Impact of mangrove forests on malaria prevalence in coastal Africa

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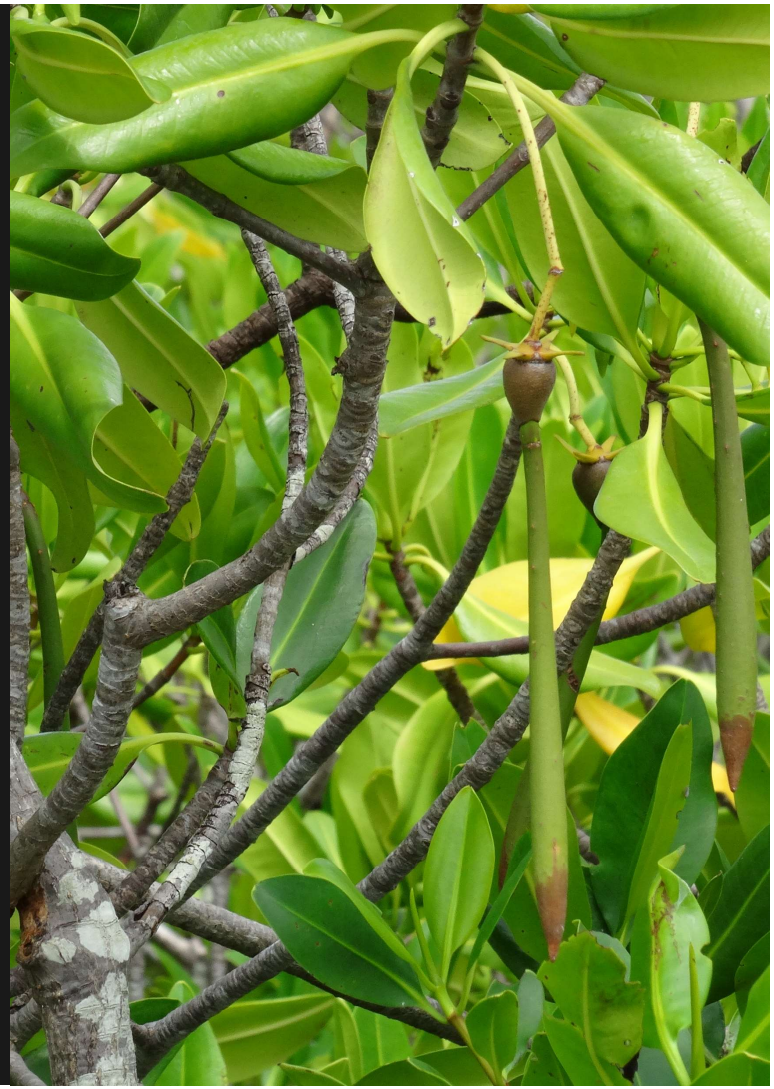
BES Meeting, 12/12/2024



Historical view: wetlands harbour diseases

forests

MDPI

Review

Ecosystem Services and Disservices of Mangrove Forests: Insights from Historical Colonial Observations

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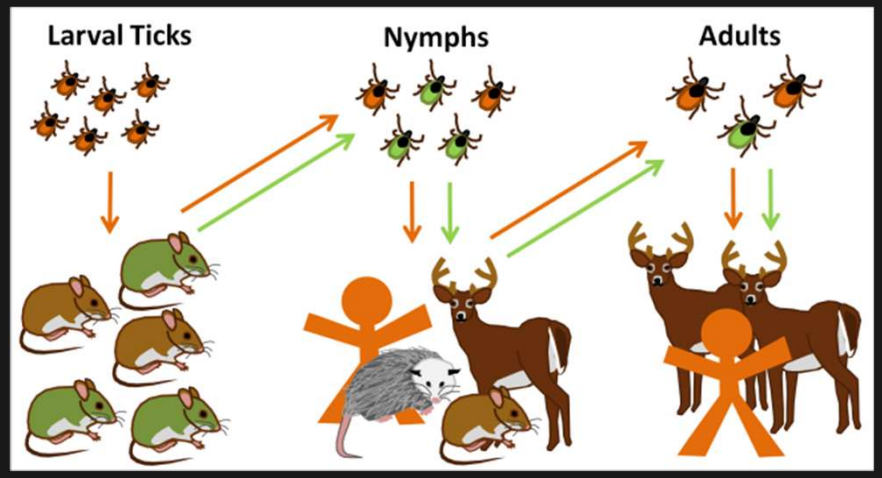
Abstract: Ecosystem services are n
new way of viewing mangrove-p
the negative interactions (ecosyst
perceptions of mangroves for centu
of mangroves as written by colo
96 expedition reports and studies.
with settlers considering mangrov
implications, such as the global dra
services were discussed, especially
new lands as ripe for economic use
control and sediment accretion tha
early as 1865. This study shows tha
We should not underestimate many
of mangroves may be influenced b
resource to study human-environm

- A European perspective

- Malaria = “bad air”, miasma theory

Healthy environment = healthy humans?

