RAMMER NETWORK OBSERVATIONS DURING SUMMER 2011/2012

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Introduction

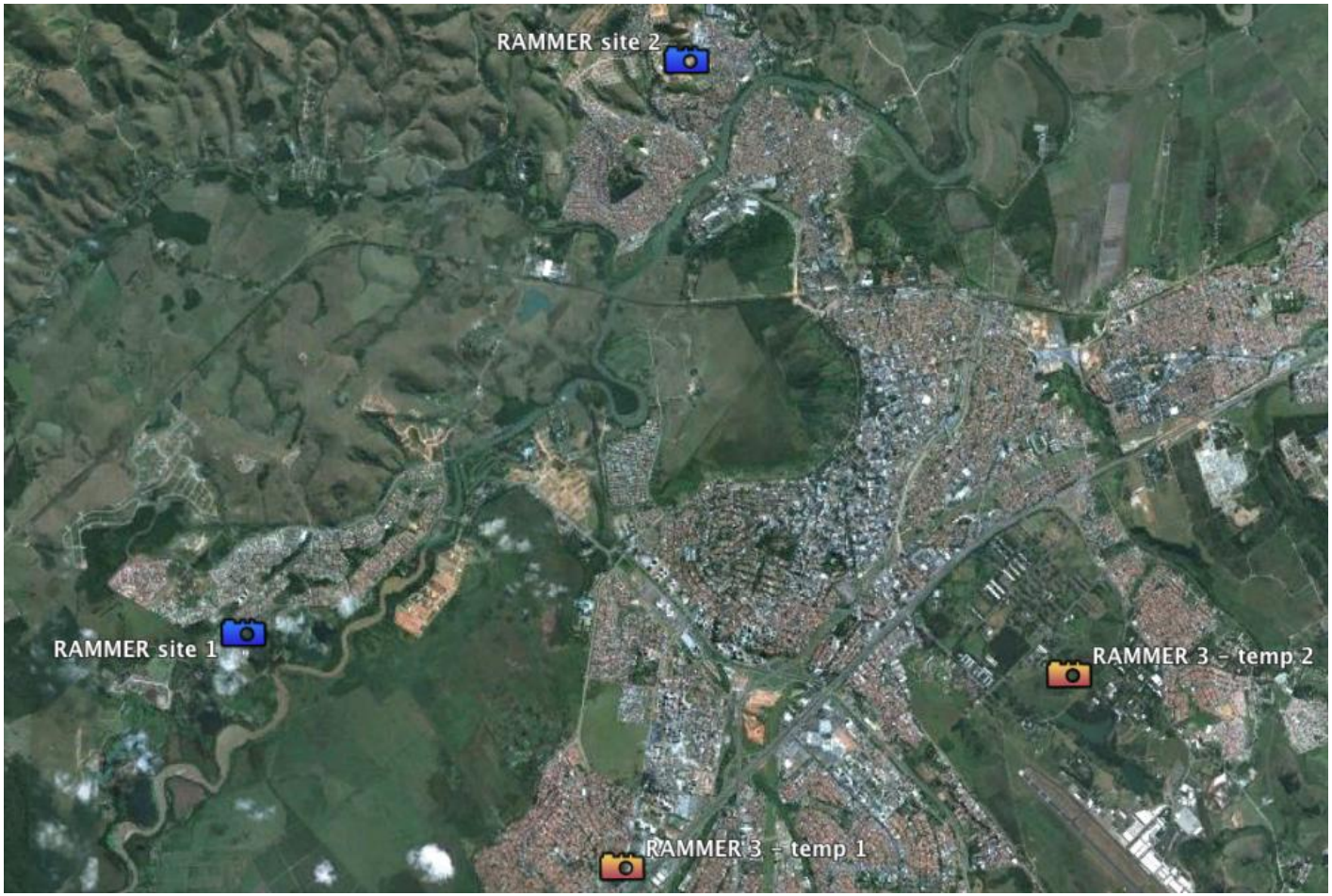
- The RAMMER project is a small network of 3 cameras installed in São José dos Campos, SP, Brazil, that operate during the summer of 2011/2012;
- Two sensors were fully automated and working since November, 2011. The third sensor operated manually during part of the campaign;
- The main objectives include:
  - Observation of lightning flashes simultaneously in order to reconstruct the lightning channel in 3D;
  - Acquiring a significant amount of flashes per thunderstorm to make reliable statistics of lightning characteristics;
  - Estimate continuously the Detection Efficiency of BrasilDAT network.
- This work is a initial report on the first campaign of the RAMMER network;
- During this summer, this project participate on the CHUVA campaign held in São José dos Campos and São Paulo.

