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SWOS
Satellite-based Wetland Observation Service

Towards a flood regulation indicator as a main regulating service provided by wetland ecosystems

EcoSummit 2016

Session: Monitoring Biodiversity to Provide Solutions: The Use of Spatial Information at Different Scales

Montpellier, France, 29 August – 1 September 2016

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Introduction

Floods are extremely hazardous in areas where people settled too close to water bodies or constructed their properties in previous flood plains. Additional problems arise when people actively modify water bodies, watersheds or flood plains.

Flood protection is one of the most important regulating ecosystem services that may increase or reduce the negative effects of water-related disasters.

Guadalhorce river mouth, *Málaga, Spain*

Year 1989

Year 2015

Introduction

Major wetland characteristics that affect floods

(Acreman and Holden, 2013)

- **Landscape location (Upstream or Downstream)**
- **Water supply mechanism**
  - precipitation-fed, river-fed, groundwater-fed
- **Percentage of wetland area respect to the river basins** (wetland extent)
- **Wetland feeding** (rain, groundwater, surface water or mixed).
- **Upstream**
  - **Topography of the landscape**
    - Flowing water from other location / to other location
    - Water storage
    - Connection to river network (timely, permanent direct connection, no connection; pay attention to ground- connection)
  - **Soil characteristic** / moisture (antecedent of water saturation on soil=soil water storage)
  - **Type of wetlands** (i.e. wetlands are close to saturation for most of the year, such as blanket bogs rarely act to attenuate flow and are much more likely to contribute to storm runoff due to their propensity for rapid saturation)
  - **Vegetation cover** (can affect the velocity of water flowing across wetlands and hence flood generation)
  - **Precipitation intensity and duration**
- **Downstream (floodplain)**
  - **Topography of the floodplain**
    - Area, Location of wetland respect to the chanel (in line, laterally), Conection with river chanel, Average depth
  - **Vegetation of wetland** (Wooded wetlands in particular increase flood storage, reduced flood peaks and increase peak travel time = manning rougness)
  - **Soil characteristic** (texture/porosity) / moisture (antecedent of water saturation on soil=soil water storage)
  - **Lithology bed** (sand)
  - **Presence of banks**
  - **Presence of constructing embankments** (increasing the flood risk dowstream due to loss of storage and attenuation)

Conceptual approach of the SWOS flood regulation indicator

An indicator on flood regulation as an ecosystem service should take into account three key variables:

- **Ecosystem or land use capacity to provide the service.**
- **Service demand of the ecosystem or land use.**

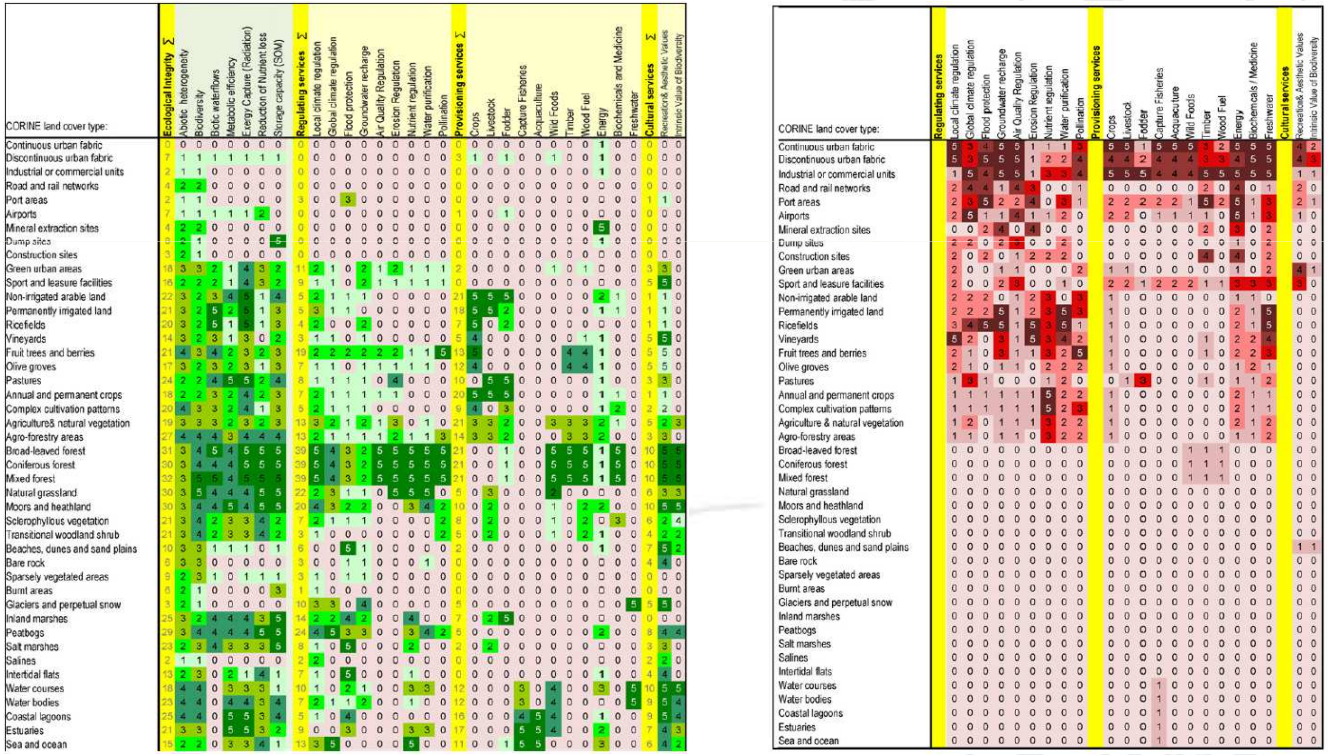
  In the case of flooding, they are mainly those areas where human activities are concentrated: agro-ecosystems, urban areas, roads, etc.

- **Conditions of the environment affecting the generation and distribution of floods and the regulation service.**

  Precipitation, slopes, land management, soil texture, vegetation density, etc. In summary, anything that could contribute to flood generation and affect or change the way an ecosystem offers its regulation service.

Conceptual approach of the SWOS flood regulation indicator

A very simple way to map ecosystem services based on land coverage would be assigning scores to each type of Land Use/Land Cover (LULC).



