A Mediterranean forest types' map – based on dominant species

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EnBiC2-Lab

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The **Mediterranean Forest Types Map**:

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European Environment Agency: Annemarie Bastrup-Birk

Map extent – WWF's Mediterranean ecoregion

25 countries along southern Europe, Middle East Asia and Northern Africa

Aim

"Create a Mediterranean-wide forest map supporting the future forest monitoring in the region, based on an harmonized definition, aiming to improve the accuracy of the forest class and, secondly, discriminated by a forest types legend"

- Provide a product with similar quality on all the Mediterranean region
- Improve forest map accuracy
- Generate a map of forest types, based on dominant species

Homogeneous satellite data for all Mediterranean countries

Training data – use of Artificial Intelligence to support scarce-data areas using data from rich-data areas

Data collection

Step 1: Land cover map

Step 2: Forest map

Land cover maps
(Lebanon, Spain, Tunisia)

Sentinel-2
Multispectral images

ASTER
Digital Elevation Model

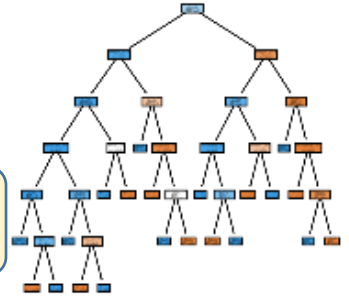
Forest databases
(All basin, several sources)

