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A global integrated strategy for laurel wilt surveillance

Technical Session: Tree Diseases

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ANNUAL REVIEW OF P

Climate Change Effects on Patl
Intelligence to Translate Big Da

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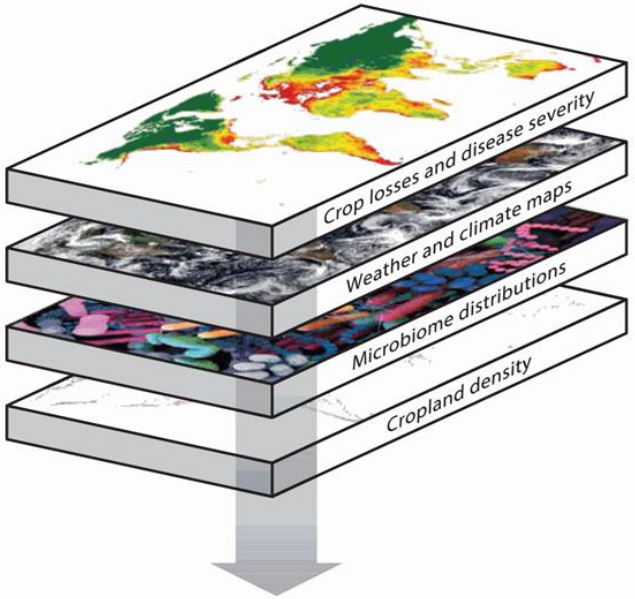
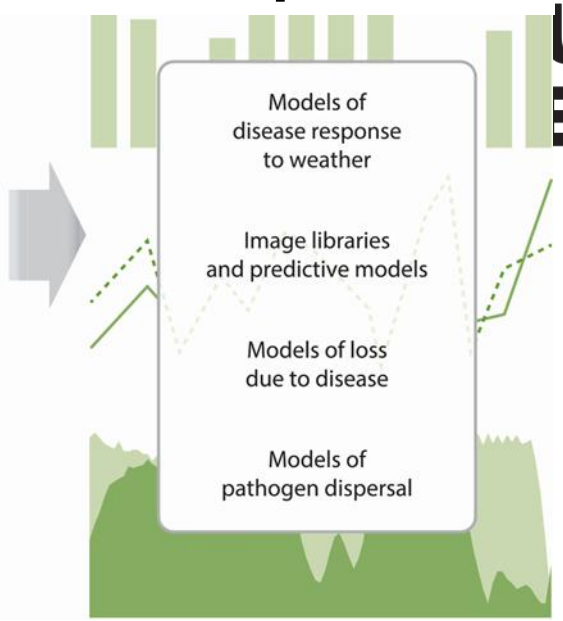
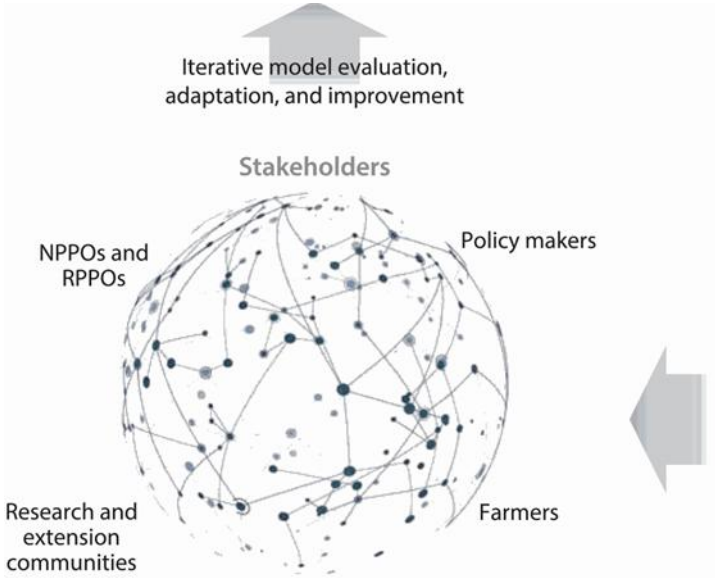
Data acquisition



