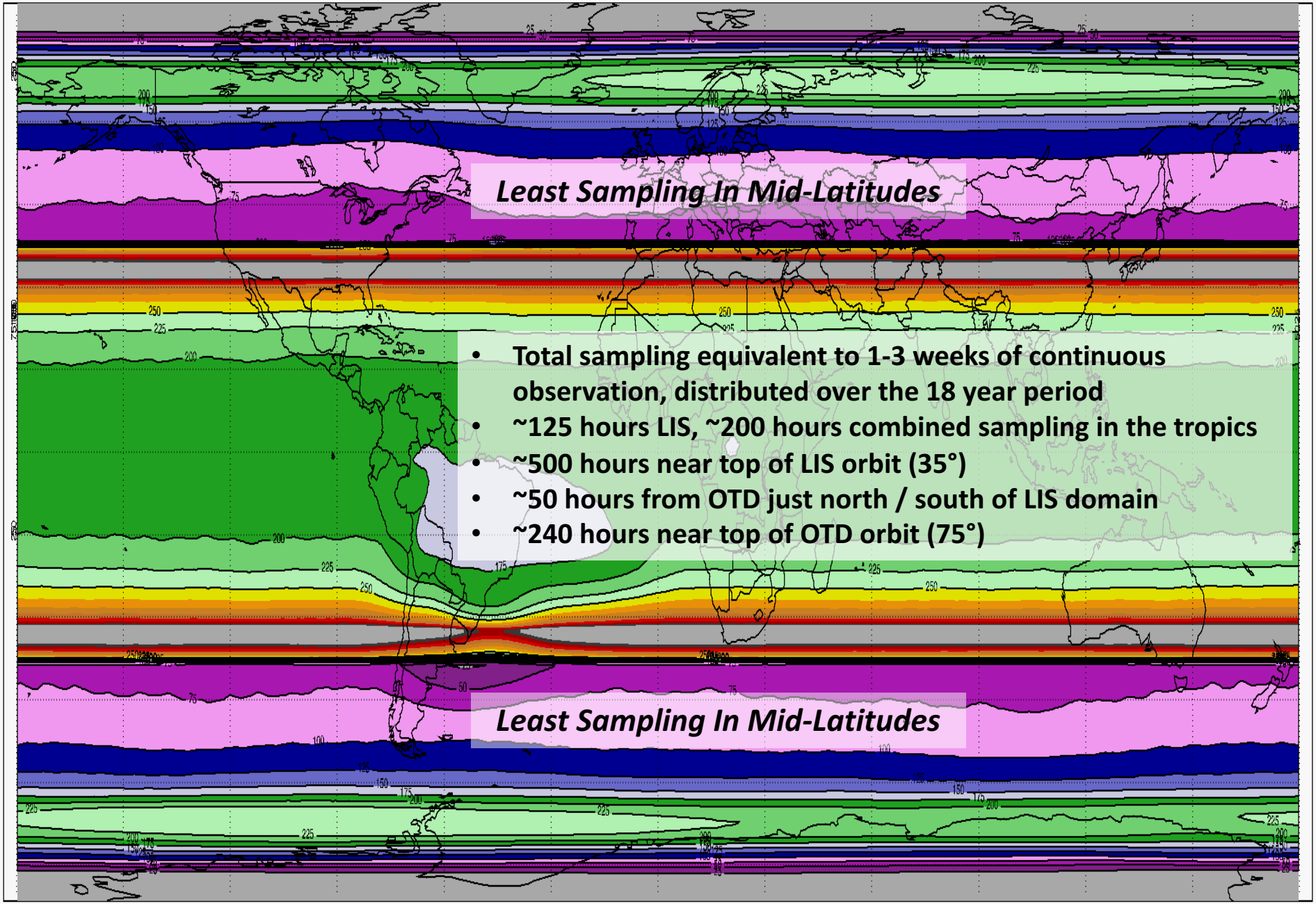
1: NASA Marshall Space Flight Center, Earth Science Office
2: University of Alabama – Huntsville, Earth System Science Center

Daniel.J.Cecil@nasa.gov

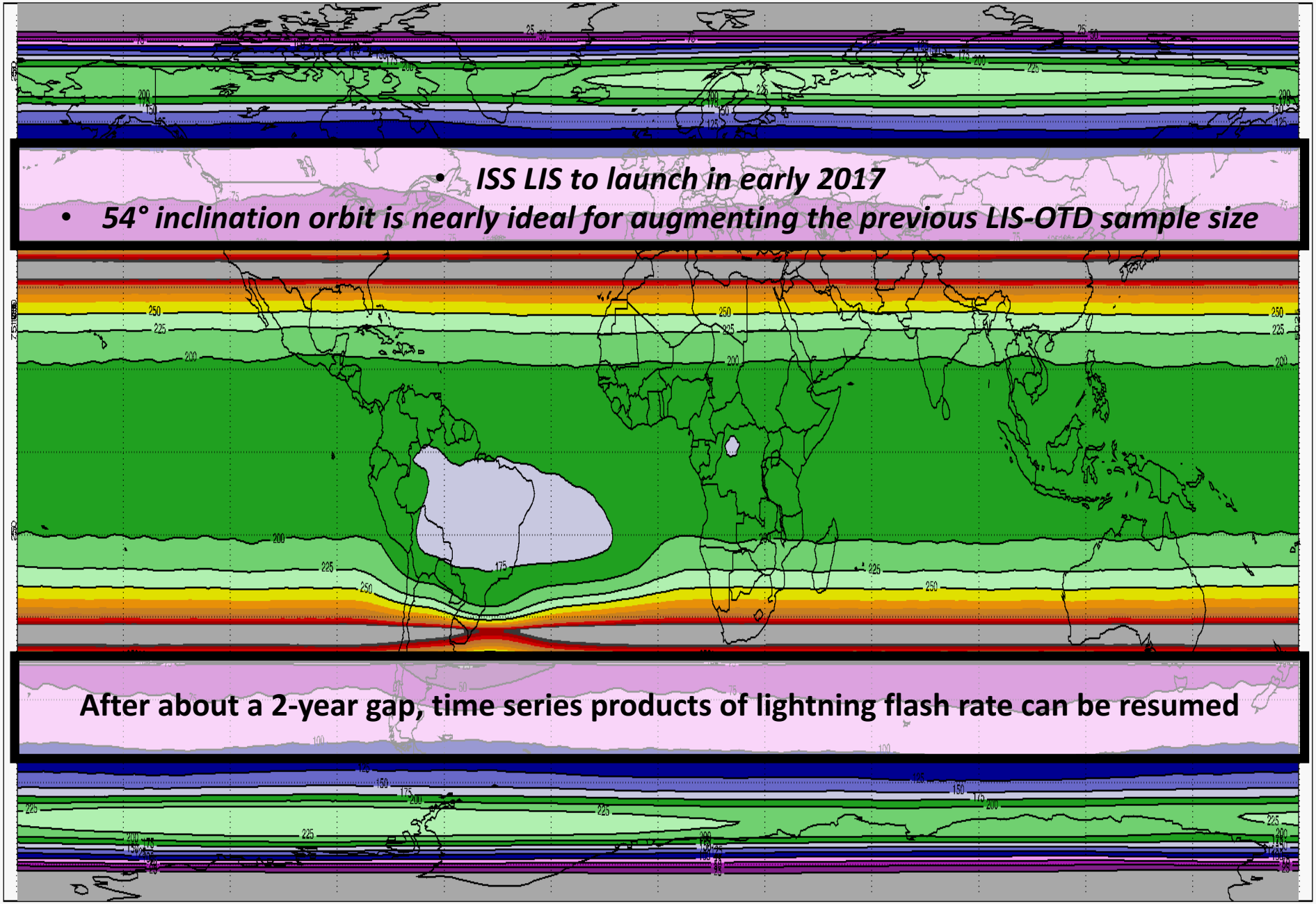
2017 AMS Conf. on Meteorological Applications of Lightning Data

