



ThunderCast: Initial Capabilities

Stephanie Ortland¹, Mike Pavolonis², and John Cintineo^{1,3}

¹University of Wisconsin-Madison

²NOAA/NESDIS/STAR

³Cooperative Institute for Meteorological Satellite Studies

CoRP Symposium

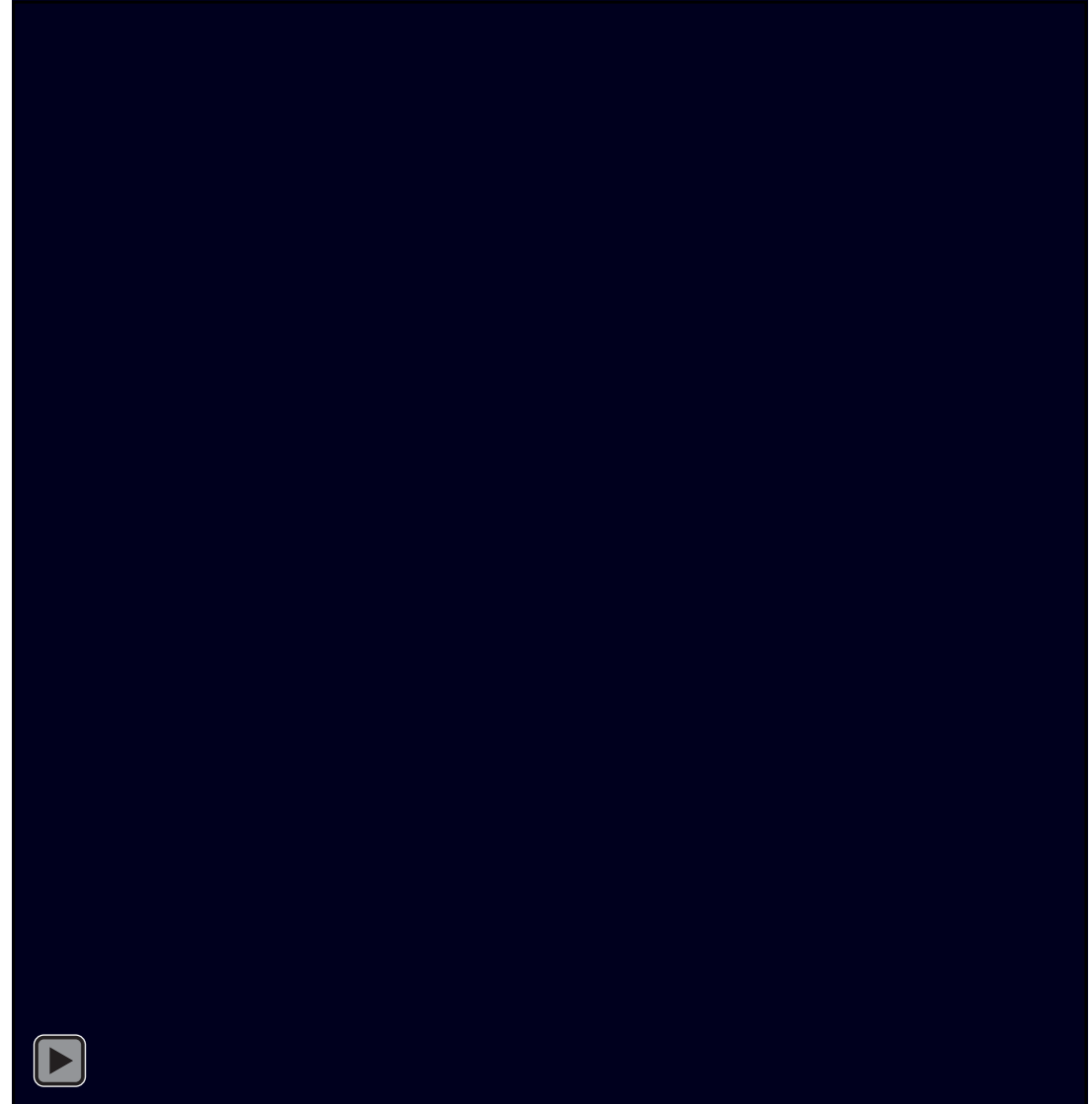
July 2023



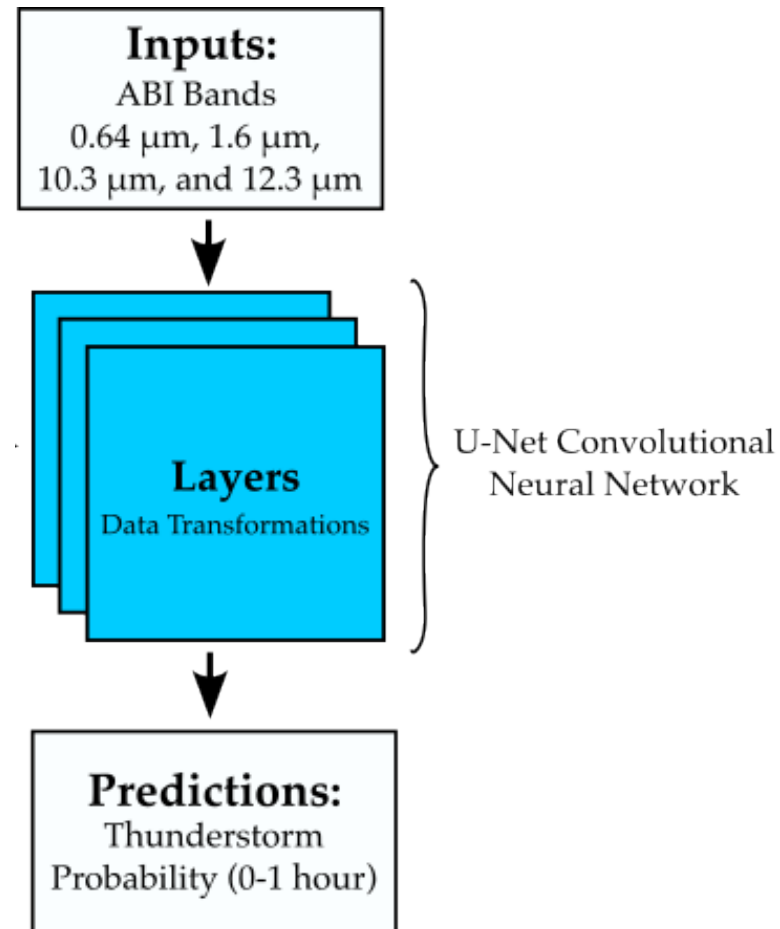
Motivation

- How well can we nowcast thunderstorms in the continental United States (CONUS) with deep learning, satellite imagery, and radar?
 - Lead Time
 - Prediction Localization
- What scientific insights can be gained?

