

Characteristics of Dual-Polarimetric Radar Variables during Lightning Cessation: A case Study for 11 April 2008 Thunderstorm

Xuanli Li, John Mecikalski, Larry Carey, Bill McCaul
Department of Atmospheric Sciences
University of Alabama in Huntsville

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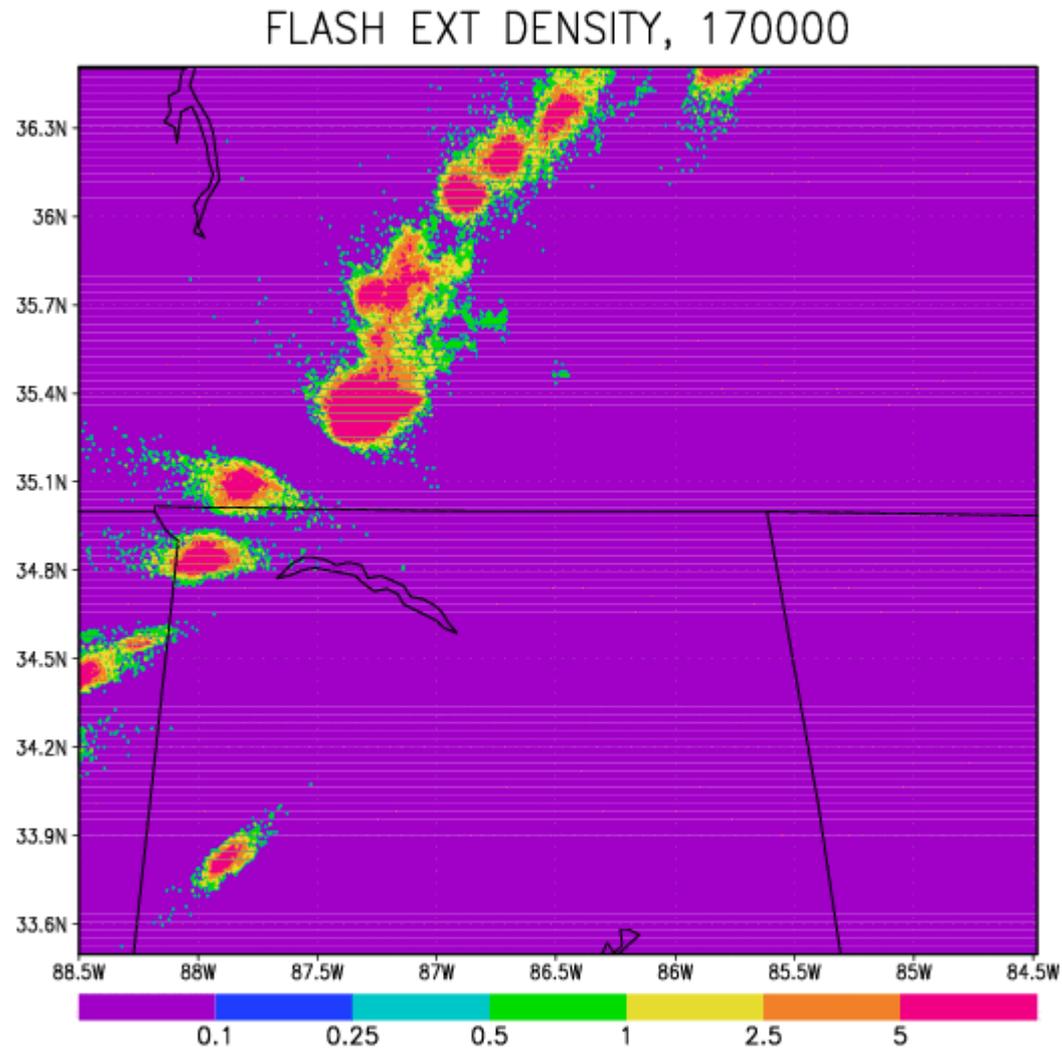
Motivation & Objectives

- Guidance for lightning cessation
- Only **a few** studies on lightning cessation:
 - Understanding of thunderstorm electrification processes:
considerable variability in storm behavior during decaying
- Storm scale dual-pol characteristics for lightning cessation
- Understand & document kinematic structure and microphysics distribution of decaying storm
- Hypothesis: threshold values on related parameters for the end of charging processes