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

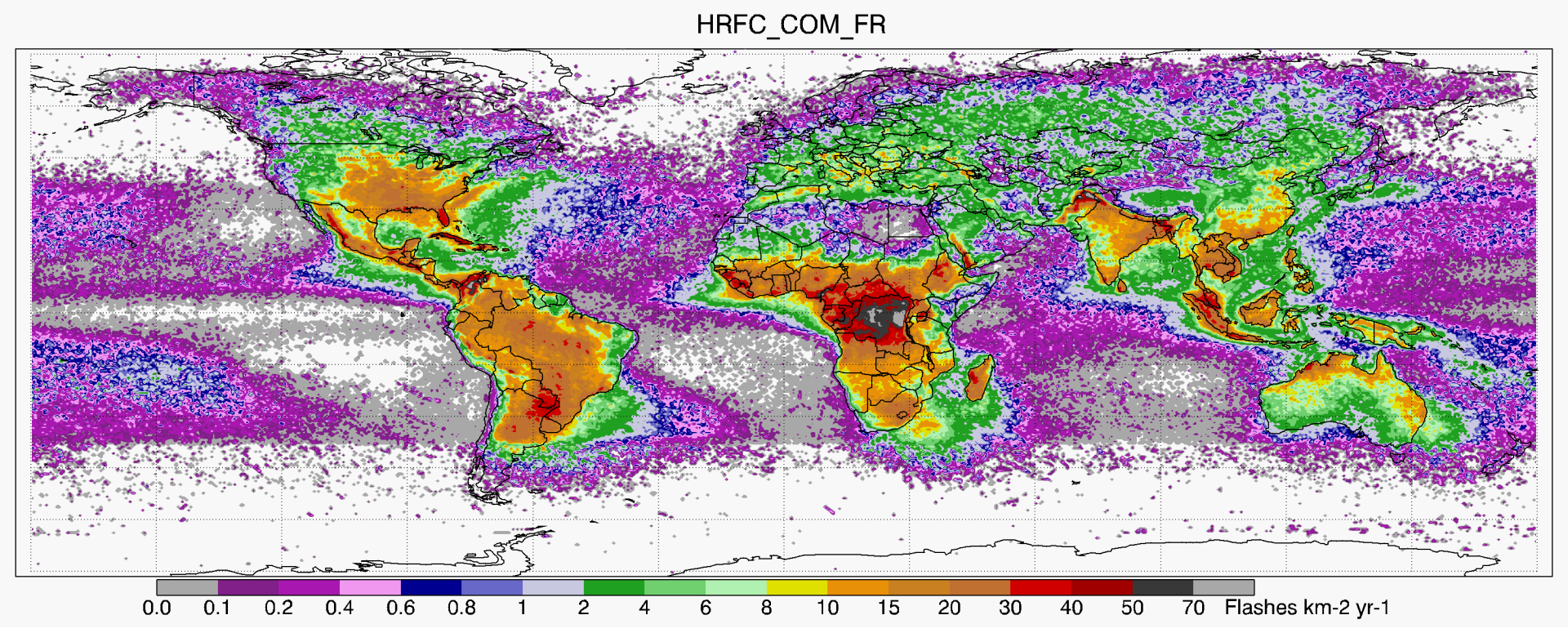
Hours of Sampling By LIS and OTD, 1995-2013



Hours of Sampling By LIS and OTD, 1995-2013



Annual Mean Total Lightning Flash Rate from TRMM-LIS and OTD (1995-2014)