≈80%

Training points

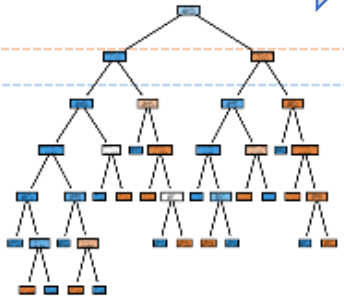
Training datasets

ML: Random Forests Classification



PRODUCT 1
LAND COVER MAP

Layer extraction:
Forest and open forests



ML: Random Forests Classification

PRODUCT 2
FOREST TYPE MAP

Training points

≈80%

Validation points

≈20%

Validation

Hackathon
+ 20% LCM points

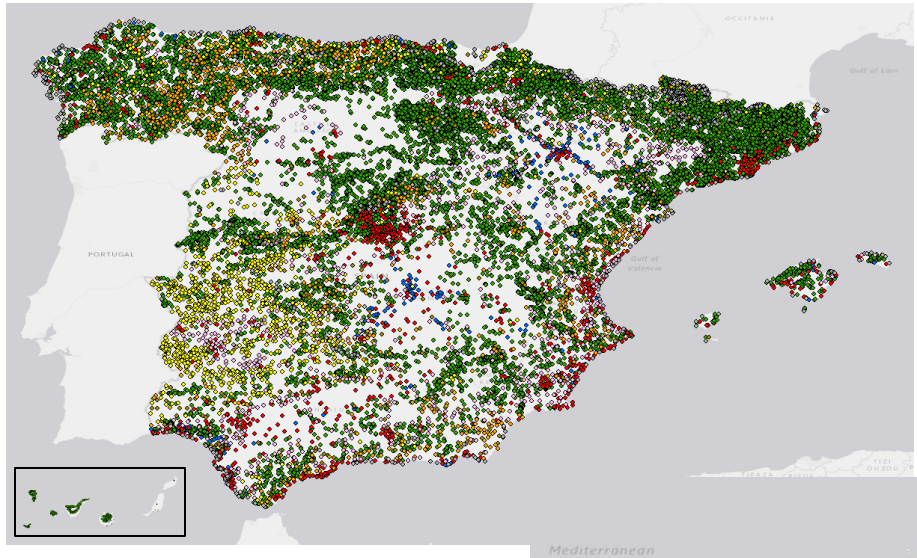
Validation points

Validation

STEP 1 – A Mediterranean Land Cover Map

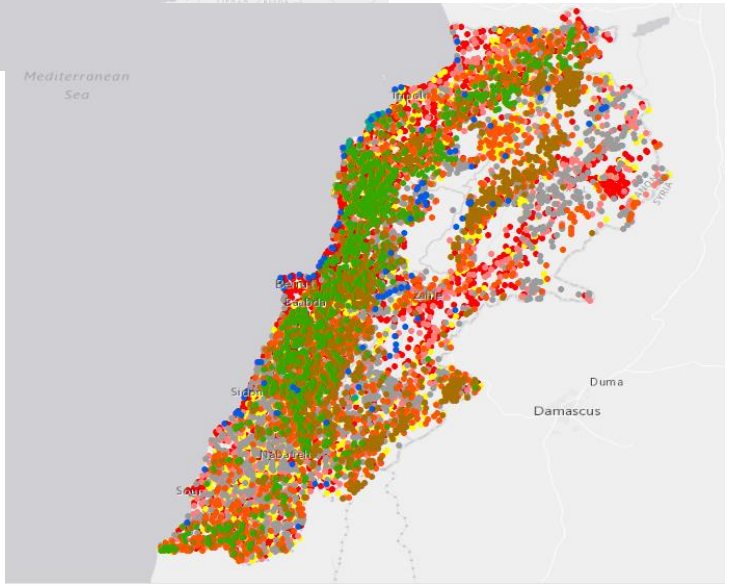
Lebanon, Tunisia and Spain: Land Cover Maps

Mediterranean - TOTAL: 45 015 samples



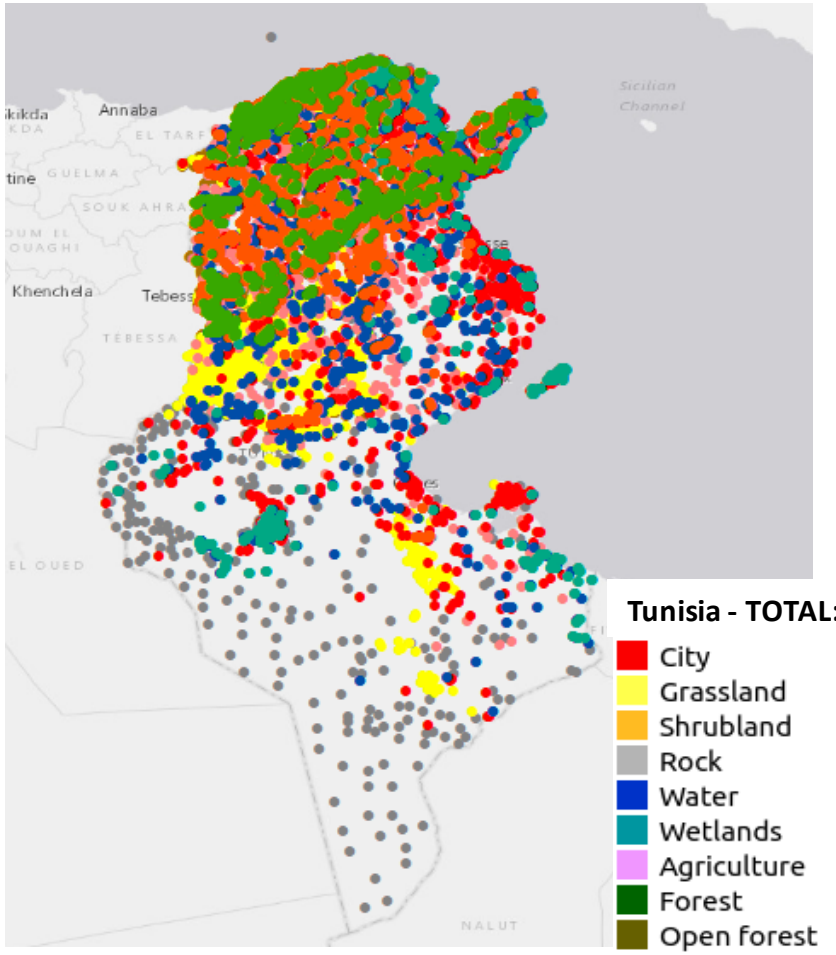
Spain - TOTAL: 31225 samples

City	902 samples
Grassland	1156 samples
Shrubland	894 samples
Rock	873 samples
Water	518 samples
Wetlands	387 samples
Agriculture	856 samples
Forest	24608 samples
Open forest	1031 samples



Lebanon - TOTAL: 8652 samples

City	1117 samples
Grassland	989 samples
Shrubland	1184 samples
Rock	1472 samples
Water	590 samples
Wetlands	180 samples
Agriculture	716 samples
Forest	1136 samples
Open forest	1268 samples