Previous Studies on Lightning Cessation

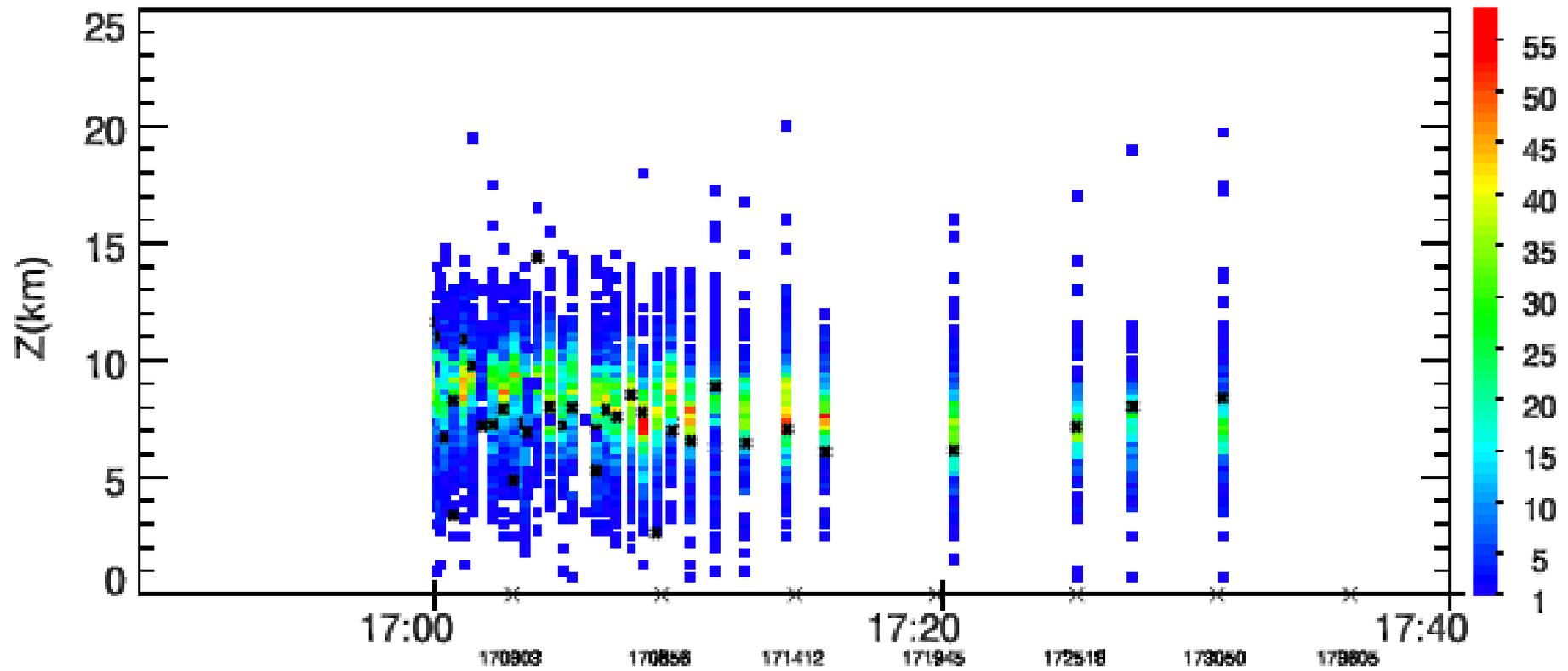
- **Hinson 1997:** radar reflectivity and lightning cessation for 3 thunderstorms over KSC
- **Roeder and Glover 2005:** log-linear curve in times between the last and second-last CG flashes
- **Wolf 2006:** reverse of initiation (40 dBZ above -10C)
- **Marshall et al. 2009:** surface electric field shows end of storm polarity oscillation
- **Stano et al. (2010):** several methods with 15 lightning, 3 radar, and 15 sounding predictors for guidance: if a certain flash is the last flash.
- **Anderson (2010):** difficult to draw a conclusion, contrary to expectations.

Thunderstorm on 11 April 2008



- Manual selection: experiencing the cessation stage within the confident coverage of ARMOR and LMA