Model development



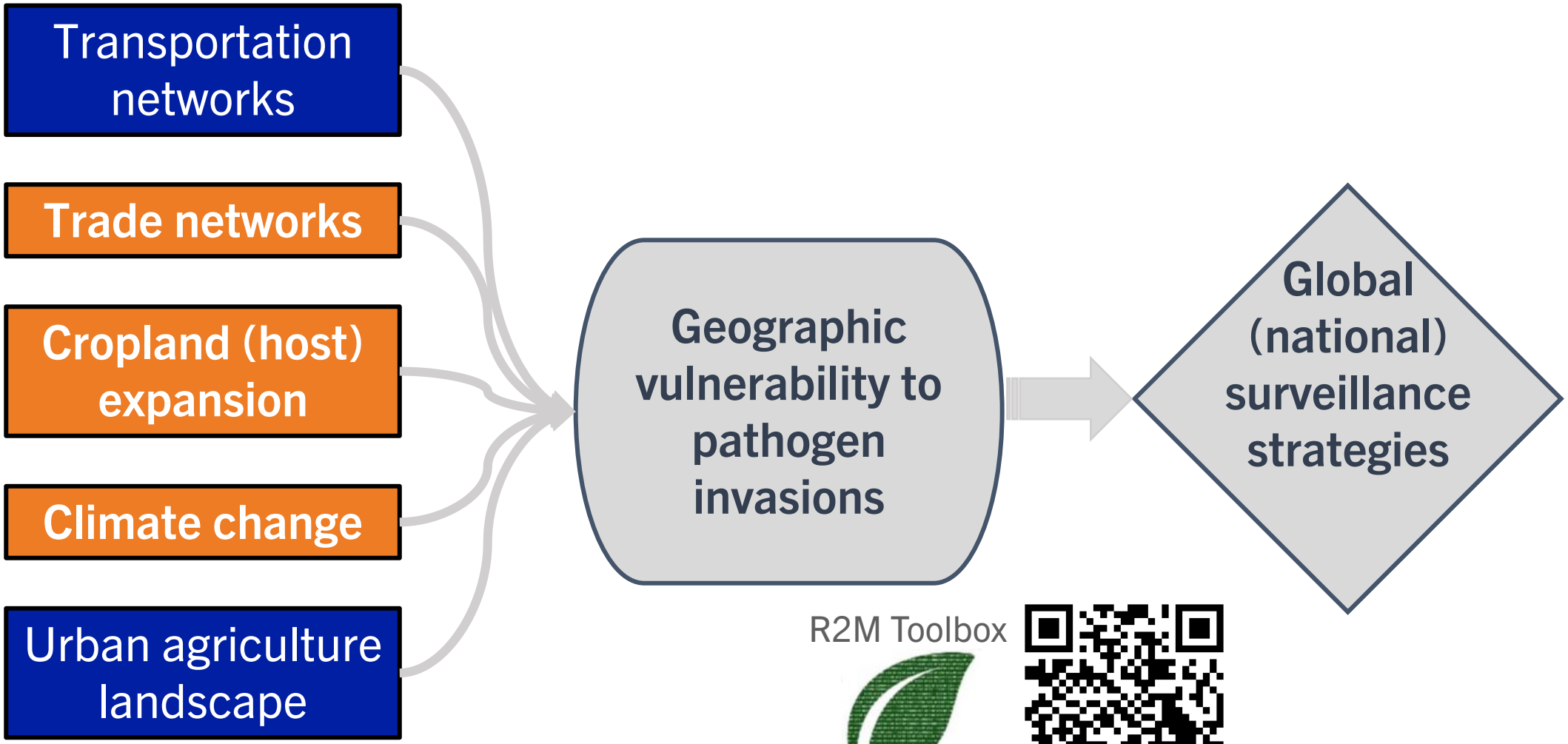
Data integration



Decision-support tools

Garrett KA, et al. 2022
Annu. Rev. Phytopathol. 60:357–78

Integrated risk assessments are urgently needed



R2M Toolbox

The “troublemaker”

An invasive complex

Photo credit: Jiri Hulcr

Ambrosia beetles (*Xyleborus glabratus*)*

Harringtonia lauricola

Photo credit: TREC UF

Favorite food?

- ✓ **Lauraceae trees**
- ✓ **300 million redbay & sassafras**

Dispersal pathways?

- ✓ **Vector species**
- ✓ **Untreated wood***

Photo credit: Florida Forest Service

Laurel wilt disease = pathogen* × susceptible host(s) × conducive environment

*ISPM15 (regulation of wood packing material) is implemented by some countries.

The “troublemaker”

An invasive complex

Photo credit: Jiri Hulcr

Ambrosia beetles (*Xyleborus glabratus*)*

Harringtonia lauricola

Management?

- ✓ **US$ 356 million**
- ✓ **Cost is problematic**
- ✓ **No global surveillance strategy**

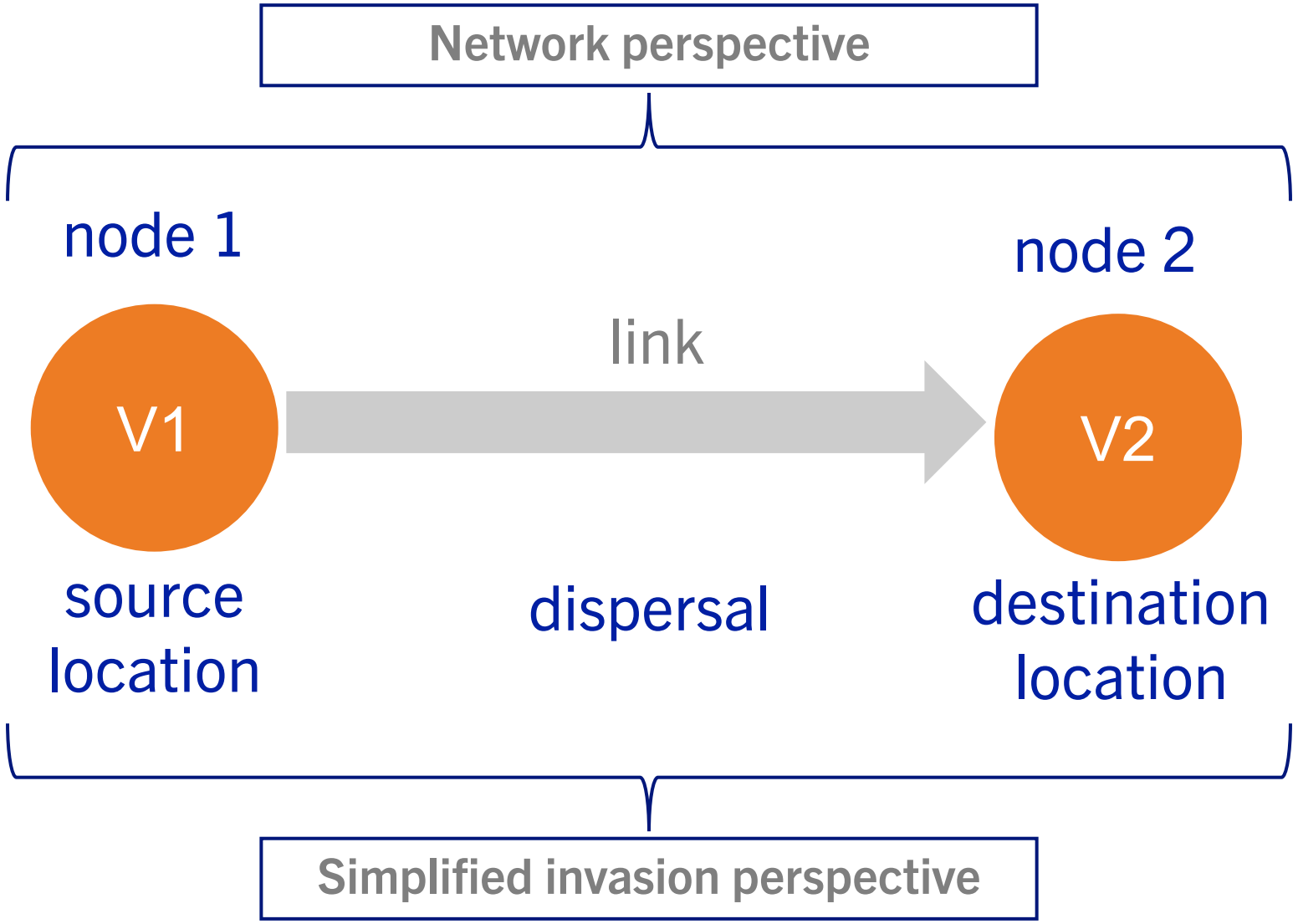
Laurel wilt disease = pathogen* × susceptible host(s) × conducive environment

*ISPM15 (regulation of wood packing material) is implemented by some countries.

