Biodiversity Data, Climate Change, and Emerging Infectious Disease

Dr. Healy Hamilton

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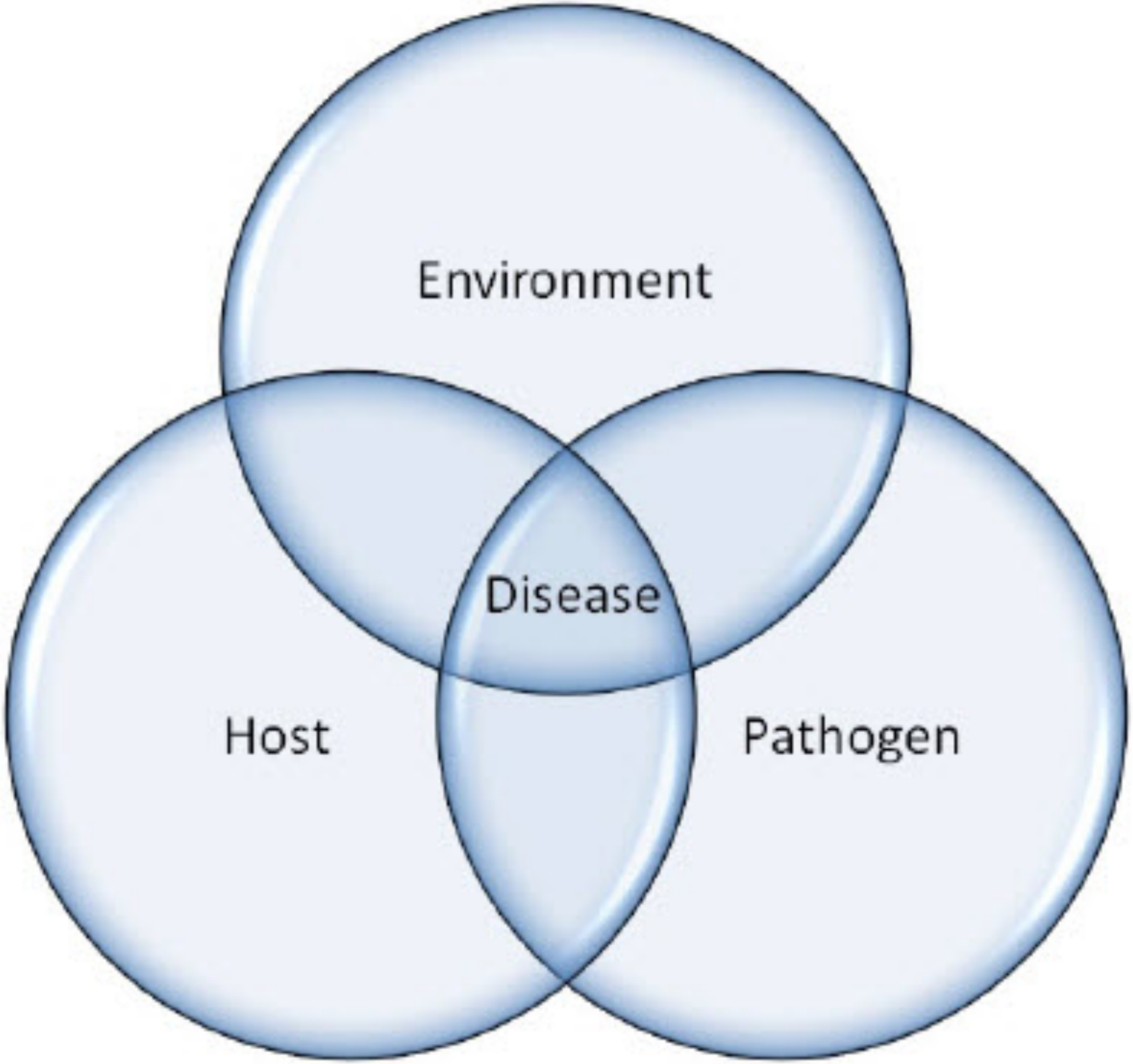
A Network Connecting Science With Conservation


Environment
Disease
Host
Pathogen

Ecology, 90(4), 2009, pp. 888–900

The ecology of climate change and infectious diseases

Kevin D. Lafferty[1]

Western Ecological Research Center, U.S. Geological Survey, Marine Science Institute, University of California, Santa Barbara, California 93106 USA

Migratory birds and West Nile virus

J.H. Rappole[1] and Z. Hubálek[2]

[1]*Smithsonian Conservation & Research Center, Front Royal, VA 22630, USA*

Zoology, Institute of Vertebrate Biology, Academy of Sciences, Klášterní 2, C.

Trends Ecol Evol. 2011 June ; 26(6): 270–277. doi:10.1016/j.tree.2011.03.002.

Frontiers in climate change-disease research

Jason R. Rohr[1], Andrew P. Dobson[2], Pieter T.J. Johnson[3], A. Marm Kilpatrick[4], Sara H. Paull[3], Thomas R. Raffel[1], Diego Ruiz-Moreno[5], and **Matthew B. Thomas[6]**

Understanding the link between malaria risk and climate

Krijn P. Paaijmans[a,1], Andrew F. Read[a,b], and Matthew B. Thomas[a]

Journal of Applied Microbiology 2003, **94**, 37S–46S

Climate change and waterborne and vector-borne disease

P.R. Hunter

School of Medicine, Health Policy and Practice, University of East Anglia, Norwich, UK

Ecology, 90(4), 2009, pp. 903–905

Climate change and the distribution and intensity of infectious diseases

Richard S. Ostfeld[1]

doi 10.1098/rstb.2001.0894

Early effects of climate change: do they include changes in vector-borne disease?

R. S. Kovats[1*], D. H. Campbell-Lendrum[2], A. J. McMichael[1], A. Woodward[3] and J. St H. Cox[2]

PNAS

Interdisciplinary approaches to understanding disease emergence: The past, present, and future drivers of Nipah virus emergence

Peter Daszak[a,1], Carlos Zambrana-Torrelio[a], Tiffany L. Bogich[a,b,c], Miguel Fernandez[d], Jonathan H. Epstein[a], Kris A. Murray[a], and Healy Hamilton[e]

[a]EcoHealth Alliance, New York, NY 10001; [b]Fogarty International Center, National Institutes of Health, Bethesda, MD 20892; [c]Department of Ecology and Evolutionary Biology, Princeton University, Princeton, NJ 08544; [d]Environmental Systems Graduate Group, University of California, Merced, CA 95344;

Vector borne diseases are sensitive to changes in climate

- Distribution of vectors depends on climate
- Disease distribution depends on vector distribution

