A decision-making activity to guide archipelago-wide rewilding of Galapagos giant tortoises

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Background

Galapagos Islands
Chelonoidis spp.

PINTA
abingdonii†

Wolf Volcano
becki

Darwin Volcano
microphyes

FERNANDINA
phantasticus

SANTIAGO
darwini

PINZON
duncanensis

SANTA CRUZ
porteri

donfaustoi

SAN CRISTÓBAL
chathamensis

Alcedo Volcano
vandenburghi

ISABELA

Cerro Azul Volcano
vicina

Sierra Negra Volcano
guntheri
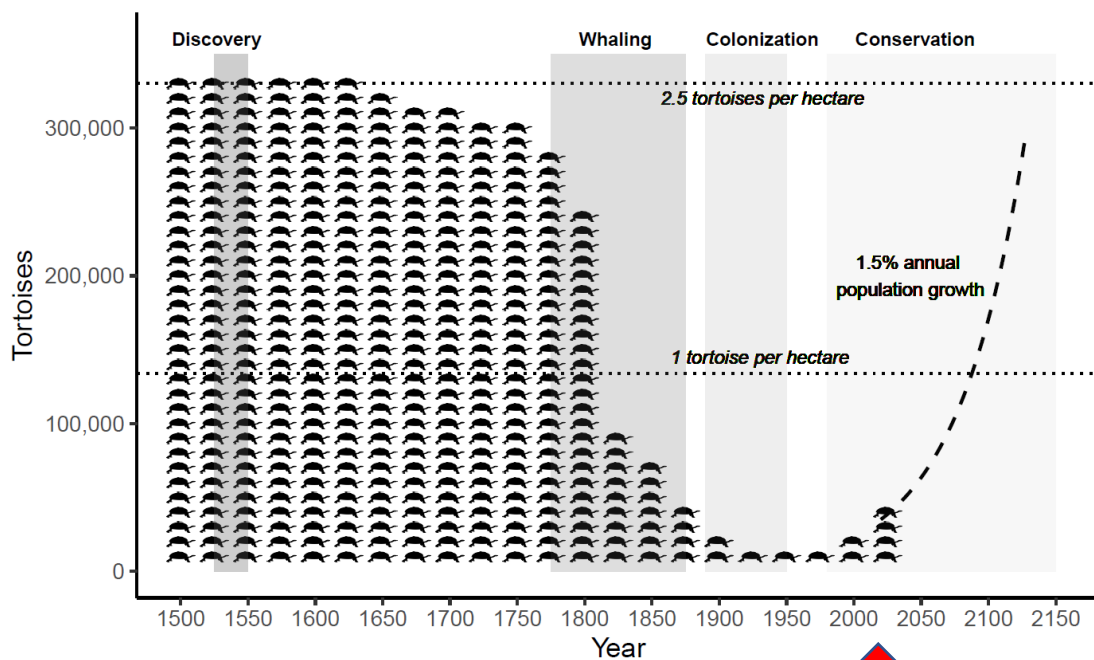
SANTA FE
undescribed†

FLOREANA
niger†

ESPAÑOLA
hoodensis

Each tortoise represents 10,000 individuals

3

Background

The Galapagos Islands have been the focus of perhaps the **largest-scale "rewilding" effort ever attempted on Earth.** Over the last 60 years, > 10,000 giant tortoises have been reared in captivity and released to the wild.

Each tortoise represents 10,000 individuals
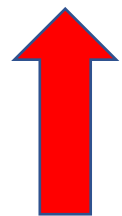
Project Motivation & End User Need

Goal: Create an **integrated decision support system** that will guide decision-making on the "**where and when**" to rewild tortoises considering:

expected future climatic conditions while meeting multiple objectives including probability of **population establishment**, **ecosystem** status, **biodiversity** enhancement, **economic** outcomes, and operational **costs**

It is anticipated the tool under development will be a key component of the decadal plan guiding restoration efforts

