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Geoscientific Model Development Discussions

Interactive comment on "INFERNO: a fire and emissions scheme for the Met Office's Unified Model" *by* Stephane Mangeon et al.

Anonymous Referee #1

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Mangeon et al. present the new fire and emissions schem ofr the Met Office's unified model. The approach presented has a reasonable complexity for to be useful in an Earth system model. The model is evaluated using two different forcing datasets and different configurations of the ignition parameterization. Additionally the model performance is compared to the performance of fire weather indices. Overall this is an interesting presentation suitable for publication within GMD. Nevertheless I have a number of suggestions which I believe will help to strengthen and improve the manuscript.

General comments:

The comparison with GFED focusses on stating that the emissions due to peat fires cannot be reproduced by a model not including peatlands. This is correct, a solution could be to exclude the emissions from peatlands from the comparison, as GFED

provides the emissions for a number of different sources.

I find the term fuel density to describe the amount of fuel per m-2 a bit confusing, as this term is often used (for instance within spitfire) as the amount of fuel per volume. If it is the density per volume then the rate of spread decreases with increasing density. I would prefer the term fuel load.

A paragraph specifying the datasets used for the model evaluation is missing. The evaluation could also be a bit extended, for instance showing not only results of carbon emissions but also for the different chemical species.

It remains unclear to me whether the fire model affects the vegetation dynamics, is there any tree mortality computed? also whether vegetation dynamics are included in the model simulations. If fire and vegetation dynamics interact a comparison of tree cover would be useful to evaluate that part of the model. If not, why don't they?

Specific comments: l. 19: you could add the outcome of the fire index diagnostics comparison.

l. 21: is this spatial or temporal correlation? Is it significant?

l. 101: the scaling factor is the 7.7, please specify.

l. 102-5: if you assume fNS=1, you don't need it in the equation, adding this assumption after presenting the equation might be more clear: total ignitions can be represented as: eq3, here fNS equals 1 for mode 1 and 3 and follows eq. 2 for mode 3.

l. 117: Leaf carbon is the living biomass?

l. 119: I think this should say FD_{PFT}, the equation actually does not scale lienarly between 0 and 1, it jumps from 0 to $Fuel_{low}/(Fuel_{high} - Fuel_{low})$. I guess the equation should be $((FPMc + leafC) - Fuel_{low})/(Fuel_{high} - Fuel_{low})$. Additionally, the equation is not defined for fuel density being equal to fuellow and fuelhigh.

l. 123: Here again, the normalization term should be $(RH - RH_{low})/(RH_{up} - RH_{low})$,

please rewrite the equation similar to eq.5 to define the bounds for relative humidity being higher and lower then the thresholds.

l. 127: FD is Fuel Density or Fuel density index?

l. 126-127: which formula are you referring to?

l. 133: explain how the average burnt area was determined. There is no difference between temperate and tropical trees?

l. 146: That suggests you should vary your pft specific burned area. Are there any indications in your results that this is necessary? it might be rather a point for the discussion of your results.

l. 154: CCmin and CCmax are the same for leaves and stems.

l. 158: I don't see why this is makes it justifyable. more interesting would be why you changed the value, was it to tune the emissions?

l. 200: what happens with population and lightning flash rates if JULES is not used in standalone version.

l. 206-225: Give equations for the fire weather indices.

l. 254: How is the correlation computed? spatial or temporal? if temporal, is the correlation computed for each grid cell or just for the global total? pleave give significance levels.

l. 258-262: I don't think the gridcell with maximum burned area is an important benchmark. But what about seasonality? Emissions for the different sources given by GFED could also be interesting. or burned area separated for grass and woody pfts.

l. 264: the peat emissions given by GFED could be excluded here, are crop fires and emissions due to deforestation actually somehow included in the model? otherwise they could also be excluded.

l. 338: interestingly the mid latitudes are not well captured by the fire weather indices. might be the human influence? Including the other ignition modes of the model could give an indication why the model in better than the indices. Any significance values on the correlation?

l. 361: where did you show that the precipitation has an important impact?

l.370: You assessed the uncertainty of the ignitions by including the different ignition modes, but how does this dampen the impact of this uncertainty in inferno?

l. 375: what do you mean by vaporized?

l. 379-382: I don't understand. what do you mean by INFERNO's meteorological and hydrological assimilation? In what sense are the other fire schemes more specialized?

Fig.A1: label the subpanels. why does the temperature function not scale between 0 and 1?

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