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

Anonymous Referee #2

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###General comments:

The article investigates extreme snow depth trends in Europe in the last 40 years and attempts to explain these trends in light of global warming and changes in atmospheric circulation. I find the topic interesting and definitively of scientific interest for WCD. However 1) I'm puzzled by the data. I'm not familiar with ERA5 and E-OBS but reading the data section, it seemed to me that the author actually analyze SWE, not snow depth. It may only be a vocabulary issue.

2) Figure 5 shows that applying a linear regression to annual maxima is not robust since it may be much influenced by 1-2 largest points. Therefore 2 subperiods are considered in Figures 6 to 9, which I support. But then wouldn't it be more consistent to consider in Figures 2-3-4 differences between the two subperiods rather than linear trends? This

is not anecdotal since the regions with largest increase/decrease might partly change (e.g. ITF1). A t-test, e.g., could be applied to test differences in means. Note that another way to get more robust trends in annual maxima is to fit a nonstationary GEV distribution but it may be unnecessarily complicated here.

3) I find the idea of comparing atmospheric fields during extreme events excellent . However I'm puzzled by several interpretations (see below) and I'm not sure that the conclusions are supported by the analysis. First I'd like to see the average Z500 fields for period 2 because I don't think one can interpret anomalies without the mean field (or at least I'm not able to). In Figure 6 the author shows that decreasing trends are mainly associated with negative anomalies over eastern Europe. I see the correlation but is this causality? In particular if one considers a neighboring region with positive trends, don't we have the same pattern (i.e. negative anomalies over EE)? Idem for the positive trends.

4) More generally, looking at the quite noisy map of Figure 4d), is there good hope to be able to explain trends from atmospheric circulation? For example in Italy I can see quite positive, null and negative trends within a few km of a quite flat region. I expect all these regions to be influenced by the same atmospheric circulation, therefore differences in trends are either due to regional characteristics or this is merely rainfall variability (or data issues). Please consider analyzing larger regions to be able interpret smoother maps.

###Specific comments

L5: "coherent with the mean global warming and previous findings": I'm not sure to understand to which of your results you refer to here.

L6: "discrepancy between trends in average and maximum SD": to investigate this, wouldn't be interesting to look at the regions with the largest discrepancies between means and extremes? Introduction: please consider referring to Beniston et al. 2018, The European mountain cryosphere: aÂăreview of its current state, trends, and fu-

ture challenges, which gives a good overview of changes in the European mountain crysophere.

L95: “large SD amounts correspond to snow to be removed“: I’m not sure about that. The weight of the snow (SWE) is much more important than the depth.

L 100: “total amount of water”: does ER5 really give you a total amount of water? Then this would be a SWE (mm of water), not a depth. Or do you mean “total snow depth”?

L 108: “from daily total precipitation”: Idem I don’t understand how you get snow depth from water amount.

L113: where does this 2/3” coefficient come from?

Figures 2-3-4; please consider exchanging colors since later on red=decrease, blue=increase.

Please consider merging Figures 2 and 3 (e.g. by crossing out the significant regions)

Figure 4: are you sure these are NUTS-2 regions? It seems to me they are much larger.

L 146-147 “Indeed . . . trends” : actually this was also the case in Fig 3a)

L 164 “due to the two outliers” : I guess these two outliers occurred at the end of the period

Figure 6: please consider showing the average field of period 2. Also the windows are much too large. Please consider showing smaller windows centered on the considered locations.

L 178 “weaker cyclonic structure” : I understand that geopotential heights are higher (positive anomalies) but don’t you need the mean field to interpret it as a “weaker cyclonic structure”?

L 179 “an anti-zonal of a blocked pattern”: I’m not an expert in atmospheric circulation

but I don’t understand where you see that

Figure 8: is the scale the same for all panels?

L 182 “the surrounding . . . events”: is tis particular to CZ03? Actually I see that in all panels.

L 187 “negative SD anomalies . . . viceversa”: I don’t see that (or I don’t understand)

L 195 “tend to suggest a stronger meridional flux” : I don’t understand this interpretation

L 196 “deeper cyclones” : I don’t understand why negative anomalies imply deeper cyclones.

L 220: “we observe more anticyclonic conditions” : where do you show that? I’m not sure that this kind of conclusion can be drawn from a few events.

###Technical corrections:

L 63: Luthi et al: commas

L 101: “higher” → larger

L 120: “tend coincide”

L 143: “NUTS2” is “NUTS-2” above

L 153: “could hep”

L 155 Altman: commas

Figure 5: NUTs2. Also I guess a) is positive and b) is negative

L167: “atmospheric” → meteo?

L 182 “positive anomalies” → negative?

L 183 “positive SD anomalies” → negative?

L 193: CH5 → CH05

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