Reviewer #1 Evaluations:
Science Category: Science Category 4
Presentation Category: Presentation Category B
Reviewer #1 (Comments to Author):

**Summary**

*The authors propose that the positive phase of Trans-Niño can be linked to an increased number of intense tornadoes in the U.S. during the months of April and May (AM). The link is in terms of enhanced low-level warm and moist air, and upper-level cool and dry air, which "converge" in the central U.S. The authors purport that such "differential advection" favors increased tornado activity.*

**Comments**

*Although the authors should be commended for attempting to understand the anomalously high tornado activity during April 2011, their proposed ideas are overly simplistic and reveal critical gaps in their knowledge of how tornadoes form.*

*One can restate their proposed link in terms of convective available potential energy (CAPE). But CAPE is but one environmental ingredient presumed necessary for tornado formation, and certainly does correlate well alone with tornado activity (this has been shown in papers by H. Brooks). The other ingredient is some amount of vertical wind shear, typically taken from the surface to the middle troposphere (5-6 km AGL). This "horizontal spinning effect" is not a "trigger" as stated by the authors, but instead represents the ambient horizontal vorticity that is tilted into the vertical to produce a rotating thunderstorm. Such a supercell storm has unique dynamics and is the storm type most apt to spawn intense tornadoes.*

*Thus, for the authors to successfully defend their hypothesis, they will need to show that the positive phase of Trans-Niño not only yields anomalously high CAPE but also large vertical wind shear.*

*My key criticism, said another way, is that high CAPE favors convective storm formation, but only a very small fraction of the set of all convective storms develop rotating updrafts, and only about 25% of rotating storms actually spawn tornadoes. The "notion" (who's notion?) that*

*"large-scale differential advection" modulates tornado activity in the central U.S. quite simply fails to recognize the rarity of tornadoes.*

*My recommendation is that this manuscript is not acceptable for publication in GRL.*

We wish to thank the reviewer for pointing out the need for discussing the vertical wind shear effect, which has been shown to be one of the most important environmental conditions required for tornado formation. We have completely revised the manuscript to correct this. In the revised manuscript, both the large-scale differential advection and lower-level vertical wind shear are discussed and analyzed as important environmental factors for tornado activity. Therefore, Table 1, Figure 1, 3, 4, S2, S6, S7, S8 and the related discussions are all revised. The model results (EXP_TNI) indeed show that the lower-level vertical wind shear over the central and eastern U.S. is increased during a positive phase of TNI (Figure 3c in the revised manuscript), thus strengthening the overall conclusion of this study.

*Additional comments*

1. *p. 2, line 12: As discussed in Brooks and Doswell, tornado days rather than tornado reports is a more time-stable indicator of tornado activity.*

As the reviewer points out, the number of intense tornadoes used in this study may not be the most objective metric for representing tornado years. For instance, 60 out of the 85 intense (F3 and above) U.S. tornadoes in AM of 1974 occurred on one convective day. Thus, some years with a large number of tornadoes are not qualified as outbreak years if the single day with the largest number of tornadoes in each year is taken out. Due to this limitation in the tornado metric used in this study, we test our main conclusions using different tornado indices. Another widely used metric is the intense U.S. tornado-days, which is obtained by counting the number of days in which more than a threshold number of intense (F3 and above) tornadoes occurred [e.g., Verbout et al. 2006]. The threshold number selected in this case is three and above, which roughly represents the upper 25% in the number of intense U.S. tornadoes in a given day of AM during 1950-2010. The time series of intense U.S. tornado-days in AM for 1950-2010 is shown in Figure S10. Table 1 is reproduced using the new metric. As shown in Table S4, the TNI is still significantly correlated (above 95% significance level) with the intense U.S. tornado-days in AM, supporting the overall conclusions of this study.

2. *p. 2, line 19 and elsewhere: Differential advection of what? I assume temperature or perhaps virtual temperature. Either way, the authors' description of differential advection as "two or more different air masses converging at different heights" is wrong. Write out the mathematical expression for differential advection of virtual temperature.*

The term “large-scale differential advection” is used here to indicate any vertical variation of the horizontal advection of heat and moisture that decreases the vertical stability of the air column, following Whitney and Miller [1956] and Miller [1955]. The related text is revised to provide a better definition of this term, and Whitney and Miller [1956] is now cited.

Whitney Jr., L. F., and J. E. Miller (1956), Destabilization by differential advection in the tornado situation 8 June 1953. *Bull. Amer. Meteor. Soc*., **37**, 224–229.

Miller, J. E. (1955) intensification of precipitation by differential advection. Journal of Meteorology (former name for the Journal of Atmospheric Science), **12**, 472-477.

3. *p. 4, line 2: This correlation is between TNI and intense AM tornado reports throughout the entire U.S., not just the central U.S.*

The reviewer is correct that the correlations shown in Table 1 are with the number of intense tornadoes in AM for the entire continental U.S. In the revised manuscript, “central U.S.” is changed to “central and eastern U.S.” to refer to the overall U.S. regions east of the Rocky mountains most frequently affected by intense tornado activity.