Comparing LIS and GLD360 Lightning Observations in the Western Pacific Ocean Basin

William Brandon Aydlett
Science and Operations Officer
National Weather Service, Guam

Steve Goodman
Thunderbolt Global Analytics

Scott Lindstrom, UW-Madison
Cooperative Institute for Meteorological Satellite Studies

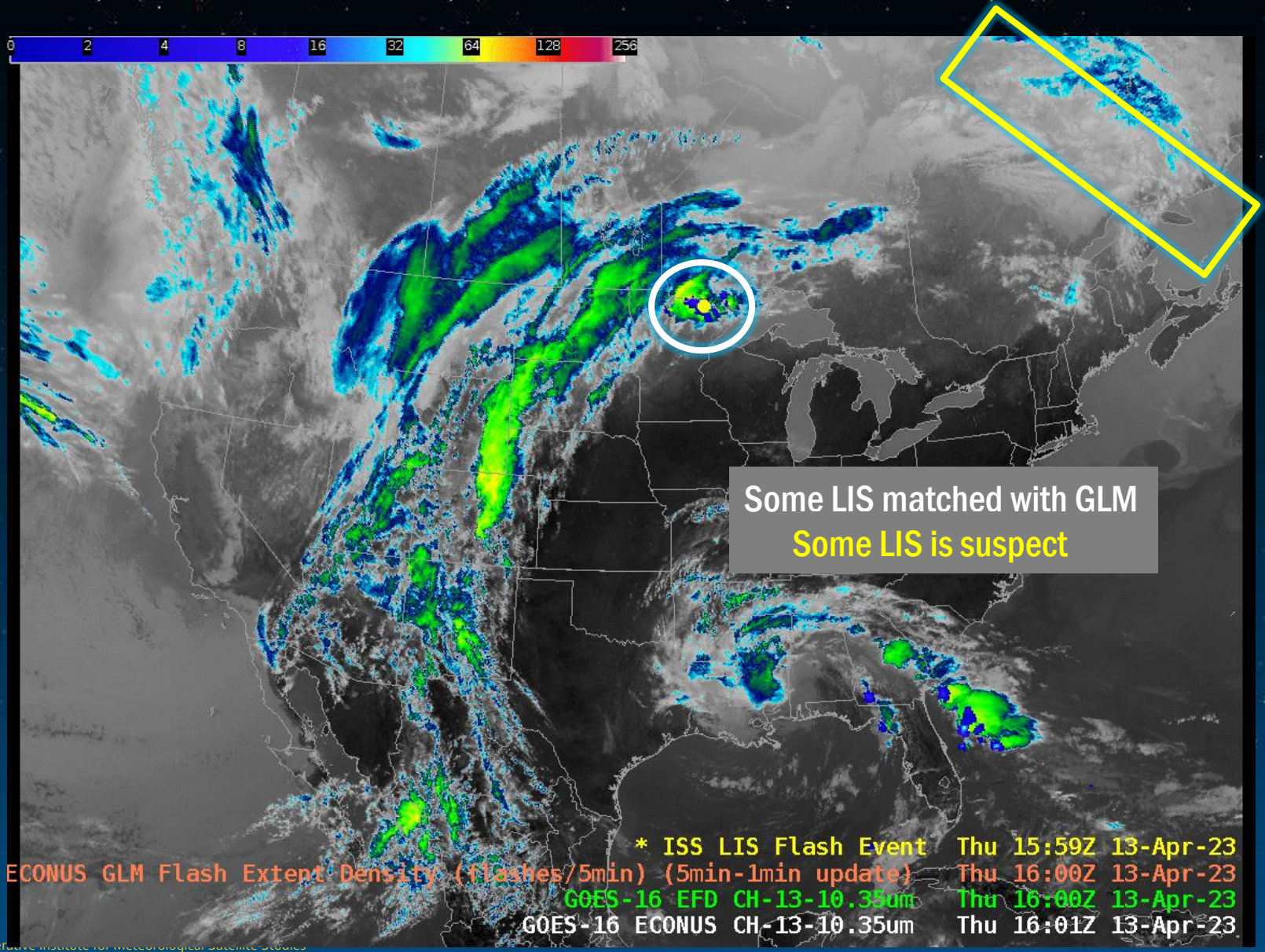
Why lightning?

- The NWS Office on Guam has responsibility for airport grounds safety at Antonio B. Won Pat International Airport
  - Airport workers are pulled from the tarmac if lightning is observed
- How is lightning anticipated
  - Radar data can be used; rules of thumb about reflectivity and IR cloud top temperatures that commonly accompany lightning events on Guam
  - Starting in 2021, LightningCast probability has been used; this is a machine-learning tool developed for NOAA at CIMSS that predicts the probability of a GLM observation in the next 60 minutes given the current observations by **ABI**.
    - RealEarth instance created
    - Gives useful information during Island-type convection
    - Gives less-useful information during trade-wind convection
    - Data flowing into the AWIPS display at the NWS Guam
    - Of course, Guam uses AHI, not ABI data, and uses GLD360 lightning

