Optical and Radio Perspectives on Lightning Flash Propagation

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Outline

- LIS and LMA Flash Propagation
- Exceptional LIS Flashes
- LIS Statistics on Flash Morphology and Motion
- Conclusions

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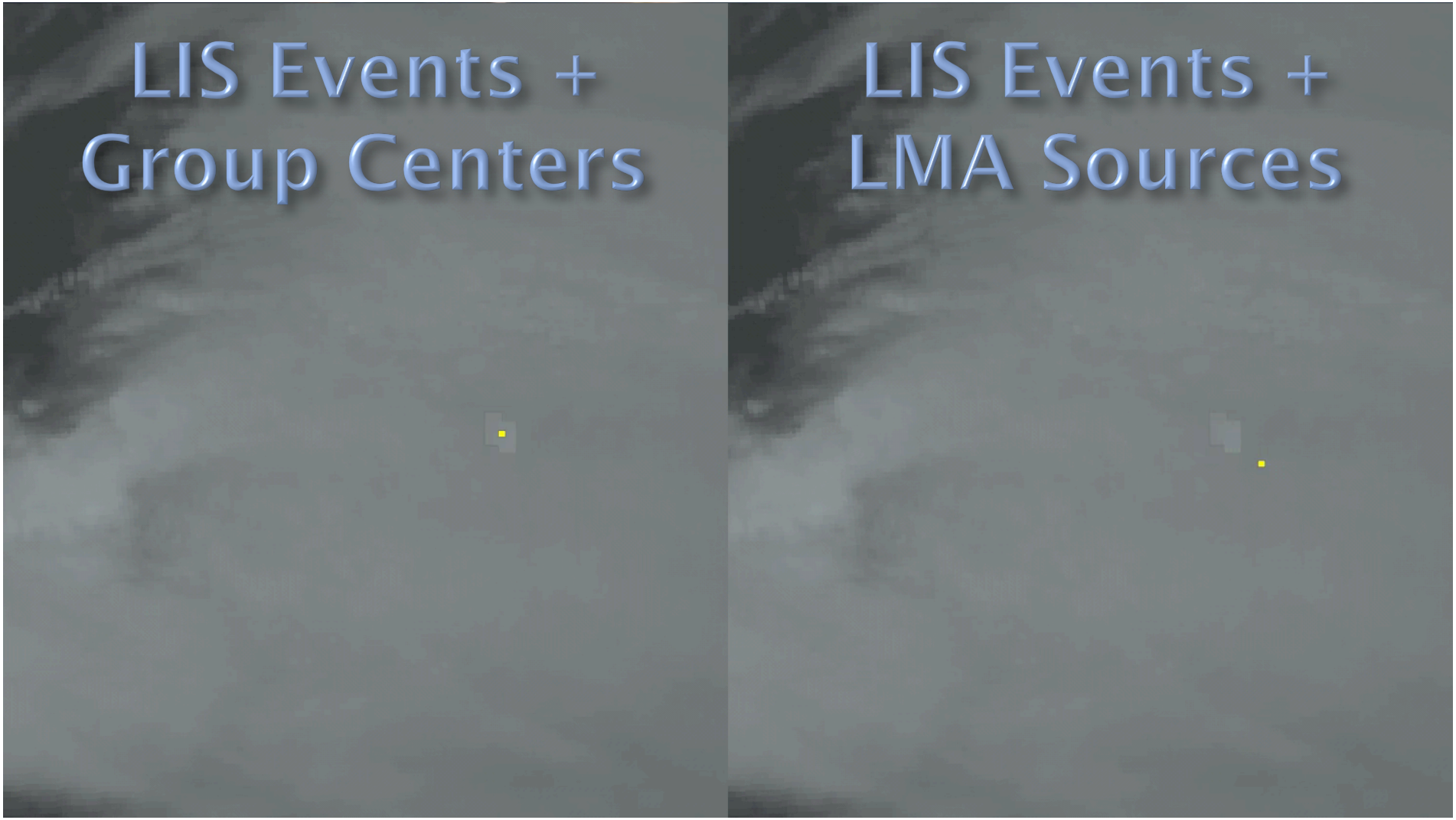
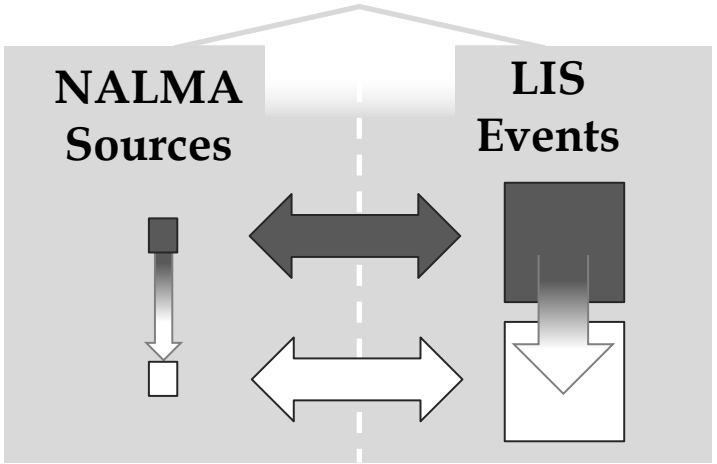
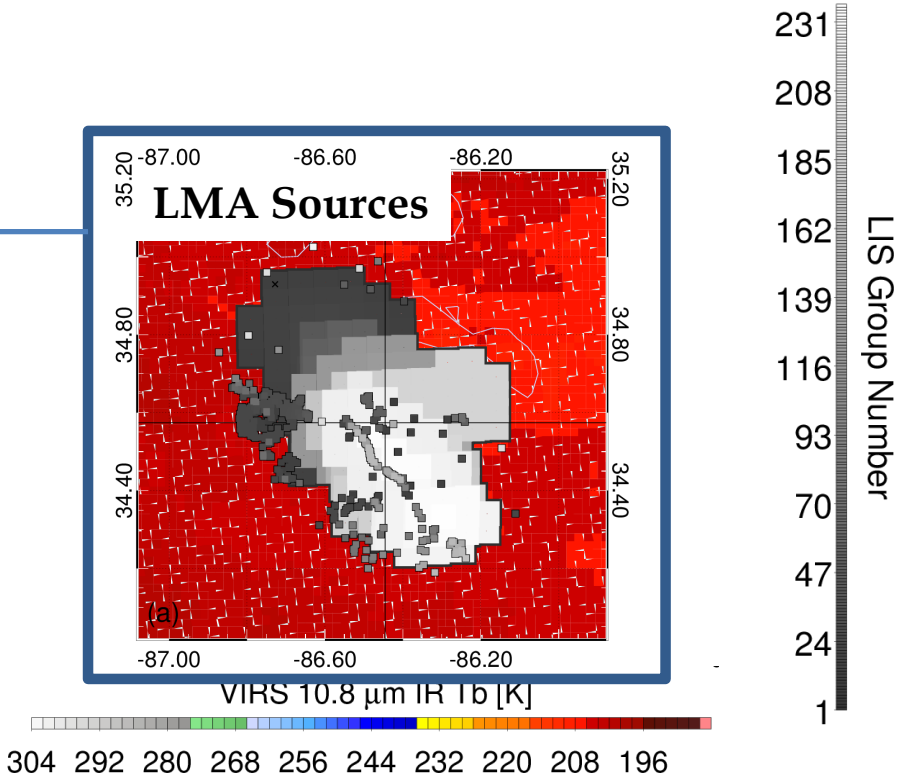

