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Predicting the effectiveness of Tejo International Nature Park in protecting vegetation under climate change

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GeoBioSciences, GeoTechnologies and GeoEngineering

Linking Landscape Environment Agriculture and Food
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1. Background

- Habitat and biodiversity loss are global concerns related to climate change
- Many studies have reported the poleward shift of species distribution as a biological sign of global warming
- Restricted-range species are particularly vulnerable to the effects of environmental change
- Redistribution of life on Earth affects the effectiveness of protected areas.
- For the other hand species that have a restricted presence could expand their distribution range resulting from climate change

2. Study objectives

- To identify the main environmental factors affecting the distribution of the priority habitat in Europe, 5210 - Arborescent matorral with *Juniperus* spp., included in the 92/43/CEE Directive. This habitat have a very limited distribution in mainland Portugal.
- To study the influence of climate change on the potential geographic distribution of that priority habitat and on the species that make up that habitat.
- For that purpose, 3 plant species with a regional distribution restricted to the Tejo International Natural Park were selected - *Juniperus oxycedrus* L., the dominant species of the priority habitat 5210 “Arborescent matorral with Juniperus spp.” (92/43/CEE Directive); and other two species indicators of the same habitat and habitat 5330 “Thermo-Mediterranean and pre-steppe scrub”: *Pistacia terebinthus* L. and *Rhamnus lycioides* L.

Prickly cedar
(*Juniperus oxycedrus* L.)

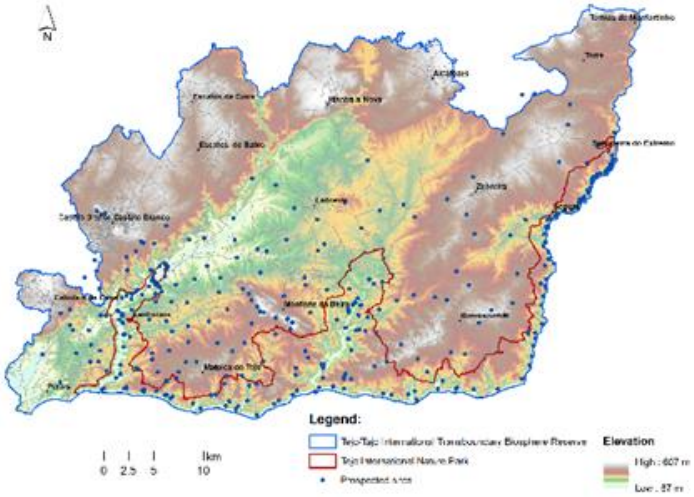
Mediterranean buckthorn
(*Rhamnus lycioides* L.)

Mastic tree
(*Pistacia lentiscus*L.)

3. Material and Methods

Study Area

- Tejo International Nature Park (PNTI) and the surrounding area belonging to the Tagus International Transboundary Biosphere Reserve (central-eastern part of Portugal)
- Extent: 1,692 sq.km
- Low altitude but with steep relief as a result of the embedding of the Tagus and its tributaries on the edge of the peneplain
- Most of the vegetation is made up of sclerophyllous formations of holm oak and cork oak, as well as abundant patches of scrub, which alternate with cultivated areas and pastures



4. Material and Methods

Data

- 295 floristic relevés were performed based on the phytosociological method Braun-Blanquet
  - Vegetation was sampled in a stratified random manner to obtain broadly representative data
  - The sample areas were defined within these patterns randomly in 100 m^2 quadrats
- Different topographical, climatic, and soil data were selected to model the species' habitat
  - To model the species distribution in future scenarios, we have considered two representative concentration pathways (RCPs) scenarios: RCP 4.5 and RCP 8.5, fitted for 2080, which is obtained from the WorldClim database

