

# living planet symposium | BONN 23–27 May 2022

TAKING THE PULSE  
OF OUR PLANET FROM SPACE



## Towards an object-based ecosystem map of Europe combining Sentinel-2 and ancillary data

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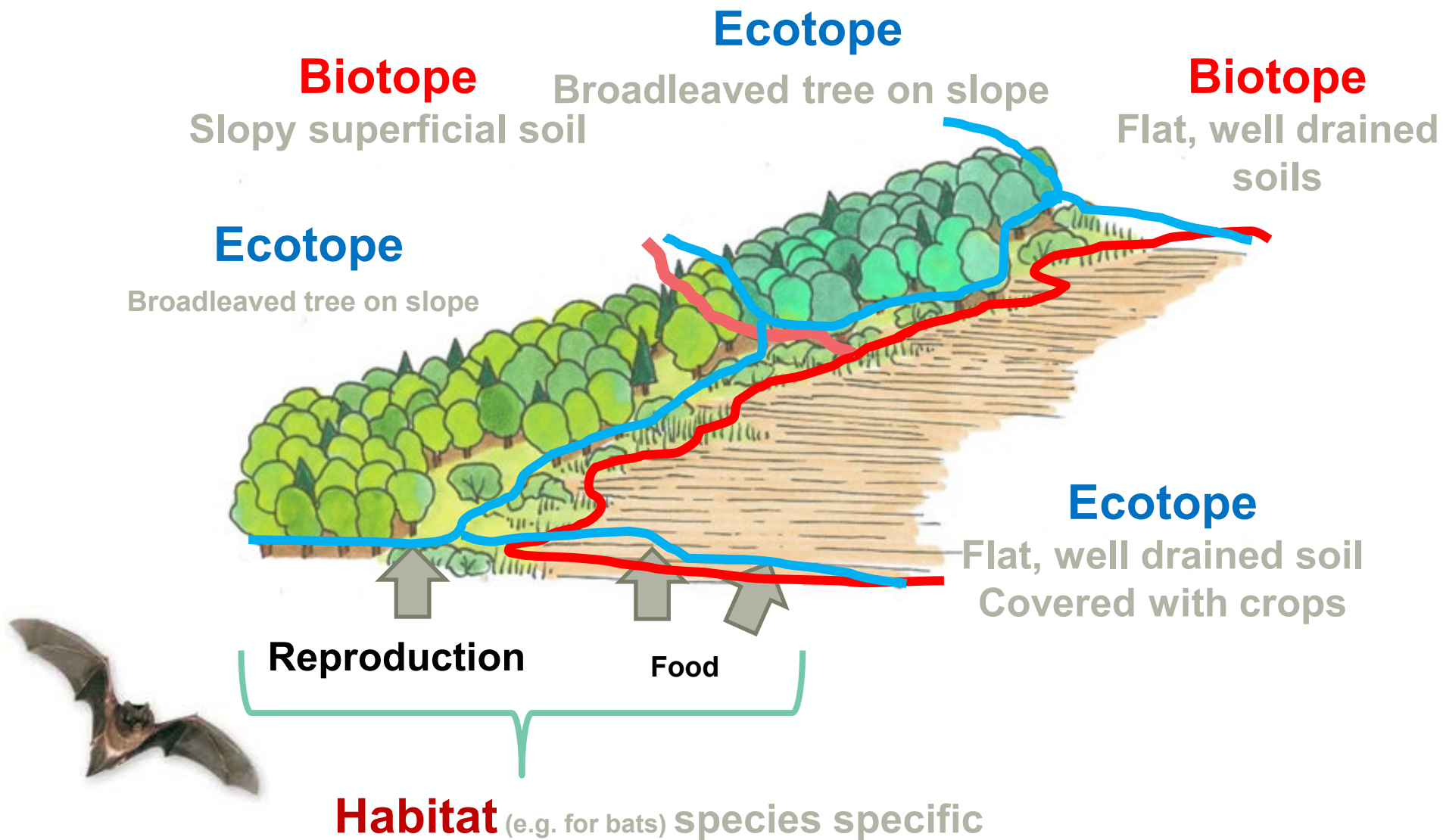
# Ecosystem extent and condition mapping



An ecosystem is a community of living organisms (biocenose) in conjunction with their non living component (biotope), interacting as a syste.

