

The variation of vegetation structure and greenness in Central Africa: Combining MODIS multi-temporal data with six million hectares of forest inventory

Global Vegetation Monitoring and Modeling

Valéry Gond, Adeline Fayolle and Sylvie Gourlet-Fleury

CONTEXT

The CoForChange project is focused on predicting the effects of global change on forest biodiversity in the Congo Basin region

The **objective** of the study presented here is to characterize the spatial patterns of tropical forests in the CoForChange area in relation with climatic variables (rainfall and light intensity)

Hypothesis

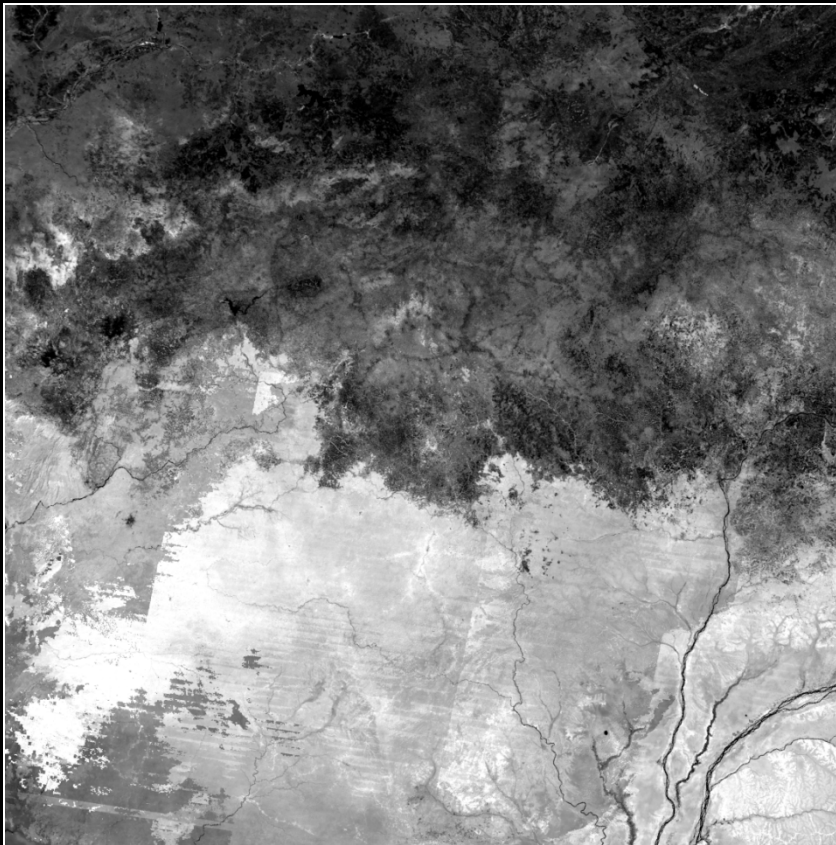
Temporal remote sensing acquisition permits to identify forest structure and functioning (evergreen/deciduous) as a response to climatic environment

CoForChange

Mayaux *et al.*, 2004

Remote sensing material

Vegetation Indices 16-day L3 Global 500m (MOD13A1c5) to collect the Enhanced Vegetation Index (EVI) information



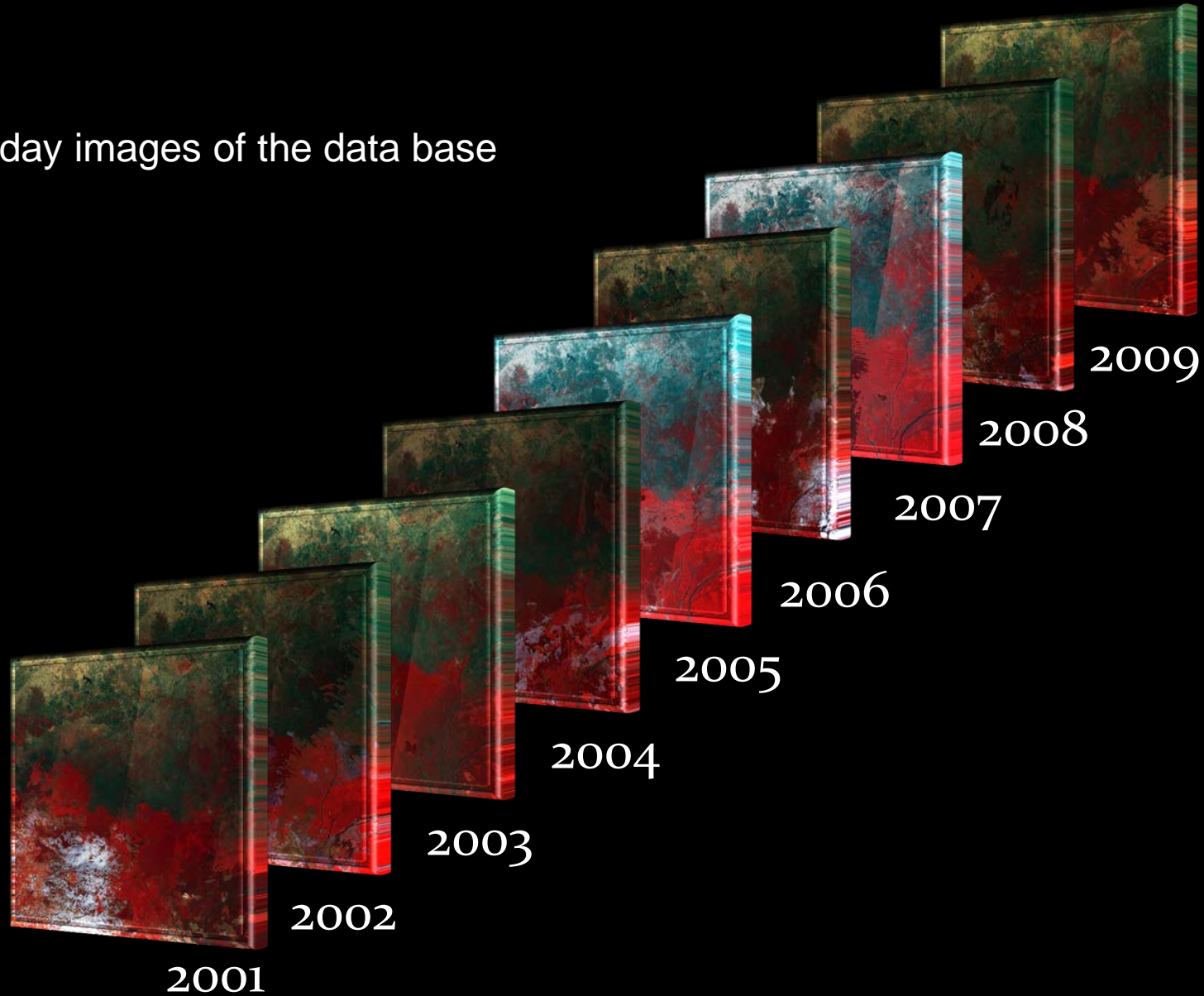
$$EVI = 2,5.(NIR - R) / (NIR + 6.R - 7,5.B + 1)$$

