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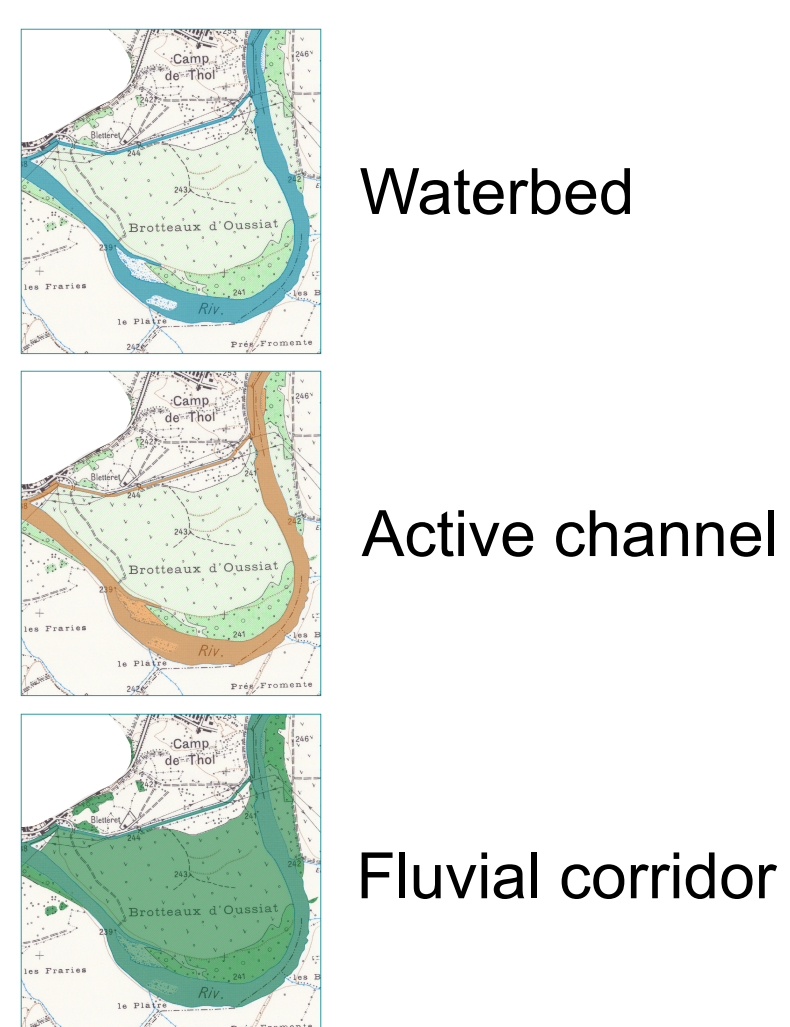
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Automatic vectorization of historical maps: a way to characterize fluvial corridors evolution at a regional scale?