Decision Support Tool

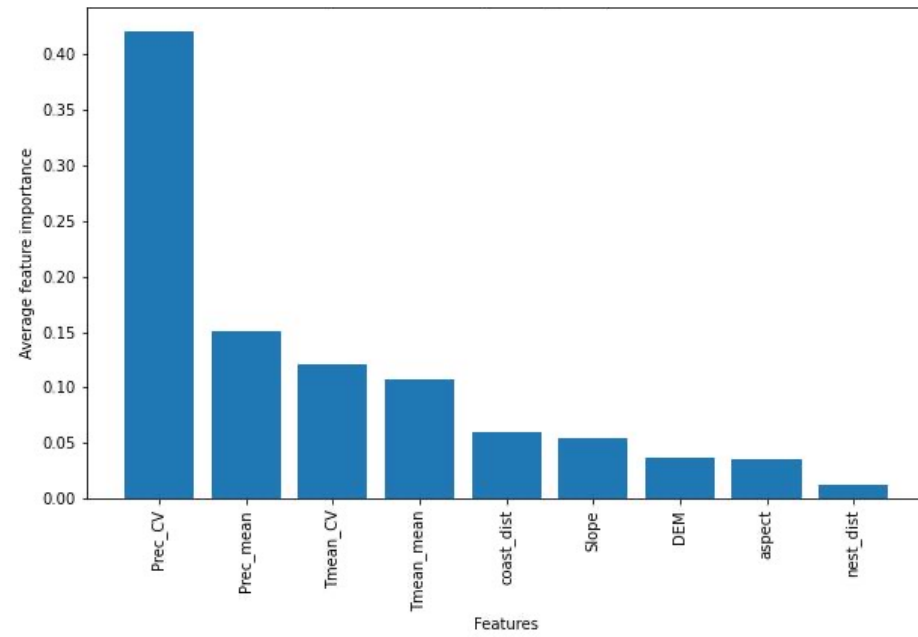## Development in R Shiny

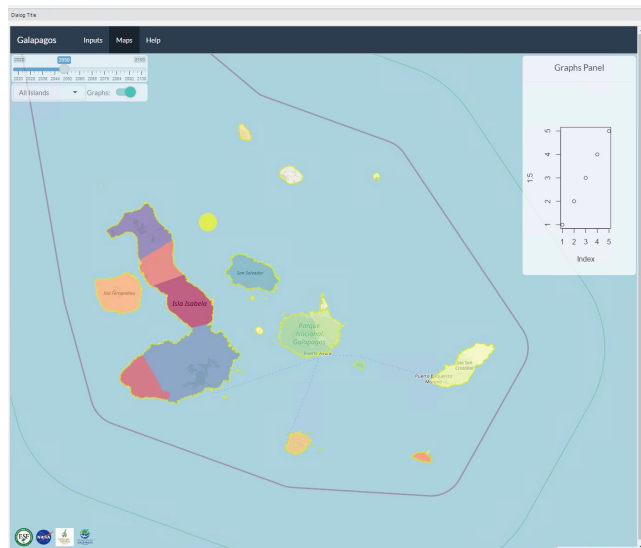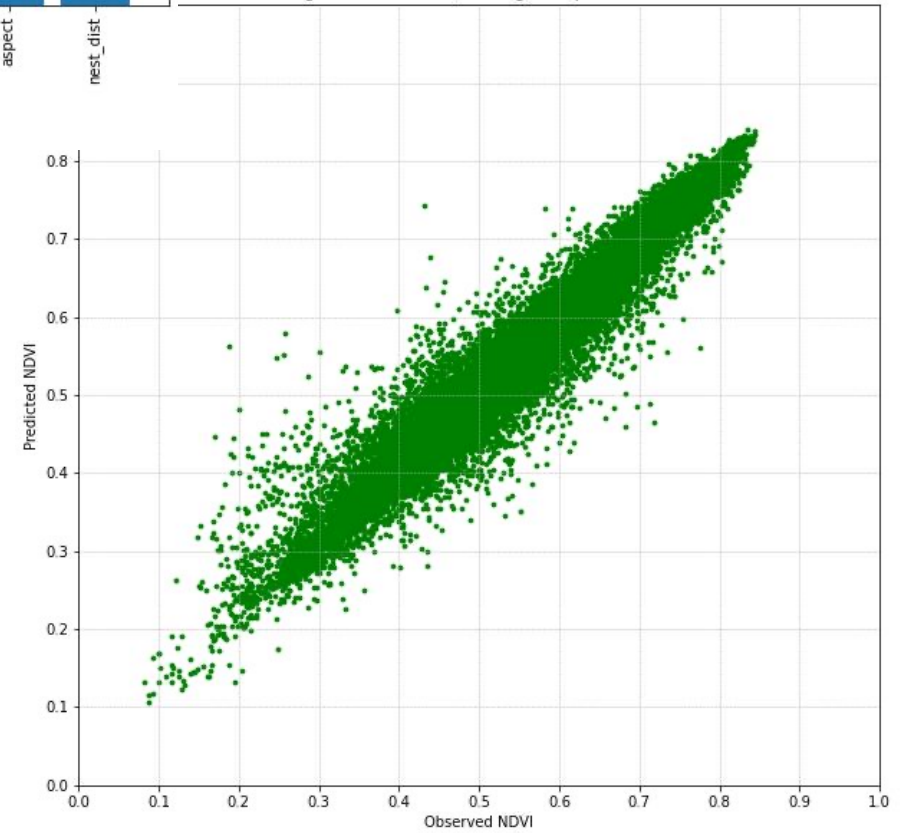# Decision Support Tool

Processing Steps

User Defined Scenario
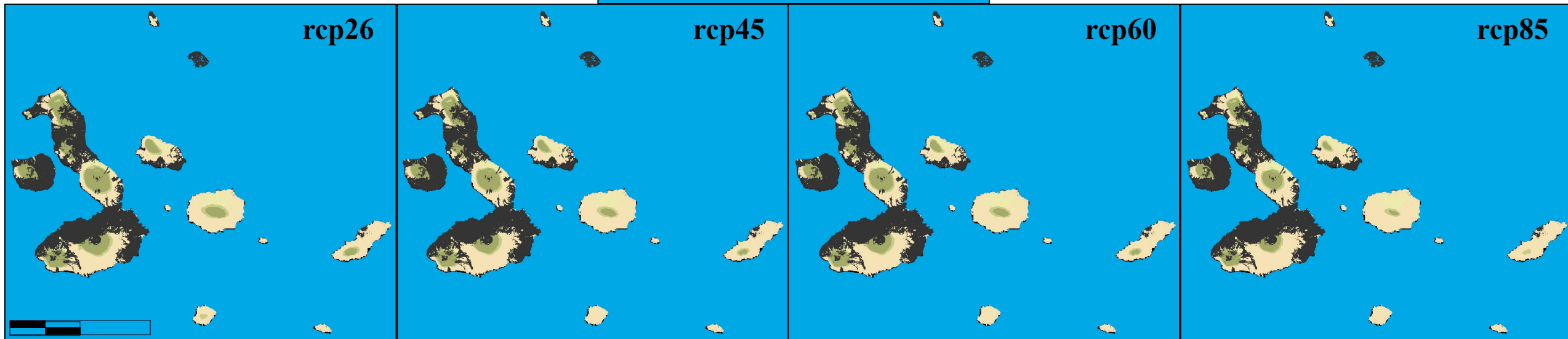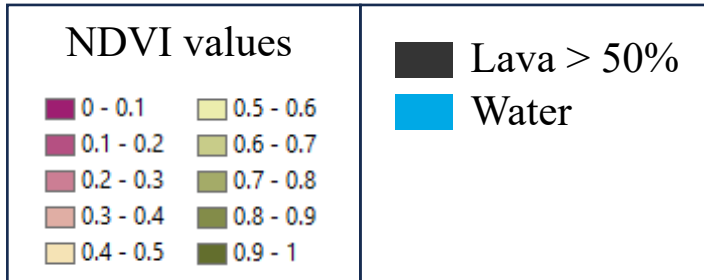
⬇

Vegetation Prediction

Predicted Vs actual NDVI values - combined 10 CV folds
Average RMSE = 0.021, Average R-squared = 0.969
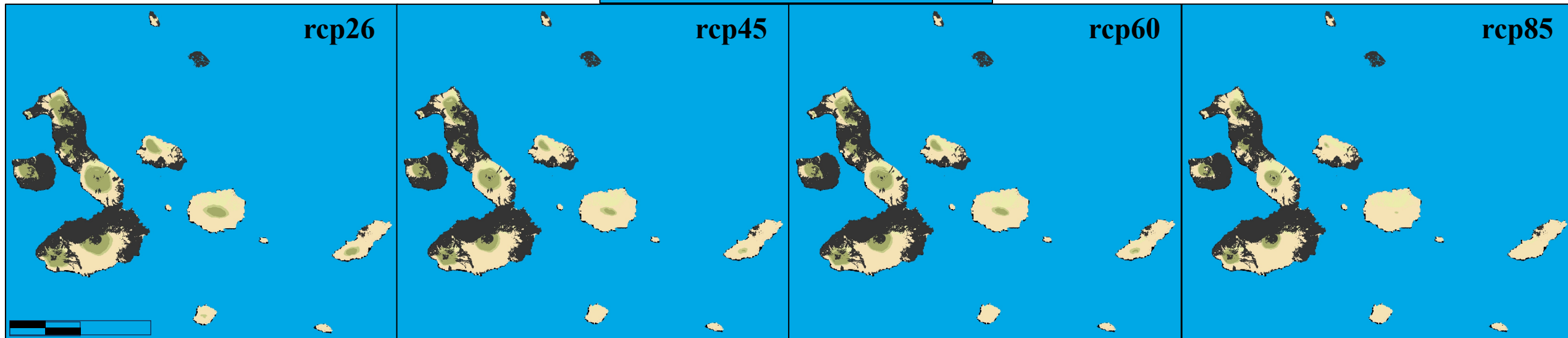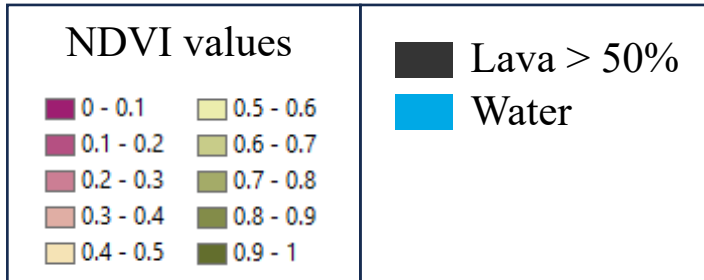
NDVI 2041-2060 Prediction under different RCPs

