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PROPAGATOR,
a Cellular Automata model for fast wildfire simulations: latest improvements and future developments

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Introduction

The use of fast operational tools in emergency response, based on reliable wildfire spread maps and efficient risk maps, is an urgent requirement for first responders and CPAs.
Wildfire models can be useful in predicting the wildfire spread and helping the identification of the best firefighting strategies to be applied.

The different approaches and models specific for modeling wildfire spread and behavior are usually catalogued as [1 2 3]:

- empirical and semi-empirical models: simulate wildfire spread basing on statistically derived laws;
- macroscopic-deterministic models: fire spread is modelled as a continuum, using computational fluid dynamics techniques and atmospheric, heat transfer and combustion models;
- stochastic lattice or grid-based models: discretize the simulation in time and space, and model the fire front propagation from a cell to another by adopting evolution rules that comprehend the underlying physics at the desired level of resolution.

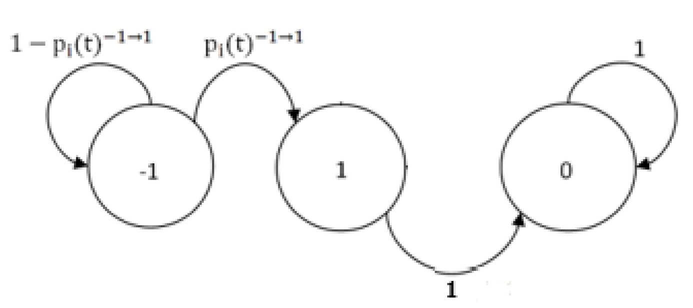
The model:

PROPAGATOR is a quasi-empirical stochastic CA model that produces probabilistic outputs [4].

The model is based on a raster implementation of the domain and the main required input data are the DEM and the vegetation cover (with a spatial resolution of 20 m).

The model also required boundary conditions on wind speed and direction, and fine fuel moisture content, which are considered constant for the entire domain.

All these variables are used for evaluating both the fire spread probability and RoS of the simulated fire front.



The cells of the domain can assume 3 possible states:

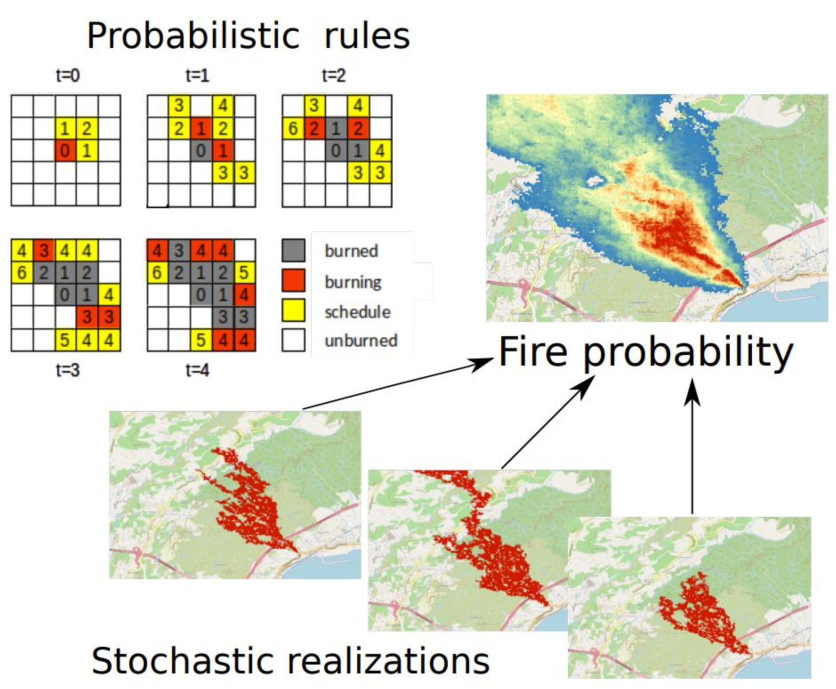
- burning cells during the current time-step (state 1);
- already burned cell, burned in previous steps (state 0);
- unburned cell, which can burn in following steps (state -1)

which can vary during the simulation if the cells are affected by the simulated wildfire.

The fire spread in time is model evaluating the RoS of the fire on each burning cell. The RoS model considers all the input variables (DEM, vegetation cover, wind speed and direction, and FFMC) [5].

The model calculates the burning probability of each cell of the domain in a specific time interval, evaluating the fire frequency of each cell.

