

# ProbSevere LightningCast Probabilities over Guam using Himawari imagery

**William Brandon Aydlett**

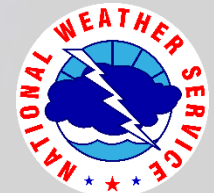
NWS, WFO Guam

**Scott Lindstrom, John Cintineo**

UW-Madison Cooperative Institute for Meteorological Satellite Studies

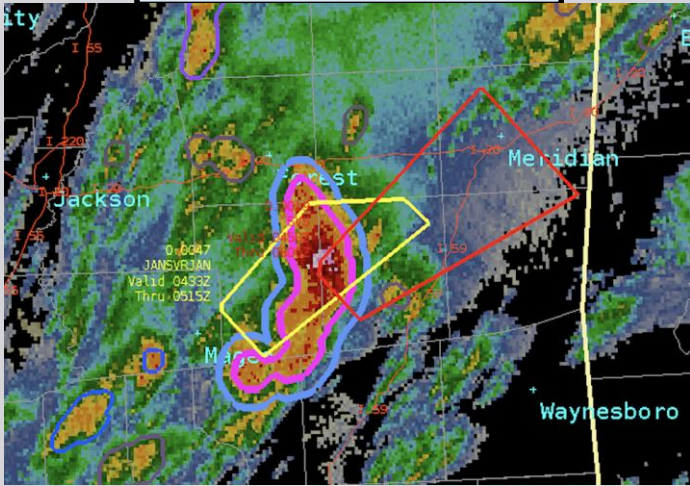
**Michael Pavolonis**

NOAA/NESDIS/STAR

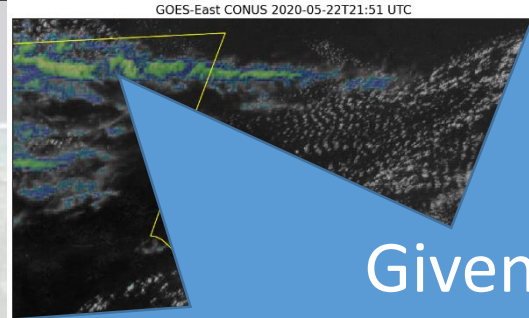


# LightningCast is part of ProbSevere Portfolio

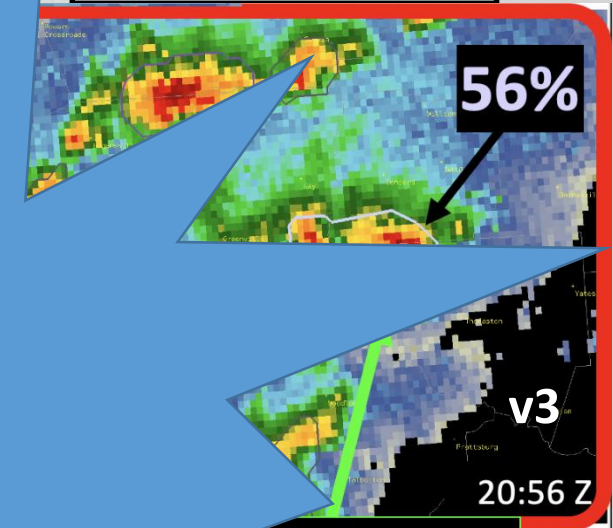
## 1. ProbSevere v2



## 2. Intense Convection Nowcasting

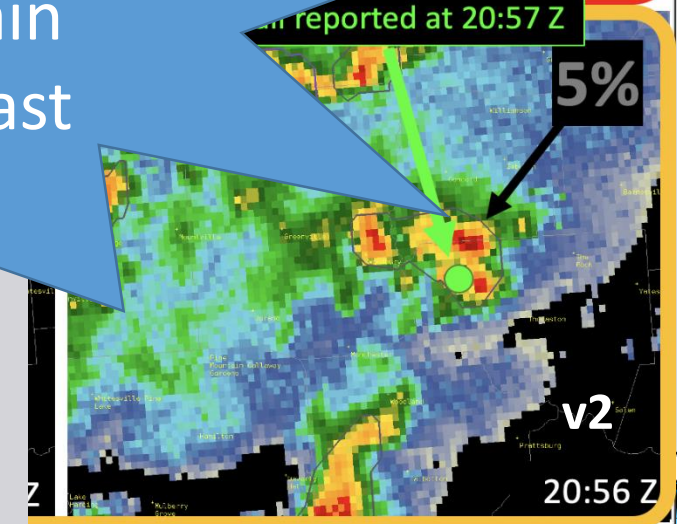
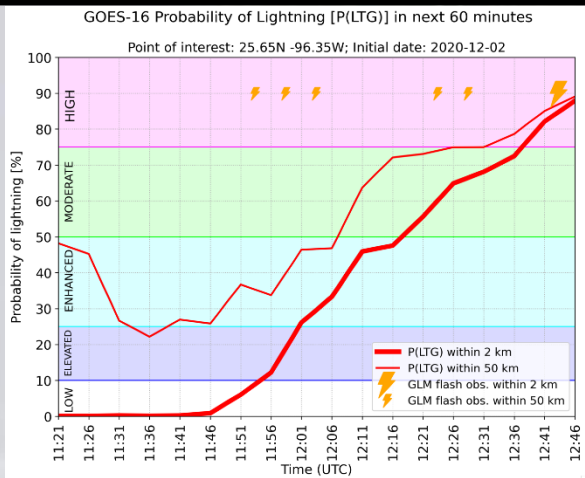


## 3. ProbSevere v3

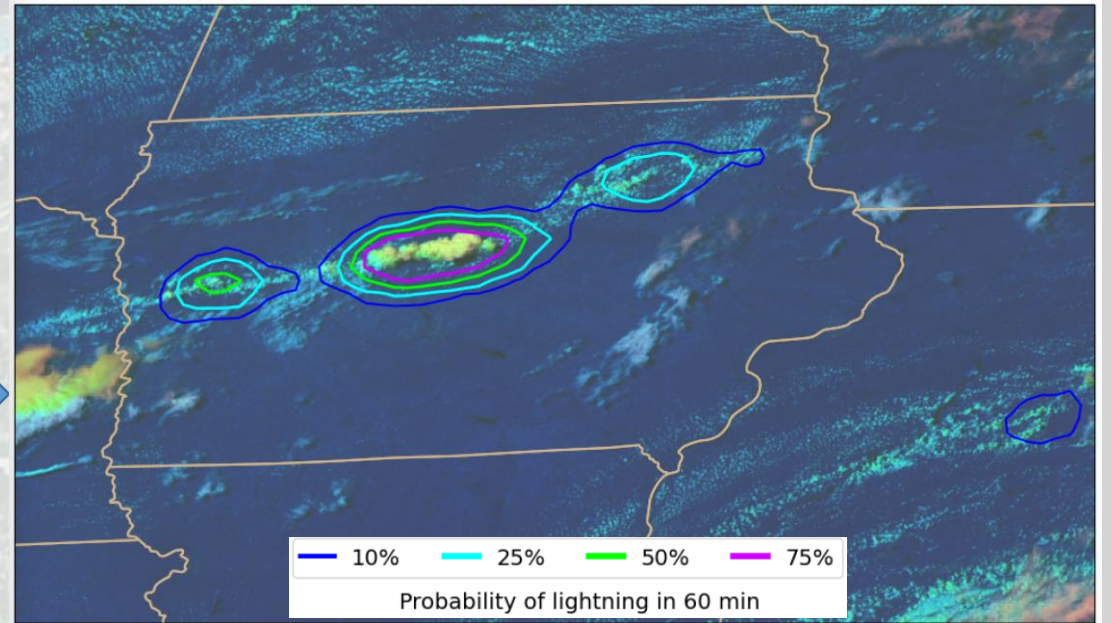
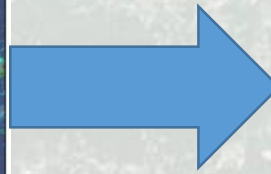
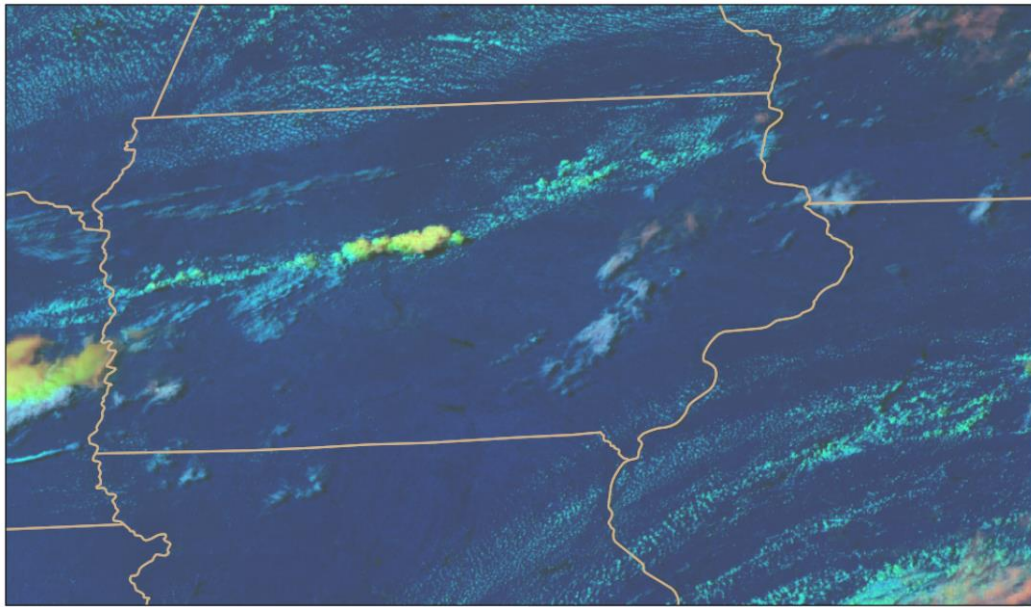


