Fire Monitoring and Analysis for Climate Change Mitigation and Improved Fire Management: the firemaps.net Platform Approach

Photo credit: A. Hoffmann

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firemaps.net

Background

Vegetation and peat fires contribute substantially to global emissions of greenhouse gases (GHG). Improving the management of fires in frequently burning ecosystems can help to reduce GHG emissions and thus contribute to mitigation of climate change. In order to implement, monitor and document success in fire management, timely and accurate data on fire extent and impact, as well as weather and burning conditions is needed.

Key features of the firemaps.net web platform presented here are: Near real time monitoring of fire activity and carbon fluxes, weekly updated burned areas, daily analysis and forecast of relevant weather parameters, long time series of fire emissions to calculate baselines, fire risk and vulnerability maps and tools to monitor success of fire management planning and implementation.

Monitoring

- firemaps.net presents current fire activity in a dashboard updated every 15 minutes (fig. 1)
- Active fire detections and carbon emissions
- Forecast fire weather information (Canadian Fire Weather Index and sub indices)
- Burned areas from Sentinel-2 and Landsat, updated weekly (fig. 2)

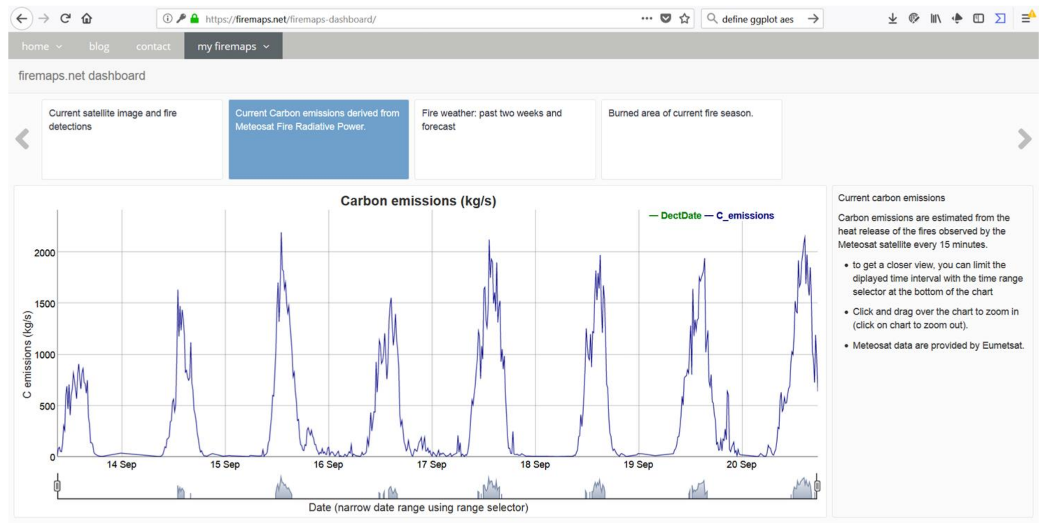

Fig. 1 firemaps.net dashboard: near real time 15-min carbon emission rate derived from Meteosat FRP