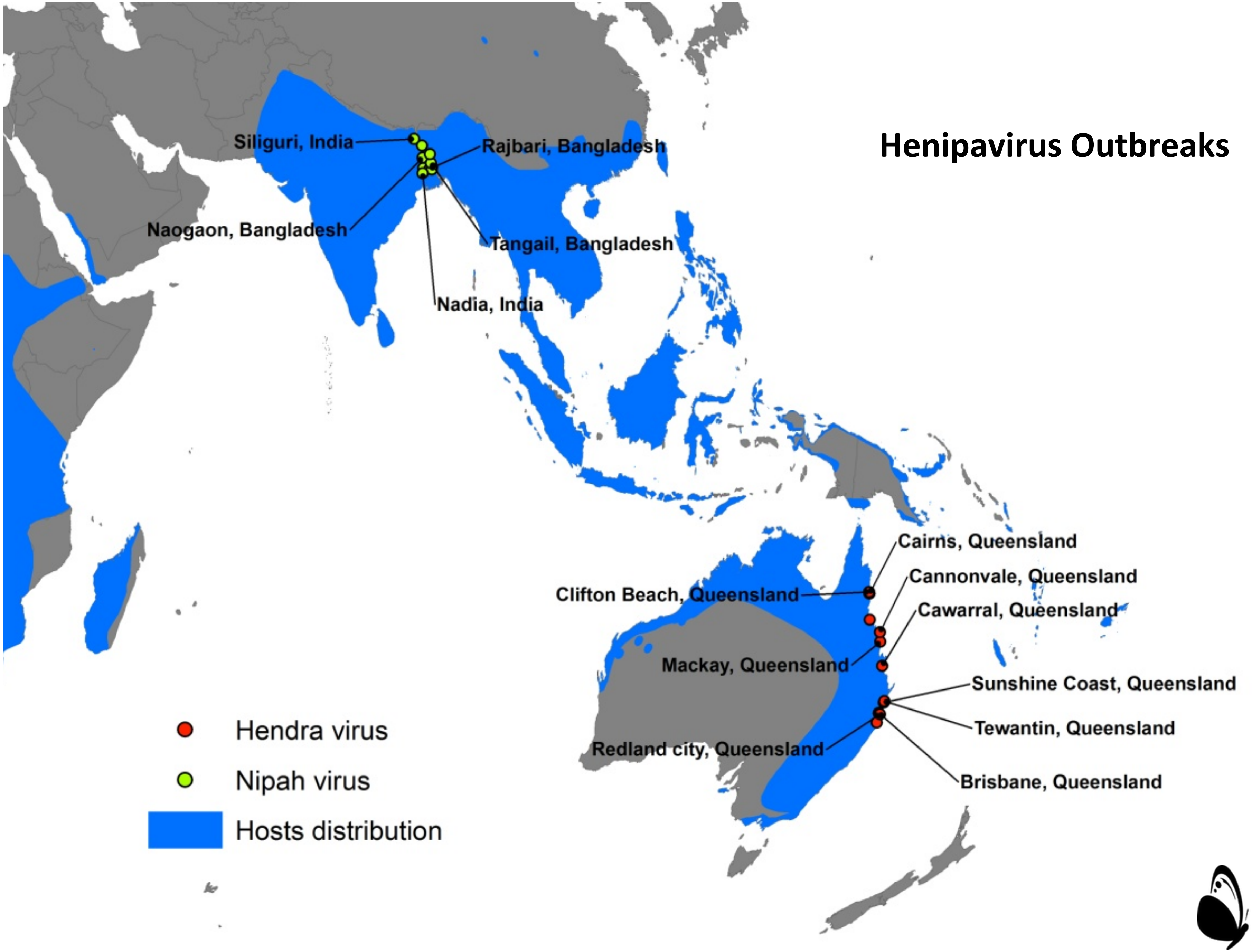
Need to predict potential distribution shifts of disease vectors as part of preventative public health measures

Henipavirus

15 species of bats reported as hosts for Henipa virus

Henipavirus
Virus classification
Group: Group V ((-)ssRNA)
Order: *Mononegavirales*
Family: *Paramyxoviridae*
Genus: ***Henipavirus***
Species:
Hendravirus (Type)
Nipahvirus

Henipavirus Outbreaks



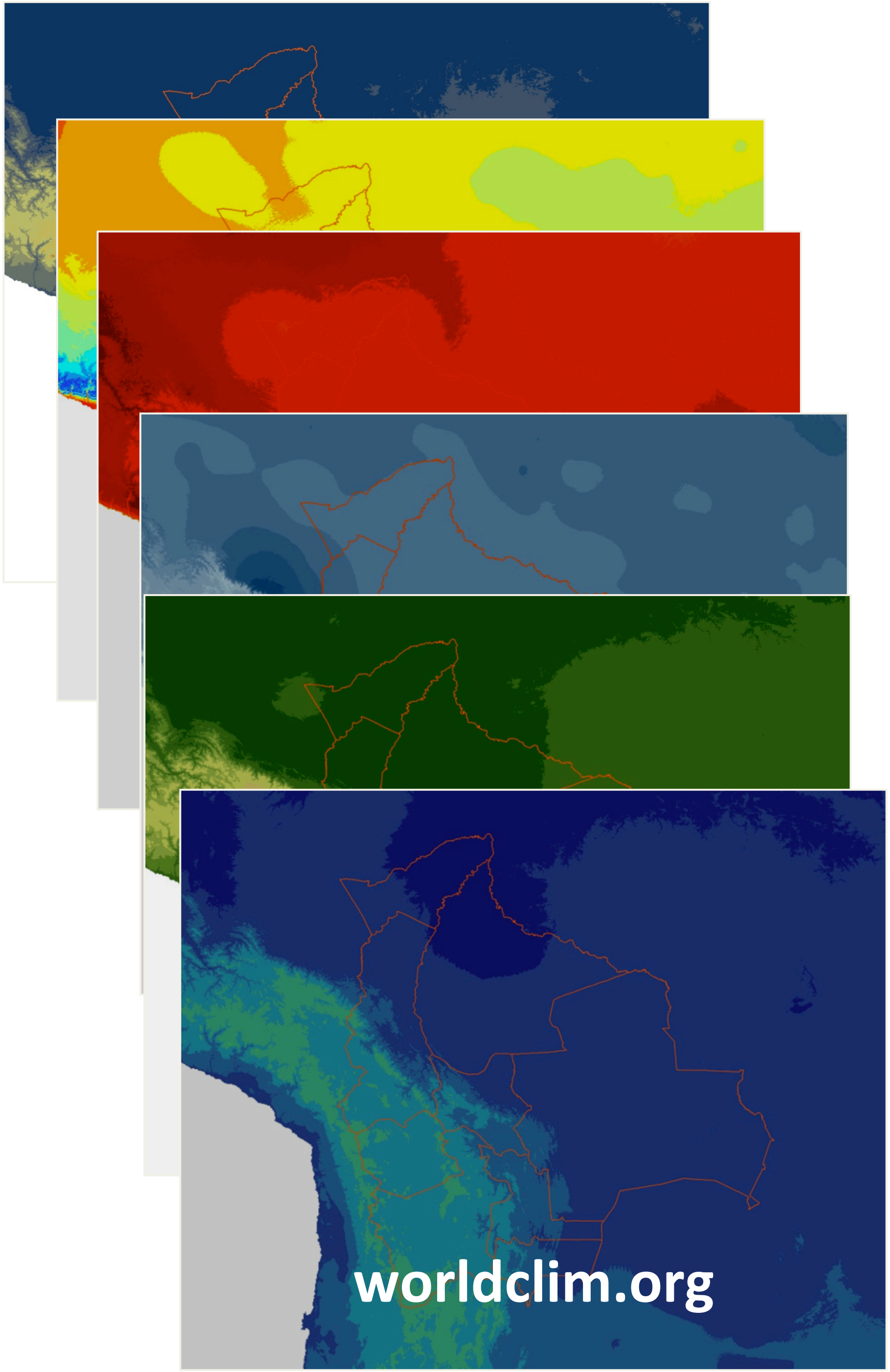
GBIF

Global Biodiversity Information Facility

	GBIF Participant	Total Number of Records ^	Total Number of Data Providers
1.	USA	43,217,033	56
2.	UK	16,531,570	6
3.	Ocean Biogeographic Information System	11,625,354	5
4.	Sweden	9,826,156	1
5.	Germany	5,486,515	
6.	France	4,053,581	
7.	Costa Rica	3,223,204	
8.	Australia	3,159,164	
9.	Austria	2,390,825	
10.	Canada	2,266,298	
11.	South Africa	2,118,214	

