Interreg
Alpine Space
EUROPEAN UNION
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Integrative Alpine wildlife and habitat management for the next generation

SACA Mapping methodology

SACA Mapping – Introduction to the methodology

The identification of Strategic Alpine Connectivity Areas (SACA) is a central aim of the ALPBIONET2030 project and of special importance for the Alps on their way of becoming a future model of ecological connectivity. The structuring of the Alpine and EUSALP territory in three classes of SACA will offer the possibility to better target actions for ecological connectivity in the area and increase the impact of these actions.

Three classes of Strategic Alpine Connectivity Areas will be identified in the Alpine and EUSALP areas:

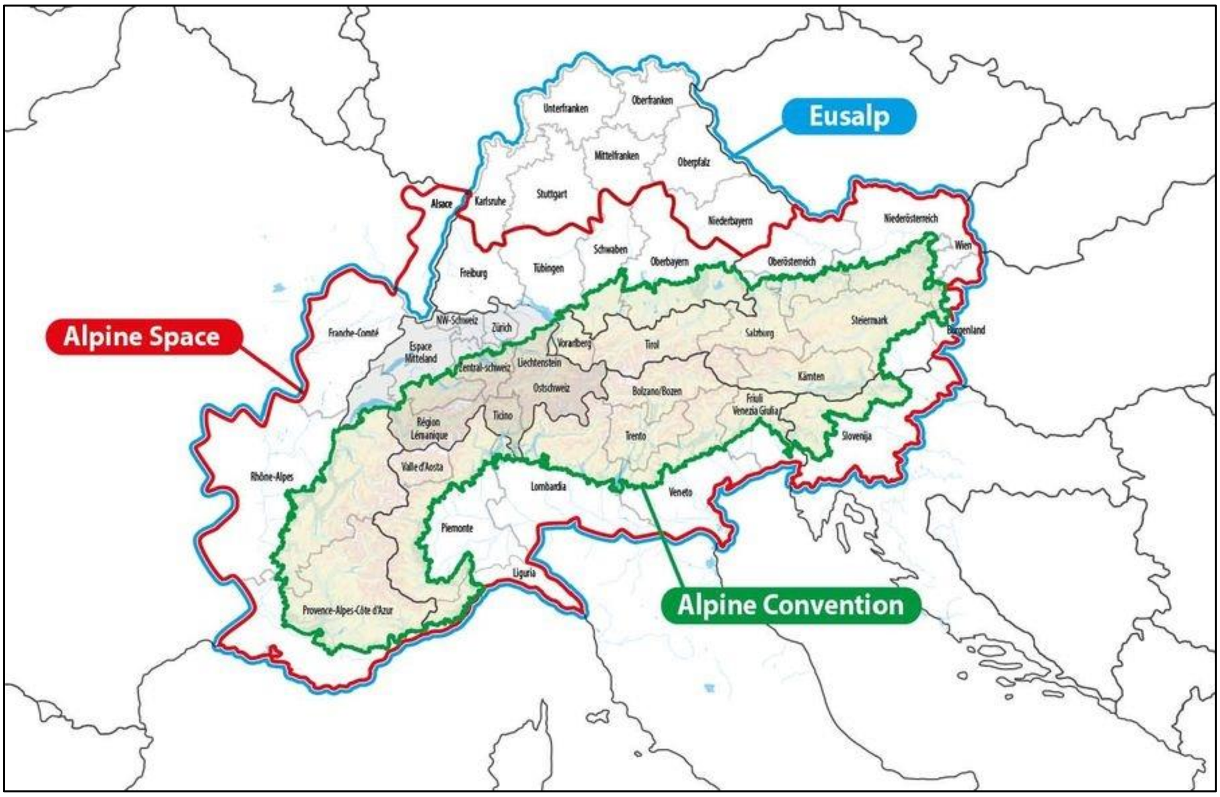

Fig 1: Map of the Alpine Convention area, the EUSALP area and the Interreg Alpine Space area.

SACA 1: Ecological Conservation Areas (ECA)

Areas that still have considerable space for connectivity with non-fragmented surfaces and where connectivity needs to be conserved. Such areas are characterized by a sparse infrastructure, dispersed settlements and large natural areas at mid-altitude. Actions: a well targeted large scale conservation policy is recommended (passive approach).