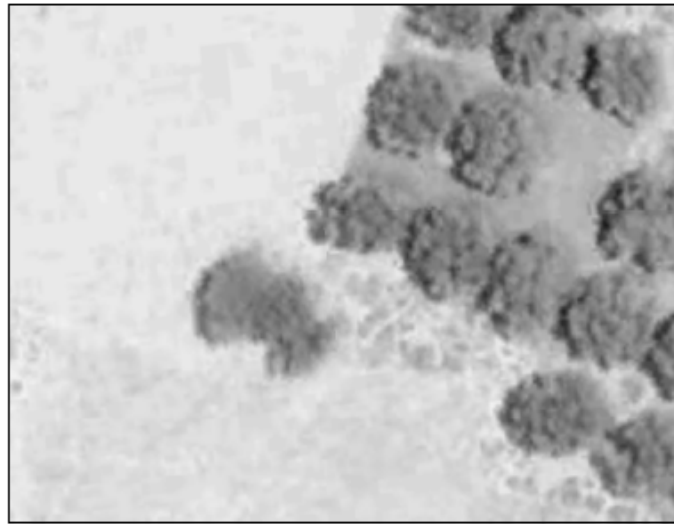


# Different partitions of landscape in ecology



Ecotope:  
functionally  
homogeneous  
building blocks  
(Ellis et al, 2006)

# Ecotopes: linked with spatial region concepts



## Spatial objects

- Categorical description
- Well defined boundaries

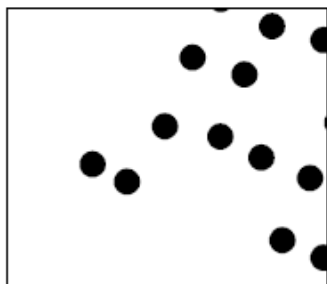
## Spatial regions

- Arbitrary boundaries
- Quantitative description

## Field

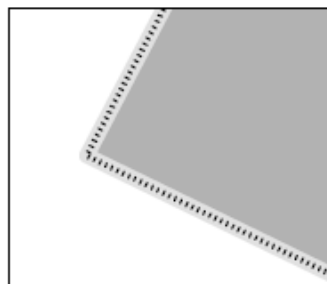
- No boundaries
- Quantitative variables

Spatial objects



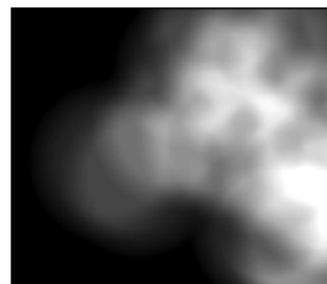
● Trees

Spatial regions



□ Pasture    □ Orchard

Field



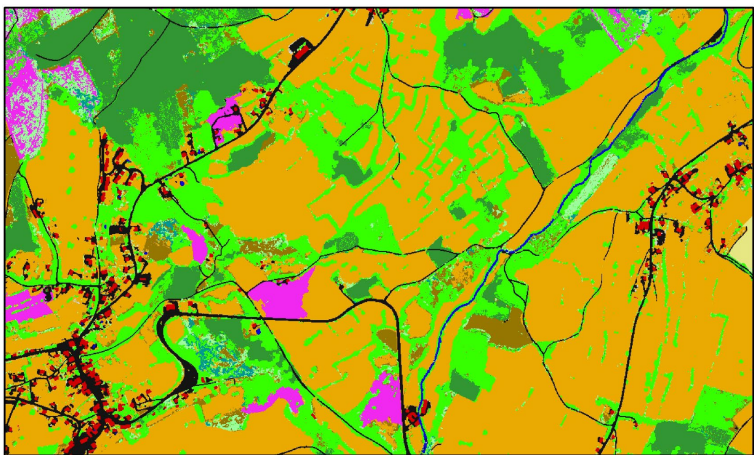
Carbon  
Low    High

# Ecotopes: proof of concept in Belgium

Automated image segmentation (topography and orthophotos)



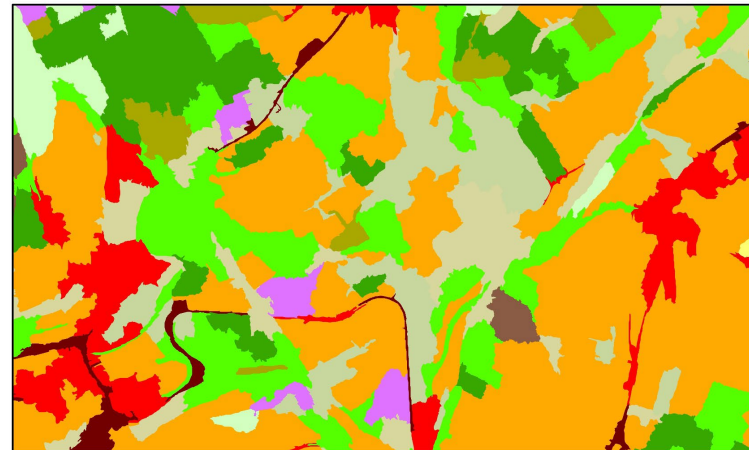
Pixel-based land cover classification (2 m)