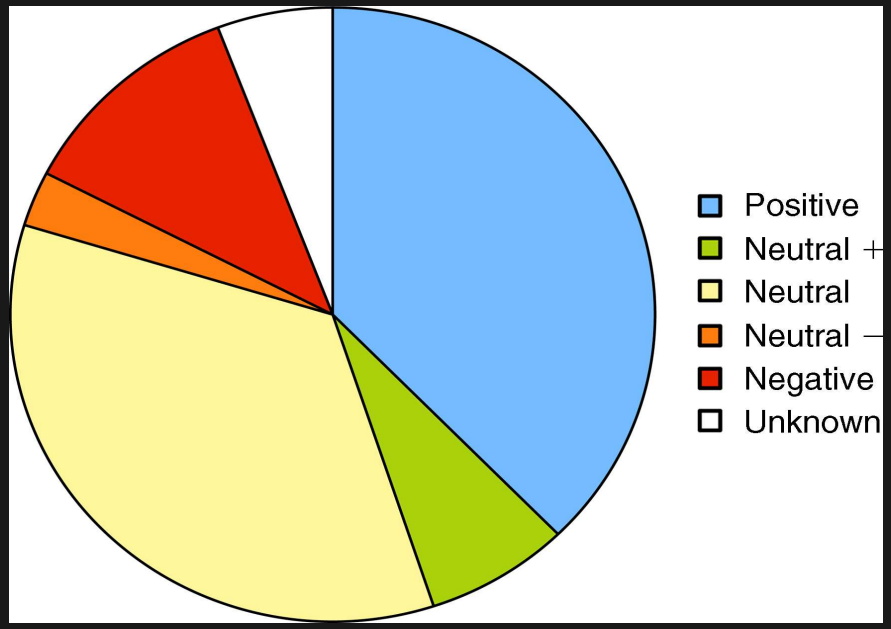


Wood & Lafferty 2013. Trends Ecol Evol 28:239-247

- Dilution effect: pathogen finds fewer competent host species in diverse ecosystem

- Lyme disease in North America

… but is this a general effect?



Wood et al. 2014, Ecology 95:817-832

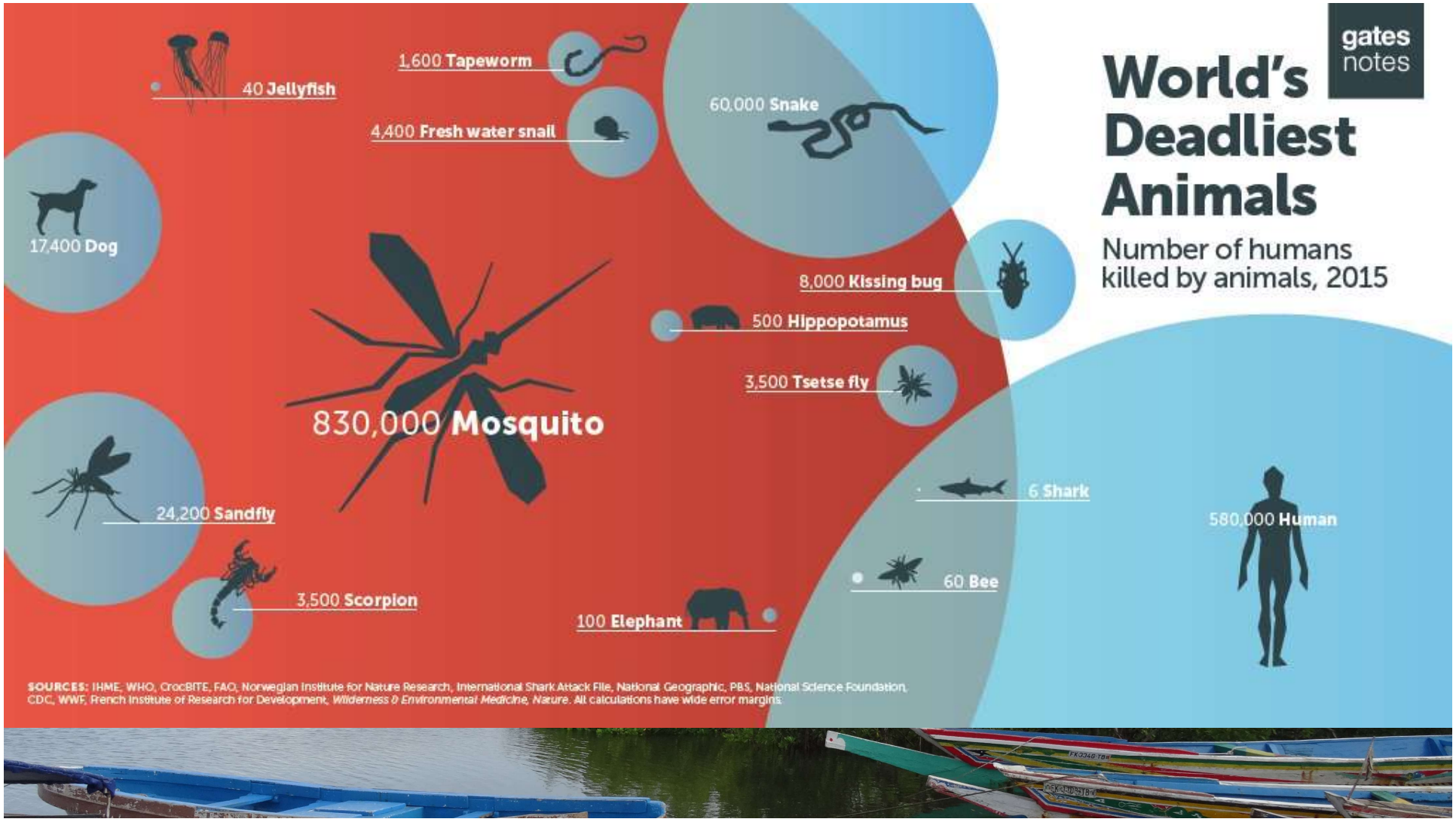
Relative frequency of positive, negative (the "dilution effect"), neutral, and unknown responses of disease to biodiversity