Given current observations, what is the likelihood of an event occurring? Train the algorithm with past data

## 4. Lightning Nowcasting



# How does ProbSevere LightningCast work?



## GOES-16 Input:

- 0.64  $\mu\text{m}$  reflectance (band 2)
- 1.6  $\mu\text{m}$  reflectance (band 5)
- 10.3  $\mu\text{m}$  brightness temperature (band 13)
- 12.3  $\mu\text{m}$  brightness temperature (band 15)

Works day and night; Applicable to any domain  
(subject to computing resources)

## Output:

- probability that GLM will observe lightning in the next 60 minutes



# Do AHI v. ABI differences mean much?

- **Big difference in resolution**
  - ABI Band 5 (1.61  $\mu\text{m}$ ) has 1-km resolution
  - AHI Band 5 (1.61  $\mu\text{m}$ ) has 2-km resolution
- **Slight differences in central wavelength**
  - ABI Band 13 (10.3  $\mu\text{m}$ )
  - AHI Band 13 (10.4  $\mu\text{m}$ )
- **Does this mean anything? No evidence (yet)**

# Why is this product needed?

- **Watches and Warning are issued for Guam International Airport**
  - Lightning is a hazard for those working on the tarmac
  - Other Lightning-prediction products show limited skill
- **What's been used in the past? Radar interrogation**

# RealEarth instance of LightningCast created at request of WFO GUM

The screenshot displays the NOAA/CIMSS ProbSevere LightningCast web interface. The browser address bar shows the URL: [https://cimss.ssec.wisc.edu/severe\\_conv/pltg.html](https://cimss.ssec.wisc.edu/severe_conv/pltg.html). The interface is titled "LightningCast" and includes a description: "The ProbSevere LightningCast model is a convolutional neural network." Below this, there are links for "Training materials and GRLevelIX" and "LightningCast in AWIPS".

The main interface features a sidebar on the left with a "Select sector" dropdown menu. The selected sector is "Guam". The main map area shows a lightning forecast for Guam, with a time stamp of "2022-10-26 20:20UTC" and coordinates "17.48°N 145.94°E". The map displays a lightning forecast with a color scale from blue (low) to red (high). A magenta circle highlights the location of Guam on the map.

The "Products & Layers" panel on the right shows a collection of products, including "LightningCast Himawari Guam", "OPC & TAFB Offshore Zones", "GOES-West GLM FED CONUS", and "Himawari AHI Full Disk B03 Hi-Res 'Red' Visible".

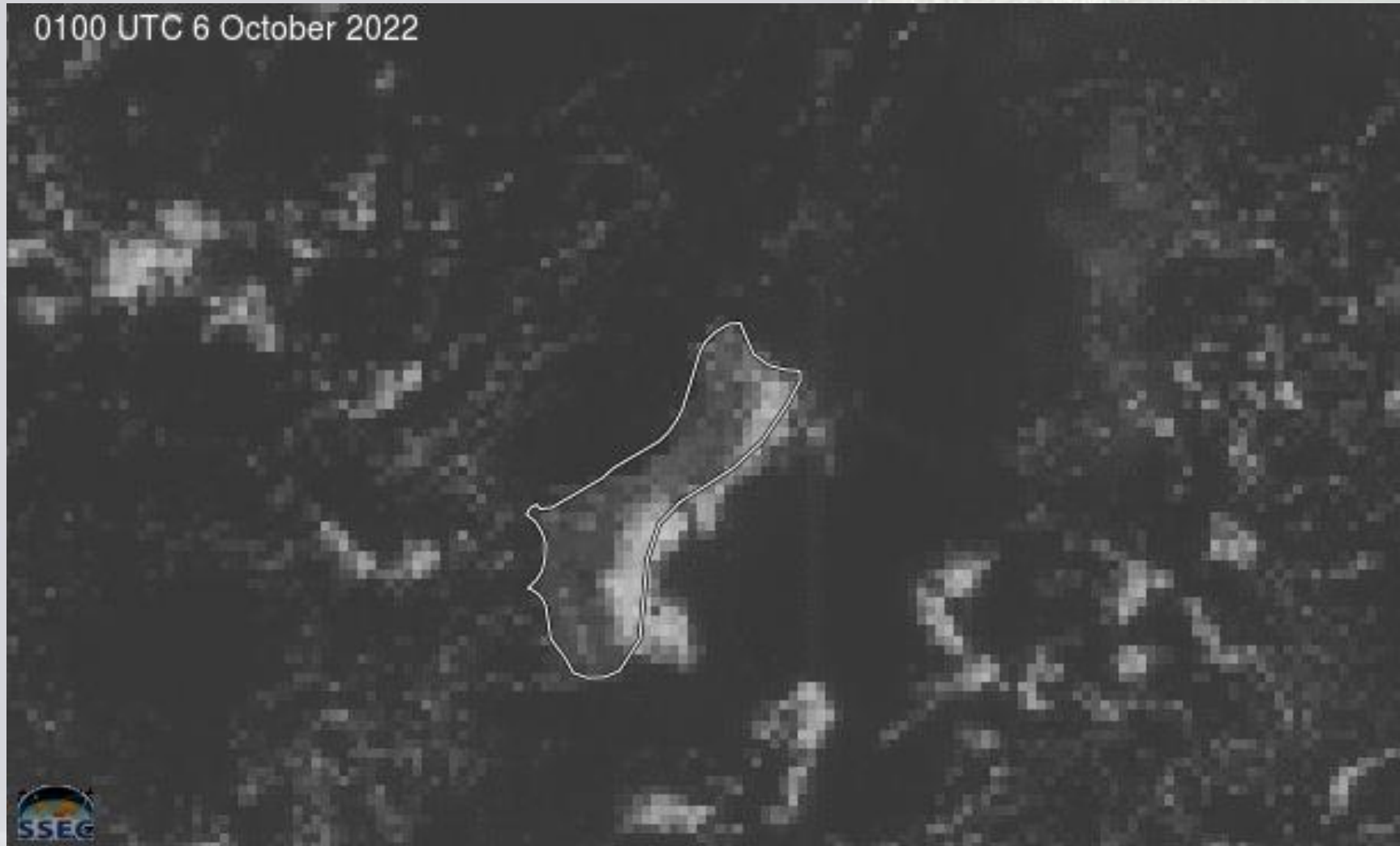
At the bottom of the page, there is a disclaimer: "ProbSevere uses data from NOAA-sourced or NOAA-contracted satellites, radars, lightning networks, and numerical weather prediction models. This webpage is hosted at the Space Science and Engineering Center at the University of Wisconsin. Any user of this webpage and its associated pages implicitly agrees to use the services and data available as is with no warranty issued or implied and should be used for informational purposes only. Any use of this data for decision making processes is done at the sole risk of the end user. Do not reproduce or disseminate without consent of University of Wisconsin-Madison CIMSS/SSEC. For more information about this product, please [contact us](#)."