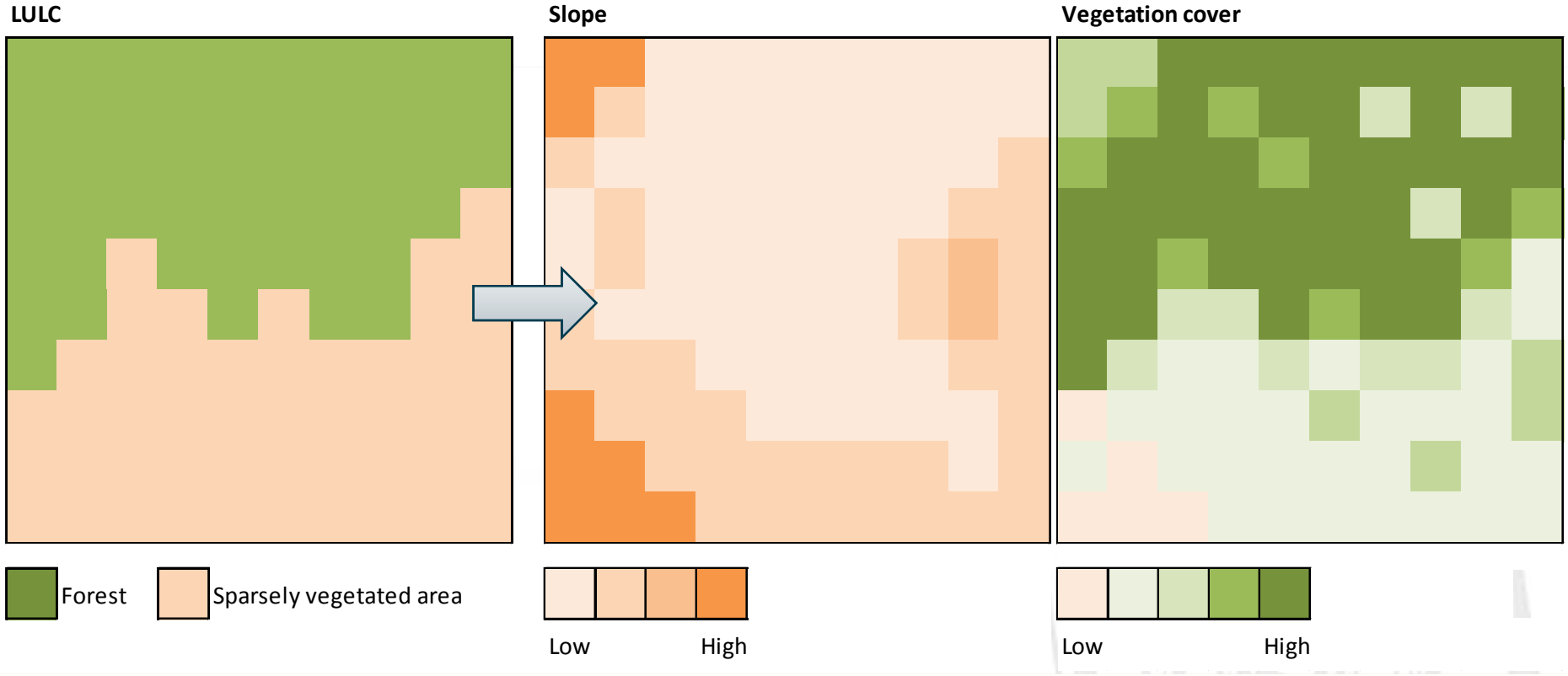
Ecosystem Service supply and demand for CLC classes

(Burkhard et al., 2012)

Conceptual approach of the SWOS flood regulation indicator

In the case of flood regulation, a forest would have a high score while a sparsely vegetated area would have a very low score.

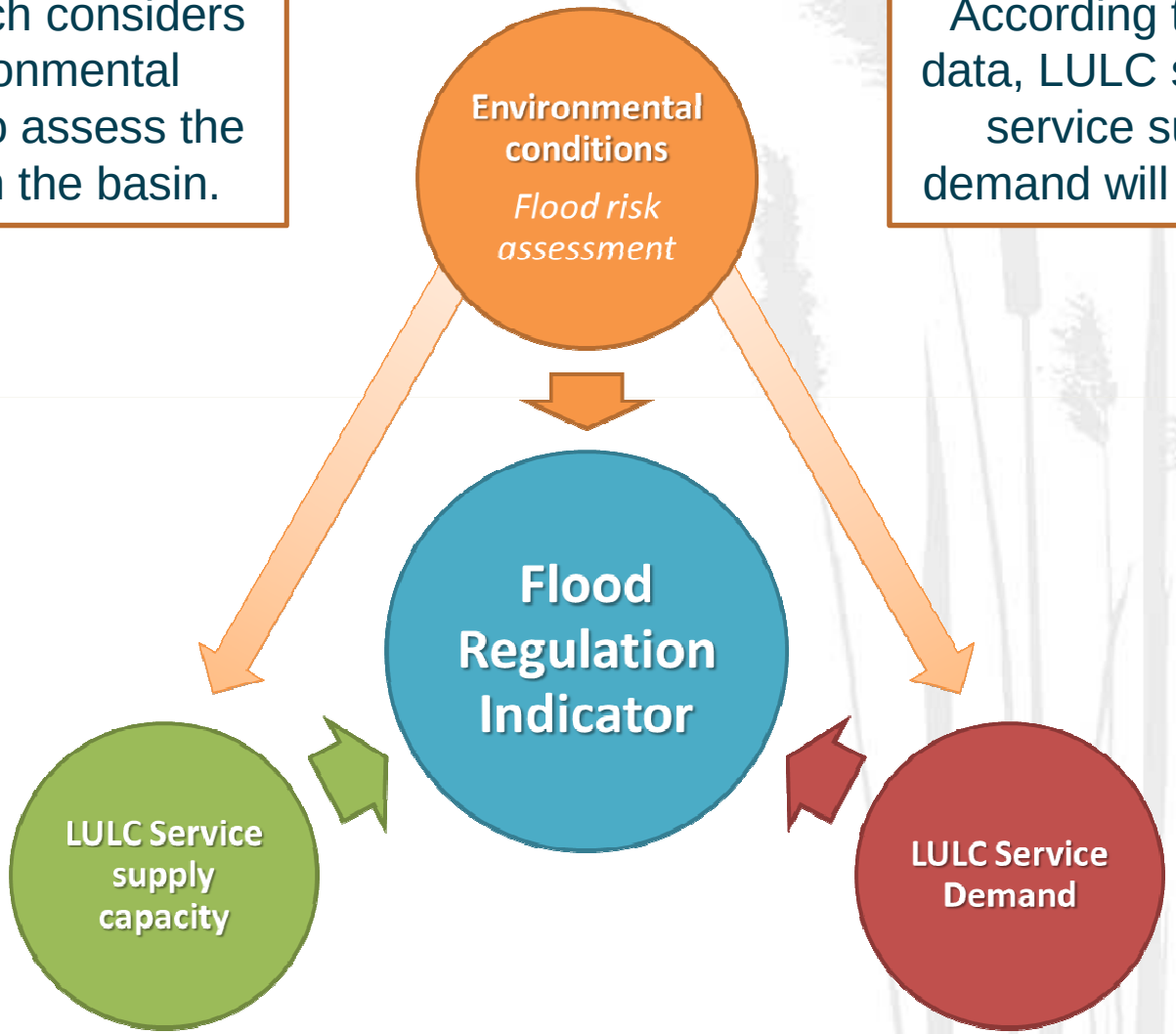
However, one cannot assume that these scores have a uniform distribution on the territory as the properties which regulate water can change within the same type of LULC.



Conceptual approach of the SWOS flood regulation indicator

The approach considers the environmental conditions to assess the flood risk in the basin.

