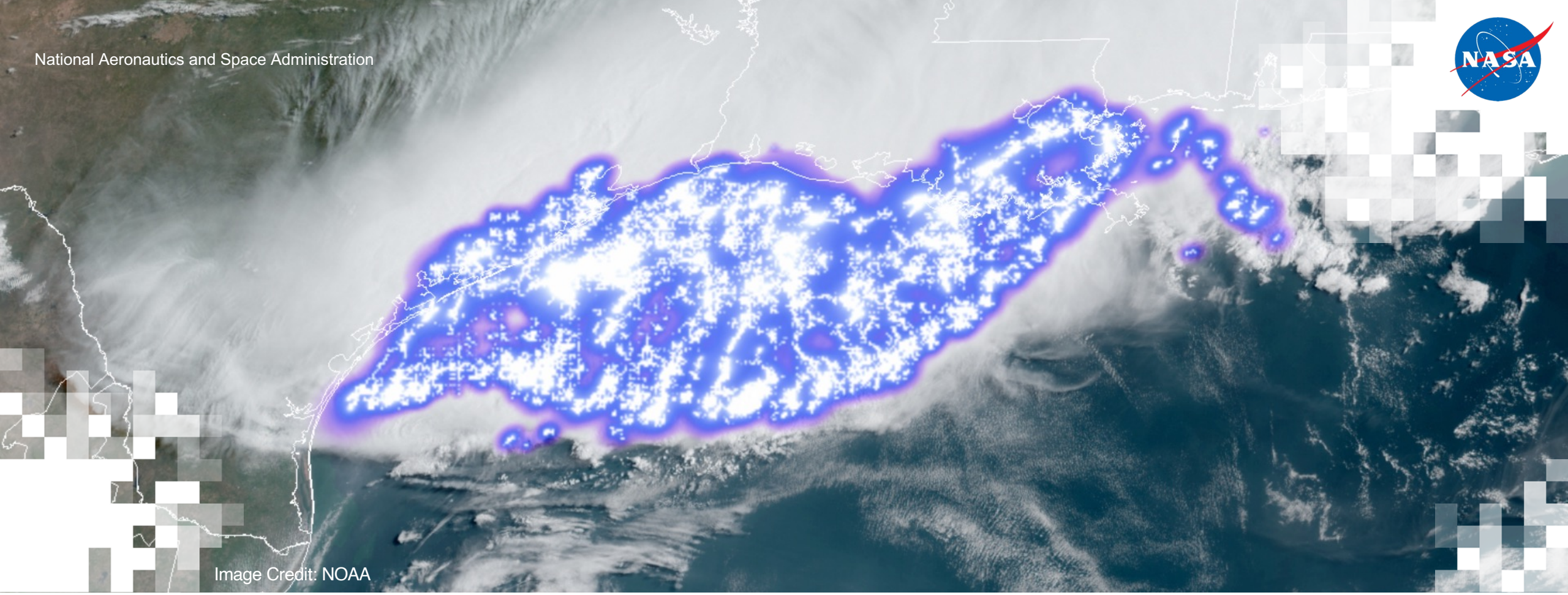


Introduction to Lightning Observations and Applications

Part II: Overview of Current Lightning Data Products from NASA Remote Sensing and Ground-Based Measurements

Guest Instructor: Timothy Lang (NASA)

March 28, 2024

Training Outline

Part 1

Background and History of Lightning Measurements

March 26, 2024

Time

Part 2

Overview of Current Lightning Data Products from Remote Sensing and Ground-based Measurements

March 28, 2024

Time

Part 3

Overview of Geostationary Lightning Mapper (GLM), Lightning Data Access, and Applications

April 2, 2024

Time

Homework

Opens April 2 – Due April 17 – Posted on Training Webpage

A certificate of completion will be awarded to those who attend all live sessions and complete the homework assignment before the given due date.

Review of Part 1

- Background and History of Lightning Detection from 1960s to Present:
  - Focused lightning measurements started in 1980s from Space Shuttle
  - Satellites for Lightning Measurements: MicroLab1, TRMM, GOES E & W, ISS
  - Sensors for Lightning Measurements: OTD, LIS, Near-IR Detector

- Importance and Benefits of Lightning Measurements:
  - For raising lightning safety awareness
  - An indicator of storm intensity
  - An Essential Climate Variable (ECV)
  - An indicator of wildfire ignition potential
  - For aviation and marine weather safety

- Future Lightning Measurements:
  - GeoXO Lightning Mapper

GOES: Geostationary Operational Environmental Satellite
GeoXO: Geostationary and Extended Observations (GeoXO)
TRMM: Tropical Rainfall Measuring Mission
ISS: International Space Station
OTD: Optical Transient Detector
LIS: Lightning Imaging Sensor

Part 2 – Learning Objectives

By the end of this training, participants will be able to:

- Identify current lightning data products from spaceborne and suborbital sensors
- Access global lightning data products

How to Ask Questions

- Please put your questions in the Questions box and we will address them at the end of the webinar.
- Feel free to enter your questions as we go. We will try to get to all of the questions during the Q&A session after the webinar.
- The remainder of the questions will be answered in the Q&A document, which will be posted to the training website about a week after the training.

Part 2 – Trainers

Timothy Lang

Guest Instructor

Lead Research AST, Atmospheric Measurements

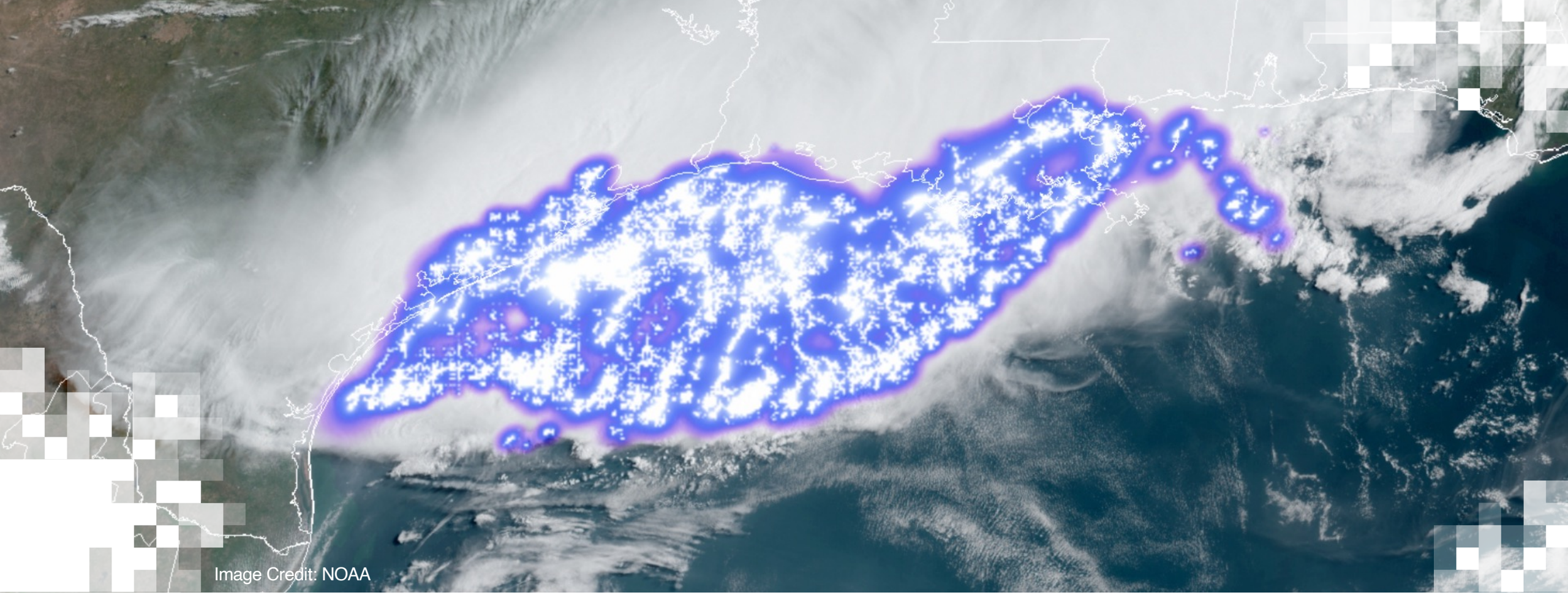
NASA-GSFC

Christopher Schulz

Guest Contributor

Research AST, Meteorological Studies

NASA-MSFC

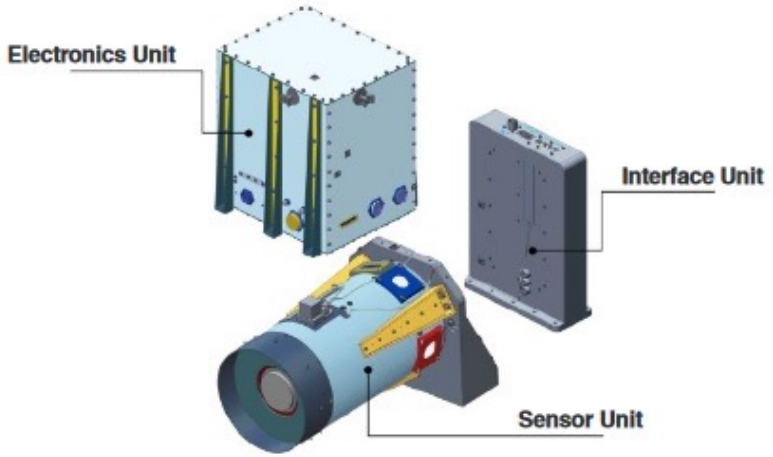


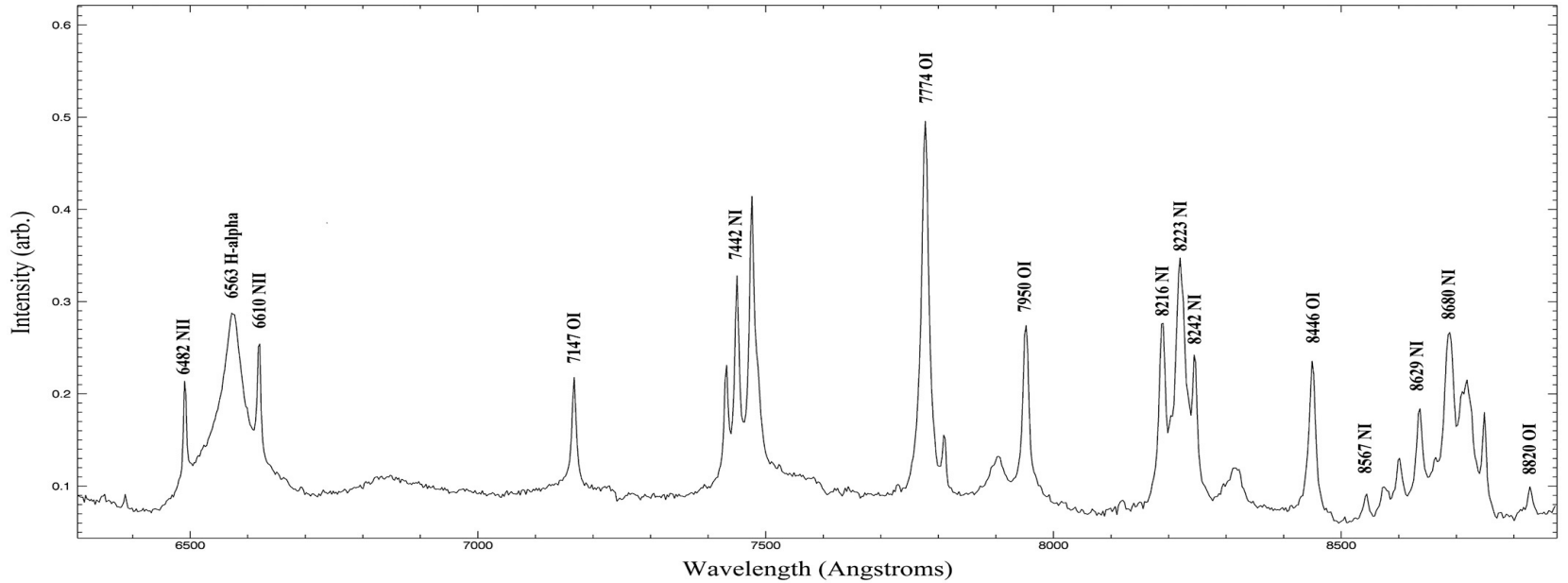
Section 1

NASA Spaceborne Lightning Measurements

How Lightning is Detected Optically from Space

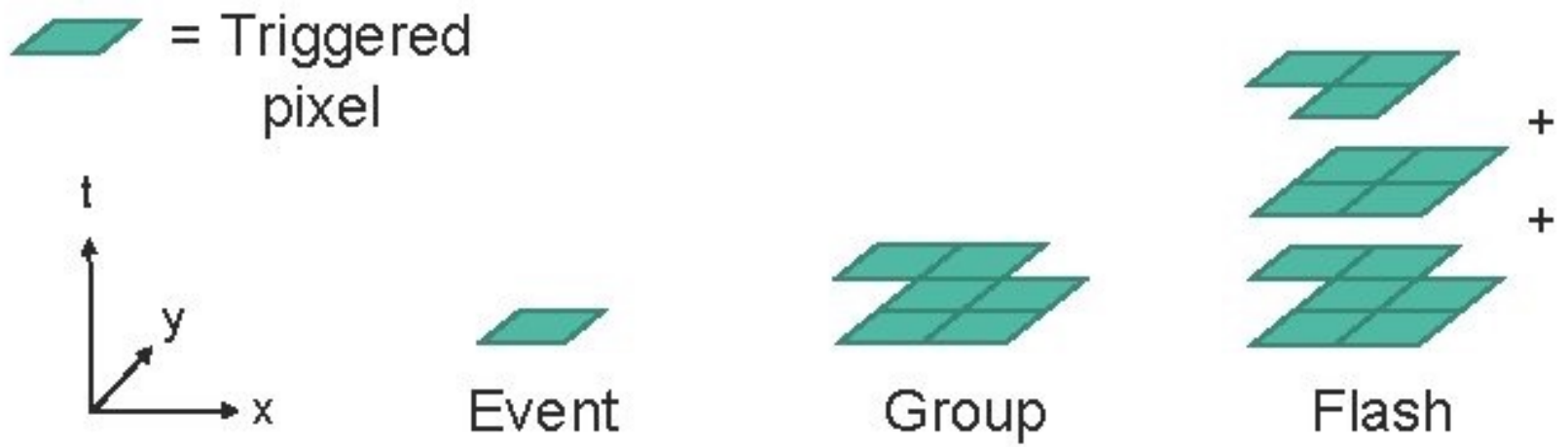
- Sensors use transient detection on high-speed (500 fps) optical camera data.
- Camera optics use a narrow-band filter centered on 777.4 nm (near IR), an oxygen emission band within lightning channels.
- A strong signal is detected during day and night.
- The camera has a digital focal plane (CCD or CMOS) to collect signals.



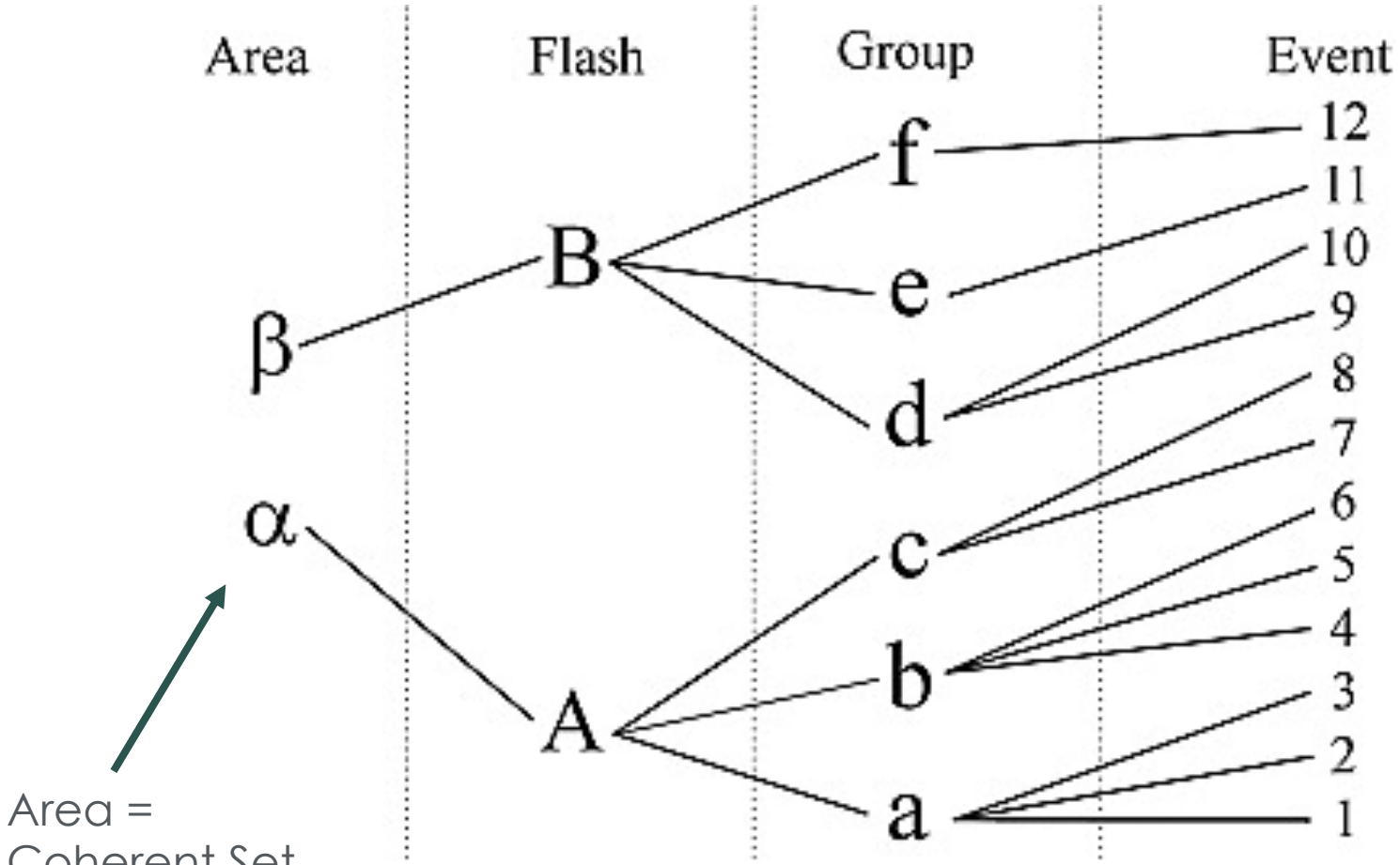


Hierarchy of Spaceborne Lightning Data

- Events
  - Single pixel in a single frame (2 ms) with transient change above background threshold
- Groups
  - Set of contiguous events in the same frame
  - Analogous to pulses/strokes in radio lightning data
- Flashes
  - Set of spatiotemporally related groups that persist for 1 or more frames

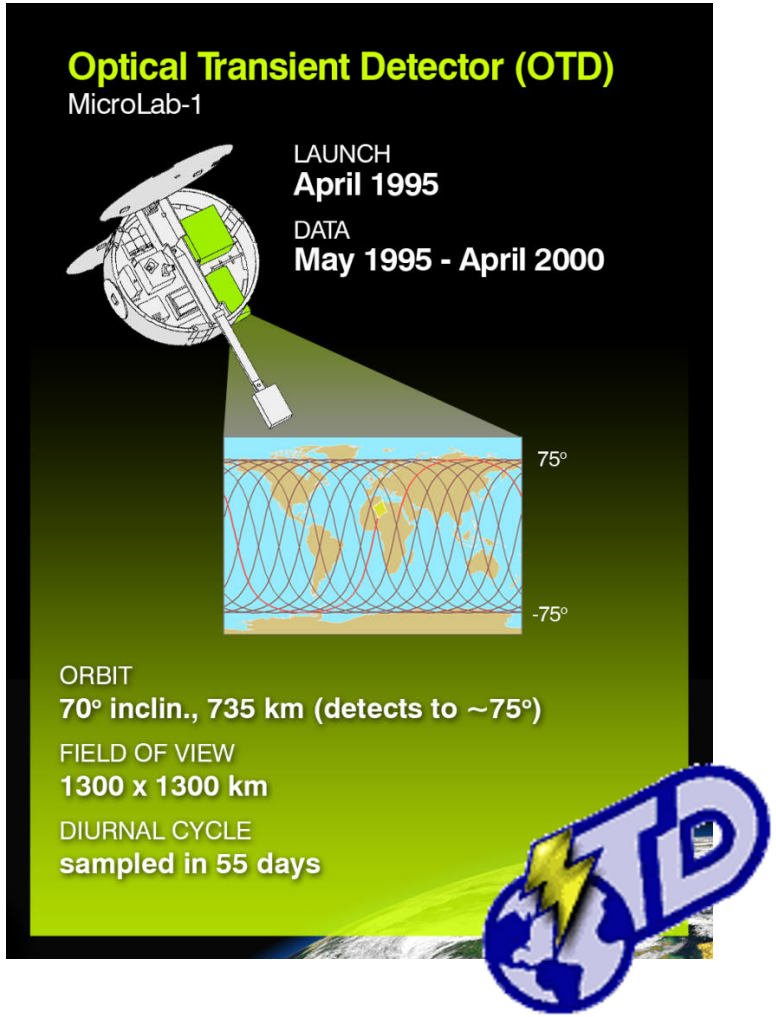


Hierarchy of Spaceborne Lightning Data



Optical Transient Detector (OTD)

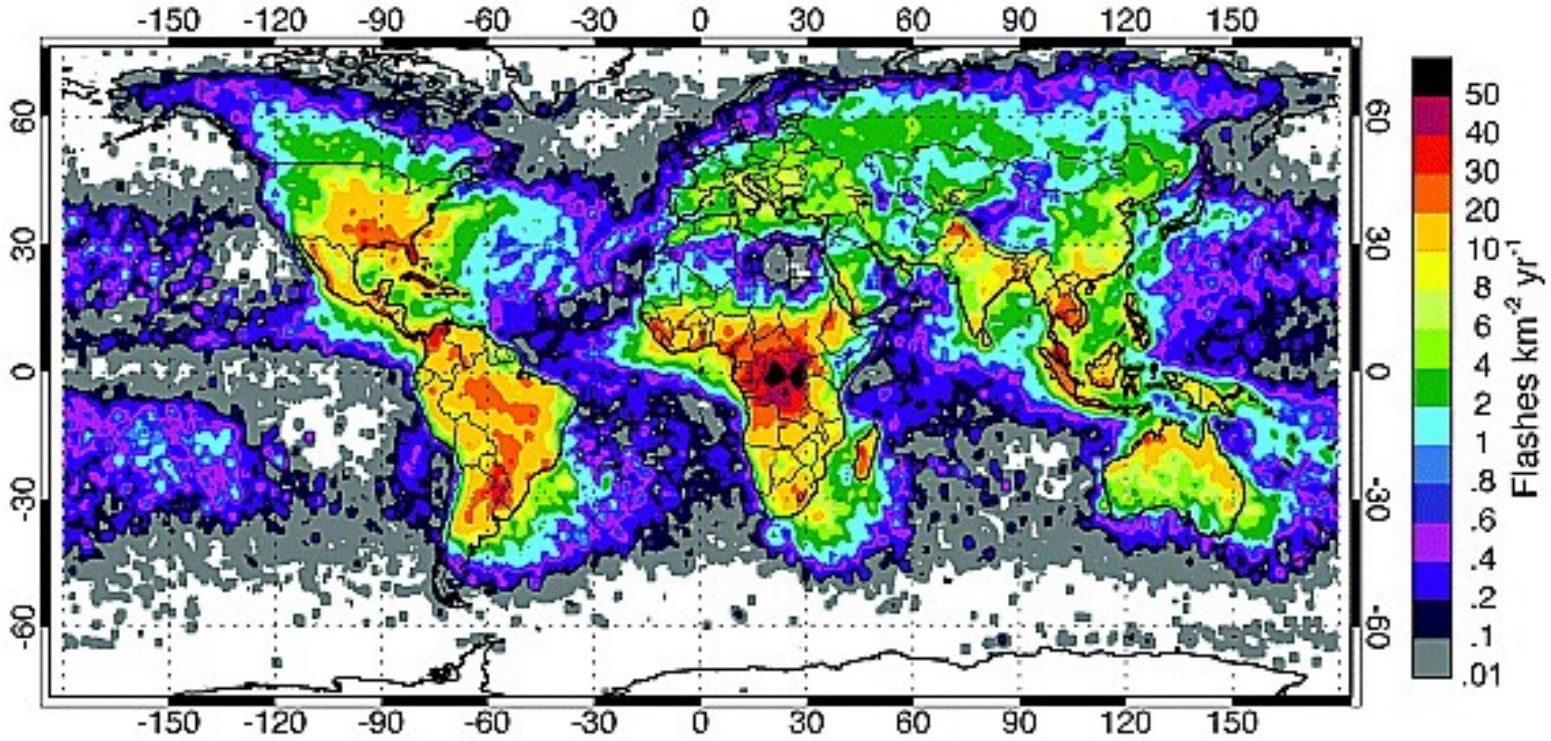
- **Satellite: MicroLab-1/OrbView-1**
  - Inclination: 70 deg
  - Altitude: 740 km
  - Data Available: May 1995-April 2000
  - Granule Data Link



