Tackling Climate Change with Machine Learning

NeurIPS 2020

“Understanding global fire regimes using AI”

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Motivation and challenge

- Our understanding of global fire activity is limited.

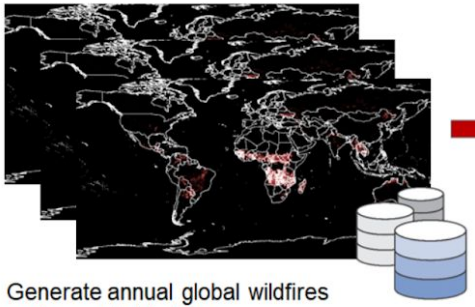
- Several studies
  - only use regional data,
  - non-consistent definitions of “wildfire regimes”
  - Lack of a unified quantitative framework to analyze global fire activity

- Impact on multiple research areas: atmospheric science, human mobility, fire ecology...

Fire data

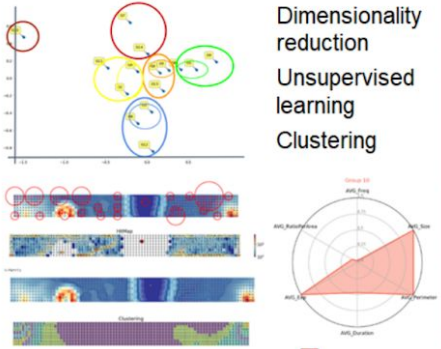
Annual individual level wildfire data from 2000 - 18

Data processing



Generate annual global wildfires rasters and database

Wildfire regimes classification & characterization

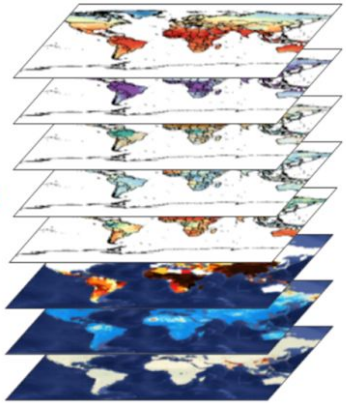


Dimensionality reduction

Unsupervised learning

Clustering

Non fire features



Temperature

Precipitation

Land Cover

Drought index

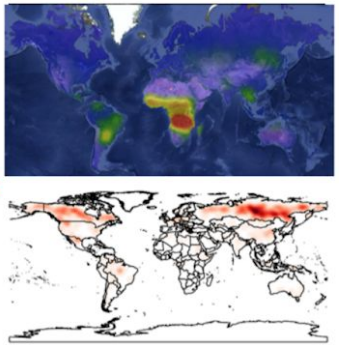
Water deficit

GDP

Accessibility

Population density

Spatio-temporal analysis



Zonal density maps, time series, and statistics to characterize the regimes

Outputs

Global datasets and computational scripts are uploaded to the cloud and open source repository

