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Toward an Open Resources Using Services

**Computer Architecture and Environmental Science Application  
Ferrara 6-10 June 2016**

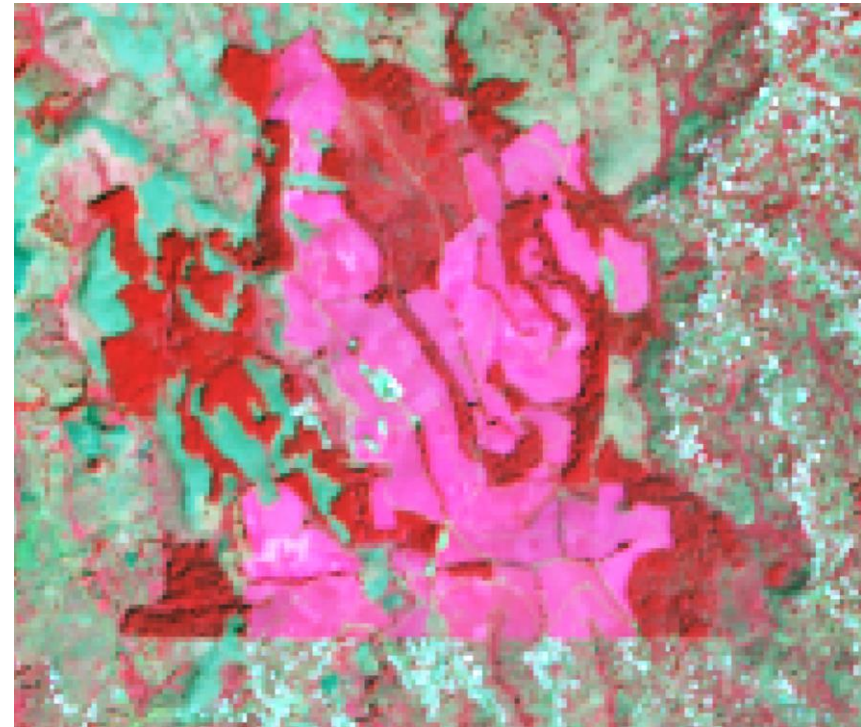
*Dominique LAFFLY  
Ergodic approach in Geography*

To me science that answers only one question: Why here now but not there?



Aerial photo

Bug or not bug?



Landsat LOI

# Society is shaping the environment in landscapes that can not be reduced to the single dimension of "land surface"... even if it is much easier to analyze!



Google Earth



Panoramio

Not a bug!

## OTHER DEVELOPMENTS

**DJUTTITSA TEA ESTATE:** This plantation saw the light of day in 1977. Former disputed land turn to tea cultivation to separate warring villages.

