

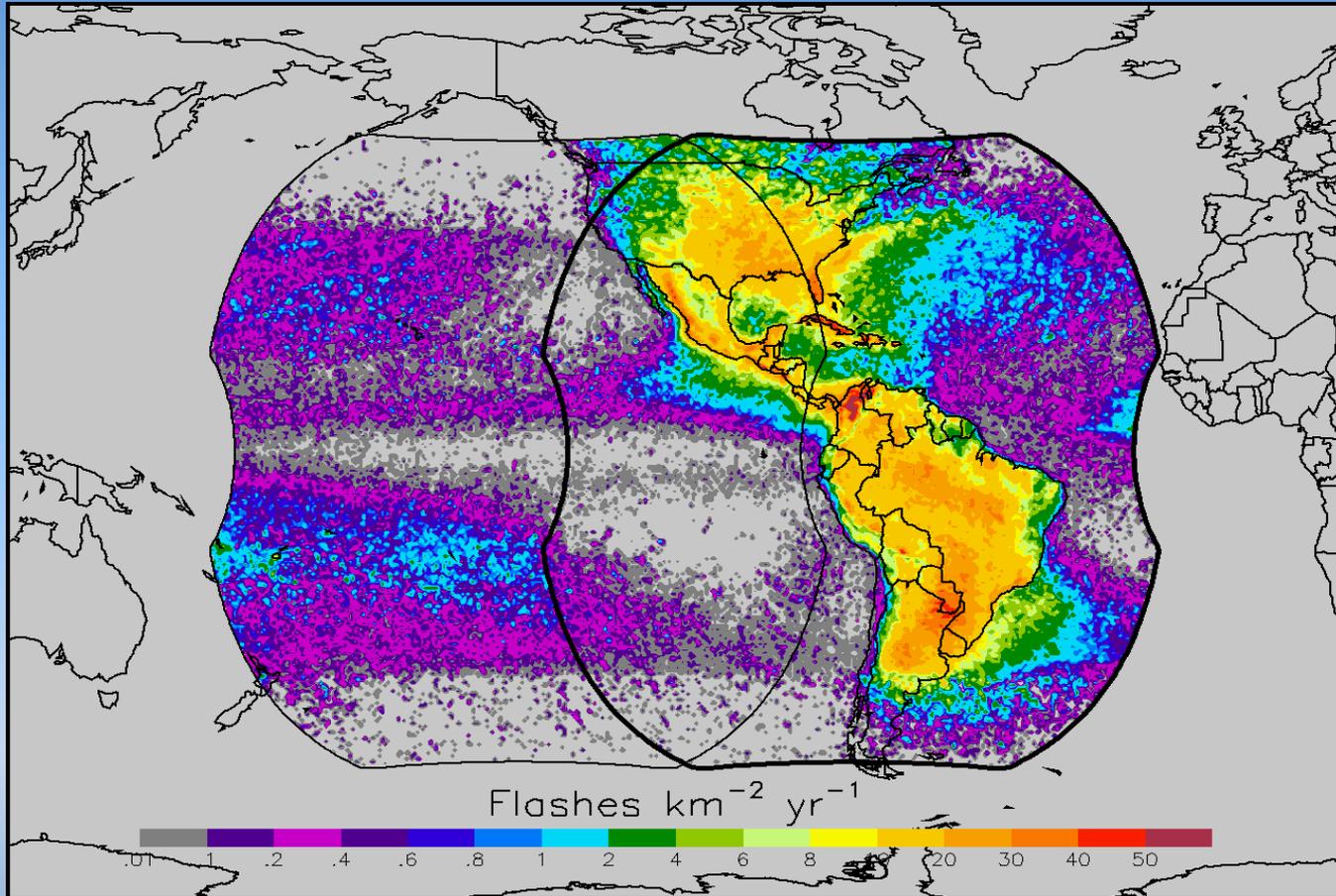
Monitoring the Performance of Space-based Optical Lightning Instruments

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GLM



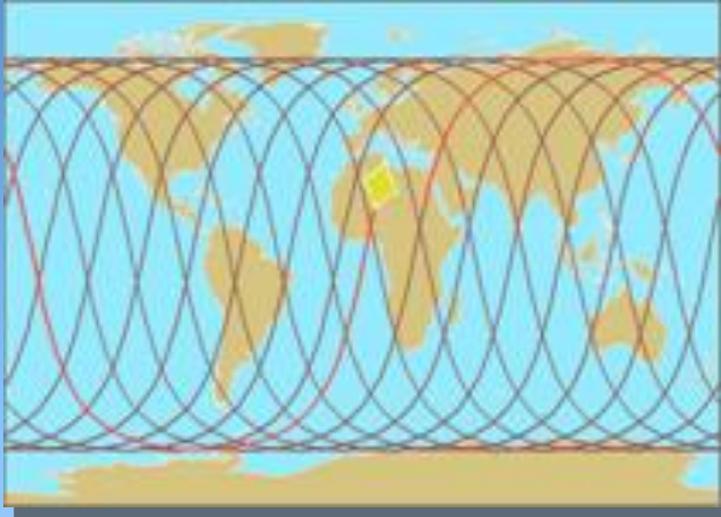
GLM field of view from East and West positions. Lightning data is from OTD (1995-2000) and LIS (1998-2010) observations. L0 data will be stored at GHRC DAAC.

