



Universitat
de les Illes Balears

DOCTORAL THESIS
2024

Theoretical and data-driven models in Ecology

Àlex Giménez Romero



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DOCTORAL THESIS 2024

Doctoral programme in Physics

Theoretical and data-driven models in Ecology

Àlex Giménez Romero

Thesis Supervisor: Manuel A. Matías
Thesis Tutor: Cristóbal López Sánchez

Doctor by the Universitat de les Illes Balears

Supervisors:
Manuel Matías

Àlex Giménez Romero.
Theoretical and data-driven models in Ecology. ©
Palma de Mallorca, July 2024

A en Manuel Miranda
pel seu suport i ajuda
durant tots aquests anys.
Sempre estaràs amb mi.
i recordare sempre
el que em vas ensenyar.

Dr Manuel A. Matías of the Consejo Superior de Investigaciones Científicas (CSIC)

I DECLARE:

That the thesis title *Theoretical and data-driven models in Ecology*, presented by Àlex Giménez Romero to obtain a doctoral degree, has been completed under my supervision and meets the requirements to opt for an International Doctorate.

For all intents and purposes, I hereby sign this document.

Signature

Dr. Manuel A. Matías
Thesis Supervisor

Palma de Mallorca, July 2024

Acknowledgements

Acknowledgements go here.

Resum

El resum va aquí.

Resumen

El resumen va aquí.

Abstract

Abstract goes here.

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1. **Abella-2022**
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3. Aging in Symmetrical Threshold Models
4. Idealista model for complex systems housing
5. Idealista spatial segmentation of the real state market

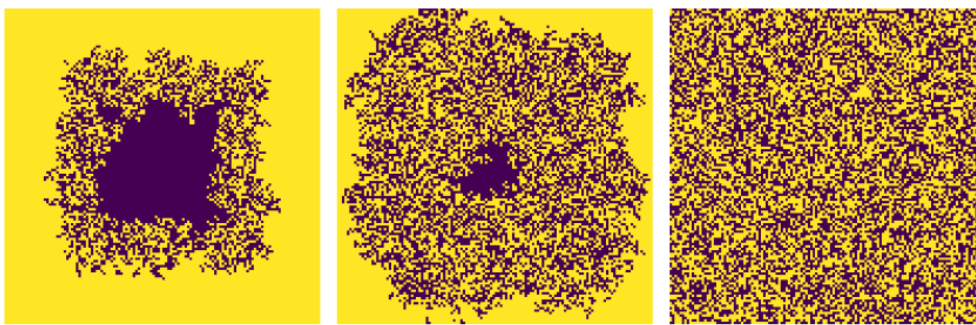


Introduction

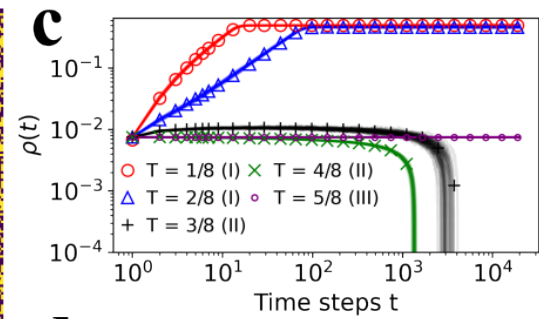
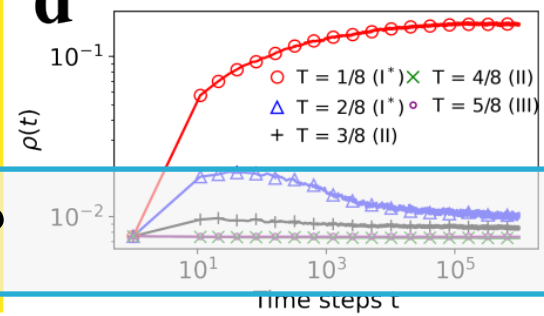
1	The global biodiversity crisis	19
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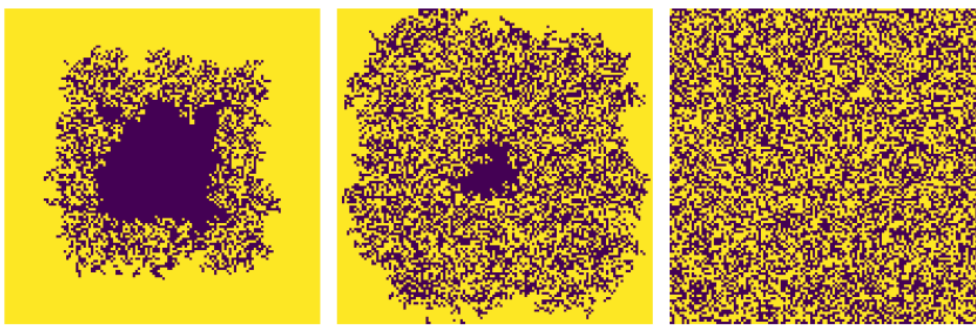
A world map where the landmasses are filled with a dense pattern of small, multi-colored dots and triangles. The colors include shades of blue, green, yellow, orange, and red. The map is centered on the Atlantic Ocean, with North and South America on the left and Europe and Africa on the right. A semi-transparent grey banner with a thin blue border is positioned horizontally across the middle of the map.