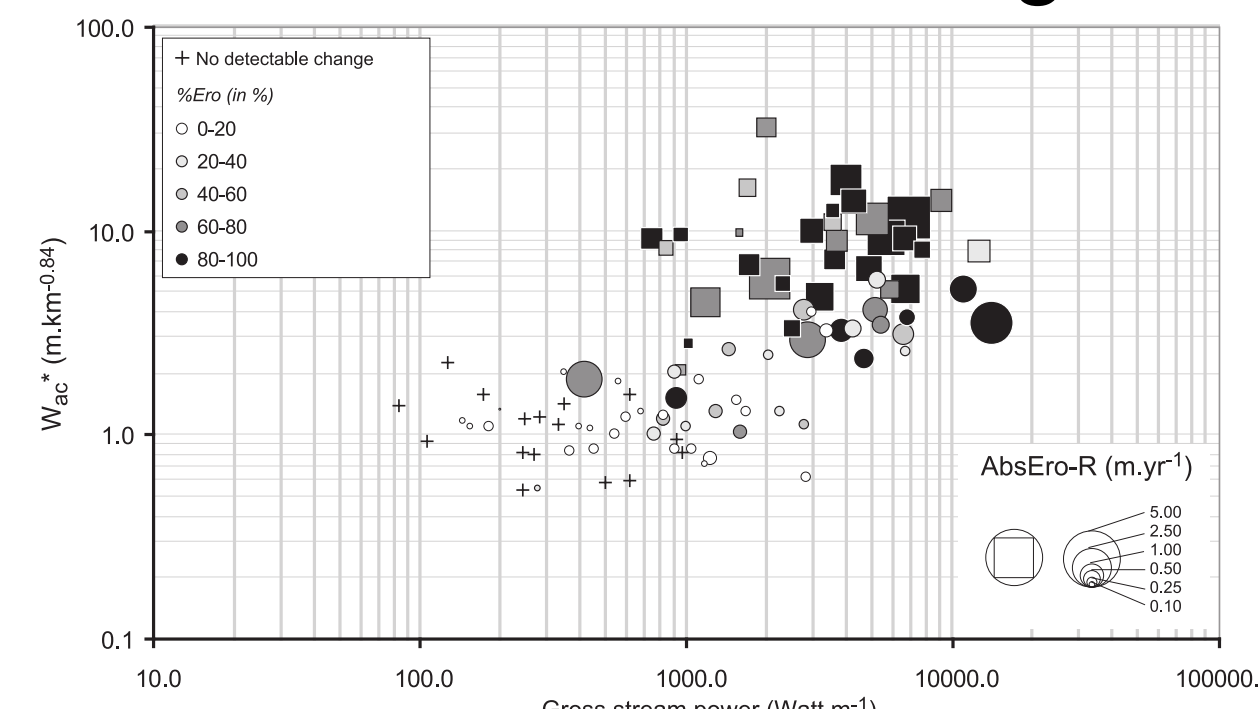
Acquired

Raw data extracted
to detect changes



But also sinuosity,
fluvial form typology, ...

Indicators of channel
characters and changes

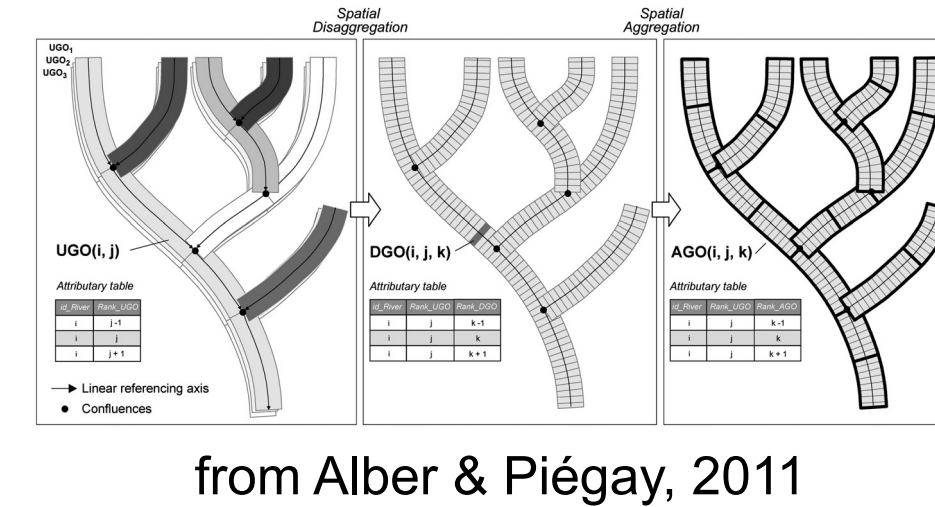


AbsEro-R : Absolute linear migration rate
from Alber & Piégay (2017)
But also narrowing, changes in channel pattern,
in riverscape at the corridor scale, ...

Network characterization tools available



Extraction of the centerlines, valley bottoms,
watersheds. Calculations and measurements of
indicators at UGO, DGO and AGO scale.



1. Data characterization

New survey techniques are implemented on the Nouvelle Carte de France:
generalization of the use of photogrammetry, Bilby signal, light duralumin, electric mirrors
and projectors, motorized transport.