Tunisia - TOTAL: 5138 samples

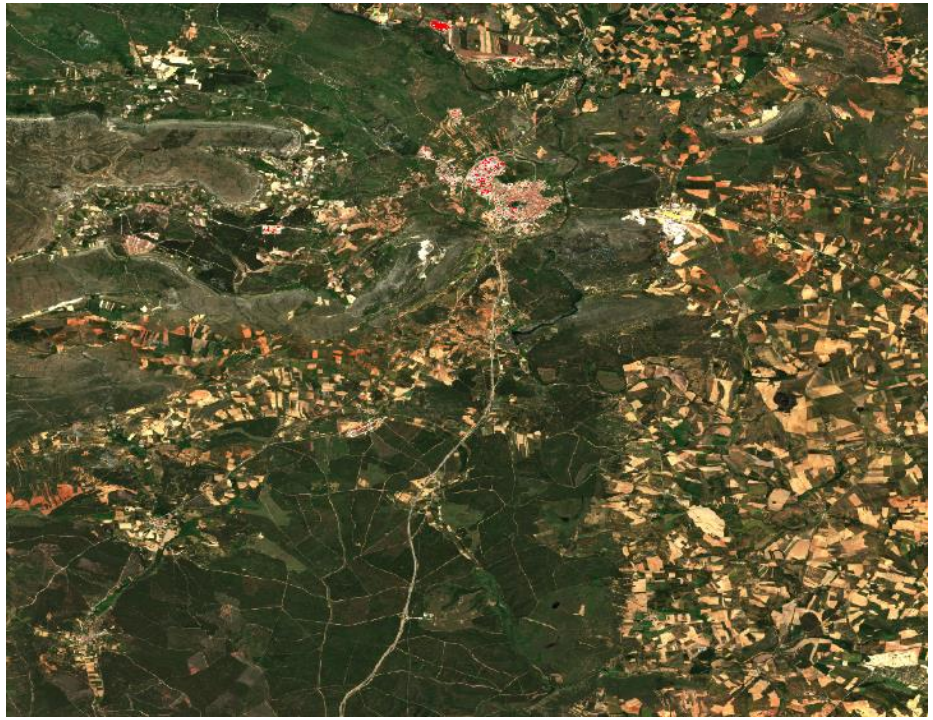
City	354 samples
Grassland	152 samples
Shrubland	527 samples
Rock	421 samples
Water	994 samples
Wetlands	334 samples
Agriculture	672 samples
Forest	1363 samples
Open forest	848 samples

STEP 1 – A Mediterranean Land Cover Map

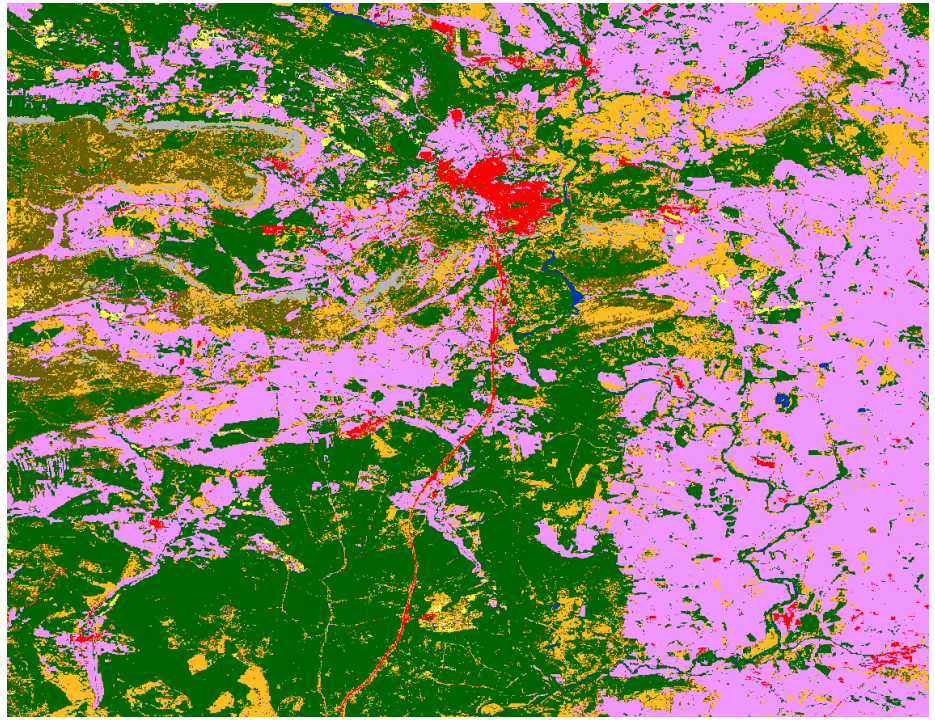
Preliminary results

Spain – Soria

Sentinel-2 2021



EnBic2Lab 2021



96.5% total map accuracy for Spain

99.9% for dense forests

97.4% for open forests

Results for the rest of the Mediterranean coming Sept. 2022!

