**Review „Characteristics of a hailstorm over the Andean La Paz Valley“ by Marcelo Zamuriano, Andrey Martynov, Luca Panziera and Stefan Brönnimann, submitted to NHESS**

The manuscript examines a severe convective storm event associated with large hail and heavy rainfall that occurred in February 2002 over the La Paz region in South America. Due to the scarce availability of suitable observational data, WRF simulations complemented by sensitivity studies with different model setups were conducted. The main objective of the study is to identify the mechanisms and processes most relevant for the triggering and maintenance of the convective storms. The topic of the paper is basically relevant for NHESS. However, there are a number of important issues that have to be considered and addressed before the paper can be published. Above all, an in-depth discussion of all figures, the findings and the most important results is necessary.
All my suggestions and comments are listed below as major, minor, and (a few) editorial points.

**Major revision points:**

1) The results and illustrations are mostly discussed very briefly, superficially and descriptively. A thorough, in-depth discussion and interpretation is lacking. This applies in particular to the sensitivity studies and to the application of the Hailcast model. In order to use them in a sensible way, a much deeper discussion and interpretation of the results is necessary. Furthermore, the interconnection of all subsections has to be improved.
2) Please explain in which way the result can be generalized and how the findings may apply to comparable events.
3) I do not agree that the model capture well the main features of the severe thunderstorms. There are large discrepancies in both the location and precipitation intensity. Even the two major convective cells are not well reproduced by the model. The conclusion (Sect. 3.1.2) that the model is able to simulate the main features and, thus, capture the mechanisms decisive for the triggering and maintenance of the storms is not justified.
4) The effect of a lake breeze that is relevant for convection triggering cannot be derived solely from the wind field, but requires analyses of temperature / moisture gradient or vertical lifting. As sea/lake breezes have a limited vertical extent of a few hundred meters, they cannot be detected at 500 hPa, not even over the elevated terrain around Lake Titicaca.
5) The discussion Section (together with the Conclusion Section) is more a summary than really a discussion (this applies at least for the first half of the text). I'd like to see a more thorough discussion and a better synthesis of the results instead of repeating what was already written. I also suggest to extend the comparison with other related studies and references.
6) **Be accurate in your citations**!
   Sect. 2.1.2: I'm puzzled about the statement "known uncertainties of precipitation estimates over complex terrain (Rasmussen et al., 2013)" as this does not make sense for the TRMM algorithm. The cited reference investigated the range of the rain bias in storms containing four different types of convection in extreme radar echoes over South America, but did not investigate a relation between bias and terrain characteristics.
   The study of Kunz et al., 2018 investigates a supercell over low-mountain ranges and not over the Alps.
   These are just two examples that I've checked.
7) The number of cited references is rather small.
8) Most of the Figures are too small and/or have a too low resolution; it's hardly possible to see any details. Furthermore, as most of the readers are not familiar with the study area, an

additional figure that indicates all areas and cities referenced in the text (Altiplano, Amazonas, …) would be helpful (Fig. 3a is too small!).

9) The English language requires a thorough check by a native speaker. I have listed a few corrections, but these are too numerous to fully list.

**Minor points**

1) The title should be changed as the paper goes beyond the investigation of one single hailstorm.
2) Abstract: Can you highlight the most important findings (e.g., We show the importance of orographic configuration… is too general; be more specific). Consider to move the last sentence after the 2nd one.
3) The use of LST is weird: Twelve noon local solar time (LST) is defined as when the sun is highest in the sky, i.e., it is a function of the geographical coordinates. Do you mean local time instead (LT)? What is LT in UTC at La Paz?
4) Introduction, 1st paragraph: Give a brief reason why hail hazard assessment is not available. But also note that there are some studies available that uses either satellite data (e.g., Cecil and Blankenship 2012) or reanalysis (e.g., Prein and Holland 2018) to estimate hail frequency, that may be mentioned (e.g., by giving an estimate how frequent the region is affected by SCSs, similar events in the past, …).
5) Introduction, 2nd paragraph: give some more details about the event: total rainfall accumulation, hail sizes, wind gusts; what was the reason for the large number of casualties?
6) P2L5: "The lack of formal physical process knowledge" is unclear: I think you mean what makes this region special related to thunderstorms compared to others? The physical processes for thunderstorm formation are the same all over the world.
7) Introduction, last paragraph: Say a few more words about the motivation and objectives of this study to be published. Only saying the goal is to better understand the processes is too simple. What are the research questions / hypotheses? What are the reasons for performing sensitivity studies?
8) P3L14: how many gauges? If all stations are shown in Fig. 3a, you cannot say "around 1 km distance" given the large spatial differences.
9) P3L16: "some data quality issues": what do you mean?
10) Sect. 2.2.1, 2nd paragraph: give some more details about the schemes and the configurations you have used (besides: write out YSU); also give a reference for the radar-forward operator you have used to create Fig. 4. Furthermore, you should motivate here - or maybe better in the introduction (see minor point 7)- the reasons why you have conducted the sensitivity experiments. What do you expect from those additional runs?
11) 2.2.2: Why did you not consider deep layer shear (DLS) or storm-relative helicity SRH, which are important ingredients for supercells? The unit of IVTU/IVTV in 100 g $(s\ m)^{-1}$ (yes, this is the result when using the units you stated) is very strange and not an SI unit. I strongly recommend to insert dp not in hPa, but in Pa. Why do you integrate until 200 hPa?
12) Always put a blank between two units (e.g., $ms^{-1}$ could be m/s or millisecond).
13) How is CAPE computed? Mixed layer CAPE, most unstable CAPE, …?
14) P5L4-6: As you did not investigate runoff or flash floods, soil saturation is irrelevant. You may mention this in the introduction, but not in the result section.
15) Sect. 3.1.1 / Fig. 1b: Showing only one isoline of the geopotential at 200 hPa (also without labelling) does not make sense as the flow at lower levels, which are most important for the triggering, could be completely different from that at 200 hPa.
16) P5L13-14: what do you mean by "northward displacement of the Bolivian High"?
17) P5L18: specify what is meant by "mesoscale features"