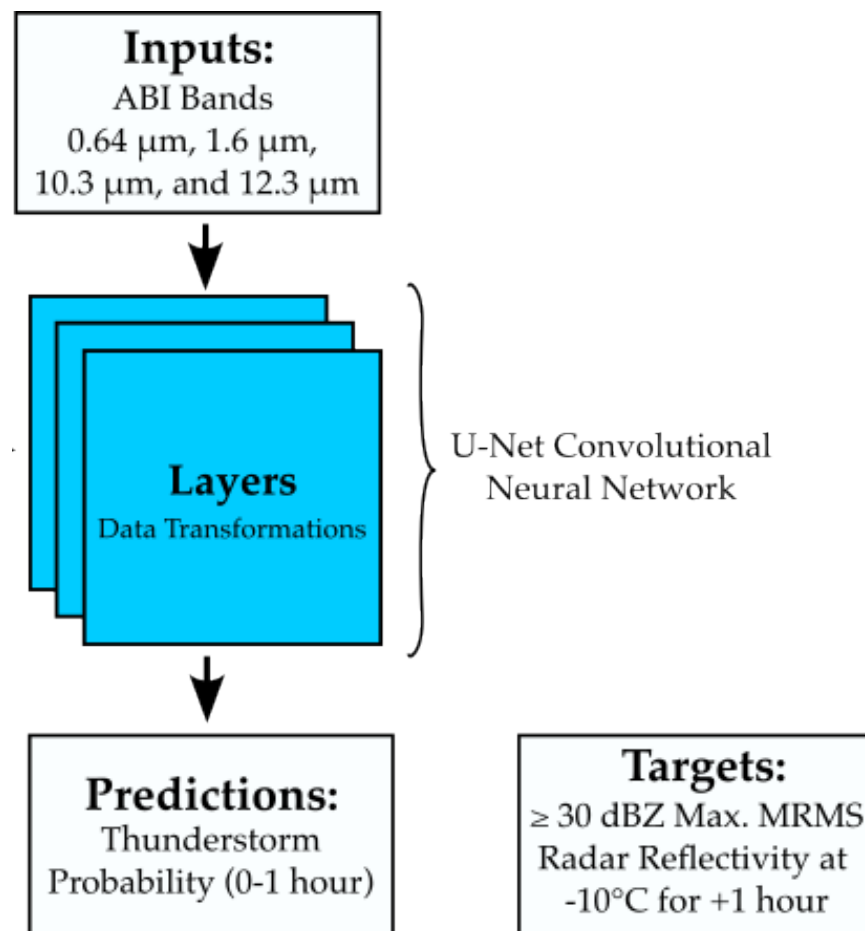
Visible False
Color Image
R: $10.3 \mu m$
G: $0.64 \mu m$
B: $1.6 \mu m$



