

Exploring environmental variables based on ecotopes derived by remote sensing

Julien Radoux, Briec François, Thomas De Maet,
Quentin Vandersteen, Elie Khalil, Pierre Defourny

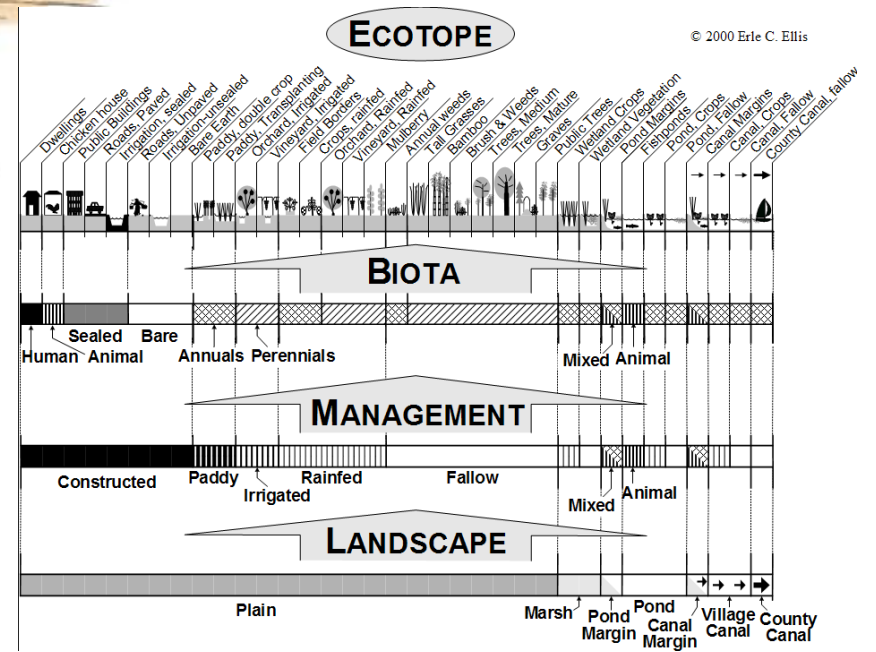
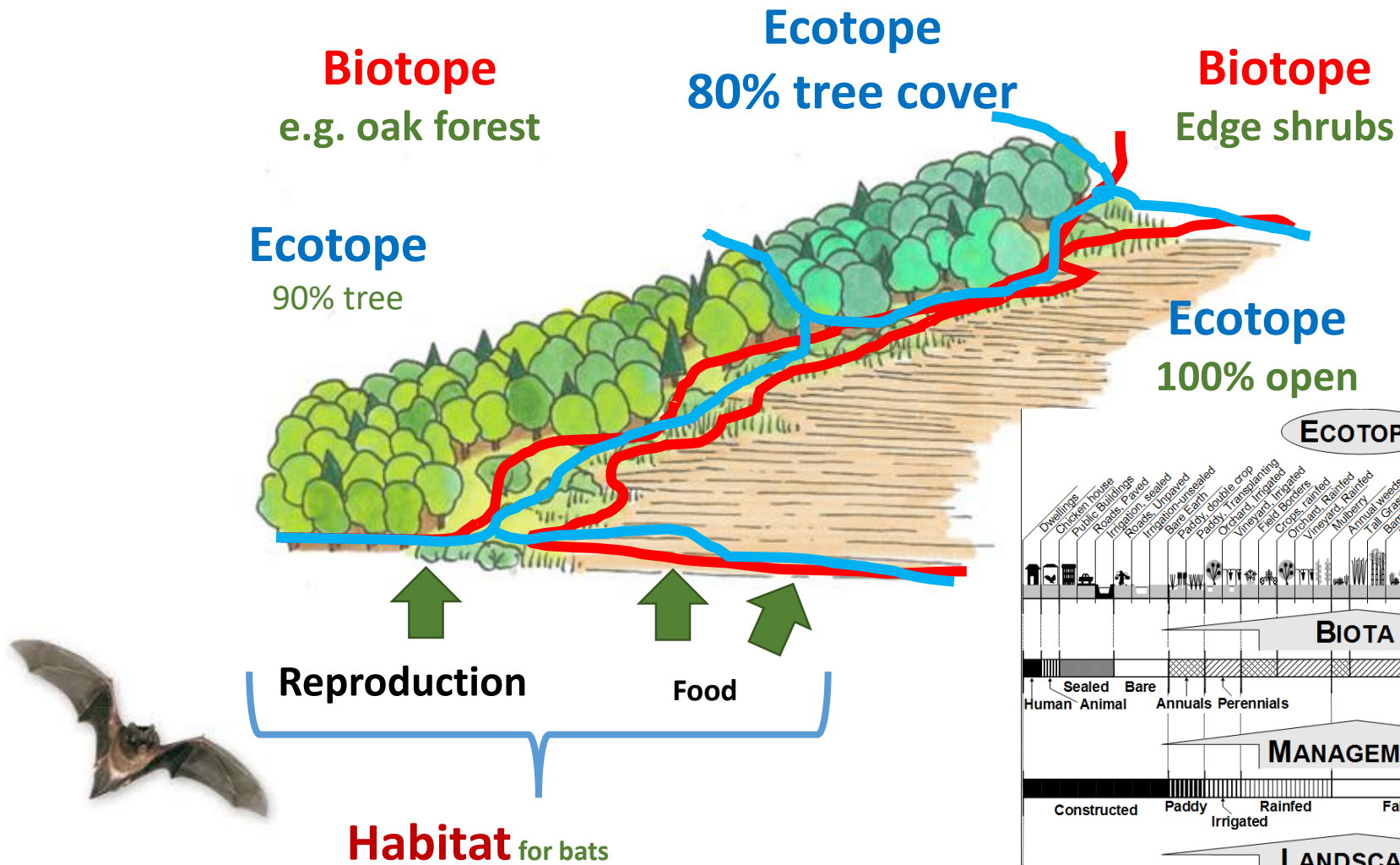


International conference on ecological informatics
Jena, Germany, September 24th 2018

Landscape delineation strategy impacts the performance of habitat suitability models

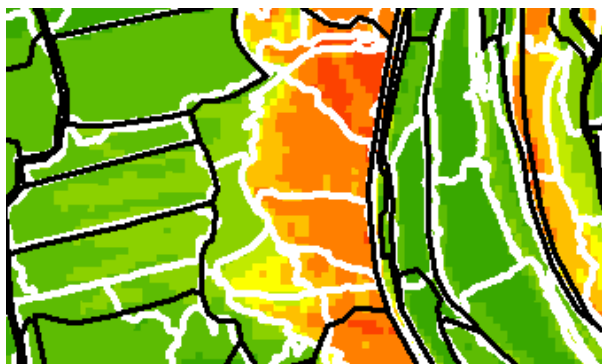
- Grid-based models have many advantages
 - Link with systematic inventory data
 - Possible hierarchical aggregation
 - Easy to build
- ...but landscapes are not squares (well, not always)
 - Irregular polygons better match biotopes
 - GNSS-based observations are precisely located
 - Hierarchical aggregation is less obvious

