

Tutorial 1: Exploring major tropical biomes

BIOL 448C

January 15, 2021

Group exercise!

Gather and assimilate information on major tropical habitats

Using tree species inventories to map biomes and assess their climatic overlaps in lowland tropical South America

Silva de Miranda et al. 2018, *Global Ecology & Biogeography*

10,306 tree species

1,062 genera

148 families

www.neotropree.info

- Mapping biomes using floristic composition (rather than by climate)
- Authors used tree inventories (>4000!) across tropical South America and performed an analysis of community composition to group sets of species
 - Hierarchical clustering analysis
 - Considered “cluster” structure while considering site vegetations types (guided by previous classifications of LTSA: wet/moist tropical forest, SDTF, subtropical forest, savanna, chaco woodlands)

Using tree species inventories to map biomes and assess their climatic overlaps in lowland tropical South America

Silva de Miranda et al. 2018, *Global Ecology & Biogeography*

6 domains used to guide conservation and management policy:

Amazon Forest

Atlantic Forest

Cerrado

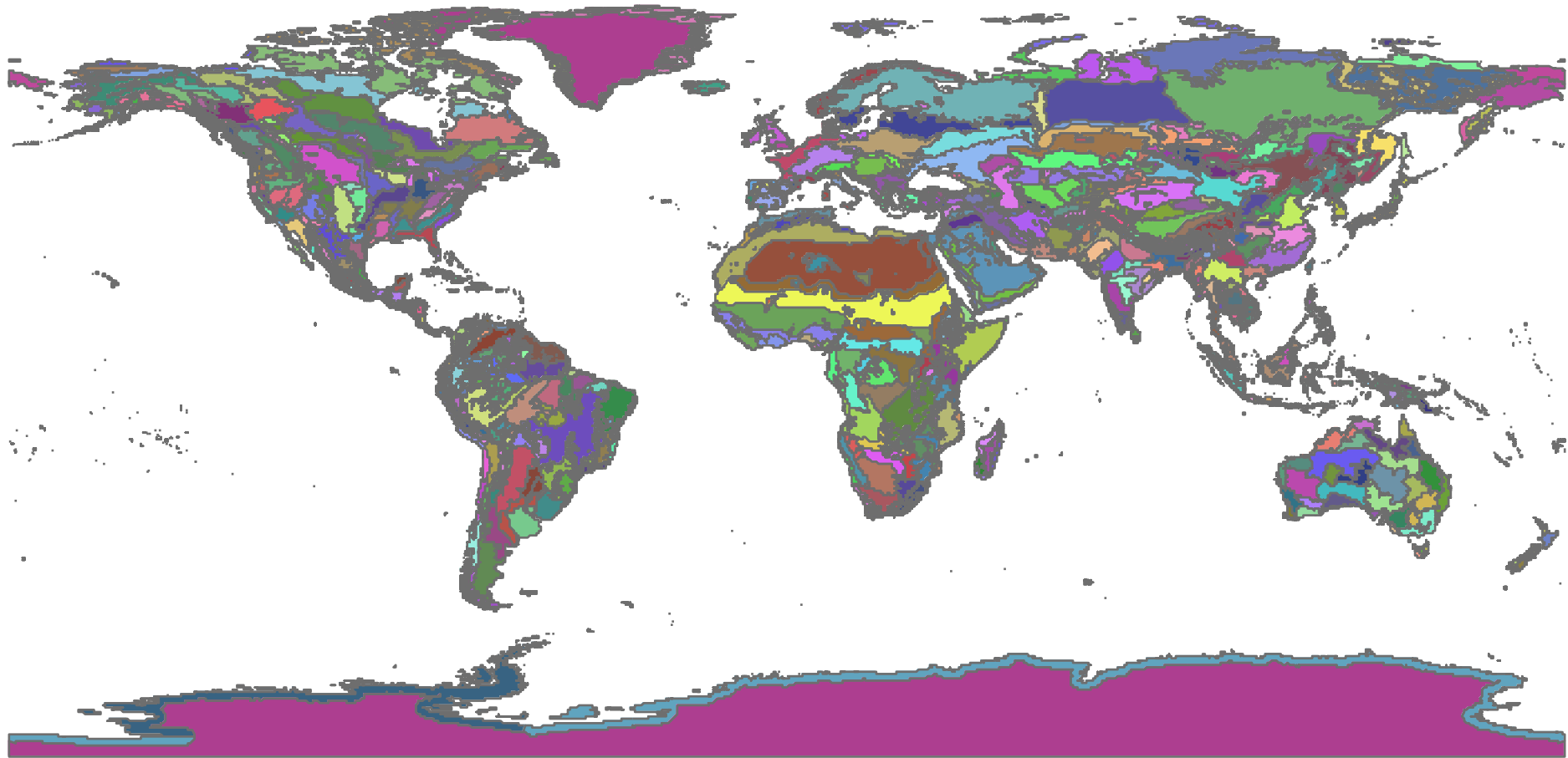
Caatinga

Pantanal

Pampa

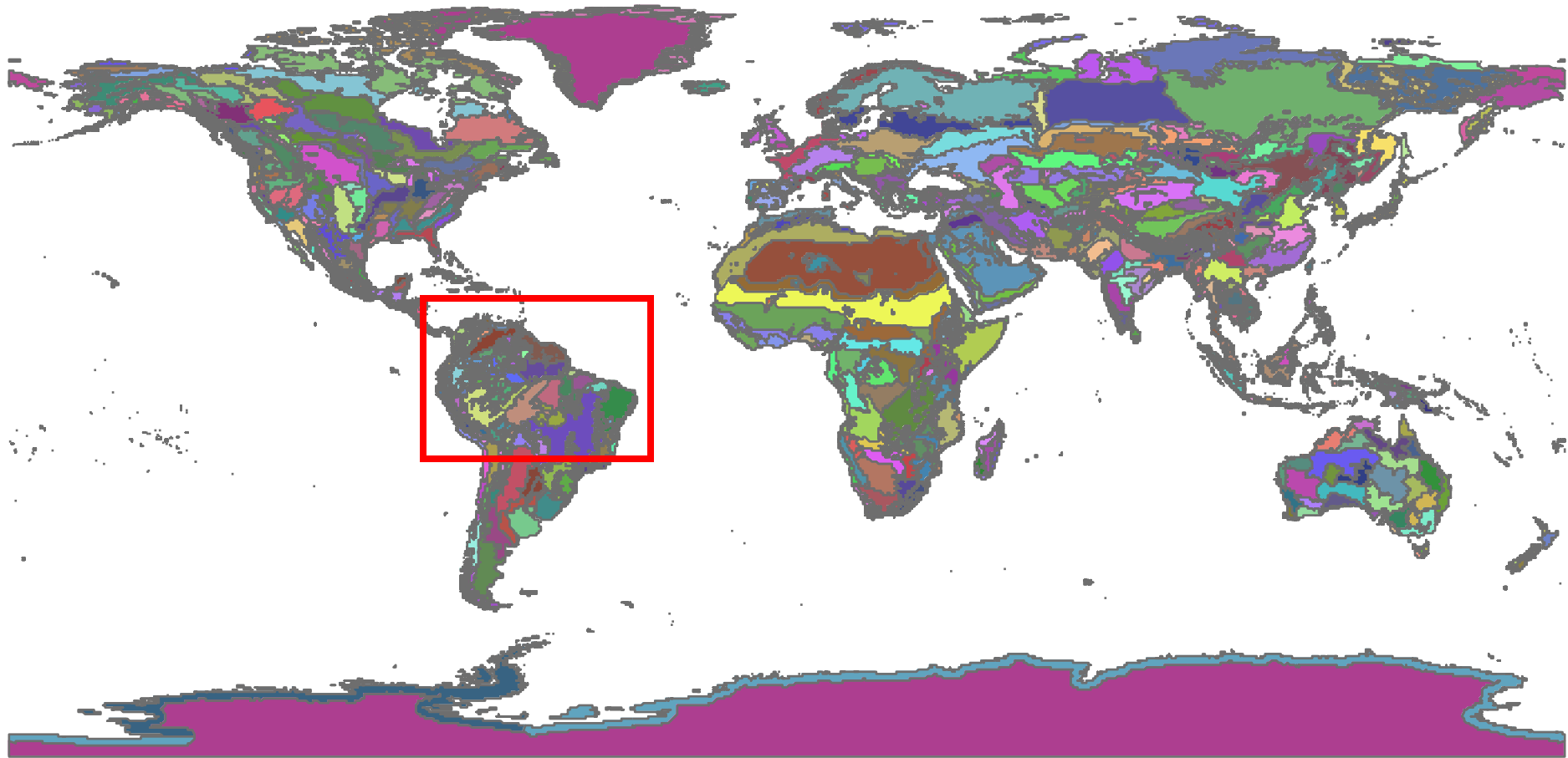
- Paper reflects some of the history of conflict in defining communities as units (*sensu* Clements)
- For a long period, biomes were defined based on MAT and MAP
- But vegetation is inextricably tied to these climate variables, and should be useful in classifying biomes
 - Functional traits
 - Structural features
 - (these are also reflected in floristics)

Data Source: Terrestrial Ecoregions of the World



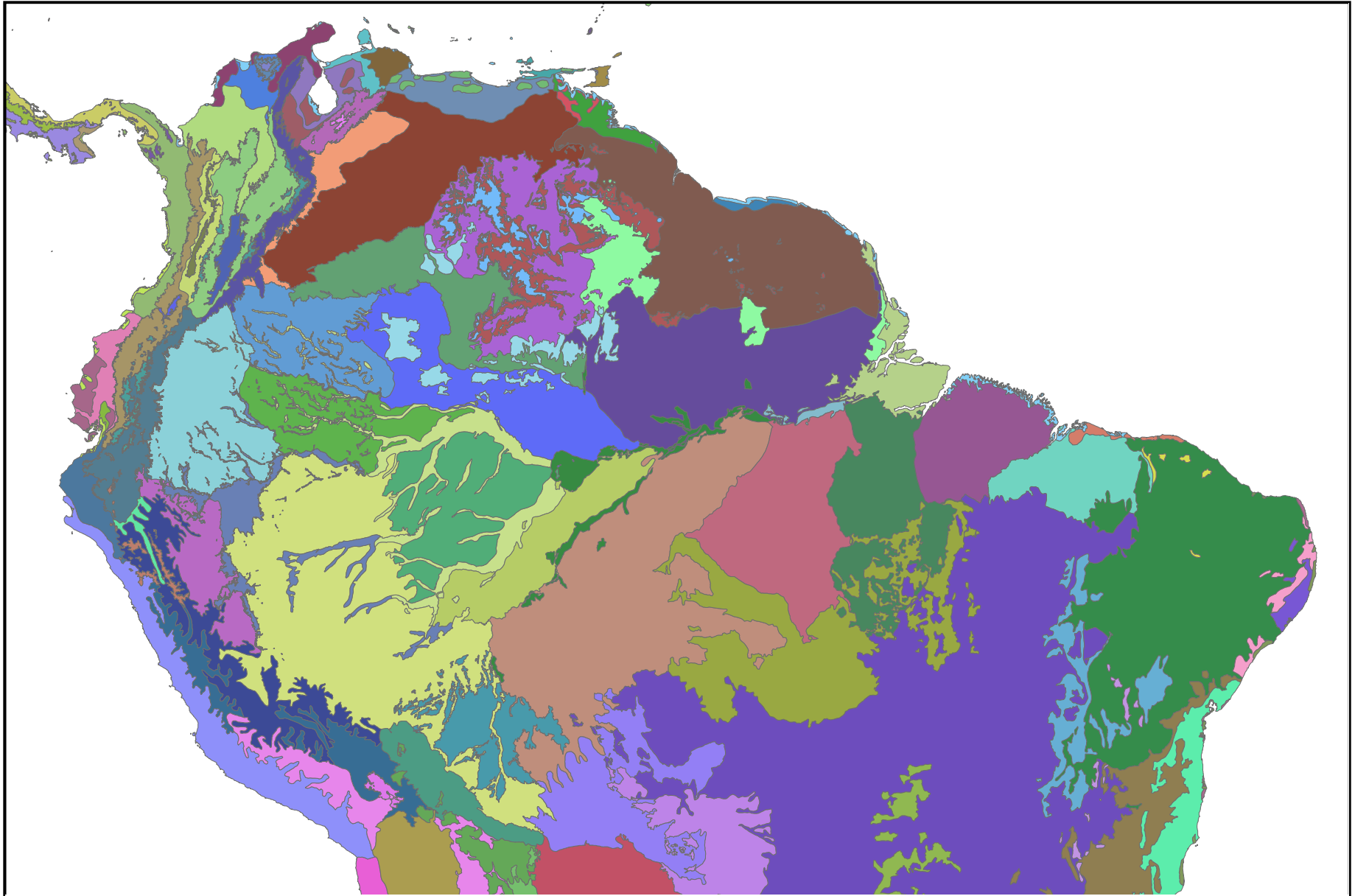
Olson et al. 2001, *Bioscience*; WWF Conservation Science Program