SACA 2: Ecological Intervention Areas (EIA)

Areas with high potential for connectivity in which larger, more or less natural non-fragmented zones could easily be created, especially by connecting protected areas, Natura 2000 sites or other precious biotopes. Actions: a spatial planning policy aiming at the creation of large scale non-fragmented areas is recommended (active approach) but also single action like to creation or restoration of wildlife passages.

SACA 3: Connectivity Restoration Areas (CRA)

Areas where fragmentation has already progressed so far that interlinked habitats and a transparent landscape matrix are no longer a realistic option using reasonable, viable interventions. Actions: ad hoc measures to improve ecological connectivity are recommended (punctuated approach).[1]

1) Methodological proposal for SACA definition and mapping

Preliminary remark

CSI

The SACA calculation and mapping approach is based on the Continuum Suitability Index (CSI). The Continuum Suitability Index is a combined analysis of structural landscape connectivity and landscape permeability. The landscape is considered as a matrix where each patch promotes more or less ecological connectivity. The CSI-Tool is, however, not thought as a planning tool. It rather gives a first insight into the initial situation.

A detailed description of the CSI is available here: http://jecami.eu/doc/Intro.pdf

[1] Further reading on this approach: Plassmann et al 2016

The CSI base used for the SACA mapping is composed by 5 indicators:

- Altitude and topography (TOP)
- Population (POP)
- Land use (LAN)
- Environmental protection (ENV)
- Fragmentation (FRA)

The resistance matrix is created using the following weighting of the indicators:

CSI = (2 x POP + 2 x LAN + 1 x ENV + 1 x TOP + 1 x FRA) / 7

General remarks

- Two types of different SACA categories cannot overlap
- The map of the SACA will be realized at Alpine scale. Further zooming in the area would require a more detailed analysis

SACA 1

The definition of the first SACA category "SACA 1" representing the areas of good status of ecological connectivity is directly derived from the CSI.

SACA 1 areas have a minimum size of 100 ha (in accordance with the ALPARC mapping of protected areas above 100 ha).

Step 1

Recalculation of the CSI using the methodology of the "nearest neighbor" ("Grass" Software application) in order to smooth the CSI values. This helps to eliminate tiny patches and smooths the borders of the polygons that entered the calculation). The value of each pixel is recalculated based on the average value of the neighboring pixels (located in a circle of 1 km of diameter around it).

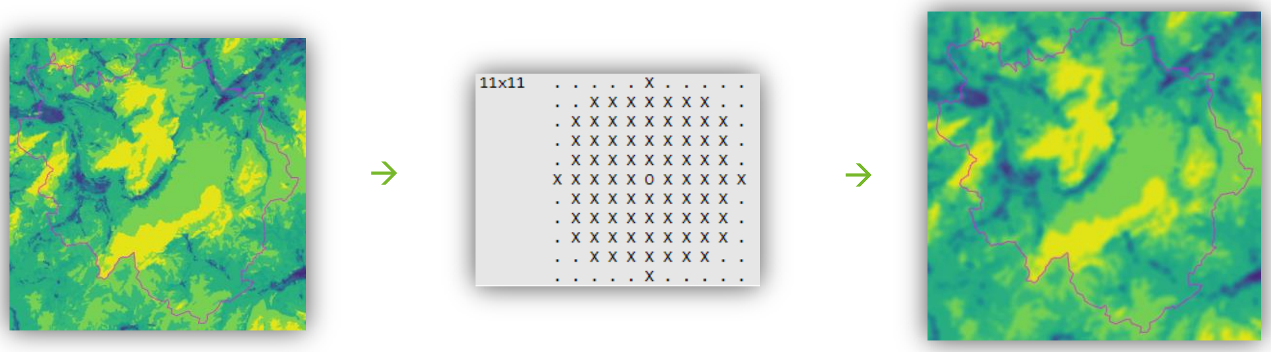

Fig. 2: CSI recalculation. The "r.neighbors" application makes each cell category value a function of the category values assigned to the cells around it, and stores new cell values in an output raster map layer). Calculation done using a circle of 21 pixels (1 pixel = 100 m; the circle has therefore a diameter of 1 km).