On the hydrographic layer, important updates are also observed: leveling of the
profiles in length, greater variety of conventional signs, updated with each edition of the
visible streams on aerial photography.

All the sheets of the Nouvelle Carte de France have been **digitized and georectified by the IGN**. This important work represents a
considerable gain of time for a vectorization on a regional
scale. The validation of the data represented on the
maps is also possible thanks to the **generalization of the photogrammetry**: all the photographs used for
mapping are digitized and accessible via the portal
remonterletemps.ign.fr

	Type 1922	Types 1952-64 Surface	Type 1972
Flood zone		no changes	no changes
Sand and vase			
Gravel and pebbles			no changes
Large width permanent stream*	>10m* 	>6m* 	>7.5m*
Large width non permanent stream*	type 22 v1 type 22 v2 undefined 	>6m* 	>7.5m*
Aquatic vegetation		few changes 	few changes
Wood (species determined by stencil)	type 22 v1 type 22 v2 		
Brushwood	High and low distinguished by stencil 	High Low 	
Small width permanent stream*	5-10m* <5m* 	<6m* 	<7.5m*
Small width non permanent stream*	<10m* 	<6m* 	<7.5m*
Trees along streams		Isolated 	no changes

The evolution of the figures over the types of legend, illustrated above, is **not significant enough to be a technical lock for vectorization**. A potential constraint is linked to the evolution of the flow width limit between a linear representation and a surface representation, as well as the appearance of the green color to represent the type 22 vegetation.

Aim

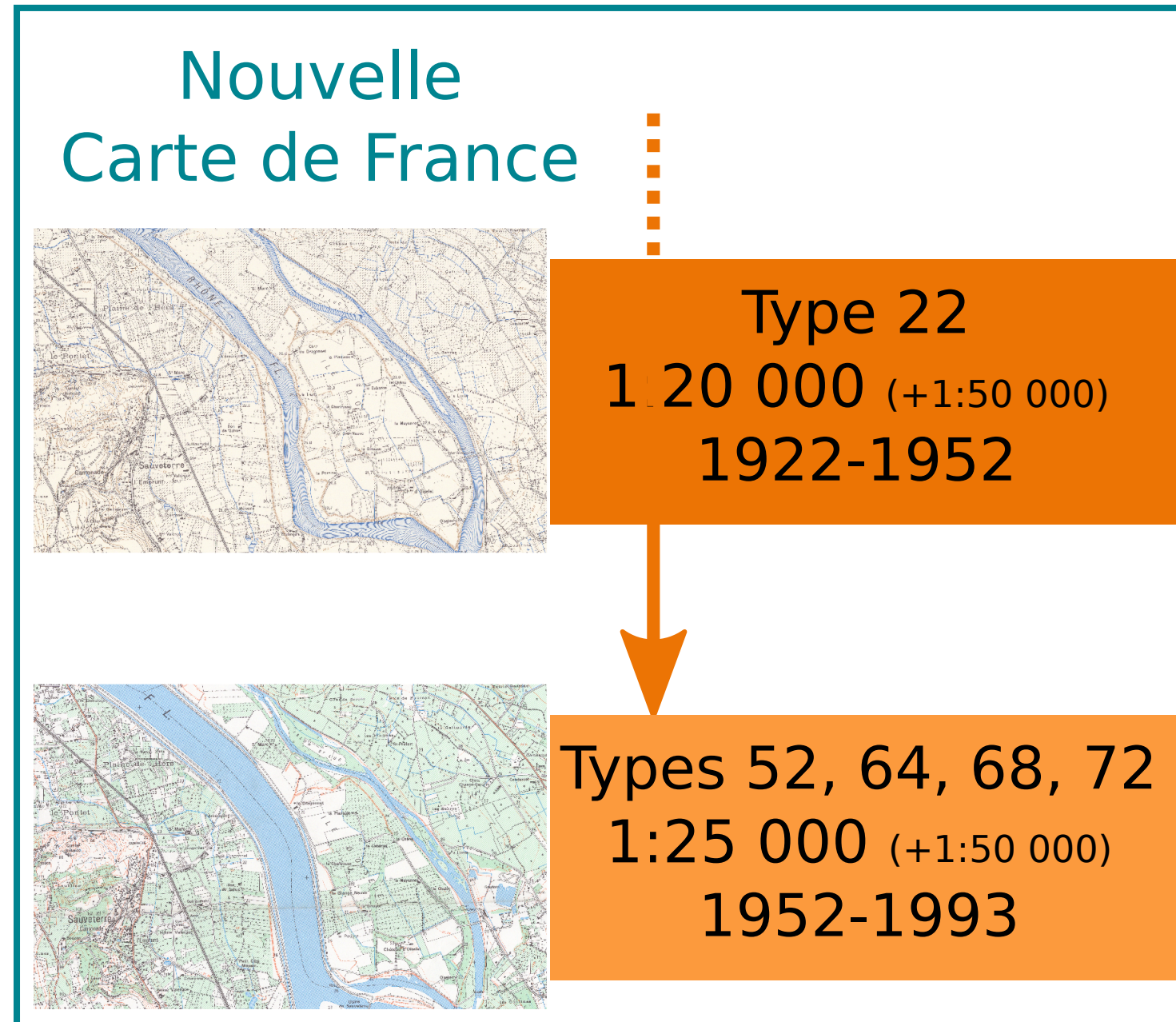
Characterization of the physical state of fluvial corridor and its multi-decadal
evolution at a regional scale, based on the cartographic resources of the IGN.

