Hydrology and
Earth System
Sciences

Discussions

Interactive comment on "Widespread Decline in Terrestrial Water Storage and Its Link to Teleconnections across Asia and Eastern Europe" *by* Xianfeng Liu et al.

Anonymous Referee #2

Received and published: 14 October 2019

The manuscript titled "Widespread decline in terrestrial water storage and its link to teleconnections across Asia and Eastern Europe" by Liu et al., has identified an interesting research gap of analyzing the linkage between teleconnections (TCs) with terrestrial water storage (TWS) in Asia and Eastern Europe. They have utilized comprehensive set of TCs for the study. The TWS has been abstracted from GRACE observations. The TWS is partitioned using GLDAS to generate surface water (SW), soil moisture (SM) and groundwater. The TWS components are then de-seasonalized. This is followed by spatio-temporal trend analysis, comparison analysis with TCs and dissection of each TWS component's contribution to TWS.

Although the manuscript embeds a promising research topic, the level of write up lags far behind the study done which in turn lags behind the research gap stated. The manuscript lacks crisp, clear messages. Most of the time this is due to poor sentence structure and grammar. The reader has to infer what the authors are trying to state or sometimes even conclude. I would not recommend to accept the manuscript in its current form and structure. I would suggest the following major revisions to the authors, if the editor decides to move the process forward -

Major Comments -

- It is mentioned that the lead author wrote the manuscript with contributions from all others. However, there are significant improvements required in the sentences, paragraphs and information sequence structure. This shows the manuscript was not sufficiently revised before submission. In its current form, the manuscript doesn't facilitate an uninterrupted flow.

- Tabulation of data information and a flow diagram of data processing are necessary in the section "Data". It might be a better idea to make an overall methodology flow diagram that includes this.

- There is no background on TCs and subject matter of the manuscript in regards to the study area in the section "study area".

- Although the subtopic headings of results section are clear, the content is very poorly structured and sequenced. Smooth reading flow is missing.

- Although the subtopic headings of discussion section are clear, the content is very poorly structured and sequenced. For an instance, in section "4.2 Possible mechanisms of TC influence on TWS variability", only the dominant TC and their role in the regions are mentioned. However, the result from this study and discussion on "possible linkage" with these "roles" are missing.

- The figures and tables of the supplementary section are directly and heavily referred

to in the manuscript. This needs to be ratified. The grouping of figures is also not optimal.

- The preparation of figures and tables is poor and needs significant revising. This includes axes labeling, color combination, color code, headers, data source declaration in the captions.

Specific Comments (in order of sections of the draft)-

1 Introduction

Line 38: May be the gap is mainly in Asia. There are existing studies for Europe. E.g. Rakovec et al. (2016) have already analyzed the TWS anomaly using GRACE in 400 European river basins.

Line 42: "...are undergoing intensive..."

Line 44: mm/y vs mm yr-1 (in abstract). Inconsistent usage of unit format.

Line 63-64: "...and the remainder of the TWS time series...". Its not clear for the reader what this is referring to.

2.1 Study Area

Figure 1a: Source/ citation is missing. Color representation for Semi-arid and dry sub-humid regions don't have sufficient contrast.

Line 72: Mount Kilimanjaro is in Africa, not the study area.

Line 73: The URL link doesn't have public access. And its mentioning here is also not clear.

Line 75: I couldn't grasp the usage of "...in this area". Did you mean to say "More importantly, the Asian and Eastern European regions are the most densely populated regions in the world, sustaining nearly half of the global population and contain some of the largest and most intensively irrigated lands of the world"? If so, kindly cite the

source.

Figure 1b: Source is missing.

Line 75-77: Split long sentence to two. Also kindly include the source.

Line 69-77: The research gap of comprehensive TWS-TC correlation would need some background on TCs in the study area. This is missing and should be discussed in more detail in this section. If the manuscript space permits, additional map/s depicting the TCs and their role in the regions would improve the clarity of the topic to the readers.

2.2 Data

Line 79-110: Tabulating the dataset information would be a more efficient way of presenting than the current form. E.g. Line 91 mentions the exact same thing mentioned in previous sentence just adding additional spatial information. This is followed by the web URL for the dataset. Tabulation of info would be the perfect solution here.

Line 92: Avoid using direct URLs for data reference. There are better ways to cite datasets.

Line 93: Bicubic interpolation doesn't preserve the mass while resampling. Mass-conservative remapping is advised (e.g. remapcon operator of CDO)

Line 94-97: This sentence has 62 words! This doesn't help readability of the manuscript. Kindly break into shorter sentences. One message per sentence.

Line 98: The x-axis header for Figure S1 is missing. Moreover, the x-axis is not uniform across figures S1, S2, S3, S6.

Line 101: "... by deducting..."

Line 79-110: Apart from tabulating the dataset information, the data assimilation approach would be much easier presented as flow diagram.

Line 105-110: This can go into the data table. However, some elaboration of these 12

TCs in regards to the study area is missing. I would suggest to switch the position of 2.1 and 2.2. With this new sequence, the authors can provide further insight on TCs from view point of study area in the section "Study Area".

2.3 Methods

2.3.1 Time series decomposition

Line 113: The first sentence here is out of subject. The current subject is decomposition and this sentence is about trend analysis (belongs to section 2.3.2?)

Line 113-124: Revise the order of the sentences and info. Not in optimum order.

Line 118: STL is a robust method? Then cite the papers who have proven this method to be robust.