Optical Transient Detector (OTD)

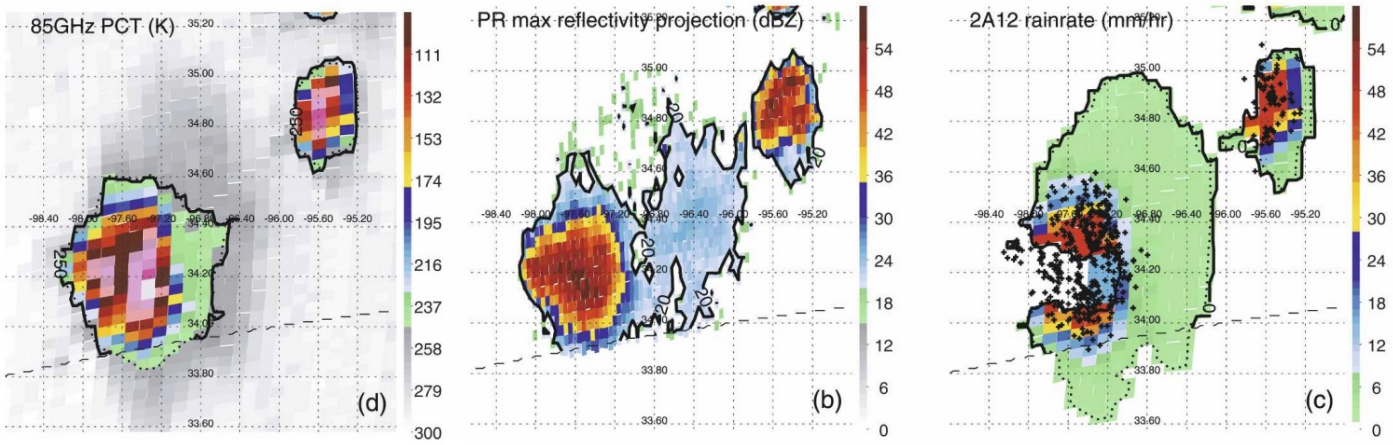
First mission to fully map global lightning from space

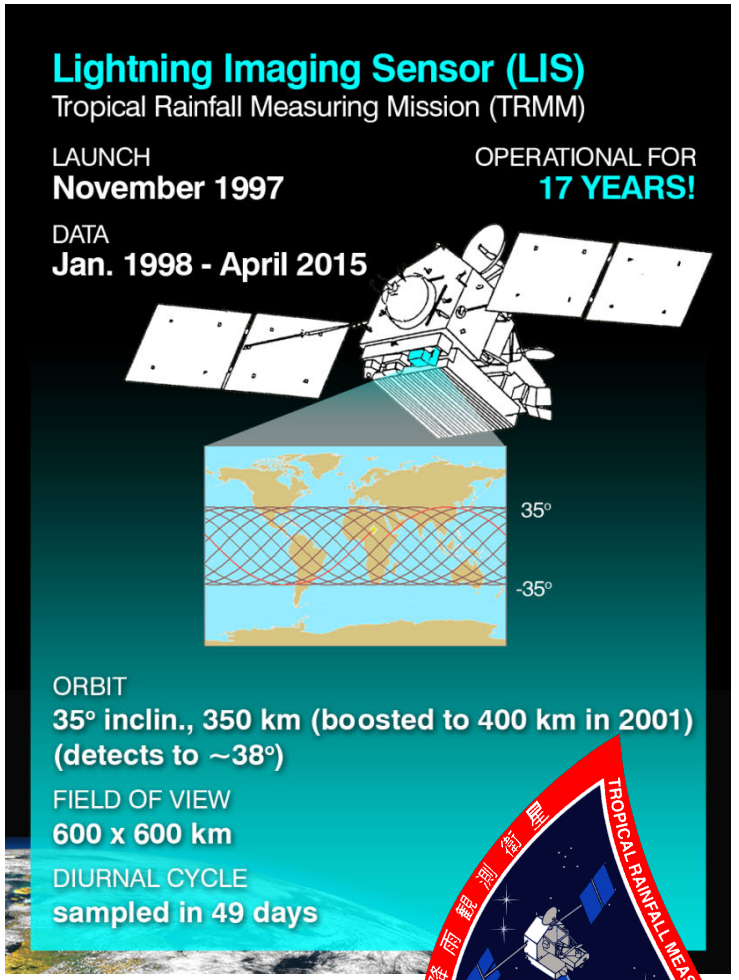
- Proved the optically based lightning detection concept
- Demonstrated how lightning favors land vs. ocean
- Showed the importance of the tropics to the global electrical circuit



Tropical Rainfall Measuring Mission Lightning Imaging Sensor (TRMM LIS)

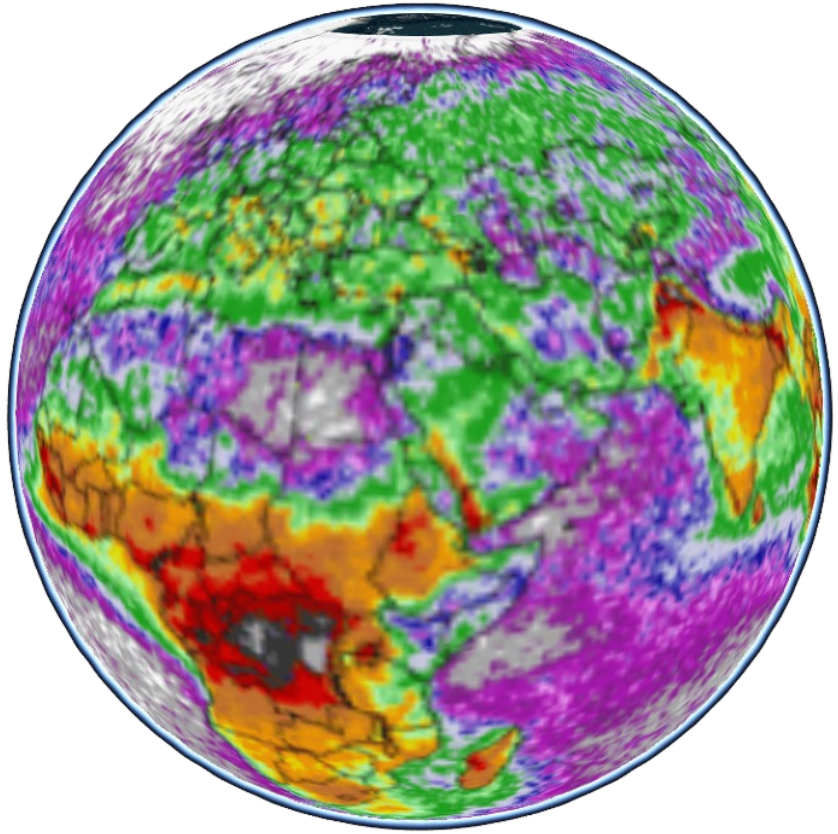
- TRMM LIS was in 35-deg orbit, favoring coverage of the global tropics, and sampled 1998-2015. See granule data link.
- First combined spaceborne observations of lightning with other sensors, including microwave radars and radiometers.





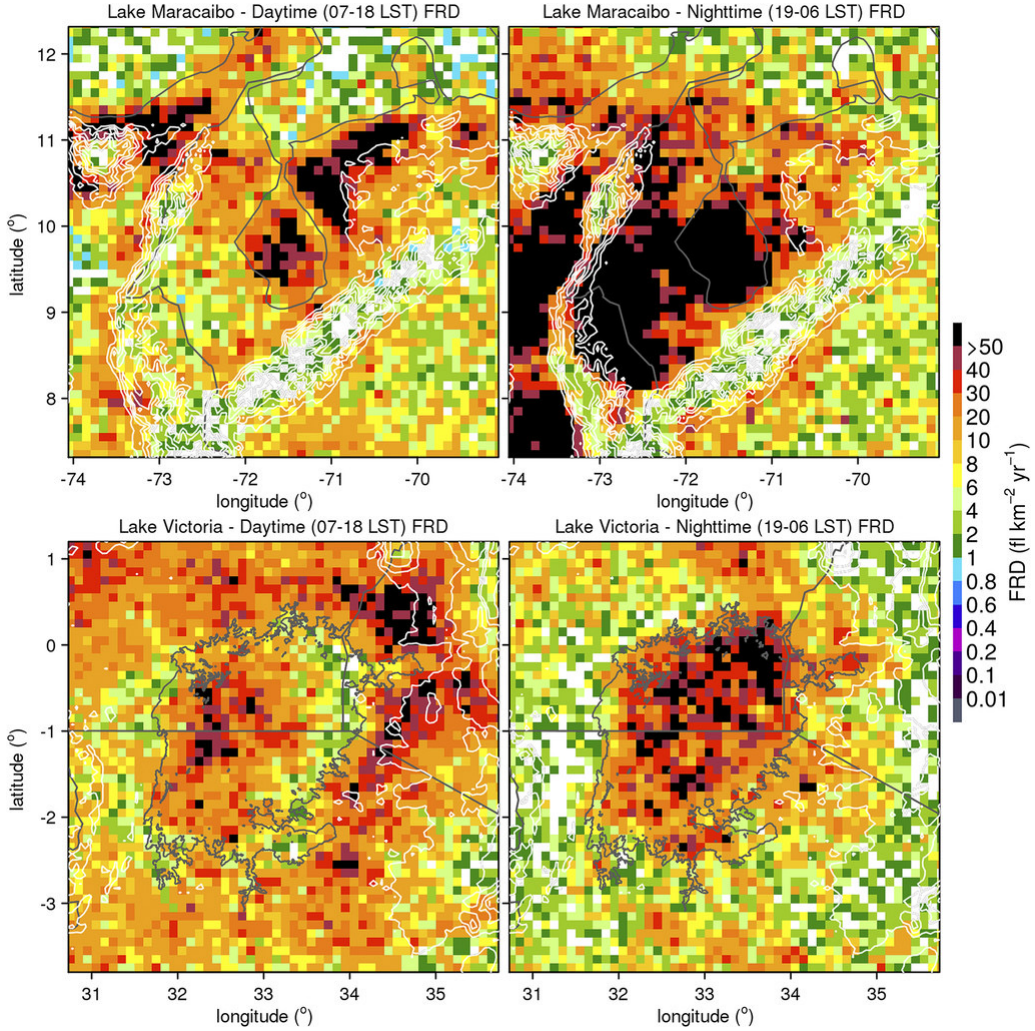
TRMM LIS/OTD Global Climatology (1995-2014)

- Merged climatology that combines the OTD and TRMM LIS sensors
- Sensors overlapped during 1998-2000, so OTD flash rates adjusted to be consistent with TRMM LIS sensitivity
- Includes 0.5-degree and 2.5-degree climatologies
- Data available from the Global Hydrometeorology Resource Center (GHRC)



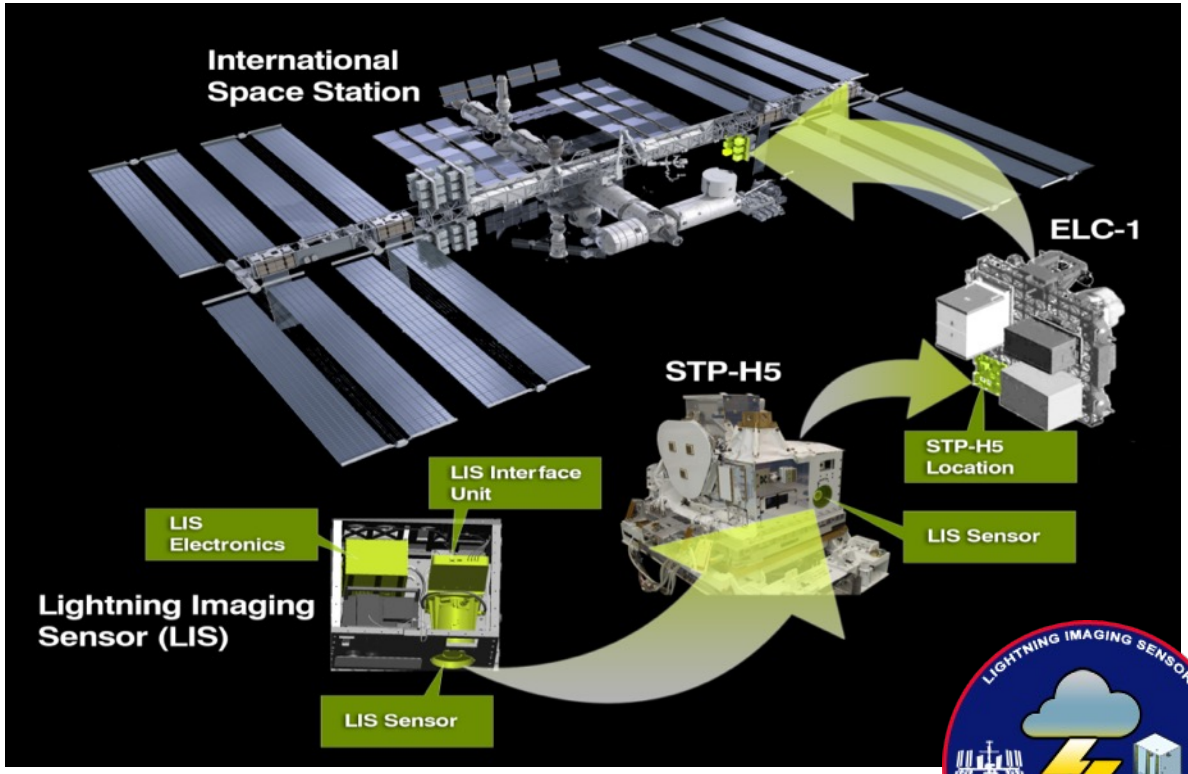
TRMM LIS Very High Resolution (VHR) Climatology (1998-2013)

- 0.1-degree resolution dataset averaged over the full TRMM LIS mission
- Includes diurnal, monthly, seasonal, annual, and full climatological means
- Enables detailed exploration of relationships between lightning and geographical features like lakes, mountain ranges, etc.
- Data also available from the GHRC

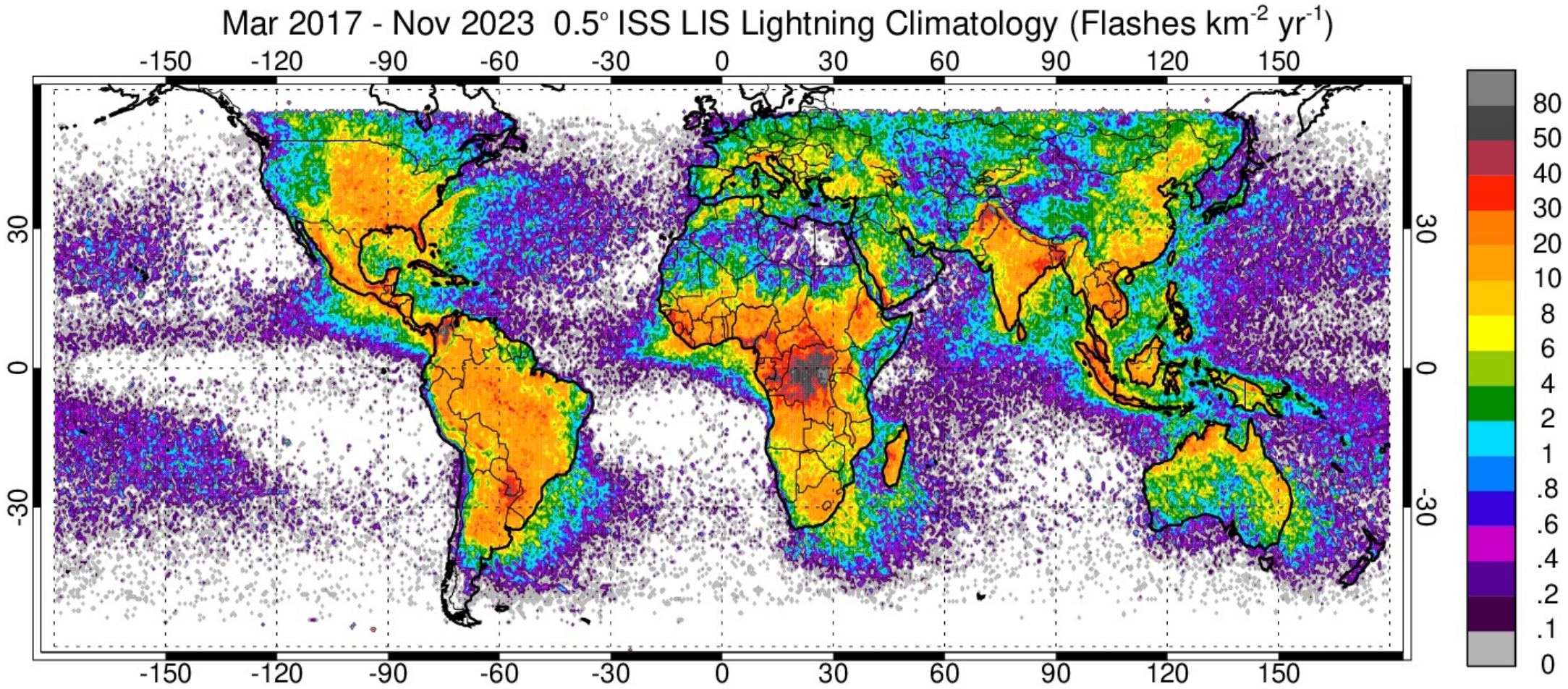


International Space Station Lightning Imaging Sensor (ISS LIS)

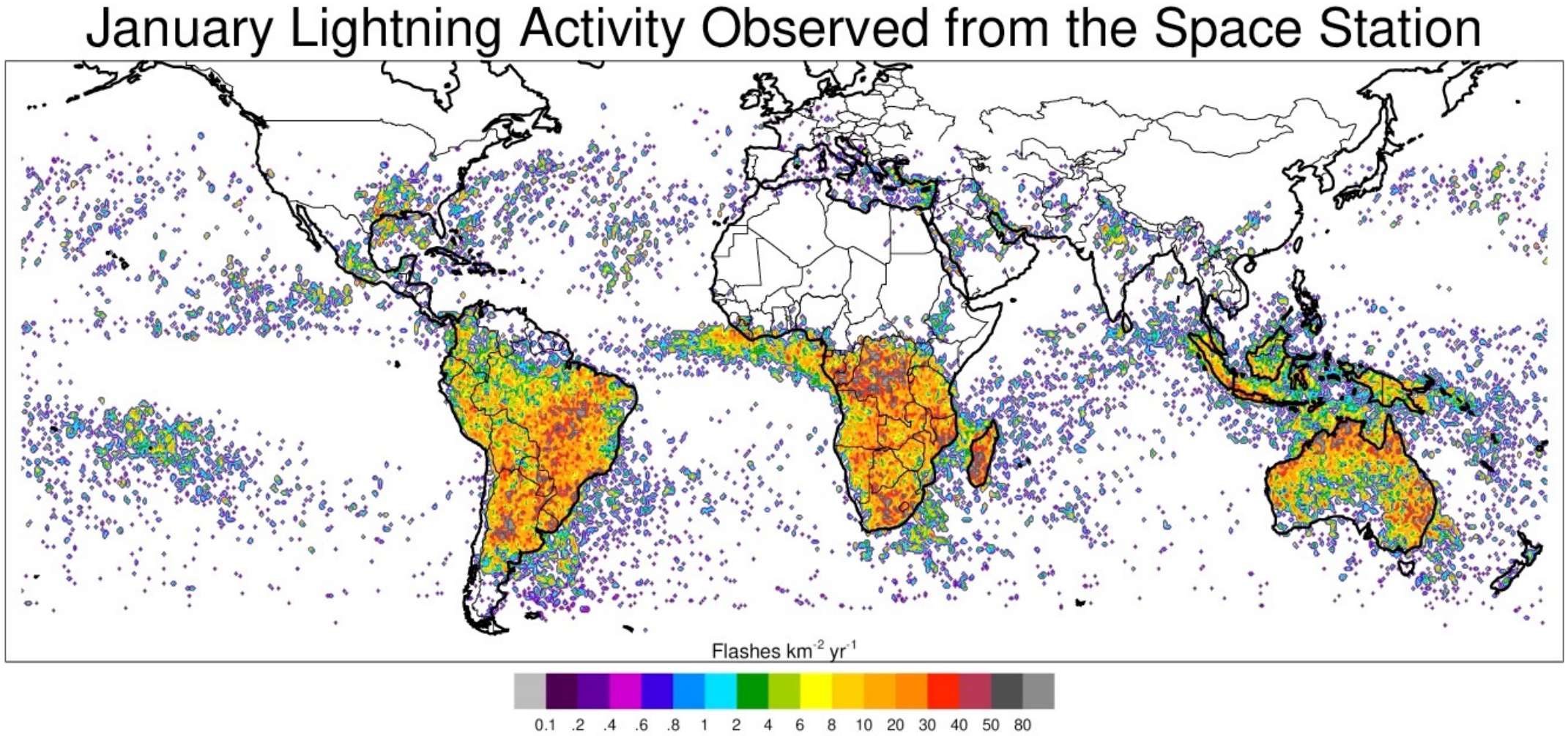
- Flight spare for TRMM LIS, which was kept in storage for 15+ years and then modified to work on ISS
- Incorporated within 5th Space Test Program Houston (STP-H5) payload and launched via commercial resupply service
- ISS LIS expanded the LIS climatology to +/- 55 degrees and provided near-realtime data to operational users
- Operated March 2017 – November 2023
- Granule Data Link



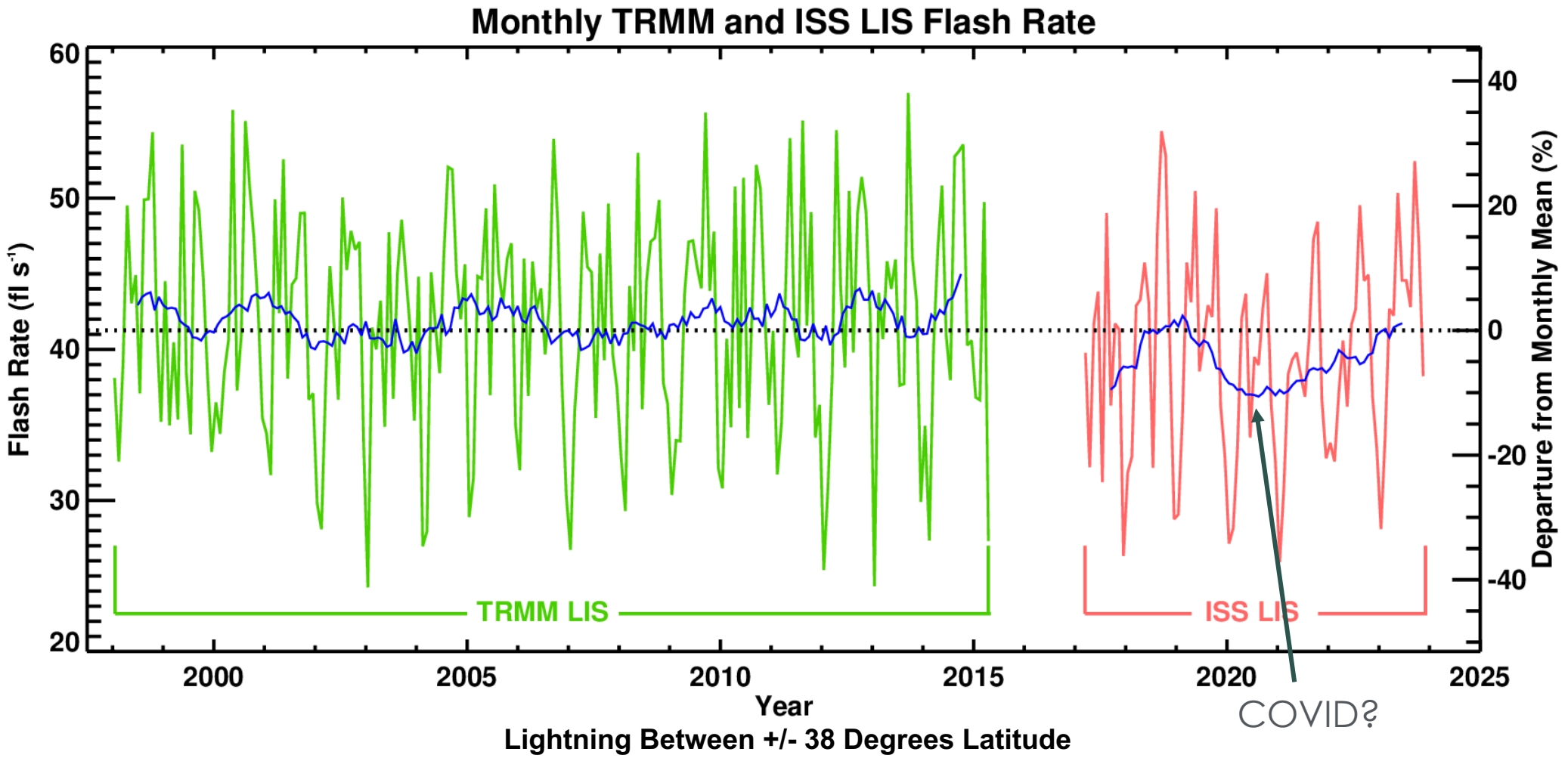
Global Lightning Climatology from ISS LIS



