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Hydrology and Earth System Sciences
Discussions

# *Interactive comment on* "Ambiguous agricultural drought: characterising soil moisture and vegetation droughts in Europe from earth observation" *by* Theresa C. van Hateren et al.

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The paper describes an investigation into the effect of soil moisture on agricultural droughts. It argues for a distinction between soil moisture drought and anomalies in vegetation as different responses of vegetation to soil moisture anomalies are observed. Using monthly standardized CCI SM and NDVI anomalies the correlation and skill scores between SM and NDVI are calculated for major European drought events. The analysis shows that depending on the soil moisture availability, i.e. water limited regions or other regions, SM and NDVI are stronger or weaker correlated and SM is a stronger or weaker predictor for NDVI anomalies.

I have difficulties to see the novelty of this research and I also have some issues with



lack of analysis and discussion of results. First of all, the current study seems to confirm results of previous studies using slightly different metrics but does not introduce any new findings. To name a few (and some of these papers are mentioned in the introduction, and there are more studies available): In 2010 Peled et al. published in HESS on the relation between SM, drought indices and NDVI. Stating that in northern areas there is a lower correlation between SM and NDVI, due to the strong influence of temperature on vegetation. In addition, they argue that correlations are stronger when soil moisture stress is higher. Over Australia Chen et al. (2014) have found similar results, demonstrating increasing correlation between satellite-based SM and NDVI with increasing soil moisture stress, both in space and time. One of the most comprehensive studies, from Nicolai-Shaw et al. (2017) showed the difference in vegetation response to drought for different regions, arguing that over regions such as Northern and Central Europe soil moisture deficits are not sufficient to limit ET or vegetation activity as here vegetation is radiation driven. The positive response of vegetation to dry and hot conditions has also been shown by Zscheischler et al. (2015). An overview of studies on interaction between CCI SM and vegetation is also given in Dorigo et al., (2017).

All these previously mentioned studies have already demonstrated the different response of vegetation to soil moisture anomalies. What these studies also all stated is the lagged response of NDVI to SM anomalies, which most commonly was found to be one month. What most of these studies also have addressed is the different response for different land cover types. Chen et al. (2014), Nicolai-Shaw et al. (2017), Peled et al., (2010), Liu et al. (2017), McNally et al., (2016) showed a different response in NDVI to SM anomalies for densely vegetated areas such as forests, compared to less dense vegetated areas such as grass- and croplands. I am missing the analysis on lags and land cover in the current study. As there has been no additional analysis on the lag between SM and NDVI anomalies I am left with the question if not taking into account the lagged response of NDVI can explain the low skill scores? It would be interesting to see how skill scores change with introducing a lag between SM and NDVI. Further-

more, the different land covers in Europe have not been addressed in this study. It is absolutely necessary to include land cover in the discussion of the results, as so many studies have already shown the different response. In Figure 4 it can also be seen that for some droughts the area in drought for SM seems to be preceding NDVI area in drought. This should be explained, and could it be related with the fraction of forest in the total area investigated per drought?

A more technical question on the data is how and if you masked for frozen soils and snow cover? The 2018N area goes up to $\sim$69°N, the 2002 area up to $\sim$66°N. You also use observations starting from April. In these regions there is a possibility that soils will be frozen or snow cover is still there. How did you mask for this? In Figure 4 in the 2002 drought there is a larger drought area in SM than in NDVI. As frozen soils and snow cover can lead to low backscatter and high Tb, this could lead to erroneously low SM values and possibly explain the larger drought area in SM in April and May for the 2002 drought? Another minor question, was the combined, active or passive dataset used?

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