Validation Hackathon

45 areas in 16 countries! **Expected: 23.000 validation points!**

Validation Hackathon – Participant institutions

Algeria: Ecole Nationale Supérieure d'Agronomie
University of Sciences and Technology
University Mouloud Mammeri Tizi Ouzou
Direction Générale des Forêts Algérie

Bosnia & Herzegovina: University of Banja Luka

Croatia: University of Zagreb

Cyprus: Cyprus University of Technology

Greece: Aristotle University of Thessaloniki
Mediterranean Agronomic Institute of Chania

Italy: Free University of Bozen-Bolzano
Sapienza University of Rome
Italian forest Ministry

Lebanon: International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM)

Morocco: Ministere d'Eaux et Forêts

Montenegro: National Parks of Montenegro

Macedonia: University Ss. Cyril and Methodius

Portugal: CIBIO-InBIO

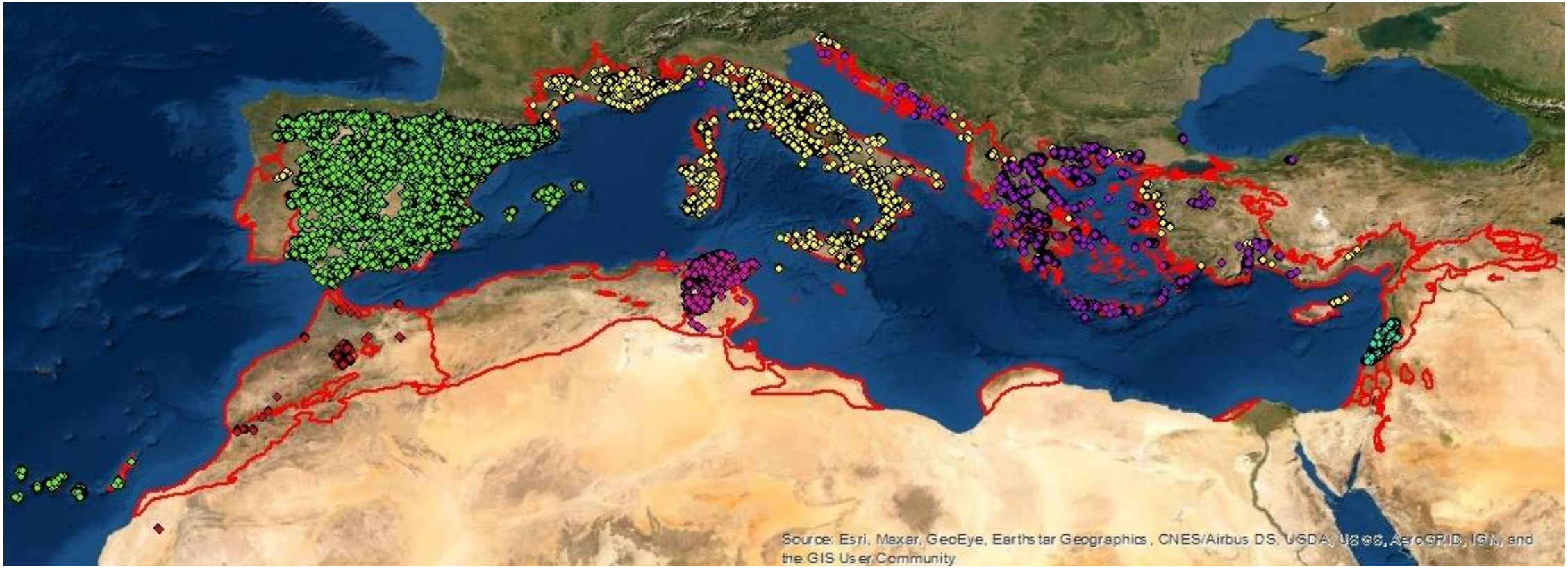
Slovenia: Research Center of the Slovenian Academy of Sciences and Arts