1. The global biodiversity crisis

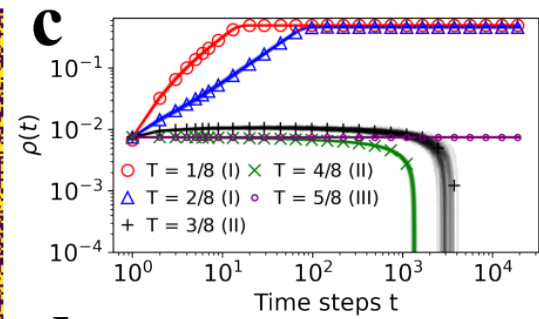
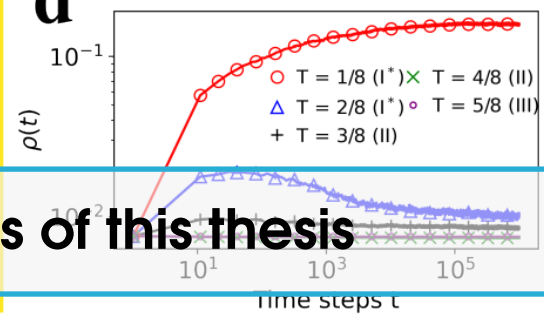
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2. Why do we need models?

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3. Main original contributions of this thesis