Emission scenarios: Representative Concentration Pathways
RCP26 (lowest), RCP45, RCP60 and RCP85 (highest emissions)

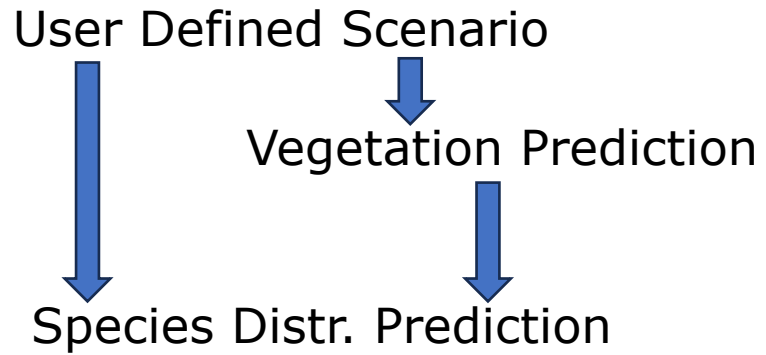# NDVI 2061-2080 Prediction under different RCPs

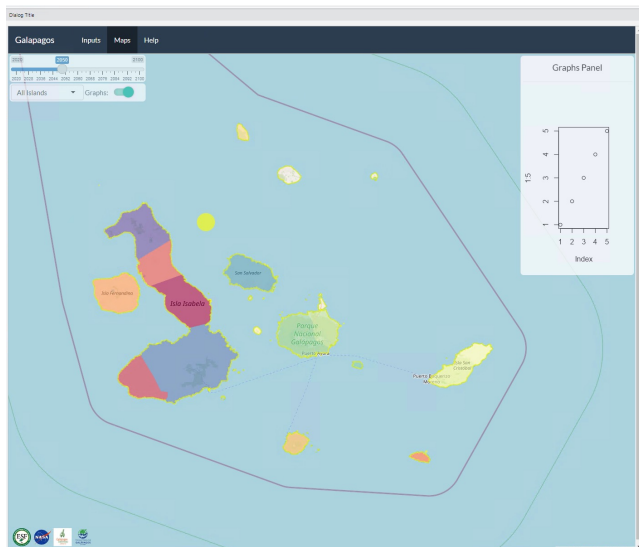Emission scenarios: Representative Concentration Pathways
RCP26 (lowest), RCP45, RCP60 and RCP85 (highest emissions)

Processing Steps

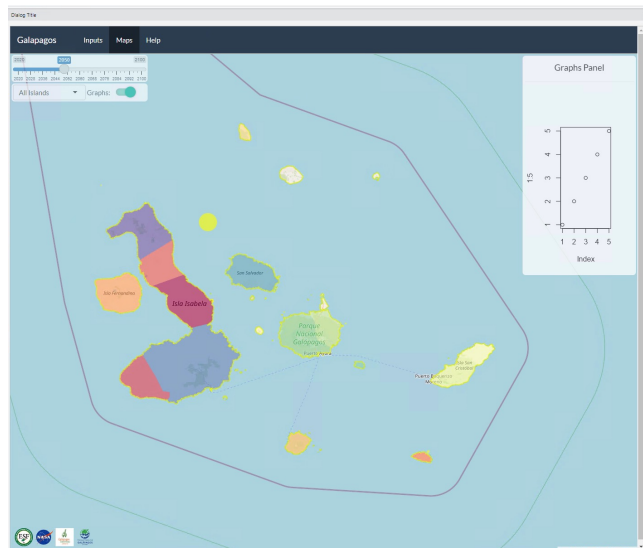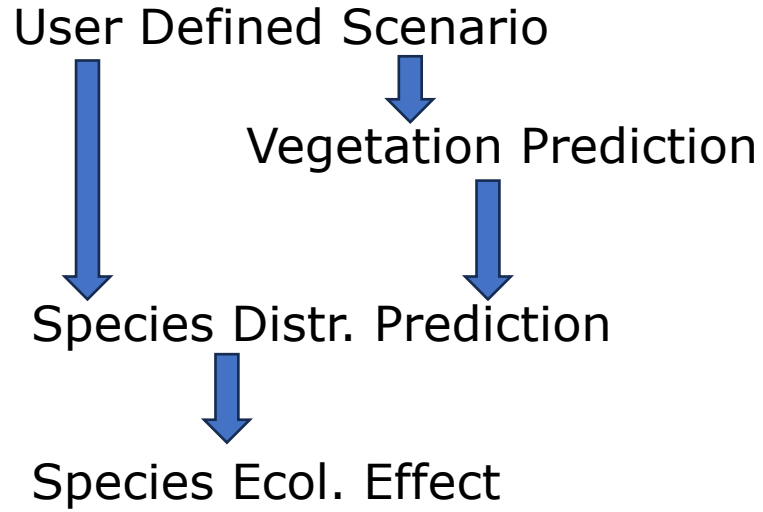User Defined Scenario

Vegetation Prediction

Species Distr. Prediction

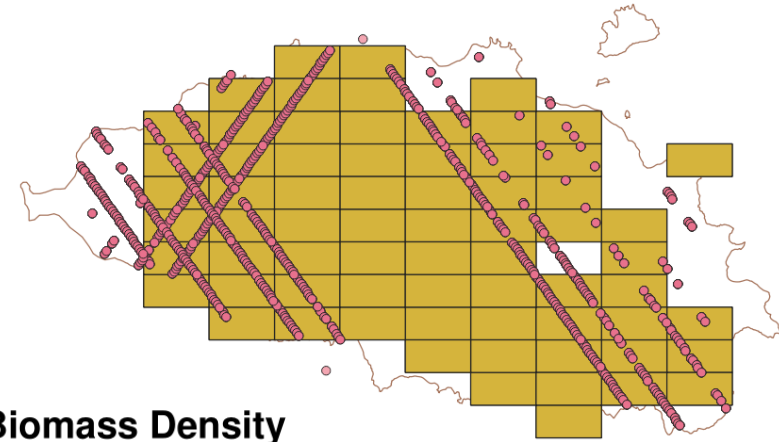| Variable	Percent contribution
ndvi-mean	59.9
nest_dist	27.3
prec_mean_chelsea_v1	3.9
slope	3.4
tmean_mean_chelsea_v1	2.8
aspect_catg	2.7

AUC = 0.73

Processing Steps

Linking GEDI-derived Biomass to Tortoise Density

User Defined Scenario

Vegetation Prediction

Species Distr. Prediction

Species Ecol. Effect

Tortoise Effects on Above Ground Biomass Density

AGBD (Log10)

Tortoise Density (Inds per Hectare)