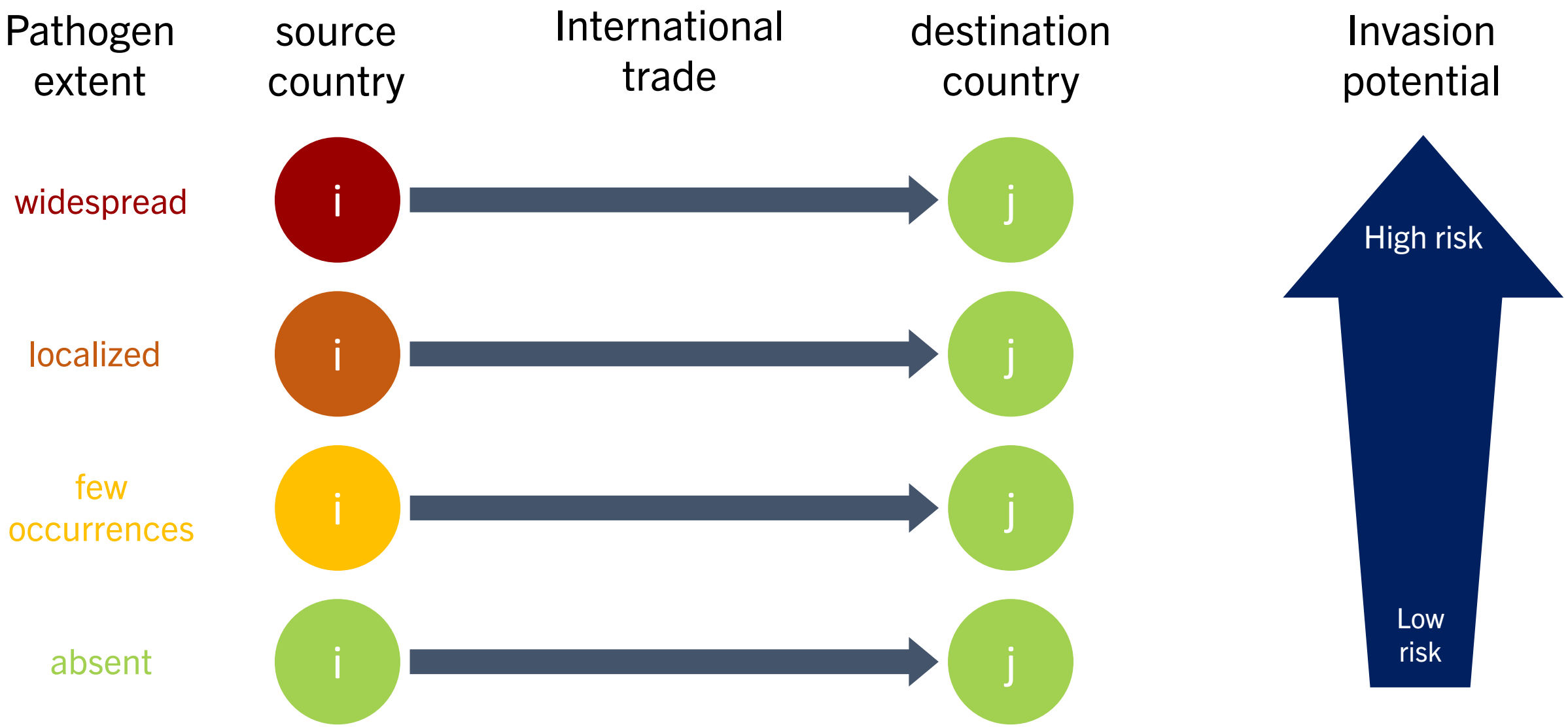
Translating ecological perspectives to define biosecurity priorities for emerging diseases

- Invasion through trade networks
- Invasion through host networks
- Pathogen spread with current climate
- Pathogen spread with future climate

