<u>Review of paper "Projected decrease in wintertime bearing capacity on different</u> <u>forest and soil types in Finland under a warming climate" by Lehtonen et al.</u>

The paper presents the results of a study aimed to evaluate the projected decrease in the bearing capacity of Finnish soils in function of the changing climate during the 21st century. The paper appears well written and the results are interesting for the scientific community, even if related to the specific territory of Finland. The method is general and can be applied also in other nations in which the wood harvesting is economically important.

However, a lack in this paper is the detail related to the choices of parameters performed in the model used, the description of the pre-processing procedures (inclusive of the choices of the several parameters used in this study), the statistical comment about the values (especially those selected as a result of several simulations), and in general a too short description about the consequences and the limitations of these choices on the interpretation of the results. In my opinion, this part deserves a deepening, because it could help to evaluate the results and also give more strength and robustness to the conclusions. This is the reason for which I do not think that this paper could be accepted in the present form, but requires some modifications that, in my view, can be intended as minor. The list of requirements can be understood better by looking at the specific comments here listed page by page.

- Introduction: in my opinion, a too large part of the introduction is dedicated to explain the industrial problems, while a too small part is dedicated to the scientific problem and the models used.
- Page 4 lines 4-28: the equation proposed to estimate soil temperature seems not consider the effects of soil moisture (unless thermal conductivity is kept variable, but since there are no measures of soil moisture it is hard to consider such variations). A comment on this consideration may be required.
- Page 5 line 15: regarding KT values, is the interval of values used significant for the considered soils?
- Page 5 lines 18-19: "while, for example, KT seemed to steadily increase with soil depth." this is consistent with the assumption of increasing soil moisture at increasing depth (or change of soil texture): do you have any data evidencing these facts? Please comment.
- Pages 4-5: the method elaborated to retrieve soil thermal conductivity is strongly linked to the availability of soil temperature data, and thus will become representative of the experimental sites during the measurement periods. If I have correctly understood, such values optimized for each site will be adopted for the following simulations. However, there is no any reason for which such values could remain constant also in future climate... This could be a limitation for the reliability of future simulations. If authors do not agree with my conclusion, they could explain why...
- Page 6 lines 1-10: the choice of different thresholds for soil freezing changed substantially the evaluation of the number of days with frozen soil? How and how much?
- Page 6 lines 17-23, and page 7 line 5: I suggest to say here that the values used in eqs. 5 and 6 will be discussed later.
- Page 8 lines 3-12: again, the method elaborated to retrieve the values of parameters is strongly linked to the availability of measured data, and thus will become representative of the experimental sites during the measurement periods. Since such values optimized for each site will be adopted for the following simulations, there is no any reason for which such values could remain constant also in future climate... Also in this case, if authors have a different idea, they could explain why...
- Pages 8-9 lines 29-4: in this paper, many decisions about parameters are just summarized by "hiding" the results. For instance, in this case, the choice of values for kmin and kmax is not

justified, and the reader cannot understand how it has been made. In my opinion, this may deserve an additional subsection (similarly as all other choices of this model).

- Page 9 lines 9-10: authors use only R2 as indicator of good simulations. However, if just for example I would have a simulation in which simulated snow depth has almost the same time trend of observations, but a value that is double, R2 will be close to one even if the relative error will be 200%... I suggest to use also bias or standard error as a criterion to validate simulations, and not only use correlation coefficient (and, by the way, it is better to use R and not R2).
- Page 9 lines 30-32: how the GCM and RCM have been chosen (I think you should mention here more clearly that the detailed list of model chosen is reported in Table S3), and why those models, among the whole EURO-CORDEX dataset?
- Page 10 line 20: is the modeled annual average number of days evaluated as the average of all GCMs and RCMs, respectively?
- Page 12 lines 6-15: how large is the difference among model ensembles (separately for RCM and GCM) in the three climatic periods? I think that also this information is important to statistically locate your results. Section 3,4 and Figure 6, in my opinion, are not informative, as they mention only the two models giving the maximum and the minimum values, and not the distribution. As climate cannot be described just by extremes, but needs a complete statistical information, for the same reason I think that the standard deviation or some equivalent statistical parameter can be more informative about the dispersion of individual model calculations.
- Table 3: the numerical values given for each parameter have too many digits, most of them without any statistical meaning. Instead of giving a number with too many not significant digits, authors should give a number and an error associated with the experiments and comparisons, like a = value ± error
- Figure 2: since it is hard to appreciate differences among the three figures, given the quite large interval of variation of the number of days, it could be better to plot, for second and third column, the differences among GCM and observations, and RCM and observations, respectively (similarly to what you did for Fig, 3). Or maybe you can add such figures, if you want to keep the total number of days.