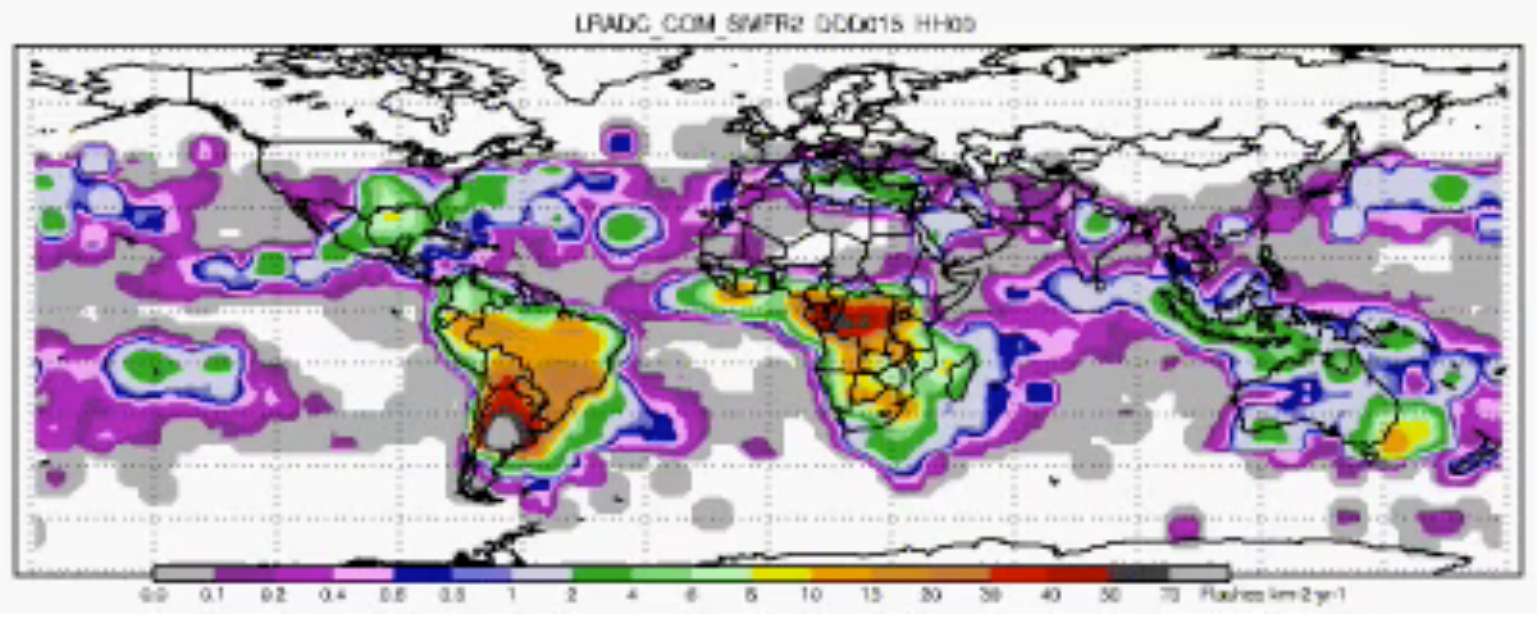
From a simple counting experiment, the total number of flashes observed divided by the total observation duration for each 0.5° grid box

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)

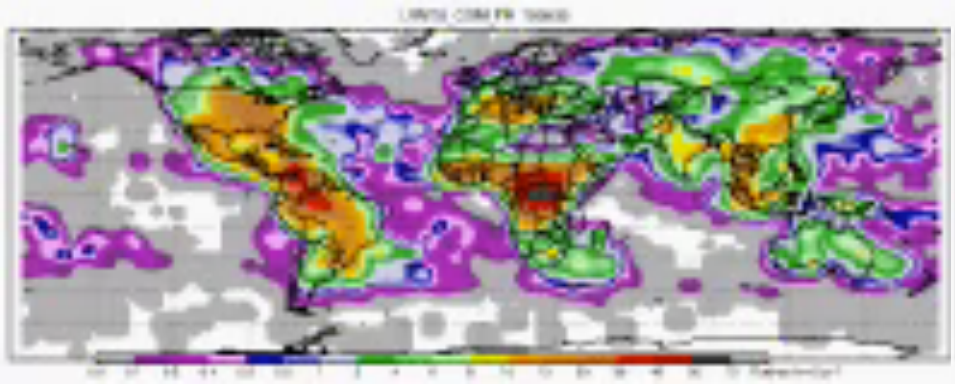


Animation of Diurnal Cycle (in UTC), separately for each month

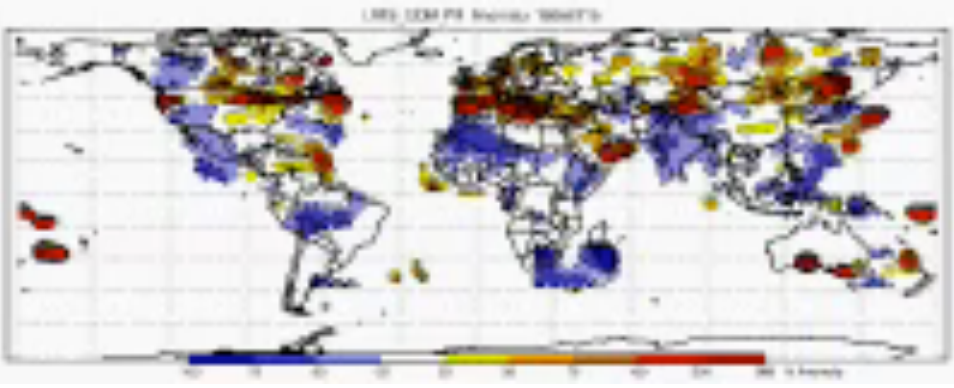
Good data for analyzing this in the tropics already, but ISS-LIS will make characterization of mid-latitudes much more robust

Time Series of Flash Rate from TRMM-LIS and OTD (1995-2014)

