Two hailstorms in **Southeastern Brazil** show different **lifecycles** and **hailfall intensity**.

Microphysics, Kinematics and Lightning Activity of Hailstorms during SOS-CHUVA Project

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INTRODUCTION

- Hailstorms show great variability around the world
- Southeastern South America is a hotspot for hailstorm occurrence[1,2]
  - Southeastern Brazil is on the edge of this area
- SOS-CHUVA Project developed research in thunderstorm nowcasting in São Paulo state

METHODS

1. 2 cases selected based on **hailpad** measurements
2. S-band dual pol radar (FCTH) to calculate **hydrometeor ID** with CSU_RadarTools Python Package[3]
3. FCTH + S-band single pol (SR) + X-band dual pol (XPOL) radars to **retrieve tridimensional wind with multi-doppler** (according to data availability and optimal setup) with MultiDop Python package[4]
4. BrasilDAT IC/CG lightning detection network to **analyze electrical activity**

Fig. 1: Sensitized hailpad at Indaiatuba site.

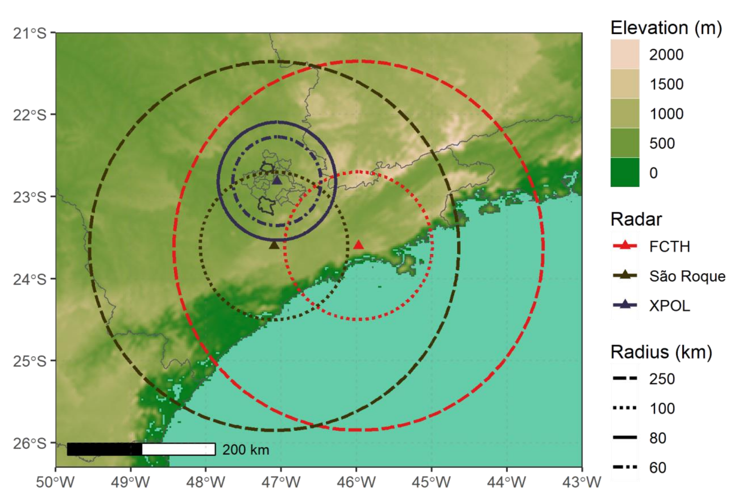

Fig. 2: Location and spatial range of selected weather radars.

RESULTS

- **Case 1 (late Summer)**: smaller hail size distribution, longer lifetime (multicellular convective system favored by synoptic conditions), two hailfall events), more lightning (*Table 1, Figs. 4 and 5*)
- **Case 2 (Spring)**: larger hail size distribution, shorter lifetime (smaller system favored by local conditions, practically unicellular, one hailfall event), less lightning (*Table 1, Figs. 4 and 5*)
- Hydrometeor ID is affected by radar resolution (study area more than 100 km away from FCTH radar location) specifically below 0°C height but identifying hail cores (*Fig. 6*)
- Multi-Doppler retrieval shows more intense updraft cores in Case 1 than Case 2, with weaker updrafts during hailfall compatible with its descent (*Fig. 7*)

CONCLUSIONS

- Different atmospheric conditions led to two hailstorms with different characteristics that led to hailfall with smaller or larger hail
- More hailfall cases (8 sensitized hailpads during the experiment) can be analyzed to identify further relations

Table 1: Summary of main physical and electrical features of the hailfall cases.

		Case 1 2017-03-14	Case 2 2017-11-15
Lifetime (h)		6,2	2,2
3-km Max Z (dBZ)		69,7	67,6
Max Size (km^2)		2312	253
Mean Hail (mm)		7,8	10,3
Max Hail (mm)		11,8	22,4
Total Lightning (*flashes*)	IC	10525	46
	CG	2576	20
Max Flash Rate (*flashes* min^{-1})	IC	107	3
	CG	31	2

