# WHAT IS WRONG WITH POST-FIRE SOIL EROSION MODELLING?

Girona-García A*; Lopes AR; Corticeiro S; Martins R; Keizer J; Vieira DCS

Centre for Environmental and Marine Studies (CESAM), University of Aveiro

*antoniogironagarcia@ua.pt

Wildfire patterns are shifting all over the world as a consequence, among others, of changes in land use and climate, which may entail remarkable social, environmental, and economic implications.

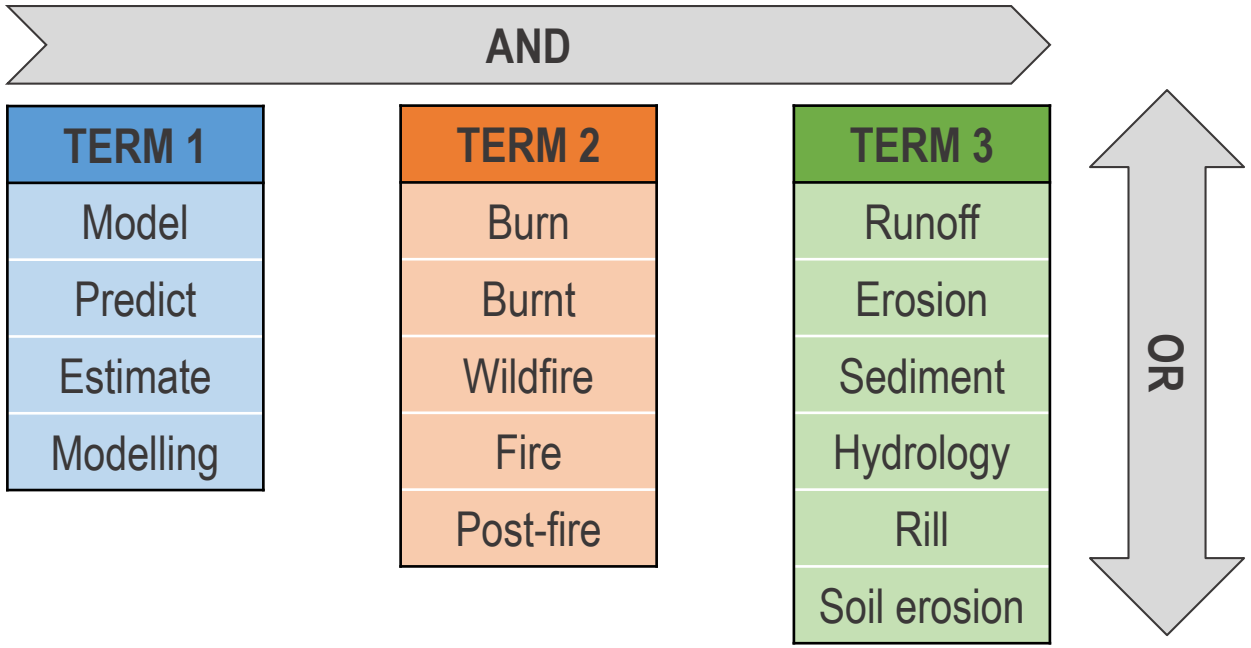
Wildfires are often linked to increased post-fire hydrological and erosive responses, which are hard to predict due to the complexity of factors involved.

Soil erosion models are a resourceful tool in the decision-making process for environments that are or could be affected by wildfires, from emergency response to long-term planning.

However, current soil erosion models were not originally developed for post-fire conditions, so they are not adapted to include fire-related changes into their predictions.

**This work aimed to review the scientific advances in the last twenty years in post-fire soil erosion modelling from a meta-analysis approach, conducting a critical overview of the modelling approaches used and providing guidelines for future studies.**

An extensive search was conducted in the Scopus database the 27 February 2020 for articles published until 2019 using the following combinations:




The search was aimed at finding modelling studies that tested and/or adapted models to estimate post-fire soil erosion by water, from an existing burned area study case.

This search retrieved 664 works that were screened and excluded if they met any of the following criteria:

- ✕ review and/or meta-analysis papers;
- ✕ journals without peer-review process;
- ✕ books or book chapters;
- ✕ reports;
- ✕ editorials;
- ✕ conference proceedings;
- ✕ works in which the modelling was conducted on individual processes;
- ✕ studies modelling debris flows and landslides;
- ✕ empirical or statistical regressions;
- ✕ works that did not conduct post-fire soil erosion modelling in an existing burned area;
- ✕ works that are not written in English.

The selected publications (41) were divided in two groups according to the formulation basis of the models used: physical or empirical (52 cases).