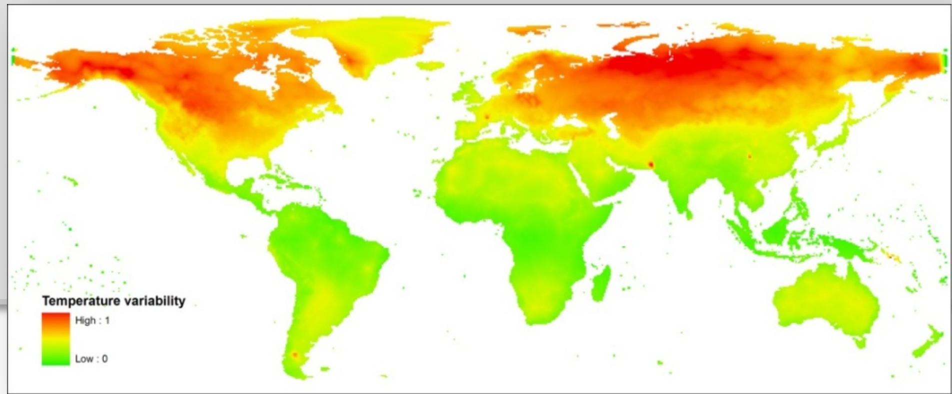
Species	# points
Cynopterus brachyotis	231
Eidolon helvum	69
Eonycteris spelaea	142
Hipposideros larvatus	23
Pteropus alecto	128
Pteropus conspicillatus	32
Pteropus giganteus	13
Pteropus hypomelanus	44
Pteropus poliocephalus	118
Pteropus scapulatus	176
Pteropus tonganus	34
Pteropus vampyrus	16
Scotophilus kuhlii	50

