

Interactive comment on “Signals of El Niño Modoki in the tropical tropopause layer and stratosphere” by F. Xie et al.

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Signals of El Niño Modoki in the tropical tropopause layer and stratosphere F. Xie, J. Li, W. Tian, and J. Feng

This paper seeks to explore the effects of El Niño Modoki events on the tropical tropopause layer (TTL) and on the stratosphere. Consistent with previous studies, El Niño Modoki events tend to depress convective activities in the western and eastern Pacific but enhance convective activities in the central Pacific. El Niño Modoki activities tend to moisten the lower and middle stratosphere, but dry the upper stratosphere. El Niño Modoki events have a reverse effect on high latitudes stratosphere, as compared

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with the effects of typical El Niño events. However, nonlinear interaction was found between the El Niño Modoki and QBO signals. This is an interesting subject and the study presents novel conclusions.

My review will focus on one specific aspect of their work: the QBO leads to a reversal of the effect of El Niño Modoki in the NH in WACCM and that El Niño and the QBO interact nonlinearly. First, it is not clear to me that 15 year simulations are long enough to confidently claim such a result. Either a significance test should be included, or the simulations should be extended for longer (or both). In my experience, at least 25 or 30 years of integration length are necessary before a 1K signal at the polar vortex (which is the magnitude of the effect the authors discuss) becomes robust.

Second, it is possible that the nonlinearity is not necessarily occurring in the stratosphere (e.g. line 20 of page 3635): Garfinkel and Hartmann 2008, 2010 find that the QBO can alter the strength of El Niño teleconnections in the troposphere. In particular they show that El Niño teleconnections are weaker during EQBO than during WQBO (though this is slightly different from the nonlinearity the authors discuss). This effect is present in WACCM, though it is weaker than the comparable effect in reanalysis data (Garfinkel and Hartmann 2010). Since the presumed mechanism whereby El Niño influences the polar vortex is via its North Pacific teleconnection, it is possible that El Niño Modoki teleconnections are being modified in the presence of a QBO in their WACCM integrations and that this leads to a different stratospheric response. GH10's specific mechanism for nonlinear interaction in the troposphere is that WQBO leads to a stronger subtropical jet and a stronger subtropical jet leads to a stronger North Pacific teleconnection to an identical tropical vorticity source. The authors should examine (1) whether El Niño Modoki teleconnections in the North Pacific troposphere are qualitatively different, or are weaker, in the presence of a QBO, and (2) whether introducing a QBO impacts the strength of the subtropical jet.

Typographic comment Line 20: should “typical Modoki events” be “typical El Niño events”?

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Garfinkel, C.I., and D.L. Hartmann(2008), Different ENSO Teleconnections and Their Effects on the Stratospheric Polar Vortex, *J. Geophys. Res. Atmos*, 113, D18114, doi:10.1029/2008JD009920.

Garfinkel, C.I. and D.L. Hartmann(2010), The Influence of the Quasi-Biennial Oscillation on the North Pacific and El-Nino teleconnections, *J. Geophys. Res. Atmos* , 115, D20116,doi:10.1029/2010JD014181

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