Orbital Characteristics

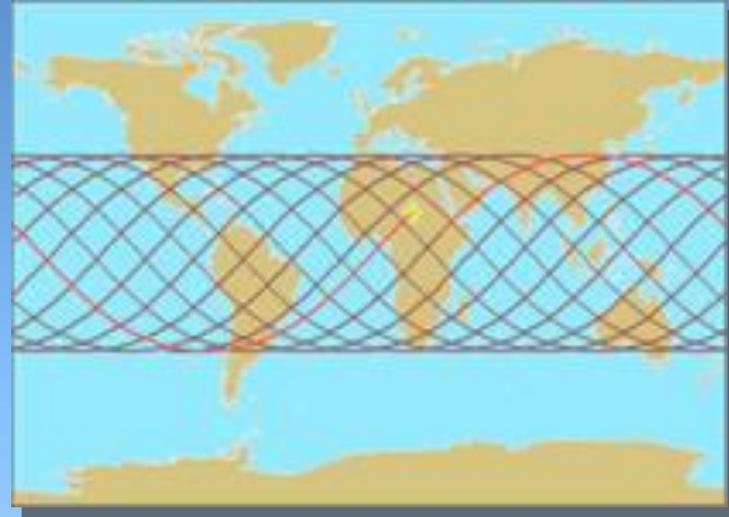
OTD

LIS

1995 -
2000



1998 -
present

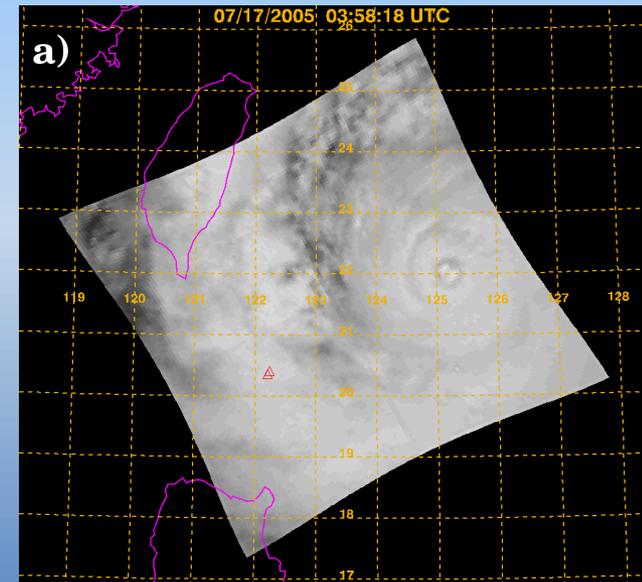
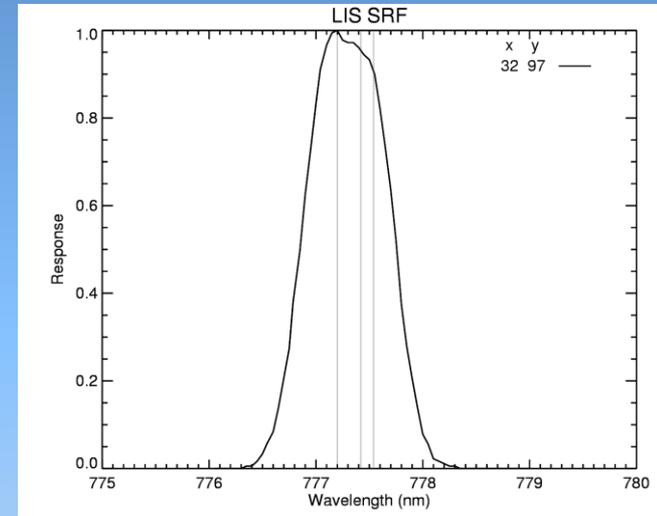


	OTD	LIS Pre-boost	LIS post-boost
Inclination	70°	35°	35°
Altitude	735 km	350 km	402 km
FOV (across)	1253 km	560 km	650 km
Period to sample diurnal cycle	~55 days	~46 days	~47 days
Pixel FOV (nadir)	7.9 km	3.6 km	4.2 km
Observation time	190 s	83 s	97 s
Orbital Period	99.5 min	91.5 min	92.56 min

