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Interactive comment on “Carbon storage versus albedo change: Radiative Forcing of forest expansion in temperate mountainous regions of Switzerland” by J. Schwaab et al.

Anonymous Referee #2

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First, let me say that, in general, I like this analysis and think that it's important. The authors have done a good job incorporating many quality dataset to address a complex problem, and the spatial nature of the analysis is a major strength. However, I have a major problem in that the presentation of the study design and methods are incomplete, such that I cannot determine whether the study design is sound. I am left fully confused by what was actually done. I therefore cannot determine whether the analysis is actually fine, but the methodology simply needs to be explained better, or rather the study design is flawed or could be improved. I will be more specific below.

The fundamental problem is that, despite an emphasis on the spatial nature of this analysis, it is not at all indicated where the land use transitions you include actually

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happen, or even how much land area is converted. Figures 3 and 4 indicate results are “wall to wall”, where every pixel has experienced a radiative forcing. This implies that all pixels were assigned a land use transition, which seems very unreasonable. You considered five land use transitions; which pixels received each transition? Figures 3 and 4 (and 5??) are presented for a particular transition (Intensively Used Open Land (<1000 m) and Extensively Used Open Land (>1000) to Closed Forest), so was the analysis done five times where all pixels received the same transition? Where are the figures for the other transitions? Is this supposed to represent a maximum afforestation case, where all open land is converted to forest? Is that climatologically reasonable? Could forests grow in all of these pixels? Right now your relevant study design text spans about five lines (P10129, lines 6-11). Please expand this and include new figures and tables that illustrate the location and amount of area where particular land use transitions occurred, and text that addresses whether these transitions are supposed to represent reality (between 1985 and 1997) or a hypothetical case? I cannot imagine it is the former, since every pixel seems to have been altered (and experienced a radiative forcing).

Also, crucially, what is the impact of aggregating 19 land classes into five? The authors need to include figures to clarify the impact of these simplifications in their analysis. Again, how much area is affected?

The abstract will also need to be revised so that it is very clear how the land use transitions were assigned.

I think the paper would be greatly improved if it was organized to address a very clear and specific statement of the research objective.

Major comment:

Assuming constant upward transmissivity in the radiative forcing calculation is a major simplification. I would think the upward transmissivity would vary a lot over the elevation gradient in this region. I appreciate that you have quantified the error associated with

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30% variance in this variable, but why not make an effort to include some real spatial information here? I suspect this will exacerbate the elevational effects you are seeing. I think you could use some archived high-resolution climate model data to develop a climatology of upward transmissivity in the region and use that.

Minor comments:

p. 10126, line 21: change “biogeophysical (mainly albedo) and biogeophysical” to “biogeophysical (mainly albedo) and biogeochemical” ??

Figure 3 captions are scrambled

Equation 6, need to clarify whether the RF is at top of atmosphere (TOA) or at the surface. It should be at the top of atmosphere. Also need to clarify whether the incoming global radiation data are for the surface, or TOA. It needs to be at the surface, so that the incoming beam is already attenuated by clouds, aerosols etc. This helps reduce the error associated with assuming a constant upwelling transmissivity over the whole domain (although I hope you will address that problem separately).

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