Parcs Gabon

LIÈGE université Gembloux Agro-Bio Tech

UNIVERSITY of STIRLING

European conference of Tropical Ecology – 12-16 February 2024, Lisbonne

Tracking the seasonal rythm of tropical forests (and savannas) with phenocams in Lopé NP, Gabon

Presented by Marjane Kaddouri

Promotors : Pr. Adeline Fayolle & Pr. Katharine Abernethy

With the contribution of Loic Makaga and Nassim Daher

EOS THE EXCELLENCE OF SCIENCE

CENAREST

INERA

CANOPi

Phenology, the first climate indicator of trees?

Rare ground data confirm significant warming and drying in western equatorial Africa

Emma R. Bush[1], Kathryn Jeffery[1,2], Nils Bunnefeld[1], Caroline Tutin[1],

Patterns of fruit-fall phenology in the Lopé Reserve, Gabon

Publié en ligne par Cambridge University Press: **10 July 2009**

Lee J. T. White

Annual cycles are the most common reproductive strategy in African tropical tree communities

Gabriela S. Adamescu, Andrew J. Plumptre, Katharine A. Abernethy, Leo Polansky, Emma R. Bush, Colin A. Chapman, Luke P. Shoo, Adeline Fayolle, Karline R. L. Janmaat ... See all authors

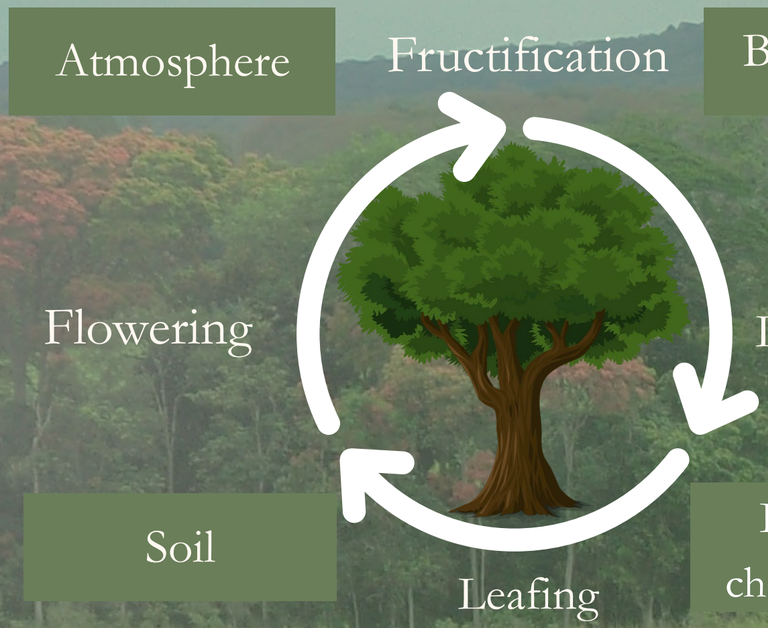
Latitudinal shift in the timing of flowering of tree species across tropical Africa: insights from field observations and herbarium collections

Dakis-Yaoba Ouédraogo[1,*], Olivier J. Hardy[2], Jean-Louis Doucet[1],

TROPICAL FOREST

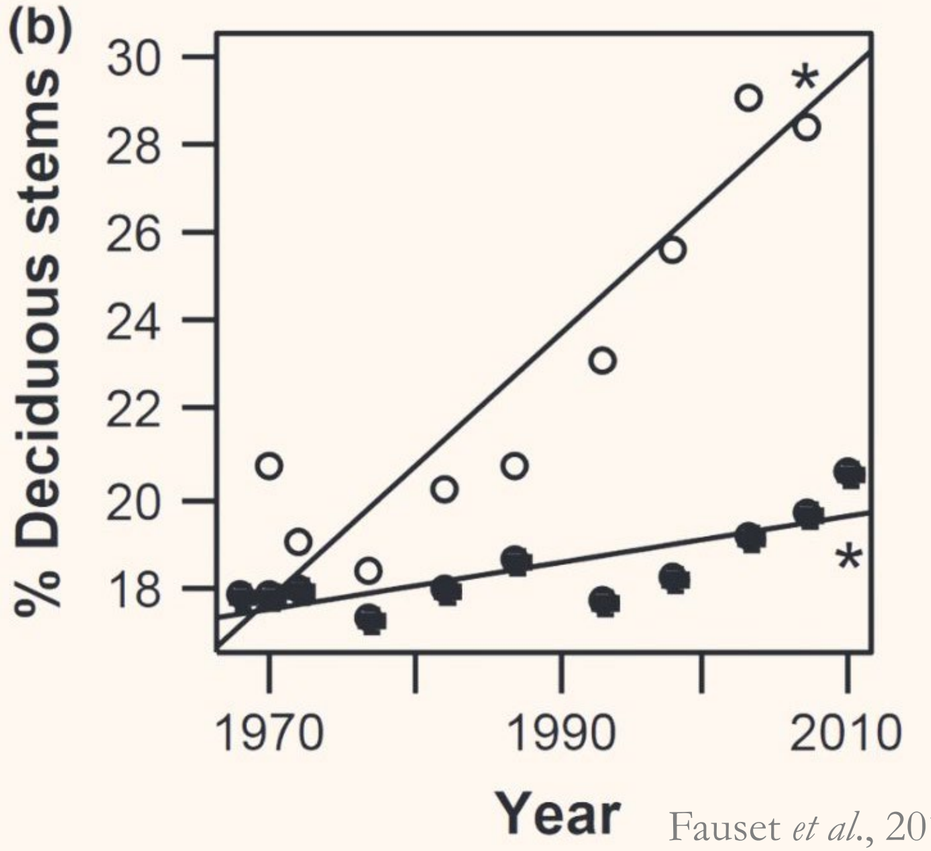
Long-term collapse in fruit availability threatens Central African forest megafauna

Emma R. Bush[1,2*†], Robin C. Whytock[1,3*†], Laila Bahaa-el-din[4], Stéphanie Bourgeois[3], Nils Bunnefeld[1],

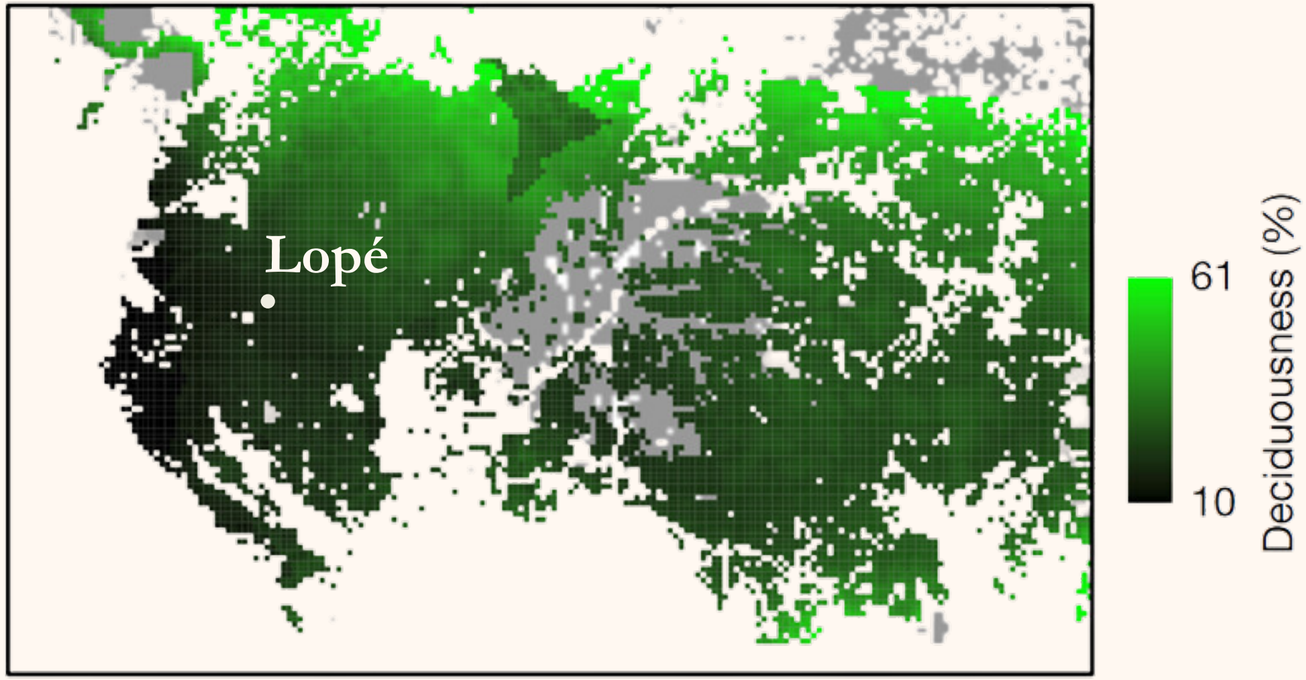


Koch et al., 2007

What do we know about leafing phenology in central africa?