For this we have:

1. Carried out a characterization of the corpus of historical maps.
2. Evaluated the spatio-temporal potential of these resources.
3. Set up the basics of a 2-step automatic vectorization method.

The exploited data are those of the Nouvelle Carte de France:

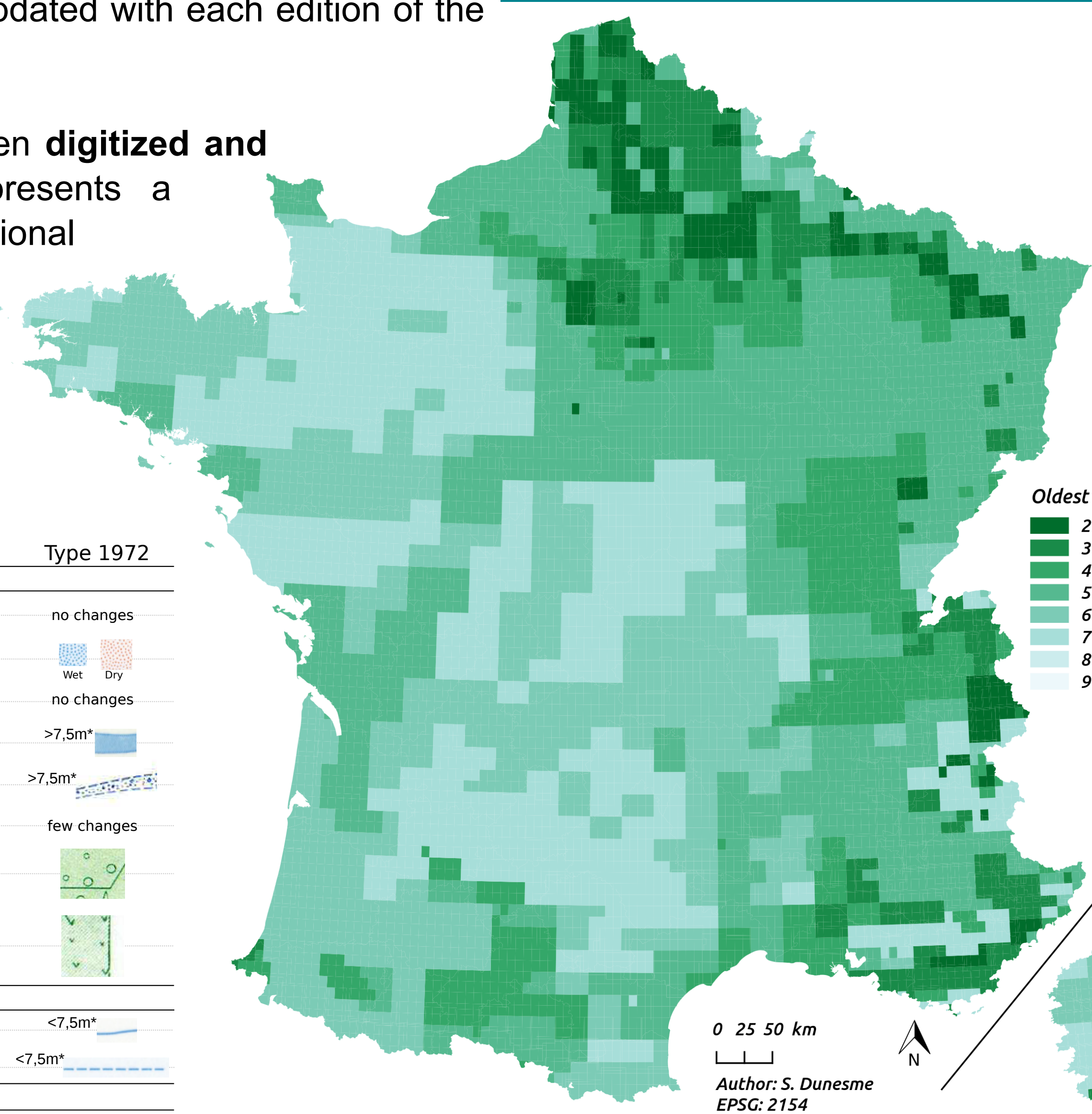
- The projections used are recent and the geometric accuracy is correct.
- We have validation data on the production dates of these maps (20th century) from aerial photographs.