Cell#1: Lightning Activity

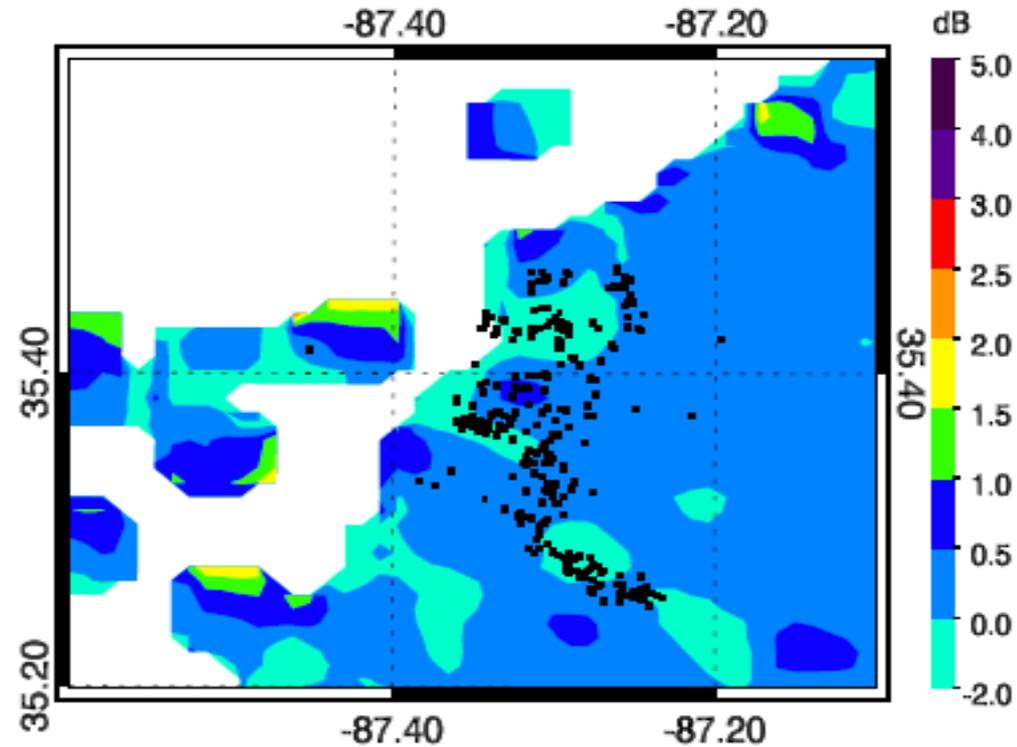
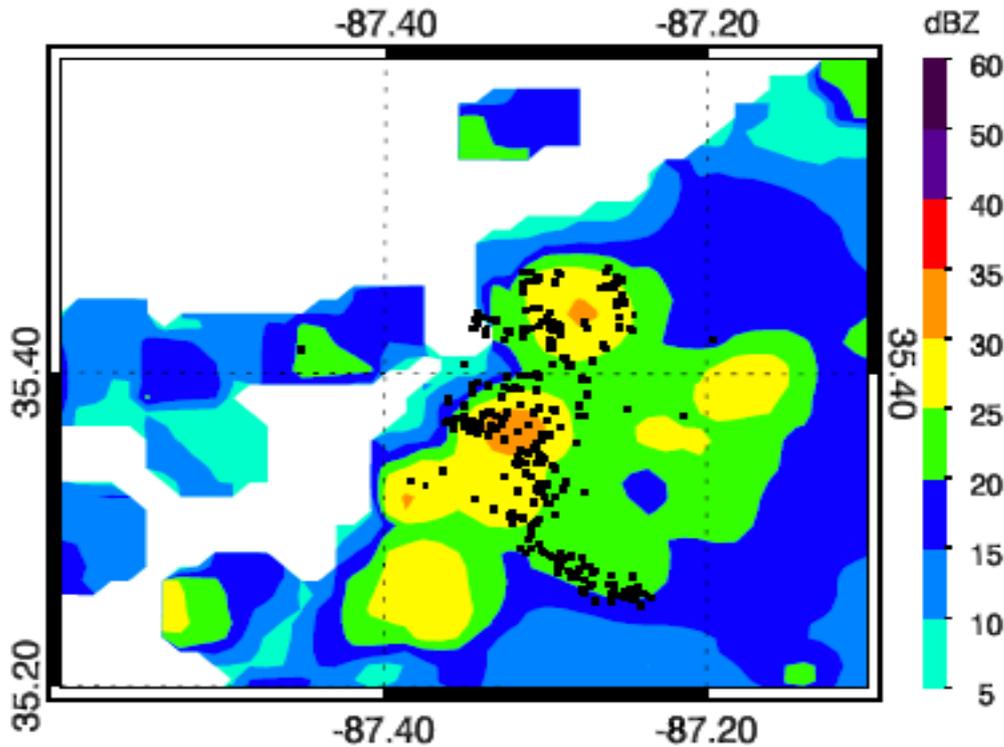


Last flash: 173103 UTC, 0.8 ~ 19.5 km

Radar Reflectivity & Differential Reflectivity

173050 UTC

6 km (-10C)