Note: USA NWS offices can get this information directly into AWIPS displays in the forecast office;

CIMSS is working on implementing this into the AWIPS at NWS GUM.

(Guam is circled in magenta)

# Example with very light winds

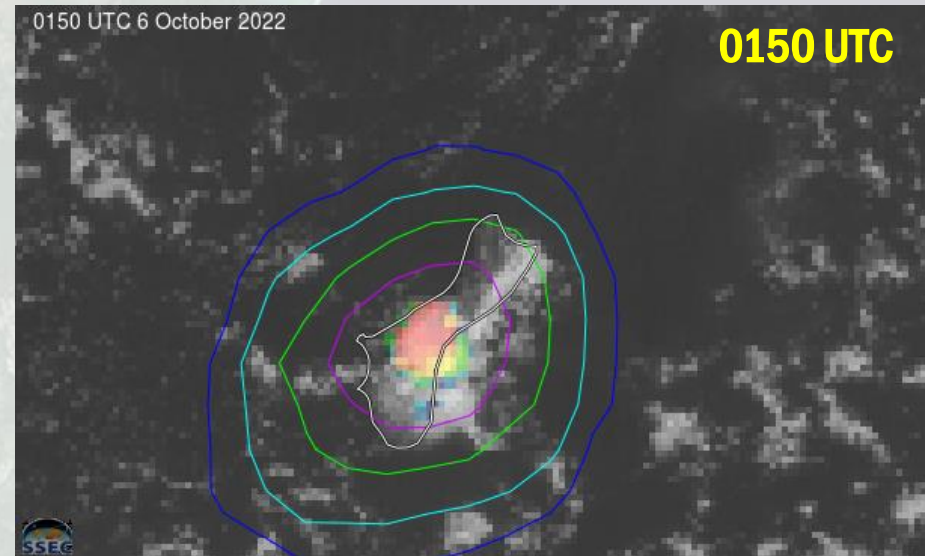
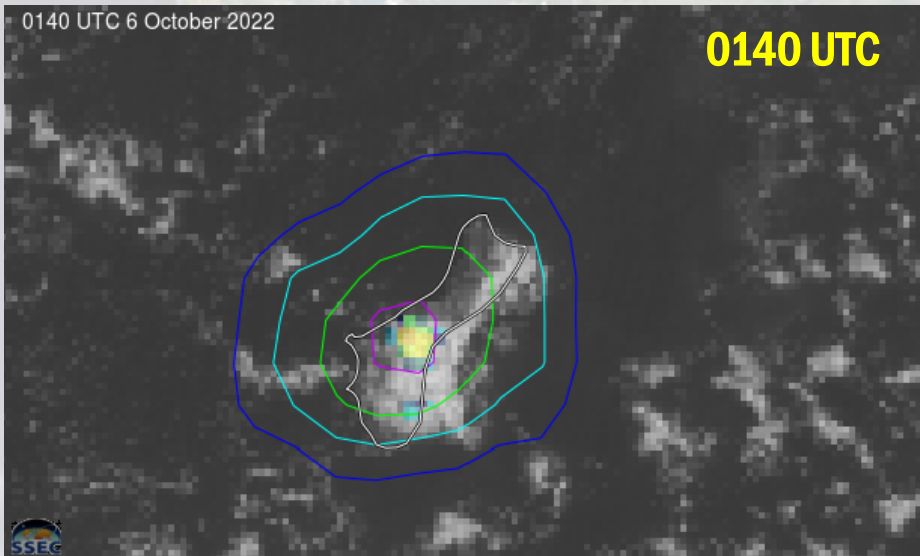
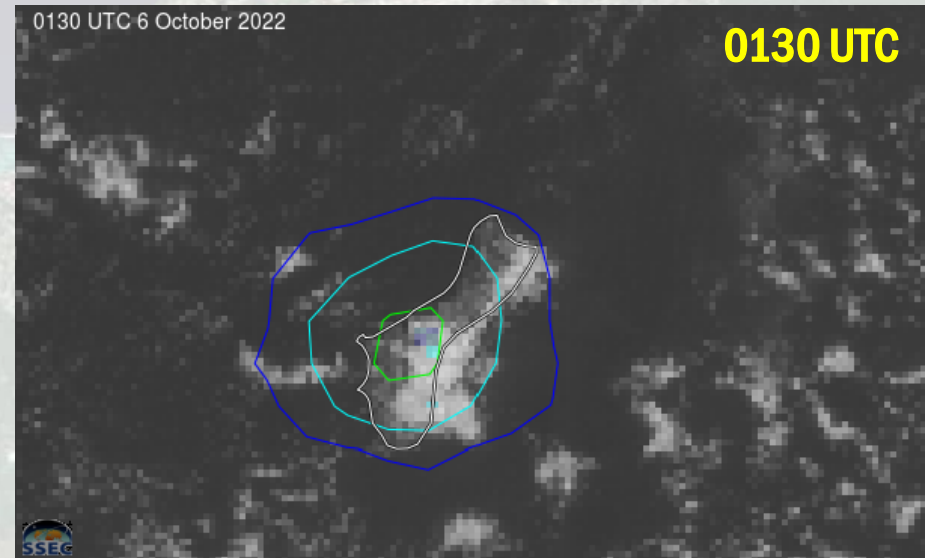
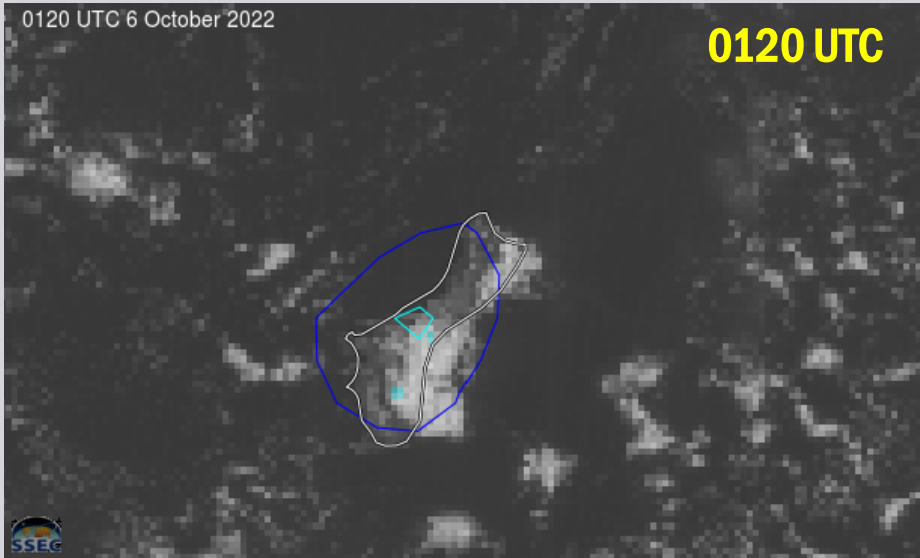


Watched this in real time

Surprised to see that contour show up at 0110 UTC – especially given that very little else seemed to change!