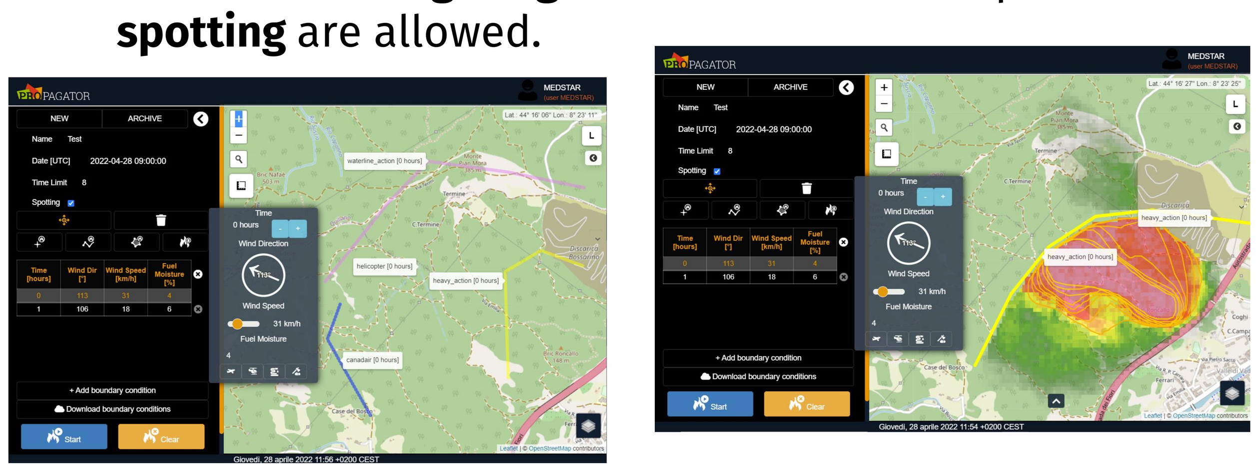
The evaluation is based on a significant number of stochastic simulations (N=100) which are performed from the same ignition point (or line, or polygon) and same wind conditions (with a small perturbation).



Latest Improvements:

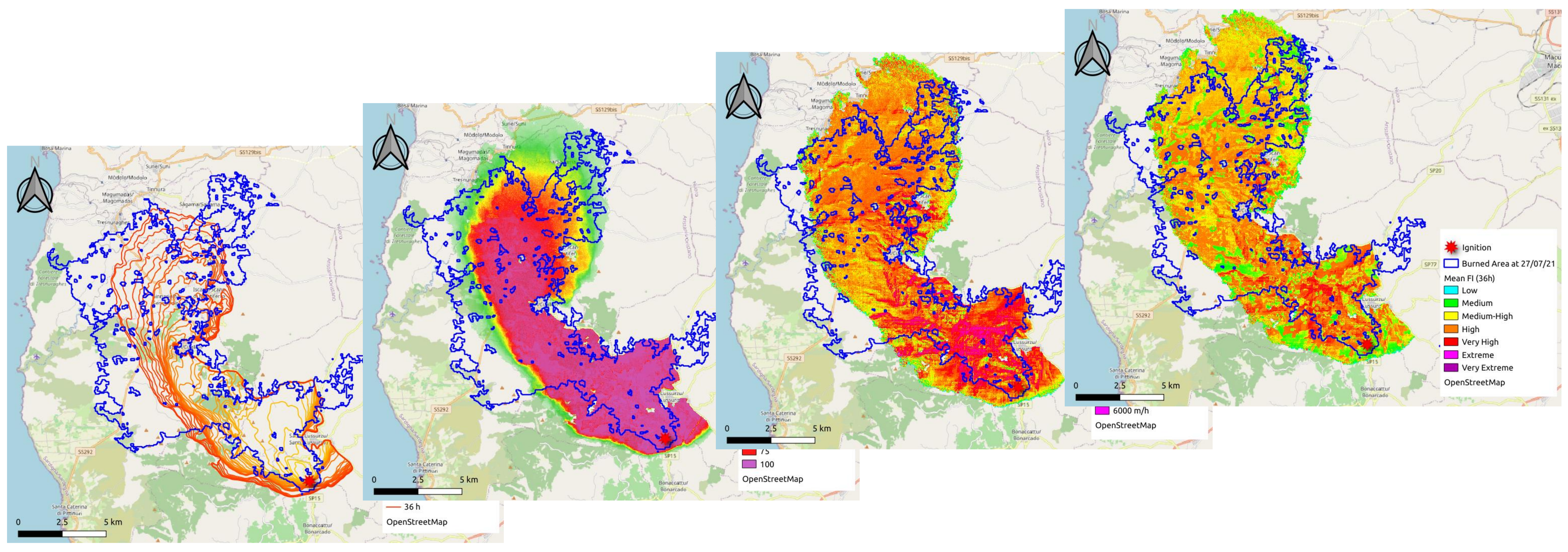
MEDCOOPFIRE

Thanks to the MedCoopfire project the possibility of simulating **different firefighting actions** and the phenomenon of **fire spotting** are allowed.