93 %  
OA

■ Built up  
 ■ Grassland  
 ■ Needleleaved  
 ■ Broadleaved  
 ■ Water

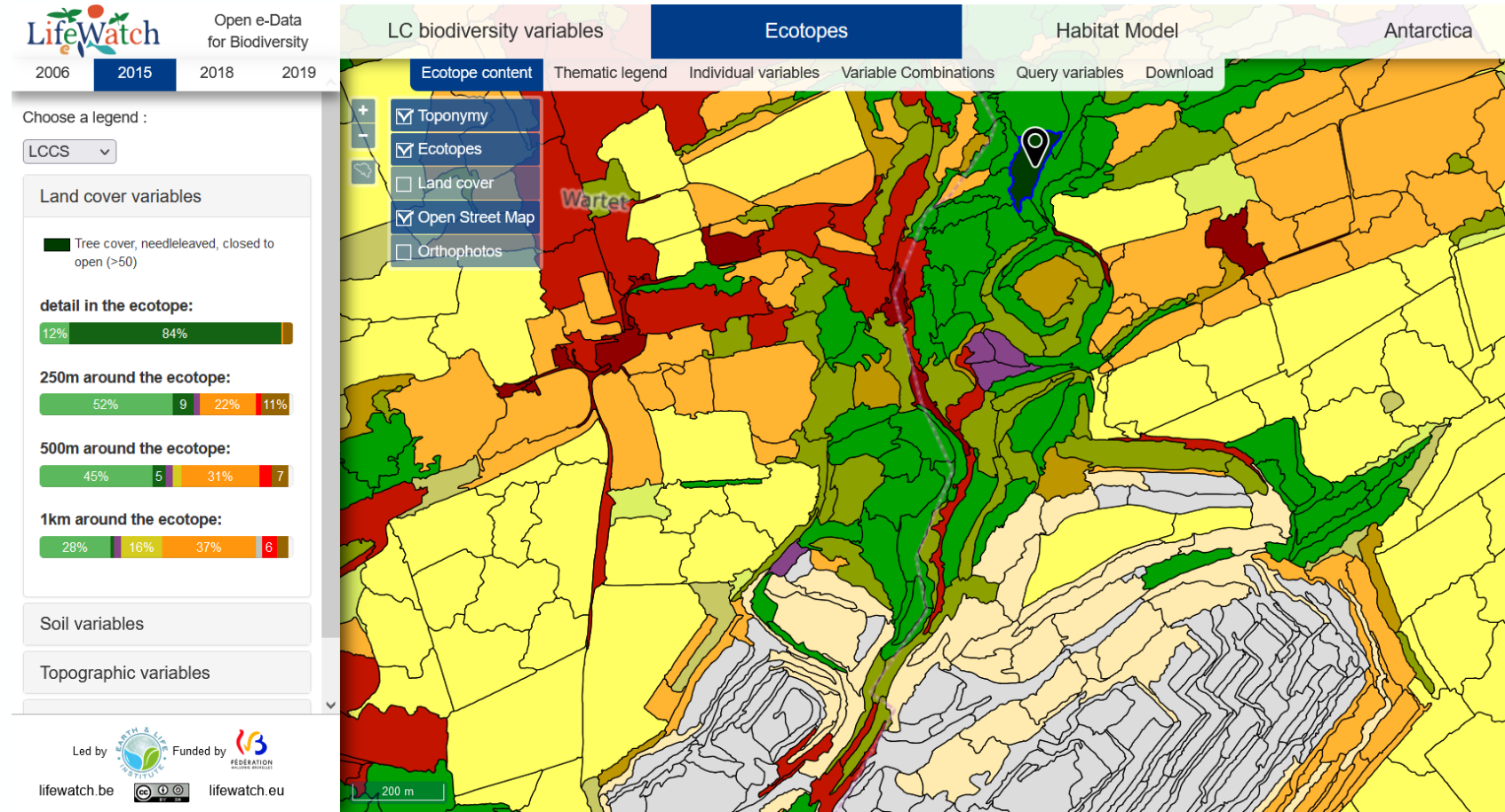
Ecotopes (here with LCCS labels)



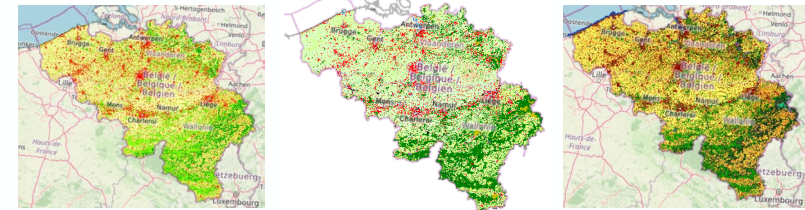
0 0,25 0,5 1 1,5 Kilometers

Including topographic information into segmentation process increased homogeneity of soil, topography and even land cover (Radoux et al, 2017)

