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Comment on nhess-2021-384

Anonymous Referee #1

Referee comment on "A data-driven model for Fennoscandian wildfire danger" by Sigrid Jørgensen Bakke et al., Nat. Hazards Earth Syst. Sci. Discuss., https://doi.org/10.5194/nhess-2021-384-RC1, 2022

This paper uses Random Forests to estimate wildfire probability in the mostly boreal Fennoscandia region. Comparable studies using similar data and Random Forest models have been performed over various spatial domains but this study is the first one focusing on Fennoscandia in particular. The analyses are thorough and very well documented. There are a few issues I would like to see addressed before publication:

- What was the motivation to perform the analysis at a 0.25° and not the native MODIS resolution, or at least at the finest meteorological resolution? You lose a lot of spatial detail in this way.Pixel product data are available at a 250 m resolution.

- Not including dynamic vegetation predictors or specific land cover is a weakness. Recent work (e.g. Kuhn Regnier et al., 2021) has shown that adding vegetation dynamics has considerable impact on model skill. NDVI not being modelled by DGVMs is not a valid justification as several productivity-related indicators estimated by DGVMs are available from Earth observation. The same applies to (more static) land cover information, such as crop fraction or tree type (e.g. Forkel et al., 2019).
- The same applies to socio-economic drivers such as population density. Fig.3 suggests that there is clear link between wildfire occurrence and population centres. Probably, including crop fraction as variable would already be a good proxy for this.

Detailed comments

The title is a bit misleading: The model identifies the main hydrometeorological drivers of past wildfire occurrences. It estimates the probability of wildfire occurrence but it does not predict (i.e. forecast) wildfire occurrence itself; It this should be made clear in the title.

l68-69: It is misleading to state that fire-weather indices based on climate model and reanalysis data can be used for monitoring and forecasting.

l91: mention some of these limited studies using data-driven methods to predict intra- and inter-annual dynamics, e.g. Forkel et al. (2017, 2019) and Kuhn-Regnier et al. (2021), who predict monthly global patterns.

l92: How do you define a data-rich region? With recent satellite availability, practically all regions have become data rich and several studies ha

l97: "In addition, a bottom-up approach is typically less straightforward in its data requirements and
methodology as compared to the process-based approaches" -> explain

l123: unclear whether this dataset is used for training or as independent validation reference. If used as target in model development, this doesn't come out clearly in Fig.1 (as it should also be split up into training and testing)

l127: How can the machine learning algorithm both be simpler and more sophisticated?

l181: Why are dynamic vegetation predictors not included? Recent work (e.g. Kuhn Regnier et al., 2021) has shown that adding vegetation dynamics ha considerable impact on model skill.

l220: why is wind speed included as predictor? More a predictor of fire spread than of occurrence

l314: Which threshold was used beyond which no more predictors were removed?

l394: Why did you not assess the impact of a predictor that is

Section 3.1/l415: The final set of predictors, which mostly excludes anomaly-based indicators, seems to suggest that the model is tuned to predict fire occurrence climatology rather than typical fire weather situations. Is this correct?

L419-421: is the minor difference between the RF model and the FWI predictors really significant?

l442-447: To me it's not very surprising that simply including NDVI does not improve model skill as it's climatology closely follows that of soil moisture and meteorological variables. Did you also test the inclusion of NDVI anomalies?

l445: High fire danger (luckily) most of the times does not lead to actual wildfire activity as an ignition source is required.

Fig.9: it seems that the correlation patterns closely follow the border between Finland and Russia (ans to lesser degree Sweden). How can this be explained?

Can it be that the superior skill of FWI over the RF model is because FWI describes anomalous conditions whereas your model more relates to describing fire weather climatology and spatial patterns?

l496: In this context, reference should me made to Forkel et al., 2012, who showed that antecedent moisture conditions are better predictors of fire occurrence in a Boreal environment than FWI and precipitation anomalies.

l498: to what extent is soil moisture an indicator of litter fuel conditions? This is usually where fires start, not in the tree crowns.

l531: This statement underestimates the role observations play in reanalysis.

l533-534: Could it be that wind is not directly but indirectly related, i.e. by the dominant weather patterns? High-pressure conditions, which are favourable to fire weather, are typically associated with low wind speeds. Vice-versa, westerlies bring high wind speeds and precipitation.

l539: are latitude and months of the year not already implicitly included in the other predictors?

l545: vegetation variables like fAPAR and LAI would be more obvious candidates than NDVI as these are simulated by DGVMs (which is an argument you brought up earlier).

l546: Vegetation Optical Depth from microwave satellites has been proposed as fuel moisture indicators (e.g Forkel et al., 2017, 2019).

l582: Several studies have done this before as proved by the references below. Please rephrase.

l611: I'd be careful with the word easily here as in other regions others drivers can be dominant, some of which may not even have been originally tested here. Besides, high-quality datsets such as the EOBS and observation-heavy reanalysis data may be unavailable or have reduced skill, respectively, in other regions and hence lead to a different model. Also fire management is different in many parts of the globe (e.g. rangeland burning management in Africa or deforestation).

References

Kuhn-Regnier et al., 2021: https://bg.copernicus.org/articles/18/3861/2021/

Forkel et al., 2012: https://iopscience.iop.org/article/10.1088/1748-9326/7/4/044021/

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Forkel et al., 2019: https://bg.copernicus.org/articles/16/57/2019/