Monthly Flash Rate



Percentage Anomaly

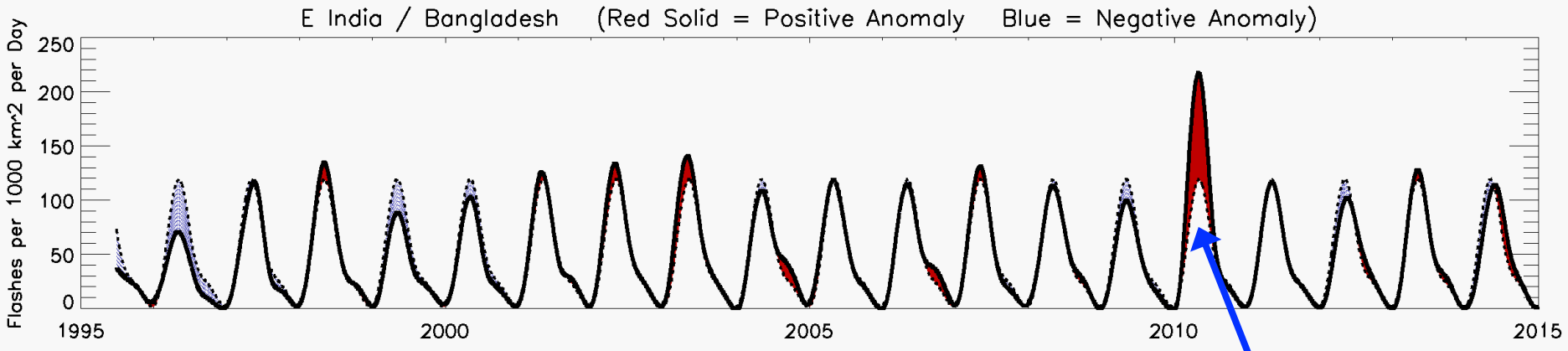


The long record from OTD and TRMM-LIS allows comparisons of different years

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.

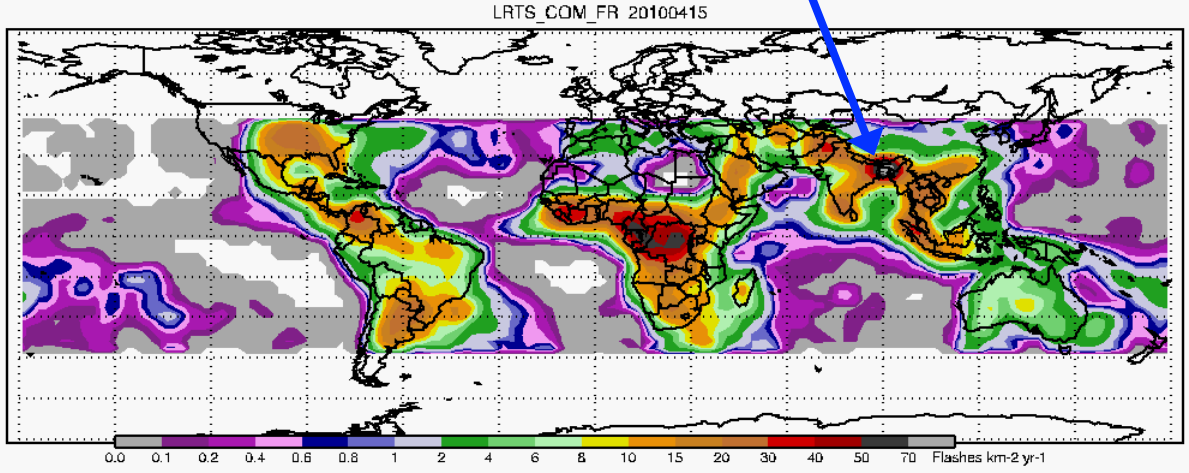
Time Series products have ~3-month temporal smoothing, 7.5° spatial smoothing

