Biodiversity and climate change: Impacts and conservation perspectives

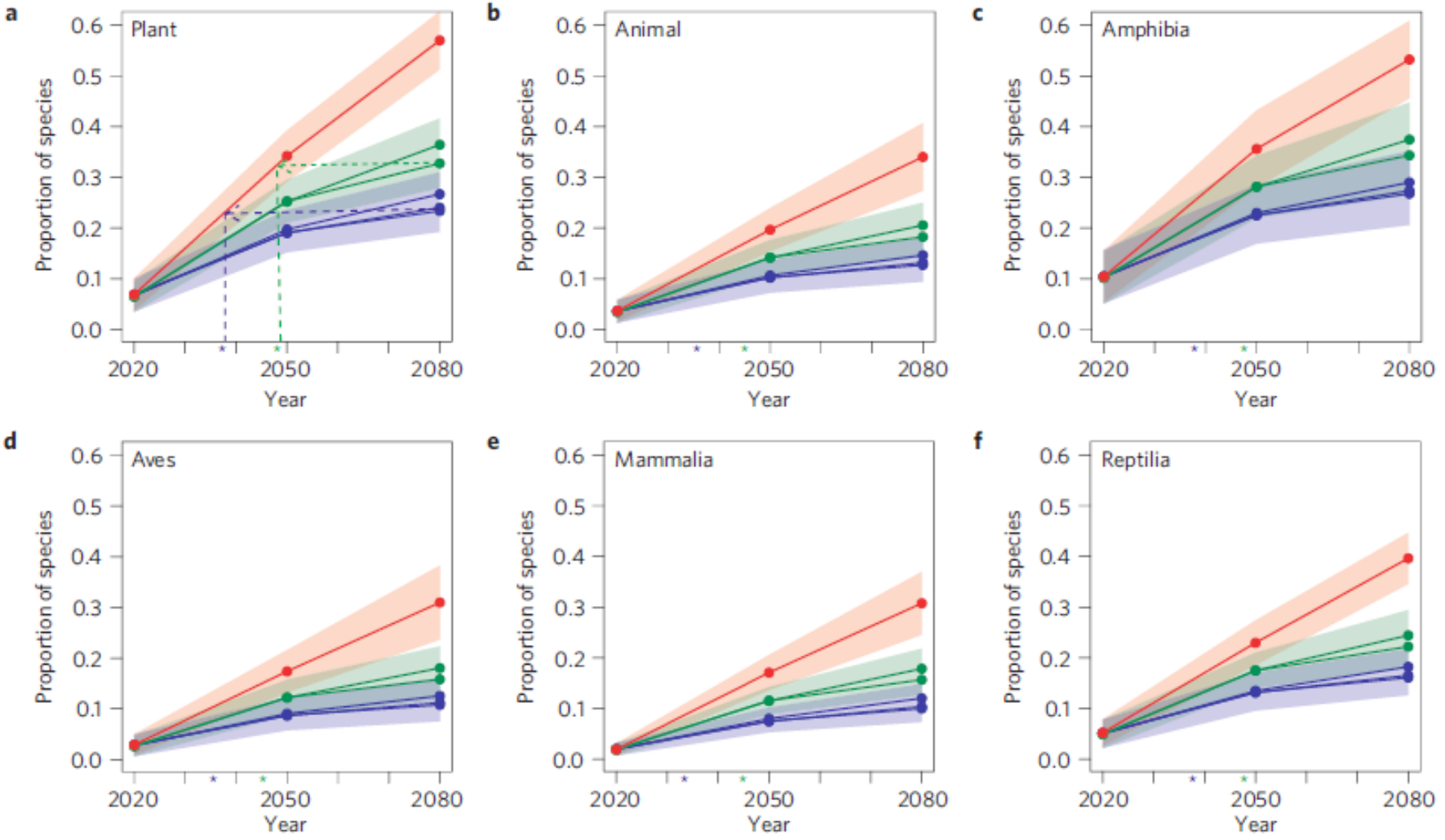
CGIAR

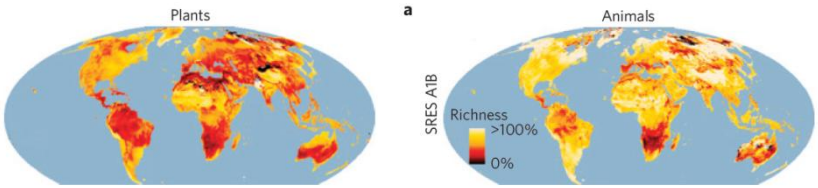
RESEARCH PROGRAM ON
Climate Change, Agriculture and Food Security

CCAFS

CIAT

Major biodiversity loss predicted





Quantifying the benefit of early climate change mitigation in avoiding biodiversity loss

R. Warren[1]*, J. VanDerWal[2,3], J. Price[1], J. A. Welbergen[2], I. Atkinson[2,3], J. Ramirez-Villegas[4,5,6], T. J. Osborn[7], A. Jarvis[4,5], L. P. Shoo[2,8], S. E. Williams[2] and J. Lowe[9]

First strategy: mitigate emissions! Most effective strategy for reducing biodiversity losses