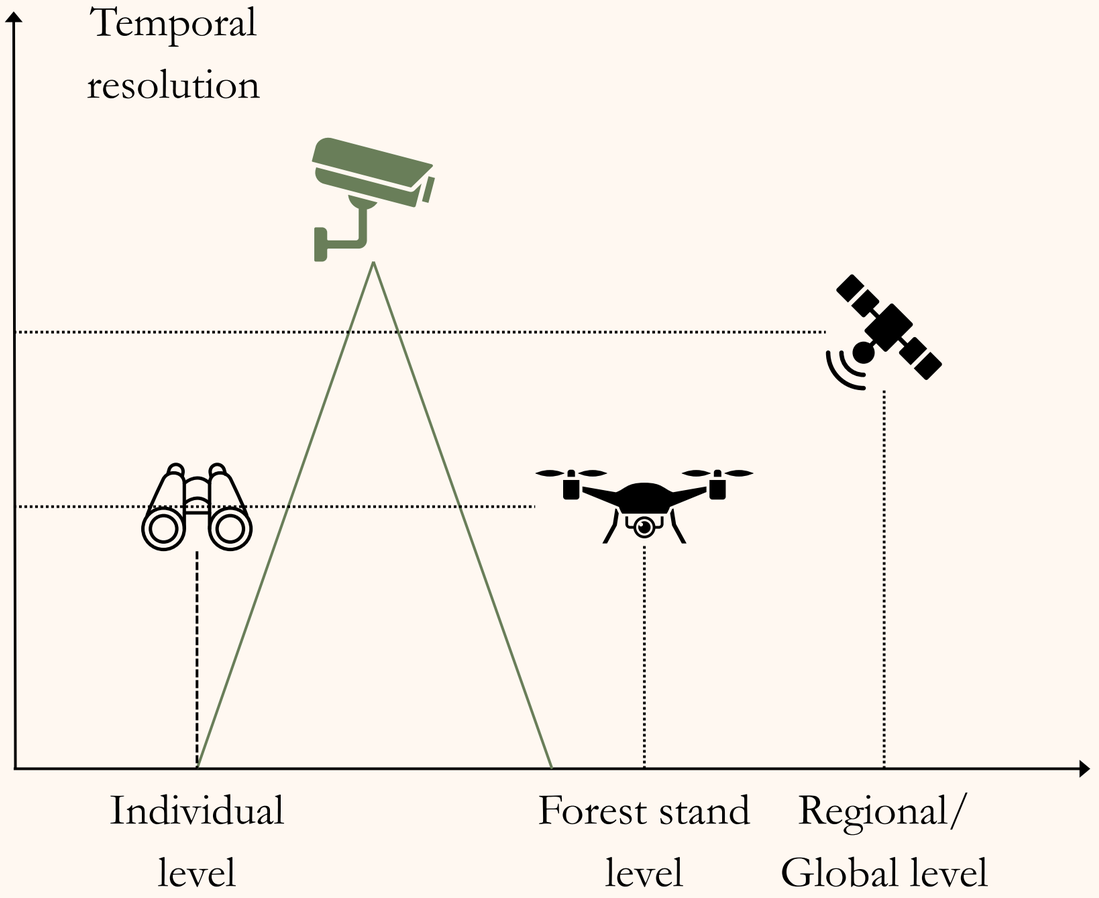
Fauset *et al.*, 2012

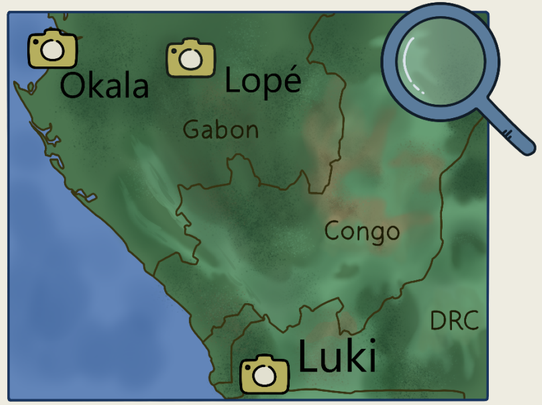


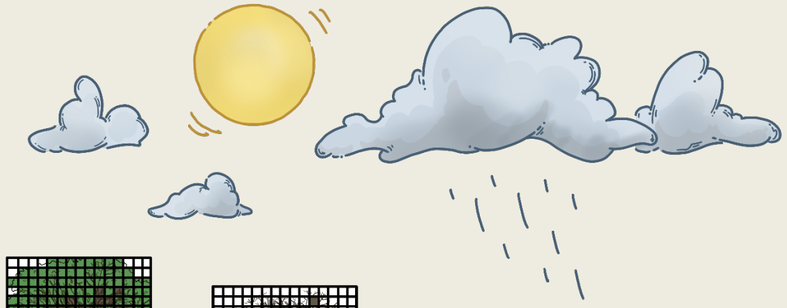
Réjou-Méchain *et al.*, 2021

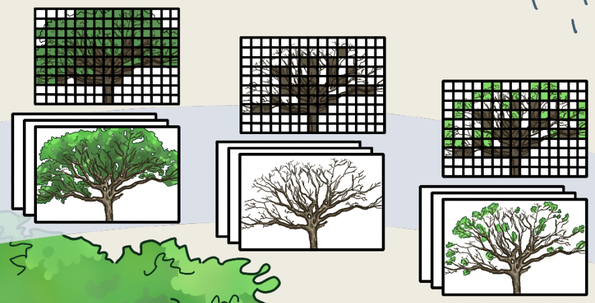
What are the patterns and drivers of leaf loss ?

