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Earth System Dynamics Discussions

Interactive comment on "The influence of vegetation on the ITCZ and South Asian Monsoon in HadCM3" *by* M. P. McCarthy et al.

Anonymous Referee #2

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1 General Comments

The authors have presented an interesting paper highlighting the importance of the representation of land-surface properties in the northern hemisphere extratropics to tropical anomalies in general and the simulation of the South Asian monsoon in particular. The manuscript could be made acceptable for publication with a few changes in order to better demonstrate the mechanism involved and to allow the variety of experiments used to be more easily followed.

2 Specific Comments

Page 93, line 24: please elaborate on why the shorter time periods used in other experiments revealed that the land cover change did not affect regional and local climate. Do you mean that the experiment samples were not long enough to reveal statistically significant results (signal above noise), or that the experiments were not run out for long enough for the various land-atmosphere feedbacks to actually emerge?

Page 94, lines 3-7: is there any suggestion in Osborne et al. (2004) as to why the regional responses to the land surface conditions differ over India and China? Are there different climate mean state conditions over those two regions, for example, that mean the response of the atmosphere to the surface is suppressed in one and enhanced in the other?

Page 94/95, Model description: it would be good to briefly describe or validate the model's simulation of the monsoon in HadCM3 since much of the rest of the paper discusses it. E.g., in Turner AG and Slingo JM (2009; Q J R Meteorol Soc 135:549-567) or in Turner AG, Inness PM, Slingo JM (2005; Q J R Meteorol Soc 131:781-804).

Page 96/97, Experimental description: I feel the experimental description (particularly the naming) used here and in Table 1 could be improved upon, allowing better clarity. Specifically, since many of the paired experiments change the leaf phenology, it would be better to describe them (for example) as WHS and WHSnoleaf, as this would obviate the reader having to refer back to the table. TRIF3 could become TRIF1future also.

Page 97, line 6: the results in this manuscript seem to rely on a shift in the thermal equator and associated movement of the ITCZ. Given that only northern hemisphere extra-tropical vegetation is perturbed in these experiments, the manuscript should at least speculate on how the results would change if the same datasets were compared in the southern hemisphere. Would there be any cancellation of the influences of the

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northern and southern extratropical vegetation on the thermal equator and ITCZ?

Page 97, line 26: the southward shift of the ITCZ could be ascribed to a southward shift of the thermal equator (in this case caused by the preferential cooling of the northern hemisphere extratropics). Such shifts in the ITCZ and thermal equator have been described for HadCM3 by Johns et al. (2003), already cited, in their case being northward in response to anthropogenic greenhouse warming occurring preferentially in the northern hemisphere. It would be useful to mention that study here in this context.

Page 99, line 27: rather than just being "affected" it would be better to describe more precisely what is happening during the onset and decay phases of the monsoon. Are they strengthened/weakened or advanced/delayed for example? This will help explain the W01 index to the reader, whereby there are strong increases around onset and withdrawal times and possible changes to the length of the monsoon season. Page 100, line 6 also contains a generic mention of a dynamical response to the vegetation changes.

Page 100, line 20: the manuscript may be correct that the changes in snow cover and large-scale temperature perturbations in over Eurasia are weakening the monsoon but it would be worth exploring this mechanism more carefully. Turner Slingo (2011), for example, suggest that Himalaya/Tibetan Plateau warming through winter and spring (corresponding to reduced snow cover and similar to Figure 3 here) would lead to increased monsoon rainfall. The results in Figure 3 suggest reduced monsoon rainfall. It may be then that the monsoon is actually responding to the cold temperature anomalies and increased snow much further north. This discrepancy should be mentioned. I would also suggest employing another index (that of Xavier et al., 2007: Xavier PK, Marzin C, and Goswami BN (2007) An objective definition of the Indian summer monsoon season and a new perspective on the ENSO-monsoon relationship. Q J R Meteorol Soc 133(624):749-764) to help determine in what way the various experiments are perturbing the meridional tropospheric temperature gradient. The reversal

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of such an index is closely linked to the onset of the monsoon. One would expect to see a weakening of this index, or a delay to the time at which the index reverses, in the experiments presented in Figure 3.

Page 101, line 14: the crucial point about the onset in particular being perturbed is that the anomalies of snow do not persist beyond late spring and so cannot affect so well the remainder of the monsoon season (as explained in Turner Slingo, 2011).

3 Technical Comments

Page 93, line 19: change "models" to "model".

Page 95, line 17: insert a colon after "periods".

Page 100, line 25: it would be useful to point to the relevant figure panels when describing the resulting temperature perturbations.

Figures 1,3: these figures are currently too small and should be enlarged to at least fit the width of the associated figure caption. Even when blown up on the screen, it is difficult to interpret the wind vectors in Figure 3 and these should be improved. In addition, at present there is much overlap of some titles from Figure 3 into the adjacent columns, which looks messy. Both these figures would be easier to interpret if there were separate column and row titles.

Figure 4: since colour has already been used in the manuscript, it would be clearer if the curves in Figure 4 were different colours rather than line styles.

Interactive comment on Earth Syst. Dynam. Discuss., 3, 91, 2012.