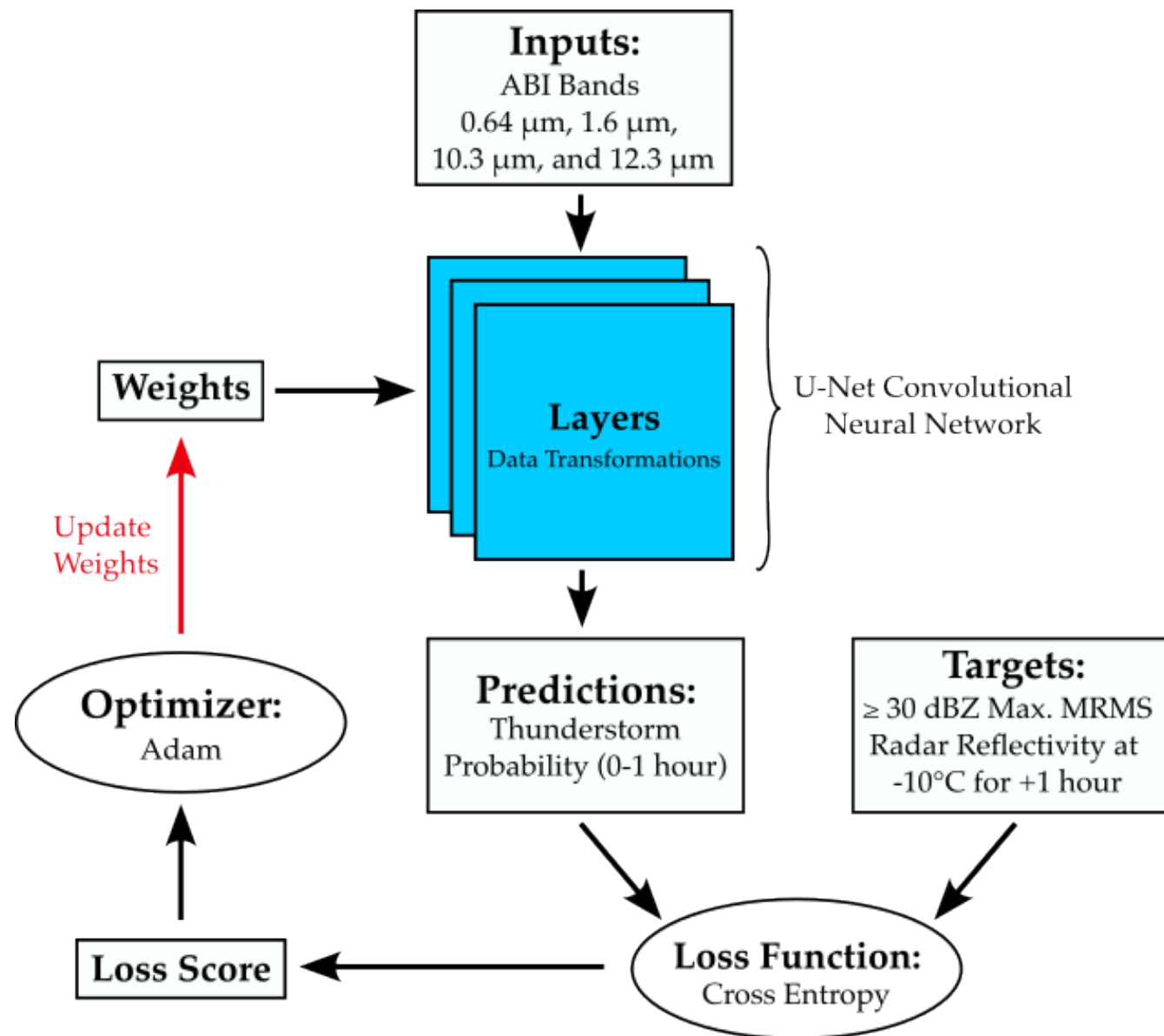
Building a Model



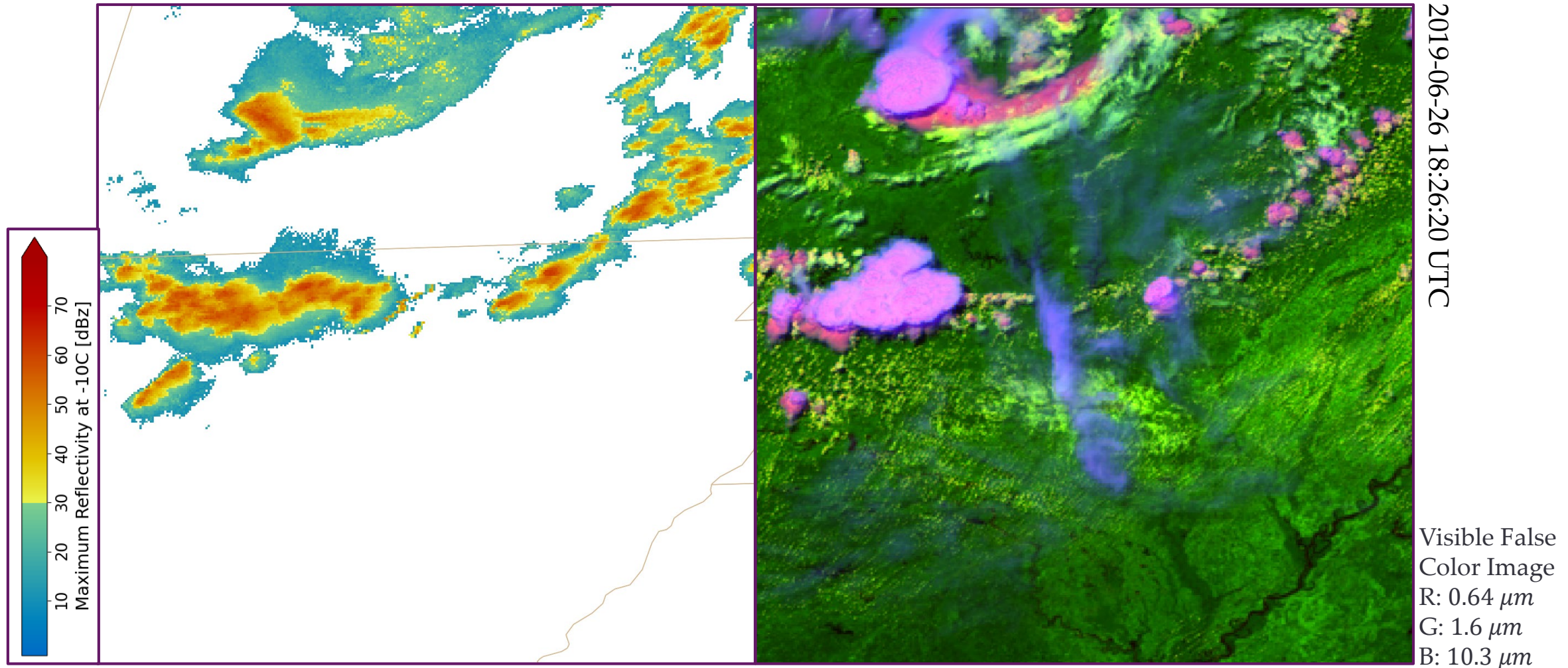
Building a Model



Building a Model



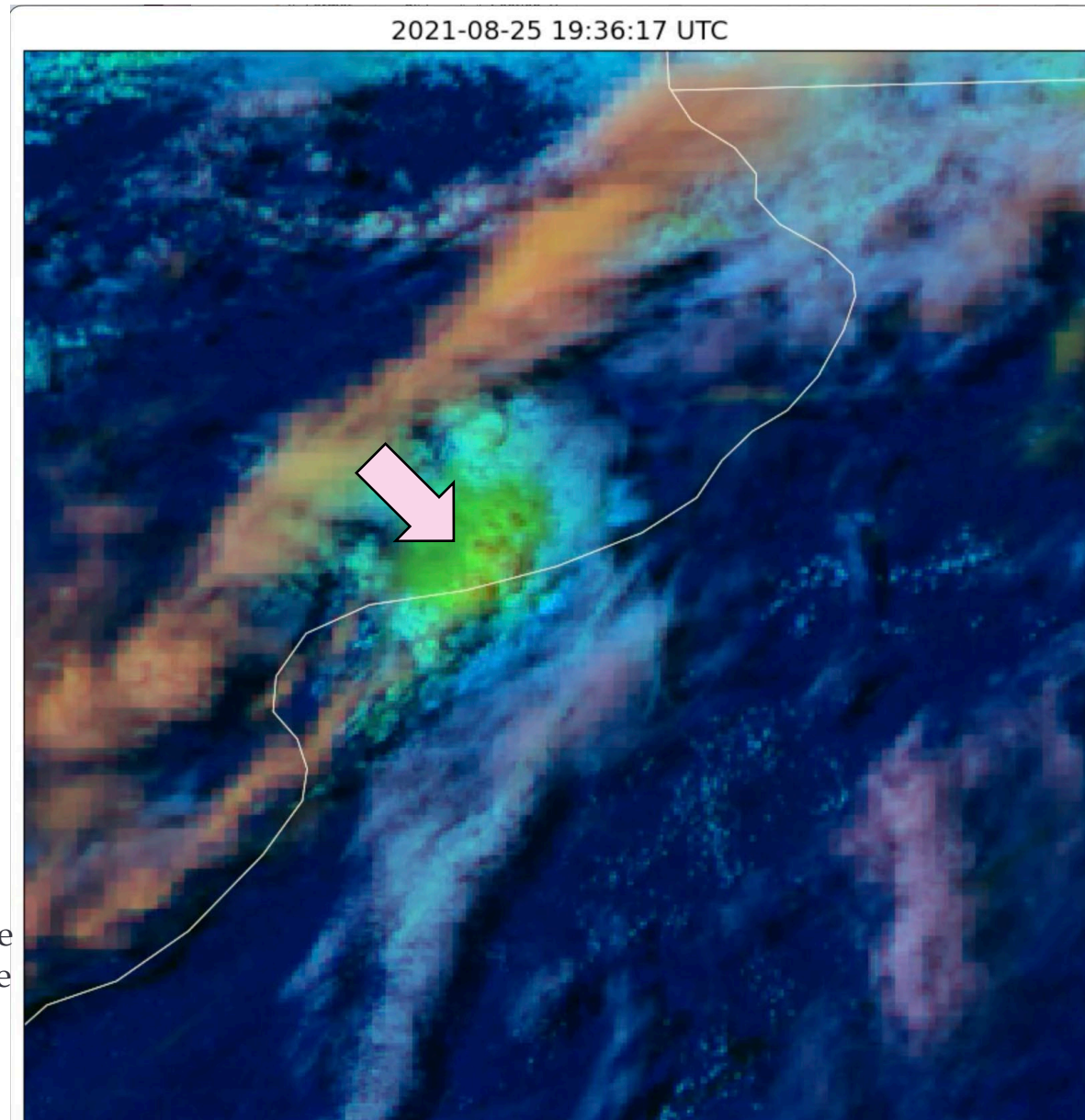
Inputs and Targets



Targets: +1 hour Maximum MRMS Reflectivity at -10°C where ≥ 30 dBZ is a Thunderstorm

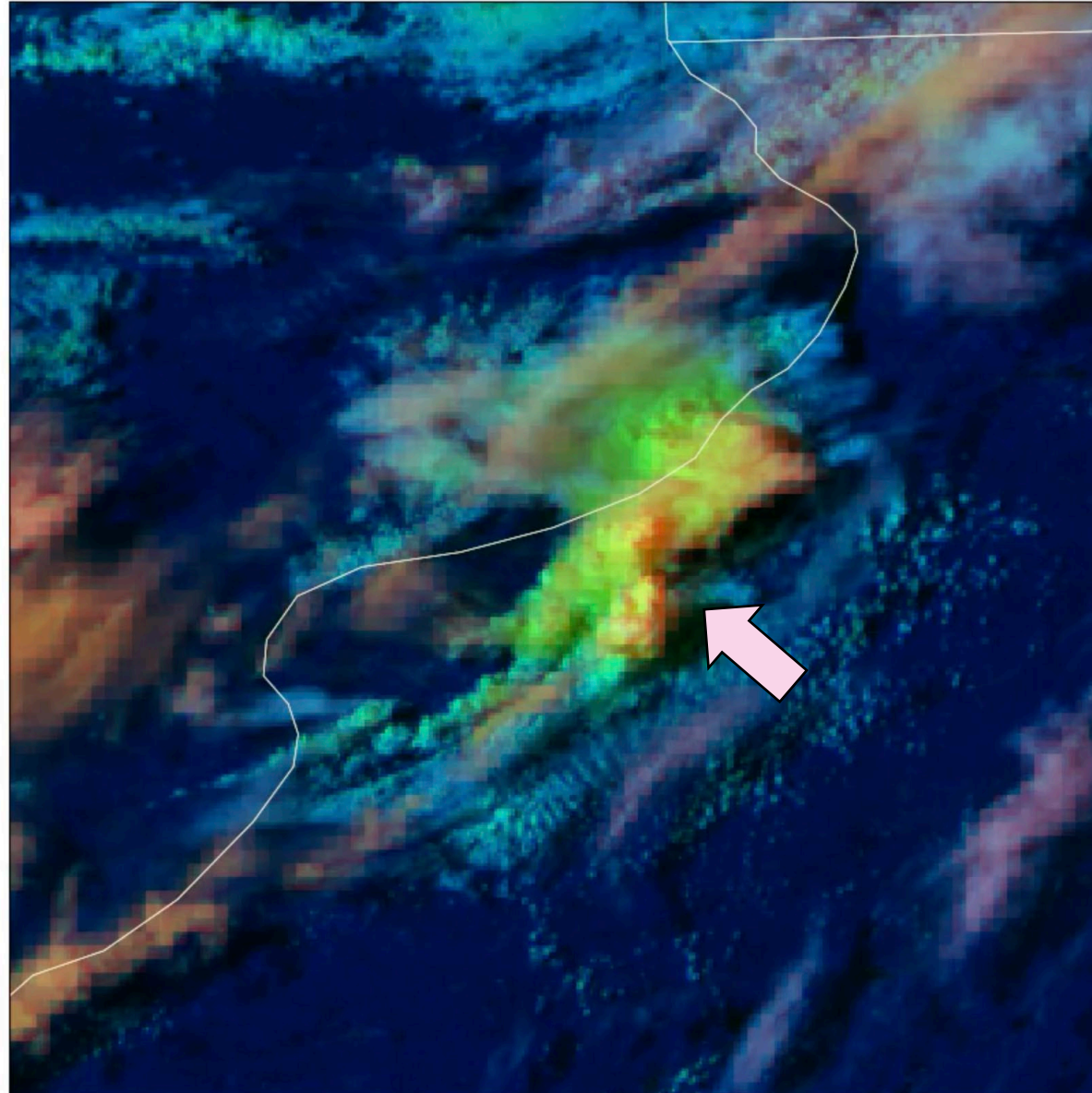
Inputs: ABI Bands 0.64 μm (2), 1.6 μm (5), 10.3 μm (13), 12.3 μm (15)