Equipment

- High-speed camera;
- Computer;
- GPS;
- Lightning sensor;
- Housing;
- Control circuit;
- Control software.

Equipment

RAMMER sites



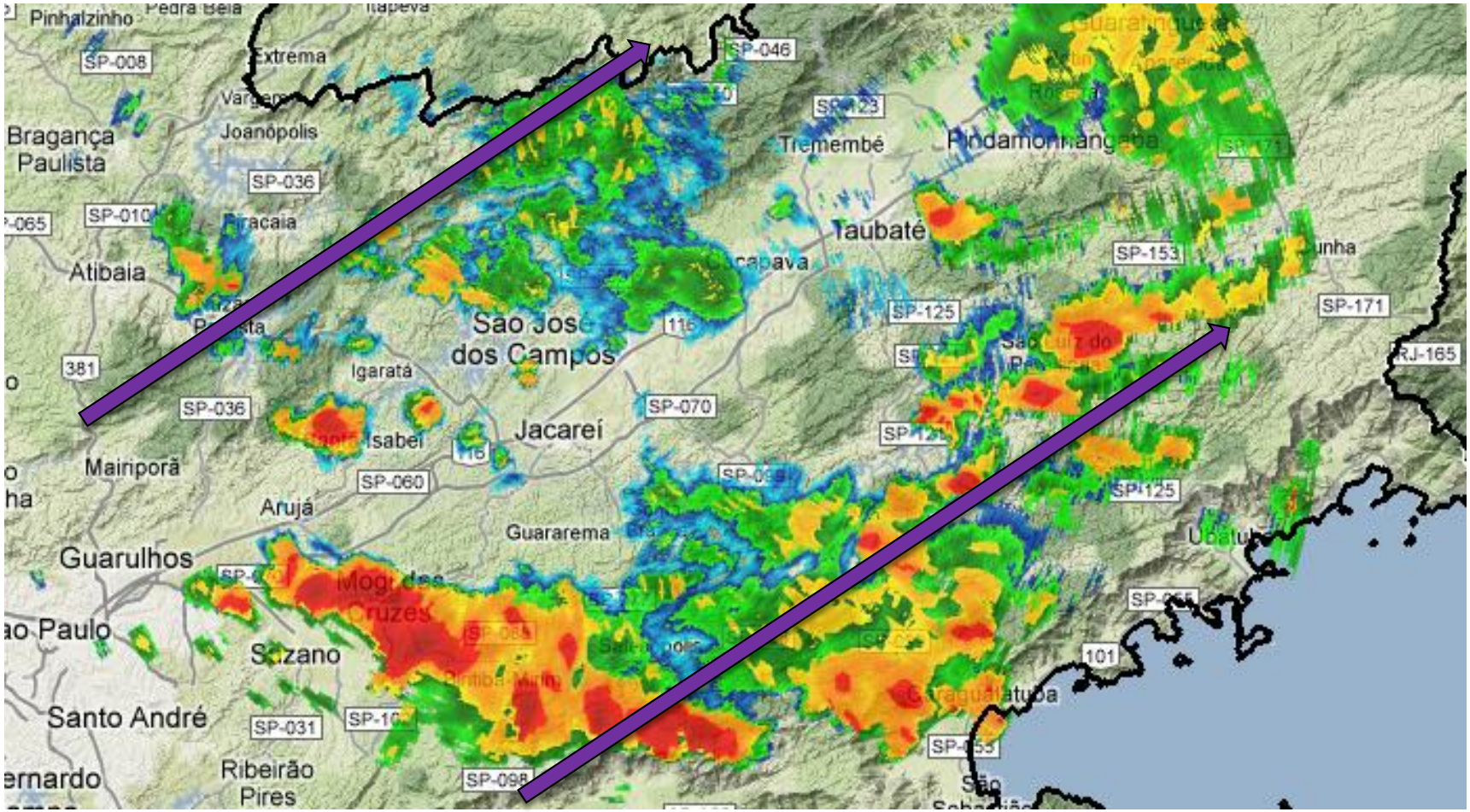
Campaign of 2011/2012

- The first sensor became operational in the end of November 2011;
- The second sensor was installed in December 2011;
- A third sensor was not officially installed but operated for isolated events during the summer;
- Some problems with the sensors prevented the continuous observation;