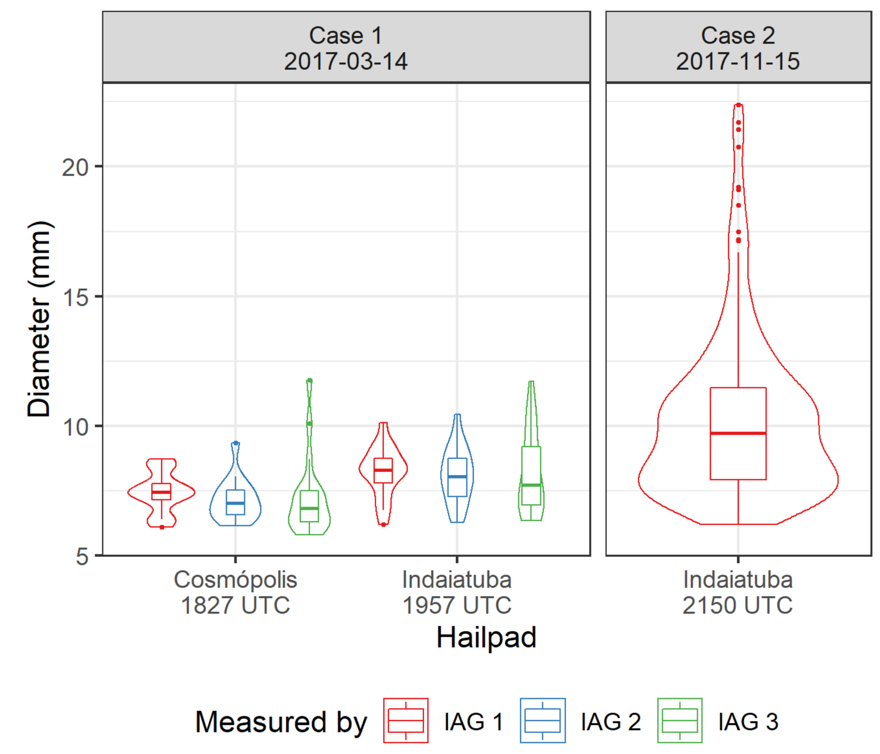

Fig. 4: Violin boxplots of hail diameter distributions of different measurements made by IAG separated by case.