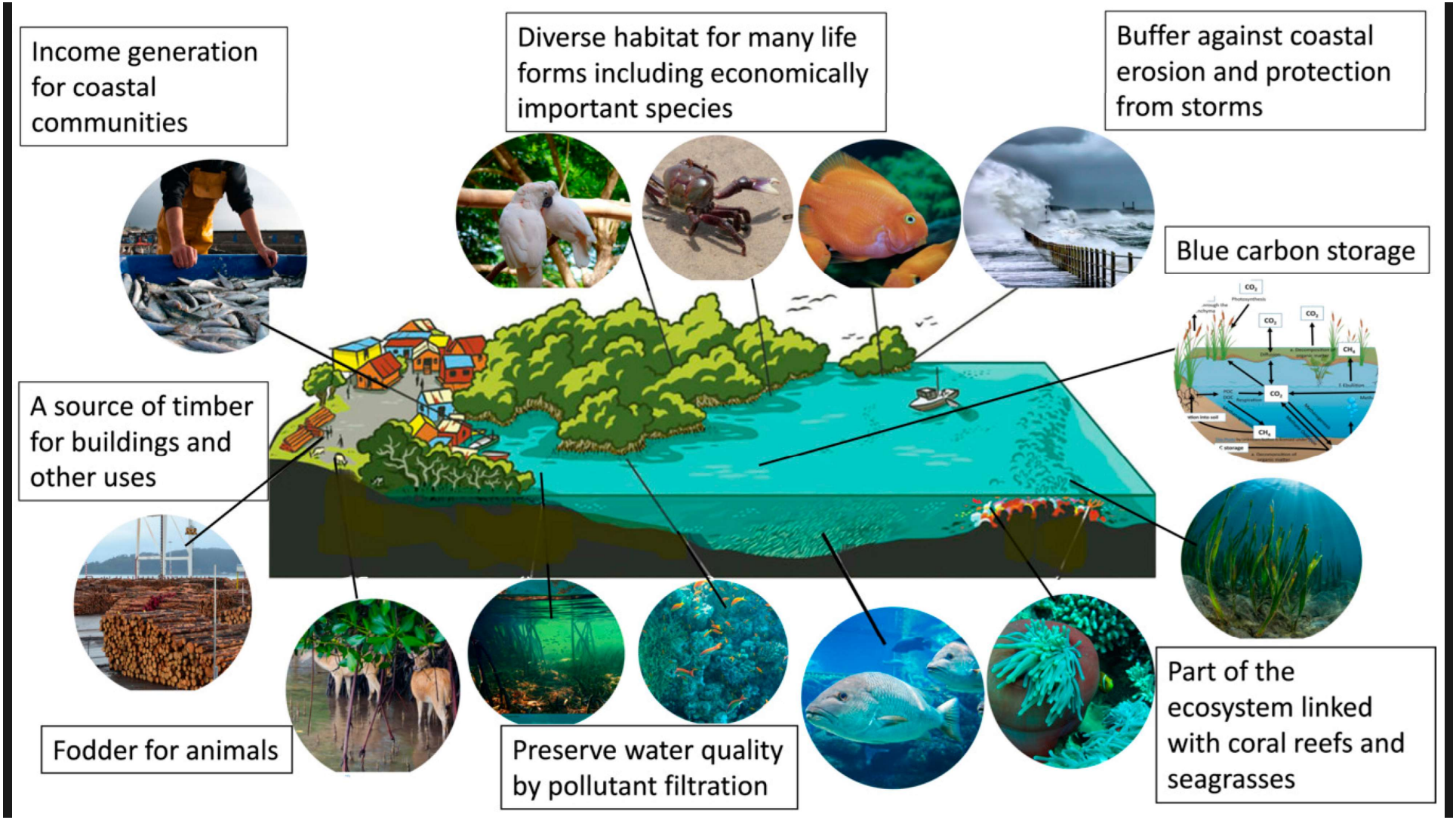
→ Dilution effects form a minority
→ Few winners, many losers among parasites

