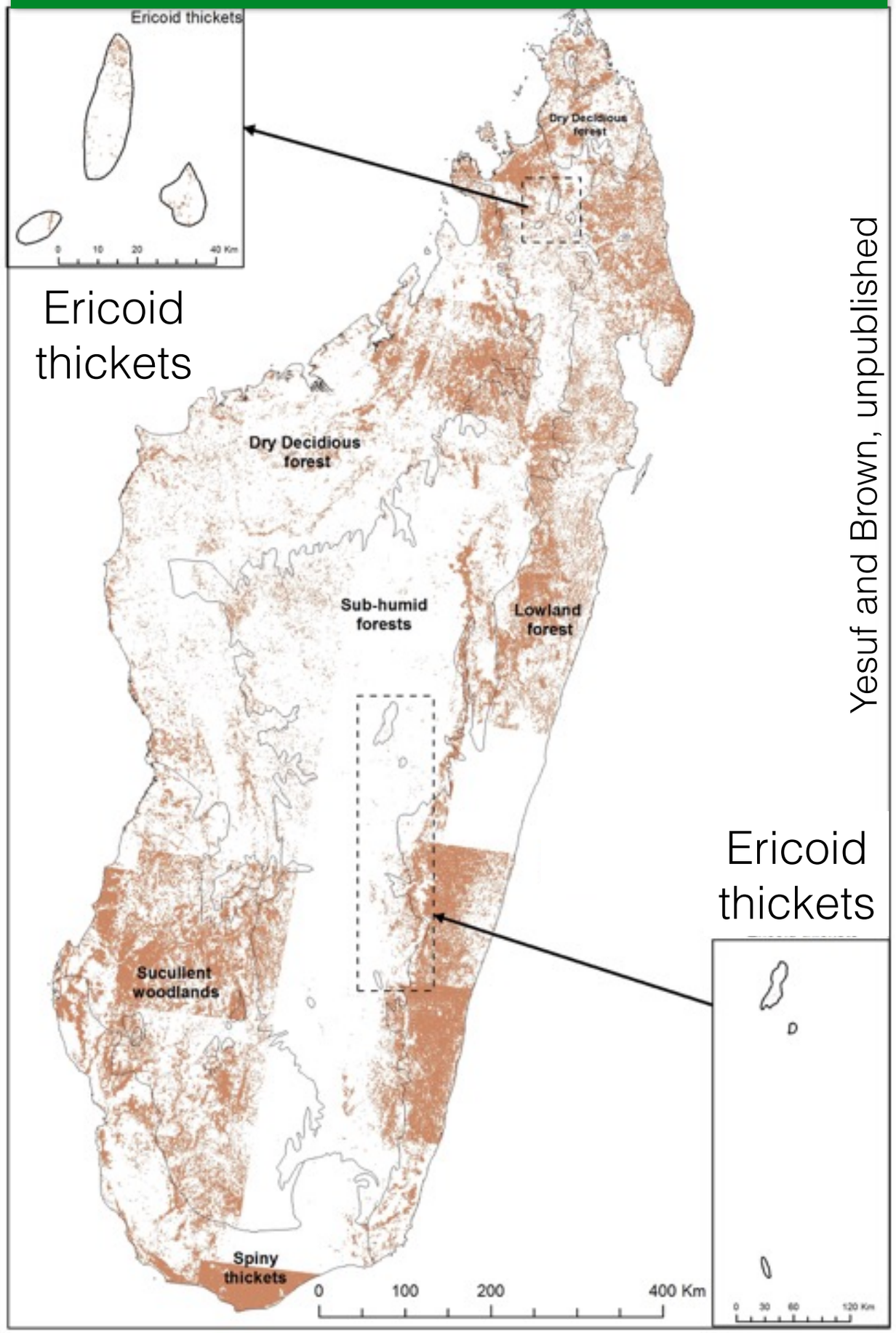
Predicting future plant diversity patterns in Madagascar

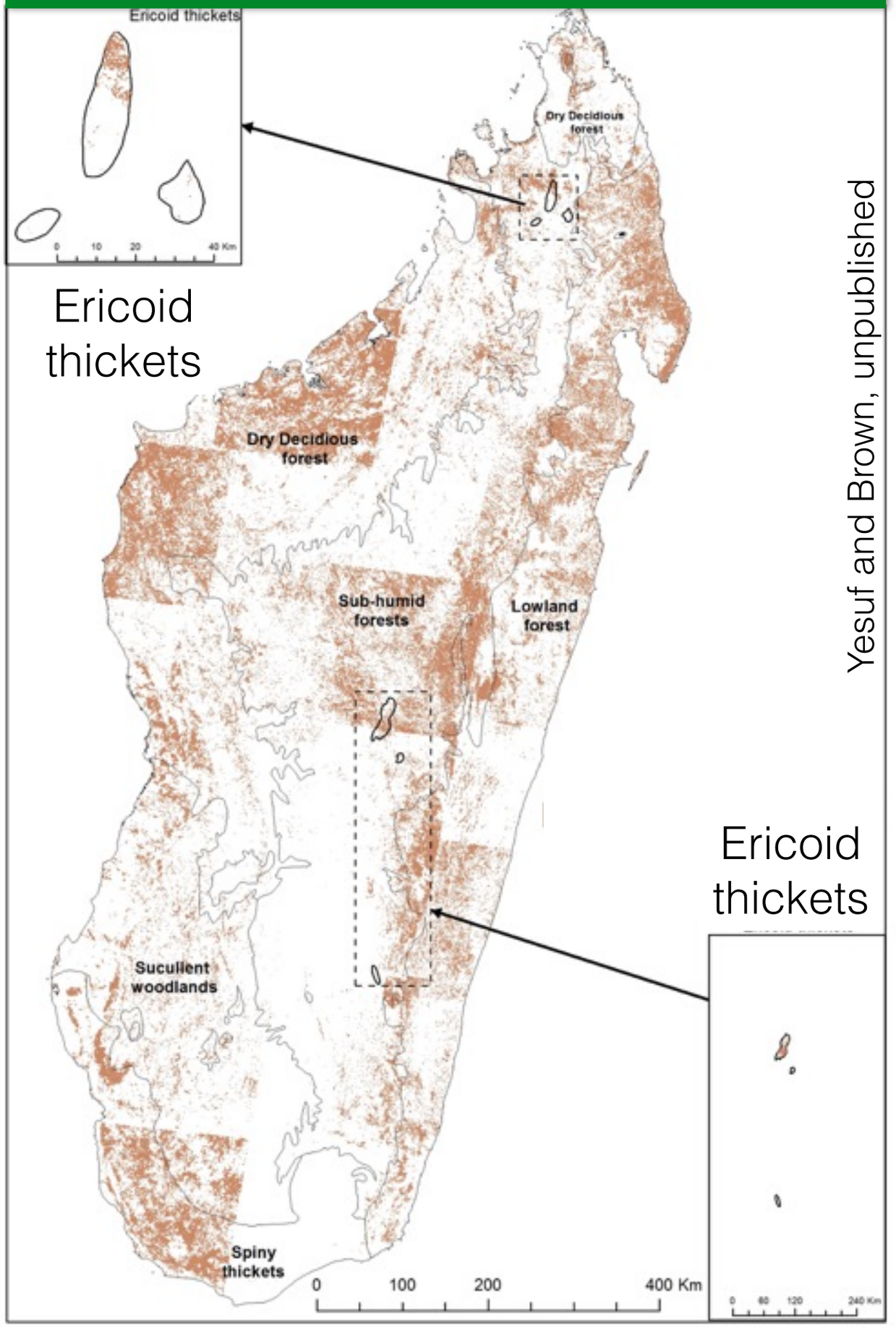
Kerry A Brown, PhD
Kingston University London
Department of Geography and Geology
MadGBIF
October 07, 2015