Example 1: Mesoscale Convective Vortex



Example 1

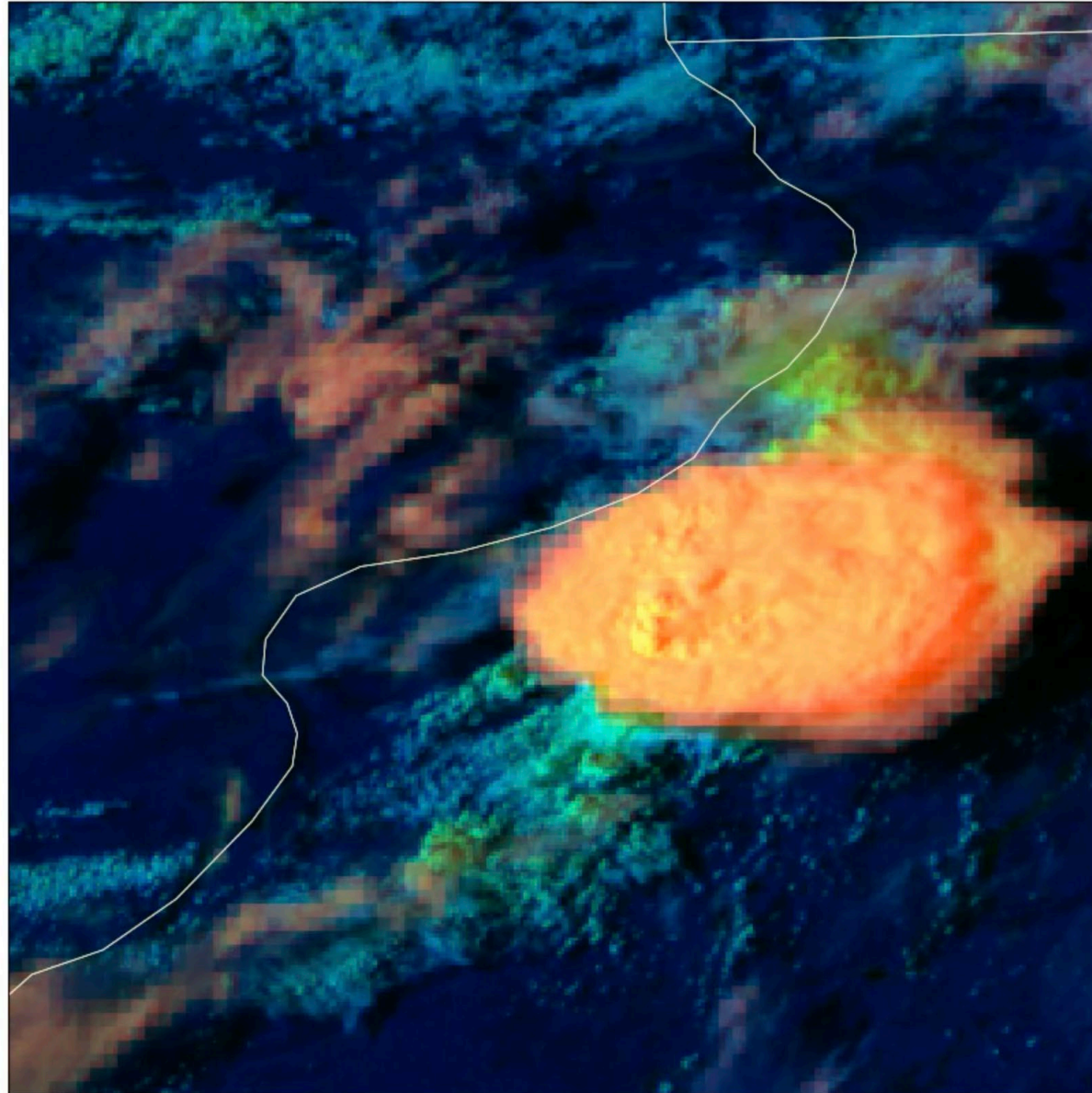
2021-08-25 20:26:17 UTC



Visible False
Color Image
R: $10.3 \mu m$
G: $0.64 \mu m$
B: $1.6 \mu m$

Example 1

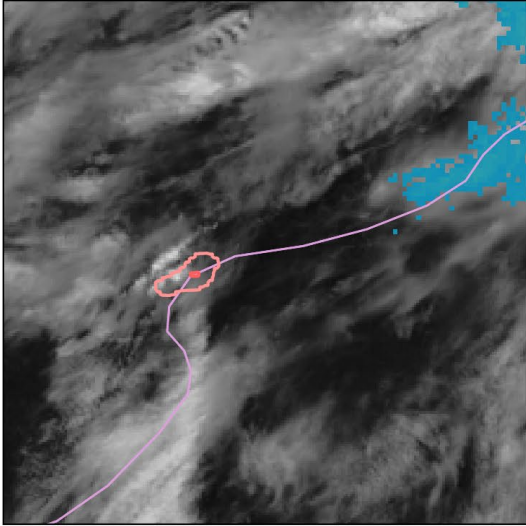
2021-08-25 21:16:17 UTC



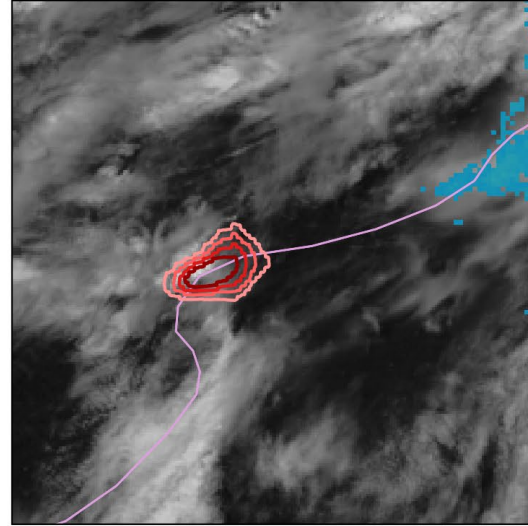
Visible False
Color Image
R: $10.3 \mu\text{m}$
G: $0.64 \mu\text{m}$
B: $1.6 \mu\text{m}$