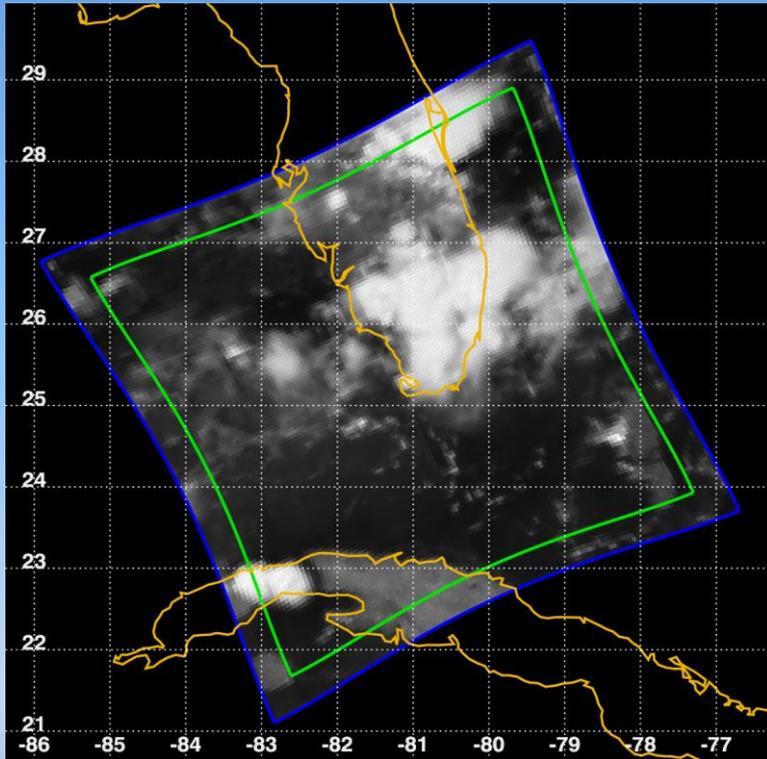
TRMM boost completed August 22, 2001

OTD/LIS Characteristics

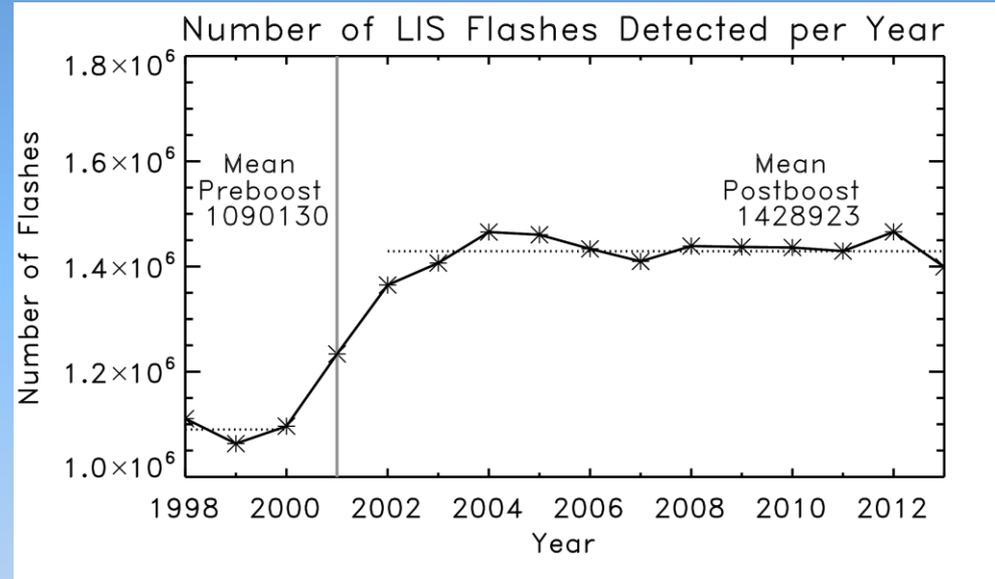
- Detects total lightning both day and night
- Fast lens, narrowband (~ 1 nm wide) filter at 777.4 nm
- 128 x 128 pixel CCD array
- 500 fps imaging (every 2 ms)
- Frame-to-frame subtraction used to isolate lightning transients against bright daytime background
- Backgrounds ~ 35 s for LIS and ~ 45 s for OTD (GLM every 2.5 min)
- Filter out noise events
- Cluster into groups and flashes