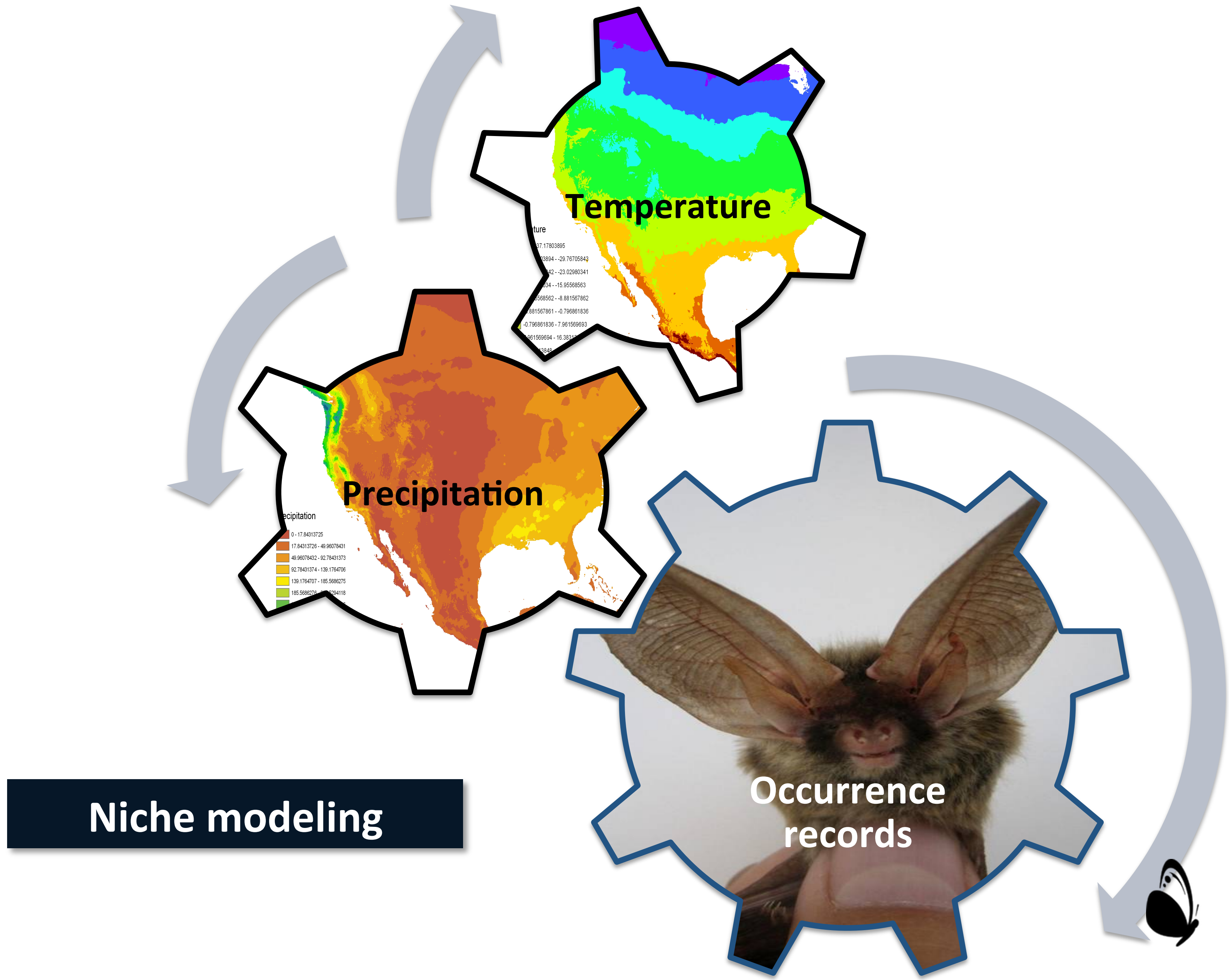
http://www.gbif.org/



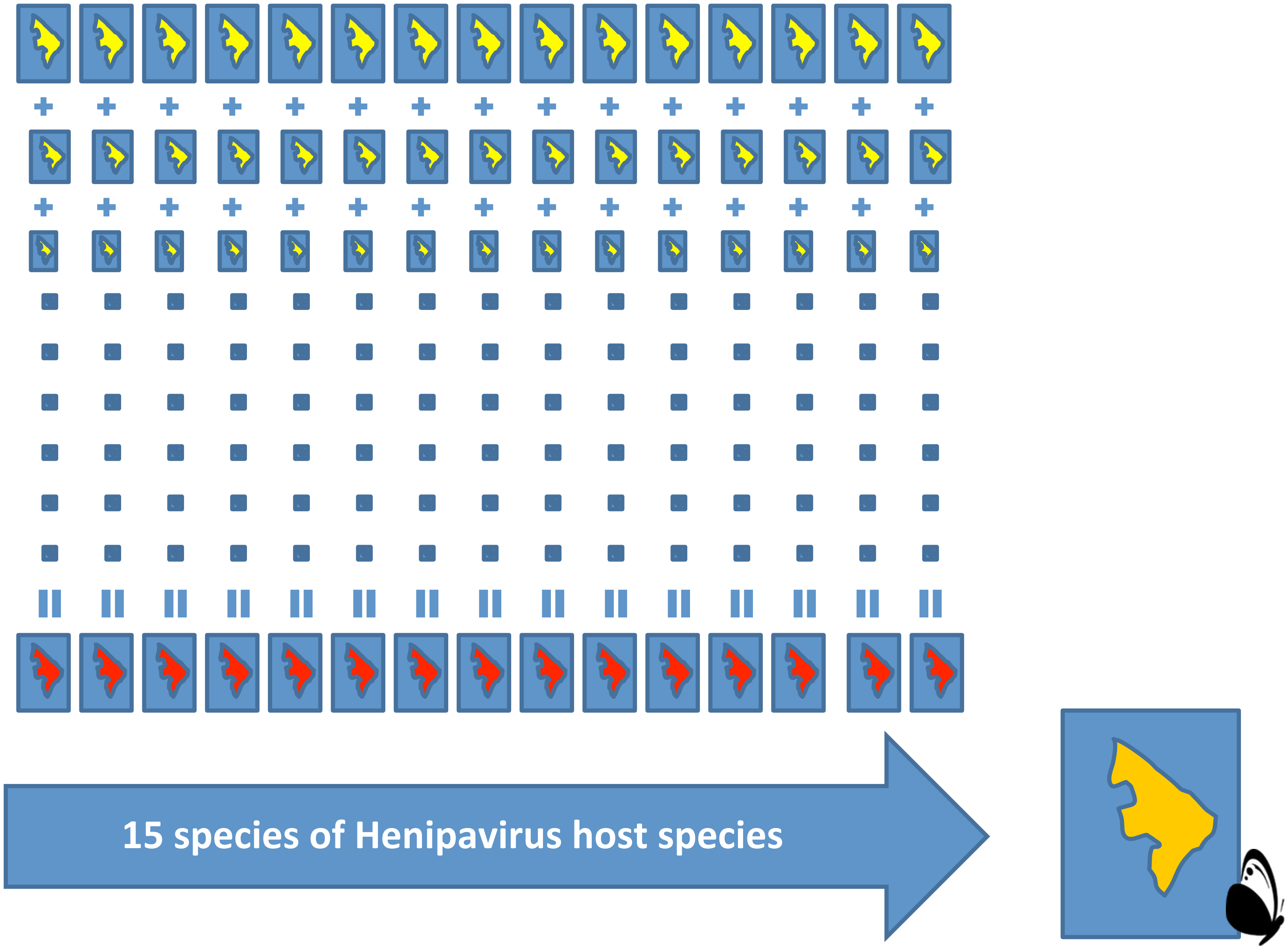
BIO1 = Annual Mean Temperature
BIO2 = Mean Diurnal Range
BIO3 = Isothermality
BIO4 = Temperature Seasonality
BIO5 = Max Temperature of Warmest Month
BIO6 = Min Temperature of Coldest Month
BIO7 = Temperature Annual Range
BIO8 = Mean Temp of Wettest Quarter
BIO9 = Mean Temperature of Driest Quarter
BIO10 = Mean Temp of Warmest Quarter
BIO11 = Mean Temp of Coldest Quarter
BIO12 = Annual Precipitation
BIO13 = Precipitation of Wettest Month
BIO14 = Precipitation of Driest Month
BIO15 = Precipitation Seasonality
BIO16 = Precipitation of Wettest Quarter
BIO17 = Precipitation of Driest Quarter
BIO18 = Precipitation of Warmest Quarter
BIO19 = Precipitation of Coldest Quarter

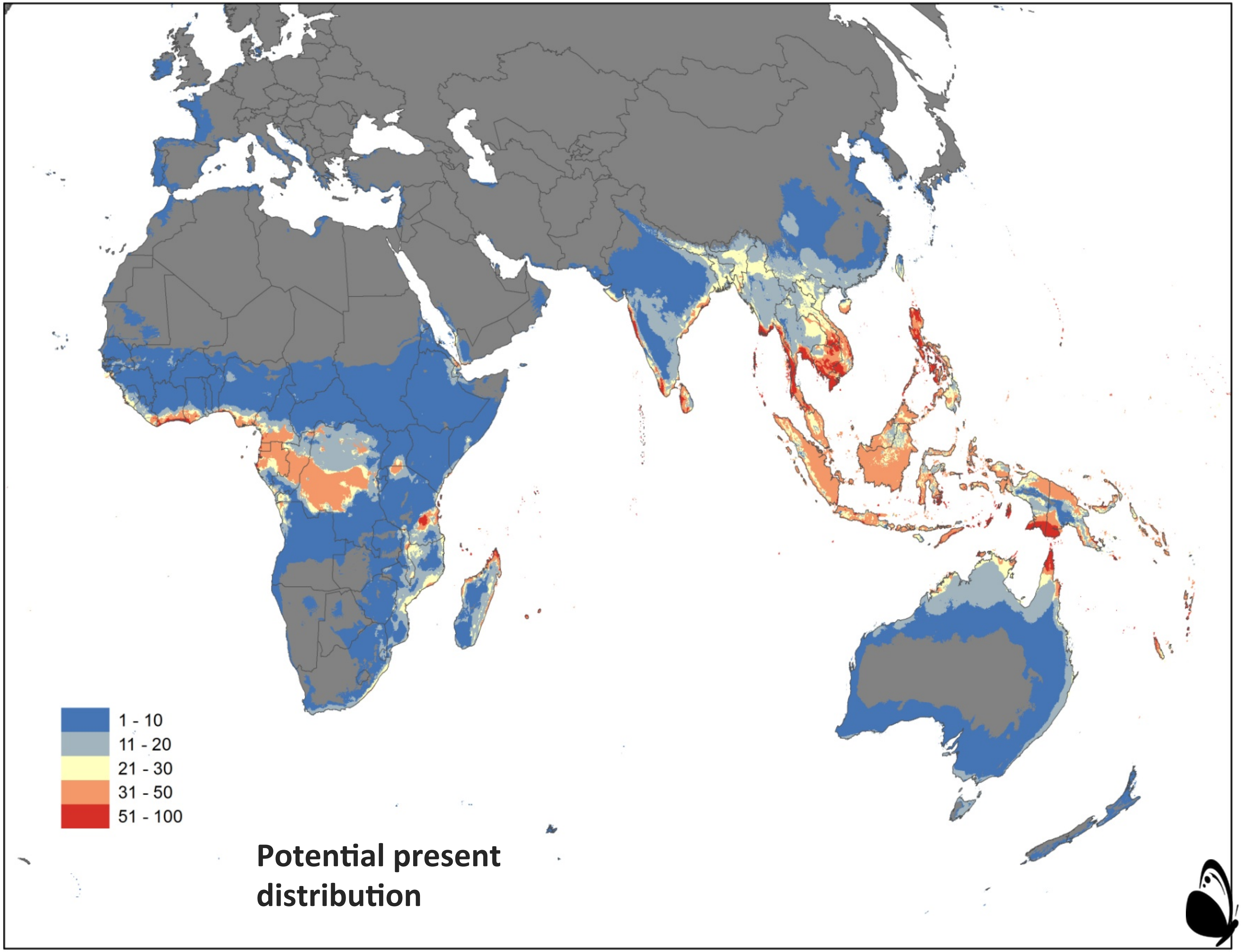
- Future climate
- Method: Interpolated deltas
- Baseline: Worldclim
- Future time slice: decadal averages through 2100
- Variables: BIOCLIMATIC based on Max Temp, Min Temp, Mean Temp, Precipitation
- IPCC Scenario: A2, A1B, B1
- Number of GCM's: 20
- Spatial resolution: $10km^2$