Step 2

Selection of all pixels with a value higher then CSI 80 in order to determine the areas corresponding to SACA 1 areas.

The value of CSI 80 has been defined considering JECAMI Version 1 where pixels with this CSI value were defined as "hotspots". The significance of this threshold is also confirmed by the distribution of the CSI values. It allows excluding a large number of pixels located just below the threshold (see below)

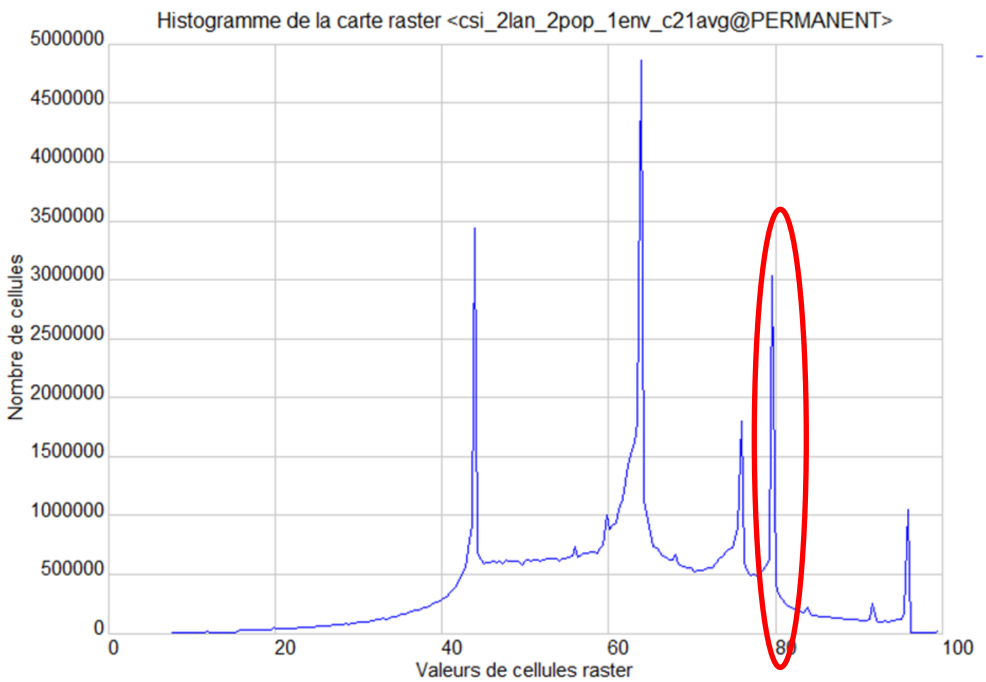

Fig 3: Distribution of the CSI values. All pixels with a value greater than CSI 80 are selected.

Step 3:

Only polygons with an area above 100 ha are considered as SACA 1 areas.

