Reply to the editor

Dear Somnath,

thanks for your evaluation and comments. We are glad to hear that you are satisfied with our responses to the reviewer's comments.

In this document, your comments are in *italics* and additions to the manuscript are highlighted in blue.

Major comment:

Line 101: If I understand you correctly, the total change is decomposed into dynamical and residual components where the total change is calculated from the RCP runs and the dynamical component is from the 1% CO2 run. Is my understanding correct? If so, how will the decomposition work because the CO2 forcing in the RCP scenarios are all different? I assume there is a simple explanation for this because otherwise the whole analysis will fall apart because the residuals will contain some CO2 forcing signal, less in RCP2.6 and more in RCP8.5.

Author response
Please note that we account for the different forcing in the different RCPs by comparing different time windows of the 1%CO2 simulation with the end decades of the RCP scenarios. Specifically, we calculate the year in which CO2 concentrations in the 1%CO2 run are equal to the final CO2 concentration in the RCPs (see Table 1). For example, the RCP85 CO2 concentrations at the end 21st century are about 935 ppm, which corresponds to the year 1971 in the 1%CO2 simulation. By contrast, RCP26 end of century concentrations are only 420ppm, corresponding to the 1891 concentrations in the 1%CO2 simulation.

Minor comment 1:
Line 106: What do you mean by primary and secondary land and "changes in primary and secondary land"? This is not very clear to me and that is why I am not able to fully comprehend what is shown in Fig 2 column 4. Does primary and secondary land refer to primary and secondary vegetation, respectively, as in line 97?

Author Response
Thanks for bringing up this language consistency issue. We adopted the language from the LUH dataset description where „*Secondary* refers to land previously disturbed by human activities and recovering, while *primary* refers to land previously undisturbed by human activities in GLM, both since the beginning of the historical simulation." [Hurtt et al., 2011]. In other words, primary land is the fraction of the grid cell that is covered by undisturbed vegetation (i.e., primary vegetation) while secondary land is the fraction of the grid cell that is covered by vegetation recovering from disturbances (i.e., secondary vegetation).

We decide to link the lines 97 and 106 more clearly to avoid similar confusion in the future.

Changes to the manuscript
l. 97:

in all locations that contain either primary or secondary vegetation. While primary vegetation refers to vegetation that has been previously undisturbed, secondary vegetation refers to vegetation that recovers from human intervention. Following the LUH naming convention from Hurtt et al. (2011), we use the term primary (secondary) land to refer to the fraction of a grid cell that is covered by primary (secondary) vegetation.

Minor comment 2
Line 168: Please explain in the text what the IMAGE, MiniCAM and MESSAGE acronyms stand for.
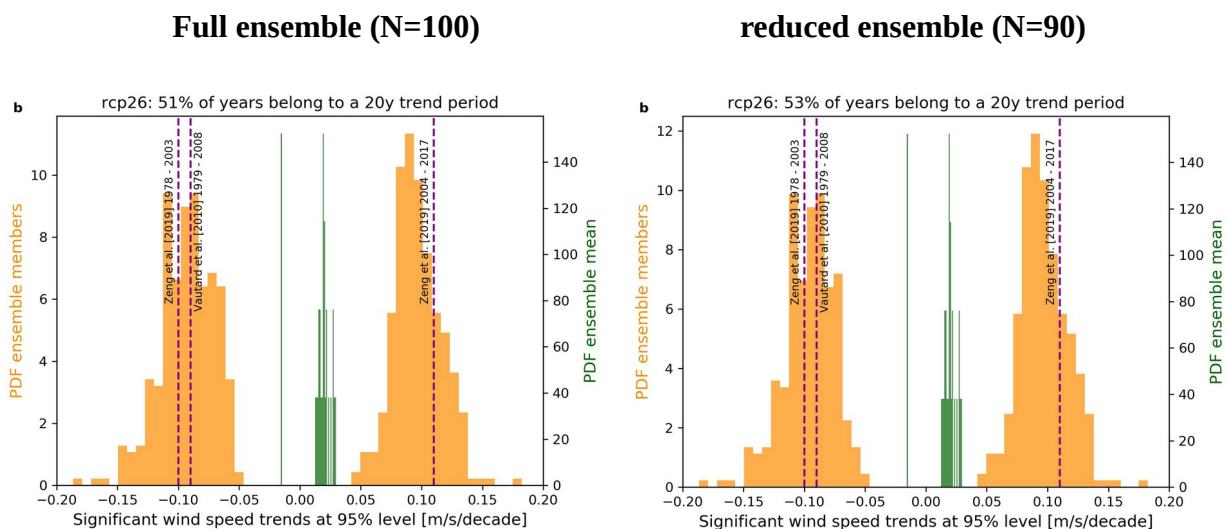
Changes to the manuscript

Caption of Fig. 4

> **in the rcp scenarios.** The subplot titles give the acronym of the Integrated Assessment Model followed by the name of the rcp. IMAGE stands for Integrated Model to Assess the Global Environment; MiniCAM is the Mini-Climate Assessment Model; MESSAGE is the Model for Energy Supply Strategy Alternatives and their General Environmental Impact. Maps show ...

Additional author comment

In a final internal review, we noticed that in the RCP2.6 ensemble members 28-33 and 36-40 are identical. We re-downloaded the data to ensure that the problem wasn't created by our preprocessesing and we informed the dataset providers at MPI about the issue (no answer since early August).

We checked whether the duplicates affect our results, and their impact is too small to matter. For instance, we repeated the trend calculation with the subset of ensemble members that are distinct (i.e., from the total of 100 ensemble members, we exluded the 10 members that are dubplicates). As displayed in the Figures below, both the probability of trend occurrence (51% vs. 53%) and the distribution of the trends relative to the reported number from the literature are very similar. Since the issue is also limited to RCP26 and does not affect the pre-industrial control, historical, rcp45 and rcp85 simulations, we consider it justified to ignore the duplicates here. However, we added a sentence to the Methods section to clearly and transparently flag the issue.

Full ensemble (N=100)   reduced ensemble (N=90)

Changes to the manuscript
l. 71 ff:
> Out of the total 500 ensemble members (5 experiments times 100 members), three members were excluded from the analysis as a cautionary measure because they had a dozen

duplicate time steps. Moreover, we found that ensemble members 28-33 and 36-40 have identical wind speeds in rcp2.6. These duplicates only have negligible effects on our results which we verified by repeating the analysis with a subset of members that are mutually distinct. For internal consistency, and since the other scenarios are not affected, we decided to always use the full ensemble.

Kind regards,
Jan (for all authors)