Supporting Information for

Gauging the Severity of 2012 Midwestern U.S. Drought for Agriculture

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Contents of this file

Introduction

This Supporting Information file includes some details of the introduction and results of this study. This analysis was undertaken to determine whether higher drought severity led to higher yield loss at crop reporting district (CRD) scale. In addition, it is also important to understand whether this relationship exists in early (May), middle (July), or late (September) growing season. To achieve this, we compared different drought categories with yield loss in the corresponding CRDs for the three stages of growth season, as seen in Supporting Information figures S4-S7.

First, it was found that 13 out of 15 drought assessments showed a good relationship with yield loss in the middle of the growing season. In other words, higher drought severity in the midseason led to higher yield loss. Considering the early (and late) growing season, there are only 6 (and 7) out of 15, respectively, of the indices that show this relation. That is to say, drought indices performed well in the middle of the growing season, but not so well in the early or late parts of the growing season. Second, only two indices (SPI-3 and SPEI-6) showed good matches at all times, while four indices (PDSI, SPI-1, SPEI-9 and SPEI-12) had either one or no match and the remainder of the indices had two matches with yield loss. Third, it was found that higher drought severity is only loosely correlated to lower yield unless the cumulative impacts are being considered, as in the case of PADI. However, limited by the data size of this experiment, this analysis is only a tentative result and more will be conducted in the future.

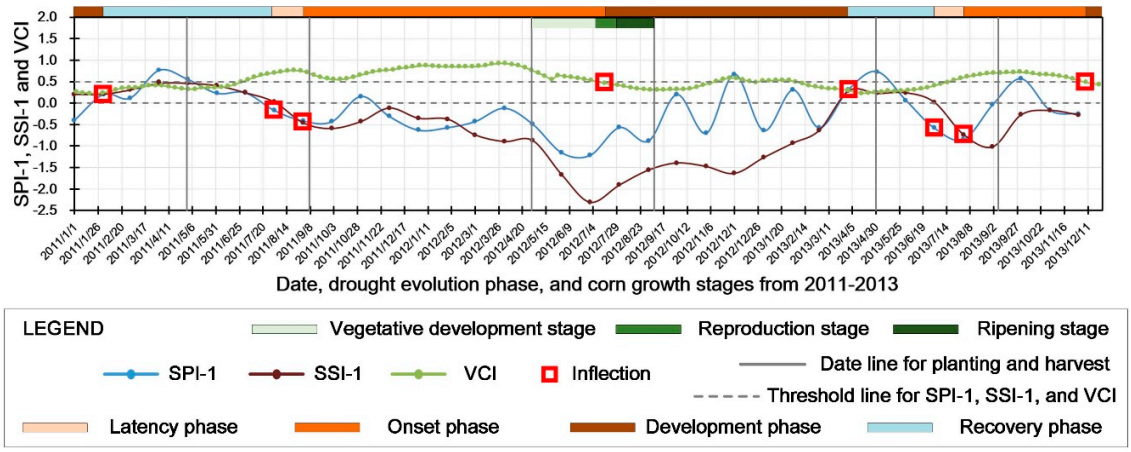

Figure S1. The temporal evolution from 2011 to 2013 of SPI-1, SSI-1, and VCI in the study area from 2011 to 2013 using the EPMC method. Corn growth period with three stages in 2012, threshold, and four drought evolution phases with the inflection time points are marked.