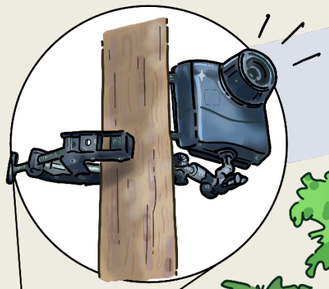
Phenocams wordwide

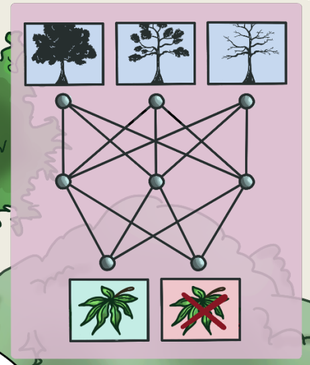


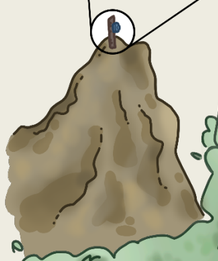


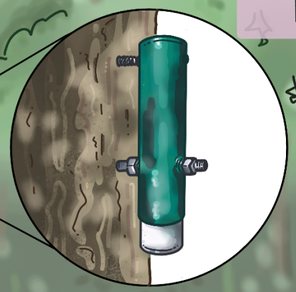


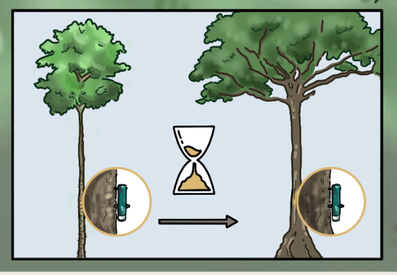








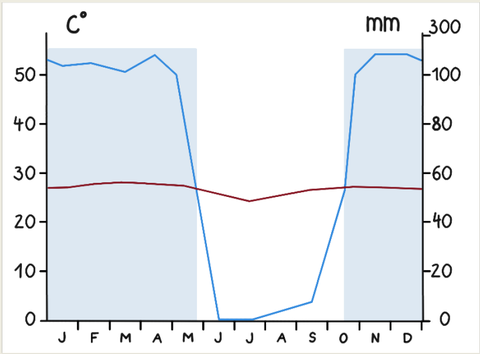




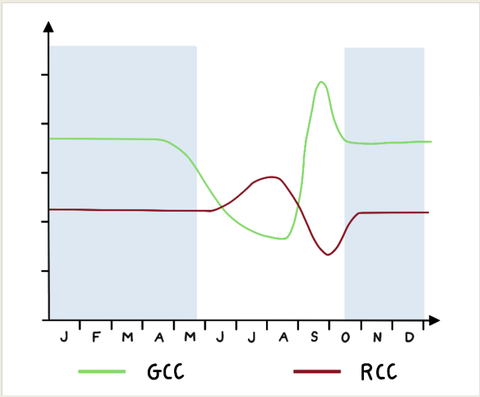
Chapter 1 : Patterns and drivers of deciduousness
Chapter 2 : Automatic recognition of deciduousness
Chapter 3 : Seasonnality of growth and deciduousness

Climat

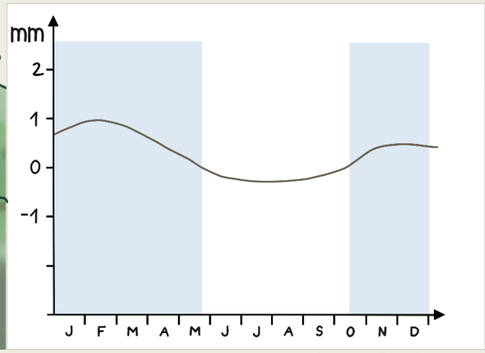
rain season



Deciduousness



Growth



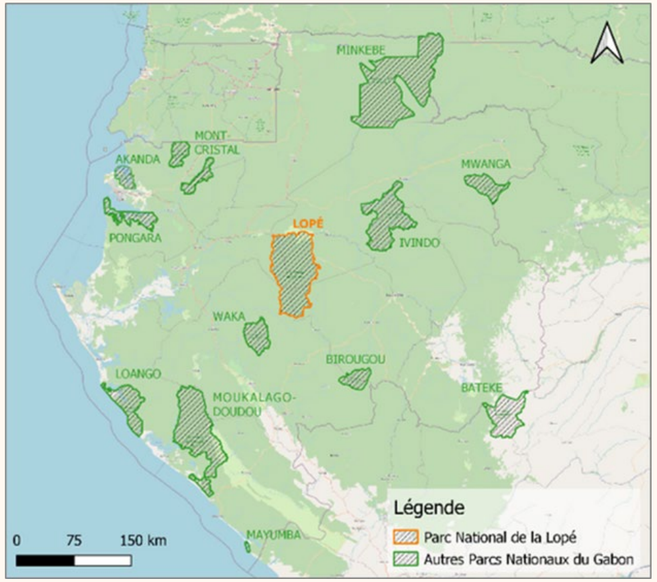
Objectives

Monitor the **deciduousness patterns** in canopy trees with Phenocams

1. **Translate images to phenological events**
2. **Analyze the timing, duration and seasonality of phenological events**