Example 1

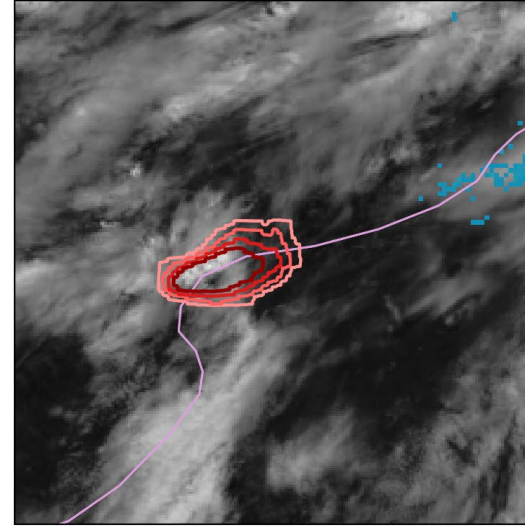
2021-08-25 18:31:17 UTC



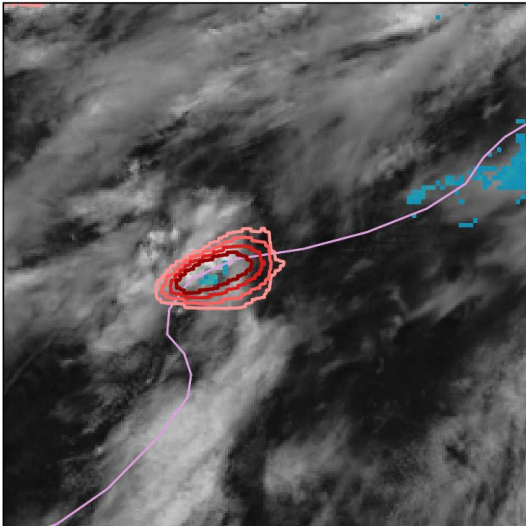
2021-08-25 18:36:17 UTC



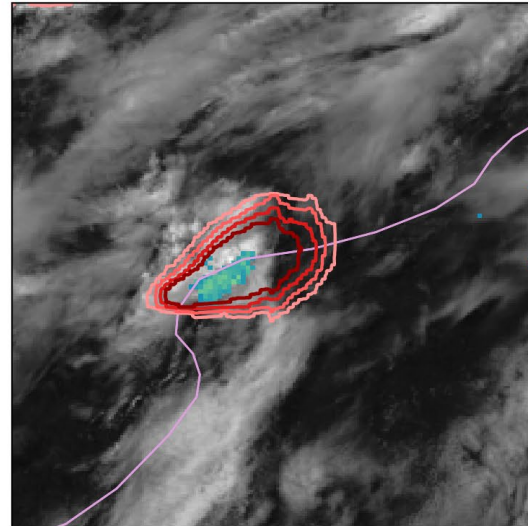
2021-08-25 18:41:17 UTC



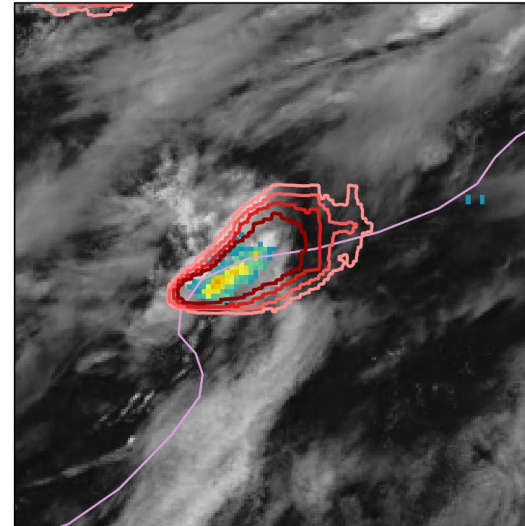
2021-08-25 18:46:17 UTC



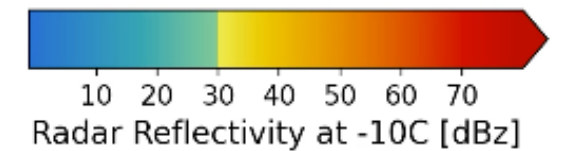
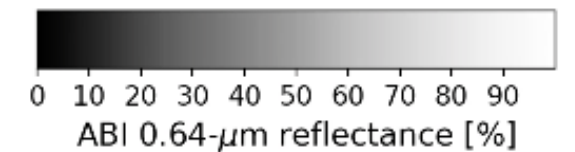
2021-08-25 18:51:17 UTC



2021-08-25 18:56:17 UTC

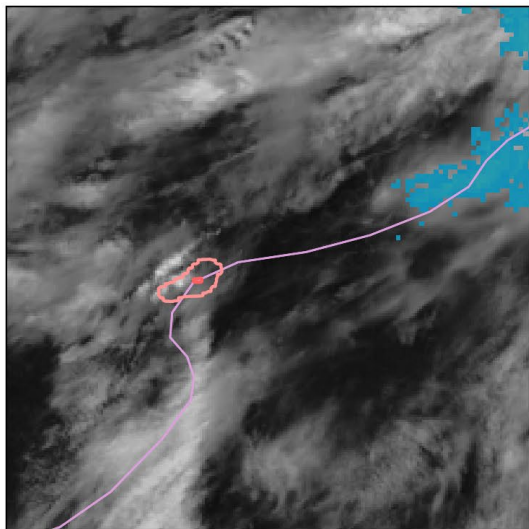


1) Within a cumulus field, ThunderCast identifies areas with potential for further development.

