# PEAR/WWE Seminar Series: GREMLIN + LxCast

Christopher Smith

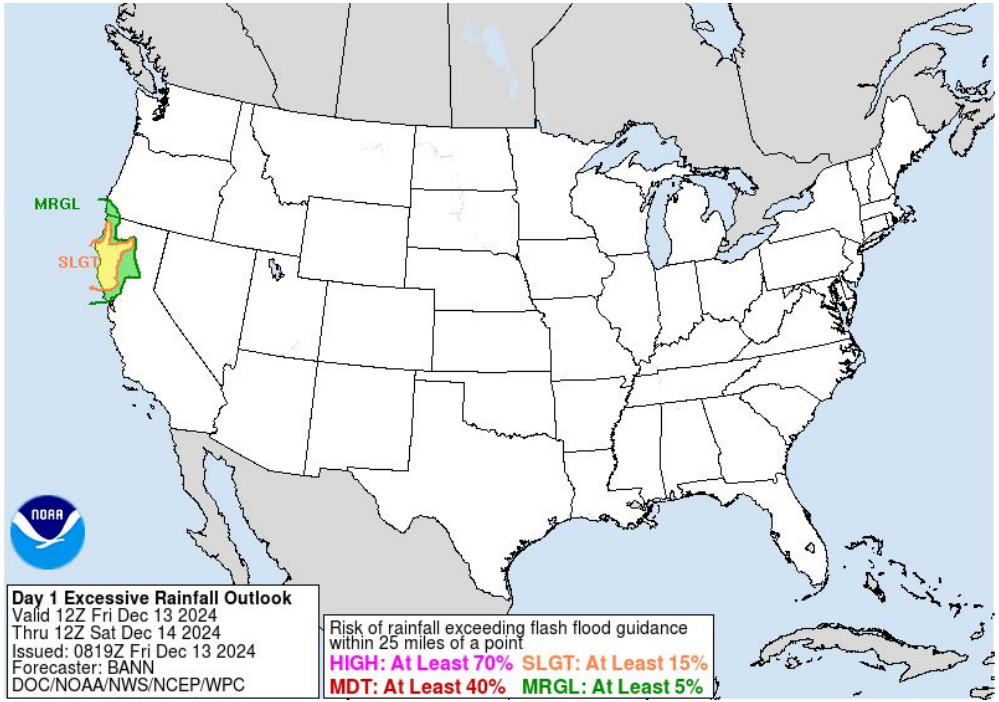
GOES-R Satellite Liaison: NWS WPC/OPC

# My Role

- Infuse satellite products (GOES & LEO) into NWS WPC and OPC operations - mainly through AWIPS-II
- R2O - O2R connection
- Develop outlets for testing new products and provide training on how to use them

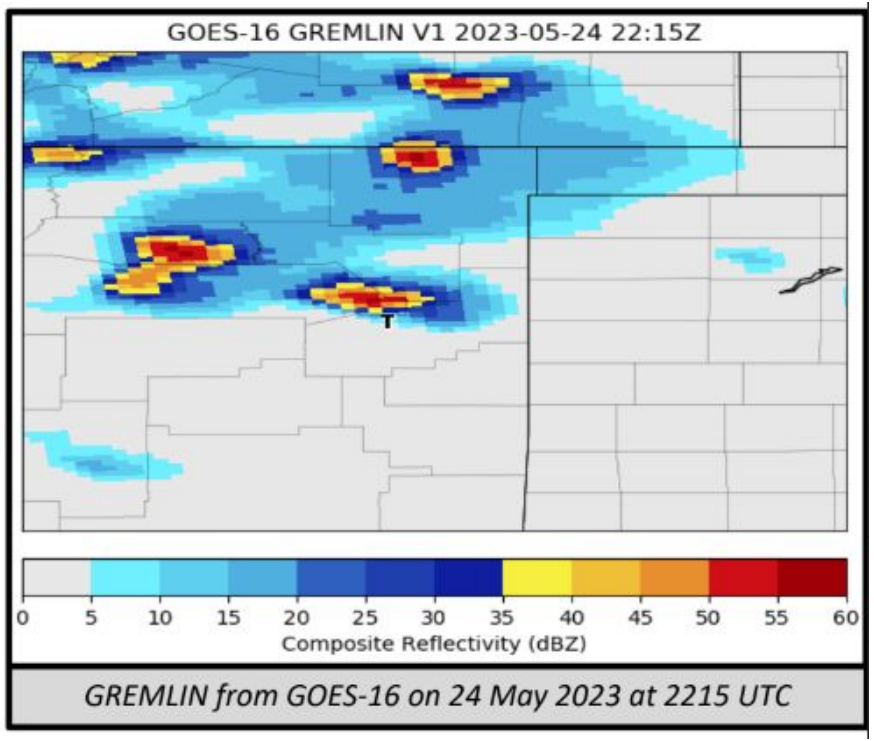
# WPC Overview

- The main desks using satellite products in the WPC Operations Forecast Branch are:
  - Excessive Rainfall Outlook (ERO) Desk
  - QPF Desk
  - MetWatch Desk
  - Surface Analysis Desk



