



## Fire Monitoring and Fire Management in Comoé National Park

### Background

The Comoé National Park in the north-east of Côte d'Ivoire, listed as UNESCO World Heritage site and Biosphere reserve, is situated between the Sudanian Savanna and the forest formations of the Guinean field. Covering 1,148,756 ha, it is one of the largest protected areas in West Africa. It is characterized by a high diversity of wildlife species. Since 2015, German Development Cooperation has been contributing to the conservation and the management of the Park via the GIZ project PROFIAB. On behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ), PROFIAB works on strengthening the capacities of the Ivoirian Protected Areas Authority (OIPR).

While fire is an integral part of savannah ecosystems, uncontrolled fires are one of the main threats to habitats and wildlife species. In July 2016, OIPR developed a fire management strategy. Implementation of this strategy is supported by the fire monitoring platform firemaps.net.

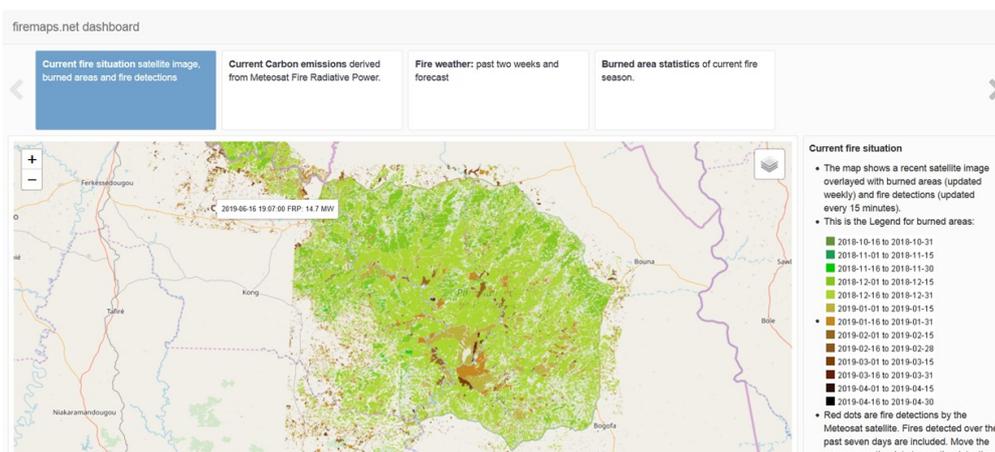


Kob Antelope in Comoé National Park

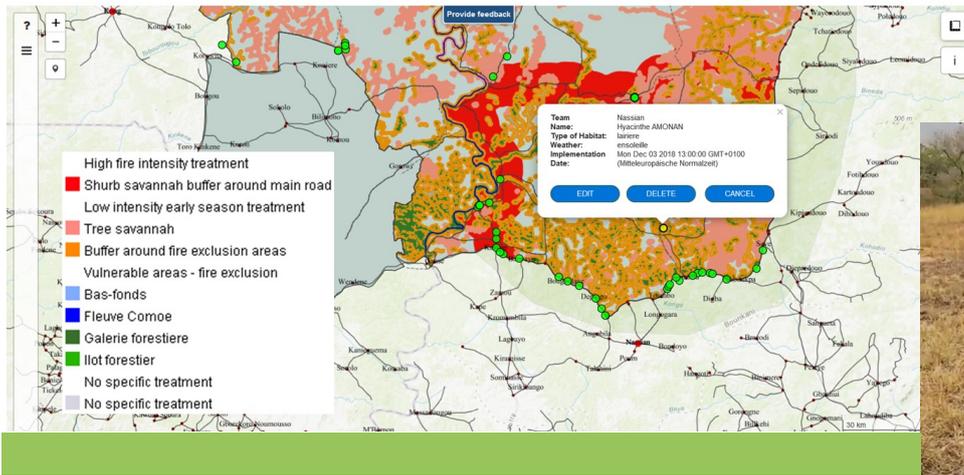
The platform provides online monitoring of fire activity, burned area, greenhouse gas emissions by fires and weather variables defining fire risk. A management module supports documentation and evaluation of fire management activities.

### Monitoring

A management dashboard contains information on actively burning fires and current carbon emissions in near real time. Information on weather conditions affecting fire occurrence and fire spread is available from daily weather forecasts. Burned area is updated weekly to monthly based on the most recent satellite images.