Light showers were occurring along the eastern shore of Guam under those clouds

# Given how things were changing...lightning?



There is also a time delay in the imagery coming in – about 12-15 minutes, not because it takes a long time for LightningCast to be computed – that’s really very fast – but because the Himawari-8 data has to move from JMA to NOAA



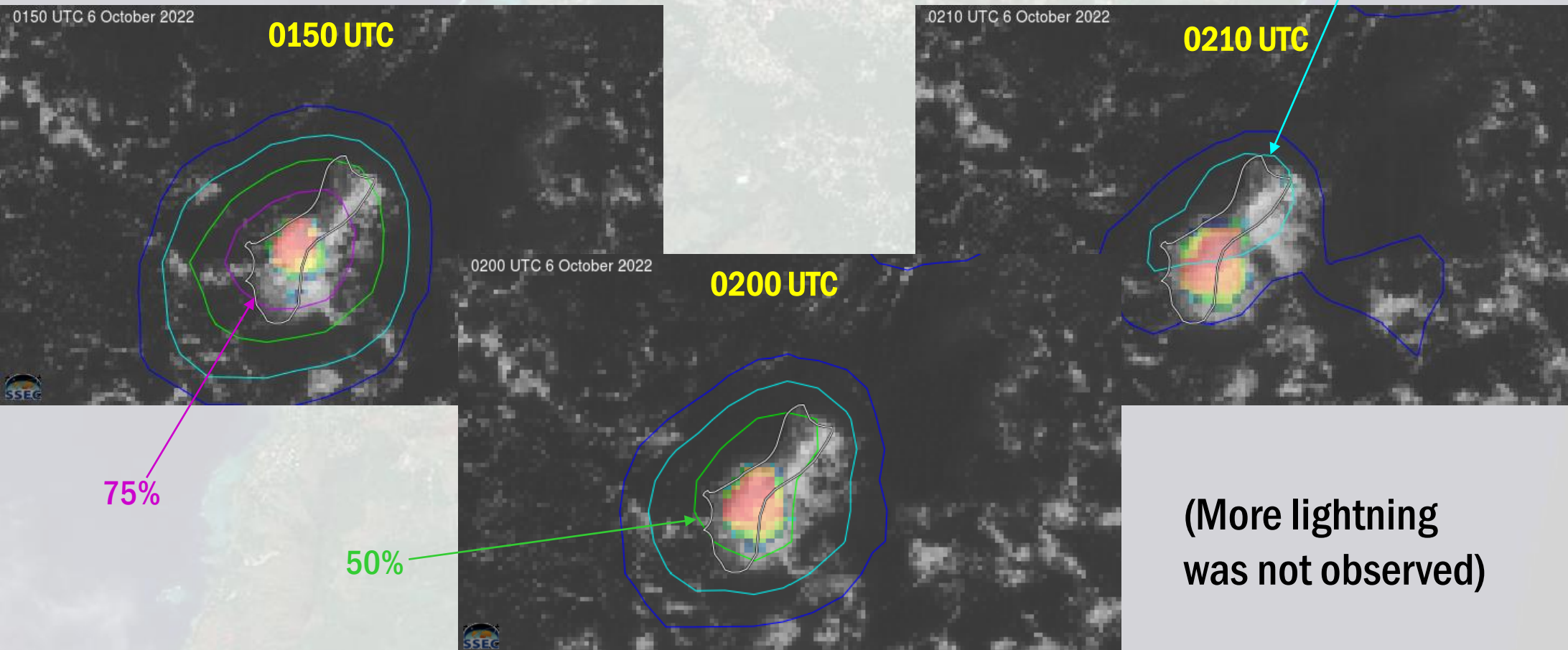
# First lightning: Off the east coast of Guam at 0141 UTC



Range Rings  
5 Minute CG Return Stroke NLDN & GLD Lightning Plot Thu 01:45Z 06-Oct-22  
\* 5 Minute Cloud Pulse NLDN & GLD Lightning Plot Thu 01:45Z 06-Oct-22  
5 Minute Old CG Return Stroke NLDN & GLD Lightning Plot Thu 01:45Z 06-Oct-22  
4 Minute Old CG Return Stroke NLDN & GLD Lightning Plot Thu 01:45Z 06-Oct-22  
3 Minute Old CG Return Stroke NLDN & GLD Lightning Plot Thu 01:45Z 06-Oct-22  
2 Minute Old CG Return Stroke NLDN & GLD Lightning Plot Thu 01:45Z 06-Oct-22  
1 Minute Old CG Return Stroke NLDN & GLD Lightning Plot Thu 01:45Z 06-Oct-22  
No Data Available

# Given how things were changing.....

- Would you expect lightning to continue?

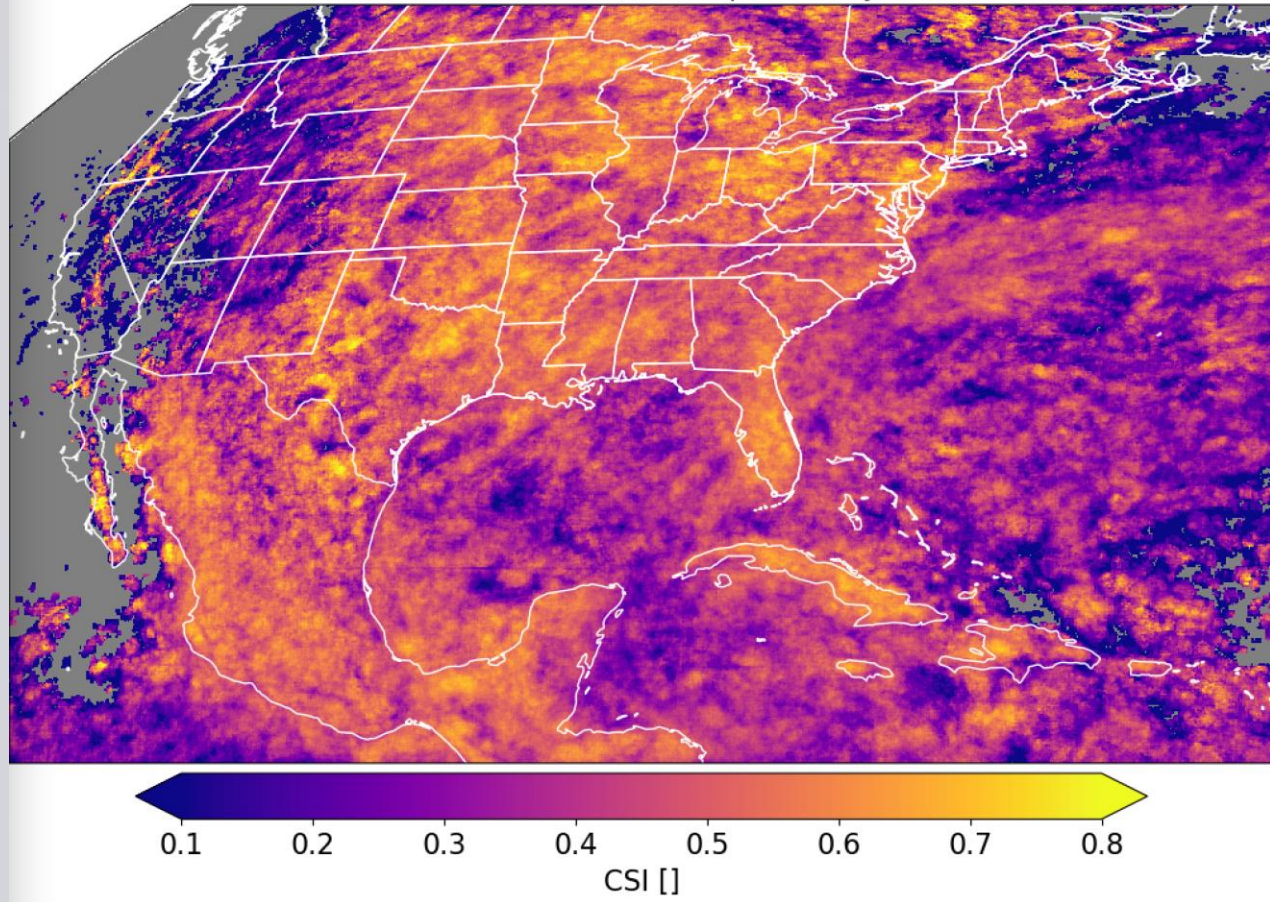


# Commentary from Guam

- Just last night, we had several booms close to the airport, but unfortunately the airport TS warning was issued after the booms. The next morning, looking at radar and LC, I noted the cells developed fairly quickly east of the island and matured to Itg production over the island. Without LC, I'd agree such cases would be difficult to predict by Sat/Rad alone, but the LC did show 50% and even 75% just before Itg occurred. Convection was generally short-lived across the region with cells tending to produce a quick burst of Itg then dissipating. LC probs were expectedly noisy with all the convection around, but did seem to latch on to the active convective elements with some slight off-centeredness (perhaps bridging multiple areas?). I'd asked the forecaster today if he was looking at LC online, but he wasn't
- One of the lead forecasters had recently cited a 75% prob that ultimately had no Itg. I believe I loaded the loop or an image on it. I'll admit, tropical convection can be confounding with occasions of widespread convection and -70C to -80C cloud tops and no Itg, and other times, warmer cloud tops and much Itg.
- A number of forecasters have been using it and seem to be fond of it. Like anything new, though, longer-term forecasters will be more gradual in adopting new datasets into ops, but I believe LC would provide tangible benefits to our situational awareness. I'm thumbs up for considering getting this into our AWIPS.