Exploring the Seasonality of Global Lightning with ISS LIS



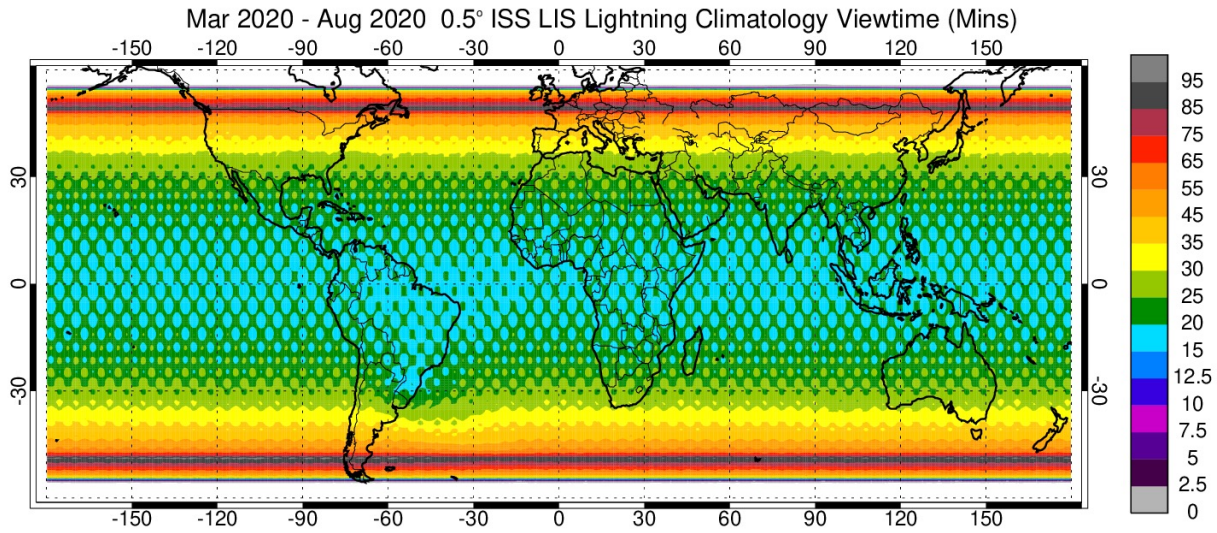
TRMM + ISS LIS Time Series of Lightning in the Global Tropics

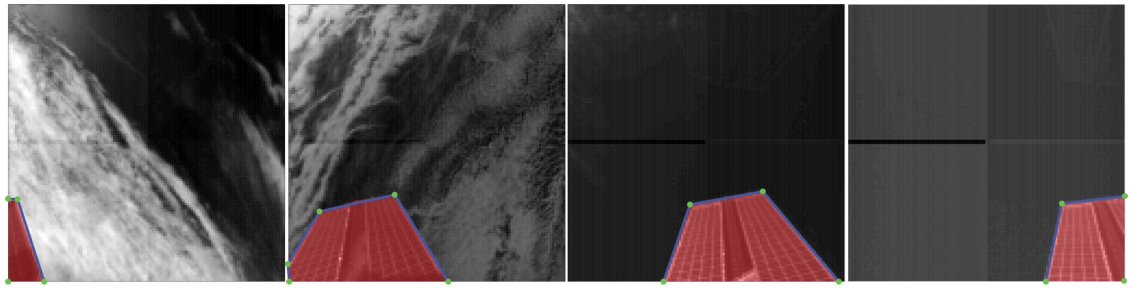


Viewtime

- Viewtime is a critical metadata variable for Low-Earth Orbit (LEO) lightning observations.
- LIS typically views a given location for 90-120 seconds during an overpass.
- Even if lightning doesn't occur, we need to know if LIS/OTD were looking at the area!
- Viewtime is calculated on a 0.5-degree grid, and viewtimes in granules need to be binned and summed up to create global maps like the top right.

```
H = binned_statistic_2d(
    lis_v1.viewtime_lon.data, lis_v1.viewtime_lat.data,
    lis_v1.viewtime_effective_obs.data.astype('float')/1e9,
    statistic='sum',
    bins=[nlon-1, nlat-1], range=[lonrange, latrange])
```

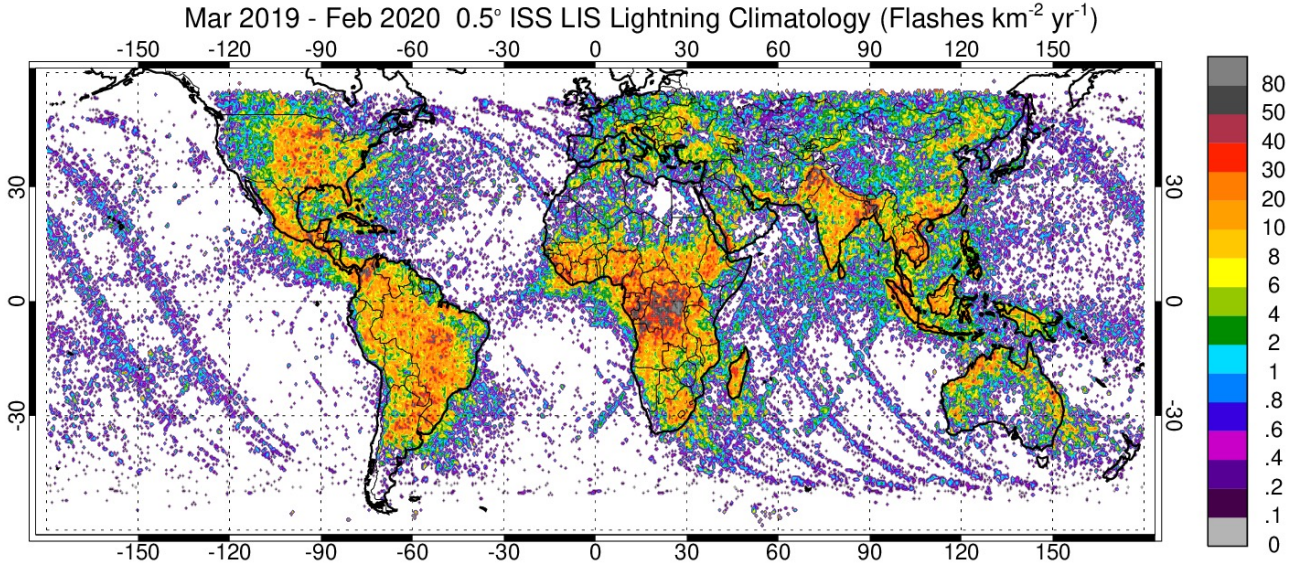


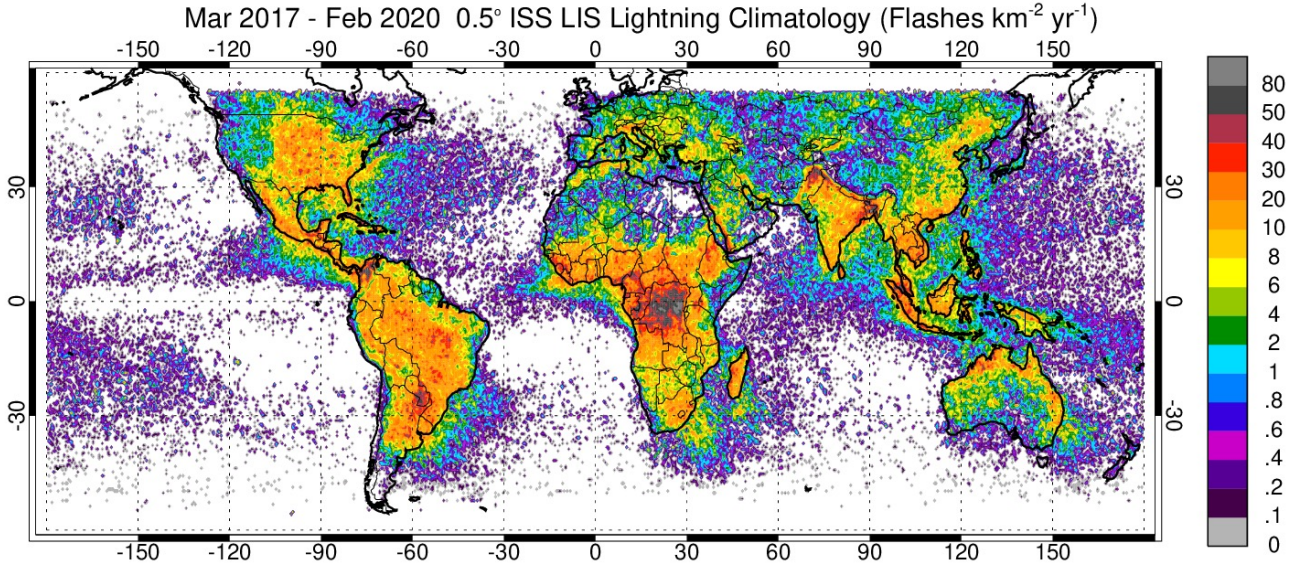


ISS LIS viewtimes consider the presence of solar arrays in the field of view.

LIS/OTD Quality Control

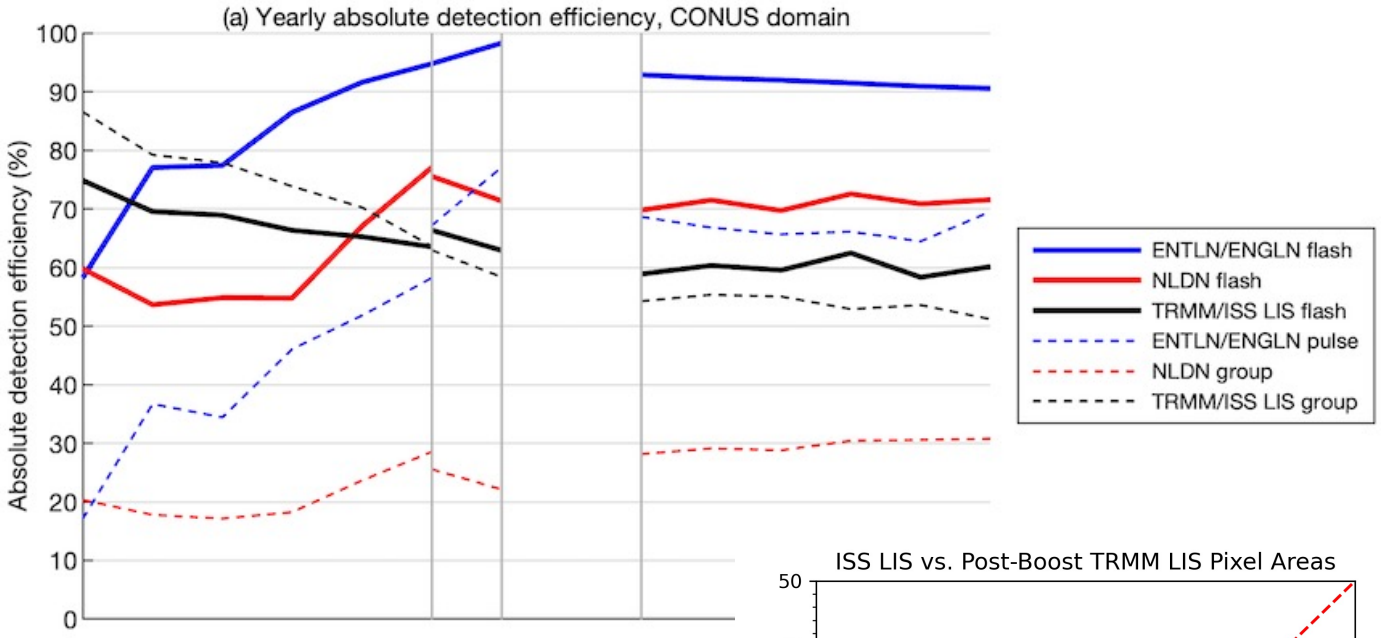
- Instruments and satellites don't always work properly, so LIS & OTD datasets exclude orbits (either partial or full) where data do not appear correctly or data flags suggest fatal data problems.
- This review process is performed by human analysis of every granule.
- The example to the right shows how some ISS LIS orbits feature excessive noise, which would pollute global climatologies if those granules were not removed.

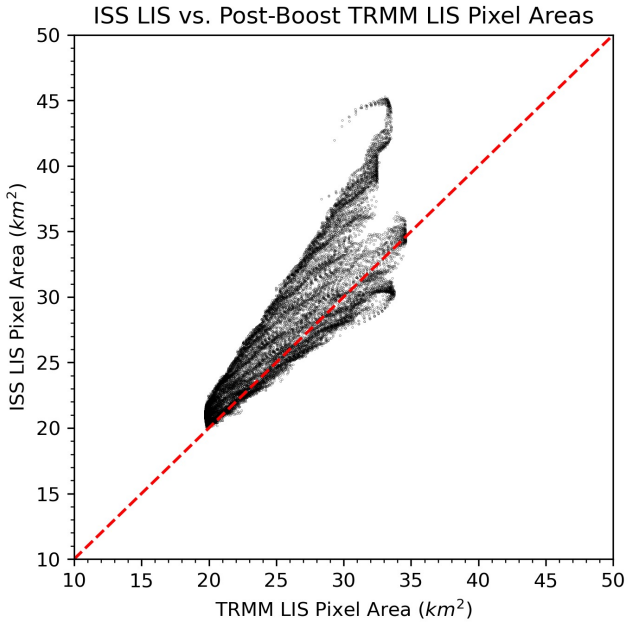




ISS vs. TRMM LIS

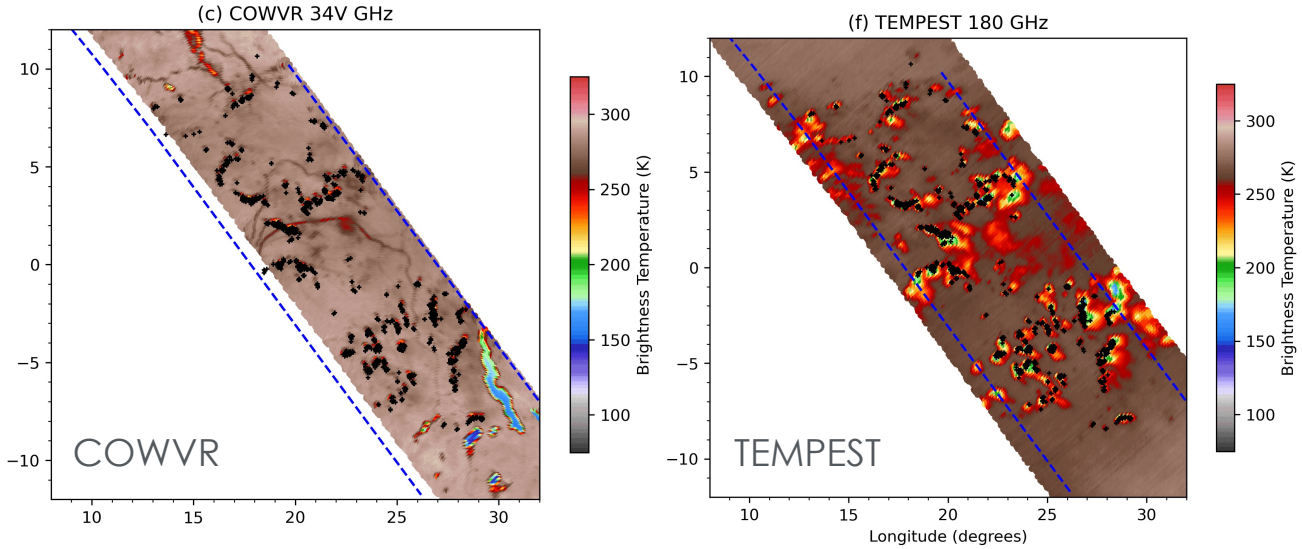
- Even though TRMM and ISS LIS did not overlap, their relative sensitivities can be estimated using a Bayesian comparison with ground-based commercial sensor networks.
- ISS LIS had a detection efficiency ~5% less than TRMM (~60% vs. 65%).
- This decrease in detection efficiency is due at least in part to larger ISS LIS footprint sizes, which reduce overall sensitivity.
- The ISS platform is canted more than TRMM was, so the Earth incidence angle is larger.

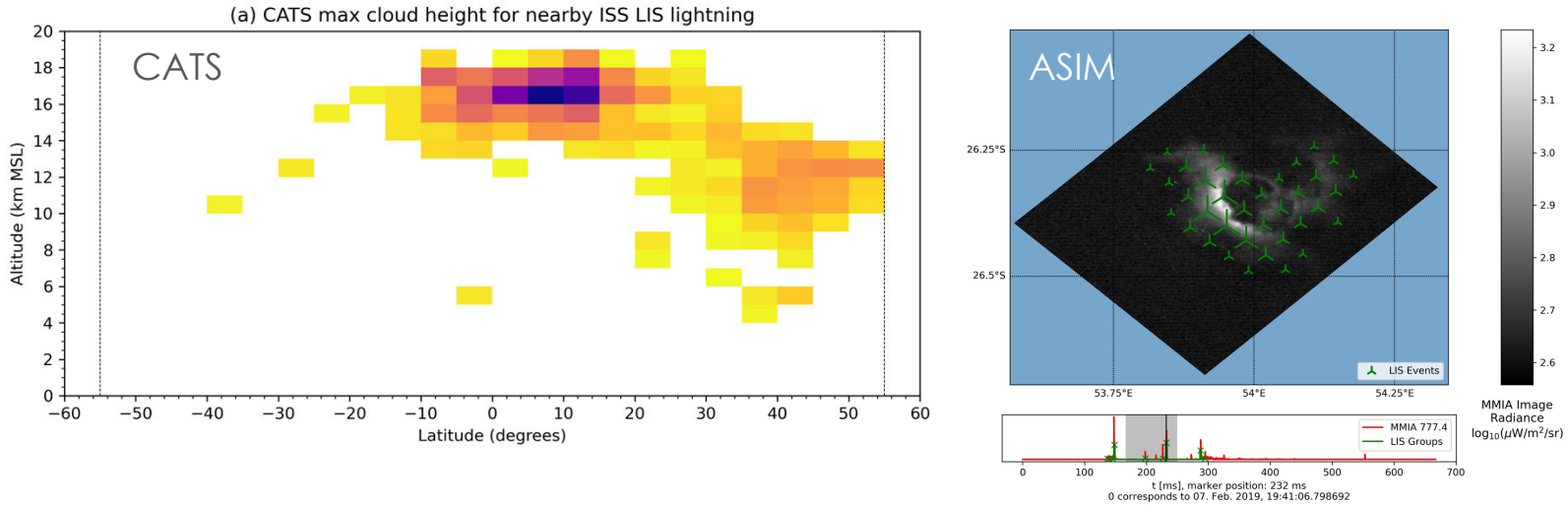




ISS LIS Combinations with Other Instruments

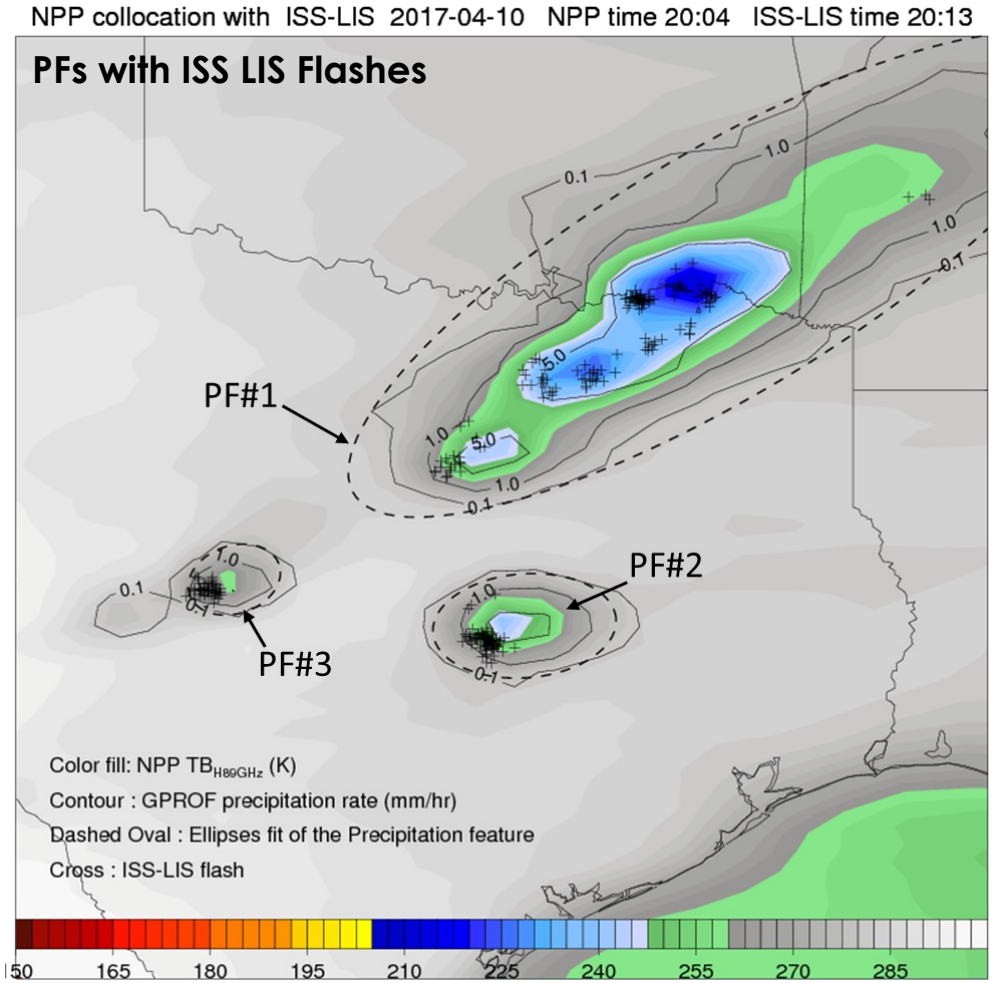
- The ISS hosts other Earth science instruments and many of these offer complementary science to LIS.
- Examples to the right include the STP-H8 radiometers covering 18-182 GHz (COWVR/TEMPEST; overlap during 2022-2023), Atmosphere-Space Interactions Monitor (ASIM; overlap 2018-2023), and Cloud-Aerosol Transport System LiDAR (CATS; overlap 2017).