DEFORESTATION 1994-2000



Yesuf and Brown, unpublished

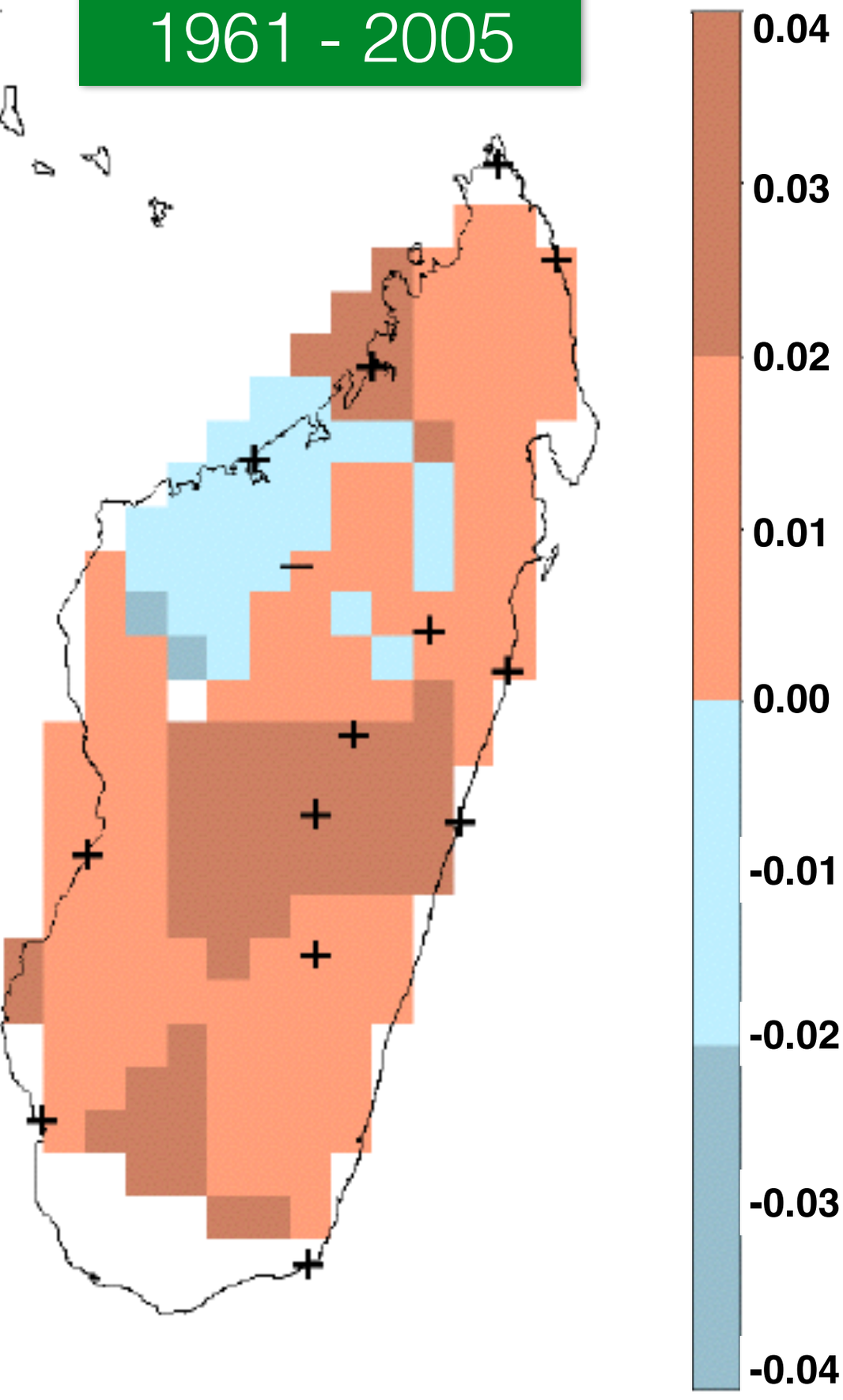
DEFORESTATION 2000-2014



Yesuf and Brown, unpublished

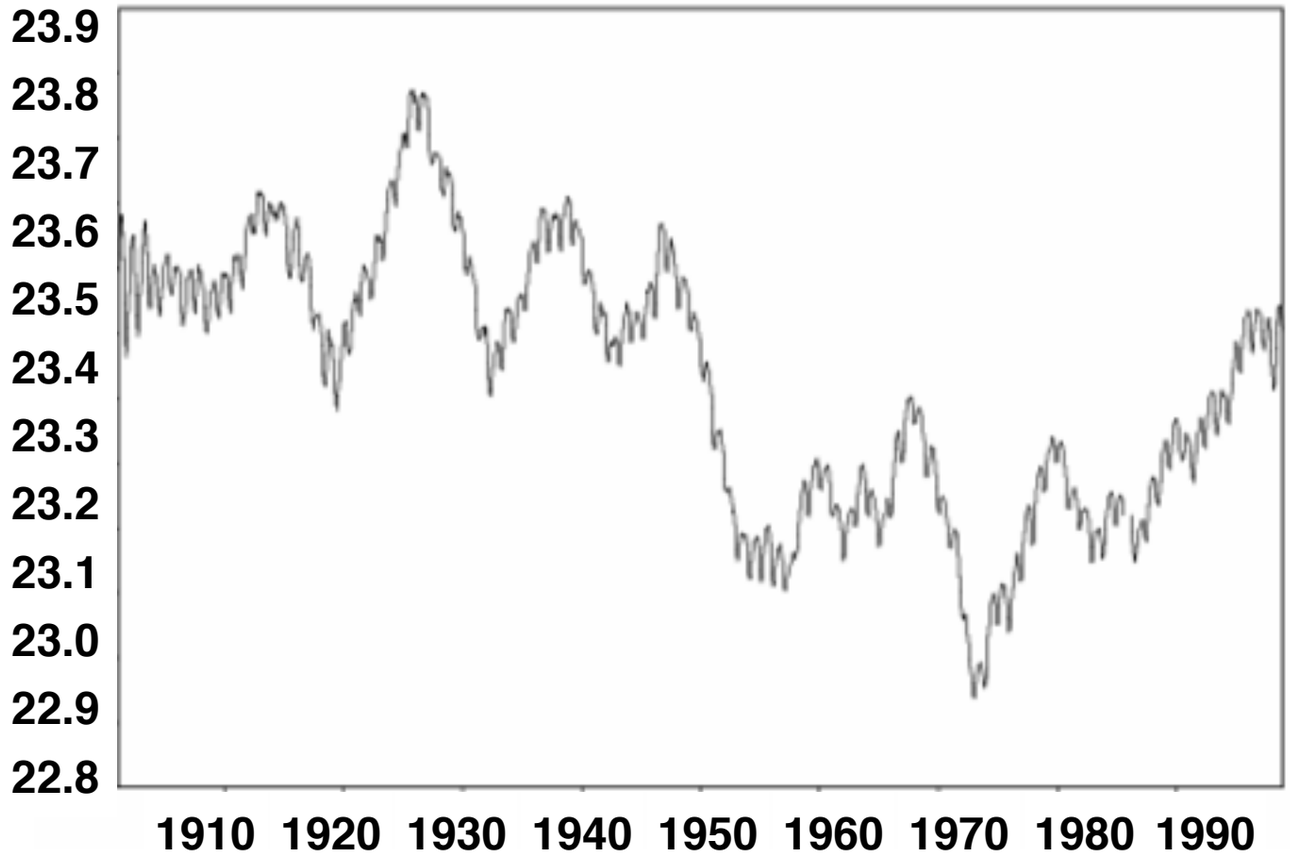
Max Temperature (°C)

1961 - 2005

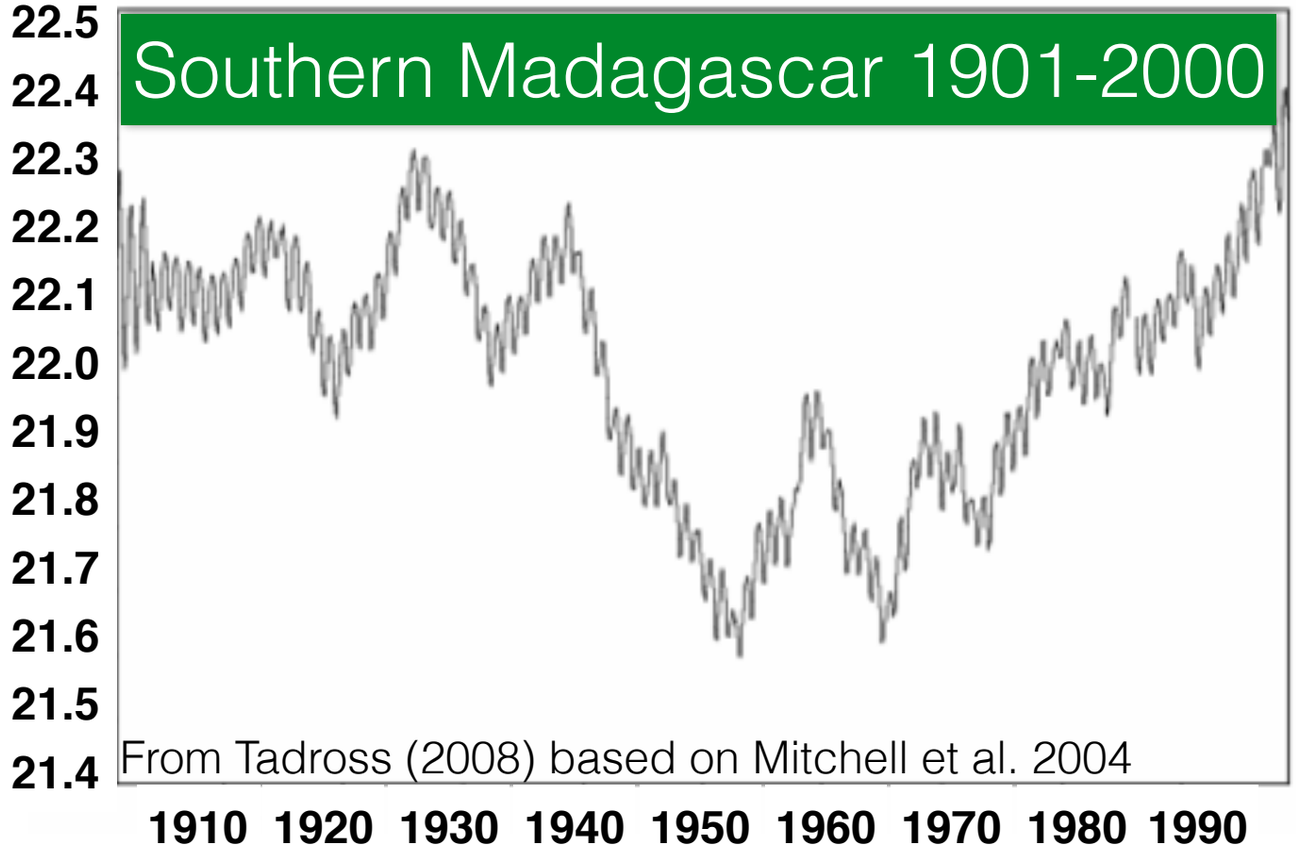


Temperature (°C)

