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Discussions

Interactive comment on "Impact of two different types of El Niño events on runoff over the conterminous United States" *by* T. Tang et al.

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Note for the authors and editor

The following review was written by a student of the MSc programme Earth and Environment at Wageningen University. As part of the course Integrated Topics in Earth and Environment, students are asked to prepare a review of a scientific paper. The supervisor of this review process is Ryan Teuling. The manuscript by Tang et al. was one of the manuscripts that was selected for this exercise. The review is written as an official review in order to comply with the course guidelines, but it should be considered by the authors as a regular comment which they can use to improve the manuscript. I hope that this comment will positively contribute to the review process and that it will

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help the authors to improve their manuscript for possible publication in HESS.

1 Introduction

The manuscript by Tang, Li, and Sun (2015) looks at the difference in runoff between a central Pacific (CP) El Niño and an eastern Pacific (EP) El Niño event. The EP El Niño has a maximum sea surface temperature anomaly in the eastern Pacific. The maximum sea surface temperature anomaly of a CP El Niño can be found in the region of the central Pacific (Mo, 2010). This separation of the two types has already been used by several researches (Ashok, Behera, Rao, Weng, & Yamagata, 2007; Kao & Yu, 2009; Kug, Jin,& An, 2009). The goal of this manuscript is to understand the different impacts of the two types of El Niño's. Data from gauging stations, have been used in combination with output from a global climate model. The authors decided to use the NCAR-CCSM4 model as it have the highest pattern correlations. From their results, the authors conclude that modelled runoff data are according to the runoff data of gauging station. This is both for the annual runoff anomaly as for the seasonal anomaly. Looking at the spatial variation they concluded that the responses where similar in the some areas of the CONUS. In general CP El Niño events tend to give lower runoff amounts than EP El Niño events. Besides that the authors also found that with global warming the ET would play a more important role in surface runoff. Overall, the study is very interesting. Barsugli and Sardeshmukh (2002) showed that regional precipitation anomalies are depending on the location of the sea surface temperature anomalies. So to look at the different El Niño types influences on runoff gives potentially a better representation of the runoff than when the authors would look at El Niño in general. Yu, Zou, Kim, and Lee (2012) did more or less the same kind of study. They looked at the influences of the two types on for winter temperatures in the United States. There are also studies which looked at the influences of El Niño on (regional) runoff and streamflow (Guetter & Georgakakos, 1996; Kahya & Dracup, 1993; Piechota, Dracup,

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& Fovell, 1997; Twine, Kucharik, & Foley, 2005). However none of them so far has studied the effect on runoff on the regional scale across the CONUS for the two different types. Although that this manuscript is potentially interesting, I have some doubts on parts of the manuscript. I will specify this further on in this review.

The manuscript is well written and well structured. Clear and relevant references are given when needed and the decisions are mostly well motivated. The graphs in the manuscript are clear to understand. This manuscript is really in the scope of Hydrology and Earth System Science journal as it looks at the influences of two large scale weather events on the hydrological runoff, which fits within the scope of the cycling of continental water due to large scale climatology events. I would advise the editor to accept this article after some minor revisions have been made to it. I will give some remarks in the next sections of this review.

2 Major comments

2.1 Significance testing

In the method section the authors mention that a Monte Carlo technique has been used to test the statistical significance. From this sentence alone it is not clear what the authors tested with this Monte Carlo technique. I suggest to be more specific and explain what has been tested. I assume that they have tested if the runoff deviation from zero is significant. However what also should be tested is if the data between the two kinds of El Niño events are significantly different. Before the start of the experiment the authors decided to separate the runoff data for the two El Niño types. What I am wondering at, can those patterns be seen when all those cases are put together. So is it possible to take the opposite approach, and try to separate or identify those two types based on runoff data only? Due to the fact that the authors on forehand decided

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to separate the data it is not strange to find different results for the two types, however those differences are maybe not significant. So if the authors would test this, this can strengthen their results.

2.2 Hypothesis and discussion missing

In line 3 of page 8981 the authors mention their research goals. However there is no hypothesis given in their manuscript. With a well described hypothesis it is easier to write a discussion about the results (Hess, 2004). Although they now and then argue a bit about the results, for example in on page 8984, it is a really good point to mention that the gauge stations are not well distributed over the whole CONUS. However I suggest to also add a paragraph “discussion”. In the discussion the authors can give a more critical look at their own results. For example at their summary at page 8985, I think this is not well enough motivated, given that the amount of points that satisfy the 95% significance criterion in Figure 4e, 4f are low. This is about 10% of their points in Figure 4e (rough estimation). So I am doubting how reliable this conclusion is. To strengthen their research they could discuss that in the section “discussion”.