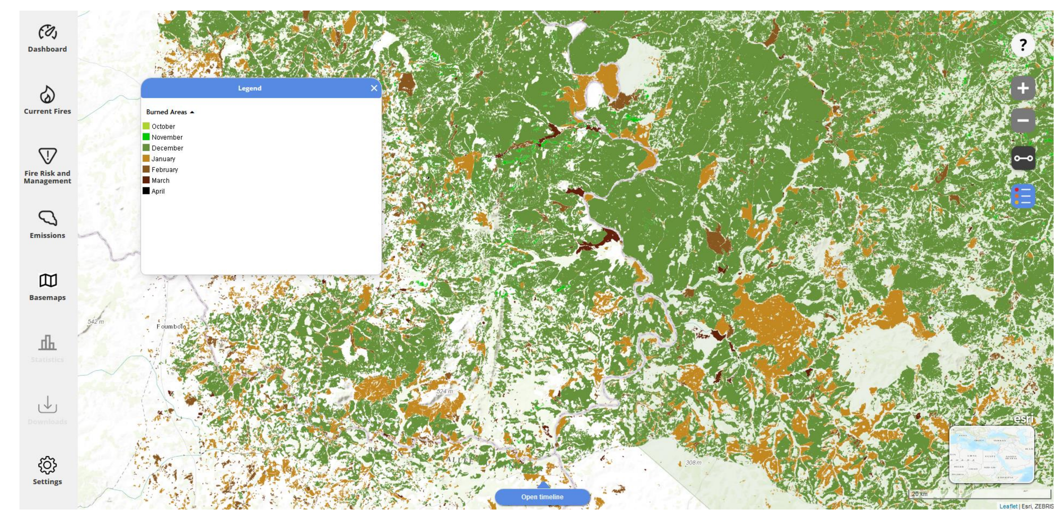
Fig. 2 firemaps.net burned area map derived from Sentinel 2 data, updated every 5 days

Analysis

- Multi-year burned area time series derived from MODIS or Sentinel-2 and Landsat
- Fire radiative power (FRP) from MODIS is used to derive time series of fuel consumption and greenhouse gas emissions to establish a fire baseline for an area of interest (fig. 3 and 4).
- Burned areas are intersected with land cover to provide reporting-ready analysis and charts.

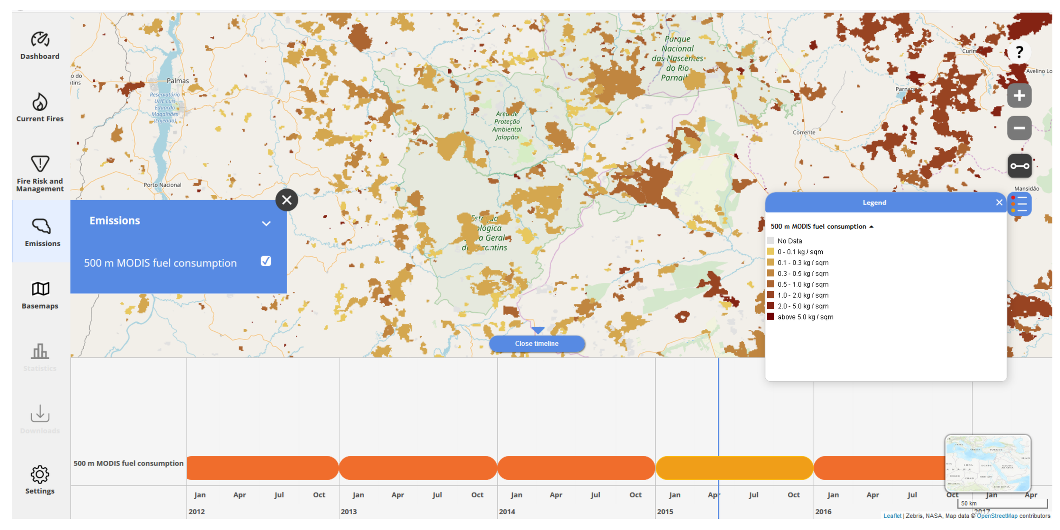
Fig. 3 Yearly fuel consumption map for the Brazilian Cerrado derived from burned area and MODIS FRP. The timeline in the lower part of the screen enables swift navigation in time.