TRMM Orbit Boost



Comparison of LIS field of view pre and post orbit boost

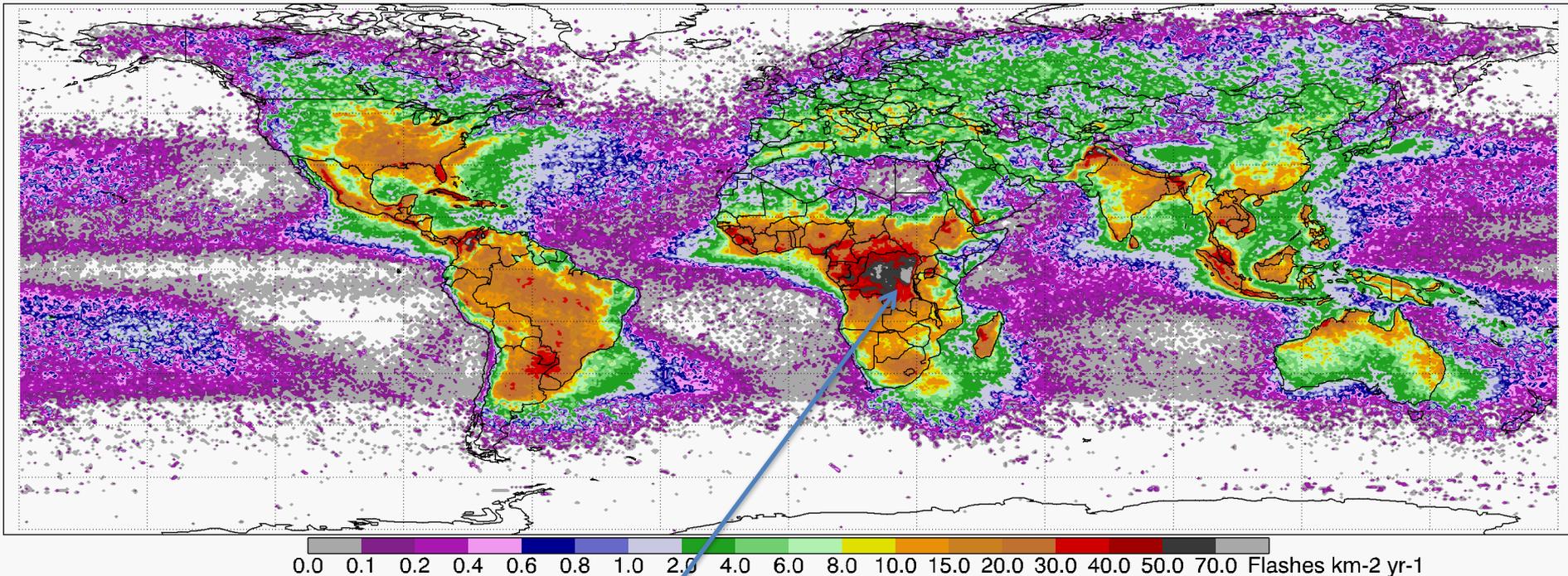


Number of flashes detected by LIS per year. Values post-orbit boost exhibit little change.

High Resolution Flash Climatology

0.5 ° resolution

HRFC_COM_FR



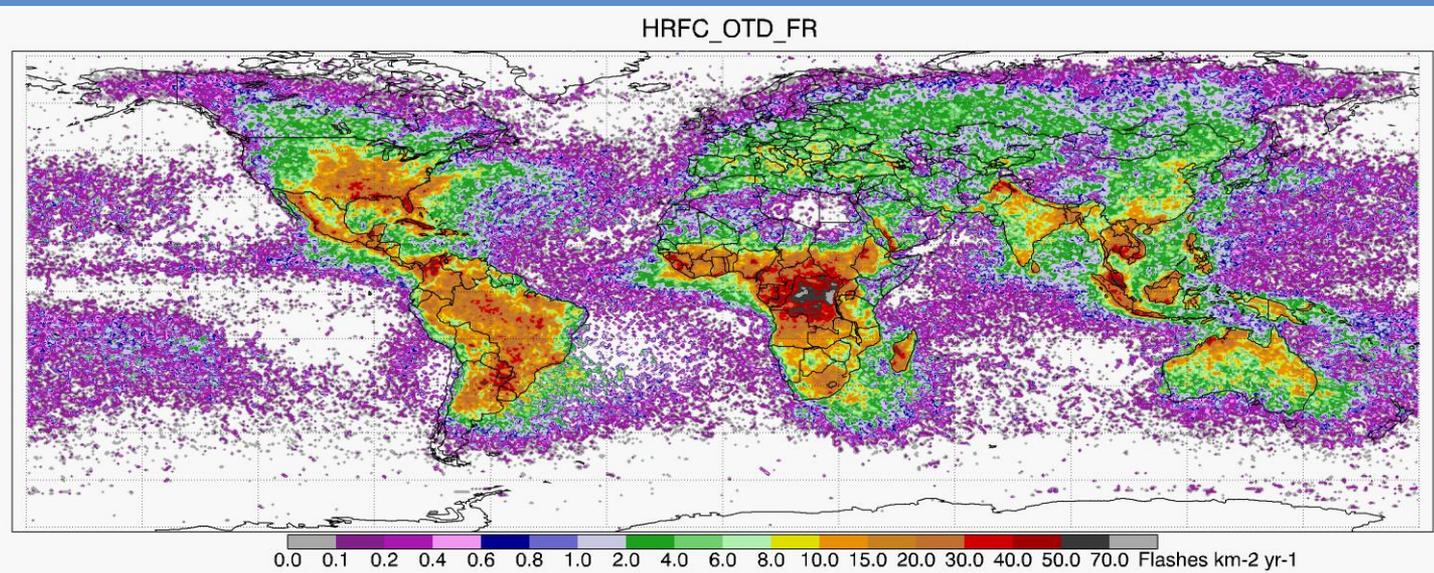
- Peak: ~ 160 fl km⁻² yr⁻¹ in eastern Congo
- Higher resolution study shows peak near Lake Maracaibo, Colombia
- Other peaks in Maritime Continent, Bangladesh / East India, Pakistan, N. Argentina / Paraguay, west coasts of Mexico and Arabia
- Huge land-ocean contrast

Mean Annual Flash Rate

Optical Transient Detector (OTD):