Different partitions of landscape in ecology: Habitat, Biotope and Ecotope

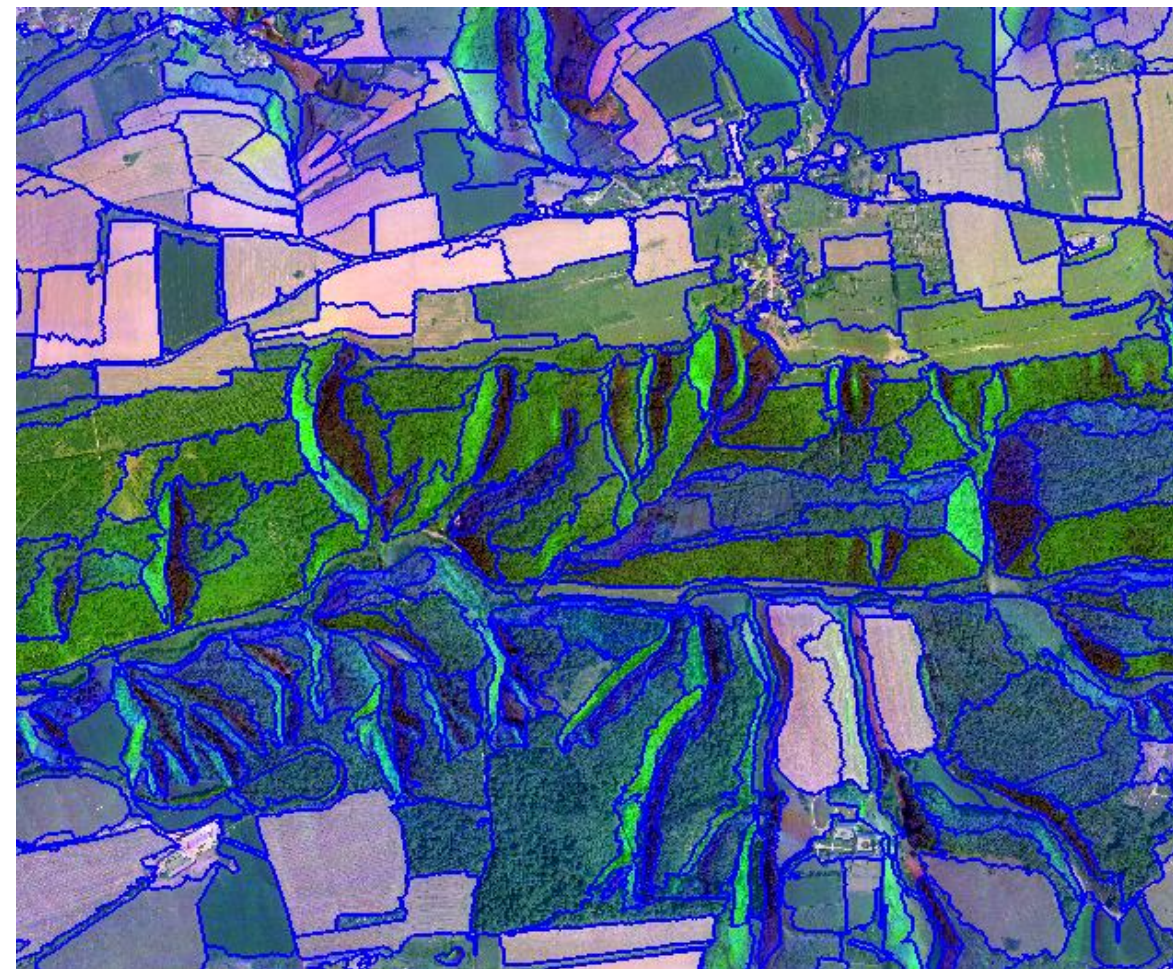


Automated delineation based on land cover and topography

Orthophotos + Hillshade + Height



Black lines : NO use of topography
 White lines : use of topography
 (steep slopes in orange and red)

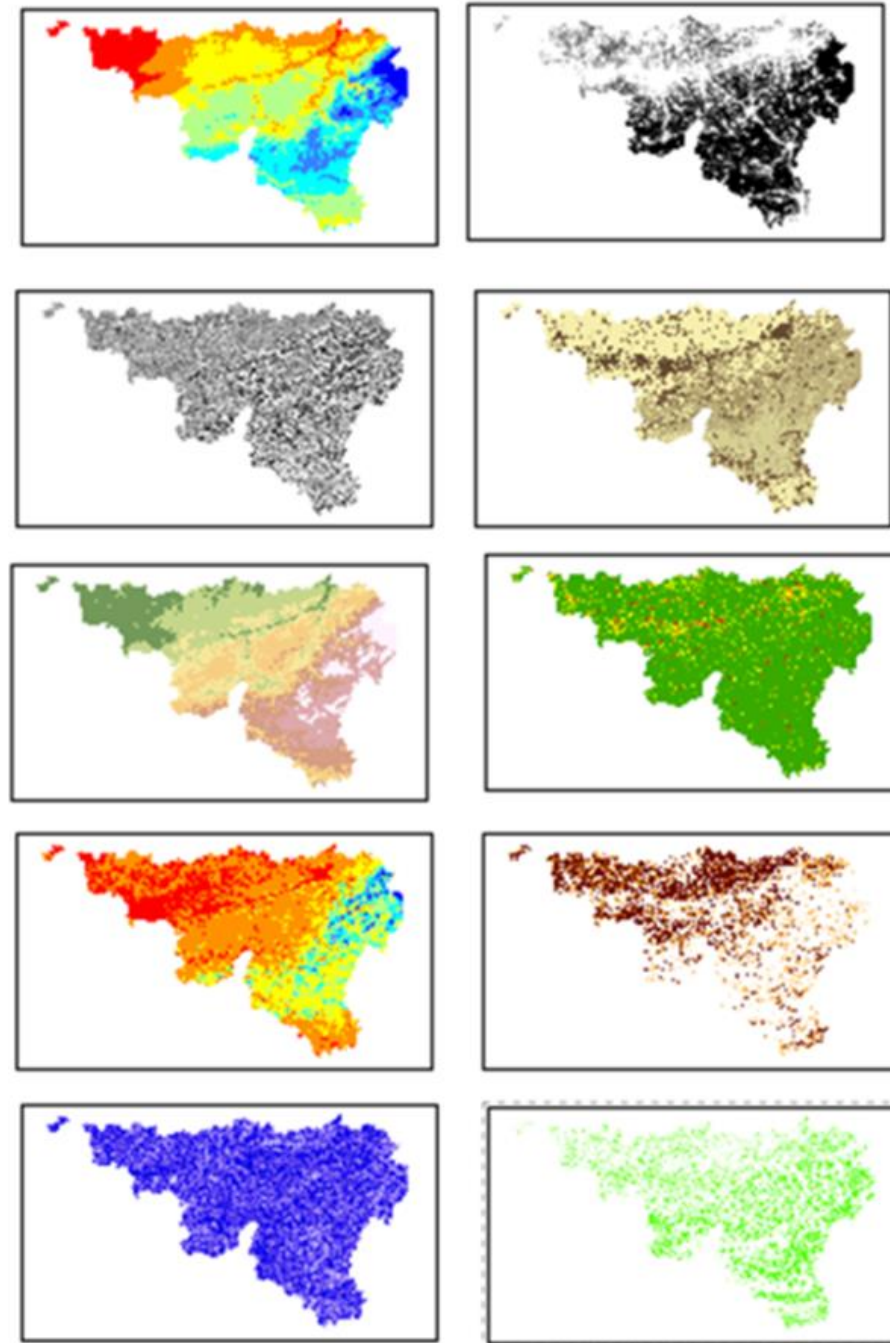


Impact of delineation on AUC for ravine forest biotope

Weight of topography	0	0,5	1	2
RF	55	71	79	72
GAM	79	81	90	90

More than a million polygons, enriched with GIS data

- Land cover ← Image analysis
- Climate ← Worldclim
- Topography ← LIDAR
- Soils ← soil map
- Light pollution ← DMSP
- Phenology ← SPOT,MODIS,PROBA
- Context (derived from land cover)
 - Distance to water, roads, forest, buldings...
 - Proportion within 250 et 500m radius



For accurate land cover, combining RS data is the key

- Sentinel-1 and 2 time series : high temporal and spectral resolution
- Orthophotos : very high spatial resolution (25 cm)
- Height and elevation from LIDAR and photogrammetry

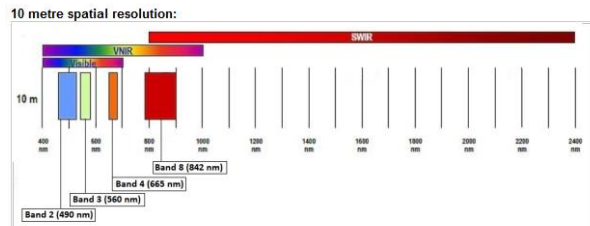


Figure 1: SENTINEL-2 10 m spatial resolution bands: B2 (490 nm), B3 (560 nm), B4 (665 nm) and B8 (842 nm)

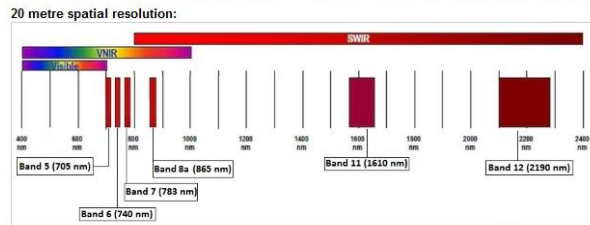
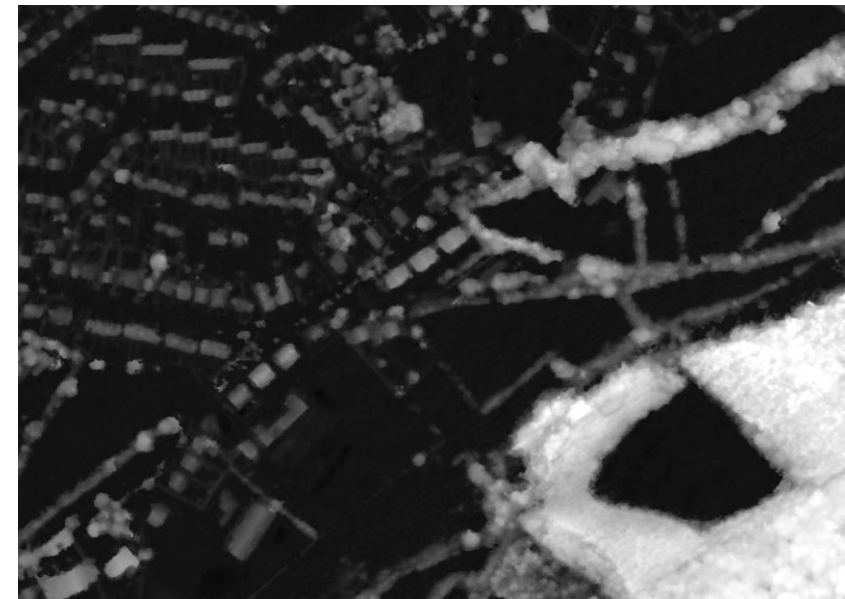


