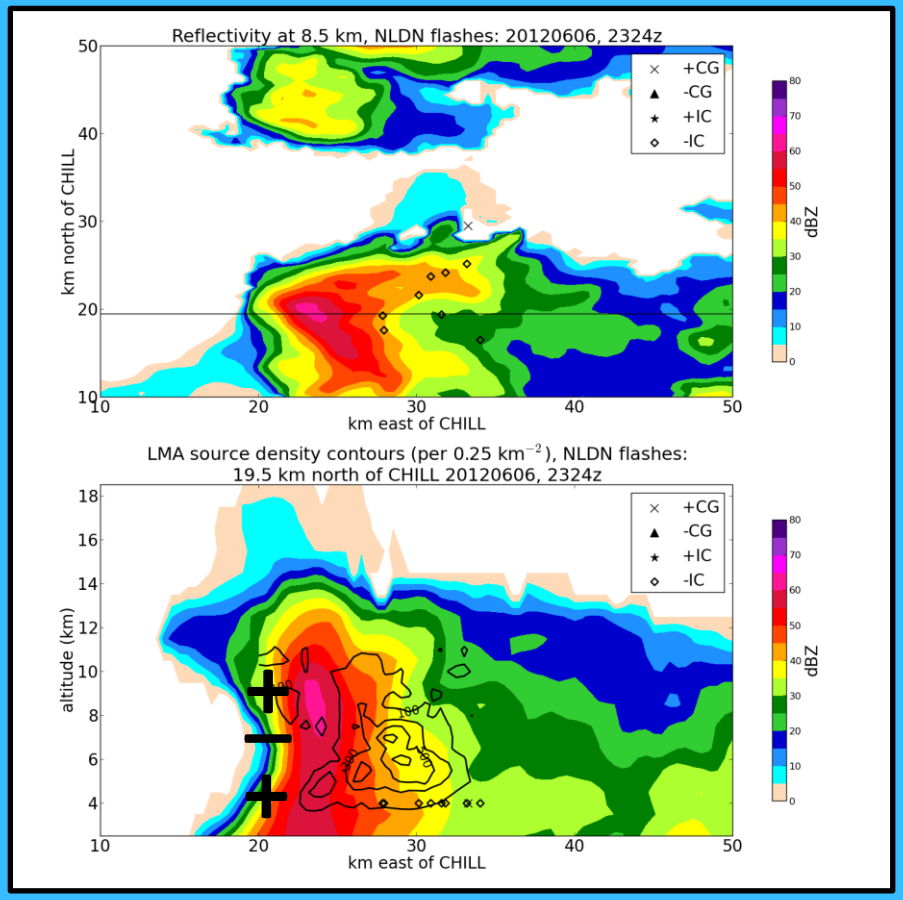
Developing an Improved Understanding of Anomalously Electrified Storms

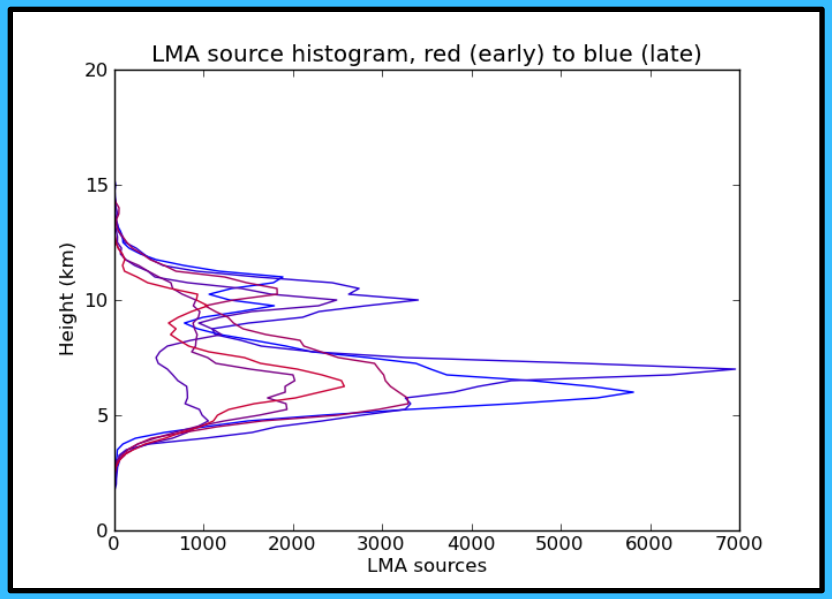
- Normal vs. inverted polarity is insufficient terminology!
- There exists a range of anomalous cases and meteorological controls

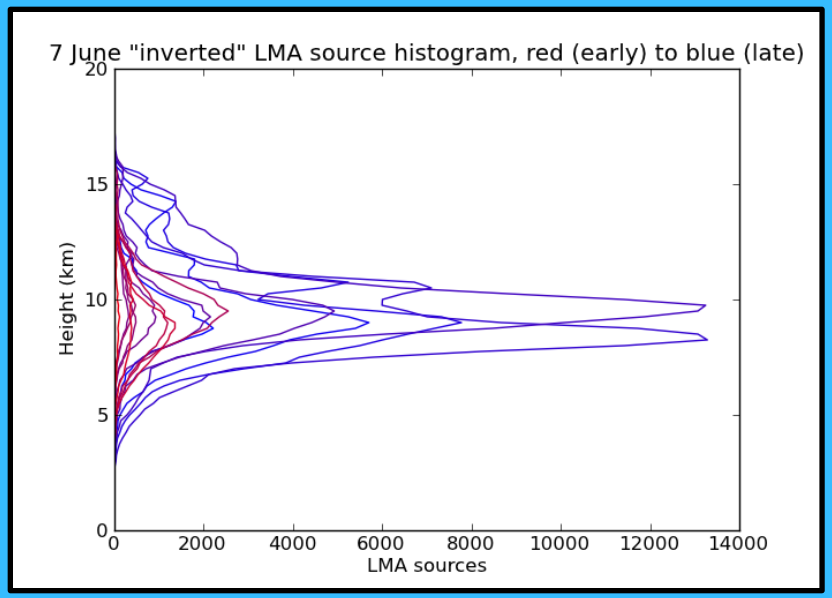
Identify Characteristics of Anomalous Storms

- With 3+ regions and a variety of LMA and flash behavior, DC3 provides opportunity to flesh out conceptual model of charge structure/flash type
- What is “anomalous”, what is “normal” and what is the continuous spectrum in between?
- New ways to classify: consider IC:CG ratio

Anomalous Storm Examples







Environmental Parameters Controlling for Anomalous Electrification

- "Normal" defined by initial mid-level negative, upper-level positive structure; departure from this structure considered anomalous
- Inverted/normal classification is oversimplification: ignores time evolution; incomplete knowledge of the controlling parameters
- Sign of graupel charging depends on amount of liquid water
  - Graupel charges negatively for low LWC → sublimational state
  - Positively for high LWC → high riming rates
  - Liquid water depletion rate important for location of charge regions
- Other parameters: Impact of biomass burning on microphysics/electrification

Future Goals

- Better understanding of charge structure:
  - Tie different storms together based on electrical characteristics
  - Develop framework to unify electrification and storm modes
- Use model derived microphysics to substantiate understanding based on field observations
- Better understanding of flash characteristics/lightning NO_x production; can use XLMA as a diagnostic tool

Visualizing Physics of a Lightning Flash