The Impact of Background ENSO and NAO Conditions and Anomalies on the Modelled Response to Pinatubo-Sized Volcanic Forcing

Helen Weierbach[1,2,3], Allegra N. LeGrande[4,5], and Kostas Tsigaridis[5,4]

[1]Earth and Environmental Sciences Area, Lawrence Berkeley National Laboratory, Berkeley, CA, USA
[2]Tulane University, New Orleans, LA, USA
[3]Lamont Doherty Earth Observatory, Columbia University, New York, NY, USA
[4]NASA Goddard Institute for Space Studies, New York, NY, USA
[5]Center for Climate Systems Research, Columbia University, New York, NY, USA

Correspondence: Kostas Tsigaridis (kostas.tsigaridis@columbia.edu)

Introduction Additional diagnostics and information for the GISS VolMIP simulations used in this analysis. We present information about the background conditions in the model and their samplings (Figure S1). We also present more in-depth information about the radiative forcing response and the dynamic responses of circulation and pressure in the northern hemisphere (Figure S2). Finally we present an analysis of the meridional temperature gradient over three months of the first post-eruptive winter. Specifically, we show the meridional temperature gradient anomalies, as well as the control and perturbed ensembles for positive, neutral and negative NAO ensemble groups (Figure S3)
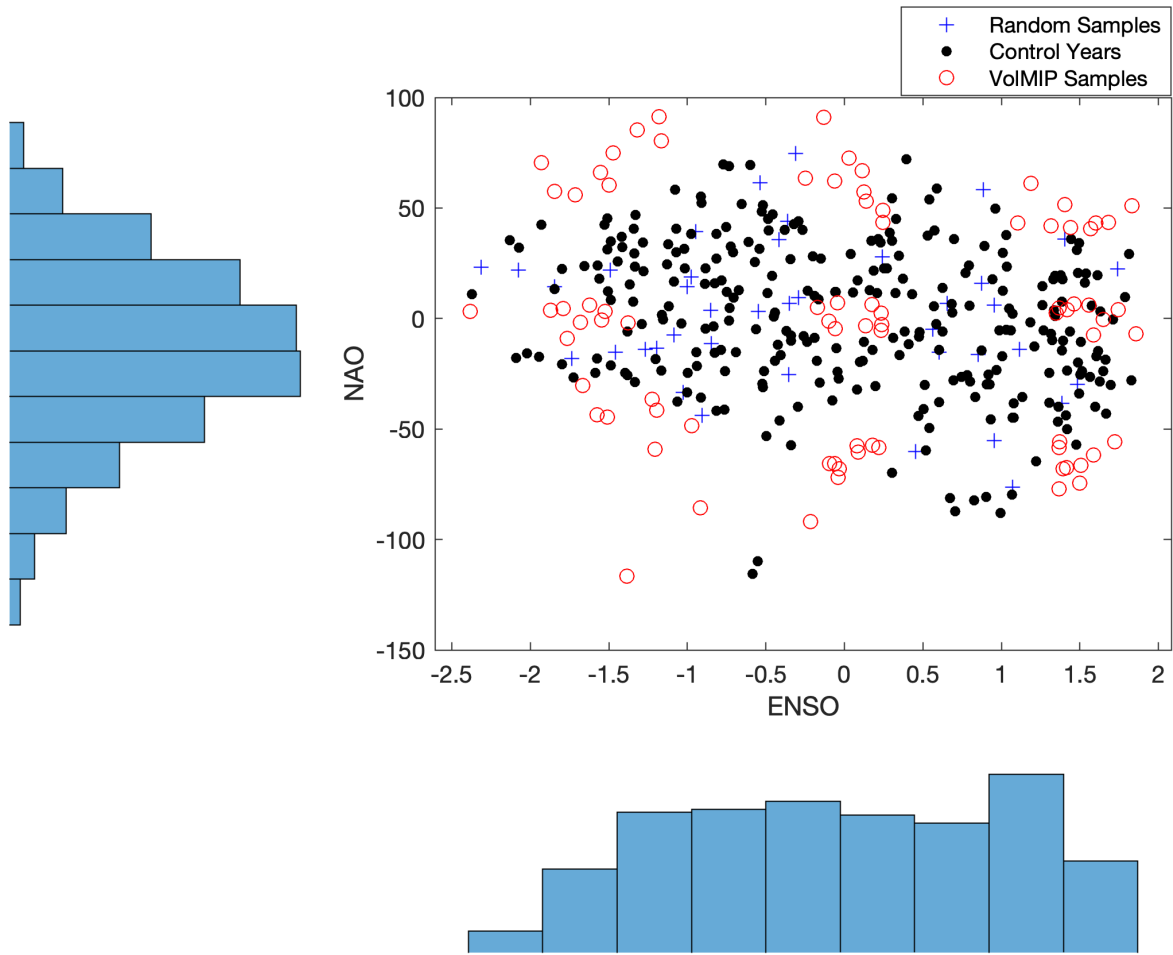
Figure. S1. Background Condition Scatter Plot for 400 years in GISS Control Model Run. Each year in the 400 year control is plotted with ENSO index on the x-axis and NAO index on the y-axis. VolMIP sampled simulations are denoted by red circles, additional randomly sampled years are blue (+) and all other years in the control run are black dots. Histograms show a distribution of background conditions. ENSO conditions exhibit a positive skew consistent with model biases addressed by Kelley et al. (2020)