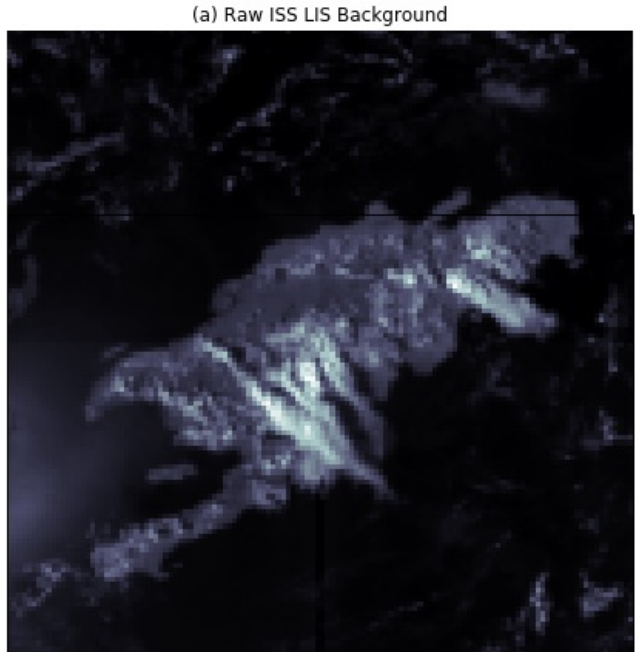
Precipitation Feature (PF) Databases

- Datasets from spaceborne radars and radiometers like the TRMM and Global Precipitation Measurement (GPM) missions are very large.
- Identifying PFs using physically reasonable criteria enables dataset simplification, and LIS flashes have been incorporated into these PFs so that microwave reflectivity, brightness temperature, etc. can be related to lightning.
- The NASA TRMM/GPM PF database is hosted by Texas A&M Corpus Christi.

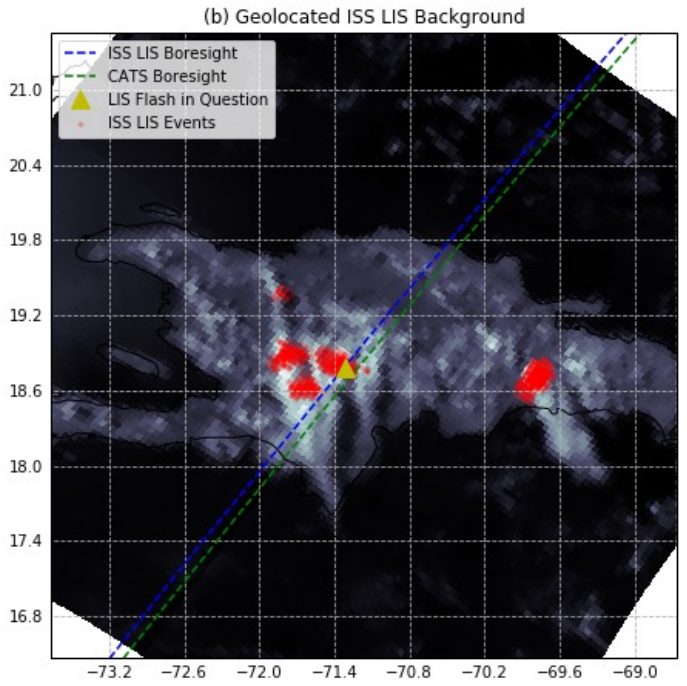


LIS Background Images

- Every 30-60 seconds, LIS sent back static background images of clouds and other features in the near infrared
- Like Channel 3 in GOES (Veggie/Near IR) but shorter wavelength (777 nm vs. 860 nm)
- Uncalibrated, and not as useful for nighttime scenes
- Search for LIS Backgrounds on NASA Earthdata
- ISS Camera Geolocate software can geolocate these images for ISS



Raw Image

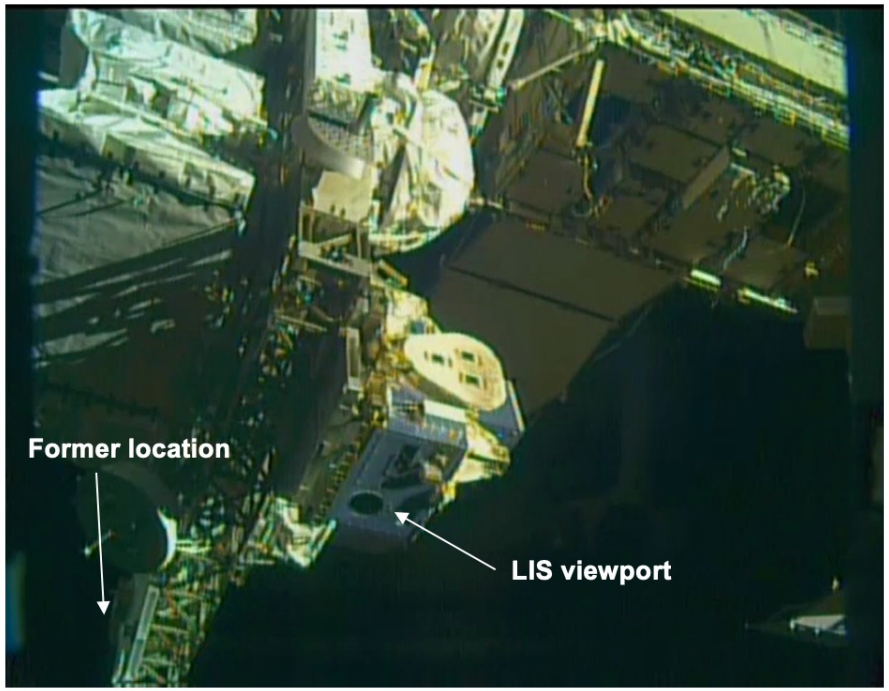


Geolocated Image

ISS LIS Relocation in July 2022

- Space on the ISS is precious! STP-H5 was once relocated on the ISS to accommodate a new instrument.
- This relocation bought ISS LIS another 14 months of operations. ISS LIS data/algorithms were modified to accommodate the new position and field of view.

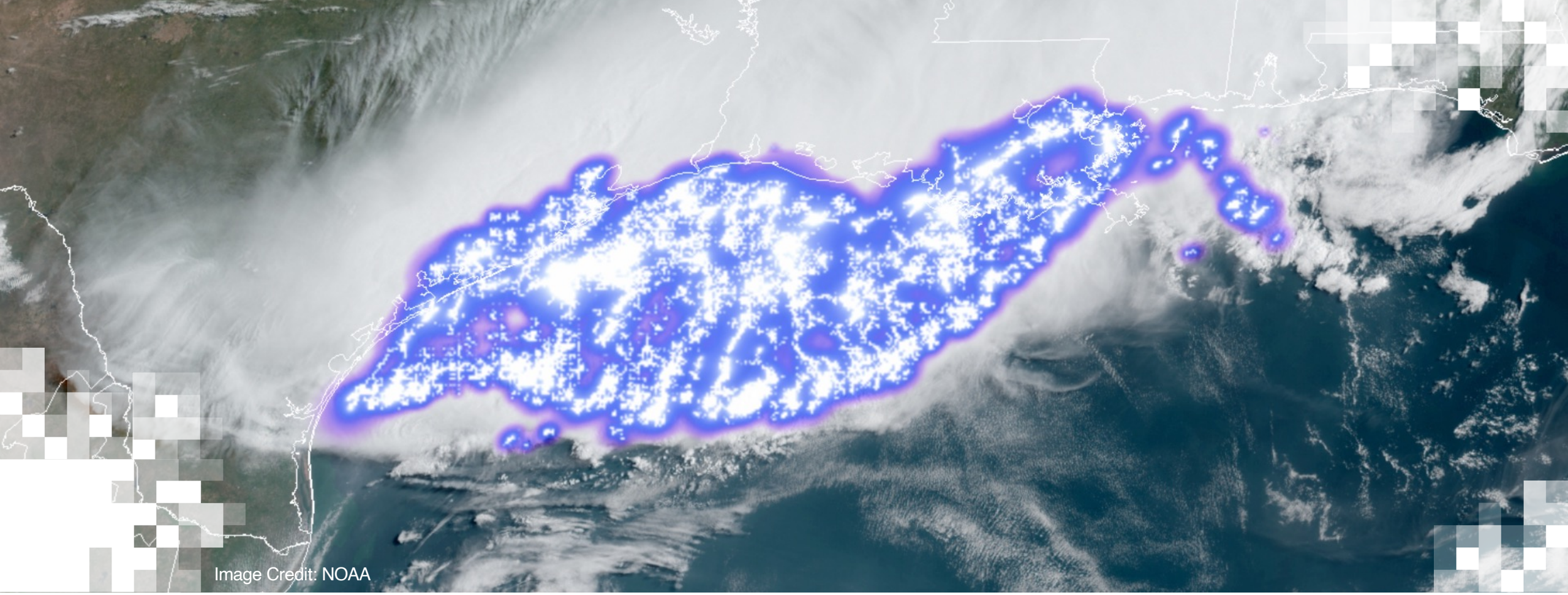
STP-H5/LIS on robotic arm during relocation



STP-H5/LIS in new site on ELC-1 (site 3)

Terrestrial Gamma-ray Flashes (TGFs)

- NASA Astrophysics instruments like the Gamma-ray Burst Monitor (GBM) on the Fermi satellite can detect short-lived (<1ms) high-energy radiation from thunderstorms, called TGFs.
- TGFs are likely caused by relativistic electron "avalanches" initiated by strong thunderstorm electric fields.
- TGFs powerful enough to be observed from space may only be a small fraction of all gamma-ray events produced by thunderstorms.

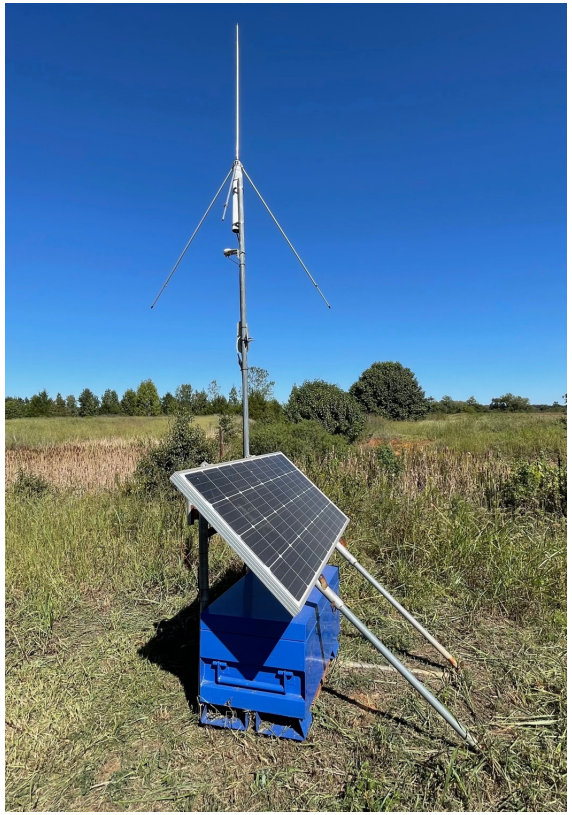


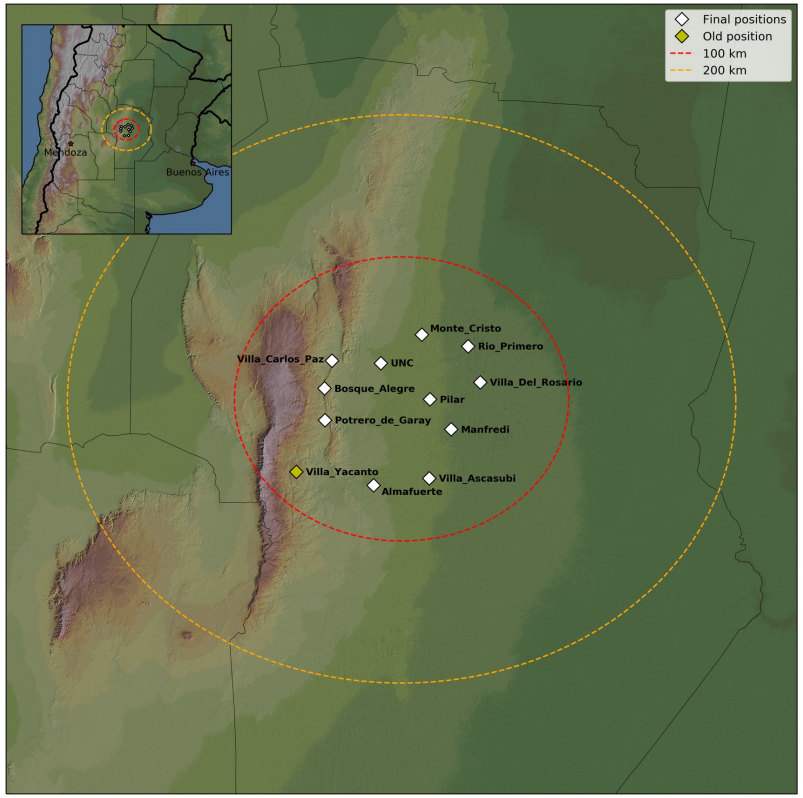
Section 2

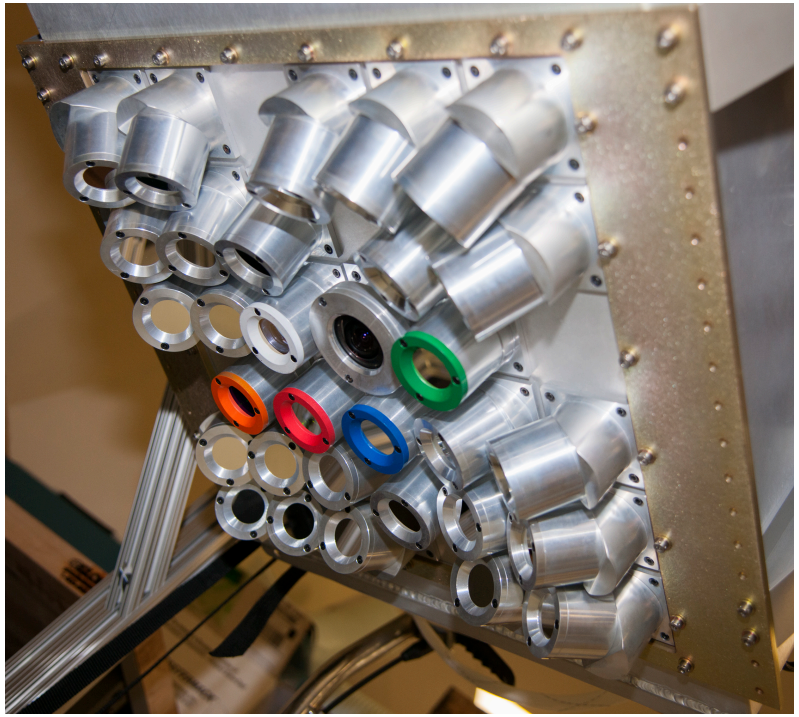
NASA Suborbital Lightning Measurements

What do we mean by Suborbital?

- Fixed Lightning Detection Networks
- Deployable Lightning Detection Networks
- Airborne Lightning Instruments

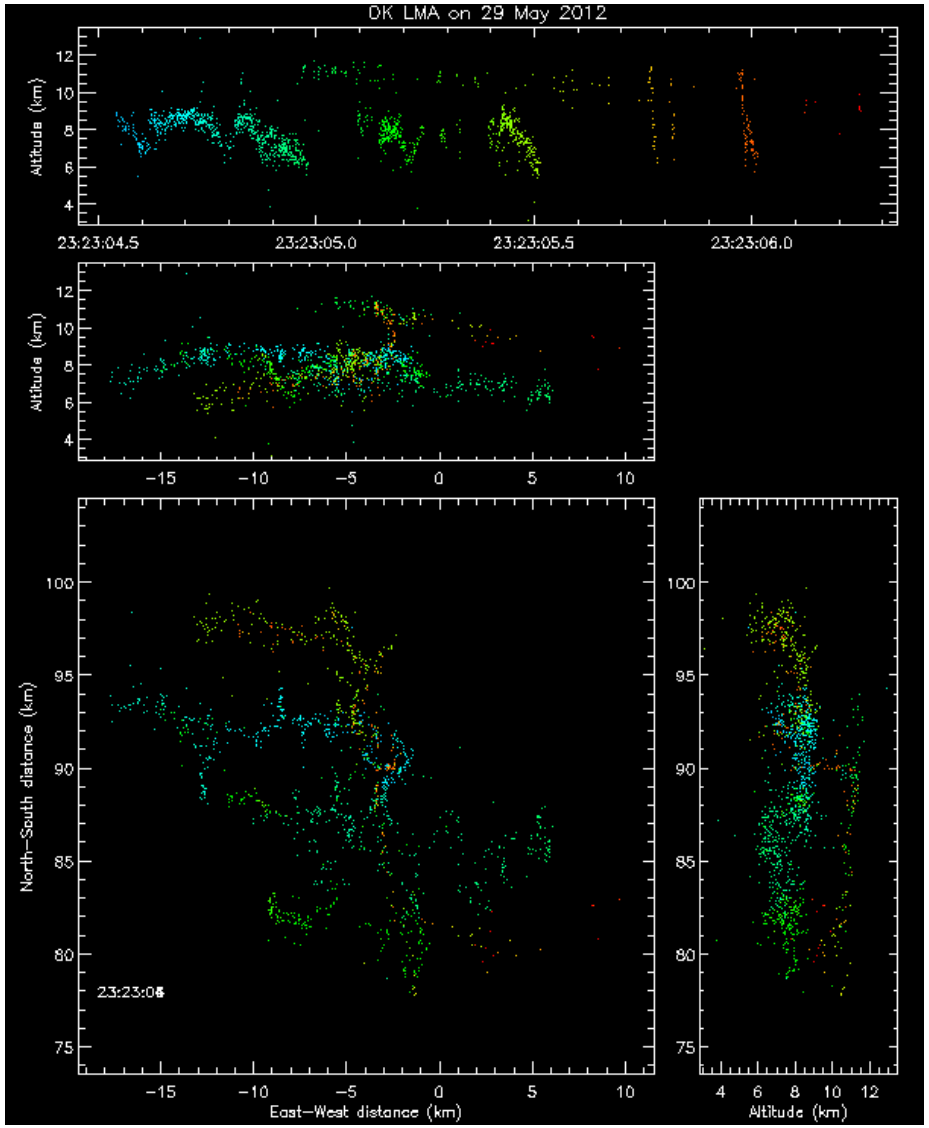






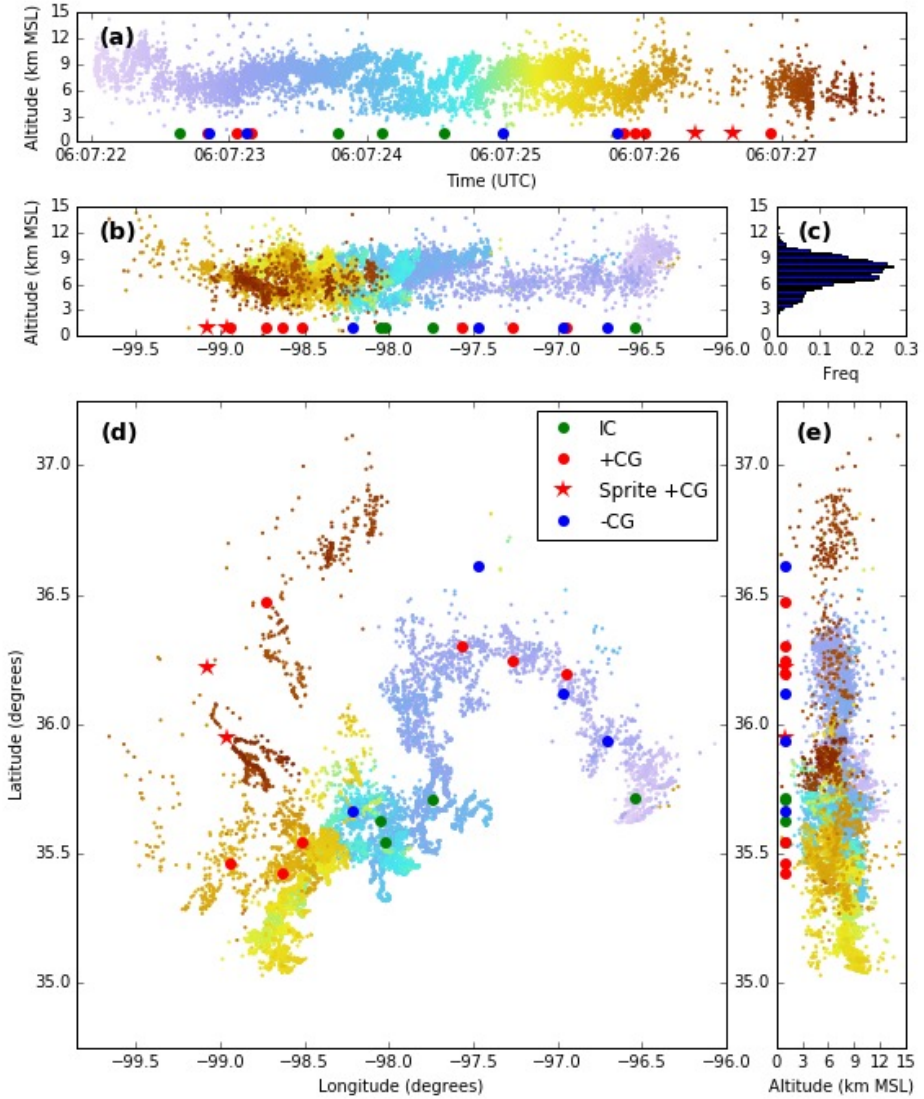
How Lightning Mapping Arrays (LMAs) Work

- Each **Lightning Mapping Array (LMA)** station has a **Very High Frequency (VHF)** antenna and receiver that measure the time of arrival of lightning signals with GPS accuracy.
- Stations are typically spaced ~10-20 km apart. The difference in the time of arrival of the same signal at different stations is then measured.
- With enough stations detecting a signal (theoretical minimum is 4, but 6+ stations is the practical standard), it can be located in 3D.



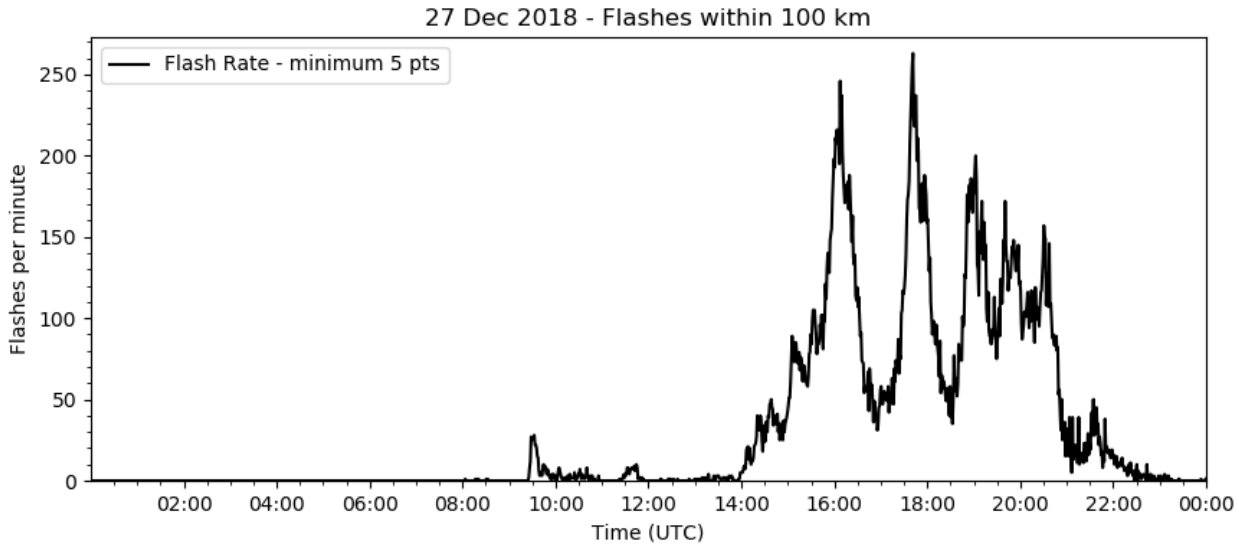
LMA Data – Level 1

- Consist of text files containing individual VHF source locations, times, and other important information.
- Contain info about the number of stations detecting a source, and the chi-squared goodness of fit statistic for that source location.
- Thresholding on these values can clean datasets at the expense of a reduced number of sources.



