A new tool to assist the calibration of fire growth models

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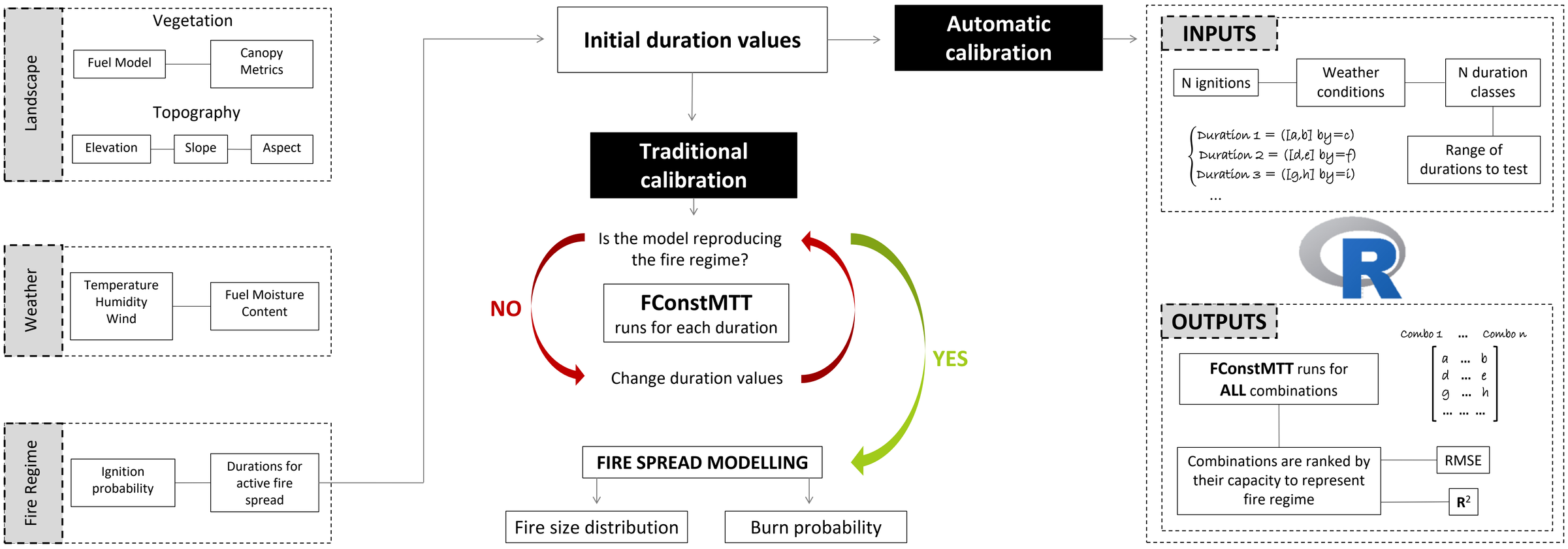
Background

Wildfire spread models are commonly used to estimate fire exposure and risk, locate optimal fuel treatment units, and to evaluate alternative management strategies.
One of the most used algorithms is the Minimum Travel Time (MTT). This algorithm may require a very **time-consuming calibration process** to produce reliable fire spread estimates. Frequently, calibration compares simulated with observed fire sizes, and it can rely on **tuning the fire spread duration**.