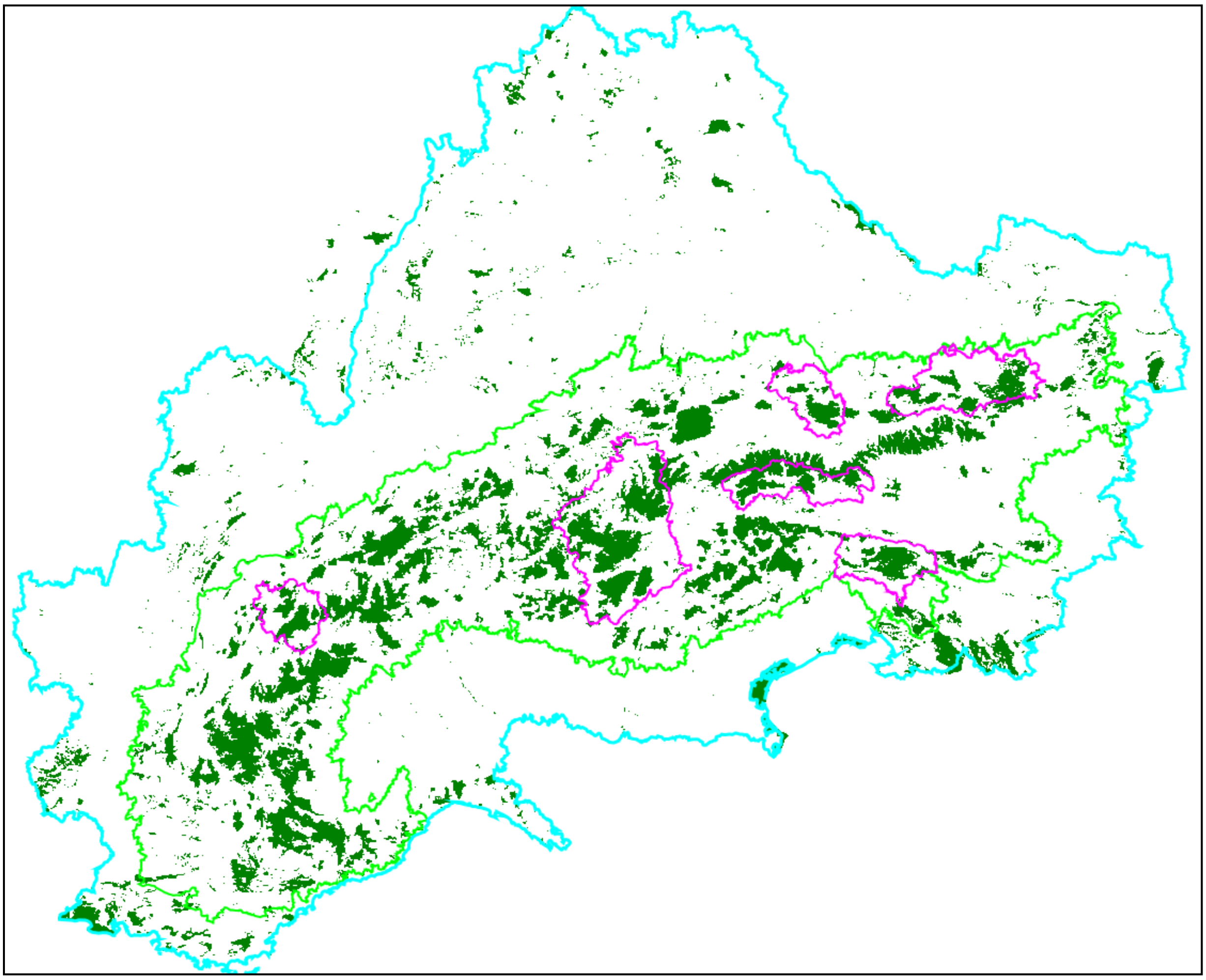

Fig 4: First results of SACA 1 mapping: alpine and EUSALP area and Project Working Regions (PWR)

General remarks

- On EUSALP scale: 95% SACA1 overlap with existing protected areas. This represents only 13% of the total surface of the protected areas in this area.
- On Alpine Convention scale: 80% SACA1 overlap with existing protected areas. This represents 70% of the total surface of the protected areas in this area.

SACA 2

SACA 2 areas are defined as essential elements to link SACA 1 with each other.

SACA 2 will be defined based on CSI used as a resistance matrix and SACA 1 mapped in a first step.

Theoretically, species move across space in a random way. But, there is a higher probability to move through areas that are easier to cross. I.e. they will tend to move across landscape patches with higher permeability (or less resistance), just as electric power would do in a power circuit: “resistance to movement in a landscape is analog to resistance in an electric power circuit” (McRae et al. 2008).

For the definition of SACA 2 the electric circuit method will be used by simulating dissemination of electric power emanating from SACA 1 polygons and disseminating through the resistance matrix between these polygons as animal species would do.

Step 1

The software to calculate the electric circuits used is “Circuitscape” (Circuitscape borrows algorithms from electronic circuit theory to predict connectivity in heterogeneous landscapes).

The result of this procedure is a gradient representing the SACA areas. The areas where connectivity is higher are the areas with higher power intensity.