Northern Madagascar 1901-2000



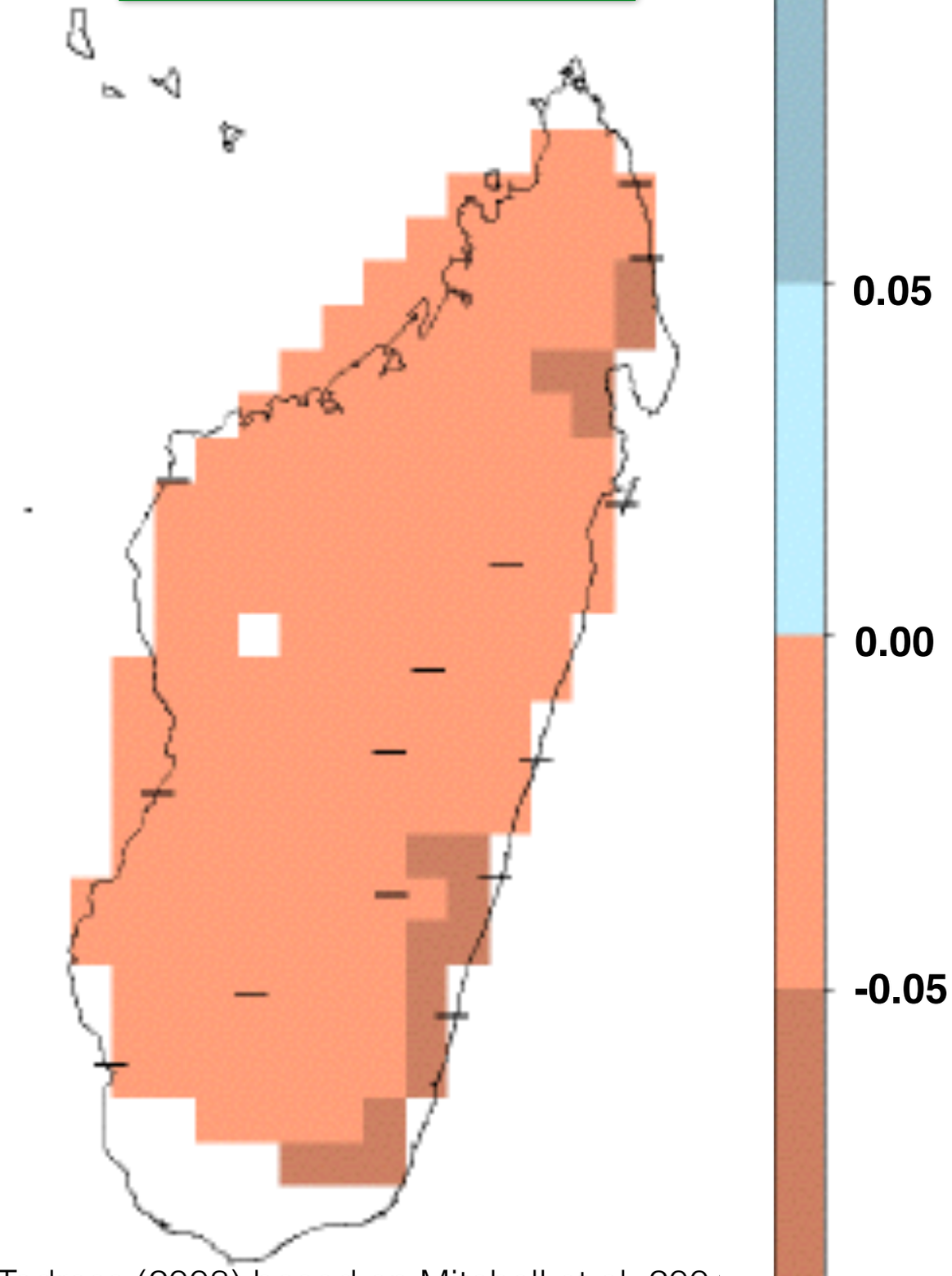
Southern Madagascar 1901-2000



From Tadross (2008) based on Mitchell et al. 2004

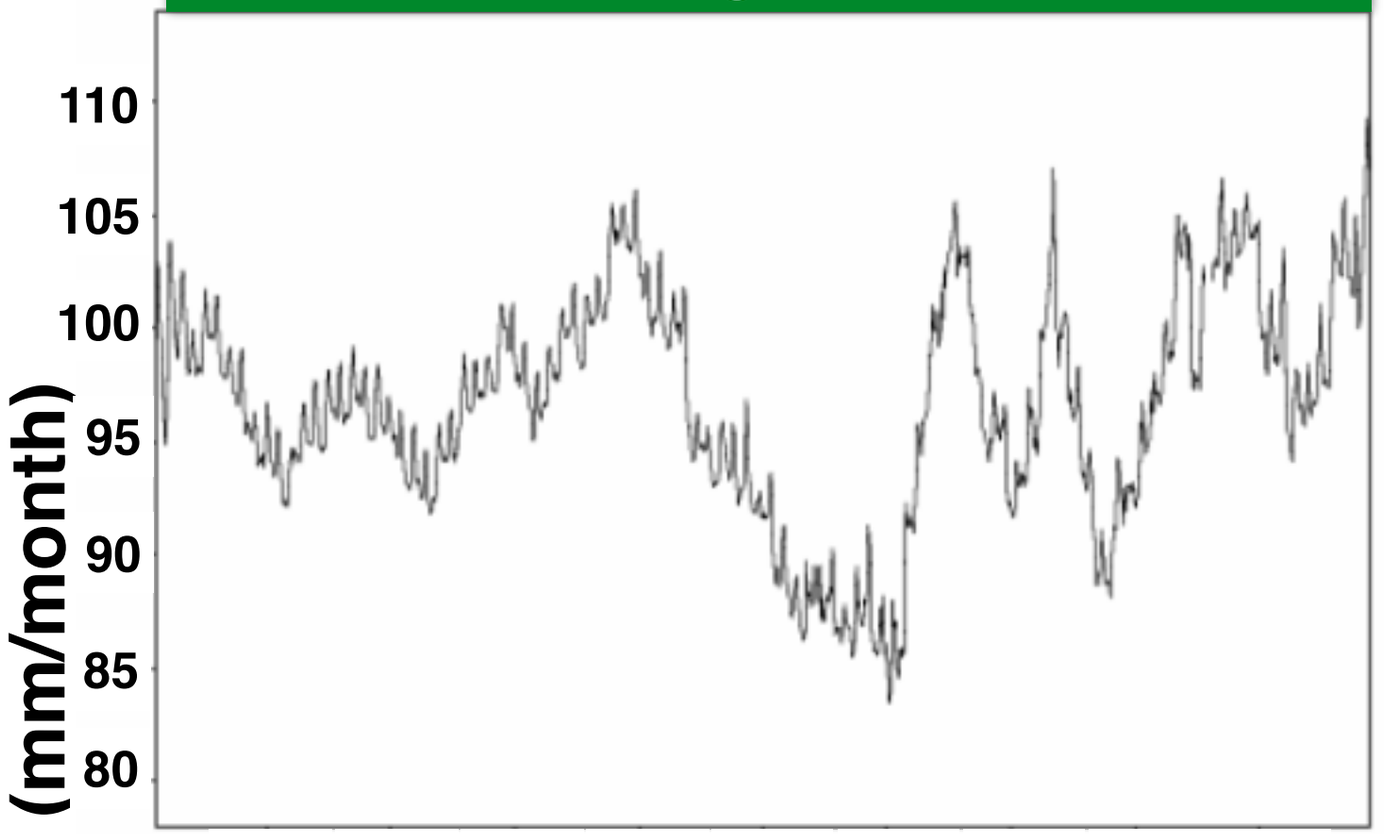
Avg Rainfall (mm day^{-1} year^{-1})