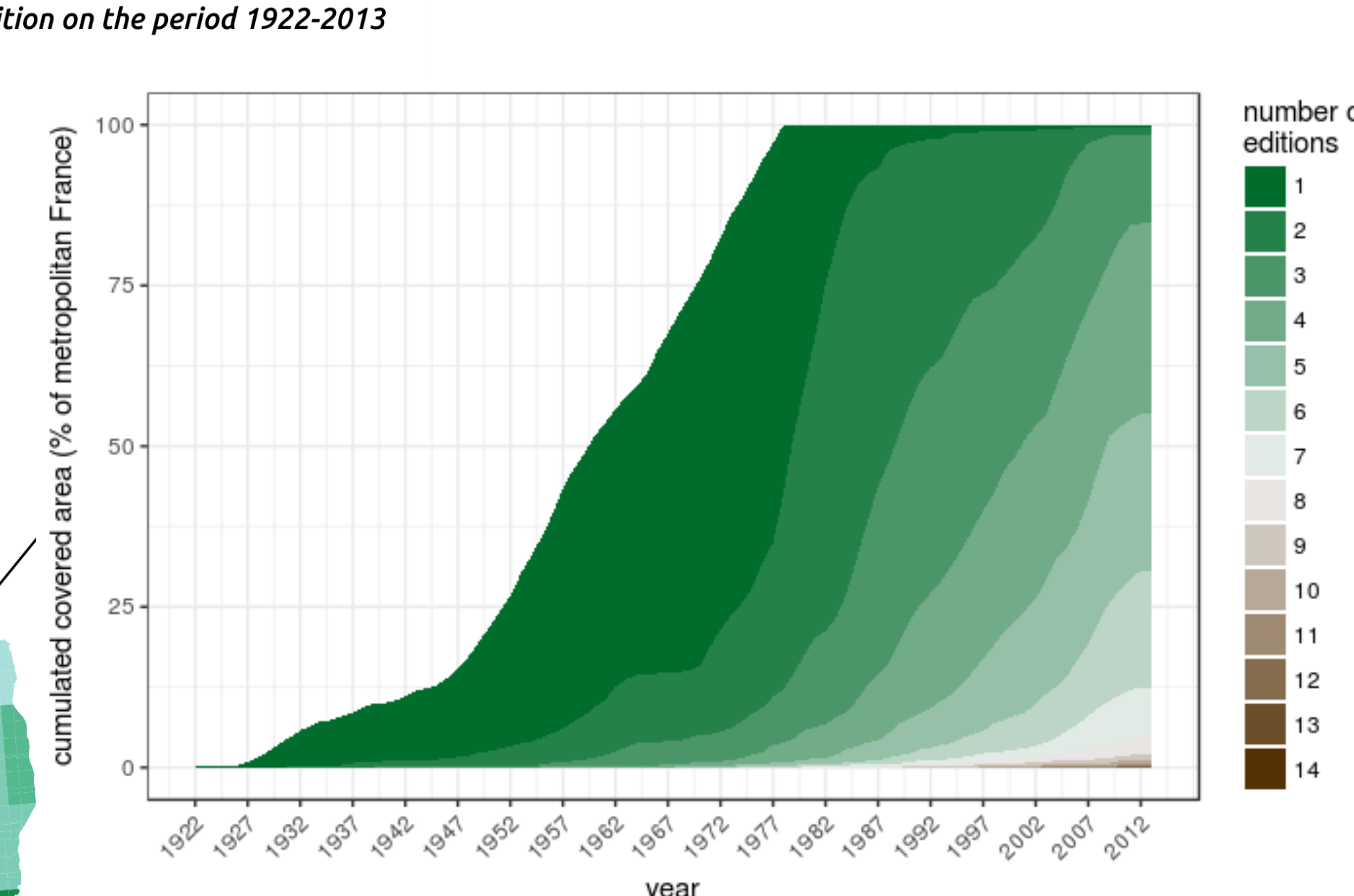
The large amount of maps to be processed (about 1900 maps in the Auvergne-Rhône-Alpes region) requires the automation of the vectorization process.

