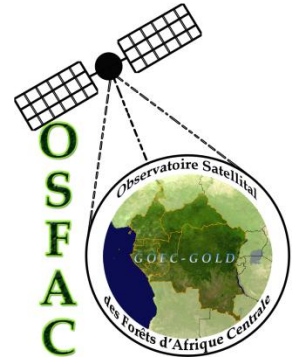


Fire Monitoring in the Congo Basin using MODIS: Current drawbacks and future requirements



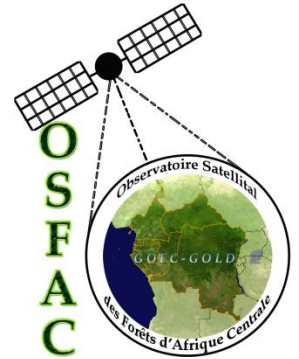
Presentation at the GOFC-GOLD Fire and UNISDR Wildland Regional Network Meeting, 9 May 2011. Side Event at the Wildland Fire Conference, Sun City, South Africa

Landing Mane and Patrick Lola Amani, Observatoire Satellital des Forêts d'Afrique Centrale (OSFAC)

Minnie Wong, University of Maryland, College Park



What is OSFAC?



- Observatoire Satellital des Forêts d'Afrique Centrale
- Began in 2000
- Regional GOFC-GOLD network for Central Africa
- Legally recognized NGO in the DRC
- OSFAC's mission is to raise awareness and promote the use of satellite information through:
 - Distribution of freely accessible satellite data and products
 - Technical training in GIS and remote sensing
 - Central african Forests monitoring
 - Mapping services using GIS and remote sensing
- Partners with government institutions, international and local NGOs, academic institutions and projects

Fire in the Congo Basin



- 6 Congo Basin (CB) Countries: Cameroon, Central African Republic (CAR), Democratic Republic of Congo (DRC), Equatorial Guinea (EG), Gabon, Republic of Congo (ROC)
- Countries cover an area of 4 million km²
- Contains the second largest tropical forest block, after the Amazon
- Also encompasses woodlands, miombo and savannas

What is fire used for?

Natural and human induced (intentional & accidental) causes:

- Lightning strikes
- Agricultural clearing in savannas and forests
- Stimulating new plant growth
- Create grazing areas for livestock
- Part of hunting process (fire drive); bushmeat hunting
- Reduce fuel load around villages and agricultural fields
- Clearing paths for walking and transportation
- Collection of termites, grasshoppers, caterpillars and other insects
- Accidents stemming from making charcoal
- Fires may even be set “for fun”

Not all fire is bad, but there is a general lack of knowledge on fire patterns and regimes on local and national scales in the Congo Basin

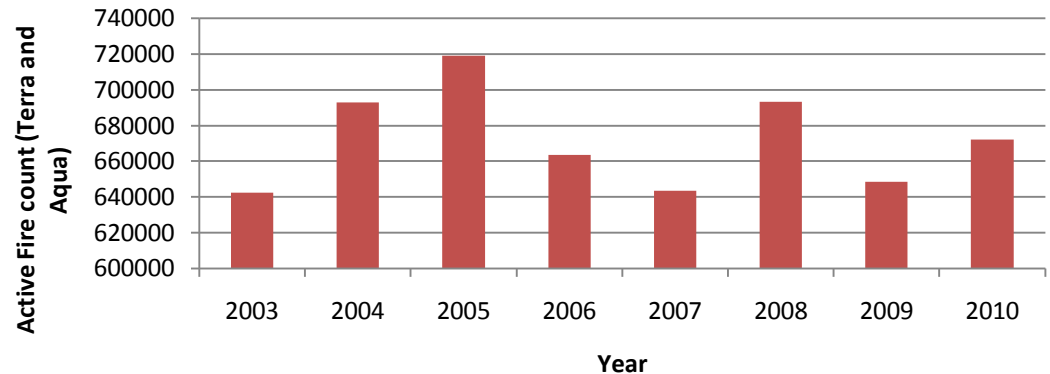
MODIS background

- MODIS, the MODerate resolution Imaging Spectroradiometer, on board NASA's Terra and Aqua satellites
- MODIS launched on the Terra satellite in December 1999, providing high quality observations since November 2000
- MODIS launched on the Aqua satellite in May 2002, providing observations since July 2002
- Local time of overpass is 10:30am and 10:30pm from the Terra satellite and 1:30pm and 1:30am from the Aqua satellite (MODIS night time data not currently processed for fire)
- Data processed by the MODIS Data Processing System (MODAPS) and MODIS Rapid Response at NASA Goddard Space Flight Center, USA