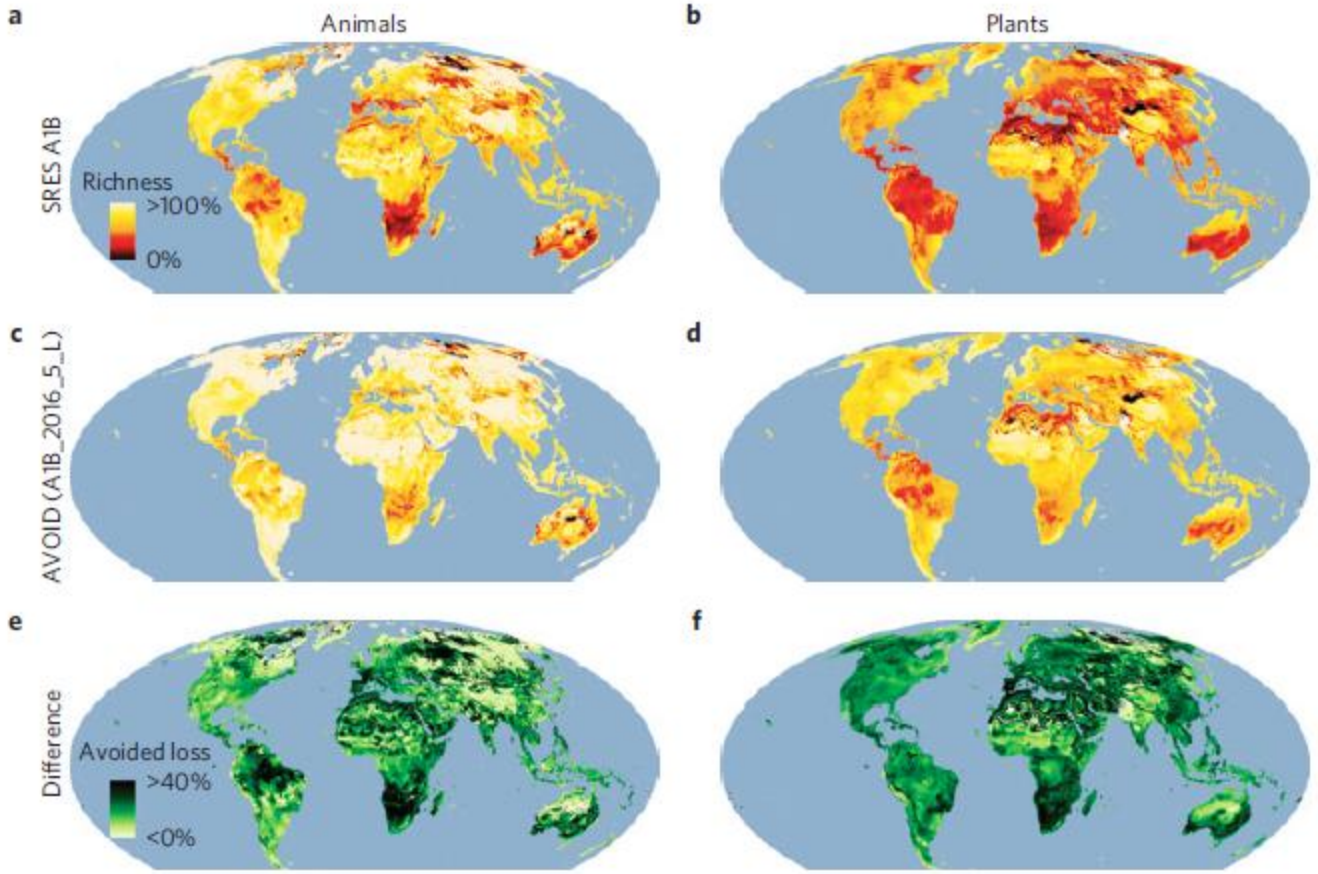
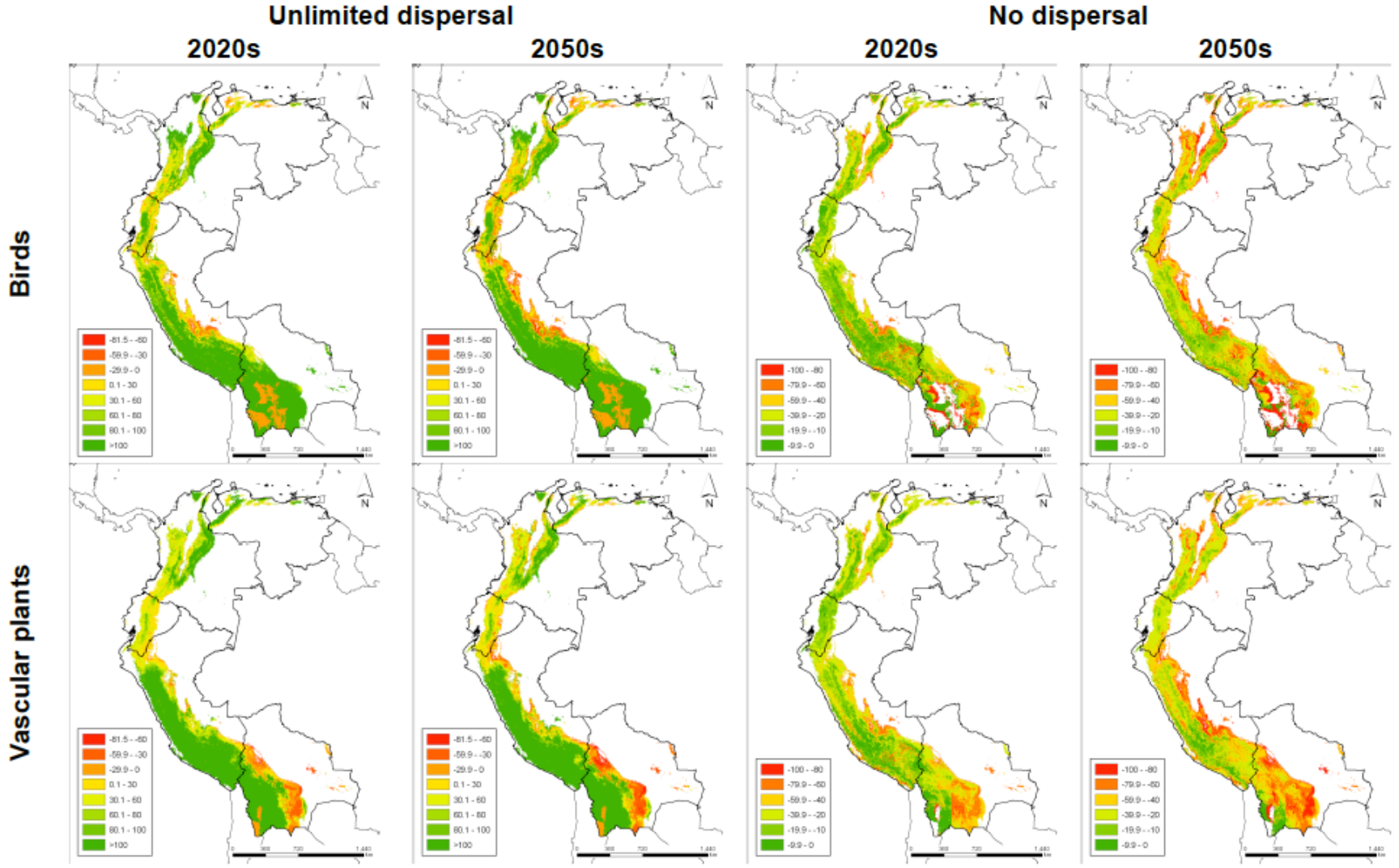


Figure 3 | Species richness in the 2080s. a–d, Species richness of animal (**a**,**c**) and plant (**b**,**d**) species in the 2080s under realistic dispersal for the stringent mitigation case in which global greenhouse gas emissions peak in 2016 and are subsequently reduced at 5% annually (**c**,**d**) compared with the no mitigation case SRES A1B (**a**,**b**). The colour scale in **a** also applies to parts **b**–**d**. **e**,**f**, The species richness change that is avoided by such mitigation. White areas are those where no data exist in the GBIF network. Species richness gains occur only on the edges of these white areas, where they are artefacts of data paucity, and hence are not shown. The colour scale in **e** also applies to **f**.