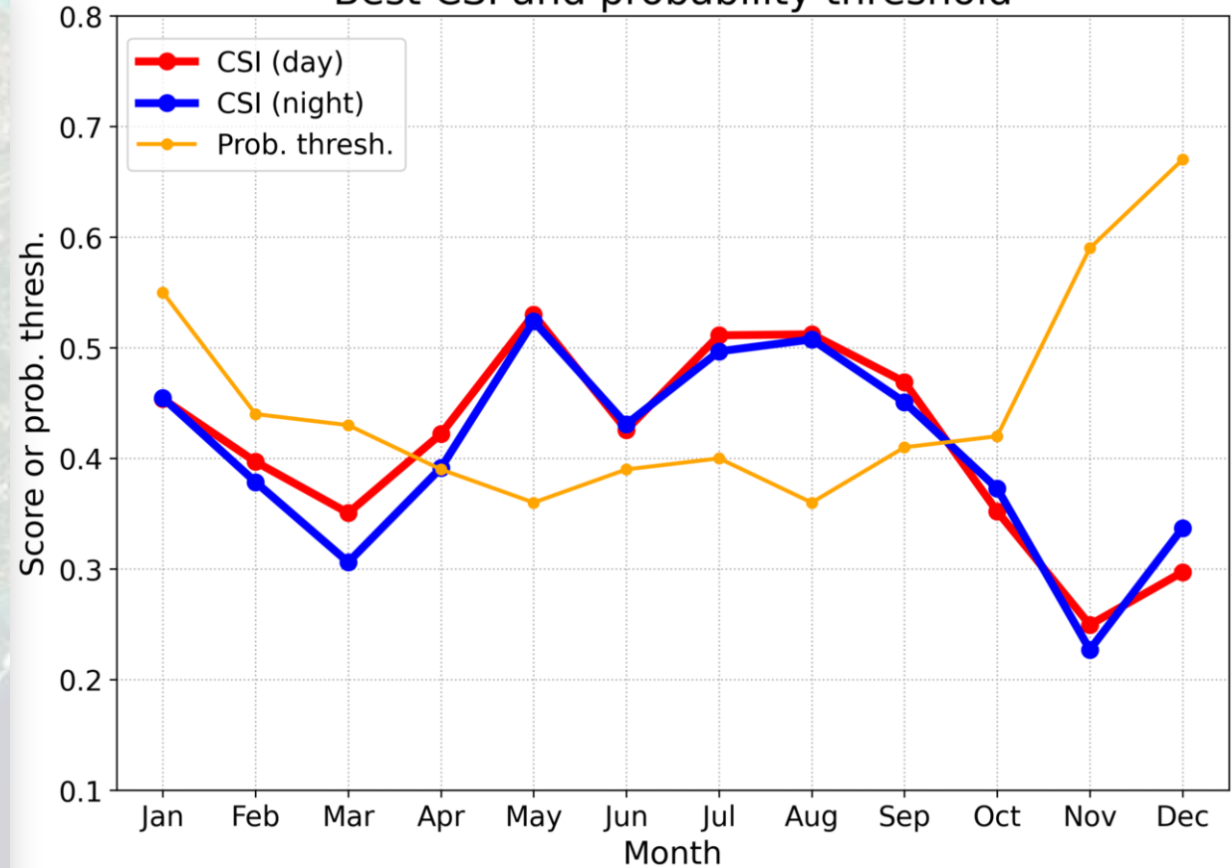
# Verification - GOES-16

Critical Success Index (CSI) at probability  $\geq 40\%$



**Critical success index for probability > 40%**

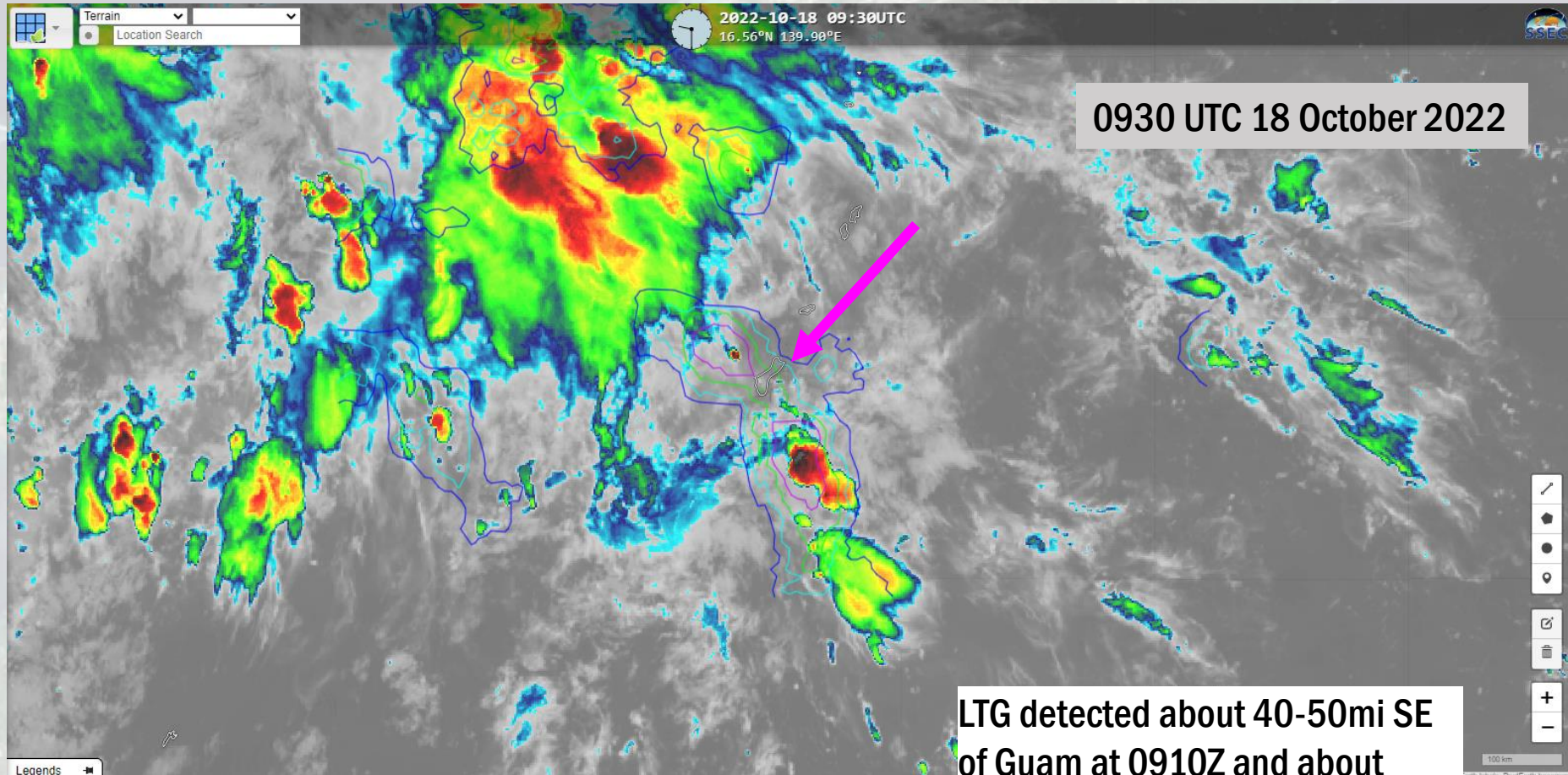
Best CSI and probability threshold



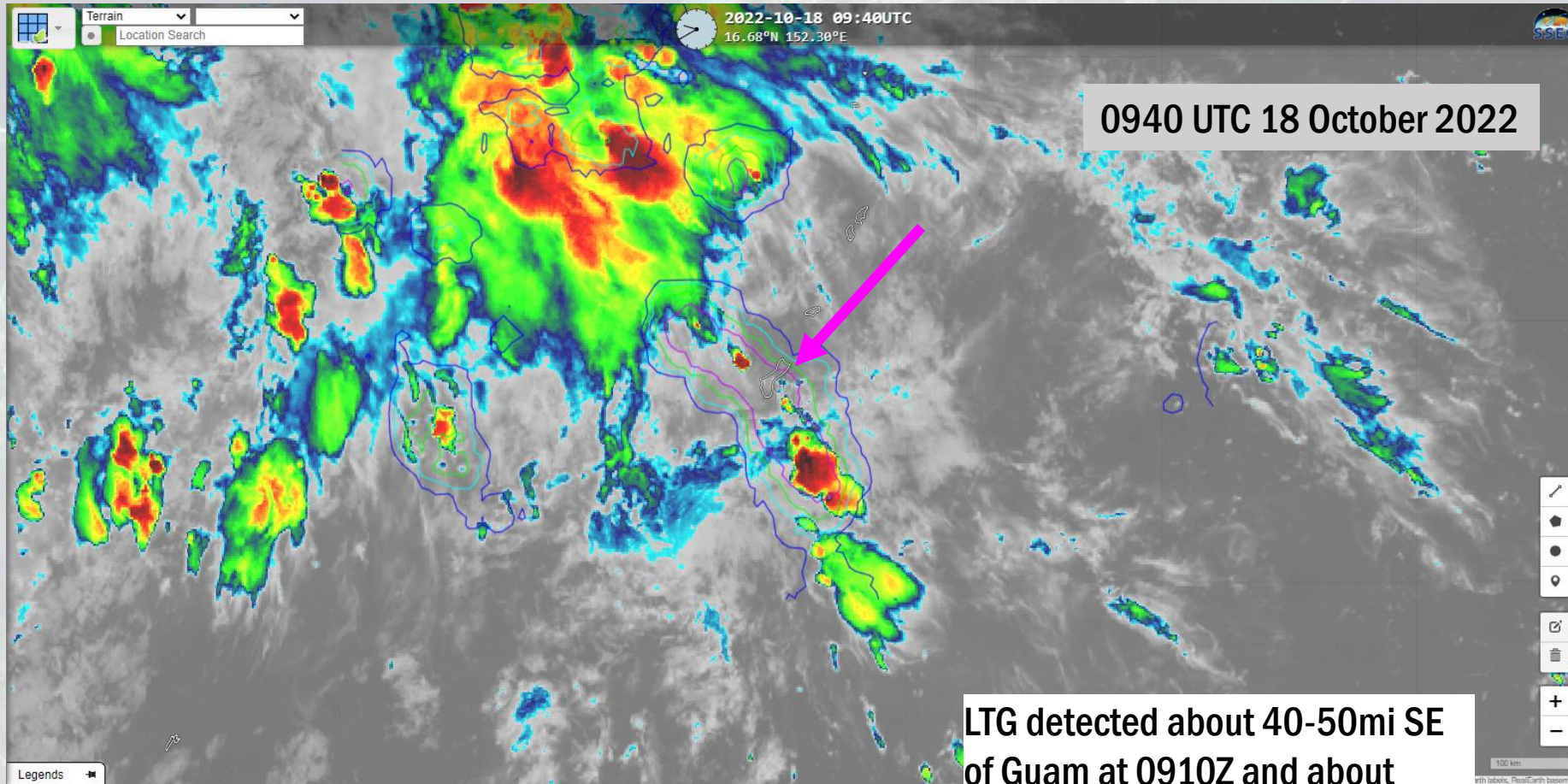
