Hydrology and Earth System Sciences Discussions

Interactive
Comment

Interactive comment on "Downscaling of daily precipitation with a stochastic weather generator for the subtropical region in South China" *by* Y. D. Chen et al.

Anonymous Referee #2

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General comments:

The stochastic weather generator approach used in this study is not new, although the mathematical background is described in considerable detail and it is applied to a new area, South China. However, the generally poor awareness shown of recent advances in climate modelling and downscaling makes this paper of rather limited interest although the scientific issues addressed clearly fall within the scope of HESS.

Weather generators are by nature highly 'tuned' and many of the figures and tables presented as examples of validation are not particularly good independent tests of performance. Figure 2, for examples, shows the model parameters calculated from the

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observations and generated series. Given the nature of the model, it is no surprise, nor a great test of model performance, that these are very similar. Contrary to what is stated in the abstract, observed and generated extreme precipitation features are not compared - at least the results are not shown. This makes it difficult to assess the significance of the changes that are shown, e.g., in Figures 9 and 10.

Many of the tables are rather dense and it is difficult to identify systematic biases. Maybe some of this information would be better shown graphically.

Specific comments:

1. Introduction:

While only GCM output may be available for the South China region, it is worth noting that for an increasing number of regions, it is now possible to use regional climate model output for impacts studies.

The references cited in the introduction indicate a limited knowledge of recent research in the field. At least, the authors should be aware of the more recent IPCC guidelines on downscaling authored by Mearns et al (dynamical downscaling) and Wilby et al (statistical downscaling). Both are available from the IPCC DDC website - http://ipcc-ddc.cru.uea.ac.uk/guidelines/. The authors should also be aware of recent developments in Europe, e.g., as part of the PRUDENCE (http://prudence.dmi.dk/) and STARDEX (http://www.cru.uea.ac.uk/cru/projects/stardex/) projects.

The availability of daily output from GCMs is now much greater than a few years ago.

The GCM used in this paper is HadCM2, which is representative of an earlier generation of models, compared with what is available today and being used in the IPCC Fourth Assessment report for example. The authors should at least acknowledge this and note that they are only using one model, whereas it is now recommended good practice to use a range of models. Somewhere in the paper, they should include some references on the HadCM2 model, specify the emissions scenarios used and, most

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importantly, comment on the reliability of this model, particularly with respect to the monthly precipitation fields that they use.

3. The model and methodology:

It would be good to include a reference to or give a few details of the simplex parameter estimation method.

This section refers to inter-site correlation. This is an important consideration for many hydrological applications. Were any validation studies undertaken to evaluate how well inter-site correlations are reproduced by the weather generator?

4.1 Parameterization of the stochastic weather generator

As noted under general comments, many of these 'validation' results seem to be of limited utility. Surely the model is constrained to reproduce things like mean precipitation and the parameters themselves. A more rigorous, independent test would be provided by looking at extremes, e.g., percentile values or 5-day totals.

The authors find that interannual variability is underestimated - which is not a new finding. Can they make any suggestions as to how this problem might be 'remedied'?

The different performance of the model at different times of the year is noted. Is it possible to comment on how this might relate to the different causal mechanisms which dominate at different times of the year?

It is difficult to know whether Figures 4 and 5 show observed or generated data. If based on observed data, then it is hard to see what they tell us about model reliability.

4.2 Downscaling procedure

Section 4.2 describes the construction of a hypothetical scenario using the steps shown in Figure 6. The logic for doing this is not really evident and needs to be explained to the reader.

The final paragraph of this section states that mean monthly and annual precipitation amounts are generally the main interests in climate change impact studies. I would contest this statement - impact assessments increasingly demand information at higher temporal resolutions and many extremes can only be explored at the daily level. If people are only interested in annual/monthly changes - then why is a stochastic weather generator needed to provide daily series?

5 Application of the model in downscaling future precipitation

Again, daily data is now more widely available than a few years ago. Having said that, it is still probably the case that output from more models/simulations is available at the monthly than daily scale. Thus the ability to extract daily parameter changes from monthly output may well allow the use of larger ensembles - an advantage in the construction of probabilistic scenarios, for example.

5.1 Projected future scenario of precipitation change

As commented before, more discussion is needed of the HadCM2 simulations.

5.2 Adjustment of parameters

Figure 6 shows how hypothetical scenarios are constructed - it would also be good to show schematically how GCM-based scenarios of change are constructed.

The procedure of adjusting the standard variance of daily precipitation is justified by some rather old modelling studies. Is it possible to further justify/evaluate the assumptions of Waggoner?

6 Discussions and conclusions

These are rather weak. It is stated that the model structure is generally reasonable - but the systematic underestimation of variance is not mentioned.

I find it very hard to understand the first two numbered bullet points. These need some rephrasing and clarification. In particular, I don't understand the point about

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'consensus changes' and the authors seem to be muddling issues of temporal and spatial resolution. It could be argued that the GCMs are more reliable at the monthly than the daily scale, but this is not explored in the paper. An interesting test of their contention, would be to compare scenarios constructed using monthly and then daily GCM output.

With respect to the third bullet point, what sort of uncertainties are the authors referring to?

References

All except two of the cited references are from 2002 or earlier. Effort should be made to incorporate more recent literature, particularly as substantial advances in climate modelling and downscaling have been made in recent years.

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