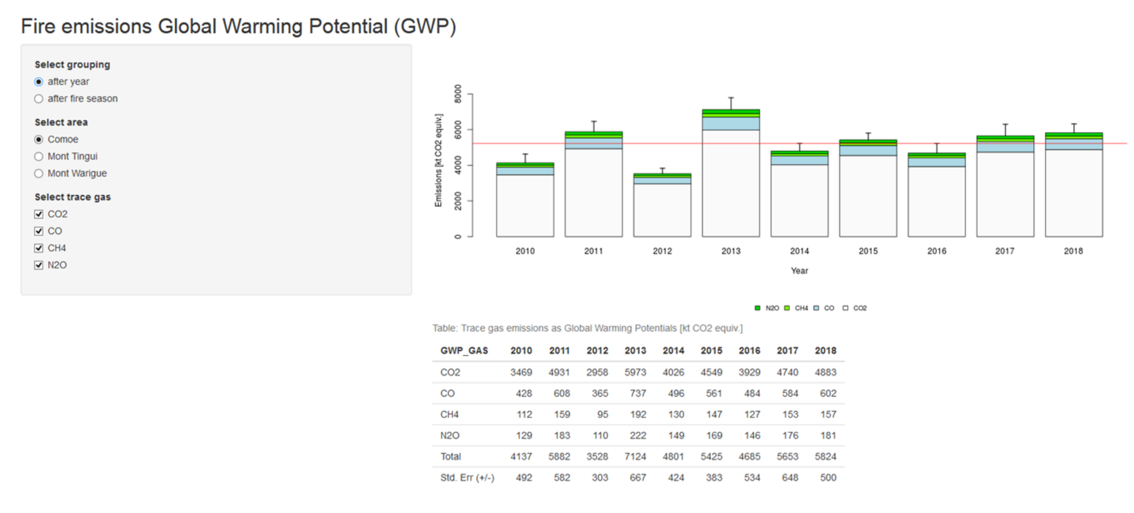

Fig. 4 firemaps.net statistics dashboard: timeline of fire emissions for Comoé National Park, Côte D'Ivoire. Fire emissions are expressed as global warming potentials (CO2 equivalents)

Management

Prescribed burning to control fuel loads is a vital part of fire management.

- Within the German-Brazilian Cerrado Jalapao program, prescribed burns were used to shift from early to late season burning (fig. 5)
- This resulted in a shift in patterns of fire emissions (fig. 5)
- In firemaps.net, a web based tool supports documentation of management fires (fig. 6).