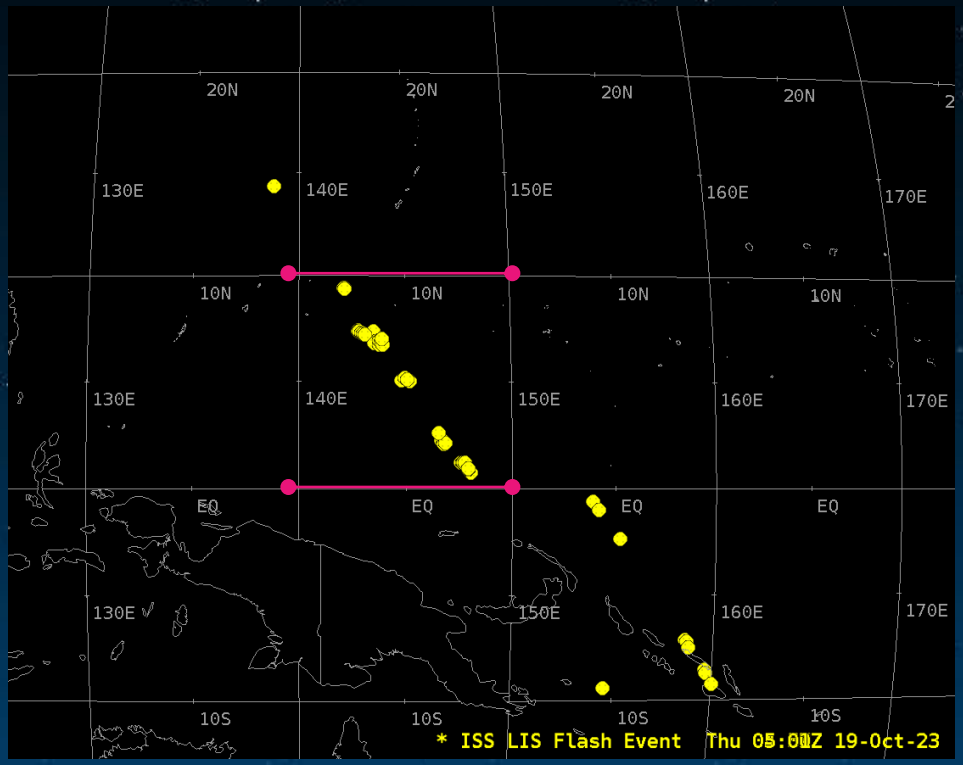
Lightning Imaging Sensor

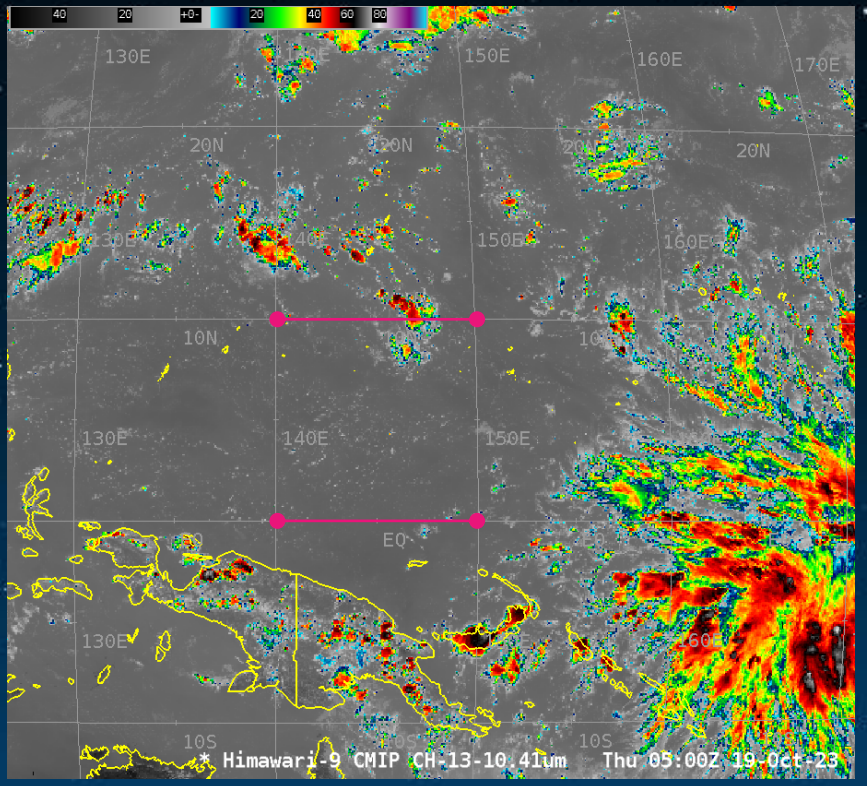
- Flies on the International Space Station (ISS)
  - 2017 - Nov, 2023
- Task: Compare LIS observations with GLD360 in/around Guam AOR
  - How well does LIS Gap-Fill when the terrestrial-based system doesn't detect?

LIS compared to GLM data



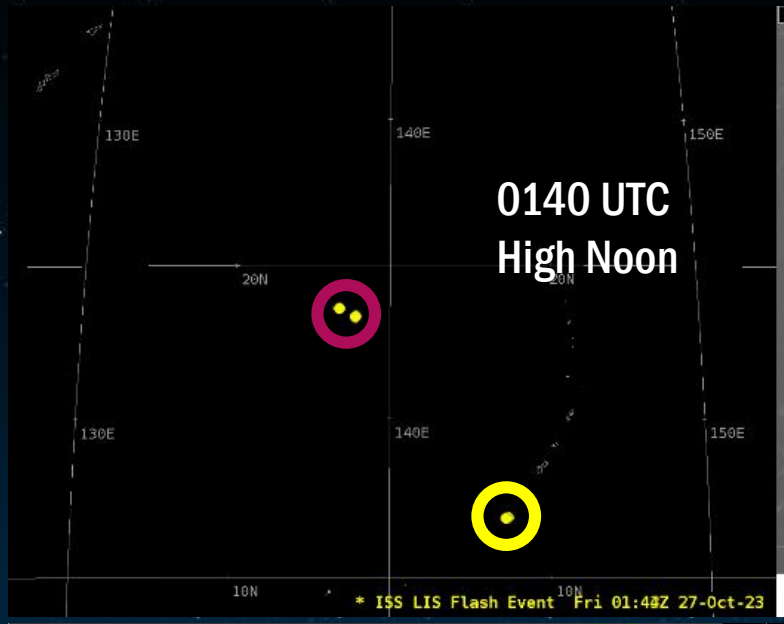
What about over the West Pacific?

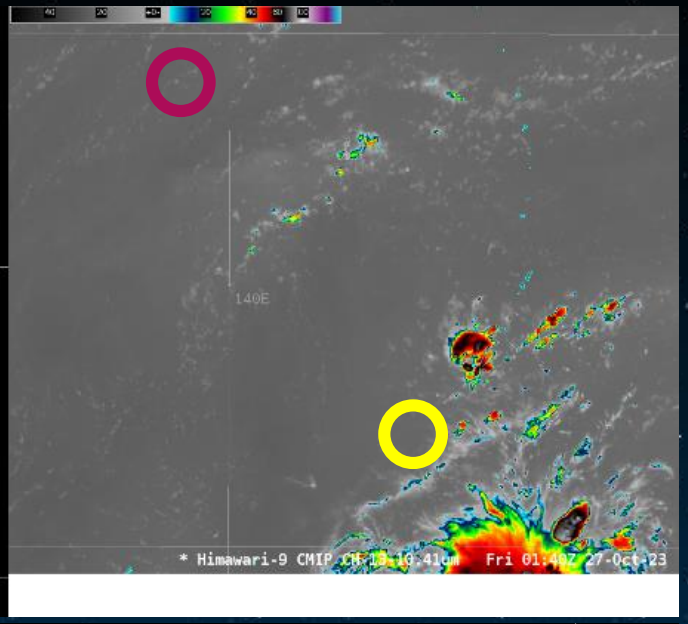


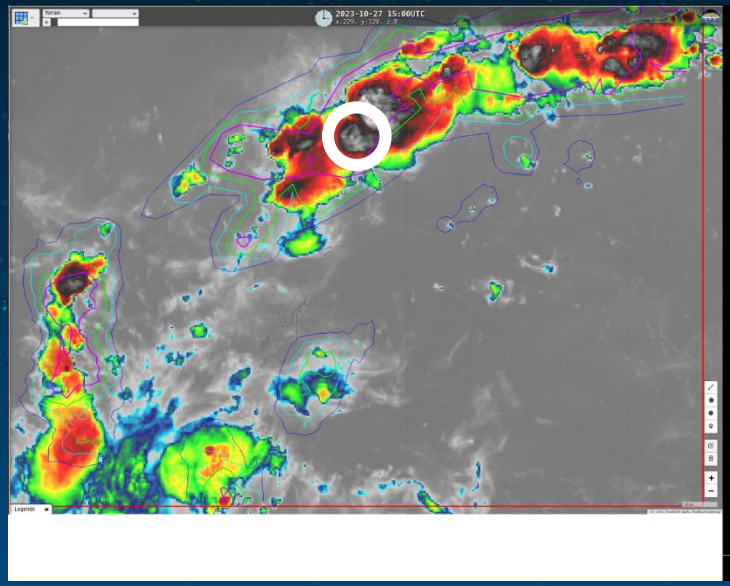


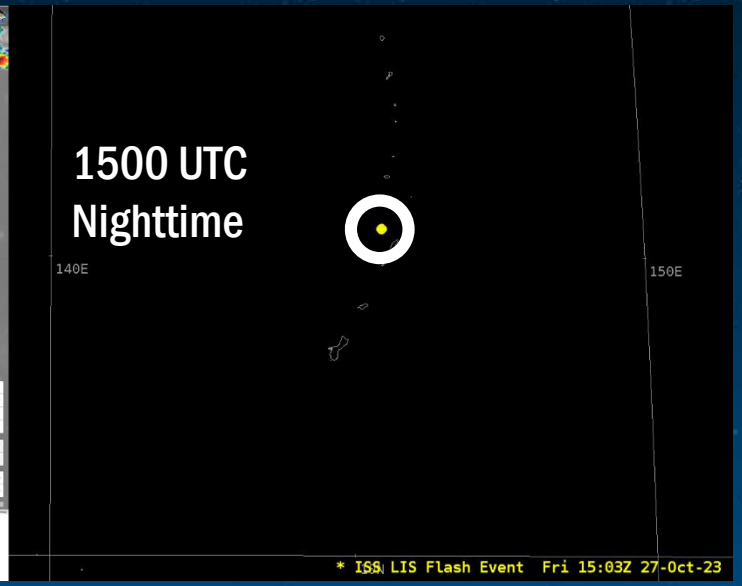
What's going on between 0 and 10 º N?