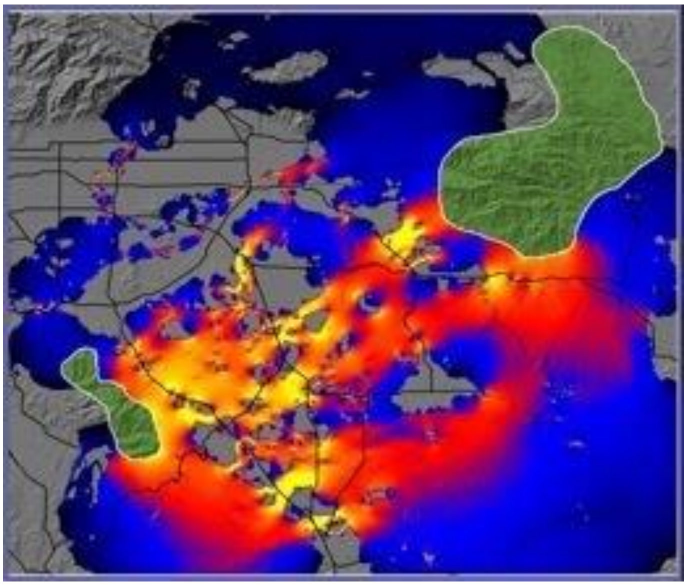

Fig. 5: Red and yellow zones correspond to SACA 2 areas between two SACA 1 patches (green).

Note: when using the CSI as basis for the resistance matrix the values of resistance are too high and prevent the electric power to spread from the SACA 1 polygons. In order to avoid this problem we transform the data: based on an exponential function, a new value between 0 and 1000 is given to each pixel.

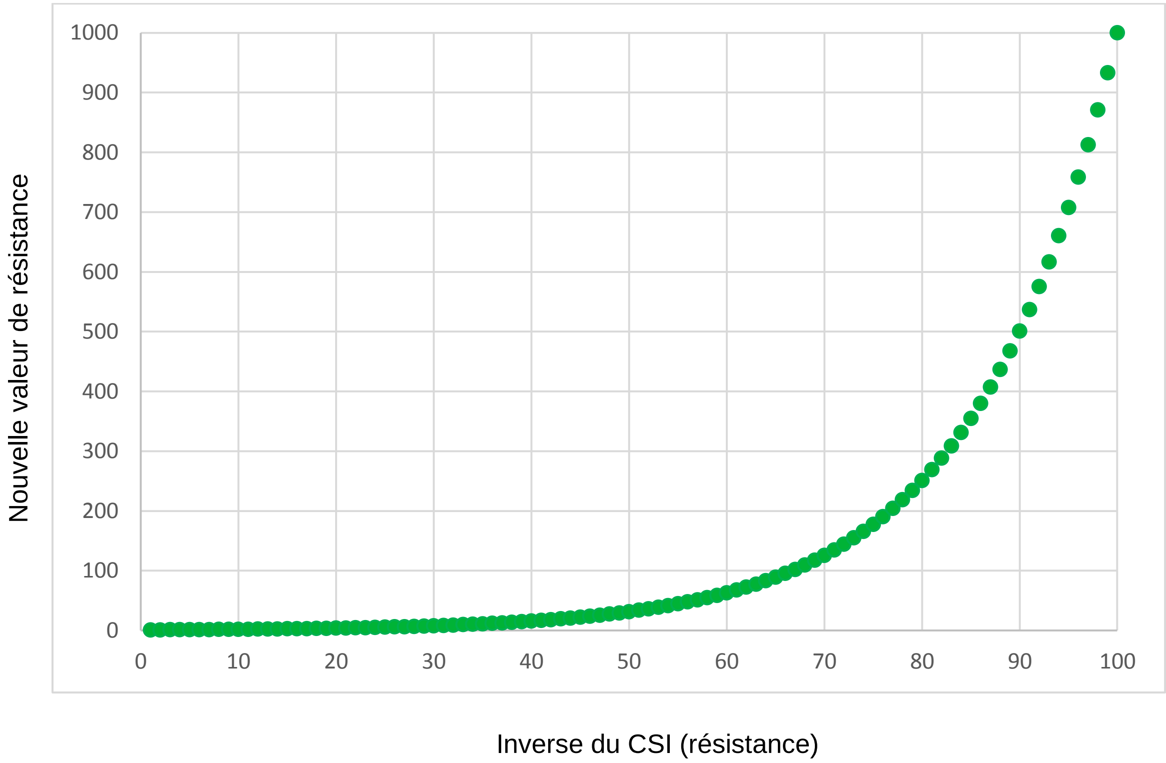

Fig. 6: inverse CSI value calculation

The exponential data transformation offers the possibility to reduce the importance of resistance of the sectors with CSI values below 50 and increases this importance for sectors with CSI values above 50 considered as "poor" in Jecami V1.