Data sources

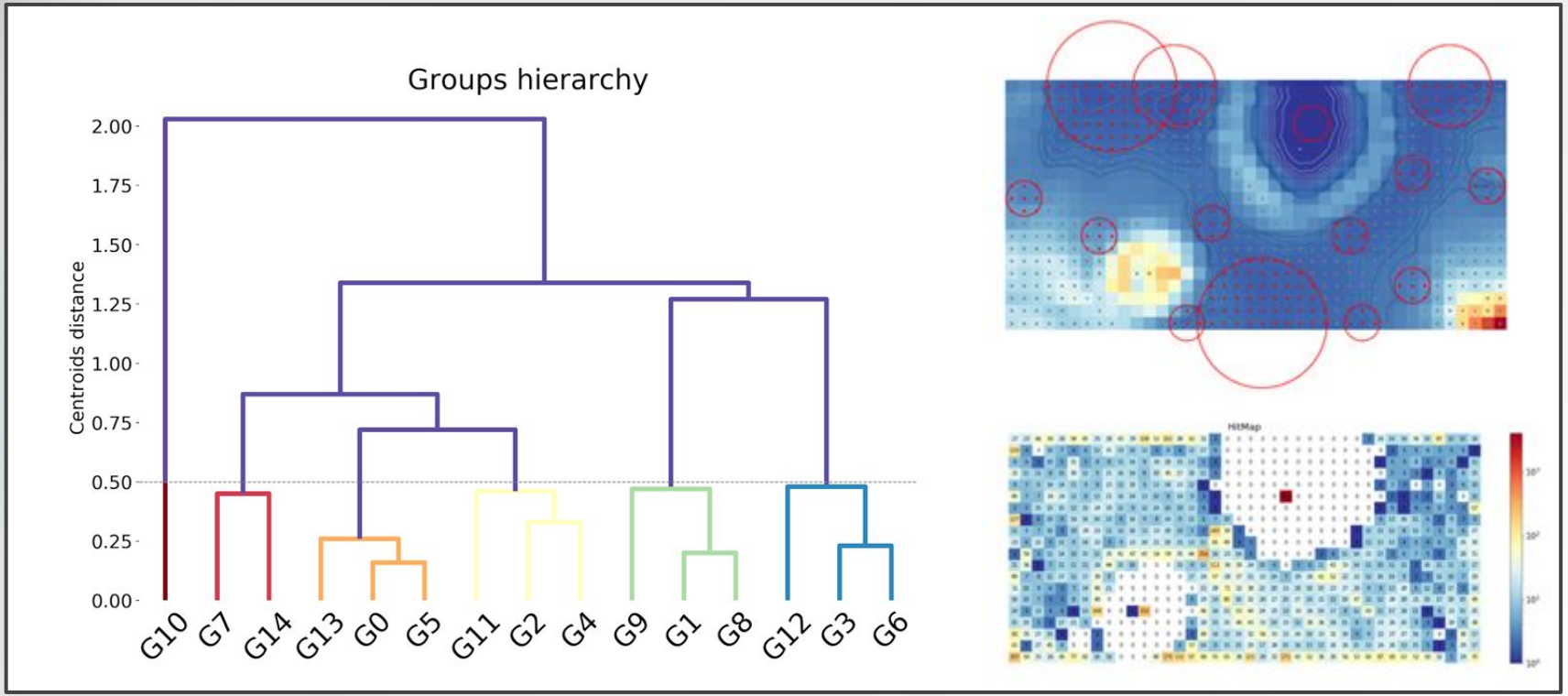
- **Historical (individual) wildfire data 2000-2019**
  - Fire Atlas https://www.earth-syst-sci-data.net/11/529/2019/
  - A global wildfire dataset for the analysis of fire regimes and fire behaviour https://www.nature.com/articles/s41597-019-0312-2

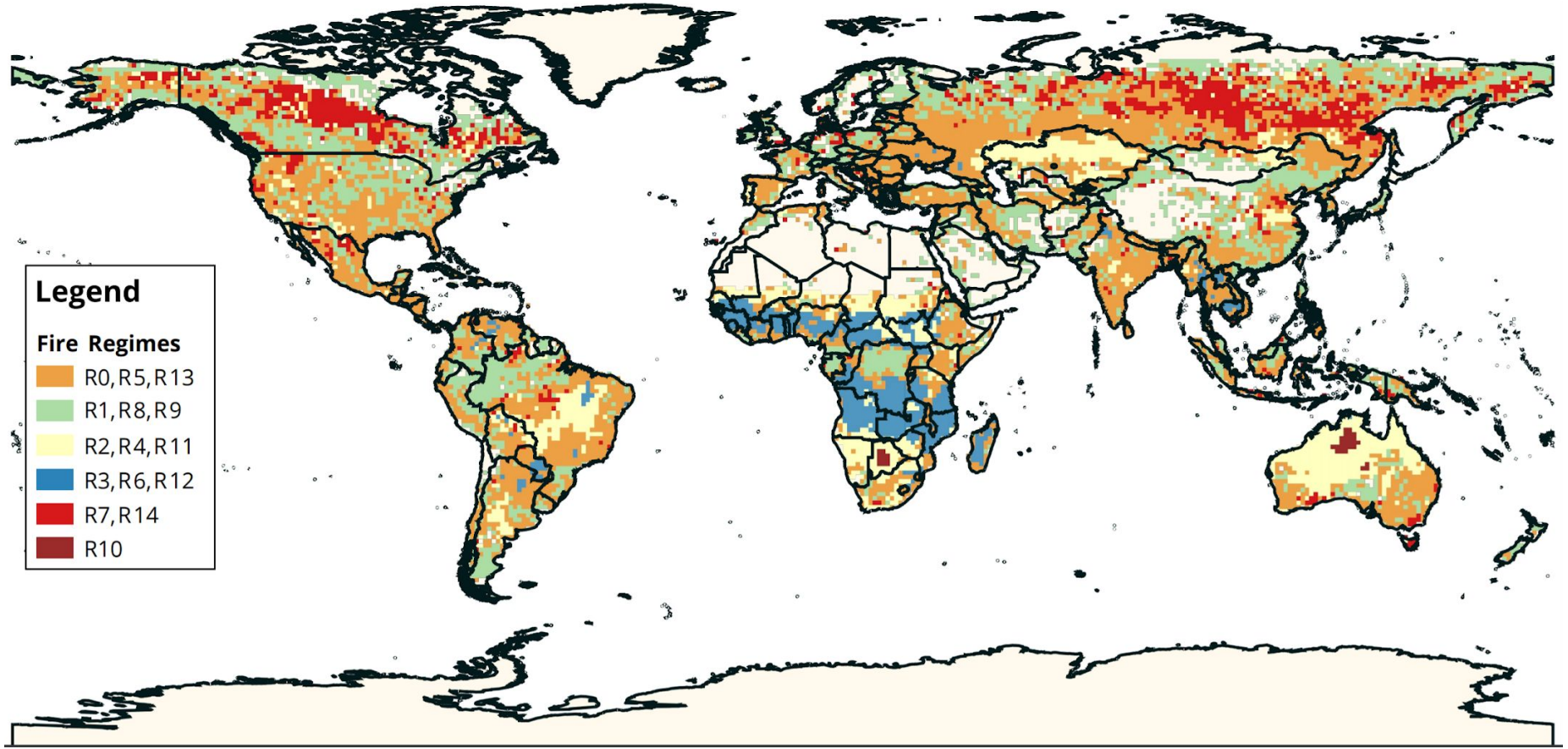
- **Monthly mean temperature, maximum temperature, total precipitation, Palmer drought index, and water deficit.**
  - http://www.climatologylab.org/terraclimate.html

