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

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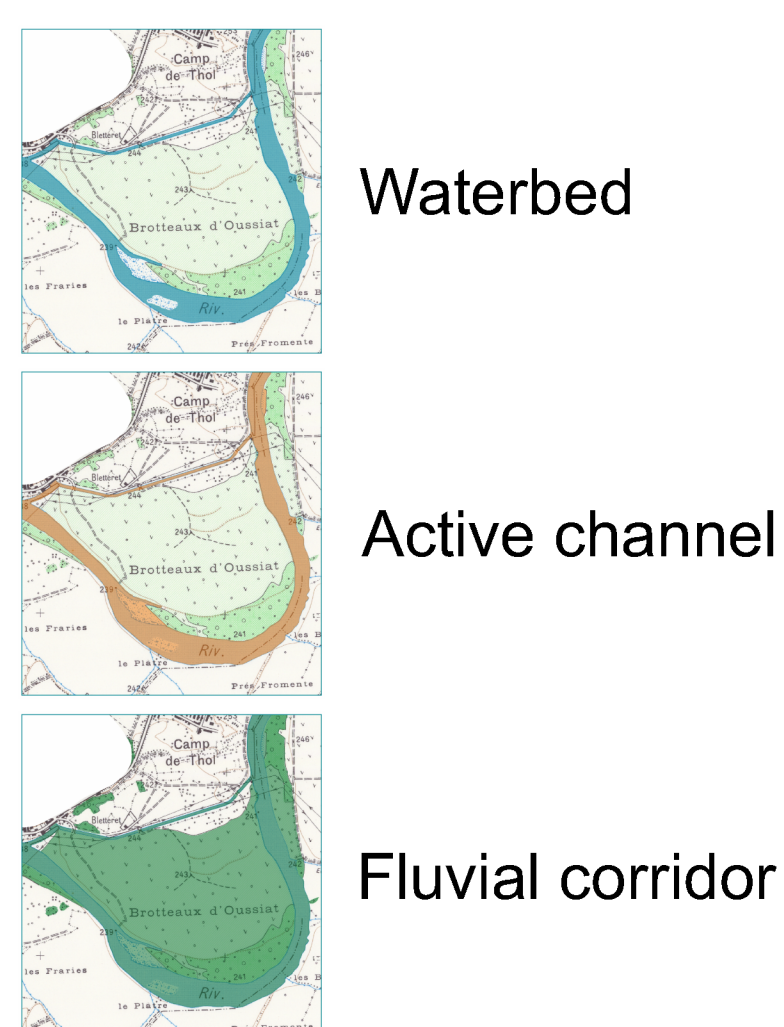
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Automatic vectorization of historical maps: a way to characterize fluvial corridors evolution at a regional scale?