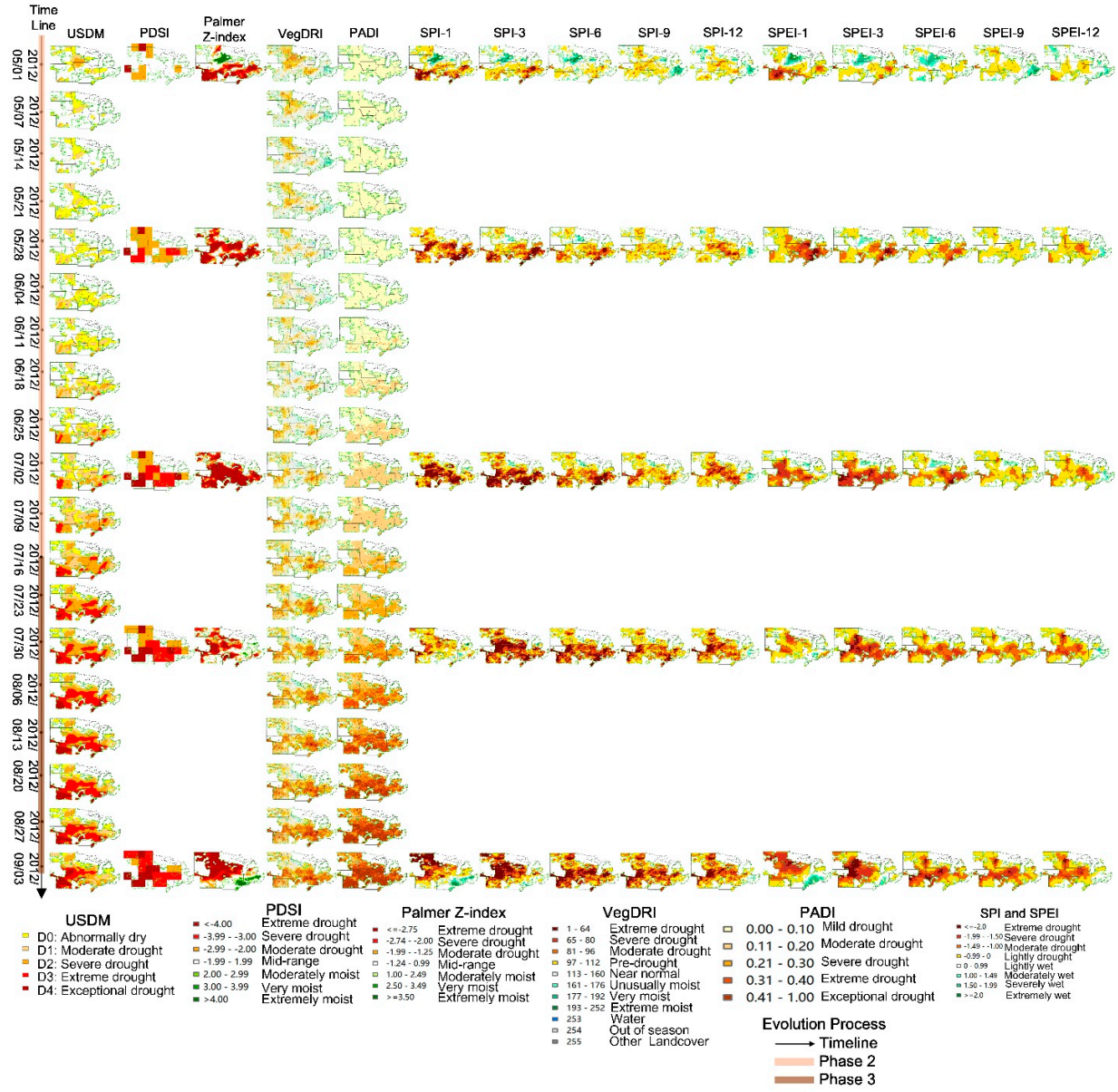

Figure S2. Details of 2012 Midwest US drought evolution spanning from May to September 2012 from perspectives of multi-drought indices, including USDM, PDSI, Palmer Z-index, VegDRI, PADI, 1-12 month SPI, and SPEI.