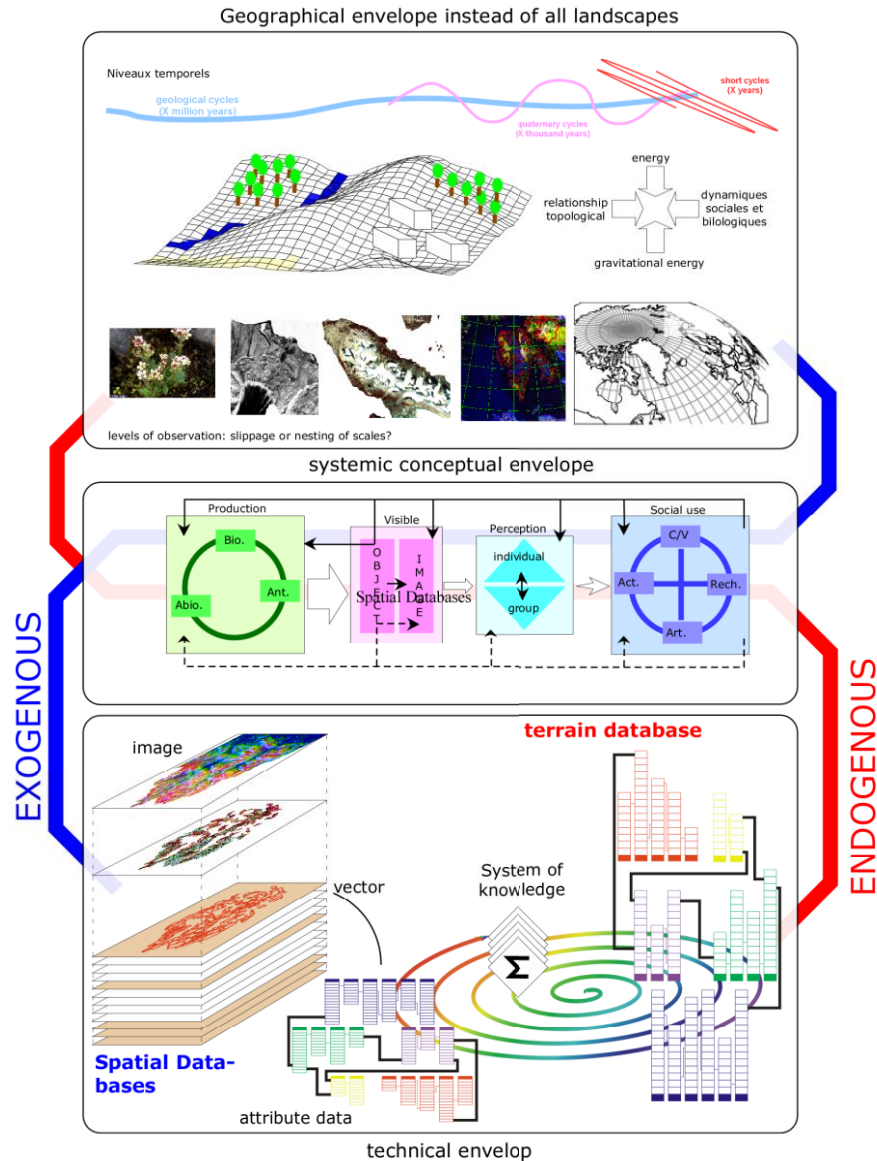
Total area planted stands at 446 hectares. Djuttitsa is in the Western Highlands of Cameroon at 1,890 m above sea level and produces about 1,300 tons of made tea.

All three plantations were run by CDC till October 2002 when the Government under pressure from international financiers privatized the Tea sector of CDC.

Brobon Finex, South Africa, took over. Thus 1568 hectares of tea were handed over to Cameroon Tea Estates a subsidiary of Brobon Finex.



<http://www.africateaconvention.com/phocadownload/cameroonian%20tea%20by%20robert%20mulutakwi.pdf>



## Point, Trace, Order, Inference: an ergodic way

**POINT:** This is the basic spatial unit endogenous observations performed in situ. It is the subject of a location (differential GPS) and a standardized description. Statements and / or investigations are done in a logical and systematic cyber protocol to lend itself to quantitative analysis that can describe and set the information structures. Sampling strategies are based on thematic and spatial criteria.

**TRACE:** This is the message, the sign reflecting the links between the structures identified from the analysis of endogenous and exogenous data information that will serve as spatial reference. In this case, satellite imagery and other geographic information such as elevation, slope, orientation, age surfaces, the distance to objects... All information that describe the landscapes and available as continuous coverage of space.

**ORDER :** Refers primarily to the spatial data structure, the arrangement of landscape elements from each other that induce constraints and differentiated spatial practices. Image analysis, the order refers to the concepts of textures and texture mosaic, spatial autocorrelation... From vector objects, analysis of the spatial structure uses topological operators.

