



SWOS
 Satellite-based Wetland
 Observation Service



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

Projet SWOS

Cartographie de l'occupation du sol et du SE de protection contre les crues

Rencontre Gestionnaires ZH Med (France)

Tour du Valat, 22/03/2018

Anis GUELMAMI (Tour du Valat)



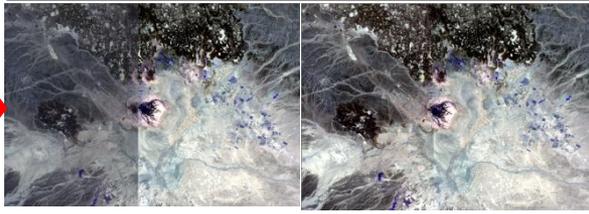
Land Use/Land Cover (LULC)

LULC and habitats dynamics

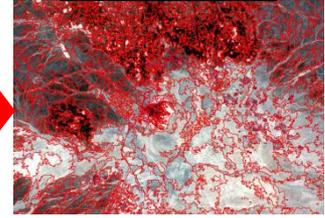
Satellite input images



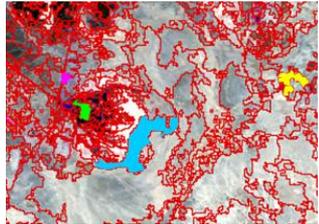
Radiometric and geometric pre-processing



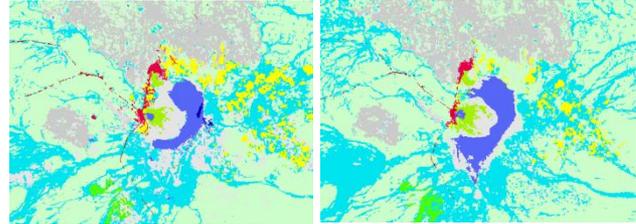
Segmentation



Training for classification



LULC classification result of 2 different years



WCR classification



T1 (ex. 1987)

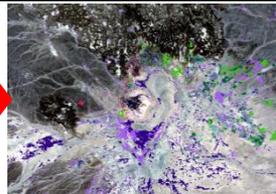
T2 (ex. 2000)

T3 (ex. 2017)

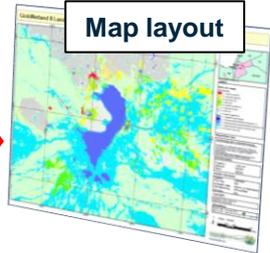
Change / no-change masking



Post classification change



Map layout

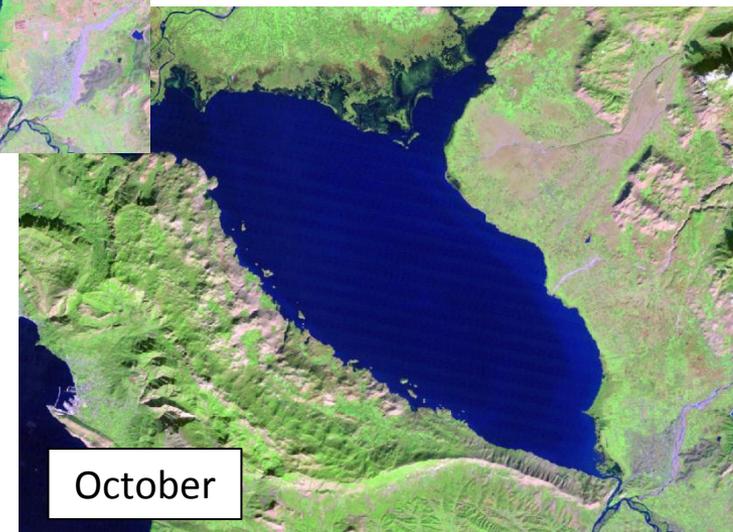
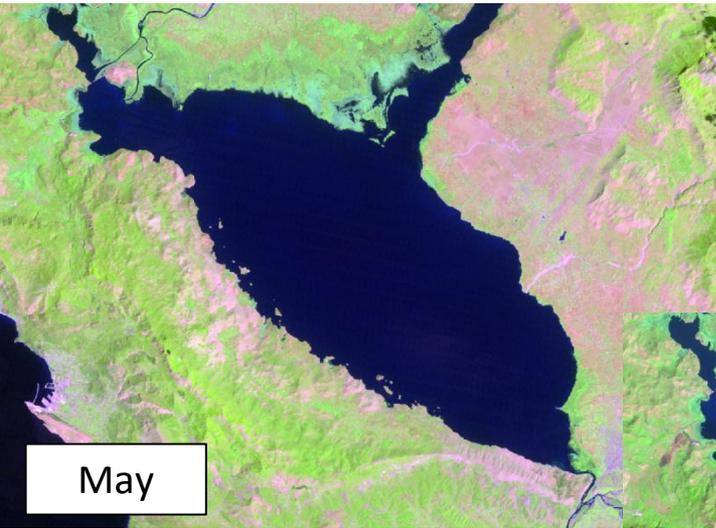


Indicator computation

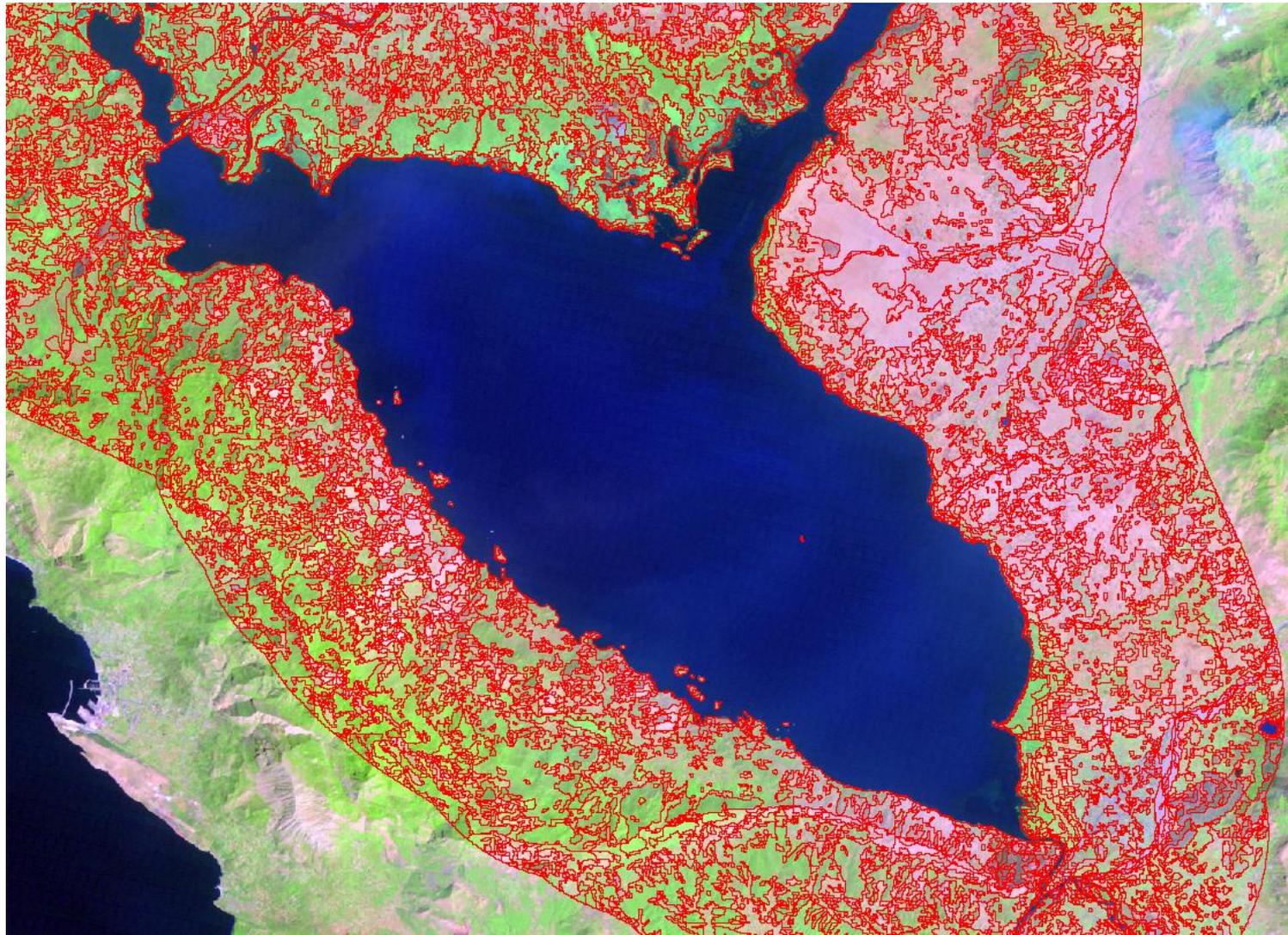
OID	Level	from Level	IndCAU
0	Agricultural areas	Artificial surfaces	0.01
1	Agricultural areas	Forests and semi-natural areas	0.31
2	Agricultural areas	Water bodies	0.25
3	Agricultural areas	Wetlands	0.96
4	Artificial surfaces	Agricultural areas	0.21
5	Artificial surfaces	Water bodies	
6	Artificial surfaces	Wetlands	