- 16-day composite images
- Data from 2000 to 2009
- Each 16-day image is revisited 10 times

This process calculates the mean of the 10 years available (based on non-noisy pixels for each 16-day period)

Remote sensing method

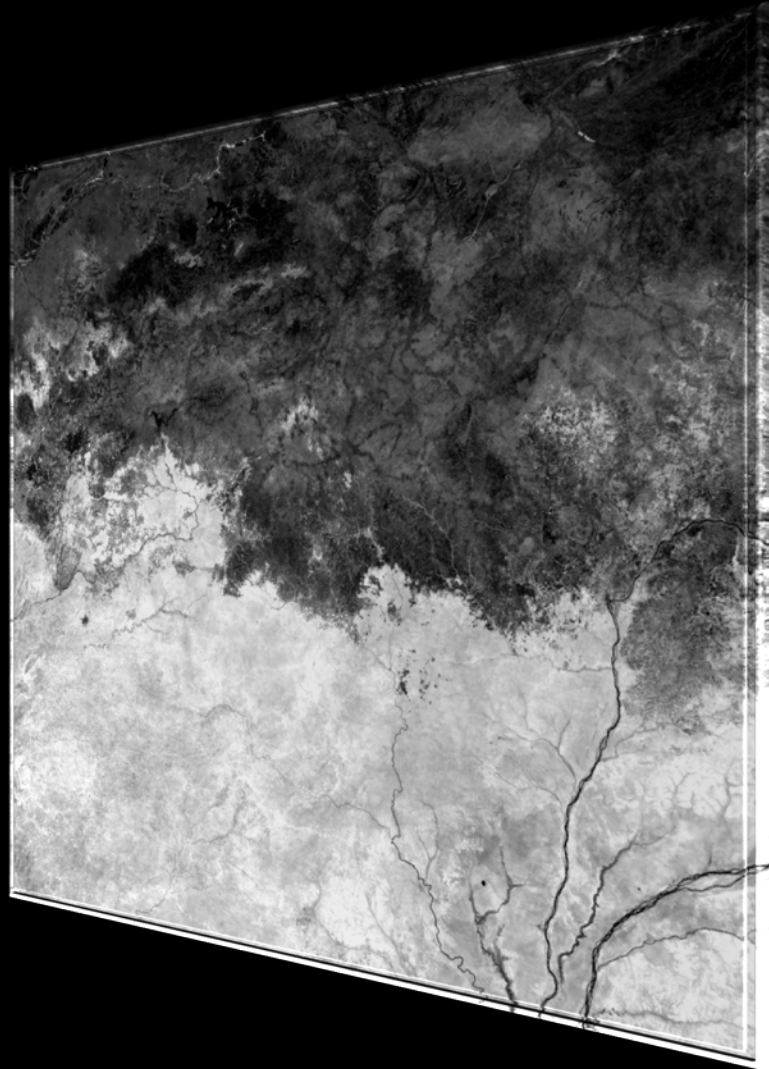
1st 16-day images of the data base



CoForChange

PREDICTING THE EFFECTS OF GLOBAL CHANGE ON FOREST BIODIVERSITY IN THE CONGO BASIN

Remote sensing method

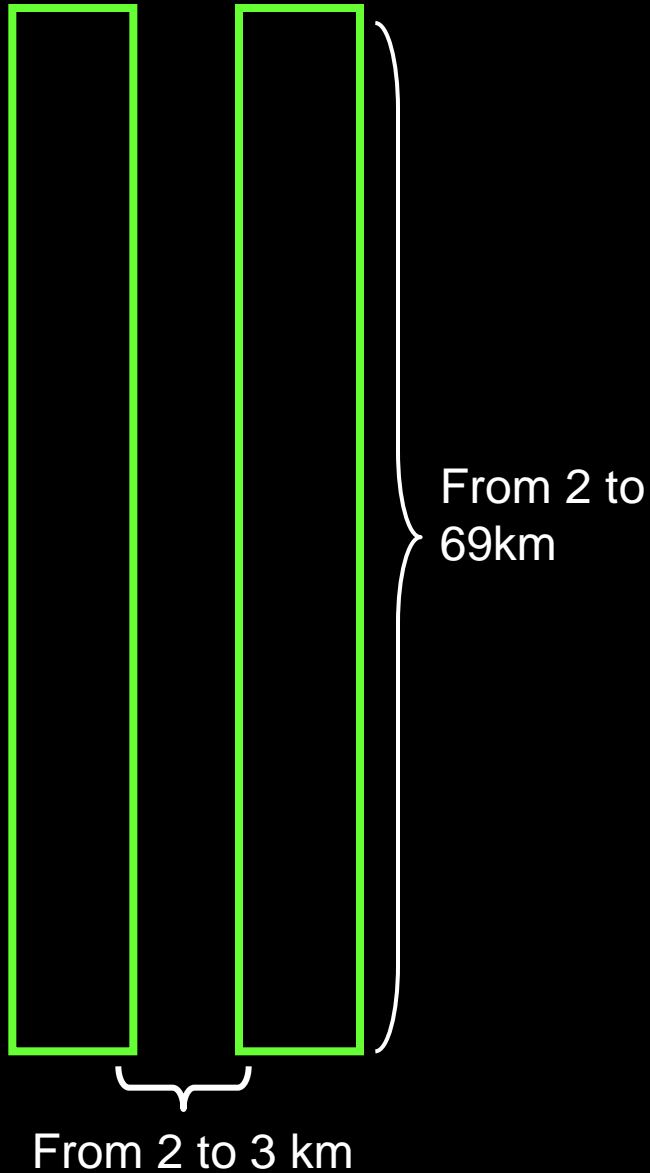


10-year average. Example for the 1st 16-day period (MOD13A1c5)

