Lifewatch-WB geodatabase (v3.14): attribute description.

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1 Major changes since last version

The variables of the ecotopes are compute with the best available dataset and adapted to model needs. The first version number (v3.*) is defined by the methodology used for the delineation of spatial units. The second number (v*.14) is defined by the methodology and the source datasets used to extract the variables.

The main changes of the .14 version are related to a new source for climate variables, the extraction method of topographic variables (average instead of center of polygon) and the grouping of soil classes for the sake of consistency across the whole country. More details are given in chapters 3 and 5, respectively. With the addition of the year 2018 (only in Wallonia) the land cover has been consolidated across all years.

2 Climatic variables

2.1 Variables extracted from climate models

Bioclimatic variable were extracted from the high-resolution future climate data for species distribution models in Europe (De troch et al, 2020). They represent historical climate between 1971 and 2005. https://zenodo.org/record/3694065

AnM_T comes from Var1, mean annual temperature in °C

AnVar_T annual variation of the temperature (stdev)

AnRg_T temperature annual range in °C

GDD_5deg Mean annual cumulated growing degree days (above 5°C)

An_PotETP Annual mean potential evapotranspiration (mm day-1)

AM_SolR Annual mean solar radiation (W m-2)

AnVar_SolR Annual variation of the solar radiation W m-2

MaxWarmM_T comes from var5, max temperature of the warmest month in °C

MinColdM_T comes from var6 min temperature of the coldest month in °C

WetM_P comes from var8 precipitation of the wettest month in mm

DryM_P comes from var9 precipitation of the driest month in mm

AnTot_P comes from var2, sum of annual rainfall in mm

AnVar_P Annual variation of the precipitation (coefficient of variation)
Metrics extracted from Lifewatch-WB land surface dynamics products

Those metrics are derived from the Lifewatch WB snow analysis, which consists in the filtering and analysis of MODIS snow product since 2000. Those variable are good proxies of the other climatic variables from Worldclim and are avaiblable with a better resolution. (www.uclouvain.be/lifewatch)

Because of the spatial resolution of 500m, values are extracted at the location of the centroid (with a nearest neigbour interpolation)

SnowStart is the earliest date of snow with more than 50 % probalities (in weeks since the European least snow cover week, i.e. week #32). The probabilities are estimated based on filtered snow cover frequencies between 2000 and 2012. A value of 999 is assigned if the probability never exceeds 0.5.

SnowEnd is the latest date of snow without more than 50 % probalities (in weeks since the European least snow cover week, i.e. week # 32). The probabilities are estimated based on filtered snow cover frequencies between 2000 and 2012. A value of -1 is assigned if the probability never exceeds 0.5.

SnowLength is the average snow duration, in weeks.

3   Topographic variables

The source of elevation information for computing the topographic variables is the 2013-2014 LIDAR dataset of the Walloon region (0.8 pts/m²). It was smoothed and resampled at 10 m resolution, then combined with the 2015 LIDAR dataset of the Flemish region in order to cover the full extent of Belgium. A linear combination of the two DEM was used in the overlap region in order to avoid sharp transitions.

Elev is the elevation, in m, measured at the centroid of the ecotope.

Azimuth is the orientation of the normal of the slope measure in the centroid of the polygon. The values is measure clockwise in centiDegrees, with 0 at the cartographic North.

SunSpring potential incident light energy in W/m² for the first day of spring, measure at the center of the polygon. This variable integrates the clear sky sun energy reaching the ground during 24h (measure every hour) on march 21. Slop is measured in the center of 4 pixels. Topographic shadows are taken into account.

Roughness mean roughness of the ecotope. Difference between the min and max slope inside o 3*3 moving window on a 10 m resolution DEM.

Slope_prc mean percentage of slope of the ecotope. Slope is derived from 1-m LIDAR data resampled at 10 m with Lancsoz method.

Position is the mean relative position of the ecotope in a 200 m radius. This value ranges from 0 (lowest elevation of the neighbourhood) to 100 (highest elevation of the neighbourhood).

4 Land cover

4.1 Proportions inside ecotopes

The ecotopes are automatically delineated based on the orthophotos and the LIDAR. More info on the method is available in Delangre et al (2017) and Radoux et al (2019). In addition to the ecotopes, different 1km grids are also available for download.

Ten land cover classes are used to characterise the ecotopes, out of which 9 are present in Wallonia. The proportion of each class is computed based on a 2m resolution layer from the Lifewatch-WB project based on the analysis of ortho-images, LIDAR data and Sentinel-2 time series. The two-meter layer has been validated by photointerpretation consolidated on the field when necessary. The Lifewatch project team thanks Jeroen Vanden Borre (INBO) for the validation of Flanders. The overall accuracy based on 1200 randomly distributed points is ~93%. The geodatabase file uses some aliases that are visible with some software. The proportions are stored in "per thousand", ranging from 0 (absence of land cover type) to 1000 (pure ecotope for this land cover type). Those fields exist for 2006 and 2015 in Wallonia, and for 2015 in Flanders.