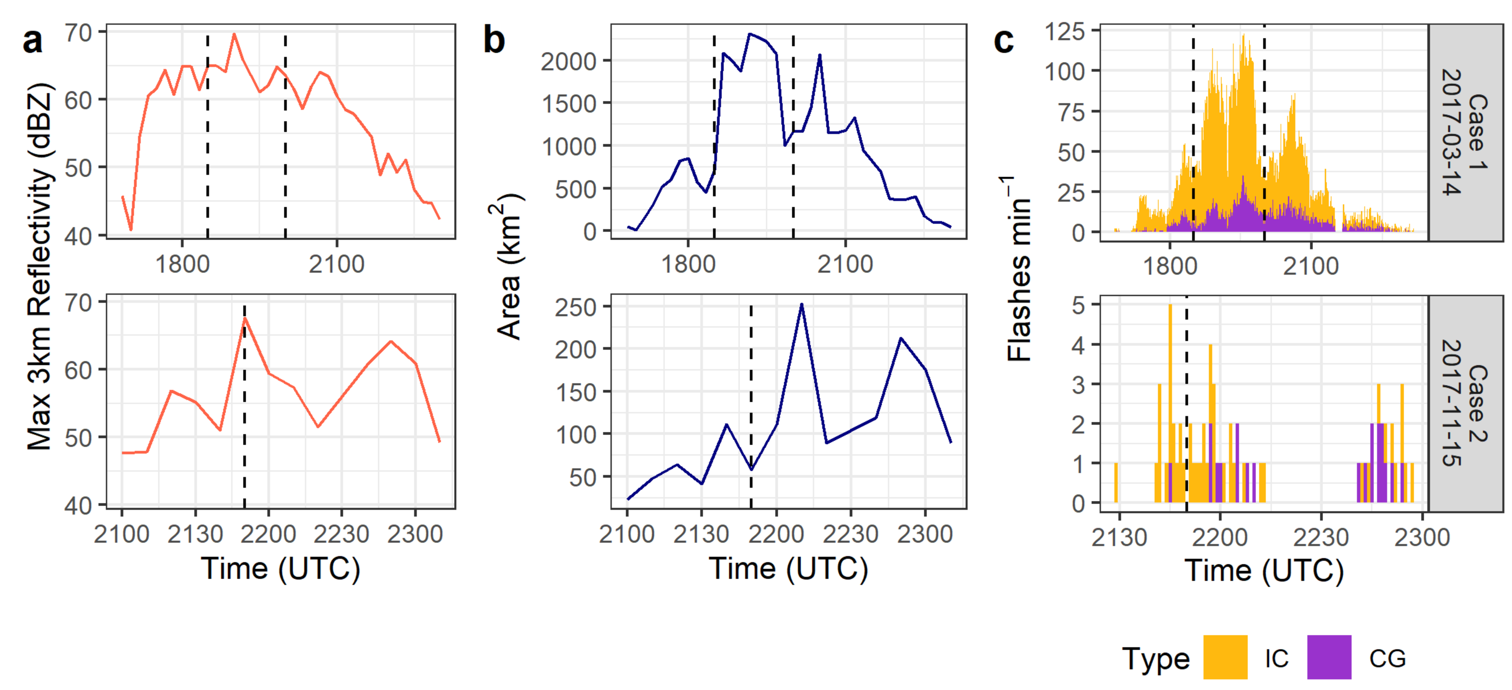

Fig. 5: Temporal evolution of 3km maximum reflectivity (São Roque radar) (a), system area estimated by ForTraCC-Radar (b), and IC/CG flash rate (c). Dashed lines indicate when the measured hailfall occurred.

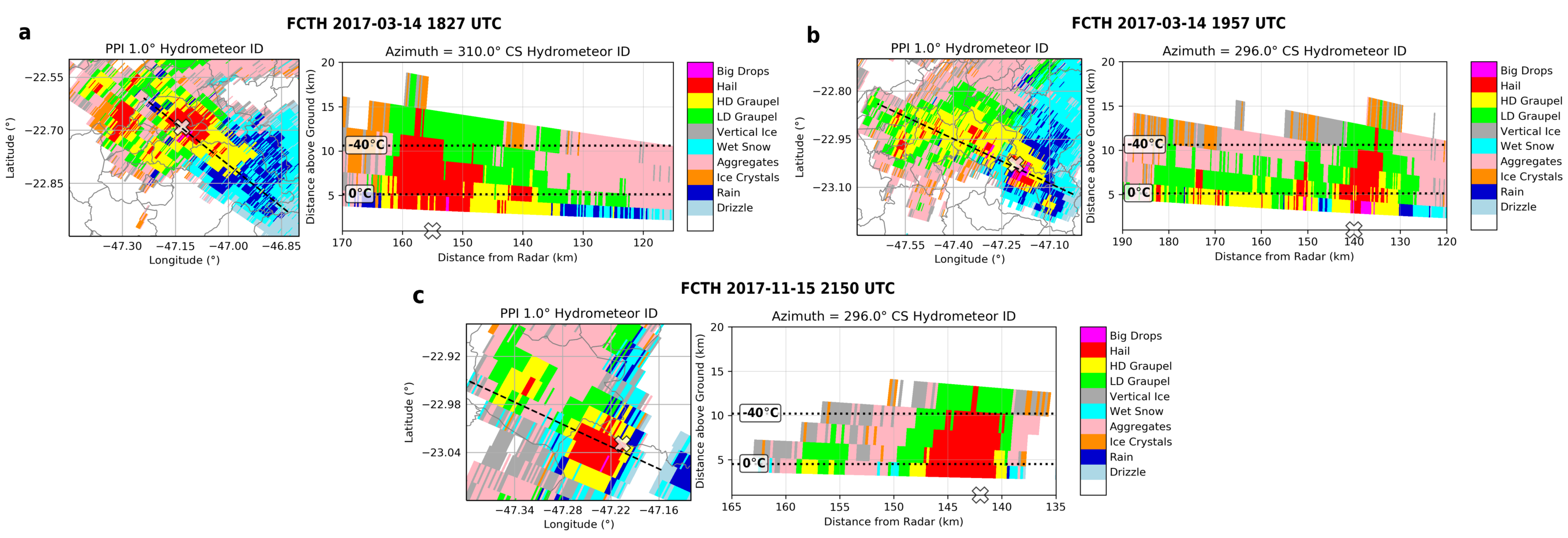

Fig. 6: 1° PPI and azimuthal cross-section of hydrometeor identification derived from FCTH radar in Case 1 (a, b) and 2 (c), approximately when hailfall occurred at each location. The "x" indicates the hailpad location, while the dashed line in the left panel highlights the chosen azimuth and distances from radar used in the right panel. The 0 and -40°C isotherms were defined using a SBMT (Campo de Marte, São Paulo city) radiosonde. Gray lines in the left panel delimit borders of São Paulo state cities.

