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Title: Global Assessment of Socio-Economic Impacts of Subnational Droughts: A Comparative Analysis of Combined Versus Single Drought Indicators

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General comments

This study analyses the propagation of drought hazards to socio-economic impacts using GDIS data, incorporating multiple drought indices and developing a novel CDI. The results indicate that CDI outperforms other indices, underscoring its utility in risk assessment and prioritisation of affected areas. The scope of the study fits well with the journal's theme of the study interactions with human activity, particularly in relation to droughts¹.

Although the paper is well-written and structured, it does present some limitations in addressing the socio-economic aspects under study. Additionally, the results provided are insufficient to definitively support the conclusions. Based on the results presented in this paper, it cannot be definitively stated that the CDI index alone can determine the existence of socio-economic drought. After reviewing the manuscript and based on these comments, I recommend that the manuscript be reconsidered after a **major revision** to address the identified shortcomings.

Specific comments

The work uses the Global Disaster (GDIS) dataset distributed by SEDAC NASA to identify study areas, which are referred to as GDIS drought events. It is considered that the socio-economic variables used by this database to classify the area as affected should be detailed more precisely, since, as indicated in the discussion, vulnerability depends on the degree of development of the country in which it is located, and therefore the characterisation of the socio-economic variables is an important aspect to consider. The introduction should be expanded to include a detailed description of the socio-economic aspects related to drought and present the state of the art in this field.

This study exclusively utilises climatic variables, such as rainfall and temperature, along with indices like soil moisture and the vegetation index NDVI, without incorporating socio-economic variables. It is important to explain why these variables are not included in characterising drought events.

Given the global scope of this work, only climatological and vegetation predictors are utilised, without considering any socio-economic factors. An important question arises: Are there regions where the proposed index identifies periods of drought that are not recorded as such by the GDIS database? Figure 5 illustrates that certain areas experiencing extreme drought are not within any GDIS polygons. Additionally, it is noteworthy that Figure 5 does not include any European countries.

In section 2.3 it is indicated that soil moisture is obtained using a weighting for each of the strata; however, it is not detailed how it is obtained, and the way in which this is done should be explained, since it is one of the variables used to characterise the combined drought index, and as shown in the weights in Figure 4, this variable is quite important in the determination of this combined factor.

Section 2.5 states that '*we assumed January as the starting month and December as the end month of the respective event, and further analysis was carried out*'. Taking into account that the hydrological year in many databases is from October to September, it

would be important to know what percentage of the data used assume an unknown period, and to analyse the sensitivity of the results obtained to a possible alteration of the hydrological year.

Regarding the results section, the results are presented in absolute terms by quantifying the number of detected and undetected events, which makes them difficult to understand. The quantification of the accuracy of the proposed methodology should be done using specific metrics obtained from a confusion matrix, detailing: Accuracy, Precision, recall, specificity, F1-score, AUC, etc. This will allow the discussion section to be completed by comparing similar metrics from previous work.

From the visual analysis of Figure 7, it cannot be concluded that the combined index is clearly better than the individual indices, as indicated in line 525 as the results represented in that figure the combined index performs almost as well as the NDVI and in some cases slightly worse.

The analysis of the accuracy of the different indices could be completed with information on the socio-economic characteristics of each region as well as the typology of land cover in the region analysed, the accuracy metrics according to these variables in order to be able to conclude in a quantifiable way under which conditions one index performs better than another.

From line 470 to Figure 9, the purpose of testing the correlation between the combined index and the indices should be clarified. Considering that the combined index has been obtained from a principal component analysis of these variables, it is logical that it is correlated with the different parameters according to the weighting weights, it should be clarified what the purpose of this analysis is.

As mentioned above, there are conclusions that are not justified by the results presented. Lines 593 to 595, The following is stated: '*This novel index surpassed the performance of four commonly used single-parameter-based traditional indices, demonstrating superior accuracy in identifying GDIS droughts and effectively representing their socio-economic impacts*'. However, as mentioned above, this conclusion is not supported by the information and results presented in this work.

Lines 599 to 600: The following is stated: '*CDI-derived drought clusters exhibit a statistically significant representation of GDIS drought events (indicative of socio-economic impacts), with 95% of the GDIS events successfully identified using the CDI*'. However, to support this assertion, it is necessary to consider the full set of metrics from the confusion matrix. While the index may identify GDIS-catalogued drought events, it could also detect other drought events that do not necessarily have socio-economic effects. Based on the results presented in this paper, it cannot be conclusively stated that the CDI index alone can determine the existence of socio-economic drought.

Technical corrections

It should be clarified whether the ranges in Figure 3 correspond to the classification set out in Figure 1, and if so, the nomenclature should be homogenised.

Figure 7 has very low resolution, however, as it is proposed to replace the figure with a display of the results in terms of the metrics of the confusion matrix, I understand that this figure will be replaced in its new format.