Data Source: Terrestrial Ecoregions of the World



Olson et al. 2001, *Bioscience*; WWF Conservation Science Program

Ecoregions of Northern South America

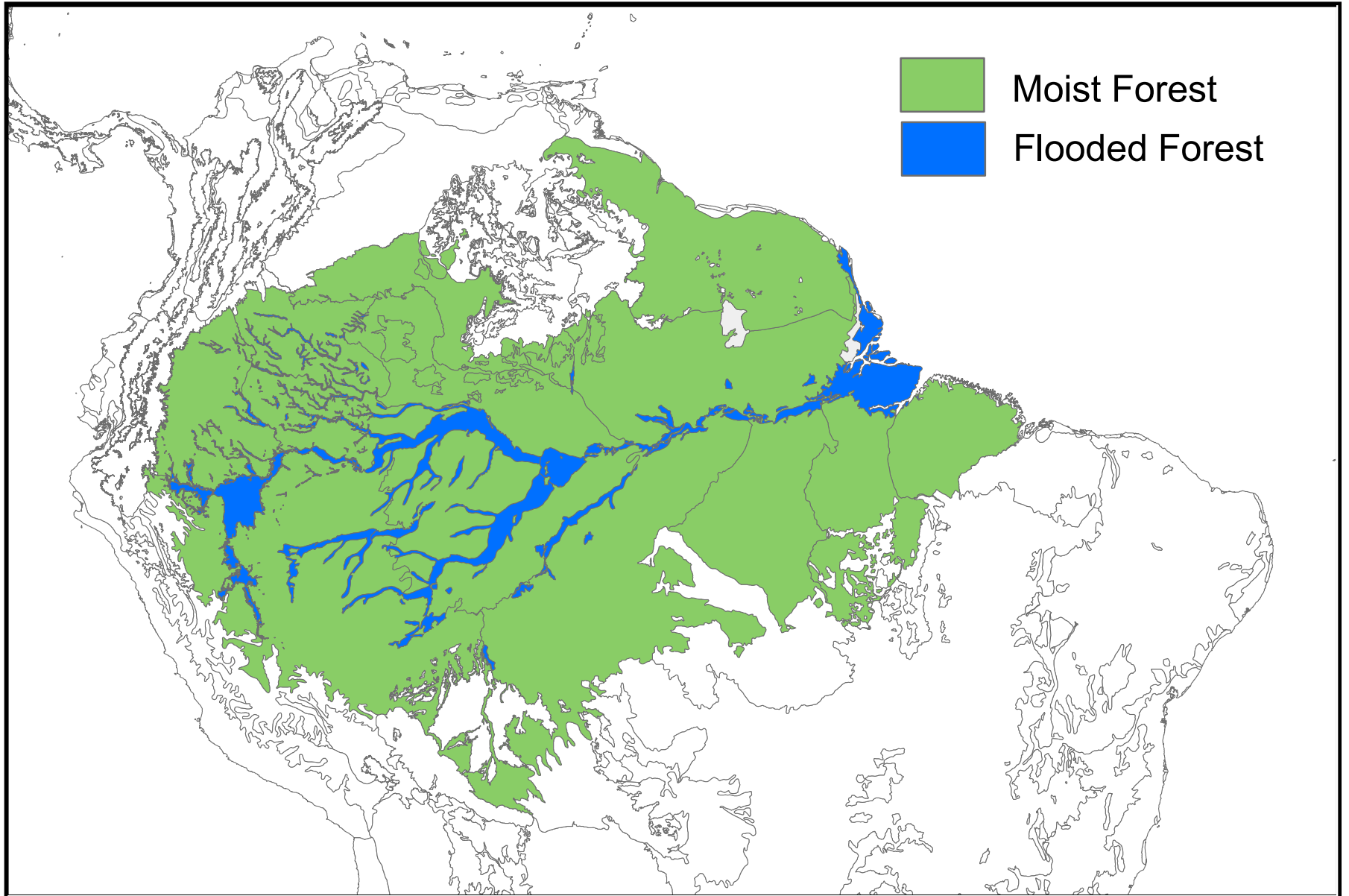


Olson et al. 2001, *Bioscience*; WWF Conservation Science Program

Amazonia



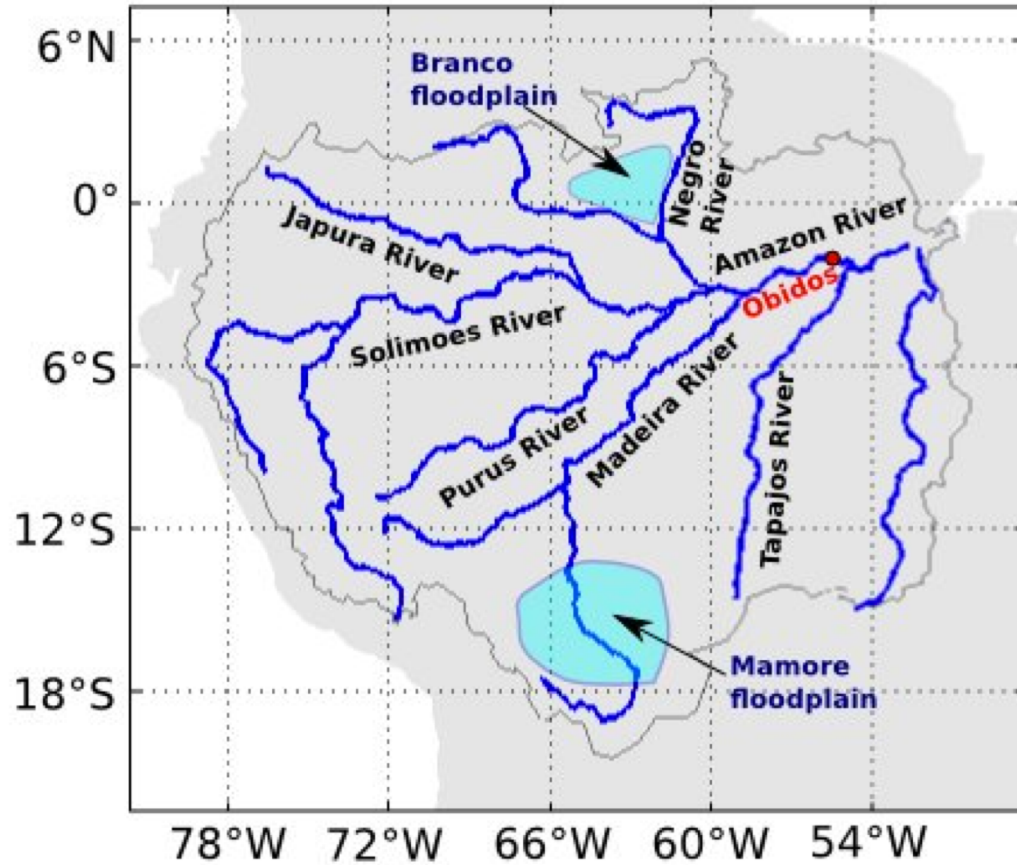
Amazonia



Amazonian Ecoregions