Something else wat would be interesting to add to this manuscript is comparing of the results with the results of other researches. For example Twine et al. (2005) looked at only one region (Mississippi river basin, in this manuscript region 7) and did not separate the two types of El Niño. In his conclusion they stated that they found a significant seasonal anomaly of streamflow during an El Niño year but no annual anomaly. However when I look at figure 3 of the manuscript of Tang et al. (2015), clear negative anomalies can be seen. Looking at the same type graph for the seasonal anomaly (Figure 5), there is indeed a big variation visible in the anomaly. The seasonal variation is found in bot researches however the annual anomaly is only found in this manuscript. The question that this raises to is, is this difference arise by separating the El Niño types or by the different period which both researches looked at. It is very interesting

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to look at this comparison, but also the other researches can be interesting to compare with the result of this manuscript.

2.3 Research period

Kug et al. (2009) did their research of these two types of El Niño. In their article the CP and EP El Niño are referred to as Warm Pool El Niño and Cold Tongue El Niño, respectively. As they described in their data section, after 1990 most El Niño events that occurred were CP El Niño's. In this research the authors looked at the period of 1999-2009. Which will mean that they find more CP El Niño's than EP El Niño's. This reflects the reason that four CP and only two EP El Niño's have been found in the research period. Because of the limited amount of EP cases, it is better to extend this period before 1990. This will increase the amount of possible cases for especially EP but also for CP El Niño's. As soon as there are more events would have been studied the amount of results that satisfy the 95% significance criterion can increase.

2.4 Goal of the research

The goal of this research was to understand the different impacts of the El Niño types. After reading this manuscript, I wonder if this was the right goal. It is mainly shown what the different impacts are, but little is shown that increases the understanding of the impacts. Several maps with spatial distributions have been showed but there is no explanation given why runoff anomaly in a certain area higher is than in an another area. For example, in the conclusion is given that the runoff anomalies for the two types of El Niño are the same in Western coastal regions. However in North eastern part the runoff anomalies are different for both types. So I would suggest to change the goal or revise the conclusion to come with an explanation. For example Orographic effects can be a reason why there is regional difference in runoff. Orographic effects in

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the CONUS area (e.g. Rocky Mountains) influences the perception anomalies during an El Niño event (Kahya & Dracup, 1993). This might partly explain the difference in regional runoff anomalies over this area.

3 Minor comments

- In the introduction I already mentioned that the authors decided to choose the Atmospheric Research Community Climate System Model version 4 (NCAR-CCSM4) because it has the highest correlation. This model takes ocean, atmosphere, land and ice components and their interactions into account (Capotondi, 2013; Gent et al., 2011). I think it is good that they decided to really look at which model is the most suitable for this research. This is of course better than choose a model which the authors are familiar with or which is easy to use. So they decided well to choose the NCAR-CCSM4 model.
- In the methods section the authors are saying that there are four CP El Niño events and two EP El Niño events according to Table 1 of Yu et al. (2012). However when I take a look at that table I see only 4 cases during the study period (2002-03, 2004-05, 2006-07, 2009-10). So I suggest to add a table as overview of the cases that have been used in this manuscript, because they are not mentioned in the table of Yu et al. (2012).
- A short summarization of models which have been used in this research is given, I think it is well described why they have chosen those models. However I would like to see also a short explanation of the models. What kind of models are it and what kind of variables are needed for the model.

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4 Specific comments

- Page 8979 Line 21, this the first time that ENSO is mentioned. I would also mention that this stands for “El Niño Southern Oscillation”.
- Page 8980 line 1 to 3, in this sentence it is given that El Niño is the dominant mode of climate variability. I would suggest to add a reference to it. For example Van Oldenborgh, Philip, and Collins (2005).
- Page 8981 line 24, mention that ERA-Interim a global atmospheric reanalysis is.
- Page 8982 line 20, replace ‘(SSTAs)’ by ‘(SSTA)’ as further in the manuscript always SSTA has been used.
- Page 8983 line 8, the absolute value which belongs to the -11% is missing, I think it is good to mention this value too.
- Page 8985 line 5, it is not really clear what the percentages in this line means.
- Table 1, add in the caption where CP and EP stand for.

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