Cartolis : vers un outil géomatique pour identifier et caractériser les segments de lisières forestières

Audrey Alignier, Philippe Espy, Marc Deconchat, Sylvie Ladet

CARTOLIS: towards a geomatic tool to identify and characterize the segments of forest edges

Alignier A.; Espy P.; Deconchat Mr.; Ladet S.

UMR DYNAFOR INRA- University of Toulouse/ENSAT

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F-31326 Castanet-Tolosan cedex

Sylvie.Ladet@toulouse.inra.fr

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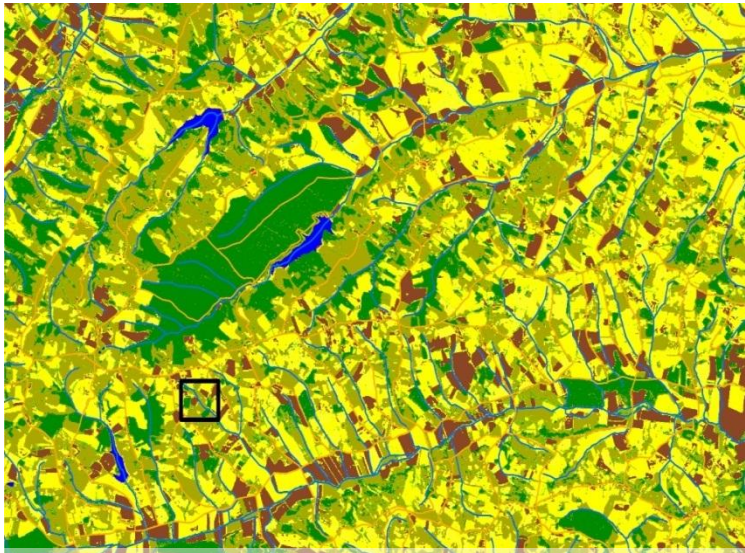
Importance of forest edges

(1/2)

- Forest edges are **key elements of landscapes** (habitats and resources for many animal and plant species)
- Edges are very **diverse and have consequences** on the biodiversity and land management
- The ecologists can apprehend this diversity at local scale or around a wood but not at the landscape scale →**question to the geomaticians**

With the scale
- of an edge
- of a wood
- of a landscape



Extract of land cover map (SPOT5; Barrussaud, 2008).

Question

(2/2)

How to localise and quantify the diversity of forest edges at a landscape scale?

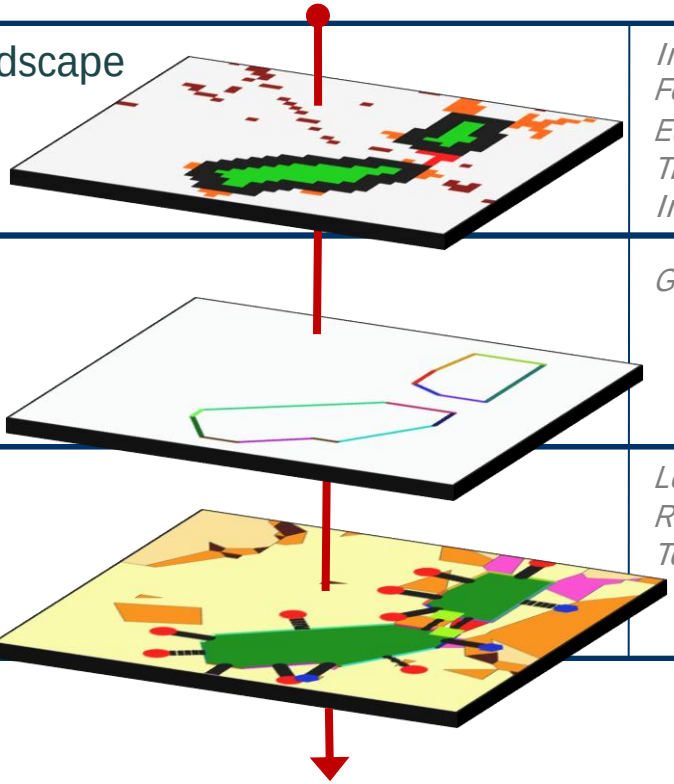
- **To search for or to create** a tool to take into account the diversity of edges, on a large spatial extent.
- **CARTOLIS**, to build a geomatic tool to meet ecologists needs to identify and characterize edges.
- **Line** = choice of the data model of CARTOLIS

"the edges are then seen like a set of segments".

