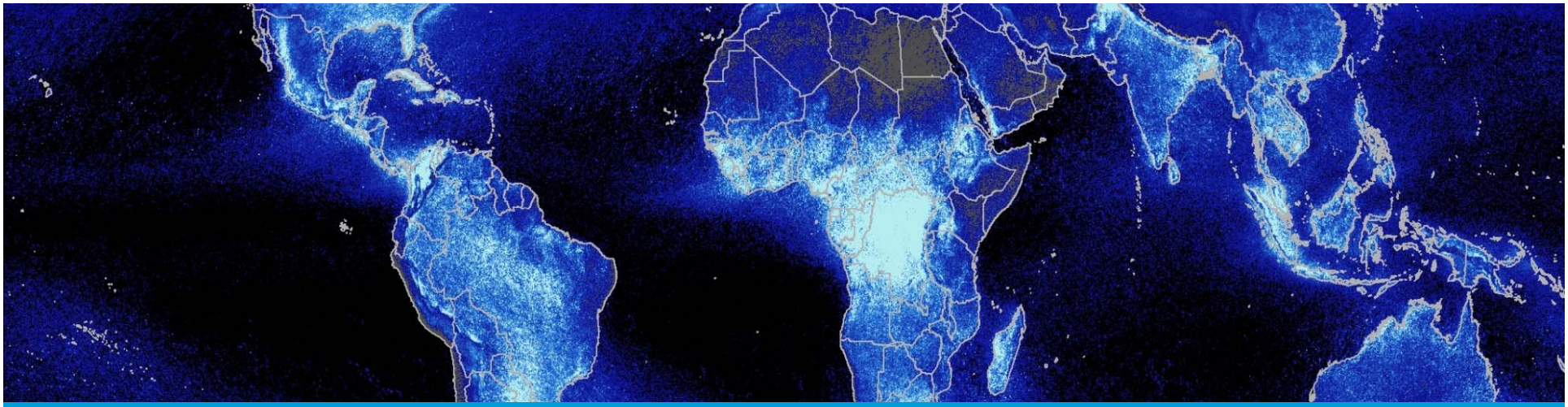


GHRC Lightning Support

Dr. Geoffrey Stano

DAAC Scientist

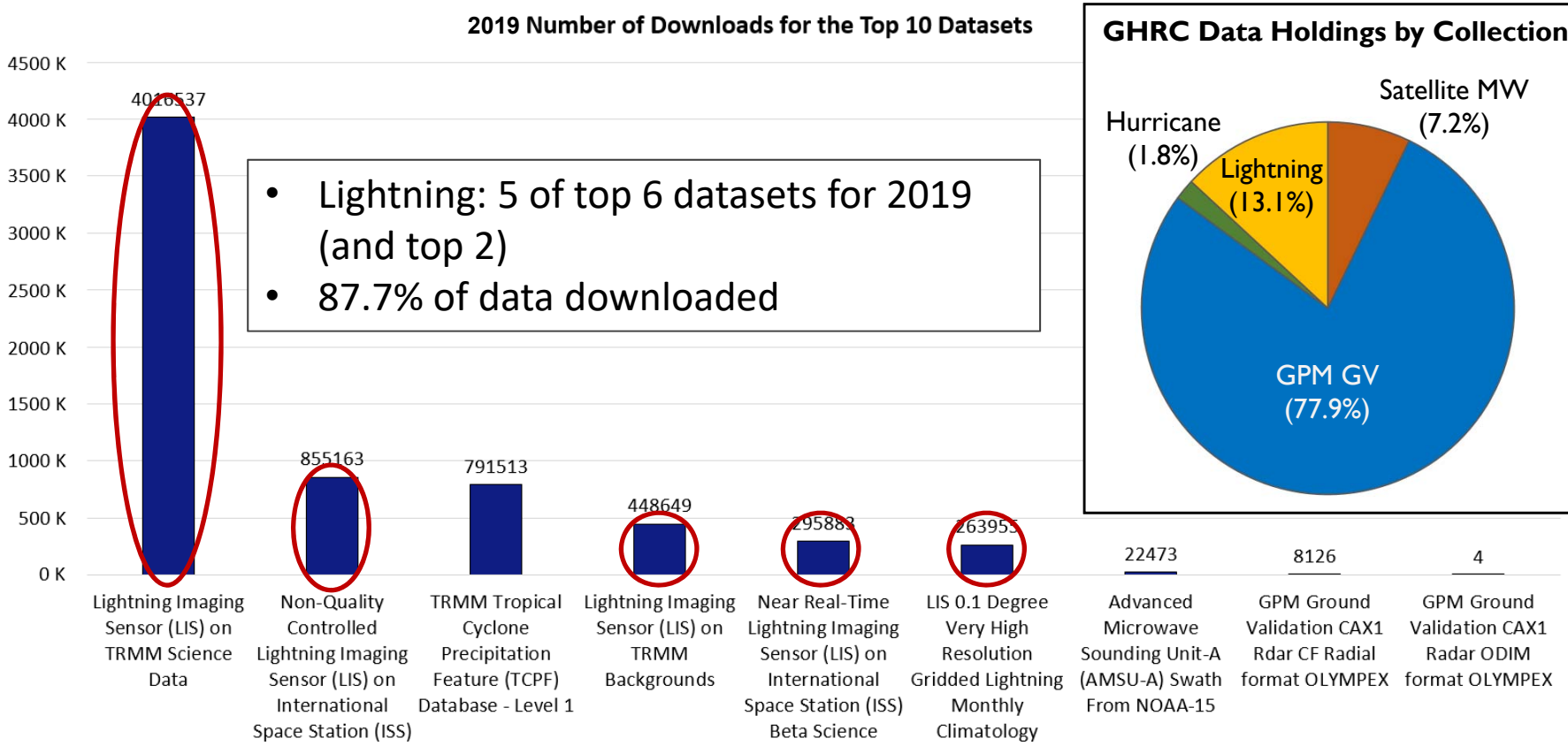
Introduction

- GHRC known as the lightning DAAC
- Lightning part of the “Storm Hazards” category
- Variety of ground, airborne, and space-based instruments
- Period of record spans 1973 – present
  - Operational Linescan Sensor to the International Space Station Lightning Imaging Sensor (LIS)
- Benefit from local expertise
  - LIS Science Team
  - NASA and UAH lightning researchers
  - Current DAAC Scientist

