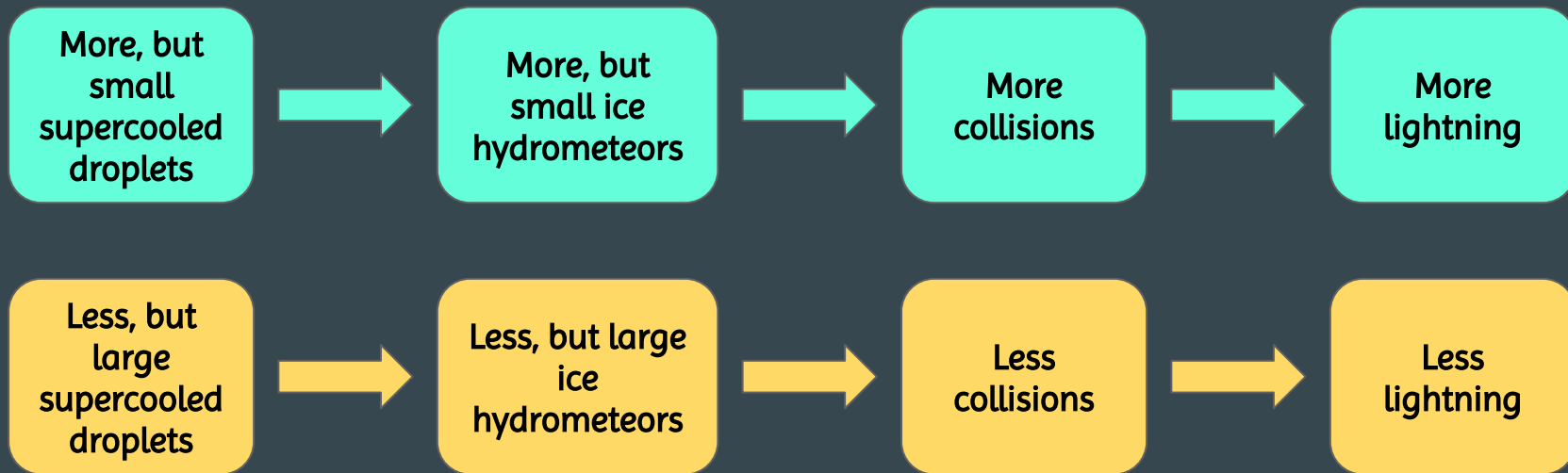STORM-T

SOS CHUVA

The Influence of Hail on Severe Storms Electrification

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BSc. Camila Lopes, Profª Drª Rachel Ifanger Albrecht
Master's Project in progress
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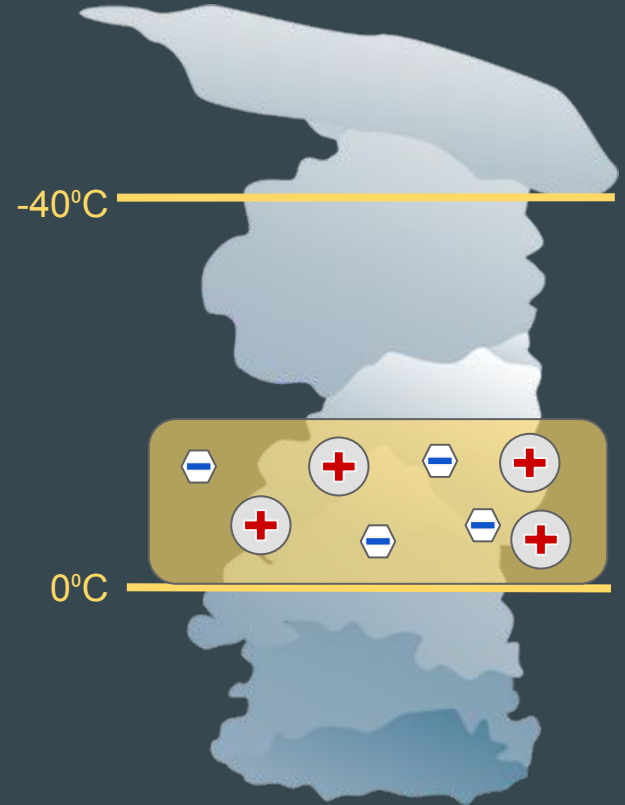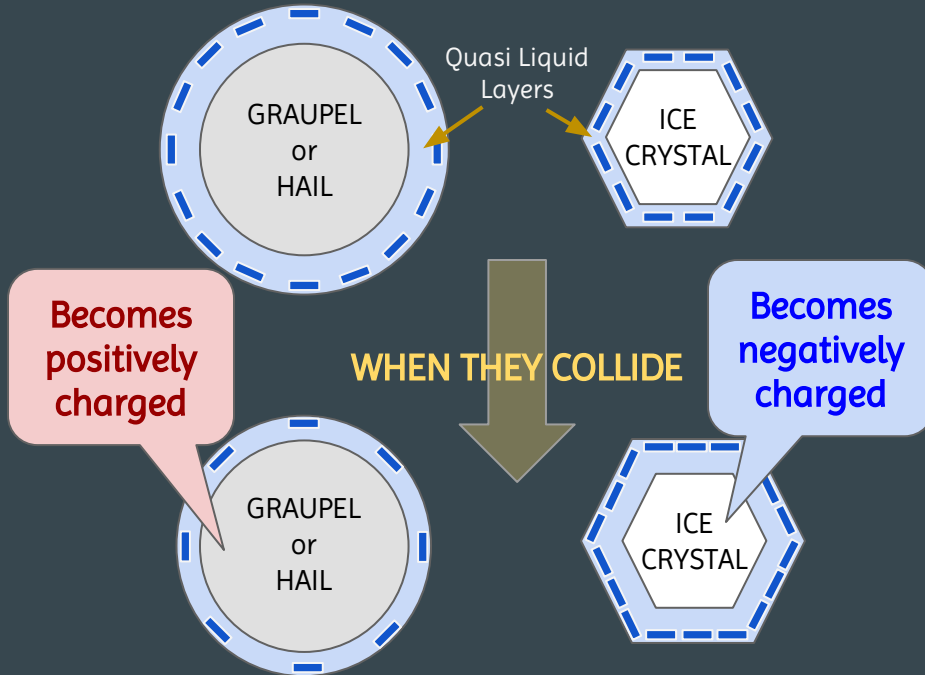INSTITUTO DE ASTRONOMIA,
GEOFÍSICA E CIÊNCIAS
ATMOSFÉRICAS

USP

Introduction: how hail is related to cloud electrification?

- The distribution of ice hydrometeors within cloud is controlled by the amount of supercooled liquid water, that depends on:
 - Updrafts
  - Cloud Condensation Nuclei (CCNs)

| More, but small supercooled droplets | → | More, but small ice hydrometeors | → | More collisions | → | More lightning |

| Less, but large supercooled droplets | → | Less, but large ice hydrometeors | → | Less collisions | → | Less lightning |

# Introduction: how hail is related to cloud electrification?

Introduction: how hail is related to cloud electrification?