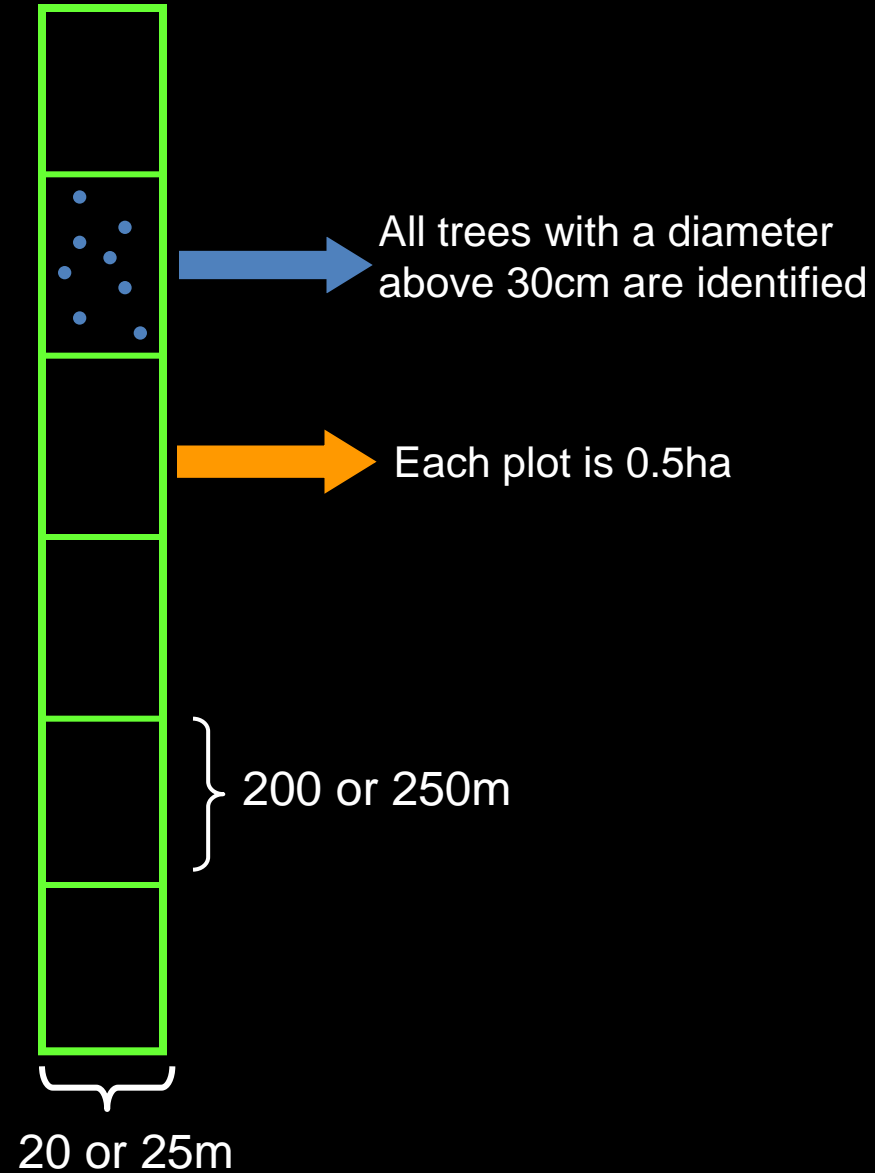
An isodata classification was used to separate pixels clusters