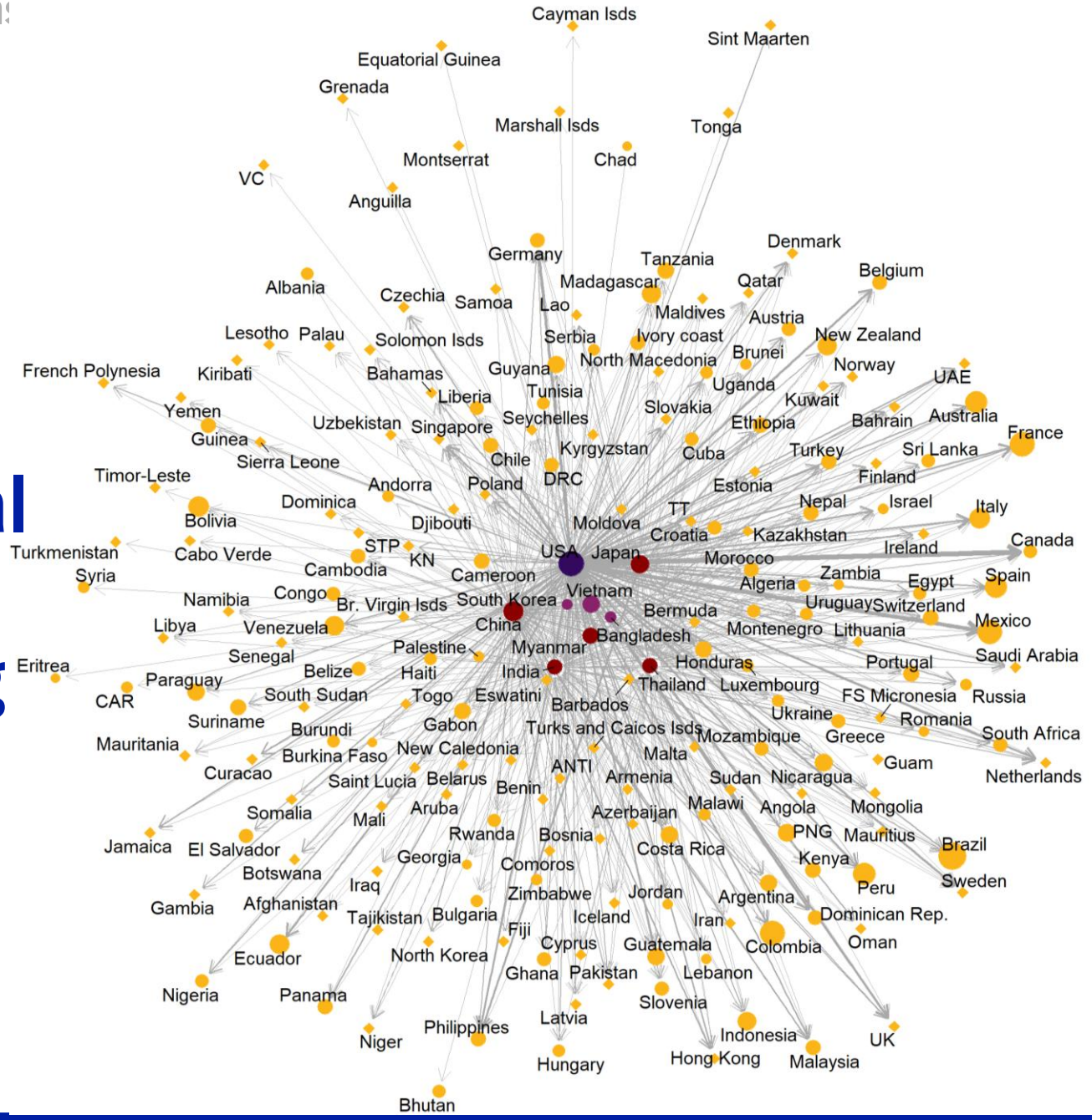
Pathogen “invasion” or epidemic networks



Pathogen invasion through trade networks



Potential pathogen dispersal through global network of wood packing material movement



Reported distribution of *Harringtonia lauricola*

- Absent
- Native
- Present
- Widespread

Relative pathogen invasion potential

- 0
- 200
- 400
- 600

Pathogen trade movement potential

- 0.25
- 0.50
- 0.75
- 1.00

Country category

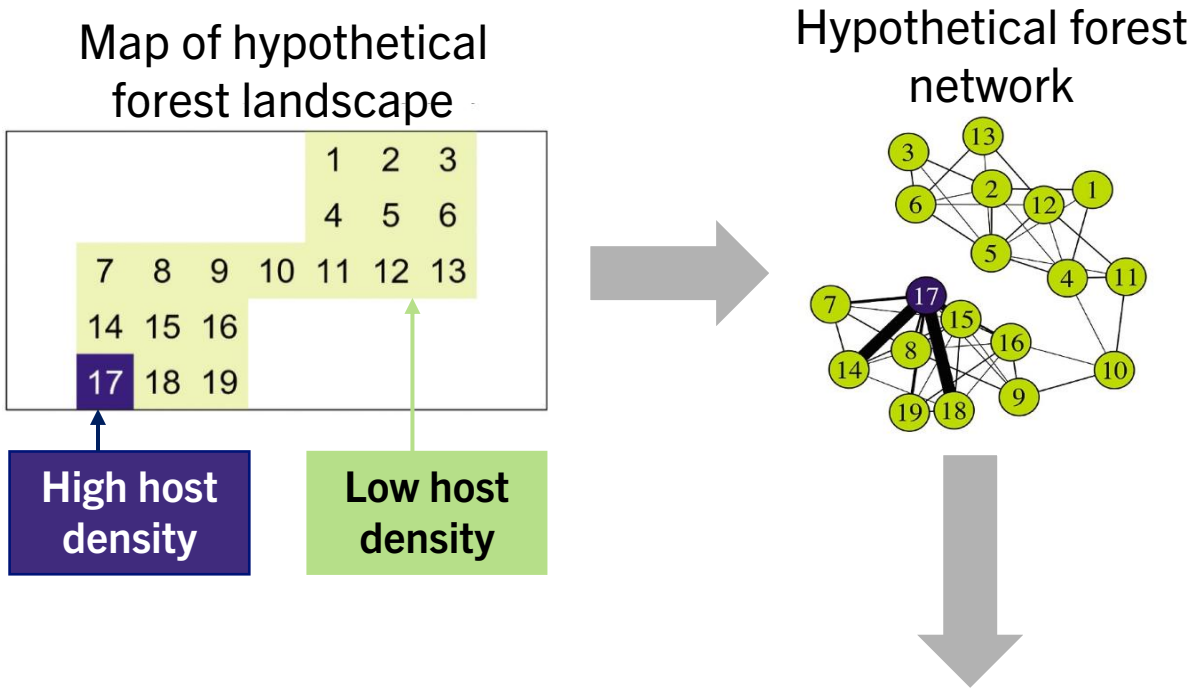
- Intermediary
- Producer

Data: WTO for wood packaging material, FAO for avocado-producing area, and CABI for national pathogen status.