- Main mechanism of cloud electrification: **non-inductive charging**
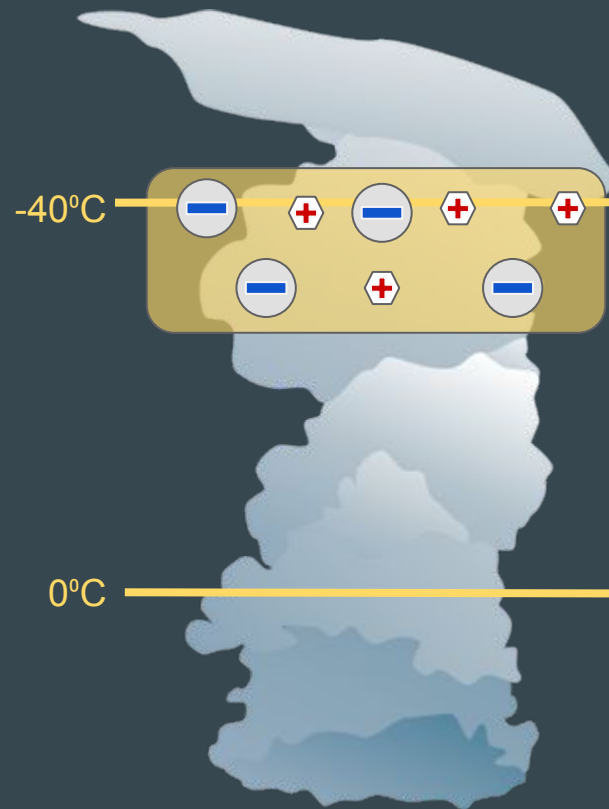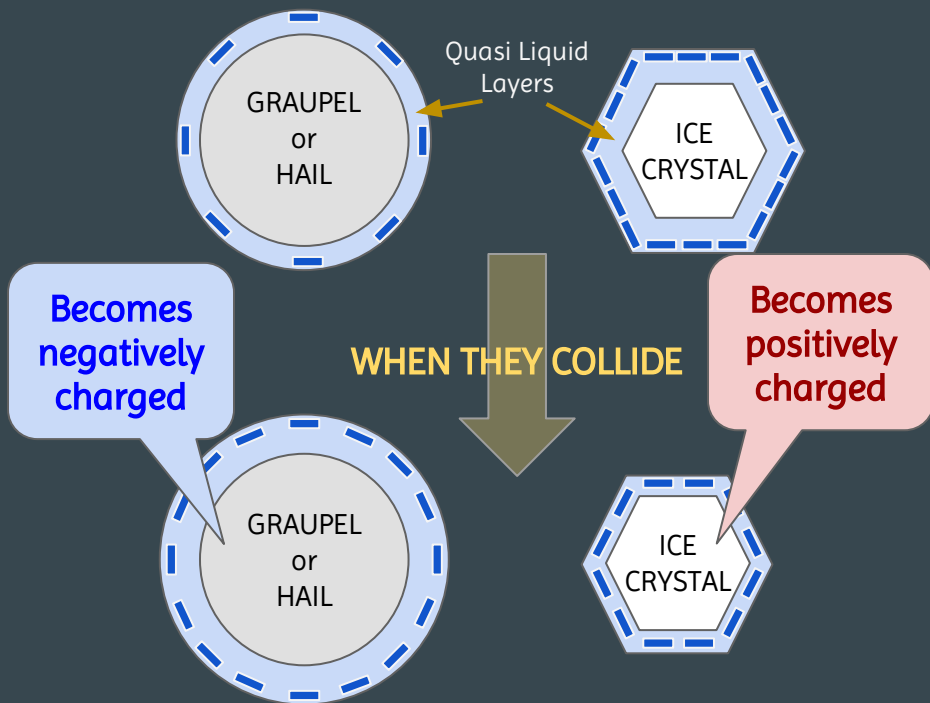
# Introduction: how hail is related to cloud electrification?

- Explain the **tripolar structure of thunderstorms** (Williams et al. 1991)

- Generates ~80% **negatively polarized** cloud-to-ground lightning
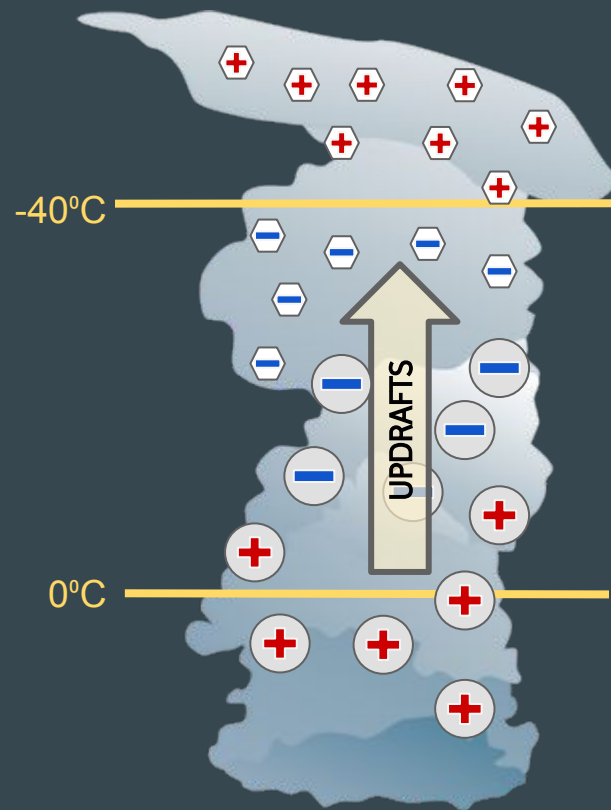
Introduction