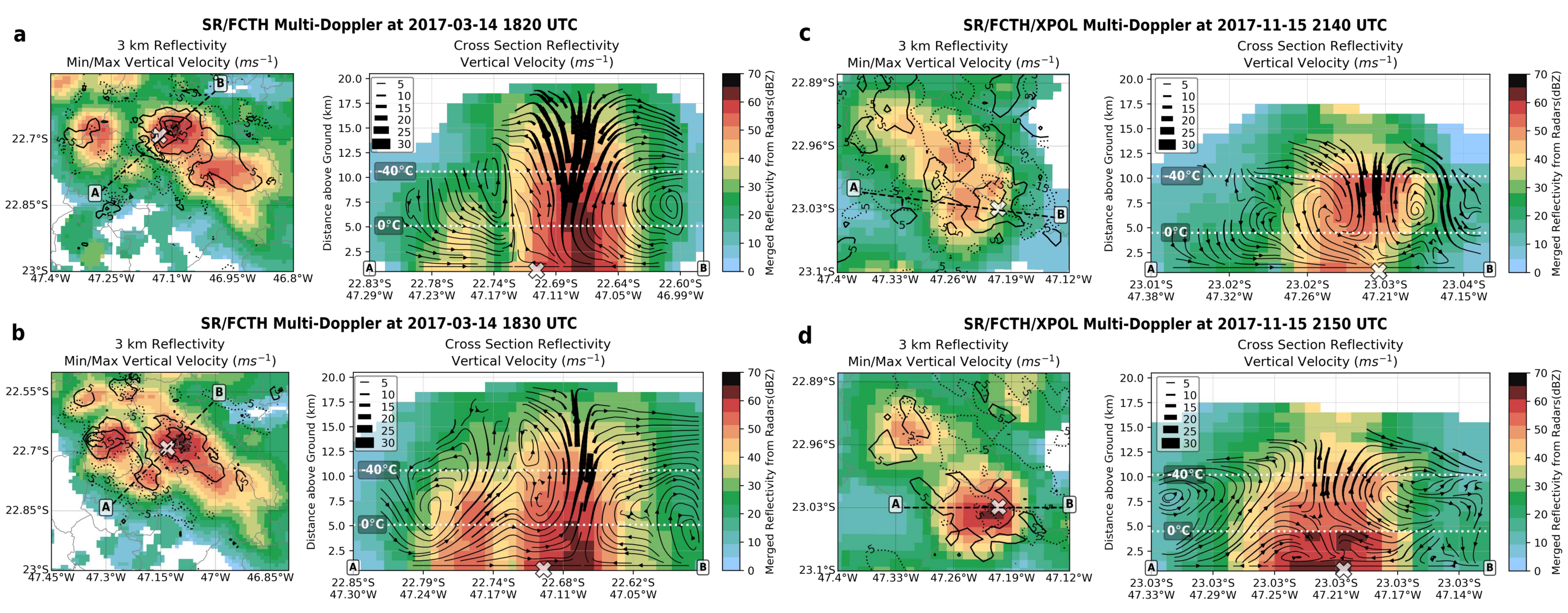

Fig. 7: 3 km height horizontal and vertical cross-section from points A to B points of reflectivity and wind (maximum updrafts and downdrafts in the left panel, streamlines in the right panel) derived of Dual-Doppler retrieval in Case 1 - 2017-03-14 at 1820 (a) and 1830 UTC (b) and Tripple-Doppler retrieval in Case 2 – 2017-11-15 at 2140 (c) and 2150 UTC (d). The "x" indicates the hailpad location, while the 0 and -40°C isotherms were defined using a SBMT (Campo de Marte, São Paulo city) radiosonde. Gray lines in the left panel delimit borders of São Paulo state cities.

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Acknowledgements

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