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Processing European habitats probability maps for EUNIS Forest (T), Heathland, scrub and tundra (S) and Grassland (R) habitat types based on vegetation relevés, environmental data and Copernicus land cover

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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 European 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 European 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: https://www.eionet.europa.eu/etcs/etc-bd

1.2 Objectives

This report is affiliated with task 1.7.5.A from the ETC/BD Action Plan 2018. The general objectives of this task are:

- To support the development of the EEA assessment framework up to 2020 by contributing to assessments of ecosystems and their conditions based on existing information and data to support the EU Biodiversity Strategy to 2020 (and its targets), in particular relevant data gathered from the Nature Directives, 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 of the links between pressures, conditions and services.
- To explore the contribution of Copernicus to biodiversity and ecosystem assessments.
- To explore the results of Art. 12 (Birds Directive) and Art. 17 (Habitats Directive) for various ecosystem assessment purposes.

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 actual high-resolution habitat probability maps for EUNIS habitat types at level 3 for the formations Forest, Heathland scrub and tundra, and Grassland.**

In 2018 all EUNIS habitat types belonging to the groups E (grassland), F (heathland, scrub and tundra) and G (forest) have been revised under the Framework Contract EEA/NSS/17/002/Lot 1 (Schaminée et al. 2018). The revision resulted in an improved classification that was used to assign a large part of the European Vegetation Archive (EVA) to EUNIS habitat types. This work was the starting point for the current study for

ETC/BD, Task 1.7.5.1 to deliver distribution, suitability and probability maps for the EUNIS habitat types belonging to group E, F and G.

This resulted in newly defined EUNIS habitat suitability maps which were also based on much more in-situ vegetation plot data.

Table 1.1 Targeted EUNIS formations, their old and new codes and their number

EUNIS Formation	Old code	New Code	Number of habitats processed
Forests	G	T	# 38
Heathland, scrub and Tundra	F	S	# 34
Grasslands	E	R	# 48
Total			#120

On basis of this in newly defined EUNIS habitat suitability maps, 120 new habitat probability maps have been processedby exploiting Copernicus land cover data.

Table 1.2 shows the 120 habitat types for which habitat probability maps have been produced by combining the EUNIS habitat suitability maps with a 10-percentile threshold with Copernicus land cover information. For forests and grasslands habitats the Copernicus high resolution layers (HRLs) forest and grasslands could be used with a 20 meter spatial resolution across Europe, while for the formation Heath, scrub and tundra, we had to use the CORINE land cover information at a 100 meter resolution. For all habitat types we used the most actual Copernicus land cover information (Chapter 4) .

Table 1.2 List of 120 EUNIS habitat suitability types at level 3 that has been used as an input for the processing of the habitat probability maps based on actual land cover information.

#	New Code	New code	Old code	10-per threshold	New name
GRASSLANDS (#48)					
1	R11	R11	E11a	0.2075	Pannonian and Pontic sandy steppe
2	R12	R12	E11b	0.3212	Cryptogam- and annual-dominated vegetation on siliceous rock outcrops
3	R13	R13	E11d	0.3279	Cryptogam- and annual-dominated vegetation on calcareous and ultramafic rock outcrops
4	R14	R14	E11e	0.4348	Perennial rocky grassland of the Italian Peninsula
5	R16	R16	E11g	0.4221	Perennial rocky grassland of Central and South-Eastern Europe
6	R17	R17	E11h	0.3769	Heavy-metal dry grassland of the Balkans
7	R18	R18	E11i	0.4481	Perennial rocky calcareous grassland of subatlantic-submediterranean Europe
8	R19	R19	E11j	0.3681	Dry steppic submediterranean pasture of the Amphi-Adriatic region
9	R1A	R1A	E12a	0.5139	Semi-dry perennial calcareous grassland (meadow steppe)

10	R1B	R1B	E12b	0.4671	Continental dry grassland (true steppe)
11	R1D	R1D	E13a	0.3103	Mediterranean closely grazed dry grassland
12	R1E	R1E	E13b	0.4214	Mediterranean tall perennial dry grassland
13	R1F	R1F	E13c	0.3826	Mediterranean annual-rich dry grassland
14	R1G	R1G	E15a	0.409	Iberian oromediterranean siliceous dry grassland
15	R1H	R1H	E15b	0.4381	Iberian oromediterranean basiphilous dry grassland
16	R1J	R1J	E15c	0.7475	Cyrno-Sardean oromediterranean siliceous dry grassland
17	R1K	R1K	E15d	0.4082	Balkan and Anatolian oromediterranean dry grassland
18	R1M	R1M	E17	0.366	Lowland to montane, dry to mesic grassland usually dominated by Nardus stricta
19	R1N	R1N	E18	0.2982	Open Iberian supramediterranean dry acid and neutral grassland
20	R1P	R1P	E19a	0.3652	Oceanic to subcontinental inland sand grassland on dry acid and neutral soils
21	R1Q	R1Q	E19b	0.3371	Inland sanddrift and dune with siliceous grassland
22	R1R	R1R	E1A	0.3524	Mediterranean to Atlantic open, dry, acid and neutral grassland
23	R1S	R1S	E1B	0.4431	Heavy-metal grassland in Western and Central Europe
24	R21	R21	E21	0.4891	Mesic permanent pasture of lowlands and mountains
25	R22	R22	E22	0.5017	Low and medium altitude hay meadow
26	R23	R23	E23	0.5072	Mountain hay meadow
27	R24	R24	E24	0.2779	Iberian summer pasture (vallicar)
28	R31	R31	E31a	0.3904	Mediterranean tall humid inland grassland
29	R32	R32	E32a	0.2409	Mediterranean short moist grassland of lowlands
30	R33	R33	E32b	0.4507	Mediterranean short moist grassland of mountains
31	R34	R34	E33	0.3335	Submediterranean moist meadow
32	R35	R35	E34a	0.5076	Moist or wet mesotrophic to eutrophic hay meadow

33	R36	R36	E34b	0.4289	Moist or wet mesotrophic to eutrophic pasture
34	R37	R37	E35	0.4278	Temperate and boreal moist or wet oligotrophic grassland
35	R41	R41	E41	0.4397	Snow-bed vegetation
36	R42	R42	E43a	0.4427	Boreal and arctic acidophilous alpine grassland
37	R43	R43	E43b	0.5696	Temperate acidophilous alpine grassland
38	R44	R44	E44a	0.4782	Arctic-alpine calcareous grassland
39	R45	R45	E44b	0.3489	Alpine and subalpine calcareous grassland of the Balkans and Apennines
40	R51	R51	E52a	0.3103	Thermophilous forest fringe of base-rich soils
41	R52	R52	E52b	0.2576	Forest fringe of acidic nutrient-poor soils
42	R54	R54	E53	0.2841	Pteridium aquilinum vegetation
43	R55	R55	E54	0.4702	Lowland moist or wet tall-herb and fern fringe
44	R56	R56	E55	0.4299	Montane to subalpine moist or wet tall-herb and fern fringe
45	R57	R57	E56	0.292	Herbaceous forest clearing vegetation
46	R61	R61	E61	0.229	Mediterranean inland salt steppe
47	R62	R62	E62	0.3853	Continental inland salt steppe
48	R63	R63	E63	0.2774	Temperate inland salt marsh
HEATHLAND, SCRUB & TUNDRA (#34)					
49	S11	S11	F11	0.4529	Shrub tundra
50	S12	S12	F12	0.4846	Moss and lichen tundra
51	S21	S21	F21	0.4666	Subarctic and alpine dwarf Salix scrub
52	S22	S22	F22a	0.3955	Alpine and subalpine ericoid heath
53	S23	S23	F22b	0.3254	Alpine and subalpine Juniperus scrub
54	S24	S24	F22c	0.4228	Subalpine genistoid scrub of the Amphi-Adriatic region

55	S25	S25	F23	0.2624	Subalpine and subarctic deciduous scrub
56	S26	S26	F24	0.4512	Subalpine Pinus mugo scrub
57	S31	S31	F31a	0.2249	Lowland to montane temperate and submediterranean Juniperus scrub
58	S32	S32	F31b	0.3188	Temperate Rubus scrub
59	S33	S33	F31c	0.2908	Lowland to montane temperate and submediterranean genistoid scrub
60	S35	S34	F31d	0.415	Temperate and submediterranean thorn scrub
61	S36	S36	F31f	0.3407	Low steppic scrub
62	S37	S37	F31g	0.3292	Corylus avellana scrub
63	S38	S38	F31h	0.2725	Temperate forest clearing scrub
64	S41	S41	F41	0.3406	Wet heath
65	S42	S42	F42	0.3732	Dry heath
66	S51	S51	F51	0.38	Mediterranean maquis and arborescent matorral
67	S52	S52	F53	0.2878	Submediterranean pseudomaquis
68	S53	S53	F54	0.3869	Spartium junceum scrub
69	S54	S54	F55	0.606	Thermomediterranean arid scrub
70	S61	S61	F61a	0.3847	Western basiphilous garrigue
71	S62	S62	F61b	0.3862	Western acidophilous garrigue
72	S63	S63	F62	0.3521	Eastern garrigue
73	S65	S65	F67	0.3171	Mediterranean gypsum scrub
74	S66	S66	F68a	0.3091	Mediterranean halo-nitrophilous scrub
75	S71	S71	F71	0.4912	Western Mediterranean spiny heath
76	S72	S72	F73	0.3033	Eastern Mediterranean spiny heath (phrygana)
77	S73	S73	F74a	0.4215	Western Mediterranean mountain hedgehog-heath

78	S74	S74	F74b	0.551	Central Mediterranean mountain hedgehog-heath
79	S75	S75	F74c	0.3861	Eastern Mediterranean mountain hedgehog-heath
80	S91	S91	F91	0.3036	Temperate riparian scrub
81	S92	S92	F92	0.3492	Salix fen scrub
82	S93	S93	F93	0.3467	Mediterranean riparian scrub
FORESTS (#38)					
83	T11	T11	G11	0.3275	Temperate Salix and Populus riparian forest
84	T12	T12	G12a	0.451	Alnus glutinosa-Alnus incana forest on riparian and mineral soils
85	T13	T13	G12b	0.3385	Temperate hardwood riparian forest
86	T14	T14	G13	0.3985	Mediterranean and Macaronesian riparian forest
87	T15	T15	G14	0.395	Broadleaved swamp forest on non-acid peat
88	T16	T16	G15	0.3793	Broadleaved mire forest on acid peat
89	T17	T17	G16a	0.492	Fagus forest on non-acid soils
90	T18	T18	G16b	0.4627	Fagus forest on acid soils
91	T19	T19	G17a	0.4576	Temperate and submediterranean thermophilous deciduous forest
92	T1A	T1A	G17b	0.3804	Mediterranean thermophilous deciduous forest
93	T1B	T1B	G18	0.4756	Acidophilous Quercus forest
94	T1C	T1C	G19a	0.3399	Temperate and boreal mountain Betula and Populus tremula forest on mineral soils
95	T1D	T1D	G19b	0.2487	Southern European mountain Betula and Populus tremula forest on mineral soils
96	T1E	T1E	G1Aa	0.488	Carpinus and Quercus mesic deciduous forest
97	T1F	T1F	G1Ab	0.4862	Ravine forest
98	T1G	T1G	G1Ba	0.4885	Alnus cordata forest
99	T1H	T1H	G1C	0.4058	Broadleaved deciduous plantation of non site-native trees

100	T21	T21	G21	0.4832	Mediterranean evergreen Quercus forest
101	T22	T22	G22	0.3111	Mainland laurophyllous forest
102	T24	T24	G24	0.2536	Olea europaea-Ceratonia siliqua forest
103	T27	T27	G26	0.3789	Ilex aquifolium forest
104	T29	T29	G28	0.2897	Broadleaved evergreen plantation of non site-native trees
105	T31	T31	G31a	0.5703	Temperate mountain Picea forest
106	T32	T32	G31b	0.5128	Temperate mountain Abies forest
107	T33	T33	G31c	0.4368	Mediterranean mountain Abies forest
108	T34	T34	G32	0.5222	Temperate subalpine Larix, Pinus cembra and Pinus uncinata forest
109	T35	T35	G34a	0.4268	Temperate continental Pinus sylvestris forest
110	T36	T36	G34b	0.4283	Temperate and submediterranean montane Pinus sylvestris-Pinus nigra forest
111	T37	T37	G34c	0.4211	Mediterranean montane Pinus sylvestris-Pinus nigra forest
112	T39	T39	G36	0.3135	Mediterranean and Balkan subalpine Pinus heldreichii-Pinus peuce forest
113	T3A	T3A	G37	0.4017	Mediterranean lowland to submontane Pinus forest
114	T3C	T3C	G39a	0.2991	Taxus baccata forest
115	T3D	T3D	G39b	0.2777	Mediterranean Cupressaceae forest
116	T3F	T3F	G3A	0.5426	Dark taiga
117	T3G	T3G	G3B	0.5686	Pinus sylvestris light taiga
118	T3J	T3J	G3Da	0.4502	Pinus and Larix mire forest
119	T3K	T3K	G3Db	0.4123	Picea mire forest
120	T3M	T3M	G3F1	0.4456	Coniferous plantation of non site-native trees

Notice that the value of all habitat suitability maps below the 10 percentile threshold has been set to zero as an input for the calculation of the habitat probability maps.

1.3 Content of the report

This report on the production of the EUNIS forest, heathland, scrub & tundra and grassland habitat probability maps at level 3 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, followed by habitat suitability and finally the habitat probability maps. The integration of in-situ vegetation relevés, environmental data layers and Remote Sensing enabled Essential Biodiversity Variables (RS-EBVs), including Copernicus 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 the Copernicus land cover data sources. Chapter 5 describes how the habitat probability maps have been processed based on the integration of the low resolution habitat suitability maps with the high resolution Copernicus land cover data.

Appendix 1 shows the # 38 Forests (T formation) probability maps, including the distribution map (original in-situ vegetation plots) and a detail of the probability maps that shows the real detail of the maps. So in total Appendix 1 has 114 figures.

Appendix 2 shows the # 34 Heathland, scrub and Tundra (S formation) probability maps, including the distribution map (original in-situ vegetation plots) and a detail of the probability maps that shows the real detail of the maps. So in total Appendix 2 has 102 figures.

Appendix 3 shows the # 48 Grassland (R formation) probability maps, including the distribution map (original in-situ vegetation plots) and a detail of the probability maps that shows the real detail of the maps. So in total Appendix 3 has 144 figures.

2 Habitat modelling

2.1 Introduction

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 vegetation plots which can be assigned to a 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 actual land cover information.

2.2 Methodology

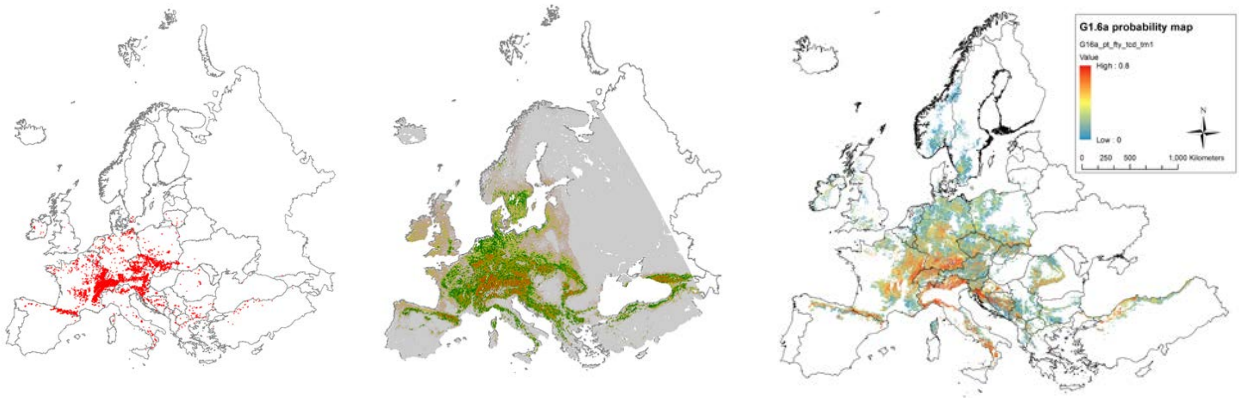


Figure 2.1 G1.6a: Fagus woodland on non-acid soils

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, see Figure 1, 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,** see Figure 1**.** 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, in the map in Appendix B with colours 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, is used to filter the suitability map to eventually get to a refined **probability map,** see Figure 1. 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 of the habitat type. Although the probably map still 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, et al. (2015).

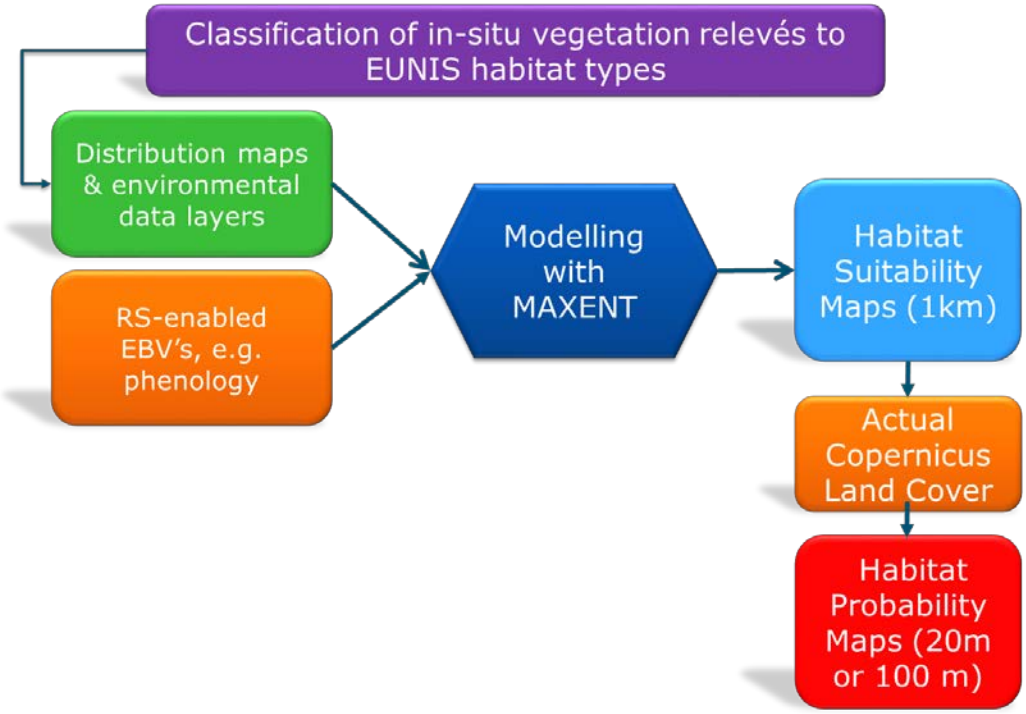


Figure 2.2 **Newly adjusted general workflow for the processing of refined EUNIS forest habitat probability maps (adjusted from Mücher et al., 2015).**

3 Habitat suitability maps

For 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 us 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 modelling procedure 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. The layers were selected from meaningful environmental predictors commonly used for modelling non-tropical plant and vegetation diversity, and are not mutually strongly correlated. In addition to what was selected as predictors in previous years (Hennekens 2016, 2017), also so-called RS-enabled EBV's (Remote Sensed Essential Biodiversity Variables; predictors based on remote sensing data), such as LAI, phenology, land cover, chlorophyll content, inundation, vegetation height have now been applied (Skidmore et al, 2015, Pettorelli et al., 2016).

It is assumed that by using additional meaningful predictors such as the RS-enabled EBV's, the modelling will result in more realistic suitability maps with less outliers (prediction in areas where the habitat is not expected to be present).

As a side effect of using the RS-EBS's the study area now excludes countries like Russia, Belarus and Ukraine in the east part of Europe. This also has led to better predictions because the very eastern part of Europe is currently not well represented in EVA.

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

Climate

- 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

Topography

- Distance to water (rivers, lakes, sea)
  derived from the shapefile 'Inland_Waters.shp'
- Digital Elevation Map (DEM)

Soil

- Bulk density of the soil (kg/m³)
  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

RS-EBV's

- Inundation; occurrence
  Global Surface Water Explorer, 1984-2015, 30m, resampled to 1km (resampling methods: average resampling and mode resampling (selects the value which appears most often of all the sampled points))
- Phenology; End of Season (day number)
  End of Season, defined as the point in time where the NDVI drops below the NDVI at the start of the growing season
- Phenology; Length of season (days)
  Length of season, number of days between EoS and Sos [days]
- Phenology; Low of season (day number)
  Phenology; Low of season (day number with lowest NDVI)
- Phenology; NDVI mean
  Mean NDVI [0..10000]
- Phenology; NDVI seasonality
  Minimum NDVI [0..10000]
- Phenology; Peak of season (day number)
  Phenology; Peak of season (day number with highest NDVI)
- Phenology; Start of Season (day number)
  Start of Season, defined as the point in the year with the largest positive rate of change (maximum of 1st derivative) [day of year 1..365]
- Vegetation height (m)
  3D Global Vegetation Map, 2000, 1km

More information on predictors and particularly on RS-EBS's can be found here:
https://www.synbiosys.alterra.nl/nextgeoss/docs/Description_Abiotic_and_RSEBVs.pdf

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 therefore 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 by Maxent from the study area, whereas the second approach concerns a random stratified (one sample per 1x1 km grid) selection of 5,000 background locations of plots present in the EVA database. Concerning the observed occurrences of the EUNIS types also a random stratified selection has been applied with a maximum of 5000 observations.

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. Surprisingly the current study showed that all maps using background data that was randomly selected by Maxent were far more better (by visual inspection) than the maps produced using background randomly derived from the EVA database. Figure 3.1 clearly shows on overestimation of habitat type F1.6a (Fagus forest on non-acid soils) in a large part of Europe, whereas figure 3.2 presents a more realistic picture.

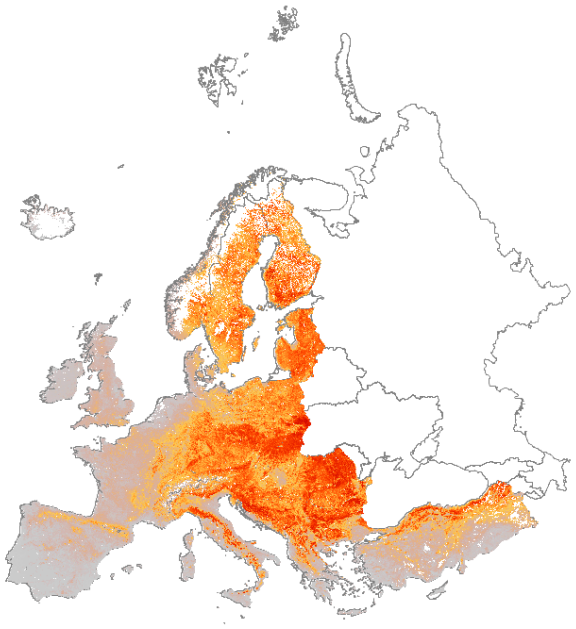


Figure 3.1 EUNIS type F1.6a; background data based on locations from randomly selected plots n the EVA database.

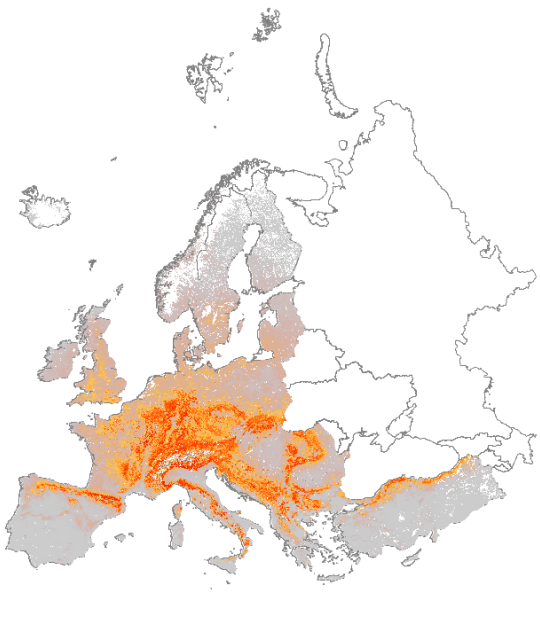


Figure 3.2: EUNIS type F1.6a; background data randomly selected from the study area by Maxent.

Another test that was performed was running all models with and without the RS-EBV's predictors. In figure 3.3 and 3.4 it is shown that leaving out RS-EBS's does not affect the distribution range. However it also shown that including RS-EBS's the suitability is more differentiated, compare figure 3.5 and 3.6.

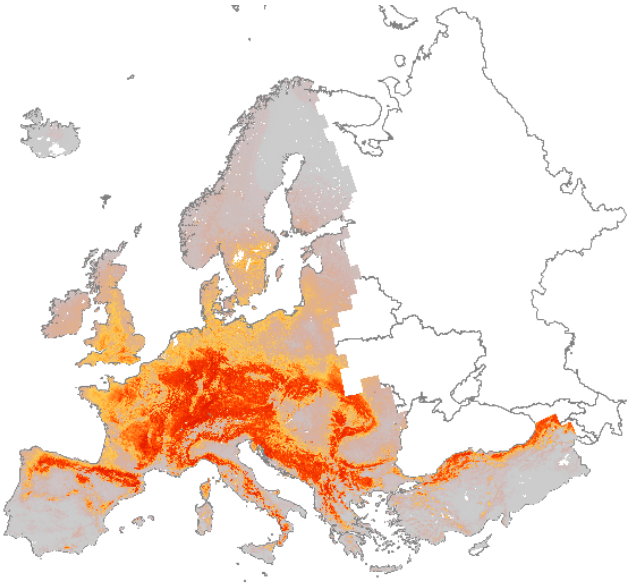


Figure 3.3: model without RS-EBV's

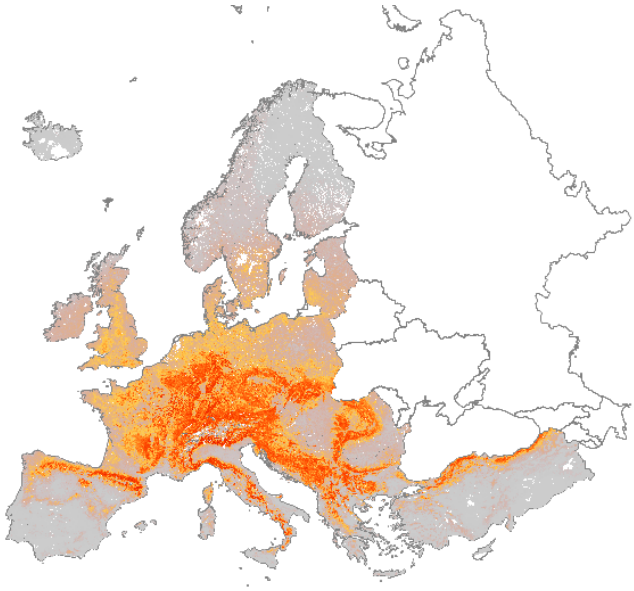


Figure 3.4 : model with RS-EBV's

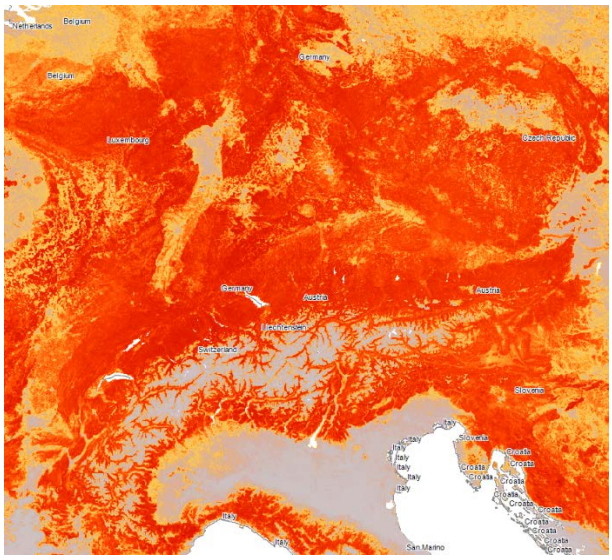


Figure 3.5: Detail of model without RS-EBV's

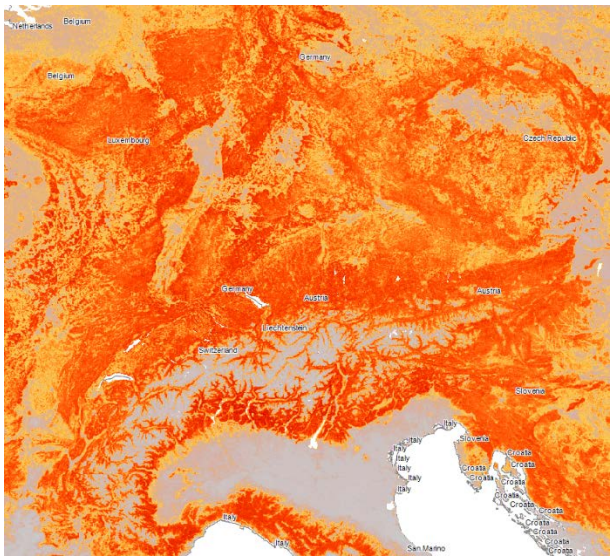


Figure 3.6: detail of model with RS-EBV's

In a next step, actual land cover information plays a key role to fine-tune the habitat suitability maps into habitat probability maps, and the land cover sources and processing are discussed in Chapter 4, while the methodology for the habitat probability maps is discussed in Chapter 5.

4 Copernicus Land Cover

The European land cover databases with the highest spatial resolution are the Copernicus HRLs (High Resolution Layers with a 20 meter spatial resolution and exist for specific themes: 1) imperviousness 2) forests; 3) permanent waterbodies; 4: grasslands and 5) wetlands (see also https://land.copernicus.eu/).

So for the Forest habitat probability maps we incorporated the Copernicus Forest HRL with a spatial resolution of 20 meter. For the Grassland habitat probability maps we incorporated the Copernicus Grassland HRL with a spatial resolution of 20 meter. And only for the formation Heathland, scrub and tundra no Copernicus HRL was available, and therefore we used the most recent CORINE land cover information at a 100 meter spatial resolution.

For forest we used the Copernicus HRL Forest for 2015 with the forest types: broadleaved forest (1) and coniferous forest (2) (source: FTY_2015_020m_eu_03035_d04_full.tif from EEA).

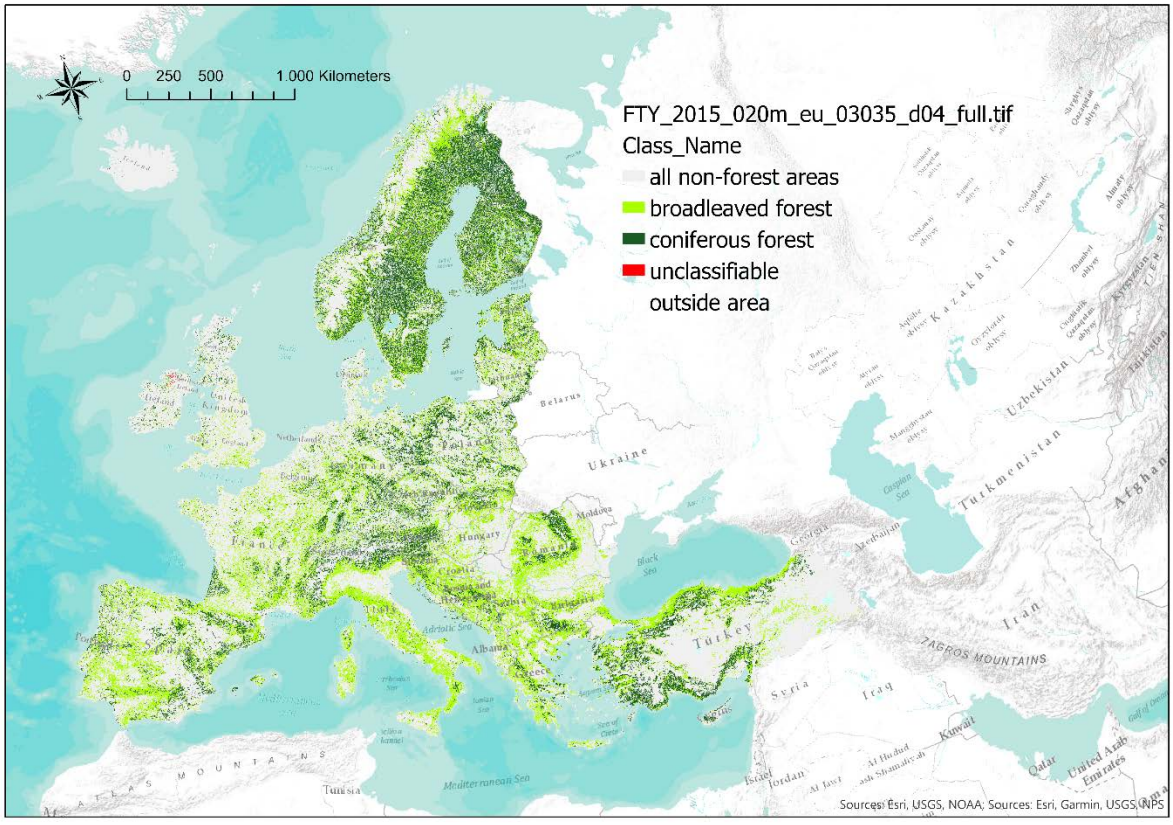


Figure 4.1 Copernicus HRL Forest for 2015 with the forest types: 1) broadleaved forest and 2) coniferous forest (source: FTY_2015_020m_eu_03035_d04_full.tif from EEA).

For each EUNIS forest habitat type at level 3 we had to determine if the habitat was related to 1) broadleaved forest or 2) coniferous forest.

Table 4.1 Relation between EUNIS Forest habitat type and Copernicus HRL forest type

#	New Code	Old code	New name	Forest type
1	T11	G11	Temperate Salix and Populus riparian forest	1-Broadleaved
2	T12	G12a	Alnus glutinosa-Alnus incana forest on riparian and mineral soils	1-Broadleaved
3	T13	G12b	Temperate hardwood riparian forest	1-Broadleaved
4	T14	G13	Mediterranean and Macaronesian riparian forest	1-Broadleaved
5	T15	G14	Broadleaved swamp forest on non-acid peat	1-Broadleaved
6	T16	G15	Broadleaved mire forest on acid peat	1-broadleaved
7	T17	G16a	Fagus forest on non-acid soils	1-broadleaved
8	T18	G16b	Fagus forest on acid soils	1-broadleaved
9	T19	G17a	Temperate and submediterranean thermophilous deciduous forest	1-Broadleaved
10	T1A	G17b	Mediterranean thermophilous deciduous forest	1-broadleaved
11	T1B	G18	Acidophilous Quercus forest	1-broadleaved
12	T1C	G19a	Temperate and boreal mountain Betula and Populus tremula forest on mineral soils	1-broadleaved
13	T1D	G19b	Southern European mountain Betula and Populus tremula forest on mineral soils	1-Broadleaved
14	T1E	G1Aa	Carpinus and Quercus mesic deciduous forest	1-Broadleaved
15	T1F	G1Ab	Ravine forest	1-Broadleaved
16	T1G	G1Ba	Alnus cordata forest	1-Broadleaved
17	T1H	G1C	Broadleaved deciduous plantation of non site-native trees	1-Broadleaved
18	T21	G21	Mediterranean evergreen Quercus forest	1-Broadleaved
19	T22	G22	Mainland laurophyllous forest	1-Broadleaved
20	T24	G24	Olea europaea-Ceratonia siliqua forest	1-Broadleaved
21	T27	G26	Ilex aquifolium forest	1-Broadleaved
22	T29	G28	Broadleaved evergreen plantation of non site-native trees	1-Broadleaved
23	T31	G31a	Temperate mountain Picea forest	2-Coniferous
24	T32	G31b	Temperate mountain Abies forest	2-Coniferous
25	T33	G31c	Mediterranean mountain Abies forest	2-Coniferous
26	T34	G32	Temperate subalpine Larix, Pinus cembra and Pinus uncinata forest	2-Coniferous
27	T35	G34a	Temperate continental Pinus sylvestris forest	2-Coniferous
28	T36	G34b	Temperate and submediterranean montane Pinus sylvestris-Pinus nigra forest	2-Coniferous
29	T37	G34c	Mediterranean montane Pinus sylvestris-Pinus nigra forest	2-Coniferous
30	T39	G36	Mediterranean and Balkan subalpine Pinus heldreichii-Pinus peuce forest	2-Coniferous
31	T3A	G37	Mediterranean lowland to submontane Pinus forest	2-Coniferous
32	T3C	G39a	Taxus baccata forest	2-Coniferous
33	T3D	G39b	Mediterranean Cupressaceae forest	2-Coniferous
34	T3F	G3A	Dark taiga	2-Coniferous
35	T3G	G3B	Pinus sylvestris light taiga	2-Coniferous
36	T3J	G3Da	Pinus and Larix mire forest	2-Coniferous
37	T3K	G3Db	Picea mire forest	2-Coniferous
38	T3M	G3F1	Coniferous plantation of non site-native trees	2-Coniferous

For grasslands there are two Copernicus High Resolution Layers (HRL), namely for 2012 and 2015 that differ substantially. While HRL grassland 2012 focussed on natural and semi-natural grasslands, the HRL grassland 2015 focussed on all grasslands (from natural to managed grasslands) within one class called grasslands. Due to poorer classification results in 2012, the 2015 product is based on a longer time series of imagery from a number of different sensors. SAR radar and optical data were combined for the first time to improve the classification accuracy of grasslands. The main product for 2015 is a binary grassland/non-grassland product. Both HRL products of 2012 and 2015 have 20m pixels size.

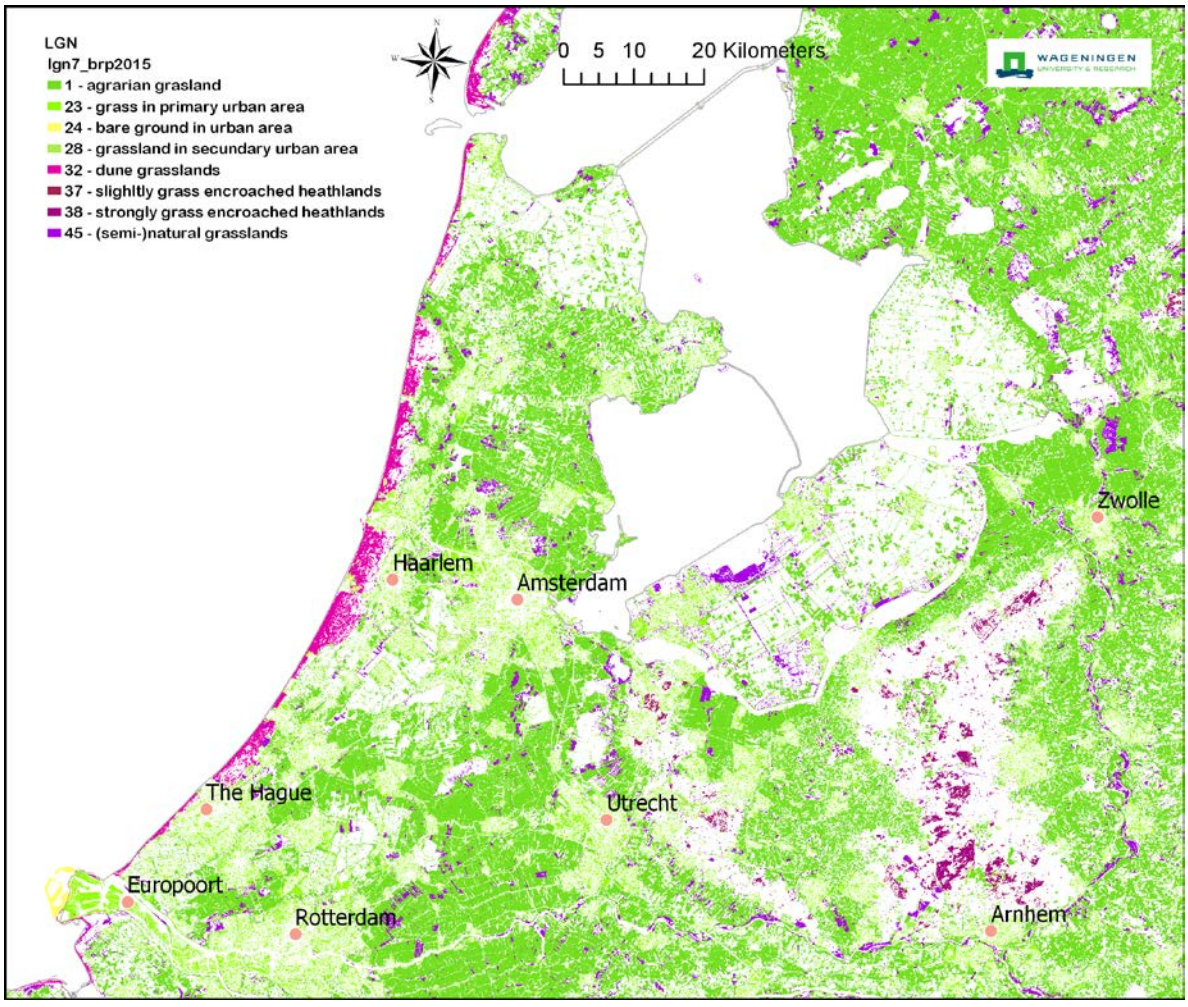


Figure 4.2 **the Dutch national land cover database LGN7 showing here only all grassland related land cover classes**

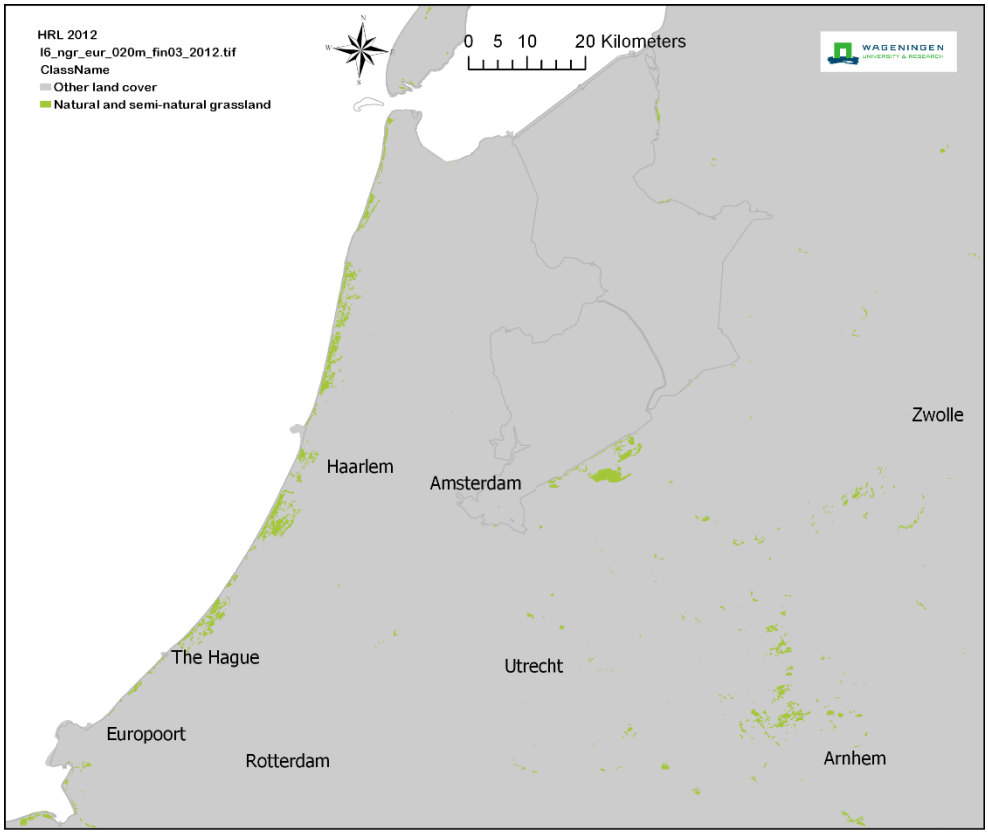


Figure 4.3 the Copernicus HRL grassland for 2012 showing only natural and semi-natural grasslands

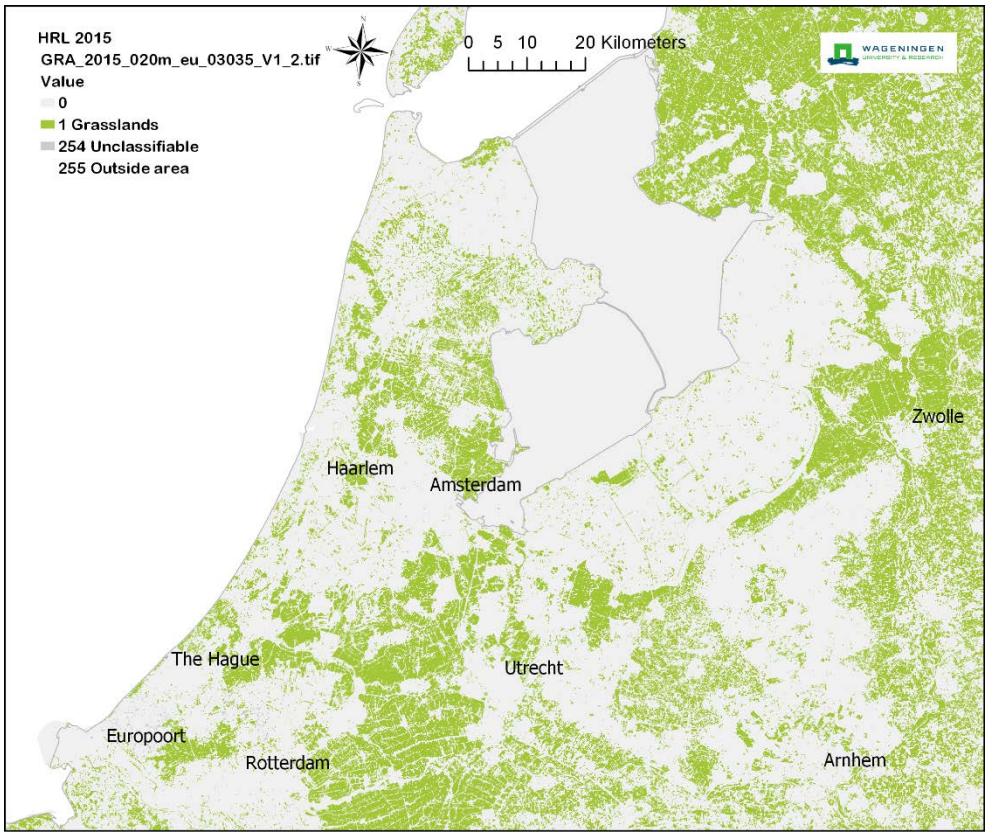


Figure 4.4 the Copernicus HRL grassland for 2015 showing all grasslands as one class.

Despite the poorer classification results for 2012 compared with the HRL grassland product from 2015, we decided to combine the two products in a new product HRL_grass20m that distinguished two classes namely 1) natural and semi-natural grasslands and 2) managed grasslands. The reason for this is that if we didn't combine the two we would miss a lot of grassland areas for example in the dunes. The 2012 product did overrule 2015 for semi-natural grasslands. The example below for the Netherlands clearly shows that we would miss the dune grasslands if we did not integrate the 2012 HRL product.

Therefore on basis of the integration of HRL grassland 2012, see Figure 4.5, and HRL grassland 2015, see Figure 4.6, we made the new product HRL_grass20m with a 20 meter resolution and having two thematic grassland classes; 1) natural and semi-natural grasslands and 2) managed grasslands. For the HRL_grass20m database, see figure 4.7

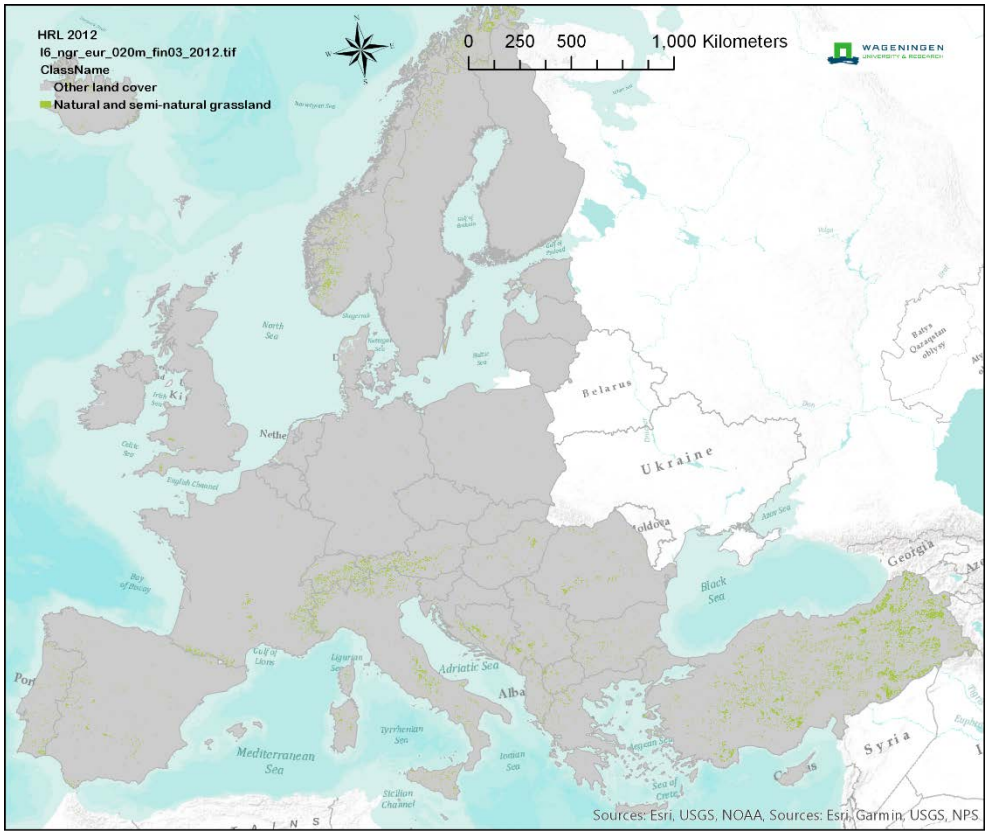


Figure 4.5 **the entire Copernicus HRL grassland database for 2012 showing only natural and semi-natural grasslands**

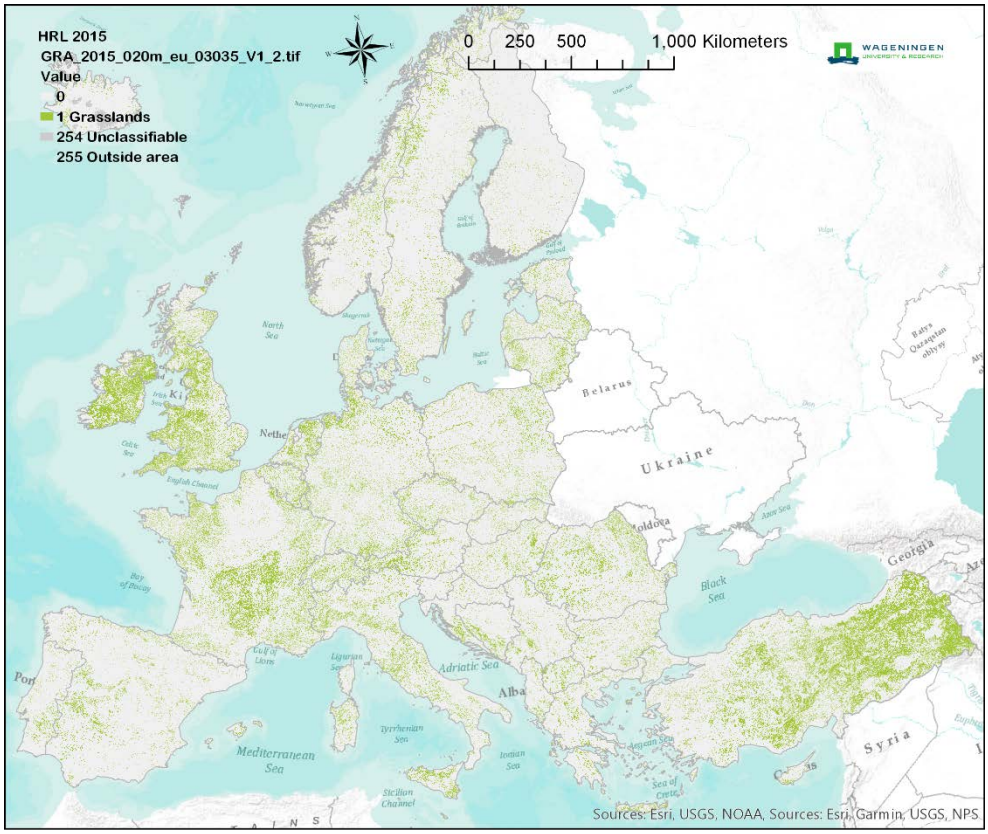


Figure 4.6 **the entire Copernicus HRL grassland database for 2015 showing all grasslands as one class**

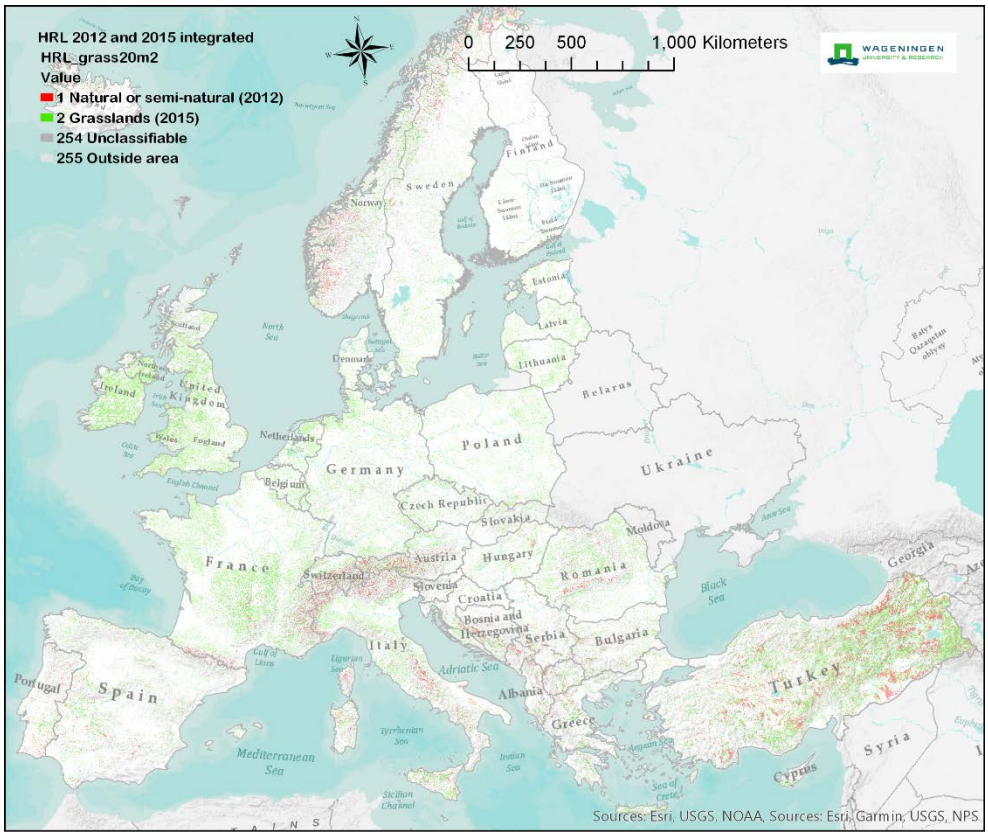


Figure 4.7 **Integrated grassland database based on Copernicus HRL grassland database for 2012 and 2015 distinguishing class 1) natural and semi-nature grassland and class 2) managed grasslands**

For the formation Heathland, scrub and tundra we had to use the most recent CORINE land cover information from 2018 since there is no associated Copernicus HRL.

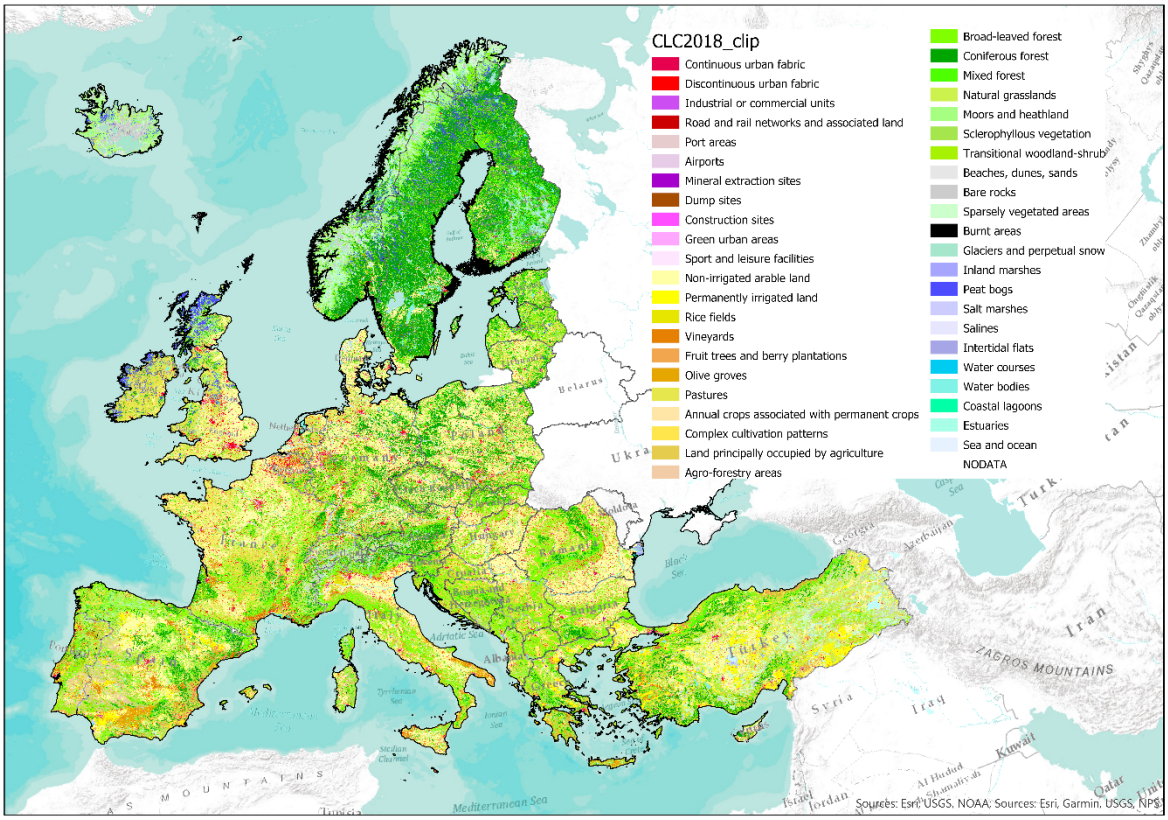


Figure 4.8 Corine land cover 2018 (source: EEA, CLC2018_CLC2018_V2018_20.tif)

Table 4.2 shows the decision rules for each habitat type in their relation with CORINE land cover classes. So especially for the formation (S) Heathland, scrub and tundra, the relationship between habitat type and land cover type is more complicated than for the formation Forest (G) and Grasslands (R)

Table 4.2 Decision rules EUNIS Heathland, scrub and tundra habitat types in relation to CLC2018

Nr	EUNIS-3 code	EUNIS-3 habitat name	Relationship to CLC (D. Moss)	Relationship to CLC (releves)
1	S11	Shrub tundra	Sparsely vegetated (333)	322, 332, 333
2	S12	Moss and lichen tundra	Sparsely vegetated (333)	322, 332, 333
3	S21	Subarctic and alpine dwarf Salix scrub	Sparsely vegetated (333)	332, 333
4	S22	Alpine and subalpine ericoid heath	Moors and heathland (322)	321, 322, 332, 333
5	S23	Alpine and subalpine Juniperus scrub	Moors and heathland (322)	321, 322, 324, 333
6	S24	Subalpine genistoid scrub of the Amphi-Adriatic region	Moors and heathland (322)	321, 322, 324, 333
7	S25	Subalpine deciduous scrub	Moors and heathland (322)	321, 322, 324, 332, 333
8	S26	Subalpine Pinus mugo scrub	Moors and heathland (322)	321, 322, 324, 333
9	S31	Lowland to montane temperate and submediterranean Juniperus scrub	Moors and heathland (322)	321, 322, 324, 333

10	S32	Temperate Rubus scrub	Moors and heathland (322)	321, 322, 324
11	S33	Lowland to montane temperate and submediterranean genistoid scrub	Moors and heathland (322)	321, 322, 323, 324
12	S35	Temperate and submediterranean thorn scrub	Moors and heathland (322)	321, 322, 324
13	S36	Low steppic scrub	Sparsely vegetated (333)	324, 333
14	S37	Corylus avellana scrub	?	311, 312, 313, 321, 324, 332
15	S38	Temperate forest clearing scrub	Sparsely vegetated (333)	311, 312, 313, 321, 322, 324
16	S41	Wet heath	Moors and heathland (322)	321, 322, 412
17	S42	Dry heath	Moors and heathland (322)	321, 322, 412
18	S51	Mediterranean maquis and arborescent matorral	Sclerophyllous vegetation (323)	323, 324
19	S52	Submediterranean pseudomaquis	Sclerophyllous vegetation (323)	311, 312, 313, 321, 323, 324
20	S53	Spartium junceum fields	Moors and heathland (322)	321, 322, 323, 324
21	S54	Thermo-Mediterranean arid scrub	Sclerophyllous vegetation (323)	323
22	S61	Western basiphilous garrigue	Sclerophyllous vegetation (323)	321, 322, 323, 324
23	S62	Western acidophilous garrigue	Sclerophyllous vegetation (323)	321, 323, 324, 331
24	S63	Eastern garrigue	Sclerophyllous vegetation (323)	321, 323, 324, 333
25	S65	Mediterranean gypsum scrub	Moors and heathland (322)	322, 323, 333
26	S66	Mediterranean halo-nitrophilous scrub	Moors and heathland (322)	322, 323
27	S71	Western Mediterranean spiny heath	Sclerophyllous vegetation (323)	323, 331
28	S72	Eastern Mediterranean spiny heath (phrygana)	Sclerophyllous vegetation (323)	321, 323, 331, 333
29	S73	Western Mediterranean mountain hedgehog-heath	Sclerophyllous vegetation (323)	321, 322, 323, 324, 333
30	S74	Central Mediterranean mountain hedgehog-heath	Sclerophyllous vegetation (323)	321, 323, 333
31	S75	Eastern Mediterranean mountain hedgehog-heath	Sclerophyllous vegetation (323)	322, 323, 324, 333
32	S91	Temperate riparian scrub	Moors and heathland (322)	321, 322, 331, 511
33	S92	Salix fen scrub	Moors and heathland (322)	321, 322, 323
34	S93	Mediterranean riparian scrub	Moors and heathland (322)	321, 322, 323

5 Habitat probability maps

The habitat probability maps are created by downscaling the habitat suitability maps with a 1km resolution by actual land cover. This report concerns European Forest, Heathland, scrub & tundra and grassland habitat types. For this purpose, we use the most actual land cover information. For forests and grasslands habitats the Copernicus high resolution layers (HRLs) forest and grasslands could be used with a 20 meter spatial resolution across Europe, while for the formation Heath, scrub and tundra, we had to use the CORINE land cover information at a 100 meter resolution.

As mentioned in Chapter 4 we used the Copernicus HRL Forest for 2015, the combined Copernicus HRL grasslands 2012 and 2015 and the CLC2018 for Heathland, scrub & tundra. Figure 5.1 shows the principle of the methodology that we follow. In principle the habitat suitability maps were integrated basis of the actual Copernicus land cover.

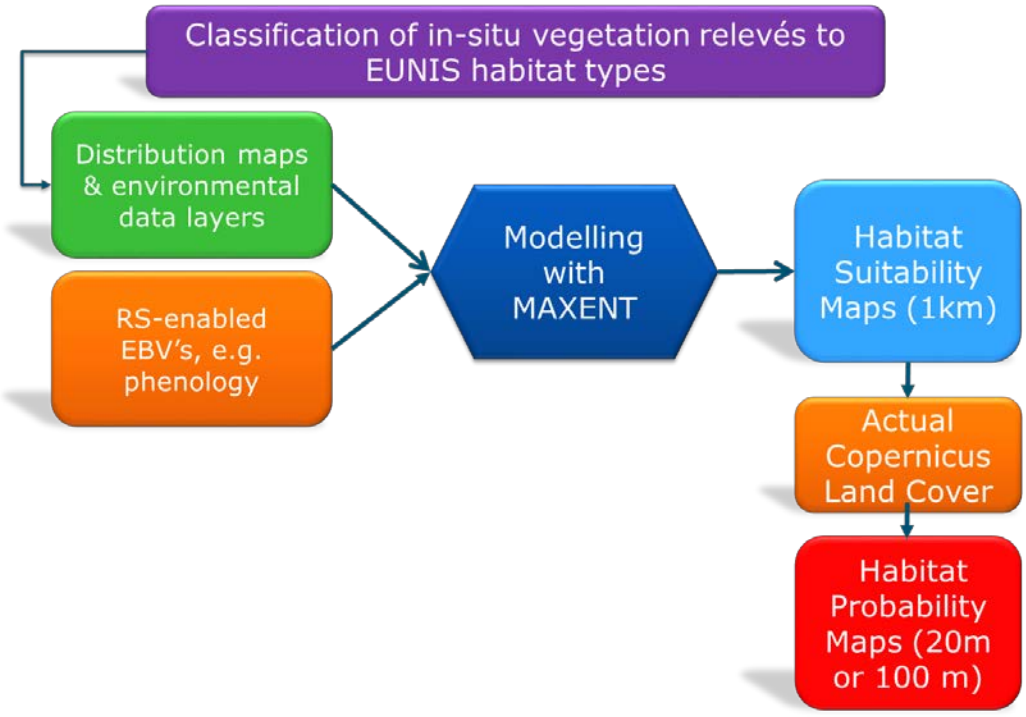


Figure 5.1 Flowchart of the methodology implemented to obtain habitat probability maps

In principle, we used four models in ARCGIS PRO for each EUNIS formation: 1) Forests 2) Heathland, scrub and tundra and 3) Grasslands, namely:

1) Thresholding the habitat suitability maps with the 10 percentile threshold,
2) Preparing the actual land cover information,
3) Process the probability maps by integrating the actual land cover with the habitat suitability maps,
4) Export the probability maps to geotiffs.

Ad 1 and Ad2 models could be run relatively easily, but processing the probability maps at 20 meter resolution did costs approximately 8 hours processing time per habitat type (# 120 habitat types).

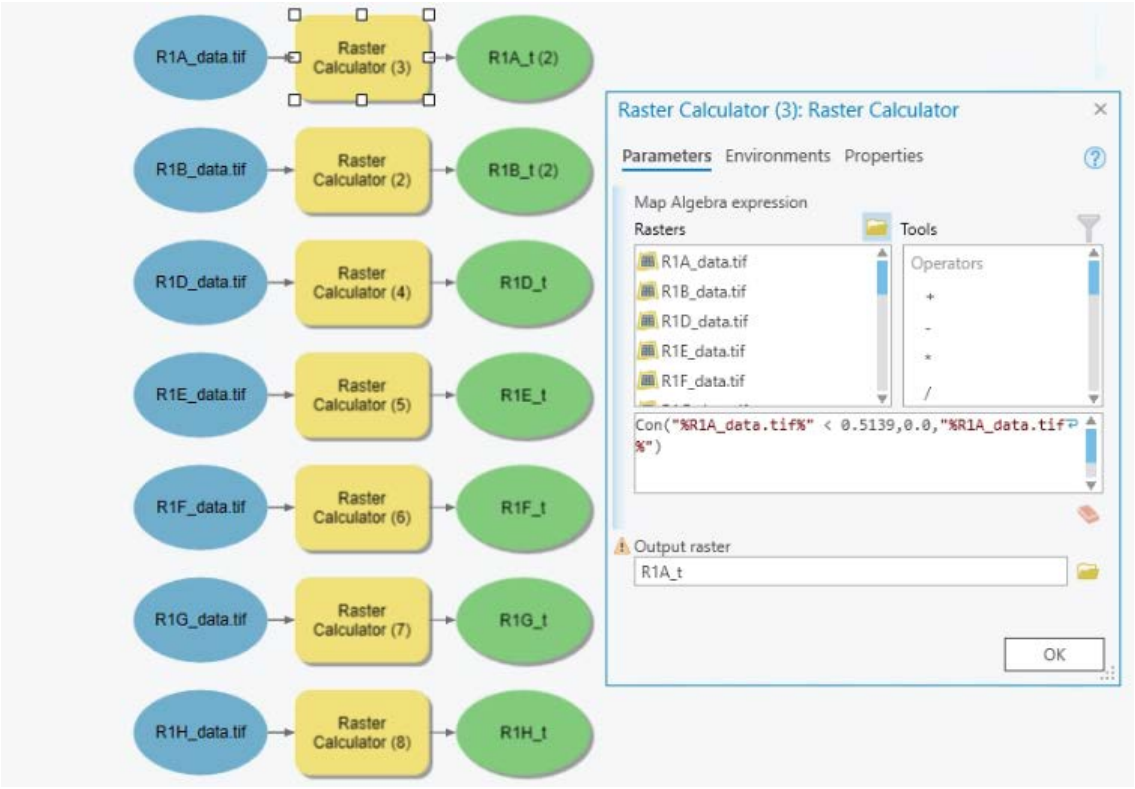


Figure 5.2 Model 1. ARCGIS PRO graphical model for thresholding each habitat suitability map

The original 10p-thresholds for each of the 120 processed habitat types can be found in Table 1.2.

After preparing the actual land cover information, as said before, most computing time was spent on processing the habitat probability maps at 20 meter resolution across Europe.

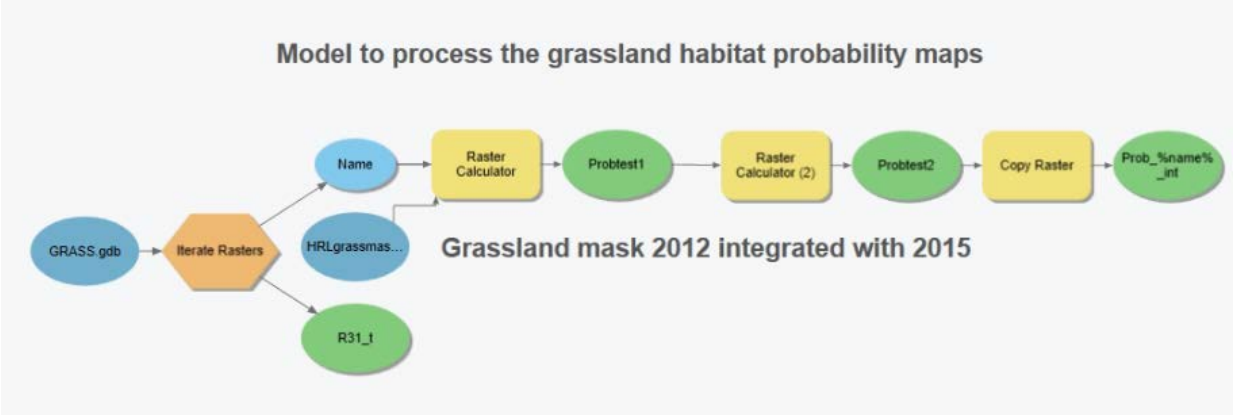
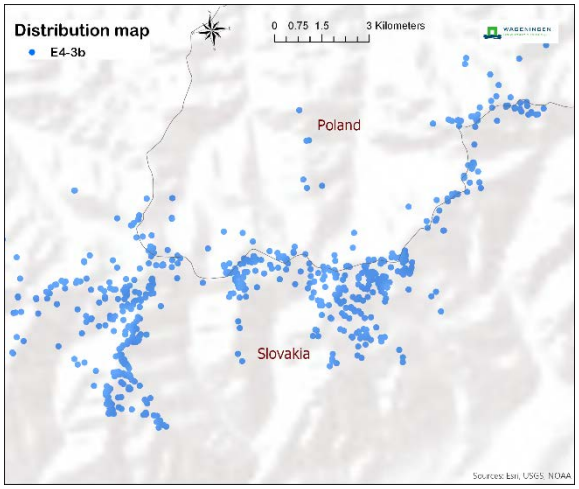
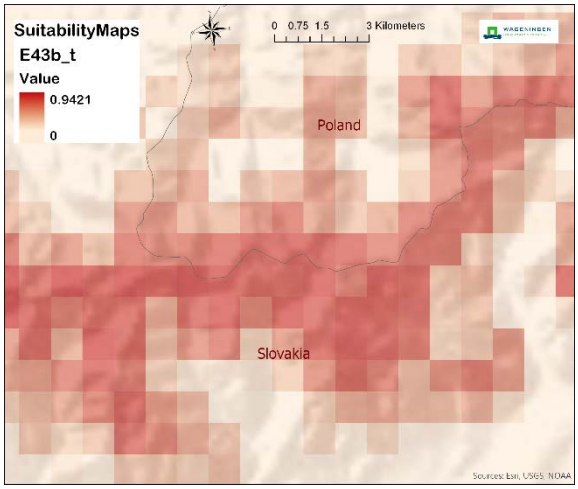


Figure 5.3 Model 3. ARCGIS PRO graphical model to process the habitat probabiliy maps

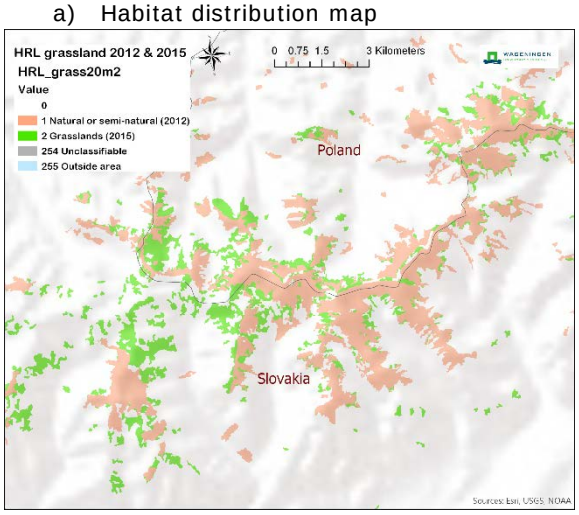
Figure 5.4 **Figures sumarizing all the methodological steps for a small area on the border of Poland and Slovakia for EUNIS habitat type E4.3b *'Temperate acidophiluous alpine grasslands'*.**



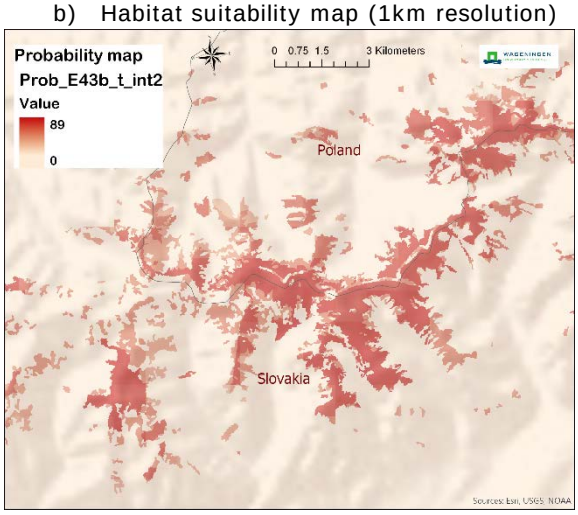
a) Habitat distribution map



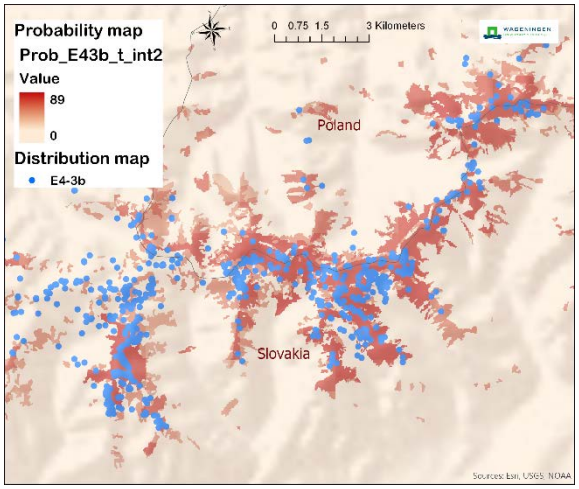
b) Habitat suitability map (1km resolution)



c) Copernicus HRL grassland integrated for 2012 and 2015.



d) Habitat probability map (20 m resolution)



e) Habitat probability map overlaid with recorded vegetation plots (distrubution map)

Figure 5.4 makes it clear that going from habitat suitability maps to habitat probability maps through actual land cover information makes a big difference. It is also nice to see in Figure 5.4 that the final habitat probability represents well the actual distribution of the habitat as reflected by the distribution map (in-situ vegetation plot data used ground truth). But despite this fact, many grassland habitat probability maps in the Appendix I show local misfits between the probability maps and the recorded vegetation plots (distribution maps). This can be due to several reasons:

1) The geographic location of the vegetation plot is sometimes not accurate enough;
2) The Copernicus high resolution layer misses sometimes grassland patches;
3) The recorded vegetation plot has disappeared over the last twenty years.

Therefore we recommend always an independent assessment of the habitat probability maps based on e.g. Article 17 database.

6 References

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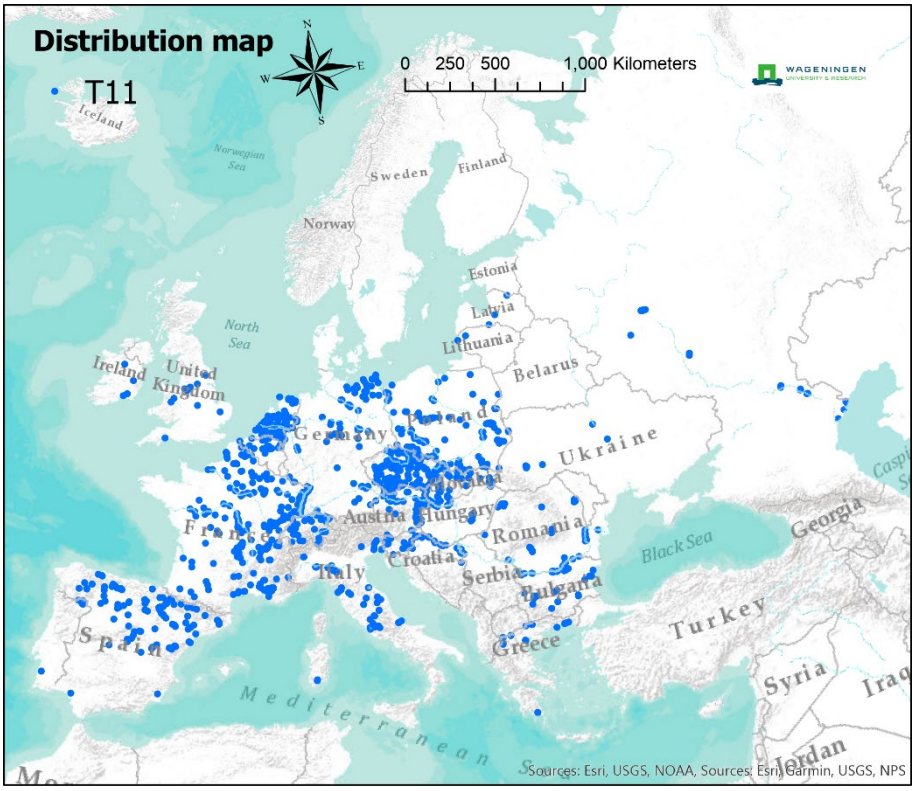
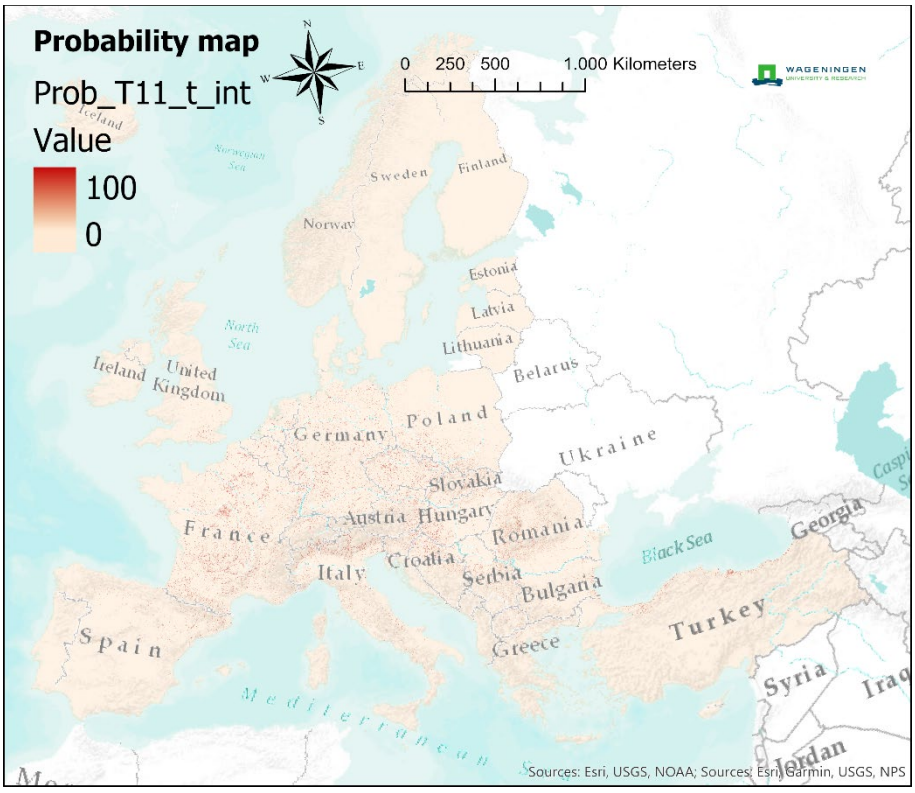
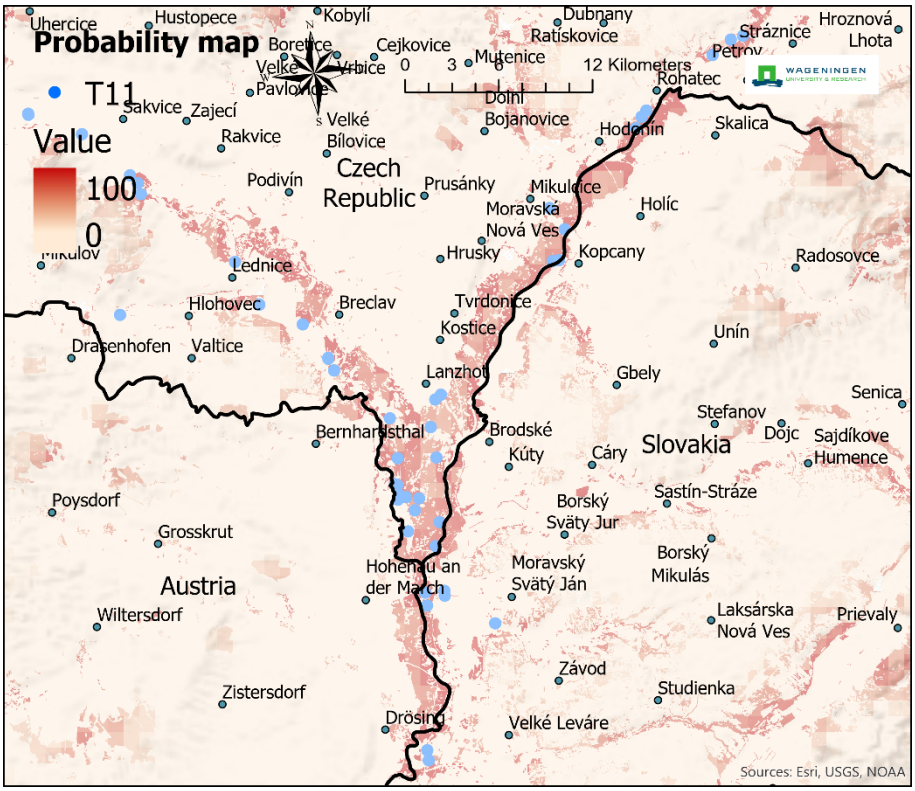
Appendix 1 Forest habitat probability maps

T11 - [G11] Temperate Salix and Populus riparian forest

Willow- and poplar- (Salix- and Populus-) dominated forest of periodically-inundated terraces and shoals with deposition of nutrient-rich alluvium in the active floodplains of rivers through the lowlands of the boreal, nemoral, submediterranean and steppe zones.

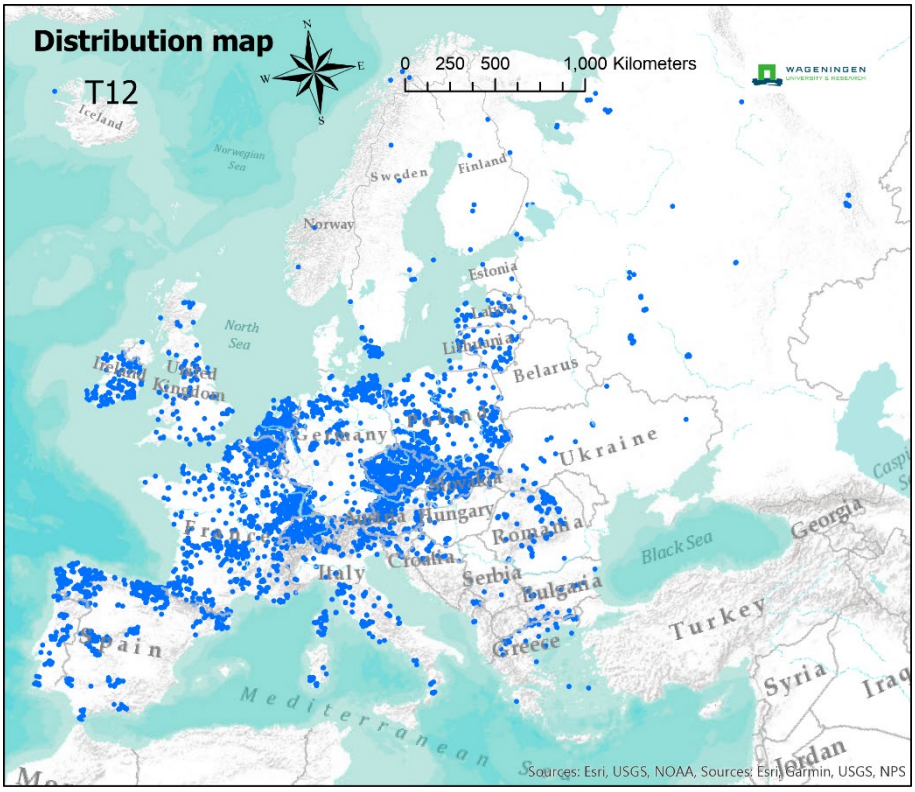


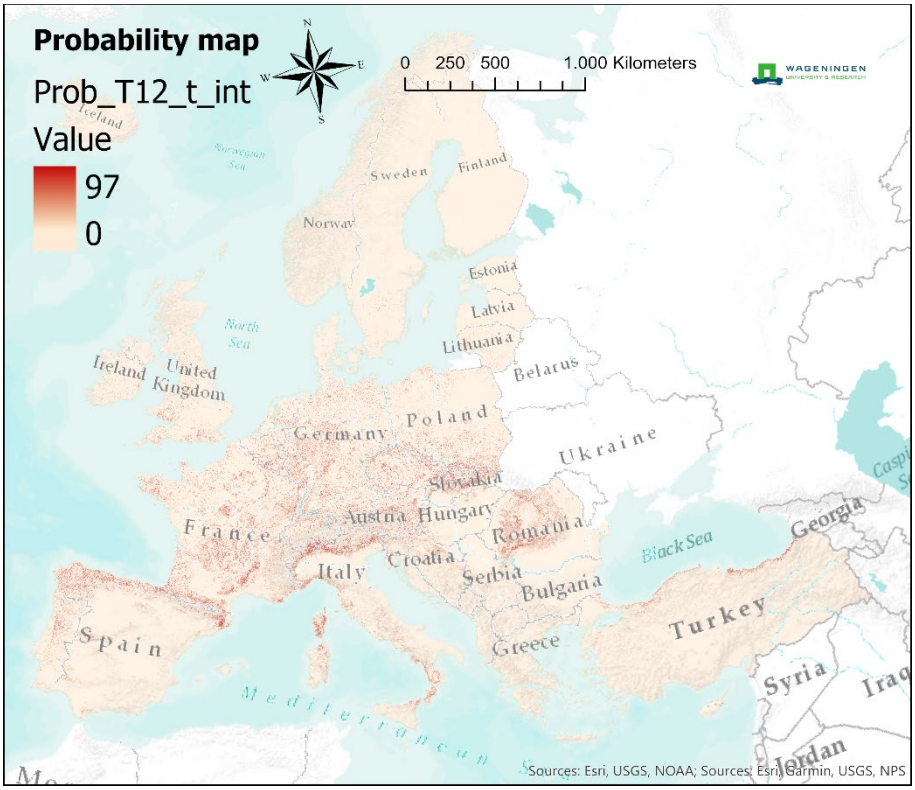


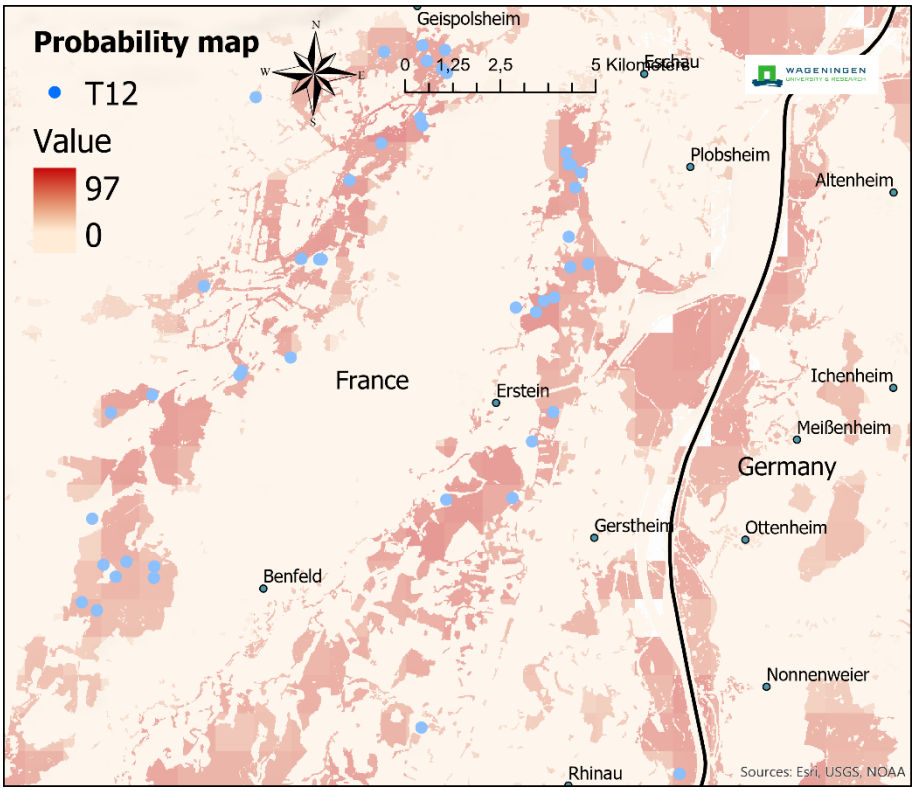

Probability map
T11
Value
100
0
Uhercice
Hustopece
Kobylí
Dubnany
Hroznová Lhota
Strážnice
Ratiskovice
Cejkovice
Mutenice
Petrov
Velké Vrbice
Pavlovice
0 3 6 12 Kilometers
WAGENINGEN UNIVERSITY & RESEARCH
Rohatec
Dolní Bojanovice
Sakvice
Zajecí
Velké Bílovice
Hodonín
Skalica
Rakvice
Podivín
Czech Republic
Prusánky
Mikulcice
Holíc
Moravská Nová Ves
Hrusky
Kopcany
Radosovce
Lednice
Hlohovec
Breclav
Tvrdonice
Kostice
Unín
Drasenhofen
Valtice
Lanzhot
Gbely
Senica
Stefanov
Bernhardsthal
Brodské
Dojc
Sajdíkove
Humence
Kúty
Cáry
Slovakia
Sastín-Stráze
Poysdorf
Borský Sväty Jur
Grosskrut
Borský Mikulás
Hohenau an der March
Moravský Svätý Ján
Austria
Laksárska Nová Ves
Prievaly
Wiltersdorf
Závod
Studienka
Zistersdorf
Drösing
Velké Leváre
Sources: Esri, USGS, NOAA

T12 - [G12a] Alnus glutinosa-Alnus incana forest on riparian and mineral soils

Riparian and land-upheaval forests dominated by Alnus glutinosa, A. incana, and sometimes Fraxinus excelsior, typically without many softwood willows in the canopy and occurring throughout Europe along streams and small to medium rivers. The field layer can be quite species-rich, especially in moister situations, when more nutrient demanding herbs such as Urtica dioica and Filipendula ulmaria may be abundant.

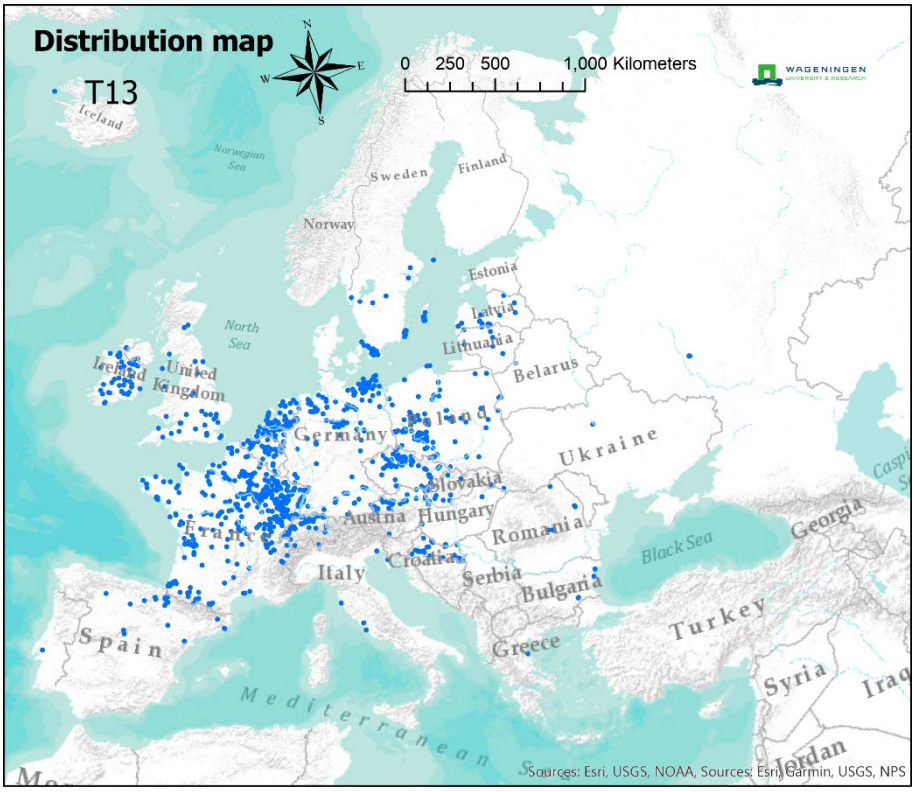


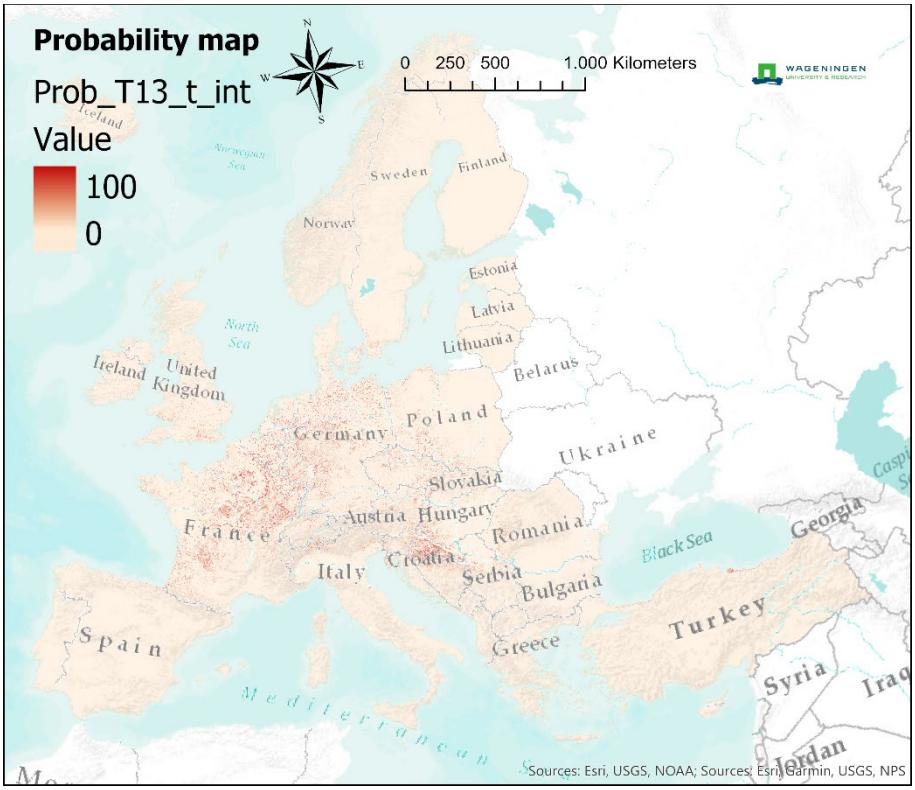


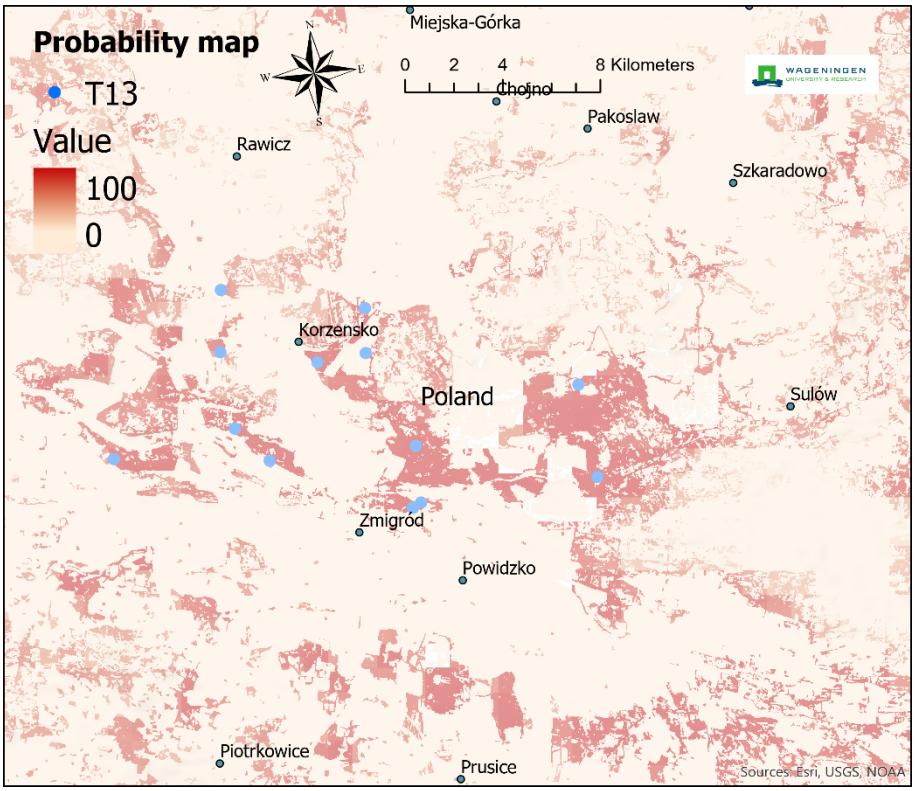

Probability map
T12
Value
97
0
Geispolsheim
0 1,25 2,5 5 Kilometers
Erstein
Plobsheim
Altenheim
France
Ichenheim
Meißenheim
Germany
Gerstheim
Ottenheim
Benfeld
Nonnenweier
Rhinau
Sources: Esri, USGS, NOAA

T13 - [G12b] Temperate hardwood riparian forest

Mixed broadleaved forests typical of less-frequently flooded, well-aerated mineral soils on floodplains of major European rivers. The canopy in high-forest stands can be very tall and multi-layered and is typically dominated by mixtures of Fraxinus excelsior, F. angustifolia, Alnus glutinosa, Populus alba, P. canescens, Quercus robur, Prunus padus, Ulmus glabra, U. minor and U. laevis. There is typically an abundant and varied understorey, with a range of small trees, shrubs and lianes.

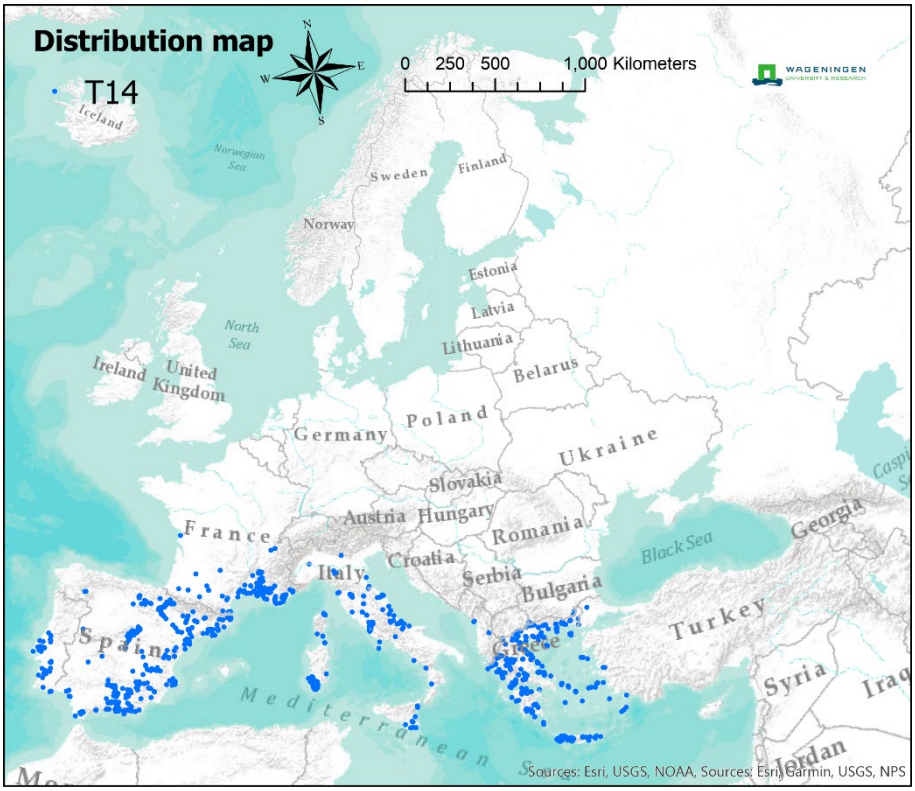


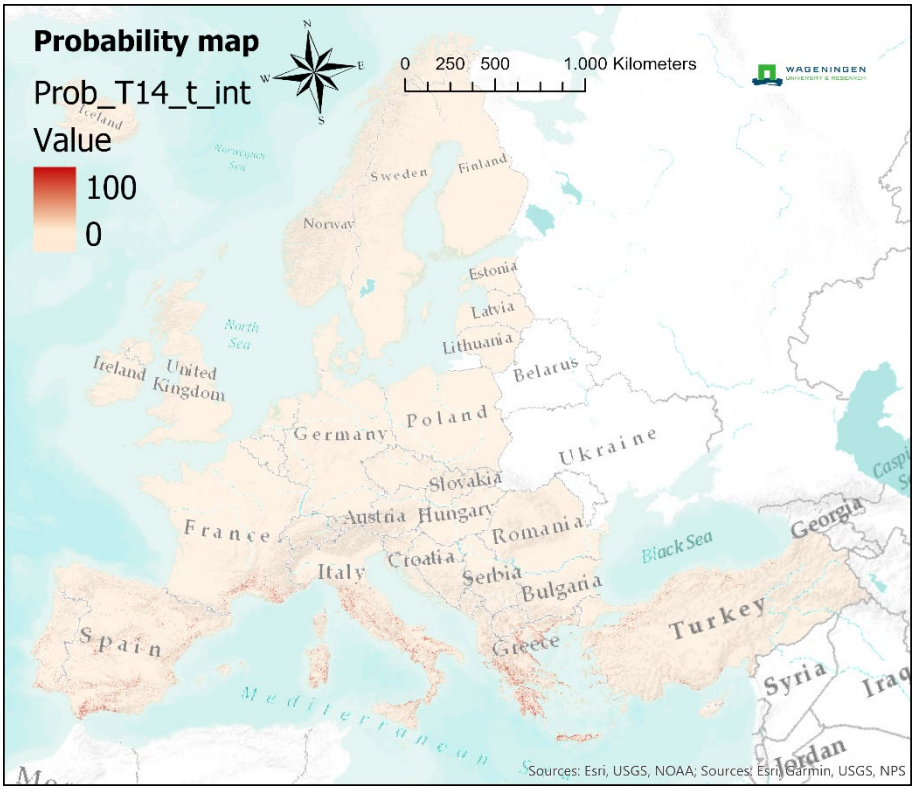


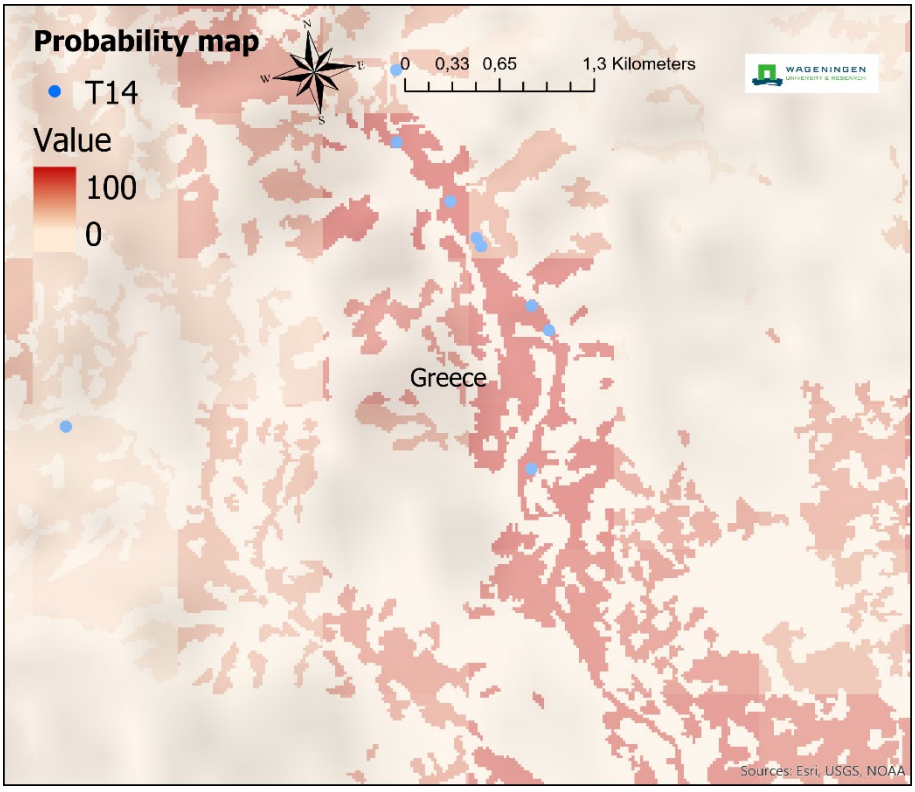

Probability map
T13
Value
100
0
Miejska-Górka
0 2 4 8 Kilometers
Chojno
Pakoslaw
Rawicz
Szkaradowo
Korzensko
Poland
Sulów
Zmigród
Powidzko
Piotrkowice
Prusice
Sources: Esri, USGS, NOAA

T14 - [G13] Mediterranean and Macaronesian riparian forest

Deciduous broadleaved forest, most commonly dominated by poplars (Populus), willows (Salix) or oriental plane (Platanus orientalis), on periodically flooded alluvium or gravel terraces and streamsides in humid localities in the mediterranean zone and Macaronesia. Also includes streamside forests with Rhododendron ponticum and birch (Betula pendula var. fontqueri) in Spain.

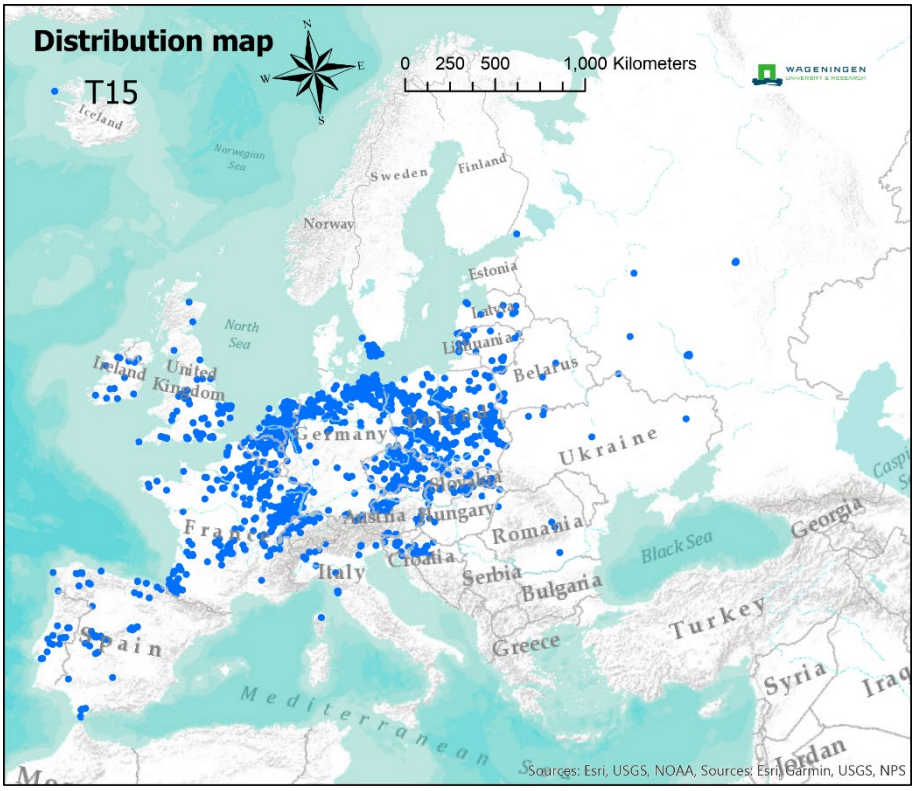


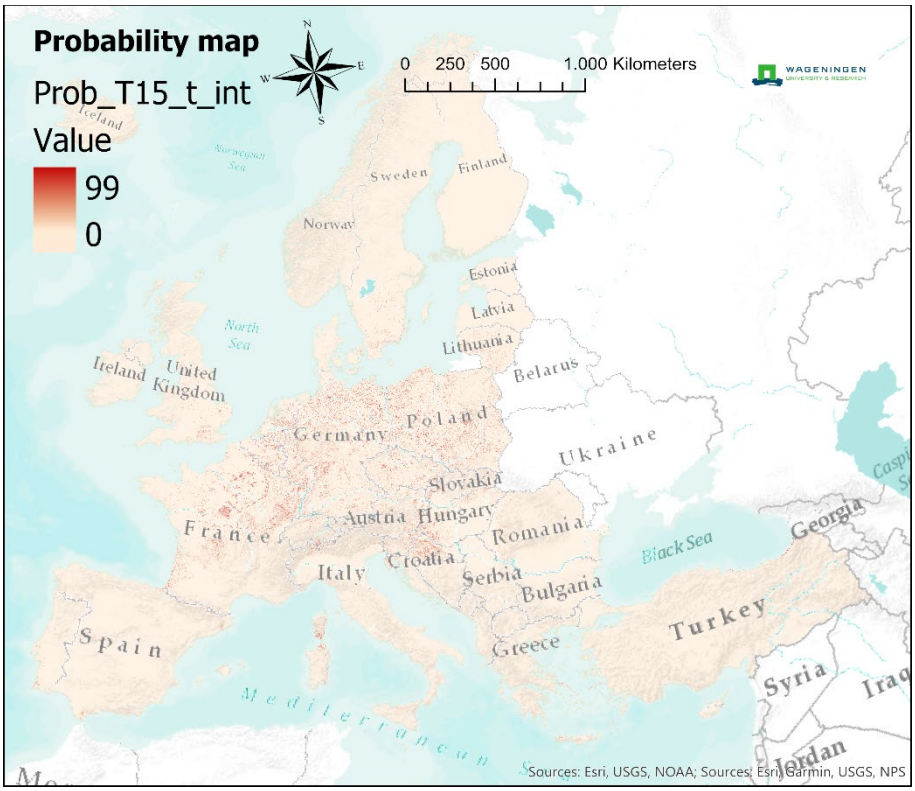


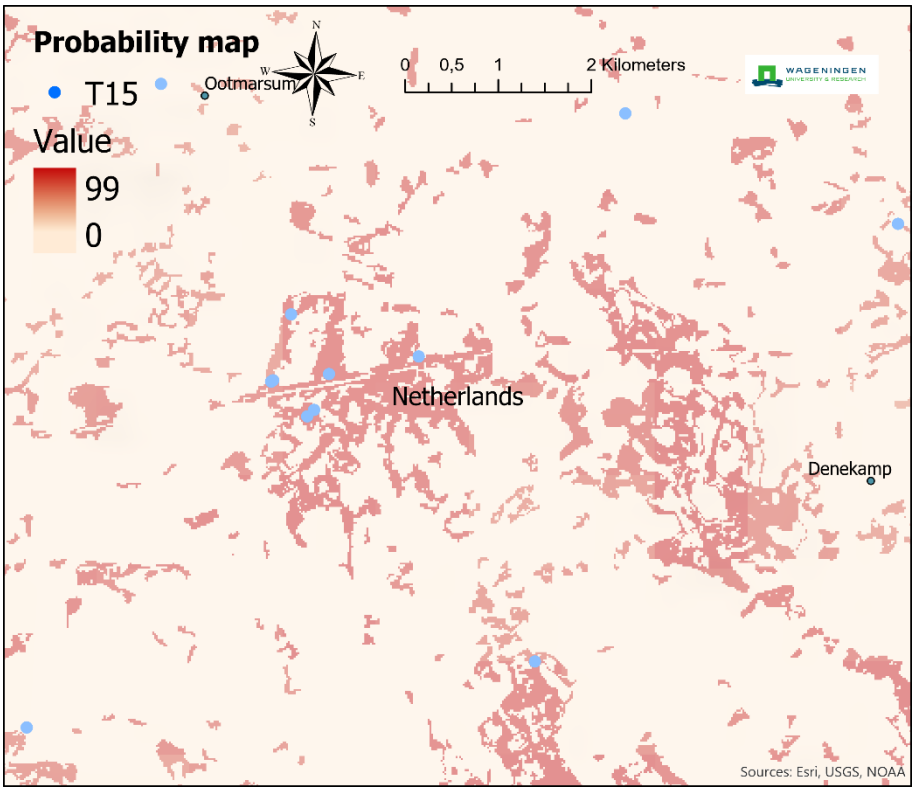

Probability map
T14
Value
100
0
N
W
E
S
0 0,33 0,65 1,3 Kilometers
WAGENINGEN
Greece
Sources: Esri, USGS, NOAA

T15 - [G14] Broadleaved swamp forest on non-acid peat

Deciduous broadleaved forest, commonly dominated by alder (Alnus glutinosa, A. incana), oak (Quercus robur) or aspen (Populus tremula) on non-acid peat with ground water at or seasonally above the surface in swamps through the lowlands of the nemoral and boreal zones.

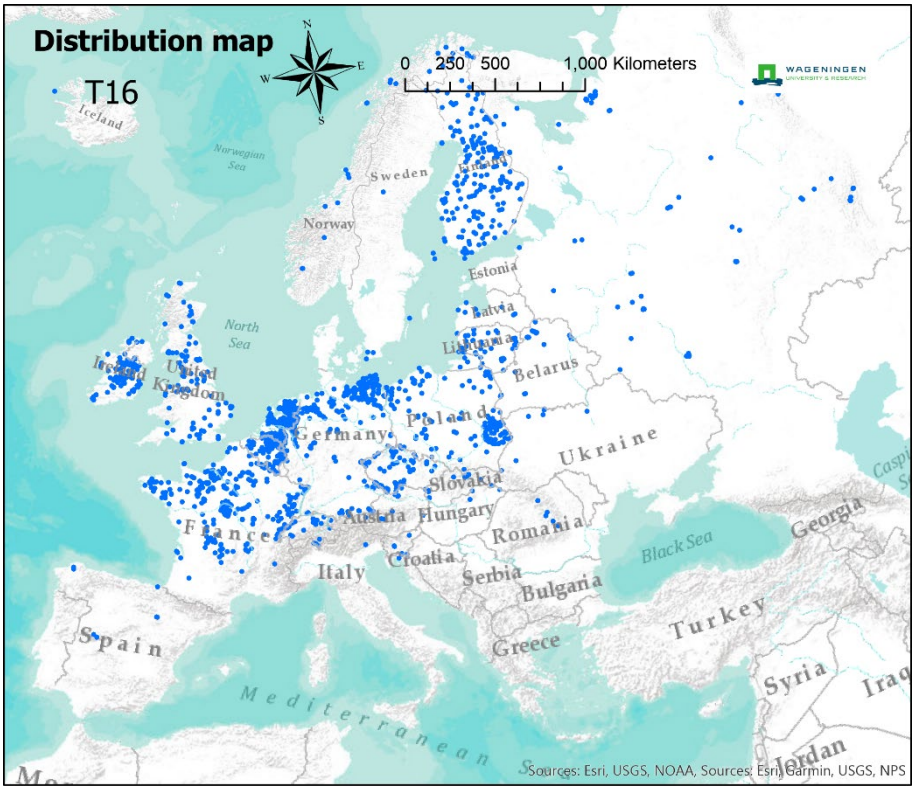


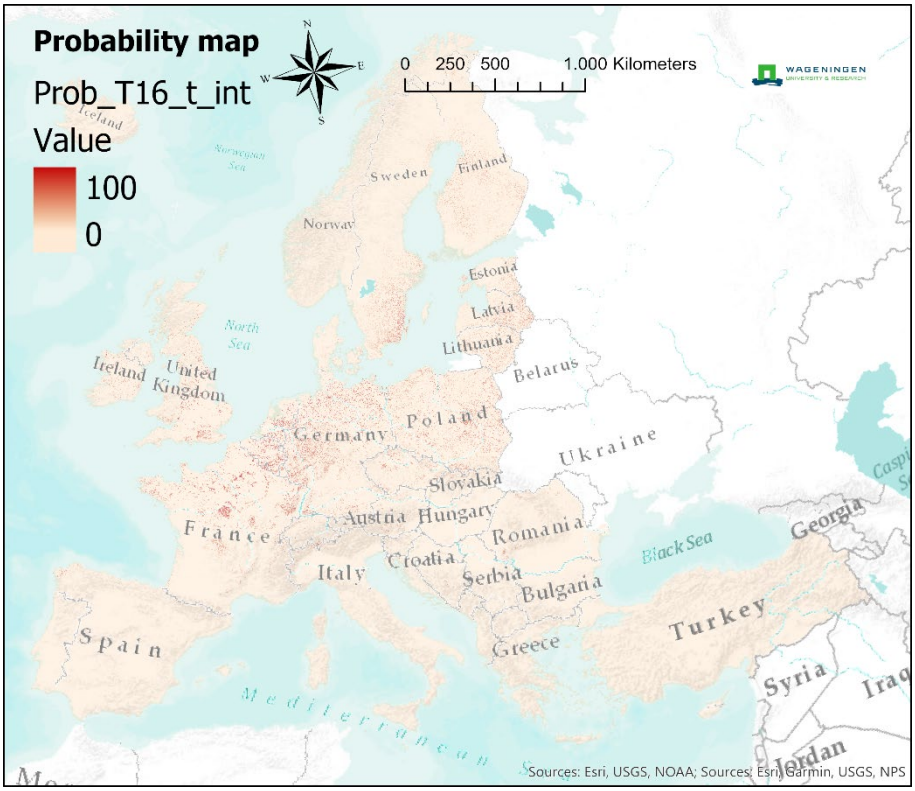


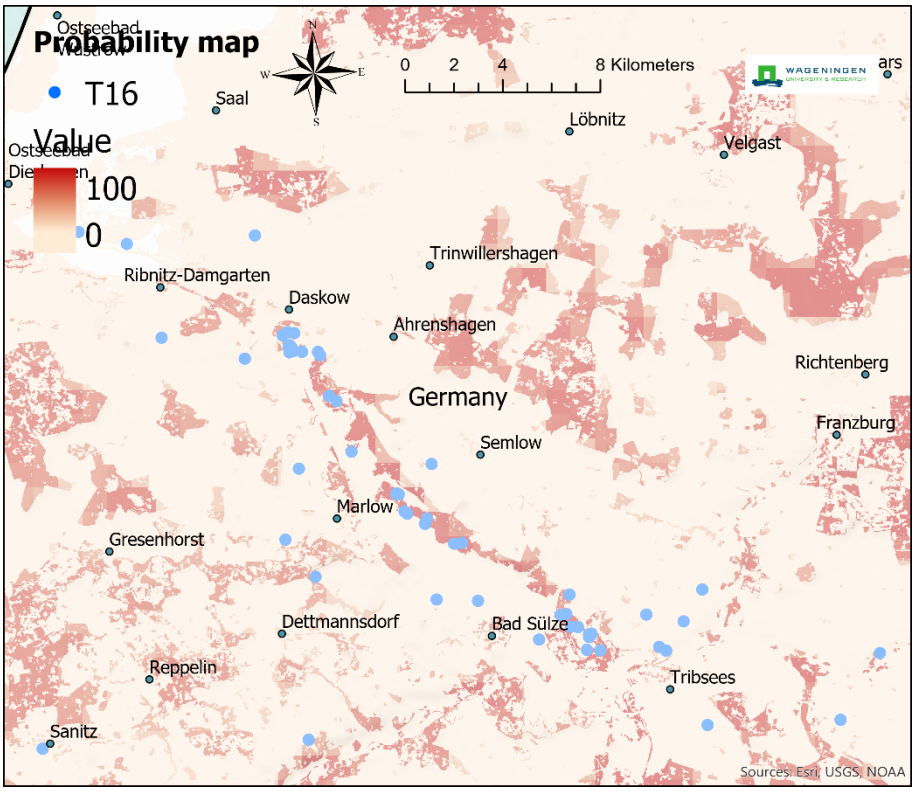

Probability map
T15
Value
99
0
Ootmarsum
N
W
E
S
0 0,5 1 2 Kilometers
WAGENINGEN
Netherlands
Denekamp
Sources: Esri, USGS, NOAA

T16 - [G15] Broadleaved mire forest on acid peat

Deciduous broadleaved or mixed forest on acid peat on or around active bogs and poor fens with nutrient-poor ground waters occurring through the atlantic and boreal zones and locally, where ground conditions permit, in the continental zone. Usually dominated by birch (Betula pubescens).