Impacts of CC in the Andes



Julián Ramírez-Villegas[1, 2, 4, *], Francisco Cuesta C.[3], Christian Devenish[5, 6], Manuel Peralvo[3], Andy Jarvis[1, 2], Carlos Arnillas[7], in press, Conservation of Andean biodiversity under climate change, Journal for Nature Conservation.

The future of biodiversity rests on the ability to migrate

– up mountains, and across plains

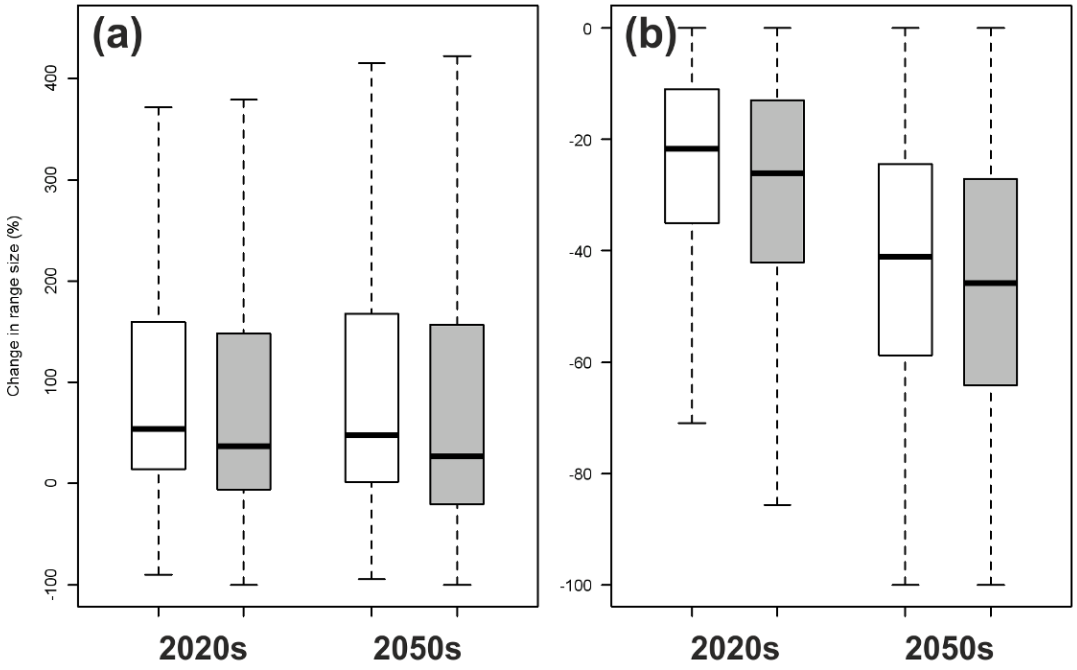


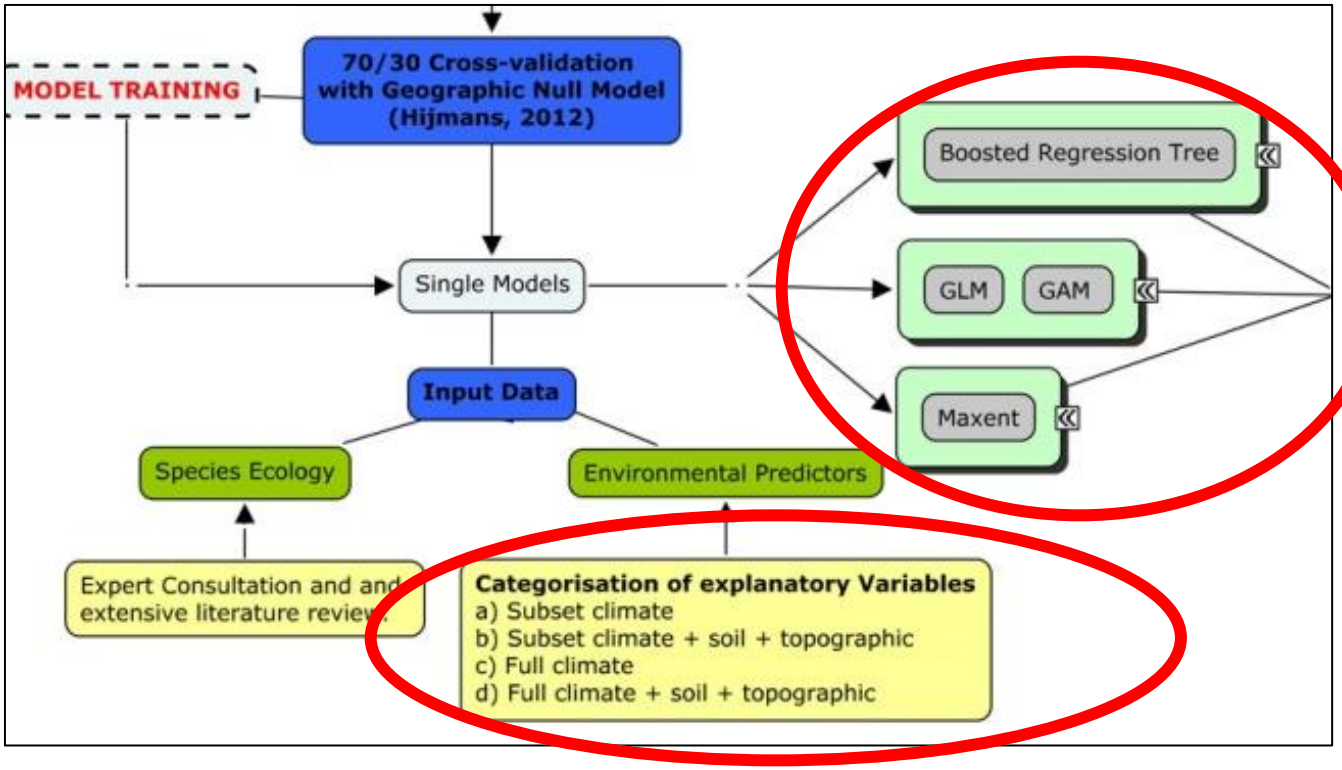
Figure 6 Climate change impacts on individual species. Change in range size for birds (white bars) and vascular plants (grey bars) for A. Unlimited dispersal and B. No dispersal, for the SRES-A2 emission scenario and both periods (2020s and 2050s) (outliers have been removed from the plot for easier visualization). Box plots were constructed with n=1,456 and n=9,062 for birds and vascular plants, respectively.