Processing Steps

User Defined Scenario

Vegetation Prediction

Species Distr. Prediction

Species Ecol. Effect
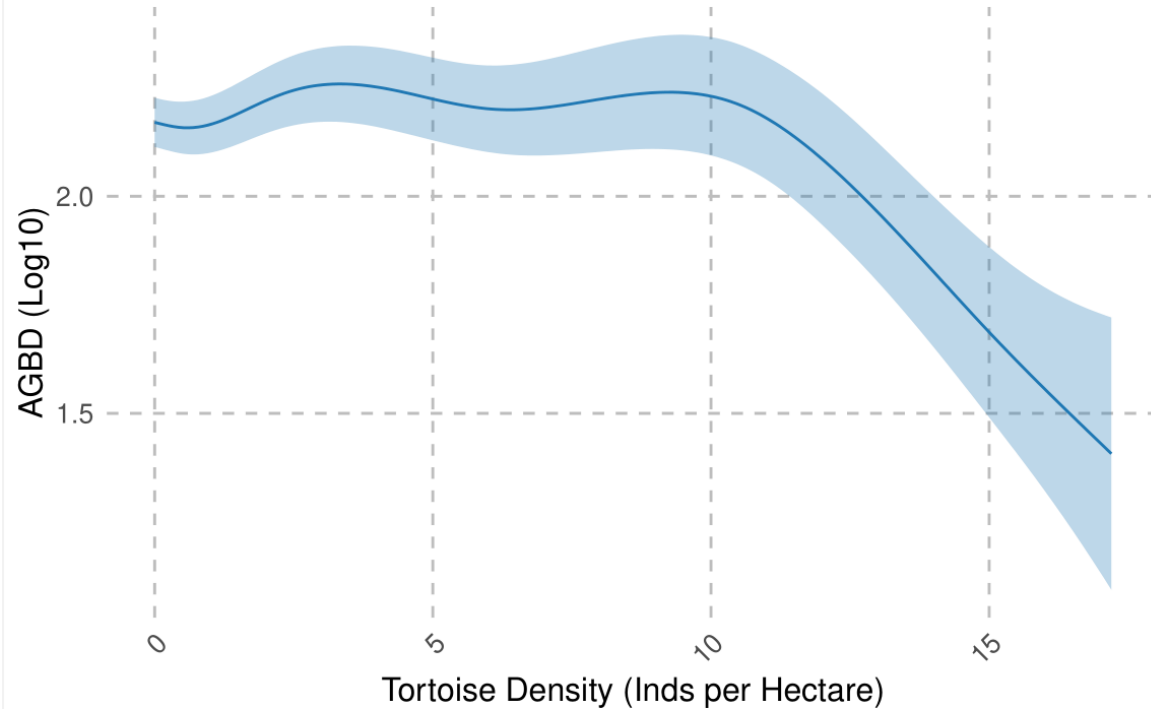
Economic Effects
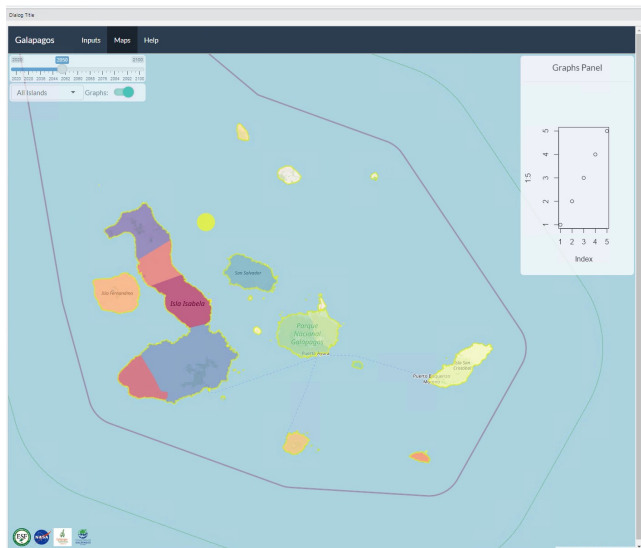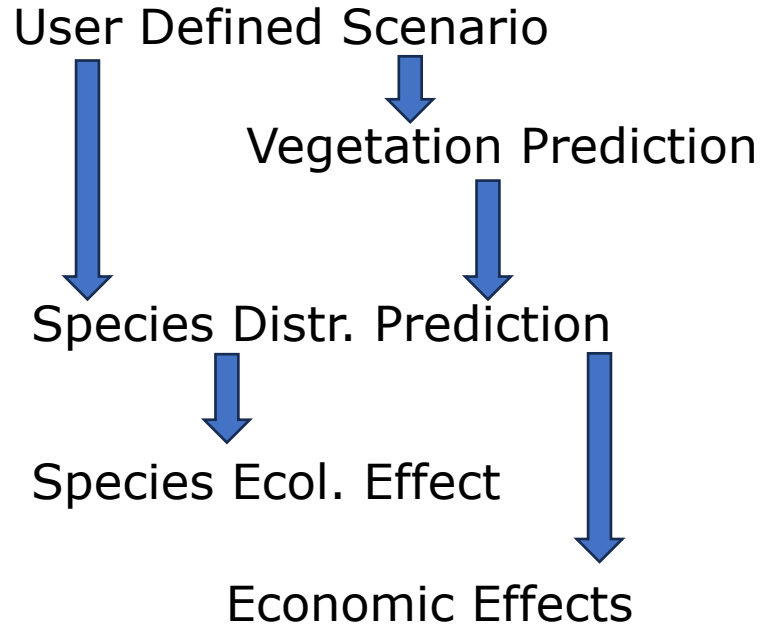
## Rewilding Costs

Costs		
Captive care (US$/tortoise/year)	Constant	190
Translocation: captivity to Floreana (US$/trip)	Constant	10,000
Translocation: Wolf Volcano to captivity or Floreana (US$/trip)	Constant	100,000
New corral (US$/corral)	Constant	35,000
Genetic testing (US$/sample)	Constant	15