Field inventories

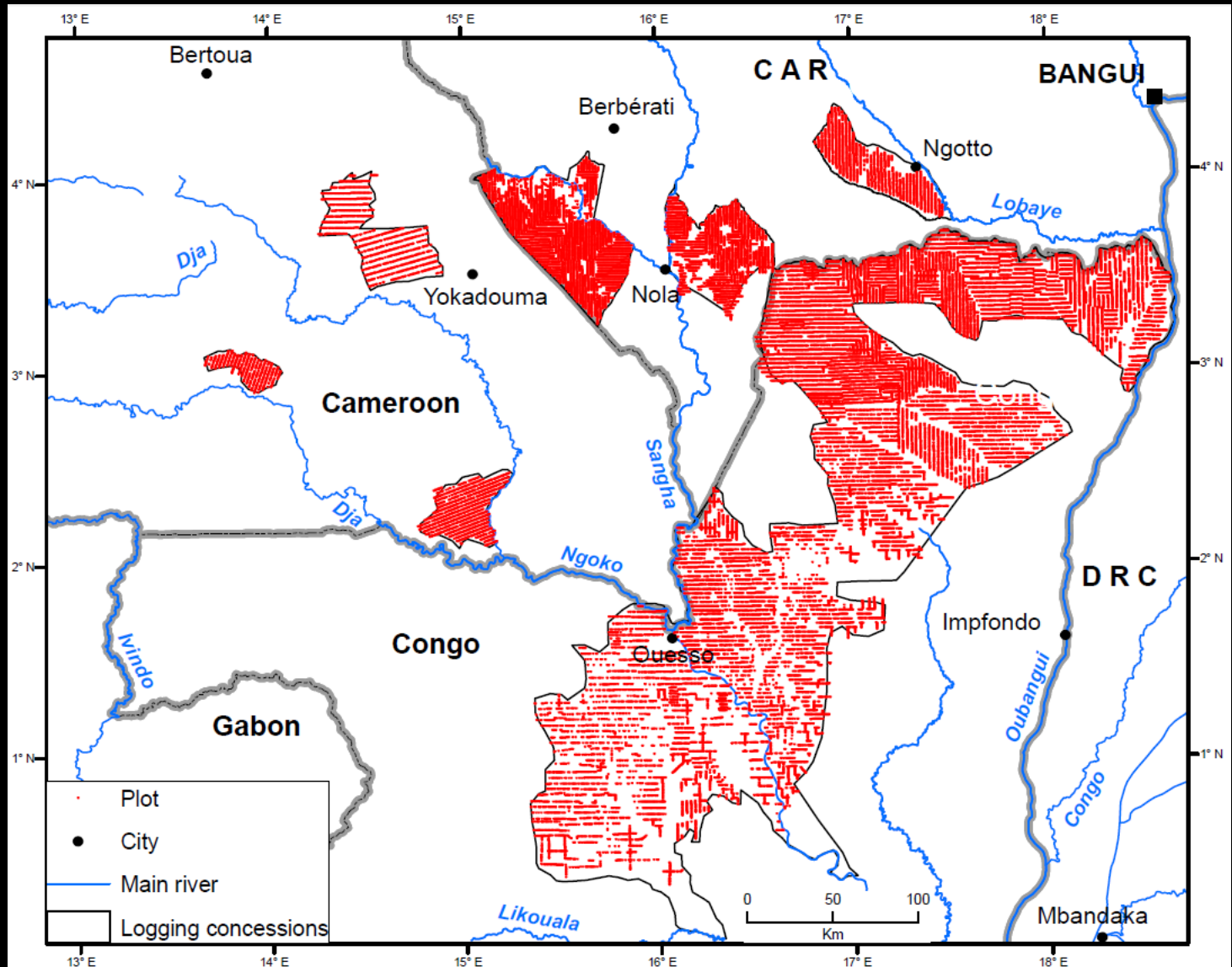
Tracks



Plots

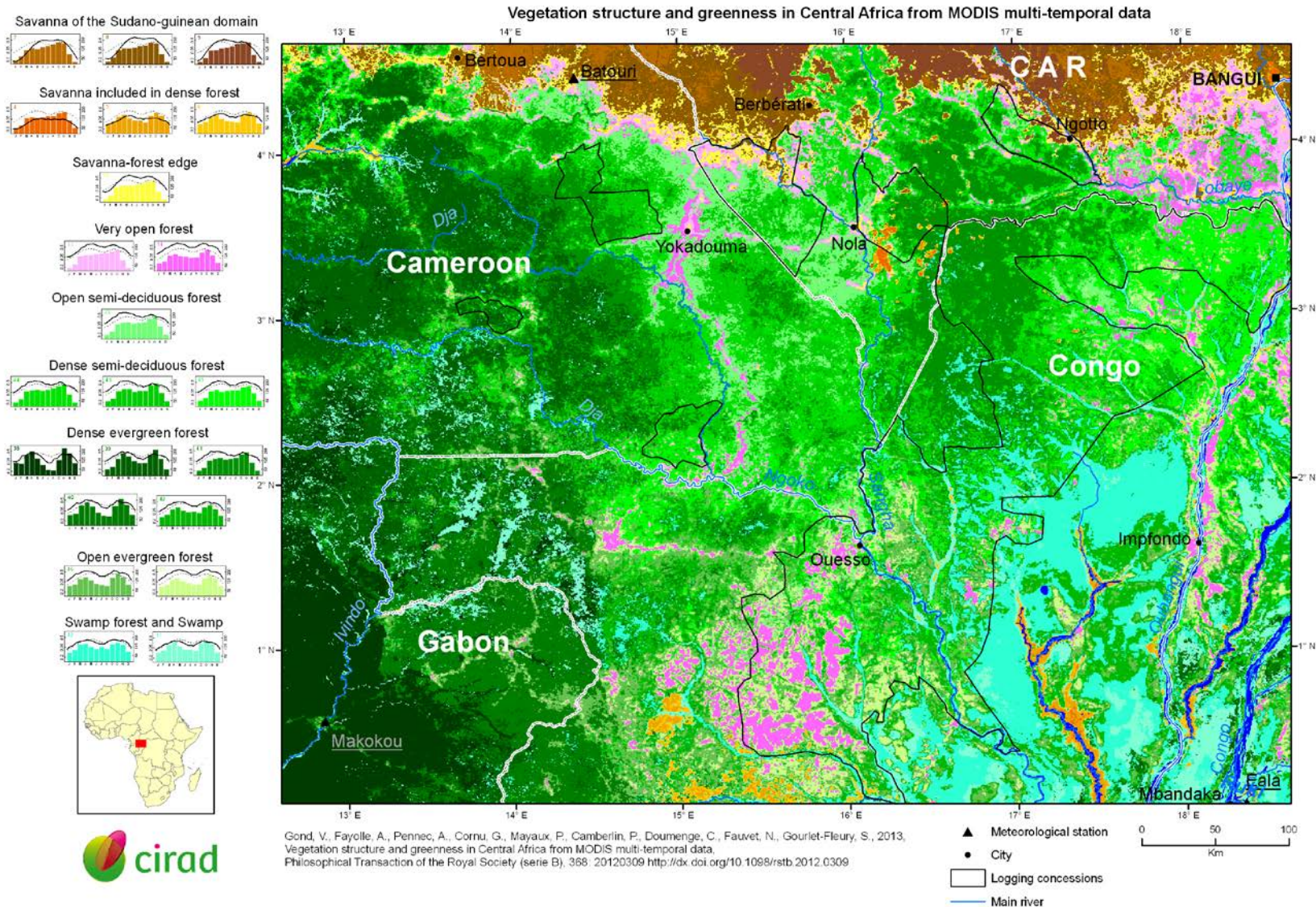