Conceptualization of the method

- Combination of preexistent tools with an adaptation of script
- Installation and test of **model of treatment**

	Parameters
Phase 1: Identification of the edges in the landscape	*Image resolution data* *Foreground Connectivity* *Edge Width* *Transition* *Intext*
Phase 2: Creation of the segments of edge	*Generalize tolerance*
Phase 3: Characterization of the segments	*Length of the transect* *Resolution of the MNT* *Tolerance of slope*



Sequence of operations (including inputs, outputs, and parameters of treatment) **with methodological choices and formalization of the questions of ecologists**

Phase 1: Identification of the edges

How to separate the edges on an image?

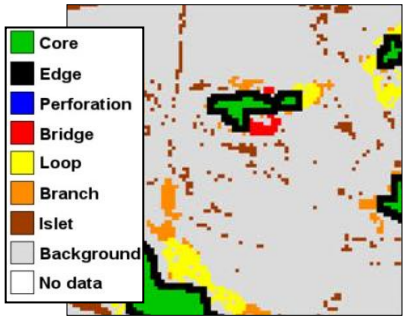
- **Localization of the edges using software GUIDOS. Why?**
  - **G**raphica**l** **U**ser **I**nterface for the **D**escription of image **O**bjects and their **S**hapes
  - **Standard Tool** for characterization of forest fragmentation, created by the EU
  - Open source
  - Allows to distinguish in a landscape from broad extent, the **class of the edges but in an undifferentiated way**

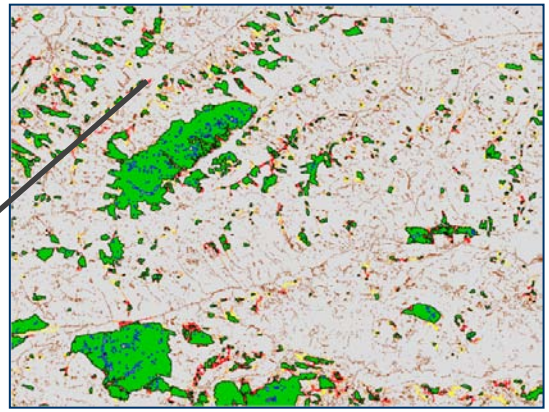
European Commission Joint Research Centre — European Forest Data Centre

Input data:
binary image
wood/not wood

MPSA

with Edge width=20m (2 pixels)





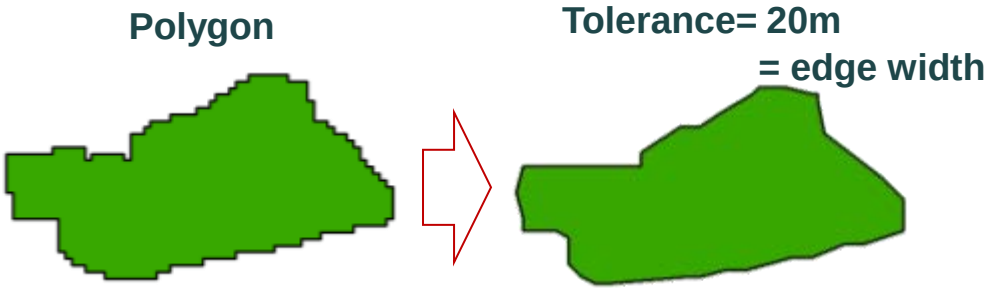
Output data:
classified image of the various wooded elements in 7 classes

Phase 2: To identify the segments of edges (1/2)

How to approach the perception of the ecologists by building rectilinear edges?