Sometimes good and bad in one day







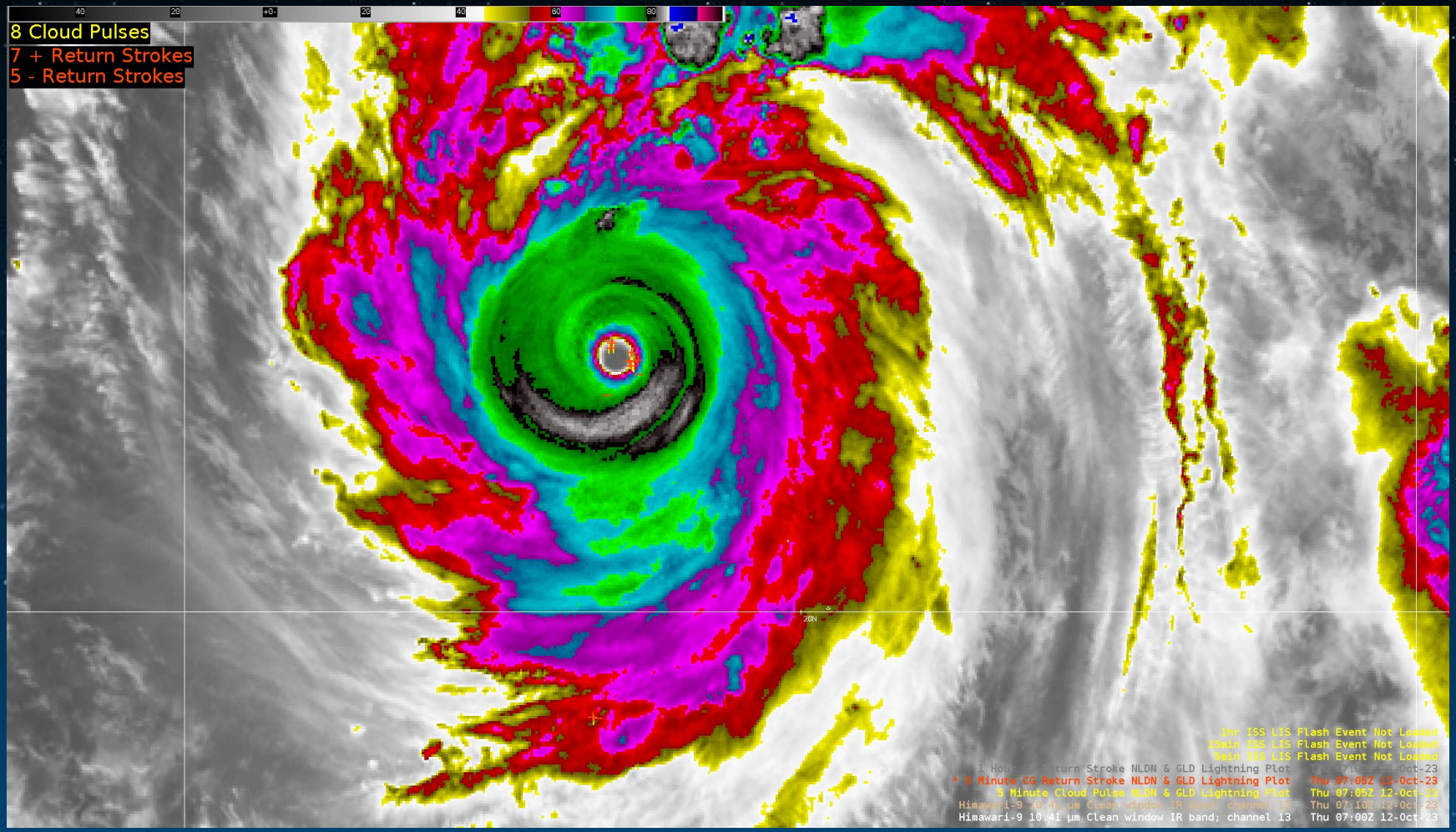


Relatively Frequent Occurrences of LIS observations where Himawari wasn't really showing convection

- May be related to High Energy particles, or reflection off the ISS Solar panels.
- "I believe those are being caused by glint. The scene is bright and there are some high clouds in the area. The on-ground filtering usually filters these out but [...] sometimes these make it through the filtering algorithms as lightning. Sometimes the instrument just has noise- sometimes very bad (I think you've seen this before) and other times just a few flashes. ***We will add this to the list of anomalies to look at in improving the filtering algorithms***."
- "This appears to be another instance of noise from the ISS LIS. From the path of the lightning in the animation it appears there's a pixel or two on the instrument that are generating false events. These are usually filtered out but not always."
- GLM data are also being examined constantly and ground systems are being changed as reasons for data anomalies are defined.

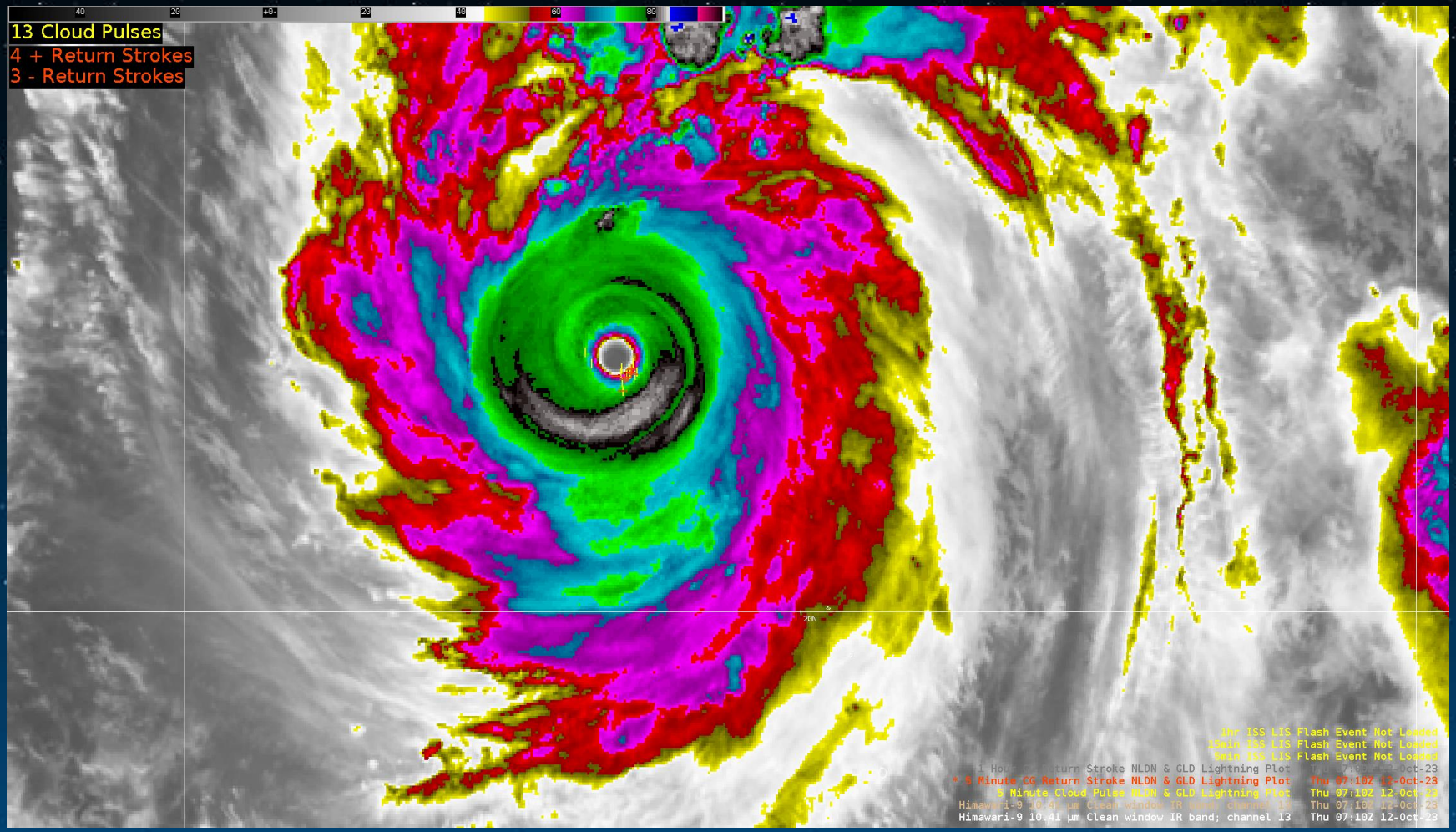
GLD360 Lightning in Bolaven Eyewall

Why is lightning an important variable?



