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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Climate change impacts on river discharge in West Africa: a review" *by* P. Roudier et al.

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General Observations:

The paper provides an in-depth analysis of the available studies related to the effect of climate change on the runoff behavior of the Sahelian, Sudano-Sahelian and Sudanian rivers in West Africa. The effect of changes in land use, water consumption and higher carbon concentrations on the hydrograph of the rivers in this region of the African continent, due to the limited number of available studies focusing hereon, is less developed. Although future predictions suggest an increase in precipitation (referred in this paper and elsewhere as the main factor affecting runoff) in the study area, the results evidence contrasting findings and therefore a lack of a clear tendency

for most of the rivers or subzones. The manuscript not only stresses the need to assess the uncertainty bounds on the predictions of future scenarios, particular in view of decision-making, but also provides where possible uncertainty ranges.

The paper is well written and concrete; the methodology is simple and easy to follow. However, I would suggest the following minor changes before final publishing in order to improve the comprehension of the reading:

1.Page 2488, Line 23: Consider adding an explanation (after Section 2.3), including some references, on the type of scenarios considered in the database, at least the most common ones, their evolution and considerations (for instance, from the IPCC92 type scenarios until the more recent RCP scenarios). Besides it would be good to include a comparison of two or more common contrasting scenarios like A1F (or A2) vs. B1 (which are we believe are available in the authors database). The better understanding of implications/considerations of each scenario is a key to understand discordances (lack of a clear trend, or uncertainty) between results of different studies. Different climate change scenarios can yield large and contrasting differences in the estimated impact on discharges (e.g., Arnell and Reynard, 1996).

2. Page 2489, Lines 14-18.: This affirmation is not completely correct. If correctly understood the studies to which the authors refer are primarily based on the SRES and the IS92-type (IPCC 92) GHG scenarios. Just one research paper, the database, is using the lastly developed RCP scenario.

Specific Comments:

1. Page 2485, Line 8: . . .“and especially in rainfall, plays a significant role in flow variation in WA”. Suggest to delete “WA”, because the statement is true not only for WA, but many other regions.

2. Page 2485, Line 9: This sentence needs a reference (e.g., IPCC report or Wuebbles and Ciuro, 2013).

3. Page 2485, Lines 18-19: Why not referring to one of the recent and widely known IPCC evaluations of climate change, which contains trends of some hydrological parameters at regional scales?

4. Page 2486, Line 20: . . . "some rivers in WA can be very large", ... are not all of the rivers considered in the study large?

5. Page 2487, Lines 19-20: Are the ranges over a specific period of time, for example a year, and for which scenario? For instance: the average annual range specified in the mentioned document is between 1.8 and 4.7°C for the A1B scenario using a set of 21 global models. The authors could also specify the range for future evolution of precipitation mentioned in the same report (from -9% to 13%). Instead referring to the ranges cited in Christensen et al. (2007), why not mentioning the new ranges mentioned in the last IPCC 2013 report?

6. Page 2488, Lines 19-22: Are the rising CO2 concentrations not inherently considered in the climate change scenarios? What you are referring to in this paragraph is the effect of rising CO2 on PET and leaf area index; which on its turn indirectly might affect runoff. Would it more appropriate to rename this paragraph to "Carbon effect on plant water use", as used in Section 3.4.

7. Page 2489, Line 8: . . . "19 peer-reviewed papers, Ph.D thesis or" . . . Do you mean 1 Ph.D thesis or more than 1 Ph.D theses?

8. Page 2489, Lines 23 and 26: Might be appropriate for the readers not familiar with the topic to define the acronyms RCM (Regional Climate Model) and GCM (General Circulation Model).

9. Page 2493, Line 1: . . . All these results show that futures studies . . .. "futures" should be replaced by "future".

10. Page 2493, Section 3.2. The fact that precipitation is the major driver for changing trends in discharge, compared to the effect of PET or temperature, should not come

as a surprise as stated by Dai et al. (2009) and Gerten et al. (2008). Although the fitting of the discharge values with rainfall is rather moderate (R=0.49), most likely the consequence of the diversity in methodologies, hydrological models and scenarios used in the different studies, the conclusion that rainfall is the main driver is still an acceptable conclusion.

