

# **Interactive Maps from:**

## **Modelling 21st century refugia and impact of climate change on Amazonia's largest primates**

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### **Abstract**

**Aim:** Unsuitable edaphic and vegetation conditions can render climatically suitable sites inadequate for a species to persist, constraining both the amount of suitable habitat and the possibilities of tracking their preferred climatic niche under future climate change. We combined climatic and remotely sensed data to estimate current and future distributions of nine extant taxa of ateline primates across the whole Amazon basin. We used these estimations to identify and quantify range changes and potential refugia at taxon and complex levels up until the mid-21st century.

**Location:** Amazonia.

**Taxon:** Atelinae (Primates).

**Methods:** We applied an ensemble forecasting approach for species distribution models in the 'biomod2' R package using 596 spatially rarefied occurrences. We parameterised these models combining reflectance data from a basin-wide Landsat TM/ETM+ image composite, and three sets of bioclimatic layers containing data for the current time period (1981-2010), and two different (moderate and worst-case) climate change scenarios for 2041-2070.

**Results:** Eight out of the nine taxa are likely to experience pronounced range losses, with seven of them predicted to lose over 50% of their currently suitable habitats irrespective of climate change scenarios. Modelled ateline richness exhibited a broadly similar spatial pattern under both climate change scenarios with a visual decrease in areas with higher predicted richness, and a possible redistribution/migration along the northernmost parts of western Amazonia. Refugia from 21st century climate change for the conservation of the whole complex were mostly concentrated in the western part of the Amazon basin, especially in the southern region.

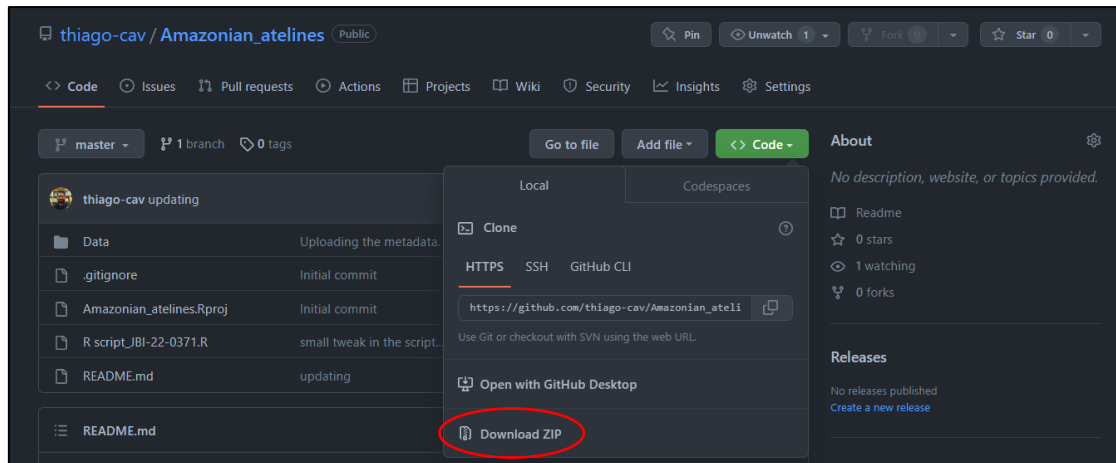
**Main conclusions:** We identified hotspots of vulnerability to climate change and 21st century refugia for all Amazonian atelines while accounting for habitat characteristics that must remain coupled with climatic conditions to guarantee the continued existence of colonizable habitats for these strictly arboreal forest-dwelling taxa. Increasing the understanding of reactions to climate change for this climate-sensitive group can help to spatially-inform conservation planning decisions and management to sustain forest-dwelling biodiversity over large areas such as Amazonia.

### **Keywords**

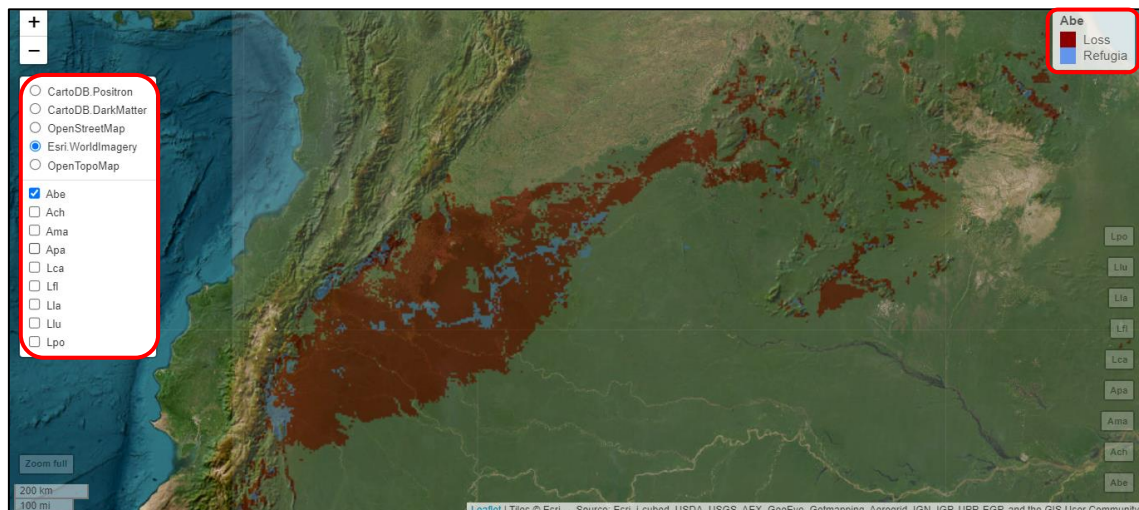
Amazonia, climate change, forest-dwelling biodiversity, habitat suitability, Landsat satellite, remote sensing, species distribution modelling

## Accessing the Maps

The interactive maps generated by the study are easily accessible for researchers and decision makers. To access the maps, simply download the repository (Figure 1), and extract the compressed file.



Within the "Data" folder, open the .html files to launch a web-based map visualization. The maps feature a range of components that can be used as background, such as satellite imagery and street maps (Figure 2), allowing for easy assessment of the study's findings.



## Uncertainty Maps

We assessed the overall ensemble uncertainty by calculating the standard deviation of the predictions from all individual models, providing a measure of the variability between the predictions made by different algorithms. Smaller standard deviation in the ensemble uncertainty maps represents lower variability between the predictions made

by different algorithms and a more consistent agreement among individual models (Figure 3).

