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Climate of the Past Discussions

Interactive comment on "Teleconnections and relationship between ENSO and SAM in reconstructions and models over the past millennium" *by* Christoph Dätwyler et al.

Anonymous Referee #1

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Overview – the authors are examining relationships between austral summer ENSO and SAM indices from reconstructions and model simulations over the last millennia. As these relationships are important for understanding climate variations across the mid and high latitudes of the Southern Hemisphere, and no research to my knowledge has been done on these relationships this far back in time, the work is very important.

The paper is extremely well written, concise, and easy to follow. I enjoyed it very much, and suggest it be published after the authors address my three main concerns, and two very minor suggestions.

Major concerns:

1. Figure 1 – is there a way that uncertainty in the reconstructions (both the Fogt and the proxy-based) can be accounted for when calculating the correlation, and this can be shown as some sort of confidence interval around the correlations? While you can do this as a statistical test that the correlation is zero (95% confidence interval on the correlation magnitude itself), I think it would be more telling to represent the confidence intervals as a function of the error / uncertainty in the various reconstructions, perhaps through some Monte Carlo sampling? This would help to determine if shifts to positive correlations in Fogt reconstruction in 1955 or the proxy-based reconstructions in years 1100-1300 are different than zero when accounting for the uncertainty in the reconstructions. I understand this a goal of Figure 2, but you can also do this in the real-world sense in Figure 1.

2. I have trouble interpreting Figure 4, since it is based on the sign of the correlation, rather than the phases of either ENSO or SAM. This would mean the negative composite, for example, contains years of ENSO+ and SAM- (El Nino with SAM-) as well as ENSO- and SAM+ (La Nina with SAM+). One would expect this would lead to cancellation of many of the circulation features since the phase of the two modes are opposite, and indeed in Fig. 4 you do not see any SAM signatures in SLP over Antarctica, or really any ENSO signatures in temperature or SLP in the tropical Pacific. I suggest redoing these to have a more meaningful result, since previous work suggests high southern latitude ENSO teleconnections are stronger when there is a negative ENSO-SAM correlation. To do this, you can continue to use the correlation as a tool to select years, but then make sure to adjust the anomalies based on the phases of ENSO / SAM before compositing to be consistent and avoid cancellation. For example, you could multiply the years of SAM- and El Nino by negative 1 before adding these two the years with SAM+ and La Nina, to represent the circulation specifically during negative correlation events. I think this would be much more meaningful. The IPO signature may emerge more than the ENSO one since it is a persistent mode of variability, whereas ENSO and SAM change phase much more frequently.

3. Also, it is odd to have a focus on the Aleutian Low in Fig. 4 – why would this be influenced by ENSO and SAM? A more robust measure would be in the SH (where SAM has a direct influence), such as the Amundsen Sea Low, which is known to change in its magnitude based on ENSO / SAM relationships. Compositing Fig. 4 in the fashion described above should make for a clear connection with the ASL.

Minor suggestions:

1. Figure 1 – suggest clarifying that ENSO is based on the Nino 3.4 index, as some other studies have used the SOI and therefore had a positive correlation

2. The authors may wish to cite / incorporate a recent study which looked at stationarity in pressure relationships between the mid / high latitudes of the SH over the last century in models and reconstruction, also using perfect pseudoproxy model reconstructions (Clark and Fogt 2019):

Clark, L., and R. Fogt, 2019: Southern Hemisphere Pressure Relationships during the 20th CenturyâĂŤImplications for Climate Reconstructions and Model Evaluation. Geosciences, 9, 413, https://doi.org/10.3390/geosciences9100413.

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