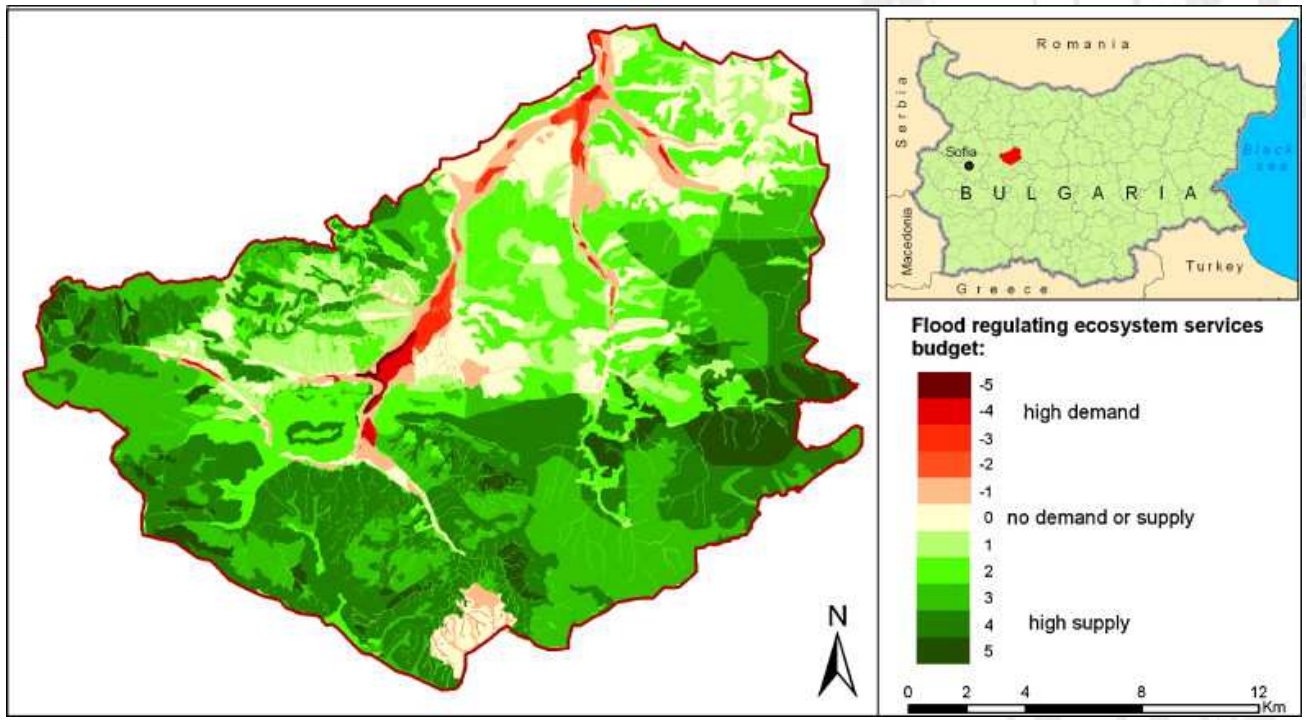
According to this flood data, LULC scores of the service supply and demand will be modified.



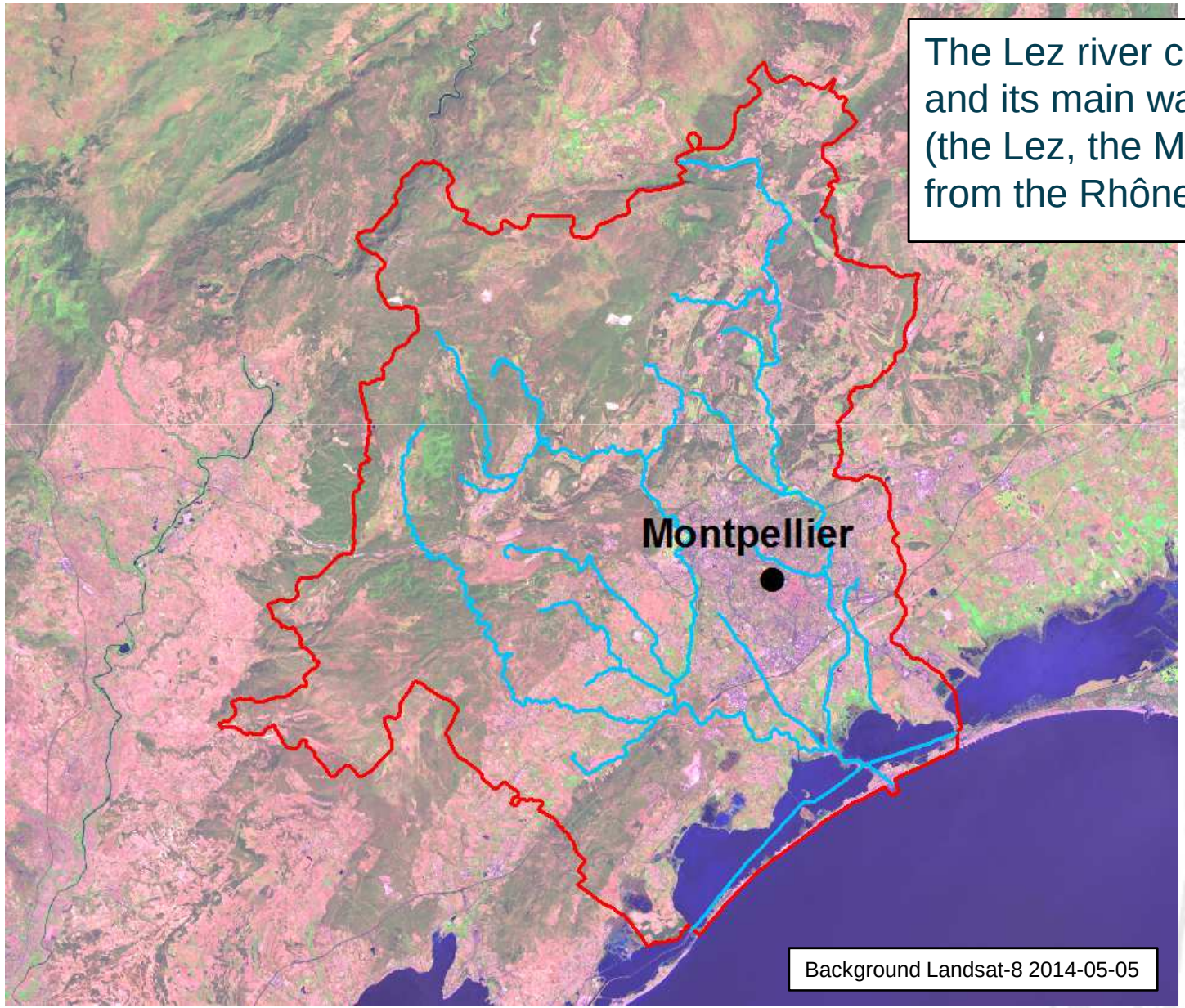
Conceptual approach of the SWOS flood regulation indicator

The final output of the SWOS flood regulation indicator would look quite similar to the maps generated by Nedkov and Burkhard, 2012.