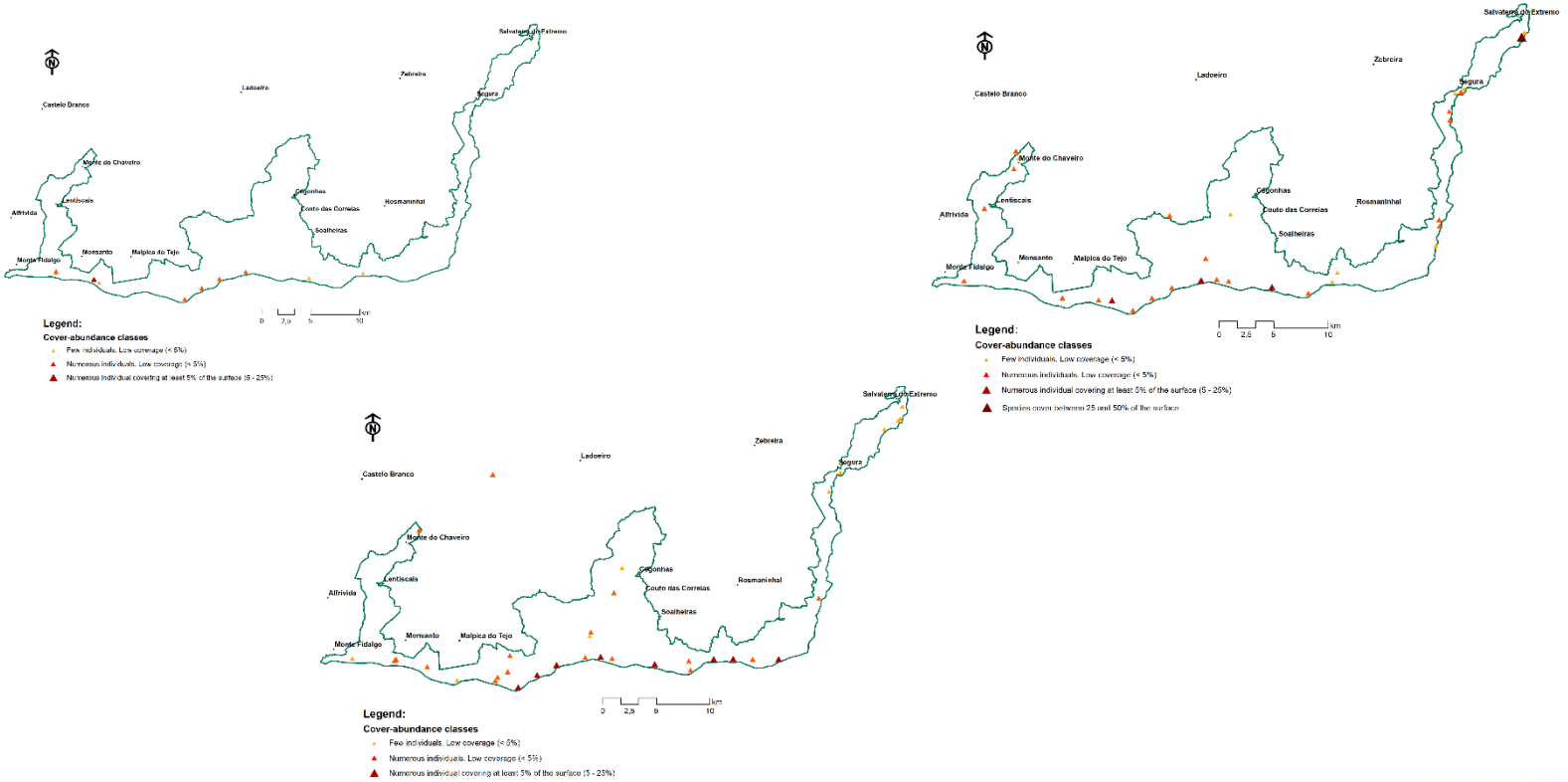
Analysis

- The species' ecological niche model (ENM) was computed employing the software Maxent v3.4.1

5. Results

Present Distribution

Present distribution of species: a) *Juniperus oxycedrus*; b) *Pistacia terebinthus*; c) *Rhamnus lycioides*



