The Effect of Liquid Water on Thunderstorm Charging

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Introduction

• Past laboratory studies show that charge transfer from ice crystals to graupel is enhanced by liquid water.
• The objective of this work is to quantify this effect.
• Measure the charge transfer during graupel-ice interactions for different temperatures and liquid water contents.
Past studies noted a ‘temperature-sensitive’ charging mechanism in thunderstorms.

$T > T_{\text{reversal}}$
Less liquid water decreases $T_{\text{reversal}}$

$T < T_{\text{reversal}}$
More liquid water increases $T_{\text{reversal}}$
Experiment

• Cloud of water droplets inserted into chamber under known temperature & LWC conditions

• Measured charge transfer to riming target
Some results...

Warmer temperature, higher LWC: *Positive* current to the riming target

Colder temperature, higher/lower LWC: *Negative* current to the riming target
LWC matters, too...

Notice the negative charge transfer to the riming target as LWC decreases.

-12 & -15°C
... Dendritic growth... coincidence??

Does this have something to do with ‘charged dislocations’ of the ice particles (Keith & Saunders, 1990)?
Putting the results to good use

Saunders et al. (1991) parameterized their results for use in models of thunderstorm electrification.

**Fig. 7.** The positive and negative target charging zones as a function of temperature and effective liquid water content.