Tourism Benefits
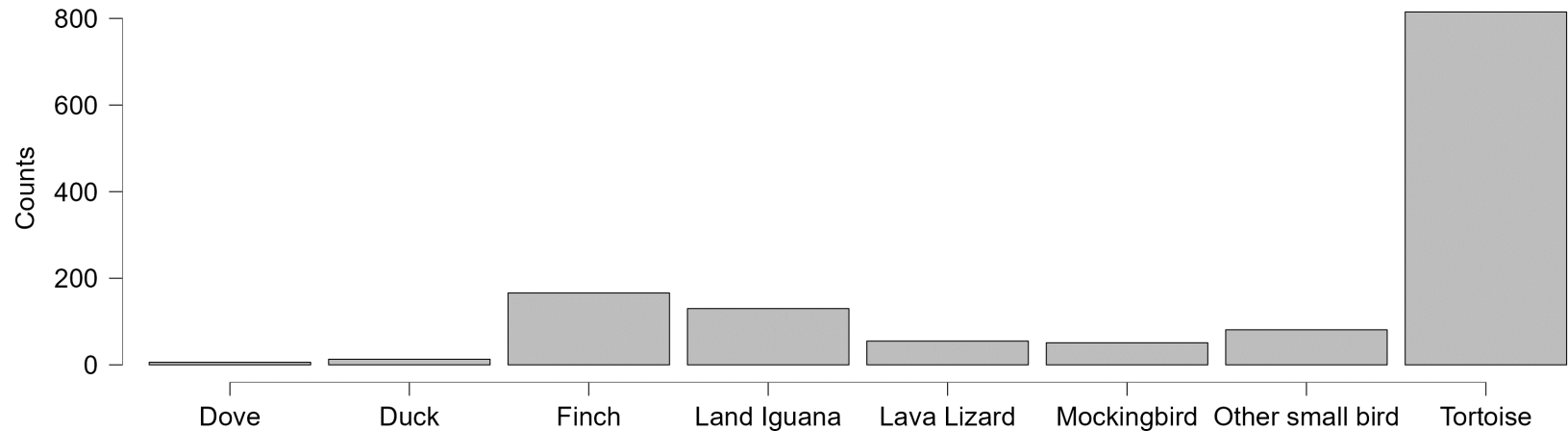
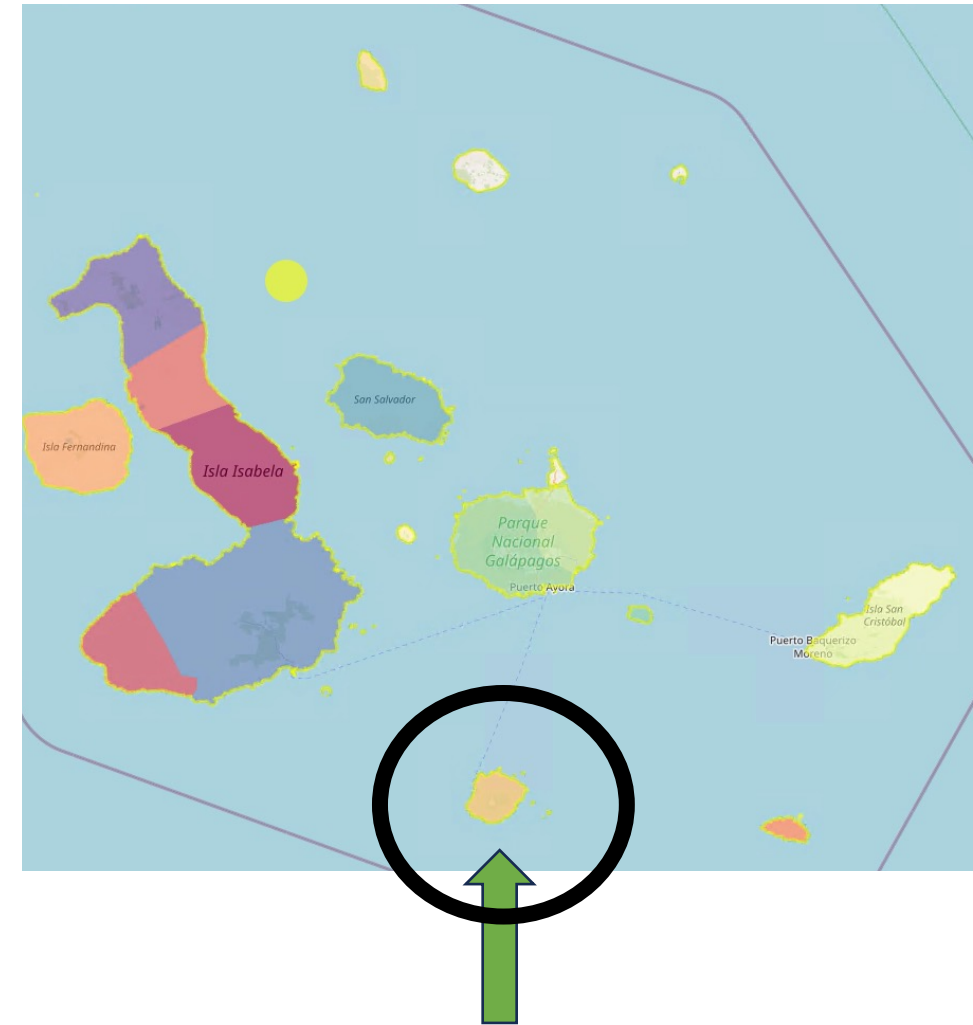~10,000 images mined from Flickr, Classified with ML