# Data prism: irregular polygons with quantitative and categorical data



100 + quantitative variables  
Land cover proportions per ecotope  
5 categorical legends



Models with irregular polygons are more efficient than datacubes for the majority of the tested species  
(Delangre et al, 2018)

# Downscaling ecotopes for Europe: ecopatches

Coarser data available than in Belgium

Not the details of ecotopes

Concepts remain useful at another scale

Same three steps

Image segmentation

Upgraded land cover characterisation

Curated environmental variables

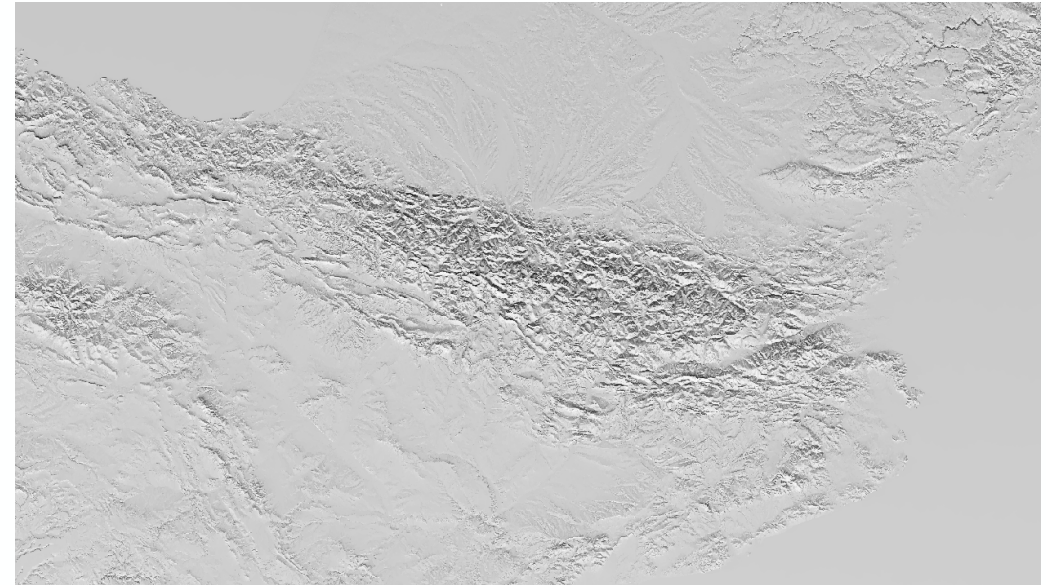
# Extent mapping primarily based on topography

Unsupervised segmentation with multiresolution segmentation

Topographic variables:

Spring sunshine

Topographic position index



Land cover variables

Sentinel-2 NDVI based on Copernicus mosaic

Vegetation height based on Hanssen product



# Following topography and land cover transitions



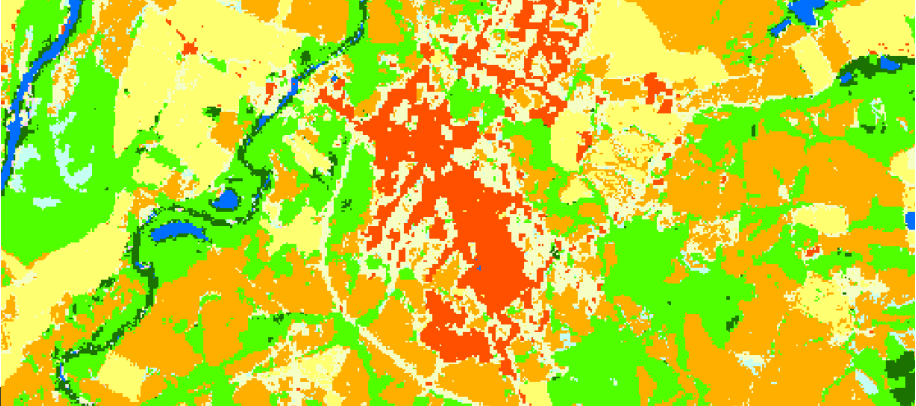
# HR LC maps of Europe: pick up choice ?