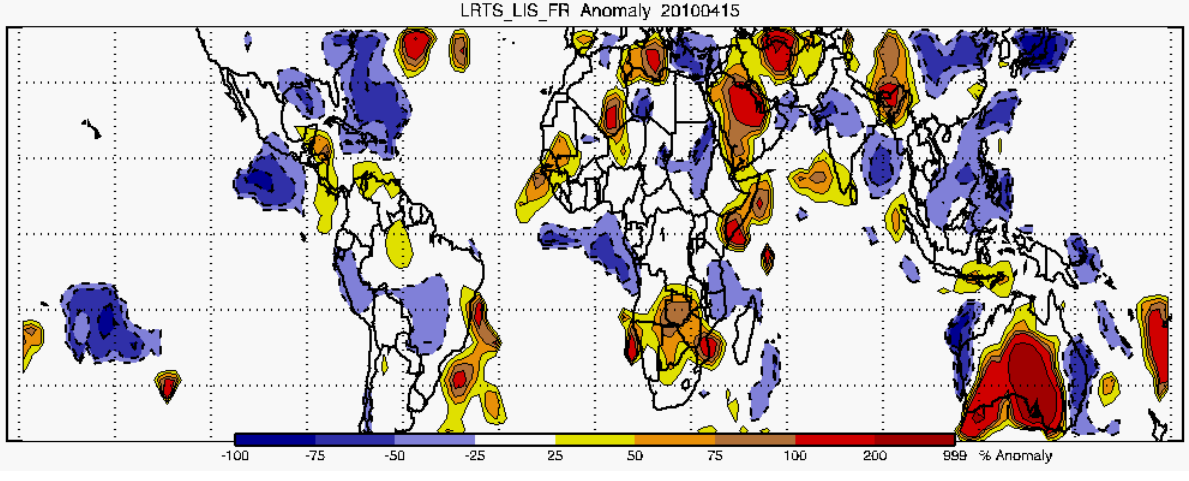


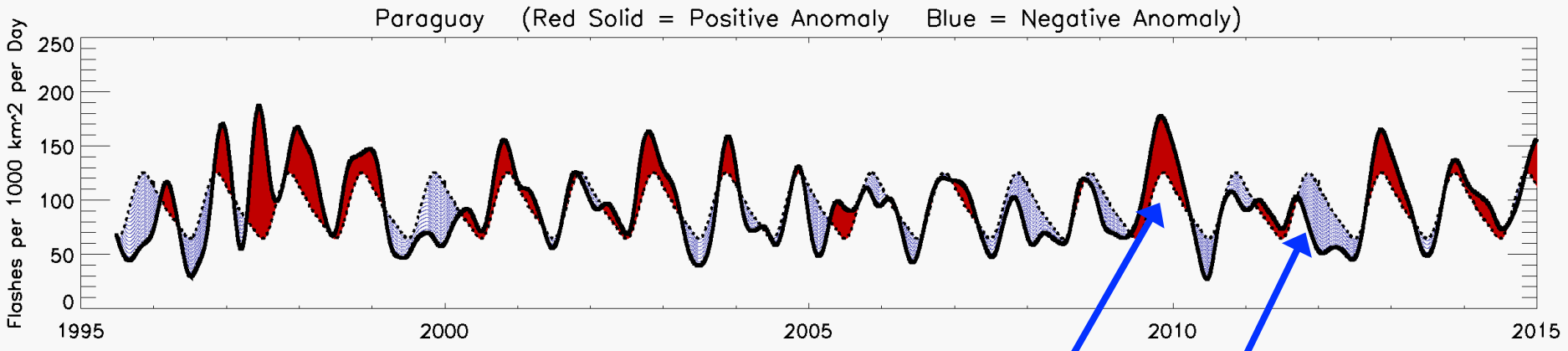
Top: Flash Rate Time Series and Anomalies for a box including **East India and Bangladesh**

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



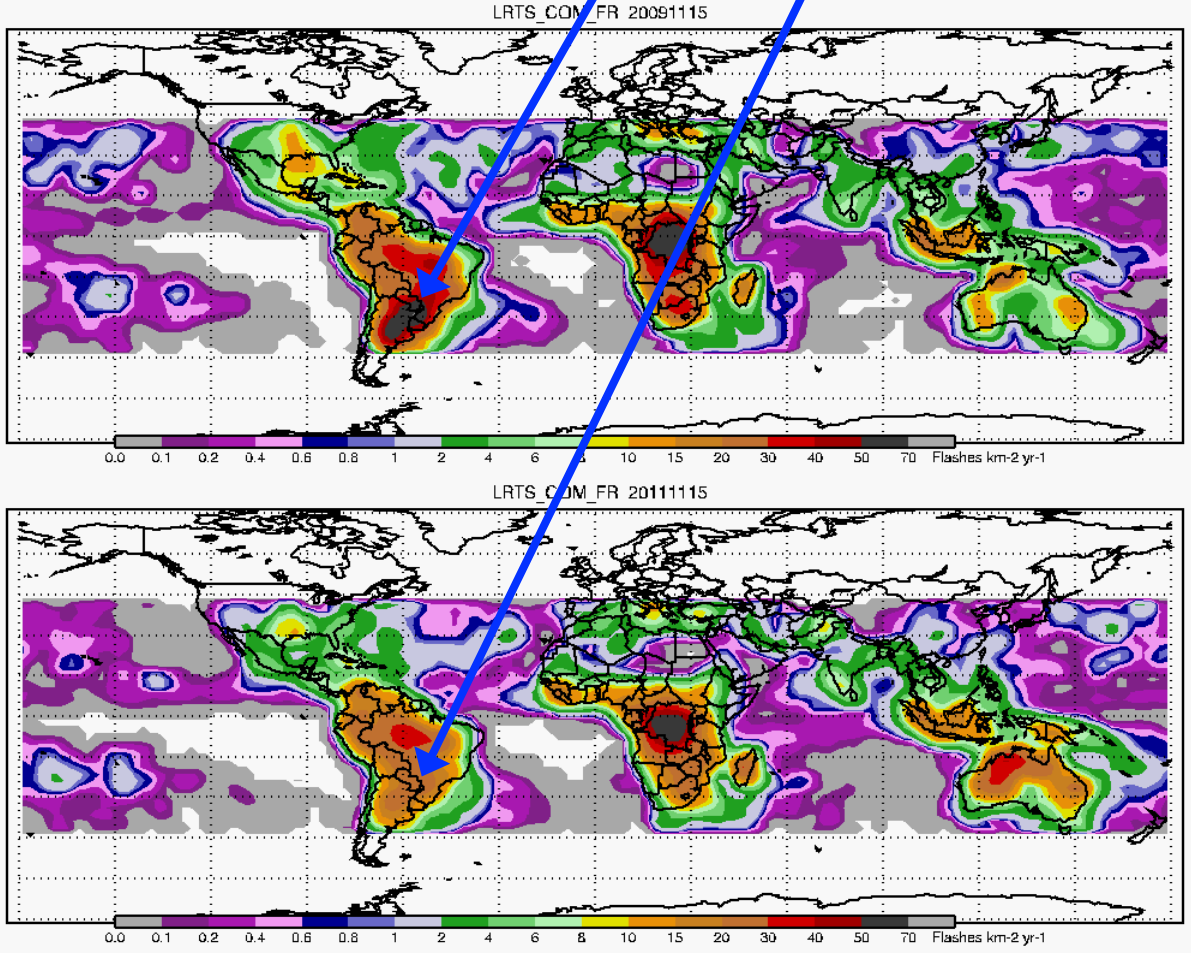


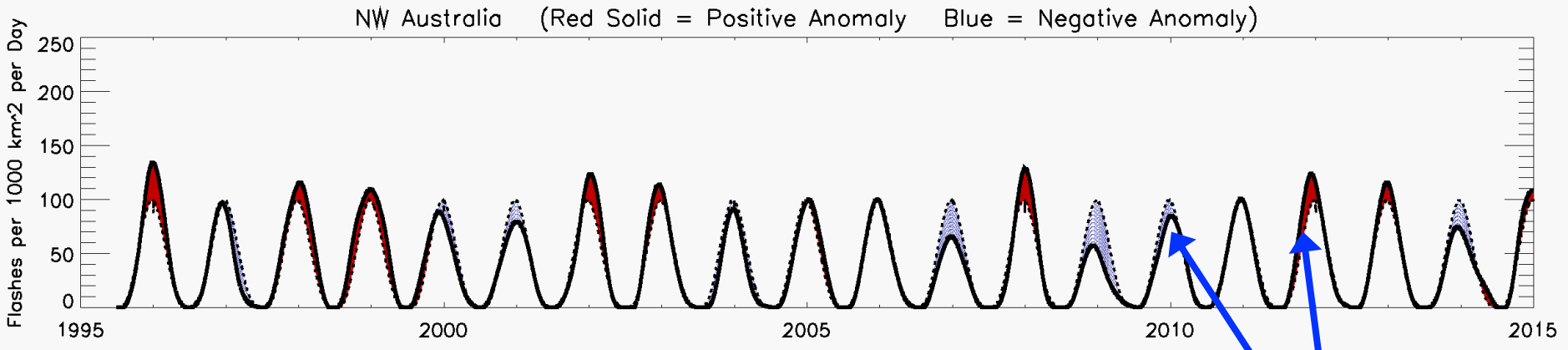


Top: Flash Rate Time Series and Anomalies for a box including **southern Paraguay**