General remarks

For the moment it was not possible to apply this procedure using the 100m pixel size. The calculations realized so far are based on a CSI with a pixel size of 500m.

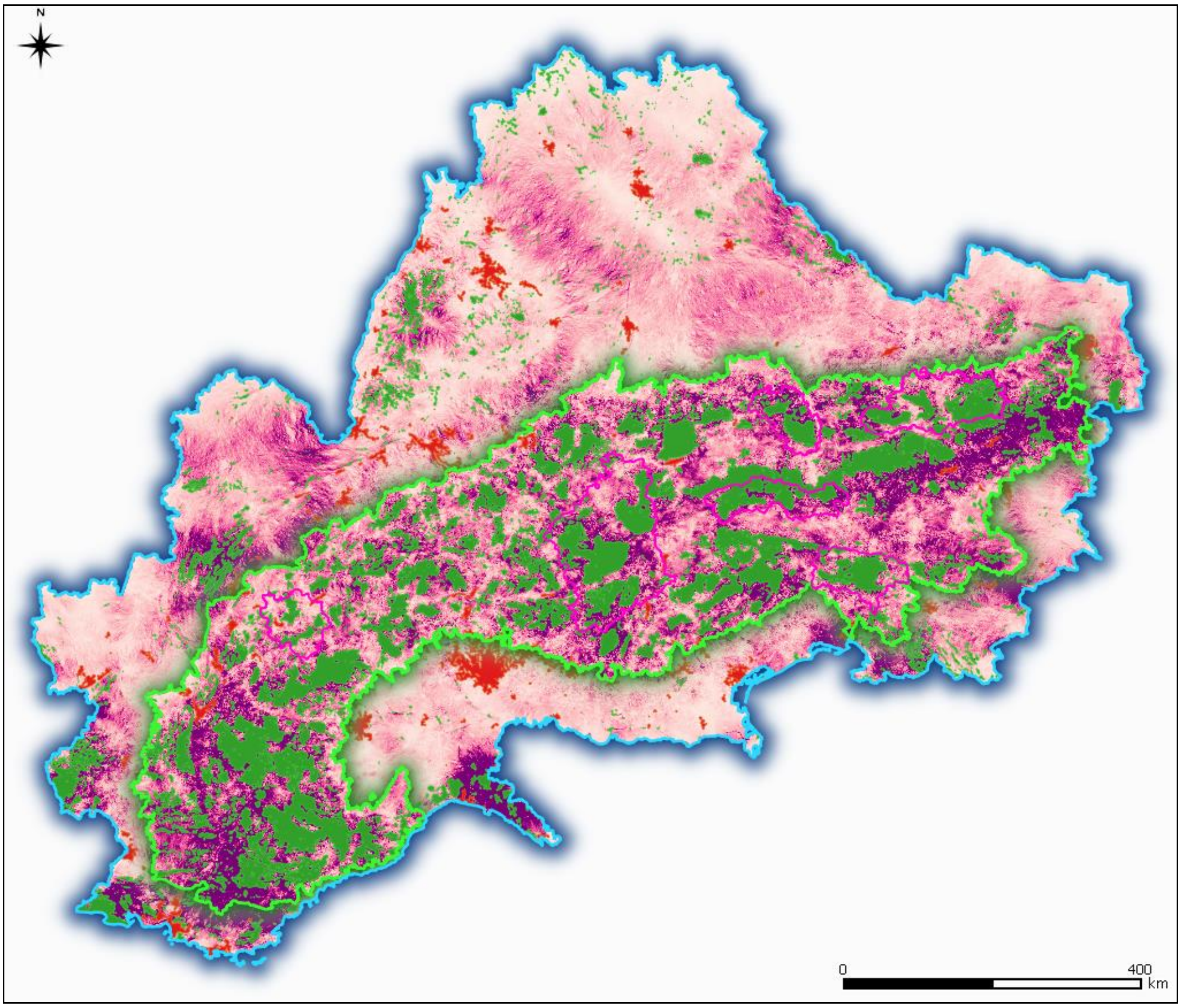

Fig. 7: Map with final results.