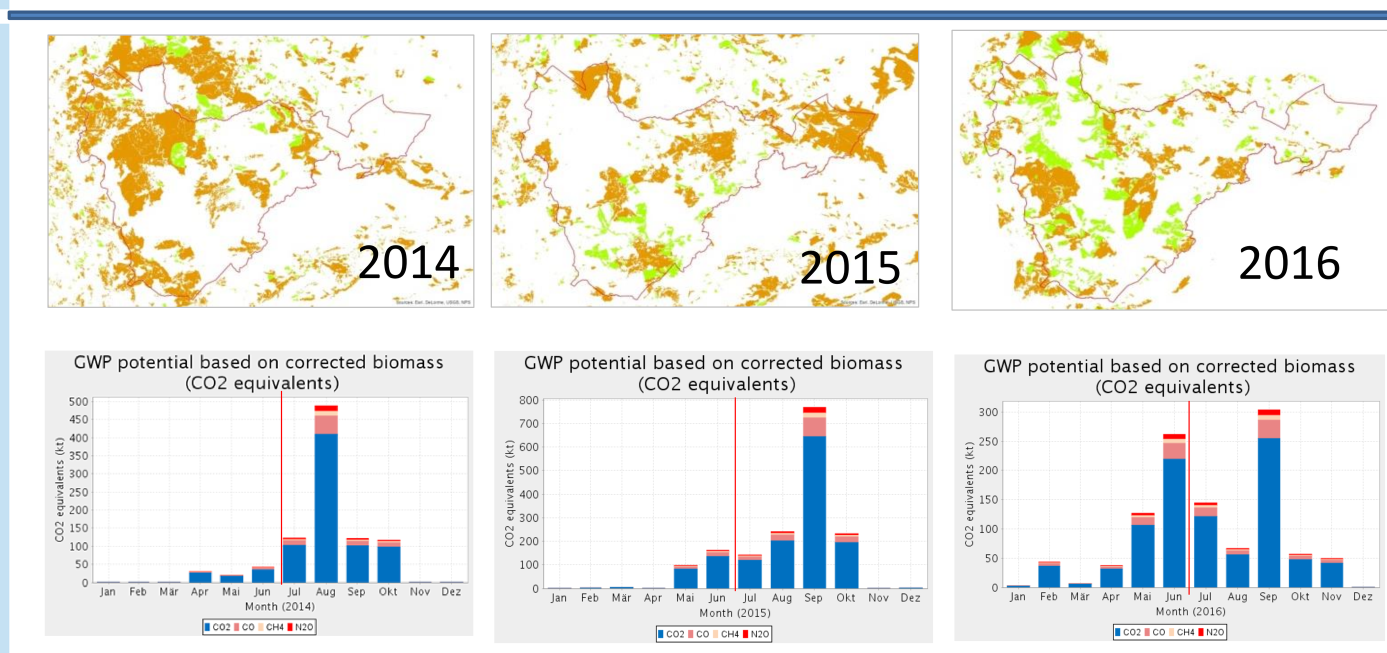

Fig. 5 Time series of fire seasonality (above) and monthly greenhouse gas emissions (below) for Estacion Ecologica de Serra Geral do Tocantins, Brazilian Cerrado. Using management fires, the late season dominated fire regime could be shifted Towards an early season fire regime. Emission patterns shifted accordingly.

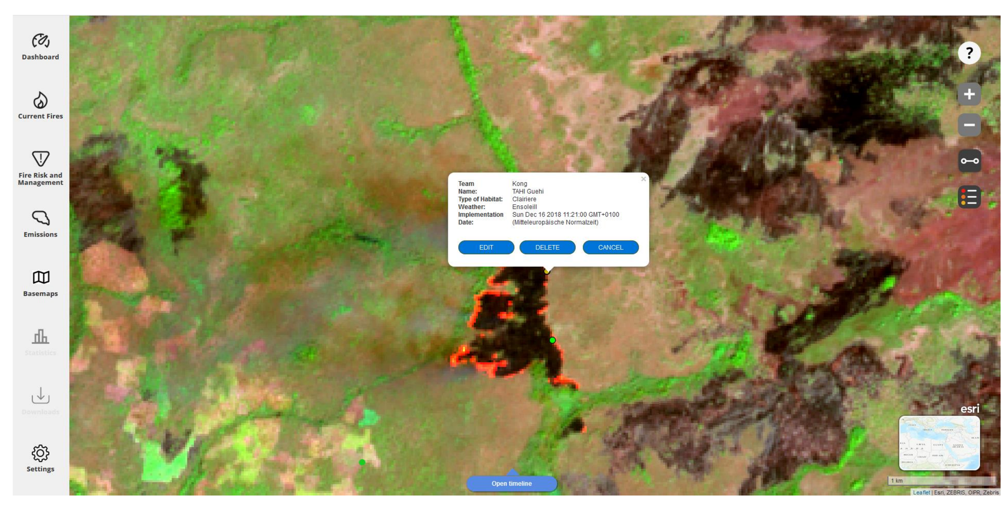
Fig. 6 Management fires implemented in Comoé National Park, Côte D'Ivoire. The ignitions are documented in firemaps.net using an online tool.
Management fires can then be evaluated against the management objectives specified in a management plan which is also stored in firemaps.net.
Also fire intensities of management fires can be estimated using a fire model (see below).

Modeling

- We use the Canadian Forest Fire Behaviour Prediction System (CFFBPS) to forecast fire behaviour from weather and fuel information
- Automation of modelling using the Prometheus fire growth simulator enables fire spread modelling over large areas based on observed fires or as a planning tool for management fires (fig. 7).
- A locally calibrated fuel type was defined for dry Dipterocarp forests in Thailand (fig. 8).