LULC mapping

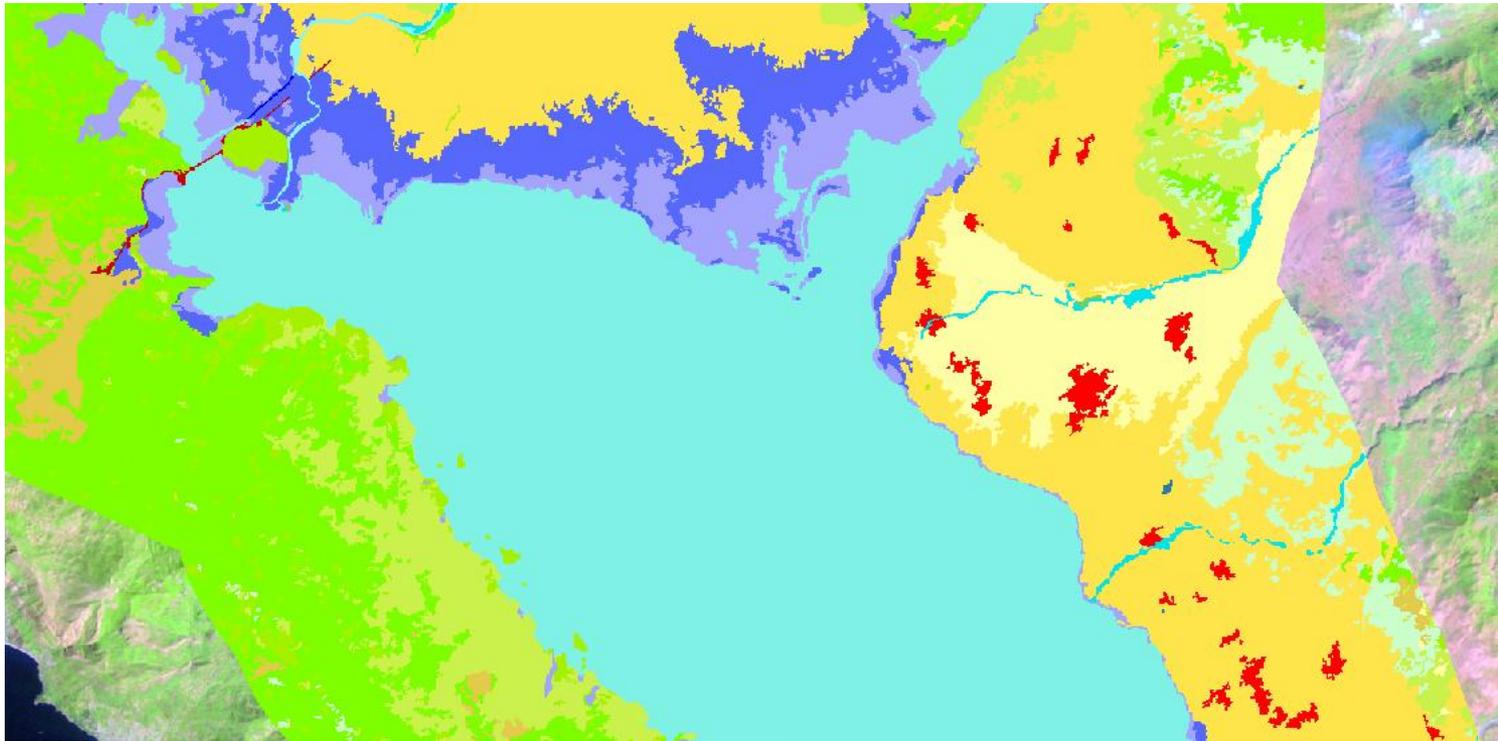
A multi-temporal approach for
the intra-annual mapping



Object-based approach → image segmentation

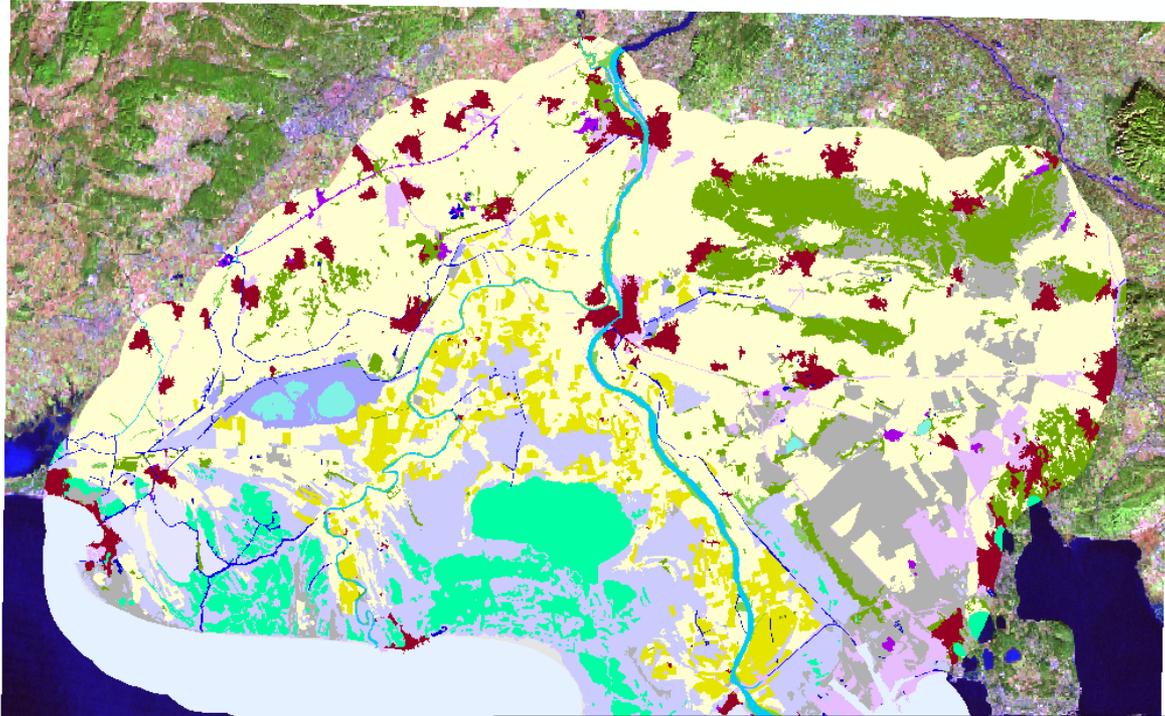


Object-based approach → image classification



- | | |
|--|--|
|  CLC 112: Discontinuous urban fabric |  CLC 321: Natural grassland |
|  CLC 121: Industrial or commercial units |  CLC 324: Transitional woodland shrub |
|  CLC 122: Road and rail networks and associated land |  CLC 333: Sparsely vegetated areas |
|  CLC 124: Airports |  CLC 411: Inland marshes |
|  CLC 131: Mineral extraction sites |  CLC 4111: Reedbeds and high helophytes |
|  CLC 142: Sport and leisure facilities |  CLC 4114: Permanent saline/brackish/alkaline marshes/pools |
|  CLC 211: Non-irrigated arable land |  CLC 4115: Seasonal/intermittent saline/brackish/alkaline marshes/pools |
|  CLC 221: Vineyards |  CLC 4117: Seasonal/intermittent freshwater marshes/pools on inorganic soils |
|  CLC 223: Olive groves |  CLC 5112: Permanent rivers/streams/creeks; includes waterfalls |
|  CLC 231: Pastures |  CLC 5113: Seasonal/intermittent/irregular rivers/streams/creeks/wadis |
|  CLC 242: Complex cultivation |  CLC 5114: Canals and drainage channels, ditches |
|  CLC 243: Land principally occupied by agriculture, with significant areas of natural vegetation |  CLC 512: Inland water bodies |
|  CLC 311: Broad-leaved forest |  CLC 5130: Ponds; includes farm ponds, stock ponds, small tanks; (generally below 8 ha) |
| CLC 3112: Wet forests including riparian | CLC 5131: Water storage areas; reservoirs/barrages/dams/impoundments (generally over 8 ha) |