LIS Events +
Group Centers
LIS Events +
LMA Sources

Flash Evolution Plots

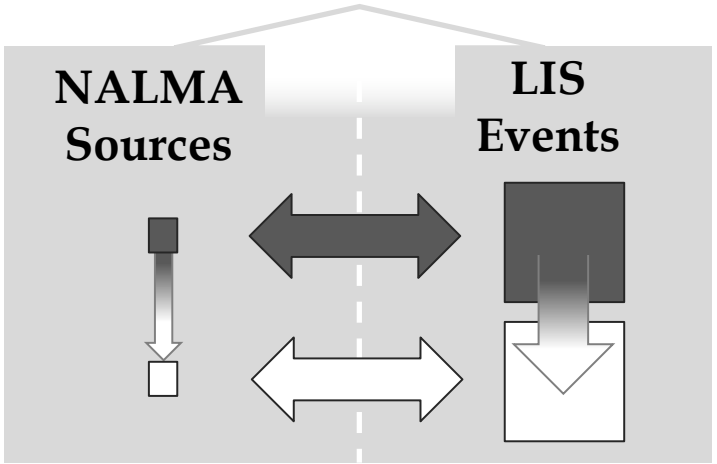
LIS & LMA Plan View

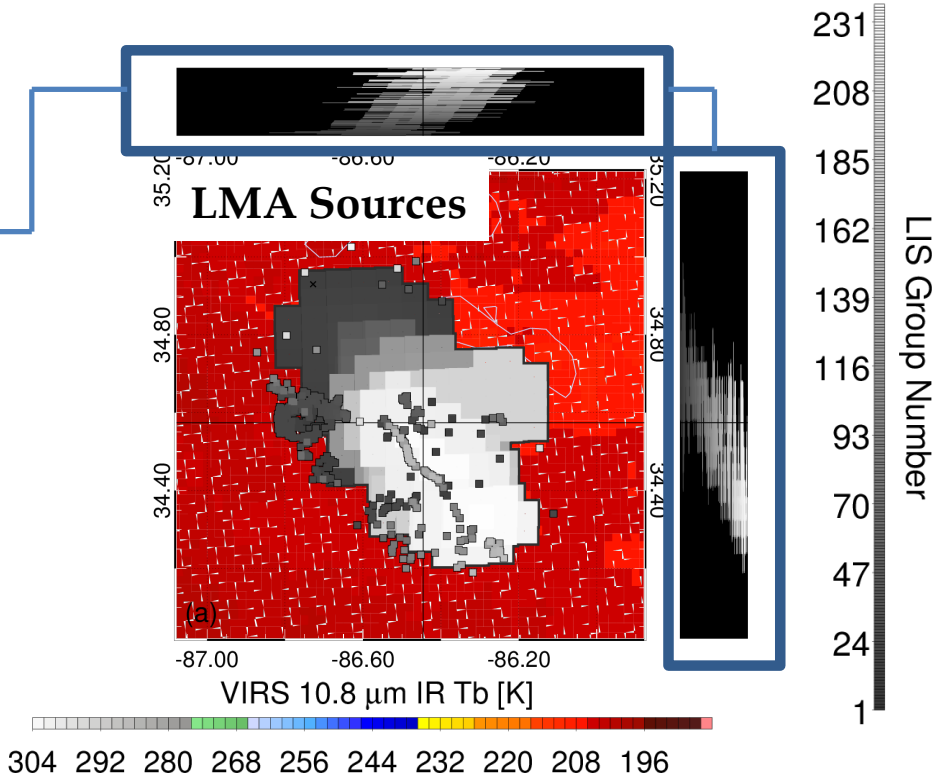




Flash Evolution Plots

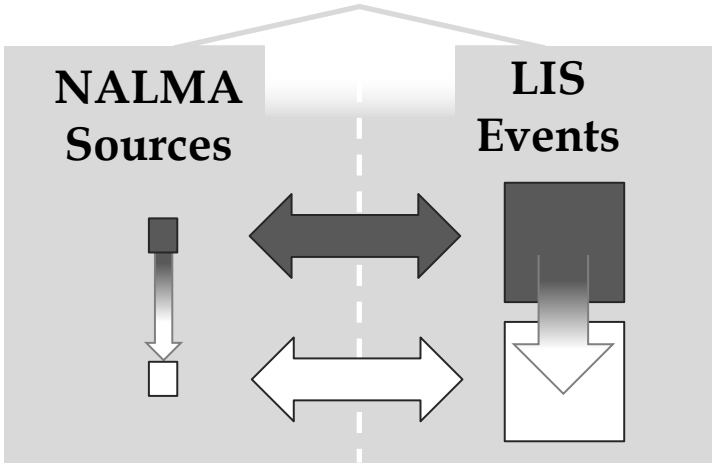
LIS Group Extent & Time History

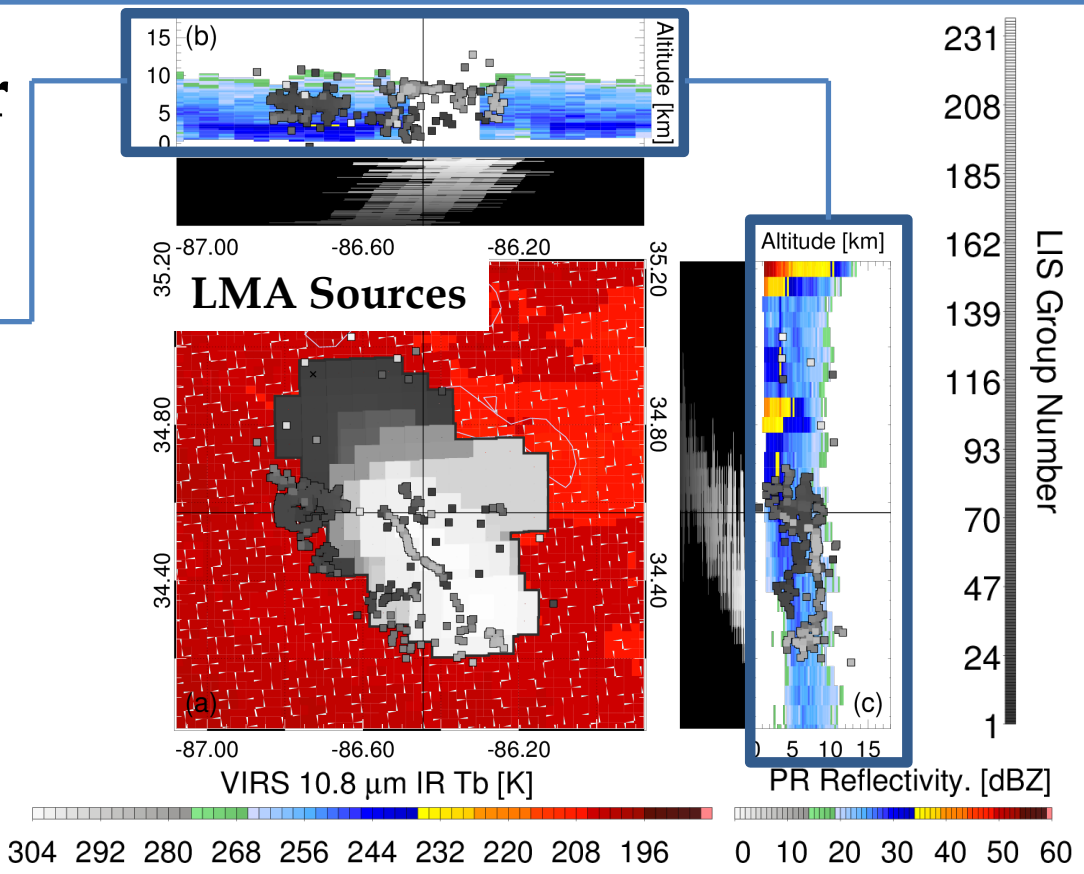




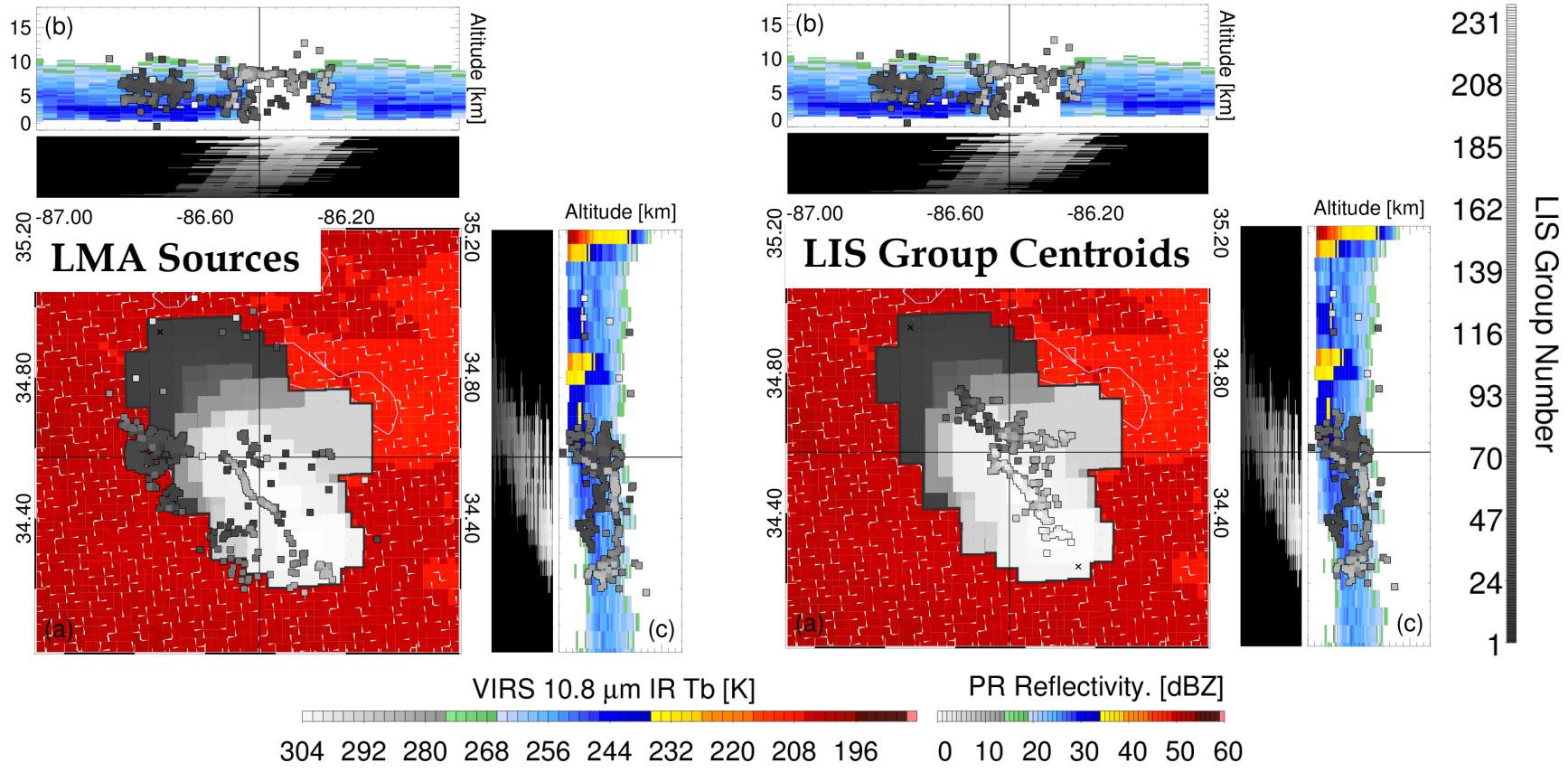
Flash Evolution Plots

Precipitation Radar & LMA Source Cross Section

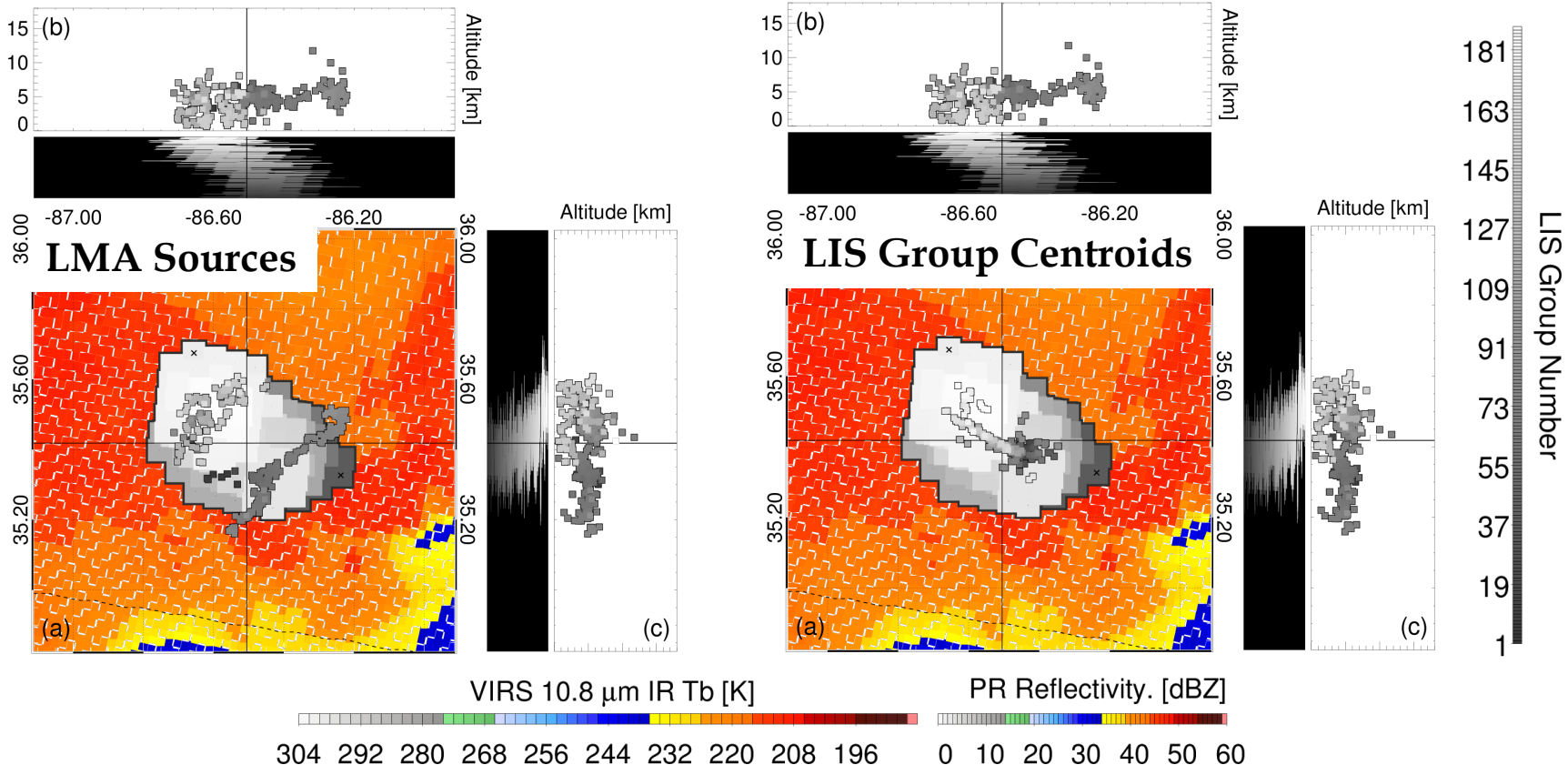