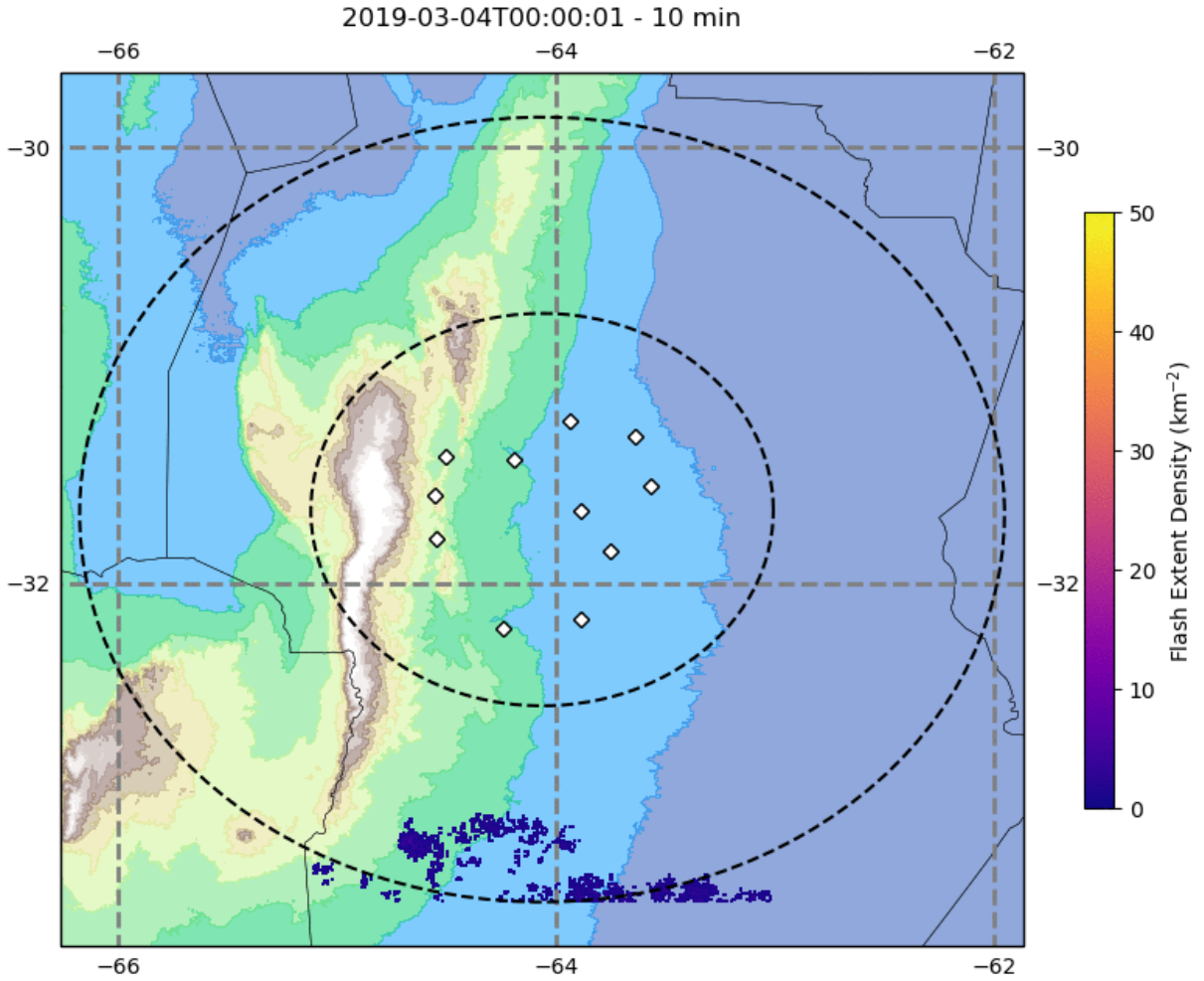
LMA Data – Level 2

- Level 2 LMA data consist of flashes identified by clustering sources that are spatiotemporally related.
- Spatiotemporal clustering algorithms are adjustable to suit scientific needs, but no more than 150 ms and 3 km between successive sources in a flash is a common threshold used in the literature.
- Flash algorithms also keep track of the total number of sources in a flash, and one can threshold on this.



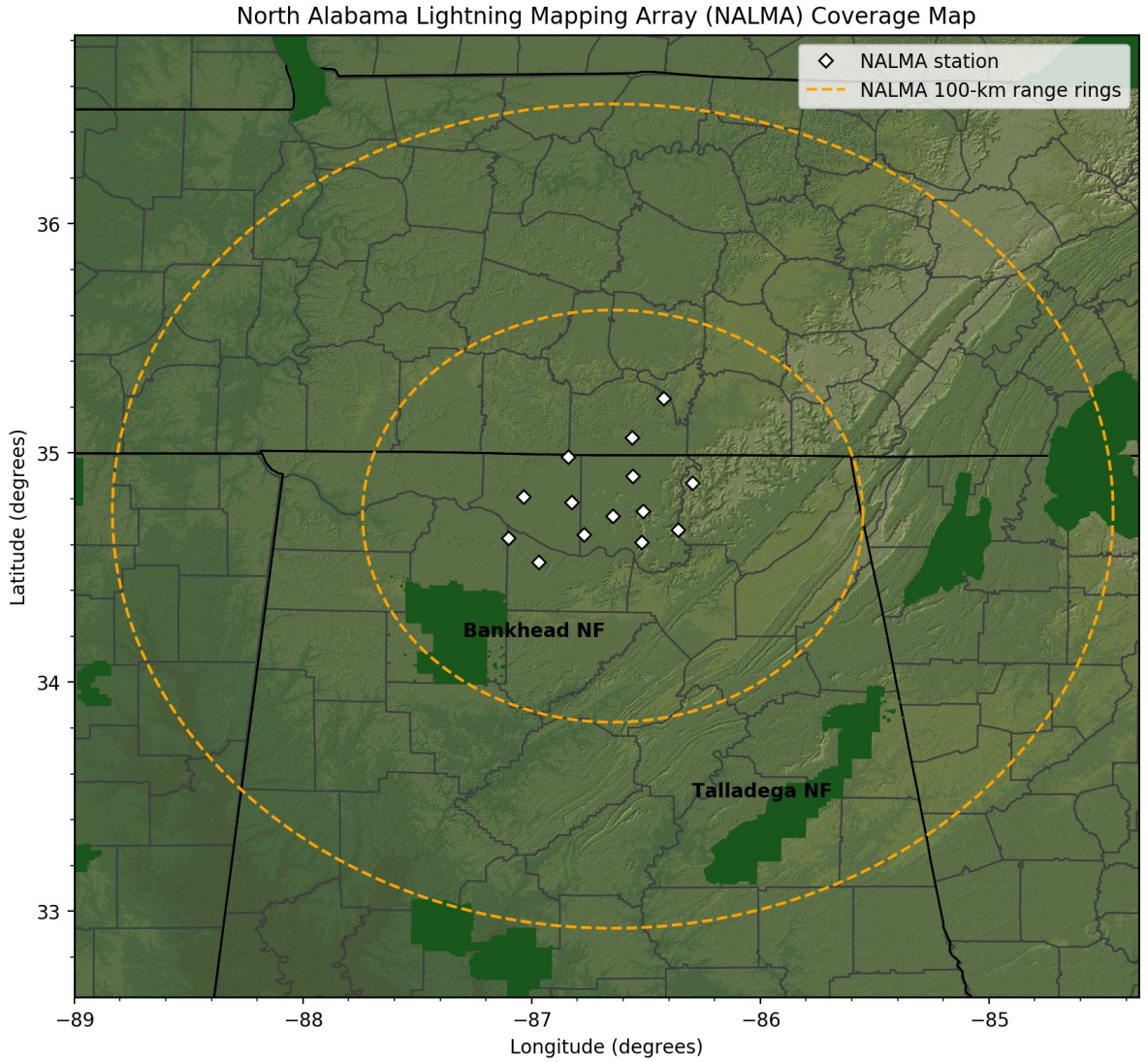
LMA Data – Level 3

- Level 3 LMA data products are gridded and commonly include information about **Flash Extent Density (FED)**.
- FED is the total number of flashes that passed through a given spatially defined grid point in a unit of time.
- FED algorithms connect sources within a flash in a physically meaningful way and are a useful way to account for detection efficiency limitations.



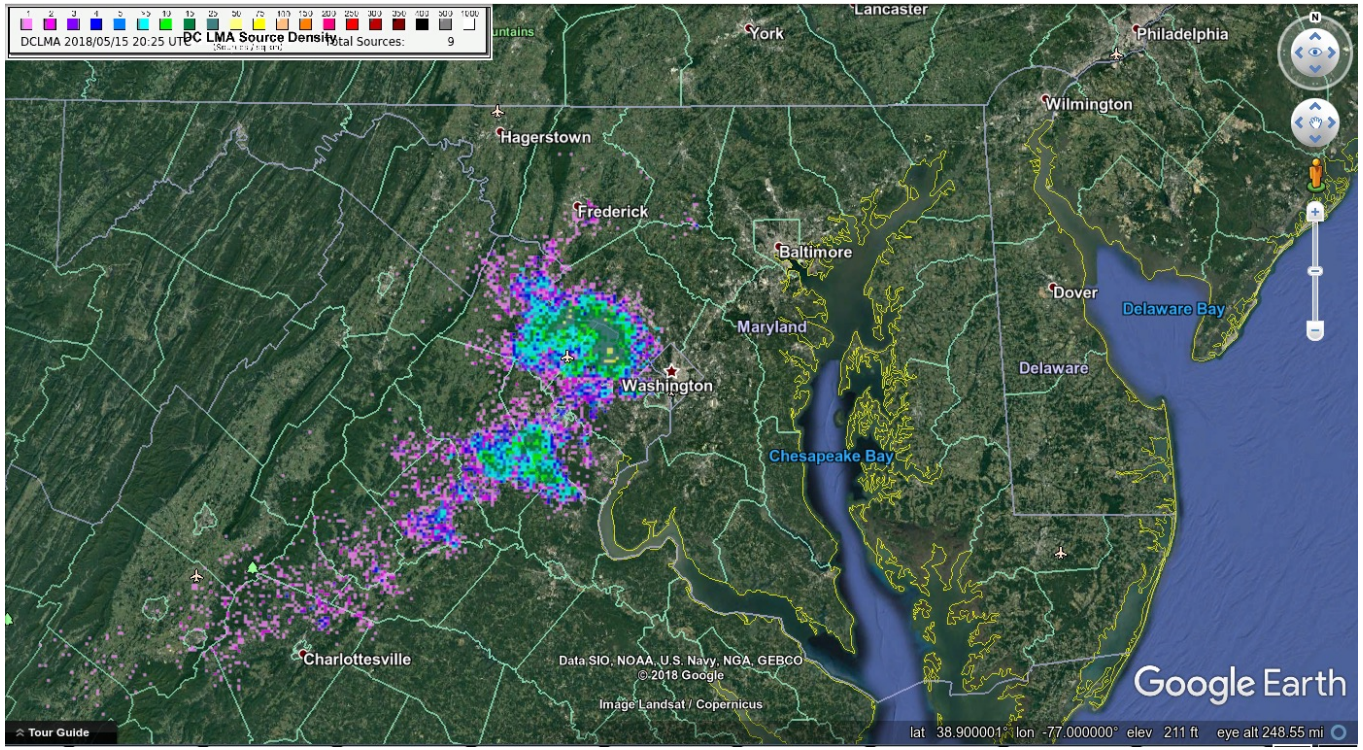
North Alabama Lightning Mapping Array (NALMA)

- Operational since early 2000s
- Used extensively to validate spaceborne lightning observations
- Near-real time imagery available on the web
- Full-rate data processed daily and provided by the GHRC



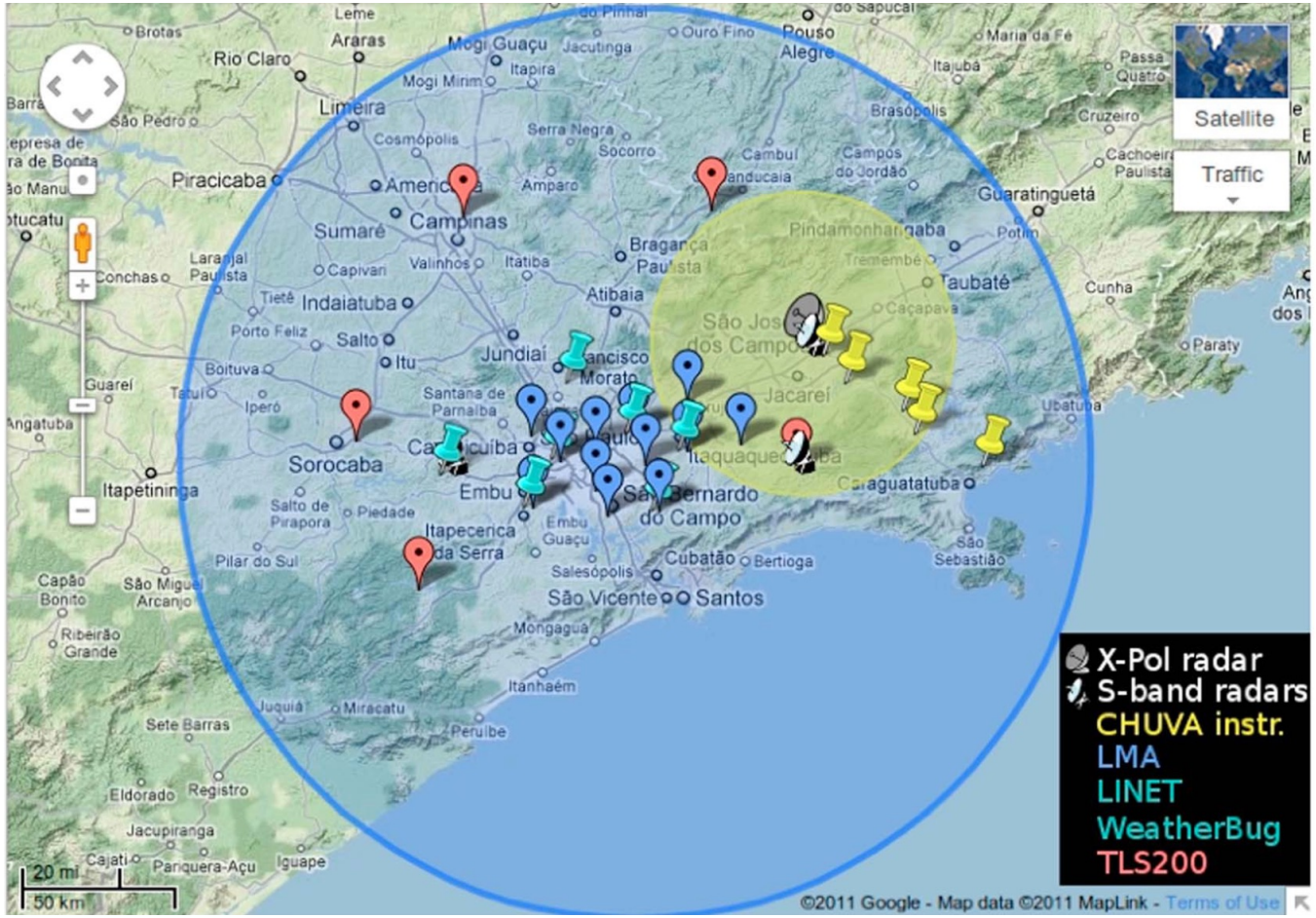
District of Columbia/Wallops Flight Facility LMAs

- Two different NASA-owned LMAs are centered near Washington, DC and the Wallops Flight Facility (WFF) on the Delmarva peninsula.
- These LMAs are usually processed separately, but NASA is working on processing them combined as the Mid-Atlantic LMA (MALMA).
- GHRC hosts data subsets from these and other LMA networks.



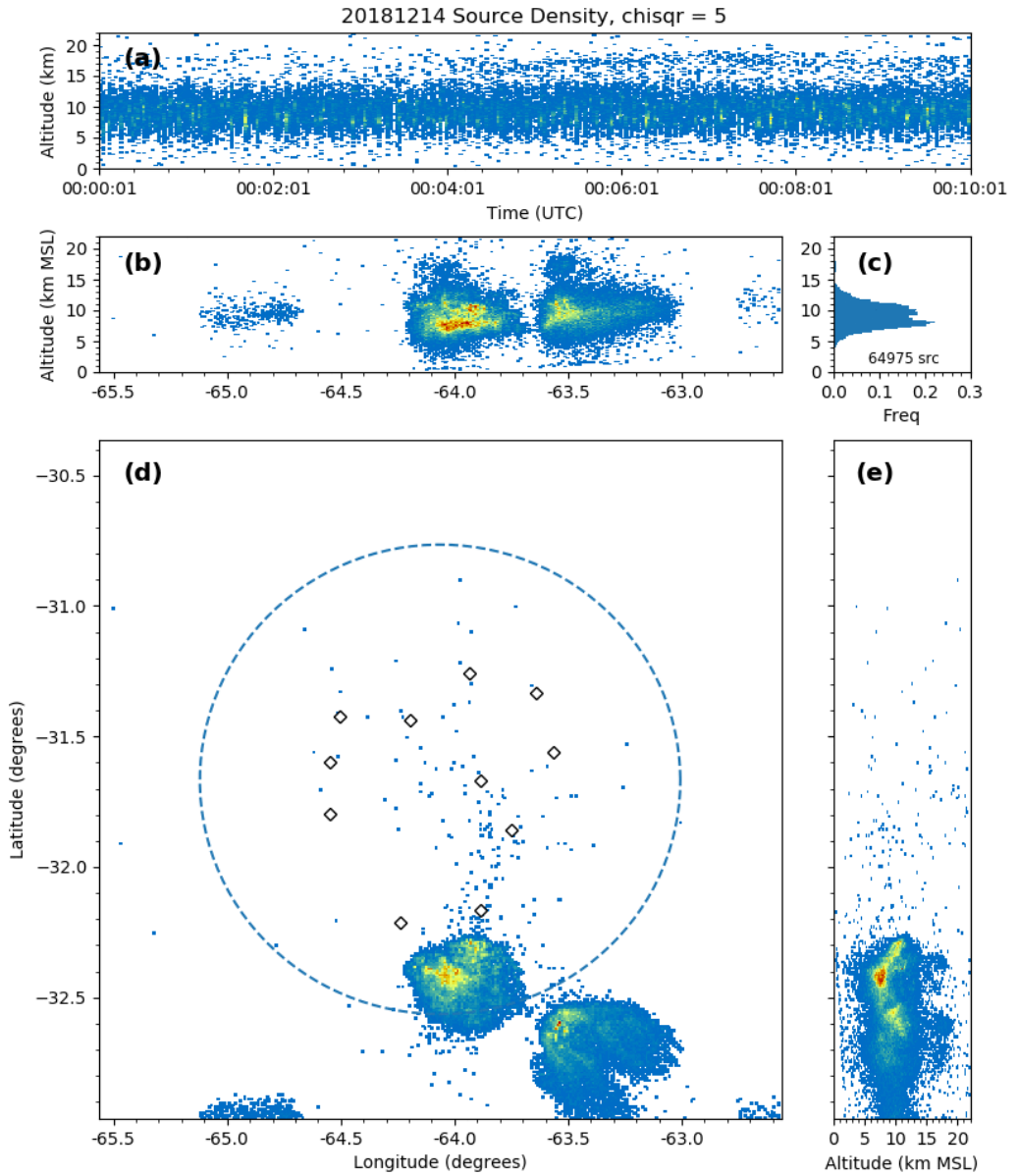
CHUVA LMA

- A 12-station NASA LMA was deployed to the Sao Paulo, Brazil region during October 2011-April 2012, in support of a field campaign called CHUVA.
- Also supported by weather radars and other ground-based lightning networks.
- Data hosted on the CHUVA Project Website.



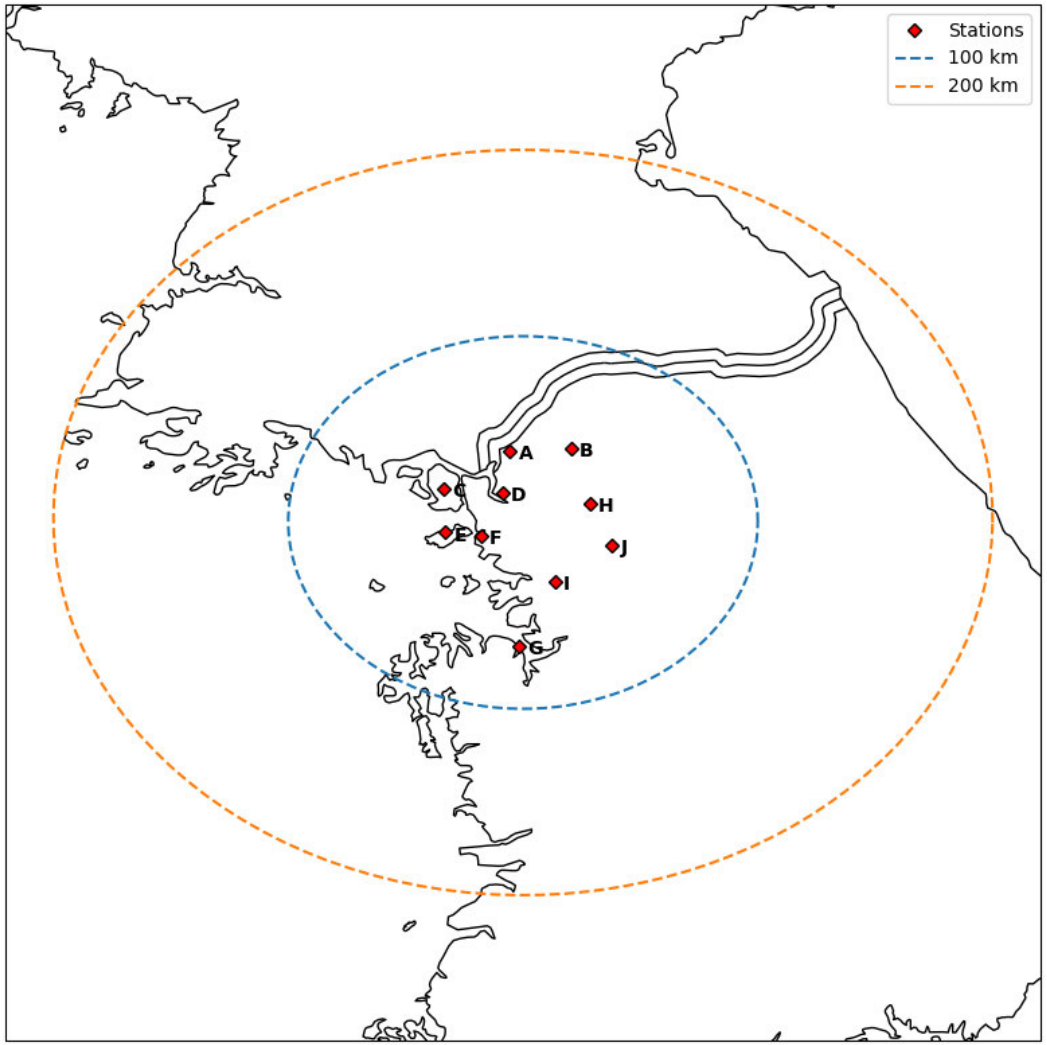
RELAMPAGO LMA

- An 11-station NASA LMA was deployed to the Cordoba Province in Argentina during November 2018-April 2019.
- This LMA supported Geostationary Lightning Mapper (GLM) validation and operated coincidentally with the RELAMPAGO/CACTI field campaigns, which studied intense convection near the Sierras de Cordoba range.
- Data hosted at the GHRC.



Korea LMA

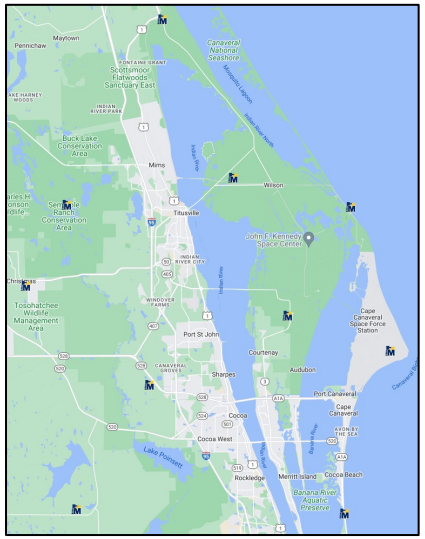
- A 10-station NASA LMA network was deployed to the Seoul area for a Korean-led campaign examining mesoscale convection.
- Deployment was May-October 2023, covering the monsoon season.
- Data available by request to timothy.j.lang@nasa.gov and will be posted to the GHRC later this year.