Cell: 35 km X 30 km

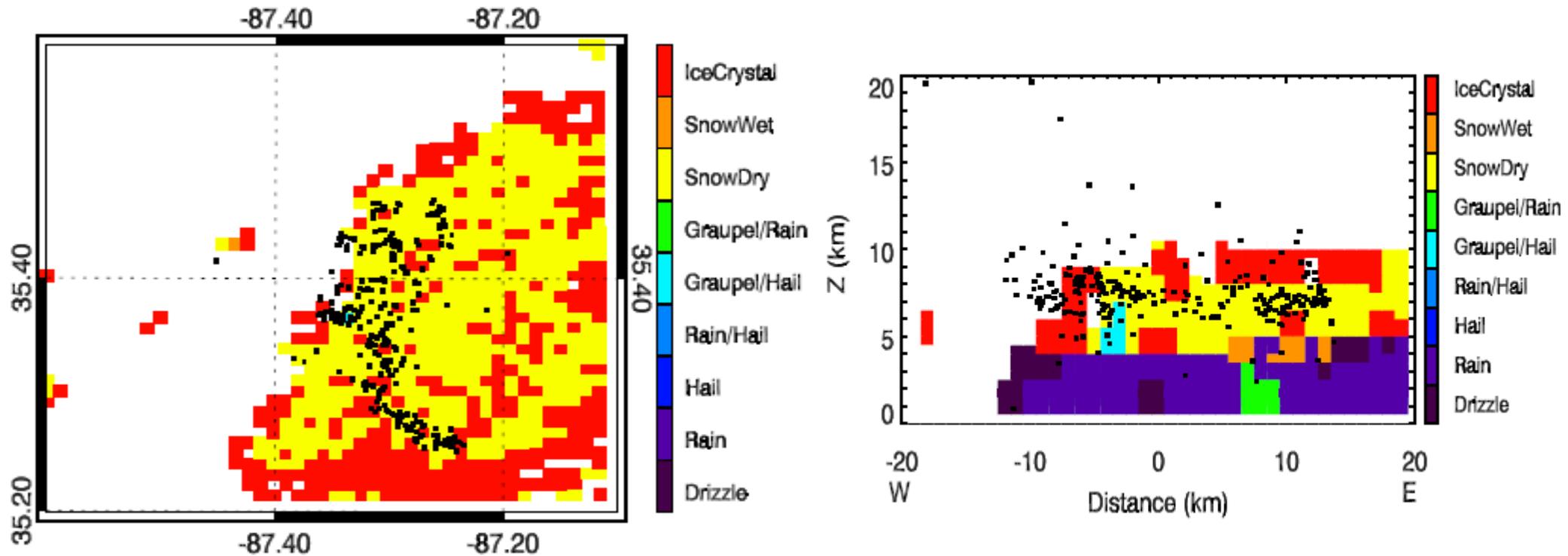
Zh: below 40 dBZ

Zdr: below 1.0 dB

Particle ID

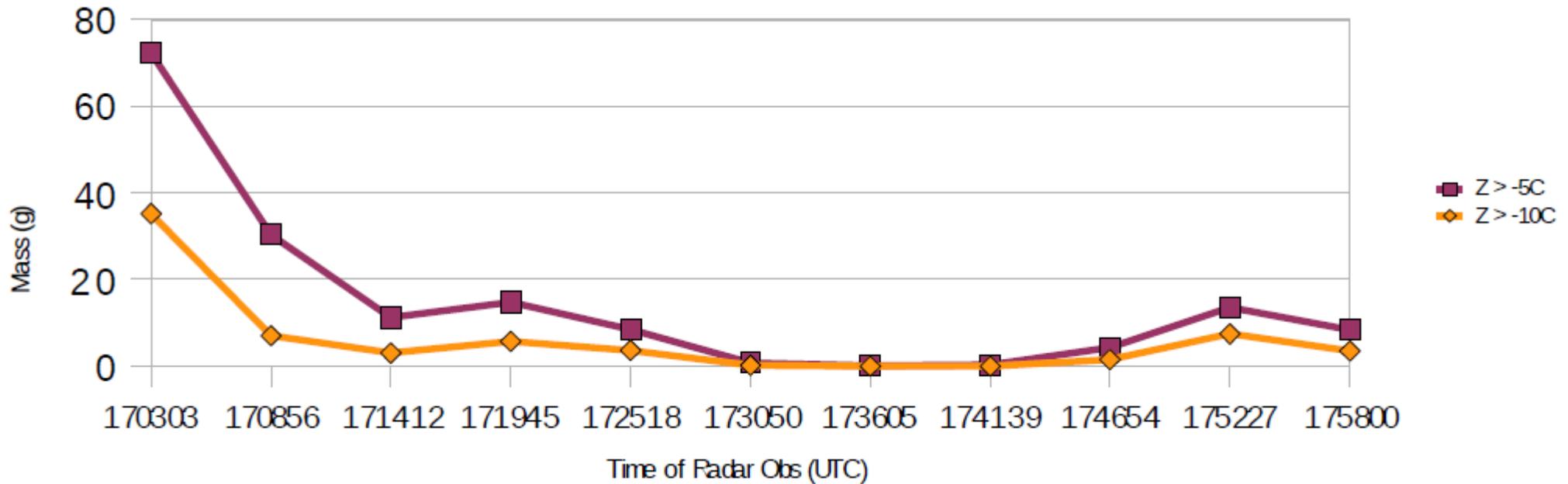
6 km (-10C)