- *Improve the level of detail using high-resolution data and satellite images*
- *Integration of new classes to the used nomenclature (combine CLC and MAES with the Ramsar classification system.*

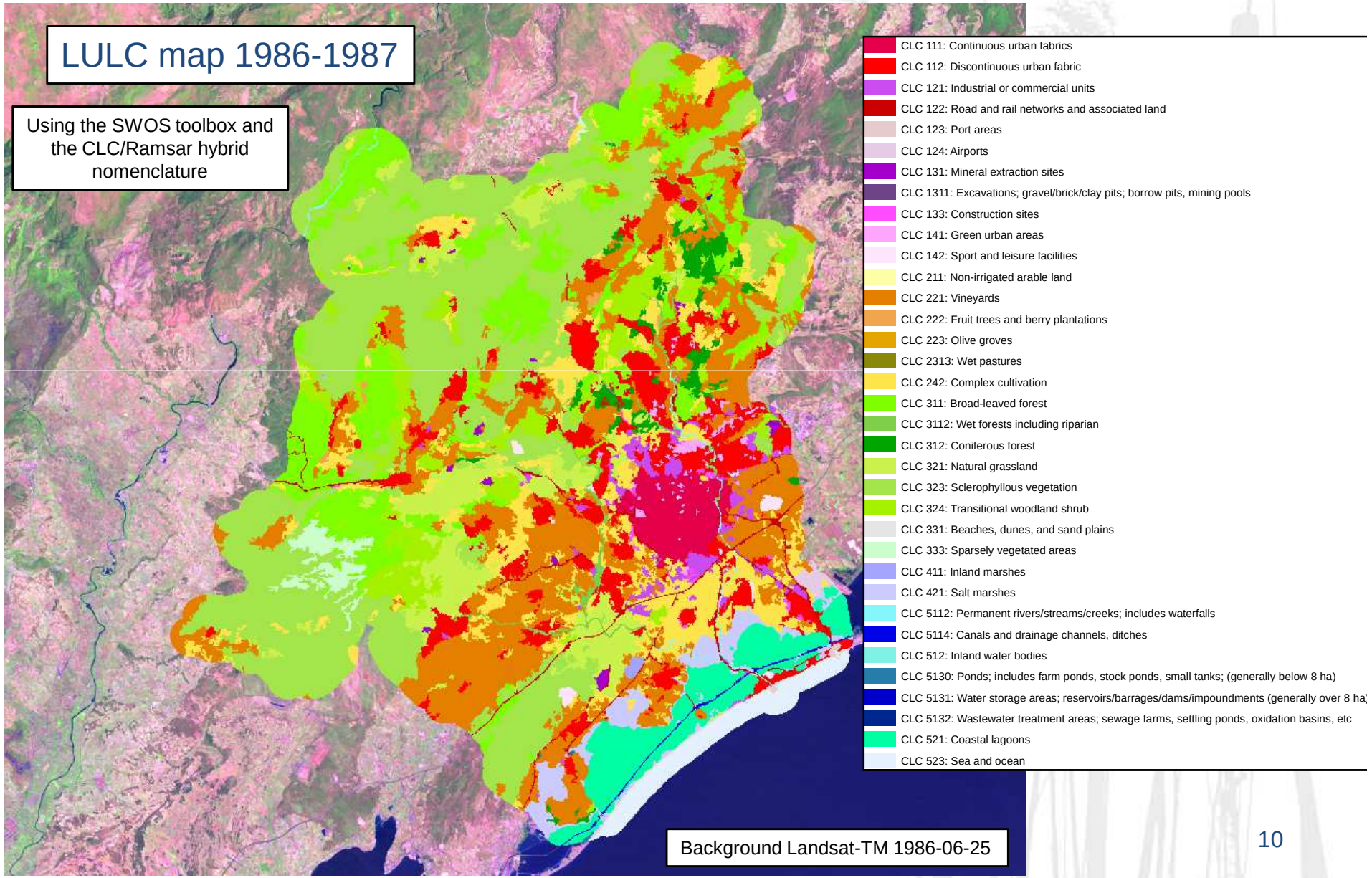


Example of the Lez river basin (SWOS test site)



The Lez river catchment (in red) and its main water courses in blue (the Lez, the Mosson and the canal from the Rhône to Sète)

Example of the Lez river basin (SWOS test site)



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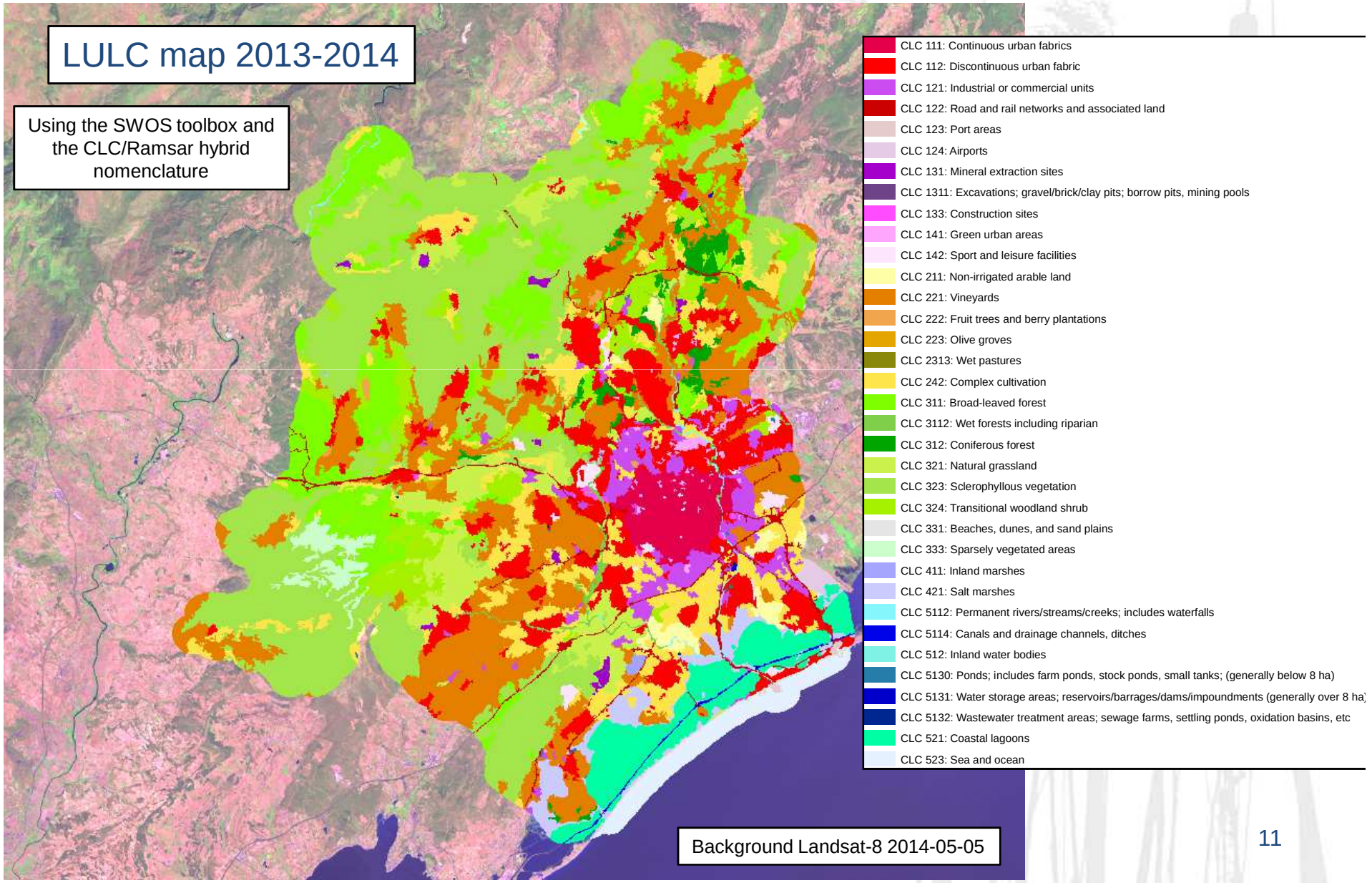
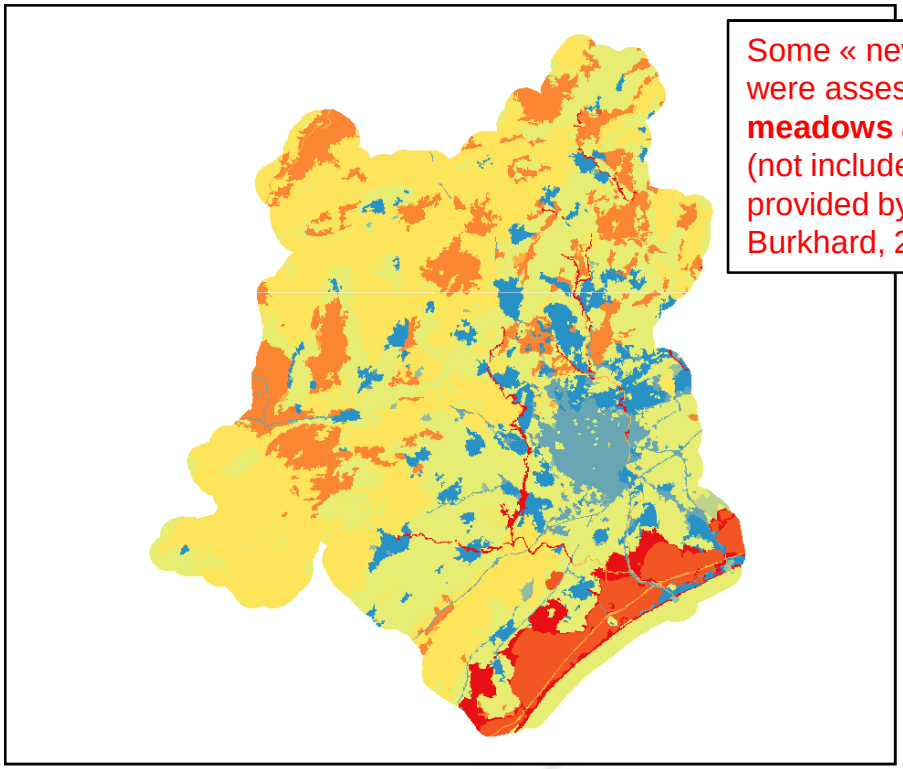