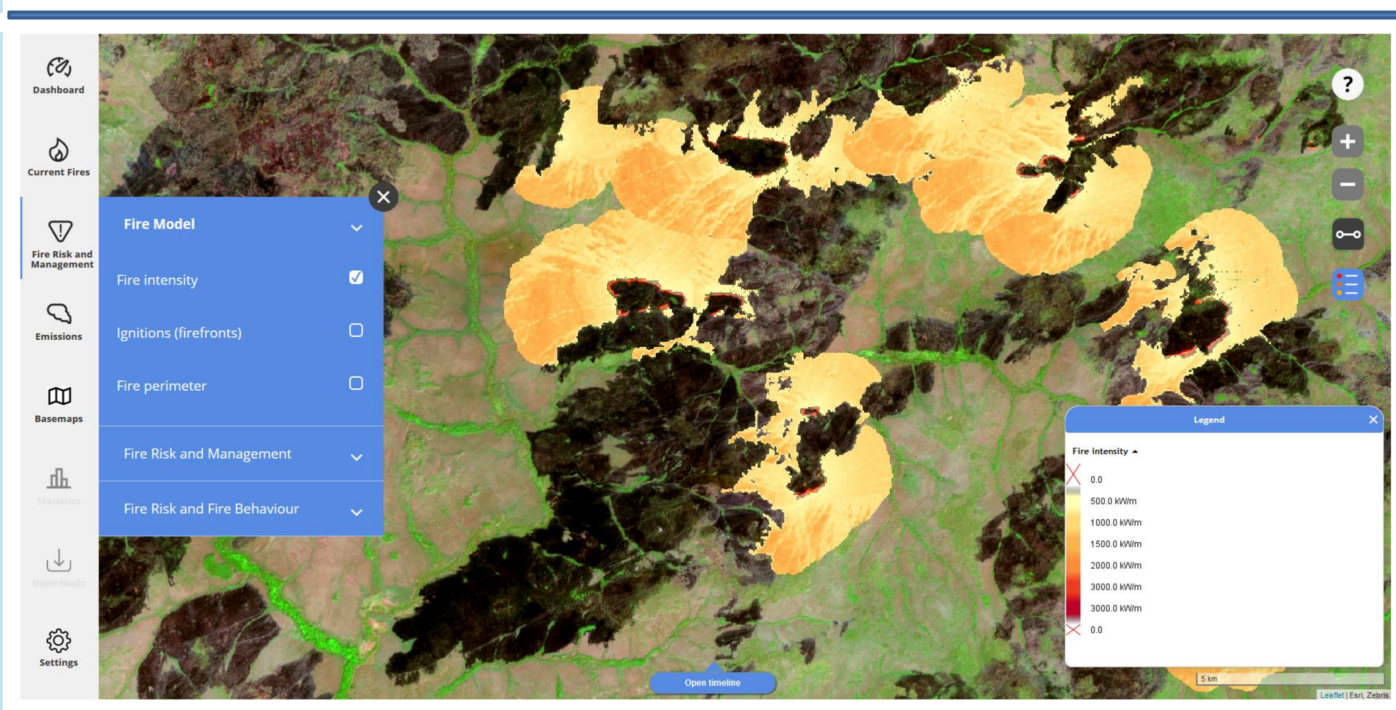

Fig. 7: The Prometheus fire growth model is based on the Canadian Forest Fire Behaviour Prediction system. Here it is driven by automated processing of Sentinel 2 derived fire fronts, fire weather from weather forecasts and a fuel map derived from land cover information. Location: Comoé Park, Côte d'Ivoire, 2017-12-19.