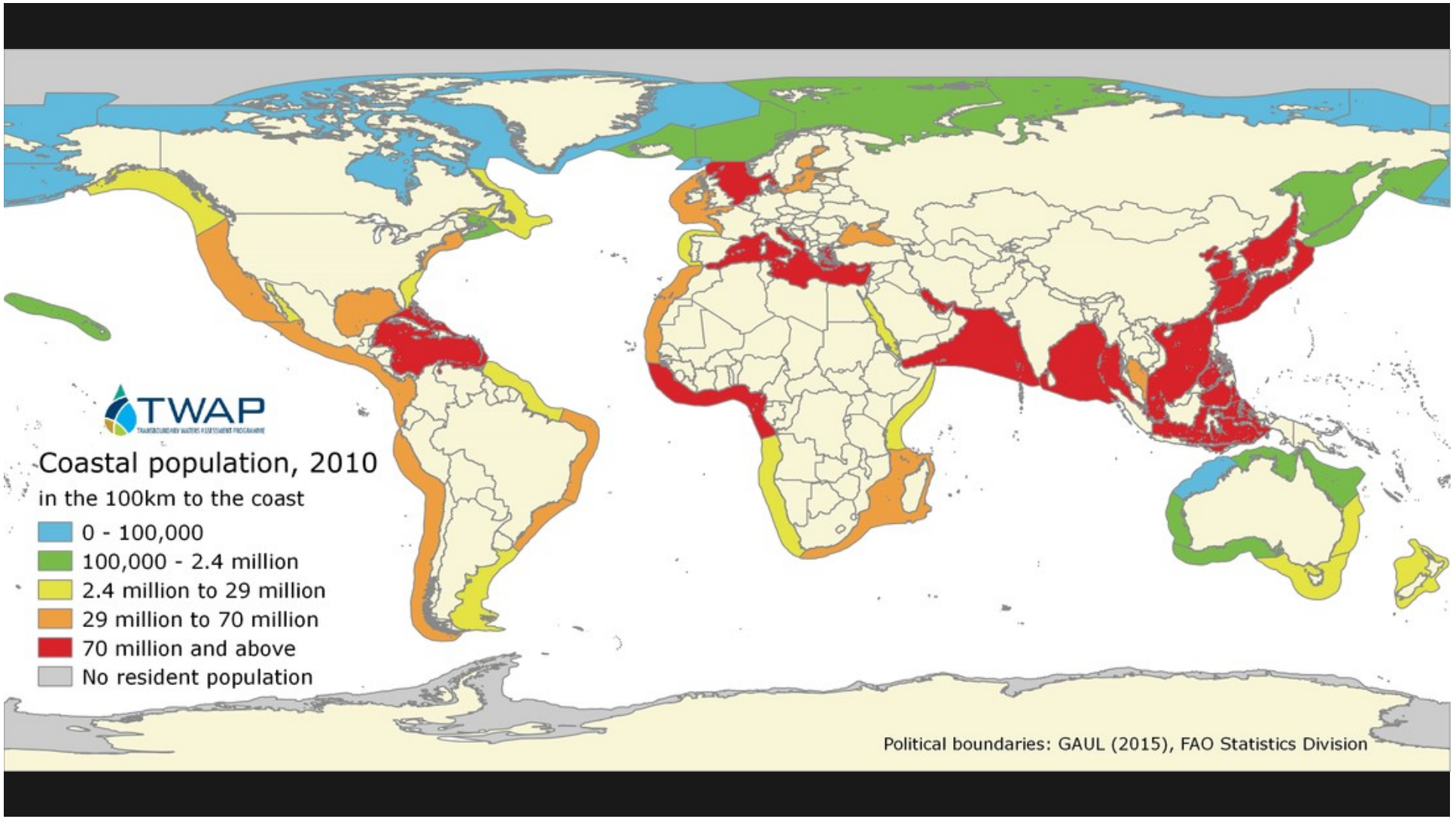

IRD
ZARGES

Mangroves are in many places

... and are important for people


gates notes
World's Deadliest Animals
Number of humans killed by animals, 2015
40 Jellyfish
1,600 Tapeworm
4,400 Fresh water snail
60,000 Snake
17,400 Dog
8,000 Kissing bug
500 Hippopotamus
3,500 Tsetse fly
830,000 Mosquito
24,200 Sandfly
6 Shark
580,000 Human
3,500 Scorpion
60 Bee
100 Elephant
SOURCES: IHME, WHO, CrocBITE, FAO, Norwegian Institute for Nature Research, International Shark Attack File, National Geographic, PBS, National Science Foundation, CDC, WWF, French Institute of Research for Development, Wilderness & Environmental Medicine, Nature. All calculations have wide error margins.


Income generation for coastal communities
Diverse habitat for many life forms including economically important species
Buffer against coastal erosion and protection from storms
Blue carbon storage
A source of timber for buildings and other uses
Fodder for animals
Preserve water quality by pollutant filtration
Part of the ecosystem linked with coral reefs and seagrasses


TWAP
Coastal population, 2010
in the 100km to the coast
0 - 100,000
100,000 - 2.4 million
2.4 million to 29 million
29 million to 70 million
70 million and above
No resident population
Political boundaries: GAUL (2015), FAO Statistics Division

Mosquitoes in (African) mangroves transmit:

Malaria and lymphatic filariasis

But do mangrove forests really amplify these diseases?