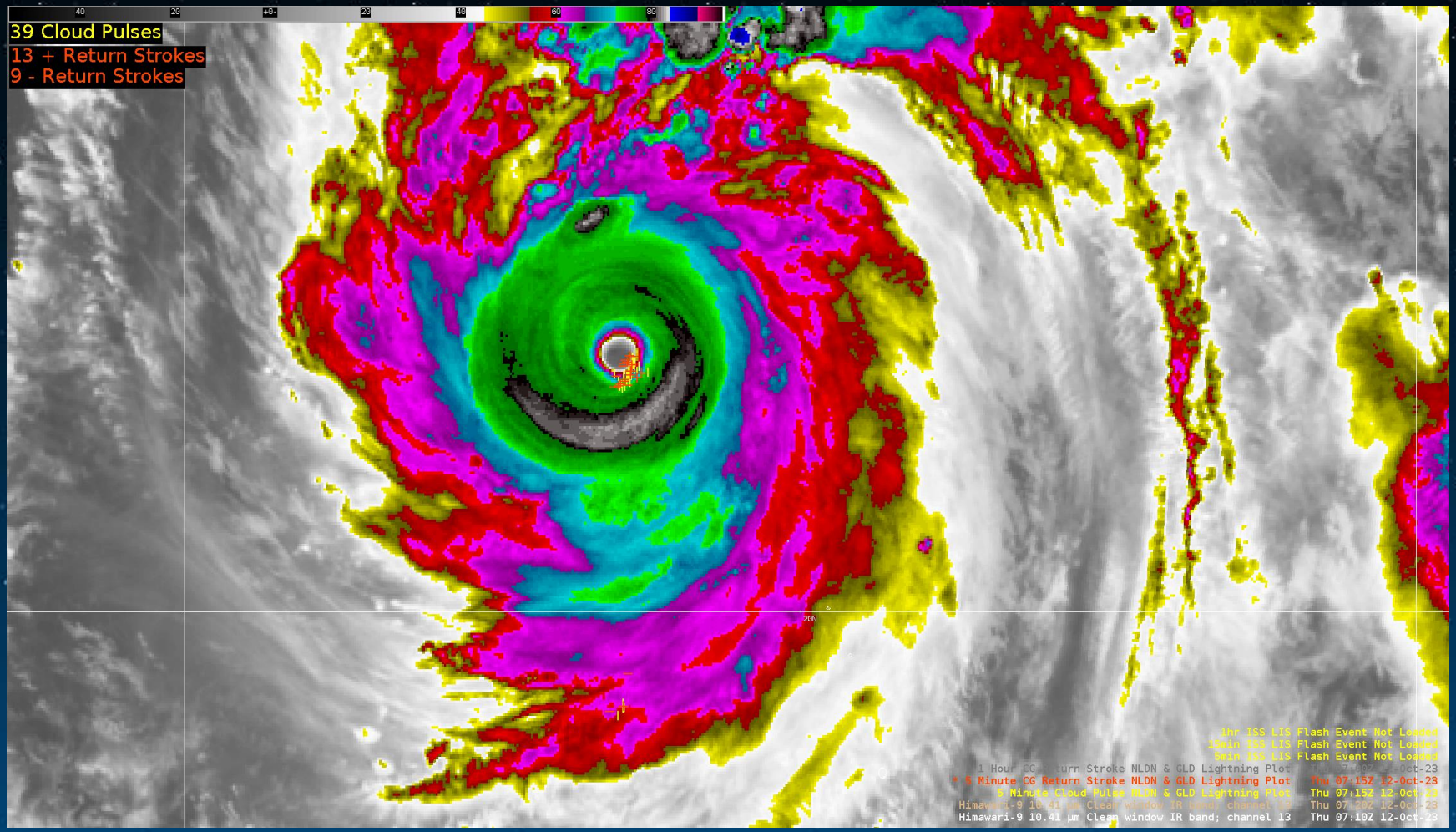
1 of 8, GLD at 0705

GLD360 Lightning in Bolaven Eyewall



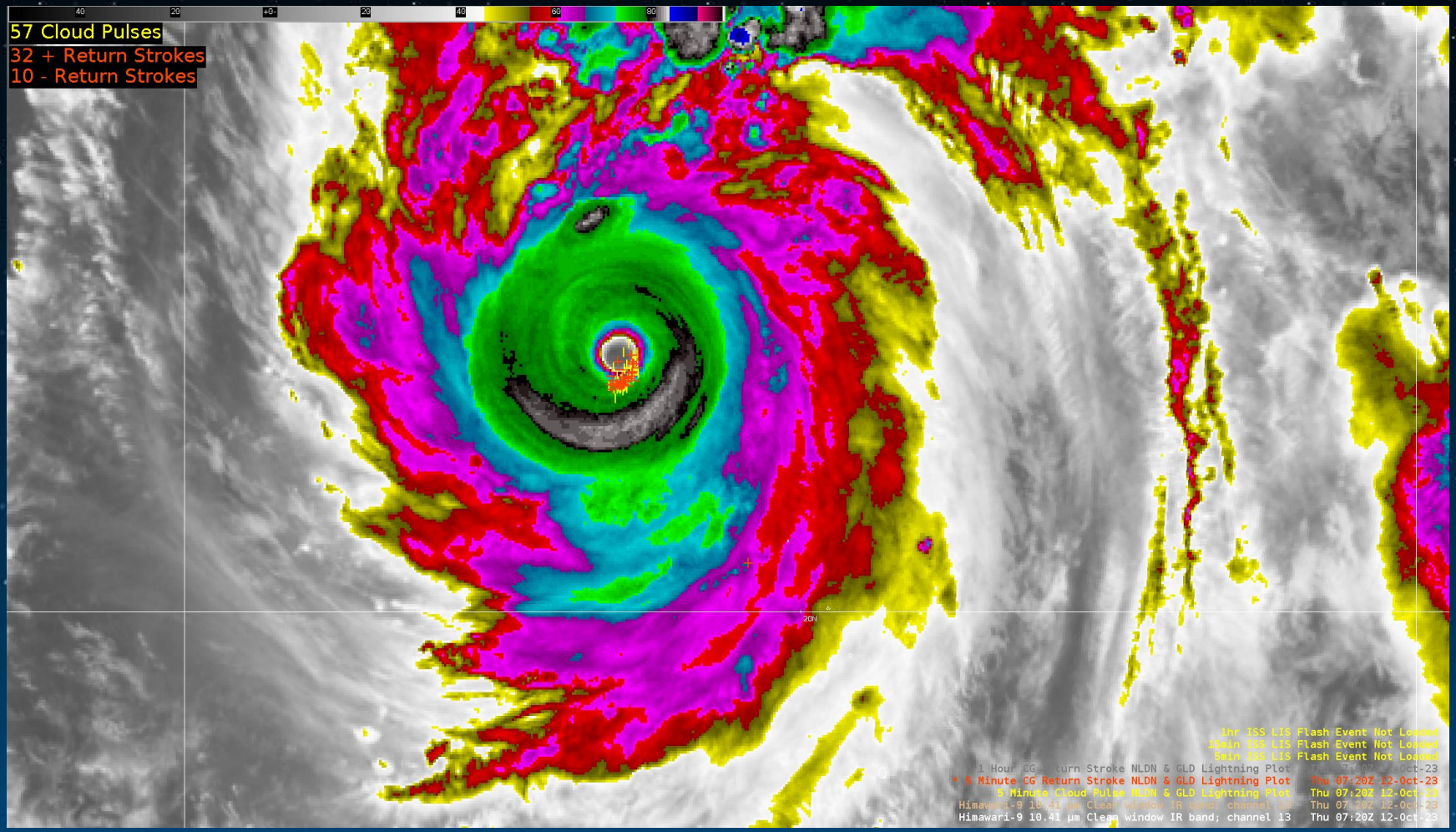
2 of 8, GLD at 0710

GLD360 Lightning in Bolaven Eyewall



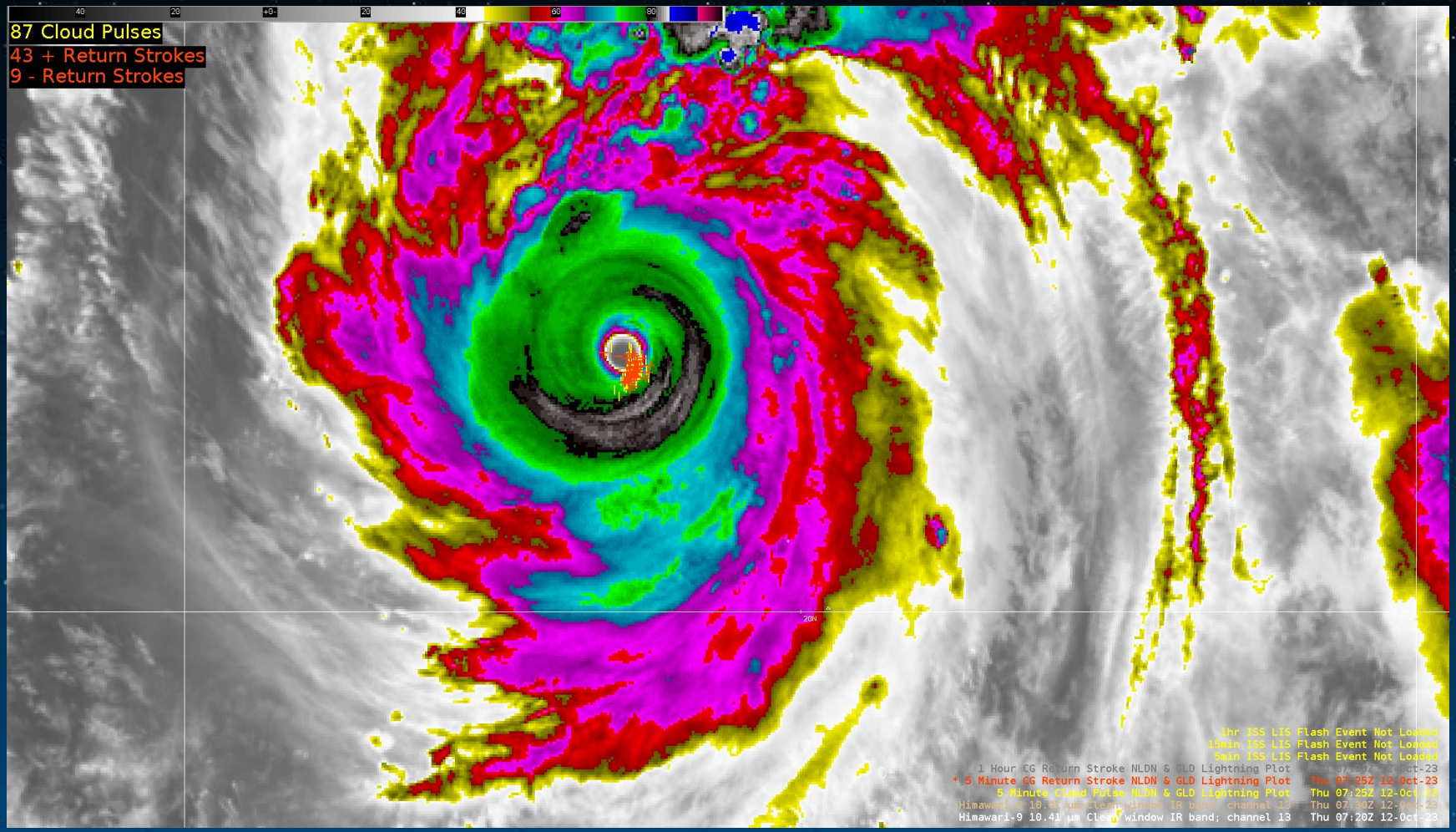
3 of 8, GLD at 0715

GLD360 Lightning in Bolaven Eyewall



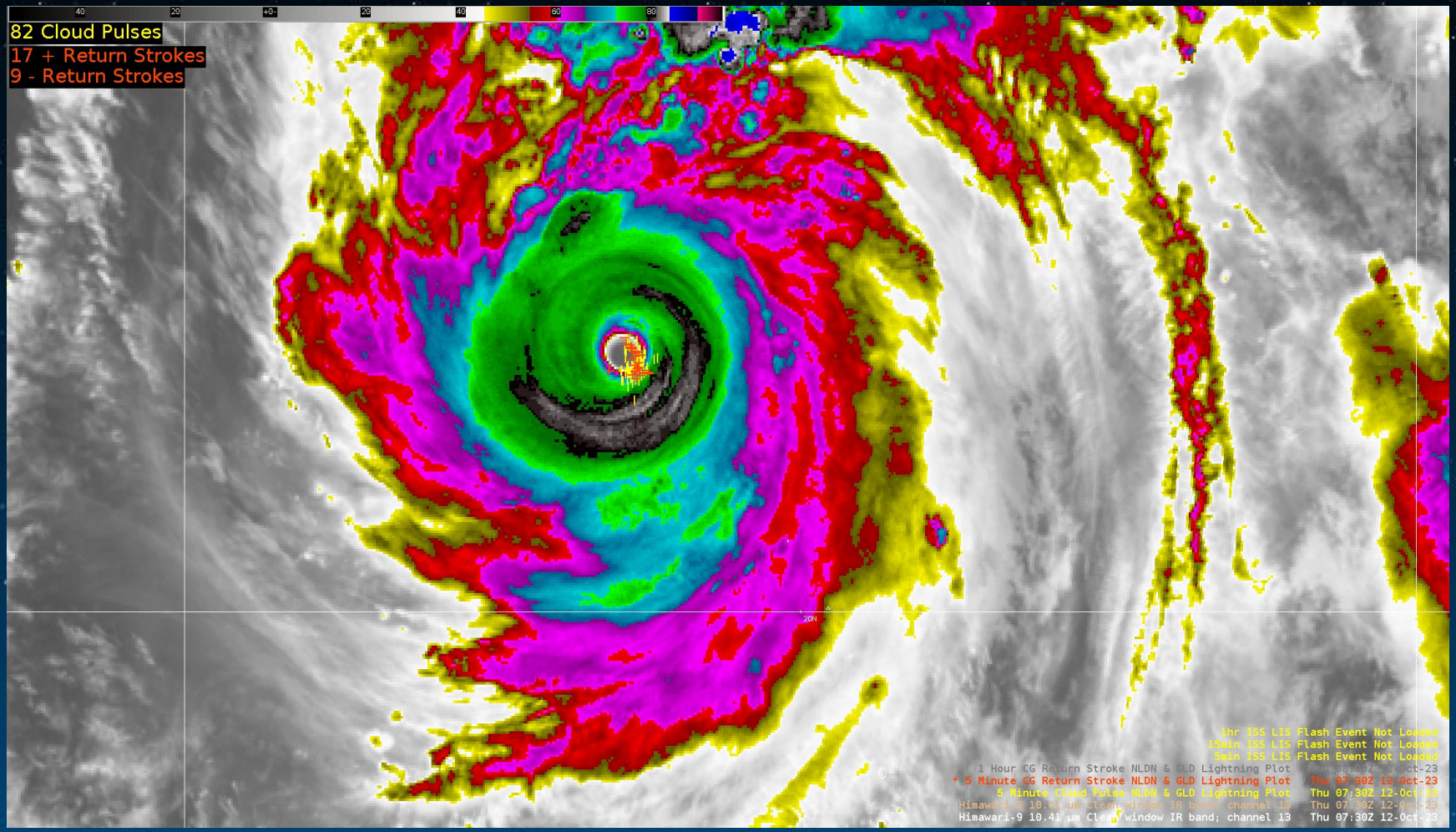
4 of 8, GLD at 0720

GLD360 Lightning in Bolaven Eyewall



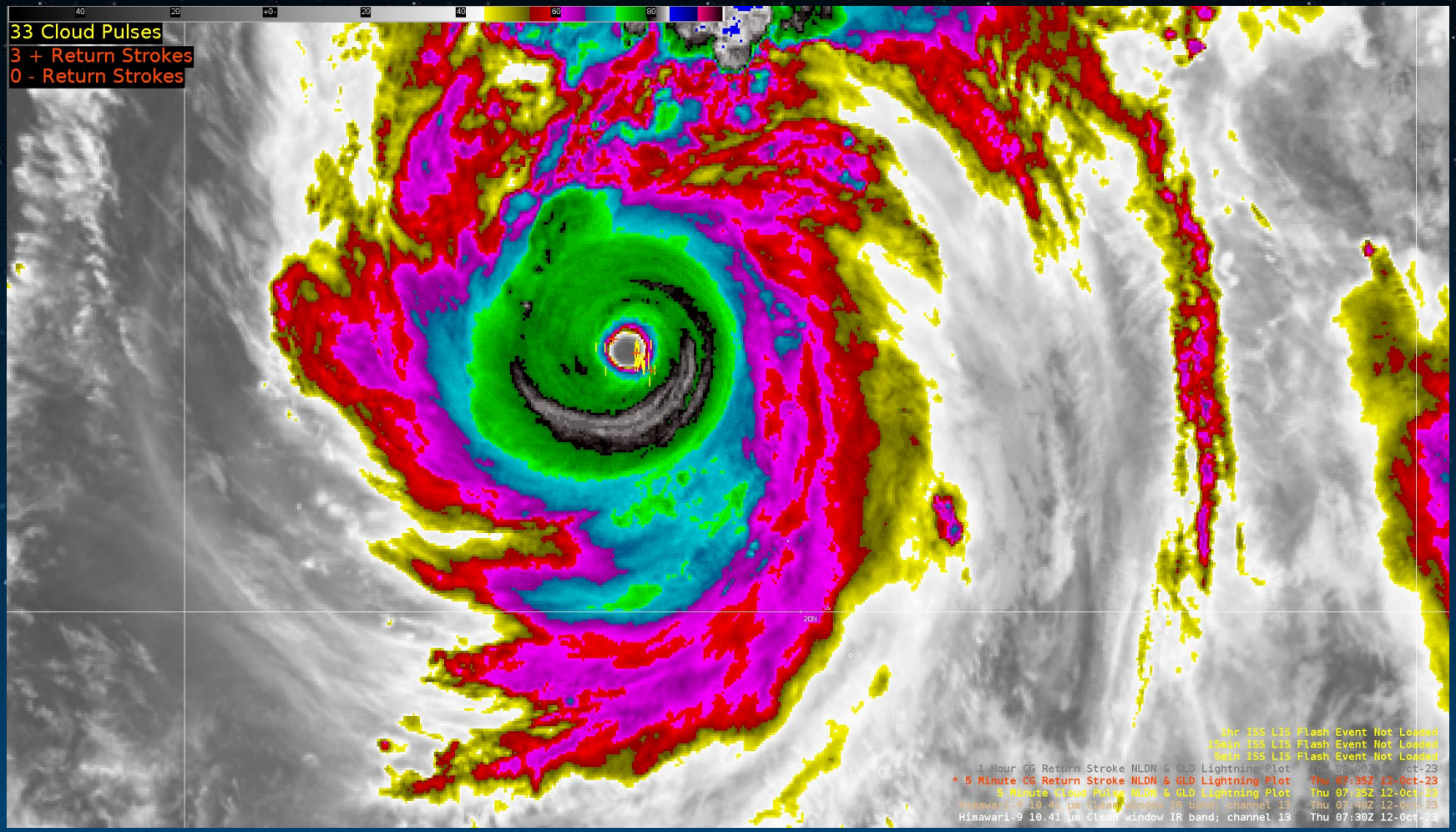
5 of 8, GLD at 0725

GLD360 Lightning in Bolaven Eyewall



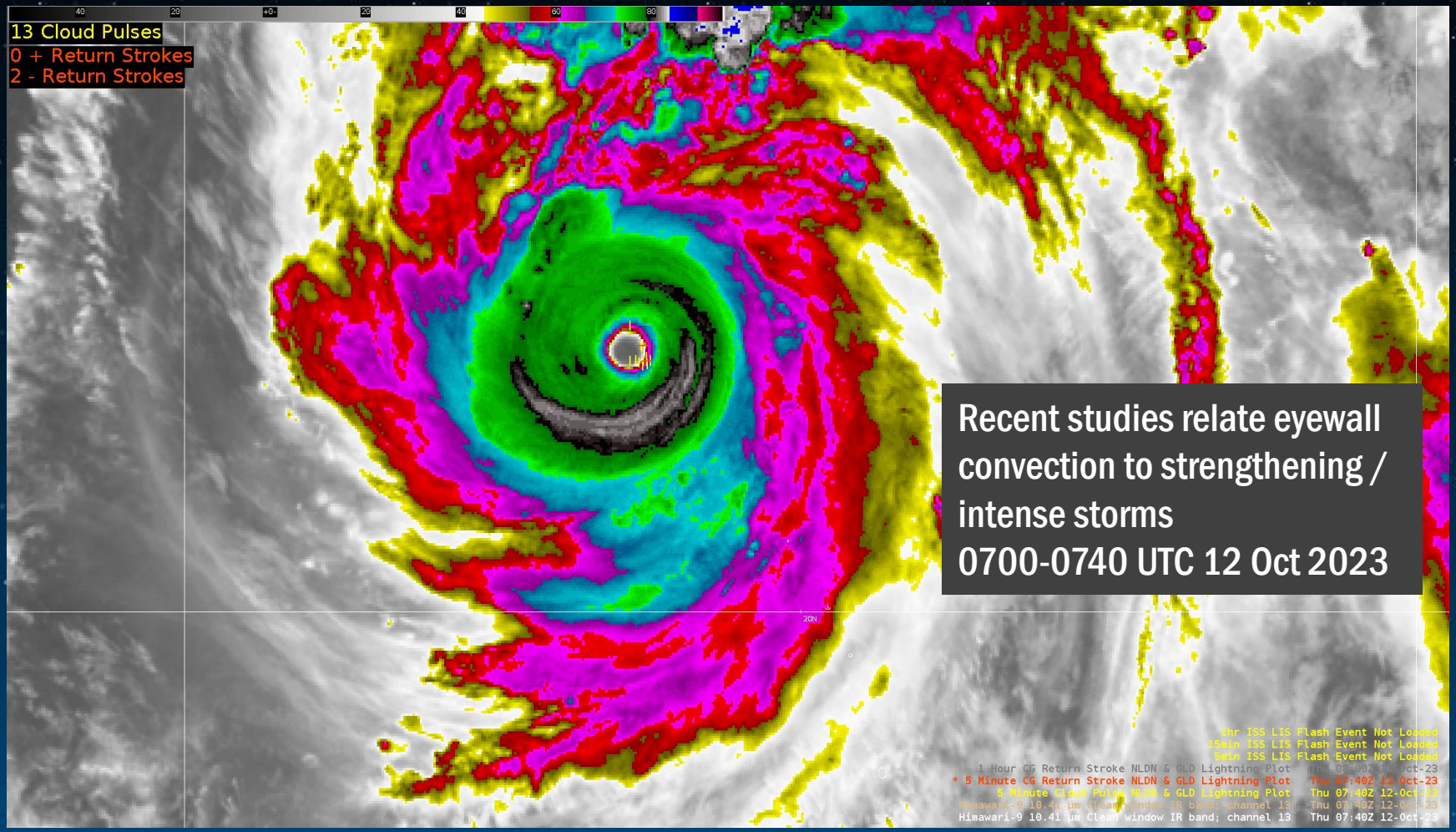
6 of 8, GLD at 0730

GLD360 Lightning in Bolaven Eyewall



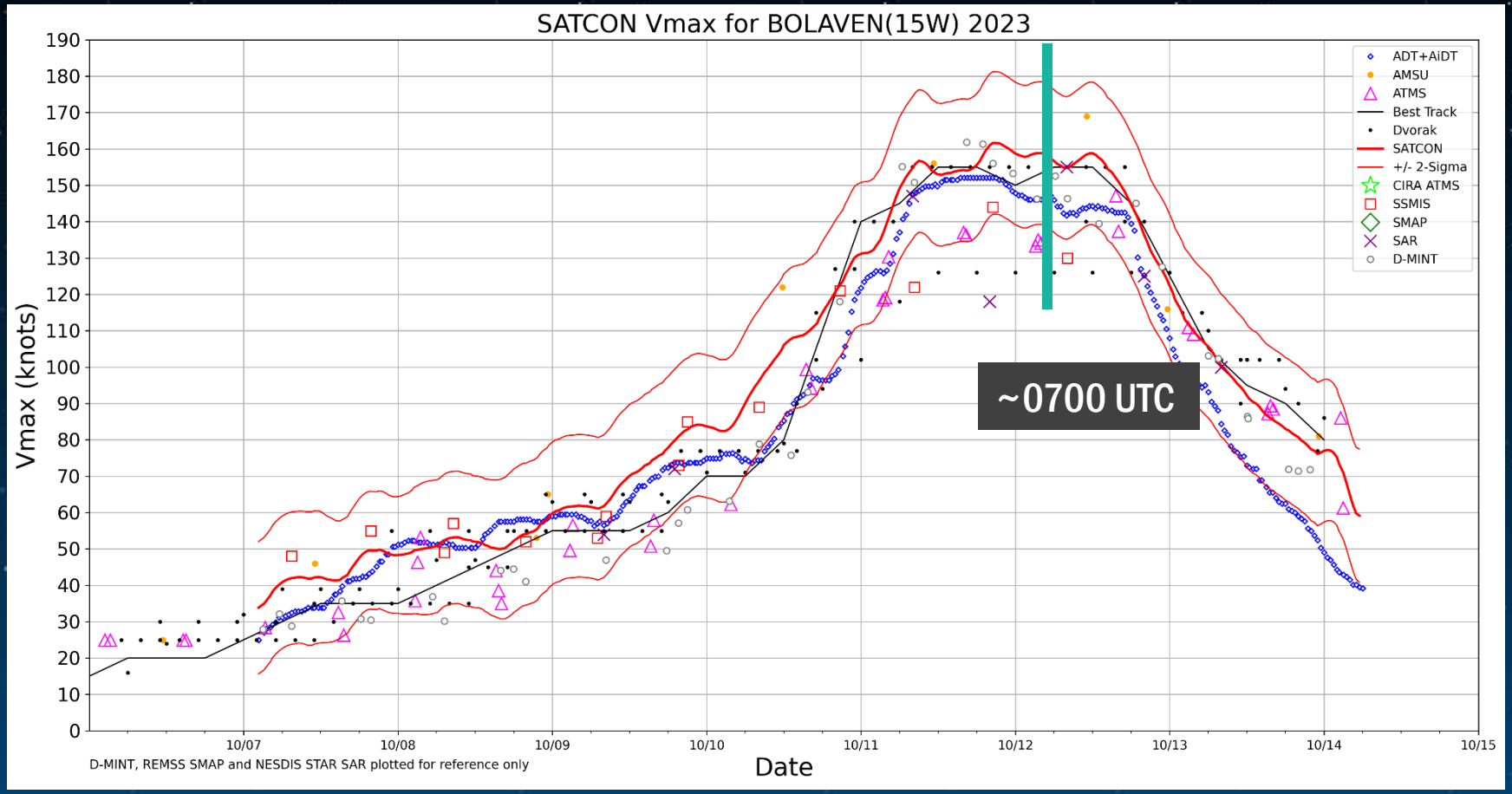
7 of 8, GLD at 0735