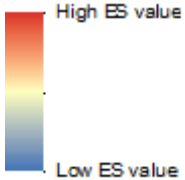
Example of the Lez river basin (SWOS test site)

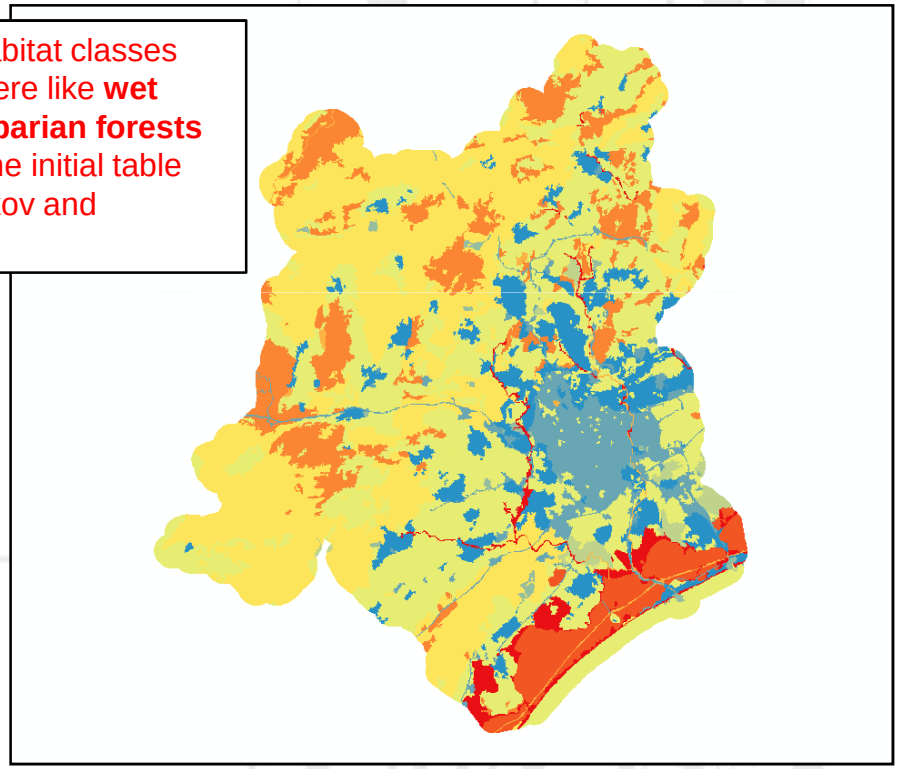
Calculation of the ES indicator “Flood regulation” based only on LULC classes scoring (budget of demand and supply services)

Some « new » habitat classes were assessed here like **wet meadows** and **riparian forests** (not included in the initial table provided by Nedkov and Burkhard, 2012)



Flood regulation service based on LULC (period 1986-1987)



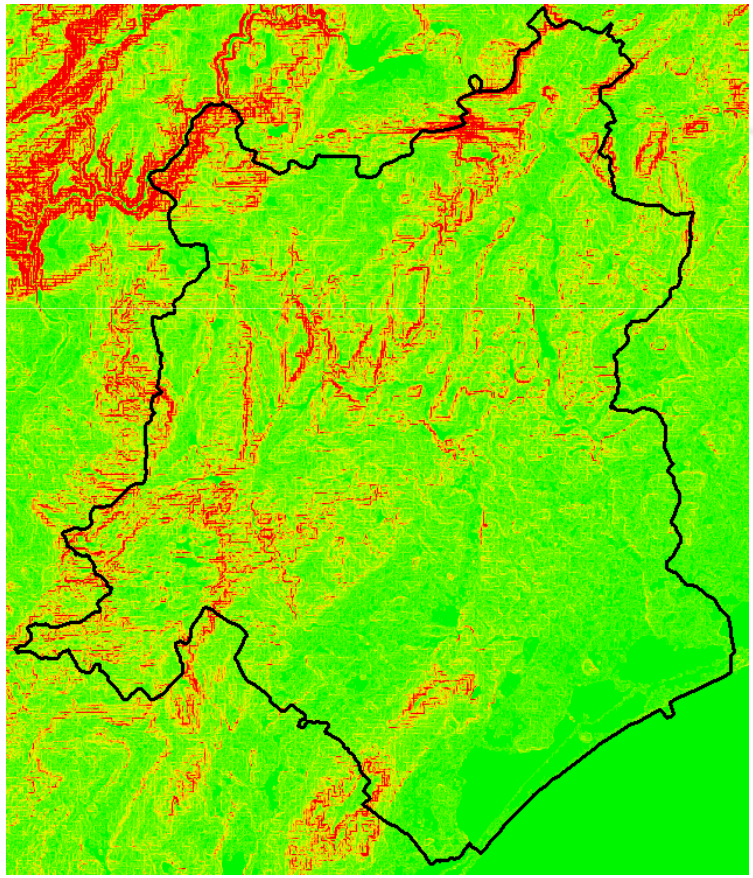


Flood regulation service based on LULC (period 2013-2014)