Field inventories

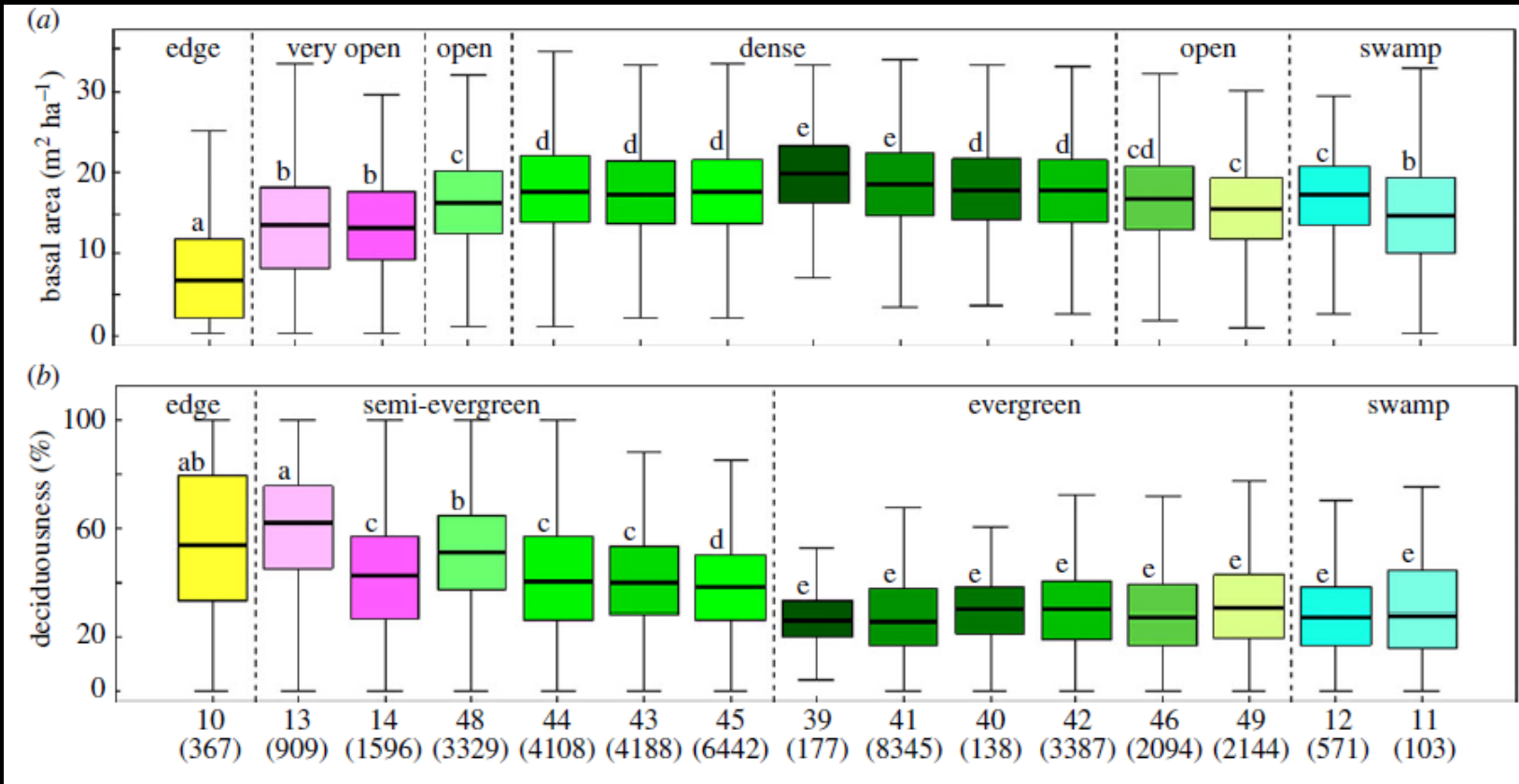


37.898 plots of 0.5ha were used (6 million of hectares)