GLD360 Lightning in Bolaven Eyewall

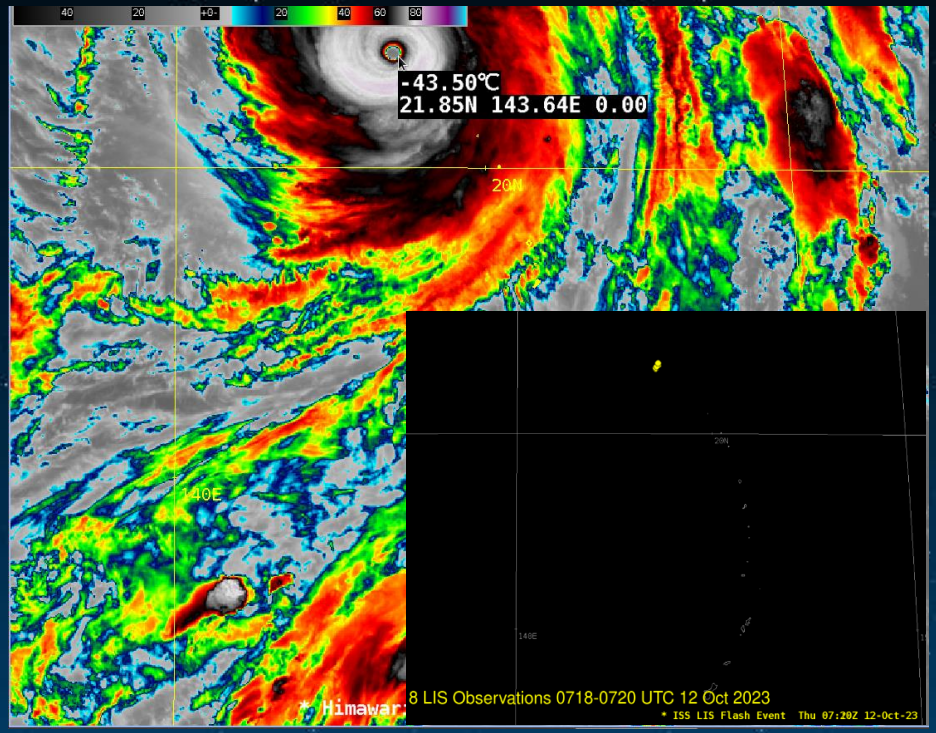


8 of 8, GLD at 0740

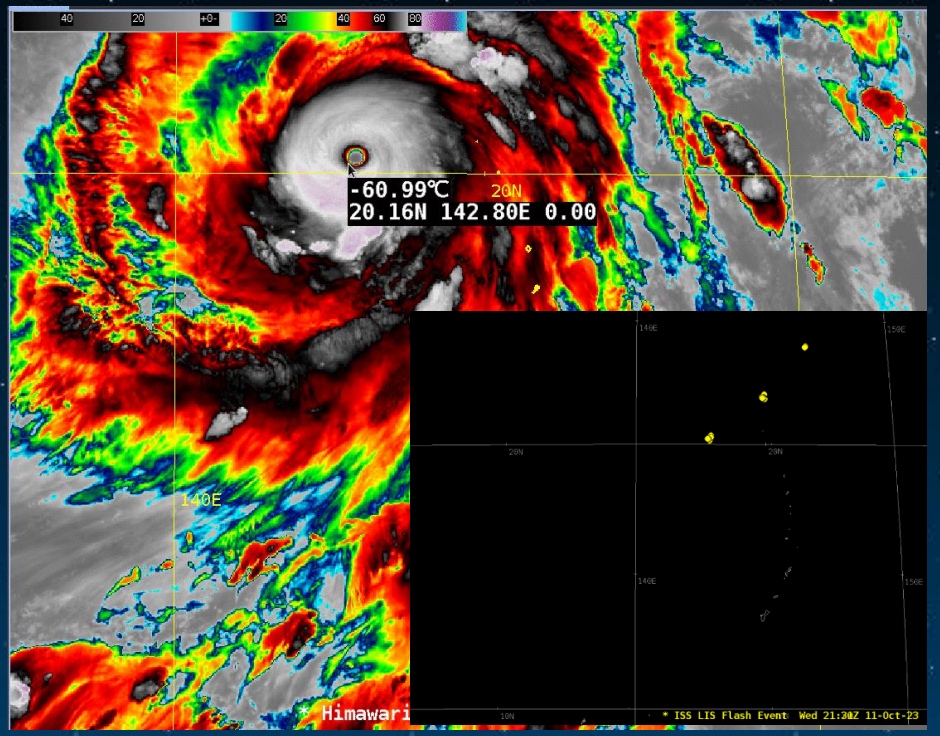
SATCON for Bolaven



LIS observations in Bolaven's Eyewall at the same time, and a bit earlier

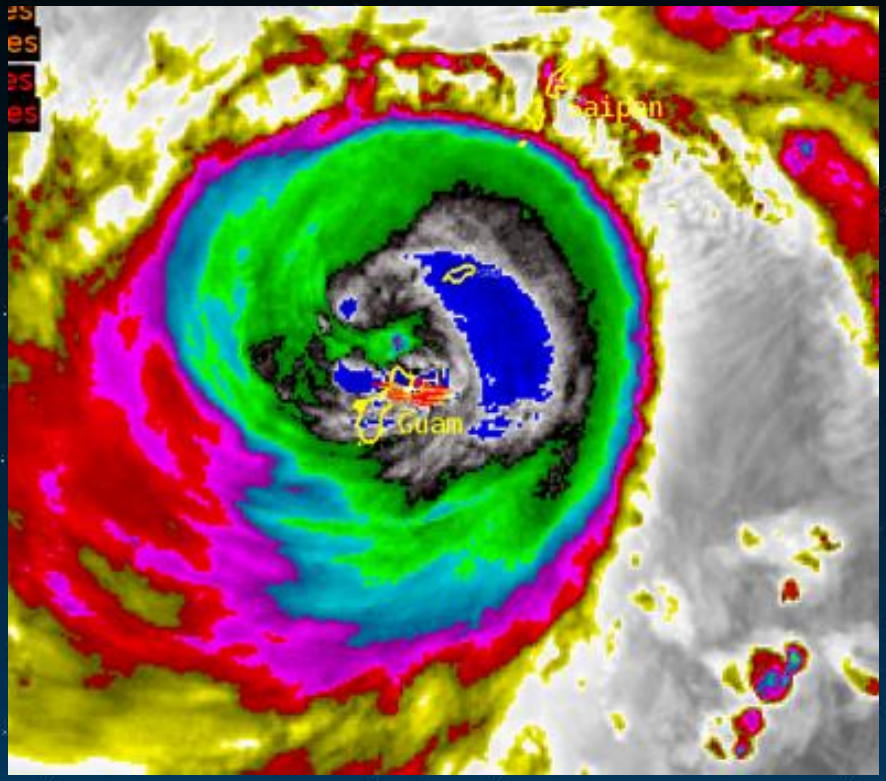


0720 UTC 12 October

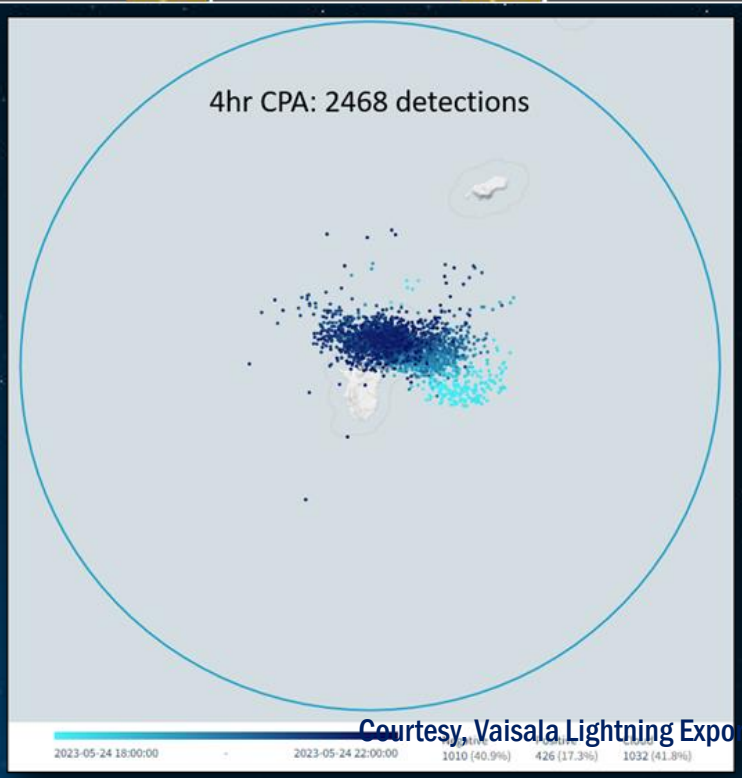


2130 UTC 11 October

Mawar also showed extreme lightning behavior



24 May 2023



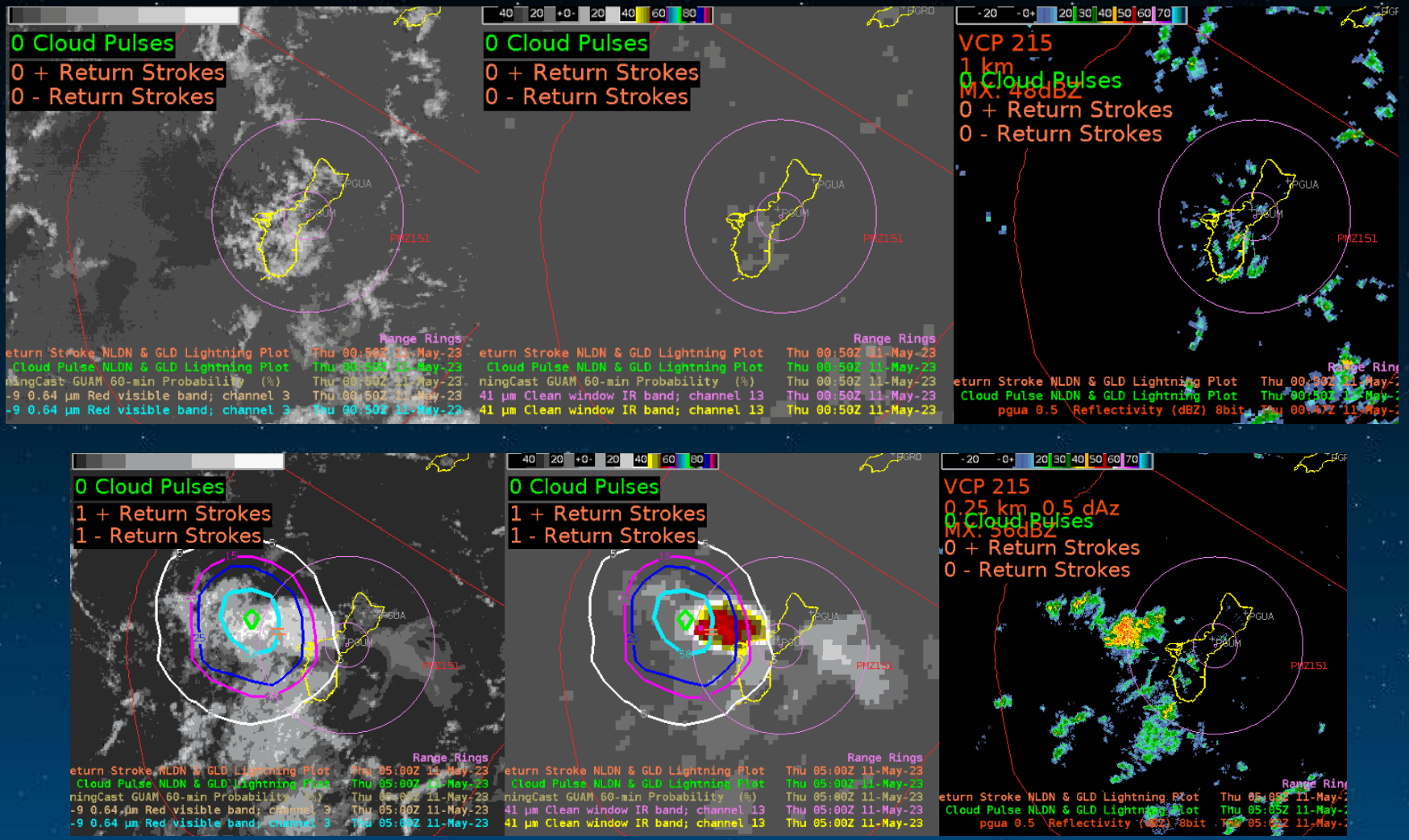
Courtesy, Vaisala Lightning Exporter

LIS did not overfly Mawar on this day

LightningCast Probabilities around Guam

- ML tool that relates ABI Bands 2 (0.64), 5 (1.61), 13 (10.33), 15 (12.3) to the likelihood that a GLM observation will occur in the next 60 minutes