LIS/LMA Comparison



LIS/LMA in Disagreement



Motivation

- Lightning imagers and LMAs are sensitive to flash development / structure
- Each instrument provides its own perspective:
  - Both can resolve structures not detected by the other
  - Differing domains, products, caveats, and levels of detail
- Potential synergy between ground-based and orbital lightning measurements

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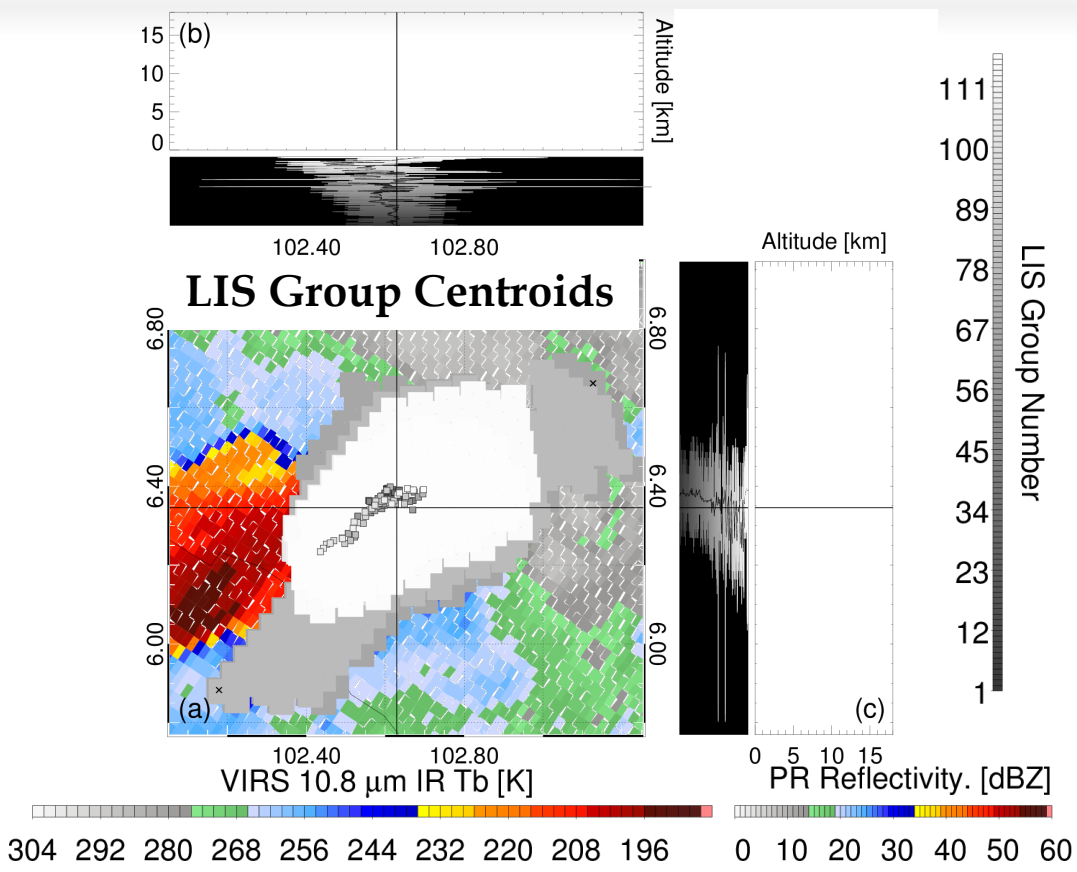
Furthest Separated Events