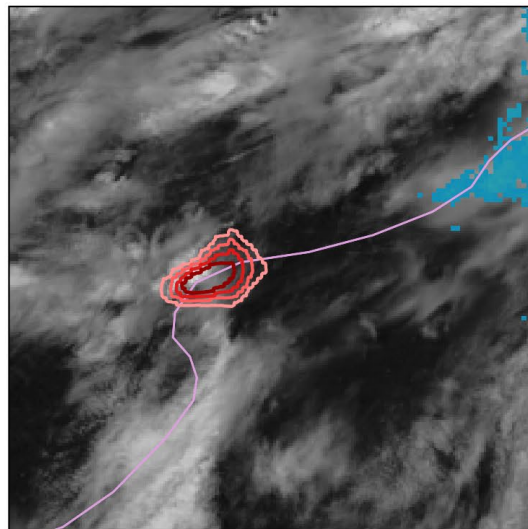


Example 1

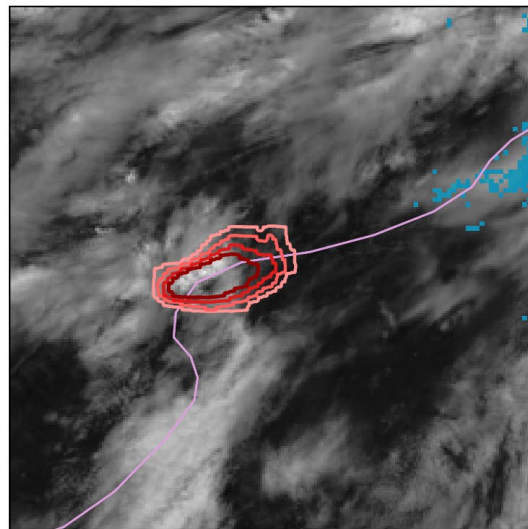
2021-08-25 18:31:17 UTC



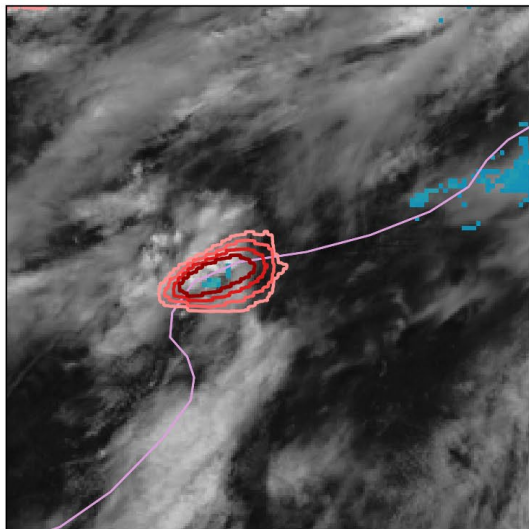
2021-08-25 18:36:17 UTC



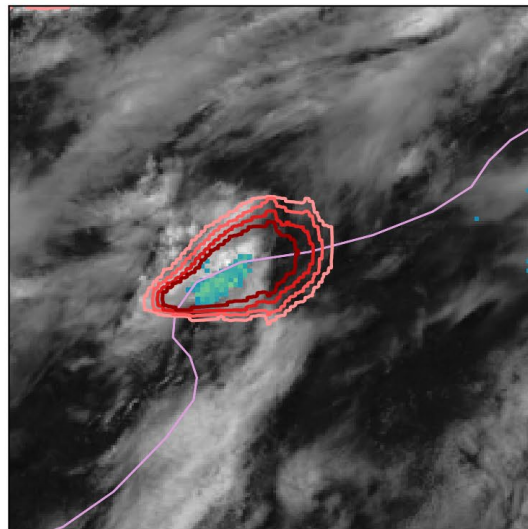
2021-08-25 18:41:17 UTC



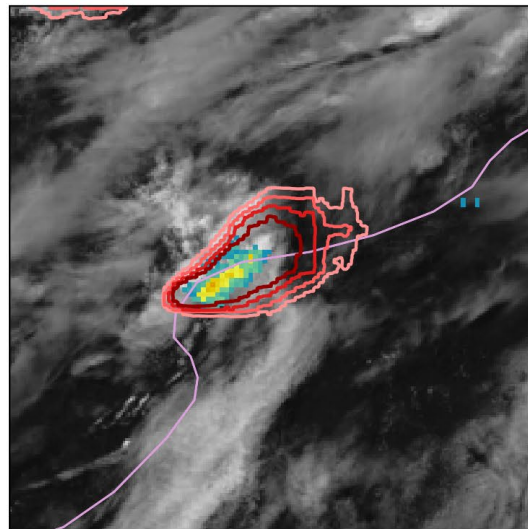
2021-08-25 18:46:17 UTC



2021-08-25 18:51:17 UTC

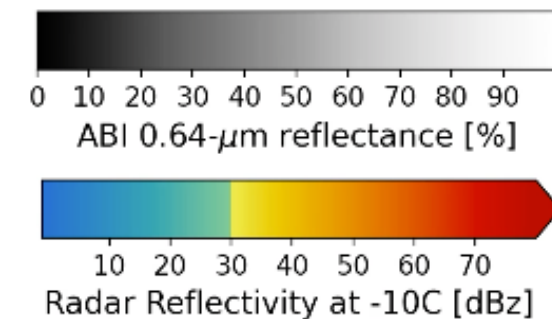


2021-08-25 18:56:17 UTC



2) ThunderCast provides prediction lead time (prior to 30 dBZ at -10 °C). For this case ~25 minutes.

Lightning occurs 20 minutes after 30 dBZ.