LULC mapping

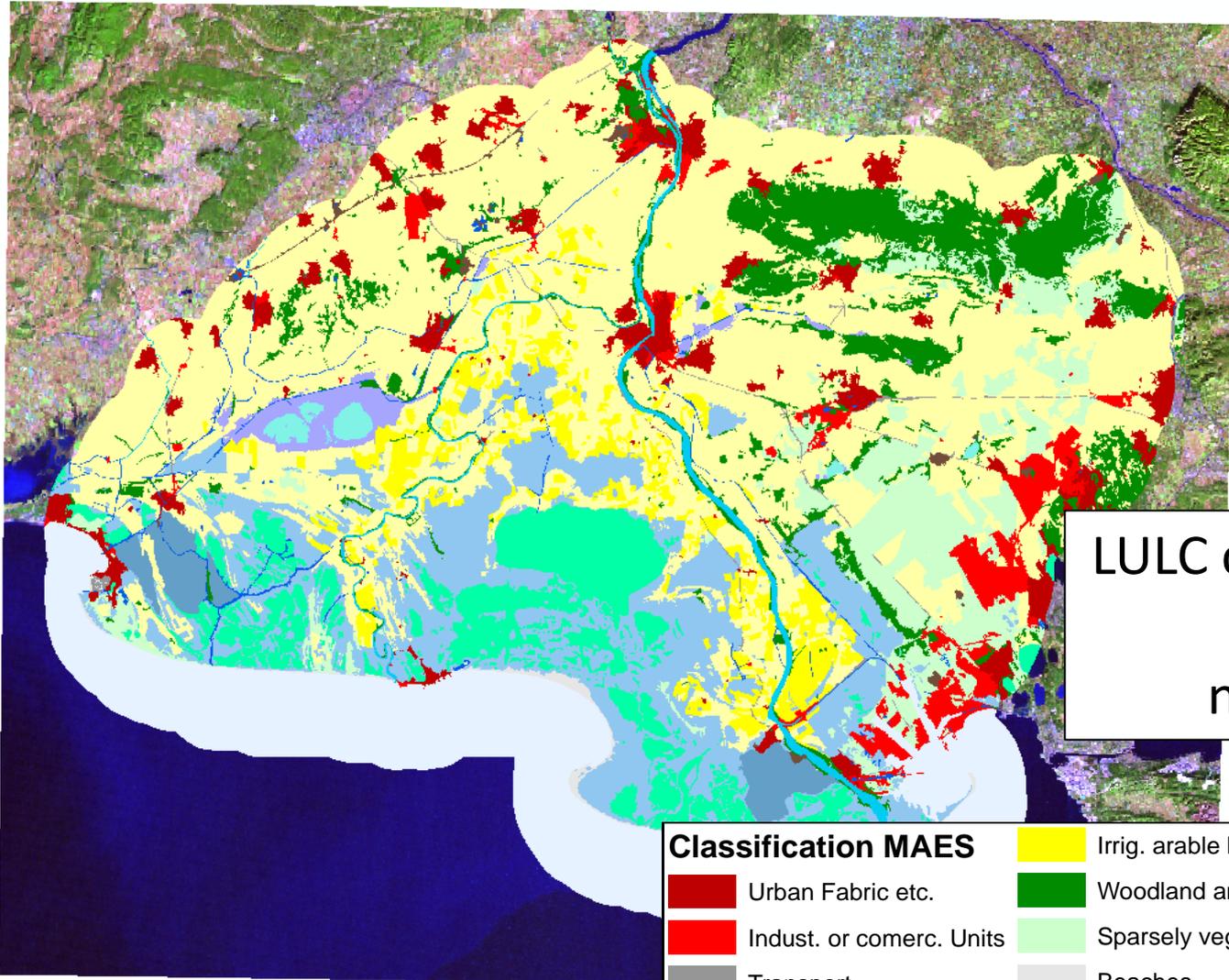


LULC classification 2015
using CLC/Ramsar
nomenclature

Classification GWII

- | | |
|--|--|
|  CLC 11: Urban fabric |  CLC 411: Inland marshes |
|  CLC 12: Industrial, commercial and transport units |  CLC 421: Salt marshes |
|  CLC 13: Mine, dump and construction sites |  CLC 422: Salines |
|  CLC 2: Agricultural areas |  CLC 511: Inland water courses |
|  CLC 213: Rice fields |  CLC 5114: Canals and drainage channels, ditches |
|  CLC 31: Forests |  CLC 512: Inland water bodies |
|  CLC 3112: Wet forests including riparian |  CLC 5131: Water storage areas; reservoirs/barrages/dams/impoundments (generally over 8 ha) |
|  CLC 33: Open spaces with little or no vegetation |  CLC 521: Coastal lagoons |
|  CLC 331: Beaches, dunes, and sand plains |  CLC 523: Sea and ocean |

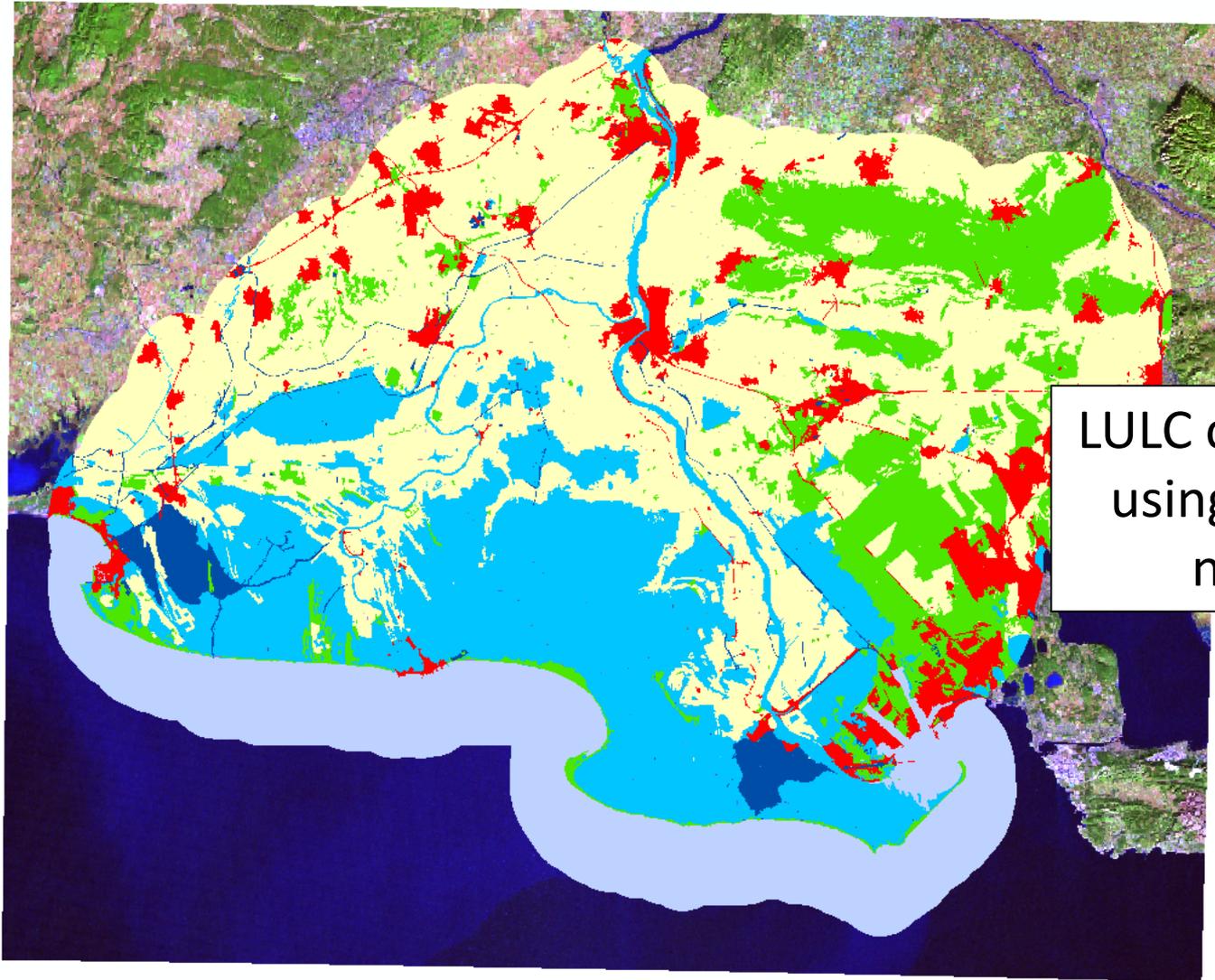
LULC mapping



LULC classification 2015
using MAES
nomenclature

Classification MAES			
	Irrig. arable land and rice		Salines
	Urban Fabric etc.		Woodland and Forests
	Indust. or comerc. Units		Sparsely vegetated areas
	Transport		Beaches
	Mineral extraction etc.		Inland freshwater marshes
	Croplands		Maritime wetlands
			Coastal lagoons
			Water courses
			Natural water bodies
			Artificial water bodies
			Marine (other)