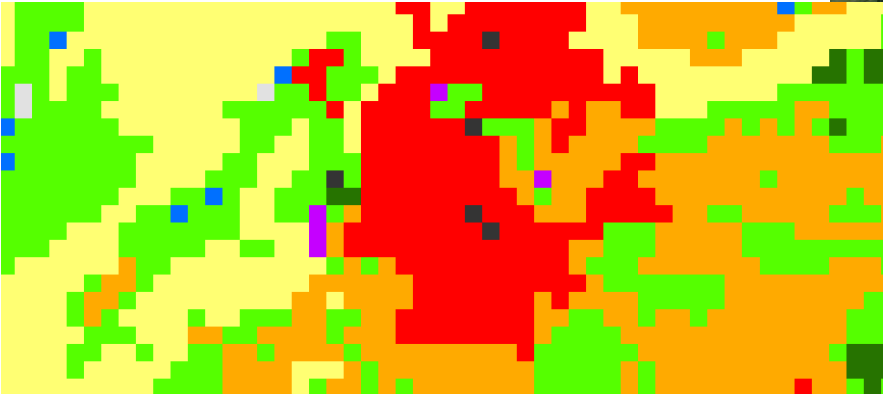
Corine land cover



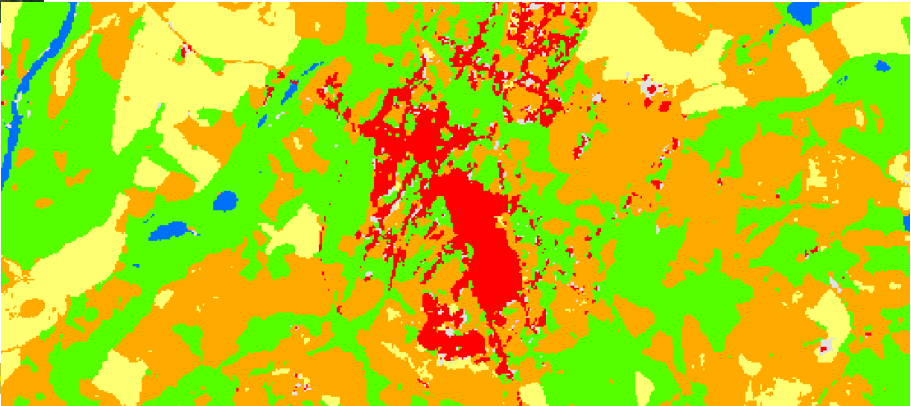
Worldcover



EEA Ecosystems



S2GLC



# Data fusion with categorical and RS data

Copernicus high resolution layers :

- Thematically precise
- LULC legends
- Spatially uncomplete : riparian, coastal, urban, NATURA 2000,
- Thematically uncomplete : grassland, forest, impervious, wetland, water

Land cover map : Open street map, worldcover, fromGLC, S2GLC, ESA CCI, ESRI LC

- Spatially complete (except Open street map)
- Coarser spatial and/or thematic resolution

