We thank the anonymous referee #2 for his/her review and the positive feedback for our manuscript. We will address the referee comments in blue font below.

**RC2**: 'Comment on egusphere-2024-174', Anonymous Referee #2, 25 Mar 2024

Title: Thunderstorm characteristics with lightning jumps and dives in satellite-based nowcasting

Author(s): Felix Erdmann and Dieter Roel Poelman

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MS type: Research article

Thunderstorm characteristics with lightning jumps and dives in satellite-based nowcasting" by Felix Erdmann and Dieter R. Poelman presents an attempt of adapting the Lightning Jump to satellite imagery (Lightning Imager), as also introduces a new concept, such as the Lightning Dive.

We agree that the Lightning Dive (LD) is a new concept that has not been found in any publication (hence, no reference). The idea was first mentioned by US colleagues during the GLM science meeting 2022 (remotely), that found decreases in the lightning activity of a storm prior to or during tornadoes. The LDs are defined as negative LJs.

Since the objective of this paper is to investigate satellite-detected changes in the flash rate (i.e., GLM LJs and LDs), we included the LDs in our study. We added a paragraph in the introduction that introduces the idea behind the LDs:

“The LD exhibits behavior contrary to that of a LJ, leading to a rapid reduction in the FR as first mentioned by Losego et al. (2022). It is based on the idea that a decrease in lightning activity can precede events such as tornadoes or significant hail. That is the case since the rear flank downdraft (RFD) can be related to tornado development (e.g., Satrio et al., 2021; Mashiko, 2016; Markowski, 2002). Within the RFD, internal momentum surges can temporarily weaken the updraft or alter the hydrometeor content. Such a weakening of the updraft is correlated with reduced lightning activity, as noted by Deierling and Petersen (2008). Furthermore, downdrafts caused by intense rainfall or hail can interact with the storm's updraft and charging structure. These interactions can temporarily reduce lightning activity, as fewer ice particles collide, which is necessary to sustain strong electric fields through non-inductive charging.”

The results are interesting and promissing, having in mind the put in operation of the MTG in an early future. The main issue the lack of information regarding this last concept, because it is a novelty and it should be better introduced, with some examples that should help to make more understandeable to the reader.

Thank you for the positive feedback. We introduce the idea behind the LDs in the revised paper, but simultaneously focus more on the LJs.

Besides, there is some vaguety about the "severe weather" convept, which it must be better explained.

Severe weather is defined by the presence of a tornado, strong winds, and/or large hail. We use the NWS definition of a severe thunderstorm ("A thunderstorm that produces a tornado, winds of at least 58 mph (50 knots or ~93 km/h), and/or hail at least 1" in diameter.", https://www.weather.gov/bgm/severedefinitions). We added this reference to the introduction in manuscript.

Finally, the results are sometimes presented in a difuse way and I think the Authors could do an effort to improve the quality of presentation.

We re-structured our manuscript, with more focus on specific selected cloud characteristics.

You can find below the specific comments associated with the review.

L21: "The opposite behavior, a sudden decrease in the FR is termed a lightning dive (LD)" Referència?

We introduce the term here, based on an idea of colleagues from Georgia Tech. We introduce the concept in a short paragraph in revised manuscript, and we added the link to the presentation (https://goes-r.nsstc.nasa.gov/home/sites/default/files/2022-10/session_4/Losego_Megagraph.pptx, last accessed 19/04/2024) and the meeting (https://goes-r.nsstc.nasa.gov/home/index.php/meeting-agenda-2022)

Introduction: "Severe" or "Adverse" weather?

We added that we use the NWS definition of a severe thunderstorm.

Have you noticed if "However, most LJ algorithms were tuned based on ground-based lightning mapping array (LMA) data." are operational and running in real-time? (L44)

For example, the Meteorological Service of Catalonia runs a LJ algorithm operationally (Rigo and Farnell, 2022). A real-time use is possible since the algorithm is fast (less than 1 minute delay). Since the LJ algorithm are defined on the flash level, it should be considered that ground-based data must be clustered to flashes before the application of the algorithms, and there are effective algorithms to do that.

L80: "The object-oriented approach can effectively differentiate between convective and non-convective cloud cells, and track the convective cells through image recognition, identification of known patterns, and statistical models." Have you any feed-back comparing with weather radar database?

No, weather radar data were not analyzed and we do not know any comparison of the RDT cell tracking algorithm with a radar based cell tracking approach. Usually, the RDT cloud cells would

be somewhat larger than radar based cells since the cloud shield covers a larger area than the convective cores and/or updrafts that can be detected with weather radars. You can compare Table 2 of Schultz et al. (2016) and Table 2 of Erdmann and Poelman (2023) for more details.

L104: why these thresholds?

We used the thresholds that were defined in previous studies (Schultz et al., 2009, 2011), also to be able to compare our results to the results of those studies.

Caption: "Figure 1. Relations between tools and data of this study." Is this a data flow? If yes, please change the caption.