Firemaps dashboard showing a map of burned areas color-coded by date of burning



Left: Management map and locations of management fires. Below: lighting a management fire



### Analysis

Burned areas derived from medium and high resolution satellites can be analysed with maps and an interactive statistics tool.

Fire radiative power (FRP) observed by infrared satellite sensors is used to derive time series of greenhouse gas emissions from fires.

Burned areas intersected with land cover provide reporting-ready analysis and charts.

### Management

Controlled burning to manage fuel loads is an important part of the fire management strategy. Application of burns is driven by a management plan based on vulnerability of vegetation. The plan indicates zones where fires should be applied to manage fuels or reduce bush encroachment.

In the 2018/19 fire season, management fires were documented in firemaps.net for the first time, and results of the previous season's fire analysis were used to plan management fires.

An estimate of 6% of the burned area was burned in management fires implemented by OIPR.

A web based tool was developed for planning and documentation of management fires. A fire intensity model informs on the fire intensities achieved.

According to this model, controlled fires burned mostly at moderate intensity. Experience of the management burns will be used to further improve fire management in the park.

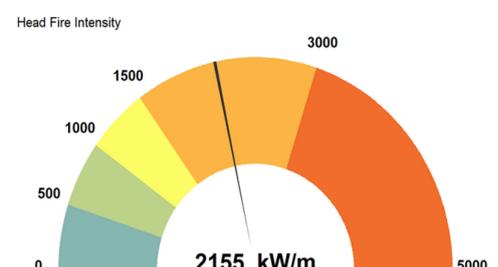


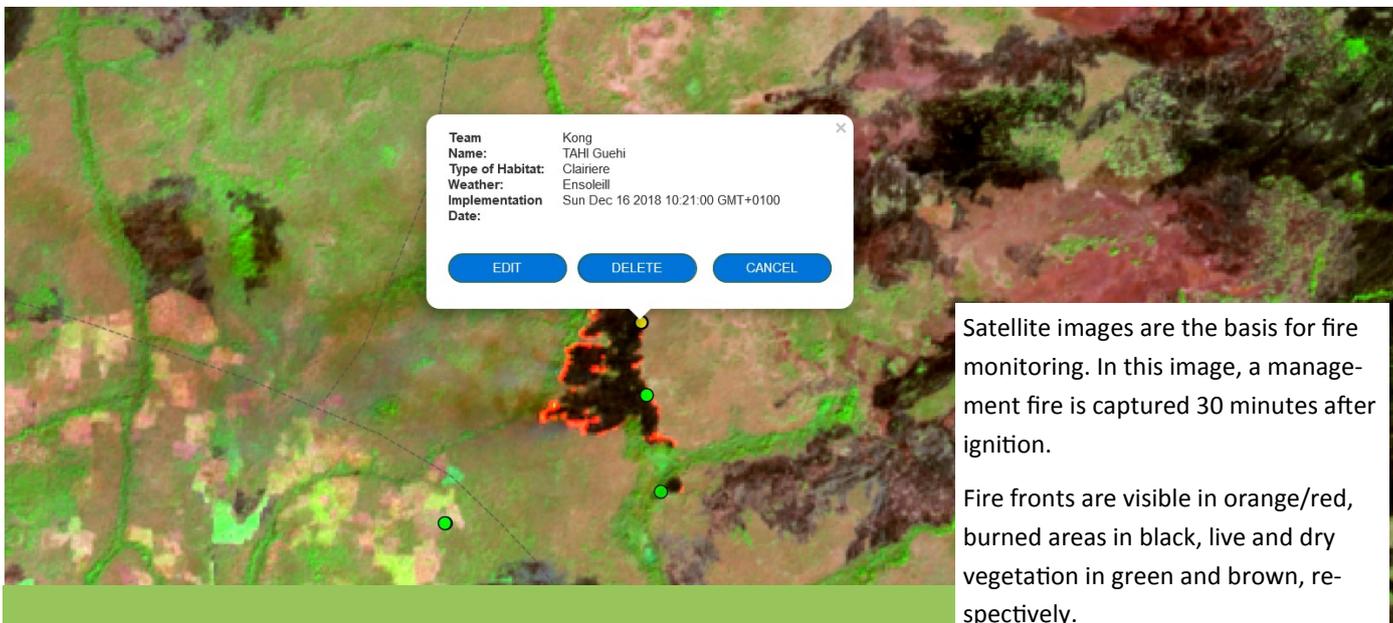
Fire intensity is decisive for achieving management objectives. A fire model helps managers to plan and evaluate management fires. A report is generated for each fire (below).

