Reconstructing 20th century burned area through machine learning

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EGU Abstract

1.The Challenge

Our most reliable global burned area observations come from satellites. However, these datasets only go back to ~the year 2000.

How fire has evolved since the early 1900s is, in many regions, not fully understood.

Ideally, we use process-based models to reconstruct past burned area. However, these models currently often fail to reconstruct observed fires.

Part of this can be solved through model improvement. However, fires behave stochastically making them (especially their extremes) hard to model.

Therefore, we want to couple fire model input to a ML model to predict the observed satellite-based burned area. Once trained, this model can be used to reconstruct 20th century burned area.

How did burned area evolve over the last 120 years?

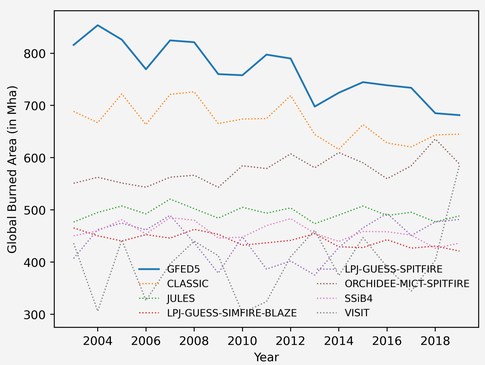
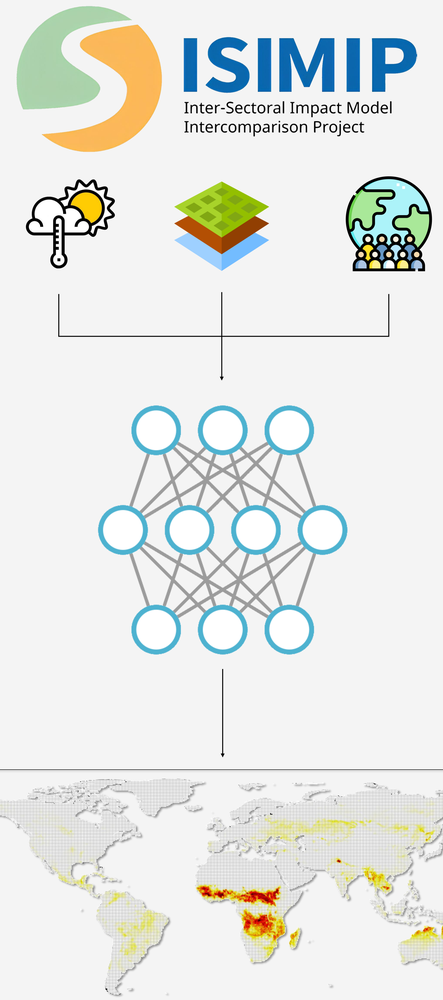


Figure 1: Global burned area. Observations (GFED5) are shown in full line. Seven fire models from ISIMIP are shown in stripes.

2. Our Approach

Use the input that is used to drive fire models (ISIMIP, 0.5°, monthly) to train ML algorithms to predict burned area from GFED5 (MODIS-based).

ISIMIP
Inter-Sectoral Impact Model Intercomparison Project



3. What we've done so far

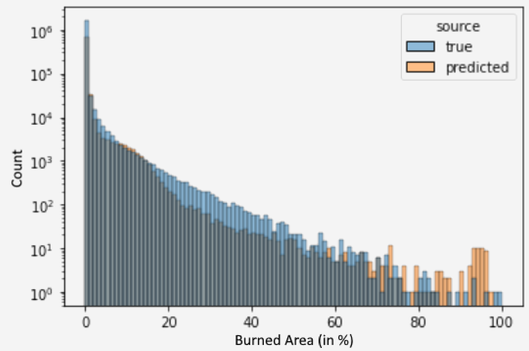
So far, we have only tried to predict single pixels, one month at a time. We have trained several algorithms and tried out different preprocessing steps of the predictors and predictand:

We have also added SPEI (1, 2, 4 & 6-month) to the feature list (SPEIbase)

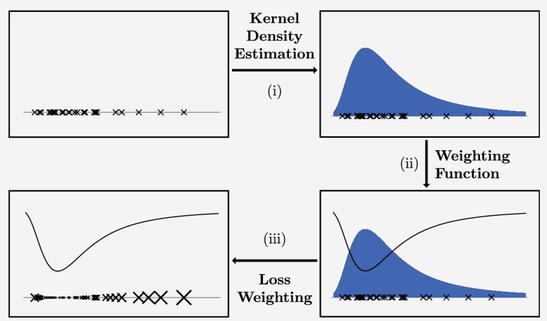
We trained

1) Random forests & ZeroInflatedRegressor (RF Classifier + RF regressor)

With log-transformed burned area percentage (0-100)



2) Simple Neural Networks (dense layers and activation functions)
With DenseWeight



Steiniger et al. (2021)

4. What we want to do

There's several things on our to-do list.

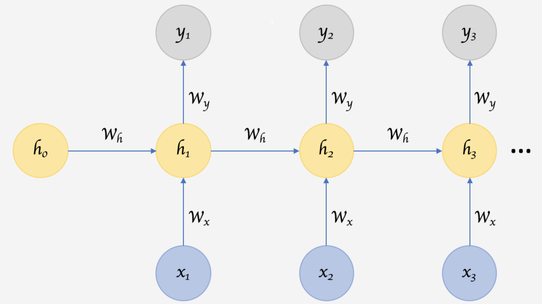
Engression (data augmentation)

Recurrent neural networks

Output a distribution

Evaluating against fire model benchmarking tools

Comparing reconstruction against regional estimates from tree rings, lake sediments, etc.



5. Your Suggestions

Please write any suggestions you have down on a post-it! This can be algorithms, preprocessing steps, technical tips, etc.

Free chocolates for anyone who writes something down!

Contact

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References

Steininger, M., Kobs, K., Davidson, P., Krause, A., & Hotho, A. (2021). Density-based weighting for imbalanced regression. Machine Learning, 110, 2187-2211.