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Hydrology and Earth System Sciences Discussions

Interactive comment on "Assessing residual hydropower potential of the La Plata Basin accounting for future user demands" *by* I. Popescu et al.

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GENERAL COMMENT

The manuscript main aim is to quantify the maximum and residual hydropower potential of the whole La Plata Basin (LPB, area: 3500000 kmˆ2; population over 200 millions) and compare it with the current hydropower production and electric energy in the region and estimated future energy demand (i.e. year 2040). The study adopts tools that were previously developed to perform the estimation, therefore it is not innovative in this sense. Nevertheless, given the geographical scale of the analysis, the hydrologi-

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Discussion Paper

cal relevance of the study region, and the topical issue addressed, in my opinion the manuscript presents a very important piece of information which is definitely of broad international interest. It also raises some serious questions on how to manage in a sustainable way the future energy demand of the area, which cannot be fulfilled by hydropower production only.

I really enjoyed reading this manuscript, which is neatly organized and which I believe is worth publishing in HESS. I only have a few main remarks and some minor comments on this manuscript that should be considered while revising the manuscript for improving the clarity of the presentation. I detail them below in the hope that the authors will find them to be useful while revising their manuscript.

With warm regards,

Attilio Castellarin

MAIN COMMENTS

- Climate and hydrological variability

Reading the manuscript I got the impression that natural climatic and hydrological variability of the study region is only marginally accounted for. Once detected positive change points in the mean of annual flows for a large number of gauging stations in the region around year 1970, the authors discarded all observation predating the change-point year and focused on observations collected in the last 40 years. The authors could better discuss in the context of environmental change (see e.g. Barros et al., 2006) the reliability of this assumption for estimating the (maximum and residual) hydropower potential, which is used as a reference also in 2040.

Also, hydropower potential is evaluated on the basis of the local mean annual flow. Nevertheless inter- and intra-annual variability of streamflow may be very significant (and even under the hypothesis of stationarity of streamflow regime, see e.g. Castellarin et al., 2004 and 2007), particularly so in monsoon areas. On top of this, non linear

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relationships exist between streamflow and hydropower production (see e.g., Vogel and Fennessey, 1995), together with threshold effects (e.g. hydropower production may be hampered during major floods). I believe that a discussion on these points and how they impact the accuracy of the estimated hydropower potential would enrich the article, also given the hydrological readership of the Journal.

- Uncertainty of the estimated 2040 scenario

The authors should make an effort to strengthen the discussion on the reliability of the proposed estimates for year 2040 (see also specific comments), concerning in particular the evolution in time of the energy demand. Results of their investigations are presented in a deterministic fashion, while the analysis involves a number of assumptions and sources of uncertainty. In Fig. 8 the authors reports the CLARIS-project estimates of the energy demand, which are characterized by upper and lower limits. While the main message of the paper still holds (i.e., the future energy demand cannot be satisfied by means of hydropower production only, no matter what) and its strength is not impacted, the upper and lower scenarios provide the reader with a fairer picture and a rough idea of the uncertainty of the estimates.

- Suitability of the Vapidro-Aste tool

The GIS tools adopted in the analysis was developed in a different climatic and geographical environment and, perhaps, made a direct reference to a particular hydropower production scheme. I would encourage the authors to discuss the suitability of the tool in the context of this study.

SPECIFIC REMARKS

Abstract (and p.5640,line18):

“maximum available water in the catchment”, please reword or clarify.

“1970-2000”, or 2010, please check.

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p.5636,line 24-26:

“it has low impact on the environment”, I believe it depends on several factors, e.g. presence and size of the reservoir.

p.5638, line 12:

2010 appears twice

p.5638, lines 18-19:

Is “major hydropower development” appropriate for a 200MW development shared by 2 countries? Please, check. Related to this, the Introduction could better clarify what the main focus is between large, small or micro project, and dammed or run-on-the-river project.

p.5639, line 7:

Alterach et al. (2008a,b): there is just one entry in the reference list

p.5639, line 11:

Contextualize acronym LPB also in the body of the article

p.5639,line 27:

Consider dropping potential

p.5639,line 29:

“some factors”, please clarify

p.5640,line 2:

Add “World” before “Water”

p.5640,line 13:

“accurate”, how accurate is the estimation? An assessment should be provided (see

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also my main comments)

p.5641,lines1-2:

