Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2019-192-RC1, 2019

Atmospheric Measurement Techniques Discussions

Interactive comment on "SAETTA: high resolution 3D mapping of the total lightning activity in the Mediterranean basin over Corsica, with a focus on a MCS event" *by* Sylvain Coquillat et al.

Anonymous Referee #1

Received and published: 8 July 2019

General comments:

This paper introduces the SAETTA 3D Lightning Mapping Array installed on the island of Corsica and discusses its general performance and climatology, and also illustrates the data by two case studies. It is found that in summer afternoons, a thunderstorm often forms at the particular location on the island, where the intersection of 3 wide valleys brings together the moist air by sea breeze circulation. One case study showcases the use of the rates of lightning flashes separated by size and finds surges of rates of tiny flashes confined to high altitudes during intense convective development. The other case study reveals a negative upper charge layer in the stratiform region of a

Printer-friendly version

Discussion paper

Mesoscale Convective System (MCS) by activity of positive or recoil leaders detected by the LMA. In general, the paper is a good contribution. The selected case studies are interesting, but some earlier papers on the matter of small discharges as well as some with examples of negative charge layers in the stratiform region are missing. Also, the inclusion of radar images could give the case studies some more depth. The text also needs a number of technical corrections, suggested below.

Specific comments:

1. Aircraft-related trails claimed in statistical results, but this has not been detailed with an example.

2. Surges of tiny flashes. Other works have described them before, it is possible to add references and some discussion.

3. Stratiform high-altitude positive leaders. Other works have shown these before. Is it possible to investigate if they spawn off the first negative leader branch and then grow upward and sideward? This mechanism looks similar to the case of negative leader suddenly spawning (up or down) from a horizontal positive leader branch as in examples in van der Velde and Montanyà (2013).

Radar analysis could help provide some context for topics 2 and 3, in terms of confirming cloud top altitude and evolution stage. Time-distance plots need the slopes indicated to have a proper reference. The text may be written a bit more concisely (remove some details or similar paragraphs).

Technical corrections:

Page 1

12: 80 us is the resolution per station, but after locating the sources, this is not the resulting temporal resolution, which is decreased. 16: masking (also Page 5, line 10) 18: integrated across the domain; reaches a first maximum 19: intersection of 21: lightning 22: and includes some high precipitation events

Page 2

5: relaxation but perhaps a limiter? 14-15: thunderstorm cell; remove On another hand 22: high precipitation; climate change 24-25: network instead of instrument 27: which means 31: put comma after summits; meters altitude

Page 3

8: carrying humid air 14+18: original could be unique or unusual

Page 4

4: lightnings → lightning processes

Page 6

Table 1: "Gap" → vertical difference. But the table is not very interesting, the two columns are almost identical. Is it necessary?

Page 7

13: average minimum altitudes

Page 8

6: at best → in the optimal situation 8: Koshak (also later on) 13: is therefore a suitable tool 18: north, south, east, west are not to be capitalized (also occurs later) 20: remove of before altitude

Page 10

Figure 4: maybe provide a figure with the difference between the two? At first sight they look almost identical. Also: Thomas et al. 2004 (also on Fig 3) 19: better goodness of fit, lower reduced chi-squared

Page 11

4: From here on, 14: this seems to be the first sample. 15: Looking at the top frame

Page 12

3: check if this is the continuation of the same leader as before using a time-distance plot (van der Velde and Montanya 2013)

Page 13

2: The sample size is not yet large enough to call this climatology 9: north, forming... 10: Need to show more detail and example of aircraft. It seems unlikely to result in more sources when a lightning flash produces far more. Could be interference from local noise that creates patterns?

Page 14 10: stormy day... maybe better lightning day or thunderstorm day?

Page 16

2: southern France or in the south of France. 5-6: These ingredients are universally indicated in textbooks. The reference provided is not the real source. 7: begins

Page 17

8-12: duration 3h50m 10: on top of a convective core 17: northerly wind 18: turns to northeasterly 19: is composed of general: it would help to have radar images and number the cores discussed in the text, then coordinates are not needed. How are convective surges defined? Just from LMA data? 28: Marshall (also elsewhere) 29: thunderstorm structures (charge structures?)

Page 18

14: source density In this section or discussion, make references to small discharge surges, like Ushio et al 2003, Emersic et al 2011, MacGorman et al 2017

Page 19

Fig 11 right, power: what do the diagonal lines mean here?