BroadLV (Alias Broadleaved trees): broadleaved trees (angiosperms), located in forests or other land use (hedges, orchards…)

NeedlLV (Alias needleleaved trees): Coniferous trees (gymnosperms) located in forests or other land use (hedges, gardens…).

Plowed (Alias ploughed herbaceous cover): arable lands (annual crops and temporary herbaceous cover)

MGramin (Alias permanent monospecific graminoid cover): permanent monospecific gramninoid cover resulting from intensive land uses such as intensive farming, gardens, leisure …

NOpen (Alias open area with relatively dry soils): permanent herbaceous cover mixed with other non lignous vegetation. This class covers a large number of potential biodiversity hotspots such as heathlands or extensive grasslands

WOpen (Alias open area with humid soils): flooded herbaceous cover mixed with other non lignous vegetation. This class covers a large number of potential biodiversity hotspots such wetlands and peatlands.

Water (Alias permanent water bodies): permanent water bodies

Bare (Alias bare soils): bare soils or soils sparsely covered by vegetation (<15%), mainly quarries in Wallonia

Ice (Alias permanent snow and ice): permanent snow and ice (absent in Wallonia)

Artif (Alias artificialised surface and building): surface of the soil covered with man-made impervious surfaces (e.g. concrete or bitumen) and buildings. This class includes roads, car parks, bridges, houses and other buildings.

COpen (Alias disturbed open area) : Permanent herbaceous and shrub cover from forest adventice plants and young trees. This class includes recent clear cuts, small forest gaps where tree crown cover is absent as well as ruderal vegetation from recently disturbed areas or Christmas tree plantations.

4.2 Contextual land cover proportions

Contextual information is based on the 2-m land cover information resampled at 10-m with a majority rule. Two circular neighborhoods are used: the first has a radius of 25 pixels and the second has a radius of 50 pixels. The size of the radius, in meter, is mentioned in the field name. The average of the proportion of each land cover is computed for each ecotope and rescale between 0 and 100%. The proportions are stored in "per thousand", ranging from 0 to 1000.

Warning : currently, land cover information is only available inside the boundaries of Belgium. Pixels outside of this boundary are therefore ignored by the neighbourood, which means that polygon along the boundaries are not characterized identically to the boundary polygons. A quality flag allows you to know how much data is missing.

The Q_boundary field has been removed from this version because the land cover across the boundaries is now available for the buffer area.

BroadLV250 or 500 : broadleaved trees (angiosperms),

NeedlLV250 or 500 : coniferous (gymnosperms)

Plowed250 ou 500 : land being ploughed during the year

MGramin250 or 500 : permanent monospecific herbaceous cover

 NOpen250 or 500 : permanent mix of herbaceous cover and other non lignous vegetation or small shrub

WOpen250 or 500 : permanent inundated mixture of herbaceous cover and other non lignous vegetation or small shrub

COPen250 or 500 :

Water250 or 500 : open water bodies

Bare250 or 500 : permanent bare soil

Artif250 or 500 : built up and impervious surfaces

4.3 Thematic categories

For the sake of representation, different classification systems have been applied on top of the land cover proportions. Currently, three classification systems are available: LC CCI-like, majority based and kmean

LCCS categories based on the ESA land cover CCI legend are available in field « LCCS ». Those classes are based on fixed thresholds selected based on global landscapes. The grassland class from the LCCS was split into two classes : monospecific and diversified grasslands. Furthermore, one additionnal urban class has been added because a majority of settlements of Wallonia have a built up proportion below the 50 % threshold. Details about the validation of the product are available in Radoux et al, 2017.

Code	Description
10	Periodically herbaceous
60	Broadleaved deciduous forest
70	Needleleaved sempervirens forest
80	Needleleaved deciduous forest
130	Permanent monospecific productive grassland
135	Diversified grassland and shrubland (see annex)
180	Shrub and herbaceous flooded
190	Densely artificialized (>50% artificial surface)
195	Sparsely artificialized (>25% artificial surface)
200	Bare soil
210	Water
90	Mixed forest
100	Mixed herbaceous and tree cover (with majority of trees)
110	Mixed herbaceous and tree cover (with majority of herbaceous)
150	Mixture of vegetation and bare soils
120	Recently cleared areas with forest regrowth, also includes forest gaps and Xmas trees
30	Mixed crop cover (with majority of crops)
40	Mixed crop cover (with minority of crops)

The majority of the land cover proportions is provided as an additional label for a more simple representation of the land cover. The labels are not fixed in this case.