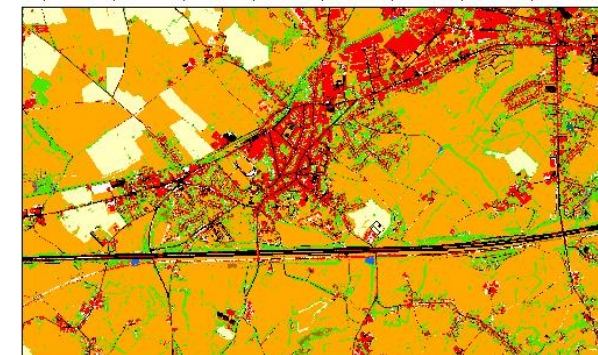
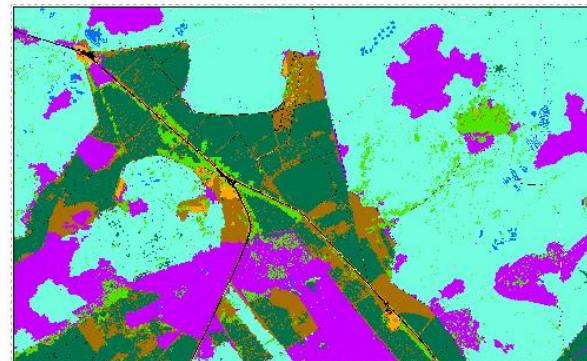
Figure 2: SENTINEL-2 20 m spatial resolution bands: B5 (705 nm), B6 (740 nm), B7 (783 nm), B8a (865 nm), B11 (1610 nm) and B12 (2190 nm)



2m pixel-based classification as a source of land cover

- RS image analysis consolidated in low confidence areas
 - Ancillary data and photointerpretation still needed for specific cases
- Final product with 94,5 +/- 1,2 overall accuracy with 11 classes

Land cover			
	building		Wet open
	Water		Arable land
	Bare soil		Herbaceous
	Impervious surf		Dry open
			Needleleaved
			Broadleaved
			clear cut



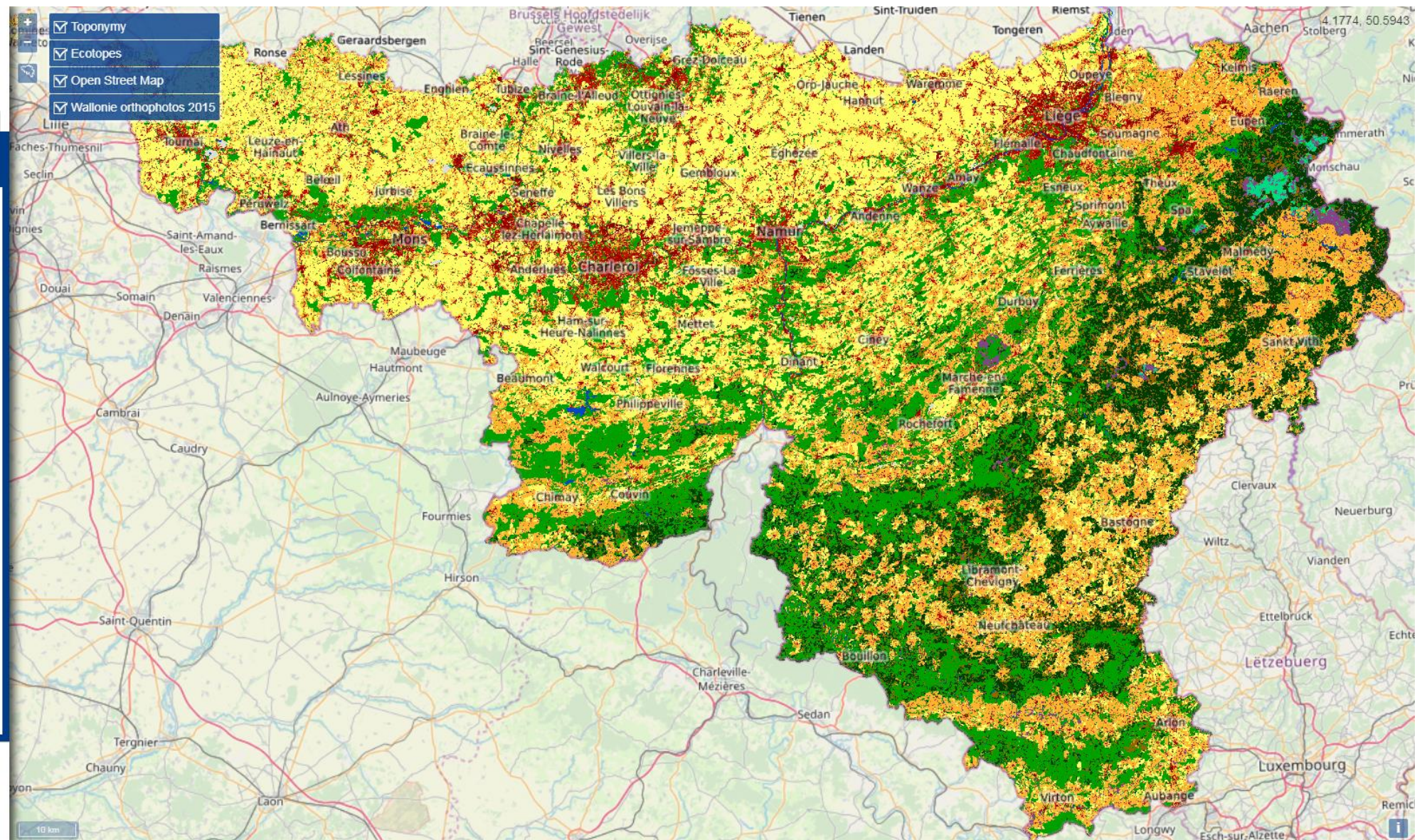
So how to represent a 90+ quantitative variables database ?

- Selecting a legend to create categories
 - Advantage : easy to conceptualize
 - Disadvantage : frozen definition
- Graduated colours for quantitative variables
 - Advantage : a lot of information
 - Disadvantage : only one variable at the time
- Advanced tools to get more...
 - Advantage: more flexibility to users
 - Disadvantage : more difficult to use
- For even more : download database or extract by points

Web portal using OpenLayer and MapServer

- Cropland, rainfed
- Mosaic cropland / vegetation
- Mosaic vegetation / cropland
- Tree broadleaved evergreen
- Tree broadleaved deciduous
- Tree needleleaved evergreen
- Tree needleleaved deciduous
- Tree mixed leaf type
- Mosaic tree, shrub / HC
- Mosaic HC / tree, shrub
- Pioneer vegetation and forest gap
- Monospecific grassland with graminoids
- Diversified grassland and shrubland
- Sparse vegetation
- Shrub or herbaceous flooded
- Dense Urban areas
- Urban areas
- Bare soil
- Water bodies
- No data

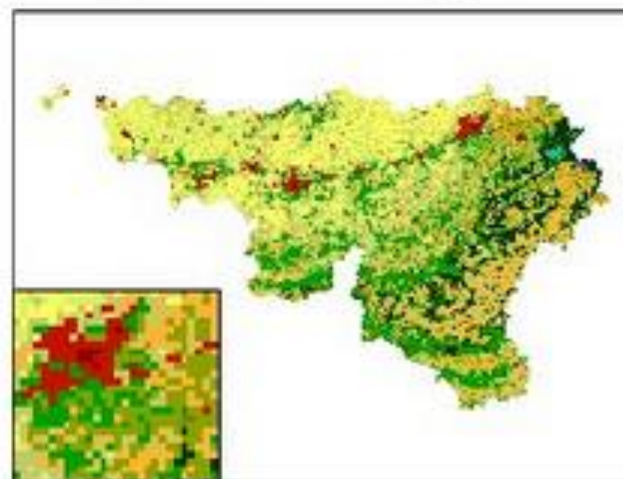
You have to select a polygon to see its properties (selection available with sufficient zoom)



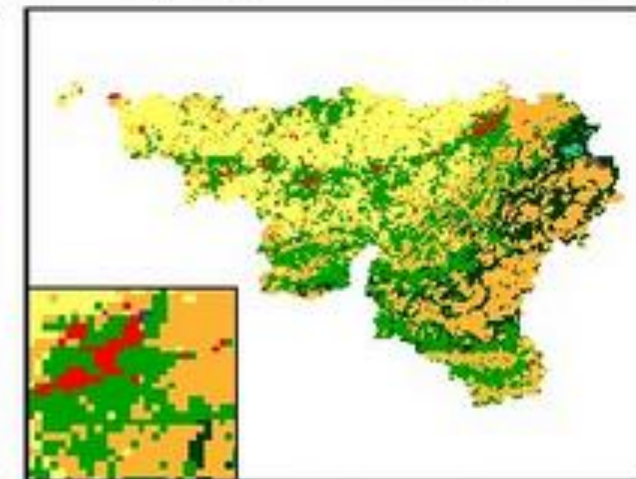
Inside the ecotopes: categorical legend

- Standard classification systems
 - LCCS
 - Majority based
- Choice based on the ESA land cover CCI legend
 - Lower threshold on urban areas
 - Larger threshold for forests
 - New class for diversified grasslands

LCCS-based legend



Majority-based legend



Inside the ecotopes: land cover proportions

Polygons | Variables | Download

Ecotope content | Thematic legend

Land cover variables

Urban areas

detail in the ecotope:



250m around the ecotope:



500m around the ecotope:

