

Interactive comment on “The influence of dynamic vegetation on the present-day simulation and future projections of the South Asian summer monsoon in the HadGEM2 family” by G. M. Martin and R. C. Levine

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Anonymous Referee #1

The vegetation processes are complex and one of the major sources resulting biases in current model simulation and future climate projection. For instance, majority models projected that the monsoon will enhance in the global warming scenario. But the observations did not show the enhancement till now. This disagreement implies that something (such as vegetation, cloud processes) may be missed or incorrect in the

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models. This work investigated the influence of dynamic vegetation on South Asian Monsoon through some sensitive experiments. The results should be interesting for the community. I list some suggestions for authors to improve the current ms or to do some possible examinations in future.

(1) Both the mean state and variability of the South Asian summer monsoon are important. Some previous works (e.g., Meehl and Washington, 1993: *Science*, 260, 1101-1104; Hu et al. 2000: *GRL*, 27 (17), 2681-2684) suggested that the mean state and variability of the South Asian summer monsoon will change in global warming scenario. It will be interesting to check what is the impact of the vegetation processes on the variability.

[Reply:] We agree that this is perhaps an even more interesting aspect and one that we will be focussing on in future. In addition, we are interested in the impacts (or lack thereof) of the dynamic vegetation in this model on other monsoon regions such as West Africa and East Asia. We felt that the current manuscript was already long enough without including these aspects, which will form the basis of future papers.

(2) Model dependence: It is clear that there are obvious biases of GCM in simulating the regional climate, such as the monsoon. Thus, I believe that these sensitive results in this work are also largely model dependent. Thus, some additional discussion in the last section may be necessary.

[Reply:] We agree that some of the specific impacts are likely to be model dependent; in particular, the additional dust in our -ES configuration results from the particularly large negative bias in rainfall over India in our atmosphere component. We have already mentioned this dependence in section 5 (paragraph 4 in original submission), but in the revision we have added a little more to emphasise this point. In our opinion, the key point is the illustration that including additional processes can lead to unexpected results when these interact with existing model biases. As models become increasingly complex, that universal point will be important across the model develop-

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ment community.

(3) In addition to the direct impact of vegetation processes on the Monsoon, the vegetation processes may alter the climate variability modes that affect the Monsoon. For example, Potter et al. (JGR 2003, 108(D17)) pointed out the connection of SO and AO with carbon flux. Hu et al. (JGR 2004, 109 (D21113)) suggested that an energy sink/leak over land may change the mean state in the tropical Pacific and ENSO, implying the potential impact of land property change (such as deforest) on ENSO and ocean climate. So these indirect influences might be mentioned.

[Reply:] We agree that the wider impacts of vegetation changes warrant further mention. We have added a reference to Hu et al. to section 5 in the revised version.

(4) Figs. In addition to the wind vectors (Figs. 2, 10, 15, 18, 21), it would be more straightforward for the explanation to add the divergence and convergence.

[Reply:] This is a useful suggestion, and we did try this, but we found that adding changes in convergence/divergence was confusing (e.g., is it more convergence or less divergence?) as well as partially obscuring the wind vectors. Therefore we have decided to leave these plots as they are.

(5) Fig. 5. It is better to add the corresponding observations.

[Reply:] Agreed, although observed estimates of latent heat fluxes are not considered very reliable. However, in response to a request from the other reviewer to reduce the number of figures, we have removed this figure in the revised manuscript.

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