SPATIAL AND TEMPORAL MODELLING OF ECOSYSTEM SERVICES

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Introduction: issues in ES mapping

Ecosystem service (ES) as a key concept in environmental governance

Crucial component for justification & implementation of environmental policies

Most of the work dedicated to ethical or economical issues

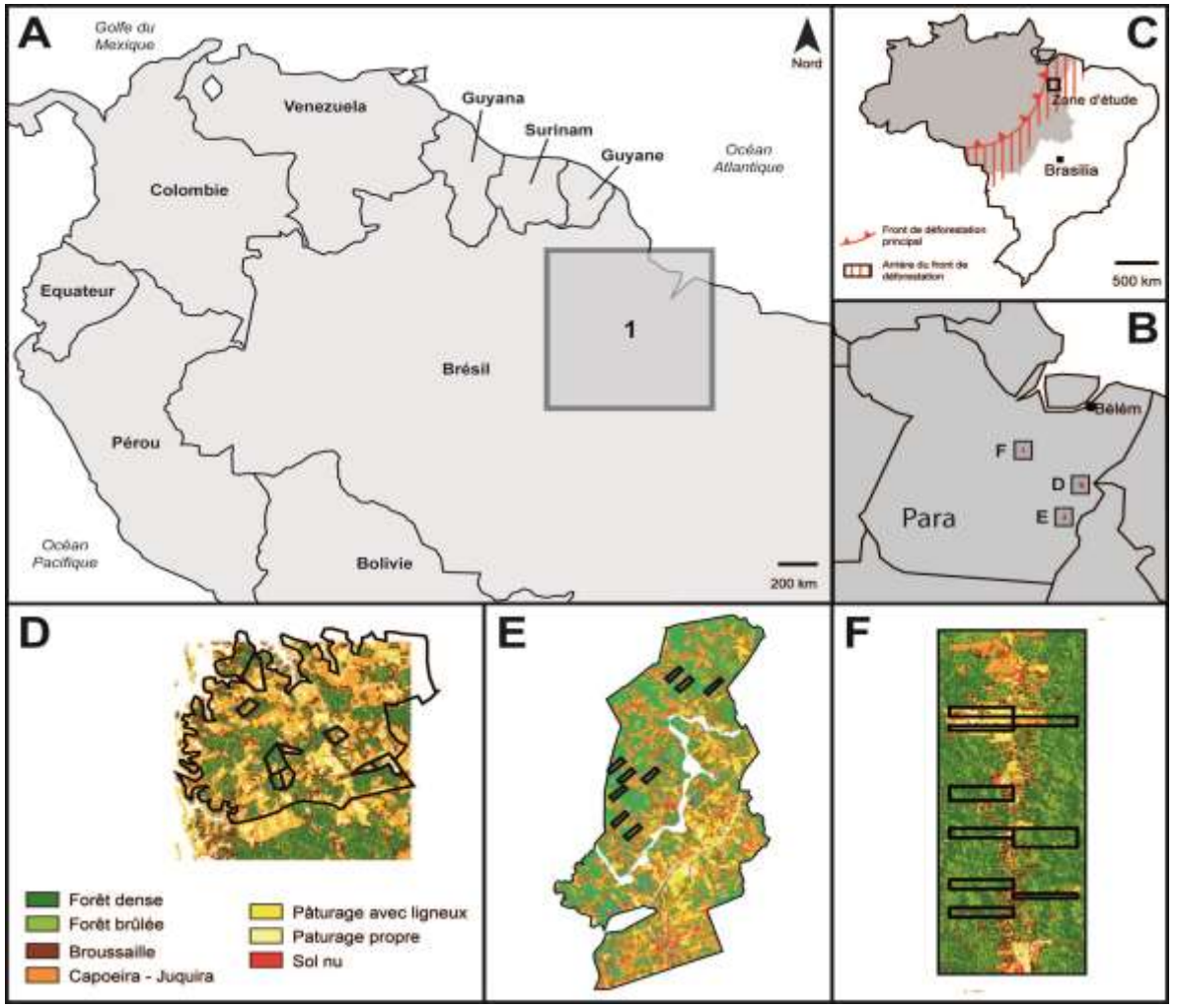
Yet, accuracy and usefulness of maps depend on the spatial and temporal scales

→ **How to take different spatial and temporal scales into account in ES maps?**

Spatial scales and study sites

Deforestation dynamics

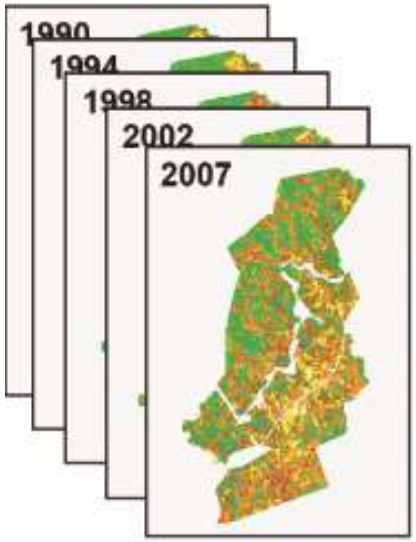
Regional and local scales



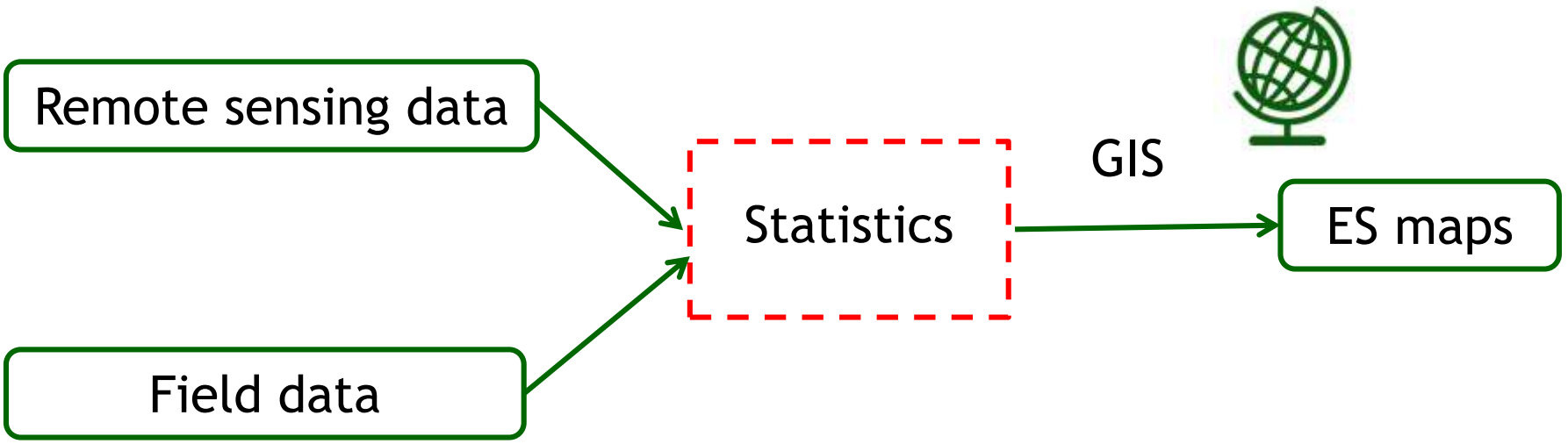
Temporal scales

Current situation (2007)

Evolution over one decade (1990-2007)



General approach



Five steps methodology:

1. Local-scale ES maps, from statistical methods (2007)
2. Validation of the current ES map from sampling data
3. Temporal ES mapping (1990-2007)
4. Regional-scale ES maps, from a statistical method
5. Validation of ES regional maps from sampling data and local ES maps.