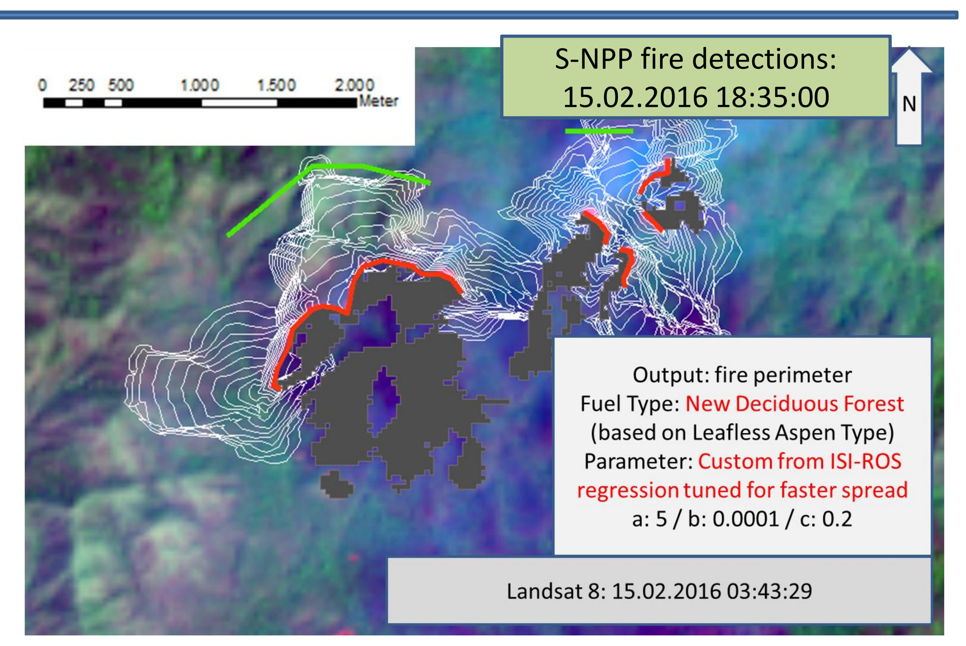

Fig. 8: Since no suitable fuel model was available for Dry Dipterocarp forests in Thailand, an existing fuel model in Prometheus was used and adapted to local conditions using data from fire experiments and remote sensing derived fire spread analysis. The red lines in the above image are fire fronts identified in a Landsat image, the green lines show the location of the fire fronts in observed by S-NPP VIIRS.

Verification

- Field experiments were implemented to assess fuel consumption and fire intensity in Comoé National Park, Côte d'Ivoire with the support of the National park administration (OIPR) (fig. 9).
- FRP was derived from radiometers mounted on 6 m poles over the fire, and rate of spread was derived from fire travel time (fig. 9 bottom).
- Results indicated that the standard fuel model overestimates fire intensity by about 40% due to a higher estimated rate of spread in the model vs. ROS observed in the field (fig. 10).
- Further experiments are needed to develop a locally calibrated fire intensity model.