**Field record**  
 X coordinate: 378423 Y coordinate: 1005388  
 Date and time of ignition: 2018-12-16 10:21:00

**Team member:** TAHI Guehi  
**Weather (observed):** EnsoleillÃ  
**Habitat type:** Clairiere **Habitat status:** Sec **Wind direction (from - to):** E-O

**Forecast weather and fire behaviour**  
**Temperature:** 29.89 **wind direction:** 75 **Wind speed:** 7.74 **Relative humidity:** 19  
**Fine Fuel Moisture Code:** 94 **Initial Spread Index:** 11  
**Head Fire Intensity:** 2155 **Rate of Spread:** 21





Satellite images are the basis for fire monitoring. In this image, a management fire is captured 30 minutes after ignition.

Fire fronts are visible in orange/red, burned areas in black, live and dry vegetation in green and brown, respectively.

### Key facts on fire activity and fire management in the Comoé National Park

Most fire activity in the Comoé National Park occurs from end of November through February. Late season fires occur up to April. The month with the highest area burned is December.

During each of the 2017/2018 and 2018/19 dry season an approximate area of 820,000 hectares, or about 70% of the park area burned. Most of the fires occurred in the predominant vegetation types tree savanna and bush savannah, but more vulnerable areas like the fringes of gallery forests, forest islands, and wetland were also affected.

Based on the vulnerability analysis, three fire management activities were assigned to corresponding zones of vulnerability:

- Zones where fires should be excluded (Gallery forests, forest islands)
- Zones where early season burning should be employed to reduce fuel flammability (tree savanna, forest fringes)
- Zones where high intensity burns shall be employed to combat tree or bush encroachment into grassland areas (limited areas in bush savannah)

#### Key fire management and fire monitoring terms:

**Fire intensity:** describes the rate of spread combined with the amount of fuel consumed. An intense fire advances fast and has high flames.

**Fire Radiative Power (FRP):** Rate of heat released by a fire. It is directly related to smoke emissions and amount of biomass burned. FRP can be measured by satellites or from the ground using radiometers or special cameras.

### Verification

Field experiments were conducted to assess biomass burned and fire intensity and verify model and satellite-based estimates

Fire Radiative Power was derived from radiometers mounted over the fire, and rate of spread was derived from fire travel time.

Results indicated that the satellite based model of biomass burned and the fire intensity model estimates provide realistic results.



Photographs from field verification measurements

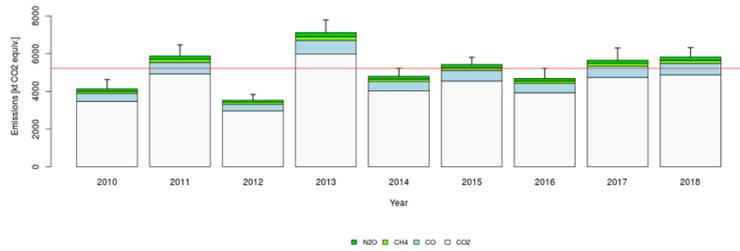
Interactive chart of fire emissions from 2010 through 2018.

Fire emissions Global Warming Potential (GWP)

Select grouping  
 after year  
 after fire season

Select area  
 Comoe  
 Mont Tingui  
 Mont Warigue

Select trace gas  
 CO<sub>2</sub>  
 CO  
 CH<sub>4</sub>  
 N<sub>2</sub>O



Conclusions

The experience of three fire seasons using firemaps.net showed that adoption of the tool by OIPR was characterized by continuous learning and development. This helped to establish new decision processes in fire management. The platform first served as for monitoring and information tool of the fire situation, then as an instrument to further develop fire management strategy and finally as a tool to plan, document and monitor the implementation of this strategy.

Global Warming Potentials (in CO<sub>2</sub> equivalents) derived in this study aim at first quantifying and then define ways for reducing greenhouse gas emissions through better fire management. Thus, carbon funds that contribute to the long-term conservation of the park shall be mobilized.

Implemented by:



Monitoring and analysis powered by:



Supported by:



Comoé National Park is a UNESCO World Heritage Site and Biosphere Reserve



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