1995-2000

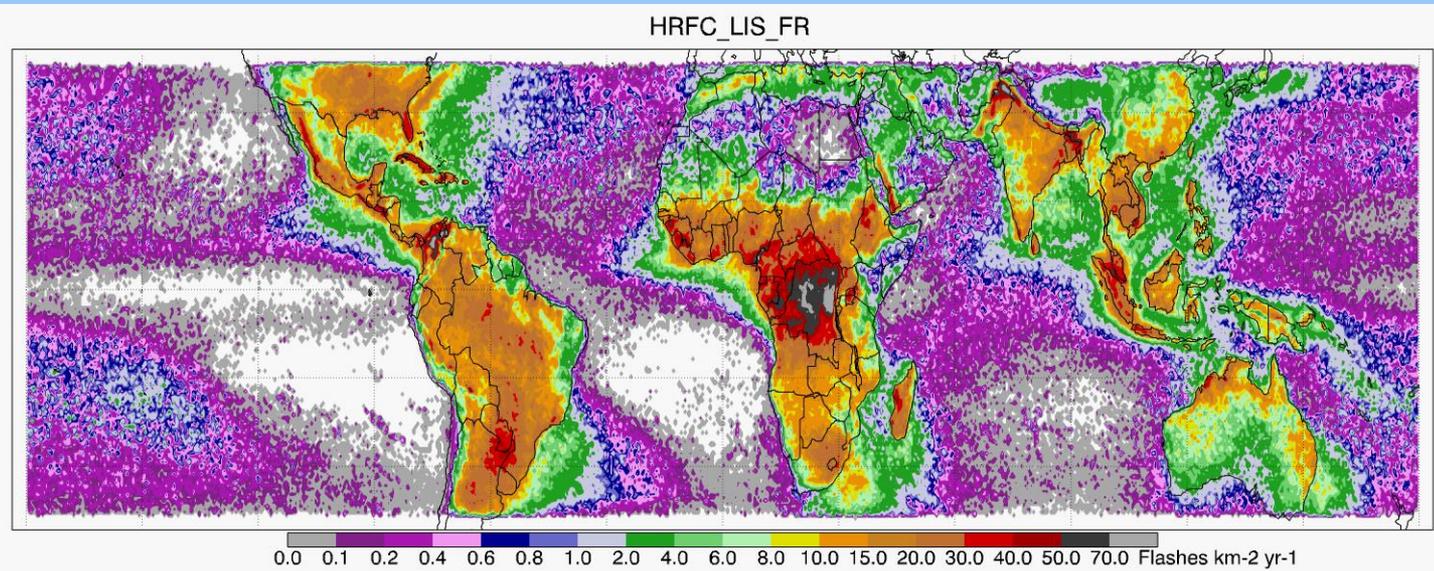
High inclination orbit, sampled virtually all locations that have lightning



Lightning Imaging Sensor (LIS):