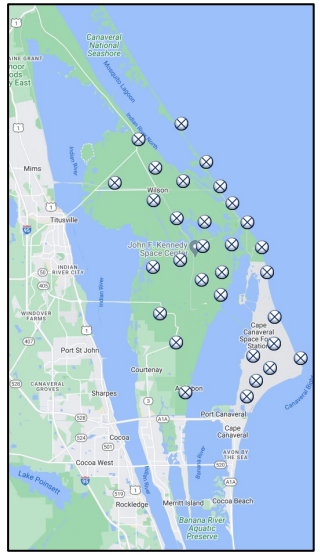
Kennedy Space Center Lightning Measurements

- Local Lightning Detection Network
  - **Mesoscale Eastern Range Lightning Information Network (MERLIN)** includes ten Total Lightning Sensor (TLS)-200 sensors that detect and locate both cloud-to-ground and intracloud lightning
- Surface Electric Field Mill Network
  - **Launch Pad Lightning Warning System (LPLWS)** is a large-area network of 31 electrostatic field sensors that measures vertical component of electrostatic field
- Data archived and publicly accessible on KSC Weather Data Archive
- Additional information can also be found in Instrumentation, Data Format, and Network Document

MERLIN Sensors



LPLWS Sensors

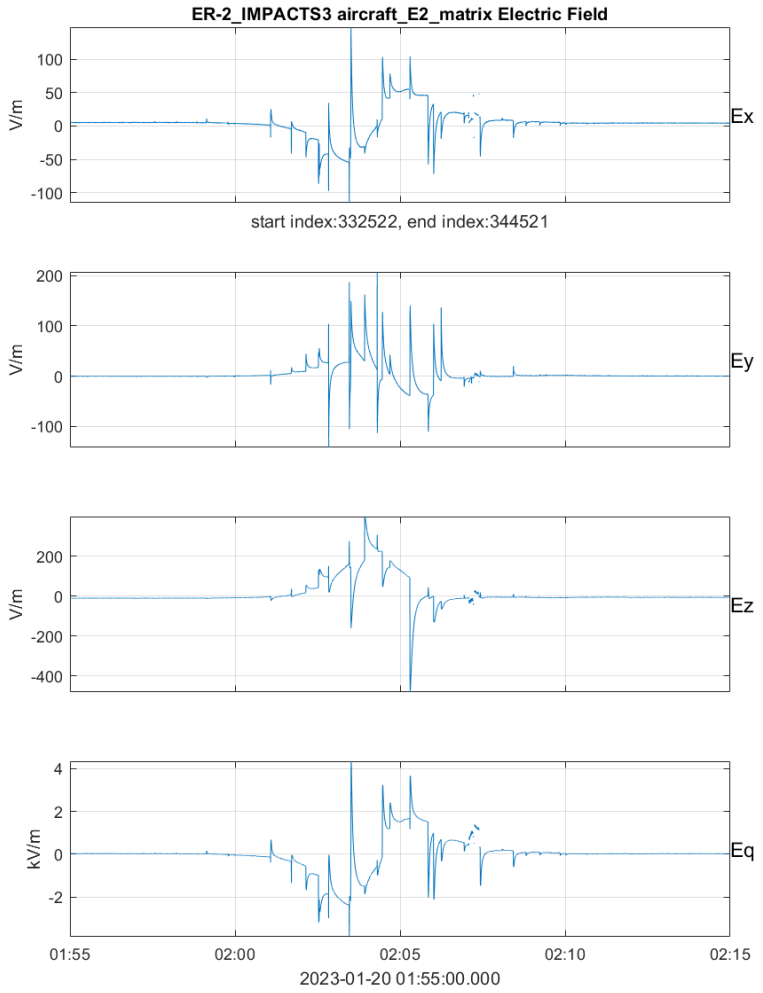


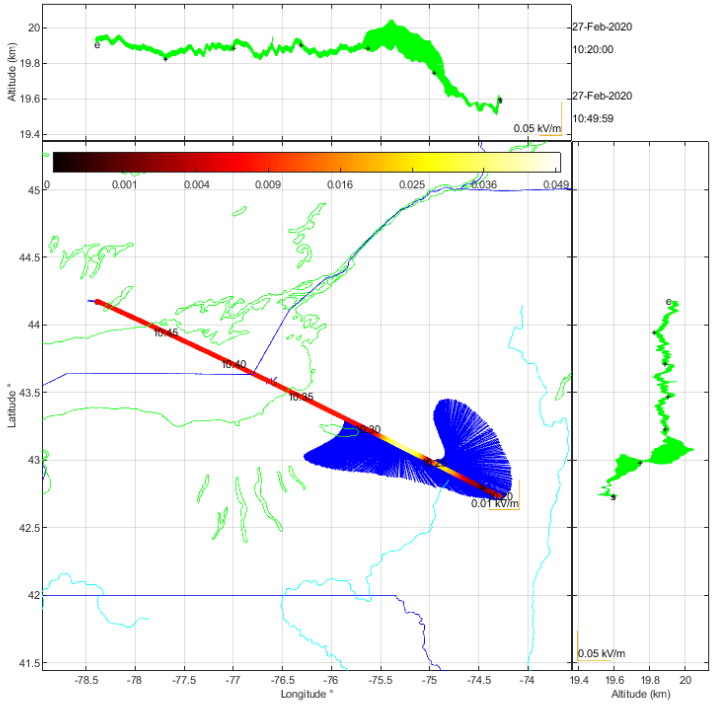
Lightning Instrument Package (LIP)

- Instrumentation:
  - Electric Field Mills (7)
  - Conductivity probe (optional)
- Measurements:
  - Vector Components of the Electric Field (E_x , E_y , E_z)
  - Aircraft Charge
  - Lightning Statistics (Identified from Electric Field Changes)
  - Storm Electric Currents (Derived Result)
  - Storm Charge Structure (Derived Result)
- Measurement Range/Accuracy:
  - Electric Field: Few V/m to tens of kV/m (~10%)
- LIP Data on NASA Earthdata

LIP Observations of Electric Charge and Thunderstorms

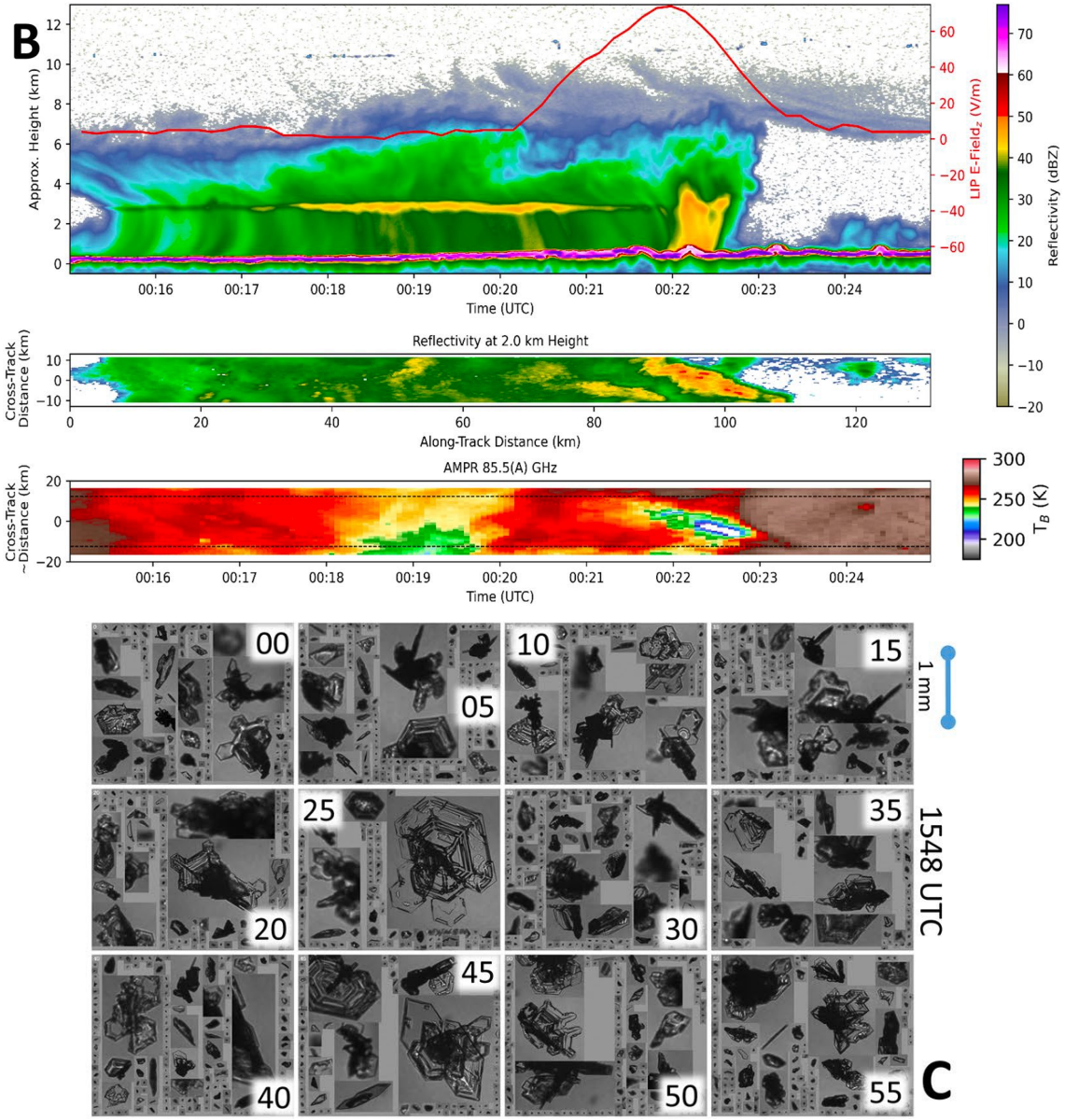
- Overpasses of thunderstorms show enhancements in electric field (DC), plus field changes due to lightning (AC)
- Electric field points away from positive charge
- Charge on aircraft itself also needs to be considered





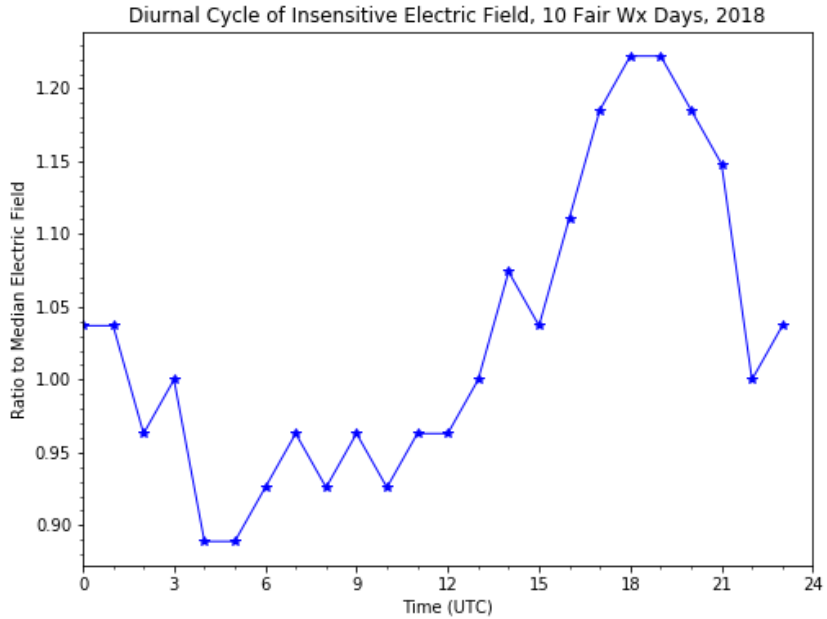
LIP Utility in Non-Thunderstorms

- LIP is useful even when flying over non-thunderstorms, as enhanced electric fields indicate the presence of charging and thus provide information about storm microphysics.
- Statistics from LIP overflights show the importance of electrified shower clouds (ESC; not thunderstorms) to the global electric circuit.
- Wilson currents for ESCs are ~30% of thunderstorms.



LIP on a Ship

- LIP field mills are designed for aircraft; however, in 2018 they were mounted on a research ship during an ocean-focused field campaign in the West Pacific (PISTON).
- A rough estimate of ship electric field enhancement factor was performed using a nearby ground plane when in port.
- Able to measure Carnegie curve for fair weather field.

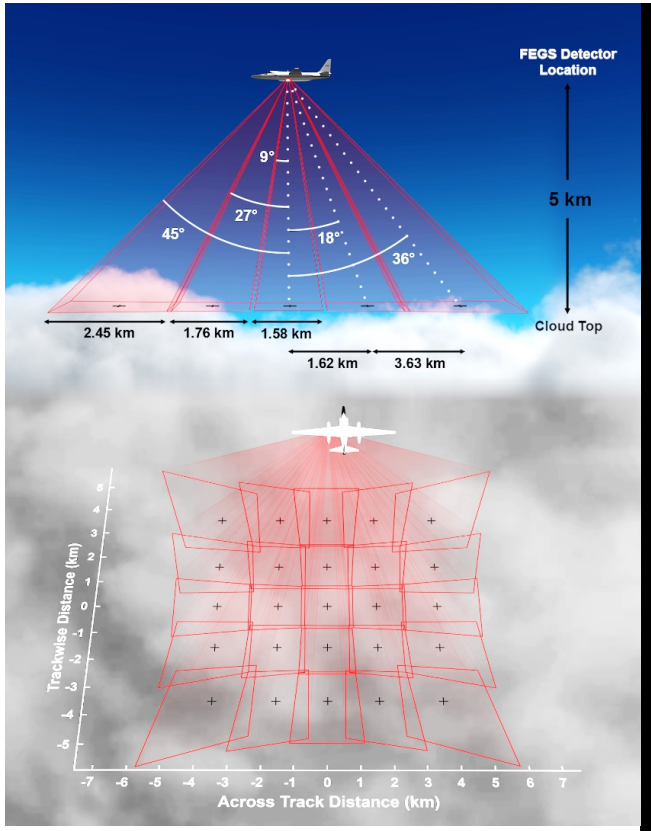


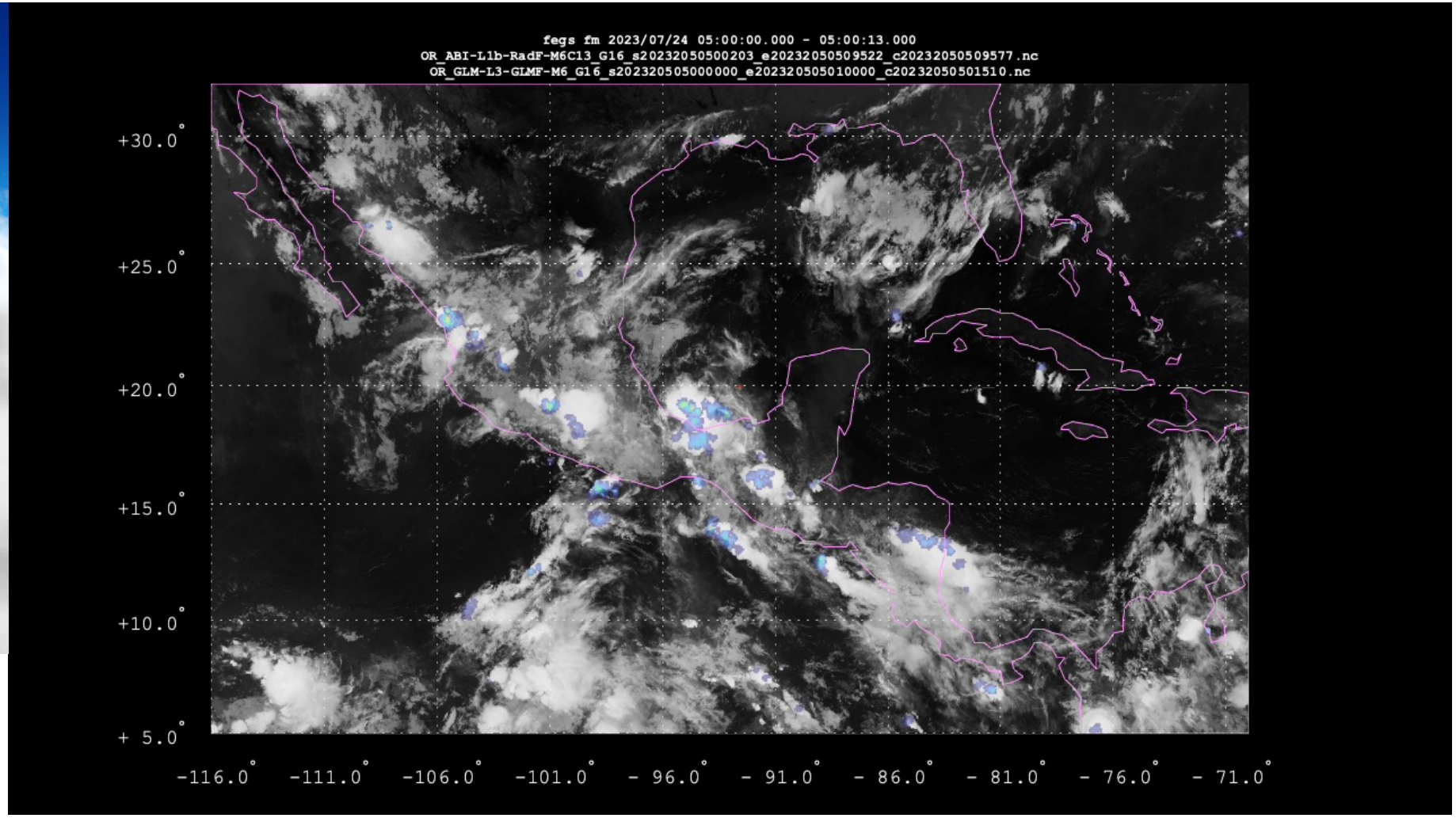
Fly's Eye GLM Simulator (FEGS)

- Array of 30 photometers
  - 25 tuned for 777 nm
  - 5 tuned for other wavelengths
- 777-nm photometers arranged to cover a 10x10 km^2 area, with each photometer viewing a 2x2 km^2 pixel
- Also has featured high-definition camera and a spectrometer
- Built to help validate GLM, flew in GOES-R Post-Launch Test (2017) and ALOFT (2023)

FEGS

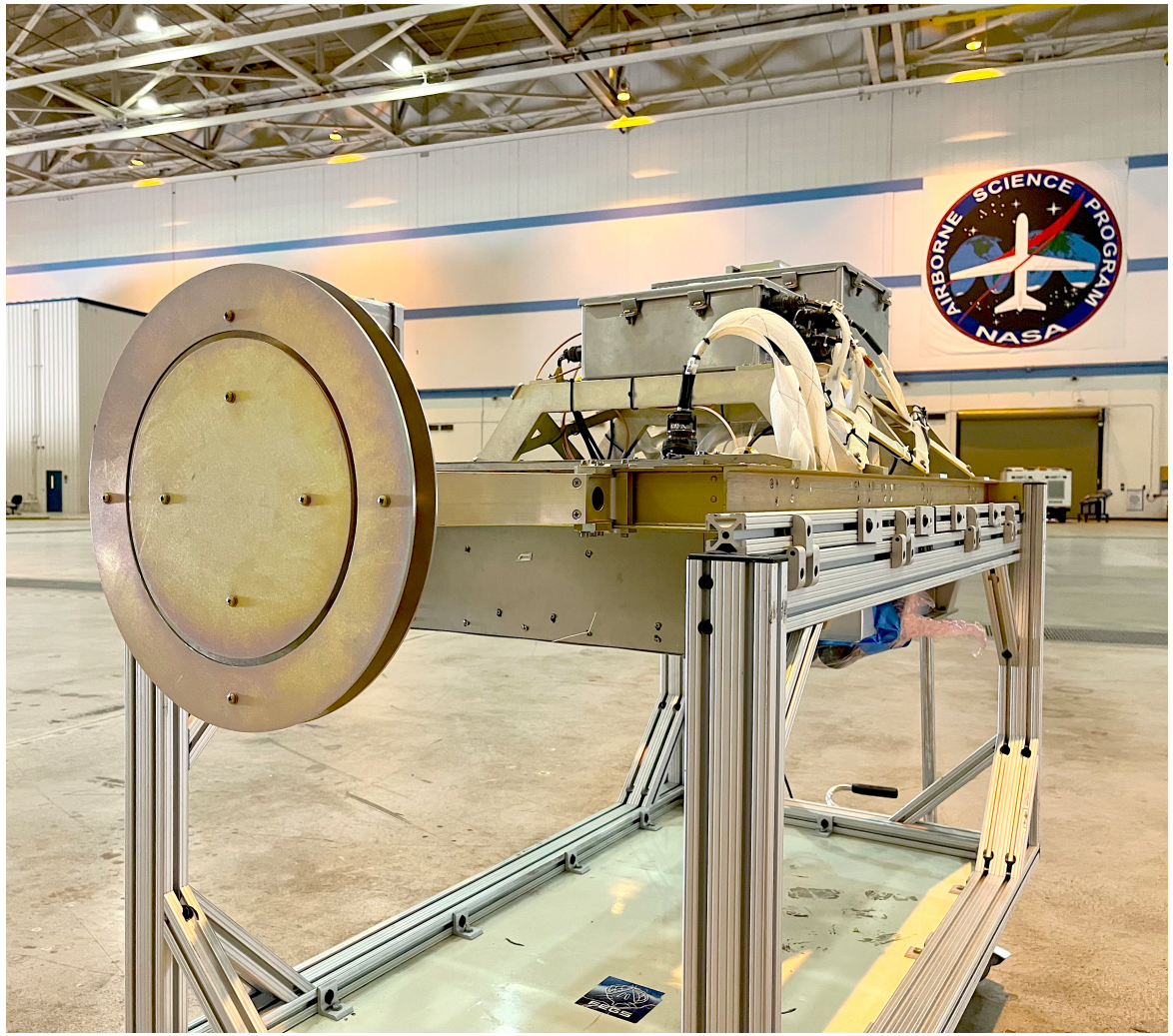
FEGS over a Storm





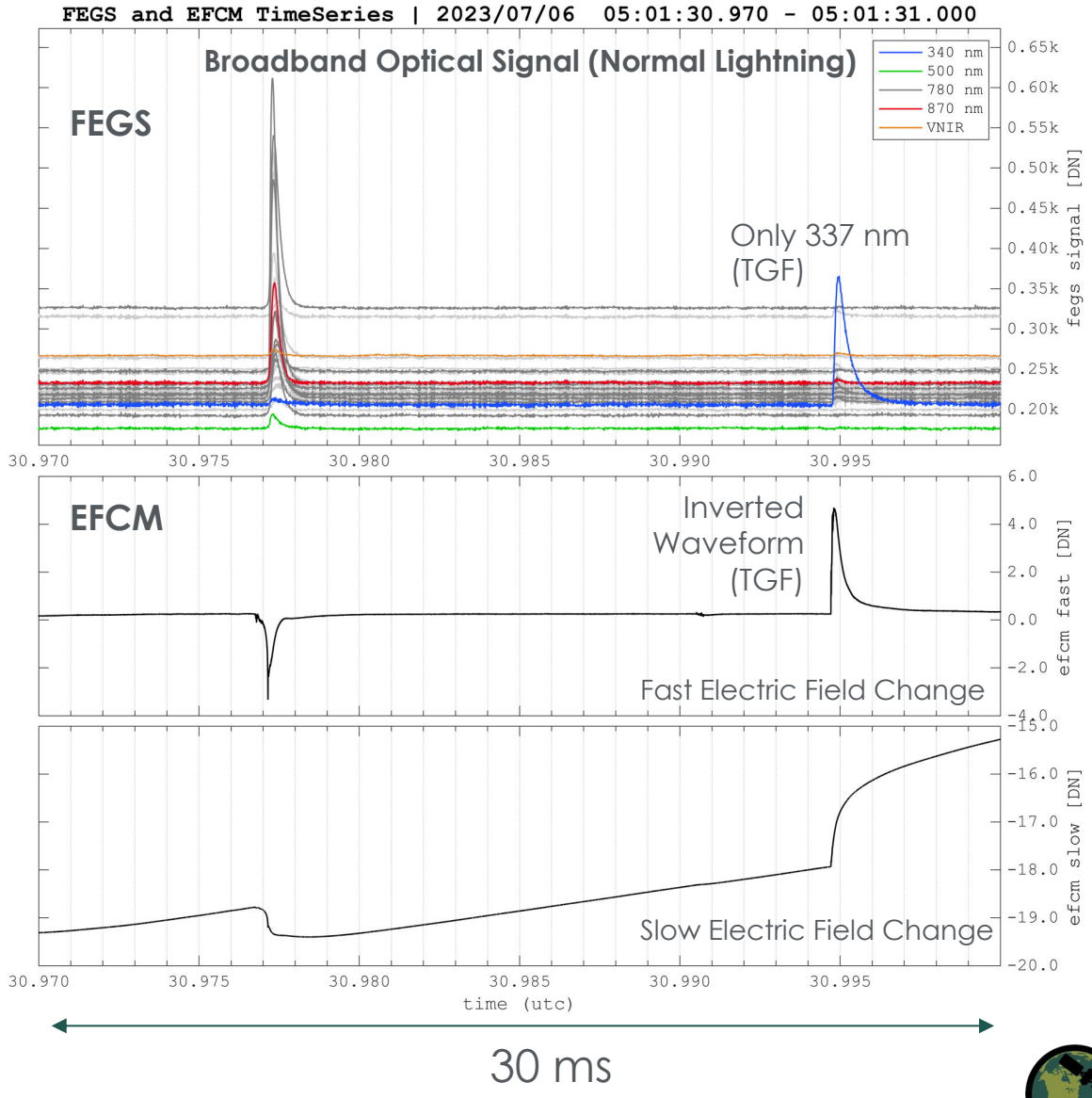
Electric Field Change Meter (EFCM)

