Referee #2

The paper applies complex network approach to study connectivity patterns in the global terrestrial water storage (TWS) data. The authors use two complementary TWS data bases – Gravity Recovery and Climate Experiment (GRACE) satellite mission data and the Global Land Data Assimilation (GLDAS) NOAH model – with the resolution of 1x1 degree. The network is constructed of the land nodes (cells of 1x1 degree) that might be connected pairwise depending on the correlation of the respective TWS time series. The authors analyze several network statistics – neighbor edge density, connectivity, and connection length – to characterize the principal river basins of the World and reveal some significant teleconnections in the global water dynamics. The findings of the study are consistent with the existing climate teleconnection literature, which supports the validity of the proposed approach. At the same time, the examined way of treating TWS time series seems to be novel for this type of data and may inform a range of studies focused on the global water cycle. In addition, the study quantifies the differences between the two examined global databases, which is an important independent contribution. The paper is clearly written and effectively organized. The main conclusions seem to be valid and robust with respect to the data noise and time series processing.

Reply: Thank you.

There are some minor remarks, which should be easily addressed by the authors:

1) p. 786, ll.1-2: The sentence is unclear. What is the definition of "relevant edges"? Probably the authors refer to the nodes (not edges) that are relevant to each other? This sentence should be revised.

Reply: Agree. The full sentence is rephrased to "*In the pruning step, an appropriate similarity threshold (\tau) is imposed to the edge set to retain only those connections that exceed the threshold value*."

2) p. 787, ll.3-4: It is unclear what is meant by "all meaningful features". Please be more specific here.

Reply: Agree. The word "meaningful" is vague, we will change to significant. The full sentence is rephrased to "*Additional statistical analyses (see Section 4) are performed to ensure that all significant connections are retained in the constructed networks.*" The last paragraph of Section 4.1 also mentions "In this study, the threshold \tau is set to 0.57 because (a) the corresponding fraction of connected edges is relatively small (0.036), at which level more than 96% of edges is removed, (b) the edge densities of GRACE and GLDAS happen to be the same at that level; and importantly (c) the cutoff threshold is still below the maximum correlation exhibited at all separation distances, as suggested 10 by Fig. 1b. Thus, the selected \tau value ensures that all important network features are represented by the constructed networks."

3) p.787, l.10: "correlation between edge" probably means "correlation between nodes i and j"
Reply: Accept. Please see our reply to Comment #7 from Reviewer 1.

4) p. 787, l.10: Here and in other places: Please define what you mean by "correlation between time series". Is this Pearson cross-correlation at lag zero?

Reply: On p.787 L.10, the correlation coefficient doesn't have to be at lag zero, it can also mean maximum correlation. Therefore, we didn't specify the type of correlation there. Instead, on p.790, L18-19, we wrote "Note in the discussion below, R is calculated at zero lag unless otherwise specified."

5) p. 788, Eq. (5): Do we need this? There is a lot of network statistics that are not used in this study. Why does this particular one needs to be discussed with a dedicated equation?

Reply: We presented the classic average distance measure to give rationale for using the measure given in Eq 6. A direct application of Eq. 5 is computationally demanding when the number of nodes is large.

6) p. 788, Eq. (6): I'm not sure that this measure can quantify "average distance between node i and all other nodes". Do you have examples or theoretical argument in support of Eq. (6) being a proxy for Eq. (5)? Importantly, this statement is probably not necessary. Why not introducing Eq. (6) as a connectivity measure used in this study, without referring to the true average distance?

Reply: The description on p. 788, L. 10 is an oversight. We will rephrase it to "In this work, the average distance between node i and other nodes, L_i , is approximated according to…" because we only used the first neighbors of L_i to calculate the average distance. We feel that average (topological) distance is still an integration measure, instead of a connectivity measure as the reviewer suggested.

A reference for Eq. 6 can be found in Section 3.3.3 in Donges et al. 2009 [a],
Donges, J. F., Zou, Y., Marwan, N., and Kurths, J.: Complex networks in climate dynamics, Eur. Phys. J.-Spec. Top., 174, 157–179, 2009a.

7) p. 788, l. 12: "are included", not "is included"

Reply: Accept. Changed to "are included".

8) p. 789, l. 3: "linear interpolation". Do you refer to linear interpolation between the two neighboring values? Do you use deterministic or stochastic linear interpolation? What if more than one value in a row is missing? Please describe this process in more detail.

Reply: Linear interpolation is done between datasets of two months. It's temporal, not spatial. Such an approach has often been used in the GRACE community. Of course, one may seek to do cubic spline, but luckily as we mentioned on p789, L3, the missing months are not contiguous, so simple linear interpolation suffices for the mildly changing TWS time series.

9) p. 790, l. 24: Why using the maximum correlation coefficient is representative?

Reply: This is because the network similarity is based on correlation and we want to make sure the maximum correlation at all distances are included. As we show on p790, L8-10, the main purpose of Figure 1b is to show that "the cutoff threshold \tau is still below the maximum correlation exhibited at all separation distances." So from Figure 1b we see that the cutoff value is 0.57, while the maximum correlations at all distances are greater than 0.57. Therefore, we can at least say that the most statistically significant node pairs are included.

10) p. 791, ll. 8-9, item (c): How the cutoff is related to the distribution of the correlations? (This is related to my comment immediately above)

Reply: In the edge density method (Donges et al., 2009a), the cutoff is a correlation value. This should be clear after reading Section 4.1

11) p. 791, ll. 10-11: Please explain what you mean by "all important network features"

Reply: Please see our reply to Comment # 9 in the above.