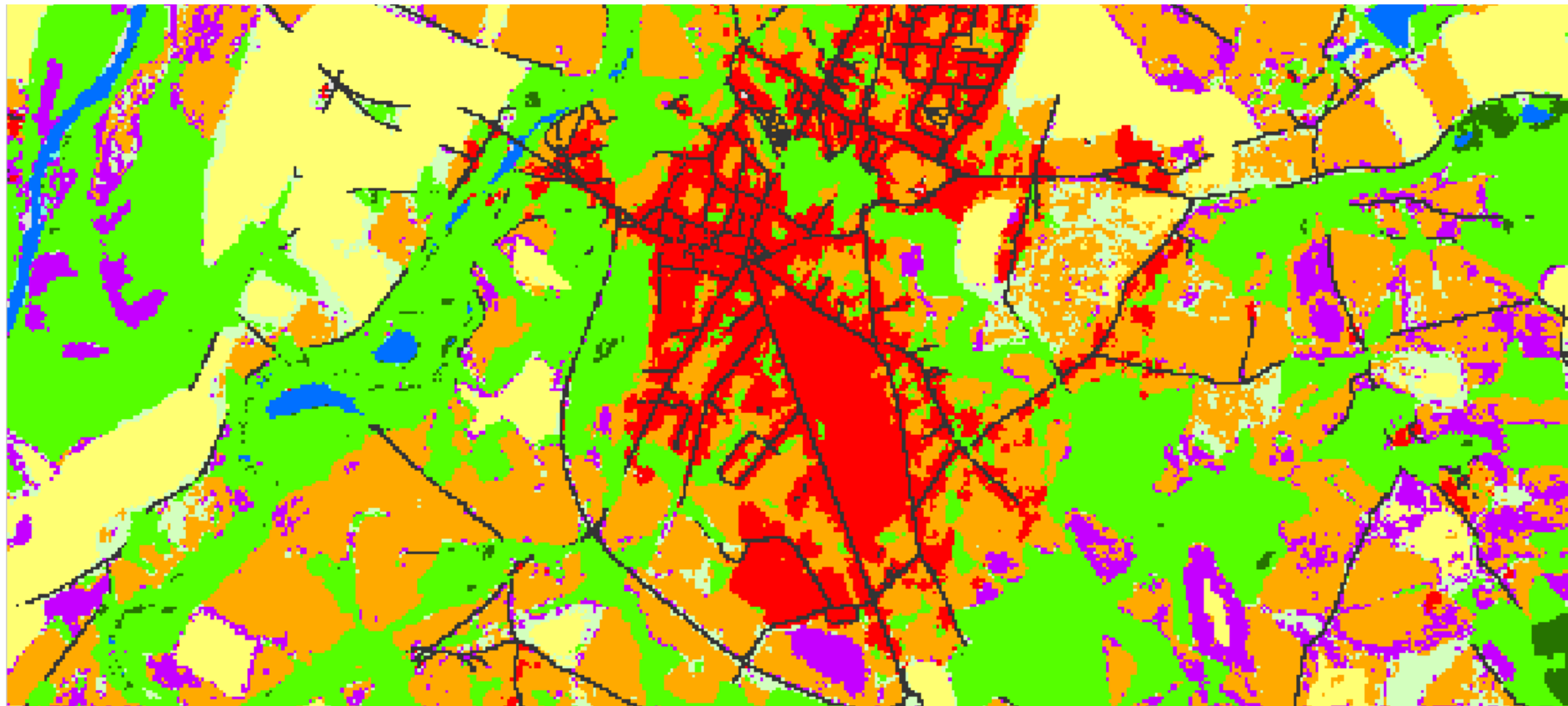
Others

- JRC's crop type map
- Hanssen's forests, JAXA's forests

Remote sensing data

- Sentinel-2 NDVI features (Copernicus)
- Sentinel-2 reflectance (summer months from S2mosaic)

# Data fusion with categorical data and S2 features

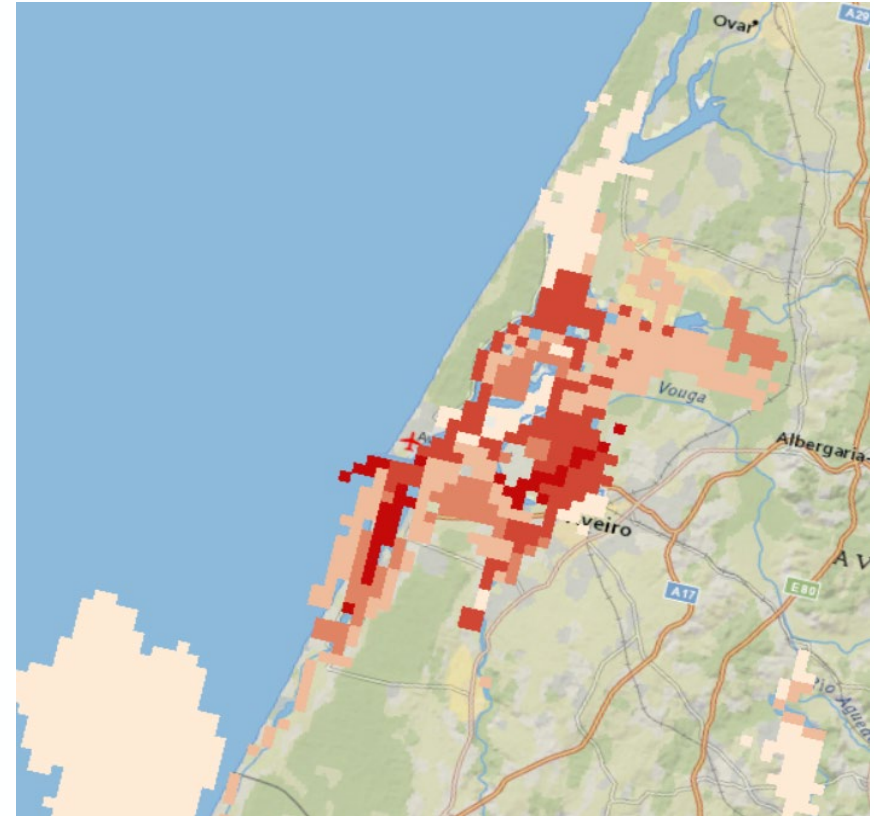
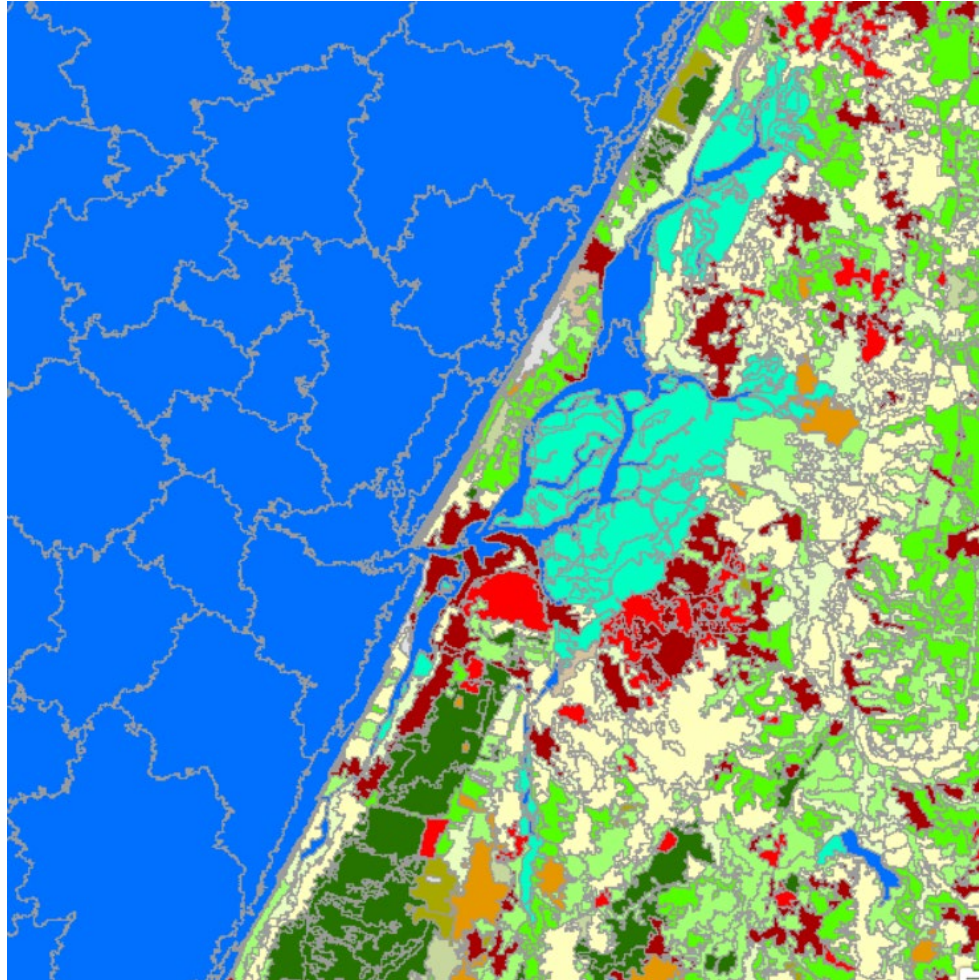