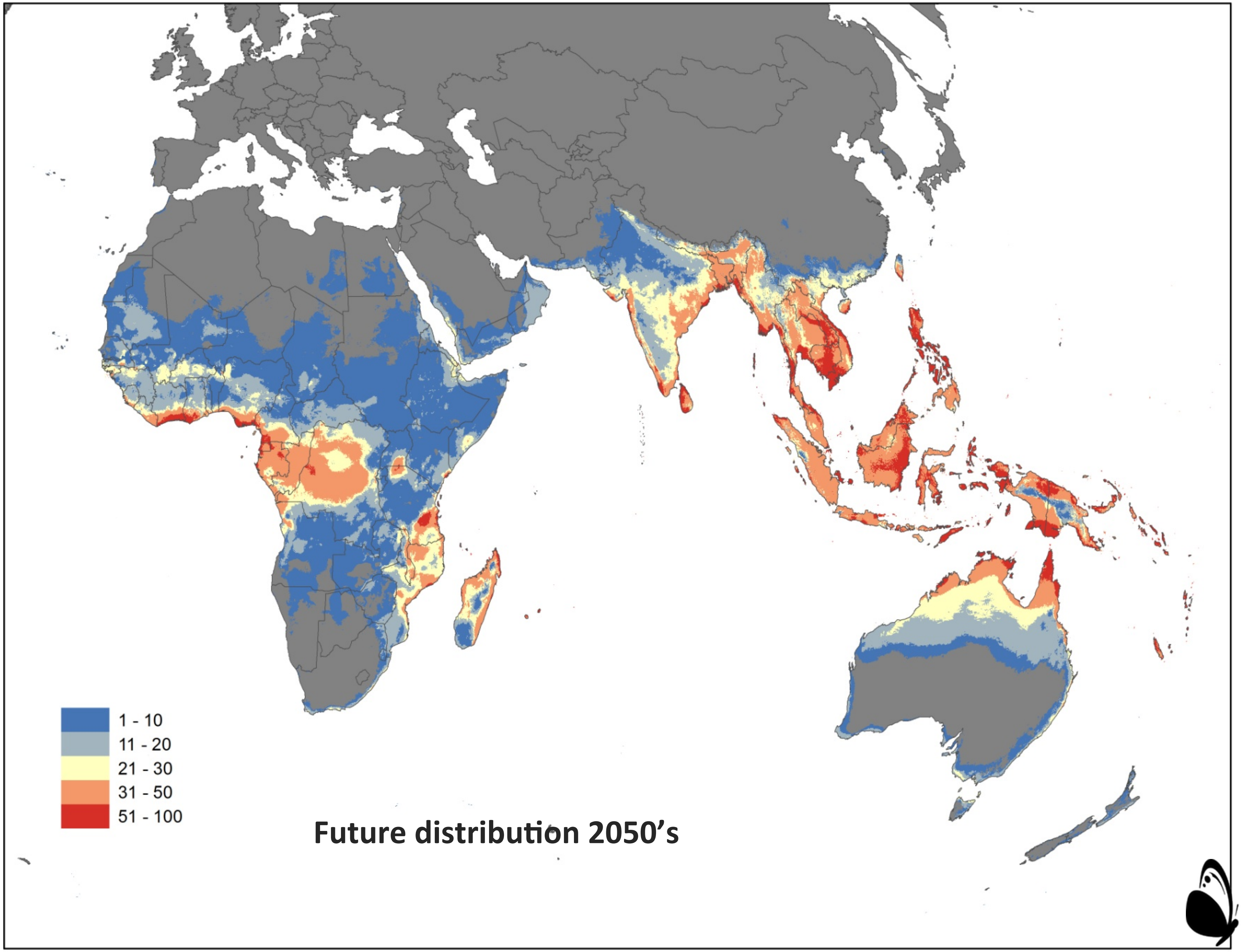



Temperature
Precipitation
Occurrence records
Niche modeling

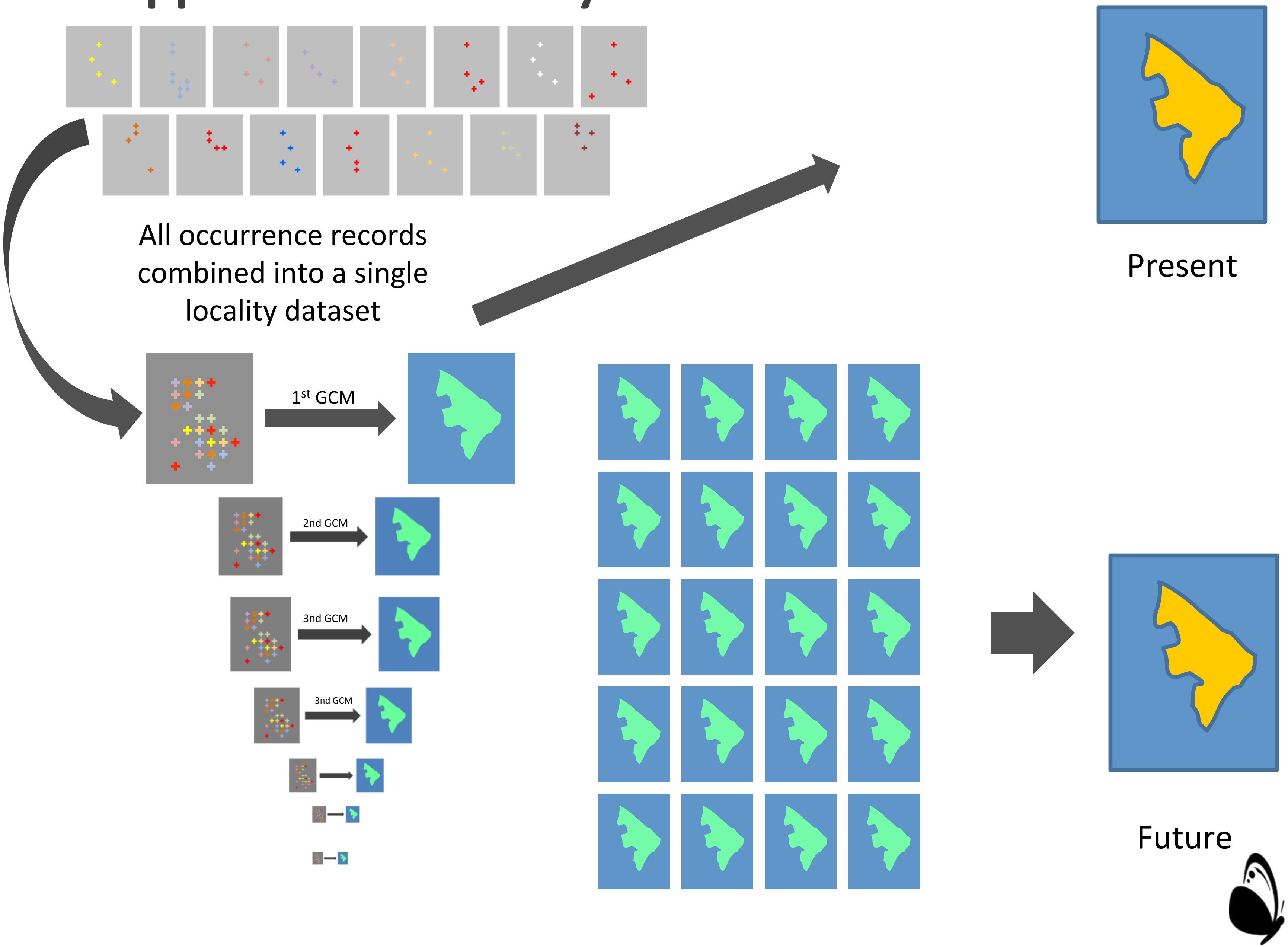
1st approach: Species density

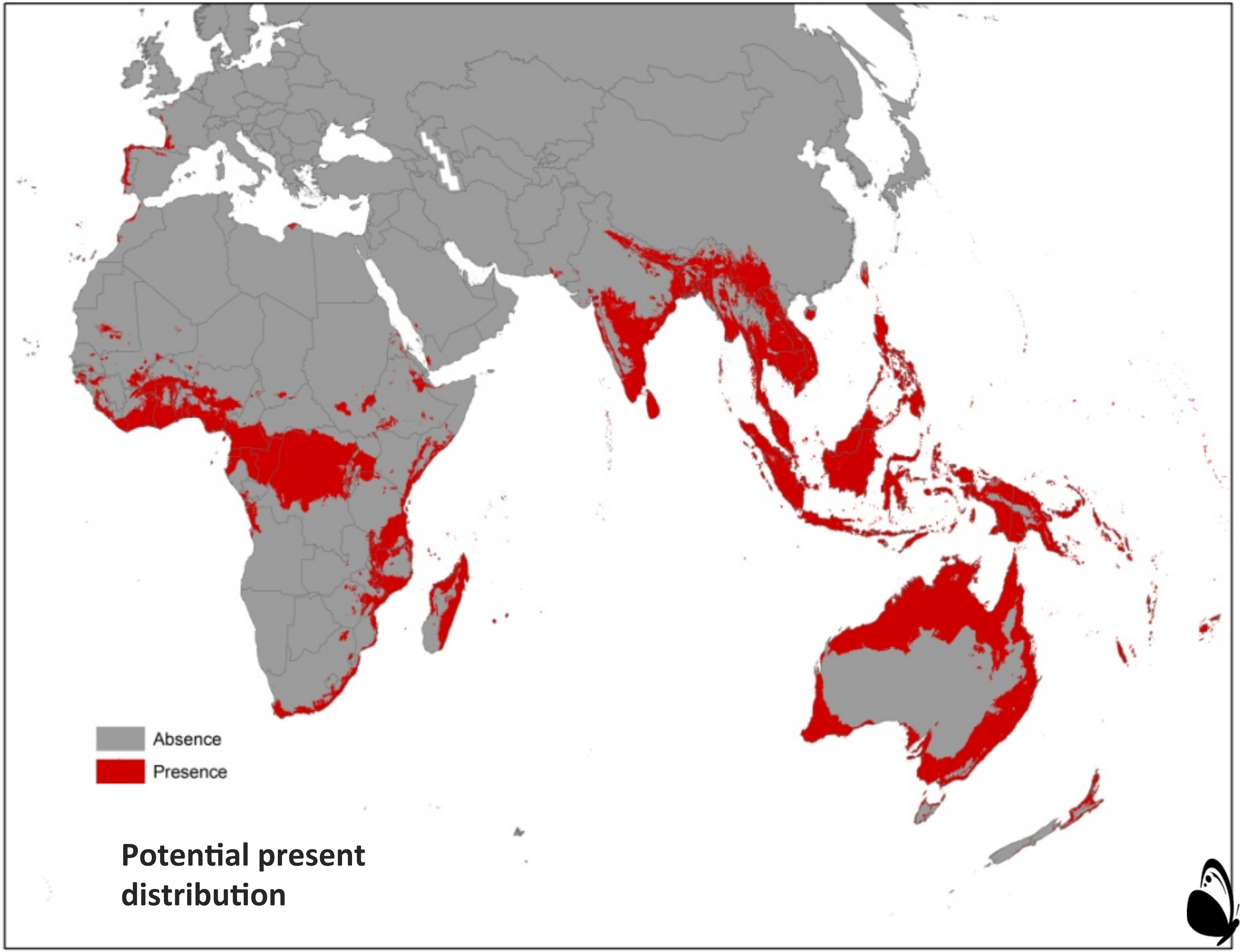



1 - 10
11 - 20
21 - 30
31 - 50
51 - 100
Potential present distribution