**Seasonal performance**



# The previous example was straightforward



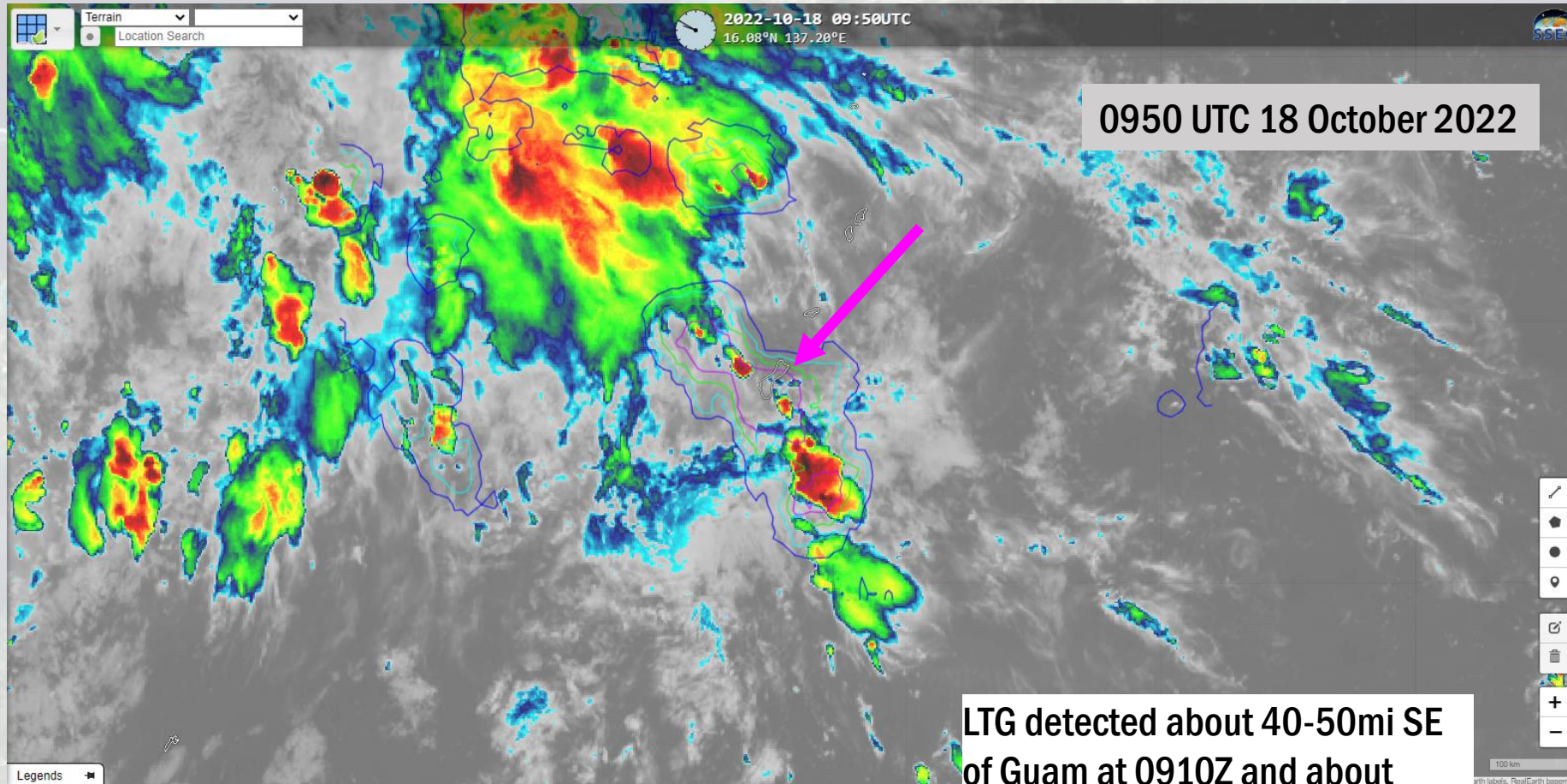
**In this example, Lightning occurred nearby but not within the LightningCast contours over the island**



0940 UTC 18 October 2022

LTG detected about 40-50mi SE of Guam at 0910Z and about 30mi WNW of Guam at 0950Z