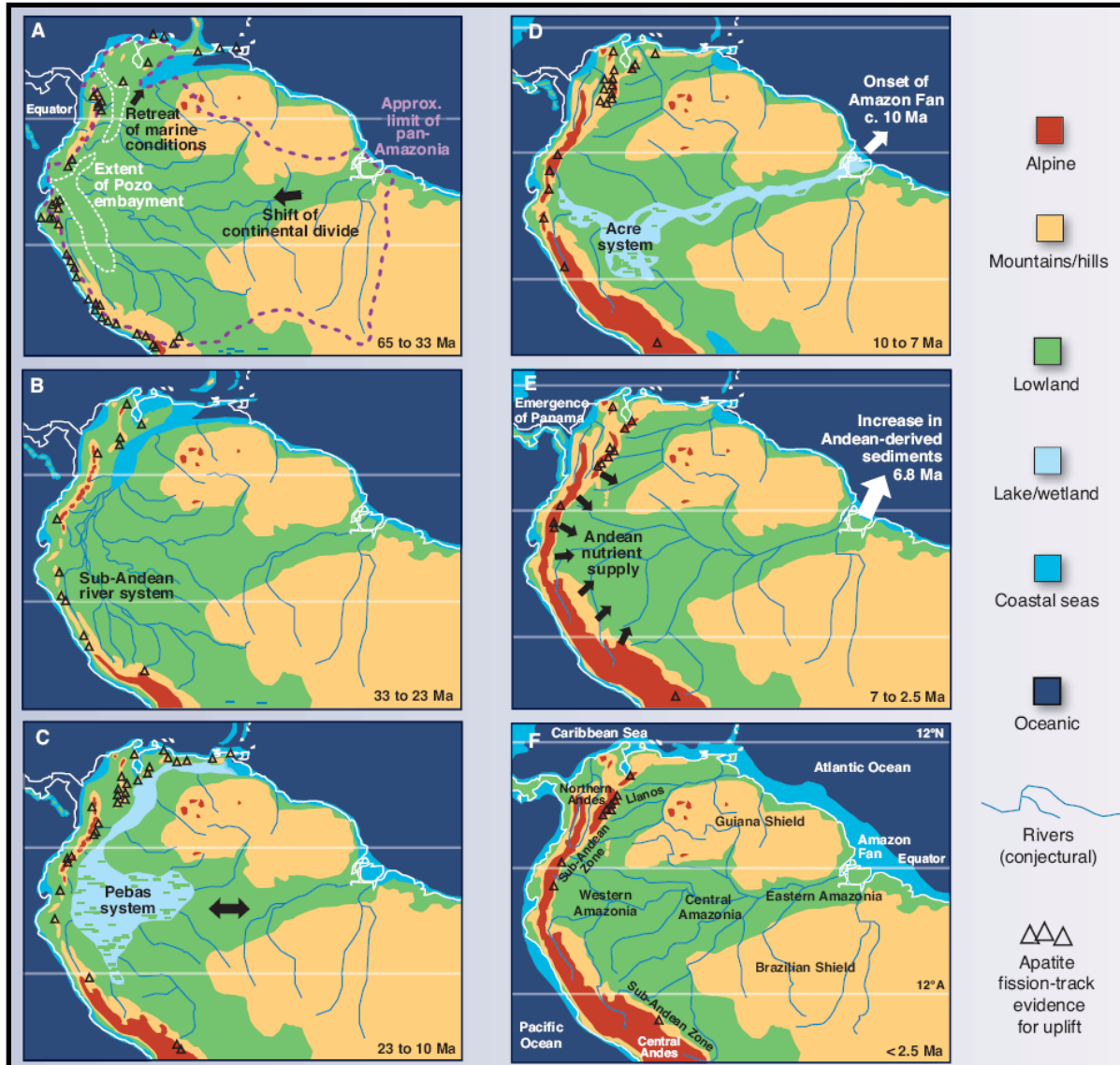
Maps of major Amazon rivers



A timeline of the Cenozoic

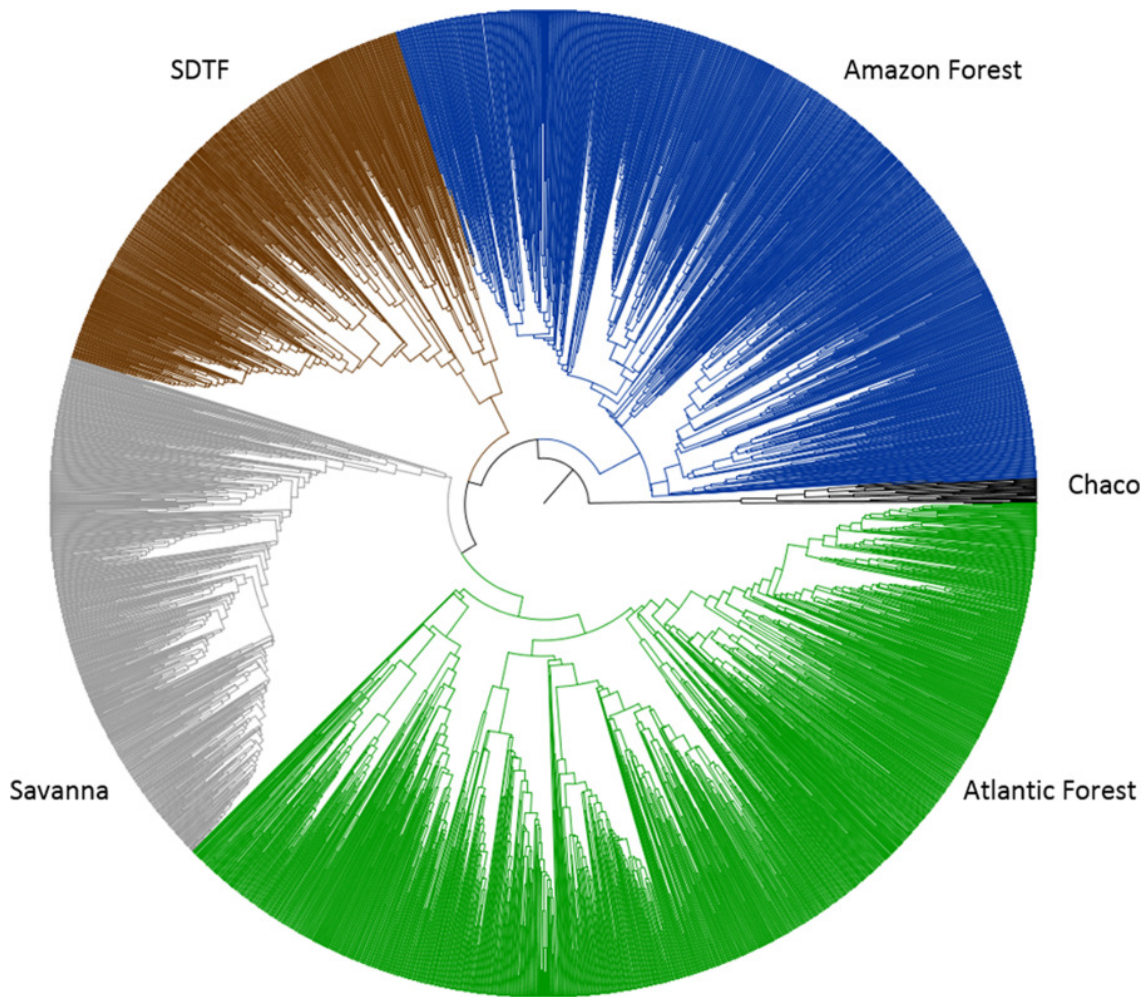
Era	Period	Epoch (start mya)	
Cenozoic	Quaternary	Holocene 0.01	
		Pleistocene 2.6	
	Tertiary	Neogene	Pliocene 5.3
			Miocene 23.0
		Paleogene	Oligocene 33.9
			Eocene 55.8
			Paleocene 65.5