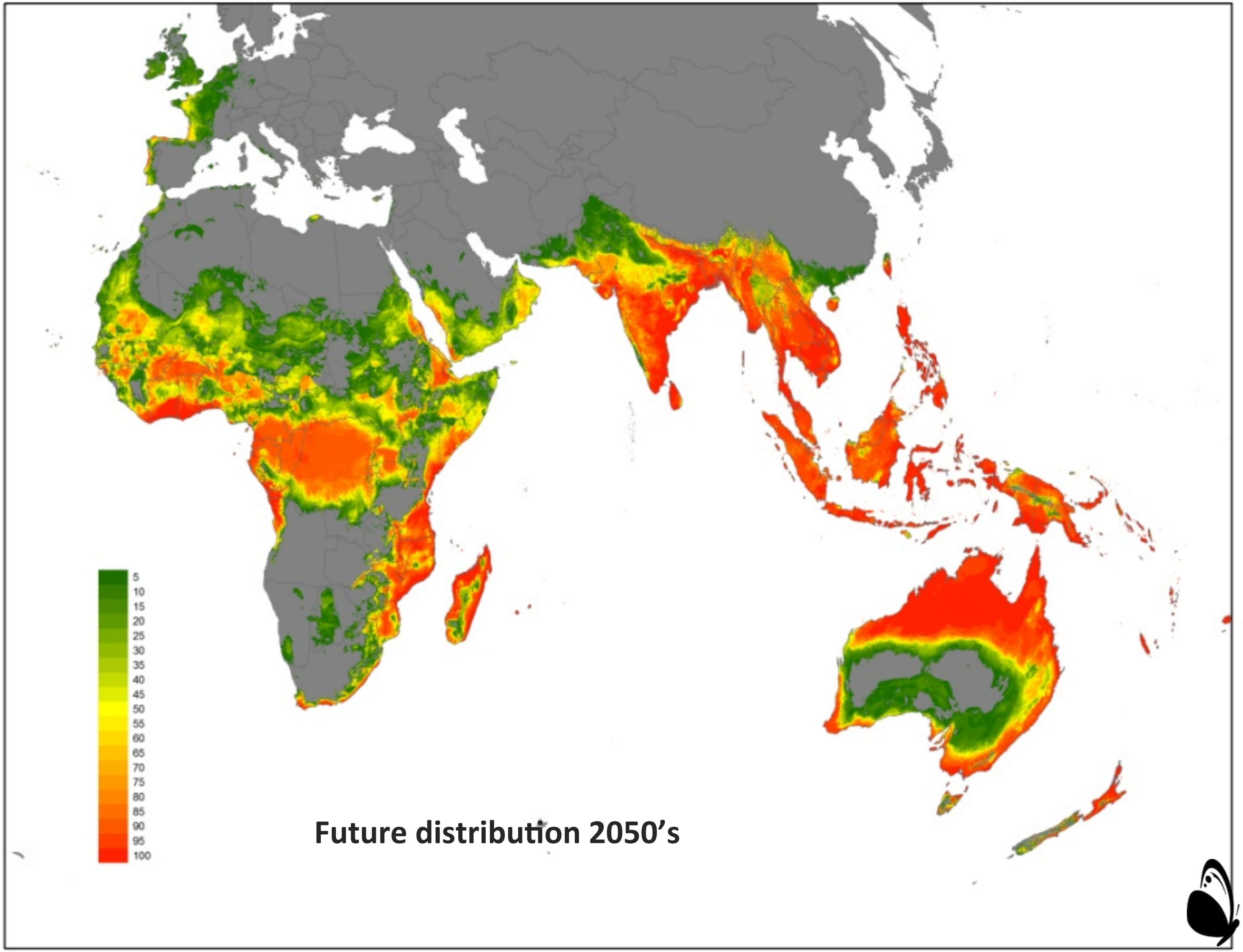

1 - 10
11 - 20
21 - 30
31 - 50
51 - 100
Future distribution 2050’s

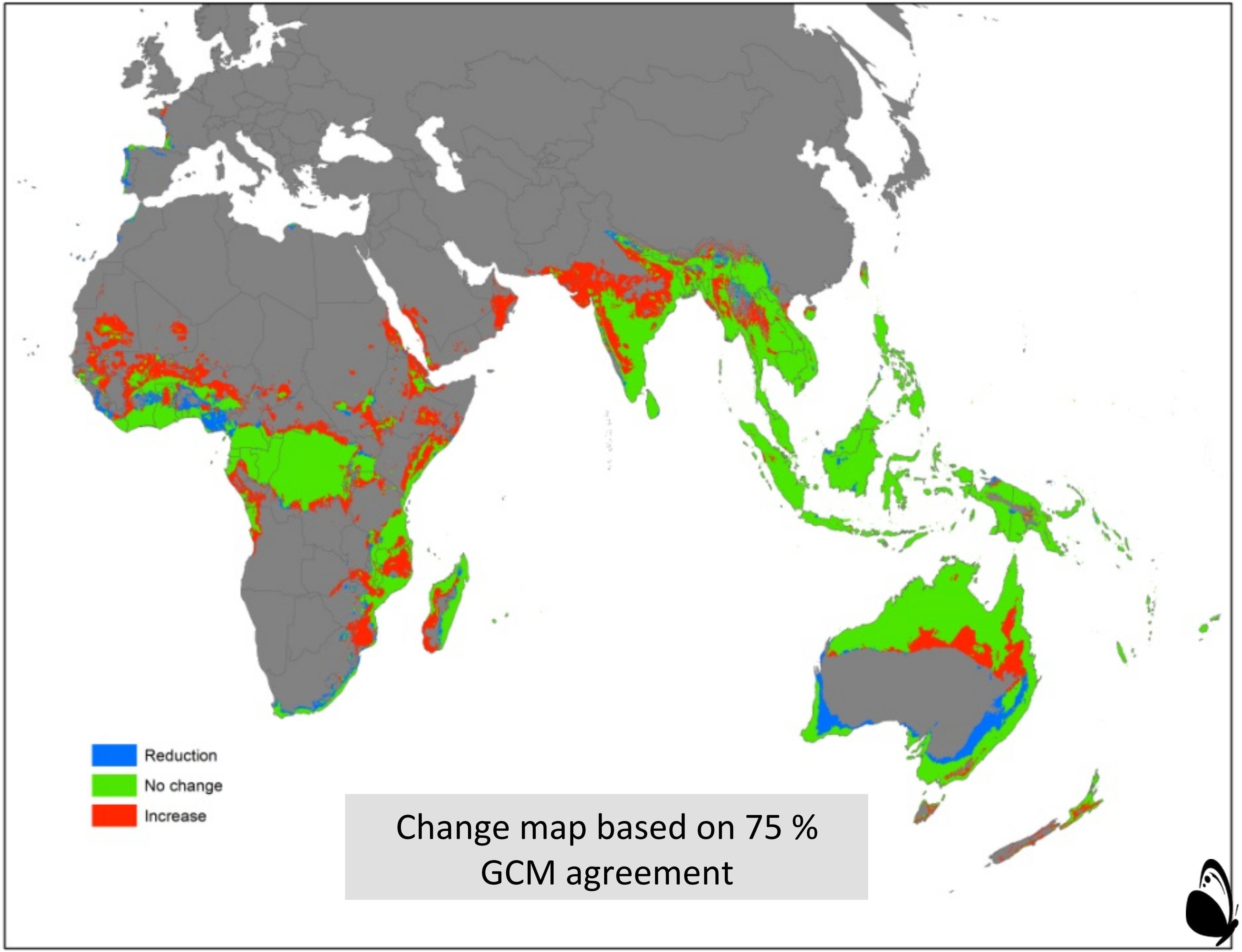
2nd approach: Variability across GCM's

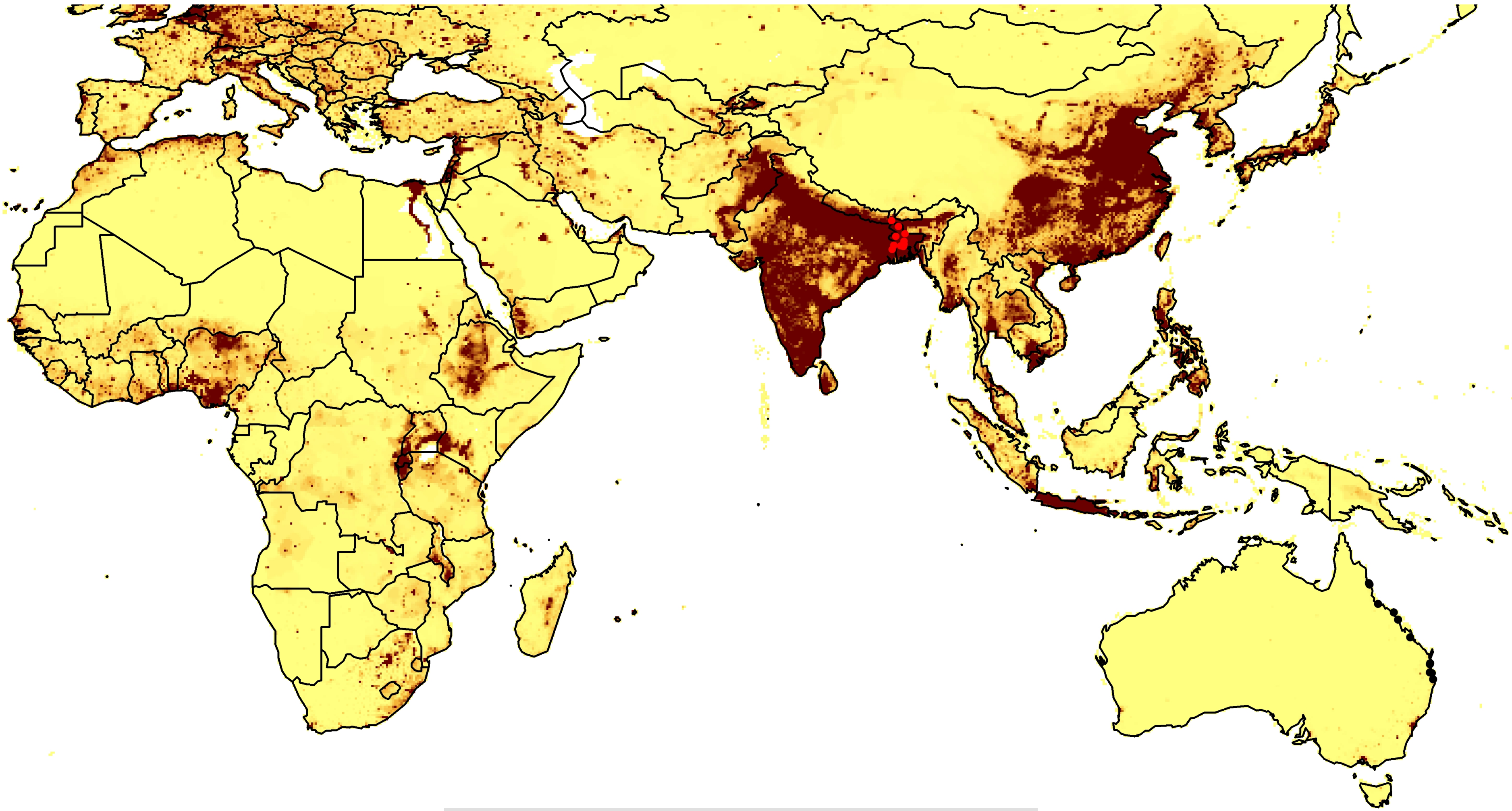




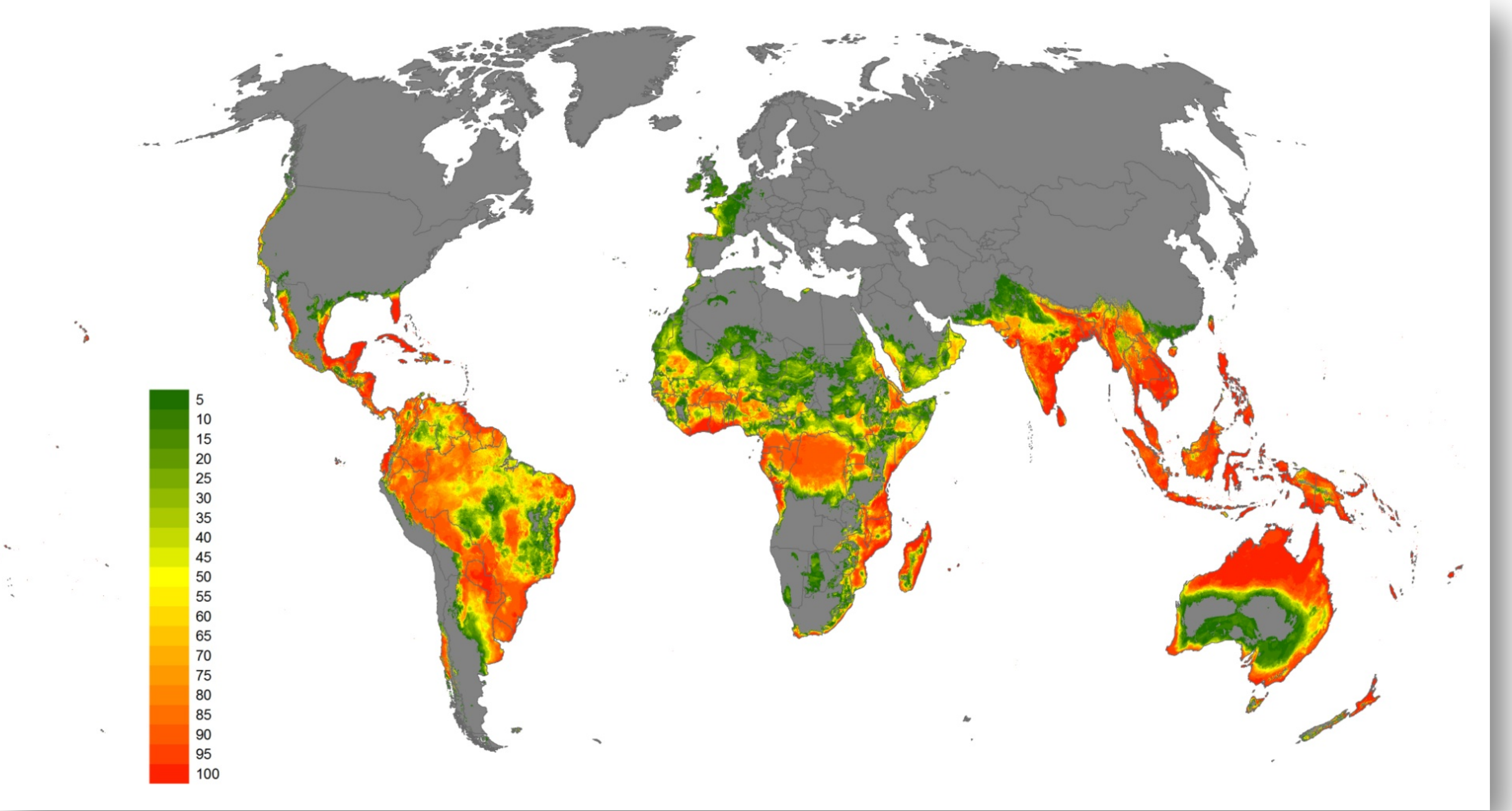
Potential present distribution


5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
Future distribution 2050's


Reduction
No change
Increase
Change map based on 75 %
GCM agreement



Influence of human population density



Projecting emergence conditions in Americas

I would like to acknowledge my collaborators….

Dr. Peter Daszak
Carlos Zambrana-Torrelio

EcoHealth Alliance

Dr. Miguel Fernandez
Institute for Diversity, Leipzig, Germany

Otto Alvarez
University of California, Merced

GBIF

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