Statistics of RAMMER 1 sensor

Day	# of movies	# of CG flashes recorded	Daily ED	Thunderstorm ED
11/30/11	4	4	100%	-
12/01/11	3	3	100%	-
01/06/12	1	1	100%	-
01/18/12	33	1	3%	-
01/25/12	14	2	14%	33%
02/09/12	13	5	39%	100%
02/10/12	69	13	19%	34%
02/12/12	32	3	9%	50%
02/14/12	21	7	33%	100%
02/17/12	48	5	10%	71%
02/23/12	25	24	96%	96%
02/24/12	6	1	17%	-
03/02/12	39	35	90%	95%

Thunderstorms development



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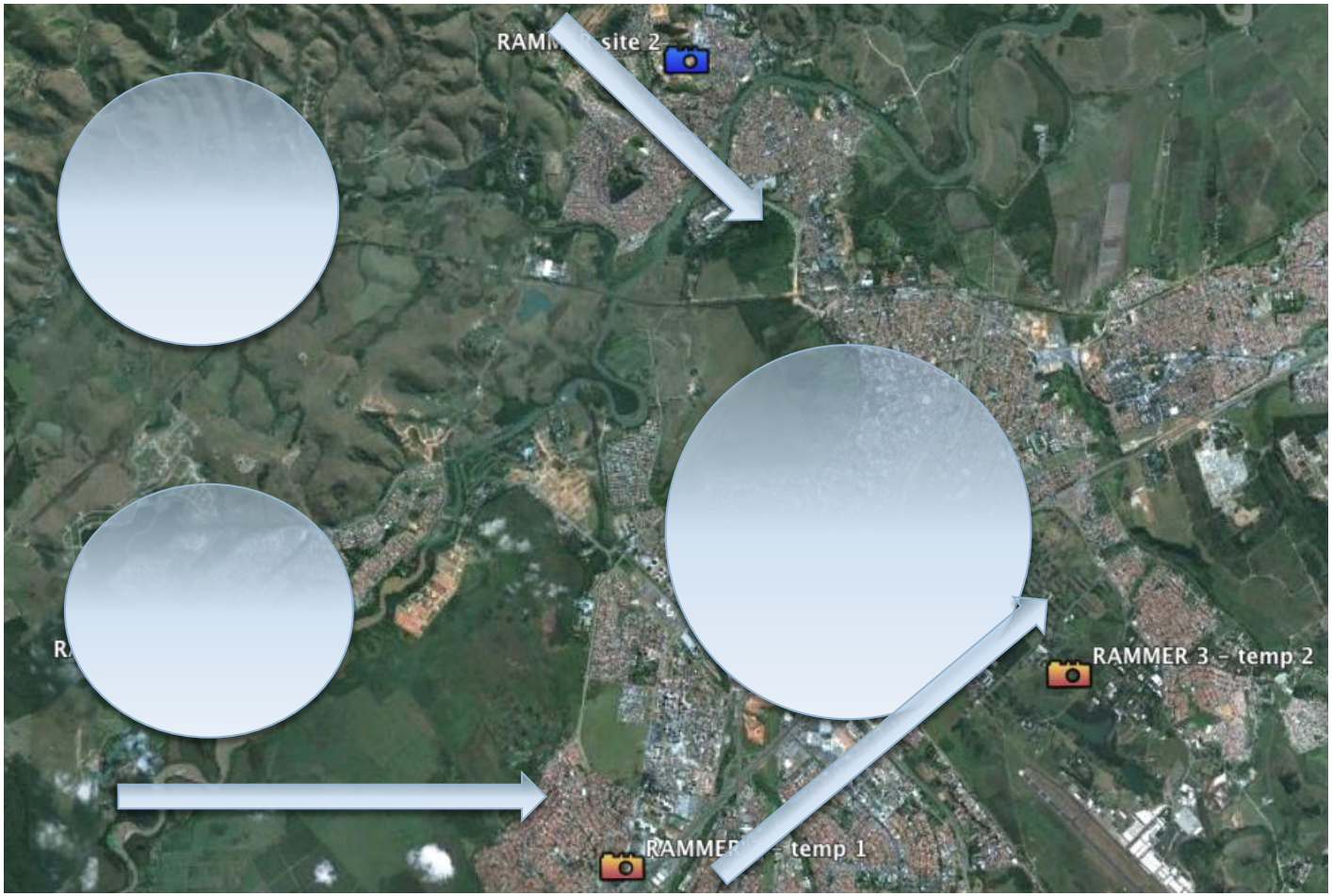