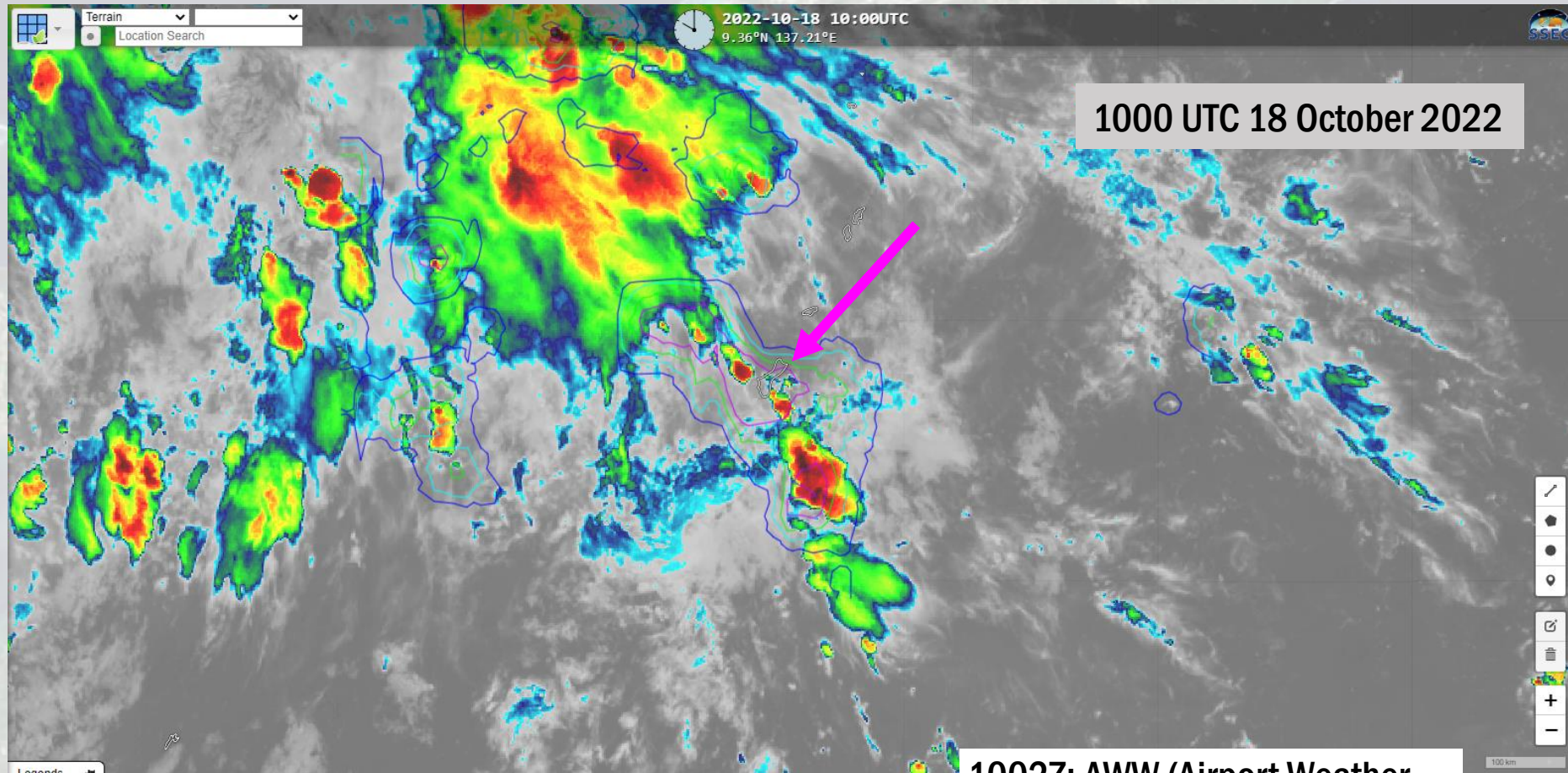
**In this example, Lightning occurred nearby but not within the LightningCast contours over the island**



0950 UTC 18 October 2022

LTG detected about 40-50mi SE of Guam at 0910Z and about 30mi WNW of Guam at 0950Z

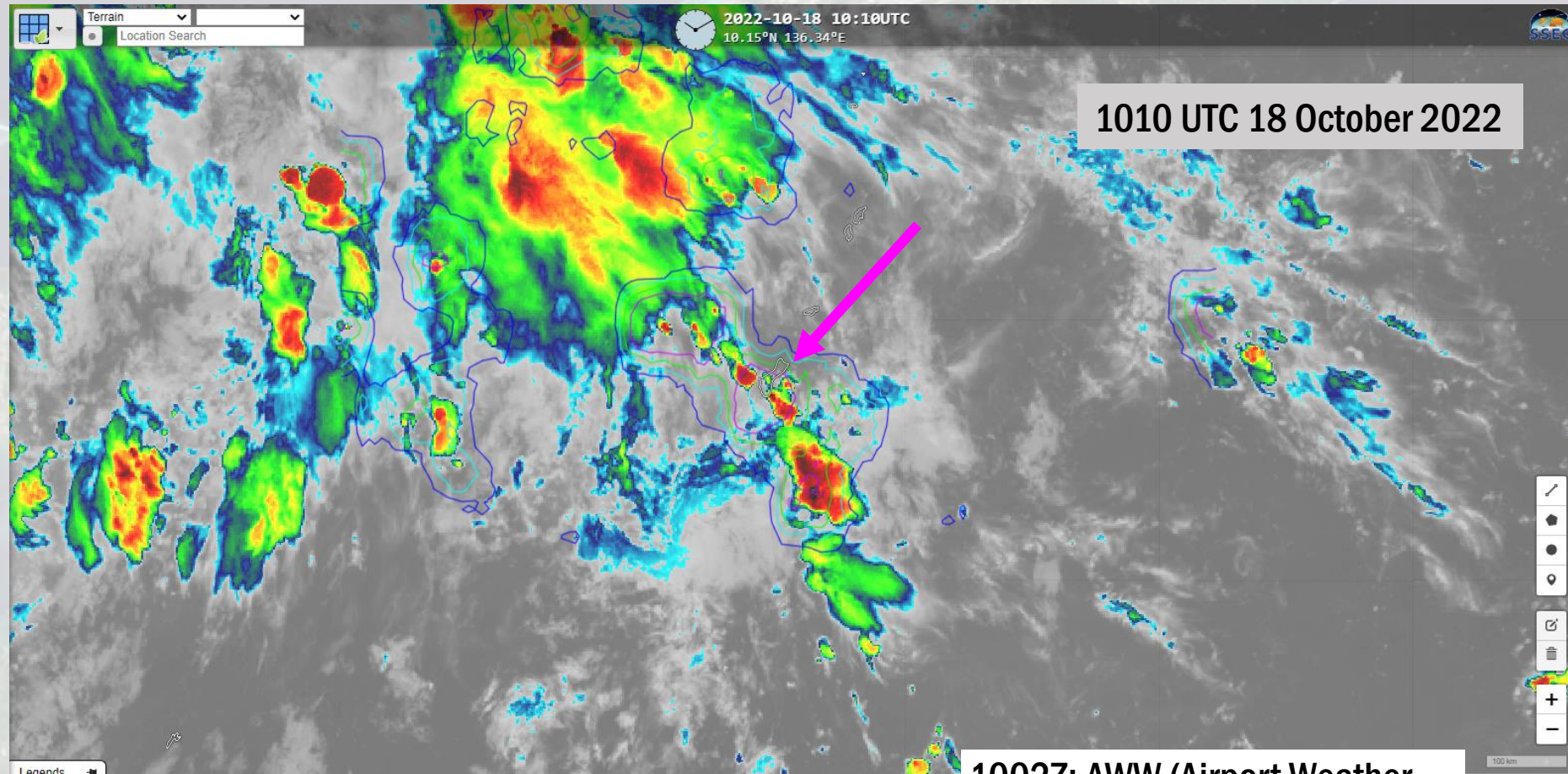
# In this example, Lightning occurred nearby but not within the LightningCast contours over the island