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).**

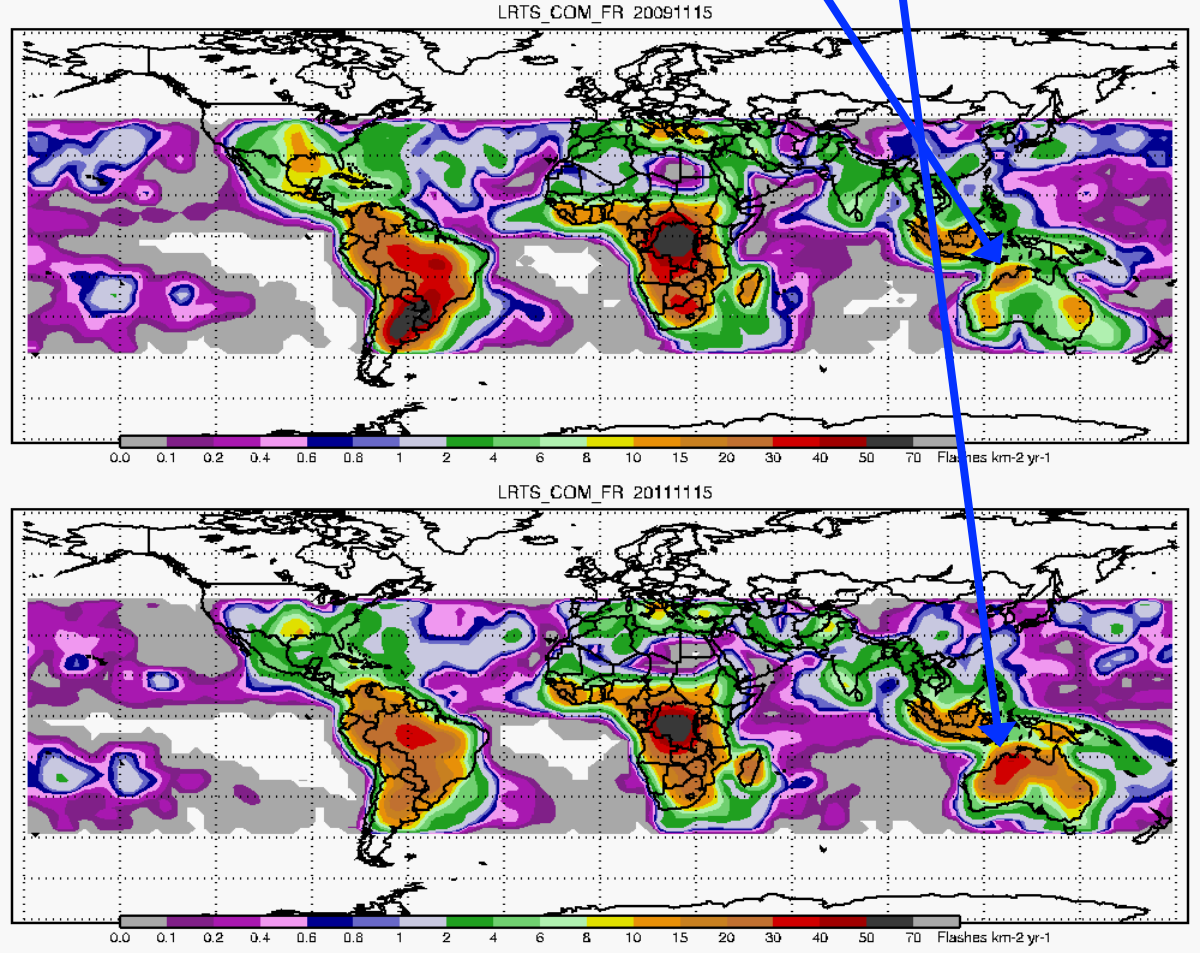




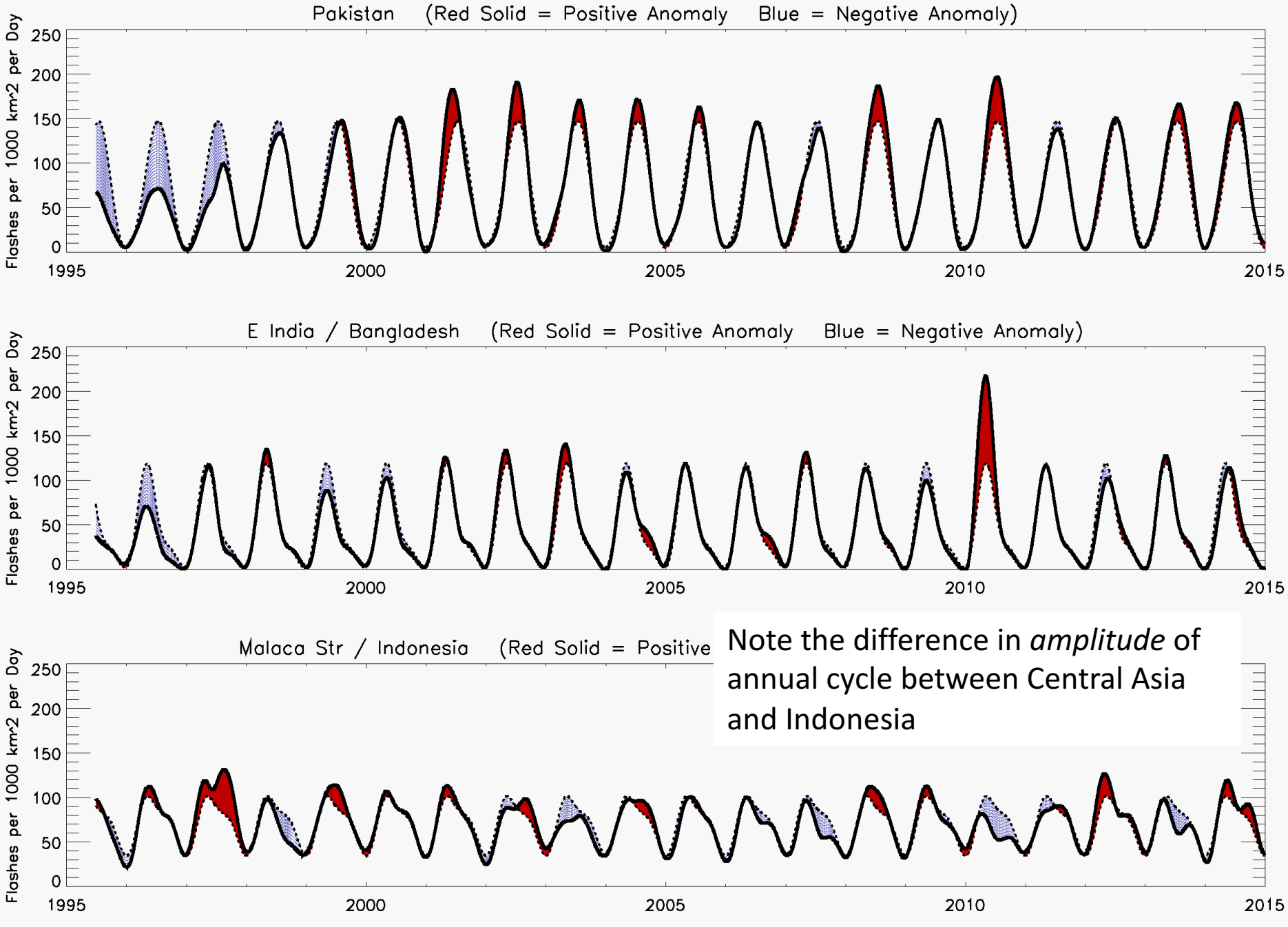
Top: Flash Rate Time Series and Anomalies for a box including **northwestern Australia**