Data: ES indicators

Indicators of ES: field mesurements

Vegetation carbon stocks

1. Climate regulation

Soil biophysical processes

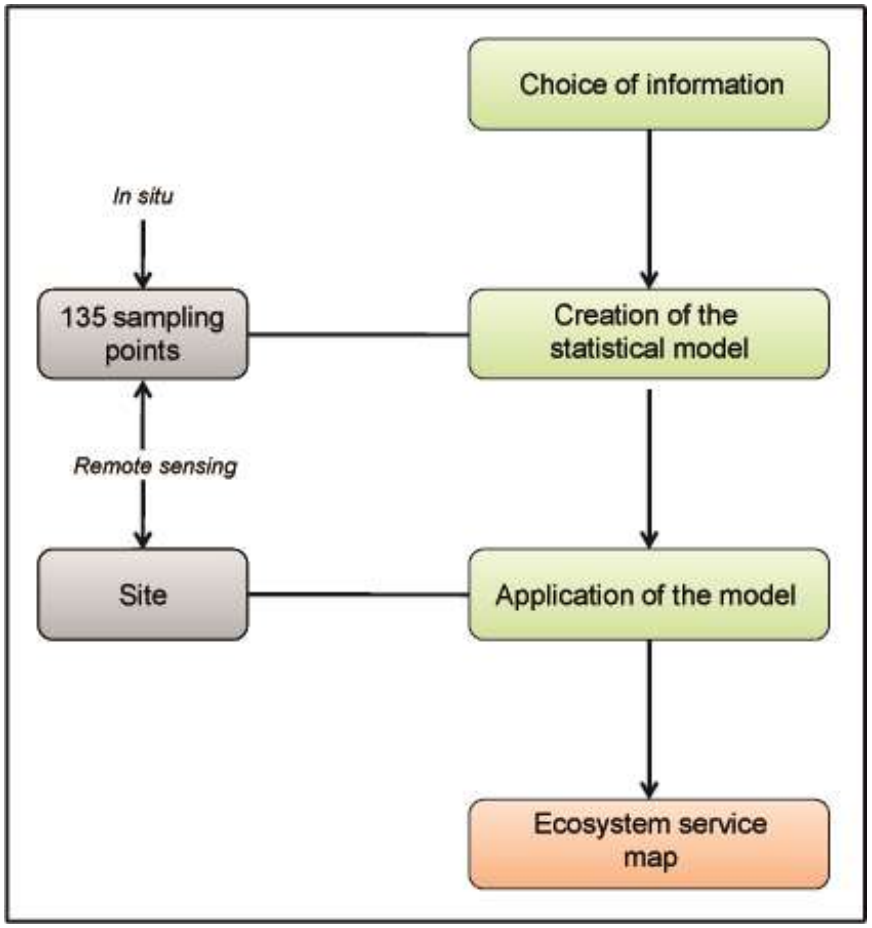
2. Primary production support
3. Control of soil erosion

Biodiversity

4. Food web support

Current state
-
Local scale

At the local scale, how to map ES ?



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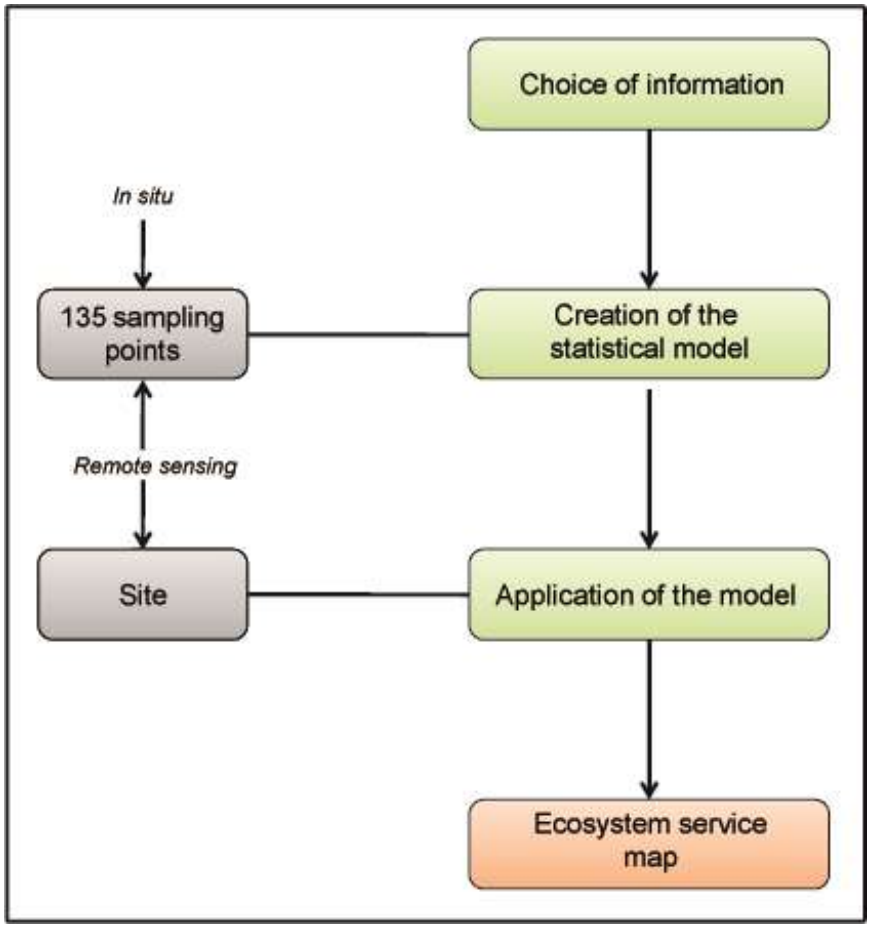
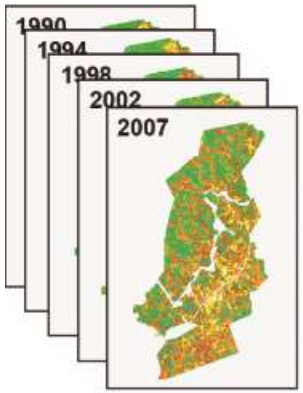


Field data:

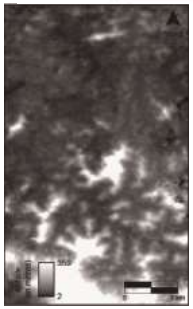
- ES indicators

Remote sensing data:

- Landsat TM (current and temporal landcover, NDVI and NDWI)



- DEM ASTER (elevation, slope, topography and distance to water)



Respond variable	R^2	Main predictive variables
Vegetation carbon stocks	0.71	**Current land** cover, site
Rates of water infiltration into the soil	0.57	**Historical land cover trajectory,** land cover
Soil chemical quality index	0.67	**NDWI**, land cover, site
Biodiversity index	0.65	**NDVI**, Site, distance to rivers

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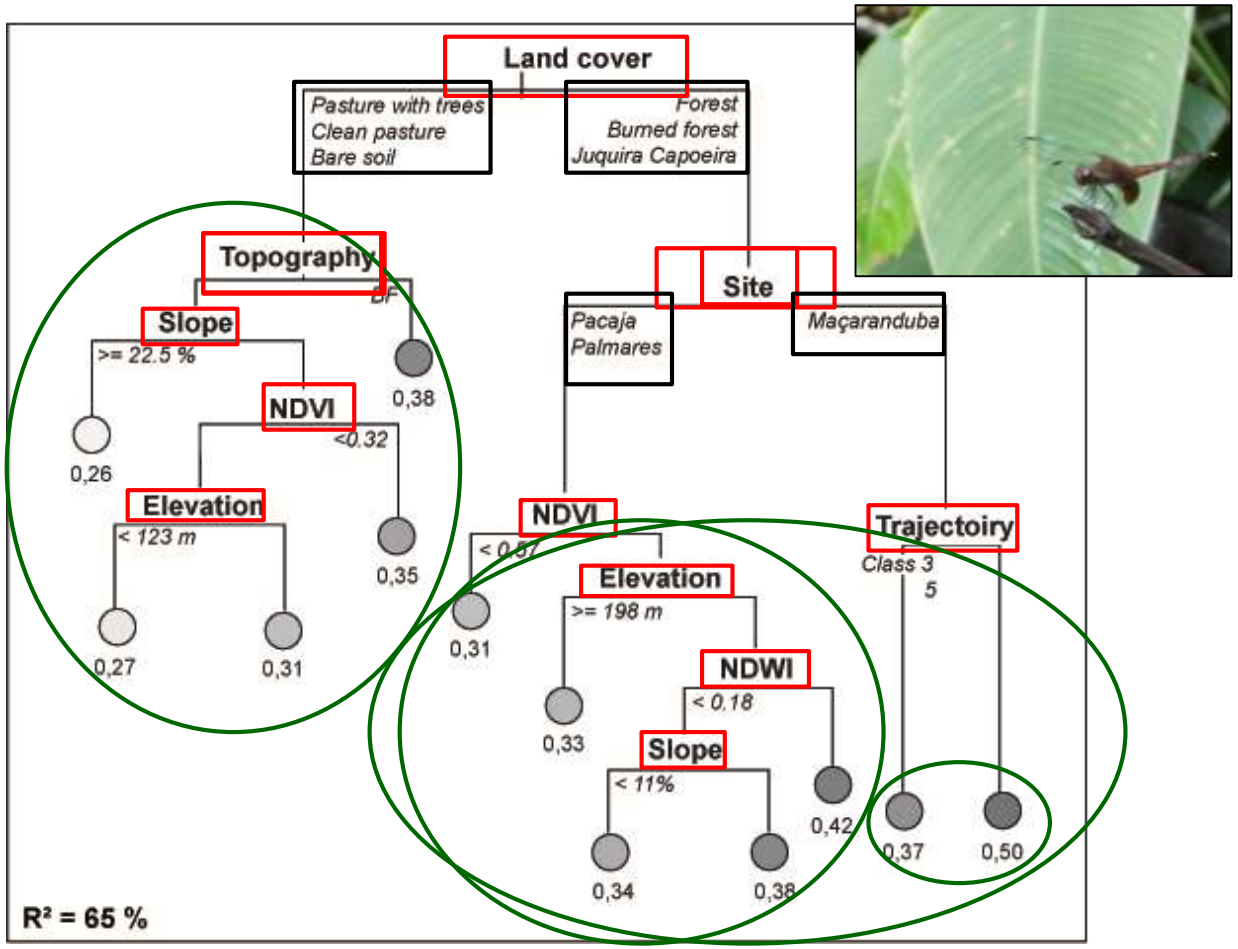
Biodiversity index