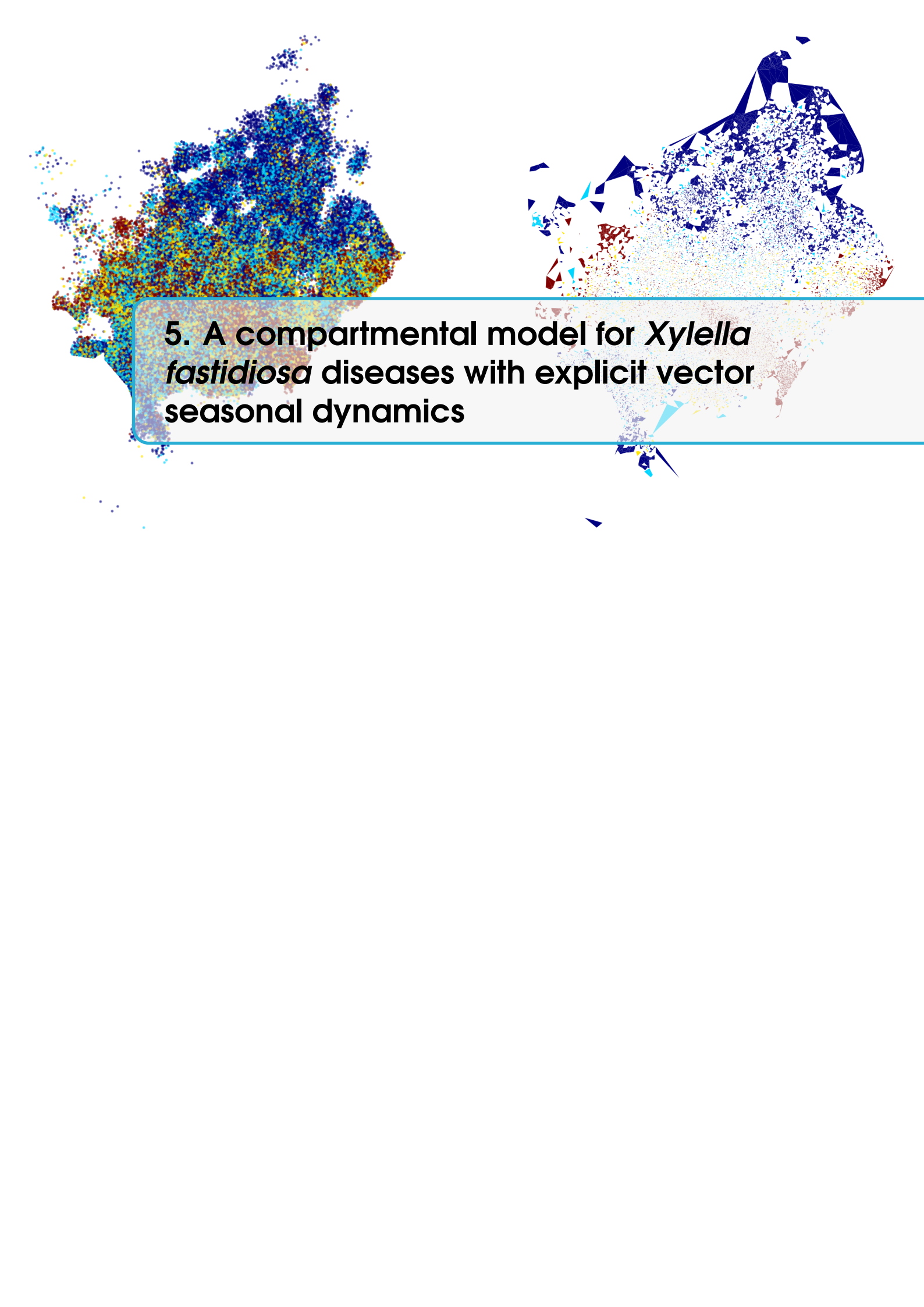
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Realistic models for vector-borne plant diseases