Line 118: "for detecting non-linear time series in trend estimates". What do you mean? The sentence doesn't make sense to me.

Line 123-124: Refer to previous publication of this journal to understand how to cite in such situation.

2.3.2 Theil-Sen trend analysis

Line 126: "..the linear trend of .... and precipitation for the ..."

Line 126: Trend analysis on the deseasonalized time series? or the residuals? I am guessing the first sentence of section 2.3.1 belongs here [??]

Line 126-127: Break the long sentence into two. Move the second part to the end of the section. In this way flow of read regarding Theil-Sen trend analysis is maintained.

Line 128: "... of the Theil-Sen trend analysis is ..."

Line 130: Remove "non-robust". And cite the literature proving this statement.

Line 130: "The TWS trend, ß, for a ..."

2.3.3 Cross-correlation analysis

Line 136: TWS or TWS residual?

Line 139: Move the "," to the end of the equation. At the moment its on the denominator.

Line 139: What is the meaning of the symbol Tau here? Is it the lag?

Line 140-141: "auto-covariace"?

Line 142: Why between 0 and 24? Reason, in brief, required. Moreover, can cross-correlation have value greater than 1?

Line 143-146: Break the sentence to get one message per sentence.

3 Results

3.1 Spatiotemporal changes in TWS

Line 149: Mention that both JPL-M and CSR-M showed similar spatio-temporal pattern to begin with. Then let the reader know that the values will be referred to JPL-M.

Line 152: The 5 hotspots are clearly shown in Figure 2a. This should be included in the reference illustrations.

Line 152: Figure 2f doesn't have color code. Unit of time is missing. Time axis with years as axis tick labels would enhance clarity.

Line 153: Figure S6 doesn't have color code.

Line 154: Precipitation is in figure 2b, not 2c.

Line 157: Precipitation is in figure 2b, not 2c.

Line 158: How is this "within" Rodell's findings? The estimates are completely contrasting each other. Plus, the reasoning is not convincing and/or explained properly.

Line 162: -73.2 mm y-1 is out of range for figure 2a.

3.2 Influence of TC indices on TWS variability

Line 174: Which section of the multi-plot Figure 2? Revise the header and legend header of figure S5 to something more explicit. In caption of Figure S5, replace "phase shift" by "lag". Usage of same terminology maintains the flow of reading. And what are the symbol alpha and "n" in the caption?

Line 175: "... and NAO have a significant area of influence on TWS variability."

Line 181: Resolve the structural error. Two sentences or one?

Line 189: "Proportions of time .... Figure 2d". This sentence should be the starting sentence of this paragraph.

Line 190: Tibetan plateau and Mongolia have more pixels of longer lags than SE Asia.

3.3 Contributions of water storage components to TWS

Line 194: The first sentence is concluding findings. Thus, it is more suitable to be placed towards the end of the section.

Line 195: The hotspots have been well established in the manuscript and doesn't need the reference to Figure 2a every time.

Line 195: "Groundwater depletion dominates the contribution to TWS loss in region 1..."

Line 197: "Similar results were observed in northwest..."

Line 210: The term "sea level" could be confused with the world mean sea level. Suggested rephrasing: "...Caspian Sea with a decrease in its water level elevation by -73.2 mm y-1..."

3.4 Divergent response of water storage components to TCs

Line 217: The first sentence is concluding findings. Thus, it is more suitable to be placed towards the end of the section.

Line 222: "...is a synthesis signal i.e. its trend ...". "... different ways. Furthermore, the groundwater ..."

Line 223: "...which indicates lower correlation..."

Line 225: Reference to a figure or table missing

4 Discussion

4.1 Comparison of our results to previous studies

Line 235-257: Please be clear about which region are you talking about. If you start with "Region 1 shows ..." then its clear that the information corresponding to that region (1, 3 and 4) else its hard to follow (regions 2 and 4).

Line 258-260: Break the sentence to get one message per sentence.

Line 260-263: Break the sentence to get one message per sentence.

Line 263-264: Revise the sentence for clarity. The concluding sentence should be clear.

4.2 Possible mechanisms of TC influence on TWS variability

Section 4.2: This is probably the most interesting subtopic of the paper. The writing style should have followed this pattern: 1) result observation at each hotspot, 2) literature on the dominant TC for the hotspot, 3) linking "possible mechanism" between the literature and the results. Currently the section is filled with only 2. There is no linking going on.

4.3 Implications for future hydrological studies

Line 288: "... could explain the variability in TWS in most of the remote and ..."

Line 290: "... variability interacts with human..."

Line 297: "claim" is a very strong word. Moreover, it doesn't make sense especially

as the paper hasn't included any prediction or scenario analysis of droughts and heat-waves.

Line 300-314: Usage of "First, Second, Third" in paragraph structure requires different approach of writing. Instead, bullet style enumeration of the three recommendations would suit the current sequence and structure of writing i.e. start first bullet with "Withdrawal of ...", and so on.

5 Conclusions

Line 321: "...component vary from region to region. The ..."

Line 323: "...and regions. This highlights the importance ...."

References:

RAKOVEC, O., KUMAR, R., MAI, J., CUNTZ, M., THOBER, S., ZINK, M., ATTINGER, S., SCHÄFER, D., SCHRÖN, M. and SAMANIEGO, L.: Multiscale and Multivariate Evaluation of Water Fluxes and States over European River Basins, J. Hydrometeorol., 17, 287–307, doi:10.1175/JHM-D-15-0054.1, 2016.