Reviewer #1

The paper uses CCLM in order to investigate what effects afforestation in the year 1986 to 2015 had on the climate in Europe. I think the paper has a clear idea and research agenda and properly executes on it. From my point of view an improvement is needed in the validation.

Reply: Thank you very much for reviewing this manuscript, for your assessment and your helpful comments. Detailed answers to your comments can be found below. Changes in the revised manuscript will be implemented with tracked changes.

The paper discusses effects on temperature and precipitation but only looks at the model performance with respect to temperature. I think a discussion similar to temperature but looking at precipitation is needed. Even though the authors look at averages and extremes of the two variables, the validation only looks at averages. I think one can live with that but, again, a look at precipitation (averages) is needed.

Reply: Thanks for pointing this out. We agree with your assessment that a model validation with respect to precipitation is important and have now included a validation for precipitation in the revised manuscript. The discussion of the model performance is extended in the following way:

"First, we analyze the capability of CCLM-VEG3D to reproduce the general climate conditions in Europe. Figure 2 shows the differences between the reference simulation (REF) and the ERA5-Land reanalysis (Muñoz-Sabater et al., 2021) for (a) the yearly mean 2 m temperatures and (b) the yearly total precipitation sums during the period 1986-2015.

A warm bias is simulated over most parts of Europe in the reference simulation, extending from Southern Europe over Central Europe to Eastern Europe. However, these deviations to ERA5-Land are in the same range as the biases of other RCMs, as demonstrated by Kotlarski et al., (2014). Regarding Northern Europe and the British Isles, the simulation results agree well with the reanalysis data.

Total precipitation sums are underestimated in CCLM-VEG3D in southern and western Europe, but overestimated in eastern and parts of northern Europe (shown as a percentual deviation in Fig. 2). This is also true for the mountainous regions of the Pyrenees and the Alps. On the other hand, the simulated precipitation sums agree well with the reanalysis data over large parts of Central and Eastern Europe as well as of southern Scandinavia. Thus, the results of CCLM-VEG3D reflect the already known precipitation pattern of regional climate simulations with CCLM (Kotlarski et al., 2014).

Therefore, although a certain model bias for the simulated 2 m temperature and the total precipitation sums is found, the simulation results of CCLM-VEG3D are comparable with the results of other RCMs (Kotlarski et al., 2014) and we conclude that the model is generally able to reproduce the general climate conditions in Europe." (Lines 178-195)
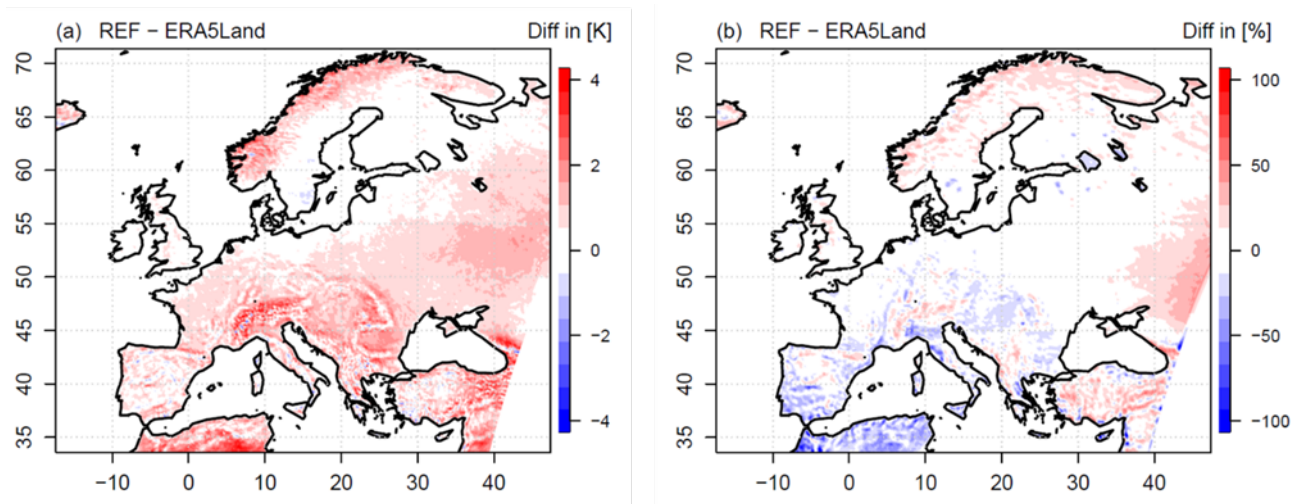
Figure 2: Differences in the (a) yearly mean 2 m temperature and (b) the percentage deviation in the yearly mean total precipitation sums between REF and the ERA5-Land reanalysis for the period 1986-2015.