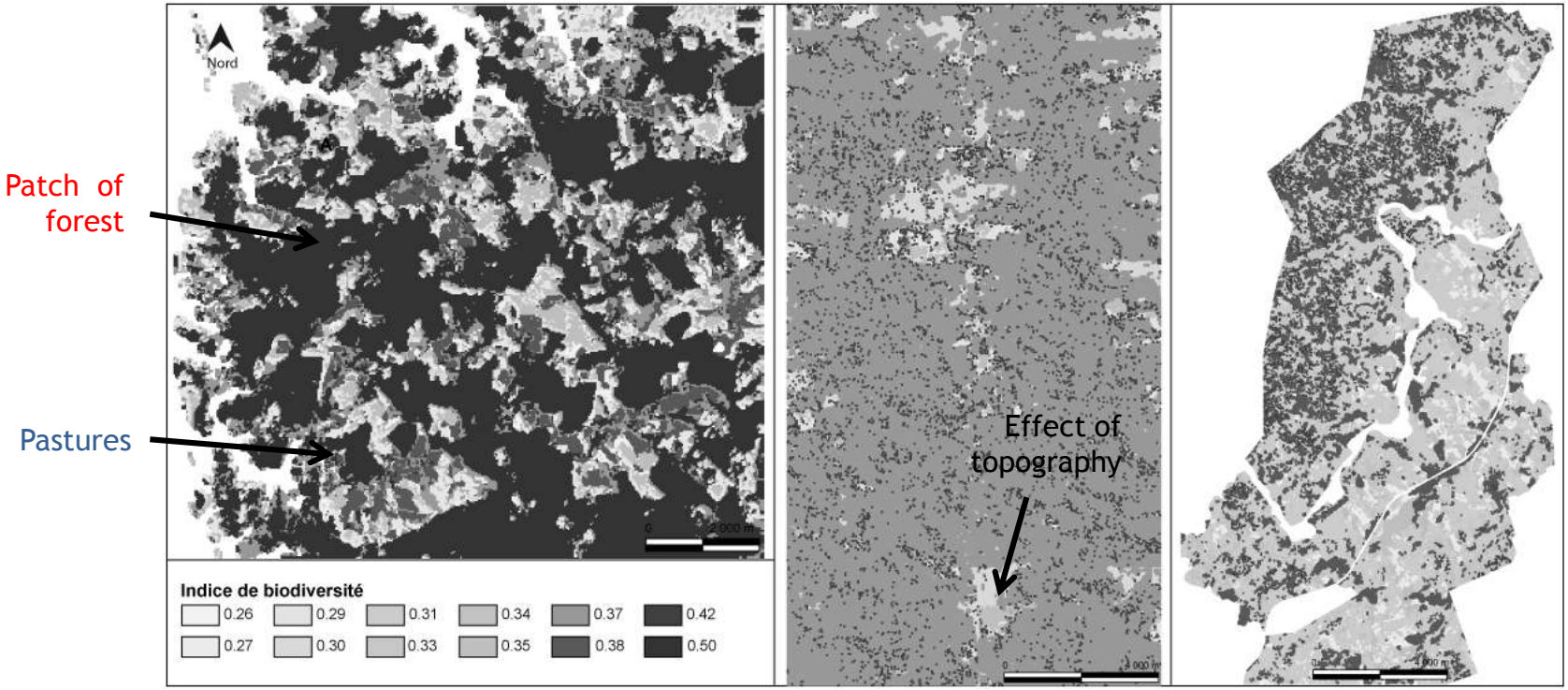
Complexity of the phenomenum

Importance of land cover changes

Effects of other factors



Biodiversity index



Current state
-
Regional scale

At the regional scale, how to map ES ?

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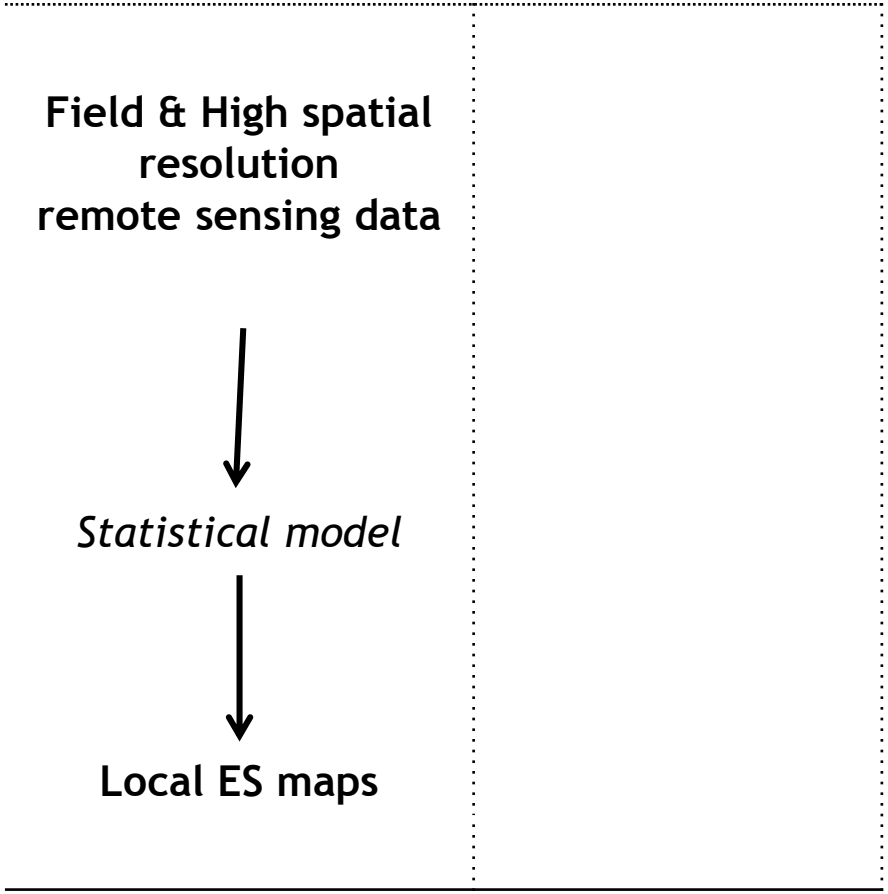

