Hydrol. Earth Syst. Sci. Discuss., 12, C6482–C6486, 2016
www.hydrol-earth-syst-sci-discuss.net/12/C6482/2016/

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Synchrony of trend shifts in Sahel summer rainfall and global oceanic evaporation, 1950–2012" *by* A. Diawara et al.

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Received and published: 31 January 2016

Overview: This paper described a multi-decadal link of boreal summer rainfall over Sahel region with the global oceanic evaporation by using long-term observation and reanalysis data. The analysis of global climate fields suggested that a recent positive shift in the Sahel rainfall variability may be induced by the increased oceanic evaporation in both the Northern and Southern Hemisphere. The results shown here are interesting and the paper is well written, but a detailed mechanism behind the multi-decadal link between the Sahel rainfall and the global oceanic evaporation is not clearly examined. Also, the relation between the global SST and LHF variability are not fully investigated in the relevant figures. These issues should be carefully addressed to improve our historical understanding of the multidecadal rainfall variability over Sahel

region. Therefore, this paper requires major revision before possible publication. Below are the major and specific comments on this paper.

Reply: Thank you for your comments, we addressed all answers regarding to the questions. We appreciated your consideration.

Major comments: Multi-decadal link between the Sahel rainfall and the global oceanic evaporation (Section 3.1). In the introduction section, the authors clearly stated that understanding the source of Sahel rainfall should help explaining the variation, but they did not perform any detailed analysis for the source of Sahel rainfall variability. Although the multi-decadal link between the Sahel rainfall and the global oceanic evaporation was mainly discussed in this study, a detailed mechanism behind the source of Sahel rainfall variation is not well studied. Which part of global oceans plays a key role in the Sahel rainfall variation? How does the evaporation over the above ocean affect the Sahel rainfall variability? The authors should provide more detailed information on the source of Sahel rainfall variability.

Reply: Thank you for the comments. Sahel region is one the most visible area affected by climate change, during this last sixty years it has been one of the most incomprehensible regional interest for researchers because the region is a typical mystery through its evolution. The first possible explanation since 1985 have been Folland et al. 1985 which established the first relationship between Southern SST and the variability over Sahel region however any direct link have been made explaining where exactly or how or through which process that phenomenon over the change of temperature of the ocean could influence on the amount of precipitation in Sahel region. In our research, we documented major studies done during this past sixty years of the Sahel region and highlight new discovery as not limited the oceans but taking all options of the oceans and the consideration of the participation of SST map through the evaporation released under the form of latent heat flux which is by definition is the evaporation of water over the surface of ocean in our case to a condensation water vapor in the troposphere. This is an introduction in more exciting window view of the source of Sahel rainfall.

However, as in your comment, our paper has not capture exact “source” that remotely influences on the Sahel rainfall. We will modify the introduction. We summarized the multi-decadal processes on Fig.8. It says that the southern hemisphere have shown a direct influence of wind stress. So, we can see that a strong wind could produce a large amount of evaporation. The latent heat flux there has a significant effect over Sahel region. However, this does not explain remote influence on the Sahel rainfall but the local process. To show the remote influence and show a key part of the ocean and how, the map of horizontal moisture flux correlated with Sahel rainfall will be added in the revised version.

2. Role of oceanic evaporation in the SST variability (Sections 3.2-3.4) the link between the SST and LHT variability is still unclear. The authors claimed that in the Northern Hemisphere, the positive shift in the SST variability induces the positive shift in the LHT variability. However, this is not evident in the zonal mean figure, where the SST variability north of 40 âŰę N clearly shows the negative shift (Fig. 4). Also, the authors mentioned that in the Southern Hemisphere, the positive shift in the wind variability contributes to the positive shift in the LHT variability. But, it is hard to see the positive shift in the wind variability, because the wind variability represents opposite signs north and south of 20 âŰę S (Fig. 6). Furthermore, the negative shift in the SST variability cannot be clearly seen north of 50 âŰę S. The authors should carefully describe regional differences in the multidecadal variability among the variables.

Reply: In Figure 4, the Northern hemisphere SST has its major part, except a remote area in the North-East Pacific ocean, correlated with positive sign. Even though the same area is negative for the LHF, the average over the Northern Hemisphere itself will incorporate the major pattern of relationship between SST and LHF in Northern Hemisphere. We will carefully describe detailed explanation on the relationship with LHF in particular areas in the revised version.

3. Data quality before the satellite era, there is ample evidence that the observational data in the Southern Hemisphere before the satellite era are not as reliable as those in

the Northern Hemisphere, but the authors elaborated on the multidecadal link with the Southern Hemisphere before the satellite era as well. The multidecadal link with the Southern Hemisphere should be focused in the recent satellite era. Rather than the Southern Hemisphere, the neighboring oceans such as the tropical Atlantic and North Atlantic Oceans would have a major role in the multi-decadal rainfall variability because of proximity to Sahel region.

Reply: We agree to the fact that the recent data sets are much more accurate estimation. We totally understand that the reliability and the choice of the data is crucial in a specific study. To compensate this problem, we will add the dependence on the choice of used dataset by showing in additional table or figures.

Minor comments:

P11270 L1: “summer” should be “boreal summer”. Reply: Thank you for the suggestion. We will change this accordingly.

L4-6: This argument is very strong and needs to be modified with further analysis. Reply: We will adjust the part indicated by the comments.

L7-9: Analysis of moisture flux would be helpful for identifying whether the anomalous moisture advects over the continent or not. Reply: Thank you. We will show this accordingly.

P11271 L21-24: Did the authors compare their results with other available rainfall data (e.g. GPCC)? Reply: Actually we started with the GPCC and GPCP data set then we used the Prec/L data set which gives the similar results. We will describe this in the revised version.

P11272 L17-25: The defined box does not cover major Sahel rainfall region. I do not Understand why the authors used the box covering only half of the boreal summer rainfall peak, although the signature is not sensitive to the definition. Reply: We defined the Sahel region in removing the direct influence of the surrounding ocean over the

coast line up to 100km, so we have been able to compare what influence could get at the area. This explanation will be added in the revised version.

P11277 L4-6: This sentence seems to have nothing to do with the purpose of this study. Reply: We will take your suggestions in account.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 11269, 2015.