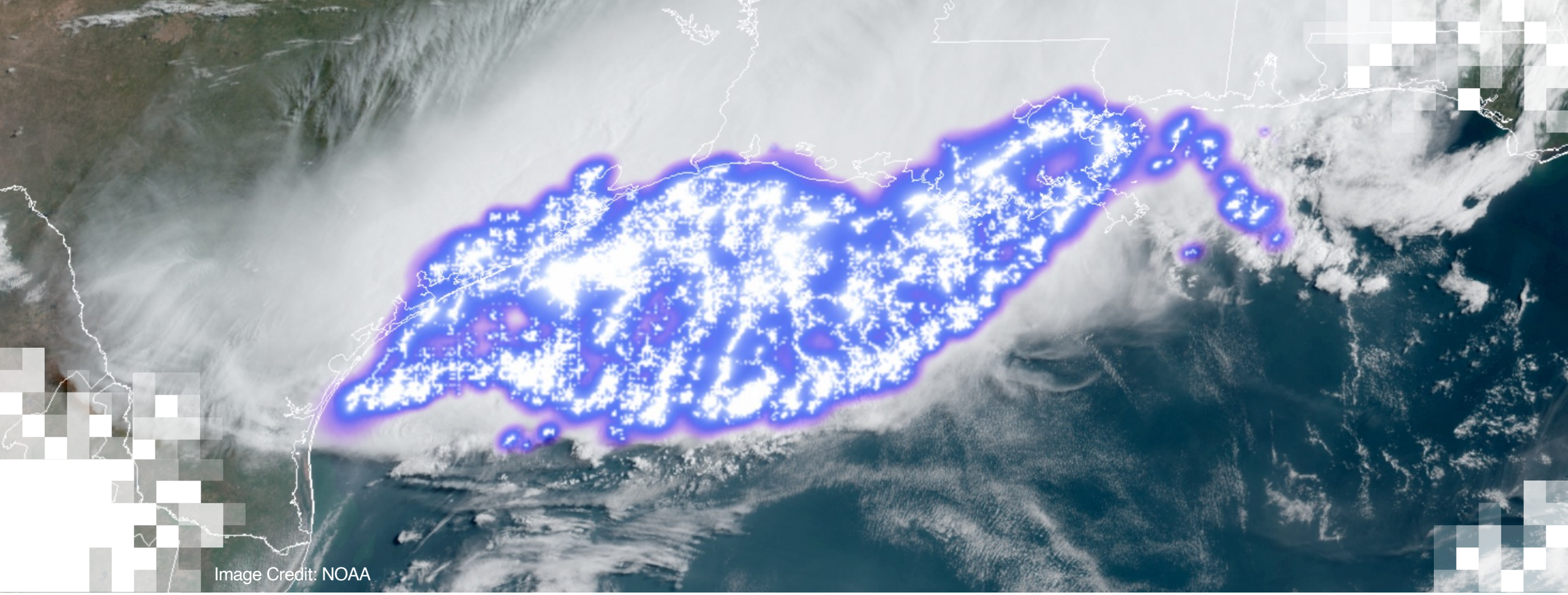
- Flat plate antenna (also known as a Marx meter) detects electrostatic field changes due to lightning
- Has fast channel and slow channel (controlled by different resistor-capacitor decay constants)
- Mounts on same rack as FEGS and flies along, sharing same data system
- Also flew in GOES-R PLT (2017) and ALOFT (2023)



FEGS + EFCM View of Lightning

- Lightning normally appears as short-lived pulses in optical and EFCM channels.
- FEGS/EFCM data can count these pulses (e.g., counting lightnings) or resolve individual waveforms at 100 kHz for more detailed analysis.
- Not all lightning is created equal! Lightning pulses associated with TGFs can have very different optical and radio-frequency (RF) characteristics compared to more typical lightning.



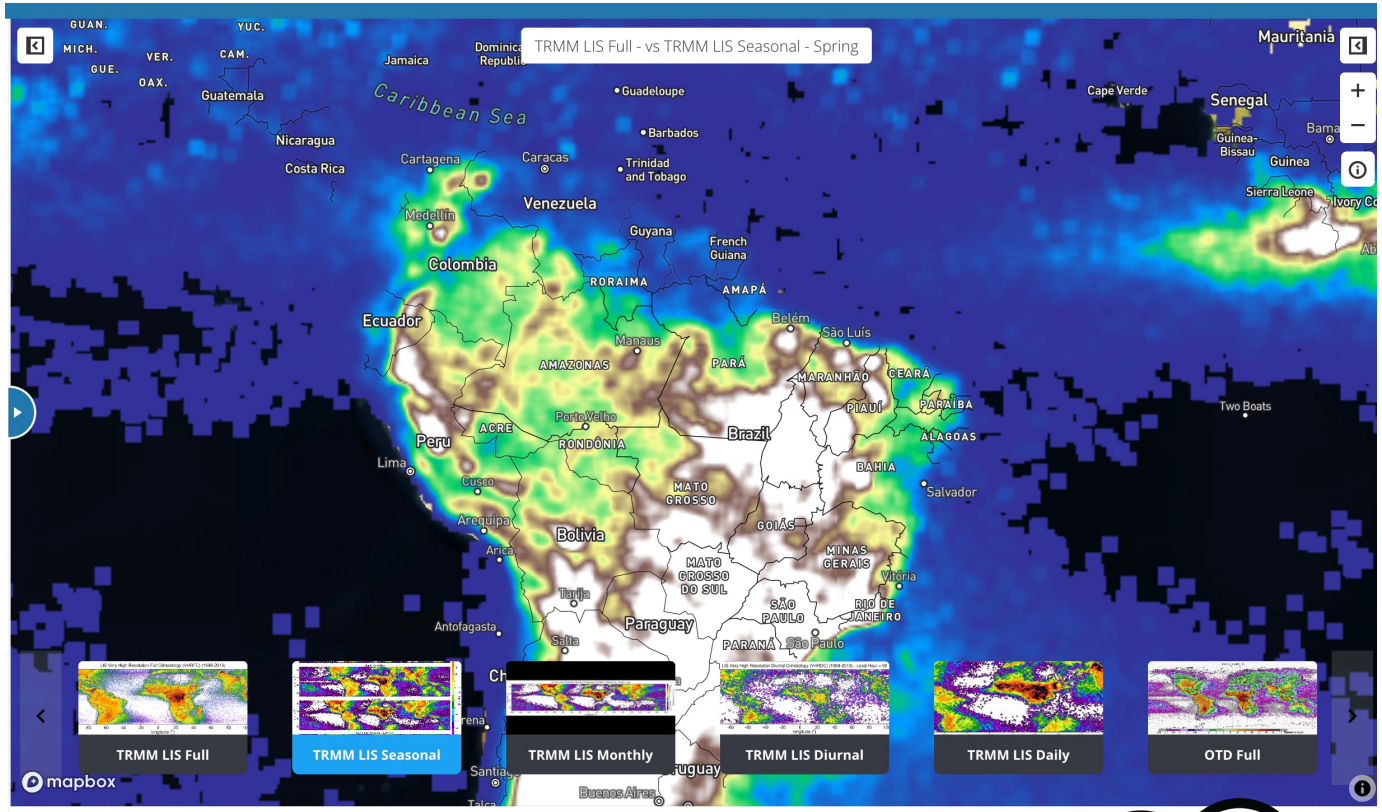


Section 3

Obtaining NASA Lightning Datasets

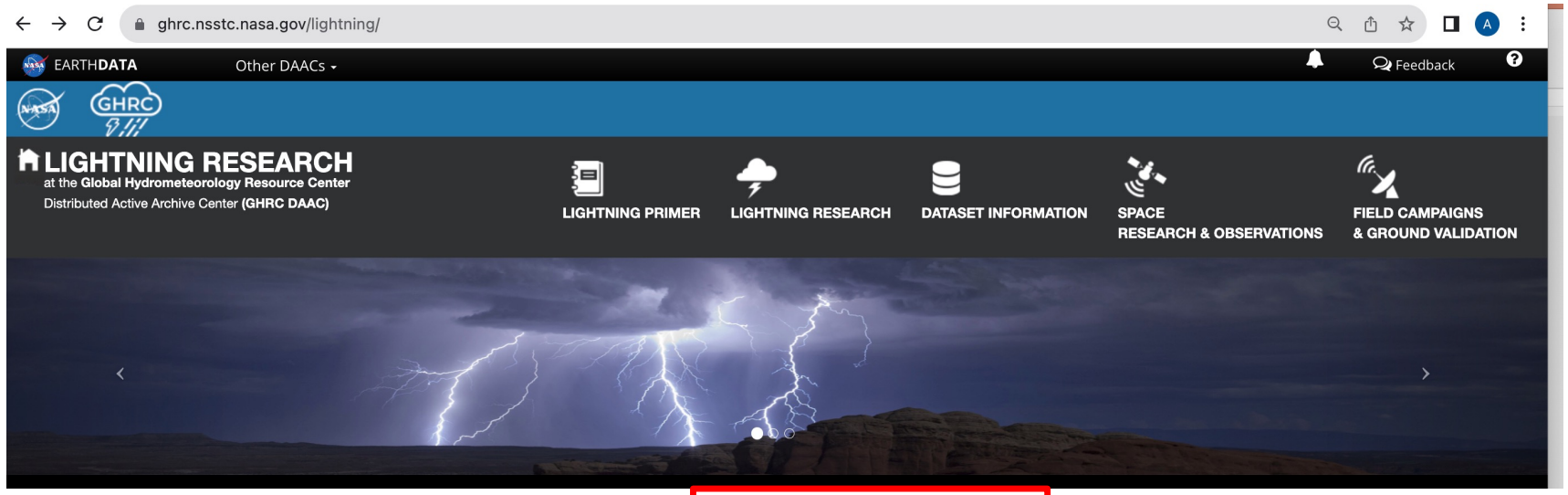
Global Hydrometeorology Resource Center (GHRC)

- GHRC is the NASA Distributed Active Archive Center (DAAC) for nearly all NASA lightning data.
- Curates and maintains both orbital and suborbital lightning datasets.
- Also maintains a lightning visualization dashboard and other data exploration tools.



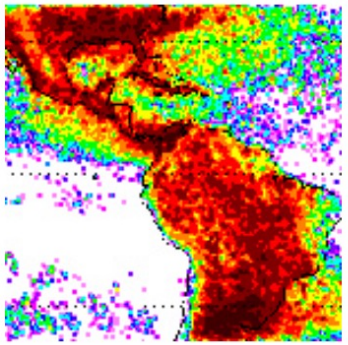
Lightning Data Search and Download

GHRC NASA Distributed Active Archive Center - Lightning



Lightning Primer

Lightning Research



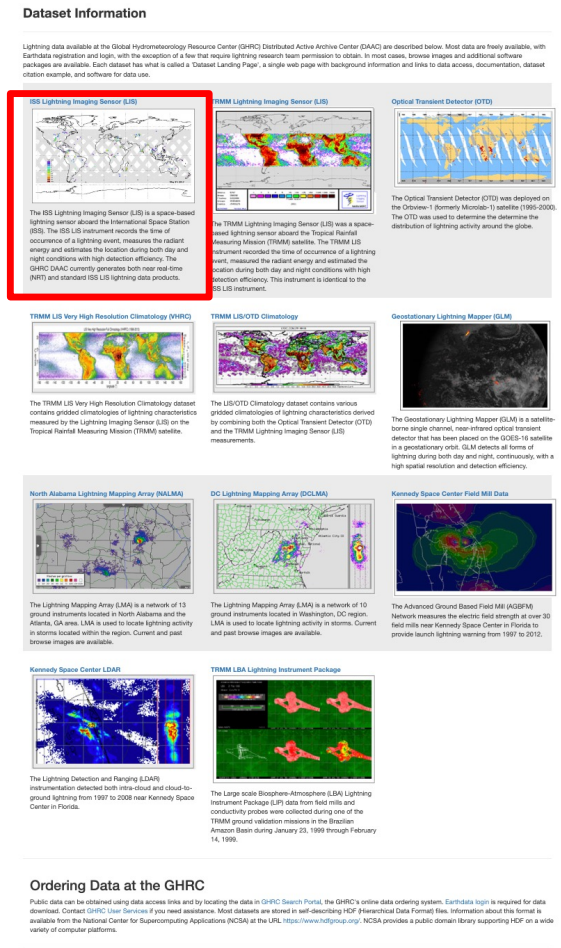
Dataset Information

Space Search & Observation

Field Campaigns & Ground Validation

ISS – LIS Lightning Data Search

Lightning Data Information



Dataset Information

Lightning data available at the Global Hydrometeorology Resource Center (GHRC) Distributed Active Archive Center (DAAC) are described below. Most data are freely available, with Earthdata registration and login, with the exception of a few that require lightning research team permission to obtain. In most cases, browse images and additional software packages are available. Each dataset has what is called a 'Dataset Landing Page', a single web page with background information and links to data access, documentation, dataset citation example, and software for data use.

ISS Lightning Imaging Sensor (LIS)

The ISS Lightning Imaging Sensor (LIS) is a space-based lightning sensor aboard the International Space Station (ISS). The ISS LIS instrument records the time of occurrence of a lightning event, measures the radiant energy and estimates the location during both day and night conditions with high detection efficiency. The GHRC DAAC currently generates both near real-time (NRT) and standard ISS LIS lightning data products.

TRMM Lightning Imaging Sensor (LIS)

The TRMM Lightning Imaging Sensor (LIS) was a space-based lightning sensor aboard the Tropical Rainfall Measuring Mission (TRMM) satellite. The TRMM LIS instrument recorded the time of occurrence of a lightning event, measured the radiant energy and estimated the location during both day and night conditions with high detection efficiency. This instrument is identical to the ISS LIS instrument.

Optical Transient Detector (OTD)

The Optical Transient Detector (OTD) was deployed on the Orbview-1 (formerly Microlab-1) satellite (1995-2000). The OTD was used to determine the determine the distribution of lightning activity around the globe.

TRMM LIS Very High Resolution Climatology (VHRC)

The TRMM LIS Very High Resolution Climatology dataset contains gridded climatologies of lightning characteristics measured by the Lightning Imaging Sensor (LIS) on the Tropical Rainfall Measuring Mission (TRMM) satellite.

TRMM LIS/OTD Climatology

The LIS/OTD Climatology dataset contains various gridded climatologies of lightning characteristics derived by combining both the Optical Transient Detector (OTD) and the TRMM Lightning Imaging Sensor (LIS) measurements.

Geostationary Lightning Mapper (GLM)

The Geostationary Lightning Mapper (GLM) is a satellite-borne single channel, near-infrared optical transient detector that has been placed on the GOES-16 satellite in a geostationary orbit. GLM detects all forms of lightning during both day and night, continuously, with a high spatial resolution and detection efficiency.

North Alabama Lightning Mapping Array (NALMA)

The Lightning Mapping Array (LMA) is a network of 13 ground instruments located in North Alabama and the Atlanta, GA area. LMA is used to locate lightning activity in storms located within the region. Current and past browse images are available.

DC Lightning Mapping Array (DCLMA)

The Lightning Mapping Array (LMA) is a network of 10 ground instruments located in Washington, DC region. LMA is used to locate lightning activity in storms. Current and past browse images are available.

Kennedy Space Center Field Mill Data

The Advanced Ground Based Field Mill (AGBFM) Network measures the electric field strength at over 30 field mills near Kennedy Space Center in Florida to provide launch lightning warning from 1997 to 2012.

Kennedy Space Center LDAR

The Lightning Detection and Ranging (LDAR) instrumentation detected both intra-cloud and cloud-to-ground lightning from 1997 to 2008 near Kennedy Space Center in Florida.

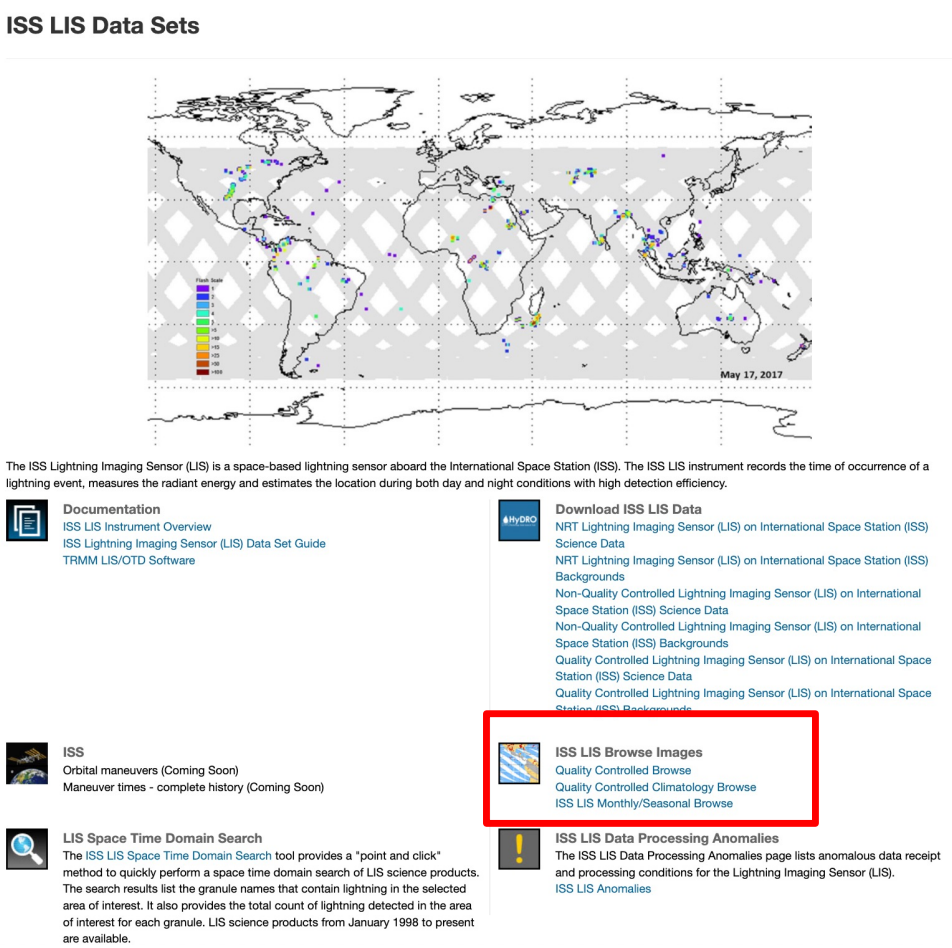
TRMM LBA Lightning Instrument Package

The Large scale Biosphere-Atmosphere (LBA) Lightning Instrument Package (LIP) data from field mills and conductivity probes were collected during one of the TRMM ground validation missions in the Brazilian Amazon Basin during January 23, 1999 through February 14, 1999.

Ordering Data at the GHRC

Public data can be obtained using data access links and by locating the data in GHRC Search Portal, the GHRC's online data ordering system. Earthdata login is required for data download. Contact GHRC User Services if you need assistance. Most datasets are stored in self-describing HDF (Hierarchical Data Format) files. Information about this format is available from the National Center for Supercomputing Applications (NCSA) at the URL https://www.hdfgroup.org/. NCSA provides a public domain library supporting HDF on a wide variety of computer platforms.

ISS – LIS Data



ISS LIS Data Sets

The ISS Lightning Imaging Sensor (LIS) is a space-based lightning sensor aboard the International Space Station (ISS). The ISS LIS instrument records the time of occurrence of a lightning event, measures the radiant energy and estimates the location during both day and night conditions with high detection efficiency.

Documentation
ISS LIS Instrument Overview
ISS Lightning Imaging Sensor (LIS) Data Set Guide
TRMM LIS/OTD Software

Download ISS LIS Data
NRT Lightning Imaging Sensor (LIS) on International Space Station (ISS) Science Data
NRT Lightning Imaging Sensor (LIS) on International Space Station (ISS) Backgrounds
Non-Quality Controlled Lightning Imaging Sensor (LIS) on International Space Station (ISS) Science Data
Non-Quality Controlled Lightning Imaging Sensor (LIS) on International Space Station (ISS) Backgrounds
Quality Controlled Lightning Imaging Sensor (LIS) on International Space Station (ISS) Science Data
Quality Controlled Lightning Imaging Sensor (LIS) on International Space Station (ISS) Backgrounds

ISS
Orbital maneuvers (Coming Soon)
Maneuver times - complete history (Coming Soon)

ISS LIS Browse Images
Quality Controlled Browse
Quality Controlled Climatology Browse
ISS LIS Monthly/Seasonal Browse

LIS Space Time Domain Search
The ISS LIS Space Time Domain Search tool provides a "point and click" method to quickly perform a space time domain search of LIS science products. The search results list the granule names that contain lightning in the selected area of interest. It also provides the total count of lightning detected in the area of interest for each granule. LIS science products from January 1998 to present are available.

ISS LIS Data Processing Anomalies
The ISS LIS Data Processing Anomalies page lists anomalous data receipt and processing conditions for the Lightning Imaging Sensor (LIS).
ISS LIS Anomalies

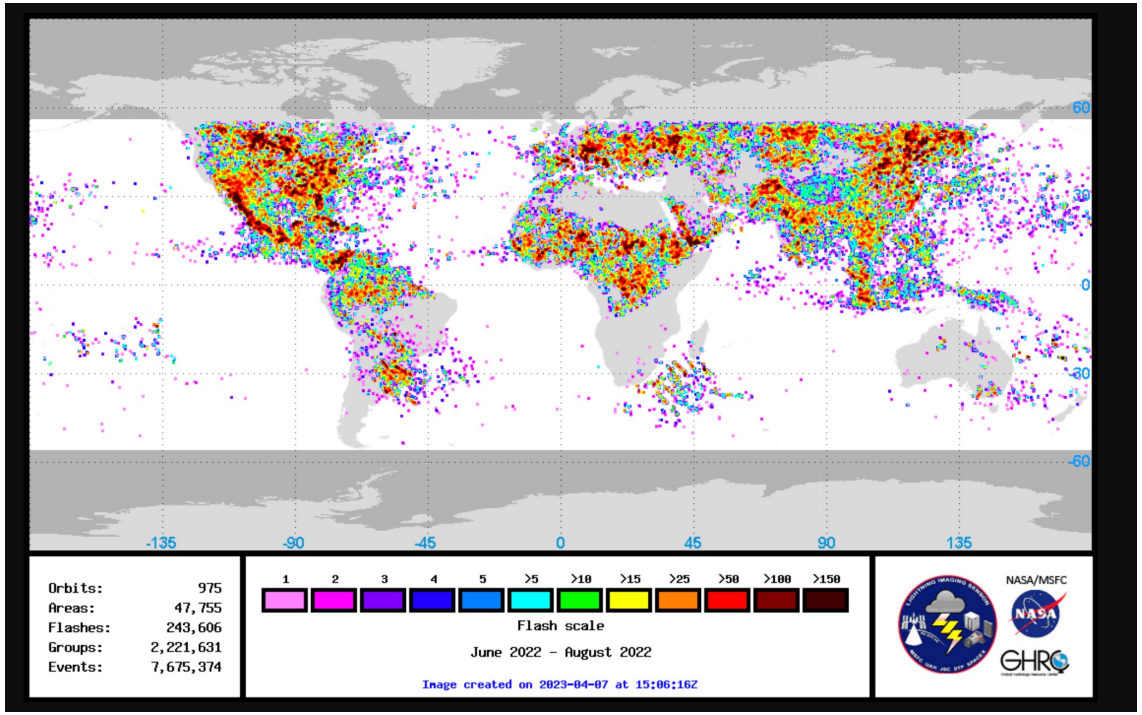
ISS – Monthly and Seasonal Lightning Image Browser

ISS LIS Global Lightning Distributions

Important Note: The ISS LIS version 1 summary images are created using Quality Controlled (QC) data when available, otherwise Non-Quality Controlled (NQC) data (October 2020 to current) are used. Also, note that the images have not been corrected for viewtime.