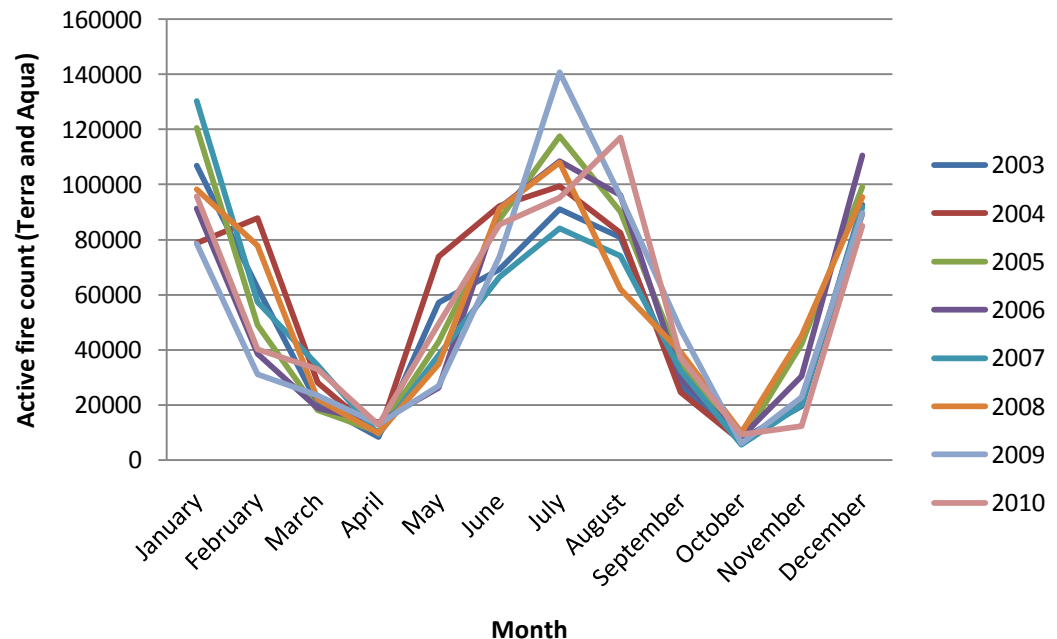
MODIS fire statistics (Congo Basin)

- Total yearly fire counts show a high number of fires in 2005 and the lowest in 2007, compared to other years
- Monthly fire counts show two peak fire seasons: December – January (northern Congo Basin) and June – August (Southern Congo Basin). Coincides with the respective dry seasons.