Lopé national parc

Forest-savanna mosaic



Materials

11 Phenocams Windscapes
2 images each day (11 and 12 AM)
+-19000 images
1053 days of data (2019-2023)

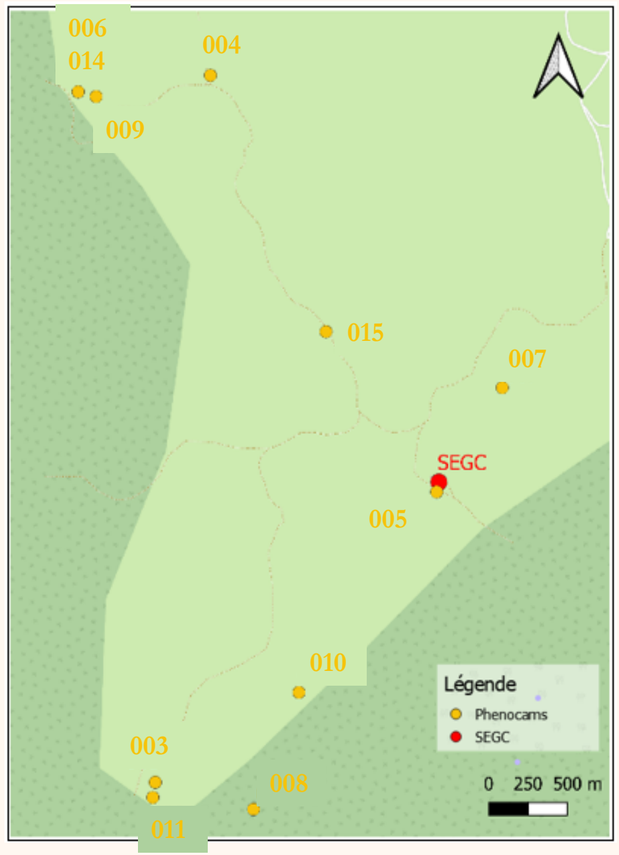
Phenocam 014

Phenocam 003

Phenocam 006

Phenocam 009

Phenocam 011



Phenocam 004

Phenocam 015

Phenocam 007

Phenocam 005

Phenocam 008

Phenocam 010

Methods 1.1.Data Preatreatment

Image Renaming

Trees segmentation

Image calibration

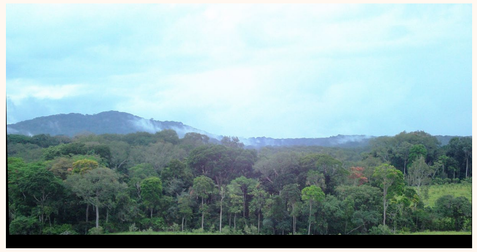
Database clean-up

1

2

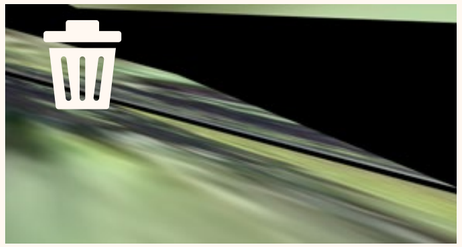
3

4

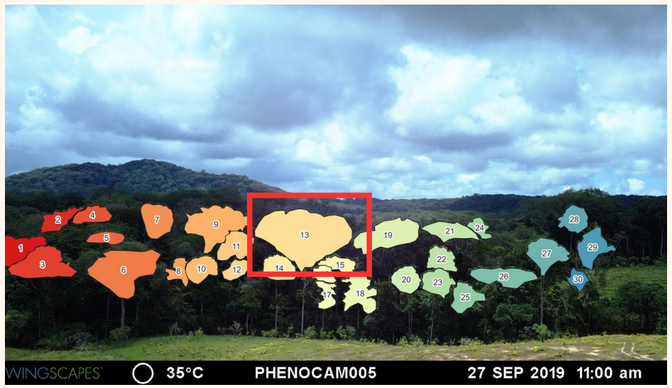


Raw data

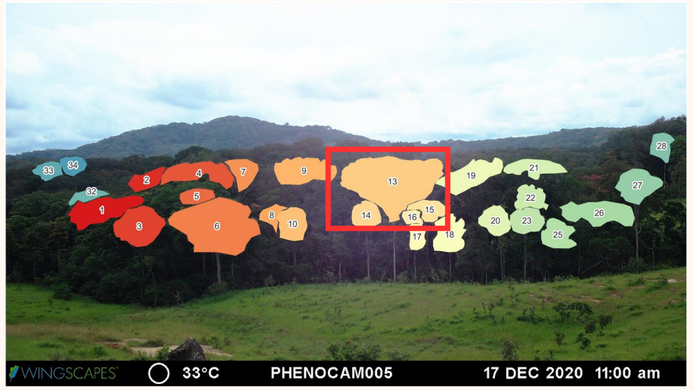
Image reference



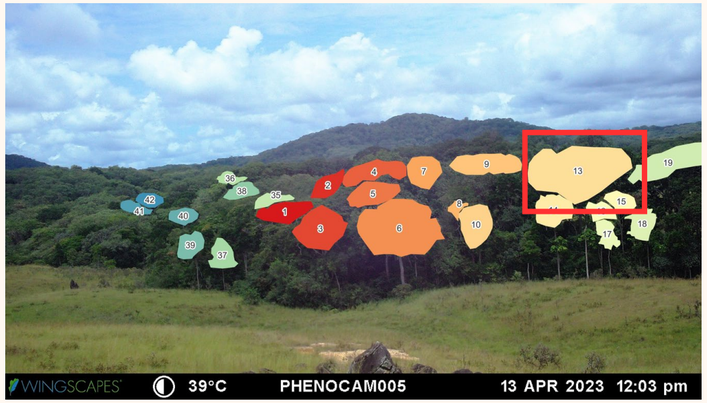
Images Database



2019



2020



2023

Methods 1.2.Data Analysis

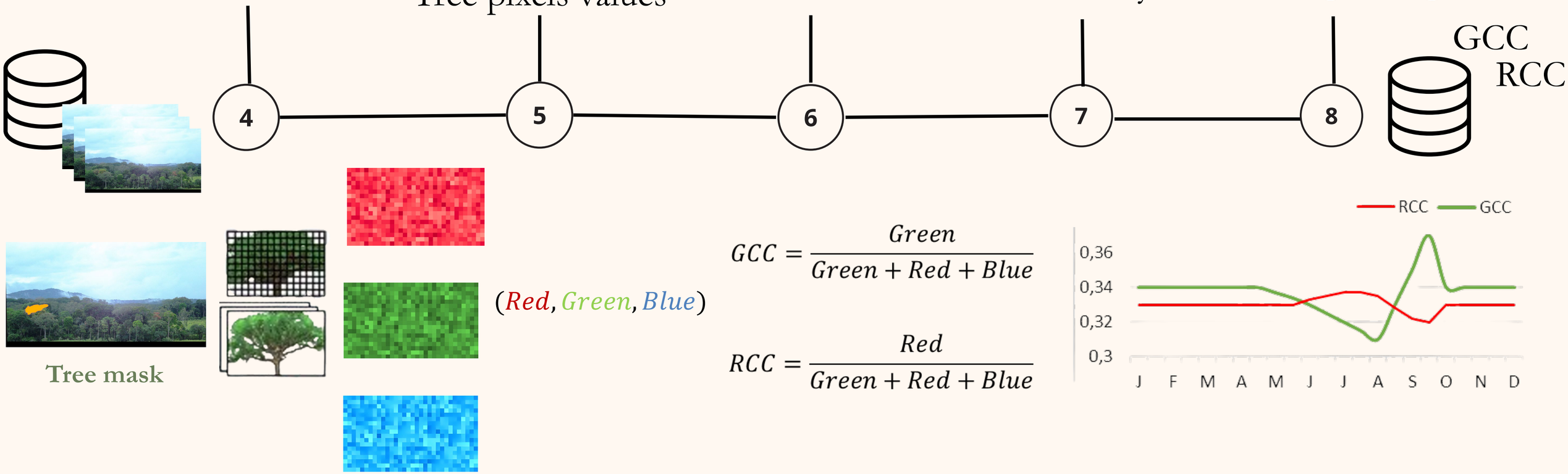
