

# ***Interactive comment on “An attempt to explain recent trends in European snowfall extremes” by Davide Faranda***

**Anonymous Referee #1**

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Comments on " An attempt to explain recent trends in European snowfall extremes" by Dr. Davide Faranda submitted to WCD.

General comments: In this study, the author investigates recent trends in yearly total snow depth and maximum snow depth in the European region, and for the latter discusses the relationship between the trend and atmospheric circulation and global warming. The reviewer agrees that the manuscript contains a lot of scientific interests to be published since the author focuses on a counterintuitive result the increasing maximum snow-depth trend under global warming. The author tried to understand the relationship between the result and change of atmospheric circulation. However, the relationship or causality would be not fully discussed to be published in this manuscript, and in the current status it seems not suitable to the scope of the WCD journal, be-

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cause the current manuscript contains less investigation on the atmospheric dynamics that causes trends of yearly total and maximum snow-depth. Therefore, I would recommend to resubmit this paper after substantial revision for discussion on the atmospheric dynamics, or the author may address to more elaborate on an observational study such as the comparison with in-situ observations and the ERA5 reanalysis datasets.

Specific comments: The conclusions described in Abstract and Conclusions seem not be supported by the results in Sections 2-4. It looks to me only the result that support the conclusion is "This suggests a non-trivial relation between the occurrence of extreme snowfalls, global mean warming and the internal, long-term variability of the atmospheric circulation" (L136-137). Discussions about atmospheric circulations are too few and thus it is difficult to conclude that "the subtle effects of atmospheric circulation in driving extreme events and the non-trivial relation with global warming: a warmer Mediterranean Sea may enhance convective precipitation in winter-time and trigger heavy snowfalls" (L7-9). At least, there is no figures and discussions on specific humidity, climatological temperature that can determine whether snowfall or rainfall, and sea surface temperature and its related surface fluxes (latent and sensible) on Mediterranean Sea. Also, the reviewer is dissatisfied that the ambiguity of which scale of the atmospheric circulations the author focused on: the synoptic scale or the low-frequency variability? This point was difficult to be understood in Introduction and Section 4.

Another concern is that the author compared the daily composite fields of the period 1979-1998 with those of 1999-2018 (Figs. 6-9). If my understanding is correct, this comparison is the average of 20 daily fields versus that of 20 fields. It seems to me that the number of composite fields is not enough to discuss the daily atmospheric fields, since the daily fields can emphasize synoptic disturbances such as locations of extratropical cyclones. Thus we may need more larger number of daily fields to be composited, or focus on longer timescale fields for low-frequency variability (e.g., Nakamura et al. 1997). (Nakamura et al. 1997: "The Role of High- and Low-Frequency

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In addition, there would be less discussion on the relationship between atmospheric circulation and global warming. For example, could you compare the increasing/decreasing snow-depth trends with estimation of the Clausius-Clapeyron relationship?

Instead, the author could focus on the observational part. I am not familiar with observation research, yet it would be valuable and novel to compare the ERA5 snow estimations with observations. It will provide useful information for reanalyses that are crucially important for weather and climate researches.

It would be helpful to refer to Kawase et al. (2016) who investigated future changes of averaged (yearly total) and extreme (maximum) snowfall events over Japan (East Asian regions), and their results seem partly consistent with your results here. Also you can find Steenburgh and Nakai (2020) for some reviews of snowfall over Japan. (Kawase et al. 2016: Enhancement of heavy daily snowfall in central Japan due to global warming as projected by large ensemble of regional climate simulations, Climatic Change. Steenburgh and Nakai 2020: Perspectives on sea- and lake-effect precipitation from Japan's "Gosetsu Chitai", Bulletin of the American Meteorological Society)

Technical corrections: -L143: What is the "ERA5 data per NUTS2"? Please describe.  
-L153: "hep" => "help". - What is "the block-maxima procedure"? Please explain.

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Interactive comment on Weather Clim. Dynam. Discuss., <https://doi.org/10.5194/wcd-2019-15>, 2019.

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