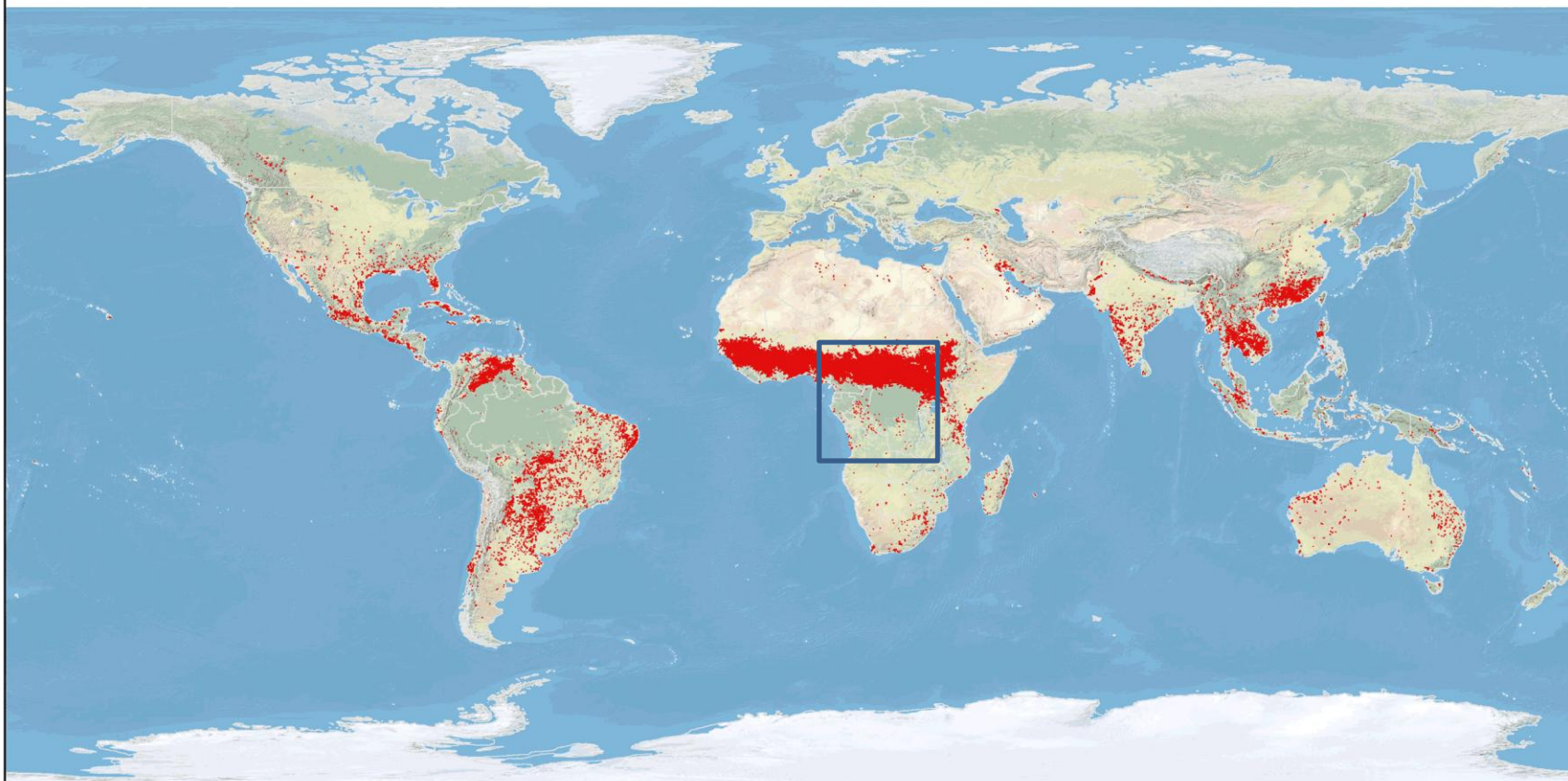
2003 – 2010 MODIS yearly fire counts



2003 - 2010 MODIS monthly fire counts



MODIS Rapid Response Active Fire Detections for 2009



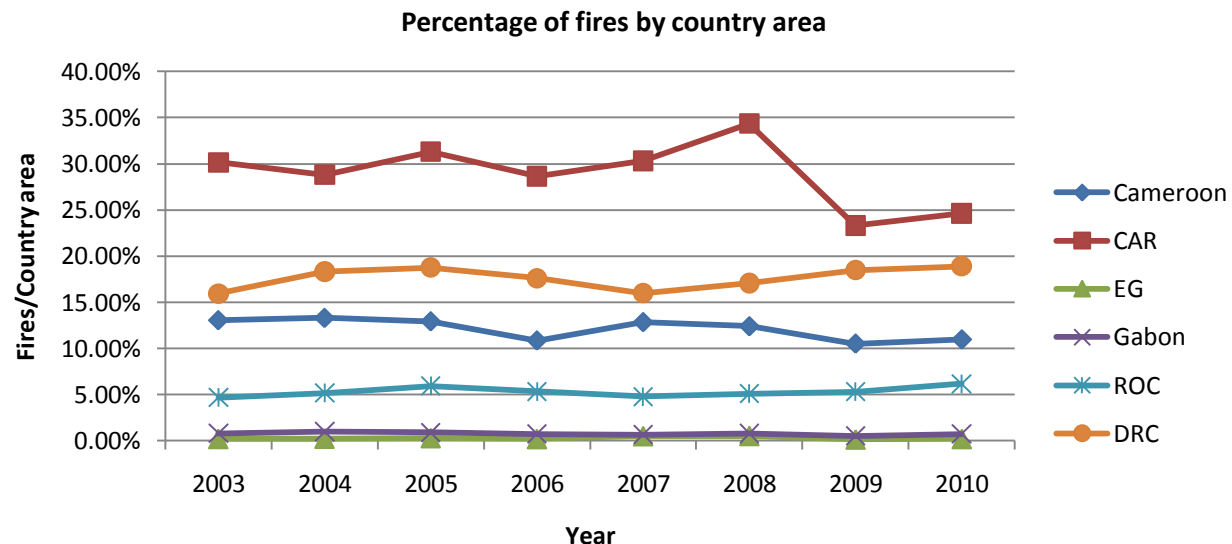
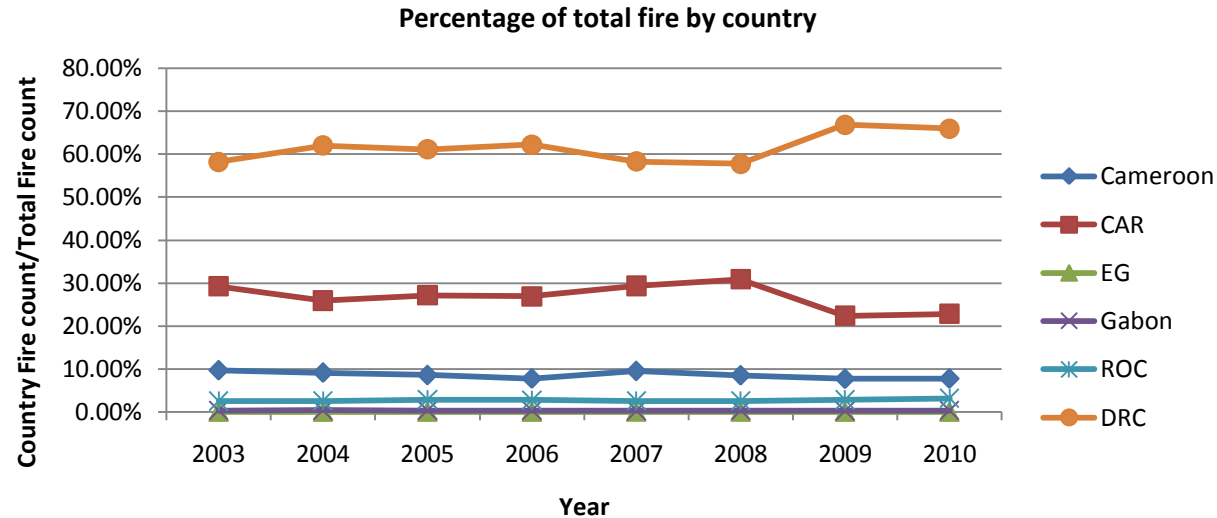
January February March April May June July August September October November December