- Two important steps:
  - **Simplification of the contour of wood**
  - **Extraction of the segments of edges**

⇔ **Raster To Vector**
GENERALIZATION
SEGMENTATION



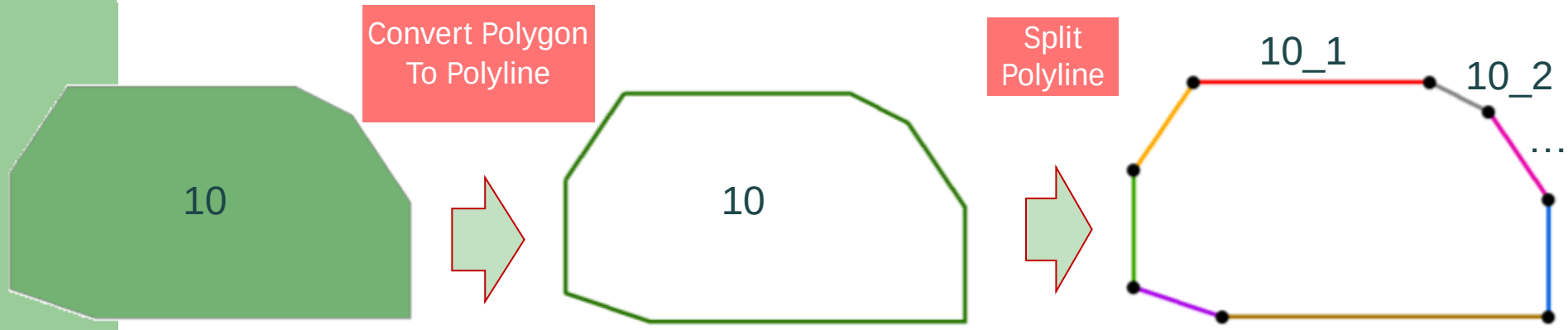
- GENERALIZATION: **Use of the function "Generalize" (ET GeoWizards):**
  - Douglas-Peucker algorithm :

Simplification of the shape of the polygons by reducing their number of sides while preserving their topology

  - Parameter of tolerance (T)

Phase 2: To identify the segments of edges (2/2)

How to cut out the edges by keeping genealogy?



- SEGMENTATION: **Use of the function "Split" (ET GeoWizards):**
  - Algorithm of segmentation
  - Split in all vertices
- Logical LABELLING:
  - Array of pairs of co-ordinates
  - Concatenation of identifiers

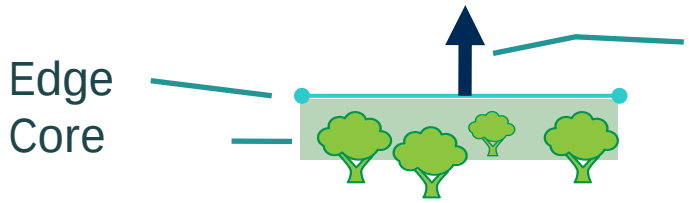
Phase 3: Characterization of the segments (1/2)

- **Calculation of attributes,** saved in database
  - **Intrinsic variables** on the segment
  - **Extrinsic variables** from other dataset

➢ Choice of a new objet= **Transect** and interrogation by spatial jointure

- In conformity with methodological choices in Ecology where many studies are based on transects

- Allows to cross with Raster or Vector data



TRANSECT=Perpendicular at the central point of each segment, Directed outside wood, length=40m