5. Results

Data for Habitat modeling

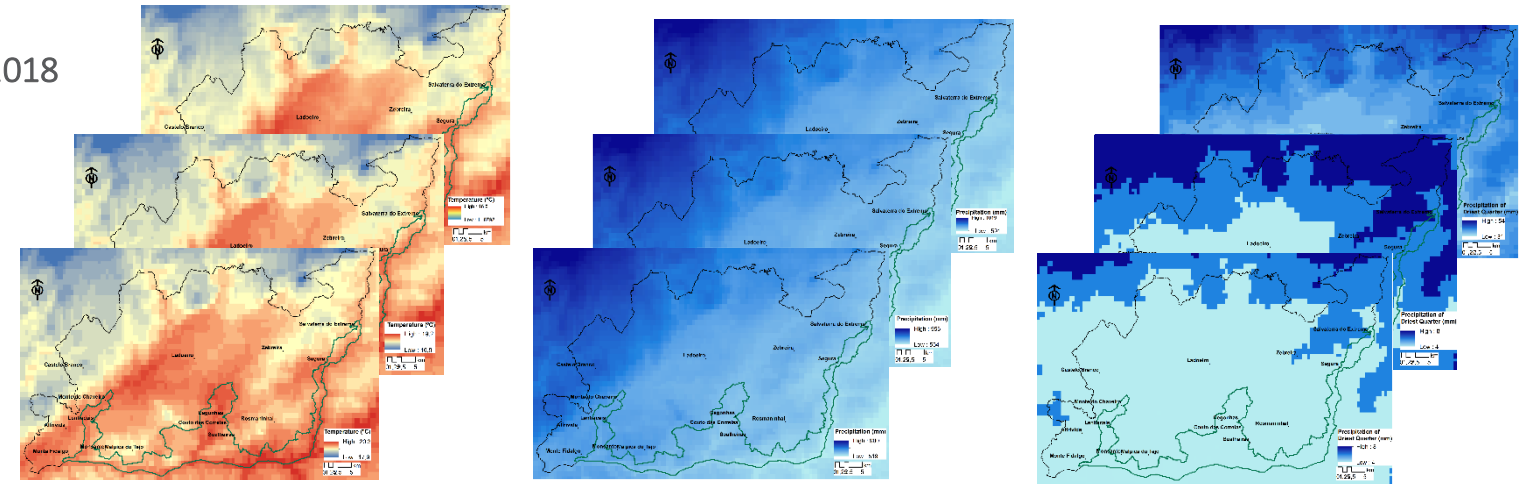
- Climatic Data

Mean Temperature | Annual Precipitation | Precipitation of driest quarter

2010-2018

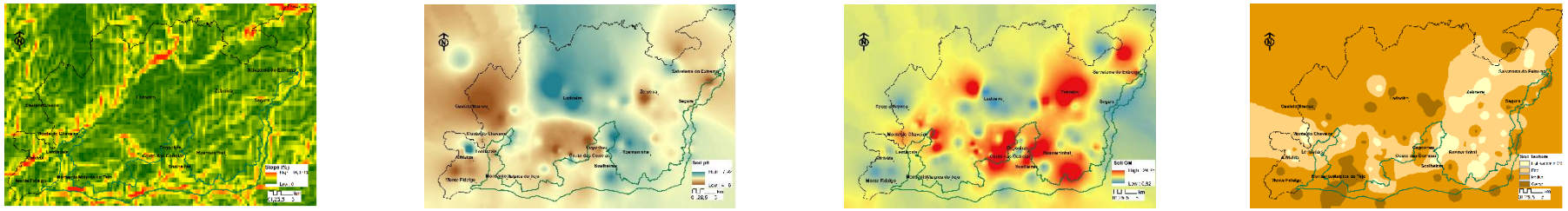
2080 - RCP 4.5

2080 - RCP 8.5



- Topographical and soil data

Slope | Soil pH | Soil Organic Matter | Soil Texture

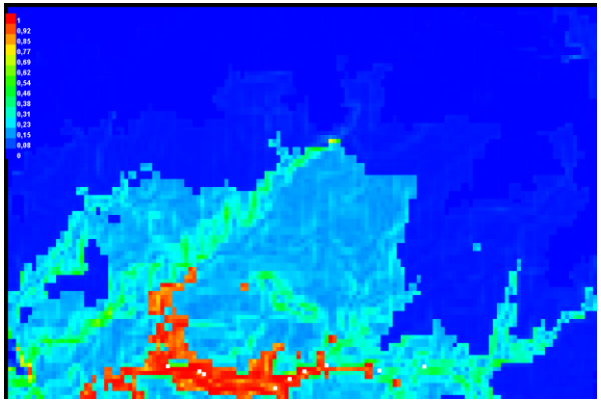


5. Results

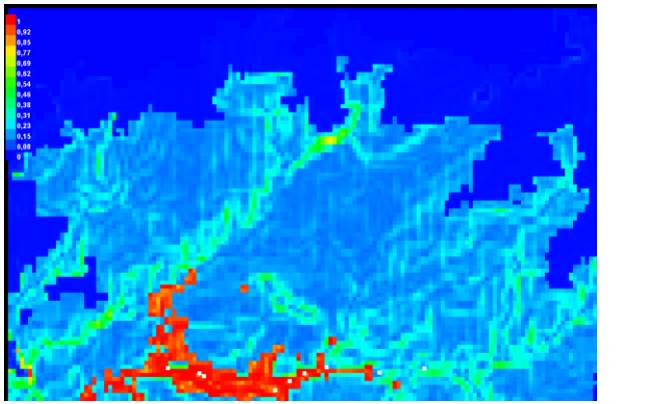
Future Potencial Distribution

Juniperus oxycedrus

RCP 4.5



RCP 8.5

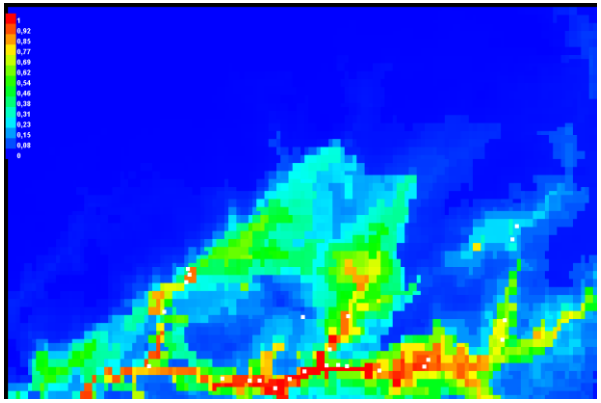


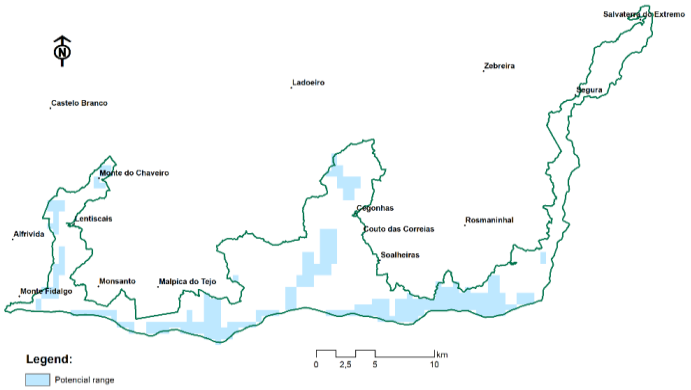
5. Results

Future Potential Distribution

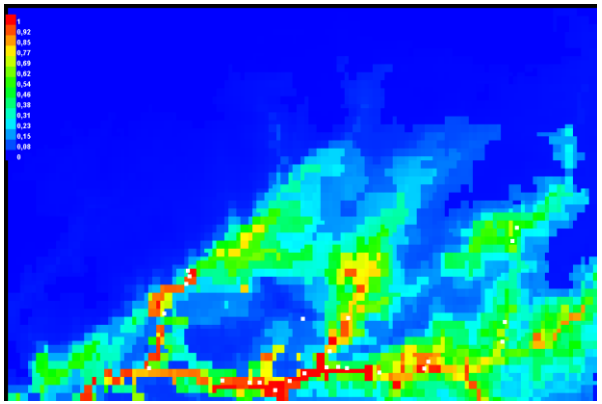
Pistacia terebinthus

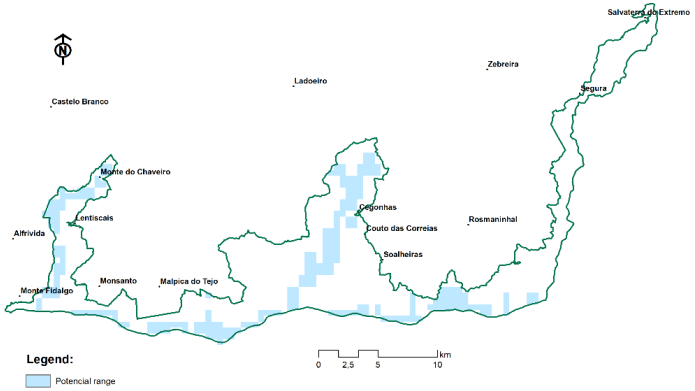
RCP 4.5





RCP 8.5



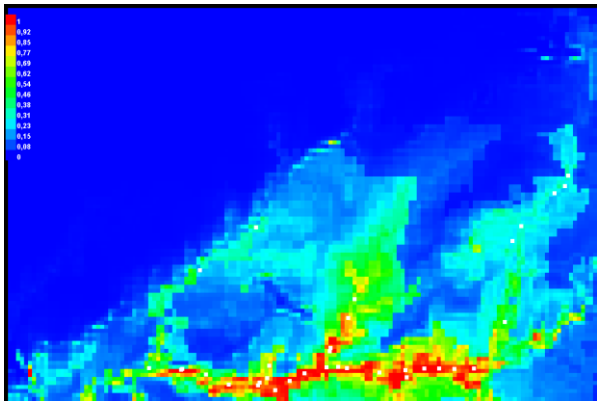


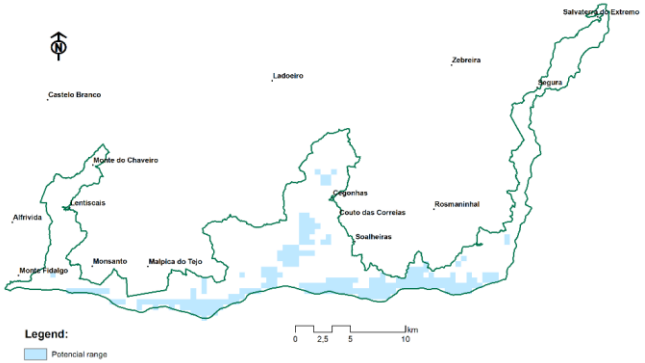
5. Results

Future Potential Distribution

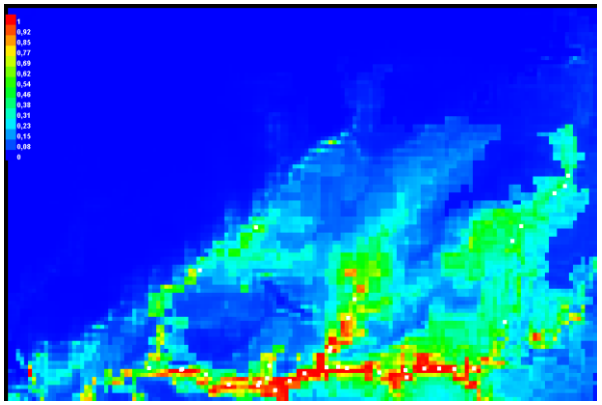