- **Yearly global land cover**
  - https://doi.org/10.5067/MODIS/MCD12Q1.006

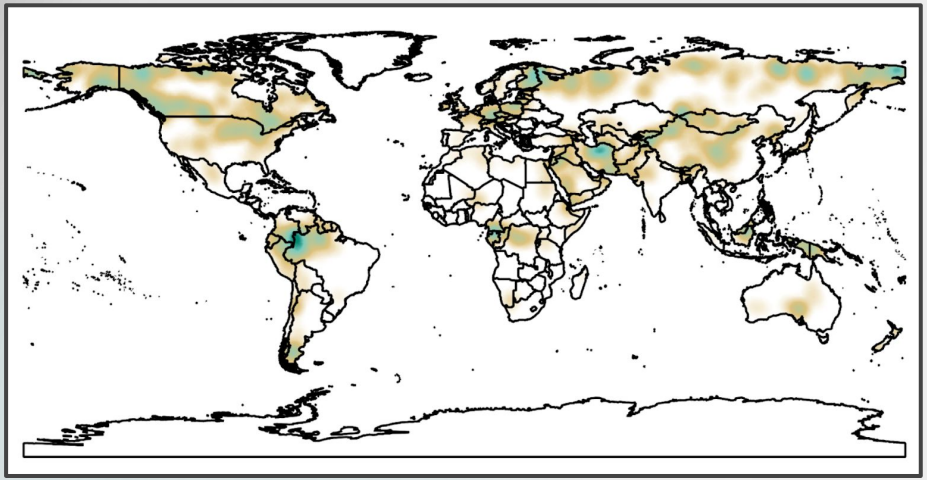
- **Regional GDP** https://datadryad.org/stash/dataset/doi:10.5061/dryad.dk1j0 (up to 2015)
- **Population density** http://sedac.ciesin.columbia.edu/data/collection/gpw-v4 (up to 2020)
- **Accessibility** https://malariaatlas.org/research-project/accessibility_to_cities/ (2015)