1961 - 2005

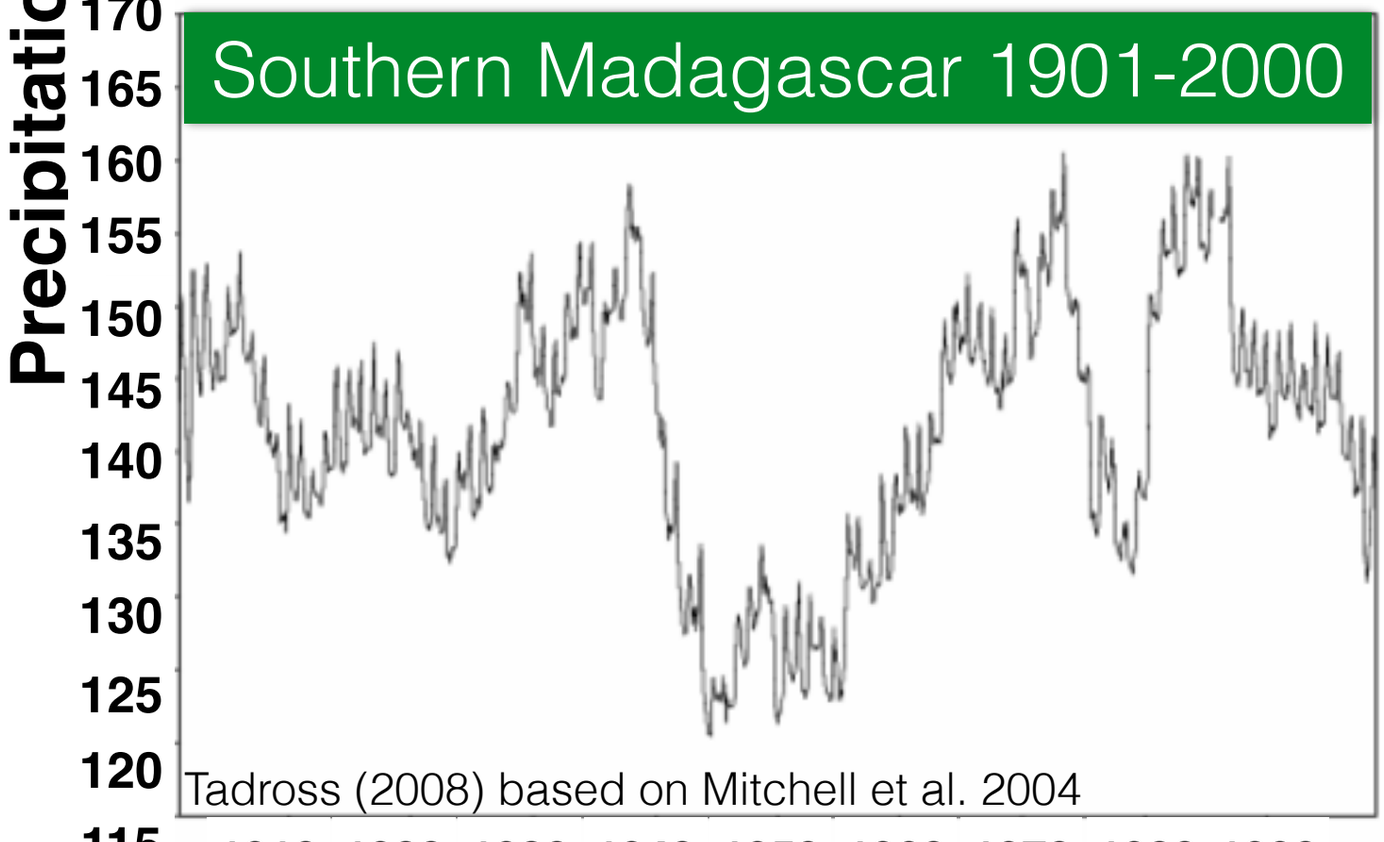


Tadross (2008) based on Mitchell et al. 200

Northern Madagascar 1901-2000



Southern Madagascar 1901-2000



Tadross (2008) based on Mitchell et al. 2004

RESEARCH FOCUS

- Influence on **future plant diversity patterns** in Madagascar

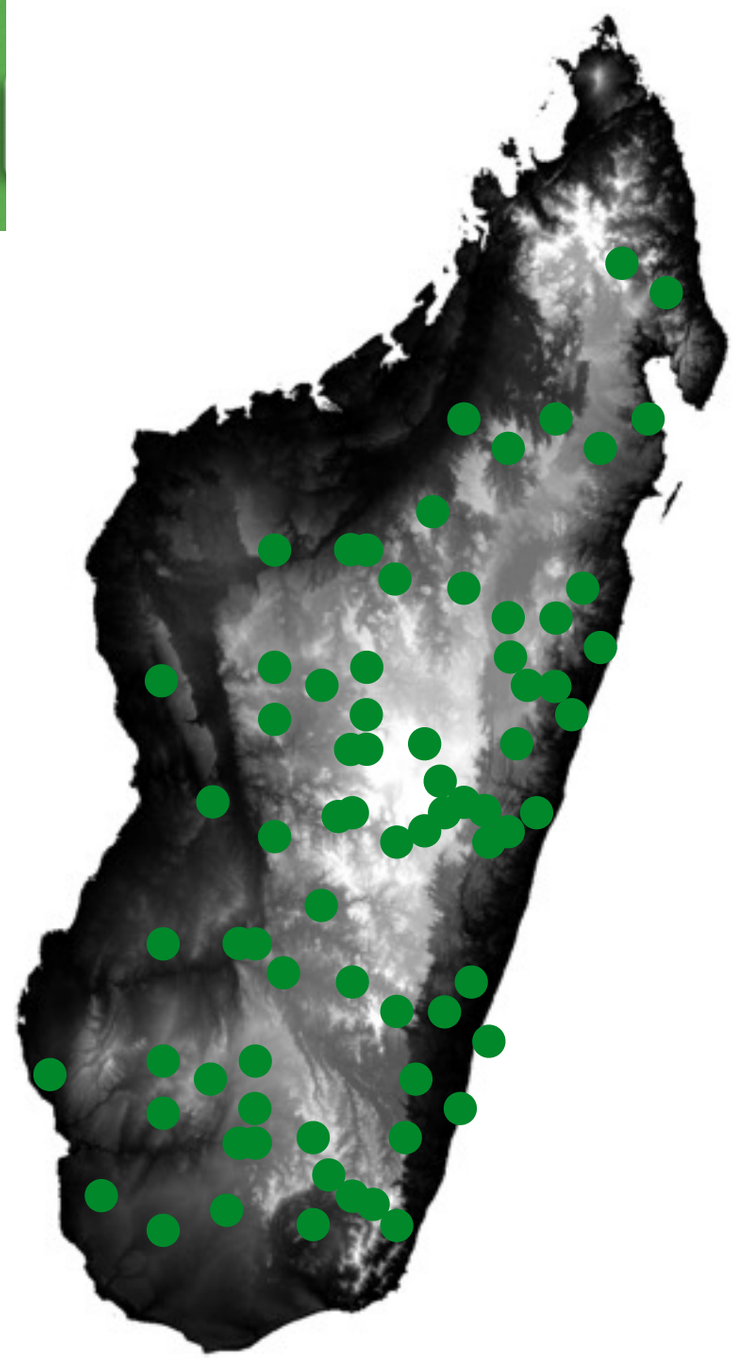
➡*l'influence du climat et changements dans l'utilisation du sol sur la distribution futures de la diversité végétale à Madagascar*

- Change by **eco-region and elevation**

➡*changements dans la distribution futures de la diversité par **l'éco-région et l'altitude***

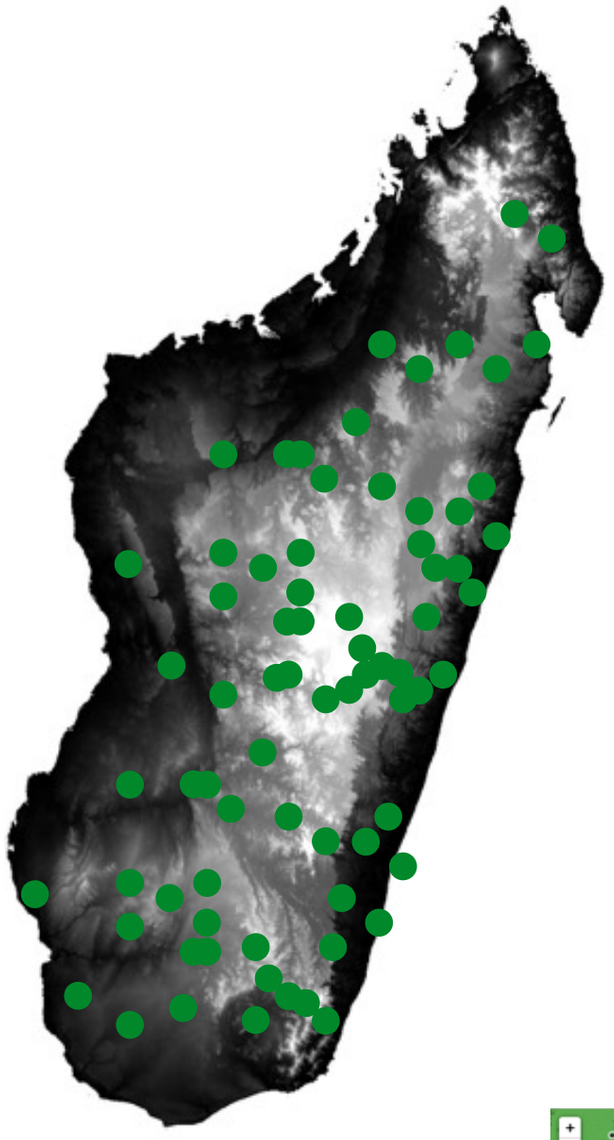
PRESENCE LOCATIONS

- **FILTERS (*DES FILTRES*)**
  - -duplicate records (occurring within same 1-km^2)
  - - misspelled records
  - - occur in seascape (not landscape)
  - - collected pre-1980
  - ->2876 (m.a.s.l)
  - - >10 occurrences
- **DID NOT FILTER (*NE FILTRAIT PAS*)**
  - -presence of synonyms
  - -plant mis-identification