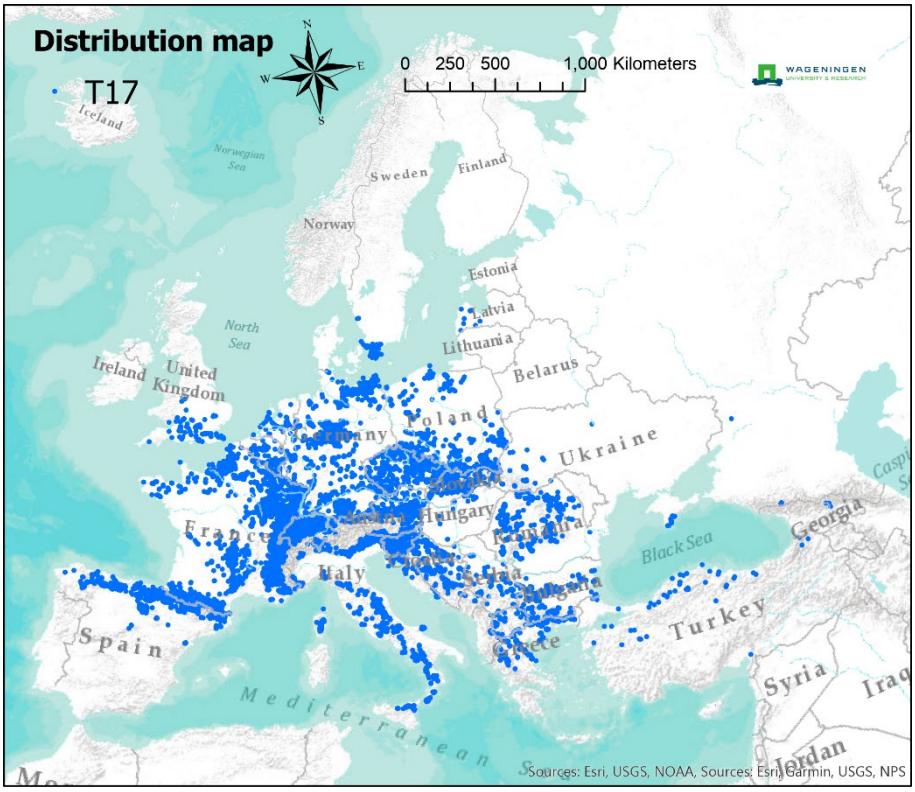


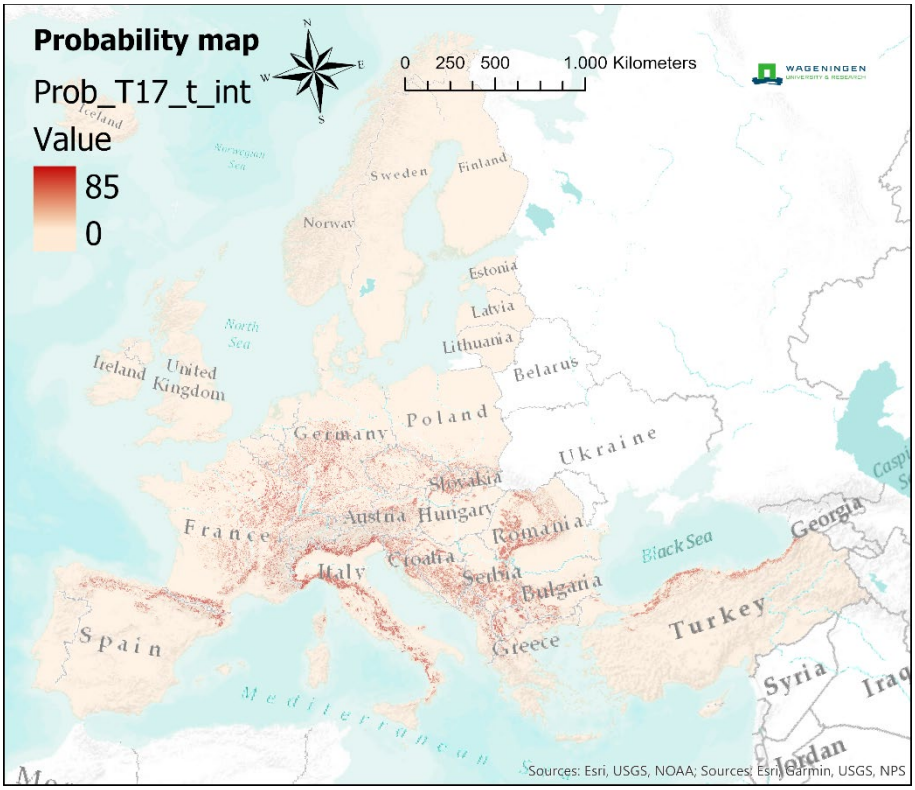


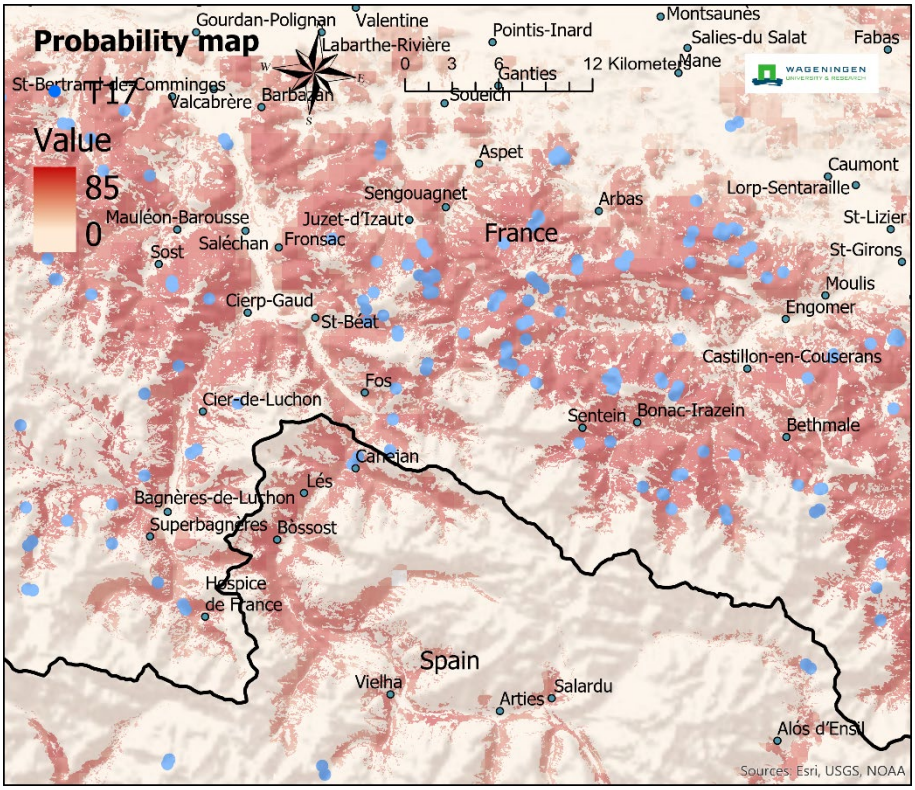

Probability map
T16
Value
100
0
0 2 4 8 Kilometers
N
W
E
S
Saal
Löbnitz
Velgast
Trinwillershagen
Ribnitz-Damgarten
Daskow
Ahrenshagen
Richtenberg
Germany
Franzburg
Semlow
Marlow
Gresenhorst
Dettmannsdorf
Bad Sülze
Reppelin
Tribsees
Sanitz
Sources: Esri, USGS, NOAA

T17 - [G16a] Fagus forest on non-acid soils

Beech- (Fagus sylvatica and F. orientalis) dominated forest of base-rich to neutral, oligotrophic to mesotrophic, mineral soils occurring through the atlantic and continental zones, and reaching into the alpine and, at higher altitudes, the submediterranean region. Associated trees, including evergreen conifers like fir (Abies alba) and spruce (Picea abies) which figures at the altitudinal limit. The field layer can be species-rich.

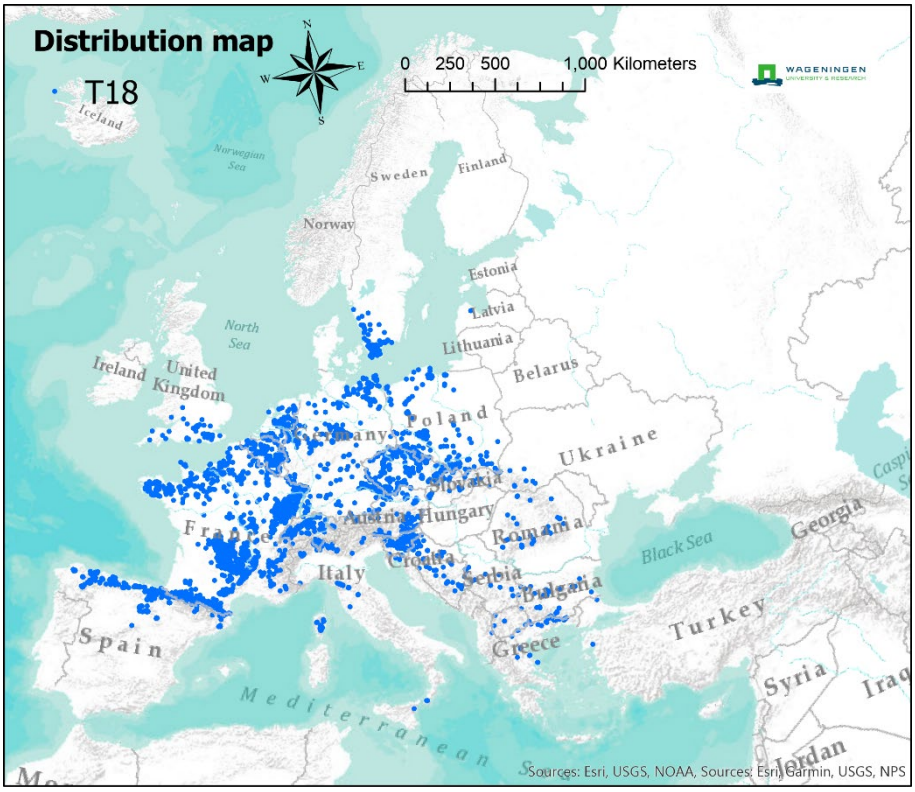


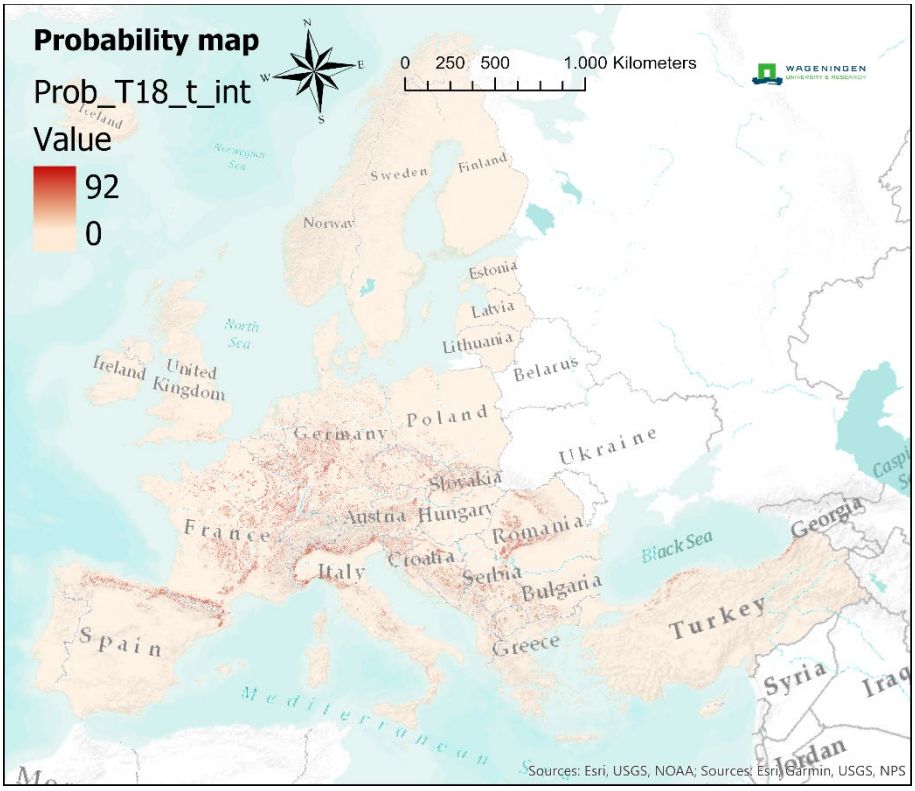


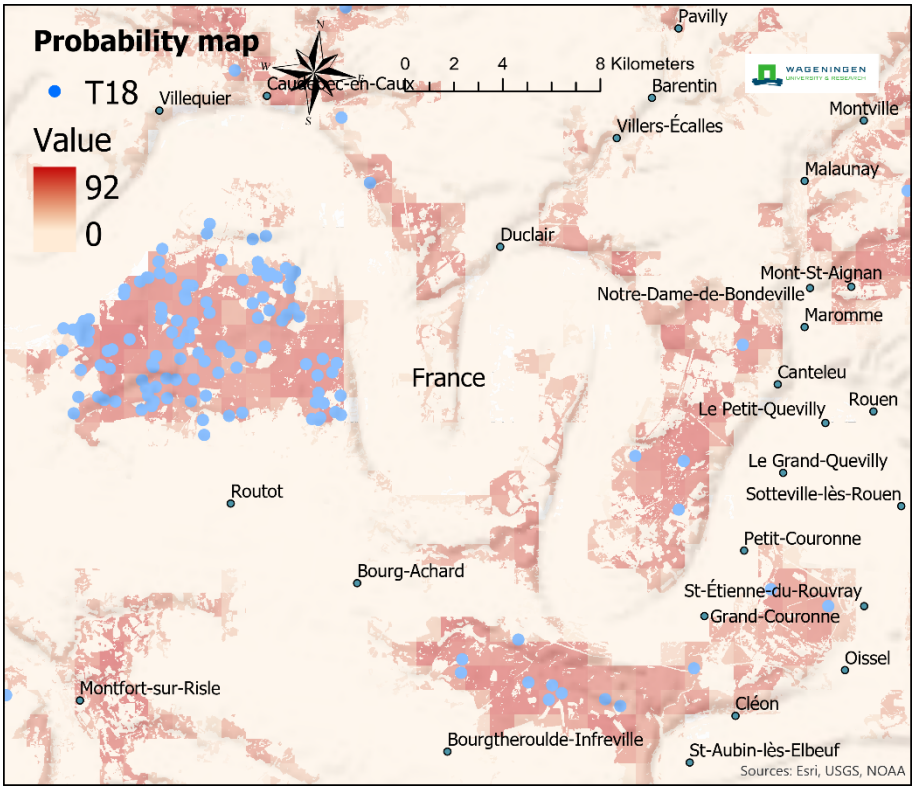

Probability map
T17
Value
85
0
Gourdan-Polignan
Valentine
Labarthe-Rivière
Pointis-Inard
Montsaunès
Salies-du Salat
Fabas
Mane
Ganties
12 Kilometers
0 3 6
St-Bertrand-de-Comminges
Valcabrère
Barbazan
Soueich
WAGENINGEN
Aspet
Caumont
Lorp-Sentaraille
Sengouagnet
Arbas
St-Lizier
Mauléon-Barousse
Juzet-d'Izaut
France
Saléchan
Fronsac
Sost
St-Girons
Moulis
Engomer
Cierp-Gaud
St-Béat
Castillon-en-Couserans
Fos
Cier-de-Luchon
Sentein
Bonac-Irazein
Bethmale
Cazeian
Lés
Bagnères-de-Luchon
Superbagnères
Bossost
Hospice
de France
Spain
Vielha
Salardu
Arties
Alos d'Ensil
Sources, Esri, USGS, NOAA

T18 - [G16b] Fagus forest on acid soils

Beech- (Fagus sylvatica and F. orientalis) dominated woodland of oligotrophic, base-poor mineral soils through the atlantic and continental zones, into the alpine and, at higher altitudes, the submediterranean zone. Associated broadleaved trees are few and always subordinate in cover, though oaks may be co-dominant. Evergreen conifers like fir (Abies alba) and, at the altitudinal limit, spruce (Picea abies) can figure as minority canopy components. The field layer is generally species-poor.

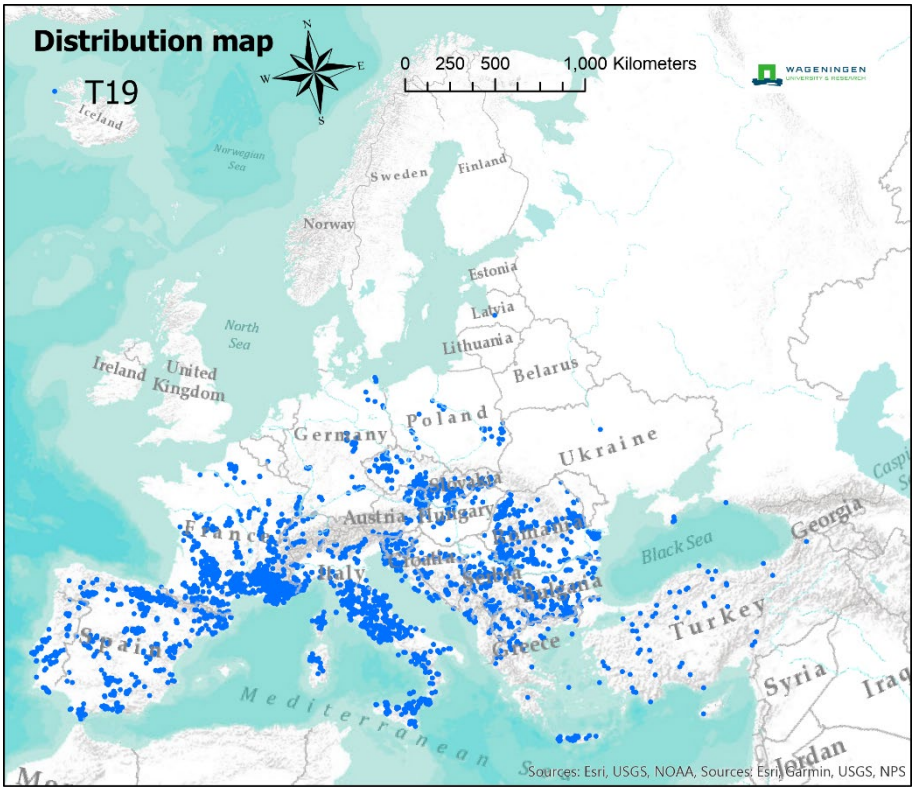


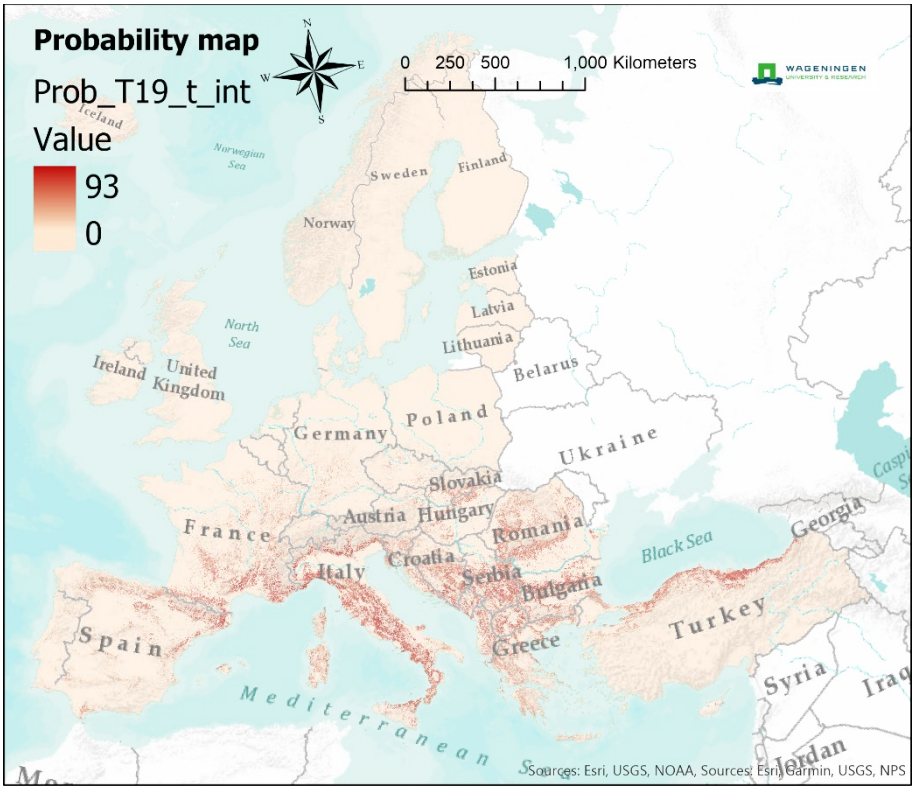


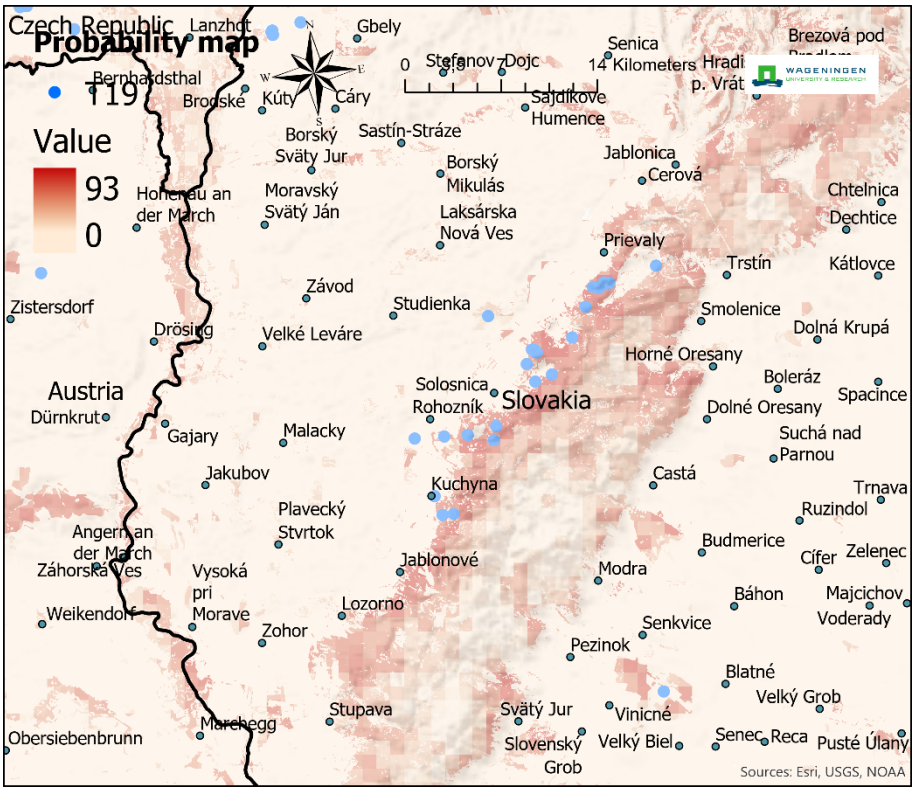

Probability map
T18
Value
92
0
N
W
S
0 2 4 8 Kilometers
WAGENINGEN
UNIVERSITY & RESEARCH
Pavilly
Villequier
Barentin
Montville
Villers-Écalles
Malaunay
Duclair
Mont-St-Aignan
Notre-Dame-de-Bondeville
Maromme
France
Canteleu
Rouen
Le Petit-Quevilly
Le Grand-Quevilly
Routot
Sotteville-lès-Rouen
Petit-Couronne
Bourg-Achard
St-Étienne-du-Rouvray
Grand-Couronne
Oissel
Montfort-sur-Risle
Cléon
Bourgtheroulde-Infreville
St-Aubin-lès-Elbeuf
Sources: Esri, USGS, NOAA

T19 - [G17a] Temperate and submediterranean thermophilous deciduous forest

These thermophilous broadleaved deciduous forests form a wide, but interrupted, belt across the submediterranean zone of Europe, with milder winters and warmer drought-prone summers than sustain the broadleaved temperate forests, but colder, intermittently frosty and snowy winters than are typical for the evergreen broadleaved forests and scrub of the Mediterranean. To the north, they tend to occupy lower altitude, drier and warmer sites, to the south, rainier sites at higher altitudes.

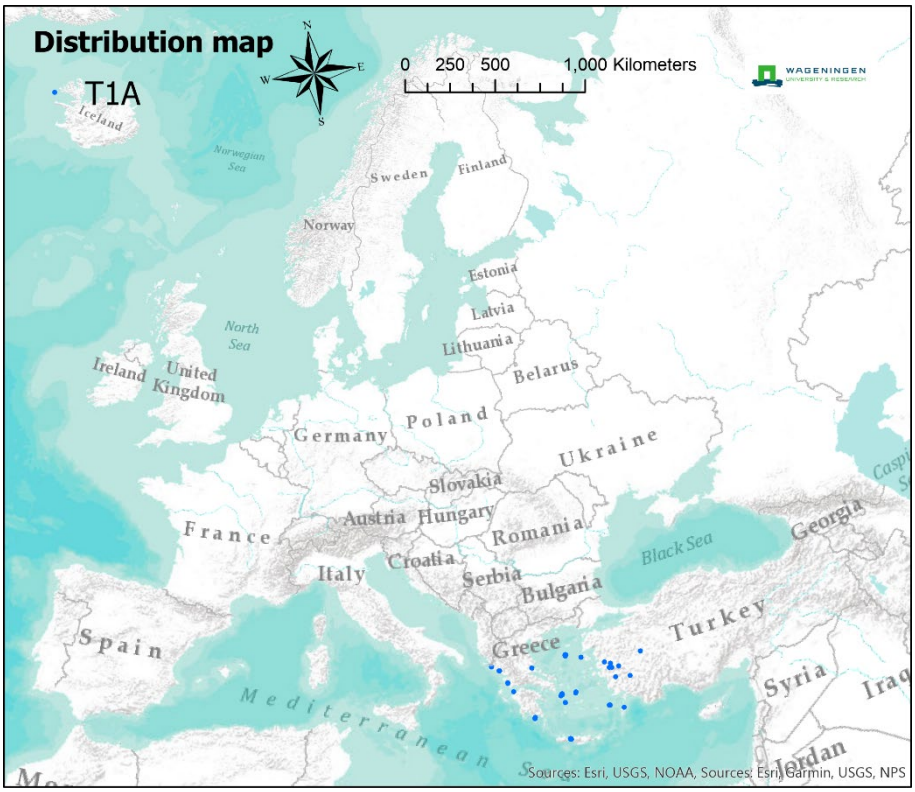


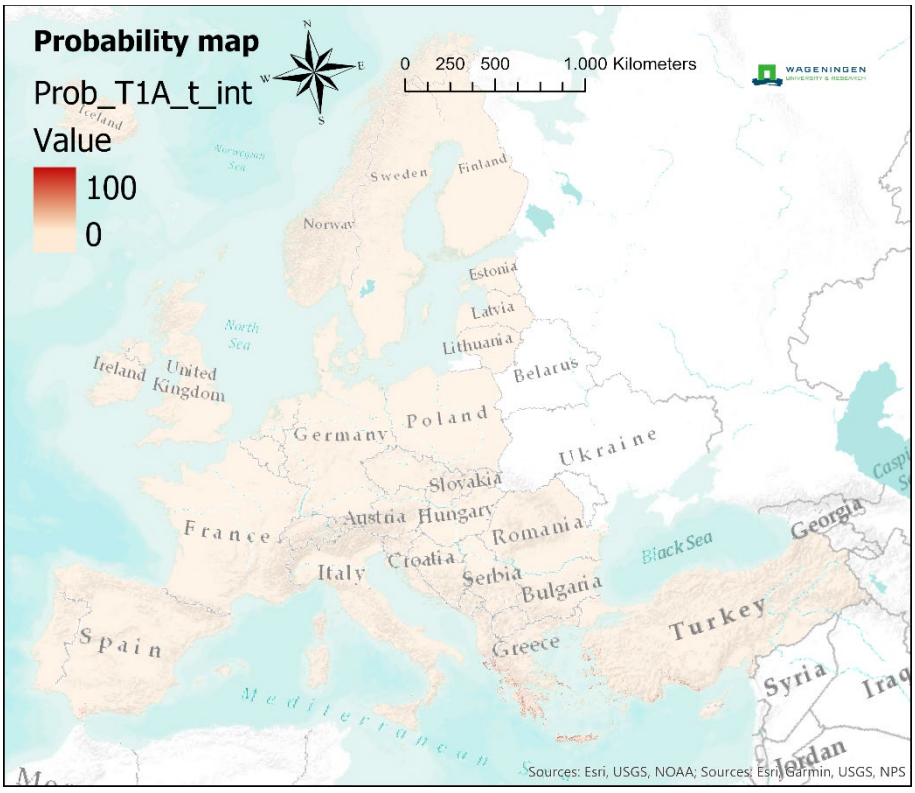


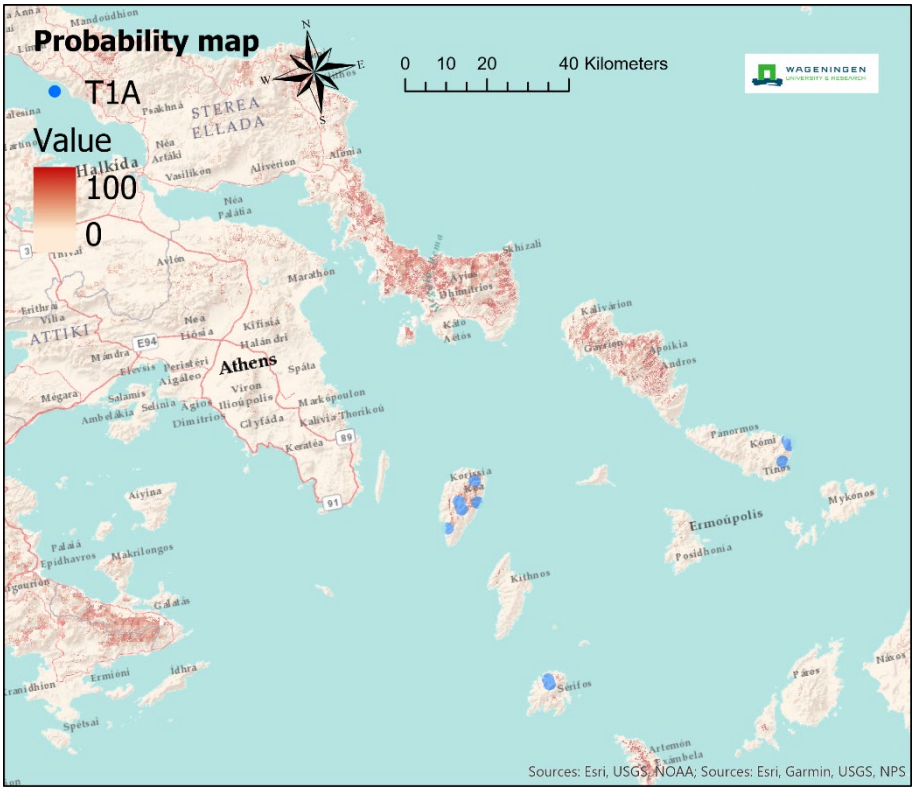

Probability map
Value
93
0
119
Czech Republic
Austria
Slovakia
Lanzhot
Gbely
Bernhardsthal
Brodské
Kúty
Cáry
Borský Sväty Jur
Sastín-Stráze
Stefanov
Dojc
Senica
14 Kilometers
Hradi p. Vrát
Brezová pod
Sajdíkove Humence
Jablonica
Cerová
Borský Mikulás
Laksárska Nová Ves
Moravský Sväty Ján
Hohenau an der March
Chtelnica
Dechtice
Prievaly
Trstín
Kátlovce
Závod
Studienka
Smolenice
Dolná Krupá
Zistersdorf
Drösing
Velké Leváre
Horné Oresany
Boleráz
Spacince
Solosnica
Rohozník
Dolné Oresany
Dürnkrut
Gajary
Malacky
Suchá nad Parnou
Jakubov
Kuchyna
Castá
Trnava
Ruzindol
Plavecký Stvrtok
Angern an der March
Budmerice
Cífer
Zelenec
Záhorská Ves
Vysoká pri Morave
Jablonové
Modra
Majcichov
Báhon
Weikendorf
Lozorno
Voderady
Senkvice
Zohor
Pezinok
Blatné
Velký Grob
Marchegg
Stupava
Svätý Jur
Vinicné
Obersiebenbrunn
Slovenský Grob
Velký Biel
Senec
Reca
Pusté Úlany
Sources: Esri, USGS, NOAA

T1A - [G17b] Mediterranean thermophilous deciduous forest

Mediterranean deciduous forests usually dominated by Quercus ithaburensis subsp. macrolepis forming open forest, the canopy may be pure or with other oaks. Stands are mostly on shallow soil at usually at altitudes less than 700 m.

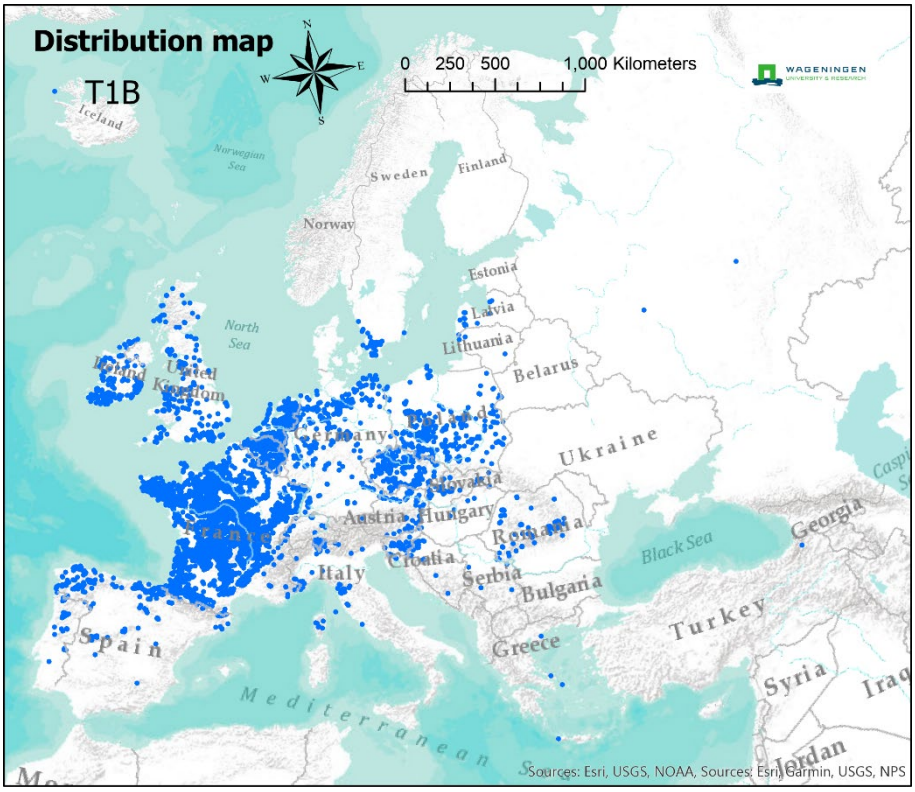


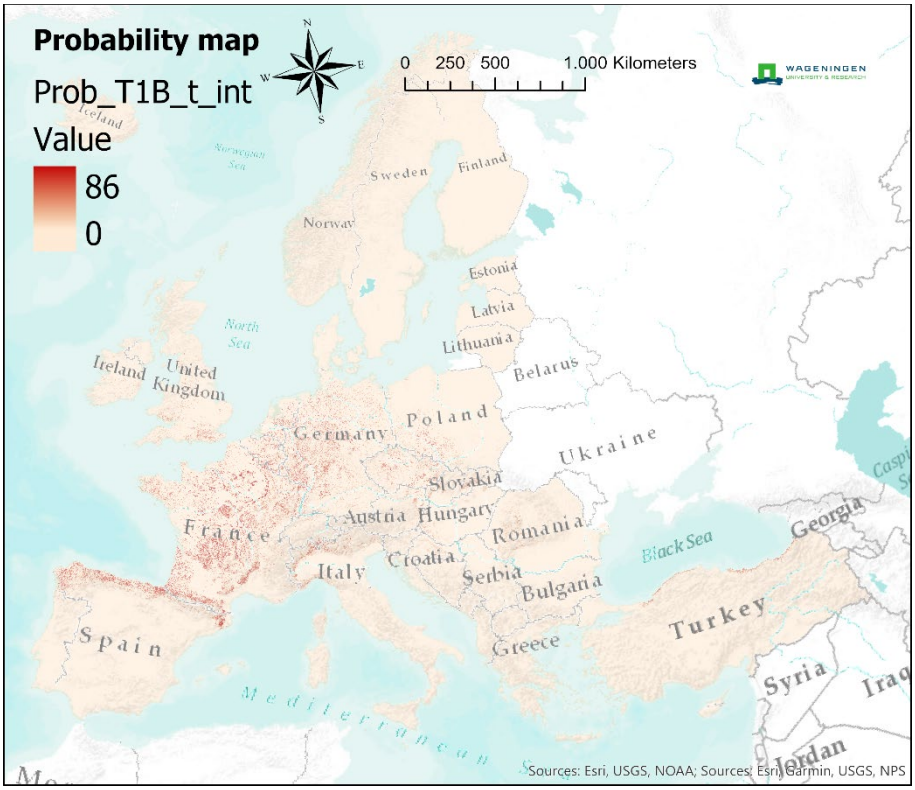


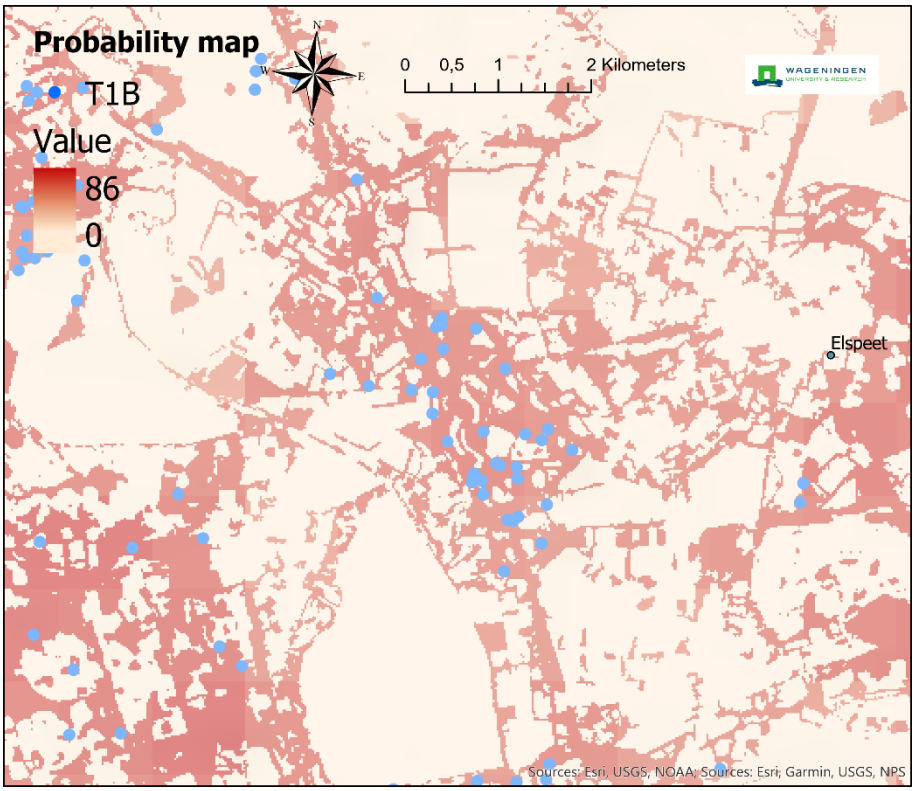

Probability map
T1A
Value
100
0
N
W
E
S
0 10 20 40 Kilometers
WAGENINGEN
STEREA ELLADA
ATTIKI
Athens
Halkida
Aliveri
Skhizali
Kalivia Thorikou
Ermoúpolis
Posidhonia
Kithnos
Serifos
Mykonos
Sources: Esri, USGS, NOAA; Sources: Esri, Garmin, USGS, NPS

T1B - [G18] Acidophilous Quercus forest

Oak-dominated forest (mainly Quercus robur and Q. petraea but also other regional species) of impoverished acid soils through the atlantic and continental zones, where beech (Fagus sylvatica) is a potential competitor and extending northwards into the boreal zone where Scot's pine (Pinus sylvestris) increasingly figures in the canopy. Associated floras are generally rather poor but show towards the very humid western Atlantic seaboard extraordinary richness of ferns and cryptogams.

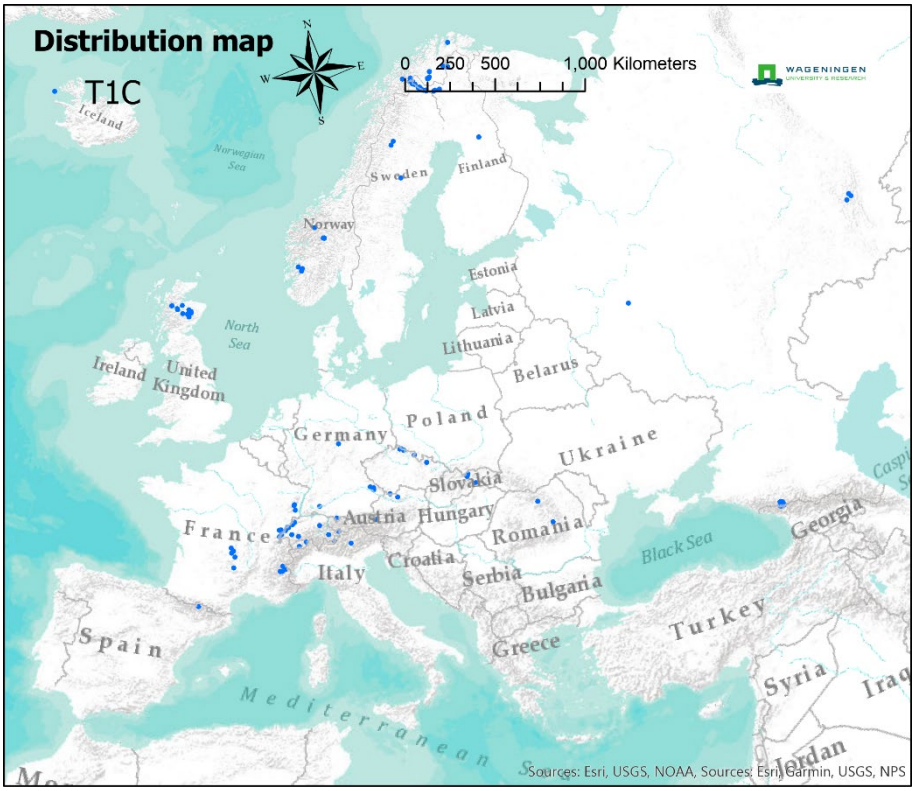


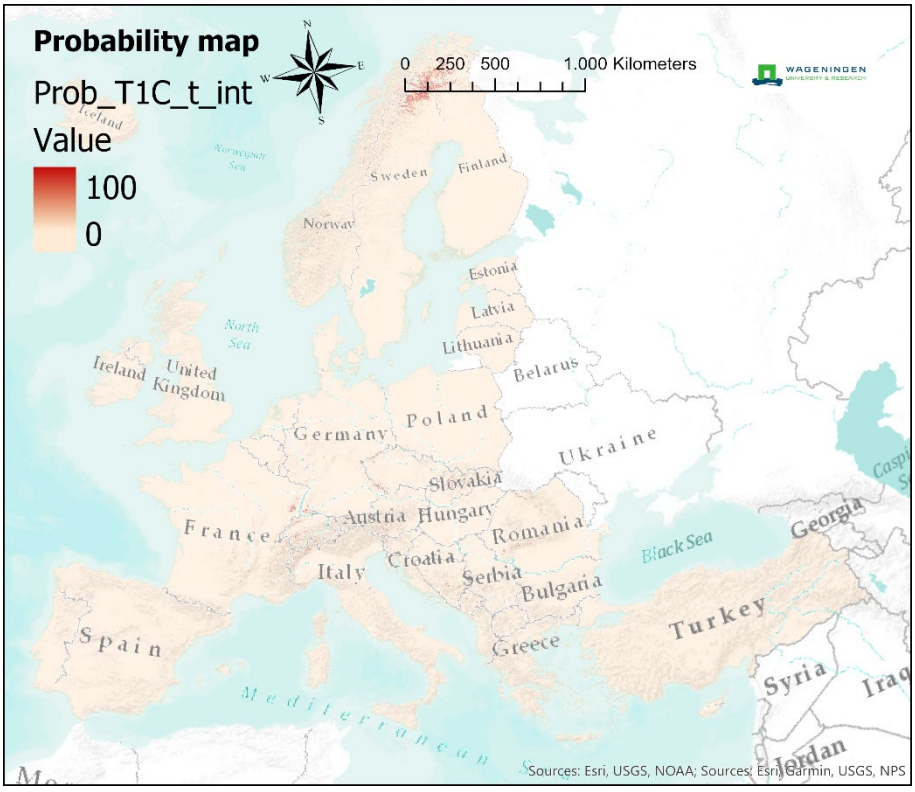


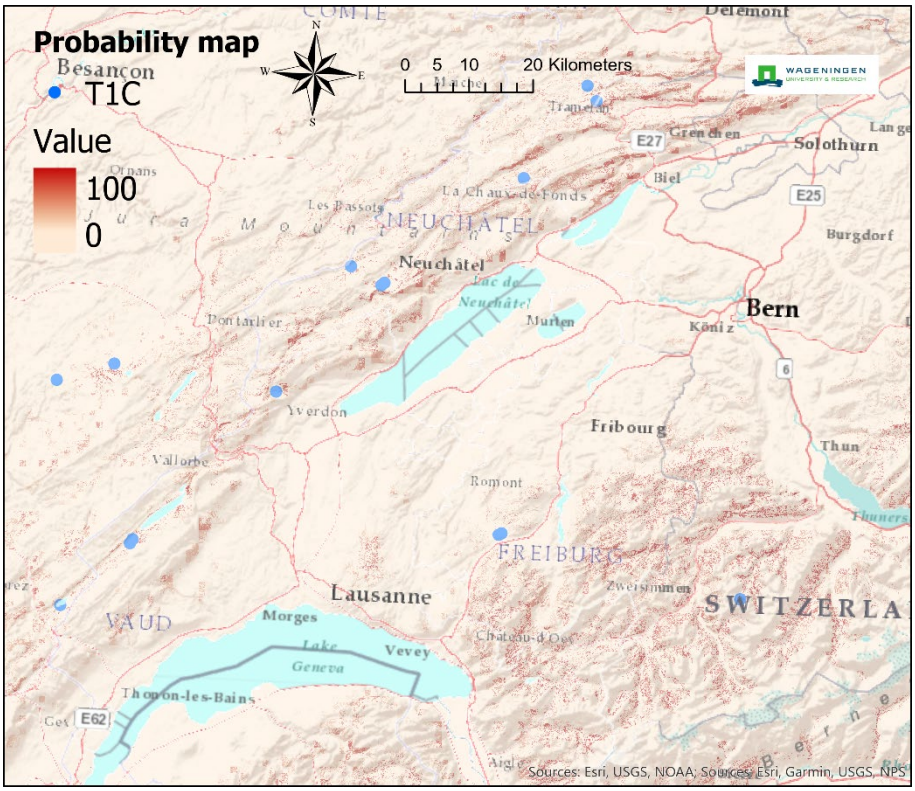

Probability map
T1B
Value
86
0
N
W
E
S
0 0,5 1 2 Kilometers
WAGENINGEN
UNIVERSITY & RESEARCH
Elspeet
Sources: Esri, USGS, NOAA; Sources: Esri, Garmin, USGS, NPS

T1C - [G19a] Temperate and boreal mountain Betula and Populus tremula forest on mineral soils

Open, low canopy climax birch forests (Betula pubescens var. glabrata, Betula pubescens var. pumila, Betula litwinowii) with a heathy or herb-rich field layer in the boreal region, in temperate mountain ranges, and in the Caucasus.

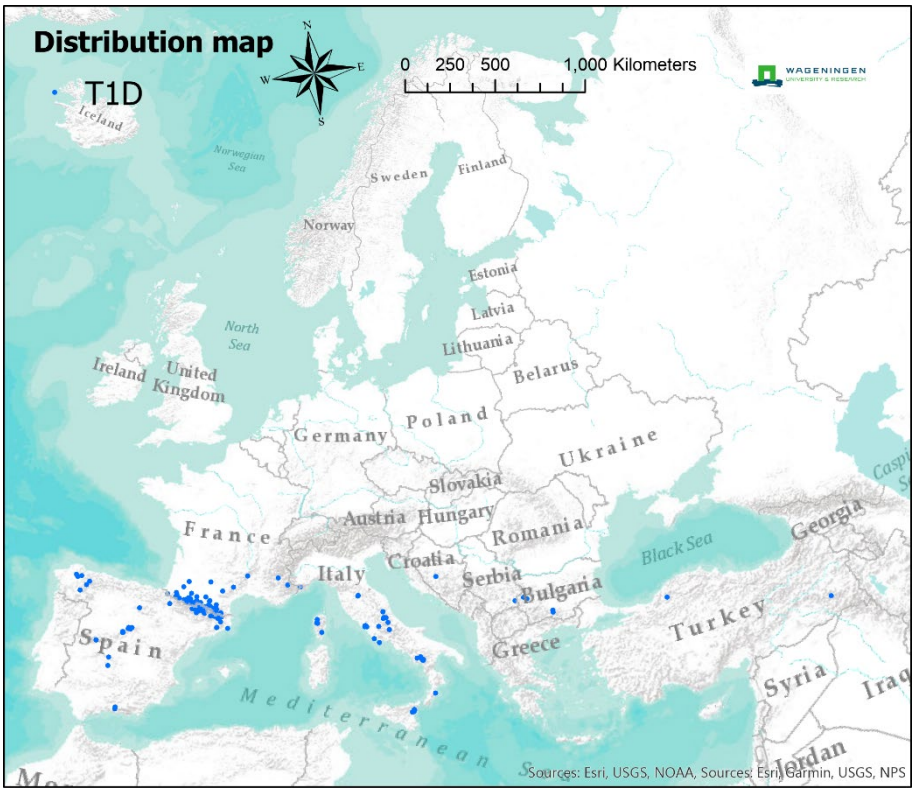


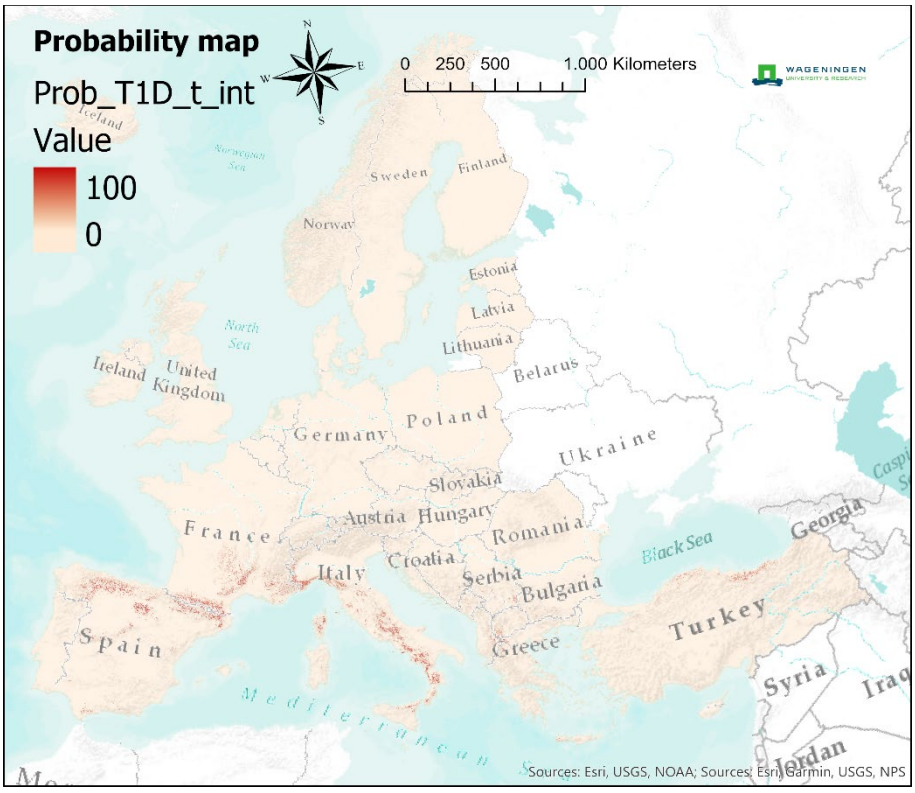


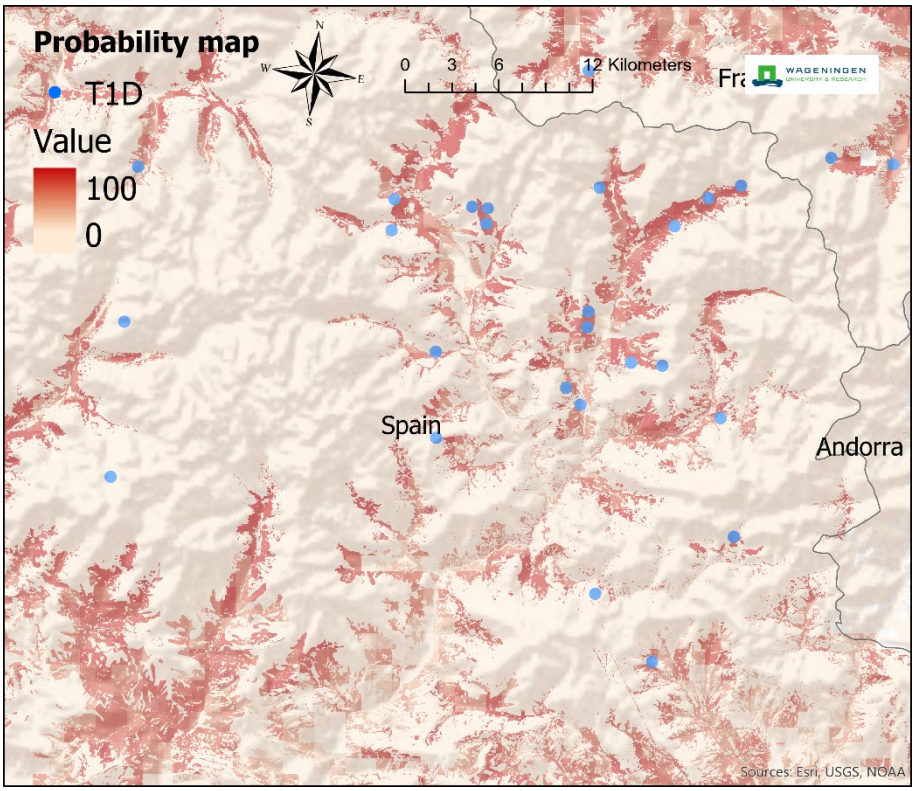

Probability map
T1C
Value
100
0
0 5 10 20 Kilometers
Besançon
Delémont
Solothurn
Grenchen
Biel
Burgdorf
Bern
Neuchâtel
Lac de Neuchâtel
Yverdon
Fribourg
Thun
Romont
Lausanne
Morges
Vevey
Lake Geneva
Thonon-les-Bains
Pontarlier
Vallorbe
Murten
Köniz
Zweisimmen
Sources: Esri, USGS, NOAA; Sources: Esri, Garmin, USGS, NPS

T1D - [G19b] Southern European mountain Betula and Populus tremula forest on mineral soils

Diverse climax forests dominated by birch (Betula pendula and closely related species) or aspen (Populus tremula) on usually acidic mineral soils in humid ravines and gorges in the sub-alpine Pyrenees, Corsica, the Apennines and Sicily, with associated floras characteristic of the local climatic conditions.

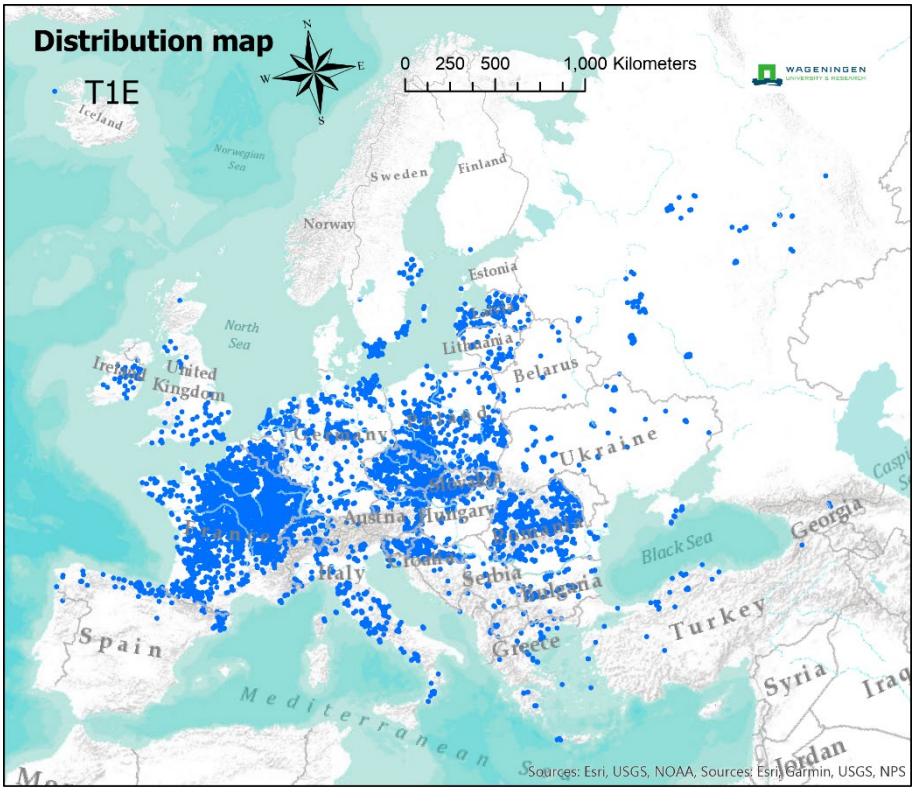


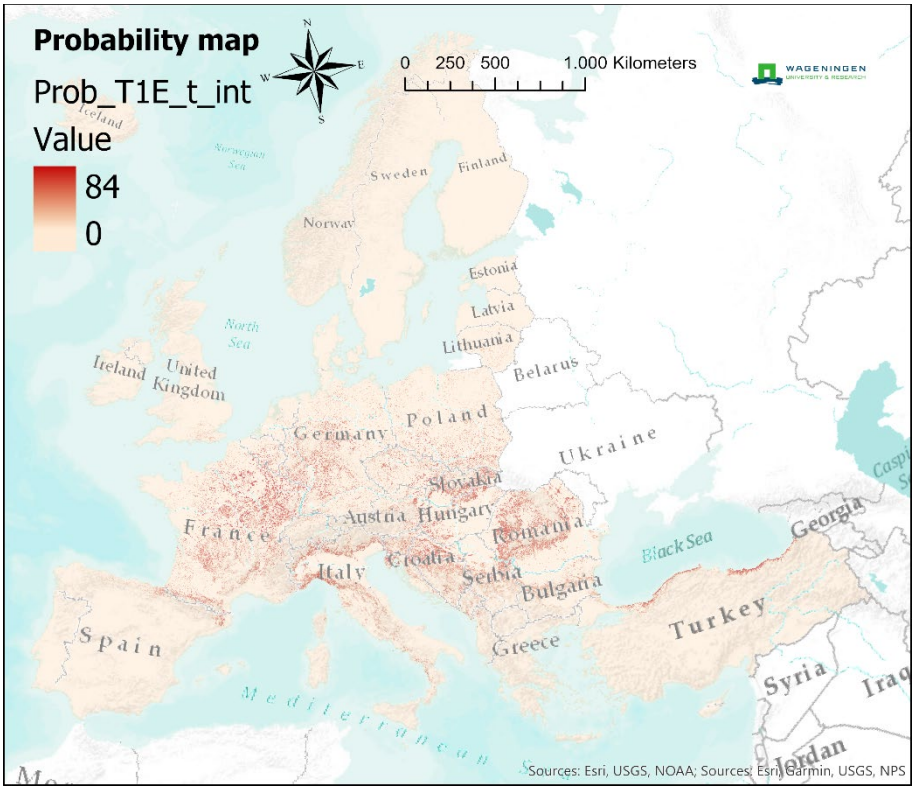


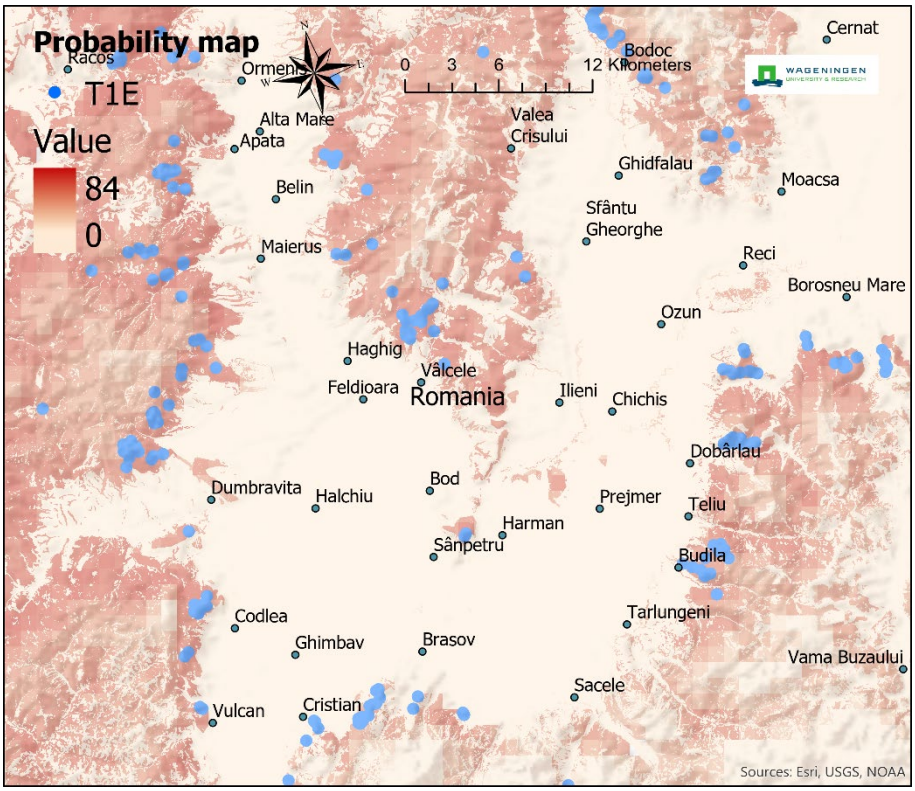

Probability map
T1D
Value
100
0
N
W
E
S
0 3 6 12 Kilometers
Fra
WAGENINGEN
Spain
Andorra
Sources: Esri, USGS, NOAA

T1E - [G1Aa] Carpinus and Quercus mesic deciduous forest

Deciduous broadleaved forests typical of somewhat to strongly impeded brown earth soils and gleys of quite low, moderate to high base-status and moderate to high nutrient content across the lowlands and foothills of the temperate zone of western, central and southern Europe, with local extensions into regions of submediterranean, Pannonian and boreal climate. Partially this includes alluvial Quercus/ Carpinus-dominated forests in mountain valleys with infrequent indundation.



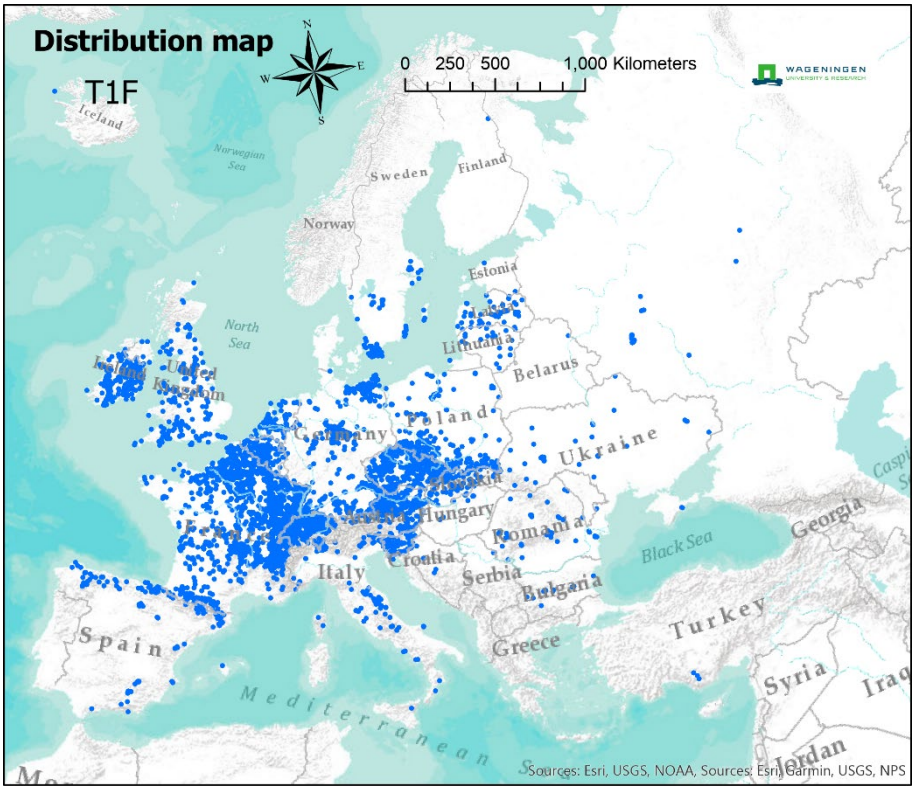


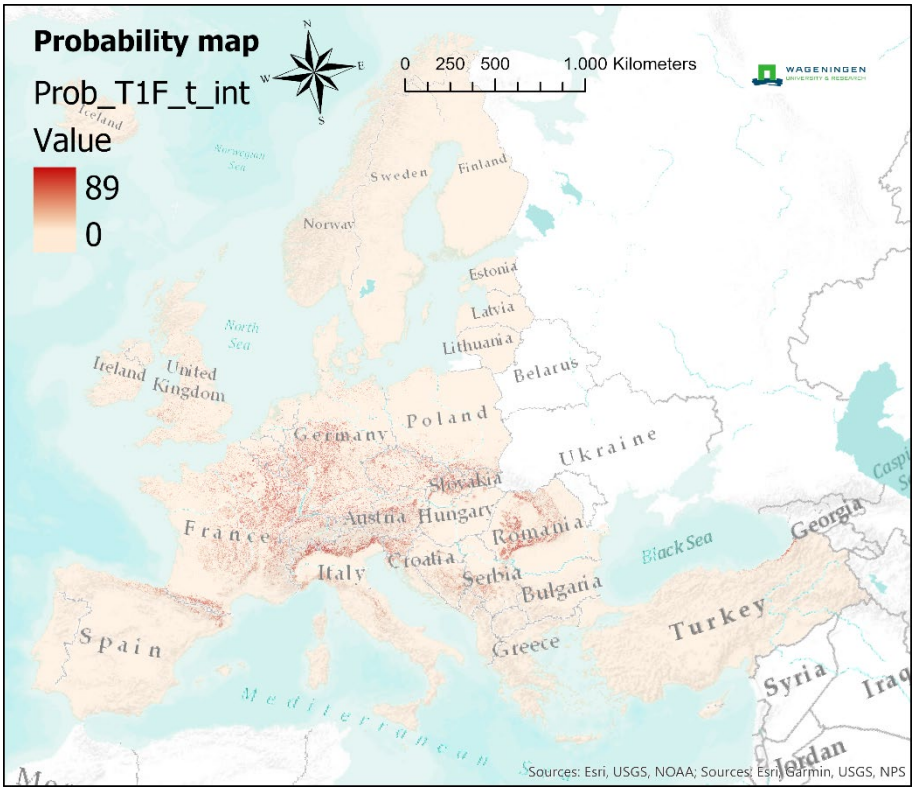


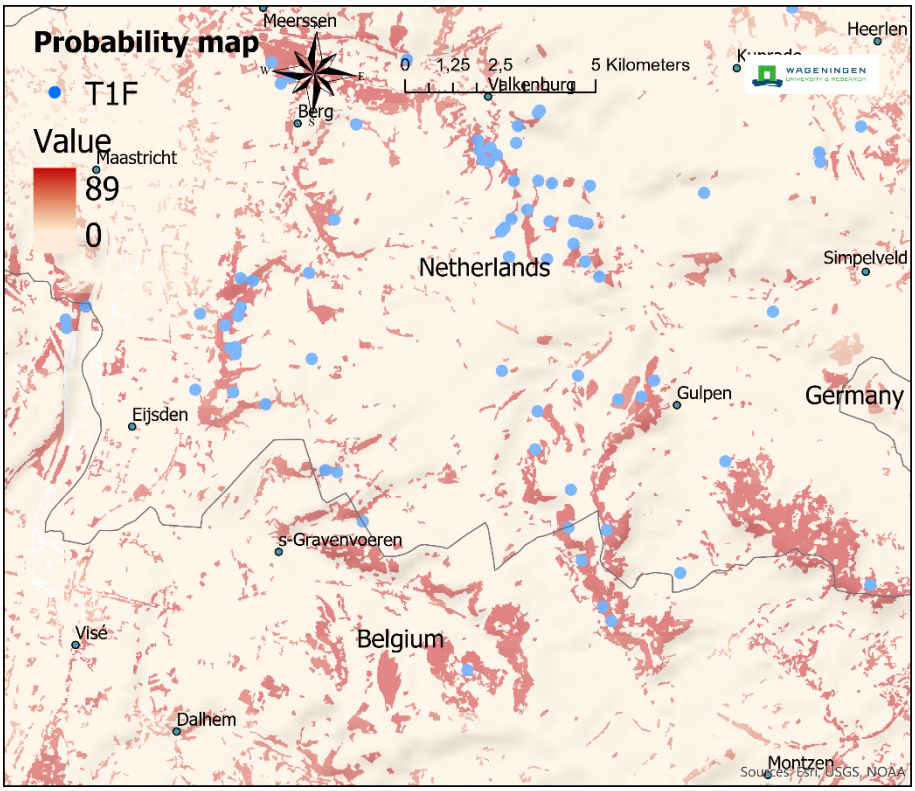
The canopy is typically of mixed composition with oaks figuring prominently, notably Quercus robur and Q. petraea but with regional contributions from other oaks, along with Carpinus betulus, Fraxinus excelsior, Acer pseudoplatanus, A. campestre, A. platanoides, Ulmus glabra, Tilia cordata and T. tomentosa. Typically, Fagus sylvatica is at most a minor component. The canopy can have a complex, multi-layered structure including shrubs and lianes while the herb layer can be species-rich with much regional variation in composition.

T1F - [G1Ab] Ravine forest

Forests on steep slopes, frequently in ravines, where deep, well drained and fertile soils develop which allow trees such as Fraxinus excelsior, Acer pseudoplatanus, A. platanoides, Ulmus glabra, Tilia platyphyllos and Tilia cordata to outcompete trees such as Fagus sylvatica and Quercus spp.



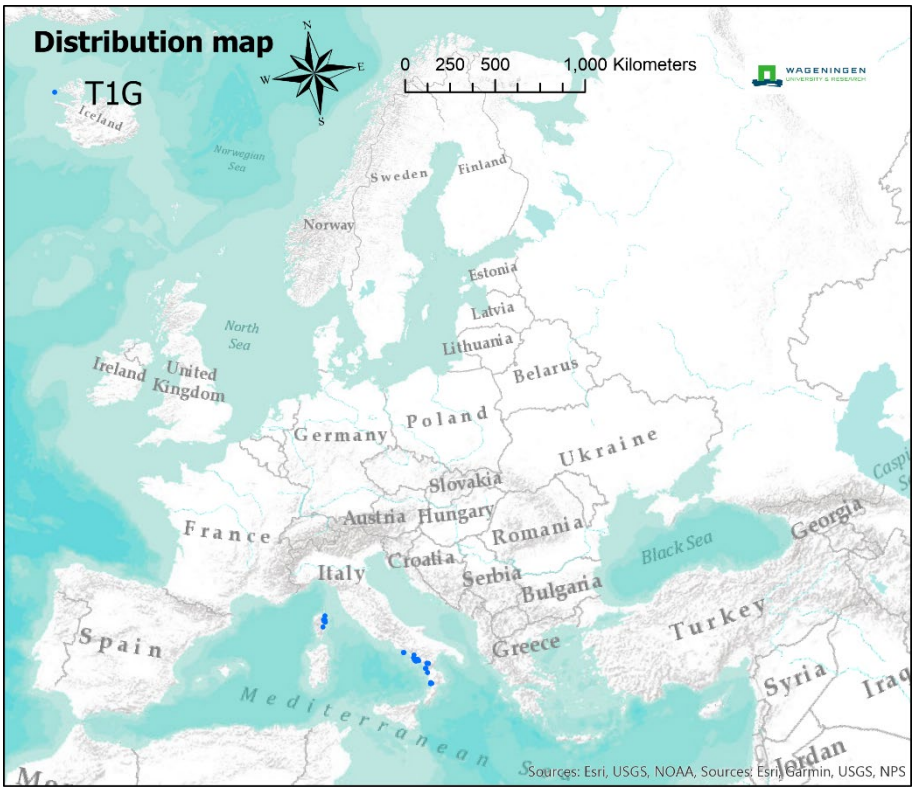


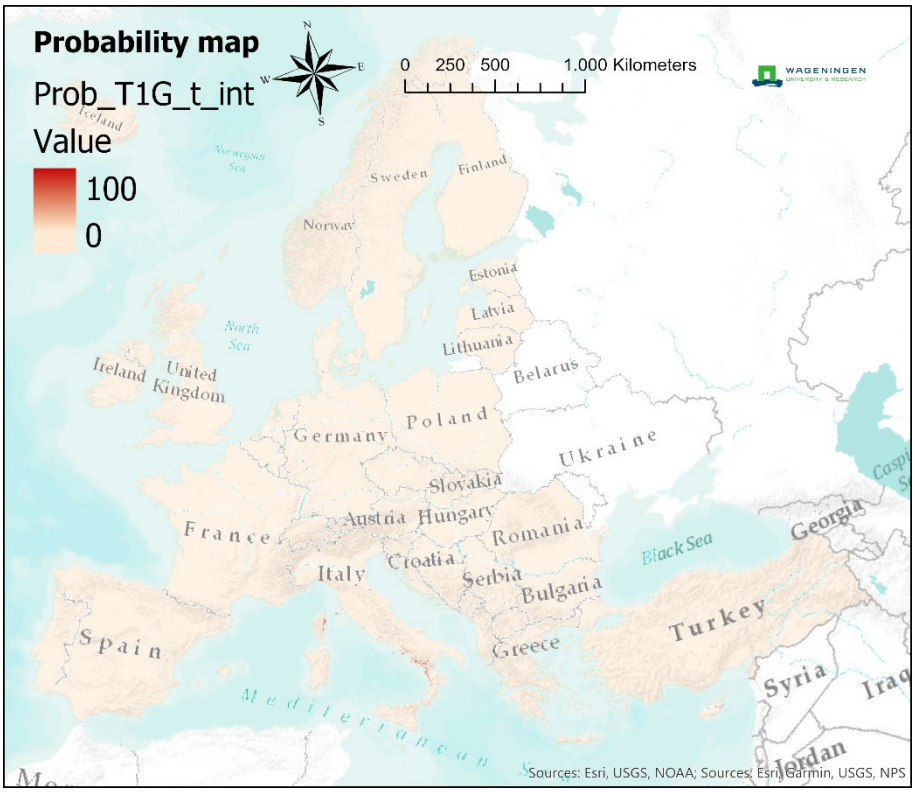


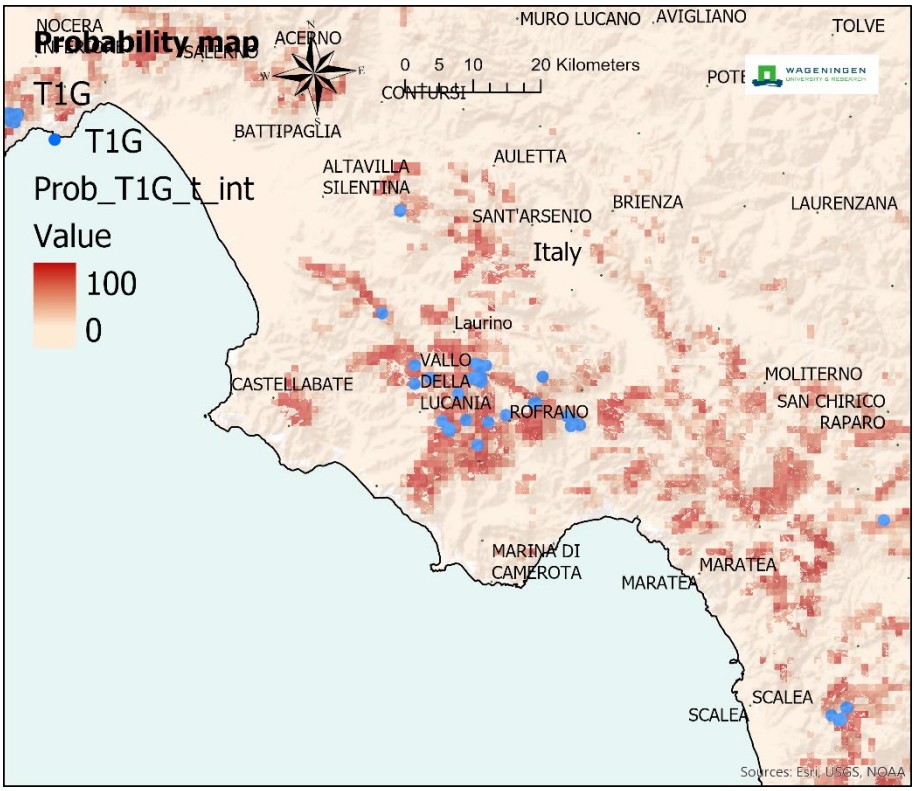
The herb layer is dominated by luxuriant nitrophilous herbs such as Urtica diocia, Aegopodium podagraria and Impatiens noli-tangere, moisture-loving vernal plants like Allium ursinum and, on the typically base-rich soils, Mercurialis perennis, Geranium robertianum, Brachypodium sylvaticum and Circaea lutetiana. In the southern part of its distribution thermophilous species such as Cotoneaster integerrimus, Sesleria caerulea, Athericum ramosum and Vincetoxicum hirundinaria appear.

T1G - [G1Ba] Alnus cordata forest

Temperate nonriparian, nonmarshy forest dominated by Alnus cordata.

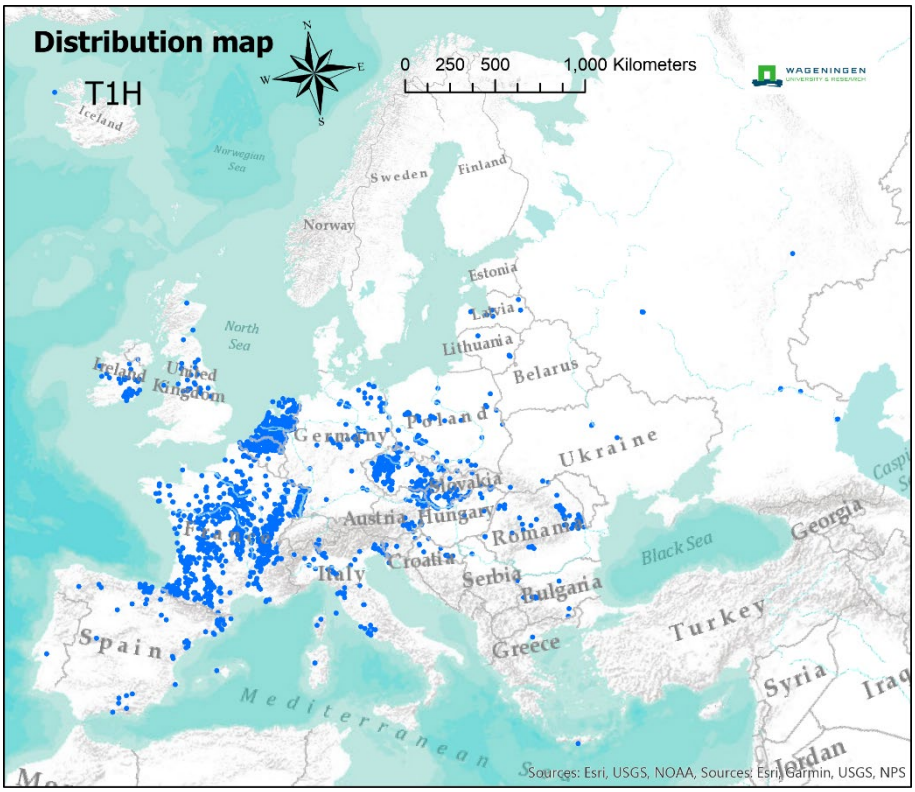


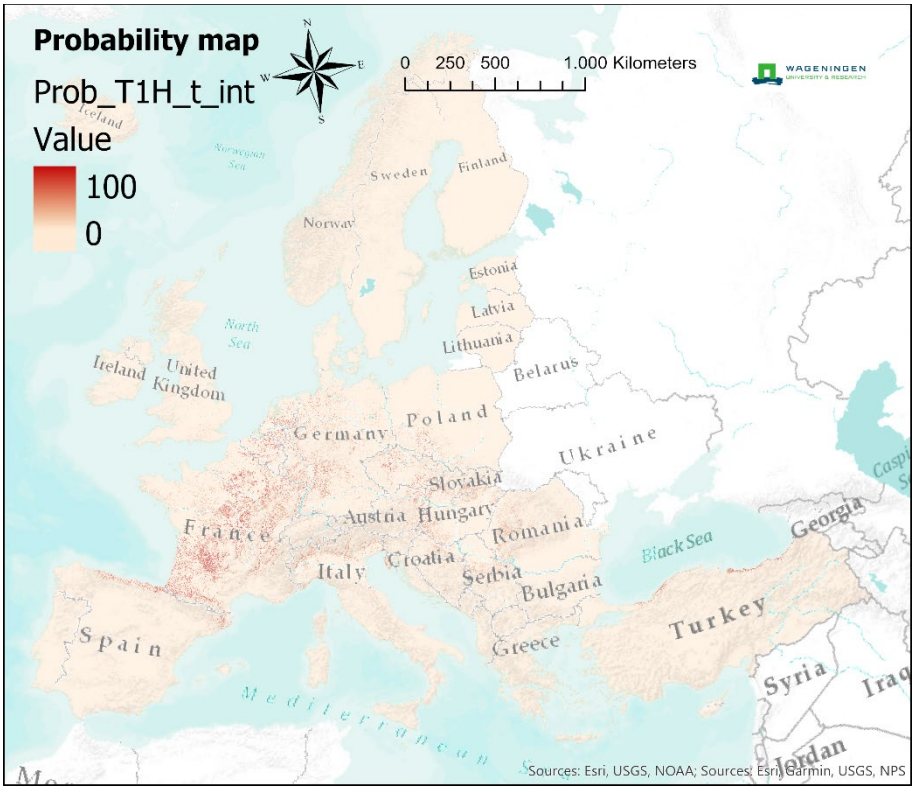


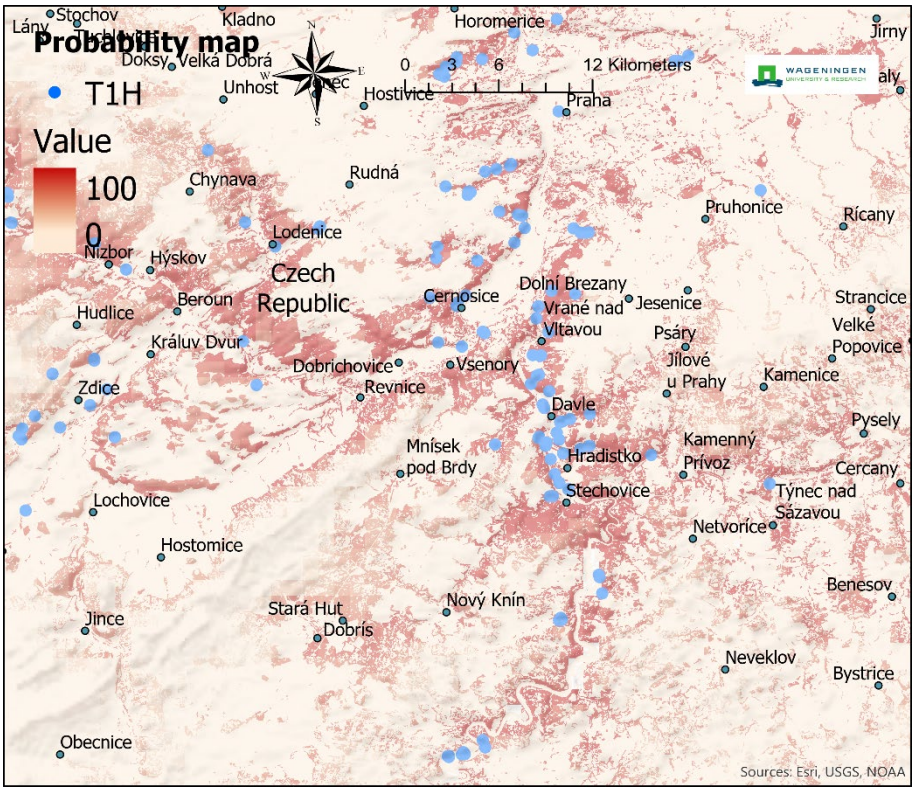

Probability map
T1G
T1G
Prob_T1G_t_int
Value
100
0
NOCERA
SALERNO
ACERNO
BATTIPAGLIA
MURO LUCANO
AVIGLIANO
TOLVE
0 5 10 20 Kilometers
CONTURSI
POTE
WAGENINGEN
AULETTA
ALTAVILLA
SILENTINA
SANT'ARSENIO
BRIENZA
LAURENZANA
Italy
Laurino
VALLO
DELLA
LUCANIA
CASTELLABATE
ROFRANO
MOLITERNO
SAN CHIRICO
RAPARO
MARINA DI
CAMEROTA
MARATEA
MARATEA
SCALEA
SCALEA
Sources: Esri, USGS, NOAA

T1H - [G1C] Broadleaved deciduous plantation of non site-native trees

Cultivated deciduous broadleaved tree formations planted for the production of wood, composed of exotic species or of native species out of their natural range.

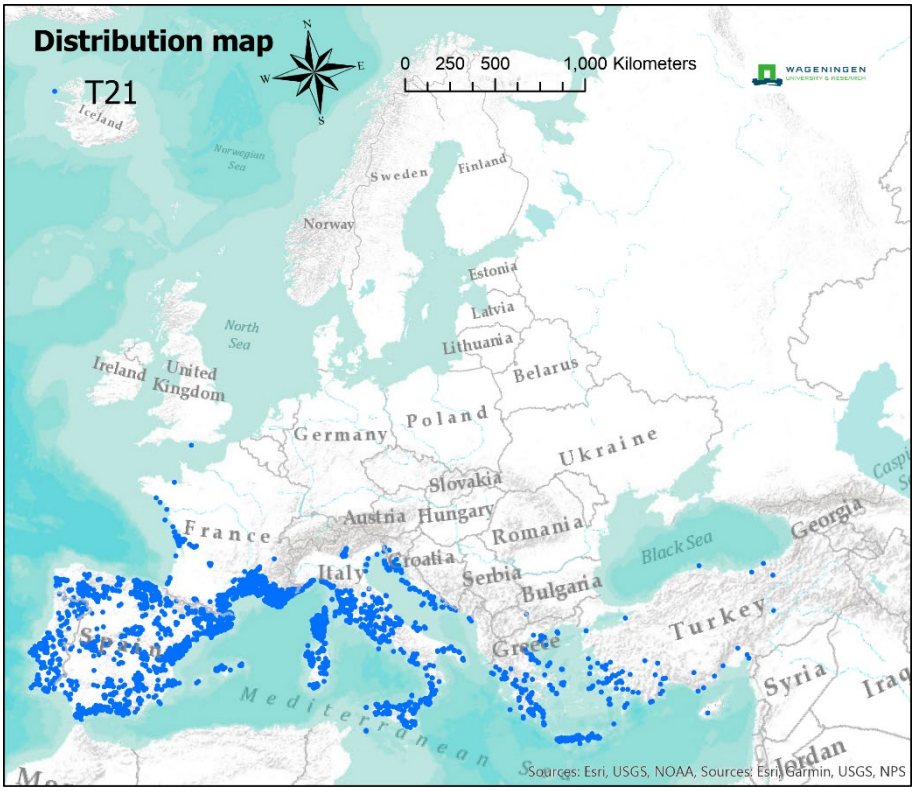


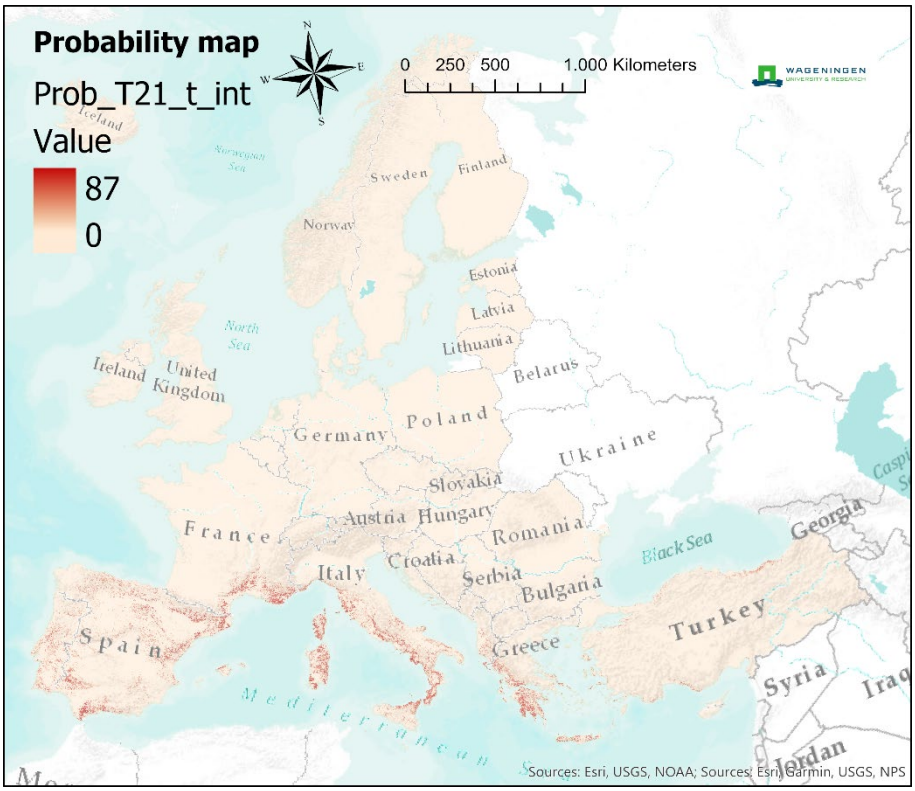


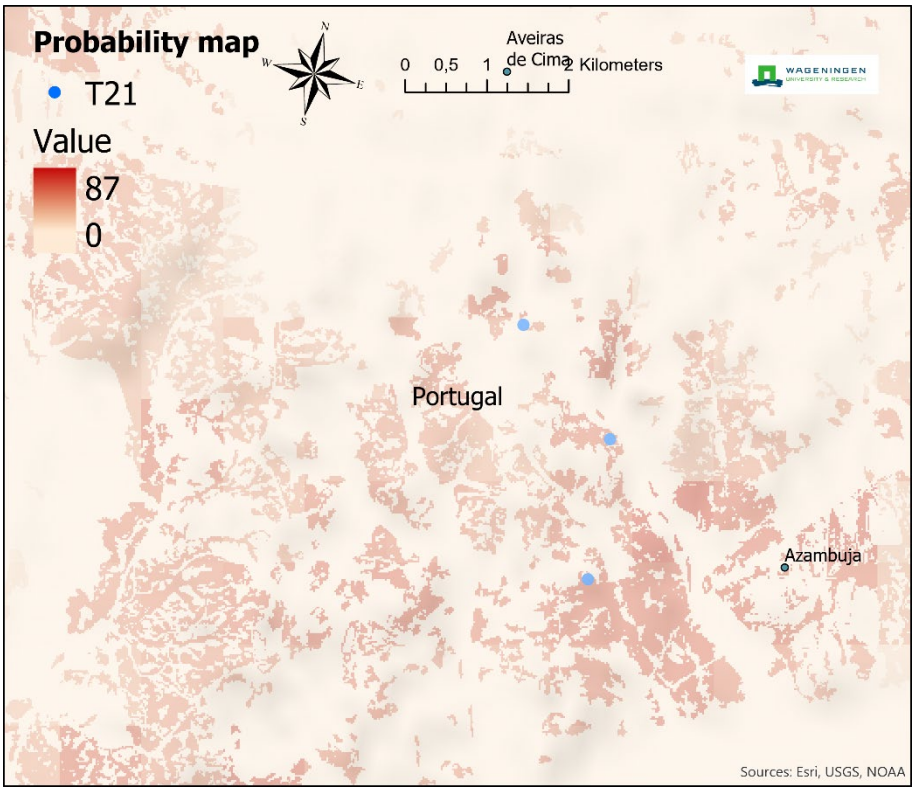

Probability map
T1H
Value
100
0
Czech Republic
0 3 6 12 Kilometers
WAGENINGEN
Stochov
Kladno
Horomerice
Jirny
Doksy
Velká Dobrá
Unhost
Hostivice
Praha
Chynava
Rudná
Pruhonice
Rícany
Lodenice
Nizbor
Hýskov
Beroun
Hudlice
Cernosice
Dolní Brezany
Vrané nad Vltavou
Jesenice
Strancice
Velké Popovice
Psáry
Jílové u Prahy
Kamenice
Králuv Dvur
Dobrichovice
Vsenory
Revnice
Zdice
Davle
Pysely
Mnísek pod Brdy
Hradistko
Kamenný Prívoz
Cercany
Stechovice
Týnec nad Sázavou
Lochovice
Netvorice
Hostomice
Benesov
Nový Knín
Stará Hut
Dobrís
Jince
Neveklov
Bystrice
Obecnice
Sources: Esri, USGS, NOAA

T21 - [G21] Mediterranean evergreen Quercus forest

Forest dominated by evergreen broadleaved oaks (most widely Quercus ilex) with associated sclerophyllous and laurophyllous trees and shrubs in the summer-drought climate of the mediterranean lowlands and foothills. The tree canopy is often low and much modified, with widespread transitions to scrubby maquis/matorral and open dehesa/montado wood pasture.

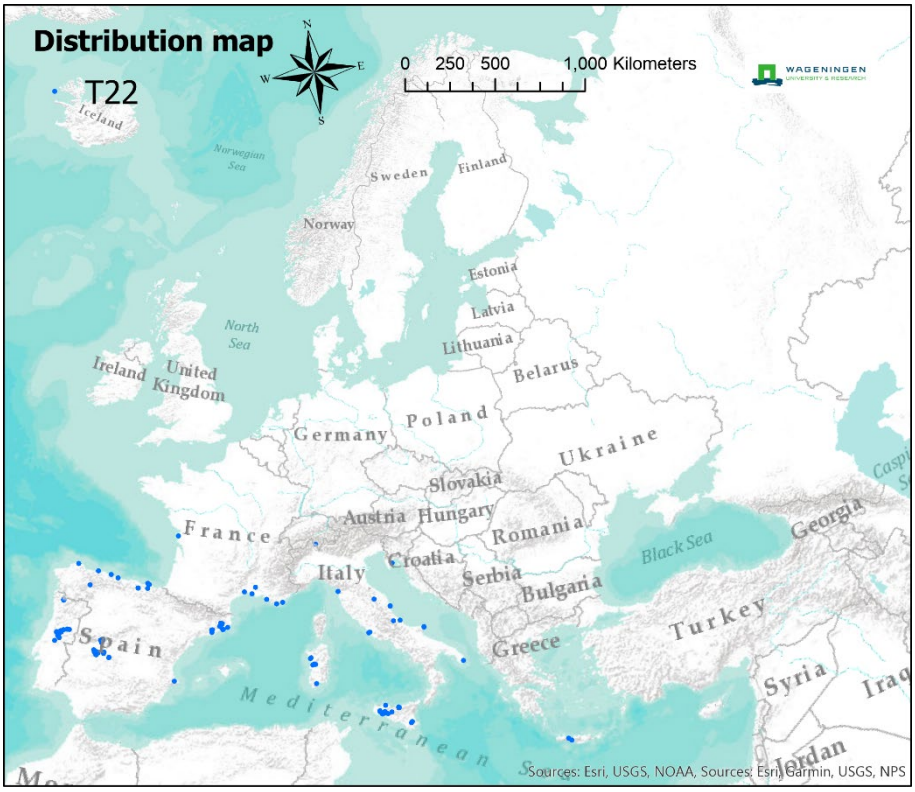


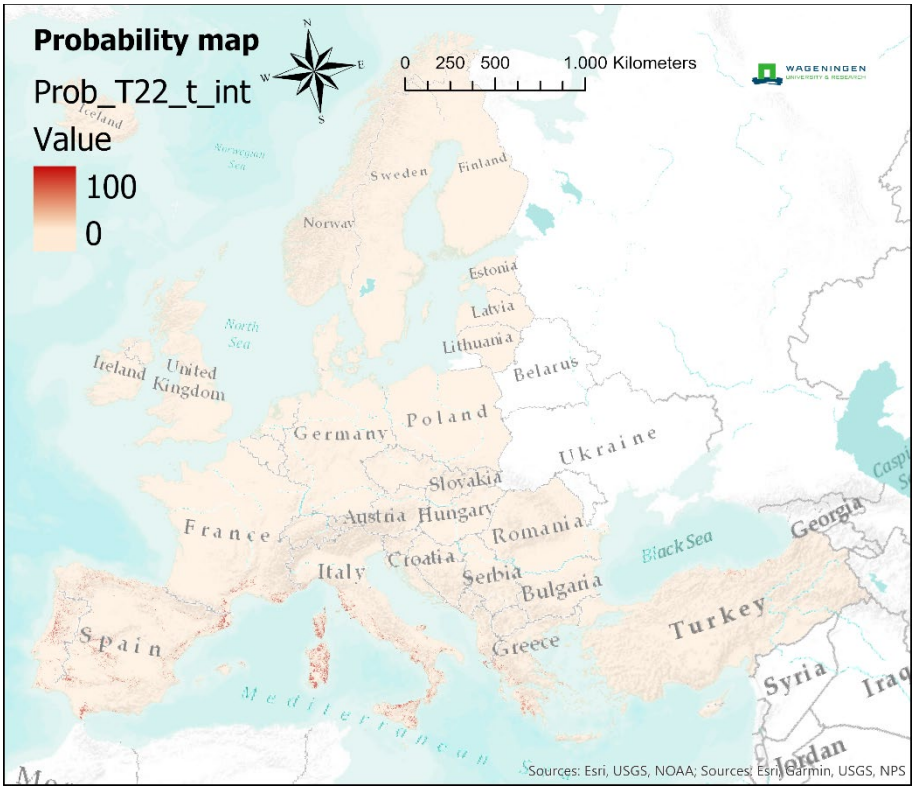


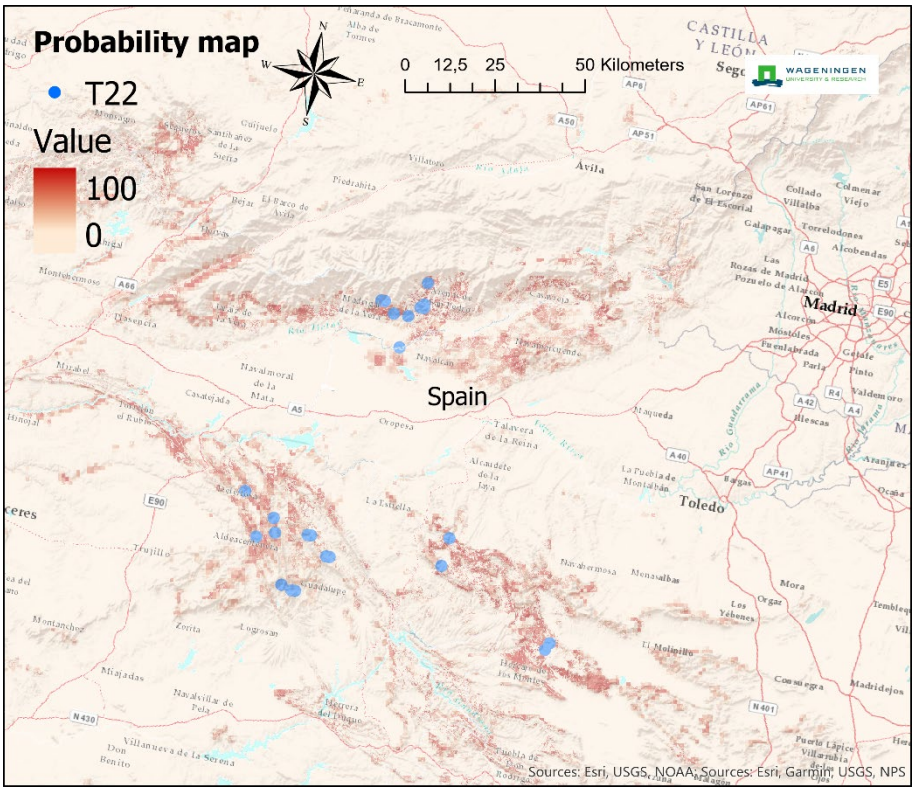

Probability map
T21
Value
87
0
N
W
E
S
0 0,5 1 2 Kilometers
Aveiras de Cima
WAGENINGEN
Portugal
Azambuja
Sources: Esri, USGS, NOAA

T22 - [G22] Mainland laurophyllous forest

Evergreen laurophyllous short-stature woodland, often dominant by bay (Laurus nobilis), firetree (Morella faya) and Portugal laurel (Prunus lusitanica subsp. lusitanica) in warm temperate oceanic and hyper-humid situations, now surviving as small relics in sheltered situations like ravines along the Atlantic coast of Portugal and Spain and in Sardinia, southern Italy and Sicily. Typically species-poor with an associated flora similar to T21.

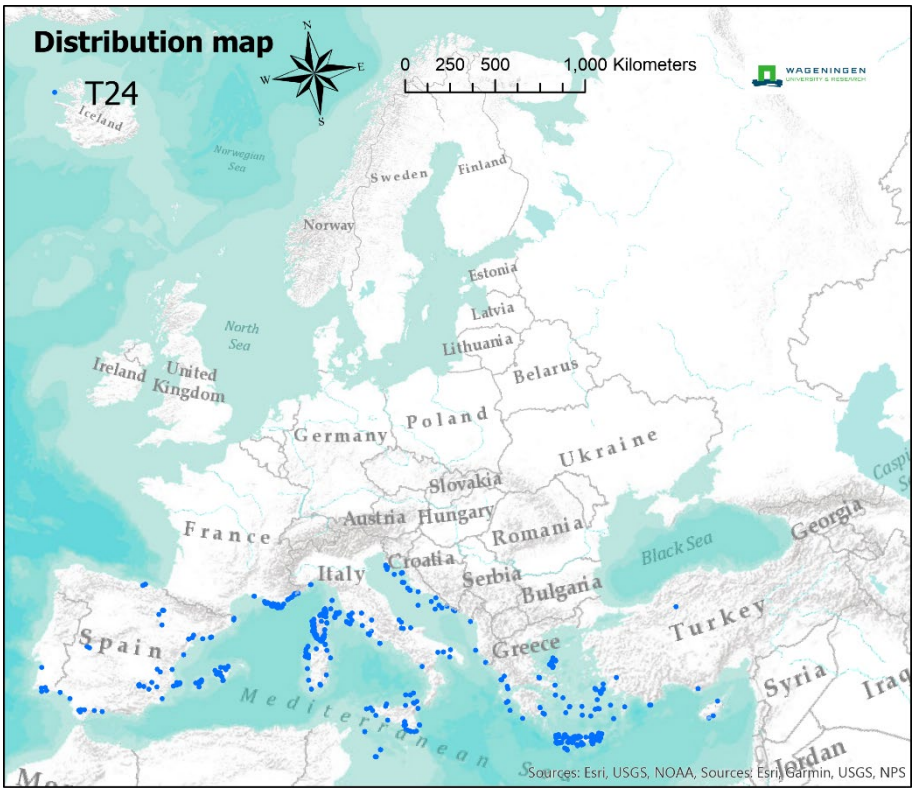


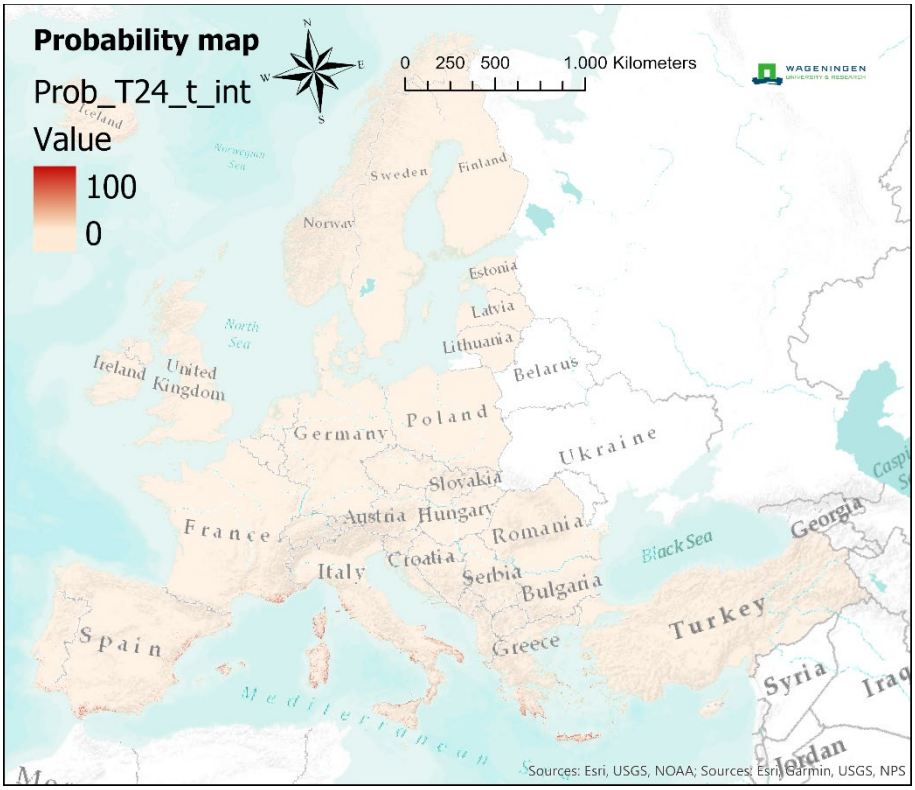


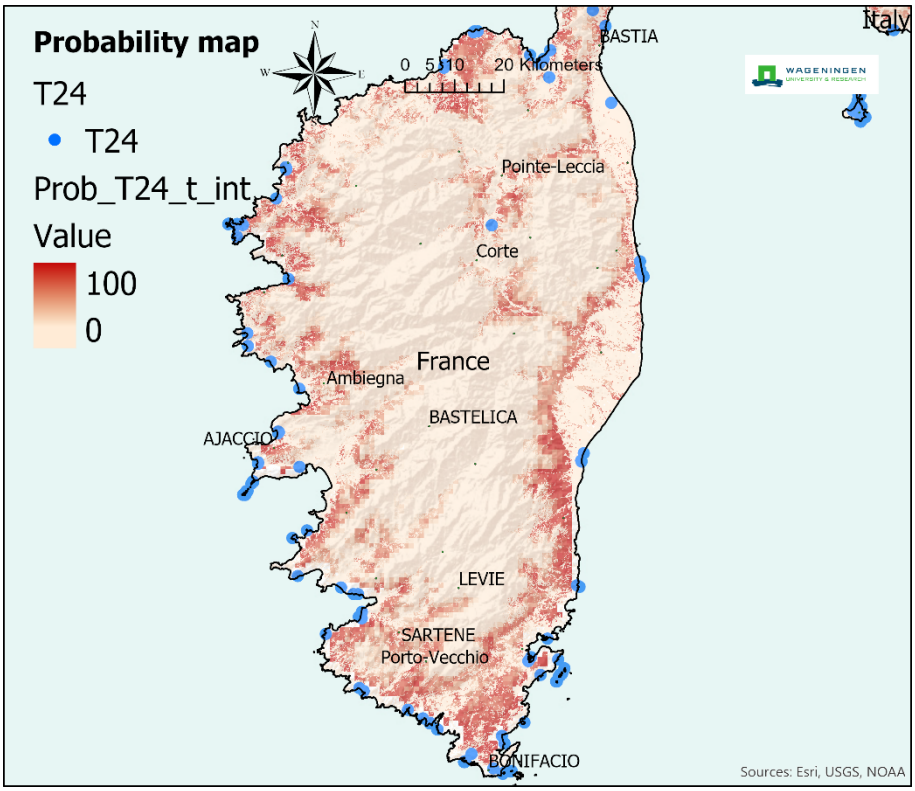

Probability map
T22
Value
100
0
0 12,5 25 50 Kilometers
Spain
Madrid
Toledo
Avila
Sources: Esri, USGS, NOAA; Sources: Esri, Garmin, USGS, NPS

T24 - [G24] Olea europaea-Ceratonia siliqua forest

Olive (Olea europea), carob (Ceratonia siliqua) and mastic (Pistacia lentiscus) forest with a tall, closed tree canopy in the drought-prone lowlands and foothills of the Mediterranean and Macaronesia.

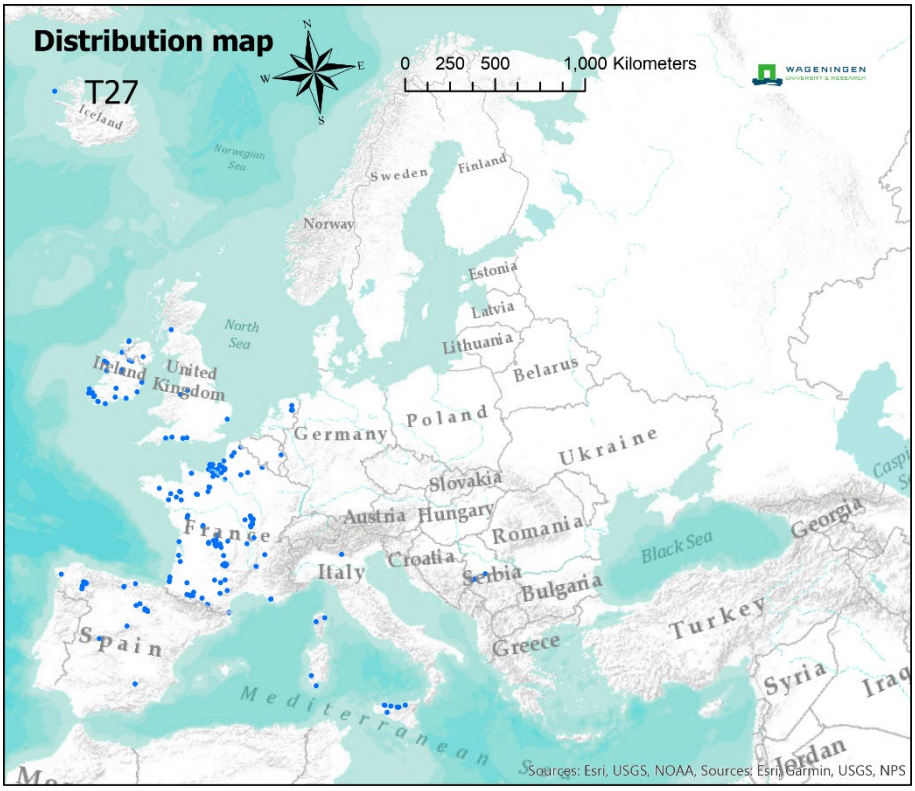


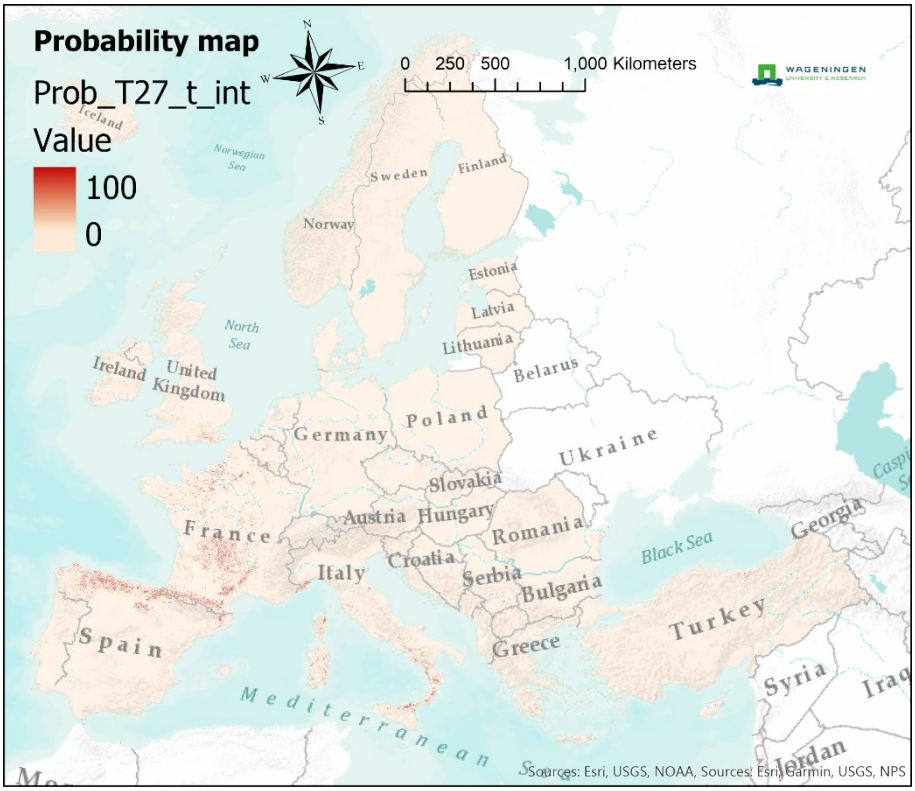


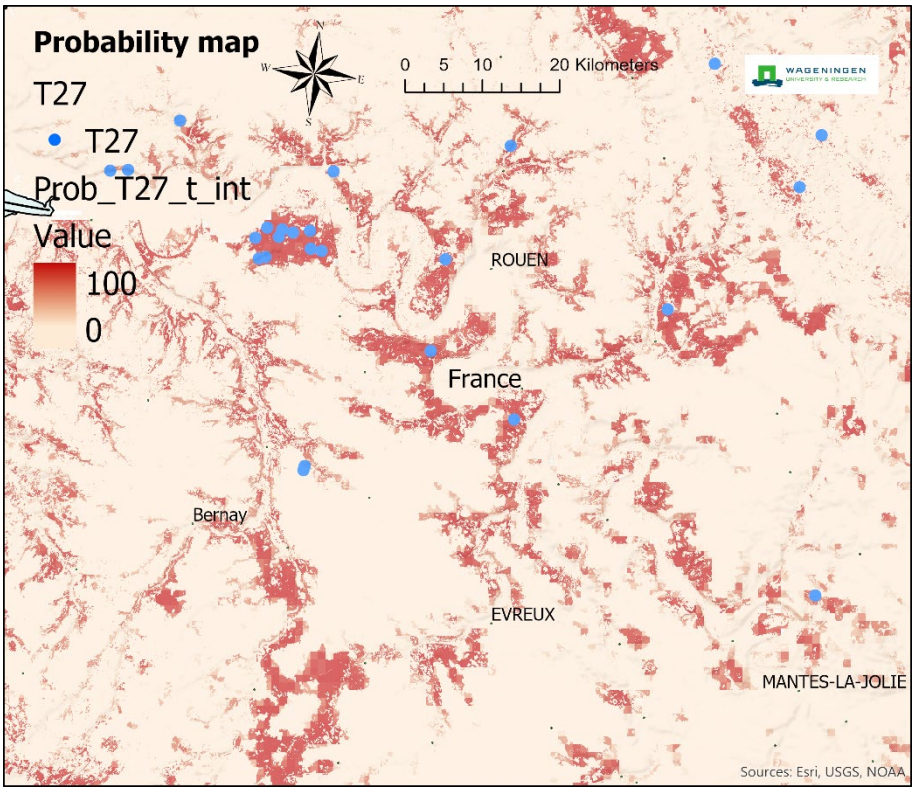

Probability map
T24
T24
Prob_T24_t_int
Value
100
0
0 5 10 20 Kilometers
BASTIA
Italy
Pointe-Leccia
Corte
France
Ambiegna
BASTELICA
AJACCIO
LEVIE
SARTENE
Porto-Vecchio
BONIFACIO
Sources: Esri, USGS, NOAA

T27 - [G26] Ilex aquifolium forest

Holly (Ilex aquifolium) dominated forest occurring in scattered localities across Europe and probably an arborescent survival of T3D Taxus forest at middle altitudes in the Mediterranean zone and of T17 and T18 beech forests and T1B oak forests in the nemoral lowlands.

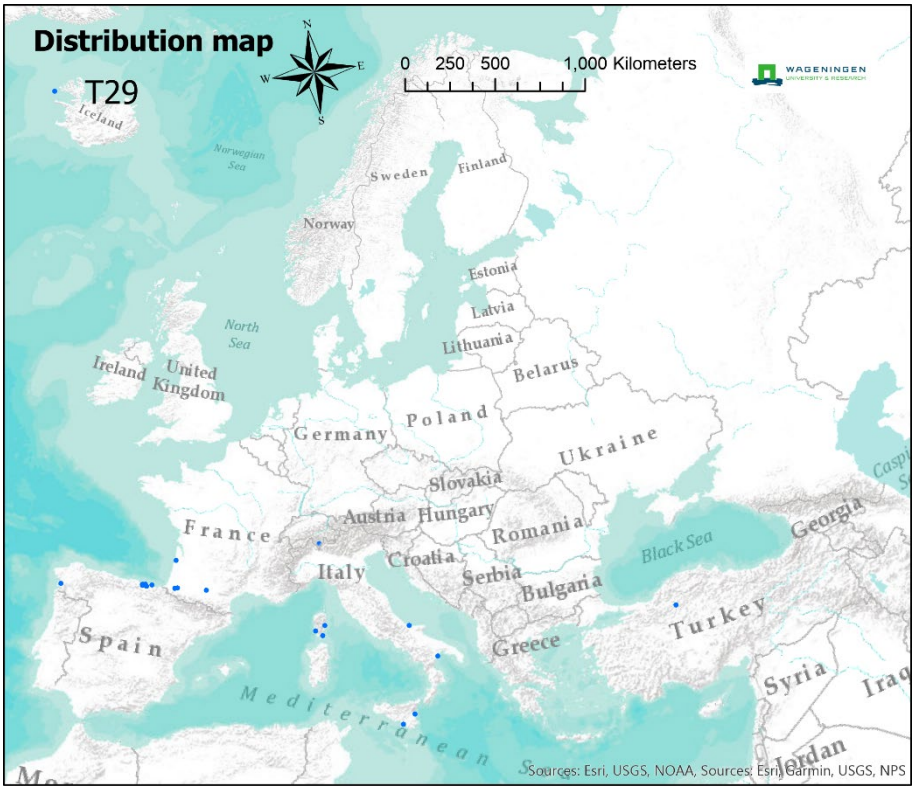


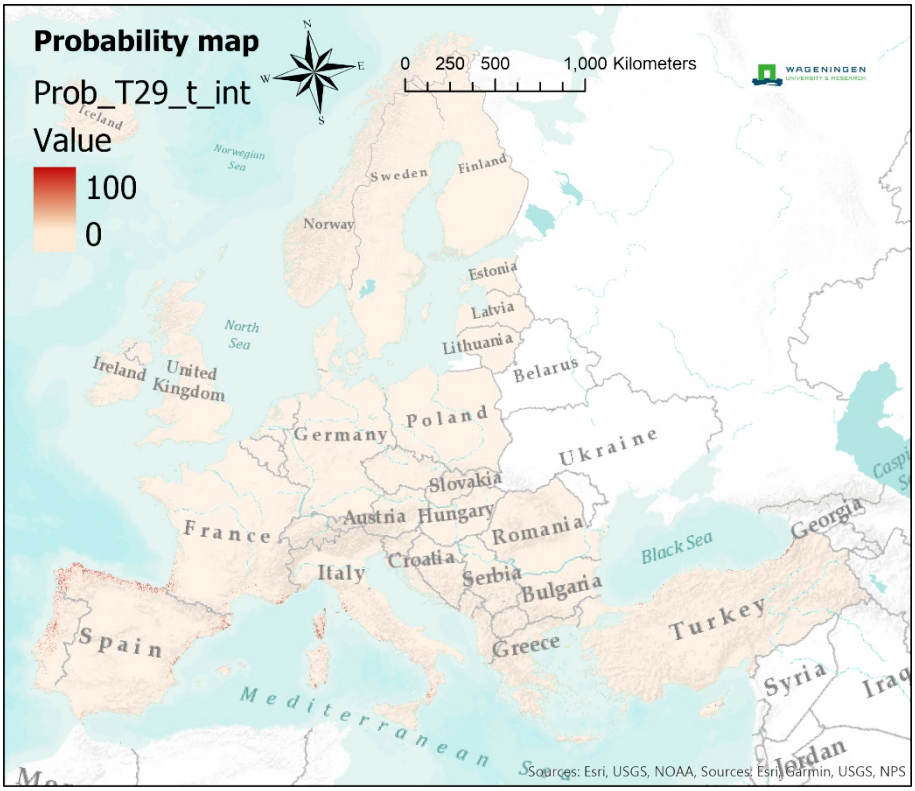


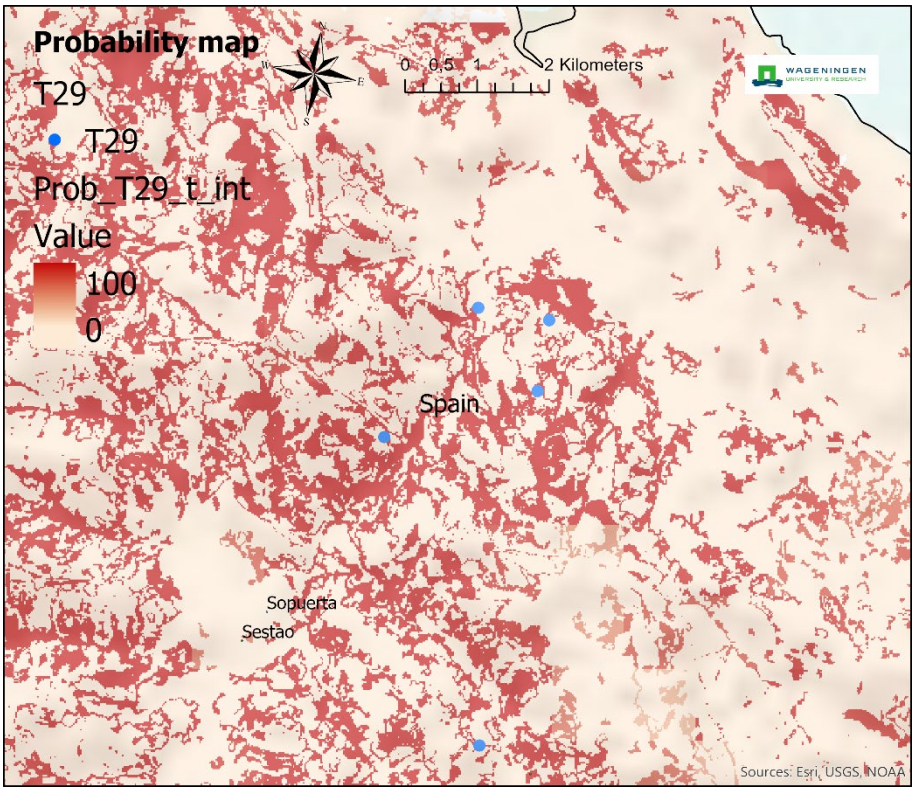

Probability map
T27
T27
Prob_T27_t_int
Value
100
0
0 5 10 20 Kilometers
WAGENINGEN
ROUEN
France
Bernay
EVREUX
MANTES-LA-JOLIE
Sources: Esri, USGS, NOAA

T29 - [G28] Broadleaved evergreen plantation of non site-native trees

Cultivated evergreen broad-leaved tree formations planted for the production of wood, composed of exotic species, of native species out of their natural range, or of native species planted in clearly unnatural stands, often as monocultures.