Cross-section along 35.367N



Graupel/hail existence at 0C ~ -20C level

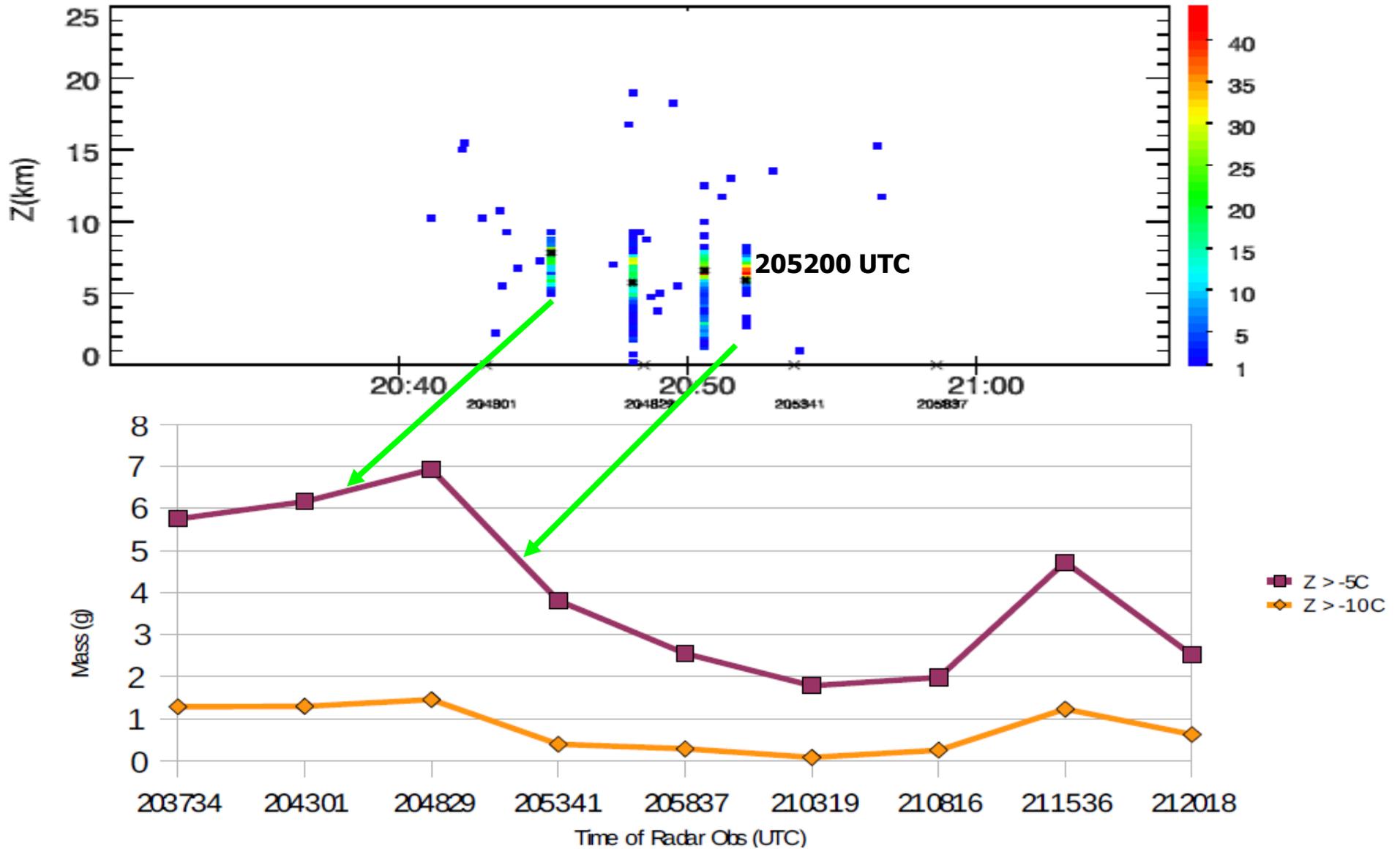
Time Series of Precipitation Ice



173050 UTC: mass 0.73×10^9 g (above -5C)

0.18×10^9 g (above -10C)

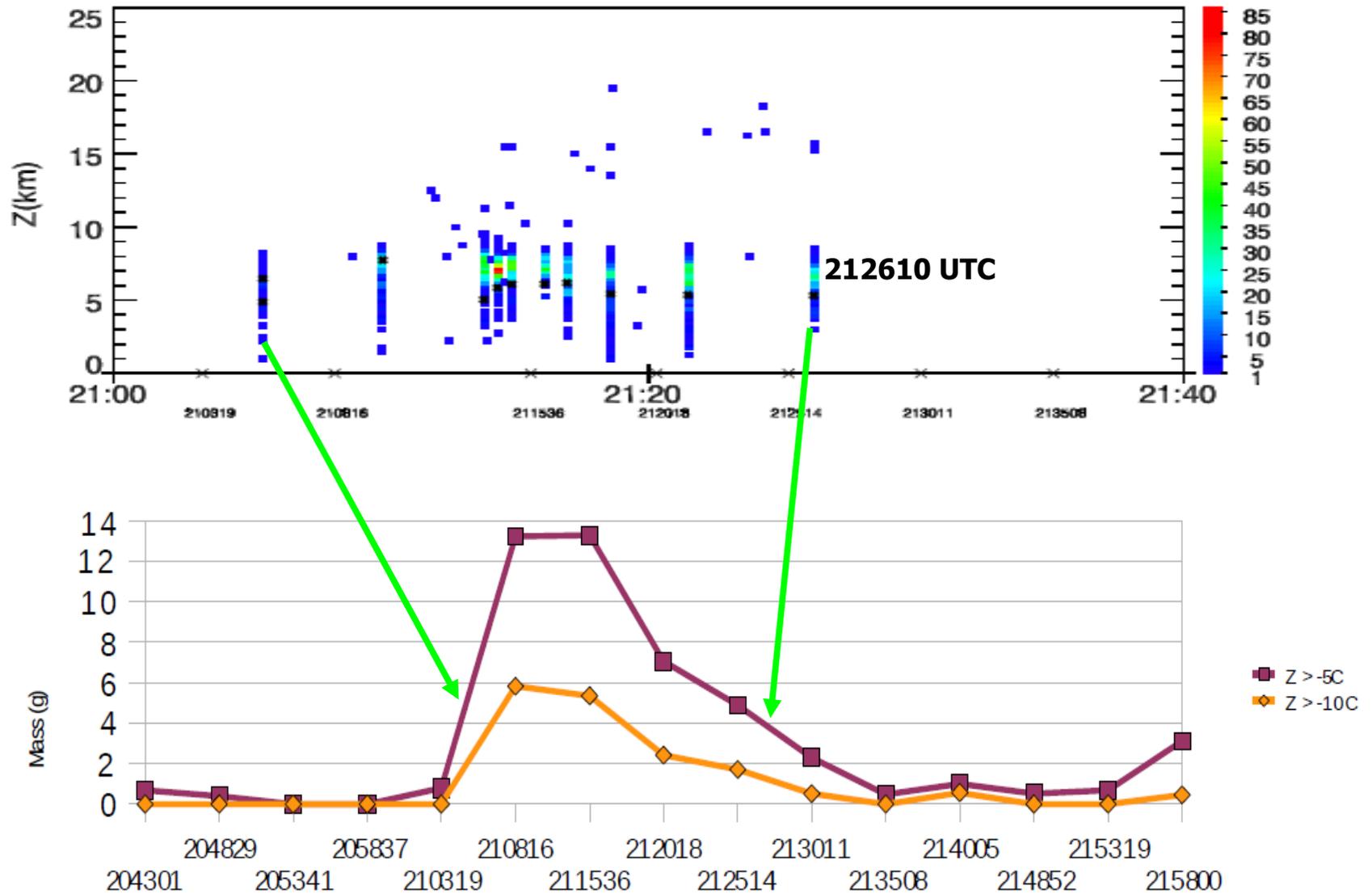
Cell#2



215341 UTC: mass 3.81×10^9 g (above -5C)

0.4×10^9 g (above -10C)