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).**

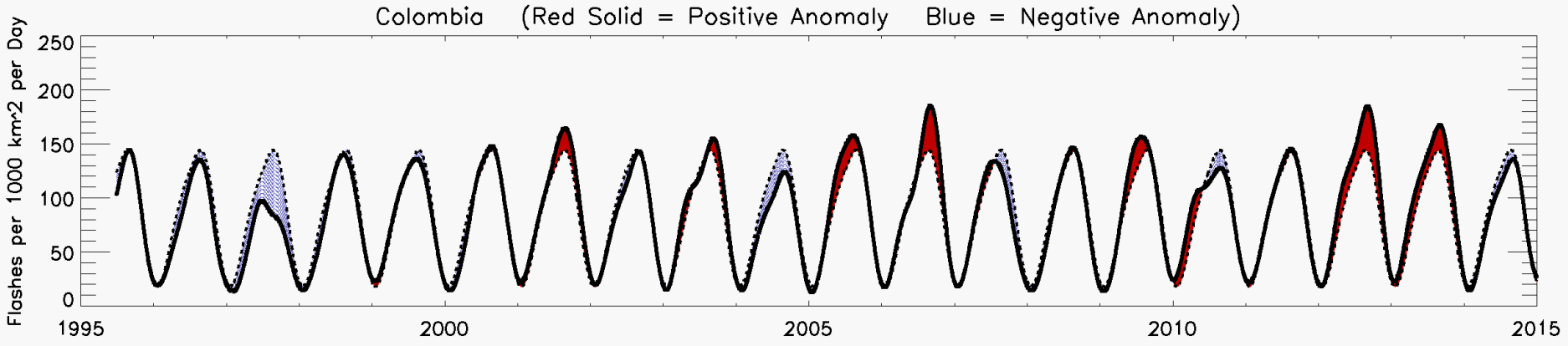


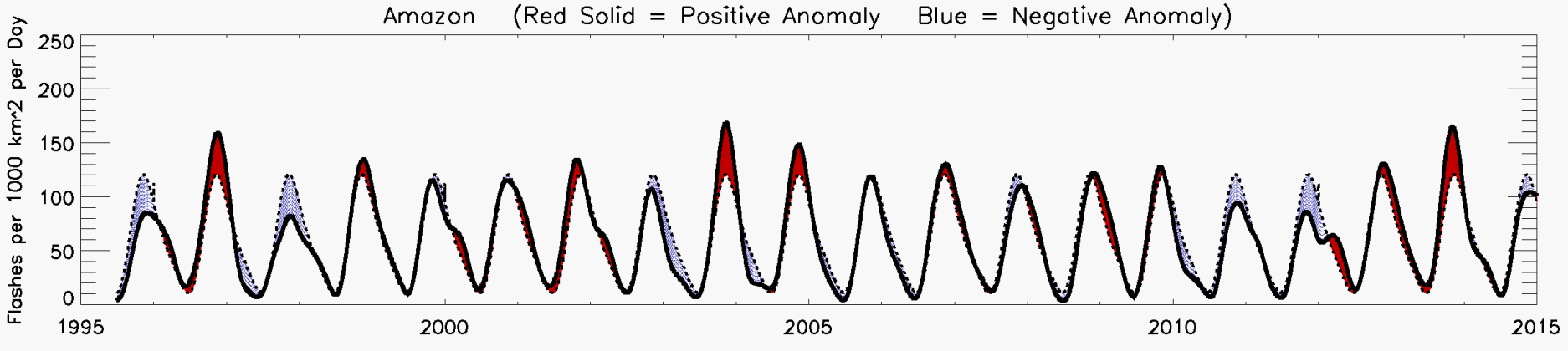
Central Asia and Indonesia

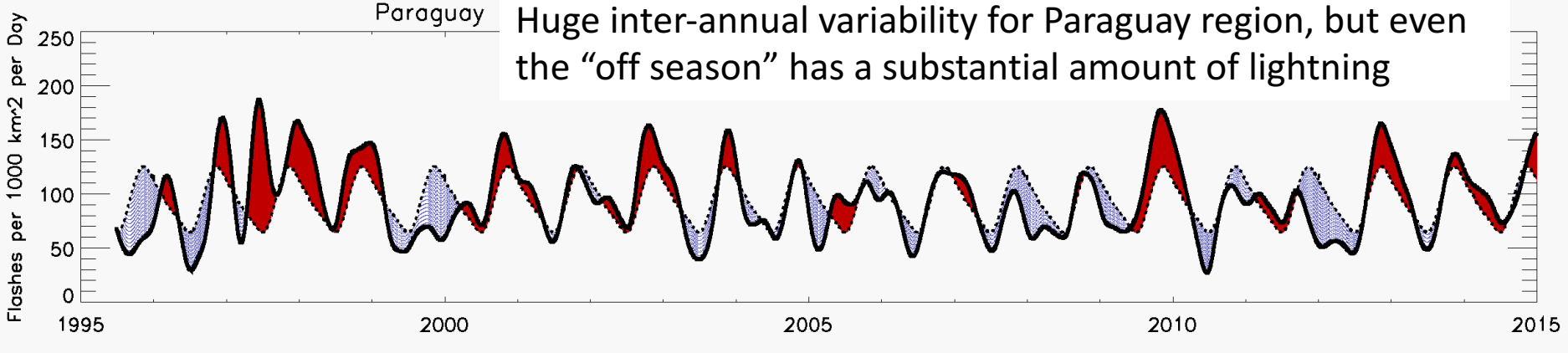


Note the difference in *amplitude* of annual cycle between Central Asia and Indonesia

