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Modelling habitat probability maps for EUNIS habitat types heathland, scrub and tundra based on vegetation relevés, environmental data and Copernicus land cover data

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The European Topic Centre on Biological Diversity (ETC/BD) is a consortium of thirteen organisations
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1 Background and objectives

1.1 Background

This report is part of the assignment of Wageningen Environmental Research (Alterra) for the European Topic Centre Biological Diversity (ETC/BD). The European Topic Centres (ETCs) are international consortia brought together to support the European Environment Agency (EEA) in its mandate on environmental information. ETCs are according to the EEA regulation and in practice, an important instrument in supporting the EEA through the execution of sizeable, continuous, well-defined tasks with the involvement of member countries. In particular ETCs support EEA data centres for the issues related to air, climate change, water, biodiversity and land use and may provide help to EEA in supporting other data centres coordinated by Eurostat and JRC. The ETC/BD is an international consortium working with the European Environment Agency under a framework partnership agreement. The main tasks of ETC/BD are to:

1. Assist the EEA in its task of reporting on Europe's environment by addressing state and trends of biodiversity in Europe.
2. Provide the relevant information to support the implementation of environmental and sustainable development policies in Europe in particular for EU nature and biodiversity policies (DG Environment: Nature and Biodiversity).
3. Build capacity for reporting on biodiversity in Europe, mainly through the European Information and Observation Network (Eionet).

More information about ETC/BD can be found at: http://bd.eionet.europa.eu/

1.2 Objectives

This report is affiliated with task 1.7.5A from the ETC/BD Action Plan 2016. The general objectives of this task are:

- To support the preparation of EEA contributions to ecosystems assessments and their conditions based on existing information and data to support the 2020 EU Biodiversity Strategy (and its targets), in particular relevant data gathered from the Nature Directives, Agriculture and Forests, in close dialogue with the MAES process.
- To contribute to the biodiversity knowledge base by gathering evidence on the main drivers of biodiversity loss and biological characterisation of ecosystems helping a better understanding on links between pressures and conditions.
- To explore the contribution of Copernicus on the monitoring of habitats, species and the Natura 2000 network.
- To explore the results of the Article 12 (Birds Directive) and Article 17 (Habitats Directive) contained in the EEA State of Nature report – for diverse assessment purposes.
- To support thematic assessments including agricultural, forest, marine and freshwater assessments.
- To support the work on further convergence of the assessments between Water, Nature Directives and biodiversity information flows.

More specifically, the objective in relation to this report is: **to enhance the spatial delineation of ecosystems with remote sensing data, environmental data and in-situ vegetation relevés to produce habitat probability maps for heathlands, scrublands and tundra.** Starting point are the habitat suitability maps ‘Distribution and habitat suitability maps of revised EUNIS heath, scrub and tundra types’ delivered within the 2015 EEA contract (Hennekens & Schaminée, 2016). Next to the EEA report ‘Review of EUNIS heathland-scrub-tundra habitats’ (Schaminée et al., 2015). This review report has been made to underpin the EUNIS classification with well-documented information on the highly diverse European vegetation. Crosswalks have been developed between level 3 EUNIS terrestrial habitat types and vegetation syntaxa. More specifically, the project reviewed the description and classification of level 3 of **habitat group F** of **EUNIS Heathland, scrub and tundra** as well as heathland and scrub included under **habitat group B** (B1.5: Coastal dune heaths; B1.6: Coastal dune scrub; B2.5: Shingle and gravel beaches with scrub). Proposals were made for improving the EUNIS classification and the above reports were used as point of departure for the study in this report.

Table 1.1 List of the revised EUNIS heath, scrub and tundra habitat types at level 3

EUNIS-3 code	EUNIS-3 habitat name
F1.1	Shrub tundra
F1.2	Moss and lichen tundra
F2.1	Subarctic and alpine dwarf Salix scrub
F2.2a	Alpine and subalpine ericoid heath
F2.2b	Alpine and subalpine Juniperus scrub
F2.2c	Balkan subalpine genistoid scrub
F2.3	Subalpine deciduous scrub
F2.4	Subalpine Pinus mugo scrub
F3.1a	Lowland to montane temperate and submediterranean Juniperus scrub
F3.1b	Temperate Rubus scrub
F3.1c	Lowland to montane temperate and submediterranean genistoid scrub
F3.1d	Balkan-Anatolian montane genistoid scrub
F3.1e	Temperate and submediterranean thorn scrub
F3.1f	Low steppic scrub
F3.1g	Corylus avellana scrub
F3.1h	Temperate woodland clearing scrub
F4.1	Wet heath
F4.2	Dry heath
F4.3	Macaronesian heath
F5.1-2	Arborescent matorral and maquis
F5.3	Submediterranean pseudomaquis
F5.4	Spartium junceum fields
F5.5	Thermo-Mediterranean scrub
F6.1a	Western basiphilous garrigue
F6.1b	Western acidophilous garrigue
F6.2	Eastern garrigue
F6.6	Supra-Mediterranean garrigue
F6.7	Mediterranean gypsum scrub
F6.8a	Mediterranean halo-nitrophilous scrub
F6.8b	Caspian halo-nitrophilous scrub

F7.1	Western Mediterranean coastal garrigue
F7.3	Eastern Mediterranean spiny heath (phrygana)
F7.4a	Western Mediterranean mountain hedgehog-heath
F7.4b	Central Mediterranean mountain hedgehog-heath
F7.4c	Eastern Mediterranean mountain hedgehog-heath
F7.4d	Canarian mountain hedgehog-heath
F8.1	Canary Island xerophytic scrub
F8.2	Madeiran xerophytic scrub
F9.1a	Arctic, boreal and alpine riparian scrub
F9.1b	Temperate riparian scrub
F9.2	Salix fen scrub
F9.3	Mediterranean riparian scrub
B1.5a	Atlantic and Baltic coastal Empetrum heaths
B1.5b	Atlantic coastal Calluna and Ulex heaths
B1.6a	Atlantic and Baltic coastal dune scrub
B1.6b	Mediterranean and Black Sea coastal dune scrub
B1.6c	Macaronesian coastal dune scrub
B2.5	Shingle and gravel beaches with scrub

1.3 Content of the report

This report on the production of the EUNIS habitat probability maps at level 3 for Heathland, Scrub and Tundra has 4 chapters. Chapter 1 describes the background and the objectives of the project. Chapter 2 is an introduction on the habitat modelling, starting with the distribution maps, followed by habitat suitability and habitat probability. The integration of in-situ vegetation relevés, environmental data layers and remotely sensed information, such as high resolution land cover information, plays an important role in the overall methodology. Chapter 3 explains how the EUNIS habitat suitability maps have been produced. Chapter 4 describes how the habitat probability maps (100 m resolution) have been derived from the habitat suitability maps (on a 1km resolution). Annex I shows all 38 habitat probability maps for Heathland, Scrub and Tundra, including the habitat distribution and suitability maps, and a detailed example of the habitat probability maps.

2 Introduction to habitat modelling

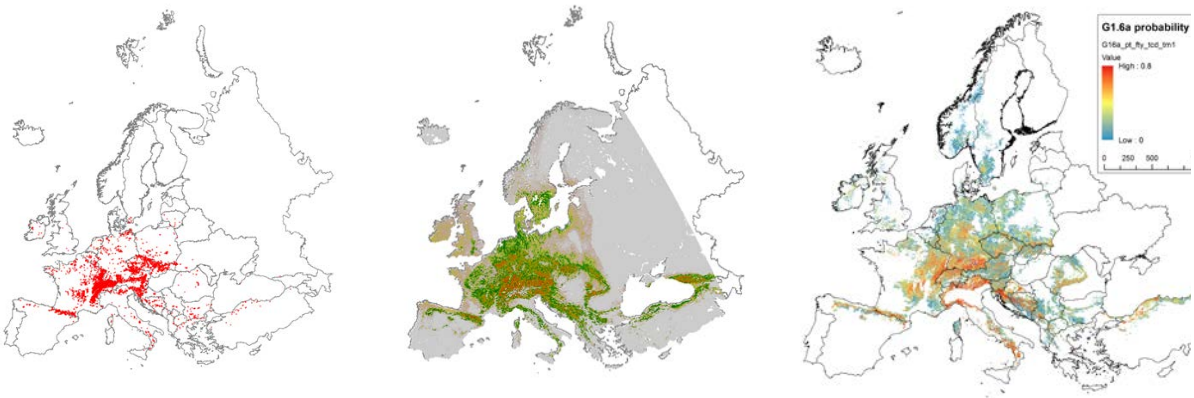
Although it is rare to record or map EUNIS habitat types in the field, there are many data sources which allow mapping of their distribution. The most important single source of information are vegetation plots (also known as relevés), given areas in which all plant species occurring are recorded. In the past few years a large number of national and regional databases with such data have been brought together within the European Vegetation Archive project (http://euroveg.org/eva-database). Together with other sources of data, they allow the production of several types of distribution map as explained below.

Distribution - maps of known occurrences based on the locality of plots which can be assigned to the EUNIS habitat class. They show localities where the habitat is known to occur (at least at the time of survey), but give an incomplete record of the actual distribution.

Suitability - modelling of areas where the environment is suitable for the habitat.

Probability - the modelled suitability map is refined by using information on land cover.

2.1 Methodology



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Distribution → *Suitability →* *Probability*

Figure 2.1 G1.6a: Fagus woodland on non-acid soils

The road from individual vegetation relevés to finally a probability map of a EUNIS class, roughly comprises three steps (see also figure 2.1).

1. Relevés stored in the European Vegetation Database (EVA) are assigned to EUNIS classes using expert rules. An expert rule defines the floristic composition (which species should be present and which species should be absent) of a class and is used to select those relevés that meet the imposed condition. The selection is used to create a **distribution map,** as far as the geographic location is tied to the relevés.
2. The distribution, by means of geographic locations of the relevés, is used in the second step, the distribution model. For the modelling the distribution data are related to climate and soil data, environmental data that is stored in grid maps at a European scale. The modelling software Maxent (Phillips et al., 2006) calculates which environmental layers have the largest contribution to the model, in other words, explains the distribution of the vegetation relevés (thus the EUNIS class) the best. One of the outcomes of the model is a **suitability map**. This map indicates how suitable, in terms of climate and soil conditions an area is for the EUNIS class concerned. This on a scale of 0 to 1 with colors running from white, via green to red.

3. Where step 1 and 2 are bottom-up approaches, the third step is a top-down approach, where all kind of land cover data (earth observation data like high resolution satellite data), and in some cases abiotic data (e.g. distance to rivers, presence of podzolls), is used to filter the suitability map to eventually get to a refined **probability map**. As such the probability map is a refinement of the suitability map.

While the suitability map can be considered as a potential distribution map, the probability map presents more the actual distribution. Still the latter map represents a modelled distribution and overestimates the actual distribution.

All three steps are explained more in detail in the unpublished report 'Modelling the spatial distribution of EUNIS forest habitat types' by Mücher, C.A., Hennekens, S.M., Schaminée, J.H.J & Halada, L. (2015).

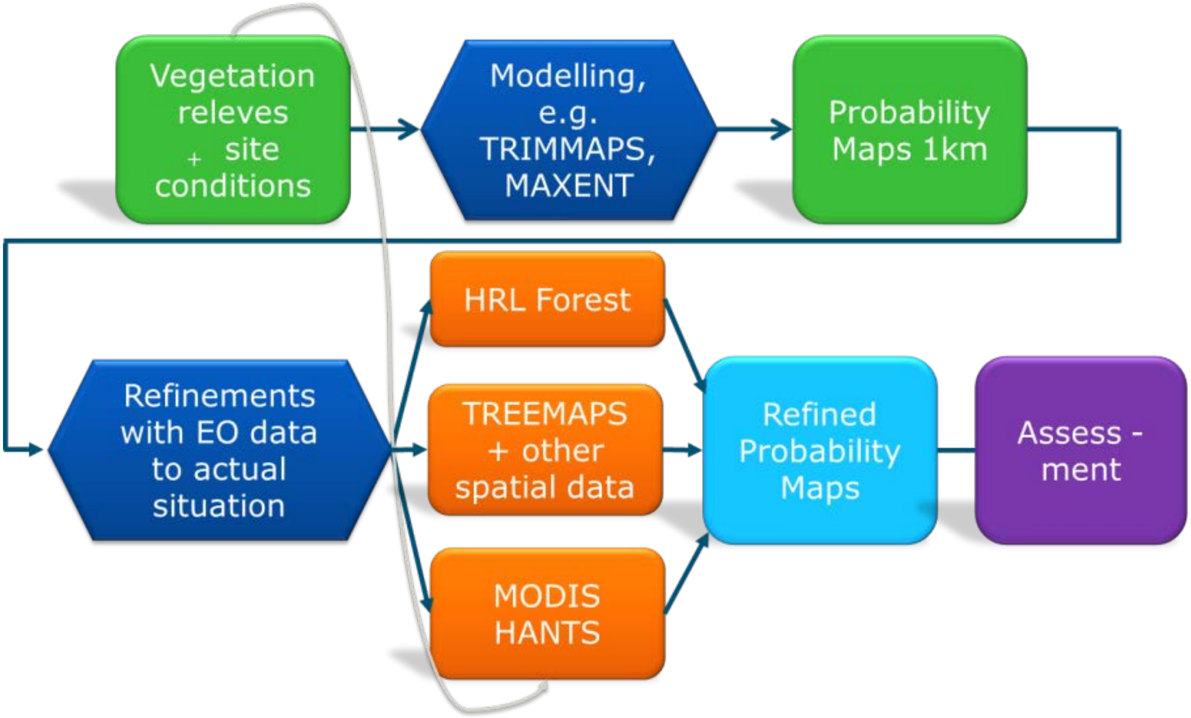


Figure 1.2 General workflow for the processing of refined EUNIS forest habitat probability maps (Mücher et al., 2015)

3 Habitat suitability maps

For the habitat suitability modelling, the widely used software Maxent for maximum entropy modelling of species' geographic distributions was used. Maxent is a general-purpose machine-learning method with a simple and precise mathematical formulation, and has a number of aspects that make it well-suited for species distribution modelling when only presence (occurrence) data but not absence data are available (Philips et al. 2006). Because EUNIS habitats have a particular species composition, they are assumed to respond to specific ecological requirements, allowing to generate correlative estimates of geographic distributions. Modelling habitats that have been floristically defined is a well-known procedure for ecological modelling at local scales, and a promising technique to be applied also at the continental level.

The Maxent method considers presence data (known observations of a given entity) and the so-called background data. Background data comprise a set of points used to describe the environmental variation of the study area according to the available environmental layers. It is assumed that these layers represent well the most important ecological gradients on a European scale. These layers were selected from meaningful environmental predictors commonly used for modelling non-tropical plant and vegetation diversity, and are not mutually strongly correlated.

As environmental data (and their sources) the following climate and soil layers have been used:

- Potential Evapotranspiration
  http://www.cgiar-csi.org/data/global-aridity-and-pet-database
  Solar radiation
  http://www.worldgrids.org/doku.php?id=wiki:inmsre3
- Temperature Seasonality (standard deviation *100)
  http://www.worldclim.org/bioclim
- Mean Temperature of Wettest Quarter
  http://www.worldclim.org/bioclim
- Annual Precipitation
  http://www.worldclim.org/bioclim
- Precipitation Seasonality (Coefficient of Variation)
  http://www.worldclim.org/bioclim
- Precipitation of Warmest Quarter
  http://www.worldclim.org/bioclim
- Distance to water (rivers, lakes, sea)
  derived from the shapefile 'Inland_Waters.shp'
- Bulk density of the soil (kg/m^3)
  Hengl et al. 2014
- Cation Exchange Capacity of the soil
  Hengl et al. 2014
- Weight in % of clay particles (<0.0002 mm)
  Hengl et al. 2014
- Volume % of coarse fragments (> 2 mm)
  Hengl et al. 2014
- Soil organic carbon content (‰)
  Hengl et al. 2014
- Soil pH (water)
  Hengl et al. 2014
- Weight in % of silt particles (0.0002-0.05 mm)
  Hengl et al. 2014

- Weight in % of sand particles (0.05-2 mm)
  Hengl et al. 2014

Compared with the habitat suitability models set up for the EUNIS forest types (Schaminée et al. 2014) we have now included 8 recently published soil paramaters (Hengl et al 2014), instead of only one (soil pH).

Maxent is expected to perform well for estimating the geographic distribution of EUNIS habitats in Europe. However, as with any other modelling techniques, this method is sensitive to sampling bias, i.e. when the spatial distribution of presence data is reflecting an unequal sampling effort in different geographic regions. In Maxent, it has been proposed that the best way to account for sampling bias (when bias is known or expected to occur) is to generate background data reflecting the same bias of the presence data. When a complete set of presence data is available, a general recommendation is to generate background points from the occurrences of other species/communities that were sampled in a similar way (Elith et al. 2011).

Two different approaches have been followed for the selection of a maximum of 5,000 locations for the background data, assuming biased and non-biased presence data. For the first approach, 5,000 locations were randomly selected from the heathland, scrub and tundra plot pool, assuming that they reflect the general geographic bias of heathland, scrub and tundra sampling in Europe. The second approach concerns a random selection of 5,000 background points in the whole study area, assuming that the presence data describe a representative subset of the real distribution range of the target habitat.

The two modelling approaches (assuming biased and non-biased data) were evaluated for each of the EUNIS habitat types in order to estimate which assumption is more likely. This evaluation was based on the expert knowledge of the team members of the distribution of heathland, scrub and tundra types by assessing (i) the distribution of the available presence data as an estimate of geographic bias, (ii) the realism of the habitat suitability maps to reflect known distribution of heathland, scrub and tundra, and (iii) the environmental predictors that contribute most substantially to the models. The best performing model was then selected by consensus of the expert team for each habitat type
For 5 EUNIS types (B1.6c, F4.3, F7.4d, F8.1, F8.2) no data was available and for 5 types (B1.6b, F1.2, F2.2c, F3.1d, and F6.8b) there was insufficient data to create a model.

For each EUNIS heathland, scrub and tundra type the following data are presented:

- A distribution map showing the location of the relevés that have been assigned to the EUNIS type concerned and therefore used as presence data.
- A habitat suitability map with colors varying from gray, through green to red, indicating increasingly favorable ecological conditions for the type (expressing the logistic output of the model between 0 and 1).
- AUC, or the “Area Under the Curve”, as a general estimate of model performance. This is the probability that the classifier correctly orders two points (a random positive example and a random negative example). In general, AUC values in the range 0.5-0.7 were considered low, 0.7-0.9 were moderate and >0.9 were high, suggesting poor, good and very good model performances, respectively. We provide two estimates of the AUC as calculated by Maxent. ‘AUC training’ reflects the internal fit between observed and predicted occurrences in the computed model. ‘AUC test’ provides the mean AUC obtained from a 10-fold cross-validation procedure in which ten different models were computed with a random selection of 90% of data (calibration data set) and 10% for testing the model (validation data set).
- Contribution variables to the Maxent model (%). Indicates to what extent the environmental variables contribute to the model.

The habitat **suitability** maps are used as input to model habitat **probability** maps using amongst others actual land cover, next to the use of topographic information such as, biogeographic regions, countries, distance to coast and rivers.

4 Habitat probability maps

The habitat probability maps are created by downscaling the habitat suitability maps by actual land cover. This report concerns heathland, scrub and tundra and therefore we would like to use very high resolution land cover maps for these land cover types. Unfortunately the Copernicus HRLs (High Resolution Layers with a 20 meter spatial resolution) only exist for the following specific topics: 1) imperviousness 2) forests; 3) permanent waterbodies; 4: grasslands and 5) wetlands. Nevertheless, we have the Copernicus land cover database Corine with a spatial resolution of 100 meter. The most recent version is Corine Land Cover 2012 (CLC2012). Since the minimum mapping unit of CLC is 25 ha, and therefore still quite course for habitat mapping, we decided to use some of the HRLs as a mask for CLC2012, and is further explained below.

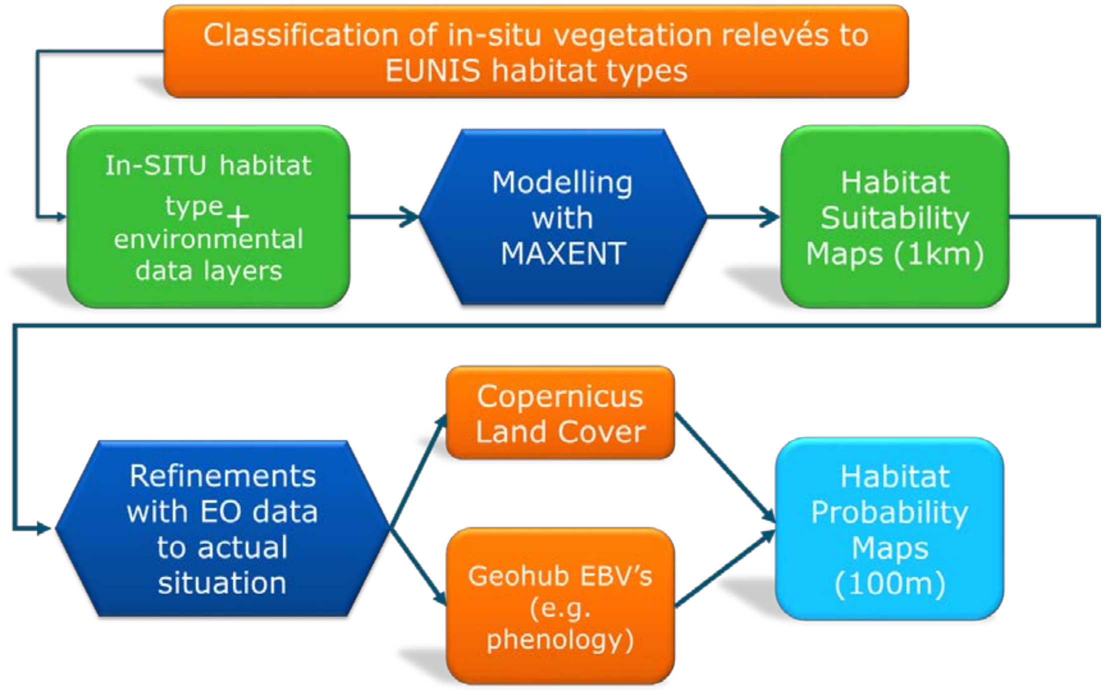


Figure 4.1 Flowchart of the methodology implemented to obtain habitat probability maps

4.1 Land Cover

CLC2012 is the 4th CORINE Land Cover inventory and took 3 years to finalize. The CORINE Land Cover (CLC) inventory was initiated in 1985 (reference year 1990). Updates have been produced in 2000, 2006, and 2012. It consists of an inventory of land cover in 44 classes. CLC uses a Minimum Mapping Unit (MMU) of 25 hectares (ha) for areal phenomena and a minimum width of 100 m for linear phenomena. Therefore the rasterized version of the original vector based CLC is 100 m. For CLC20102 a dual coverage of satellite images were used. Computer Assisted Photo-Interpretation (CAPI) was the dominating mapping technology. The number of countries using advanced (bottom-up) solutions has slightly increased. All of the EEA39 countries have participated within the official lifetime of the project. It is still possible that minor updates will follow with next version. The product is only partially validated.

Table 4.1 Nomenclature Corine Land Cover

	level 1		Level 2	Code	Level 3 CORINE land cover class	Nr.
1.	Artificial surfaces	1.1	urban fabric	1.1.1	continuous urban fabric	1
				1.1.2	discontinuous urban fabric	2
		1.2	industrial, commercial and	1.2.1	industrial and commercial units	3
			transport units	1.2.2	road and rail networks and associated land	4
				1.2.3	port areas	5
				1.2.4	airports	6
		1.3	mine, dump and	1.3.1	mineral extraction sites	7
			construction sites	1.3.2	dump sites	8
				1.3.3	construction sites	9
		1.4	artificial non-agricultural	1.4.1	green urban areas	10
			vegetated areas	1.4.2	port and leisure facilities	11
2	Agricultural areas	2.1	arable land	2.1.1	non-irrigated arable land	12
				2.1.2	permanently irrigated land	13
				2.1.3	rice fields	14
		2.2	permanent crops	2.2.1	vineyards	15
				2.2.2	fruit trees and berry plantation	16
				2.2.3	olive groves	17
		2.3	pastures	2.3.1	pastures	18
		2.4	heterogeneous agricultural areas	2.4.1	annual cops associated with permanent crops	19
			agricultural areas	2.4.2	complex cultivation patterns	20
				2.4.3	land principally occupied by agriculture with significant natural vegetation	21
				2.4.4	agro-forestry areas	22
3.	Forests and semi-natural	3.1	forest	3.1.1	broad-leaved forest	23
	Areas			3.1.2	coniferous forest	24
				3.1.3	mixed forest	25
		3.2	shrub and/or herbaceous	3.2.1	natural grasslands	26
			vegetation associations	3.2.2	moors and heath lands	27
				3.2.3	sclerophyllous vegetation	28
				3.2.4	transitional woodland-scrub	29
		3.3	open spaces with little or no	3.3.1	beaches, sand, dunes	30
			vegetation	3.3.2	bare rocks	31
				3.3.3	sparsely vegetated areas	32
				3.3.4	burnt areas	33
				3.3.5	glaciers and perpetual snow	34
4	Wetlands	4.1	inland wetlands	4.1.1	inland marshes	35
				4.1.2	peat bogs	36
		4.2	coastal wetlands	4.2.1	salt marshes	37
				4.2.2	salines	38
				4.2.3	intertidal flats	39
5	Water bodies	5.1	inland waters	5.1.1	water courses	40
				5.1.2	water bodies	41
		5.2	marine waters	5.2.1	coastal lagoons	42
				5.2.2	estuaries	43
				5.2.3	sea and ocean	44

In a next step, the CLC2012 has been masked with the HRLs Forest, Imperviousness and permanent waterbodies. This is especially relevant for the semi-natural land cover classes from CLC2012 that have a MMU of 25 ha and in realty more fragmented (by for example small artificial features, waterbodies or forest patches).

The use HRLs Forest, Imperviousness and permanent waterbodies are also from 2012. But for all 3 HRLs 2012 we used the aggregated 100m products which have the same spatial resolution as rasterized CLC2012. For Forests we used the HRL forest type (FTY). The forest type product allows to get as close as possible to the FAO forest definition. The FTY distinguishes 3 classes: deciduous, needleleaf and mixed forest. All forests classes were used as a mask. Permanent Water bodies: 1) Permanent Water Bodies; 254: unclassifiable (no satellite image available, or clouds, shadows, or snow); 255: outside area. Only class 1, permanent water bodies, was used as a mask for CLC2012. Imperviousness indicated to built-up areas that are characterized by the substitution of the original (semi-) natural land cover or water surface with an artificial, often impervious cover. These artificial surfaces are usually maintained over long periods of time. The imperviousness HRL captures the spatial distribution of artificially sealed areas, including the level of sealing of the soil per area unit. The level of sealed soil (imperviousness degree 1-100%) is produced using an automatic algorithm based on calibrated NDVI.

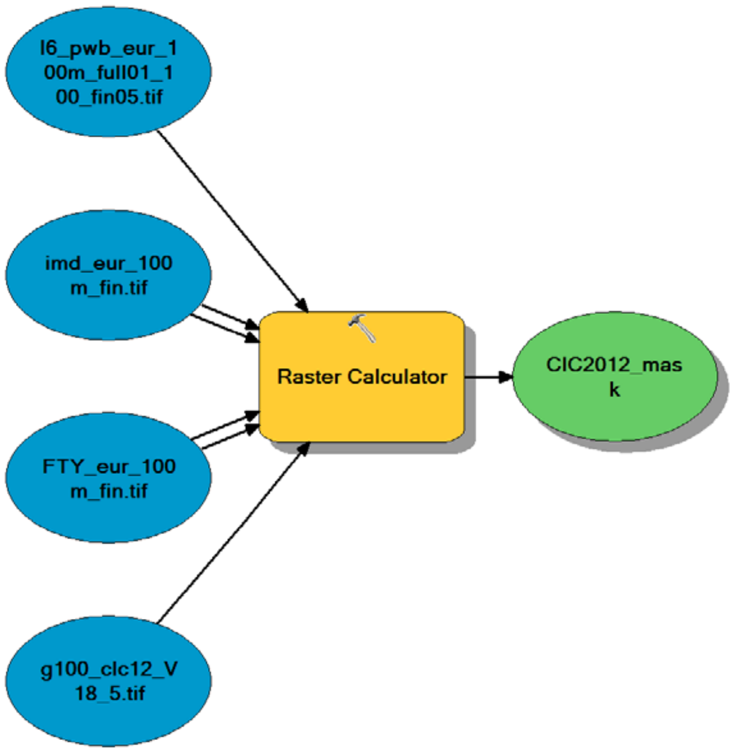


Figure 4.2 Flowchart for the calculation of the CLC20102 masked by imperviousness, water bodies and forests. The conditional in the raster calculator is: Con((("%FTY_eur_100m_fin.tif%" > 0) & ("%FTY_eur_100m_fin.tif%" < 4)),0, Con((("%imd_eur_100m_fin.tif%"> 0) & ("%imd_eur_100m_fin.tif%" < 101)),0, Con("%l6_pwb_eur_100m_full01_100_fin05.tif%" >0,0, "%g100_clc12_V18_5.tif%")))

The result of the CLC2012_mask is shown in Figure 4.3.

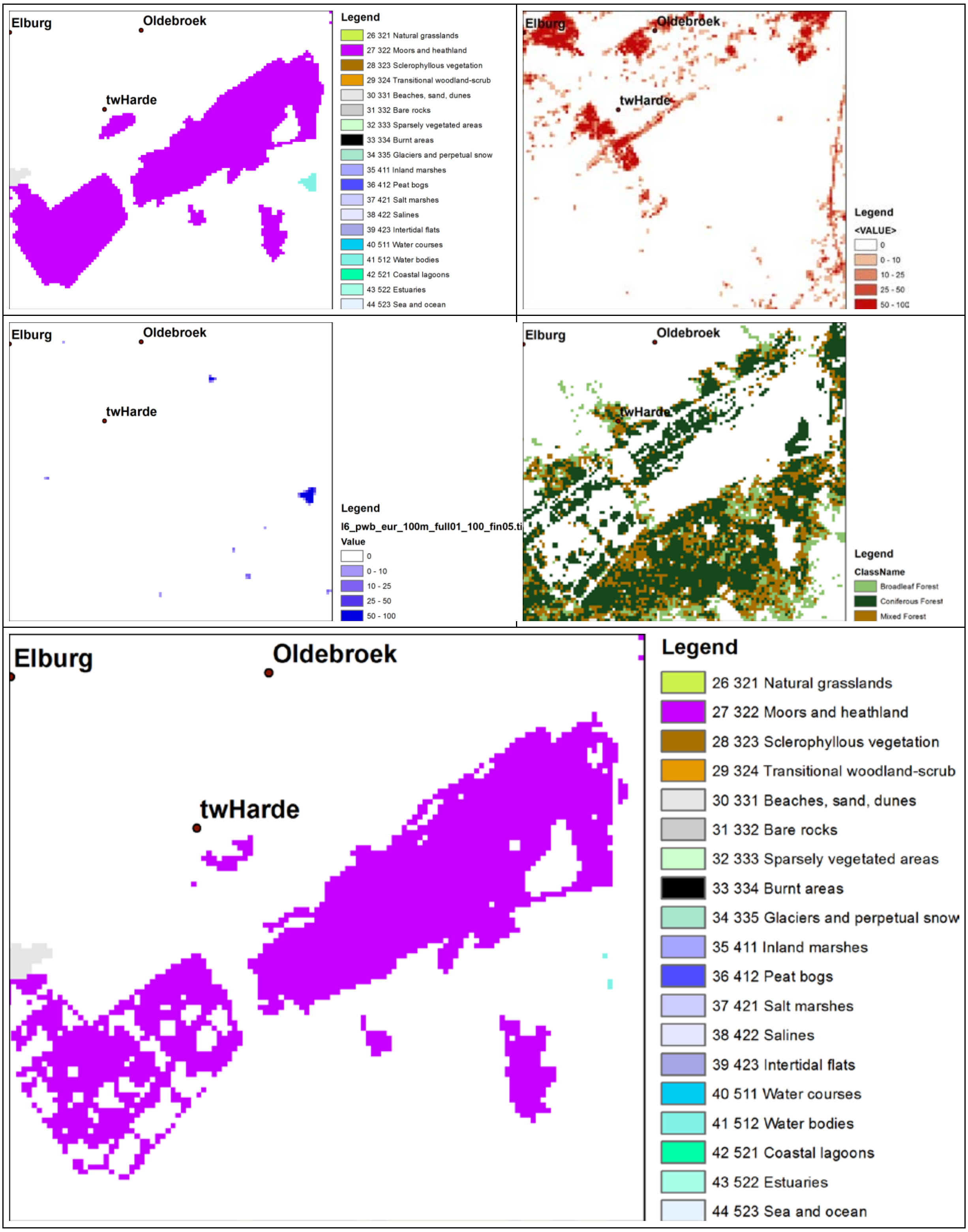


Figure 4.3 Process of masking CLC2012 with HRLs 2012: Imperviousness, Waterbodies and Forest. The results is CLC21012 masked that shows a more realistic fragmented semi-natural land cover

4.2 Relationship CLC with in-situ vegetation relevés

To determine the relationship between the EUNIS habitat types at level 3 and the Corine Land Cover (CLC20102) we used the report of D. Moss (2012) ‘A crosswalk between EUNIS habitats Classification and Corine Land Cover’ (source: http://biodiversity.eionet.europa.eu) as starting point. However, this report shows a one-to-one relationship, while we know that in most cases the EUNIS habitat types are not related to a single land cover types. Since we have 34,324 vegetation relevés for Heathland, Scrub and Tundra that overlay with CLC20102, we calculated for each EUNIS habitat type with which land cover types their vegetation relevés match (spatial summary statistics).

Thus, if we take EUNIS habitat type F4.1 ‘Wet heath’ as an example, we find the following spatial relationship between the 2290 vegetation relevés and the CLC2012, which is a one-to-many relationship, as show in the table below. Since there can be a spatial mismatch between CLC2012 and the vegetation relevés for several reasons, we did look only at percentages of 5% or higher. And of course we did look at the relationship with CLC2012 only for the semi-natural land cover classes (excluding the forest classes as well). In Table 4.2, this analysis reveals that for EUNIS habitat type F4.1 ‘Wet heath’, there is especially a relationship with CLC2012 classes 26 ‘natural grasslands’ (5.72), class 27 ‘moors and heath lands’(20.66%) and class 36 ‘peat bogs’ (19.04%). For the nomenclature of CLC20212, see Table 4.1.

Table 4.2 Summary table of the spatial relationships between EUNIS habitat type F4.1 ‘Wet heath’ with 2290 vegetation relevés and CORINE land cover (CLC20102)

F41 (nr= 2290)		
ClC2012	Count	%
2	46	2.01
3	2	0.09
4	2	0.09
6	1	0.04
7	2	0.09
10	1	0.04
11	5	0.22
12	90	3.93
16	1	0.04
17	1	0.04
18	251	10.96
20	107	4.67
21	60	2.62
23	161	7.03
24	218	9.52
25	106	4.63
26	131	5.72
27	473	20.66
29	32	1.40
30	36	1.57
31	2	0.09
32	41	1.79
35	39	1.70
36	436	19.04
39	4	0.17
41	9	0.39
42	10	0.44
44	23	1.00
	2290	100.00

Table 4.3 shows the overall summary of the relationships between each EUNIS habitat type and CLC2012 (as indicated by D. Moss but also from our spatial analysis) and additional filters that we used to model the habitat probability.

Table 4.3 Overview of the habitat probability maps for heath, scrub and tundra and the applied Copernicus land cover information and additional filters that have been used

Nr	EUNIS-3 code	EUNIS-3 habitat name	Relationship to CLC (D. Moss)	Relationship to CLC (relevés)	BGR filter	Topo filter
1	F1.1	Shrub tundra	Sparsely vegetated (333)	32 + 27, 31	Yes	No
2	F2.1	Subarctic and alpine dwarf Salix scrub	Sparsely vegetated (333)	32 + 31	Yes	No
3	F2.2a	Alpine and subalpine ericoid heath	Moors and heathland (322)	32+ 26, 27, 31	No	No
4	F2.2b	Alpine and subalpine Juniperus scrub	Moors and heathland (322)	32 + 26, 27, 29	No	No
5	F2.3	Subalpine deciduous scrub	Moors and heathland (322)	27 + 26, 31, 32, 29	No	No
6	F2.4	Subalpine Pinus mugo scrub	Moors and heathland (322)	27 + 26, 29, 32	No	No
7	F3.1a	Lowland to montane temperate and submediterranean Juniperus scrub	Moors and heathland (322)	27 + 26, 29, 32	No	No
8	F3.1b	Temperate Rubus scrub	Moors and heathland (322)	27 + 26, 29	No	No
9	F3.1c	Lowland to montane temperate and submediterranean genistoid scrub	Moors and heathland (322)	27 + 26, 28, 29	No	No
10	F3.1e	Temperate and submediterranean thorn scrub	Moors and heathland (322)	27 + 26, 29	Yes	No
11	F3.1f	Low steppic scrub	Sparsely vegetated (333)	32 + 29	Yes	No
12	F3.1g	Corylus avellana scrub	?	23, 24, 25, 26, 29, 31	Yes	No
13	F3.1h	Temperate woodland clearing scrub	Sparsely vegetated (333)	23, 24, 25, 26, 27, 29	No	No
14	F4.1	Wet heath	Moors and heathland (322)	27 + 26, 36	No	No
15	F4.2	Dry heath	Moors and heathland (322)	27 + 26, 36	No	No
16	F5.2	Arborescent matorral and maquis	Sclerophyllous vegetation (323)	28 + 29	Yes	No
17	F5.3	Submediterranean pseudomaquis	Sclerophyllous vegetation (323)	28 + 23, 24, 25, 26, 28, 29	Yes	No
18	F5.4	Spartium junceum fields	Moors and heathland (322)	27 + 26, 28, 29	Yes	No
19	F5.5	Thermo-Mediterranean scrub	Sclerophyllous vegetation (323)	28	Yes	No
20	F6.1a	Western basiphilous garrigue	Sclerophyllous vegetation (323)	28 + 26, 27, 29	No	Yes
21	F6.1b	Western acidophilous garrigue	Sclerophyllous vegetation (323)	28 + 26, 29, 30	No	Yes
22	F6.2	Eastern garrigue	Sclerophyllous vegetation (323)	28 + 26, 29, 32	No	Yes
23	F6.6	Supra-Mediterranean garrigue	Sclerophyllous vegetation (323)	28 + 26, 29, 31, 32	No	Yes
24	F6.7	Mediterranean gypsum scrub	Moors and heathland (322)	27 + 28, 32	Yes	No

25	F6.8a	Mediterranean halo-nitrophilous scrub	Moors and heathland (322)	27 + 28	Yes	Np
26	F7.1	Western Mediterranean coastal garrigue	Sclerophyllous vegetation (323)	28 + 30	No	Yes
27	F7.3	Eastern Mediterranean spiny heath (phrygana)	Sclerophyllous vegetation (323)	28 + 26, 30, 32	No	Yes
28	F7.4a	Western Mediterranean mountain hedgehog-heath	Sclerophyllous vegetation (323)	28 + 26, 27, 28, 29, 32	No	Yes
29	F7.4b	Central Mediterranean mountain hedgehog-heath	Sclerophyllous vegetation (323)	28 + 26, 32	No	Yes
30	F7.4c	Eastern Mediterranean mountain hedgehog-heath	Sclerophyllous vegetation (323)	28 + 27, 29, 32	No	Yes
31	F9.1a	Arctic, boreal and alpine riparian scrub	Moors and heathland (322)	27 + 26, 29, 32	Yes	Yes
32	F9.1b	Temperate riparian scrub	Moors and heathland (322)	27 + 26, 30, 40		Yes
33	F9.2	Salix fen scrub	Moors and heathland (322)	27 + 26, 28	No	No
34	F9.3	Mediterranean riparian scrub	Moors and heathland (322)	27 + 26, 28	Yes	Yes
35	B1.5a	Atlantic and Baltic coastal Empetrum heaths	Moors and heathland (322)	27 + 26, 30	Yes	Yes
36	B1.5b	Atlantic coastal Calluna and Ulex heaths	Moors and heathland (322)	27 + 26, 30	Yes	Yes
37	B1.6a	Atlantic and Baltic coastal dune scrub	Moors and heathland (322)	27 + 26, 30	Yes	Yes
38	B2.5	Shingle and gravel beaches with scrub	Moors and heathland (322)	27 + 26, 30, 37	No	Yes

Annex I shows all 38 habitat probability maps for Heathland, Scrub and Tundra, including the habitat distribution and suitability maps, and a detailed example of the habitat probability maps. In total 152 maps (38 x 4).

References

Elith, J., J., Phillips, S. J., Hastie, T., Dudíte, M., Chee, Y. E. & Yates, C. J. (2011). A statistical explanation of MaxEnt for ecologists. Diversity and Distributions, 17: 43-57.

Hengl T, de Jesus J.M., MacMillan R.A., Batjes N.H., Heuvelink G.B.M., Ribeiro E., Alessandro Samuel-Rosa, Kempen, B., Leenaars, J.G.B., Walsh, M.G., Gonzalez. M.R. (2014) SoilGrids1km — Global Soil Information Based on Automated Mapping. PLoS ONE 9(8): e105992. doi:10.1371/journal.pone.0105992

Moss, D. 2012. A crosswalk between EUNIS habitats Classification and Corine Land Cover. European Topic Centre on Biological Diversity http://biodiversity.eionet.europa.eu.

Mücher, C.A., Hennekens, S.M., Schaminée, J.H.J., Halada, L. & Halabuk, A., 2015. Modelling the spatial distribution of EUNIS forest habitat types. Internal report ETC/BD for task 1.7.5.C.

Phillips, S.J., R.P. Anderson & R.E. Schapire (2006). Maximum entropy modeling of species geographic distributions. Ecological Modelling 190: 231–259.

Schaminée, J.H.J., Chytrý, M., Hennekens, S.M., Janssen, J.A.M., Jiménez-Alfaro, B., Knollová, I., Mucina, L., Rodwell, J.S. & Tichý, L. (2014). Vegetation analysis and distribution maps for EUNIS habitats. Report for the European Environmental Agency (EEA/NSV/14/006), Copenhagen.

Annex I: the EUNIS heath, scrub and tundra habitat probability maps

B1.5a - Atlantic and Baltic coastal Empetrum heaths

Distribution map *based on vegetation relevés*

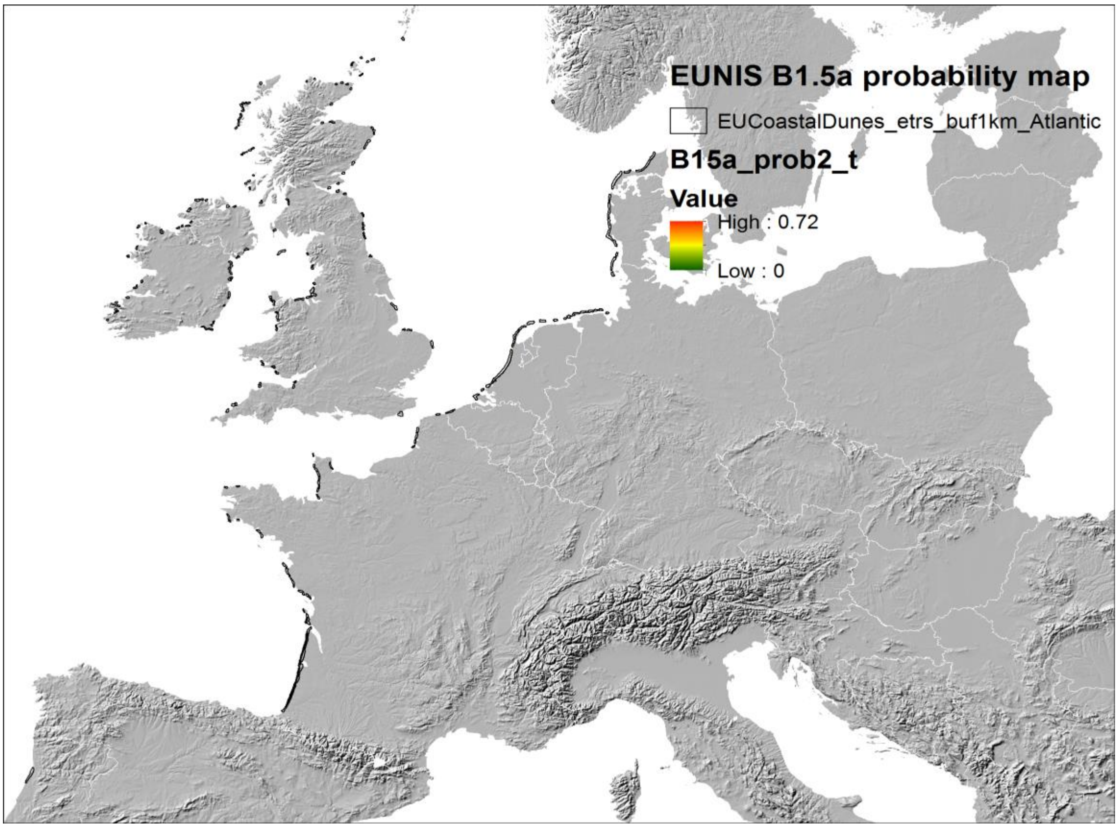
Suitability map *. Background data for model randomly selected from study area*

Geographic restriction distribution data
Coastal sand dunes and sea shores according to Bohn map (P1)

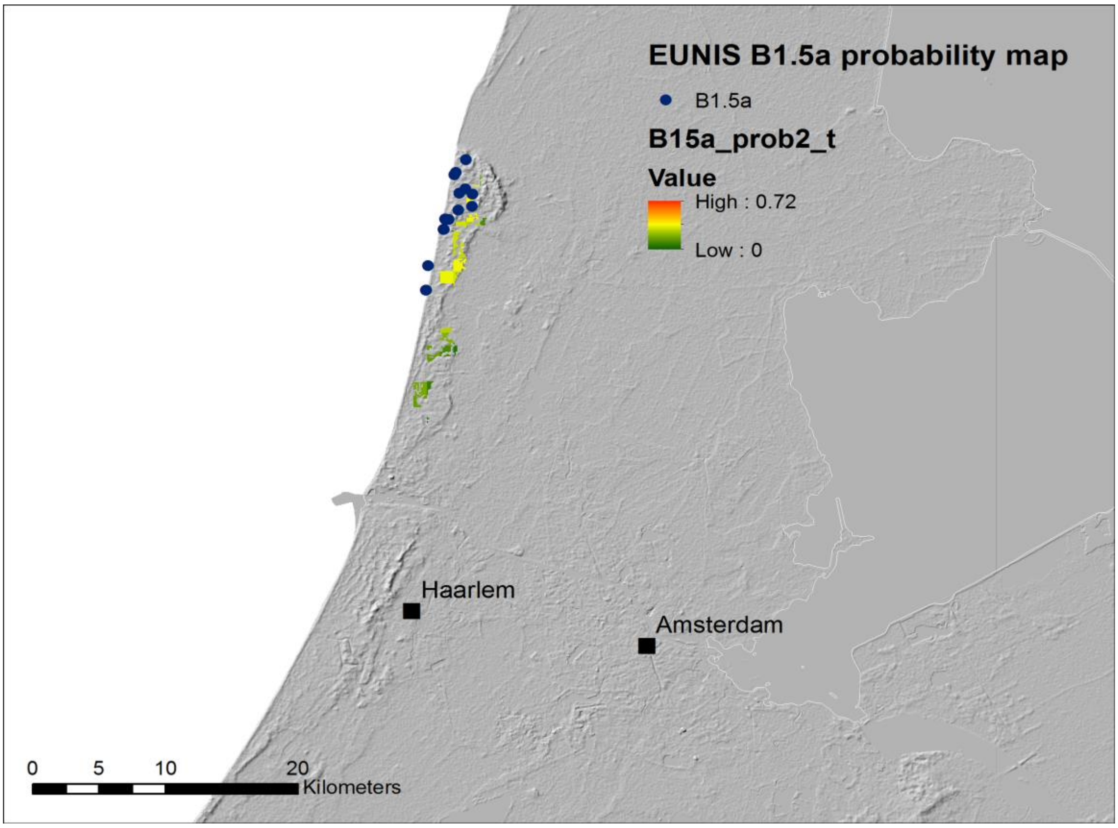
Maxent modelling statistics

AUC training (0-1)		0.9983
AUC test (0-1)		0.9978
Contribution variables to the Maxent model (%)		
	Distance to water	65.2878
	Temperature seasonality (stdev * 100)	16.8567
	Precipitation of warmest quarter	9.181
	pH (water)	3.1799
	Volume % of coarse fragments (> 2 mm)	1.8697
	Soil organic carbon content (‰)	1.6373
	Mean temperature of wettest quarter	0.9176
	Weight in % of silt particles (0.0002-0.05 m	0.4938
	Weight in % of clay particles (<0.0002 mm	0.4169
	Annual precipitation	0.0401
	Cation Exchange Capacity	0.0174
	Solar radiation	0.0154
	Weight in % of sand particles (0.05-2 mm)	0
	Bulk density (kg/m³)	0
	Potential evapotranspiration	0
	Precipitation seasonality (coef. of var.)	0

Remarks
Inland prediction should be ignored. Hardly any prediction in the Baltic region. Coastal habitats are difficult to model and often deliver unsatifying results. There are various reasons for this; 1) the area in which the habitat occurs is very small, 2) some observations do not match with all environmental layers and are therefore left out of the analysis, 3) lack of observation data in large parts of the potential area.



Probability map *(overview)*

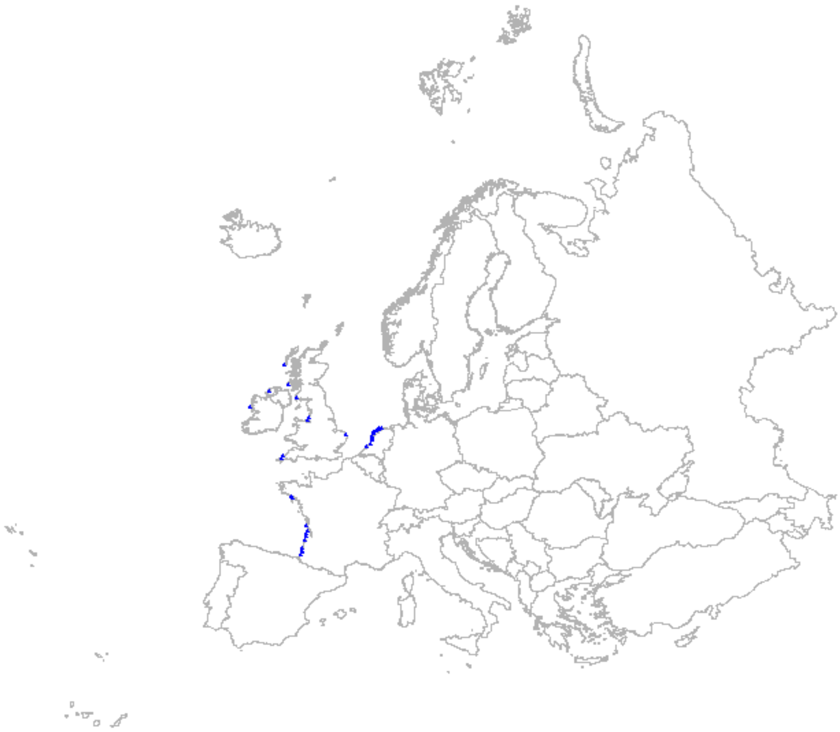


Probability map *(detail)*

Decision rules:

Relationship to CLC (D. Moss)	Moors and heathland (322)
Relationship to CLC (releves)	27 + 26, 30
BGR filter	Yes
Topo filter	Yes

B1.5b - Atlantic coastal Calluna and Ulex heaths



Distribution map *based on vegetation relevés*

Suitability map *. Background data for model randomly selected from study area*

Geographic restriction distribution data

Coastal sand dunes and sea shores according to Bohn map (P1)

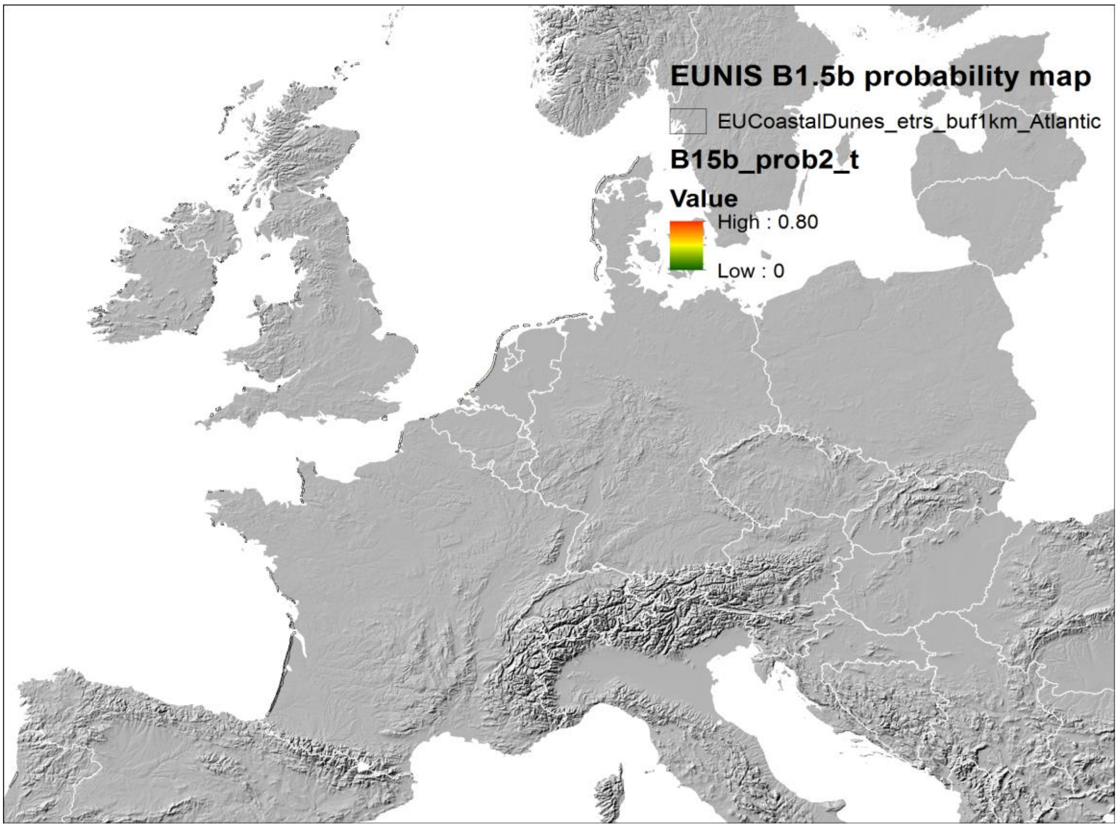
Maxent modelling statistics

AUC training (0-1)	0.9971
AUC test (0-1)	0.9984
Contribution variables to the Maxent model (%)	
Distance to water	48.7813
Temperature seasonality (stdev * 100)	27.8413
pH (water)	7.4575
Precipitation of warmest quarter	5.0517
Mean temperature of wettest quarter	3.4666
Soil organic carbon content (‰)	3.0278
Bulk density (kg/m³)	1.711
Weight in % of silt particles (0.0002-0.05 m	1.077
Precipitation seasonality (coef. of var.)	0.4732
Volume % of coarse fragments (> 2 mm)	0.3776
Annual precipitation	0.3312
Potential evapotranspiration	0.1383
Solar radiation	0.061
Weight in % of clay particles (<0.0002 mm	0.0525
Cation Exchange Capacity	0
Weight in % of sand particles (0.05-2 mm)	0

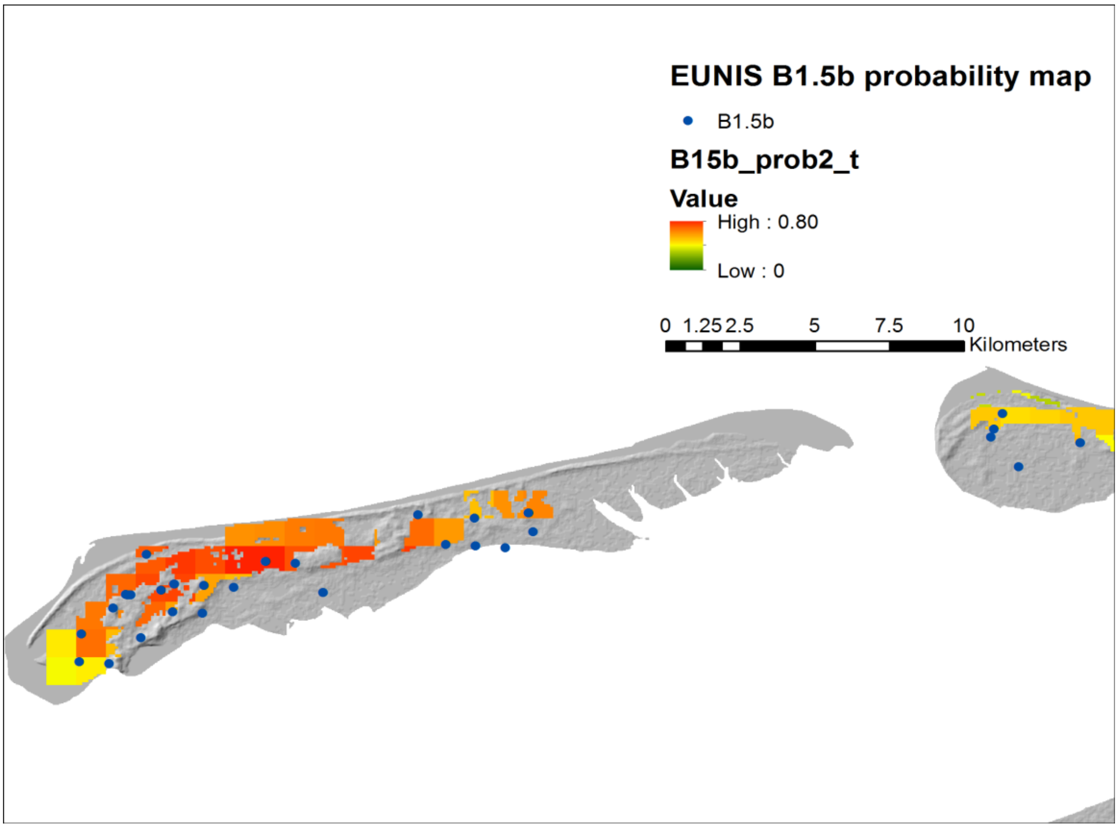
Remarks

Inland prediction should be ignored. Hardly any prediction in the along the French coast.

