Lightning Initiation from GEO
(0-1 hr Lightning Initiation Nowcasting)

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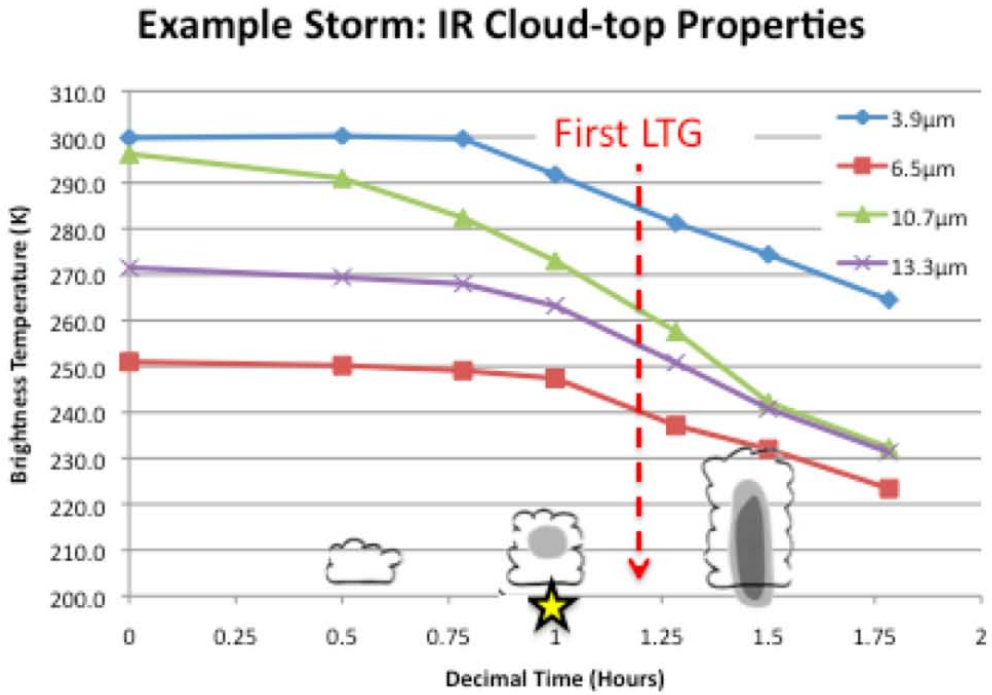
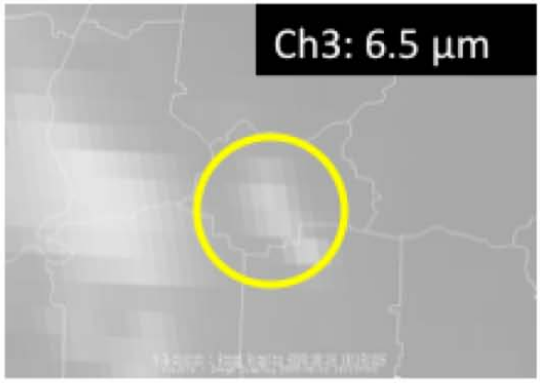
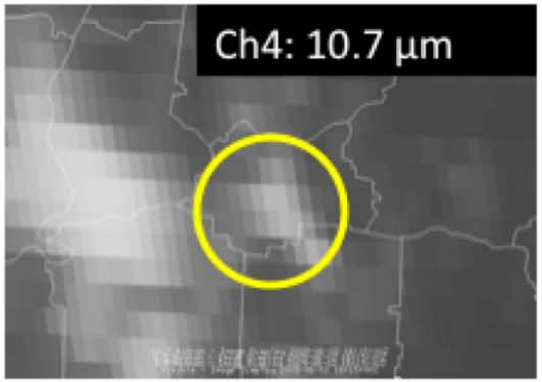
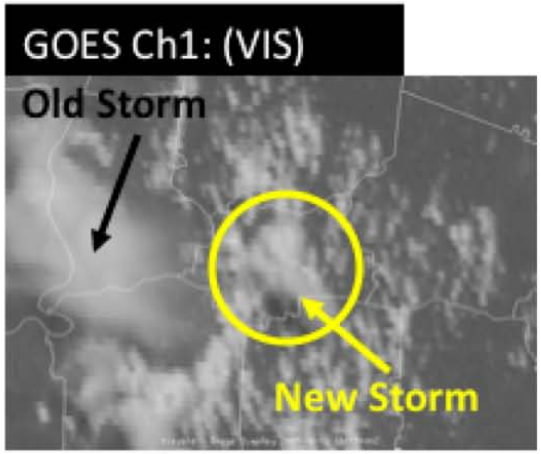
Lightning Initiation Nowcasting