# GREMLIN

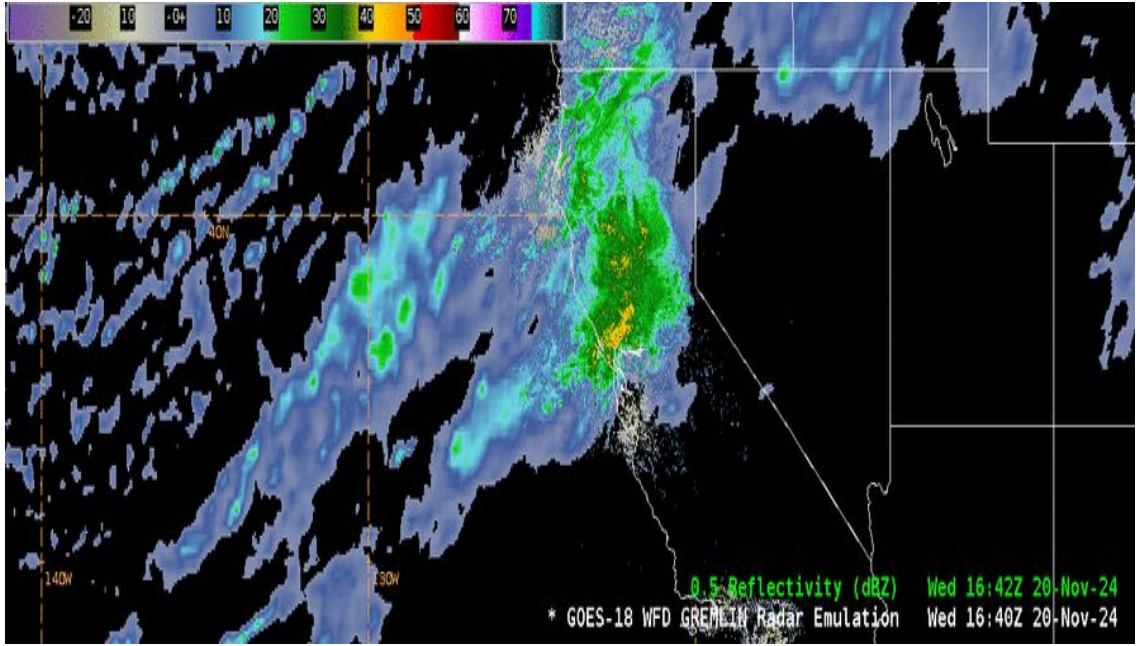
- GOES Radar Estimation via Machine Learning to Inform NWP (GREMLIN) is a machine-learning product using ABI channels (7, 9, & 13), GLM Group Extent Density, and MRMS to simulate radar reflectivity
- GREMLIN has been trained over ⅔ of CONUS, second version is being produced with MRMS training over Hawaii & Japan
- Best used for convective initiation, warm season, and with Ix
- Developer: Kyle Hillburn (CIRA)



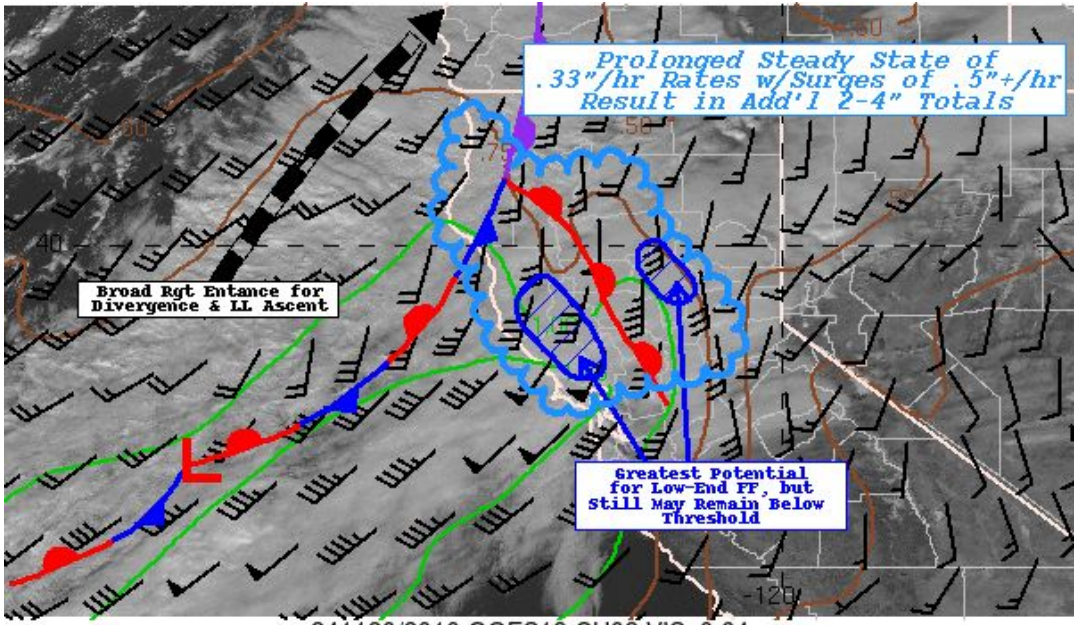
GREMLIN from GOES-16 on 24 May 2023 at 2215 UTC

# GREMLIN: ARs

- GREMLIN in AWIPS
  - Overlaid with ground radar network
- Estimate precipitation rates moving onshore