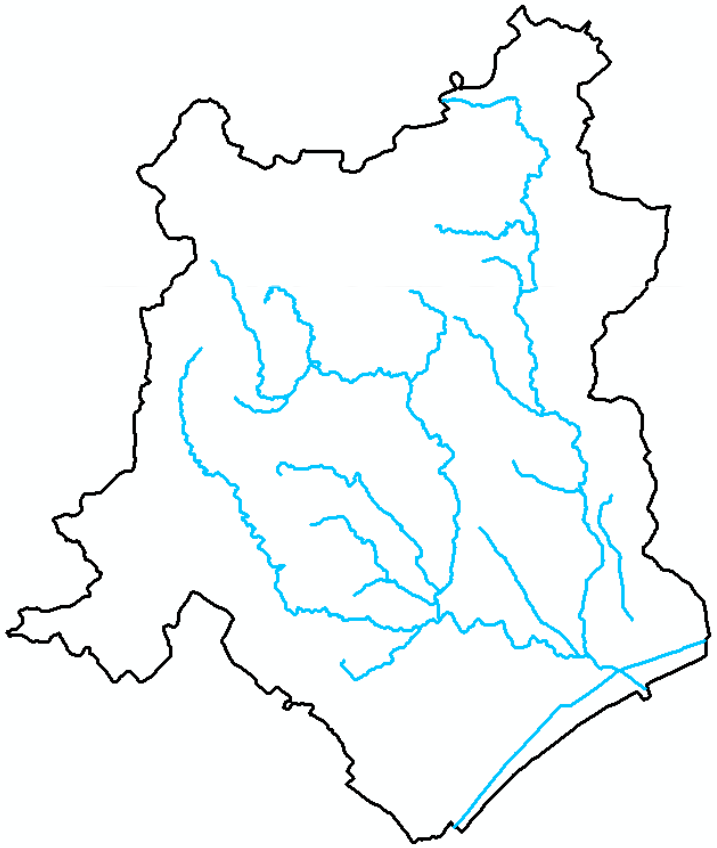
Example of the Lez river basin (SWOS test site)

Integration of environmental condition parameters (runoff flood-related risks) :

- Slope
- Distance to main water courses



Slope raster derived from the SRTM 1arc-second Global DEM



The main water courses in the catchment area (runoff conditions)

Example of the Lez river basin (SWOS test site)

Integration of environmental condition parameters (runoff flood-related risks) :

- Slope
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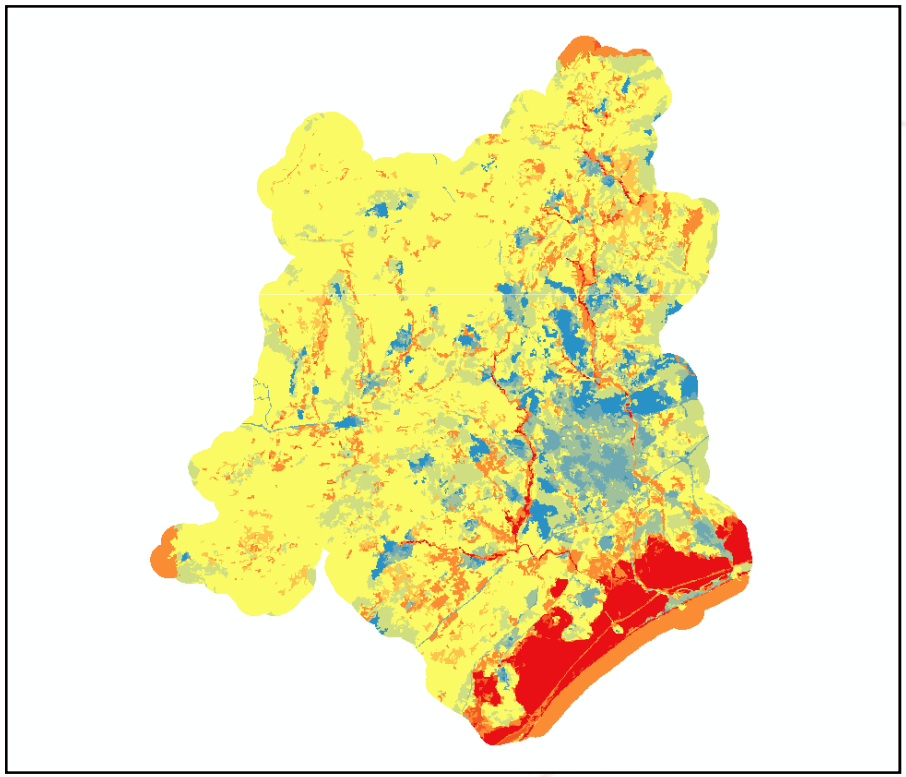
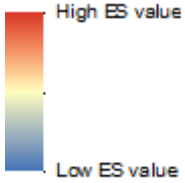
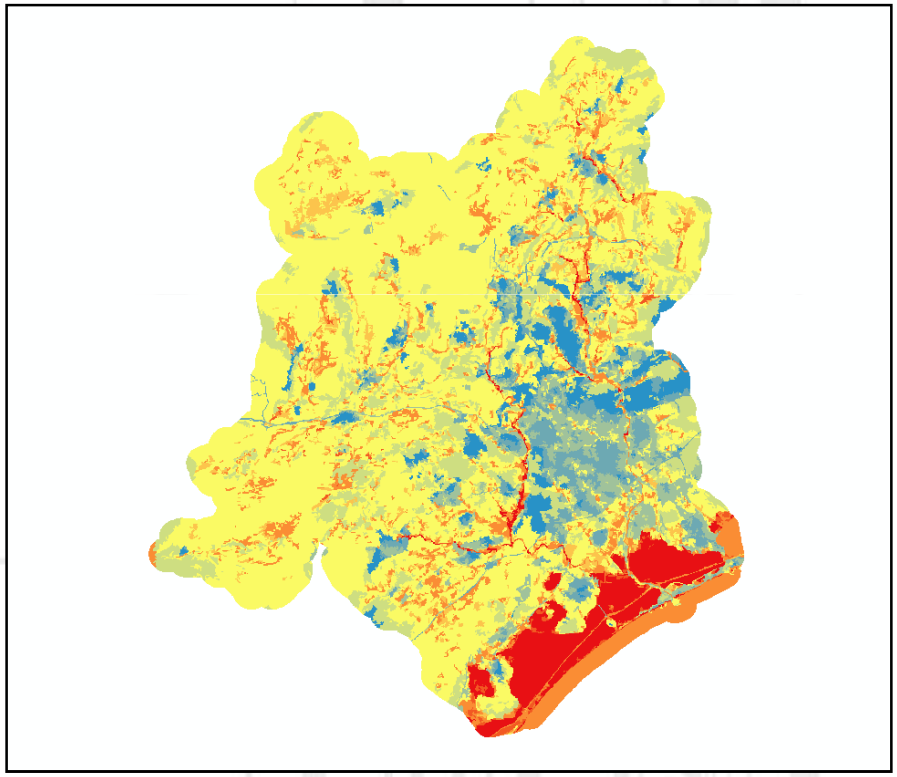


Flood regulation service based on LULC, topography and runoff generation parameters (period 1986-1987)