Pushing ecological niche modelling to an extreme: Colombian economic impacts

Construcción de ensemble: por que?

- **Ensemble:** Conjunto de modelos igualmente plausibles que permite muestrear incertidumbre
- Deben tomarse muchas decisiones en modelos de nicho:
  - Tecnica de ajuste (e.g. Maxent, bioclim, etc…)
  - Sesgo de muestreo
  - Sub-muestreo
  - Area de pseudo-ausencias
  - Cantidad de pseudo-ausencias
  - Variables de entrada

Ensemble: Configuración y ajuste



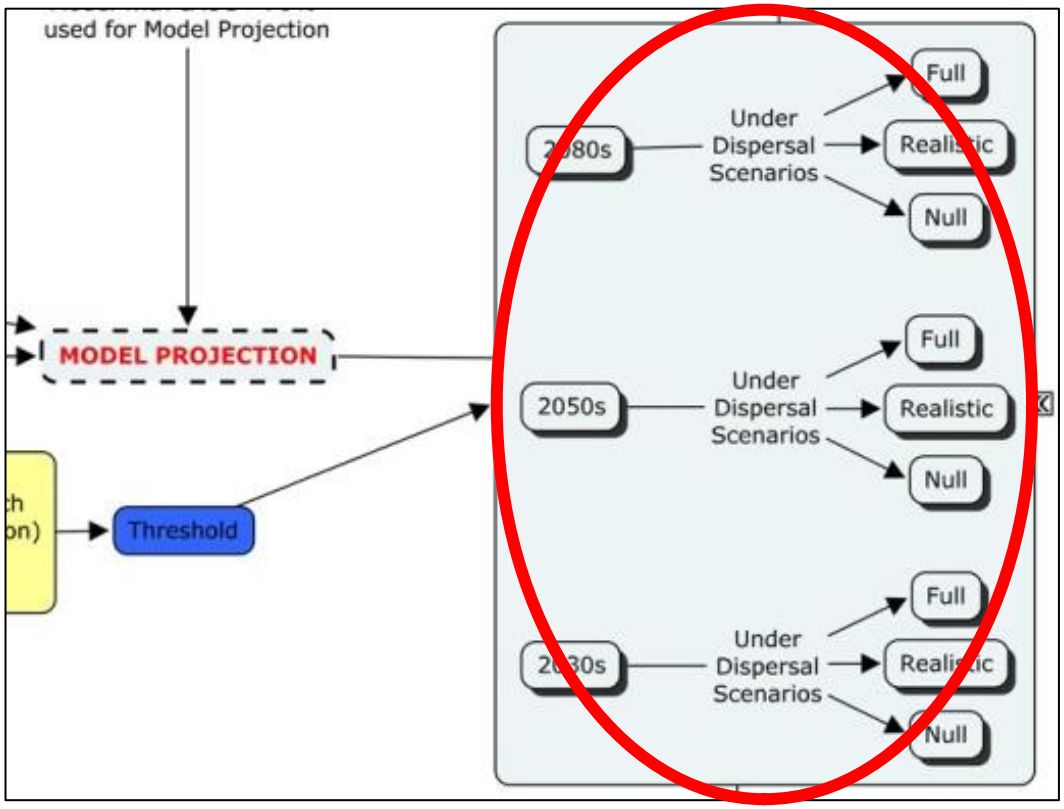
Usamos 6 tecnicas con 100 repeticiones (cada una con configuracion diferente)

Usamos 8 diferentes combinaciones de predictores ambientales (especie-especifico)

Un total de 4,800 modelos iniciales por especie

Ensemble: Proyección sobre escenarios climáticos

- Seleccionamos un rango de modelos con base en parsimonia (AIC) y desempenno (AUC)… (actualmente un reto en ENMs)



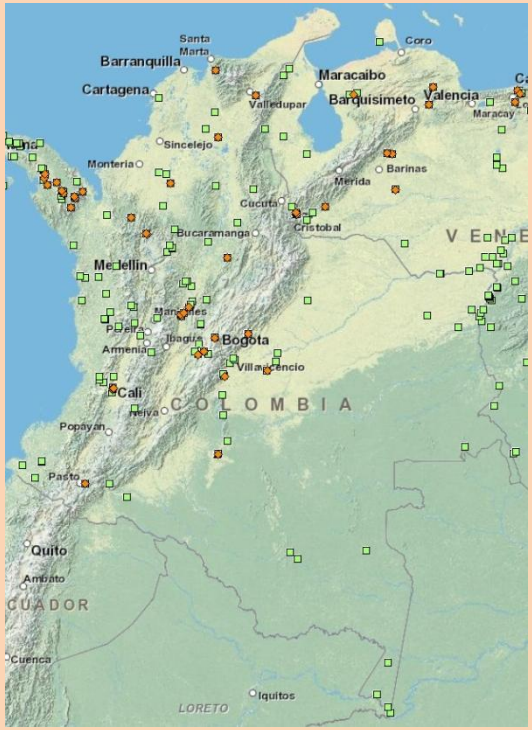
Usamos un ensemble de 19 a 24 GCMs para proyectar impactos futuros