Coastal habitats are difficult to model and often deliver unsatifying results. There are various reasons for this; 1)tThe area in which the habitat occurs is very small, 2) some observations do not match with all environmental layers and are therefore left out of the analysis, 3) lack of observations in large parts of the potential area.



Probability map *(overview)*

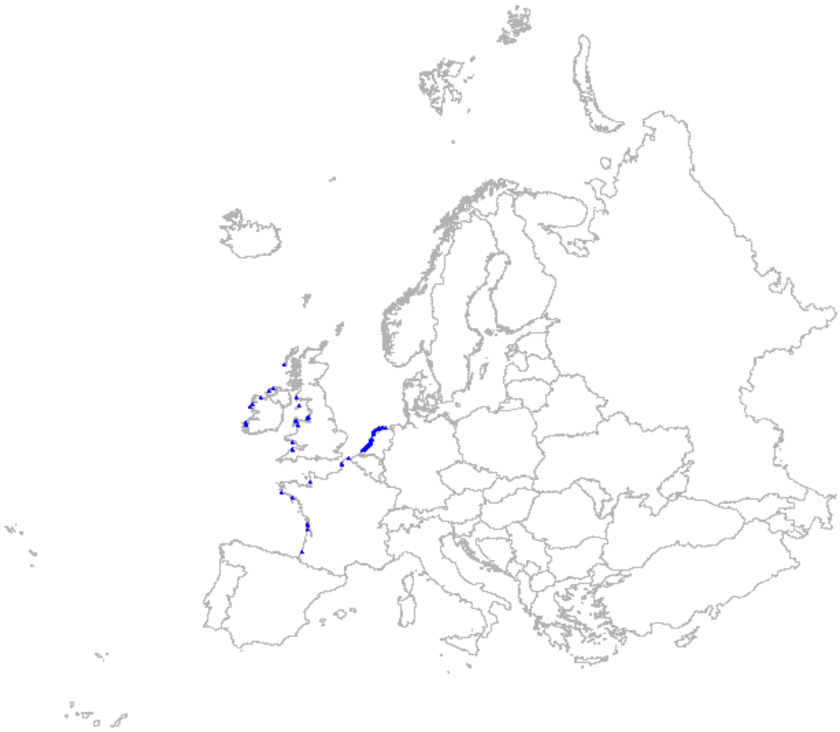


Probability map *(detail)*

Decision rules:

Relationship to CLC (D. Moss)	Moors and heathland (322)
Relationship to CLC (releves)	27 + 26, 30
BGR filter	Yes
Topo filter	Yes

B1.6a - Atlantic and Baltic coastal dune scrub



Distribution map *based on vegetation relevés*

Suitability map *. Background data for model randomly selected from study area*

Geographic restriction distribution data

Coastal sand dunes and sea shores according to Bohn map (P1)

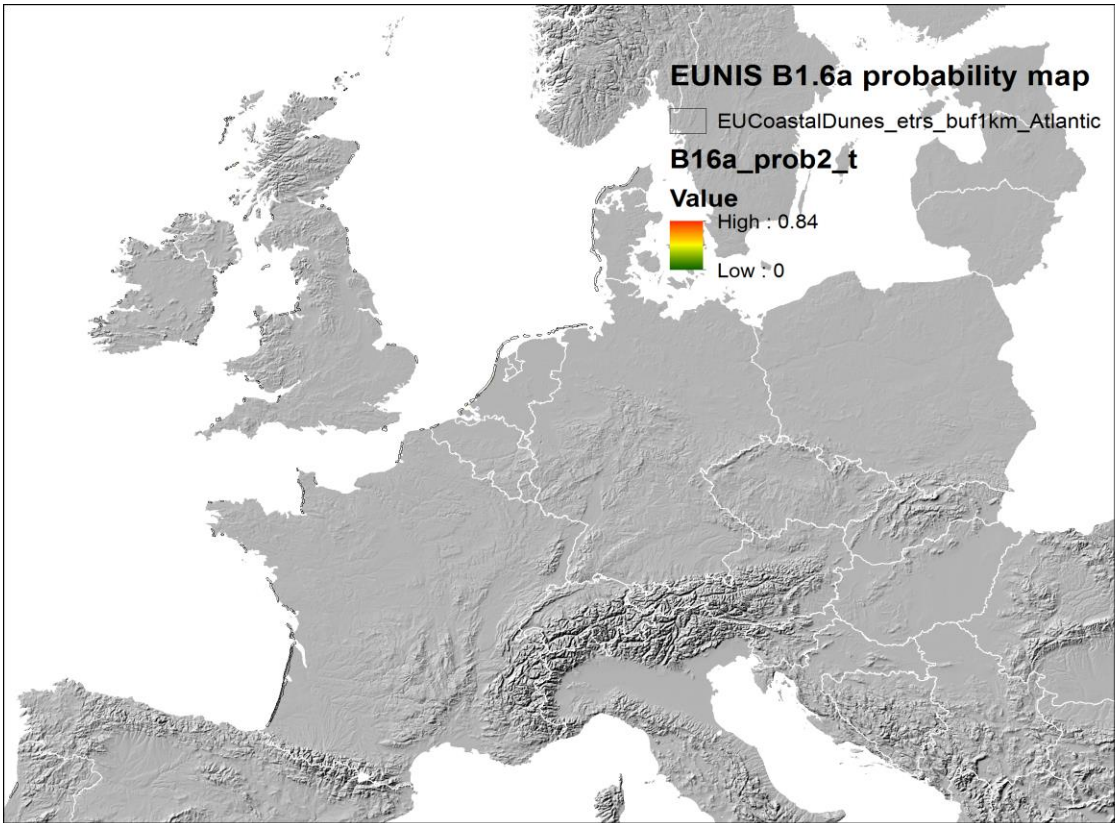
Maxent modelling statistics

AUC training (0-1)		0.9944
AUC test (0-1)		0.9974
Contribution variables to the Maxent model (%)		
	Temperature seasonality (stdev * 100)	41.7572
	pH (water)	23.9492
	Soil organic carbon content (‰)	9.389
	Volume % of coarse fragments (> 2 mm)	7.6674
	Distance to water	5.2114
	Precipitation seasonality (coef. of var.)	4.9242
	Bulk density (kg/m³)	2.5775
	Potential evapotranspiration	2.0785
	Cation Exchange Capacity	0.7106
	Weight in % of silt particles (0.0002-0.05 m	0.5353
	Weight in % of clay particles (<0.0002 mm	0.4876
	Mean temperature of wettest quarter	0.3381
	Precipitation of warmest quarter	0.2755
	Solar radiation	0
	Weight in % of sand particles (0.05-2 mm)	0
	Annual precipitation	0

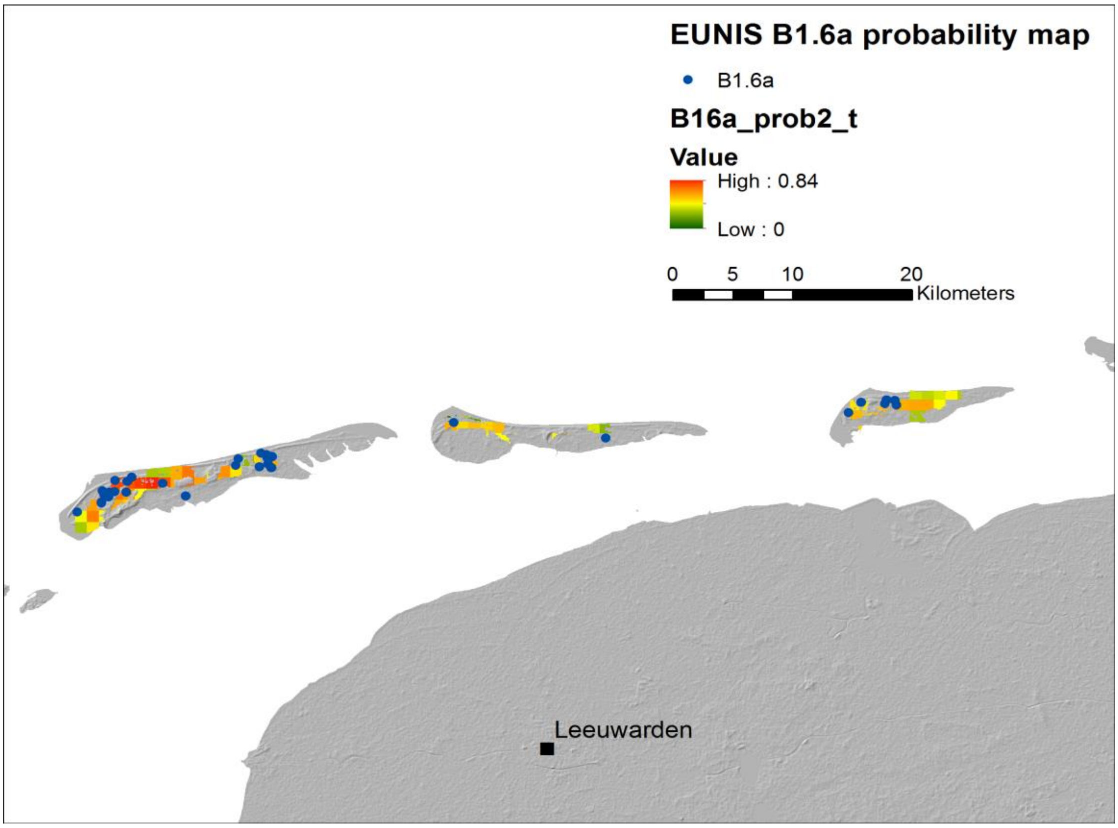
Remarks

Inland prediction should be ignored. Hardly any prediction in the along the French coast.

Coastal habitats are difficult to model and often deliver unsatifying results. There are various reasons for this; 1) the area in which the habitat occurs is very small, 2) some observations do not match with all environmental layers and are therefore left out of the analysis, 3) lack of observations in large parts of the potential area.



Probability map *(overview)*

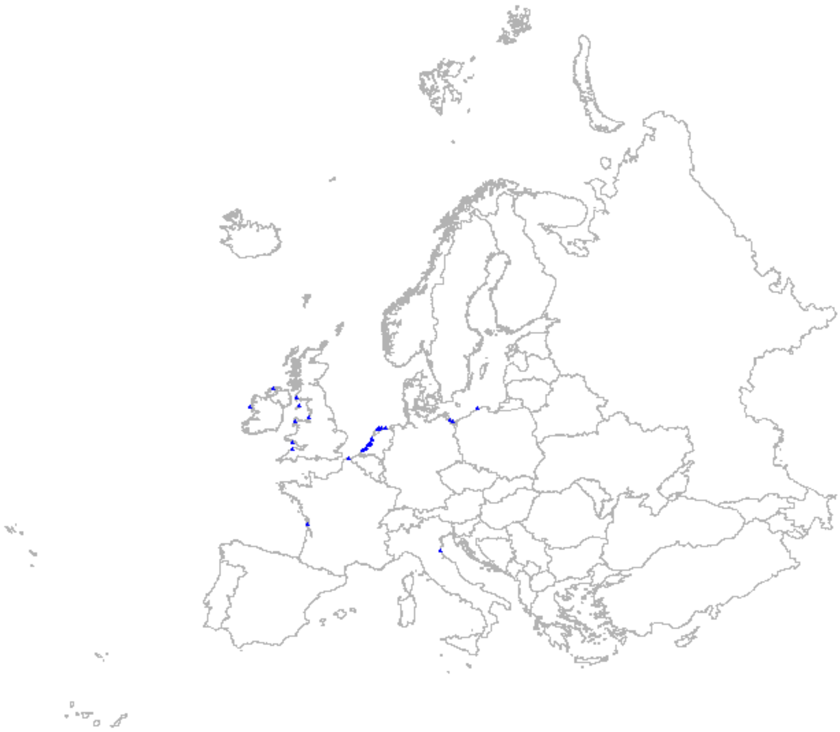


Probability map *(detail)*

Decision rules:

Relationship to CLC (D. Moss)	Moors and heathland (322)
Relationship to CLC (releves)	27 + 26, 30
BGR filter	Yes
Topo filter	Yes

B2.5 - Shingle and gravel beaches with scrub



Distribution map *based on vegetation relevés*

Suitability map *. Background data for model randomly selected from study area*

Geographic restriction distribution data

Coastal sand dunes and sea shores according to Bohn map (P1)

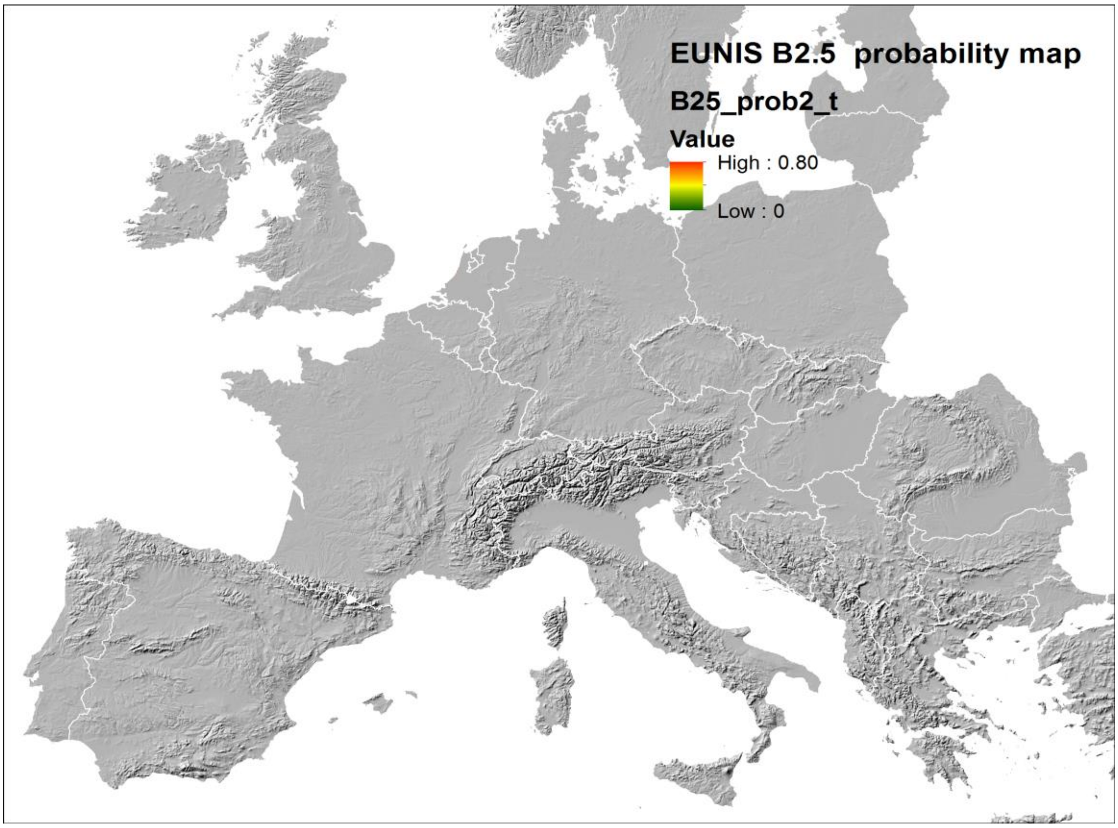
Maxent modelling statistics

AUC training (0-1)	0.9905
AUC test (0-1)	0.9929
Contribution variables to the Maxent model (%)	
Temperature seasonality (stdev * 100)	34.3603
pH (water)	29.8844
Soil organic carbon content (‰)	9.6488
Weight in % of silt particles (0.0002-0.05 m	5.8407
Distance to water	5.4668
Bulk density (kg/m³)	5.0144
Precipitation seasonality (coef. of var.)	4.0617
Potential evapotranspiration	2.2699
Volume % of coarse fragments (> 2 mm)	0.8194
Cation Exchange Capacity	0.7953
Weight in % of clay particles (<0.0002 mm	0.7418
Mean temperature of wettest quarter	0.47
Weight in % of sand particles (0.05-2 mm)	0.4136
Precipitation of warmest quarter	0.1644
Solar radiation	0
Annual precipitation	0

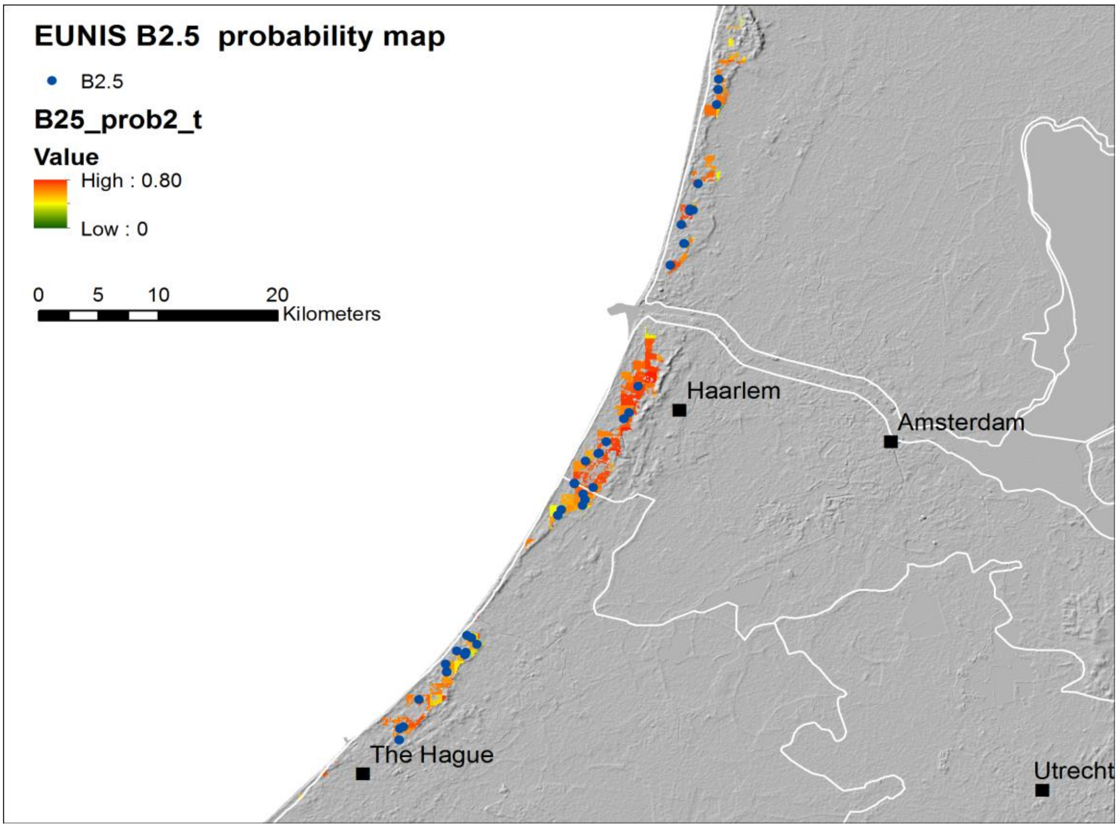
Remarks

Inland prediction should be ignored. Hardly any prediction in large parts of the potential area.

Coastal habitats are difficult to model and often deliver unsatifying results. There are various reasons for this; 1) the area in which the habitat occurs is very small, 2) some observations do not match with all environmental layers and are therefore left out of the analysis, 3) lack of observations in large parts of the potential area.



Probability map *(overview)*



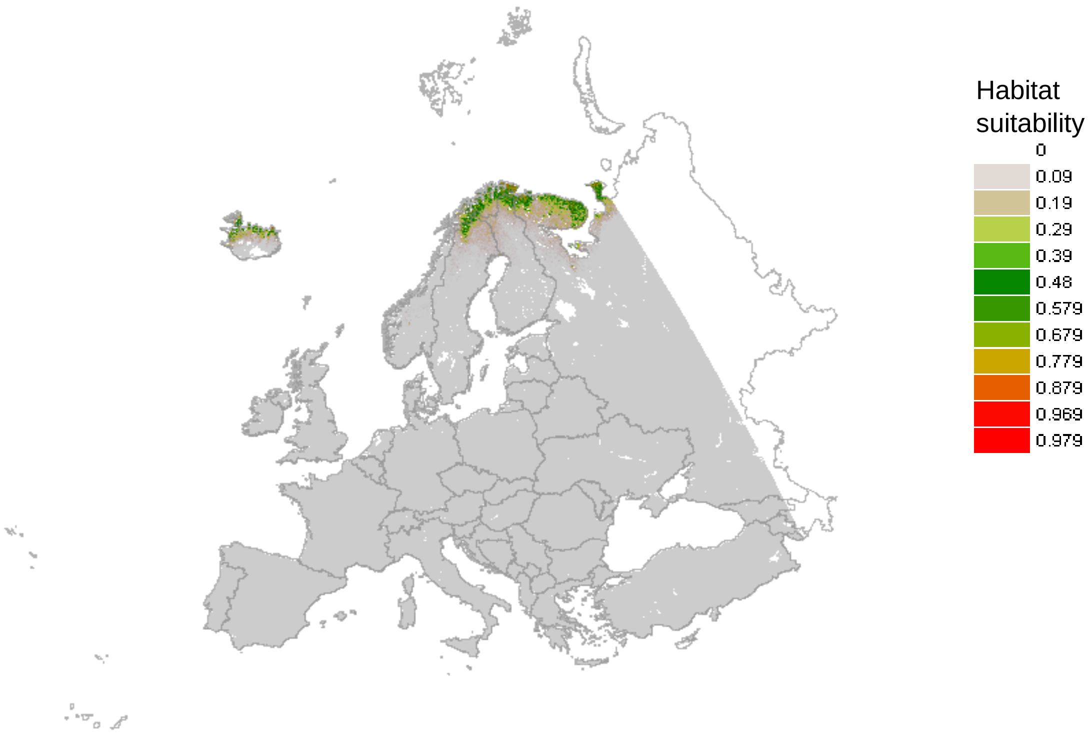
Probability map *(detail)*

Decision rules:

Relationship to CLC (D. Moss)	Moors and heathland (322)
Relationship to CLC (releves)	27 + 26, 30, 37
BGR filter	No
Topo filter	Yes

F1.1 - Shrub tundra

Distribution map *based on vegetation relevés*



Suitability map *. Background data for model randomly selected from study area*

Geographic restriction distribution data

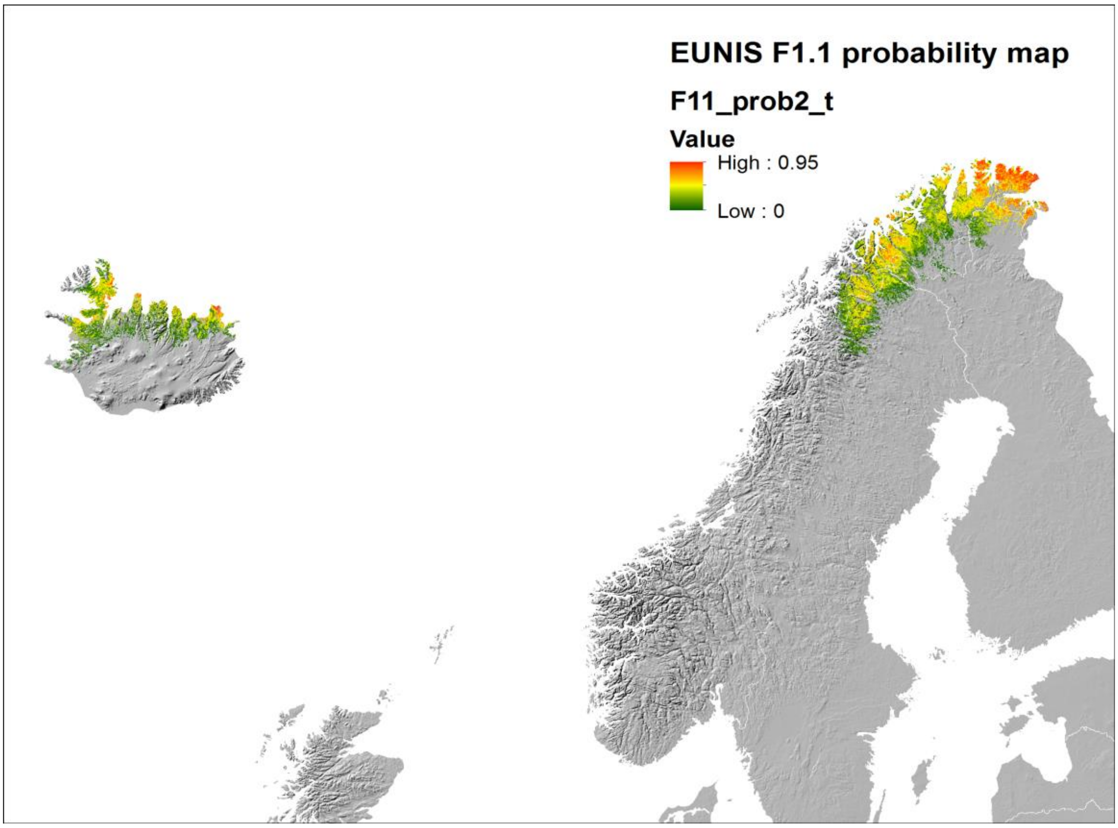
Arctic polar deserts and Arctic tundras according to the Bohn map (A1 & B1)

Maxent modelling statistics

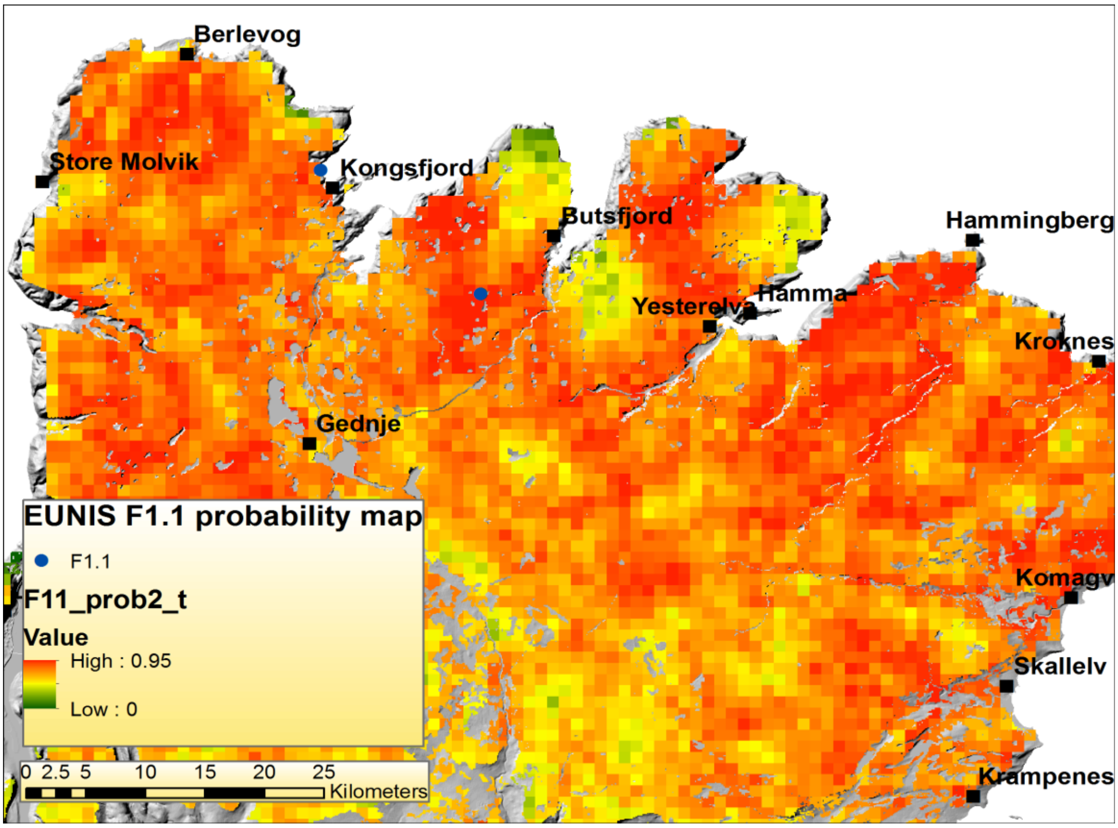
AUC training (0-1)		0.9958
AUC test (0-1)		0.9854
Contribution variables to the Maxent model (%)		
	Soil organic carbon content (‰)	67.523
	Annual precipitation	14.9997
	Mean temperature of wettest quarter	11.3119
	Distance to water	2.3658
	Solar radiation	1.9878
	Weight in % of clay particles (<0.0002 mm	1.6928
	Precipitation of warmest quarter	1.0834
	pH (water)	0.8214
	Potential evapotranspiration	0.1833
	Volume % of coarse fragments (> 2 mm)	0.0186
	Weight in % of silt particles (0.0002-0.05 m	0
	Weight in % of sand particles (0.05-2 mm)	0
	Precipitation seasonality (coef. of var.)	0
	Temperature seasonality (stdev * 100)	0
	Cation Exchange Capacity	0
	Bulk density (kg/m³)	0

Remarks

-



Probability map *(overview)*

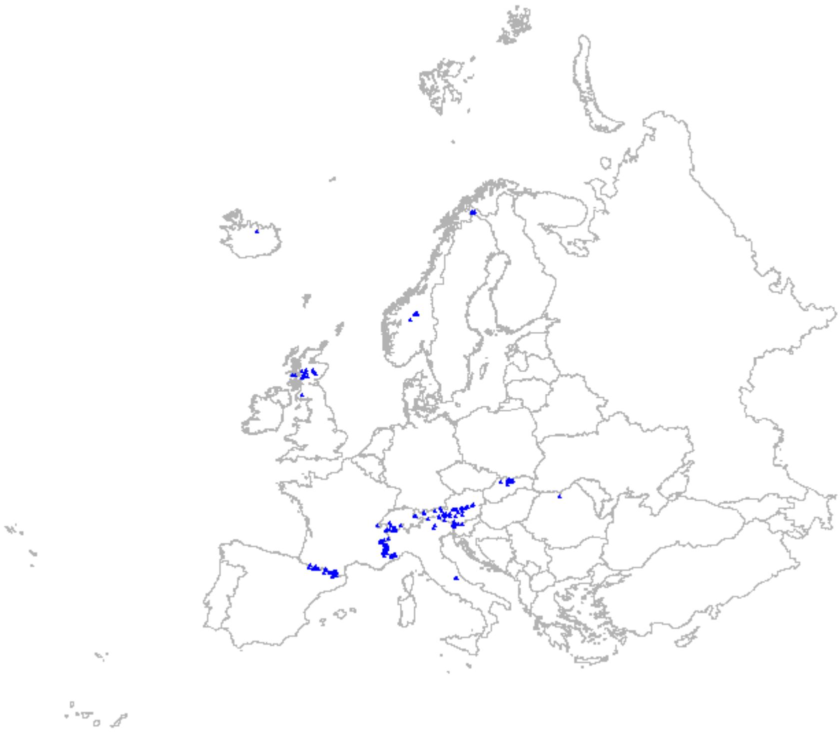


Probability map *(detail)*

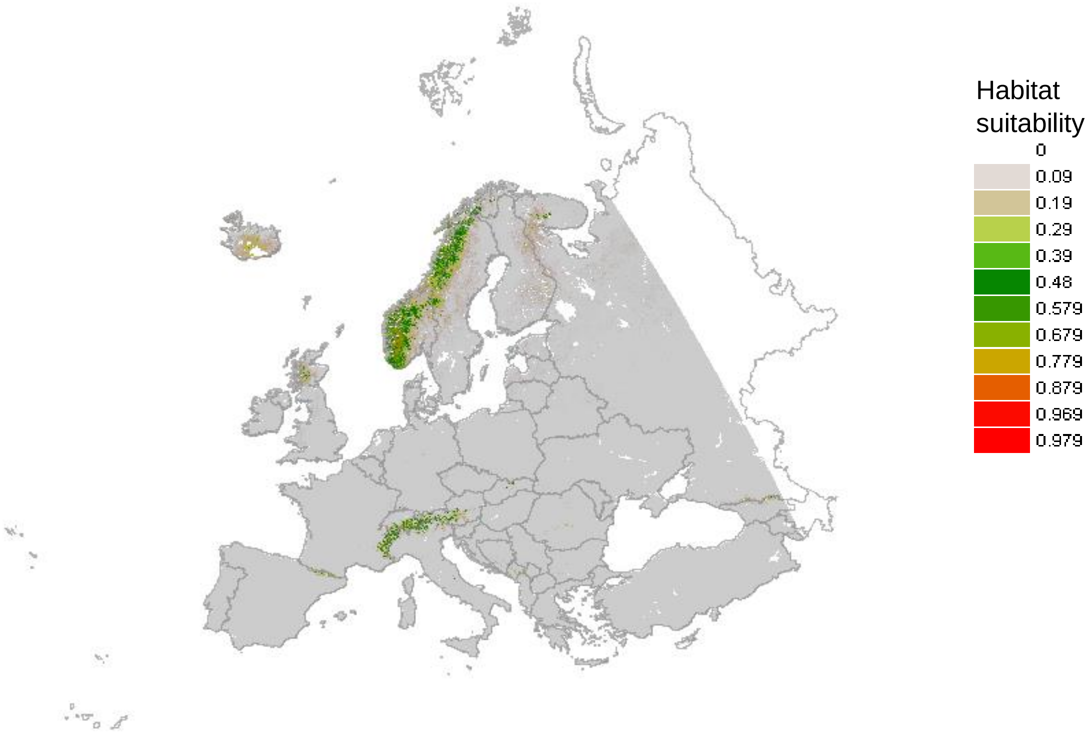
Decision rules:

Relationship to CLC (D. Moss)	Sparsely vegetated (333)
Relationship to CLC (releves)	32 + 27, 31
BGR filter	Yes
Topo filter	No

F2.1 - Subarctic and alpine dwarf Salix scrub



Distribution map *based on vegetation relevés*



Suitability map *. Background data for model randomly selected from heathland-scrub-tundra data set*

Geographic restriction distribution data

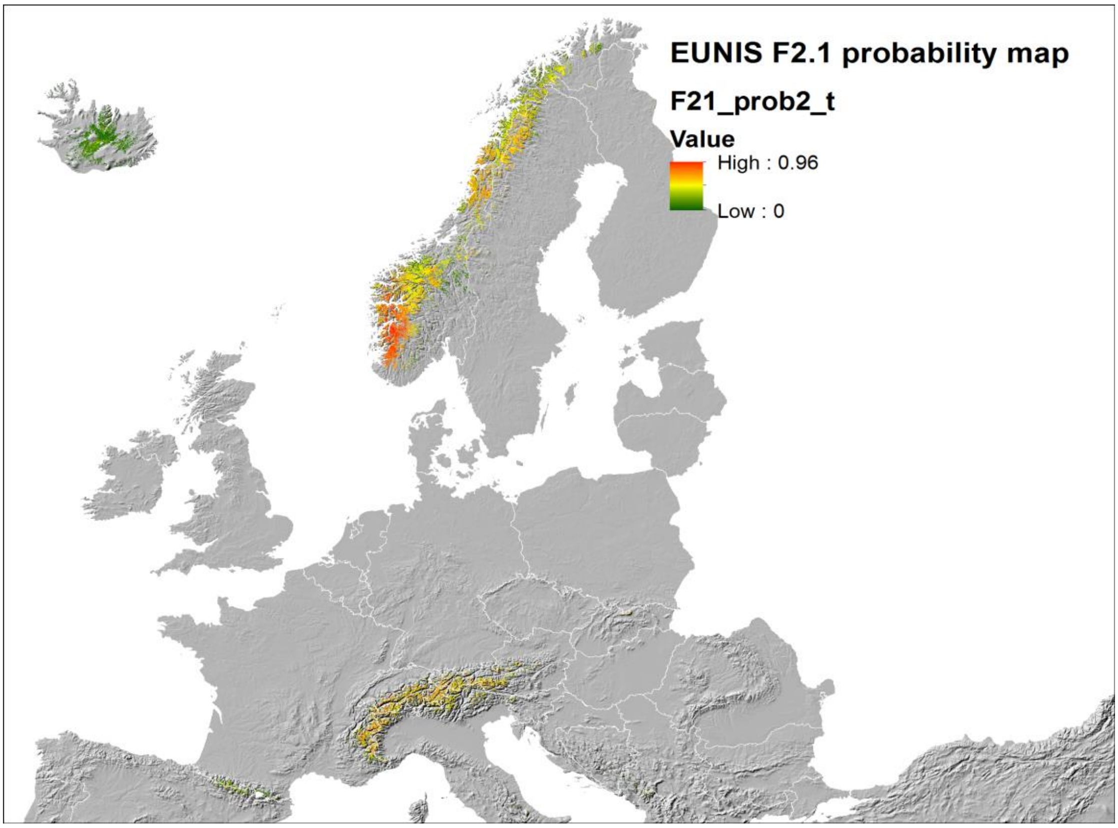
-

Maxent modelling statistics

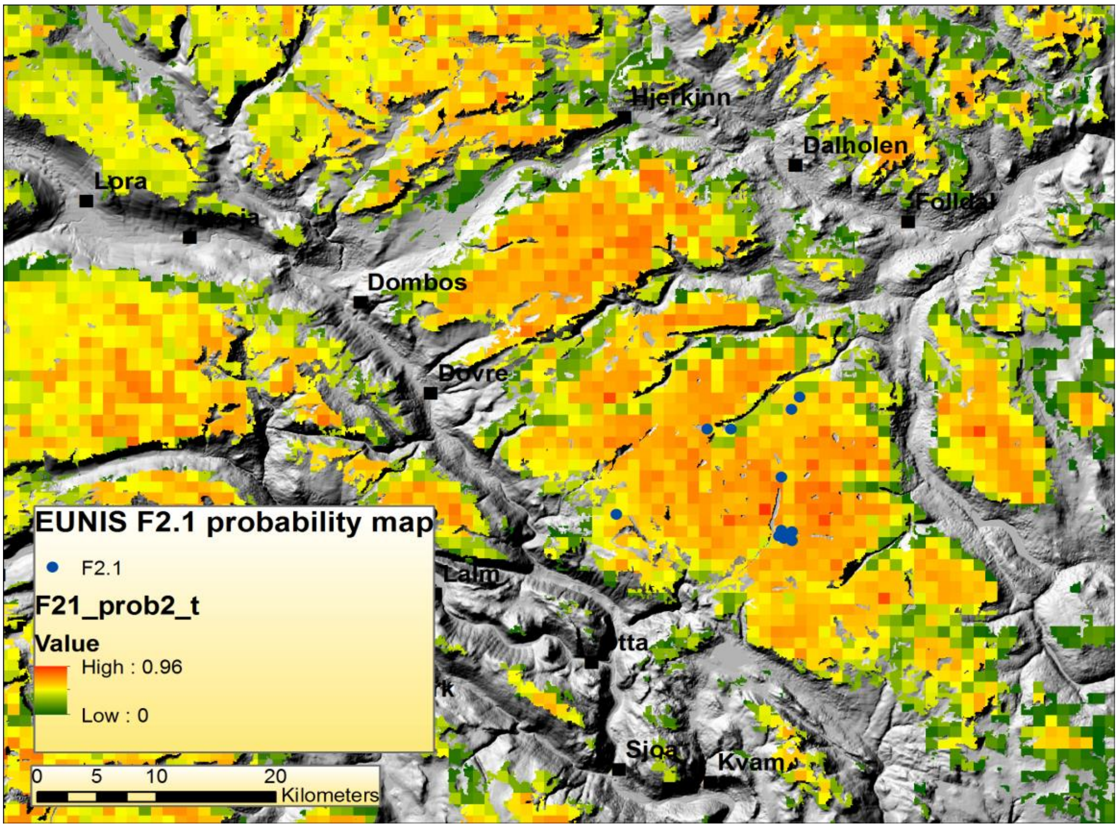
AUC training (0-1)	0.9564
AUC test (0-1)	0.9398
Contribution variables to the Maxent model (%)	
Soil organic carbon content (‰)	63.9081
Weight in % of silt particles (0.0002-0.05 m	16.818
Weight in % of sand particles (0.05-2 mm)	9.0678
Precipitation of warmest quarter	7.7665
Cation Exchange Capacity	3.4397
pH (water)	1.7674
Weight in % of clay particles (<0.0002 mm	1.2574
Volume % of coarse fragments (> 2 mm)	1.2559
Precipitation seasonality (coef. of var.)	1.1556
Solar radiation	1.0445
Annual precipitation	0.6612
Mean temperature of wettest quarter	0.5955
Temperature seasonality (stdev * 100)	0.5363
Potential evapotranspiration	0.4298
Bulk density (kg/m³)	0.162
Distance to water	0.0459

Remarks

-



Probability map *(overview)*

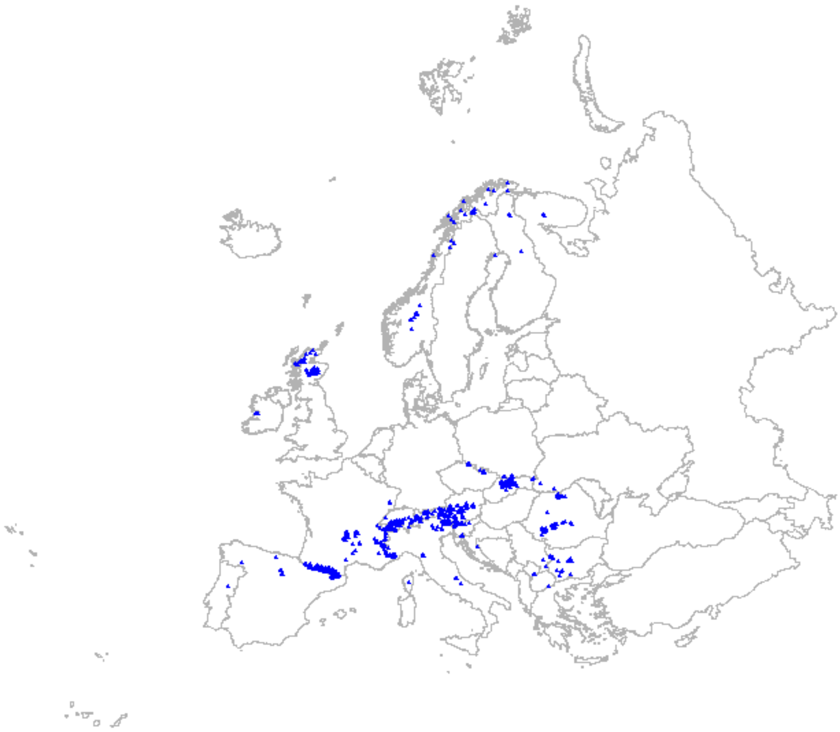


Probability map *(detail)*

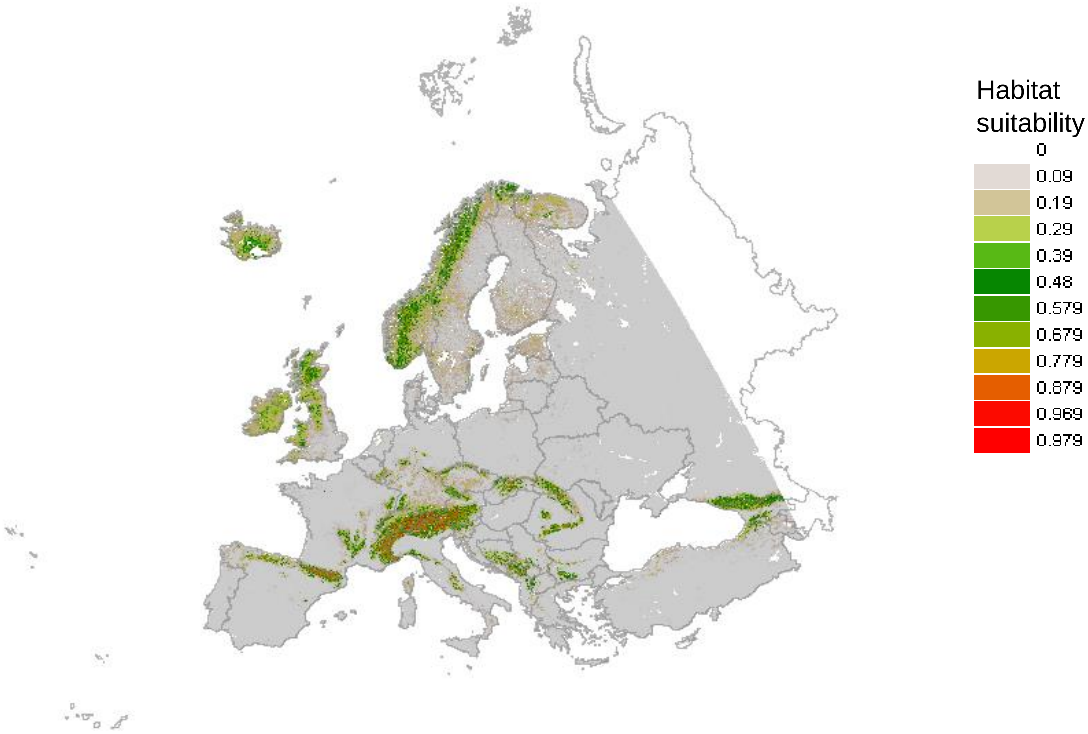
Decision rules:

Relationship to CLC (D. Moss)	Sparsely vegetated (333)
Relationship to CLC (releves)	32 + 31
BGR filter	Yes
Topo filter	No

F2.2a - Alpine and subalpine ericoid heath



Distribution map *based on vegetation relevés*



Suitability map*. Background data for model randomly selected from study area*

Geographic restriction distribution data

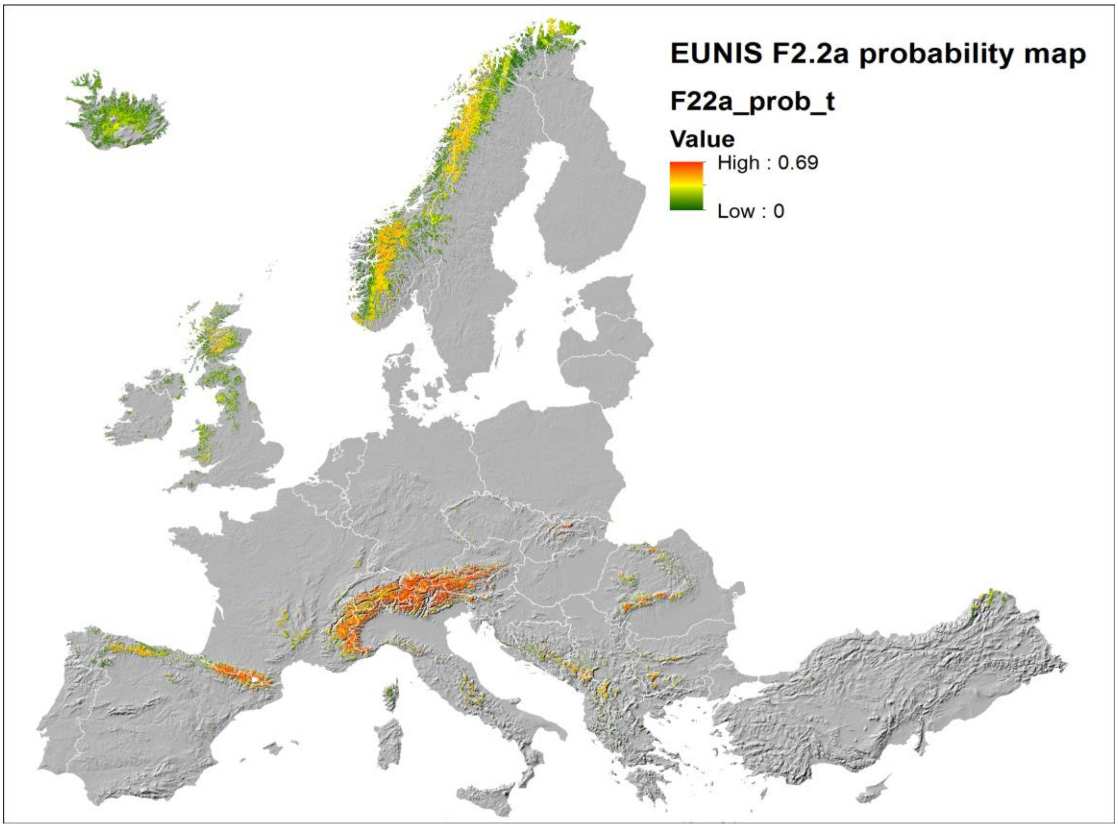
-

Maxent modelling statistics

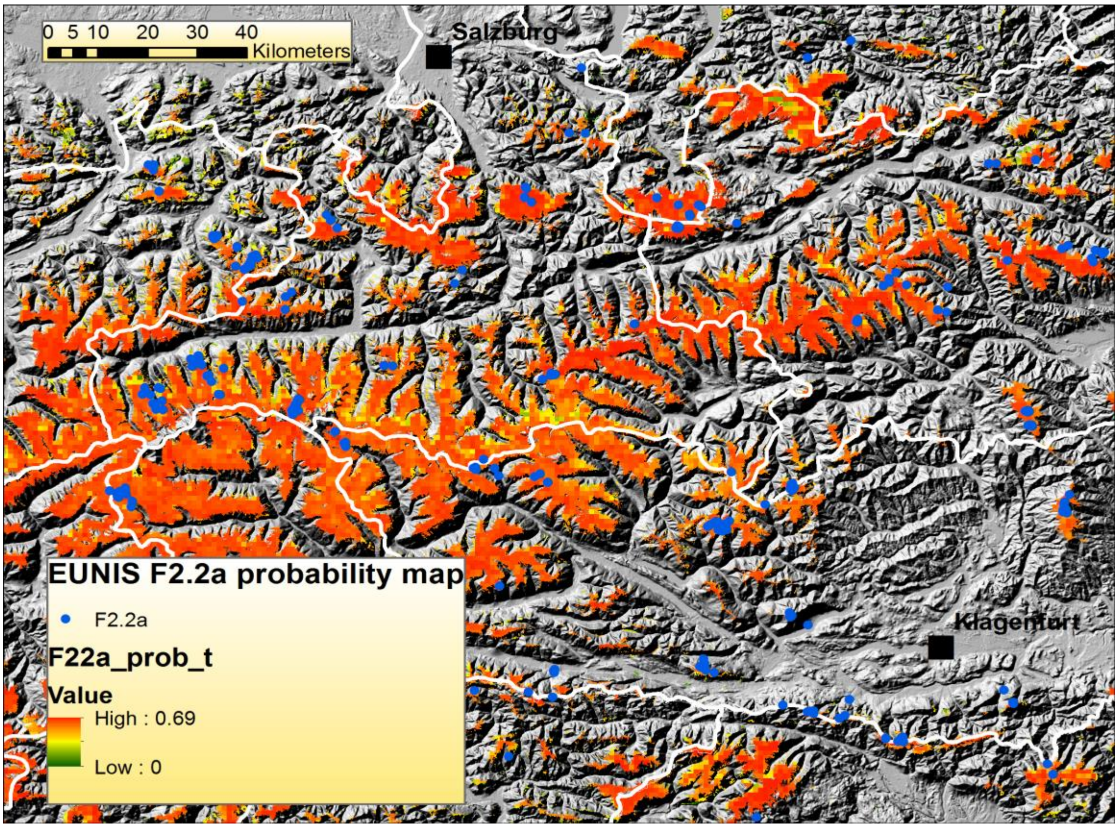
AUC training (0-1)	0.901
AUC test (0-1)	0.8861
Contribution variables to the Maxent model (%)	
Annual precipitation	33.5265
Volume % of coarse fragments (> 2 mm)	18.1061
Weight in % of sand particles (0.05-2 mm)	14.3018
Precipitation of warmest quarter	9.6382
Soil organic carbon content (‰)	3.6068
Bulk density (kg/m³)	2.8496
pH (water)	1.8458
Weight in % of clay particles (<0.0002 mm	1.2887
Solar radiation	1.0794
Temperature seasonality (stdev * 100)	1.0636
Weight in % of silt particles (0.0002-0.05 m	0.6931
Cation Exchange Capacity	0.6751
Mean temperature of wettest quarter	0.5933
Precipitation seasonality (coef. of var.)	0.1903
Potential evapotranspiration	0.1302
Distance to water	0

Remarks

Prediction in eastern part of Europe (Caucasus) is uncertain due to lack of data for that area.