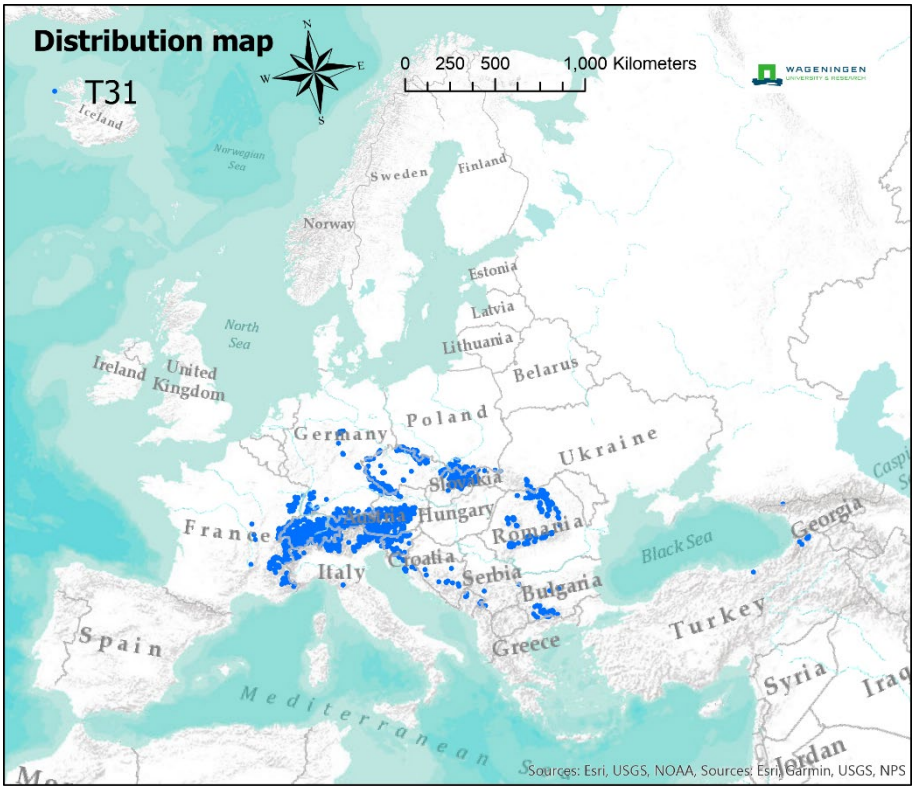


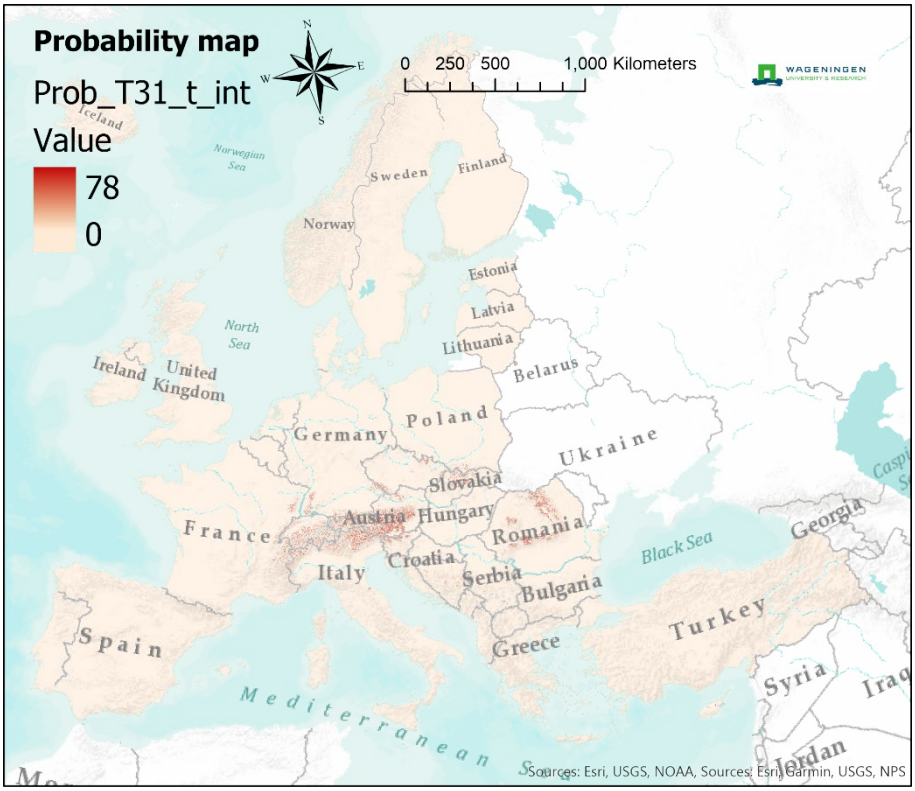


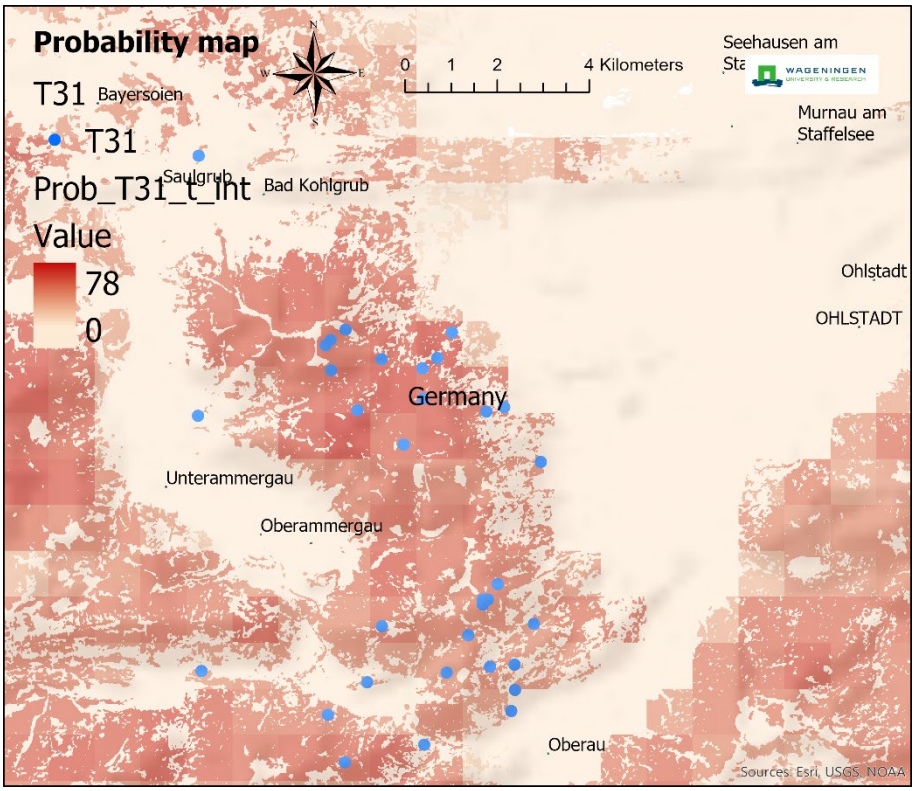

Probability map
T29
T29
Prob_T29_t_int
Value
100
0
0 0.5 1 2 Kilometers
WAGENINGEN
Spain
Sopuerta
Sestao
Sources: Esri, USGS, NOAA

T31 - [G31a] Temperate mountain Picea forest

Evergreen coniferous forest dominated by spruce (Picea abies and, in the Dinaric mountains, relict P. omorika), often with some fir (Abies alba) on usually acidic, even very oligotrophic, wet, cold or rocky soils in the montane and sub-alpine belts of nemoral mountains.

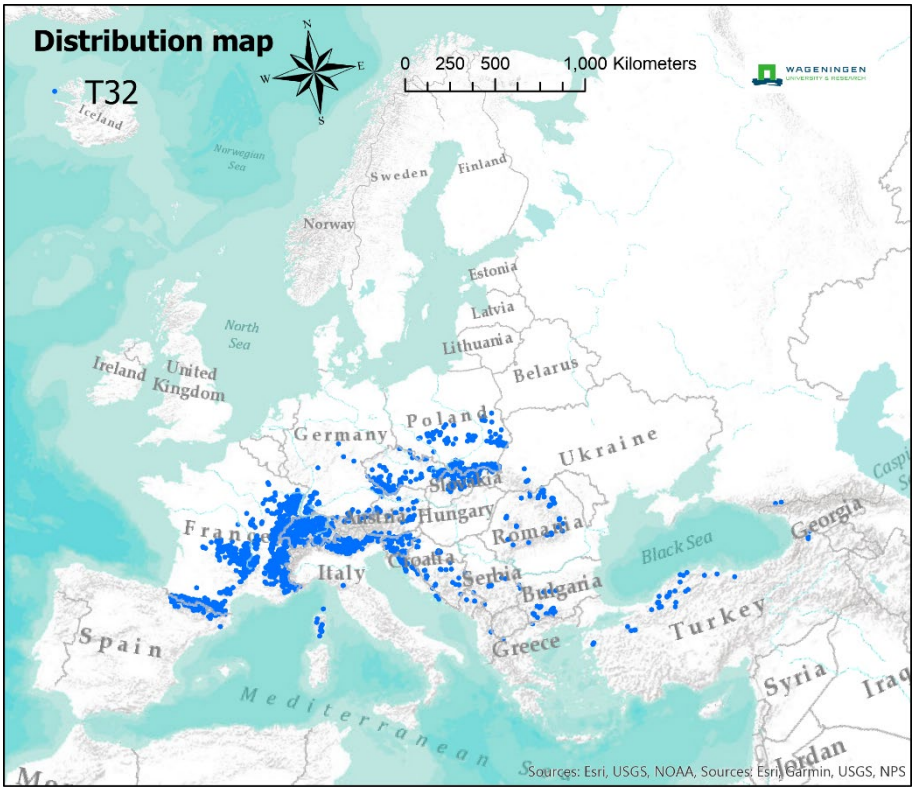


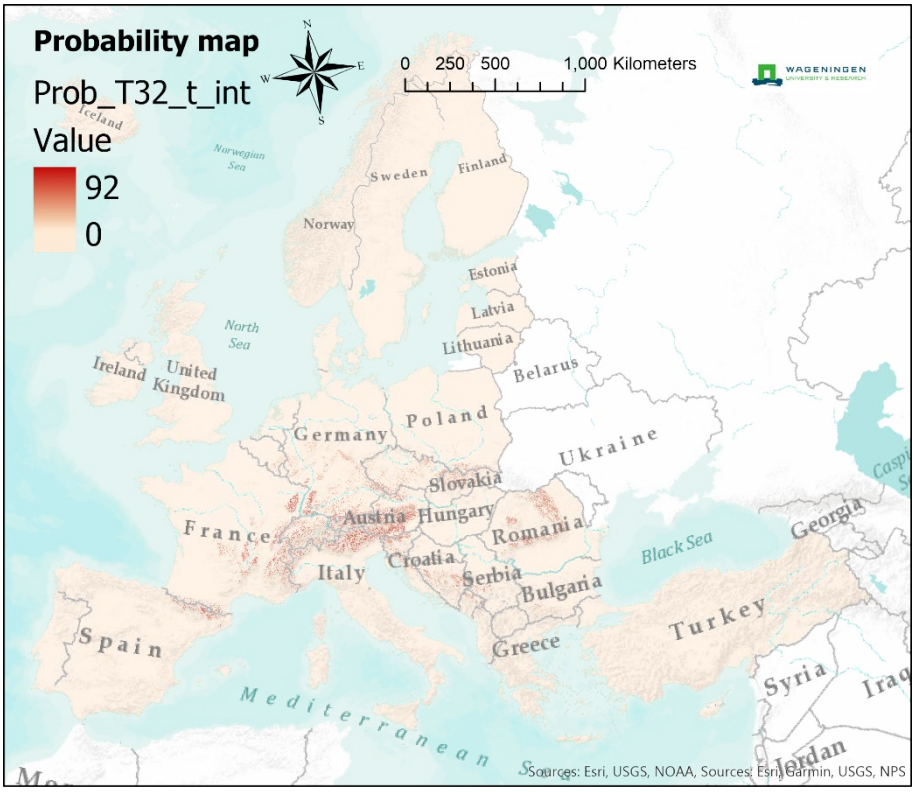


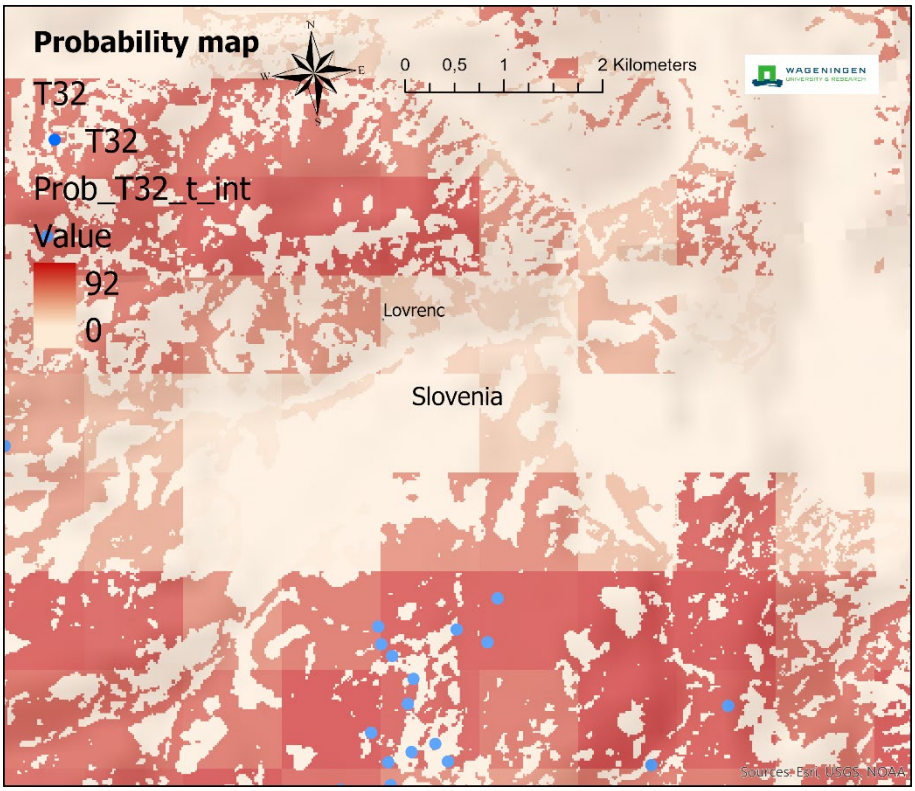

Probability map
T31 Bayersoien
T31
Prob_T31_t_Int
Value
78
0
N
W
E
S
0 1 2 4 Kilometers
Seehausen am
Murnau am
Staffelsee
Saulgrub
Bad Kohlgrub
Ohlstadt
OHLSTADT
Germany
Unterammergau
Oberammergau
Oberau
Sources: Esri, USGS, NOAA

T32 - [G31b] Temperate mountain Abies forest

forests of fir (Abies alba) in nemoral mountains, often with beech (Fagus sylvatica) towards the sub-montane limit, spruce (Picea abies) where site conditions are harsher at higher altitudes. On generally acidic soils though extending on to more base-rich and mesotrophic soils where distinctive contingents of herbs augment or replace the usually heathy field layer.

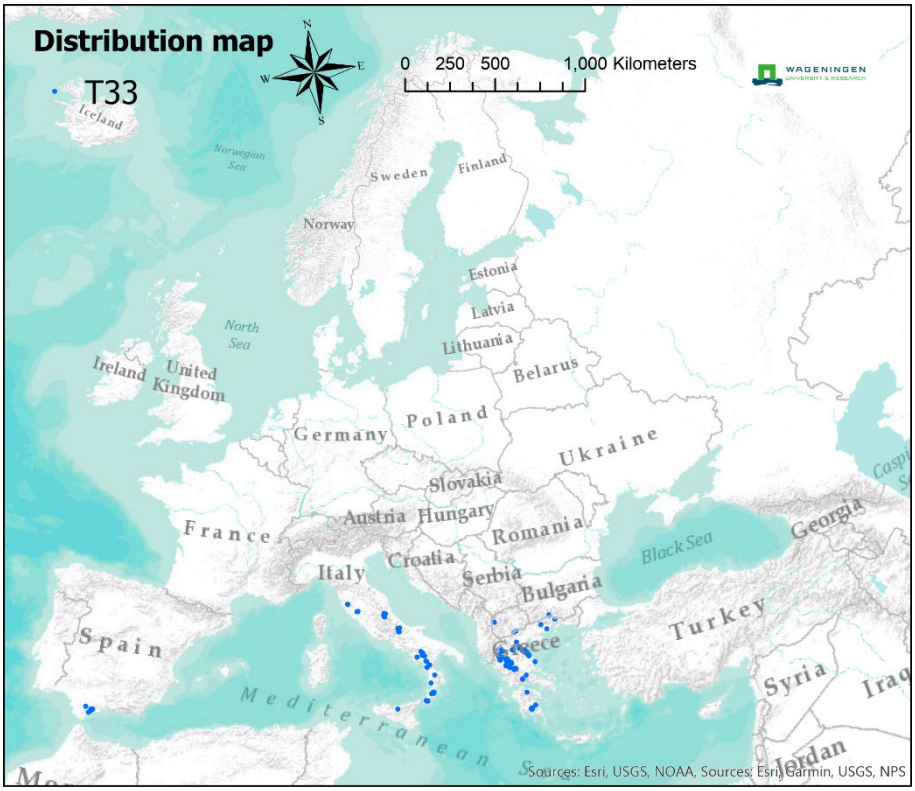


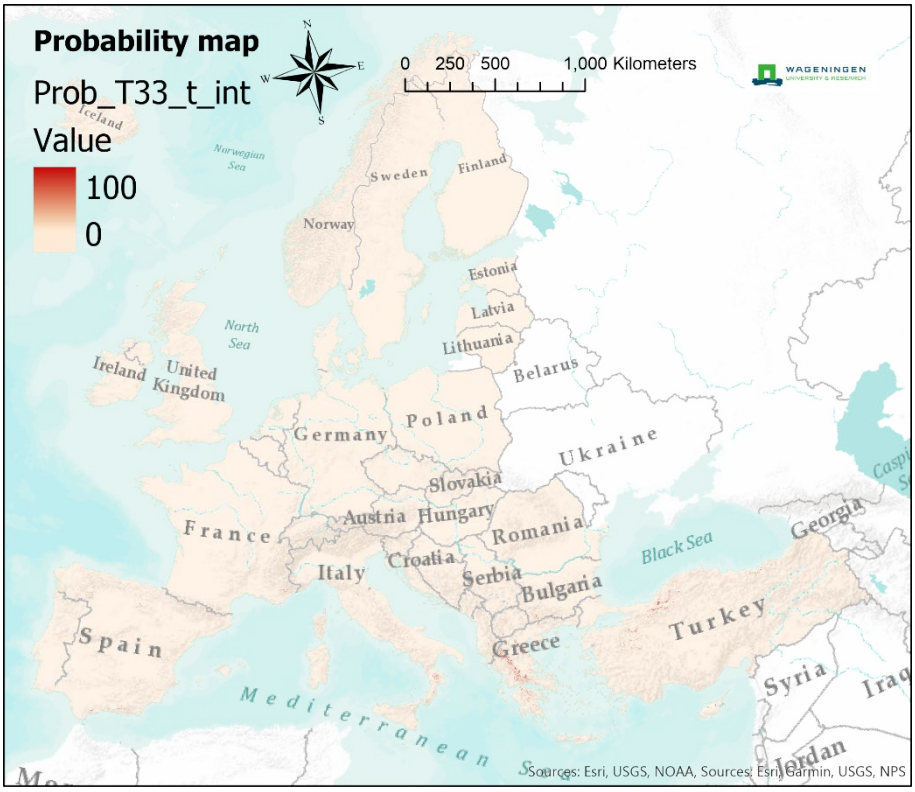


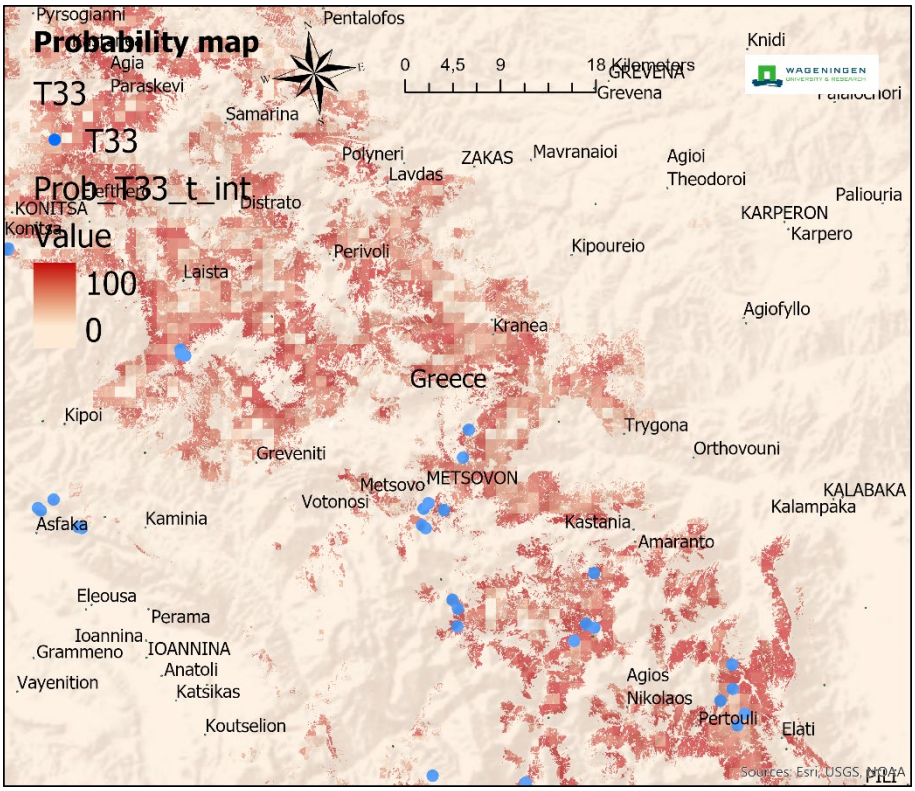

Probability map
T32
T32
Prob_T32_t_int
Value
92
0
0 0,5 1 2 Kilometers
Lovrenc
Slovenia
Sources: Esri, USGS, NOAA

T33 - [G31c] Mediterranean mountain Abies forest

Evergreen coniferous forests of more sunless or fog-bound slopes and gullies in the lower to mid altitudinal belts of mediterranean mountains where firs of very limited distribution dominate in highly distinctive relic stands: Spanish fir (A. pinsapo), Greek fir (A. cephalonica), King Boris's fir (A. borisii-regis), Apennine or Sicilian stands of silver fir (A. alba) and Sicilian fir (A. nebrodensis).

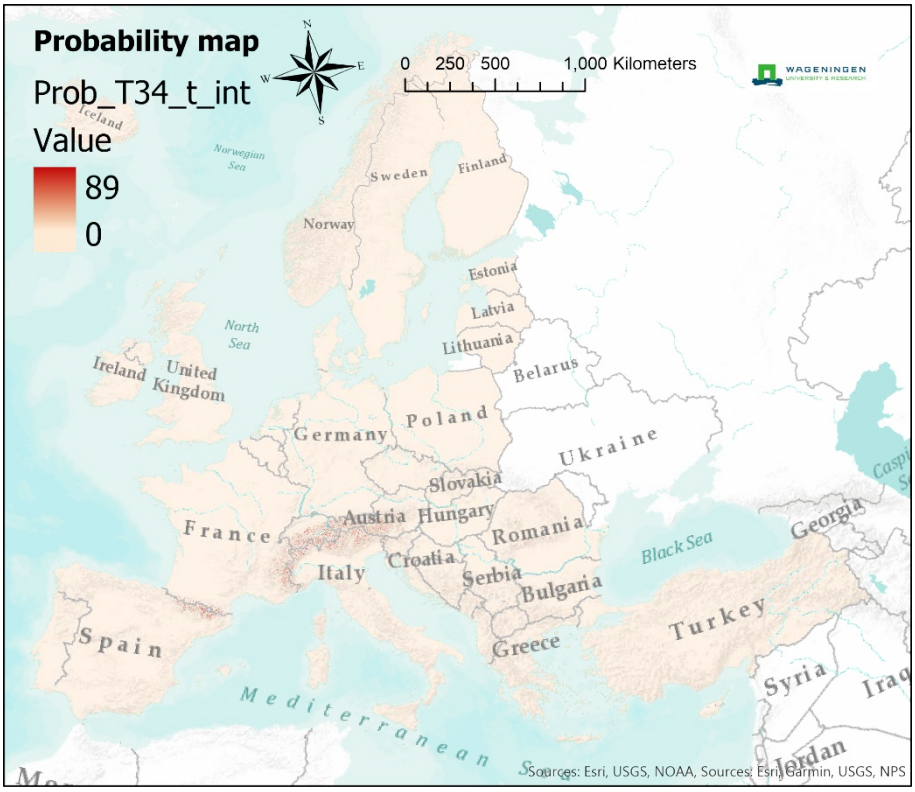


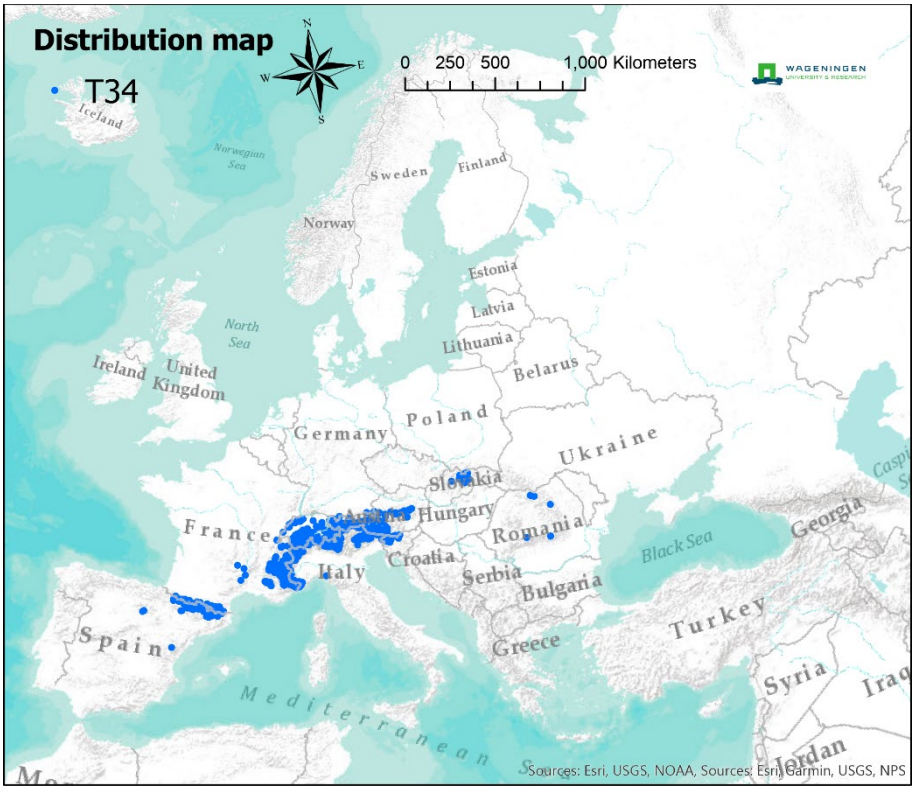


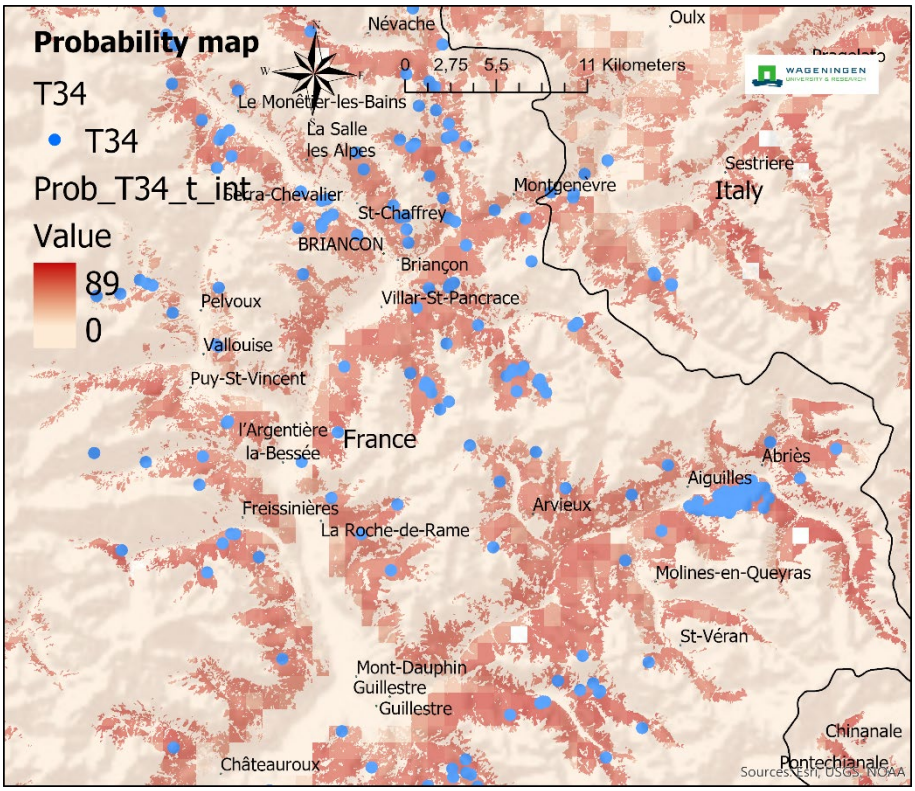

Probability map
T33
T33
Prob_T33_t_int
Value
100
0
Pyrsogianni
Agia
Paraskevi
Samarina
Pentalofos
0 4,5 9 18 Kilometers
GREVENA
Grevena
Knidi
Polyneri
Lavdas
ZAKAS
Mavranaioi
Agioi
Theodoroi
Paliouria
KARPERON
Karpero
KONITSA
Konitsa
Distrato
Perivoli
Kipoureio
Laista
Agiofyllo
Kranea
Greece
Kipoi
Trygona
Orthovouni
Greveniti
Metsovo
METSOVON
Votonosi
KALABAKA
Kalampaka
Asfaka
Kaminia
Kastania
Amaranto
Eleousa
Perama
Ioannina
Grammeno
IOANNINA
Anatoli
Vayenition
Katsikas
Koutselion
Agios
Nikolaos
Pertouli
Elati
Sources: Esri, USGS, NOAA

T34 - [G32] Temperate subalpine Larix, Pinus cembra and Pinus uncinata forest

Coniferous, in part deciduous, forest of larch (Larix decidua) or Arolla pine (Pinus cembra) in the mid sub-alpine belt of temperate mountains in the central Alps and Carpathians with long but shallow snow-lie and a short growing season. Dwarf mountain pine (P. mugo), spruce (Picea abies), fir (Abies alba), rhododendrons and other sub-shrubs are never more than subordinate but various whitebeams (Sorbus spp.) are characteristic associates.

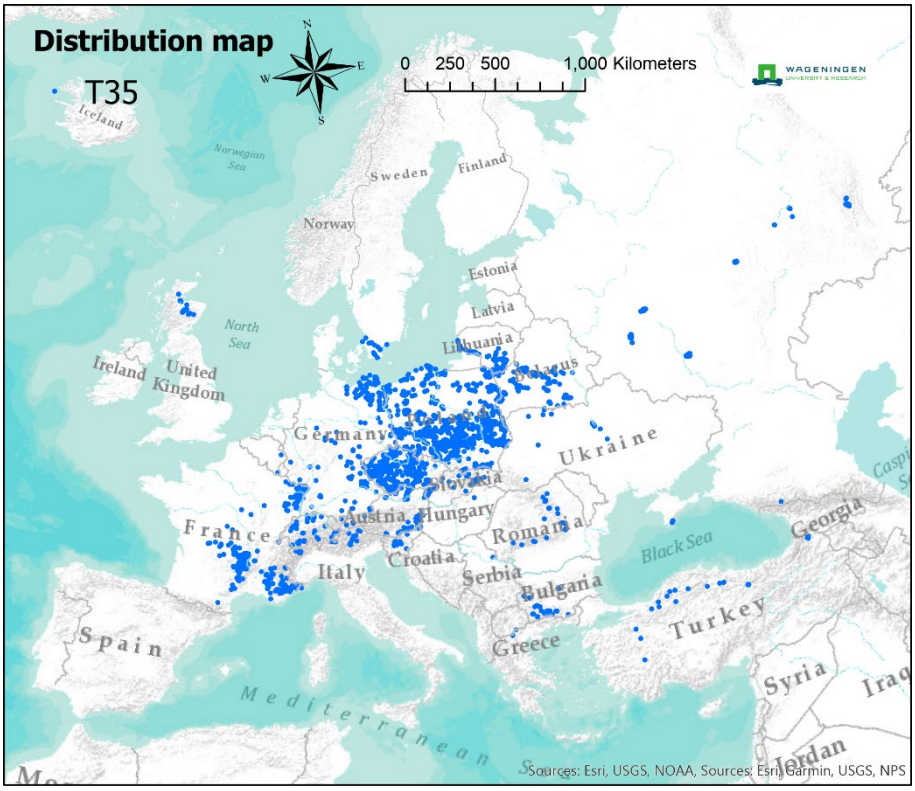


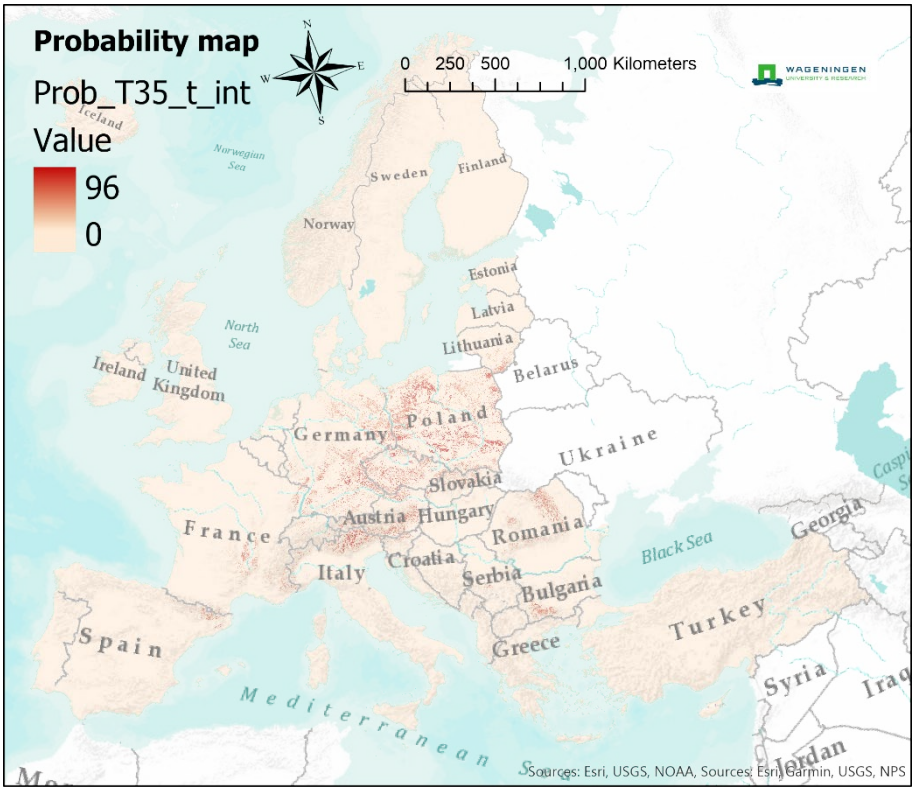


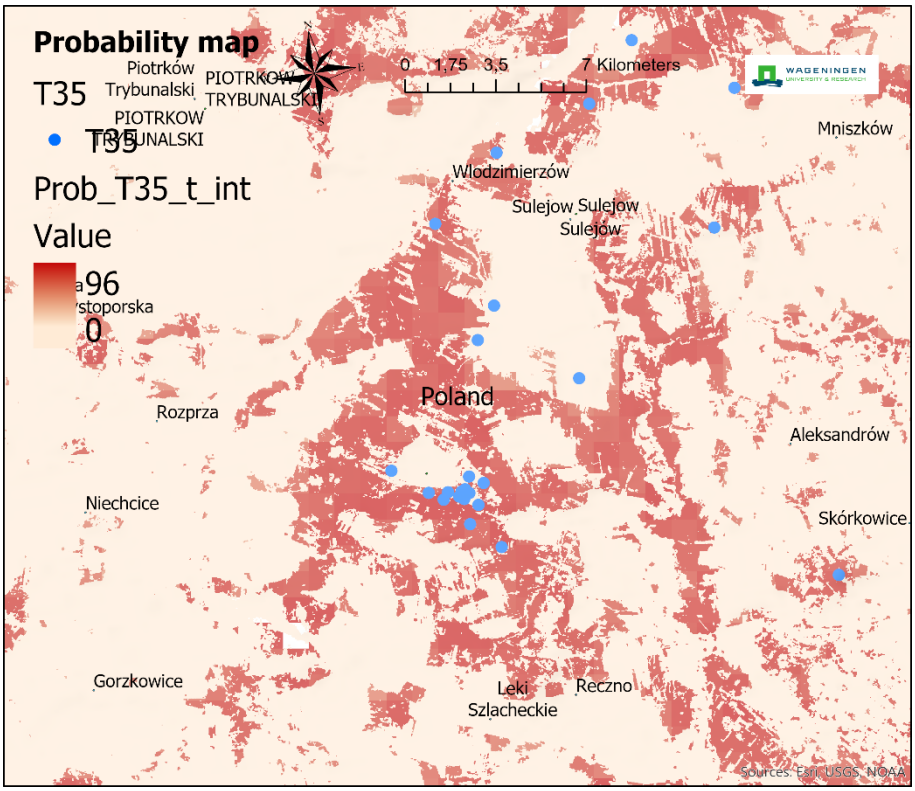

Probability map
T34
T34
Prob_T34_t_int
Value
89
0
Névache
Oulx
0 2,75 5,5 11 Kilometers
WAGENINGEN
Le Monêtier-les-Bains
La Salle
les Alpes
Sestriere
Italy
Montgenèvre
Cesana-Chevalier
St-Chaffrey
BRIANCON
Briançon
Villar-St-Pancrace
Pelvoux
Vallouise
Puy-St-Vincent
l'Argentière
la-Bessée
France
Abriès
Aiguilles
Arvieux
Freissinières
La Roche-de-Rame
Molines-en-Queyras
St-Véran
Mont-Dauphin
Guillestre
Guillestre
Chinanale
Pontechianale
Châteauroux
Sources: Esri, USGS, NOAA

T35 - [G34a] Temperate continental Pinus sylvestris forest

Forests dominated by pine (Pinus sylvestris), often with some birch (Betula pendula and B. pubescens), aspen (Populus tremula), juniper (Juniperus communis) and various whitebeams (Sorbus spp.), on acidic to base-rich soils through the north nemoral zone and into the hemi-boreal.

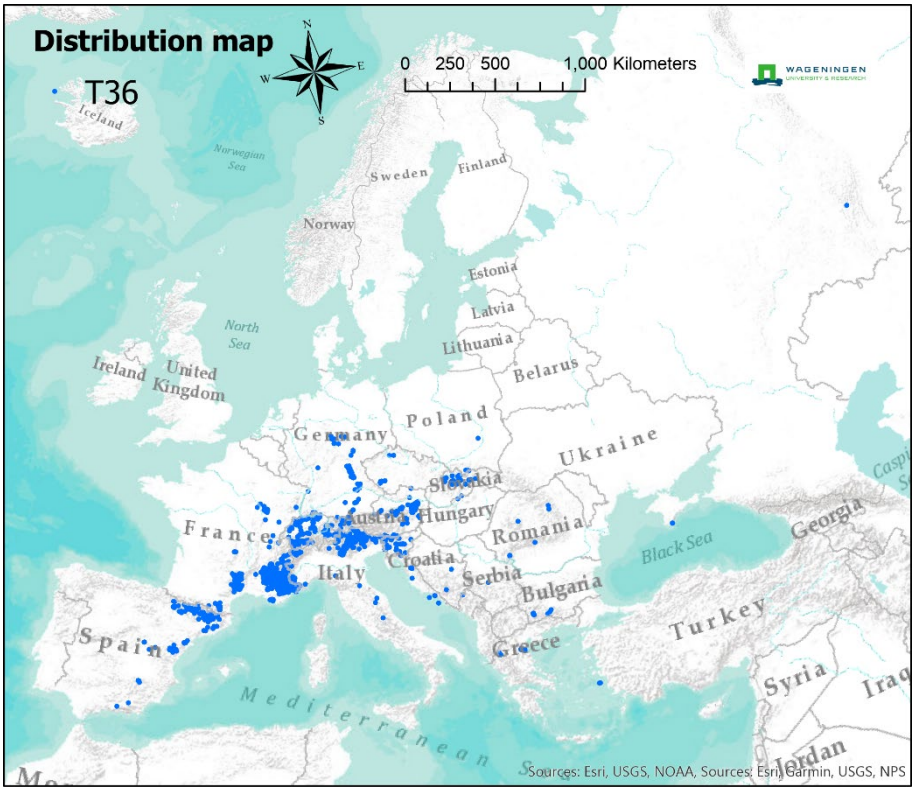


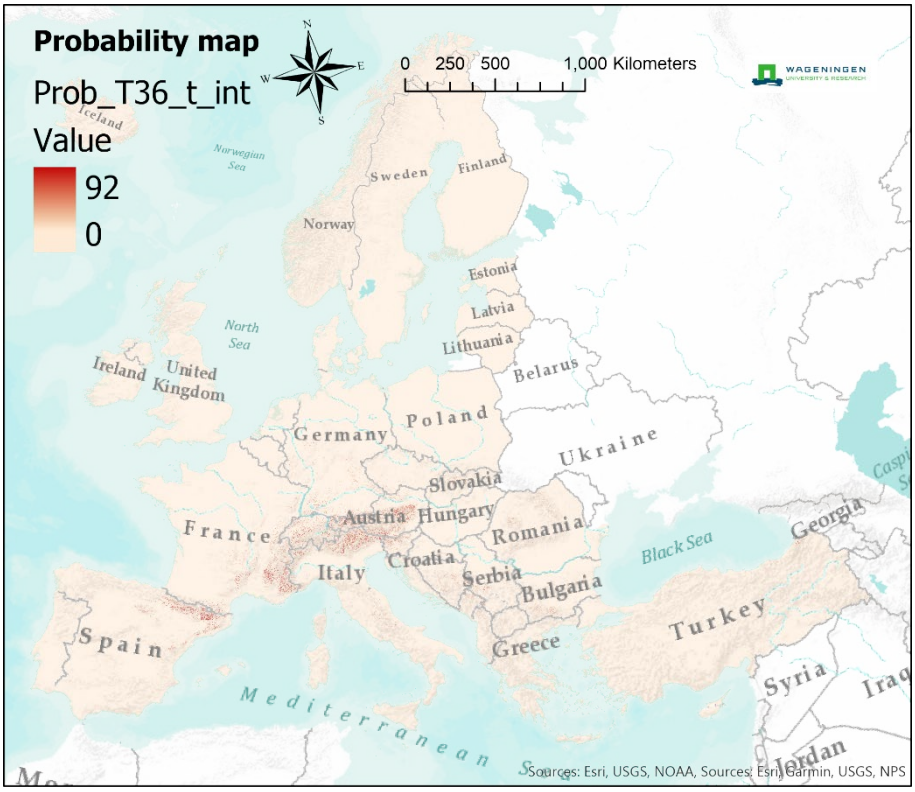


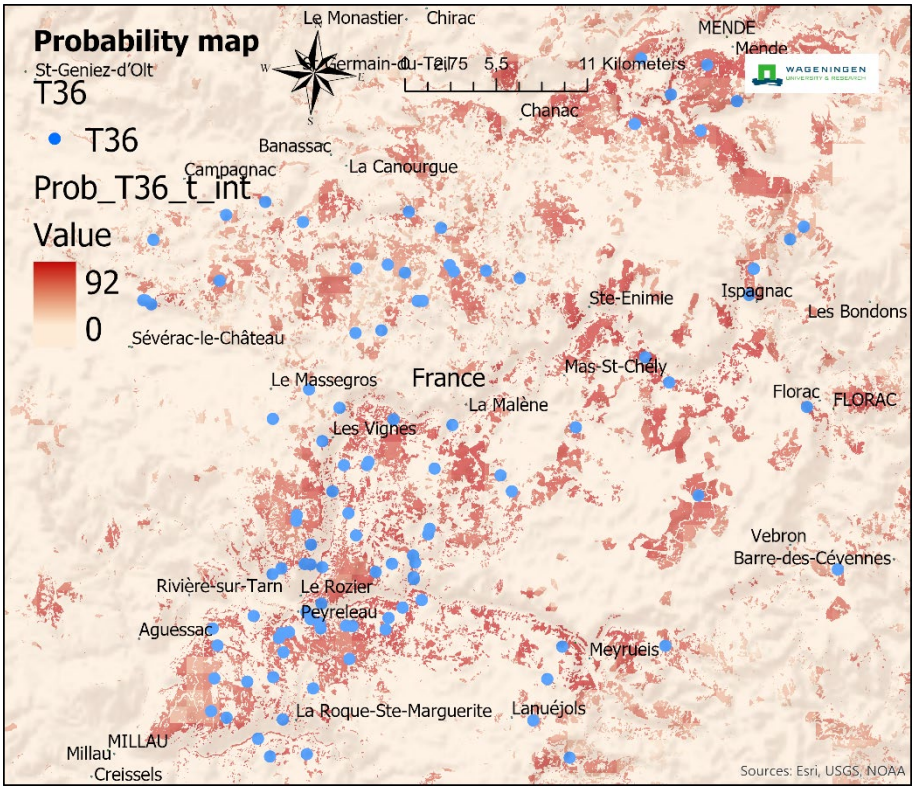

Probability map
T35
T35
Prob_T35_t_int
Value
96
0
Piotrków
Trybunalski
PIOTRKOW
TRYBUNALSKI
PIOTRKOW
TRYBUNALSKI
0 1,75 3,5 7 Kilometers
WAGENINGEN
Mniszków
Włodzimierzów
Sulejow Sulejow
Sulejów
Poland
Rozprza
Aleksandrów
Niechcice
Skórkowice
Gorzkowice
Leki
Szlacheckie
Reczno
Sources: Esri, USGS, NOAA

T36 - [G34b] Temperate and submediterranean montane Pinus sylvestris-Pinus nigra forest

Evergreen coniferous forests, generally dominated by either Scot's pine (Pinus sylvestris) or black pine (P. nigra and, towards the southern limit, various subspecies), less commonly with some spruce (Picea abies) and deciduous associates, often in isolated and small stands on base-rich soils through the mountains of the south temperate and sub-mediterranean zones.

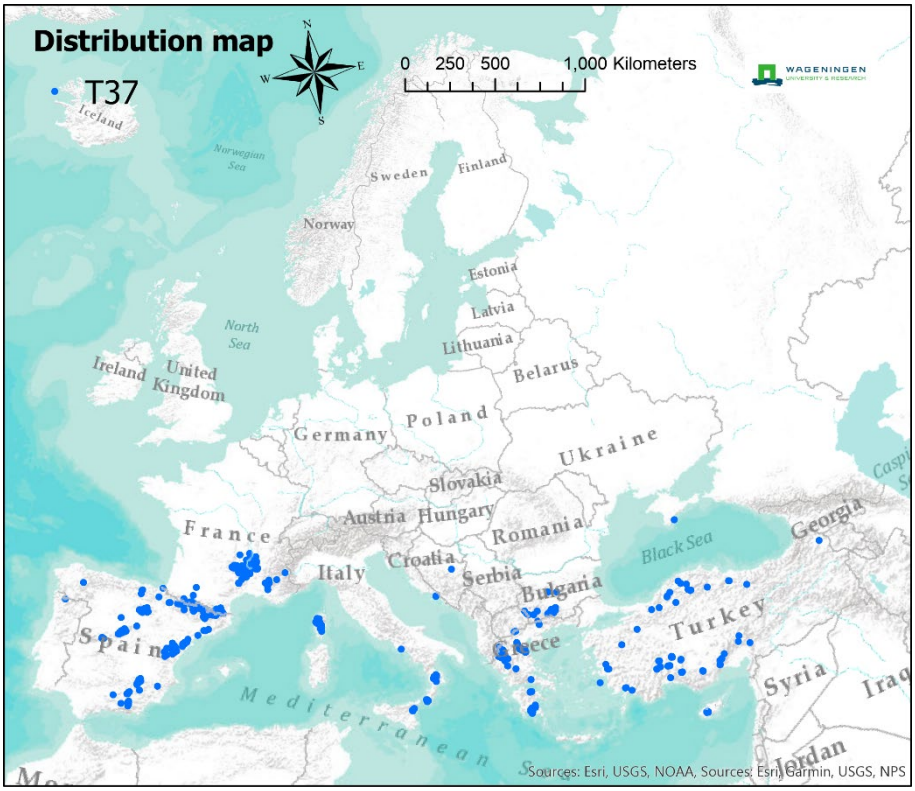


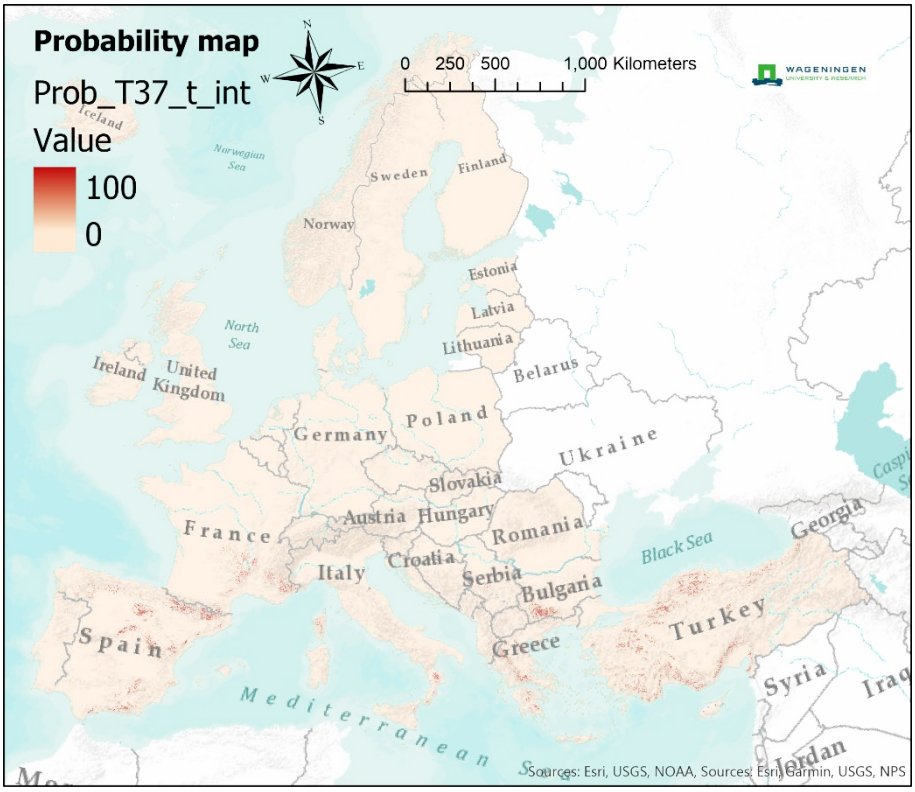


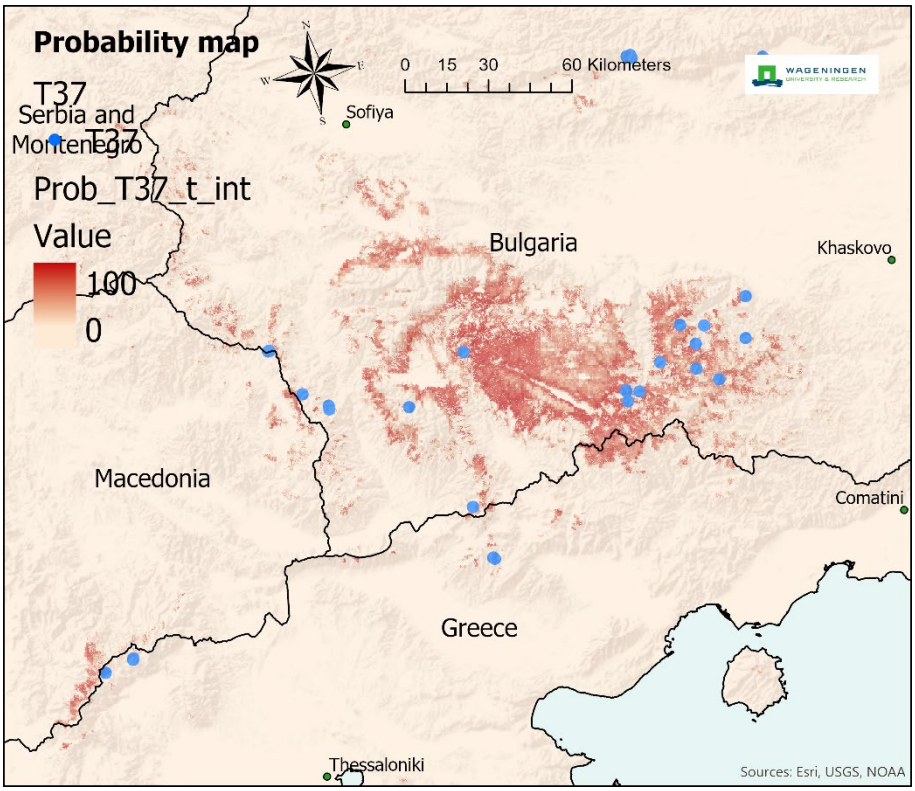

Probability map
T36
T36
Prob_T36_t_int
Value
92
0
Le Monastier
Chirac
MENDE
Mende
St-Geniez-d'Olt
Germain-du-Teil
2,75
5,5
11 Kilometers
Chanac
Banassac
Campagnac
La Canourgue
Ste-Enimie
Ispagnac
Les Bondons
Sévérac-le-Château
Le Massegros
France
Mas-St-Chély
Florac
FLORAC
La Malène
Les Vignes
Vebron
Barre-des-Cévennes
Rivière-sur-Tarn
Le Rozier
Peyreleau
Aguessac
Meyrueis
La Roque-Ste-Marguerite
Lanuéjols
MILLAU
Millau
Creissels
Sources: Esri, USGS, NOAA

T37 - [G34c] Mediterranean montane Pinus sylvestris-Pinus nigra forest

Evergreen coniferous forest of more drought-prone situations at scattered localities through the mountains of the mediterranean zone, dominated by black pine (Pinus nigra) and, except on Mediterranean islands, sometimes with subordinate Scot's pine (Pinus sylvestris), both trees often occurring as vicariant forms in different localities.

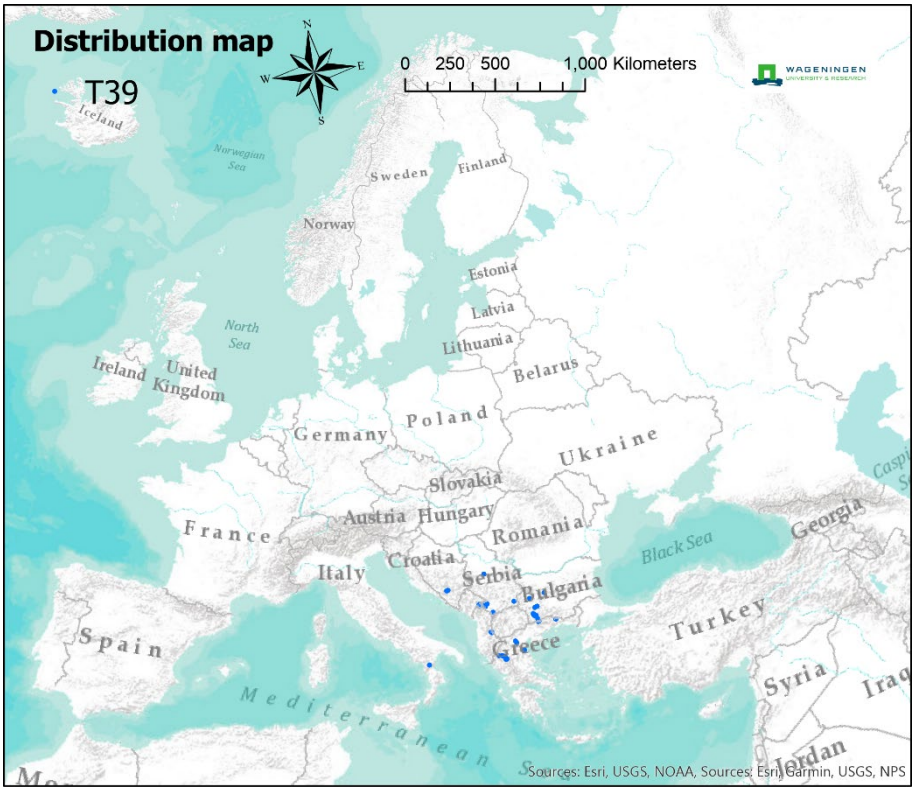


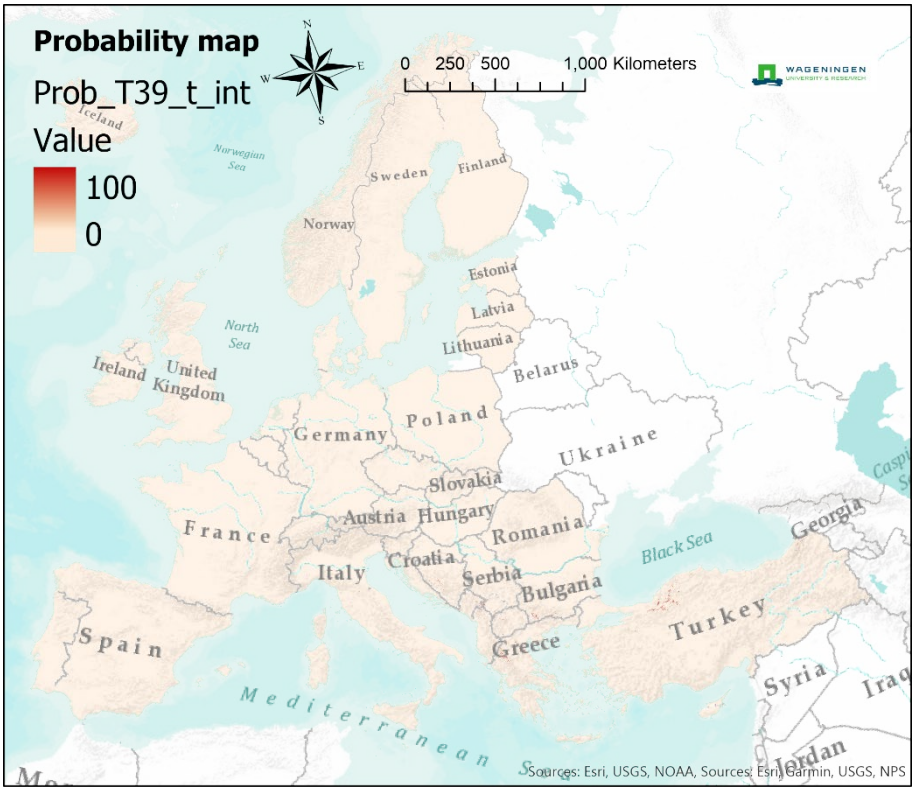


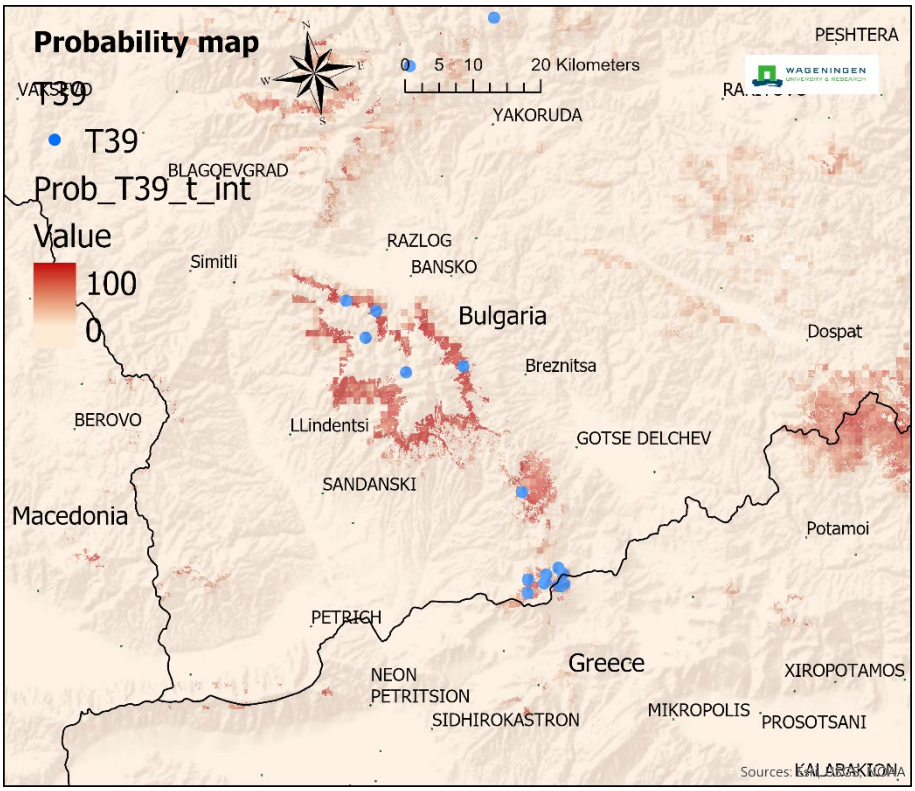

Probability map
T37
Serbia and Montenegro
T37
Prob_T37_t_int
Value
100
0
N
W
E
S
0 15 30 60 Kilometers
WAGENINGEN
Sofiya
Bulgaria
Khaskovo
Macedonia
Comatini
Greece
Thessaloniki
Sources: Esri, USGS, NOAA

T39 - [G37] Mediterranean lowland to submontane Pinus forest

Evergreen coniferous forest dominated by various thermophilous pines: maritime pine (Pinus pinaster in western mediterranean and warm atlantic zones), Aleppo pine (P. halepensis) and stone pine (P. pinea all around the southern European coast) and Aegean pine (P. brutia in Greece and Anatolia), the first three often favouring unstable substrates or pre-climax situations.

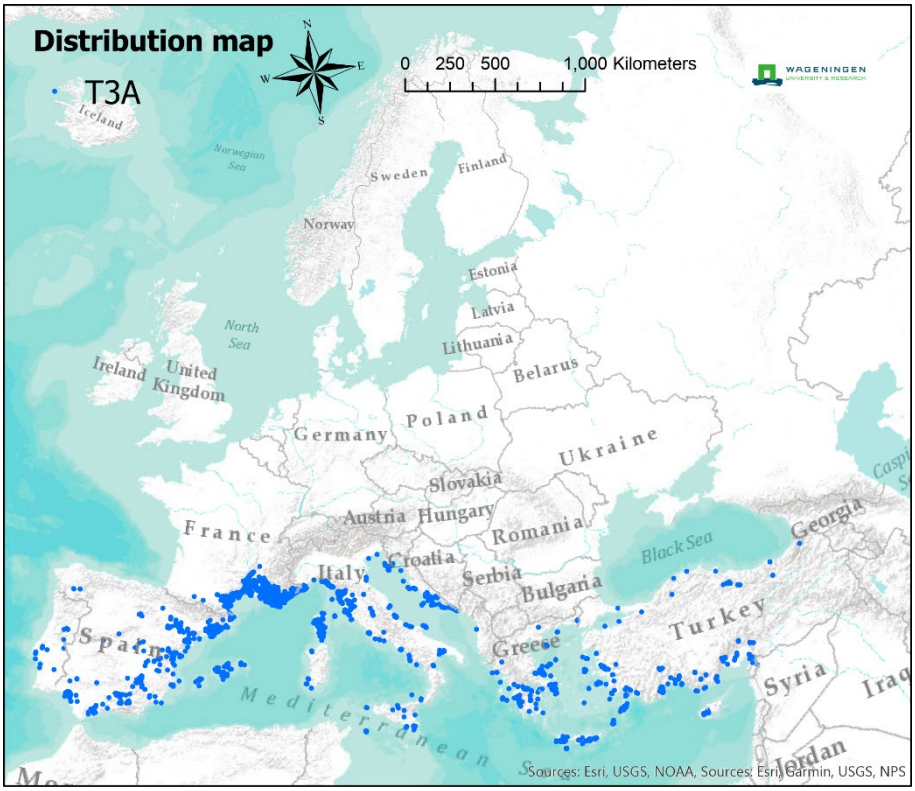


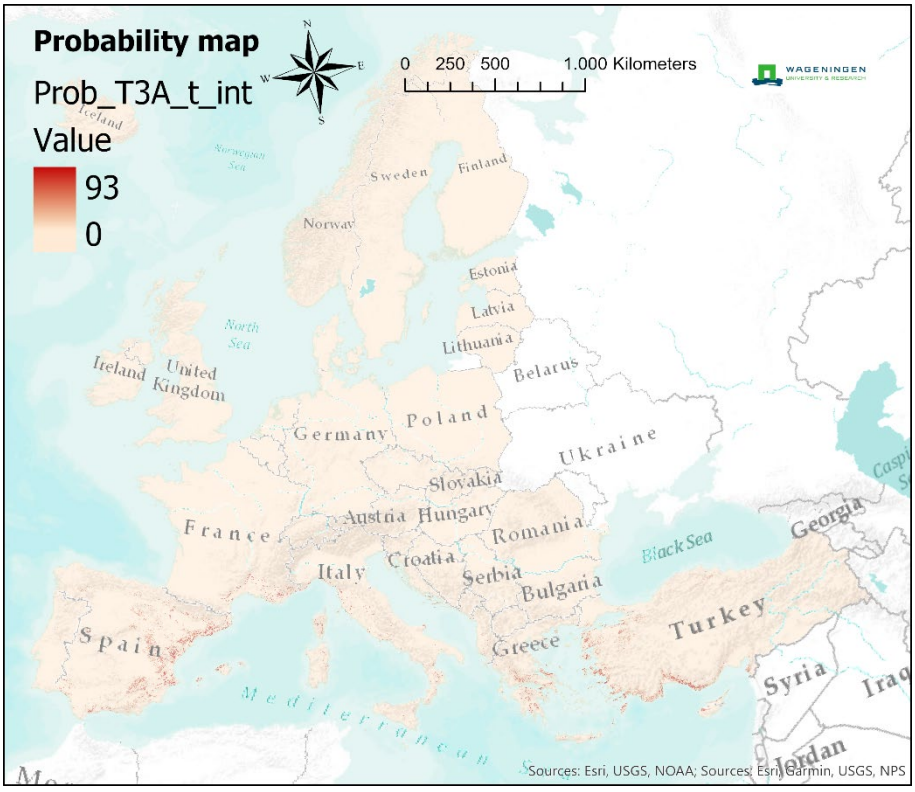


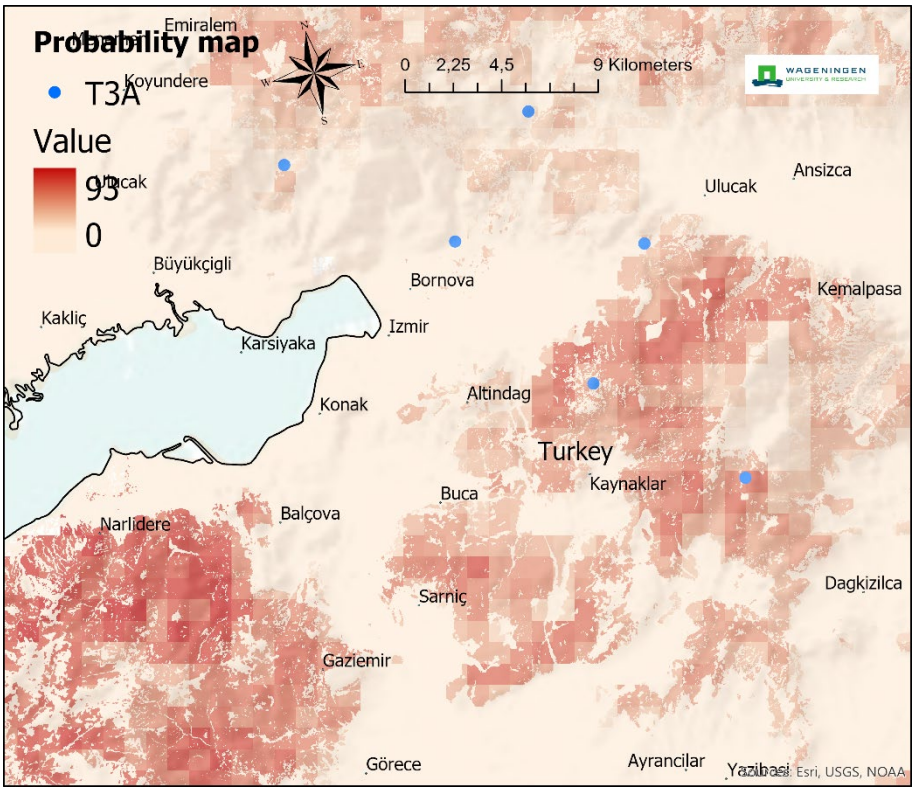

Probability map
T39
T39
Prob_T39_t_int
Value
100
0
0 5 10 20 Kilometers
PESHTERA
YAKORUDA
BLAGOEVGRAD
Simitli
RAZLOG
BANSKO
Bulgaria
Dospat
Breznitsa
BEROVO
LLindentsi
GOTSE DELCHEV
SANDANSKI
Macedonia
Potamoi
PETRICH
Greece
NEON
PETRITSION
SIDHIROKASTRON
MIKROPOLIS
XIROPOTAMOS
PROSOTSANI
KALABAKION

T3A - [G37] Mediterranean lowland to submontane Pinus forest

Evergreen coniferous forest dominated by various thermophilous pines: maritime pine (Pinus pinaster in western mediterranean and warm atlantic zones), Aleppo pine (P. halepensis) and stone pine (P. pinea all around the southern European coast) and Aegean pine (P. brutia in Greece and Anatolia), the first three often favouring unstable substrates or pre-climax situations.

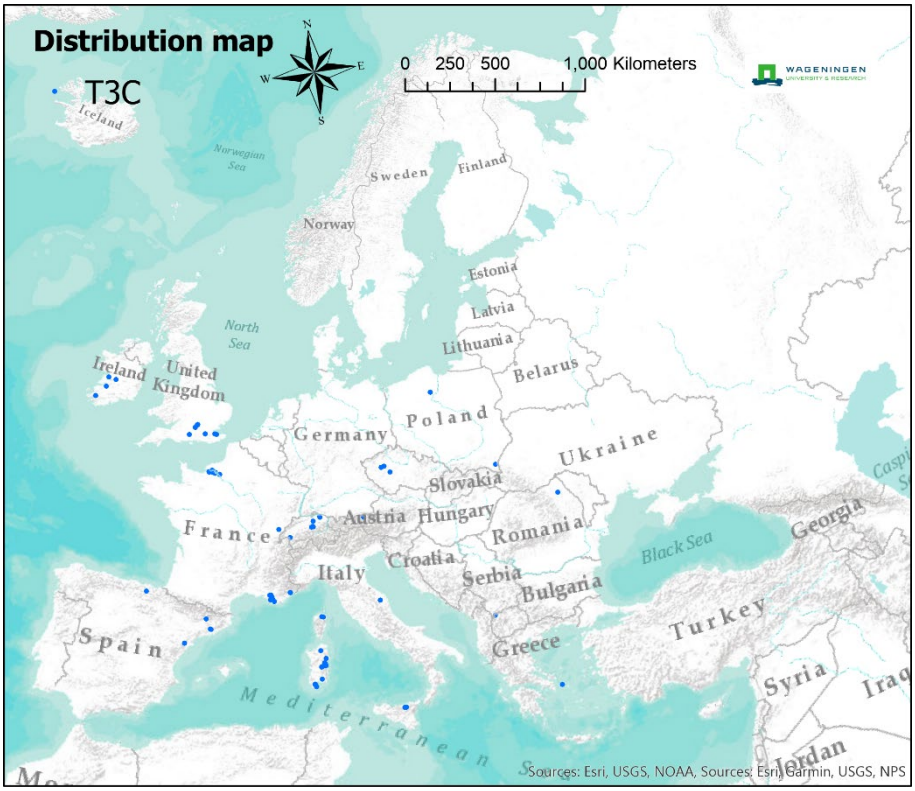


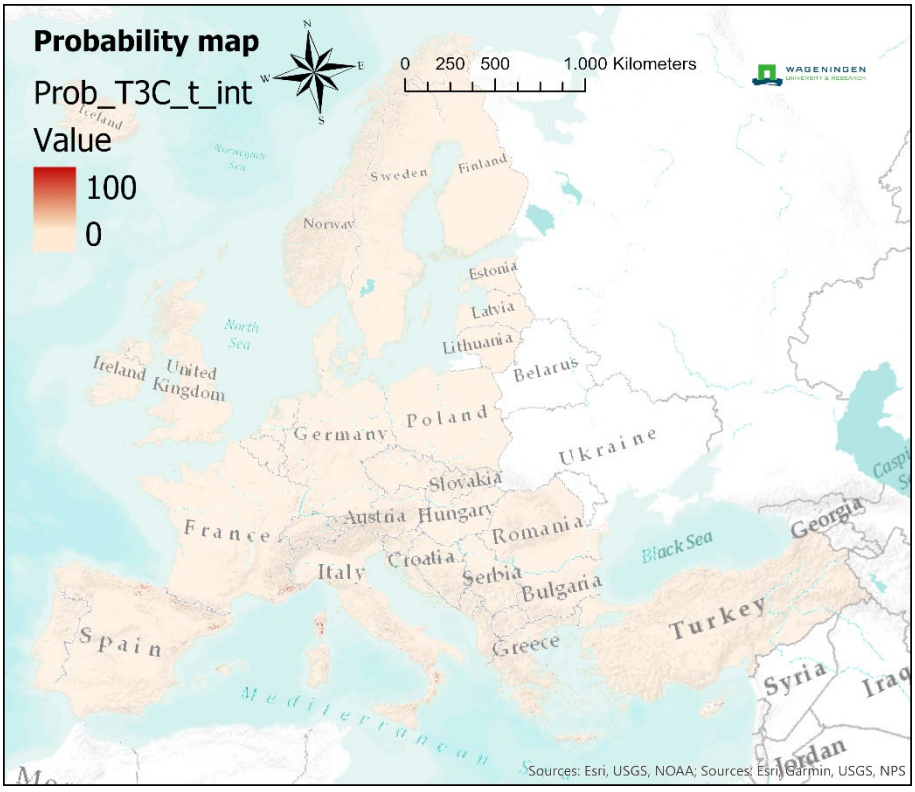


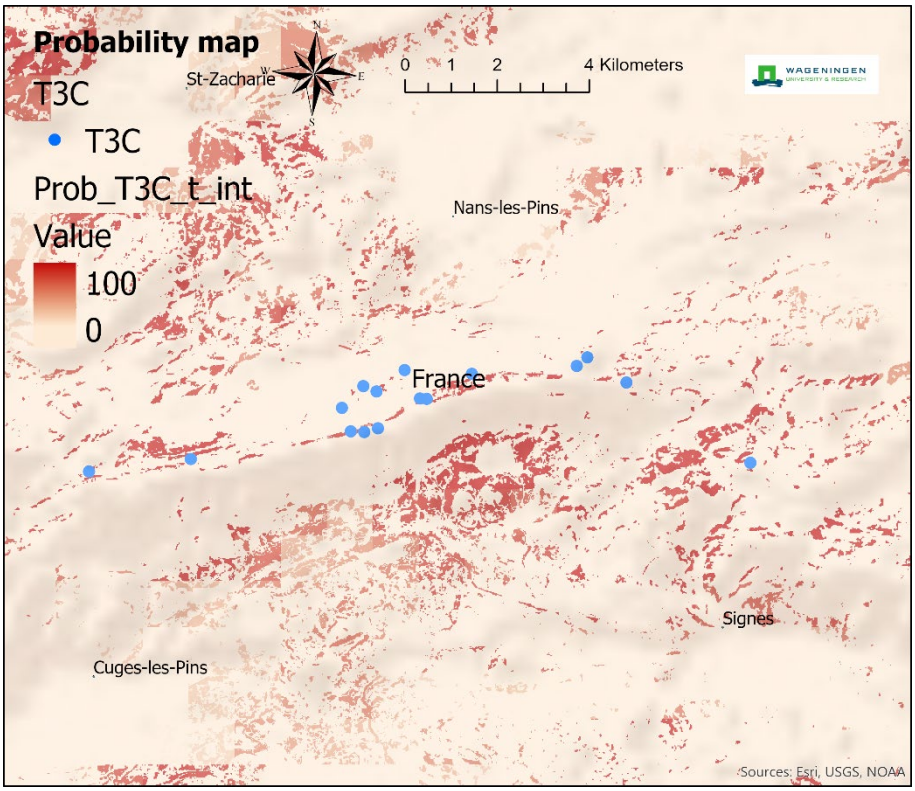

Probability map
T3A
Value
95
0
0 2,25 4,5 9 Kilometers
WAGENINGEN
Emiralem
Koyundere
Ulucak
Ansizca
Ulucak
Büyükçigli
Bornova
Kemalpasa
Kakliç
Karsiyaka
Izmir
Konak
Altindag
Turkey
Kaynaklar
Buca
Balçova
Narlidere
Dagkizilca
Sarniç
Gaziemir
Görece
Ayrancilar
Yazibasi
Esri, USGS, NOAA

T3C - [G39a] Taxus baccata forest

Evergreen woodlands overwhelmingly dominated by yew (Taxus baccata), sometimes with holly (Ilex aquifolium), whitebeam (Sorbus aria) and box (Buxus sempervirens), maybe in halted successions or as senescent survivals, occurring very locally on base-rich soils in the mediterranean zone and in the British Isles.

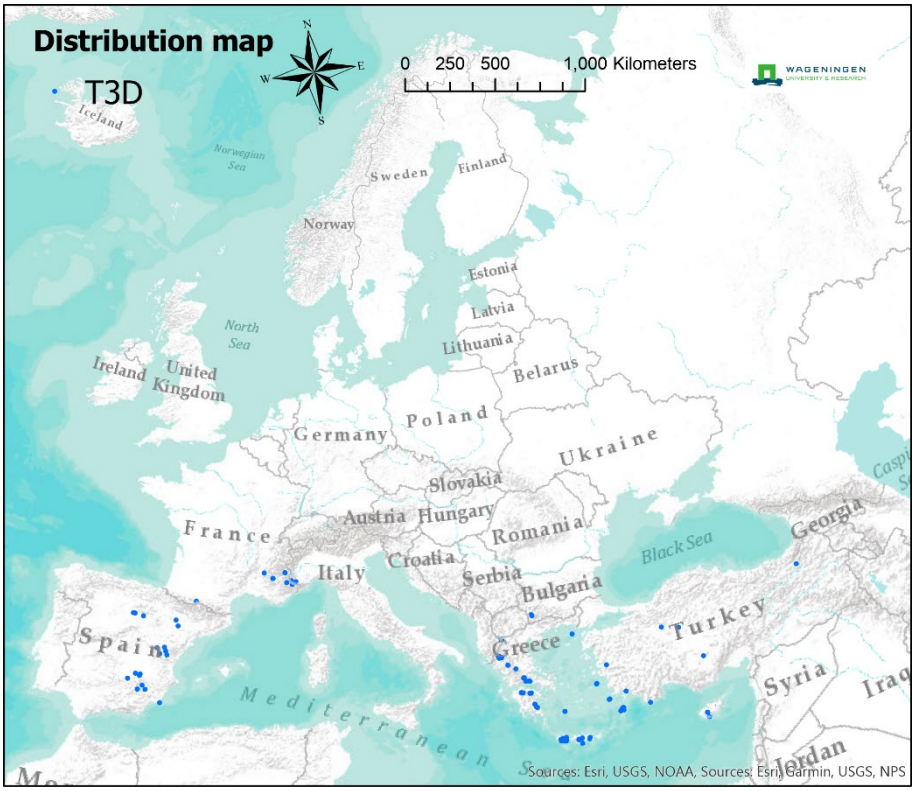


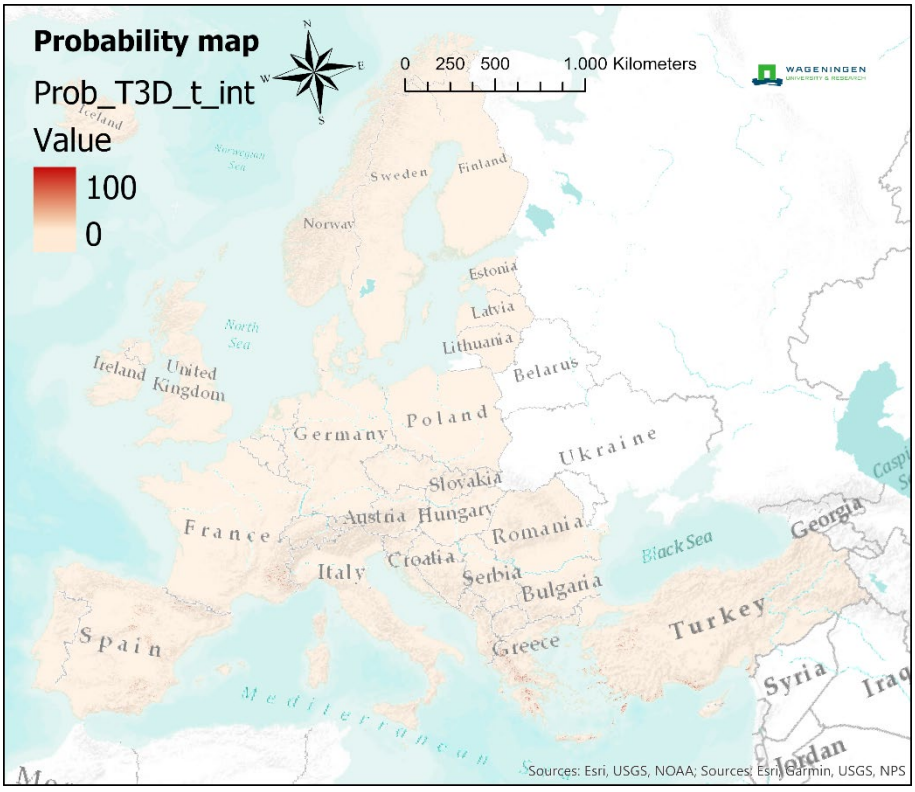


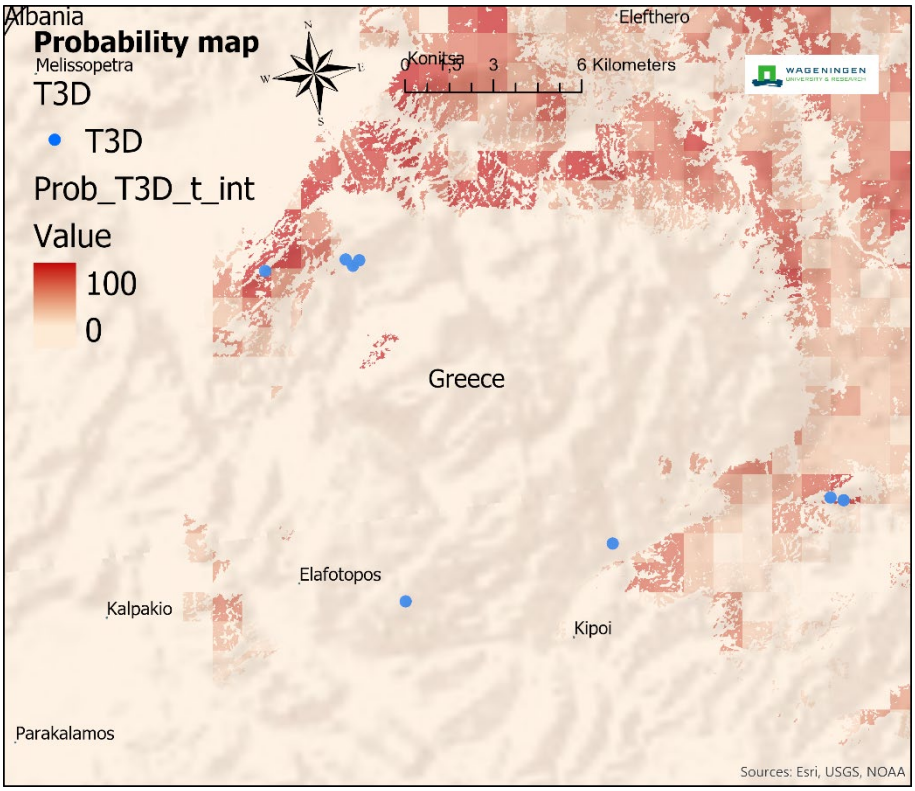

Probability map
T3C
T3C
Prob_T3C_t_int
Value
100
0
St-Zacharie
0 1 2 4 Kilometers
Nans-les-Pins
France
Signes
Cuges-les-Pins
Sources: Esri, USGS, NOAA

T3D - [G39b] Mediterranean Cupressaceae forest

Evergreen forests of cypress (Cupressus sempervirens), junipers (Juniperus drupacea, J. excelsa, J. foetidissima, J. thurifera) or alerce (Tetraclinis articulata) with a usually open canopy with scrubby understorey and grassy field layer, on shallow, usually base-rich soils, in dry rocky situations scattered through the mediterranean zone.

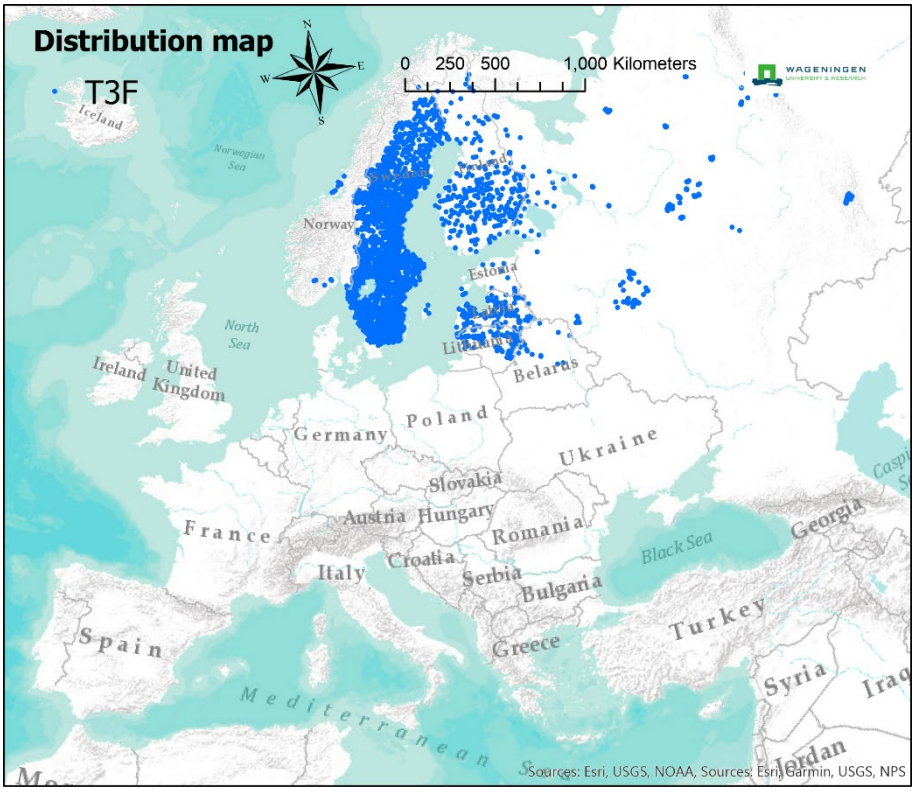


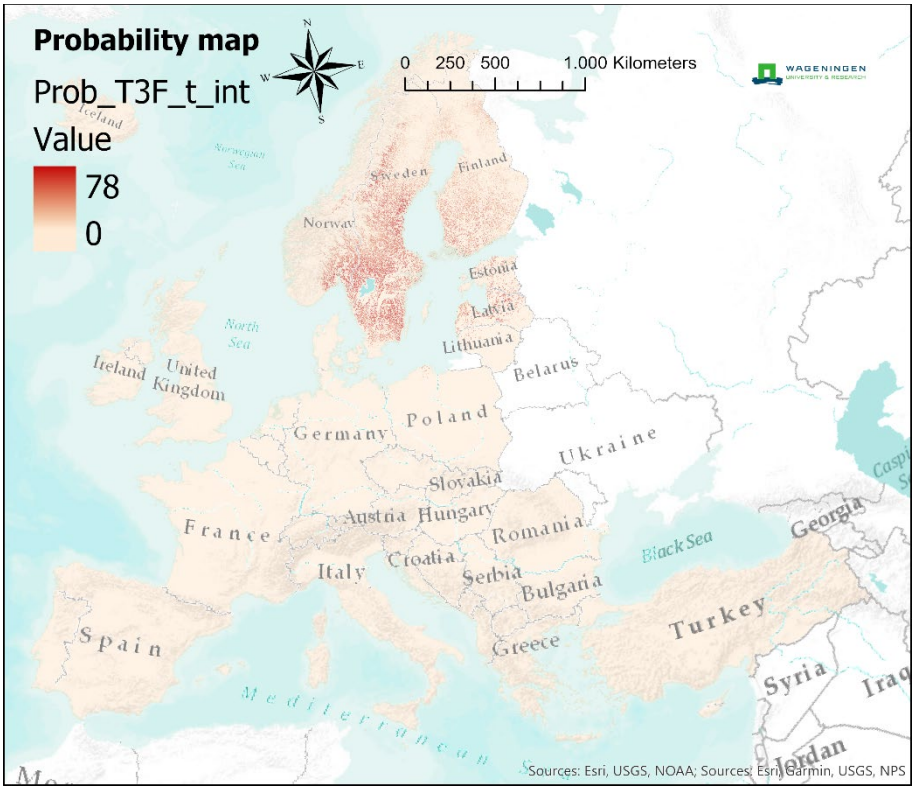


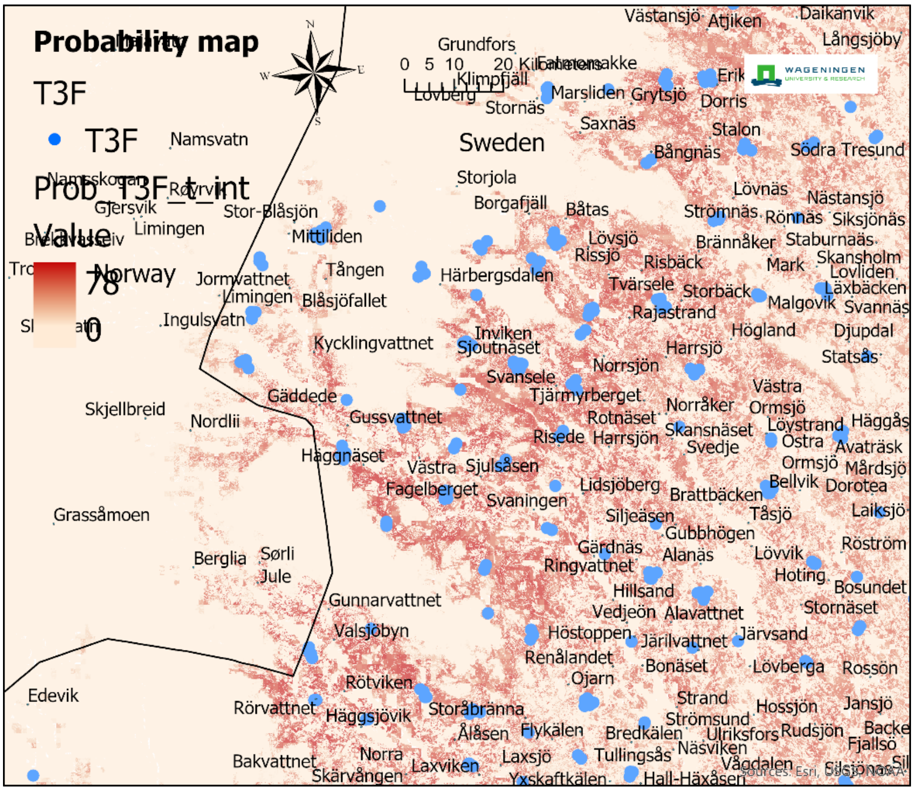

Albania
Probability map
Melissopetra
T3D
T3D
Prob_T3D_t_int
Value
100
0
Konitsa
0 1,5 3 6 Kilometers
Elefthero
Greece
Elafotopos
Kalpakio
Kipoi
Parakalamos
Sources: Esri, USGS, NOAA

T3F - [G3A] Dark taiga

Forest naturally dominated by spruce (Picea abies, P. obovata), Siberian fir (Abies sibirica) or Siberian pine (Pinus sibirica) on more mesic soils through the north-eastern continental and boreal regions, often with a subordinate deciduous broadleaf component (e.g. Betula pendula and B. pubescens) in the canopy and understorey and varied field-layer with significant participation of dwarf shrubs, bryophytes and lichens.

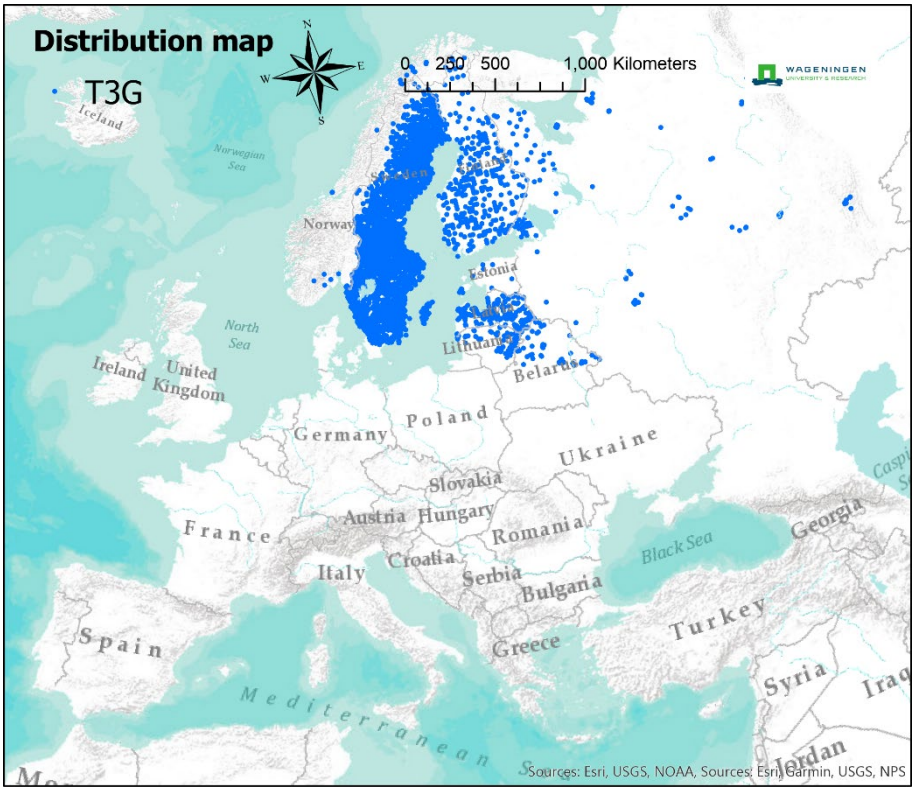


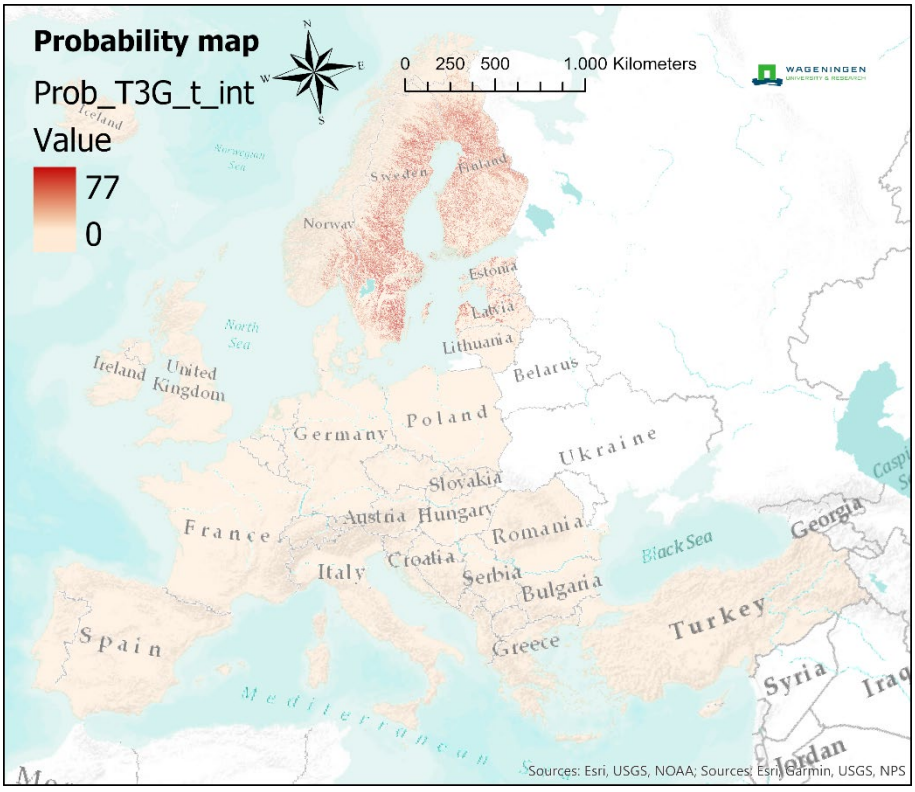


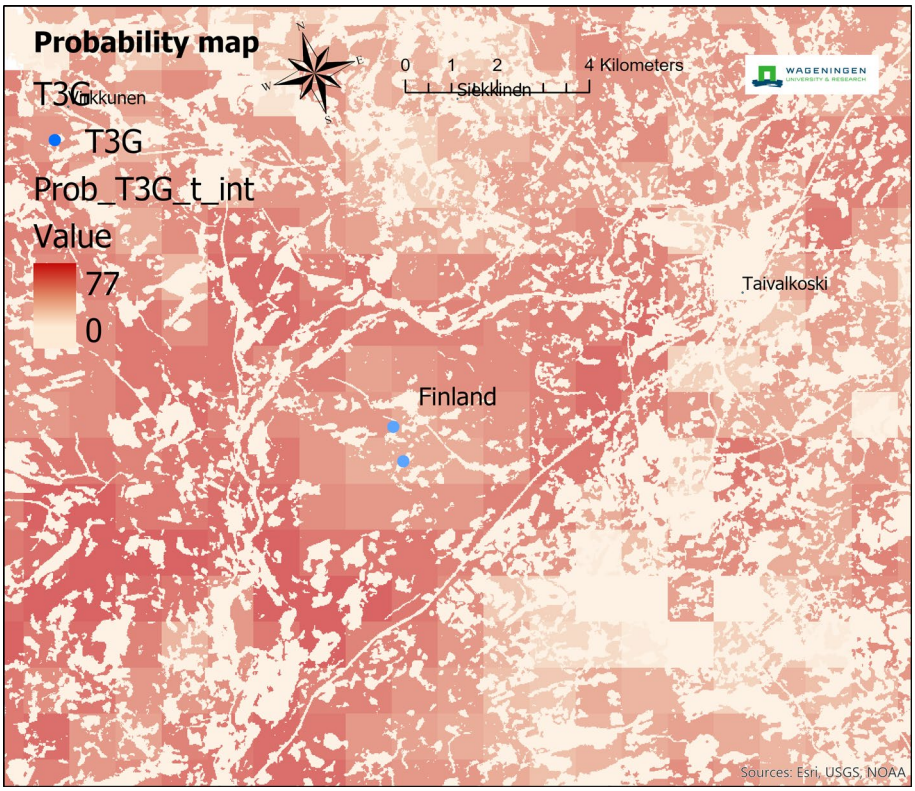

Probability map
T3F
T3F
Prob_T3F_t_int
Value
78
0
Norway
Sweden
0 5 10 20 Kilometers

T3G - [G3B] Pinus sylvestris light taiga

Forest naturally dominated by Scot's pine (Pinus sylvestris) but often with some birch (Betula pendula and B. pubescens) on lithomorphic and podzolized soils of dry and barren situations through the north-eastern continental and boreal regions with a generally heathy field layer but, when on eskers, a specialised herb flora.

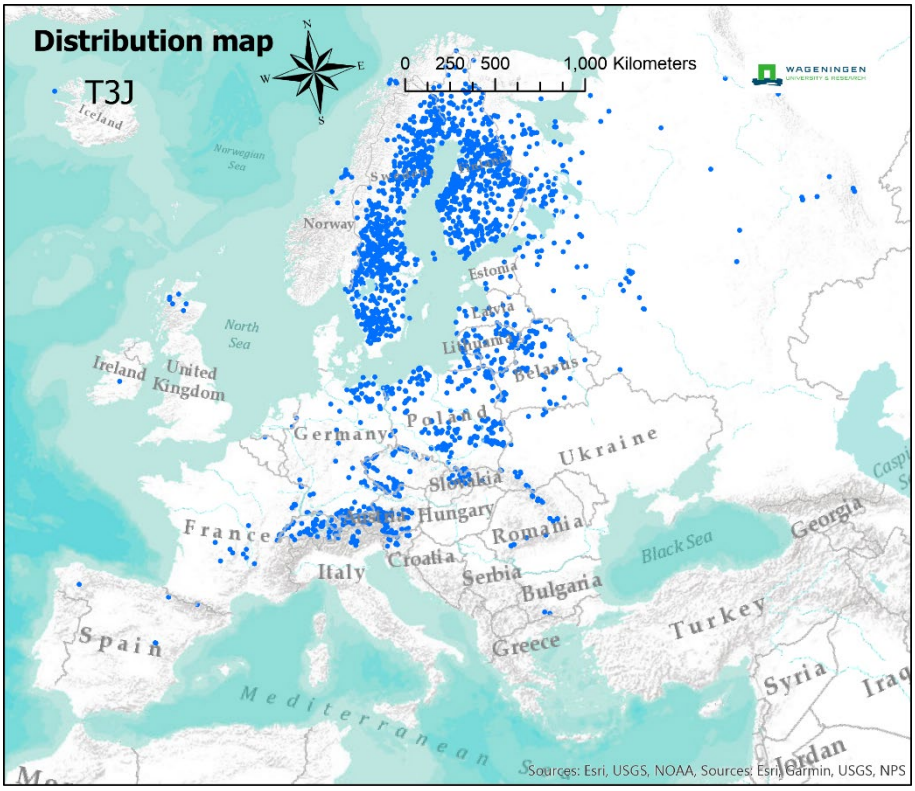


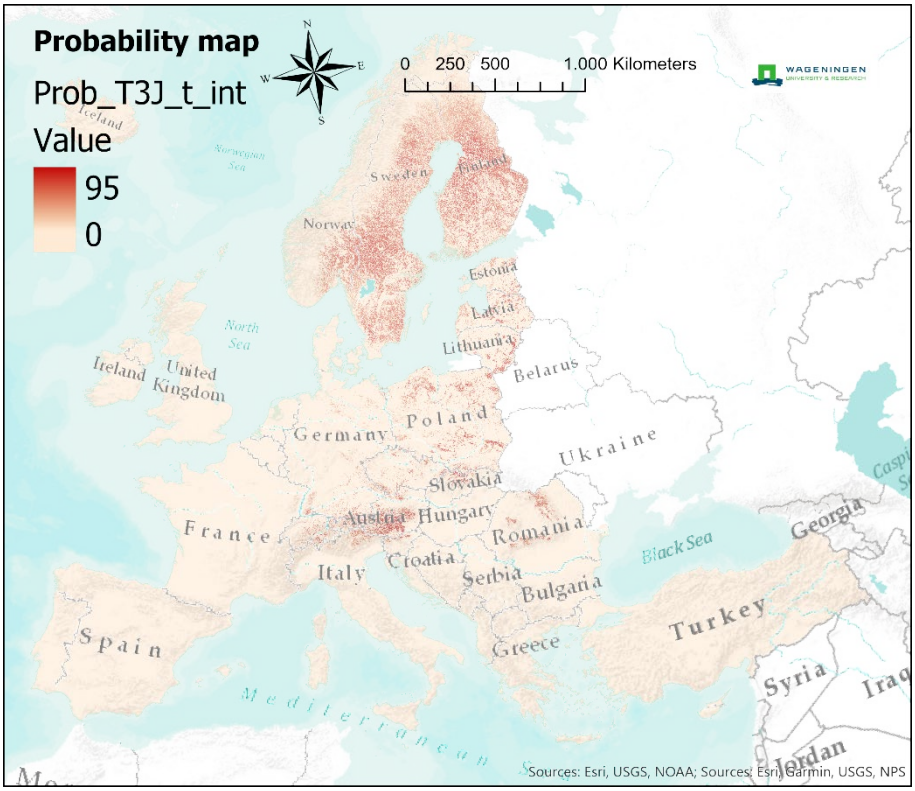


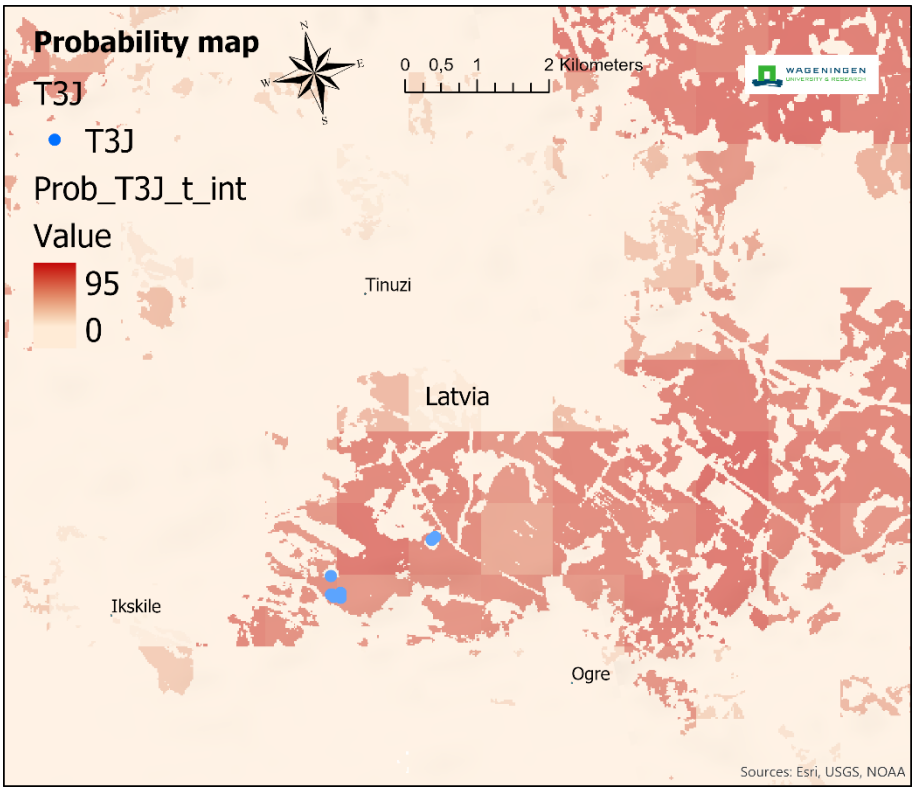

Probability map
T3G
T3G
Prob_T3G_t_int
Value
77
0
0 1 2 4 Kilometers
Sieklinen
Taivalkoski
Finland
Sources: Esri, USGS, NOAA

T3J - [G3Da] Pinus and Larix mire forest

Open woodland dominated by pine (Pinus sylvestris, P. rotundata) or larch (Larix sibirica, L. decidua) on acid peat or around active bogs and poor fens with nutrient-poor ground waters occurring through the boreal zone and locally, where ground conditions permit, in the continental zone.

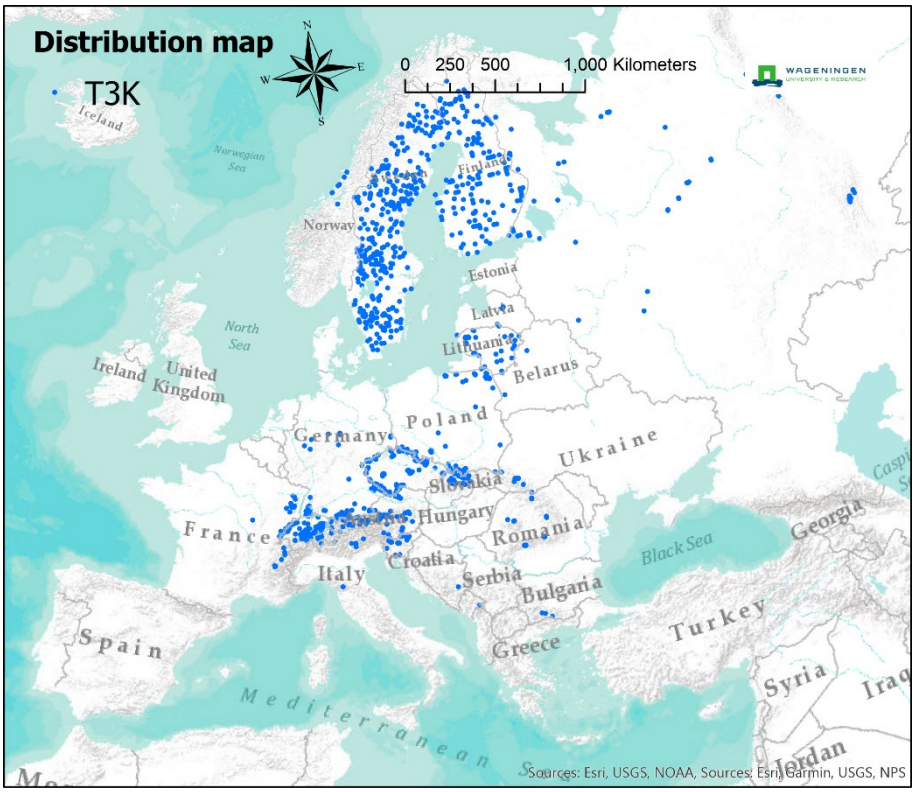


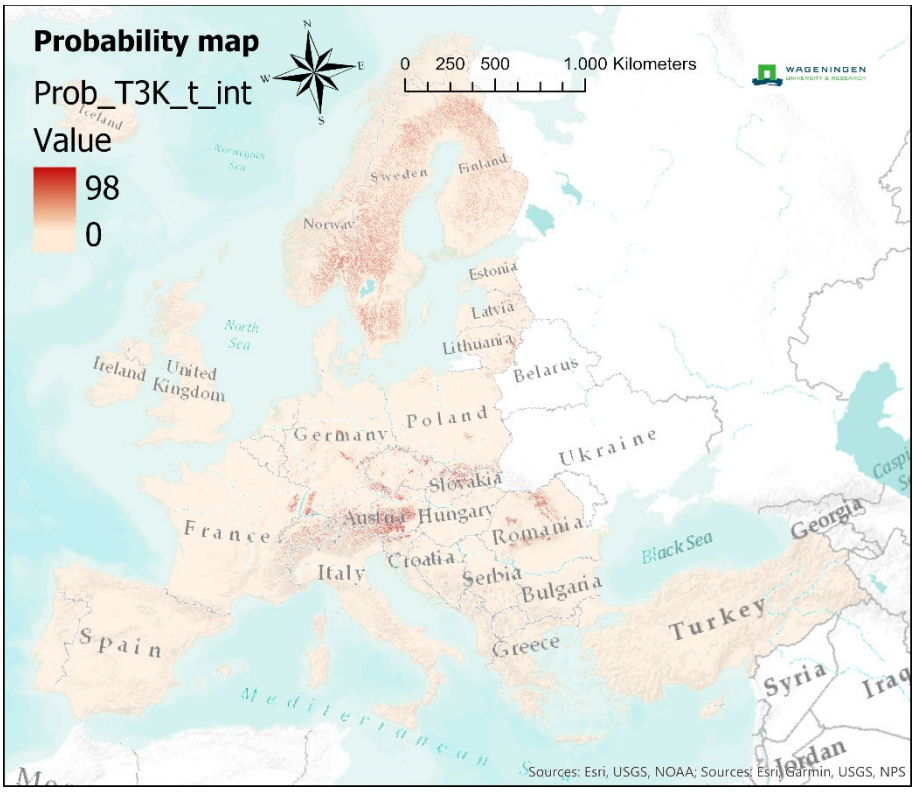


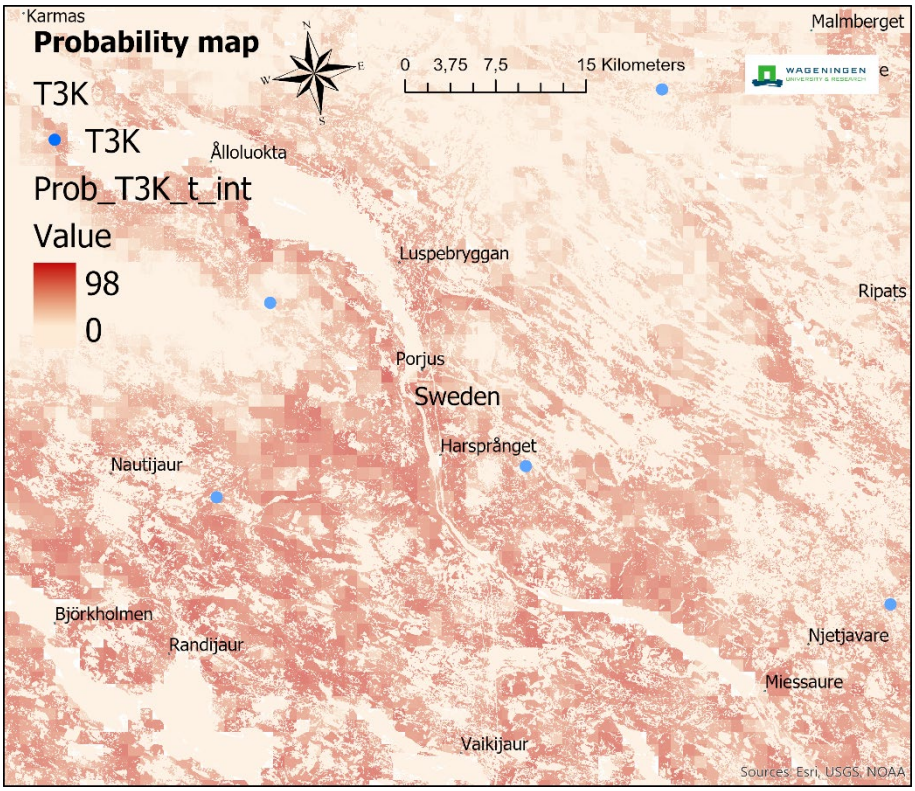

Probability map
T3J
T3J
Prob_T3J_t_int
Value
95
0
0 0,5 1 2 Kilometers
Tinuzi
Latvia
Ikskile
Ogre
Sources: Esri, USGS, NOAA

T3K - [G3Db] Picea mire forest

Open woodland dominated by spruce (Picea abies, P. obovata) on acid peat or around active bogs and poor fens with nutrient-poor ground waters occurring through the boreal zone and locally, where ground conditions permit, in the continental zone.

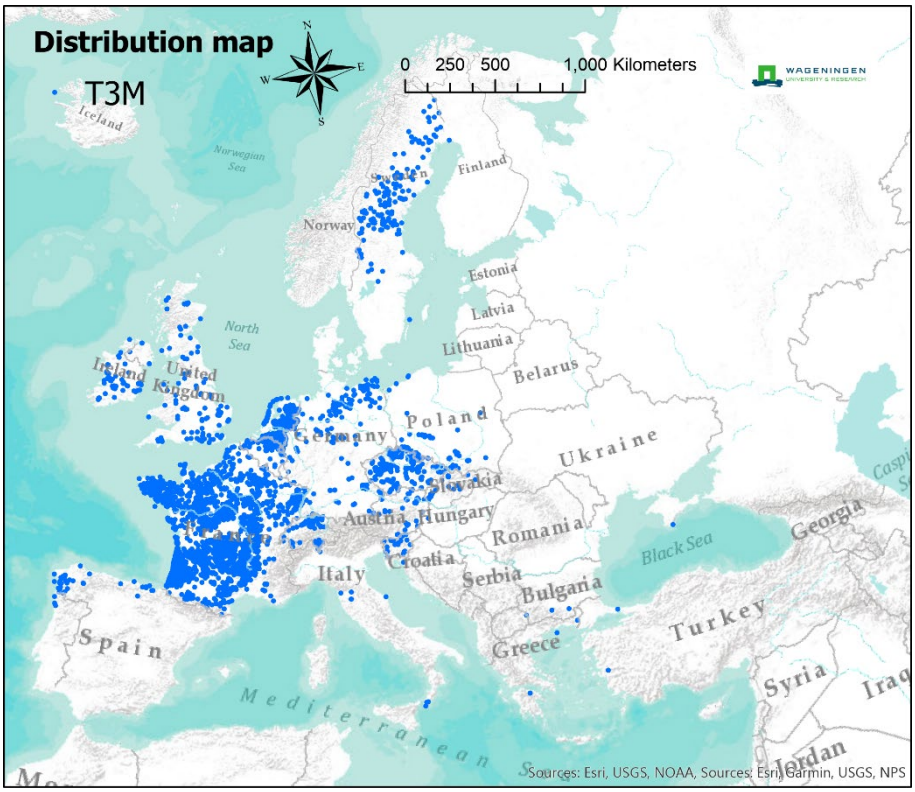


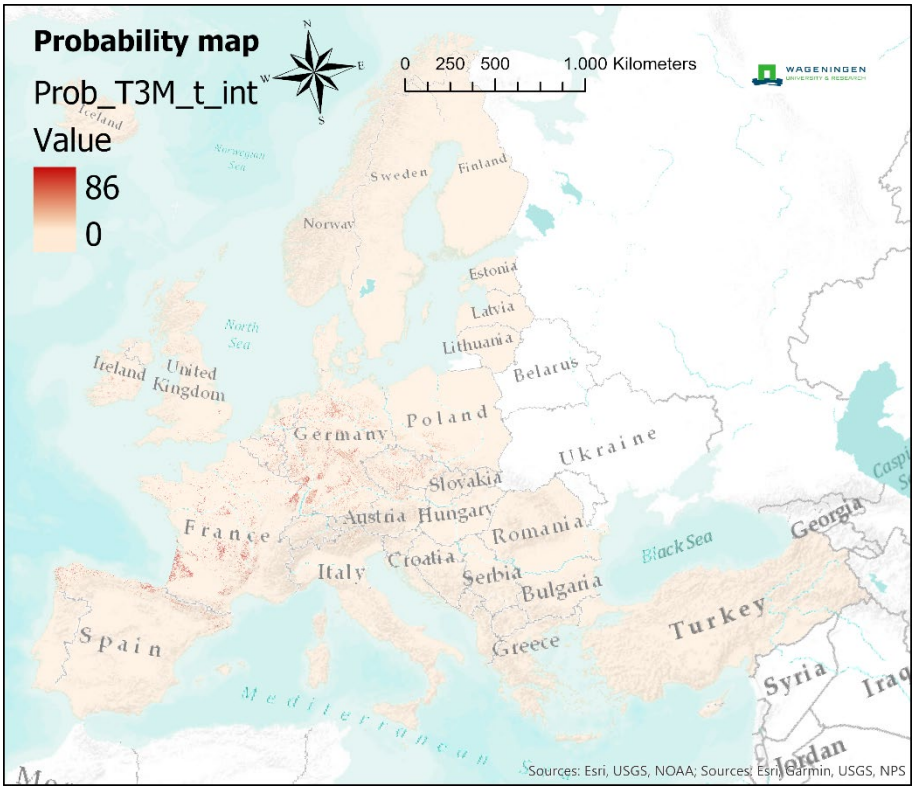


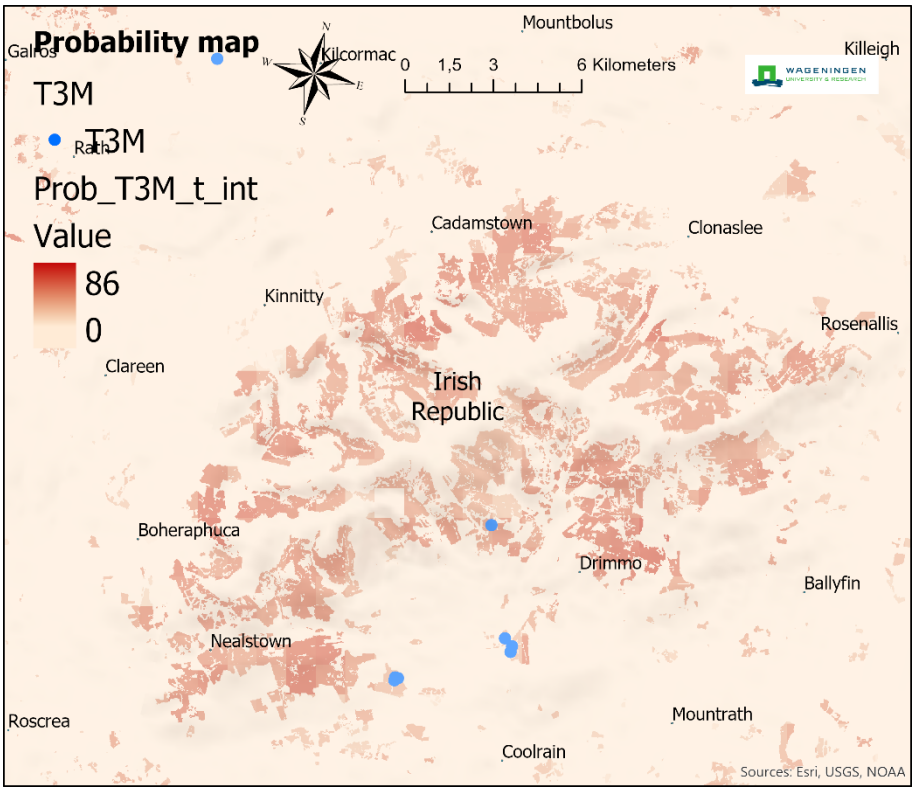

Karmas
Probability map
T3K
T3K
Prob_T3K_t_int
Value
98
0
N
W
E
S
0 3,75 7,5 15 Kilometers
WAGENINGEN UNIVERSITY & RESEARCH
Malmberget
Ålloluokta
Luspebryggan
Ripats
Porjus
Sweden
Harsprånget
Nautijaur
Björkholmen
Randijaur
Njetjavare
Miessaure
Vaikijaur
Sources: Esri, USGS, NOAA

T3M - [G3F1] Coniferous plantation of non site-native trees

Cultivated stands of coniferous trees planted for the production of wood, composed of exotic conifer species or of European conifers out of their natural range.