Mosquitoes in (African) mangroves transmit:

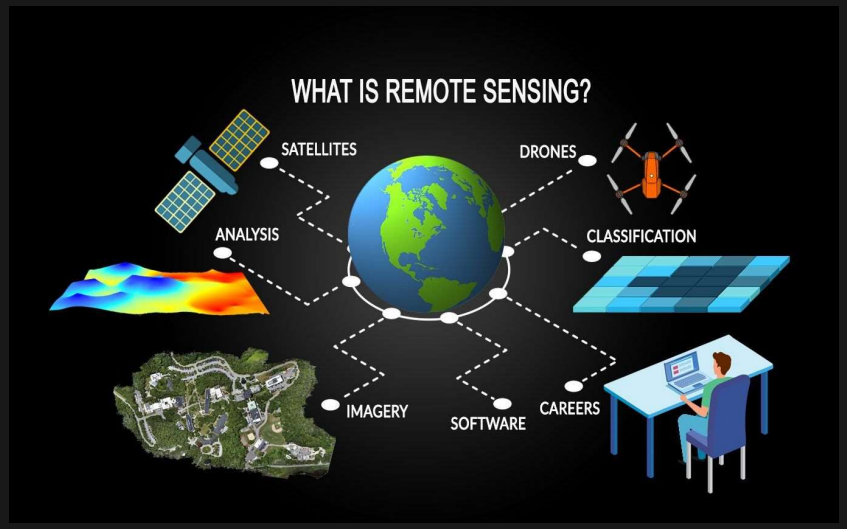
Malaria and lymphatic filariasis

But do mangrove forests really amplify these diseases?

Let’s use geographic data

- **H1: Does mangrove land cover increase malaria prevalence?**

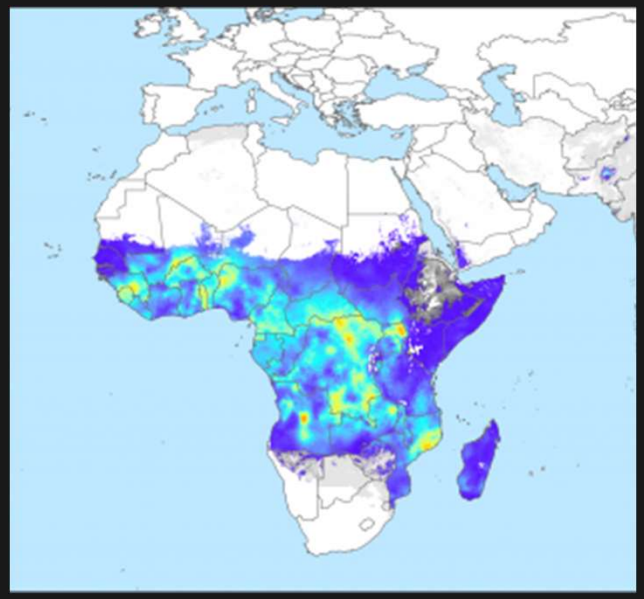
- **H2: Does mangrove health (→ ‘greenness’) decrease malaria prevalence?**



Data 1: MalariaAtlas Project

Malaria kills 600,000 people annually: most in *Africa*

MAP is the most extensive dataset for malaria infections



Data 2: ‘mangrove’ variables

Mangrove layers (1996, 2007-2010, 2015-2020)

Approximation: mangrove health = vegetation indices (NDVI): 2000-now

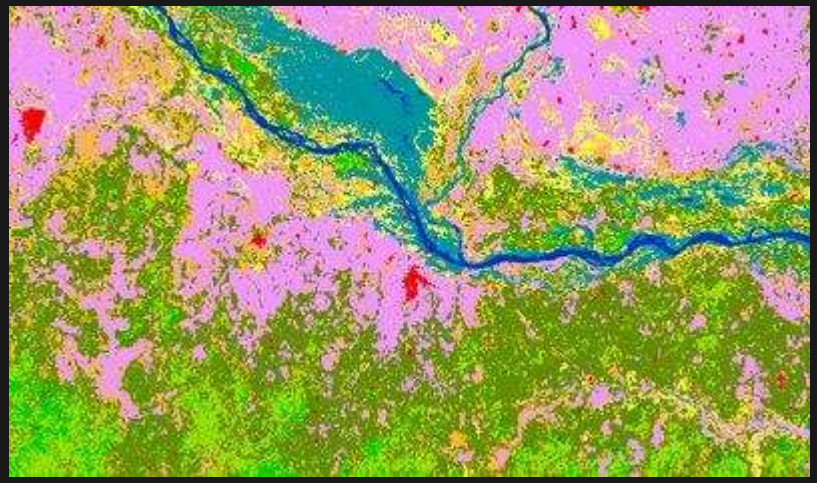
GLOBAL MANGROVE WATCH

Data 3: other variables

Human impact (population density, agricultural land cover)