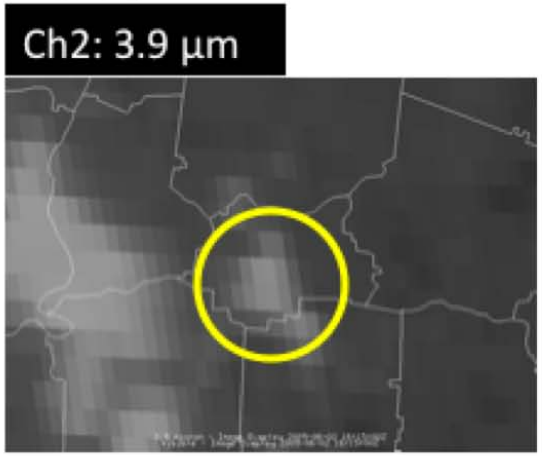
- Initial robust studies show predictive capability using GOES infrared fields.
- 3.9 μm reflectance (as a cloud-top glaciation indicator), along with 3.9 μm channel differences, show predictive skill for first time LI.
- Will update SATCAST (version 2) with LI module, for some testing within CIWS.
- Improved validation needed for GOES LI capabilities.
- Incorporating a GOES-based LI nowcasting component into other Lightning Warning or Lightning Potential algorithms would be an optimal way to maximize this algorithm.

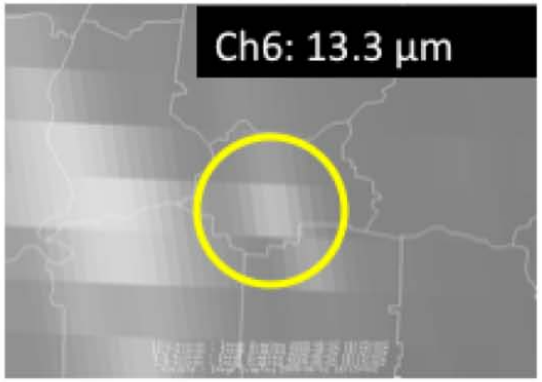

Example Storm: IR Cloud-top Properties
First LTG
3.9µm
6.5µm
10.7µm
13.3µm
Brightness Temperature (K)
310.0
300.0
290.0
280.0
270.0
260.0
250.0
240.0
230.0
220.0
210.0
200.0
0
0.25
0.5
0.75
1
1.25
1.5
1.75
2
Decimal Time (Hours)


Ch3: 6.5 µm


Ch4: 10.7 µm


GOES Ch1: (VIS)
Old Storm
New Storm


Ch2: 3.9 µm


Ch6: 13.3 µm

Current GOES Infrared and Reflectance LI Interest Fields

- Analysis of ~170 LI events, using co-located Lightning Mapping Array and GOES data.
- Some unique aspects of convective clouds (viewed by current GOES) highlight a likelihood of lightning development.
- Predictive skill to 30-45 minutes in advance of LI.
- Needs to be tested in real-time nowcasting system.