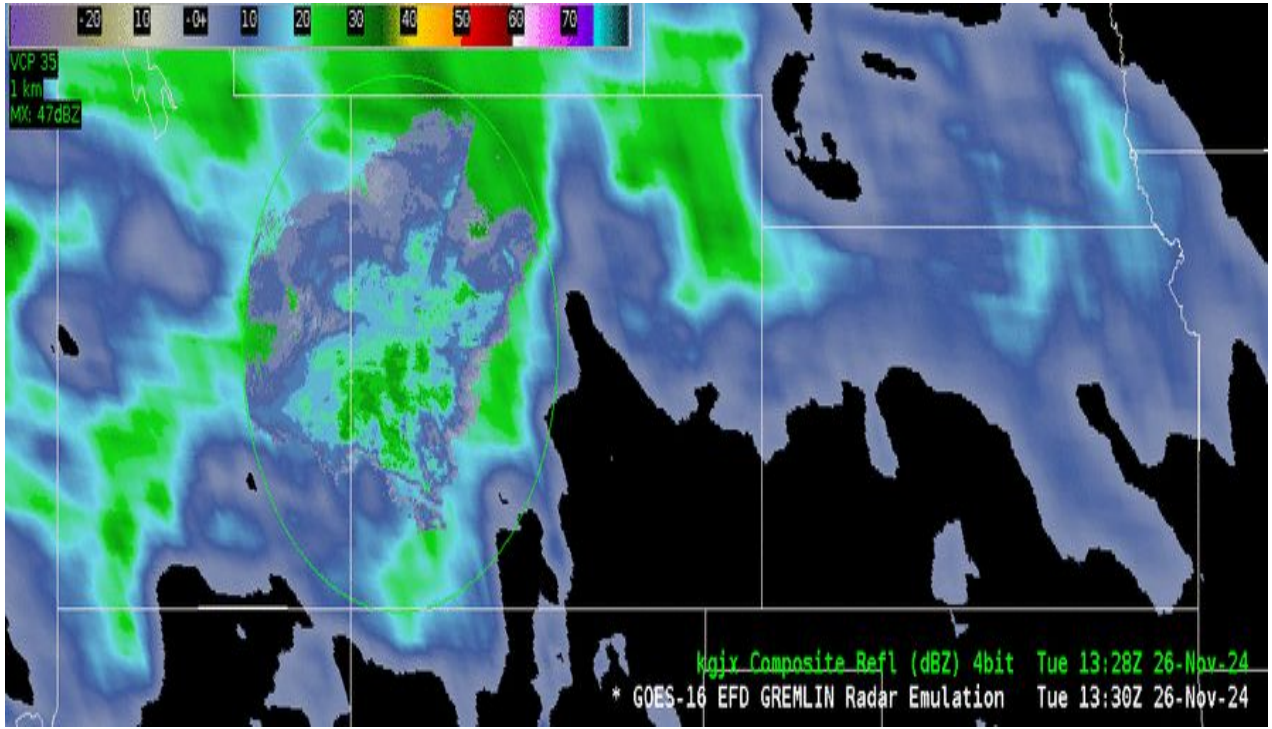


# GREMLIN Use: Mesoscale Precipitation Discussion

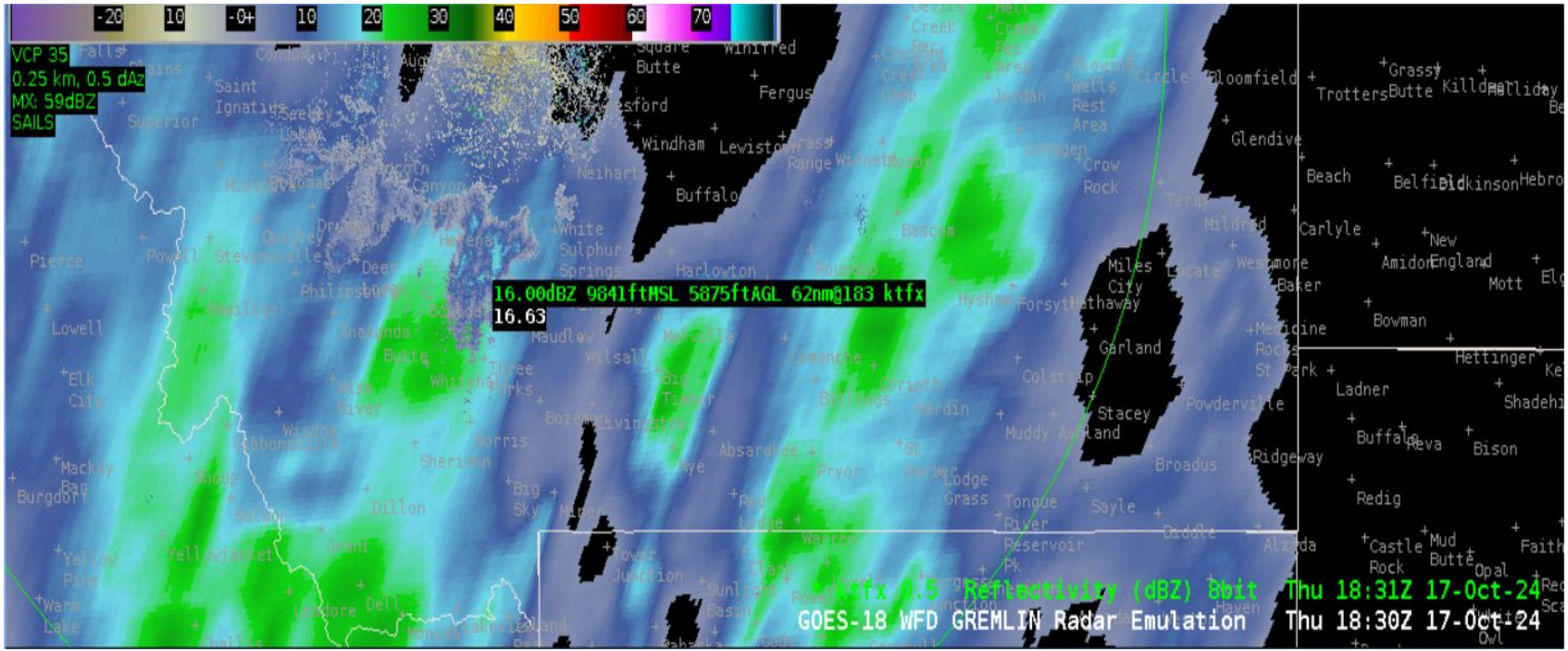


# GREMLIN: Winter Applications

- GREMLIN can fill in radar gaps over mountainous terrain

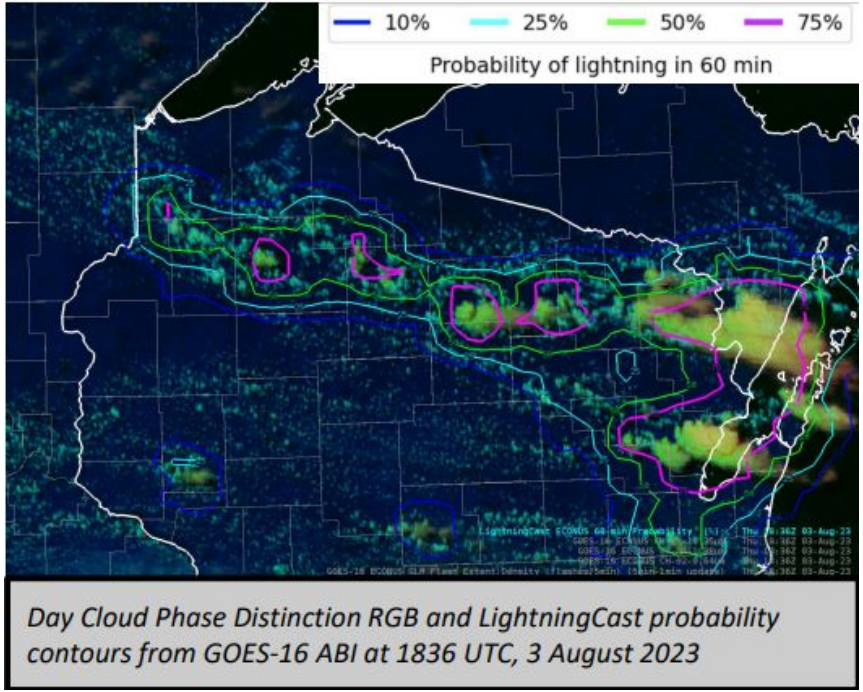


# GREMLIN: Winter Applications



# LightningCast

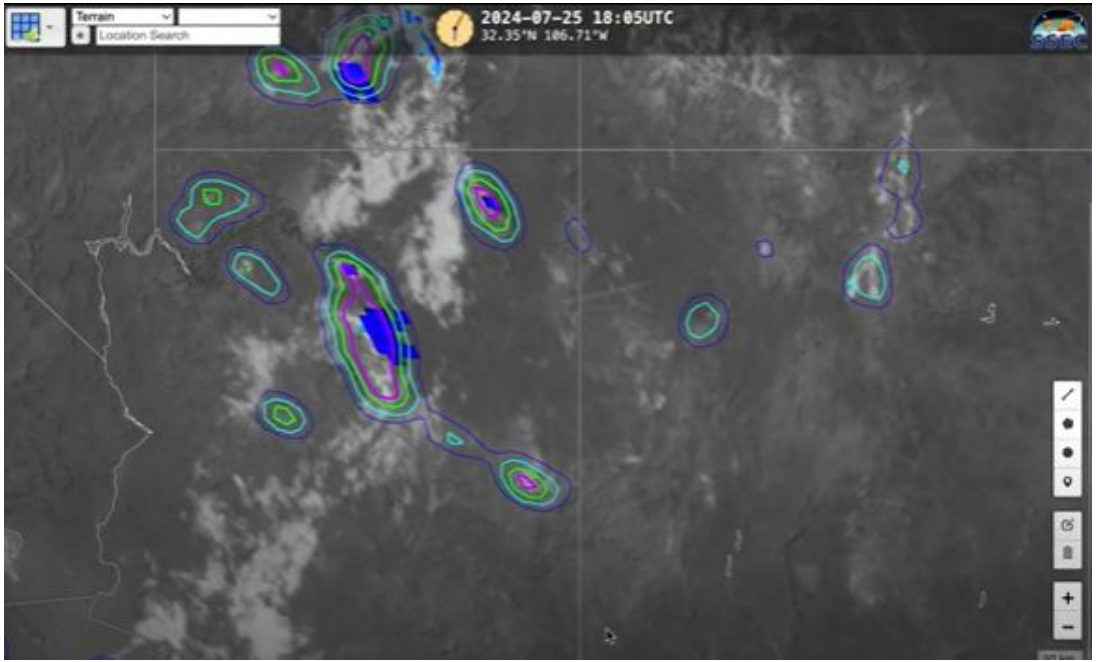
- Machine-learning model that uses ABI channels (2, 5, 13, & 15) to predict the probability that the GLM will observe lightning within the next hour
  - Display over Day Cloud Phase Distinction RGB during the day, Clean Longwave IR Window at Night
  - GLM Flash Extent Density (FED) overlaid
- LightningCast has been trained over CONUS, the Gulf of Mexico, Caribbean, American Samoa, & Guam
- Best used for convective initiation, warm season, and over land
- Developer: John Cintineo (NSSL)