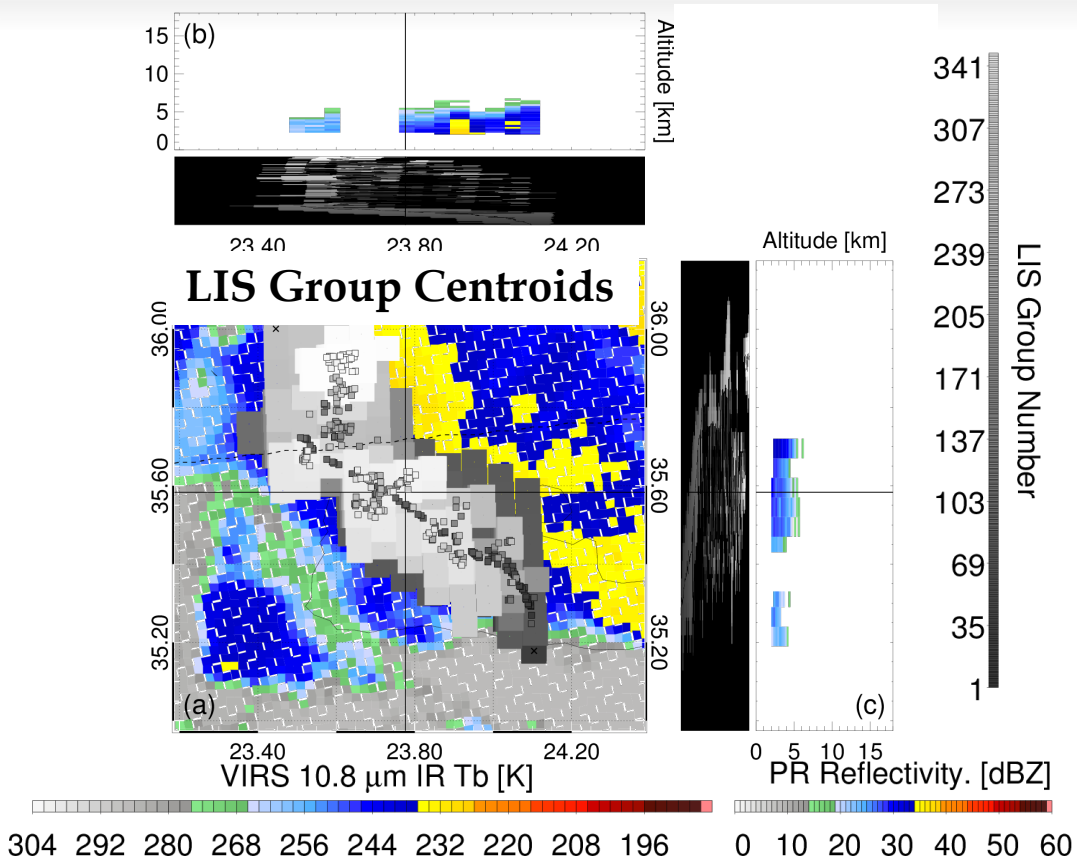


- Area: 5556 km^2
- Duration: 802 ms
- Radiance Ratio: 136
- Event Separation: 136 km
- Group Separation: 34 km

Lightning Flash from NASA ER-2

Source: NASA

Furthest Separated Groups



- Area: 3637 km^2
- Duration: 827 ms
- Radiance Ratio: 104
- Event Separation: 109 km
- Group Separation: 89 km

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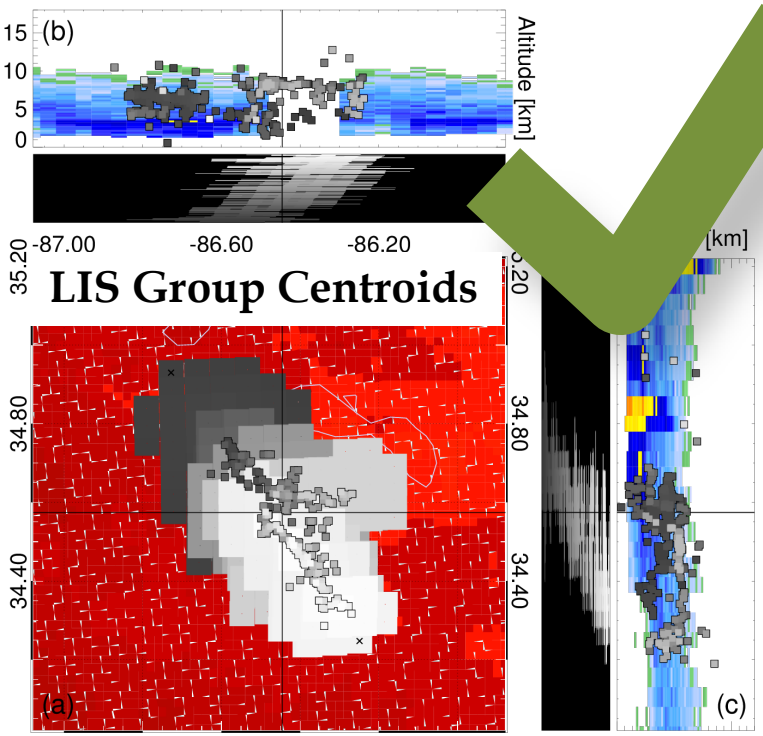
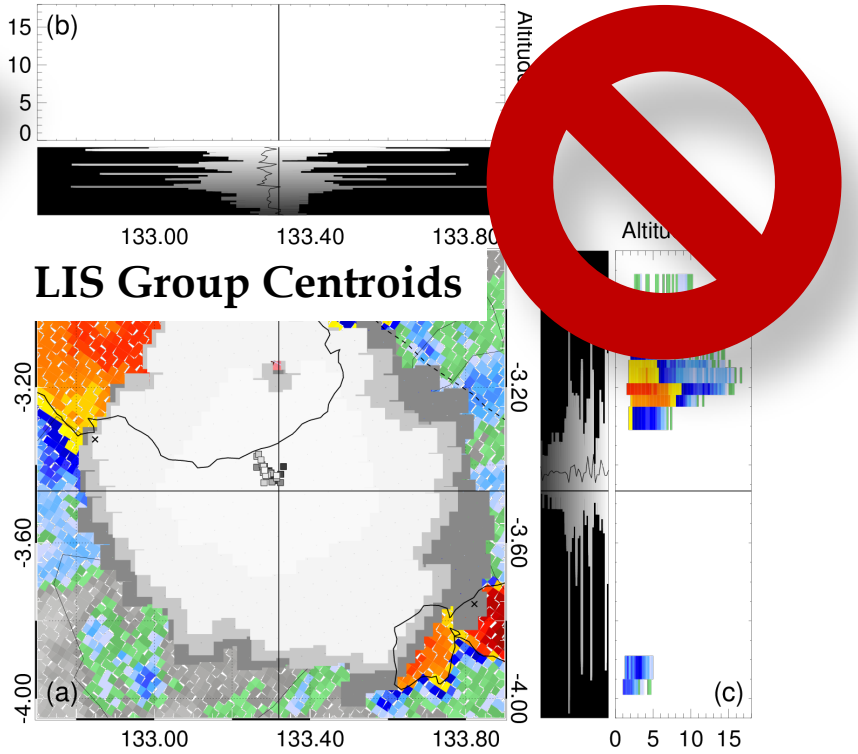
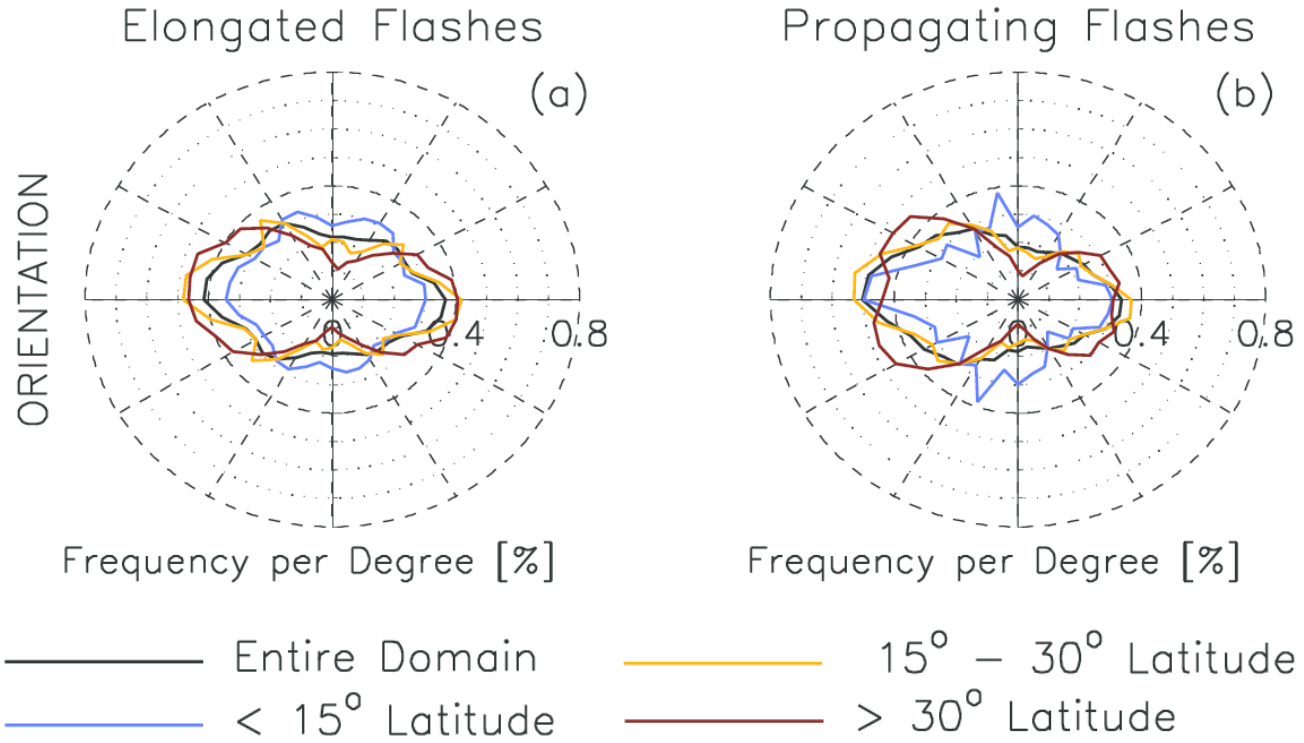
Optical Flash Propagation