Active fires, shown in red, are detected using MODIS data from the Terra Satellite.
Source: MODIS Rapid Response <http://rapidfire.sci.gsfc.nasa.gov/>
Fire Information for Resource Management System (FIRMS)
<http://maps.geog.umd.edu/firms/>

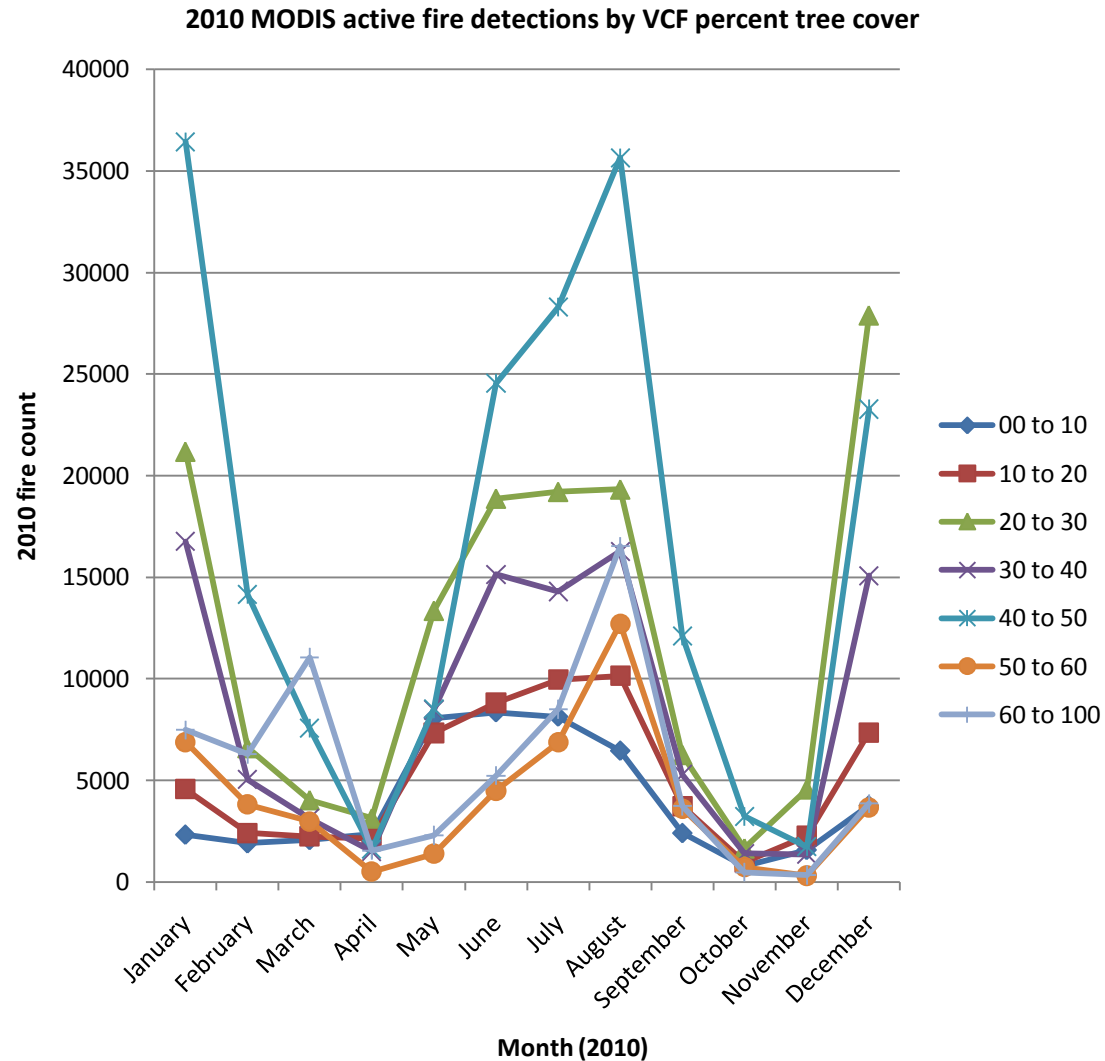
MODIS fire statistics (countries)