18) Fig. 2: There is a discrepancy between blue shaded contours and the color bar at the bottom (besides: the numbers are illegible).
19) P5L24: "…show a remarkable spatial consistency…" this statement is too general and too optimistic; of course, there is some consistency (mainly at 17 LST), but also some discrepancies. This is what one would expect as you compare visible cloud areas with rainfall.
20) P5L25: "Titicaca lake, the Amazon region, and the eastern cordillera…" These regions / features should be indicated in one Figure.
21) P5L28-30: "important convection…shallow convection". From the visible channel solely, you cannot distinguish the intensity of convection; "TRIMM is not able to capture any light rainfall". Why do you suppose that rainfall already started at that time?
22) P5L7: Why do you consider longwave radiation here? Explain and motivate this (and recall that Figs. 2a-d show the visible channel).
23) P5L10: The Figures show radiation and precipitation, and not water vapor as stated here.
24) P6L25: Also consider vertical wind shear.
25) Sect. 3.2.1, 1st paragraph: So what? What can you conclude from the Hovmoeller plot?
26) Sect. 3.2.1, 2nd paragraph (see also major comment 4): The strong north-westerly flow east of the lake between 11 and 13 LST can also originate from the cold pool of the convective cell. This may also explain the large flow divergence at 13:00 around that cell. Note that sea/lake breezes have a rather small vertical extent so that the associated wind field is of minor importance for the movement of the convective cells.
27) Fig. 5a-c: the color code of the figures and the color bar do not match; what are the areas indicated by the brown color?
28) P7L10: "While the surface humidity follows the lake breeze…" I cannot see any relation.
29) Sect. 3.2.2, 2nd paragraph (see comment 26): sea / lake breezes typically have a vertical extent of a few hundred meters. They cannot be identified at 500 hPa. Even though at 14:00 there seems to be a frontal boundary involved, which was not the case at 11:00 and even at 12:30. In the previous paragraph, however, you suggested the wind field even at 11 and 12 is associated with the lake breeze. Furthermore, I'd suggest not using different times for the plots (12:30 in Figs. 5-6 is not shown by Fig. 4). Finally, relate the fields to the convective systems.
30) Fig. 6: It's hard to see the CAPE. I suggest to include additional Figures showing only CAPE. Furthermore, it's not clear what Figs. 6a-c show.
31) P7L24-26: It's rather confusing to term that sensible heat is released as the Figures show the vertical heat flux; Solar radiation is surely not the only reason for increases in CAPE (cf: the largest increase in CAPE in the northeast is associated with lowest sensible heat flux.)
32) P7L30: As the city heat-island effect is not relevant for the convective storms, I suggest to omit this statement.
33) Fig. 7/8: It would be easier for the reader to show shear as amount and not as vector.
34) Sect. 3.2.4: In some places reference is made to convection triggering. However, convection on that day is triggered earlier as shown in Fig. 4. Be sure what is really meant here: maintenance, triggering of new cells, or – as you describe – the merging of scattered convection to a larger band showing some basic features of a squall line.
35) P8L12-14: Explain where the cold pool is located (I cannot see a convergence line; besides, the cold pool cannot be situated over the convergence line). It's not possible to speculate about a supercooled state without showing hydrometeors.
36) P8L21: This explanation for a cold pool is wrong; rather evaporation and sublimation cooling by hydrometeors drives the cold pool.
37) P8L28-29: Literature?

