

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

Theresa C. van Hateren et al.

tessa.vanhateren@list.lu

Received and published: 19 February 2021

We thank the referee for his comments on our paper and welcome this lively discussion of the topic agricultural drought.

The referee addresses several issues, which can be summarized as follows. The referee states that this research manuscript could be specified as a discussion/review rather than a research paper. Secondly, he feels that the pitch of the paper does not hold up well, based on 3 issues with our argument throughout the paper. Finally, there are some explanations of the found differences that are not touched upon in the manuscript, which we will address shortly in this reply.

C1

While we disagree with the reviewer about the novelty of the work (in our view at least part of the analysis, namely the skill score part, is novel, but we agree that many others have looked at satellite soil moisture and NDVI from different perspectives), we see the point that the work might as well be presented as an Opinions paper. Indeed part of our goal with this work was to start a debate, but we simply did not consider the option to submit as HESS Opinions. We hope to hear from the other reviewers how they feel about this suggestion.

The second statement of the referee requires a somewhat longer response, which we will provide here. The three issues the referee gives will be addressed separately, as in the review.

1. We are aware that many different definitions for agricultural drought (AD) exist, as well as many different AD indices. The definition we give in our manuscript (“a soil moisture deficit severe enough to hamper vegetation growth”) is based on the knowledge that, although the exact phrasing may differ from author to author, a combination of soil moisture and vegetation is a common denominator. We cited Wilhite and Glantz (1985), who state: “Agricultural drought definitions link various characteristics of meteorological drought to agricultural impacts”, and then continue their review citing earlier studies who define ADs slightly differently, though always relating water status to vegetation state. Similarly, Tallaksen & Van Lanen (2004) provide the definition: “The term agricultural drought is used when soil moisture is insufficient to support crops.” The references the referee provides treat different AD indices, and can be added to a newer version of the manuscript. We would like to stress that the aim of this manuscript was not to add yet another definition of ADs to the vast literature on this topic, as correctly stated by the referee, but rather to clarify to the public that the current definition of ADs can be confusing and that the term should be avoided. In a possible newer version of the manuscript we will make sure to clarify this.

2. The referee states that from our manuscript, it is unclear to him how the current definition of AD is ambiguous. For the conclusion of our paper to come across well,

C2

it is indeed important that said statement is clear. We are sorry to hear that this is currently clearly not the case. Here, we will try to clarify our statement, and will make sure in a possible revision to do the same.

The referee mentions that by stating that “a soil moisture deficit can lead to increased NDVI” we do not undermine the AD definition, as it is possible that we have been looking at soil moisture deficits that were not enough to hamper vegetation growth. That is indeed possible, and in fact this is in line with the many reports highlighting enhanced vegetation growth and ET in regions that experience drought, but where the soil moisture deficits are not low enough below the critical moisture content to cause a negative impact on vegetation and ET (see Jolly et al., 2005, Teuling et al., 2013, Mastrotheodoros et al., 2020). However, the literature is full of examples where agricultural droughts were studied just by analysing either soil moisture data (see our references in our reply to Reviewer 2) or vegetation greenness. In our manuscript we aim to show that inferring vegetation state from soil moisture levels is not always accurate, for instance when low soil moisture levels lead to enhanced vegetation growth, instead of hampered vegetation growth. This is now more clearly illustrated in a revision of Figure 1 in the manuscript (Fig. 1). Moving away from the definition “agricultural drought” towards “soil moisture drought” and “vegetation drought” would avoid any confusion, both for the public and fellow scientists.

3. The third point the referee makes is based around the lag from low soil moisture levels to hampered vegetation. In our reply to R1, we included an analysis of this lag, if the referee is interested to see such results. Secondly, we indeed claim that the “soil moisture deficit is severe enough to hamper vegetation growth” at the end of summer. However, we feel that the referee might have missed the point that we were trying to make here, namely that this is not always the case, and thus that the definition of AD is ambiguous. This is especially problematic when someone uses the term AD to describe soil moisture droughts.

The final point the reviewer makes is that there are some missed opportunities to ex-

C3

plain the differences that we found in our results, and we thank him for pointing us towards relevant literature. We will be sure to touch upon these in a possible revision of our manuscript.

REFERENCES

William M. Jolly et al., ‘Divergent Vegetation Growth Responses to the 2003 Heat Wave in the Swiss Alps’, *Geophysical Research Letters* 32, no. 18 (2005), <https://doi.org/10.1029/2005GL023252>.

Theodoros Mastrotheodoros et al., ‘More Green and Less Blue Water in the Alps during Warmer Summers’, *Nature Climate Change* 10, no. 2 (2020): 155–61, <https://doi.org/10.1038/s41558-019-0676-5>.

Lena M. Tallaksen and Henny A. J. van Lanen, eds., *Hydrological Drought – 1st Edition*, vol. 84, *Developments in Water Science* (Elsevier, 2004).

Adriaan J. Teuling et al., ‘Evapotranspiration Amplifies European Summer Drought’, *Geophysical Research Letters* 40, no. 10 (2013): 2071–75, <https://doi.org/10.1002/grl.50495>.

Donald A Wilhite and Michael H Glantz, ‘Understanding the Drought Phenomenon: The Role of Definitions’, *WATER INTERNATIONAL* 10, no. 3 (1985): 111–20.

Interactive comment on *Hydrol. Earth Syst. Sci. Discuss.*, <https://doi.org/10.5194/hess-2020-583>, 2020.

C4

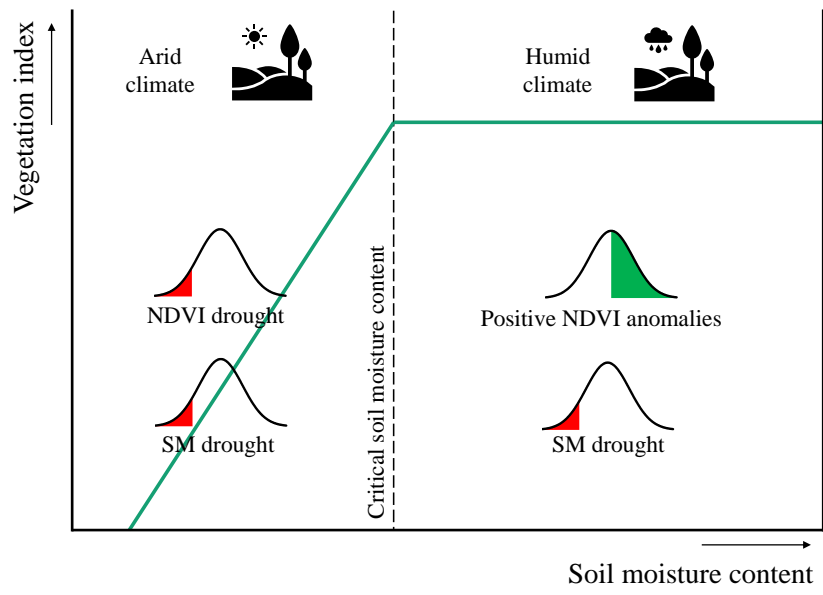


Fig. 1. Illustration that different soil moisture climatologies can potentially mean very different things in terms of vegetation.