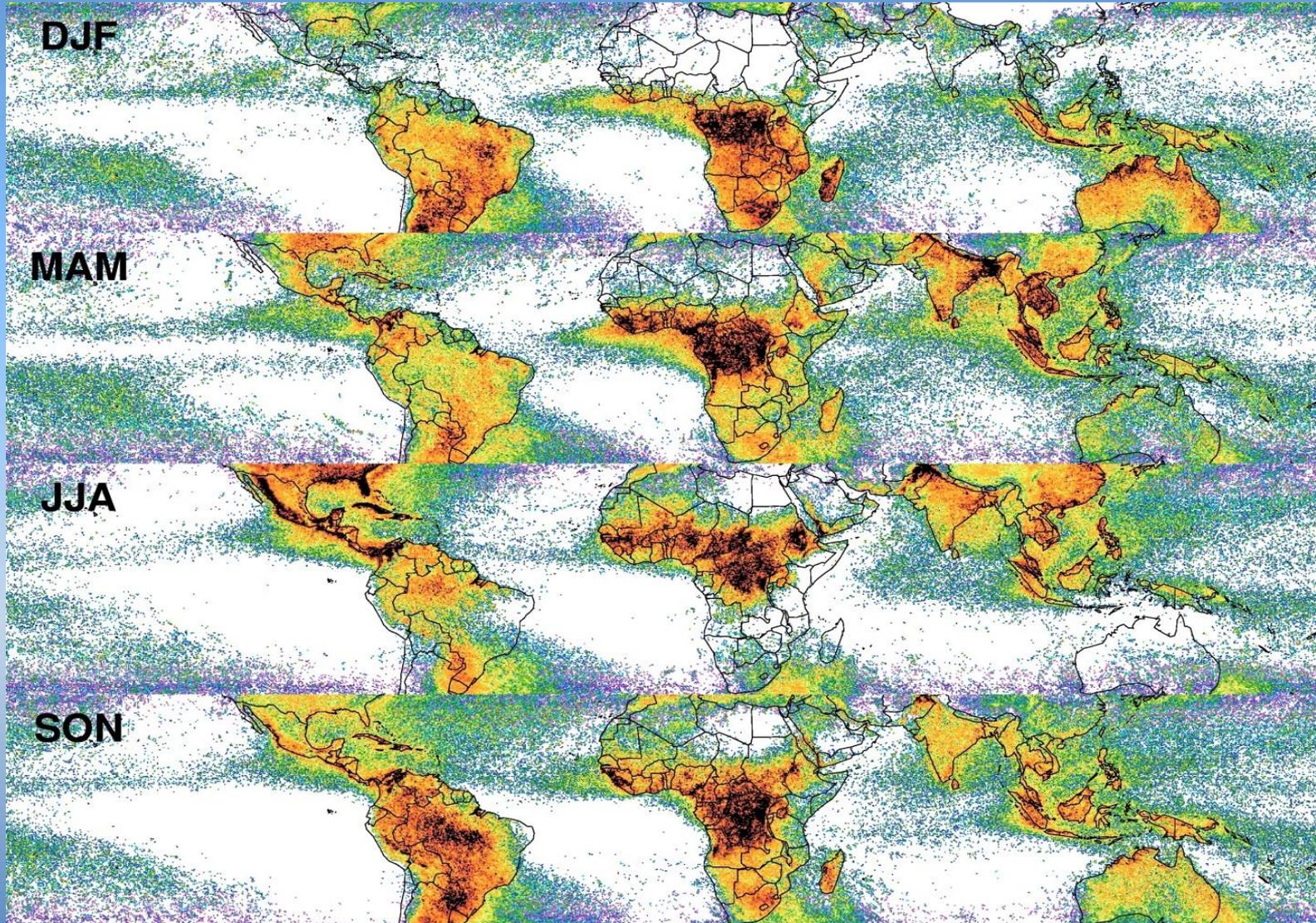
1998-2012*

35° inclination orbit (TRMM), higher quality data but limited to global tropics and subtropics

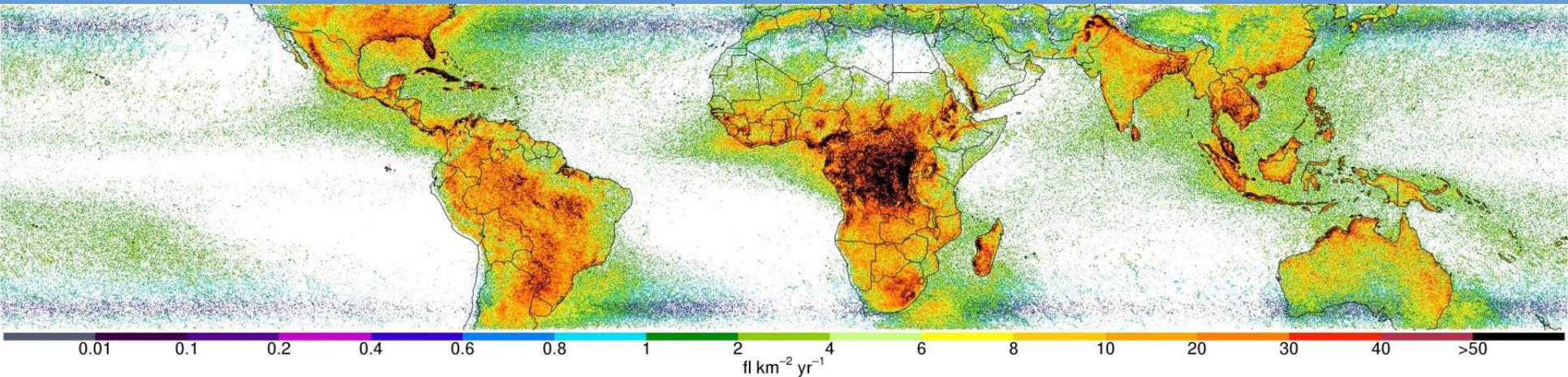


* LIS continues to collect data at present, this image is through 2012.

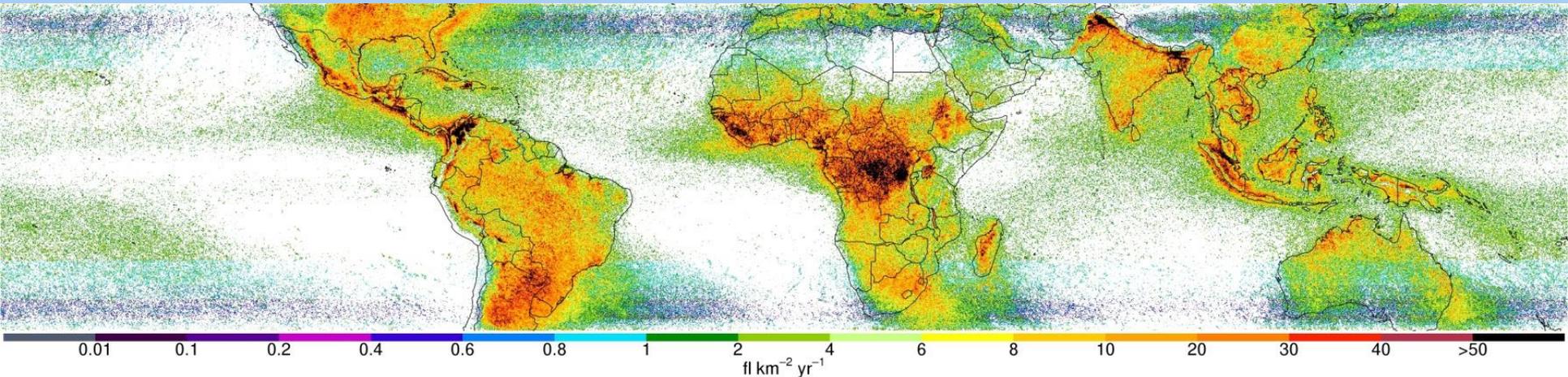
Seasonal 0.25° LIS Climatology



Day/Night 0.1° LIS Climatology



LIS Daytime Lightning (1998-2013)

