Hydrol. Earth Syst. Sci. Discuss., 9, C5755–C5759, 2012
www.hydrol-earth-syst-sci-discuss.net/9/C5755/2012/

Hydrology and Earth System Sciences Discussions

Interactive comment on "Comparing dynamical, stochastic and combined downscaling approaches – lessons from a case study in the Mediterranean region" *by* N. Guyennon et al.

N. Guyennon et al.

ivan.portoghese@ba.irsa.cnr.it

Received and published: 11 December 2012

Response to Referee #1 comments.

With regard to the manuscript submitted for publication on Hydrology and Earth System Sciences Discussions, entitled "Comparing dynamical, stochastic and combined downscaling approaches – lessons from a case study in the Mediterranean region", we have revised it following point by point both the reviewer's suggestions that allowed to significantly improve its quality and readability.

Changes and modifications are described in the following pages providing a detailed

description of the modifications introduced in the same order proposed in the review. Each specific comment (RC) is reported and followed by the corresponding reply and appropriate manuscript integration (AC).

Sincerely, Nicolas Guyennon and co-authors.

RC: This manuscript illustrates the mutual advantages of statistical and dynamical approaches to simulate the regional climate in southern Italy. The purpose is not completely original, but the aim is clearly presented, the text is well written, and the illustration is convincing. In particular, the evaluation of non-stationary features is rather original. The paper is worth publishing in HESSD after minor modification. My main comment is the fact that quantile mapping is presented as a downscaling technique whereas it is a correction technique. Of course, on average, the mean precipitation field exhibits, after mapping, smaller patterns than the original GCM pattern. But if one consider a day with a 1000km x 500km rainy event in GCM precipitation, the corrected field will keep almost the same size: the scale of the event has not be reduced, as it should be in reality. Downscaling means for me apparition of small scales even on daily fields, not just multi-year averages. I do not mean that the paper should be rewritten with another technique, like weather analogues, which produce indeed small scales, but have other detrimental aspects with respect to the quantile-quantile correction. I just ask the authors to use an accurate terminology or to define clearly what they mean by "downscaling"

AC: The authors agree on the need to better contextualize the use of quantile mapping as statistical downscaling in the study. Giorgi and Hewitson (2001) use the term 'transfer function' to describe methods that directly quantify a relationship between predictand and predictor. In that context, the quantile mapping can be classified as a regression model within the statistical downscaling family (Fowler et al., 2007), as recently done in Hayhoe (2010). We agree with the referee that a quantile mapping correction applied to daily precipitation intensity fails in introducing smaller scales patterns, because at that time scale the dry/wet succession is not space-invariant. One

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approach to address this problem is to aggregate GCM predictions into seasonal or sub-seasonal (e.g., monthly) means (Ines and Hansen, 2006). Over the monthly aggregated values, each quantile mapping at each land control station is a unique geolocalized transfer function. Thus, the global transfer function over the case study results from different corrections depending on the location. Figure 1 illustrates the quantile mapping ability in introducing smaller scales pattern over monthly precipitation, both when GCM underestimates small scale events (e.g. August 1973) or overestimates large scale events (e.g. March 1973).

We propose to keep the current terminology and to follow the suggestion of the referee by discussing in the manuscript why the quantile mapping can be considered as a kind of downscaling, at least from an end-user perspective; thus, we reformulated the introduction and the section data and methods to better contextualize the application of quantile mapping as SD at monthly time scale and to better explain in which conditions we consider it a statistical downscaling.

RC: page 5, line 8: to better inform the reader, please give the maximum elevation of the Alps and of the Apennines in ECHAM

AC: We add in section 2.1.1: For ECHAM5 the maximum elevation over the Alps is 890 m at 13.370E 47.560N (Eastern Alps), the maximum elevation over the Apennines is 155 m at 13.120E 40.100N (Central Italy)

RC: page 6, line 5: same question for PROTHEUS

AC: We add in section 2.1.2: For PROTHEUS the maximum elevation over the Alps is 2107 m at 10.516E 46.773N (Eastern Alps), the maximum elevation over the Apennines is 930 m at 13.495E 42.100N (Central Italy)

References

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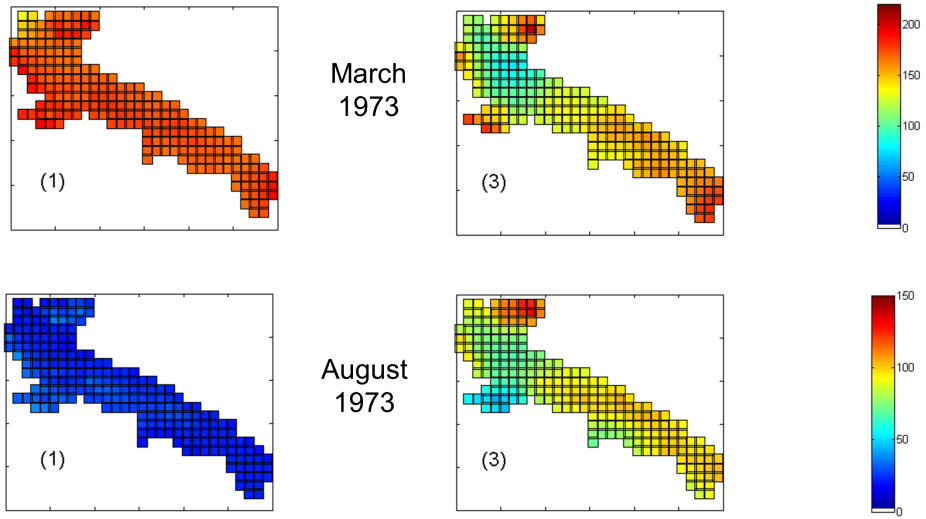

Fig. 1. Monthly cumulated precipitation (mm) in March and August 1973 for data processing (1) (GCM) and (3) (GCM-SD).

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