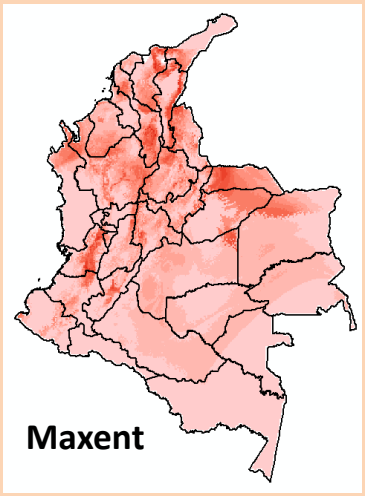
Sobre 3 SRES

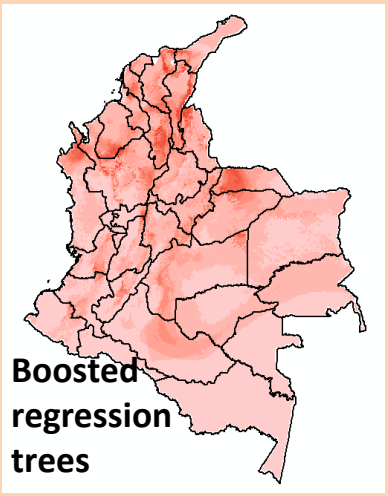
Sobre 3 periodos

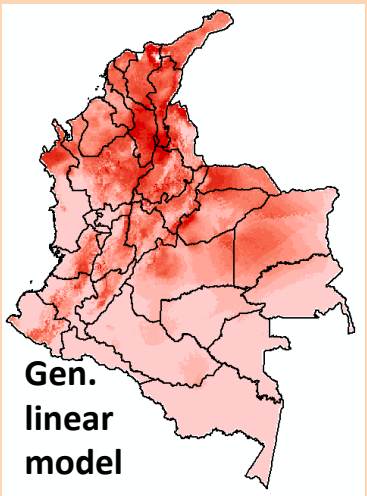
Total de ~912,000 proyecciones futuras

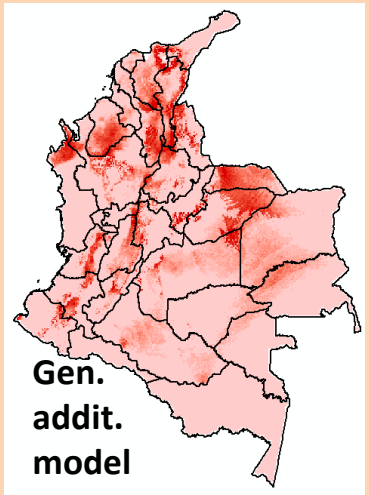
Ensemble para *J. caucana*

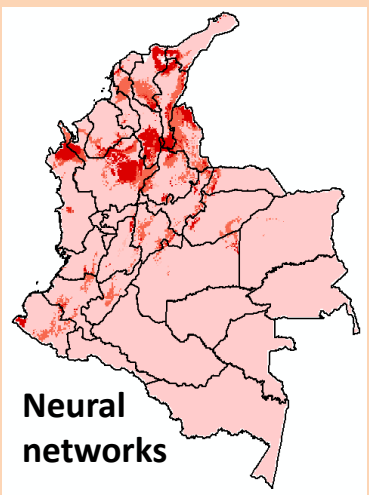










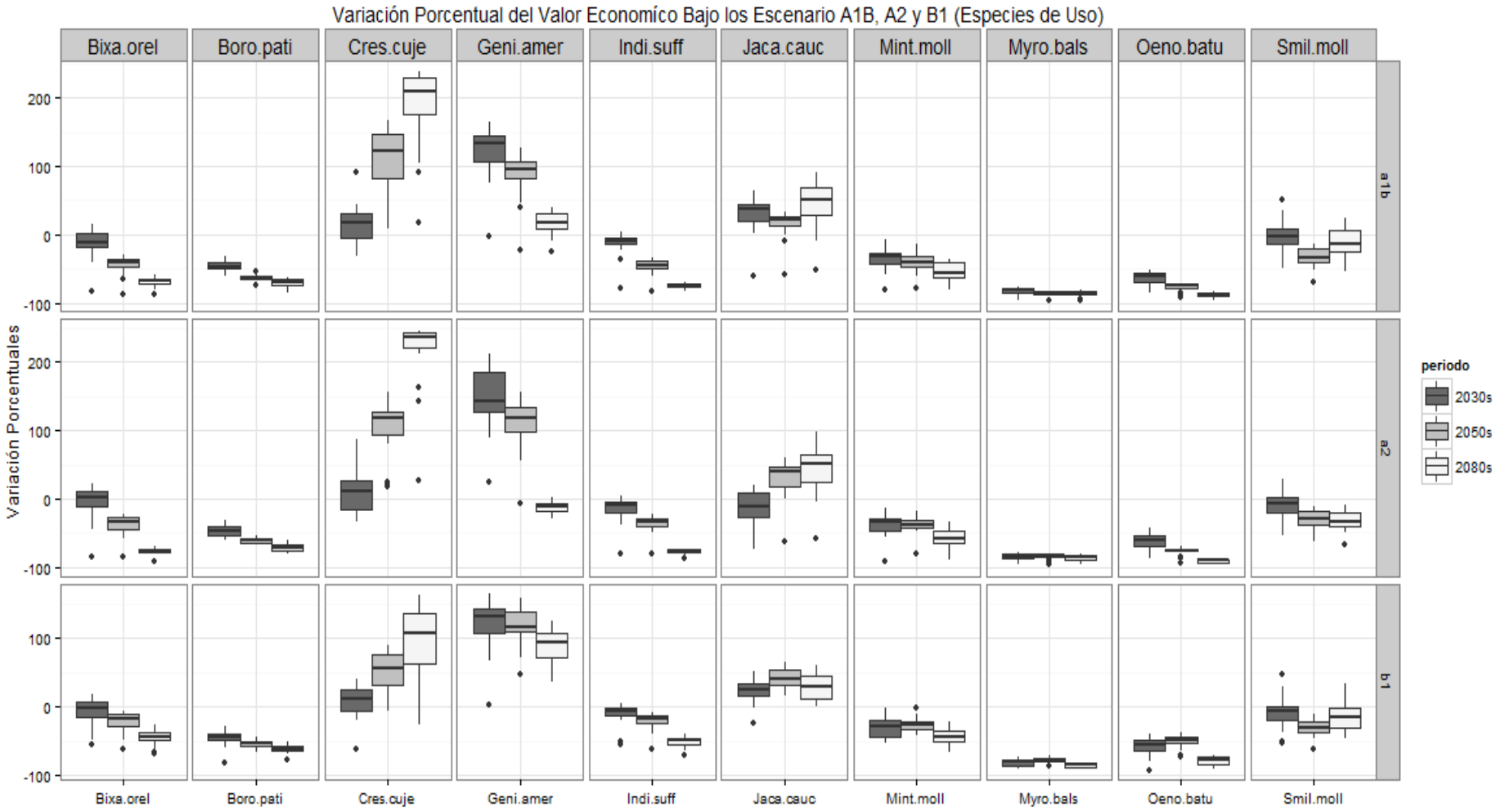


Reflexion:

- Cual creemos mas en presente?
- Cual creemos mas en futuro?