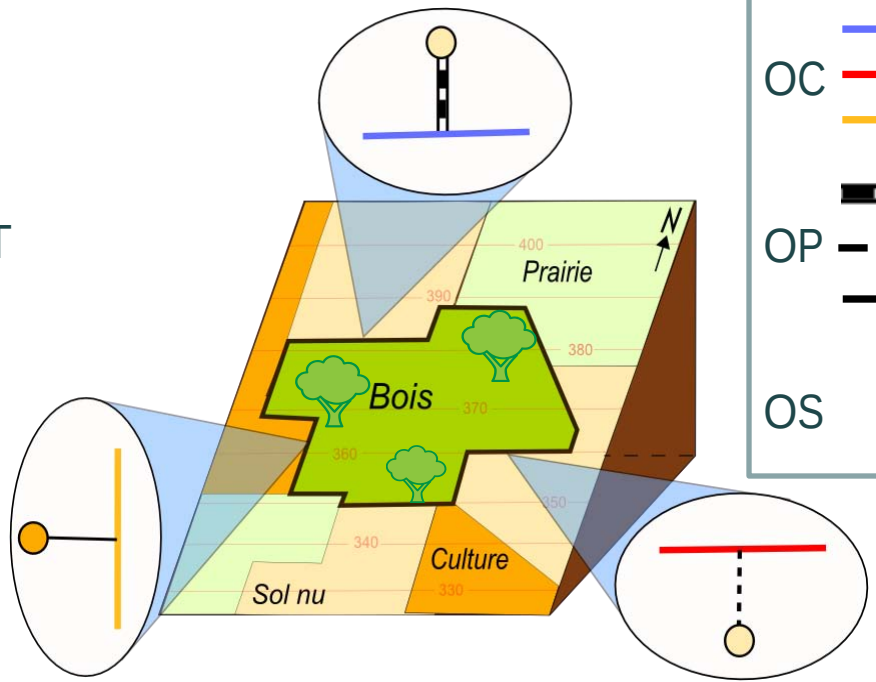
- **Use of script "PerpendicularLine " (ESRI Inc):**

- Parameter setting in language python

Phase 3: Characterization of the segments (2/2)

- **Cardinal orientation (OC):** Intrinsic; continue (0 to 360)
  - exposition of the edge compared to wood to which it belongs
- **Slope orientation (OP):** Extrinsic; discontinuous (3 Cl.)
  - Use of the MNT (TOPO database, 25m)
- **Land Cover occupation (OS):** Extrinsic; discontinuous (11cl.)
  - Use of the land cover map(INRA, 10m)

All calculated indices depend on the grain (MNT 25m) and typology (11 classes of land cover)
-Definition of an original symbology ***CartolisSymbol***



Statistical results from CARTOLIS

(1/3)