Review of Lightning Holdings

- Space-based
  - Operational Linescan Sensor (OLS)
  - Optical Transient Detector (OTD)
  - Lightning Imaging Sensor (LIS) – TRMM and ISS
- Airborne
  - Lightning Instrument Package (LIP)
  - Fly's Eye GLM Simulator (FEGS)
- Ground-based
  - Lightning Mapping Arrays (LMAs)
  - Ancillary, proprietary data (Earth Networks, Vaisala National Lightning Detection Network)

Importance of Lightning to GHRC

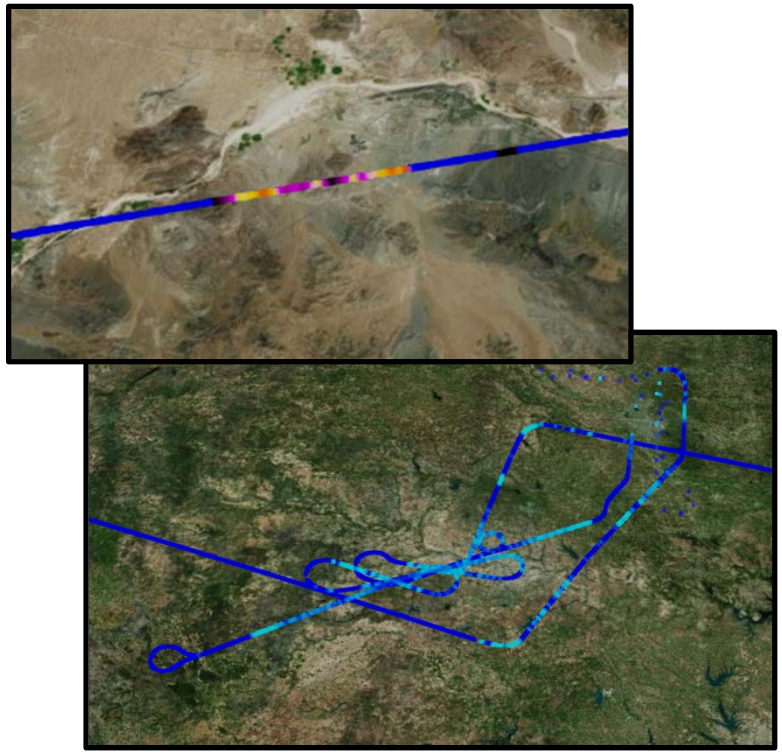


- Lightning: 5 of top 6 datasets for 2019 (and top 2)
- 87.7% of data downloaded

Accomplishments: Fiscal Year 2019

GOES-R Post Launch Test

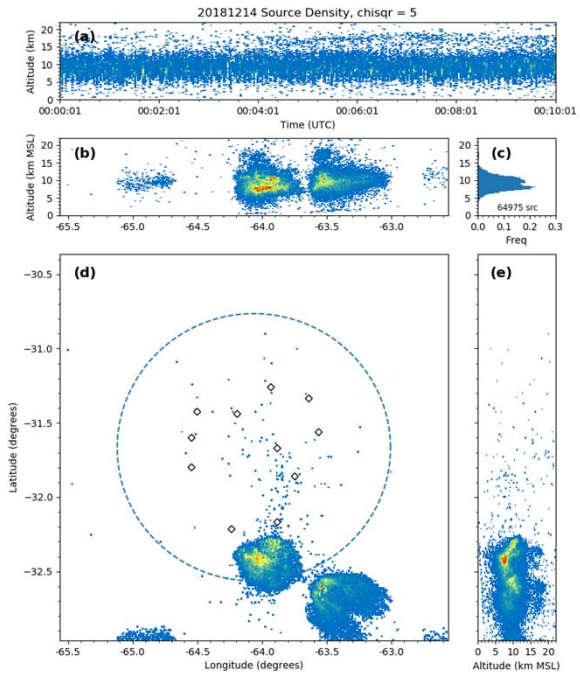
- Field campaign to calibrate and validate ABI and GLM
- Data received in late FY 2018
- Priority for publication in FY 2019
- All 9 lightning datasets published
  - 7 Lightning Mapping Arrays (LMA)
  - Lightning Instrument Package (LIP)
  - Fly's Eye GLM Simulator (FEGS)
- Key datasets for inclusion in the Field Campaign Explorer efforts



LIP in the Field Campaign Explorer

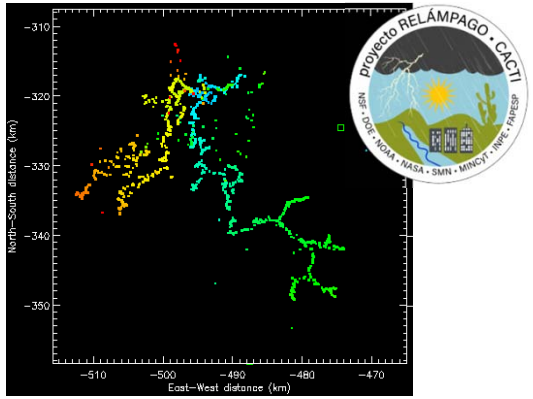
Lightning Mapping Arrays

VHF Source Density
12/14/2018 (MCS)