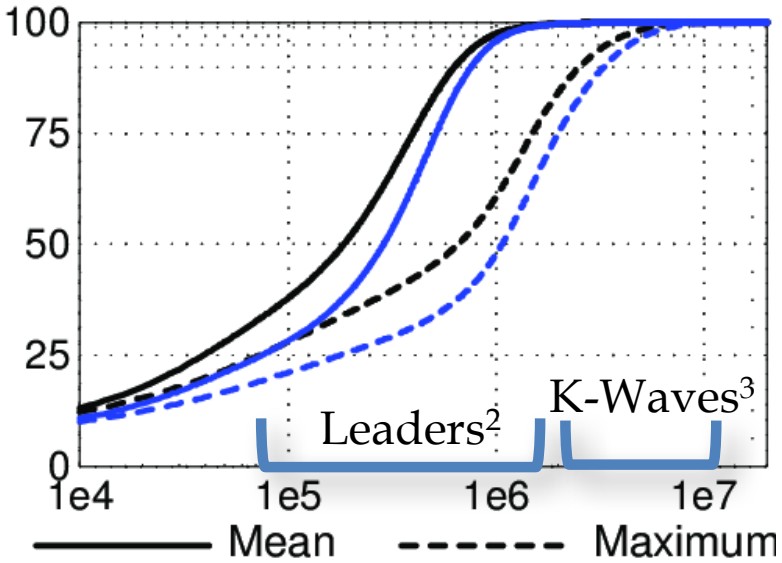


LIS Flash Orientation



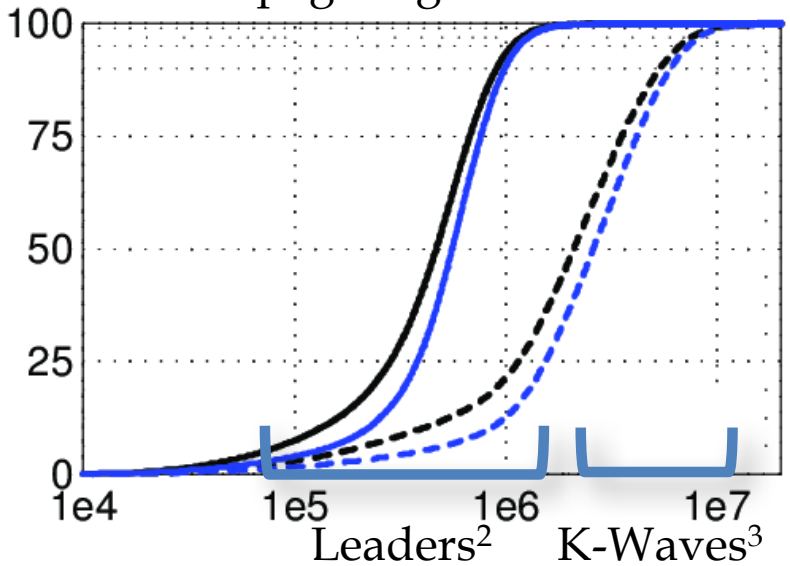
LIS Propagation Speed

All LIS Flashes



Propagation Speed [ms^{-1}]

Propagating LIS Flashes



Propagation Speed [ms^{-1}]

2. Hill et al. (2011) JGR 3. Winn et al. (2011) JGR

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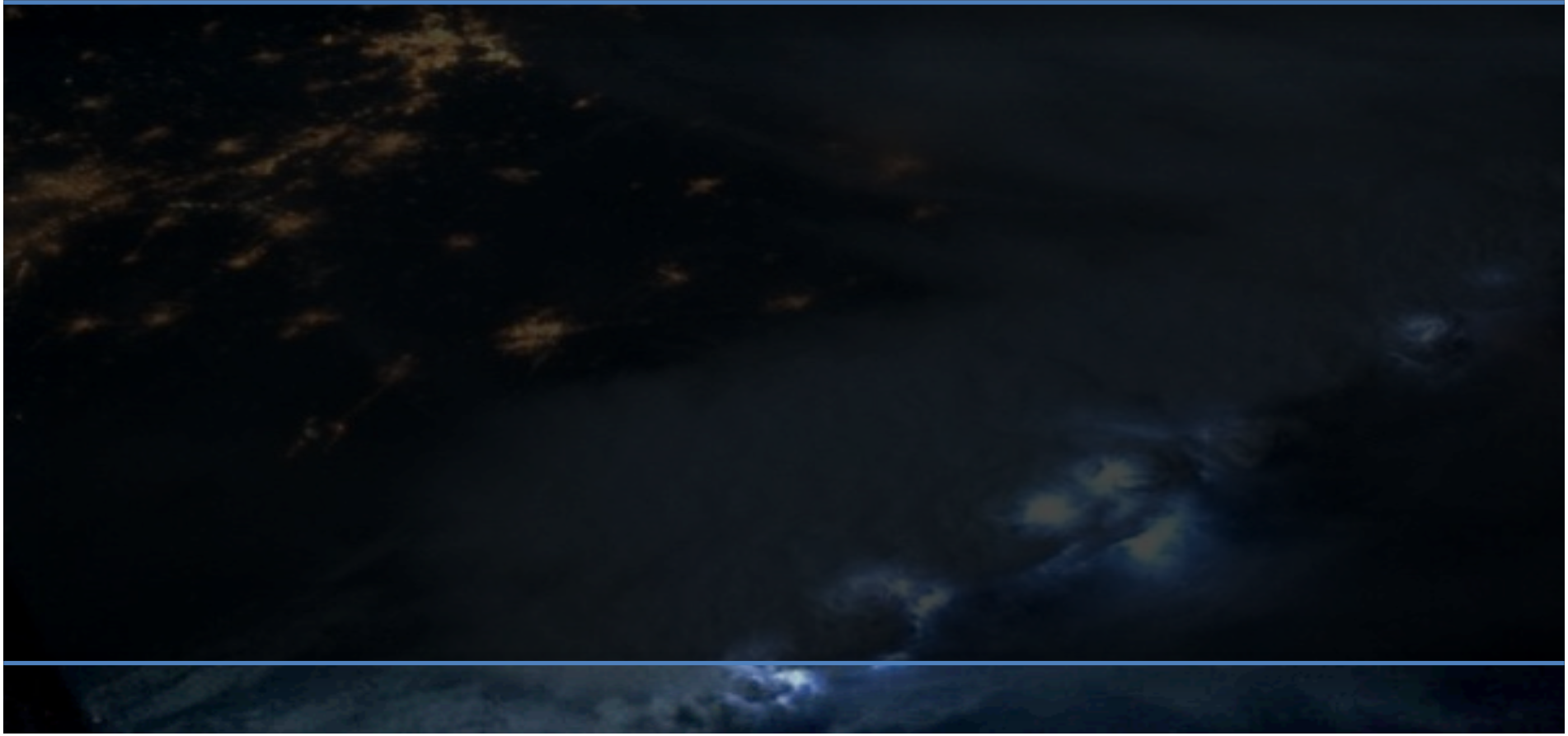
Conclusions

- Lightning imagers document the evolution of optical flashes
  - Propagating flashes can be identified
  - Propagation occurs at speeds associated with leader development and K-process waves
- Group-level and coincident storm measurements add value to LIS/GLM applications
- Explore potential synergies between satellite and ground-based lightning platforms


Questions?
New lightning animations daily
/@WeatherArchive

Additional Slides



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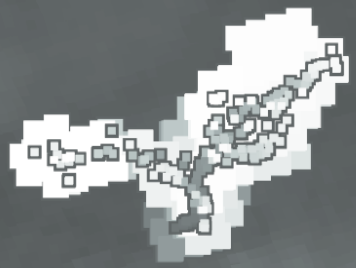