Spain: Instituto Pirenaico de Ecología-CSIC
Universidad de Castilla la Mancha
Universidad de Cádiz
Universidad de Granada
Universidad de Murcia
Universidad de Córdoba

Tunisia: INRGREF

Turkey: Bursa Technical University
General Directorate of Forestry

STEP 2 – A Mediterranean Forest Types' Map



- Spanish Forest Map (MFE) – 17483 samples
- European Vegetation Archive (EVA) – 55952 samples
- Expert contribution (Morocco) – 725 samples
- Expert FI (B&H, Croatia, Greece, Turkey) – 404+1147+41531+827 samples
- Lebanon Forest Map – 3190 samples
- Tunisian Forest Inventory – 1754 samples

TOTAL: 123 013 samples

Mediterranean ecoregion defined by World Wildlife Fund (WWF)

Definitions - Forest and forest types

Forest types	EUNIS	Dominant species
Mixed forests		
Irano-Anatolian mixed forests	T1-46	-
Southern Alnus and Betula galleries	T1-4B	Alnus spp. + Betula spp.
Southern European mountain Betula and Populus forest	T1D	Betula pendula, Populus tremula, Corylus avellana
Ravine forests	T1F	Acer pseudoplatanus, Fraxinus excelsior, Tilia platyphyllos
Other riparian forests	-	-
Sub-mediterranean thermophilous deciduous forest	T19	Quercus pubescens, Q. cerris, Q. petraea, Q. robur
Mediterranean thermophilous deciduous forest	T1A	Quercus pubescens, Q. ithaburensis
Acidophilous Quercus forest	T1B	Quercus petraea, Q. robur, Castanea sativa
Carpinus and Quercus mesic deciduous forest	T1E	Carpinus betulus, Quercus robur, Q. petraea
Other broadleaved forests	-	-
Other mixed forests of coniferous and broadleaved spp.	-	-
Plantations		
Eucalyptus plantations	T29	Eucalyptus spp.
Poplar and Platanus plantations	T1H	Populus spp., Platanus spp.
Pine plantations	T3M, T3N	Pinus halepensis, P. nigra, P. pinaster, P. pinea, P. radiata, P. sylvestris
Chestnut plantations	T1H	Castanea sativa
Other plantations	-	

Provisional list of forest types in the Mediterranean (map legend):