Probability map *(overview)*

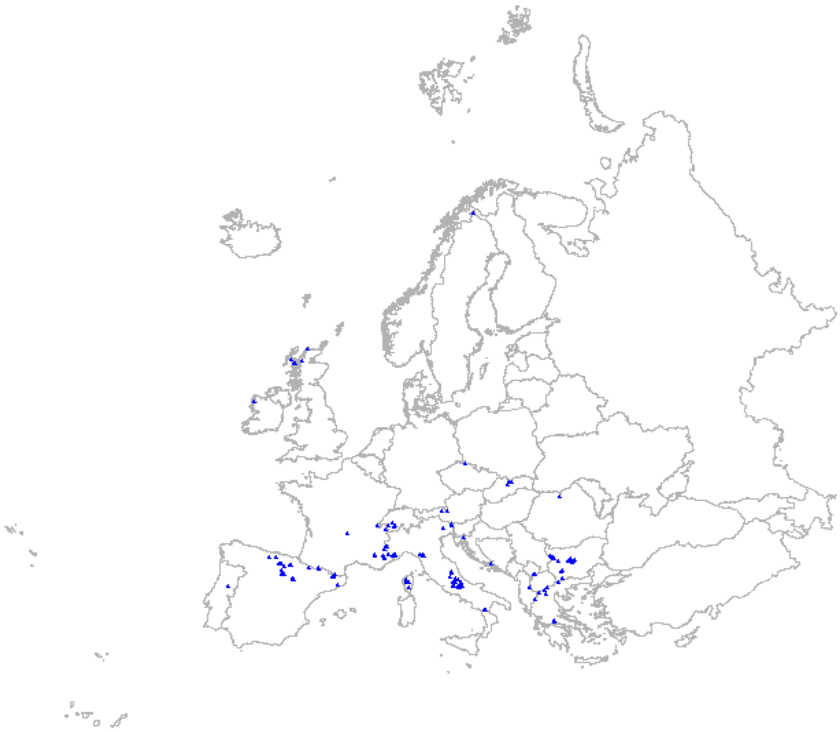


Probability map *(detail)*

Decision rules:

Relationship to CLC (D. Moss)	Moors and heathland (322)
Relationship to CLC (releves)	27 + 26, 31, 32
BGR filter	No
Topo filter	No

F2.2b - Alpine and subalpine Juniperus scrub



Distribution map *based on vegetation relevés*

Suitability map *. Background data for model randomly selected from study area*

Geographic restriction distribution data

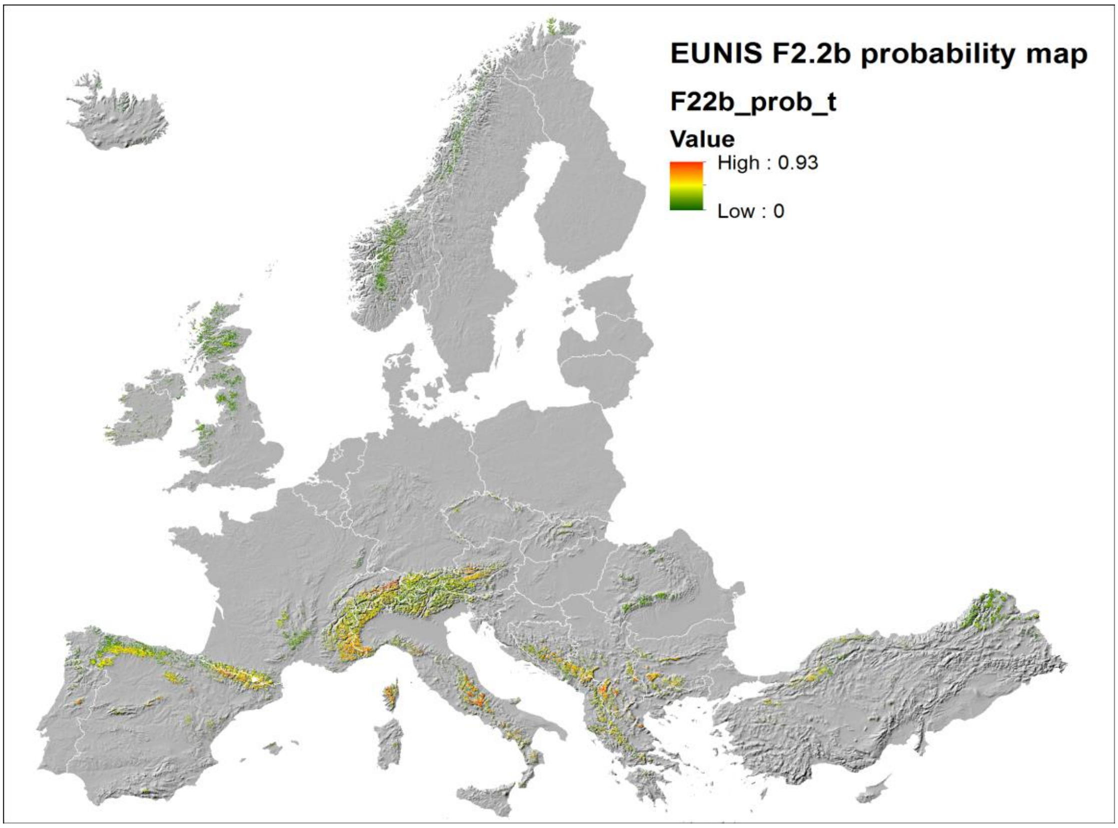
-

Maxent modelling statistics

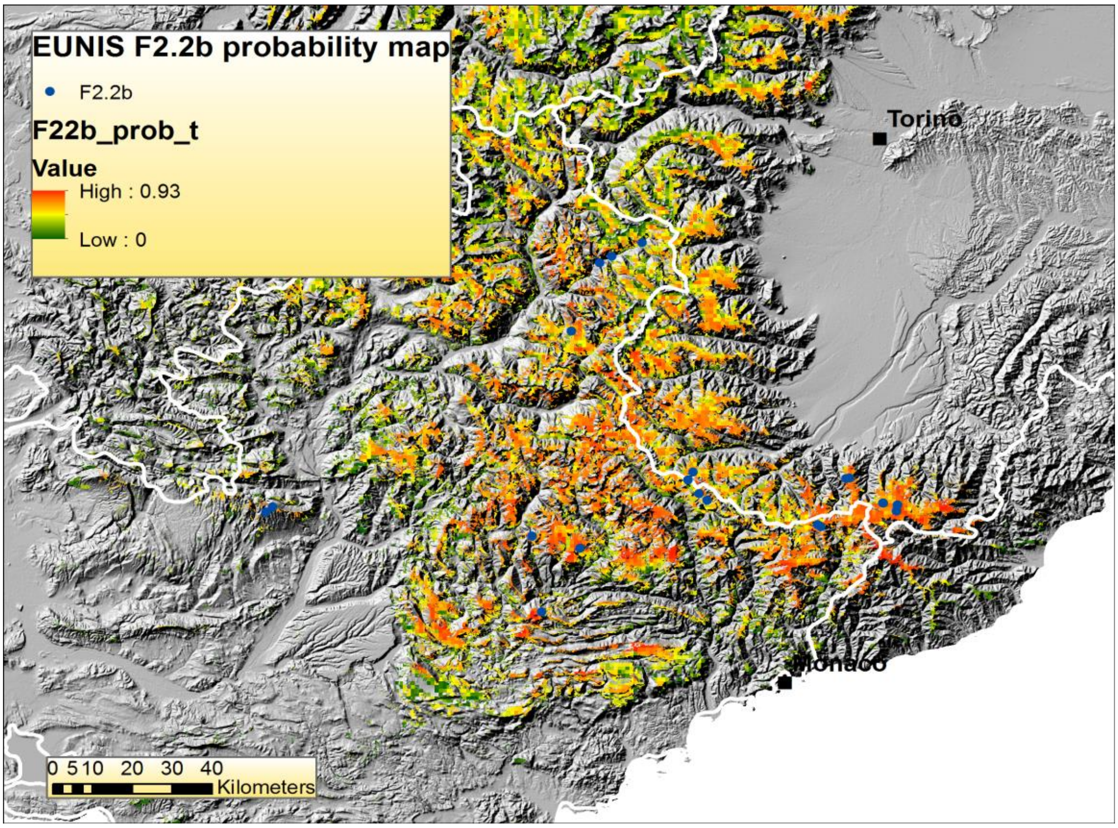
AUC training (0-1)	0.9745
AUC test (0-1)	0.8935
Contribution variables to the Maxent model (%)	
Weight in % of sand particles (0.05-2 mm)	28.4589
Volume % of coarse fragments (> 2 mm)	19.0389
Temperature seasonality (stdev * 100)	15.818
Annual precipitation	12.8929
Bulk density (kg/m³)	7.0208
Soil organic carbon content (‰)	5.0007
Solar radiation	4.0254
Precipitation of warmest quarter	2.9895
Cation Exchange Capacity	2.2118
Potential evapotranspiration	1.9823
Weight in % of silt particles (0.0002-0.05 m	1.363
Mean temperature of wettest quarter	0.9385
Weight in % of clay particles (<0.0002 mm	0.5595
Precipitation seasonality (coef. of var.)	0.3548
pH (water)	0.0419
Distance to water	0.004

Remarks

Prediction in eastern part of Europe (Causcasus, Turkey) uncertain due to lack of data for that area.



Probability map *(overview)*



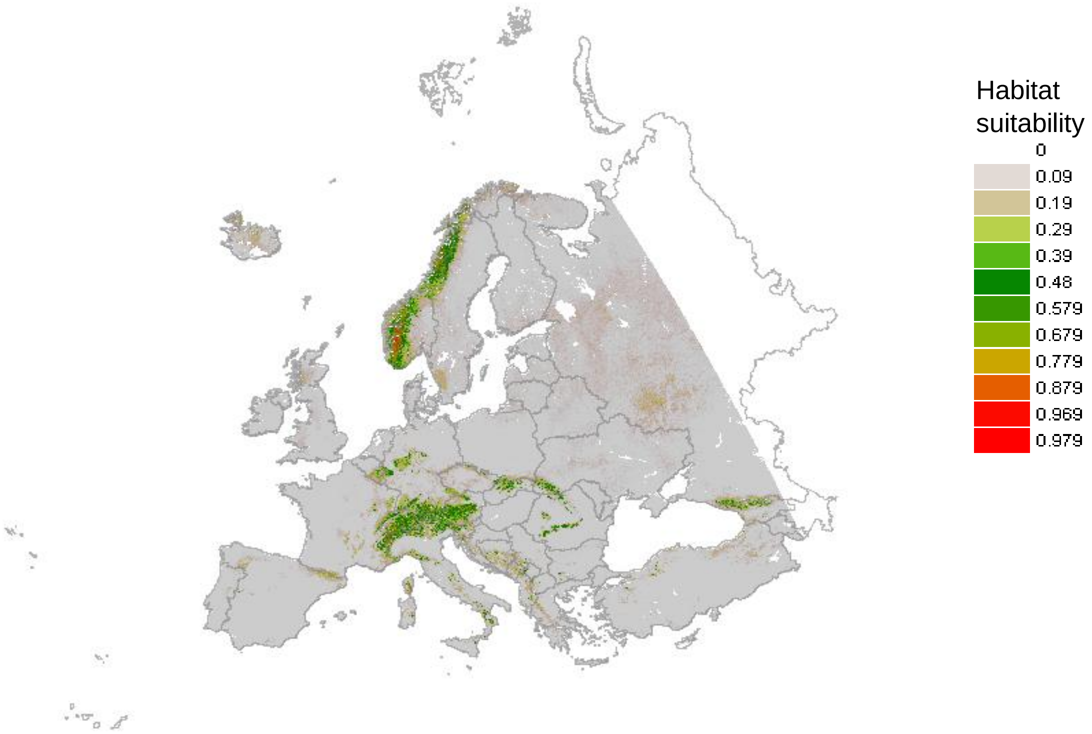
Probability map *(detail)*

Decision rules:

Relationship to CLC (D. Moss)	Moors and heathland (322)
Relationship to CLC (releves)	27 + 26, 29, 32
BGR filter	No
Topo filter	No

F2.3 - Subalpine deciduous scrub

Distribution map *based on vegetation relevés*



Suitability map *. Background data for model randomly selected from heathland-scrub-tundra data set*

Geographic restriction distribution data

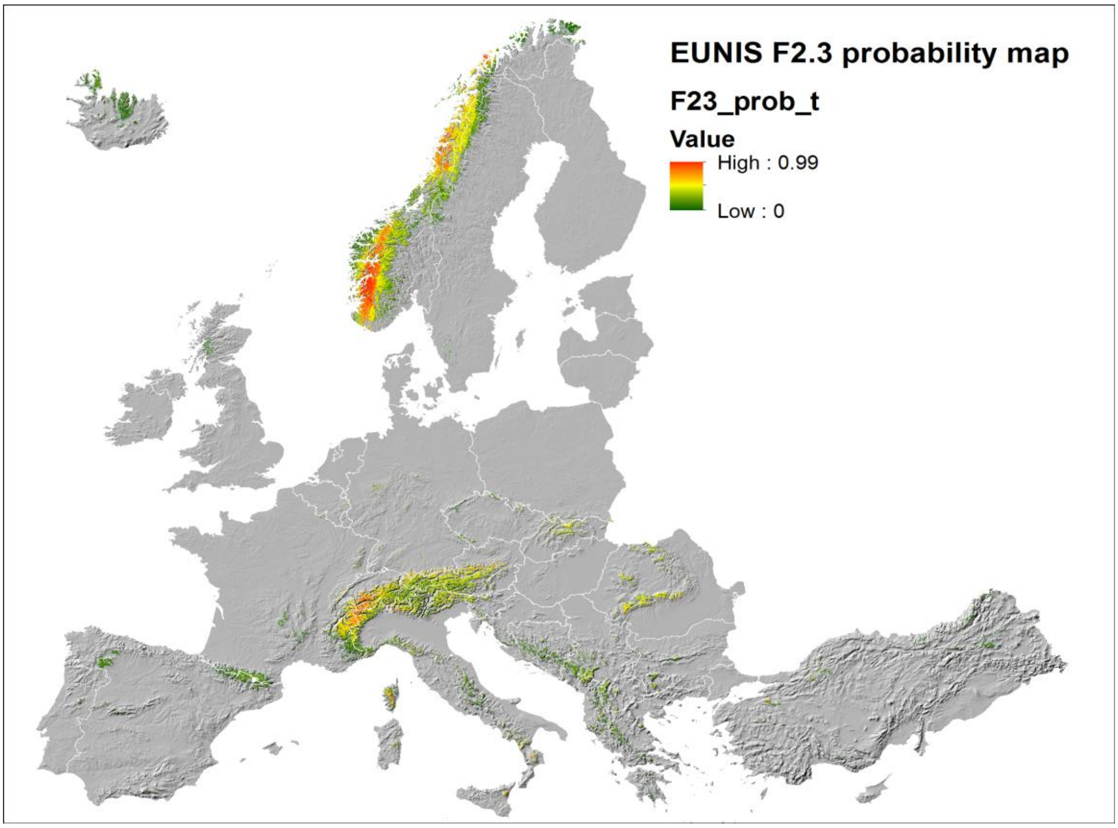
-

Maxent modelling statistics

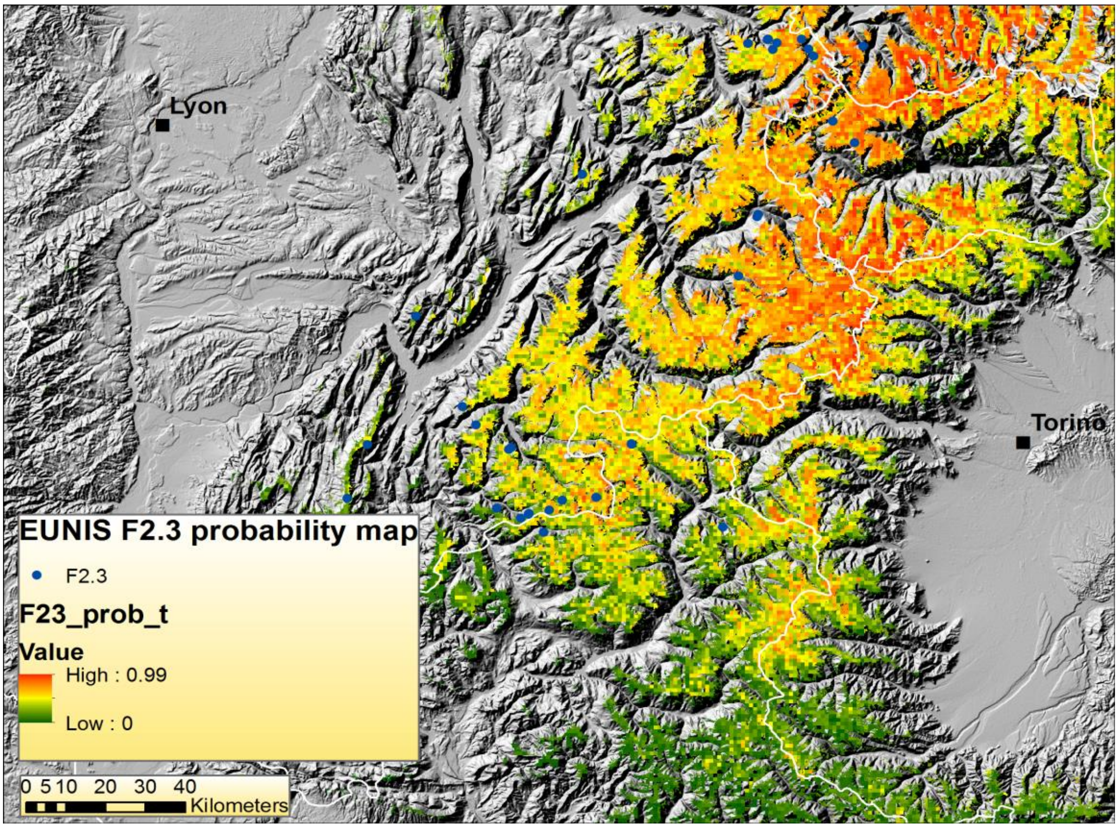
AUC training (0-1)	0.9336
AUC test (0-1)	0.9223
Contribution variables to the Maxent model (%)	
Precipitation of warmest quarter	24.867
Weight in % of sand particles (0.05-2 mm)	17.4469
Annual precipitation	16.9077
Temperature seasonality (stdev * 100)	13.9288
Soil organic carbon content (‰)	8.9444
Solar radiation	5.4636
Precipitation seasonality (coef. of var.)	4.0239
Cation Exchange Capacity	3.7884
Mean temperature of wettest quarter	2.2471
Potential evapotranspiration	1.591
Volume % of coarse fragments (> 2 mm)	1.1602
Weight in % of silt particles (0.0002-0.05 m	1.0955
Distance to water	0.6474
Bulk density (kg/m³)	0.6196
pH (water)	0.5388
Weight in % of clay particles (<0.0002 mm	0.4739

Remarks

Prediction in Germany should be ignored and prediction in eastern part of Europe (Caucasus) uncertain due to lack of data for that area.



Probability map *(overview)*

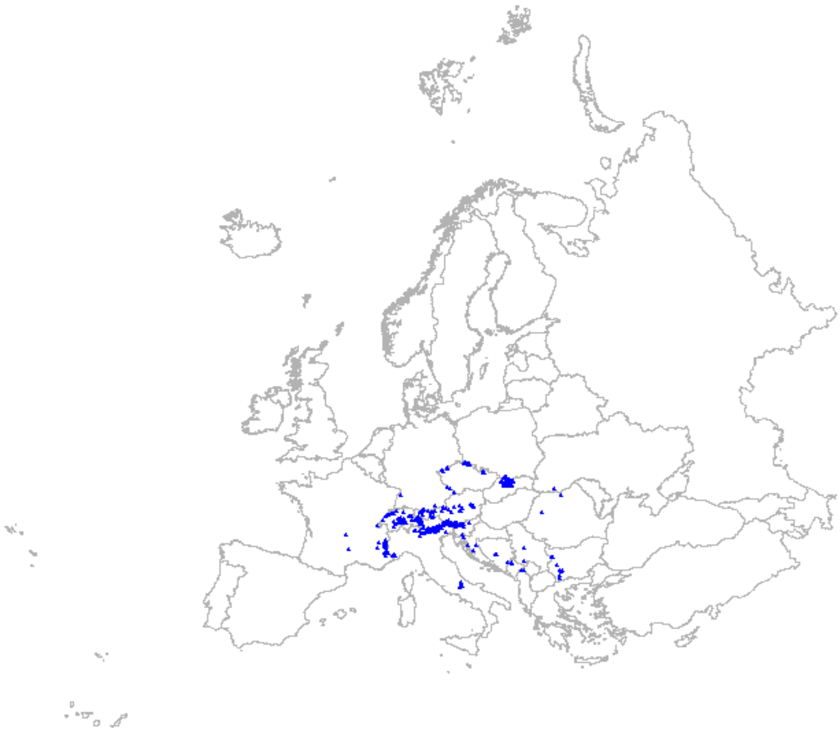


Probability map *(detail)*

Decision rules:

Relationship to CLC (D. Moss)	Moors and heathland (322)
Relationship to CLC (releves)	27 + 26, 31, 32, 29
BGR filter	No
Topo filter	No

F2.4 - Subalpine Pinus mugo scrub



Distribution map *based on vegetation relevés*

Suitability map *. Background data for model randomly selected from heathland-scrub-tundra data set*

Geographic restriction distribution data

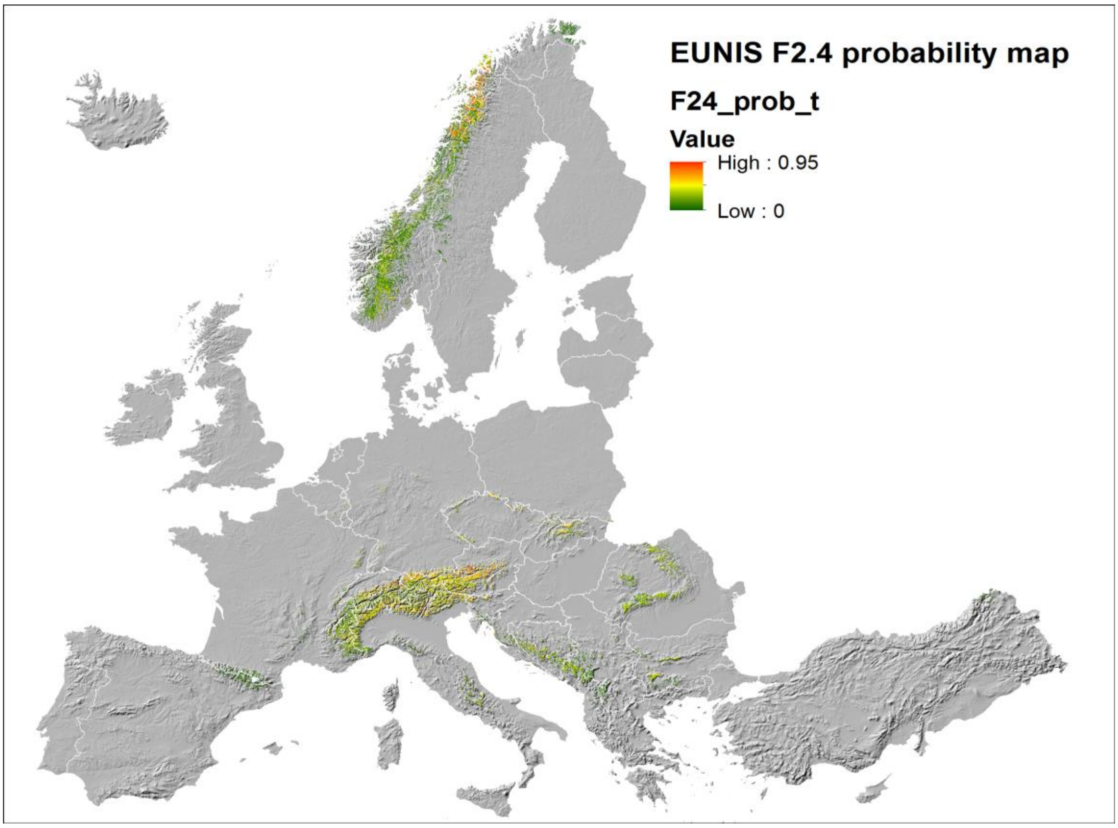
-

Maxent modelling statistics

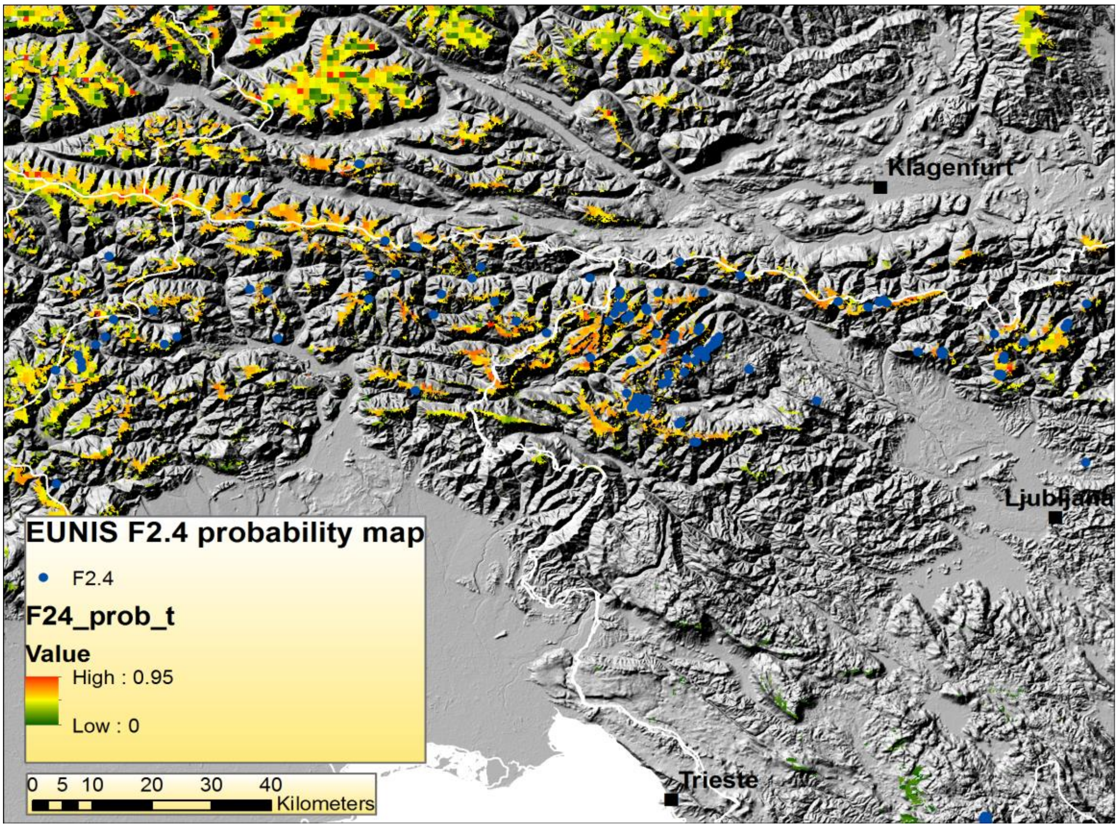
AUC training (0-1)	0.9143
AUC test (0-1)	0.9149
Contribution variables to the Maxent model (%)	
Precipitation of warmest quarter	43.9529
Temperature seasonality (stdev * 100)	13.1648
Weight in % of sand particles (0.05-2 mm)	11.1987
Volume % of coarse fragments (> 2 mm)	9.3161
Bulk density (kg/m³)	7.3518
Potential evapotranspiration	2.9277
Annual precipitation	2.7221
Precipitation seasonality (coef. of var.)	2.6403
Soil organic carbon content (‰)	1.8856
Mean temperature of wettest quarter	1.5025
Weight in % of silt particles (0.0002-0.05 m	1.415
Solar radiation	0.952
Cation Exchange Capacity	0.9019
Distance to water	0.7246
Weight in % of clay particles (<0.0002 mm	0.3665
pH (water)	0.069

Remarks

Pinus mugo does not occur in Scandinavia and therefore the prediction in this area should be ignored. Prediction in eastern part of Europe (Caucasus) is uncertain due to lack of data for that area.



Probability map *(overview)*

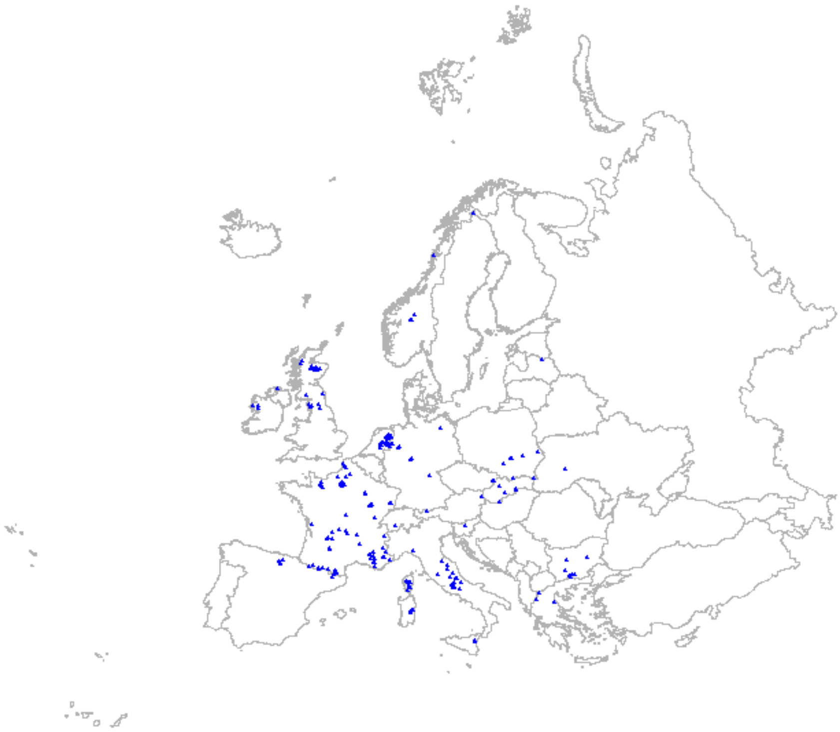


Probability map *(detail)*

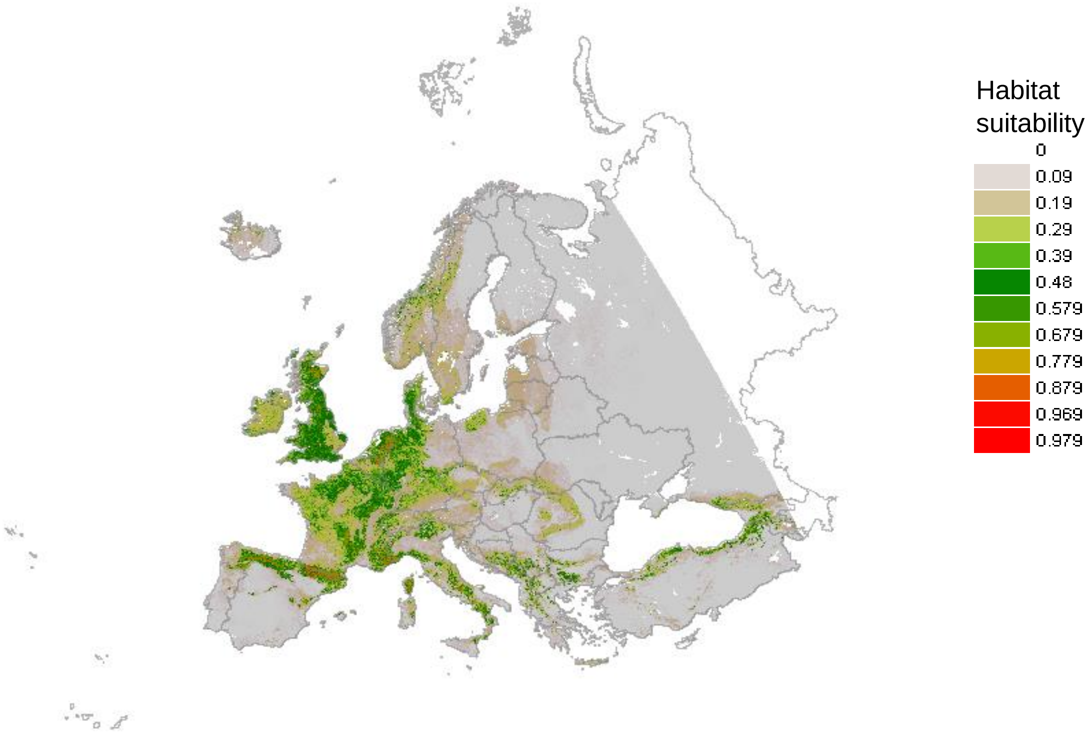
Decision rules:

Relationship to CLC (D. Moss)	Moors and heathland (322)
Relationship to CLC (releves)	27 + 26, 29, 32
BGR filter	No
Topo filter	No

F3.1a - Lowland to montane temperate and submediterranean Juniperus scrub



Distribution map *based on vegetation relevés*



Suitability map *. Background data for model randomly selected from study area*

Geographic restriction distribution data

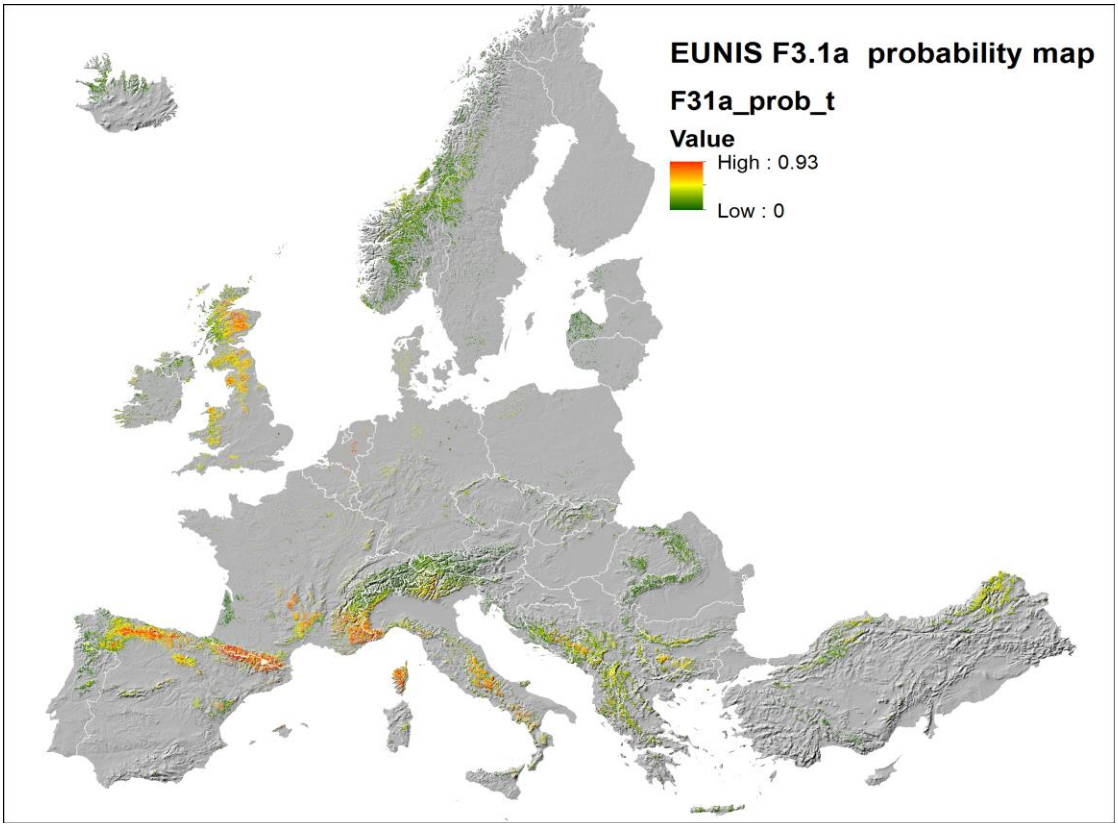
-

Maxent modelling statistics

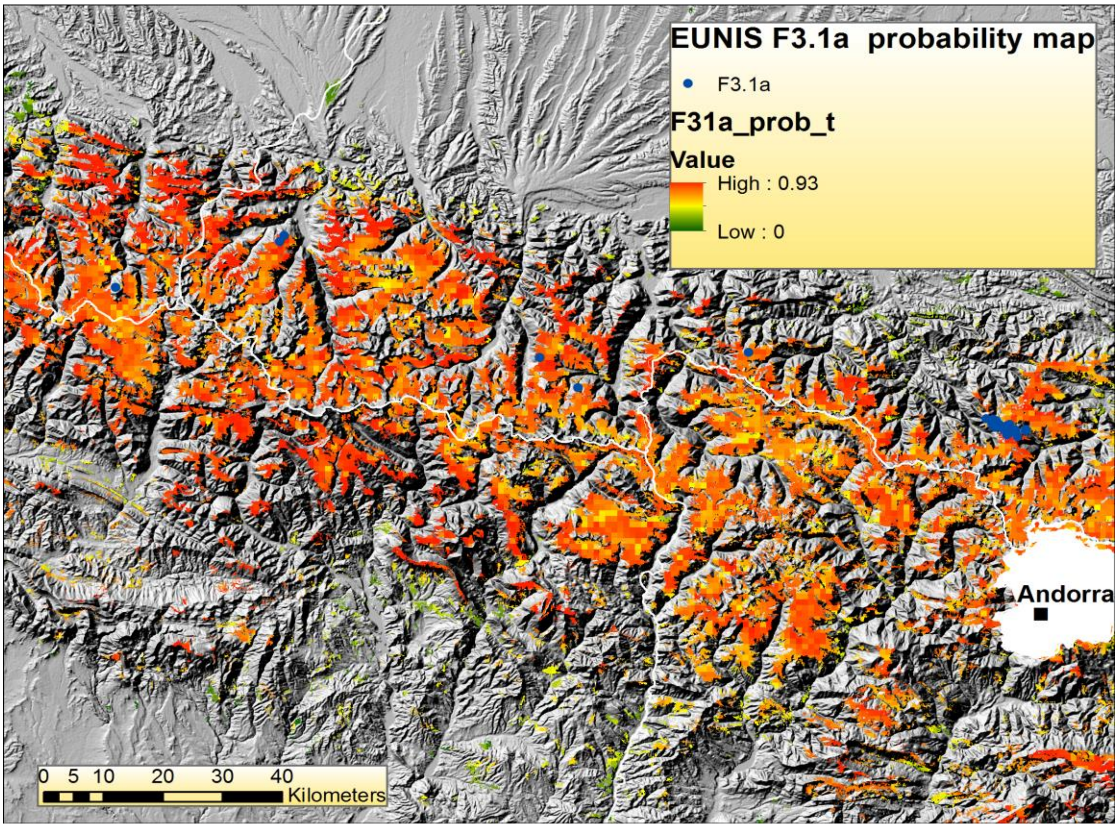
AUC training (0-1)		0.9294
AUC test (0-1)		0.9168
Contribution variables to the Maxent model (%)		
	Temperature seasonality (stdev * 100)	47.2878
	Annual precipitation	16.9278
	Soil organic carbon content (‰)	11.6802
	Solar radiation	11.098
	Weight in % of sand particles (0.05-2 mm)	6.1532
	Volume % of coarse fragments (> 2 mm)	4.1454
	Precipitation of warmest quarter	3.0896
	Bulk density (kg/m³)	2.8954
	Weight in % of silt particles (0.0002-0.05 m	2.8708
	Precipitation seasonality (coef. of var.)	1.7383
	Mean temperature of wettest quarter	1.1727
	pH (water)	0.4748
	Potential evapotranspiration	0.3306
	Weight in % of clay particles (<0.0002 mm	0.2259
	Cation Exchange Capacity	0.1047
	Distance to water	0.0476

Remarks

-Prediction in eastern part of Europe (Caucasus, Turkey) is uncertain due to lack of data for that area.



Probability map *(overview)*

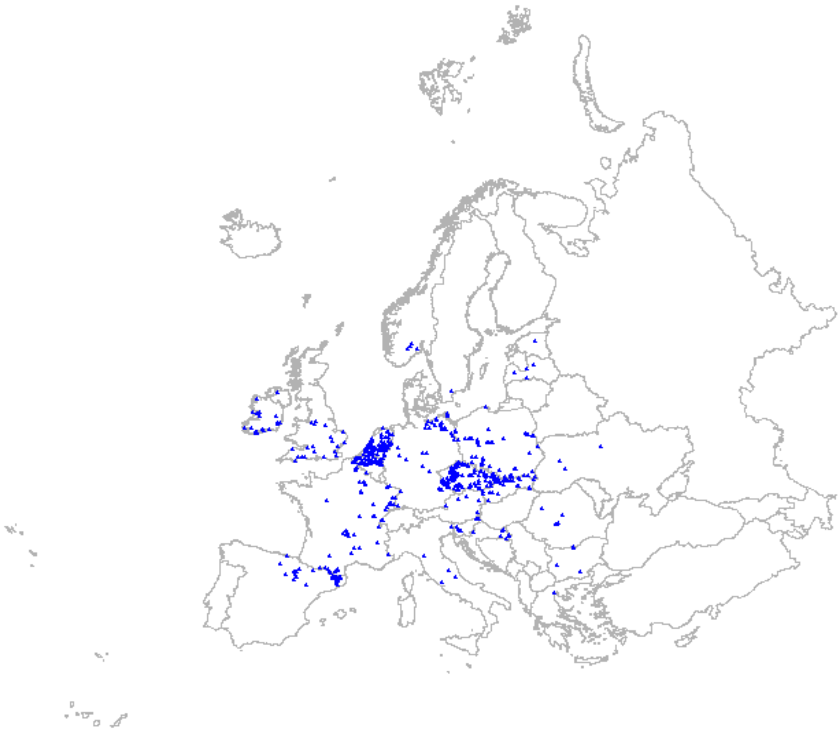


Probability map *(detail)*

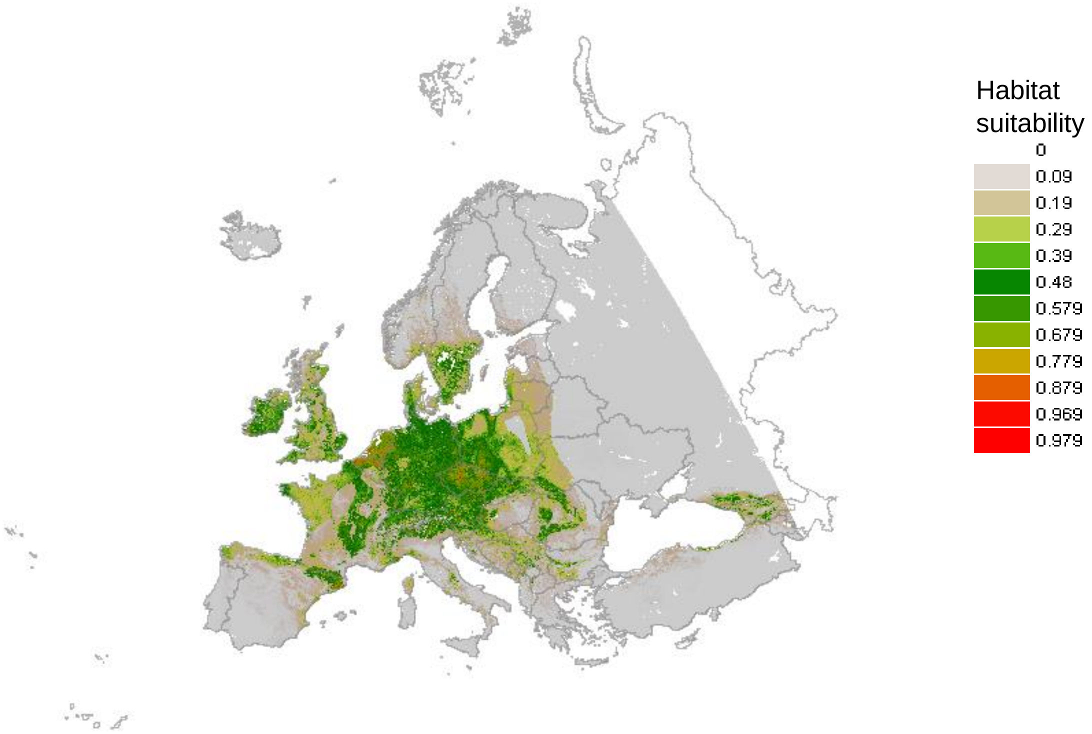
Decision rules:

Relationship to CLC (D. Moss)	Moors and heathland (322)
Relationship to CLC (releves)	27 + 26, 29, 32
BGR filter	No
Topo filter	No

F3.1b - Temperate Rubus scrub



Distribution map *based on vegetation relevés*



***Suitability map**. Background data for model randomly selected from study area*

Geographic restriction distribution data

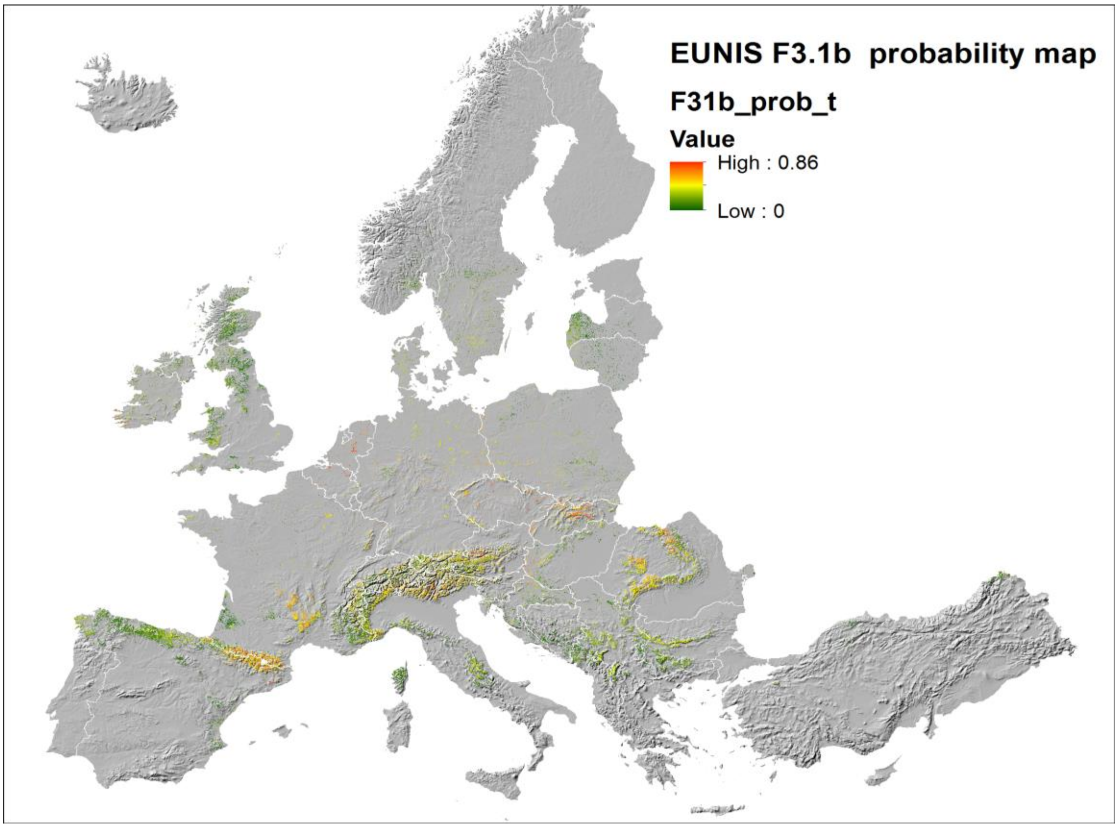
-

Maxent modelling statistics

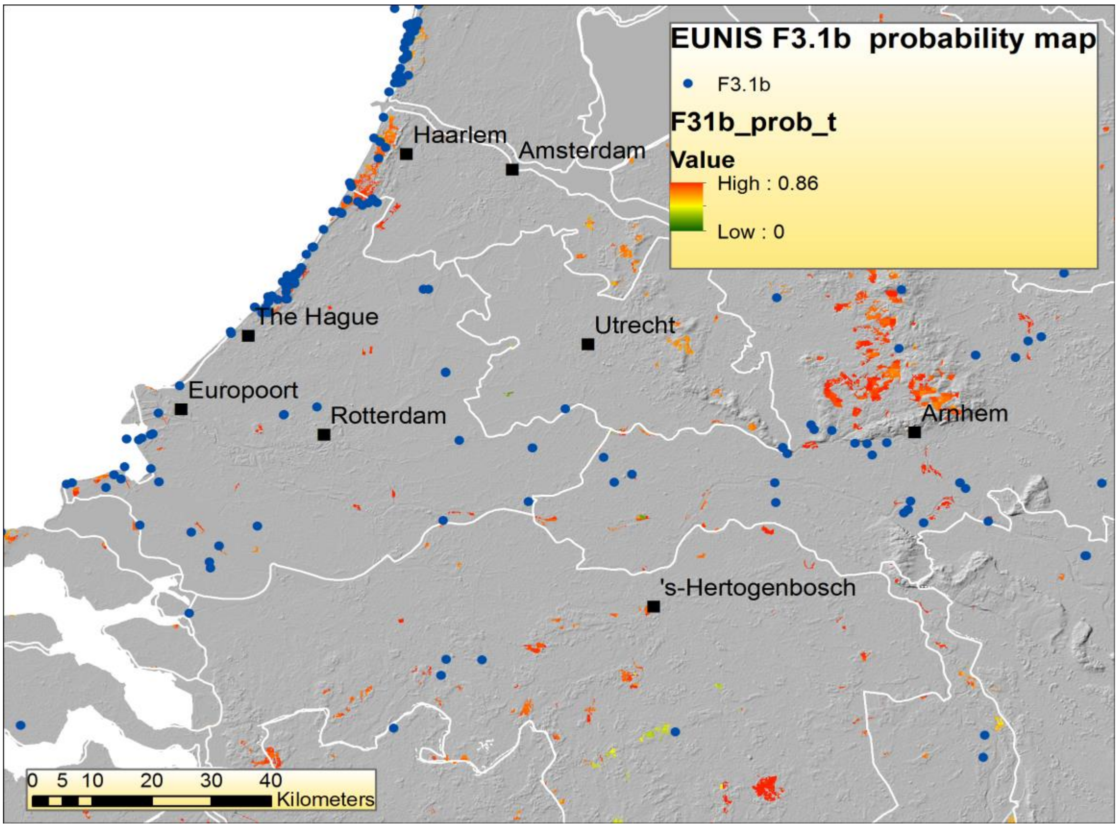
AUC training (0-1)	0.9025
AUC test (0-1)	0.8724
Contribution variables to the Maxent model (%)	
Temperature seasonality (stdev * 100)	45.0235
Soil organic carbon content (‰)	22.8131
Precipitation of warmest quarter	16.3224
Mean temperature of wettest quarter	4.7928
Cation Exchange Capacity	3.1905
Precipitation seasonality (coef. of var.)	2.4142
Solar radiation	1.4328
Weight in % of silt particles (0.0002-0.05 m	0.9949
Bulk density (kg/m³)	0.9704
Weight in % of clay particles (<0.0002 mm	0.8803
Annual precipitation	0.8323
Volume % of coarse fragments (> 2 mm)	0.4803
Distance to water	0.4007
Potential evapotranspiration	0.2595
pH (water)	0.2441
Weight in % of sand particles (0.05-2 mm)	0.1634

Remarks

Poor model that is too much affected by the distribution of input data with a high concentration in NL and CZ. The prediction in eastern part of Europe (Caucasus, Turkey) is uncertain due to lack of data for that area.