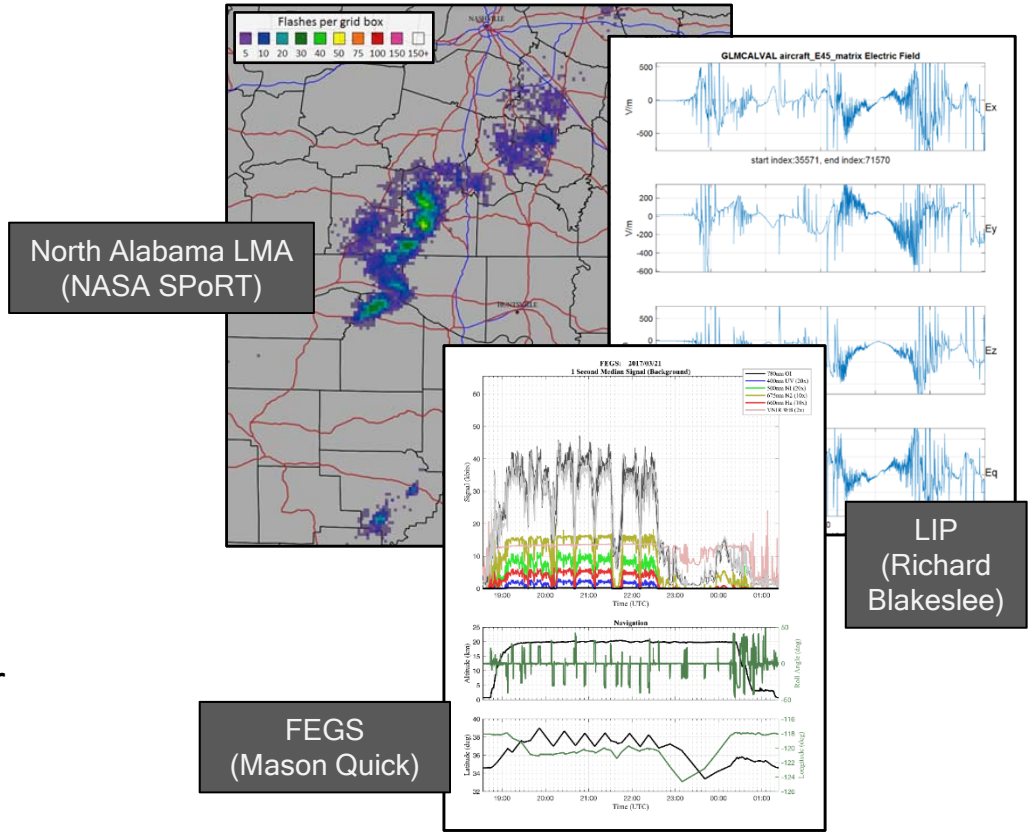
- 7 LMAs from GOES-R Post Launch Test
- RELAMPAGO LMA
  - First half of data received
  - Restricted access on GOES-R portal
  - Public release later in FY 2020
- Micro article
  - June 21, 2019

Example imagery from RELAMPAGO (left and right)



Earthdata Webinar

- Annual effort with NASA Earth data
- 2019 focused on GHRC's lightning holdings
- Discussed:
  - Importance of lightning observations
  - ISS LIS and its uses
  - Lightning data with GOES-R Post Launch Test
  - Introduction to the Geostationary Lightning Mapper
- Very well received



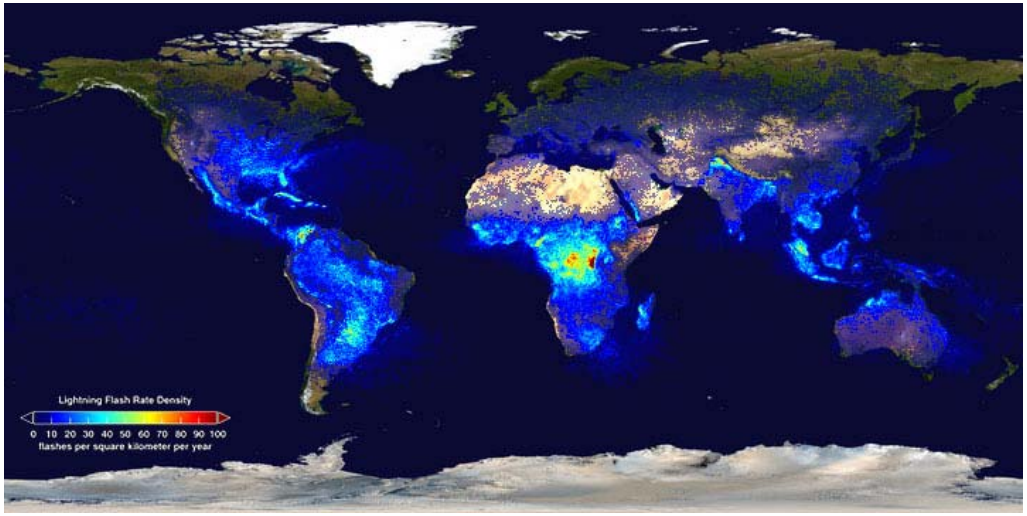
North Alabama LMA (NASA SPoRT)

LIP (Richard Blakeslee)

FEGS (Mason Quick)

ISS LIS: End of Primary Mission

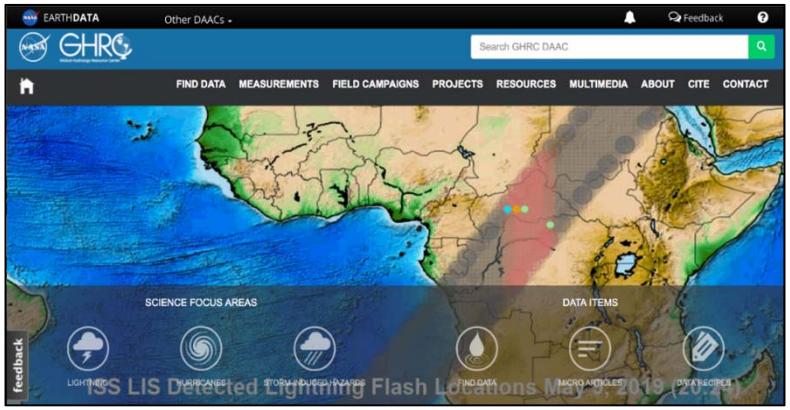
- Successful end of primary mission review
- Successfully leveraged TRMM LIS infrastructure
- ISS LIS is well characterized
  - Performing like TRMM LIS
  - GLM cal/val
  - Benchmark for global lightning climatology intercomparisons
- Will continue at least through 2020
- Potential for additional extensions