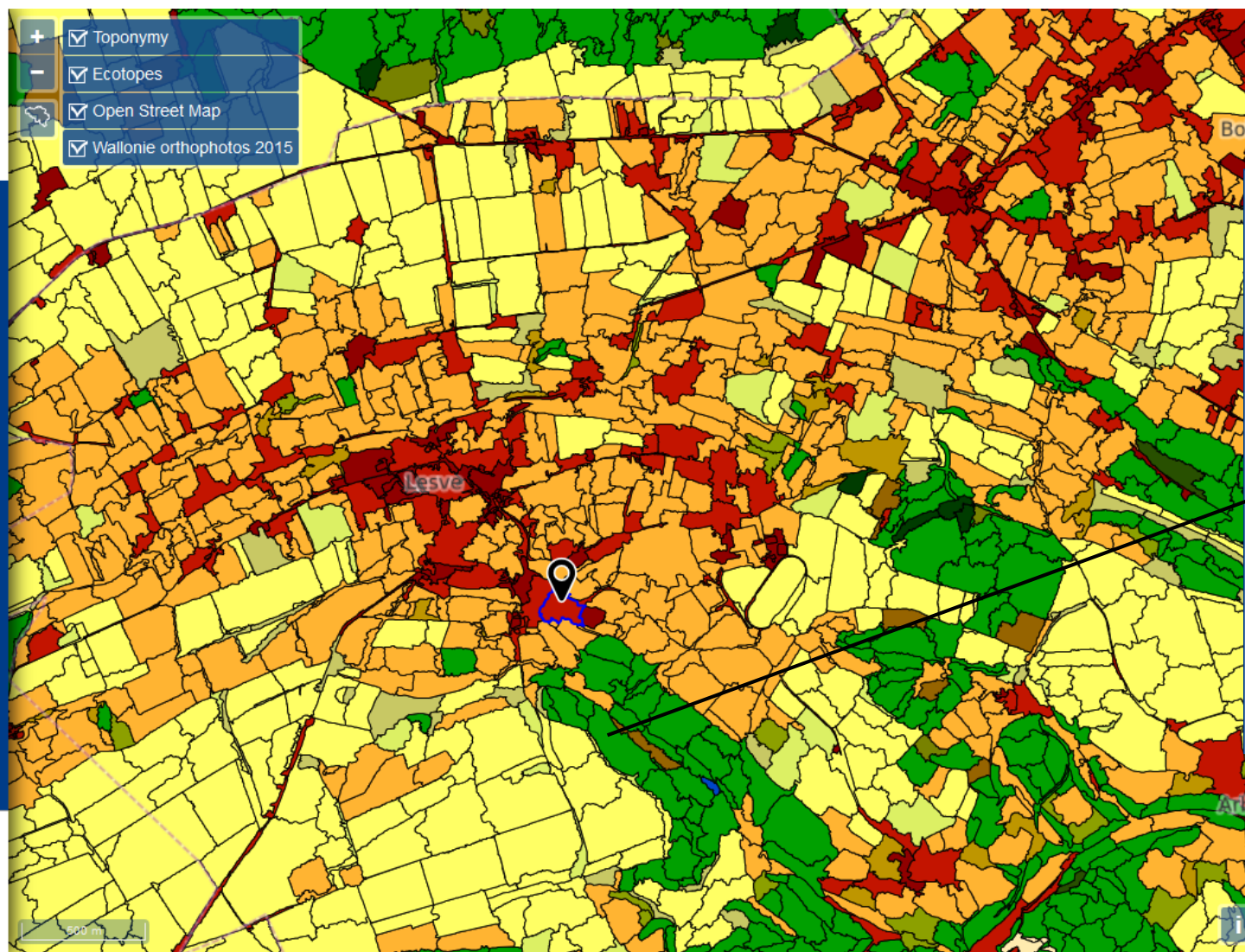


Soil variables

Topographic variables

Other

Subscribe



Land cover variables

Tree cover, broadleaved, deciduous, closed to open (>15%)

detail in the ecotope:



250m around the ecotope:

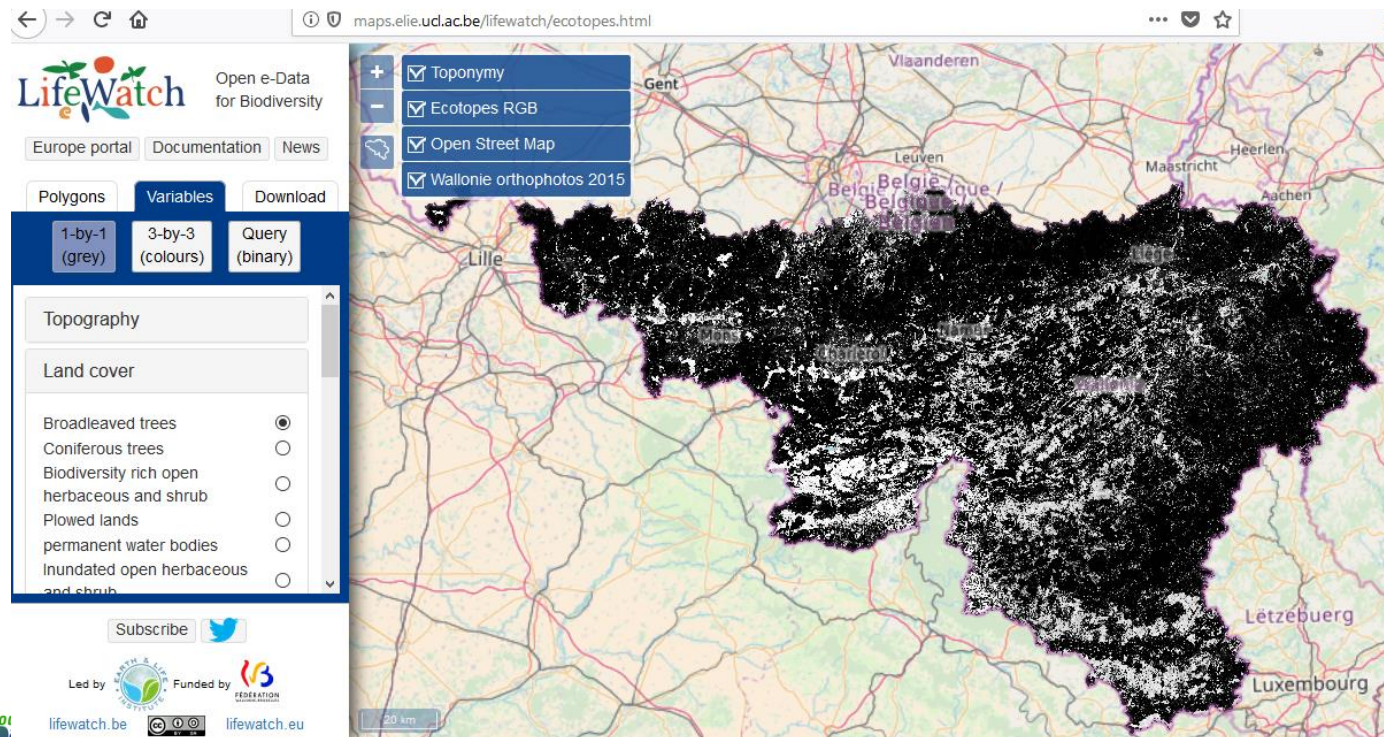


500m around the ecotope:



Inside the ecotopes: single variables

- Intensity proportional to the value
- Values need to be rescaled between 0 and 255 (8bit, screen colours)