Annual			
2017	2018	2019	2020
2021	2022		

Seasonal			
2017	**2018**	**2019**	**2020**
Winter Spring Summer Fall	Winter Spring Summer Fall	Winter Spring Summer Fall	Winter Spring Summer Fall
2021	**2022**	**2023**	
Winter Spring Summer Fall	Winter Spring Summer Fall	Winter	
Legend			
Winter: December - February **Spring:** March - May		**Summer:** June - August **Fall:** September - November	



Summer 2022

ISS – LIS Lightning Data Download

Download ISS LIS Data

NRT Lightning Imaging Sensor (LIS) on International Space Station (ISS) Science Data

NRT Lightning Imaging Sensor (LIS) on International Space Station (ISS) Backgrounds

Non-Quality Controlled Lightning Imaging Sensor (LIS) on International Space Station (ISS) Science Data

Non-Quality Controlled Lightning Imaging Sensor (LIS) on International Space Station (ISS) Backgrounds

Quality Controlled Lightning Imaging Sensor (LIS) on International Space Station (ISS) Science Data

Quality Controlled Lightning Imaging Sensor (LIS) on International Space Station (ISS) Backgrounds

Data Download

EARTHDATA CMR Search

DOCUMENTATION DIRECTORY STAC WIKI CLIENT PARTNER'S GUIDE

Short Name: isslis_v2_fin

Quality Controlled Lightning Imaging Sensor (LIS) on International Space Station (ISS) Science Data V2

C2303212754-GHRC_DAAC Version 2

The Quality Controlled Lightning Imaging Sensor (LIS) on International Space Station (ISS) Science Data dataset was collected by the LIS instrument mounted on the ISS and are used to detect the distribution and variability of total lightning occurring in the Earth's tropical and subtropical regions. This dataset consists of quality controlled science data. This data collection can be used for severe storm detection and analysis, as well as for lightning-atmosphere interaction studies. The LIS instrument makes measurements during both day and night with high detection efficiency. The data are available in both HDF-4 and netCDF-4 formats, with corresponding browse images in GIF format.

Metadata Download Options

ATOM DIF 10 ECHO 10 ISO 19115 (MENDS) ISO 19115 (SMAP)

Overview

Download Data

Variables 0

Services 0

Tools 0

Citation Information

Documentation

Additional Information

Related Collections 0

Overview

Platforms
ISS

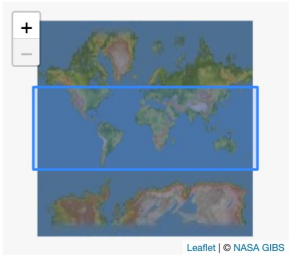
Instruments
LIS

Data Formats
Distribution: netCDF-4 - HDF4

Temporal Extent
2017-03-01 ongoing

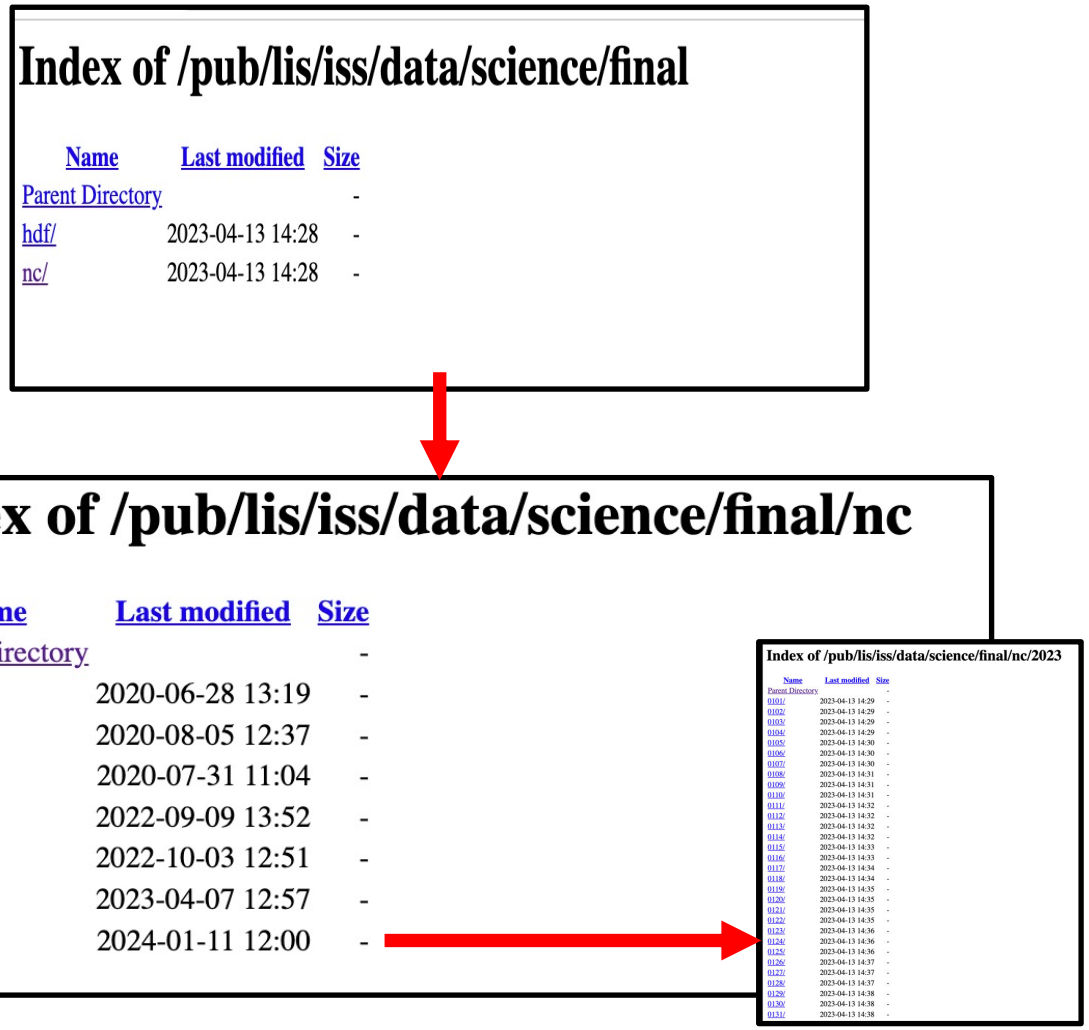
Data Centers
NASA/MSFC/GHRC

Spatial Extent
Bounding Box: (55.0°, 180.0°), (-55.0°, -180.0°)



ISS – LIS Lightning Data Selection and Download

Select Data Format and Time (Day)



Index of /pub/lis/iss/data/science/final

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Parent Directory		-
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nc/	2023-04-13 14:28	-

Index of /pub/lis/iss/data/science/final/nc

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2020/	2022-09-09 13:52	-
2021/	2022-10-03 12:51	-
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2023/	2024-01-11 12:00	-

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0108/	2023-04-13 14:31	-
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Example: Data Files for 27 August 2023

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ISS_LIS_SC_V2.2_20230827_082144_FIN.nc	2023-09-07 14:34	3.2M
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ISS_LIS_SC_V2.2_20230827_143306_FIN.nc	2023-09-07 14:34	2.7M
ISS_LIS_SC_V2.2_20230827_160556_FIN.nc	2023-09-07 14:34	3.4M
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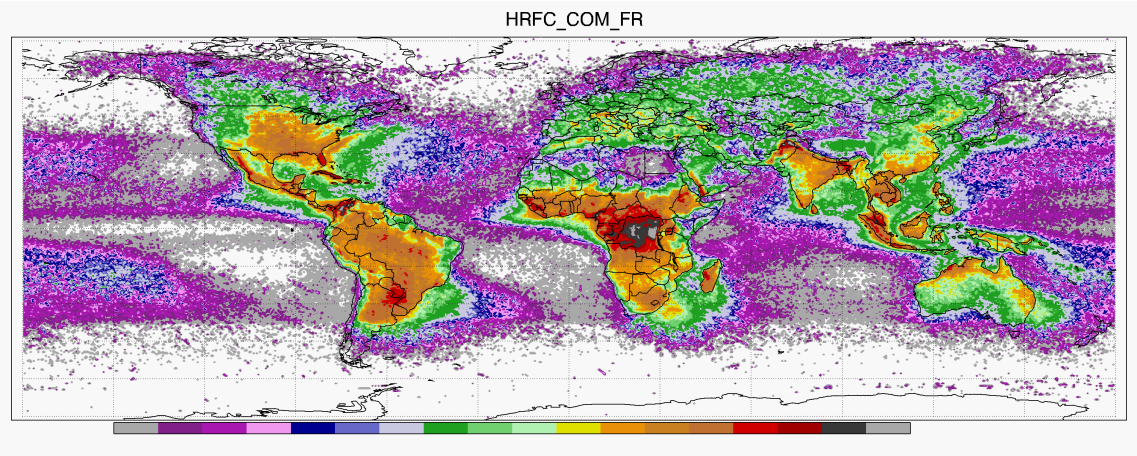
ISS_LIS_SC_V2.2_20230827_221719_FIN.nc	2023-09-07 14:34	3.5M
ISS_LIS_SC_V2.2_20230827_235009_FIN.nc	2023-09-07 14:39	3.0M

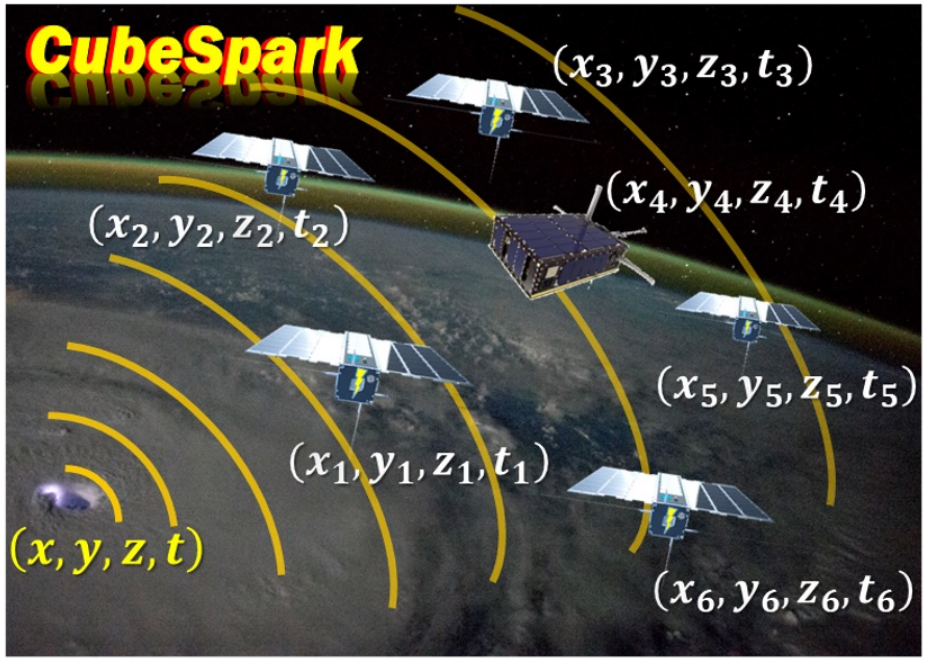
- Bulk download is available from NASA Earthdata.

Upcoming NASA Lightning Datasets

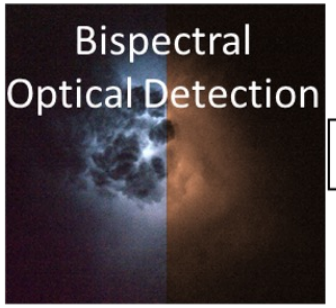
- **Airborne Lightning Observatory for FEGS and TGFs (ALOFT)**
  - ER-2 & ground observations of lightning and gamma-rays in tropical convection
  - Due Spring/Summer 2024
- **Merged and Harmonized 28-Year ISS/TRMM LIS + OTD Climatology**
  - Corrections for sensitivity differences
  - Due by 2025

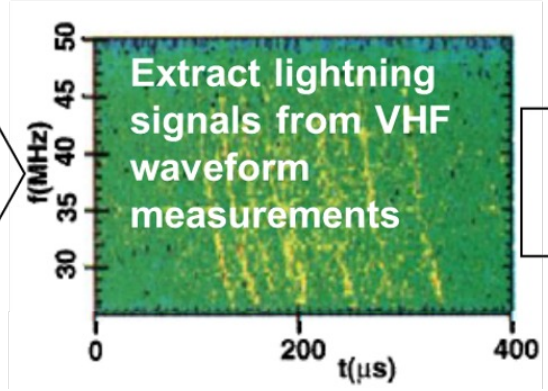


Future NASA Lightning Mission Concept

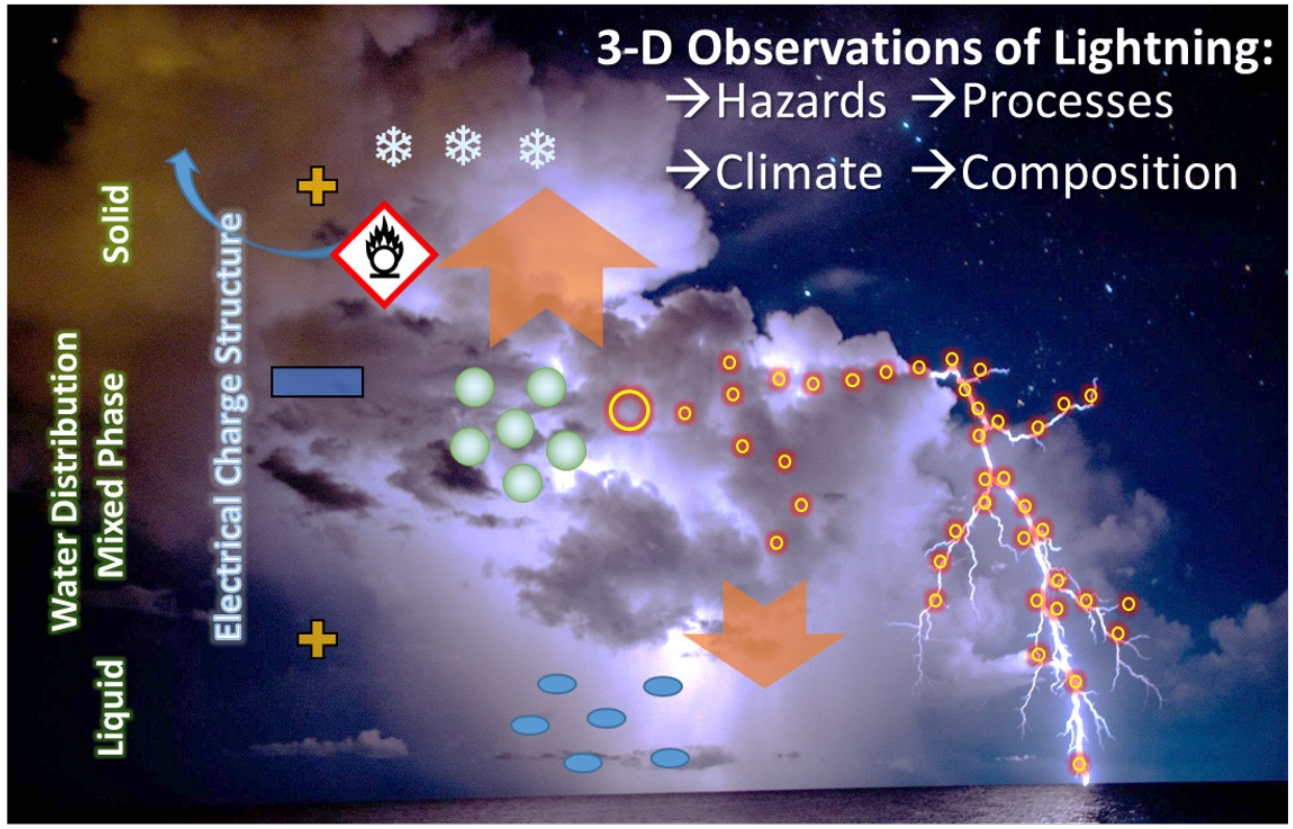


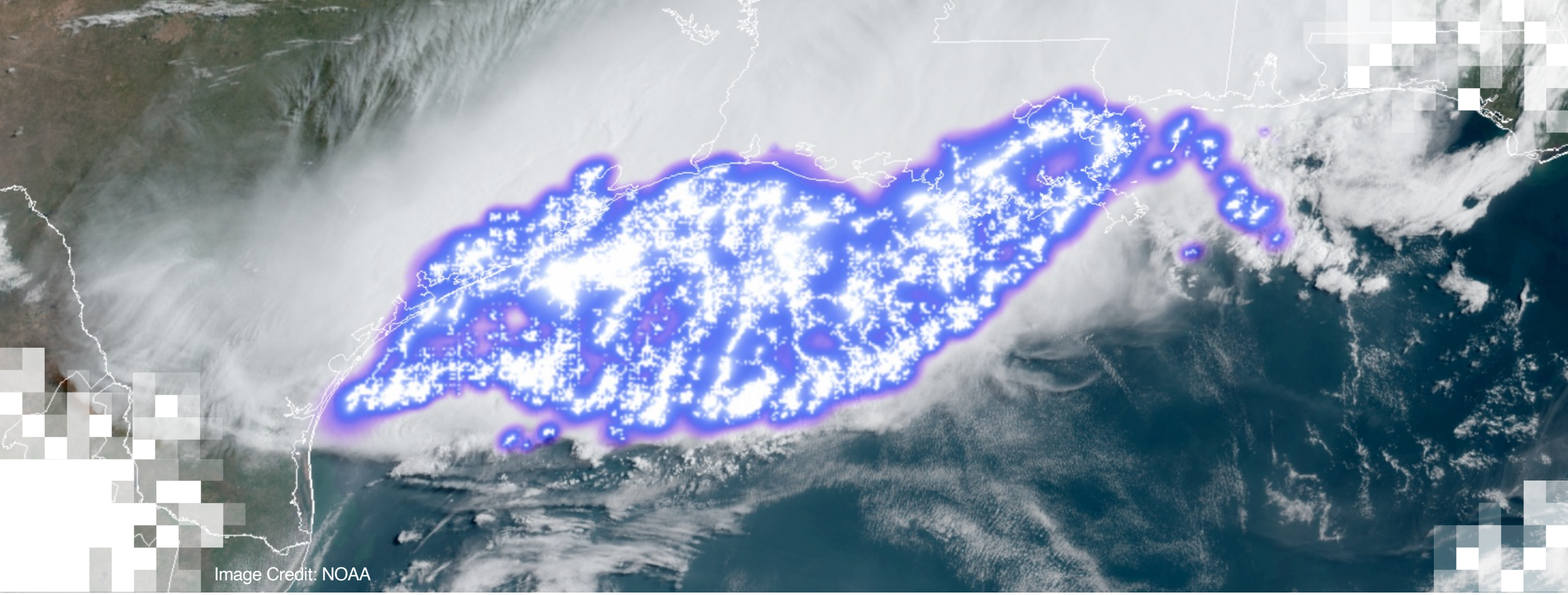
Measurement Concept





Enabled Science and Applications





Part 2
Summary

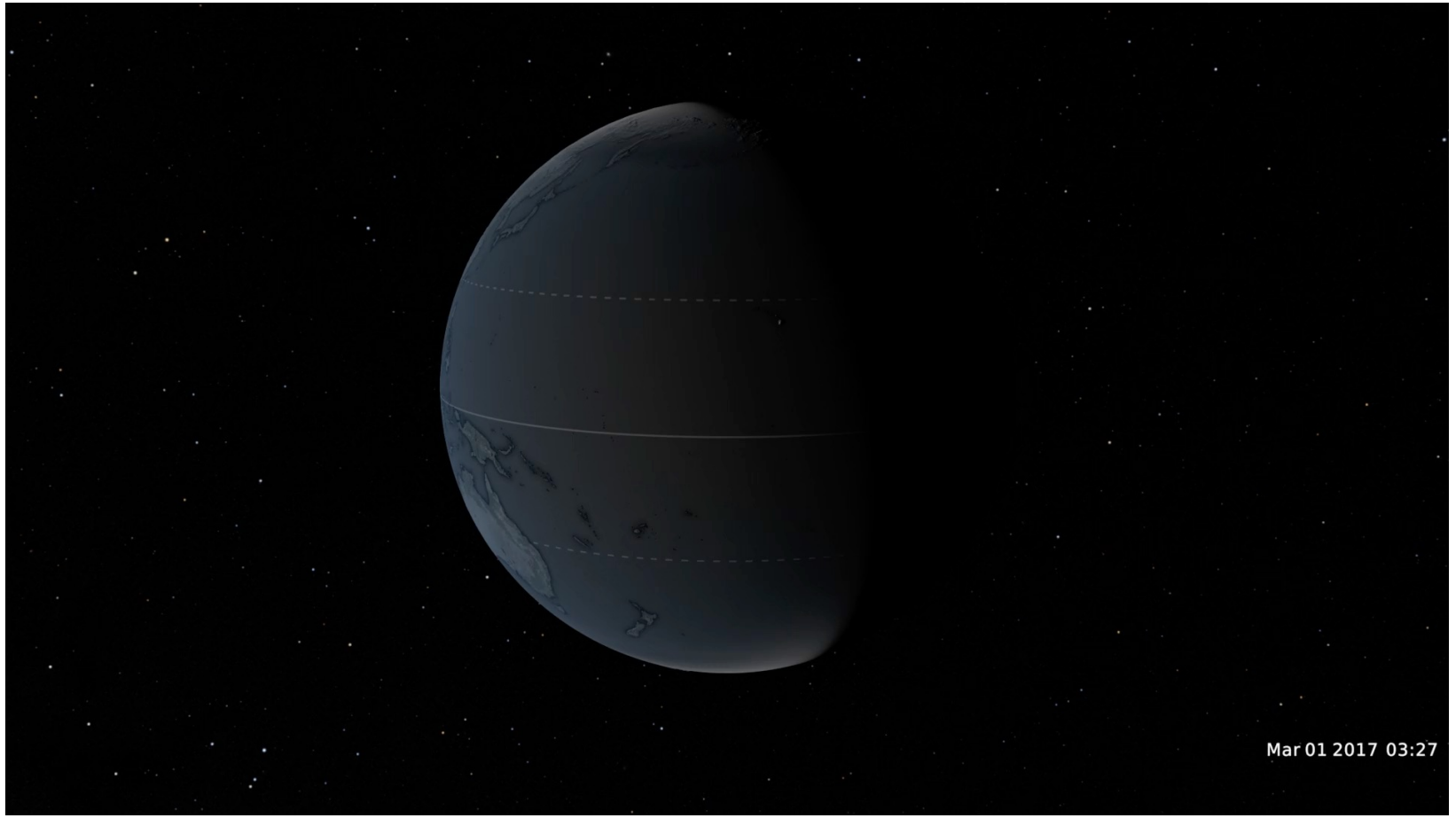
Key Takeaways

- NASA provides a wide breadth of lightning datasets, ranging from spaceborne missions like OTD and LIS, to suborbital datasets like LMAs (ground-based) and LIP (airborne).
- NASA granule-based spaceborne datasets follow a standardized event-group-flash-area hierarchy, crucially depend on the viewtime metadata metric, and undergo extensive quality control.
- NASA also provides multiple different global spaceborne lightning climatologies, which can meet different science and application needs.
- NASA ground-based suborbital lightning datasets come from long-term deployments (months to years) like LMAs and the KSC network.
- NASA airborne lightning datasets include LIP, FEGS, and EFCM, and come from short-term campaigns (~10-100 flight hours).
- The GHRC DAAC archives most spaceborne & suborbital lightning datasets and leverages NASA Earthdata Search and other tools to help discover and deliver them.

Resources

- NASA Global Hydrometeorology Resource Center (GHRC)
- NASA Lightning Datasets Home Page
- NASA Earthdata Search
- ISS Camera Geolocate Software

Lightning Events Detected by ISS-LIS between January 2017 and July 2023



NASA SVS

Homework and Certificates

- **Homework:**
  - One homework assignment
  - Opens on 02/04/2024
  - Access from the training webpage
  - Answers must be submitted via Google Forms
  - **Due by 17/04/2024**

- **Certificate of Completion:**
  - Attend all three live webinars (attendance is recorded automatically)
  - Complete the homework assignment by the deadline
  - You will receive a certificate via email approximately two months after completion of the course.

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Thank You!