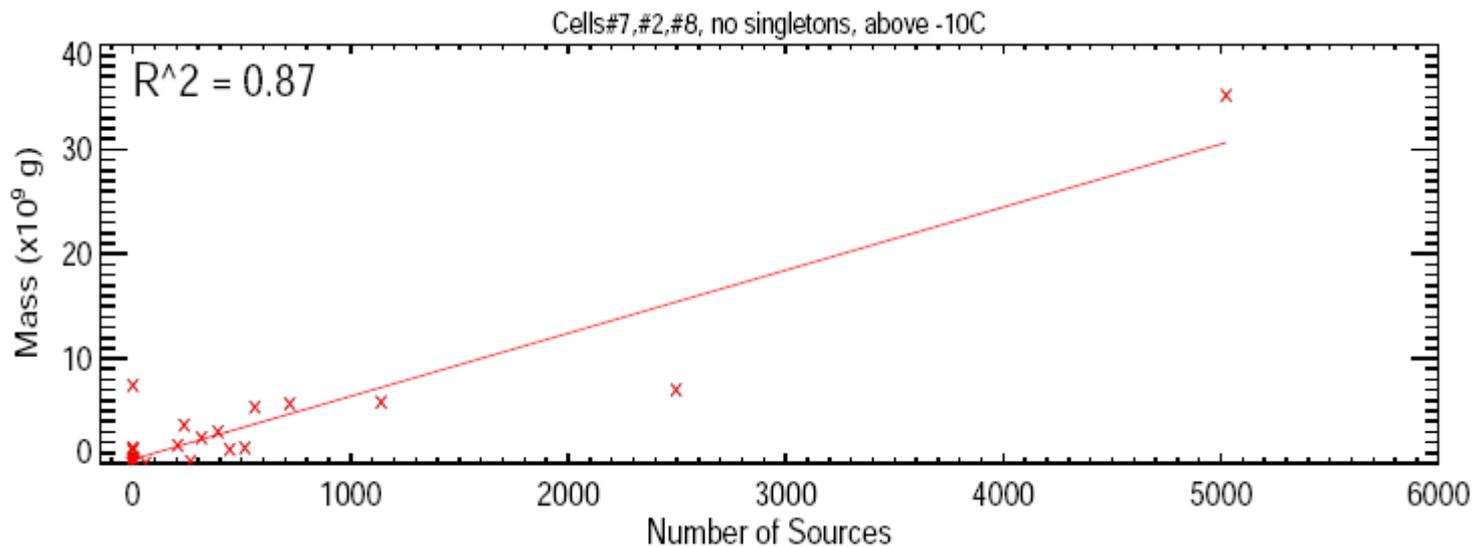
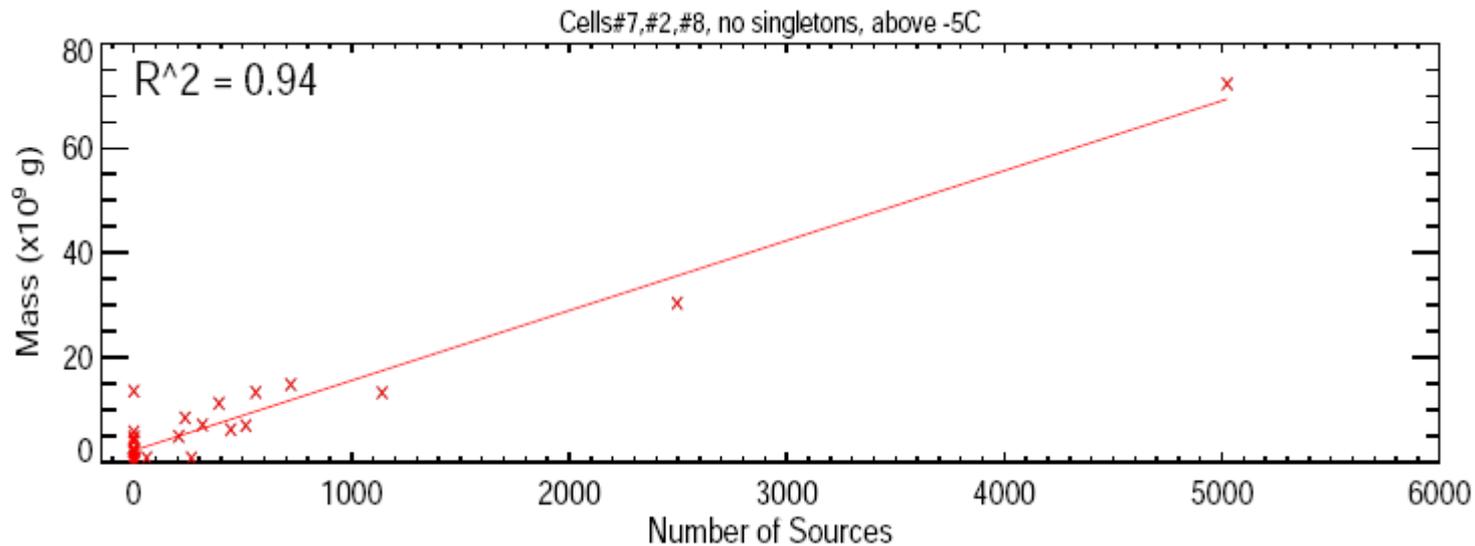
Cell#3