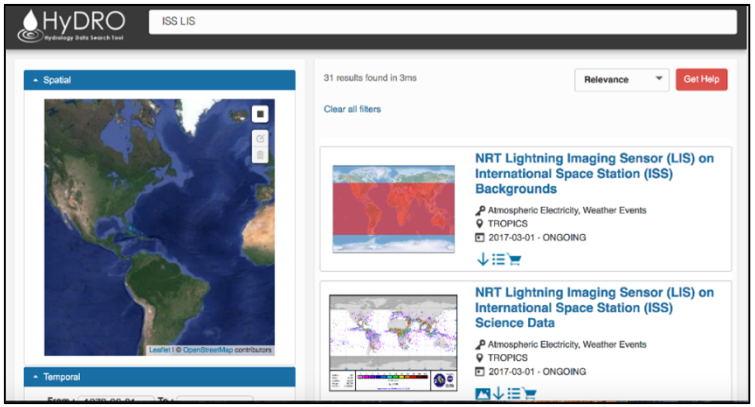
International Space Station LIS

Availability

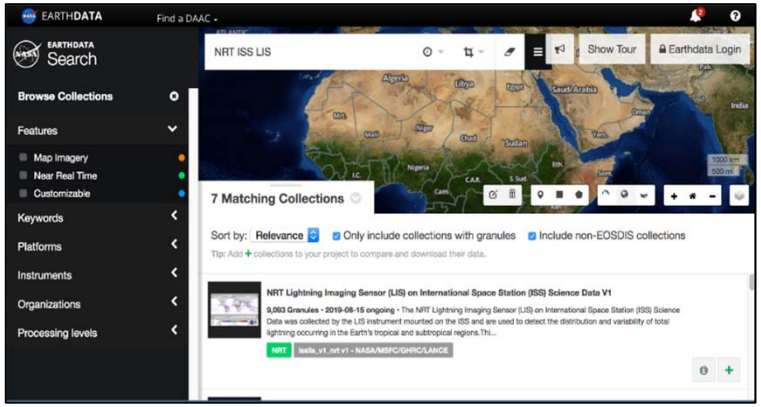
GHRC DAAC



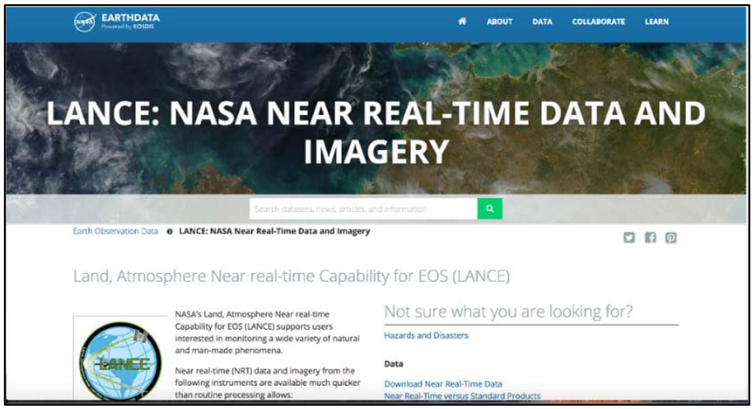
HyDRO



Earthdata Search*

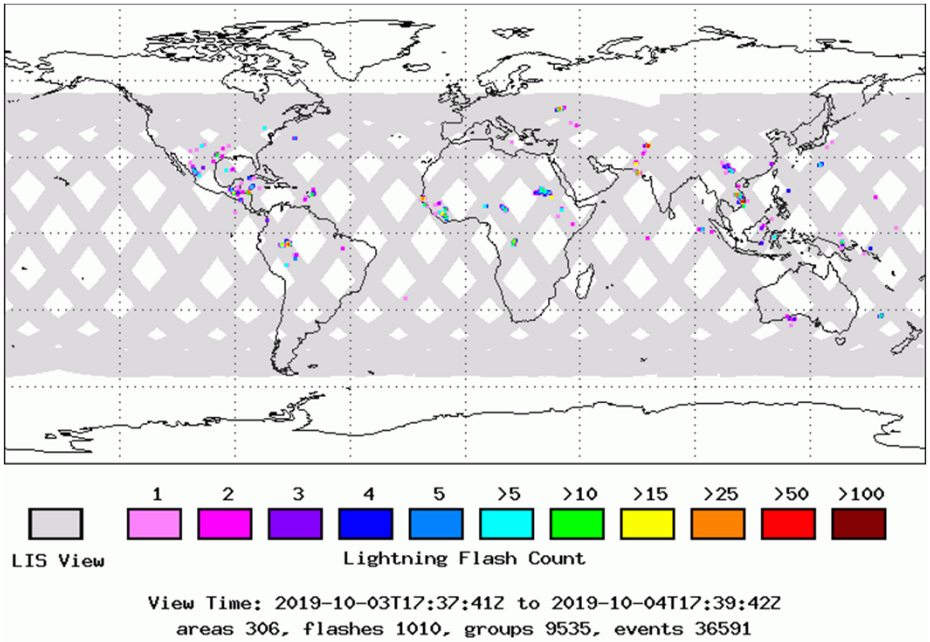


LANCE



ISS LIS: Validated Algorithm

- Validated version 1.0 started in June 2019
- Improvements to ISS LIS processing
  - Processing corrections
  - Report radiance values
- First data using this code released in June 2019
- Supersedes previous, provisional publications



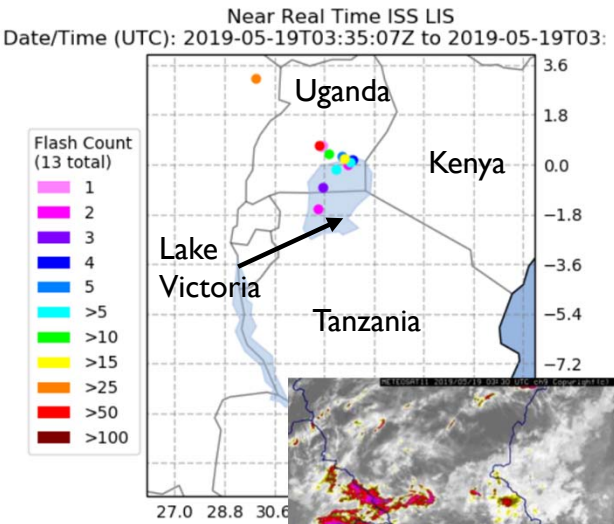
Display of 24 hours of near real-time observations (October 3-4, 2019)