LULC mapping



LULC classification 2015
using a « simplified »
nomenclature

MWO Nomenclature	
	Built-up areas
	Agricultural lands (including rice)
	Natural terrestrial lands
	Natural wetlands
	Artificial wetlands
	Sea

Flood regulation mapping

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

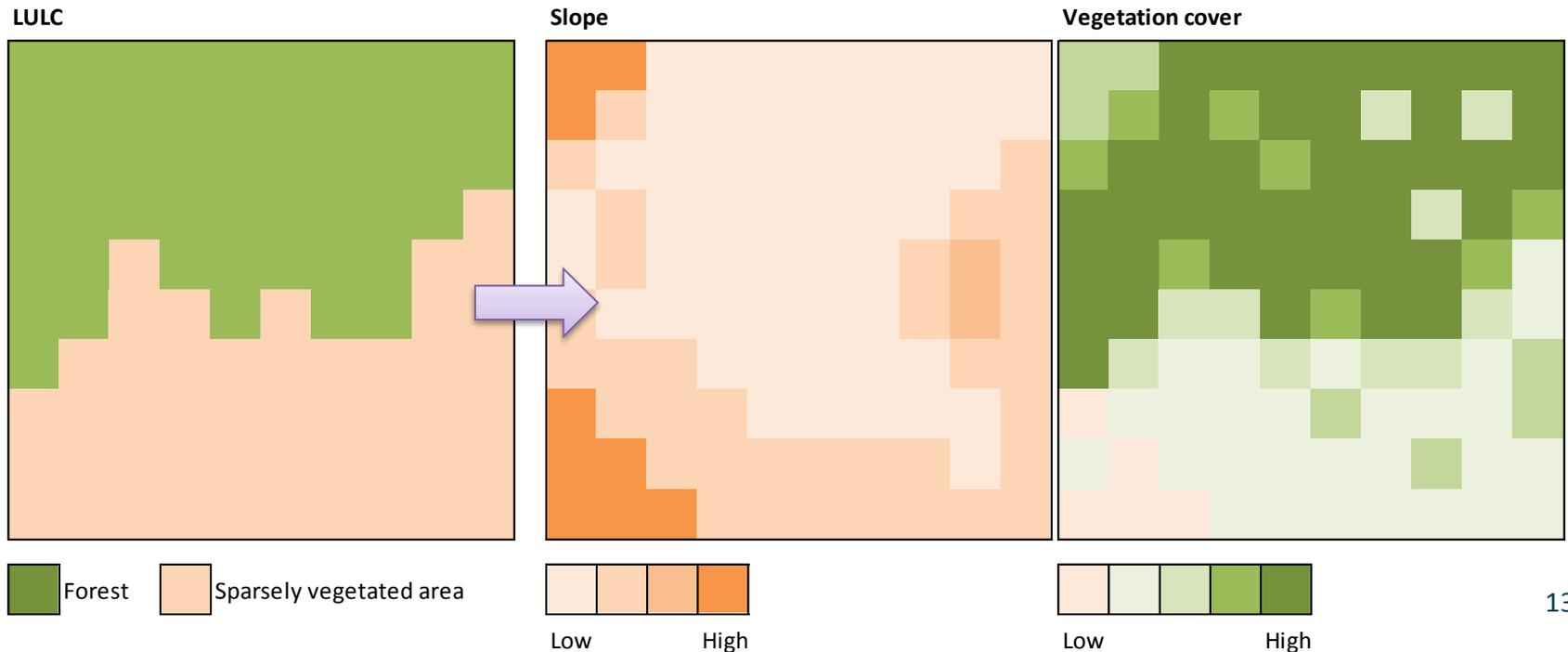
- **Ecosystem or land use capacity to provide the service**
- **Service demand of the ecosystem or land use**
In the case of flooding, they are mainly those areas where human activities are concentrated: agro-ecosystems, urban areas, roads, etc.
- **Conditions of the environment affecting the generation 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

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

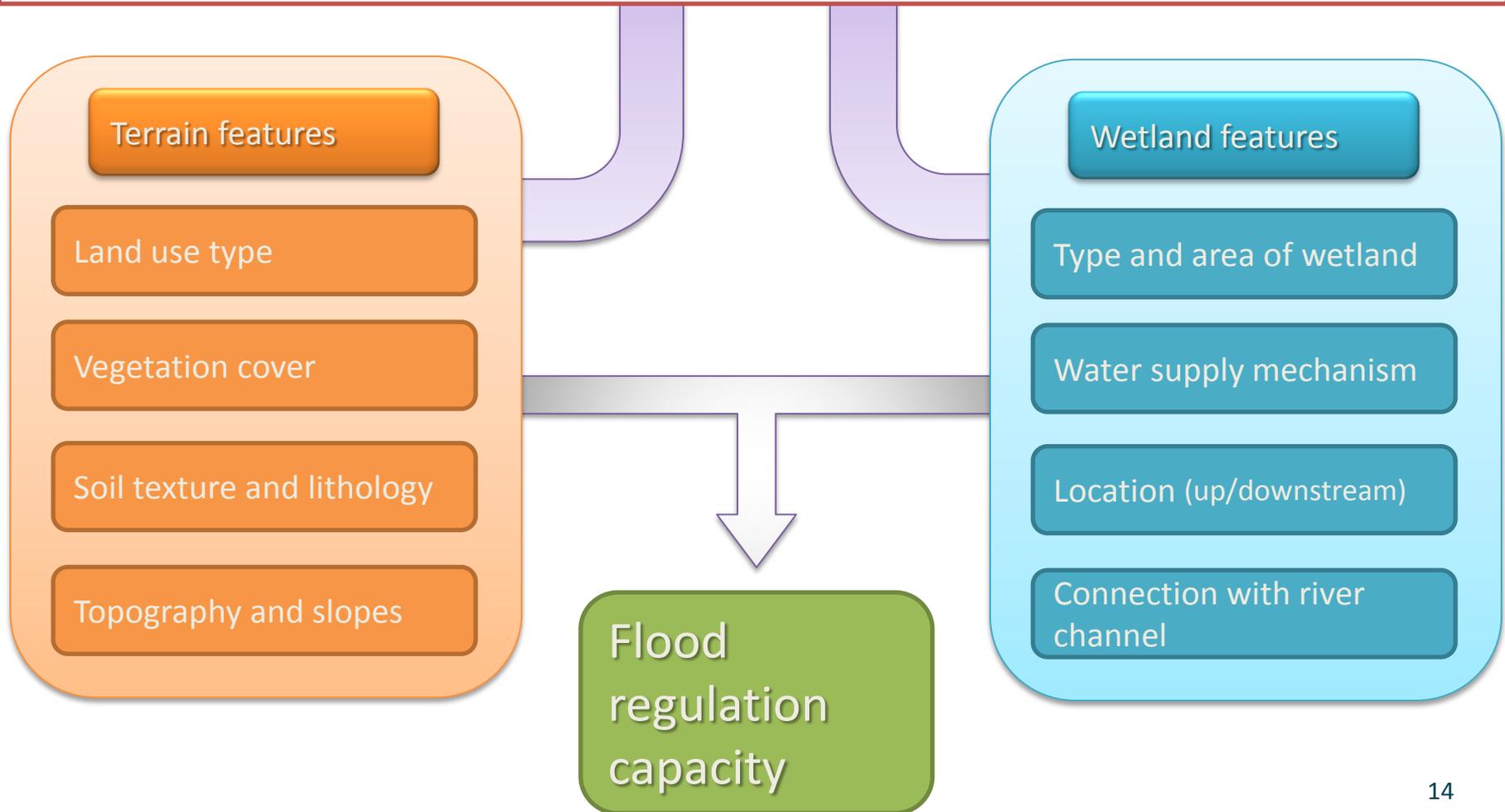
A forest would have a higher score than a sparsely vegetated area

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



Conceptual approach

SWOS flood regulation indicator considers LULC and the environmental conditions affecting the generation of water run-off to assess the flood regulation capacity.



