Nonlin. Processes Geophys. Discuss., 2, C194–C196, 2015
www.nonlin-processes-geophys-discuss.net/2/C194/2015/

Nonlinear Processes in Geophysics
Discussions

Interactive comment on "Global terrestrial water storage connectivity revealed using complex climate network analyses" *by* A. Y. Sun et al.

Anonymous Referee #1

Received and published: 5 June 2015

In their manuscript "Global terrestrial water storage connectivity revealed using complex climate network analyses", the authors investigate correlation networks which reflect mutual dependencies between the temporal variation of terrestrial water storage at different locations. Estimates of terrestrial water storage (TWS) are based on two data products, the GRACE satellite mission and the NOAH model (GLDAS-NOAH). The network topology indicates different river basins to show different connectivity patterns, pointing to teleconnection structures which seem to be present for some basins (Ganges, Mississippi, Tigris) but not for others (Amazon, Congo, Yangtze). Maps of average node connection length (in Euclidean sense) reveal regions with long connections (such as the Pacific Northwest) and those with short connections (such as the Middle East). Nodes of large area-weighted connectivity (coined "supernode regions" by the authors) seem to reflect combined effects of climate variations and an-

thropogenic activities.

The manuscript provides a network perspective on global terrestrial water storage which is a relevant and timely topic for readers of Nonlinear Processes in Geophysics. Combining insights gained from the network analysis might possibly help to identify TWS predictors and to improve land surface models. The employed methods - network measures as well as network inference by thresholding a matrix of Pearson correlation coefficients - are not new and have been frequently applied in many different scientific disciplines. Applying these methods to GRACE and GLDAS data products establishes the novelty of this work. I have only minor remarks and recommend publication after revision.

Minor remarks:

- There is a certain ambiguity when defining network nodes which is natural for such datasets. Nevertheless, how does the spatial resolution of the used data products influence the results of the network analyses? Are the results reported in this study "stable" when network nodes are defined in a different way (e.g. after coarse graining)? How does network structures change when the number of nodes is increased or decreased? I expect the maximum number of reasonably defined nodes of a network to be constrained by the numbers of degrees of freedom captured in the data (which, in case of GRACE, seems to be related to the finite resolution of the measuring instruments).

- Figure 6 shows GRACE area-weighted connectivity derived from the maximum of the cross correlation functions. Does a corresponding map of the identified lags of the maximum cross correlation reveal any interesting information?

- p. 788, l. 16: "... \bar{L} provides a measure of network integration." I believe that readers not aware of the spatial aspect of this network measure will profit from a short interpretation of \bar{L}. For the grid-like arrangements of nodes considered in this work, low values of \bar{L} would indicate a grid of nodes which are only locally con-

nected. In a topological sense, this would be a network which is not well integrated since it comes along with a large average shortest path length (which may be somewhat counterintuitive for some network scientists not investigating spatial networks).

- p. 796, l. 5: "... which are extended for use with gridded datasets." The authors need to explain how exactly they extended the "classic degree of centrality and connection length measures" (l. 4). Is here anything novel that is not yet reported in studies on spatial networks?

- p. 796, l. 19: "... and type of TWS connectivity ...". What do authors mean with "type" here?

- The authors use the notion "complex climate network theory" (CCN theory) at several places in their manuscript. Given that the employed network methods are pretty standard, it is unclear to me what exactly establishs a new theory. I recommend to refrain from using the notion "CCN theory". Instead, authors could use phrases like "applications of complex network theory to climate science" as they already did in their previous publications.

- p. 787, l. 10: "... between edge (i,j) ...". Perhaps the authors wanted to write: "... between time series i and j ...".

Interactive comment on Nonlin. Processes Geophys. Discuss., 2, 781, 2015.