Probability map *(overview)*

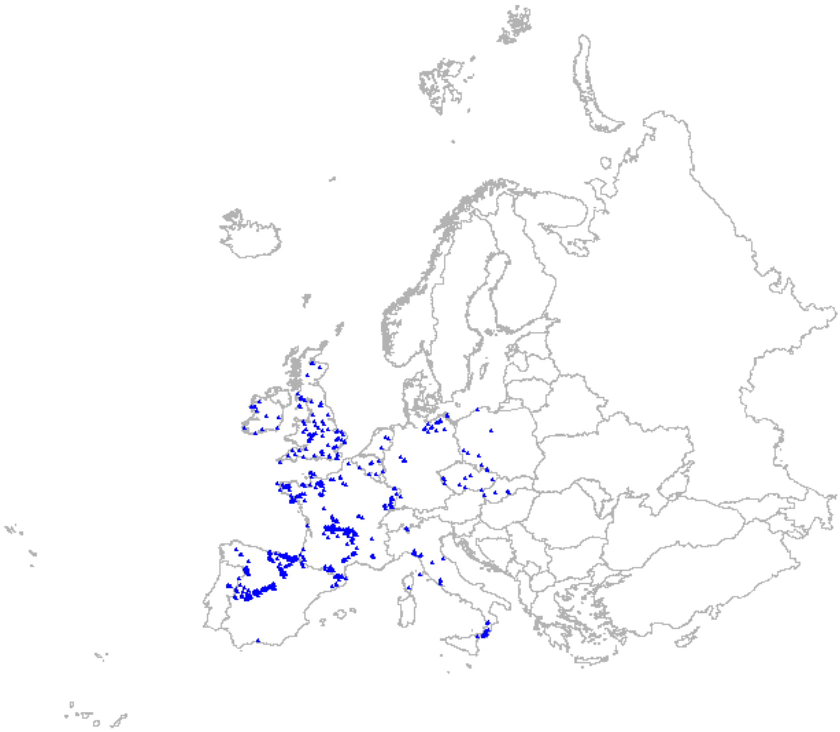


Probability map *(detail)*

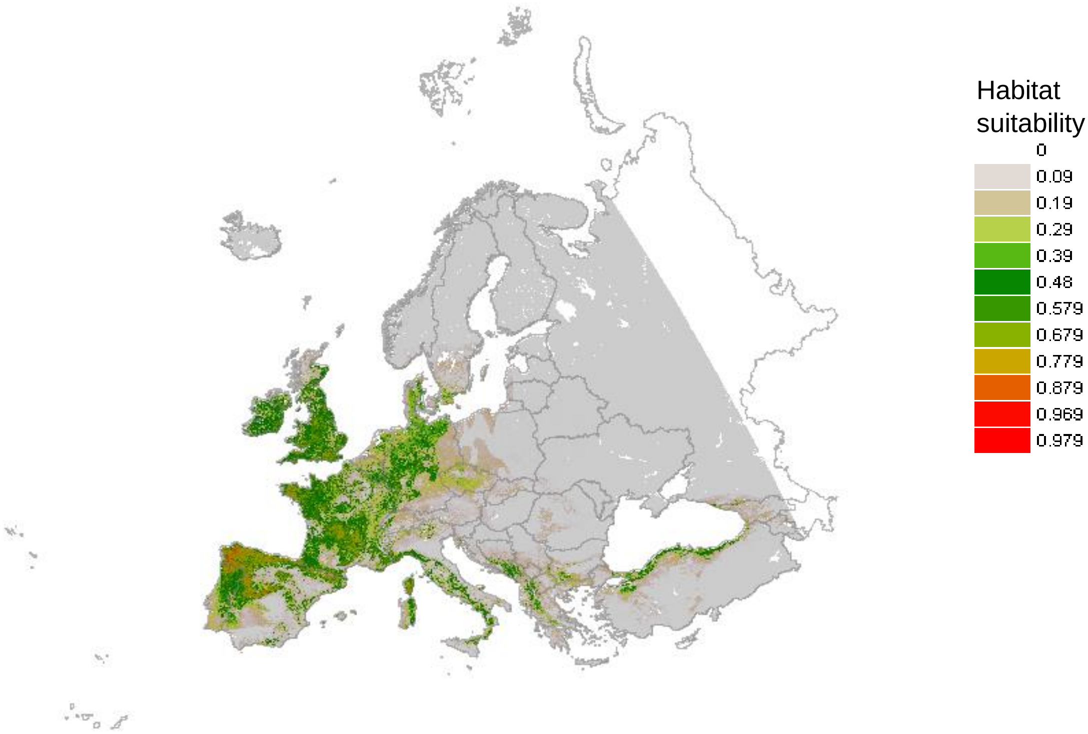
Decision rules:

Relationship to CLC (D. Moss)	Moors and heathland (322)
Relationship to CLC (releves)	27 + 26, 29
BGR filter	No
Topo filter	No

F3.1c - Lowland to montane temperate and submediterranean genistoid scrub



Distribution map *based on vegetation relevés*



Suitability map *. Background data for model randomly selected from study area*

Geographic restriction distribution data

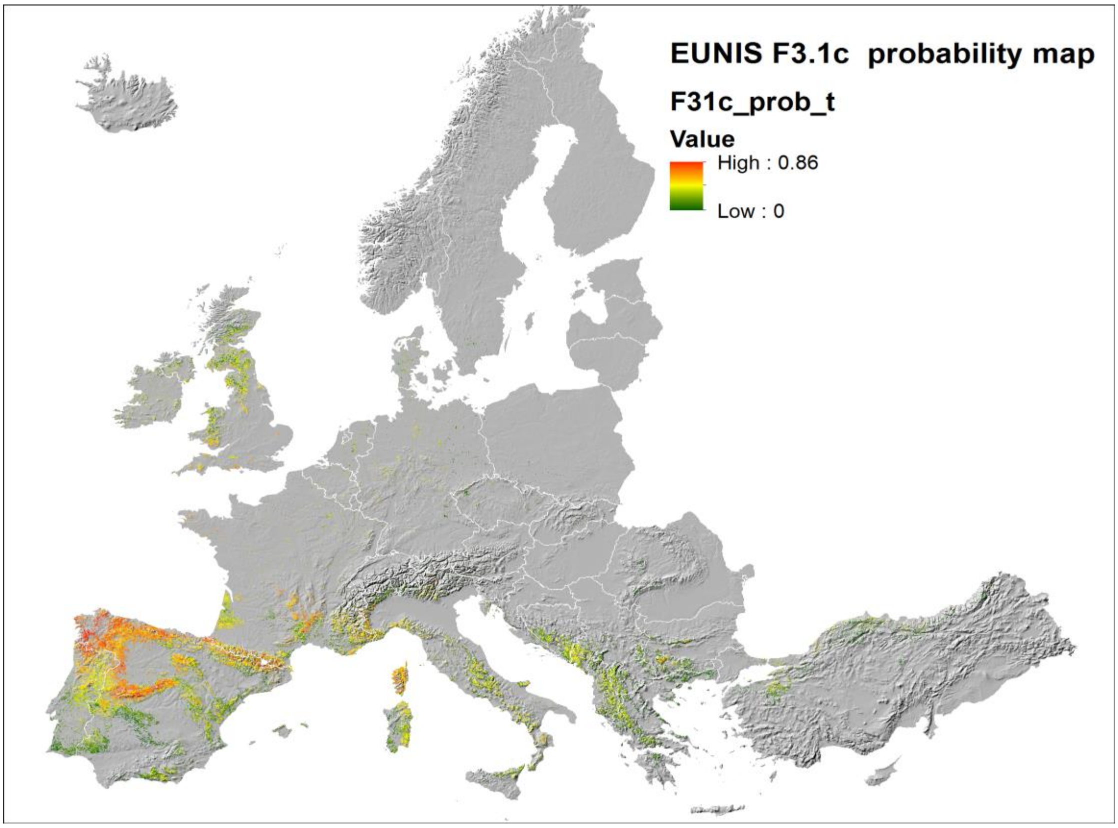
-

Maxent modelling statistics

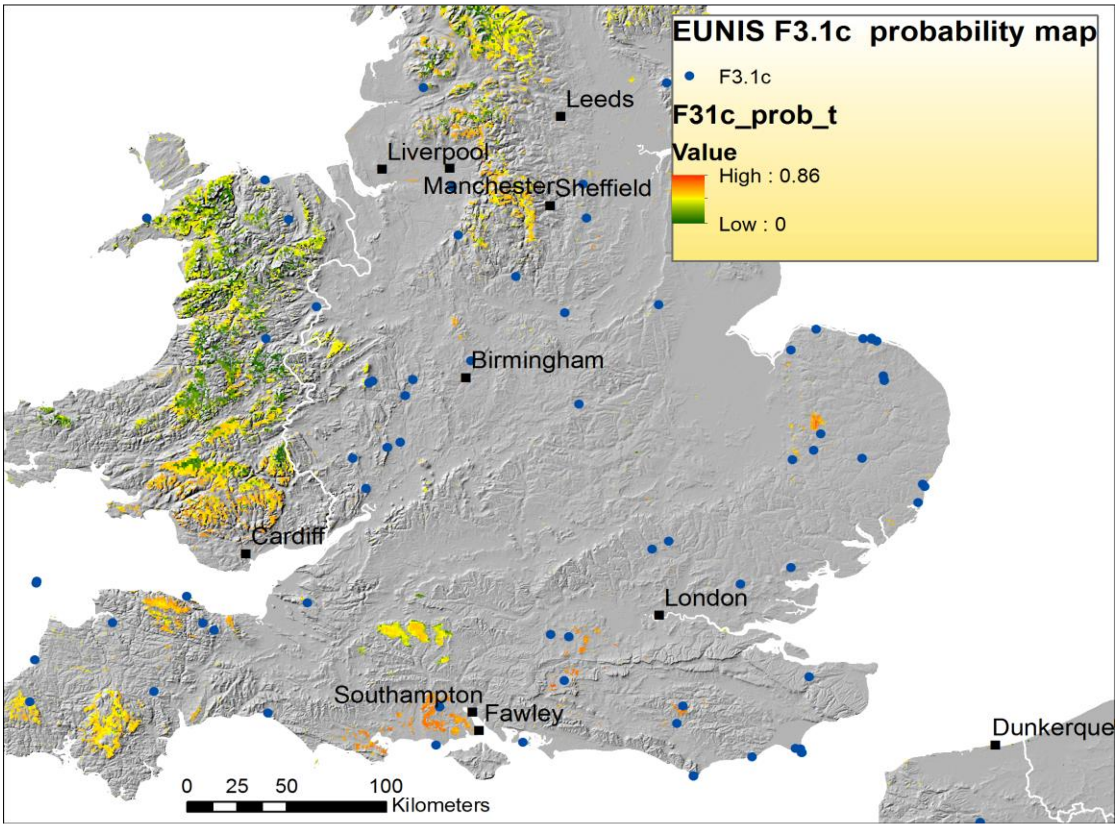
AUC training (0-1)	0.9059
AUC test (0-1)	0.8732
Contribution variables to the Maxent model (%)	
Temperature seasonality (stdev * 100)	66.1064
Potential evapotranspiration	9.5905
Soil organic carbon content (‰)	6.821
Bulk density (kg/m³)	4.9566
Precipitation seasonality (coef. of var.)	2.9731
Precipitation of warmest quarter	2.3412
Solar radiation	2.3055
Volume % of coarse fragments (> 2 mm)	2.1861
Weight in % of silt particles (0.0002-0.05 m	1.6297
Mean temperature of wettest quarter	1.2798
Weight in % of clay particles (<0.0002 mm	1.1946
Annual precipitation	0.4269
Weight in % of sand particles (0.05-2 mm)	0.2346
pH (water)	0.0545
Cation Exchange Capacity	0.0476
Distance to water	0.0257

Remarks

Prediction in eastern part of Europe (Turkey) is uncertain due to lack of data for that area.



Probability map *(overview)*

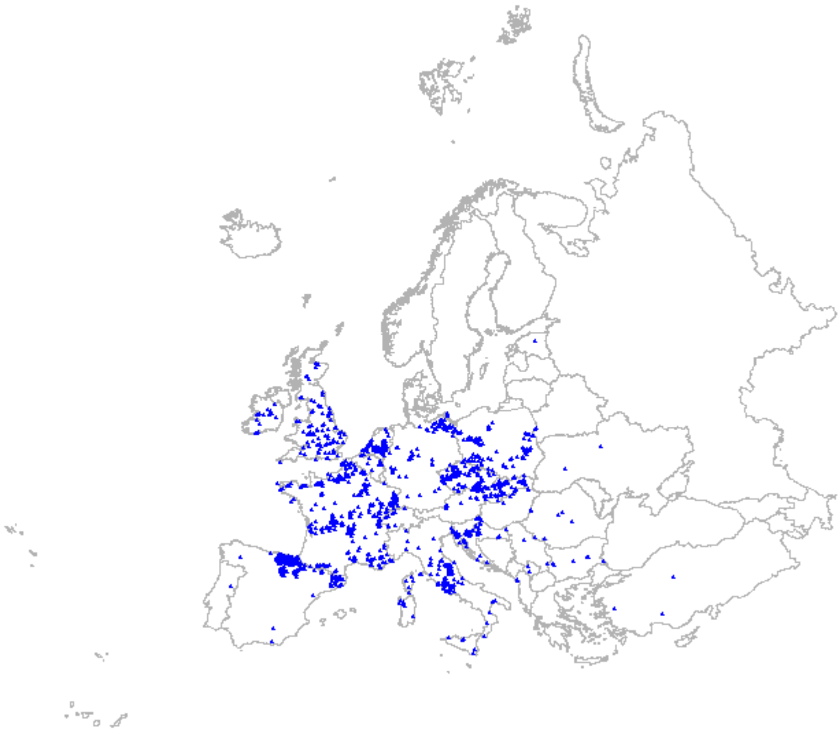


Probability map *(detail)*

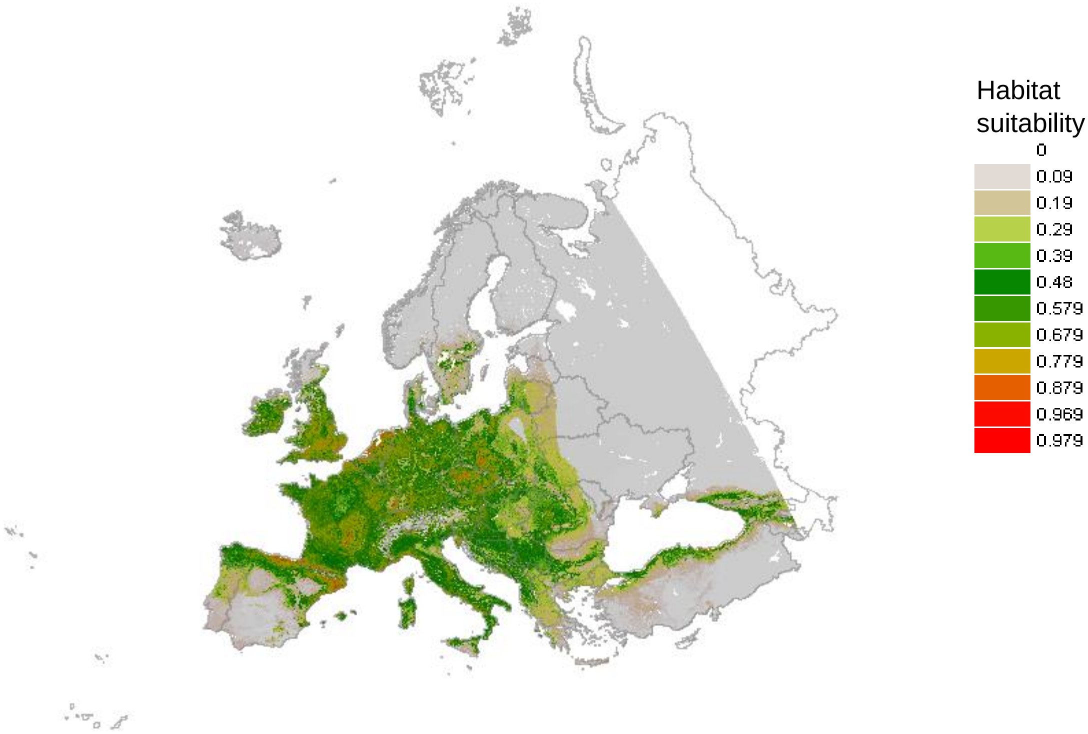
Decision rules:

Relationship to CLC (D. Moss)	Moors and heathland (322)
Relationship to CLC (releves)	27 + 26, 28, 29
BGR filter	No
Topo filter	No

F3.1e - Temperate and submediterranean thorn scrub



Distribution map *based on vegetation relevés*



Suitability map *. Background data for model randomly selected from study area*

Geographic restriction distribution data

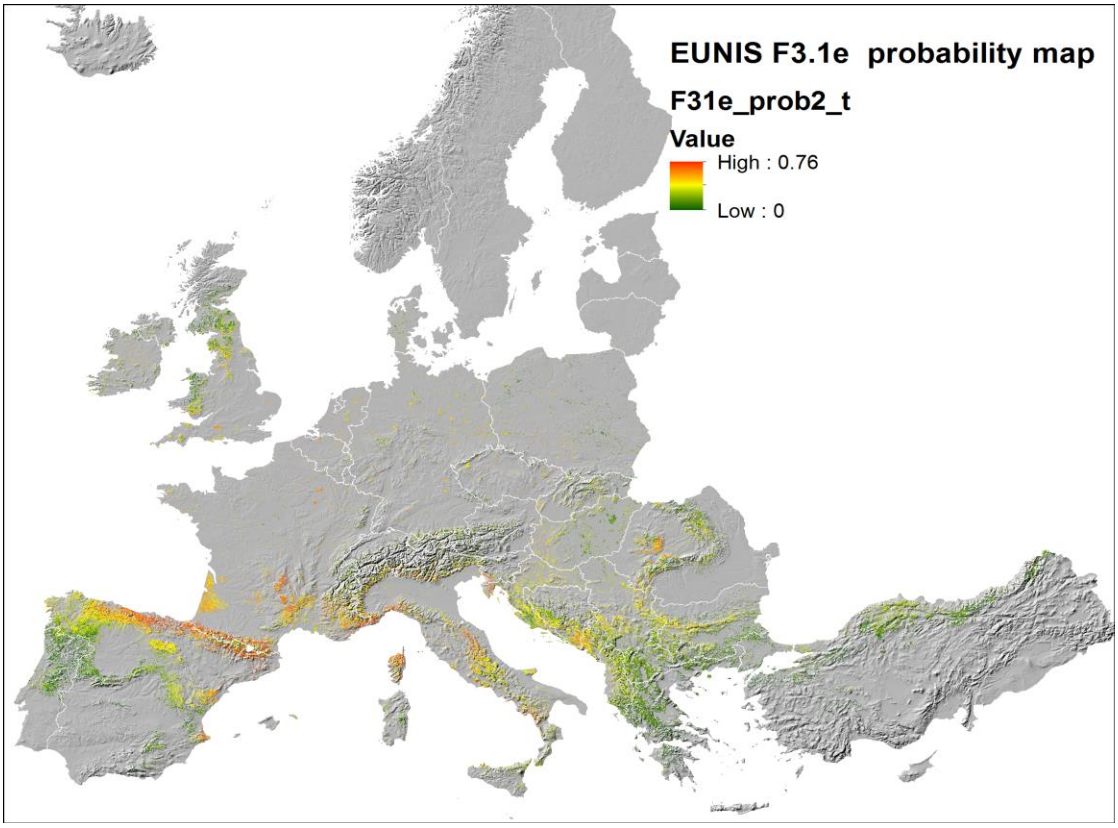
-

Maxent modelling statistics

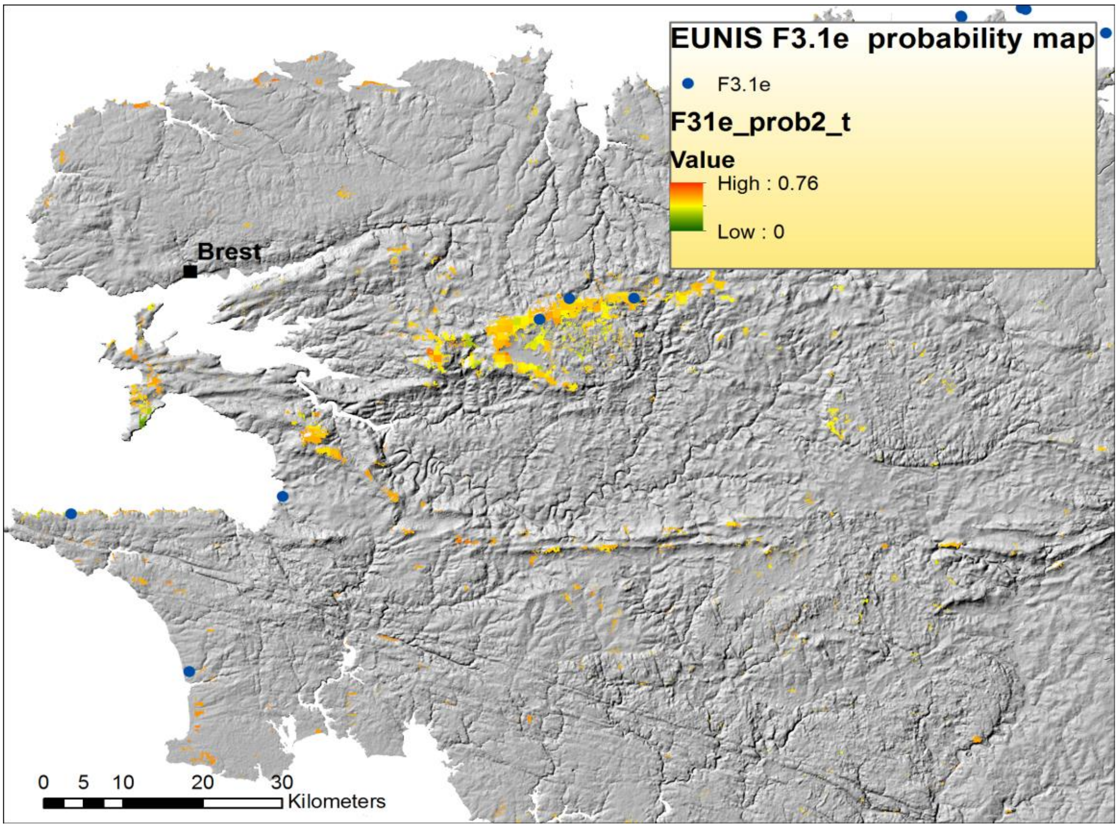
AUC training (0-1)		0.8197
AUC test (0-1)		0.8155
Contribution variables to the Maxent model (%)		
	Temperature seasonality (stdev * 100)	56.5248
	Precipitation of warmest quarter	11.9079
	Soil organic carbon content (‰)	11.7472
	Bulk density (kg/m³)	5.5983
	Solar radiation	4.3068
	Cation Exchange Capacity	4.2608
	Annual precipitation	3.2244
	Potential evapotranspiration	1.965
	Weight in % of sand particles (0.05-2 mm)	1.0066
	Mean temperature of wettest quarter	0.9434
	Precipitation seasonality (coef. of var.)	0.8685
	Distance to water	0.7498
	Weight in % of clay particles (<0.0002 mm	0.5767
	pH (water)	0.2574
	Volume % of coarse fragments (> 2 mm)	0.112
	Weight in % of silt particles (0.0002-0.05 m	0.0726

Remarks

Poor mode that is too much affected by the distribution of input data with a high concentration in NL and CZ. The prediction in eastern part of Europe (Caucasus, Turkey) is uncertain due to lack of data for that area.



Probability map *(overview)*

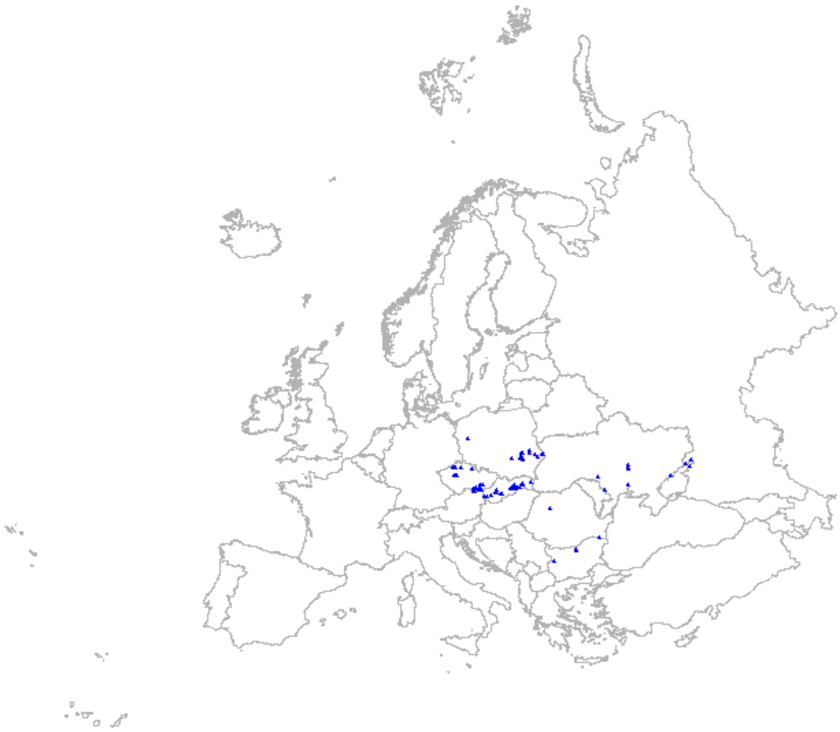


Probability map *(detail)*

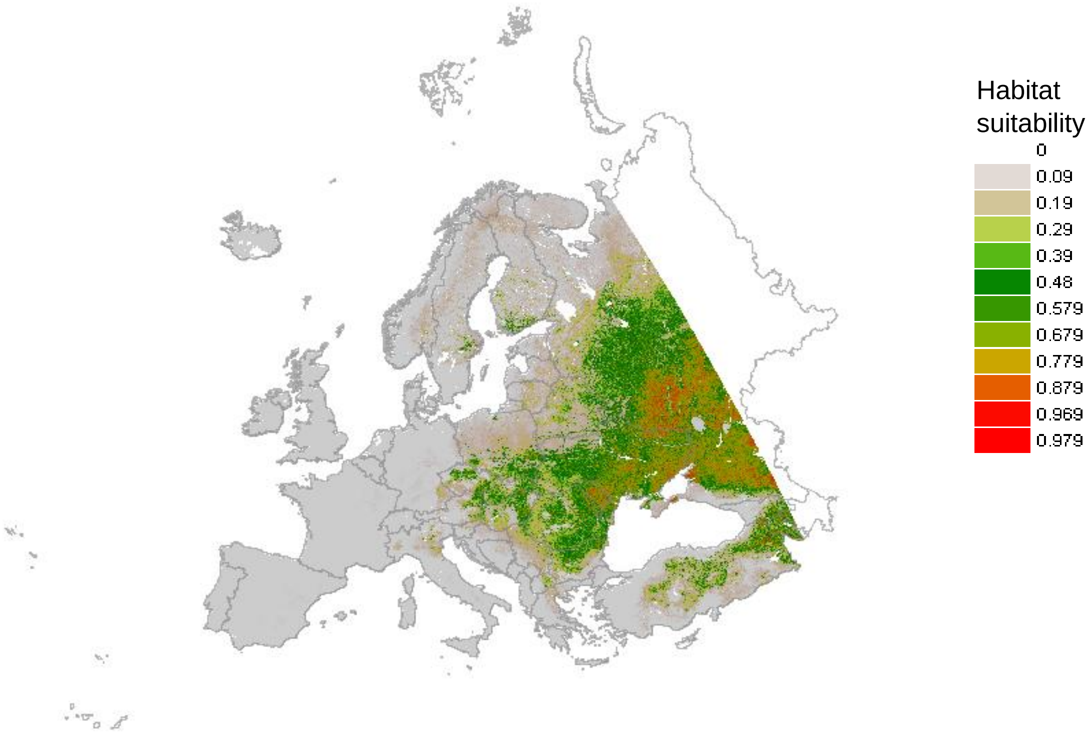
Decision rules:

Relationship to CLC (D. Moss)	Moors and heathland (322)
Relationship to CLC (releves)	27 + 26, 29
BGR filter	Yes
Topo filter	No

F3.1f - Low steppic scrub



Distribution map *based on vegetation relevés*



Suitability map. *Background data for model randomly selected from heathland-scrub-tundra data set*

Geographic restriction distribution data

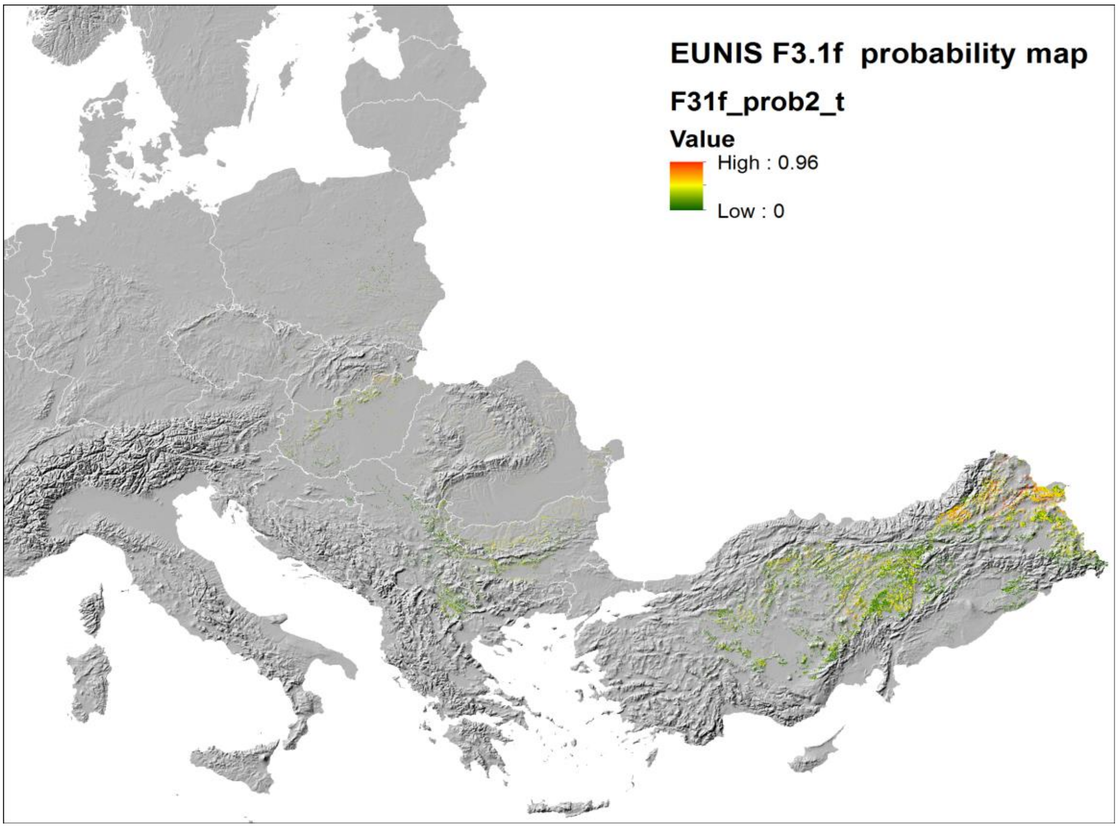
-

Maxent modelling statistics

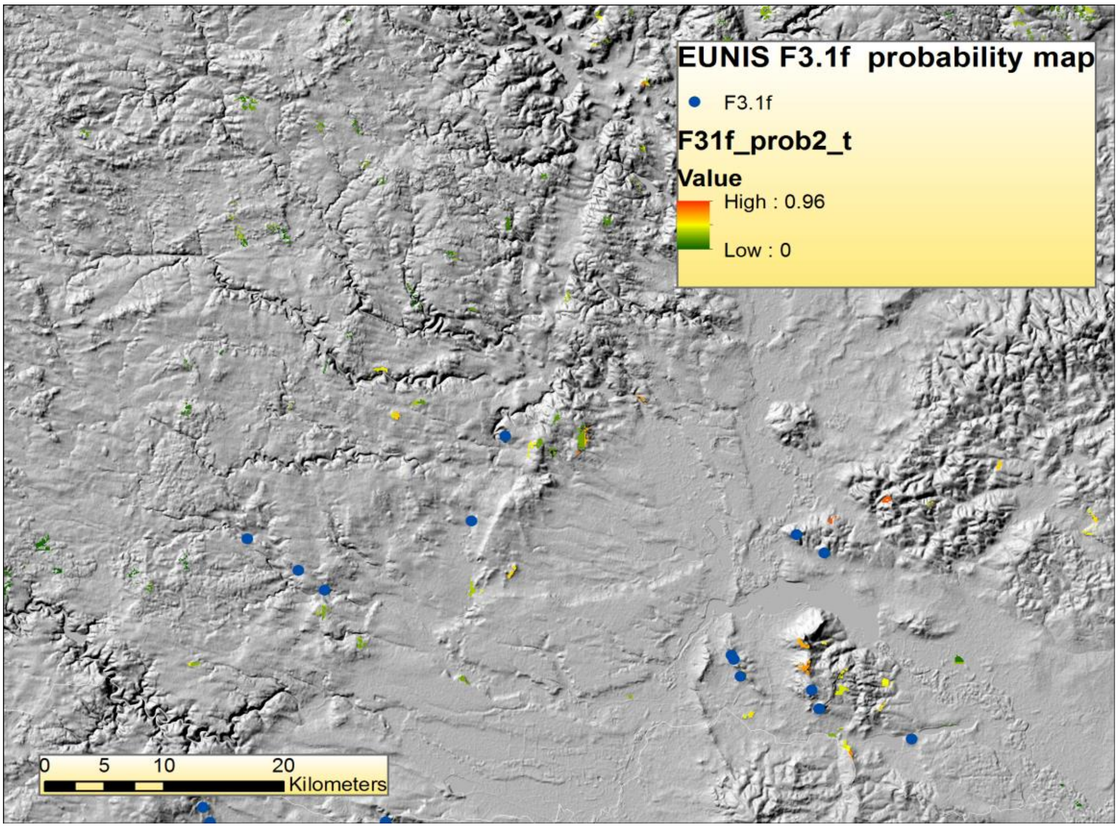
AUC training (0-1)	0.9839
AUC test (0-1)	0.9817
Contribution variables to the Maxent model (%)	
Temperature seasonality (stdev * 100)	70.2836
Weight in % of sand particles (0.05-2 mm)	11.889
Annual precipitation	6.7421
pH (water)	6.1524
Mean temperature of wettest quarter	5.0984
Potential evapotranspiration	4.5709
Soil organic carbon content (‰)	2.3728
Weight in % of clay particles (<0.0002 mm	1.4129
Volume % of coarse fragments (> 2 mm)	0.8514
Weight in % of silt particles (0.0002-0.05 m	0.6615
Precipitation of warmest quarter	0.4852
Precipitation seasonality (coef. of var.)	0.3781
Distance to water	0.3029
Bulk density (kg/m³)	0.2286
Cation Exchange Capacity	0.1622
Solar radiation	0.0496

Remarks

Prediction in eastern part of Europe is uncertain due to lack of data for that area.



Probability map *(overview)*

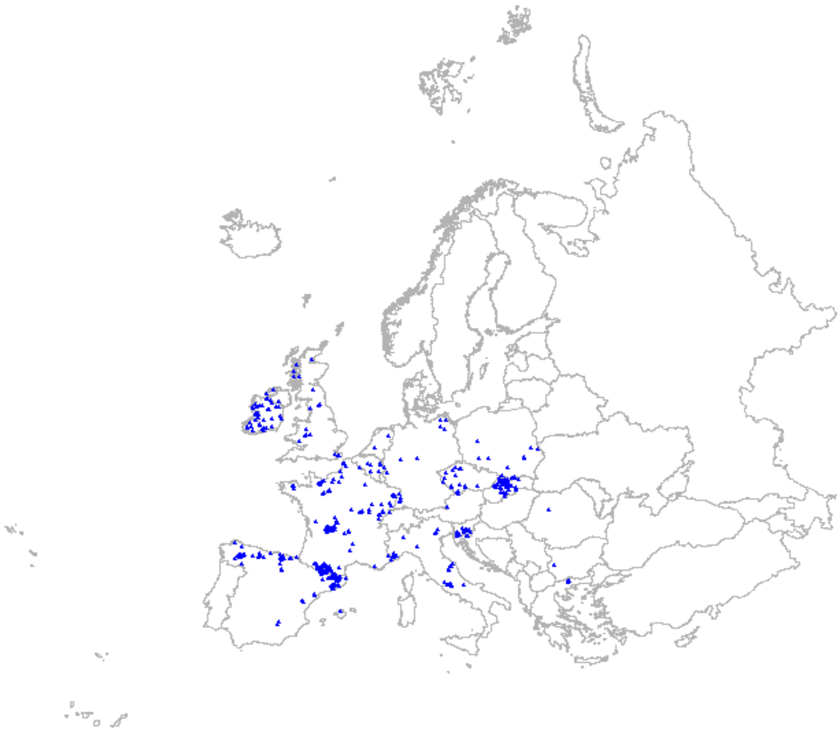


Probability map *(detail)*

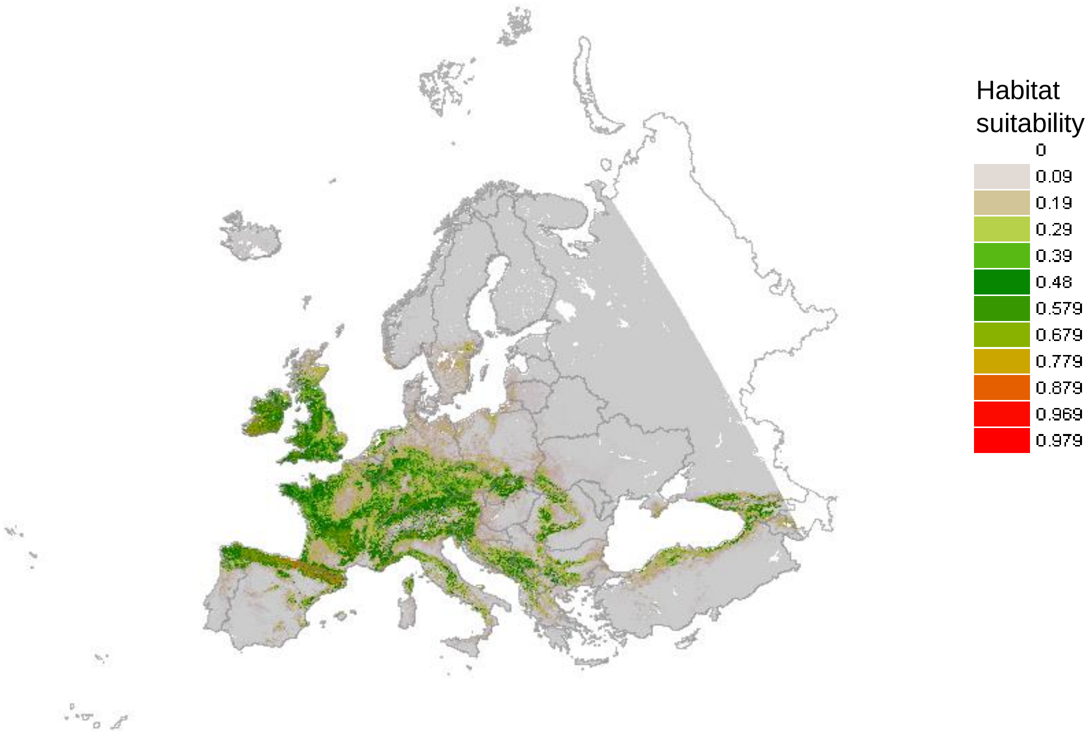
Decision rules:

Relationship to CLC (D. Moss)	Sparsely vegetated (333)
Relationship to CLC (releves)	32 + 29
BGR filter	Yes
Topo filter	No

F3.1g - Corylus avellana scrub



Distribution map *based on vegetation relevés*



Suitability map *. Background data for model randomly selected from study area*

Geographic restriction distribution data

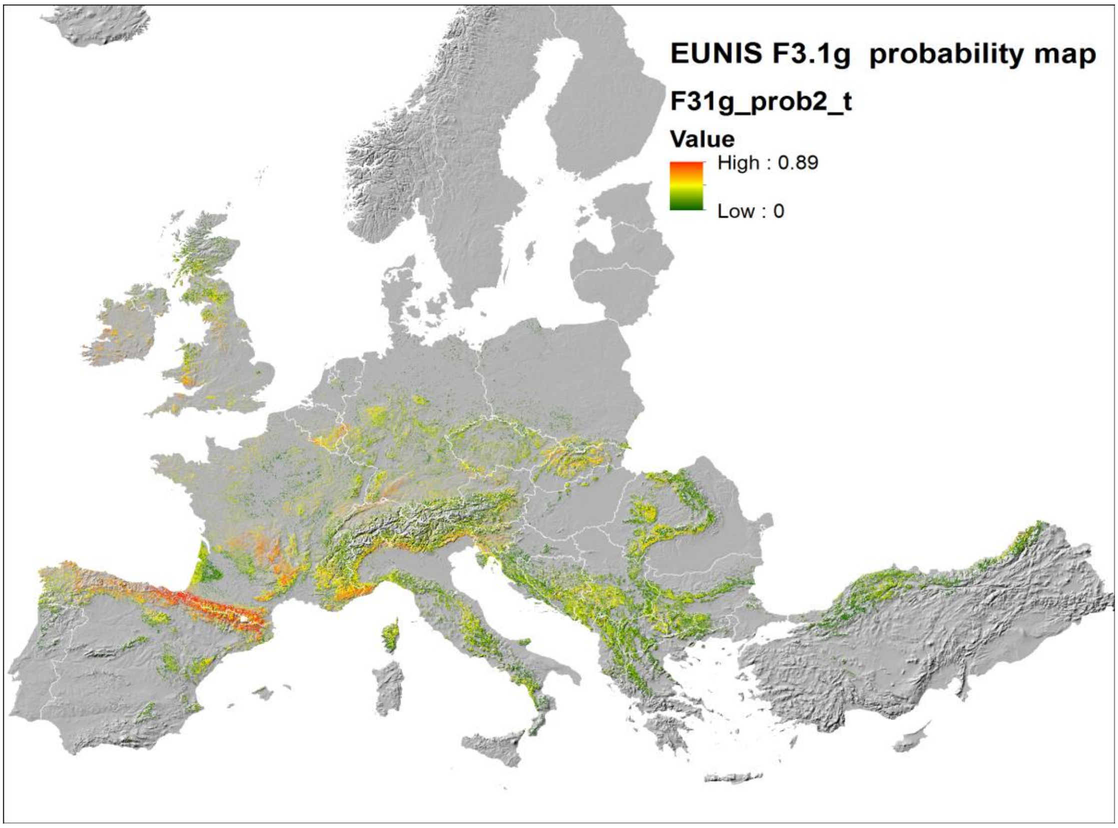
-

Maxent modelling statistics

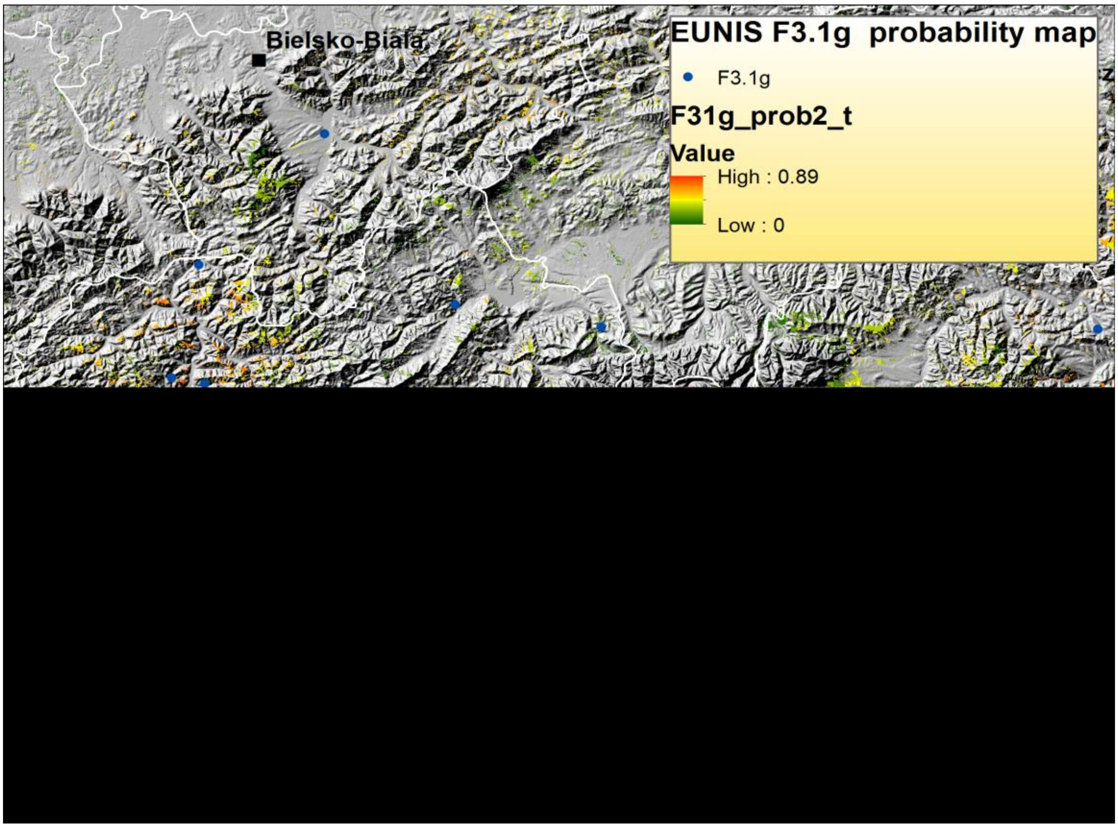
AUC training (0-1)		0.9214
AUC test (0-1)		0.9127
Contribution variables to the Maxent model (%)		
	Temperature seasonality (stdev * 100)	38.4785
	Annual precipitation	21.3753
	Soil organic carbon content (‰)	13.4663
	Bulk density (kg/m³)	6.9894
	Weight in % of clay particles (<0.0002 mm	6.0154
	Volume % of coarse fragments (> 2 mm)	4.1324
	Precipitation of warmest quarter	3.8228
	Solar radiation	2.1368
	Cation Exchange Capacity	1.5709
	Precipitation seasonality (coef. of var.)	1.4767
	Mean temperature of wettest quarter	0.5229
	Weight in % of silt particles (0.0002-0.05 m	0.4396
	Distance to water	0.3184
	Potential evapotranspiration	0.2333
	pH (water)	0.1342
	Weight in % of sand particles (0.05-2 mm)	0.0344

Remarks

Prediction in eastern part of Europe is uncertain due to lack of data for that area.



Probability map *(overview)*

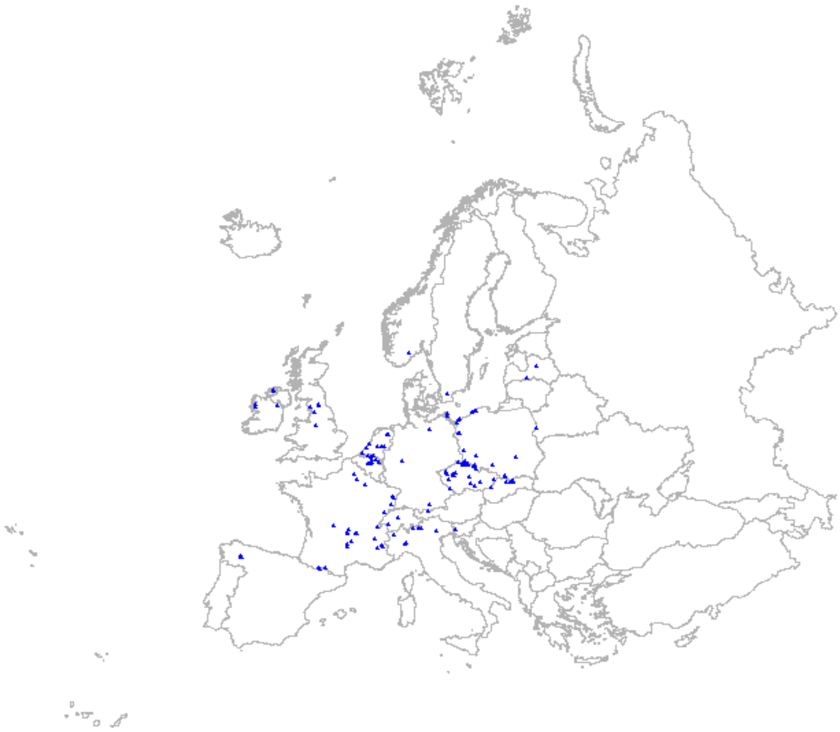


Probability map *(detail)*

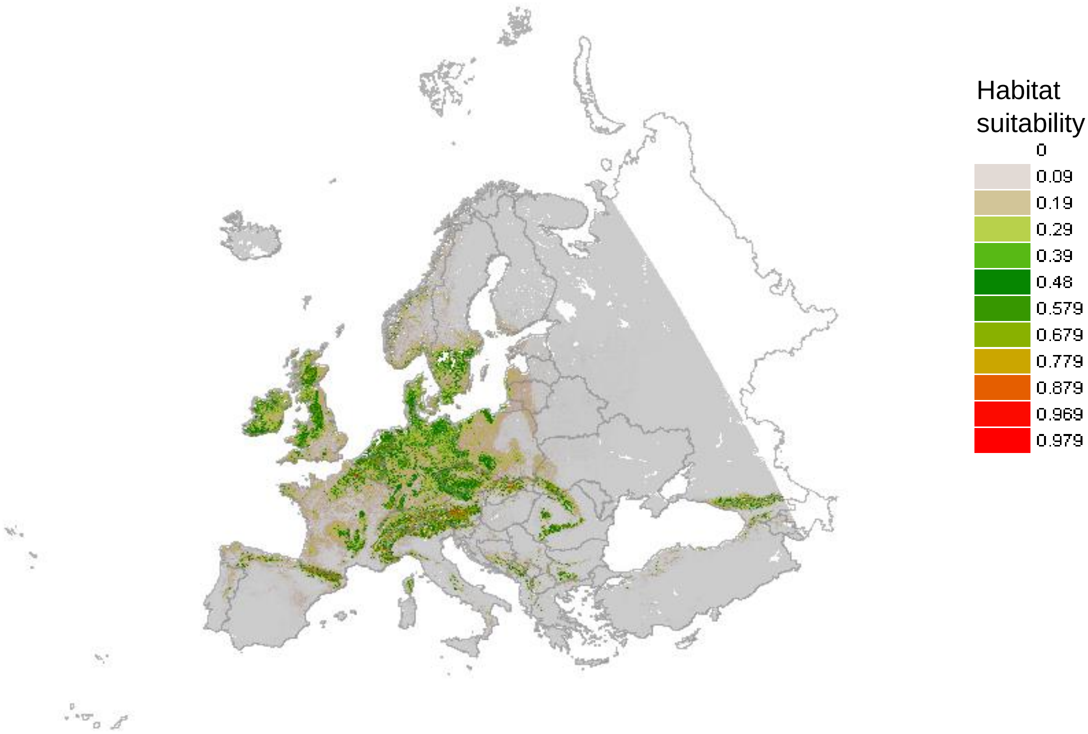
Decision rules:

Relationship to CLC (D. Moss)	?
Relationship to CLC (releves)	23, 24, 25, 26, 29, 31
BGR filter	Yes
Topo filter	No

F3.1h - Temperate forest clearing scrub



Distribution map *based on vegetation relevés*



Suitability map *. Background data for model randomly selected from study area*

Geographic restriction distribution data

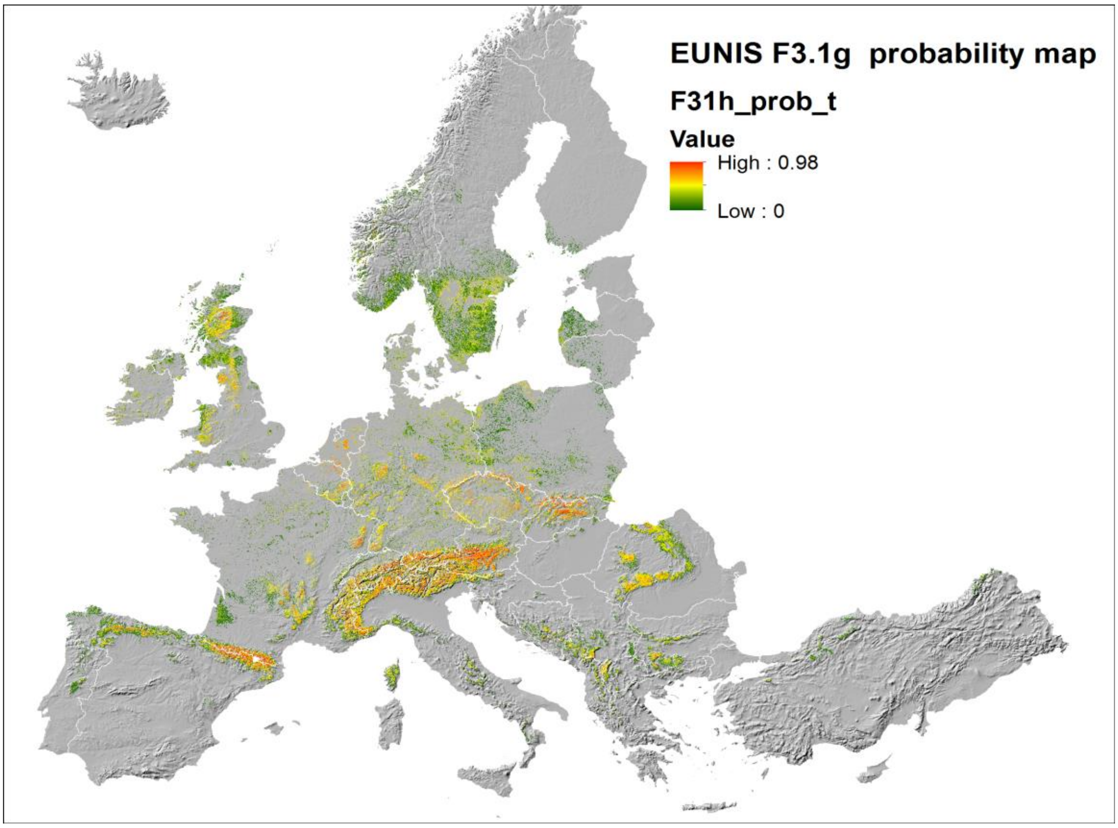
-

Maxent modelling statistics

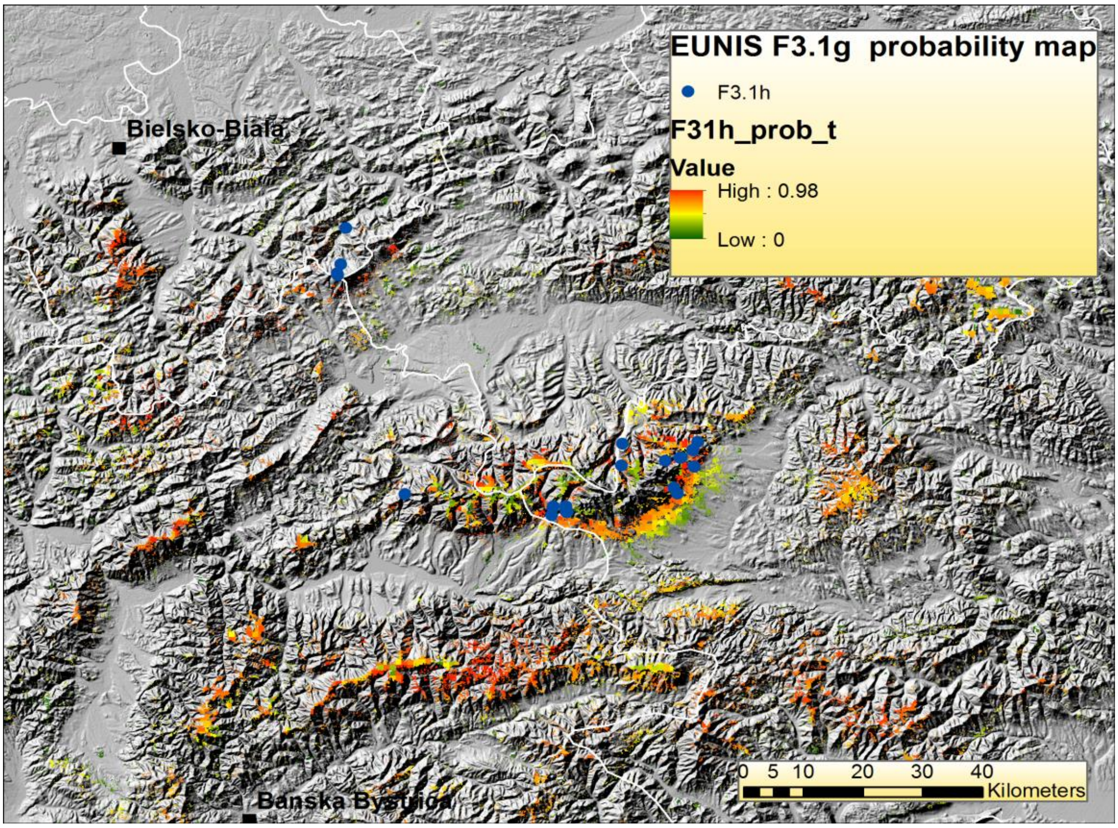
AUC training (0-1)	0.9574
AUC test (0-1)	0.9256
Contribution variables to the Maxent model (%)	
Temperature seasonality (stdev * 100)	42.3336
Soil organic carbon content (‰)	25.6775
Precipitation of warmest quarter	6.175
Potential evapotranspiration	6.1546
Volume % of coarse fragments (> 2 mm)	5.506
Weight in % of silt particles (0.0002-0.05 m	5.051
Weight in % of clay particles (<0.0002 mm	2.7162
Weight in % of sand particles (0.05-2 mm)	1.2624
Solar radiation	1.1384
Bulk density (kg/m³)	1.0246
Precipitation seasonality (coef. of var.)	0.954
Annual precipitation	0.7647
pH (water)	0.6205
Cation Exchange Capacity	0.4204
Mean temperature of wettest quarter	0.1205
Distance to water	0.0265

Remarks

Prediction in eastern part of Europe is uncertain due to lack of data for that area.



