

Title: Assessment of centennial (1918—2019) drought features in the Campania region by historical in situ measurements

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MS No.: nhess-2021-41

MS type: Research article: First review

Special Issue: Recent advances in drought and water scarcity monitoring, modelling, and forecasting (EGU2019, session HS4.1.1/NH1.31).

Summary

In this manuscript, the authors explore the Centennial (1918 – 2019) drought features in the Campania, region (southern Italy) by performing a trend analysis using the Modified Mann Kendall test (MMK) and characterize the multi-scale SPI index combining with the Run Theory.

This paper does several things that make it a novel and timely contribution of broad interest to many communities (including the hydrologic, hydro-climatologic, and water resources) and a good fit for NHESS, with its integrative perspective as a journal. The overall context of the subject seems to be appropriate for this journal.

Although the number of regional and continental-scale studies of drought have increased over the last decade, too few exist for many locations in the world to make these results accessible and viable for use by climatologists and water resource professionals. This paper helps ameliorate this issue for a large region of the Mediterranean region (Italy).

A second contribution of this work is that it presents a flexible methodology for others to follow to increase the number of regional to continental scale interpretations of drought for the purposes of water resource management.

Thus, the importance of this paper is that it demonstrates a new method by using the RUN theory approach for exploring, interpreting historical data; and to recognize the feature of droughts such as duration, severity, intensity, and interarrival in order to address water resources and climatic assessments of extreme events such as meteorological droughts for others to follow. The manuscript is also well structured and written. I would suggest to publish the paper after some minor revisions.

General comments

0) To be more concise and precise, I suggest the authors better to add “southern Italy” to the title to be direct to the point and reflect the geographical location of the study area like this: **Assessment of centennial (1918—2019) drought features in the Campania region by historical in situ measurements (southern Italy)**

I) In the abstract, introduction, and the conclusion, respectively the authors stated that:

P.2, line 12-13: " understanding historical drought conditions in this area is necessary to plan mitigation strategies to further face future climate change impacts".

P.3 Line 44-45: "the southern Europe regions indeed, thus historical in-situ long term measurements are crucial for understanding historical drought conditions and to plan mitigation strategies to face future climate change impacts".

P.20, Line 300-301: "The reported research illustrated how historical in-situ long term measurements are crucial for understanding historical drought conditions to plan mitigation strategies to further face future climate change impacts".

I-a) The statements listed also seemed to be redundant in the paper, expressing the same similarities and are not conclusive. I would suggest rephrasing or remove this sentence in one section. It would make it easier to read.

I-b) For instance, How is the statement “The reported research illustrated how historical in-situ long term measurements are crucial for understanding historical drought conditions to plan mitigation strategies to further face future climate change impacts” justified?. However, I suggest to strengthen the study motivation here with more details on the value of historical data or analysis.

II) The SPI indicator at a given location can be calculated for different temporal scales. Here, six-time scales, i.e. 3, 6, 12, 24, 36, and 48-month, were considered. Why? Is 48 months long enough to capture also long-term variability of meteorological drought in the Campania region?

III) As far as I know, the classification of drought is also a challenging task. Therefore, a validation of SPI or another drought indicator is challenging. However, I guess it is not enough to evaluate an indicator without an exhaustive comparison with other indicators (multiscale indicators, SPEI, PDSI, among others). The main criticism of the SPI index is that it only integrates the effect of precipitation on drought, while other driving factors such as air temperature, wind speed, evapotranspiration, and soil moisture are not taken into account. Consequently, the advantage of using "SPI" is a little unclear in your paper. We can understand that the SPI index would give a robust estimate of wet/dry conditions (as described in the paper), however, it is still unclear why SPI index is chosen given its limitations.

Would be helpful to give some more information about the criteria used to select the SPI indicator to explore the drought event. The response to this comment is not mandatory, however, this information would be helpful for the reader's understanding of the characteristics (limitation) of SPI indice.

IV) Statistical tools (Application package software), that authors used in the study are not well defined in the present paper. I encourage the authors to cite them.

Minor revisions

The paper has a few inconsistencies in terms of citation style. Please, check all the citations to make sure that e.g. Authors et al. (2020), (Authors et al., 2020), and so on are used in a consistent way. This will improve the readability of the manuscript! Some examples are listed in **the technical comments (See page 4)**

P.5, L97-107: How many precipitation gauges were used in the whole area to interpolation approach? Please, specify the sources of data in the dataset section (Meteorological offices?).

P.5, Line 95: The map figures (Figure 1) are not up to publication standards. It is hard to read. The caption is unclear. They need to be improved (Fig1, Left panel), resized (Fig1, Left panel), and projected with latitude and longitude coordinates (Right panel: the Italian peninsula).

P.5, Line 95: Based on the caption (Fig 1, Middle panel) the title of the map (Middle panel) should be written in English.

P.9, Line 195: Furthermore, based on the caption of Fig 2, the label of the y axis should be "time". Please, add the label to be more clear.

P.10, Line 210-213: The following paragraph should be integrated with the 2.4 Trend analysis section, not in the Results and discussion section:

"The reason for the use of the Modified Mann-Kendal test (MMK) lays in its accuracy for the analysis of correlated data (Hamed and Rao, 1998; Mondal et al., 2012; Sa'adi et al., 2019), which is the case for the SPI time series in this study, compared to the original Mann-Kendall trend test without any loss of power."

P.8, Line 179; P13, Line 239: The title of the related 2 sections (2.5 Drought characteristics, 3.2 Drought characteristics) is confusing regarding the content. It's a little bit difficult to see the difference between the first title (2.5 Drought characteristics) and the second (3.2 Drought characteristics). It's the same!. Better to re-write this second title to be direct to the point and reflect the objective of the section.

P.15, Line 275-276: The authors stated that: “The SPI₁₂ represented a neutral condition, with a very important spatial variability of peak conditions. It is not clear sentence. The authors should expand their explanation.

P.3, Line 41-46: The same idea is rephrased twice in the section. Consider re-writing this paragraph to avoid repetition and to improve clarity.

Technical comments

A couple of examples of typos that need correction:

P.4, Line 84: The Campania region is located in the southwest of Italy (not in southern Italy) and occupies an area of about 13600 km² (not 14000 km²). Please, check this information.

P.4, Line 86: Replace “2000 m.m.a.s.l “ by “2000 m a.s.l. ” (metres above sea level (m a.s.l).

P.5, Line 105: Cite one spatial resolution is enough (0.09°x0.09° or 10 x 10 km).

P.7, Line145: Should be: “...for non-parametric Modified Mann-Kendall (MMK) and Sen’s test approaches”.

P8, Line 180: Should be: “To describe meteorological drought features of the studied area, the occurrence of drought events was evaluated for each cell of the gridded dataset according to the SPI threshold, and...”.

P.10, Line 209: should be: “The Modified Mann-Kendall (MMK) test and the Sen’s slope estimator were used to investigate temporal trends”

P.10, Line 211: Should be: “Modified Mann-Kendall”.

P.12, Line 231: Should be: “the MMK test”.

P.19, Line 308: Should be: “Modified Mann-Kendall”.

Please, check all the citations to make sure that e.g. Authors et al. (2020), (Authors et al., 2020):

P.3, Line.36;

P.3, Line 36: No entry in the references for (Change, 2014).

P8, Line 169.

P.9, Line 195;

P.9, Line 186;

P.19, Line 309-310;

P.69, Line 69.