Análisis de impactos e incertidumbres

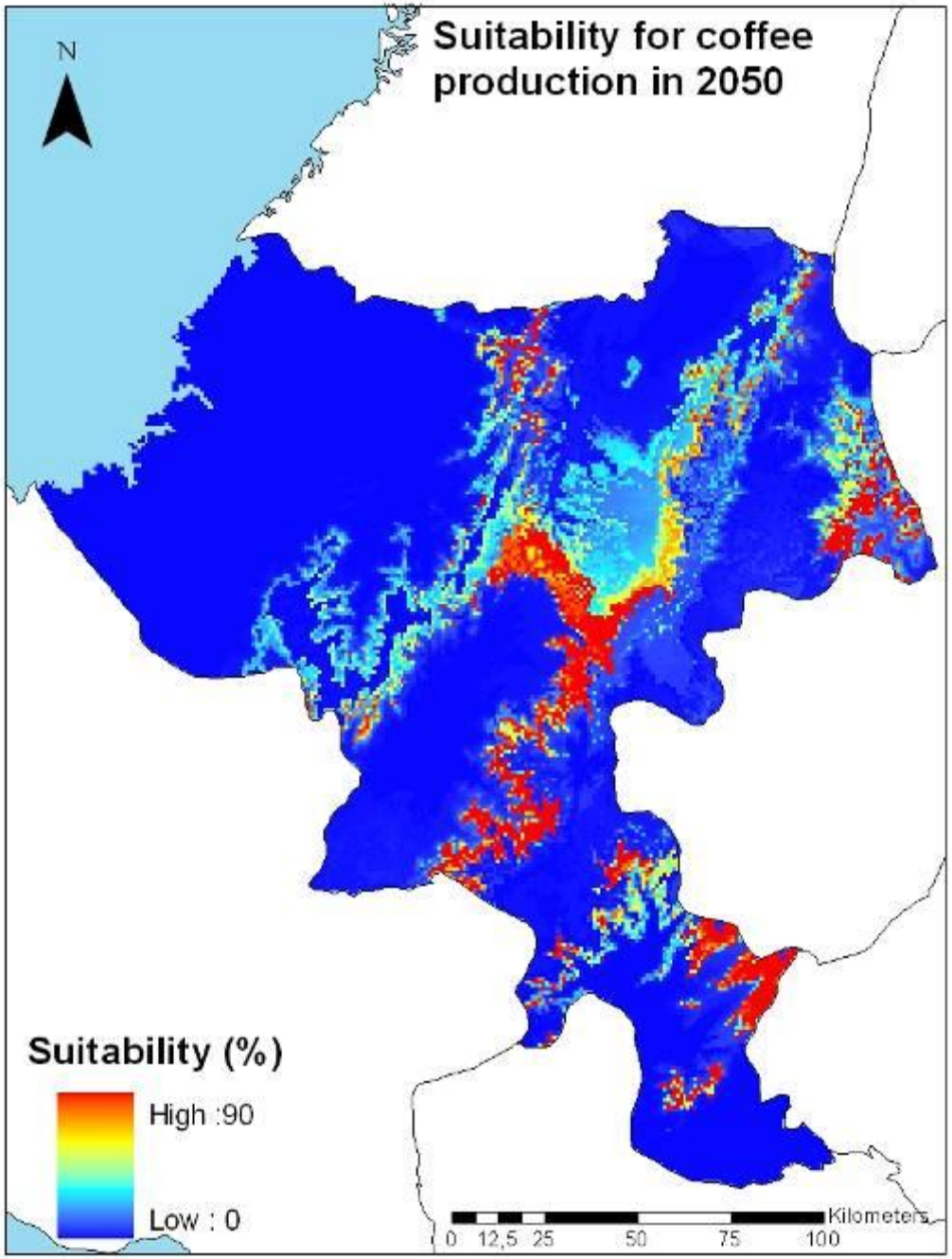
- Con ensemble podemos
  - Mapear probabilidad de impactos positivo y/o negativo (no solo el cambio promedio)
  - Investigar la consistencia de los resultados atribuyendo cambios a variables (e.g. estres de calor vs. estres de sequia)
  - Cuantificar la incertidumbre y… mas importante: las fuentes de incertidumbre
  - Generar estrategias de adaptacion mas robustas (que reducen riesgo, o que funcionan en multiples situaciones)


Variación Porcentual del Valor Economíco Bajo los Escenario A1B, A2 y B1 (Especies de Uso)
Bixa.orel
Boro.pati
Cres.cuje
Geni.amer
Indi.suff
Jaca.cauc
Mint.moll
Myro.bals
Oeno.batu
Smil.moll
a1b
a2
b1
Variación Porcentuales
200
100
0
-100
periodo
2030s
2050s
2080s

