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Earth System Dynamics Discussions

Interactive comment on "Assessing the Impact of a Future Volcanic Eruption on Decadal Predictions" *by* Sebastian Illing et al.

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Anonymous Referee 1 Received and published: 12 March 2018

The paper nicely explains the impact of volcanic eruptions on decadal predictions on a number of climatic variables. The authors find that although the global response (cooling and drying) to volcanic eruptions is independent of initial conditions, the regional response could be very different based on the initial state. I recommend acceptance with minor revisions as stated below.

Comment: An easy yet important addition to the paper would be to include the impact of the volcanic forcings on ENSO prediction. Since the data is already there it is just about computing some of the ENSO indices and presenting how they change due to volcanic forcings under different initializations.

We thank the reviewer for the constructive comment and useful suggestion. We added the suggested ENSO indices, in particular the temperature based NINO4 index and the ENSO precipitation index (ESPI), to the manuscript (Fig. 10). Indeed, we find some interesting behavior in these indices and extended section “3.4 Precipitation” with the following text:

"In the global precipitation maps, we see a decrease of precipitation for both experiments through the volcanic aerosol in large parts, especially over land, in the first four prediction years (Fig. 9). The drying effect is strongest over the tropics, particularly in Southeast Asia, and is even more pronounced in exp-2014. In fact, the tropical precipitation pattern in Southeast Asia and the East Pacific in exp-2014 is very similar to an El Nino response. Recent model studies (Maher et al., 2015; Pausata et al., 2015; Khodri et al., 2017) revealed that volcanic eruptions have a significant impact on ENSO and there is some ongoing debate whether tropical volcanic eruption can trigger an El Nino event (Meehl et al., 2015; Predybaylo et al., 2017; Swingedouw et al., 2017). To further investigate this, we calculated the temperature based Nino4 index (Trenberth and Stepaniak, 2001) and the ENSO precipitation index (ESPI, Curtis and Adler, 2000) for both experiments for the first four prediction years (Fig. 10) as twelve month running means to reduce variance. The ensemble initialized in 2014 with a Pinatubo-like eruption shows a tendency towards El Nino conditions, whereas the baseline1 ensemble favors a weak La Nina condition (Fig. 10 b, d). The difference between the two experiments in the ESPI is significant until simulation months 18-30 when both indices come back to neutral conditions. In exp-2012 there is no difference evident in the first three prediction years, but in year four the baseline1 ensemble starts simulating a La Nina phase (Fig. 10 a, c) with a significant difference to the Pinatubo-like experiment. In general, exp-2014 shows a stronger drying response in the tropical region. In contrast, in this experiment, wetter conditions over Western Europe can be found which does not occur in exp-2012 (Fig. 9)."

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Discussion paper

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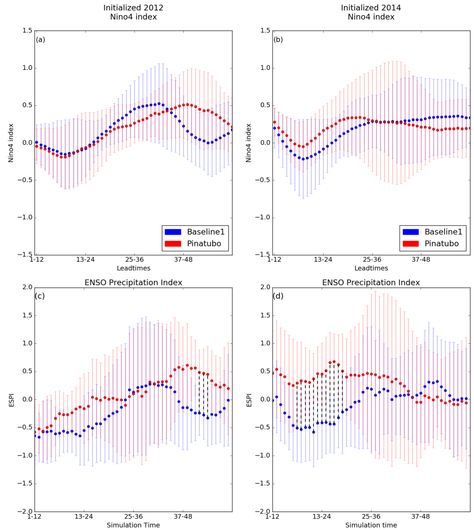

Figure 10: Top row shows the Nino4 index and bottom row shows the ENSO Precipitation Index (ESPI) for the first four prediction years calculated as a 12 month running mean to reduce variance. Left (right) column shows the 2012 (2014) initialized experiments. Error bars show the standard deviation of the ensemble and vertical black lines indicate a significant difference.

Fig. 1.