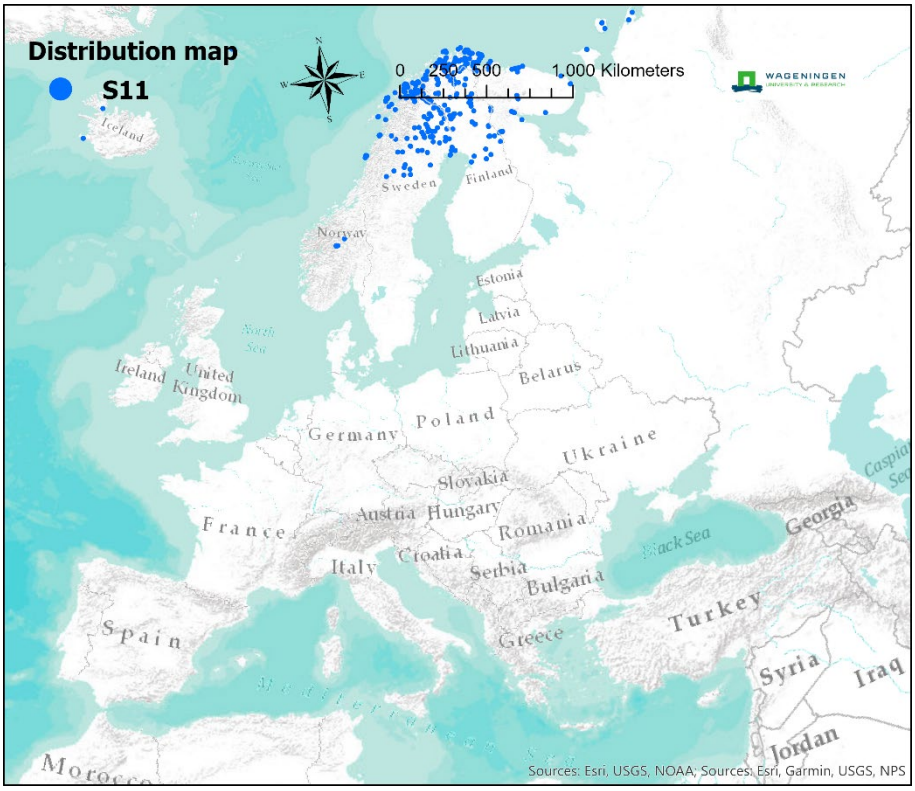


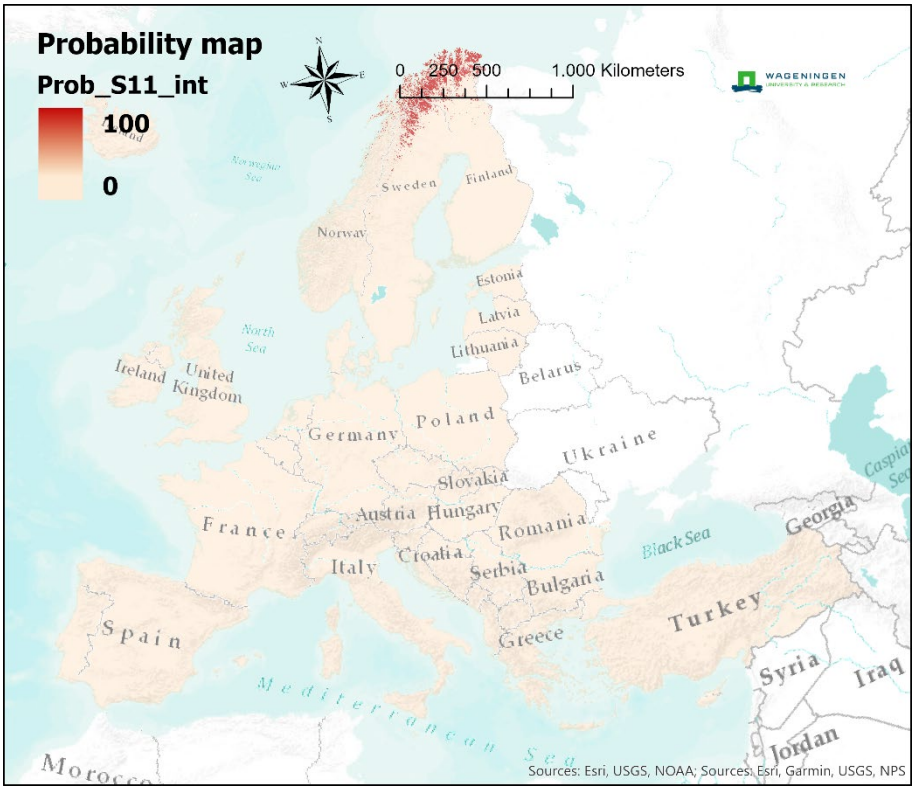

Probability map
T3M
T3M
Prob_T3M_t_int
Value
86
0
Mountbolus
Killeigh
Kilcormac
0 1,5 3 6 Kilometers
WAGENINGEN
Cadamstown
Clonaslee
Kinnitty
Rosenallis
Clareen
Irish
Republic
Boheraphuca
Drimmo
Ballyfin
Nealstown
Roscrea
Mountrath
Coolrain
Sources: Esri, USGS, NOAA

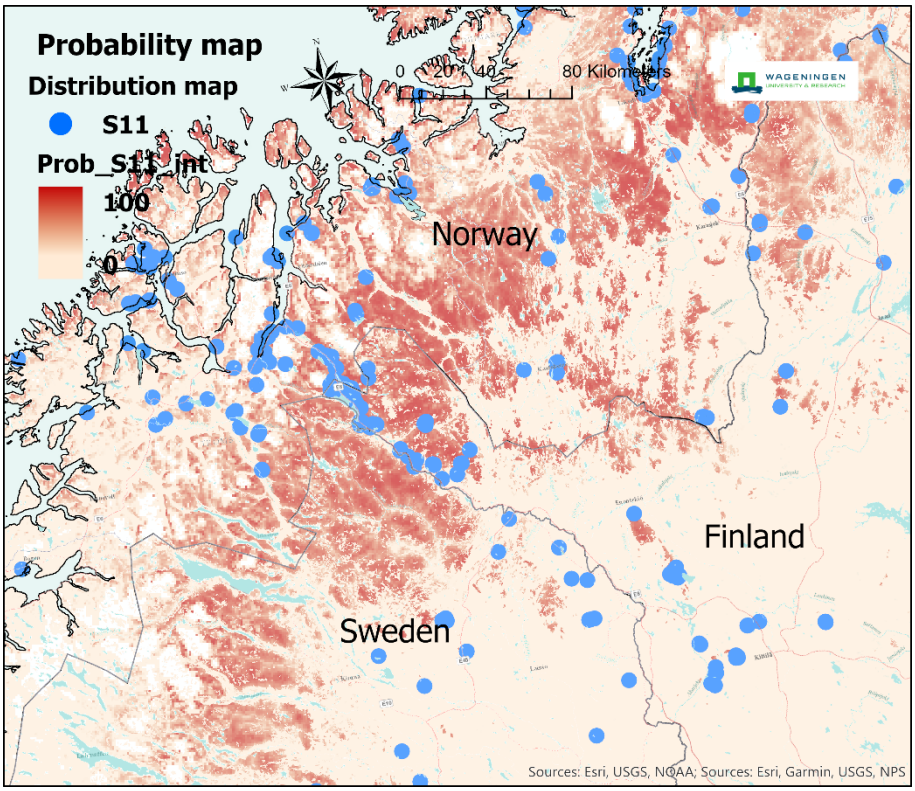
Appendix 2 Shrubs habitat probability maps

S11 – [F11] Shrub tundra

Tundra with a usually extensive cover of sub-shrubs or low shrubs over herbs, mosses and lichens on sporadically permafrost soils of the southern arctic and subarctic zones, often grazed into grassy mosaics.

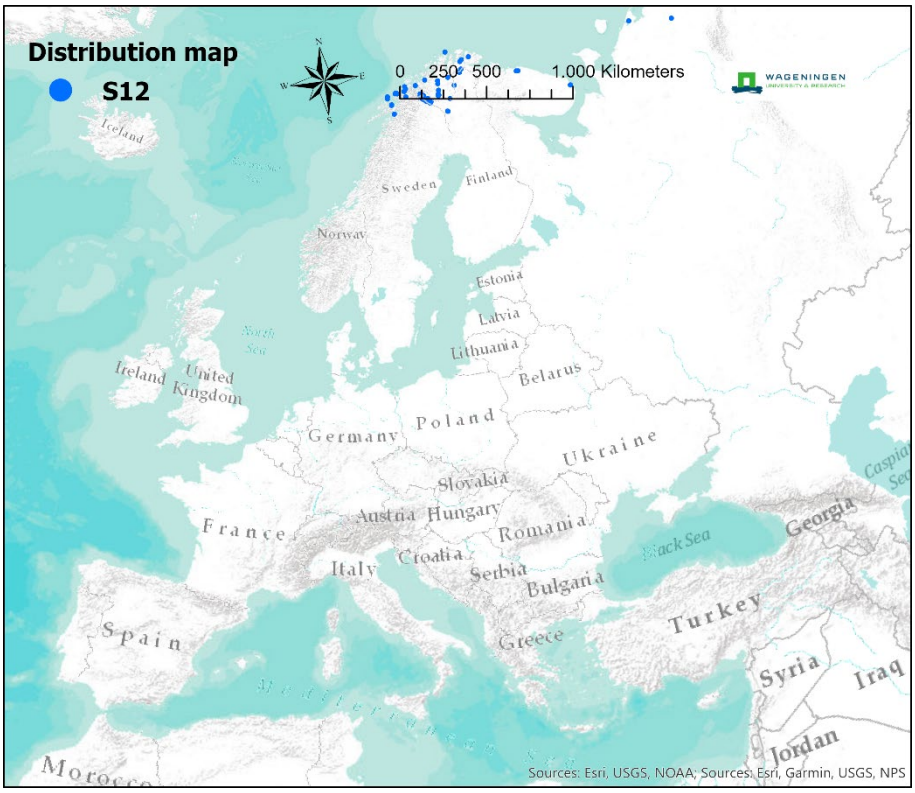


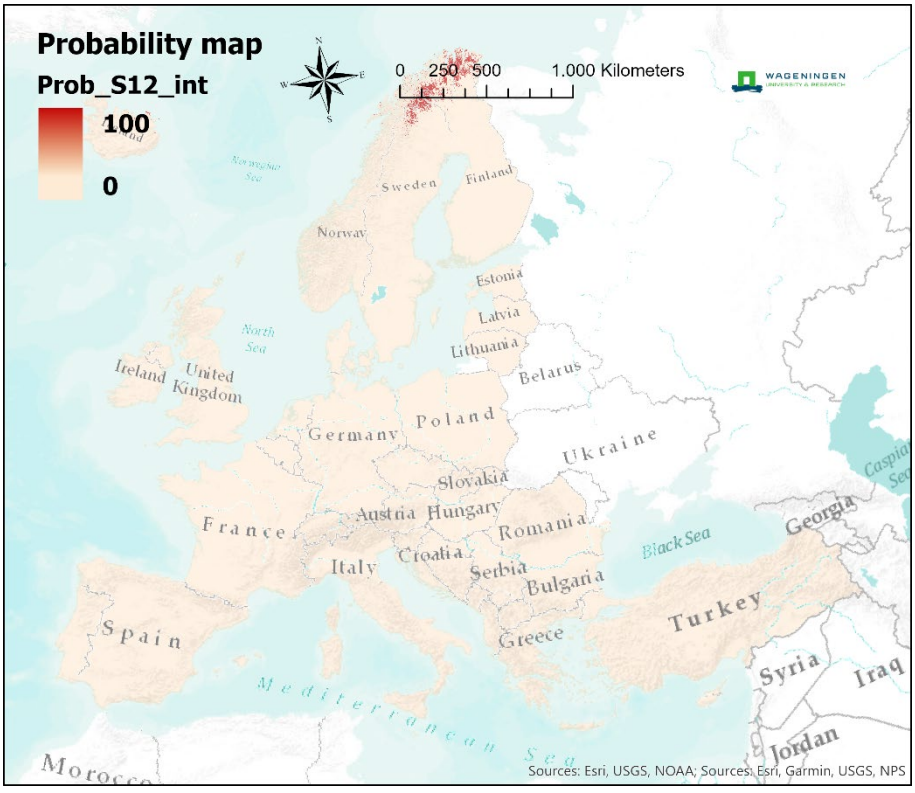


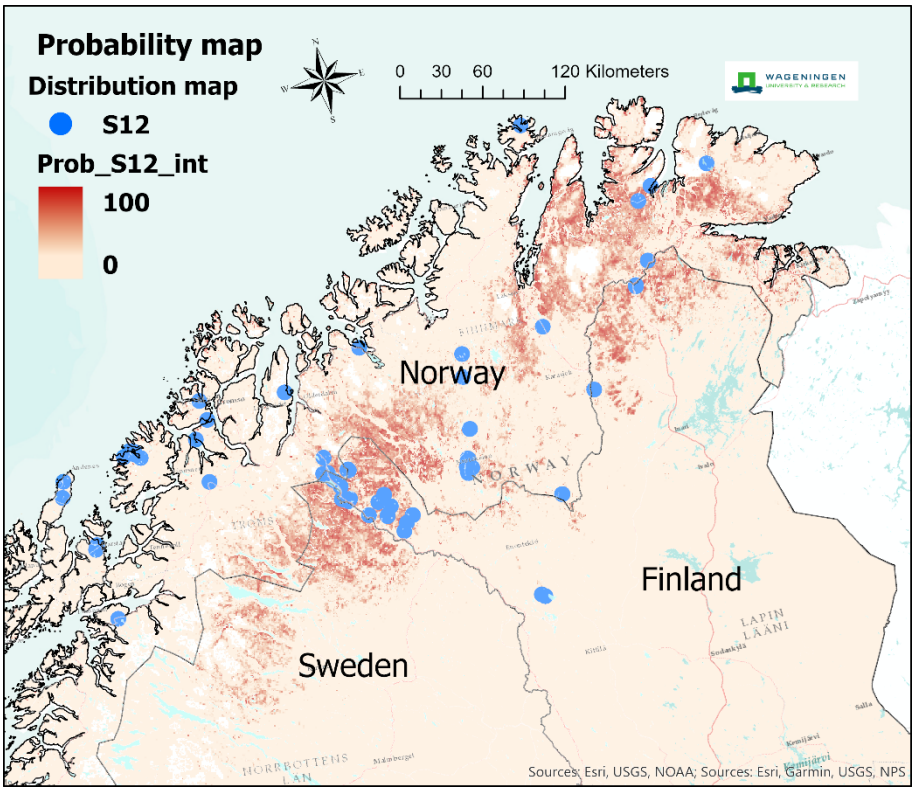

Probability map
Distribution map
S11
Prob_S11_int
100
0
0 20 40 80 Kilometers
WAGENINGEN
Norway
Finland
Sweden
Sources: Esri, USGS, NOAA; Sources: Esri, Garmin, USGS, NPS

S12 – [F12] Moss and lichen tundra

Tundra of the middle and northern high arctic zone where permafrost soils, often occurring in patterned ground, support a frequently sparse cover of mosses, lichens and low herbs.

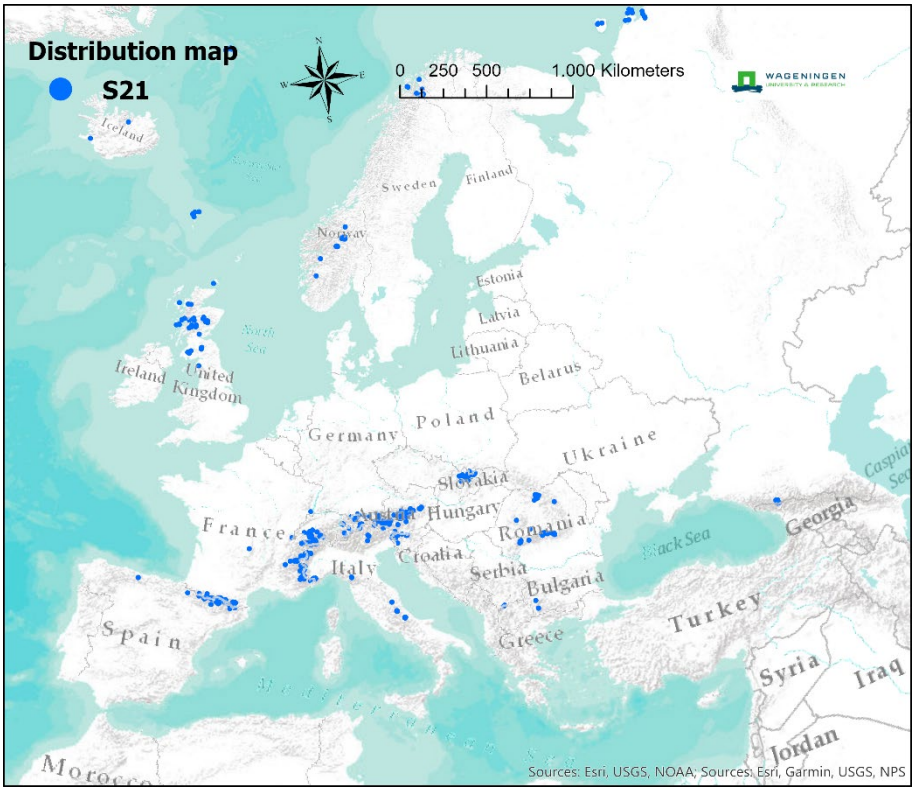


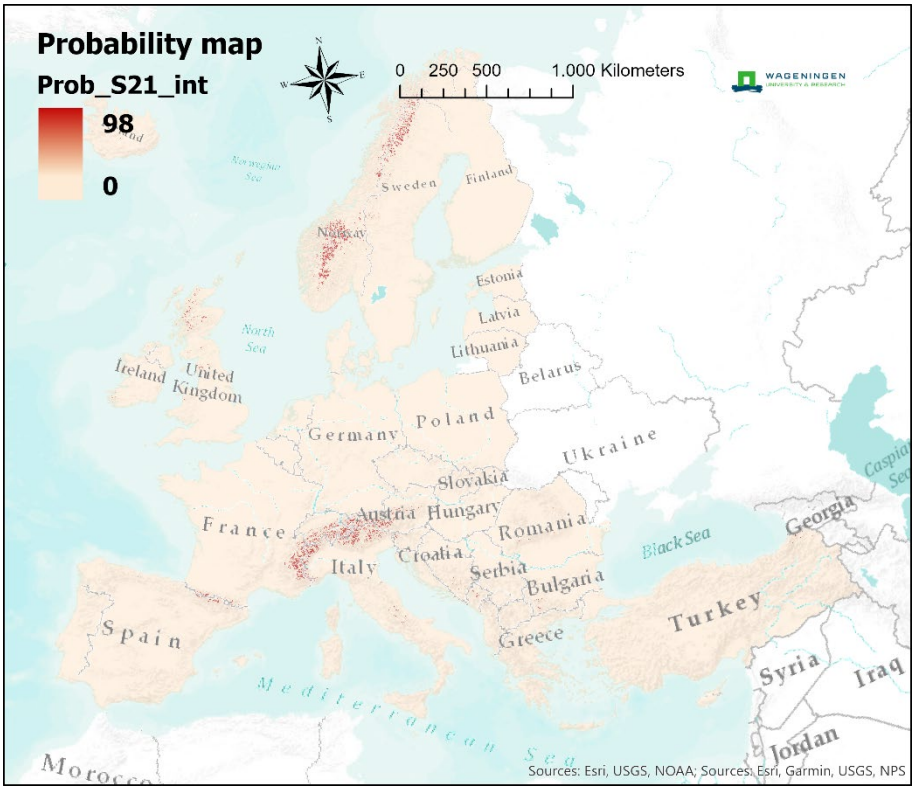


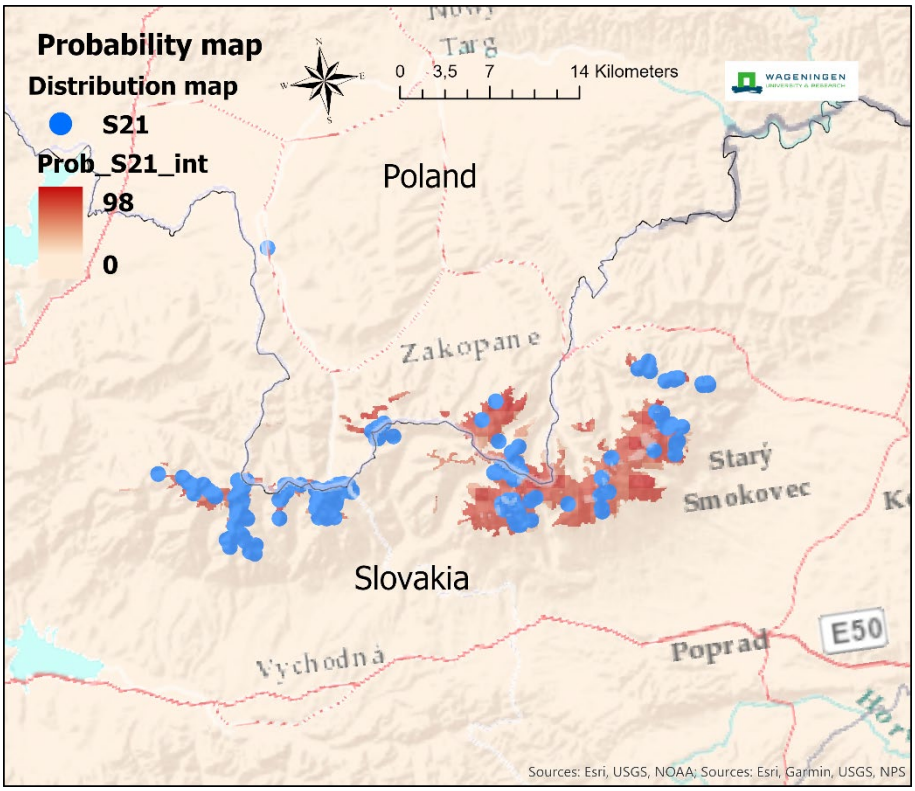

Probability map
Distribution map
S12
Prob_S12_int
100
0
0 30 60 120 Kilometers
WAGENINGEN
Norway
Finland
Sweden
Sources: Esri, USGS, NOAA; Sources: Esri, Garmin, USGS, NPS

S21 – [F21] Subarctic and alpine dwarf Salix scrub

Salix-dominated dwarf scrub, often with abundant bryophytes and lichens, on skeletal calcareous or siliceous soils in late snow beds with a short growing-season, occurring in the subarctic north of the forest zone and in the high mountains of nemoral Europe, increasingly local and fragmentary to the south.

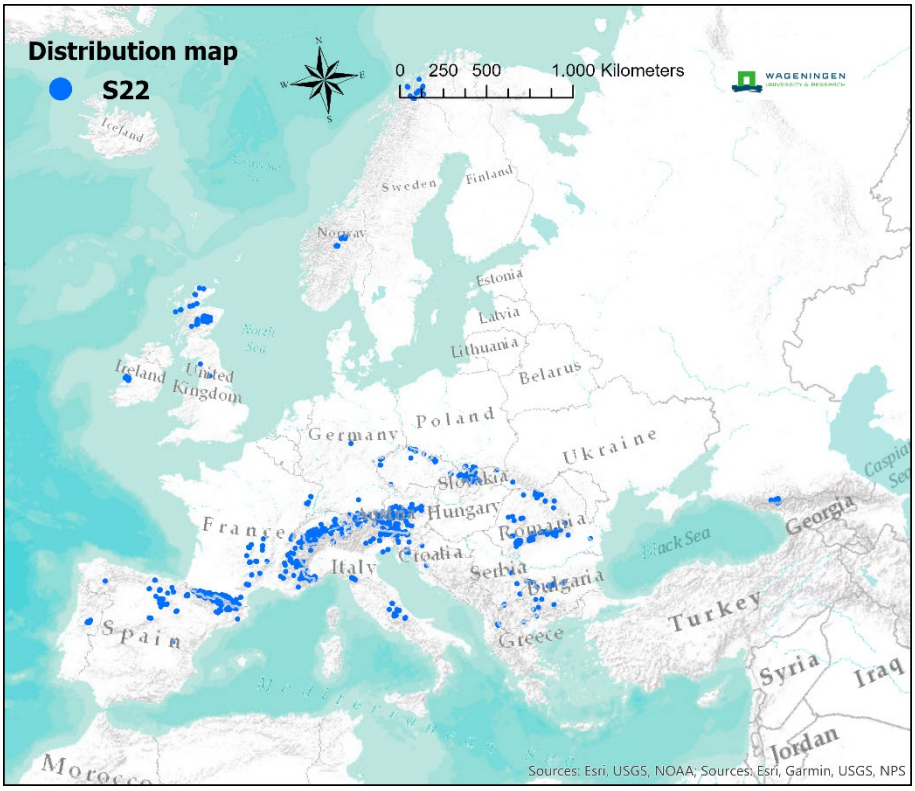


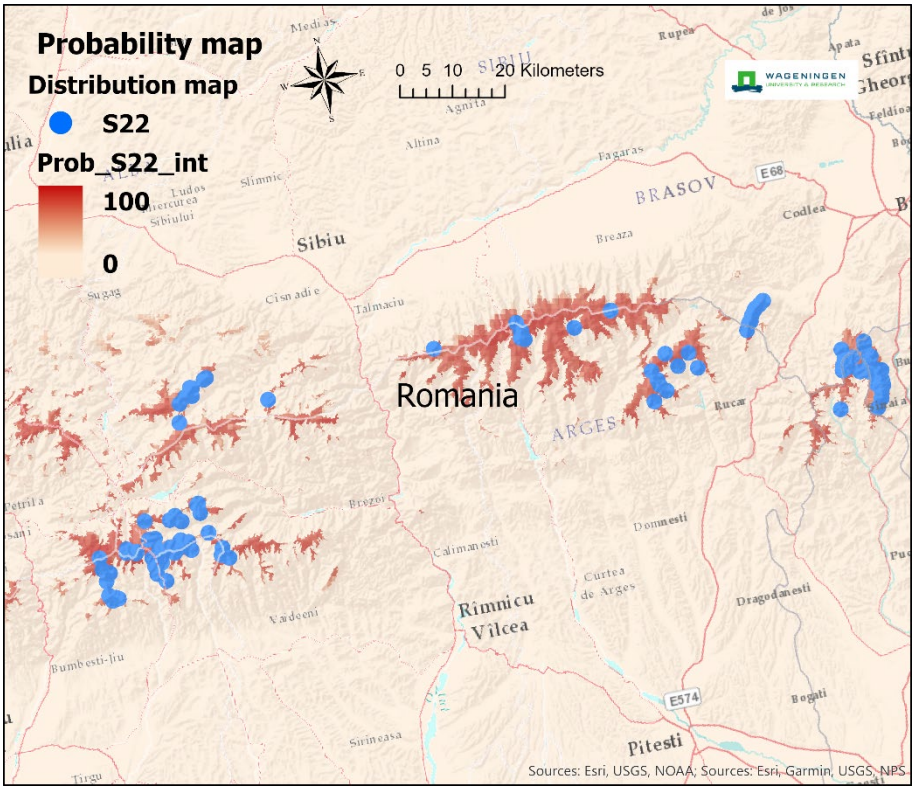


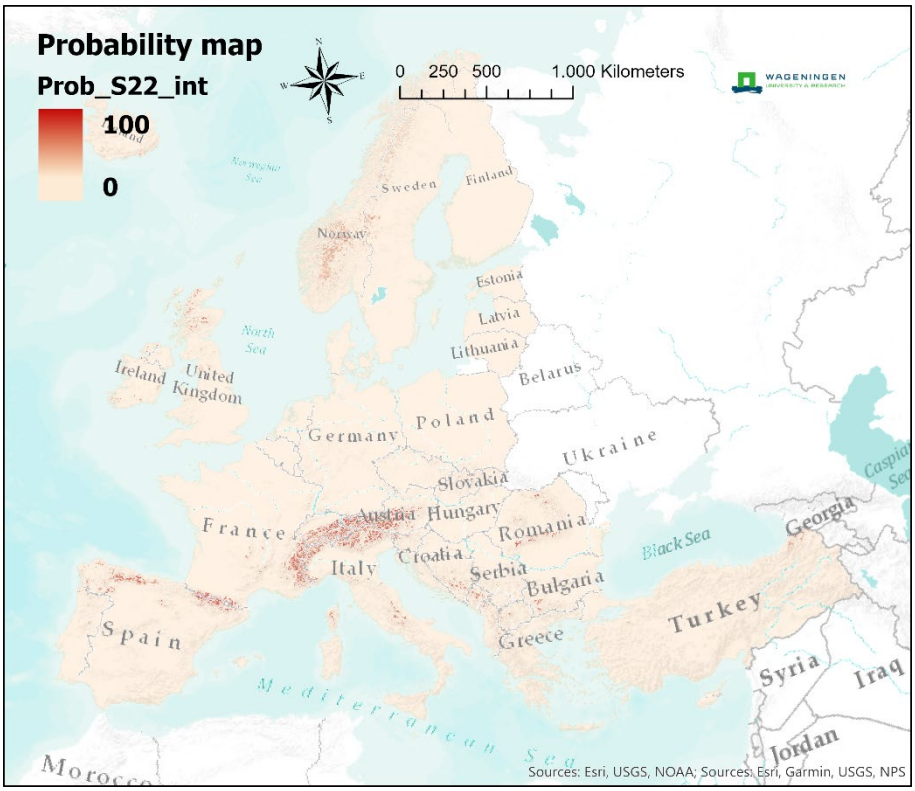

Probability map
Distribution map
S21
Prob_S21_int
98
0
0 3,5 7 14 Kilometers
Poland
Zakopane
Starý Smokovec
Slovakia
Východná
Poprad
E50
Sources: Esri, USGS, NOAA; Sources: Esri, Garmin, USGS, NPS

S22 – [F22a] Alpine and subalpine ericoid heath

Dwarf-shrub vegetation dominated by ericoids and other woody species (not Juniperus or genistoids) occurring in high mountains throughout Europe, varying in dominants and associates according to regional climate, degree of exposure and snow lie, soil reaction, soil depth and moisture.

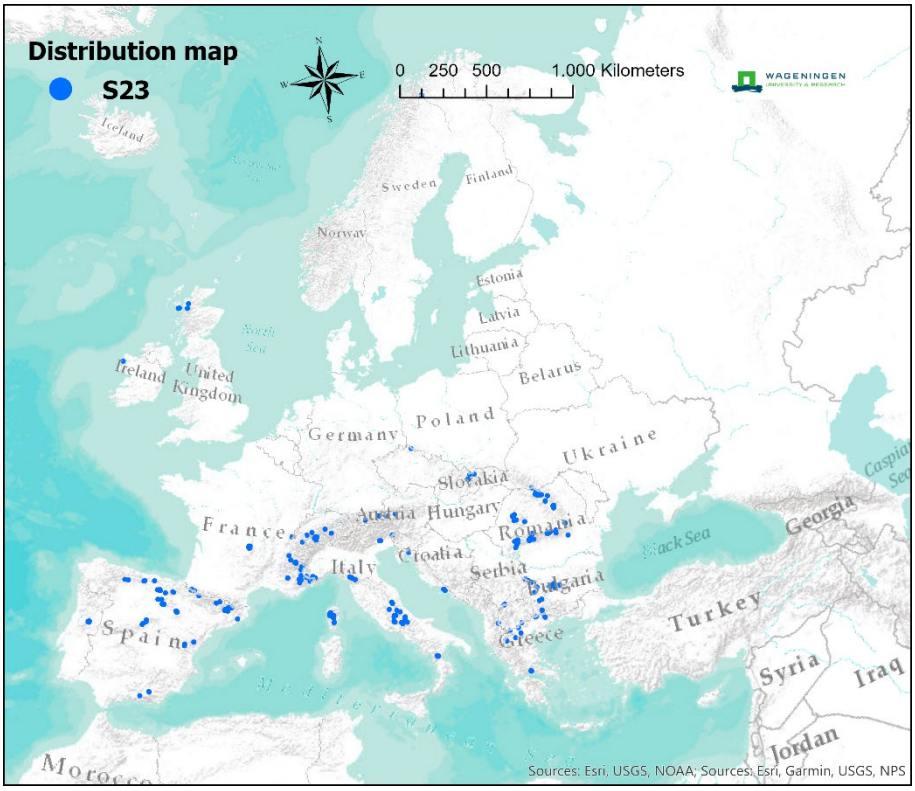


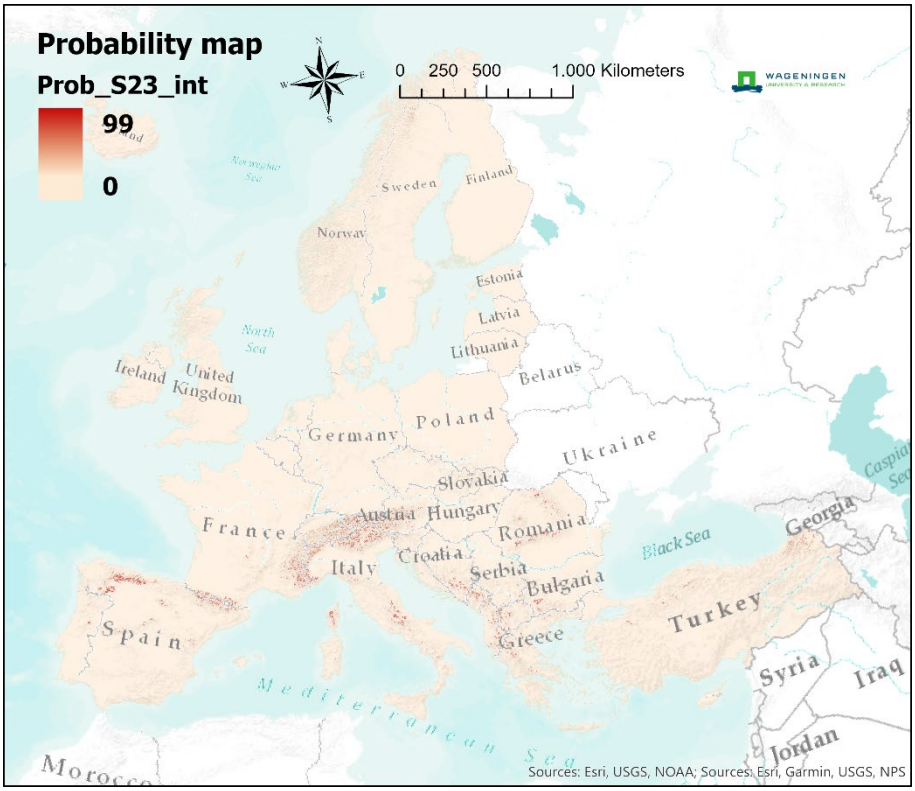


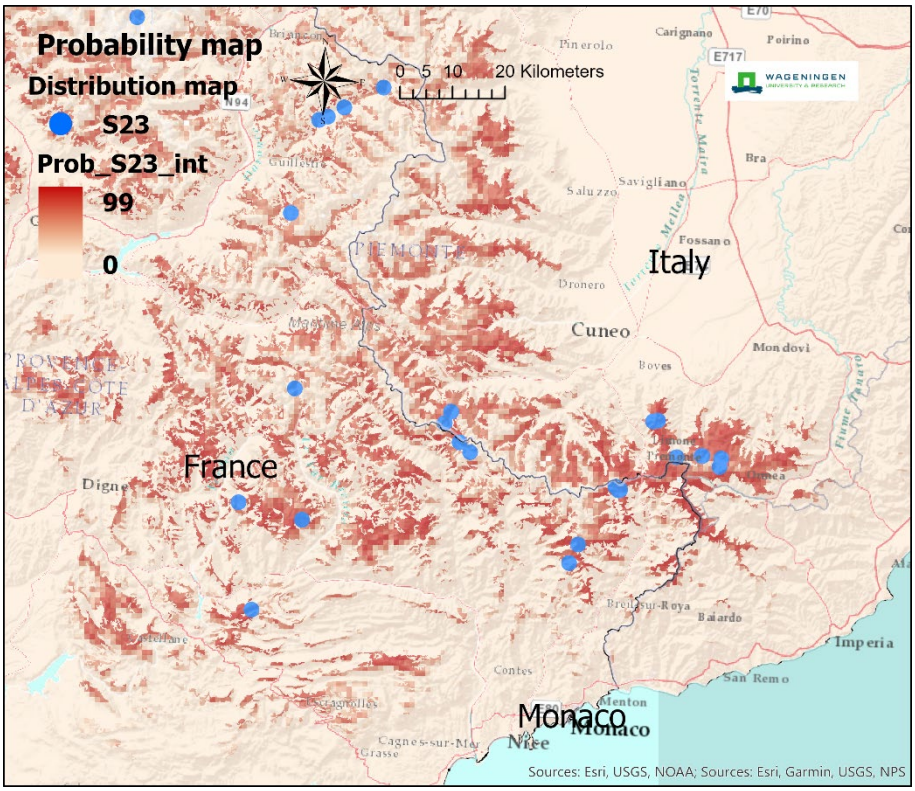

Probability map
Prob_S22_int
100
0
0 250 500 1.000 Kilometers
WAGENINGEN
Sweden
Finland
Norway
Estonia
Latvia
Lithuania
Belarus
Ireland
United Kingdom
Germany
Poland
Ukraine
Slovakia
Hungary
Austria
France
Romania
Croatia
Italy
Serbia
Bulgaria
Black Sea
Georgia
Turkey
Spain
Greece
Syria
Iraq
Jordan
Mediterranean Sea
Sources: Esri, USGS, NOAA; Sources: Esri, Garmin, USGS, NPS

S23- [F22b] Alpine and subalpine Juniperus scrub

Juniper-dominated vegetation of the montane to sub-alpine belts of European mountains, occurring as primary vegetation tolerant of both high exposure and snow-lie, but also a secondary derivative of deforested, long-grazed and eroded ground at high altitudes.

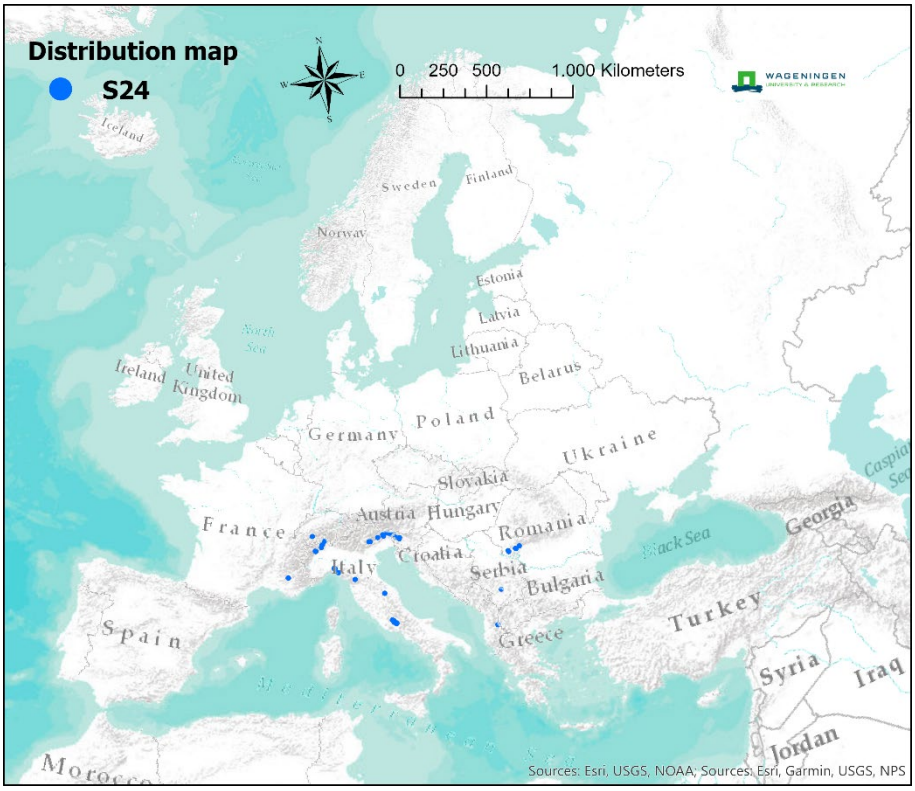


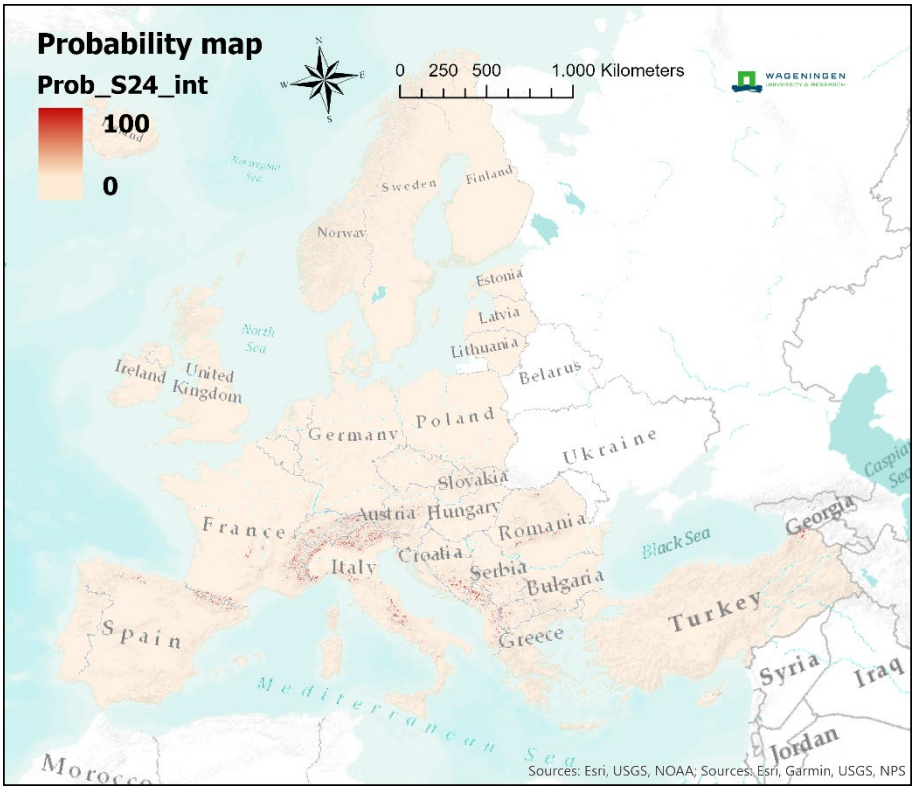


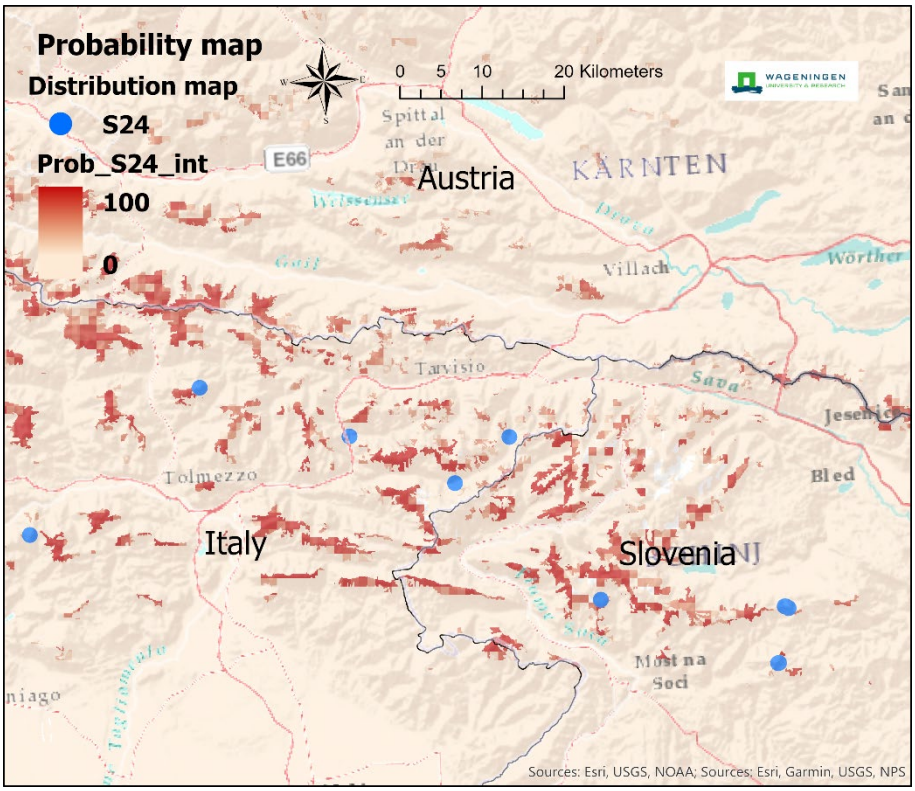

Probability map
Distribution map
S23
Prob_S23_int
99
0
0 5 10 20 Kilometers
Italy
France
Monaco
Cuneo
Sources: Esri, USGS, NOAA; Sources: Esri, Garmin, USGS, NPS

S24 – [F22c] Subalpine genistoid scrub of the Amphi-Adriatic region

Genistoid heath and scrub of high mountains in Italy and the Balkans, often in primary grassy mosaics at higher altitudes, but also extending below the timberline where wood-cutting and grazing open up the forest cover and sustain the vegetation as an anthropogenic replacement.

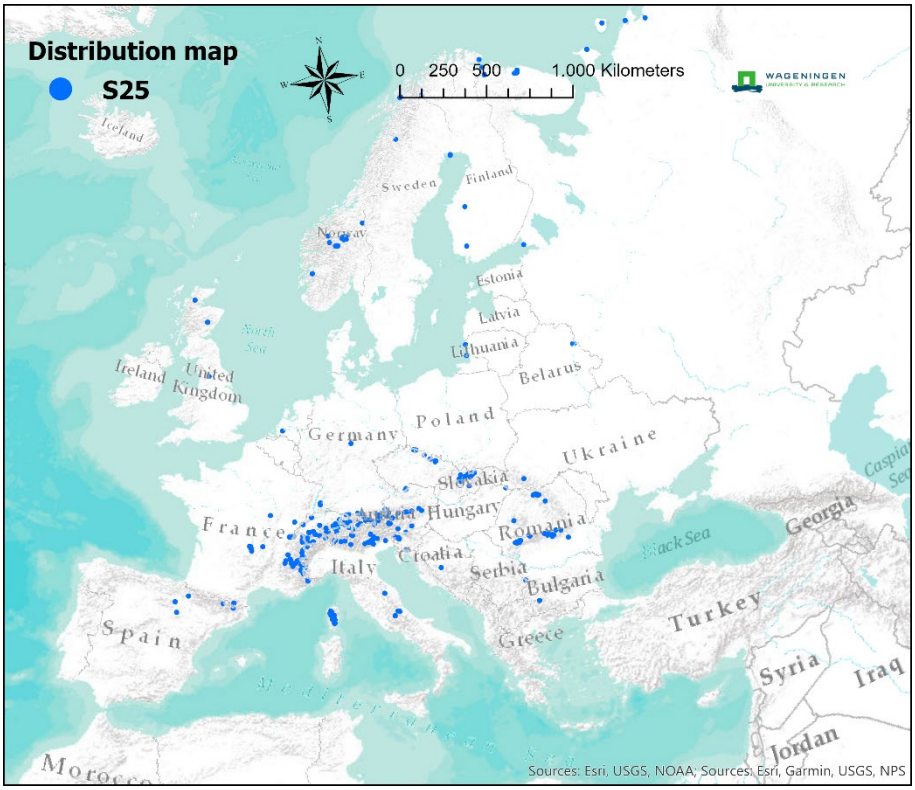


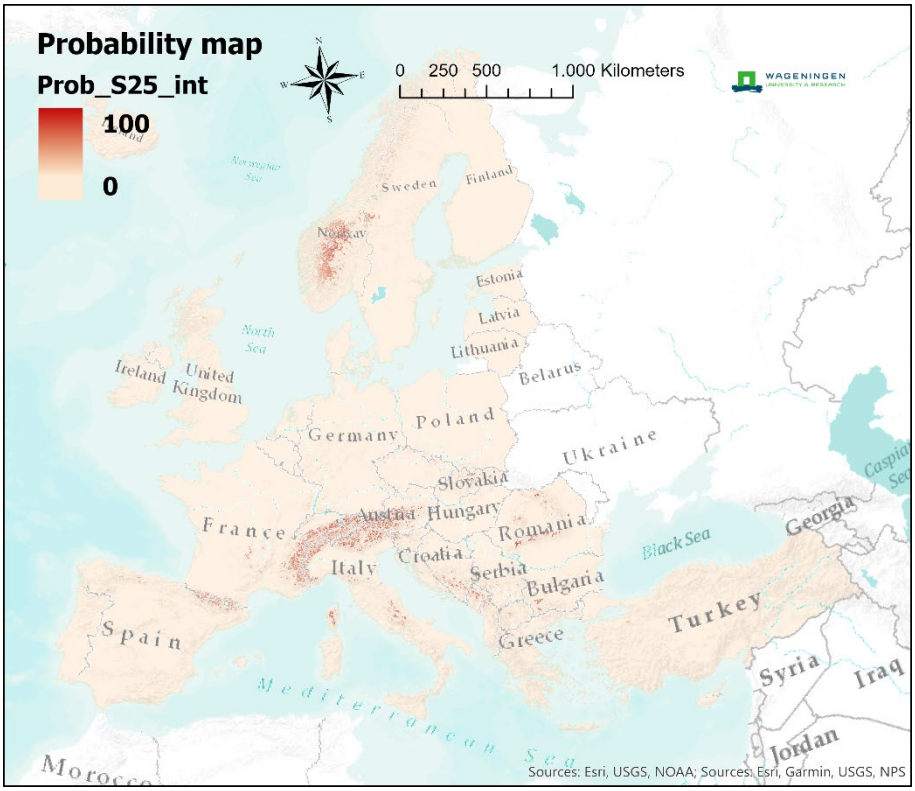


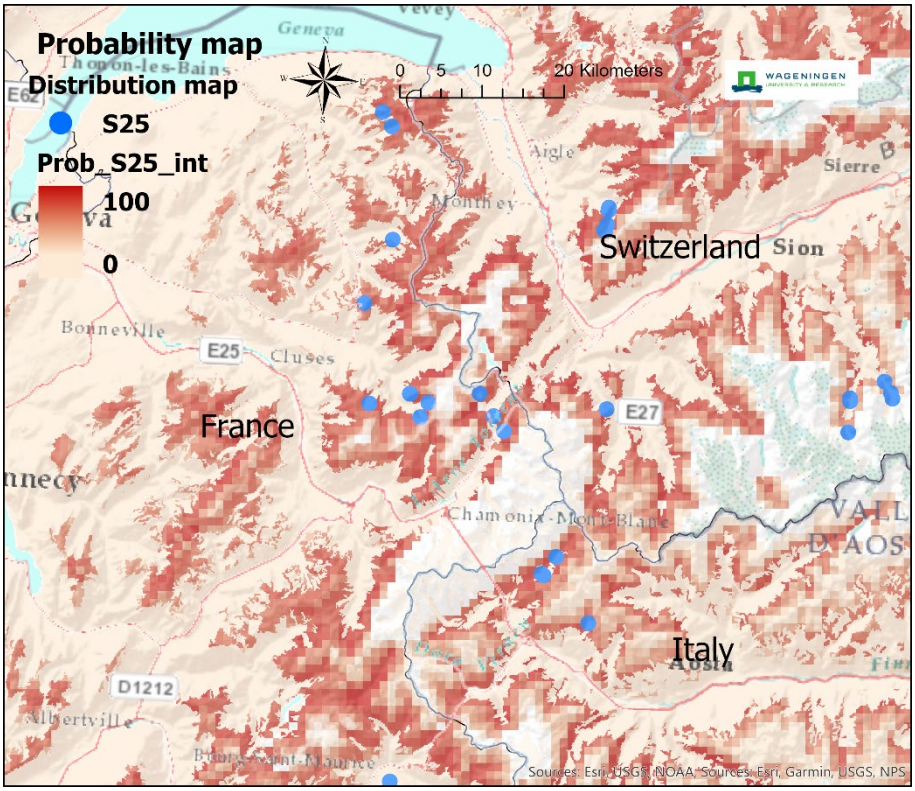

Probability map
Distribution map
S24
Prob_S24_int
100
0
0 5 10 20 Kilometers
WAGENINGEN
Austria
KÄRNTEN
Villach
Tarvisio
Tolmezzo
Italy
Slovenia
Bled
Sources: Esri, USGS, NOAA; Sources: Esri, Garmin, USGS, NPS

S25 – [F23] Subalpine and subarctic deciduous scrub

Low scrub, including krummholz, dominated by various deciduous trees and shrubs, on moist but free-draining, sometimes quite fertile, soils on high mountain slopes throughout Europe, often with long snow-lie and prone to natural disturbance due to avalanche and scree slides, after which it is well able to recover and recolonise. The associated flora can be rich in tall mountain herbs. It can also be found as a secondary succession stage in abandoned subalpine pastures and meadows.

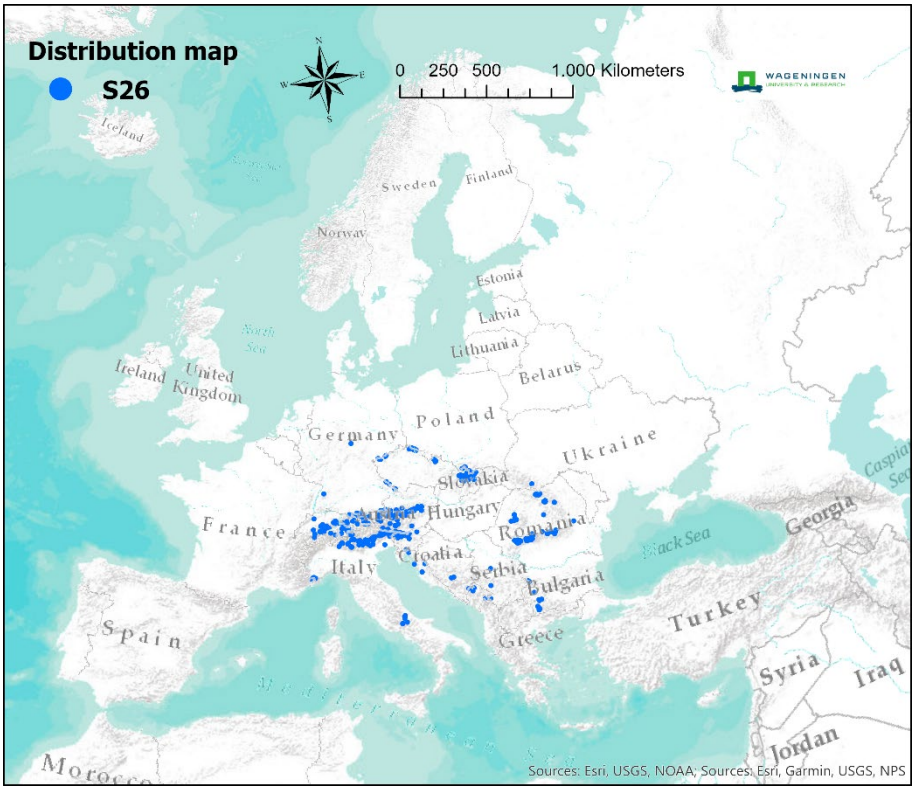


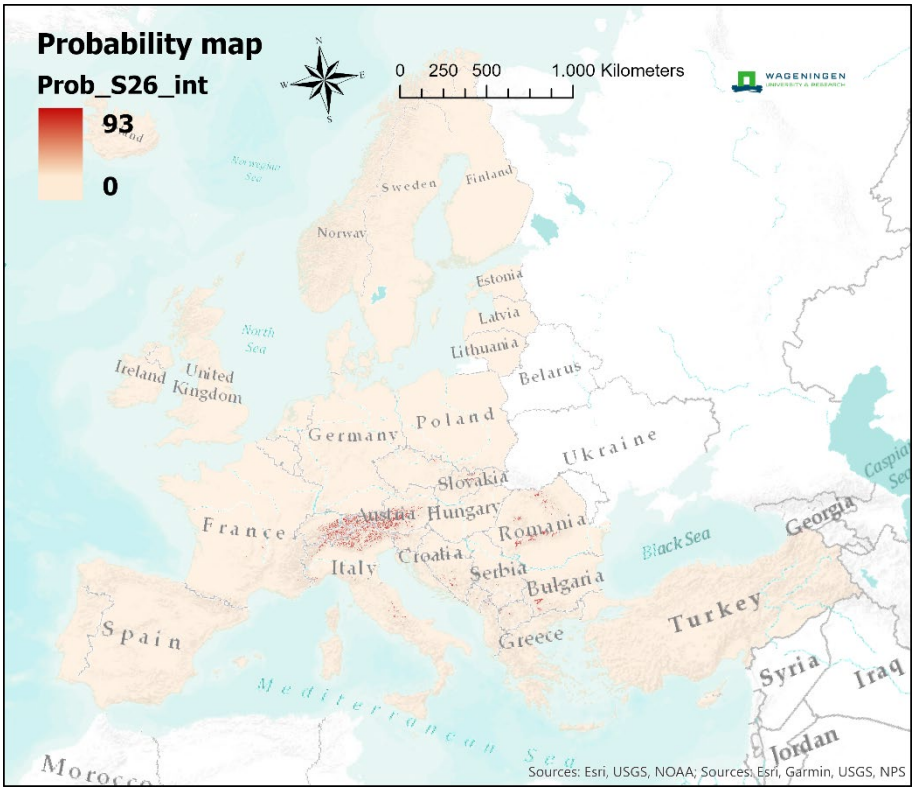


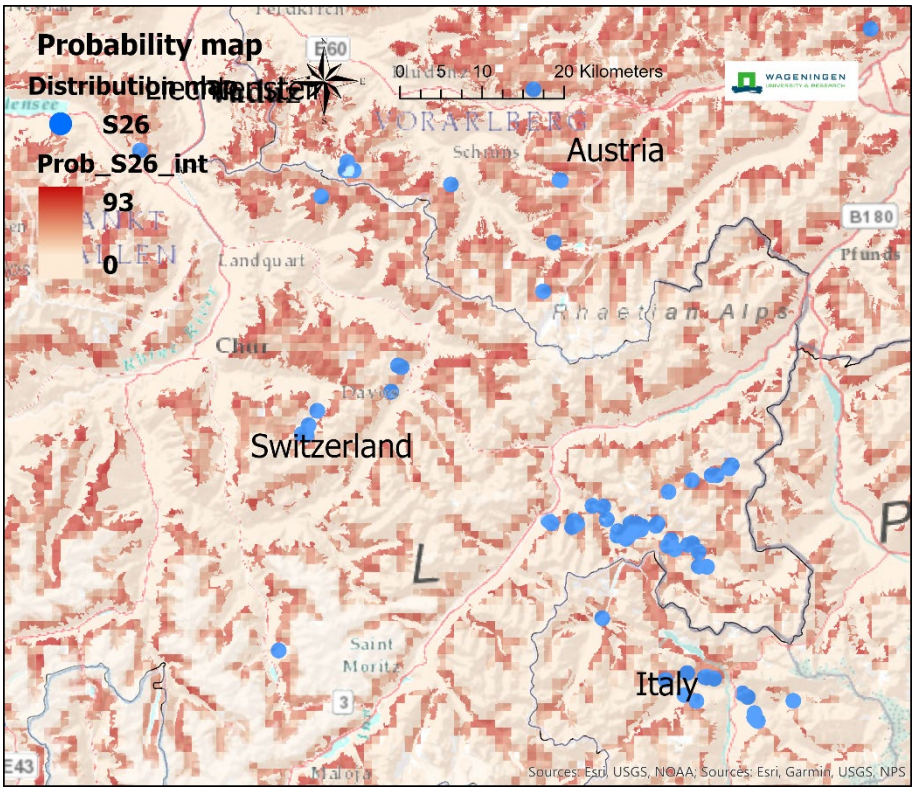

Probability map
Distribution map
S25
Prob_S25_int
100
0
0 5 10 20 Kilometers
Switzerland
France
Italy
Sion
Sierre
Aigle
Monthey
Bonneville
Cluses
Chamonix-Mont-Blanc
Albertville
E25
E27
D1212
Sources: Esri, USGS, NOAA, Sources: Esri, Garmin, USGS, NPS

S26 – [F24] Subalpine Pinus mugo scrub

Pinus mugo krummholz on mineral soils with long snow-lie above the tree line through the mountains of central and south-eastern Europe. Woody and herbaceous associates and the sometimes abundant bryophyte layer vary according to the base-richness of the soils and ground moisture.

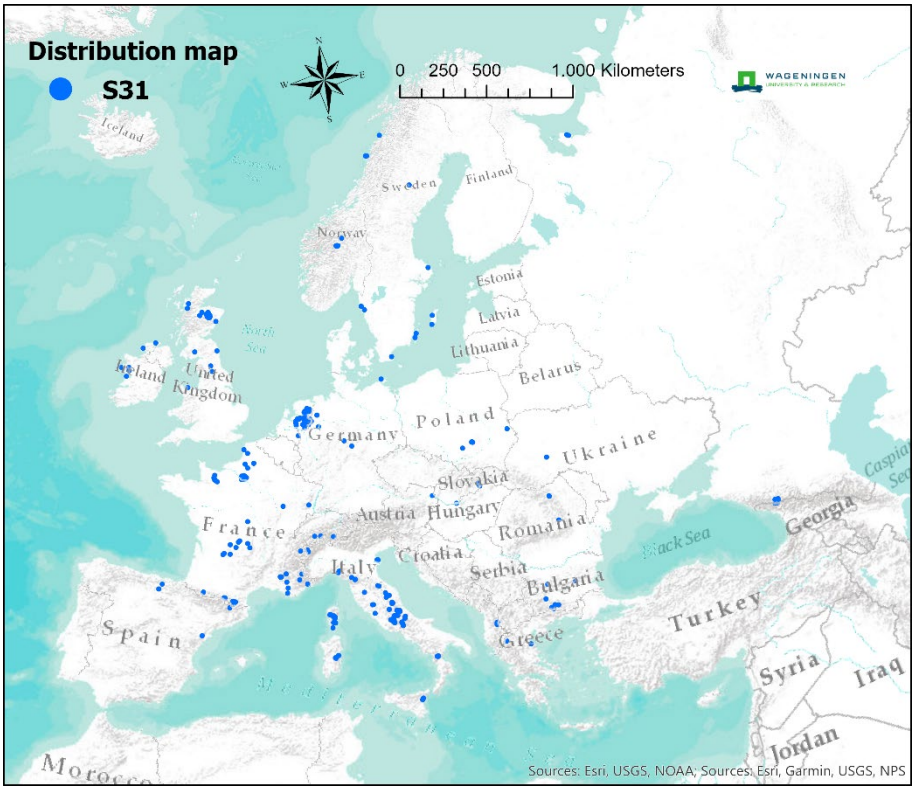


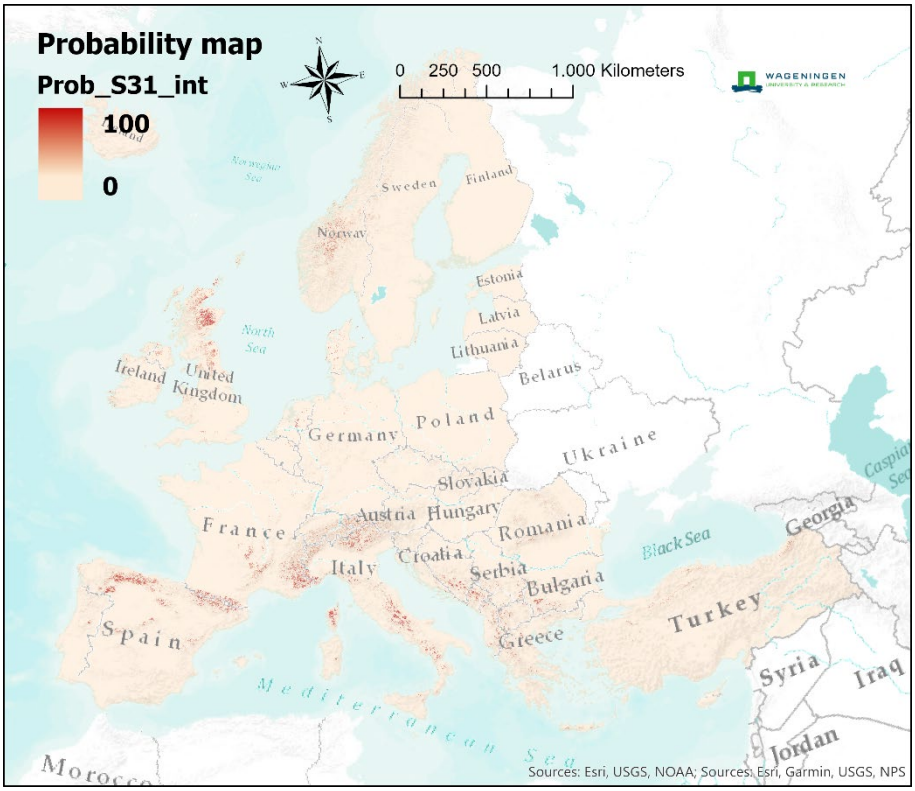


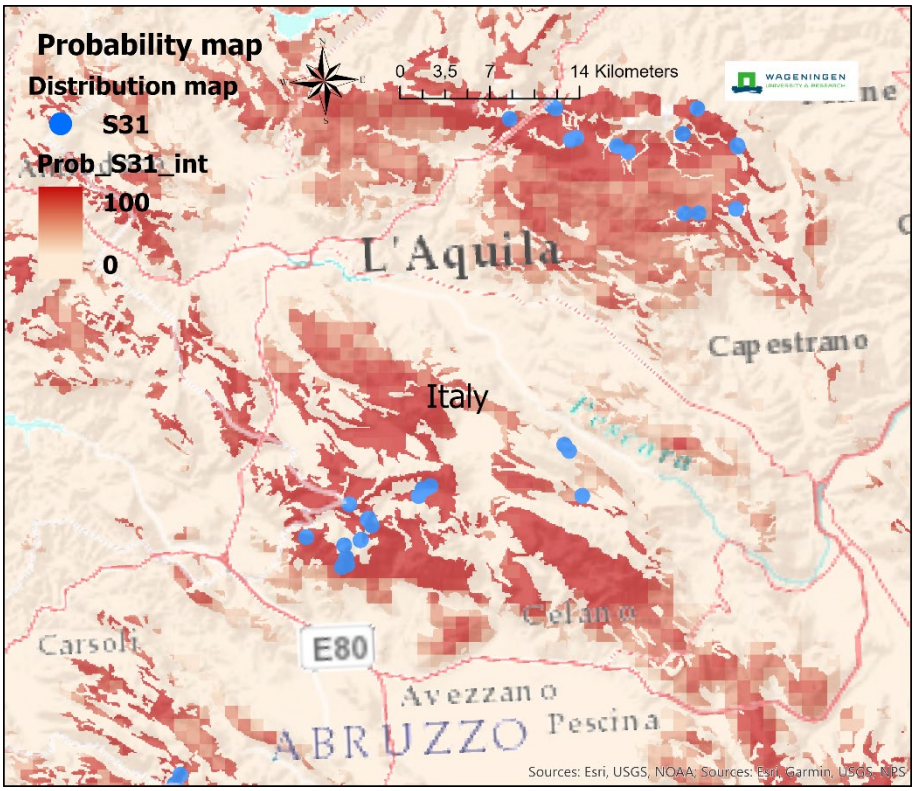

Probability map
Distribution data
S26
Prob_S26_int
93
0
0 5 10 20 Kilometers
Austria
Switzerland
Italy
Landquart
Chur
Davos
Saint Moritz
Maloja
Pfunds
B180
Rhaetian Alps
Sources: Esri, USGS, NOAA; Sources: Esri, Garmin, USGS, NPS

S31 –[F31a] Lowland to montane temperate and submediterranean Juniperus scrub

Juniperus communis scrub on nutrient-poor sandy and calcareous soils through the temperate and submediterranean lowlands and foothills of Europe. The juniper can be very patchy in occurrence, often related to past land-use, and with a striking variety of growth forms, the associated flora being very diverse according to soil base-status, sharing much in common, where the scrub is open, with local calcicolous grasslands or heath.

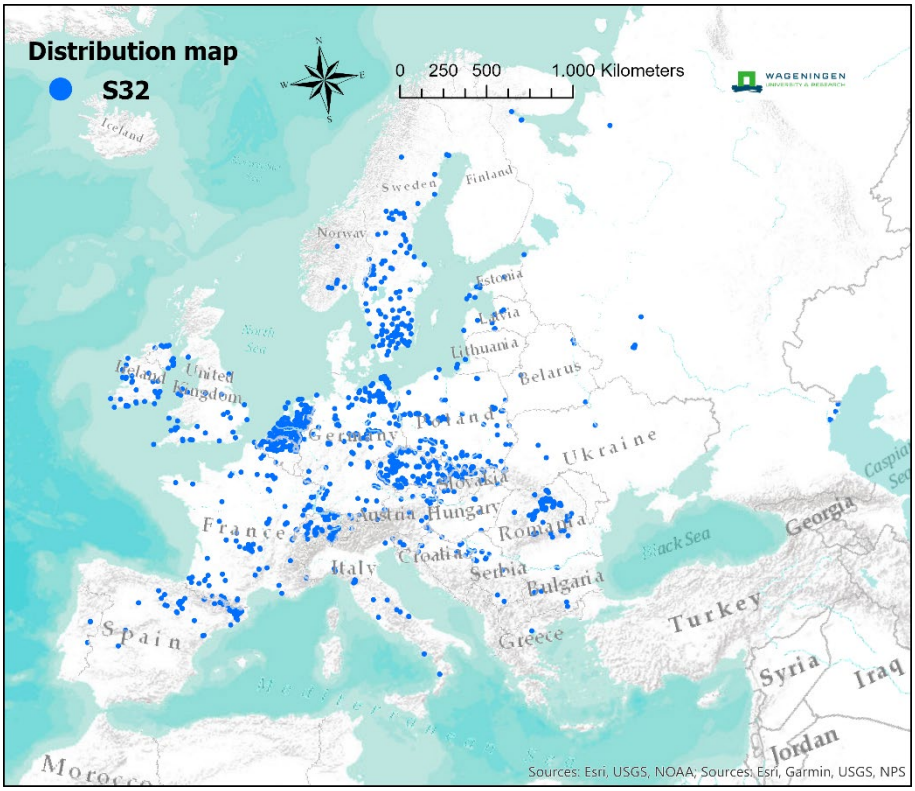


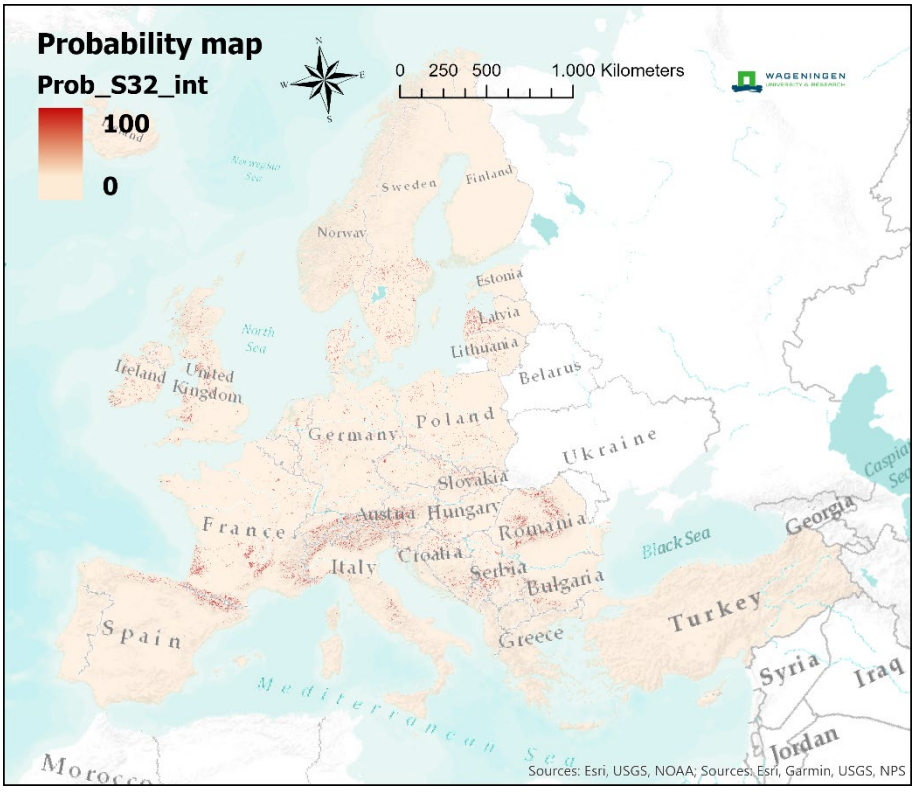


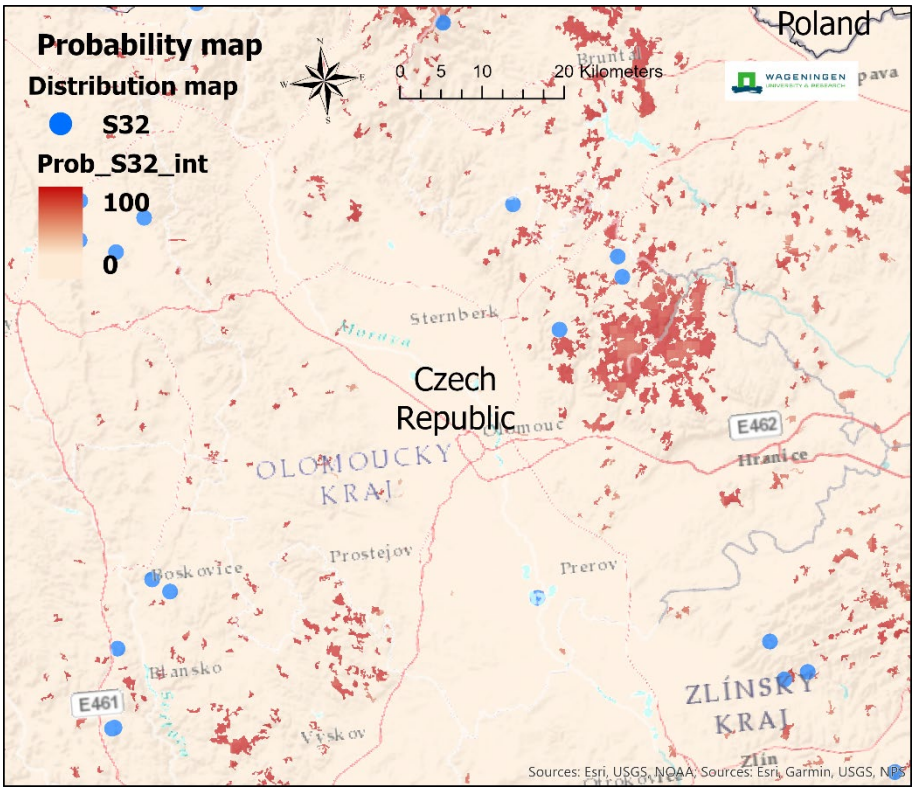

Probability map
Distribution map
S31
Prob_S31_int
100
0
0 3,5 7 14 Kilometers
WAGENINGEN
L'Aquila
Capestrano
Italy
Tirino
Celano
Carsoli
E80
Avezzano
Pescina
ABRUZZO
Sources: Esri, USGS, NOAA; Sources: Esri, Garmin, USGS, NPS

S32 –[F31b] Temperate Rubus scrub

Low Rubus-dominated scrub, deciduous or sometimes evergreen, of successions and ecotones in a wide variety of semi-natural landscapes through the atlantic zone and elsewhere in sub-montane Europe where a locally moist climate prevails. Rubus is an enormously diverse genus of often apomictic and endemic taxa with associated floras related to soil base-status and moisture.

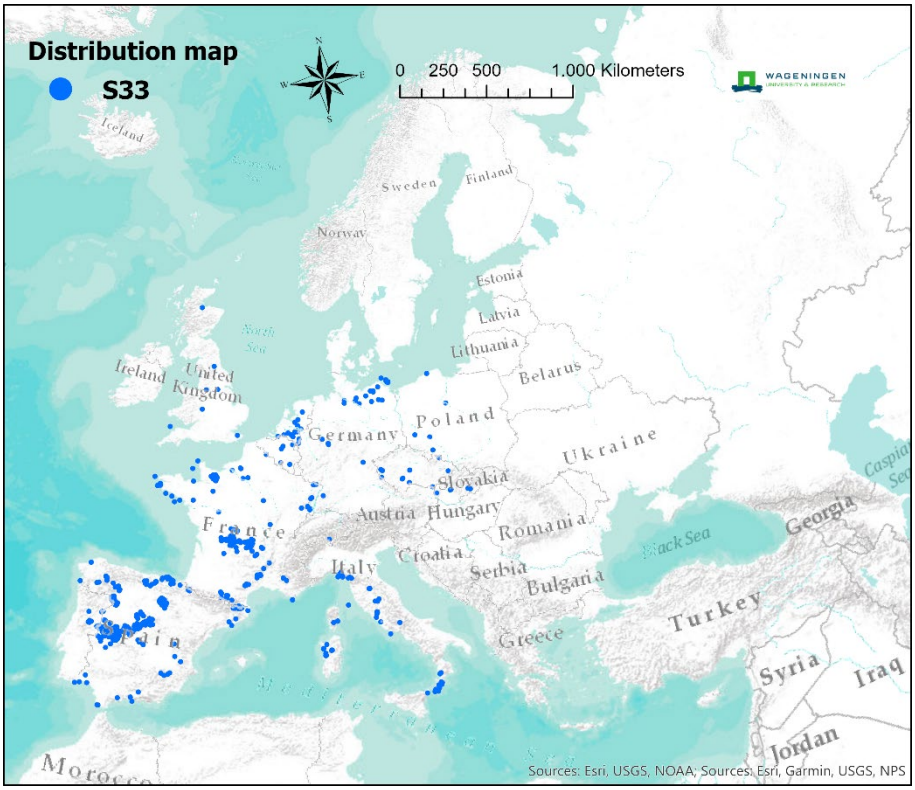


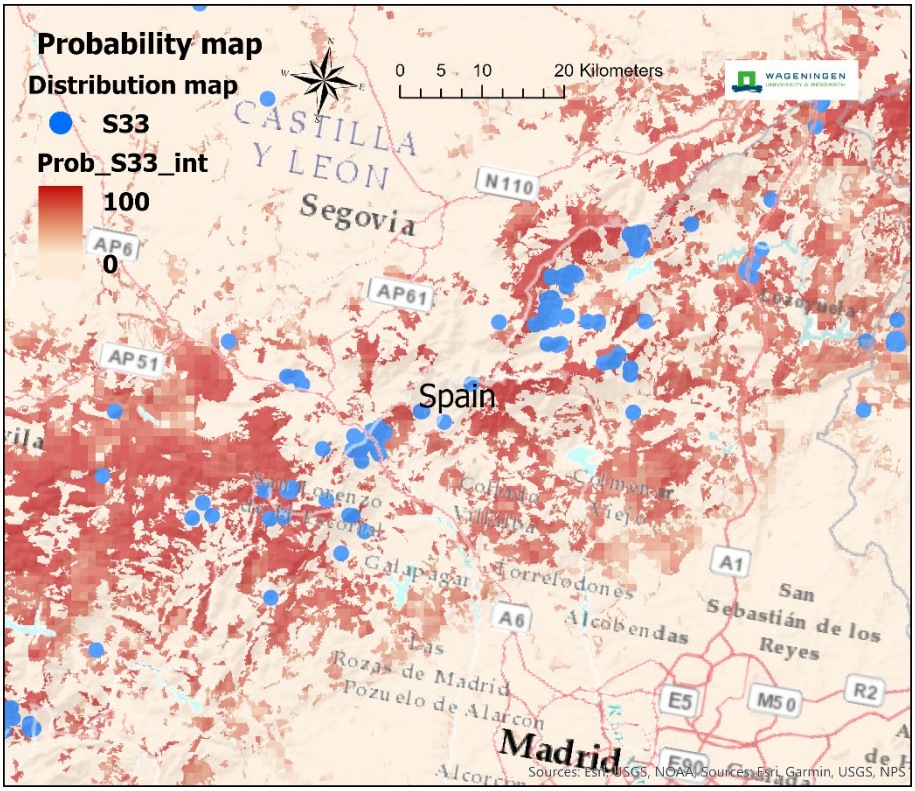


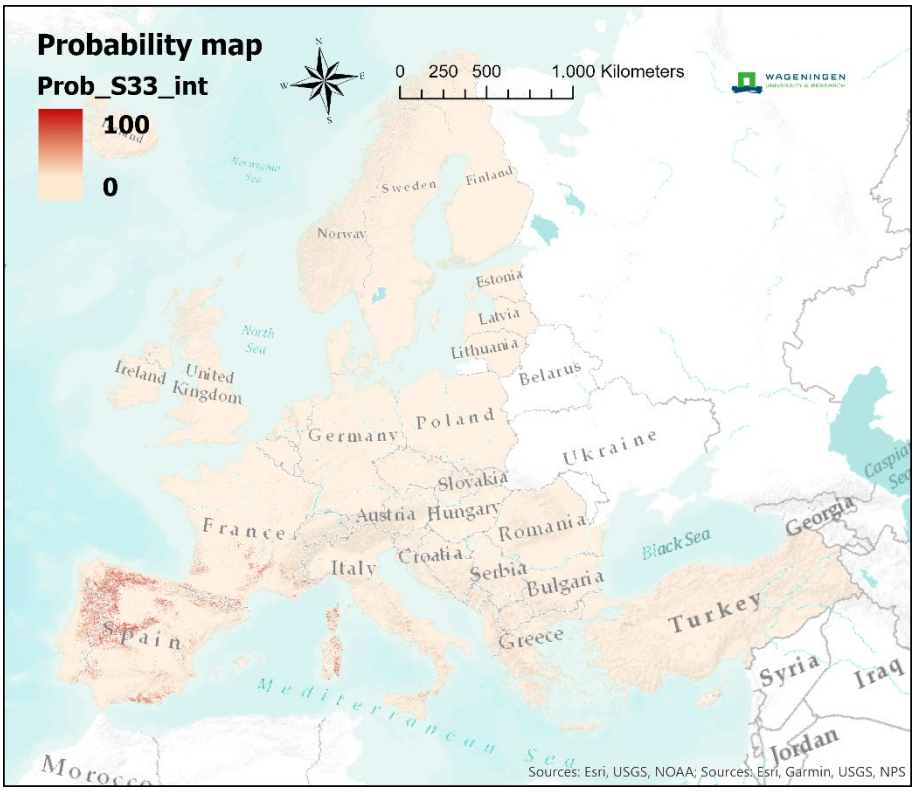

Probability map
Distribution map
S32
Prob_S32_int
100
0
0 5 10 20 Kilometers
Poland
Czech Republic
Sternberk
Morava
OLOMOUCKY KRAJ
Prostejov
Prerov
Hranice
E462
E461
Blansko
Boskovice
Vyskov
ZLÍNSKÝ KRAJ
Zlin
Sources: Esri, USGS, NOAA; Sources: Esri, Garmin, USGS, NPS

S33 – [F31c] Lowland to montane temperate and submediterranean genistoid scrub

Low scrub dominated by various woody legumes on mostly sharply-draining, nutrient-poor acidic soils through the temperate and submediterranean lowlands and mediterranean foothills of Europe. To the north the vegetation is usually found in successions or ecotones within pastoral landscapes and is often rather species-poor; further south, the scrub can occur as a more persistent or repeatedly renewed habitat among rocky or unstable hill-slopes with richer associated floras.

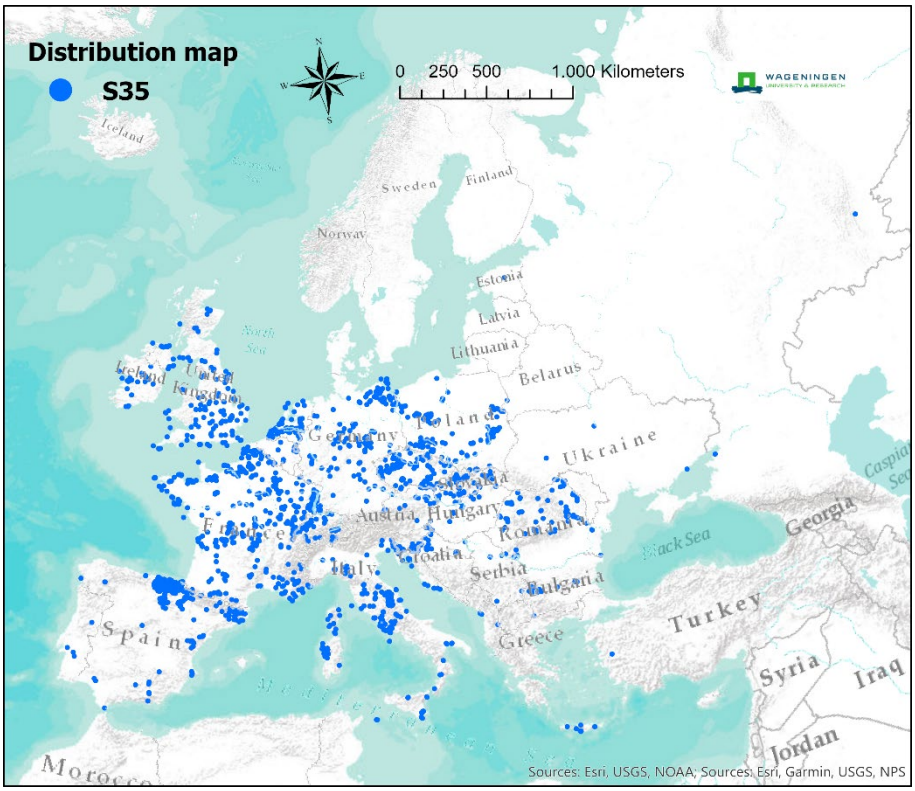


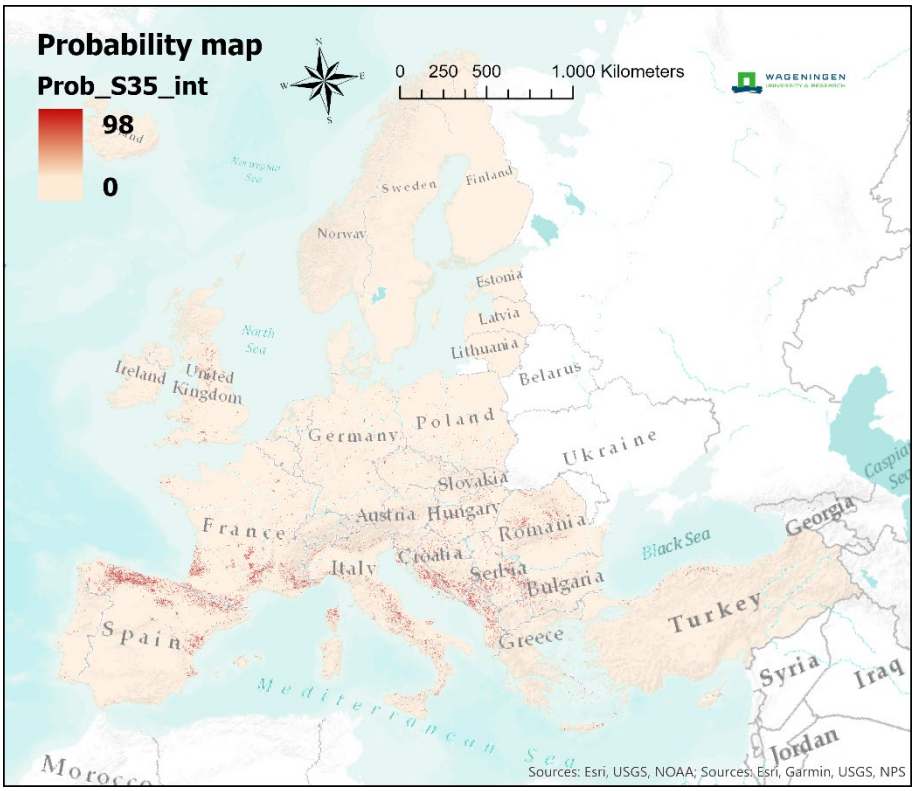


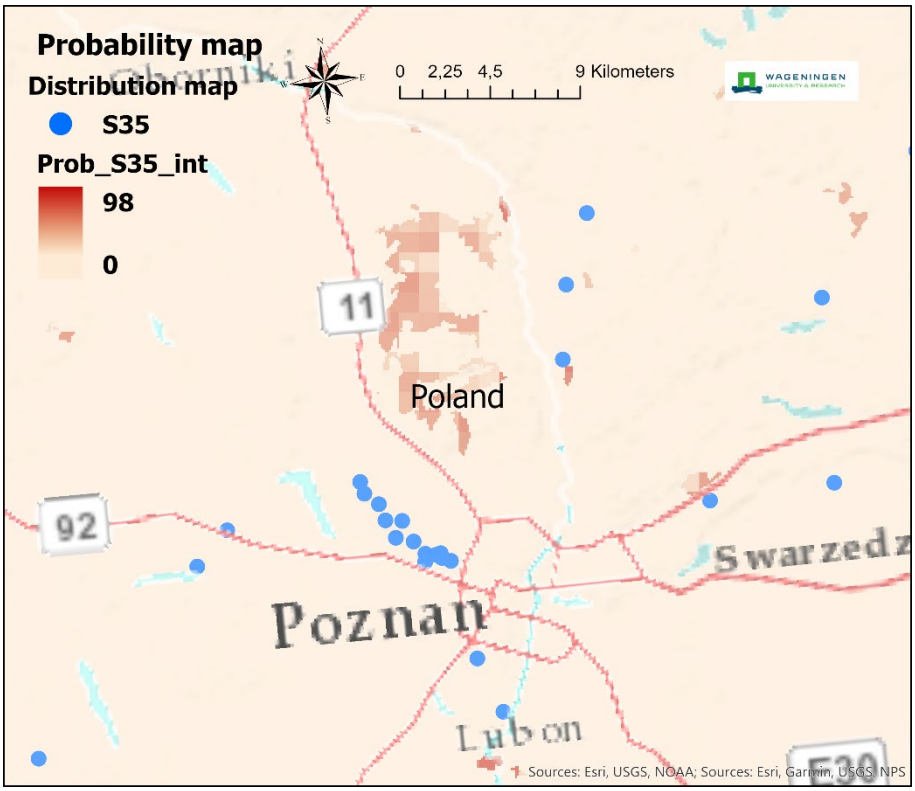

Probability map
Prob_S33_int
100
0
0 250 500 1.000 Kilometers
WAGENINGEN
Sweden
Finland
Norway
Estonia
Latvia
Lithuania
Belarus
Ireland
United Kingdom
Germany
Poland
Ukraine
Slovakia
Austria
Hungary
Romania
France
Italy
Croatia
Serbia
Bulgaria
Black Sea
Georgia
Turkey
Spain
Greece
Syria
Iraq
Jordan
Mediterranean Sea
Sources: Esri, USGS, NOAA; Sources: Esri, Garmin, USGS, NPS

S35 – [F31d] Temperate and submediterranean thorn scrub

Scrub dominated by a diversity of mostly thorny shrubs, small trees and saplings, in successions and ecotones on mesic soils in a wide variety of semi-natural landscapes through the temperate and submediterranean lowlands of Europe but sometimes extending to higher altitudes, as with the Balkan šibljak. The dominants and associated floras vary widely with differences in regional climate and soils.

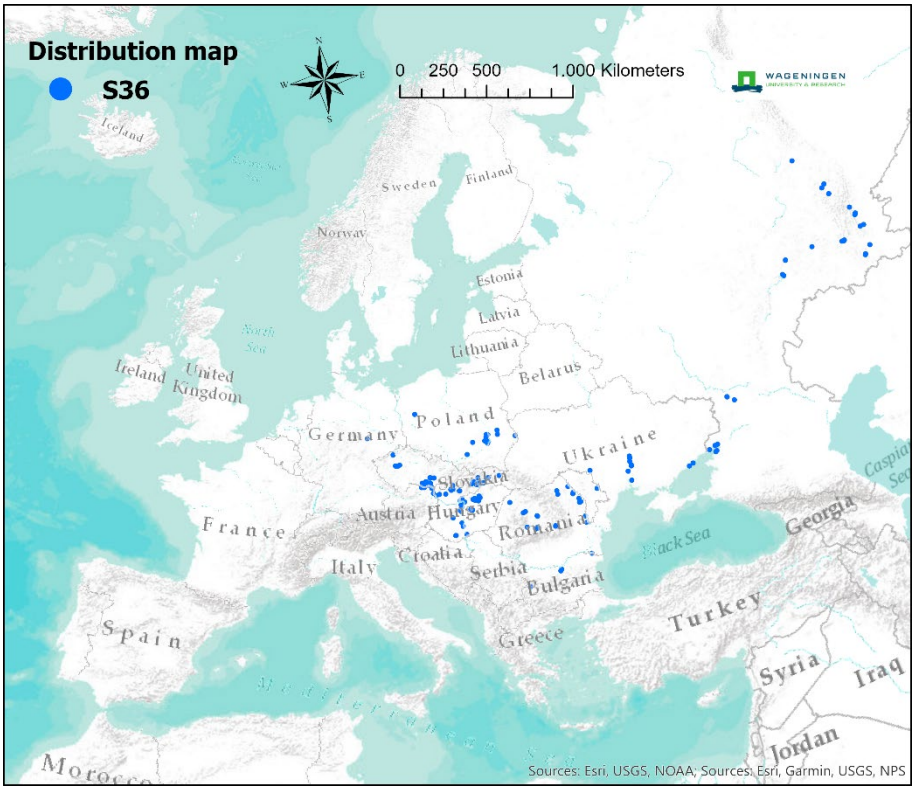


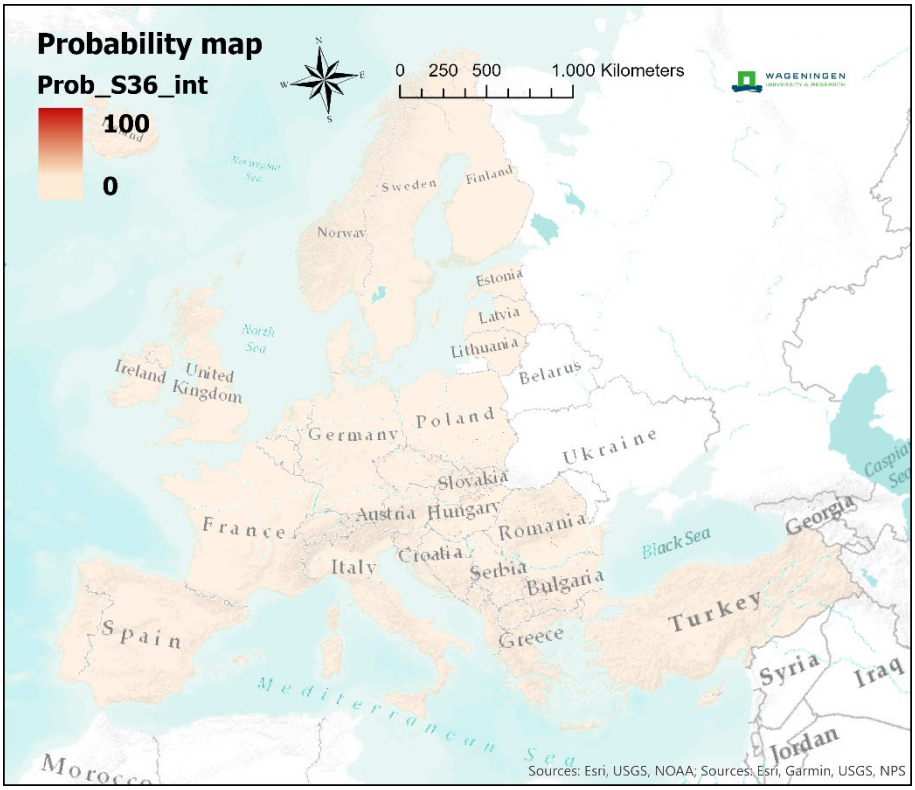


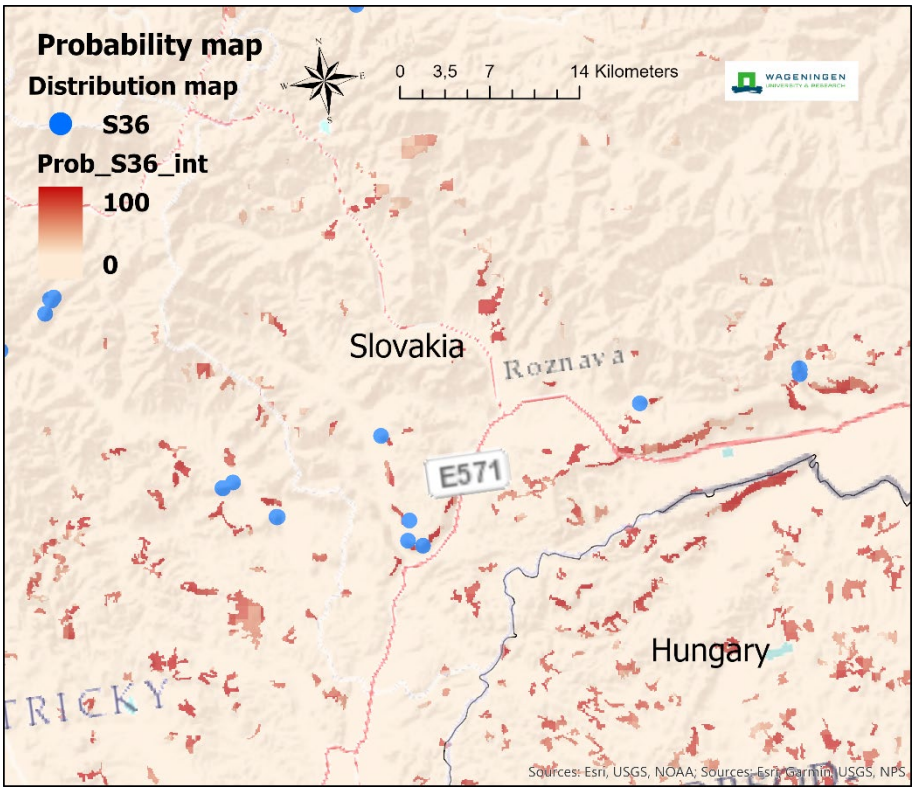

Probability map
Distribution map
S35
Prob_S35_int
98
0
0 2,25 4,5 9 Kilometers
WAGENINGEN
11
Poland
92
Poznan
Swarzedz
Lubon
Sources: Esri, USGS, NOAA; Sources: Esri, Garmin, USGS, NPS

S36 – [F31f] Low steppic scrub

Low scrub, dominated by various, often clonal, shrubs frequently forming patches in locally mesic and sheltered situations within the dry grasslands of the steppe zone of central and eastern Europe. It can form a persistent natural landscape element or develop after abandonment of pasturing.

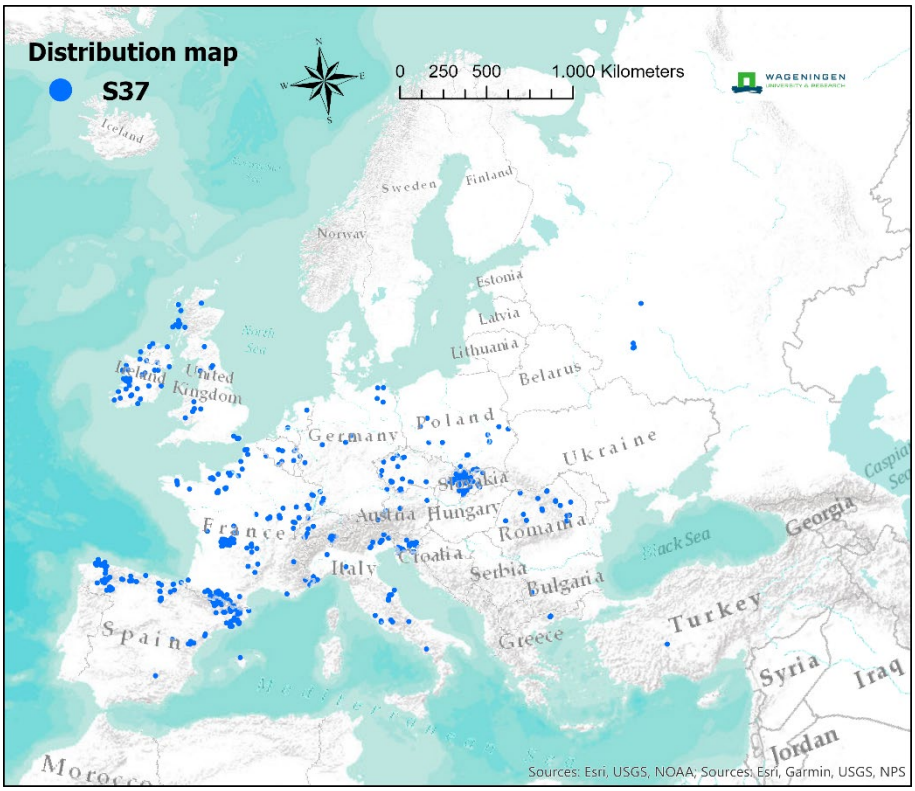


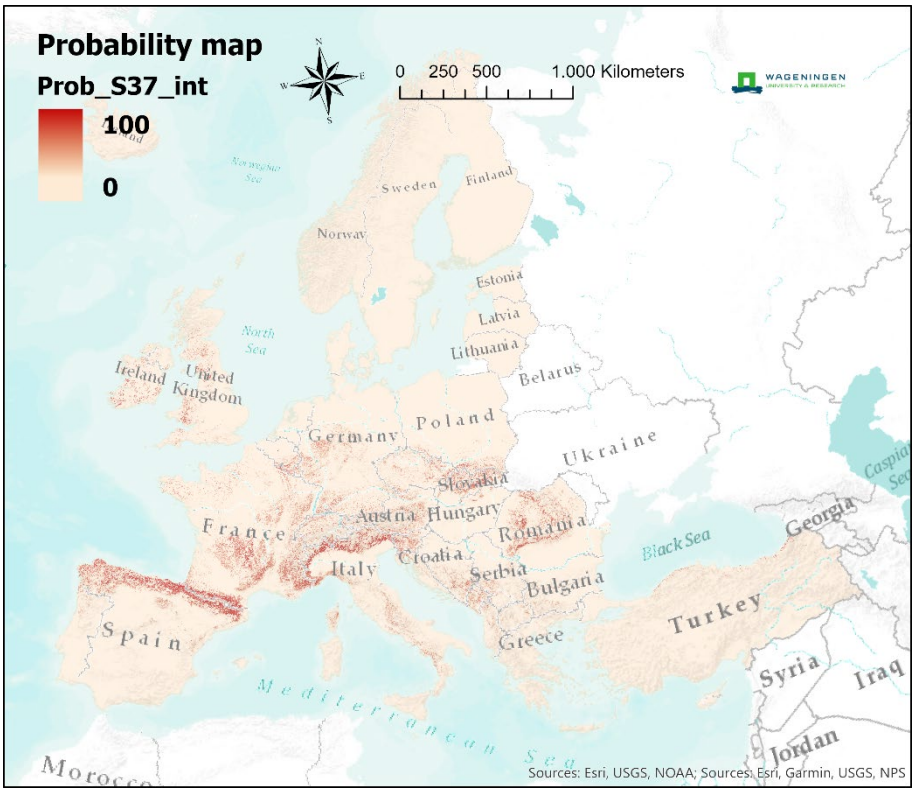


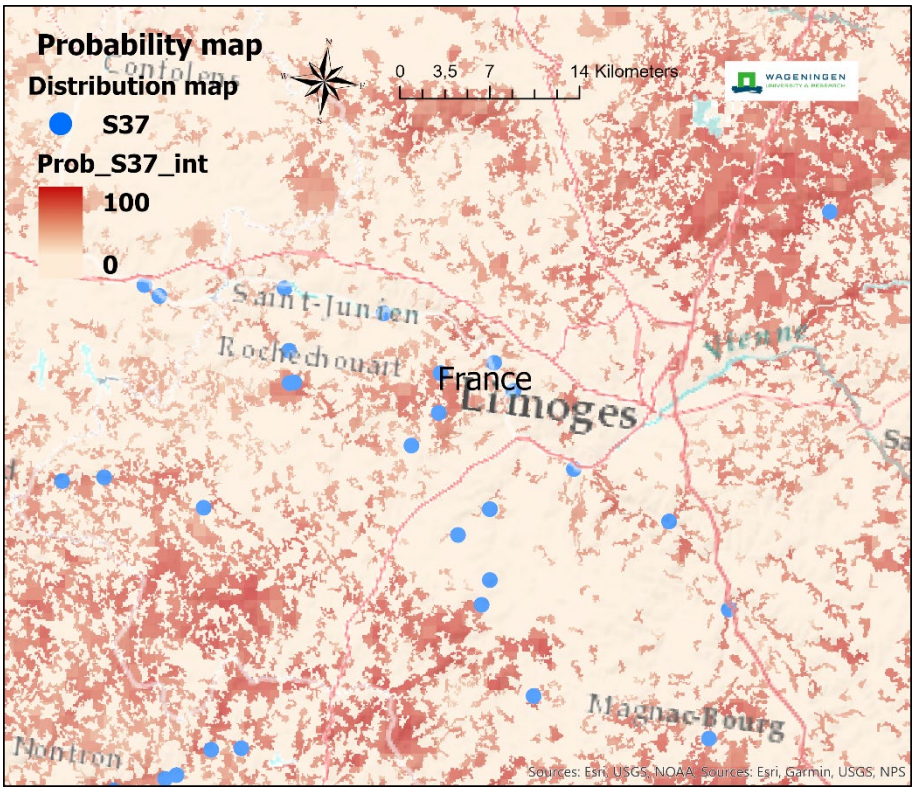

Probability map
Distribution map
S36
Prob_S36_int
100
0
0 3,5 7 14 Kilometers
WAGENINGEN
Slovakia
Roznava
E571
Hungary
Sources: Esri, USGS, NOAA; Sources: Esri, Garmin, USGS, NPS

S37 – [F31g] Corylus avellana scrub

Low scrub dominated by Corylus avellana, permanently maintained by exposure to winds and on shallow soils along the north Atlantic coast and locally on rocky slopes and cliffs through the continental region.

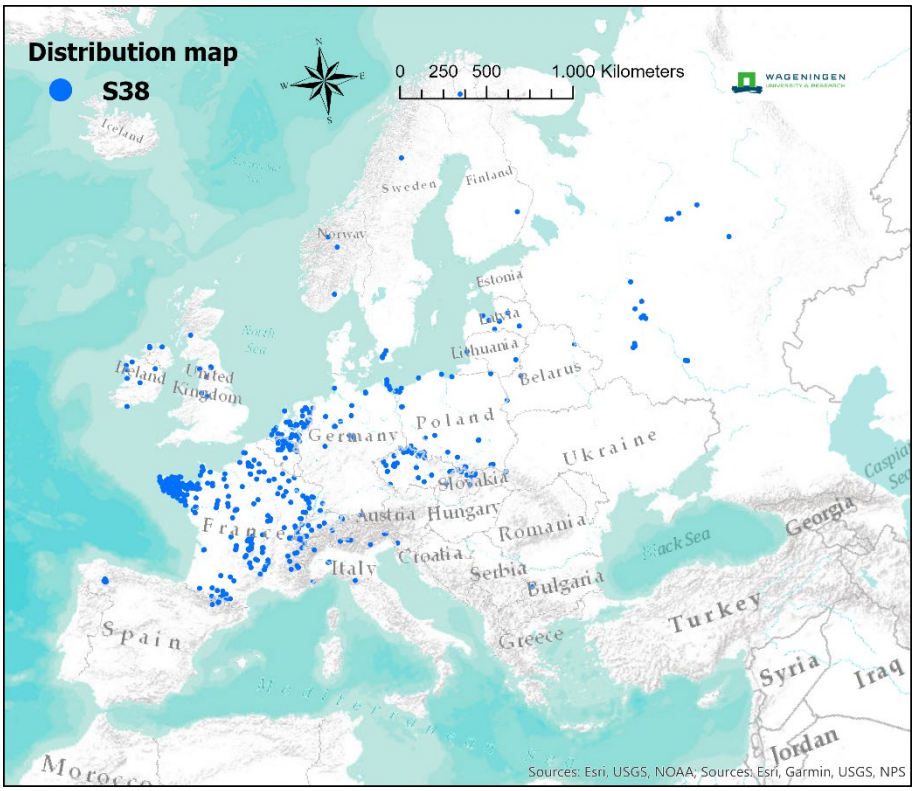


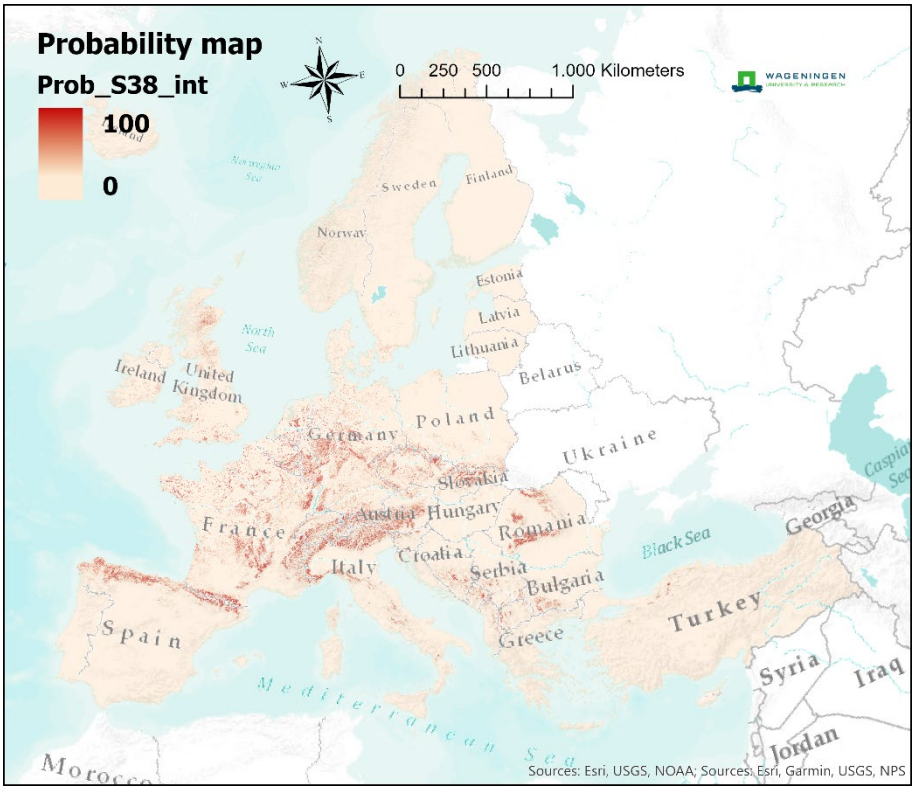


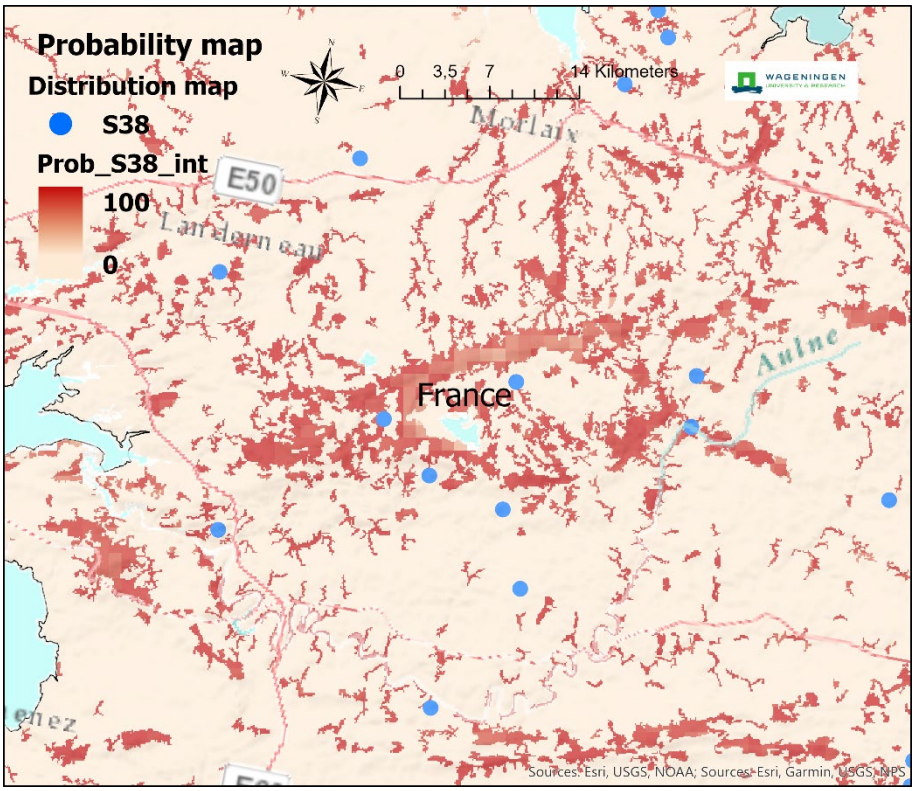

Probability map
Distribution map
S37
Prob_S37_int
100
0
0 3,5 7 14 Kilometers
WAGENINGEN
Saint-Junien
Rochechouart
France
Limoges
Magnac-Bourg
Montron
Sources: Esri, USGS, NOAA Sources: Esri, Garmin, USGS, NPS

S38 – [F31h] Temperate forest clearing scrub

Often dense scrub of shrubs and small trees invading after natural or anthropogenic clearance in forests of the temperate zone.

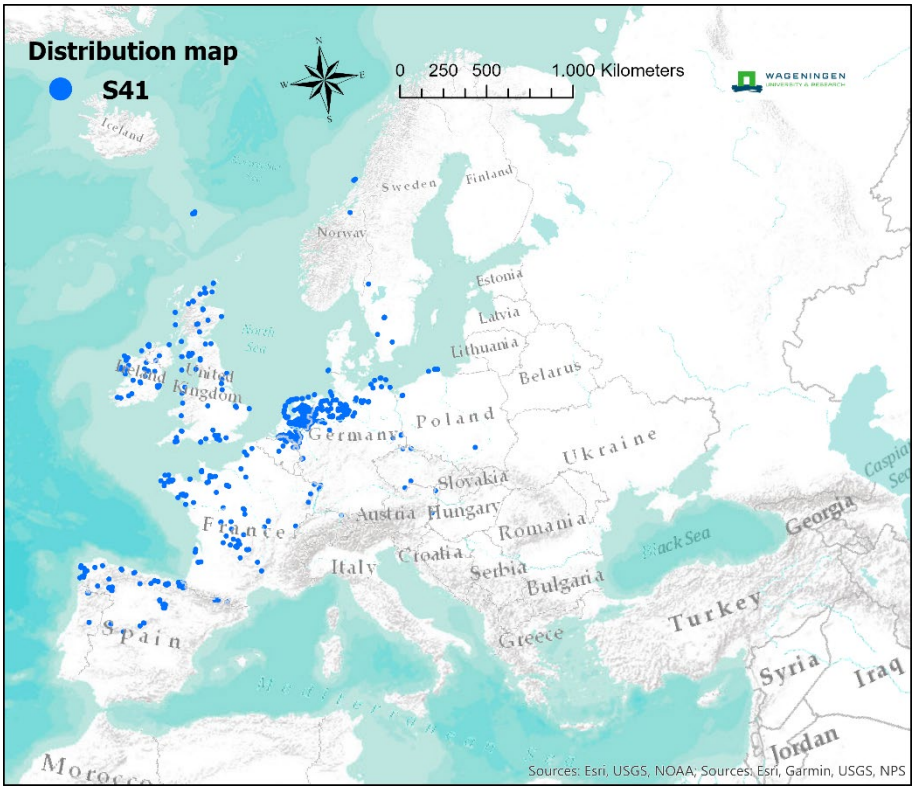


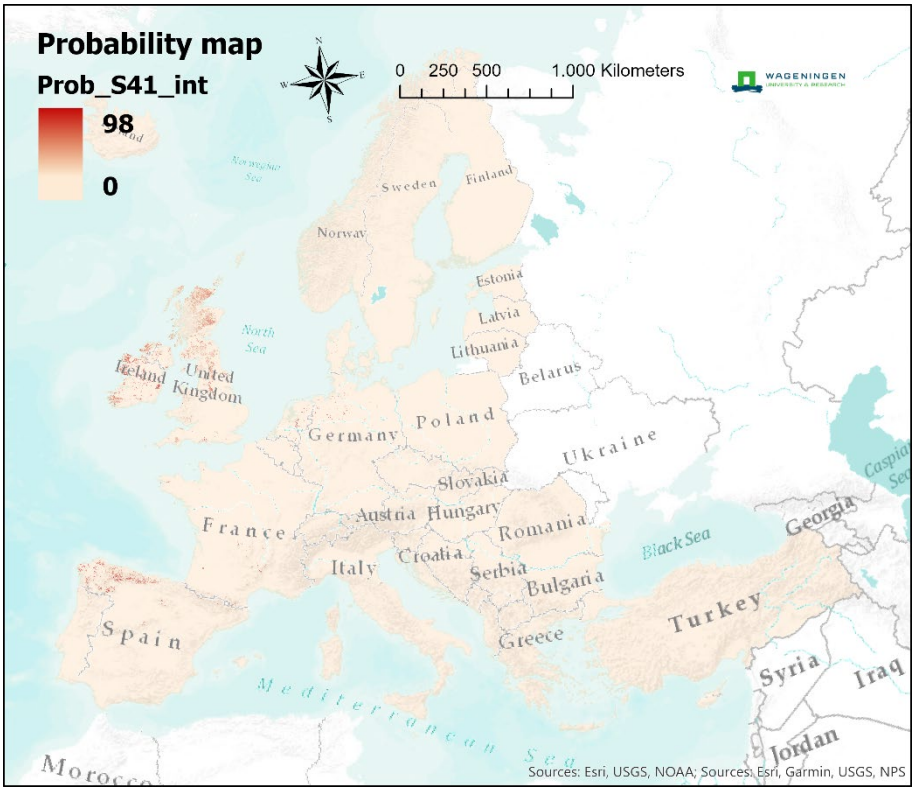


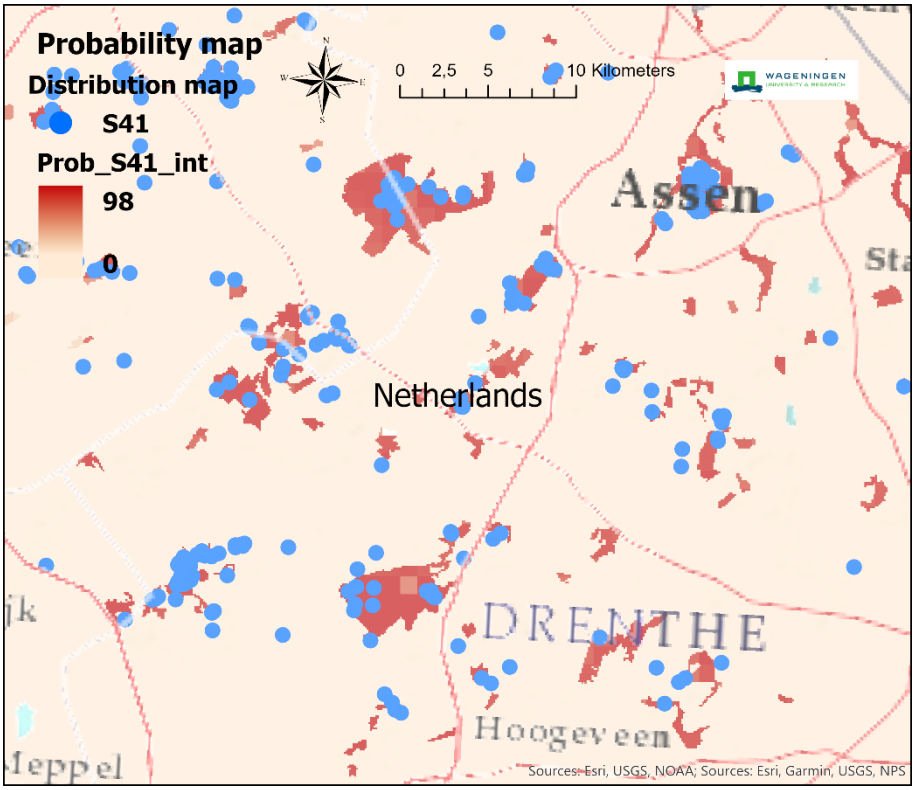

Probability map
Distribution map
S38
Prob_S38_int
100
0
0 3,5 7 14 Kilometers
E50
France
Sources: Esri, USGS, NOAA; Sources: Esri, Garmin, USGS, NPS

S41 – [F41] Wet heath

Heath with prominent Erica tetralix on shallow, acid, nutrient-poor peats and peaty mineral soils, kept moist for much of the year and often seasonally waterlogged, through the atlantic and subatlantic lowlands and foothills of Europe.



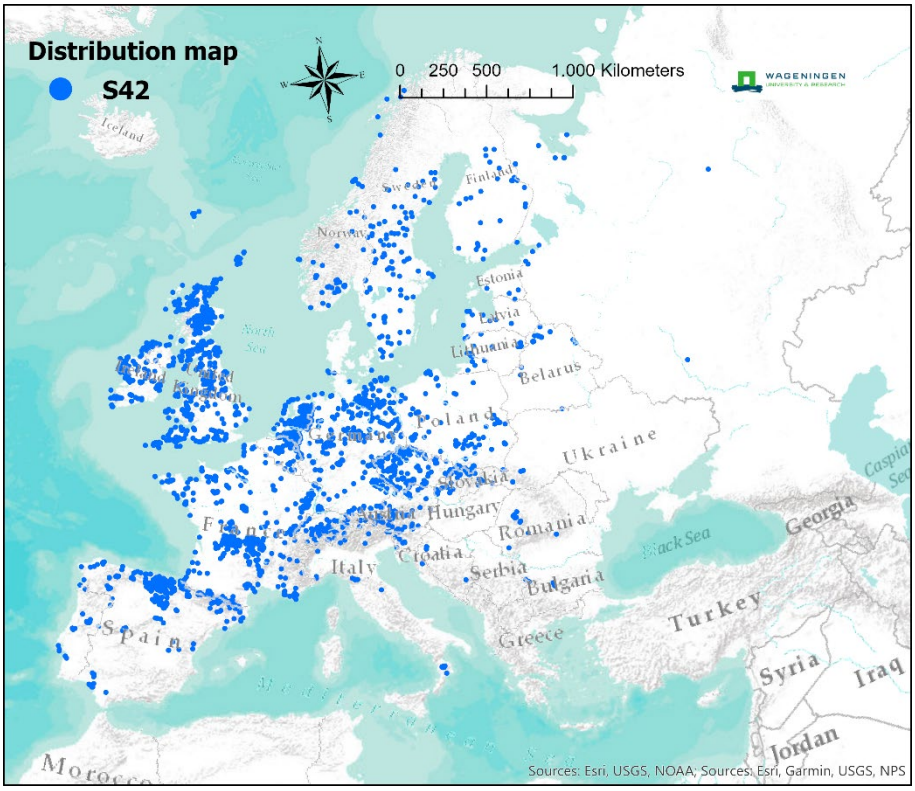


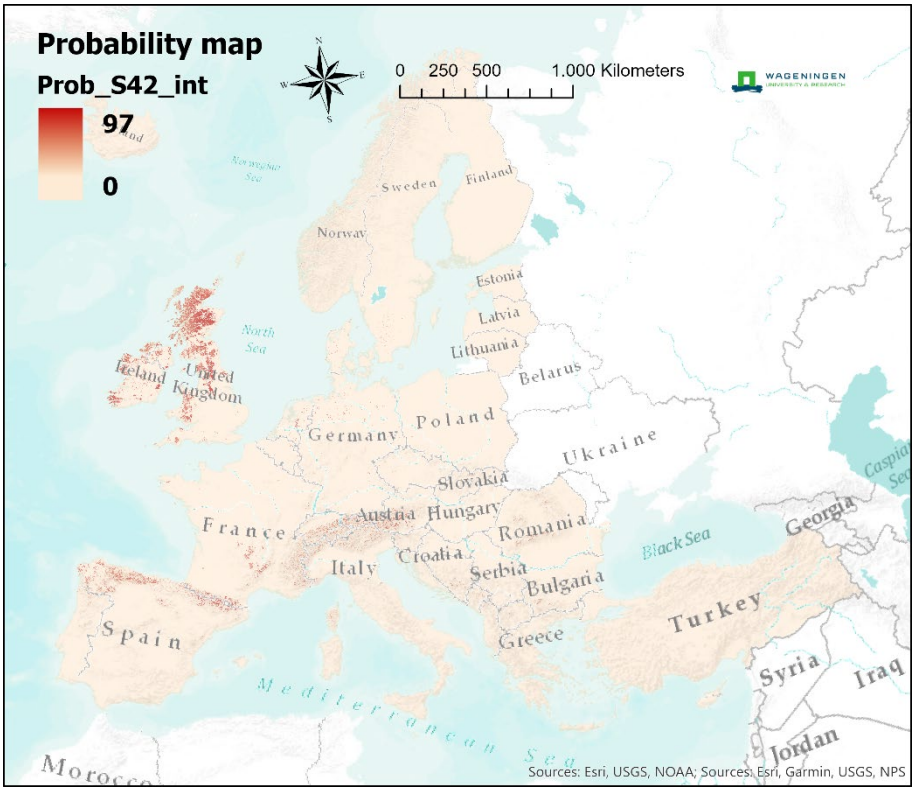


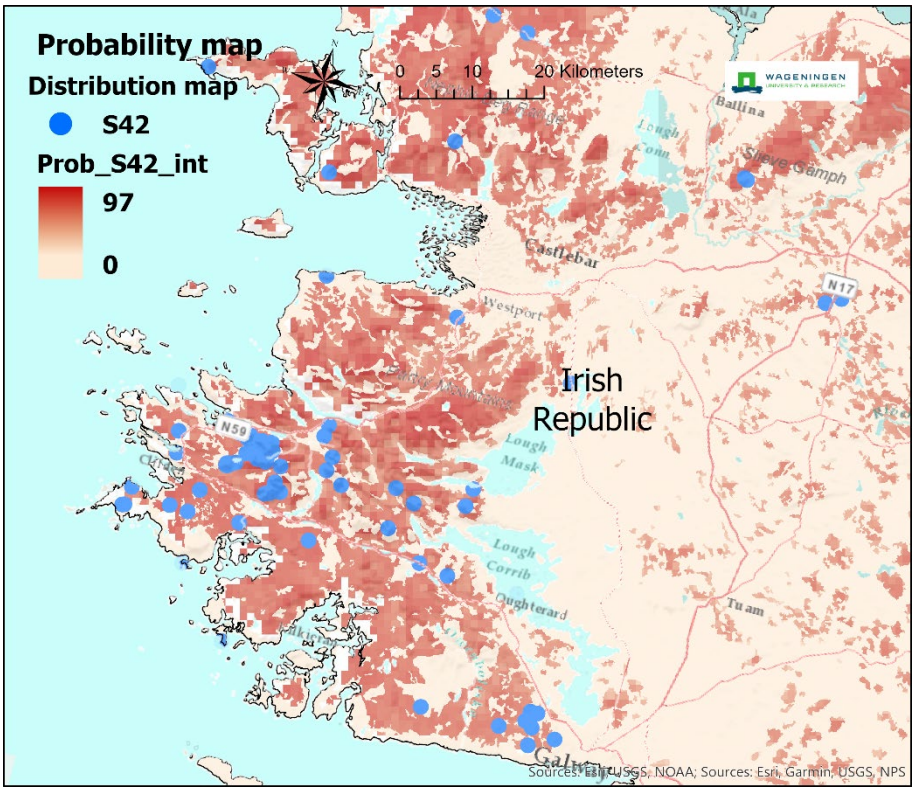
Typically occurring in wet depressions and seepage areas within dry heaths or as a marginal zone around bogs where drainage of deeper peats can increase its extent. In milder oceanic climates, other Erica and Ulex spp. occur in richer humid heath. Frequently influenced by grazing and sod-cutting.