Result from the remote sensing approach



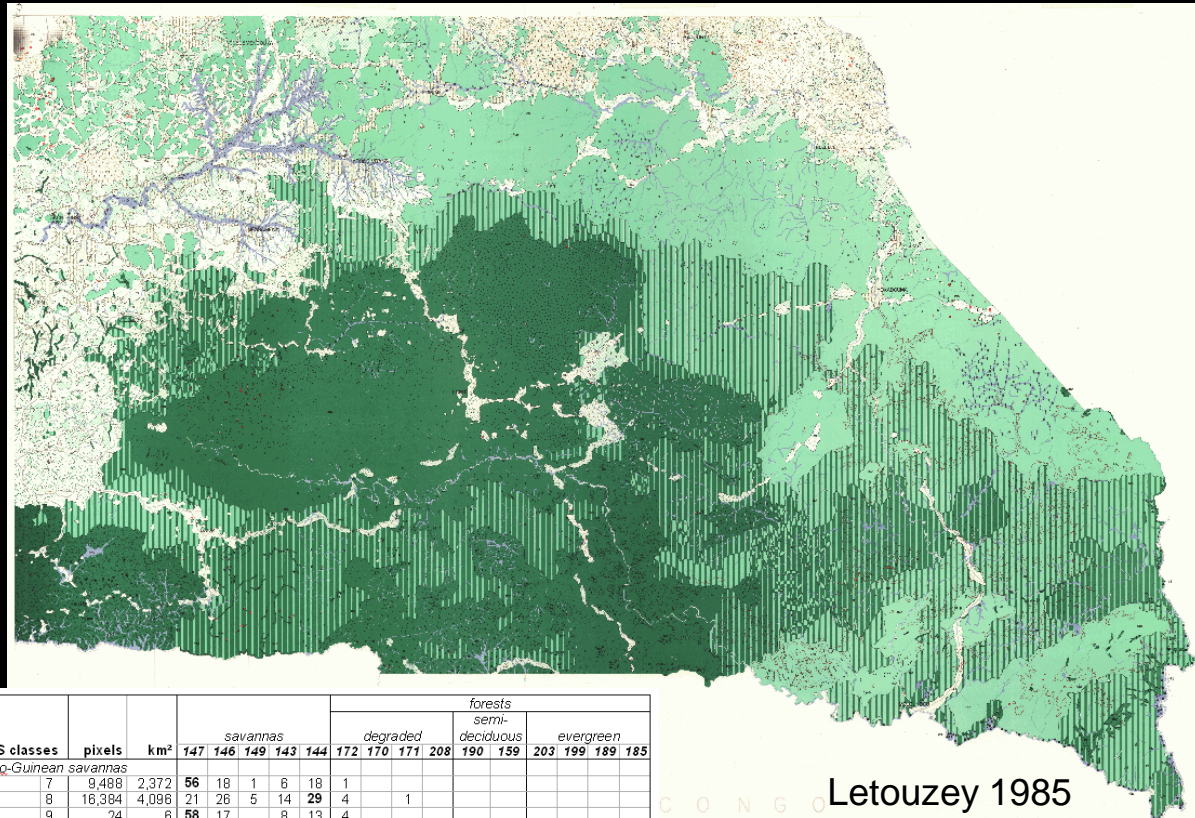
Validation using field inventories



Different lowercase letters ($P < 0.001$) indicate significant differences in the pair wise Wilcoxon test.

Test for differences in plot basal area (up) and degree of deciduousness (down) among classes with pair wise Wilcoxon test and Bonferroni's adjustment for multiple comparisons. Only for Congo and Centrafrican Republic.

Validation using existing maps

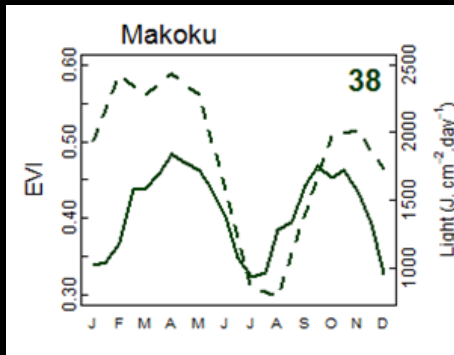
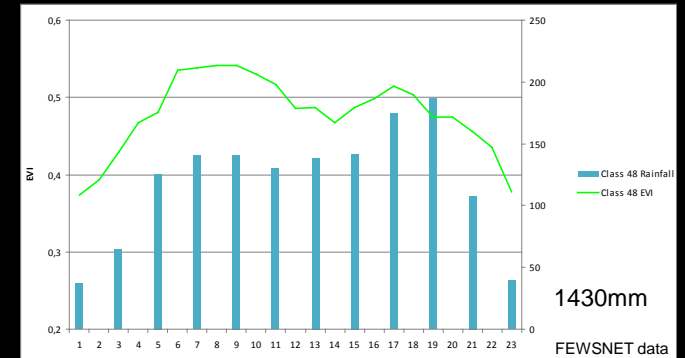
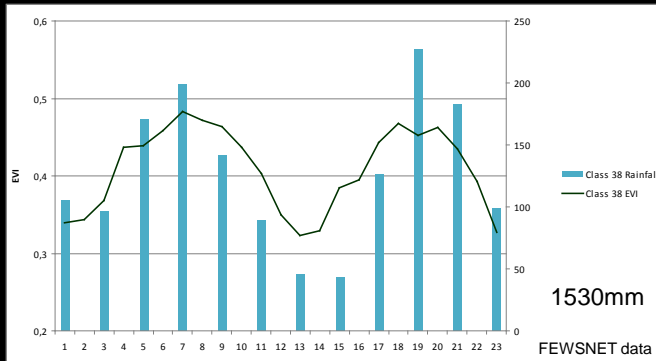


MODIS classes	pixels	km²	savannas					degraded				forests semi-deciduous		evergreen			
			147	146	149	143	144	172	170	171	208	190	159	203	199	189	185
Sudano-Guinean savannas																	
7	9,488	2,372	56	18	1	6	18	1									
8	16,384	4,086	21	26	5	14	29	4		1							
9	24	6	58	17		8	13	4									
included savannas																	
4	89	22	29			8	19										
5	108	27			44	50		30	8	3	6	1	2				
6	1,143	286	1	1	1			5	8	11	63	2	4			3	
savanna-forest edge																	
10	12,990	3,248	21	21	8	4	16	10	6	9	1		4				
very open forests																	
13	12,363	3,091	7	6	3	1	9	21	7	20	1	4	19			2	
14	6,207	1,552	1	1			1	9	1	18	1	25	38			4	1
open semi-deciduous forests																	
48	37,279	9,320						8	6	1	29	47			8		1
dense semi-deciduous forests																	
44	28,459	7,115		1				2	2			33	44		17		1
	19																
43	79,965	991						2	1	2	1	30	42		14		8
45	17,492	4,373	1	2	2			8	8	12	4	20	32		9		2
dense evergreen forests																	
38	6,621	1,655						1		1	3	1	1	1	45		47
	115	28															
39	793	948						3	1	5	2	9	10	1	19		50
	15																
41	63,994	999						1		1	1	26	33		17		21
	10																
40	41,643	411						3	1	10	3	10	8		20		45
42	11,739	2,935						4	3	12	4	7	16		20	1	33
open evergreen forests																	
46	8,598	2,150		1				3	1	6	9	11	19		13		37
49	2,621	655	1	1				4	1	5	15	36	21		8		8
swamp forests																	
12	4,797	1,199								3	2	10	8			16	4
11	12,880	3,220						2	3	5	16	2	4	1	24		57
																	42

