Comments on Discussion Paper

Modeling water resources trends in Middle East and North Africa towards 2050

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This paper attempts to assess the impacts of climate change on water resources availability in the MENA region using a physically-based distributed hydrological model coupled to a water allocation model. The study gives due respect to changes in socio-economic conditions in comparison to impacts of climate change. I see this paper as a valuable contribution to the assessment of climate change and development scenarios on large and less well studied region. It is not clear, though, if the used models are suitable for a hyper-arid region where most of the rain falls in the form of intense and short storms causing flash floods in many times that may not be well-captured by daily time steps. In addition, I have some comments on the approach in addition to some specific comments as follows;

P4382 L5: use “physically” instead of “physical”

L8: use “Sectoral” instead of “Sectorial” and throughout

L10-12: I do not understand how the shortage in 2050 (199 km^3/yr) can be larger than the total demand (132 km^3/yr) – please clarify?

L 11, 14: use units of (km^3/yr) instead of (km^3)

P4384 L22-23: Latitudes and Longitudes are interchanged by mistake – Add a reference to Fig. 1

L25: add “of the area” after “about 85%“

P4386 L5-10: there is no debate about the flows of the Nile: the average natural flow is 84 km^3/yr (for the period 1901-1950) and the number was used in the design of the High Aswan Dam (HAD) and to establish a treaty between Egypt and Sudan in 1959 allocating 55.5 km^3/yr to Egypt and 18.5 km^3/yr to Sudan while the remaining 10 km^3/yr are considered to be lost to Evaporation from lake Nasser which was formed after the construction of the HAD – check (Abu-Zeid and El-Shibini, 1997).

L18: The model will not “combine” supply and demand, it will rather simulate the allocation of supplies to demands according to the given rules and constraints – please rephrase.

P4385 L11: Iran is not an Arab country – but it is still in the Mashreq region of MENA – rephrase to remove the confusion

L16: in search “for” instead of “of”

L29: do you consider “springs” as surface water sources?

P4389 L21-22: There are some problems with Hydro1K datasets in flat areas like the Sudd Swamps in Sudan – these limitations should be noted especially that the MENA region has large flat areas.

P4390 L5: define what you mean by “crop factors”

L11: was the “formal accuracy assessment” part of the current study? If so then report on the results, if not refer to the study.

P4392 L18: the scenario with the largest emissions is A1FI not A2 – refer to IPC SRES report.

L21: explain why you selected the “9” best performing scenarios – there is a large debate on the definition of “best” which needs to be referred to

L24: A short paragraph on the downscaling method is required in addition to the mentioned references

P4393 Model Validation: I do not see that validating using long-term average discharge is sufficient at all. This only takes care of the water balance and ignores both seasonal and inter-annual variability which are very important aspects of the assessment and puts the whole approach in jeopardy. Why waste effort coupling a hydrological model (using a daily time step) to a water allocation model (using a monthly time step) and then validate that model using long-term average flows? I understand there are always data limitations but seasonal patterns from available data can still be used to provide better validation!

L9-13: please discuss more the issues of relative and absolute model accuracy and show some evidence – the statements given is speculative.

Fig. 5: flow stations need to be mentioned along with river names – e.g. White Nile appears three times! Black and White Volta do not contribute to the water resources of MENA, explain why they are included in the calibration/validation

L13-22: I do not see a good match for the Nile neither the Blue nor the White – note that you are only comparing long term averages and if the model cannot get a very close match, then it casts doubts on its performance in terms of seasonal and inter-annual variability. There are many good models of the Blue Nile and the Atbara and they are not difficult to model (e.g. (Conway, 1993) and (Elshamy, 2008))

L15: non-calibrated model results are not shown

L24-27: EL-EKhsase lies on the main Nile in Egypt upstream the delta. Therefore irrigation abstractions in the delta will not affect its flows as mentioned. There are of –course abstractions along the Nile from Khartoum to El-Ekhsase in Sudan and Egypt. Moreover, if Geizera scheme is not completely included then it will affect the Blue Nile flows at Khartoum and the main Nile downstream while the authors claim that the simulation of the Blue Nile is very good – this is

inconsistent. There are other smaller schemes in Sudan (e.g. Rahad). Contact Nile Basin Initiative for information.

P4394 L1-3: The Sudd wetland losses should affect the White Nile – another contradiction with the previous statement that the model performance is very good for the Nile.

P4395 L25: The authors mentioned a significant decline in groundwater recharge (P4394 L17) while here it is mentioned that groundwater supply shows a slight decrease despite the increase in demand. Please explain.

L27: It is not logical (as stated) that urban and industrial demands are not affected by climate change – temperature increase will affect those demands. Industrial demands include cooling water requirements and domestic demands include bathing to overcome heat stress.

P4396 L15-16: water shortage does not depend only on observed precipitation and temperature but also on demand parameters like population, consumption rates, etc.

P4397 L4: better rephrase ”contribution of merely climate change” to “contribution of climate change alone”

L13: explain why demands are less under wet projections

P4398 L23: It is not clear what you mean by “the desired required accuracy of projections”

P4399 L2-3: Explain why the increase in unmet demand is related to hydrological non-linearity. In my opinion it is related to the amount of unmet demand currently (which is relatively small compared to the future and thus diving a large number by a small one gives a large ratio)

L13-23: relate the results obtained in this study to those presented from earlier studied mentioned.

L18: add “EACC” after the study name such that it is clear when the abbreviation is used later

References

Abu-Zeid, M. and El-Shibini, F.Z., 1997. Egypt’s High Aswan Dam. Water Resources Development, 13(2): 209-217.

Conway, D., 1993. The development of a grid-based hydrological model of the Blue Nile and the sensitivity of Nile river discharge to climate change, University of East Anglia.

Elshamy, M.E., 2008. Assessing the Hydrological Performance of the Nile Forecast System in Long Term Simulations. Nile Water Science & Engineering Magazine, 1: 22-36.