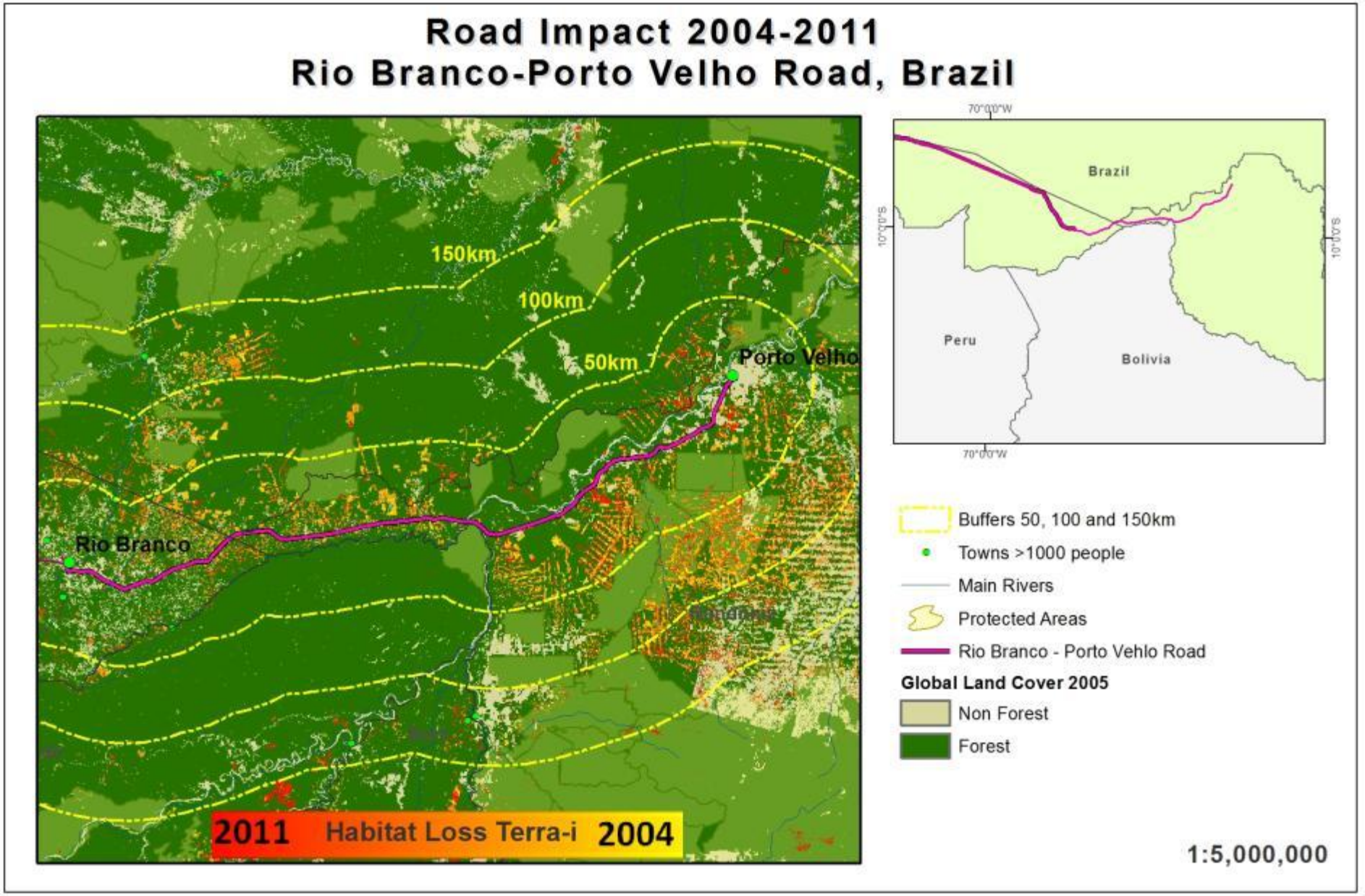
But wait, it gets more complicated!

Suitability in Cauca

- Significant changes to 2020, drastic changes to 2050
- The Cauca case: reduced coffeee growing area and changes in geographic distribution. Some new opportunities.



2.1. Road Impact Results: BR-364 Highway, Brazil



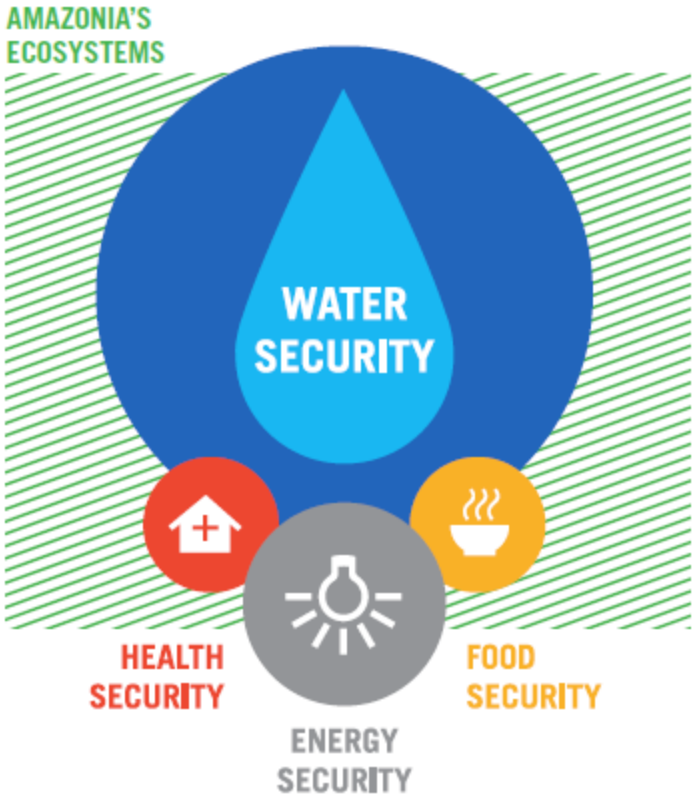
Biodiversity right in the middle of the nexus – food, energy and water
Biodiversity "collateral damage"?

FIGURE 2: WATER, ENERGY, FOOD AND HEALTH SECURITY IN AMAZONIA ARE INTERDEPENDENT

WATER SECURITY INTERACTIONS:
AGRICULTURAL PRODUCTION
FISH PRODUCTIVITY
HYDROELECTRIC POWER GENERATION
AVAILABILITY OF CLEAN DRINKING WATER
PUBLIC HEALTH

ENERGY SECURITY INTERACTIONS:
MECHANISED AGRICULTURE
COMPETITION WITH CROPS FOR LAND AND WATER
POLLUTION FROM EXTRACTIVE INDUSTRIES
PROVISION OF HEALTH SERVICES

FOOD SECURITY INTERACTIONS:
COMPETITION WITH BIOFUELS FOR LAND AND WATER
POLLUTION THROUGH USE OF AGROCHEMICALS
NUTRITION FOR HEALTH