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)

Montpellier

The Lez river basin



Example of the Lez river basin (SWOS test site)

LULC map 1986-1987

Using the SWOS toolbox and
the CLC/Ramsar hybrid
nomenclature

- CLC 111: Continuous urban fabrics
- CLC 112: Discontinuous urban fabric
- CLC 121: Industrial or commercial units
- CLC 122: Road and rail networks and associated land
- CLC 123: Port areas
- CLC 124: Airports
- CLC 131: Mineral extraction sites
- CLC 1311: Excavations; gravel/brick/clay pits; borrow pits, mining pools
- CLC 133: Construction sites
- CLC 141: Green urban areas
- CLC 142: Sport and leisure facilities
- CLC 211: Non-irrigated arable land
- CLC 221: Vineyards
- CLC 222: Fruit trees and berry plantations
- CLC 223: Olive groves
- CLC 2313: Wet pastures
- CLC 242: Complex cultivation
- CLC 311: Broad-leaved forest
- CLC 3112: Wet forests including riparian
- CLC 312: Coniferous forest
- CLC 321: Natural grassland
- CLC 323: Sclerophyllous vegetation
- CLC 324: Transitional woodland shrub
- CLC 331: Beaches, dunes, and sand plains
- CLC 333: Sparsely vegetated areas
- CLC 411: Inland marshes
- CLC 421: Salt marshes
- CLC 5112: Permanent rivers/streams/creeks; includes waterfalls
- CLC 5114: Canals and drainage channels, ditches
- CLC 512: Inland water bodies
- CLC 5130: Ponds; includes farm ponds, stock ponds, small tanks; (generally below 8 ha)
- CLC 5131: Water storage areas; reservoirs/barrages/dams/impoundments (generally over 8 ha)
- CLC 5132: Wastewater treatment areas; sewage farms, settling ponds, oxidation basins, etc
- CLC 521: Coastal lagoons
- CLC 523: Sea and ocean

Background Landsat-TM 1986-06-25

Example of the Lez river basin (SWOS test site)

LULC map 2013-2014

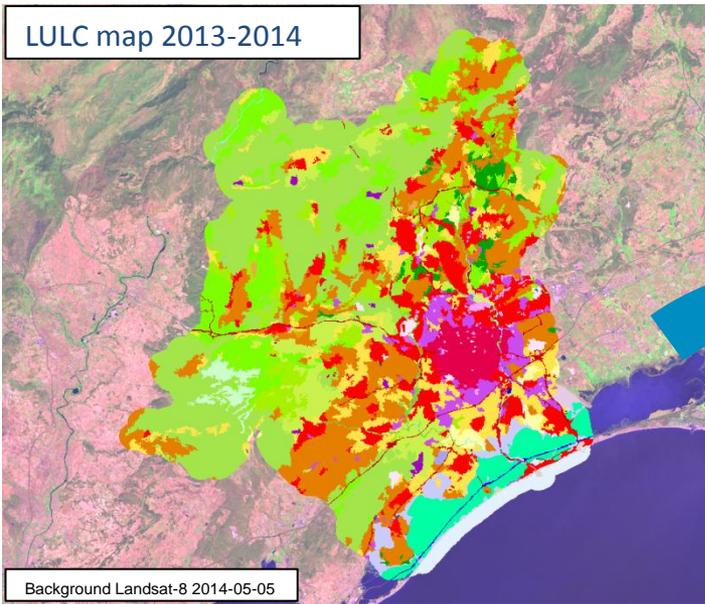
Using the SWOS toolbox and
the CLC/Ramsar hybrid
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Background Landsat-8 2014-05-05

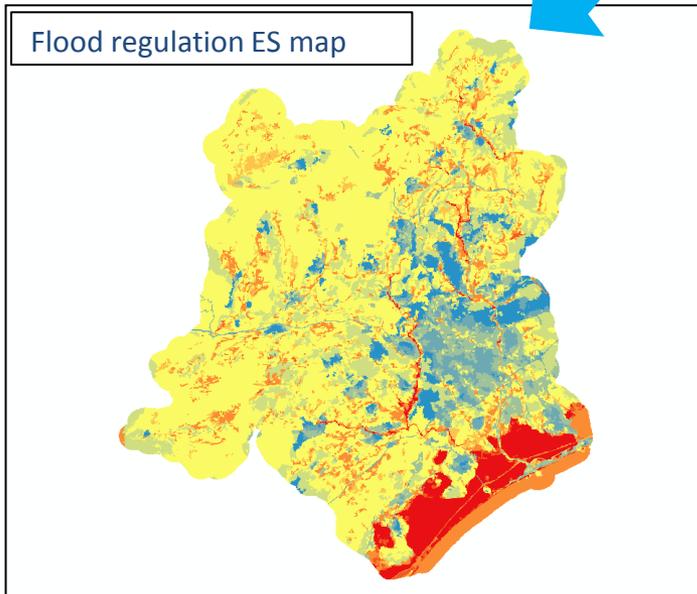
Example of the Lez river basin (France)

LULC map 2013-2014

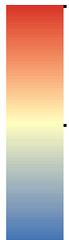


Background Landsat-8 2014-05-05

Flood regulation ES map



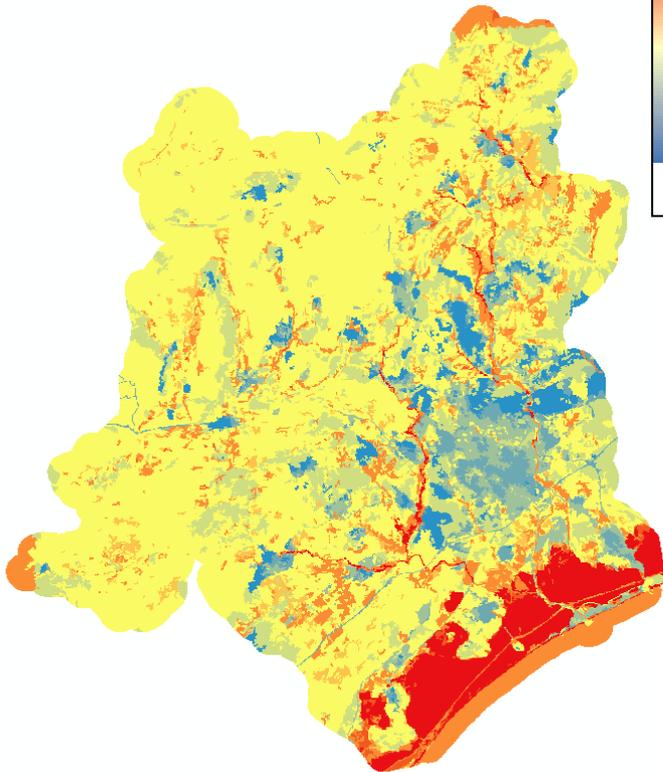
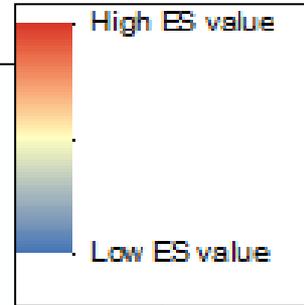
High ES value



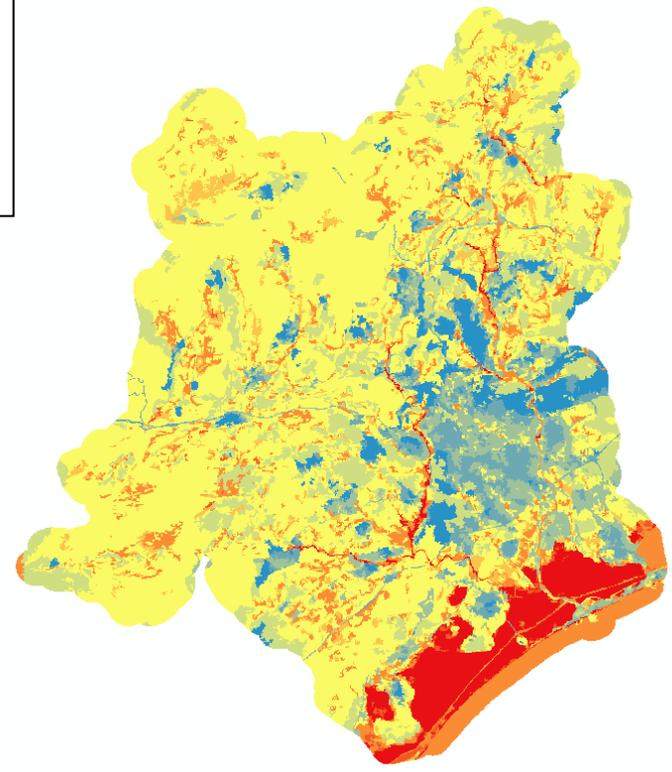
Low ES value

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Example of the Lez river basin (SWOS test site)