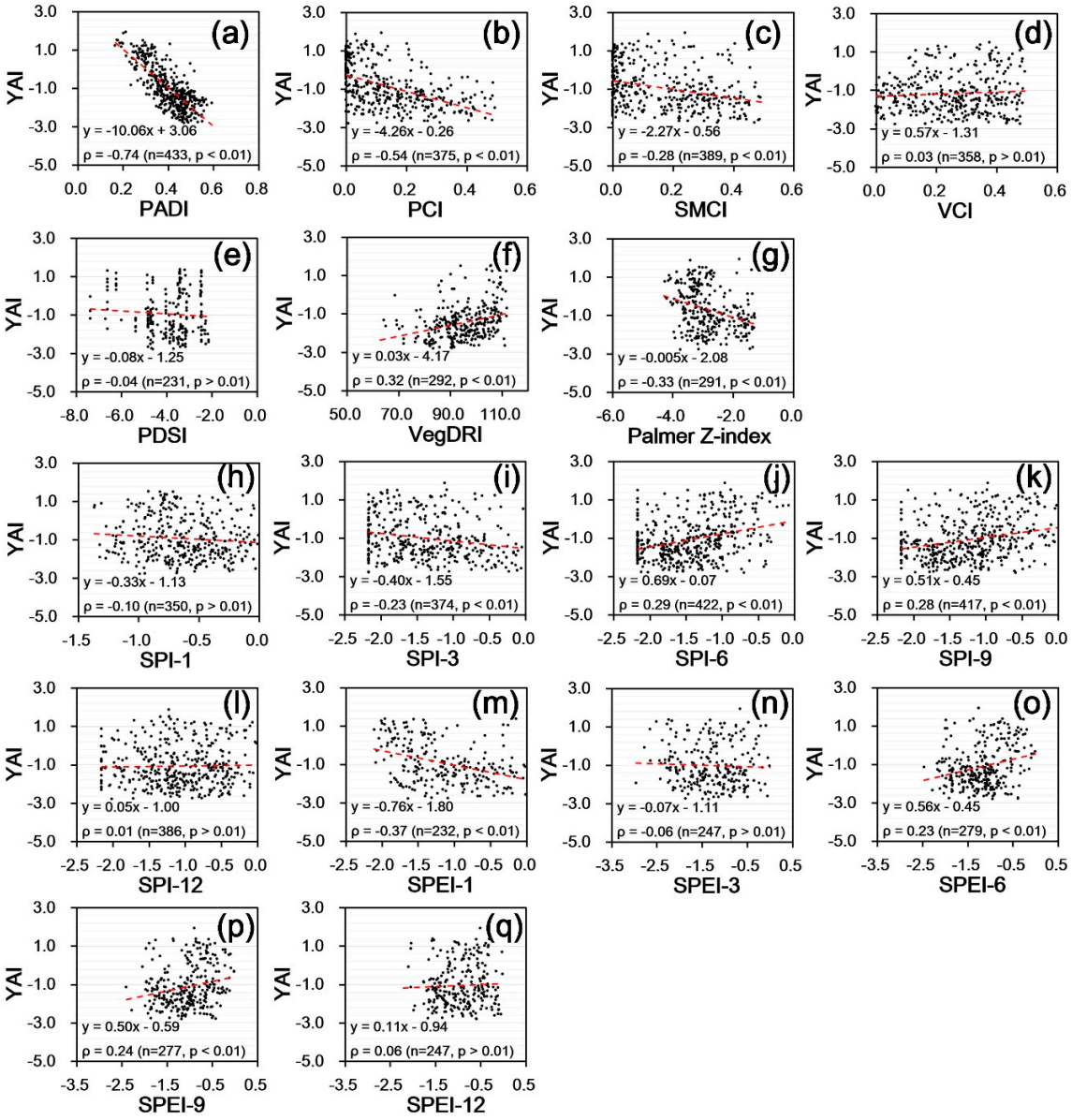

Figure S3. Scattering plot between YAI and nine drought indices (PDAI, PCI, SMCI, VCI, PDSI, VegDRI, Palmer Z-index, SPIs (SPI-1, -3, -6, -9, and -12) and SPEIs (SPEI-1, -3, -6, -9, and -12)) based on all counties in the study area. Linear regression line and Spearman's rank correlation value were given as well. Only drought condition was considered here, which means only pixel with lower value than indices thresholds (for example negative value for SPI and -2.00 for PDSI) were plotted in these panels.