Likely roles of locations in habitat networks

Forest (habitat) networks

- Geographic locations (nodes)
- Geographic connections (links)



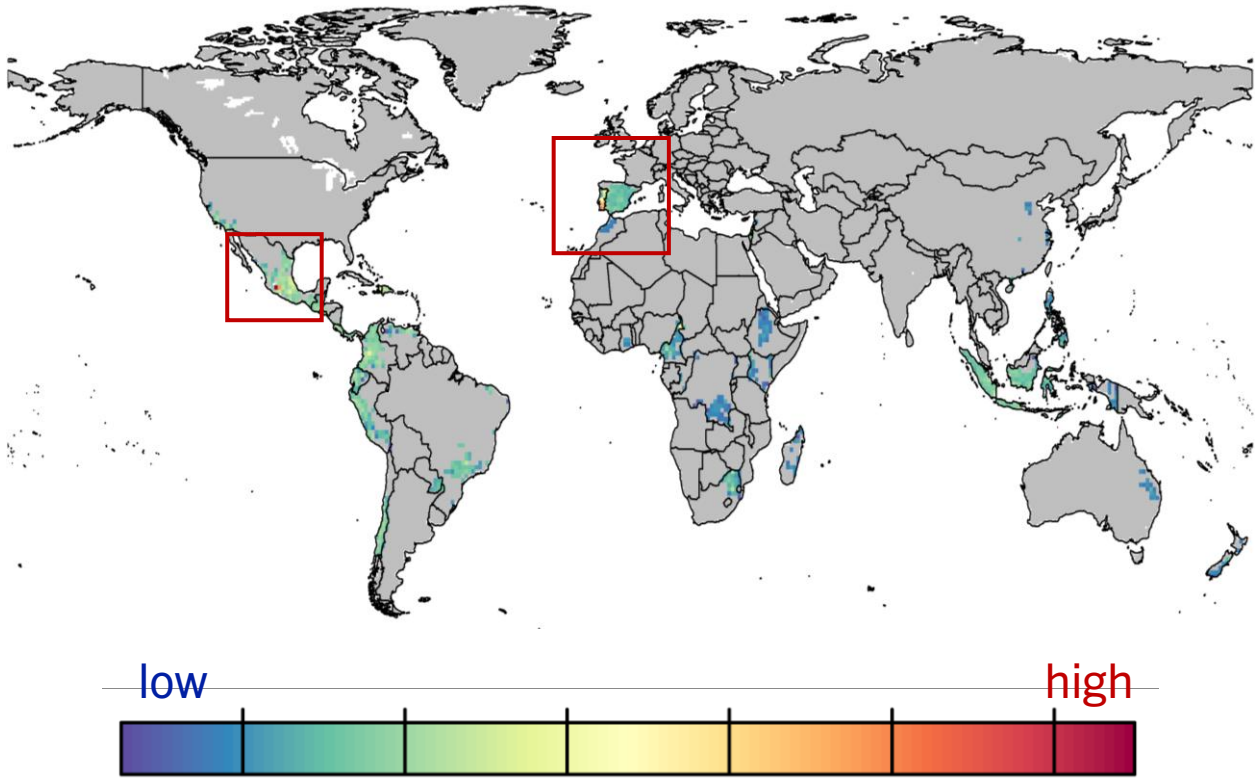
Geographic priorities

- geohabnet

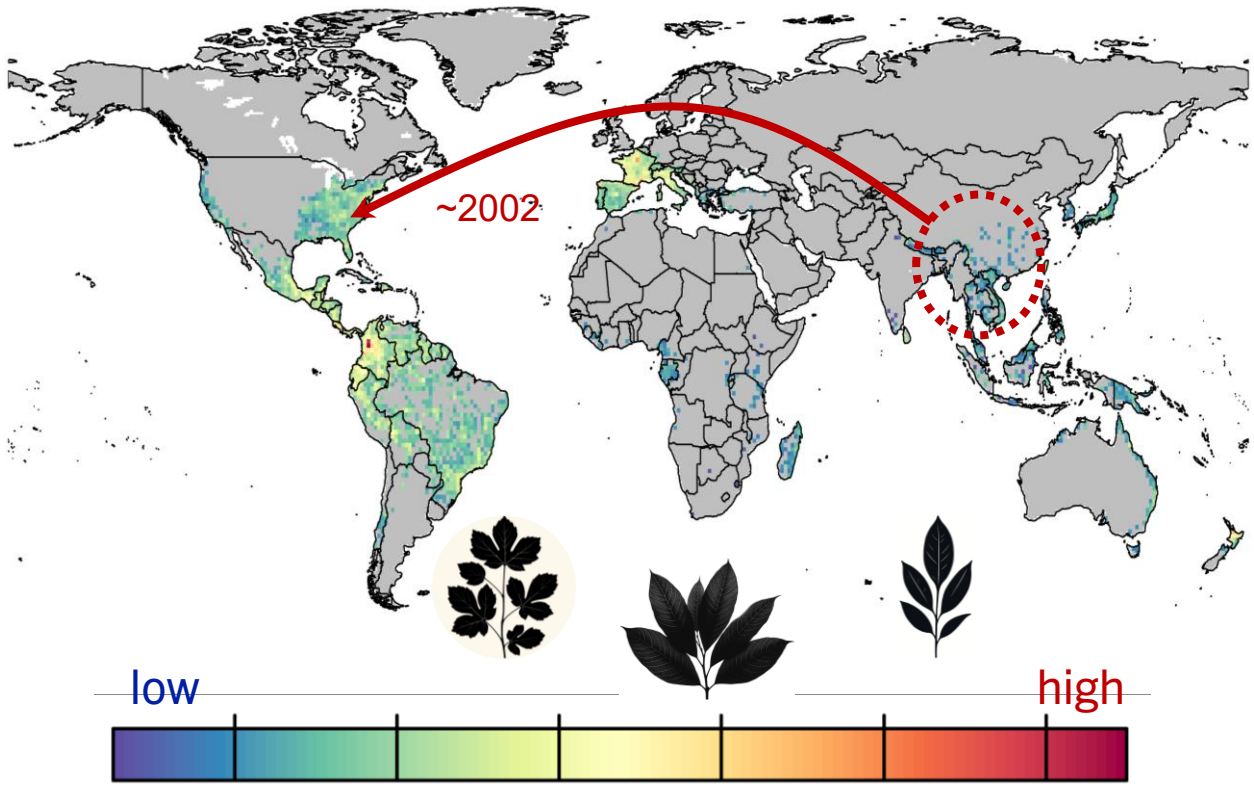
Xing et al. (2020); Margosian et al. (2009)

Global host connectivity for pathogen invasions

Example for laurel wilt (*Harringtonia lauricola*)