Code	Description
10	Periodically herbaceous
60	Broadleaved deciduous forest
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130	Permanent monospecific productive grassland
135	Diversified grassland and shrubland (see annex)
180	Shrub and herbaceous flooded
190	Artificialized
200	Bare soil
210	Water
120	Recently cleared areas with forest regrowth, also includes forest gaps and Xmas trees

The land cover types are also grouped according to a hierarchical kmean based on the non artificialized land cover classes.

5	Annual crop
9	Broadleaved deciduous forest
8	Needleleaved sempervirens forest
6	Intensive (usually monospecific) productive grassland
7	Natural open area (herbaceous and or small shrub) of potentially high biodiversity
3	Artificialized
4	Water bodies
2	Sparse vegetation and recently disturbed open areas (e.g. clear cuts)

The CorLike legend is a tentative model to translate the ecotope content into Corine land cover codes. The results are not validated and the information should be used with care.

4.4 Raw raster layers

The raw raster layers of 2006, 2015 and 2018 (2m) are available "as is" for specific advanced use. This dataset is consolidated when integrated into the ecotopes: they are not complete and should therefore not be used to build official statistics. The class codes are the following:

10: Open water, including rivers, ponds and lakes

15: Permanent bare soil or vegetation cover < 10%, including dunes, bare rocks and quarries

20: Artificialized impervious surface, including roads, railroads and car parks

21: buildings taller than 1 m, including houses, commercial and industrial buildings, and bridges

30: Arable land (plowed at least once during the year), including cropland and temporary grassland

35: Grassland (managed), including intensive agricultural grassland, gardens and leisure grasslands

40: Open vegetation with biological interest (dry), including extensively managed grassland with biological interest, natural grassland and heathland vegetation (also peatlands if they are dry on top).

45: Open vegetation with biological interest (wet), including reed beds and marshes

48: Recently disturbed (less than 5 years before) ligneous vegetation, including young plantations and clear cuts

50: Needleleaved trees (>3m), isolated, in hedges or inside forests, including Christmas trees

51: Needleleaved shrub (<=3m), isolated, in hedges or inside forests

55: Broadleaved trees (>3m), isolated, in hedges or inside forests

56: Broadleaved trees (<=3m), isolated, in hedges or inside forests, including intensive orchards

100 : No data (lack of information to classify the pixel, due to shadows or unconfirmed change)

5   Soil attributes

Soil attributes are derived from the digital soil map of Wallonia (Source : Copyright – SPW-licence n° 160114-0837 – Legrain et Brieuc, 2012). Proportions are stored as integer values between 0 and 1000. Data is not complete: values are missing in and around urban and some military areas. In this case, the sum of the proportions is not equal to 1000. Note that polygons with a complex of soils could be counted twice. The sum of Sandy and clay could therefore exceed 1000.

5.1 Specific soils

Type	Texture	Definition
Peaty	V-E	Peat and clay
	V	Peatland
Organic	V-E	Peat and clay
	V	Peatland
	W	Inactive peatland
	(v)	Organic soil (more than 40 cm)
	(v3)	Organic soil (between 20 and 40 cm)
	(v4)	Organic soil (less than 20 cm)
Sandy	Z	Sandy soil
	S	Silty sand
	P	Silty sand complex
	Complex	All soil complexes including S or Z
	X, dunes	Dunes
Clay	U	Heavy clay
	E	Light clay
	Complex	All complexes including E or U
	M	Marl

Type	Charge	Definition
Calcareous	N ; nx	Chalk ; Chalk and silex
	N	Chalky complex
	I, iu	marl charge, clay from marl alteration
	K,kf ,kr,	Calcareous, Schisto-calcareous, Sell/sandstone/calcareous,
	K, Kf	Clay-calcareous complex, Sell/clay/calcareous complex
	M, Ma	Marl
	Km	Macigno-calcareous
	J	Calcareous sandstone
	J	Dicontinuous calcareous sandstone
	Do	Doline,
	X	Dunes

Type	Symbol	Definition
Source	B, B(1) ; B/o	Sources
Alluvial	Soil profile p and drainage efg	Undefined soil profile with low drainage
	R ; R(1)*	Pebble alluvial soil
	S ; S(1)*	Silty alluvial soil
	Soil profile p and drainage hi	Undefined soil profile with low drainage

Changes since the version 2.11 are linked with the extension of the ecotopes mapping to the entire Belgium.

1) New categories of sandy soils (additional sandy complexes) were added as well as two other types of calcareous soils (marls and dunes).
2) Because of the lack of details about alluvial soils in most of Belgium areas, the different types of alluvial soils were merged into one.