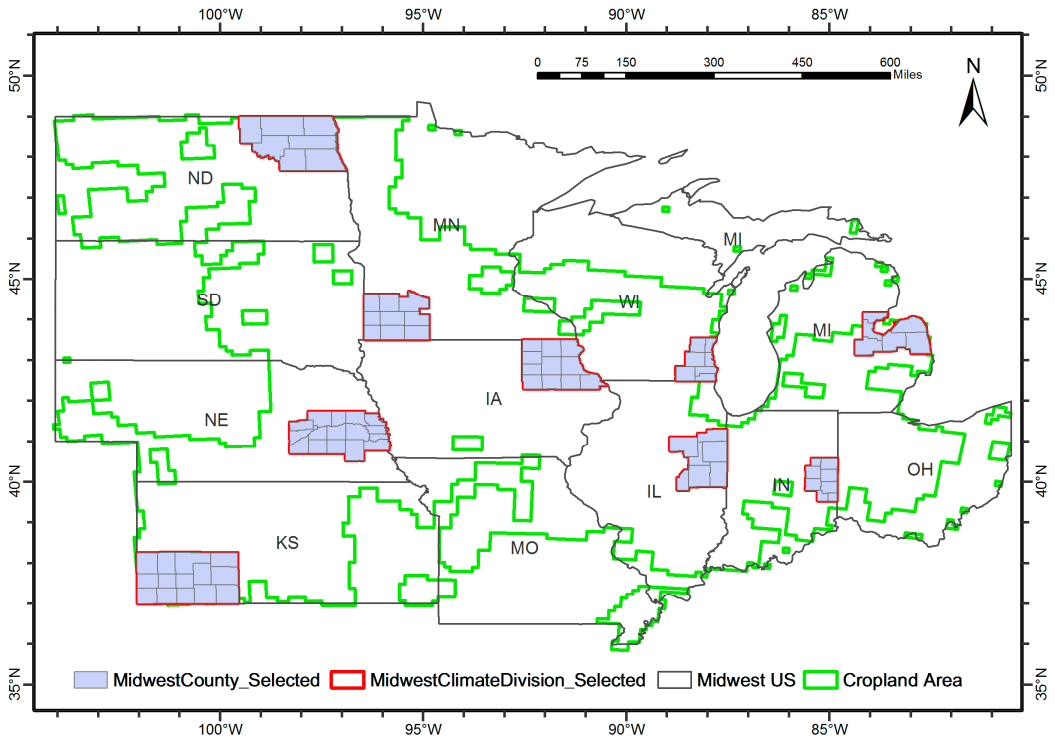

Figure S4. Selected nine climate divisions in the study area for testing the relationship between drought category and yield loss. The yield loss in each division was averaged by the county yield loss in it. The distribution of these divisions is relatively even in the study area to ensure representativeness.