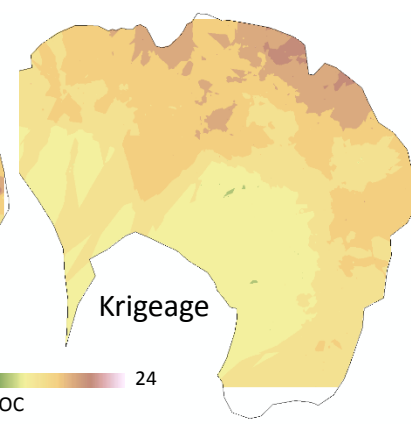
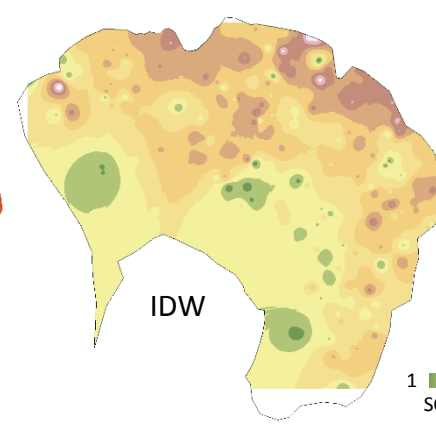
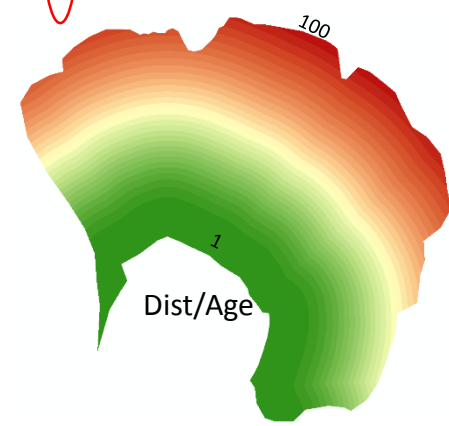
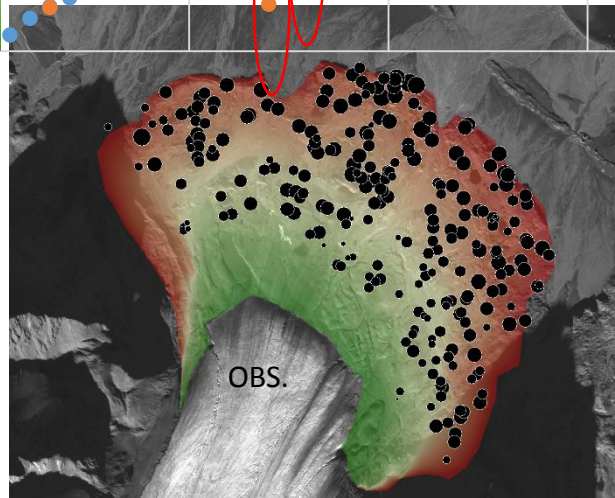
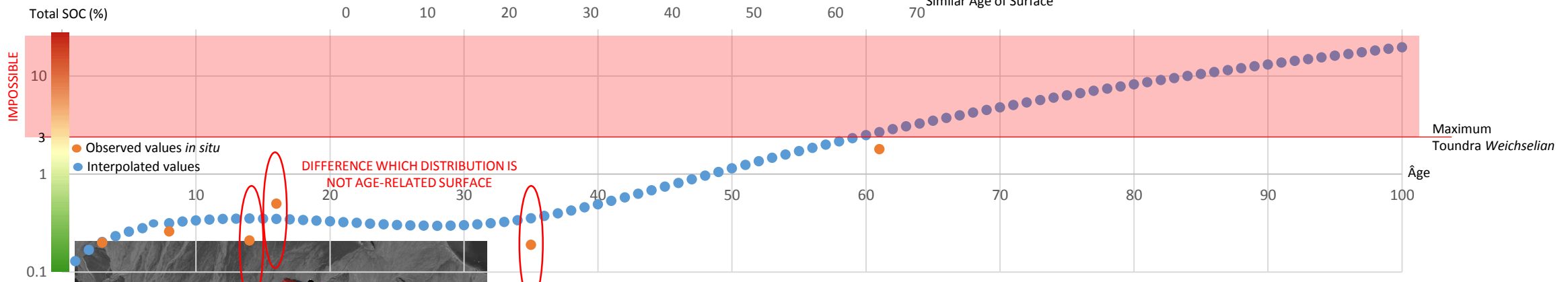
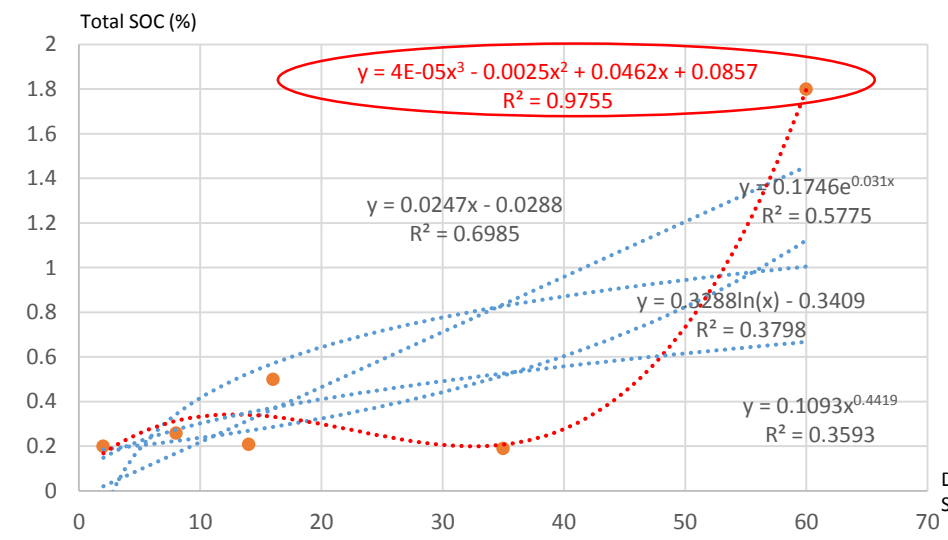
**INFERENCE :** This is inference statistical sense, that is to say the rules developed in the previous steps to ensure the link between internal and external information. It is an ergodic process, based on probability models (Bayes here), which allows to restore the continuity of the geographical area from a partial discontinuous knowledge.