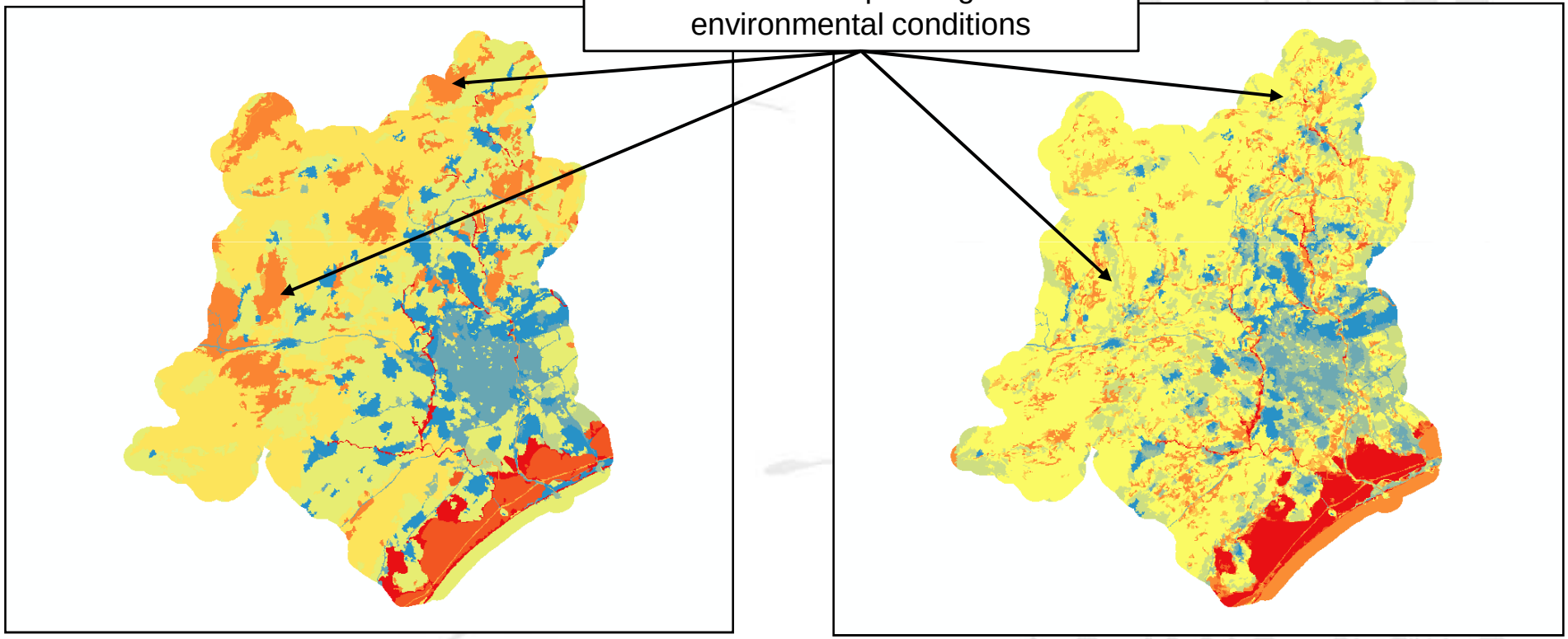


Flood regulation service based on LULC, topography and runoff generation parameters (period 2013-2014)

Example of the Lez river basin (SWOS test site)

If we compare between the tow approaches for the same time period…

A better definition of the ES indicator with different values for the same LULC class depending on its environmental conditions



Flood regulation service based on LULC (period 2013-2014)

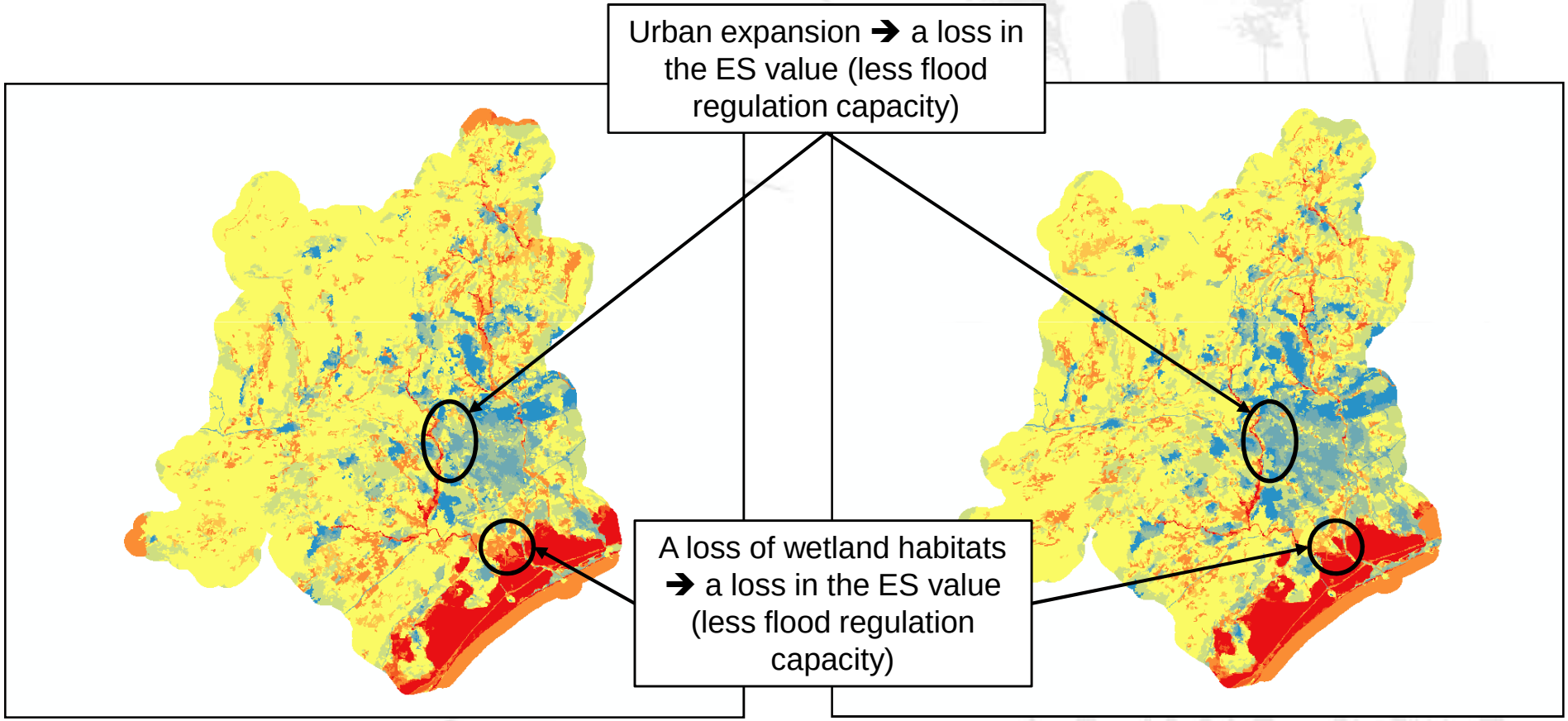
High ES value

Low ES value

Flood regulation service based on LULC, topography and runoff generation parameters (period 2013-2014)

Example of the Lez river basin (SWOS test site)