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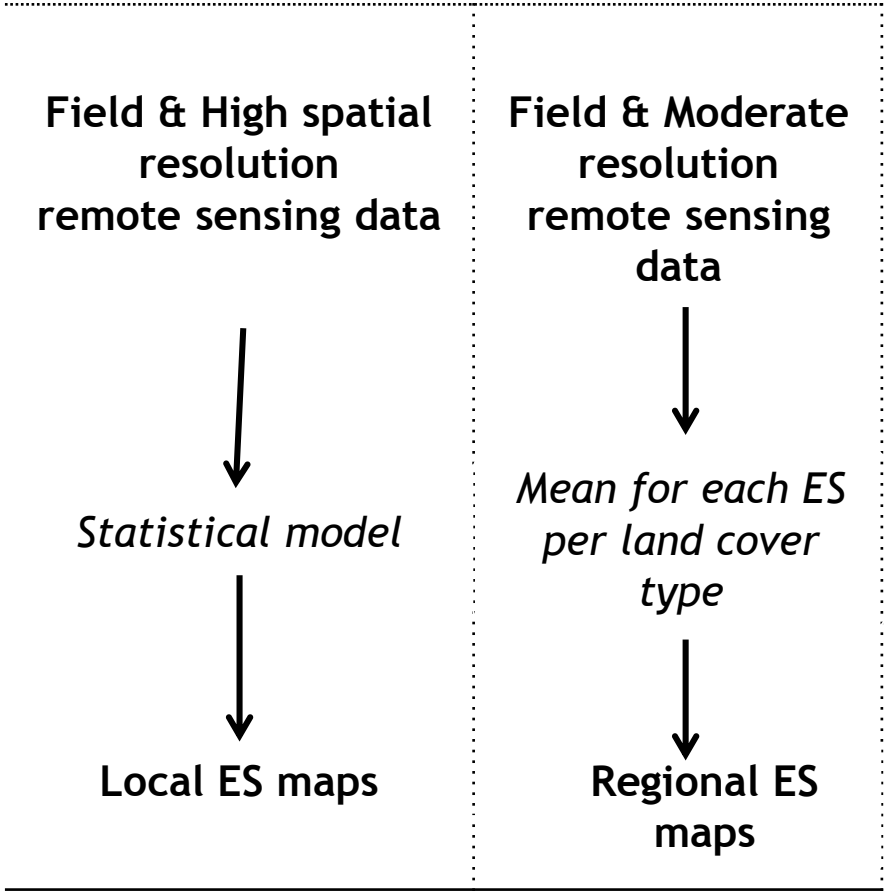

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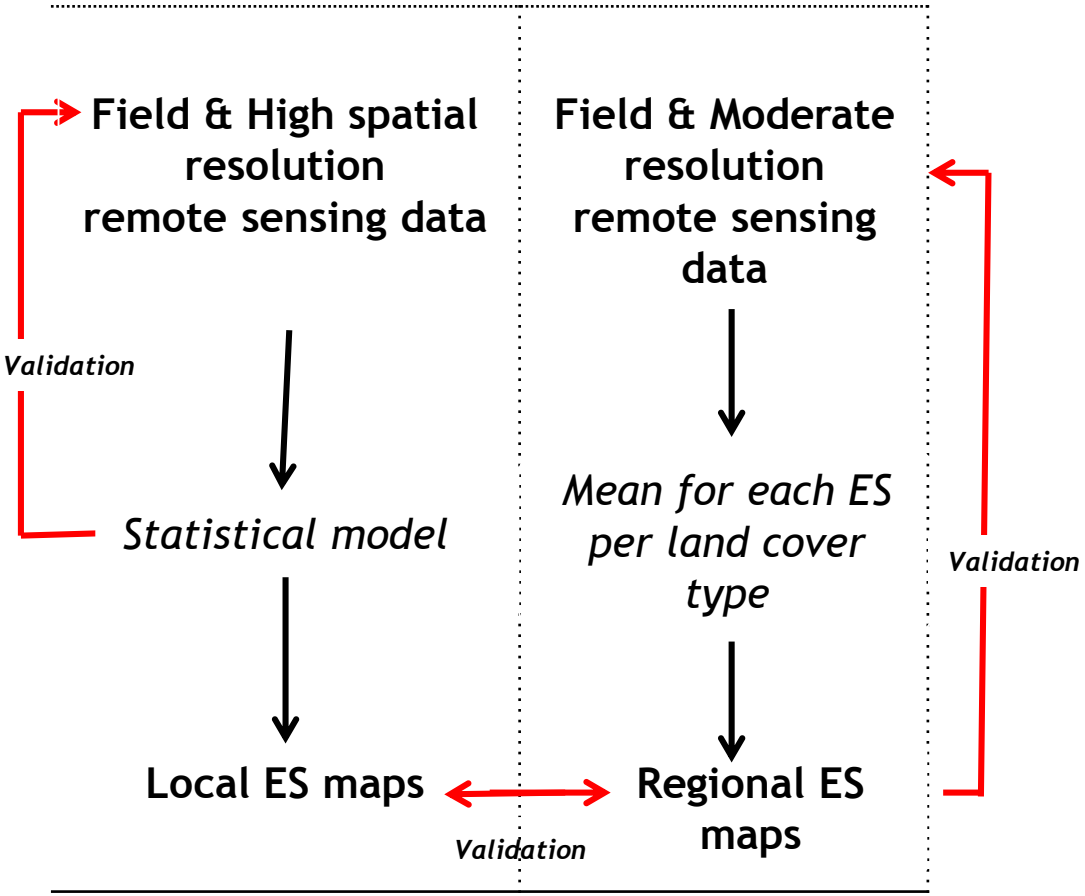

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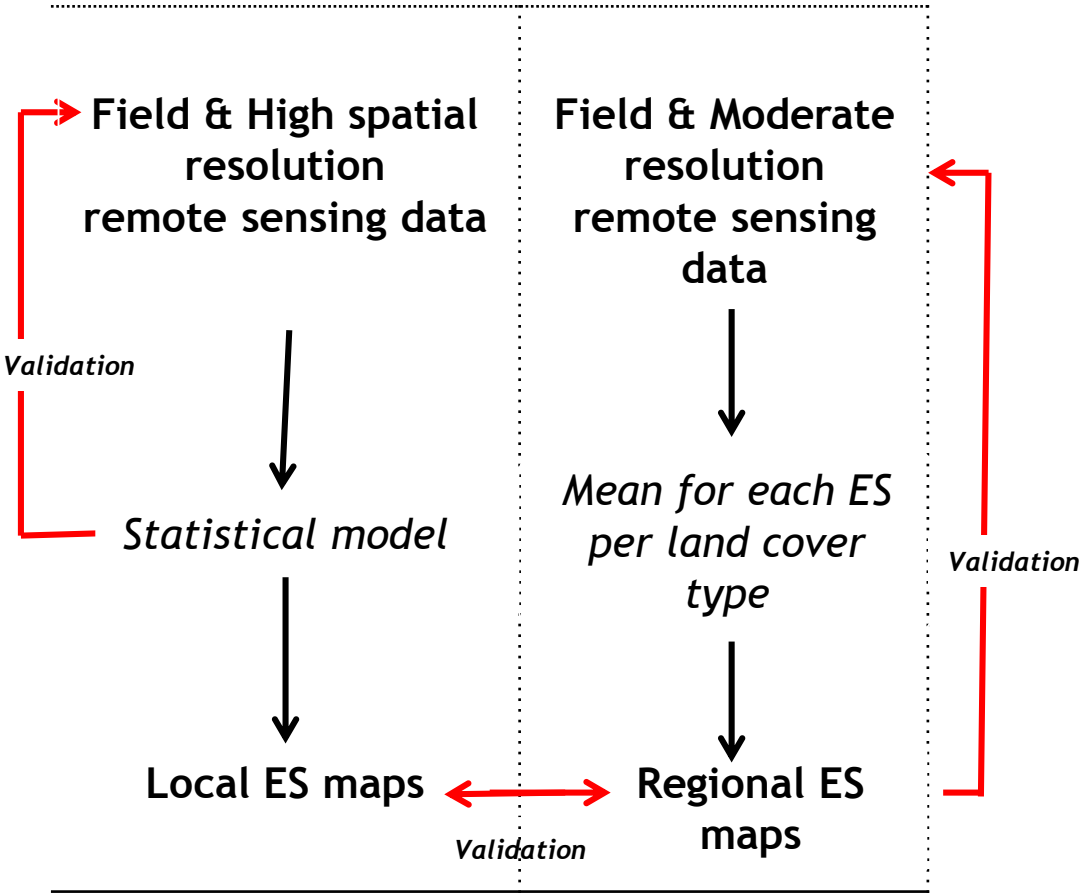
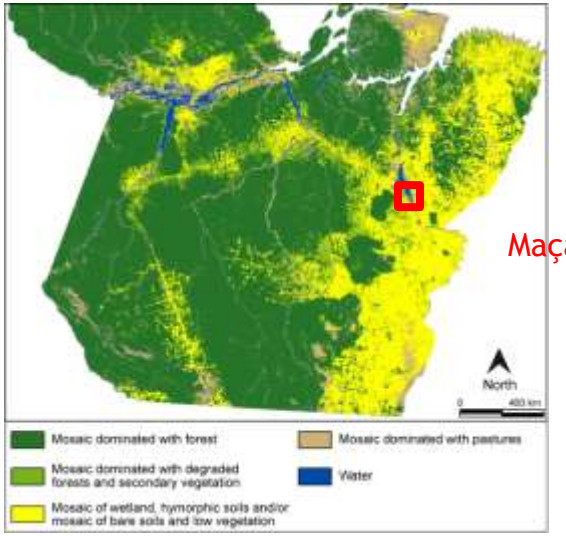


