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Discussions
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Interactive comment on "Reliability of meteorological drought indices for predicting soil moisture droughts" *by* D. Halwatura et al.

D. Halwatura et al.

d.halwatura@uq.edu.au

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We would like to thank the Anonymous Referee #2 for this review and the constructive comments. We appreciate the reviewers' positive comments on the significance of our work "in agriculture drought monitoring in places without adequate soil moisture observations". We have addressed the referee's comments as follows:

Comment 1: As the key idea about the research is testing the ability of meteorological drought indices in predicting soil drought. Why only use soil water pressure to quantify the 'soil moisture droughts'? I suggest the author should use the observed soil moisture to test the capability of these drought indices. You may not use the SM data of all layers studied, at least the average condition of SM and its correlation with the drought indices should be revealed. Comment 2: As agricultural drought or eco-drought are

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usually measured by soil moisture. The relationship between soil moisture and soil water pressure used in current research should be further studied in the 3 stations.

Response 1 & 2: We use soil water pressure over soil moisture as this allows us to examine potential water fluxes between plant roots and the soil water storage. Only water pressure provides the relevant information to assess water availability for plants, which is required for estimating agricultural droughts. The unique relationship between soil water pressure and soil moisture is described by the water retention curve (Table 2 in manuscript). Implicitly, water retention characteristics are usually fundamental to soil moisture based indices such as the soil water deficit index (Martínez-Fernández et al., 2015). As the soil water retention curve is monotonic, we have no reason to believe that the use of soil moisture over soil water pressure would affect our findings on the false alarm (FAR) and failure rate (FR). However, we acknowledge the role of soil moisture defining the total store of water and provide the web plots of correlations between soil moisture and drought indices (Fig. 1 below), as well as the corresponding simulated time series (Fig. 2 below). We do not propose to include these Figures in the paper, but we thought useful to show these for the review process.

Comment 3: I suggest the author also analyze the effect of drought timescale on soil moisture. You may analyze more on soil moisture and drought with changing timescales e.g.1-12months.

Response 3: “The SPI and RDI were calculated using climate inputs averaged over one, three and twelve month time periods. However for the sake of simplicity and to keep the paper length reasonable we present only the results based on the three month time period” (manuscript P3L25). The correlation was most significant at the 3-monthly timescale and qualitatively the same across all timescales (Figure 3, not included in paper).

Comment 4: In addition to model parameter setting, the input of the model including the climatic data should be clarified to enhance the comparison between model output

and the drought indices calculated from precipitation/PET.

Response 4: Without further details we don't know what further information is requested by the referee other than Tables 1 and 2 in the manuscript.

Comment 5: In discussion, the author mentioned that 'our results point to the simplest being the best'. Such kind of expression should be very careful as the study only analyses SPI and RDI. Actually there are many effective drought indices with precipitation and PET, e.g. SPEI. The author can read more literatures on this.

Response 5: We agree with the reviewer here and will expand our discussion on the capability of simple drought indices to detect soil moisture droughts and explicitly consider the references provided by Reviewers #1 and #3.

References

Martínez-Fernández, J., González-Zamora, A., Sánchez, N., Gumuzzio, A., 2015. A soil water based index as a suitable agricultural drought indicator. Journal of Hydrology 522 265-273.

Please also note the supplement to this comment:
http://www.hydrol-earth-syst-sci-discuss.net/hess-2016-467/hess-2016-467-AC3-supplement.pdf

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., doi:10.5194/hess-2016-467, 2016.

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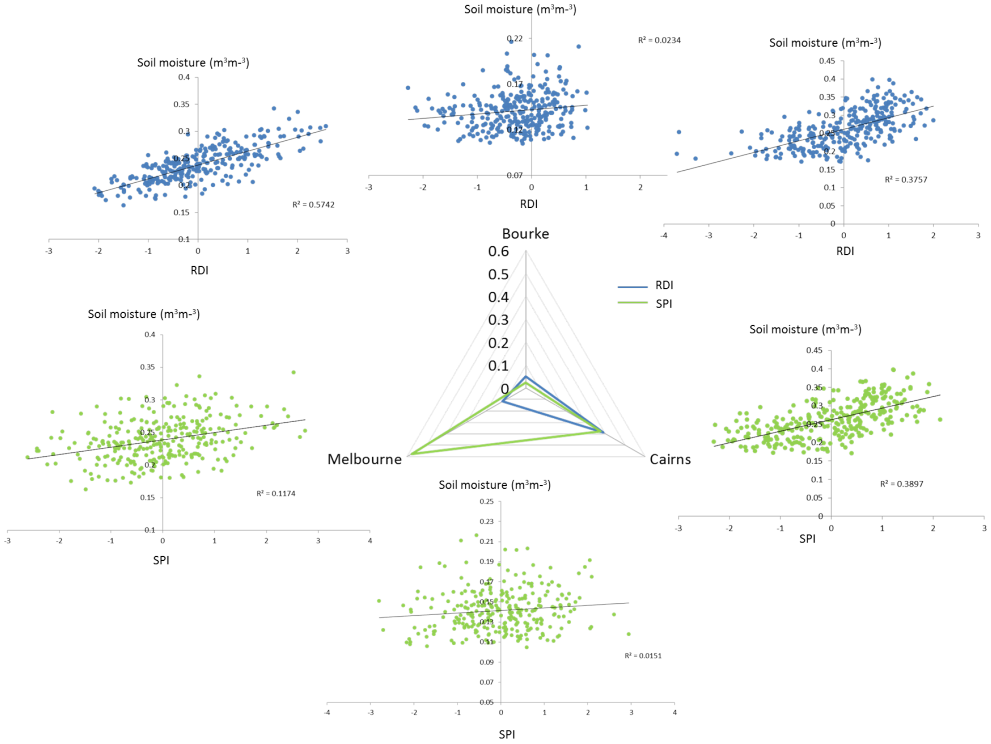