*Day Cloud Phase Distinction RGB and LightningCast probability contours from GOES-16 ABI at 1836 UTC, 3 August 2023*

*Courtesy of CIMSS*

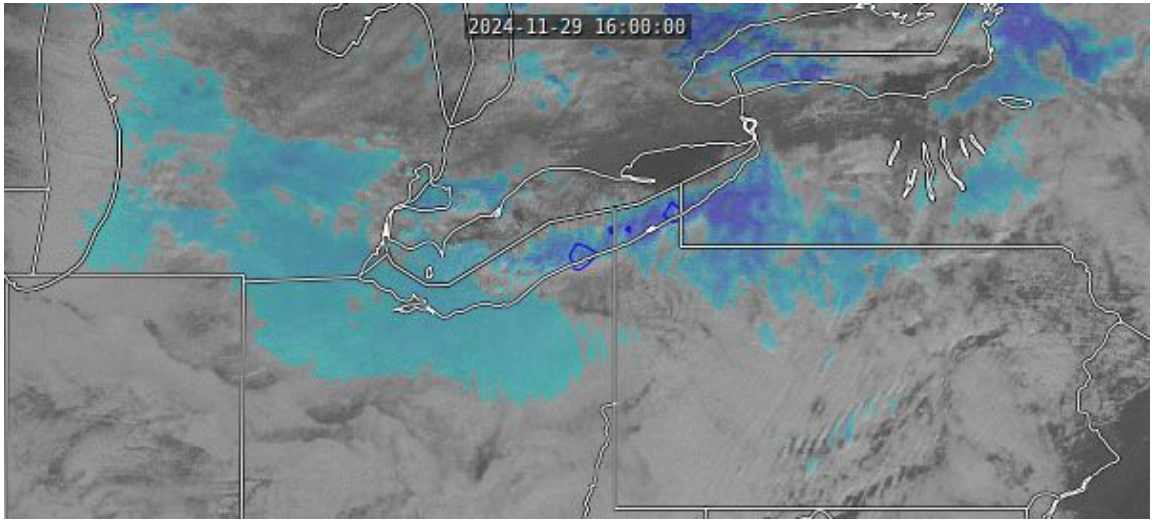
# LightningCast




*Source: SSEC RealEarth, UW-Madison*

# LightningCast: Winter Applications

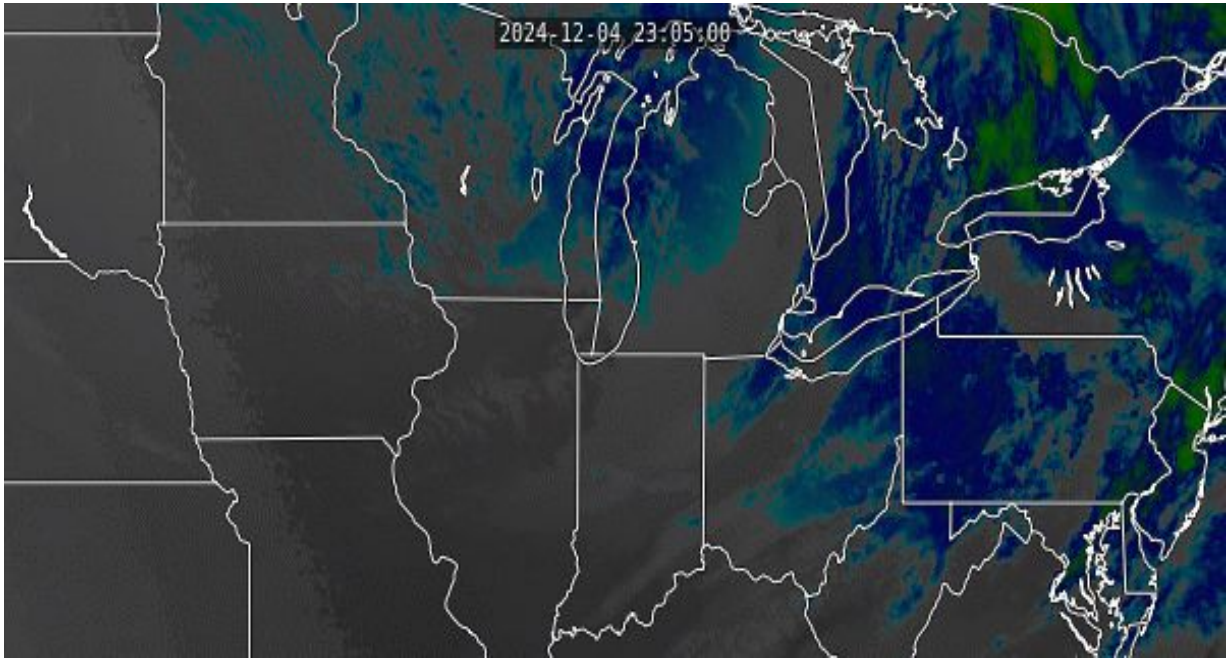
- Available for AWIPS implementation
- LightningCast for this lake effect snow (LES) event focuses on colder cloud top temperatures