Rhamnus lycioides

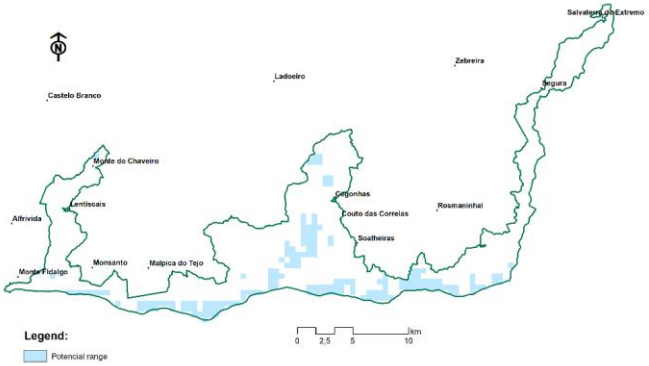
RCP 4.5





RCP 8.5





6. Discussion

Future Scenarios

- For *J. oxycedrus*, the increase in the potential area of occurrence will be the same in both scenarios (RCP 4.5 and 8.5).
- For *P. terebinthus* and *R. lycioides*, the trend is also the increase in the species' range, with a slightly higher increase in the RCP 4.5 scenario.
- The variables most impacting on the species distribution were the mean precipitation of the driest quarter, annual precipitation, mean annual temperature, and slope
- The results suggested some range expansion in the future for all three species for the studied scenarios

7. Conclusions

- This work aimed to study the influence of climate change on the potential geographic distribution of those species as indicators of typical Mediterranean vegetation
- Results show an increase in the potential area of occurrence of the plant species in the next future
- The studied species and the vegetation where they occur will probably remain confined to center-eastern Portugal in the future, where they will continue to face relevant threats like human activity, reinforcing the need for its conservation
- The increase in potential area for *Juniperus oxycedrus* is relevant to promote the conservation of the habitat 5210 - Arborescent matorral with *Juniperus* spp., a priority for conservation at a European level. Also, maquis conservation, with *P. terebinthus* and *R. lycioides* as indicator species, is important at a local and regional level under the habitat 5330 of 92/43/CEE Directive.
- Our study helps to better understand the implications of climate change in the conservation and management of plant species and habitats in the Tagus International Transboundary Biosphere Reserve

Thank you!

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