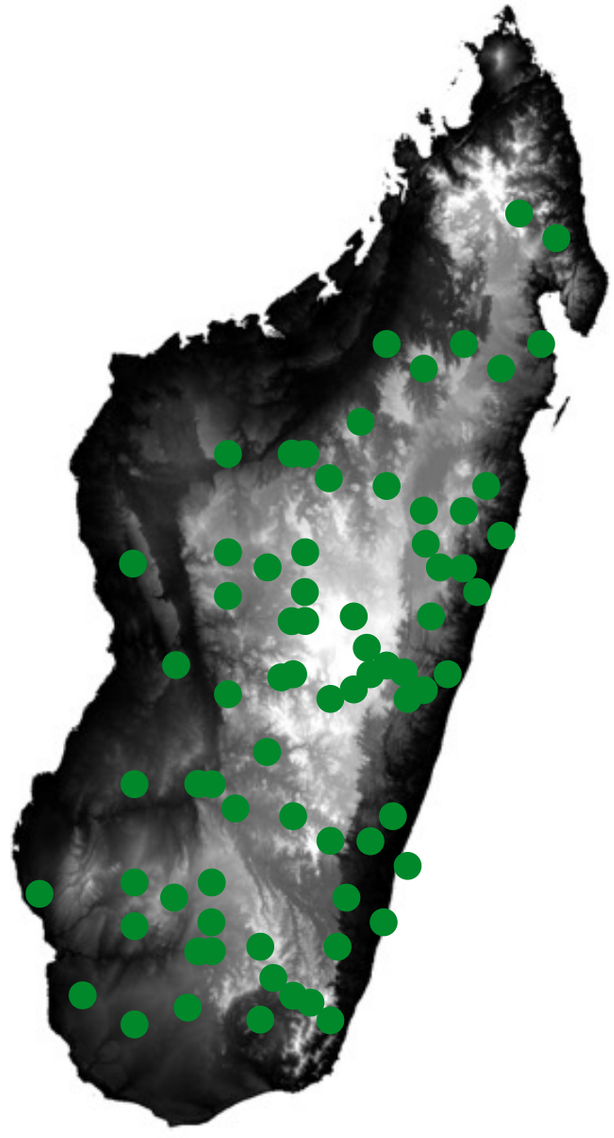


PRESENCE LOCATIONS

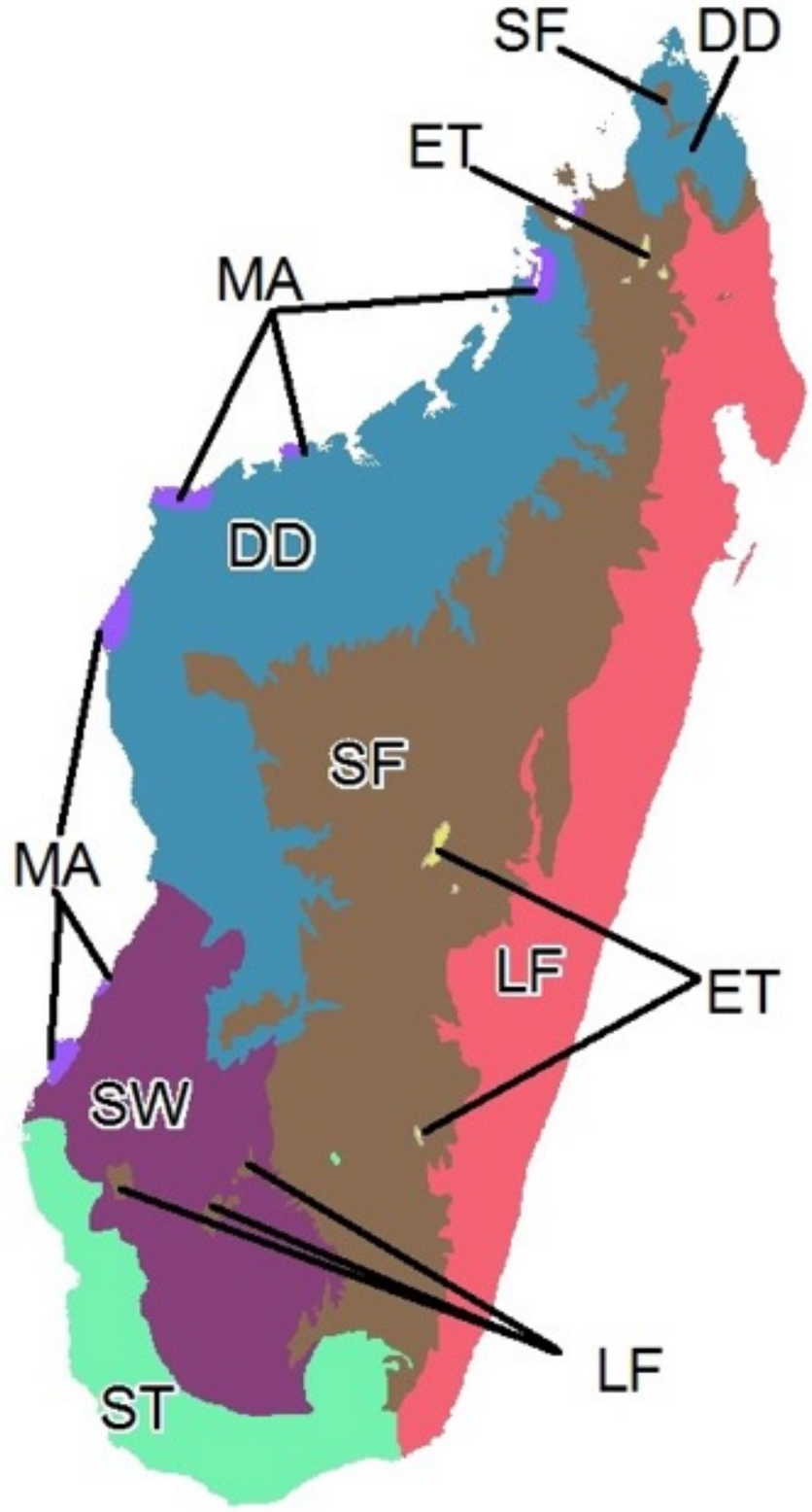
2186 SPECIES

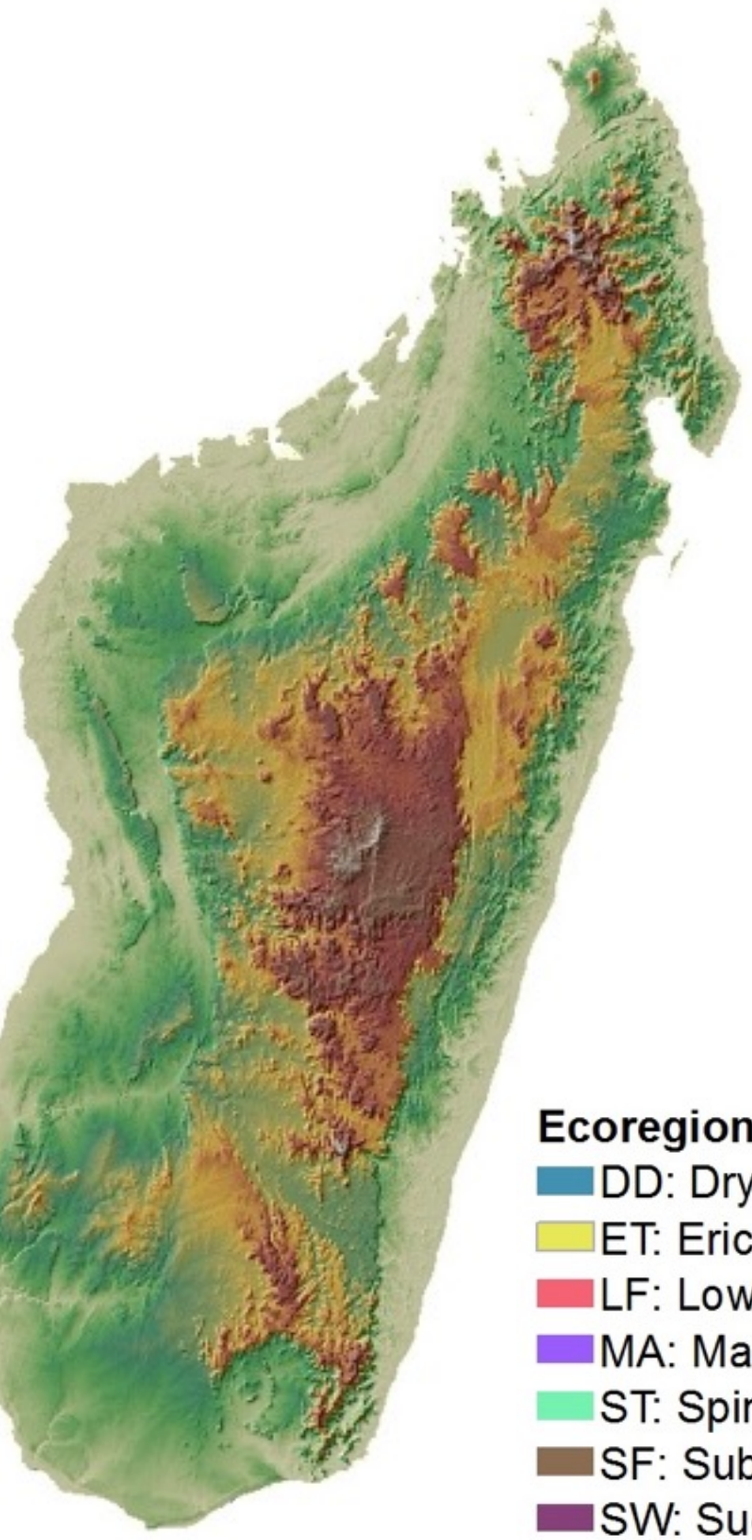


828 GENERA



ECO-REGIONS AND ELEVATION





Elevation bands

1: 0 - 62 m
2: 63 - 178 m
3: 179 - 323 m
4: 324 - 555 m
5: 556 - 799 m
6: 800 - 1066 m
7: 1067 - 2744 m

Ecoregions

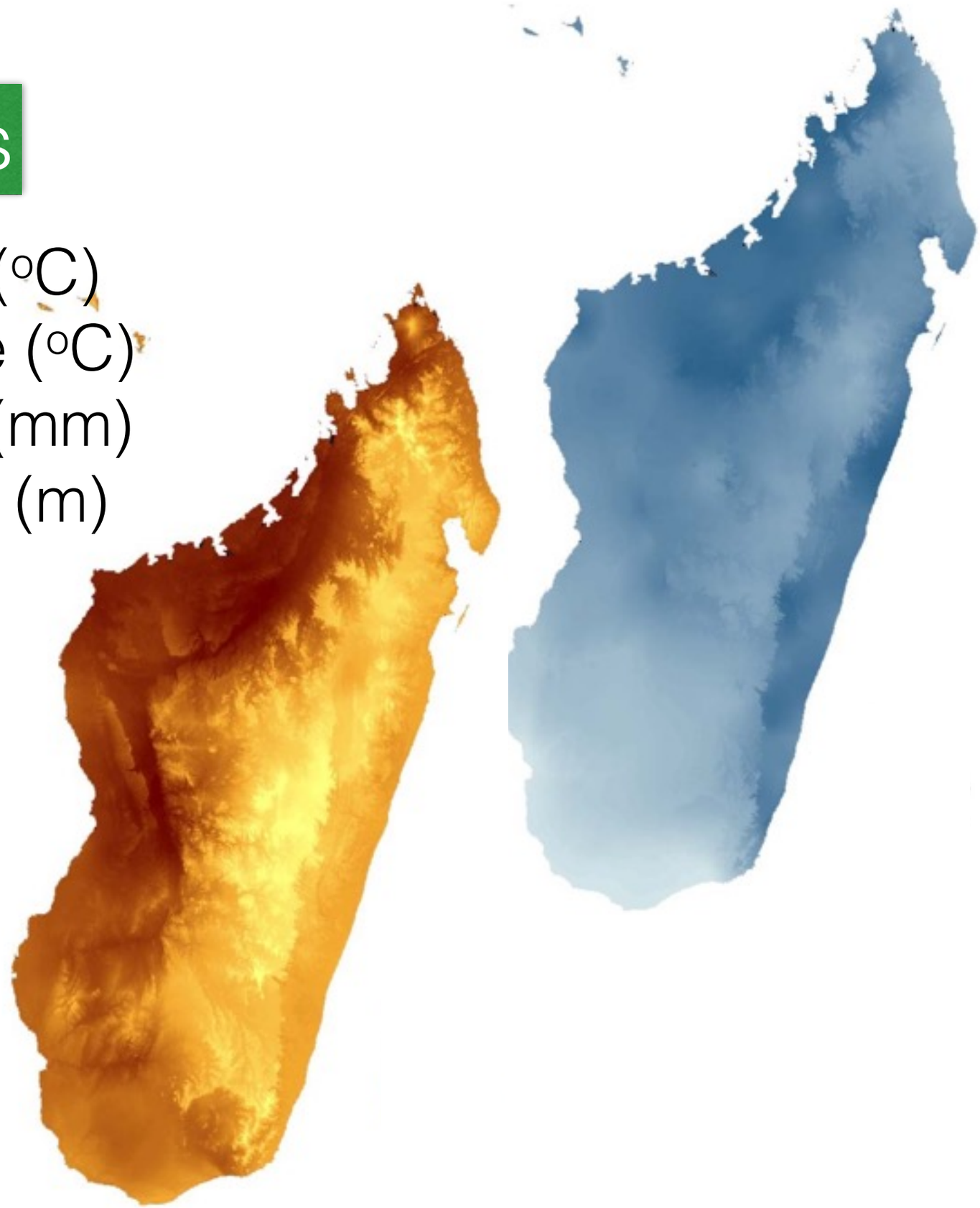
- DD: Dry deciduous forests
- ET: Ericoid thickets
- LF: Lowland forests
- MA: Mangroves
- ST: Spiny thickets
- SF: Subhumid forests
- SW: Succulent woodlands

