

Interactive comment on “Dryness/wetness variations in China during the first 50 years of the 21st century” by J. Q. Zhai et al.

Anonymous Referee #1

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review of ‘Dryness/wetness variations in China during the first 50 years of the 21st century’ by J.Q. Zhai, B. Liu, H. Hartmann, B.D. Su, and K. Fraedrich (MS No.: hess-2008-1006)

The authors report on an analysis of future changes in dryness/wetness in China during the first half of the 21st century. The analysis is based on monthly precipitation data from three emission scenarios forcing the ECHAM5 model, using the Standardized Precipitation Index (SPI) as a metric for droughts or pluvials. The conclusion from this manuscript is that there is a general trend towards drier conditions from Northeast to Southwest China in one particular scenario and that the other two scenarios gives similar results. The paper continues with a discussion of trends towards either drier or wetter conditions in China’s river catchment areas.

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There is a clear need to look into changes of the frequency or severity of droughts and pluvials in China's near future, both from a scientific and a societal viewpoint. Potentially, this paper should make a valuable contribution. However, in my view, the current study fails to deliver.

The two major concerns are that if the authors wish to report on trends in dryness/wetness, then a discussion of the use of the SPI should be part of this paper. The SPI only includes information of precipitation, no account is given to potential changes in (potential) evaporation in this manuscript and the reader is not informed about the importance, or lack thereof, of evaporation for China's hydrologic balance. Alternatively, the focus of the paper should shift from drought/pluvials to variations in precipitation. The second concern relates to the use of the model results. There are three ECHAM5 runs for each of the scenario's available (for one scenario there are four): the authors must make use of all available runs to give an idea of the potential uncertainty of their results. Moreover, the comparison between model results and station records should be more comprehensive and informative. This relates also to the extraordinary attention the behaviour of the SPI receives over China's 10 major river catchment areas for each of the three emission scenarios without a proper validation of the model's merits in simulating these smaller scale phenomena.

There is a third concern related to an error in the analysis method.

Scientific Significance: Good (2)

Scientific Quality: Poor (4)

Presentation Quality: Fair (3)

I would like to advise the editor to accept the paper subject to MAJOR REVISIONS.

Major points

concerning the use of the Standardized Precipitation Index

1. The use of the SPI is never motivated and the focus on the 12-monthly timescale

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(page 1390) is not motivated either.

2. The SPI is based solely on precipitation. In a study on drought, evaporation should be discussed as well - or the title and focus of the study should be changed to "Precipitation variations in China...."

concerning the use and presentation of the model results

1. The ECHAM5/MPI-OM model is one of the best models available for this type of work (although it may have problems when the soils dry out). However, there is no information in the ms. that *all* available scenario runs are used - and this is essential to get a sound understanding of potential future changes in precipitation. For the A2 scenario, 4 runs are available, and for the A1b and B1 scenario, 3 runs are available. These simulations can readily be obtained via the KNMI Climate Explorer (<http://climexp.knmi.nl>). The information in these runs should be used to get an understanding of the variability in one ensemble, en allow the authors to test their derived trends against the spread in the ensemble. These features can all be tested in the Climate Explorer by the way.

This point directly relates to Fig. 5 and its discussion. This figure shows the results for the three greenhouse gas scenarios and there is considerable variation between the simulations. These variations concerns the amplitude of the trend, but - more worryingly - the sign as well! The authors must make clear what part of this signal is robust and what part of the signal is likely to be related to climate variability.

If the authors want to excel, they could use a 17-member ensemble from the ESSENCE project, which is based on the same model and the same greenhouse gas scenarios, but with the added value of a much larger ensemble. These simulations are also available from the KNMI Climate Explorer.

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2. Producing a projection of future changes in precipitation, obviously requires a thorough comparison between model results and observations. This comparison relates directly to the relevance of the conclusions of the study. There are a few comments to be made on this aspect of the study. Annual averaged precipitation of model and observations are compared, the authors should change this to a comparison on a seasonal basis, given the strong seasonality of precipitation over China. Furthermore, the variations in precipitation, averaged over *complete* China, are compared between the observations and the model in fig. 3. The authors claim that the trend in precipitation towards wetter conditions from 1980 onwards is similar between model and observations. The resemblance is not too convincing, but the authors should make their comparison more quantitative. Moreover, if the authors want to present results for the catchment areas for the major Chinese rivers, they should do a similar analysis for each of these catchment areas. The results shown in figs. 6,7 & 8 are only relevant if this analysis is included in the paper.

Other points

- §2.2: The authors may want to expand the explanation of the SPI to include a little more detail, so that readers unfamiliar with this index can understand it too. It is central in the analysis of this study, it should receive the attention it deserves.
- §2.2: The authors may want to spend a little more time on the introduction and use of the Mann-Kendall tests, and refer to standard references like Von Storch (1999) or Wilks (1995) for further explanation.
- §2.2: In my opinion, the use of a spatial interpolation method *after* a selection of areas with a high number of dry month to produce a fully covered grid is plain wrong. There is no need to use this technique at all: you can do the analysis directly. So, for each gridbox, you count the number of months with a SPI value <

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- 1, and on this grid you calculate trends. The method followed in the paper leads to erroneous results.
- Fig. 1: Give the names and numbers of the river basins
- Fig. 2a: put in the 483 stations as dots. Can you give an impression over what time interval these stations have data? Do they all commence in 1961?
- Page 1394: lines 11 & 12; totally unclear what this conclusions means.
- The quality of the English prose in the article can be improved. The Abstract and the Introduction are much better than other sections.

Minor points

- page 1387, line 1: The reference to Narasimha and Srinivasan misses a "n" after Narasimha.
- page 1389, line 26: the use of the word "detect" is erroneous in this context.
- page 1390, line 1: replace the word "grid" with "gridbox"
- page 1390, lines 1/2: replace the sentence with: The number of months with SPI values less than -1 were counted..."
- page 1390, line 3: insert "with" before the word "more"
- page 1390, line 3: define IDW
- page 1390, line 5: replace "At last" with "Finally"
- page 1390, line 6: reformulate this sentence

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- page 1390, line 23: replace "drought" with "dry"
- page 1390, line 23: replace "regarding the" with "using the"
- page 1390, line 24: insert "as drought metric" after SPI
- page 1394, lines 13/14; reformulate this conclusion
- page 1395, line 15; replace "Mckee" with "McKee"
- page 1398: replace "denotes pass" with "passes"
- page 1404: replace "dryness/wetness" in caption with "SPI"
- page 1406: replace "dryness/wetness" in caption with "SPI"
- page 1408: replace "dryness/wetness" in caption with "SPI"

References

- H. von Storch and F. W. Zwiers. *Statistical Analysis in Climate Research*. Cambridge University Press, Cambridge, 1999.
- D. S. Wilks. *Statistical methods in the Atmospheric Sciences*. Academic Press, 1995.

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