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Interactive comment on "Nonlinearity in the Tropospheric Pathway of ENSO to the North Atlantic" *by* Bernat Jiménez-Esteve and Daniela I. V. Domeisen

Anonymous Referee #1

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Review of " Nonlinearity in the Tropospheric Pathway of ENSO to the North Atlantic" by Bernat Jiménez-Esteve; Daniela I.V. Domeisen. Recommendation: minor revisions

The authors analyze the North Atlantic sector impacts of ENSO in simulations in which nudging is applied to the stratospheric circulation to shut down a stratospheric pathway. When the stratospheric pathway is shut down, the strongest –NAO response is achieved for the strong El Niño forcing, while the strongest +NAO like response is for a strong La Nina forcing. However the specific patterns are not linear, and the authors provide various diagnostics in order to explain the responses. The analysis is convincing, and nearly ready for publication.

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Major comments: The authors note that the North Atlantic response to ENSO is much weaker than that in the Pacific sector, and they don't fully quantify this effect. Recent papers by Deser et al 2017, Garfinkel et al 2018, and Weinberger et al 2019 (all cited) perform a Monte Carlo analysis to compute how many events must be subsampled from all available model simulations before a given nonlinearity becomes statistically robust, and I think a similar analysis here would be helpful. If it turns out that e.g. >50 events are needed before nonlinearities become apparent, then such a nonlinearity may not be particularly useful for seasonal forecasting purposes. However this paper is publishable even if it turns out that nonlinearities are not large enough to be helpful.

Minor comments: 1. Line 79: That ENSO only accounts for some 10% of vortex variability was already pointed out by Garfinkel et al 2012. The correlation of Nino3.4 with seasonal mean vortex strength is $\sim$0.3 in reanalysis and also in a range of models (see their figure 5).

2. The studies conceptually most similar to the present one are Bell et al (2009) and Cagnazzo and Manzini (2009). While these papers are already cited, it would be helpful in the introduction to more explicitly discuss how the present analysis builds on this previous work.

3. Line 206 "Another interesting result is that "

4. Line 223: My understanding is that ISCA has a slab ocean at the bottom, not fixed SSTs. SSTs can be "specified" by running a tag-along Python script that computes the oceanic q-flux pattern that must be imposed in order to generate a desired SST pattern (Vallis et al 2018). If this is indeed the configuration the authors used, please clarify.

5. Line 405: "weak an asymmetric respect to" needs to be rewritten

6. Colorbar for figure 2: I find the units gdam confusing. Isn't this just dm?

7. The North Atlantic jet seems to be too zonally oriented in the climatology (see figure 3). This bias should be mentioned in the discussion section.

Garfinkel, C. I., Butler, A. H., Waugh, D. W., Hurwitz, M. M., and Polvani, L. M. (2012), Why might stratospheric sudden warmings occur with similar frequency in El Niño and La Niña winters?, J. Geophys. Res., 117, D19106, doi:10.1029/2012JD017777.

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