Host landscape connectivity for **avocado (*Persea americana*)**

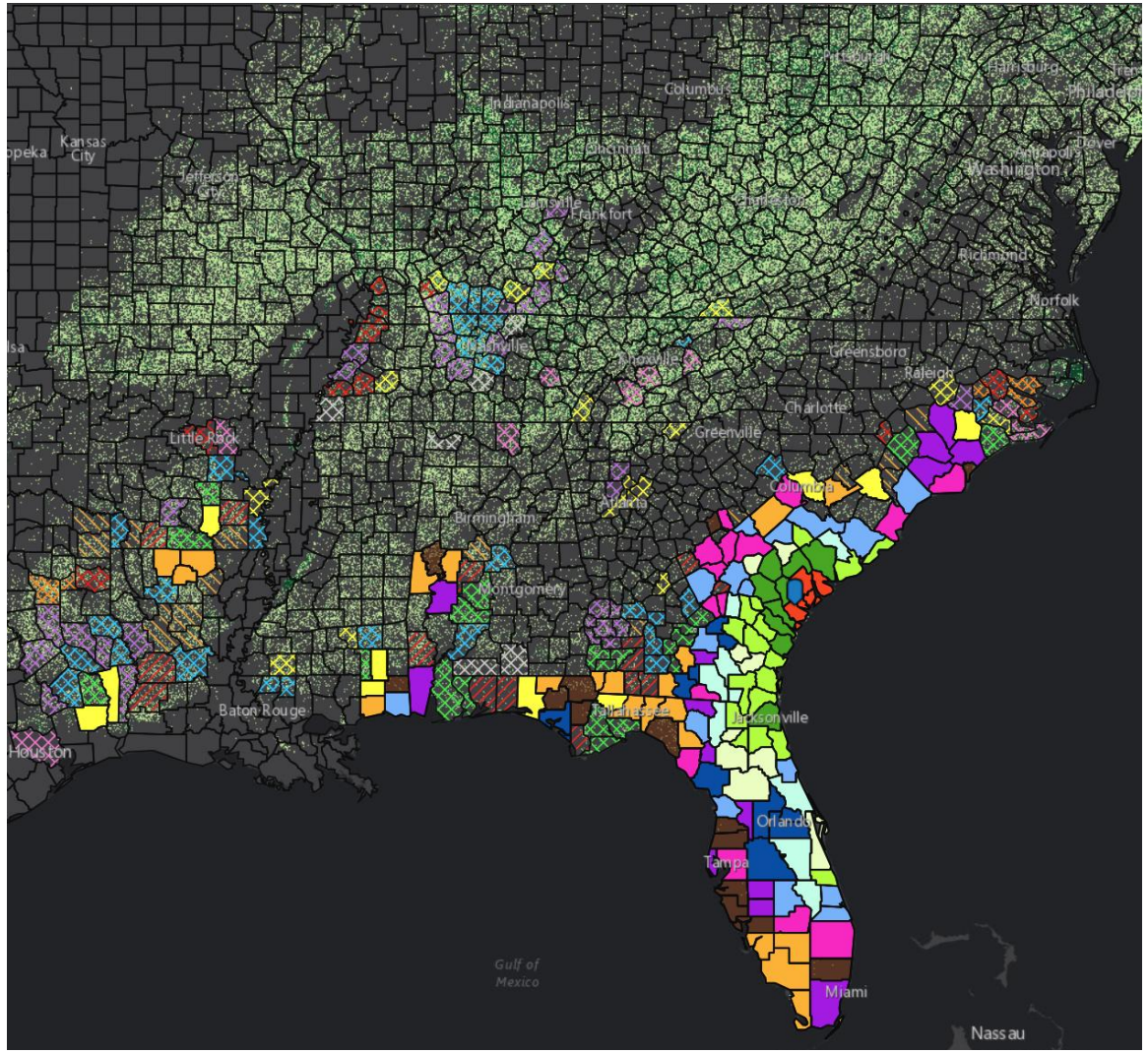


Host landscape connectivity for **2271 Lauraceae species**

Data: Monfreda et al (2005) for avocado and GBIF for other host species.