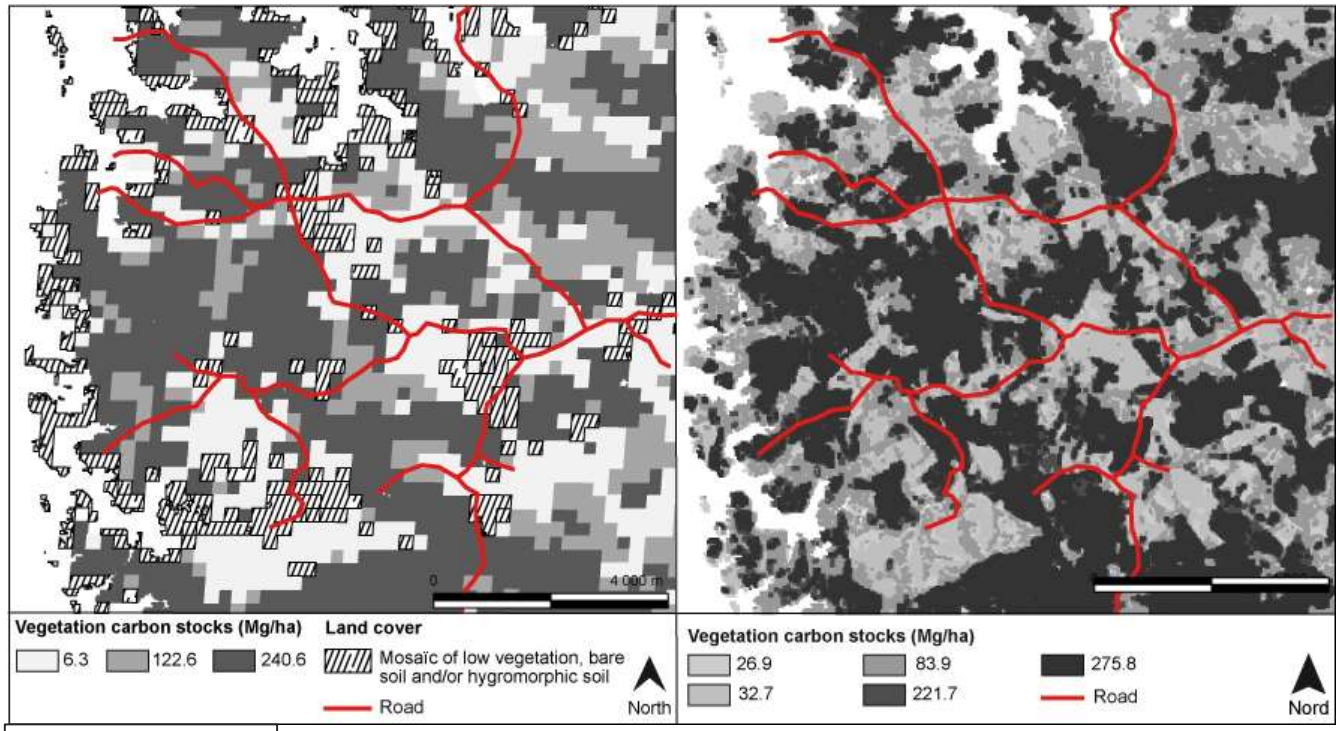
Field data:

- ES indicators

Remote sensing data:

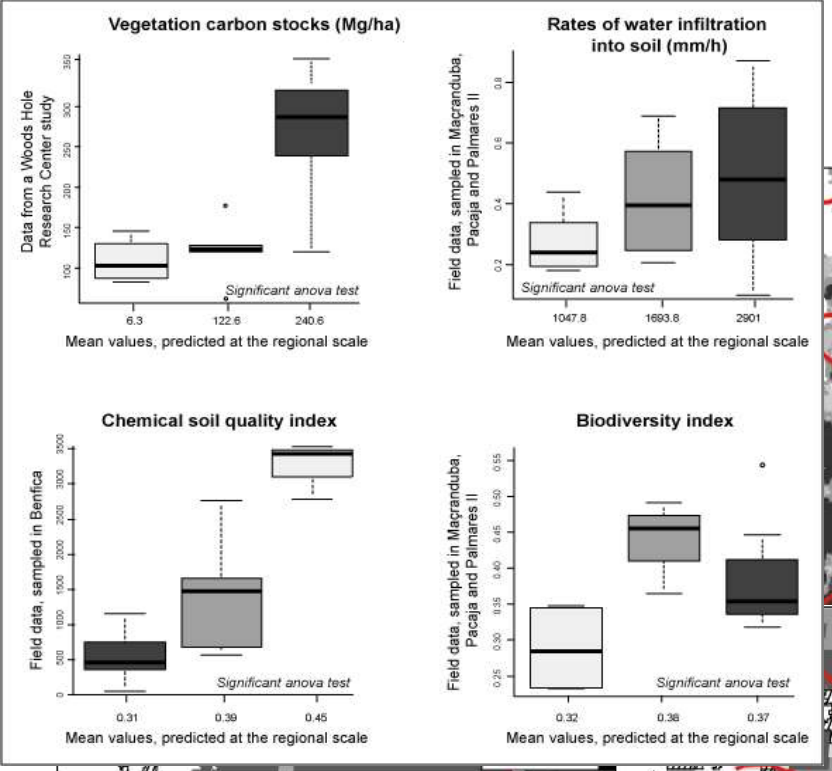
- MODIS time-serie (250 x 250m)

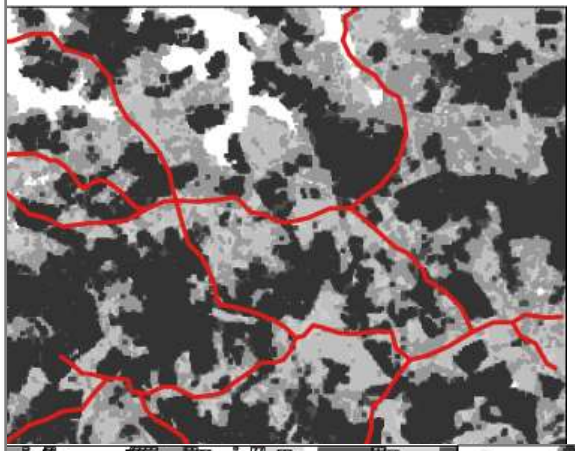


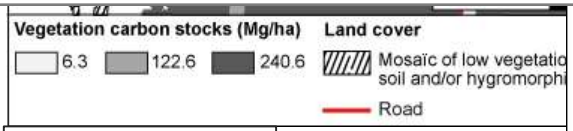

0
4 000 m
Vegetation carbon stocks (Mg/ha)
6.3
122.6
240.6
Land cover
Mosaïc of low vegetation, bare soil and/or hygromorphic soil
Road
North
Vegetation carbon stocks (Mg/ha)
26.9
32.7
83.9
221.7
275.8
Road
Nord

