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Climate of the Past Discussions

Interactive comment on "Multiscale regression model to infer historical temperatures in a central Mediterranean sub-regional area" *by* N. Diodato et al.

Anonymous Referee #1

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The manuscripts presents a method to estimate regional temperatures in the past centuries based on a documentary records and previous large-scale reconstructions based on proxy data.

I found the manuscript quite confusing. I had to struggle to understand its overall structure and some technical details. Perhaps the English usage, which often seems strange, would not help the reader to understand what the authors are trying to say. I have the impression that the manuscript has not undergone a careful final reading – there are some unfinished sentences, and the language is sometimes imprecise. In my opinion, the manuscript needs an extensive revision to clarify the content of the study.

The abstract is my opinion not very informative. It contains very general sentences that are not needed in an abstract (' To reconstruct sub-regional European climate over the past centuries, several efforts...), too detailed technical information (the autocorrelation of the residuals) , and on the other hand does not include which are the large-scale reconstruction used or a basic description of the statistical model.

The introduction uses often the term modelling in a potentially confusing way. I guess that most readers of Climate of the Past would interpret the word 'modelling' as climate modelling, unless sit is specified, or it becomes clear from the context, that the authors are referring to statistical modelling. However, the introduction does not clearly specify what type of modelling the authors are referring to.

al., 2005; Jones et al., 2009). However, as pointed out by Riedwyl et al. (2009), the issue of downscaling to small spatial and temporal scales has become a priority in order to achieve a better understanding of sub-regional climates. Brewer et al. (2007) investigated tree-ring sites to support the reconstruction of historical droughts in Mediterranean areas during the last 500 years. However, temperature series have not been modelled for this region so far. Moreover, continuous and homogeneous instrumental series cannot be extended before the 19th century (Camuffo et al., 2010). On the other hand, high-resolution climate information is increasingly needed for the study of past, present and future climate changes (Vrac et al., 2007).

The text flow changes suddenly in the middle of the paragraph. It starts with the issue of regional reconstructions, and turns to the the issue of existing proxies and which variables have been reconstructed.

tions across European land areas back to 1500. In particular, Luterbacher et al. (2004) developed separate multiple regression equations between each leading principal component (PC) time series of the proxy records and all the leading PC time series of the instrumental data.

In my understanding Luterbacher et al. applied the regression equations with the in-

strumental PCs and predictands and the proxy PCs as predictors. It would be more adequate to say that 'the regression equations between each principal component of the instrumental data and all leading principal component of the proxy records

Several authors such as Luterbacher and Xoplaki (2003), Pauling et al. (2003), and Ge et al. (2005) suggested that pre-modern instrumental weather indices may be promising to enrich climate reconstructions at regional or local scales. DiïňĂerent sets of....

This paragraph is also confusing. It mixes different questions: the possibility to reconstruct past climate from documentary indices- this is not related to the small vs large scale issue; the empirical relationships between proxies and temperatures, which is also a general requirement, not specific of the problem at hand; the possibility to use a linear method or a non-linear method – also not specific to the regional problem; and finally the local correlation between proxy and temperature and the estimation of uncertainties. I honestly do not see the connection between all these issues

In this study, we have considered an alternative approach to address the training- and-extrapolation issue. In particular, a documentary-based technique was developed

The 'training and extrapolation issue' has not been mentioned before in the manuscript. It remains unclear what the authors would be addressing

Regional temperature data (hereafter called TR) were derived from Luterbacher et al. (2004) for Europe over 1500–2002. The data, upscaled at about 0.25-degree grid resolution (âĹij35–50 km) from historical instrumental series and multi-proxy data

The original Luterbacher et al reconstructions are on a 0.5x0.5 grid

duce reliable outcomes (i.e. time-series reconstruction). Two distinct climate periods (1867–1903 and 1972–2002) were included in the calibration dataset (68 records in

The authors mean 68 time years, not records. There are several time series over this period and the manuscript deals with summer and winter means

Information held in the written documentary sources was extrapolated to derive temperature related indices. DiïňĂerent types of indices have been proposed in historical

I think 'extrapolation' is not the right word here and its use here is also confusing

The description of the method to derive the index is not complete. The authors write that their method deviate from the standard 7-level scale, but they do not specify in which sense their method is different, and why it captures extreme months. better.