Acquired

Raw data extracted
to detect changes



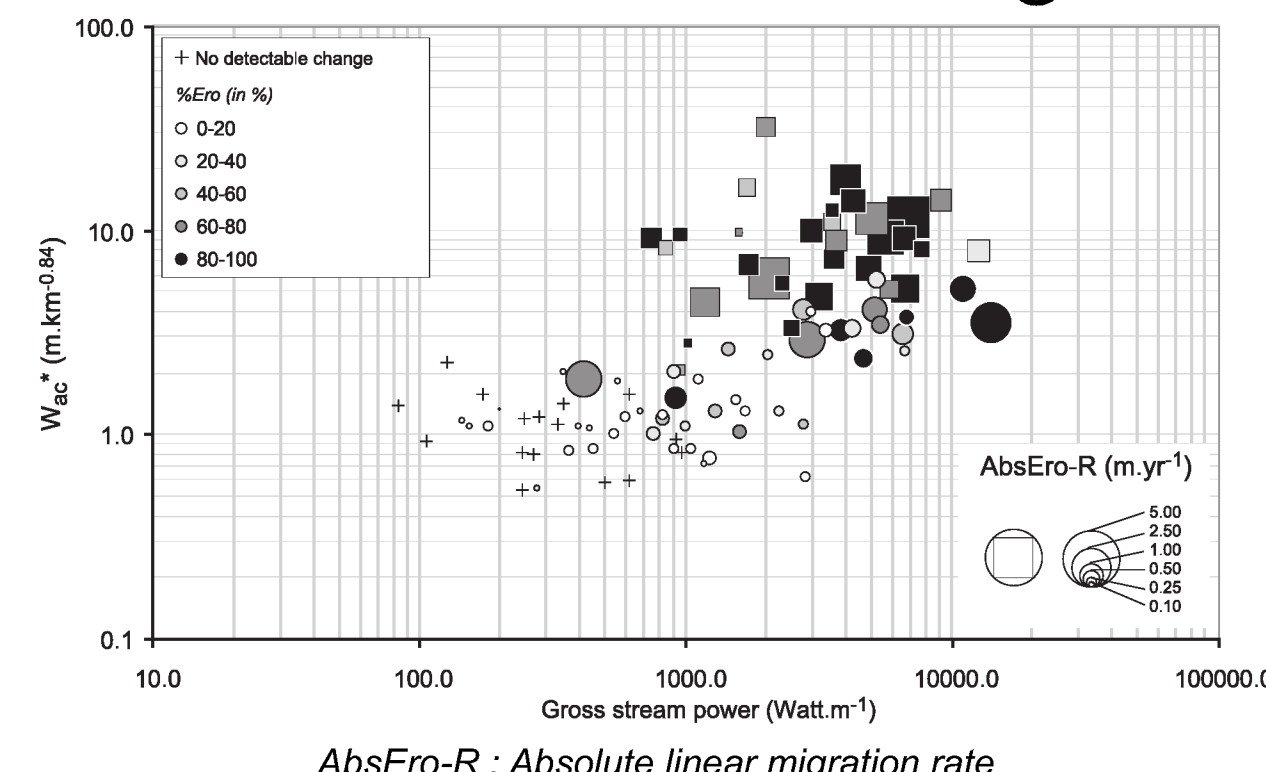
Waterbed

Active channel

Fluvial corridor

But also sinuosity,
fluvial form typology, ...

Indicators of channel
characters and changes

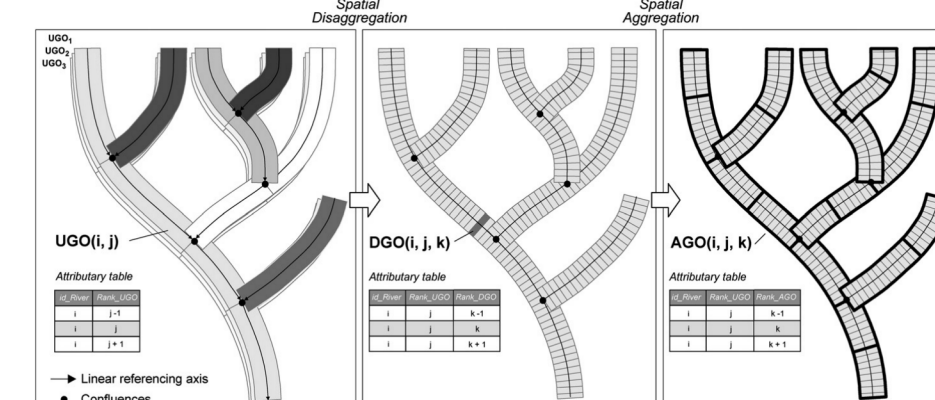


But also narrowing, changes in channel pattern,
in riverscape at the corridor scale, ...