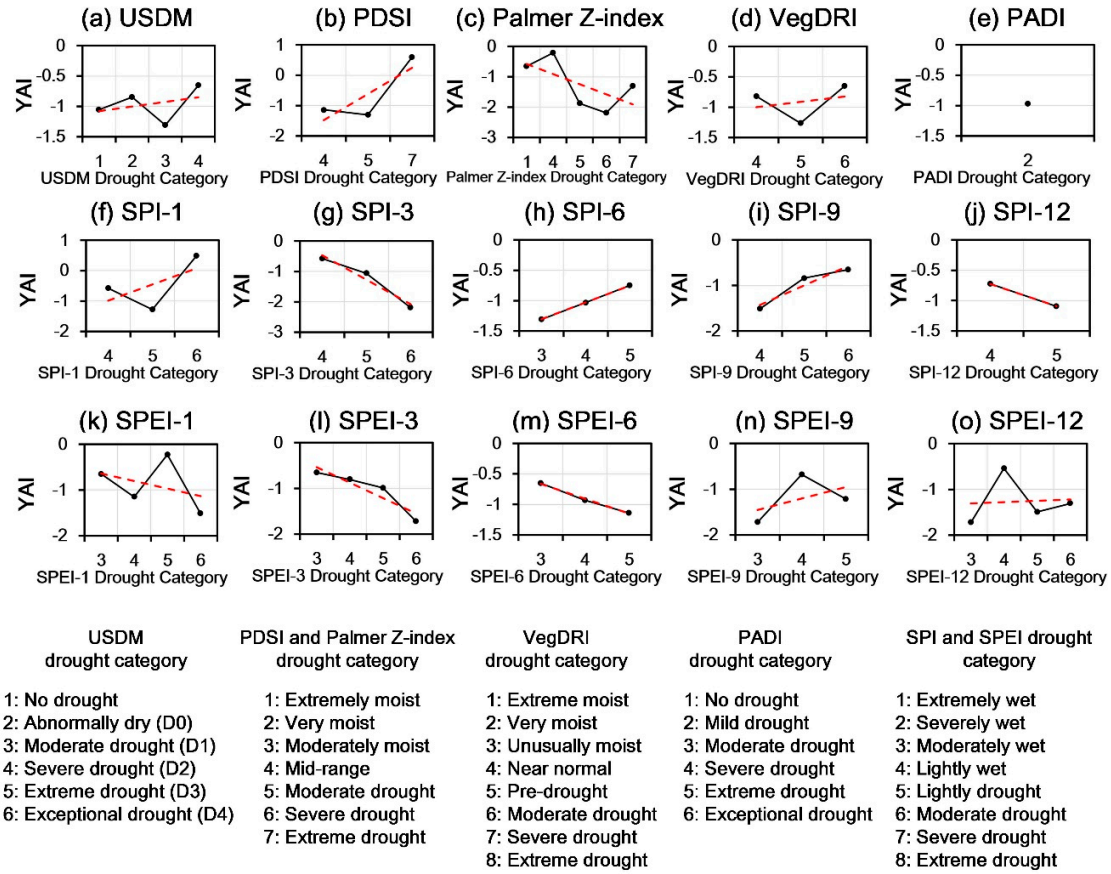

Figure S5. Drought category and corresponding yield anomaly index of USDM, PDSI, Palmer Z-index, VegDRI, PADI, SPIs, and SPEIs with YAI in the early growth season (May).