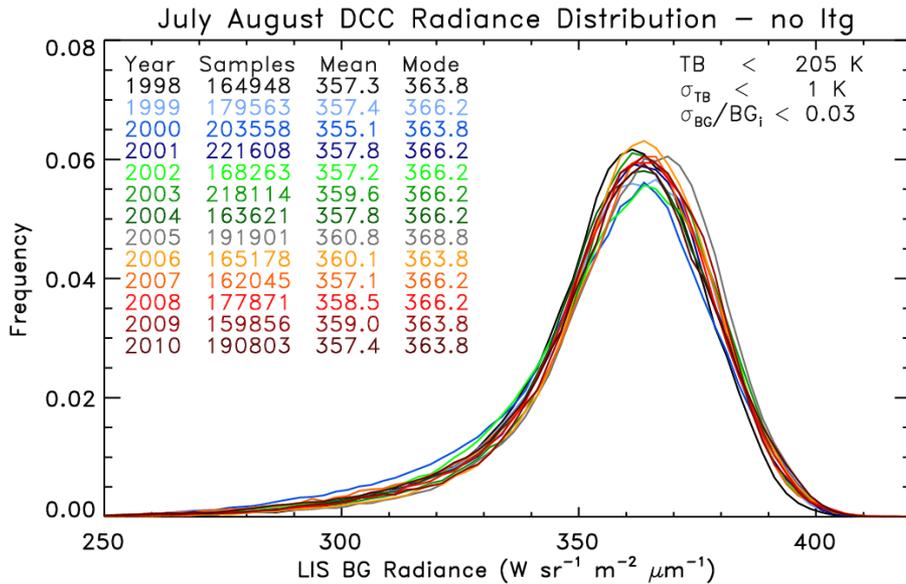


LIS Nighttime Lightning (1998-2013)

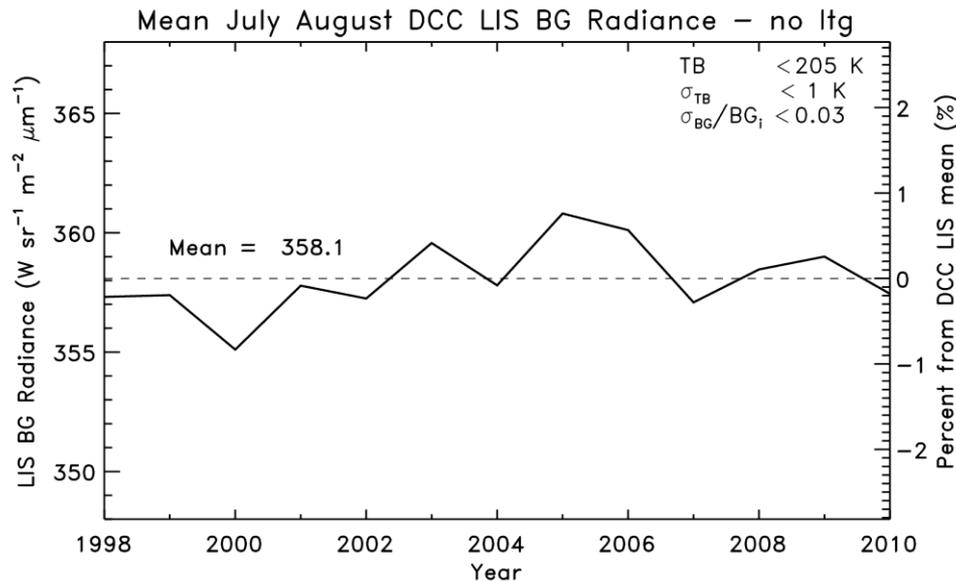
LIS performance 1998-2010

- No on board calibration
- Deep Convective Clouds (DCCs) are used as vicarious calibration targets
- The radiance of DCCs near the tropics are nearly constant
- Use VIRS (Visible Infrared Sensor - colocated onboard TRMM with LIS) 11 μm IR channel to identify DCCs ($T_b < 205\text{K}$)
- Identify colocated LIS Background (BG) pixels
- Analyzed each July and August from 1998-2010
- Method to be used to monitor Geostationary Lightning Mapper (GLM) on-orbit performance
- For more details see Buechler et al., 2014: Assessing the performance of the Lightning Imaging Sensor (LIS) using Deep Convective Clouds, Atmos. Res.