Probability map *(overview)*

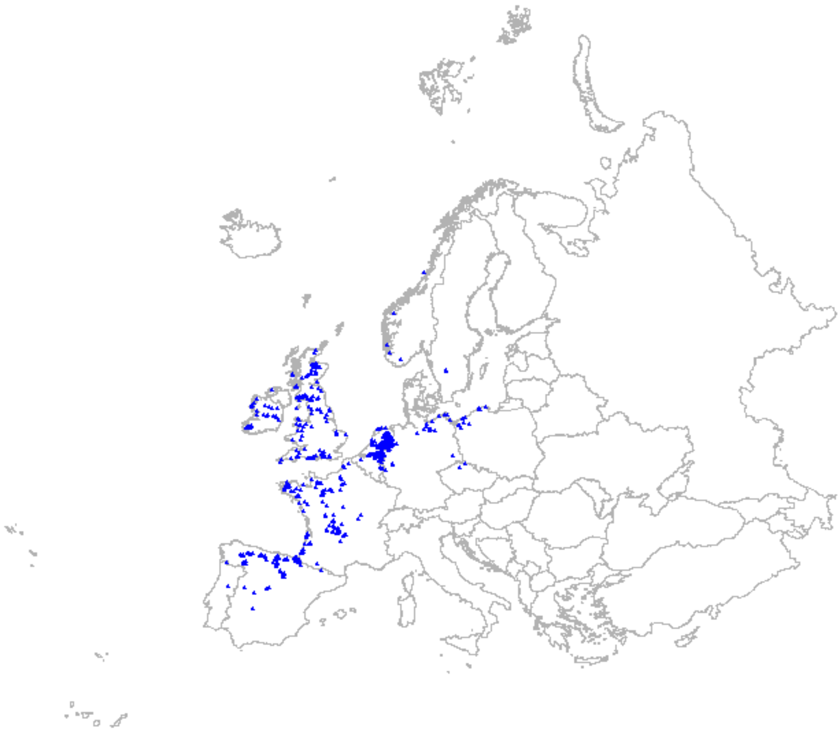


Probability map *(detail)*

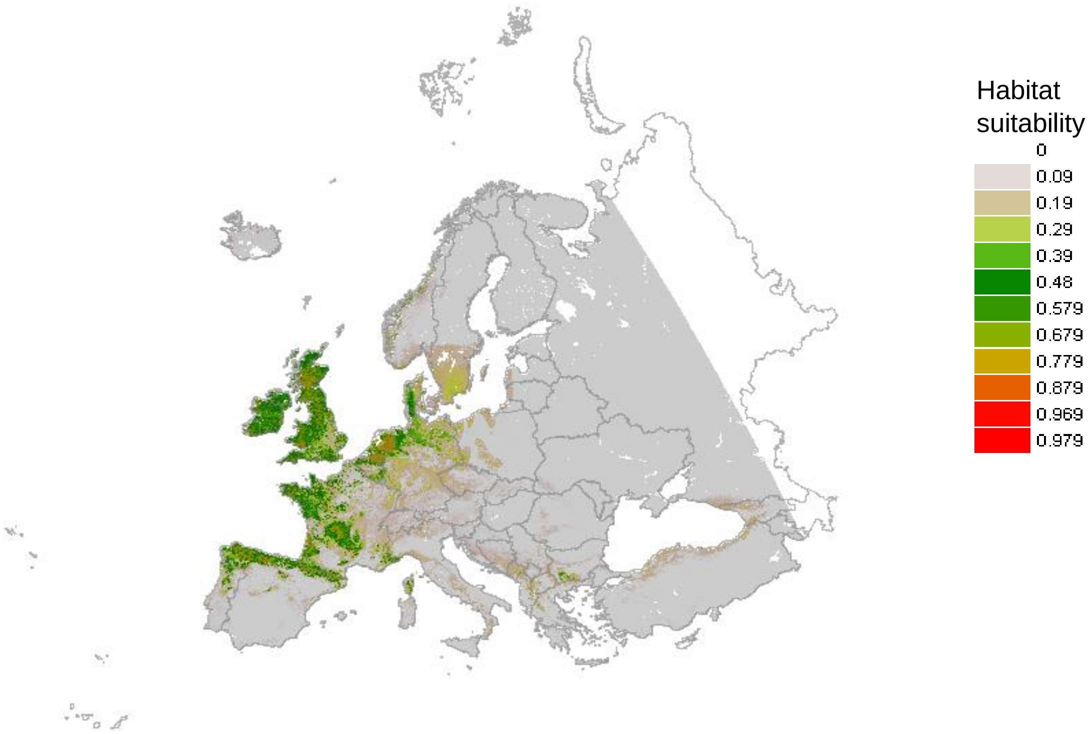
Decision rules:

Relationship to CLC (D. Moss)	Sparsely vegetated (333)
Relationship to CLC (releves)	23, 24, 25, 26, 27, 29
BGR filter	No
Topo filter	No

F4.1 - Wet heath



Distribution map *based on vegetation relevés*



Suitability map *. Background data for model randomly selected from study area*

Geographic restriction distribution data

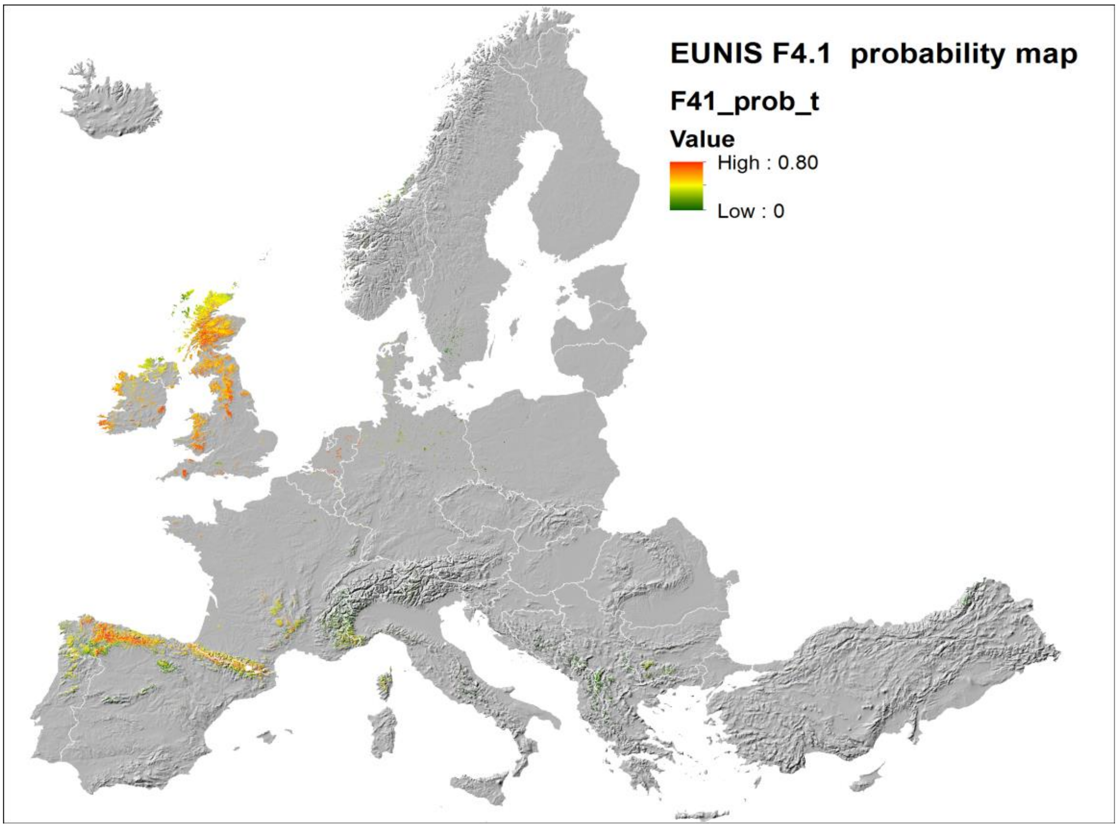
-

Maxent modelling statistics

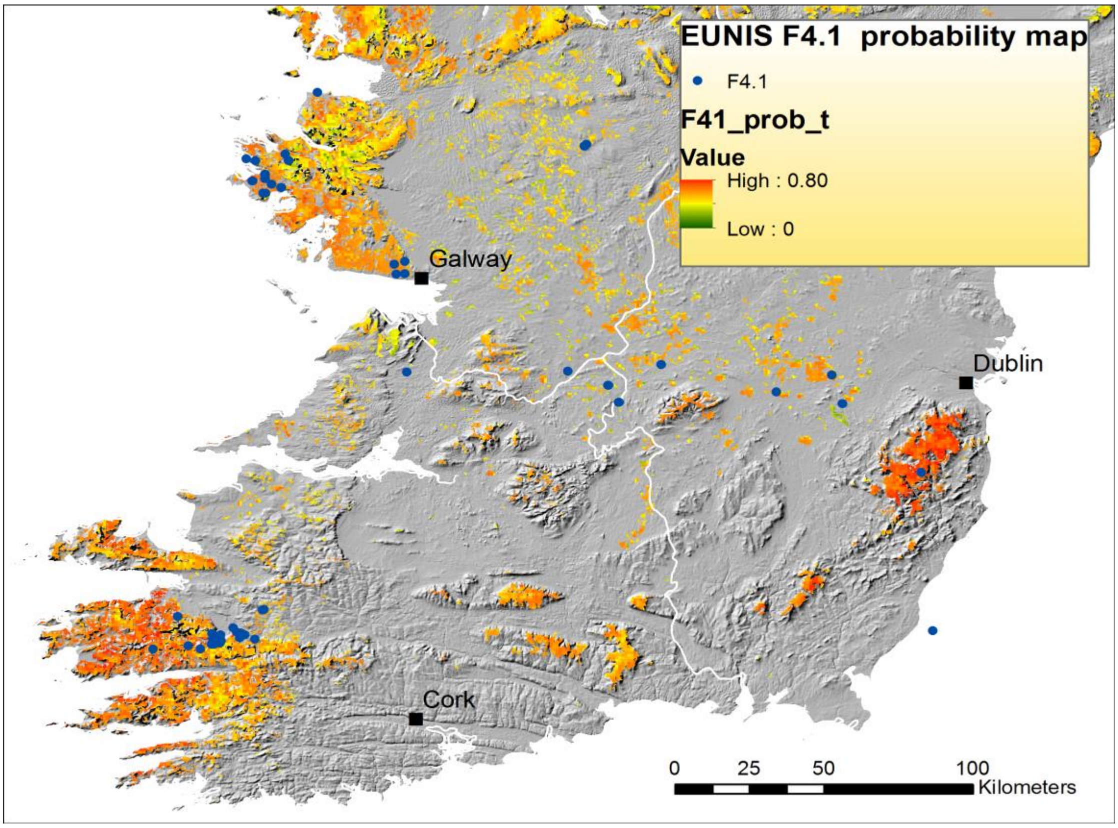
AUC training (0-1)		0.9118
AUC test (0-1)		0.9158
Contribution variables to the Maxent model (%)		
	Temperature seasonality (stdev * 100)	74.6549
	Potential evapotranspiration	6.5263
	Soil organic carbon content (‰)	5.217
	Bulk density (kg/m³)	4.9738
	pH (water)	4.9587
	Weight in % of silt particles (0.0002-0.05 m	1.1275
	Precipitation seasonality (coef. of var.)	0.6302
	Weight in % of clay particles (<0.0002 mm	0.6261
	Solar radiation	0.5099
	Precipitation of warmest quarter	0.3854
	Mean temperature of wettest quarter	0.3431
	Weight in % of sand particles (0.05-2 mm)	0.2921
	Annual precipitation	0.1603
	Distance to water	0.0314
	Cation Exchange Capacity	0.0011
	Volume % of coarse fragments (> 2 mm)	0.001

Remarks

-



Probability map *(overview)*

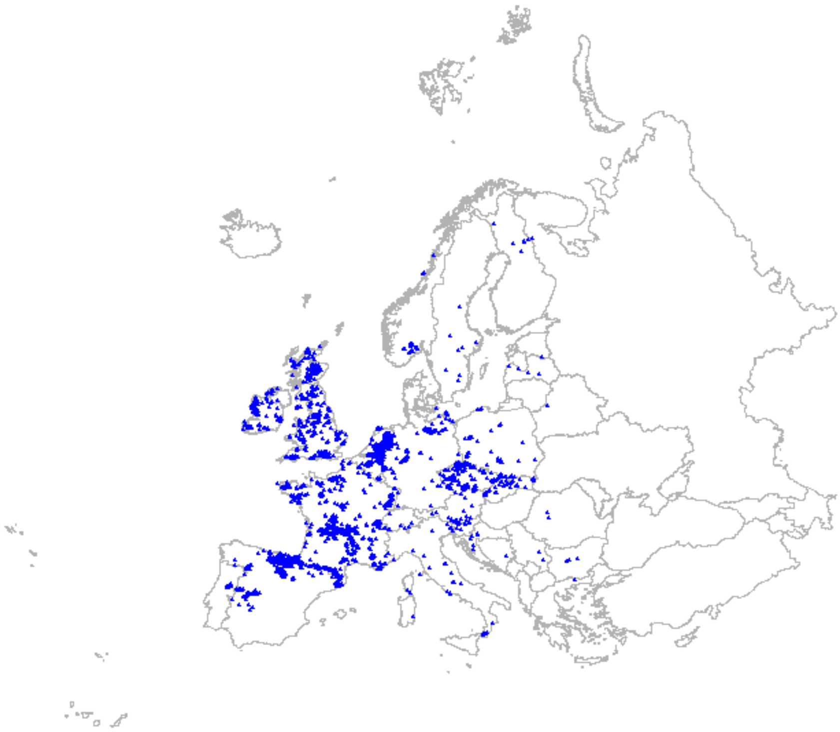


Probability map *(detail)*

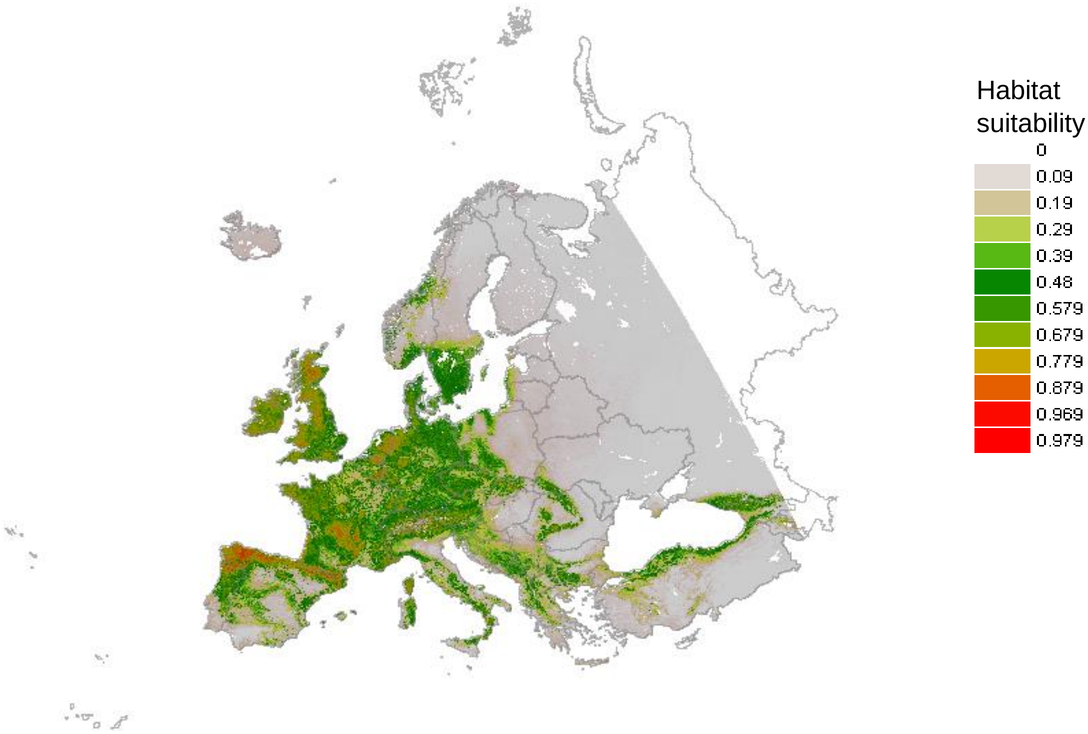
Decision rules:

Relationship to CLC (D. Moss)	Moors and heathland (322)
Relationship to CLC (releves)	27 + 26, 36
BGR filter	No
Topo filter	No

F4.2 - Dry heath



Distribution map *based on vegetation relevés*



Suitability map *. Background data for model randomly selected from study area*

Geographic restriction distribution data

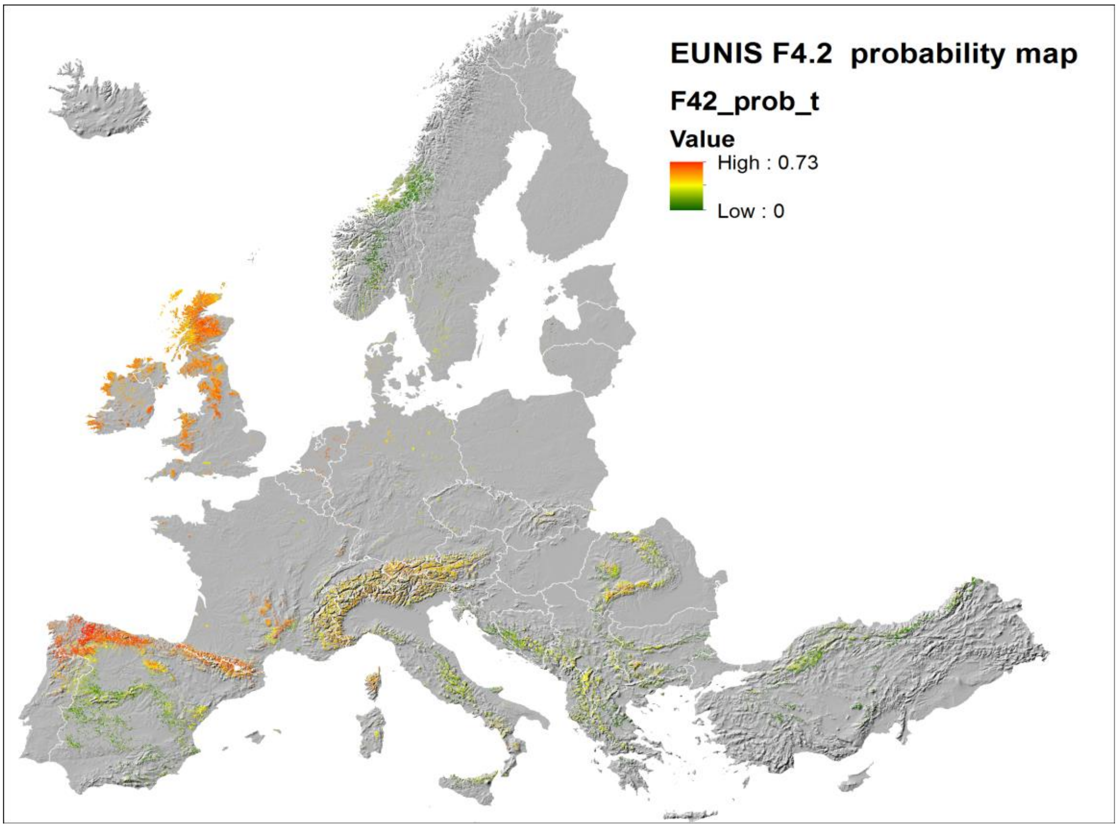
-

Maxent modelling statistics

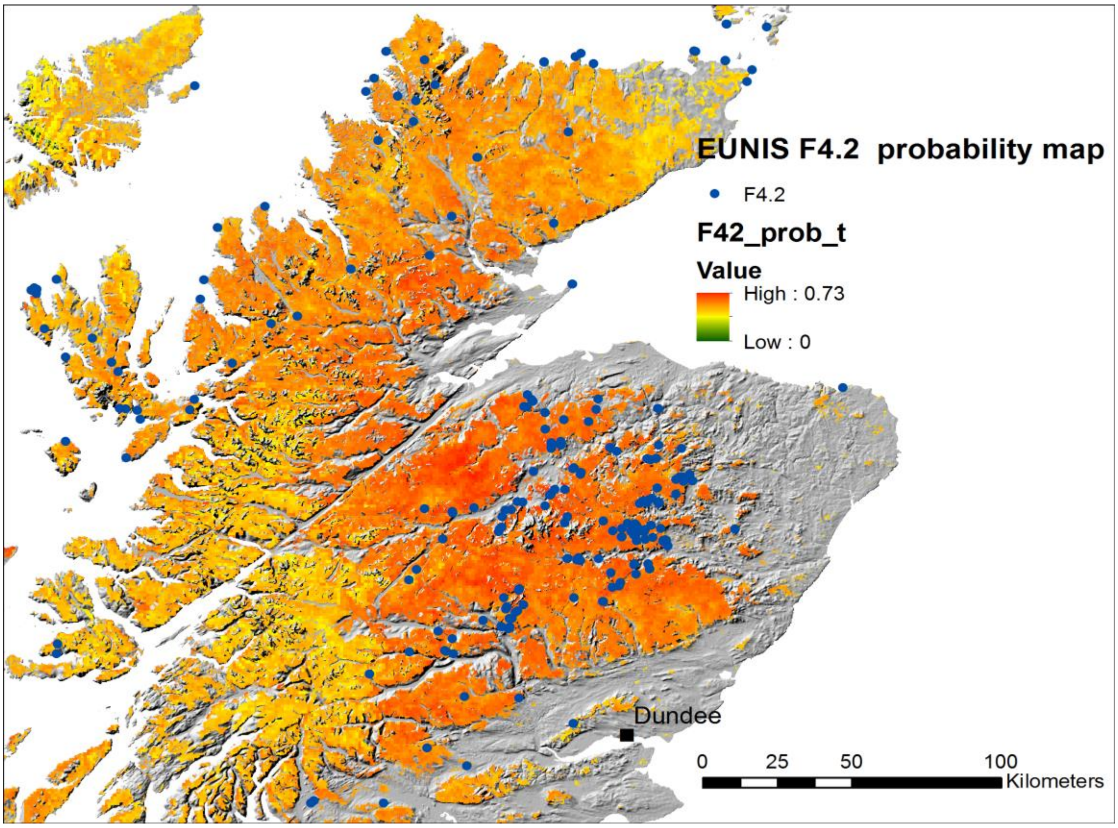
AUC training (0-1)	0.7839
AUC test (0-1)	0.7792
Contribution variables to the Maxent model (%)	
Temperature seasonality (stdev * 100)	72.1137
Potential evapotranspiration	11.3945
Soil organic carbon content (‰)	9.17
Annual precipitation	3.1502
Precipitation seasonality (coef. of var.)	1.5042
Weight in % of clay particles (<0.0002 mm	0.4387
Volume % of coarse fragments (> 2 mm)	0.432
Weight in % of silt particles (0.0002-0.05 m	0.3866
Bulk density (kg/m³)	0.3832
Weight in % of sand particles (0.05-2 mm)	0.303
pH (water)	0.2384
Precipitation of warmest quarter	0.1225
Solar radiation	0.117
Distance to water	0.0888
Cation Exchange Capacity	0.0446
Mean temperature of wettest quarter	0.0238

Remarks

Prediction in eastern part of Europe is uncertain due to lack of data for that area.



Probability map *(overview)*

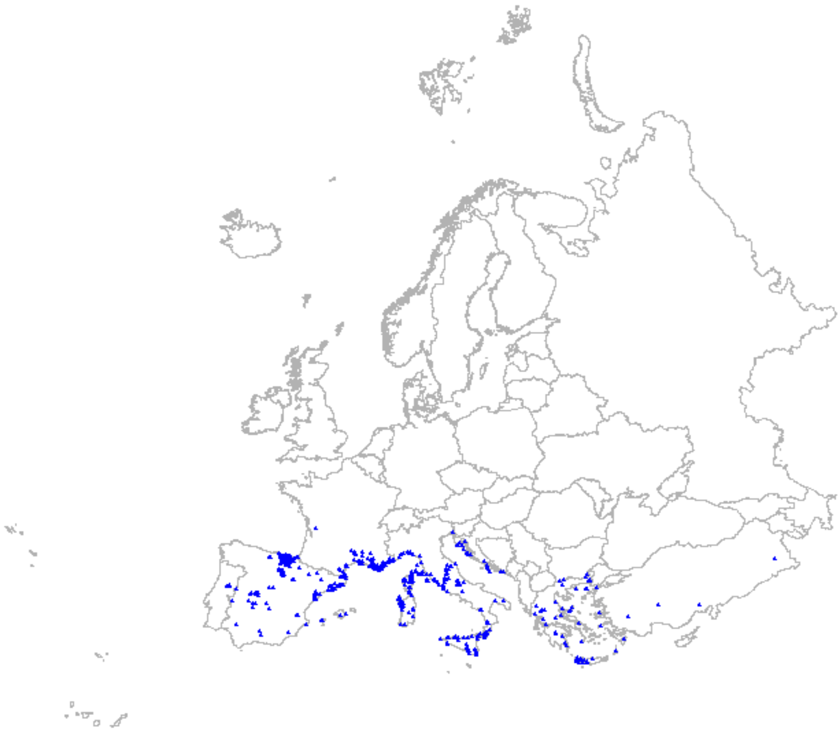


Probability map *(detail)*

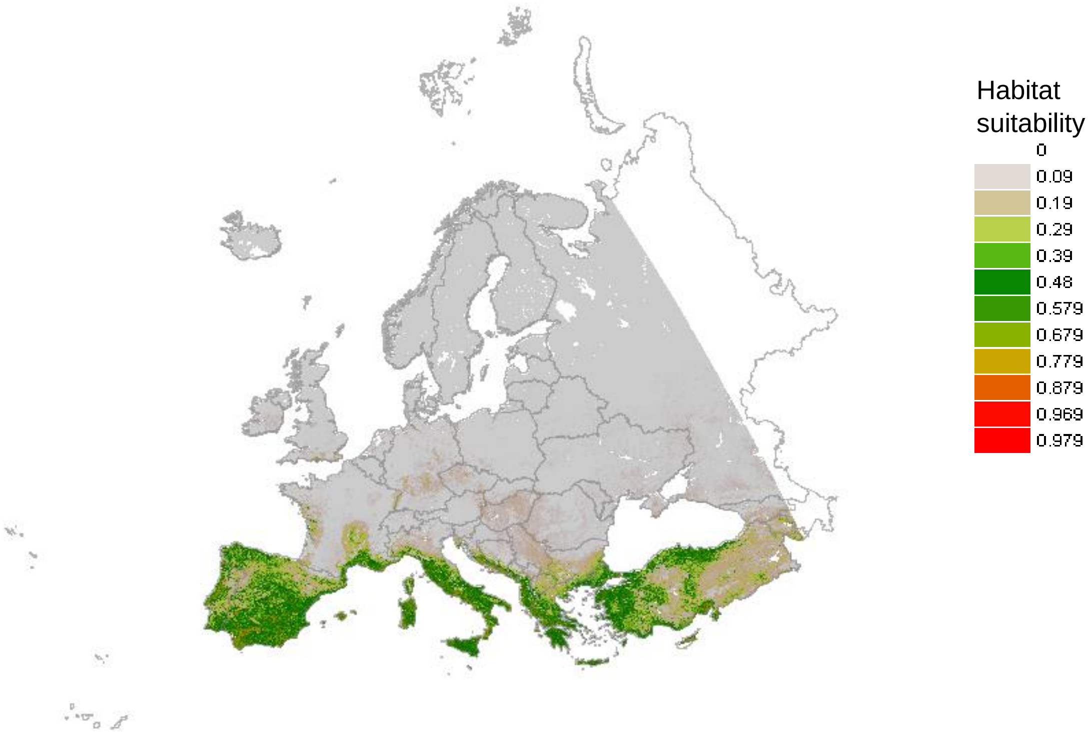
Decision rules:

Relationship to CLC (D. Moss)	Moors and heathland (322)
Relationship to CLC (releves)	27 + 26, 36
BGR filter	No
Topo filter	No

F5.1-2 - Arborescent matorral and maquis



Distribution map *based on vegetation relevés*



Suitability map *. Background data for model randomly selected from heathland-scrub-tundra data set*

Geographic restriction distribution data

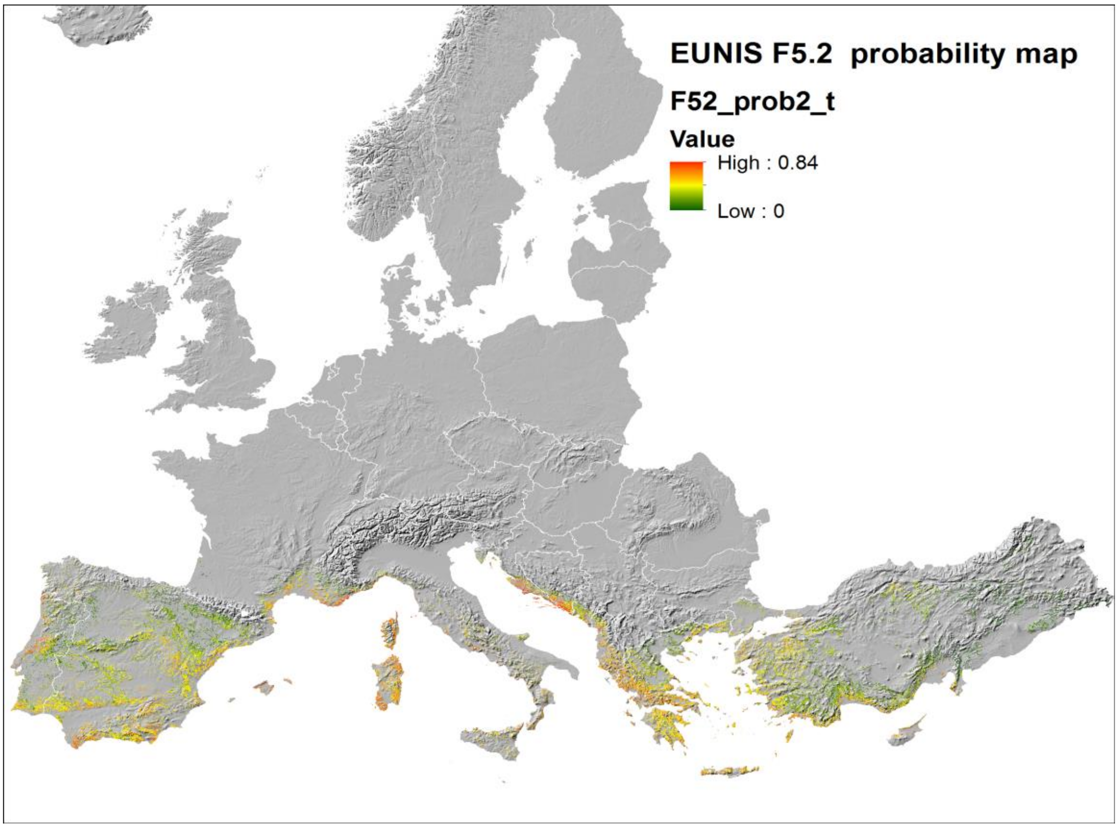
-

Maxent modelling statistics

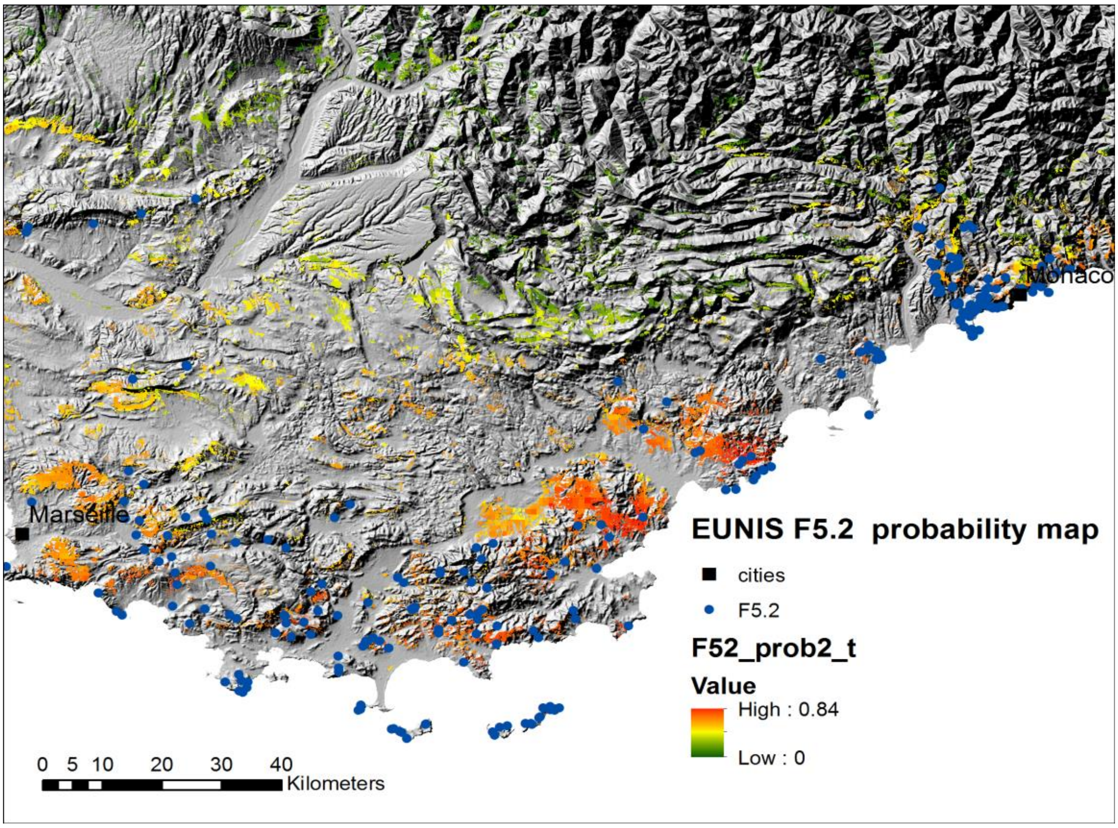
AUC training (0-1)		0.896
AUC test (0-1)		0.8916
Contribution variables to the Maxent model (%)		
	Precipitation of warmest quarter	43.1301
	Soil organic carbon content (‰)	19.0313
	Weight in % of clay particles (<0.0002 mm	15.6443
	Solar radiation	12.6142
	Precipitation seasonality (coef. of var.)	7.0148
	Potential evapotranspiration	5.0247
	Temperature seasonality (stdev * 100)	2.3359
	Cation Exchange Capacity	2.3304
	Weight in % of sand particles (0.05-2 mm)	2.1861
	Distance to water	1.3011
	Mean temperature of wettest quarter	1.0568
	Annual precipitation	0.7252
	Bulk density (kg/m³)	0.7121
	pH (water)	0.3943
	Weight in % of silt particles (0.0002-0.05 m	0.1041
	Volume % of coarse fragments (> 2 mm)	0.1013

Remarks

Prediction in eastern part of Europe (Turkey) is uncertain due to lack of data for that area.



Probability map *(overview)*

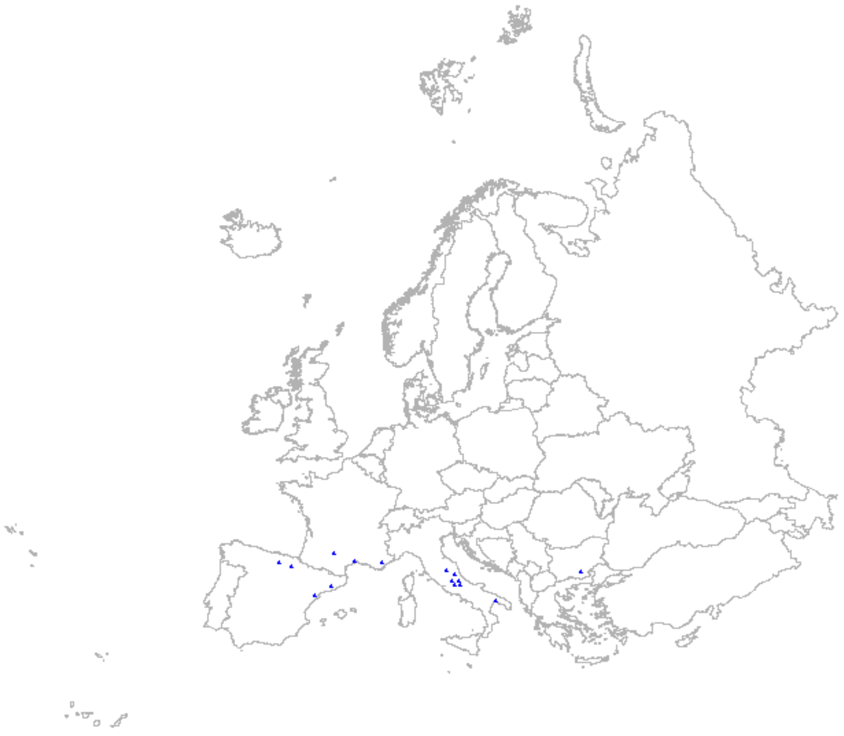


Probability map *(detail)*

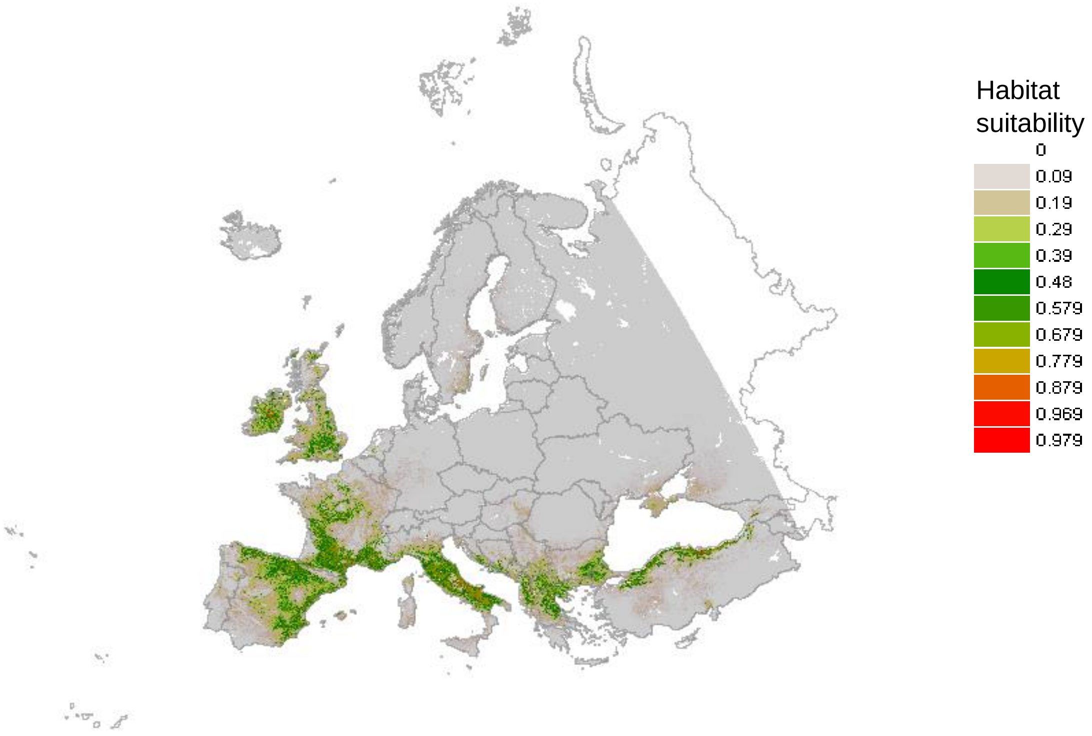
Decision rules:

Relationship to CLC (D. Moss)	Sclerophyllous vegetation (323)
Relationship to CLC (releves)	28 + 29
BGR filter	Yes
Topo filter	No

F5.3 - Submediterranean pseudomaquis



Distribution map *based on vegetation relevés*



Suitability map. *Background data for model randomly selected from study area*

Geographic restriction distribution data

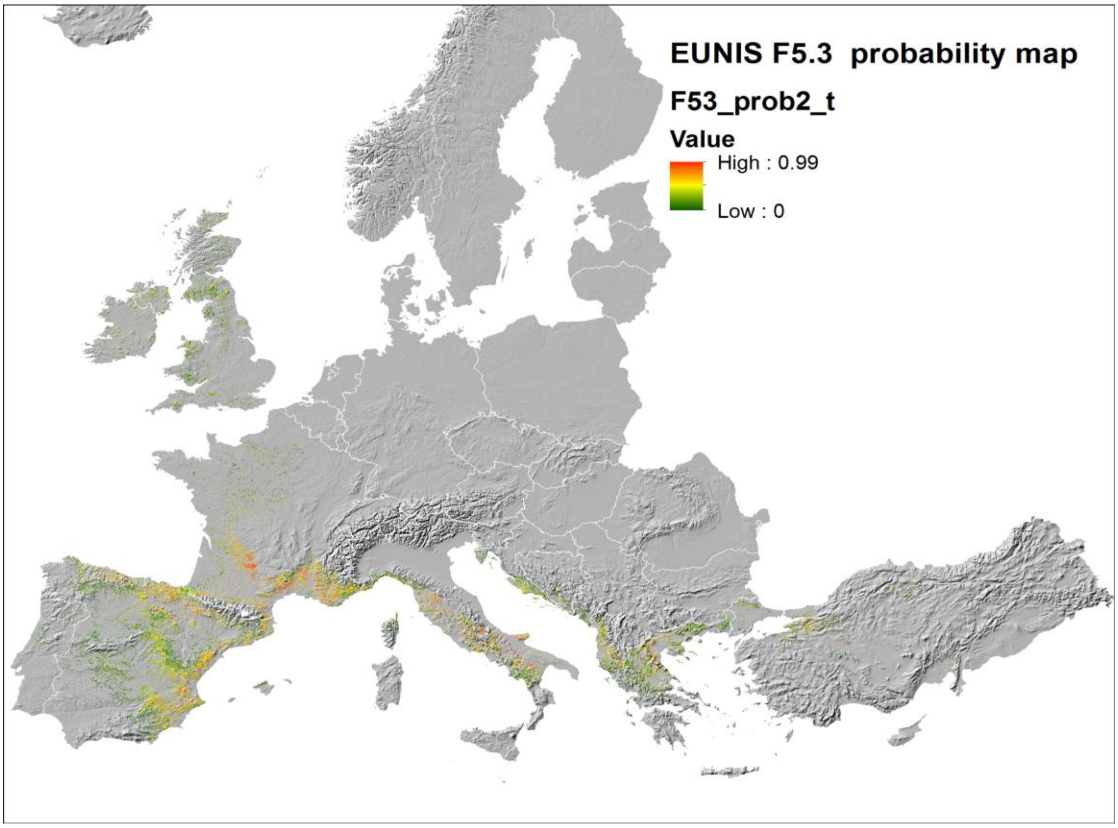
-

Maxent modelling statistics

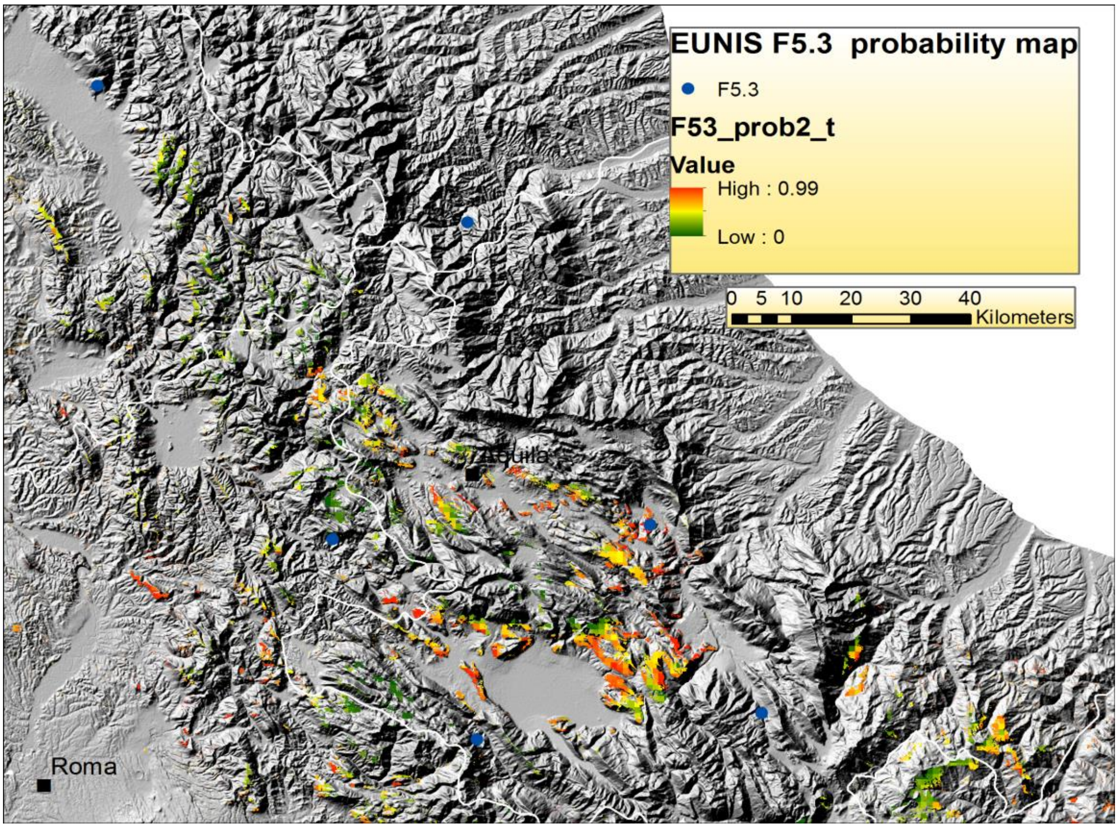
AUC training (0-1)	0.9786
AUC test (0-1)	0.9577
Contribution variables to the Maxent model (%)	
Temperature seasonality (stdev * 100)	27.2165
Precipitation seasonality (coef. of var.)	13.3498
Potential evapotranspiration	11.8113
Weight in % of silt particles (0.0002-0.05 m	11.1609
Volume % of coarse fragments (> 2 mm)	10.1288
pH (water)	8.4849
Soil organic carbon content (‰)	6.334
Precipitation of warmest quarter	5.0467
Weight in % of sand particles (0.05-2 mm)	3.2053
Weight in % of clay particles (<0.0002 mm	2.2254
Solar radiation	1.046
Annual precipitation	0.7049
Cation Exchange Capacity	0.3314
Mean temperature of wettest quarter	0
Bulk density (kg/m³)	0
Distance to water	0

Remarks

Bad model, because of prediction in Ireland, England, and Hungary where the habitat certainly does not occur. The reason is the poor relation to climatic factors. The prediction in eastern part of Europe (Turkey) is uncertain due to lack of data for that area.



Probability map *(overview)*

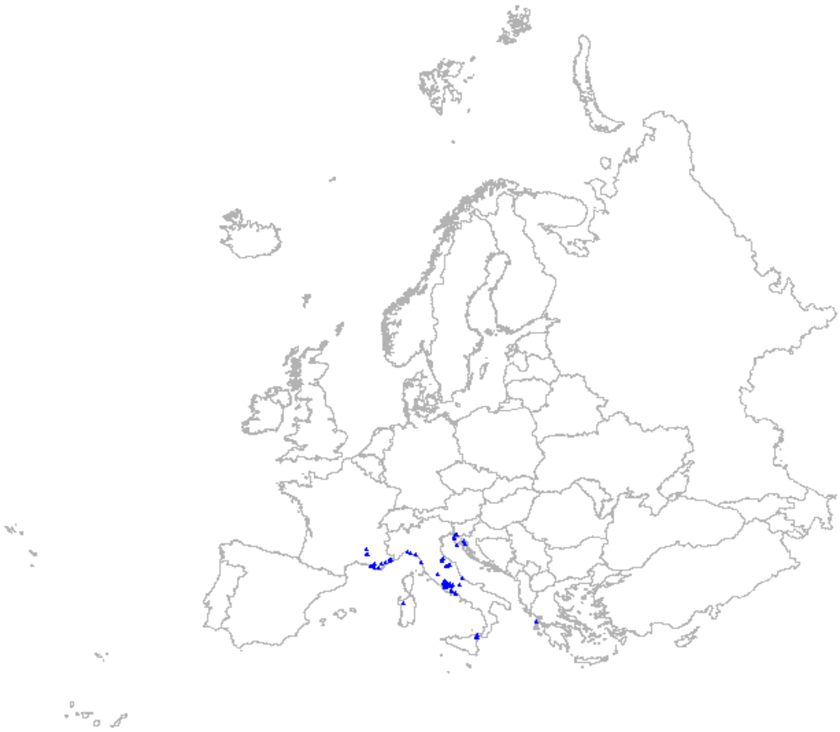


Probability map *(detail)*

Decision rules:

Relationship to CLC (D. Moss)	Sclerophyllous vegetation (323)
Relationship to CLC (releves)	28 + 23, 24, 25, 26, 28, 29
BGR filter	Yes
Topo filter	No

F5.4 - Spartium junceum fields



Distribution map *based on vegetation relevés*

Suitability map *. Background data for model randomly selected from study area*

Geographic restriction distribution data

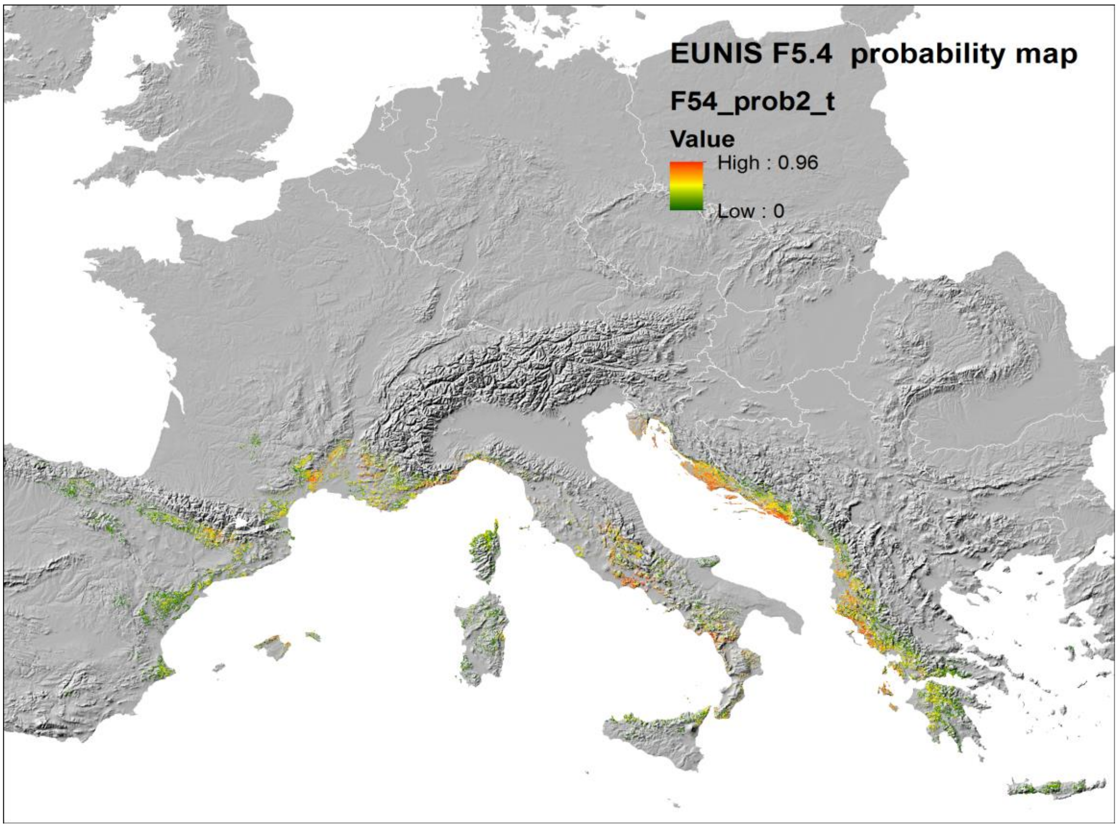
-

Maxent modelling statistics

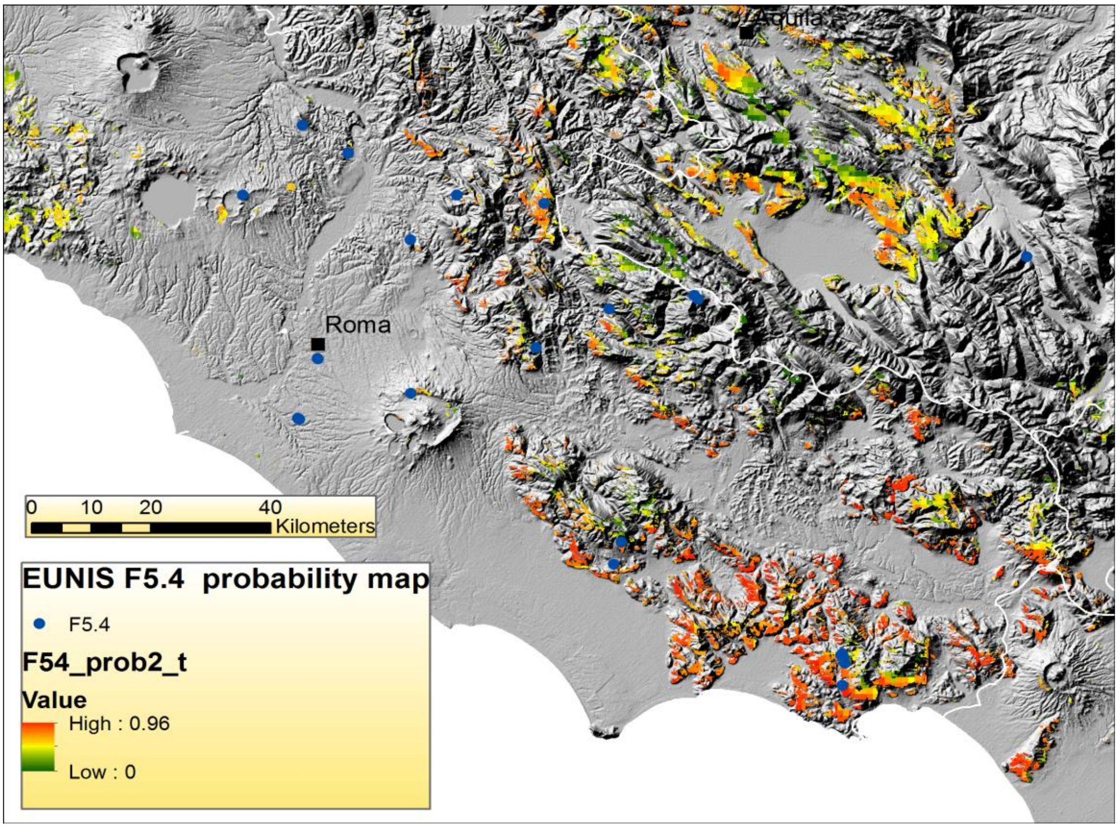
AUC training (0-1)	0.9873
AUC test (0-1)	0.9804
Contribution variables to the Maxent model (%)	
Weight in % of clay particles (<0.0002 mm	26.3259
Temperature seasonality (stdev * 100)	22.7849
Solar radiation	20.5001
Annual precipitation	18.9034
Potential evapotranspiration	13.4566
Mean temperature of wettest quarter	6.4925
Precipitation seasonality (coef. of var.)	3.7847
pH (water)	2.8043
Precipitation of warmest quarter	2.6968
Bulk density (kg/m^3)	1.4665
Volume % of coarse fragments (> 2 mm)	0.7765
Soil organic carbon content (‰)	0.0964
Distance to water	0.0908
Cation Exchange Capacity	0.0768
Weight in % of silt particles (0.0002-0.05 m	0.0555
Weight in % of sand particles (0.05-2 mm)	0.0156

Remarks

Poor prediction for Spain due to lack of data. Spartium junceum actually occurs throughout Spain. The prediction in eastern part of Europe (Turkey) is uncertain due to lack of data for that area.