5.2 Soil depth

Proportion of the soil depth classes inside each ecotope. Currently not available in Flanders.

Dpt_Zero : no soil (flushing rock and strong slopes with flushing rocks: A, J and J-H).

Dpt_Superf : superficial soil, less than 30 cm (not including flushing rocks from the previous class).

Dpt_Mid : depth between 30 and 80 cm, also includes V and (w) soils

Dpt_Deep : deep soils, more than 80 cm, also includes W soils

5.3 Drainage

Proportion of the soil drainage classes inside each ecotope.

Classe	drainage	Definition
Dr_Dry	a ; A (a+b+c+d) & texture=Sandy ; b & texture=Sandy Dunes Flushing rocks	Very dry soils.
Dr_Mid	b & texture≠Sandy ; B & texture≠Sandy; A & texture≠Sandy ; c ; D(c+d) ; d	Favourable (clay or silt) or moderate drainage (from no gley to moderately gleyish)
Dr_Humid	H;i;I;j	Poor drainage, gleyish, without reduced horizon, temporary saturated by water + schorre
Dr_Satur	e;f;g;e-f;e-i	Permanently saturated by water, with reduced horizon (+ peatland soil + sources)

Changes since version 2.10: the limits of the classes have been adjusted by moving the d soils from humid to moderately humid, in order to make the Dr_Humid class more specific.

5.4 Completeness

Q_Soil: proportion (between 0 and 1000) of the ecotope that is actually described in terms of soil.

6 Other variables

6.1 Height

Height classes are derived from different data filtered in the frame of Lifewatch-WB project. The height dataset is a combination of different sensors (LIDAR + photogrammetry) with post – processing, therefore the quality differs. The proportions of tree/shrub in each height class is computed and rescale between 0 and 1000.

H_L1m : Less than one meter, but larger than the threshold of 25cm used to exclude sensor noise.

H_1To4m : 1 to 4m (shrubs)

H_4To7m : de 4 à 7 m (small trees)

H_7To50m : de 7 à 50 m (trees)

In addition in this version, the average height of pixels detected as trees or shrubs has been added.

H_mean: average canopy height in the ecotope (does not take < 1m into account)

6.2 Artificial light

Light is the night light intensity measured by DMSP (Defense Meteorological Satellite Program) and interpolated at the location of the centroid.

6.3 Distance

Distances are measured in meter from linear features

Dst_Road : Weighted geometric mean of euclidian distance to roads, based on road categories (from Open street Map)

Dst_Rail : Mean euclidian distance to rails (from Open street Map)

Dst_River : Weighted geometric mean of euclidian distance to rivers based on their categories (from integrated river database of the Walloon region, Brussels and Flanders). Water bodies are not taken into account for this metric

Dst_Forest : Mean euclidian distance to forest blocks. Forest blocks are delineated using by filling « small » gaps (< 100m) and with an area of at least 10 ha. Distances inside forest blocks is negative.

Dst_Settl : Mean euclidian distance to settlement. Settlements are defined as patches grouping buildings at no less than 100 m from each others

Dst_Sea: Mean Euclidian distance to the sea

Bibliography

De Troch, R., Termonia, P., & Van Schaeybroeck, B. (2020). High-resolution future climate data for species distribution models in Europe [Data set]. Zenodo. http://doi.org/10.5281/zenodo.3694065

Hijmans, R.J., S.E. Cameron, J.L. Parra, P.G. Jones and A. Jarvis, 2005. Very high resolution interpolated climate surfaces for global land areas. International Journal of Climatology 25: 1965-1978.

Fick, S.E. and R.J. Hijmans, 2017. Worldclim 2: New 1-km spatial resolution climate surfaces for global land areas. International Journal of Climatology.

Radoux, J. Bourdouxhe, A, Coos,W, Dufrêne,M, Defourny, P 2019 Improving Ecotope Segmentation by Combining Topographic and Spectral Data, *Remote Sens.*, *11*(3), 354

Radoux, J. & Bogaert,P., 2017, Good Practices for Object-Based Accuracy Assessment, *Remote Sens.* 2017, *9*(7), 646; doi:10.3390/rs9070646

Delangre,J, Radoux, J & Dufrêne, M. 2017 Landscape delineation strategy and size of mapping units impact the performance of habitat suitability models, Ecological informatics, in press

Legrain X. & Brieuc M., 2012. Révision de la Carte Numérique des Sols de Wallonie – Campagne 2011-2012. Rapport final d'activités. Convention financée par le Service Public de Wallonie (DGO3, DDR), sous la direction de Bock L & Colinet G. Gembloux, Belgique : Unité de Science du Sol, Gembloux Agro-Bio Tech (Ulg).