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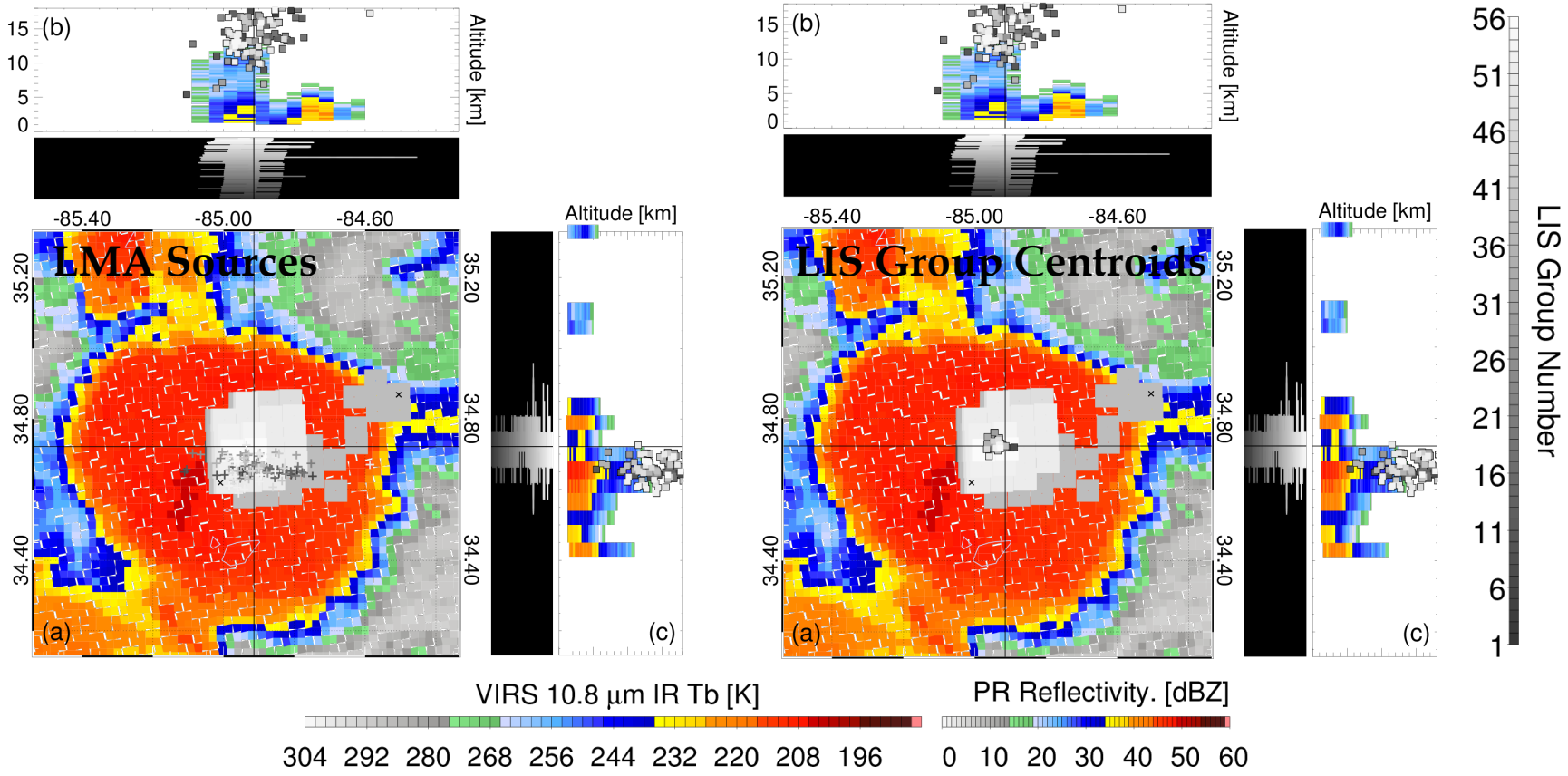
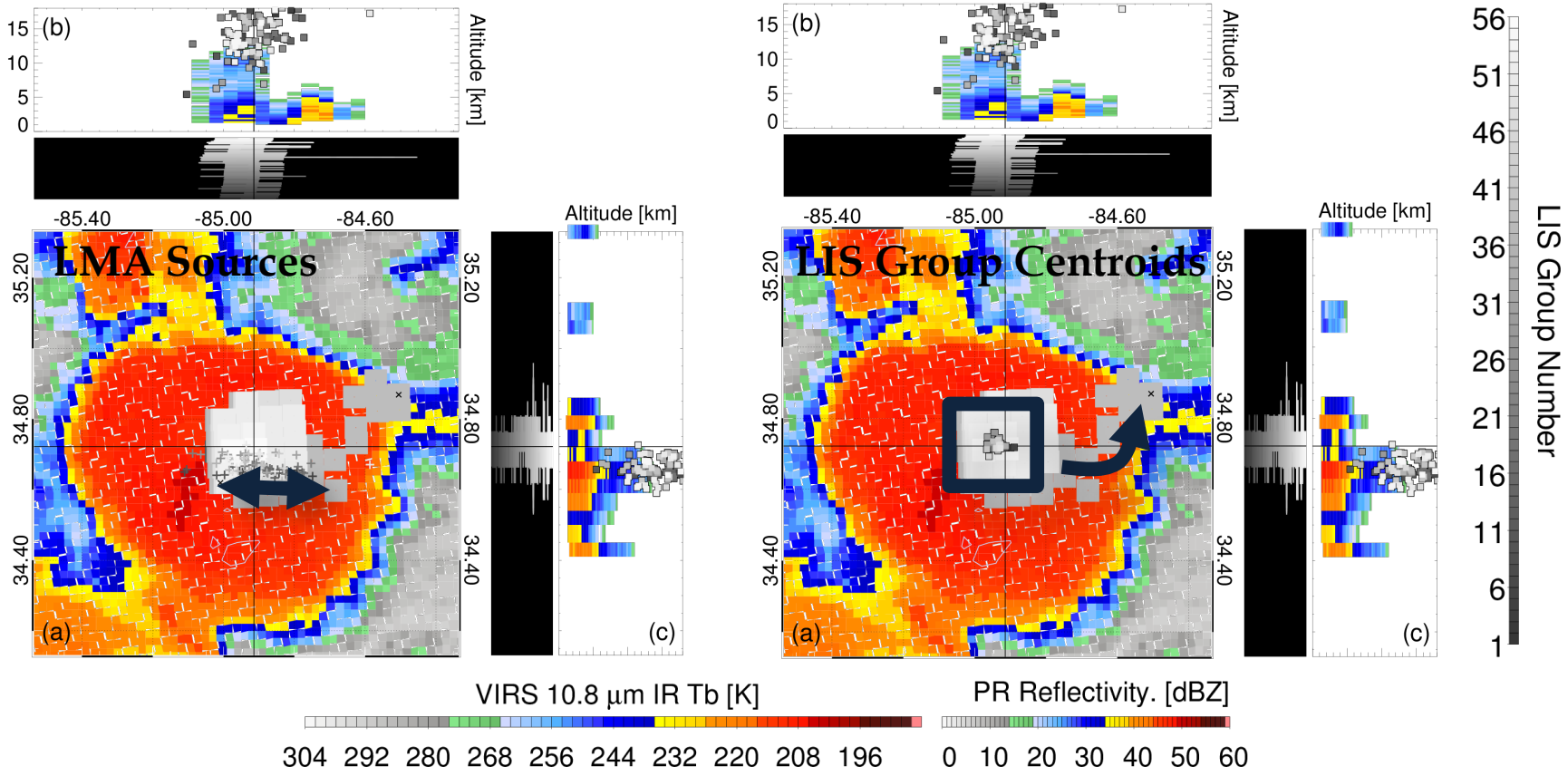
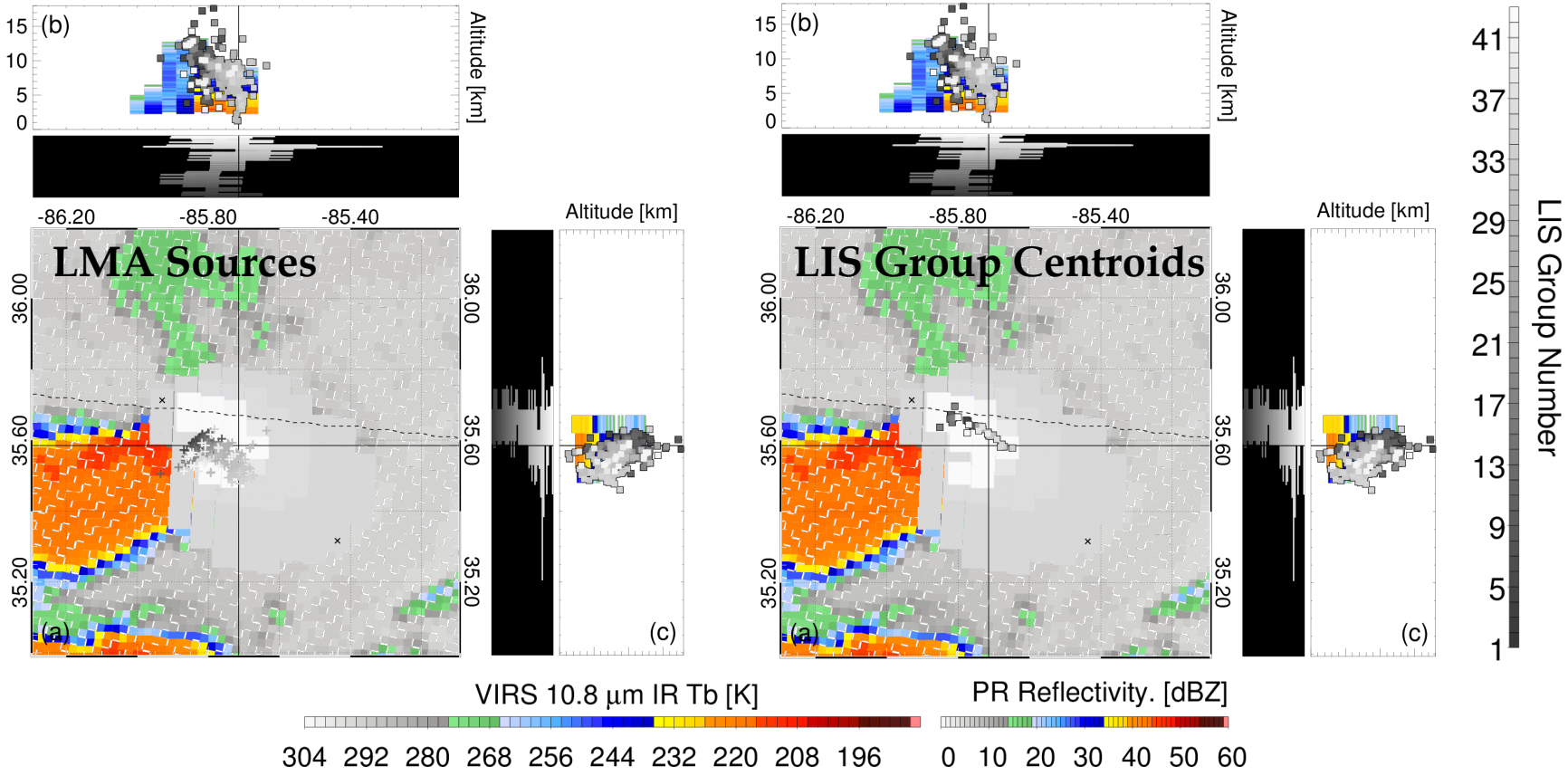
Group Level Structure