Carbon

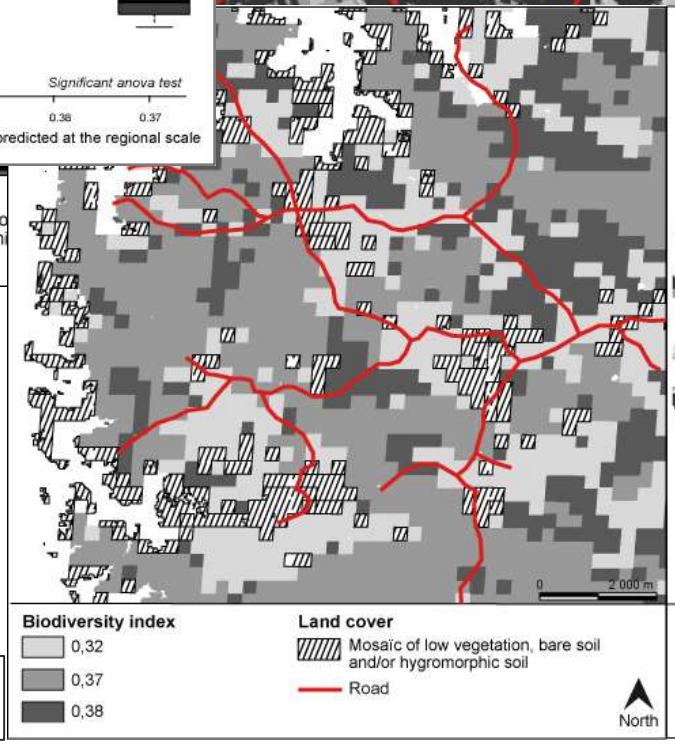
Results

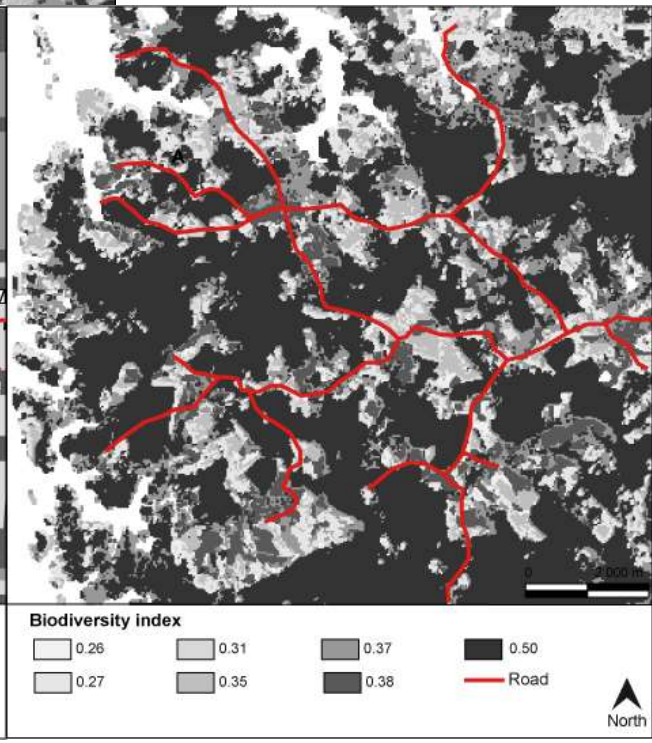






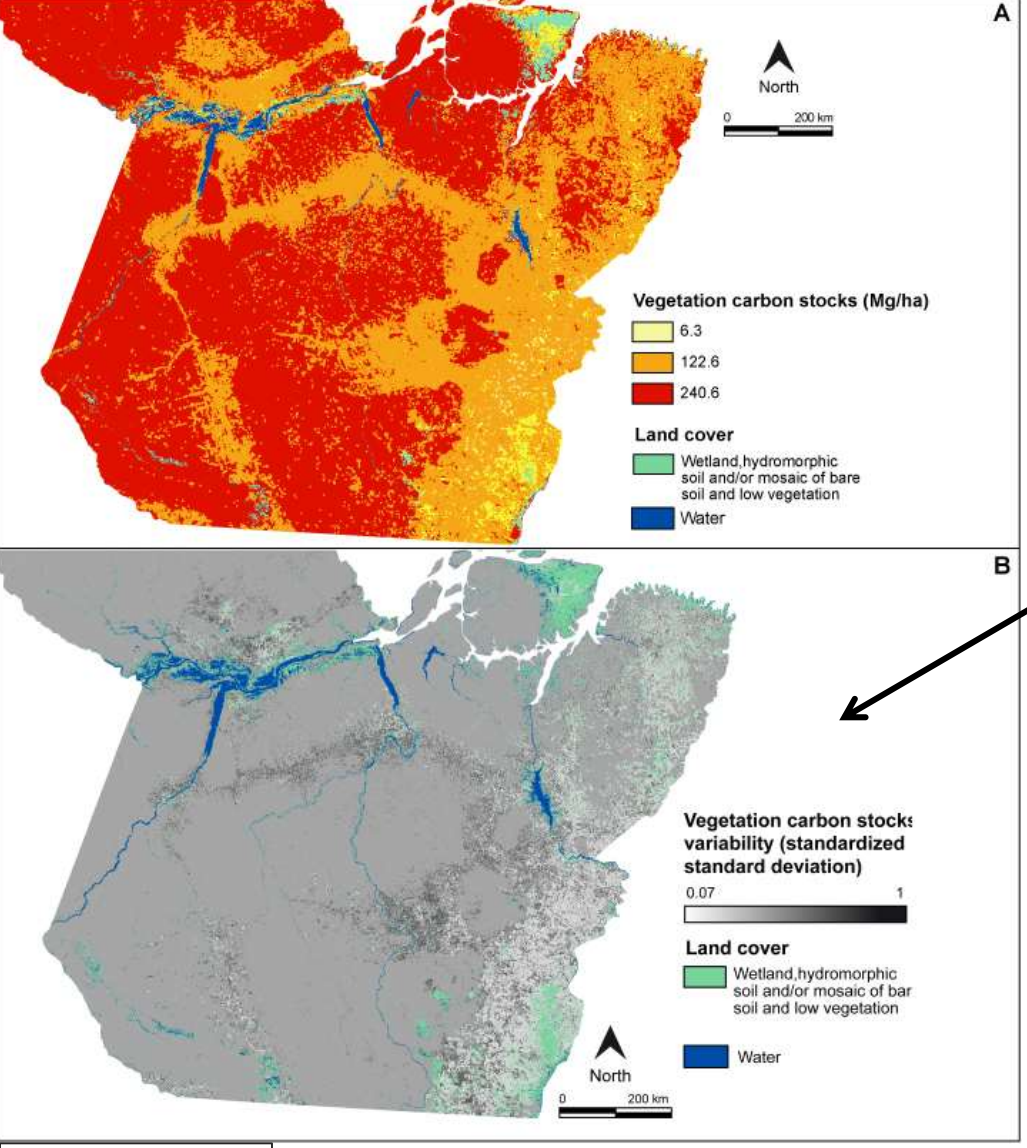
Carbon





Biodiversity

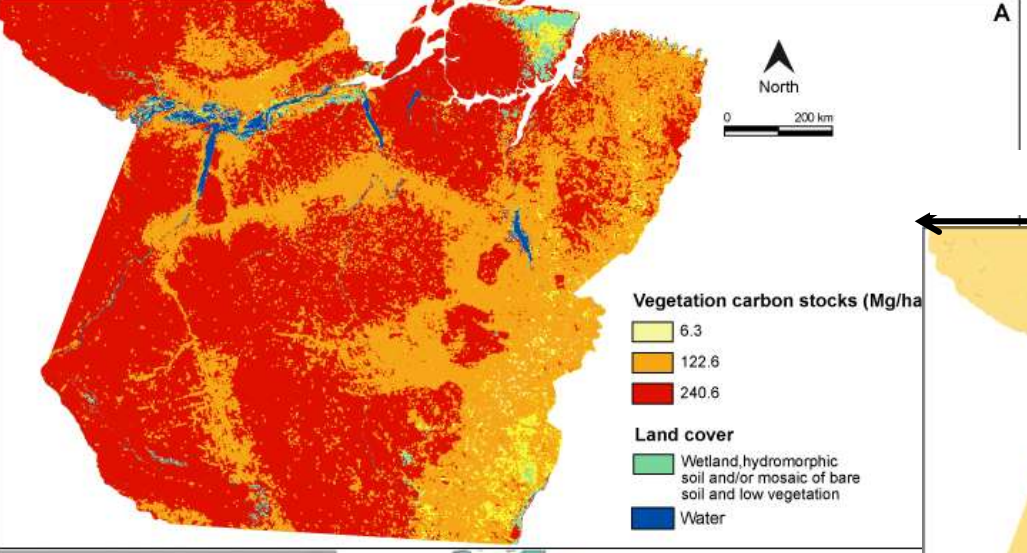
Results

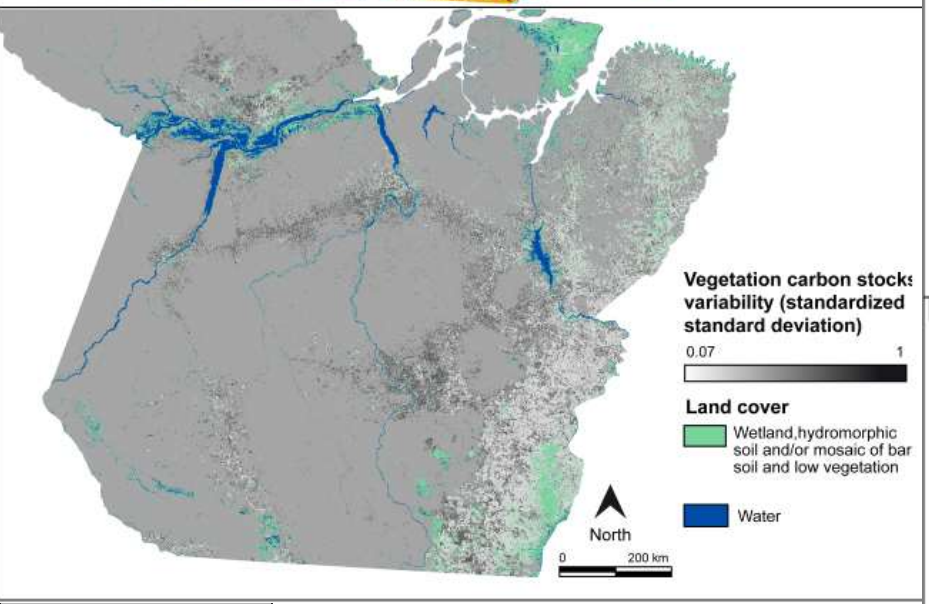