1730 UTC: mass 4.88×10^9 g (above -5C)

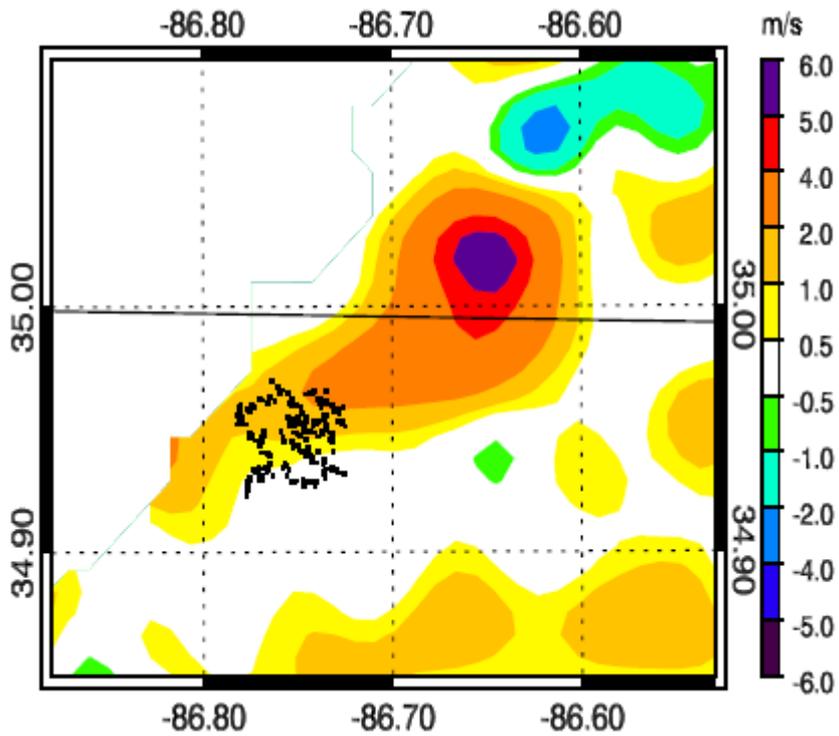
1.7×10^9 g (above -10C)

Linear Correlation between Precipitation Ice & Lightning Activity

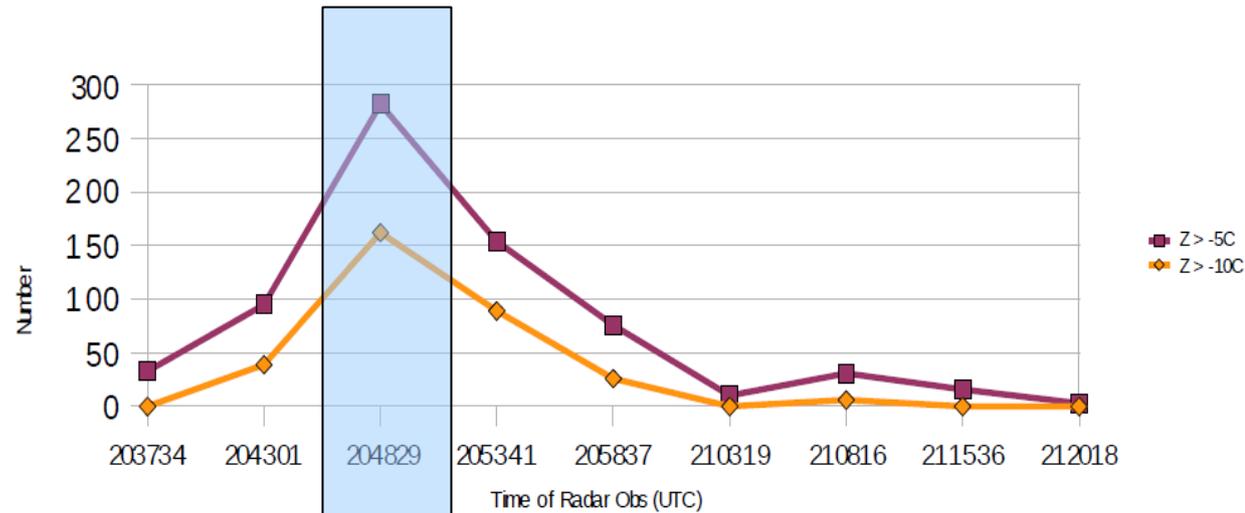


Vertical Velocity: Cell#2

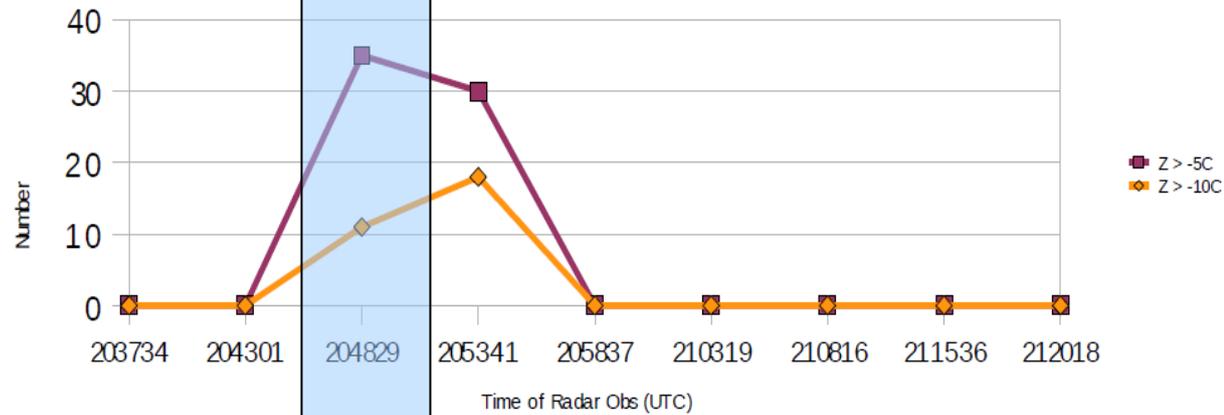
5 km (-5C level)