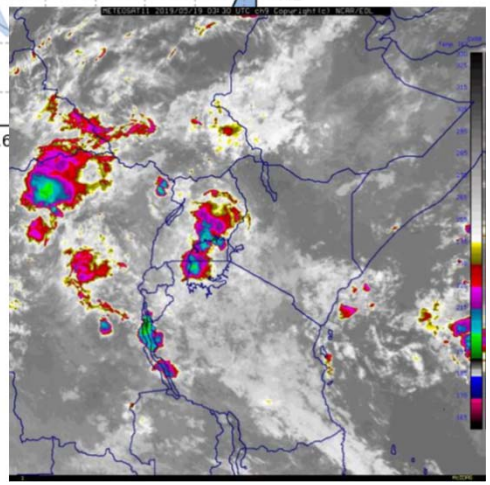
ISS LIS: LANCE Near Real-time

- ISS LIS has a 2 minute near real-time ability

Two Efforts Underway

- Share data with operational users
  - Aviation Weather Center, Ocean Prediction Center, National Hurricane Center, and NWS Pacific Region
- HIGH Impact Weather lAke sYstem (HIGHWAY)
  - Center on Lake Victoria in Africa
  - ~5,000 individuals die on the lake annually
  - HIGHWAY, with ISS LIS, delivers improved early warnings to local communities
  - Leverage scientific expertise and national meteorological services

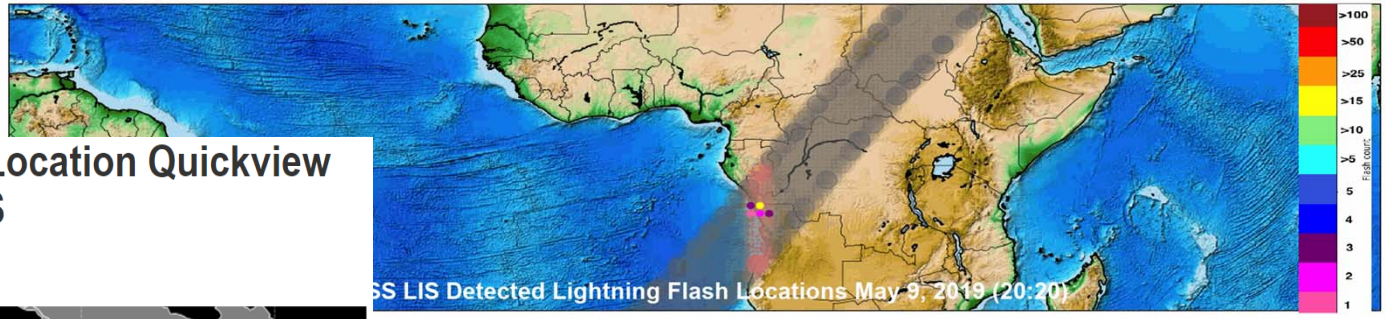




METEOSAT
10.8 μm IR

May 19, 2019
0330 UTC

ISS LIS: Data Recipe and Masthead



ISS LIS Lightning Flash Location Quickview using Python 3.0 and GIS

Description | How to Use | Dataset Information | Key Parameters

Description

The Lightning Imaging Sensor (LIS) onboard the International Space Station (ISS) retrieves optical lightning measurements over the majority of the Earth. This data recipe guides the user through a Python script that enables visualization of ISS LIS lightning flash locations. It is designed to compile information from a series of user-selected ISS LIS swath data files and generate a gridded heat map plot of lightning flash locations. In addition, a CSV file is generated containing the lightning flash coordinates in a format that can be input into other software. For this data recipe, the CSV file will be used to plot lightning flash locations in ESRI's ArcMap GIS software.

Hemispheric view of all ISS LIS lightning flash data captured from January 4, 2018

Above

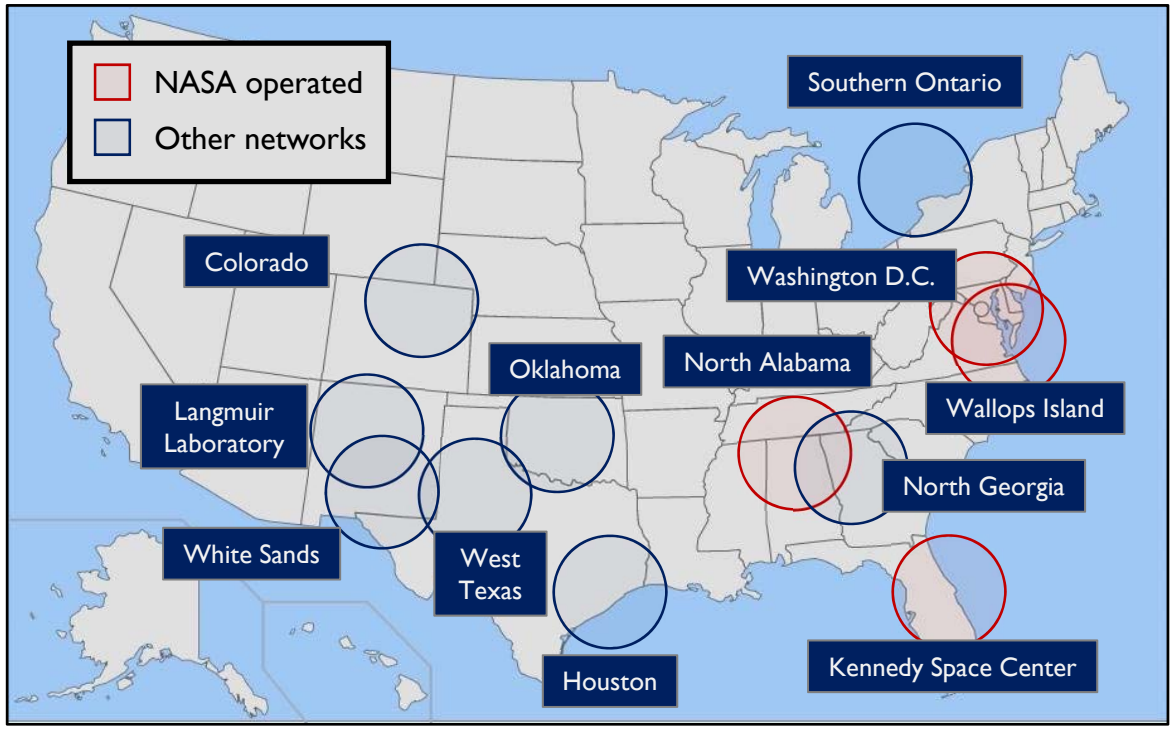
- ISS LIS supported 2 mastheads
- First GHRC animated masthead