S42 – [F42] Dry heath

Heath dominated by various ericaceous sub-shrubs on free-draining, nutrient-poor, acid sands and siliceous soils through the lowlands and foothills of western and central Europe, extending northwards in more oceanic situations and into continental regions at higher rainier altitudes.



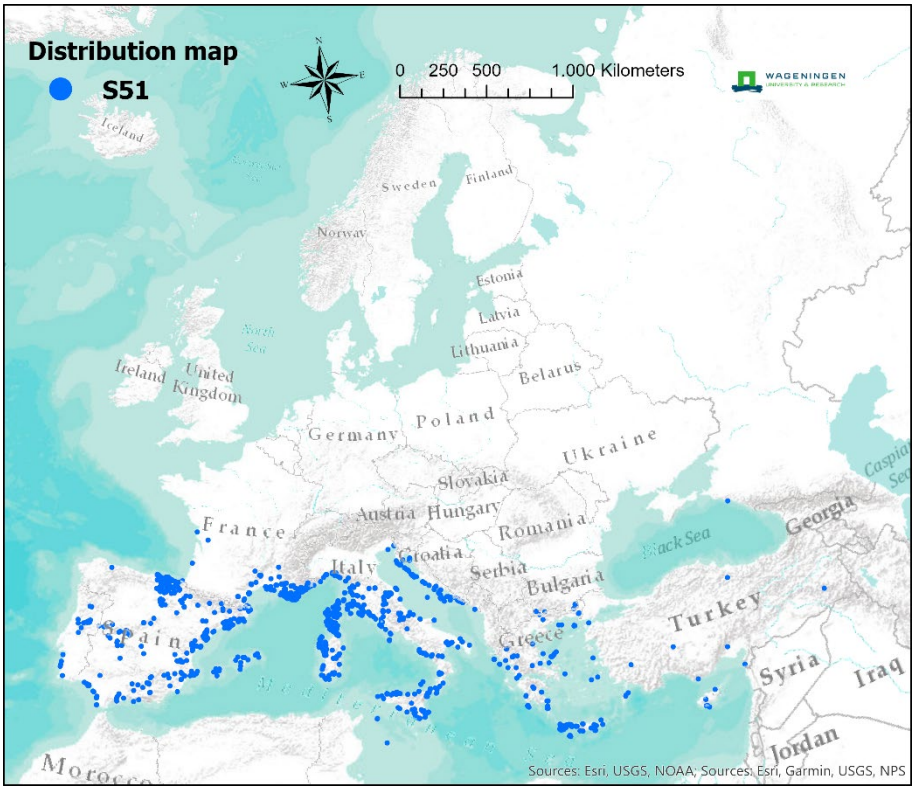


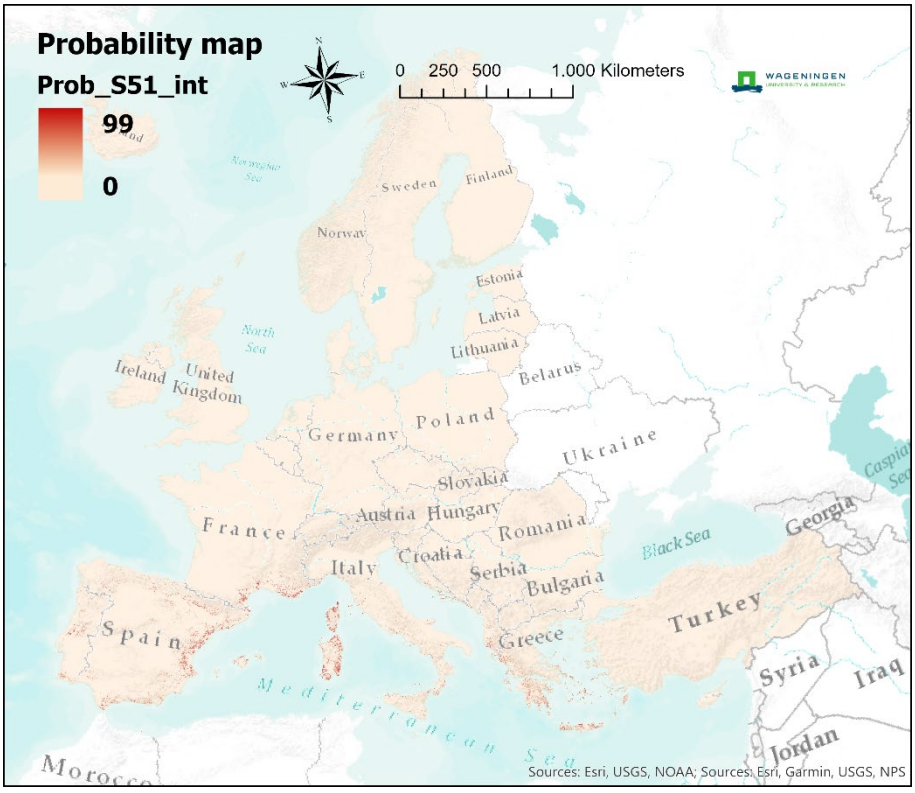


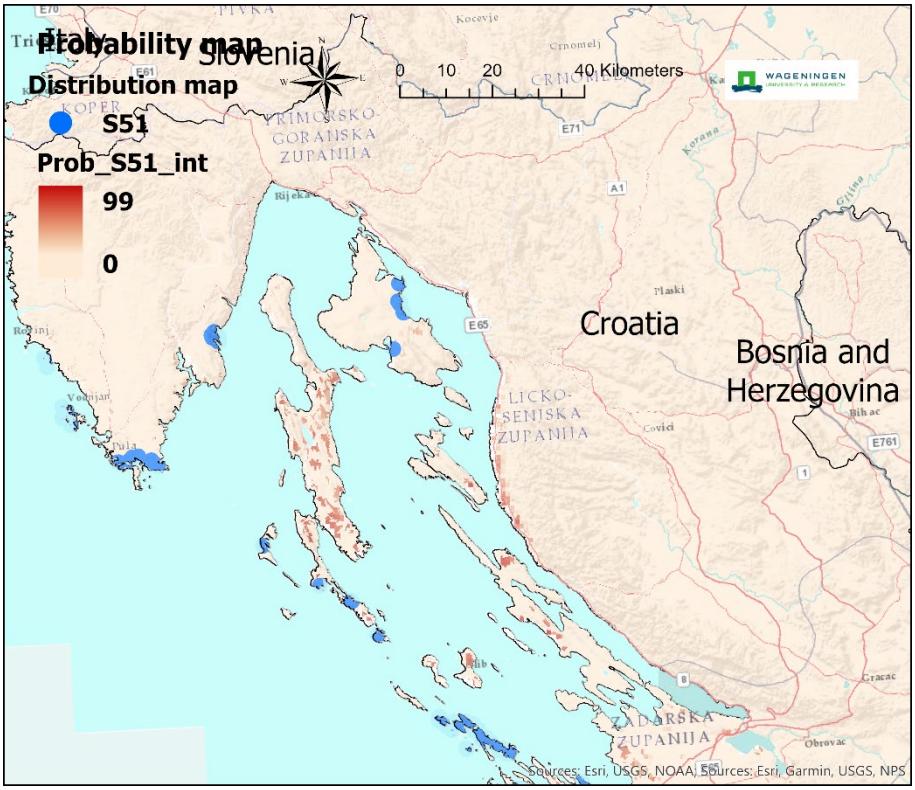
Very often influenced by grazing and burning and frequently a secondary vegetation type derived by clearance of acidophilous forest and maintained anthropogenically.

S51 – [F51] Mediterranean maquis and arborescent matorral

Evergreen sclerophyllous or laurophyllous shrub vegetation forming a dense closed canopy, with or without low emergent trees, on a wide variety of substrates and soils through the thermo- to mesomediterranean belts.



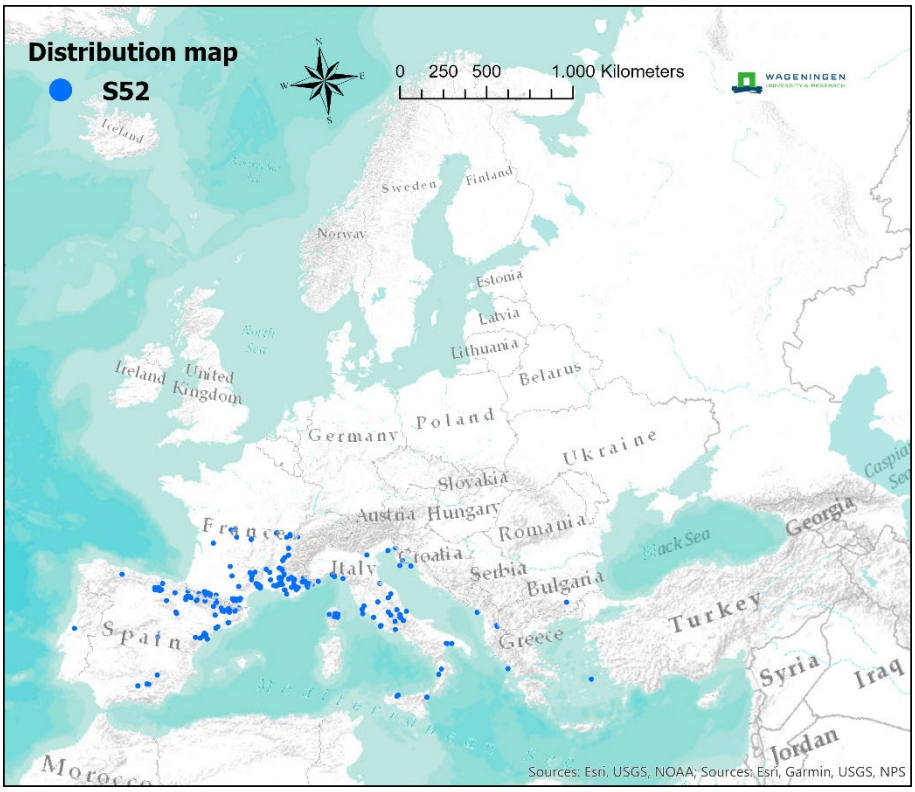


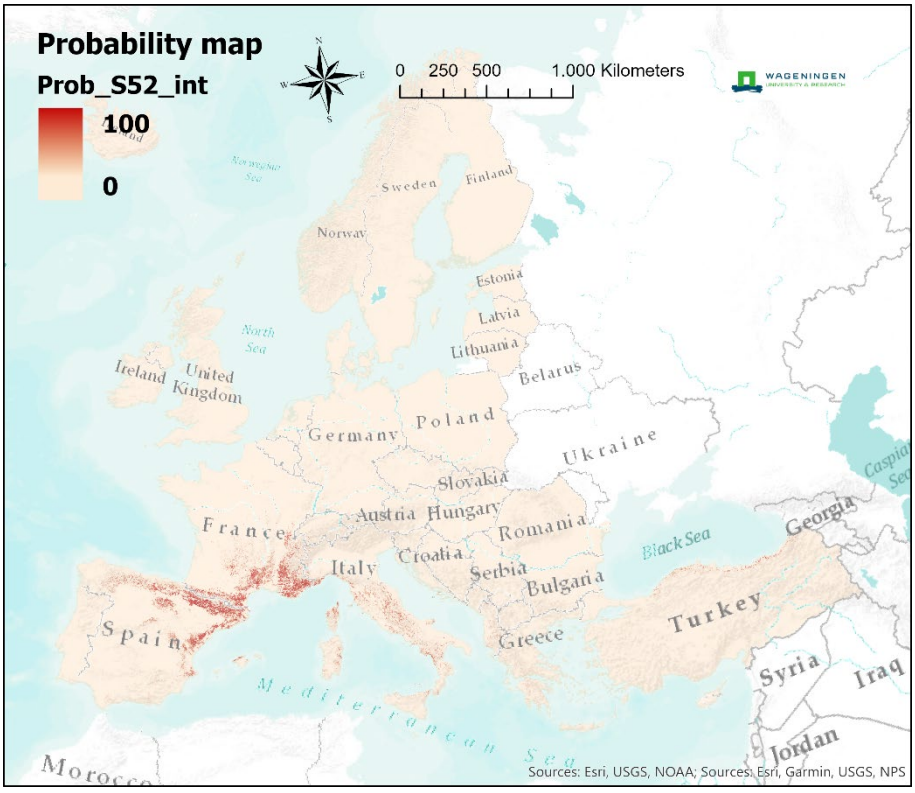


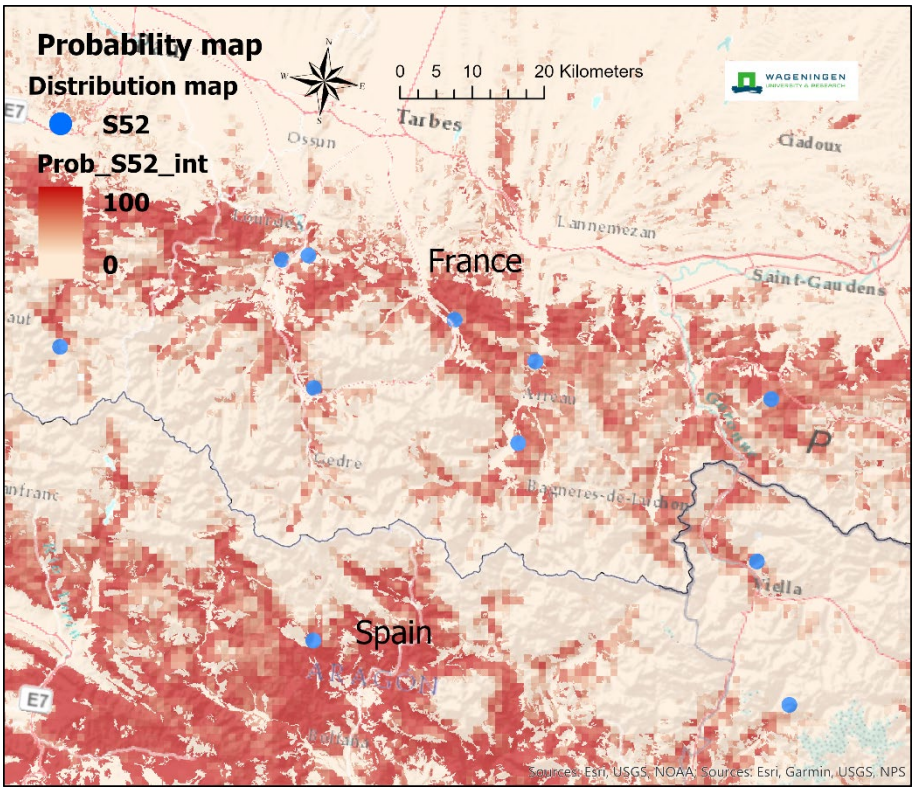
May be permanent primary vegetation on xeric sites but is usually derived by degradation of evergreen deciduous or coniferous forest and much influenced in structure and composition by grazing and fire.

S52 – [F53] Submediterranean pseudomaquis

Mixed deciduous and evergreen scrub of shallow, rocky, mostly calcareous soils in the lowlands and foothills of southern Europe, particularly the east. Usually derived by forest degradation and much affected in structure and composition by grazing, fire and logging.

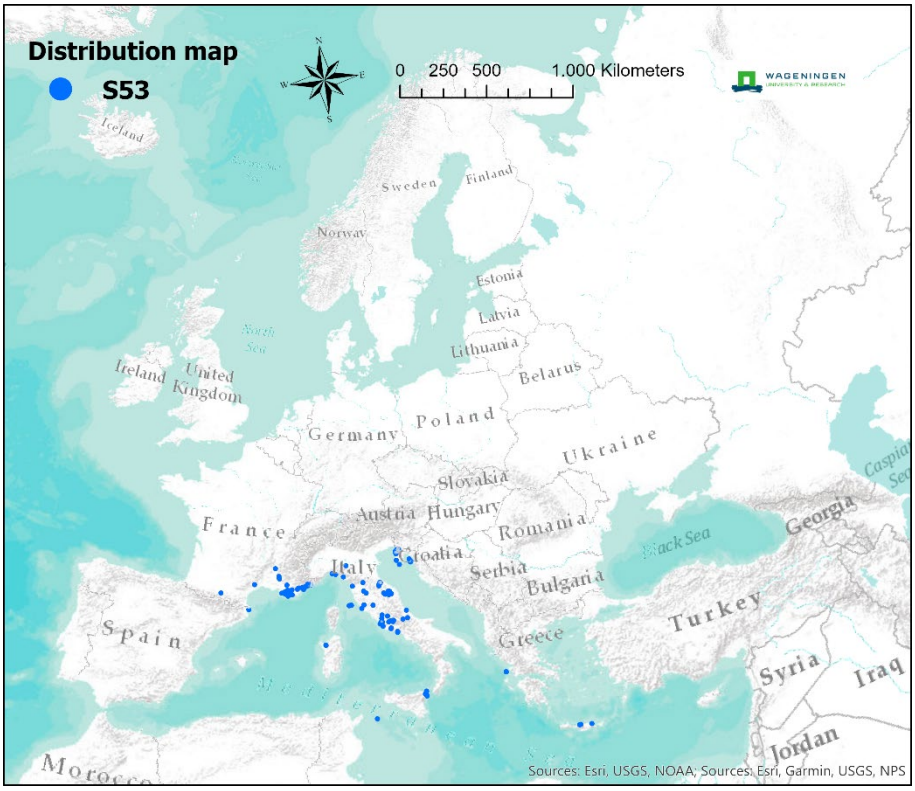


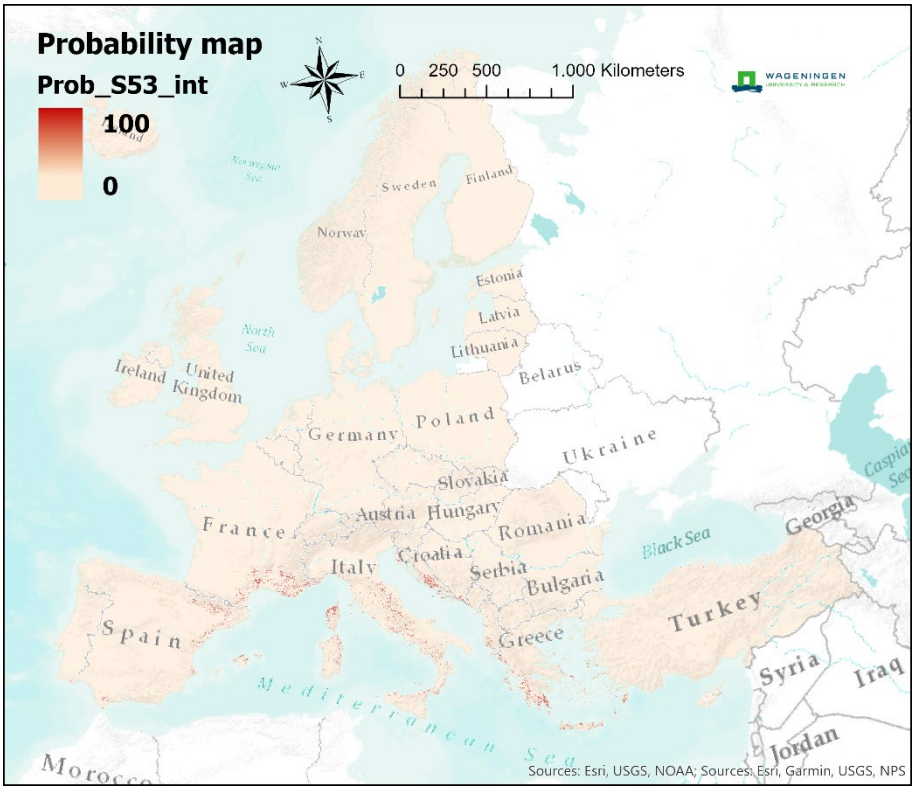


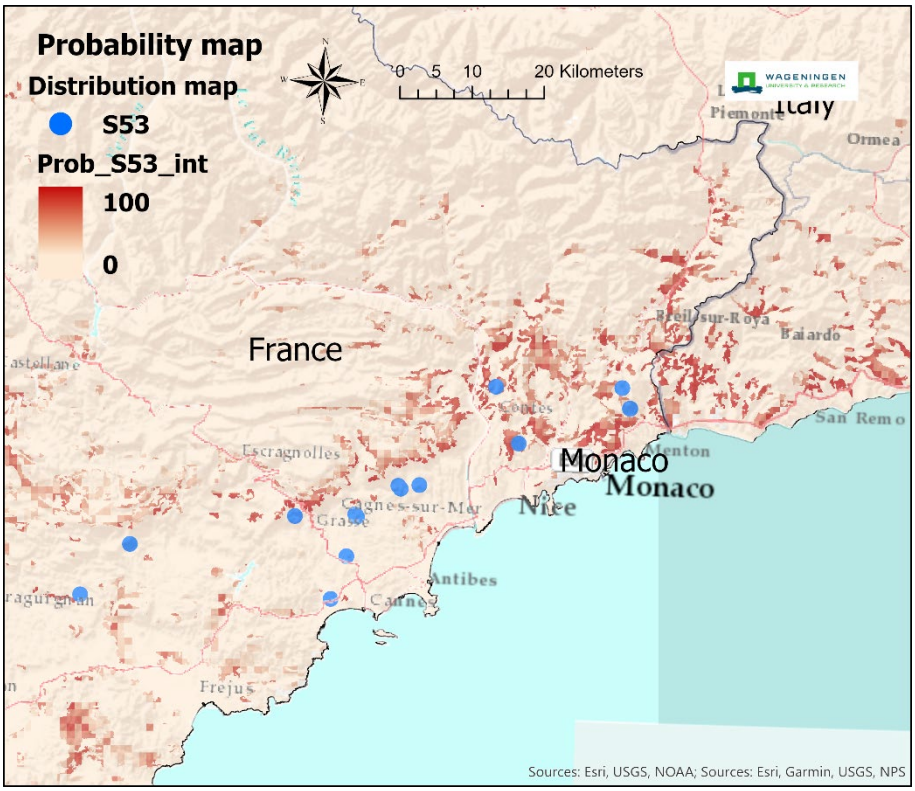

Probability map
Distribution map
S52
Prob_S52_int
100
0
0 5 10 20 Kilometers
WAGENINGEN
Tarbes
Ossun
Lannemezan
Saint-Gaudens
Cadoux
France
Spain
Sources: Esri, USGS, NOAA; Sources: Esri, Garmin, USGS, NPS

S53 – [F54] Spartium junceum scrub

Scrub dominated by Spartium junceum, typical of disturbed, open, sunny situations on a wide variety of soils through the mediterranean and submediterranean zones, where its rapid establishment is favoured by post-fire seed germination, aggressive rooting, nitrogen-fixation and unpalatability.

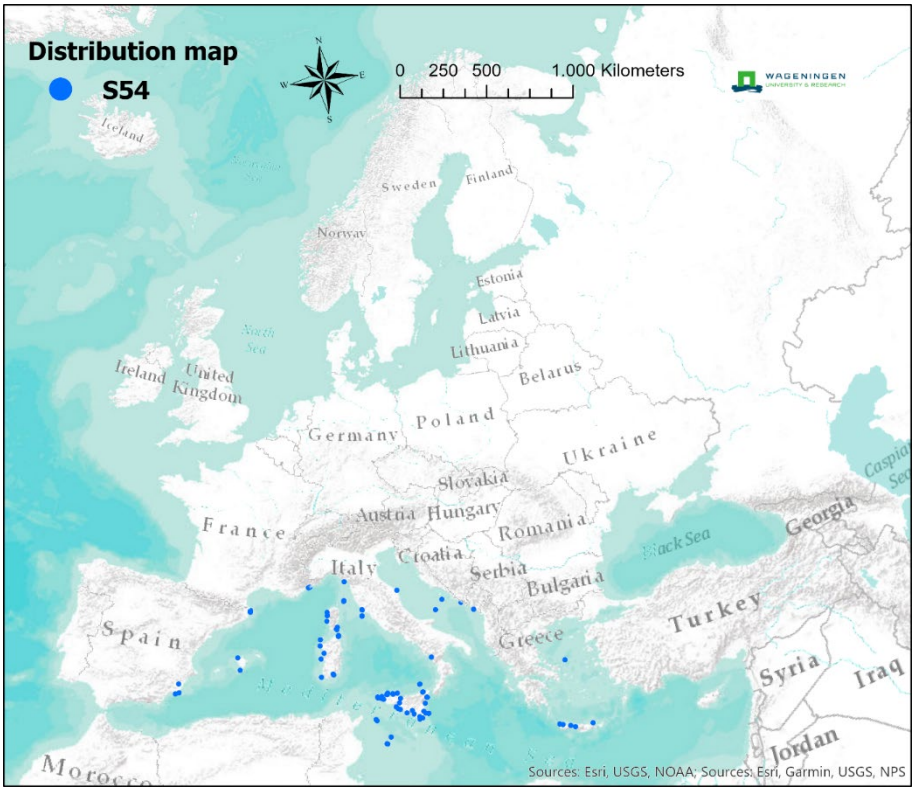


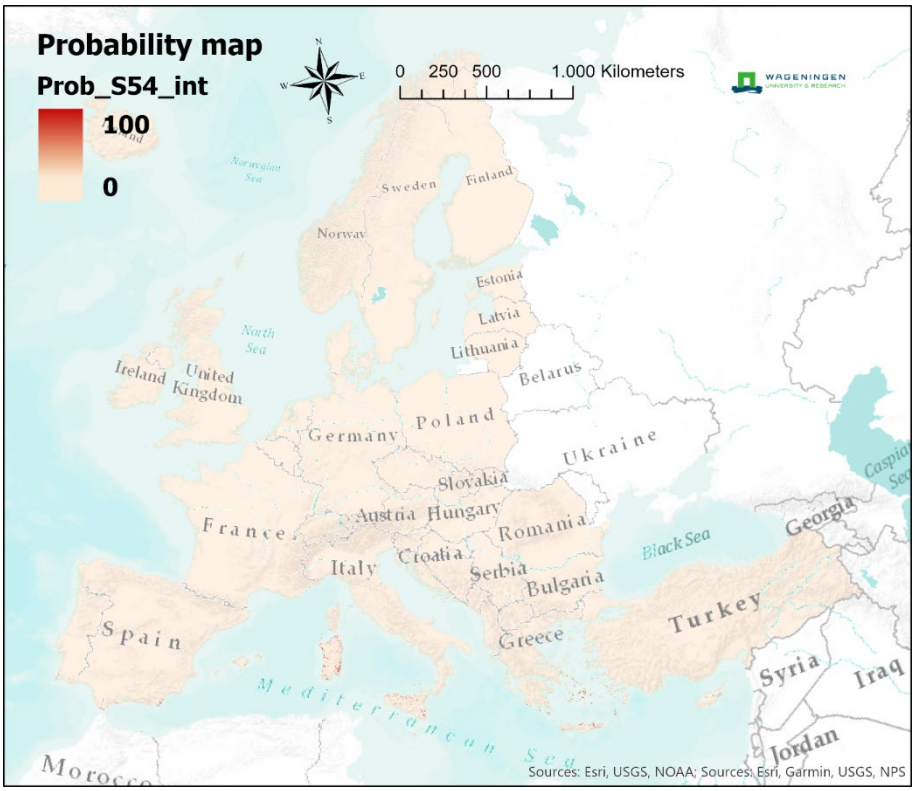


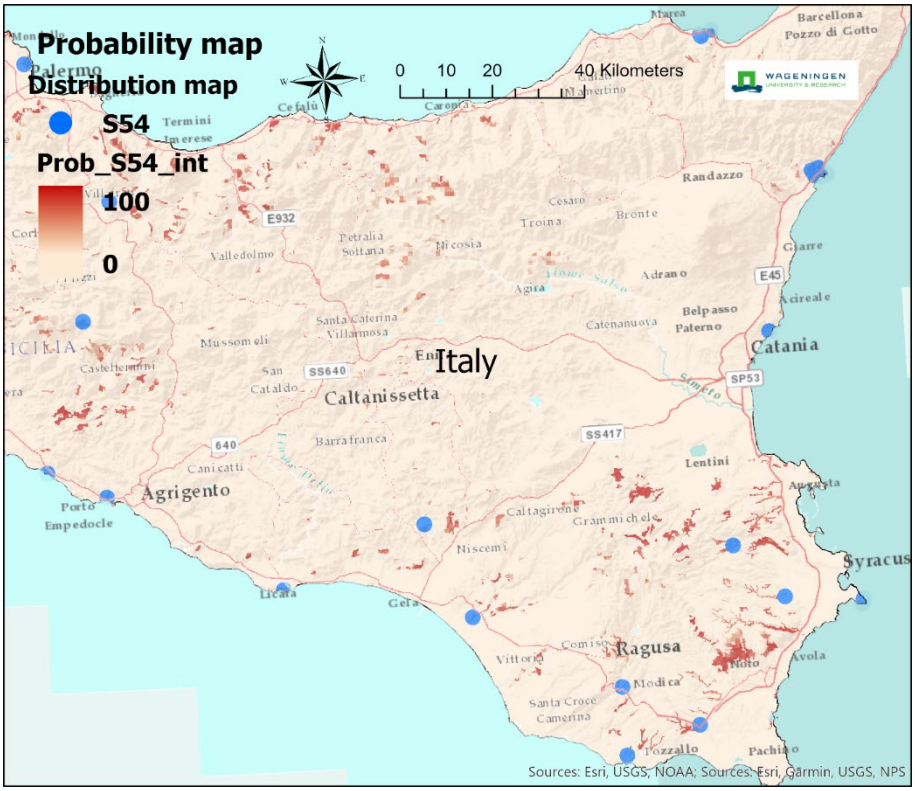

Probability map
Distribution map
S53
Prob_S53_int
100
0
0 5 10 20 Kilometers
WAGENINGEN
France
Italy
Monaco
Monaco
Nice
Cannes
Antibes
Grasse
Frejus
Escragnolles
Ormea
San Remo
Sources: Esri, USGS, NOAA; Sources: Esri, Garmin, USGS, NPS

S54 – [F55] Thermomediterranean arid scrub

Scrub with a usually low and rather open cover of shrubs with sub-shrubs, dwarf shrubs and herbs between, on dry soils of varied composition through the thermomediterranean zone, and of very diverse local composition. Primary and permanent in more arid and exposed situations, but can be successional to forest and often much affected by grazing.

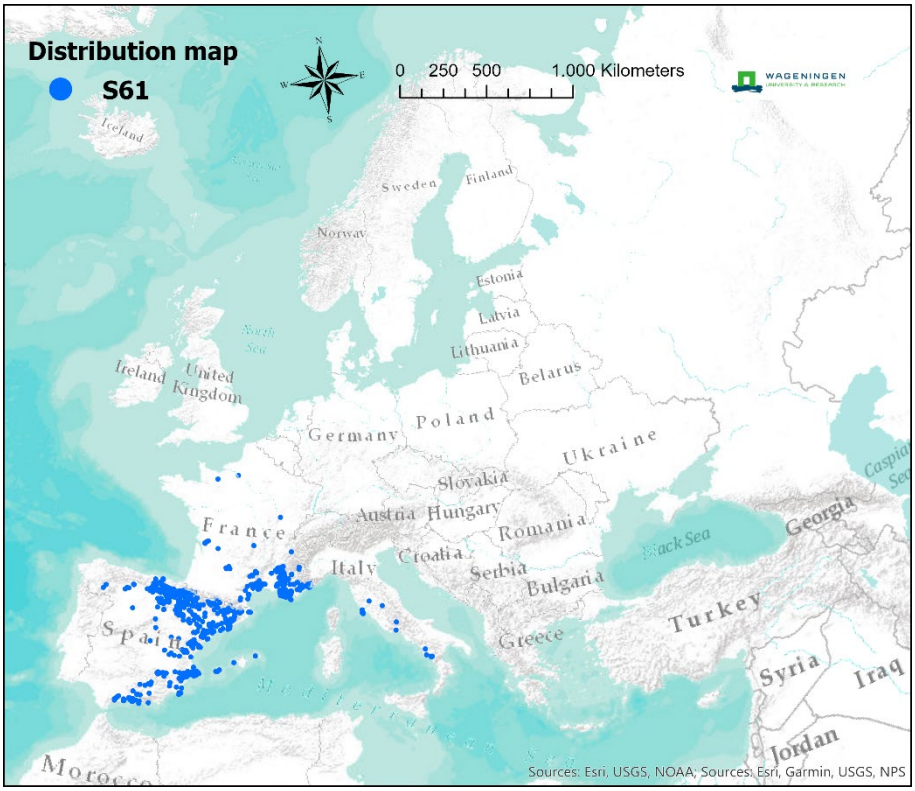


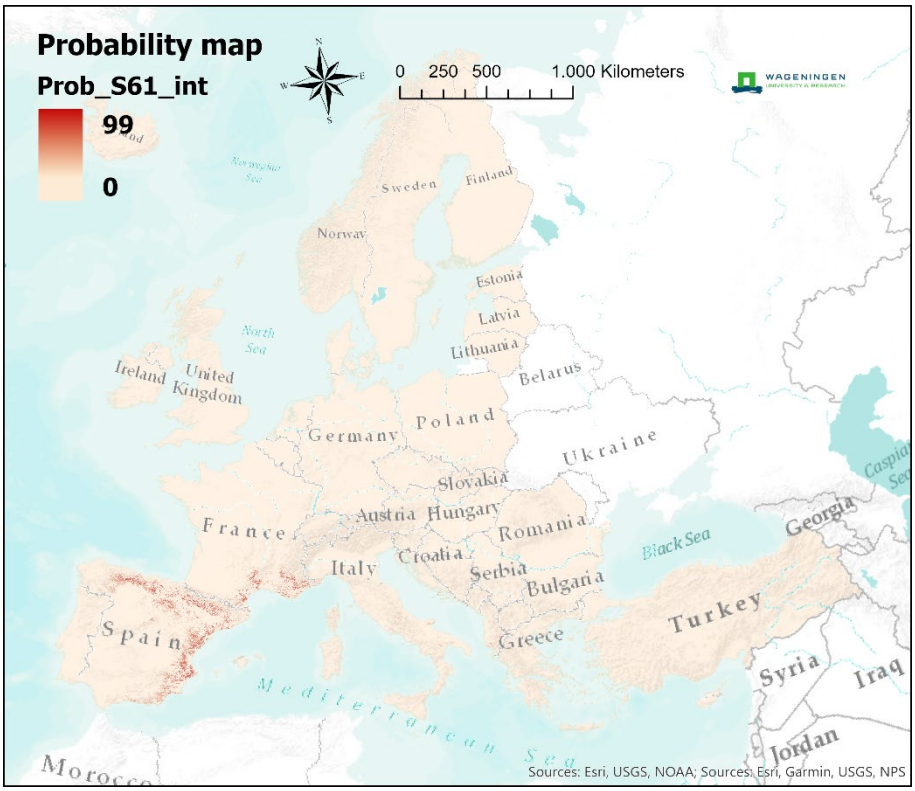


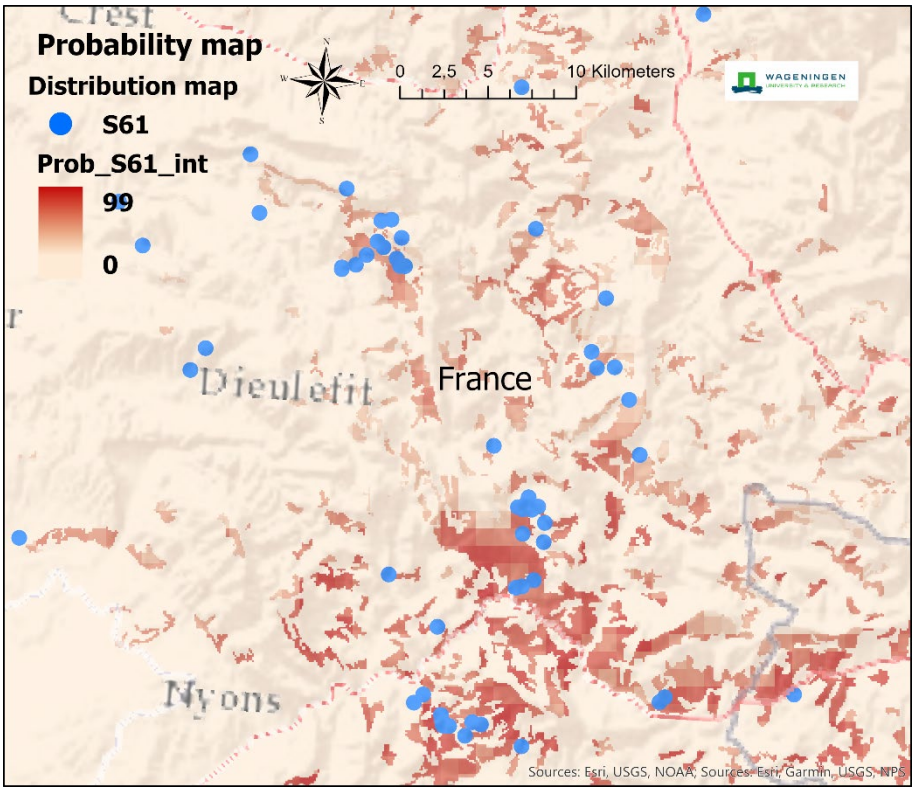

Probability map
Distribution map
S54
Prob_S54_int
100
0
0 10 20
40 Kilometers
WAGENINGEN
Italy
Palermo
Cefalù
Termini Imerese
Barcellona Pozzo di Gotto
Milazzo
Randazzo
Cesaro
Troina
Bronte
Nicosia
Petralia Sottana
Valledolmo
Gioiosa Marea
Agira
Adrano
Giarre
Acireale
Catania
Belpasso
Paterno
Catenanuova
Santa Caterina Villarmosa
Mussomeli
Castelterrmini
San Cataldo
Caltanissetta
Enna
Barrafranca
Canicatti
Agrigento
Porto Empedocle
Licata
Gela
Niscemi
Caltagirone
Grammichele
Lentini
Augusta
Syracuse
Vittoria
Comiso
Ragusa
Modica
Noto
Avola
Santa Croce Camerina
Pozzallo
Pachino
E932
SS640
SS417
SP53
E45
640
Sources: Esri, USGS, NOAA; Sources: Esri, Garmin, USGS, NPS

S61 – [F61a] Western basiphilous garrigue

Sub-shrub vegetation dominated by nanophanerophytes and chamaephytes on thin, base-rich soils through the western thermo- to mesomediterranean belts, very diverse in composition with differences in local climate and soils. In rockier situations, it can be a permanent coloniser but is often derived from forest clearance and is much affected by grazing and fire.

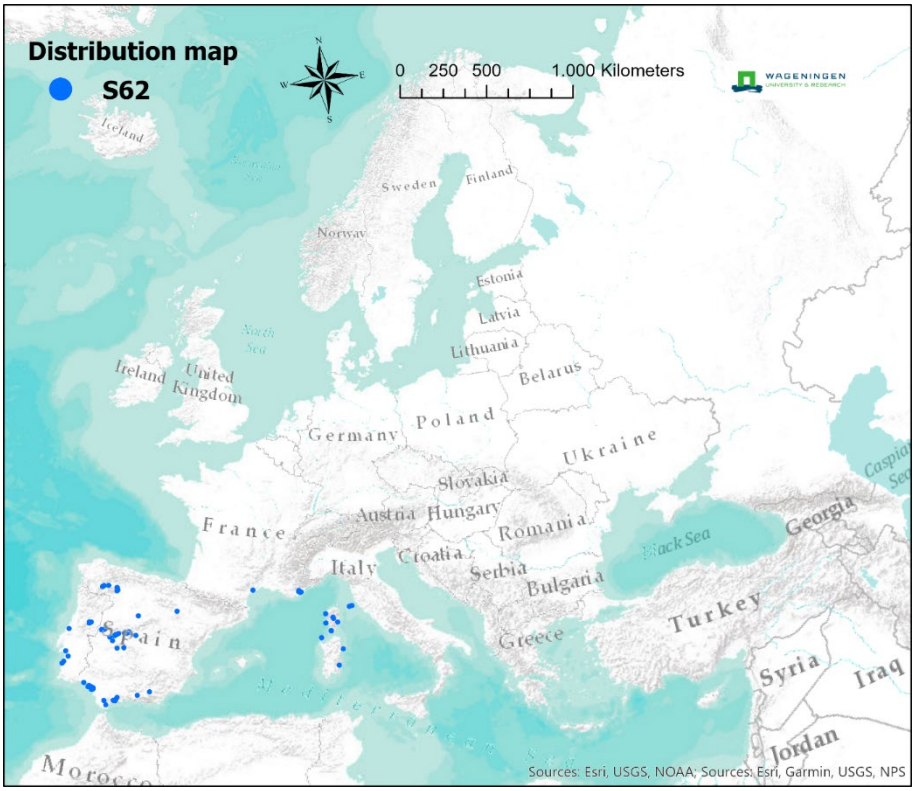


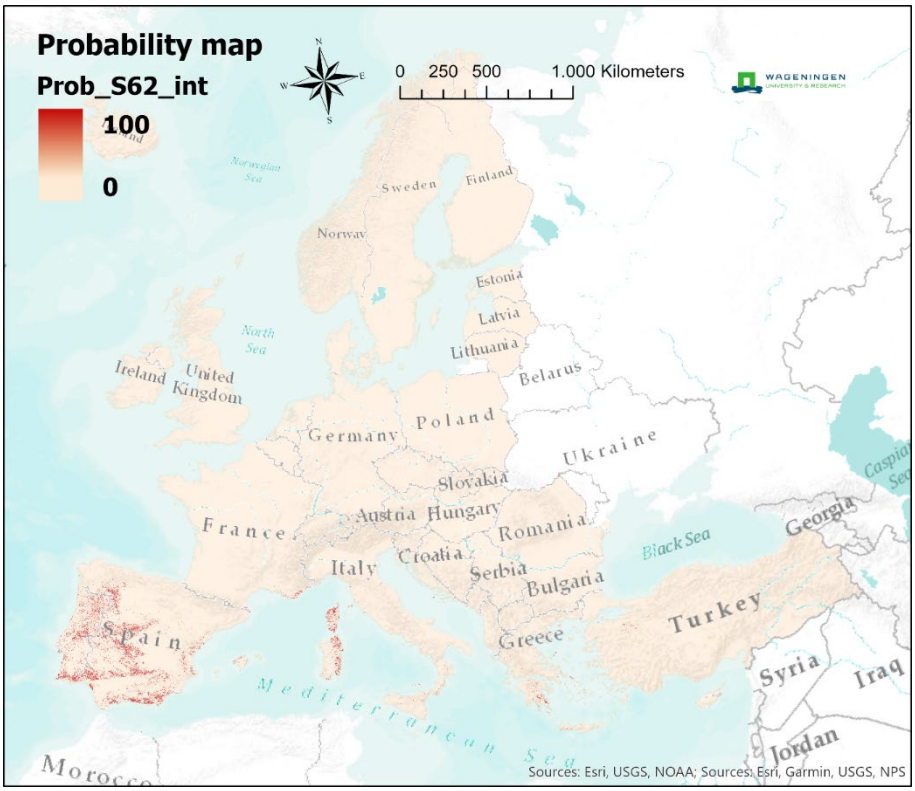


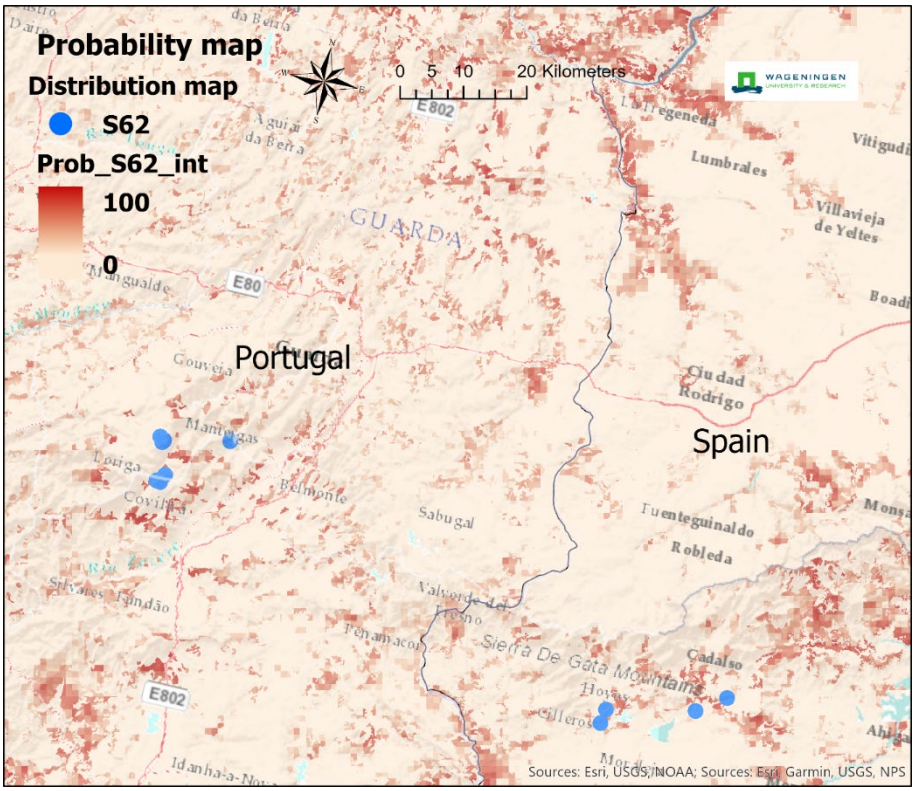

Probability map
Distribution map
S61
Prob_S61_int
99
0
0 2,5 5 10 Kilometers
WAGENINGEN
France
Dieulefit
Nyons
Sources: Esri, USGS, NOAA, Sources: Esri, Garmin, USGS, NPS

S62 – [F61b] Western acidophilous garrigue

Sub-shrub vegetation dominated by nanophanerophytes on thin acidic soils, both hard silicate and soft sands, through the western thermo- to lower supramediterranean belts, very diverse in composition with differences in local climate and soils. In rockier situations, it can be a permanent coloniser but is often derived from forest clearance or abandonment of farm fields and is much affected by grazing and fire.

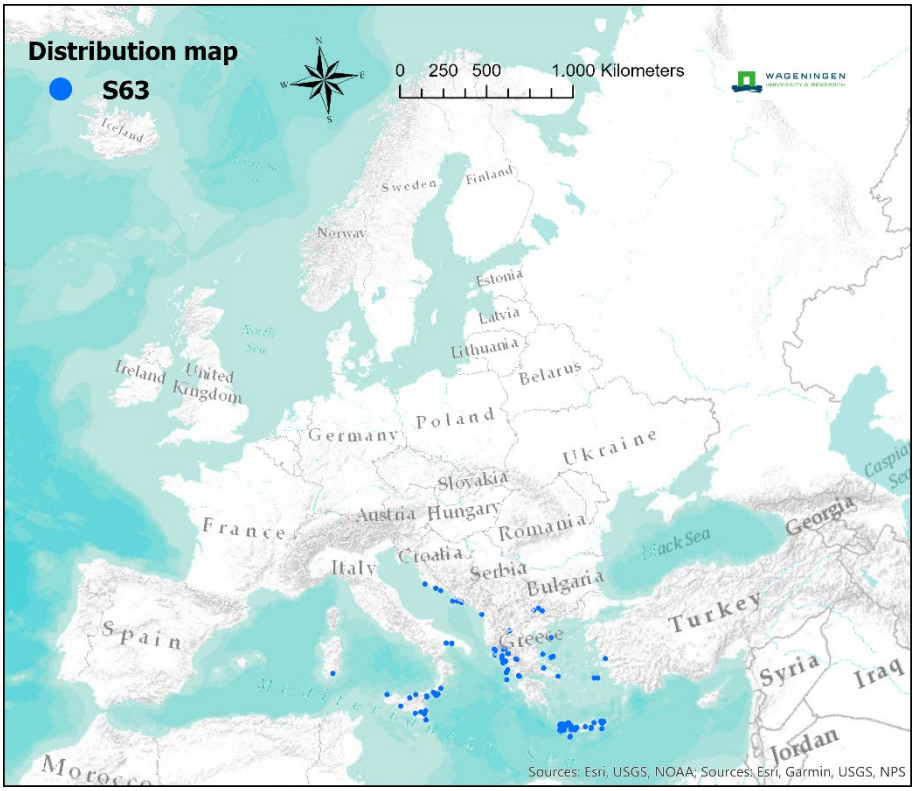


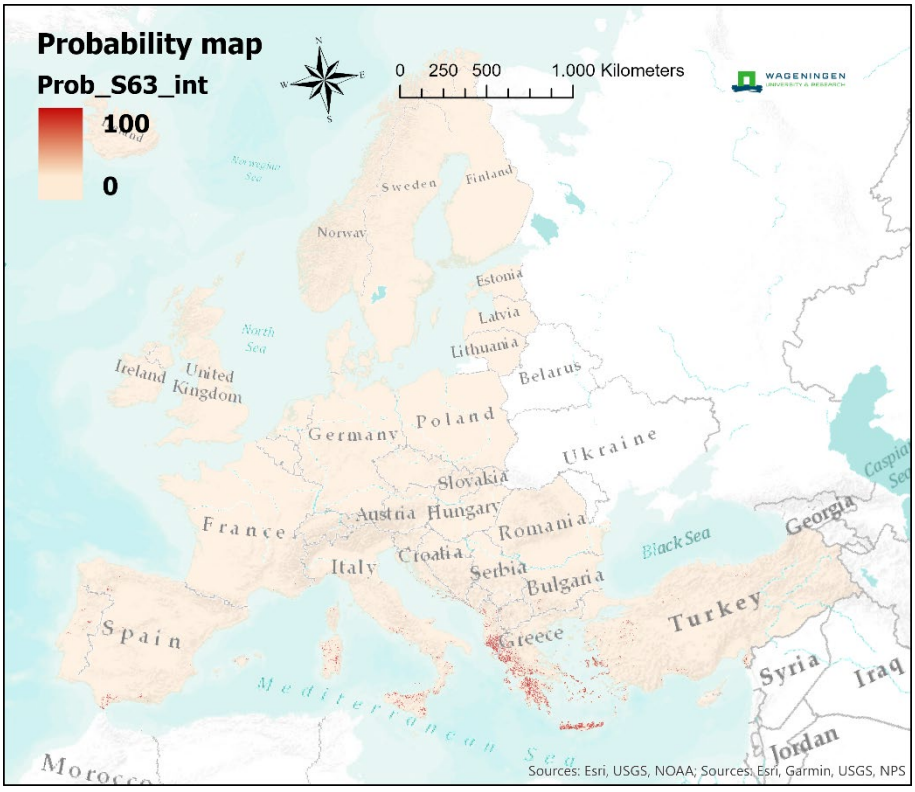


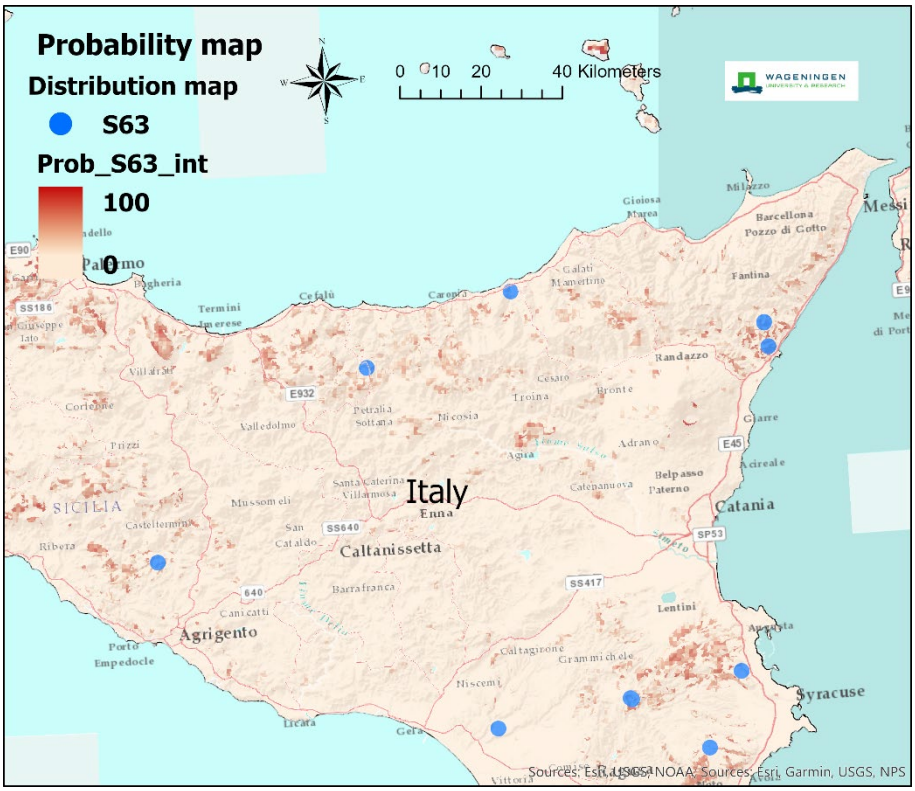

Probability map
Distribution map
S62
Prob_S62_int
100
0
0 5 10 20 Kilometers
Portugal
Spain
GUARDA
E80
E802
Lumbrales
Villavieja de Yeltes
Ciudad Rodrigo
Fuenteguinaldo
Robleda
Sabugal
Cadalso
Sierra De Gata Mountains
Sources: Esri, USGS, NOAA; Sources: Esri, Garmin, USGS, NPS

S63 – [F62] Eastern garrigue

Low, mostly evergreen sclerophyllous scrub on diverse soils through the eastern meso-, thermo- and occasionally supramediterranean belts, including around the Black Sea, where deciduous species can prevail. Derived by forest degradation and usually maintained by grazing and fire, their structure and composition vary greatly with local climate and human impacts.

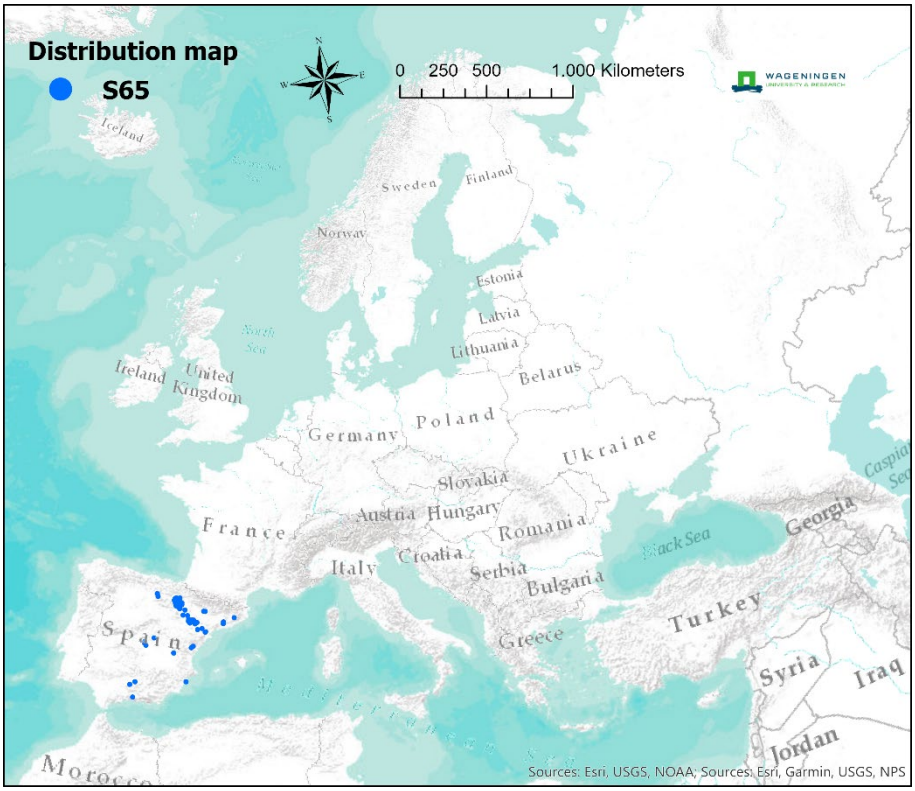


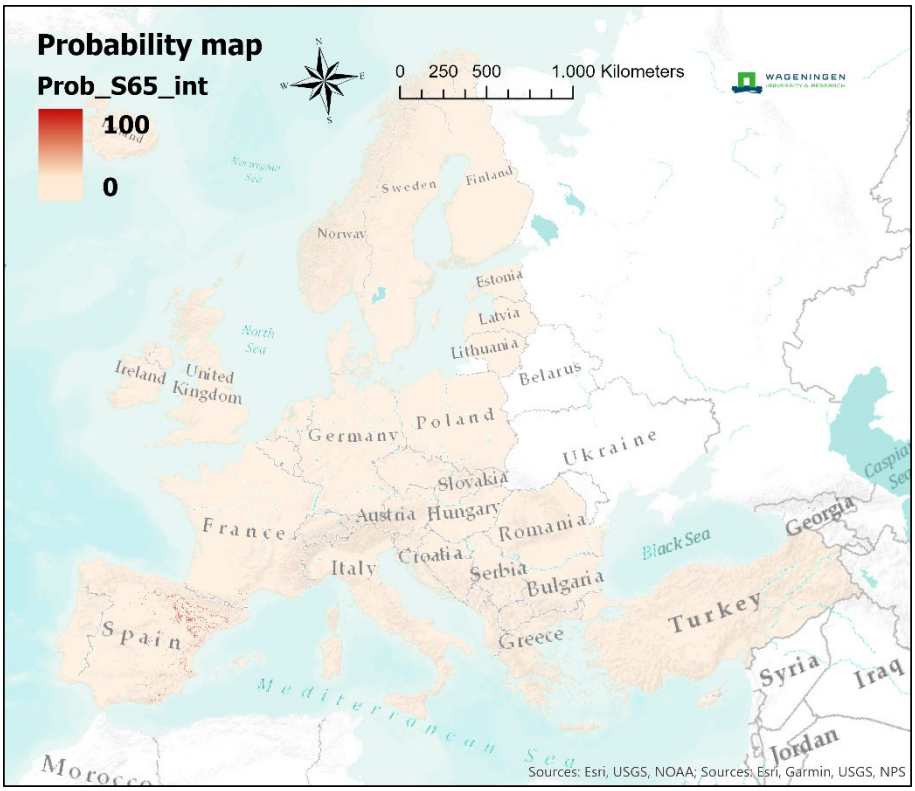


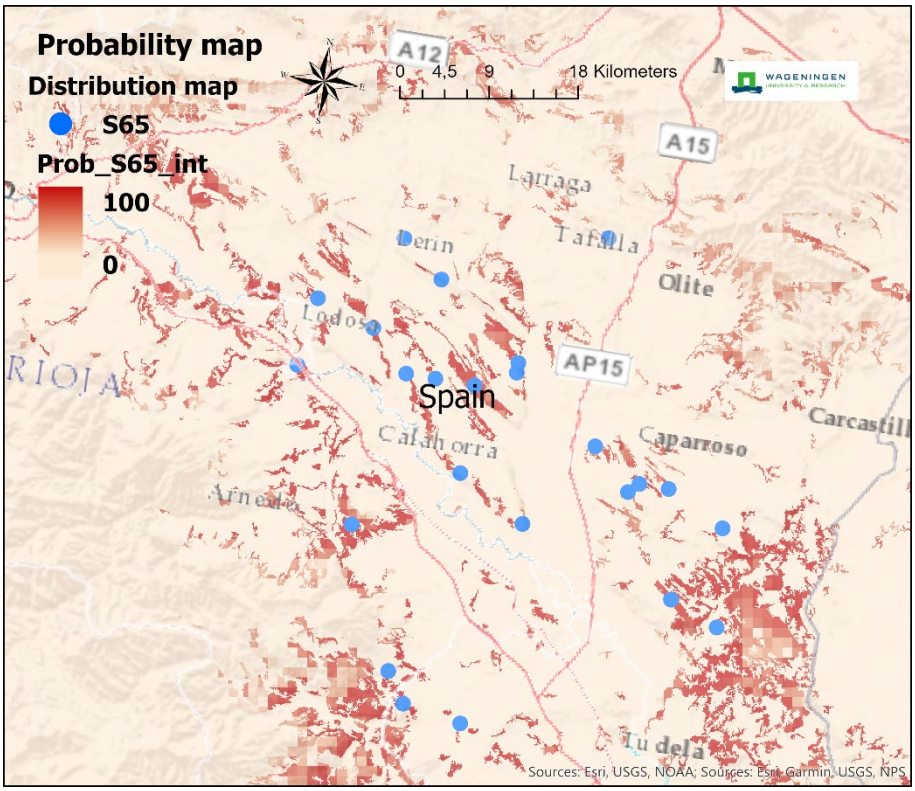

Probability map
Distribution map
S63
Prob_S63_int
100
0
0 10 20 40 Kilometers
WAGENINGEN
Italy
Palermo
Catania
Agrigento
Caltanissetta
Enna
Syracuse
SICILIA
Sources: Esri, USGS, NOAA
Sources: Esri, Garmin, USGS, NPS

S65- [F67] Mediterranean gypsum scrub

Open chamaephyte scrub with a lichen crust and rainy-spring annual herb flora, on gypsum-rich substrates in areas with a dry to semi-arid mediterranean climate in the Iberian Peninsula. The extreme climatic and edaphic conditions maintain the habitat as naturally stable but it can bear some light grazing.

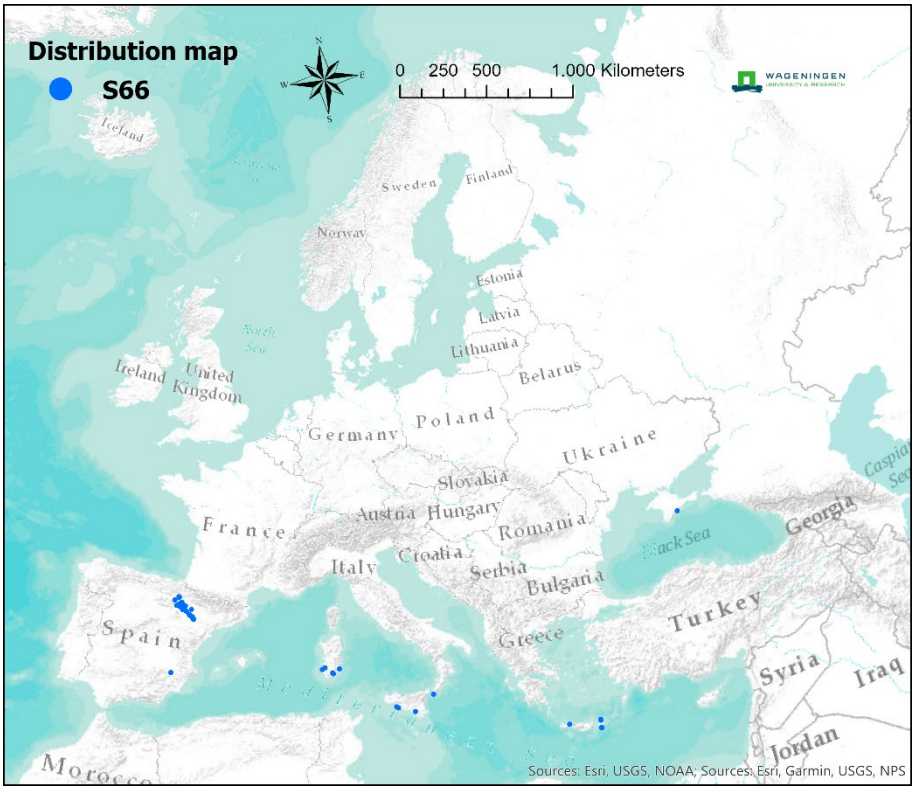


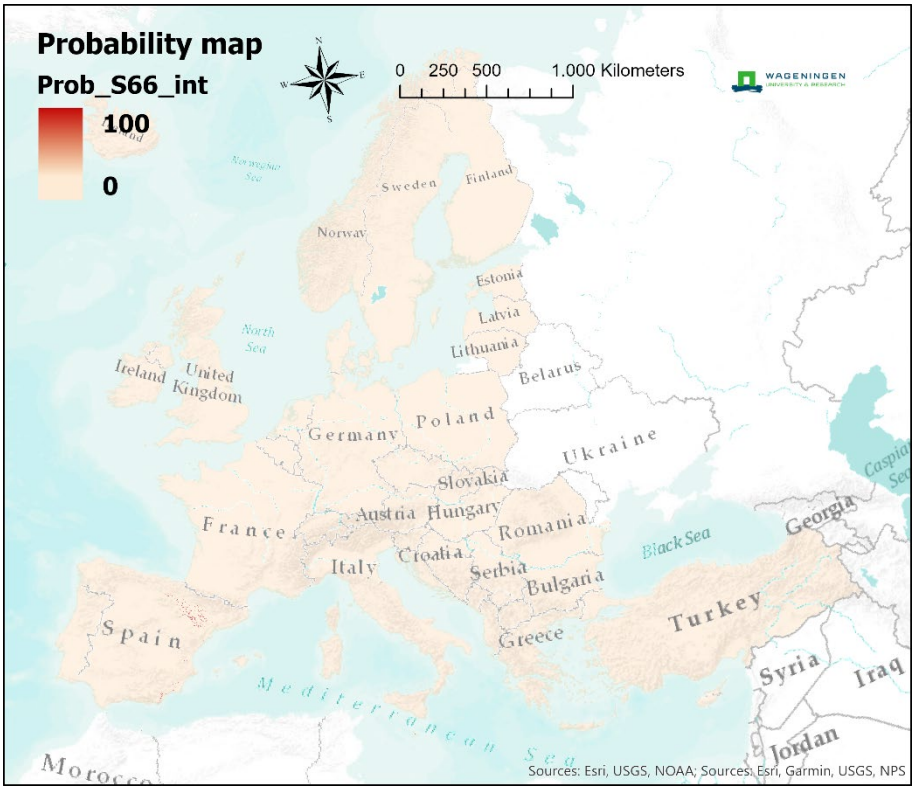


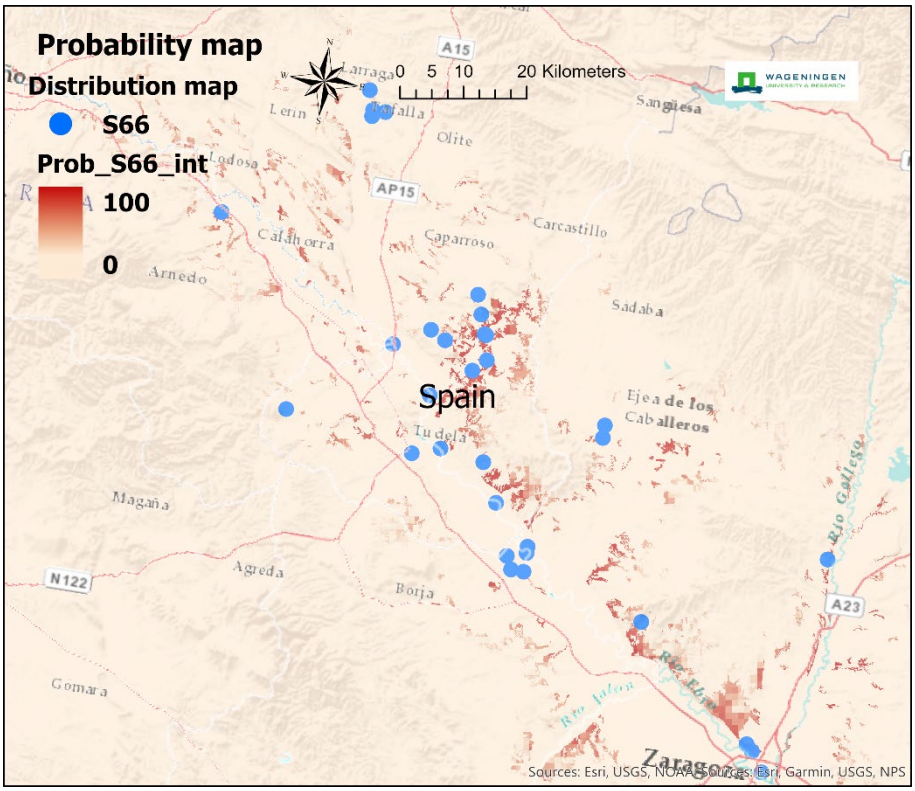

Probability map
Distribution map
S65
Prob_S65_int
100
0
A12
0 4,5 9 18 Kilometers
A15
AP15
Spain
Larraga
Olite
Caparroso
Sources: Esri, USGS, NOAA; Sources: Esri, Garmin, USGS, NPS

S66 – [F68a] Mediterranean halo-nitrophilous scrub

Perennial scrubby vegetation with nitrophilous and salt-tolerant associates in often artificially-disturbed places through the semi-arid thermo- and inframediterranean belts where the dry climate slows the decomposition of litter and aids precipitation of salt from the soil.

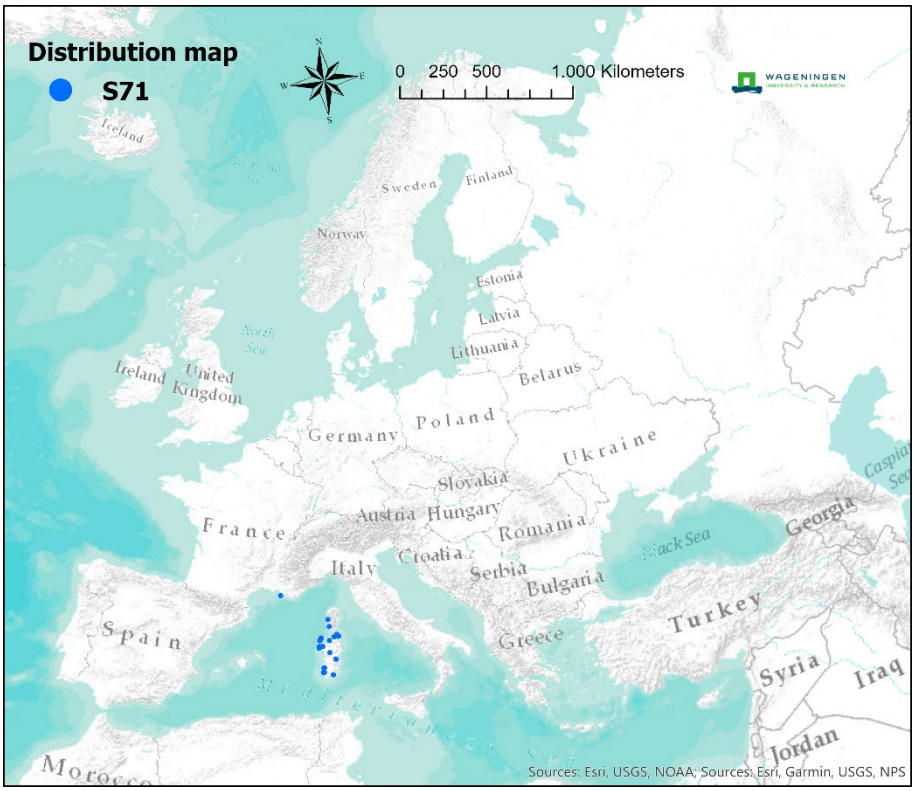


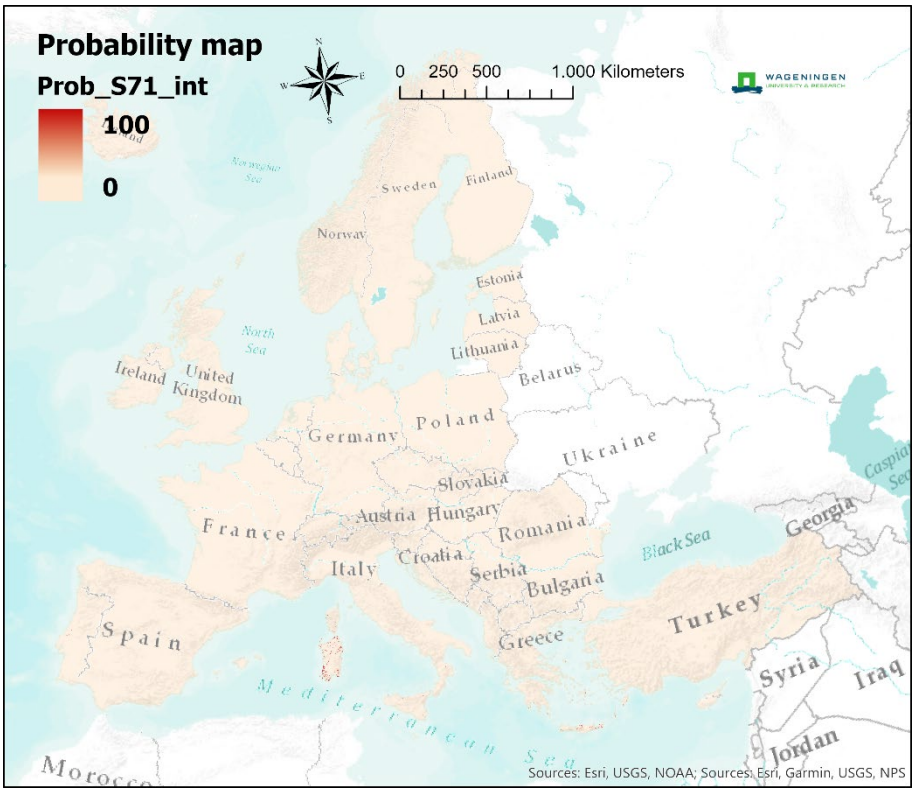


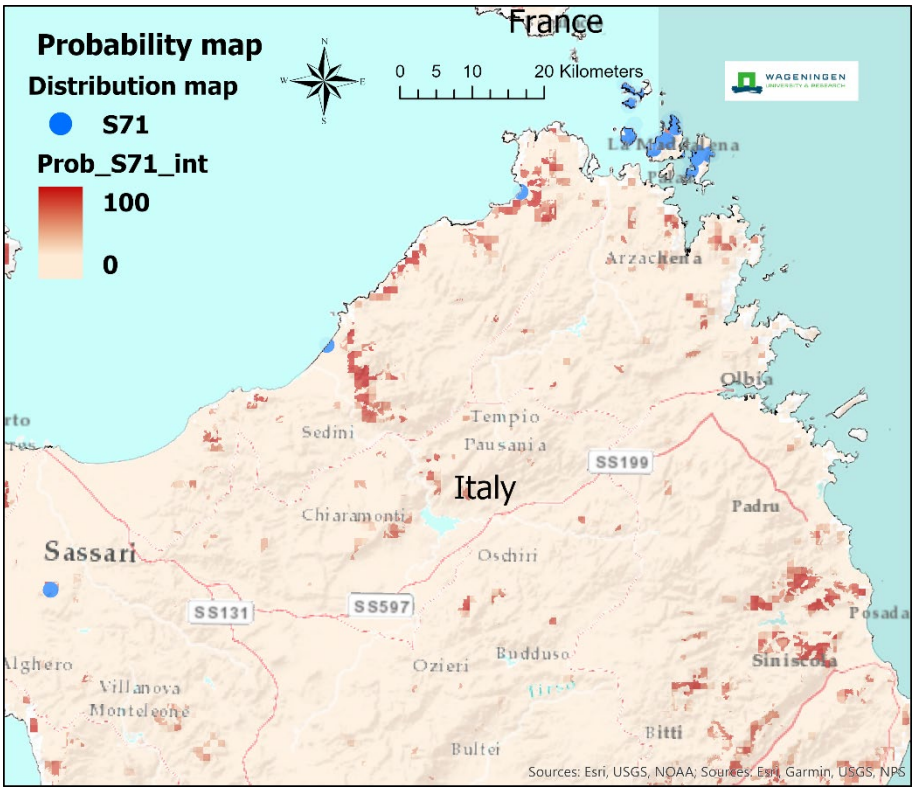

Probability map
Distribution map
S66
Prob_S66_int
100
0
0 5 10 20 Kilometers
Spain
Sources: Esri, USGS, NOAA

S71 – [F71] Western Mediterranean spiny heath

Low scrub of often spiny, cushion-forming plants on thin soils on wind-exposed and spray-splashed tops of rocky cliffs on Corsica, Sardinia, Pantelleria and in the Gulf of Taranto.

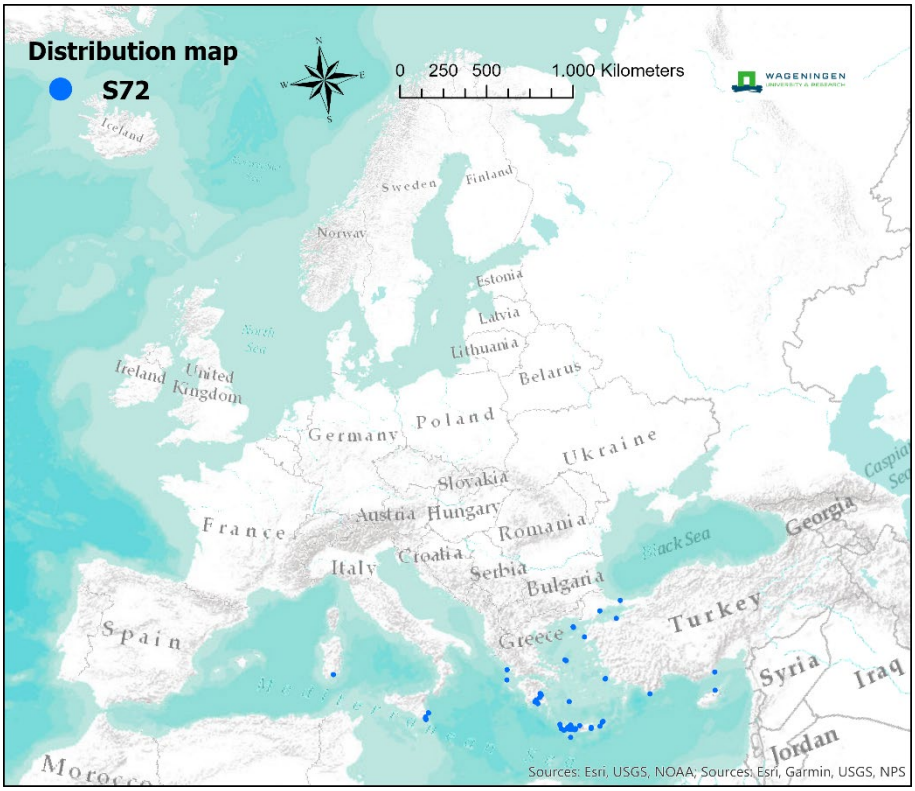


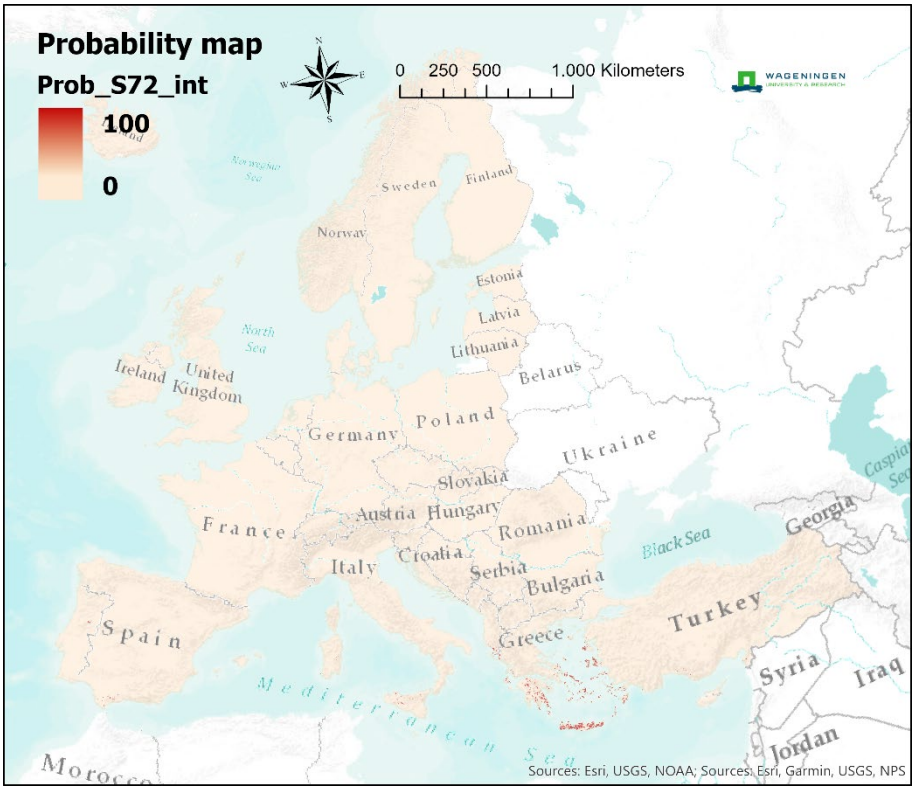


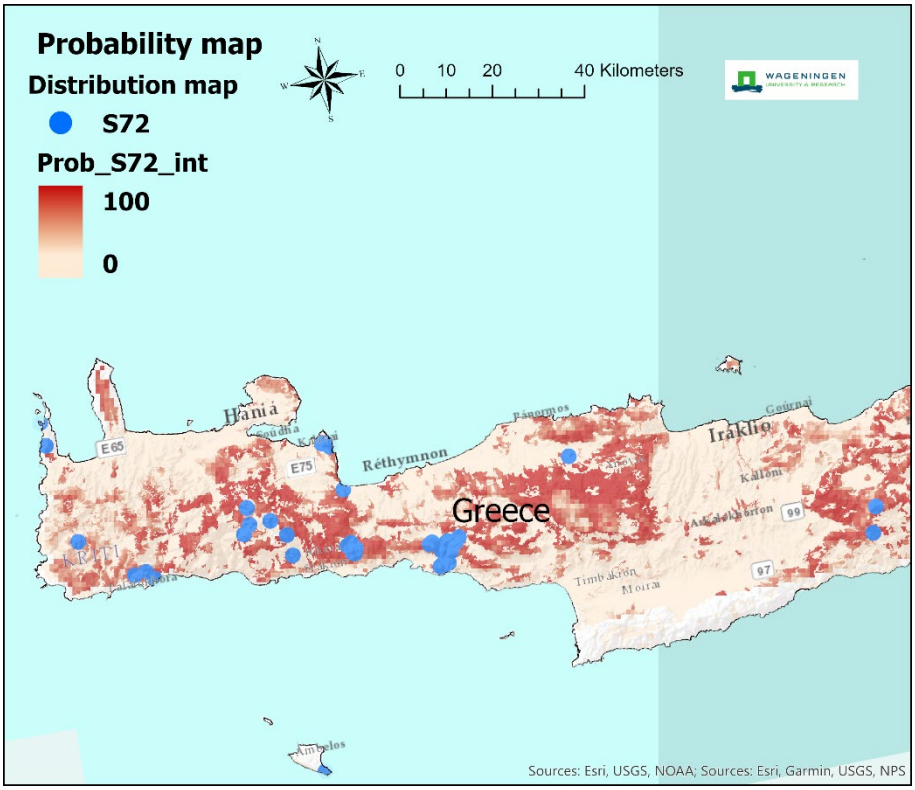

Probability map
Distribution map
S71
Prob_S71_int
100
0
0 5 10 20 Kilometers
France
Italy
Arzachena
Olbia
Tempio
Pausania
Sedini
SS199
Padru
Chiaramonti
Sassari
Oschiri
SS131
SS597
Posada
Budduso
Ozieri
Sinisco
Villanova
Monteleone
Bitti
Bultei
Sources: Esri, USGS, NOAA; Sources: Esri, Garmin, USGS, NPS

S72 – [F73] Eastern Mediterranean spiny heath (phrygana)

Low scrub dominated by thorny hemispherical chamaephytes on various base-rich and acidic substrates in the thermo-, meso- and supramediterranean belts of mainland Greece, Anatolia, the Aegean and Ionian islands, Crete, Cyprus and the north-east Mediterranean coast, rarely also in Sicily. Can be of primary origin or result from clearance of evergreen sclerophyll forest.

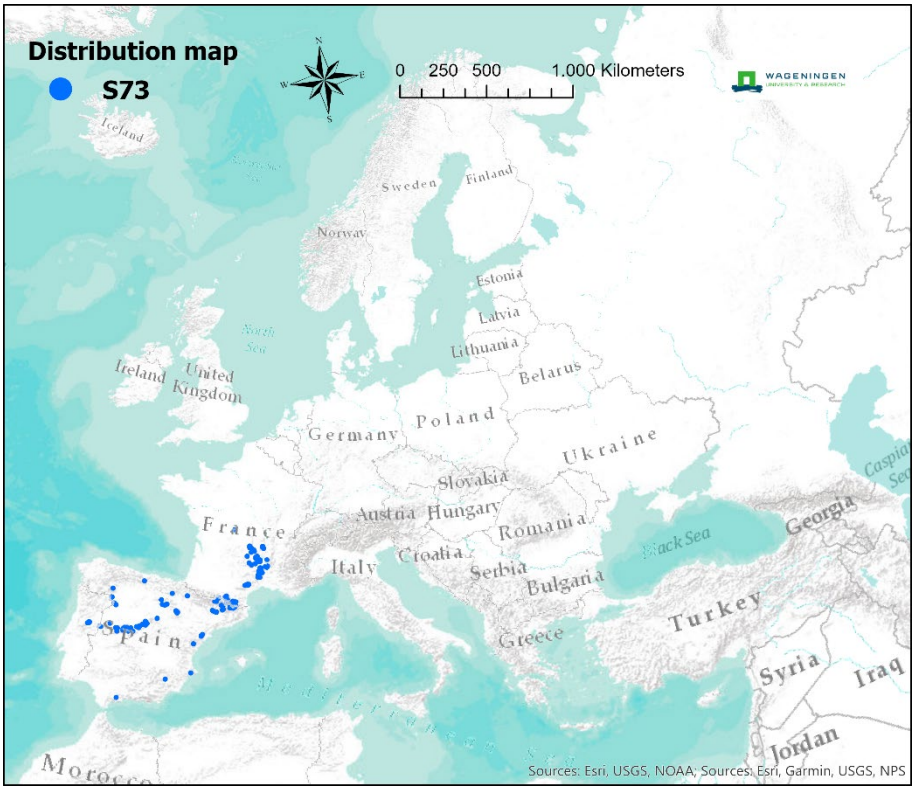


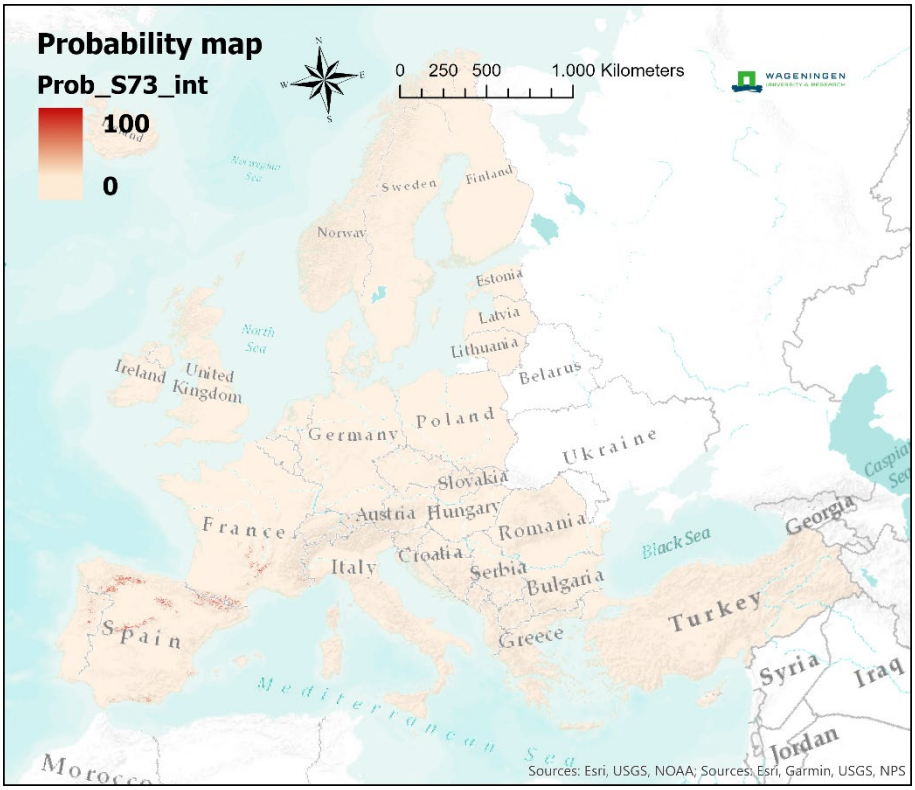


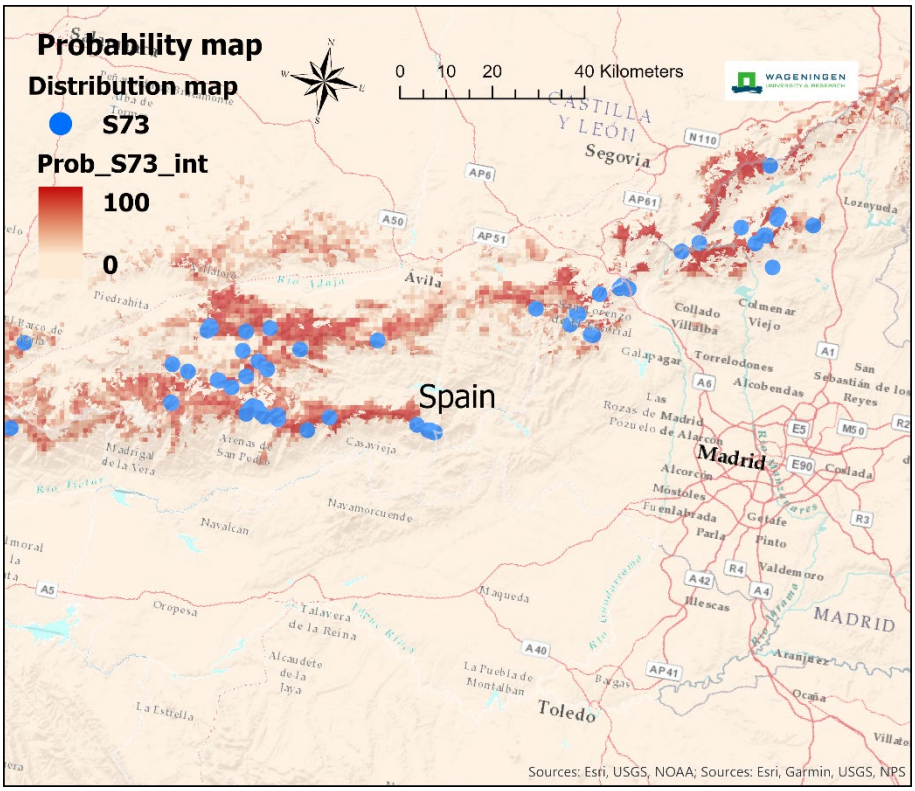

Probability map
Distribution map
S72
Prob_S72_int
100
0
0 10 20 40 Kilometers
WAGENINGEN
Hania
Réthymnon
Greece
Iráklio
E65
E75
99
97
Sources: Esri, USGS, NOAA; Sources: Esri, Garmin, USGS, NPS

S73 – [F74a] Western Mediterranean mountain hedgehog-heath

Heath of often spiny hedgehog sub-shrubs on base-rich and acidic soils in the cold and droughty upper supra- and oromediterranean belts of the Iberian Peninsula, historically sustaining transhumance pastoralism but often extending down from crests and steep slopes due to grazing and burning.

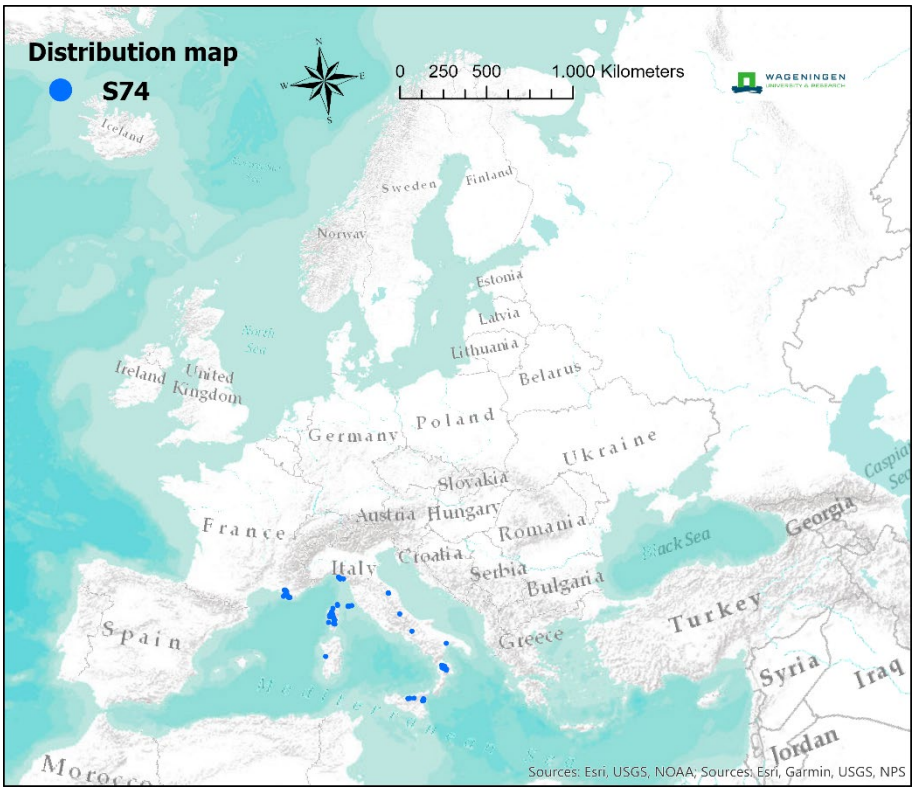


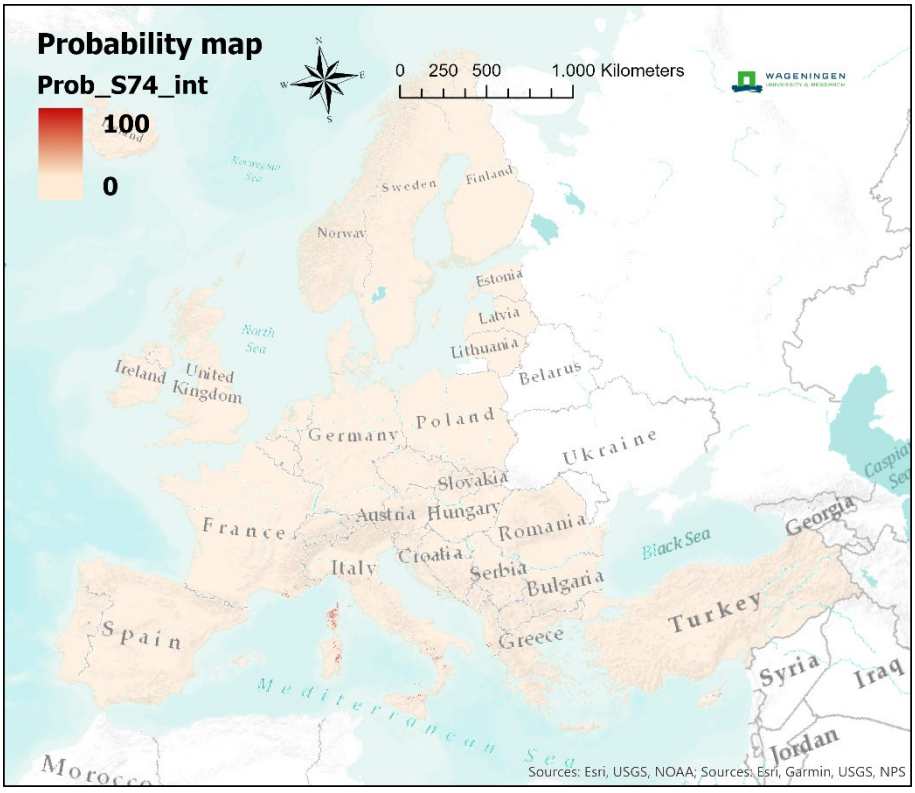


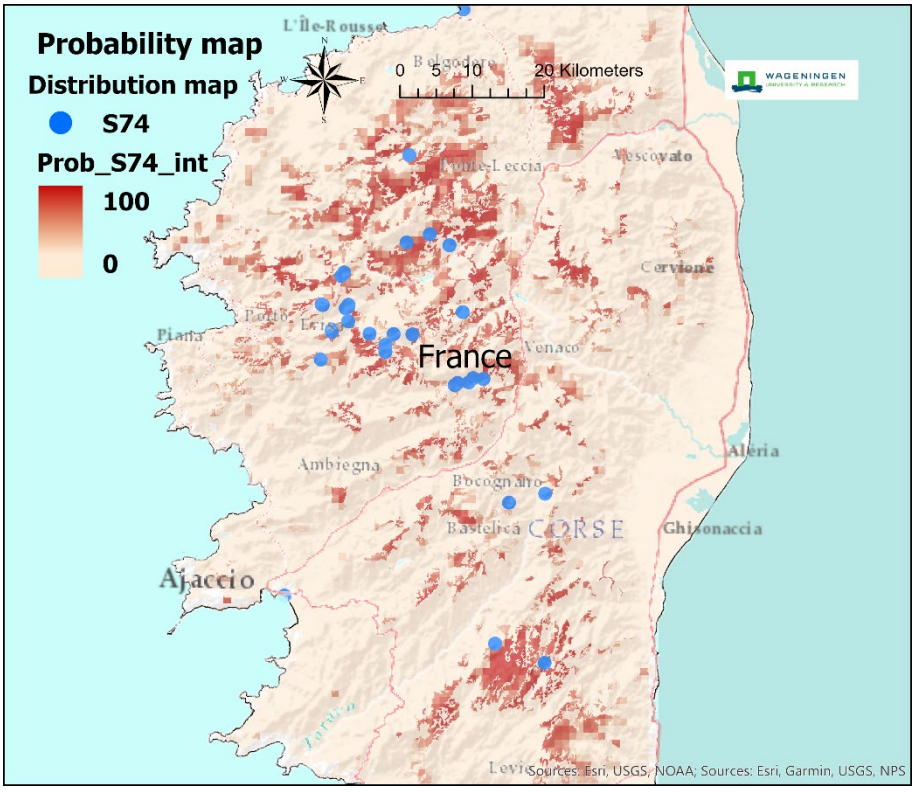

Probability map
Distribution map
S73
Prob_S73_int
100
0
0 10 20 40 Kilometers
WAGENINGEN
Spain
Madrid
Segovia
Ávila
Toledo
MADRID
Sources: Esri, USGS, NOAA; Sources: Esri, Garmin, USGS, NPS

S74 – [F74b] Central Mediterranean mountain hedgehog-heath

Heath of often spiny hedgehog sub-shrubs on base-rich and acidic soils in windy and sunny situations in the supra- and oromediterranean belts of Corsica, Sardinia, Elba, Sicily and the southern mainland Mountains of Italy. Downslope expansion below the timberline can follow clearance and grazing.

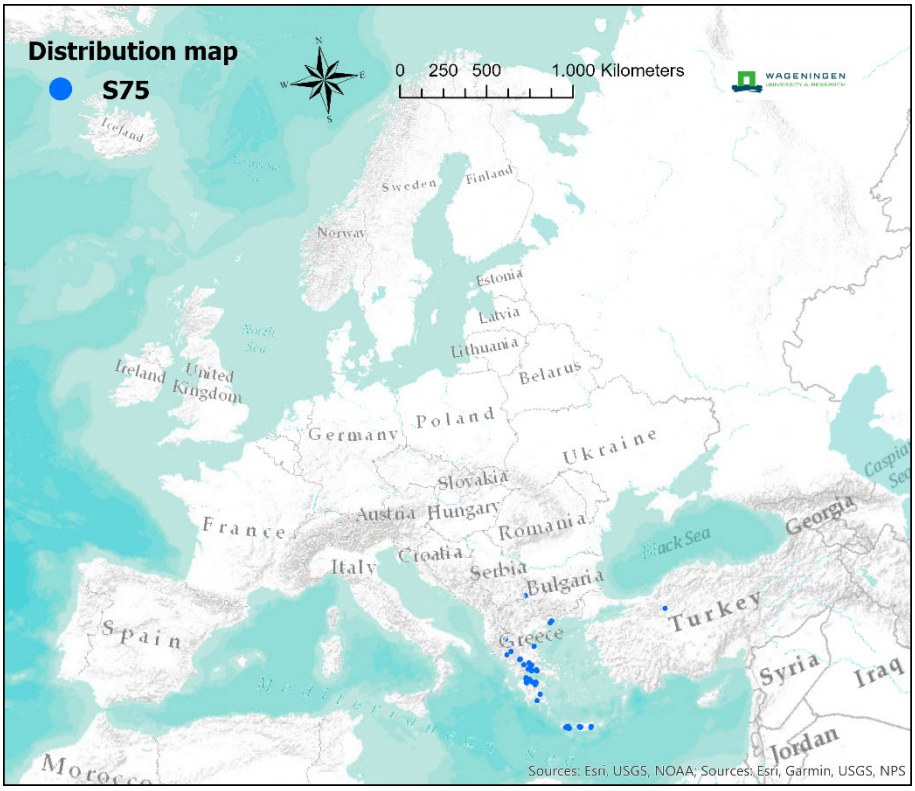


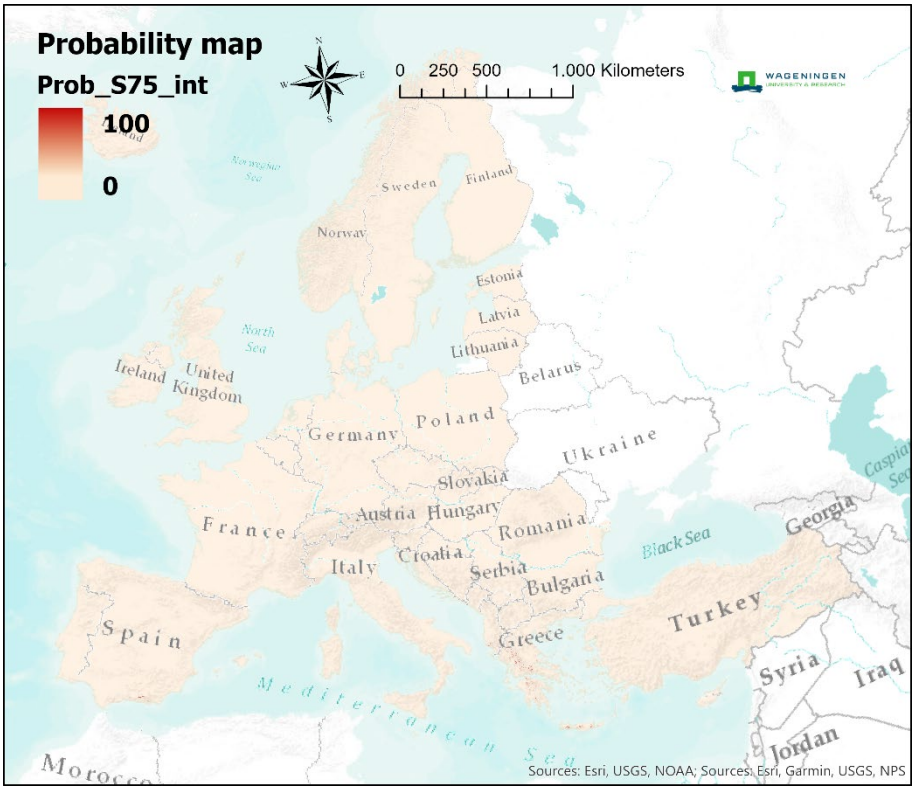


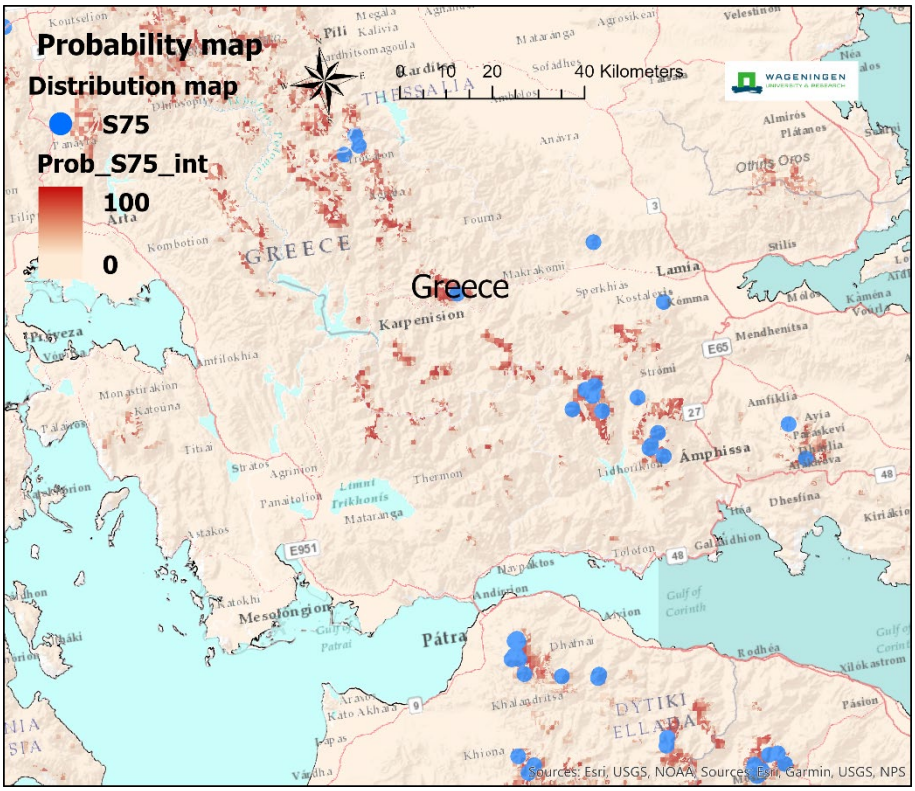

Probability map
Distribution map
S74
Prob_S74_int
100
0
0 5 10 20 Kilometers
WAGENINGEN
L'Île-Rousse
Belgodere
Ponte-Leccia
Vescovato
Cervione
Piana
Porto
Evisa
France
Venaco
Ambiegna
Bocognano
Bastelica
CORSE
Ghisonaccia
Aleria
Ajaccio
Sources: Esri, USGS, NOAA; Sources: Esri, Garmin, USGS, NPS

S75 – [F74c] Eastern Mediterranean mountain hedgehog-heath

Heath of often spiny hedgehog sub-shrubs on mostly base-rich soils in dry mountains of the supra- and oromediterranean belts of the east Mediterranean. Downslope expansion below the timberline can follow clearance and grazing.

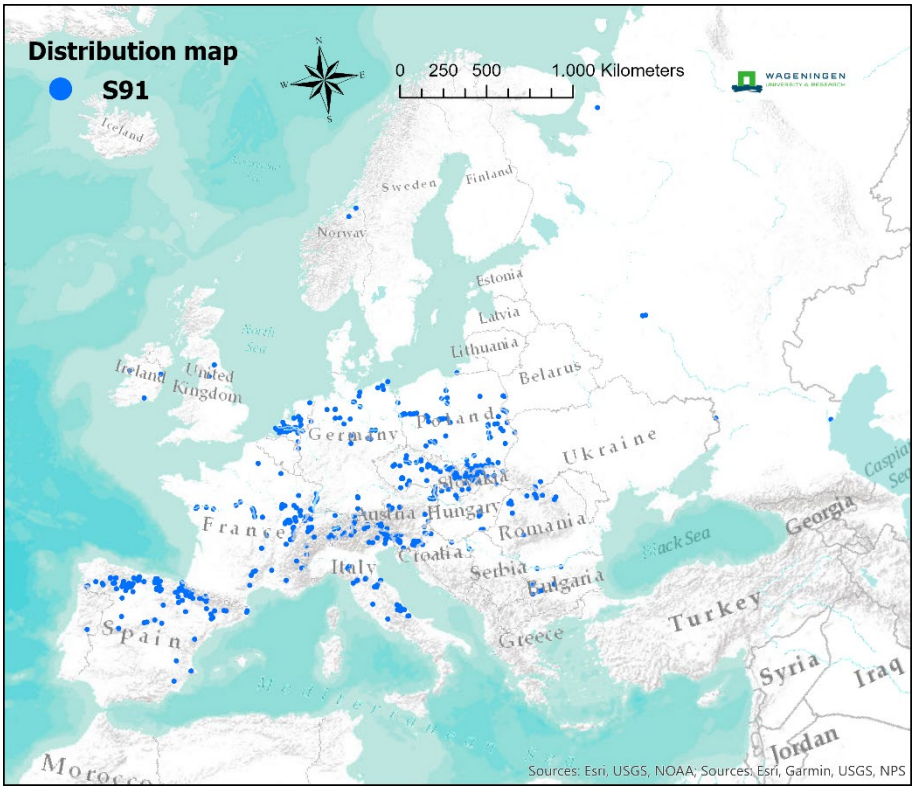


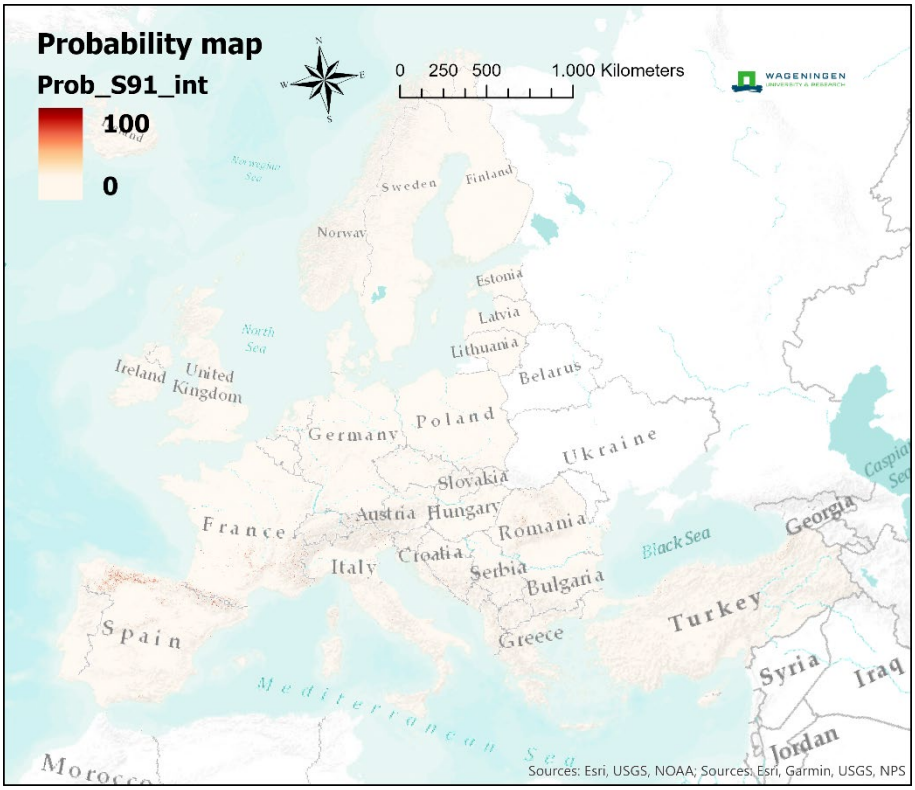


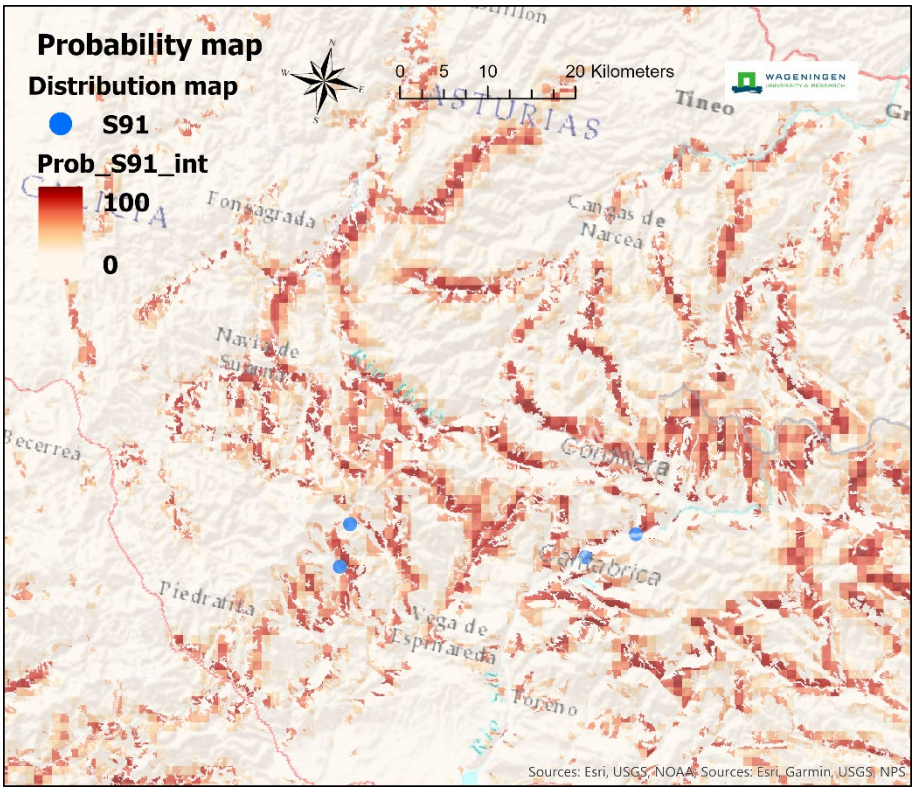

Probability map
Distribution map
S75
Prob_S75_int
100
0
0 10 20 40 Kilometers
Greece
GREECE
Sources: Esri, USGS, NOAA, Sources: Esri, Garmin, USGS, NPS

S91 – [F91] Temperate riparian scrub

Scrub of Salix spp. and Myricaria germanica developed on the mineral sediments of shoals and banks of lowland rivers through the temperate zone, re-establishing after seasonal flooding or succeeding to riparian and gallery forest where the sediments stabilise.

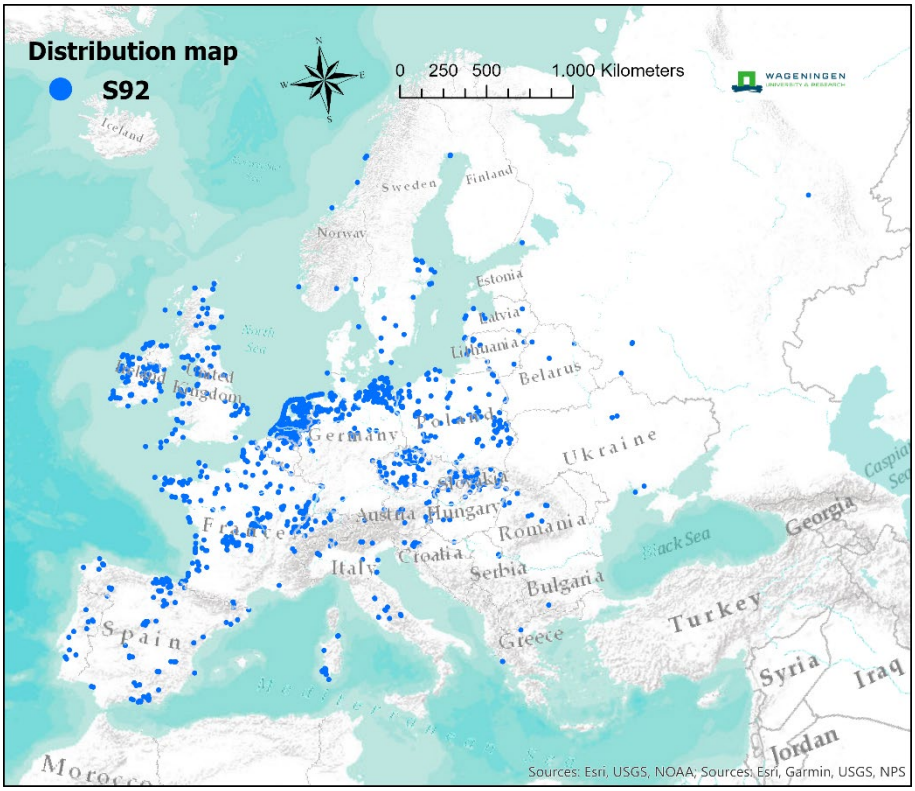


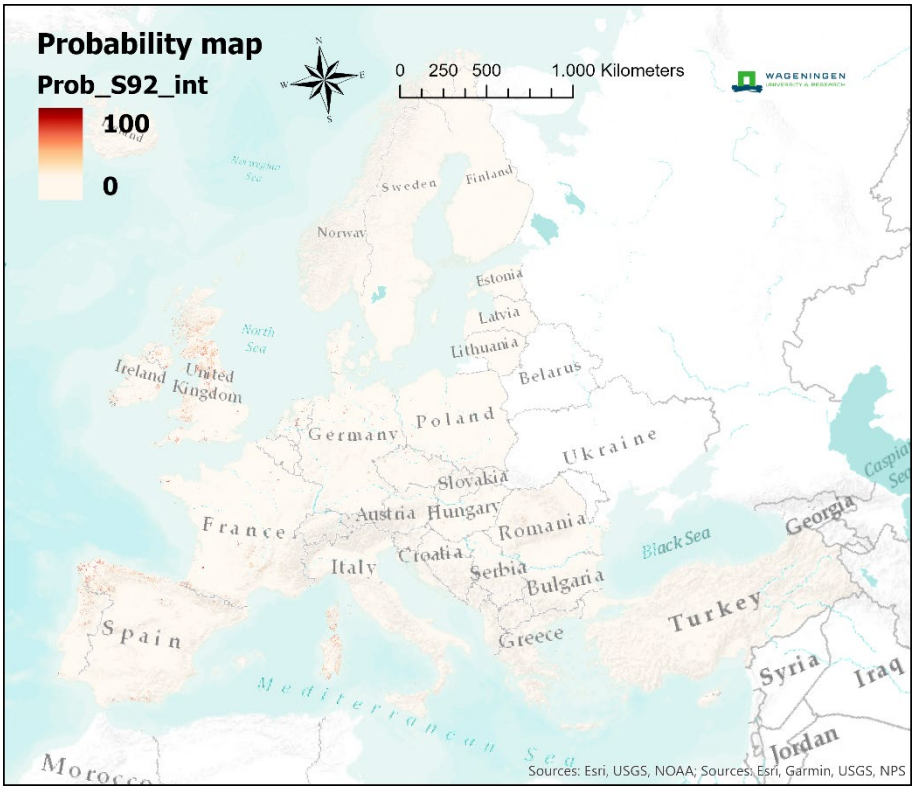


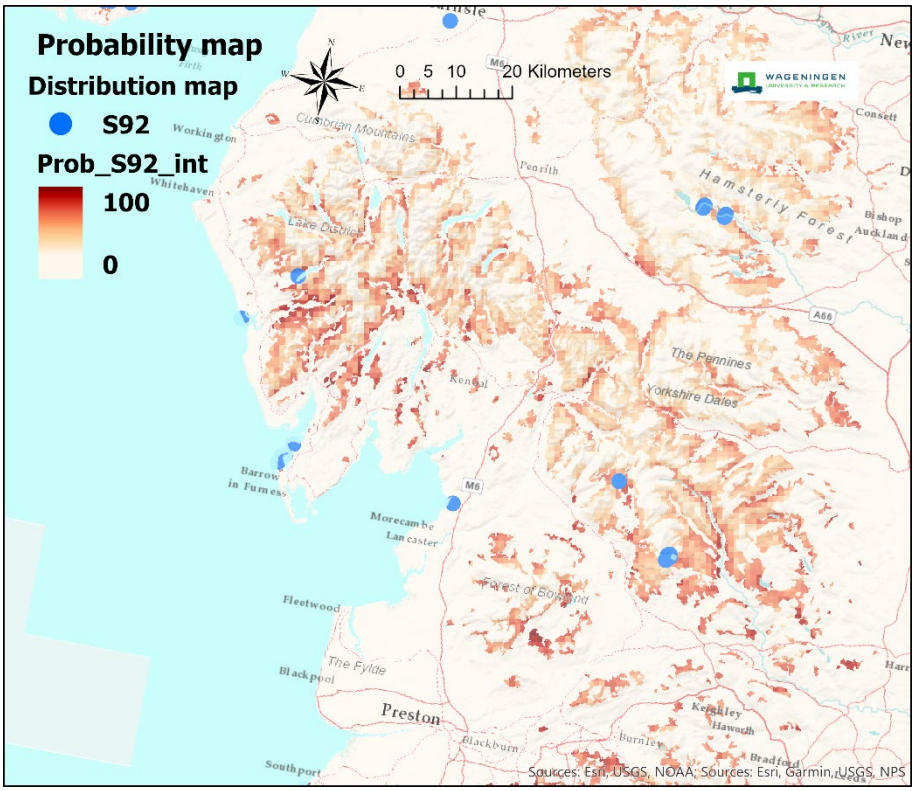

Probability map
Distribution map
S91
Prob_S91_int
100
0
0 5 10 20 Kilometers
WAGENINGEN
ASTURIAS
Tineo
Cangas de Narcea
Fontagrada
Navia de Suarna
Becerrea
Piedrafita
Vega de Espinareda
Folgoso
Sources: Esri, USGS, NOAA, Sources: Esri, Garmin, USGS, NPS

S92 – [F92] Salix fen scrub

Scrub dominated by various Salix spp. on peaty and mineral soils maintained in a permanently waterlogged state by high ground water in floodplain backwaters, around lakes and ponds, among mires and dunes, and in abandoned wet meadows and pastures, occurring through the lowlands of atlantic, boreal and continental Europe and extending into the mediterranean region at higher altitudes.