- DRC has the greatest percentage of fires out of the 6 countries: around 60 – 65%; Equatorial Guinea has the lowest (could be due to cloud cover)
- When looking at fire count by country area, CAR has the highest percentage of fires: 25 – 35%; Equatorial Guinea still has the least



MODIS fire statistics (VCF)

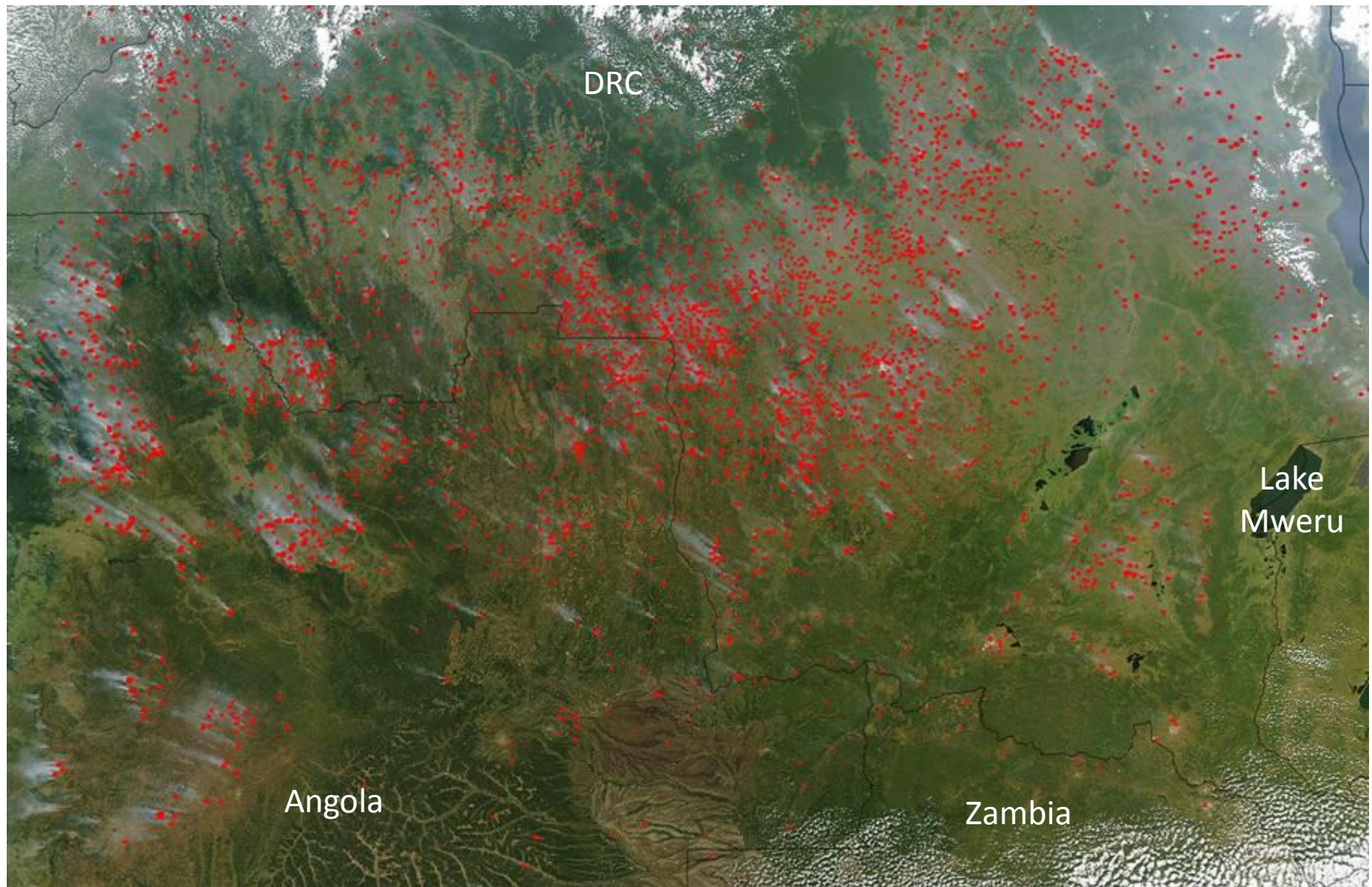
- Using the MODIS Vegetation Continuous Fields (VCF) tree product (MOD44B), fires were analyzed within ranges of percent tree cover. Tree cover of 60% and greater is often considered dense humid forest.
- Most fires occurred in 40 – 50% tree cover and the least in 00 – 10% tree cover, in a representative year (2010)