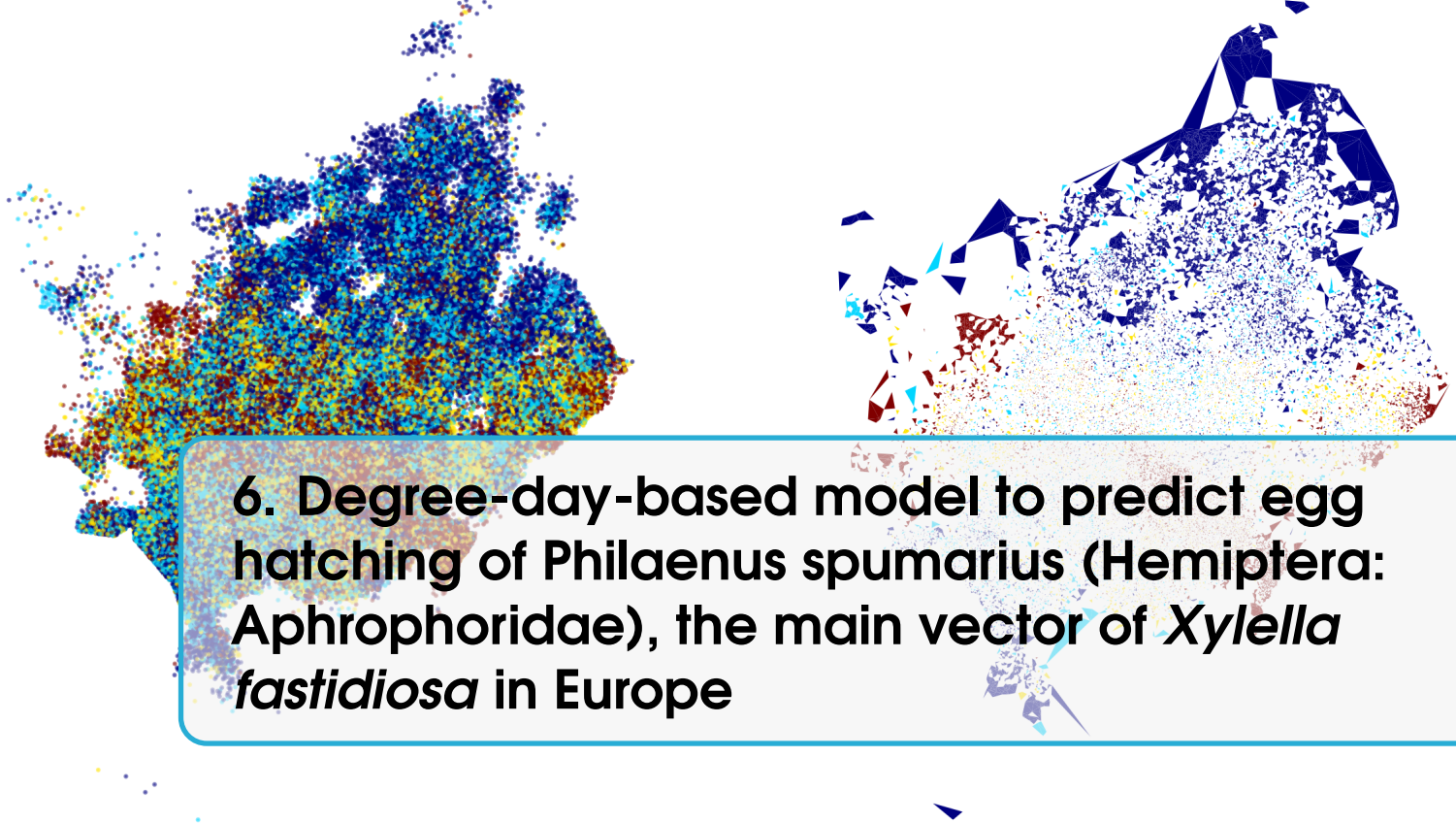
- 4 Vector-borne diseases with non-stationary vector populations: the case of growing and decaying populations 27
- 5 A compartmental model for *Xylella fastidiosa* diseases with explicit vector seasonal dynamics . 29
- 6 Degree-day-based model to predict egg hatching of *Philaenus spumarius* (Hemiptera: Aphrophoridae), the main vector of *Xylella fastidiosa* in Europe 31



4. Vector-borne diseases with non-stationary vector populations: the case of growing and decaying populations

The background of the slide is a complex, abstract composition. It features a dense field of small, multi-colored dots (blue, green, yellow, orange, red, and purple) scattered across the upper half. Overlaid on this is a large, dark, irregular shape that resembles a map of a continent or a cluster of landmasses. This shape is composed of many small, dark, triangular and polygonal facets, giving it a crystalline or fragmented appearance. A horizontal, semi-transparent grey bar with a thin blue border runs across the middle of the slide, containing the text.