Fig. 1. Correlations between simulated monthly minimum soil moisture in 5 cm soil depth vs SPI and RDI. The scatter plots represent the correlation for each location.

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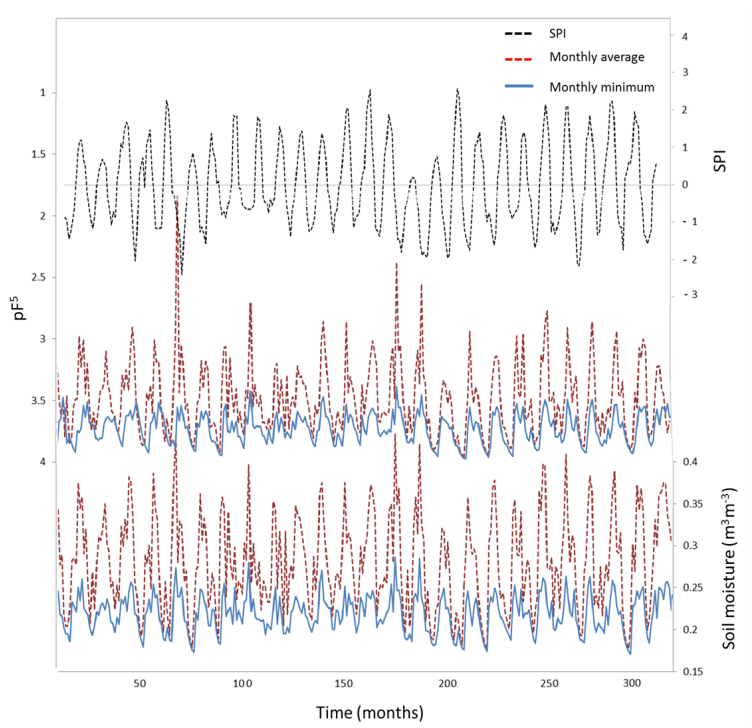

Figure 2.1: Time series of the SPI, the simulated monthly minimum soil water pressure and monthly average soil water pressure, and the monthly minimum soil moisture and monthly average soil moisture in 5 cm depth in Cairns. Note: average and minimum soil moistures are also included to this figure aligned with the reviewer #3 comments.

Fig. 2.

