

***Interactive comment on* “Brief Communication: An Electrifying Atmospheric River: Understanding the Thunderstorm Event in Santa Barbara County during March 2019” by Deanna Nash and Leila M. V. Carvalho**

Anonymous Referee #1

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Review of ‘Brief Communication: An Electrifying Atmospheric River: Understanding the Thunderstorm Event in Santa Barbara County during March 2019’ by Nash and Carvalho.

Overview: This brief manuscript describes meteorological characteristics of an atmospheric river event from March 2019 that caused an unprecedented amount of lightning in Santa Barbara. The manuscript is clearly written, and the analysis is straightforward: brief but appropriate for publication as a brief communication. My biggest concern with the manuscript in its present form is that, while the exceptional nature of the amount of

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lightning is well described and detailed, the links between the meteorology and lightning itself are presumed and not very clearly described. The manuscript also restates the lightning results a bit more than necessary given the (very short) length of the manuscript.

Specific comments: L. 7-8, 41-43, and 70-71: This result (i.e., the average flash density for the region) is restated three times by the fourth page of the manuscript. Redundancies such as this example are not warranted in such a brief manuscript, and the text should be tightened up to remove them. The text of the abstract needs particular attention to ensure it conveys the most salient results of the manuscript: I suggest removing this peripheral detail in favor of an additional sentence at the end of the abstract that links the meteorology with the exceptional lightning.

L. 111-112: It's rather difficult to see this synoptic feature (WCB) with such a zoomed-in domain.

L. 147-150 and much of this entire section: Much of this text relays presumptions as conclusions. For example, 'The convective updraft in the lower troposphere was very important for the onset of electrification,...' this manuscript in no way proves what was or wasn't important for the onset of electrification (instead it presents the meteorology, documents that there was quite a lot of electrical activity, and requires inference between the two). This section needs revision to clarify what previous literature suggests are important factors for lots of lightning in storms, and how those factors relate to this particular storm. I was unable to read the citation Price 2013 from the manuscript, but found Pessi and Businger (2009) helpful in framing my review.

L. 193-203: This summary paragraph could do a better job relating what was unusual about this atmospheric river (AR) event that potentially led it to produce so much lightning. ARs in particular are not terribly unusual for Santa Barbara (e.g. Rutz et al. 2014). In addition, the authors suggest that the 2.5km 0 degree C isotherm was a large factor in allowing hail to develop, but 2.5 km is not a particularly low freezing level

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for a midlatitude storm at this latitude (Cannon et al. 2017). More care and thought should be put toward this aspect of the manuscript; without this connection the main emphasis of the manuscript becomes a bit fuzzy. The dry air layer at 250 hPa is alluded to as a possible mechanism (and note there is another dry layer at ~500 hPa).

References Cannon, F., Ralph, F. M., Wilson, A. M., & Lettenmaier, D. P. (2017). GPM satellite radar measurements of precipitation and freezing level in atmospheric rivers: Comparison with ground-based radars and reanalyses. *Journal of Geophysical Research: Atmospheres*, 122, 12,747–12,764. <https://doi.org/10.1002/2017JD027355>

Pessi, A.T. and S. Businger, 2009: Relationships among Lightning, Precipitation, and Hydrometeor Characteristics over the North Pacific Ocean. *J. Appl. Meteor. Climatol.*, 48, 833–848, <https://doi.org/10.1175/2008JAMC1817.1>

Rutz, J.J., W.J. Steenburgh, and F.M. Ralph, 2014: Climatological Characteristics of Atmospheric Rivers and Their Inland Penetration over the Western United States. *Mon. Wea. Rev.*, 142, 905–921, <https://doi.org/10.1175/MWR-D-13-00168.1>

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