These classes were allocated by an asymmetric matrix in order to take into account temporal

I do not understand what the authors mean by 'asymmetric matrix' in this context. Why is a matrix - as a mathematical object needed to allocate the classes ?. Perhaps the authors mean 'asymmetric table' as shown in Table 1 ? For a matrix to be symmetric or asymmetric, it should be first a square matrix, which is not the case of Table 1. I also have problems with the definition of the categories and of their index coding in Table 1. I agree that 'freezing in June' is indicative of a much colder anomalies than in 'freezing in March' for instance. But why is 'cold in June' linked to a more negative anomaly than 'cold' in February'? Arent the categories defined as deviations from the normal ? By the same token, 'warm in January' should be linked to a higher value of the index than 'warm in July'. All in all, the table seems to be not justified, or seems to be the result of a quite subjective assessment

In some experimental situations, it is possible to measure more than one response for each case. This is also the case of temperature, which needs multi-scale predictors

Again, I am confused. What is an experimental situation (a measurement ?) , what is a 'response' and what is a 'case' ?

In some experimental situations, it is possible to measure more than one response for each case. This is also the case of temperature, which needs multi-scale predictors to be modelled over diïňĂerent space- and time-domains. In the analysis of these ex-

I do not see why temperature should need multiscale predictors ? If a thermometer happens to be located on the spot, one would need just the information provided by this thermometer, and nothing else.

In the analysis of these ex-periments, information from all the collected responses can be combined to provide parameters that are more accurate and, in turn, determine more realistic tempera- ture data (after Bates and Watts, 2007). In this way, the information collected was downscaled to reasonably approximate the behaviour of the disturbance terms in the temperature measurements. These approximations reside on the general assumption 5

I cannot understand this paragraph. What are the 'experiments' ? what are the disturbance terms ?(no statistical model has been laid out so far). why should the information be downscaled ? what is the scale of this information ?

the disturbance terms have a fixed, unknown variance-covariance matrix for different responses. A model was written along this path, assuming M responses (measured on each of N experimental runs) and dependence on P parameters, θ*, as referred to*

what are the experimental runs ? The description of the statistical model is unnecessarily convoluted and disorganized. I guess that one of the indices denotes time, the other is some spatial index, but I am not sure. The terms used here are also unnecessarily unclear. Does 'stimulus variables' mean simply predictors ?

In equation 2, the authors write that the vector of temperatures Y contains the parameter matrices. I am completely lost here. Y is the multivariate temperatures , as stated in equation 1. How can it contain now the parameters matrices ?

The authors should define much more clearly the meaning of all symbols used in equations 1 and 2. X is in equation 1 'experimental settings' and in equation 2 'the actual data'. Y is in equation 1 the temperature random variable; in equation 2 it is the model estimate. .

I am sorry, but the description of the method and of the statistical model is confusing to the extreme. From what I could understand, I can only hypothesize that the method is based on some type of recursive fitting of something as a function of something.

ters were estimated using an iterative, knowledge-driven approach to bias correction steps (after Box et al., 1978). For instance, after a first run, it was found that regional temperatures (TR) were increasingly biased over historical times. Likewise, Mann et al. (2000) found a decreased number of spatial degrees of freedom in the earliest regional inferences (associated with significantly decreased variance). To account for

Why is a reduction of degrees of freedom associated with a bias in the estimation? I would understand that it was associated with an increase in the variance (not decrease, as the authors write).

The rationale of equation 4 is very unclear. why is the regional mean temperature square rooted in the first term and not in the second term?. Is omega the winter and summer regional climatological temperatures ? Why are the index anomalies added to the regional mean temperature? This would be roughly reasonable if the categories to define the index had been defined as deviations from a regional mean for each month., but it seems to me that the categories (e.g. cold) are defined as deviations from long-term mean, independently of whether the regional mean is also cold or warm. In that case, equation 4 would be adding the same information twice. Also, equation 4 is not units-consistent. The left-hand-side has temperature units (I guess). The first term on the right-hand-side has units of squared temperature, whereas the other terms on the right-hand-side seem to have units of temperature. The model would then produce different results when using different temperature units (e.g. Kelvin or Celsius). What are the units of beta and omega, given in the following paragraph ? how can uncertain ranges in the estimation of these parameters be calculated? what is the uncertainty range in the final estimation of regional temperature?

the calibration dataset, indication of possible correlation is produced at 0.01 < α *< 0.05*

significance level for winter only (Table 2). This may be due to some internal constraint in the calibration stage, probably related to the fact that winter temperatures in the regional dataset and model outputs are more similar in recent times (the period of years used for calibration) than it was in historical times. However, both calibration

I do not see how this could explain the presence of autocorrelation in the residuals.

The multi-scale regression approached here overcomes the inherent loss of variance in both early instrumental records and univariate least-squares calibration equations. In

This has not been shown here, as the study does not systematically analyse the variances of the reconstructions versus observations. Furthermore, the problem of variance loss in statistical reconstruction does not appear in all least-square-methods, but only in those where direct regression is used. It should not appear when total least squares or inverse regression are used.

Interactive comment on Clim. Past Discuss., 6, 2625, 2010.