Brown et al. 2015

CURRENT & FUTURE CLIMATE

WorldClim variables

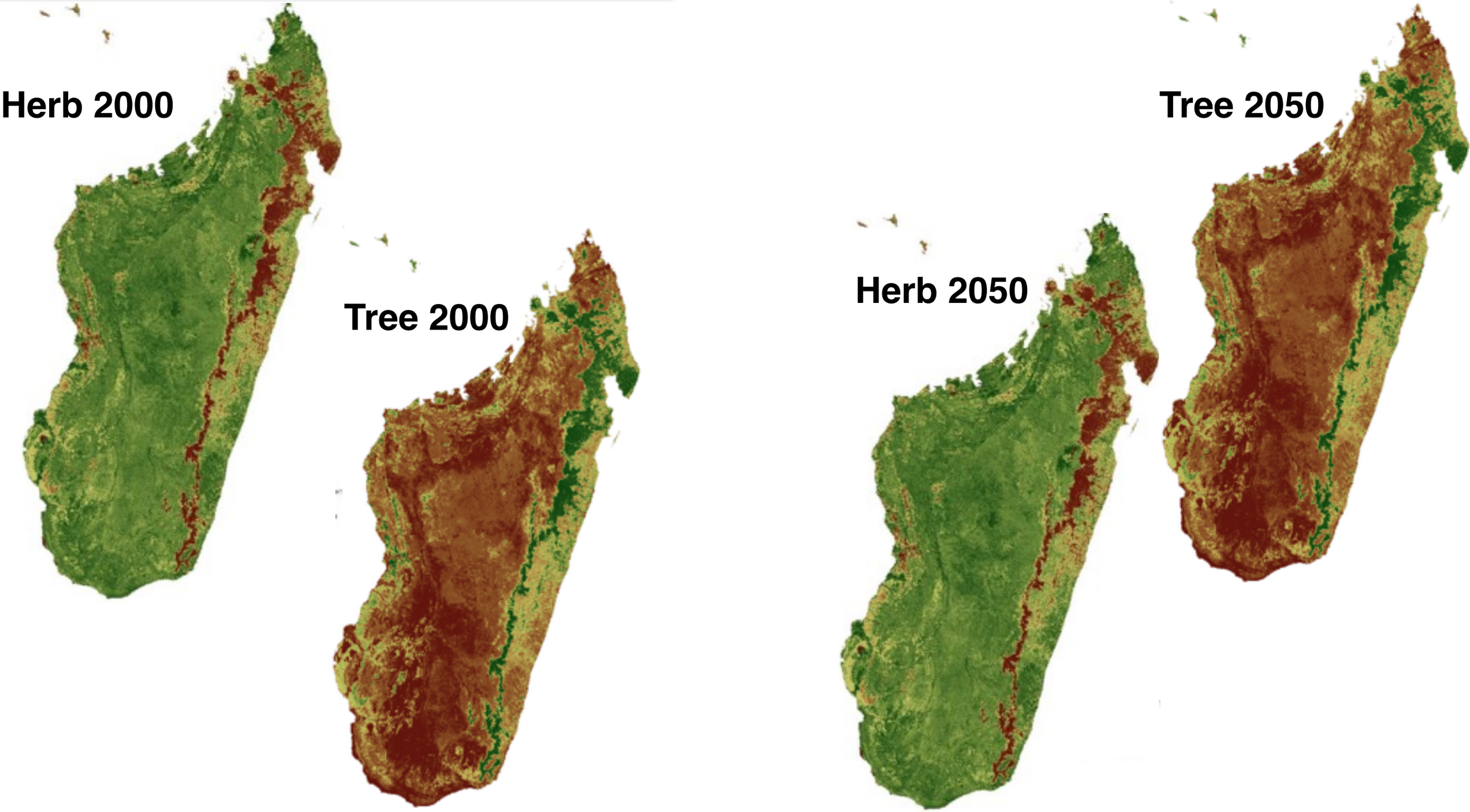
- Temperature - Min & Max (°C)
- Mean Annual Temperature (°C)
- Precipitation - Min & Max (mm)
- Mean annual precipitation (m)
- Water balance (mm)
- Evapotranspiration rate
- Positive water balance



CURRENT & FUTURE LAND USE

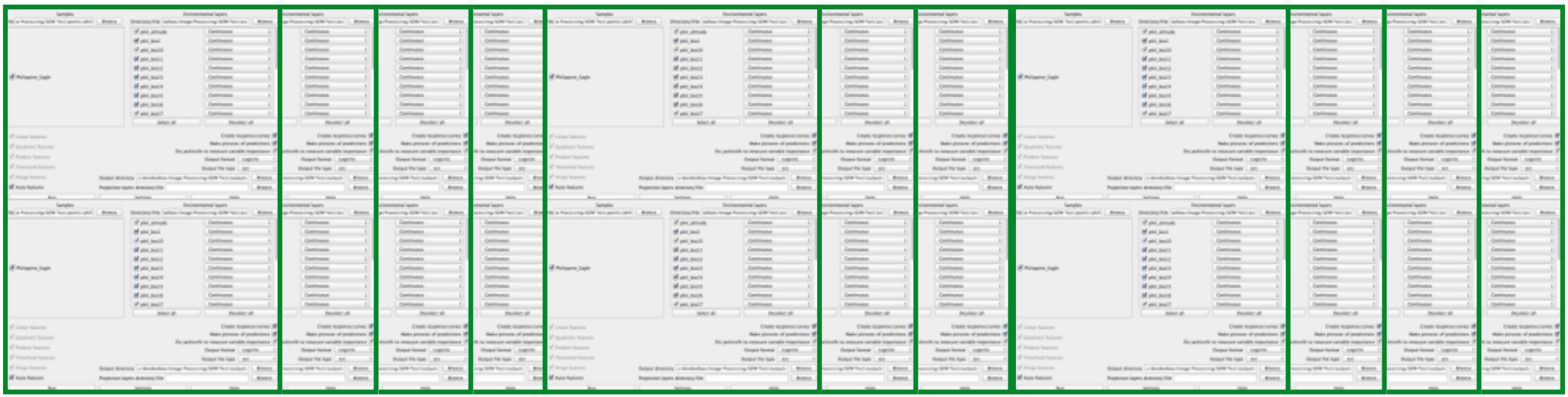
Current tree and herb cover

Future deforestation and degradation scenario



MODELLING ALGORITHM

- **Maxent Species Distribution Modelling** (http://www.cs.princeton.edu/%7Eschapire/maxent/):
- Presence-only
- Constructed **2186 species** and **828 genera** distributions for **three scenarios** for **current and future** time stamps