Network characterization tools available

Fluvial Corridor Toolbox

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



from Alber & Piégay, 2011

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			
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		
Small width permanent stream*	5-10m*	<6m*	<7.5m*
Small width non permanent stream*	<10m*	<6m*	<7.5m*
Trees along streams			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

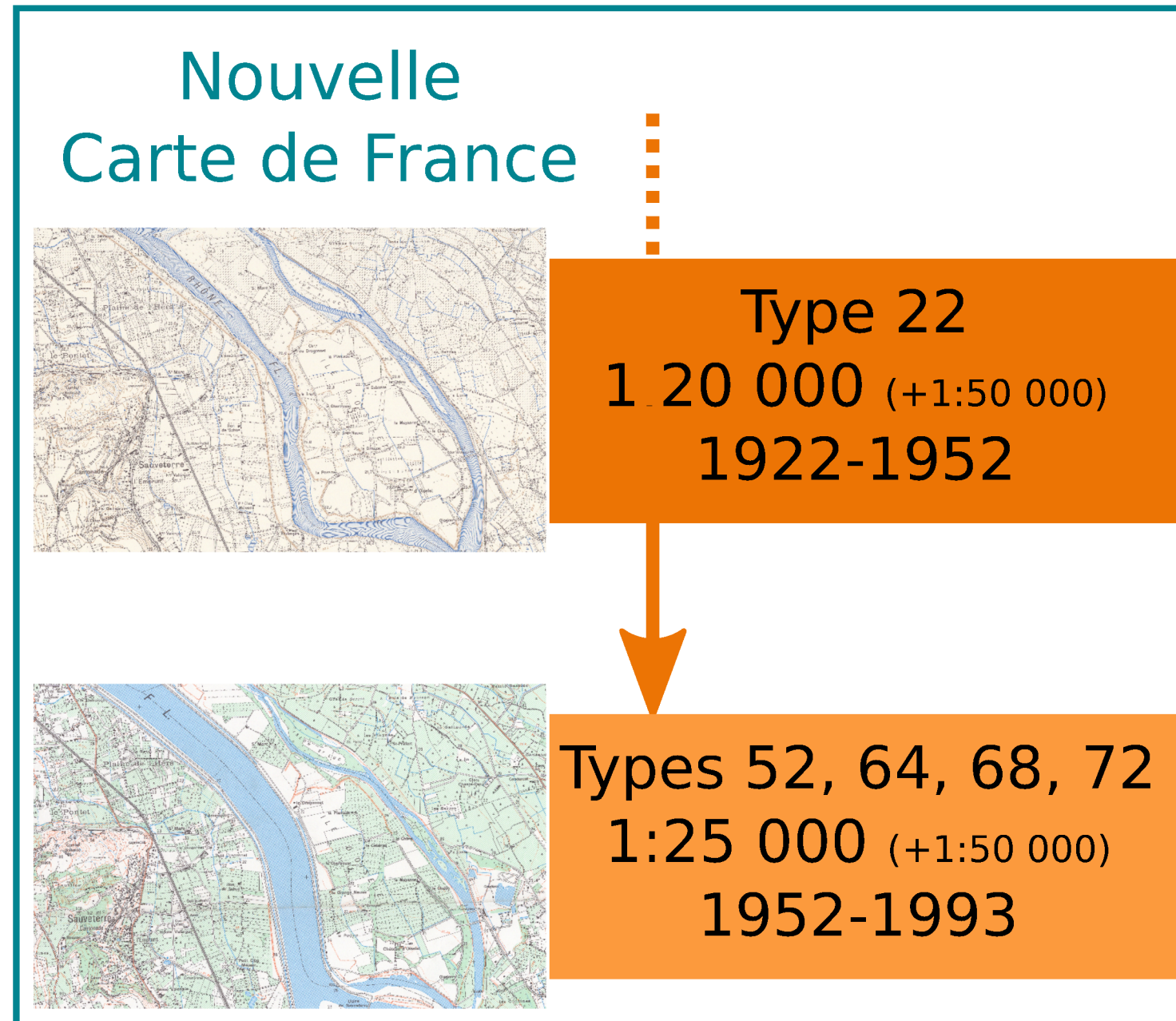
Characterization of the physical state of fluvial corridor and its multi-decadal
evolution at a regional scale, based on the cartographic resources of the IGN.

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.