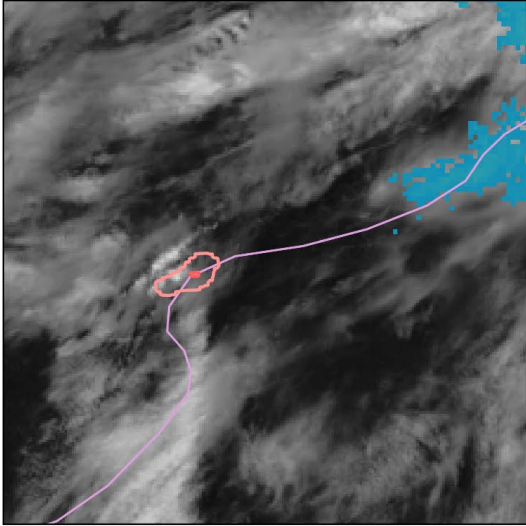


0-60 min. Thunderstorm Probability

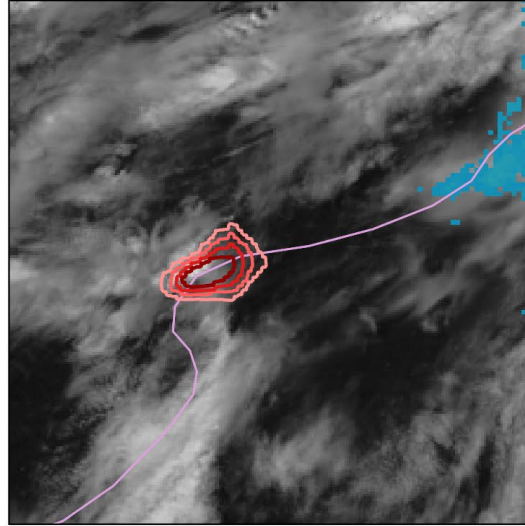
— 20% — 40% — 60% — 80%

Example 1

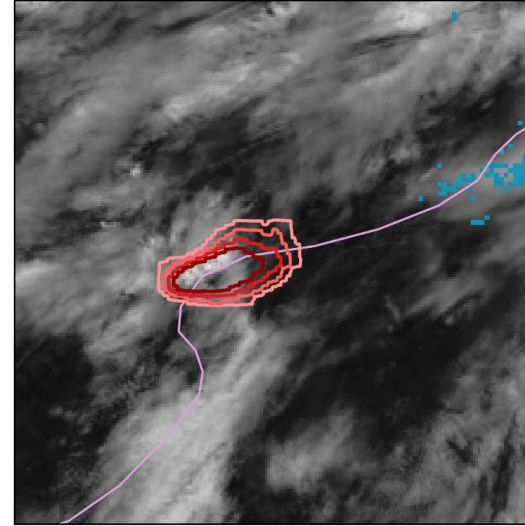
2021-08-25 18:31:17 UTC



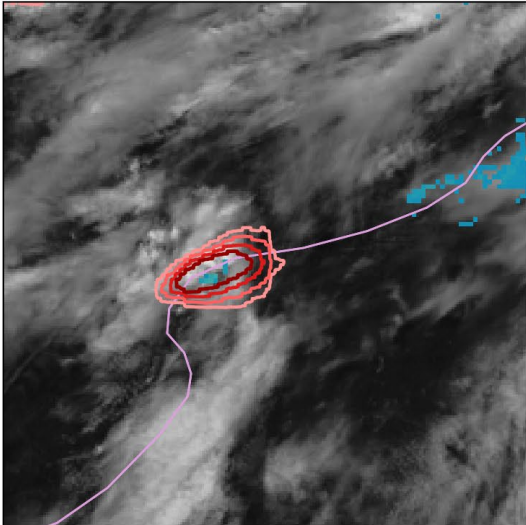
2021-08-25 18:36:17 UTC



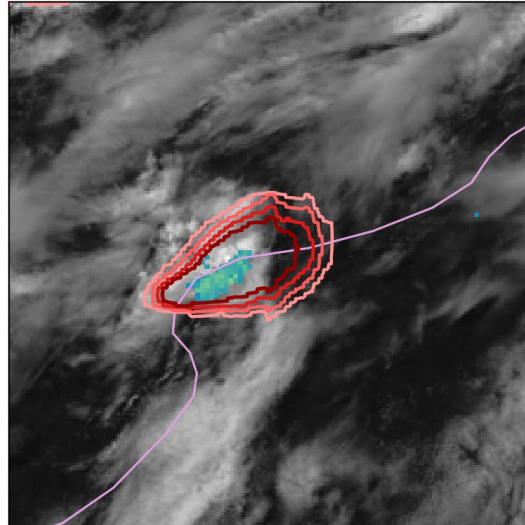
2021-08-25 18:41:17 UTC



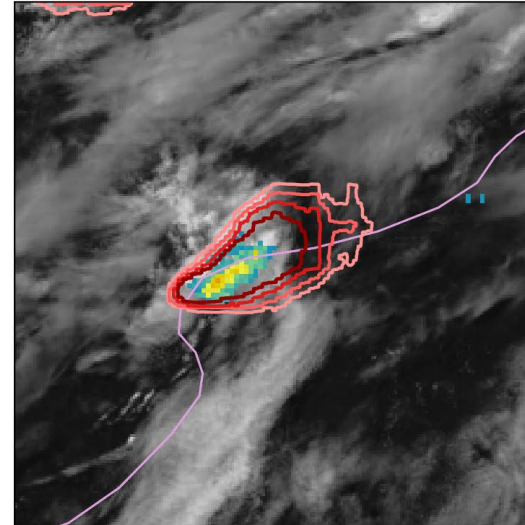
2021-08-25 18:46:17 UTC



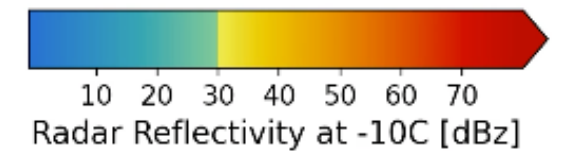
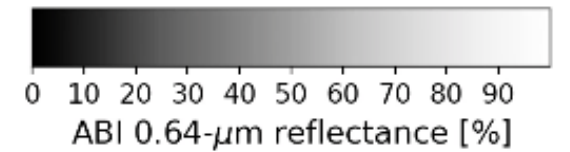
2021-08-25 18:51:17 UTC



2021-08-25 18:56:17 UTC

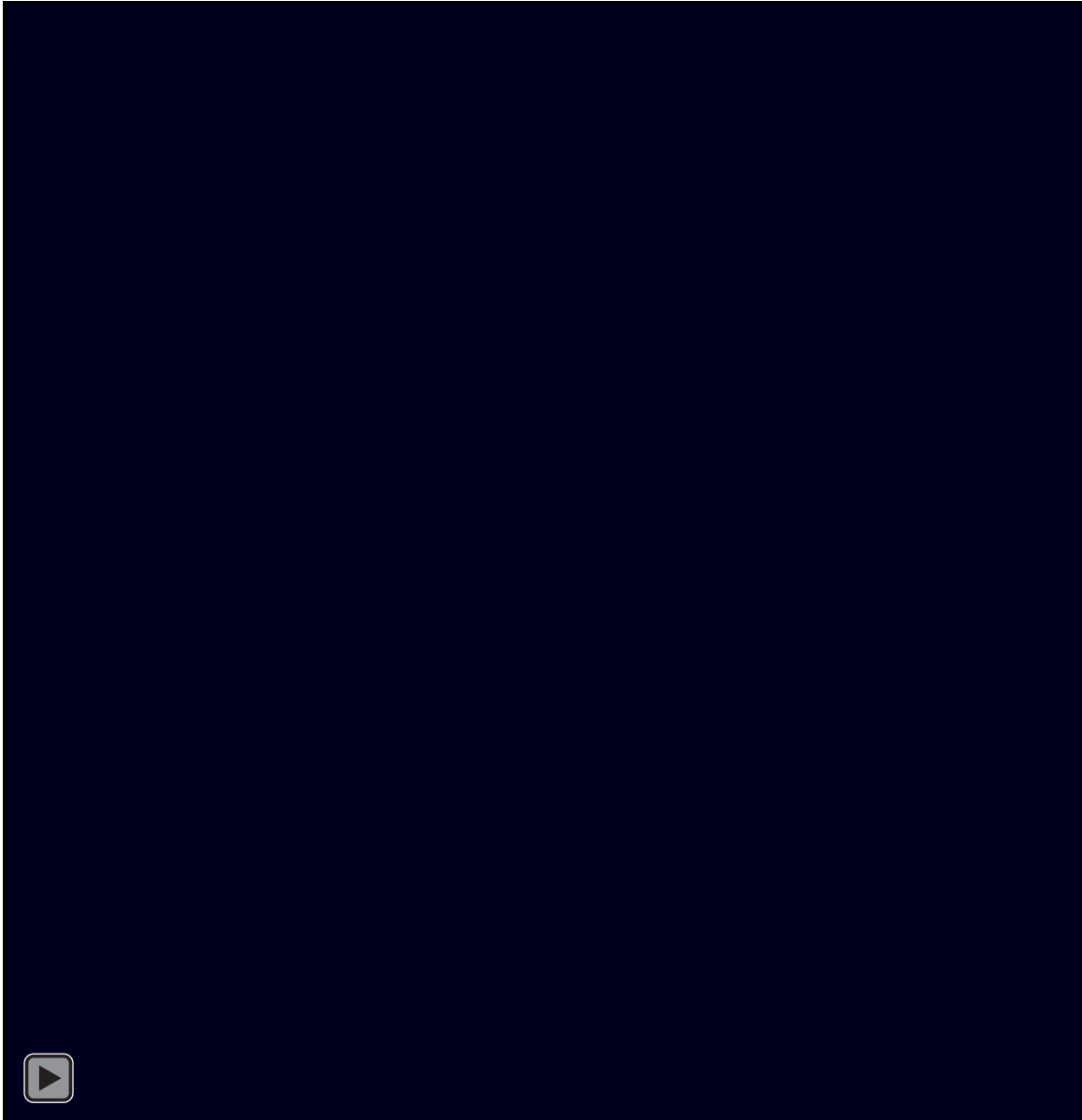


3) ThunderCast identifies patterns to discern future locations of storms.