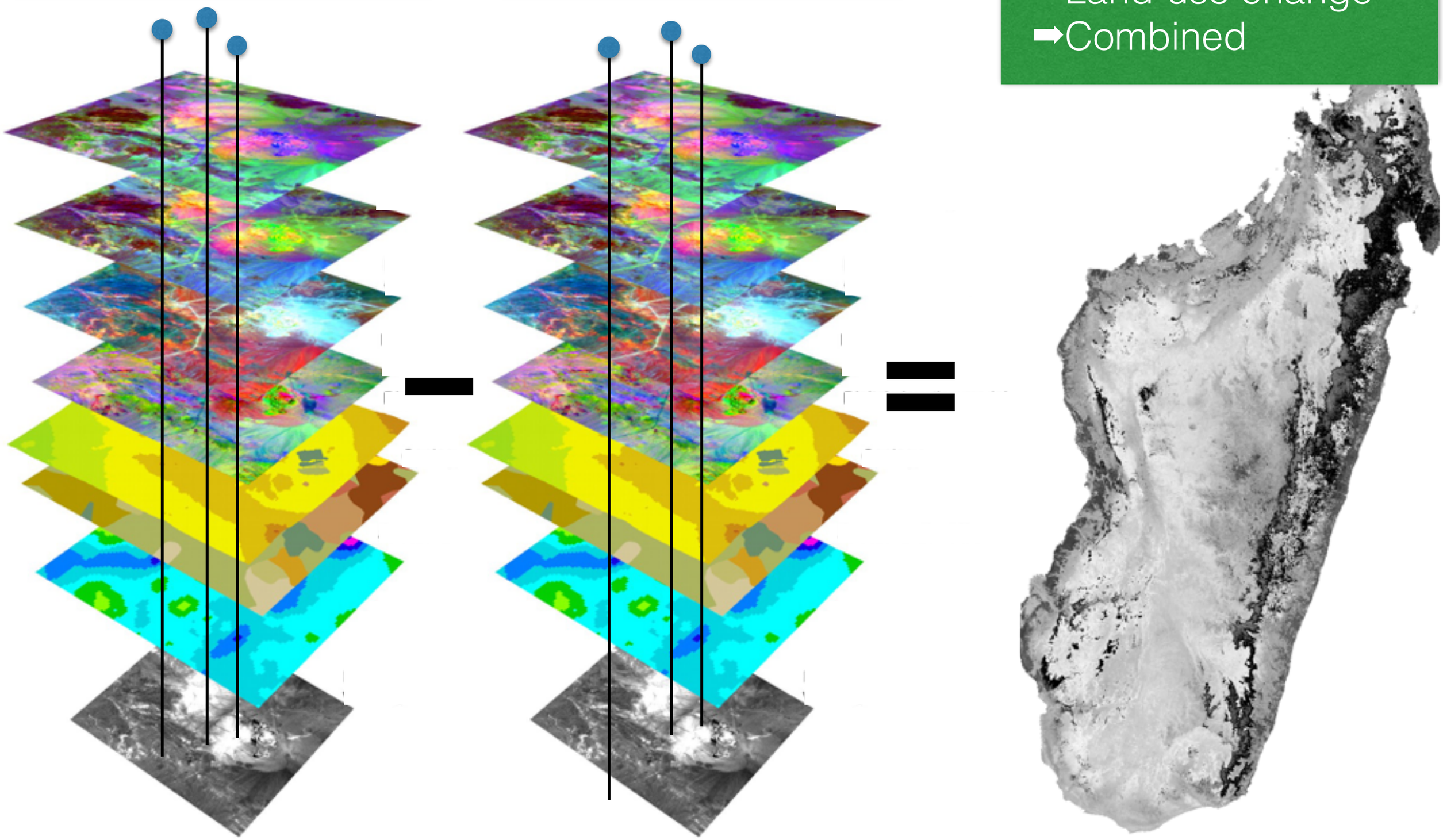


ASSEMBLE DISTRIBUTIONS

Current richness

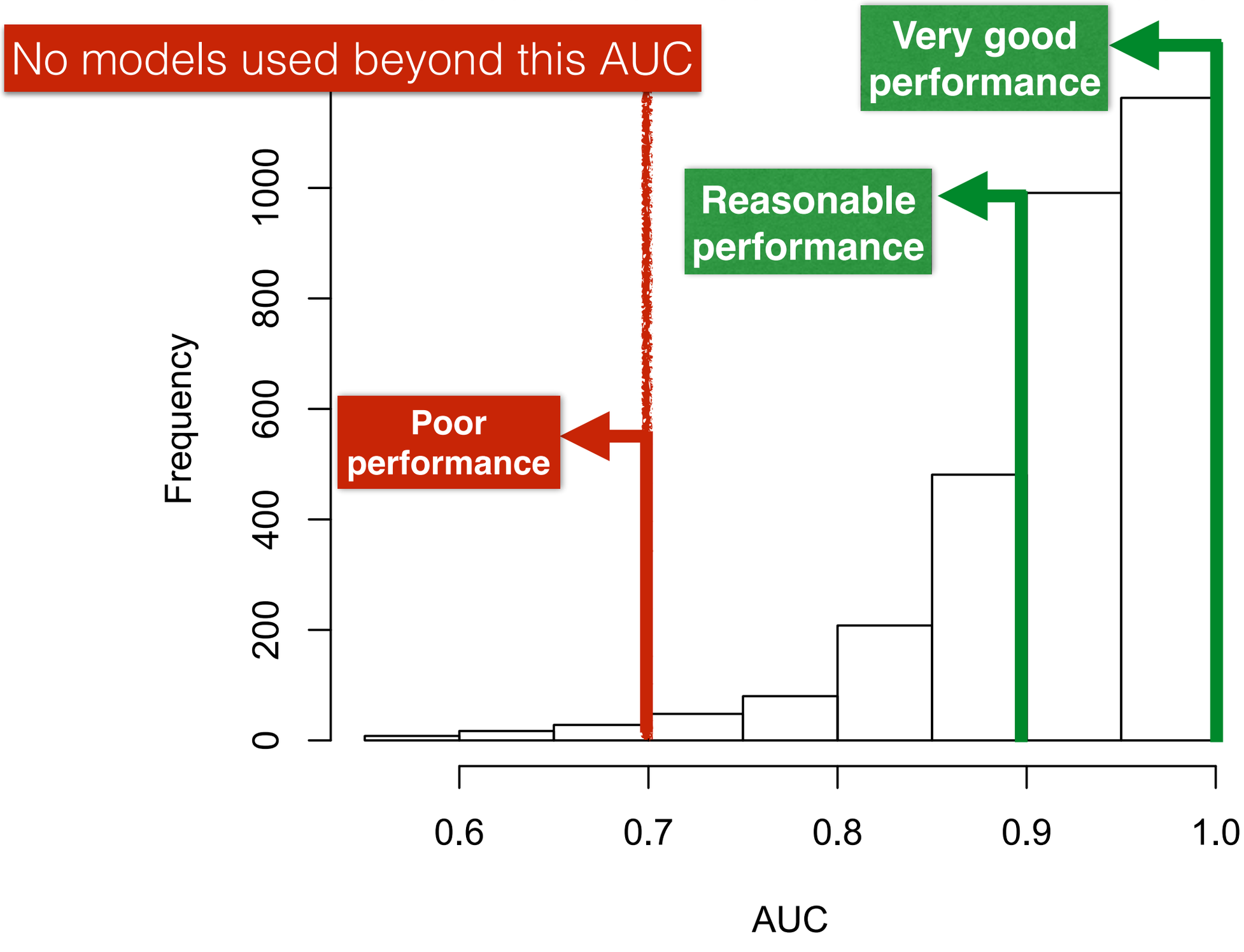
Future richness

Richness maps
- ➡Climate change
- ➡Land-use change
- ➡Combined

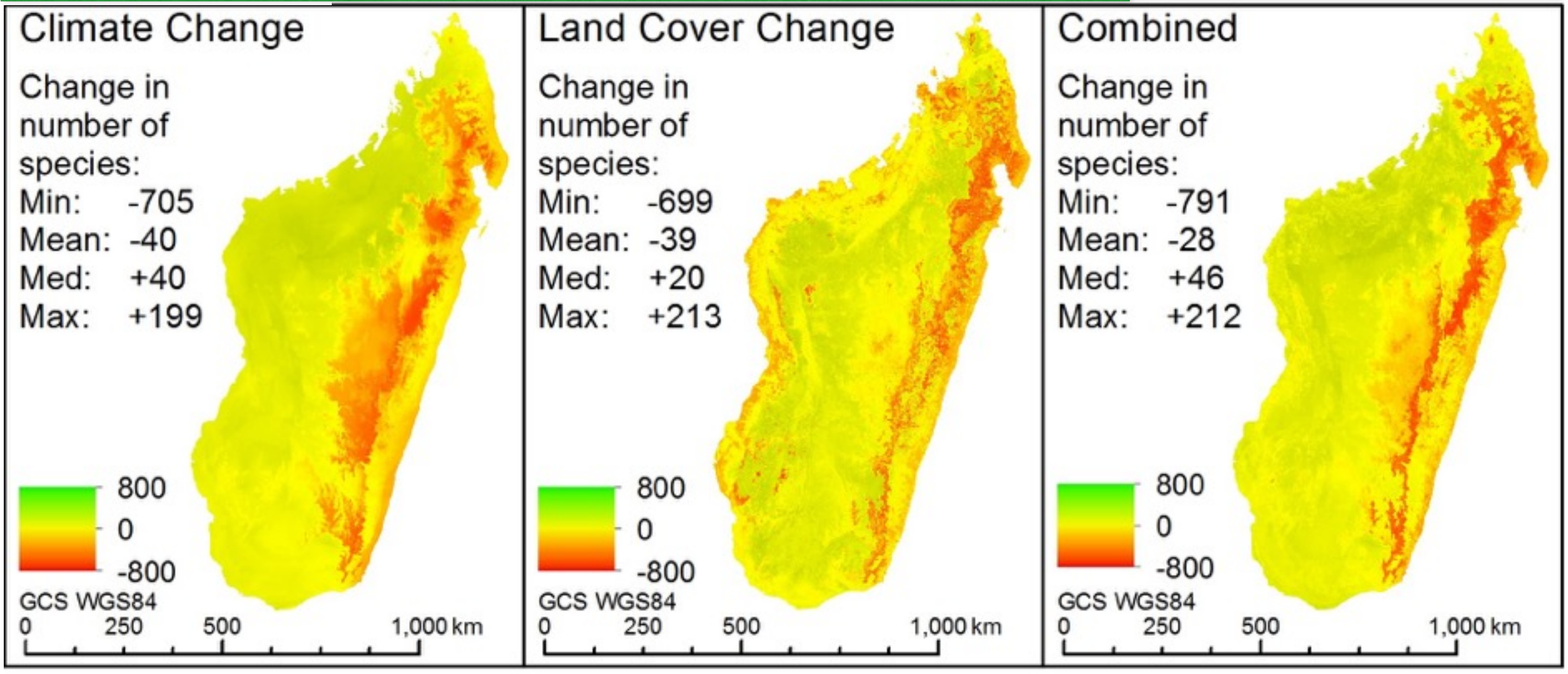


RESULTS

AUC values for all models



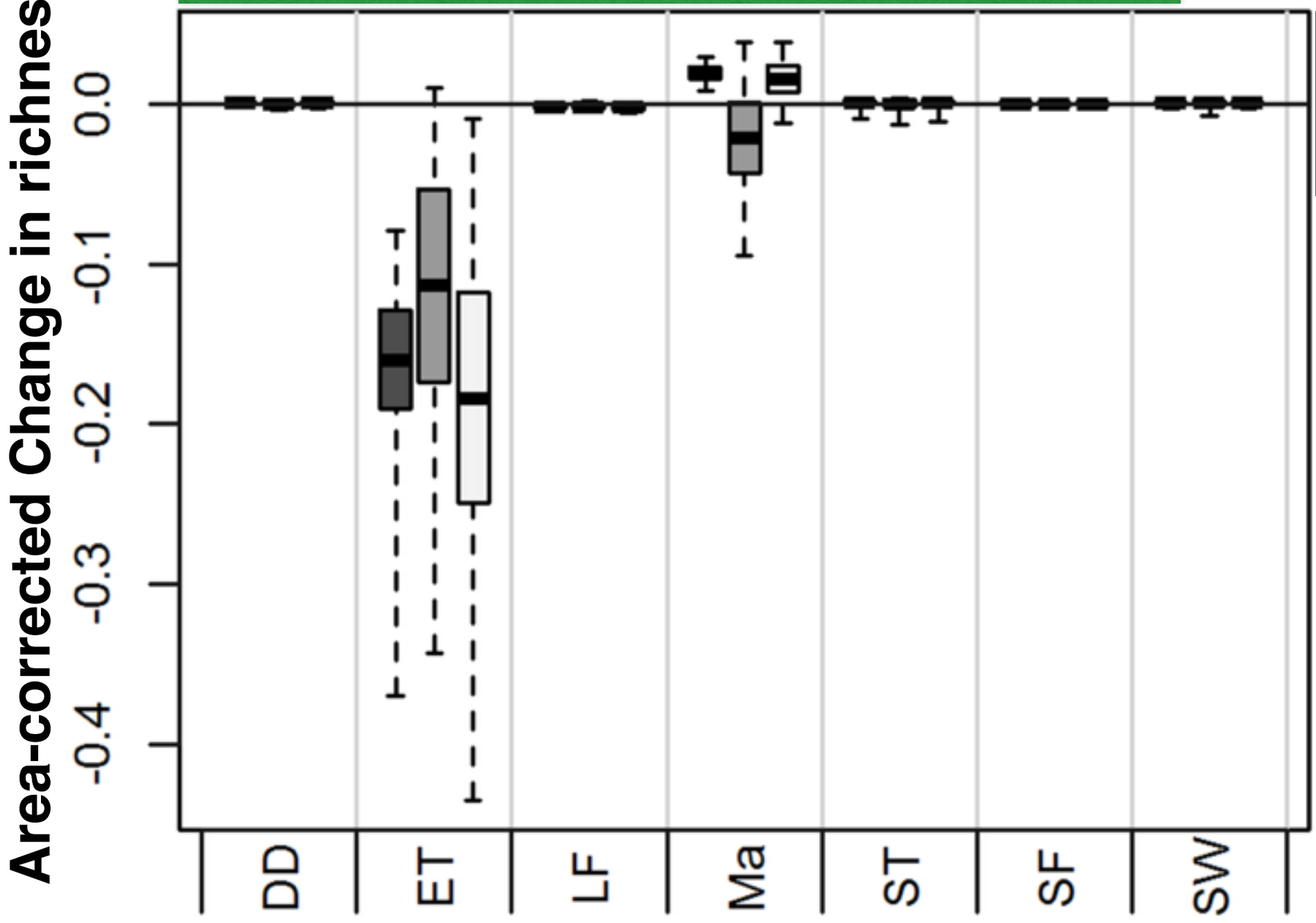
FUTURE SPECIES RICHNESS



Brown et al. 2015

- Heterogeneous responses
- Large declines in lowland forests & Ericoid thickets
- Combined scenario did not show additive effects