Probability map *(overview)*

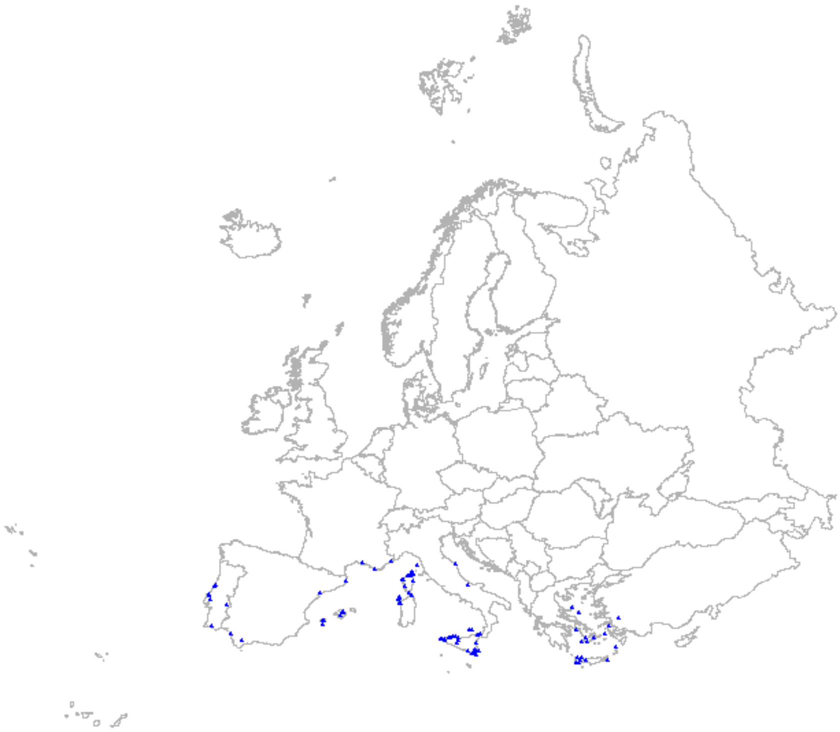


Probability map *(detail)*

Decision rules:

Relationship to CLC (D. Moss)	Moors and heathland (322)
Relationship to CLC (releves)	27 + 26, 28, 29
BGR filter	Yes
Topo filter	No

F5.5 - Thermo-Mediterranean scrub



Distribution map *based on vegetation relevés*

Suitability map *. Background data for model randomly selected from study area*

Geographic restriction distribution data

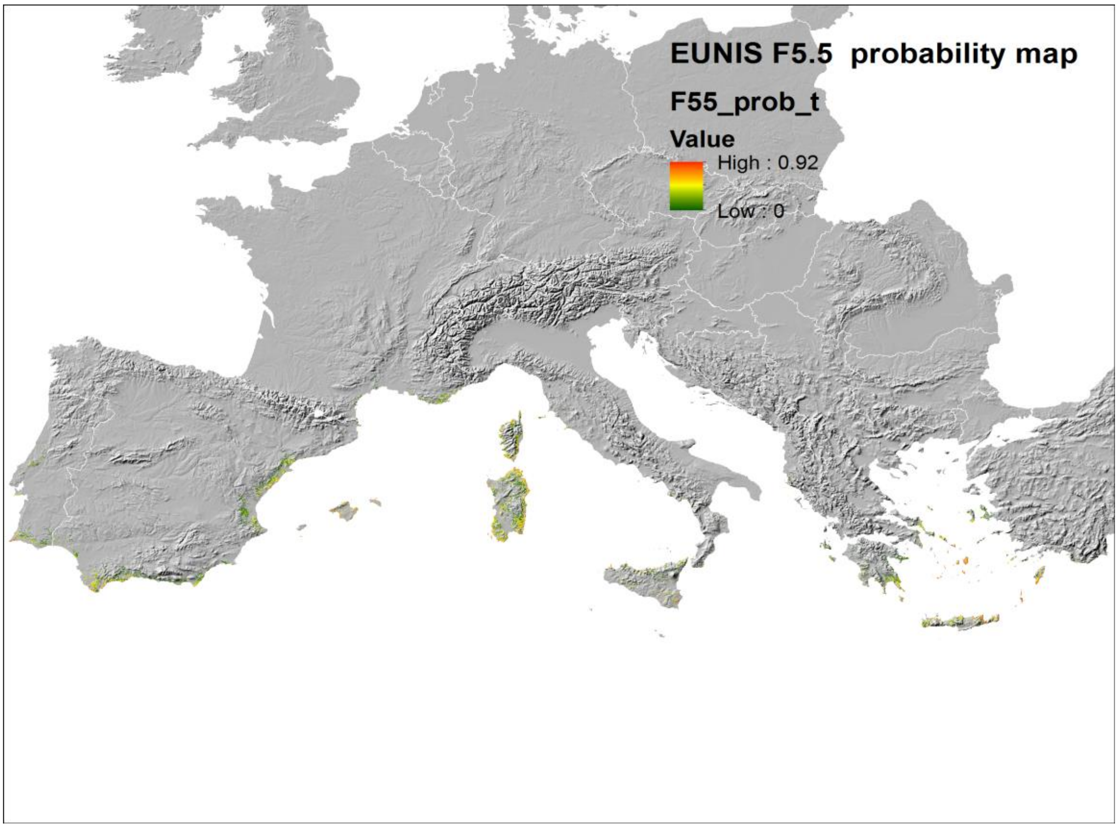
-

Maxent modelling statistics

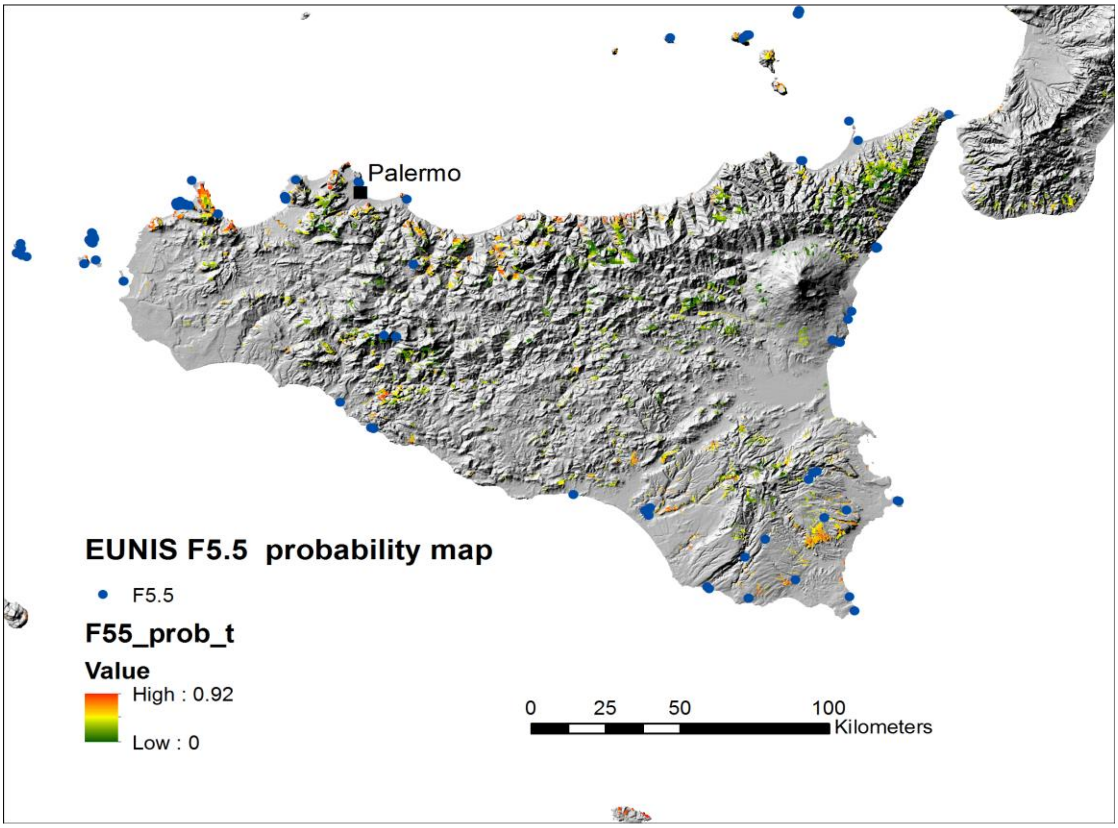
AUC training (0-1)	0.9874
AUC test (0-1)	0.9814
Contribution variables to the Maxent model (%)	
Temperature seasonality (stdev * 100)	38.2369
Precipitation of warmest quarter	28.1046
Precipitation seasonality (coef. of var.)	11.8497
Mean temperature of wettest quarter	7.9066
Weight in % of clay particles (<0.0002 mm	3.5663
Soil organic carbon content (‰)	2.799
pH (water)	2.5521
Potential evapotranspiration	2.0164
Weight in % of silt particles (0.0002-0.05 m	0.7747
Volume % of coarse fragments (> 2 mm)	0.7313
Weight in % of sand particles (0.05-2 mm)	0.655
Bulk density (kg/m³)	0.3056
Solar radiation	0.2875
Annual precipitation	0.0773
Distance to water	0.0443
Cation Exchange Capacity	0

Remarks

-



Probability map *(overview)*

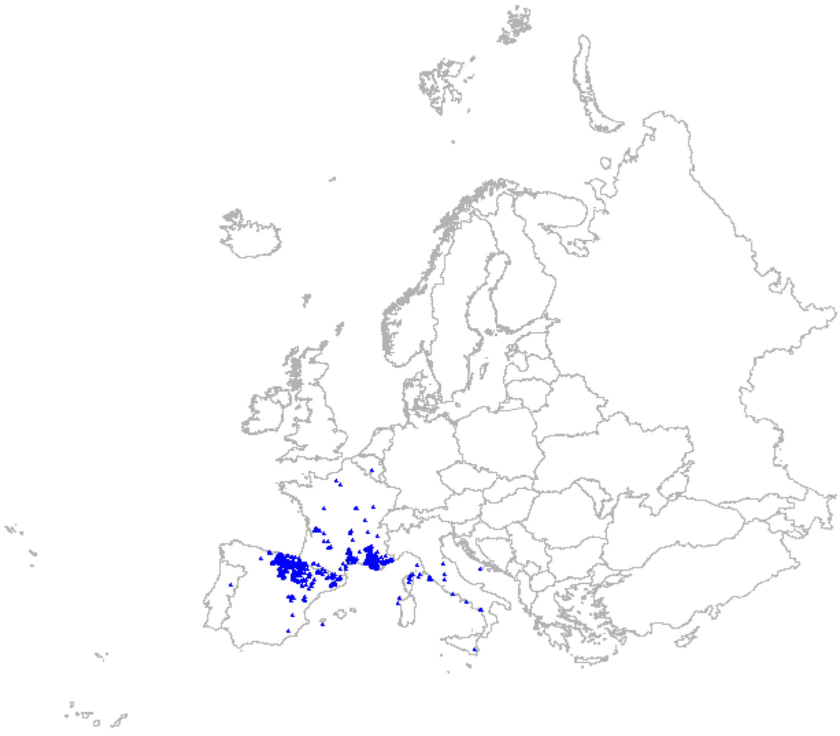


Probability map *(detail)*

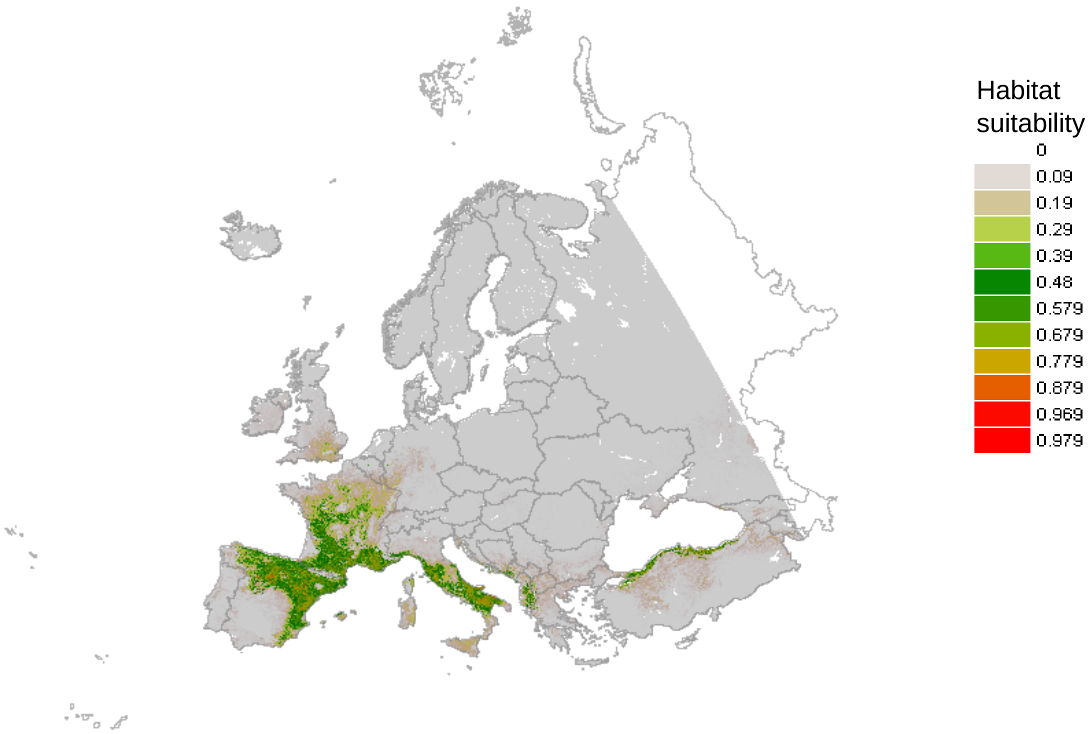
Decision rules:

Relationship to CLC (D. Moss)	Sclerophyllous vegetation (323)
Relationship to CLC (releves)	28
BGR filter	Yes
Topo filter	No

F6.1a - Western basiphilous garrigue



Distribution map *based on vegetation relevés*



Suitability map *. Background data for model randomly selected from heathland-scrub-tundra data set*

Geographic restriction distribution data

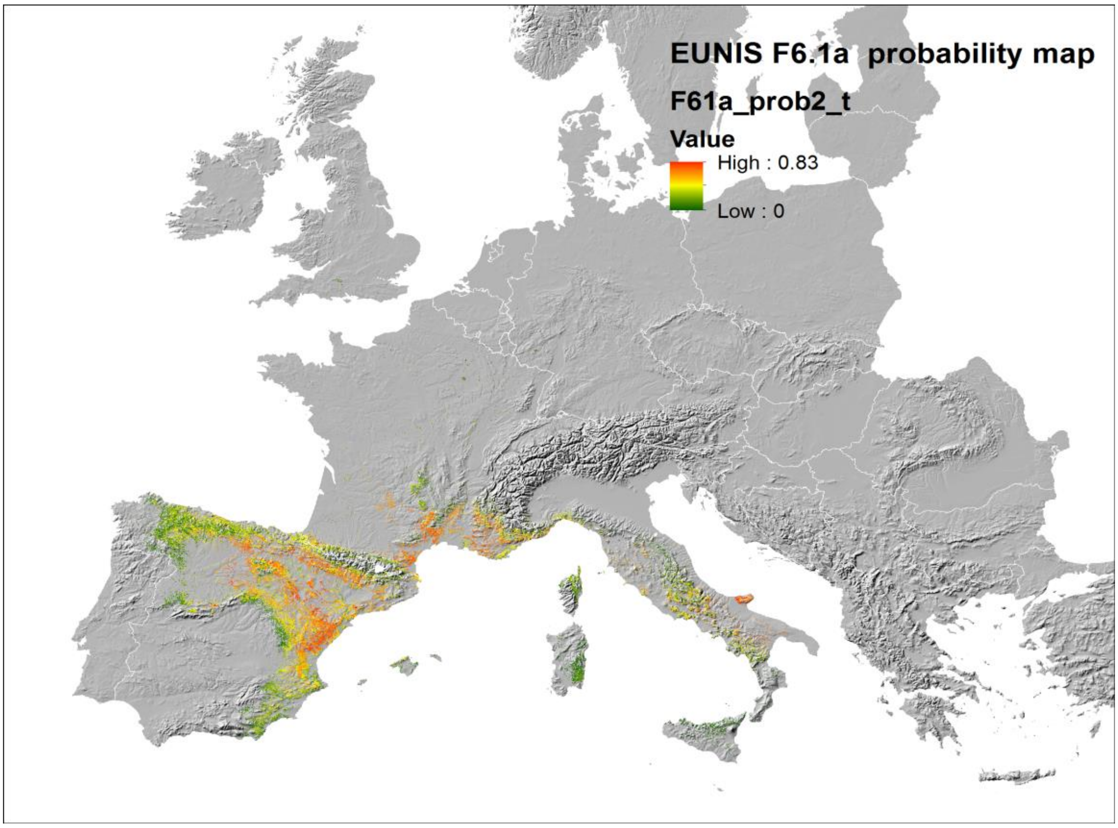
-

Maxent modelling statistics

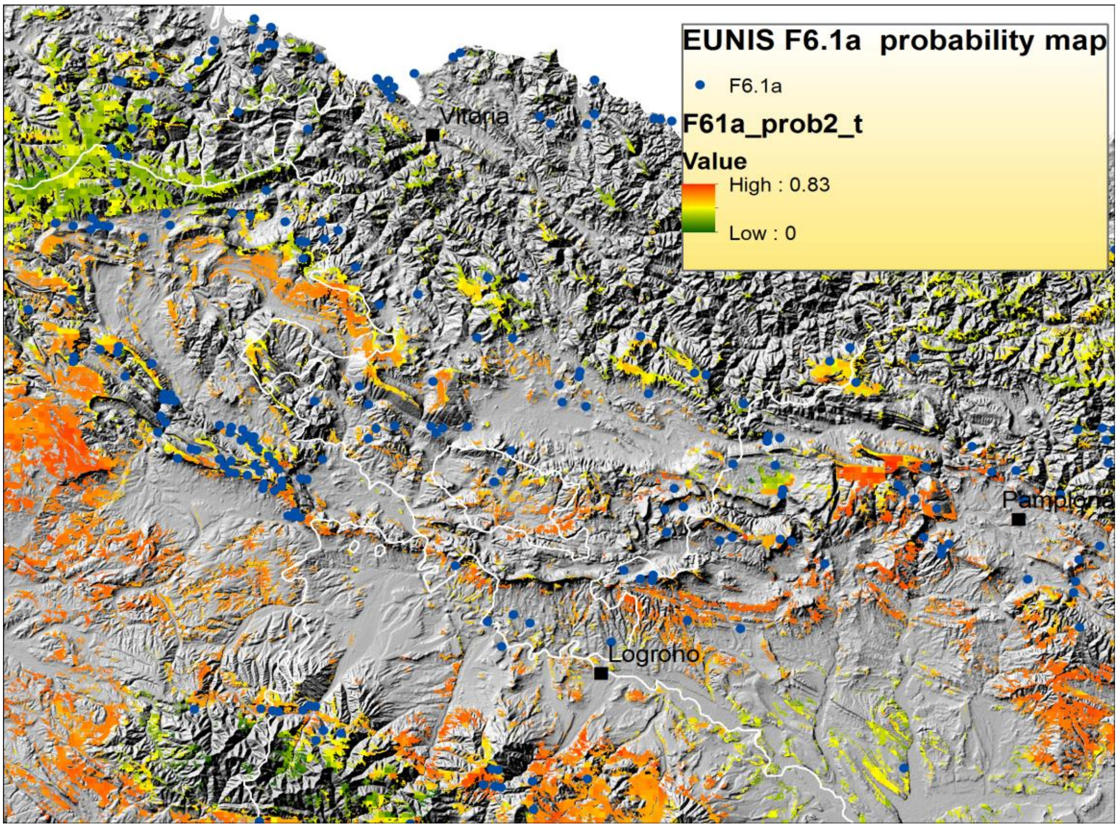
AUC training (0-1)		0.9066
AUC test (0-1)		0.8951
Contribution variables to the Maxent model (%)		
	Soil organic carbon content (‰)	40.1732
	pH (water)	14.1712
	Solar radiation	13.2695
	Temperature seasonality (stdev * 100)	13.2573
	Weight in % of clay particles (<0.0002 mm	8.9195
	Precipitation seasonality (coef. of var.)	6.7018
	Volume % of coarse fragments (> 2 mm)	6.6706
	Precipitation of warmest quarter	4.066
	Bulk density (kg/m³)	3.7736
	Weight in % of sand particles (0.05-2 mm)	0.7942
	Potential evapotranspiration	0.7076
	Distance to water	0.4612
	Cation Exchange Capacity	0.3458
	Mean temperature of wettest quarter	0.3284
	Annual precipitation	0.2318
	Weight in % of silt particles (0.0002-0.05 m	0.077

Remarks

Prediction in eastern part of Europe (Turkey) is uncertain due to lack of data for that area.



Probability map *(overview)*

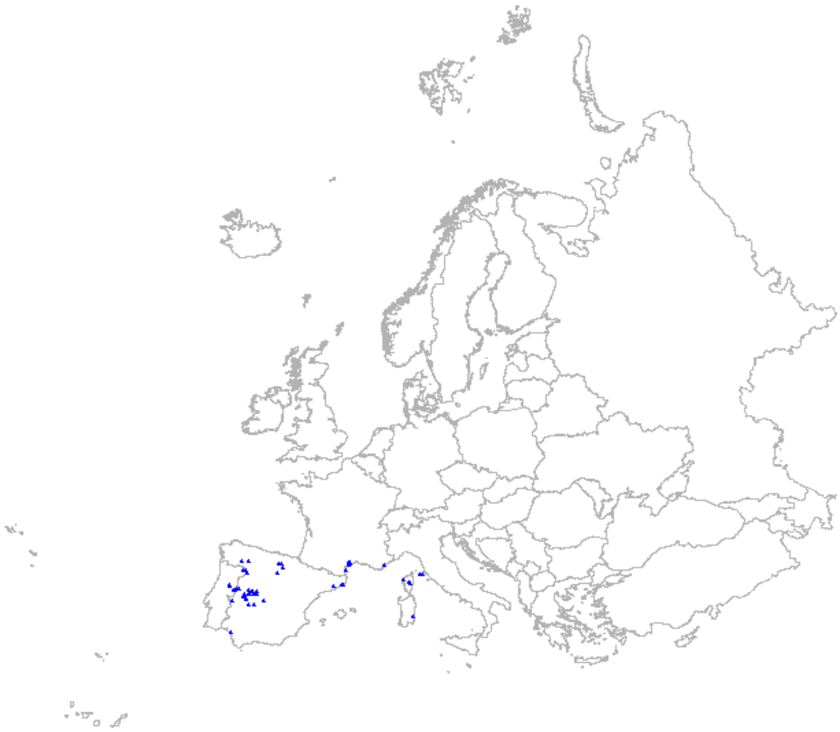


Probability map *(detail)*

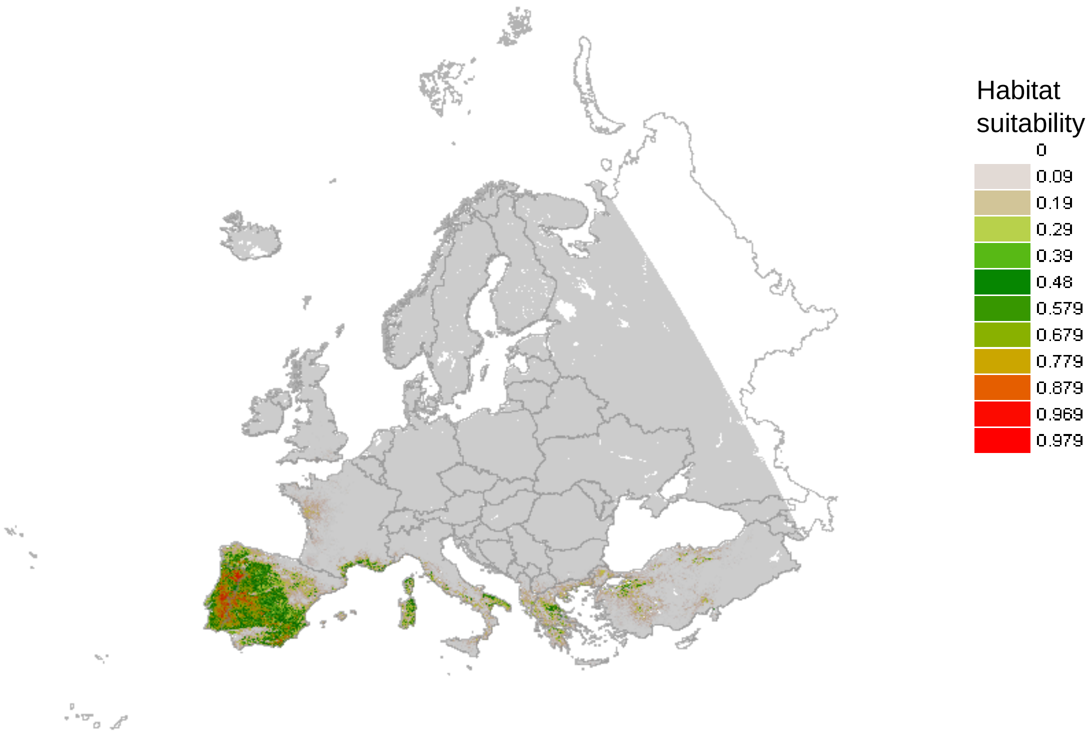
Decision rules:

Relationship to CLC (D. Moss)	Sclerophyllous vegetation (323)
Relationship to CLC (releves)	28 + 26, 27, 29
BGR filter	No
Topo filter	Yes

F6.1b - Western acidophilous garrigue



Distribution map *based on vegetation relevés*



Suitability map *. Background data for model randomly selected from heathland-scrub-tundra data set*

Geographic restriction distribution data

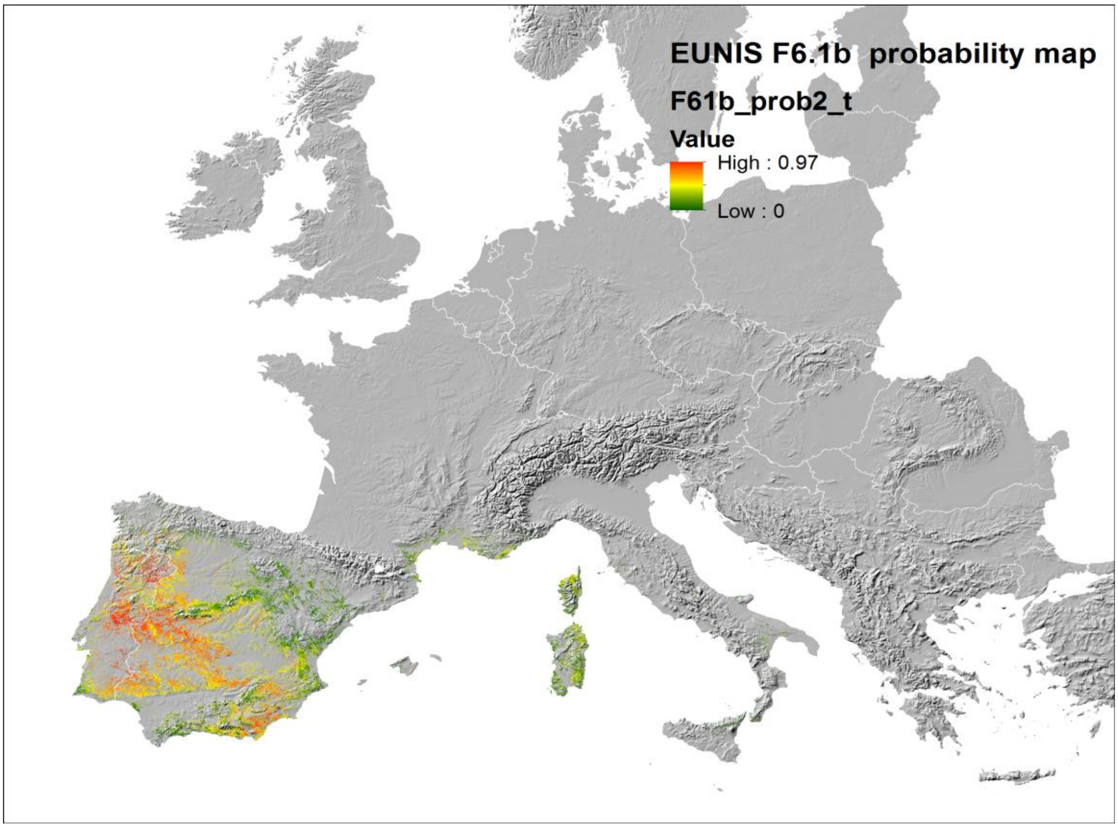
-

Maxent modelling statistics

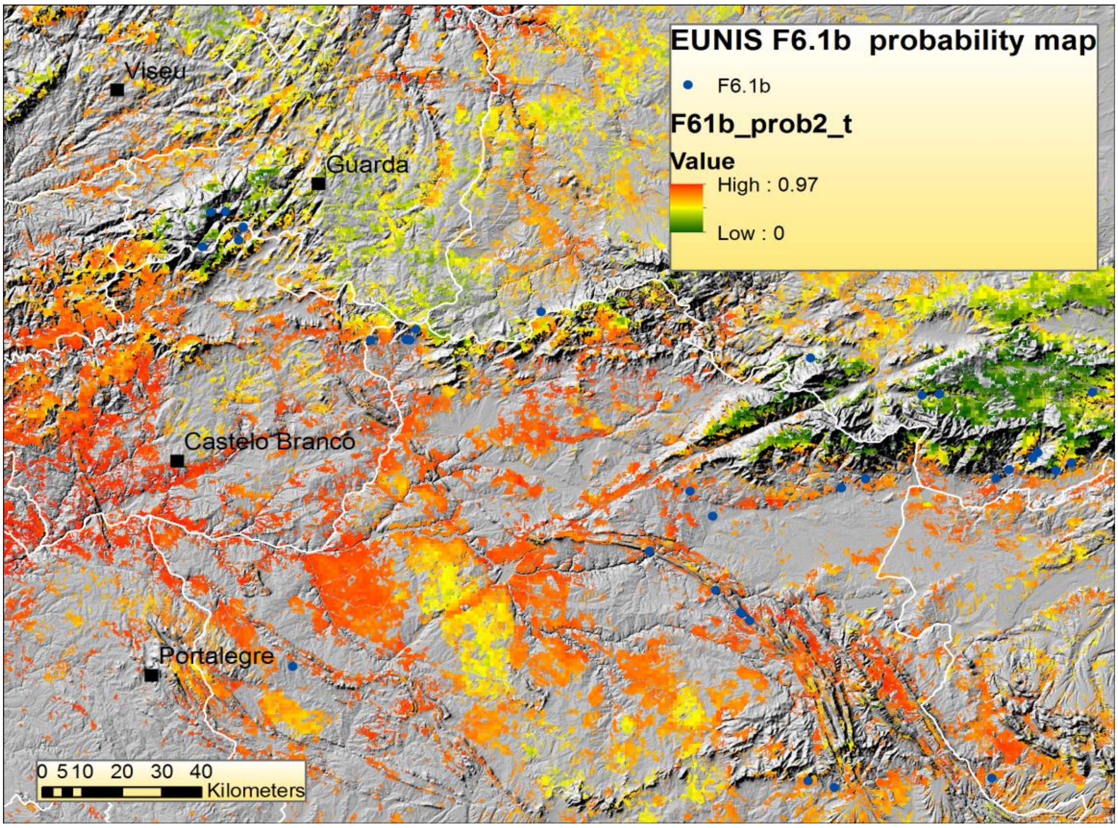
AUC training (0-1)		0.9756
AUC test (0-1)		0.9415
Contribution variables to the Maxent model (%)		
	Precipitation of warmest quarter	49.1645
	Soil organic carbon content (‰)	16.0585
	Precipitation seasonality (coef. of var.)	13.5536
	Weight in % of clay particles (<0.0002 mm	6.2395
	Solar radiation	5.8264
	Bulk density (kg/m³)	5.8124
	Weight in % of sand particles (0.05-2 mm)	3.5449
	Mean temperature of wettest quarter	2.3443
	Temperature seasonality (stdev * 100)	2.1301
	Volume % of coarse fragments (> 2 mm)	1.9674
	Weight in % of silt particles (0.0002-0.05 m	0.8768
	Annual precipitation	0.8398
	pH (water)	0.4292
	Potential evapotranspiration	0.3234
	Cation Exchange Capacity	0.14
	Distance to water	0.0443

Remarks

Predictions in the east Mediterranean area should be ignored.



Probability map *(overview)*

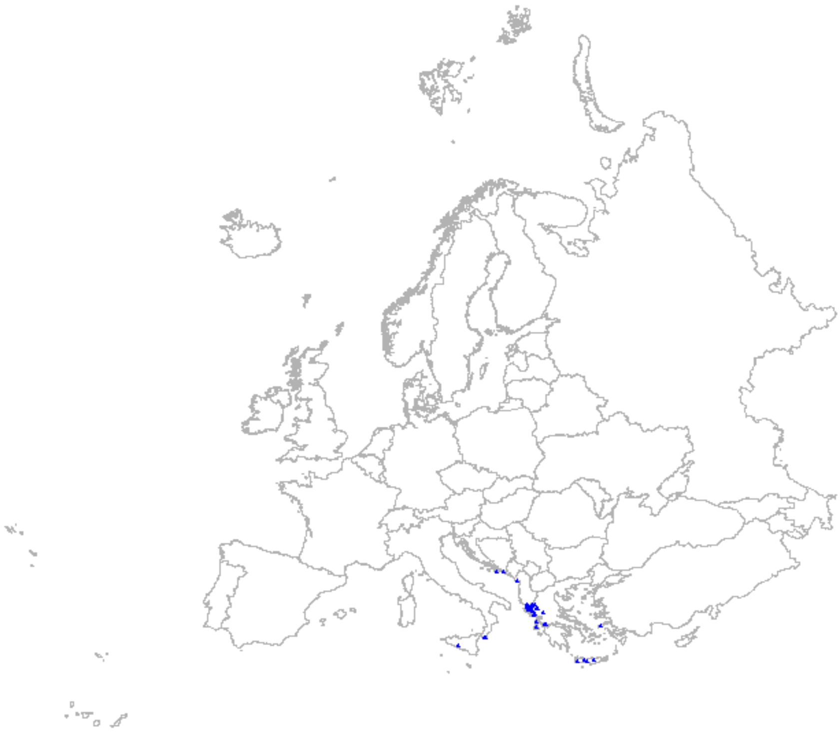


Probability map *(detail)*

Decision rules:

Relationship to CLC (D. Moss)	Sclerophyllous vegetation (323)
Relationship to CLC (releves)	28 + 26, 29, 30
BGR filter	No
Topo filter	Yes

F6.2 - Eastern garrigue



Distribution map *based on vegetation relevés*

Suitability map *. Background data for model randomly selected from study area*

Geographic restriction distribution data

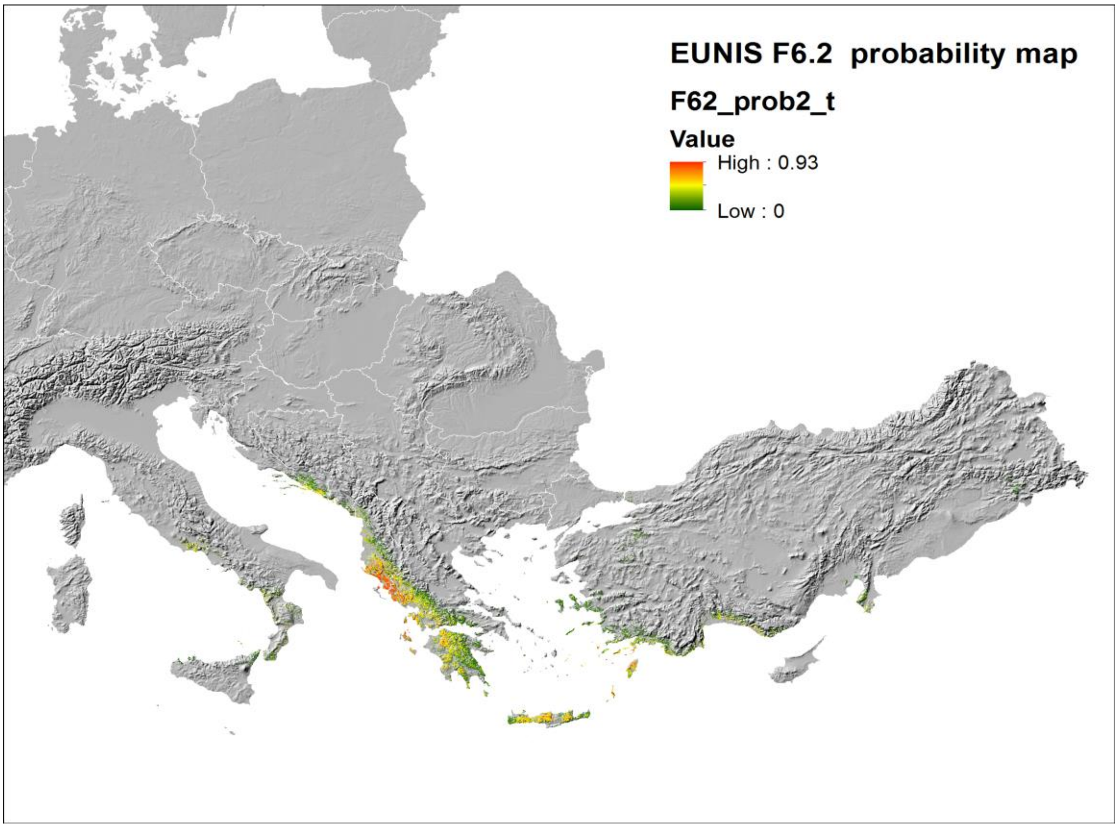
-

Maxent modelling statistics

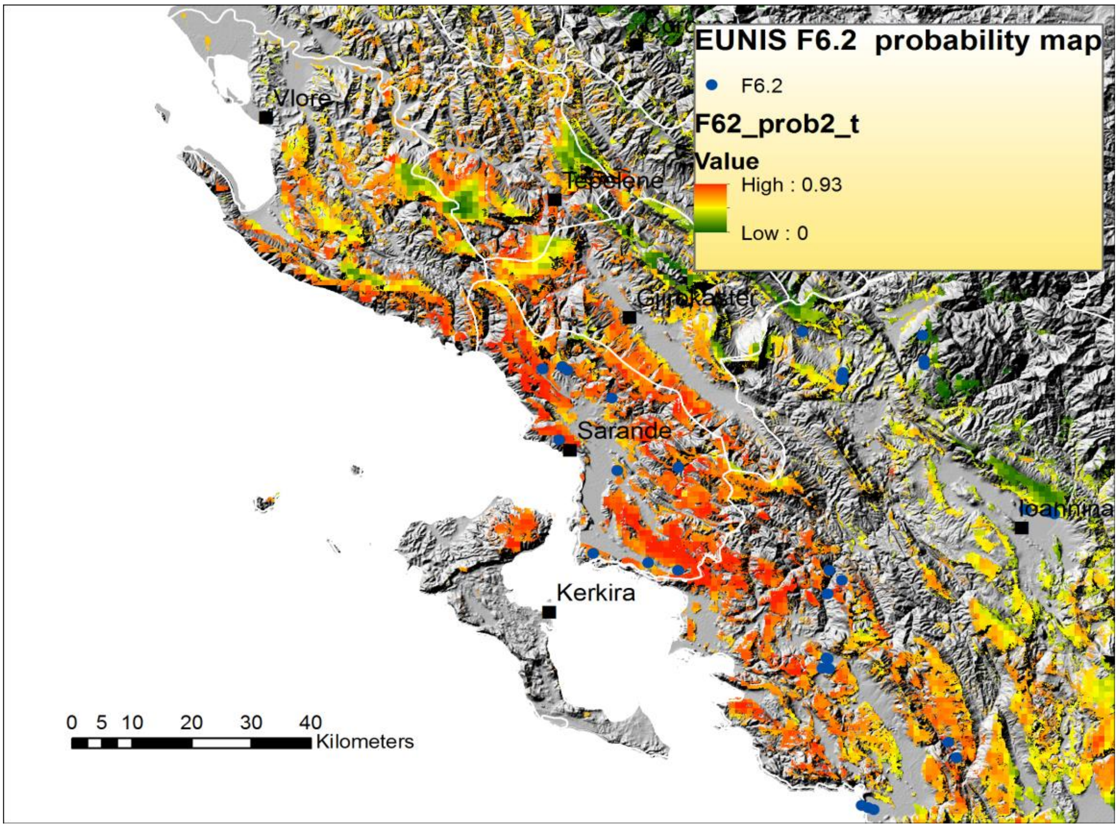
AUC training (0-1)	0.9923
AUC test (0-1)	0.9916
Contribution variables to the Maxent model (%)	
Annual precipitation	39.9468
Precipitation seasonality (coef. of var.)	37.2821
Solar radiation	13.9163
Potential evapotranspiration	11.4396
Temperature seasonality (stdev * 100)	3.8421
Precipitation of warmest quarter	2.5152
Weight in % of clay particles (<0.0002 mm	1.8396
Weight in % of silt particles (0.0002-0.05 m	0.7661
Soil organic carbon content (‰)	0.633
Distance to water	0.4519
Volume % of coarse fragments (> 2 mm)	0.0504
Cation Exchange Capacity	0.0256
pH (water)	0.0137
Mean temperature of wettest quarter	0.0112
Weight in % of sand particles (0.05-2 mm)	0.0046
Bulk density (kg/m³)	0

Remarks

Prediction in the Iberian Penissula should be ignored and the prediction in eastern part of Europe (Turkey) is uncertain due to lack of data for that area.



Probability map *(overview)*

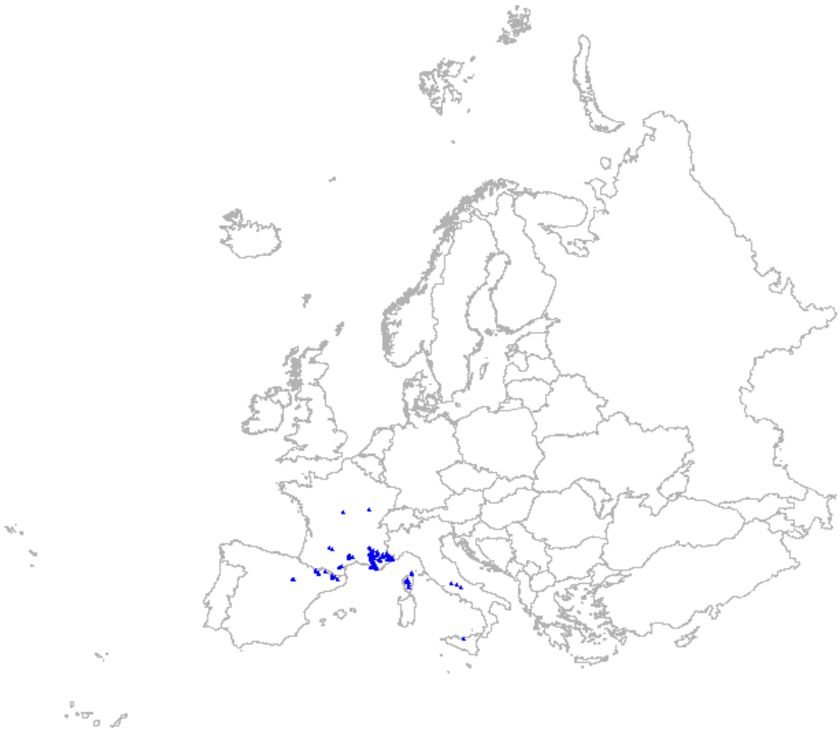


Probability map *(detail)*

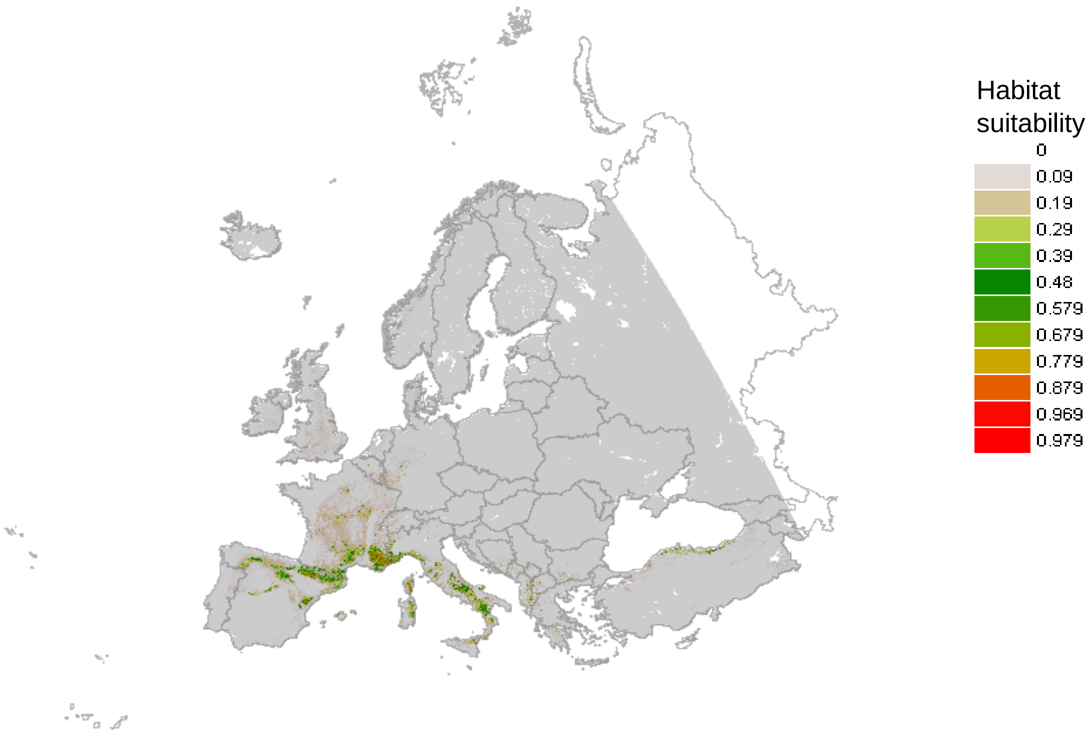
Decision rules:

Relationship to CLC (D. Moss)	Sclerophyllous vegetation (323)
Relationship to CLC (releves)	28 + 26, 29, 32
BGR filter	No
Topo filter	Yes

F6.6 - Supra-Mediterranean garrigue



Distribution map *based on vegetation relevés*



***Suitability map**. Background data for model randomly selected from study area*

Geographic restriction distribution data

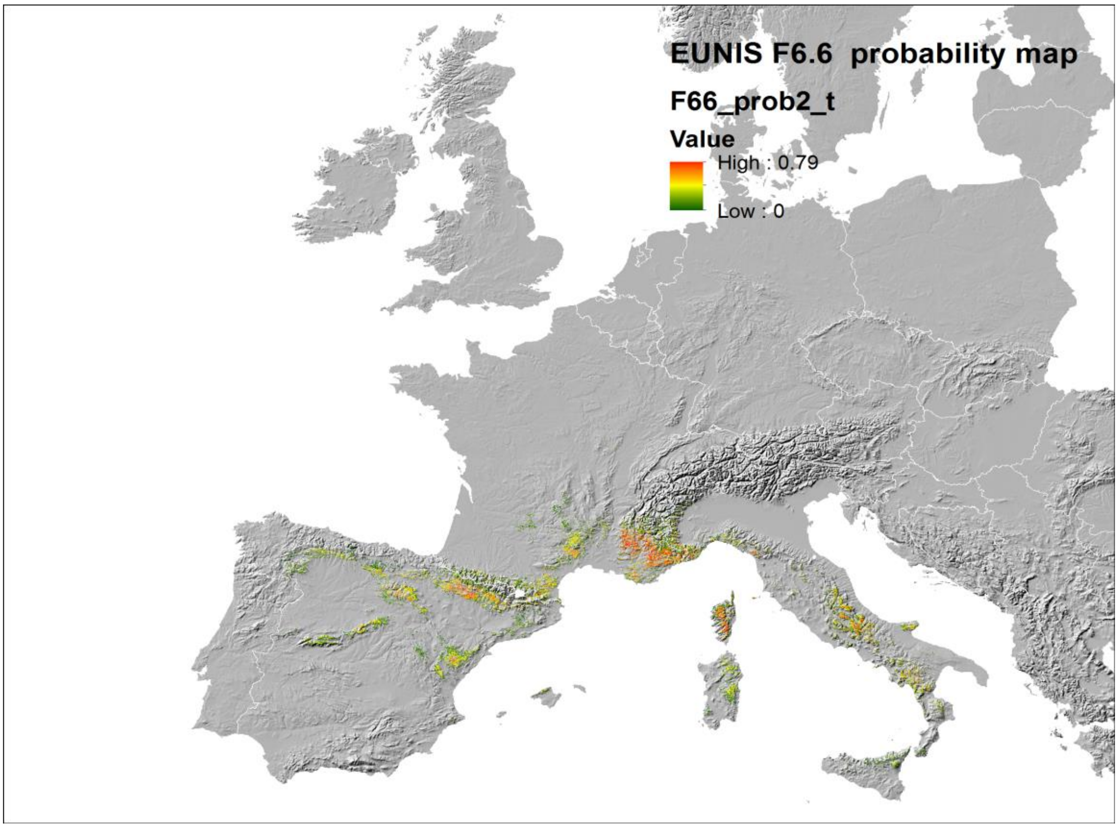
-

Maxent modelling statistics

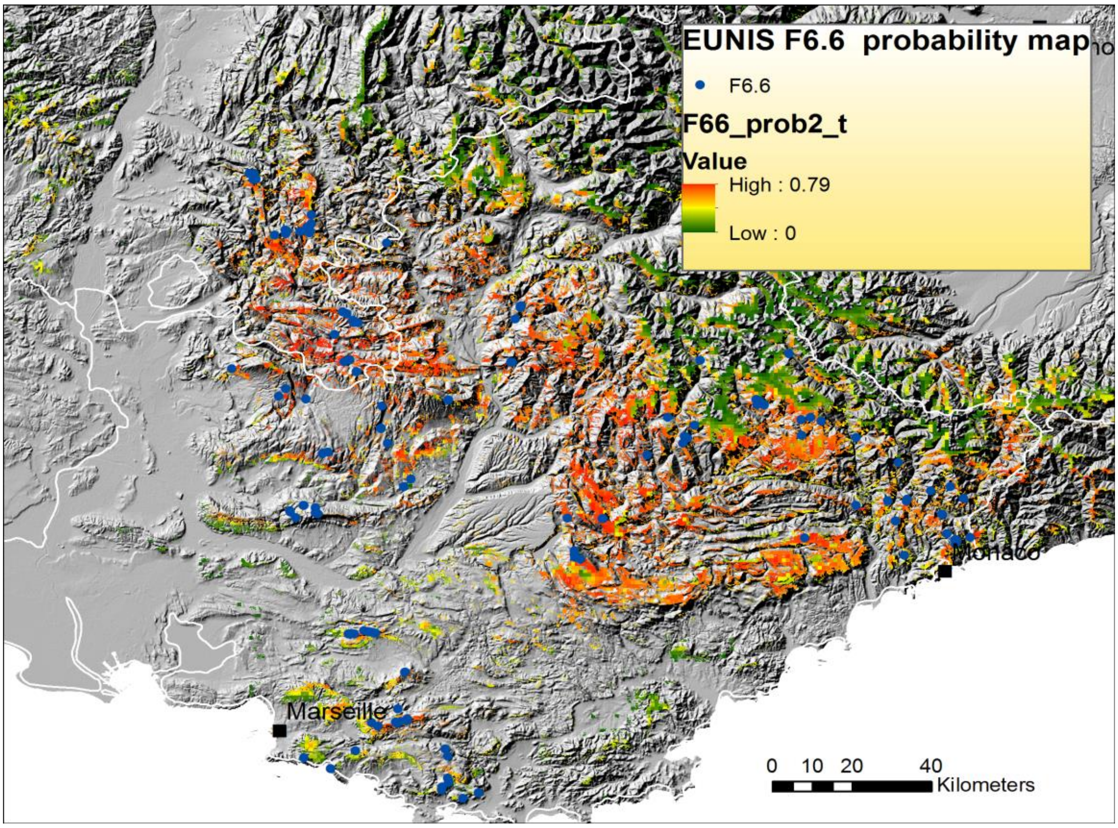
AUC training (0-1)	0.982
AUC test (0-1)	0.9828
Contribution variables to the Maxent model (%)	
Temperature seasonality (stdev * 100)	35.5355
Volume % of coarse fragments (> 2 mm)	22.2539
Annual precipitation	8.7275
Weight in % of sand particles (0.05-2 mm)	7.5503
Bulk density (kg/m³)	5.5881
Precipitation seasonality (coef. of var.)	4.2175
Potential evapotranspiration	3.9178
Soil organic carbon content (‰)	3.5513
Mean temperature of wettest quarter	2.6417
Precipitation of warmest quarter	2.4728
Solar radiation	2.2173
Cation Exchange Capacity	2.1144
pH (water)	1.0109
Weight in % of silt particles (0.0002-0.05 m	0.0835
Weight in % of clay particles (<0.0002 mm	0.0665
Distance to water	0.0067

Remarks

-



Probability map *(overview)*

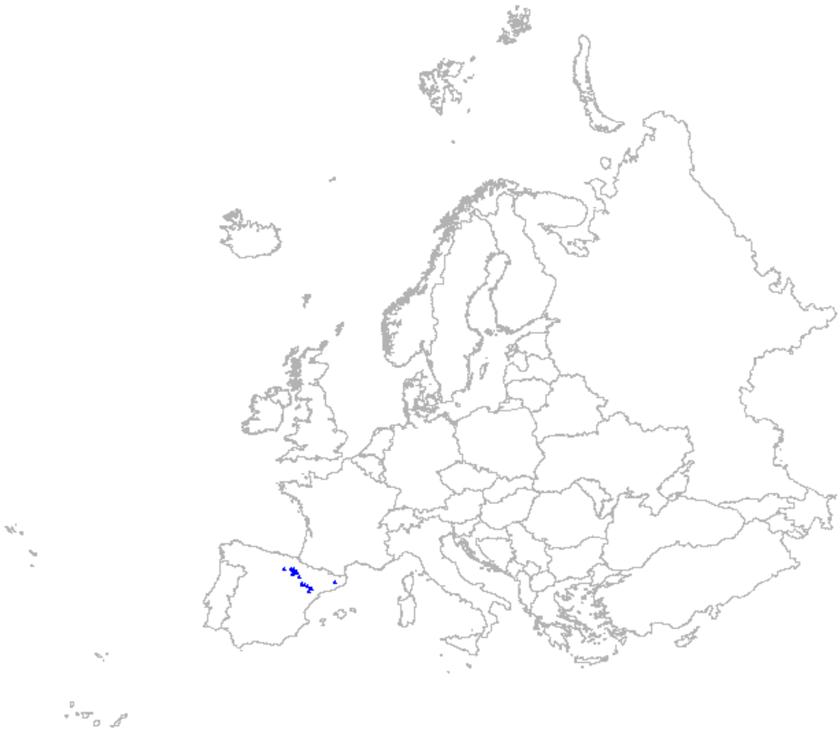


Probability map *(detail)*

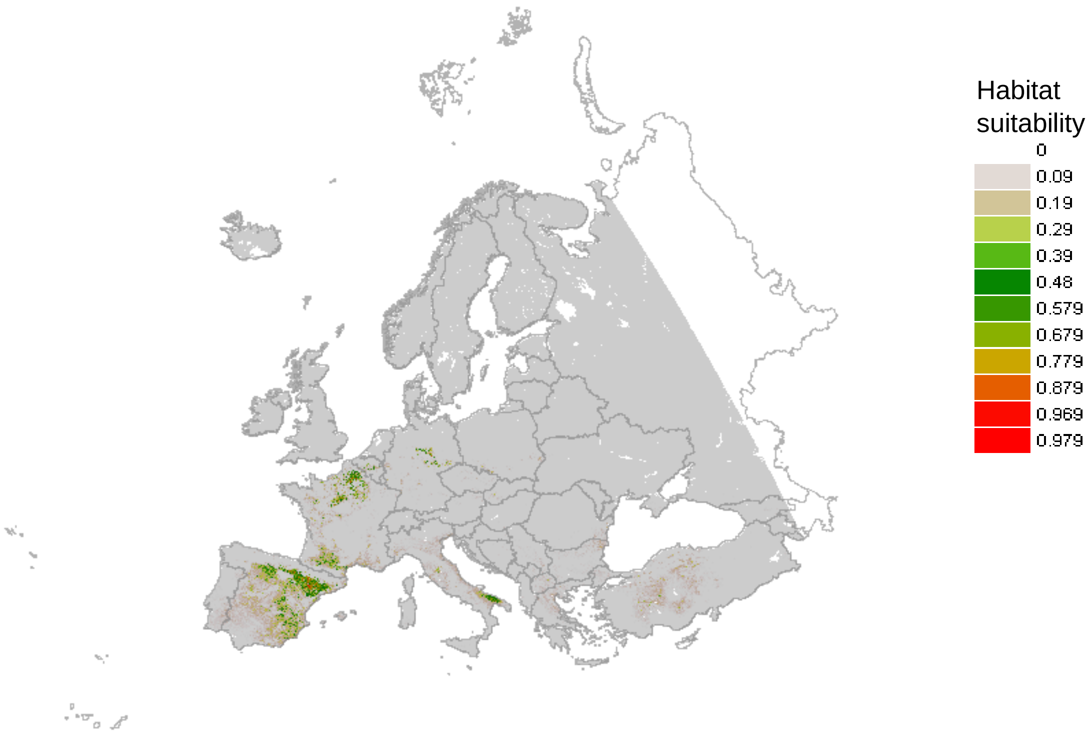
Decision rules:

Relationship to CLC (D. Moss)	Sclerophyllous vegetation (323)
Relationship to CLC (releves)	28 + 26, 29, 31, 32
BGR filter	No
Topo filter	Yes

F6.7 - Mediterranean gypsum scrub



Distribution map *based on vegetation relevés*



Suitability map. *Background data for model randomly selected from heathland-scrub-tundra data set*

Geographic restriction distribution data

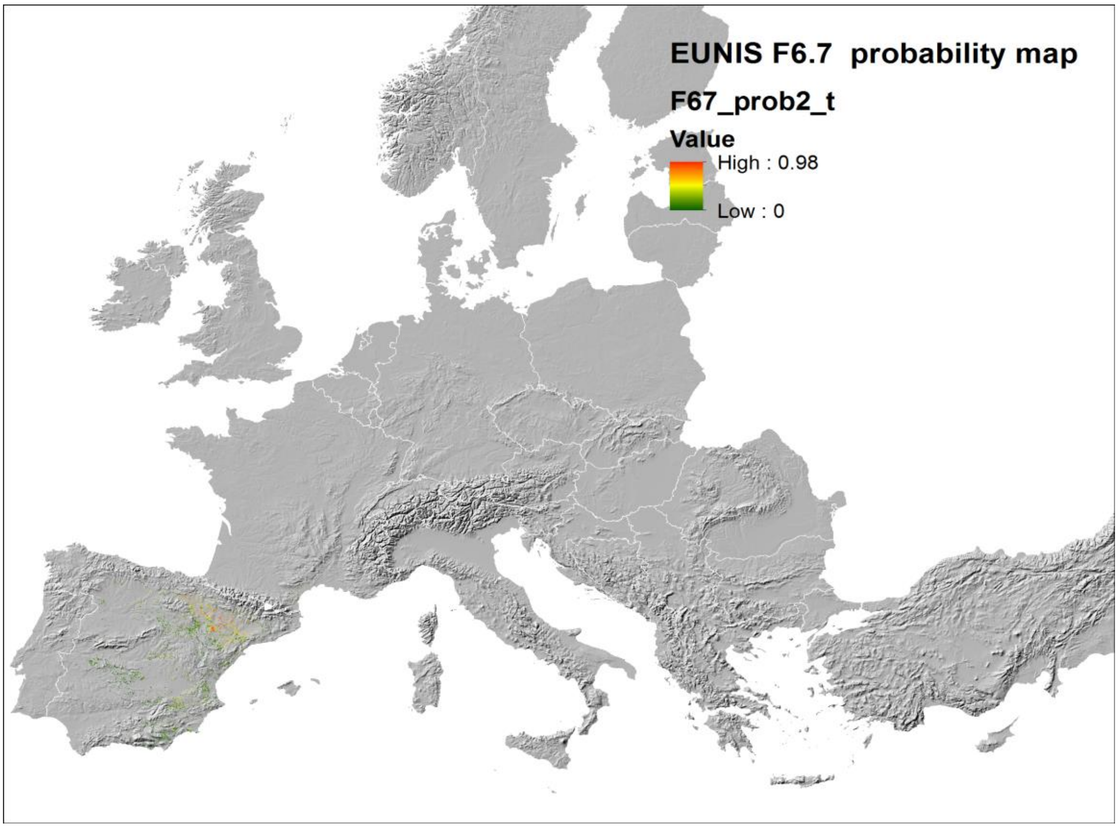
-

Maxent modelling statistics

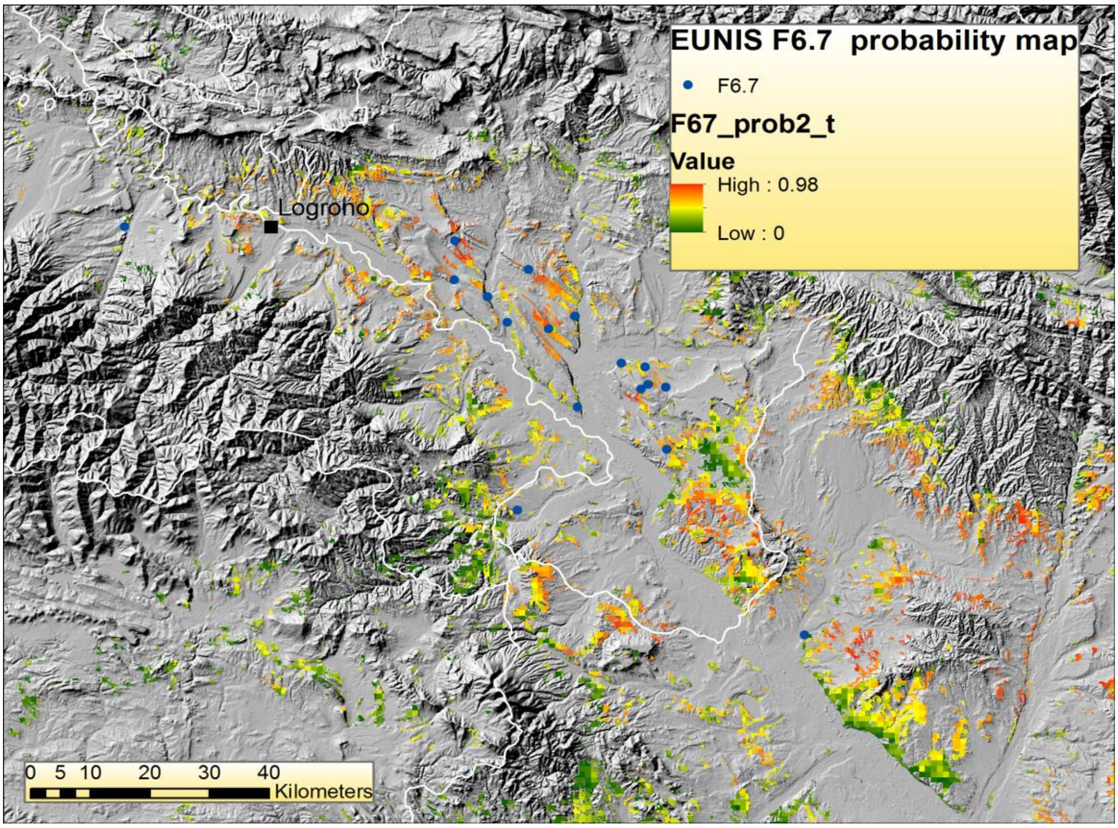
AUC training (0-1)	0.9961
AUC test (0-1)	0.9968
Contribution variables to the Maxent model (%)	
Potential evapotranspiration	21.1382
Bulk density (kg/m³)	17.2713
Soil organic carbon content (‰)	15.4644
Annual precipitation	3.5452
Distance to water	2.2883
Weight in % of sand particles (0.05-2 mm)	2.0027
Precipitation seasonality (coef. of var.)	1.9717
Temperature seasonality (stdev * 100)	1.3211
Solar radiation	1.063
Cation Exchange Capacity	0.3305
Volume % of coarse fragments (> 2 mm)	0.3214
Weight in % of silt particles (0.0002-0.05 m	0.2797
Precipitation of warmest quarter	0.0221
Mean temperature of wettest quarter	0
Weight in % of clay particles (<0.0002 mm	0
pH (water)	0

Remarks

-



Probability map *(overview)*

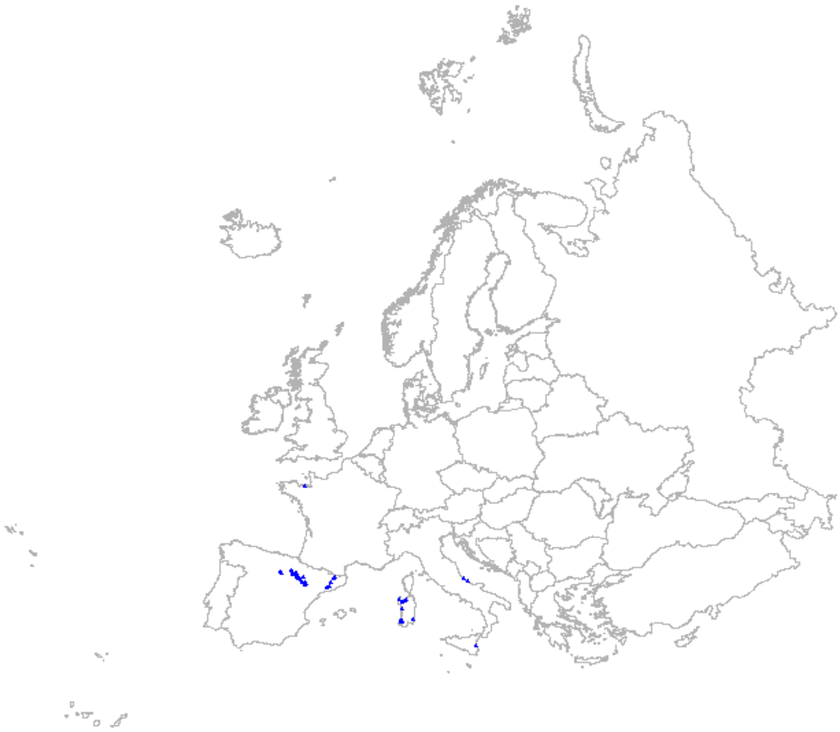


Probability map *(detail)*

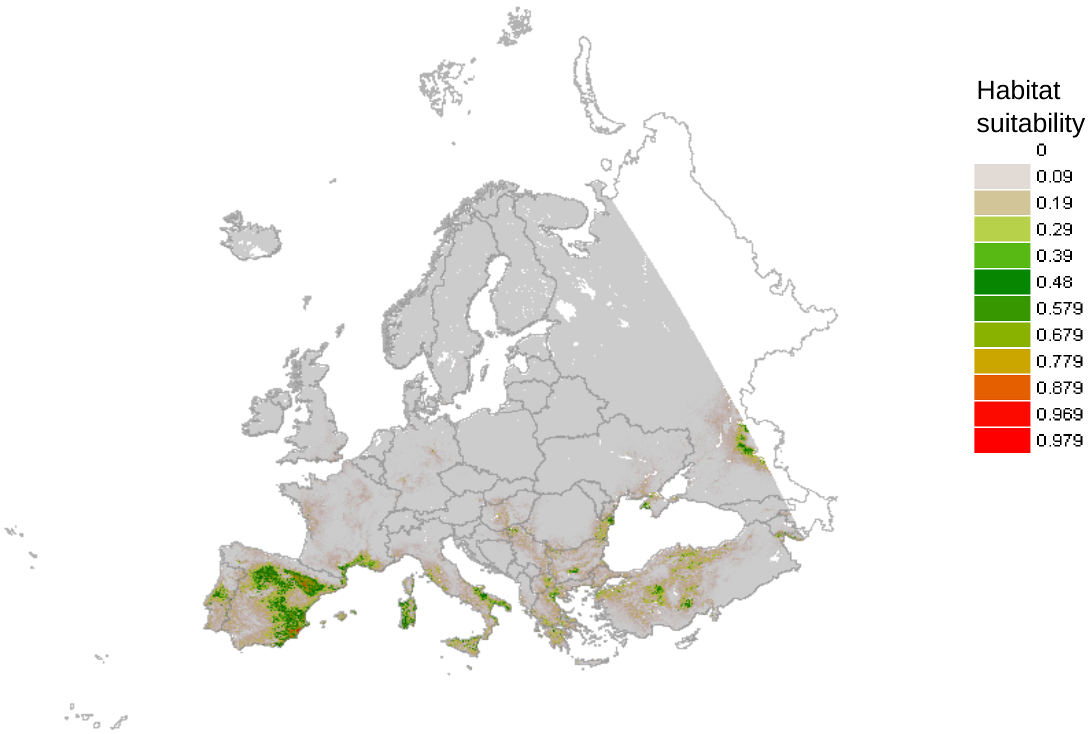
Decision rules:

Relationship to CLC (D. Moss)	Moors and heathland (322)
Relationship to CLC (releves)	27 + 28, 32
BGR filter	Yes
Topo filter	No

F6.8a - Mediterranean halo-nitrophilous scrub



Distribution map *based on vegetation relevés*



Suitability map *. Background data for model randomly selected from heathland-scrub-tundra data set*

Geographic restriction distribution data

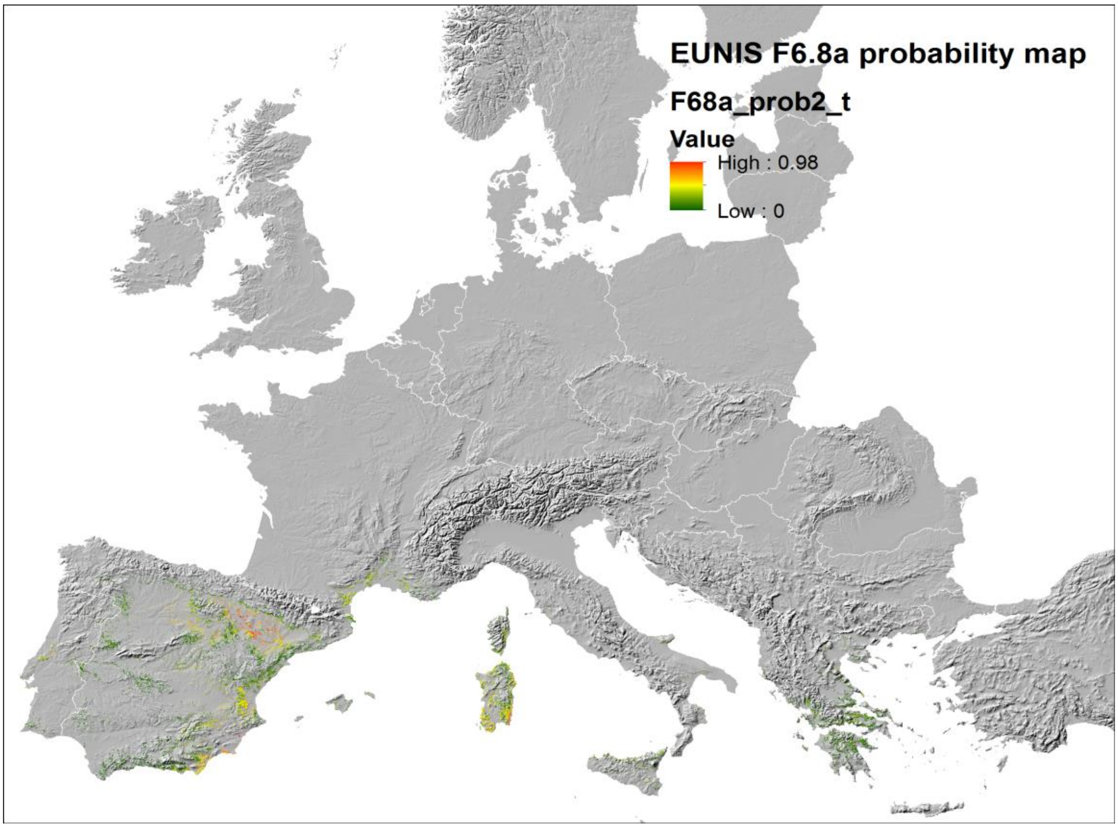
-

Maxent modelling statistics

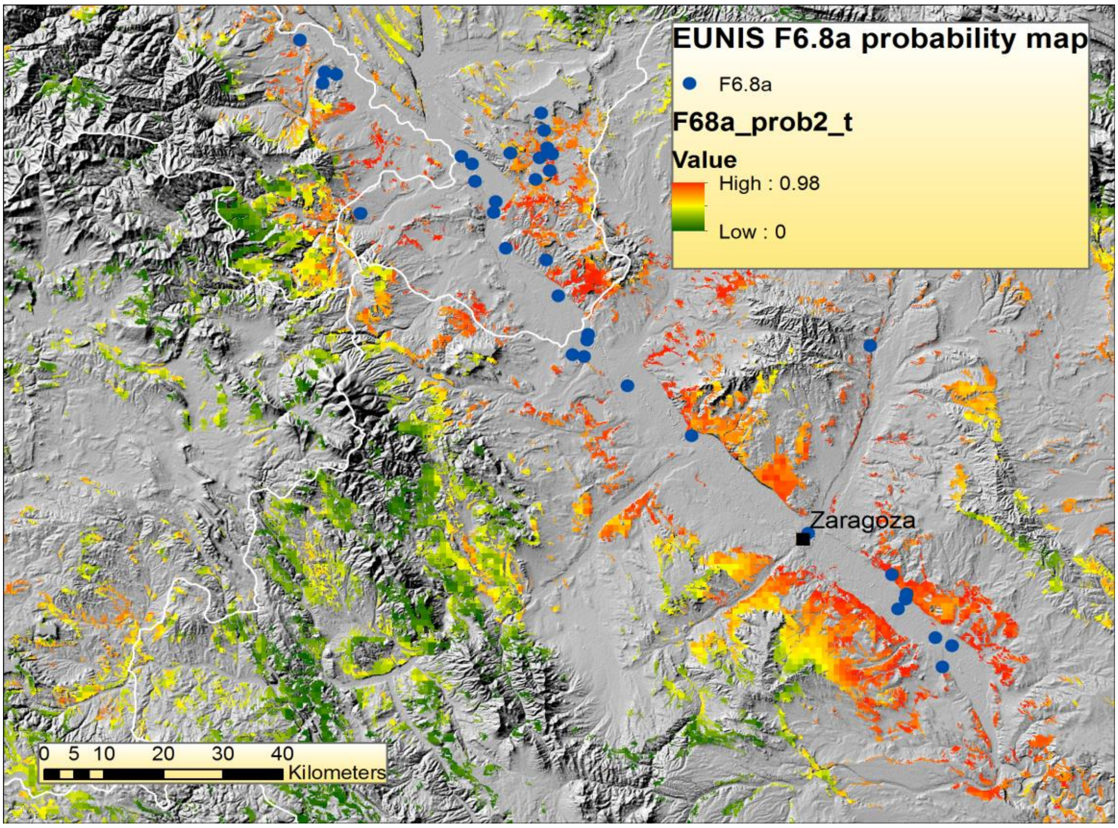
AUC training (0-1)	0.9759
AUC test (0-1)	0.911
Contribution variables to the Maxent model (%)	
Soil organic carbon content (‰)	39.1685
Precipitation of warmest quarter	16.0861
Weight in % of clay particles (<0.0002 mm	9.1065
Annual precipitation	6.3801
Solar radiation	4.6929
Bulk density (kg/m³)	3.8742
Temperature seasonality (stdev * 100)	3.4085
Precipitation seasonality (coef. of var.)	3.2556
Mean temperature of wettest quarter	2.8701
Weight in % of sand particles (0.05-2 mm)	1.4553
Distance to water	0.5444
Cation Exchange Capacity	0.3583
Potential evapotranspiration	0.3013
pH (water)	0.2237
Volume % of coarse fragments (> 2 mm)	0.0369
Weight in % of silt particles (0.0002-0.05 m	0

Remarks

Prediction in eastern part of Europe is uncertain due to lack of data for that area.



Probability map *(overview)*

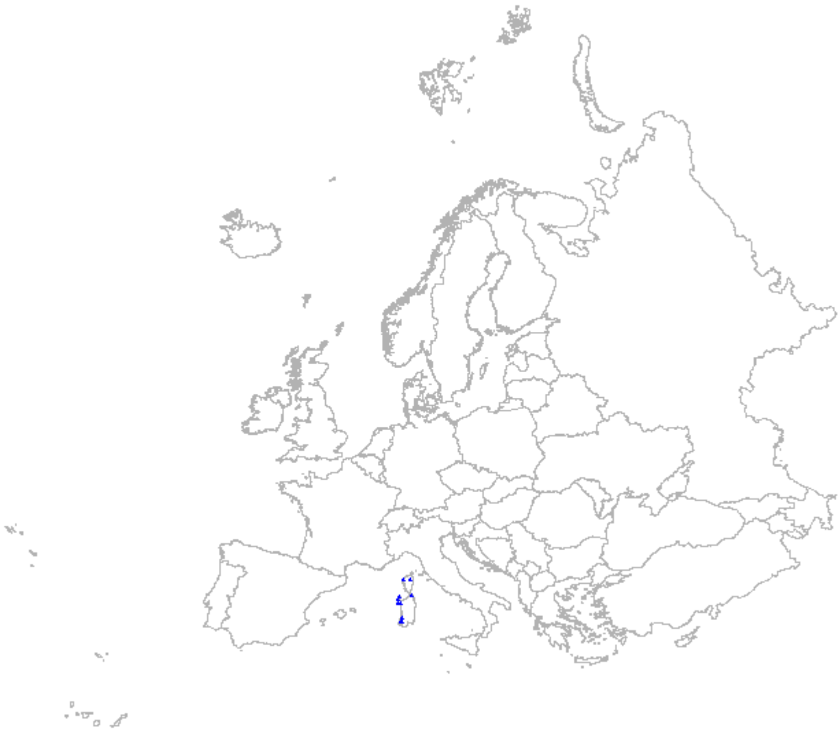


Probability map *(detail)*

Decision rules:

Relationship to CLC (D. Moss)	Moors and heathland (322)
Relationship to CLC (releves)	27 + 28
BGR filter	No
Topo filter	No

F7.1 - Western Mediterranean coastal garrigue



Distribution map *based on vegetation relevés*

Suitability map *. Background data for model randomly selected from heathland-scrub-tundra data set*

Geographic restriction distribution data

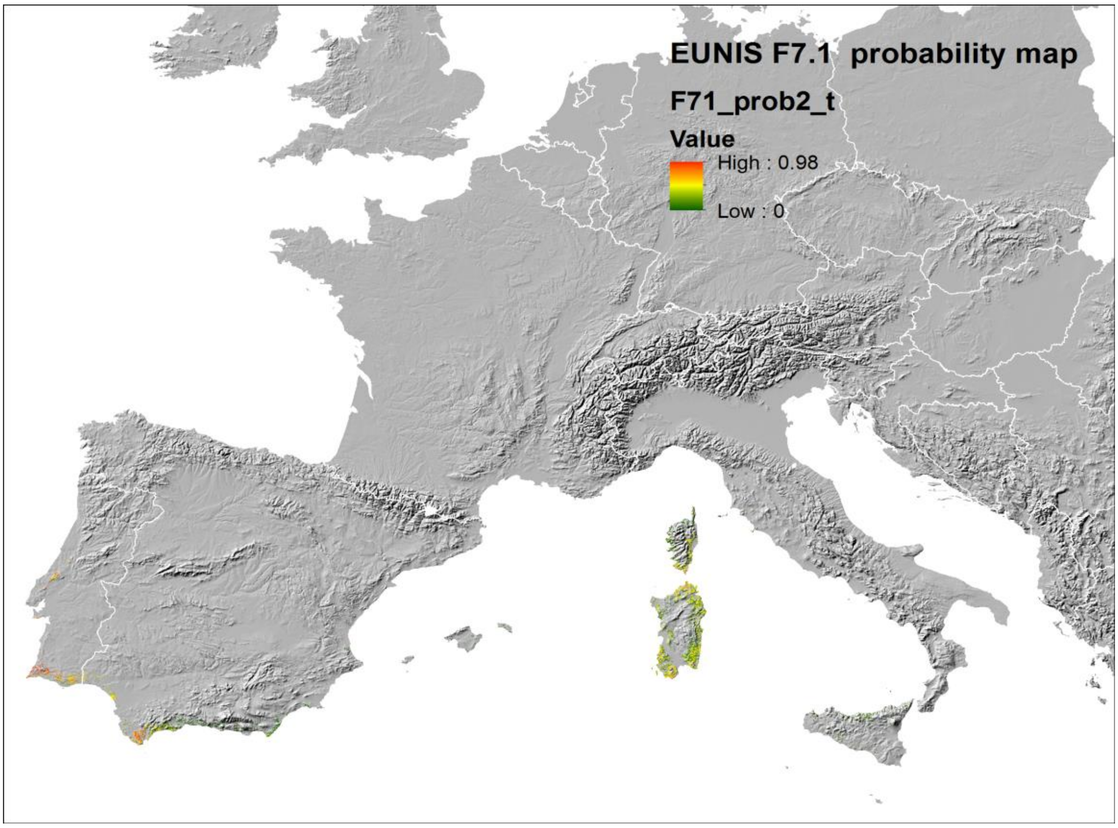
-

Maxent modelling statistics

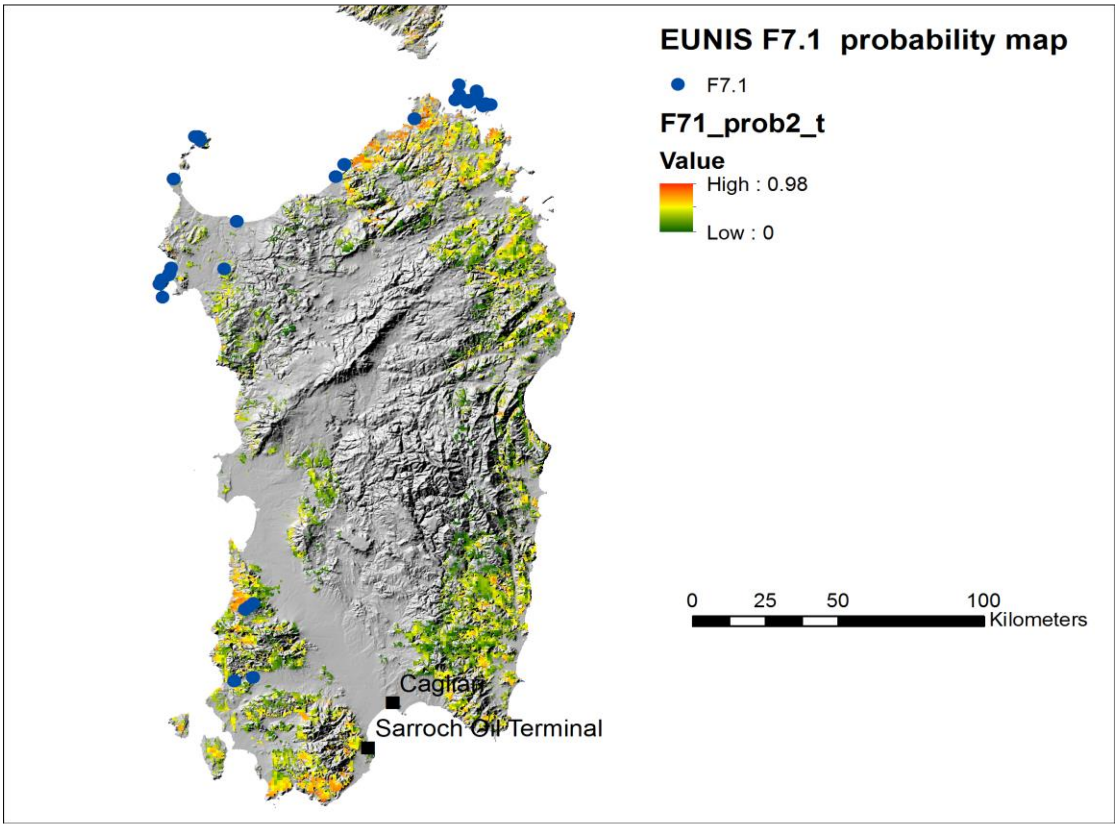
AUC training (0-1)	0.9931
AUC test (0-1)	0.9766
Contribution variables to the Maxent model (%)	
Precipitation of warmest quarter	50.9292
Precipitation seasonality (coef. of var.)	20.7746
pH (water)	8.6147
Temperature seasonality (stdev * 100)	7.3093
Annual precipitation	5.8502
Solar radiation	2.5222
Weight in % of clay particles (<0.0002 mm	2.1209
Potential evapotranspiration	0.5715
Weight in % of silt particles (0.0002-0.05 m	0.5677
Distance to water	0.5286
Soil organic carbon content (‰)	0.1832
Bulk density (kg/m³)	0.0243
Cation Exchange Capacity	0.0036
Weight in % of sand particles (0.05-2 mm)	0
Mean temperature of wettest quarter	0
Volume % of coarse fragments (> 2 mm)	0

Remarks

-



Probability map *(overview)*

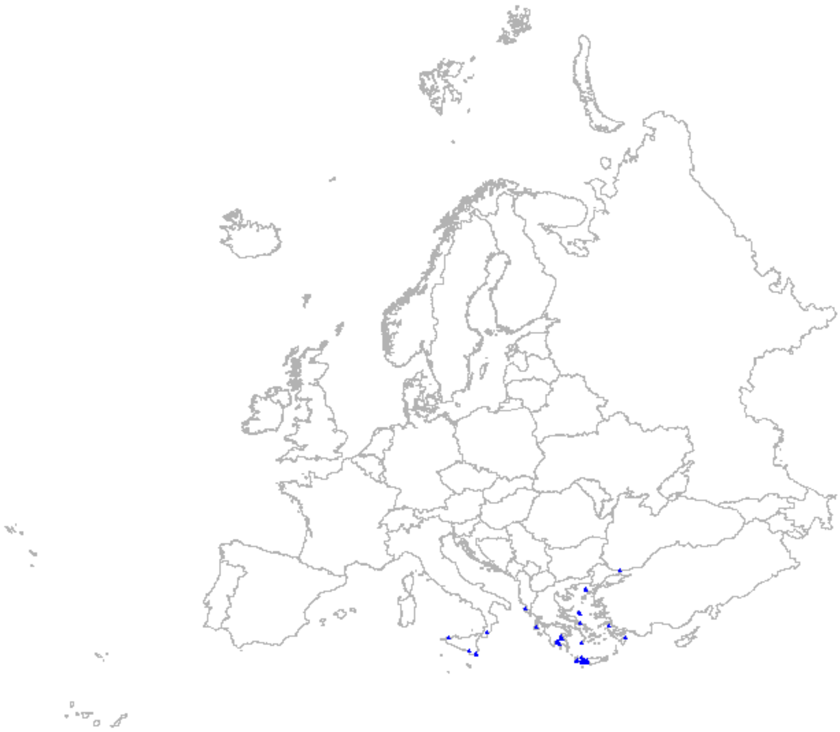


Probability map *(detail)*

Decision rules:

Relationship to CLC (D. Moss)	Sclerophyllous vegetation (323)
Relationship to CLC (releves)	28 + 30
BGR filter	No
Topo filter	Yes

F7.3 - Eastern Mediterranean spiny heath (phrygana)



Distribution map *based on vegetation relevés*

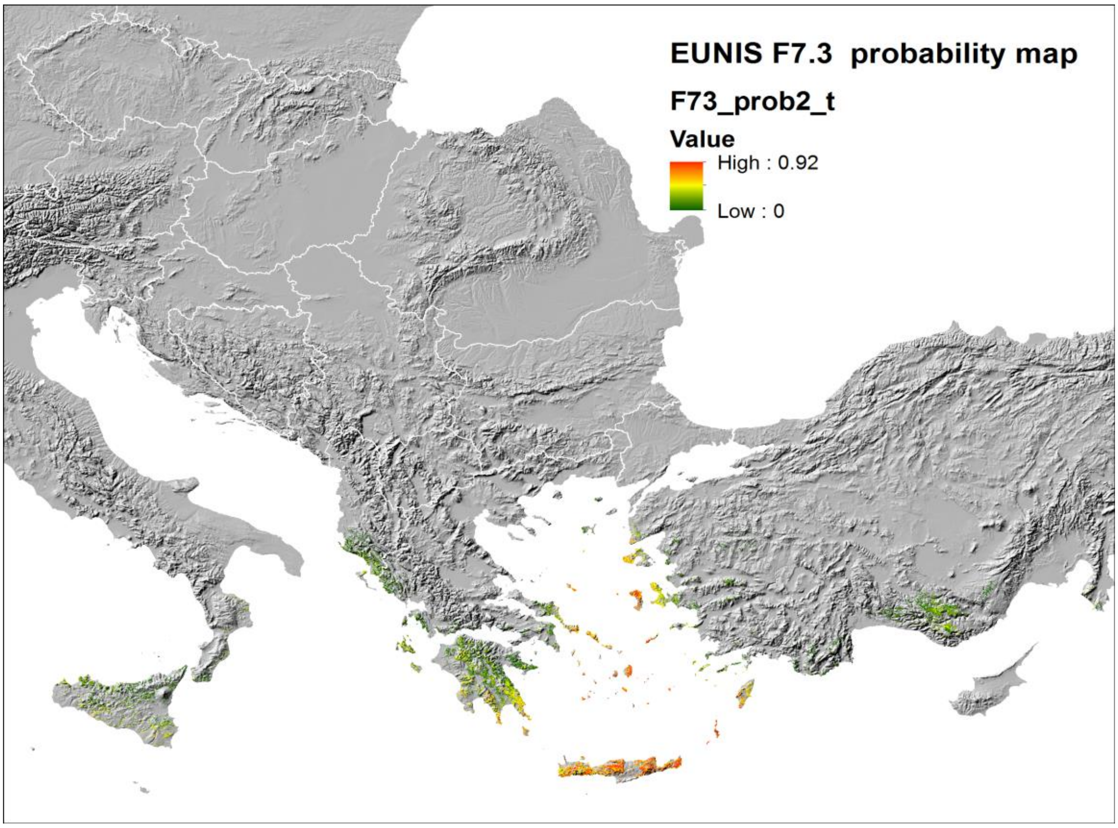
Suitability map *. Background data for model randomly selected from study area*

Geographic restriction distribution data
-

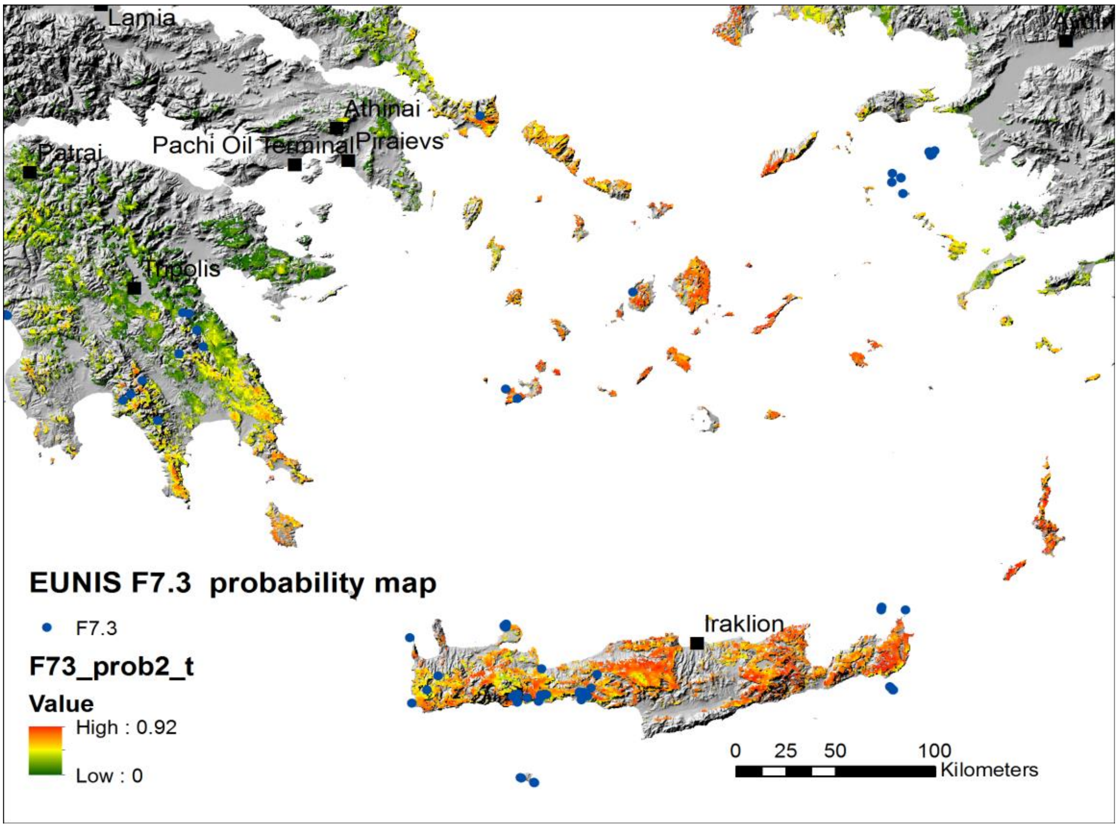
Maxent modelling statistics

AUC training (0-1)		0.9935
AUC test (0-1)		0.9902
Contribution variables to the Maxent model (%)		
	Precipitation seasonality (coef. of var.)	49.1531
	Precipitation of warmest quarter	23.7552
	Temperature seasonality (stdev * 100)	13.0809
	Soil organic carbon content (‰)	10.193
	Weight in % of clay particles (<0.0002 mm	1.3448
	Potential evapotranspiration	0.6572
	Volume % of coarse fragments (> 2 mm)	0.2328
	Bulk density (kg/m³)	0.1621
	Mean temperature of wettest quarter	0.1344
	Weight in % of sand particles (0.05-2 mm)	0.1124
	Weight in % of silt particles (0.0002-0.05 m	0.0856
	Cation Exchange Capacity	0.0163
	pH (water)	0.0147
	Distance to water	0.0032
	Solar radiation	0
	Annual precipitation	0

Remarks
Prediction in the Iberian Penissula should be ignored.



Probability map *(overview)*

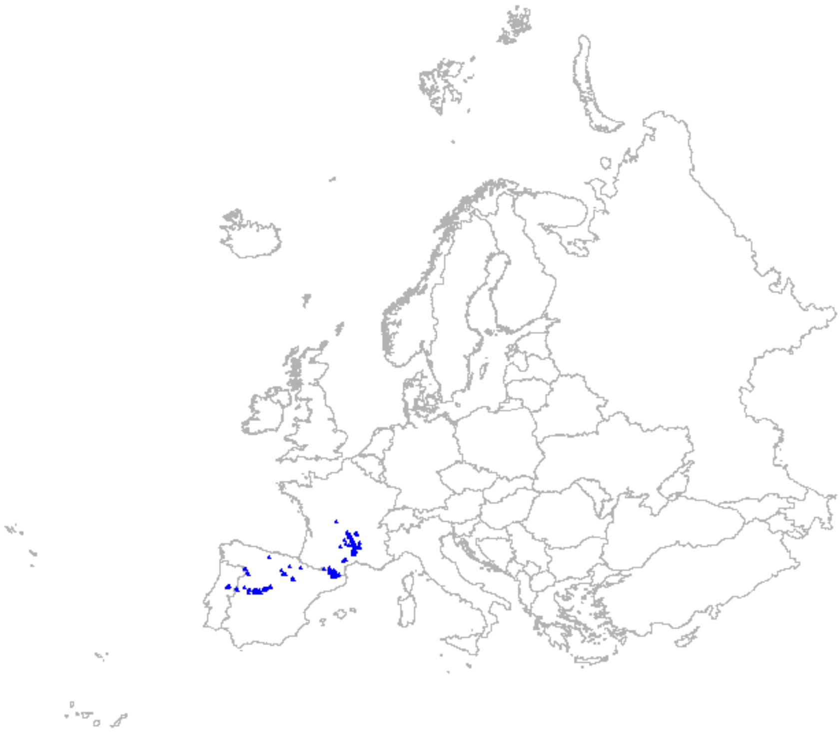


Probability map *(detail)*

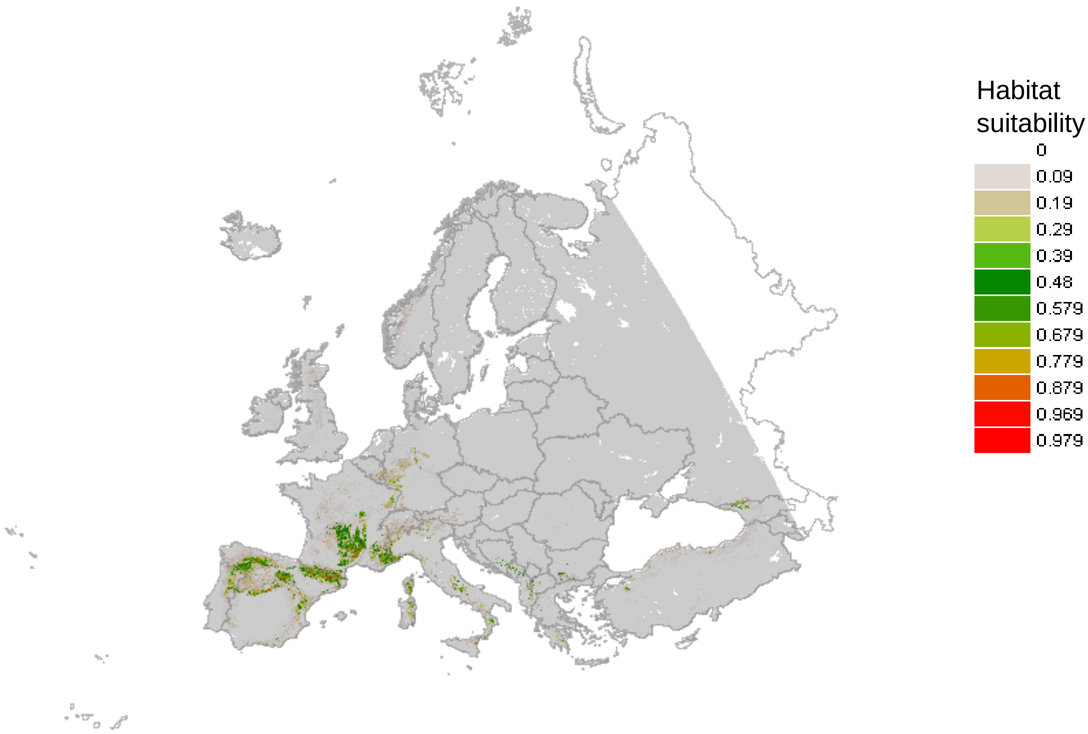
Decision rules:

Relationship to CLC (D. Moss)	Sclerophyllous vegetation (323)
Relationship to CLC (releves)	28 + 26, 30, 32
BGR filter	No
Topo filter	Yes

F7.4a - Western Mediterranean mountain hedgehog-heath



Distribution map *based on vegetation relevés*



Suitability map *. Background data for model randomly selected from study area*

Geographic restriction distribution data

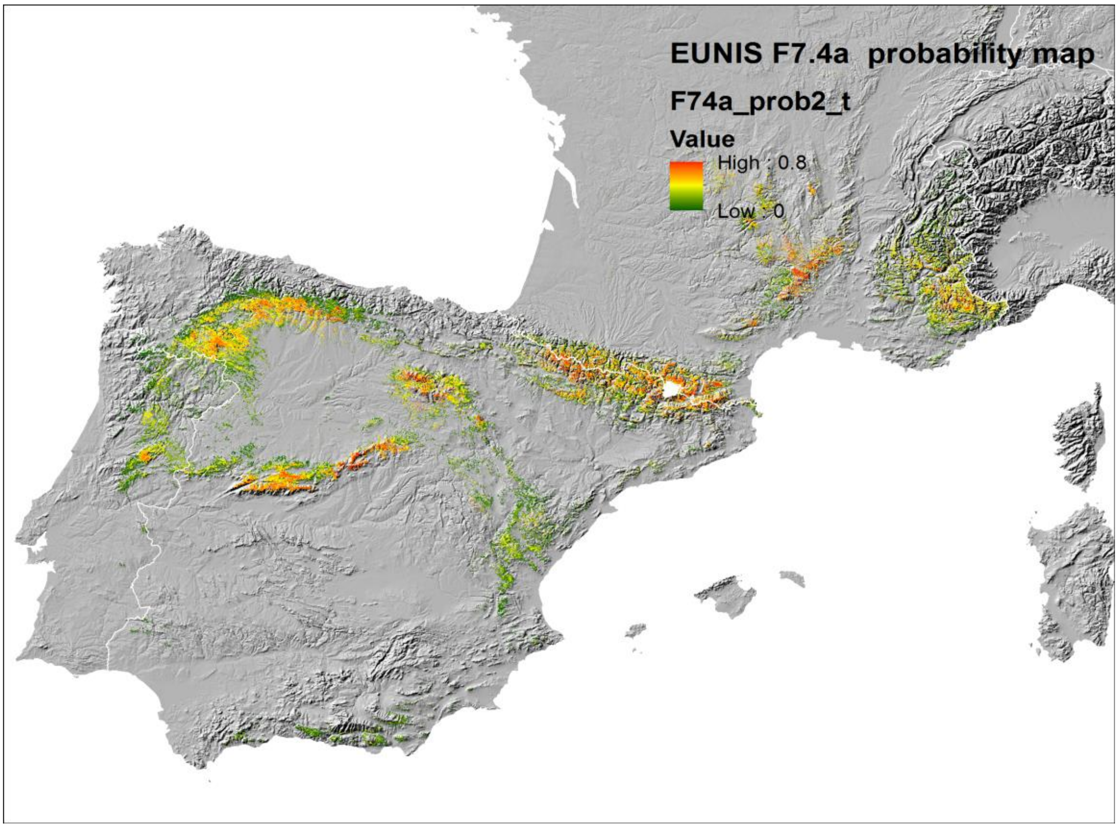
-

Maxent modelling statistics

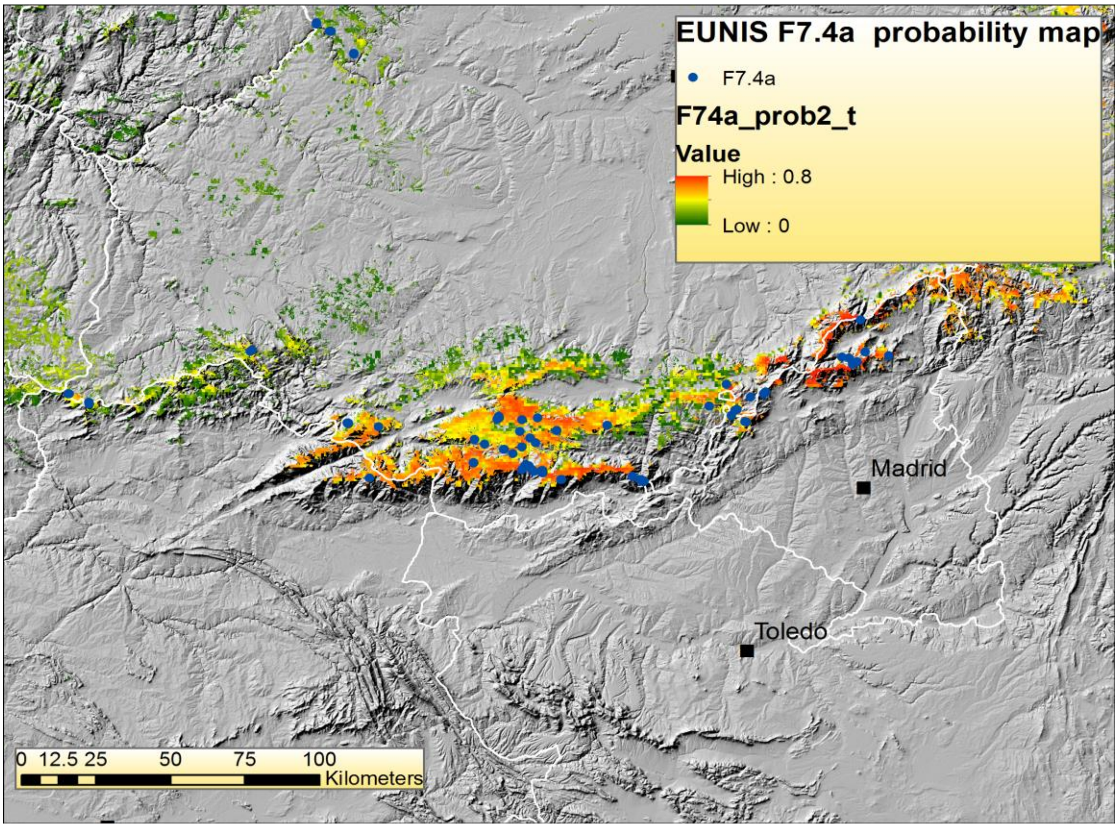
AUC training (0-1)		0.978
AUC test (0-1)		0.9749
Contribution variables to the Maxent model (%)		
	Temperature seasonality (stdev * 100)	44.1131
	Weight in % of sand particles (0.05-2 mm)	23.9843
	Volume % of coarse fragments (> 2 mm)	11.4203
	Weight in % of silt particles (0.0002-0.05 m	6.6428
	Bulk density (kg/m³)	4.8498
	Soil organic carbon content (‰)	4.481
	Precipitation of warmest quarter	1.9568
	Weight in % of clay particles (<0.0002 mm	1.069
	Precipitation seasonality (coef. of var.)	0.4649
	Potential evapotranspiration	0.4291
	Solar radiation	0.3837
	Mean temperature of wettest quarter	0.1845
	pH (water)	0.17
	Distance to water	0.1268
	Annual precipitation	0.0604
	Cation Exchange Capacity	0.0109

Remarks

Prediction in Germany should be ignored.



Probability map *(overview)*



Probability map *(detail)*

Decision rules:

Relationship to CLC (D. Moss)	Sclerophyllous vegetation (323)
Relationship to CLC (releves)	28 + 26, 27, 28, 29, 32
BGR filter	No
Topo filter	Yes

F7.4b - Central Mediterranean mountain hedgehog-heath

Distribution map *based on vegetation relevés*

Suitability map *. Background data for model randomly selected from study area*

Geographic restriction distribution data

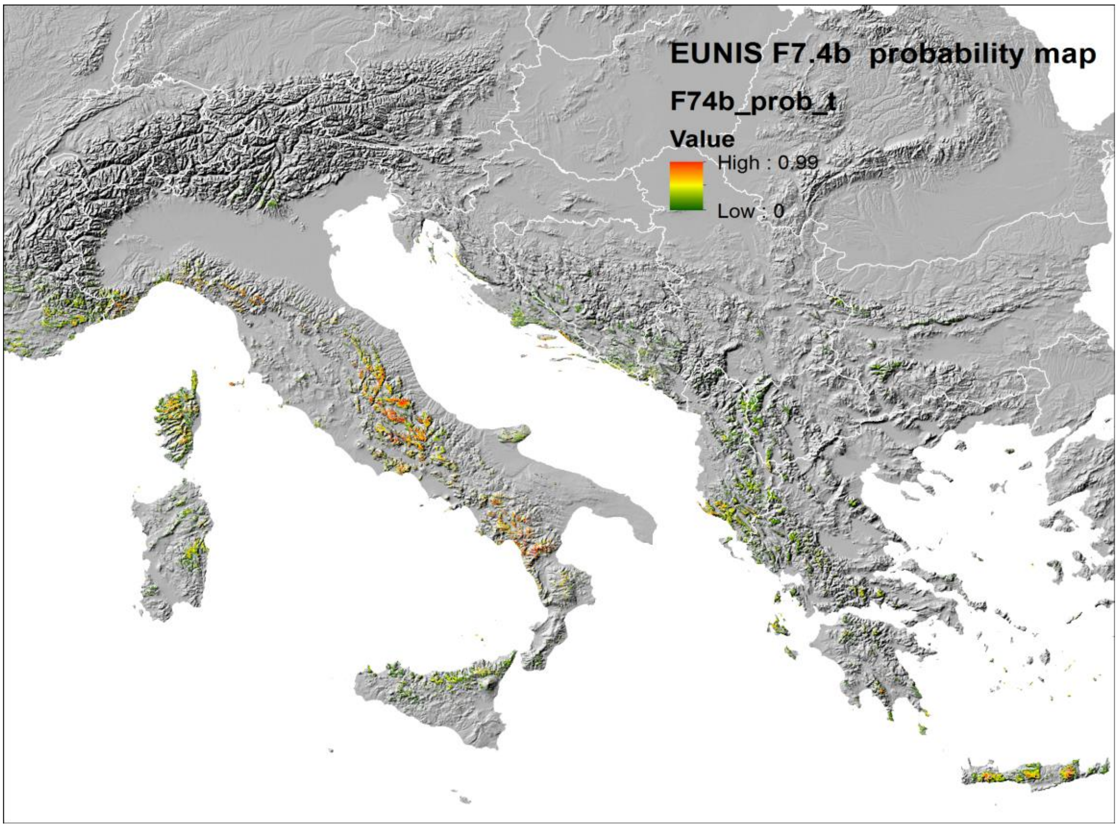
-

Maxent modelling statistics

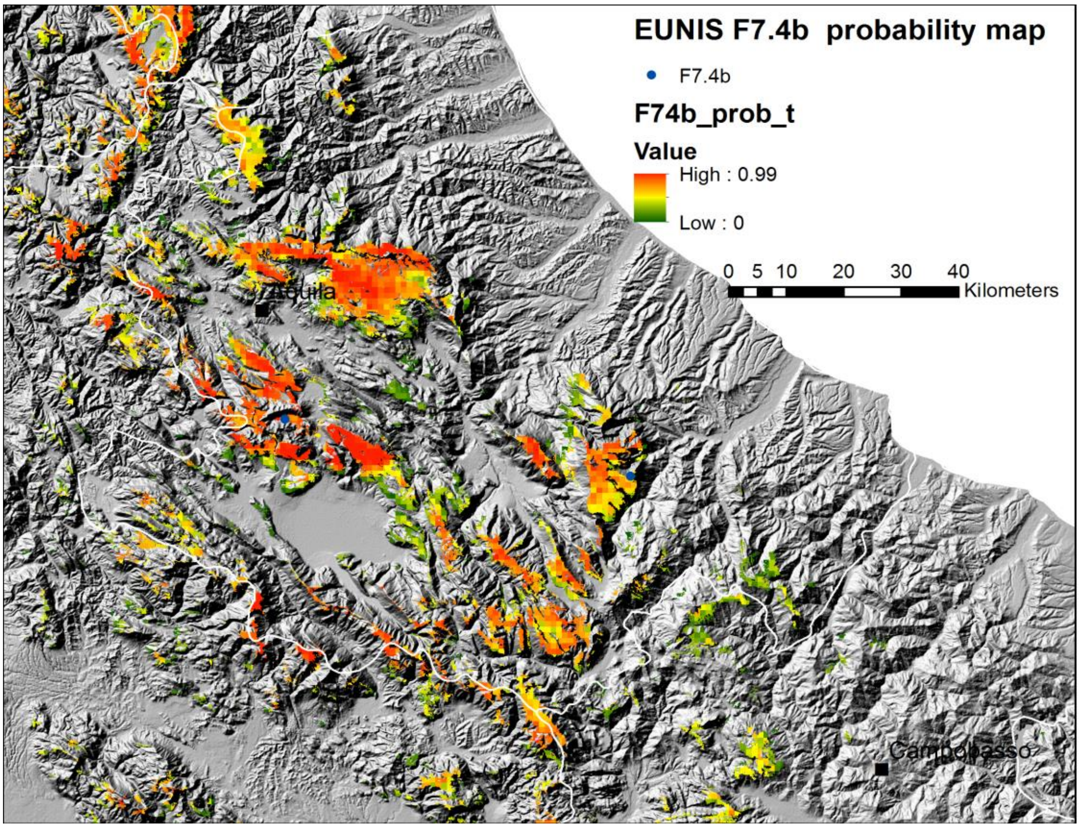
AUC training (0-1)		0.9961
AUC test (0-1)		0.9995
Contribution variables to the Maxent model (%)		
	Distance to water	31.3163
	Volume % of coarse fragments (> 2 mm)	19.27
	Temperature seasonality (stdev * 100)	13.3294
	Precipitation of warmest quarter	11.3689
	Weight in % of clay particles (<0.0002 mm	10.3818
	Soil organic carbon content (‰)	5.9573
	Cation Exchange Capacity	2.2802
	Annual precipitation	1.9425
	Solar radiation	1.9071
	Precipitation seasonality (coef. of var.)	0.6398
	Mean temperature of wettest quarter	0.5679
	pH (water)	0.2645
	Potential evapotranspiration	0.2598
	Weight in % of sand particles (0.05-2 mm)	0.204
	Bulk density (kg/m³)	0
	Weight in % of silt particles (0.0002-0.05 m	0

Remarks

Poor prediction, it should be restricted to Southern Europe. The prediction in eastern part of Europe (Turkey) uncertain due to lack of data for that area.



