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Interactive comment on "Exploring seasonal and regional relationships between the Evaporative Stress Index and surface weather and soil moisture anomalies across the United States" *by* J. A. Otkin et al.

J. A. Otkin et al.

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Thank you for your constructive and timely review.

Comments:

1. My biggest concern is failure to acknowledge EDDI in this study. In particular, EDDI part II (McEvoy et al. 2016). This analysis essentially repeats that analysis and finds many of the same conclusions without reference to the paper. Figures 1 and 2 are basically the same as Figures 1 and 4 in McEvoy et al. (2016). Figure 4 in McEvoy

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et al. (2016) actually directly compares ESI with E0 (EDDI). Figures 4-6 are also very similar to Figure 3 in McEvoy et al. (2016) regarding the regional analysis and many of the same conclusions are found regarding poor correlations in the northeast. The main reason this is all so concerning is that the authors state many times that E0 is driving ET and ESI yet fail to recognize recent literature that has already show very similar results. This paper should be framed as building upon other work that has done similar exercises. With that said, the results in this manuscript do add nice additional insight around the individual monthly correlations rather than the seasonal means used in McEvoy et al. (2016), and around some of the individual drivers of E0. McEvoy, D. J., Huntington, J. L., Hobbins, M. T., Wood, A., Morton, C., Anderson, M., & Hain, C. (2016). The evaporative demand drought index. Part II: CONUS-wide assessment against common drought indicators. Journal of Hydrometeorology, 17(6), 1763-1779.

Our response: We apologize for not including this important reference in the original manuscript. We now mention this paper in the last paragraph of the introduction and have added a new paragraph to the conclusions section that compares results from both studies.

2. The other key reference missing is regarding sensitivity of E0 to the individual drivers over CONUS. Hobbins (2016) describes this nicely. The dominant drivers of E0 are different depending on region and season. And, a key point of Hobbins (2016) finds that temperature is not the dominant driver for many regions. This is likely having a big influence on the how ESI (with E0 as one part of the ratio) is correlating to the different drivers. There should be some discussion around this reference. Hobbins, M. T. (2016). The variability of ASCE standardized reference evapotranspi- ration: A rigorous, CONUS-wide decomposition and attribution. Transactions of the ASABE, 59(2), 561-576.

Our response: We apologize for not including this important reference in the original manuscript. It is now properly referenced in the last paragraph of the introduction as well as in the conclusions section in the revised manuscript. It is also mentioned in

Section 3.2 when providing justification for the analysis regions used during this study.

3. How was CFSR chosen as the data set to be used in the analysis? Were any other data sets tested? I would think, at least for temperature and humidity, that other finer scale station-based data sets would be better. My first thoughts for other choices would be PRISM or gridMET (http://www.climatologylab.org/gridmet.html). For wind and solar a regridded CFSR would probably be just fine. Can you provide any justification (in the manuscript or response to review) for choice of data?

Our response: We chose to use the CFSR atmospheric dataset for this project because it is the dataset used by the ALEXI model. No other datasets were tested; however, it is anticipated that the correlations will have similar patterns if other datasets were used.

4. The standardization of different variables appears to have all been done using different periods of record. SPI: 1948-2015, ESI: 2001-2015, NLDAS: 1979-2015, CFSR: 1979-2015. I would think using the 2001-2015 period for all variables (standardization, not just comparisons) would provide the most robust comparison. Levels of wet and dryness will not be comparable using different time periods. Can you justify the reasoning for using different periods of record?

Our response: We agree that the use of different periods of records for the datasets introduces some uncertainty to the absolute magnitude of the correlations; however, we feel that this approach is justified because it is consistent with prior studies by the authors. One of the main motivations is that it takes at least a 30-year record to compute realistic SPI anomalies. Because the ESI dataset only covers a 15-year period, this means that we would be forced to use different periods of record for these datasets anyway, which makes it more attractive to simply use the full period of records for each dataset.

5. How were the regions in Figure 3 defined? Seems very arbitrary. Something like the NCEI climate regions would probably be better. Please provide more detail on how/why these specific regions were used.

Our response: Several sentences were added to the first paragraph in the regional correlation analysis section that provide justification for these regions: These regions were chosen based on geography, climate, and inspection of the spatial patterns in the correlations found in Figs. 1 and 2. In particular, the central U.S. regions encompass the meridional gradient between more arid climates to the west and more humid climates to the east (Seager et al. 2018). This area was further separated into south-central and north-central regions to highlight the stronger correlations over the south-central U.S. and to account for large regional differences in the variance of the atmospheric drivers of reference ET noted by Hobbins (2016). Likewise, remaining areas were simply grouped into western and eastern regions that generally encompass more arid and more humid climates, respectively.

6. The method for the correlation analysis is a bit unclear. Please add a summary of 1-2 sentences about the sample size for the time series at each grid point. This is the part that is not clear to me. For a given grid point and month, would there be 15 years x 4 weekly values (n=60)?

Our response: A sentence was added to the first paragraph of the monthly correlation analysis section that states: “This means that the sample size (n) for each grid point is equal to 60 or 75 depending upon whether a given month contains the end dates for four or five of these 4-week periods.”

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