Hydrol. Earth Syst. Sci. Discuss., 12, C4457–C4464, 2015
www.hydrol-earth-syst-sci-discuss.net/12/C4457/2015/

Hydrology and Earth System Sciences
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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.

BSc. van Tilburg

remo.vantilburg@wur.nl

Received and published: 26 October 2015

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

Introduction

In this study the goal is to understand runoff variability in the conterminous United States (CONUS) during two types of El Niño, Central pacific (CP) and Eastern Pacific (EP) determined by the location of the centre of the Sea Surface Temperature (SST) anomaly. When the SST anomaly centre is located in the eastern equatorial Pacific or central Pacific, the El Niño event is classified as an EP or CP respectively. Each type has it's own characteristics of structure, evolution and teleconnection (Kao and Yu, 2009; Yeh et al., 2009).
El Niño causes large hydrologic extremes in different regions, for example droughts in one area and simultaneously heavy precipitation in others. Coping with disasters in several regions simultaneously is challenging (IPCC, 2012). Also, in the United States large hydrologic extremes are experienced during an El Niño event (Cayan et al., 1999; Piechota and Dracup, 1996). Historical streamflow data is collected and compiled to get data that represents watersheds, which are minimally influenced by human activities. Ten years of data was available in which four CP-El Niño and two EP-El Niño events are occurring. Additionally, P and ET anomalies are also obtained. To improve the robustness of these observations eight models participating in the Coupled Model Intercomparison Project Phase 5 (CMIP5) are employed. Results of observations and model show a surface runoff corresponding to the different types of El Niño.

The paper is well written and has a clear structure. Almost every method has been well motivated and referred. Though, there aren't any fundamental new methods used. Primarily, only data that has been studied before has been used here. There is not any study performed yet about the runoff for the two types of El Niño in the conterminous United States. Some studies have investigated the relation between El Niño and runoff before, but these don't distinguish between different El Niño events or are for one catchment only (Chavasse and Seoane, 2008; Gelati et al., 2010; Yoon et al., 2013; Kahya and Dracup, 1994). Also, this study will contribute to further understand climate change and the corresponding hydrological extremes.

Personally I think this paper should be accepted, it contributes very well to the hydrologic community due to the fact that limited information is available on this topic. Also, it has a clear structure, is well motivated and has proper results. This study will contribute to further understand climate change and the corresponding hydrological extremes. Though, some minor issues should be revised.

General Comments

1. According to the section 2.2 Methods (P8982) four CP-El Niño and two EP-El Niño events have occurred during the research period. These events are then investigated on anomalies. Though, there is only tested on values different than zero for all measurement stations during these events. As far as I understand, these values are then averaged and presented in figures 2,4,6 and 7. This can give false insights and might change the outcome of this research. Because, when you average over multiple events one large anomaly can change the outcome. On top of this, it is mentioned that a Monte Carlo technique has been applied in order to test statistical significance. Though, this is mentioned without any motivation. This can cause question marks as readers want to know why this is performed and how. I suggest therefor elaborating this and perhaps making a figure to explain this more in detail, as this part is the core of the

research.

2. It is not clear why the use of the Evapotranspiration data (ERA-Interim), obtained from the European Centre for Medium-Range Weather Forecasts (ECMWF) is chosen. No motivation is given and the only reference given is to the paper of Dee (2011), which only describes the performance compared to the older ERA-40. When searching for the accuracy of this data set, some papers suggest that the ET values of ERA-Interim are overestimated (Mueller et al., 2011; Vinukollu et al., 2011). When using wrong ET data, calculations will give false results and figure 7 might be incorrect. Also, as the ET data is used to calculate runoff these values will also be incorrect. Therefor, I miss the motivation of the choice of the ERA-Interim for this paper and there might be better ET data available according to the papers. On top of this, a proper discussion about potentially false input data is missing and should be included.

3. A study regarding determination of an El Niño by investigating only runoff patterns can be included to improve the quality of this paper. At this moment, an El Niño event is determined in advance and with this point of view, runoff patterns correlated to a type of El Niño are investigated. Additionally, I would suggest determining the same patterns the other way around. Thus, taking runoff data in account and focus if an El Niño event can be determined from this data. When results are positive, correlating these specific patterns to an El Niño event can draw a more solid conclusion.

4. During section 3.2.2 WRRs (P8985), some values are used to convince the negative/positive runoff anomalies during a specific El Niño event. The values represent fractions of the amount of WRRs experiencing the corresponding runoff. Though, all values are more or less around 50

5. Some assumptions made in this paper are without any motivation or discussion. Also due to the fact that climate variability is not constant, triggers me to search

for a discussion. Unfortunately, this is lacking in this paper. I would suggest that some comments I mention in this review could be explained in such a section, causing the paper to be much stronger. On top of this, it can recommend further study on this topic. In the current paper only one suggestion has been mentioned for further study, which is due to scarcity of gauging stations.

Minor Issues

- The grid data from the model output is discussed in section 2.1 Data and at the end of this section the paper mentions that all grid data is re-gridded into a resolution of $0.5°$ x $0.5°$. Here I am missing some motivation why this choice has been made, or why it was necessary to do so.
- At P8983 L25, the word specifically has been used. This will put focus on the first coming piece of sentence, which is about the runoff anomalies of the NE region. Though, these specific anomalies aren't that unique compared to the other regions that are described as well. I would suggest that the word "Specifically" needs to be removed, or the sentence needs some reconstruction.
- P8983 L6: "Specifically, during CP-El Niño years (Fig. 2a), significant below-average runoff was observed in the whole Northern US, with extremely dry conditions of up to 180 mm yr-1 (-31 %) in Northeast (NE) and (-11 %) Pacific Northwest (PNW) regions. " Here, for the Pacific Northwest region the amount of mm yr-1 is missing. On top of that, it is not directly clear that these numbers are about precipitation; perhaps mention it instead of using "dry conditions".
- P8986 L21: "Nonetheless, such differences in El Niño frequency do not affect the main results (not shown)". I am confused why only such a short comment is

given for neglecting this. Still, it would improve the paper by explaining it.

Specific Comments

- P8979 L20: "Mo (2010) reported that the ENSO influences…", here ENSO is used as an abbreviation determined in an other report. It would be better to use the whole definition, El Niño-Southern Oscillation.
- P8981 L23: "available at http://www.esrl.noaa.gov/psd/data/gridded/data.precl.html", I would prefer to refer it to another place, instead of leaving a whole URL in the tekst. Idem for P8981 L26: "available at http://apps.ecmwf.int/datasets/".
- Figure 3: I would recommend changing the colours. This is due to the fact that previous figure (Figure 2), is using the same colour scale associating blue and red with high and low anomalies respectively. Therefor, these colours might cause some confusion. This corresponds to Figure 5 as well.
- Figure 6 and 7: I assume the black marks on the figure correspond to the 0.05 significance of the MC test. It is very hard to see this though, perhaps show it in the legend.

Literature

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 8977, 2015.