Examples and case studies of fire in the Congo Basin



Source: F. Bwebwe. Report on study: active fire points for monitoring of impact of a conservation program on canopy destruction. 2009.

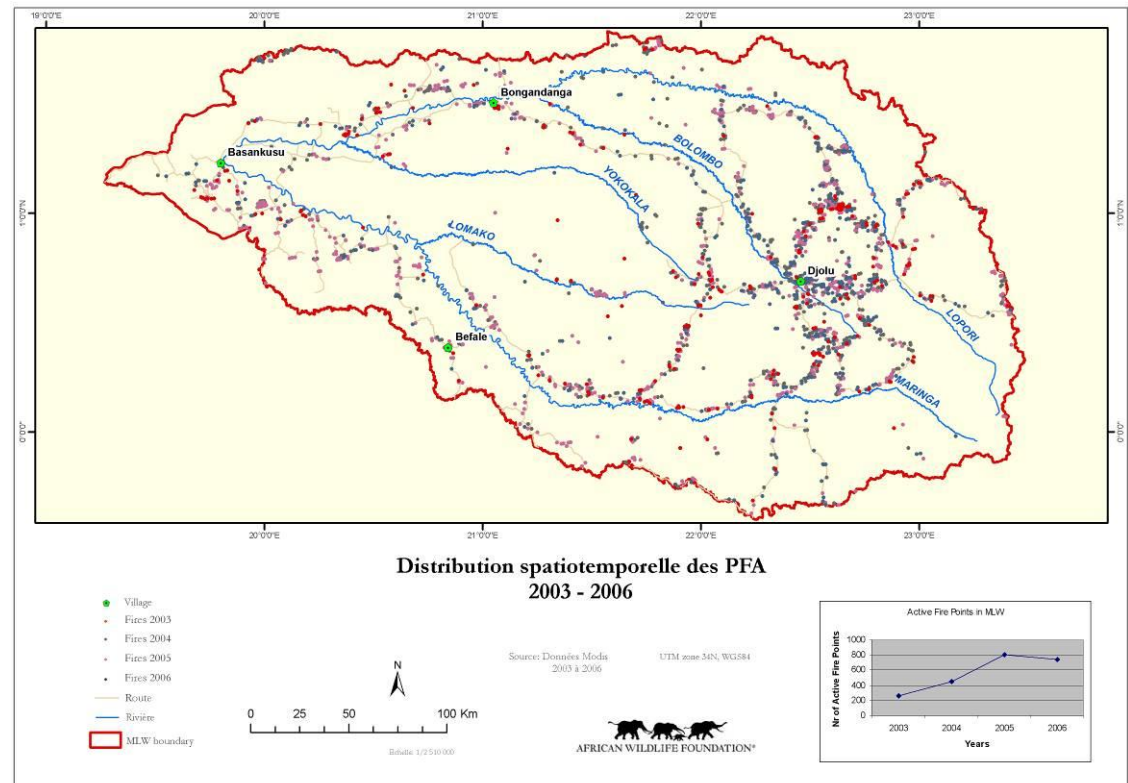


An example of a 1km MODIS surface reflectance image on 10 May 2004 of the Democratic Republic of Congo. This image shows the south eastern portion of DRC with Lake Mweru at the far right of the image. Active fires are shown in red, smoke plumes are also visible.