Left

- Python 3.0 data recipe
- Direct outcome from Earthdata webinar

Plans for Fiscal Year 2020

Expand LMA holdings

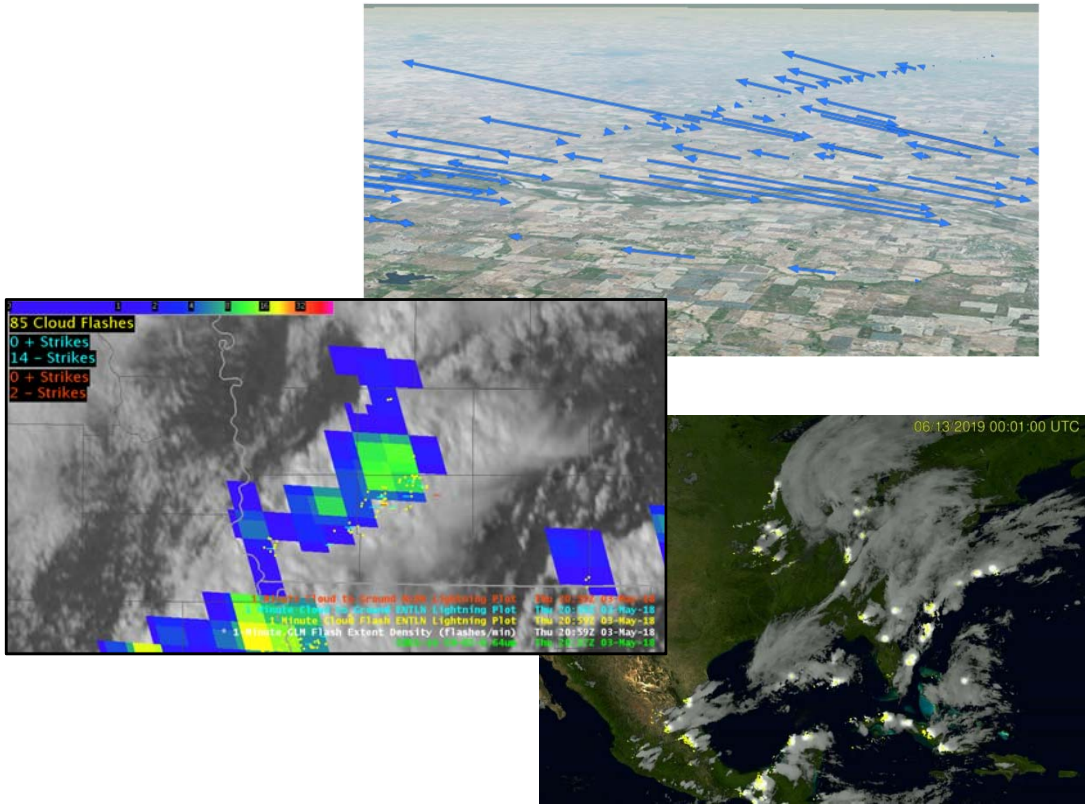


Lightning Mapping Array locations map

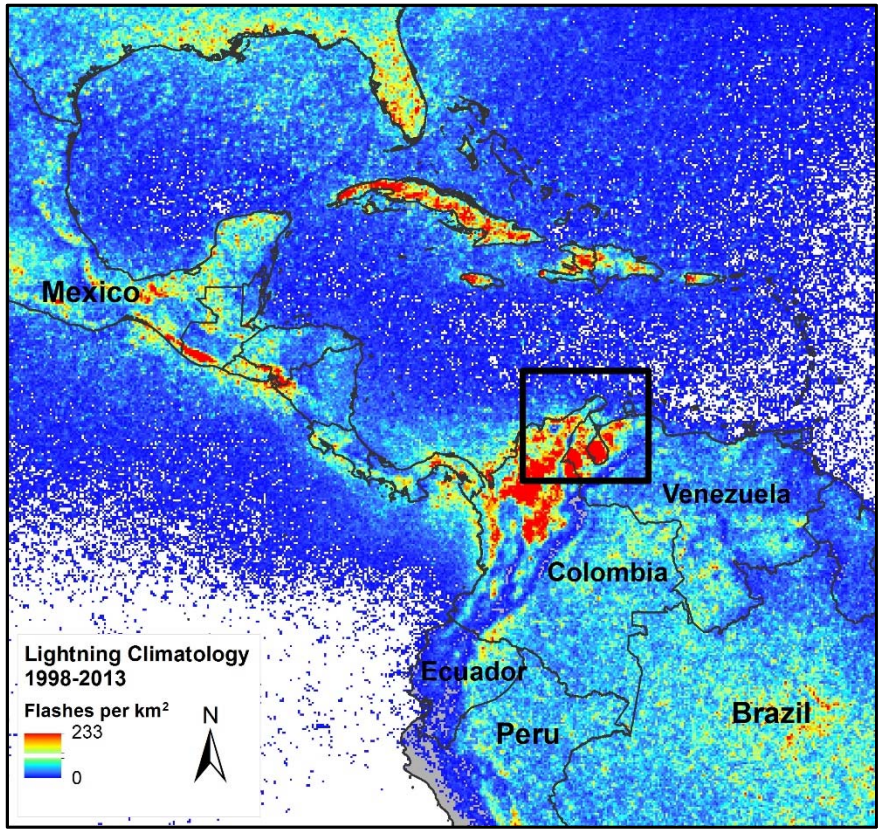
- Numerous LMAs across the country and Canada
- 7 archived for the GOES-R post launch field campaign
- Initial focus on NASA networks
- Interest from several non-NASA LMAs
- Potential older networks, like LDAR