Hypothesized historical biogeography of tropical South America

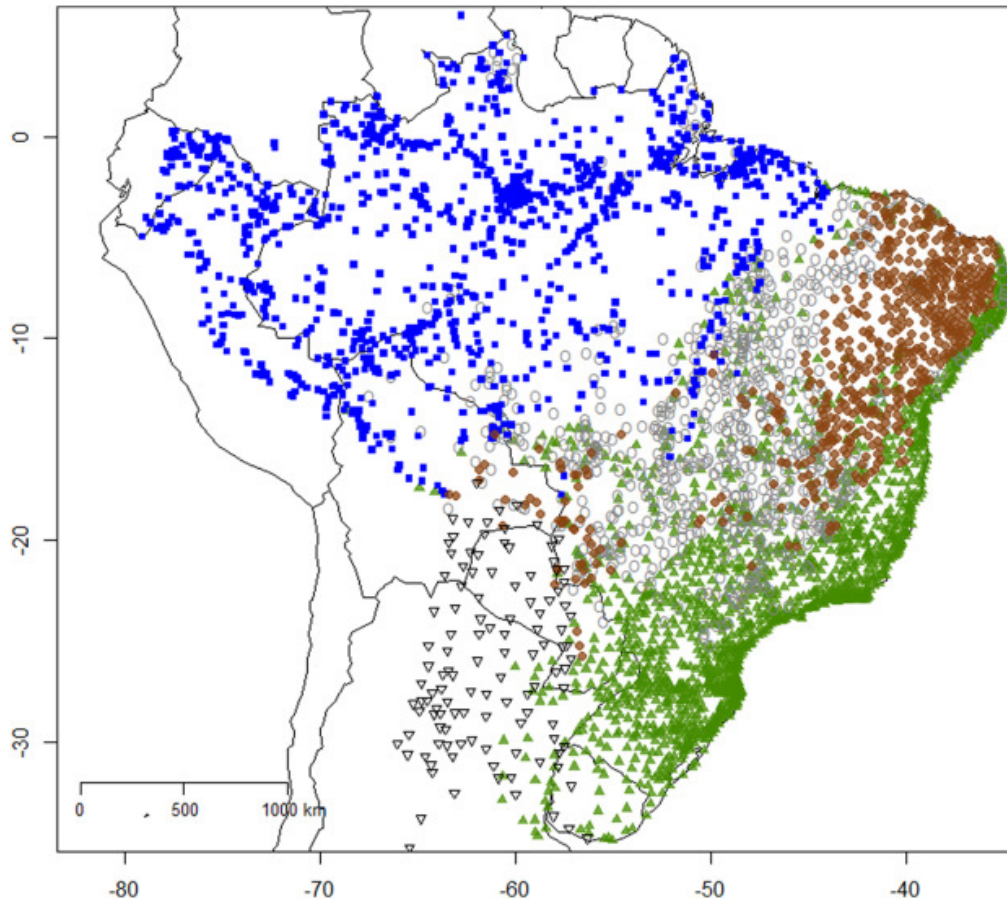


Era	Period	Epoch (start mya)		
Cenozoic	Quaternary	Holocene	0.01	
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			Miocene	23.0
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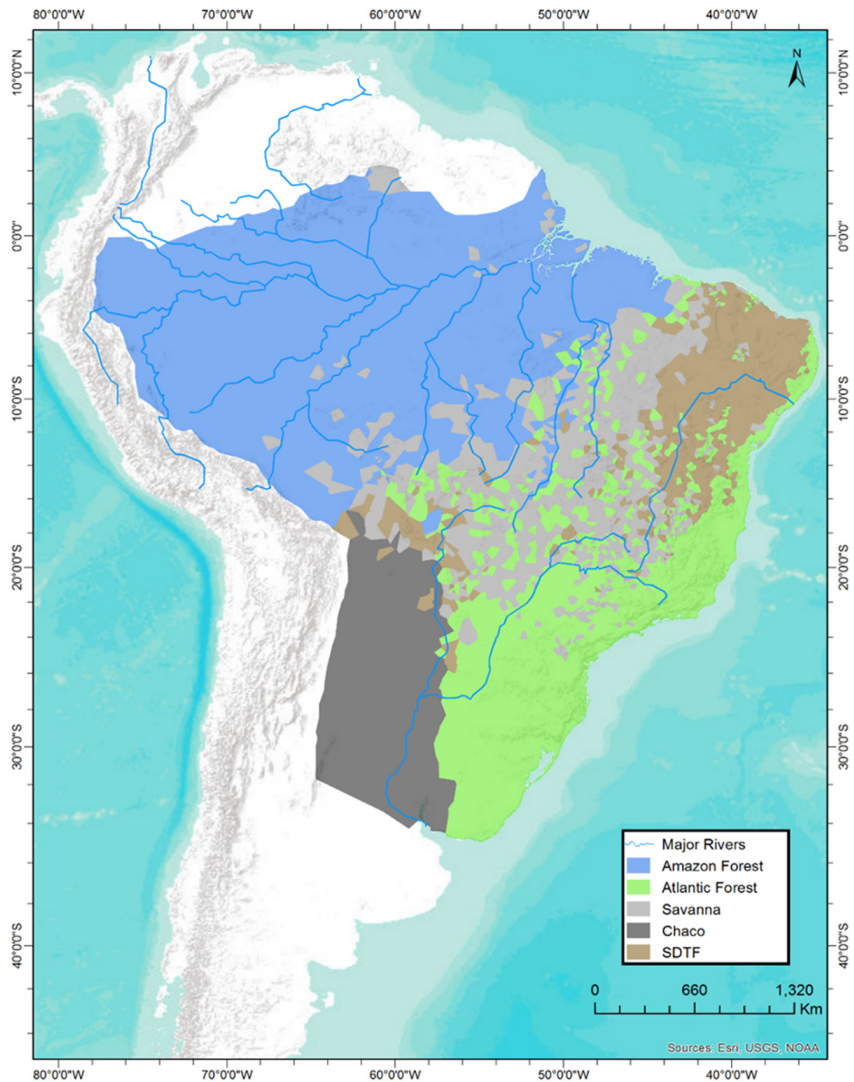
Horn et al. 2010, *Science*