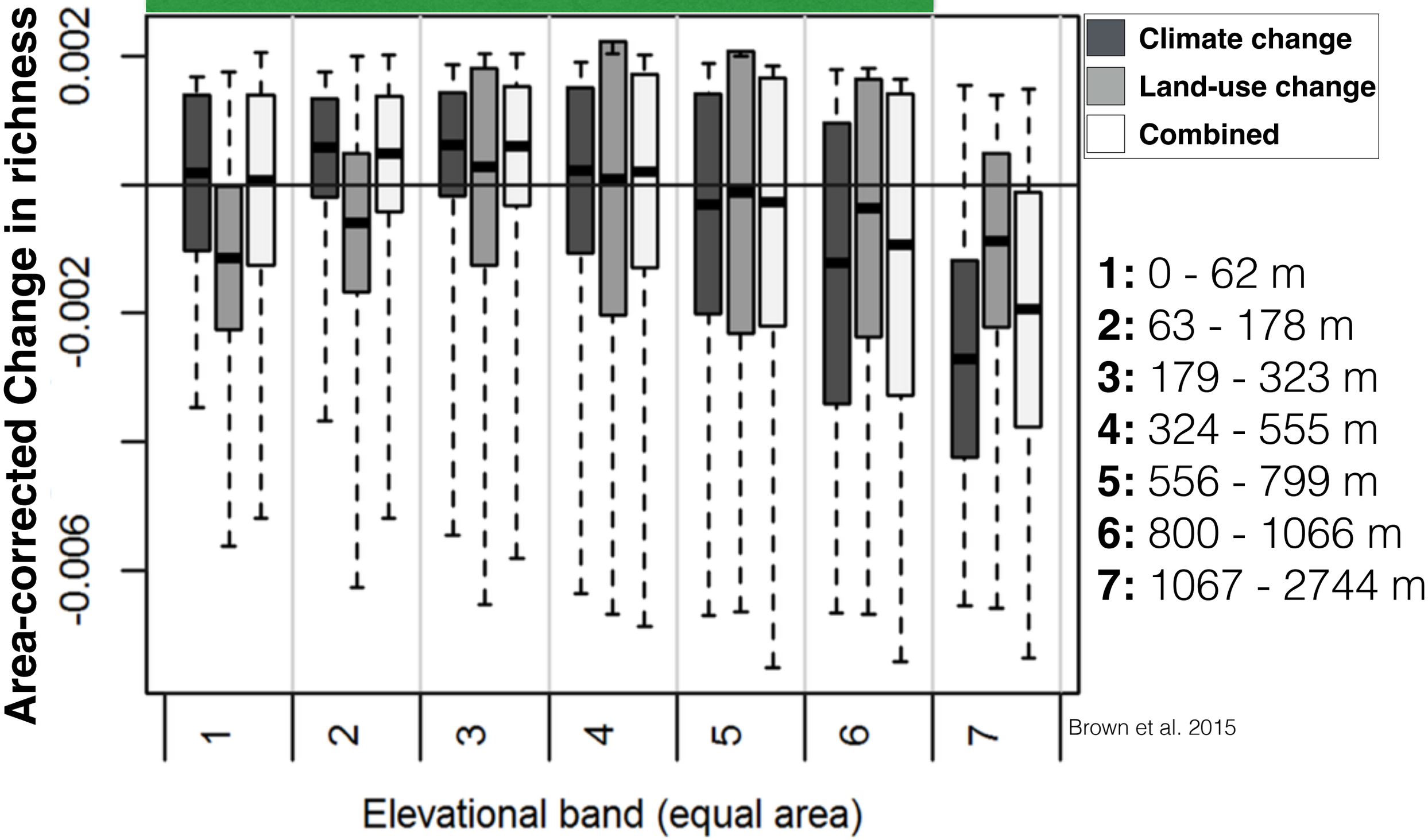
FUTURE SPECIES RICHNESS



DD: Dry Deciduous
ET: Ericoid Thickets
LF: Lowland forests
Ma: Mangroves
ST: Spiny Thickets
SF: Sub-humid forests
SW: Succulent woodlands

Brown et al. 2015

FUTURE SPECIES RICHNESS



Brown et al. 2015

- Declines at high elevations under climate scenario

DISCUSSION POINTS

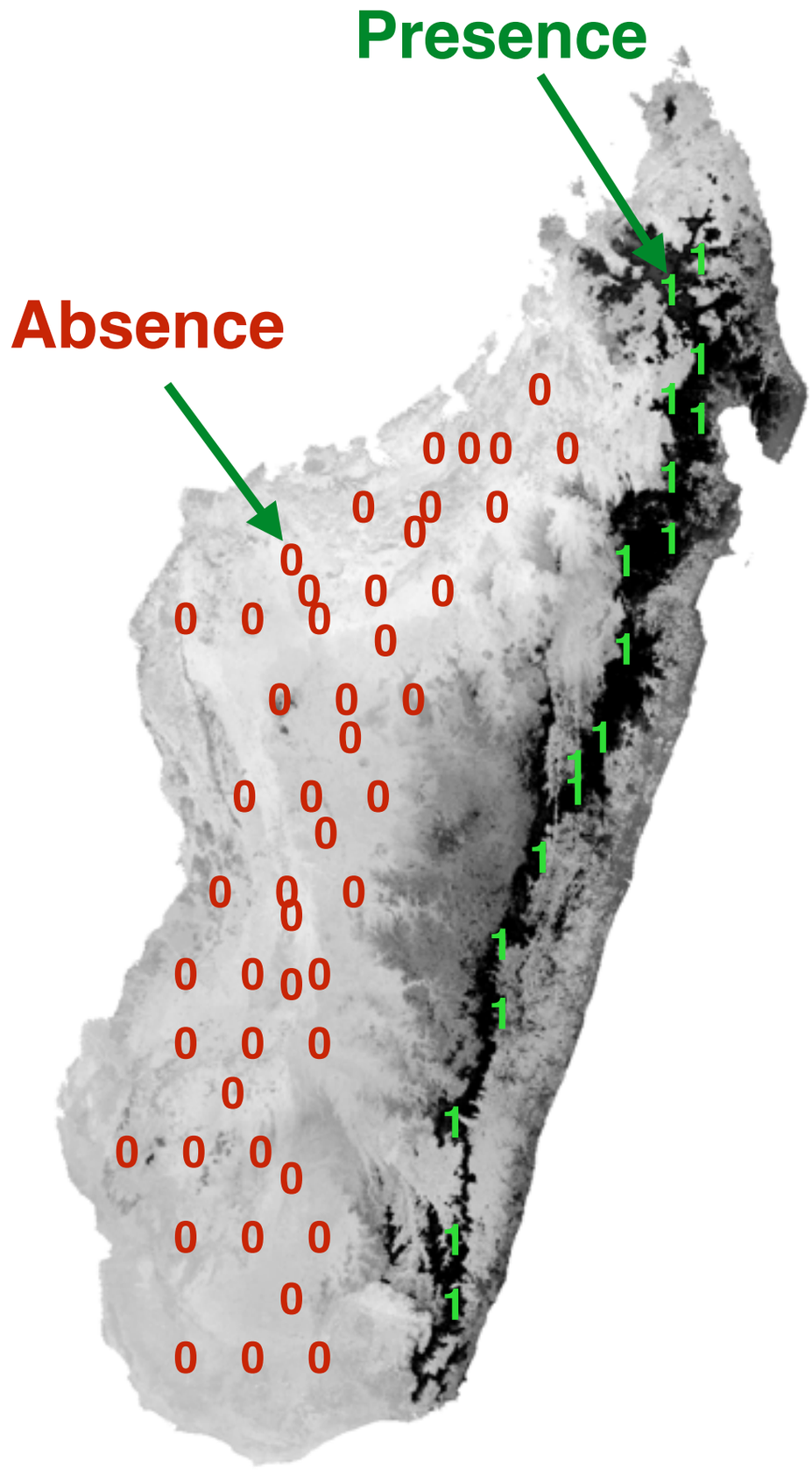
- Climate and land-use driven shifts
  - ➡Region-specific response (declines and gains
  - ➡Declines in eastern escarpment and ericoid thickets
  - ➡Consistent with future climate and land-use predictions
- Gains in northwest regions
  - ➡No dispersal corridors

THANK YOU!

QUESTIONS?

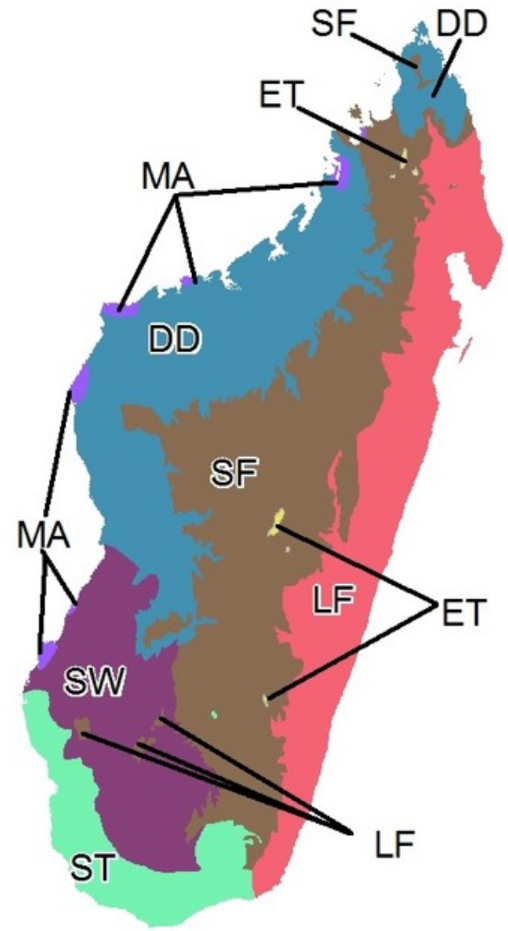
THRESHOLD DISTRIBUTIONS

- **Threshold all distributions** to determine species and genera presence or absence (i.e., 1 or 0)



Focal Eco-regions

- **Dry deciduous**: dry tropical forests and woodlands; <800m in western regions
- **Ericoid thickets**: large number of endemics in Ericaceae, Asteraceae and Podocarpaceae; the upper slopes of the four major mountain massifs;
- **Lowland forests**: humid and moist tropical forest; from low to mid elevations in eastern region
- **Spiny thickets:** low succulent and spiny thicket dominated by euphorbiaceae and didiereaceae; occurs in south and southwest.
- **Sub-humid forests:** diversity of habitats and corresponds broadly to mid-elevation forests in central and southern regions, as well as northern highlands and uplands;
- **Succulent woodlands:** comprised of deciduous woodland and spiny and succulent thicket; occurs in southwestern regions.



DEM