*Source: SSEC RealEarth, UW-Madison*

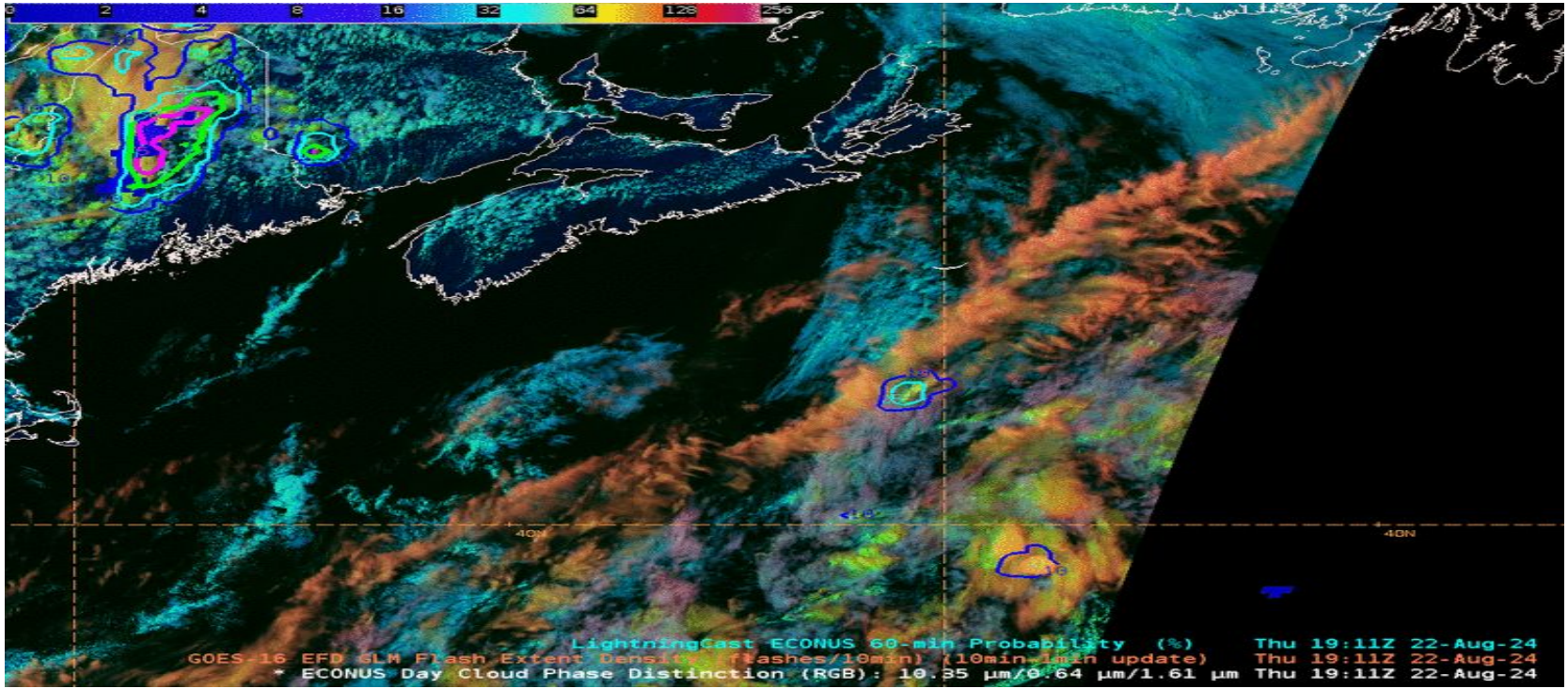
# LightningCast: Winter Applications

- Available for AWIPS implementation
- LightningCast lined up better for the snow-squall case where cold cloud top temperatures coincide with intense precip