Prediction variability

Carbon

Results

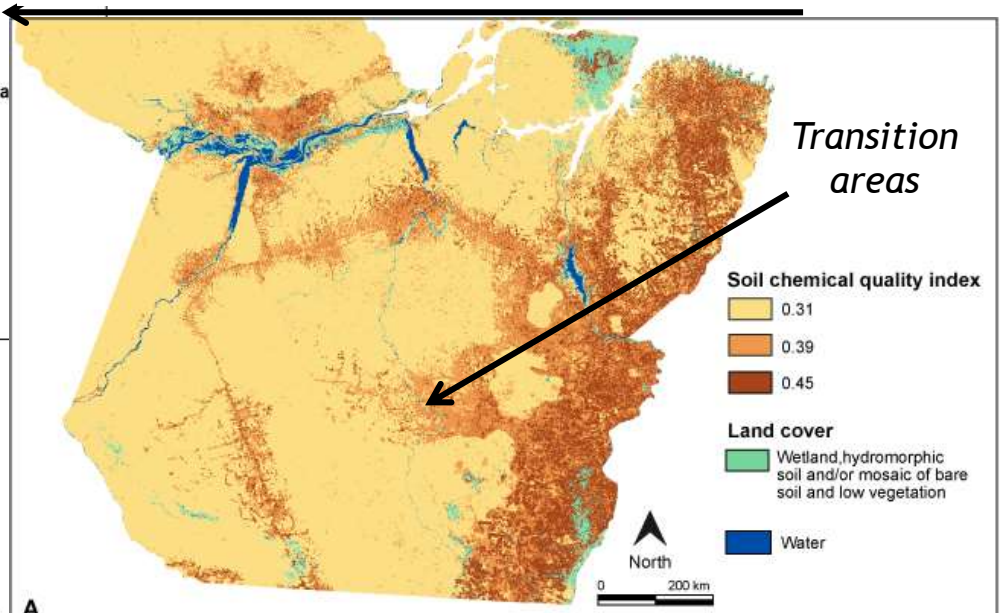


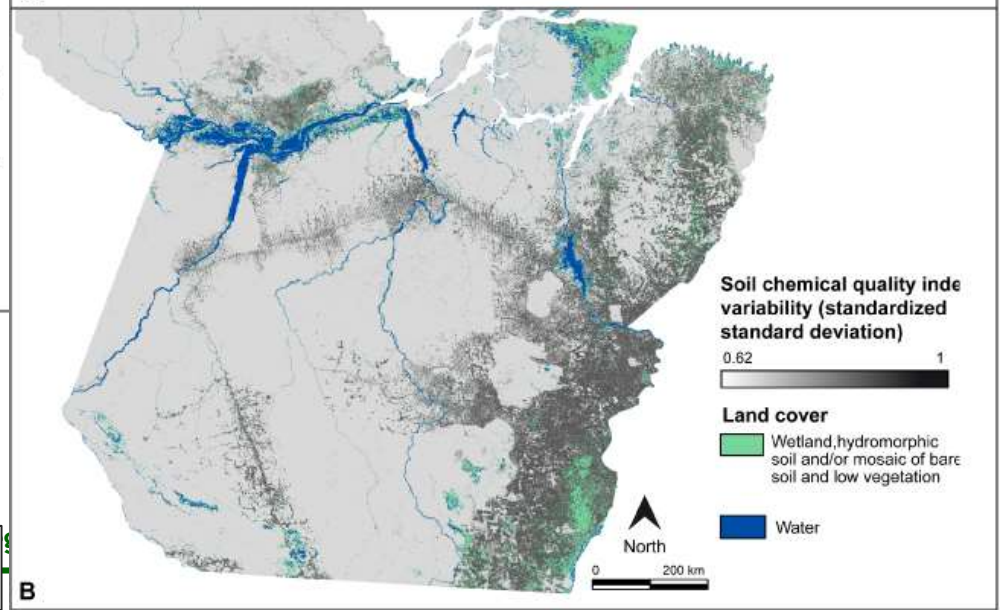


Carbon

Gradient in the landscape

Transition areas



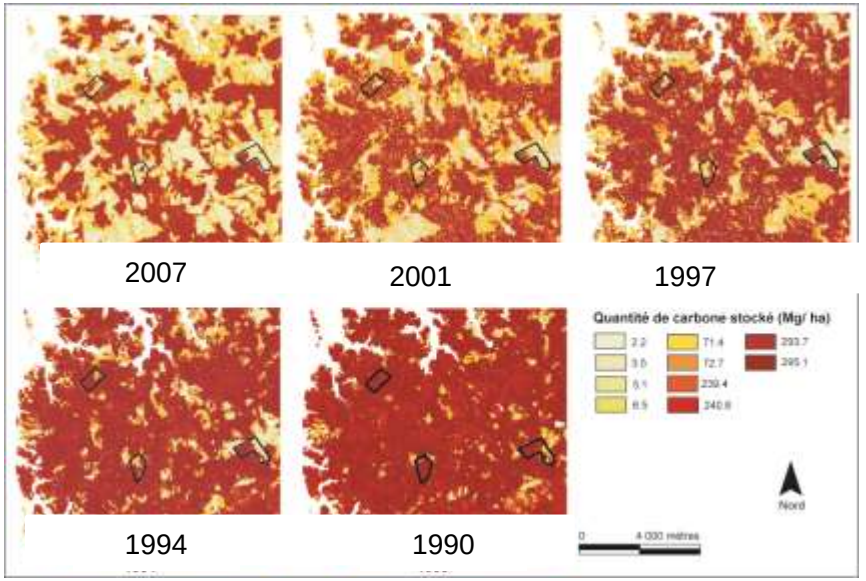


Soil

Temporal dynamics
-
local scale

Stock or storage ?