1002Z: AWW (Airport Weather Warning) TS Advy issued



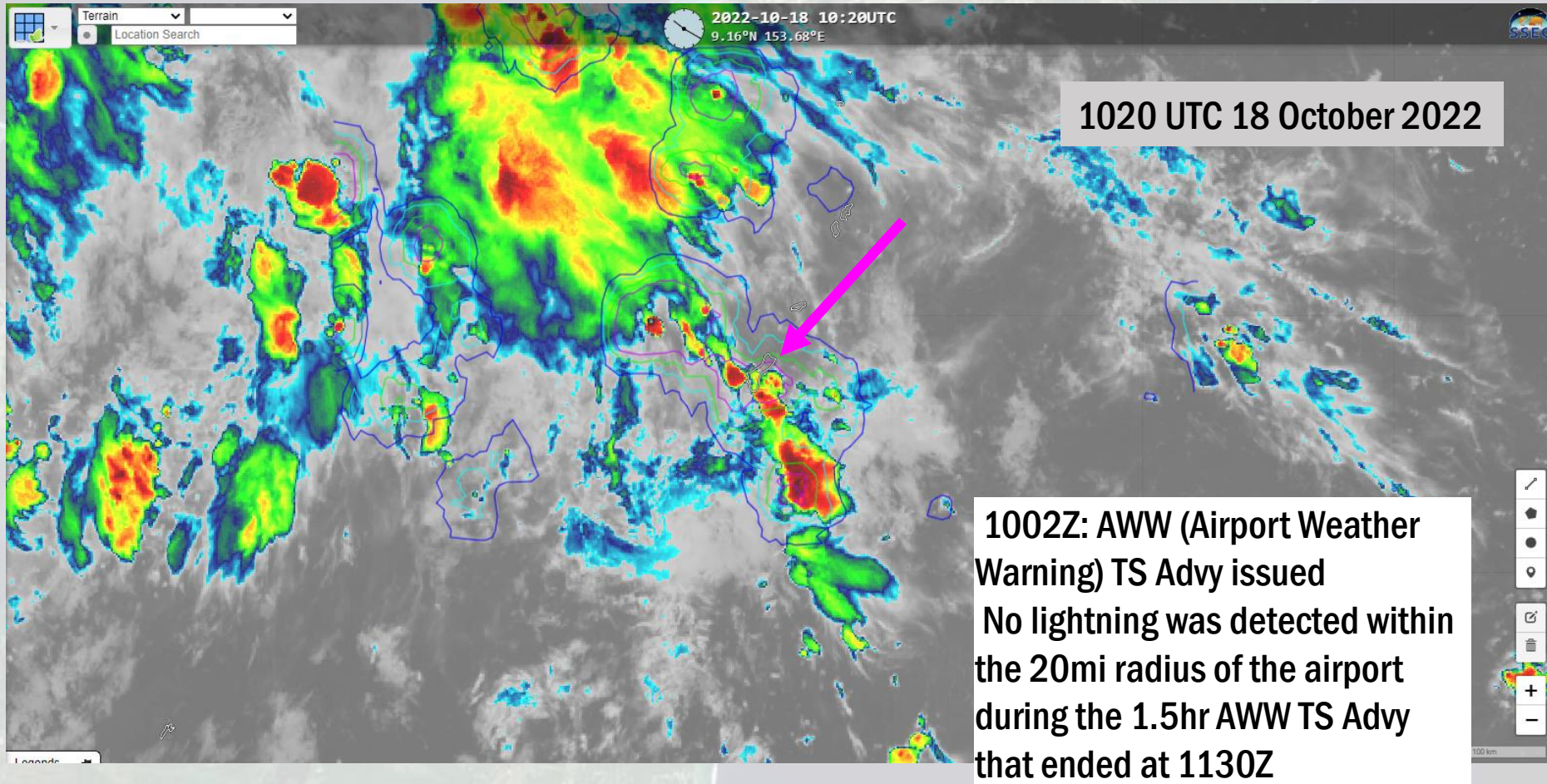
**In this example, Lightning occurred nearby but not within the LightningCast contours over the island**



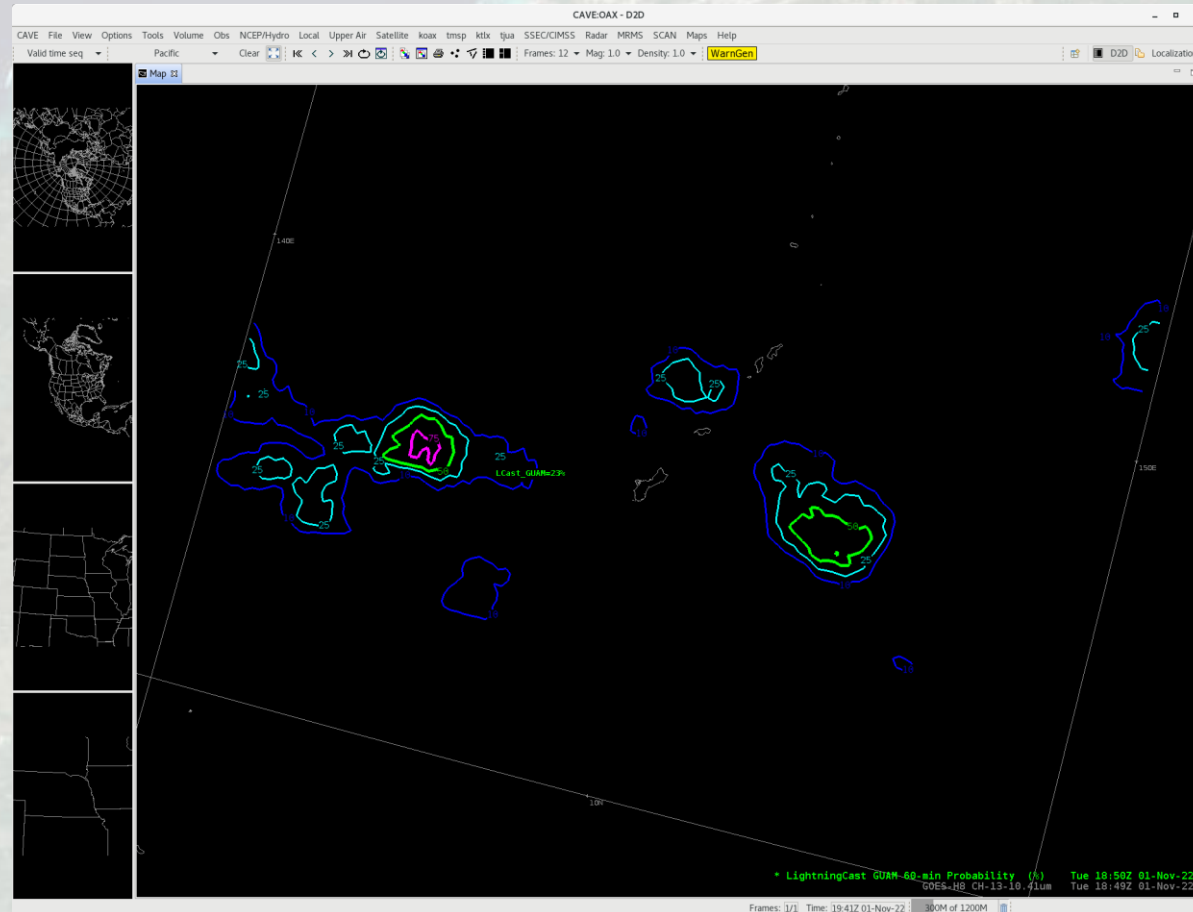
1010 UTC 18 October 2022

1002Z: AWW (Airport Weather Warning) TS Advy issued

**In this example, Lightning occurred nearby but not within the LightningCast contours over the island**



# Early November: Added to AWIPS!



# This is ongoing work!

- Forecasters at WFO Guam continue to evaluate the product, and get used to its performance under different weather regimes
- CIMSS is working on direct input into AWIPS so the product is more readily compared to satellite and radar
- Questions?
  - [william.aydlett@noaa.gov](mailto:william.aydlett@noaa.gov) (S00 at WFO Guam)
  - [scott.lindstrom@noaa.gov](mailto:scott.lindstrom@noaa.gov) (email me if you want a copy of this presentation)