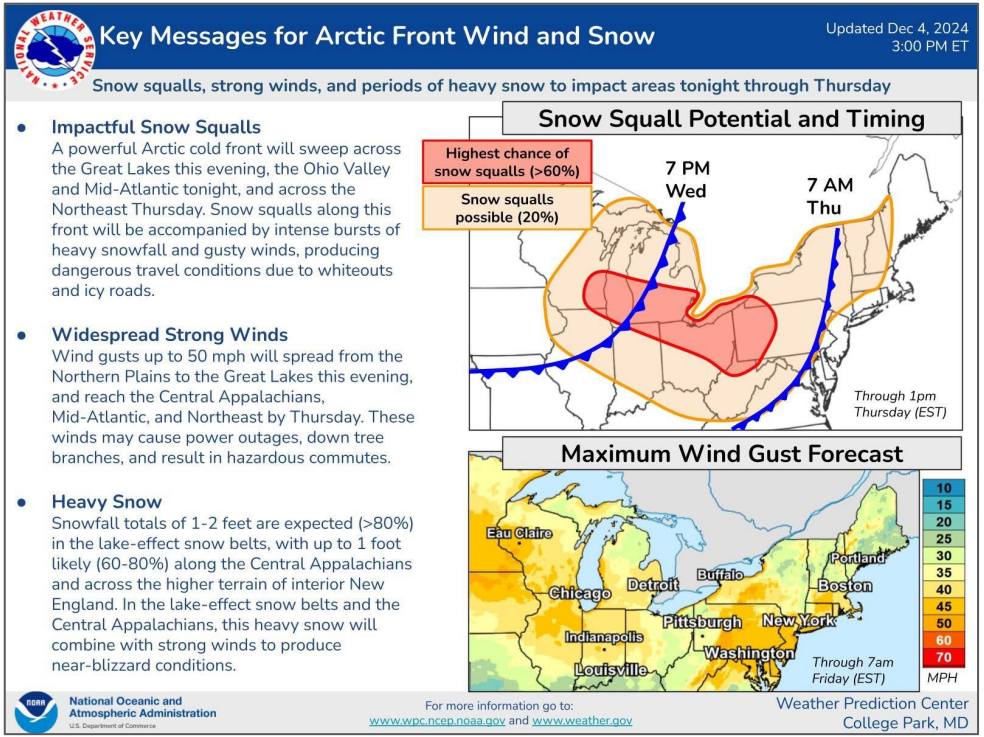

*Source: SSEC RealEarth, UW-Madison*

# LightningCast in AWIPS



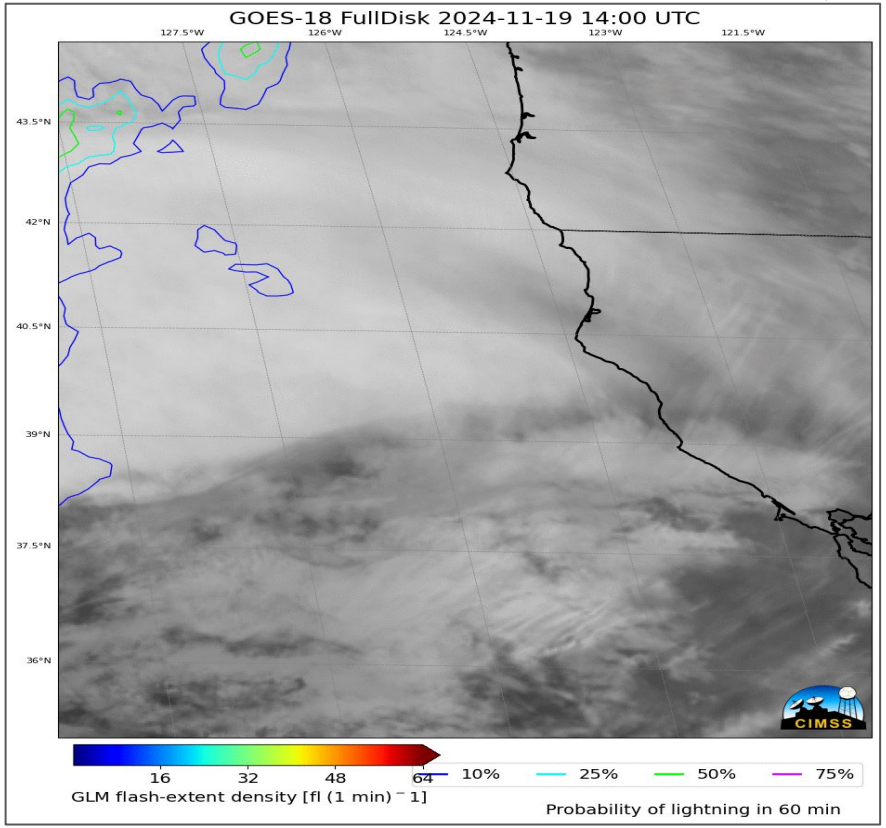
# LightningCast: Winter Applications

- Short-term key messages for heavy snowfall
- Verify WSSI parameters



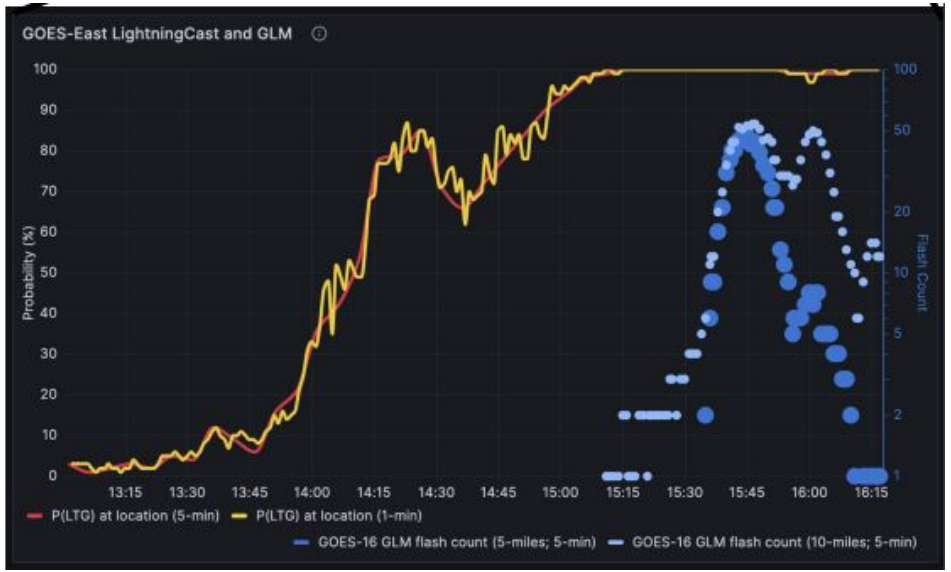
# LightningCast: ARs

- LxCast capturing atmospheric river convection



# LightningCast Future Version

- Future version plans to:
  - Incorporate MRMS
  - Add additional lx networks (i.e. EarthNetworks)
  - Train on a sequence of satellite images (see where, how convection will be advected)
- Operational feed comes 2025
  - Replaces LDM feed out of CIMSS
- Dashboards still come from CIMSS