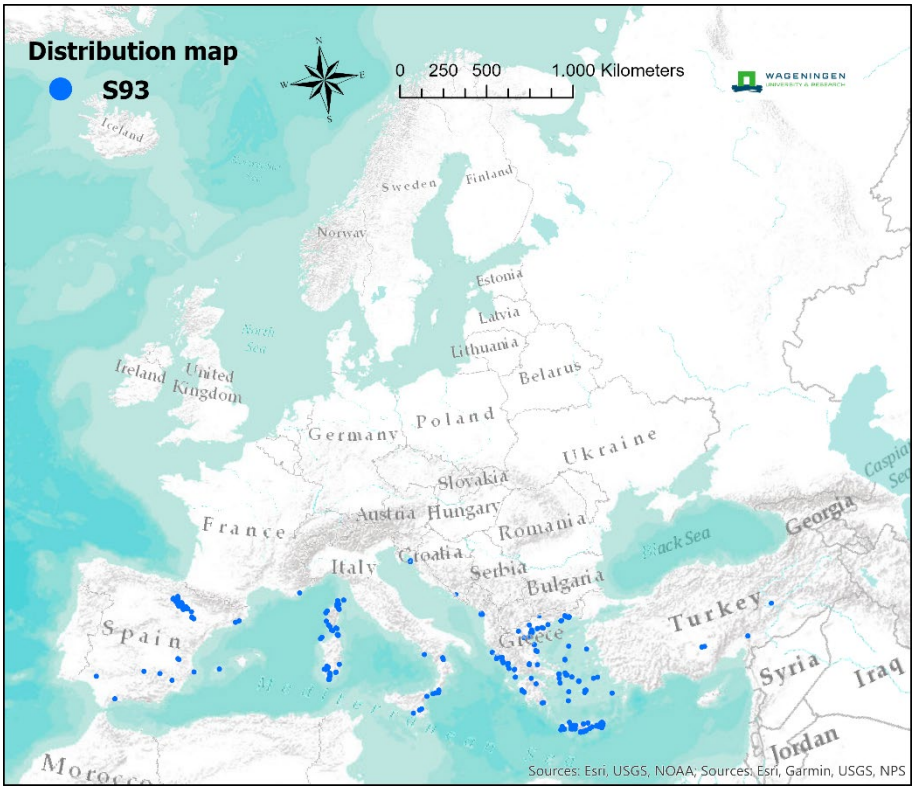


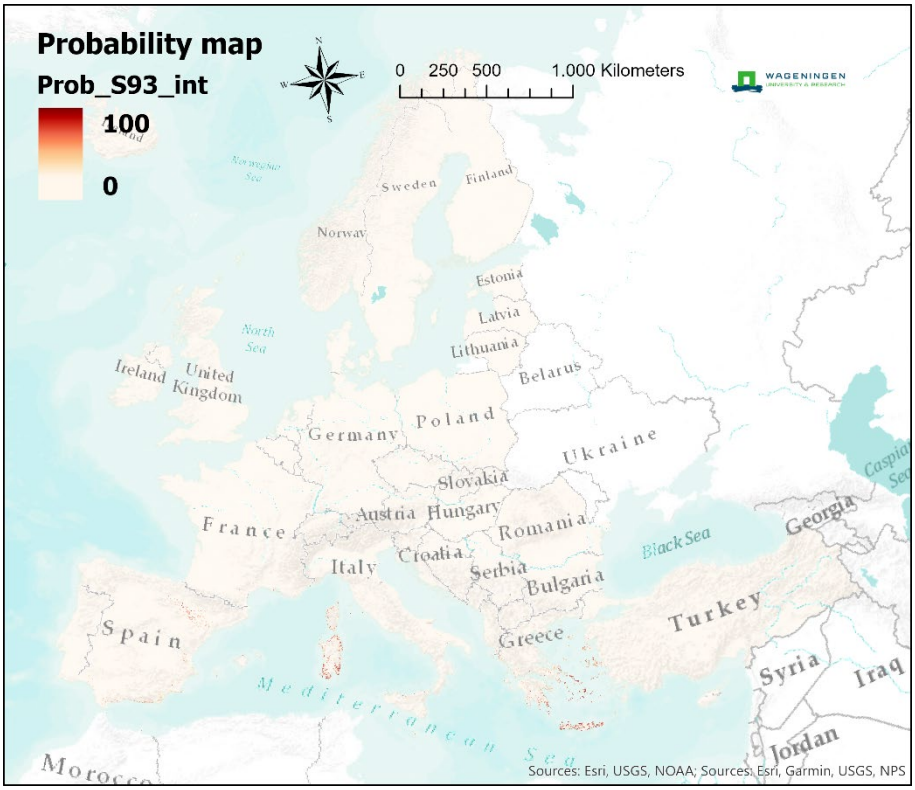


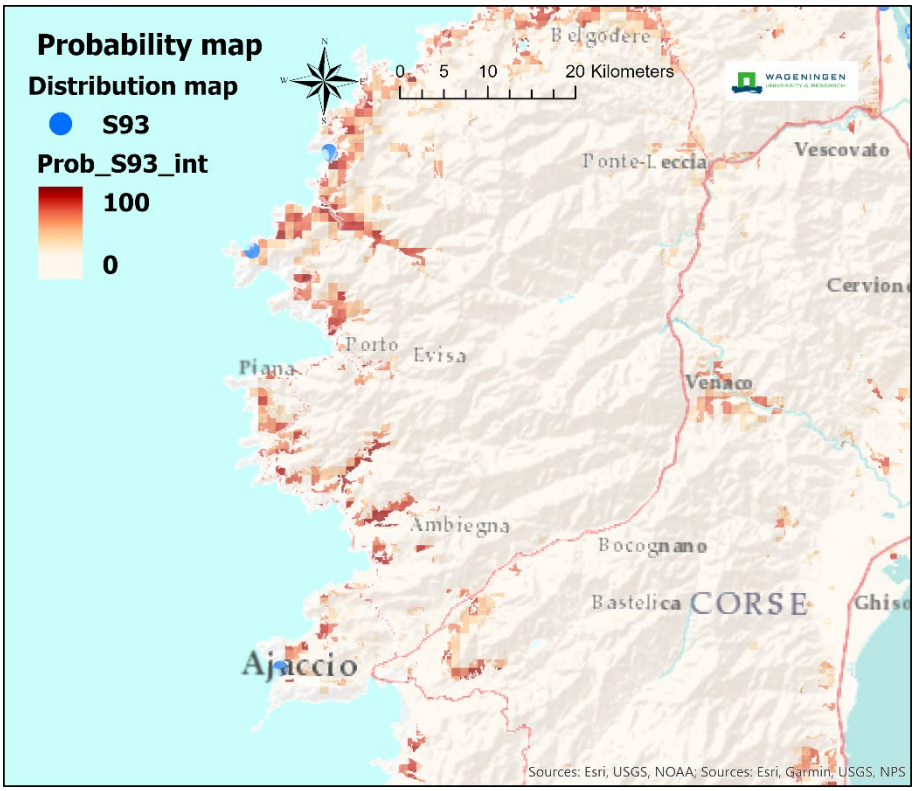
Associated floras vary according to the base status of the ground waters and soils.

S93 – [F93] Mediterranean riparian scrub

Usually open scrub of Tamarix spp., Nerium oleander, Vitex agnus-castus and similar shrubs and small trees on seasonally droughted and irregularly flooded riverbeds, streamsides and depressions through the thermo- and mesomediterranean belts.



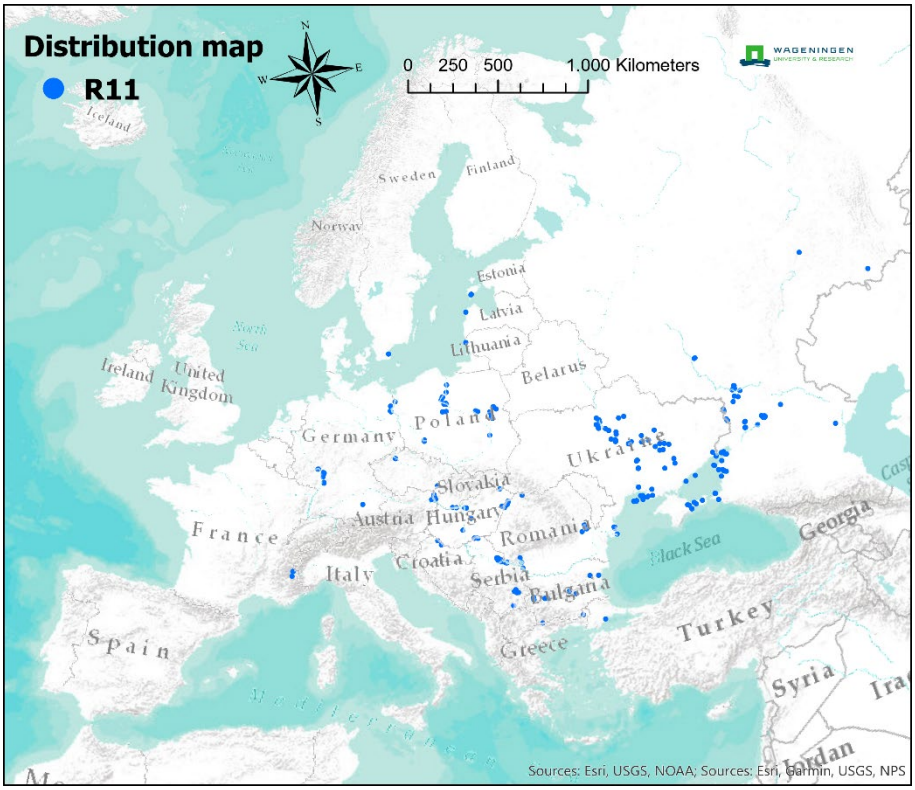


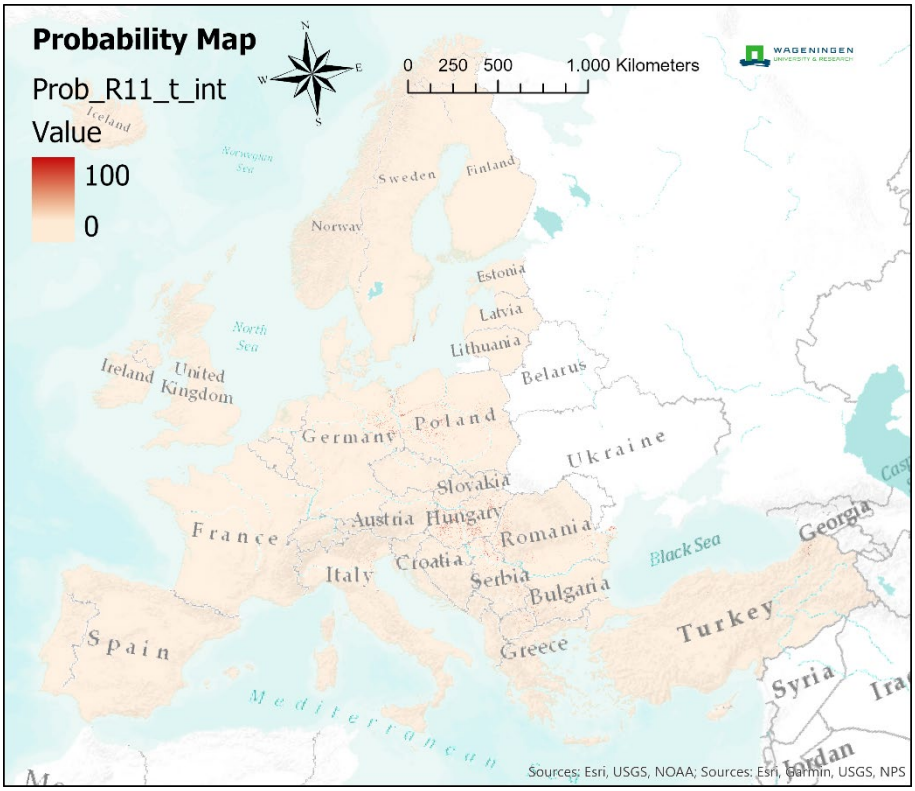

Probability map
Distribution map
S93
Prob_S93_int
100
0
0 5 10 20 Kilometers
WAGENINGEN
Belgodere
Ponte-Leccia
Vescovato
Porto
Evisa
Piana
Venaco
Ambiegna
Bocognano
Bastelica
CORSE
Ajaccio
Sources: Esri, USGS, NOAA; Sources: Esri, Garmin, USGS, NPS

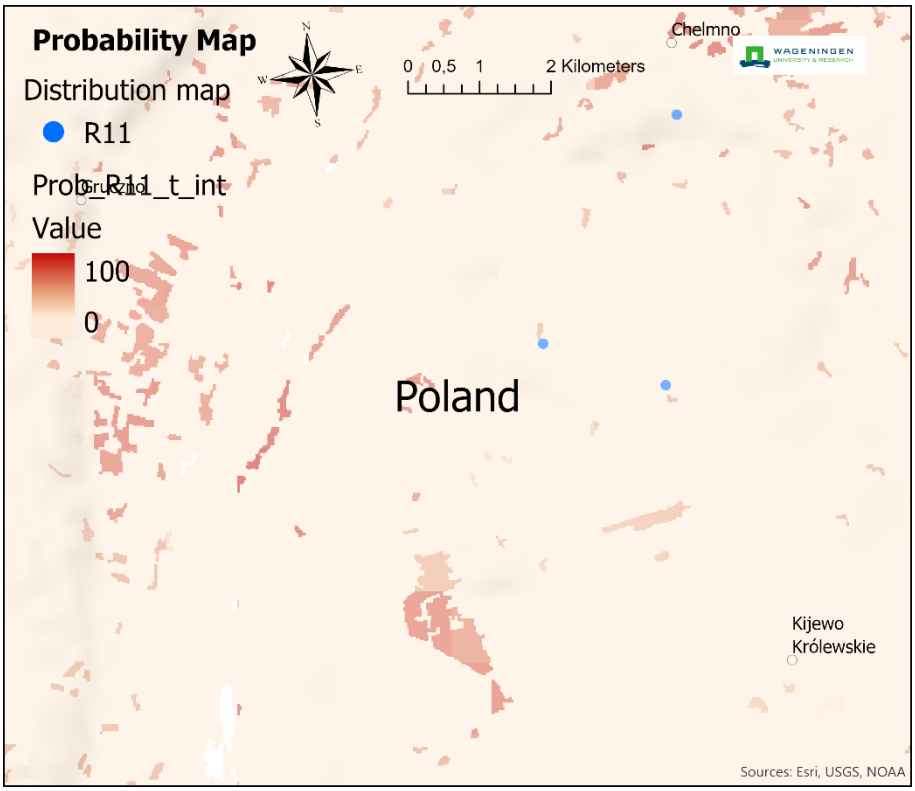
Appendix 3 Grass habitat probability maps

R11 - [E11a] Pannonian and Pontic sandy steppe

Rather open steppe grassland dominated by perennial tussock grasses and herbs, with frequent spring annuals and cryptogams, typical of nutrient-poor, sandy soils on plains and dunes through the Pannonian, Pontic and southern Baltic regions. The climate is strongly continental with cold winters, often with long frosts and shallow snow, and hot, droughty summers. Traditionally used for extensive grazing by stock, particularly sheep, but now widely abandoned.

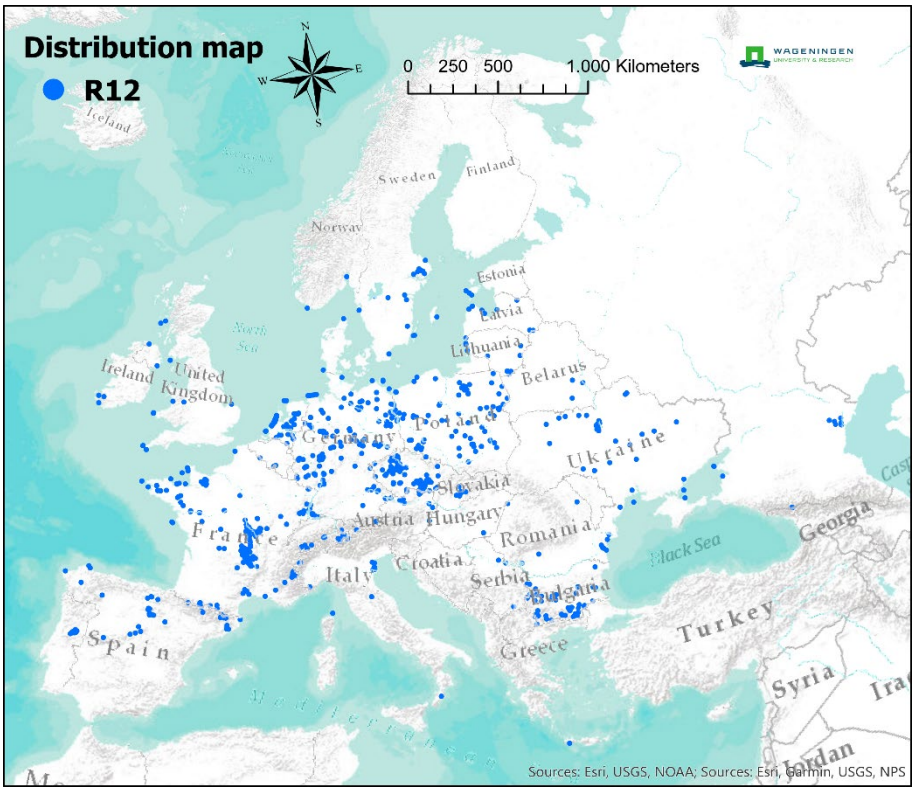


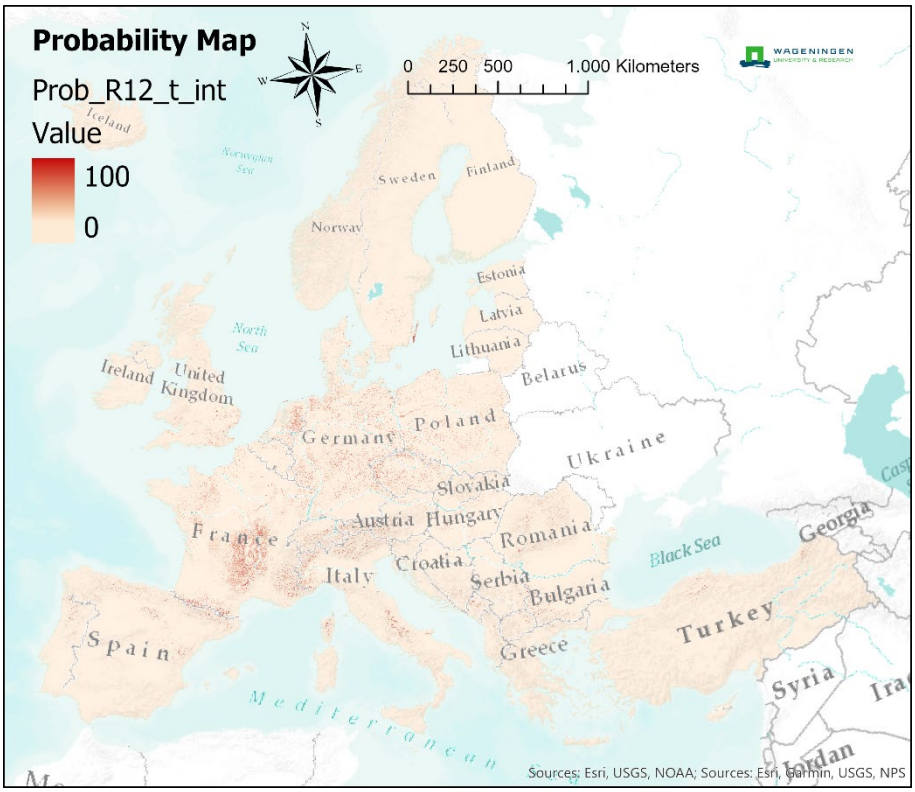


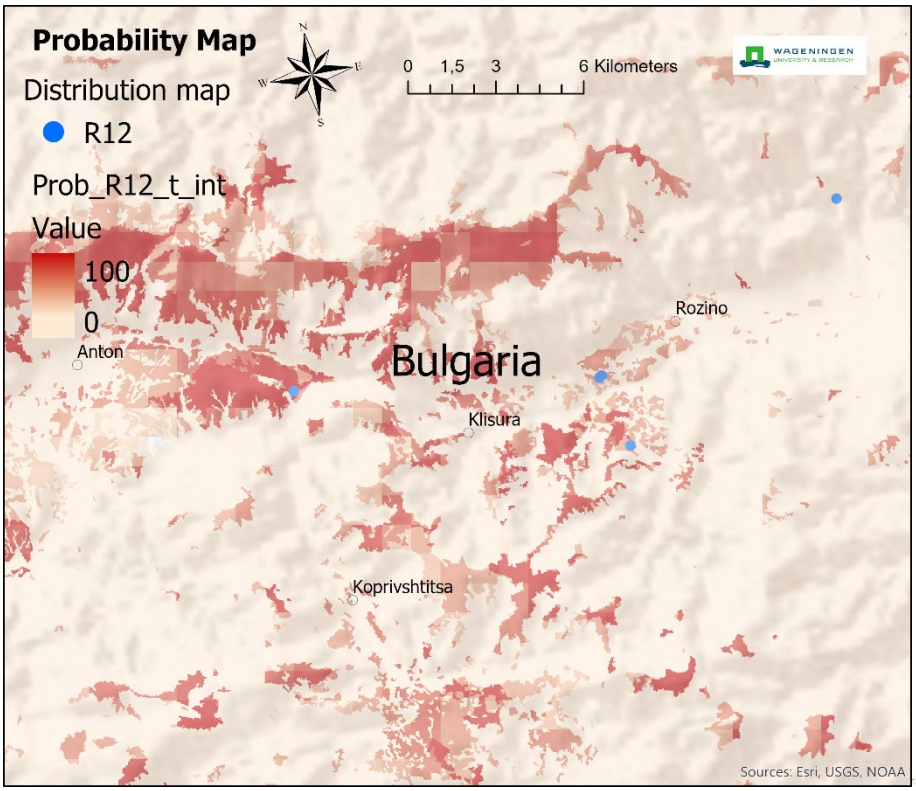

Probability Map
Distribution map
R11
Prob_R11_t_int
Value
100
0
N
W
E
S
0 0,5 1 2 Kilometers
Chelmno
WAGENINGEN
UNIVERSITY & RESEARCH
Poland
Kijewo
Królewskie
Sources: Esri, USGS, NOAA

R12- [E11b] Cryptogam- and annual-dominated vegetation on siliceous rock outcrops

Open pioneer grassland dominated by perennial succulents and annuals, with subordinate small tussock grasses, sometimes geophytes and often a prominent contingent of cryptogams.



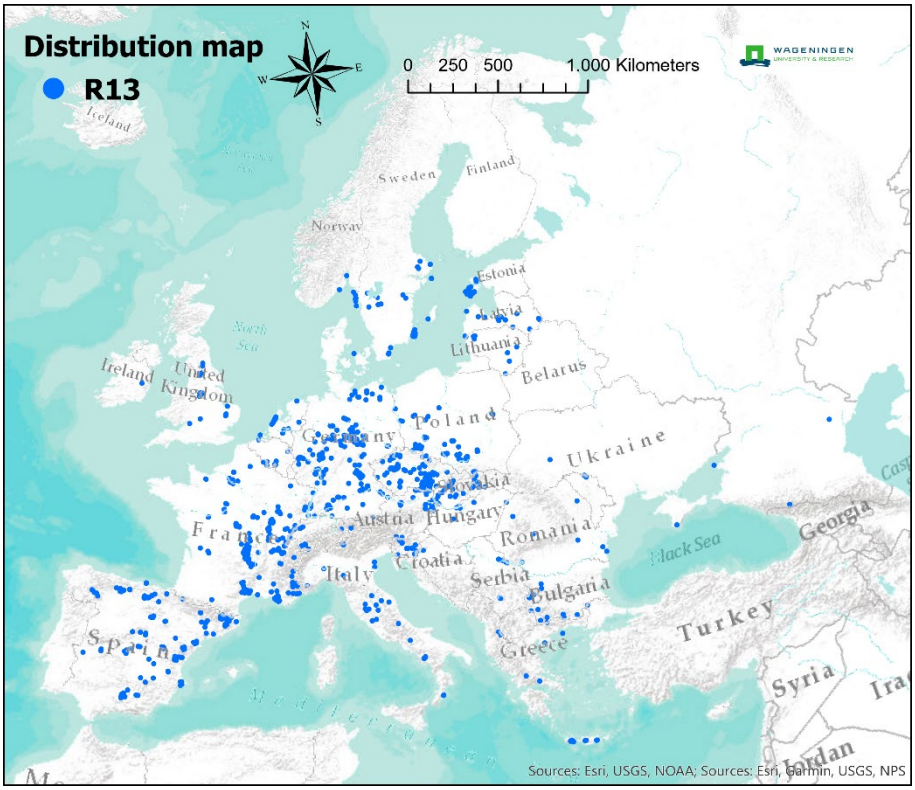


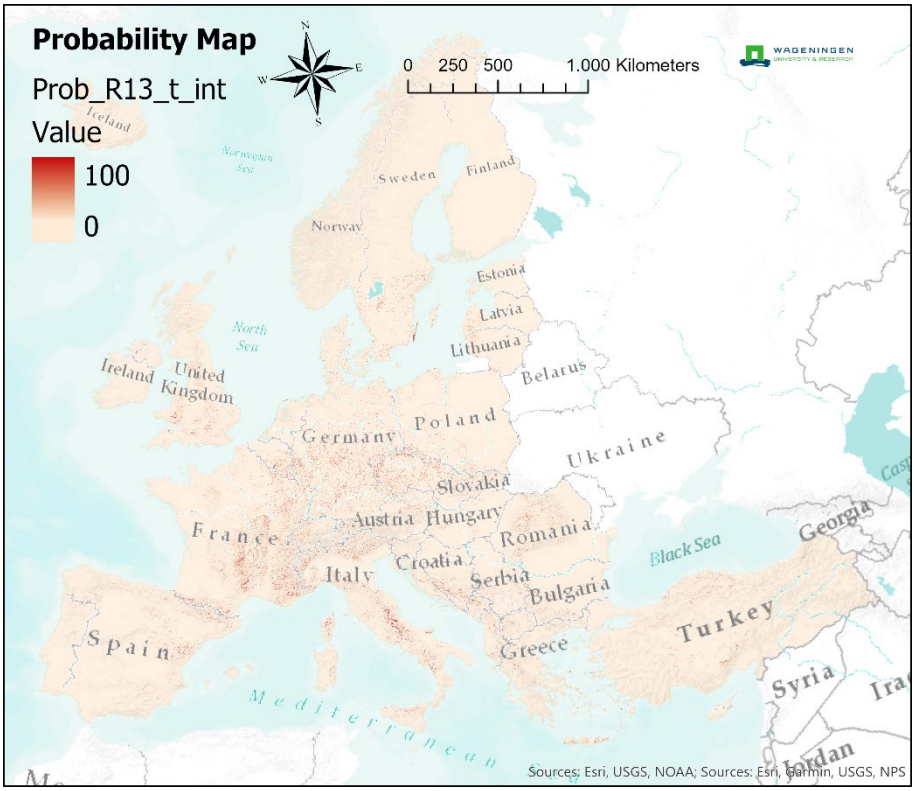


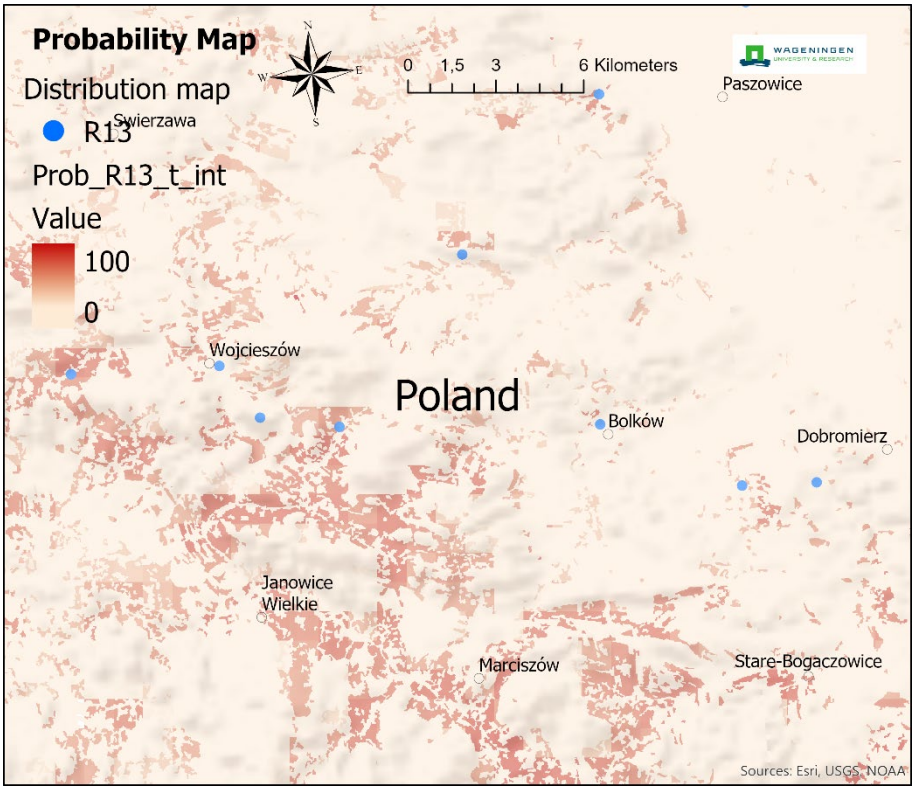
Typically forming small stands on very shallow and skeletal, impoverished, acid soils on siliceous rock outcrops, eroded slopes and disturbed or artificial habitats like soil heaps and wall tops, the habitat occurs throughout temperate and boreal Europe up to the sub-alpine level, in situations where the permeable soils dry quickly in summer, but where spring rains can permit a quick flush of growth by the annuals.

R13 - [E11d] Cryptogam- and annual-dominated vegetation on calcareous and ultramafic rock outcrops

Open pioneer grassland with perennial succulents and spring annuals, subordinate small tussock grasses and herbs, and often with a very prominent and rich contingent of cryptogams. Typically found in small patches on very shallow and skeletal, impoverished, base-rich soils on a wide variety of base-rich and sometimes ultramafic bedrocks, and similar artificial habitats like quarry spoil and wall-tops.



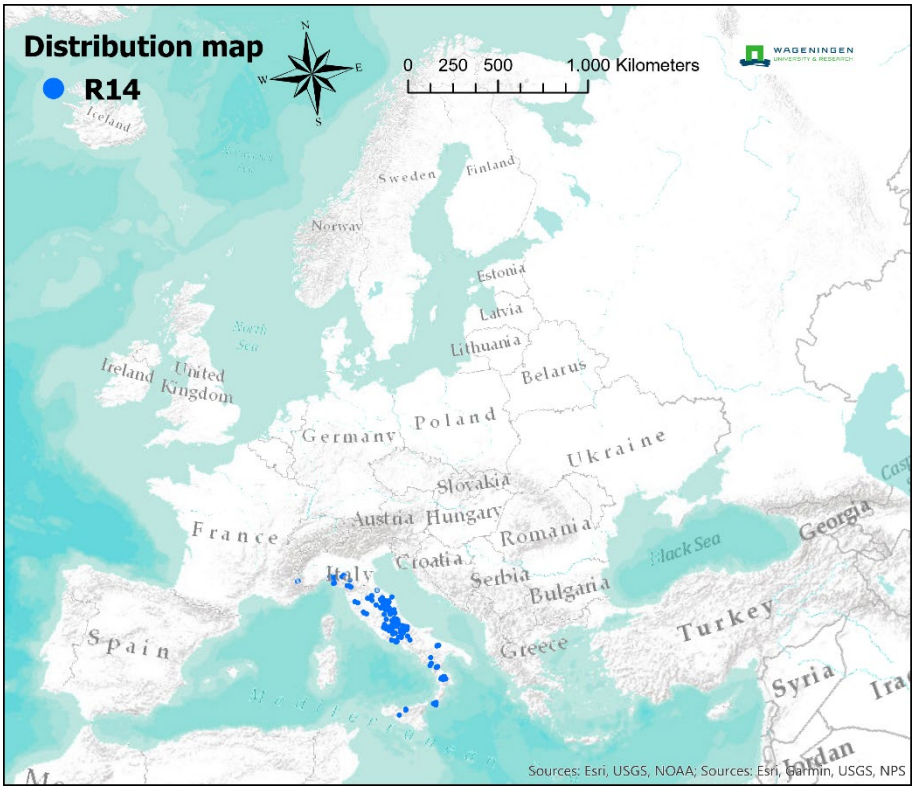


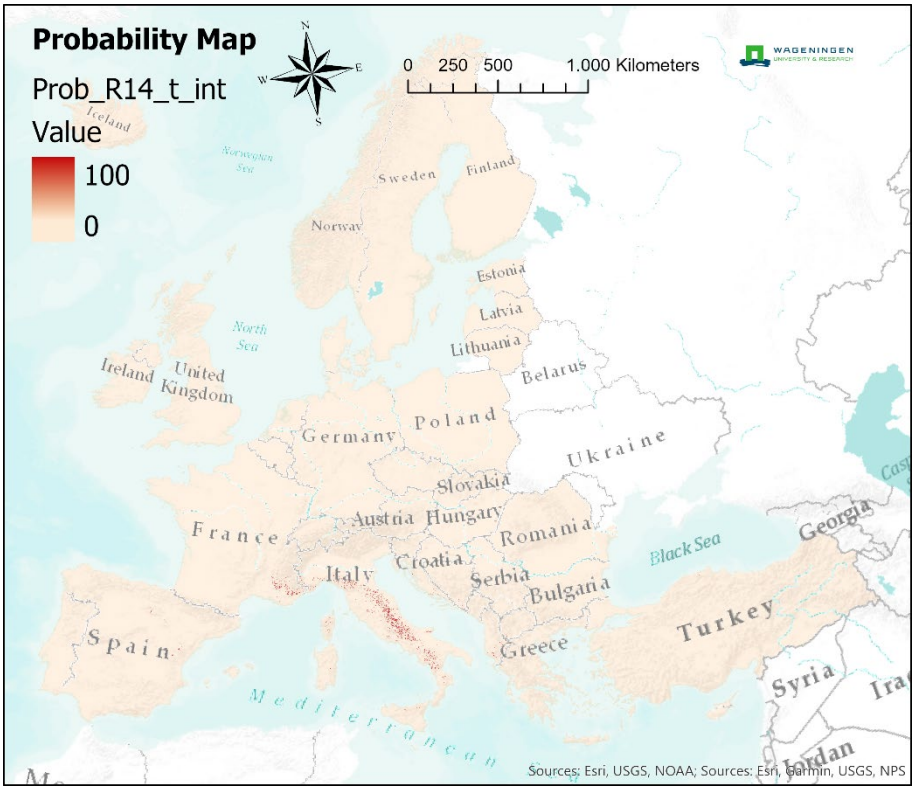


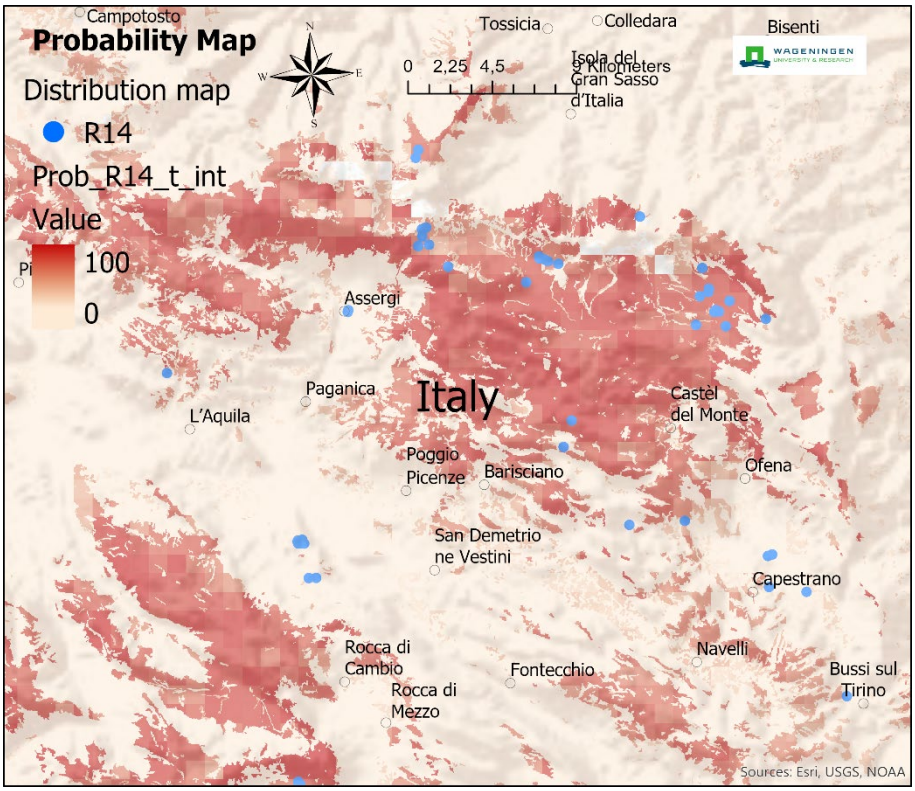
It is found from the hemiboreal to the submediterranean, occurring mainly at higher altitudes further south.

R14 - [E11e] Perennial rocky grassland of the Italian Peninsula

Unique to base-rich bedrocks in the Italian Peninsula (and maybe Sicily) and best developed within the submediterranean bioclimatic zone, this grassland is variously dominated by perennial grasses and herbs, or mat formers and sub-shrubs on steeper, rockier ground.



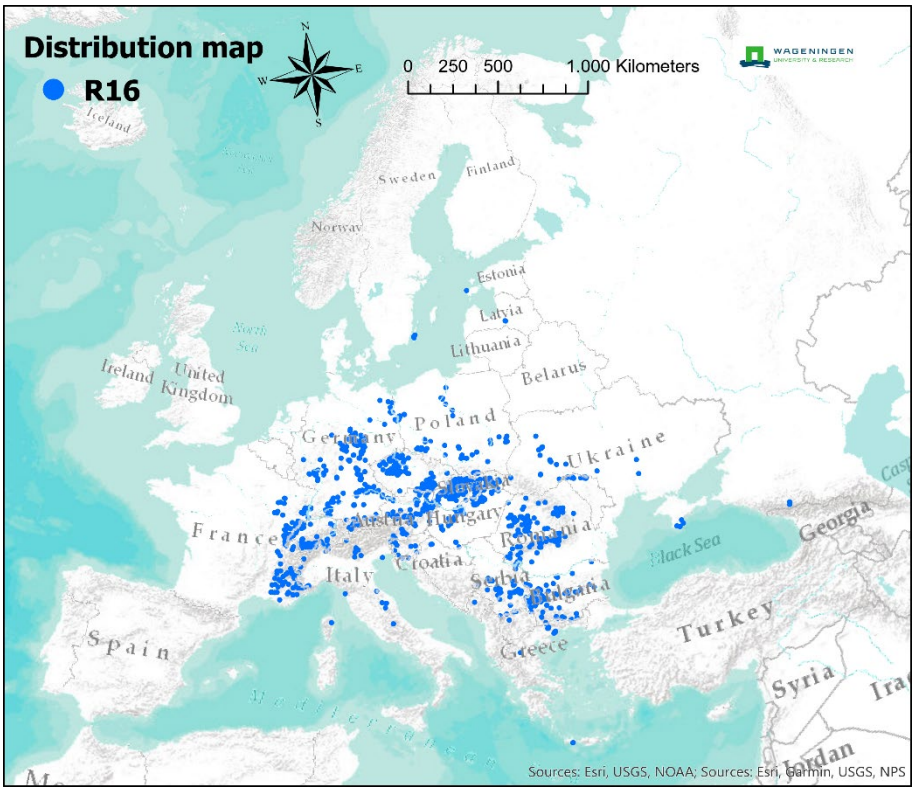


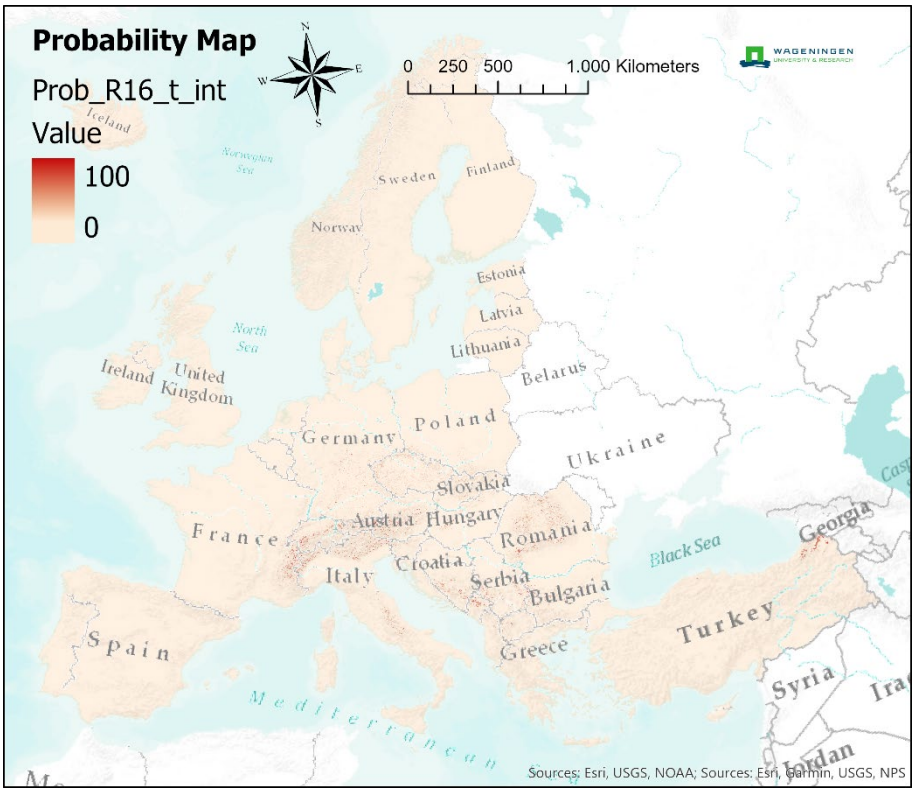


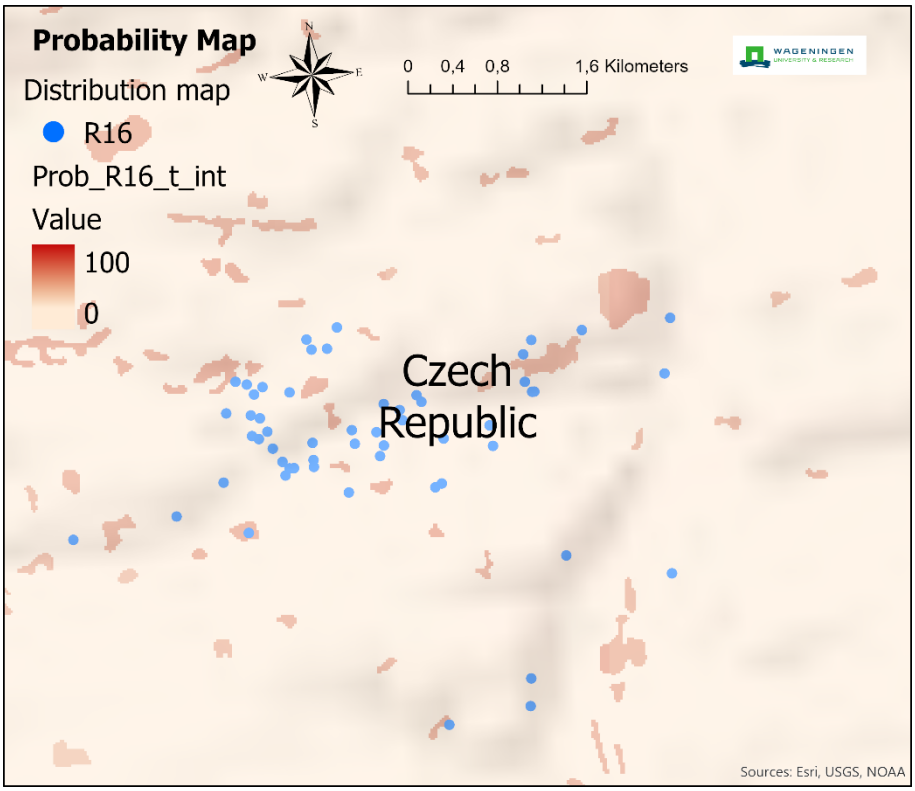
Generally species-rich, and sometimes with contingents of annuals and, in disturbed places, geophytes, the habitat sometimes hosts endemic plants. Developed through clearance of broadleaved and mixed forest it is maintained by traditional grazing in a distinctive cultural landscape.

R16 – [E11g] Perennial rocky grassland of Central and South-Eastern Europe

Open grassland generally dominated by perennial grasses with rich mixtures of associated rosette herbs, mat-formers and geophytes, and towards southern Europe especially, annuals.



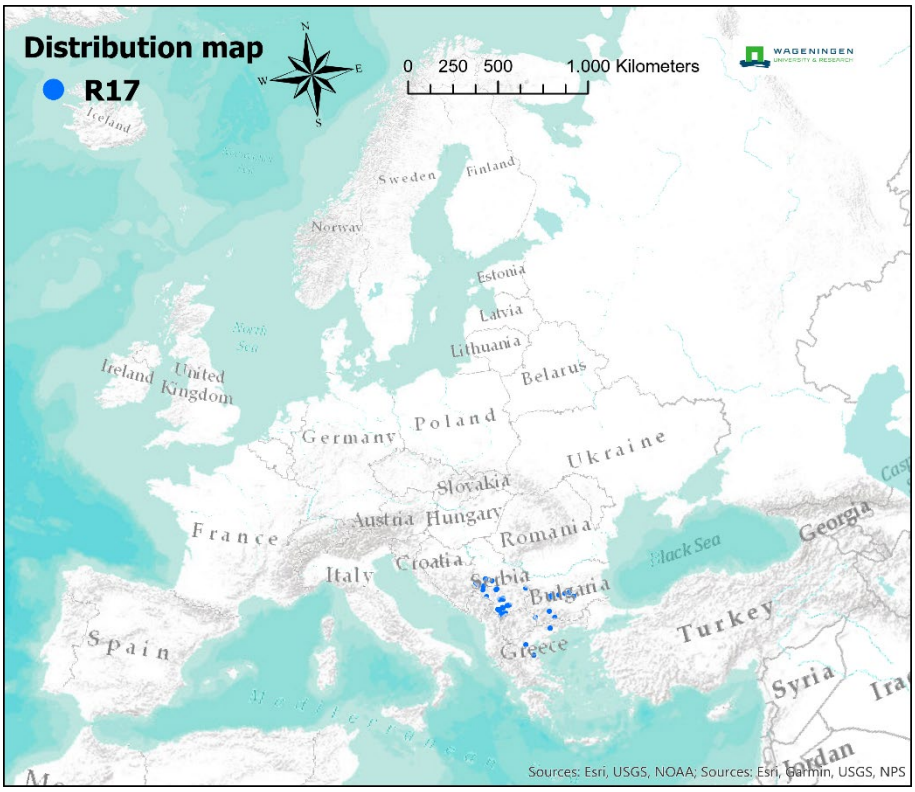


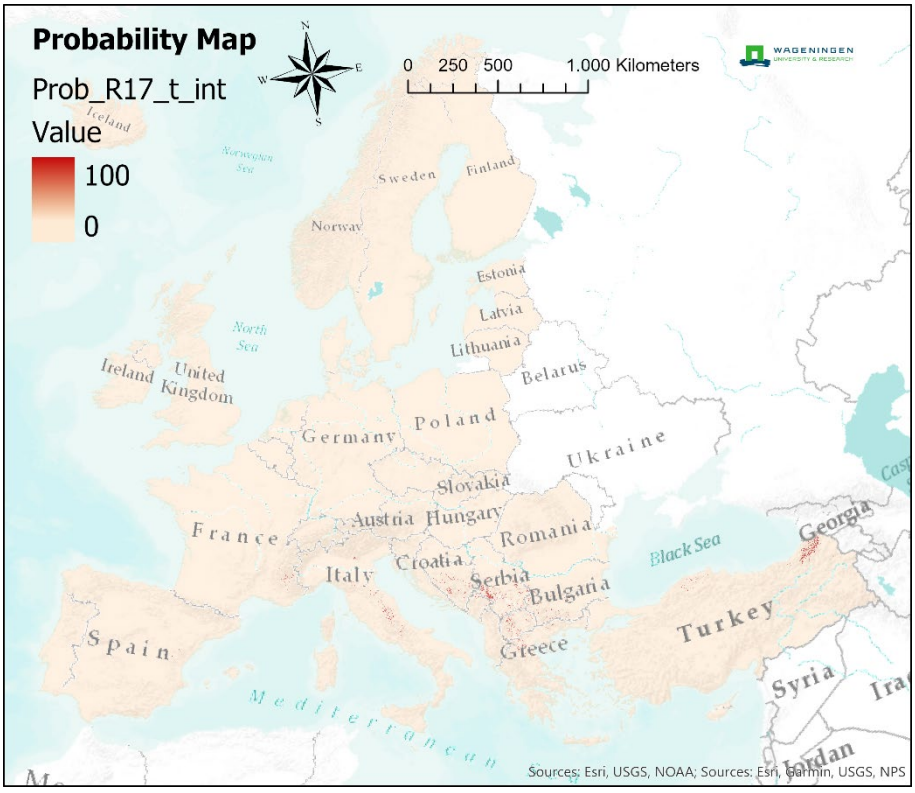


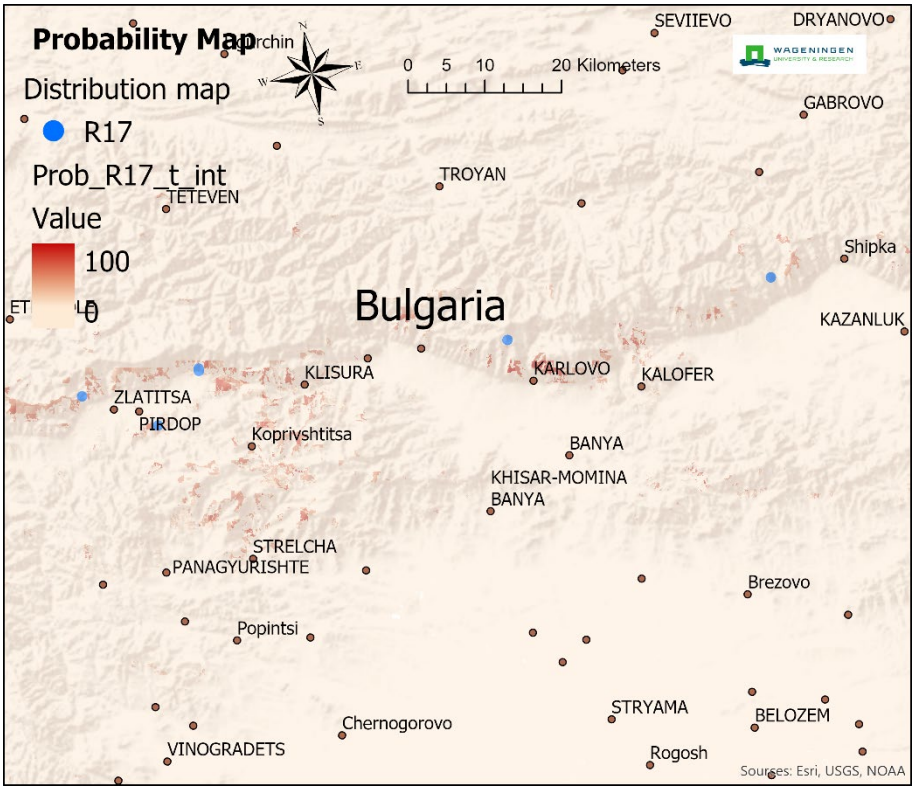
It occurs on shallow, impoverished soils over both calcareous and siliceous bedrocks, through the lowlands and submontane zone of central and southern Europe, best developed on steeper ground uncongenial for agriculture, but extended where forest clearance and grazing, particularly by goats, have been part of traditional farming.

R17 – [E11h] Heavy-metal dry grassland of the Balkans

Grassland confined to droughty, nutrient-poor soils rich in heavy metals derived from ultramafic rocks in the mountains of the Balkans and Cyprus with an open cover of grasses and forbs, including many endemics.

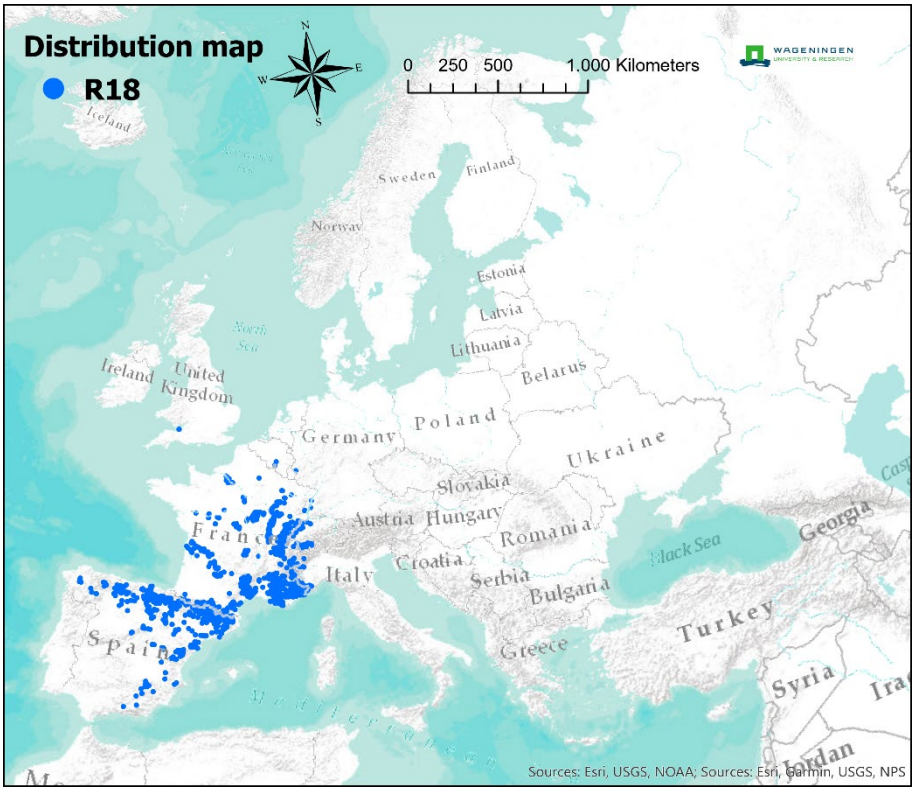


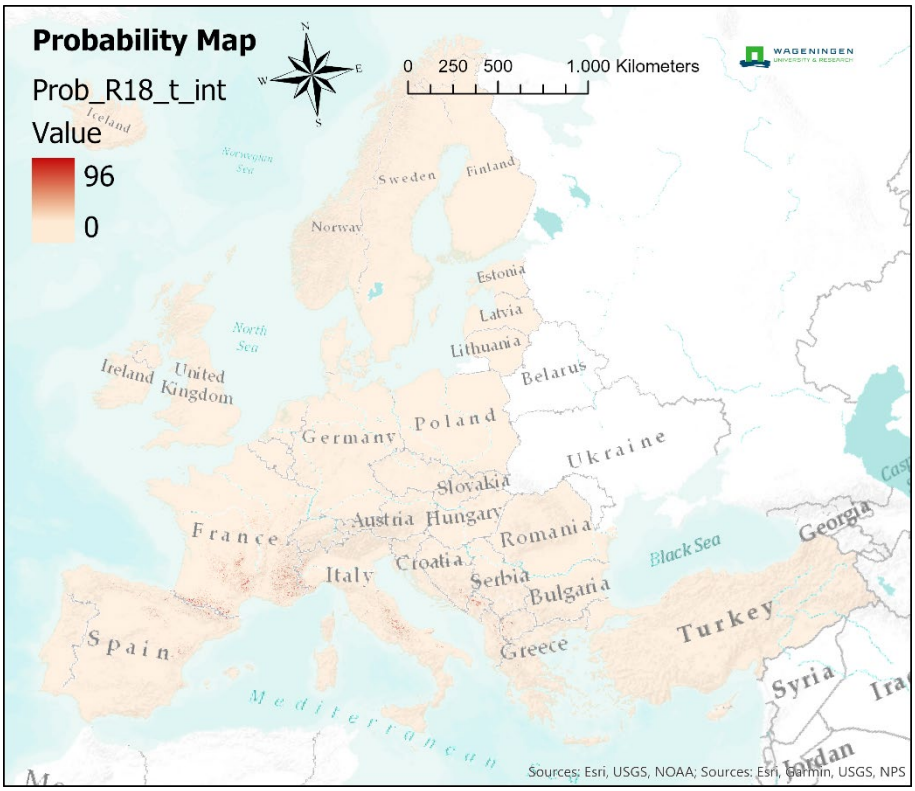


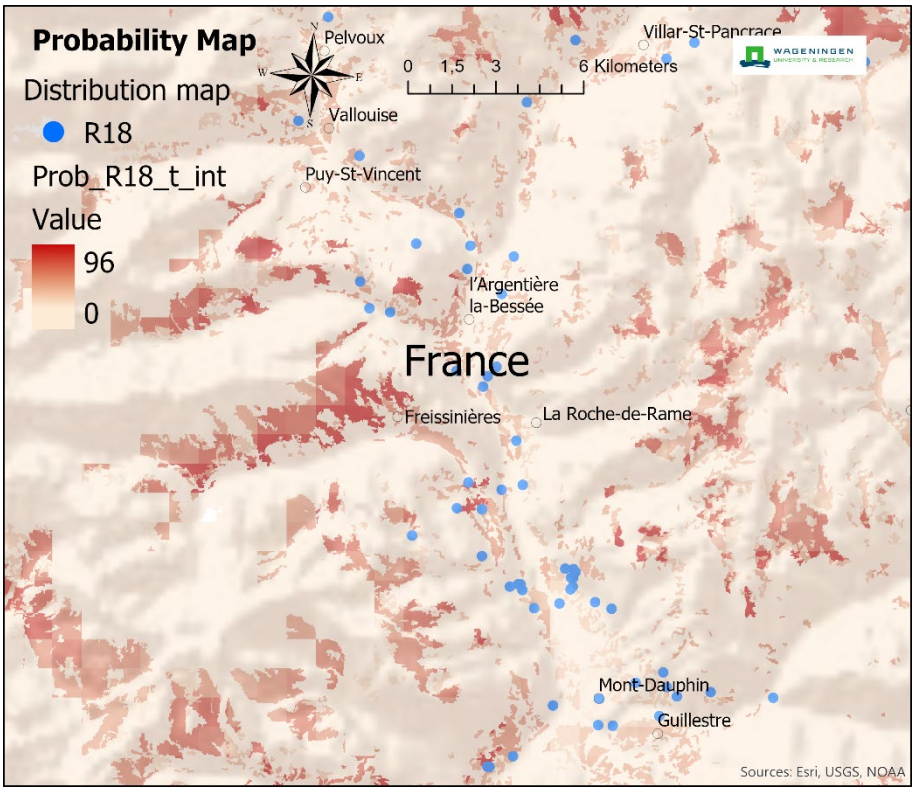

Probability Map
Distribution map
R17
Prob_R17_t_int
Value
100
0
Bulgaria
SEVIIEVO
DRYANOVO
GABROVO
TROYAN
TETEVEN
Shipka
KAZANLUK
KLISURA
KARLOVO
KALOFER
ZLATITSA
PIRDOP
Koprivshtitsa
BANYA
KHISAR-MOMINA
BANYA
STRELCHA
PANAGYURISHTE
Brezovo
Popintsi
STRYAMA
BELOZEM
Chernogorovo
VINOGRADETS
Rogosh
0 5 10 20 Kilometers
Sources: Esri, USGS, NOAA

R18 - [E11i] Perennial rocky calcareous grassland of subatlantic-submediterranean Europe

Open grasslands, dominated by perennials and especially rich in mat-formers, typical of rudimentary, shallow, nutrient-poor, base-rich soils over sloping, rubbly limestone terrain through the lowland to sub-montane levels in subatlantic and submediterranean Europe where traditionally maintained by extensive grazing.

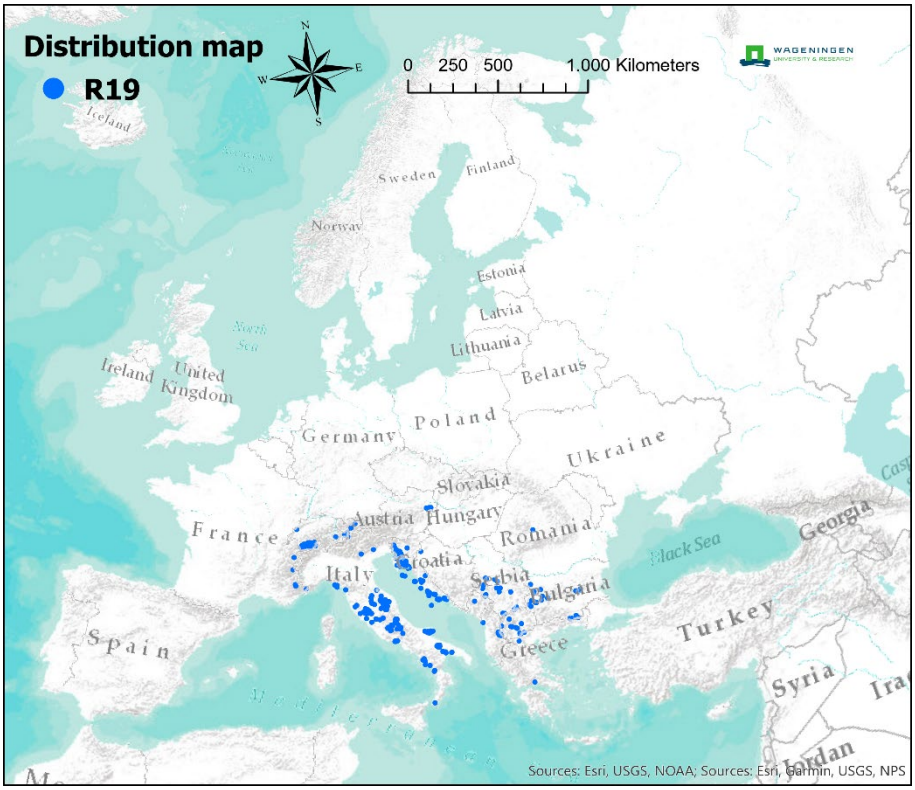


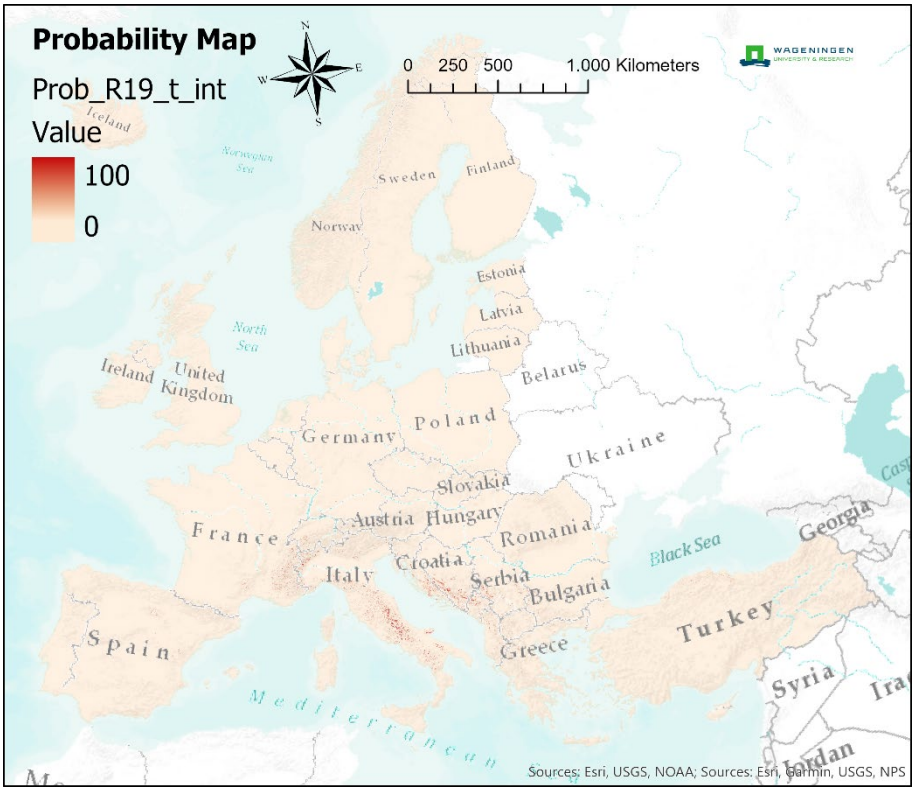


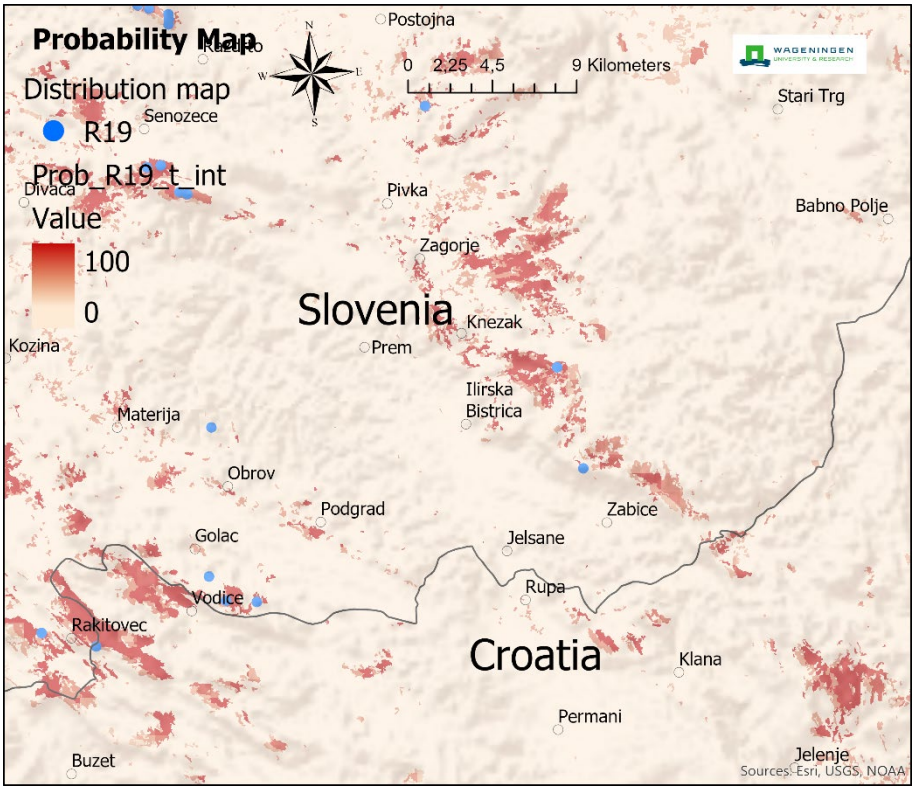

Probability Map
Distribution map
R18
Prob_R18_t_int
Value
96
0
Pelvoux
Vallouise
Puy-St-Vincent
Villar-St-Pancrace
0 1,5 3
6 Kilometers
WAGENINGEN
l'Argentière
la-Bessée
France
Freissinières
La Roche-de-Rame
Mont-Dauphin
Guillestre
Sources: Esri, USGS, NOAA

R19 – [E11j] Dry steppic submediterranean pasture of the Amphi-Adriatic region

Dry steppic pasture typical of sharply-draining, base-rich soils developed over valley sides, dolines and sink-holes around the Adriatic coasts where the submediterranean climate is characterised by late autumn and spring rains and summer drought. Dominated by often rich mixtures of graminoids, forbs and mat-formers, the habitat is dependent on extensive grazing and now often survives patchily among mosaics of scrub and forest.

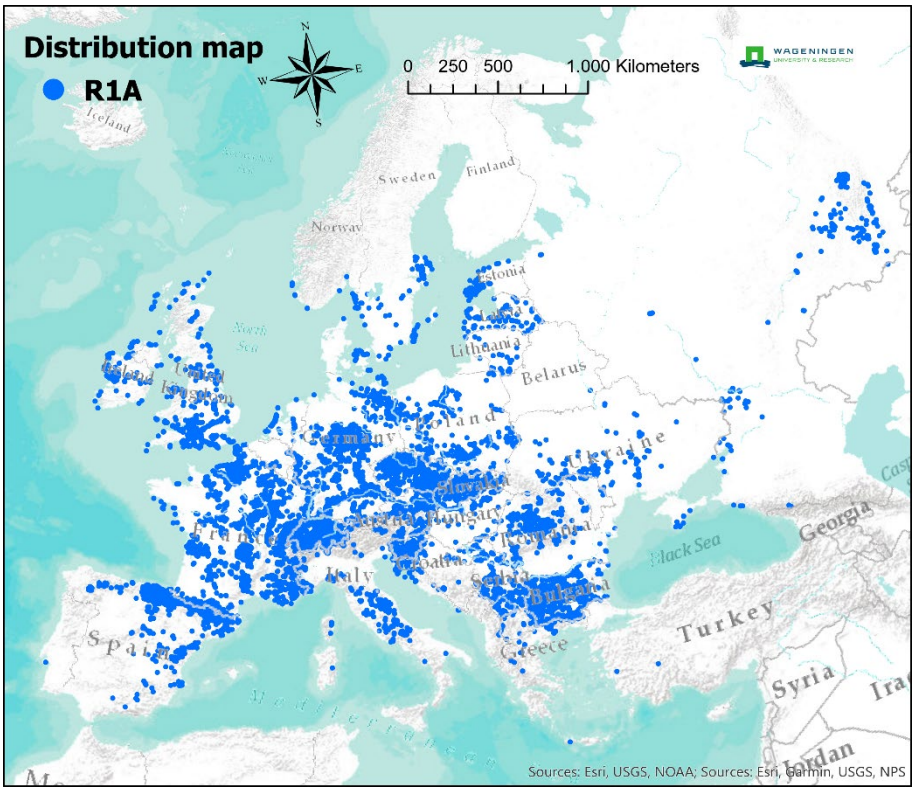


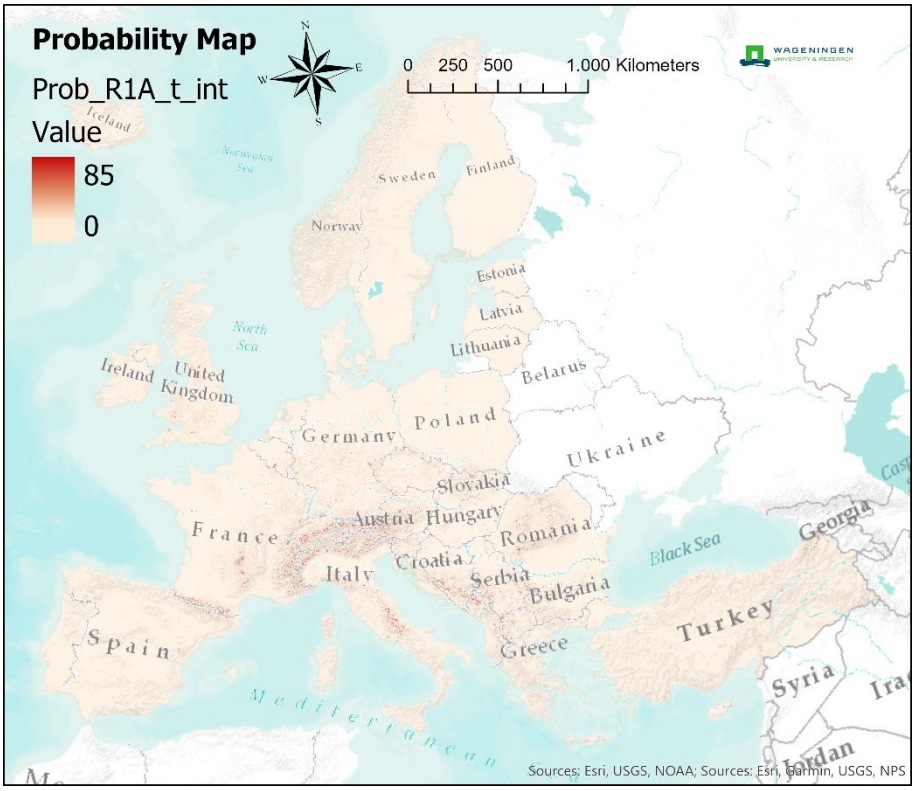


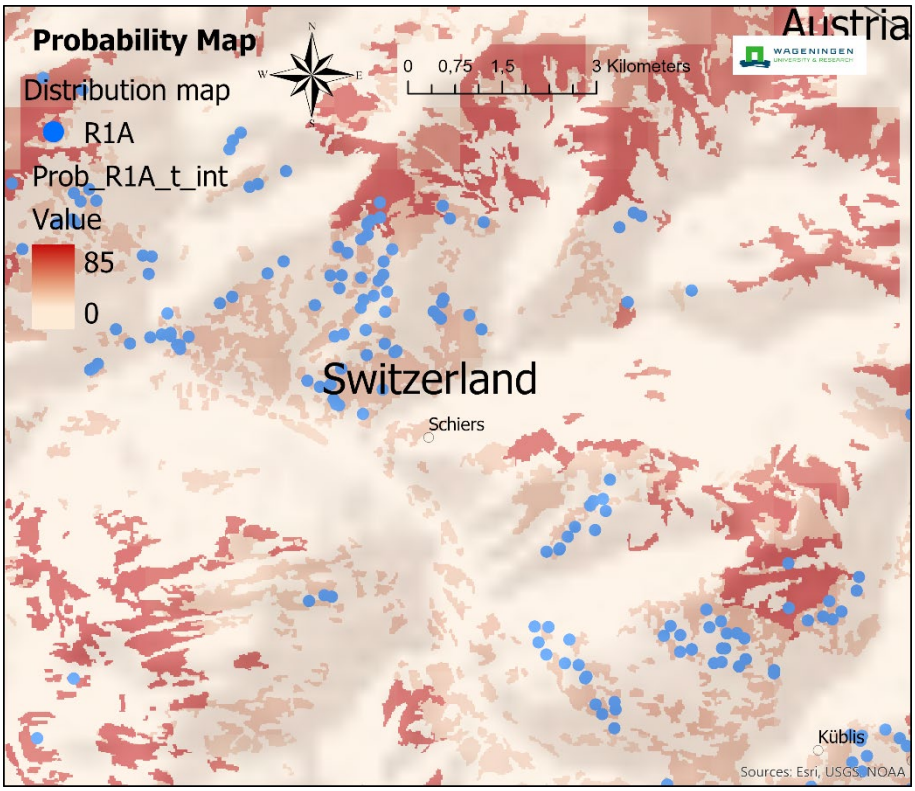

Probability Map
Distribution map
R19
Prob_R19_t_int
Value
100
0
Postojna
Senozece
Divaca
Pivka
Babno Polje
Zagorje
Slovenia
Knezak
Kozina
Prem
Ilirska
Bistrica
Materija
Obrov
Podgrad
Zabice
Golac
Jelsane
Rupa
Vodice
Rakitovec
Croatia
Klana
Permani
Buzet
Jelenje
0 2,25 4,5 9 Kilometers
Stari Trg
Sources: Esri, USGS, NOAA

R1A – [E12a] Semi-dry perennial calcareous grassland (meadow steppe)

Semi-natural grassland on deeper and not so drought-prone, nutrient-poor, base-rich soils over limestones throughout the lowlands and sub-montane levels of submediterranean to hemiboreal Europe.



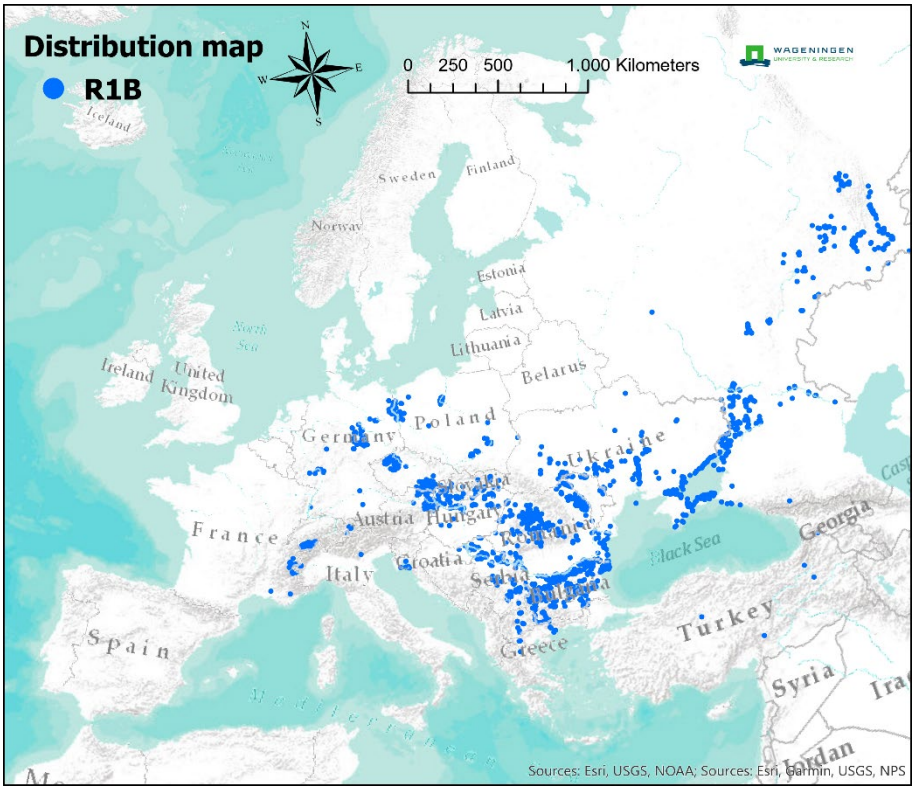


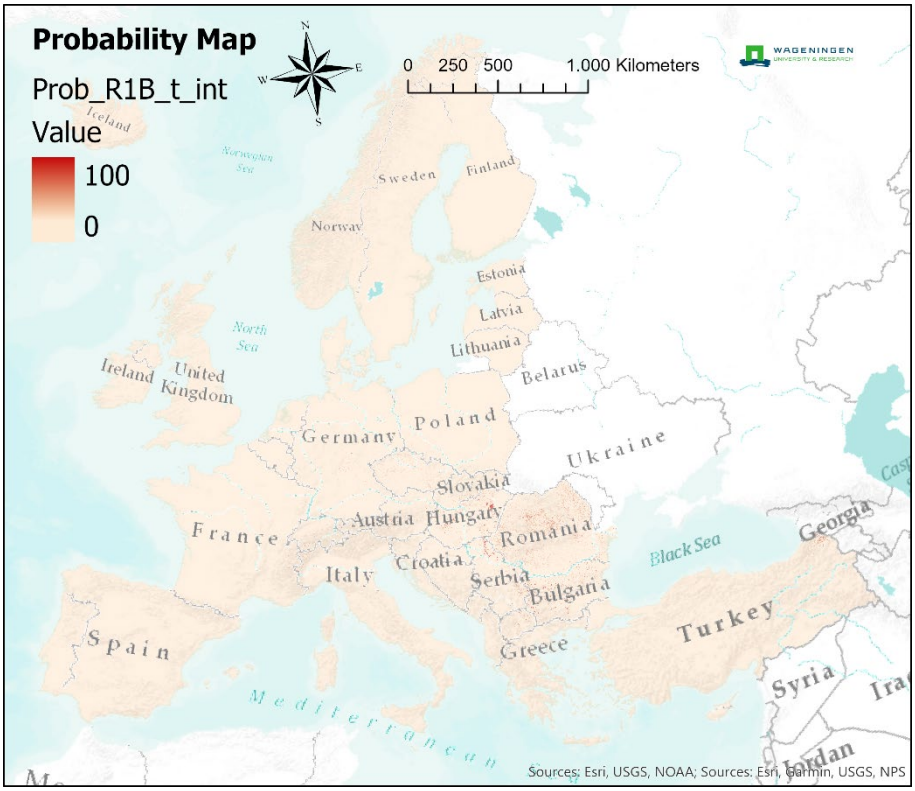


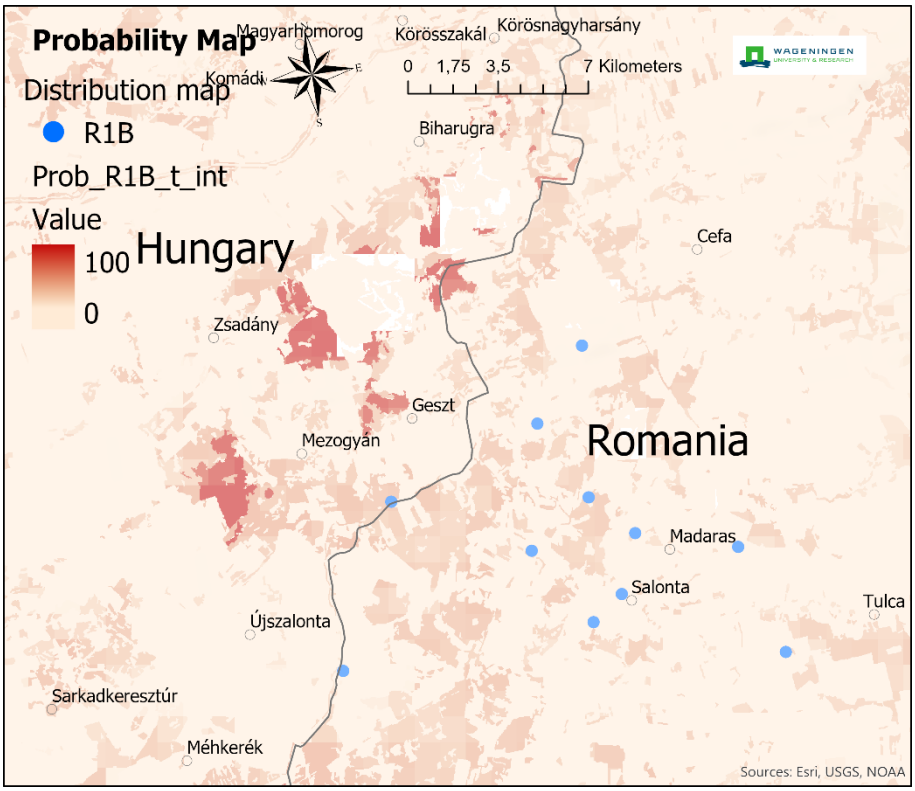
Generally closed and dominated by mixtures of graminoids and forbs, often extremely species-rich, with many rare plants and sometimes striking contingents of orchids and varying much across the large range with different sets of continental or sub-mediterranean companions. Dependent on extensive grazing, usually with sheep, or on an annual mowing, and often developed over centuries of traditional pastoralism, contributing to some striking cultural landscapes.

R1B – [E12b] Continental dry grassland (true steppe)

Steppe and steppe-like grassland on mostly base-rich soils over limestones, of varying depth and stoniness, occurring through the continental lowlands to sub-montane belts of Europe. Dominated by plants adapted to long periods of summer drought, mostly tall tussock grasses and perennial forbs, it shows wide variation in species composition and particular topographic location across the substantial range. In more extreme situations, the grasslands are natural, but they often sustain extensive grazing.

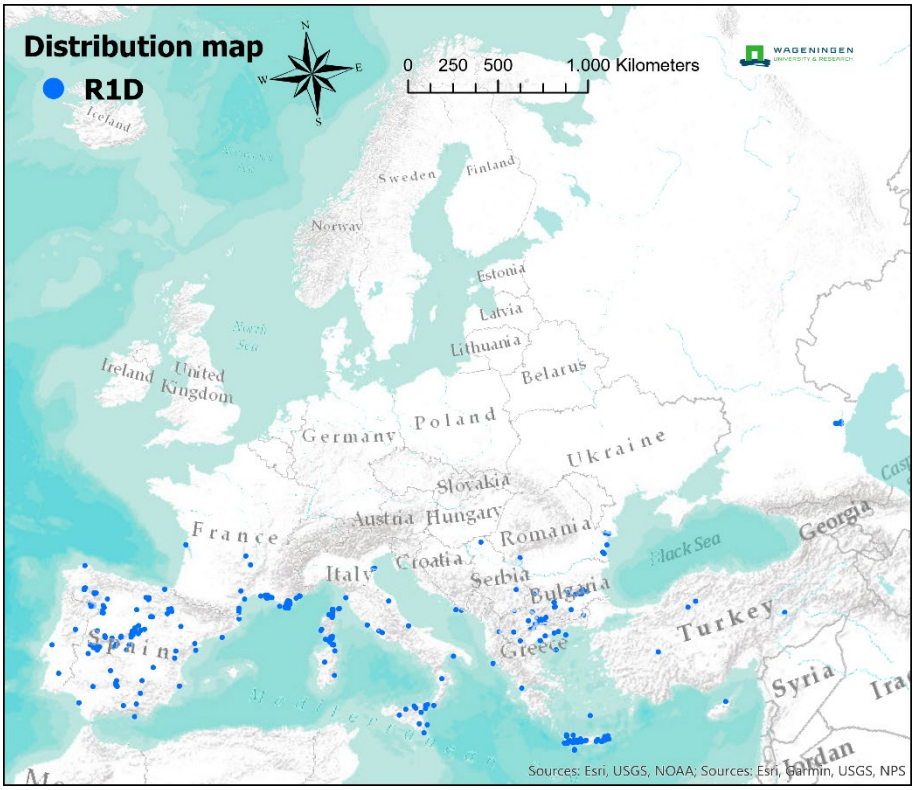


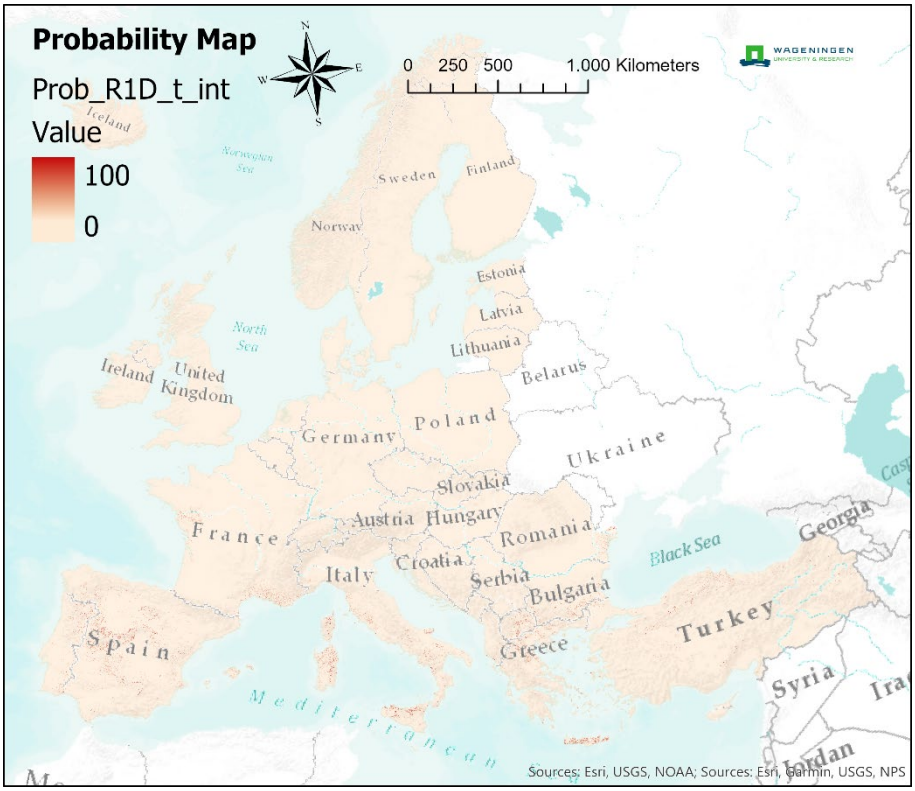


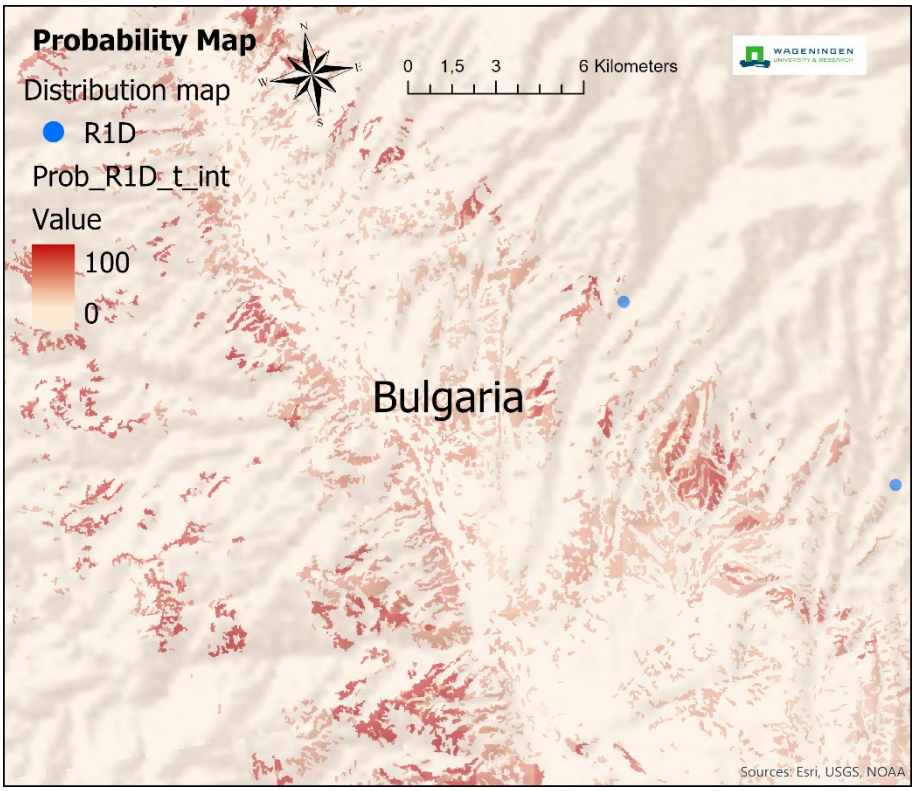

Probability Map
Distribution map
R1B
Prob_R1B_t_int
Value
100
0
Hungary
Romania
Magyarhomorog
Körösszakál
Körösnagyharsány
Komádi
0 1,75 3,5 7 Kilometers
Biharugra
Cefa
Zsadány
Geszt
Mezogyán
Madaras
Salonta
Tulca
Újszalonta
Sarkadkeresztúr
Méhkerék
Sources: Esri, USGS, NOAA

R1D – [E13a] Mediterranean closely grazed dry grassland

Heavily-grazed pasture of the Mediterranean basin, mostly on silt and clay soils in the lowlands, dominated by rosette plants and small grasses tolerant of intensive herbivory and trampling. The soils are dry in summer which helps exclude nitrophilous plants that might be encouraged by dunging but, refreshed by autumn rains, the herbage remains green and productive through the winter, providing valuable forage. Companion plants vary widely across the large range.

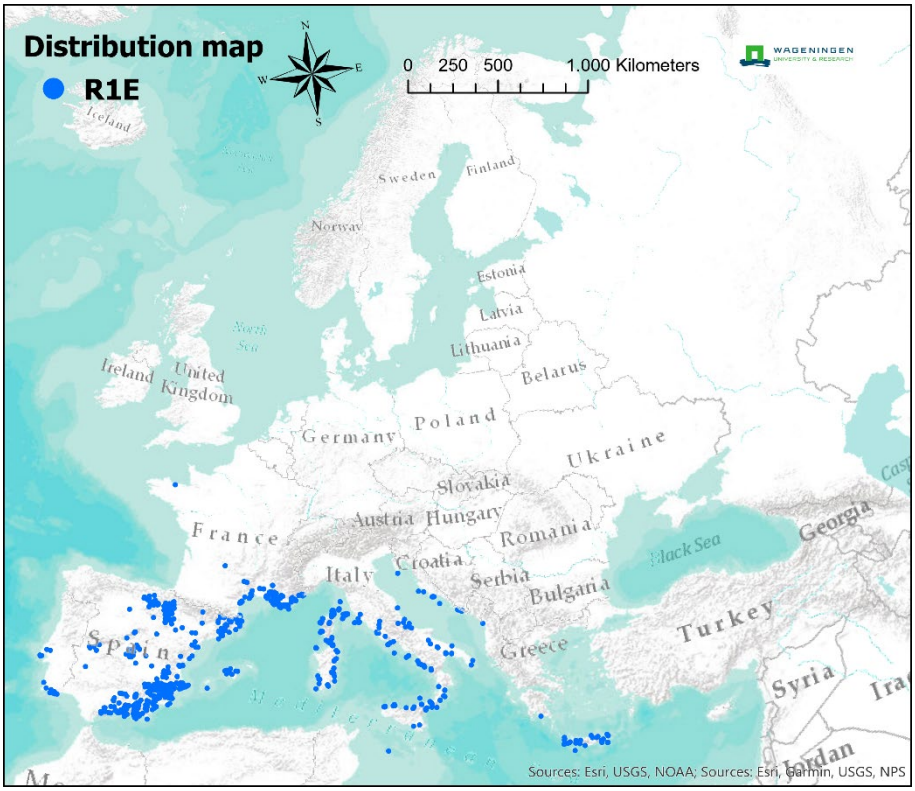


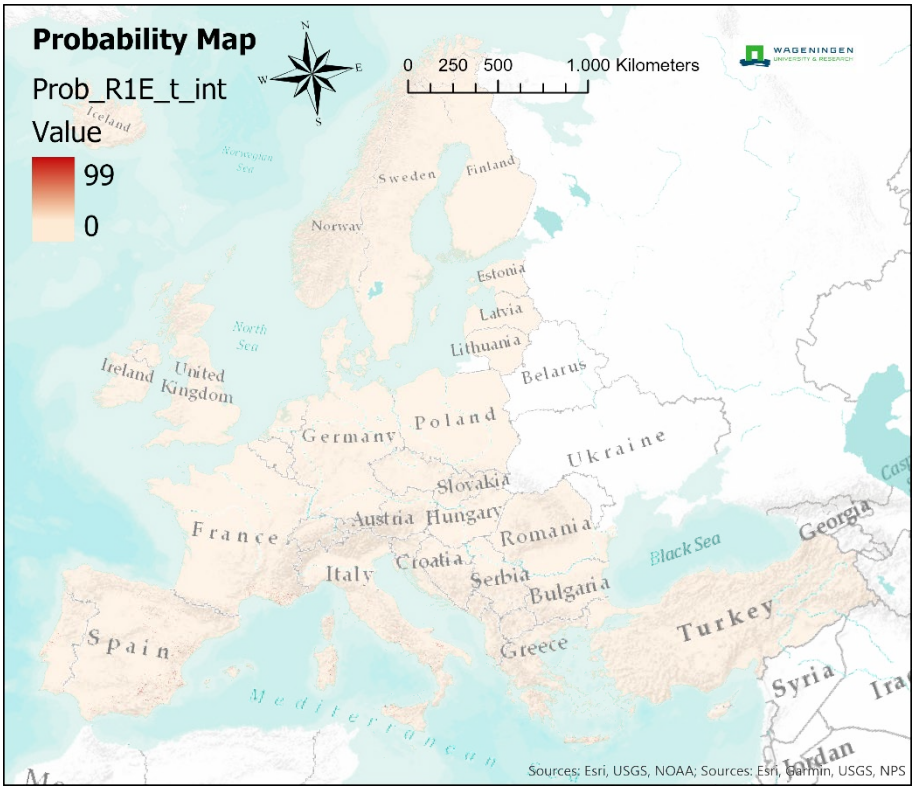



Probability Map
Distribution map
R1D
Prob_R1D_t_int
Value
100
0
0 1,5 3 6 Kilometers
Bulgaria
Sources: Esri, USGS, NOAA

R1E – [E13b] Mediterranean tall perennial dry grassland

Grassland of impoverished, base-rich soils over various calcareous bedrocks through the Mediterranean region, where grazing and trampling sustain open or closed swards generally dominated by tall, dense tussock grasses that lend a steppe-like character. Summer drought and disturbance help prevent reversion to forest but can encourage the invasion of aliens.

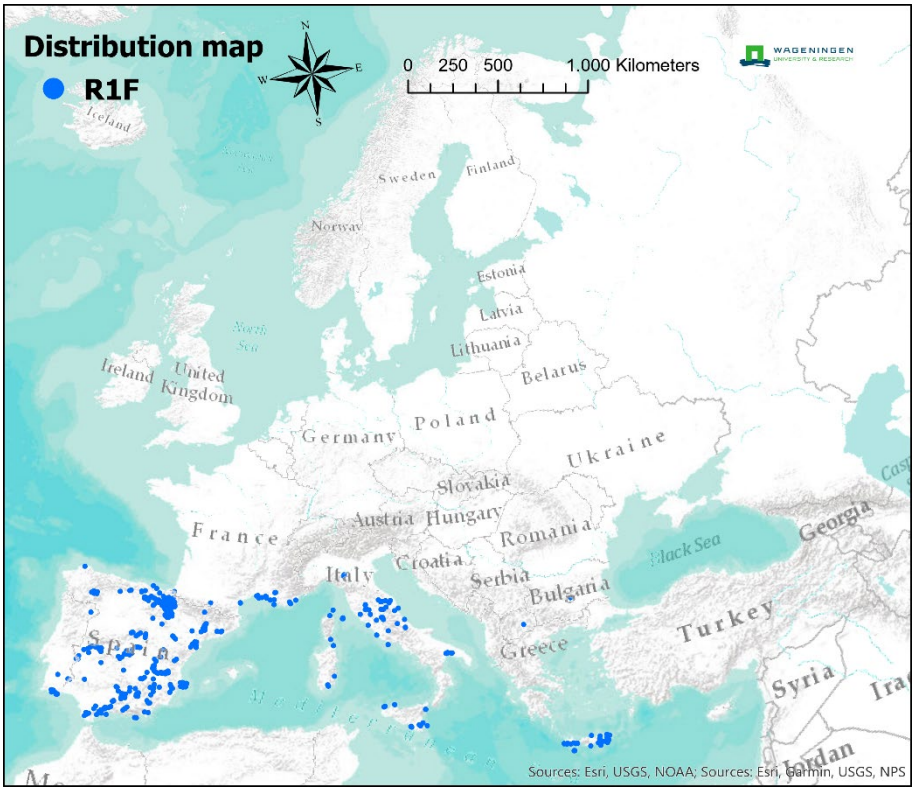


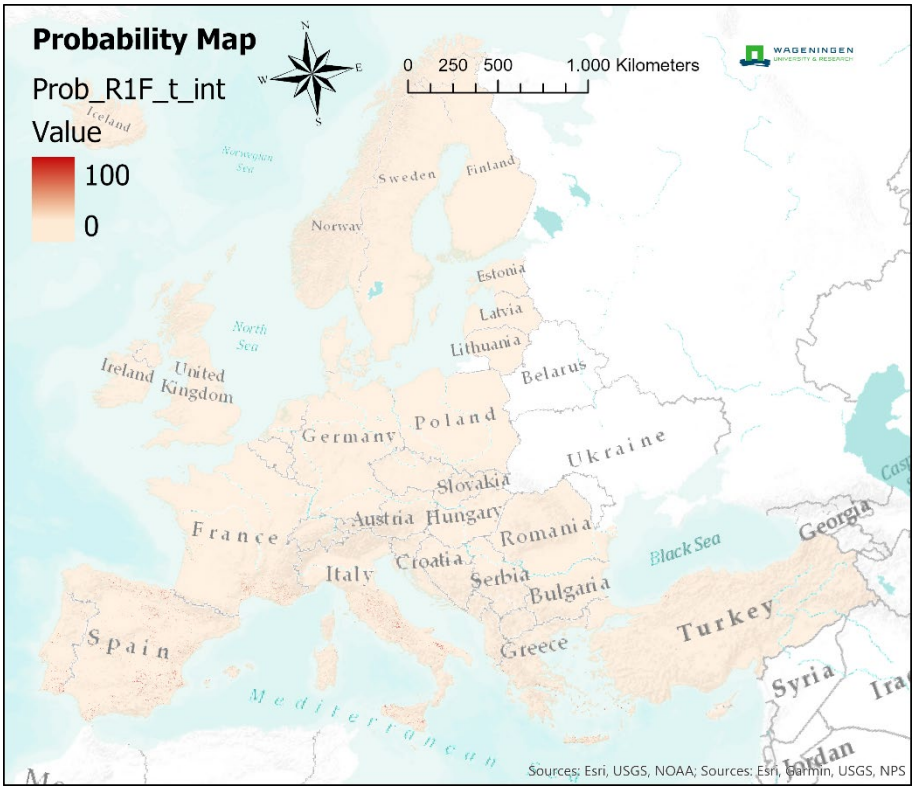


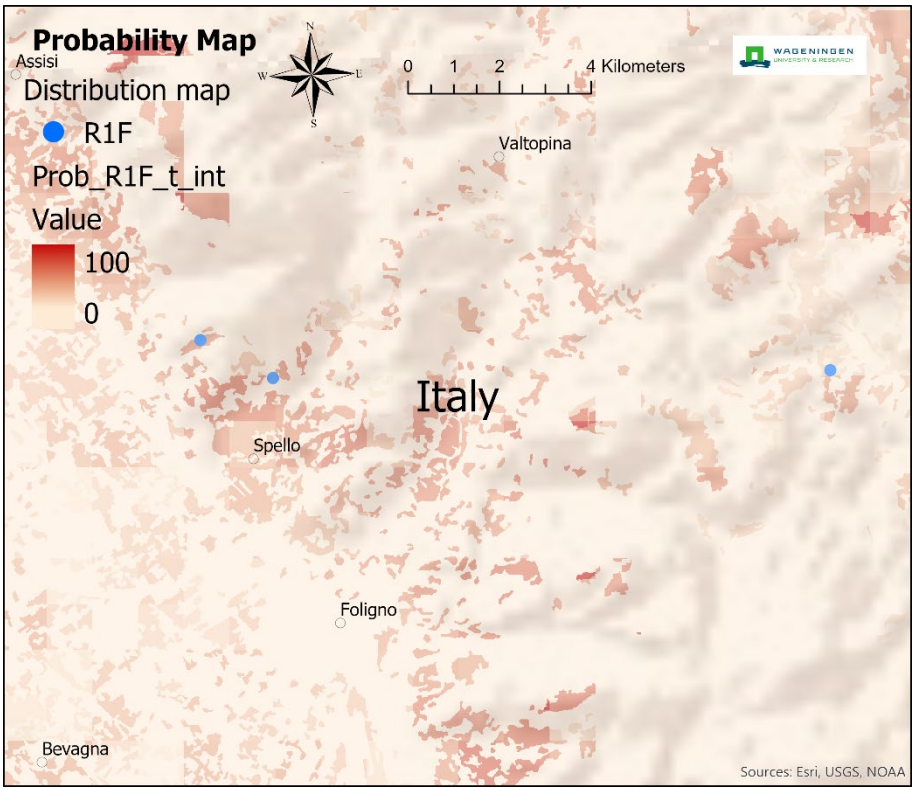

Probability Map
Distribution map
R1E
Prob_R1E_t_int
Value
99
0
0 5 10 20 Kilometers
WAGENINGEN
SOUDHA
Panormos
Gournai
IRAKLION
ANOYIA
Kalloni
Greece
Khora Sfakion
TIMBAKION
MOIRAI
Sources: Esri, USGS, NOAA

R1F – [E13c] Mediterranean annual-rich dry grassland

Usually ephemeral vegetation related to the yearly cycle of spring rains and summer drought through the Mediterranean zone where a high diversity of small annual plants make a brief colourful appearance on bare patches of mainly base-rich soils. The species composition varies greatly, according to the particular regional terrain and climate and the impact of traditional pastoralism.

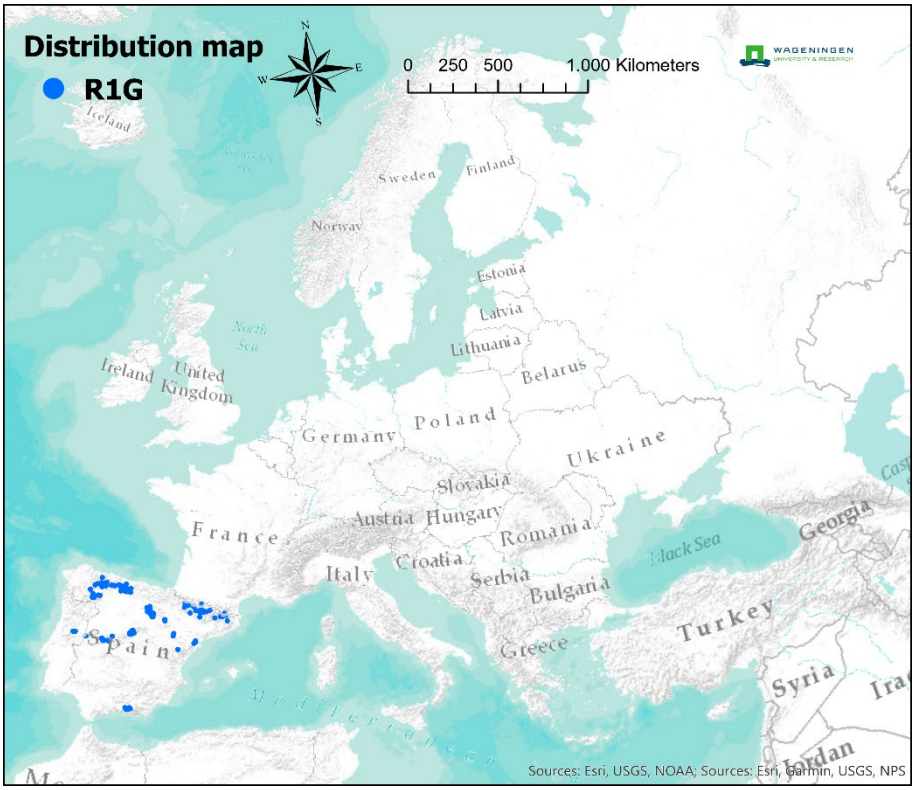


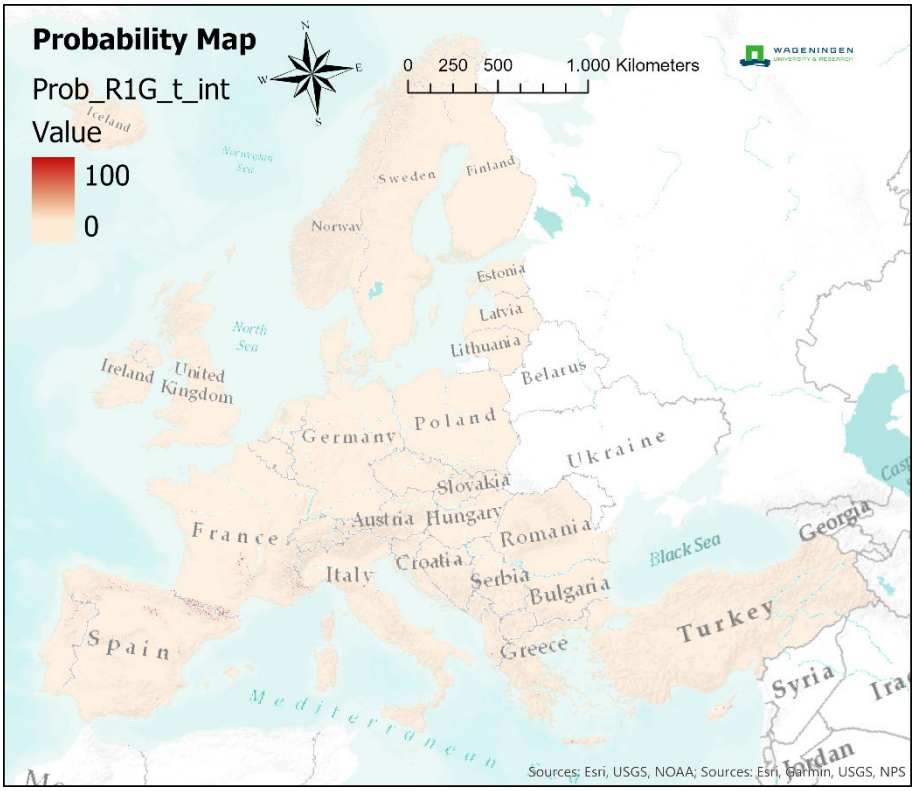


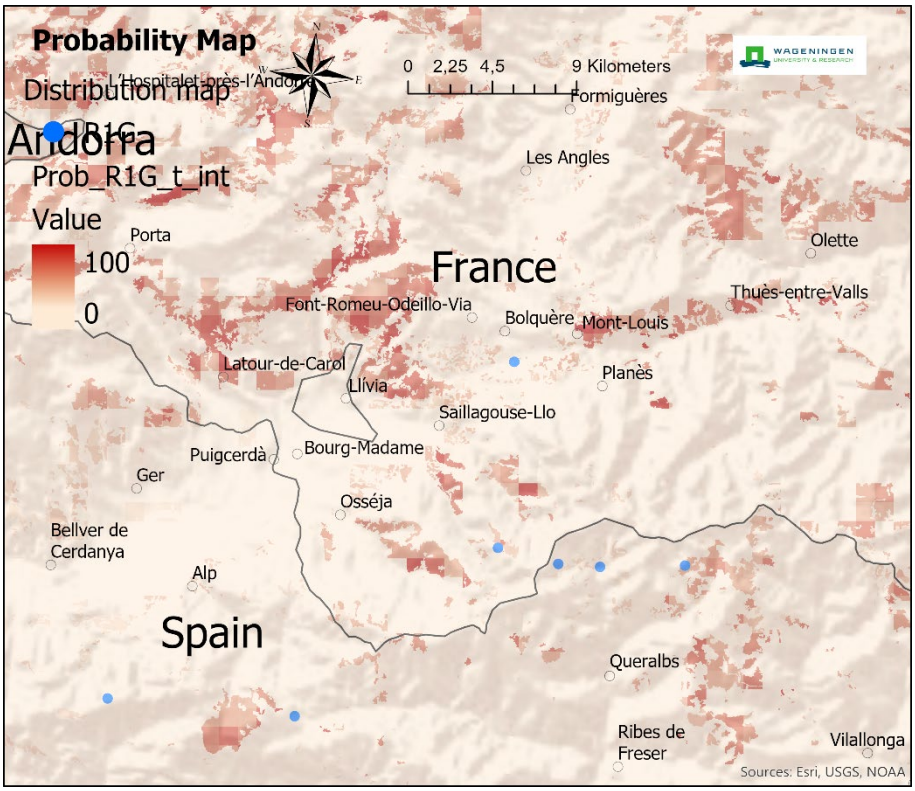

Probability Map
Assisi
Distribution map
R1F
Prob_R1F_t_int
Value
100
0
N
W
E
S
0 1 2 4 Kilometers
WAGENINGEN
UNIVERSITY & RESEARCH
Valtopina
Italy
Spello
Foligno
Bevagna
Sources: Esri, USGS, NOAA

R1G – [E15a] Iberian oromediterranean siliceous dry grassland

Grassland of base-poor soils over siliceous bedrocks on the slopes and crests of high mountains in the Iberian Peninsula with a short growing season and harsh winters with strong winds which blow the ground free of snow and leave the surface subject to deep cold and the development of freeze-thaw features. The vegetation cover, moderately open to closed, is dominated by prostrate or dwarf grasses and forbs, and includes many endemics.

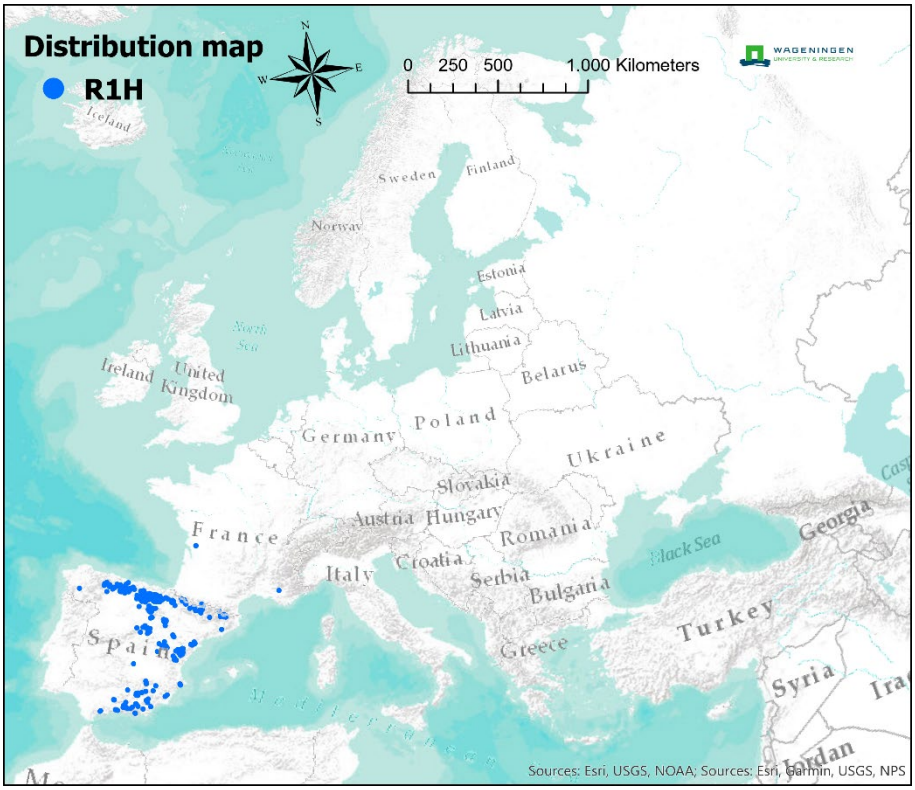


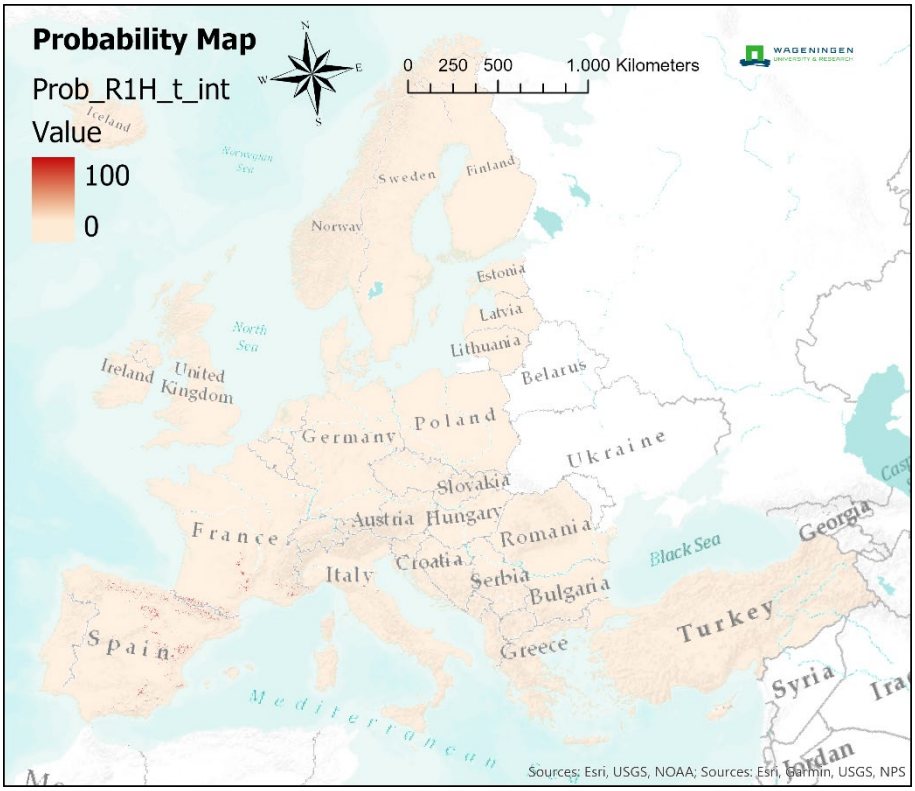


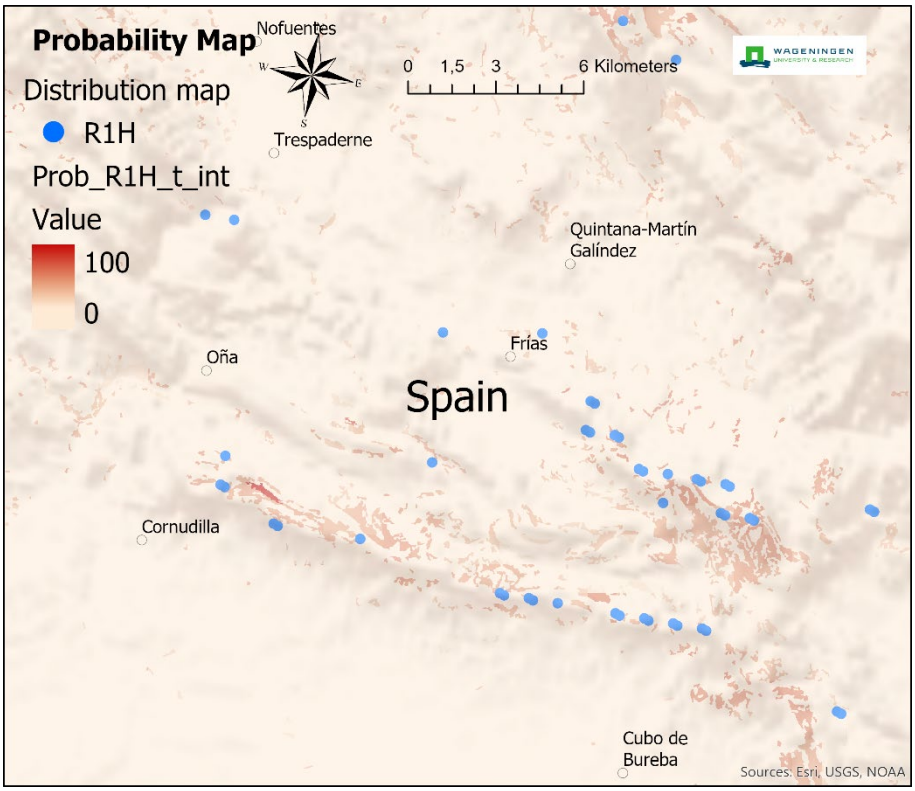

Probability Map
Distribution map
Andorra R1G
Prob_R1G_t_int
Value
100
0
0 2,25 4,5 9 Kilometers
WAGENINGEN
L'Hospitalet-près-l'Andorre
Formiguères
Les Angles
Porta
France
Olette
Thuès-entre-Valls
Font-Romeu-Odeillo-Via
Bolquère
Mont-Louis
Latour-de-Carol
Llívia
Planès
Saillagouse-Llo
Puigcerdà
Bourg-Madame
Ger
Osséja
Bellver de Cerdanya
Alp
Spain
Queralbs
Ribes de Freser
Vilallonga
Sources: Esri, USGS, NOAA

R1H - [E15b] Iberian oromediterranean basiphilous dry grassland

Grassland of base-rich soils over calcareous bedrocks on the slopes and crests of high mountains in the Iberian Peninsula and France, with a short growing season and harsh winters when strong winds blow the ground free of snow and leave the surface subject to deep cold which encourages the development of freeze-thaw features. The vegetation cover, moderately open to closed, is dominated by prostrate or dwarf grasses and forbs, and includes many endemics.