Science in Action
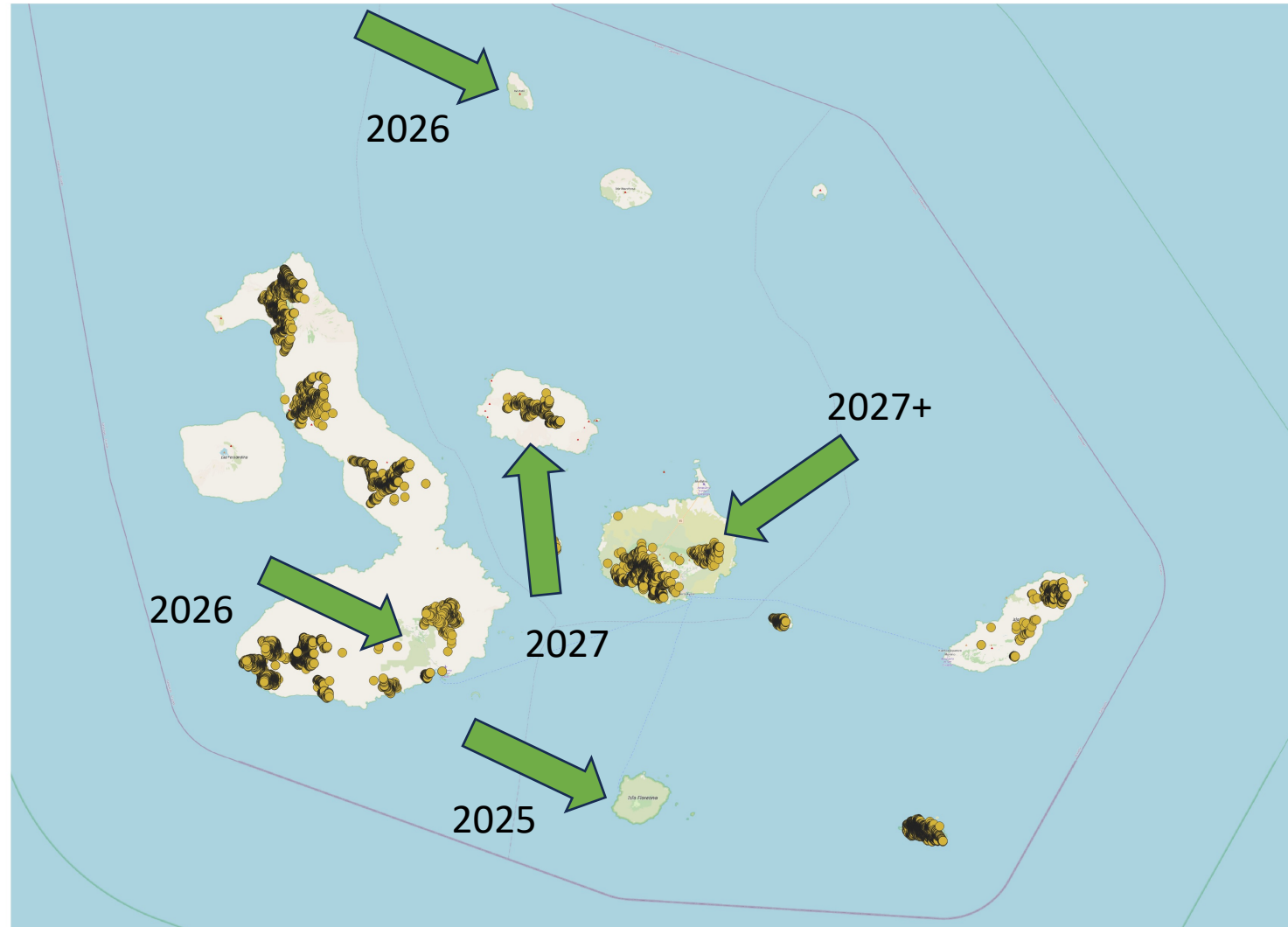
User Defined Scenario

Climatology: CHELSA (Climatologies at high resolution for the earth's land surface areas)
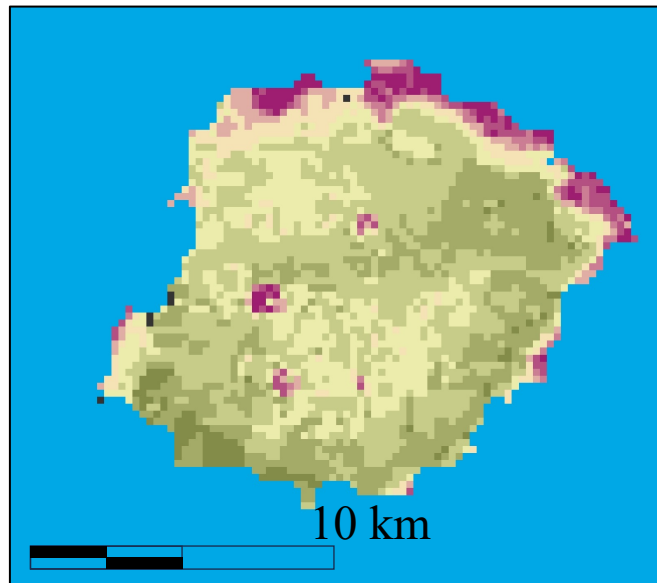
Model: IPSL-CM5A-LR model, Institut Pierre Simon Laplace, fifth version

Emission scenarios: Representative Concentration Pathways RCP26 (lowest), RCP45, RCP60 and RCP85 (highest emissions)
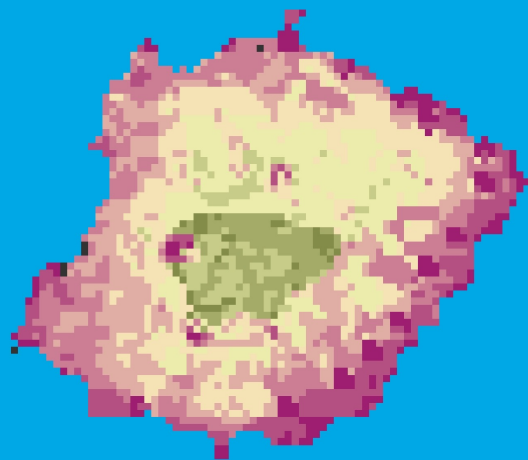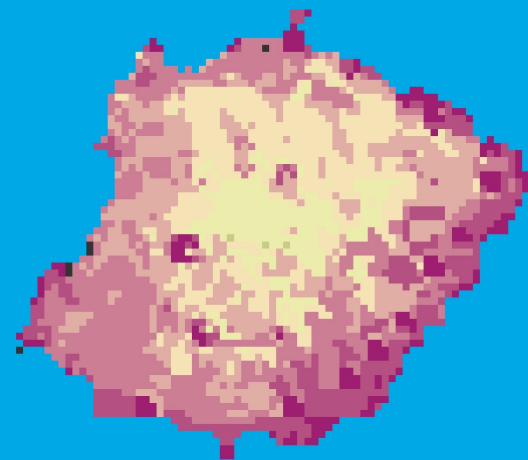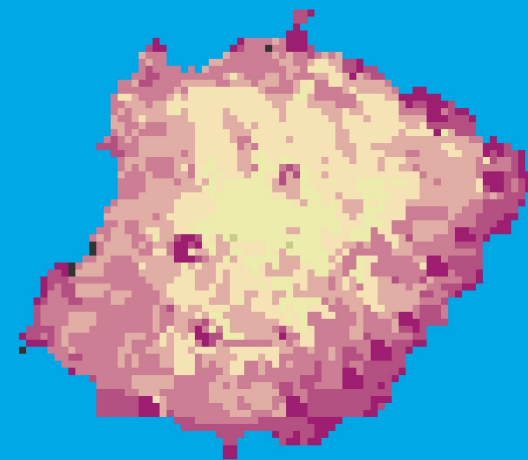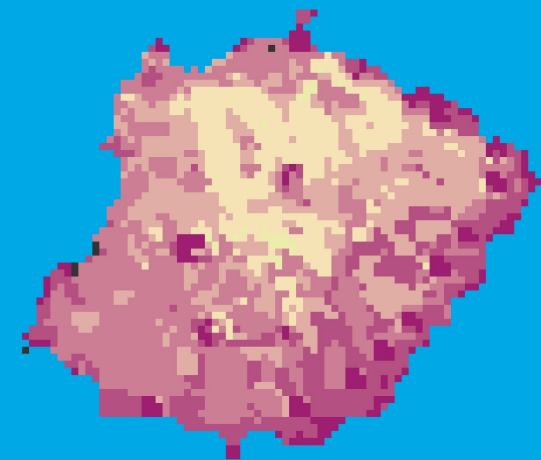

Floreana (Jan, 2025 rewilding)
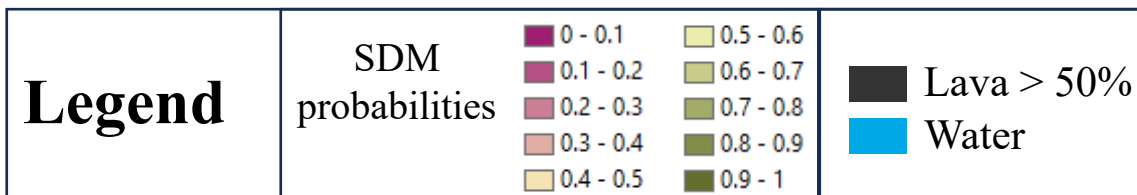
Historical