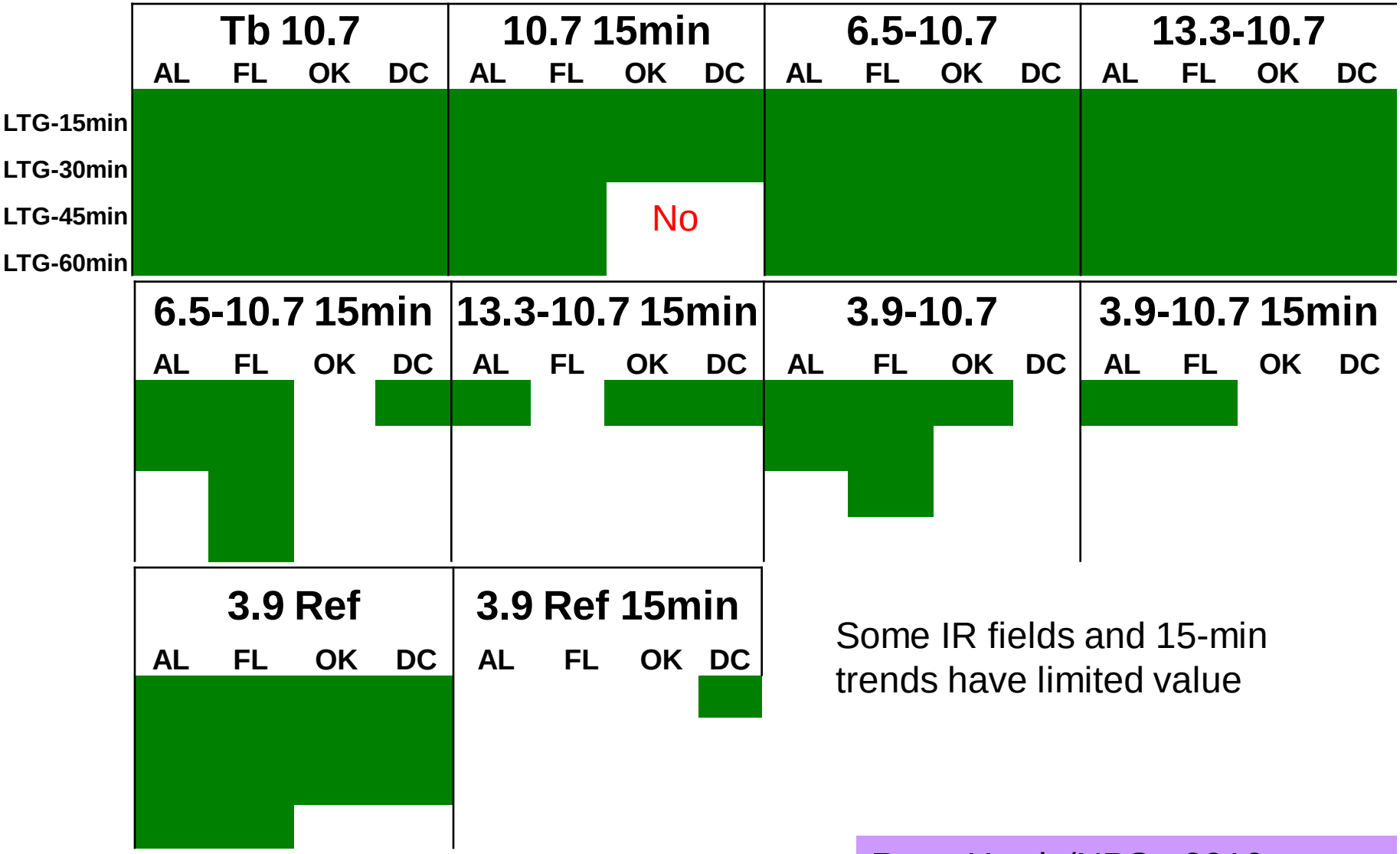
Interest Field	MB06 Critical CI Value	Siewert LI Value	15 to 30-min Threshold (This LI Study)	Description
10.7 µm Tb	< 0°C	≤ - 13°C	*< 0° C*	Cloud tops cold enough to support supercooled water and ice mass growth; cloud-top glaciation
10.7 µm Tb Time Trend	< - 4°C / 15 min (Tb / 30 min < Tb / 15 min)	≤ - 10°C / 15 min (≤ - 15°C / 30 min)	*< - 6° C / 15 min*	Cloud growth rate (vertical)
Timing of 10.7-µm Tb drop below 0° C	Within prior 30 min	*Not used*	*Not Used*	Cloud-top glaciation
6.5 - 10.7 µm Tb difference	Tb Diff: -35°C to -10°C	≥ - 17°C	*> - 30° C*	Cloud top height relative to mid/upper troposphere
13.3 - 10.7 µm Tb difference	Tb Diff: -25°C to -5°C	≥ - 7°C	*> - 13° C*	Cloud top height relative to mid/upper troposphere; better indicator of early cumulus development but sensitive to cirrus
6.5 - 10.7 µm Tb Time Trend	> 3°C / 15 min	≥ 5°C / 15 min	*> 5° C / 15 min*	Cloud growth rate (vertical) toward dry air aloft
13.3 - 10.7 µm Tb Time Trend	> 3°C / 15 min	≥ 5°C / 15 min	*> 4° C / 15 min*	Cloud growth rate (vertical) toward dry air aloft
3.9 - 10.7 µm Tb Difference**	*Not used*	*Not used*	*> 17° C*	Cloud-top glaciation
3.9 - 10.7 µm Tb Time Trend*	*Not used*	T - T(t-1) < -5°C and T - T(t+1) < - 5°C	*> 1.5° C / 15 min*	Sharp decrease, then increase indicates cloud-top glaciation
3.9 µm Fraction Reflectance*	*Not used*	≤ 0.05	*< 0.11*	Cloud top consists of ice (ice is poorer reflector than water at 3.9 µm)
3.9 µm Fraction Reflectance Trend**	*Not used*	*Not used*	*< - 0.02 / 15 min*	Cloud-top glaciation rate

* Added in Siewert's (2008) LI Study

** Added for this study

Unique from CI interest fields

Time before First Lightning Strike each Interest Field is Predictive
Regional Differences: AL, FL, OK and DC



Some IR fields and 15-min trends have limited value

Ryan Harris/NPS - 2010