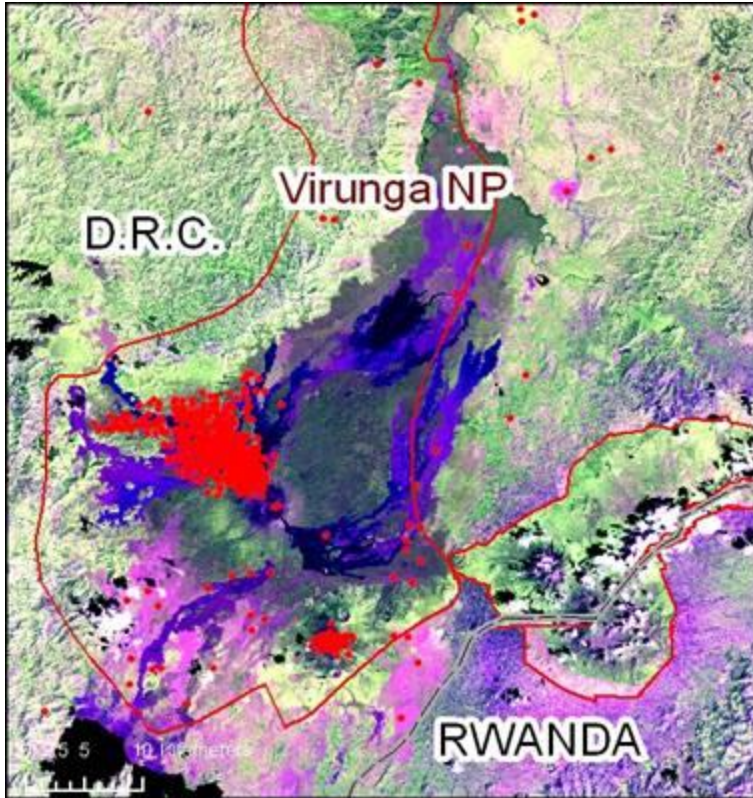
Fires in the Maringa-Lopori-Wamba Landscape (AWF)

C Fachaux, F. Bwebwe. Maringa-Lopori-Wamba Landscape Means of Verification Document. 2010.

- Forest ecosystem
- 2006 preliminary study
- Majority (69%) of fires occur within 2km of settlements (walking distance) and along roads
- But 16% occur beyond 4km of settlements, showing that there may be increasing pressure on the surrounding forest, primarily from locals carrying out slash and burn agriculture and indicates that migration into the forest may be increasing



Virunga National Park, DRC



Source: The Forests of the Congo Basin: A Preliminary Assessment. 2005

In the Virunga National Park, a prominent World Heritage site in the DRC, PA managers have used MODIS data to monitor the frequency and extent of fires within the park.

The figure on the left shows the southern section of the Park and reveals an unusual spatial distribution of fires, with 452 fire counts detected between 11th May and 21st June 2004.

Discussions with Park staff indicated that these fires were caused by local people making charcoal – an illegal activity within the protected area. This information was passed to conservation organizations working in the park to serve as a basis for immediate management and future policy decisions.