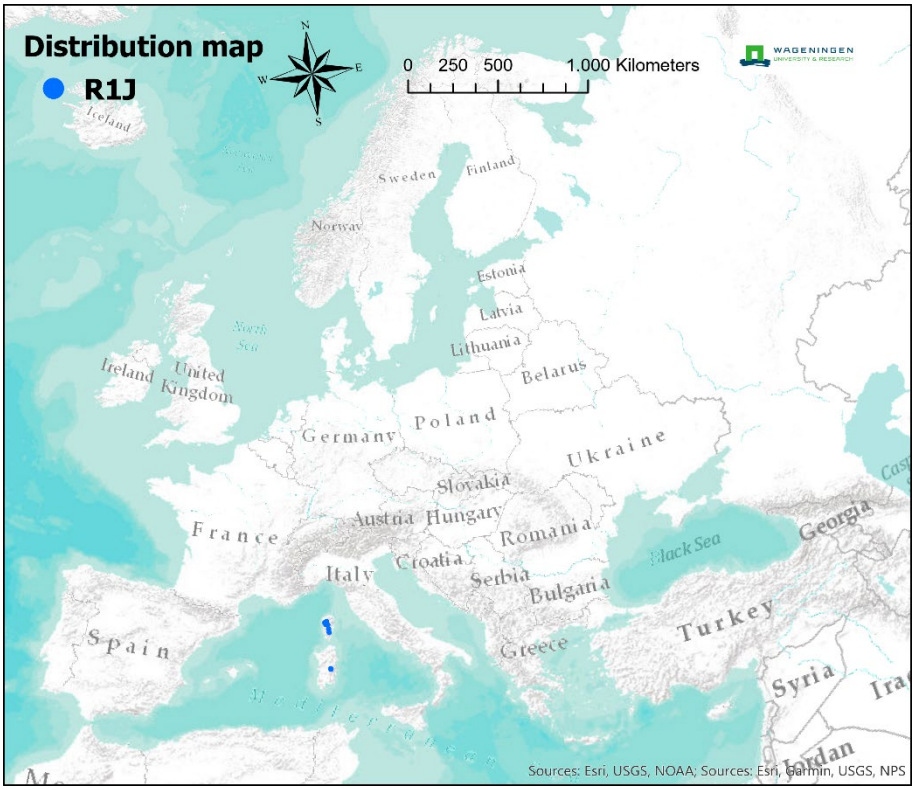


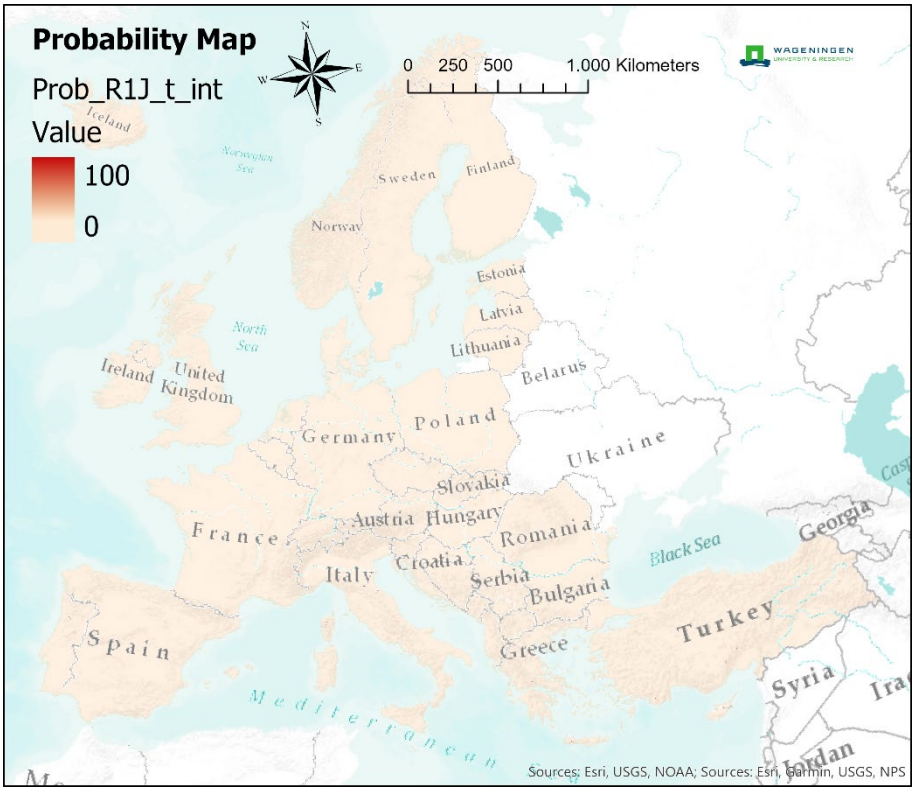


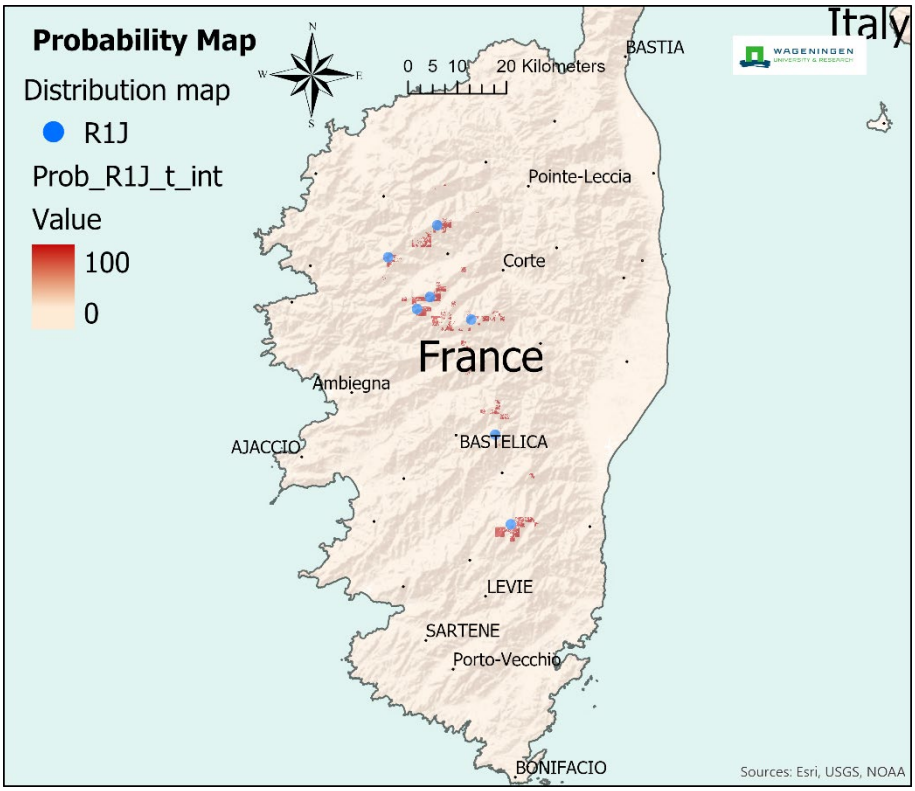

Probability Map
Distribution map
R1H
Prob_R1H_t_int
Value
100
0
Nofuentes
Trespaderne
0 1,5 3 6 Kilometers
WAGENINGEN
Quintana-Martín Galíndez
Frías
Oña
Spain
Cornudilla
Cubo de Bureba
Sources: Esri, USGS, NOAA

R1J – [E15c] Cyrno-Sardean oromediterranean siliceous dry grassland

Grassland of base-poor soils over siliceous bedrocks on the slopes and crests of high mountains in Corsica and (probably) Sardinia, with a short growing season and harsh winters when strong winds blow the ground free of snow and leave the surface subject to deep cold which encourages the development of freeze-thaw features. The cover of vegetation is intermediate to complete, dominated by prostrate herbs, cushion plants and dwarf shrubs, and includes many endemics.

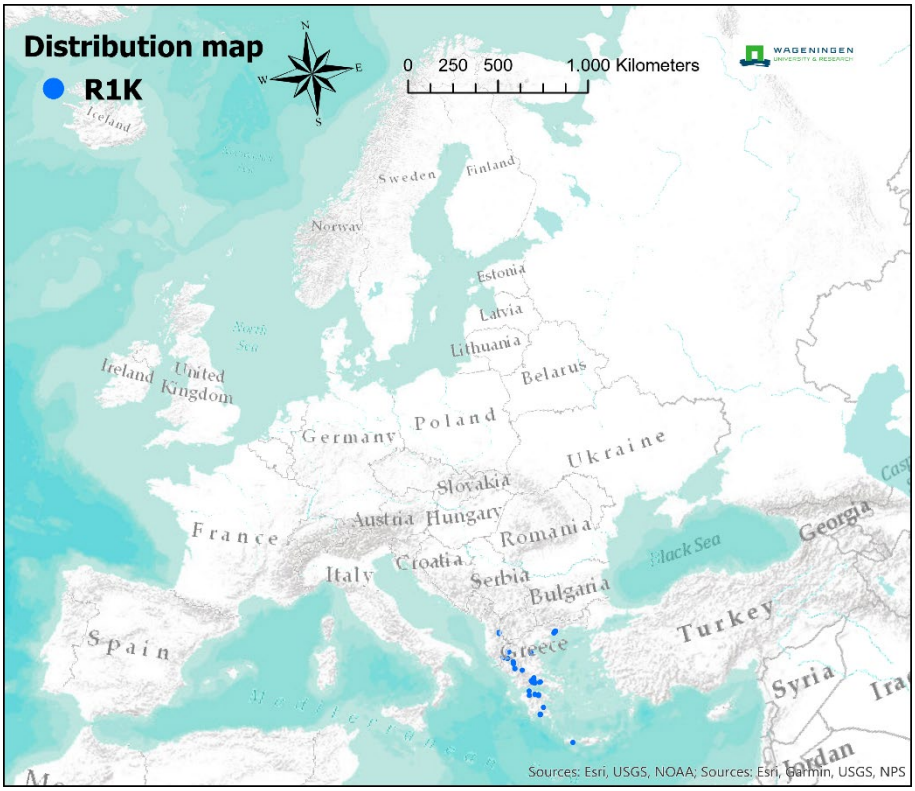


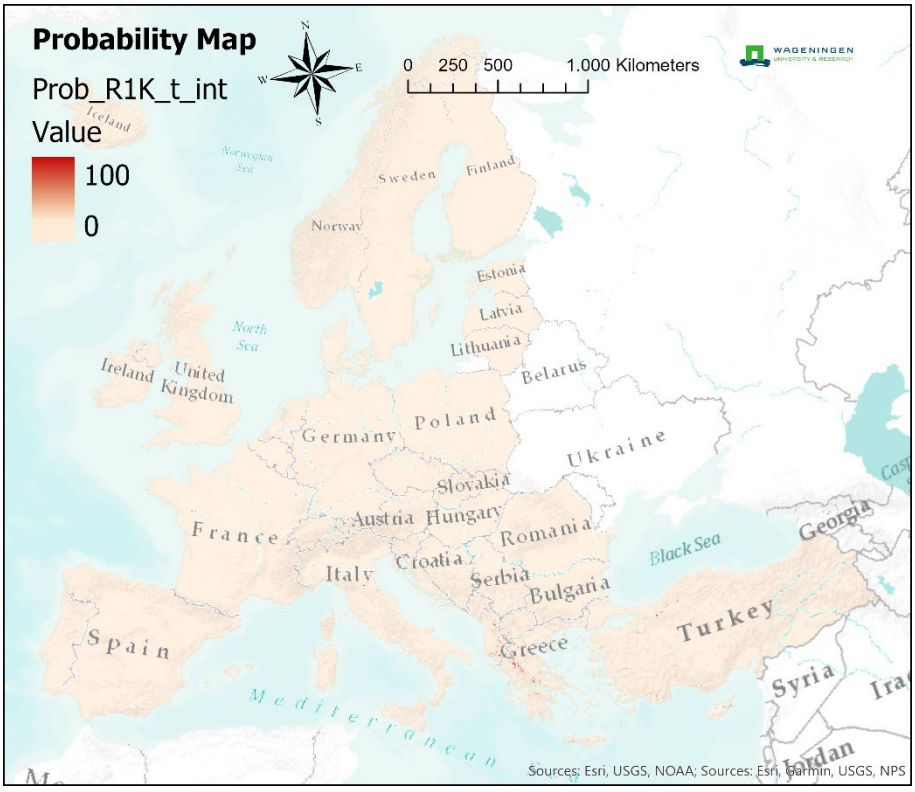


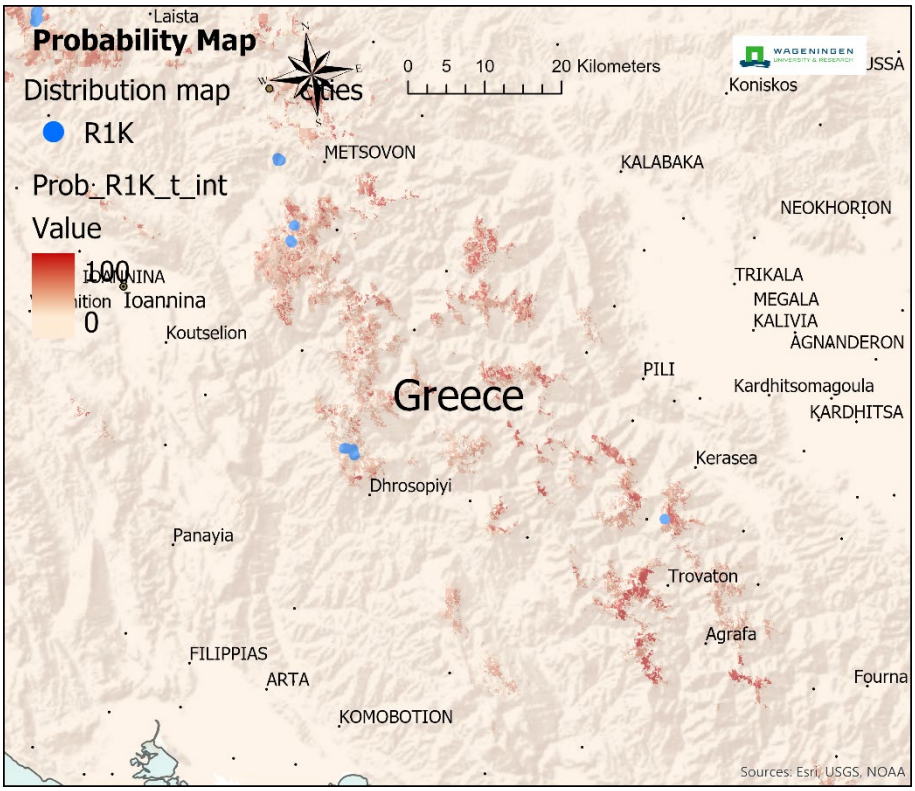

Probability Map
Distribution map
R1J
Prob_R1J_t_int
Value
100
0
0 5 10 20 Kilometers
Italy
BASTIA
Pointe-Leccia
Corte
France
Ambiegna
AJACCIO
BASTELICA
LEVIE
SARTENE
Porto-Vecchio
BONIFACIO
Sources: Esri, USGS, NOAA

R1K – [E15d] Balkan and Anatolian oromediterranean dry grassland

Closed grassland of deeper acid soils occurring over various bedrocks above the tree-line on high mountain slopes and hollows in Greece and Anatolia where snow accumulates and provides springtime irrigation with melt-water. The vegetation is species-rich but the dominants and associates vary from place to place. It provides valuable summer grazing for traditional pastoralism.

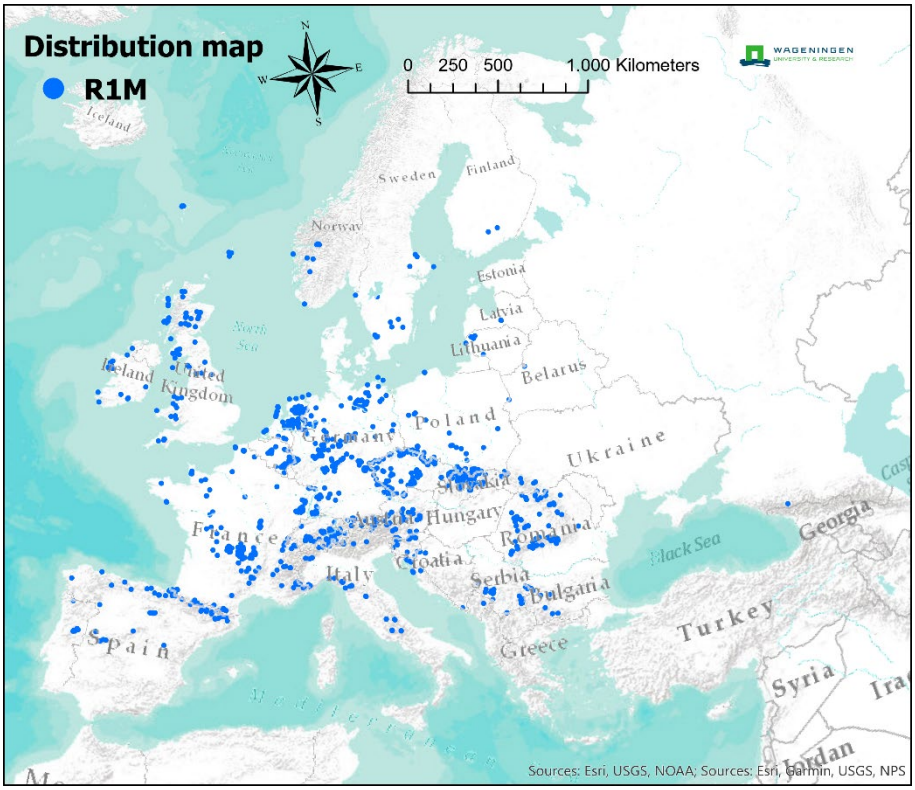


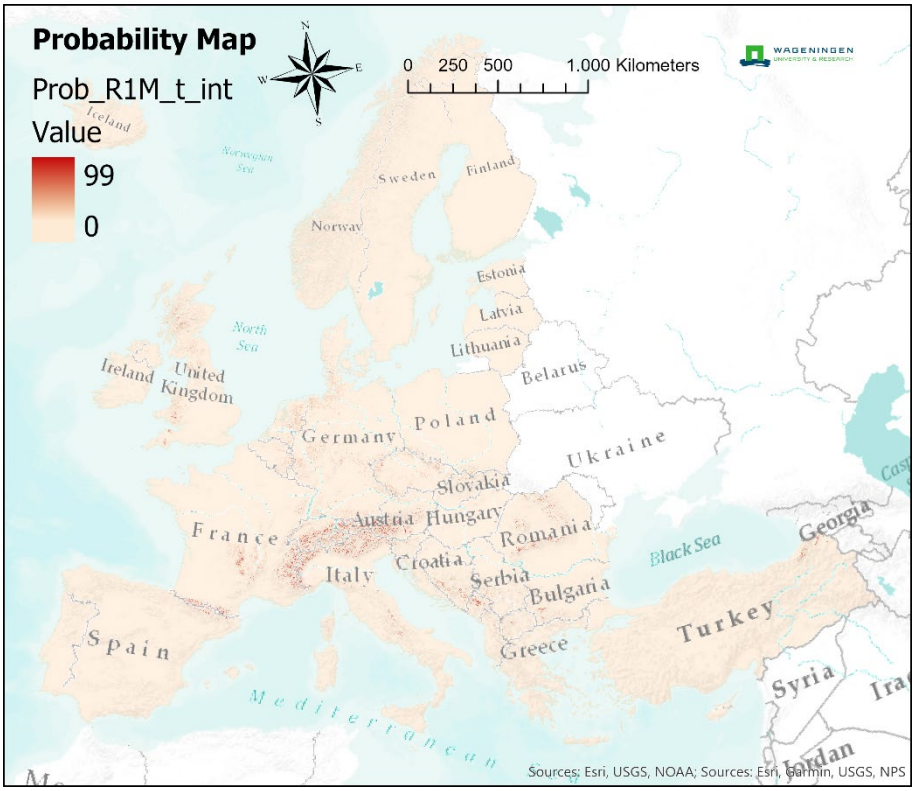


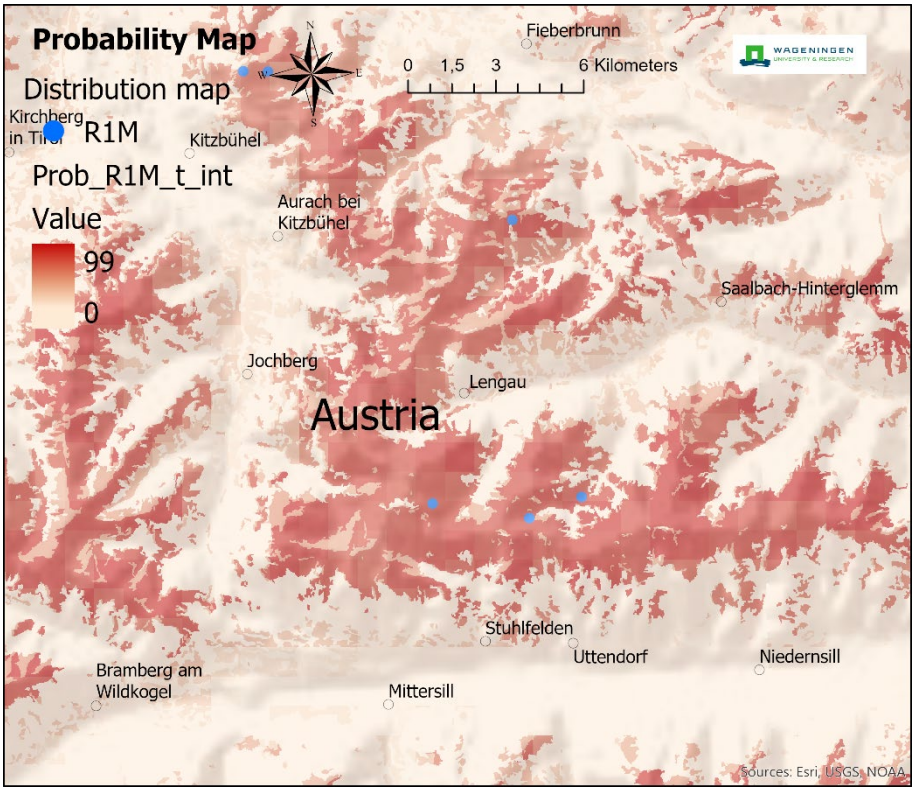

Laista
Probability Map
Distribution map
R1K
Prob_R1K_t_int
Value
100
0
0 5 10 20 Kilometers
WAGENINGEN
METSOVON
KALABAKA
NEOKHORION
TRIKALA
MEGALA
KALIVIA
AGNANDERON
Koniskos
Ioannina
Koutselion
PILI
Kardhitsomagoula
KARDHITSA
Greece
Kerasea
Dhrosopiyi
Panayia
Trovaton
Agrafa
FILIPPIAS
ARTA
Fourna
KOMOBOTION
Sources: Esri, USGS, NOAA

R1M – [E17] Lowland to montane, dry to mesic grassland usually dominated by Nardus stricta

Usually dominated by the tightly tussocky Nardus stricta, this grassland is characteristic of nutrient-poor, acidic soils, sometimes seasonally wet, on siliceous substrates through the entire lowlands and sub-montane zone of temperate Europe, though optimally developed in the cooler and rainier climate of the atlantic zone. Other grasses may share dominance but the associated flora is generally rather species-poor and related to the type and intensity of grazing.

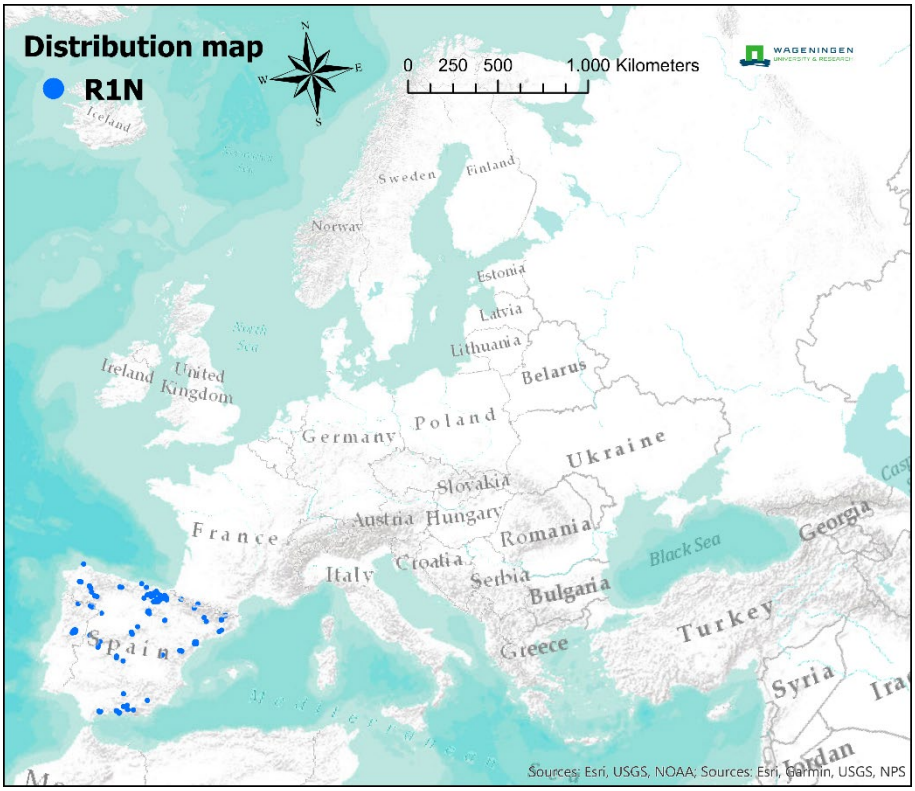


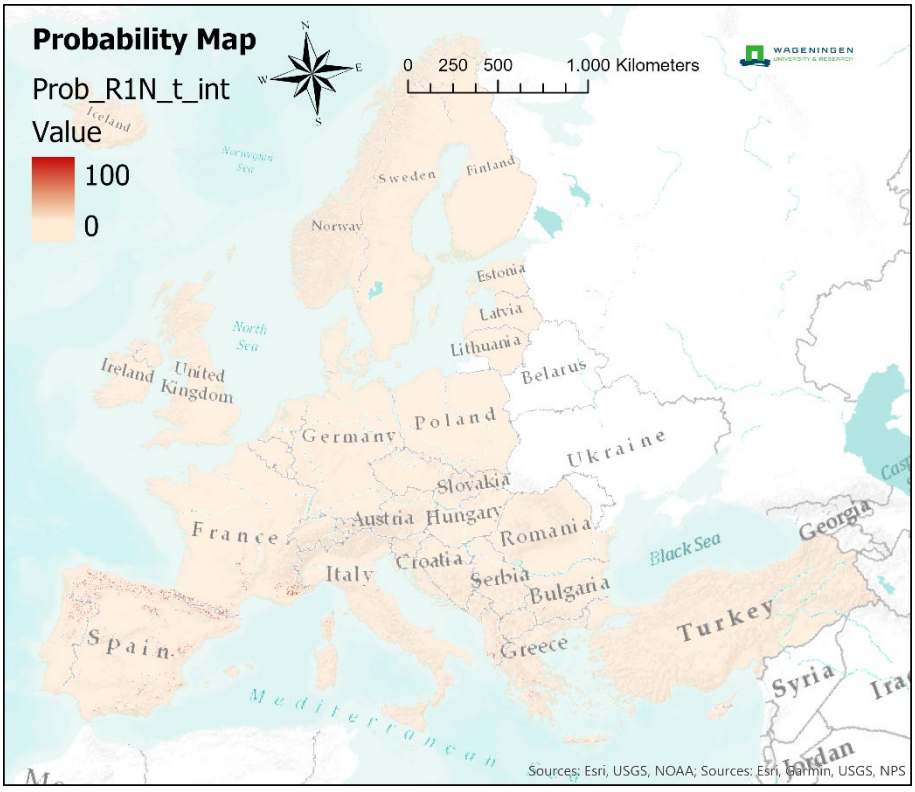


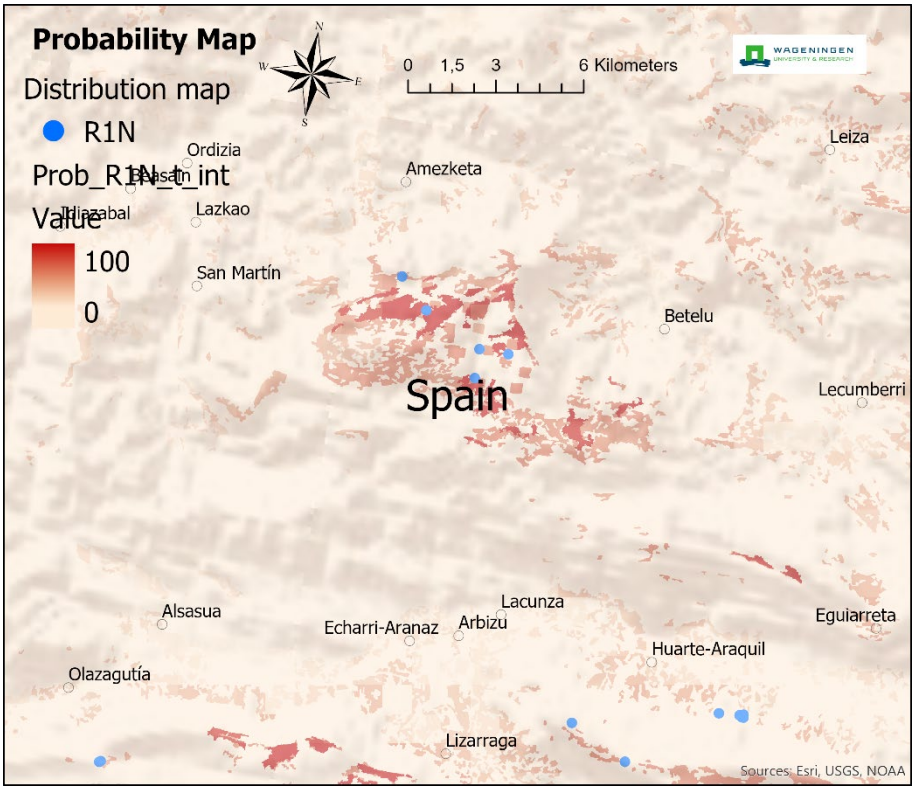

Probability Map
Distribution map
R1M
Prob_R1M_t_int
Value
99
0
Fieberbrunn
0 1,5 3 6 Kilometers
Kirchberg in Tirol
Kitzbühel
Aurach bei Kitzbühel
Saalbach-Hinterglemm
Jochberg
Lengau
Austria
Stuhlfelden
Uttendorf
Niedernsill
Bramberg am Wildkogel
Mittersill
Sources: Esri, USGS, NOAA

R1N – [E18] Open Iberian supramediterranean dry acid and neutral grassland

Dominated by small tussock grasses, forbs and mat-formers, including many endemics, this grassland occurs on shallow skeletal soils, nutrient-poor and drought-prone, developed over outcrops of siliceous and ultramafic bedrocks at moderate to high altitudes in the western Iberian Peninsula. Traditionally part of pastoral landscapes, grazed mostly by sheep.

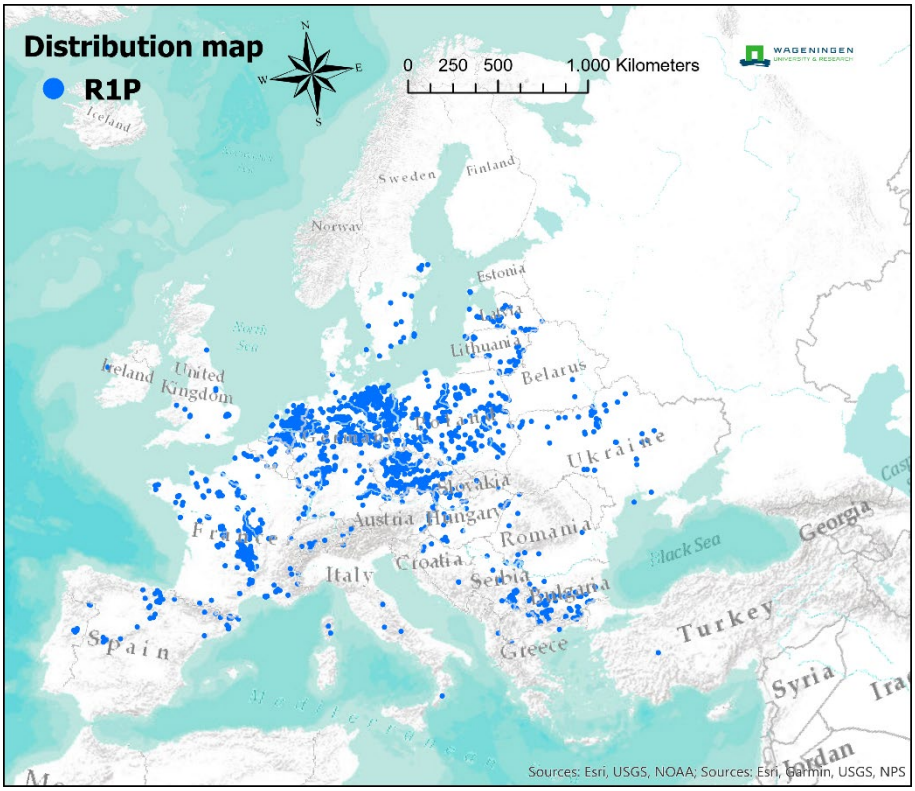


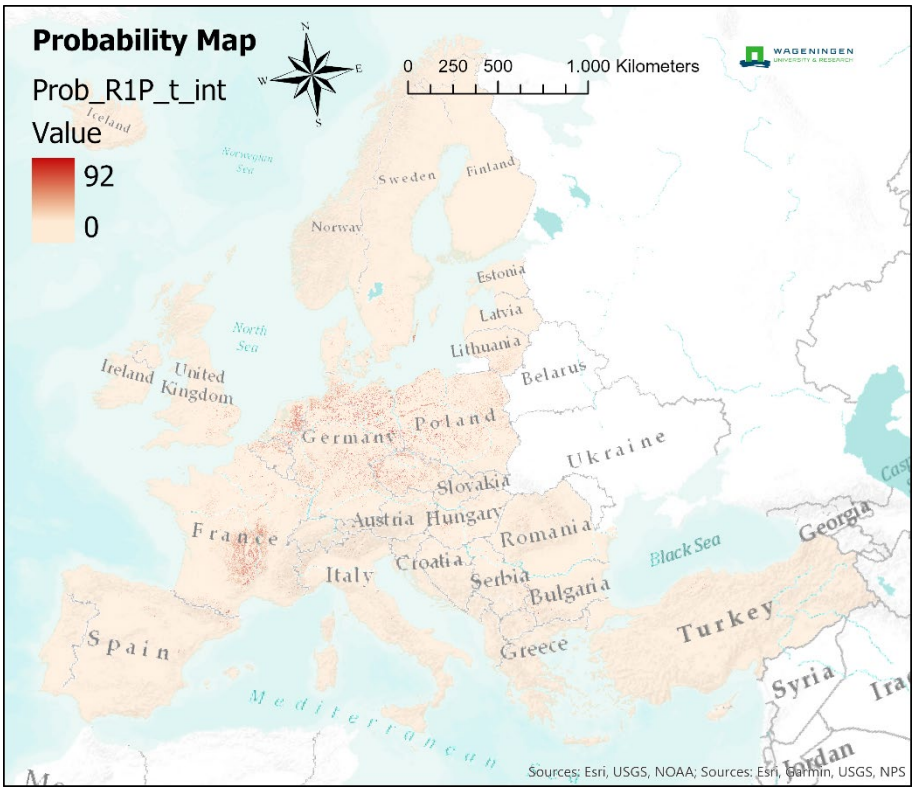


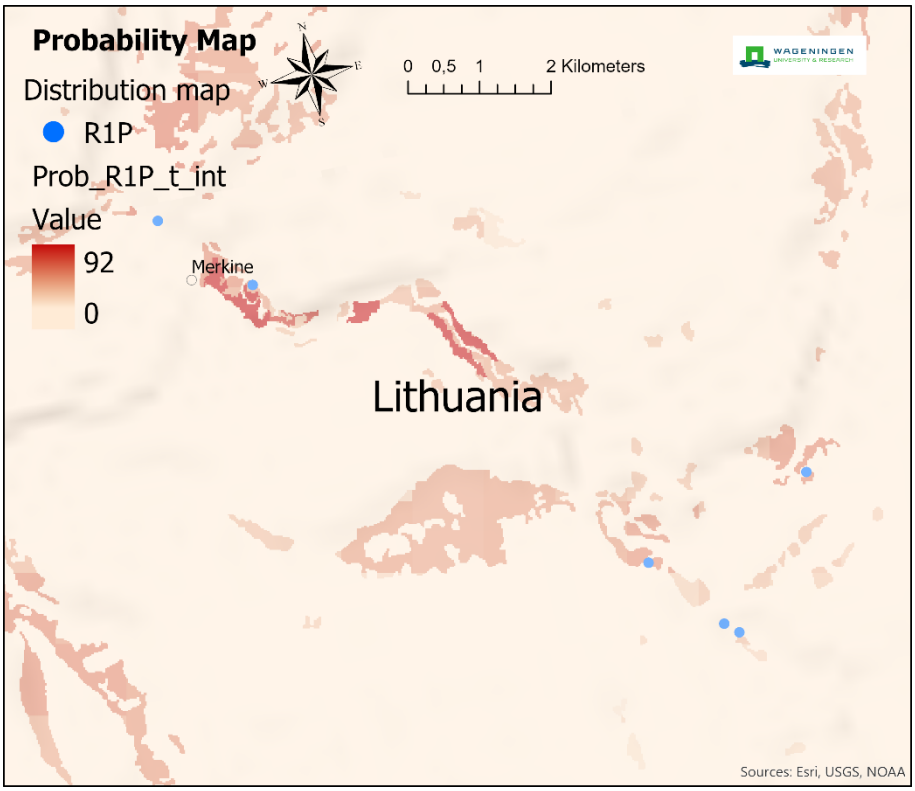

Probability Map
Distribution map
R1N
Prob_R1N_c_int
Value
100
0
N
W
E
S
0 1,5 3 6 Kilometers
WAGENINGEN
Leiza
Ordizia
Amezketa
Lazkao
San Martín
Betelu
Spain
Lecumberri
Alsasua
Lacunza
Arbizu
Echarri-Aranaz
Eguiarreta
Huarte-Araquil
Olazagutía
Lizarraga
Sources: Esri, USGS, NOAA

R1P – [E19a] Oceanic to subcontinental inland sand grassland on dry acid and neutral soils

Moderately open to closed grassland on nutrient-poor sandy soils, mostly acid to neutral though sometimes calcareous, on plains, river terraces and cliffs through the lowlands and sub-montane belts of temperate Europe. Narrow-leaved, tussocky graminoids dominate, associated herbs can be very numerous and more open swards can have rich annual and cryptogam floras.



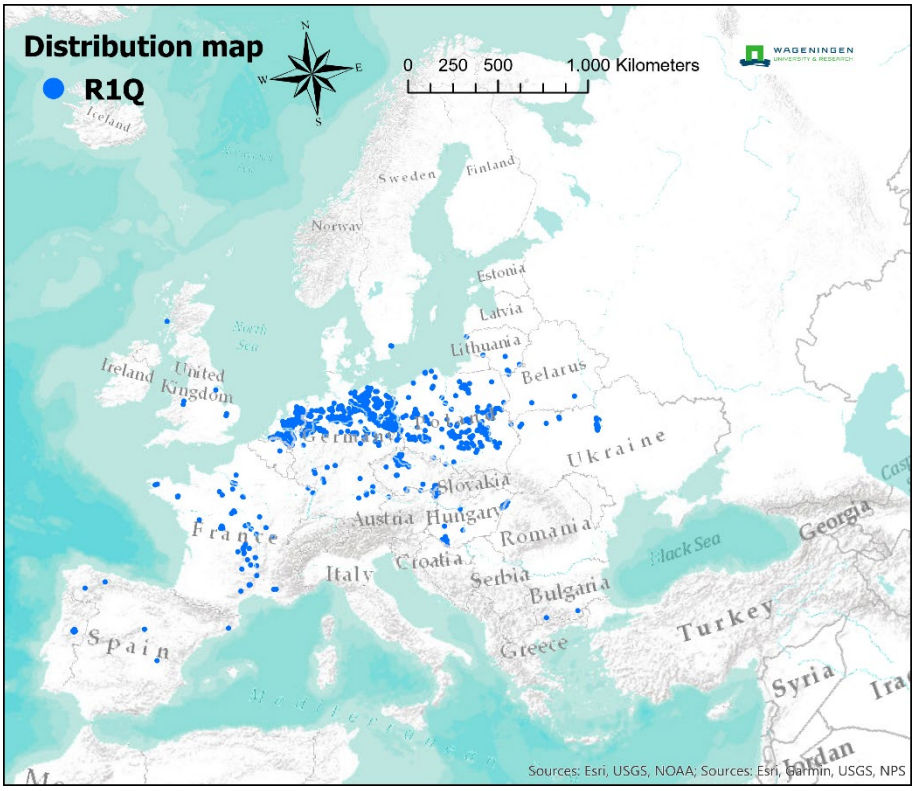


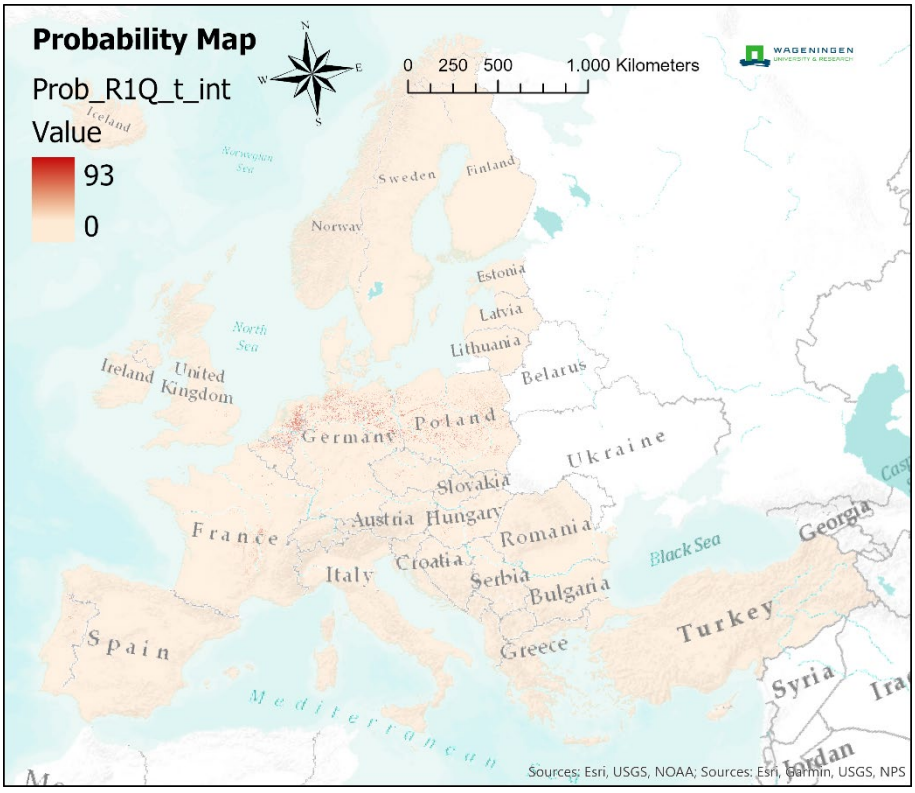


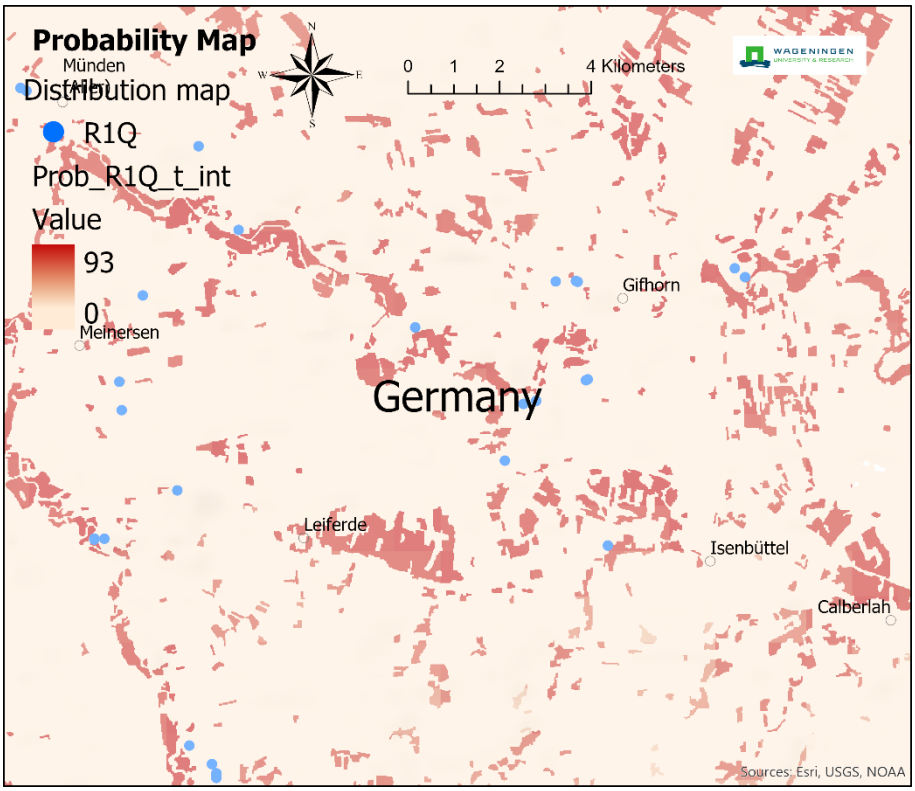
Across the wide range, there is considerable variety among the dominants and companions and the extreme topoclimate can provide a western outpost for steppe elements.

R1Q – [E19b] Inland sanddrift and dune with siliceous grassland

Usually sparse grasslands on sand drifts among inland dunes and other open landscapes, mainly in the north central European lowlands, where the nutrient-poor and highly acidic surface is prone to wind erosion and hot droughty summers, forming a highly distinctive 'Atlantic desert' landscape.



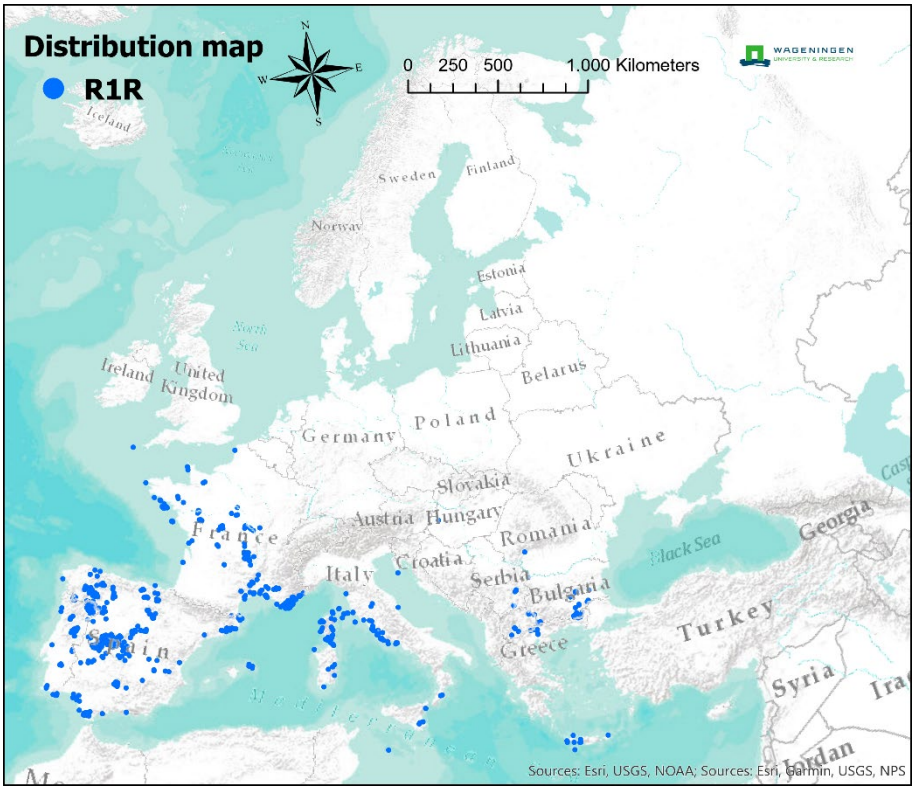


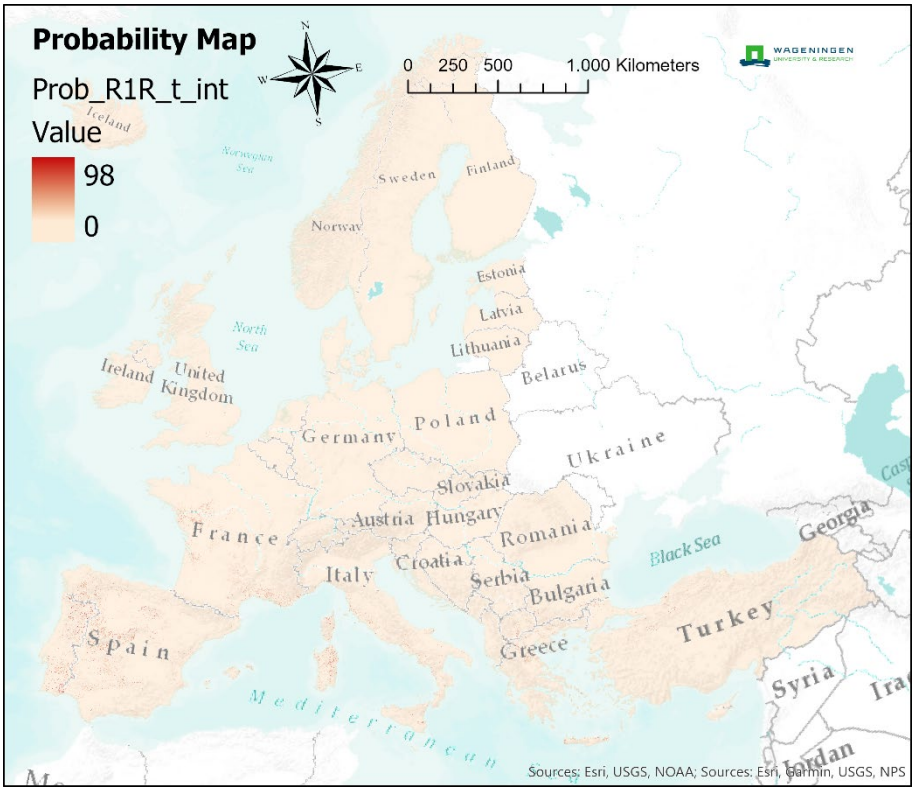


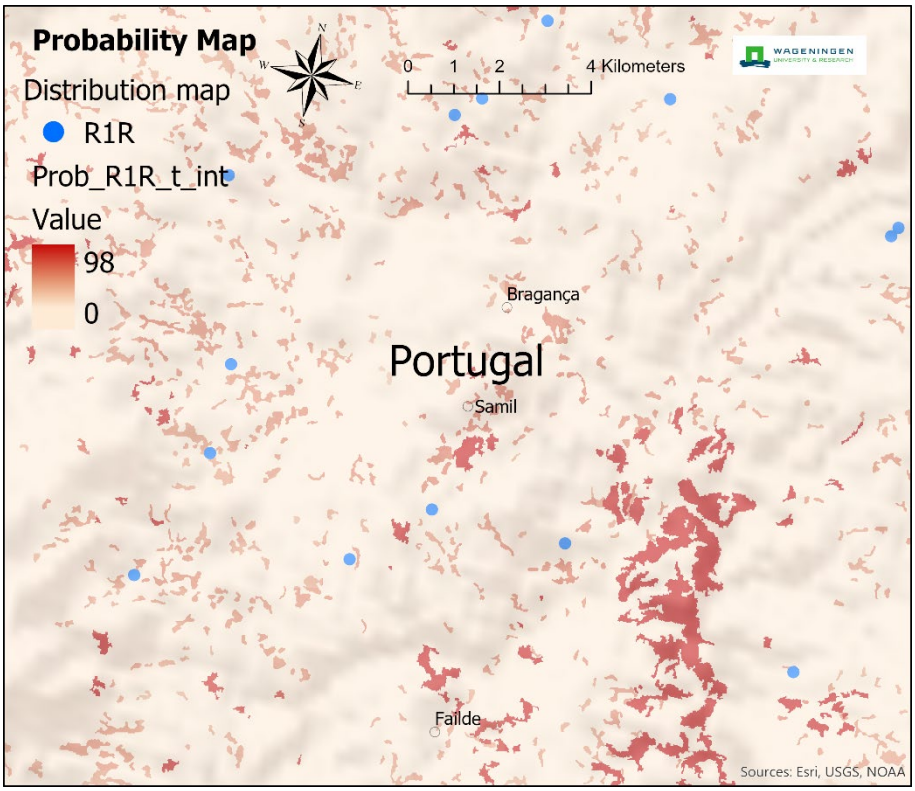
Soil development is very slow, pioneer moss vegetation succeeded by an open cover of small tussocky grasses, often with rich contingents of lichens on the compacted surface. Military training zones and abandoned lignite areas provide new situations.

R1R – [E1A] Mediterranean to Atlantic open, dry, acid and neutral grassland

Usually ephemeral vegetation related to the yearly cycle of spring rains and summer drought through the western Mediterranean and more fragmentarily into the atlantic and continental zones where a high diversity of small annual plants make a brief colourful appearance on bare patches of nutrient-poor, acidic soils. Typically, the habitat occurs as small patches in intimate mosaics with heath and scrub and has provided a valuable supplementary resource for sheep at lambing time.

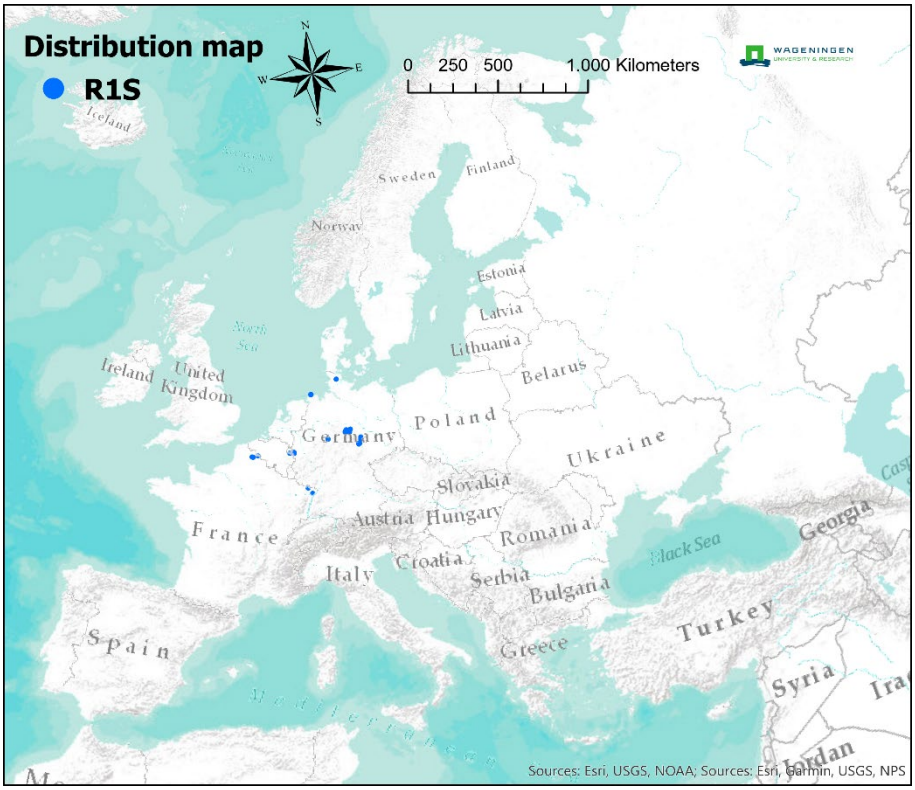


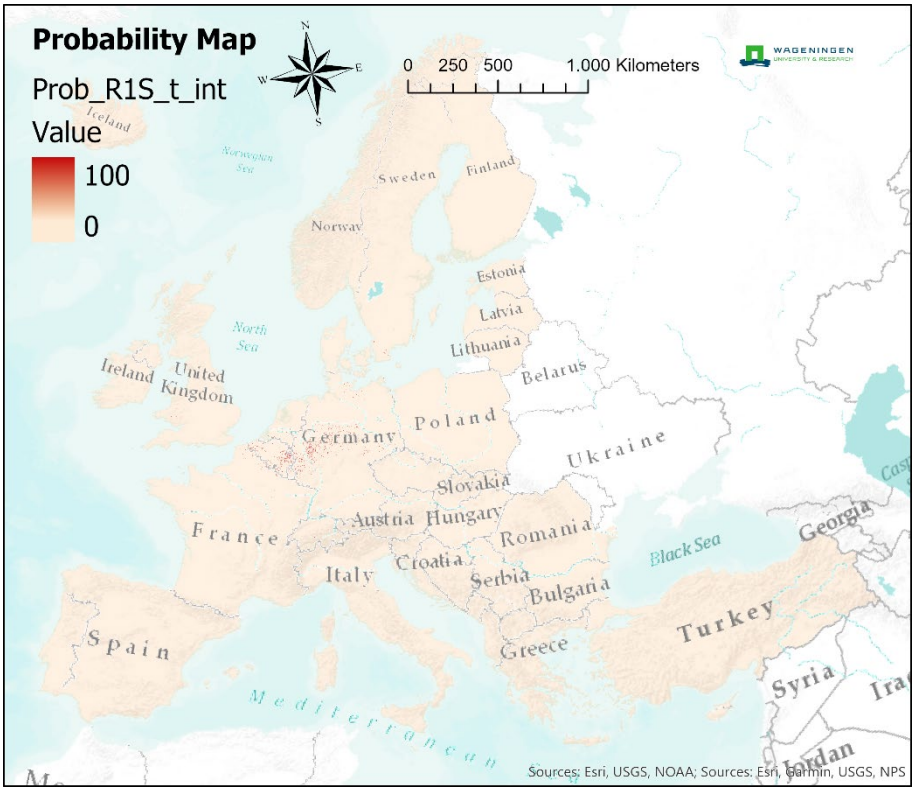


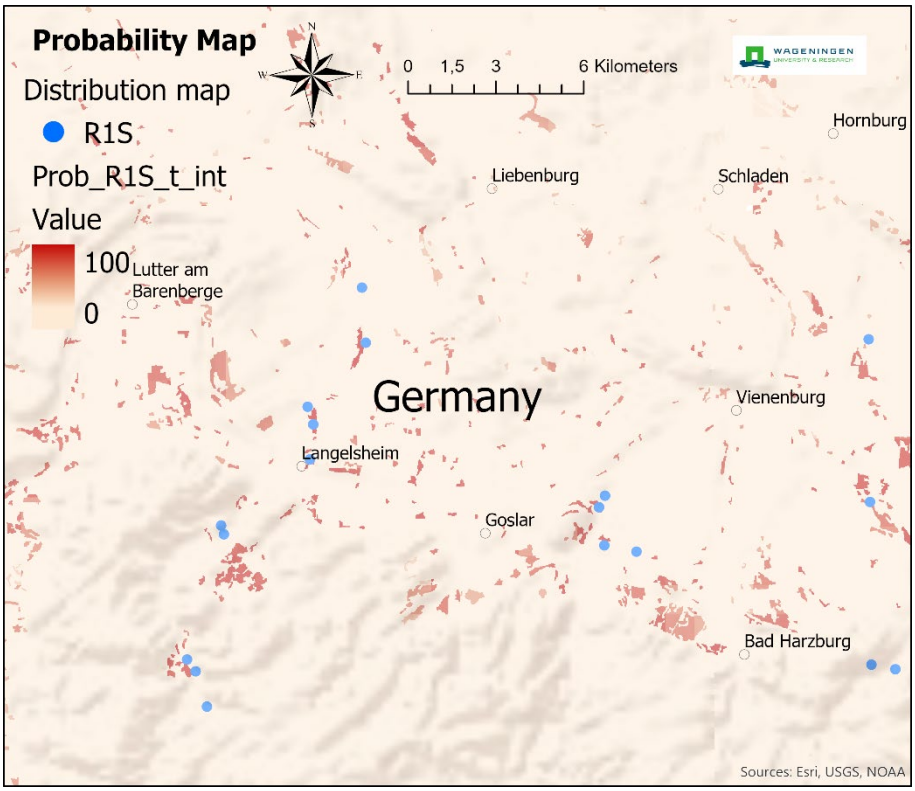

Probability Map
Distribution map
R1R
Prob_R1R_t_int
Value
98
0
N
W
E
S
0 1 2 4 Kilometers
WAGENINGEN
Bragança
Portugal
Samil
Failde
Sources: Esri, USGS, NOAA

R1S – [E1B] Heavy-metal grassland in Western and Central Europe

Short open sward with a distinctive metallophyte component, occurring on shallow, skeletal soils over natural rock exposures with heavy metals in western and central Europe, on mine spoil or ground contaminated by dust and waters from such sources. Typically occurs locally in other landscapes, colonising slowly and sustained by the extreme environment, though also sometimes dependent on grazing by wild herbivores for maintaining early successional stages which are richer in cryptogams.

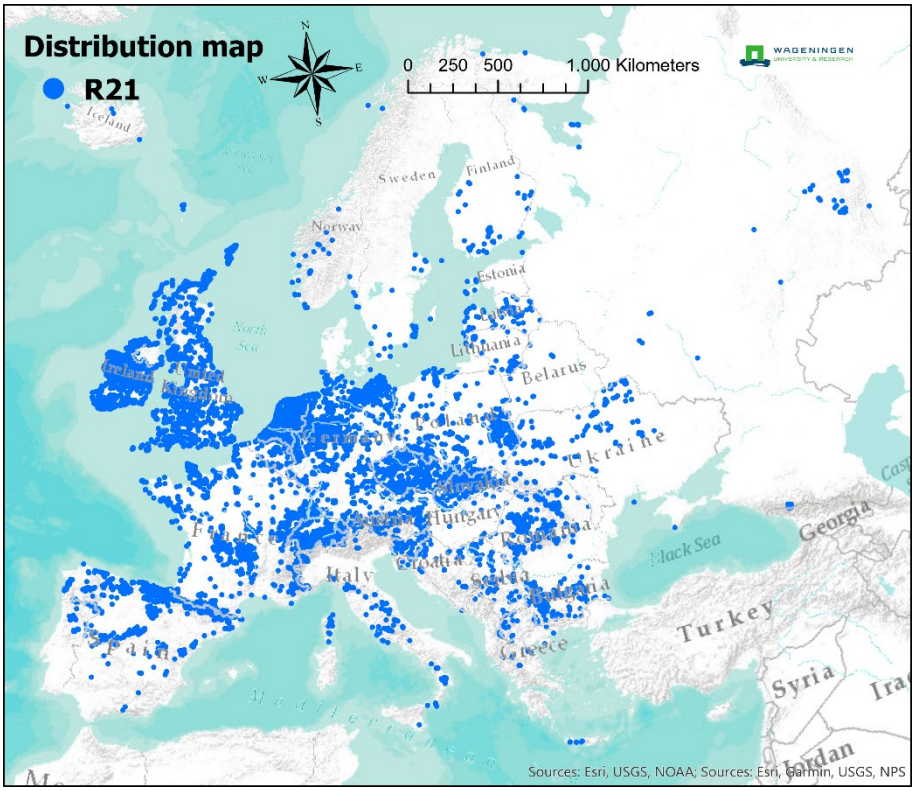


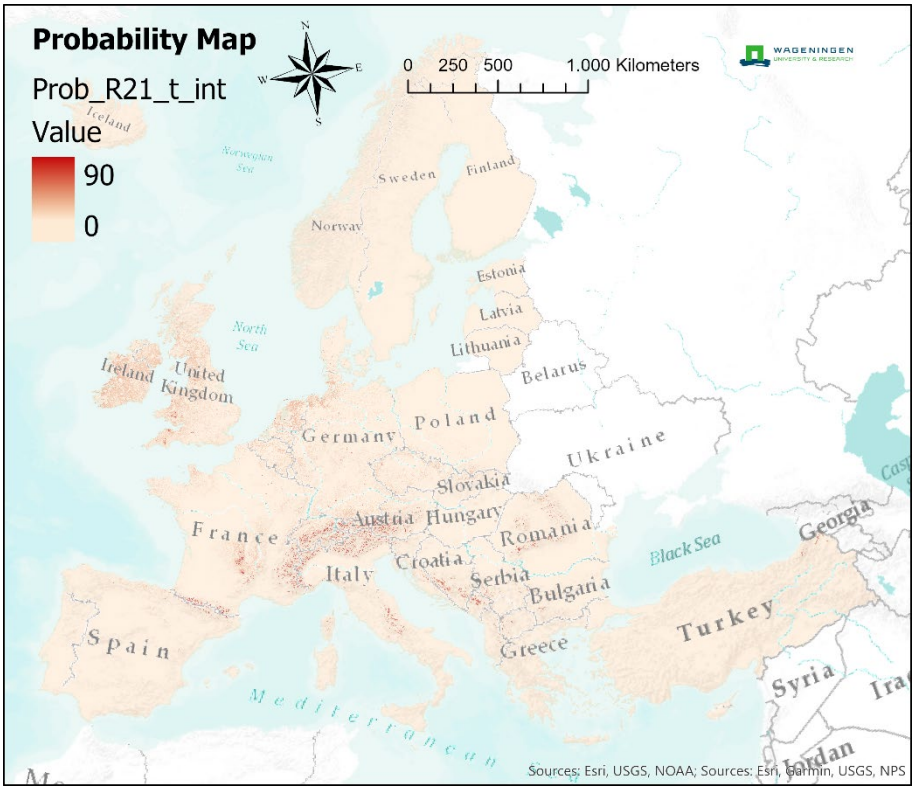


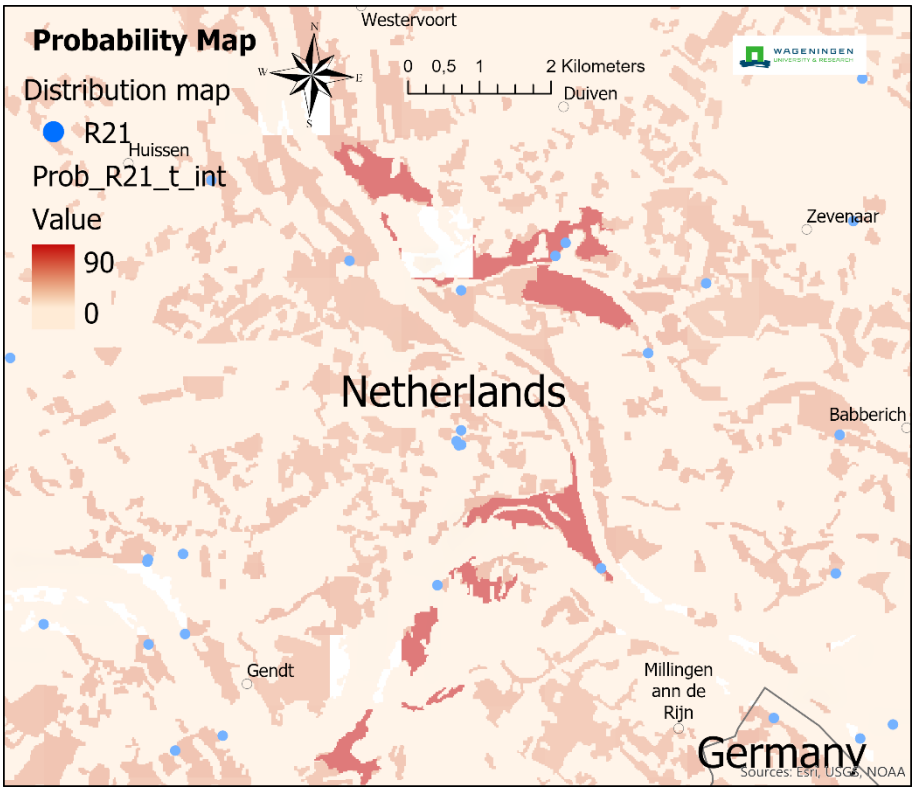

Probability Map
Distribution map
R1S
Prob_R1S_t_int
Value
100
0
Lutter am Barenberge
0 1,5 3 6 Kilometers
Hornburg
Liebenburg
Schladen
Germany
Vienenburg
Langelsheim
Goslar
Bad Harzburg
Sources: Esri, USGS, NOAA

R21 – [E21] Mesic permanent pasture of lowlands and mountains

The most common and widespread kind of traditionally managed pasture on deeper, well-drained mesic soils throughout temperate Europe, with many local types related to regional climate, terrain and pastoral traditions. Typically dominated by mixtures of productive grasses and herbs, it can be species-rich with distinctive scarce and rare plants where low input grazing and dunging are maintained



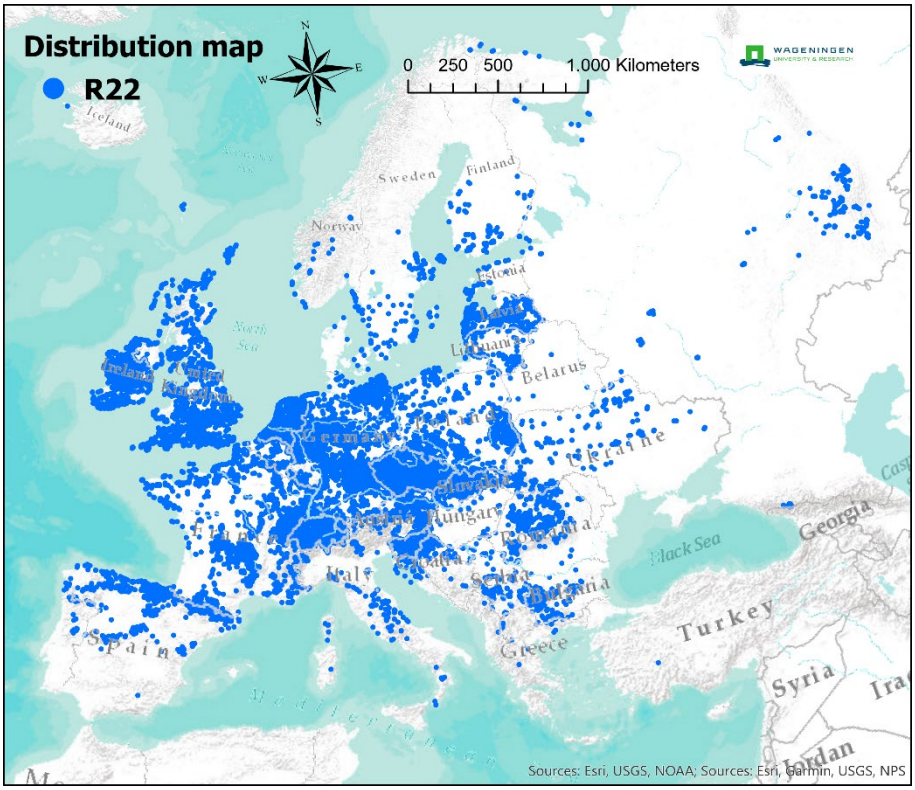


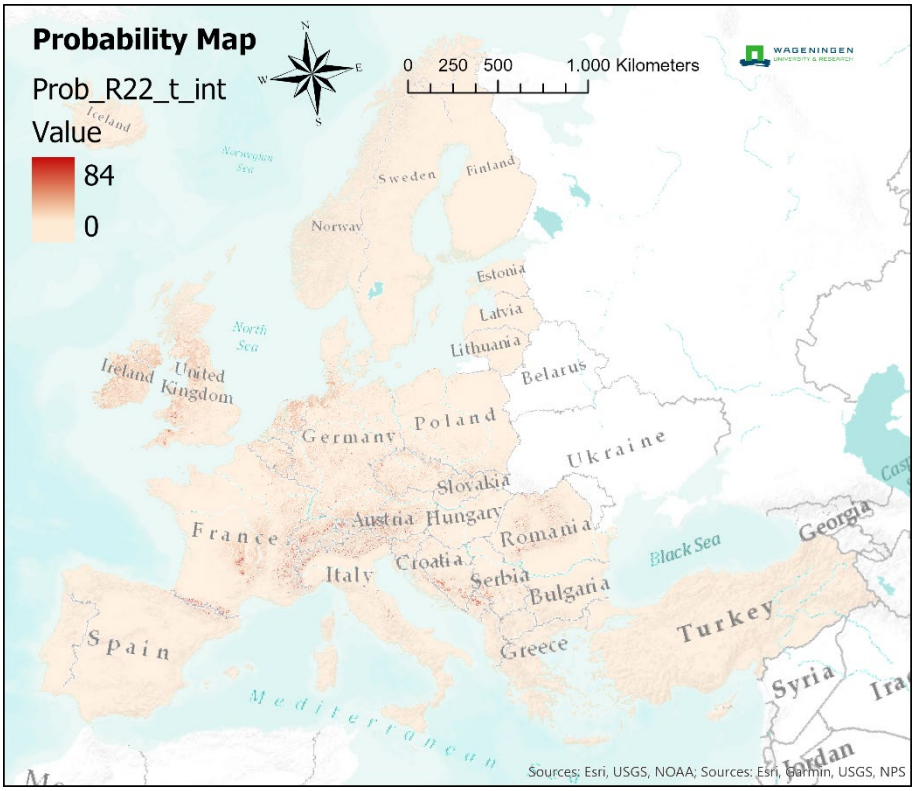


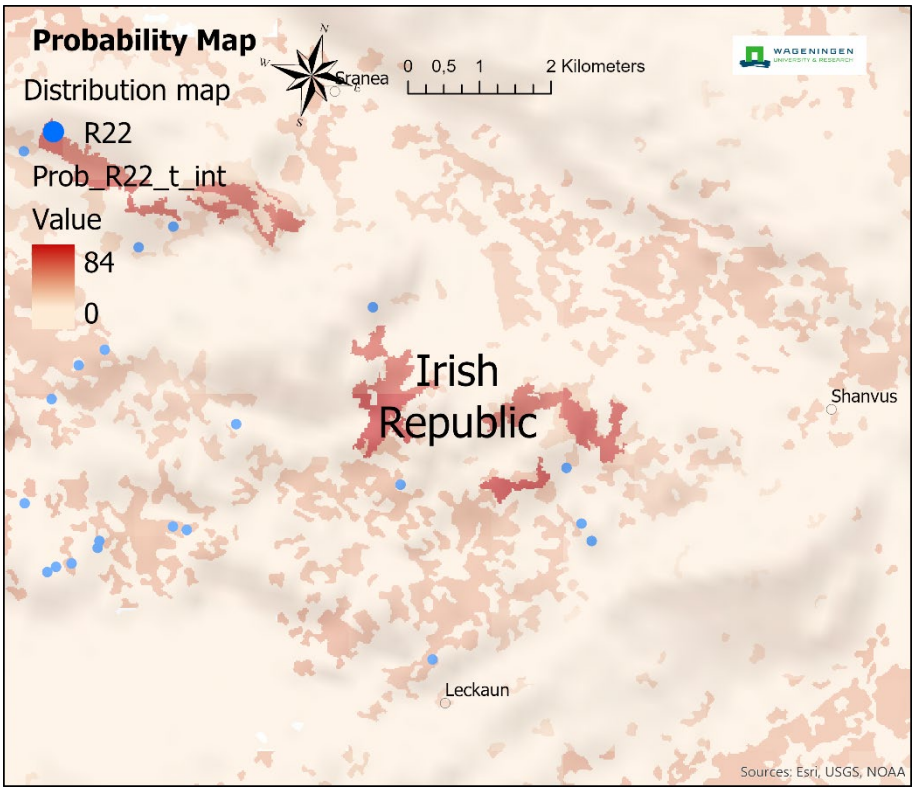
Often once part of wider pastoral landscapes with distinctive associated meadows, it is now widely transformed by intensive grazing and transitions are commonplace.

R22 – [E22] Low and medium altitude hay meadow

The most common and widespread kind of traditionally managed meadow in deeper, well-drained mesic soils throughout the lowlands and foothills of temperate Europe, with many local types differing according to regional climate, terrain and mowing traditions. Typically dominated by mixtures of productive grasses and herbs, it can be very species-rich with distinctive scarce and rare plants where traditional regimes of mowing, grazing and dunging are maintained.



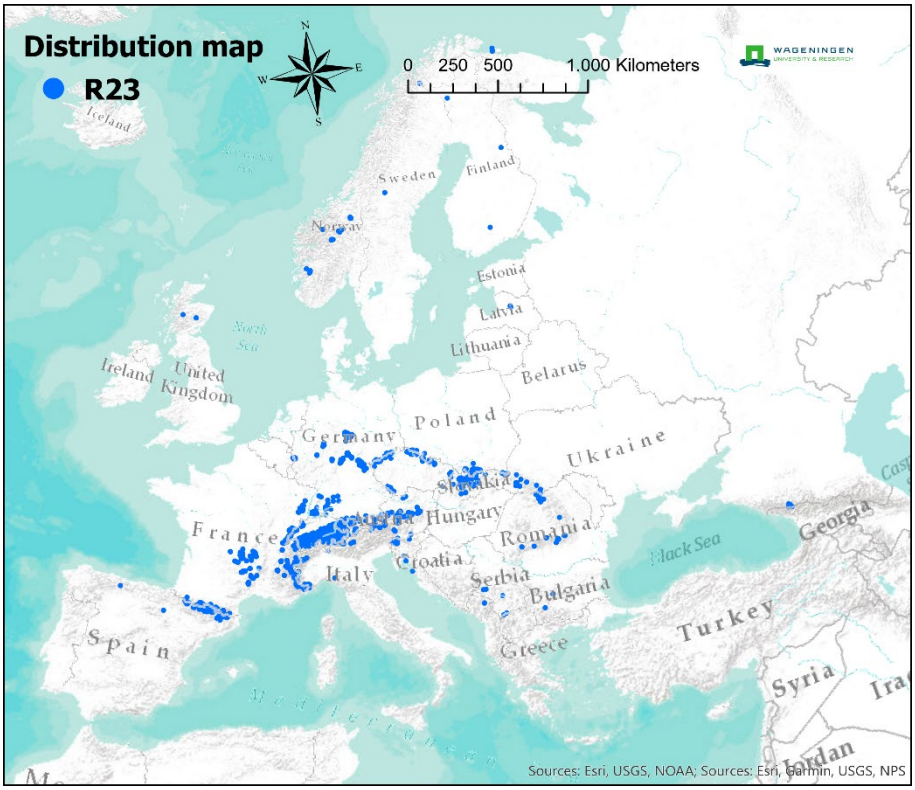


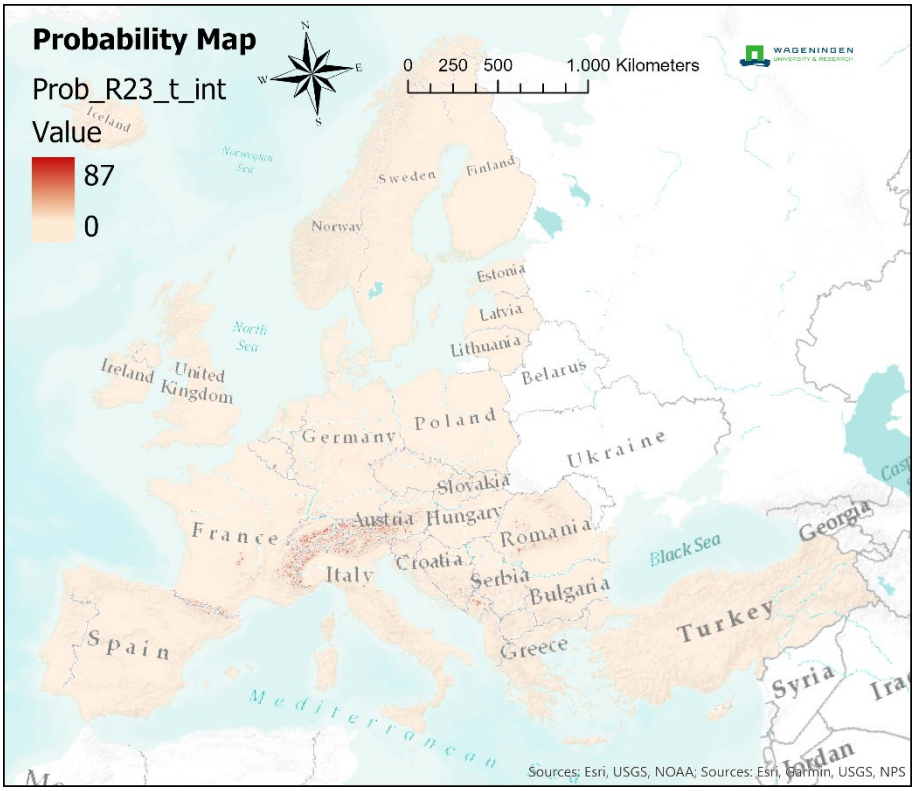


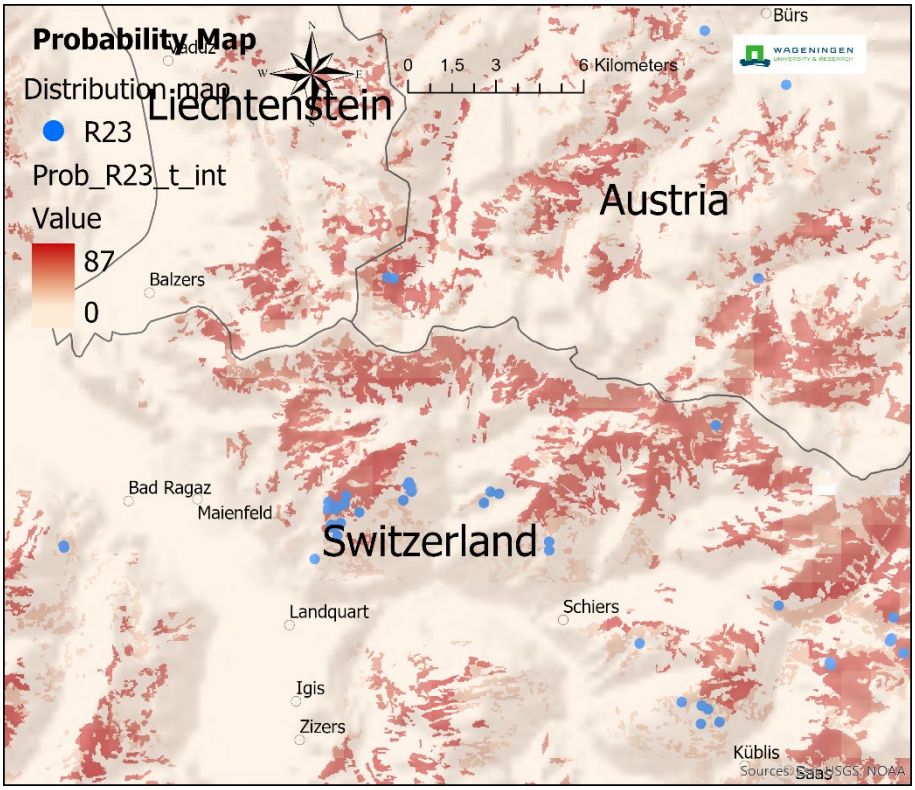
Often once part of wider agricultural landscapes with distinctive associated pastures, it is now widely transformed by shifts to silage production and transitions to intensive silage grasslands are commonplace.

R23 –[E23] Mountain hay meadow

The typical kind of traditionally-managed meadow on deep, well-drained, mesic soils throughout the mountains of northern and central Europe where there is a short cool growing season. There are many local types differing according to regional climate, terrain and farming traditions but the vegetation is typically dominated by mixtures of productive grasses and herbs, and can be species-rich with distinctive scarce and rare plants where traditional regimes of mowing, grazing and dunging are maintained.



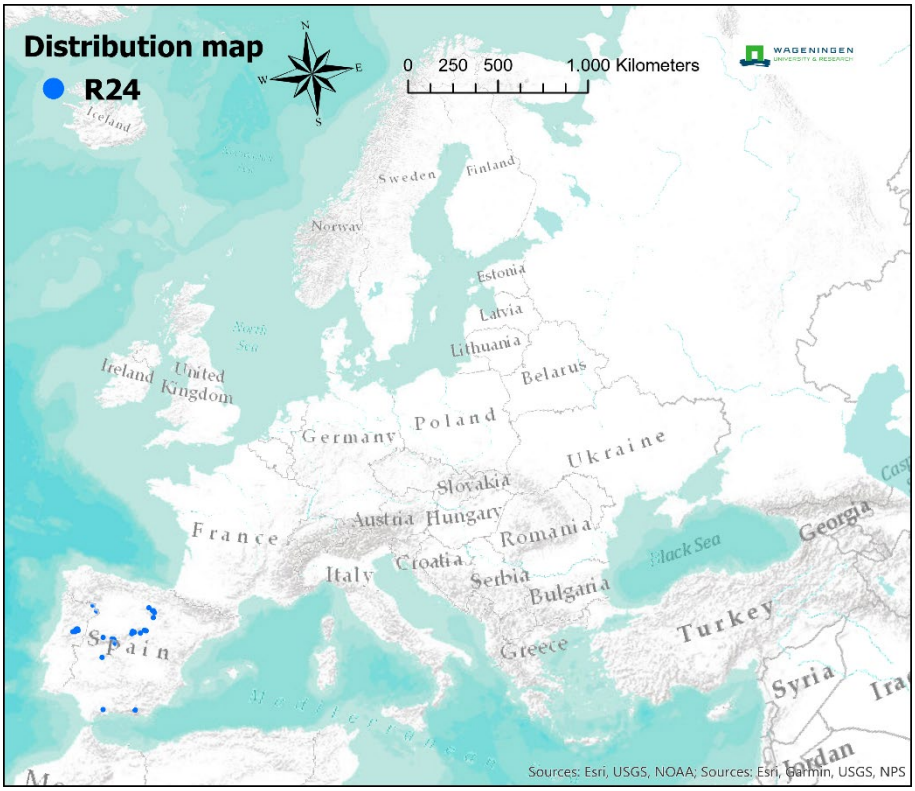


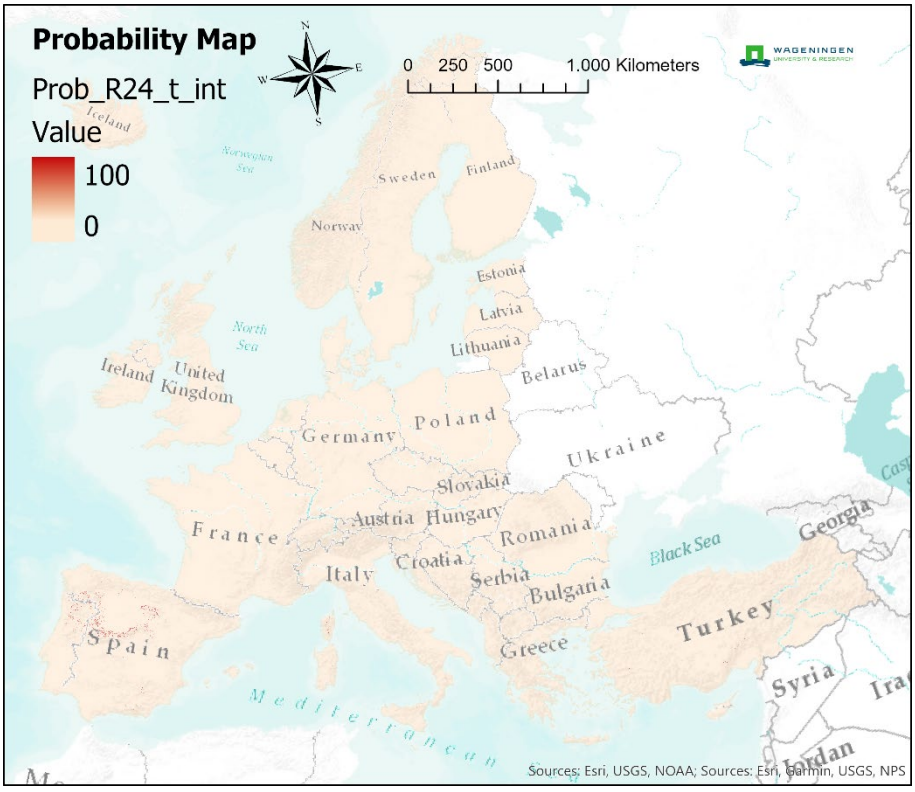


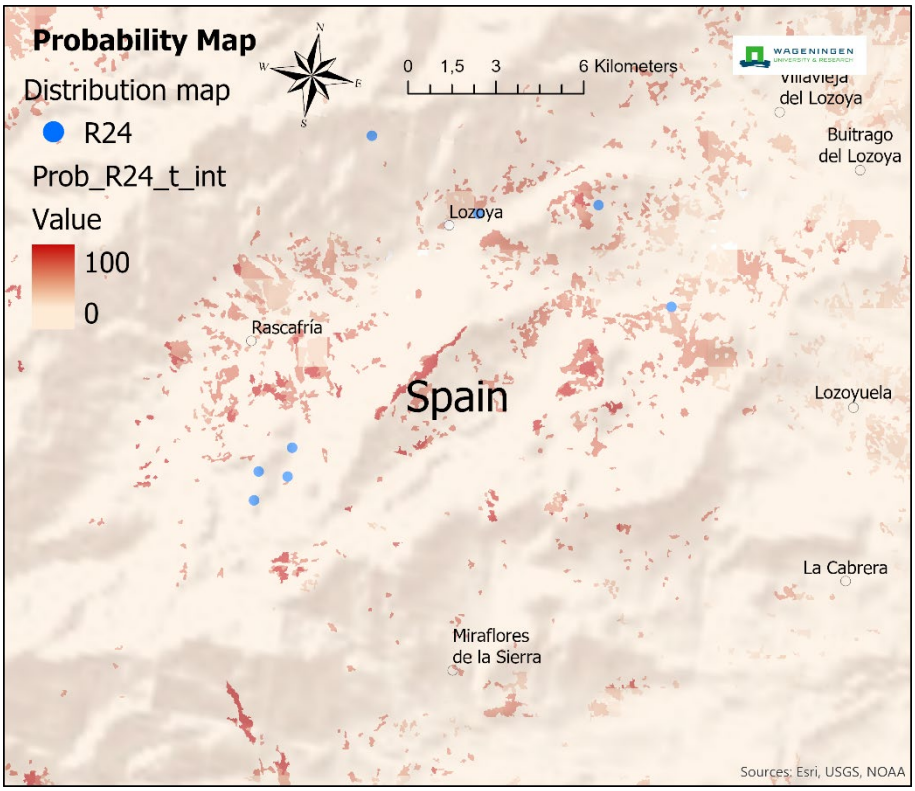
Often once part of wider agricultural landscapes with distinctive associated pastures, good examples of the habitat now often survive more fragmentarily and transitions to improved silage grassland are widespread.

R24 – [E24] Iberian summer pasture (vallicar)

Highly distinctive tall grass pasture and meadow associated with traditional cattle rearing in the lowlands and foothills of western Iberia where a mediterranean or submediterranean climate and the long-established grazing and occasional mowing regimes sustain a striking contingent of regional plants and association with dehesa.



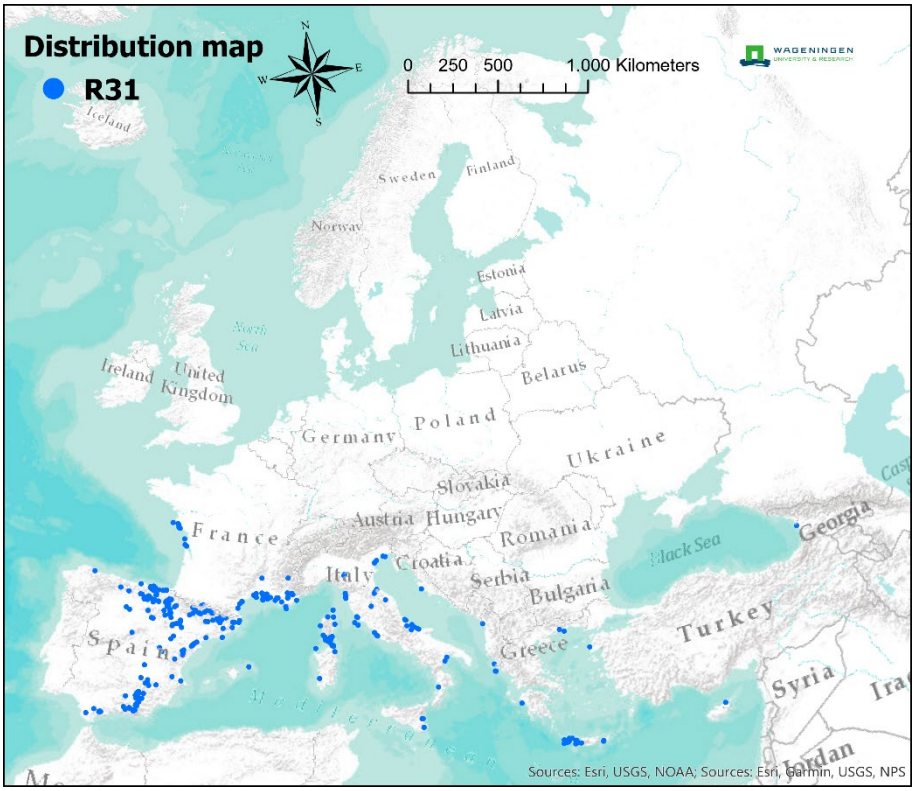


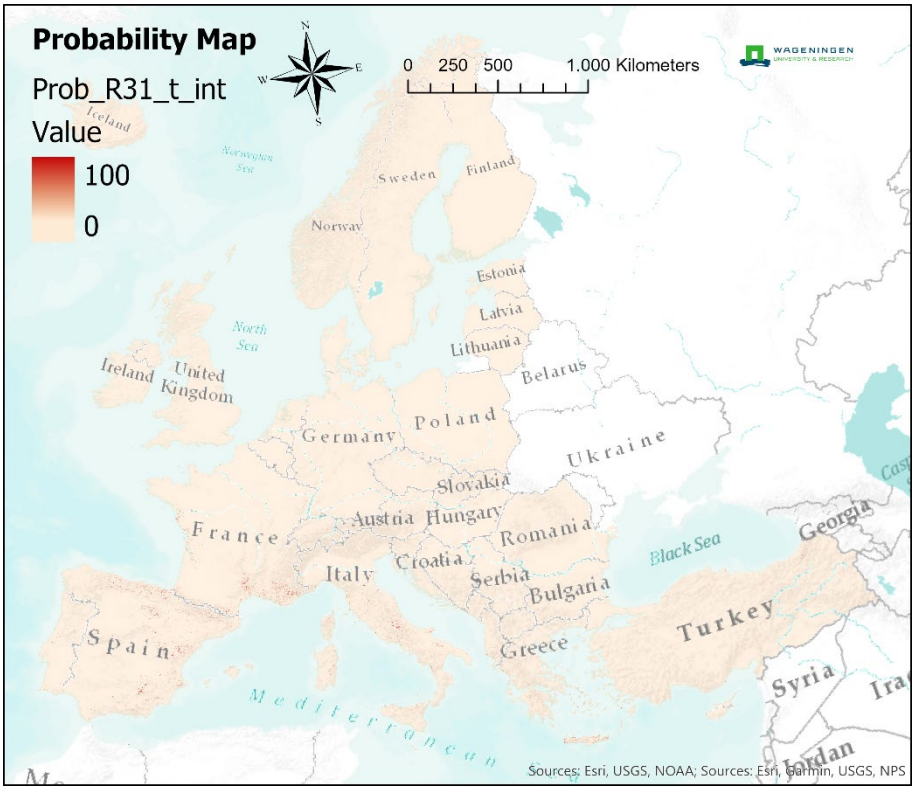


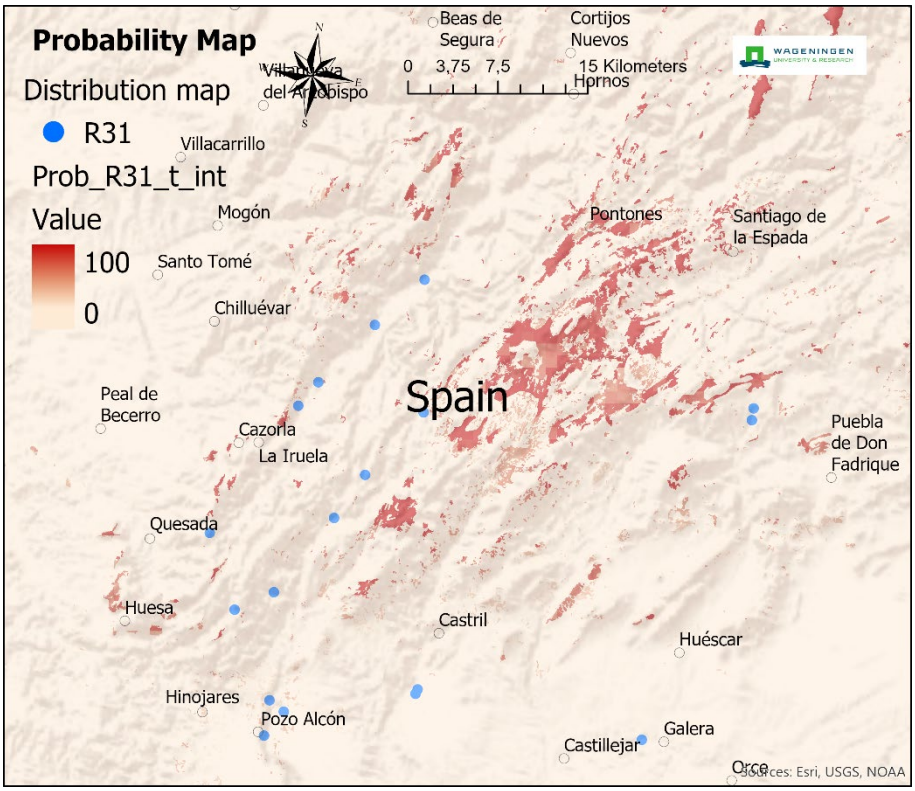
The substrate is sandy or clayey, often subject to temporary flooding with rapid dessication, conditions which affect the pattern of grass dominance.

R31 - [E31a] Mediterranean tall humid inland grassland

Rush- and tall grass-dominated vegetation of seasonally waterlogged soils, mostly acidic, occurring in depressions throughout the Mediterranean basin. Though not dependent on grazing, it can be a valuable source of fodder for cattle and sheep in traditional pastoral systems during summer when other pastures are dried up.

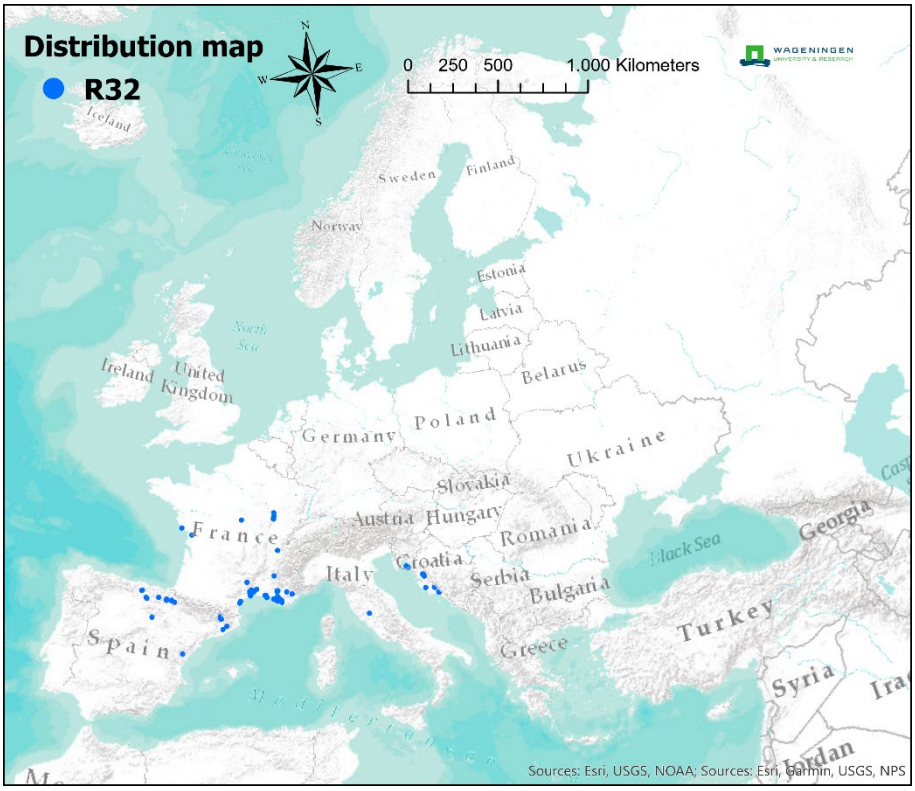


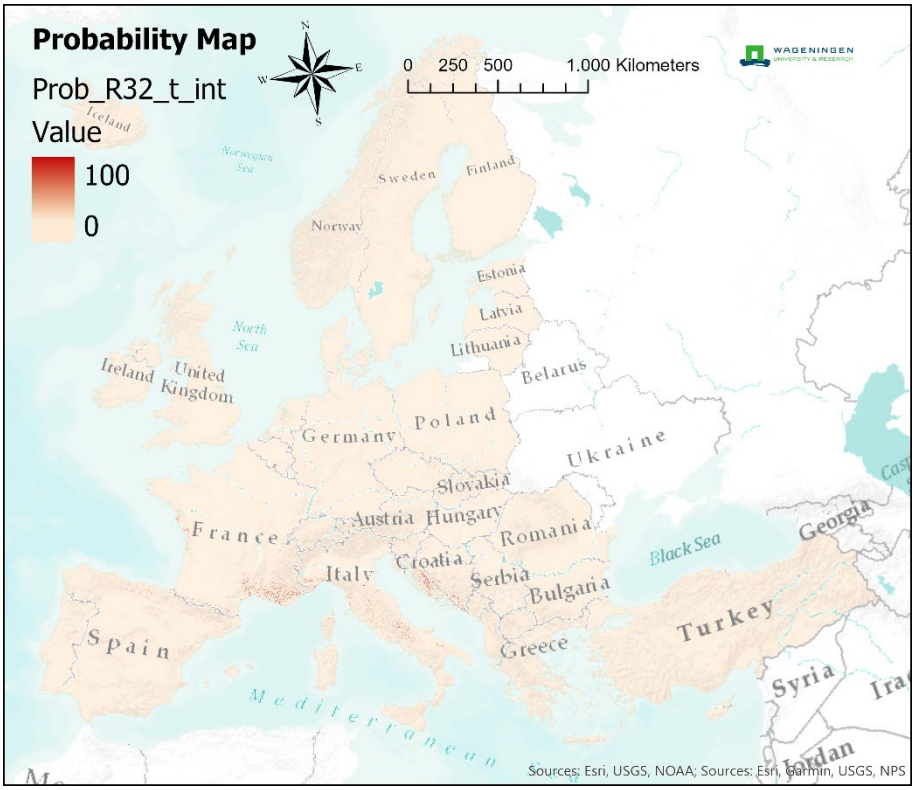


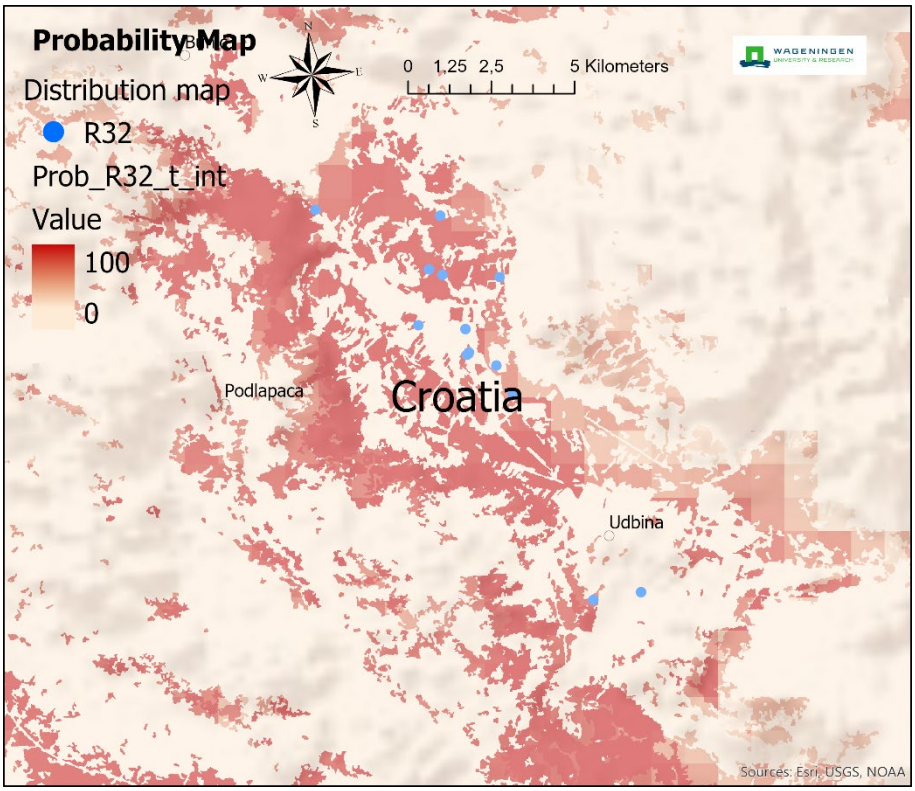

Probability Map
Distribution map
R31
Prob_R31_t_int
Value
100
0
Beas de Segura
Cortijos Nuevos
0 3,75 7,5
15 Kilometers
Hornos
Villacarrillo
Mogón
Santo Tomé
Chilluévar
Pontones
Santiago de la Espada
Spain
Peal de Becerro
Cazorla
La Iruela
Puebla de Don Fadrique
Quesada
Huesa
Castril
Huéscar
Hinojares
Pozo Alcón
Galera
Castillejar
Orce
Sources: Esri, USGS, NOAA

R32 - [E32a] Mediterranean short moist grassland of lowlands

Short species-rich grassy sward, traditionally sustained by heavy grazing, on clay soils through the Mediterranean region where there is winter waterlogging and distinctive surface cracking in the droughty summer.

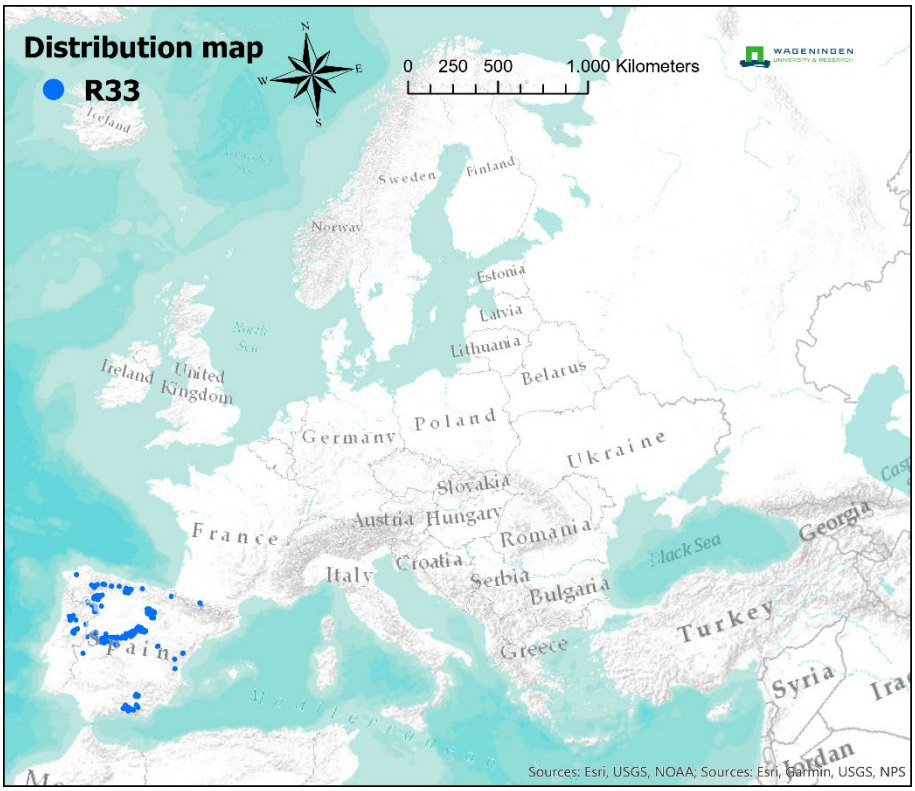


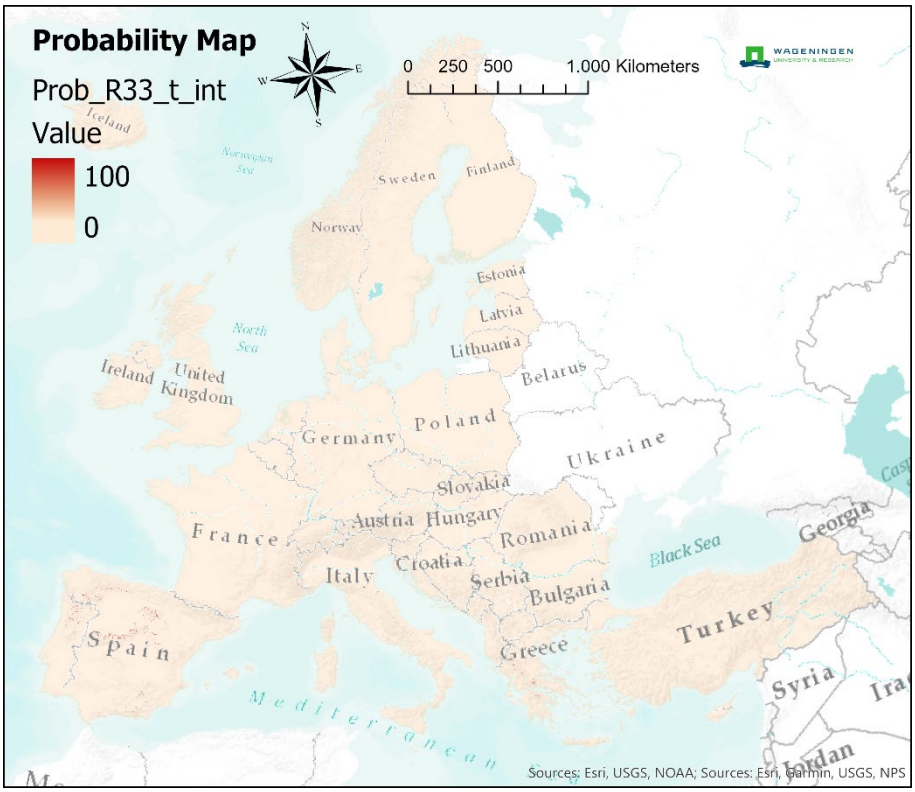


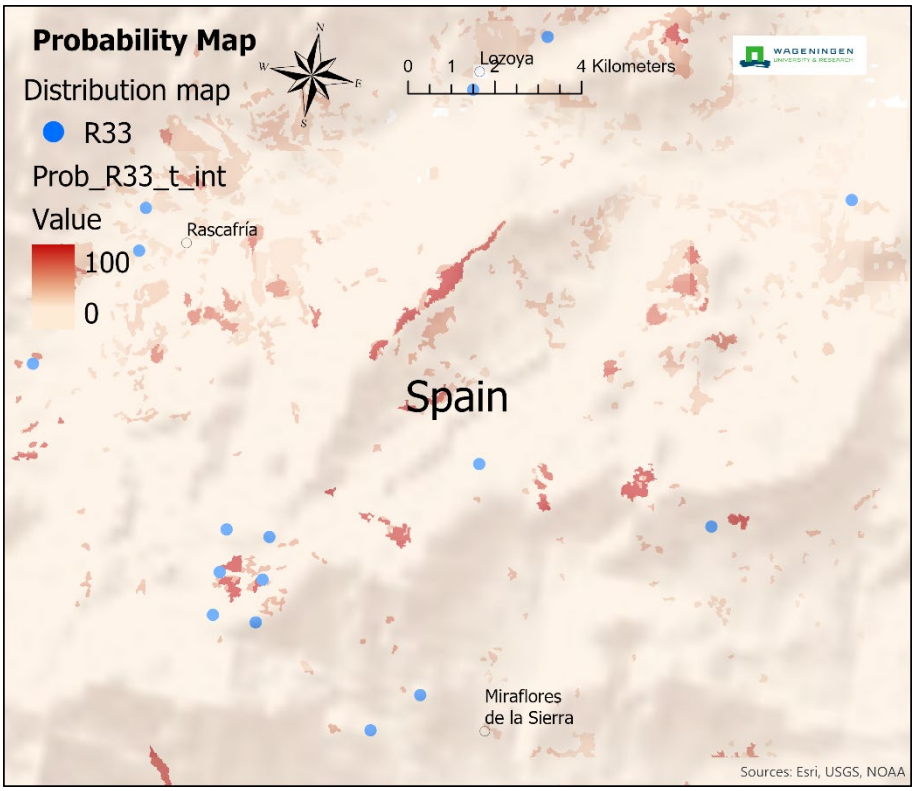

Probability Map
Distribution map
R32
Prob_R32_t_int
Value
100
0
N
W
E
S
0 1,25 2,5 5 Kilometers
WAGENINGEN
Podlapaca
Croatia
Udbina
Sources: Esri, USGS, NOAA

R33 - [E32b] Mediterranean short moist grassland of mountains

Closed tussocky grassland of moist ground at high altitudes in the west Mediterranean which, remaining green through the summer, provide valuable grazing for transhumant cattle and sheep.

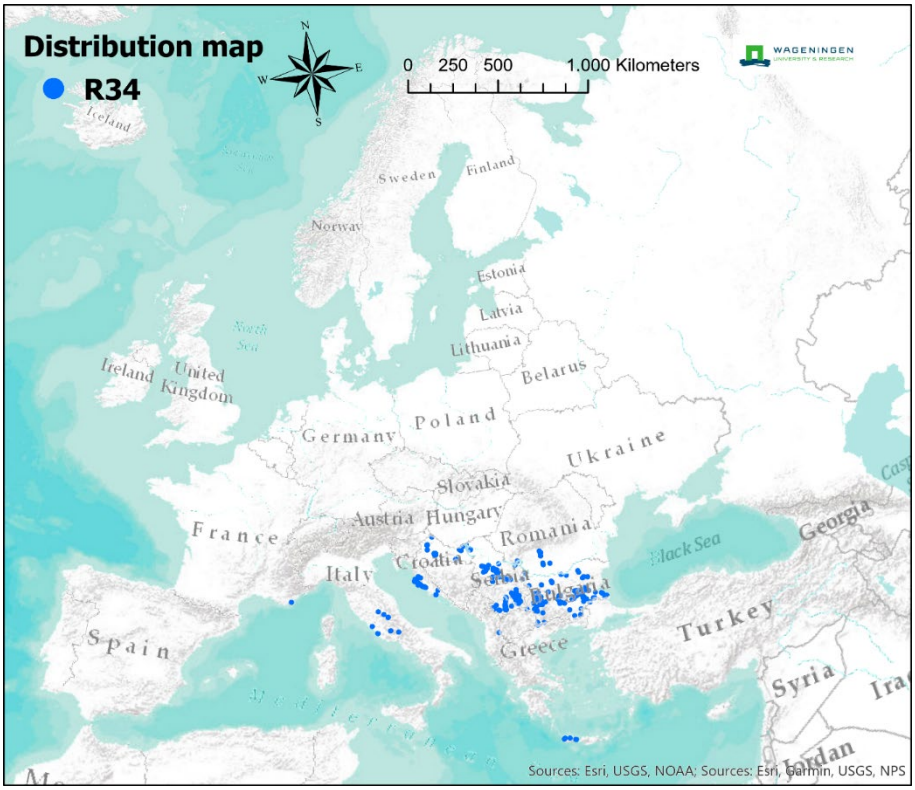


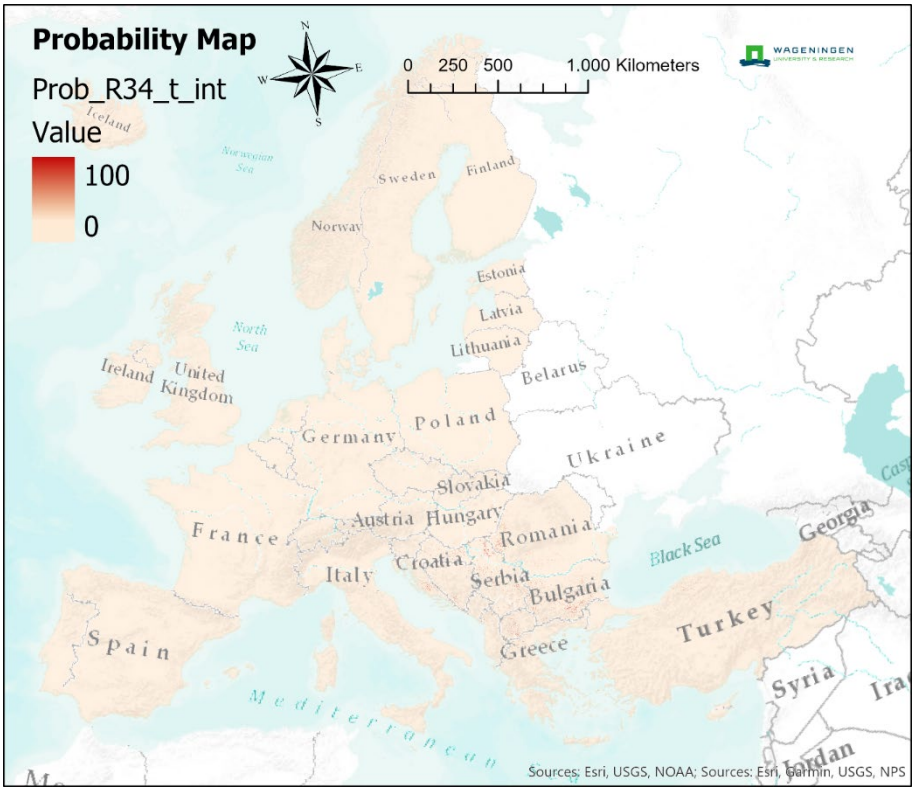


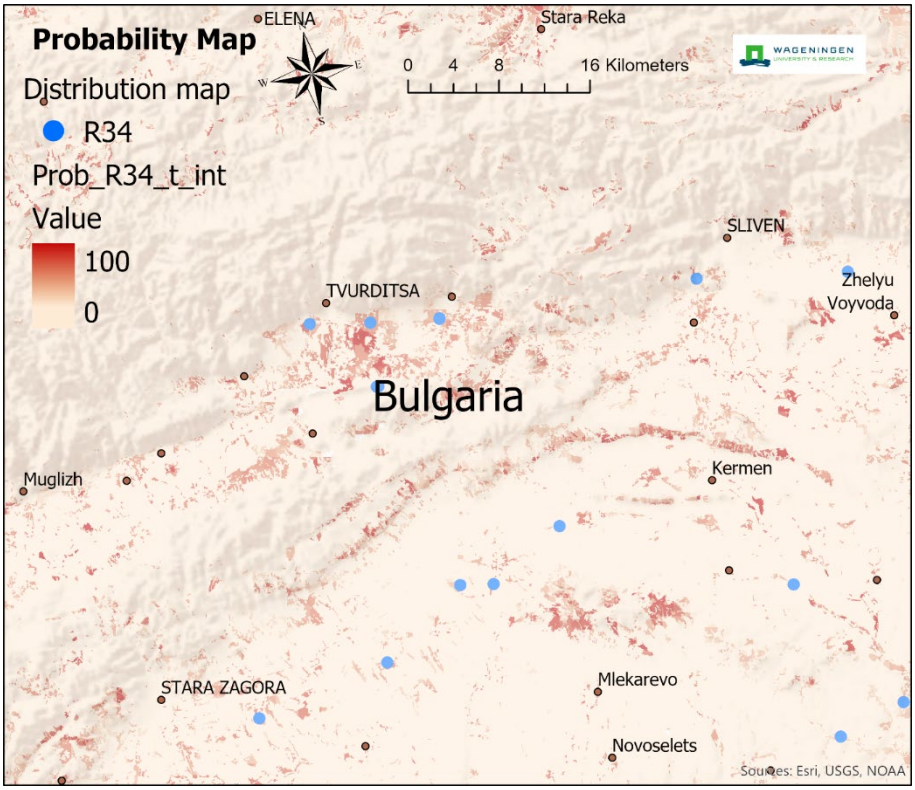

Probability Map
Distribution map
R33
Prob_R33_t_int
Value
100
0
Rascafría
Lozoya
0 1 2 4 Kilometers
Spain
Miraflores
de la Sierra
Sources: Esri, USGS, NOAA

R34 - [E33] Submediterranean moist meadow

Moist meadows of sandy to clayey, mesotrophic to eutrophic soils on riverside terraces and gentle slopes, mainly within the lowlands and sub-montane zone of south-eastern Europe, extending westwards to central Italy. Winter and spring flooding is common but later in the season the ground may dry up and become locally saline. The species composition reflects regional differences in temperature and rainfall but patterns of mowing and grazing can also affect the species composition.

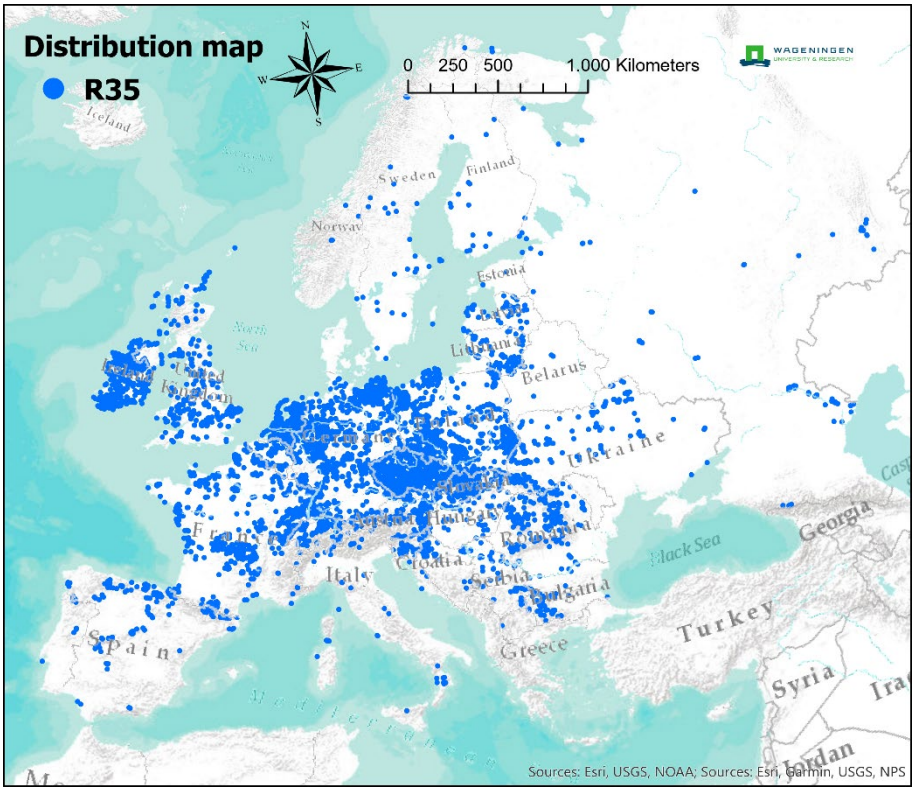


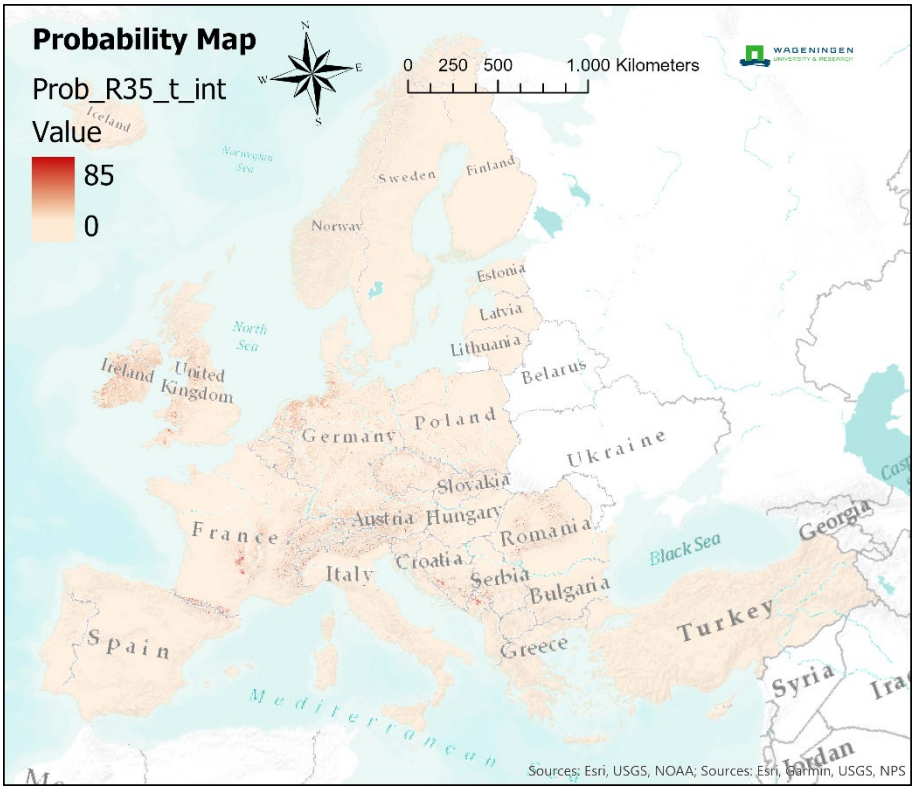


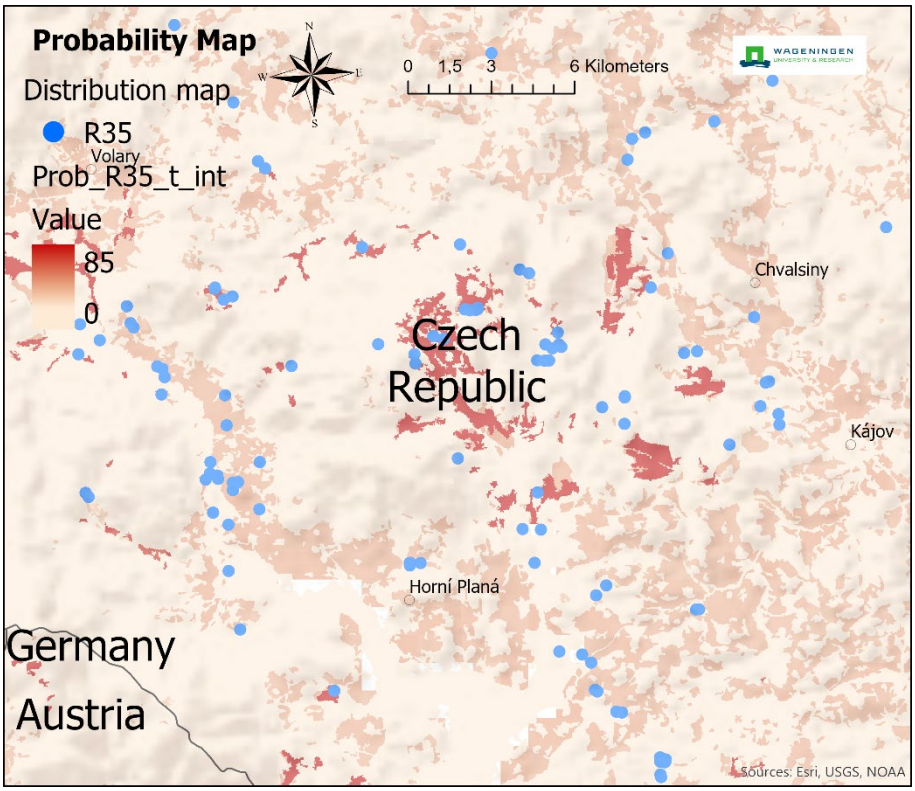

Probability Map
Distribution map
R34
Prob_R34_t_int
Value
100
0
ELENA
Stara Reka
0 4 8 16 Kilometers
WAGENINGEN
SLIVEN
Zhelyu Voyvoda
TVURDITSA
Bulgaria
Muglizh
Kermen
STARA ZAGORA
Mlekarevo
Novoselets
Sources: Esri, USGS, NOAA

R35 - [E34a] Moist or wet mesotrophic to eutrophic hay meadow

Meadows of moist, sometimes seasonally flooded, nutrient-rich soils on floodplains and in brook-valleys throughout lowland and submontane Europe. Traditionally cut for hay, though sometimes also light grazed in late summer and autumn, the vegetation is often species-rich with a diverse associated invertebrate fauna attracted by the abundance of flowers.