5. A compartmental model for *Xylella fastidiosa* diseases with explicit vector seasonal dynamics

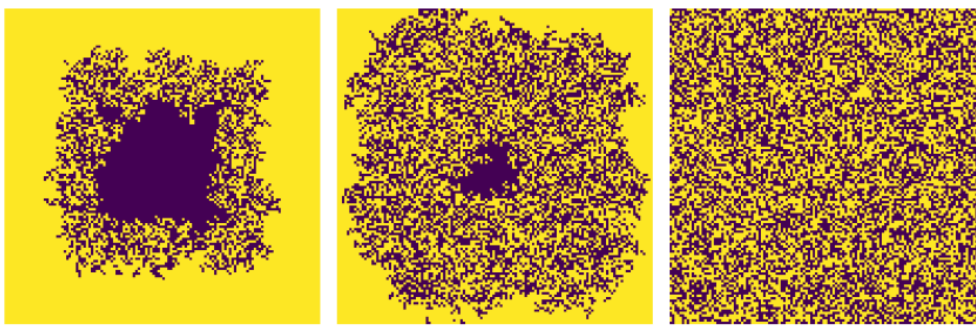
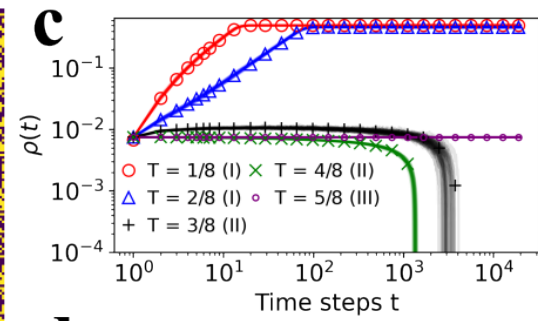
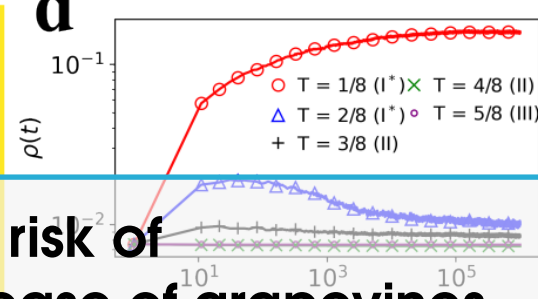


6. Degree-day-based model to predict egg hatching of *Philaenus spumarius* (Hemiptera: Aphrophoridae), the main vector of *Xylella fastidiosa* in Europe

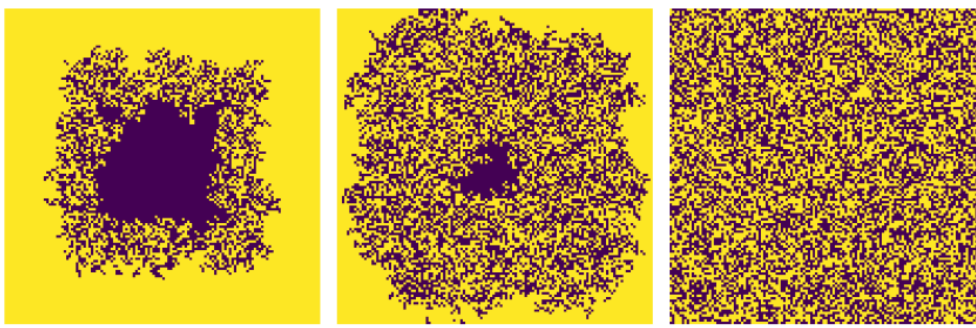
Modelling the risk of vector-borne plant diseases