Example 1

Visible False
Color Image
R: $10.3 \mu m$
G: $0.64 \mu m$
B: $1.6 \mu m$



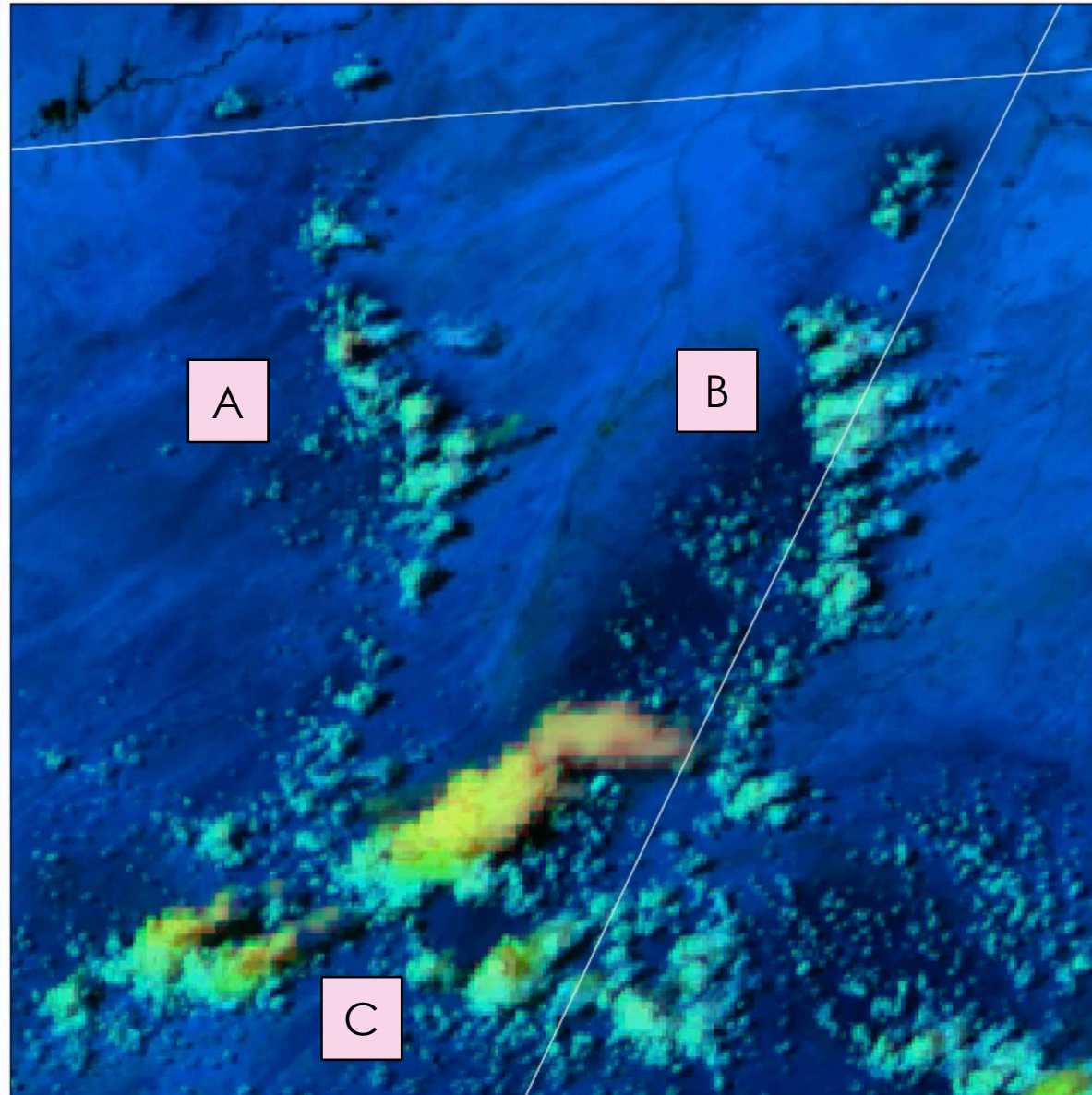
Example 2: Southwestern Monsoon Convection

Visible False
Color Image
R: $10.3 \mu\text{m}$
G: $0.64 \mu\text{m}$
B: $1.6 \mu\text{m}$

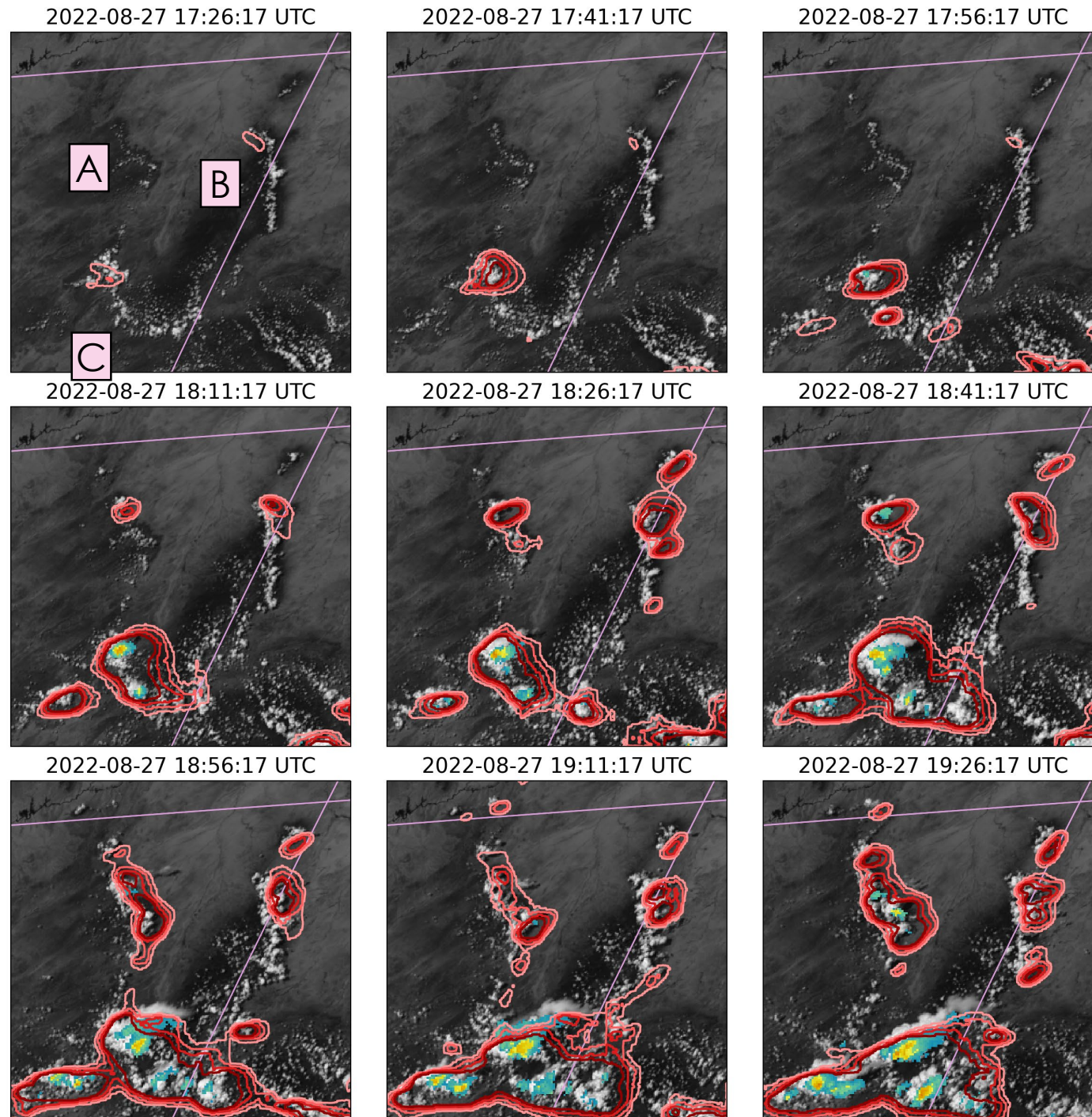


Example 2

2022-08-27 19:16:17 UTC

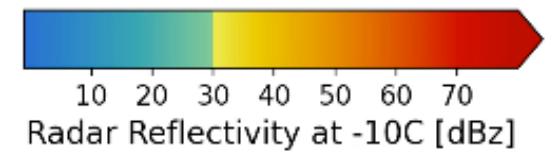
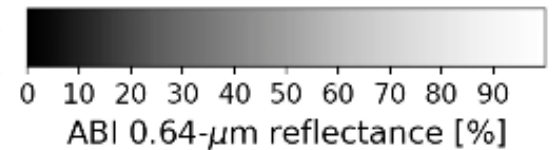


Visible False
Color Image
R: $10.3 \mu\text{m}$
G: $0.64 \mu\text{m}$
B: $1.6 \mu\text{m}$



4) ThunderCast makes predictions in areas without radar coverage.

Lead time: 25-30 minutes



0-60 min. Thunderstorm Probability

— 20% — 40% — 60% — 80%

What's next?

- “Poke” the model until it breaks
 - Are there patterns?
 - What can we learn from this?

Thank you for listening!

Questions?

Email: ortland2@wisc.edu

Visible False
Color Image
R: 10.3 μm
G: 0.64 μm
B: 1.6 μm

