**Representing socio-economic factors in the INFERNO global fire model using the Human Development Index**

Review:

The authors aim to describe the representation of socio-economic factors in a global fire model using HDI. They describe applying a linear term to the human ignition parameterisations in INFERNO and argue that it improves the model performance in general as well as producing more accurate burnt area patterns.

Apart from a decrease in bias in some regions, performance decreases in other and especially the global values of burnt area are significantly worse than in the non-HDI version of INFERNO. Fig A1 and table 2 show that the HDI implementation doesn't seem to work at all in areas with low to very low population density and still high HDI like AUST and BOAS. This is not a model improvement, and it doesn't show the potential of including HDI in a global fire model. INFERNO is considered a global fire model and, therefore, an effort to add extra value to the model should aim at a general increase in performance.

The authors have updated the model by implementing revised per-PFT-BurntArea values that are independent of the implementation of HDI and added a (1-HDI) term to the ignition equations in the fire-model (equations 2&3).

The results presented in this study suggest that the straight-forward application of this dampening term (1-HDI) is not sufficient to improve the global performance. A look at Fig A2 and the regional burnt area for AUST and BOAS might suggest an application of a correction term that might weigh HDI itself by e.g. human population density, as it seems unlikely that a generally high HDI should still have its maximal effect in remote regions.

Further, one could imagine that a retuning of the whole set of empirical parameters in equations 2-4 might help.

Finally, a linear application of (1-HDI) seems arbitrary. A derivation of a factor depending on HDI for equations 2 and 3 is needed to justify any approach.

General remarks:

- I would like to see the temporal and spatial resolution of HDI described? (fig A2 only gives a hind)
- GFED4s: I assume that it is actually GFED4.1s, right?

Comments by line:

8-9: Please describe what you mean by "reduces[..] positive biases[..] by more than 100%" Is it reducing a bias of 700% by 100% -> 600%?

48: Maybe replace "In this study" with "In their study". It is a little ambiguous.

102: It would be nice to mention that you revised the empirical parameters for INFERNO (as you did in lines 153ff) already here.

131: Please, explain the ES in JULES-ES (Earth System?).

132: "*JULES simulates surface fluxes of water, energy, vegetation and carbon*" Vegetation is named as a flux here. Please, re-phrase the sentence.

145: You write that the Analysis will be performed over the years 1997-2015 while you state in line 137 that you will analyse 1997-2016.

155 & Table1: The revised values differ substantially from the original ones and, since they have not been a result of model tuning towards the new algorithm, an explanation is needed as to why these are more suitable.

173: JULES-INFERNO+HDI seems to increase the negative bias the most in SHAF but it is not mentioned here.

Figure 4: I found it quite hard to read those two maps, especially where there is not much of a difference between the two simulations. It might help to only plot stippling where there is a significant relative decrease in bias. Slightly bigger maps might help as well. Maybe cut off Antarctica, for example.

Figure 5:  It would be nice to have colors here. The grey-scales are hard to distinguish. I would show all areas here, especially the Africas, as they are very important areas for fire and those, where Chuvieco et al. consider HDI the most important for interannual variability.

175: This sentence implies that there is an improvement in some regions while it might deteriorate in others, when in fact it seems you added a negative correction globally which might improve at large positive biases but will make negative biases worse.

179: Here, you state "JULES-INFERNO+HDI has a smaller bias than JULES-INFERNO globally, except for savanna regions in Africa, Australia, and central Eurasia." Globally the bias has

significantly worsened when, just as in the previous comment, it improves the positive biases while it worsens the negative ones. Maybe choose a more neutral wording.

188ff: Please describe in more detail what e.g. The STD is. Is it every-grid point or annual totals, what is STD/STDgfed4s supposed to show etc....
Mention $\overline{\emptyset_x}$ as constant bias to be removed.
Equations 9 & 11: I suppose you generate the observation-bias from different types of burnt area observations as you state in line 146, but in the context of Figure 5 you only mention GFED4. I would

A HDI map for e.g. 2016 would be nice get an impression of what the dataset actually looks like.

Table 2: I find it very difficult to look at. Please, do not use separators between each cell. Maybe only have separators between models and GFED data blocks. Further, it is just pure numbers, it might be more educative to have bold numbers for better performing model or even a colour code ranking them. Overall, I think this table should not be in the main article, because it is not a "product" of the article that others might later use, I would put it into the Appendix, but up to you.

Line 226: It is "RMSE_UB", I suppose.

Section 3.2: I think, it would be good to add uncertainties to the trends presented in this section, both modeled and observed. Due It is hard to figure out the actual information in Figure 6.

317: Unfortunately, I do not share the authors opinion that this study has shown that an inclusion of HDI is necessary to improve the model. The model itself seems to need an update to be able to deal with the information added.

320: Remove "Discussion & Conclusion"

321: Pechony and Shindell (2009) fire ignitions aim to reproduce anthropogenic ignitions including any circumstances (like HDI). The empirical values therein might not hold anymore when applying a term for HDI.

326: I think it shows that performance is improve in regions with large positive(!) biases. This is somewhat expected when dampening terms are included.

327: I think it can be stated that at least in AUST and SEAS the performance has been "well" before and has deteriorated significantly when introducing HDI. Not to mention the global performance.

330: In INFERNO+HDI these compensating errors are even bigger. The pattern might be better, but it is even more skewed than INFERNO.

337ff: Trends of 20 years of fire data are to be taken with a grain of salt, I think. As mentioned earlier, if we take the uncertainties of these trends into account, there might even be no improvement.

429: Doesn't it in fact add new compensating biases?