South America

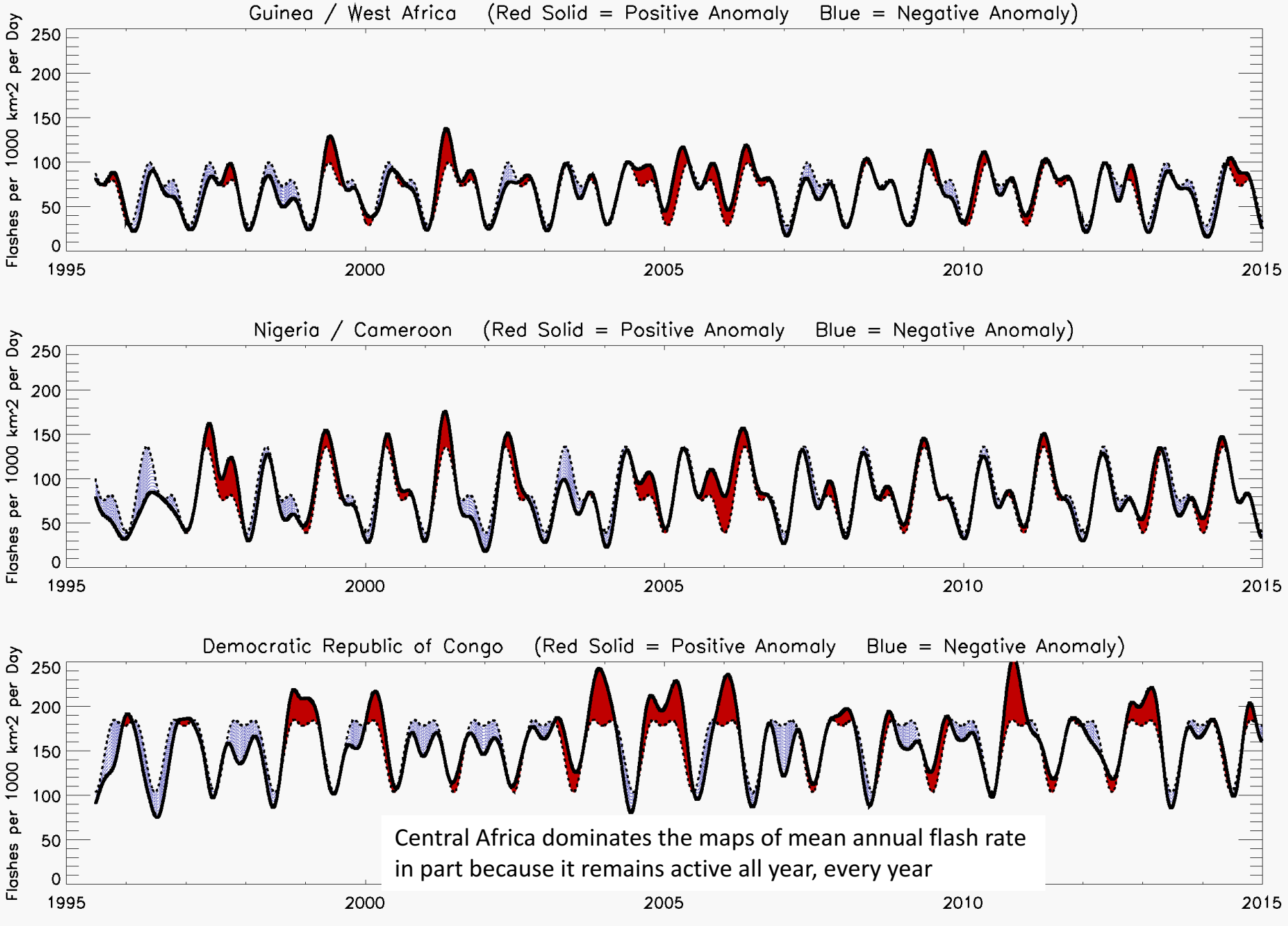






Huge inter-annual variability for Paraguay region, but even the “off season” has a substantial amount of lightning

Africa



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