Could you indicate or mention in Figures 3 and 4 which values were significant?
Reply: We thank the reviewer this comment. In general, the visualization of local effects is very challenging, since afforestation took place only on small spatial scales and isolated locations during the period 1986-2015 (see Figure 1b). Highlighting significant local effects in individual grid cells would consequently be very difficult at this high spatial resolution, and the local changes would not be visible. Therefore, we have decided for visualization purposes to summarize the local effects of afforestation for three characteristic sub-regions (NE, CE, SE). However, this means that both significant and non-significant changes in individual grid cells are included in Figures 3 and 4 and summarized in one bar. In order to be able to visualize the fraction of significant local changes, we decided to divide the bars in Figure 4 in two fractions, a significant one, which is highlighted with dashed lines and a non-significant one, which is filled blue, thus indicating the relationship between significant and non-significant results for each region and season.
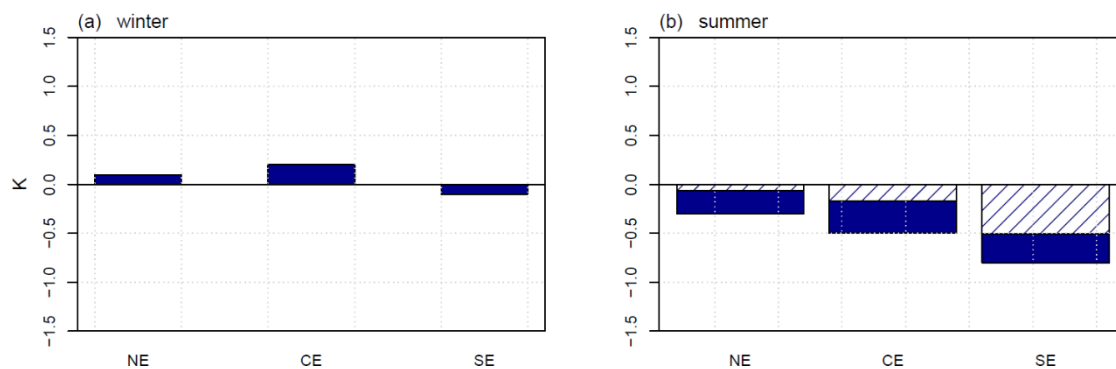
Figure 4: Local effects of afforestation (AFF-REF) on the mean surface temperature in (a) winter, and (b) summer for the three subregions NE, CE and SE. The fraction of significant local effects in the respective subregions (calculated with a Wilcoxon-Rank-Sum-Test at a 95 % level) are indicated by dashed lines.

Maybe 2 stylistic notes:
  The authors repeat the mechanisms that lead to the effects very often. I think it is good to repeat things but maybe not so often.
Reply: The high level of repetitiveness (and this redundancies) was criticized by both reviewers. Therefore, we removed parts of the text where a repetition actually occurred:
Lines 42-47

Line 244
Lines 425-429

However, we think that this apparent repetition of results arises from the fact that afforestation in Europe has similar effects on the surface energy balance in summer as well as in winter. By dividing the results into local and non-local effects, this impression was possibly reinforced. However, the weighting of the individual afforestation effects varies in the different regions of Europe. Addressing these processes in each region and in each season is key in order to be able to explain the effects of afforestation on the surface energy balance conclusively. We thus left most of the process description as it is to ensure that all afforestation effects are described in a comprehensible way.

 [Disclaimer: not a native speaker] The English word "whereby" means "by, through", it doesn't match the German "wobei".
Reply: Thanks for the comment. We rephrased the corresponding text and removed the word "whereby" in the respective sentences.

Other minor notes on English: 294 "visible" -> "can be seen"
Reply: is replaced

320 "stronger pronounced" -> "pronounced more strongly" (occurs several times)
Reply: is replaced throughout the whole manuscript.

414 is "buoyancy" the correct word here (not saying it's wrong and not entirely sure what you wanna say, but I only know it from liquids, do you mean something like convection?)
Reply: We really mean buoyancy in the hydrostatic sense. According to Archimedes' principle, the buoyancy of a body in a medium (fluid or gas) is equal to the weight of the medium displaced by the body. Transferred to the atmosphere, this means that an air mass with a high density (cold air mass) sinks, and an air mass with a low density (warm air mass) is lifted until the density of the air mass is equal to the surrounding air. Thus, buoyancy is the driving force behind convection.
The strength of turbulent heat fluxes from the surface to the atmosphere depends on two factors: buoyancy and wind shear. In southern Europe, buoyancy is generally higher than in northern Europe due to the generally higher near surface temperatures and the resulting larger density difference to the overlaying atmosphere. In combination with the higher surface roughness of forests and the associated increased wind shear, afforested areas in southern Europe can transform solar radiation into turbulent heat very efficiently.

In order to prevent ambiguities, we rephrased the corresponding text in the following way:
"In southern Europe, where insolation is higher, snow cover plays a minor role for the surface energy balance. Surface temperatures are typically higher than for central and northern Europe, and therefore, buoyancy is generally stronger in this region. In combination with the higher surface roughness of forests and the associated increased wind shear, afforested areas in southern Europe are consequently able to transform this increased energy input from solar radiation efficiently into turbulent heat and release the energy into the atmosphere (e.g. Breil et al., 2020), counteracting the increased solar radiation." (Lines 428-433)

474 "certain" -> "some"
Reply: is replaced

474 "reached as high" -> "reached values up to"

Reply: is replaced.