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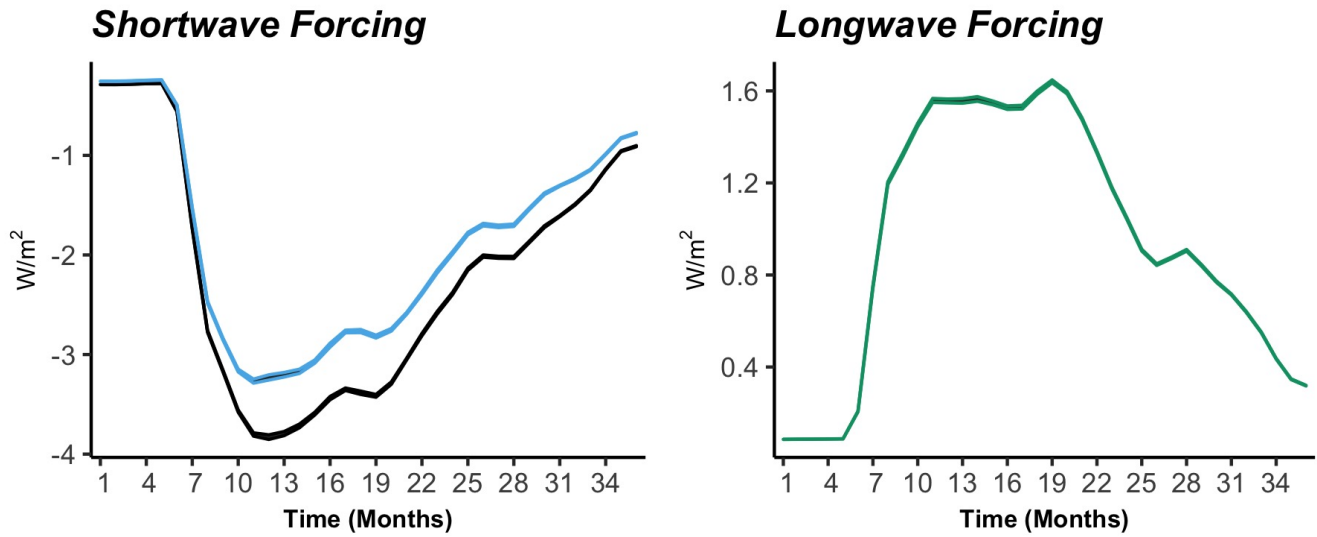
Figure. S2. 3-year time series of global shortwave radiative forcing (left) at the surface (light blue) and top of atmosphere (black). Longwave radiative forcing at the top of atmosphere (green). Each line is shaded with one standard deviation for all 81 ensembles above and below the mean response. For each ensemble the volcanic eruption occurs in the 6th month.

References

Kelley, M., Schmidt, G. A., Nazarenko, L. S., Bauer, S. E., Ruedy, R., Russell, G. L., Ackerman, A. S., Aleinov, I., Bauer, M., Bleck, R., et al.: GISS-E2. 1: Configurations and climatology, Journal of Advances in Modeling Earth Systems, 12, e2019MS002 025, 2020.