- **Quantification tool: on ~200km²:**

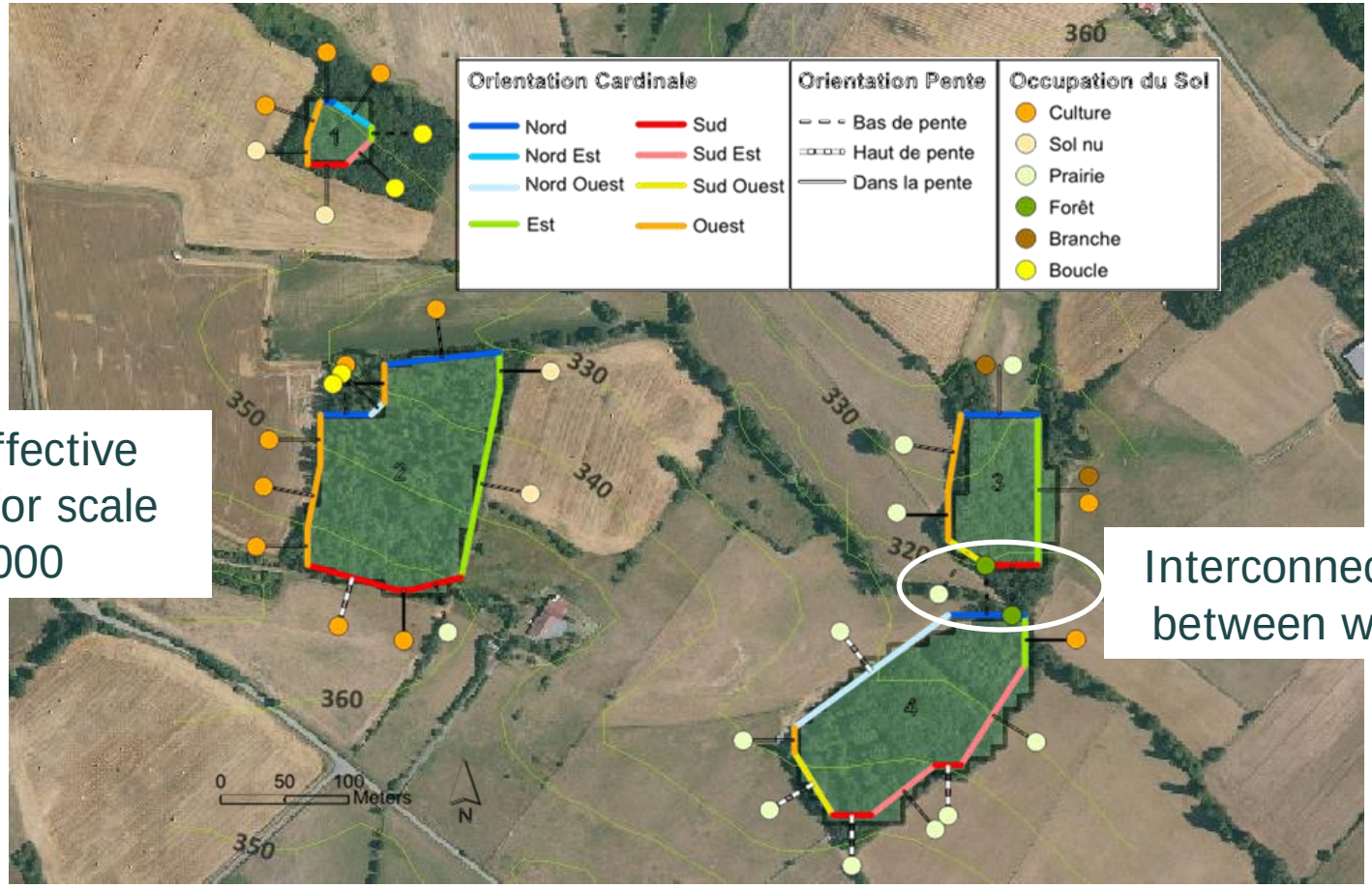
Phases	Process	Statistics
1	Classification	Water= 13,38%
		crop= 34,72%
		Meadow = 32,24%
		bareground = 10,3%
		Other = 0,63%
	Treatment under Guidos: analyze morphological MPSA	Core= 8,77%
		Edge = 4,61%
		Other wooded elements = 8,74%
2	Vectorization	109 woods
		11.194 edges
	Generalization	**101 wood**
		4921 edges
3	Calculation of the variables	OC= Southern in maj.
		OP= no slope in maj.
		OS= meadow in maj.

Statistical results from CARTOLIS (2/3)

- Wood have an average surface of 20 ha and an average perimeter of 1.9 km
- 197 km of segments of edges in our landscape
- The average length of a segment is 40m
- Density of the segments of edges = 1km/km² → very fragmented landscape compared to the national statistics
- "South/no slope/Meadow": the most current combination with 8.8 km of cumulated edges

Cartographic results from CARTOLIS (3/3)

- **Visualisation tool**



zoom for effective symbology for scale <1: 10000

Interconnection between wood

Conclusions

- **Construction of a method for 2D analysis** with functional (geomatic aspect) and relevant (ecological aspect) outputs .

- **Adaptability of the developed method** with explanation of implementation detail of each phase (parameter setting, choice of the variables).

- **Improvements** : computing time, determination of the relevant parameter setting via integration the sensitivity analysis; IHM.

- **Prospects for comparative applications** between sites of long-term studies (synchronic approach).

Contribution to Landscape Ecology

- Participation to the definition of **new metric based on the segments**
- Complementarity with metric based on the polygons (Patch metrics Fragstats)

Utilities of edge-based metrics for studying landscape fragmentation

Hui Zeng [a], X. Ben Wu [b,*]

Computers, Environment and Urban Systems 29 (2005) 159–178

Thank you for your attention

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