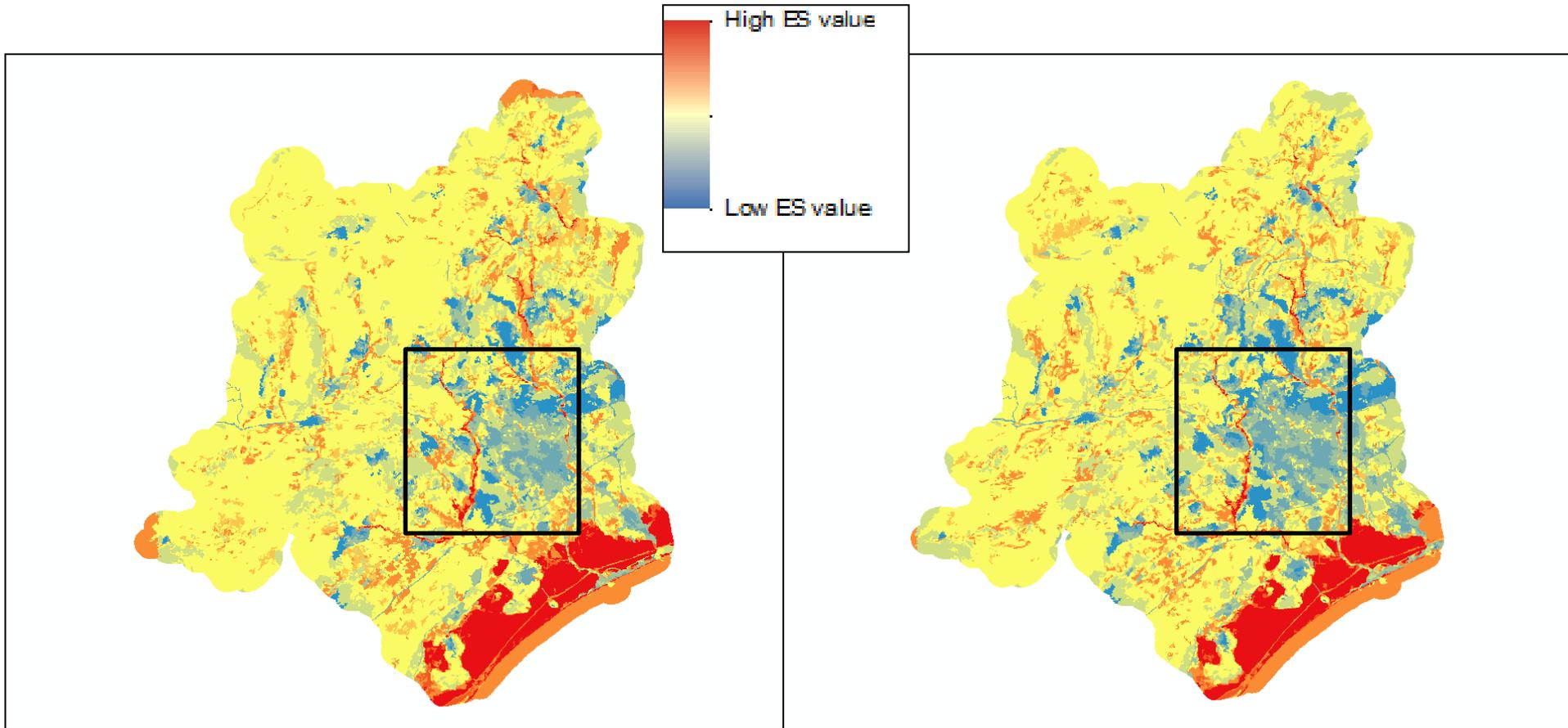


Flood regulation map 1987



Flood regulation map 2015

Example of the Lez river basin (SWOS test site)

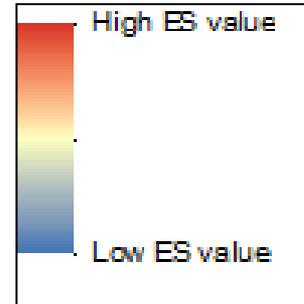
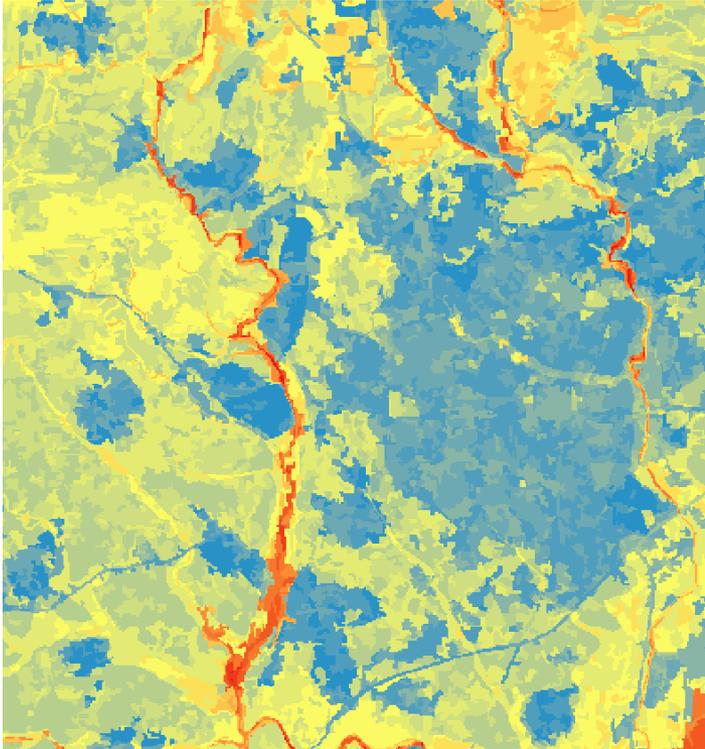


Flood regulation map 1987

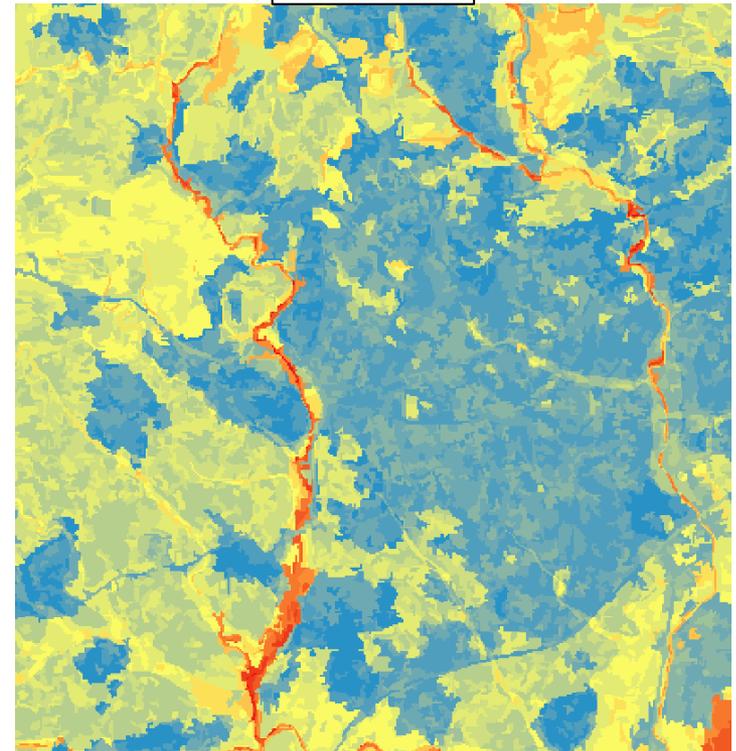
Flood regulation map 2015

Example of the Lez river basin (SWOS test site)