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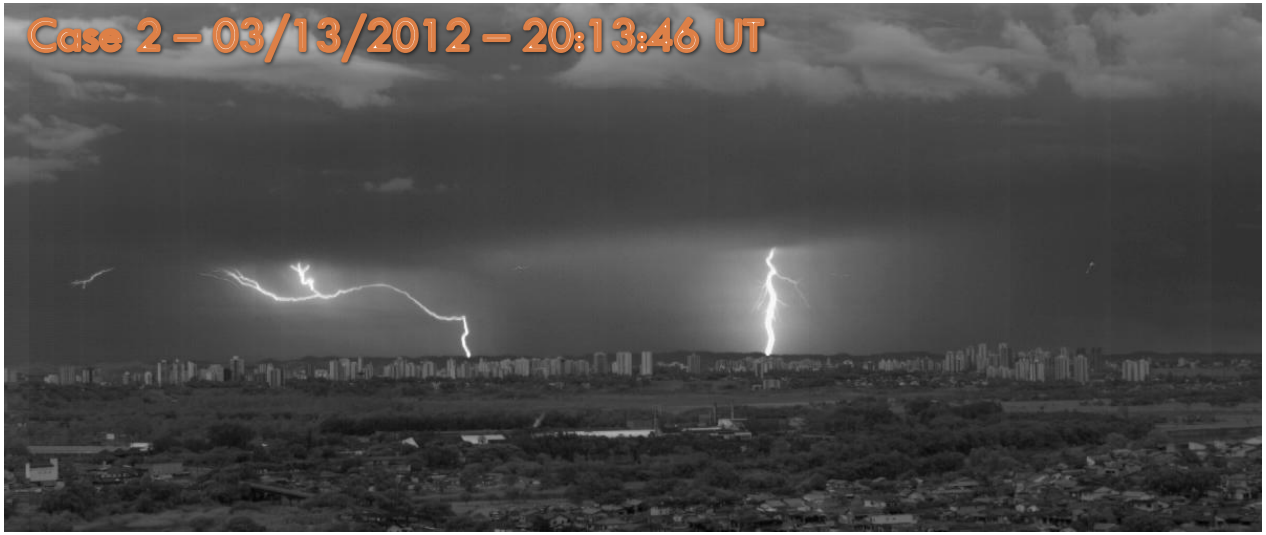
Possible analysis with high-speed cameras

- Standalone:
  - Study of visible lightning characteristics (multiplicity, flash duration, interstroke intervals);
  - Continuing currents;
- Alongside with other equipment:
  - Deep analysis on some physical parameters of lighting;
  - Used as ground truth to detection efficiency studies of lightning location systems (LLS);
  - Multiple cameras can be used to also infer the location of strokes and compare to LLS;
  - Study of cloud dynamics responsible for some lightning observations;
  - LLS peak currents x E-fields x cameras;

Current work-in-progress

- Natural bipolar downward flash;
- Study of thunderstorms that produce positive flashes;
- Analysis of the relationship between luminosity of return strokes and peak currents;
- Daily analysis of flash characteristics for selected thunderstorm days.
- Lightning channel reconstruction with multiple camera network;
- Detection efficiency calculations for BrasilDAT and RINDAT.

