

Atmos. Chem. Phys. Discuss., referee comment RC2
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Comment on acp-2022-58

Anonymous Referee #2

Referee comment on "Volcanic stratospheric injections up to 160 Tg(S) yield a Eurasian winter warming indistinguishable from internal variability" by Kevin DallaSanta and Lorenzo M. Polvani, Atmos. Chem. Phys. Discuss.,
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This ms illustrates the importance of internal variability for winter warming following volcanic eruptions, and that only for very large eruptions or an average of a very large number of eruptions the signal is expected to be significant. It is based on a largish ensemble of climate model simulations with somewhat idealized conditions. The ms describes a well conducted study, and the figures illustrate nicely how a highly significant stratospheric warming leads to significant zonal wind enhancement which, however, only sometimes reaches the surface and has to compete with strong variability there. It is a very valuable addition to the literature. I recommend a few suggestions for discussion/consideration.

a) the ensemble explicitly focuses on ENSO neutral conditions in eruption years. i find this a bit surprising and constricting - and it would be interesting to have seen if results vary between ENSO states. Alternatively, it should be flagged in abstract that this study refers to ENSO neutral start dates

b) even if the mean change is rather subtle, this could affect the tails of the distribution - would a strong winter warming be more likely with than without a preceding eruption? (the event attribution question)? Based on figure 8, the ensemble size is probably too small for a robust answer... although it would be really interesting to know.

c) i would have liked to see a bit more discussion of the observed response to Pinatubo, for example, where it sits compared to the model simulations. If it was made clear that it is within the range of what the model simulates that would have made the possibility less likely that the observations behave differently from the model. This possibility has been raised, for example, also with the recent Scaife et al results on predictability of the NAO where the simulated signal is much smaller than observed.

specific suggestions:

Abstract last sentence: this isn't very clear - i think you are discussing a single simulated response, and that only in rare cases will it emerge from internal variability? (this is what would be interesting to know - how likely is it going to emerge beyond 1sigma i expect very similar to the expectation of this occurring by chance? in any case, please phrase more clearly what the last sentence refers to

l 24: this is about global surface temperature?

l 30: a reader may like to know what is meant by methodological issues

l 85: it would be helpful here to define what region the surface temperature of eurasia refers to

l 190: Deser 2012 is one of my all-time favourite papers, yet averaging across ensemble members to arrive at fingerprints of forced change has been done a lot longer than that (e.g see discussion Tett et al nature 1999)

paragraph starting line 235: would it be worth mentioning where significant wind anomalies reach the surface? to me this is an interesting question

l 310: it would be helpful to have some idea what makes EVA unrealistic even in main text

figure 5: shading - does it refer to lack of significance for the averaged response right?