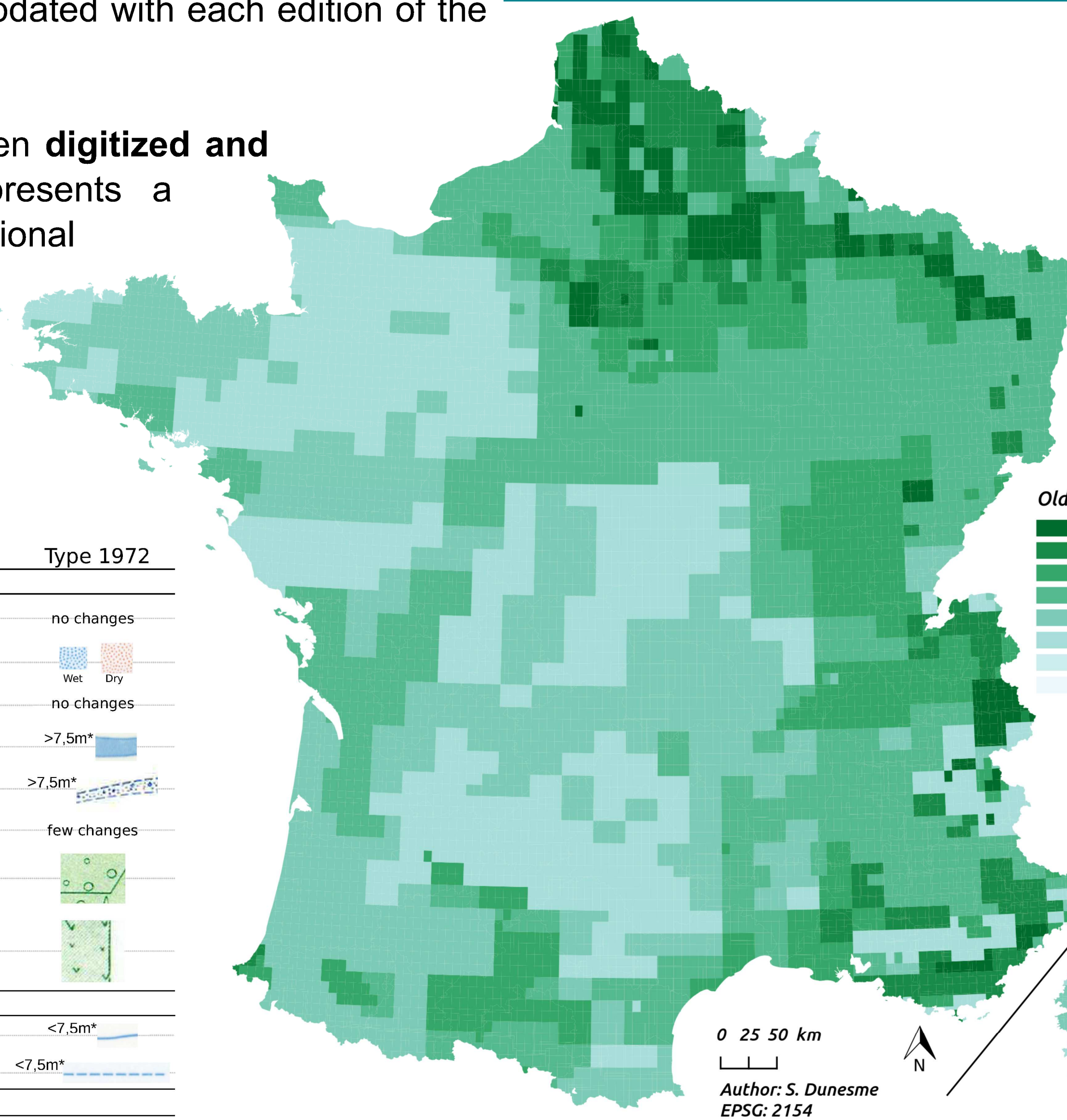


The large amount of maps to be processed (about 1900 maps in the Auvergne-Rhône-Alpes region) requires the automation of the vectorization process.