Extract RGB data

Average of GCC[1] & RCC[2] calculation

90° percentile on 3 days

Moving average

Tree pixels values



Tree mask

$(Red, Green, Blue)$

$$GCC = \frac{Green}{Green + Red + Blue}$$

$$RCC = \frac{Red}{Green + Red + Blue}$$

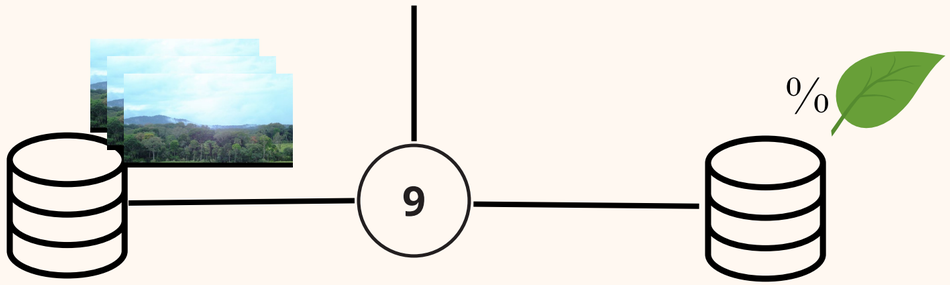
[1] Green Chromatic Coordination

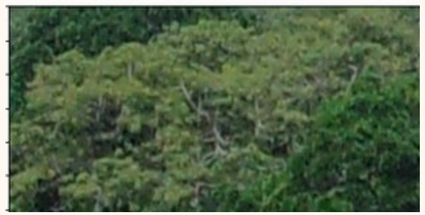
[2] Red Chromatic Coordination

Methods

Image analysis

Images annotations

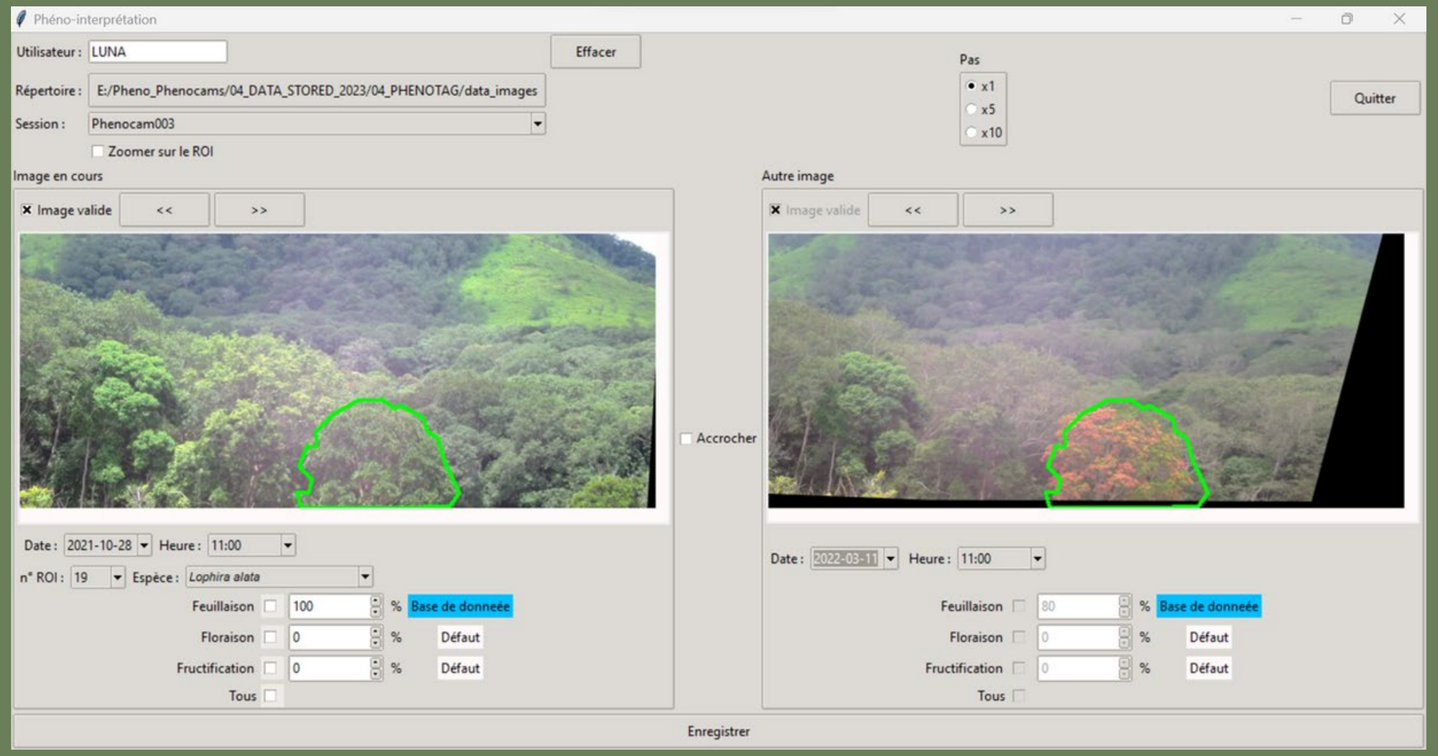




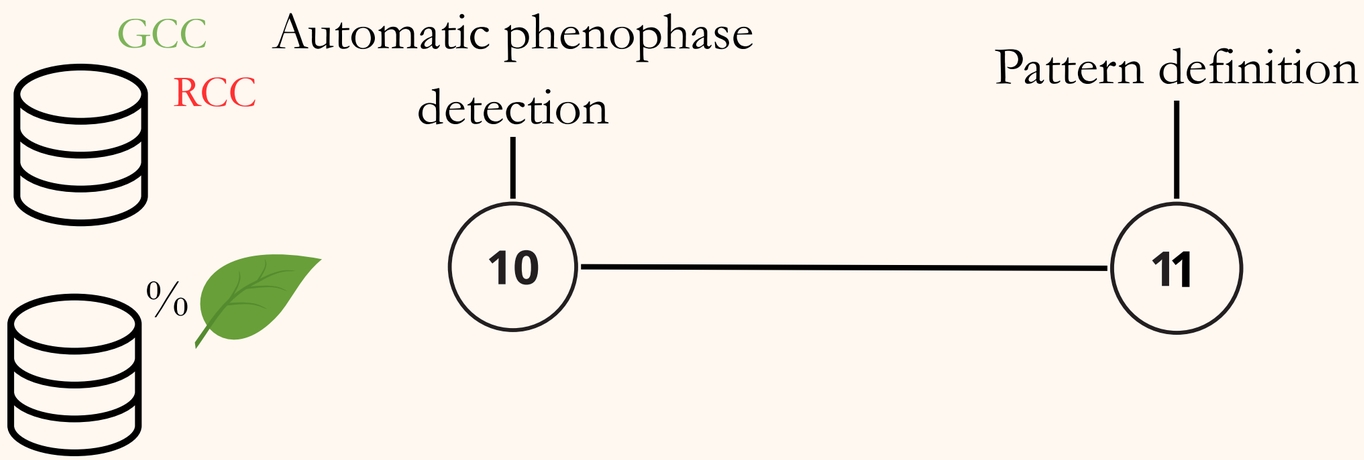
100% of leaves

0% of leaves

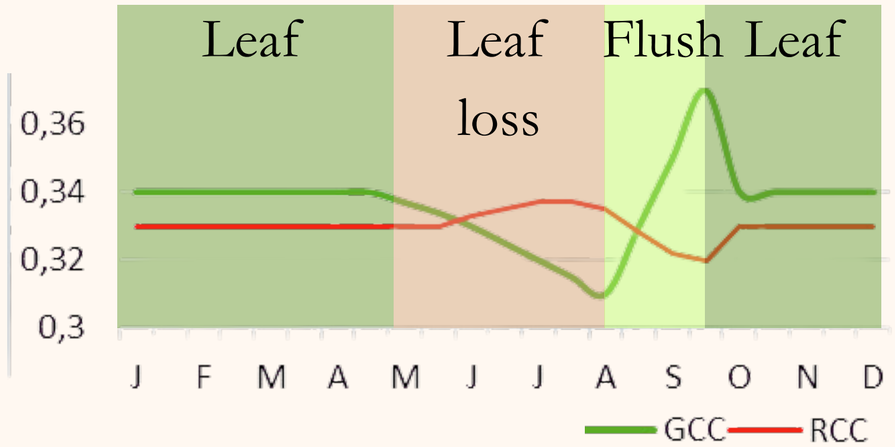
Phenotag



Methods Events detection



Tropical trees phenologicals patterns



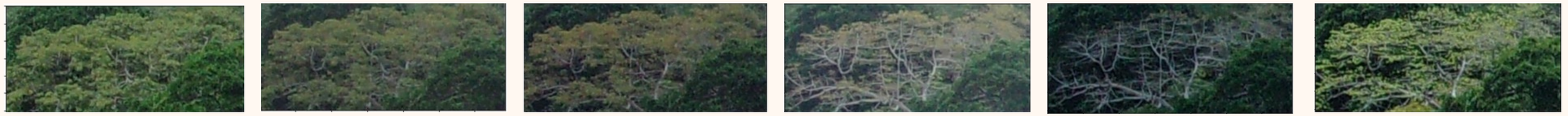
Pattern : One event of leaf loss and flush each year during X days in the rainy season