Fire in the Bateke Plateau, Gabon

G. Walters. Savanna burning yesterday and today in Gabon's Bateke Plateau: foraging-fires and ecosystem effects. 2010

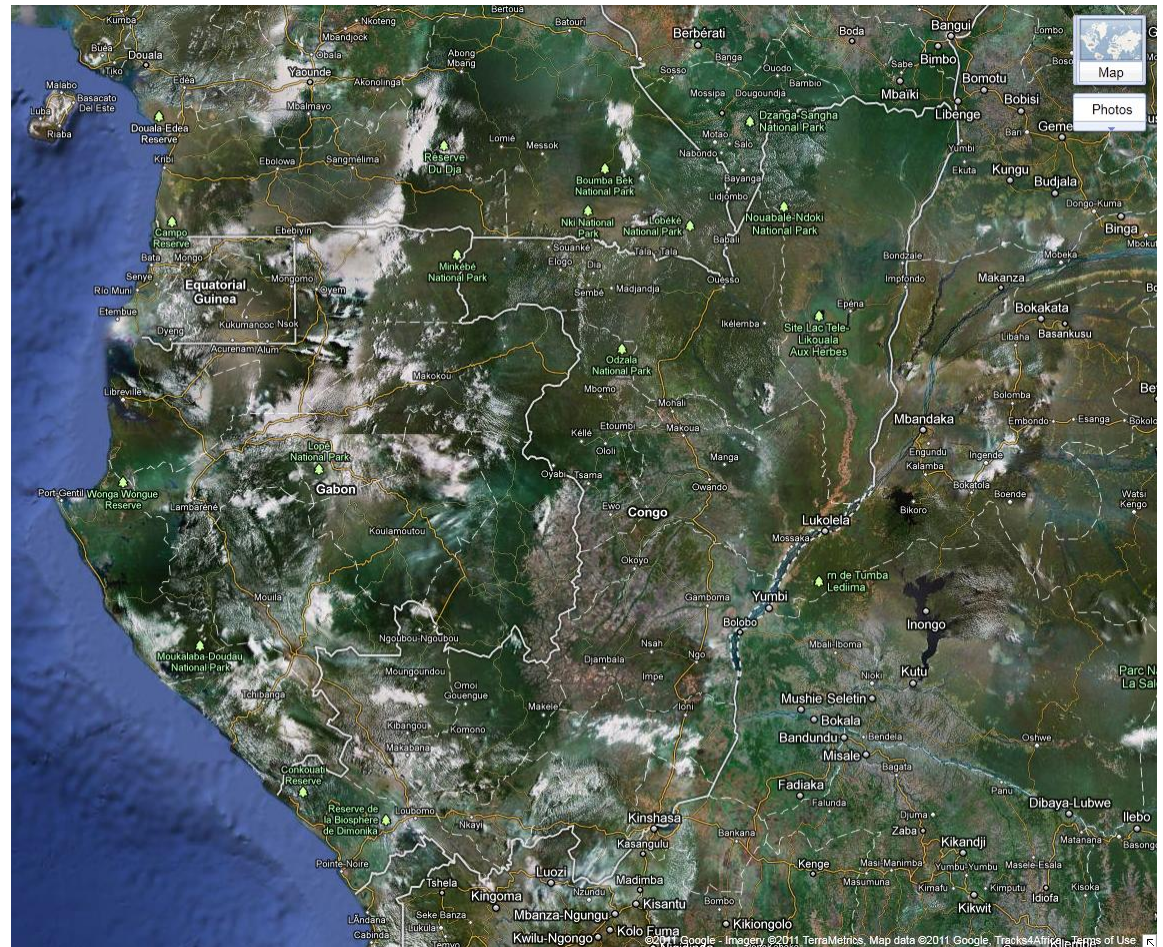
- Savanna ecosystem
- Fires peak in long dry season June – September and smaller peak in the short dry season January – February
- Historically, fires were set based upon land fertility beliefs of the Bateke people and fire foraging practices (hunting, grasshopper collection, forest plantation burning)
- Fire habits changed after 1960 due to gun introduction, changes in post independence law, and rural exodus
- Fires no longer properly managed and monitored
- Need fire management plans based on needs of local populations for subsistence and incorporate the indigenous burn rationale



Current drawbacks of fire monitoring and management

Sensor constraints

- Persistent cloud cover over western Central Africa – obscures fire and fire detection
- Time of satellite overpass may not always coincide with usual time of fire activity, we may be missing a lot of fires that occur in the region



Google Maps image shows high cloud cover over Cameroon, Equatorial Guinea, Gabon

Current drawbacks of fire monitoring and management

Technological capacity

- Poor internet connectivity
- Poor methods of information dissemination in the countries
- Lack of technological expertise in the field to analyze the data

Human/institutional capacity

- Lack of human/institutional capacity to monitor fires on local and national levels
- Lack of fire management plans on the local and national levels
- Poorly defined land tenure/ownership: Locals do not have the incentive to reduce burning or prevent fire encroachment

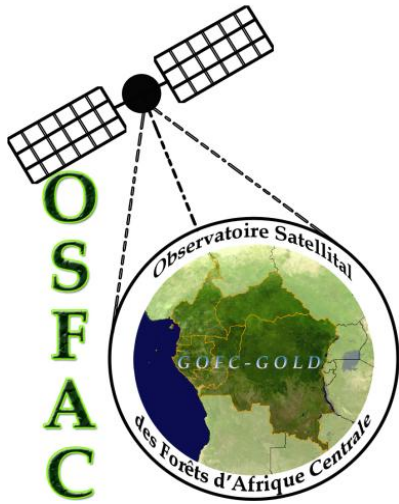
Future requirements of fire monitoring and management

Technological capacity

- Improved internet connectivity
- Capitalize on wide spread mobile phone usage and using existing mobile phone technologies (3G and 4G): SMS text messaging and Web enabled phones

Human/Institutional capacity

- Improved human/computer processing and analyzing capabilities
- Develop fire management plans and policies on local, national, regional levels
- Government agencies to start conducting fire monitoring
- Fire monitoring can be useful in establishing compliance with REDD projects (though problems with cloud cover and internet connectivity still apply)



USAID
FROM THE AMERICAN PEOPLE



GOFC-GOLD
Global Observation of Forest
and Land Cover Dynamics

THANK YOU