$$a \text{ posteriori} = \frac{a \text{ priori} * \text{likelihood}}{\text{evidence}}$$

Interpolate not play!

A statistical approach interpolation regression is therefore very limited or inadequate (Surface trend, IDW, Kriging, spline ...).

Interpolate not play!



... Nor those of the points observed *in situ* (by plants) which completely determine the spatial interpolation even if it is not the distance to the front dominates.

## Highlight hidden organizational structures of information

Multiple Correspondence Analysis

Ascending Hierarchical Classification

Using environmental data RS to map plant in LIA morain  
(arctic)

But I would also have been present:

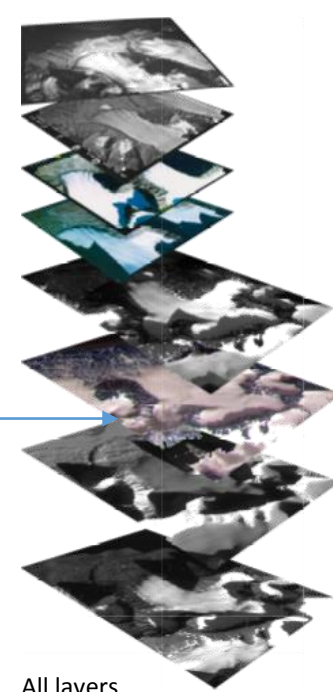
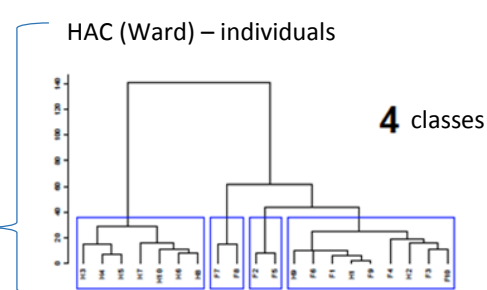