BUT IN A SEVERE THUNDERSTORM...

- More supercooled liquid water

- Stronger updrafts

- **Inverted** tripole structure

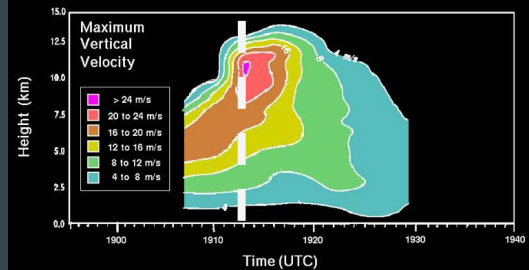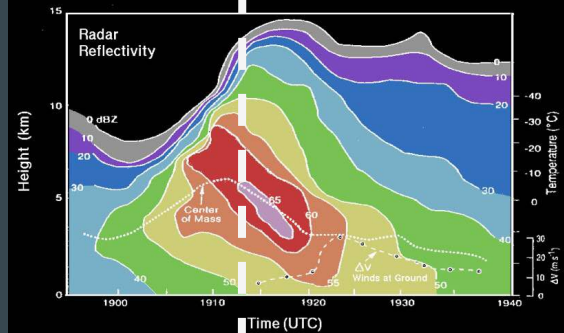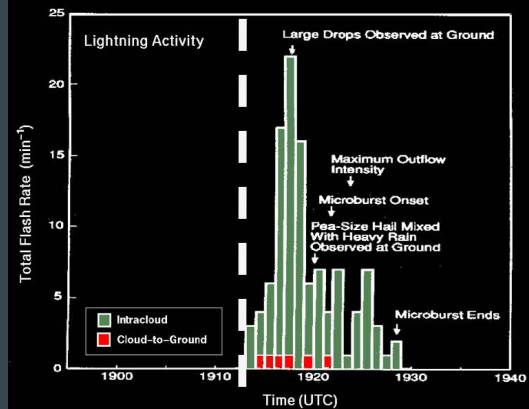- Generates more **positively** polarized cloud-to-ground lightning
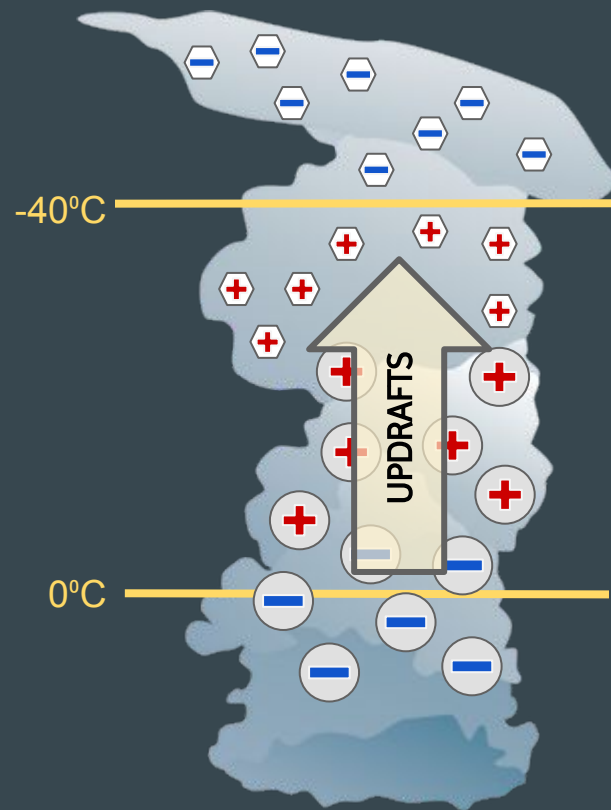
Introduction: why severe thunderstorms?