Continued FCX Development

- Lightning will remain a key dataset for FCX
- Integrating LMA and GLM tools (Eric Bruning)
- Michael Peterson displays
- Improvements to LIP, FEGS, LMAs



Full Quality Control ISS LIS



- GHRC and LIS Science Team reprocessing the ISS LIS period of record
- Once done the monthly, validated ISS LIS quality control data will be published

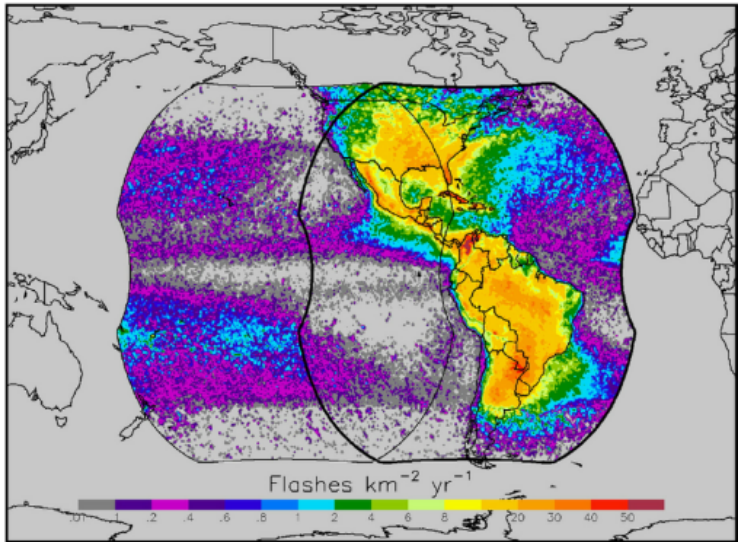
Highlight from Albrecht et al. (2016): Where are the lightning hot spots on Earth?

Continuing to Advance Lightning

- GHRC working to maintain leadership role in lightning
- Requires new projects and datasets beyond current holdings
- Current limitations
  - ISS LIS could be limited in the number of years left
  - Focus shifting to geostationary platforms (e.g., GLM, Lightning Imager)
- Proposals and collaborations offer unique opportunities
- Example: Lightning is now an essential climate variable
  - World Meteorological Organization developing a 10 km, global lightning dataset – GHRC is targeted DAAC

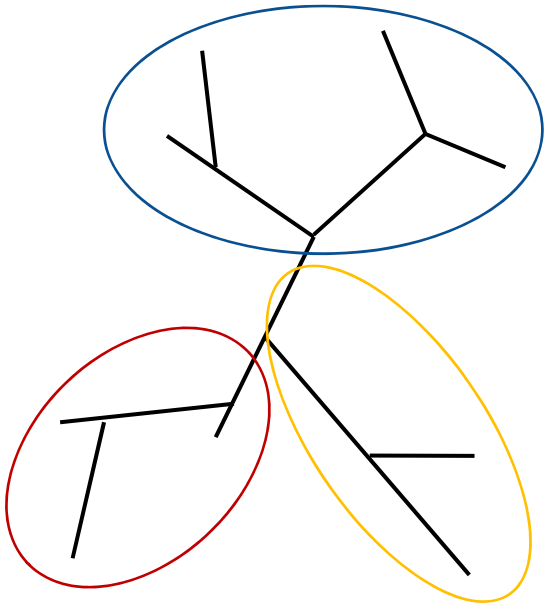
Geostationary Lightning Mapper

- Relevance to NASA
  - Joint NOAA/NASA GOES-R series satellites
  - Direct descendant of NASA technology (e.g., OTD, LIS)
- Importance for GHRC
  - Near hemispheric field of view
  - Near real-time observations
  - New platforms coming that will create almost global coverage by 2030
    - EUMETSAT Lightning Imager, equivalents with Japan, Korea, and China
  - Be involved to evolve as the lightning DAAC



GLM Science Data

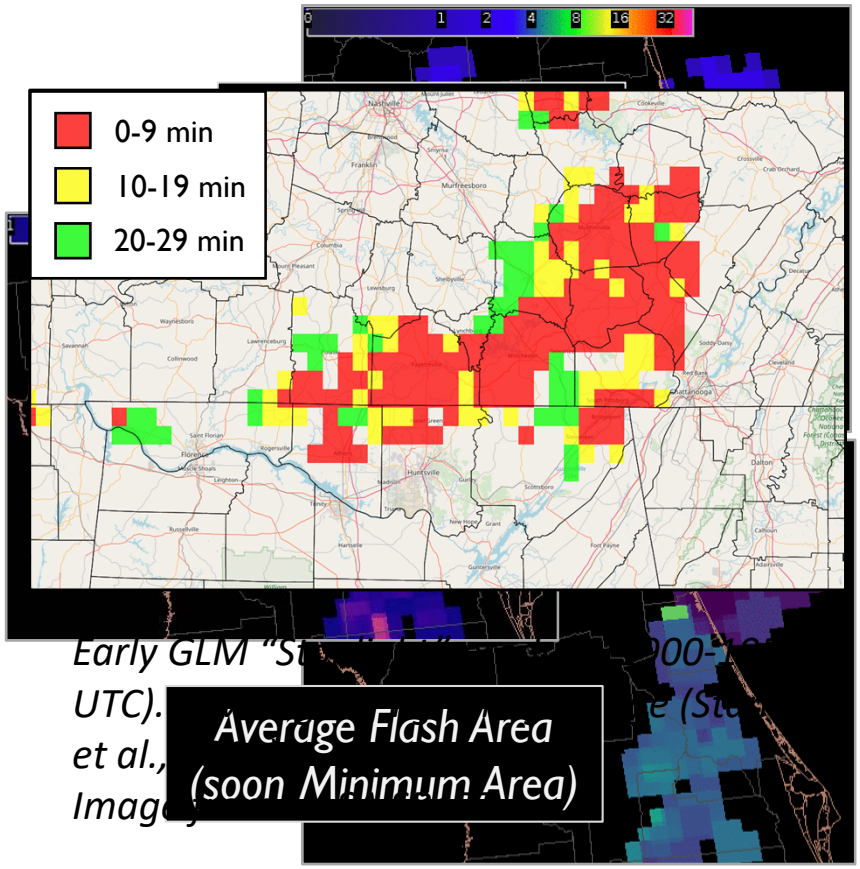
- UWG member Dr. Peterson submitted to GHRC for publication
- A “science” level algorithm
- Real-time GLM cuts processing in certain high flash rate areas
  - Splits large flashes into numerous smaller flashes
  - Cluster assurance recombines these
- Benefits
  - Research opportunities
  - “Ongoing” dataset for GHRC to support ISS LIS