Example of the vegetation carbon stocks



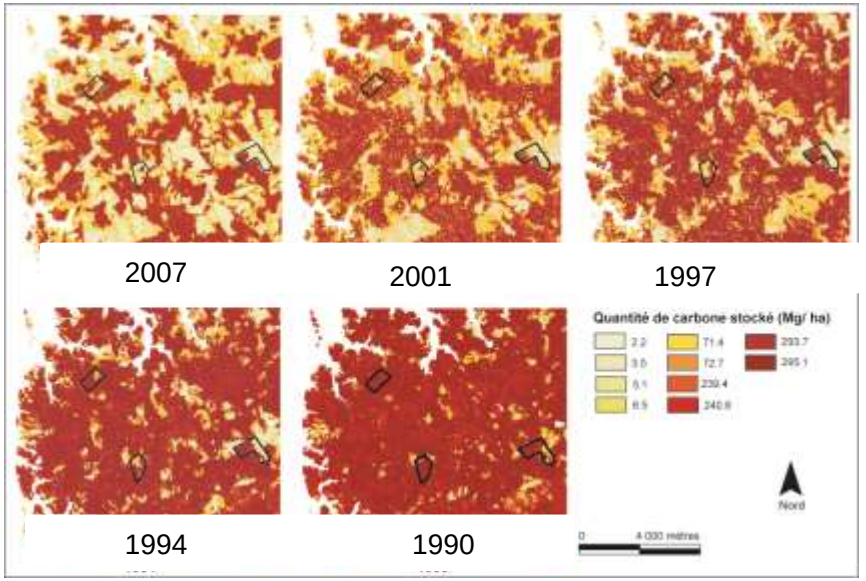
Maçaranduba study site

Stock: static state, applicable at a specific time

Storage/destorage: dynamic process

Stock or storage ?

Example of the vegetation carbon stocks



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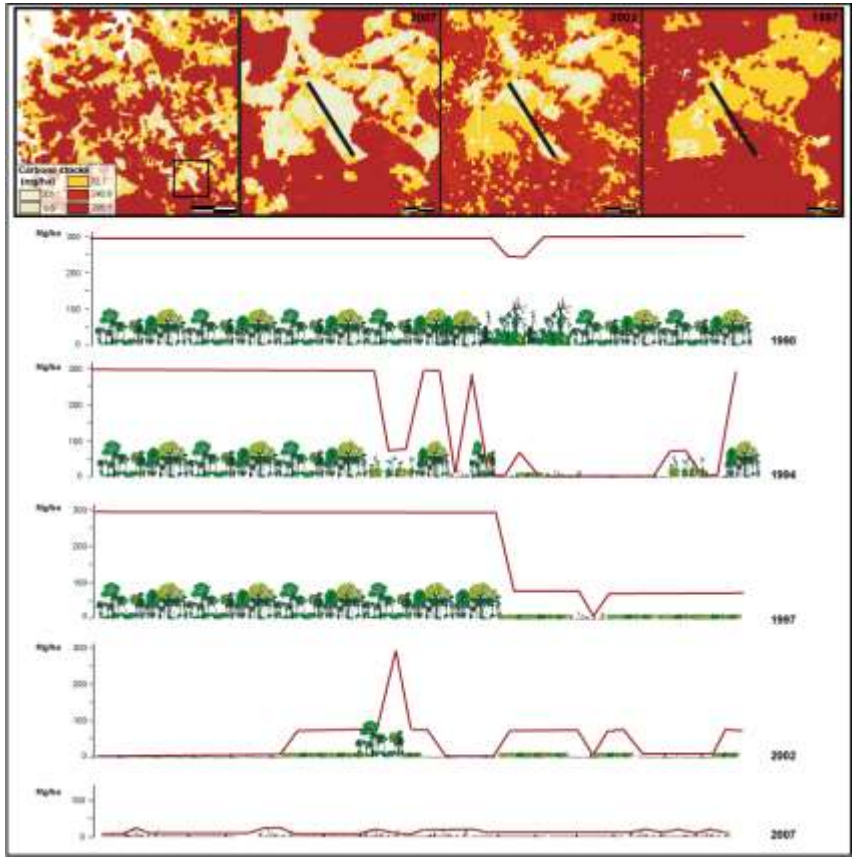

Transect with an agricutural opening

Stock or storage ?

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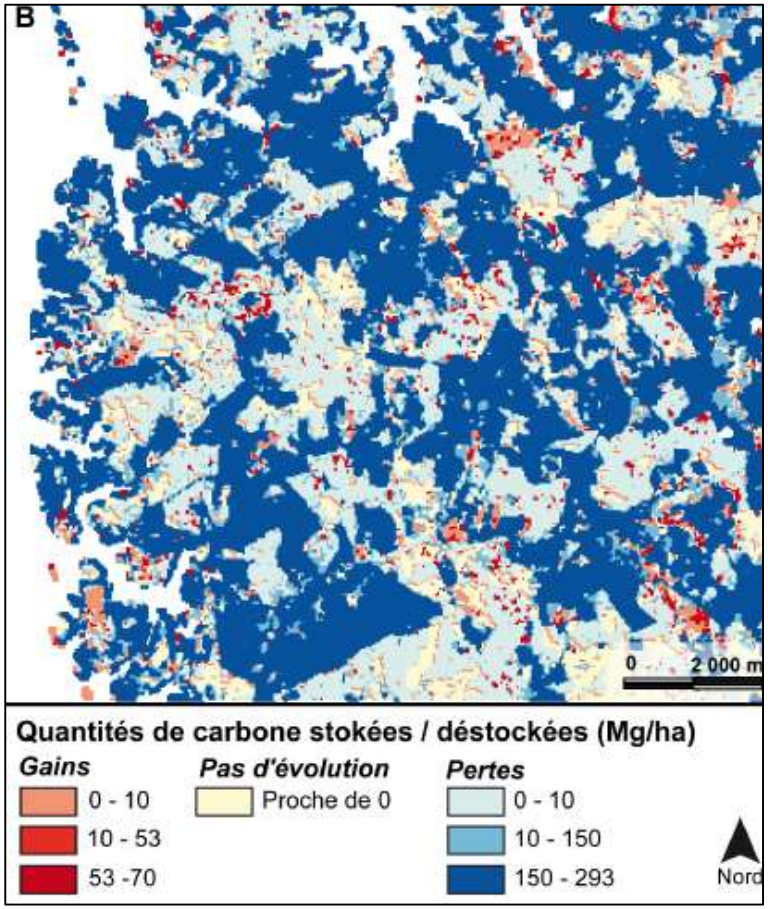

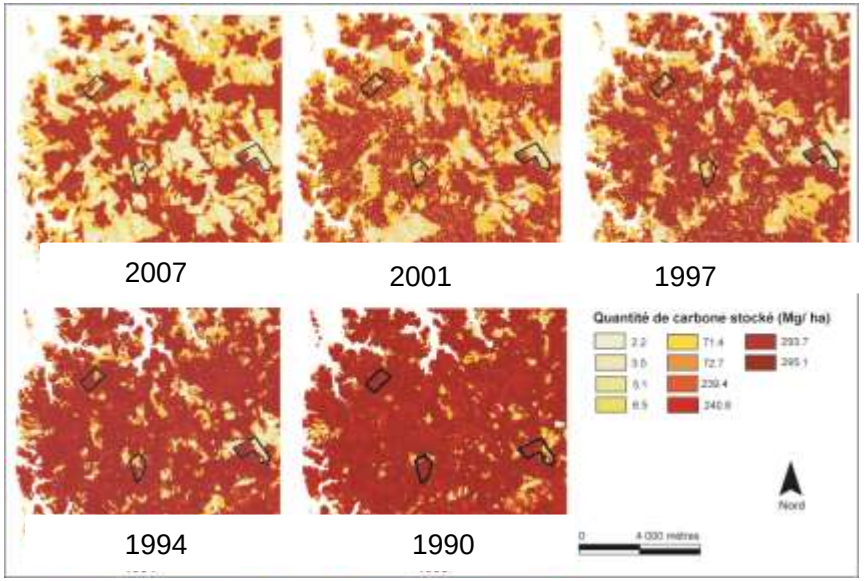

Maçaranduba study site

1990 – 2007 dynamics

Discussion, conclusions

Discussion

Unequal capacity to map ES, whatever the spatial scale they are represented at

Simplification due to the lack of available data

However, spatialized information at two decision levels + uncertainty estimation

Low cost and highly reproducible methodology

Discussion

Regional information to get a general overview

Accurate local information to complete it

ES temporal evolution to facilitate the implementation of environmental mitigation policies

Discussion

Educational

Understanding the social dependance to ecosystems

Regional scale

Heuristic

Reflexion on the exercice of mapping and on the notion itself

All maps

Ecosystem services and their mapping

Political /policies

Operational

Quantitativist approach : tool to evaluate policies

Qualitative approach : tool to bring and lead public debate

Local scale and temporal analyses



Spatial and temporal modelling of ecosystem services

Thanks for your attention!

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