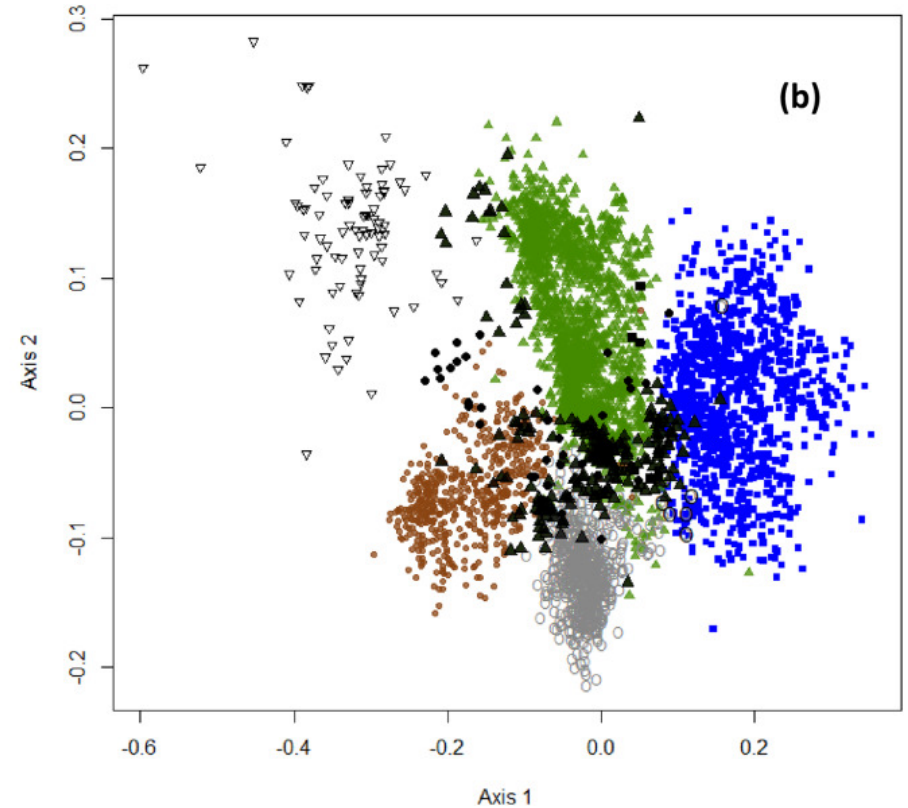
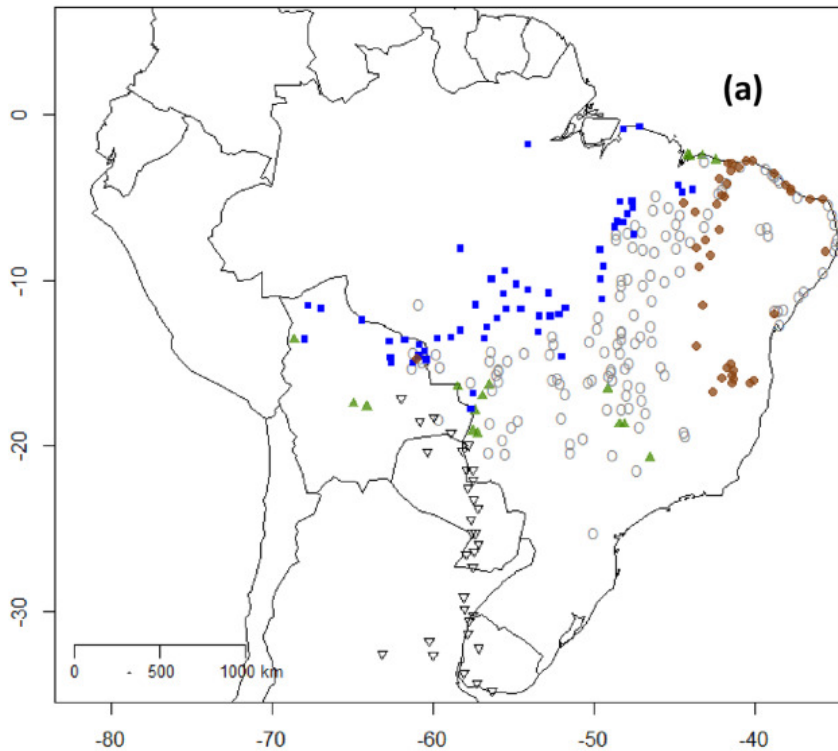
Hierarchical cluster of 4,103 sites in lowland (< 1,000 m a.s.l.) tropical South America and neighbouring subtropical areas based on tree species composition. Five principal higher-level groups can be observed, which we refer to as the Amazon Forest (blue), Atlantic Forest (green), Savanna (grey), seasonally dry tropical forest or SDTF (brown) and Chaco (black) biomes.



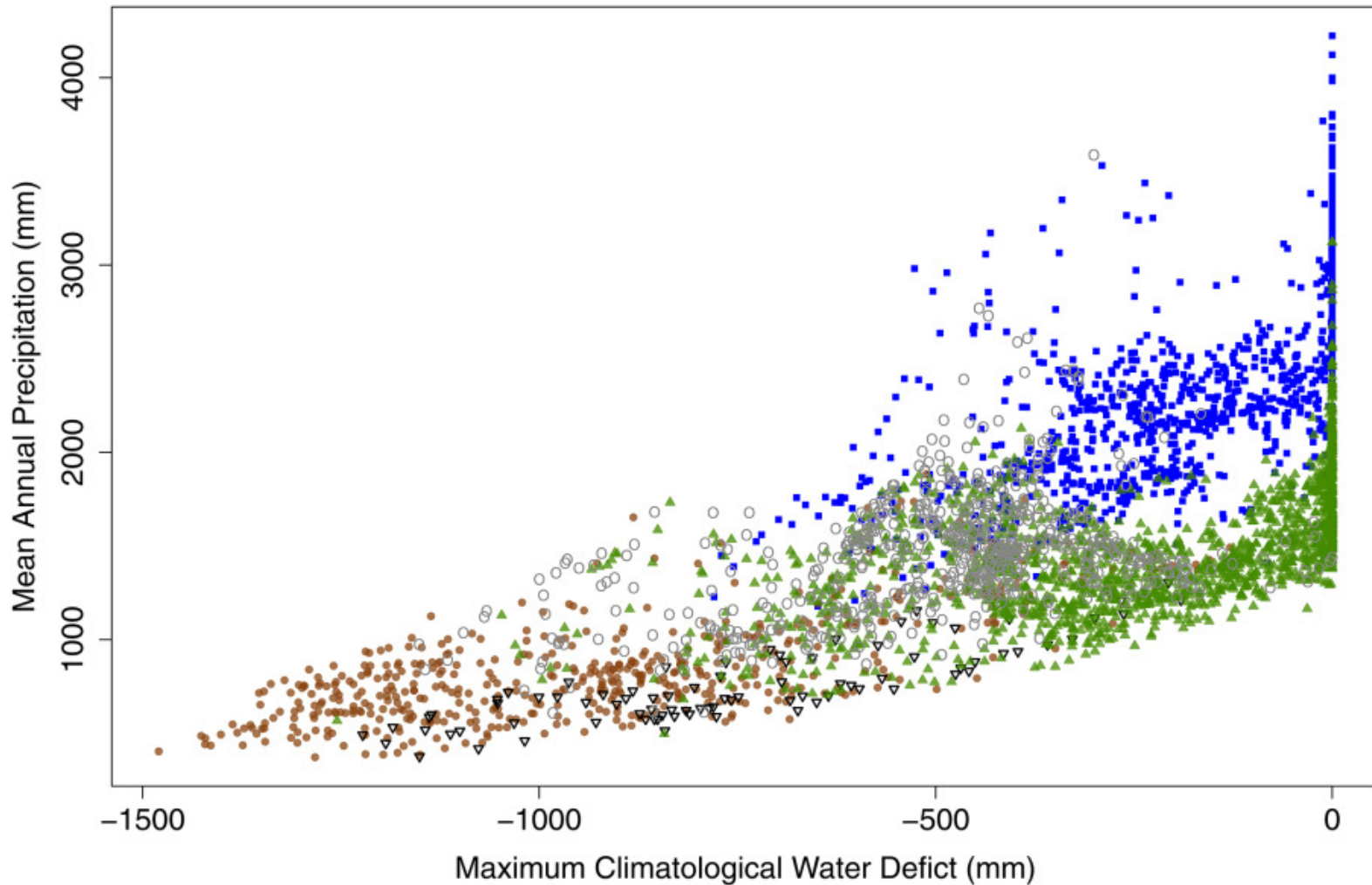
Map of lowland tropical South America, with sites classified into biomes based on hierarchical cluster analysis of tree species composition: Atlantic Forest (green triangles), seasonally dry tropical forest (brown circles), Savanna (open grey circles), Amazon Forest (blue squares), Chaco (inverted open black triangles). Sites that were revealed to be more similar floristically to a different biome from the one with which they originally clustered are here given the symbol of the floristically more similar biome.