  - Band 2, 5, 13: components of Day Cloud Phase Distinction RGB
  - Band 13, 15: Split Window Difference
- Use AHI data from Himawari-9
- Real Earth instance of the product; data also input into the Guam AWIPS

LightningCast increases, then there's lightning, then LightningCast decreases



11 May 2023 0500 – lightning strikes where LightningCast is a maximum!

Takeaway on LightningCast Use in Guam

- On the previous slide – with the brief, short burst of convection west of Guam, a forecaster would have to be more responsive to lower probabilities.
- If there are multilayered clouds and widespread convection, the forecaster should focus on the higher probabilities.
- Ongoing use of the product will help a forecaster better understand how to use and interpret it as synoptic environments change.

Concluding thoughts

- LIS and Ground-based lightning detection overlap well
  - Sometimes with LIS, false positives occur, however:
    - Can be sun glint, reflection off ISS solar panels, or defective detectors
  - Mis-navigated ground-based lightning detection is rare
- LightningCast Probabilities give useful information
  - Probabilities increase before lightning occurs, especially in regions of light winds.
  - Interpretation of the product might change as the synoptic situation changes

Concluding thoughts

- Operational Use of LIS
  - LIS does provide an additional sensor for detecting lightning, but:
    - Forecasters note that knowing the viewing footprint of the LIS at any given time is critical
    - A moving polygon to indicate the time-relative and time-sensitive position of the LIS would help
    - Lack of temporal & geographic coverage diminishes operational reliance on the sensor

Contact Information

- Brandon Aydlett, Science & Ops Officer, NWS Guam
  - email: william.aydlett@noaa.gov
- Steve Goodman, Thunderbolt Global Analytics
  - email: steven.j.goodman@noaa.gov
- Scott Lindstrom, CIMSS, UW-Madison
  - emails: scott.lindstrom@noaa.gov and scott.lindstrom@ssec.wisc.edu