- 36 classes of forests (dense and open)
- 10 classes of plantations

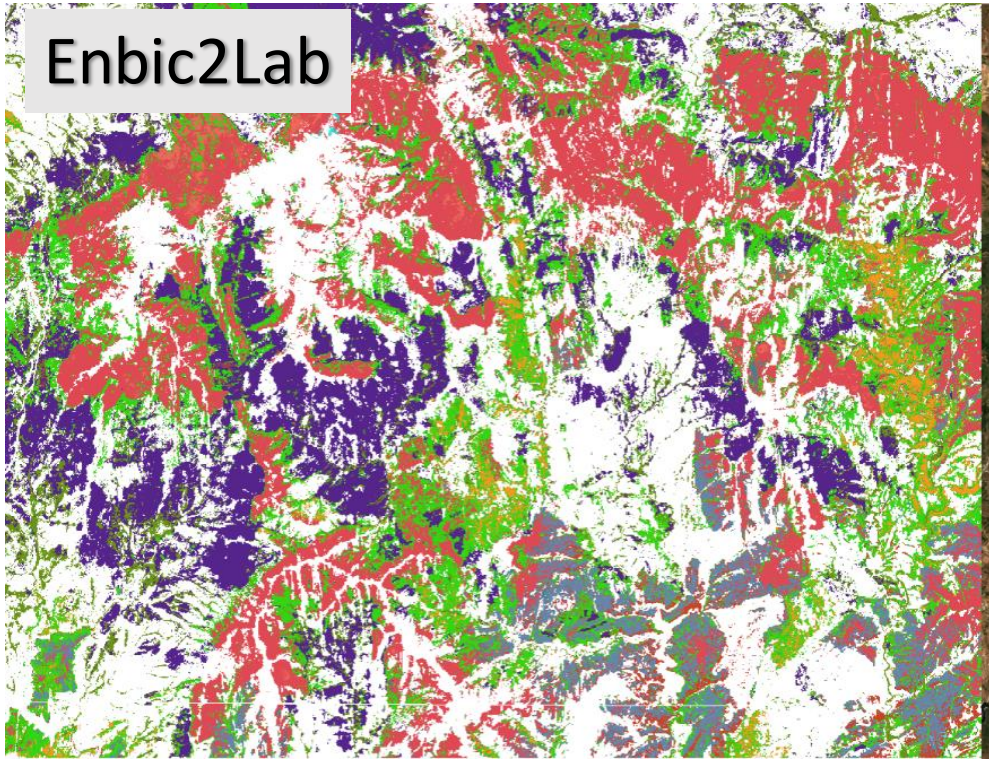
Definitions - Forest and forest types

Forest types	EUNIS	Dominant species
Coniferous forests		
Spruce forests	T32, T33	Abies alba, Abies pinsapo, Abies spp.
Cedrus forest	T38	Cedrus libani
Mediterranean lowland coniferous mixed forest	T3A	Pinus halepensis, P. pinaster, P. brutia
Sub-mediterranean montane coniferous mixed forest	T36, T37	Pinus sylvestris, P. nigra
Temperate subalpine coniferous mixed forest	T34	Larix decidua, Pinus uncinata
Balkan Pine forests	T39	Pinus heldreichii, P. peuce
Taxus baccata forest	T3C	Taxus baccata
Mediterranean Cupressaceae forests	T3D	Cupressus sempervirens, Juniperus spp. Tetraclinis articulata
Other coniferous forests	-	
Broadleaved forests		
Beech forests	T17, T18	Fagus sylvatica, Fagus orientalis
Mediterranean Salix riparian forests	T1-41	Salix spp. + Populus spp.
Mediterranean Populus riparian forests	T1-42	Populus spp.
Mediterranean Ulmus riparian forests	T1-43	Ulmus spp.
Mediterranean Fraxinus riparian forests	T1-44	Fraxinus spp.
Mediterranean Ostrya carpinifolia riparian forests	T1-45	Ostrya carpinifolia
Platanus orientalis riparian forests	T1-47	Platanus orientalis
Liquidambar orientalis riparian forests	T1-4A	Liquidambar orientalis
Mediterranean evergreen oak forest	T21	Quercus ilex ilex, Q. ilex rotundifolia
Cork oak forest	T?	Quercus suber
Gall oak forests	T?	Quercus canariensis, Q. faginea, Q. pirenaica, Q. lusitanica
Hop- hornbeam forests	T19.4	Ostrya carpinifolia
Lauriphollya forests	T22, T27	Laurus nobilis, Ilex aquifolium
Wild olive and carob forests	T24	Olea europaea, Ceratonia siliqua
Argania forests	-	Argania spp.
Acacia forests	-	Vachellia spp.

STEP 2 – A Mediterranean Forest Types' Map

Preliminary results

Soria, Spain



Validation results coming Sept. 2022!

Pinus sylvestris

Pinus pinaster

Riparian forest

Quercus pyrenaica

Mixed coniferous+ broadleaved

Quercus ilex

Summary

- Improved Land Cover map of the Mediterranean region (10 m resolution, ≈90% accuracy)
- New Mediterranean Forest Types Map, based on dominant species
- Methodology, machine and satellite image archive → extrapolation to other areas and cases
- Harmonized and consolidated Forest Database, for cartography purposes
- Spectral library of Mediterranean forests, for Sentinel-2 and ASTER data → repeatability for other years
- Solid network in 16 countries of the basin, including Ministries, universities, research institutions, National Parks and NGOs

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Thank you!

ETC-UMA, EEA and Khaos Team

EVA custodians: Ilona Knollová, Emmanuel Garbolino, Fabio Attorre, Emiliano Agrillo, Laura Casella, Željko Škvorc, Ioannis Tsiripidis, Andraž Čarni, Vladimir Stupar, Urban Šilc, Filip Küzmič, Kiril Vassilev, Gianmaria Bonari, Idoia Biurrun, Ali Kavgaci, Alessandro Chiarucci, Giuliano Fanelli, Michele De Sanctis, Vanessa Bruzzaniti, Jan Jansen, Renata Ćušterevska

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