10 km

2041-2060

rcp26

rcp45

rcp60

rcp85

Legend

SDM probabilities

- 0 - 0.1
- 0.1 - 0.2
- 0.2 - 0.3
- 0.3 - 0.4
- 0.4 - 0.5
- 0.5 - 0.6
- 0.6 - 0.7
- 0.7 - 0.8
- 0.8 - 0.9
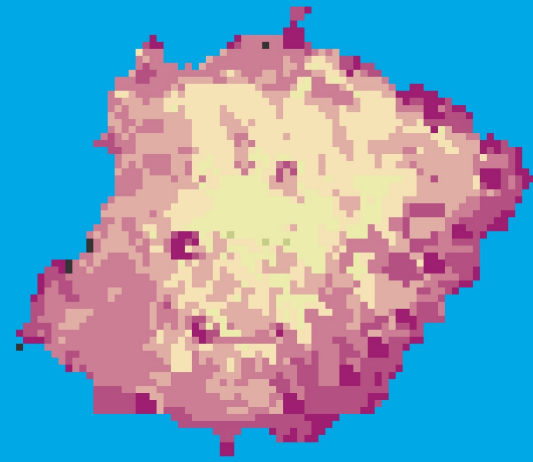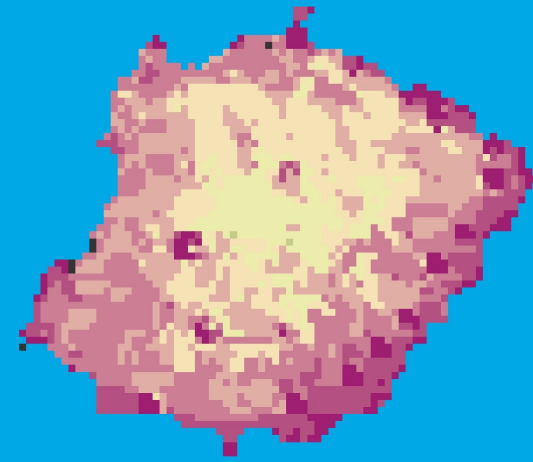- 0.9 - 1

Lava > 50%
Water

Historical

10 km

2061-2080

rcp26

rcp45

rcp60

rcp85

Legend

SDM probabilities

- 0 - 0.1
- 0.1 - 0.2
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- 0.4 - 0.5
- 0.5 - 0.6
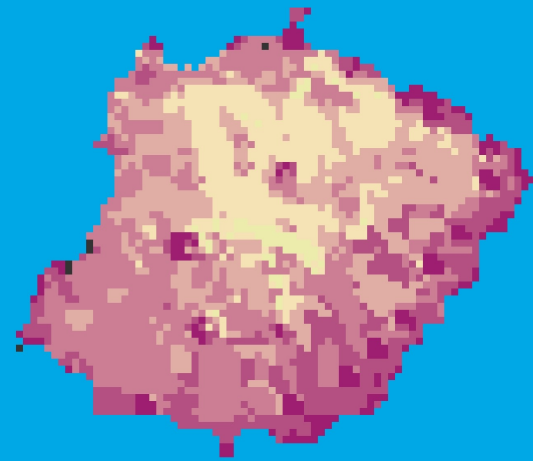- 0.6 - 0.7
- 0.7 - 0.8
- 0.8 - 0.9
- 0.9 - 1

Lava > 50%

Water
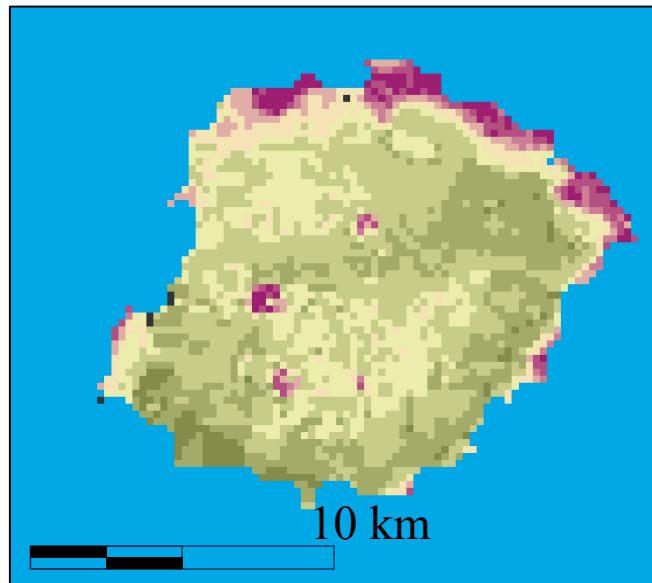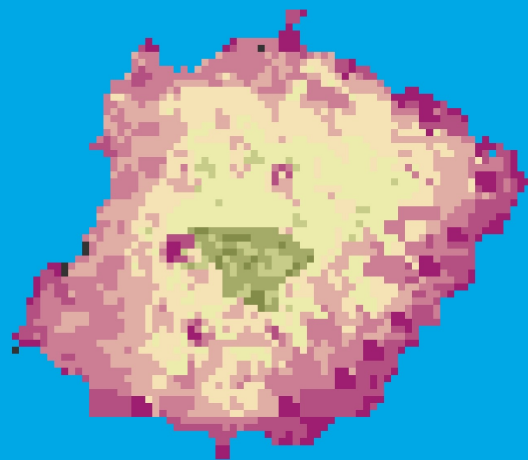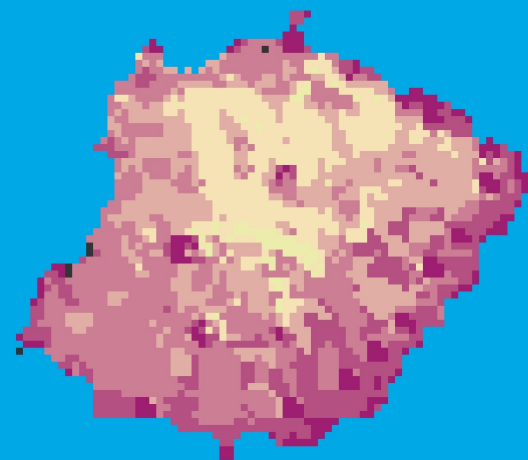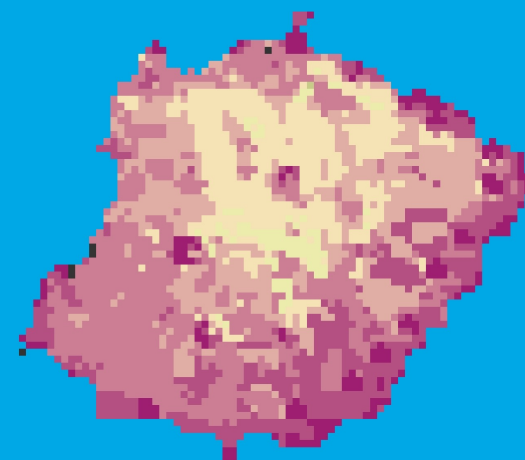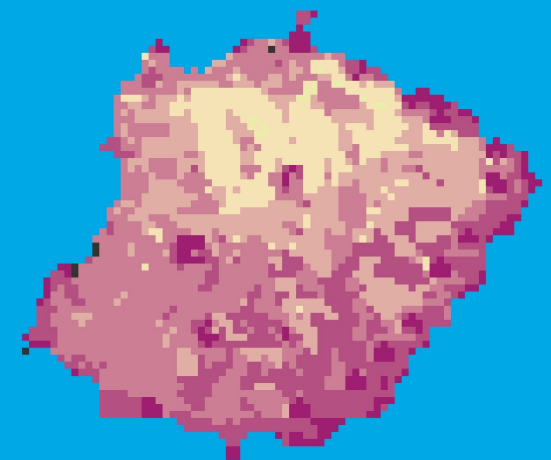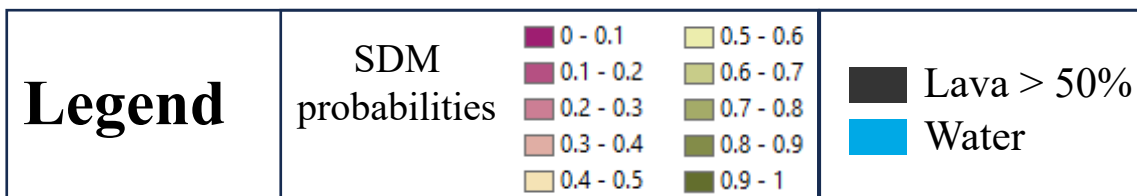
2041-2060
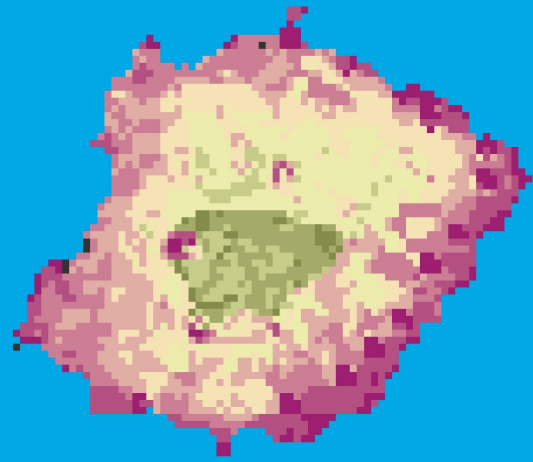
rcp26 · rcp45 · rcp60 · rcp85