1987



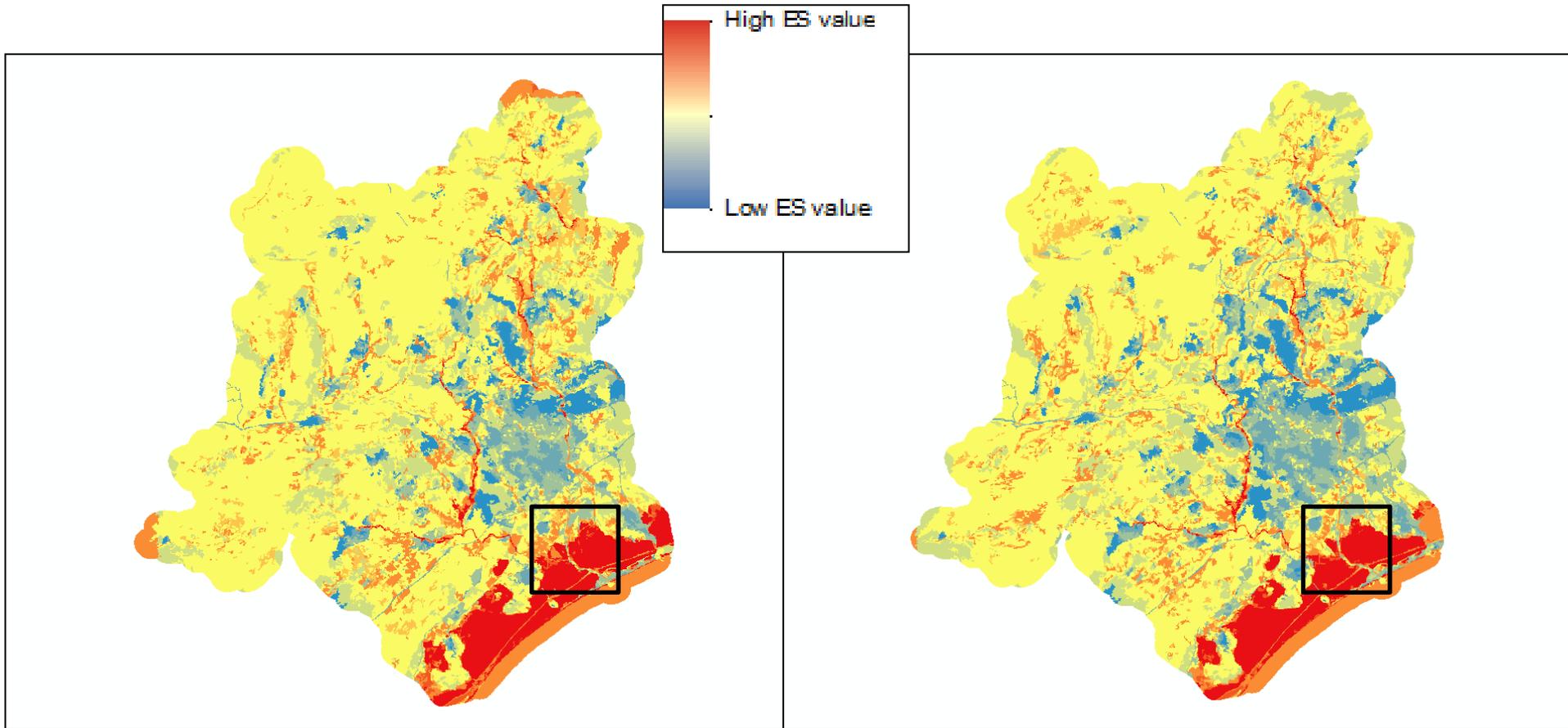
2015



Urban expansion

→ a loss in the ES value (less flood regulation capacity)

Example of the Lez river basin (SWOS test site)

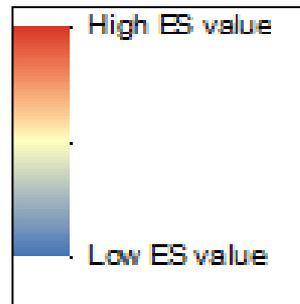
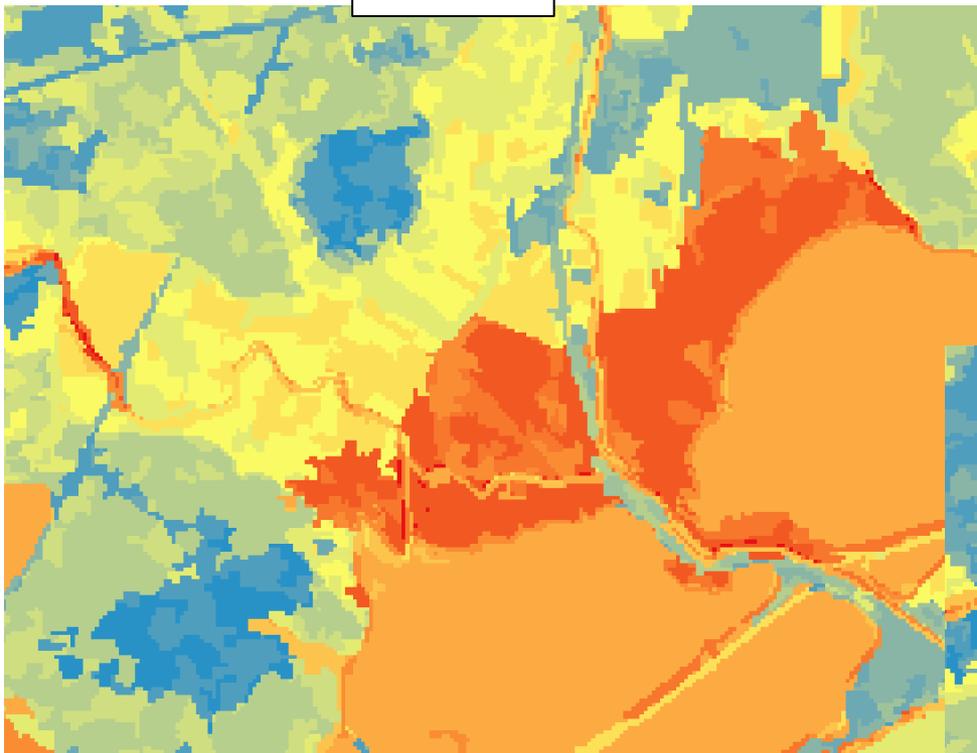


Flood regulation map 1987

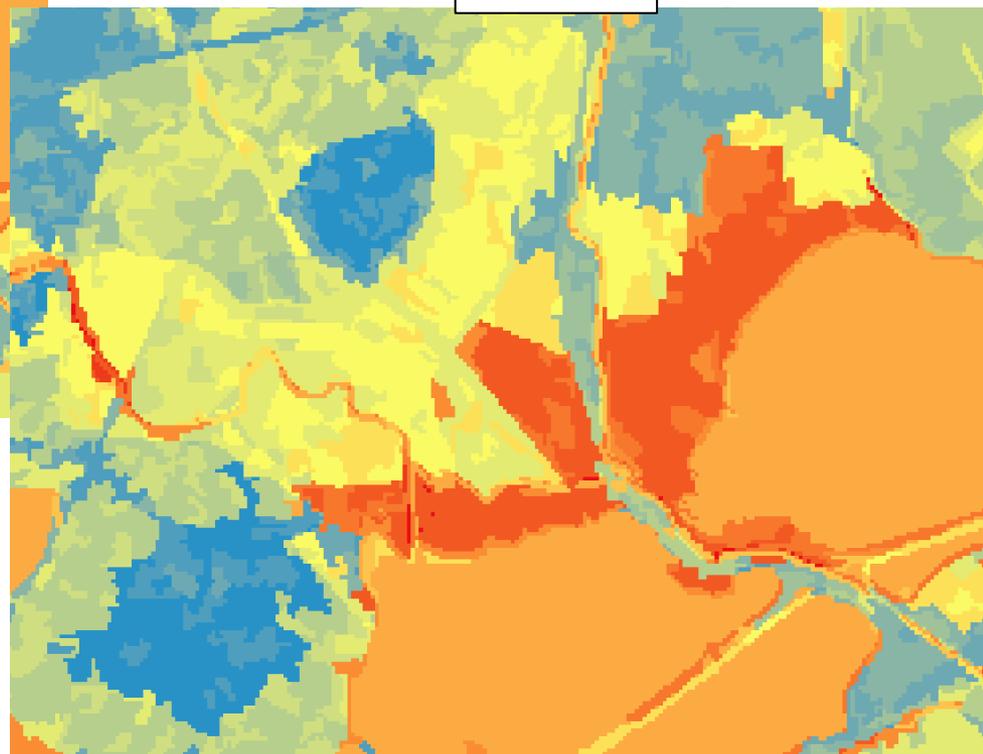
Flood regulation map 2015

Example of the Lez river basin (SWOS test site)