Simplified example of how a single flash (black lines) could be “split” into three flashes by the real-time algorithm (colored ovals)

GLM Level 3 Products

- Arose from the GLM Science Meeting
- NOAA has no plans to store Level 3 GLM products
- Direct request from NOAA if GHRC can serve as archive
- Benefits
  - Reinforce GHRC's status as the lightning DAAC
  - Extremely visible dataset
  - "Ongoing" dataset (through 2030s)
  - Sets precedent for other Level 3 products



Early GLM "St
UTC).
et al.,
Imag

Expanding DEVELOP

- Lightning Risk Assessment for the Hindu-Kush region
  - Described at 2018 UWG
- Turn the DEVELOP project into a locally developed dataset
  - Expand this effort to cover the full field of view of LIS
- Aim is a NOAA CSTAR proposal with local NWS
  - Test what is needed to expand the project
  - Provide a lightning safety product to partner(s)
- Can supplement with GLM and other geostationary platforms in the future

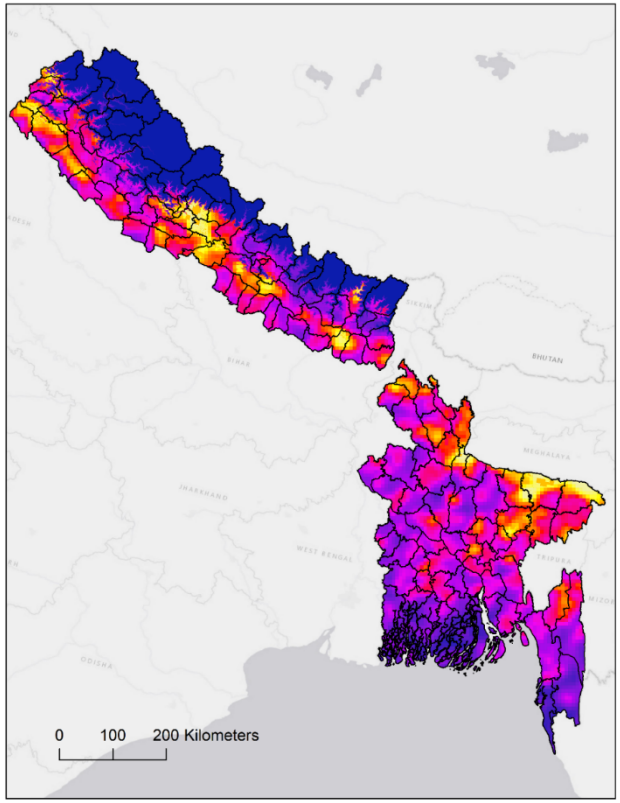
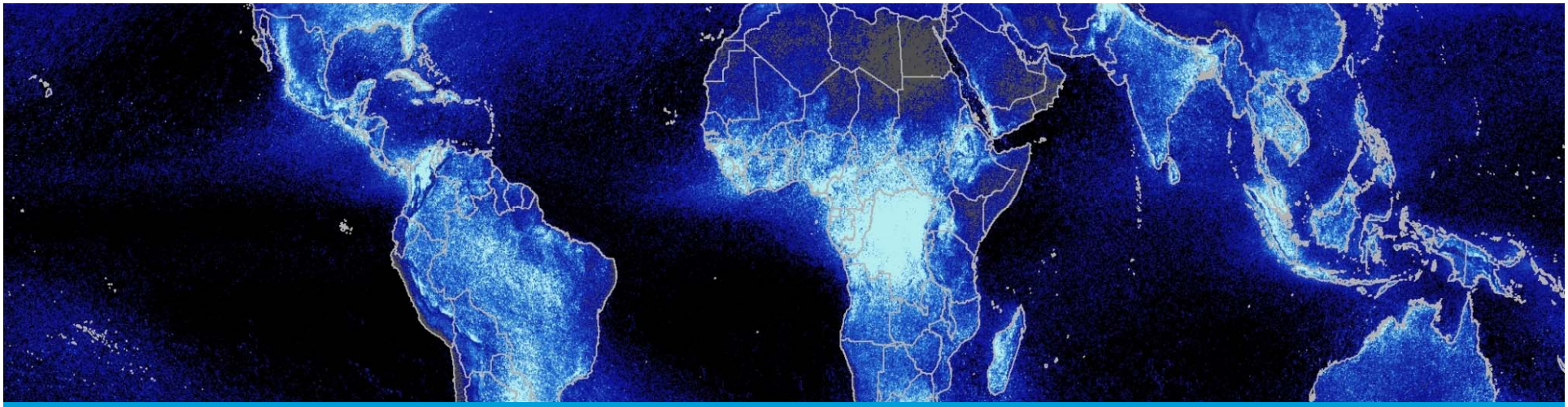


Image Source: Sisam Shrestha

Summary

- Lightning is a key piece of GHRC's success
- Active year for ISS LIS
- Opportunities with Field Campaign Explorer
  - Expand visualizations
  - Develop more data recipes
- Crucial opportunities with new lightning datasets
  - WMO global lightning dataset
  - Incorporating the GLM at GHRC



THANK YOU!

QUESTIONS?