2061-2080

rcp26 · rcp45 · rcp60 · rcp85

Legend

SDM probabilities

0 - 0.1	0.5 - 0.6
0.1 - 0.2	0.6 - 0.7
0.2 - 0.3	0.7 - 0.8
0.3 - 0.4	0.8 - 0.9
0.4 - 0.5	0.9 - 1

Lava > 50%

Water
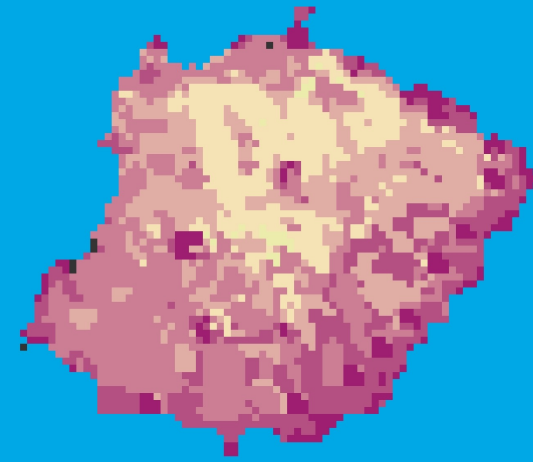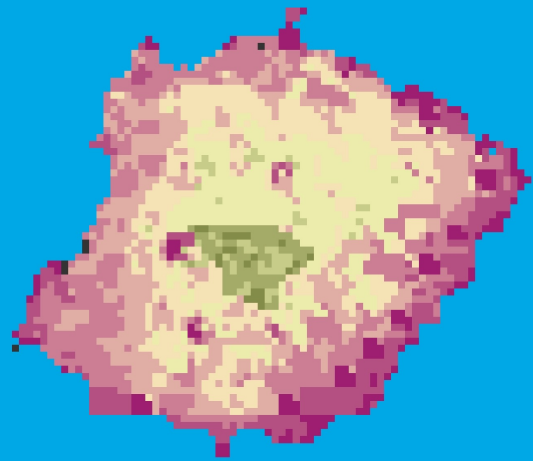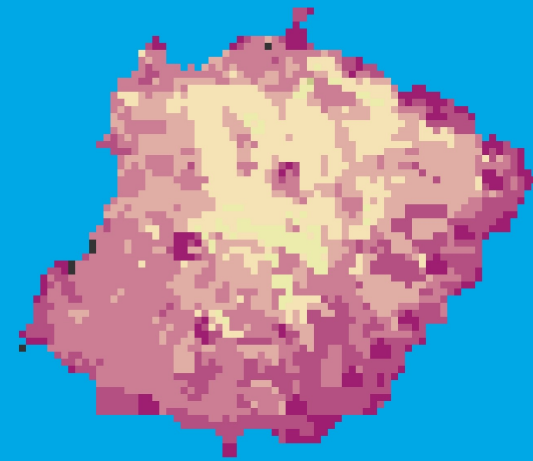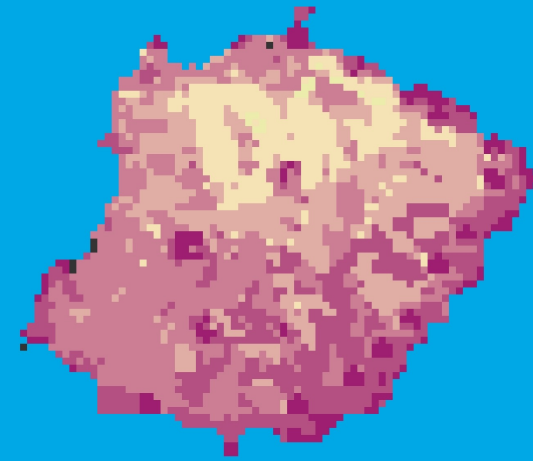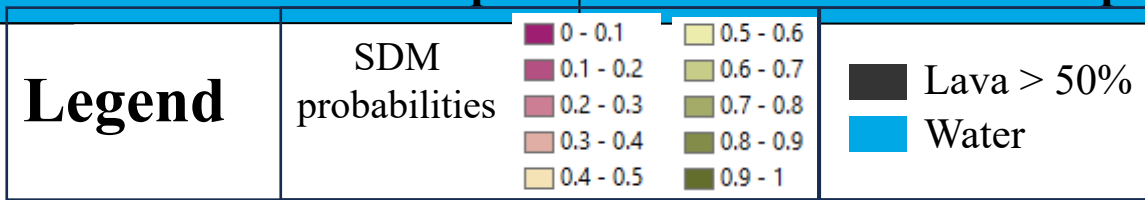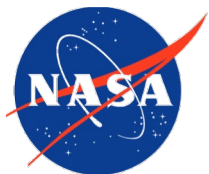
End User Engagement Activities

INTERNATIONAL WORKSHOP

Initiativa Galápagos: Blue-print for tortoise restoration 2025-2050

TBD – Jan,2025

Thank you