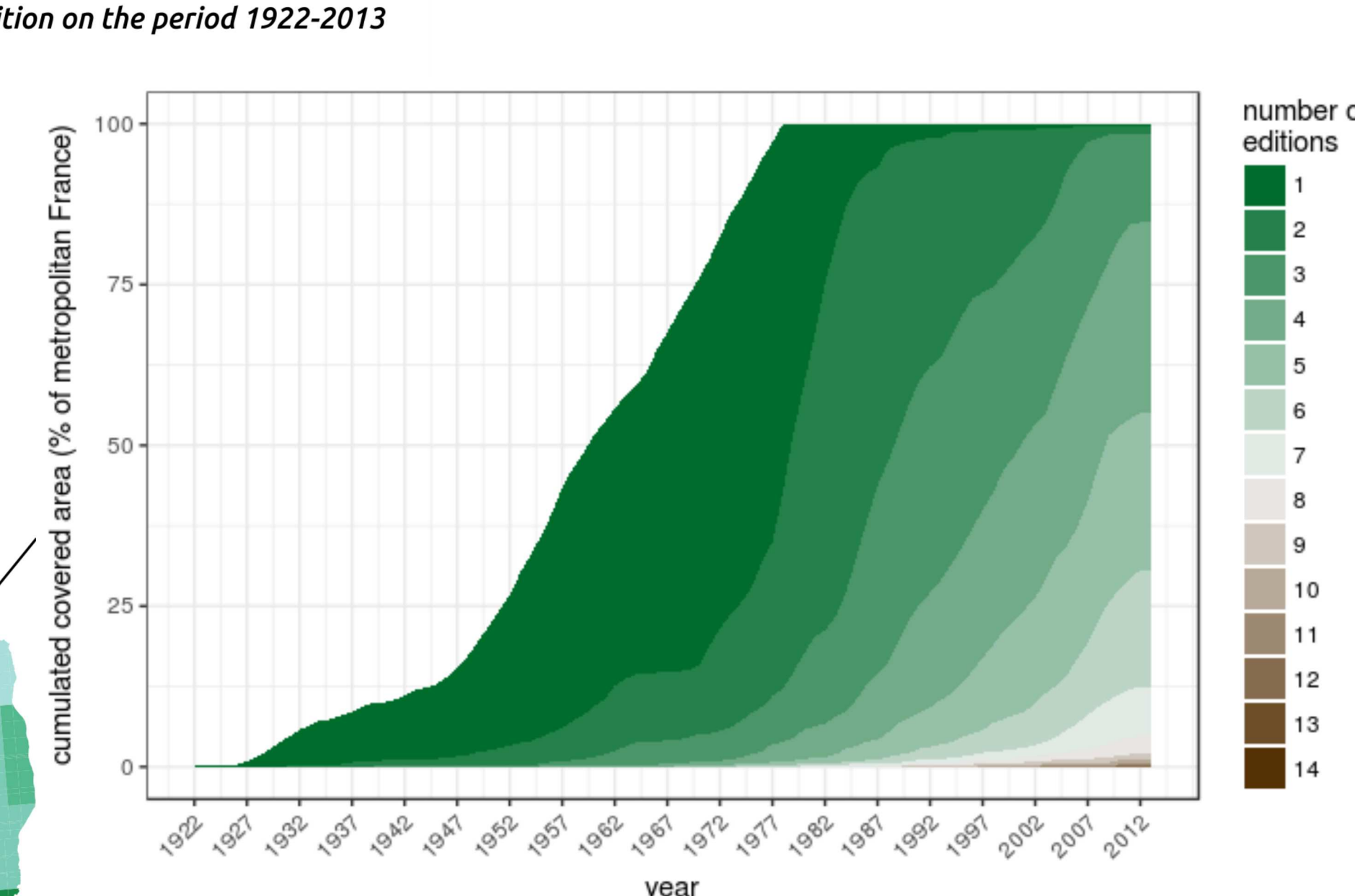
Cassini maps, Etat-Major maps and large scale local maps are not usable:

- 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)

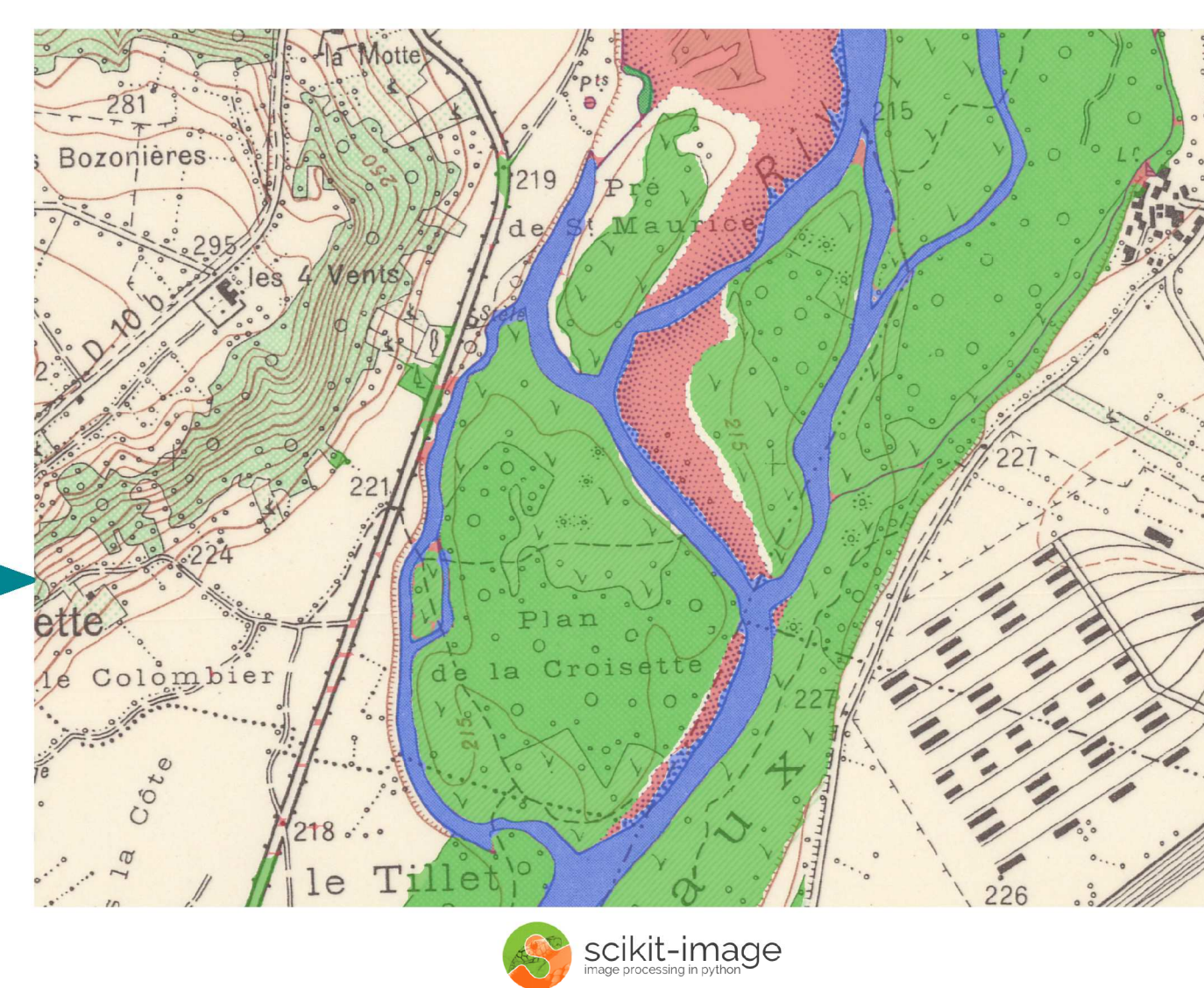
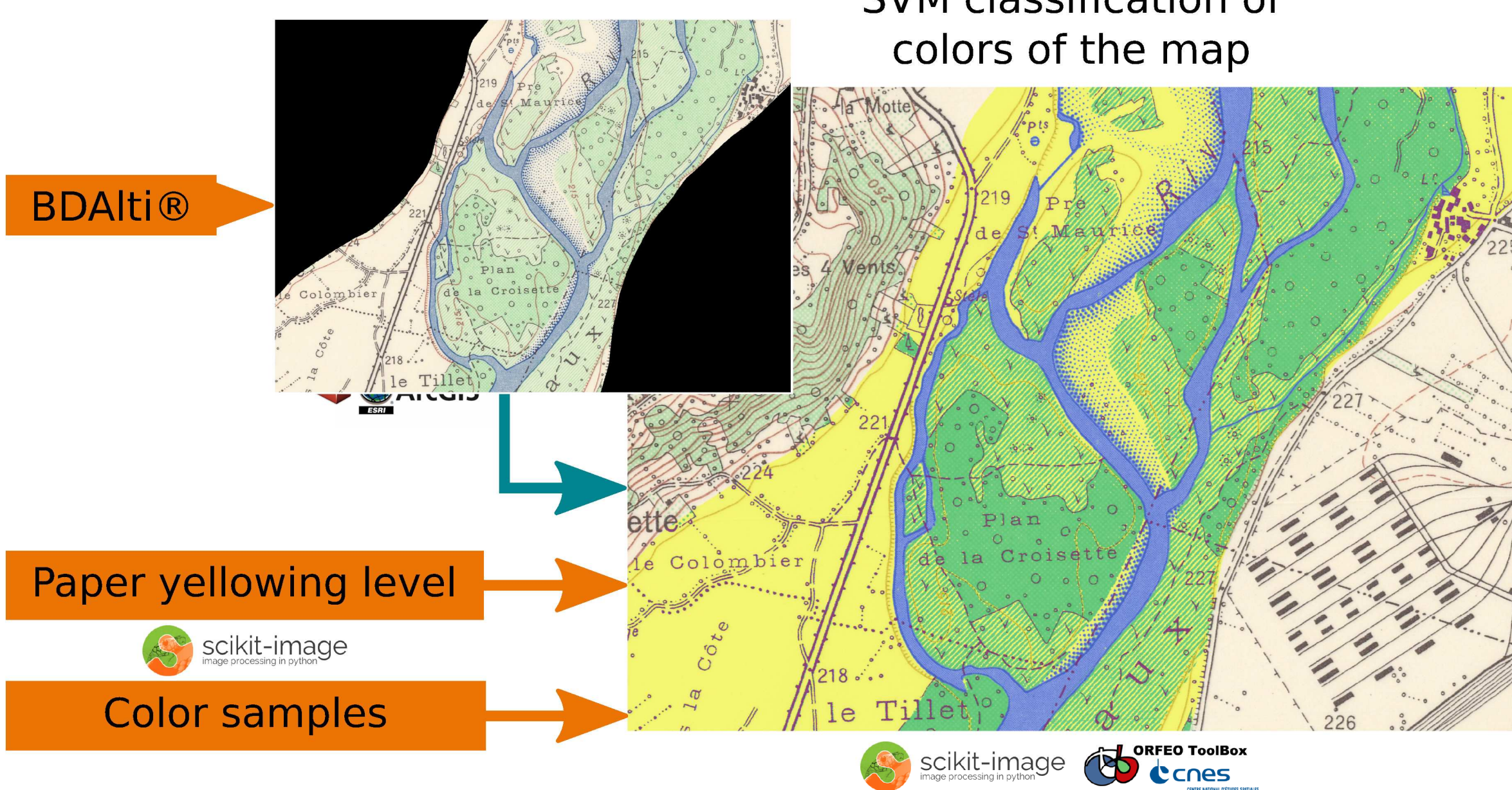
Fluvial Corridor Toolbox

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 eldering of map paper: we propose to evaluate this eldering 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).

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