RoS and **Fireline intensity maps** can be hourly produced, thanks to the researches that have been developed in the SAFERS project.

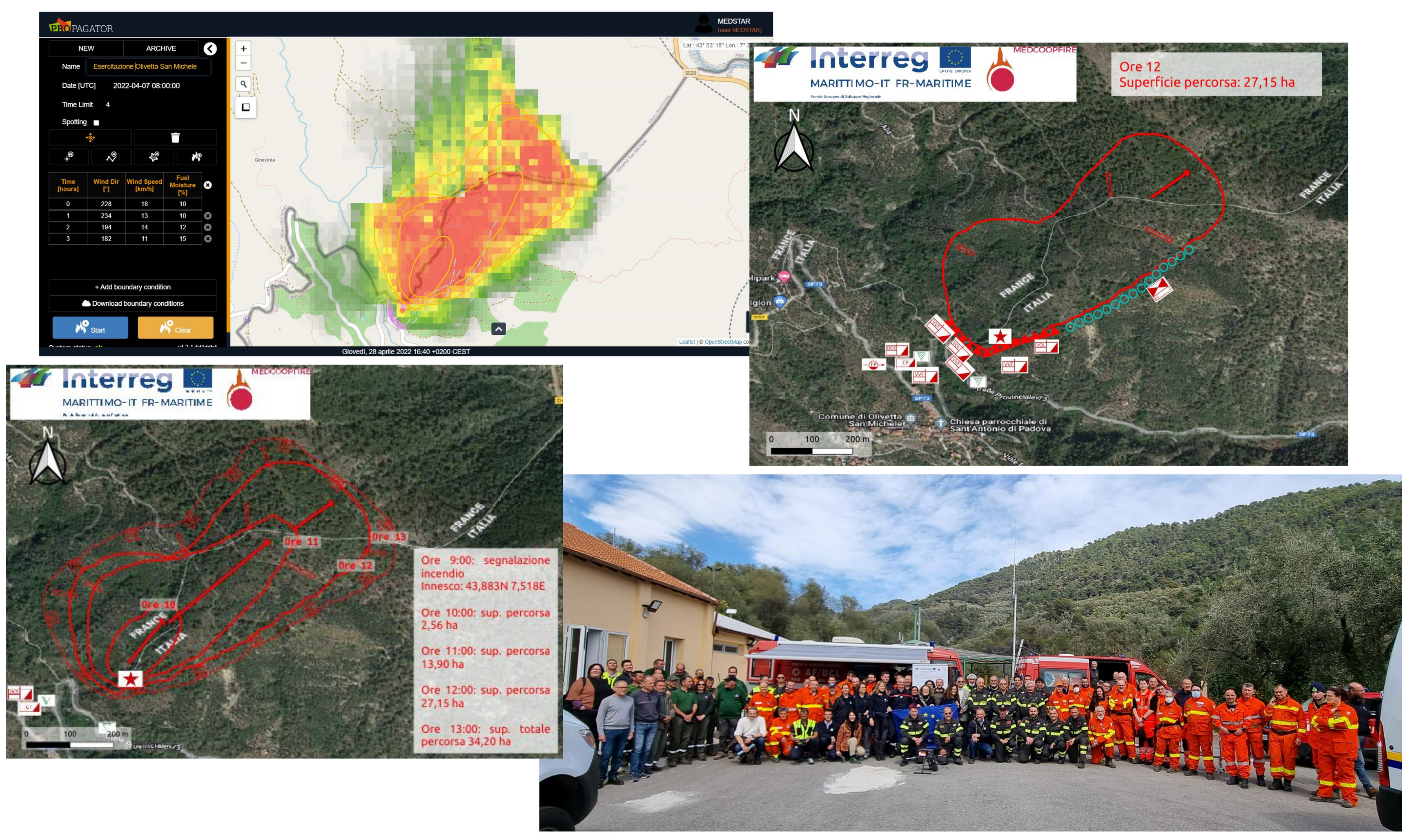
SAFERS



Future perspectives:

- Enlarge the field of application of the model (changing the resolution)
- Implementation of wind field
- Manual modification and correction of the vegetation cover
- On-demand use of Sentinel data to update the vegetation cover

Some of applications:



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