Weather anomalies (precipitation + temperature): DURING survey period and PRECEDING survey period (6 months)

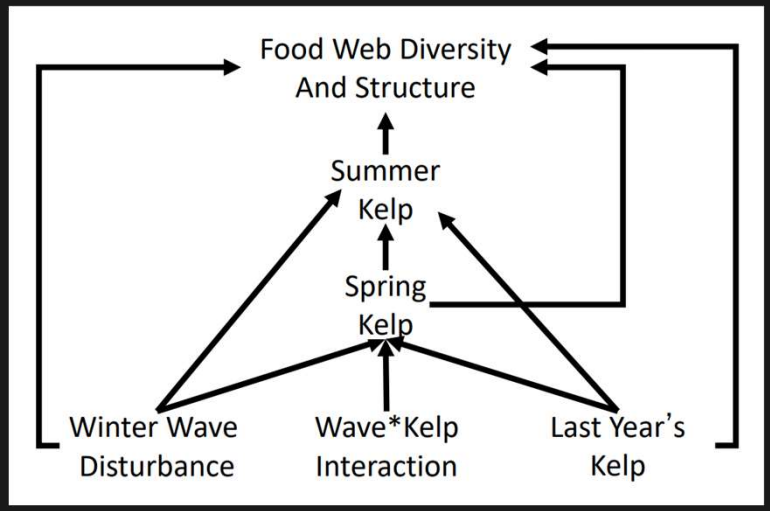
Climate Change Service
climate.copernicus.eu



Direct and indirect effects

***Structural equation models*: linking several mixed models in a single framework**

piecewiseSEM package: allows maximum flexibility (random effects, spatial autocorrelation, zero inflation etc.)