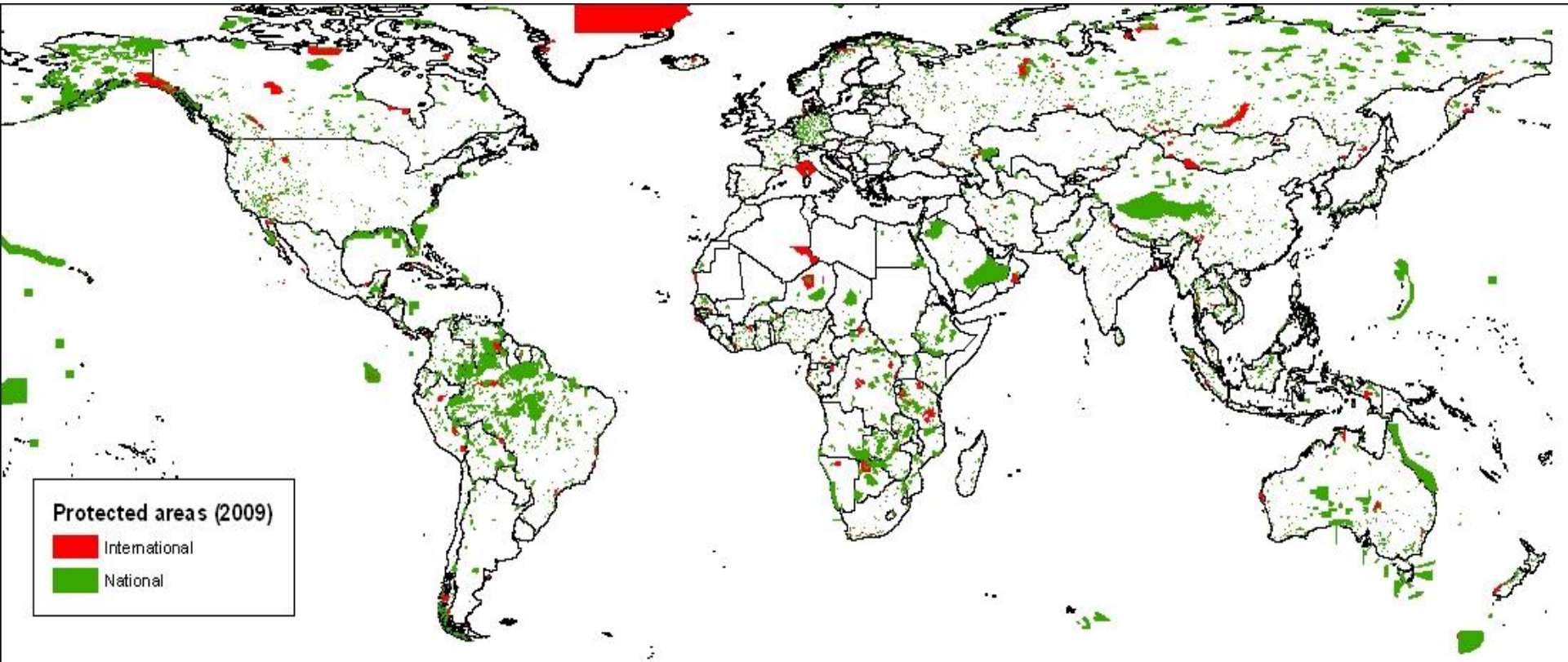


Message

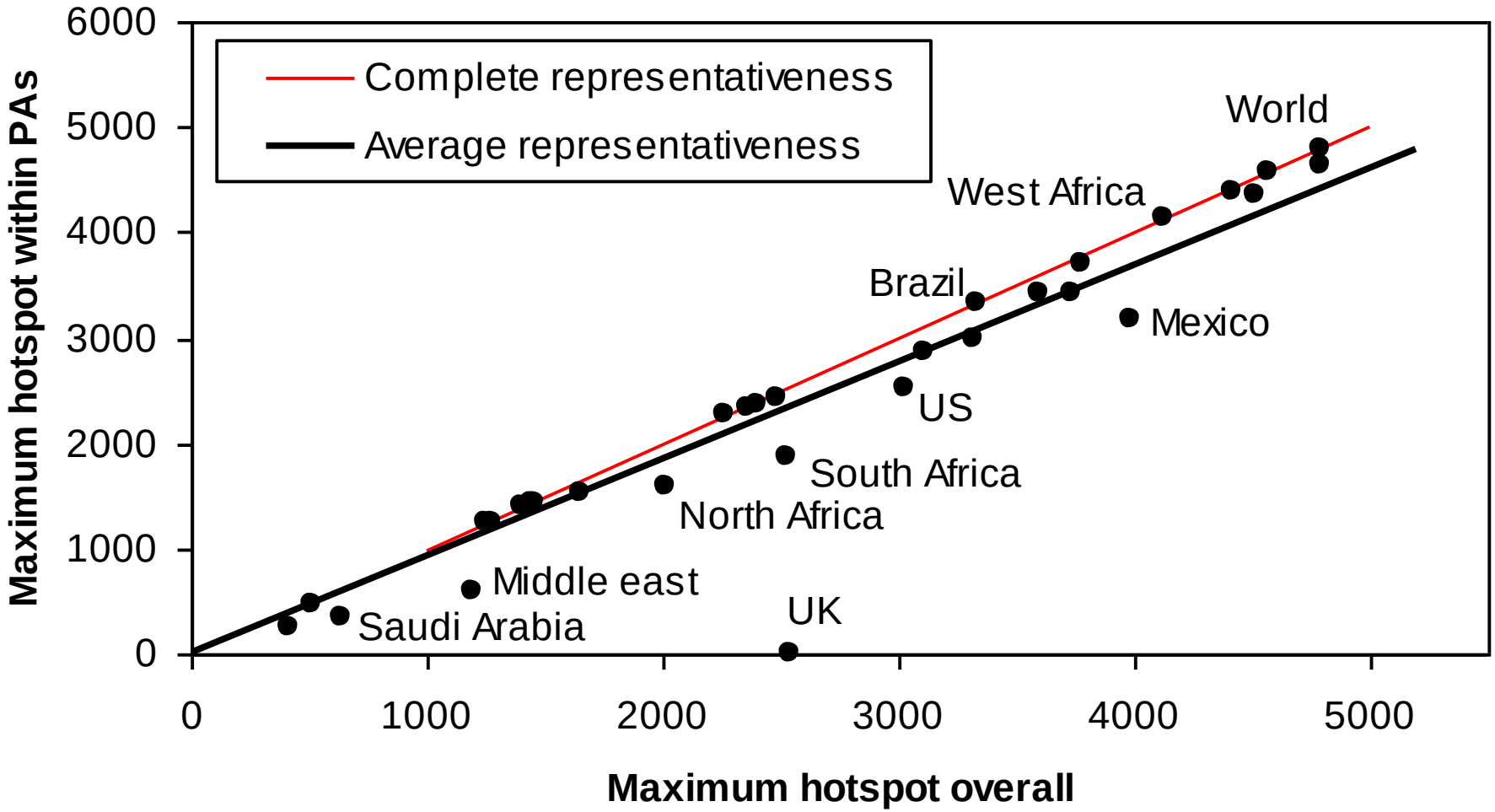
There will be greater pressure on land resources for multiple uses, as currently non-arable land becomes arable, as demands increase for food and energy

La situacion actual de conservacion

- Cubre 13.8% de la superficie de la tierra



Y estan colocados en los sitios de mayor diversidad



New paradigms for biodiversity research and conservation

- Protected areas protect biodiversity under a static climate
- Biodiversity needs to move, evolve
- Multi-functional landscapes will play a more and more important role, but we still have many unanswered research questions on how to construct them
- Nexus thinking in biodiversity research and conservation is crucial – put biodiversity research within a global change agenda,
- Move beyond impact modelling – towards improved understandings of solutions