SACA3

The procedure to identify SACA 3 areas is similar to the SACA 1 identification procedure.

Step 1

We start with the selection of areas with CSI values below 50, the value used in Jecami V1 to define “poor” areas. Like for the SACA 1, it is confirmed by the data distribution (see below).

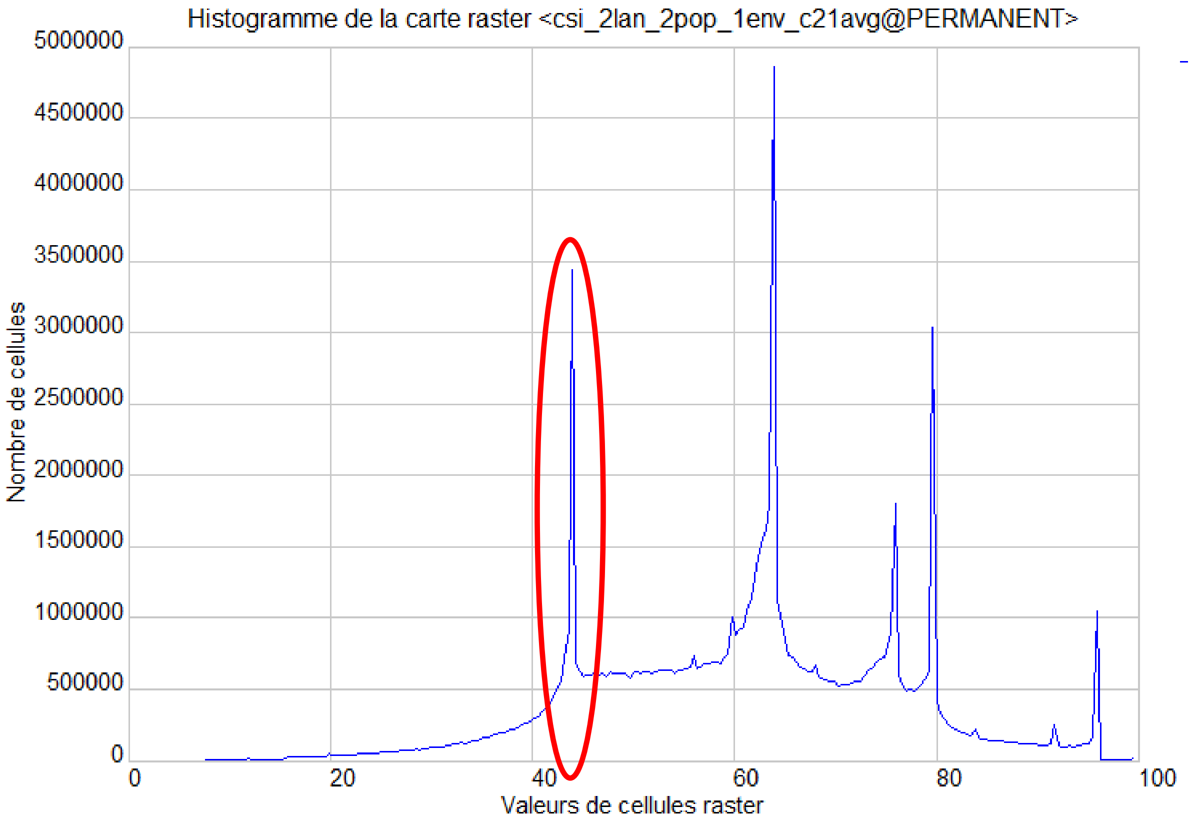

Fig. 8: Distribution of CSI values and threshold selection for SACA 3 definition

References

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