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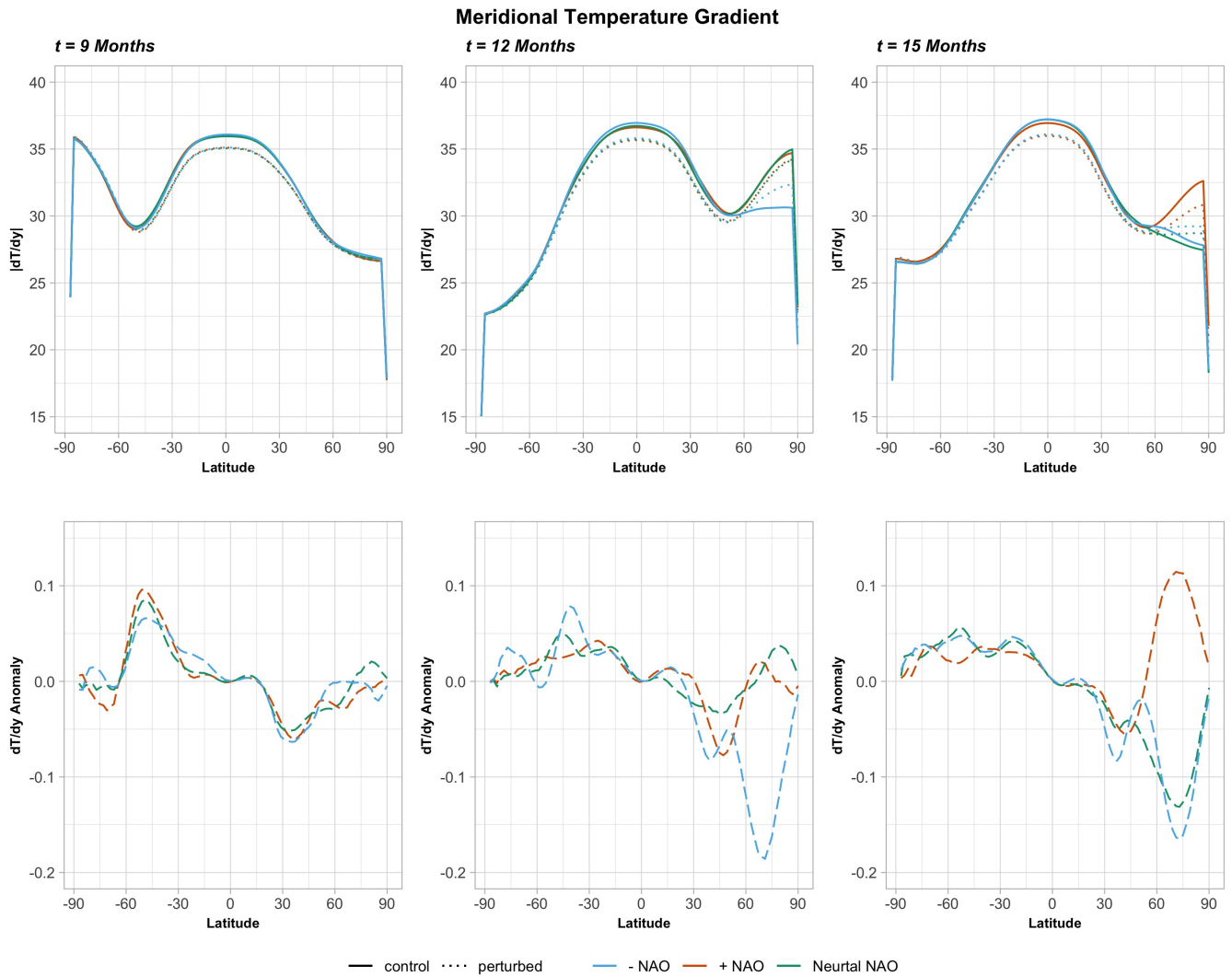
Figure. S3. The meridional temperature gradient (dT/dy) for the control and perturbed (top) and anomaly (bottom) for positive (red), negative(blue) and neutral (green) NAO ensemble groups. The meridional temperature gradient is shown at three months, corresponding to the September (left), December (middle) and March (right.) Anomalies are highest in December and March, but control conditions contribute significantly to the anomalies in negative and neutral NAO background conditions.