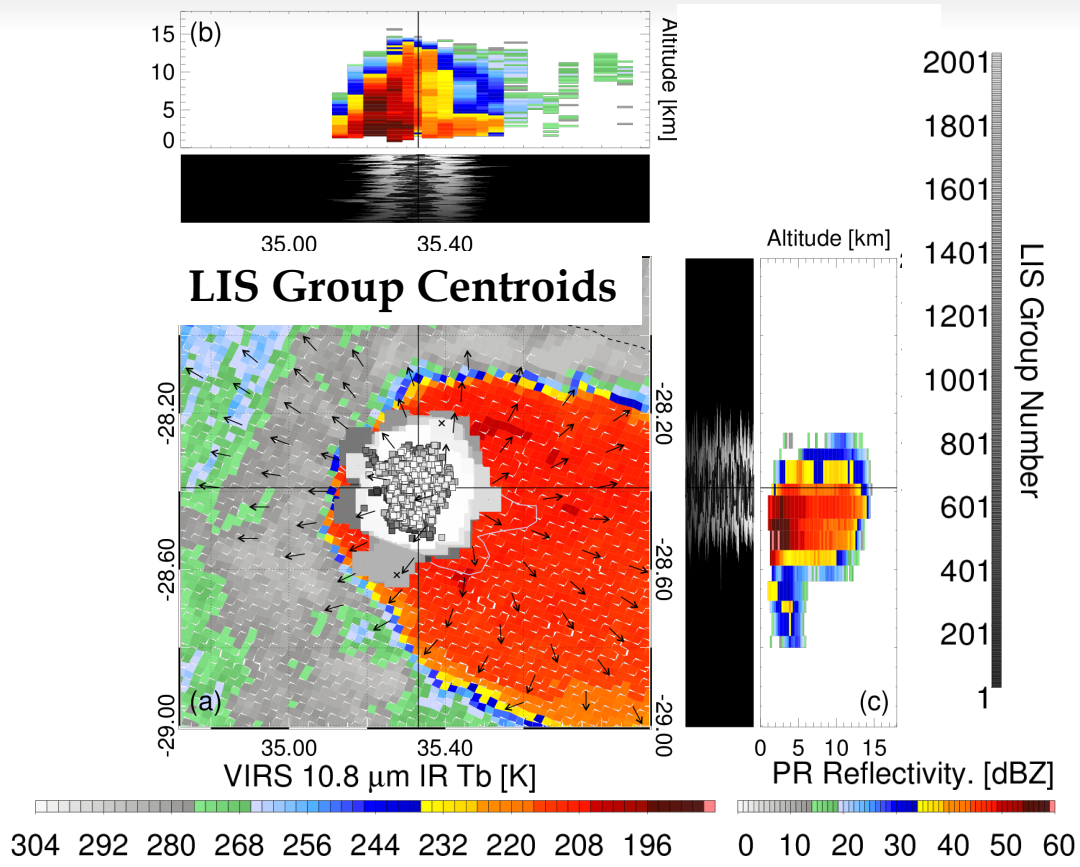
Group Level Structure



Convective CG Flash

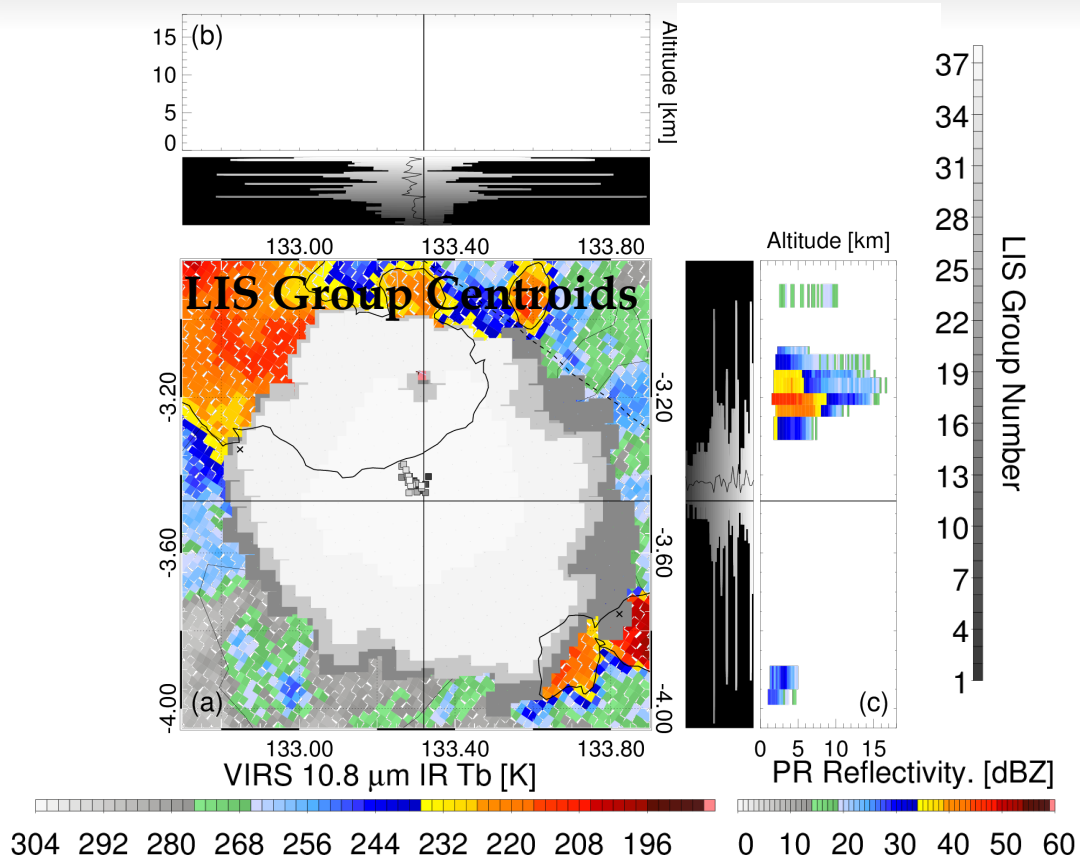


Longest Duration



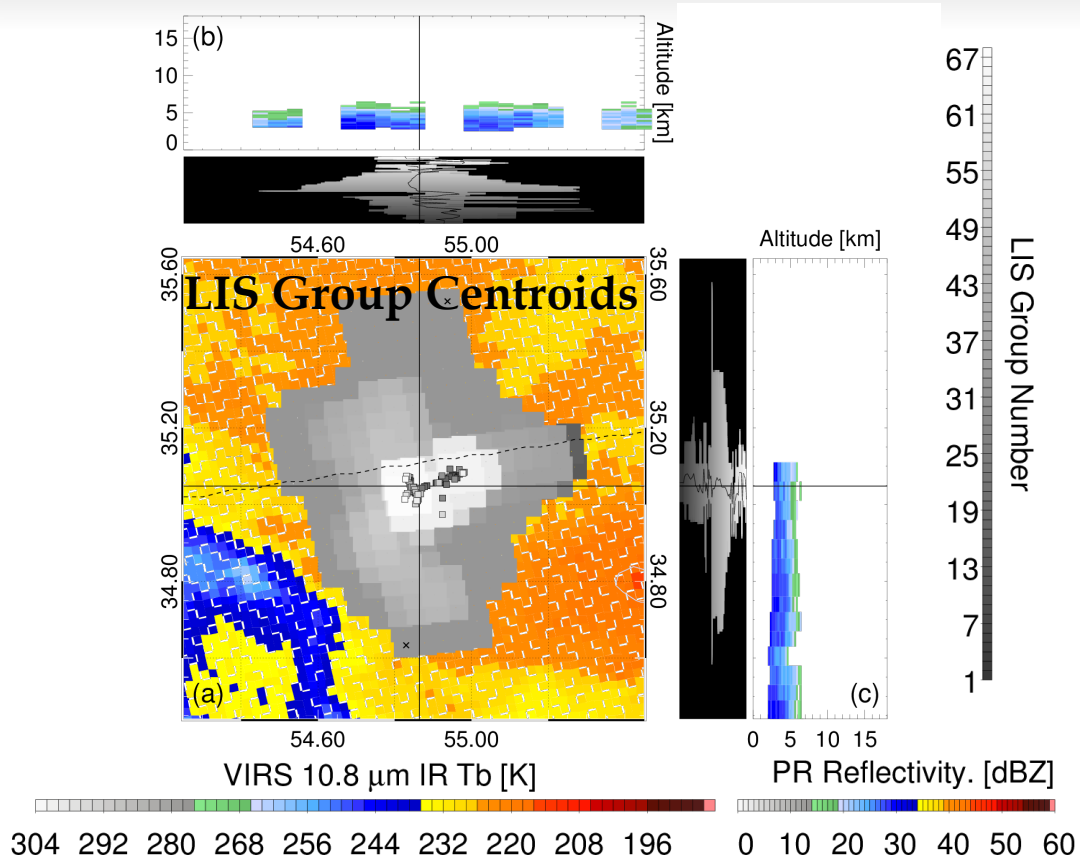
- Area: 1235 km^2
- Duration: 27,555 ms
- Radiance Ratio: 92
- Event Separation: 45 km
- Group Separation: 31 km