Page 20

m-1, min-1. . . make superscript 8: are in phase with convective surges. . .. But how can we confirm this? Radar?

Page 21

14: big flashes triggering dominates – hard to read, do the authors mean initiation of big flashes? 15-18: too much detail and everything looks similar. Needed? 20: convective surge positions

Page 22

1-2: over a vertical distance varying

Page 23

6: in this case probably positive leaders themselves because of their very low power. 7: cloud-to-ground 9: intracloud 11: slightly tilted 12: does the positive leader really grow upward from the negative leader altitude? The graph suggests not (unclear). The vertical channel is mostly a later downward negative leader. On top of. 23: the slopes are missing in Fig 14 27: rather fast. . .. This is still quite normal speed. See also van der Velde et al. 2014 27: 1.4x105 use superscript 28: Then, sources associated with the positive leader branch. . . 35: superscript

Page 24

4: descends along. . . and propagates. . . into 6: nice to see that! It could be interesting to select this point as the origin of an alternative time-distance plot. See also van der Velde et al (2014)

Page 25

2: needs rewriting, as one answer is also the question 7: van der Velde et al 2014, Lang et al 2010, Lu et al 2013, Soula et al 2015 could also fit 29: Could . . . not ? 33: one may wonder

Page 26

5: Similarly/Additionally . . .

Page 27

1: geometric performance 5: This performance 16: 2014-2016; a preliminary climatology

Page 28

5: in van der Velde and Montanya 2013 a negative leader develops vertically from a positive leader, it seems here we have the positive equivalent. Interesting. 7-8: see provided references with similar discharges

References

Ushio, T., S. J. Heckman, H. J. Christian, and Z. I. Kawasaki, 2003: Vertical development of lightning activity observed by the LDAR system: Lightning bubbles. J. Appl. Meteor., 42, 165–174.

Emersic, C., P. L. Heinselman, D. R. MacGorman, and E. C. Bruning (2011), Lightning activity in a hailâĂŘproducing storm observed with phasedâĂŘarray radar, Mon. Weather Rev., 139, 1809–1825, doi:10.1175/2010MWR3574.1.

MacGorman, D. R., Elliott, M. S., and DiGangi, E. (2017), Electrical discharges in the overshooting tops of thunderstorms, J. Geophys. Res. Atmos., 122, 2929– 2957, doi:10.1002/2016JD025933.

Soula, S., Defer, E., Füllekrug, M., Velde, O., Montanya, J., Bousquet, O., Mlynarczyk, J., Coquillat, S., Pinty, J.âĂŘP., Rison, W., et al. (2015), Time and space correlation between sprites and their parent lightning flashes for a thunderstorm observed during the HyMeX campaign, J. Geophys. Res. Atmos., 120, 11,552– 11,574, doi:10.1002/2015JD023894.

Lang, T. J., W. A. Lyons, S. A. Rutledge, J. D. Meyer, D. R. MacGorman, and S. A. Cummer (2010), Transient luminous events above two mesoscale convective systems: Storm structure and evolution, J. Geophys. Res., 115, A00E22, doi:10.1029/2009JA014500.

Lang, T. J., J. Li, W. A. Lyons, S. A. Cummer, S. A. Rutledge, and D. R. MacGorman (2011), Transient luminous events above two mesoscale convective systems: Charge moment change analysis, J. Geophys. Res., 116, A10306, doi:10.1029/2011JA016758.

Lang, T. J., Lyons, W. A., Cummer, S. A., Fuchs, B. R., Dolan, B., Rutledge, S. A., Krehbiel, P., Rison, W., Stanley, M., and Ashcraft, T. (2016), Observations of two spriteâĂŘproducing storms in Colorado, J. Geophys. Res. Atmos., 121, 9675– 9695, doi:10.1002/2016JD025299.

van der Velde, O. A., J. Montanyà, S. Soula, N. Pineda, and J. Mlynarczyk (2014), Bidirectional leader development in spriteâĂŘproducing positive cloudâĂŘtoâĂŘground flashes: Origins and characteristics of positive and negative leaders, J. Geophys. Res. Atmos., 119, 12,755–12,779, doi:10.1002/2013JD021291.

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2019-192, 2019.

Printer-friendly version

Discussion paper