Results : overview of time series

Leafy Tree

Leaf shedding

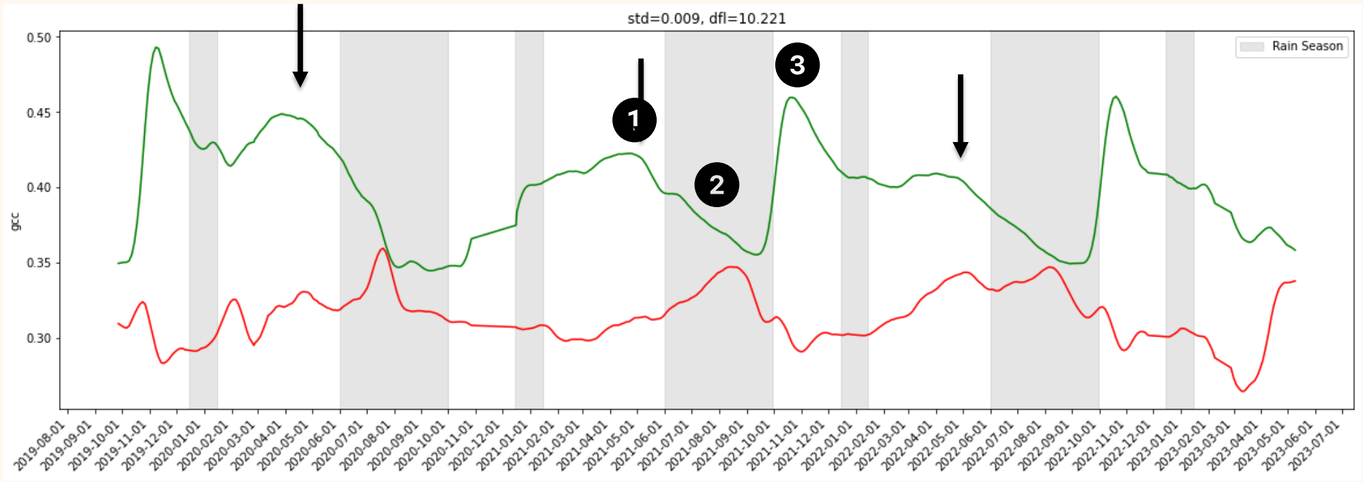
Leaf Flush



1

2

3



GCC

RCC

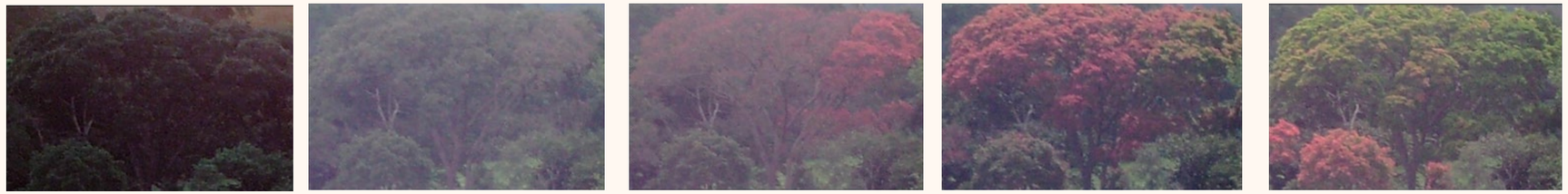
May 2020

May 2021

May 2022

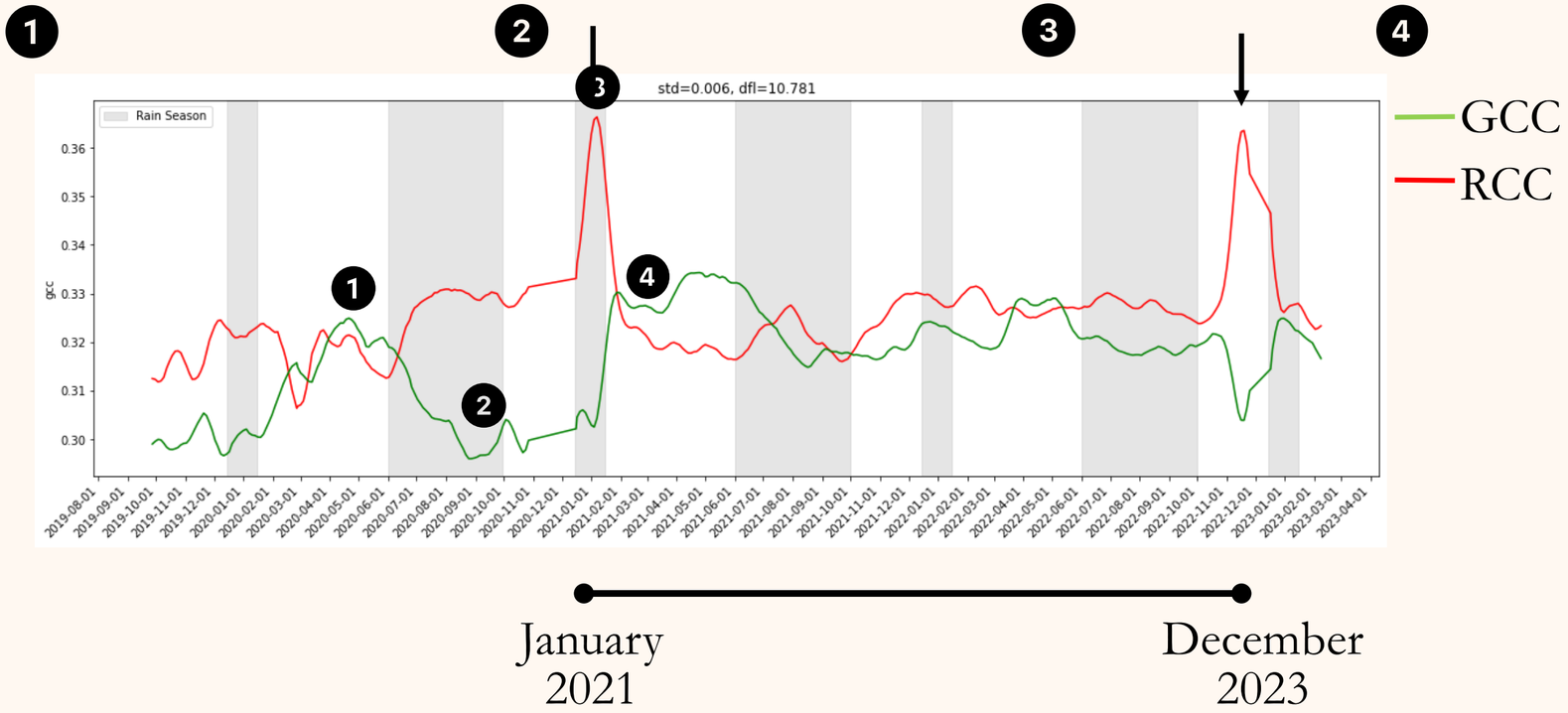
Results : Lophira alata, overview

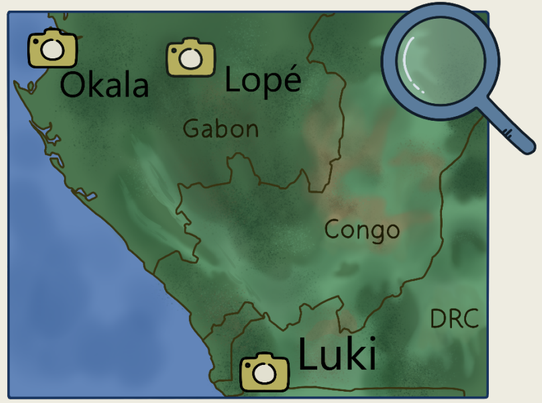
Leafy Tree | Partial Leaf shedding | Young leaves Flush | Adult leaves

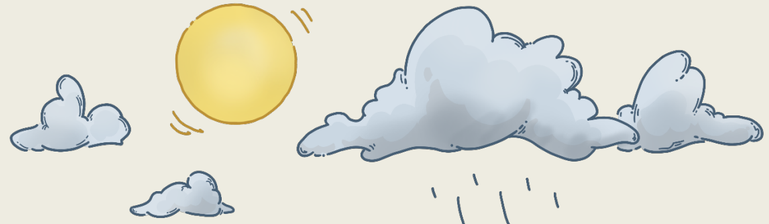


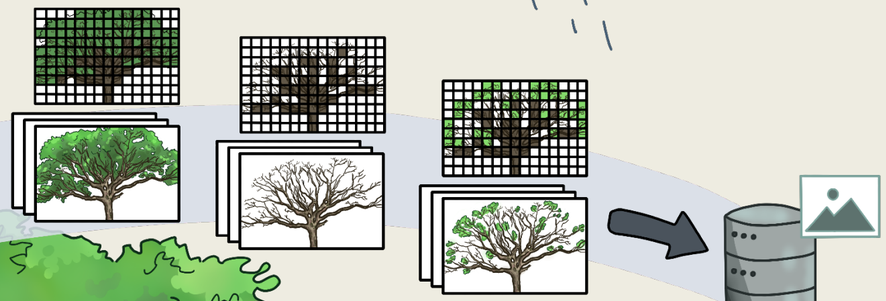
Phenotag results

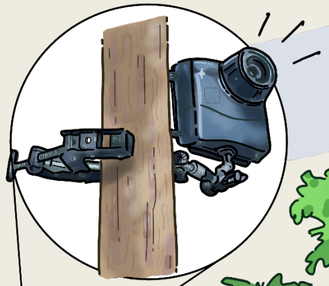
- Average duration : **18 days**
- **Synchronous** phenomenon
- **Annual** events during the **short dry season**