# Summary

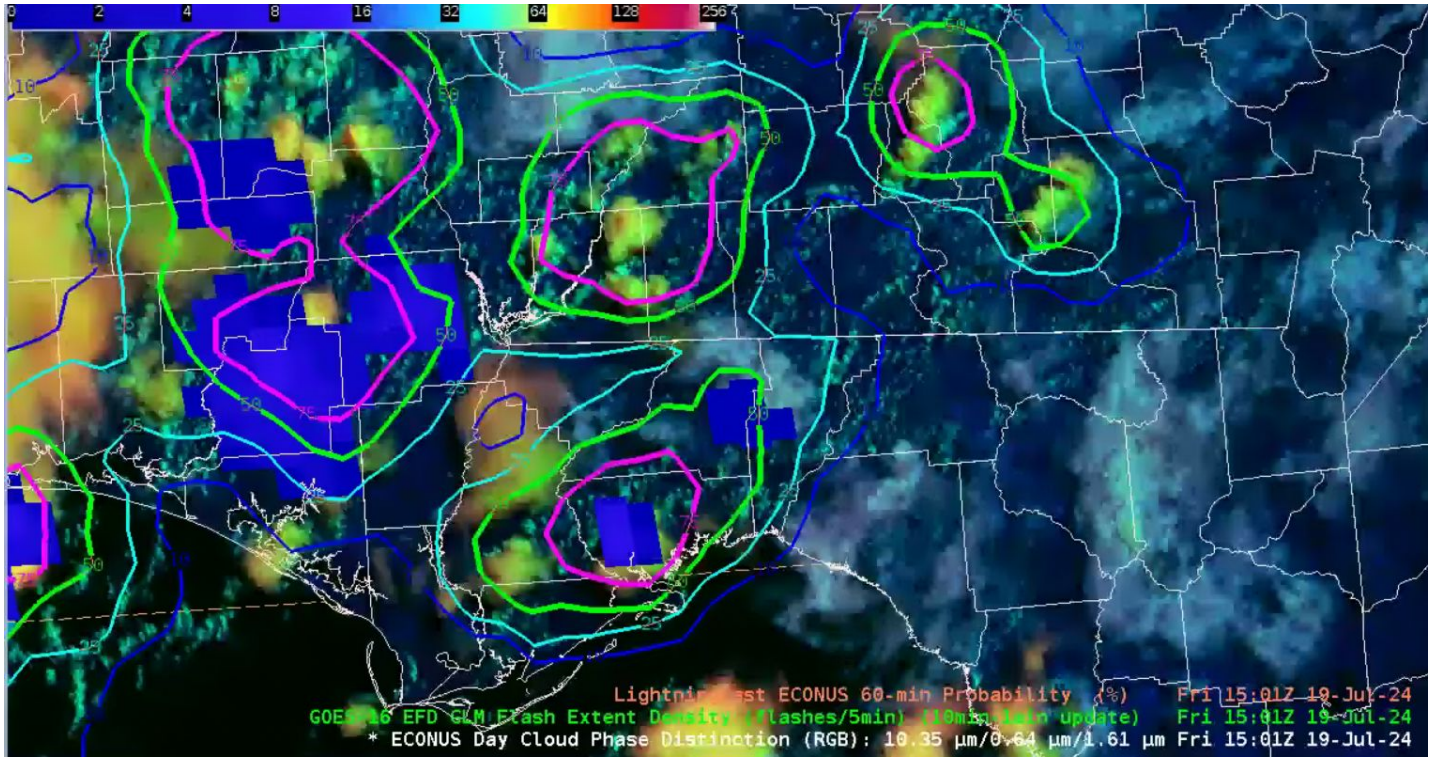
- GREMLIN can provide an estimate of precipitation rates for areas without radar
- LightningCast can signal intense convection in ARs and winter settings

DISCUSSION...The midday GOES-E Day Cloud Phase RGB in conjunction with visible imagery and the ML-driven LightningCast product suggests CI is imminent across areas of southern CO and northern NM including the Sangre De Cristo mountains. Additional areas of CI are imminent also across the higher terrain of eastern AZ. In all of these areas, there is close proximity to some weak MCV energy, and this coupled with the proximity of multiple differential heating boundaries will allow for the rapid development and expansion of heavy shower and thunderstorm activity over the next several hours.

# Resources

1. GREMLIN on CIRA Slider
2. CIMSS LightningCast
3. GREMLIN Quick Guide
4. LightningCast Quick Guide
5. CSPP-GEO: plot archived LightningCast cases
6. HWT Report

# Questions?


0 2 4 8 16 32 64 128 256
Lightning Forecast ECONUS 60-min Probability (%) Fri 15:01Z 19-Jul-24
GOES-16 EFD GLM Flash Extent Density (flashes/5min) (10min. rain update) Fri 15:01Z 19-Jul-24
* ECONUS Day Cloud Phase Distinction (RGB): 10.35 µm/0.64 µm/1.61 µm Fri 15:01Z 19-Jul-24