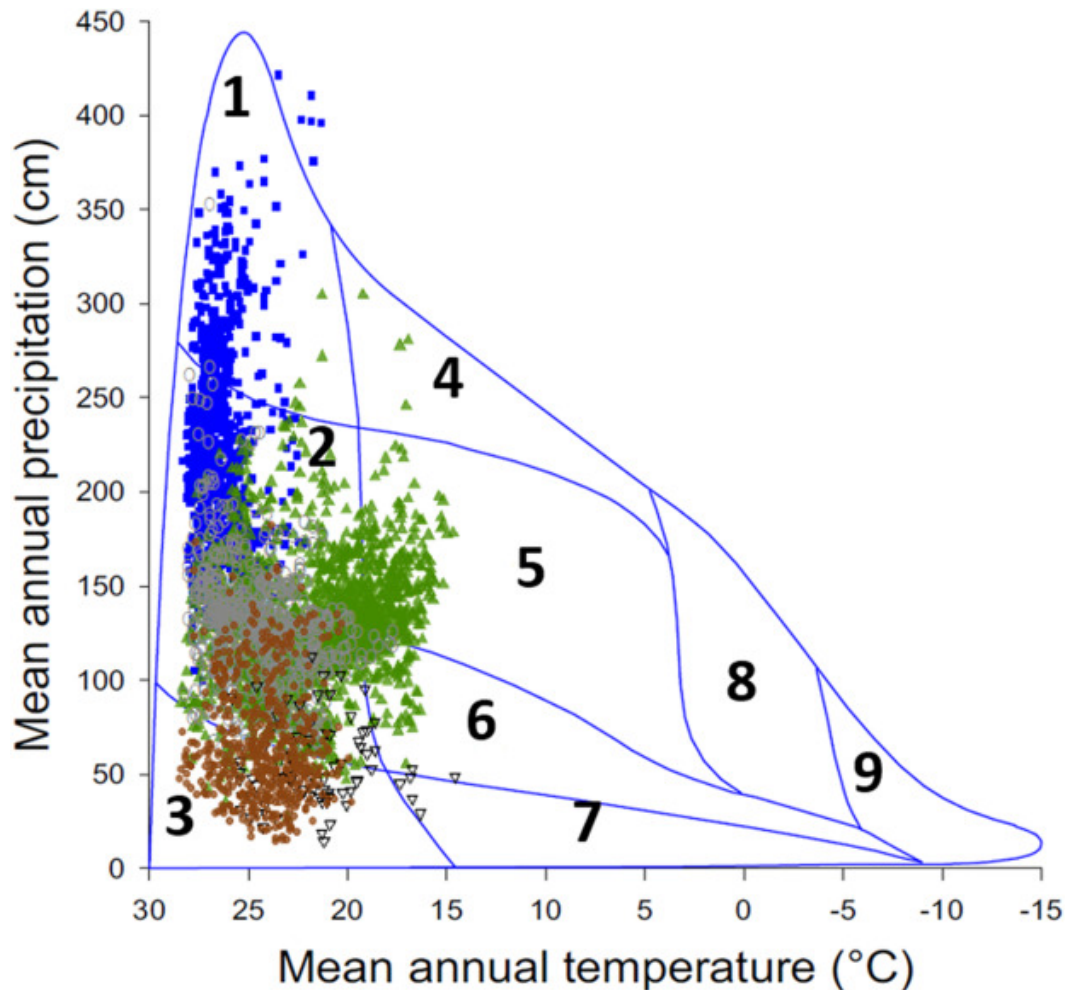
Map of South America, with a schematic representation of the biomes delimited via hierarchical cluster analysis in the present contribution [Amazon Forest, Atlantic Forest, Savanna, Chaco and seasonally dry tropical forest (SDTF)]. The map was created by applying the Thiessen polygons method on the categorized points presented in Figure.



NeoTropTree sites that have a transitional/ambiguous floristic identity, as revealed by the silhouette analysis, and how they are distributed in (a) geographical and (b) species compositional spaces. In (a), sites are categorized according to the biome to which they are floristically more similar. In (b), correctly classified sites are shown in the same colour scheme as Figure , whereas misclassified sites are represented in black and in the same shape as the sites of their biome based on the original clustering analysis. Symbols are as follows: green triangles = Atlantic Forest, brown circles = seasonally dry tropical forest, open grey circles = Savanna, blue squares = Amazon Forest and inverted open black triangles = Chaco



Distribution of sites with respect to precipitation regime. Mean annual precipitation values come from WorldClim (Hijmans et al.,), and maximum climatological water deficit comes from Chave et al. (). Symbols are as follows: green triangles = Atlantic Forest, brown circles = seasonally dry tropical forest, open grey circles = Savanna, blue squares = Amazon Forest and inverted open black triangles = Chaco. Modelled after fig. 1 of Malhi et al. (), which suggested that savannas were drier than seasonal forests, contrary to the pattern here



Distribution of sites in climatic space across the nine biomes proposed by Whittaker, R. H. (), considering mean annual precipitation (in centimetres) and mean annual temperature (in degrees Celsius). Numbers are as follows: 1 = tropical rain forest, 2 = tropical seasonal forest/savanna, 3 = tropical and subtropical desert, 4 = temperate rain forest, 5 = temperate deciduous forest, 6 = woodland/scrubland, 7 = temperate grassland/dessert, 8 = boreal forest and 9 = tundra. Symbols are as follows: green triangles = Atlantic Forest, brown circles = seasonally dry tropical forest, open grey circles = Savanna, blue squares = Amazon Forest and inverted open black triangles = Chaco