- Hailfall
- Wind gusts
  - Microbursts
  - Downbursts
  - Tornadoes
- Lightning Jump
- Low previsibility in Brazil
  - Lack of weather radars in most regions
  - NWPs can't capture this phenomenon

Rio Grande do Sul, 08/06/2017

Objectives

- Determine how hail distribution affects lightning in severe thunderstorms in Brazil using:
  - Observations
  - Numerical Weather Model

Methodology: Observations

SOS-CHUVA Project

- Campinas and surroundings
- Develop and implement nowcasting algorithms
- Two summers (**Nov/2016 to Mar/2018**)
- Instruments:
  - Dual-polarization X-Band **radar** (Campinas)
  - 3 **lightning detection networks** (LINET, STARNET and BrasilDAT)
- Select severe weather cases
  - **Observe the life cycles of the storms**

Methodology: Modelling

- WRF-ARW model (Skamarock et al. 2008)
- In **partnership** with **Dr. Ted Mansell** and **Dr. Alex Fierro** (NOAA/NSSL)
- Electrification parameterization: WRF_ELEC (Fierro et al., 2013)
- 3 different microphysical parameterizations:
  - Mansell et al. (2010) - double-moment for 6 types of hydrometeors
  - Thompson et al. (2008) - double (4) and single-moment (1 hydrometeor)
  - Morrison and Milbrandt (2015) - Predicted Particle Properties (P3)
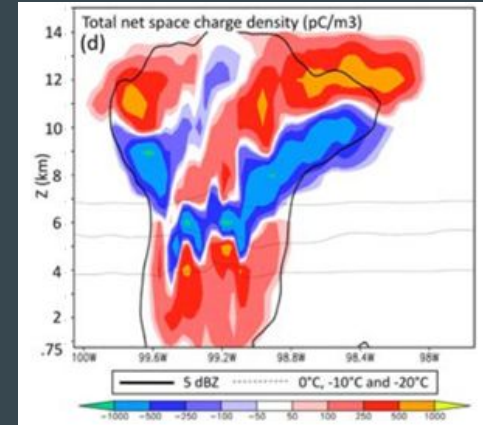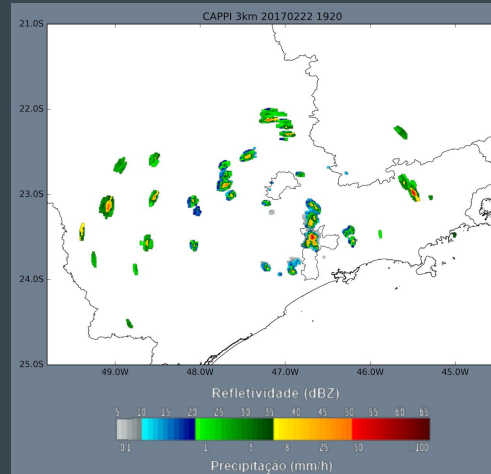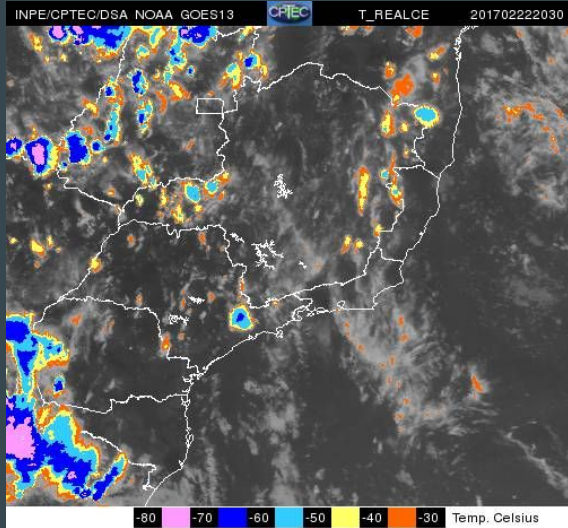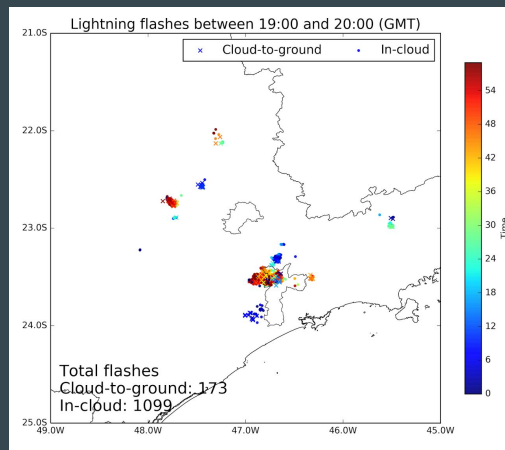
Some pre-selected cases