of pixels w>3m/s

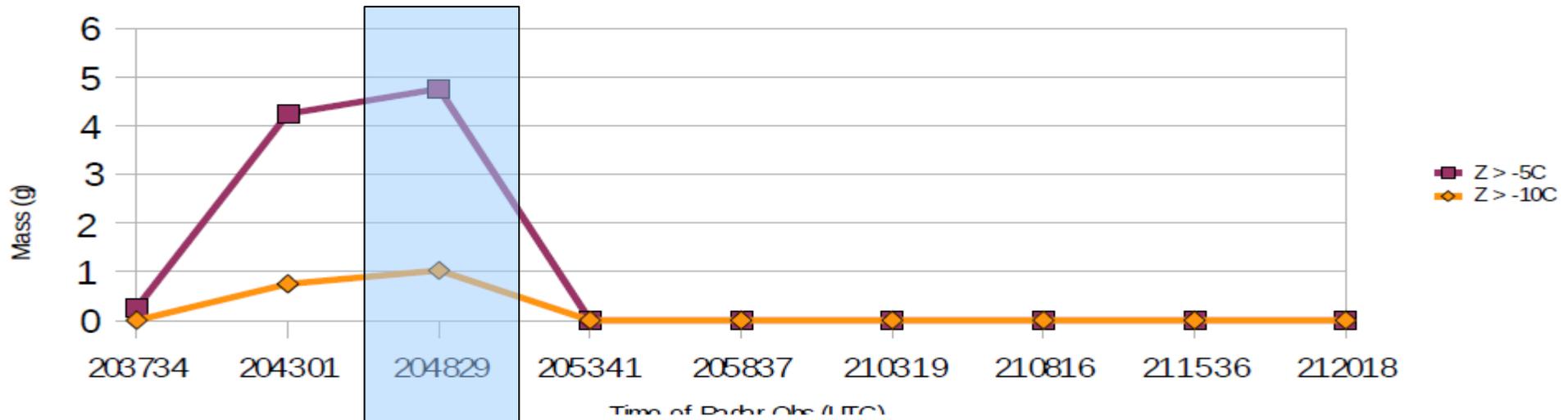


of pixels w>5m/s

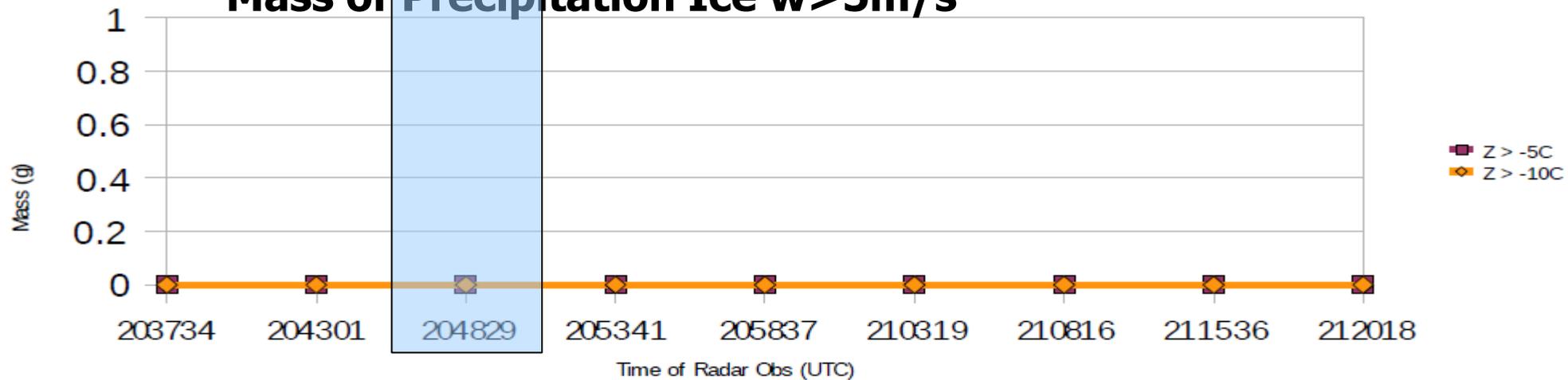


Vertical Velocity & Precipitation Ice Mass

Mass of Precipitation Ice $w > 3\text{m/s}$



Mass of Precipitation Ice $w > 5\text{m/s}$



Summary & Future Plan

- Lightning activity is highly linearly related to precipitation ice, vertical velocity above -5C & -10C. Potentially have threshold values for lightning cessation.
- A large amount of cases of different weather regimes to determine threshold values (~20 storm days, ~50 storms on list)
- IC vs. CG might have different radar signature and thresholds
- Cases for different weather regimes, single cell, super cell, multicell
- Parameters: cell size, storm duration, storm intensity (mean/max reflectivity), flash rate, flash interval, flash density, satellite parameters
- Dual-pol variables: Zdr, Kdp, phv,LDR