If we compare between the tow time periods…



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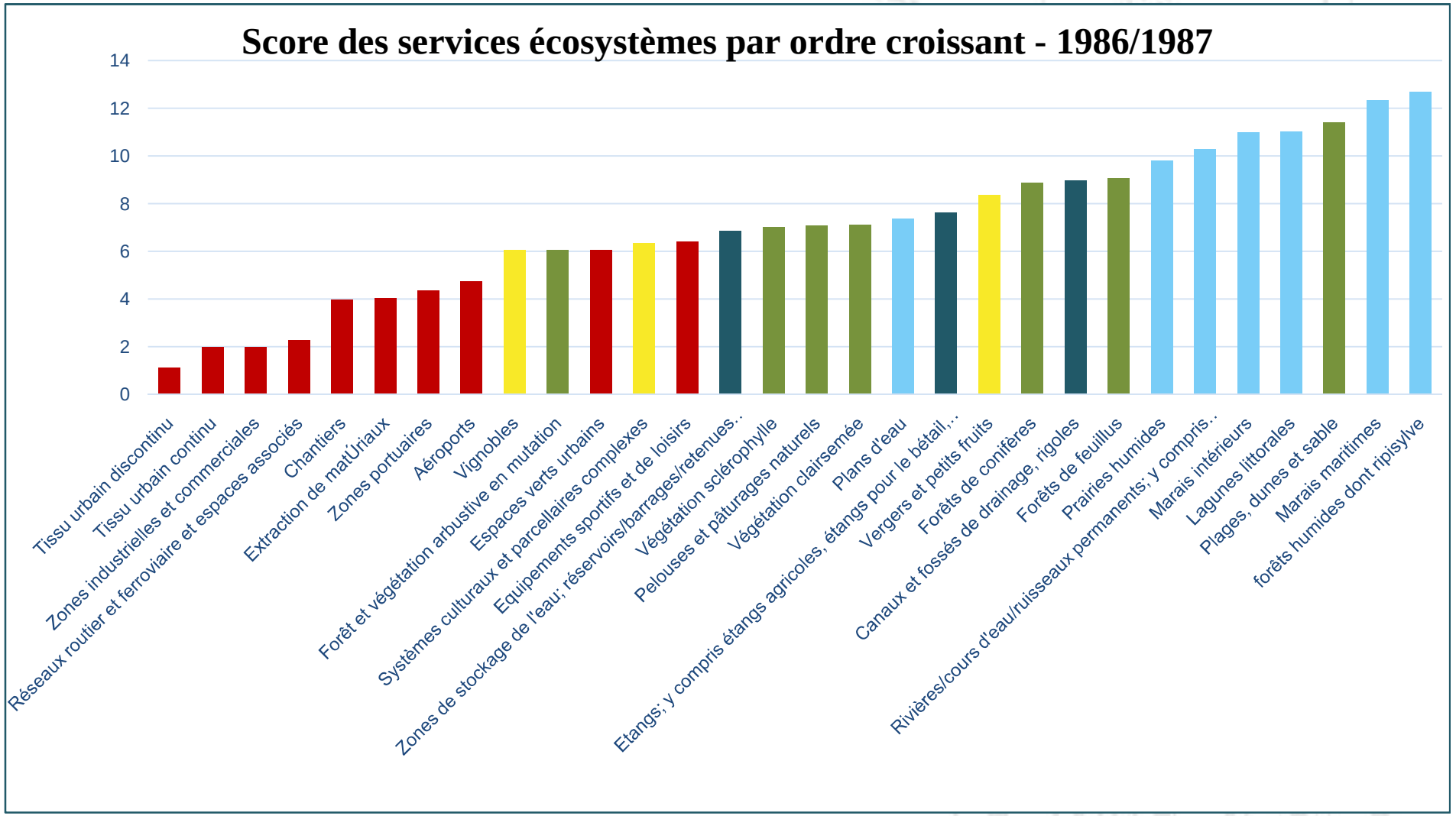

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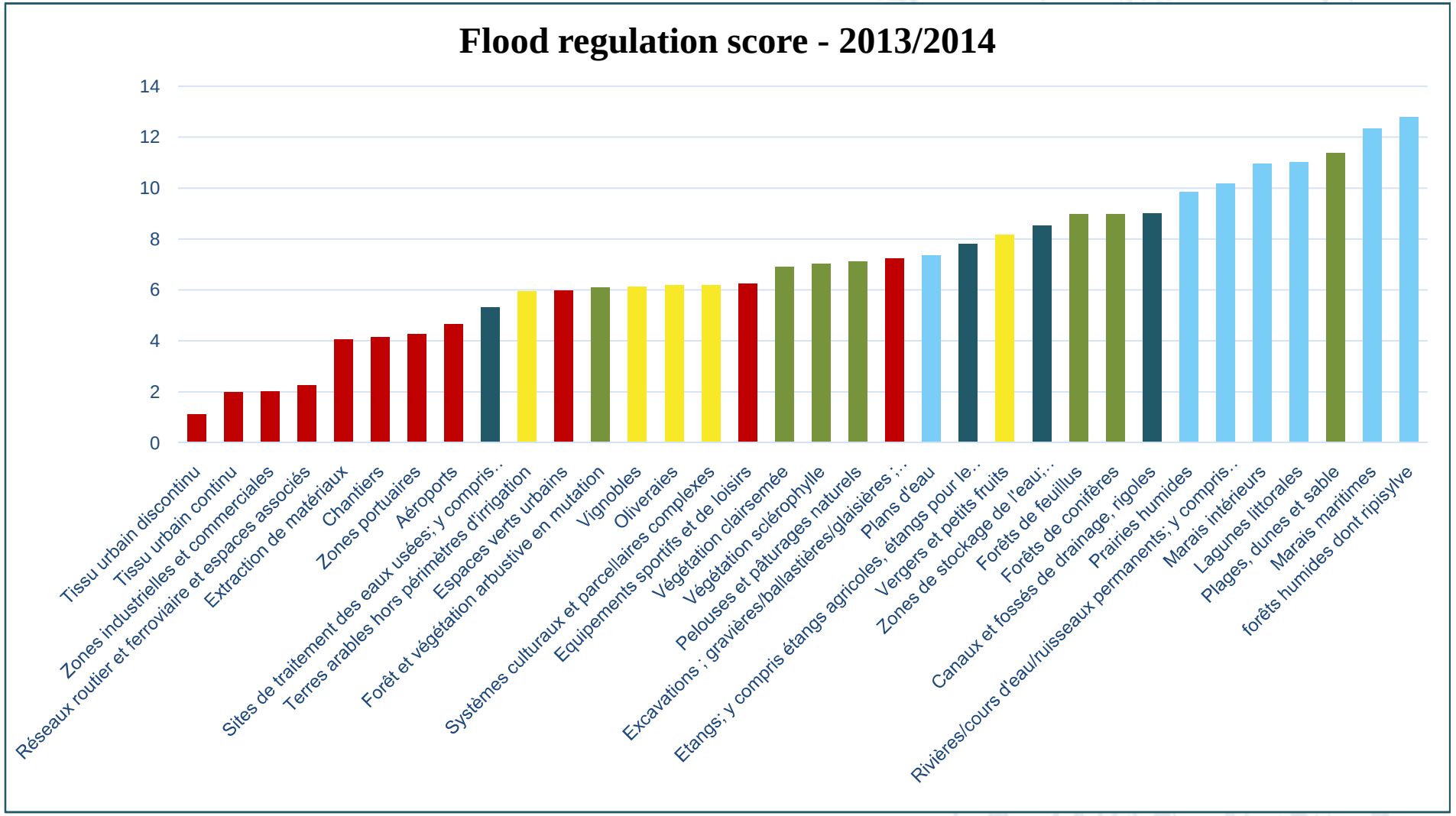

Cocnclusion

- The appraoch is easy to transfert and implement
- Use of free open data
- Need image processing and basic skills in RS
- Validated results

- Using this method we can develop and feed some ES indicators of the Mediterranean Wetlands Observatory

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 642088

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Thank you

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