18 to 19/12/2016

São Paulo, Campinas, Guarulhos and Campos do Jordão
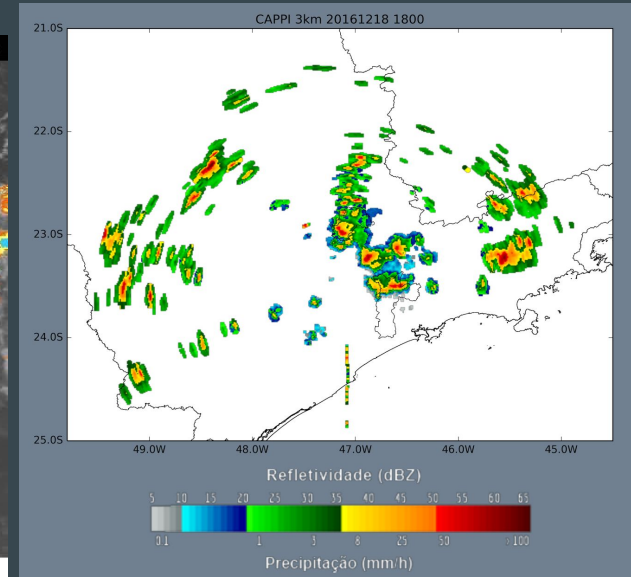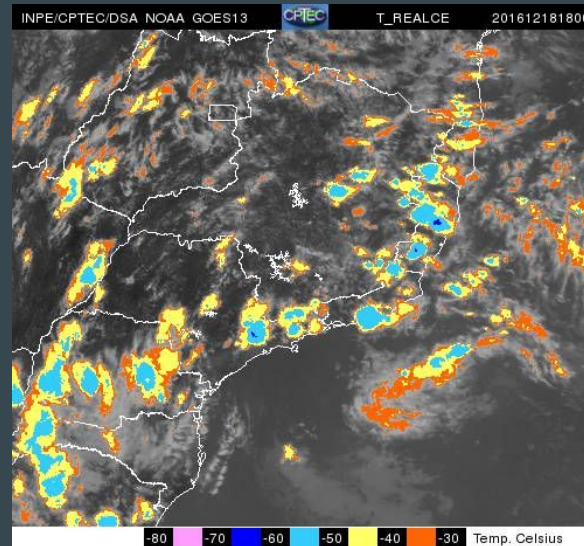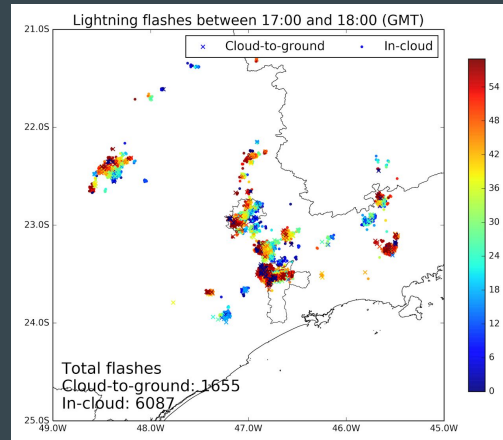
Some pre-selected cases

22/02/2017

São Paulo and Limeira

Thank You!

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camila.lopes@iag.usp.br