Can the authors anticipate the definition of maximum and residual hydropower potential somewhere around here? They both appear only later in the text. Related to this, the Introduction could better clarify which is the main focus of the study between large, small or micro projects, and dammed or run-on-the-river projects.

p.5641,line 6:

“emans”, please check

Equation (1):

Please illustrate all terms (rational formula terms are not introduced). “Conv” is not dimensionless, please indicate units, I also believe that it includes water density. Consider replacing “;” before H_i with “and”, since they both refer to elementary area i.

p.5643,line 5:

MIF computed as 10%, please support this choice (e.g. reference)

Unclear if “i” and “j” represent cells along the river network or not

Section 3.2:

Please better clarify how these test were used (e.g. confidence intervals) and provide references.

“split”, consider using “change point”

Fig. 2, include gauging station locations, if possible.

p.5644,lines 24-23:

“The explanation for this change... after 1950s in LPB”, Barros et al. (2006) include also changes and alteration of rainfall regime as possible explanation.

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p.5645,line10:

“Vapido”, please check

Exponential vs. Logistic:

I do not believe that there is the need to refer also to the exponential distribution as: (1) the population growth will eventually level out and, more importantly, (2) the initial stage of the logistic function is approximately exponential, it is therefore a matter of parameterization.

p.5647,lines 16:

“Most of the cultivations . . . using rain water”, will it be like that in the future also?

p.5648,line 2:

“crop I”, check capital i

p.5648,lines 10 and 18:

Is PG the population (eq. 10) or the population growth (eq. 11)

p.5649,bottom line:

“Fig. 9” is probably Fig. 8.

p.5650,lines 5:

Please check “hast” and “encapsulates”

p.5650,lines 11-13:

Consider anticipating the definition of residual hydropower potential (see also comment above)

p.5650,lines 15-18:

Reference is made to mean annual flow only in the computation of hydropower poten-

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tial, please comment on the accuracy (uncertainty) of this estimation.

p.5660,last paragraph:

Please justify choices of reference values, or provide references (MIF, efficiency factor, loss coefficient, etc., and also cross-section distance of 50m and 250m on p. 5651)

Section 5.

Consider rewording and clarifying 1st sentence

Conclusions:

The last conclusion appears for the first time in the text, I believe it is interesting and should be deepened further and described in more detail, if possible.

Table 1:

Please, consider rounding values at 10ˆ3. Also it appears that these value do not agree with Fig. 5 (see e.g. Brazil), but perhaps I missed something. Please clarify.

Table 2:

Please report units

Table 3 caption:

Revise “rein”

Fig. 1:

It would be great to highlight streamgauges used in the study in the main window and LPB in Latin-America small panel

Fig. 2:

Please indicate streamgauge and its location, timescale of the hydrograph, legend does not seem match with diagram, meaning of the labels Dry, Wet Mean is unclear.

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Fig. 3:

Indicate the streamgauge

Fig. 4

I do not think that naming every other streamgauge makes sense, name them all or none (and perhaps provide locations)

Fig. 5

Please, increase font size. Logistic fitted on Brazilian data does not seem to match the data properly, please explain. Also, Brazilian data seem to indicate a change in concavity (that can be described with a Logistic function) starting from the '70s, that would have a strong impact on the estimates for 2040.

Fig. 6, 7 and 8

Please, increase font size. I was struck by the strong linearity of your estimates, when the main driver in the study is population growth, which is non linear in the predictions (see Fig. 5). Please, could you comment on this and on the overall uncertainty of the estimates presented in the figures for 2040.

REFERENCES

Barros, V.R., R. Clarke, P. Silva Dias (2006) Climate Change in La Plata Basin. , Eds. CIMA - CONICET/UBA, ISBN 950-692-066-4, 19-38.

Castellarin A, Camorani G, Brath A. (2007) Predicting annual and long-term flow-duration curves in ungauged basins. Advances in Water Resources. 2007;30:937-953.

Castellarin, A., Galeati, G., Brandimarte, L., Brath, A.and A. Montanari (2004) Regional flow-duration curves: realiability for ungauged basins, Advances in Water Resources, 27(10), pp.953-965.

Vogel RM, Fennessey NM (1995) Flow Duration Curves Ii: a Review of Applica-

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tions in Water Resources Planning. Journal of the American Water Resources Association. 1995;31(6):1029-1039. Available at: http://doi.wiley.com/10.1111/j.1752-1688.1995.tb03419.x.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 5635, 2012.