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Biogeosciences Discussions

Interactive comment on "Implications of albedo changes following afforestation on the benefits of forests as carbon sinks" *by* M. U. F. Kirschbaum et al.

Anonymous Referee #3

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This paper is a welcome and very useful addition to the literature on effects of land cover change on climate. Most papers in this field rely heavily on modelling, often with rather generalised parameterisations, but this paper is very closely based on field observations in its estimation of albedo effects. I did not find any major difficulties with the method or interpretation, so the paper is pretty much ready for publication.

There is just one issue concerning the methodology which I think should be looked at more closely as it is a key assumption. In the absence of ground-based measurements for pasture, the authors use satellite data for pasture. They also compare the satellite data for forest against the ground-based data - all very sensible. But the calculation

of albedo RF is done using ground-based data for forest and satellite data for pasture, which has the potential to lead to a systematic bias. It seems from figure 3b that the satellite data systematically under-estimates forest albedo compared to ground-based data, which implies that the same bias may exist for pasture too (ie: the pasture albedo used in the study here may be too low compared to what would be have been observed if ground-based data had been available. Using the two different data sources may lead to an underestimation of the effect of changing from pasture to forest, as the pasture albedo may be too low (or the forest albedo too high, depending on whether we believe the satellite or ground data). Looking at figure 2 it seems that this effect is probably small (possibly increasing the forest-pasture albedo difference from about 7% to about 7.5% or possibly a bit more - just doing it by eye) but I think it would be important for the authors to estimate this possible bias. It might mean that NZ forests need to remove up to 30tCha-1 before the radiative cooling effect of carbon storage outweighs the warming effect of increased SW radiation - however I've only made a very rough estimate there so the authors need to do this properly for themselves.

Of course this does rely on the assumption that the validation of the satellite data for forests gives a good indication of the reliability of the satellite for pasture. Are there any reasons to think that the performance of the satellite is any more or less reliable over pasture compared to forest (can any other papers be cited that validate MODIS albedo measurements more generally?)

There is another small point of clarification that needs making. I don't think it's quite true that "this finding contrasts with the findings of Betts (2000) who concluded that in boreal regions, albedo changes could be quantitatively more important than carbon storage" (Conclusions, paragraph 1). In fact, Betts (2000) looked at sites across the whole northern temperate and boreal regions and concluded that while albedo could be more important than carbon storage in some areas, it could also be less important in others. So really this study confirms the latter part of those conclusions by Betts (which is very important, as the Betts study relied entirely on albedo simulations from

a GCM). I suggest that the statement in the conclusions be revised to reflect that - and the introduction too. (This does not in any way detract from the importance of the present paper, in fact it probably adds to it as this paper is providing ground-truth for a widely-cited model-dependent paper).

I doubt if my first point makes a huge difference to the overall message of the paper (that albedo effects of forests are important in NZ, but in the long-term they do not outweigh the carbon storage effect). However it is a point that does need checking by the authors.

Interactive comment on Biogeosciences Discuss., 8, 8563, 2011.