- Cassini maps, Etat-Major maps and large scale local maps are not usable:
- No homogeneous data at regional scale.
- Old projections and limited geometric precision.

2. IGN resources evaluation



Half of the metropolitan territory is covered in large-scale cartography from the 1950s. The northern and eastern borders are the areas which were the oldest mapped. The entire territory is covered only at the end of the 70's.



The potential for multi-temporal analysis is limited: only half of the territory is covered by at least two editions in the late 1970s.

3. Fluvial corridor vectorization: 1st results

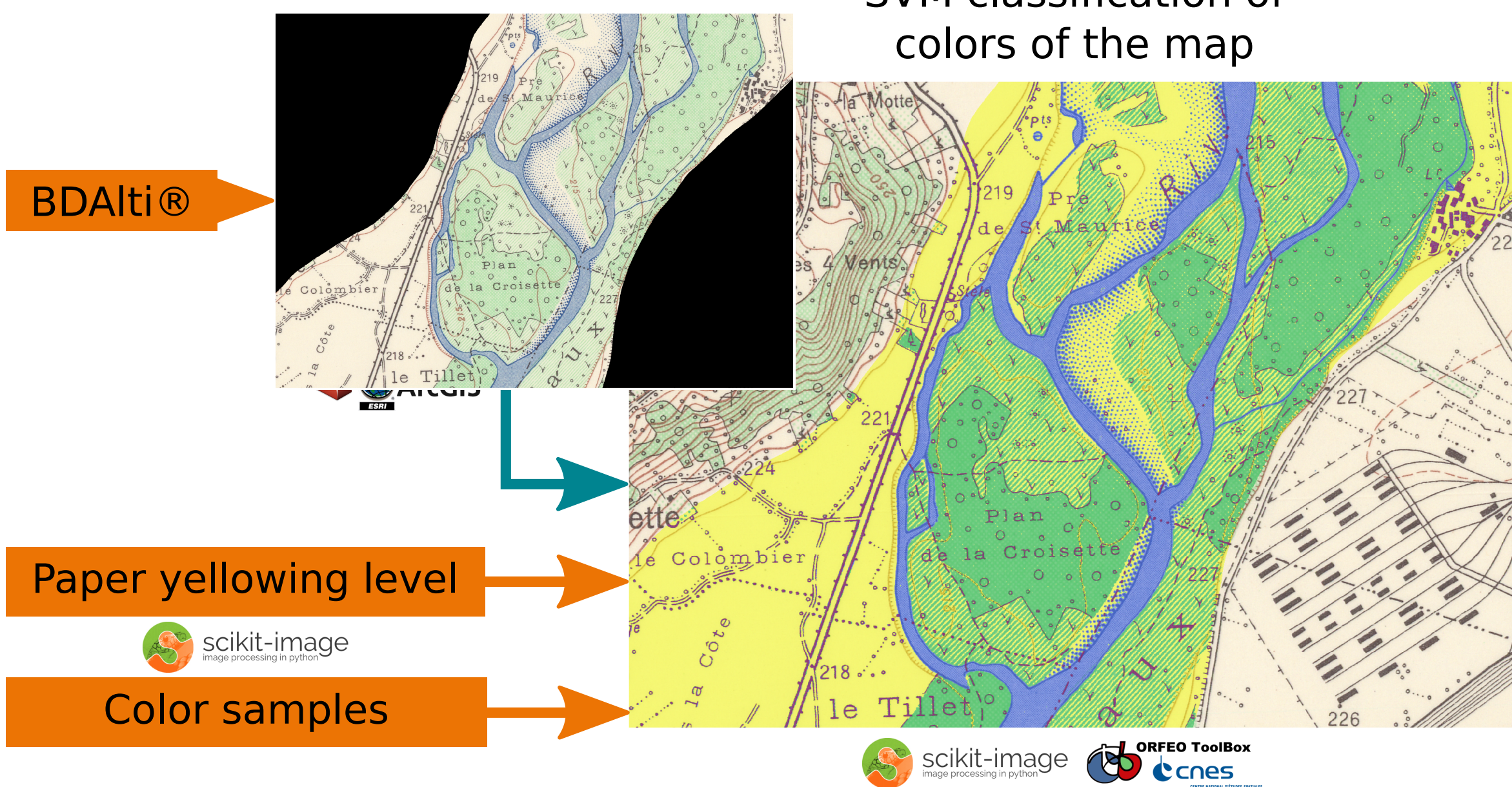
Extraction of the alluvial plain (topographic rules)

Fluvial Corridor Toolbox

SVM classification of colors of the map

Objects reconstruction by morphological filters oriented on the channels

The main technical constraints to vectorization are:



- 1) An uneven eldaring of map paper: we propose to evaluate this eldaring beforehand by comparing the white of the map to a white of reference.
- 2) The toponyms, hydronyms and bridges that segment the hydrographic network as well as the high density of information in narrow valleys and multiple channel areas: we propose a series of morphological filters to separate the sediment banks from the water surfaces. Some are oriented in the direction of the channels in order to reconstruct the objects over the toponyms and bridges and to manage the multi-channel areas without creating gaps in the hydrographic network.

In perspective, we propose directly integrating a fluvial form typology into the object reconstruction process to adapt the filters to each situation (oriented on multiple channels, not oriented on single channels).

Authors

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References

Alber, A., & Piégay, H. (2011). Spatial disaggregation and aggregation procedures for characterizing fluvial features at the network-scale: Application to the Rhône basin (France). *Geomorphology*, 125(3), 343-360.
Alber, A., & Piégay, H. (2017). Characterizing and Modelling River Channel Migration Rates at a Regional Scale: Case Study of South-East France. *Journal of Environmental Management*, 202, 479-93.
Chappart, G., & Reynard, N. (2007). La carte topographique française de 1887 à nos jours. *Le monde des cartes*, 191.
Herrault, P.-A. (2015). Extraction de fragments forestiers et caractérisation de leurs évolutions spatio-temporelles pour évaluer l'effet de l'histoire sur la biodiversité: une approche multi-sources. Université Toulouse le Mirail-Toulouse II.
IGN. (1950). La nouvelle carte de France au 20.000ème : son utilité, son exécution. Paris : Institut Géographique National.
Leyk, S. (2005). Computing the Past – Utilizing Historical Data Sources for Map-Based Retrospective Landscape Research. University of Zurich.