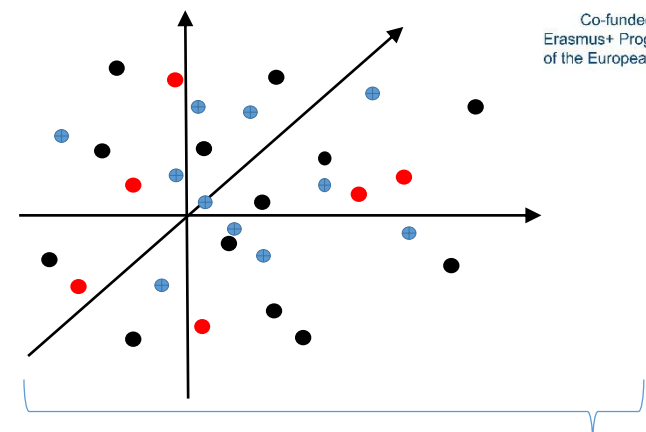
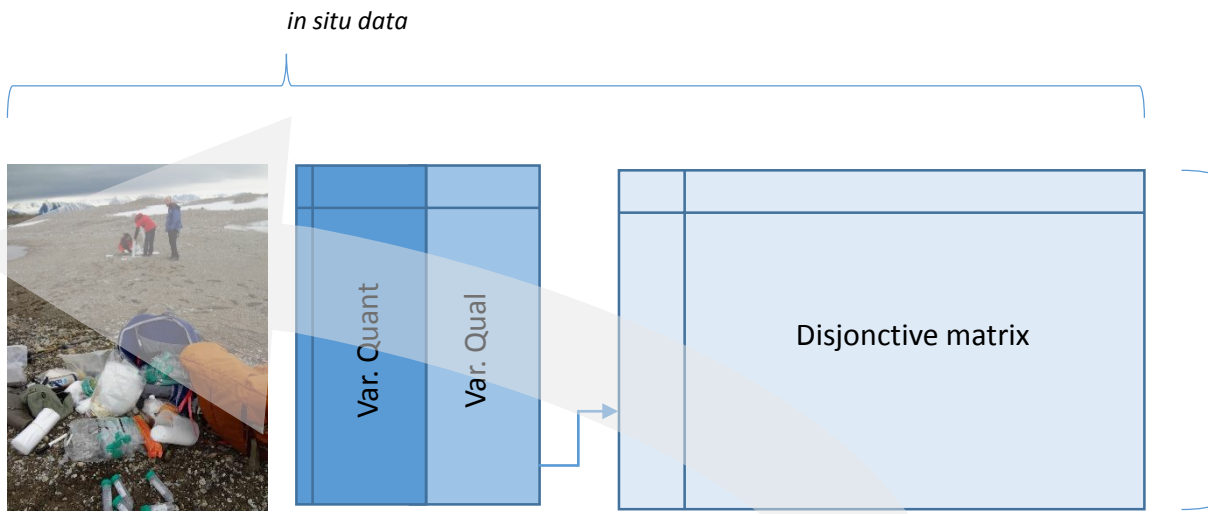
Spatial indicator of vector disease (Plague, sleeping  
sickness)

Or

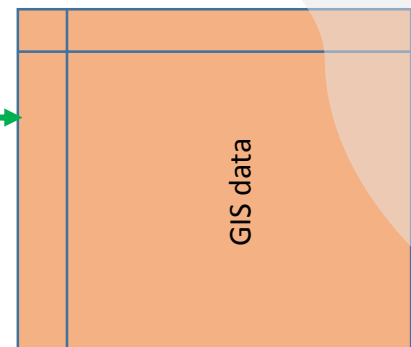
landscape impact of large development works  
(urbanization, hydroelectric dams, coal industry ...)

Multiple Correspondence Analysis (MCA)  
Ascending Hierarchical Classification (AHC)

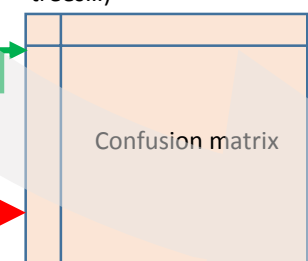
Navigation DGNSS  
 $X1_{UTM}, Y1_{UTM}$   
 $X2_{UTM}, Y2_{UTM}$   
 $X5_{UTM}, Y5_{UTM}$   
 $X3_{UTM}, Y3_{UTM}$   
 $X4_{UTM}, Y4_{UTM}$



Value  
extraction by  
geographical  
coordinates



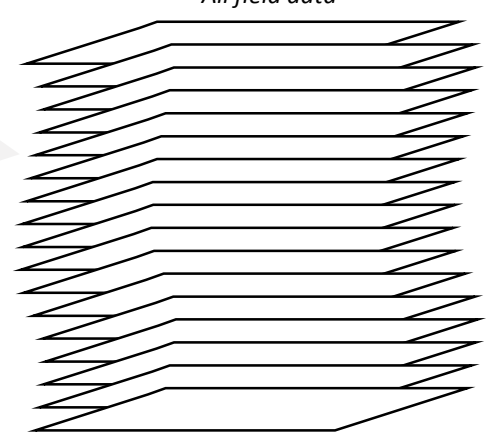
Supervised classification  
(Bayes, SVM, Hidden  
trees...)