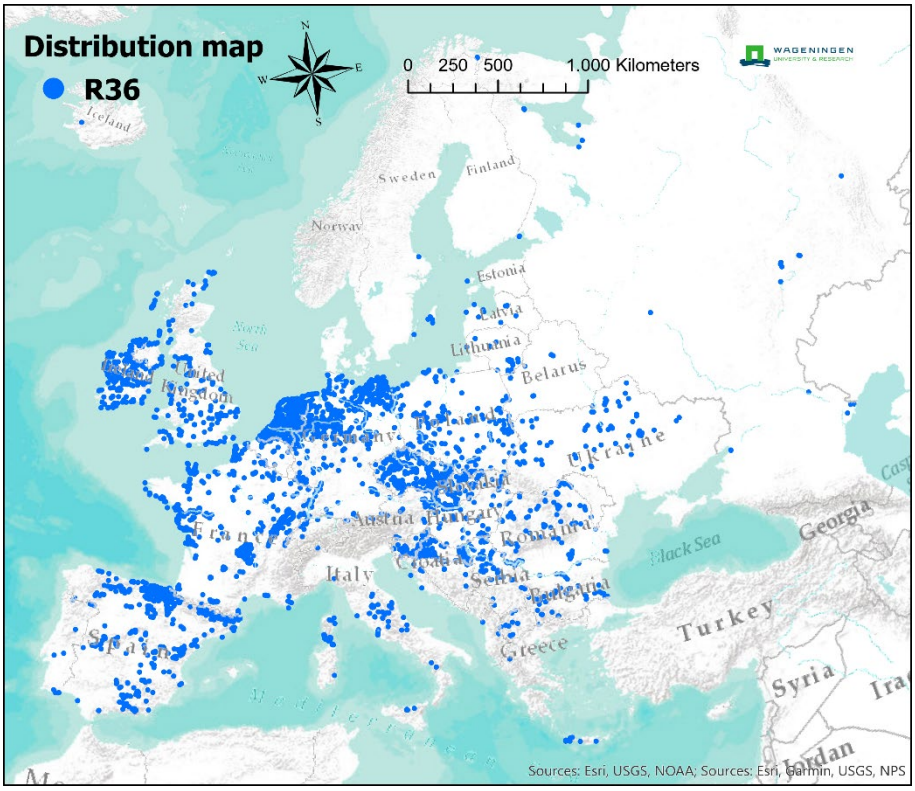


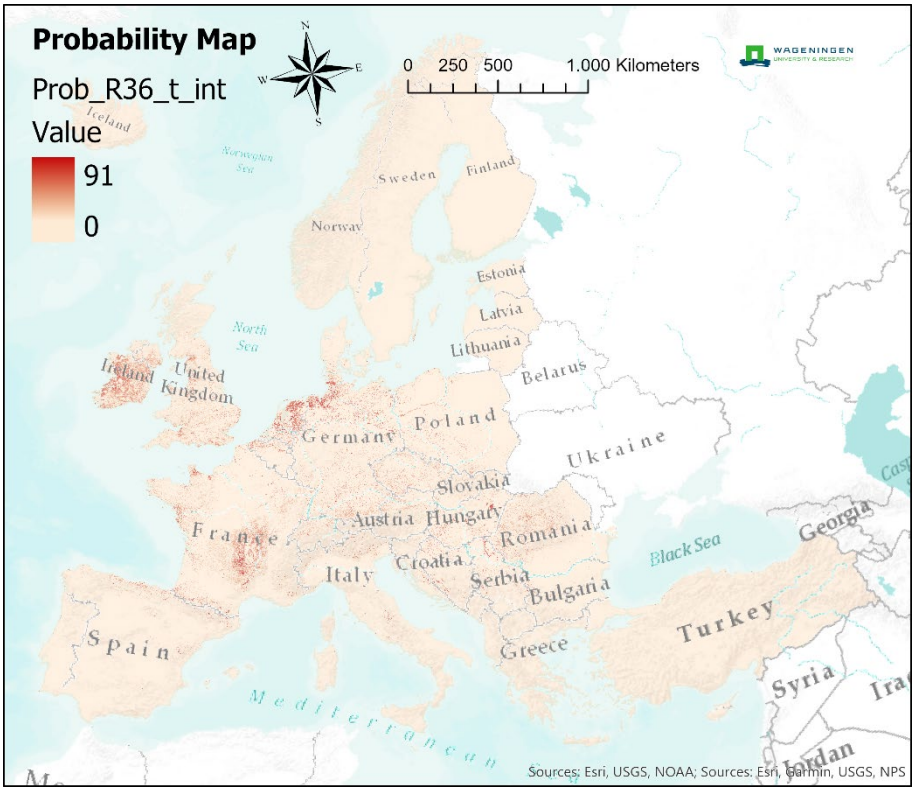


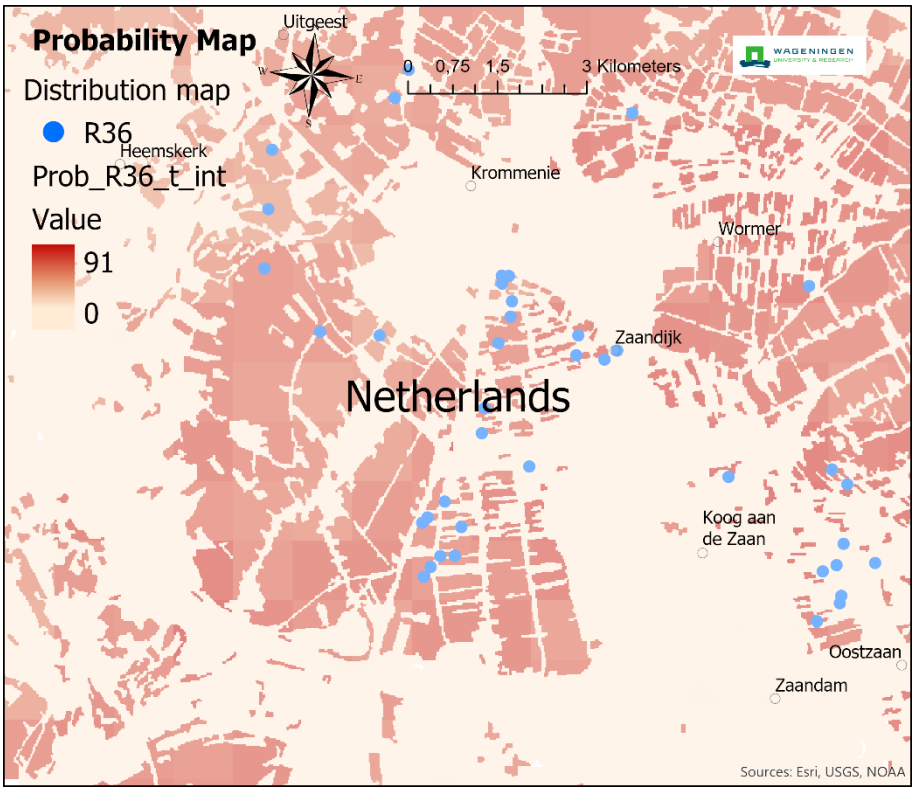
Often once part of wider agricultural landscapes with distinctive associated pastures, good examples of the habitat now often survive more fragmentarily and transitions to improved silage grassland on flood-protected land are widespread.

R36 - [E34b] Moist or wet mesotrophic to eutrophic pasture

Pastures of moist to wet, mesotrophic to eutrophic soils, generally inundated during winter and spring, on floodplains, lake shores and ditchsides throughout temperate Europe, sometimes with a brackish influence.



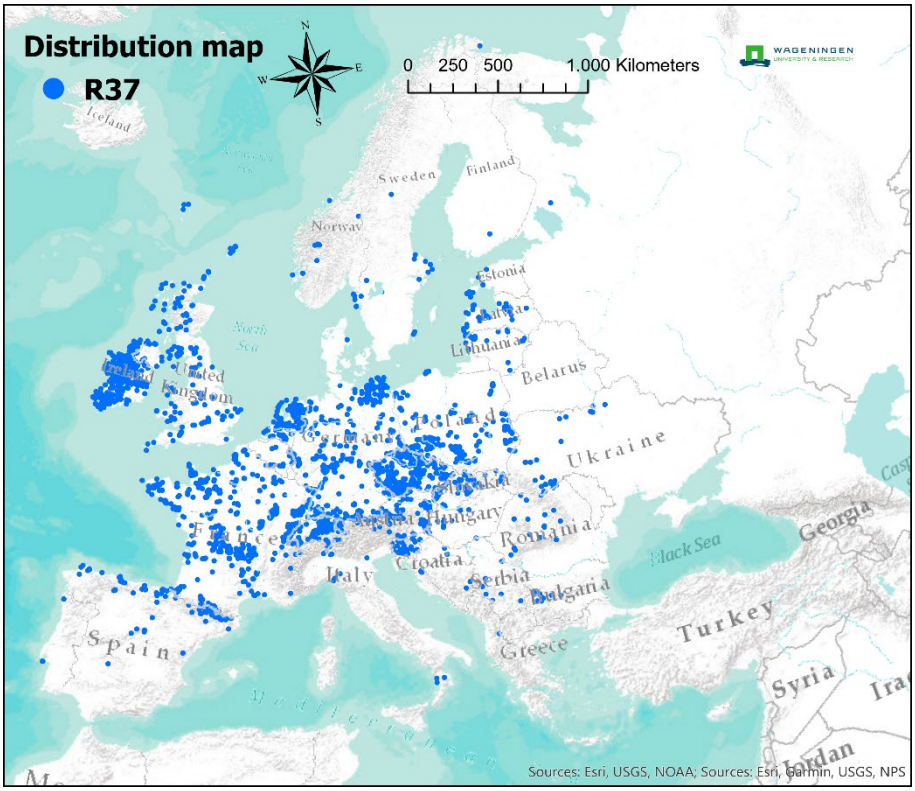


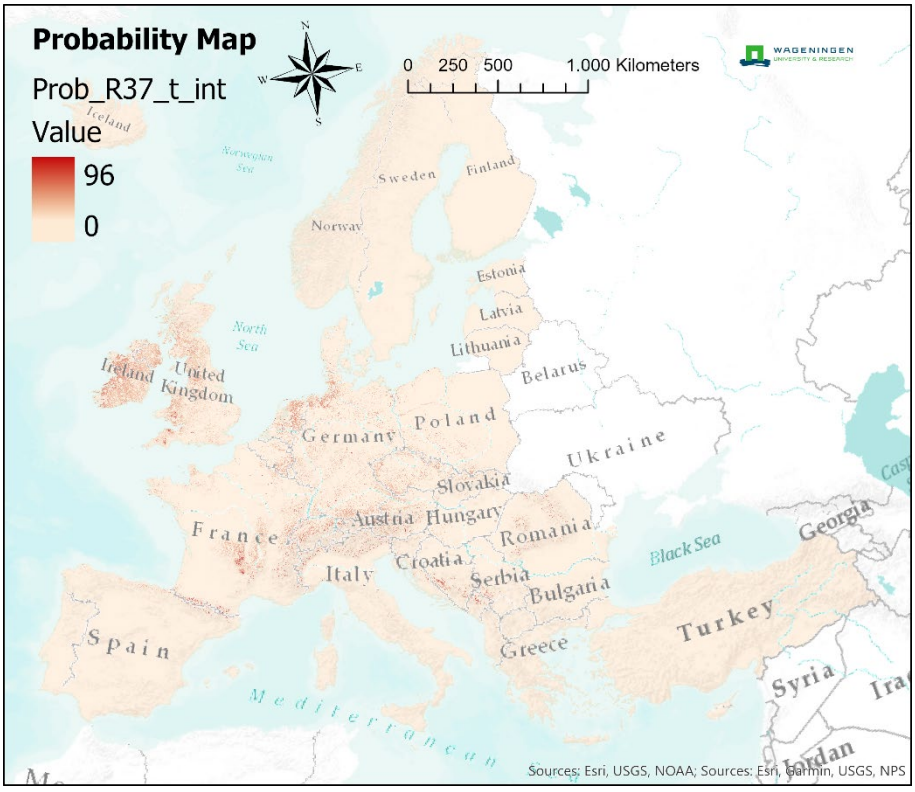


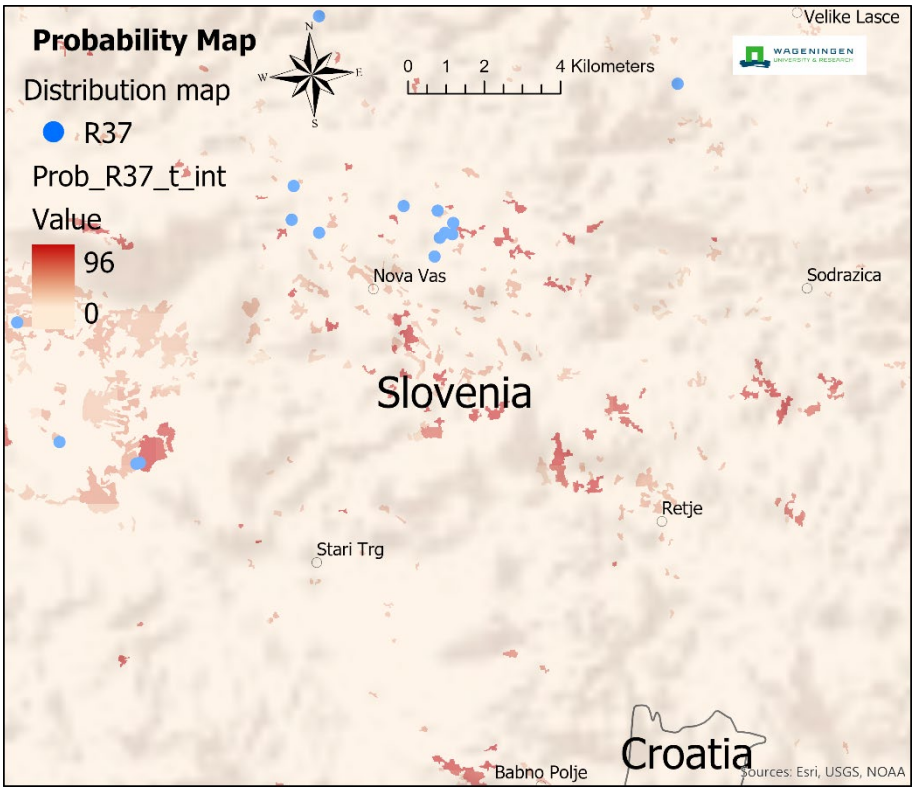
Grazing is mostly by cattle which can strongly affect the nutrient status and compaction of the soil and plants tolerant of inundation and trampling dominate here with a paucity of attractive flowers and a poor associated invertebrate fauna.

R37 - [E35] Temperate and boreal moist or wet oligotrophic grassland

Meadows and pastures of less nutrient-rich soils, wet for much of the year, though not inundated by flood-waters and drying out in summer, especially in more continental regions. The soils may be somewhat acidic to base-rich, sometimes peaty above, and through the lowlands and sub-montane zones of Europe, they have been part of wider landscapes among fens and drier grasslands.



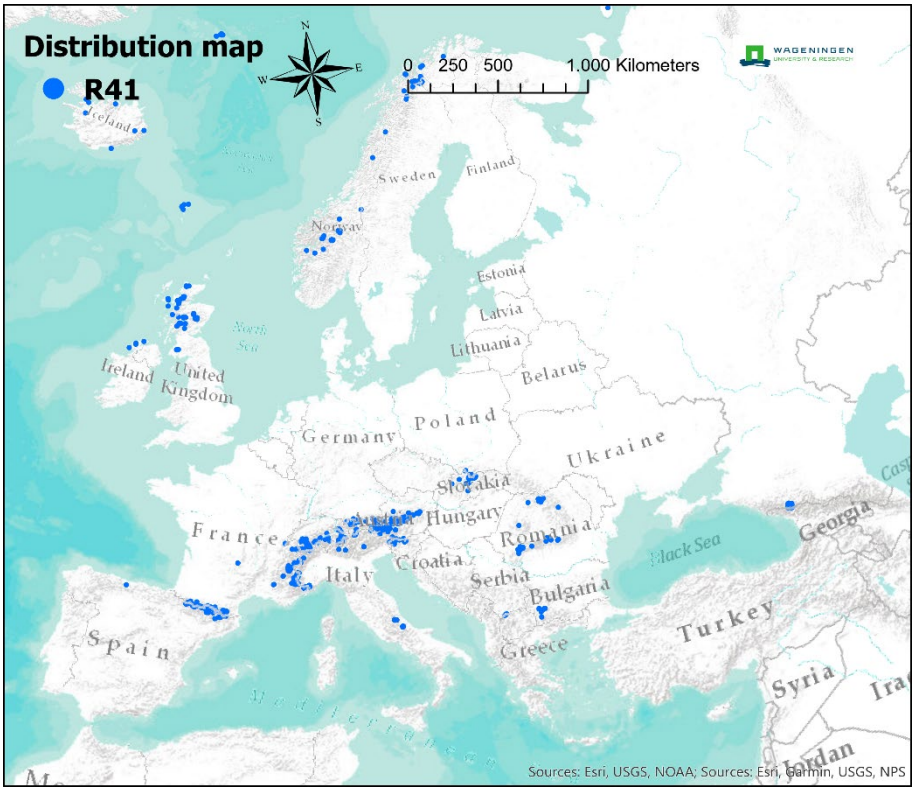


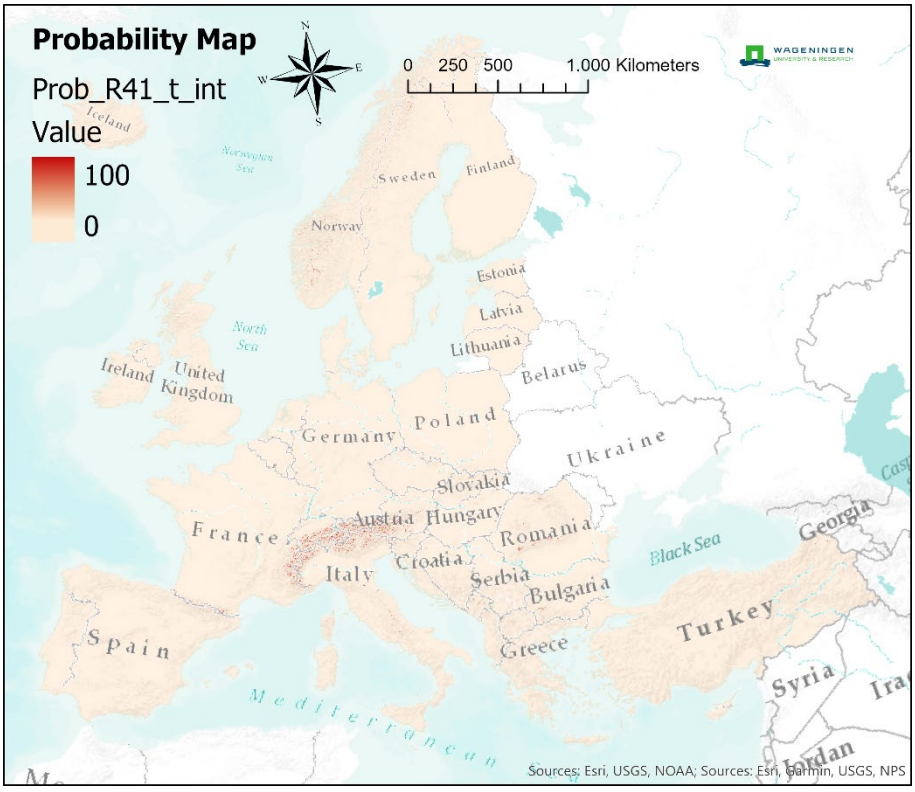


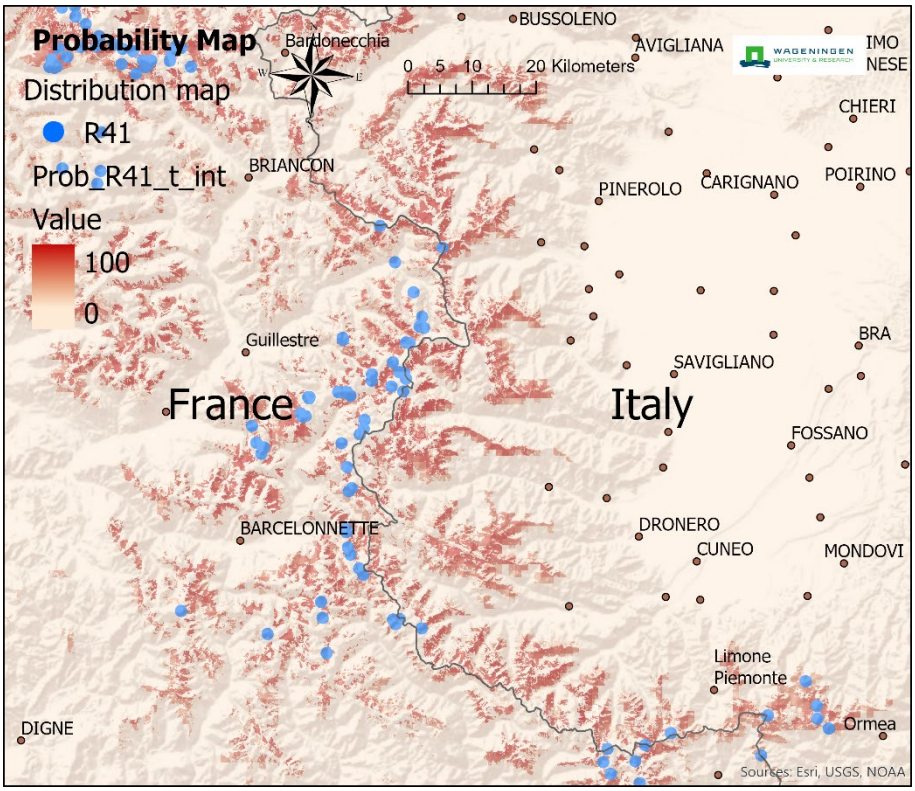
Less productive than flood meadows, they are mown just once a year, and towards the west of the range, often just lightly grazed, but they can be species-rich with some characteristic and striking species.

R41 – [E41] Snow-bed vegetation

Vegetation on skeletal, sometimes humic, soils developed beneath late-lying snow patches in boreal and arctic mountains and the subarctic lowlands of Europe. Dominated by grasses, sedges, herbs and cryptogams, the species composition depends on regional climate, altitude, bedrock and soil type, and sometimes includes endemics, particular on high south European peaks.

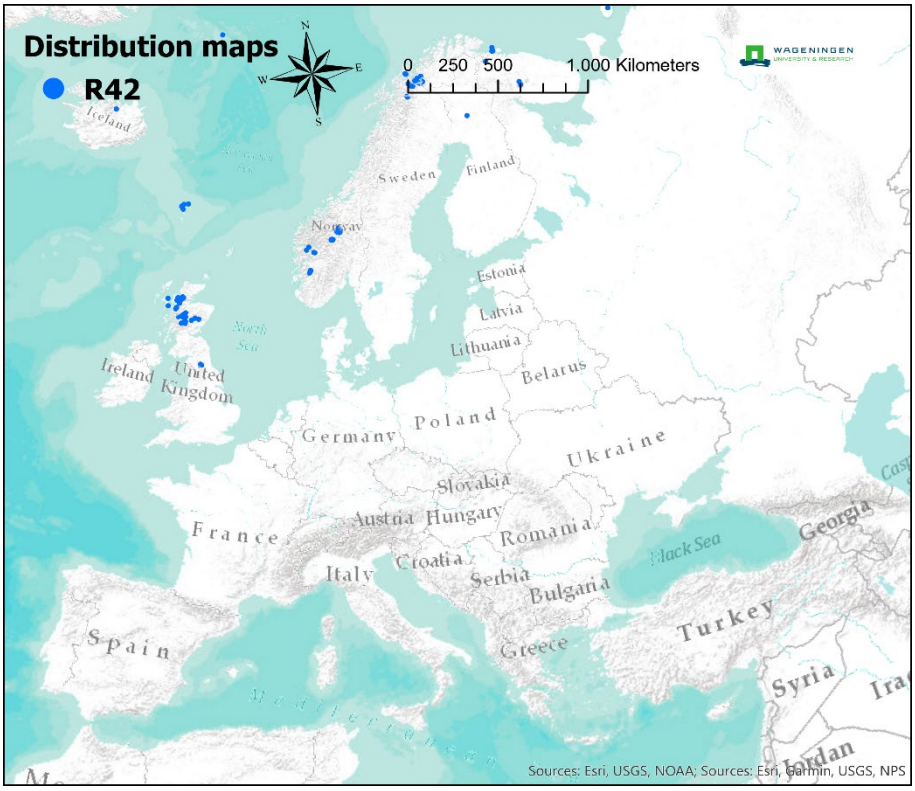


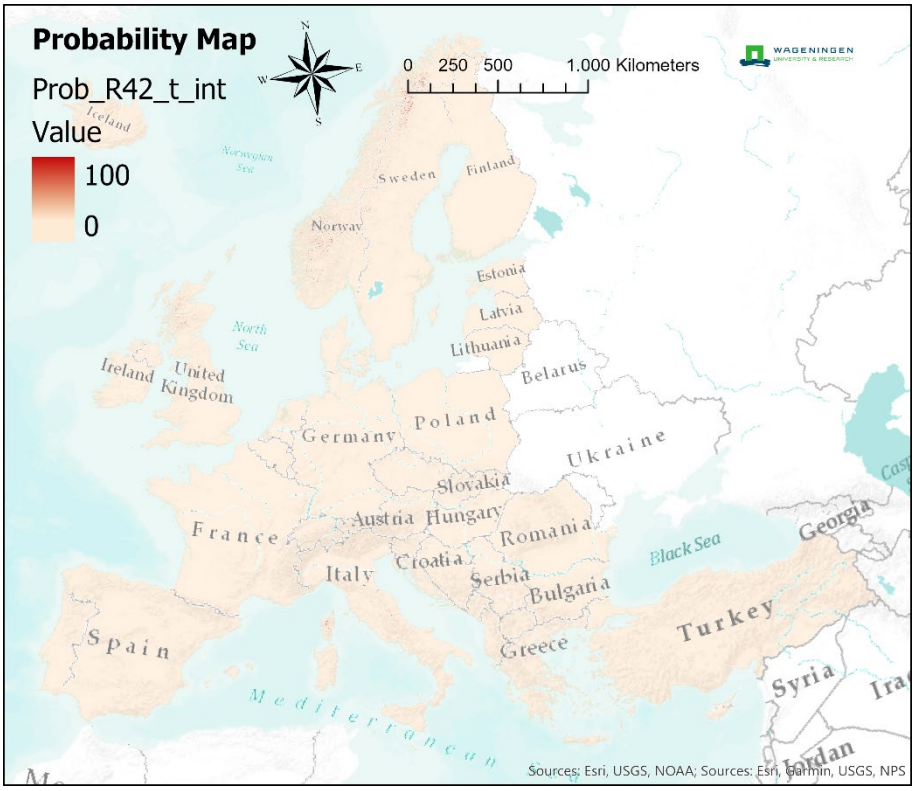


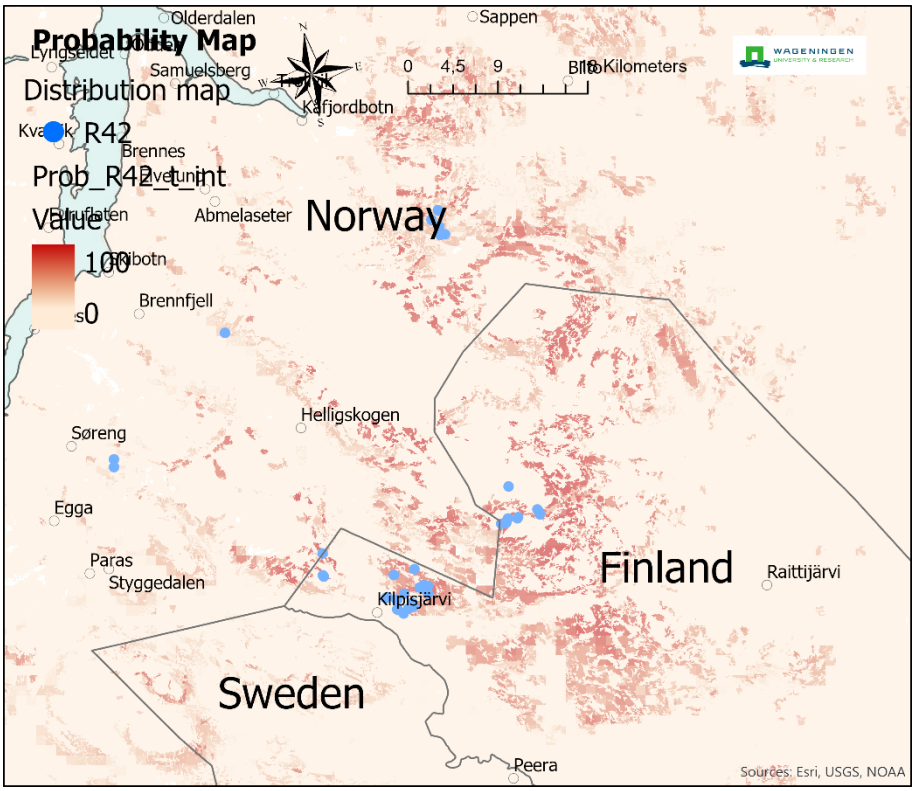

Probability Map
Distribution map
R41
Prob_R41_t_int
Value
100
0
Bardonecchia
BUSSOLENO
AVIGLIANA
0 5 10 20 Kilometers
WAGENINGEN
IMO
NESE
CHIERI
BRIANCON
PINEROLO
CARIGNANO
POIRINO
Guillestre
BRA
SAVIGLIANO
France
Italy
FOSSANO
BARCELONNETTE
DRONERO
CUNEO
MONDOVI
Limone
Piemonte
DIGNE
Ormea
Sources: Esri, USGS, NOAA

R42 – [E43a] Boreal and arctic acidophilous alpine grassland

Boreal and arctic acidophilous alpine grasslands, dominated by low graminoids and herbs, characteristic of shallow mostly base-poor soils with thick late snow-lie, occurring through the high mountains of Fennoscandia, Iceland and Scotland.

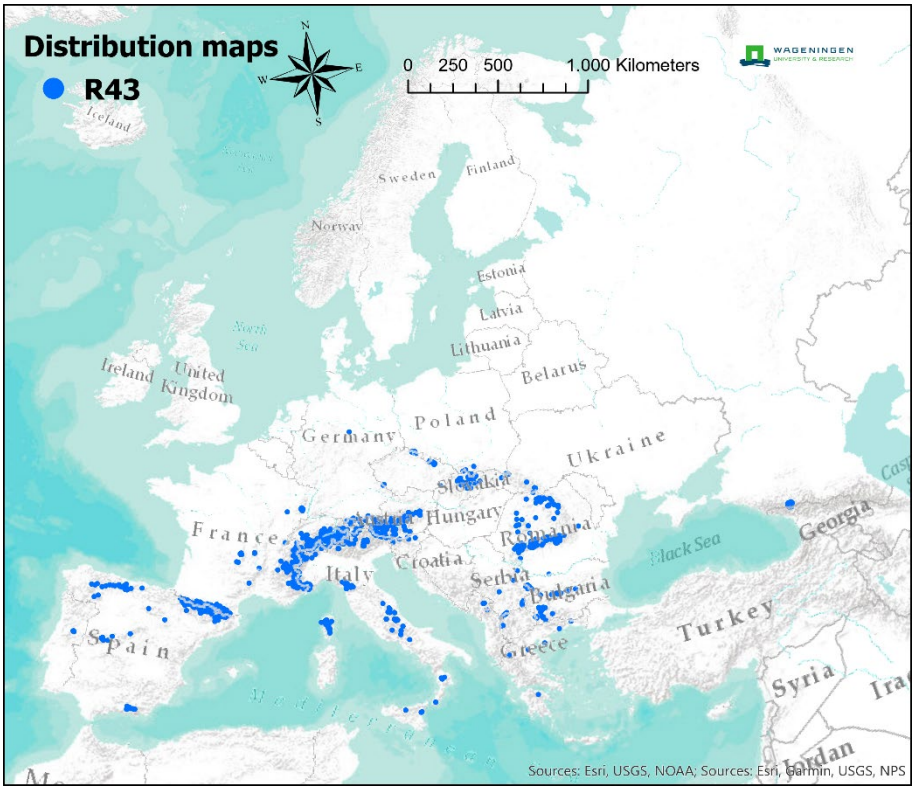


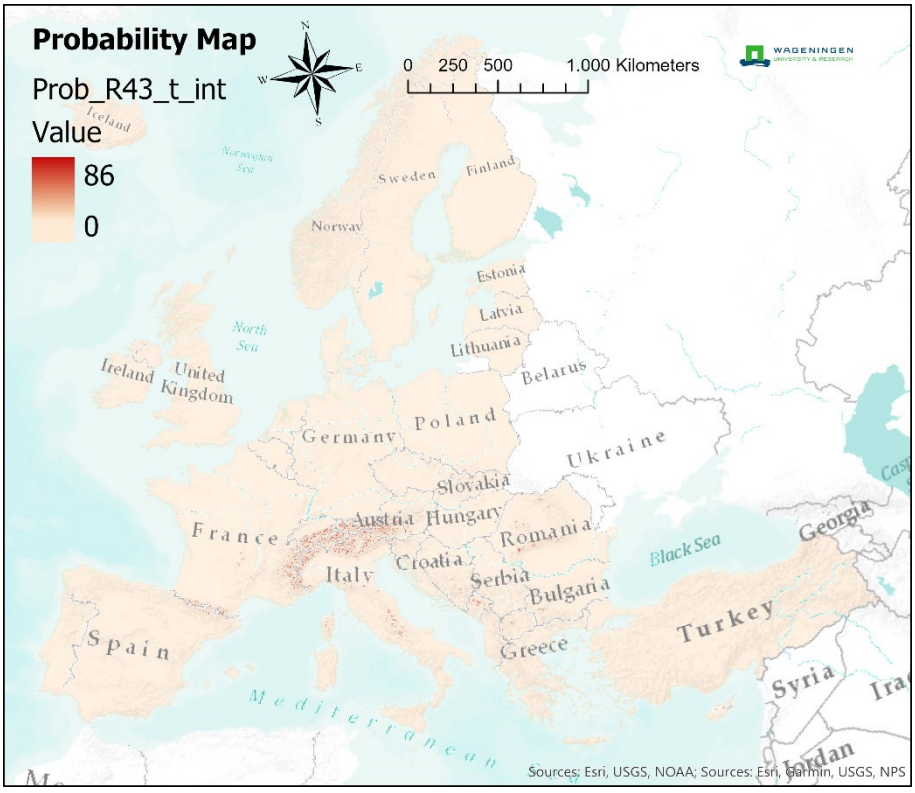


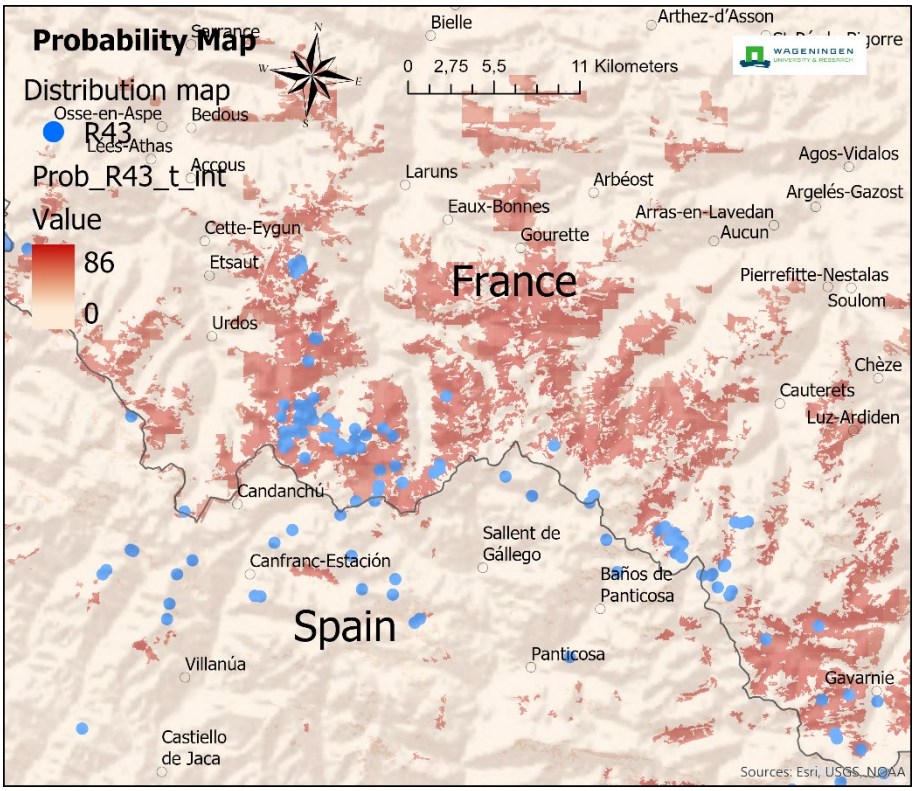

Probability Map
Distribution map
R42
Prob_R42_t_int
Value
100
0
Olderdalen
Sappen
Lyngseidet
Samuelsberg
Kåfjordbotn
0 4,5 9 18 Kilometers
Brennes
Abmelaseter
Norway
Brennfjell
Helligskogen
Søreng
Egga
Paras
Styggedalen
Finland
Raittijärvi
Kilpisjärvi
Sweden
Peera
Sources: Esri, USGS, NOAA

R43 – [E43b] Temperate acidophilous alpine grassland

Grassland and dwarf chamaephyte vegetation on skeletal and shallow soils over predominantly siliceous bedrocks in the alpine belt throughout the temperate mountains of Europe, typical of the highest summits and ridges, often very exposed to strong winds and largely blown clear of snow in the winter.

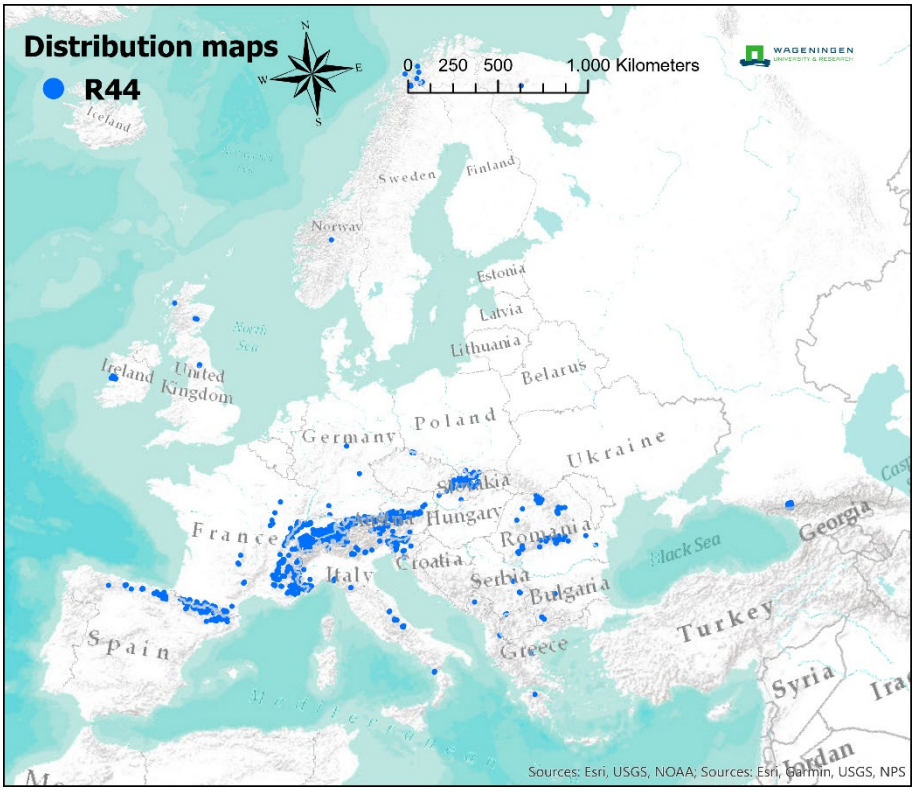


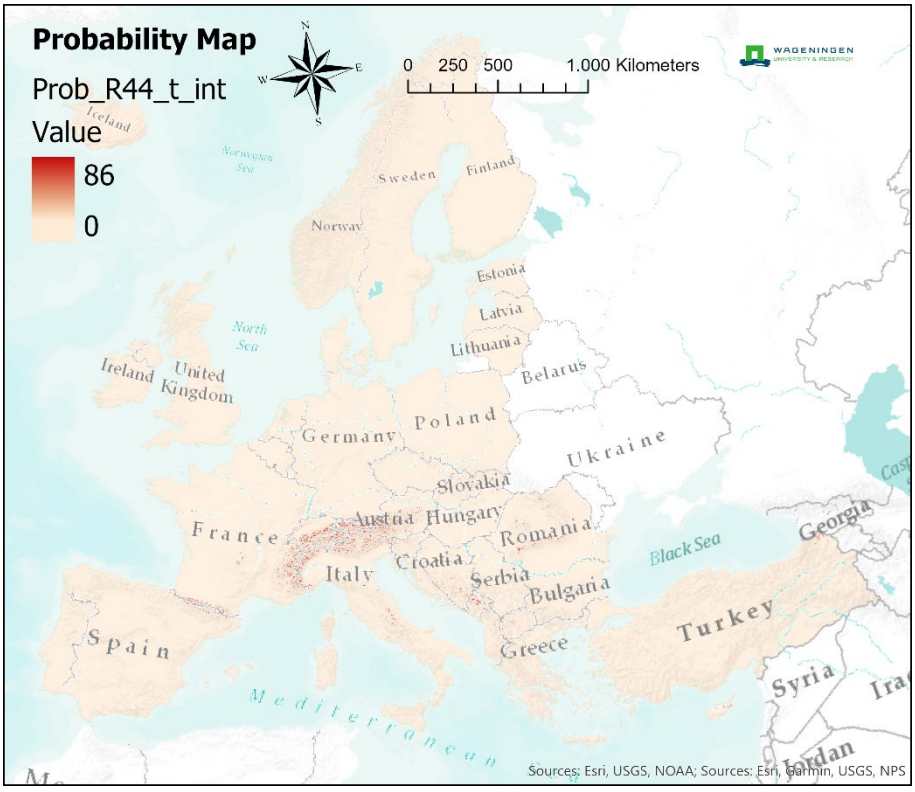


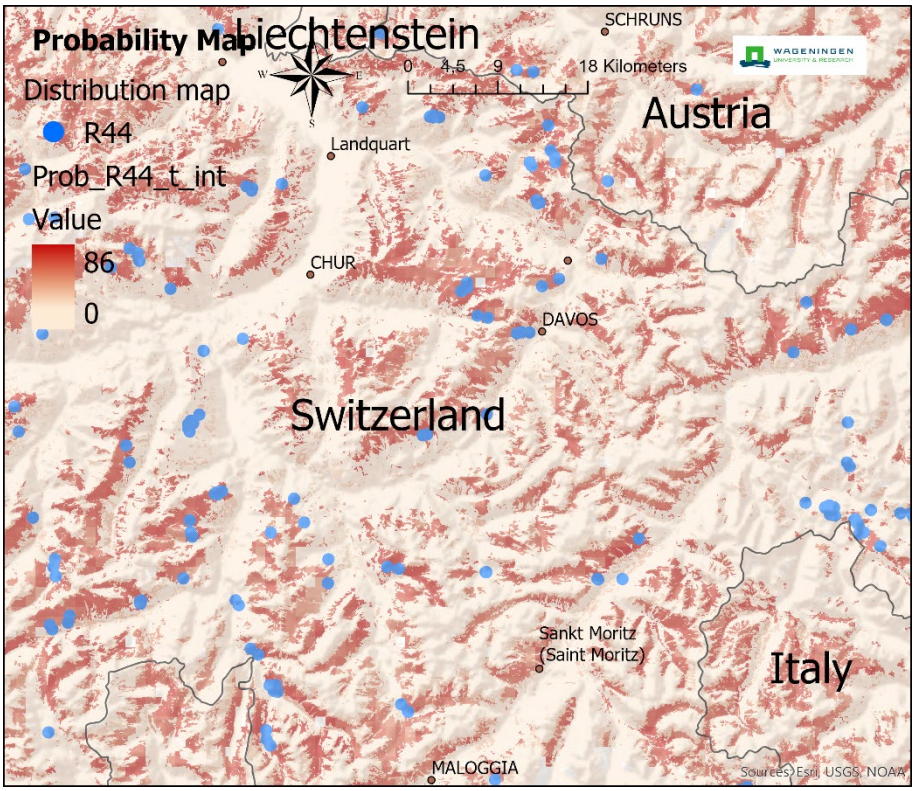

Probability Map
Distribution map
R43
Prob_R43_t_int
Value
86
0
0 2,75 5,5 11 Kilometers
Bielle
Arthez-d'Asson
Osse-en-Aspe
Bedous
Lees-Athas
Accous
Laruns
Arbéost
Agos-Vidalos
Argelés-Gazost
Eaux-Bonnes
Arras-en-Lavedan
Aucun
Gourette
Cette-Eygun
Etsaut
France
Pierrefitte-Nestalas
Soulom
Urdos
Chèze
Cauterets
Luz-Ardiden
Candanchú
Sallent de Gállego
Canfranc-Estación
Baños de Panticosa
Spain
Villanúa
Panticosa
Gavarnie
Castiello de Jaca
Sources: Esri, USGS, NOAA

R44 – [E44a] Arctic-alpine calcareous grassland

Grasslands on shallow, highly calcareous soils on limestone or dolomite slopes and ridges in the alpine or subalpine belts of the high mountains of the nemoral zone, being best developed in the Alps, but occurring also in the Carpathians and Pyrenees, with small fragmentary stands also in the Sudetes and in Scotland



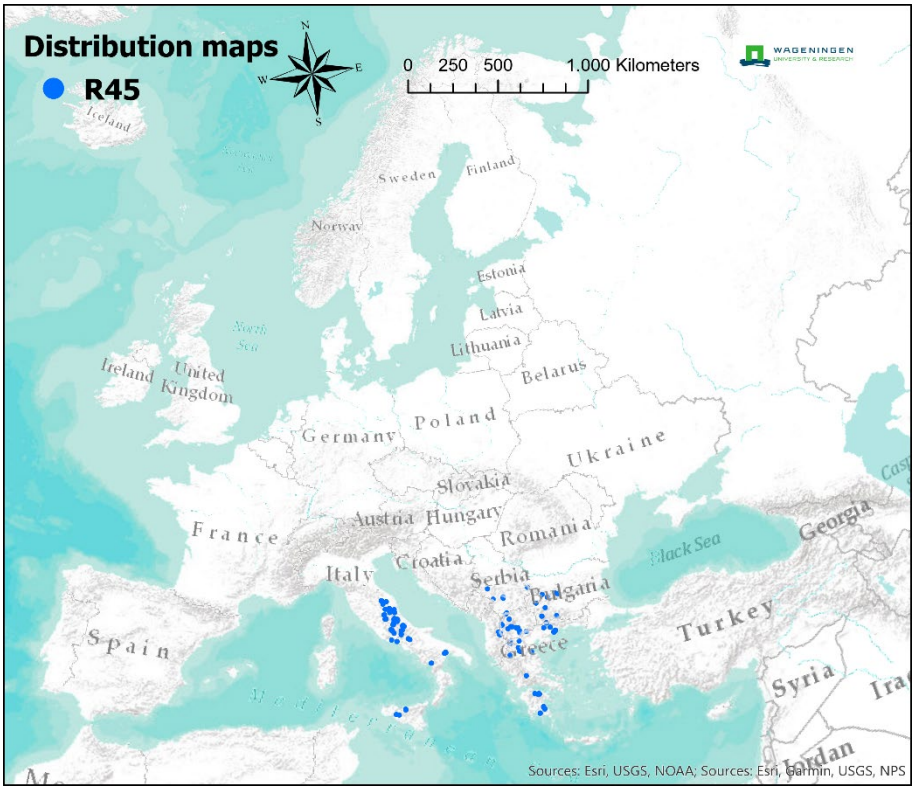


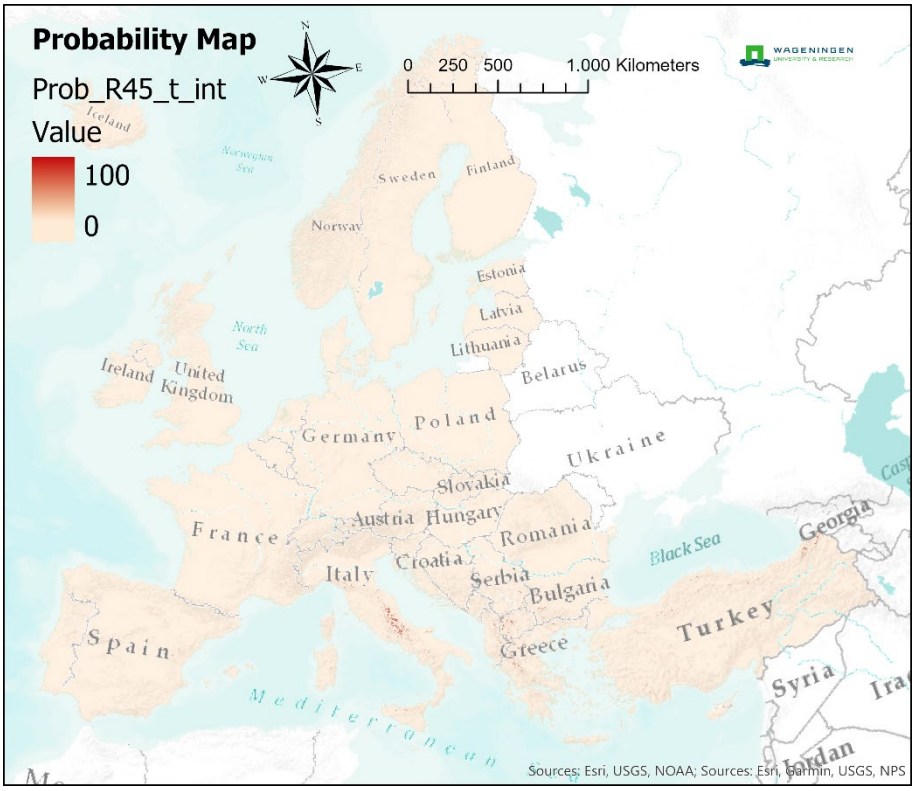


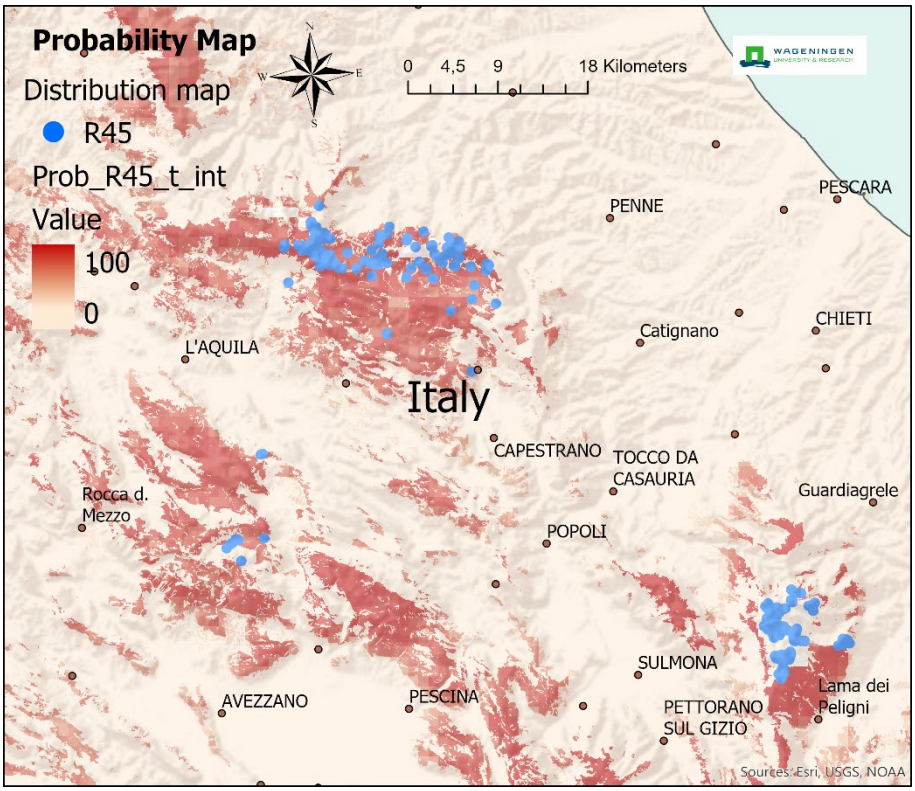
Grasses and sedges dominate, along with numerous small herbs, the cover varying from sparse to complete according to the soil depth.

R45 – [E44b] Alpine and subalpine calcareous grassland of the Balkans and Apennines

Grass-dominated vegetation of base-rich soilsd in the high mountains in the Balkans and Appenines including both primary vegetation above the tree-line but also secondary grasslands maintained by grazing at lower altitudes.

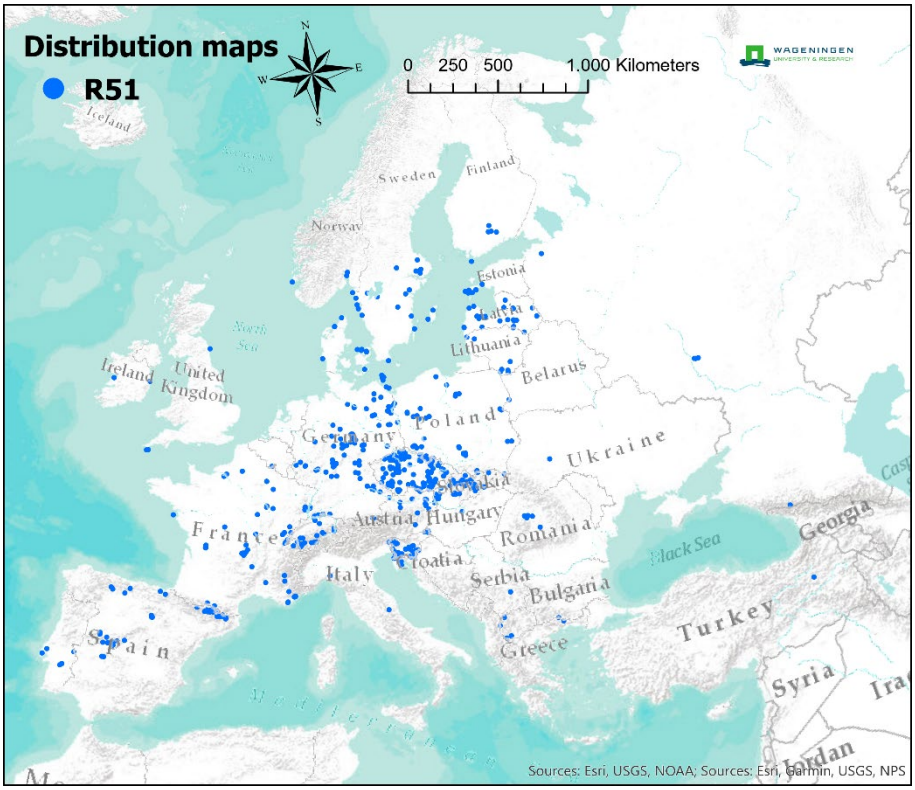


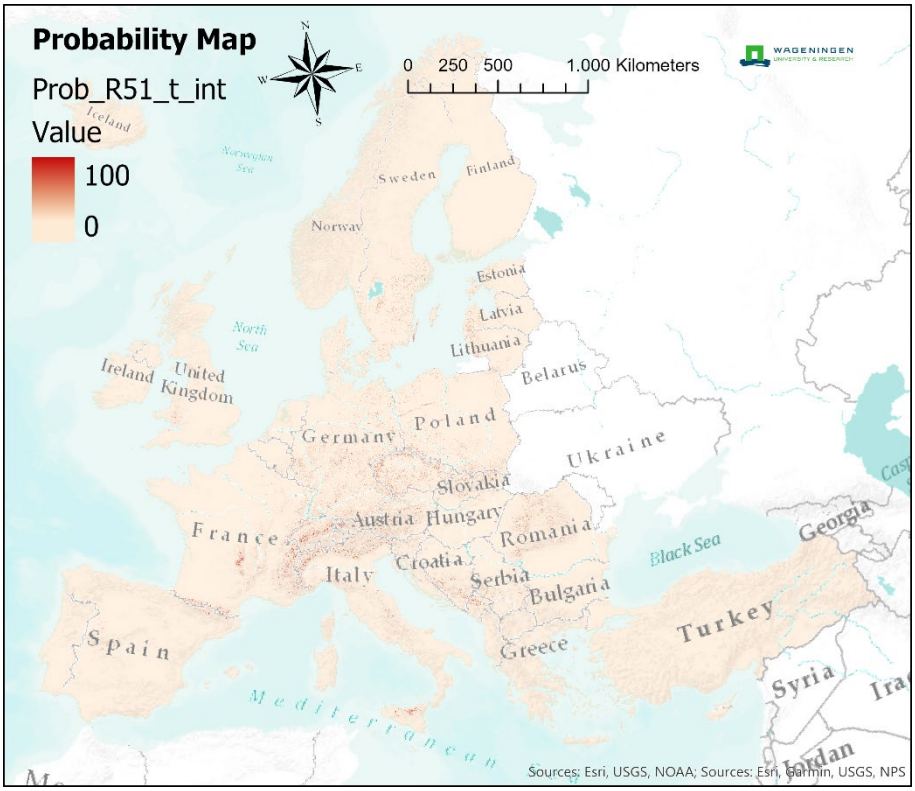


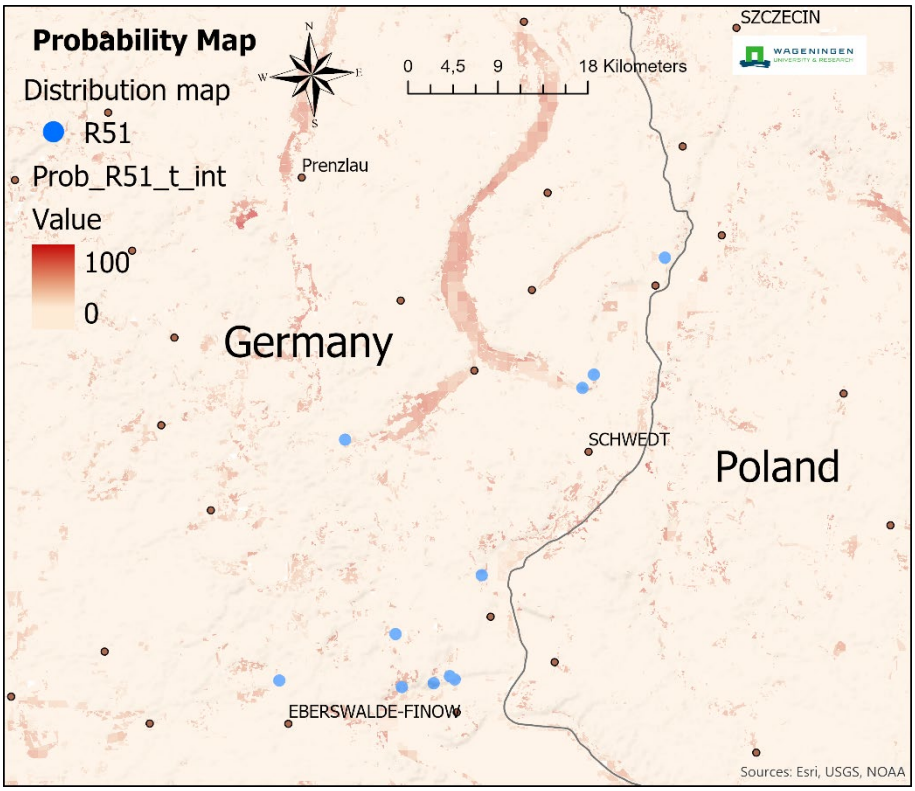

Probability Map
Distribution map
R45
Prob_R45_t_int
Value
100
0
N
W
E
S
0 4,5 9 18 Kilometers
WAGENINGEN
PESCARA
PENNE
CHIETI
Catignano
L'AQUILA
Italy
CAPESTRANO
TOCCO DA CASAURIA
Guardiagrele
Rocca d. Mezzo
POPOLI
SULMONA
Lama dei Peligni
AVEZZANO
PESCINA
PETTORANO SUL GIZIO
Sources: Esri, USGS, NOAA

R51 – [E52a] Thermophilous forest fringe of base-rich soils

Fringe communities on neutral to base-rich, only moderately nutrient-rich, soils in the transition zone between forests and open habitats or in similar situations alongside cliffs and on roadsides, occuring across large parts of lowland north-west Europe, but also extending into more continental regions where they fringe more open thermophilous forests, and into cooler montane levels to the south and south-east.



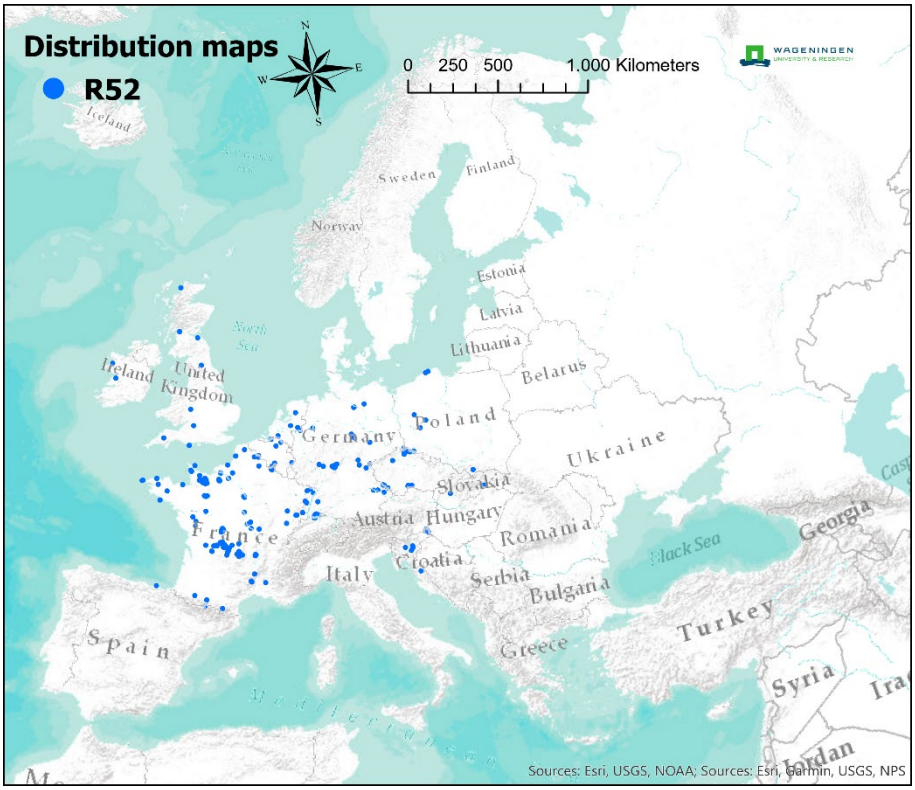


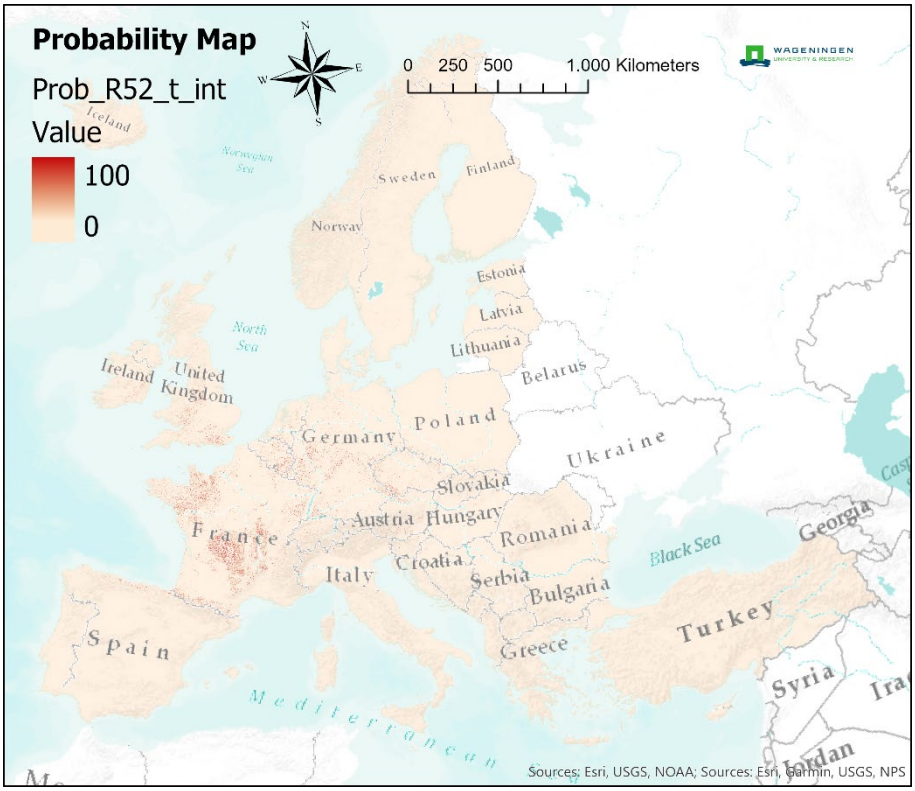


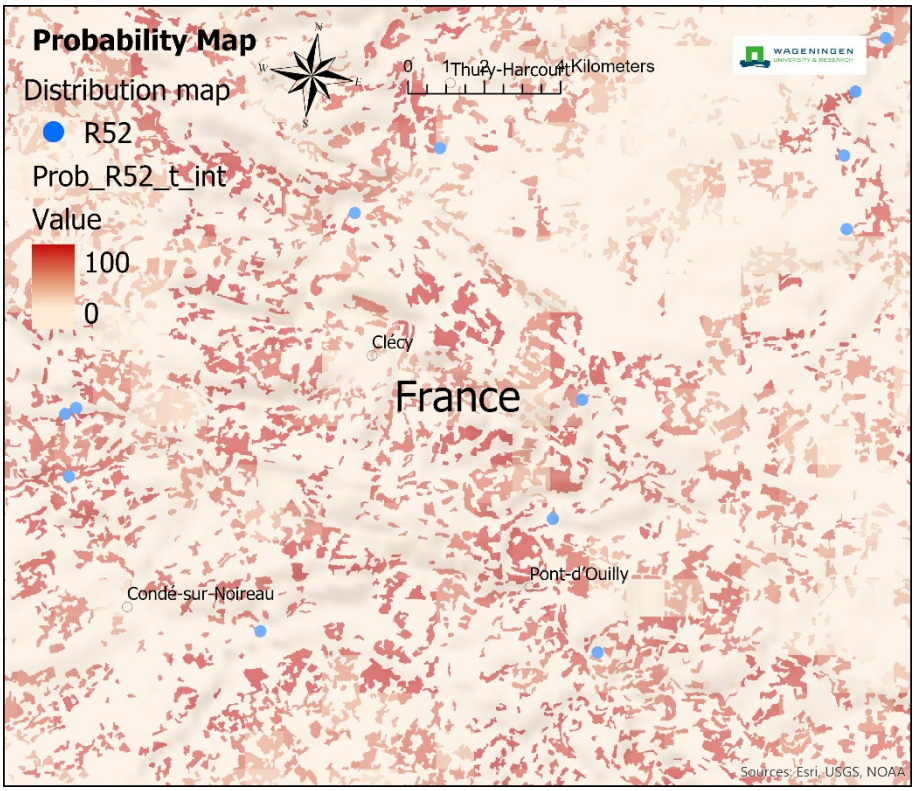
Typically comprising half-shade plants, other species of neighbouring habitats can also find a place and, in calcareous landscapes, the vegetation can be more species-rich, harbouring a lot of rare and/or endangered species. vegetation. Dependent on grazing or mowing for preventing succession.

R52 – [E52b] Forest fringe of acidic nutrient-poor soils

Fringe vegetation of semi-shaded forest margins and similar situations on acidic, nutrient-poor soils in the cooler atlantic and subatlantic regions of Europe, becoming rare and more species-poor further east. It is generally dominated by bulky grasses and tall herbs, rather species-poor, and ultimately dependent on extensive grazing or occasional mowing to prevent encroachment by shrubs and trees that threaten denser shade.

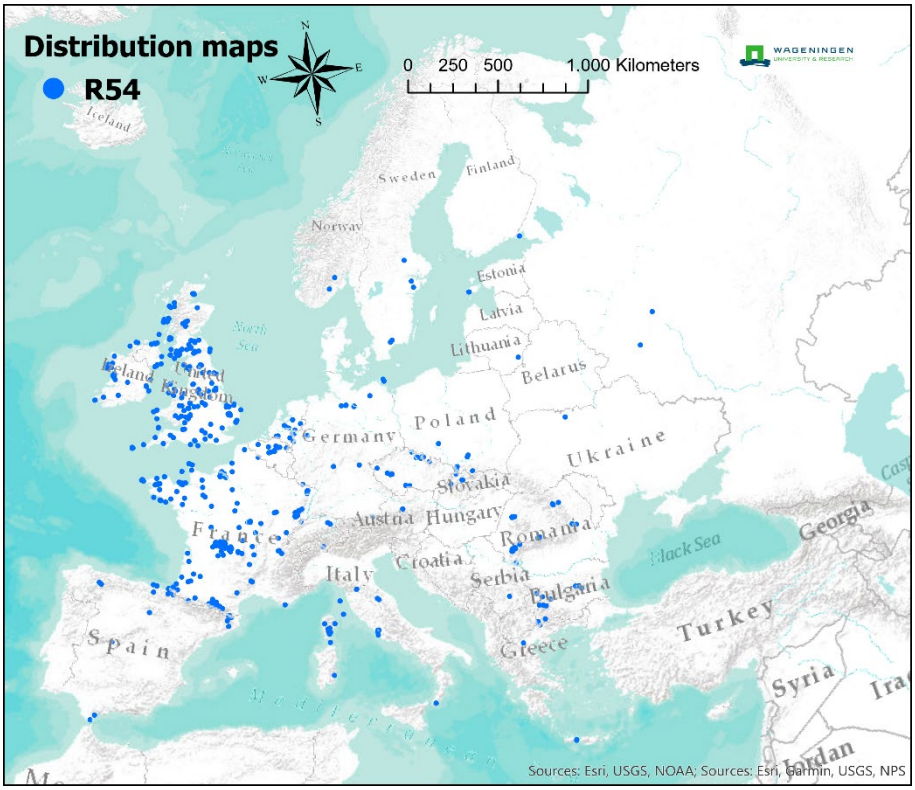


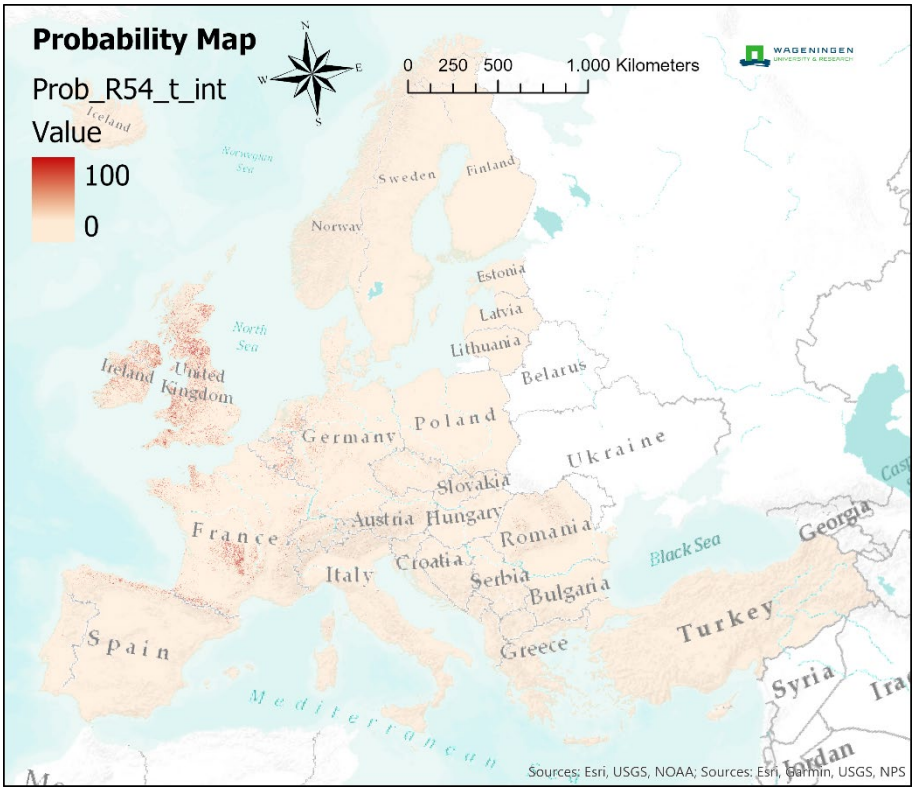


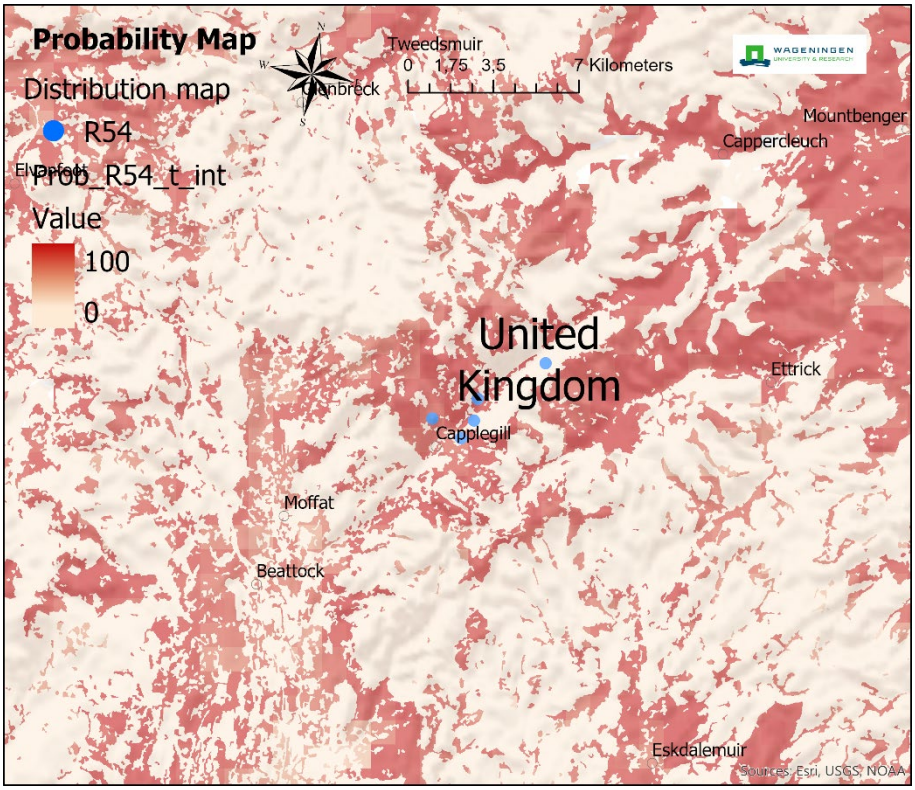

Probability Map
Distribution map
R52
Prob_R52_t_int
Value
100
0
0
1
2
4 Kilometers
Thury-Harcourt
Clécy
France
Pont-d'Ouilly
Condé-sur-Noireau
WAGENINGEN
Sources: Esri, USGS, NOAA

R54 – [E53] Pteridium aquilinum vegetation

Dense species-poor stands of bracken (Pteridium aquilinum), naturally a lowland European forest fern which, when not held in check by dense shade and lacking the traditional management of cutting and trampling by cattle, readily establishes itself as a dominant, spreading vigorously by rhizome extension and producing deep litter, a feature now of many pastoral landscapes less traditionally managed than before.

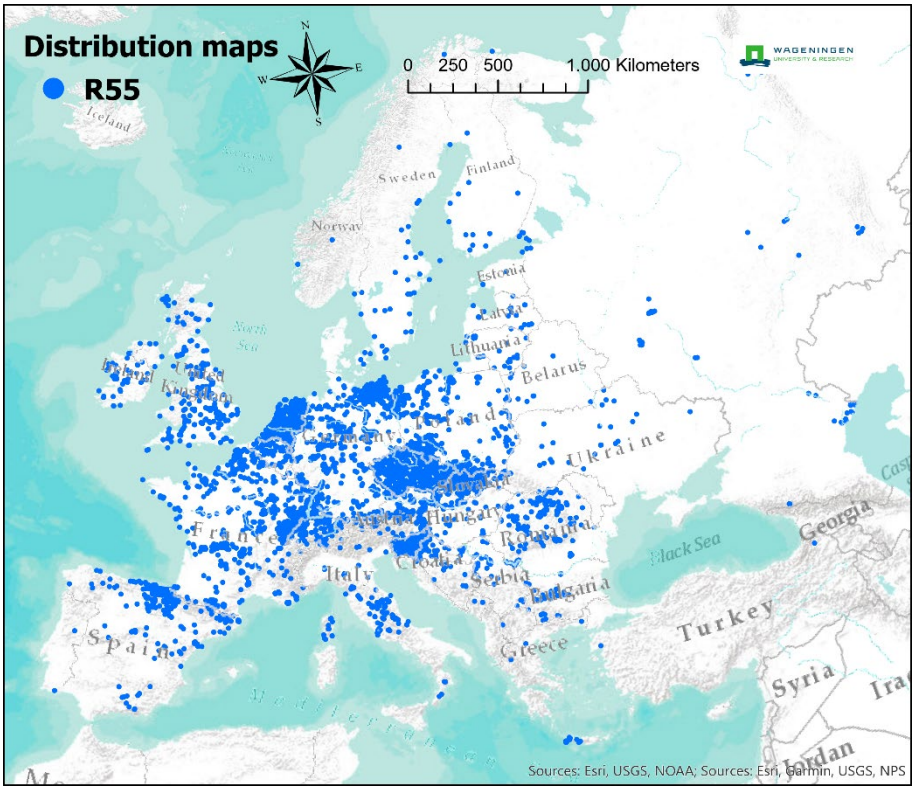


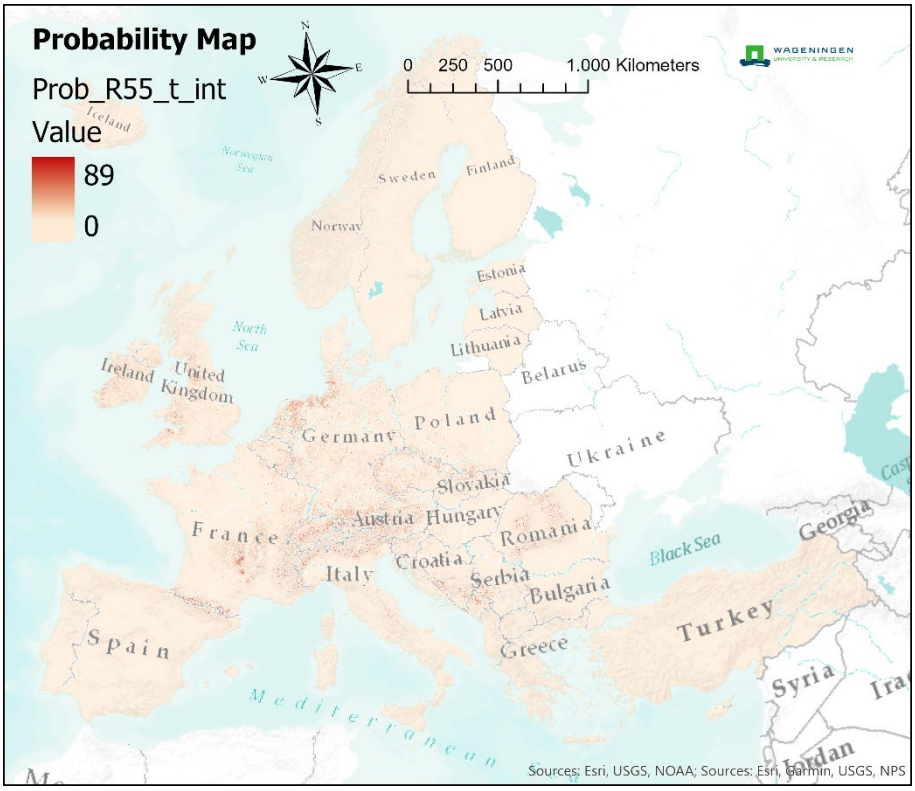


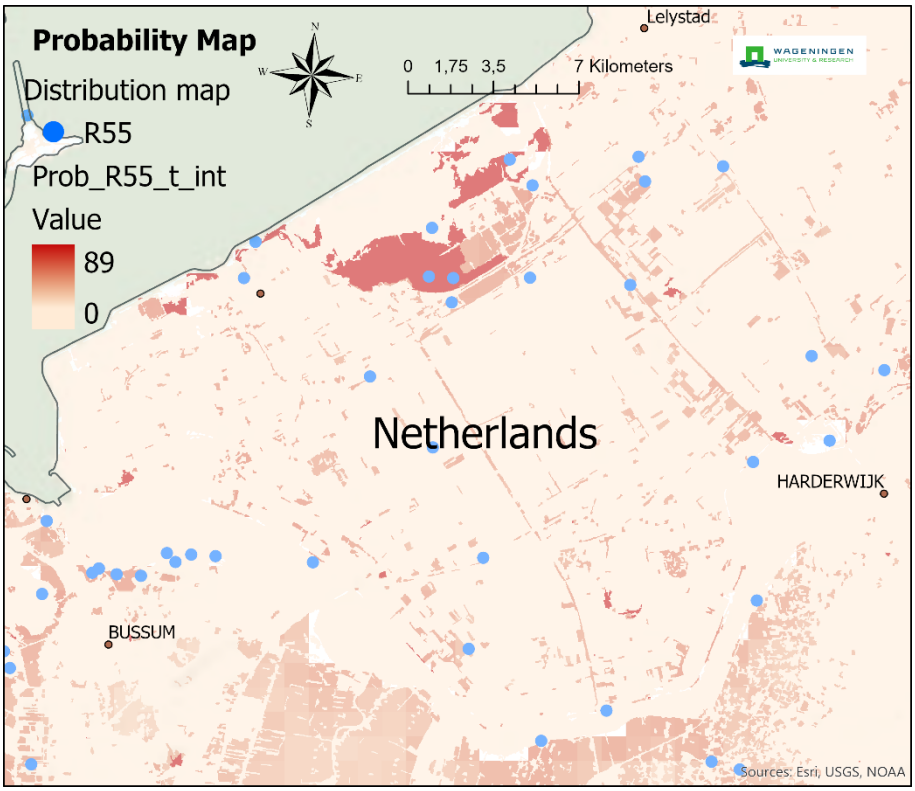

Probability Map
Distribution map
R54
Prob_R54_t_int
Value
100
0
Tweedsmuir
0 1.75 3.5 7 Kilometers
Lanbrock
Mountbenger
Cappercleuch
United Kingdom
Ettrick
Capplegill
Moffat
Beattock
Eskdalemuir
Sources: Esri, USGS, NOAA

R55 – [E54] Lowland moist or wet tall-herb and fern fringe

Tall-herb and fern-dominated communities of moist, sometimes flooded, nutrient-rich soils in the lowlands and lower mountain areas of Europe, up to the subalpine zone, through the nemoral, boreal and submediterranean regions.



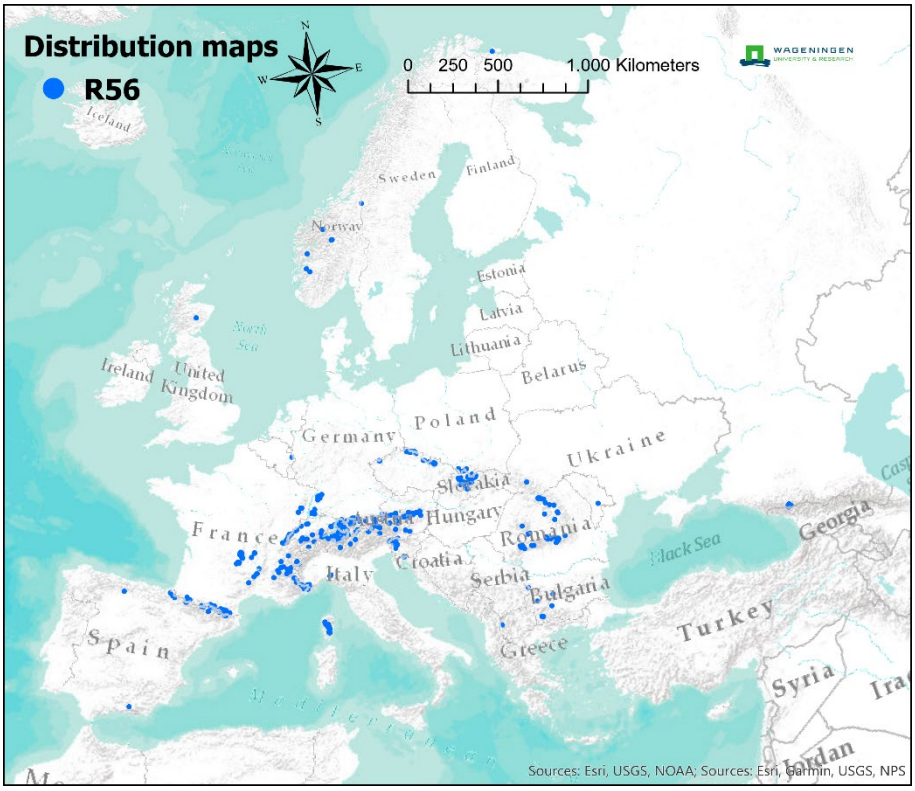


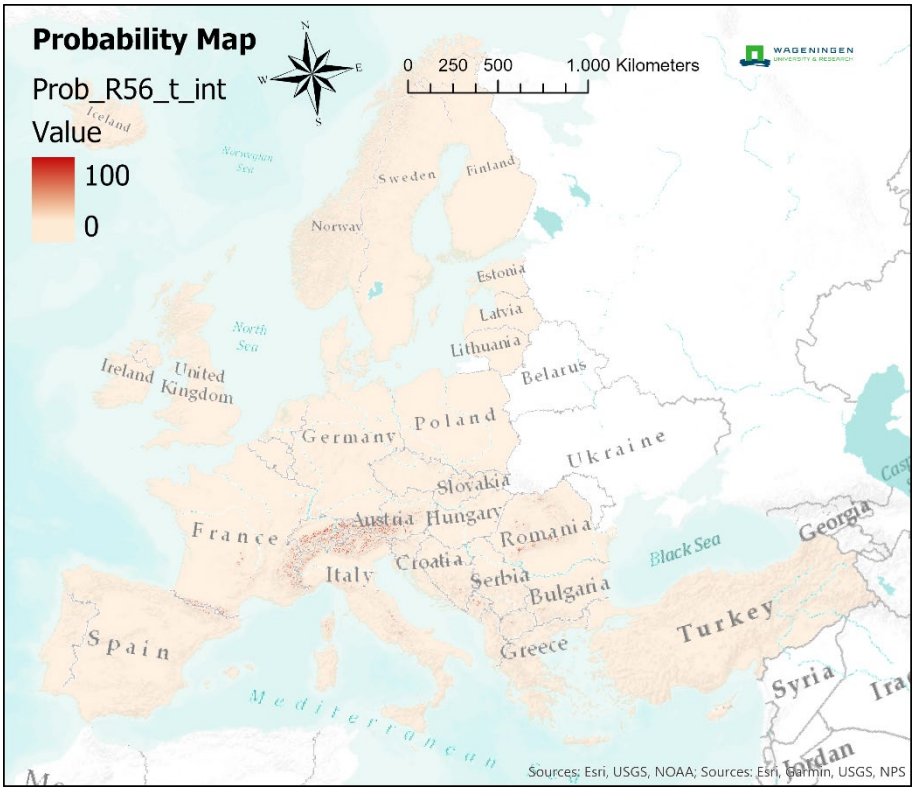


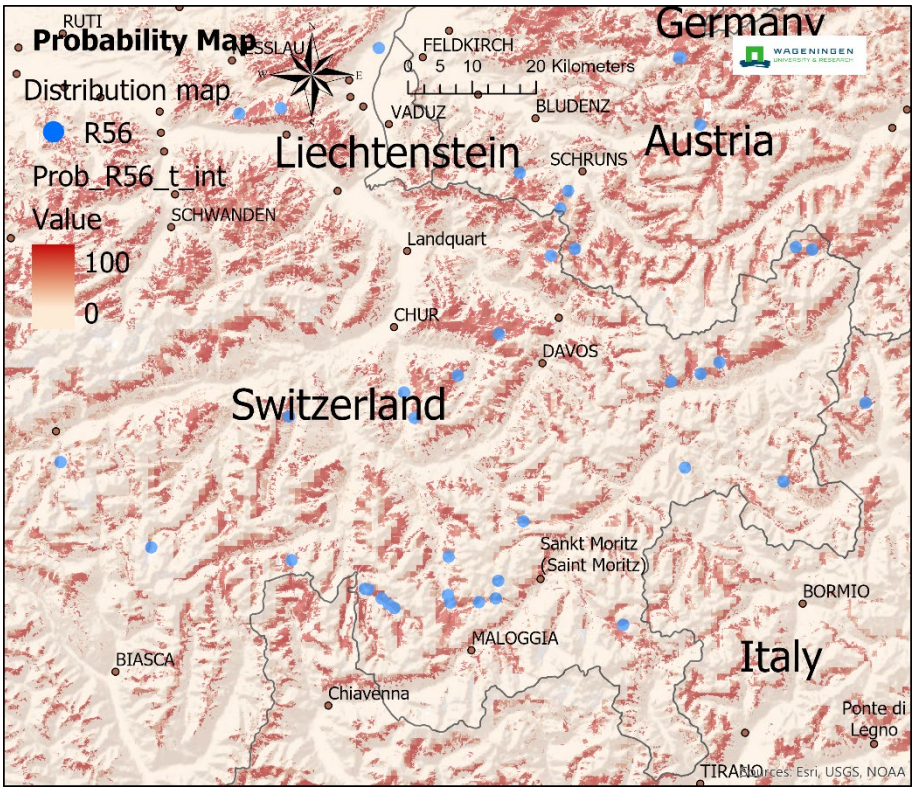
The relatively species-rich vegetation may be found in river floodplains, along smaller watercourses, in the shade at the edge of forests, often as narrow strips, and, as secondary vegetation after the abandonment of pastures and especially meadows. The species composition is quite diverse, depending on the altitude, geographic distribution and location in the landscape.

R56 – [E55] Montane to subalpine moist or wet tall-herb and fern fringe

Tall forb and fern vegetation of moist, fertile soils in relatively cool and humid situations through high levels of the mountain ranges of Europe, having its optimum in the subalpine zone but also occurring in the arctic lowlands of Scandinavia.



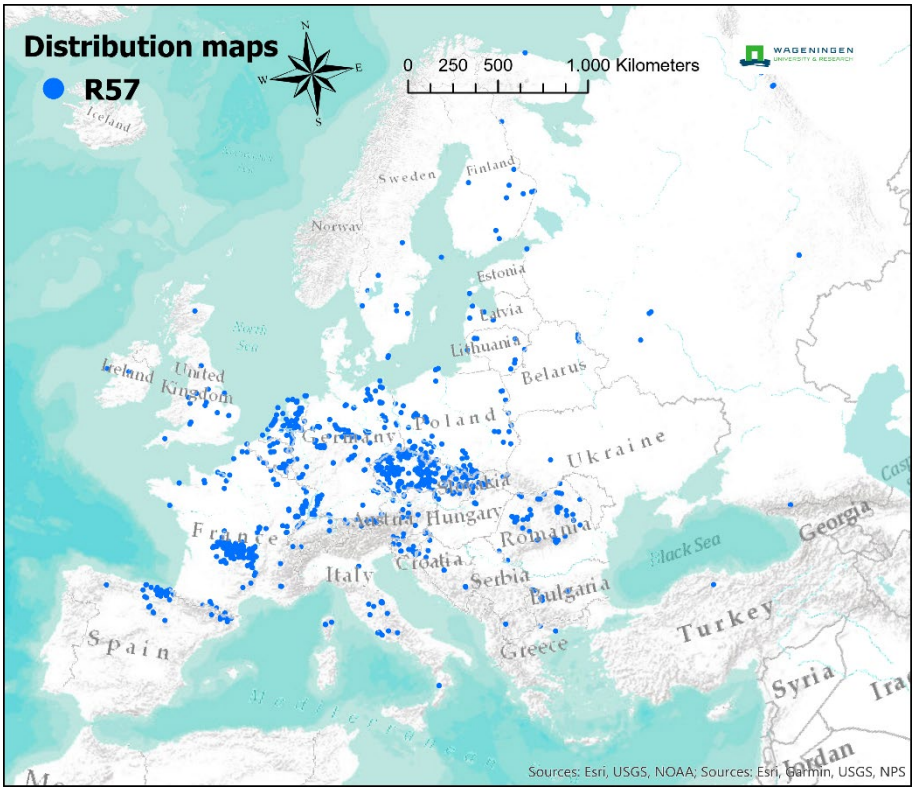


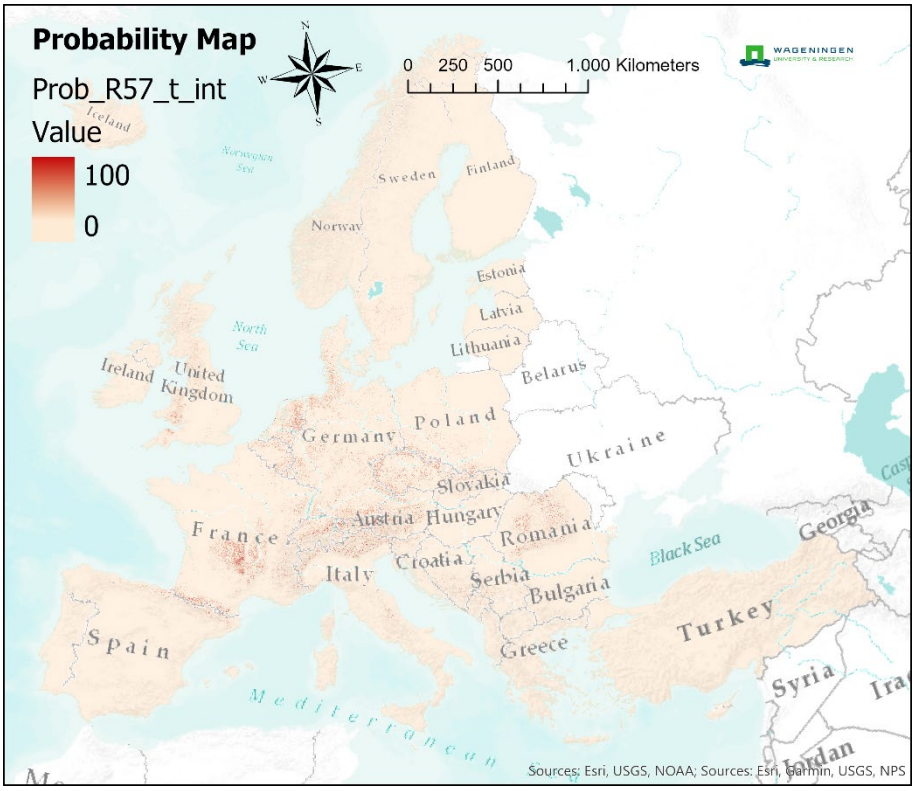


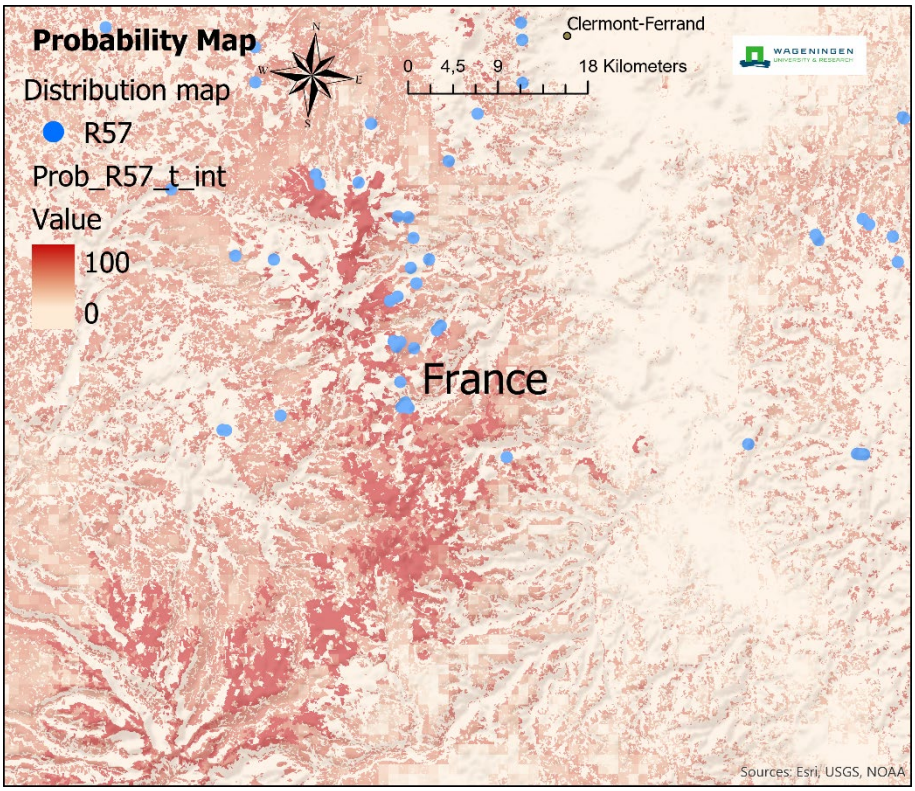
Typically found as strips along streams and on the edges of forests, in the shelter of large rocks, on mountain ledges and under scrub, sometimes also fringing snow beds where it benefits from protection from winter frosts. The vegetation is often very rich in species and hosts many local and regional endemics, as well as widespread montane plants. Vulnerable to grazing by wild herbivores and stock, but often protected by its remoteness.

R57 – [E56] Herbaceous forest clearing vegetation

Short-lived herbaceous communities colonizing recent forest clearings

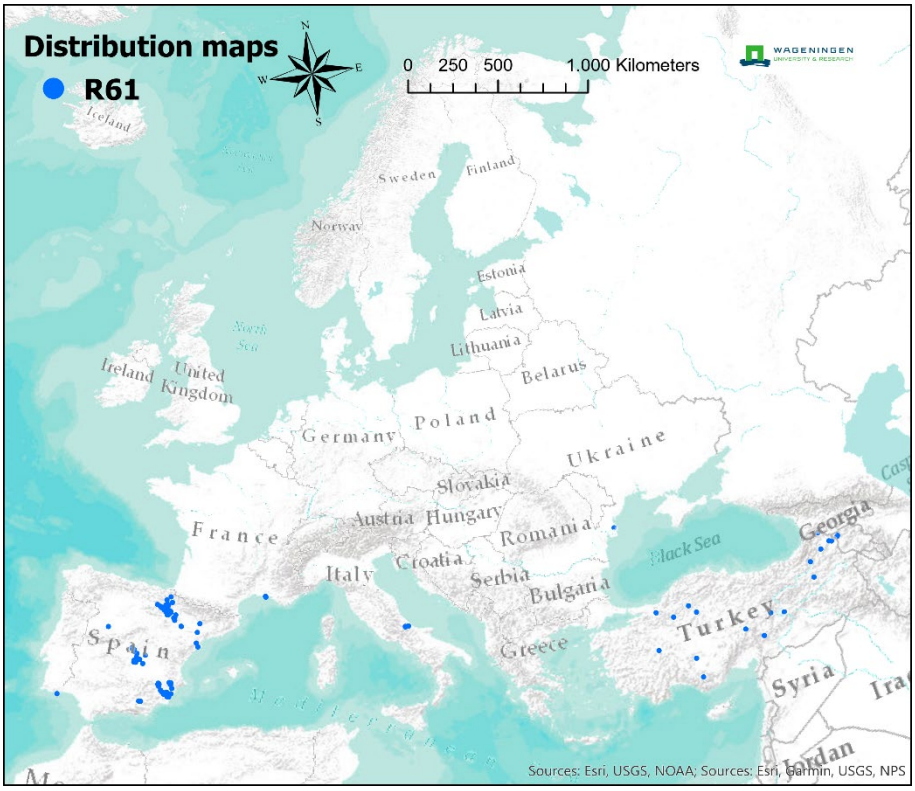


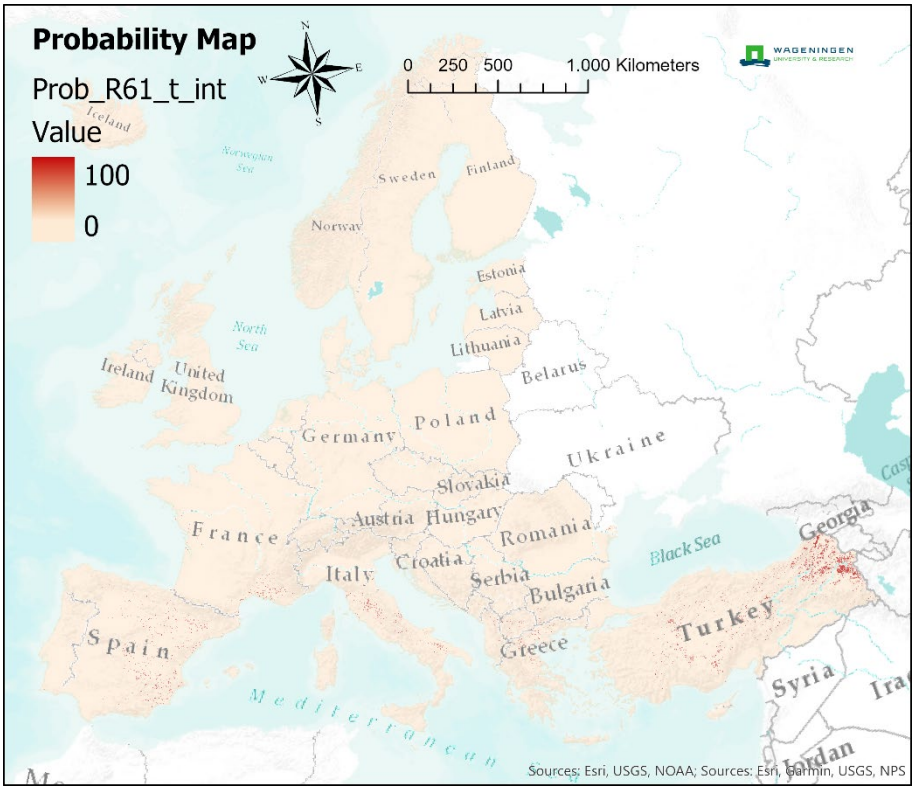


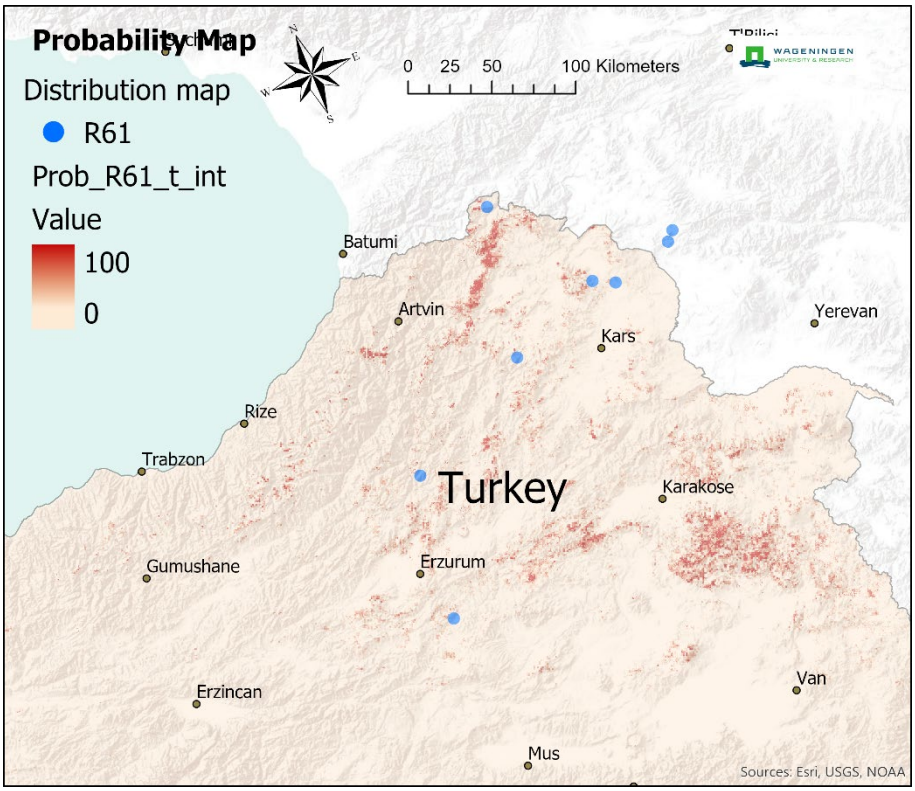

Probability Map
Distribution map
R57
Prob_R57_t_int
Value
100
0
Clermont-Ferrand
0 4,5 9 18 Kilometers
France
Sources: Esri, USGS, NOAA

R61 - [E61] Mediterranean inland salt steppe

Halophyte vegetation of inland situations in the Mediterranean region where the soils of flats or gentle hollows are permeated by waters laden with soluble salts from underlying substrates, and are then subject to extreme summer drought, with surface efflorescence of crystalline deposits.



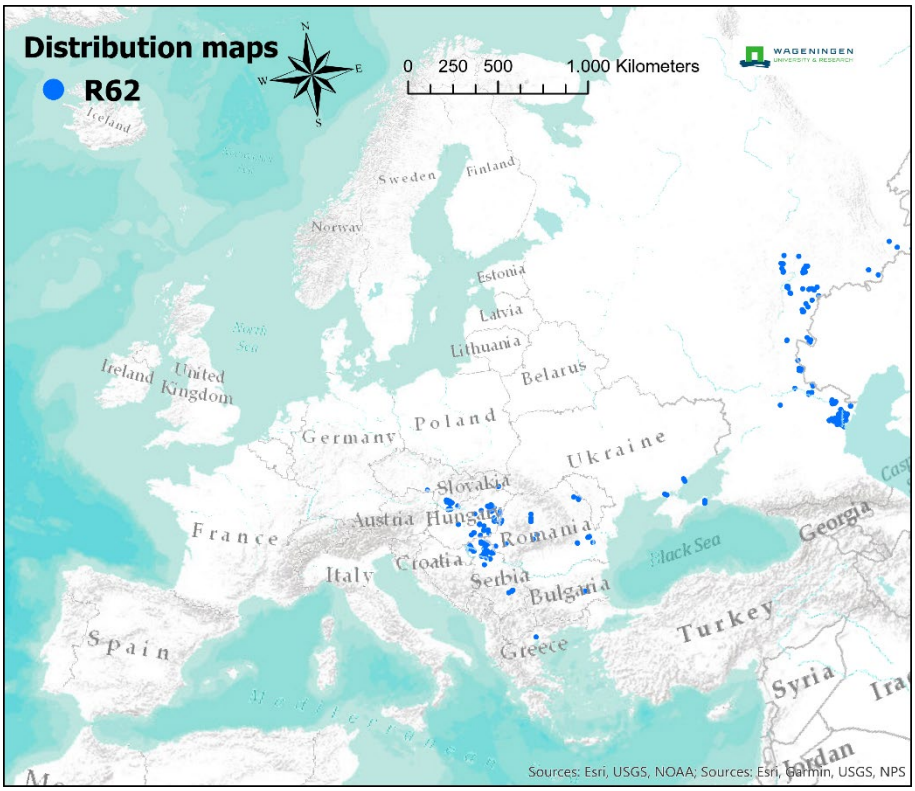


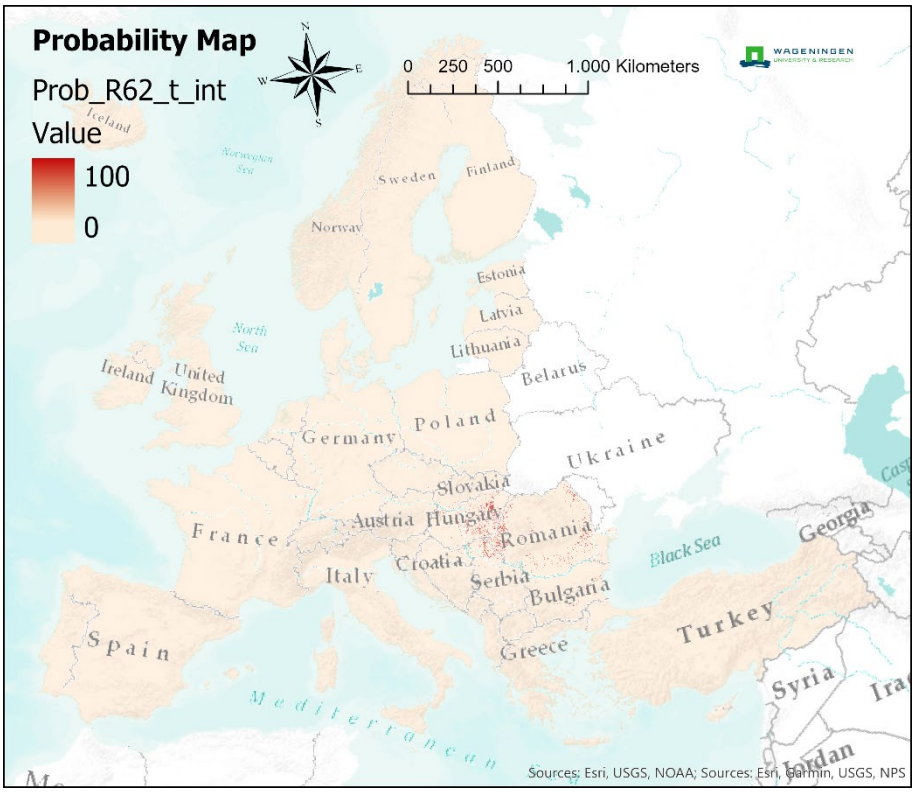


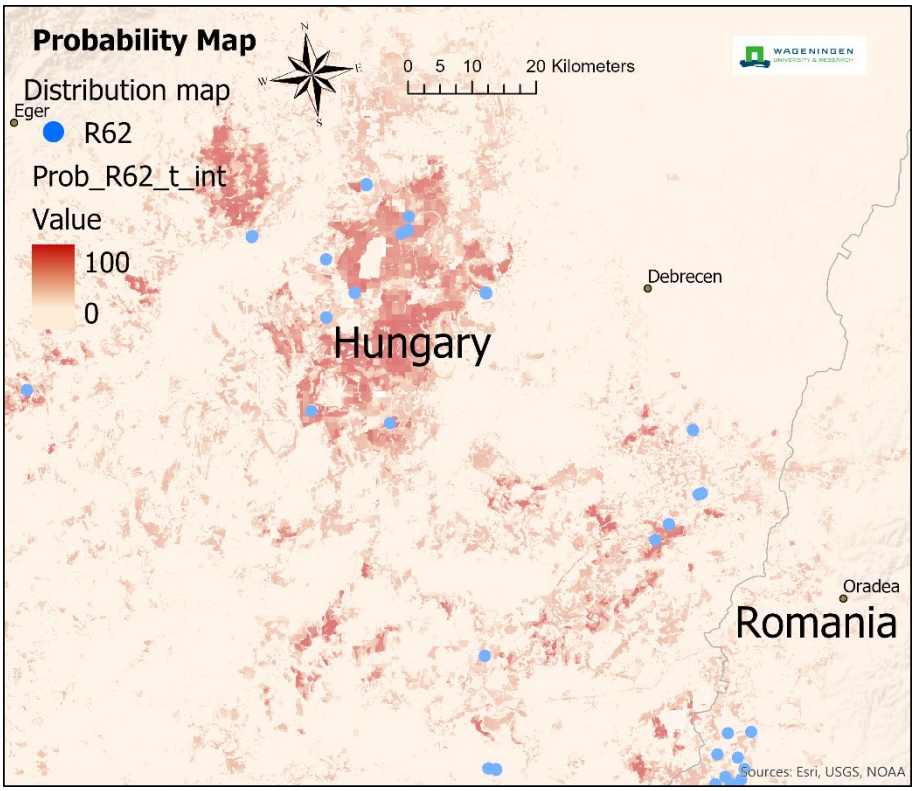
The vegetation can be rich in endemics, but the particular species composition depends on the regional climate and local soil conditions and there is often a distinctive seasonal pattern of growth and zonation around the hollows. In some regions, the vegetation has provided valuable grazing for sheep and goats in summer drought.

R62 - [E62] Continental inland salt steppe

Salt steppe of the Pannonian biogeographic region, characteristic of solonetz soils, saturated, even shallow flooded, by soluble carbonates in spring, then drying in summer with surface cracking.



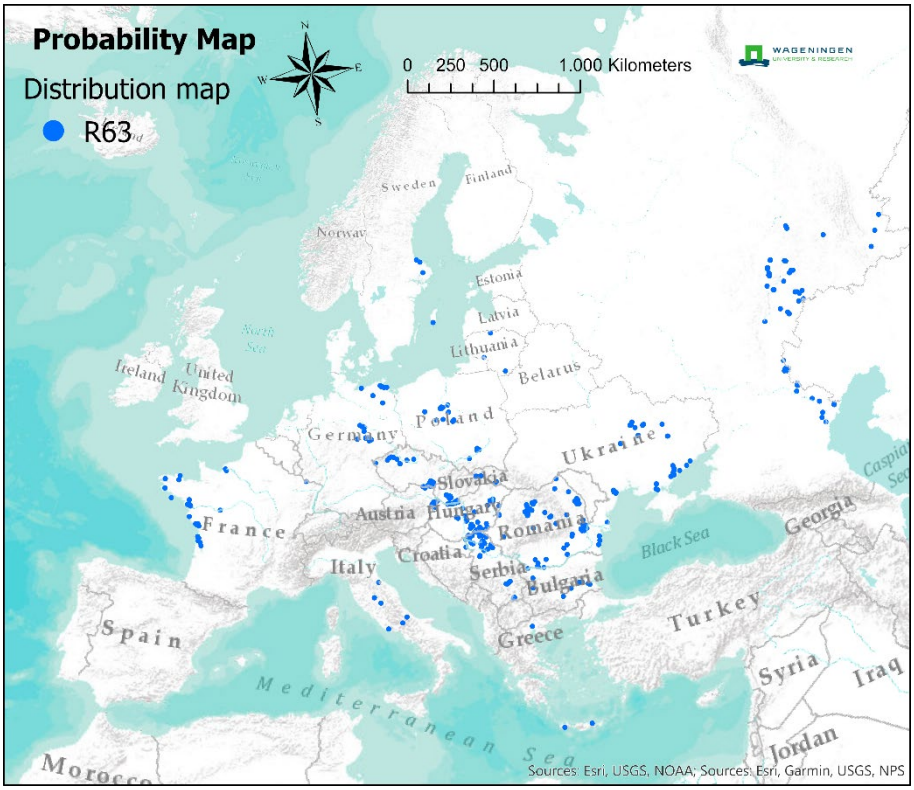


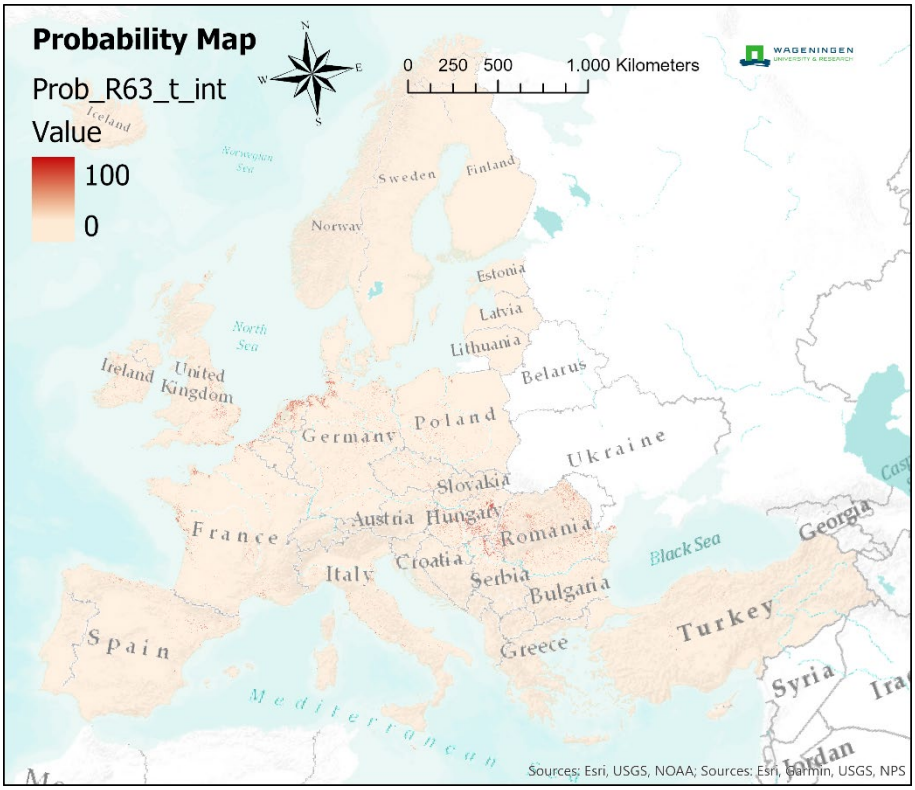


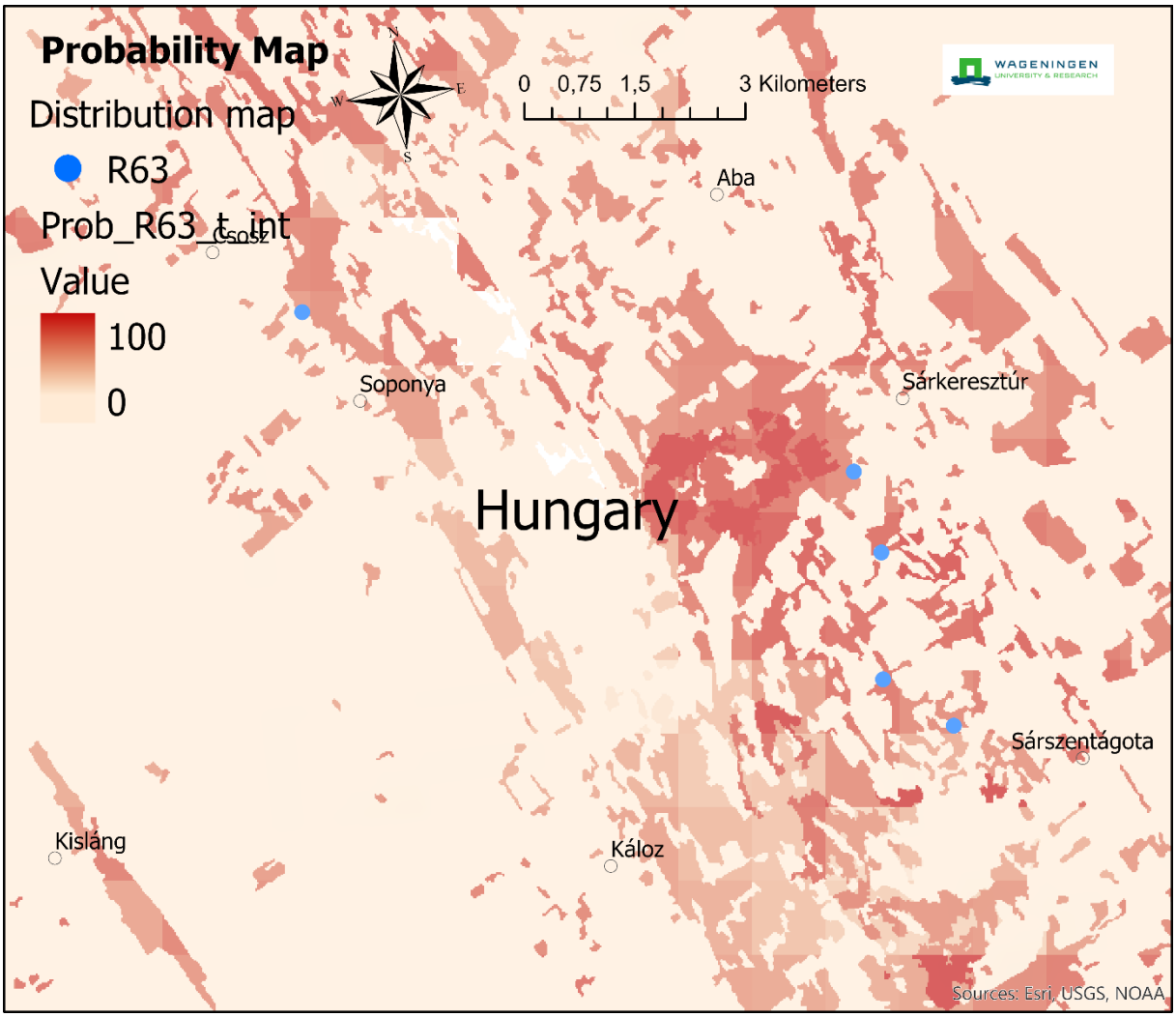
According to variations in salinity, slope and erosion by spring floods, the vegetation is a complex mosaic of grasslands and more halophytic herb communities, rich in endemic species and plant communities. Traditionally part of the pastoral landscape of older breeds of cattle.

R63 – [E63] Temperate inland salt marsh

Inland salt marsh and meadow of temperate and continental regions, characteristic of situations where fossil salt lies close to the surface or where relict sea water is present, resulting in brackish or saline ground and surface water. In more continental regions inland salt pans are more common, where the habitat is found in depressions within a matrix of salt steppes and as sub-halophytic meadows.







Elsewhere in Europe, the habitat can be found in association with a variety of salty bedrocks and also on abandoned salt workings. The species composition is very varied according the regional climate and particular site conditions.