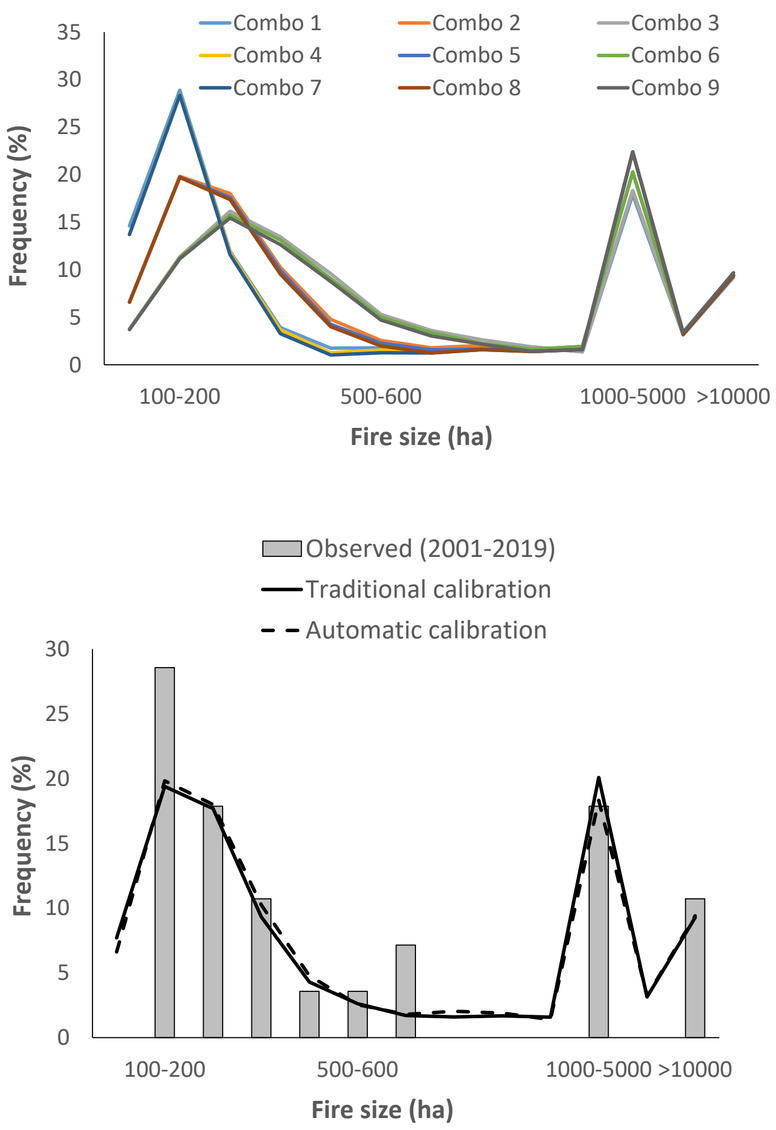
We propose a **new tool** specifically developed to assist the user with an **improved and automatic process of model calibration**. It was developed for the command-line version of the **MTT algorithm (FConstMTT)**[1] and was implemented in **R-Code**. This tool has the potential to:

- Simultaneously test multiple durations
- Automatically execute multiple runs of **FConstMTT**
- Compare for each set of durations estimated fire sizes and burn probability with reference fire data using accuracy statistic metrics (**RMSE** and **R^2**)
- Rank the combination of best estimated durations based on statistic values

Calibration Overview



Traditional vs. Automatic calibration (results)



Comparison between the estimated distribution of fire sizes resultant from running **nine** different **combinations of durations**

After running all the combinations of duration in the **FConstMTT**, the tool ranks them based on their capacity to reproduce the historical fire regime. Specifically, it calculates the RMSE derived from comparing the distribution of observed and simulated fire sizes.

The overlap between simulated and observed fires size distributions obtained from the **traditional** and the **automatic** calibration indicates similar results

Conclusions

We propose **a new tool to assist the calibration of the Minimum Travel Time (MTT)** algorithm. Its major potential is **to speed up and improve the model's calibration**. We implemented it by developing an R-code that:

a) uses the historic ignition probability surface to generate fire ignition points;
b) uses multiple weather conditions (e.g. to represent seasons);
c) enables user-defined number of duration combinations;
d) ranks the simulations by their capacity to reproduce the historical fire regime.

Overall this tool is capable to replicate the fire regime at least as well as the traditional calibration, while exploring more combinations (hence being less dependent on users' experience) and significantly decreasing the time required to successfully calibrate the model.

Next steps

Publication of the tool as a R package. We are developing new features, such as the capacity to generate a landscape file (.LCP) for the simulation inputs, and studying new metrics that can be used to rank the combinations of durations to be tested.

[1]M.A. Finney, Fire growth using minimum travel time methods, Can. J. For. Res. 32 (2002) 1420–1424 https://doi.org/10.1139/x02-068

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