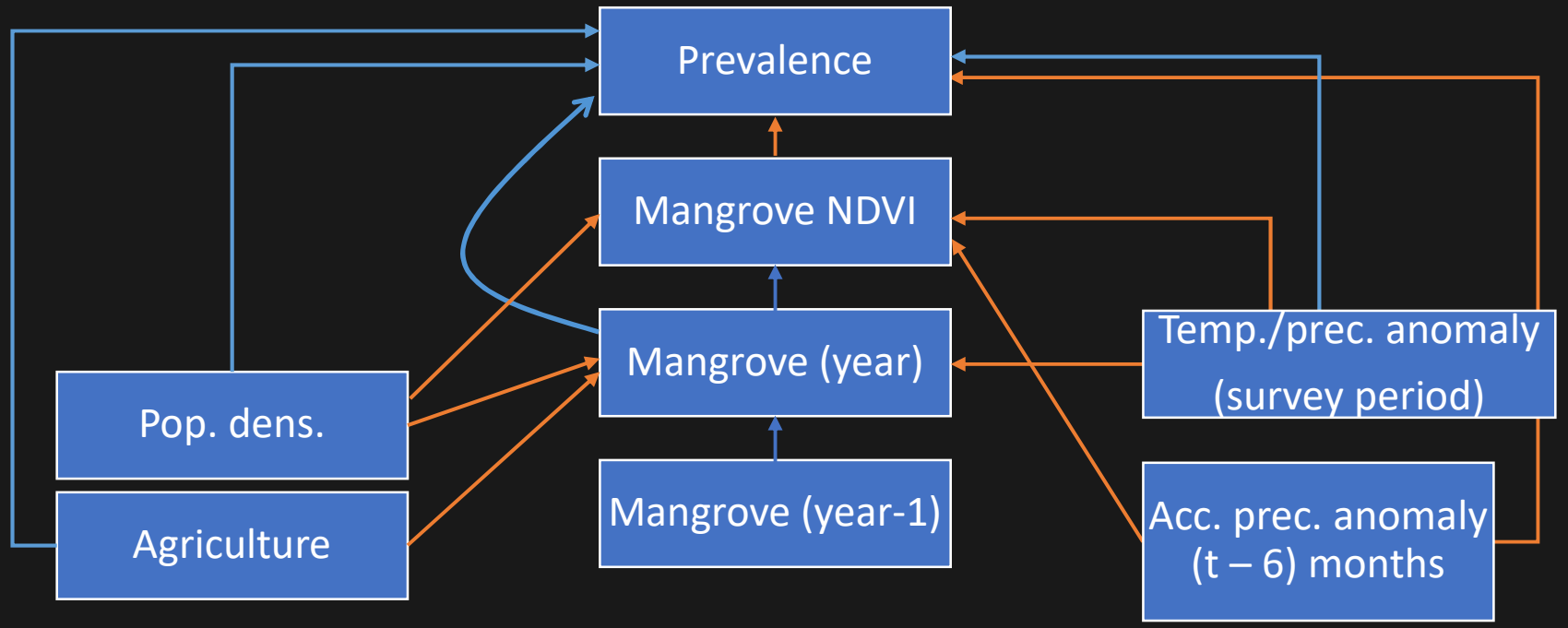


Lefcheck 2015, Methods Ecol Evol 7:573-579

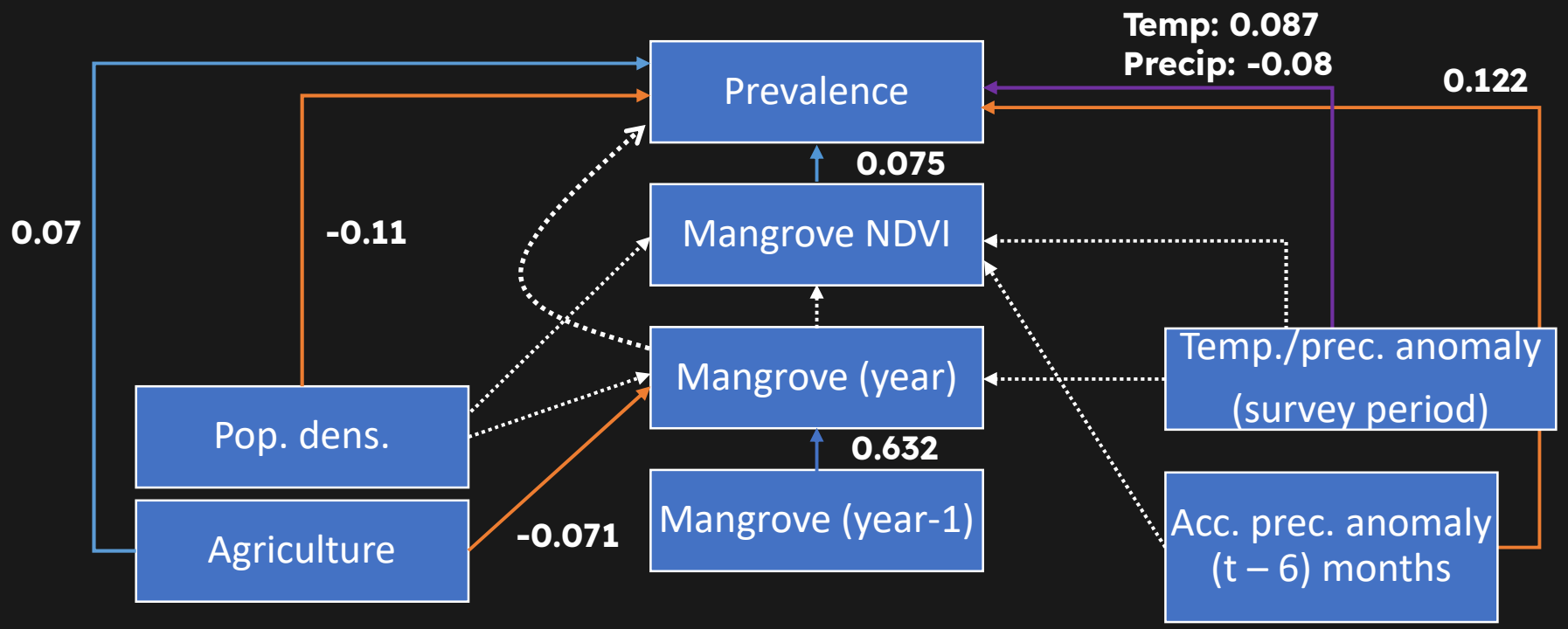
Results: optimised model

→ check robustness (mangrove radius: 1-40 km)