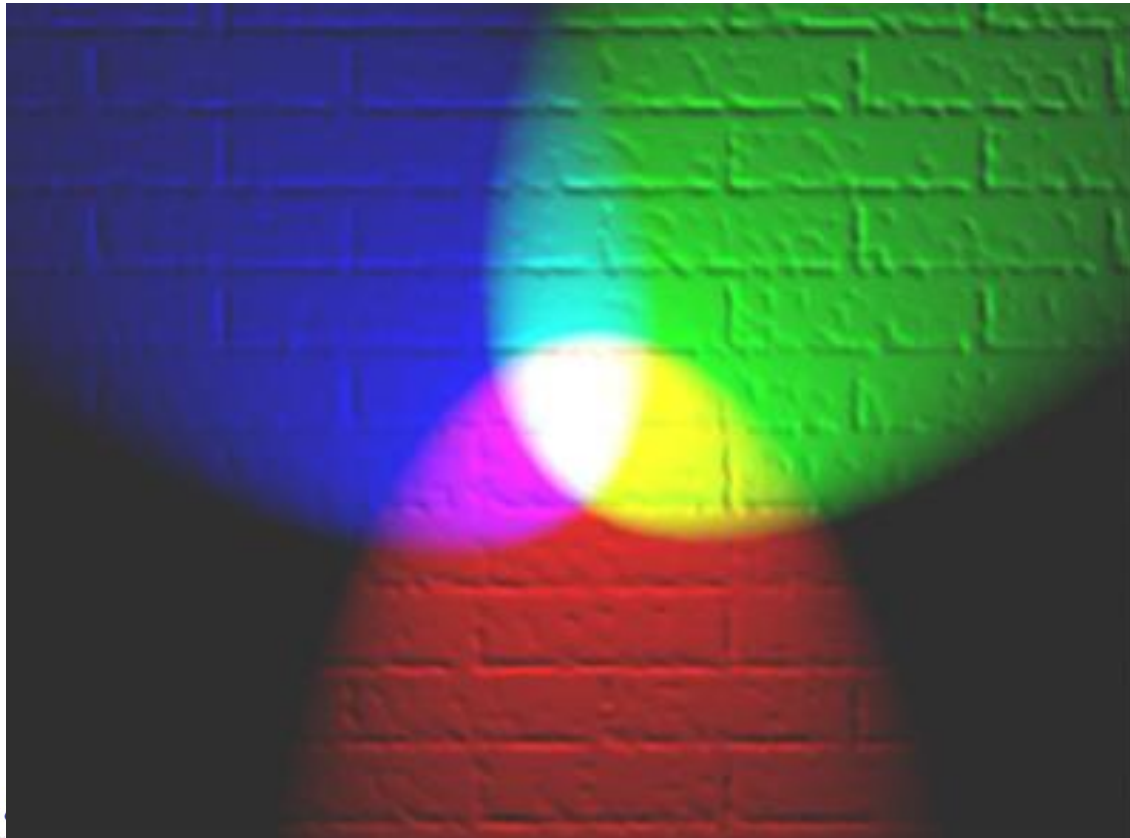
White = 100% broadleaved

Black = 0 % broadleaved

Grey = in between

Inside the ecotopes: color composite

- Human eyes has a spectral resolution of 3 colours: Red, Green and Blue



Red + Green = Yellow

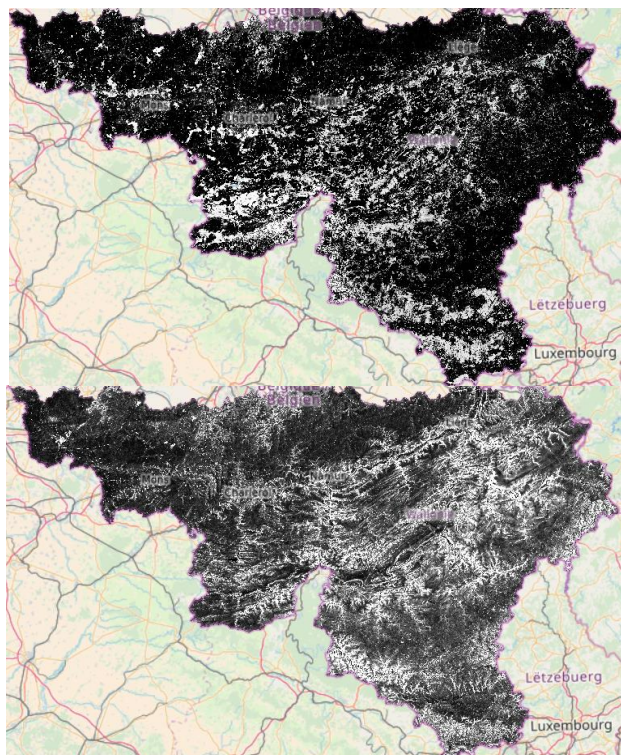
Red + Blue = Magenta

Blue + Green = Cyan

Red + Green + Blue = White

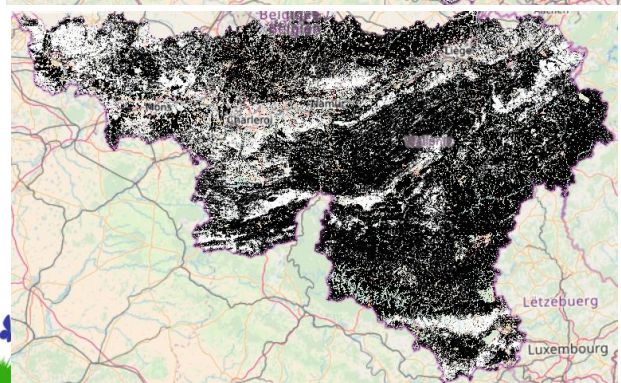
No light = Black

Inside the ecotopes: color composite

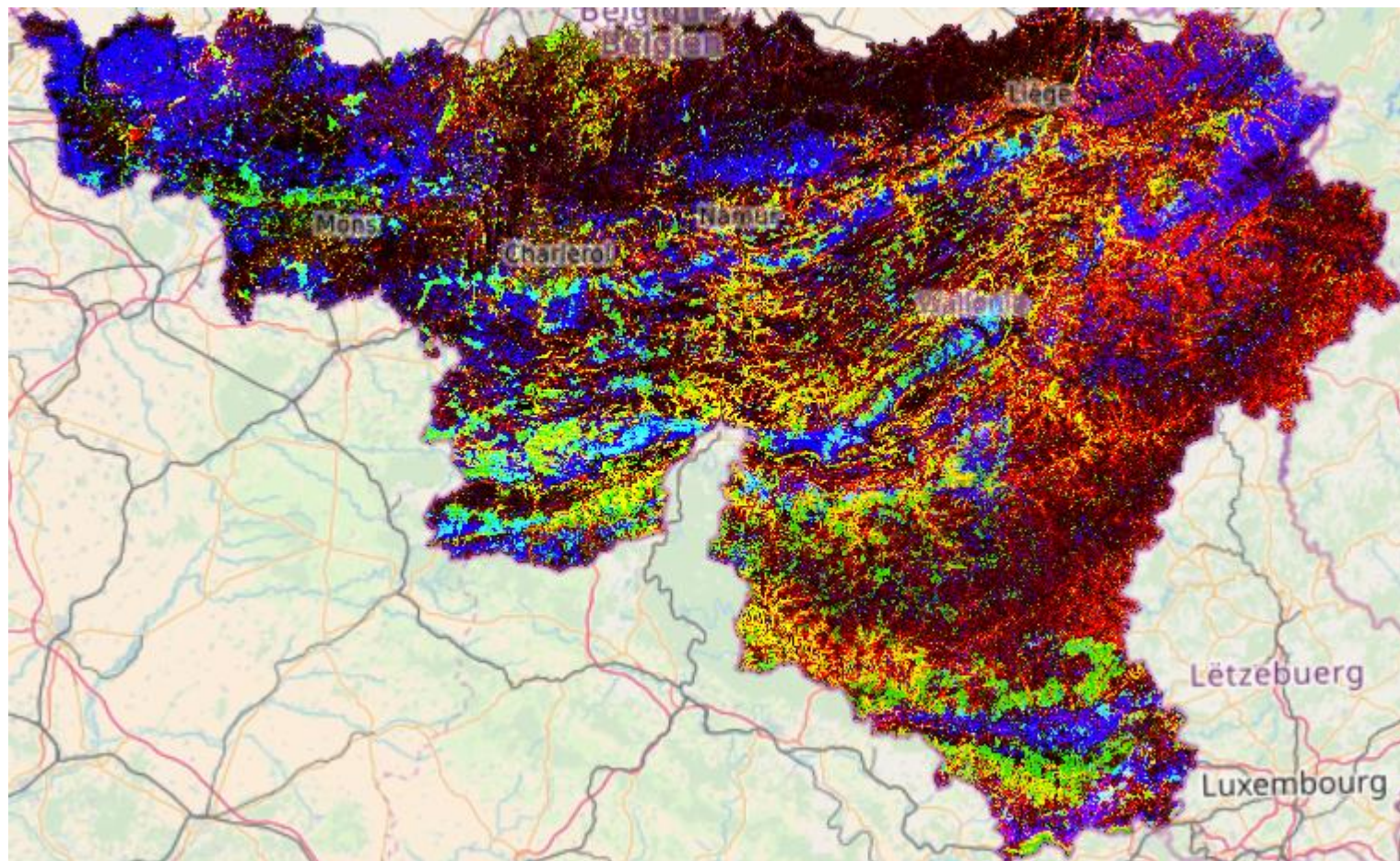


Broadleaved proportion (Green)

Slope percentage (Red)



Imperfect drainage (Blue)

