Comment on gmd-2021-69

Anonymous Referee #1

Referee comment on "Afforestation impact on soil temperature in regional climate model simulations over Europe" by Giannis Sofiadis et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2021-69-RC1, 2021

Review of: Afforestation impact on soil temperature in regional climate model simulations over Europe

Sofiadis et al.

Overall Evaluation:

The study examines the results of the LUCAS regional climate experiments, which explored the climate impacts of afforestation and deforestation in Europe. The study focuses on the effects of forest cover on soil temperatures. The study finds that the different regional climate models that participated in LUCAS give contrasting projections of changes in the annual amplitude of soil temperatures. The underlying experiments and motivations of the study are sound, however the presentation and analysis of the results are confusing and incomplete. I recommend major revisions.

General Comments:

(1) The paper lacks a clear causal explanation of why the models vary so much in the change in the amplitude of soil temperature. The attempt to explain the variation relies of two factors: the annual amplitude of ground heat flux, and soil moisture. Soil moistures is a perfectly valid explanatory variable but ground heat flux is not. Temperature and ground heat flux are both thermodynamic quantities and thus are very closely linked. Without an internal heat source (such are waste heat from soil carbon decay) subsurface temperature is surface heat flux modified changes in thermal diffusivity and heat capacity. In models thermal diffusivity is likely only being changed by soil moisture and maybe soil carbon content. Thus, it is no surprise that temperature and heat flux correlate well, but also this does not constitute an explanation.

Instead the focus should be on the differences in surface energy balance components (which are briefly examined) and the differences in model structure that may cause these

differences. Key features to examine are: how snow is treated, how litter is treated (it is a good insulator), how forest canopies are treated and how root-depth is treated.

(2) Despite being mentioned in the introduction soil profiles are never examined. Instead annual amplitudes of temperature at just one depth are examined. It would be useful to examine how temperature changed with depth in grassland and afforested conditions. Examining these profiles may also be helpful in finding a causal explanation for inter-model variance.

(3) How the models are being forced is unclear. The text implied that RCMs are being used with interactive atmospheres but the methods section seems to imply the reanalysis data is being used to force the models. The methods may be trying to say the reanalysis is being used at the RCM boundaries but this is not at all clear.

(4) The manuscript has far to many abbreviations. As a rule of thumb, only define an abbreviation if you are going to use it 5 times or more.

(5) Citation parenthesis are used incorrectly. Citations are not placed in parenthesis if they need to be pronounced as part of a sentence. For example "(Davin and de Noblet-Ducoudre, 2010) analysed a GCM's sensitivity to idealized global deforestation ..." should be: "Davin and de Noblet-Ducoudre 2010, analysed a GCM's sensitivity to idealized global deforestation ..."

(6) Using Celsius instead of Kelvin would make the manuscript more readable.

(7) The paper is not self-contained and relies on Davin et al. 2020. Elements critical for understanding the experiments should be reproduced here.

Specific Comments:
Abstract: Make it clearer you are examining soils.

Introduction: Briefly introduce the biogeochemical effects of deforestation and make clear that you are only examining the biophysical effects. Also need to explain what RCMs are and how they improve on global studies.

Line 44: Many of the models that you are referring to are Earth system models.

Line 48: Cloud feedbacks?

Line 48: "On contrary" is not grammatically correct. "However" would work.

Line 50: Citation needed.

Line 54: "Inter-comparison" should be "Intercomparison"

Line 106: This table should be reproduced for this paper.

Line 110, 112: Forest and Grass are not acronyms and thus do not need to be in all caps.

Line 113: Show the maps.

Line 117, 118: These abbreviations are barely used. They can easily be eliminated.

Figure 1: The map needs a North arrow, a scale, and inset showing the study domain, and higher resolution territorial boundaries. Using a different line style for national boarders and coastlines would also be helpful.

Line 165-166: Rewrite sentence for clarity.

178: 'assumed' is a poor choice of words. Models suggest.

Line 207: Change 'involve' to 'include'

Line 213, 215: 'Obviously' and 'totally different' are informal constructions 'Clearly' and 'largely different' would be more consistent with formal English.

Figure 3,4: Use Celsius, also in caption give depth of temperature.

Figure 5: In caption explains which direction of heat flow is considered positive.

Figure 8: Net radiation and turbulent fluxes should have opposite signs, one is opposing the other. Is melt energy included in the latent heat flux?

Figure 11: Write out the region names.

Line 371: At what depth is the cooling?

Line 389: This section is the Discussion and Conclusions.

Line 439: 'Nowadays' is English slang, very informal.