11. Page 2498, Line 17: Here, and elsewhere in the text, change the reference of the discussion Paper of Aich et al. (2013) to the final revised paper (Aich et al., 2014).

12. Page 2493, Line 24: (e.g., Guimbertau et al., 2013) instead of (Guimbertau et al., 2013).

13. Page 2494, Line 23: Did you mean . . . the trend for higher return periods (or more extreme floods) is not consistent . . .!

14. Page 2494, Line 25: Probably you did mean "Fig. 1b" instead of "Fig. 1a".

15. Page 2496, Lines 24-26: For sure changes in the behavior of runoff is the combined result of changes in rainfall, land use, water consumption and carbon concentrations. Given the lack of knowledge of the mutual interactions, studies that analyze the integrated effect of the different drivers are needed. Should here or somewhere else in the manuscript (e.g., the Conclusions) not be given a hint in what direction such studies should be conducted? Most of the time researchers study the combined effect of climate change and CO2 enrichment, or climate and land use change, or climate and water consumption change on the runoff behavior. Can those studies [such as Murray et al. (2012); Zhu et al. (2011); Liu et al. (2012); Cornelissen et al. (2013); just to name a few] be indicative how the interaction between the different drivers ought to be analyzed?

16. The abbreviation WA is used 38 times in the text (at least if correctly counted). Wonder if this abbreviation can not be deleted in a number of phrases!

17. The text labels in some figures are difficult to read, particular in the Figs. 1 and 8

when compared to 3 or 4. Also the labels in the map (top Fig. 1), particularly the dark blue color impedes easy reading the name of the rivers. Although not a problem for a digital version of the paper, consider standardizing the size of the labels in the figures.

References:

Aich, V., Liersch, S., Vetter, T., Huang, S., Tecklenburg, J., Hoffmann, P., Koch, H., Fournet, S., Krysanova, V., Müller, E. N. and Hattermann, F. F.: Comparing impacts of climate change on streamflow in four large African river basins, Hydrol Earth Syst Sci, 18(4), 1305–1321, doi:10.5194/hess-18-1305-2014, 2014.

Arnell, N. W. and Reynard, N. S.: The effects of climate change due to global warming on river flows in Great Britain, J. Hydrol., 183(3-4), 397–424, doi:10.1016/0022-1694(95)02950-8, 1996.

Cornelissen, T., Diekkrueger, B. and Giertz, S.: A comparison of hydrological models for assessing the impact of land use and climate change on discharge in a tropical catchment, J. Hydrol., 498, 221–236, doi:10.1016/j.jhydrol.2013.06.016, 2013.

Dai, A., Qian, T., Trenberth, K. E. and Milliman, J. D.: Changes in Continental Freshwater Discharge from 1948 to 2004, J. Clim., 22(10), 2773–2792, doi:10.1175/2008JCLI2592.1, 2009.

Gerten, D., Rost, S., von Bloh, W. and Lucht, W.: Causes of change in 20th century global river discharge, Geophys. Res. Lett., 35(20), L20405, doi:10.1029/2008GL035258, 2008.

Murray, S. J., Foster, P. N. and Prentice, I. C.: Future global water resources with respect to climate change and water withdrawals as estimated by a dynamic global vegetation model, J. Hydrol., 448, 14–29, doi:10.1016/j.jhydrol.2012.02.044, 2012.

Liu, M., Tian, H., Lu, C., Xu, X., Chen, G. and Ren, W.: Effects of multiple environment stresses on evapotranspiration and runoff over eastern China, J. Hydrol., 426, 39–54, doi:10.1016/j.jhydrol.2012.01.009, 2012.

Wuebbles, D. and Ciuro D.: Radiatively Important Atmospheric Constituents, in Engineering Response to Climate Change, Second Edition, pp. 45–80, CRC Press. http://dx.doi.org/10.1201/b14051-3 (Accessed 25 April 2014), 2013.

Zhu, Q., Jiang, H., Peng, C., Liu, J., Wei, X., Fang, X., Liu, S., Zhou, G. and Yu, S.: Evaluating the effects of future climate change and elevated CO2 on the water use efficiency in terrestrial ecosystems of China, Ecol. Model., 222(14), 2414–2429, doi:10.1016/j.ecolmodel.2010.09.035, 2011.

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