# Errors mainly along vegetation gradient (OA 84%)

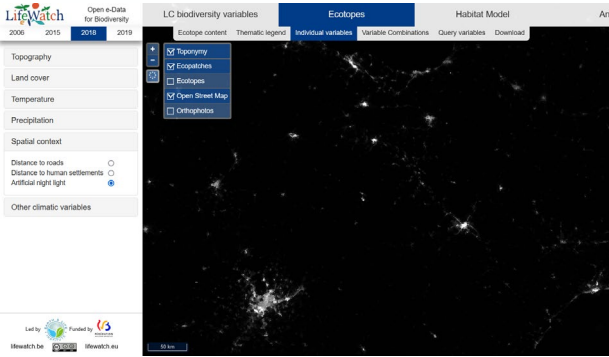


| Map \ Ref     | Water | Ice | Bare soil | Sealed | Built up | An. crop | Grassland | HBP grassland | Sparse VGT | Inundated VGT | Needle-leaved | Broad-leaved | shrub |
|---------------|-------|-----|-----------|--------|----------|----------|-----------|---------------|------------|---------------|---------------|--------------|-------|
| Water         | 14    |     |           |        |          |          |           |               |            |               |               |              |       |
| Ice           |       | 1   |           |        |          |          |           |               |            |               |               |              |       |
| Bare soil     |       |     | 7         |        |          |          |           | 1             | 1          |               |               |              |       |
| Sealed        |       |     | 1         | 26     |          |          |           | 1             |            |               |               |              | 2     |
| Built up      |       |     |           | 1      | 14       |          | 1         |               |            |               |               |              |       |
| An. crop      |       |     |           |        |          | 156      | 2         | 1             |            |               |               |              |       |
| Grassland     |       |     |           | 1      |          | 2        | 41        | 11            |            |               |               | 1            | 1     |
| HBP grassland |       |     |           | 1      |          | 6        | 2         | 70            | 9          | 2             |               | 2            | 19    |
| Sparse VGT    |       |     |           |        |          |          |           |               | 1          |               |               |              |       |
| Inundated VGT |       |     |           |        |          |          |           |               |            | 0             |               |              |       |
| Needle-leaved |       |     |           |        |          |          |           |               |            |               | 47            | 2            |       |
| Broad-leaved  |       |     |           |        |          |          | 4         |               |            |               | 7             | 182          | 11    |
| Shrub         |       |     |           |        |          |          | 3         | 1             |            |               |               | 5            | 33    |