Bipolar case study



Bipolar case study

Second stroke sequence

Stroke time:20:10:51.112
Peak current: -2 kA

Flash sequence

Stroke time:20:10:50.982
Peak current: -25 kA

Storm-to-storm analysis

- Case 1: 02/19/2013

Number of flashes: 78

% of single stroke flashes: 21.8%

Mean multiplicity: 4.5

% of multiple ground contact flashes: 52.46%

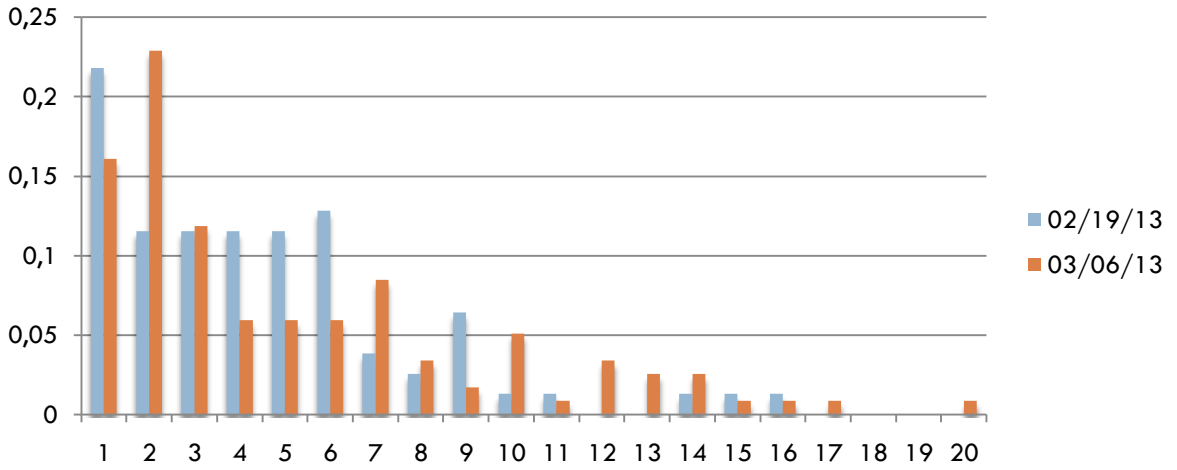
- Case 2: 03/06/2013

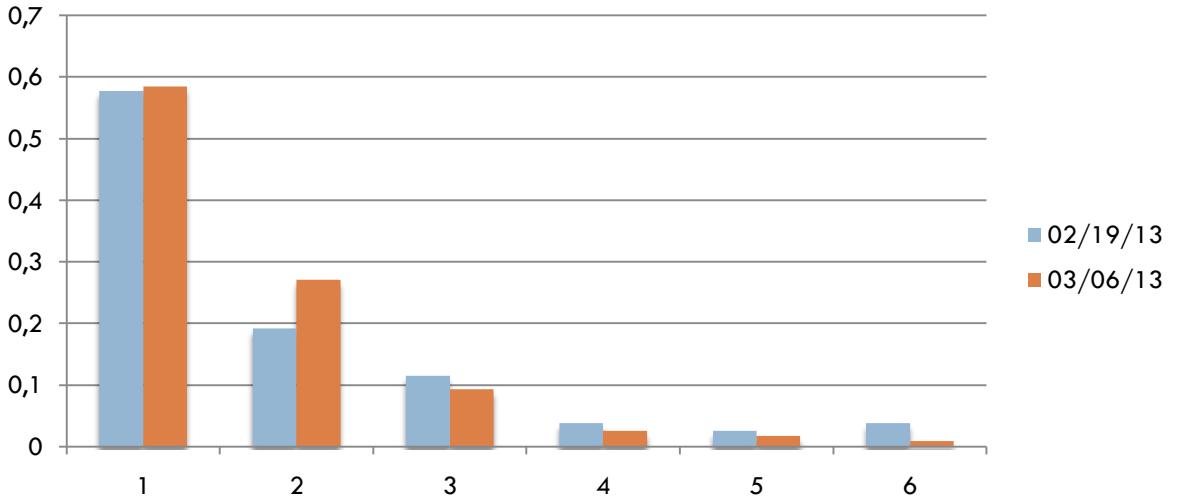
Number of flashes: 120

% of single stroke flashes: 16.1%

Mean multiplicity: 5.15

% of multiple ground contact flashes: 49.49%





Simultaneously recordings

Case from 03/12/2012. The stroke time was 18:07:52.346 UTC

RAMMER 2 data

RAMMER 1 data

Participation in the CHUVA campaign

- The CHUVA campaign was held in São Paulo and São José dos Campos (CHUVA-GLM-Vale do Paraíba) during the summer season of 2011/2012;
- Several instruments were installed in the region, like: LMA (Lightning Mapping Array) stations, LINET network, WeatherBug network, Vaisala Network, X-Band Polarimetric Radar, Field-Mils among others;
- All these techniques together will form a unique database of lightning information;

Discussions

- This work presented some information about the first campaign of the RAMMER network;
- Some bugs prevented the network to work at full capacity;
- The unusual summer also played a role in the small number of flashes recorded;
- Thunderstorm movements and characteristics can cause camera recordings without lightning in front of it;

Discussions

- Even with a small number of events recorded we had a fair amount of lightning recorded during the summer. The exact number will be known after the data processing, but we expect something like 300 flashes for this first campaign;
- We were able also to had some flashes recorded with multiple cameras and they will be used in the flash 3D reconstruction algorithm;
- The presence of CHUVA instruments added a unique dataset of lightning measurements that will improve the results that will be presented in future analyses;
- The preparation for next campaign already started and all bugs will be evaluated carefully and solved.