LIS DCC analysis



Distribution of LIS background DCC radiance changes little from year to year



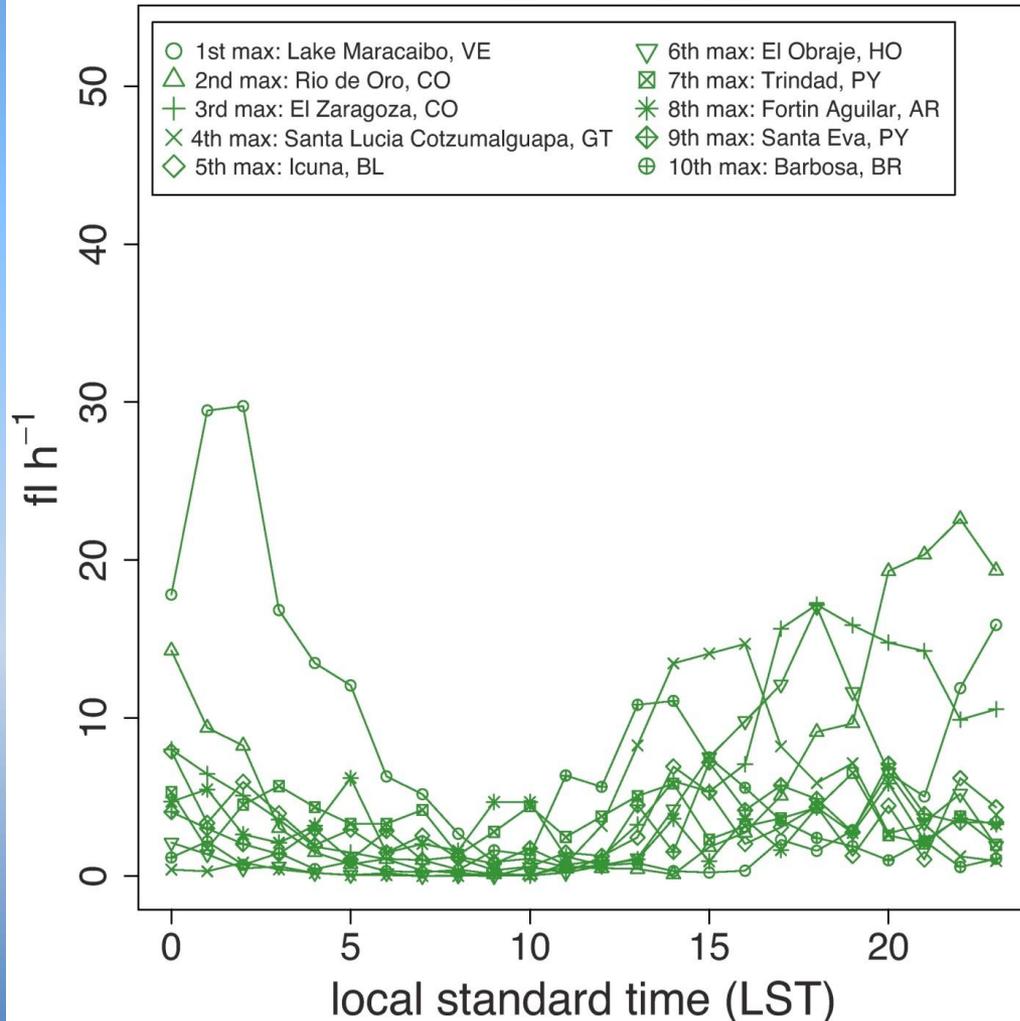
- Max LIS DCC radiance is 0.8%
- Mean LIS DCC background radiance does not exhibit a trend over the years
- Demonstrates the stability of LIS calibration

Conclusions

- 1) The DCC analysis of the LIS BG indicates no discernible degradation of instrument performance from 1998-2010.**
- 2) Because of its similar design, the GLM should also experience little performance degradation.**
- 3) The DCC technique can be used to monitor GLM instrument performance once in orbit.**
- 4) Other vicarious calibration techniques are being examined**

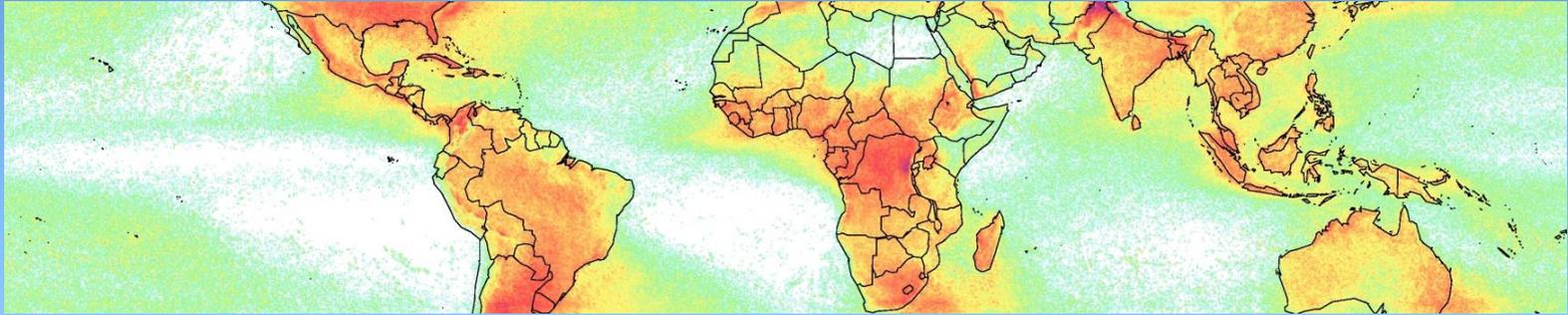
Peak South America 0.1° LIS Diurnal Climatology

Flash rate diurnal cycle over the 10 maximums in Latin America



Outline

- LIS Quality Assurance
- Lightning Climatology
- GLM



- LIS data process
 - GHRC ingests raw data and processes data daily
 - At end of month, GHRC reprocess of all data
 - Then a combination of manual and automated QA is done