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Climate of the Past Discussions

Interactive comment on "Detecting human impacts on the flora, fauna, and summer monsoon of Pleistocene Australia" *by* G. H. Miller et al.

G. H. Miller et al.

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Two comments were lodged on line for this ms, an Editor and Referee Comment. As lead author I respond to these comments on behalf of all authors.

Abstract: Both referees noted a mismatch between abstract and text. The abstract has been completely rewritten to make it more closely aligned with the ms text. This has been accomplished with a small reduction in the number of words in the abstract.

I have also added a paragraph in the Introduction that describes the purpose of the paper and its overall construction to help guide the reader. Furthermore, I have altered the lead in paragraph of each major section to more clearly connect the separate aspects of the story. I think this helps the reader follow the main storyline.

The Editor raised concerns about our "speculation" that the failure of the Holocene

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monsoon in Australia is caused by burning of vegetation. I think here that I failed to adequately describe what we meant by Holocene monsoon failure. If we are talking only about the fact that monsoon weakens during the Holocene, then I agree with the Editor that there are many alternative explanations to this other than burning. However, what we meant to imply is that the Holocene monsoon in central Australia was much weaker than the monsoon rains 65 to 60 ka, when all forcings (SST, sea level, and insolation [whether Northern or Southern Hemisphere]) are weaker than in the Holocene. Nowhere else that I know of is the peak Holocene monsoon weaker than the monsoon 65-60 ka. It is this observation that we seek to explain. And because it is apparently unique to Australia, we anticipate that it must be related to a boundary condition change over or near Australia. We recognize that our hypothesis that burning explains both the observed vegetation shift and monsoon failure is simply thatĚ. an hypothesis, and I have tried to make sure that we present it as such. We have no direct evidence for this burning, although there is tantalizing indirect evidence from the work of others that we refer to. But we do present GCM simulations that demonstrate a strong dependency of monsoon rains on the nature of vegetation and soils across Australia.

We retain the first two lines in the Introduction because some folks who might read this are relatively ignorant of the tectonic-scale history of Australia, its long isolation and the fact that is contained an exclusively marsupial mammalian fauna until very recently. And these characteristics are essential elements of the stage that was encountered by the first humans to arrive there.

Referee Comment

The referee questions whether our conclusion of Northern Hemisphere forcing of the Australian Summer Monsoon is robust. While the reviewer is correct that dating is only sufficiently precise for the Holocene to make a very strong case, we argue that the basic pattern of the MIS 6/5 transition is difficult to explain with any other age model. But even ignoring the MIS 6/5 evidence, the Holocene record very clearly

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shows an early Holocene maximum in monsoon rain, weakening in the late Holocene. This is impossible to predict with Southern Hemisphere orbital forcing, but is consistent with NH orbital forcing. I have also tried to better demonstrate how recent climate modeling experiments designed to evaluate monsoon strength during the Holocene simulate the same patterns as the paleodata, showing a stronger Australian Monsoon in the early Holocene than the late, and the opposite for the other SH monsoons (Africa and S America). I content that the coincidence of paleodata and two different climate-modeling efforts provides compelling support of our hypothesis favoring N Hemisphere forcing.

The reviewer refers to changes in precessional amplitude through the last interglacial-glacial cycle. I am aware that modeling is underway to address the relevant influence of precession and obliquity on the Australian Monsoon, but these studies are not yet published. We cannot specifically comment on this aspect because our own modeling efforts to not test this possible effect.

Our contention (I prefer to label it our “hypothesis”) that vegetation change may have been an underlying cause of the failure of the Holocene Monsoon continues to draw skepticism. The reviewer mentions the 2002 paper by van der Kaars and DeDeckker from marine cores of NW Australia. That paper shows a fundamental shift in vegetation and reduced rainfall after 46 ka compared to conditions before 64 ka (the period between these two dates is missing in the core). This conclusion is consistent with our story. The pollen in the marine core is derived from easterly winds that traverse monsoon-watered northern Australia, so the vegetation and rainfall information is a direct reflection of changes in the Australian Summer Monsoon. The core they analyzed also shows a strong early Holocene monsoon, weakening in the late Holocene, an observation that is also consistent with our arguments.

The reviewer also asks about the Pitman and Hesse (2007) paper, which attempts to evaluate the potential role of vegetation on monsoon rain in the modern regime. Although they found weak vegetation-climate feedbacks, there results are consistent

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with our hypothesis. We argue that vegetation will be influential only when monsoon forcing is at its maximum. In the modern regime, large scale forcing (boreal winter insolation in our hypothesis) is particularly weak, and vegetation feedbacks are not strong enough to override basic physics.

Regarding the comments for throughout the text:

1) Genyornis and Dromaius are italicized on my version and this must have been lost in translation to pdf. They are correctly italicized in this version.

2) I accept the formal subdivision of the Quaternary into Early, Middle and Late, with specific time domains, and use the capital letters to indicate this.

3) Other minor suggestions have been accommodated.

Interactive comment on Clim. Past Discuss., 2, 535, 2006.