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Hydrology and Earth System Sciences Discussions

Interactive comment on "Coupling statistically downscaled GCM outputs with a basin-lake hydrological model in subtropical South America: evaluation of the influence of large-scale precipitation changes on regional hydroclimate variability" *by* M. Troin et al.

Anonymous Referee #1

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The manuscript evaluates statistical downscaling techniques of large scale climate variables for the application within a hydrological model to reproduce water levels at Laguna Mar Chiquita. Although well structured and clearly described, I don't think the study needs some more work. The poor results are presented too optimistic. The results should be better evaluated and remaining discrepancies between observations and model outcome should be better explained. With respect to the poor results, the

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application of the downscaled time series for the hydrological modelling needs some justification. Finally, it is should be made clear what is the scientific novelty of this study.

EVALUATION OF THE RESULTS AND DISCUSSIONS # The reviewer disagrees on the optimistic way of presenting the results and the discussion. This should be entirely rewritten and maybe some new tests are necessary.

The proposed downscaling method (CDF-t) probably greatly improves the characteristics at station level. This is however not evaluated. It seems that the downscaled variables are aggregated (probably arithmetic mean) before evaluating. Explain why and how this is done. The aggregated downscaled variables however explain less than 50% of the variance of, which is very low. And this is only for the calibration period.

For the validation different metrics are used than for the calibration. Why? For comparisons reasons it would be better to also present the explained variance. In stead, some metrics like the average and standard deviation are compared. The metrics in tables 5 and 6 are evaluated very briefly. However, large discrepancies exist between downscaled and observed variables. These discrepancies need to be interpreted and the application of these "biased" data in the hydrological model needs to be justified.

For example, the daily standard deviation (std) of the downscaled precipitation is twice as high as the std of the observed precipitation. This is probably a side-effect of the proposed method; the six meteorological stations are all dry or all wet, the highest rainfall events occur by definition on the same day for all six stations, etc. So, the spatial disaggregation is too common and only works for average conditions. To incorporate the varying spatial pattern, dynamical downscaling by a RCM could be considered. But, as RCM simulations seems not to be generally available and are too time-consuming to be performed in this study a stochastic approach, as multi-site weather generators (Fowler et al., 2005; Wilks, 1998) or conditional resampling (Brandsma and Buishand, 1998; Wilby et al, 2003) could be considered. Also the discrepancy between observed and downscaled temperature is quite large (0.5 – 1.0 degrees Celsius). Again, interpret

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this bias and speculate about how this will affect the derivation of evapotranspiration and the hydrological modelling.

The hydrological modelling is said to give “satisfying” results. Despite the monthly time step, the NSE is less than 50% for the calibration period, which is poor. This is likely caused by the fact that the watershed is not homogeneous at all and therefore not suitable for such evaluations. It seems that the construction of the Rio Hondo reservoir has greatly affected the local hydrology, at least for the first 5-10 years after construction. This should be accounted for in the hydrological modelling. If that is not possible the hydrological model output, based on the station observations could be used as a reference alternatively.

ABSTRACT, INTRODUCTION AND GENERAL DESCRIPTION OF THE STUDY AREA # This part is very well structured and invites to continue reading. There are only some minor issues that have to be addressed: - At page 9527 it is stated that the present GCM’s are too coarse for hydrological modelling (line 4 to 8). References of 5-10 year old papers are not sufficient too state something about the presently typical GCM resolution. - Is the coarse spatial resolution really a problem in this particular study where discharges and lake levels are evaluated at a monthly time step? Explain. - Also the cited article of Wood et al. (2004) is somewhat dated. In the mean time lots of papers (.e.g. Leander and Buishand, 2007; Terink et al, 2010; Piani et al., 2010) have been published about bias correcting RCM output. Some of these bias corrections are by the way very similar to statistical downscaling methods. Yet, I can imagine that not many RCM simulations are available for South America. This should be more thoroughly explained

DATA # - It is not clear how missing values are treated (section 3.1) - The description of the NCEP/NCAR reanalysis data needs some reference (section 3.2) - Some figure of the regions and boxes with respect to the research area is needed. - Region A is much smaller than the grid cell size of the reanalysis data. How are the regional values determined? - Explicitly state that region B and box C match. Comparison of

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the reanalysis and GCM data is only possible if exactly the same area is used.

METHODOLOGY # - At page 9533, lines 18-19 it is stated that the CDF-t method can be seen as an extension of the quantile matching method. It is not entirely clear what is the extension? - In line 20 it is stated that CDF-t assumes that a mathematical transform can be used to match the CDF of the predictors with the CDF of the predictands. What transformation is used and what do you exactly mean? ïĄő Is the same transformation (scaling, shifting, power law, etc) used for all quantiles? If so, it is no quantile matching. ïĄő Is for every quantile separately a shift or scaling factor derived? - In section 4.2 the water balance is very well explained, but the routing phase gets very little attention. - Motivate why daily input is that important for the evaluation of monthly discharge and lake level? Does the CDF-t downscaling really add accuracy? It would be interesting to directly use the GCM and reanalysis output in the hydrological model and compare it to the downscaled runs. - Explain how the hydrological model is calibrated. Only on the monthly discharges? - The wrong subscripts are used in the explanation of equation 2 - The symbol gamma in equation 3 is not explained.

TABLES AND FIGURS # - For the evaluation of the calibration and validation of CDF-t two different types of metrics are used (table 3, 4, 5 and 6). Both types should be presented. - Figures 3 and 4 are not referred to in the text. - Figures 5 and 6 are too small for proper reading.

References Brandsma, T. and Buishand, T.A. (1998) Simulation of extreme precipitation in the Rhine basin by nearest-neighbour resampling. Hydrology and Earth System Sciences 2 2/3 (pages 195âĂŤ209)

Fowler, HJ and Kilsby, CG and O'Connell, PE and Burton, A. (2005) A weather-type conditioned multi-site stochastic rainfall model for the generation of scenarios of climatic variability and change. Journal of hydrology 308 1-4 (pages 50-66)

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 7, 9523, 2010.