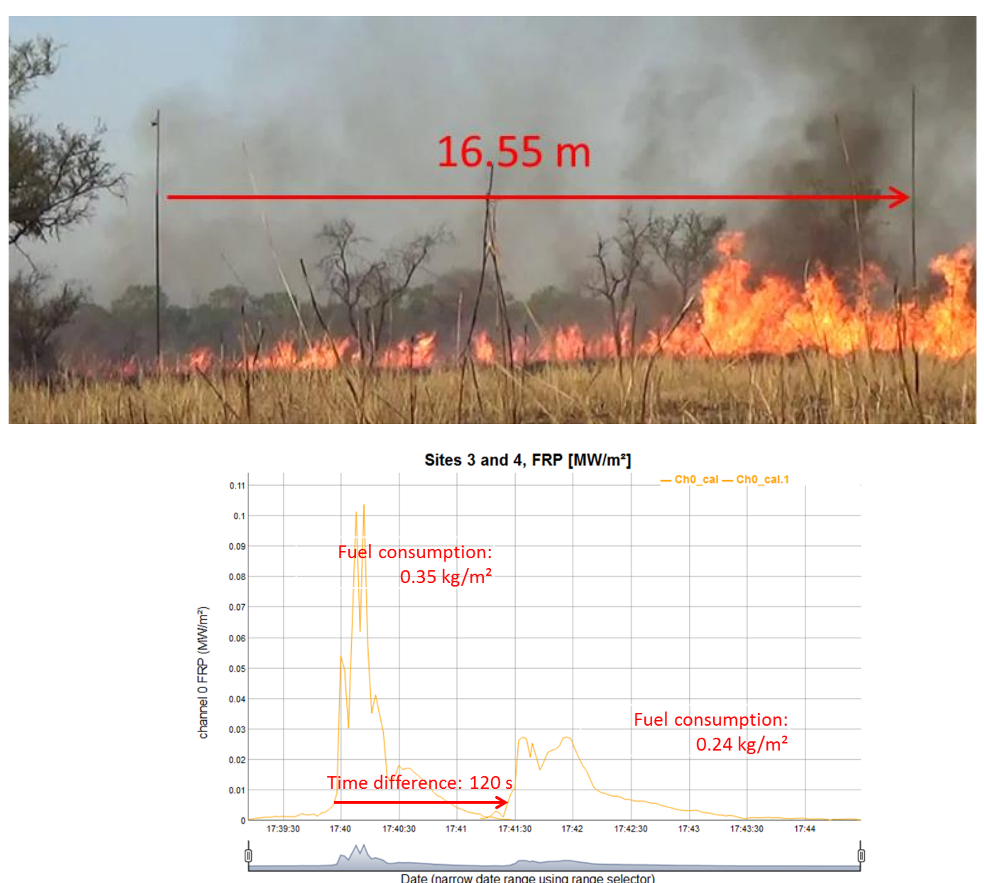

Fig. 9 field experiment: top: image of experimental fire with pole mounted radiometers indicating distance between radiometers.
bottom: chart of radiometer derived FRP against time , indicating fuel consumption under the radiometers derived from FRP and determination of fire travel time

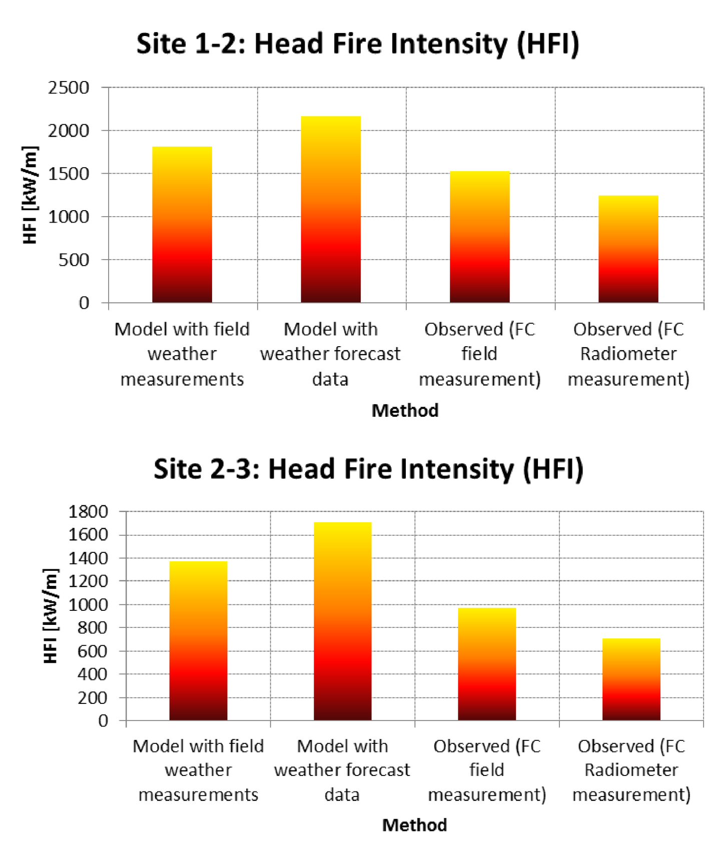

Fig. 10 field experiment: charts of modelled and observed head fire intensities at the two experimental sites in Comoé National Park.

Funding:

Awards:

References:

Thymstra et al. (2010): Development and Structure of Prometheus: the Canadian Wildland Fire Growth Simulation Model, Information Report NOR-X-417, Canadian Forest Service
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