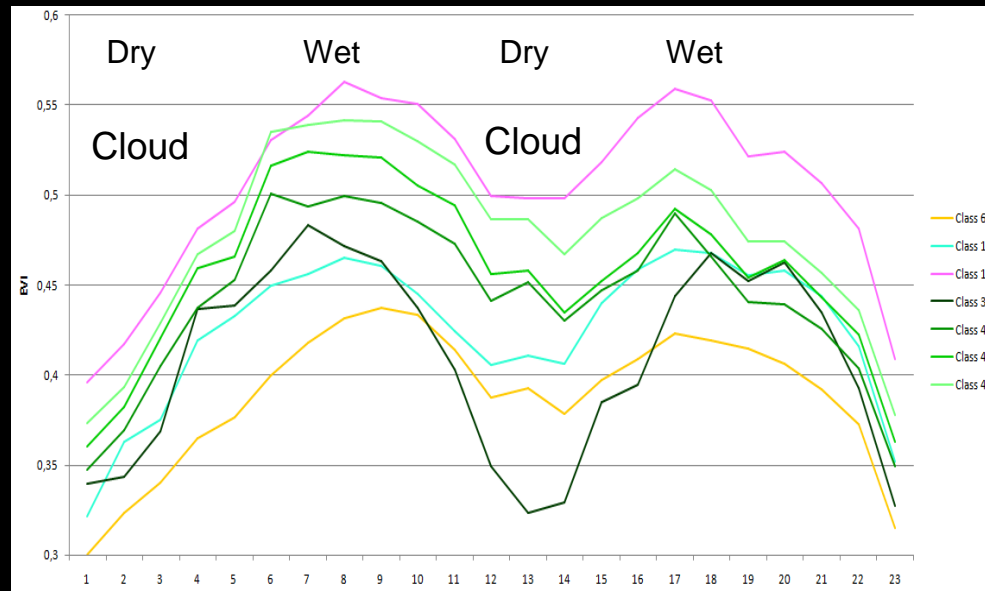
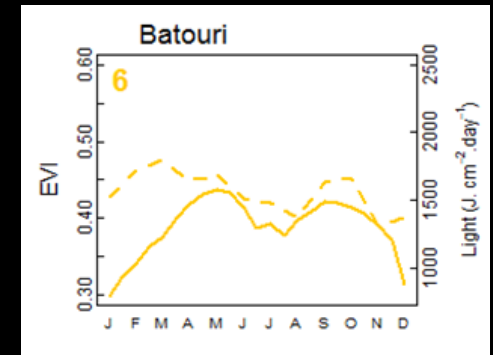
CONGO Letouzey 1985

Contingency matrix between MODIS classes and Cameroon vegetation map

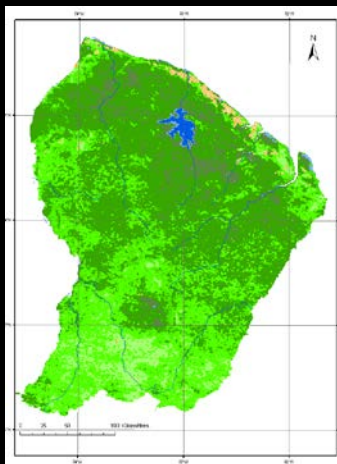
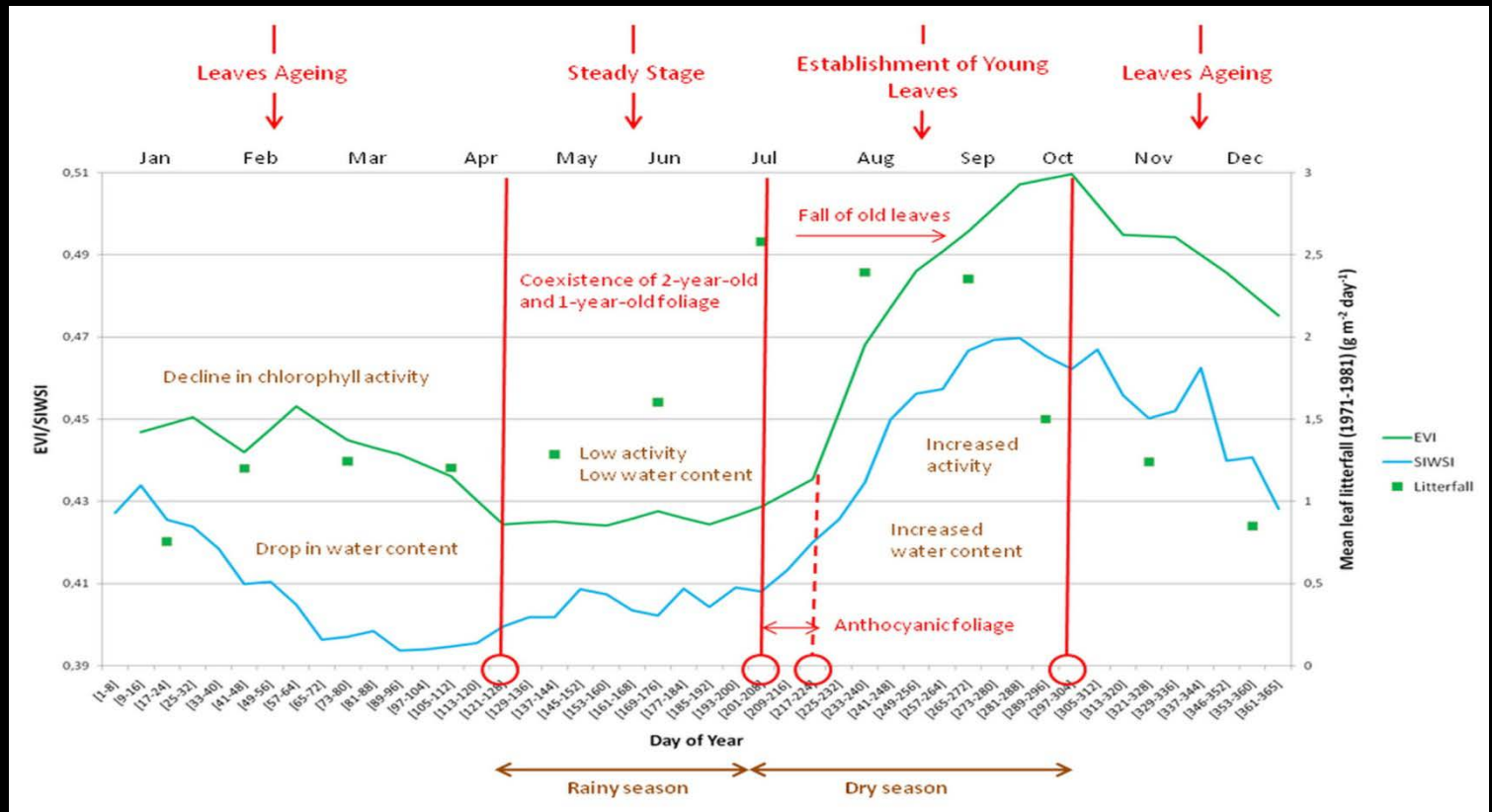
Interpretation of the phenology