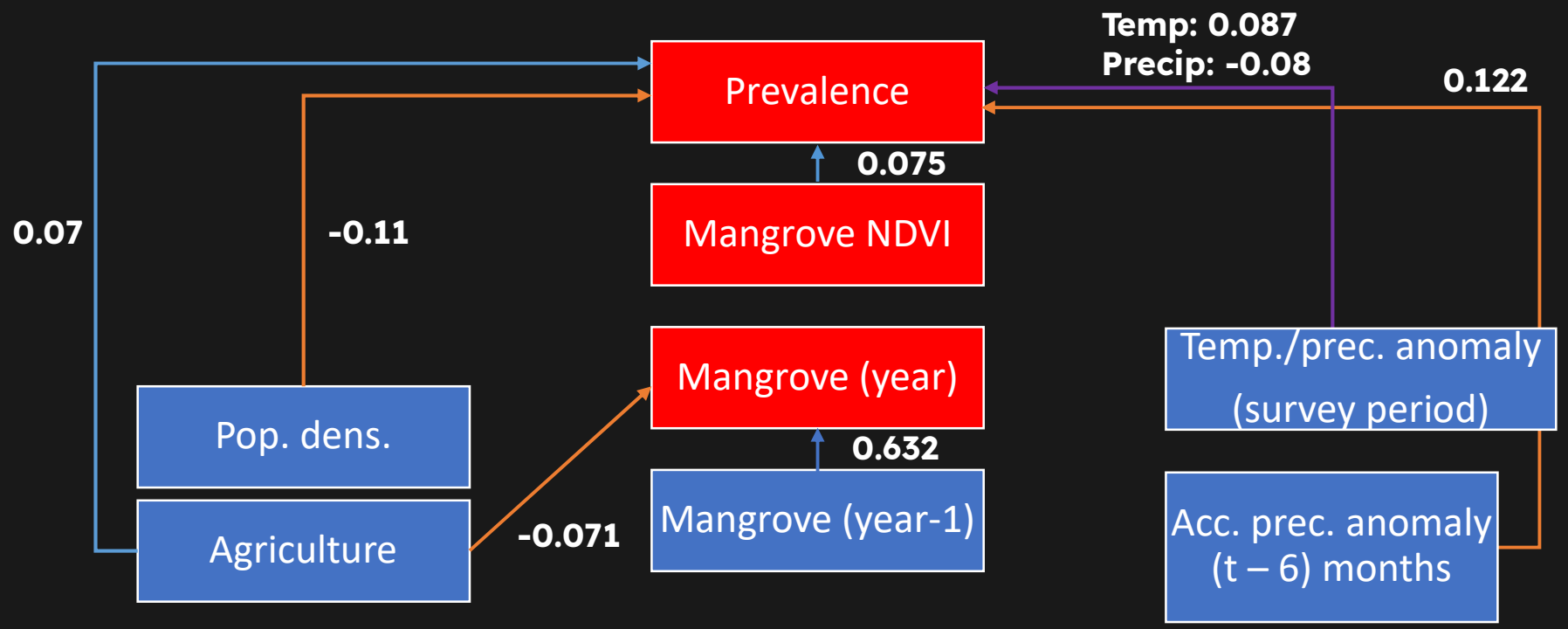
→ best support: 23 km (*C = 5.6, df = 10, p = 0.845*)



Results: effect sizes
→ check robustness (mangrove radius: 1-40 km)
→ best support: 23 km



Results: mangrove impact
→ best support: 23 km (but similar results across)



Early conclusions

Mangrove cover → no support for effects on malaria prevalence

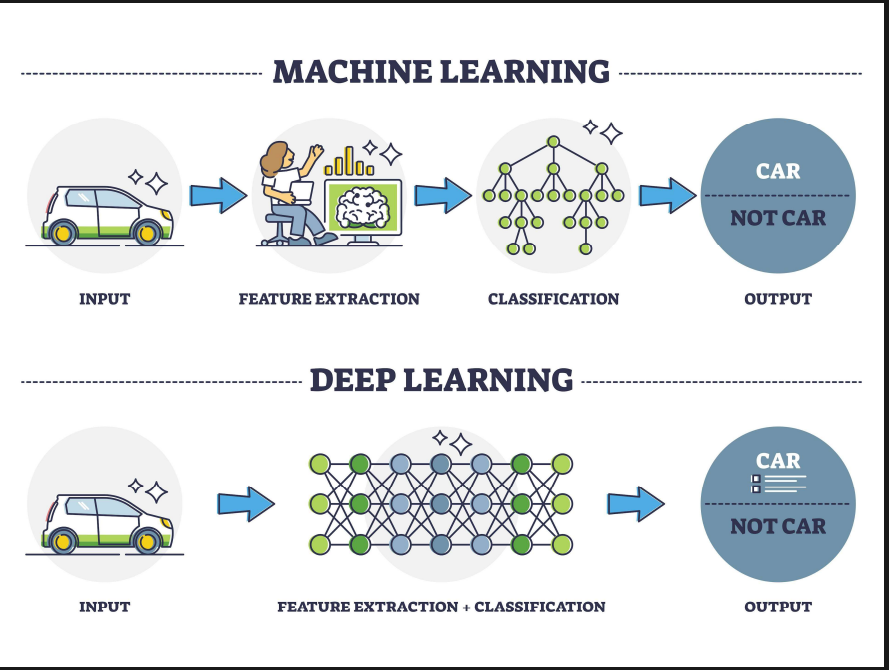
BUT: mangrove higher NDVI is linked to increased infections
→ Role of seasonal cycle?

Still do be done

Optimise model parameters

Predictor analysis (broader set of variable): machine learning

Test links in real life: mangrove fishes as predators of mosquitoes



Work in progress

Optimise model parameters

Predictor analysis (broader set of variables): machine learning

Include lymphatic filariasis

Test links in real life: mangrove fishes as predators of mosquitoes

Thank you!

Chelsea Wood

Farid Dahdouh-Guebas

Maarten Vanhove

Olexiy Kyrychenko

UHASSELT

UNIVERSITÉ LIBRE DE BRUXELLES

UNIVERSITY of WASHINGTON

VLAAMS SUPERCOMPUTER CENTRUM

Vlaanderen is supercomputing

Mangrove Specialist Group

VUB VRIJE UNIVERSITEIT BRUSSEL

Radboud Universiteit

Funders

fwo Research Foundation Flanders
Opening new horizons

Leopold III-Fonds
voor Natuuronderzoek en Natuurbehoud vzw

Flemish Supercomputer (VSC) Team
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Parasitology team (UHasselt)
Wood Lab (University of Washington)

Thank you!

SCAN ME

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