Methods

Quantifying climate risk for diseases



286 geographical coordinates of disease occurrence

Global maps of 19 bioclimatic variables

Training & validation: 10 machine learning algorithms

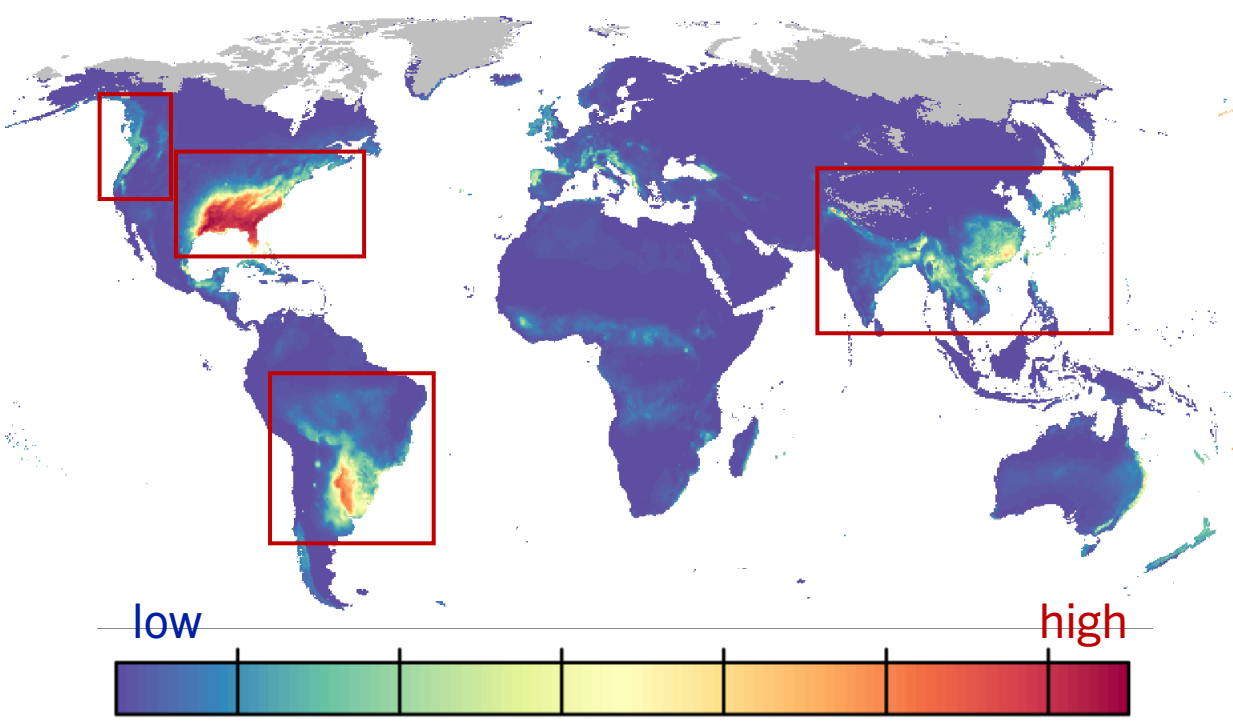
5 climate change scenarios

Global maps of spatial climate suitability

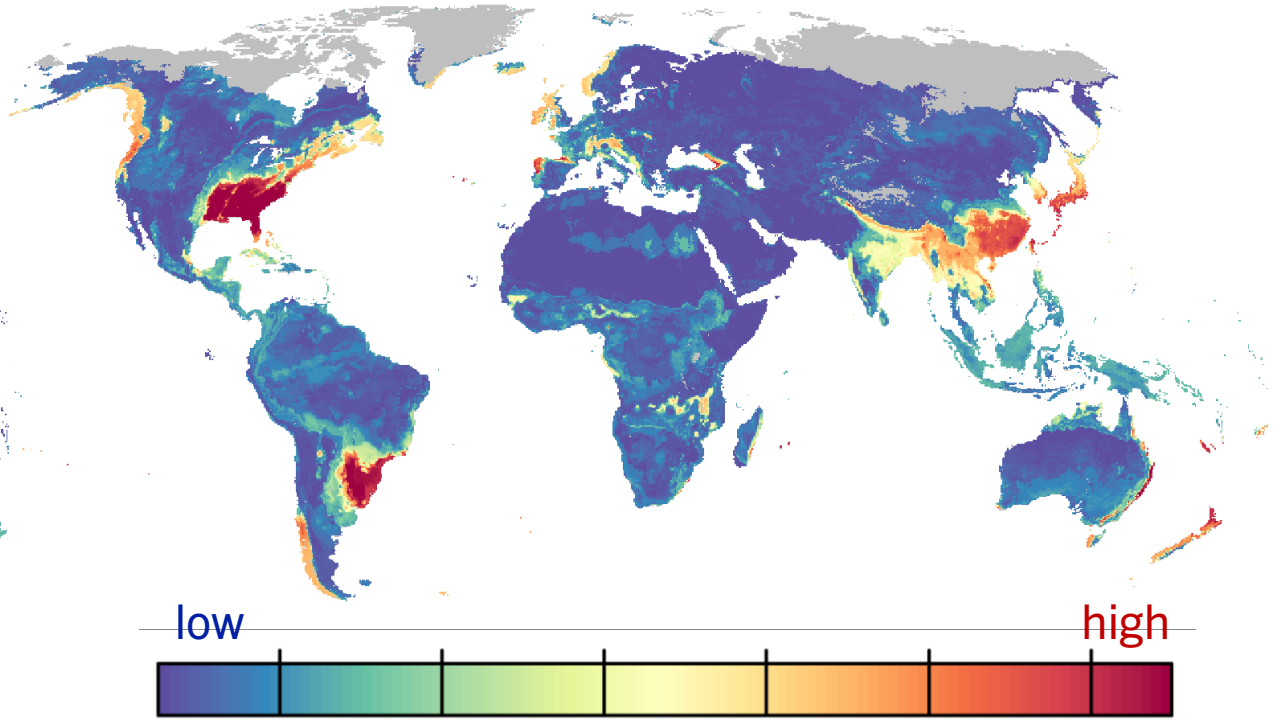
Current risk scenarios

Future risk scenarios

Projected risk scenario based on current climate suitability conditions (1981-2010)