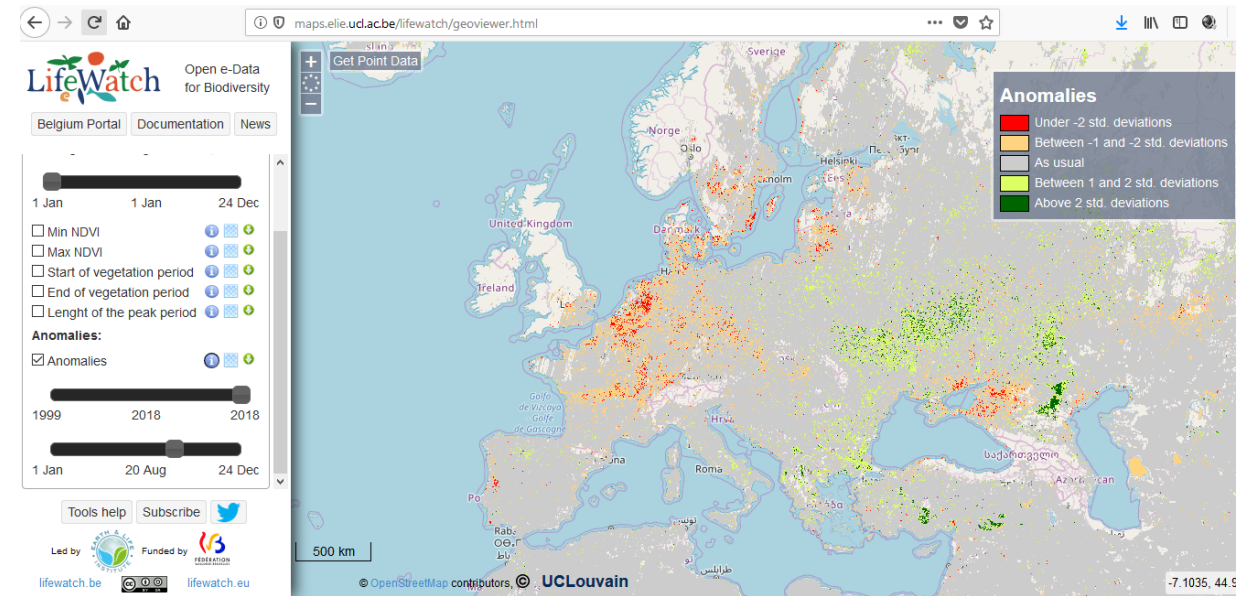
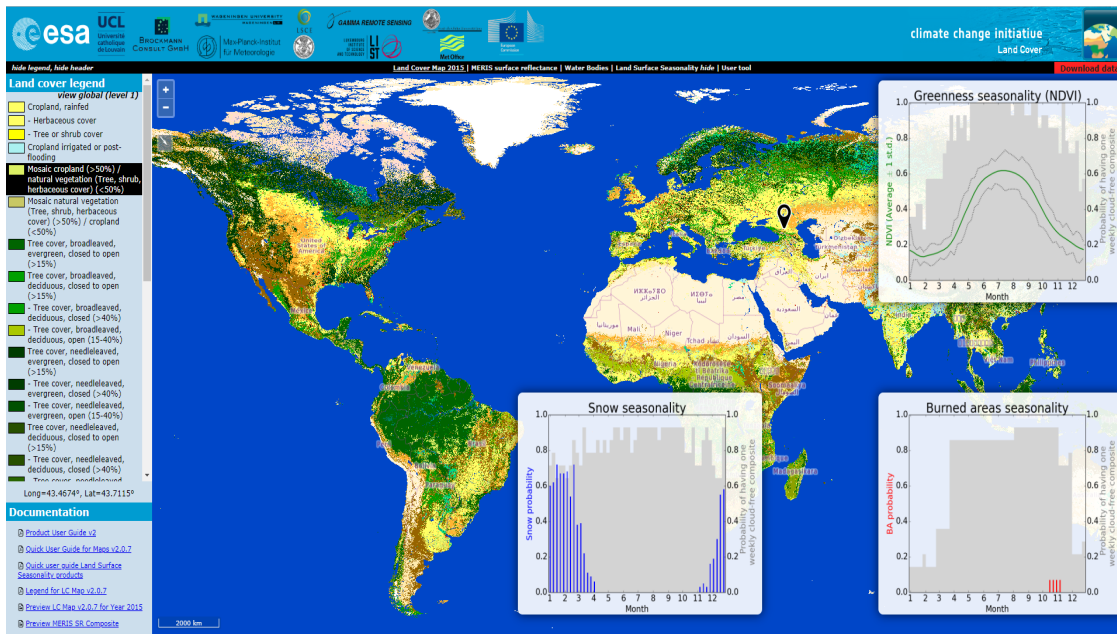


Inside the ecotopes: queries

- For more than three variables
- Binary thresholds

The screenshot displays the LifeWatch web application interface. On the left, a sidebar contains navigation tabs: "Europe portal", "Documentation", and "News". Below these are "Polygons", "Variables", and "Download" tabs. The "Variables" tab is active, showing a "Query" sub-tab. Under "Query", there are three options: "1-by-1 (grey)", "3-by-3 (colours)", and "Query (binary)". The "Query (binary)" option is selected. Below this, a "Topography" section lists several variables with dropdown menus and input fields: "Elevation", "Percentage of slope" (set to 6), "Azimuth angle of the slope", "Roughness of the terrain", and "Potential incident light in spring". Other sections include "Land cover", "Land cover context at 250 m", "Land cover context at 500 m", "Soil depth", "Temperature", "Precipitation", and "Marginal soil proportions". At the bottom of the sidebar, a query editor shows the expression "[slope_prc] > 6 && [broadiv] > 500" with "Confirm" and "manual" buttons. The main map area shows a dark background with white binary query results overlaid on a topographic map. A legend in the top-left corner of the map area lists "Toponymy", "Query", "Open Street Map", and "Wallonie orthophotos 2015". The bottom of the interface includes a "Subscribe" button, social media icons, and logos for "LIFEWATCH", "EARTH & LIFE INSTITUTE", and "LIFEWATCH BE".

maps.elie.ucl.ac.be/lifewatch



...also extreme event for Europe...

...and if you need global time series: maps.elie.ucl.ac.be/CCI

At European level, statistics on the phenology

LifeWatch Open e-Data for Biodiversity

Belgium Portal Documentation News

Fire Greenness Snow Sun

Long term average:

Snow probability

1 Jan 1 Jan 27 Dec

Start of snow period

End of snow period

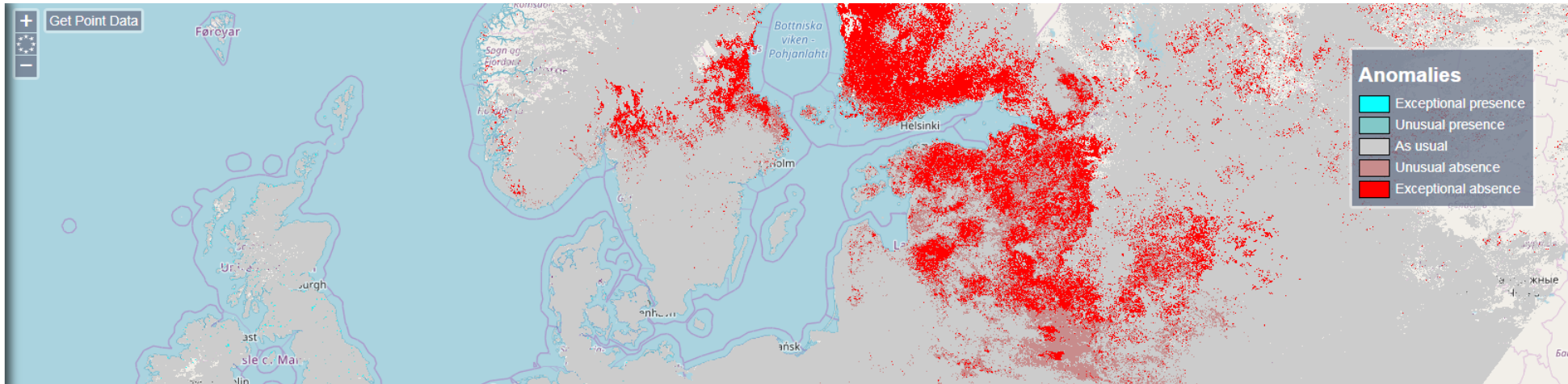
Average duration of snow period

Anomalies:

Anomalies

2001 2014 2018

1 Jan 6 Mar 27 Dec



SCIENCE ADVANCES | RESEARCH ARTICLE

ENVIRONMENTAL STUDIES

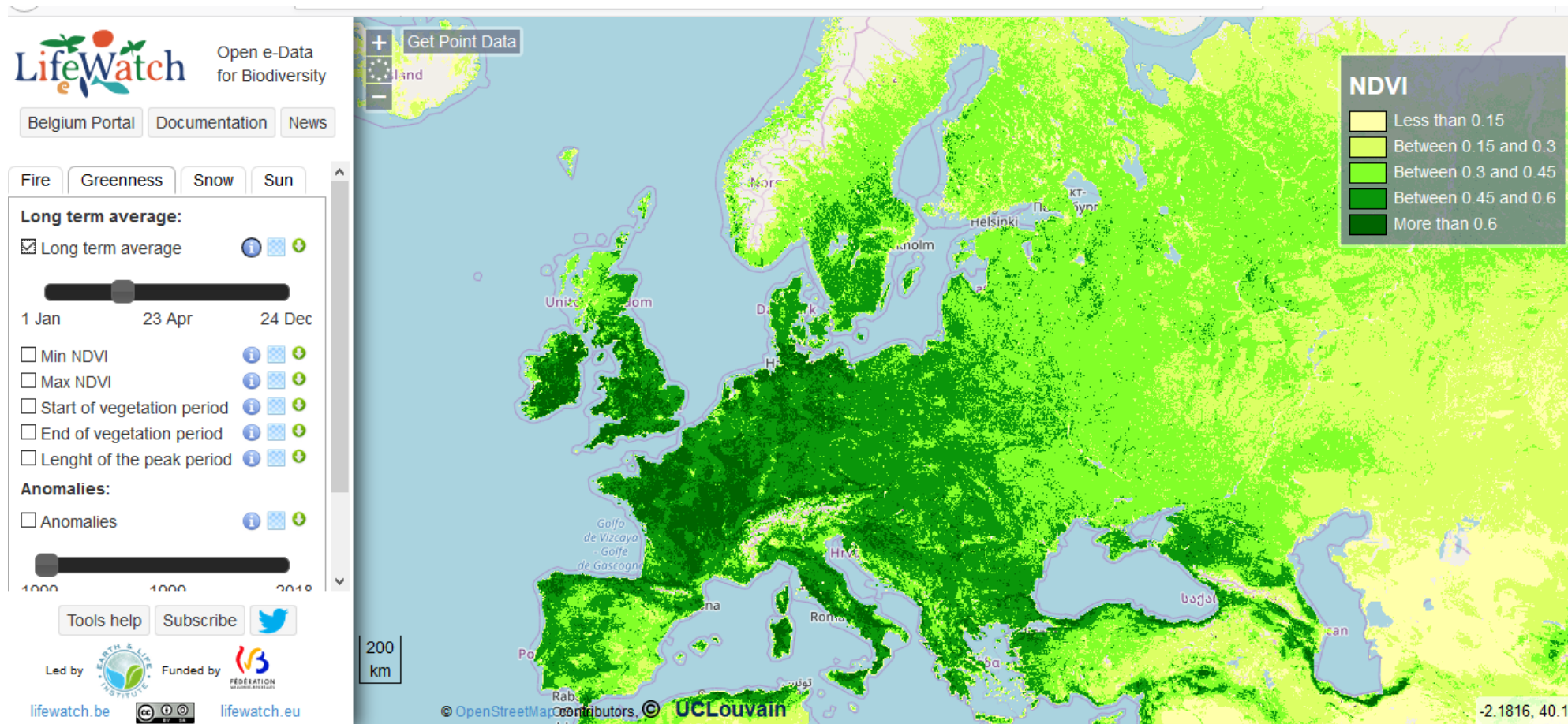
Saigas on the brink: Multidisciplinary analysis of the factors influencing mass mortality events