Probability map *(overview)*

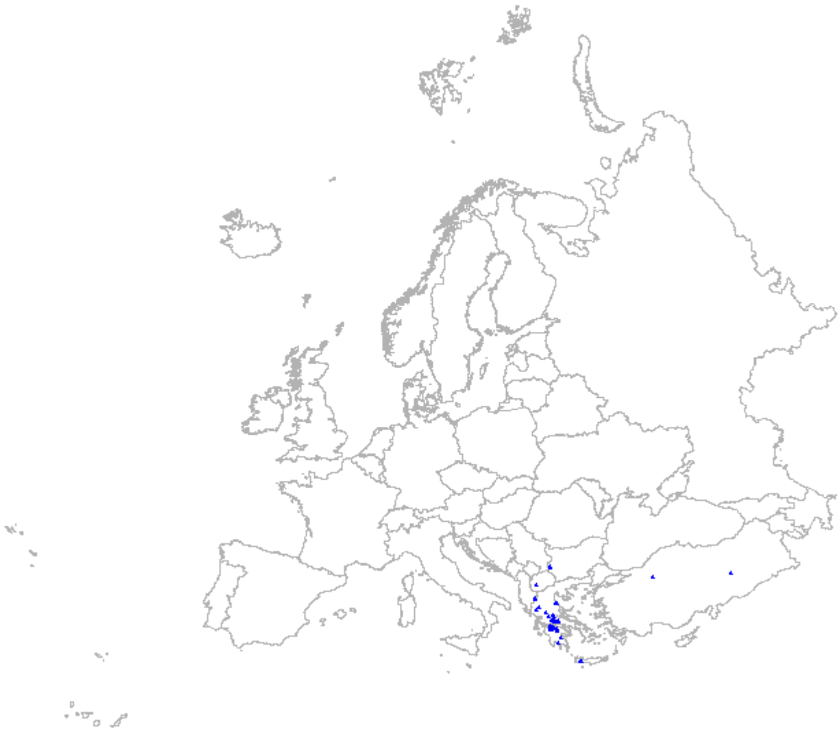


Probability map *(detail)*

Decision rules:

Relationship to CLC (D. Moss)	Sclerophyllous vegetation (323)
Relationship to CLC (releves)	28 + 26, 32
BGR filter	No
Topo filter	Yes

F7.4c - Eastern Mediterranean mountain hedgehog-heath



Distribution map *based on vegetation relevés*

Suitability map *. Background data for model randomly selected from study area*

Geographic restriction distribution data

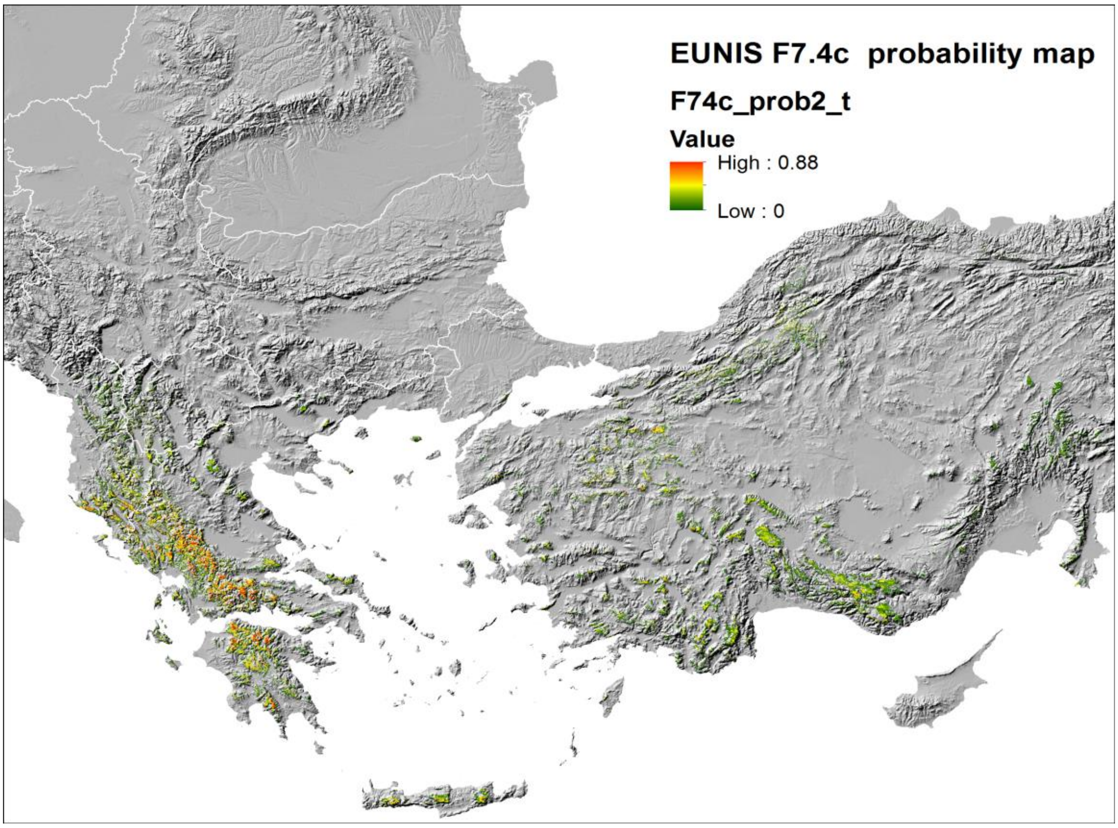
-

Maxent modelling statistics

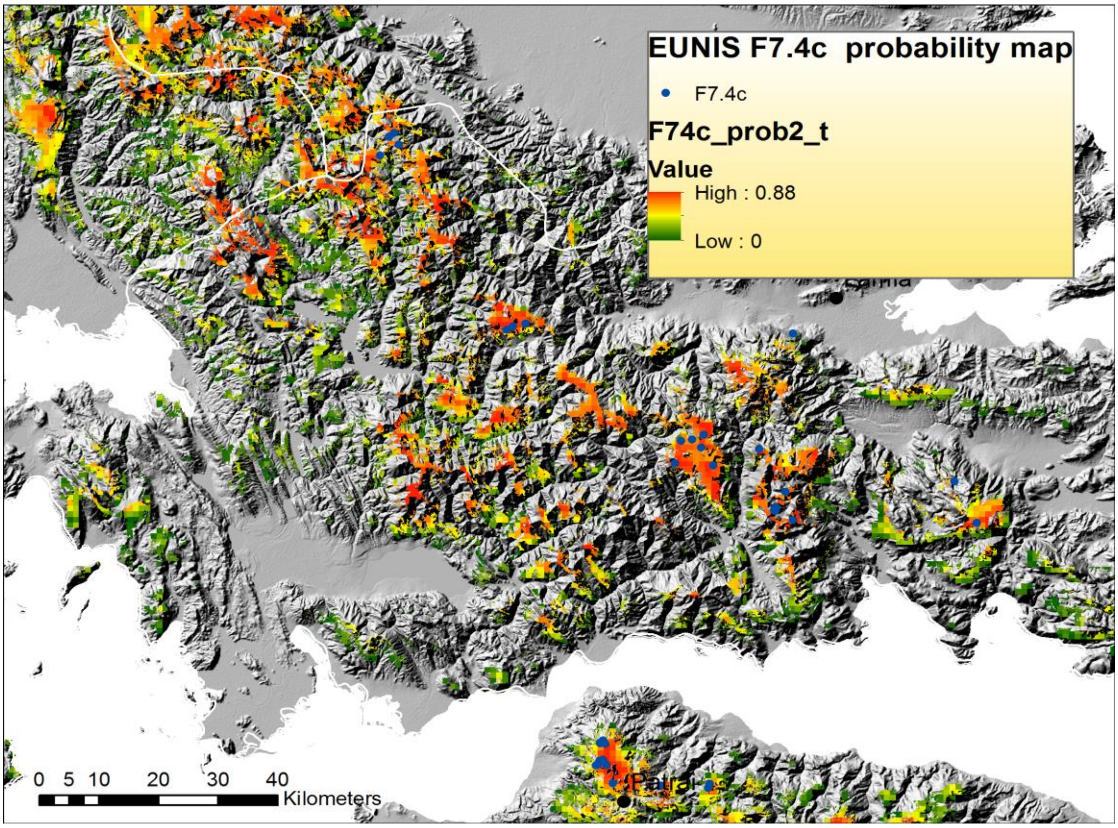
AUC training (0-1)	0.991
AUC test (0-1)	0.9575
Contribution variables to the Maxent model (%)	
Mean temperature of wettest quarter	23.2442
Volume % of coarse fragments (> 2 mm)	18.8631
Annual precipitation	15.5779
Precipitation of warmest quarter	8.5922
Weight in % of sand particles (0.05-2 mm)	7.6495
Soil organic carbon content (‰)	7.5398
Potential evapotranspiration	7.4881
Precipitation seasonality (coef. of var.)	6.2742
Solar radiation	2.1758
Bulk density (kg/m³)	2.1347
Temperature seasonality (stdev * 100)	1.0485
Weight in % of clay particles (<0.0002 mm	0.6099
Cation Exchange Capacity	0.3437
Distance to water	0.3099
Weight in % of silt particles (0.0002-0.05 m	0.2446
pH (water)	0.0592

Remarks

Prediction in the Iberian Penissula should be ignored and then prediction in eastern part of Europe (Turkey) is uncertain due to lack of data for that area.



Probability map *(overview)*

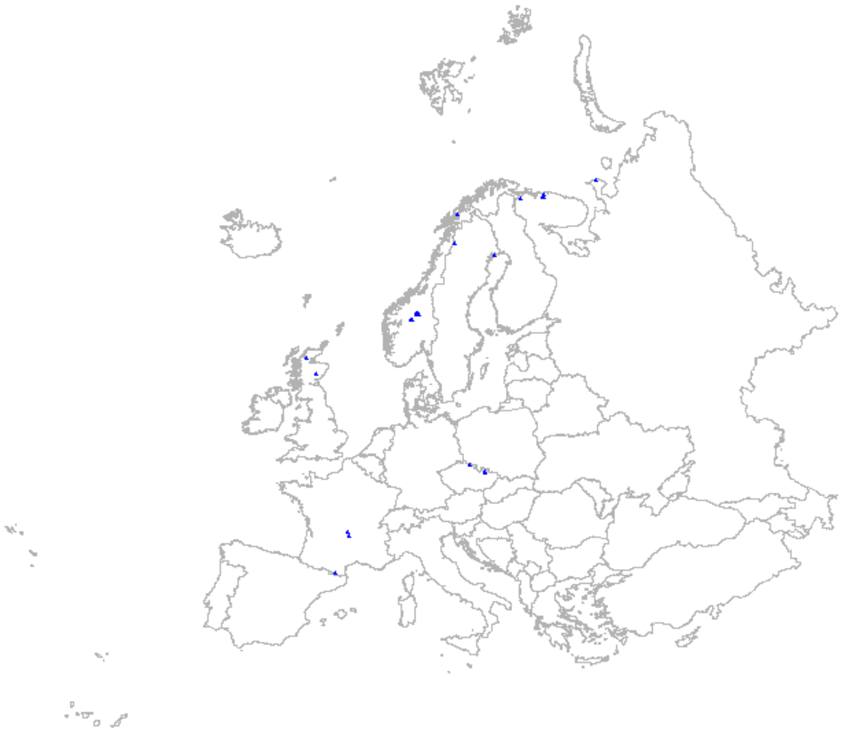


Probability map *(detail)*

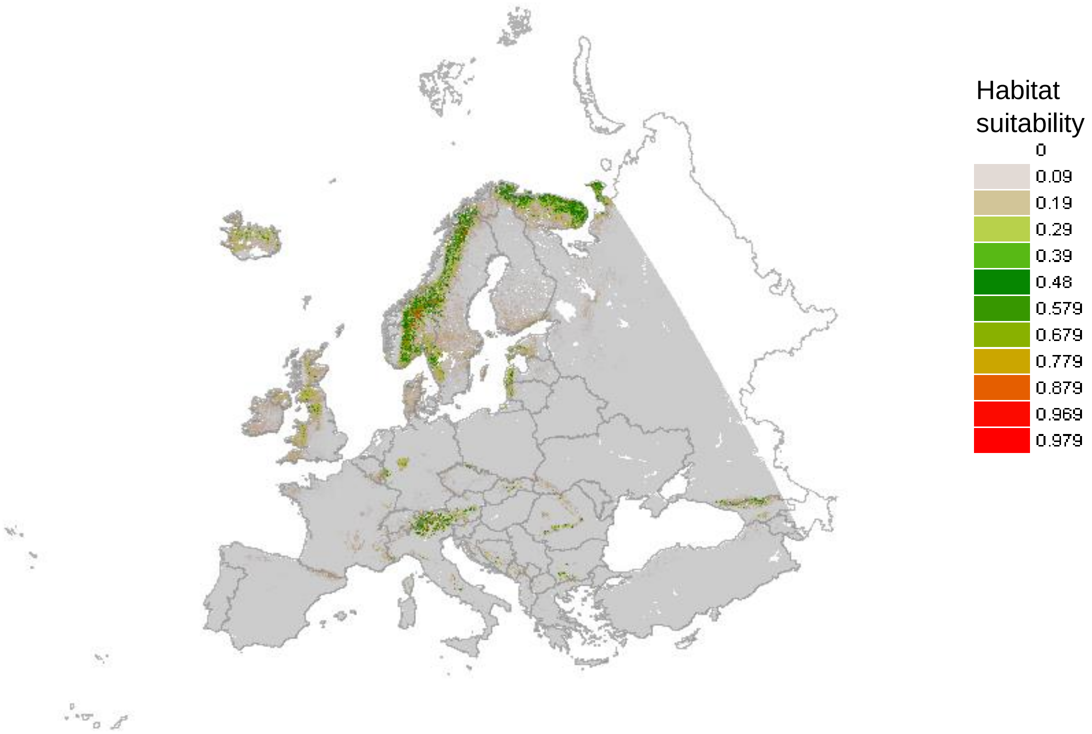
Decision rules:

Relationship to CLC (D. Moss)	Sclerophyllous vegetation (323)
Relationship to CLC (releves)	28 + 27, 29, 32
BGR filter	No
Topo filter	Yes

F9.1a - Arctic, boreal and alpine riparian scrub



Distribution map *based on vegetation relevés*



Suitability map *. Background data for model randomly selected from study area*

Geographic restriction distribution data

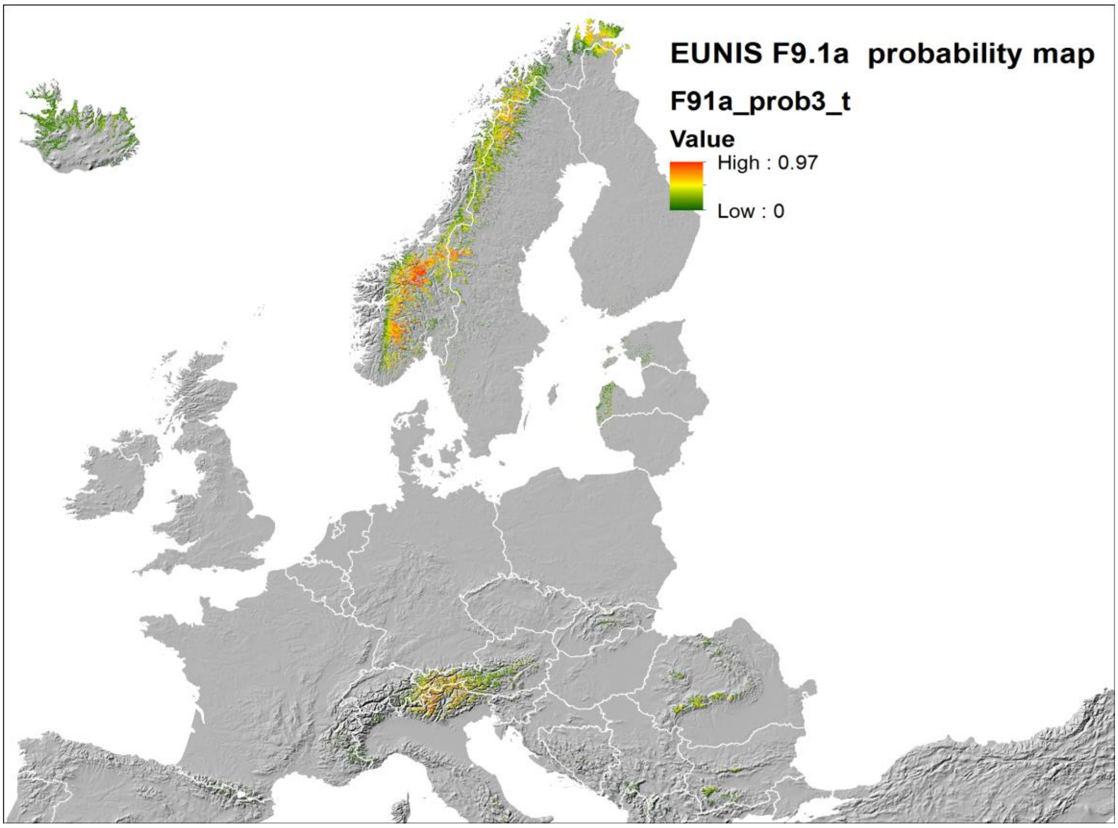
-

Maxent modelling statistics

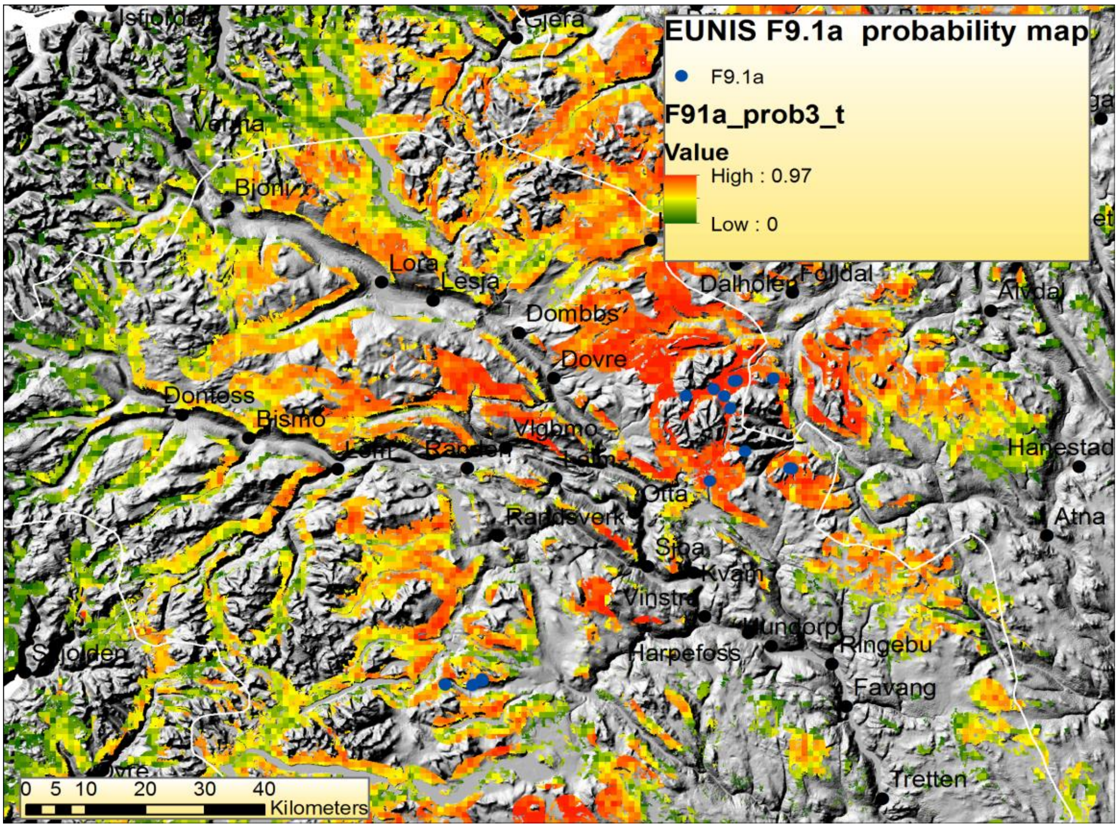
AUC training (0-1)		0.9784
AUC test (0-1)		0.9554
Contribution variables to the Maxent model (%)		
	Soil organic carbon content (‰)	39.4572
	Temperature seasonality (stdev * 100)	15.7363
	Mean temperature of wettest quarter	13.3716
	Precipitation of warmest quarter	5.4374
	Weight in % of clay particles (<0.0002 mm	4.7988
	Bulk density (kg/m³)	3.9422
	Cation Exchange Capacity	3.8722
	Precipitation seasonality (coef. of var.)	2.7475
	Solar radiation	2.6305
	Annual precipitation	2.062
	Weight in % of sand particles (0.05-2 mm)	1.6505
	Distance to water	0.0549
	Volume % of coarse fragments (> 2 mm)	0.0194
	Potential evapotranspiration	0.0006
	pH (water)	0
	Weight in % of silt particles (0.0002-0.05 m	0

Remarks

Prediction in eastern part of Europe (Caucasus) is uncertain due to lack of data for that area.



Probability map *(overview)*

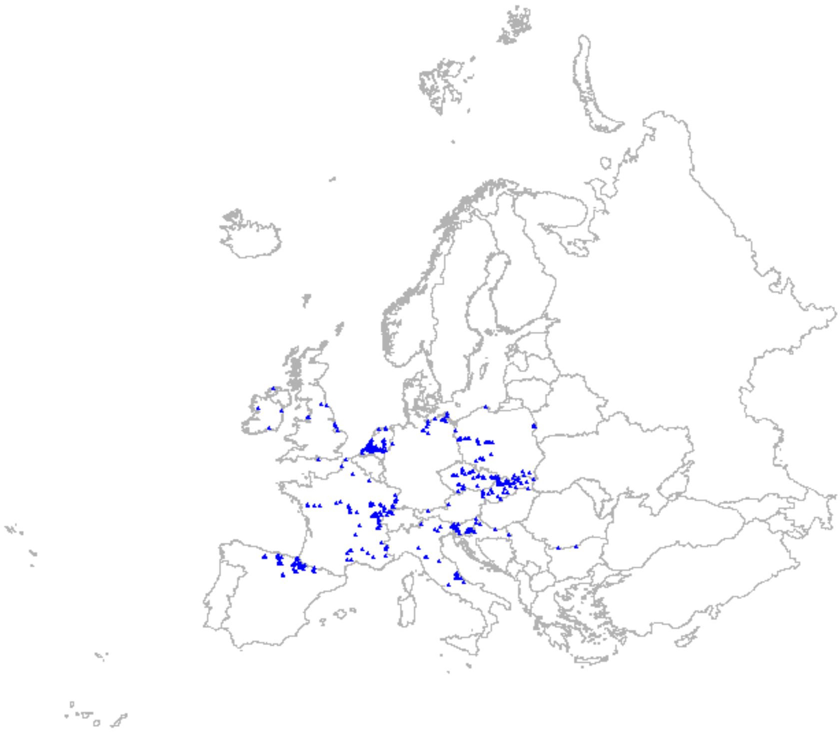


Probability map *(detail)*

Decision rules:

Relationship to CLC (D. Moss)	Moors and heathland (322)
Relationship to CLC (releves)	27 + 26, 29, 32
BGR filter	Yes
Topo filter	Yes

F9.1b - Temperate riparian scrub



Distribution map *based on vegetation relevés*

Suitability map*. Background data for model randomly selected from study area*

Geographic restriction distribution data

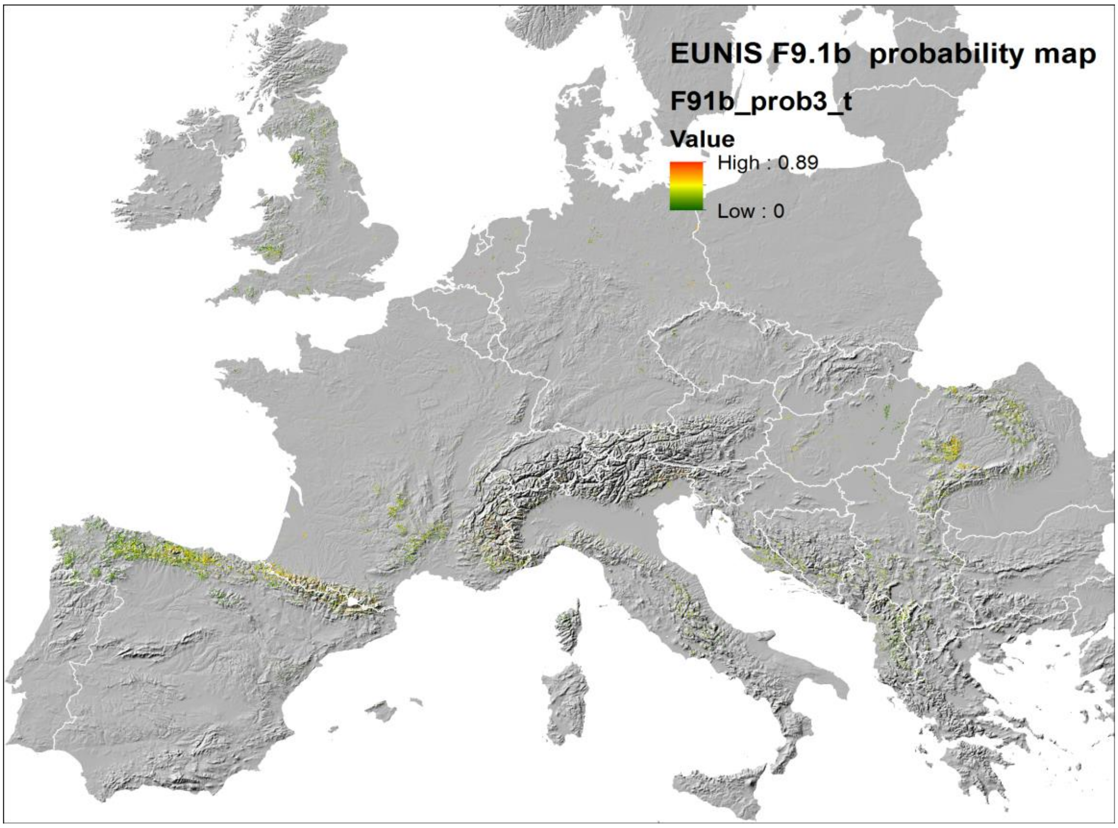
-

Maxent modelling statistics

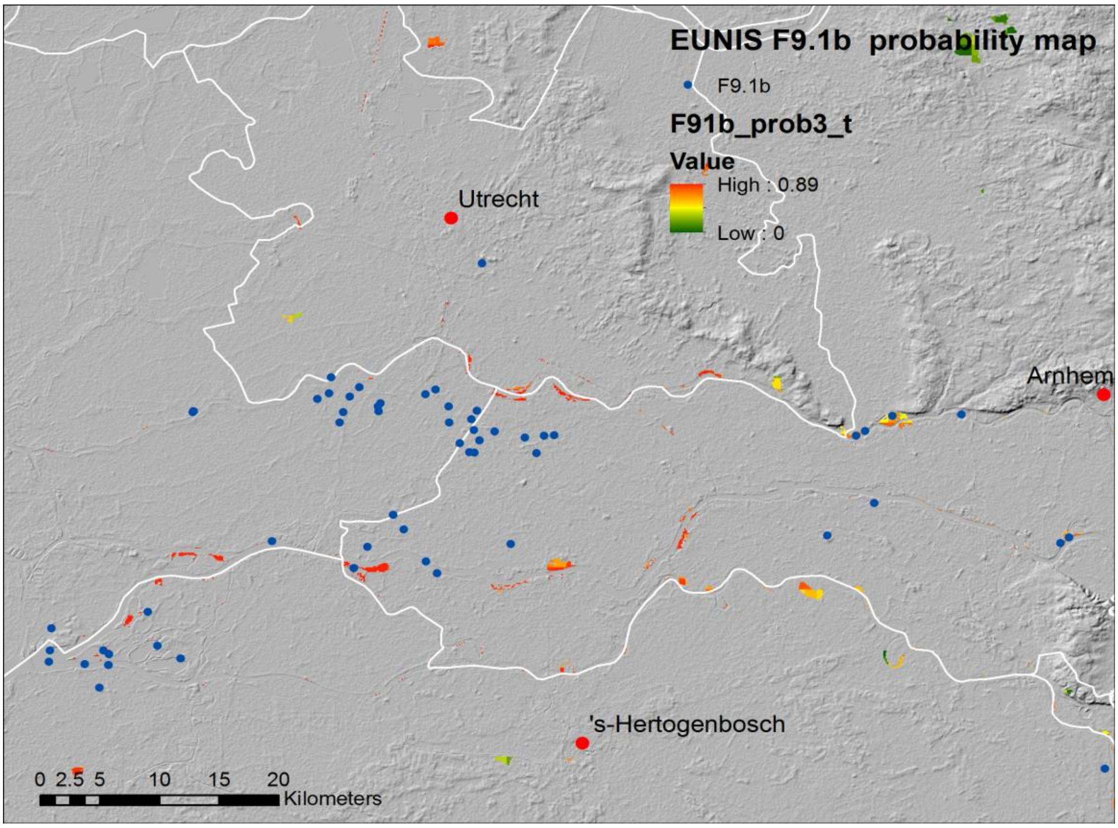
AUC training (0-1)		0.9273
AUC test (0-1)		0.9289
Contribution variables to the Maxent model (%)		
	Temperature seasonality (stdev * 100)	35.7082
	Precipitation of warmest quarter	18.0478
	Distance to water	16.3982
	Bulk density (kg/m³)	12.7256
	Weight in % of sand particles (0.05-2 mm)	4.8341
	Soil organic carbon content (‰)	4.7908
	Potential evapotranspiration	2.9534
	pH (water)	1.3926
	Annual precipitation	0.8483
	Weight in % of silt particles (0.0002-0.05 m	0.6835
	Mean temperature of wettest quarter	0.4779
	Volume % of coarse fragments (> 2 mm)	0.3478
	Precipitation seasonality (coef. of var.)	0.336
	Cation Exchange Capacity	0.3013
	Weight in % of clay particles (<0.0002 mm	0.1545
	Solar radiation	0.0724

Remarks

Prediction in eastern part of Europe (Caucasus, Turkey) isuncertain due to lack of data for that area.



Probability map *(overview)*

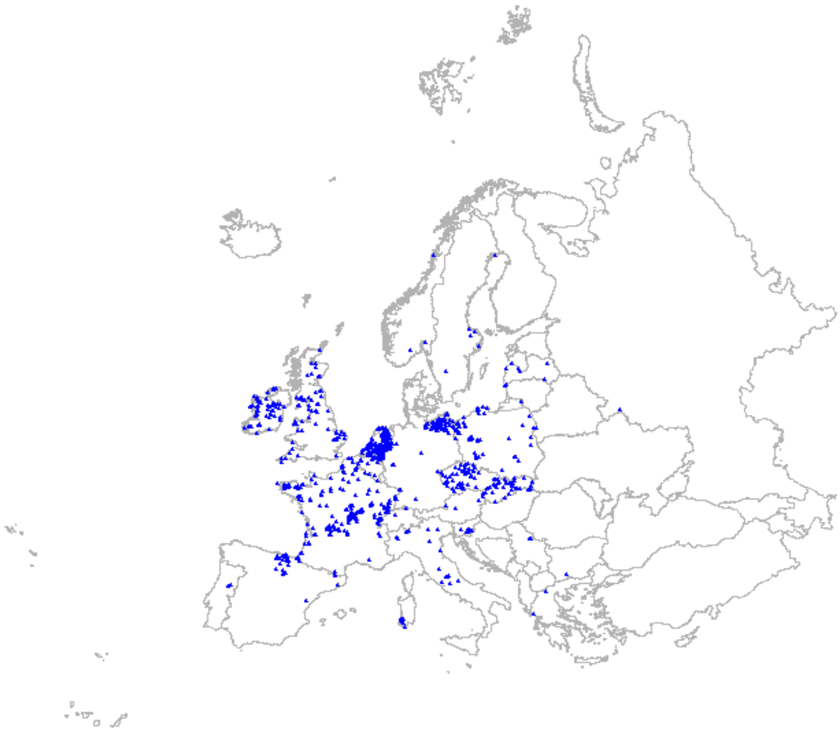


Probability map *(detail)*

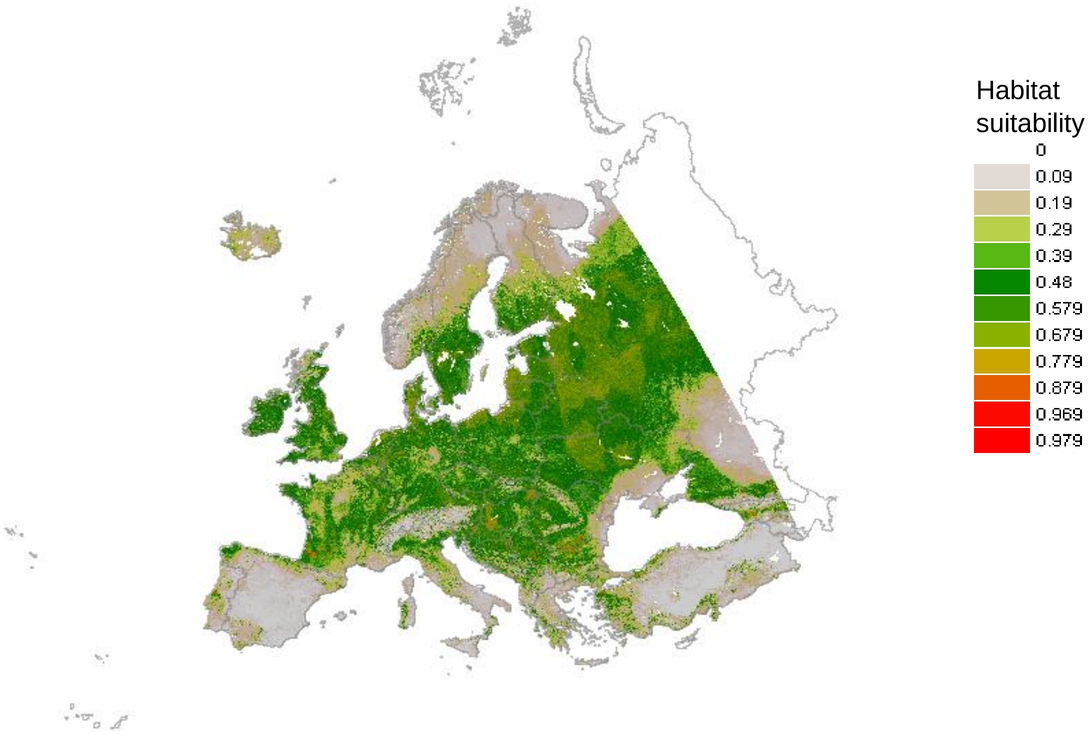
Decision rules:

Relationship to CLC (D. Moss)	Moors and heathland (322)
Relationship to CLC (releves)	27 + 26, 30, 40
BGR filter	
Topo filter	Yes

F9.2 - Salix fen scrub



Distribution map *based on vegetation relevés*



Suitability map *. Background data for model randomly selected from heathland-scrub-tundra data set*

Geographic restriction distribution data

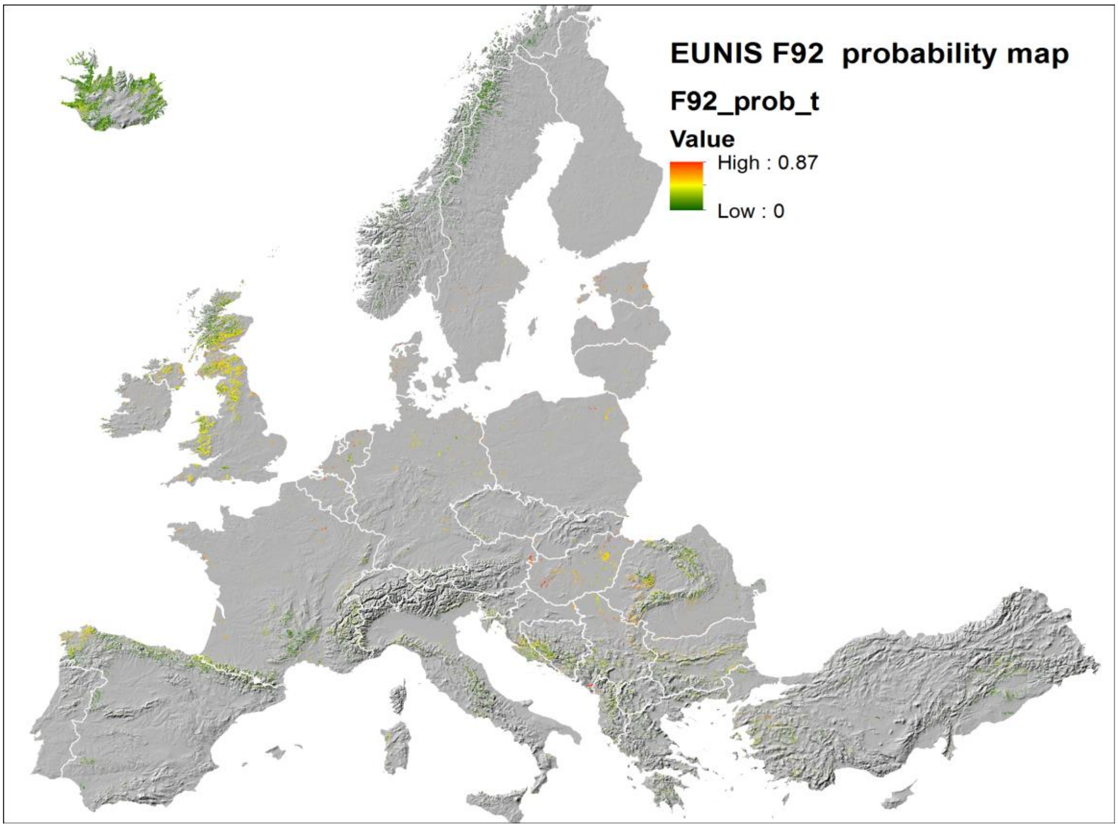
-

Maxent modelling statistics

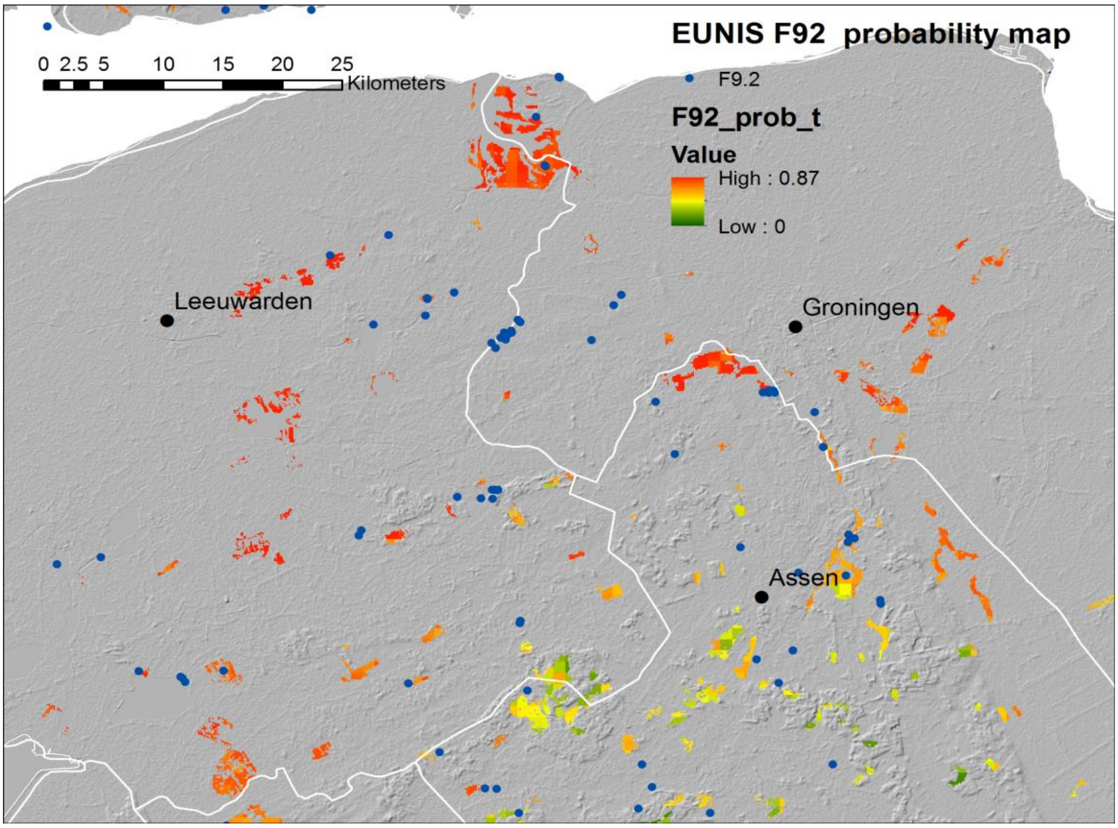
AUC training (0-1)		0.7945
AUC test (0-1)		0.7679
Contribution variables to the Maxent model (%)		
	Weight in % of silt particles (0.0002-0.05 m	32.1247
	Volume % of coarse fragments (> 2 mm)	31.0597
	Precipitation of warmest quarter	11.8177
	Solar radiation	5.6519
	Soil organic carbon content (‰)	5.1577
	Weight in % of sand particles (0.05-2 mm)	4.558
	Precipitation seasonality (coef. of var.)	3.6013
	pH (water)	2.8443
	Annual precipitation	2.8352
	Potential evapotranspiration	2.4878
	Weight in % of clay particles (<0.0002 mm	1.8138
	Bulk density (kg/m³)	1.6898
	Distance to water	1.0777
	Temperature seasonality (stdev * 100)	1.0261
	Mean temperature of wettest quarter	1.021
	Cation Exchange Capacity	0.2901

Remarks

Prediction in eastern part of Europe is uncertain due to lack of data for that area.



Probability map *(overview)*

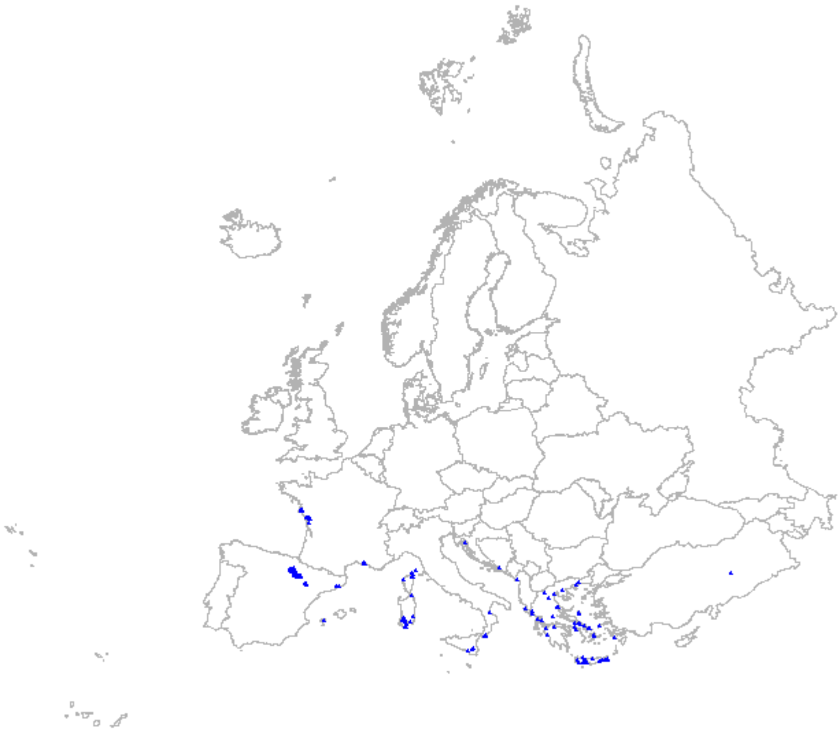


Probability map *(detail)*

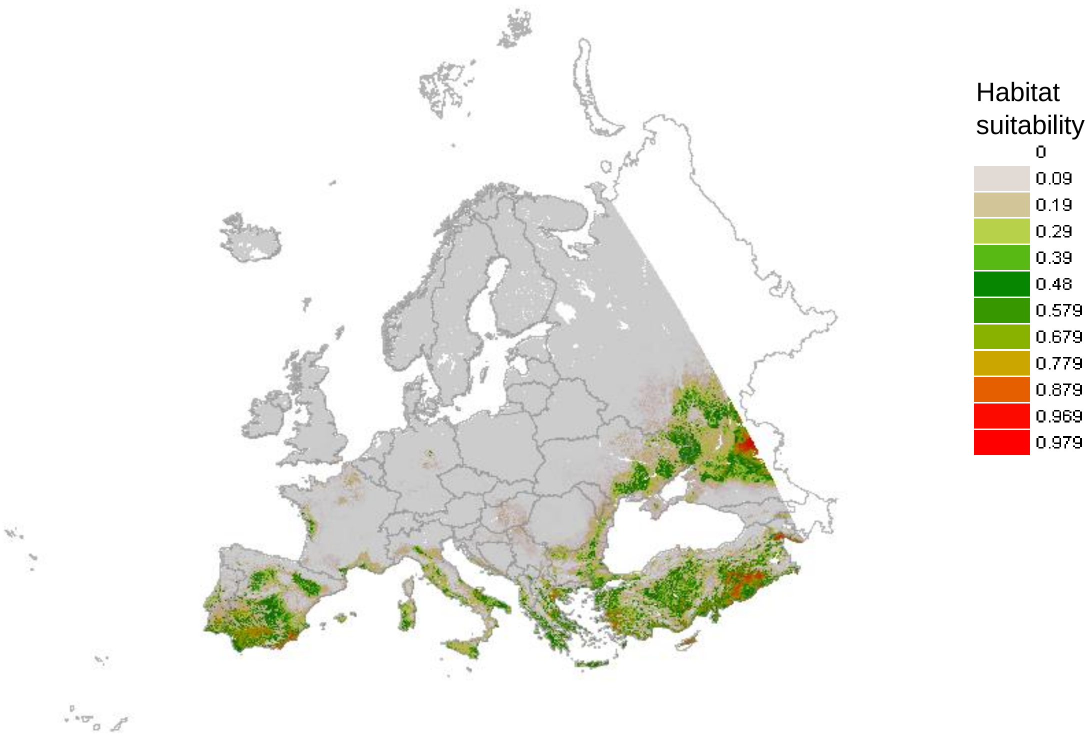
Decision rules:

Relationship to CLC (D. Moss)	Moors and heathland (322)
Relationship to CLC (releves)	27 + 26, 28
BGR filter	No
Topo filter	No

F9.3 - Mediterranean riparian scrub



Distribution map *based on vegetation relevés*



Suitability map *. Background data for model randomly selected from heathland-scrub-tundra data set*

Geographic restriction distribution data

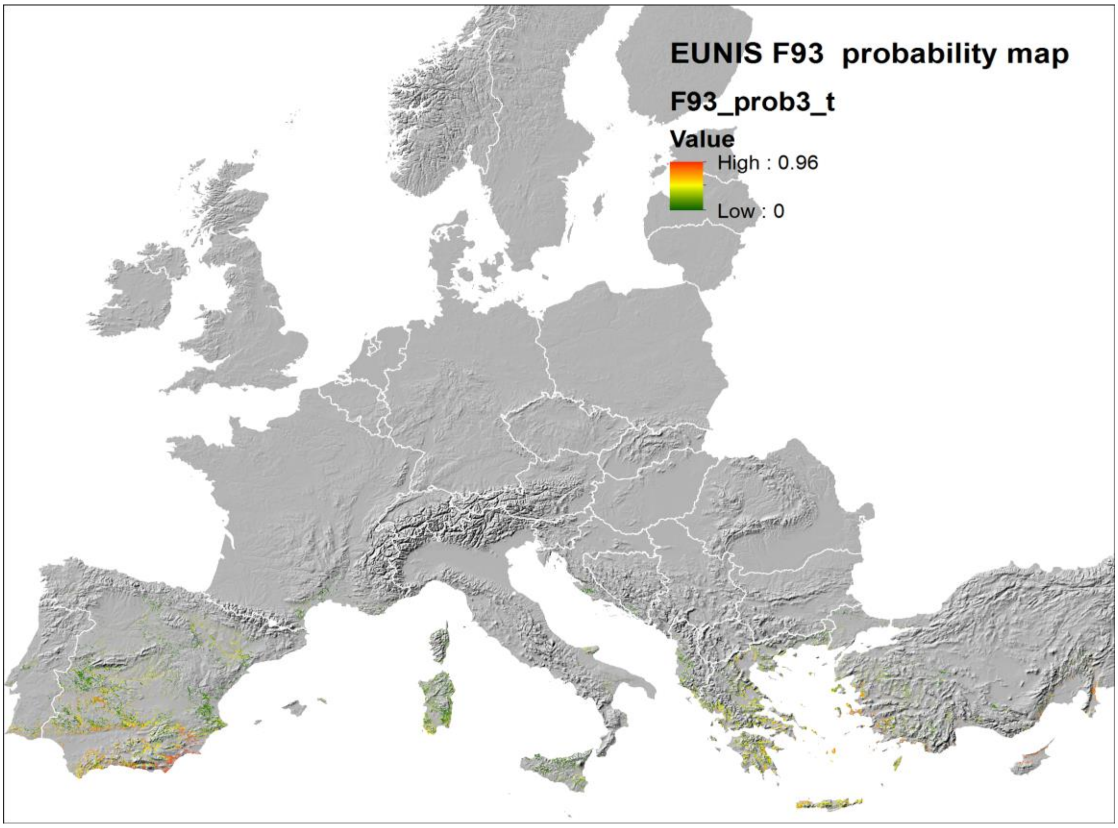
-

Maxent modelling statistics

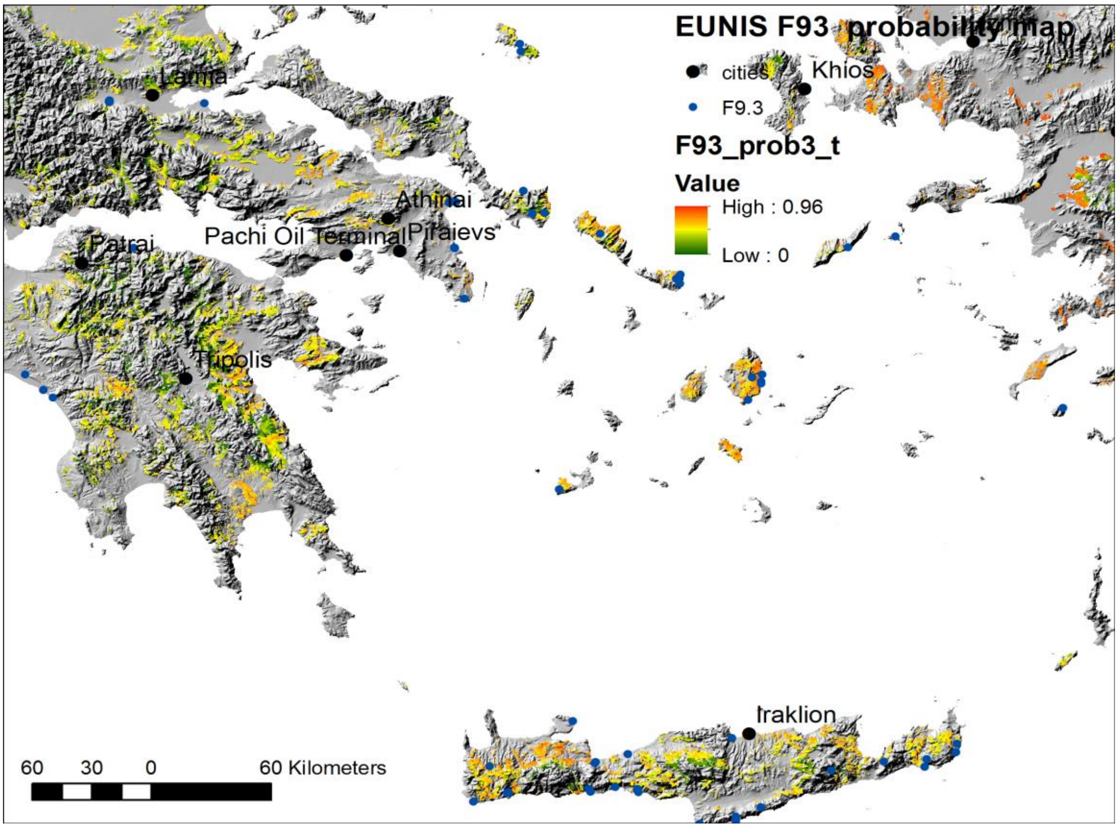
AUC training (0-1)	0.972
AUC test (0-1)	0.9649
Contribution variables to the Maxent model (%)	
Precipitation of warmest quarter	38.0612
Bulk density (kg/m³)	35.2455
Soil organic carbon content (‰)	7.2959
Weight in % of clay particles (<0.0002 mm	7.2877
Solar radiation	6.5436
Precipitation seasonality (coef. of var.)	3.1528
Weight in % of silt particles (0.0002-0.05 m	3.1492
Potential evapotranspiration	2.3526
pH (water)	0.8838
Mean temperature of wettest quarter	0.8456
Volume % of coarse fragments (> 2 mm)	0.5201
Annual precipitation	0.4784
Distance to water	0.1944
Temperature seasonality (stdev * 100)	0.1564
Weight in % of sand particles (0.05-2 mm)	0.0878
Cation Exchange Capacity	0.0865

Remarks

Prediction in eastern part of Europe is uncertain due to lack of data for that area.



Probability map *(overview)*



Probability map *(detail)*

Decision rules:

Relationship to CLC (D. Moss)	Moors and heathland (322)
Relationship to CLC (releves)	27 + 26, 28
BGR filter	Yes
Topo filter	Yes