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Climate of the Past Discussions

Interactive comment on "Evaluation of seasonal climates of the Mediterranean and nothern Africa in the CMIP5 simulations" *by* A. Perez-Sanz et al.

Anonymous Referee #1

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Previous climate model experiments have correctly simulated the direction but not the amplitude of precipitation change in the Sahel-Saharan region of Africa during the early-mid Holocene. This paper reviews results from the latest (CMIP5) generation of GCMs and expands the geographical coverage to include the Mediterranean basin. The authors find no improvement in the model results and they also conclude that failure to correctly simulate past climates is not due to any systematic bias in the ability of the models to simulate modern climate. Results are clearly presented in a series of informative diagrams and the authors' interpretations and conclusions are sound and well-balanced. I would be happy to see full publication of this manuscript after only minor modifications, as set out below. 1. Title. In addition to "r" being missing from "northern", the title makes no mention of past climates which is the main focus of the paper. Perhaps it could be rephrased at "Evaluation of modern and mid-Holocene cli-

mates of the Mediterranean and northern Africa in the CMIP5 simulations"... 2. The first four paragraphs of the introduction make almost no mention of northern Africa, although this makes up more than half the study area. This part of the paper should therefore be partly re-written to describe the whole region under investigation, not just the Mediterranean 3. p. 5350, line 8ff states that "Systematic comparisons with observations have shown that climate models are unable to reproduce the observed MH patterns of change in the Mediterranean". Actually, this is only true of global climate models. The regional climate simulation of Brayshaw et al (which should be cited in this paragraph) reproduces rather well reconstructed ΔP for the Mediterranean (see Roberts et al. 2011 The mid-Holocene climatic transition in the Mediterranean: causes and consequences. The Holocene 21(1) 3-13, figs 4 and 5) 4. p. 5352, line 19-20. I think it would be helpful to add a sentence or two explaining why pollen-based data were used as proxy-data, rather than (e.g.) lake-level fluctuations; for example, because there is good spatial coverage in the Mediterranean region. Coverage of pollen-based palaeo-P is not, however, very good across most of northern Africa (as fig. 2, bottom right map highlights) 5. p. 5361, line 26. Although there is a significant positive correlation between modern bias and mid-Holocene anomaly in the desert region, the range of data variability is actually very small, as figure 8 highlights (i.e. they are clustered across a small range), so this result may not be very significant 6. Figure 5: this might be shown linked to figure 3 (e.g. as fig 3 a and b) in order to show them together so that they can be compared. For figure 5 it might also be possible to show the latitudinal extent of different climate zones from palaeo-data as well as models for the mid-Holocene; ie monsoon zone extending further north and desert shrinking 7. Discussion. Although this is well-balanced, no mention is made of why the models may be failing to simulate correctly the mid-Holocene climate of the Sahel-Saharan region. In particular, it might be appropriate to add a short paragraph discussing the role of local-regional scale hydrological recycling from soil moisture, vegetation and freshwater lakes and marshes, following the pioneering paper on this subject by Street-Perrott et al (1991; Milankovitch and albedo forcing of the tropical monsoons: a comparison

of geological evidence and numerical simulations for 9,000 yr BP, Transactions of the Royal Society of Edinburgh, Earth Science, 81, 407-27). The 6 ka BP time horizon used for comparison was just before a major mid-Holocene climate transition in both the Sahara-Sahel and in the Mediterranean, and some features of the climate at this time may be “relict” from the early Holocene, when boundary conditions were more strongly different from the present-day than at 6 ka. In the Mediterranean, pollen evidence of deciduous forests (e.g. at Banyoles) would also have led to moisture recycling through evapo-transpiration during the mid-Holocene. 8. Conclusions. These are fine, but the authors could go one stage further and make explicit the implications of their study, namely that the failure of GCMs to simulate the amplitude of $\triangle$P in the mid-Holocene in N African and the Mediterranean implies they may also significantly under-estimate the magnitude of future changes in rainfall in these regions. At the very least, only limited confidence can be placed in the model-based predictions of greenhouse-gas warmed climate in these dryland regions.

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