38) P8L7: "convection is present without thermodynamic instability" this is a contradiction in itself.
39) P9L13: How is hail formation suppressed? Changes in microphysics, intensity/size of the updraft, or what else?
40) Experiment with no lake: when you state that the wind field for this realization is similar to a lake breeze, than I doubt even more that really a lake breeze is responsible for CI.
41) Caption Figure 10: Make clear that the smaller "hailstones" with a diameter of 4 mm are treated as hail in WRF only; according to WMO definition, hail has a minimum diameter of 5 mm.
42) Discussion: All the above critic points likewise apply to the Discussion Section
43) P10L13: Cold pools behave as density currents. Thus, their propagation results from the interaction between mean flow and density current. They do not directly propagate with the mean wind. Furthermore, cold pools emerging between two cells leads to flow divergence, which prevents and not favors cell merging. The term "auto-propagation" is not appropriate here.
44) P10L17-18: Low to moderate wind shear does not allow for substantial hail formation as it also affects the strength / width of the updraft (cf. Dennis and Kumjian, 2017 in JAS).
45) P10L24: The conclusion about a relation between instability and surface fluxes are not justified as the largest increases in CAPE occur in a region with lower fluxes (NE parts).
46) P10L26: The reduced temperature gradient was not shown.
47) Section 4, last paragraph: The question of a possible trend in the frequency of hailstorms is irrelevant for a single case study.
48) Conclusions: The most important results should be more clearly identified and highlighted. Clearly show what is new, what the reader should have learned from the study.
49) P11L6: Usually an MCS is defined as an ensemble of thunderstorms that produce a contiguous precipitation area on the order of 100 km or more in horizontal scale in at least one direction (e.g., AMS glossary). This definition does not apply to the 19 Feb. storm.
50) P11L6 (blocking): You haven't shown that blocking really occurred on that day. This, of course, would increase the substance of the paper.
51) P11L23-24: I suggest to move this part to the discussion section, but also to explain in detail Figure 11.

**Typos / Small corrections**

1) p1L1: "iconic" is not an appropriate expression
2) p1L3: Satellite observations suggest~~s~~; that **develop into** deep convection
3) p1L5: suggest**s**
4) p1L5-7: the statement about instability is trivial as this is prerequisite for convection
5) p1L6: what is meant by "rainfall discharge" as these indicate two different things?
6) p1L8: ~~the~~ deep convection
7) p1L25: that ~~on~~ between
8) p1L25: change "presented" by "designated"
9) P2L19-20: with numerical **model** studies
10) P3L9: "…low weather station~~s~~ density…"
11) P3L12: specify what is meant by "The nature of the event…"; replace "demands" by "requires"
12) P3L16: affect~~s~~
13) P3L22: consider to change "physical" into "main triggering"; change "system" into "model"
14) P3L30 and elsewhere: **Kain**-Fritsch scheme and not **Kein**-Fritsch scheme
15) P4L7: for all set**s** of…

16) P4L8: Begin a new sentence as the content changes: "…February 2002). They are useful…"
17) P4L16: "We study **here** the…"
18) P5L1: "…is assessed by ~~the calculation of~~ the convective available…"
19) P5L18: delete "still"; "…how **often** (or **frequent**) this…"; what do you mean by "formal classification"?
20) P5L28/38: the phrases "important convection" or "important cells" are weird
21) P6L1: You changed the tense within the same sentence
22) P6L4 "The infra-red images are almost the same as the visible channel" This general statement cannot be true; please formulate clearly what is meant.
23) P6L5: again avoid "important"; rather name the intensity
24) P6L19: delete therefore
25) P6L20-21: I'd suggest to slightly change the sentence "…which reflects the expected spatial heterogeneity of the convective precipitation"
26) P6L21: "In consistency with…" or "In accordance. "; confirm**~~s~~**
27) P6L25: "After **~~a~~** confirmation…"
28) P6L28: don't start a new subsection with "We therefore…"; delete the brackets (Fig. 3a)
29) P7L3: "A closer took **at**…"
30) Caption Fig. 4 (also applies for other positions): change curly vectors → wind vectors; and give a reference (arrow length vs wind speed).
31) Fig 5: indicate the unit of the reference vector
32) P7L15: "…conditions **at** 1100…"
33) P8L5: propagate**~~s~~**
34) P9L1-2: what does it mean: "rain region is less organizes"; "hail originated by valley breeze…" sloppily expressed (hail originates from clouds); you mean the triggering of convection?
35) P9L4: replace exists by occurs; L5: can still be → nevertheless is still
36) P9L6: correspond**~~s~~**
37) P10L9: grew in **size**
38) P10L19: they → it
39) P10L25: show**~~s~~**