No, the figure does not show a data flow. It simply introduces the different data types and software packages. We adapted the caption: “Data and product types of this study. The dependencies of products can be read from the top to the bottom, and they are also indicated by the arrows. On top, there is the input (grey), boxes with colored frames indicate the intermediate products, and the features in colored boxes are analyzed in the Results section.”

L 90: "During our selected study days (Table 1), there was one important GOES-16 downtime from 03 Jun 17:00UTC to 04 June 01:30UTC." change to "It is worth noting that there was one relevant GOES-16 downtime from 03 Jun 17:00UTC to 04 June 01:30UTC (Table 1)."

OK

L92: "It should be noted that only thunderstorms are analyzed that are defined as RDT cloud cells with GLM lightning activity." This sentence is difficult to understand.

We re-wrote the sentence: “An RDT cloud cell with matched GLM flashes defines a thunderstorm.”

L93: "This studies aims at understanding the meaning of LJs and LDs for thunderstorm characteristics." -> "This study aims to understand the meaning of LJs and LDs for thunderstorm characteristics."

OK

L95: "Such cells generally give rise to weaker weather phenomena compared to major thunderstorms." Partially disagree: warm rain clouds cause heavy rainfall and flash floods in many regions around the World.

Indeed, heavy rainfall or flooding can have other causes than a thunderstorm. We removed the sentence from the manuscript as it is not essential for this study.

Section 2.3: Have you considered the parallax effect? Besides, which is the general size of a RDT cell? Have you manually evaluated these thresholds in any case, to validate them?

Yes, the NWCSAF software corrects for parallax. The average size of an RDT cell is about 619.9 km2, and 2988.5 km2 for thunderstorm cells (Erdmann and Poelman, 2023). Please note that most of the time (>90% of NCEI reports matched to an RDT cloud cell) the report is located within the cloud cell contours. The 50 km threshold is applied to account for an uncertainty in the report location and/or the defined cloud contour. If a report is located within 50km of the cloud cell contour, then (i) the report is considered only if it isn't within the contour of another cloud cell, (ii) only the closest cloud cell is matched to the report. Hence, the 50 km are in practice very variable and state the maximum distance to match cell and report. We did not test longer distances.

We added to line 84: "RDT also corrects for satellite parallax effects."

L120: Have you evaluated the limitation of using standard scan instead of rapid scan? Which is the time running of the NWCSAF software?

No, we didn't. The processing times and data volume would increase significantly. This could be tested for a limited region. Since we tried to include many storms in the CONUS and GLM-16 field of view, we decided to use the 10-minute update cycle. NWCSAF can run with any satellite data that is given to the software as input. Our NWCSAF runs include the analysis and a 60-hour forecast. For one 24h period, NWCSAF runs about 20 hours on our institute server. However, a single 10-min slot with many active cells can need a processing time of up to 3 hours on our server. It should be possible to reduce the processing time through deactivation of some NWCSAF modules, but we did not test this.

L160: I think you should present an example of the LD, because is not an usual phenomenon as LJ and it needs to be assimilated by the reader.

We added a paragraph to explain the meaning of LDs in the introduction. LDs are really the opposite of the LJs where the flash rates decrease significantly (as of the LD detection algorithm) and rapidly from one minute to the other.

Section 3.1: the thunderstorm' categorization should be presented as part of the methodology. The analysis of the categories should be included in the Results section.

OK, we considered these suggestions for re-structuring the revised manuscript.

L172: Why do you think there are more LD than LJ?

This is based on the current algorithm configuration. LDs are often not only detected during the development of the storms, but also during their decay. A modified LD algorithm could exclude the dissipation phase of the storm when lightning activity always decreases and lightning dives can be triggered randomly. For example, require the flash rate to increases again after a sudden drop was detected.

L173: "A thunderstorm can produce more than one type of severe weather (the sum of withTornado, withHail, and withWind is greater than the number of severe TSs)." Please, write more clearly.

New: “The 3 categories withTornado, withHail, and withWind include the thunderstorms that produced tornadoes, hail, or wind, respectively. The sum of their counts (79+438+645=1162) exceeds the number of severe thunderstorms (970) meaning several thunderstorms produced more than one type of severe weather.”

L174: This sentence is reduntant and can be shortened

OK. We removed the explanation and just kept the first part: “All storms with a LJ also had a LD.”

L176: "There are storms with LJs and/or LDs that did not produce severe weather (59.9 % and 71.9 %, respectively)." Disagree. Severe storm can occurr but it has not been reported (or reported to the used database)

That’s a good point. We changed the sentence: “There are storms with LJs and/or LDs where no severe weather was reported (59.9 % and 71.9 %, respectively). However, these storms might have produced severe weather that was not reported.”

L319 Rigo and Farnell (2022) did not analyze LMA-based multi-LJ storms

Thank you for the comment. They used the XDDE LLS, not an LMA. We replaced “LMA-based” by “ground-based” in the manuscript.