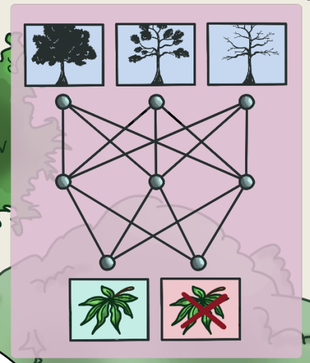


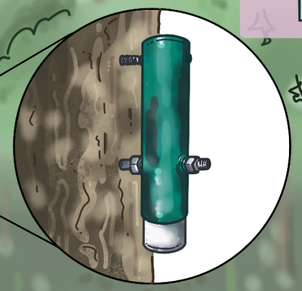


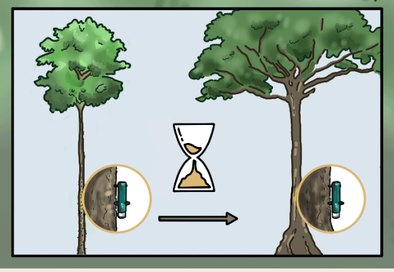






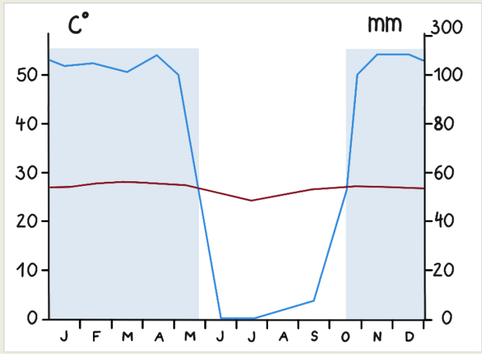




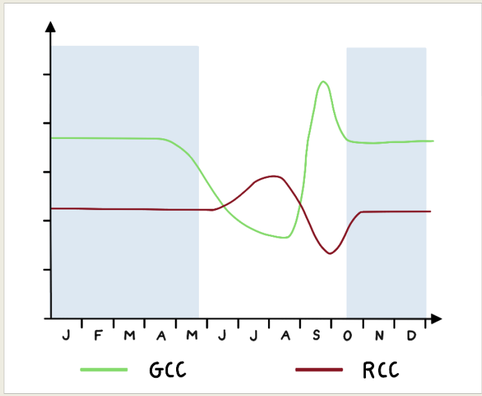


Chapter 1 : Patterns and drivers of deciduousness
Chapter 2 : Automatic recognition of deciduousness
Chapter 3 : Seasonnality of growth and deciduousness

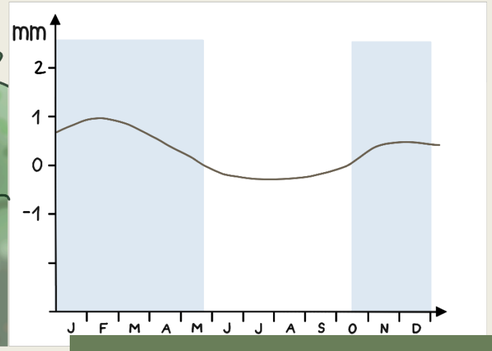
Climat



Deciduousness



Growth

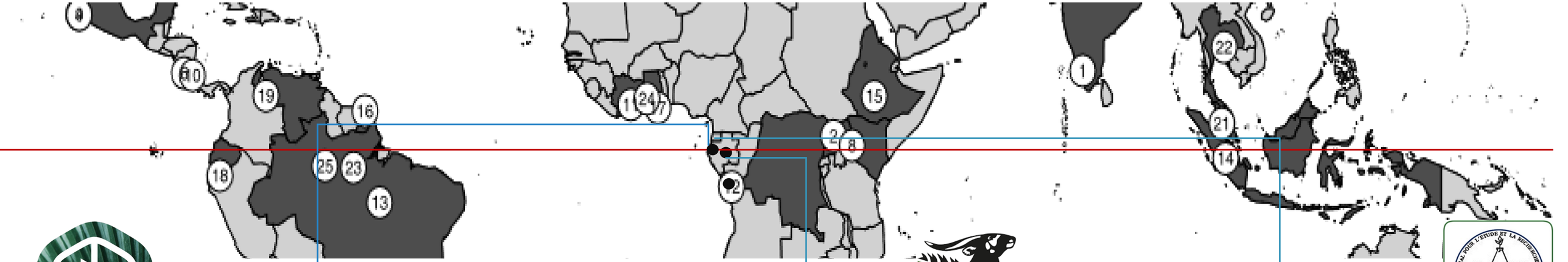


Field work

1. Phenocams installation
   - Image each 15 minutes between 11 and 15 PM
   - Manual White balance
   - 2-3 years of monitoring
   - Sun shelter

2. Digitalisation of crows on the view picture
3. Characterization of trees & selection of trees to install dendrometers
   - Tree numbering
   - Identification of the species
   - Mesure of the diameter
   - Geolocalisation
4. Installation of electronical dendrometers
5. Height mesure

Field work resume



Okala	
Phenocams	**1**
Dendrometers	**8**

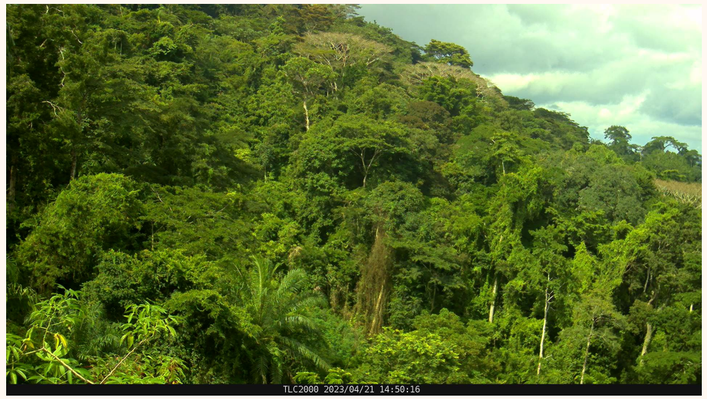
Lopé	
Phenocams	**5**
Dendrometers	**56**