Richard A. Kock,^{1*} Mukhit Orynbayev,² Sarah Robinson,³ Steffen Zuther,^{4,5} Navinder J. Singh,⁶ Wendy Beauvais,^{1†} Eric R. Morgan,⁷ Aslan Kerimbayev,² Sergei Khomenko,⁸ Henny M. Martineau,¹ Rashida Rystaeva,² Zamira Omarova,² Sara Wolfs,¹ Florent Hawotte,⁹ Julien Radoux,⁹ Eleanor J. Milner-Gulland³

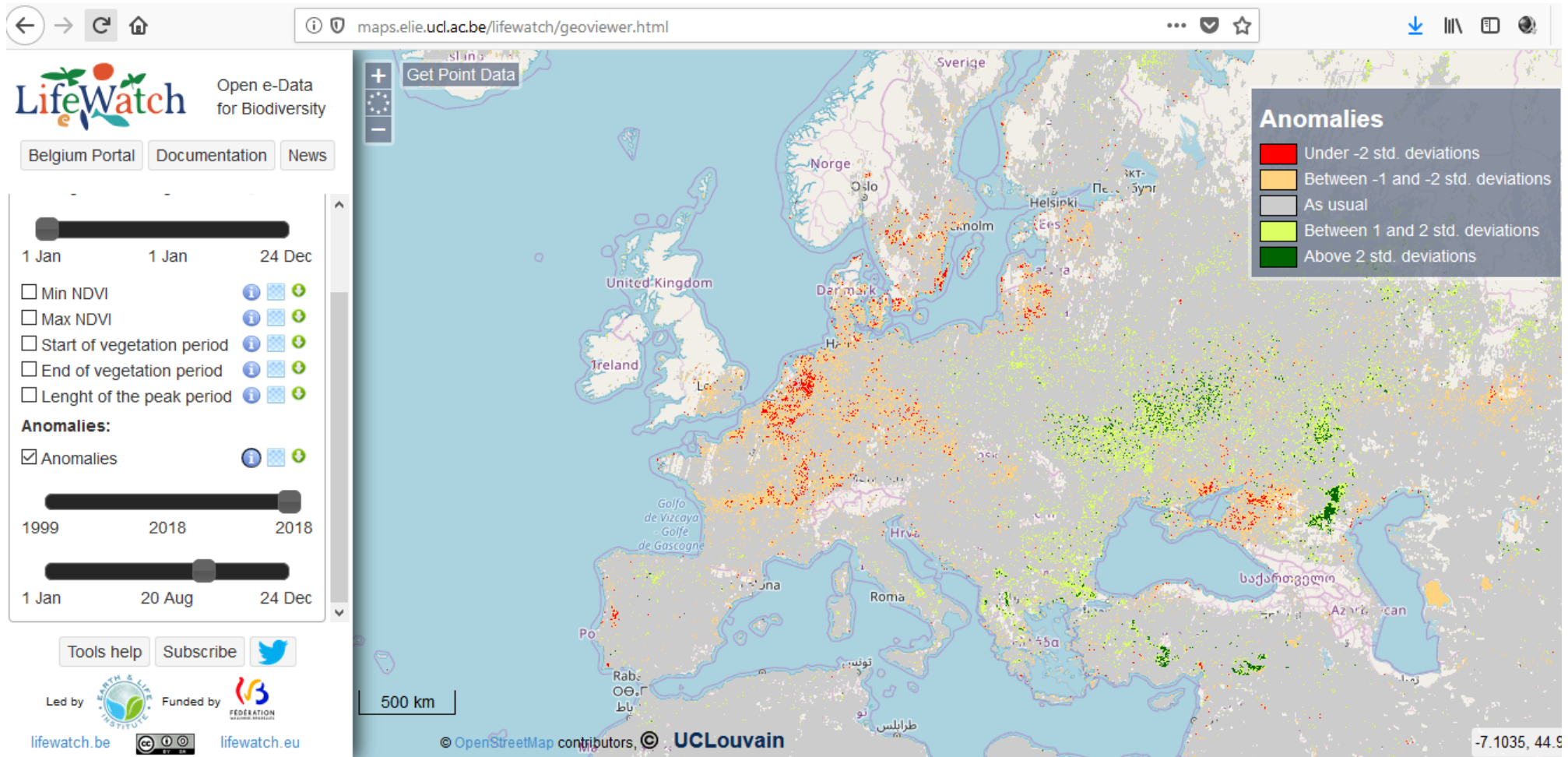
In 2015, more than 200,000 saiga antelopes died in 3 weeks in central Kazakhstan. The proximate cause of death is confirmed as hemorrhagic septicemia caused by the bacterium *Pasteurella multocida* type B, based on multiple strands of evidence. Statistical modeling suggests that there was unusually high relative humidity and temperature in the days leading up to the mortality event; temperature and humidity anomalies were also observed in two previous similar events in the same region. The modeled influence of environmental covariates is consistent with known drivers of hemorrhagic septicemia. Given the saiga population's vulnerability to mass mortality and the likely exacerbation of climate-related and environmental stressors in the future, management of risks to population viability such as poaching and viral livestock disease is urgently needed, as well as robust ongoing veterinary surveillance. A multidisciplinary approach is needed to research mass mortality events under rapid environmental change.

Copyright © 2018
The Authors, some rights reserved;
exclusive licensee
American Association for the Advancement of Science. No claim to original U.S. Government Works. Distributed under a Creative Commons Attribution NonCommercial License 4.0 (CC BY-NC).

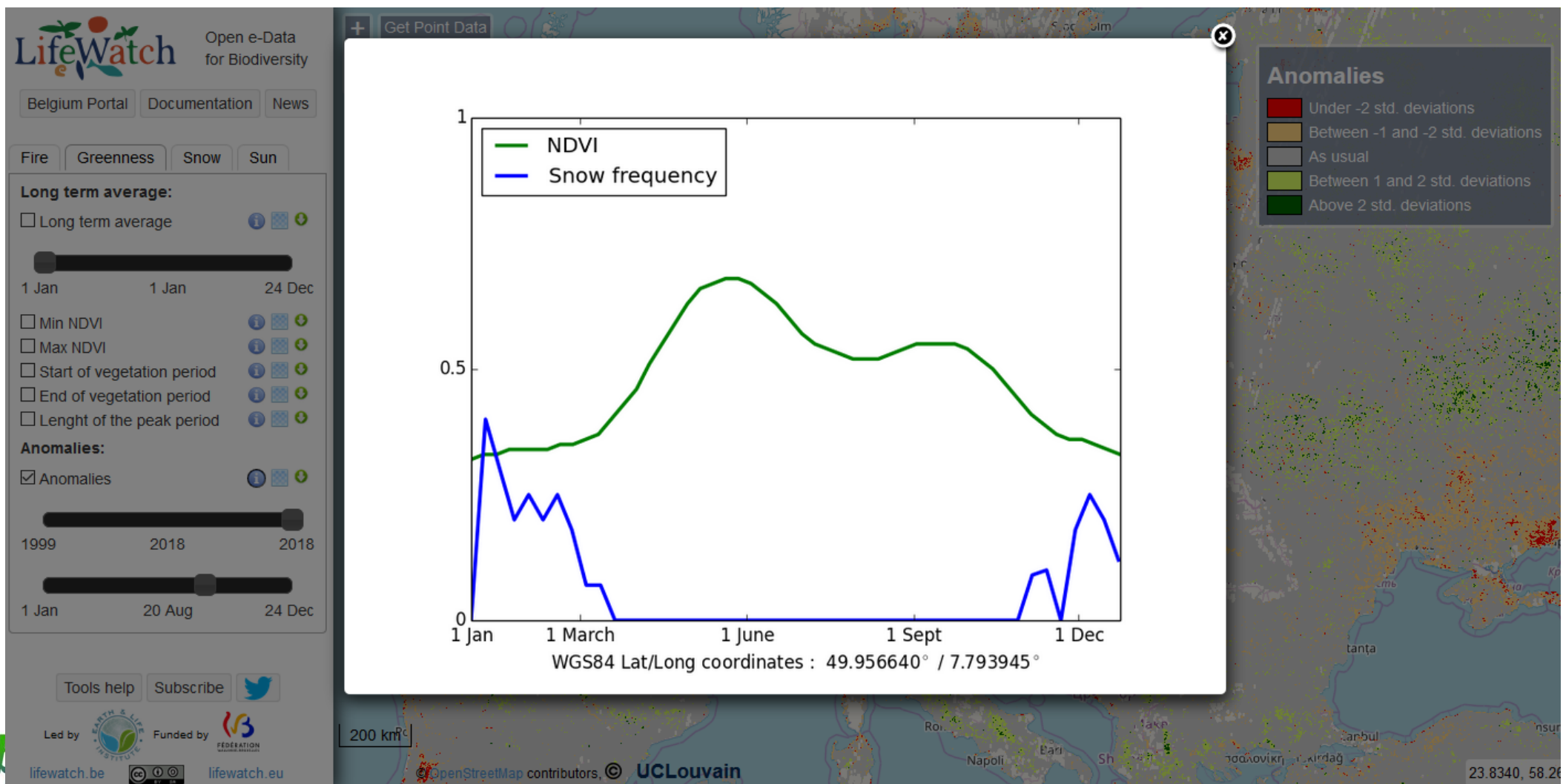
Looking at time series: Long term average