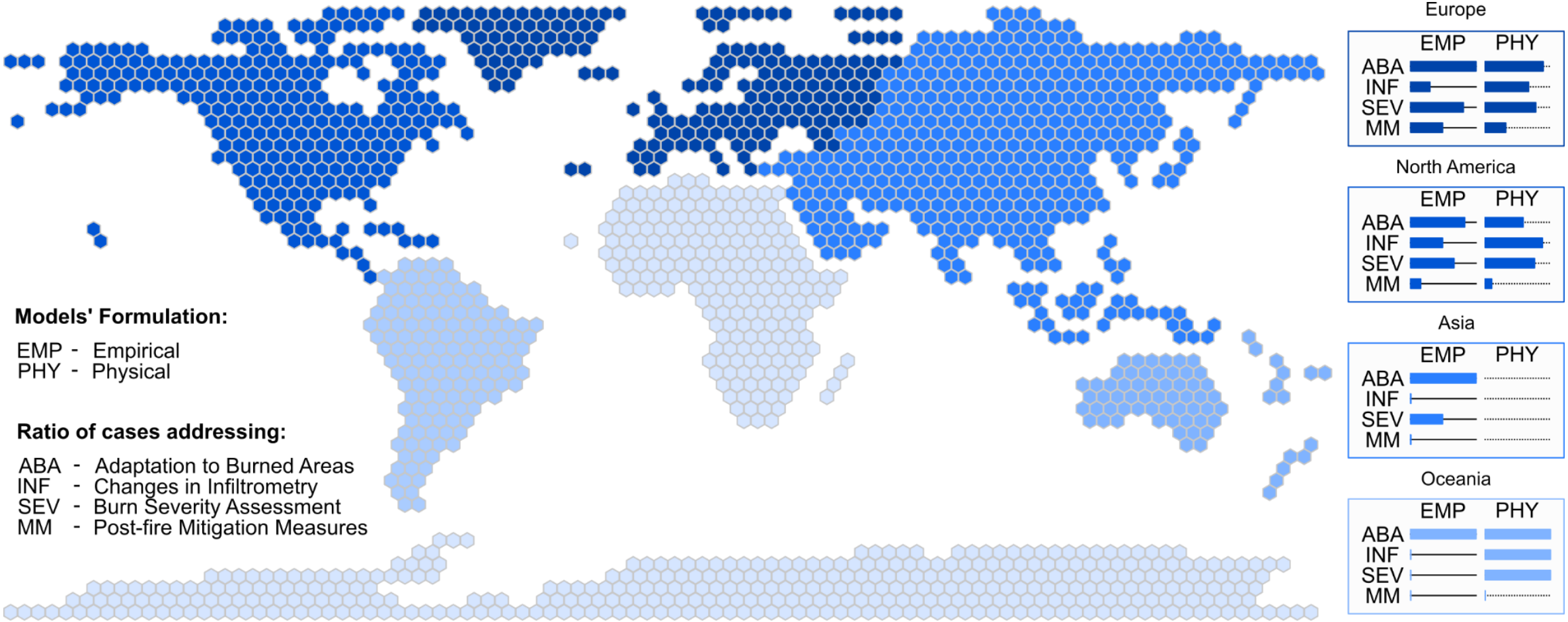
Publications were mainly searched to find whether they addressed in their modelling key-factors in the post-fire hydrological response:

- ✓ Changes in soil structure and ground cover.
- ✓ Post-fire hydrological effects related to changes in soil water infiltration.
- ✓ Changes related to burn severity.
- ✓ Post-fire erosion mitigation measures.

It was also studied whether:

- ✓ Model predictions were calibrated and validated with independent datasets.
- ✓ Models were also applied in unburned conditions.
- ✓ Model efficiency indicators were used to assess model performance.

# Ratio of cases addressing the key-factors in post-fire hydrological response for each model type




RESULTS



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Percentage of the total number of identified cases (n=52) that addressed the research questions of the meta-analysis

| | Research Questions | Cases (%) |
|---|---|---|
| **Predictions** | Erosion | 100 |
| | Runoff/Discharge | 46 |
| **Model calibration** | Unburned | 50 |
| | Model adaptation to burned areas | 73 |
| | Is infiltration addressed? | 58 |
| | Is burn severity addressed? | 75 |
| | Improvement of model components | 21 |
| | Post-fire rehabilitation measures | 27 |
| **Efficiency assessment** | Use of efficiency indices | 60 |
| | Validation | 17 |
| | Uncertainty/sensitivity analysis | 13 |
| **Structural** | Empirical | 48 |
| | Physical | 52 |
| | Process-oriented | 29 |
| | Spatially distributed | 42 |

- Post-fire erosion models are not homogeneously applied worldwide neither according to the model type used, nor where wildfires affect the larger area.

- Further efforts are required on the adaptation of erosion models to burned conditions, specially in addressing soil and infiltration changes.

- It is necessary to include systematic model efficiency metrics in post-fire modelling studies, and separate into calibration and validation phases, to better evaluate model performance and their adaptations in the future.

- Few studies included the effects of post-fire mitigation treatments on erosion models, and so far, only the mulching technique has been tested regarding this matter.

- We encourage the use of models that allow adjusting post-fire infiltration changes, calibrating the cover factor according to the degree of burn severity, and including a wider array of post-fire mitigation measures.

- Future studies on post-fire soil erosion modelling could consider a multidisciplinary model combination, and include uncertainty analysis in their predictions for a better communication of the scientific outputs.

# Thanks for your time! #shareEGU20

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