1987



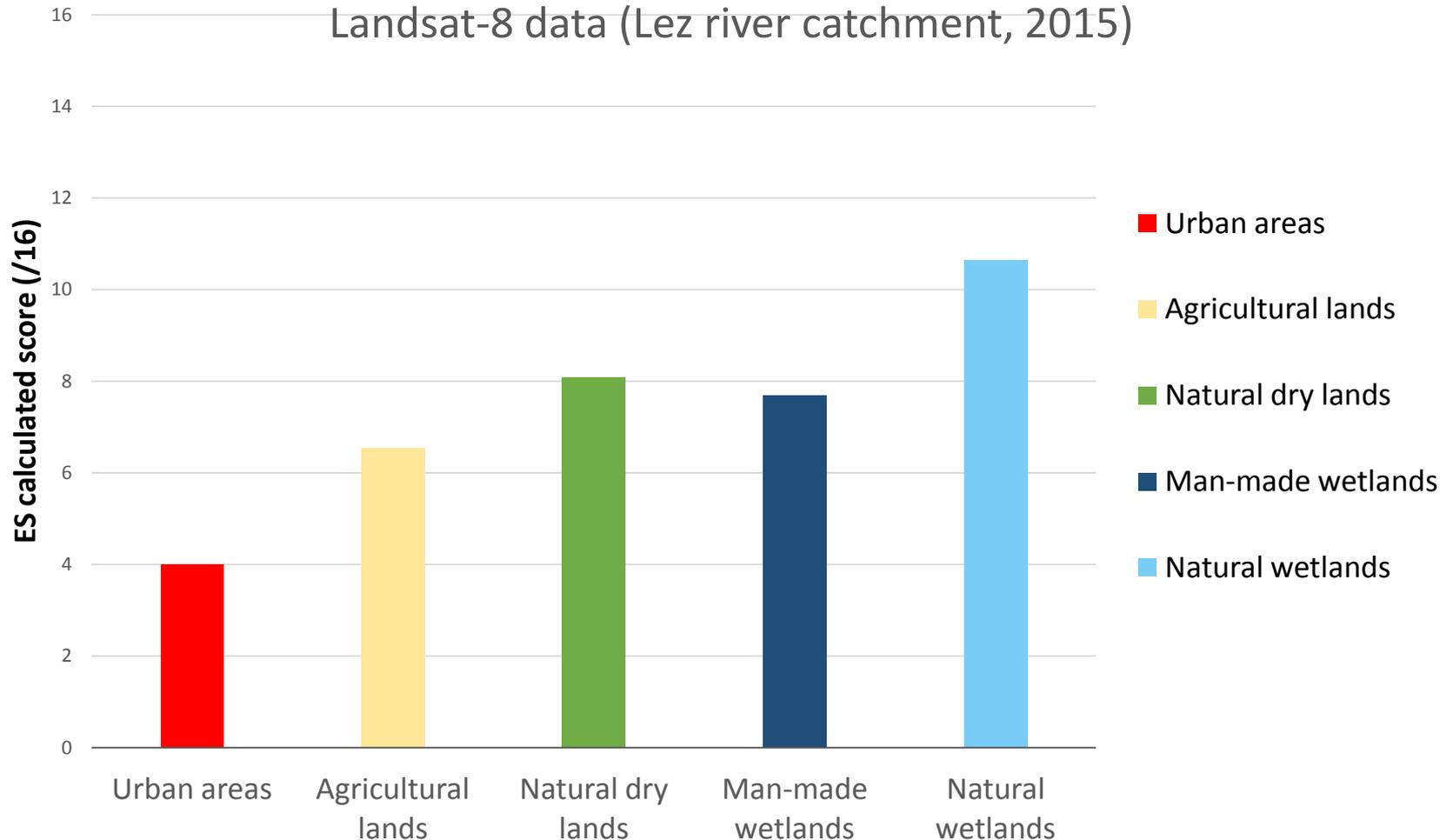
2015



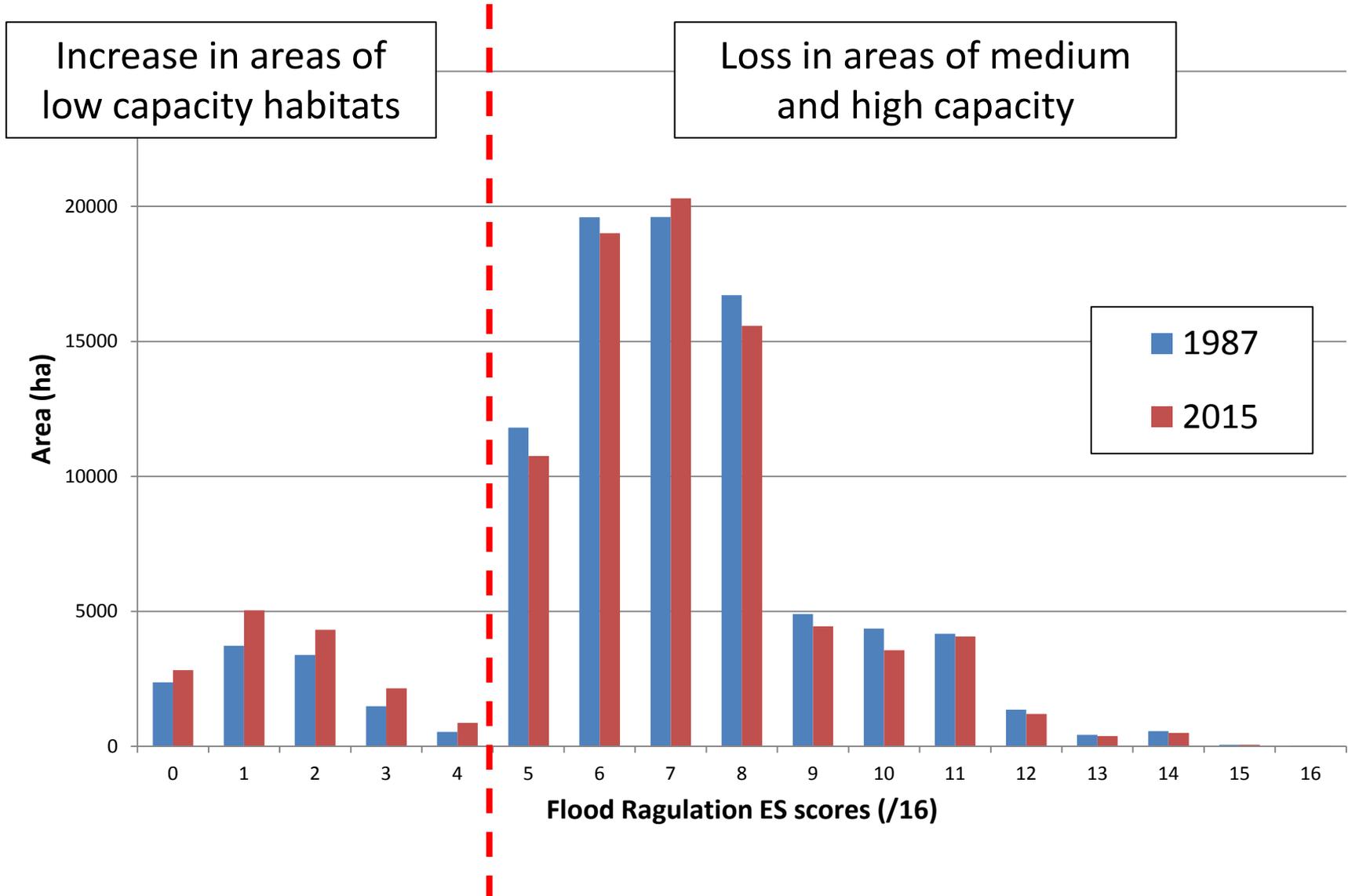
A loss of wetland habitats

→ a loss in the ES value (less flood regulation capacity)

Habitats capacity to provide flood regulation ES derived from Landsat-8 data (Lez river catchment, 2015)



Example of the Lez river basin (SWOS test site)



This approach can help us to:

- Better define the flood regulation ES
- Assess its trends over time
- Create maps with different classes of vulnerability
- Better define priority areas for habitats conservation/restoration regarding their capacity to protect populations against flood hazards
- provide useful spatial information to river basin authorities for territory planning



Thank you

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