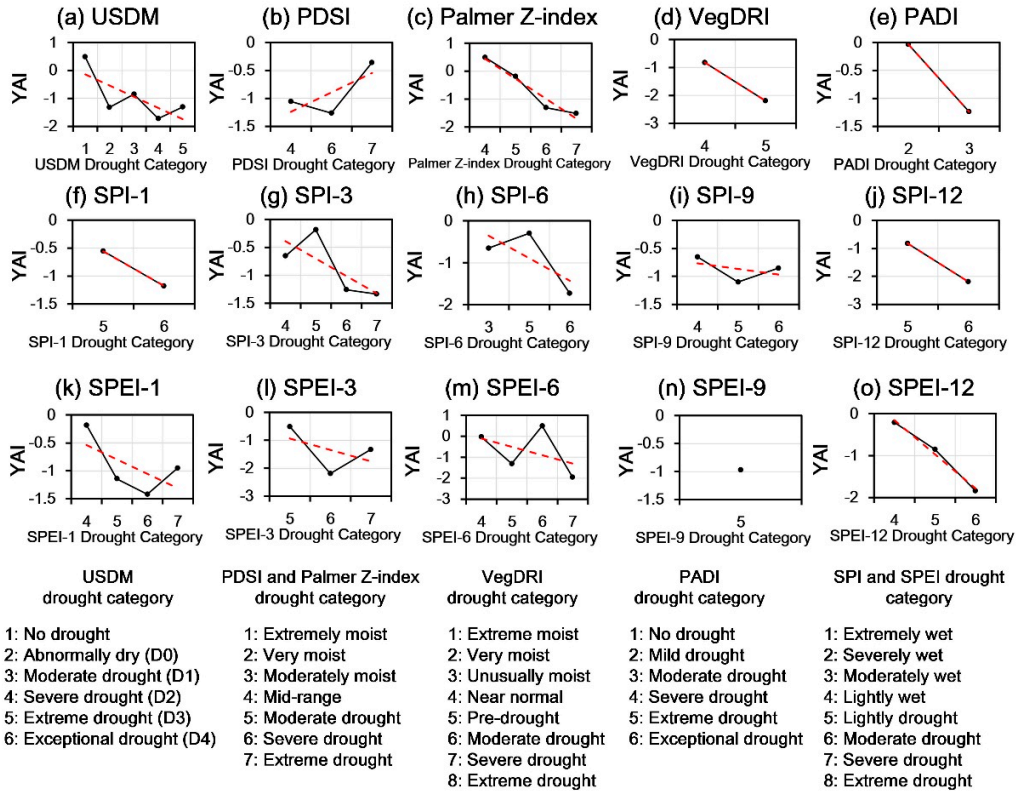

Figure S6. Same as Figure S5, except in the middle growth season (July).

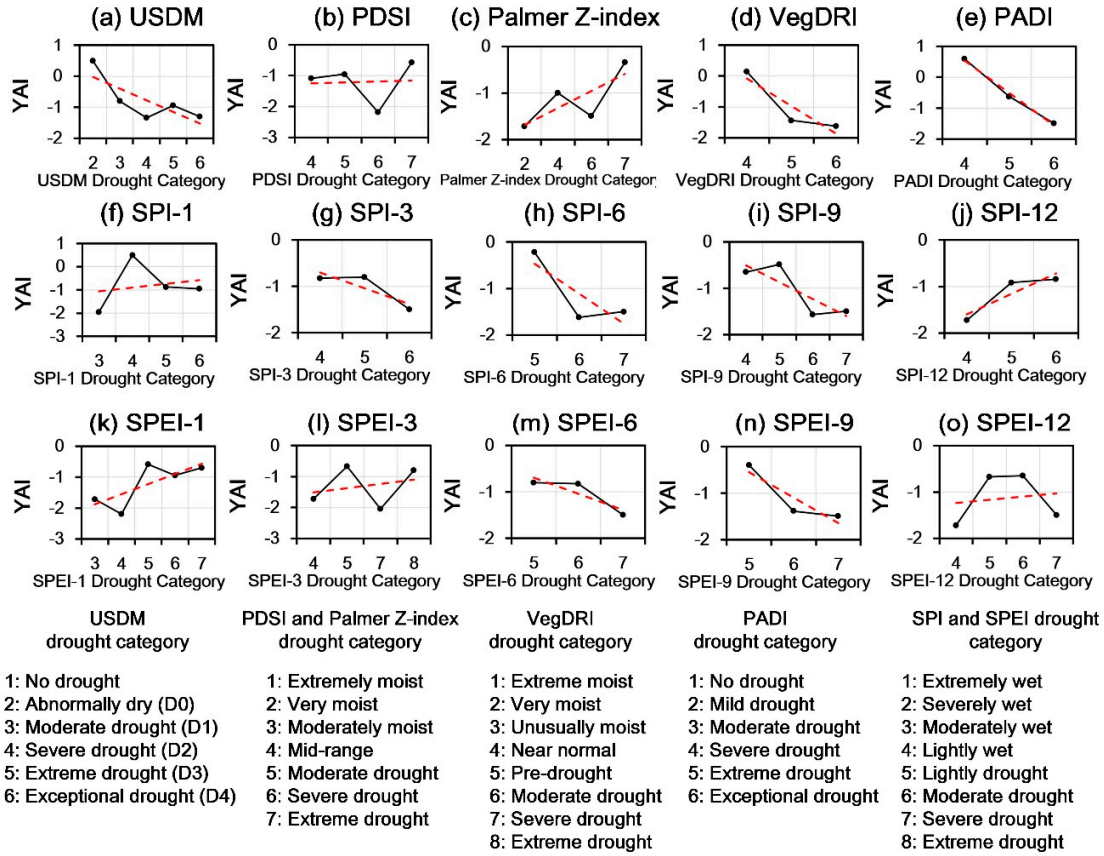

Figure S7. Same as Figure S5, except in the late growth season (September)