

## ***Interactive comment on “Drier spring over the US Southwest as an important precursor of summer droughts over the US Great Plains” by Amir Erfanian and Rong Fu***

**Anonymous Referee #1**

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This study investigates the causes of the 2011 Southern Great Plains (SGP) and 2012 Northern Great Plains (NGP) droughts during JJA by performing a systematic atmospheric moisture budget analysis. The analysis reveals the key role of zonal advection of moisture in the preceding season (MAM) in leading to the drought condition in JJA. Through a simple correlation analysis (e.g. in Fig. 12), the study points out the importance of dry conditions in the SW US during MAM for droughts in the GP during JJA. The paper is overall neatly written and enjoyable to read, the results are cleanly presented. The finding on the importance of zonal thermodynamic moisture advection is interesting. The key finding on the importance of dry condition in the SW US during MAM for dry conditions in the GP in JJA, however, appears shaky, it needs to be

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substantiated with further evidence. Please see my specific comments below.

1. Title: “Drier spring over the US Southwest as an important precursor of summer droughts over the US Great Plains”

The title appears to be based on Fig. 12, but the inference on the importance of dry spring over the U.S. Southwest as a precursor of summer droughts over the US Great Plains from Fig. 12 is not very convincing for the following reasons: 1) while the temporal correlation between JJA precipitation over the NGP and MAM precipitation over the SW US is statistically significant, it is based on all the cases, regardless of the sign and amplitude of the precipitation anomalies. If one focuses on dry cases only, the good correspondence between NGP precipitation during JJA and SW US precipitation during MAM is only shown for a limited number of cases (e.g. 1989, 2002, 2012, 2013), it is unclear whether the statistical relationship between the two regional precipitation still stands; 2) the SW US region is traditionally considered to cover the states of UT, CO, AZ and NM only. The SW US defined in Fig. 12 (black box in Fig 12a) appears to extend too far north. If limiting the SW US to cover the states of UT, CO, AZ and NM only, would the correlation results in Fig.12 change? 3) Fig.12 only suggests the relationship between MAM precipitation in the SW US and JJA precipitation in the NGP. It doesn't suggest any relationship for the JJA precipitation in SGP. It thus appears inappropriate to suggest that the MAM precipitation in the SW US can serve as a precursor for the precipitation in the GP as a whole.

2. Figure 2: the precipitation in the reanalyses are model dependent and are subject to deficiencies in the assimilation models used. How does the reanalysis precipitation in Fig. 2 compare with precipitation from observations (e.g. CPC gauge-based precipitation)?

3. Line 448: This study uses moisture budget analysis to show the importance of zonal moisture advection in MAM (due to dry anomaly in regions to the west) for both the 2011 and 2012 drought events. Droughts are known to be typically caused by

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anomalous subsidence induced by upper-level anticyclonic circulation anomalies (e.g. Namias 1983). The 2011 and 2012 droughts also appear to have upper-level high anomalies occurring during their developing periods. Some discussions on how the zonal moisture advection may or may not connect to the upper-level high anomalies would be helpful.

Namias 1983: Some causes of United States drought. *J. Climate Appl. Meteor.*,22, 30–39.

4. Figures 10-12 are used to establish the connection between MAM zonal thermodynamic moisture advection and the development of GP droughts in the following JJA. Some discussions of possible physical processes by which the former (MAM zonal moisture advection) leads to the latter (JJA droughts in GP) would be helpful. The atmosphere does not have much memory: any atmospheric anomalies in MAM would presumably disappear in about 2 weeks. Is it possible that land plays some role (in sustaining the effect of MAM anomalies through JJA) here?

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