Largest Area ICF



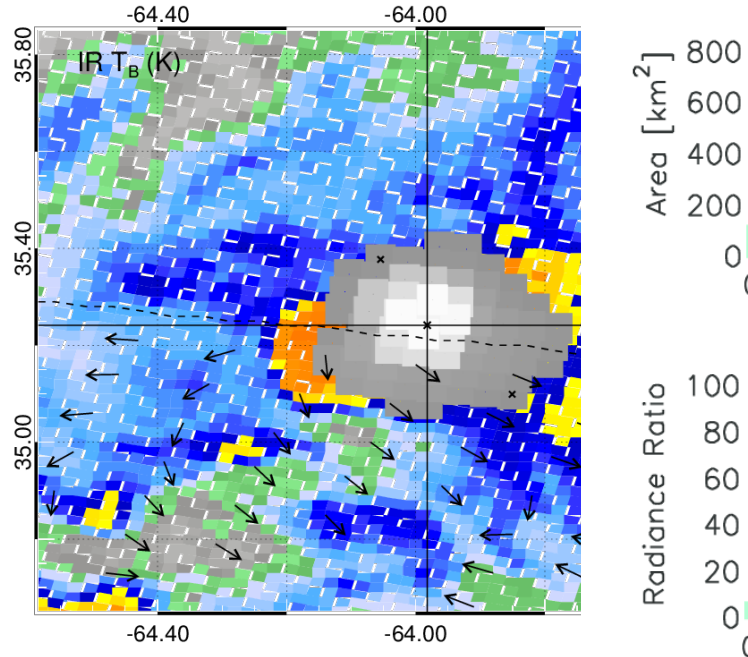
- Area: 9269 km^2
- Duration: 559 ms
- Rad. Rat: 114
- Grp. Dis: 10 km

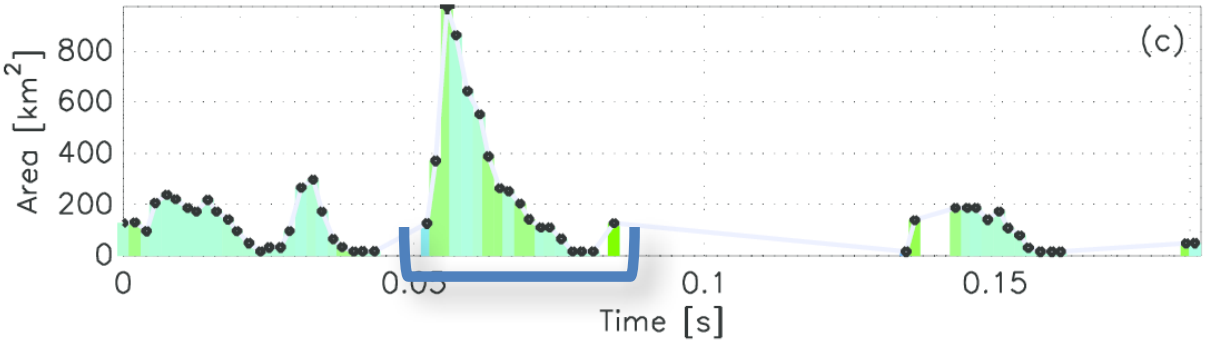
Brightest Group

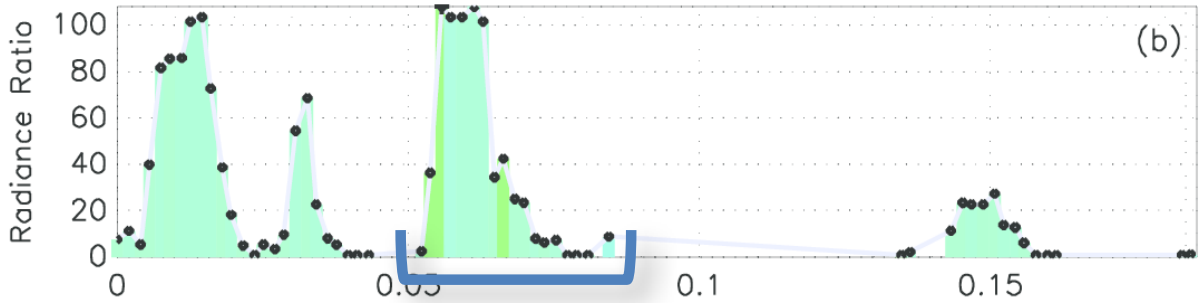


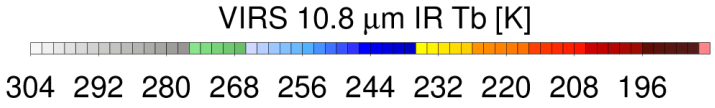
- Area: 3984 km^2
- Duration: 333 ms
- Rad. Rat: 101
- Evt. Dis: 100 km
- Grp. Dis: 14 km

Continuous Bright Segments



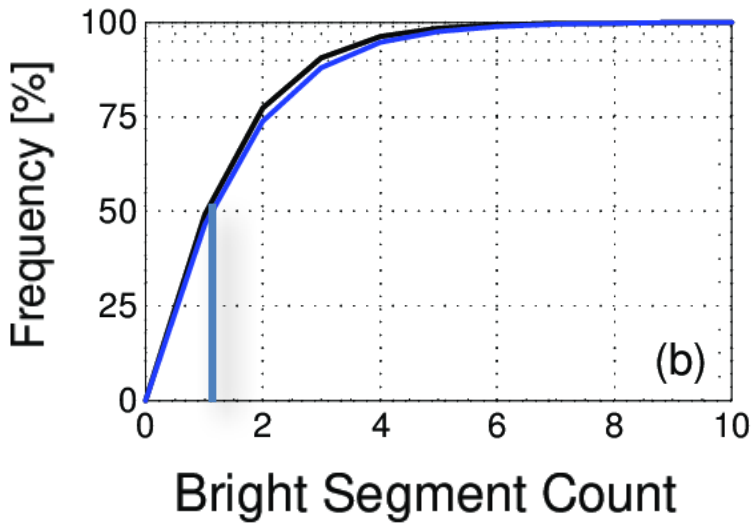




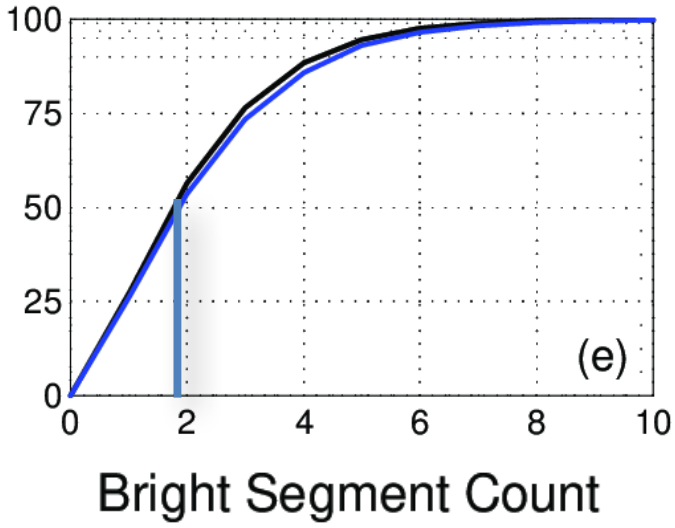


LIS Bright Segments

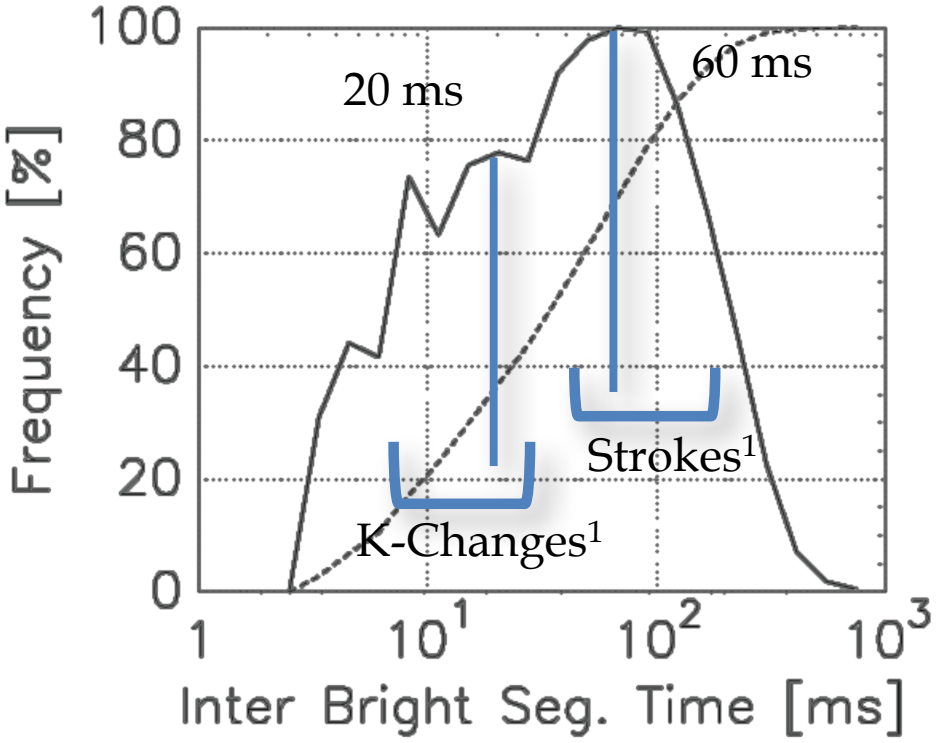
All LIS Flashes



Propagating Flashes



LIS Bright Segments



1. Various studies summarized in de Miranda et al. (2003) JASTP