

Interactive comment on “Extratropical cyclone statistics during the last millennium and the 21st century” by Christoph C. Raible et al.

Anonymous Referee #1

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This paper documented the variability of Extratropical Cyclones (EC) in a 1-deg CESM model during the last millennium and the 21st century under RCP8.5 forcing. They found natural variations on decadal and multi-decadal timescales and substantial changes in cyclone frequency and precipitation under anthropogenic forcing. It is also found that the cyclone-related precipitation changes do not always conform to the C-C relationship. The paper is presented in a clear and organized manner. Although most of the analyses are quite generalized and most of the results should be expected, studies of EC in such long-term historical simulations aren't common. I think this could serve as an introductory paper for more detailed studies using the same or similar simulations in the future.

My main comment is about the regression analysis applied in Section 4.3. It seems

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that the regression is based on the average depth/precipitation index of the entire North Atlantic. Because of the spatial average, it is no surprise that only the most dominant and large-scale circulation pattern (i.e., the NAO) would show up in Figure 5. While such analyses are convenient and easily make sense, the mechanisms that cause the spatial variations of ECs are muddled. Considering the large spatial variability of EC, I would prefer to see results that do not just focus on the regional mean. For example, the authors could try applying EOF analyses to the data to extract some spatial information.

Some minor comments:

Line 36: “millennium which” -> “millennium, which”, and similar changes throughout

Line 37-38: “the external forcing . . . characteristics” – awkward sentence. Suggest changing it to “the externally forced and internally varying extratropical cyclone activities”

Line 135: Would the cyclone statistics change if higher frequency outputs are used? What if time averaged instead of instantaneous outputs are used? Is the ERA data also 12-h instantaneous?

Line 201: “area North” -> “area of North”

Line 221: “as well as with” -> “as well as between”

Line 267: any references for the improvements?

Line 282: “missing volcanic forcing impact”. Do all the volcanic forcings have the same spatial patterns? It is likely that the effect of volcanoes cancels out due to their varying spatial patterns, but the individual volcanoes may still be impactful.

Line 322: “region of minimized” -> “region of reduced”

Line 355: “change of the” -> “change in”; “the latter one” -> “which”