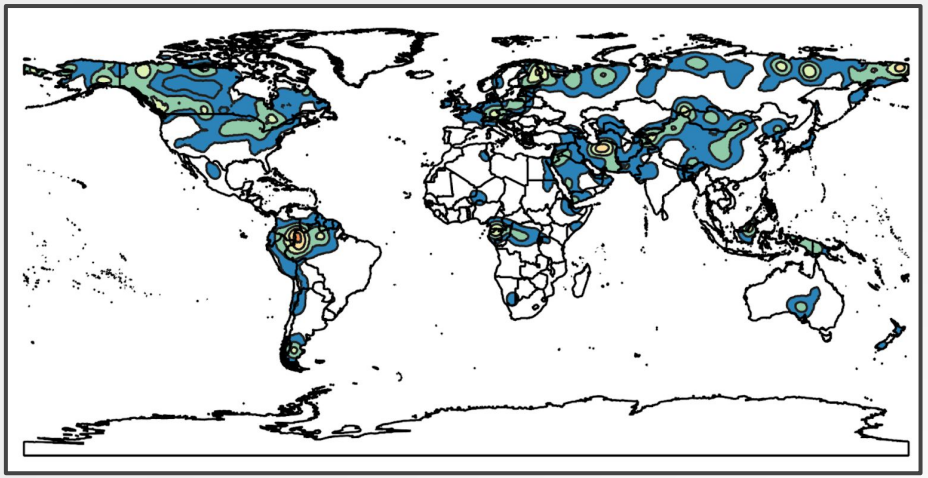
15 regimes: the magic number




Legend
Fire Regimes
R0, R5, R13
R1, R8, R9
R2, R4, R11
R3, R6, R12
R7, R14
R10

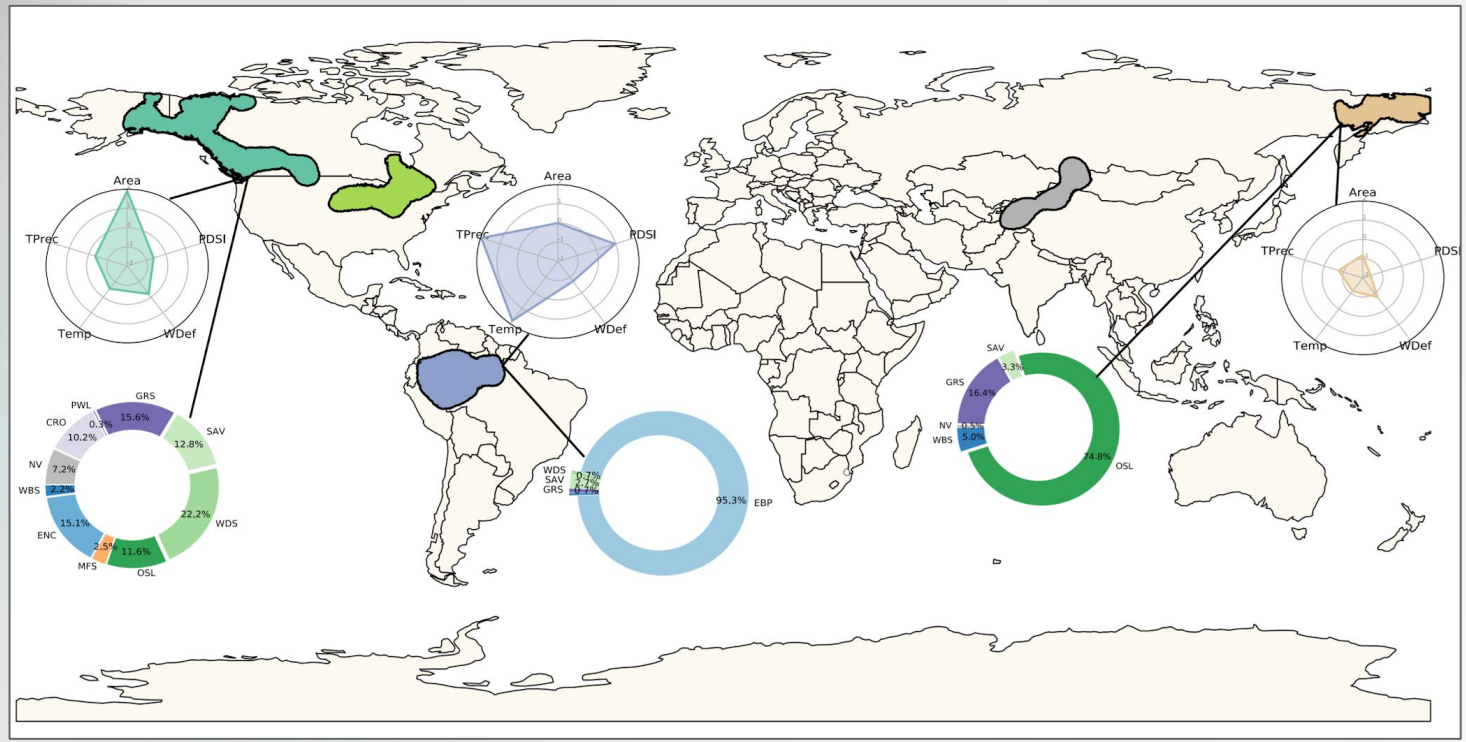
Spatial characterization





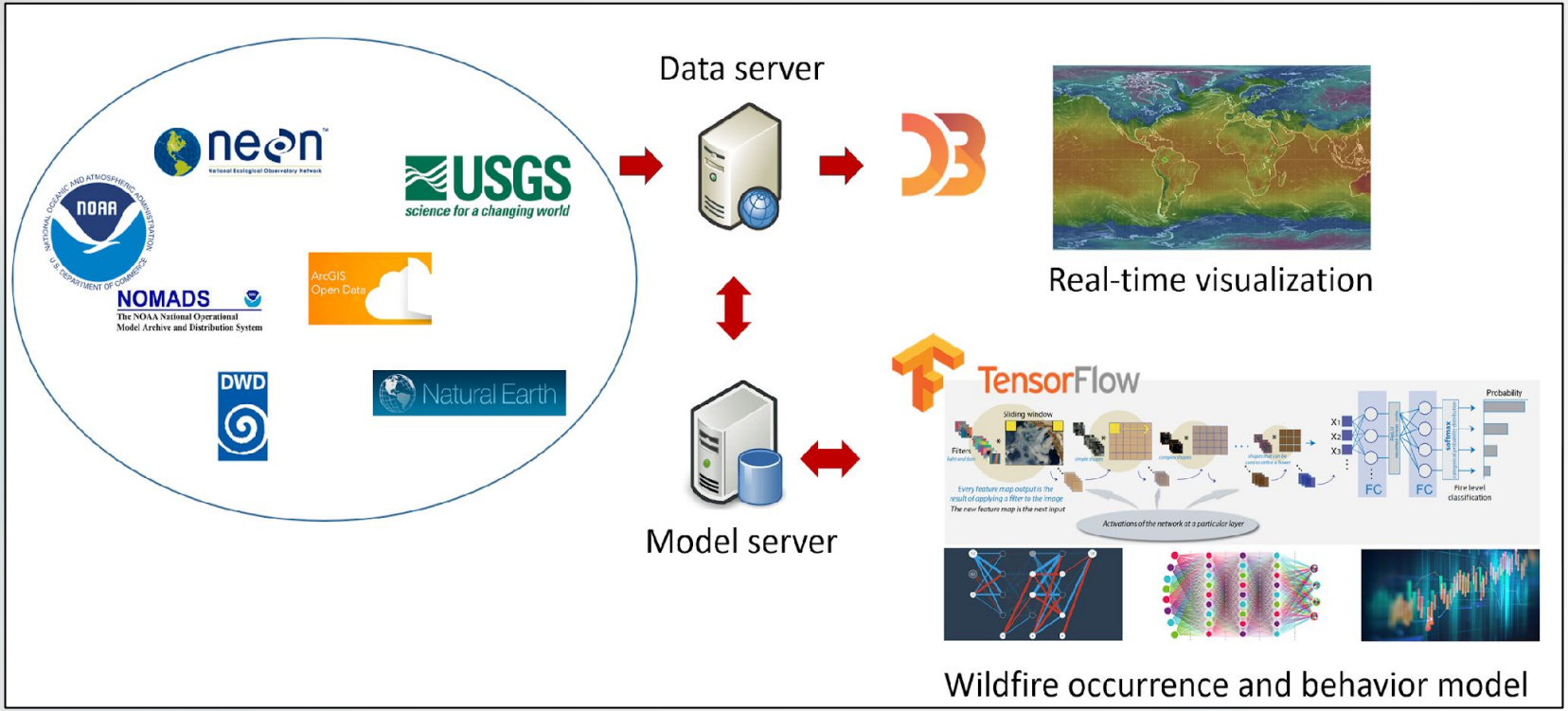
A Gaussian kernel analysis is performed, detecting the regions where observations from a regime are focused (contour lines).

Spatial & temporal characterization



We characterize all top 5 densest areas per regime, identifying the most relevant drivers of the fire activity per area.

Global fire risk index framework



Thanks for your attention

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