Supervised classification (Bayes, SVM, Hidden trees...)

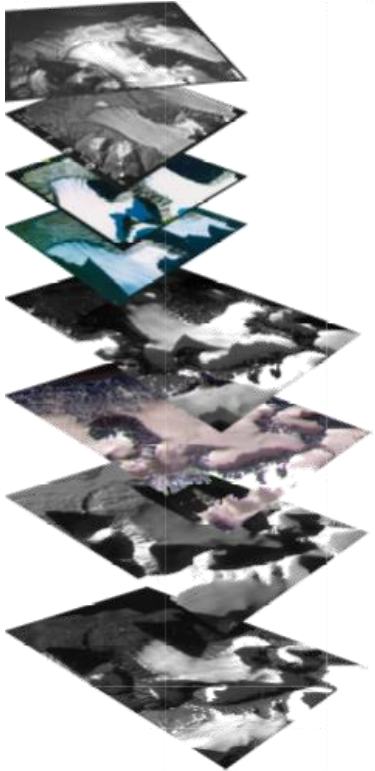
$$\sum_k \binom{n}{k}$$

Layers of probabilities:  
 - All classes  
 - All field data





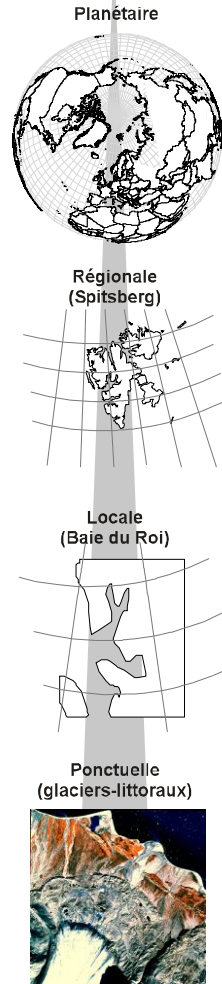
To know the available data in « real time » (Landsat, Sentinel, Spot, Terra...)



Automatically apply their calibrated pretreatments (for example, followed the melting snow, new DEM...) without having to download the data



Generalize the model to large areas.



ÉCHELLES DE PERCEPTION GÉOGRAPHIQUE

Integrating archives and / or find on the web of data that could be interesting but not semantically indicated.

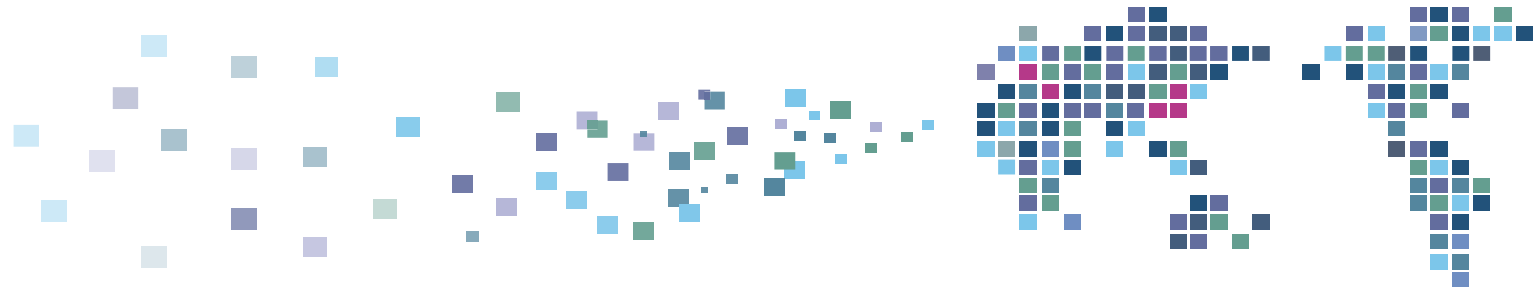


Test different models (neural networks, Monte Carlo, hidden trees, SVM ...) and verify the contribution of different environmental variables.



Web Front End simplissime!





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**Thank you**