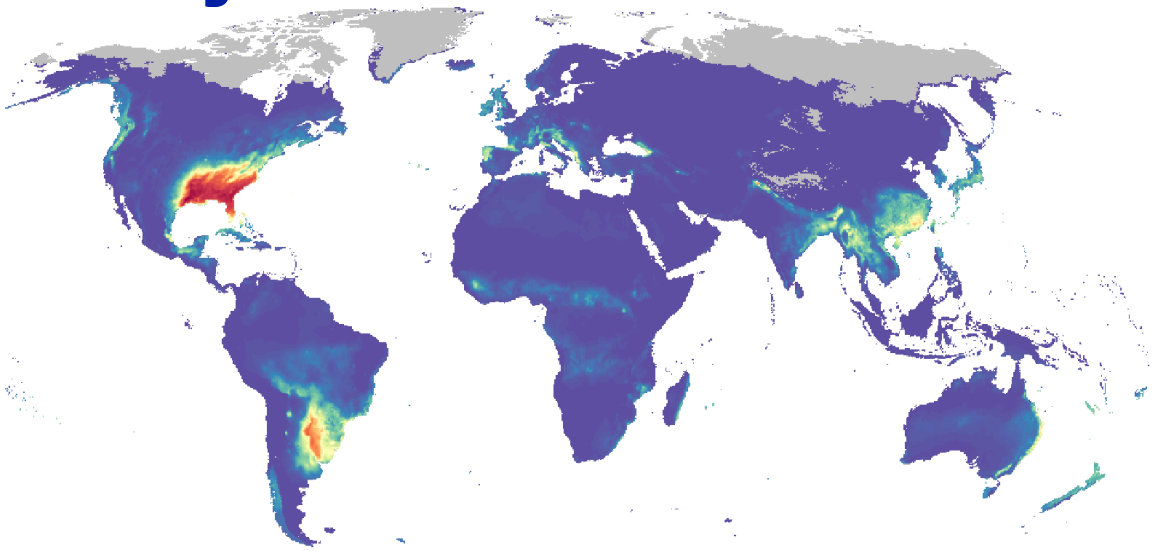


Potential climate similarity based on maximum likelihood

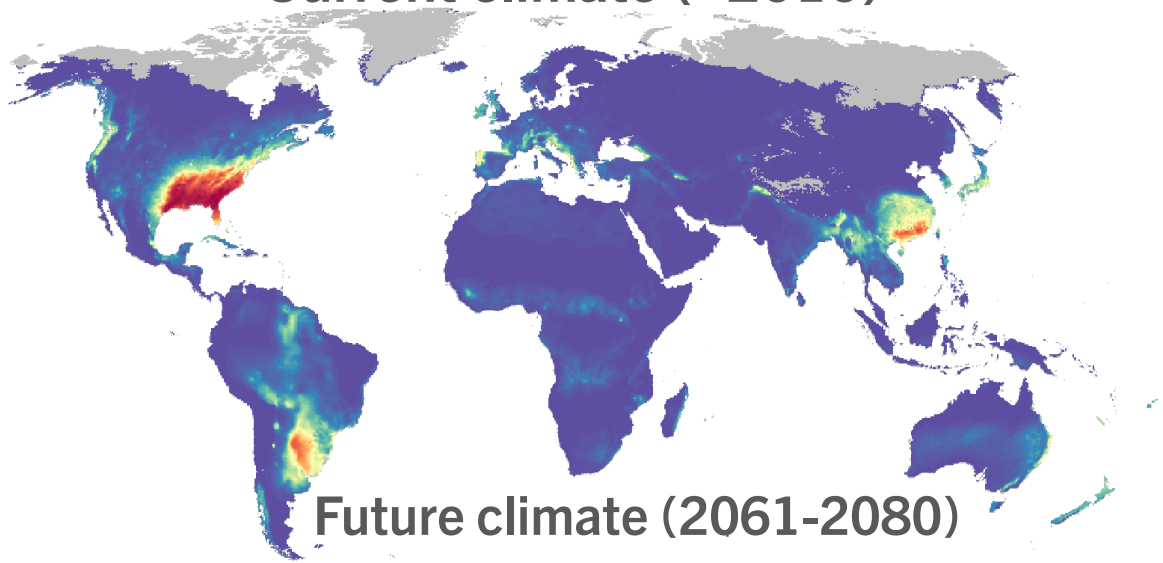


Potential climate similarity based on random forest

Projected future climate risk scenarios (2061-2080)

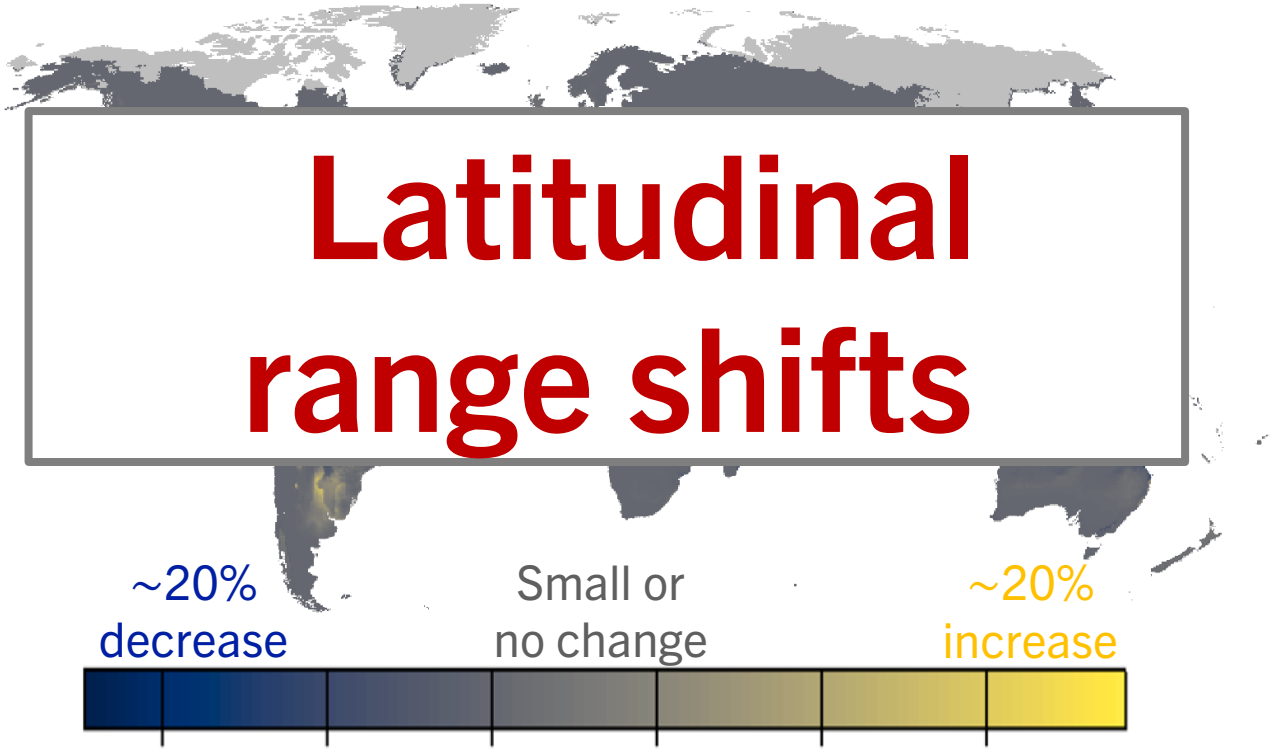


Current climate (~2010)



Future climate (2061-2080)

Can you spot 10 differences…?



Latitudinal range shifts

Potential risk change based on future climate scenarios

The proposed global surveillance strategy

Invasion through trade networks

- Prioritize surveillance in countries highly connected in the global network of wood packaging material.

Invasion through host networks

- Increase preparedness for laurel wilt in highly connected regions in the host landscape.

Climate-smart surveillance targets

- Keep track of potentially climatically suitable regions considering current and future risk scenarios.

Integrated surveillance systems

- The surveillance system depends on the collective actions by the industries, forest conservation and the public.

Thanks!

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Questions?

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