# Combine with GBIF data for cumulative impact assessment of exotic invasive species



# Data available on [uclouvain.be/lifewatch](http://uclouvain.be/lifewatch)



**Lifewatch** Open e-Data for Biodiversity  
2006 2015 **2018** 2019

Choose a legend :

Ecosystem majority ▾

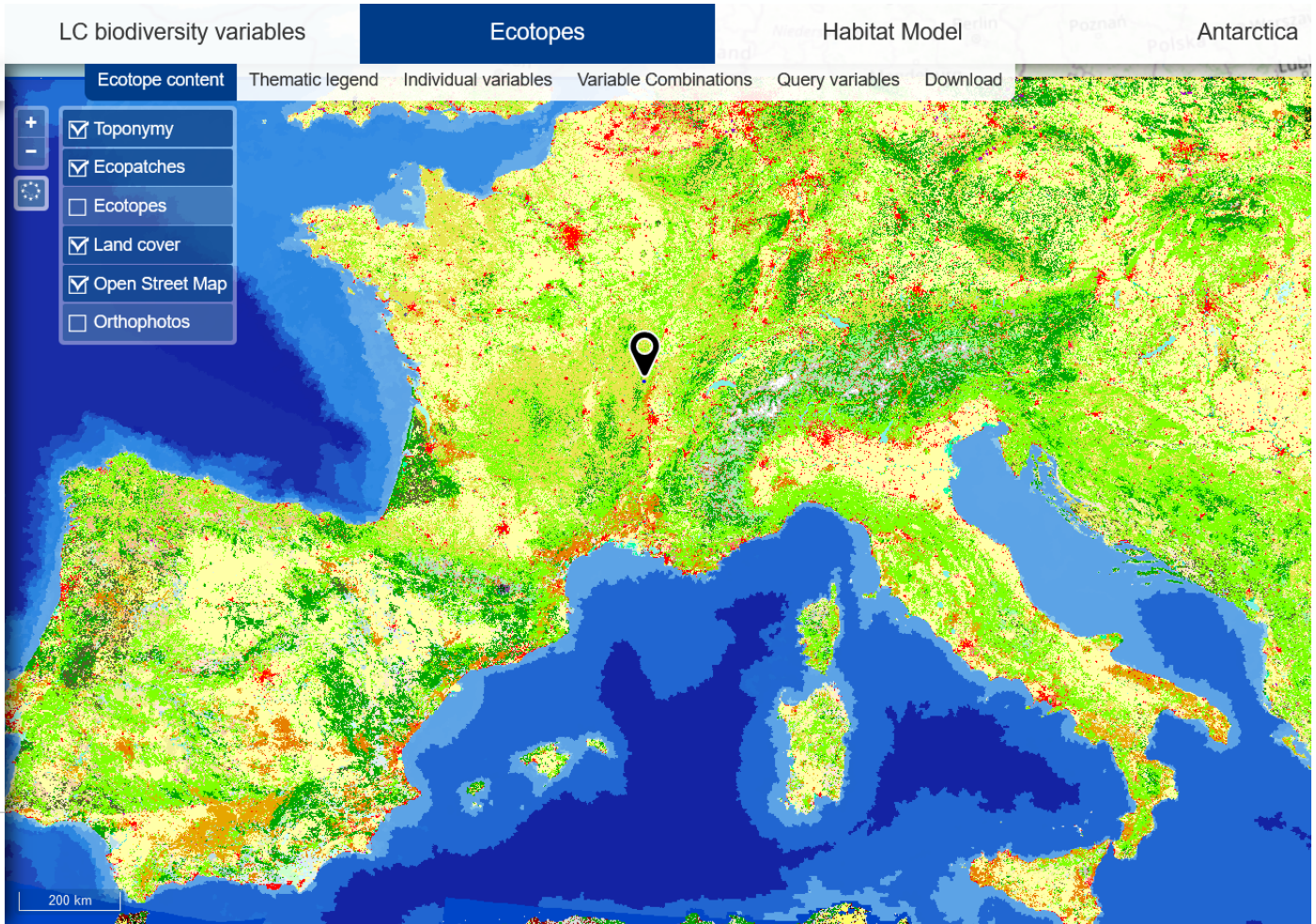
Land cover variables

- Mesic grasslands

Topographic variables

Other

- Artificial night light: 0.1 %
- Distance to settlements: 43.5714 m
- Distance to roads: 6.21901 m



## Land cover variables

Mosaic natural vegetation (Tree, shrub, herbaceous cover) (>50%) / cropland (<50%)

### detail in the ecopatch:

