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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Review Article: A comprehensive review of datasets and methodologies employed to produce thunderstorm climatologies" *by* Leah Hayward et al.

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Comment:

"The main objective and the motivation of this paper must be more clearly explained in the manuscript."

Response:

Added penultimate paragraph to introduction:

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Discussion paper

“The purpose of the paper is to conduct a systematic and comprehensive review of the datasets and methodologies applied to create thunderstorm climatologies. This review aims to assist those at the design stage of their research and those new to the subject area to become familiar with the strengths and weaknesses of the available data types, to consider which climatological approach best fits their research goal and to identify potential alternative approaches which may not have previously been considered. Whilst there are existing reviews in this subject area available (Betz et al., 2009; Cummins and Murphy, 2009; Ellis and Miller, 2016; Nag et al., 2015), these tend to focus either on analysis of a particular dataset, data type or methodology. This paper, in contrast, fills a gap in the literature by providing an overview of the whole subject area to help the reader to subsequently move on to more specific and detailed examples. Lastly, recommendations for research areas which require development are made.”

Comment:

"A paragraph at the end of the introduction that informs about the following structure of this manuscript must be added."

Response:

Added final paragraph to introduction:

“To fulfil the above purposes, we first review the dataset types in section 2, before then moving on to evaluating how different dataset types have been applied in compiling thunderstorm frequency climatologies (section 3) and thunderstorm tracking (section 4). Section 5 reviews the methods used to produce lightning flash density climatologies, using one dataset type: lightning remote sensing data. This section also includes a review on how lightning flash density results have correlated with potential drivers of thunderstorm formation, such as topography, which thereby introduces further methods and datasets. Recommendations for study design are contained in Section 6 and future research areas outlined in Section 7.”

Comment:

"The “data section” must be in a separate section, not at the section of thunderstorm climatology."

Response:

Amended section order: 1. Introduction 2. Data 2.1 Manual records 2.2 Thunderstorm remote sensing 2.3 Lightning remote sensing 2.4 Thunderstorm indices 3. Thunderstorm frequency 3.1 Manual records 3.2 Thunderstorm remote sensing 3.3 Lightning remote sensing 3.4 Thunderstorm indices 4. Thunderstorm frequency 4.1 Manual records 4.2 Thunderstorm remote sensing 4.3 Lightning remote sensing 5. Lightning flash density 5.1 Lightning flash density method 5.2 Global lightning flash density 5.3 Lightning flash density and topography 5.4 Lightning flash density and aerosols 5.5 Lightning flash density and land cover 5.6 Lightning flash density and atmospheric conditions 6. Recommendations 6.1 Dataset choice 6.2 The benefits of different types of approach 6.3 Identify the end user 7. Conclusion 7.1 Low-lightning areas 7.2 Dataset combination techniques 7.3 Reanalysis indices 7.4 Hazard communication and warnings

Comment:

"Sometimes the authors write the lightning density as “flash density”, and sometimes as “lightning flash density” or “lightning density”. One terminology must be selected."

Response: Amended, lightning flash density selected as single terminology.

Comment:

"Title: without a full stop at the end."

Response: Removed as requested.

Comment:

"Abstract: "..influenced by dataset coverage, quality and the controlling factors under investigation." What quality do you mean? Something is missing."

Response:

Amended as follows: "Regardless of approach, the choice of analysis method is heavily influenced by the coverage and quality (detection efficiency and location accuracy) of available datasets as well as by the controlling factors which are under investigation."

Comment:

"Table 1 2.14 The statement "Can be to produce longer climatologies for. . ." must be rephrased "Can be used to reconstruct activity in areas of poor coverage (Allen and Karoly, 2014)". Do you mean lightning activity?"

Response:

Amended as follows: "Can produce longer climatologies (Brooks et al., 2003)" "Can be used to reconstruct thunderstorm activity in areas of poor coverage (Allen and Karoly, 2014)"

Comment:

"You must explain the acronym CAPE at line 103, not at line 108."

Response:

Amended as follows: "Another approach is to calculate average daily values of relevant reanalysis variables such as 500 hPa and 1000 hPa geopotential heights, 500 hPa air temperature and the instability index known as CAPE (Convective Available Potential Energy) for a given temporal resolution (Gatidis et al., 2008). Reanalyses can also be used to obtain a longer climatology of thunderstorms by developing indices as proxies of thunderstorm activity (Kaltenböck et al., 2009; Kunz, 2007). Different indices may be more or less successful either in general or in different regions and seasons. An example of a commonly used index is CAPE which uses two of the three main in-

gredients for deep moist convection (namely instability and moisture) to evaluate the thunderstorm potential of environmental conditions (Moncreiff and Miller, 1976). The numerical CAPE value indicates the atmospheric potential to produce thunderstorms either looking at current conditions for forecasting or reconstructing the atmospheric conditions of the past for climatology (Holley et al., 2014)."

Comment:

"Lines 163-165: You have already mentioned about radar reflectivity in section 2.1.2"

Response:

Removed. Paragraph now begins: "Radar reflectivity value is used to provide data in relation to severity of convective events including thunderstorms and to diagnose mesoscale convective systems (Punkka and Bister, 2015); catalogue the percentage of thunderstorms that become intense; and identify thunderstorm initiation times and duration (Mohee and Miller, 2010)."

Comment:

"Line 186: "(Wapler and James, 2015) showed that 2 lightning strokes within a 15km radius was found to be the most effective.", without parenthesis at the names."

Response:

Amended as follows: "A successful threshold can be verified with alternative datasets such as human observation and radar; Wapler and James, (2015) showed that 2 lightning strokes within a 15km radius was found to be the most effective."

Comment:

"Line 327: Please, rephrase it."

Response:

Amended as follows: "Lightning flash density studies use data from lightning location

systems and some standardised analysis methods of best practice have been developed when using these datasets. Whilst most lightning climatologies are produced with the intention of minimising exposure to cloud-to-ground lightning hazards (Finke 1999), lightning climatologies can also be viewed as a form of thunderstorm climatology because lightning can be used to confirm thunderstorm activity."

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