Luki	
Phenocams	**5**
Dendrometers	**59**

Total	
Phenocams	**11**
Dendrometers	**123**

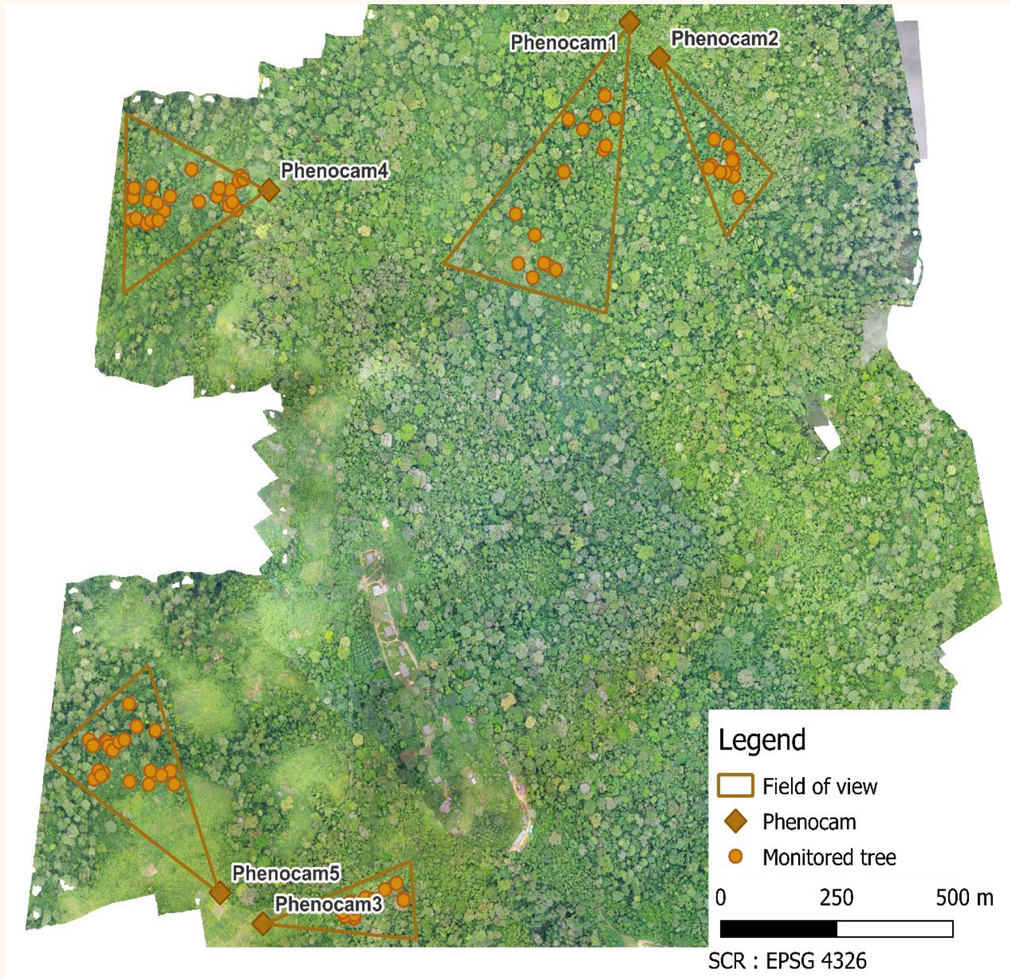
Luki

Phenocam 3



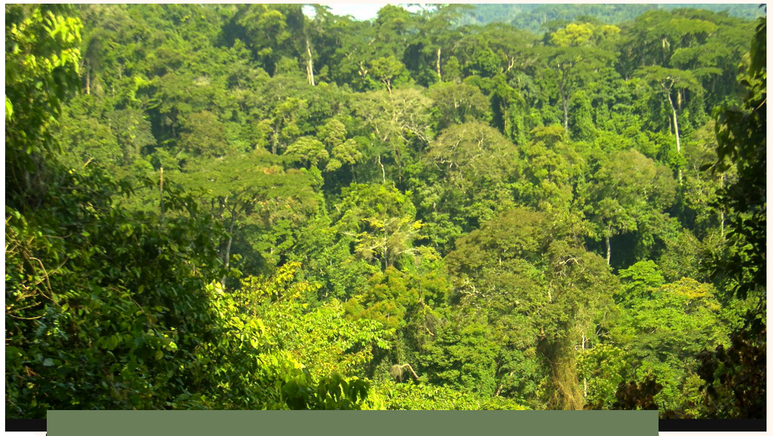
Phenocam 4

Phenocam 5



Phenocam 1

Phenocam 2

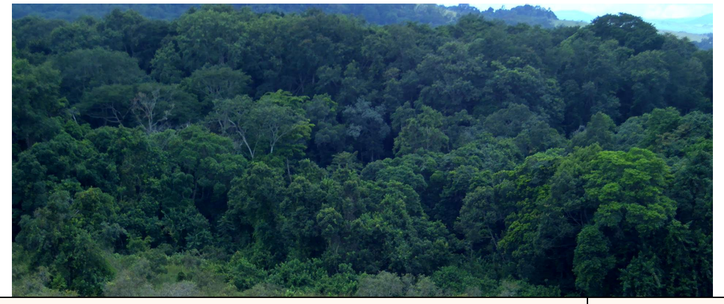


Lopé

Phenocam 4 (Tortue)

Phenocam 3(SEGC)

Phenocam 5 (Celtis 14)

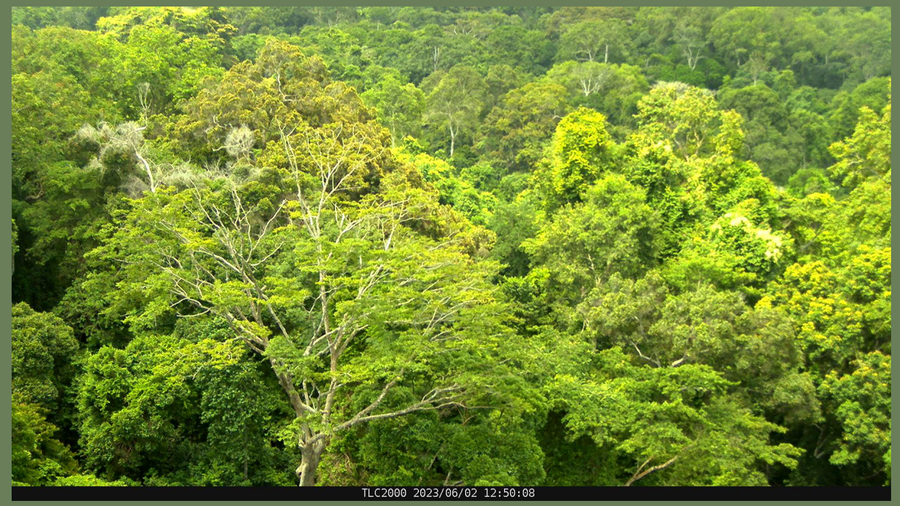


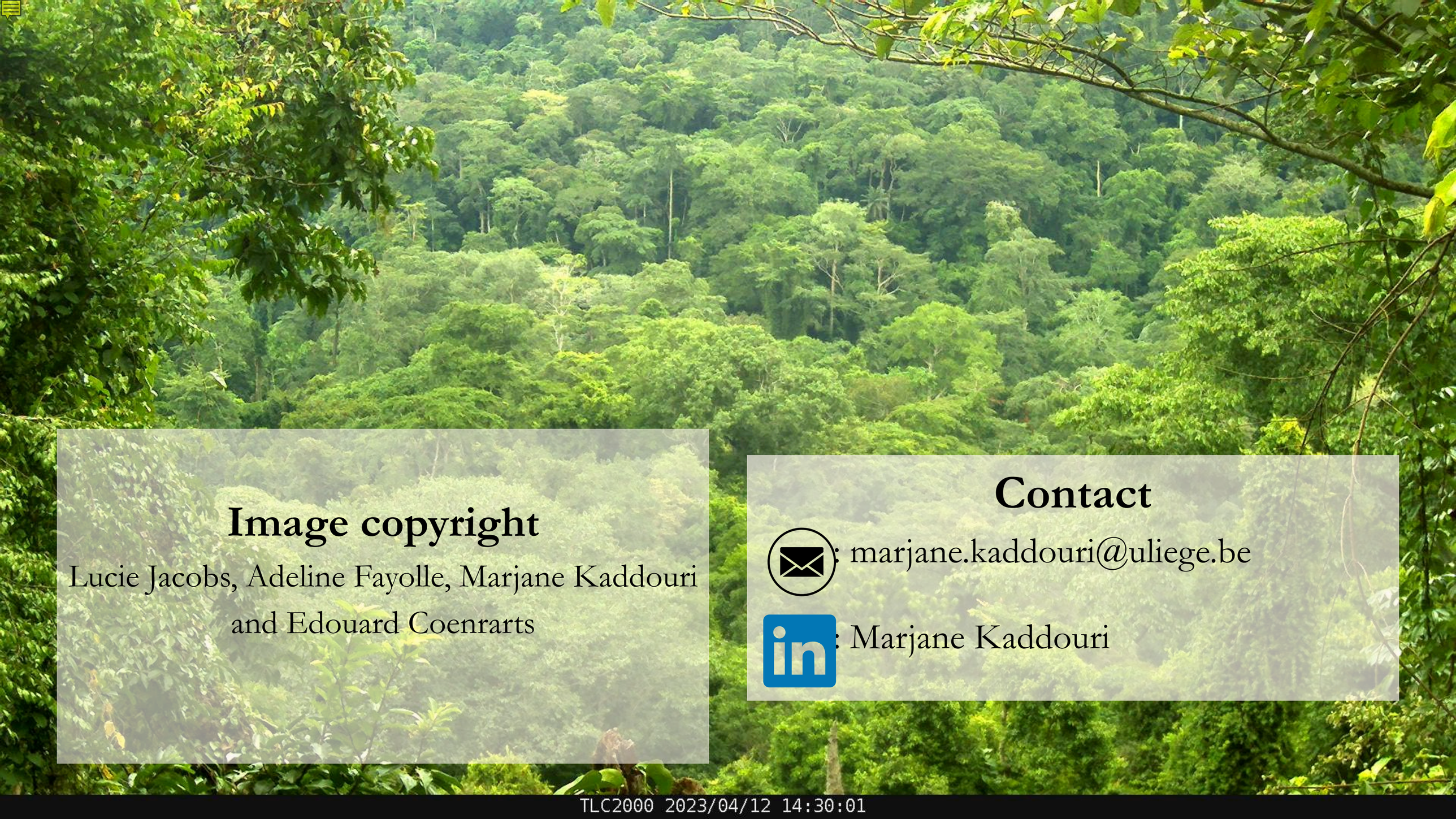
Phenocam 1 (PDV lodge)

Phenocam 2 PDV

Okala

Phenocam 1





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Lucie Jacobs, Adeline Fayolle, Marjane Kaddouri and Edouard Coenrarts

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: Marjane Kaddouri

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