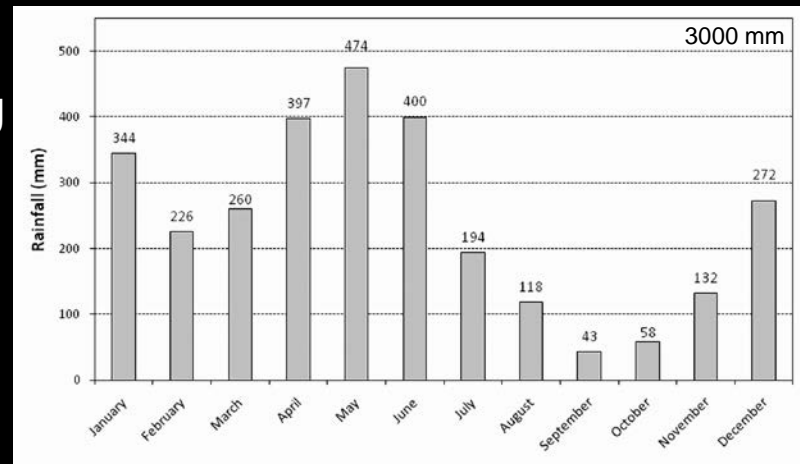
Greenness is driven by rainfall and light seasonality



Comparison with Amazonia



Opposite functioning



Conclusion

Most important findings:

- It seems that rainfall and light are the drivers of the spatial distribution of Central African forests (difference with Amazonia)
- The gradient is spatially organized and witness of contrasted forest types functioning (evergreen and deciduous composition)

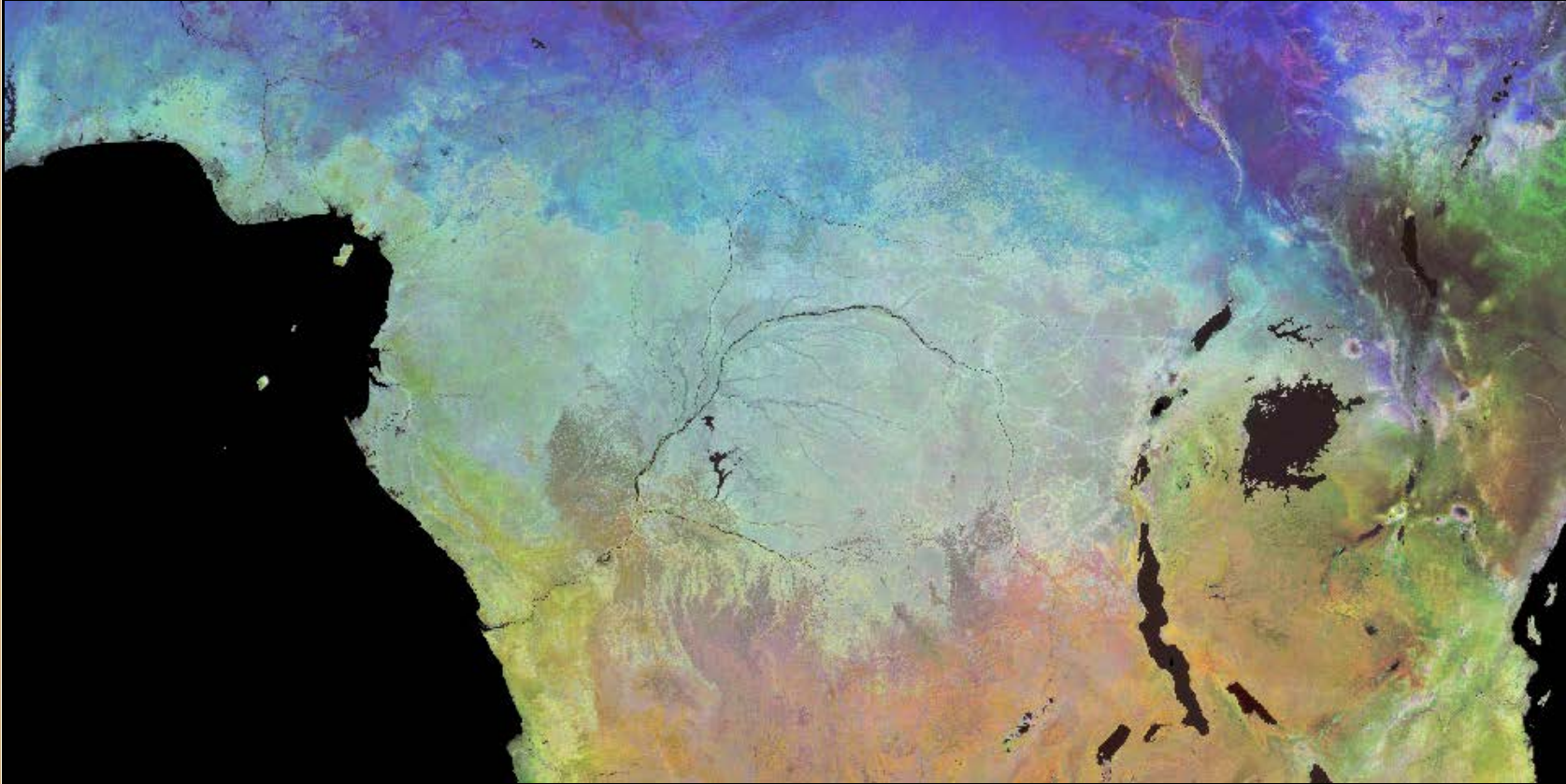
Future outlook:

- Investigate these relationships for the whole Central African forests

Implication:

- The better understanding of environmental drivers of the spatial distribution of Central African forest is of crucial importance to evaluate ecosystems resilience facing global changes and increasing anthropogenic pressures (forest management and conservation policies).

Thanks for your attention



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