Looking at time series: Anomalies



Looking at time series: temporal signature



[hide legend, hide header](#)

[Land Cover Map 2015](#) | [MERIS surface reflectance](#) | [Water Bodies](#) | [Land Surface Seasonality](#) [hide](#) | [User tool](#)

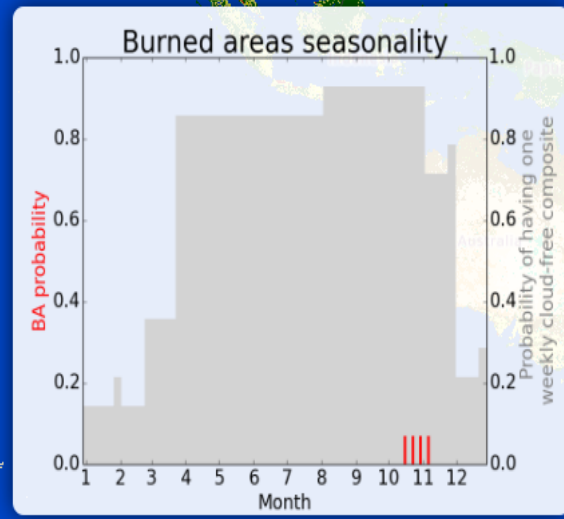
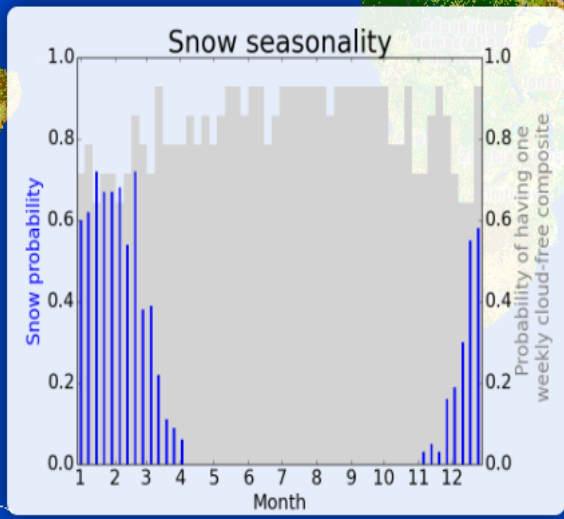
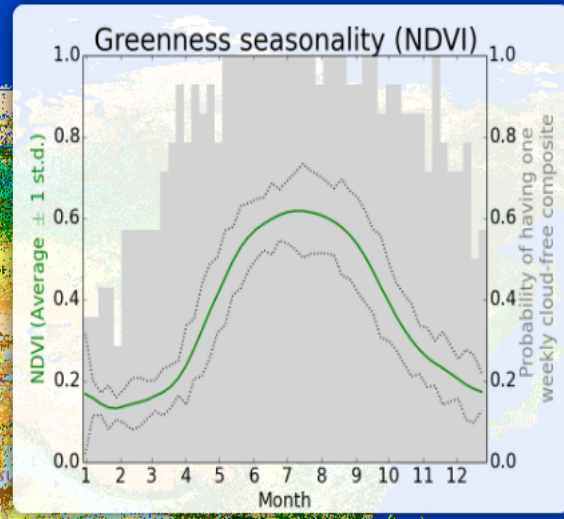
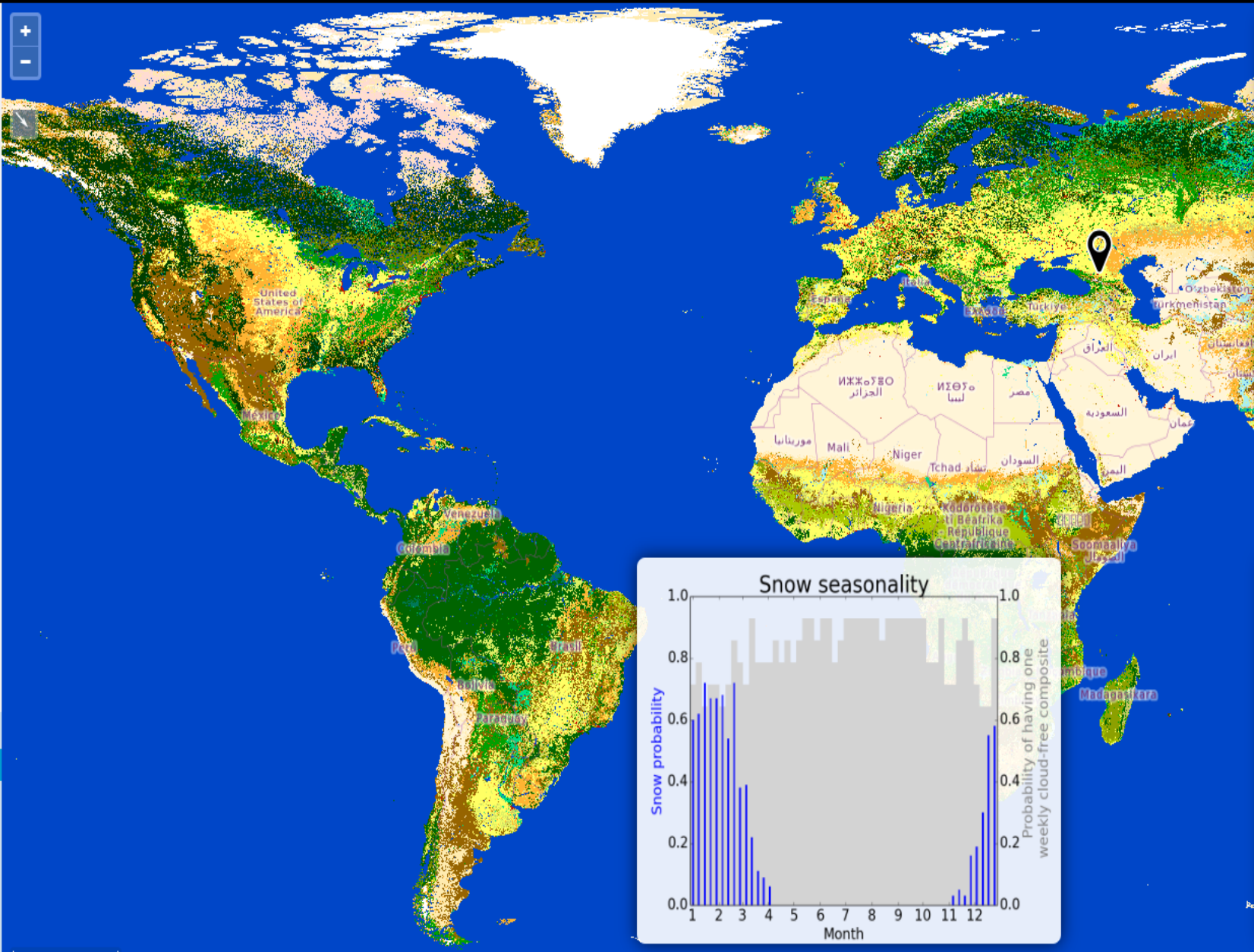
[Download data](#)

Land cover legend

- [view global \(level 1\)](#)
- Cropland, rainfed
 - Herbaceous cover
 - Tree or shrub cover
 - Cropland irrigated or post-flooding
 - Mosaic cropland (>50%) / natural vegetation (Tree, shrub, herbaceous cover) (<50%)
 - Mosaic natural vegetation (Tree, shrub, herbaceous cover) (>50%) / cropland (<50%)
 - Tree cover, broadleaved, evergreen, closed to open (>15%)
 - Tree cover, broadleaved, deciduous, closed to open (>15%)
 - Tree cover, broadleaved, deciduous, closed (>40%)
 - Tree cover, broadleaved, deciduous, open (15-40%)
 - Tree cover, needleleaved, evergreen, closed to open (>15%)
 - Tree cover, needleleaved, evergreen, closed (>40%)
 - Tree cover, needleleaved, evergreen, open (15-40%)
 - Tree cover, needleleaved, deciduous, closed to open (>15%)
 - Tree cover, needleleaved, deciduous, closed (>40%)
 - Tree cover, needleleaved, deciduous, open (15-40%)
- Long=43.4674°, Lat=43.7115°

Documentation

- [Product User Guide v2](#)
- [Quick User Guide for Maps v2.0.7](#)
- [Quick user guide Land Surface Seasonality products](#)
- [Legend for LC Map v2.0.7](#)
- [Preview LC Map v2.0.7 for Year 2015](#)
- [Preview MERIS SR Composite](#)



2000 km