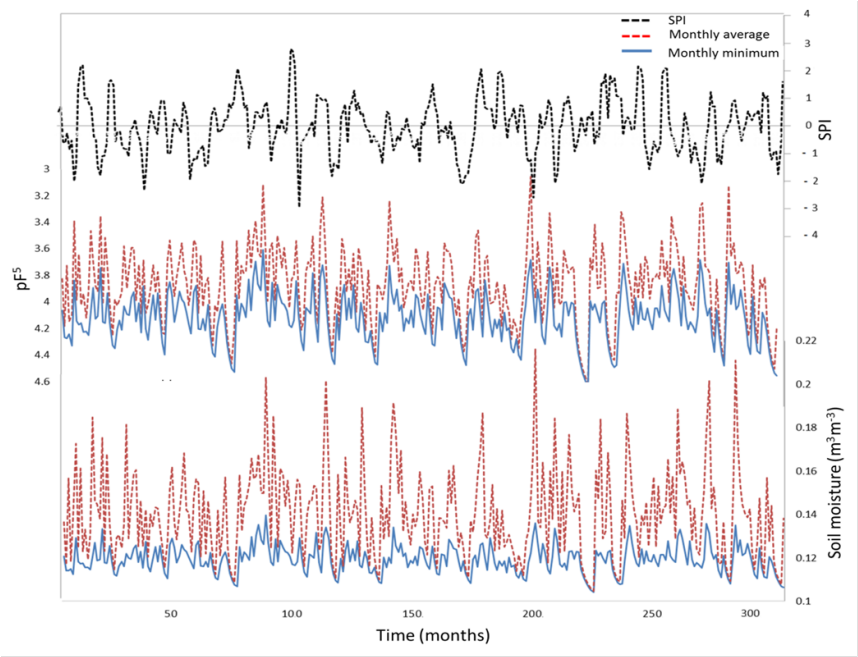

Figure 2.2: Time series of the SPI, the simulated monthly minimum soil water pressure and monthly average soil water pressure, and the monthly minimum soil moisture and monthly average soil moisture in 5 cm depth in Bourke. Note: average and minimum soil moistures are also included to this figure aligned with the reviewer #3 comments.

Fig. 3.

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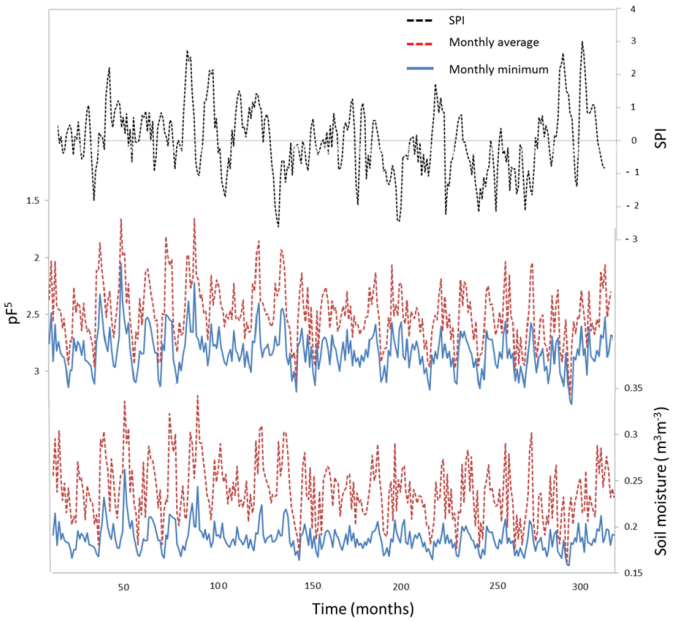

Figure 2.3: Time series of the SPI, the simulated monthly minimum soil water pressure and monthly average soil water pressure, and the monthly minimum soil moisture and monthly average soil moisture in 5 cm depth in Melbourne. Note: average and minimum soil moistures are also included to this figure aligned with the reviewer #3 comments.

Fig. 4.

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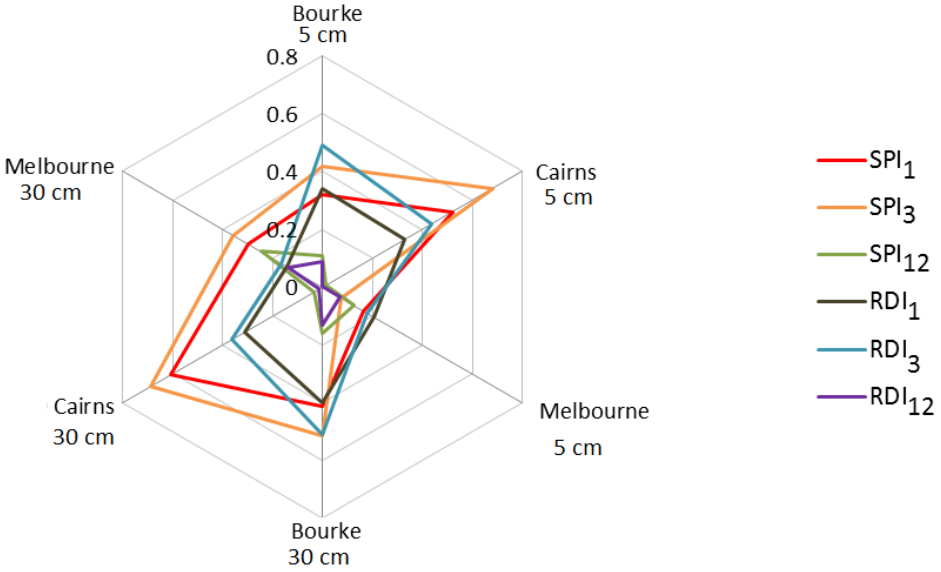

Fig. 5. Correlations between simulated monthly minimum soil water pressure (pF) vs SPI and RDI for 5 cm and 30 cm soil depth at a 1-, 3- and 12-monthly timescale, respectively.

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