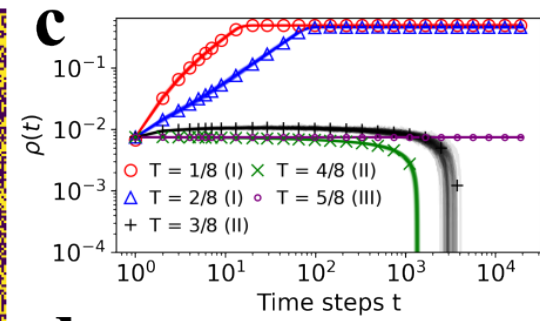
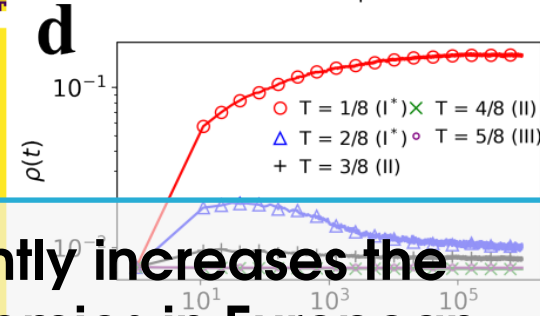
- 7 Global predictions for the risk of establishment of
Pierce's disease of grapevines 35
- 8 Global warming significantly increases the risk of
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- 9 High-resolution climate data reveals increased risk
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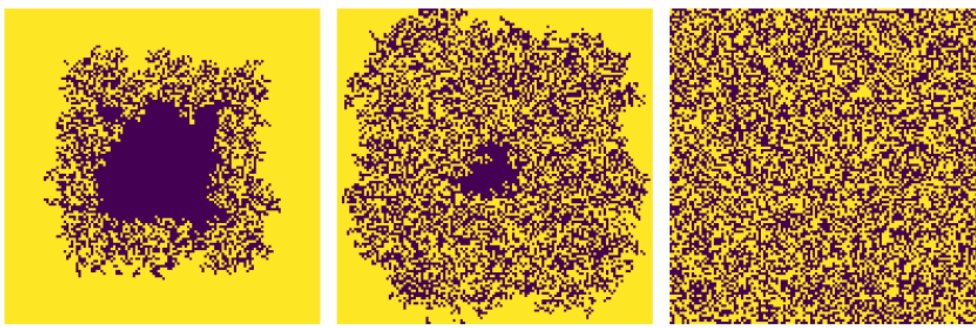
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7. Global predictions for the risk of establishment of Pierce's disease of grapevines

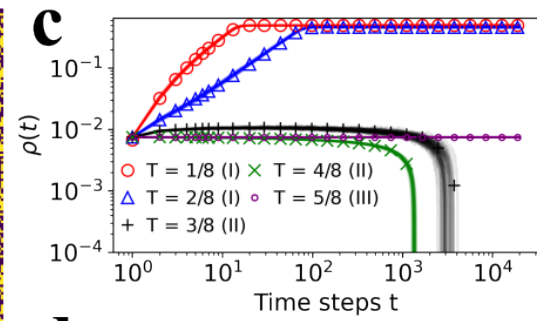
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8. Global warming significantly increases the risk of Pierce's disease epidemics in European vineyards

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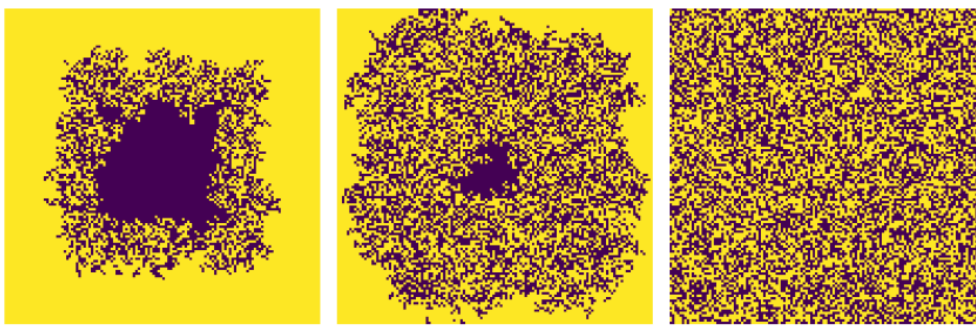
9. High-resolution climate data reveals increased risk of Pierce's Disease for grapevines worldwide

c**d**

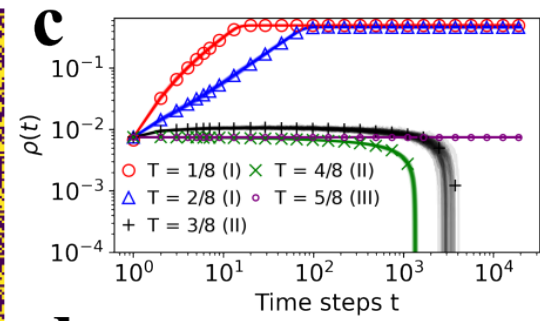
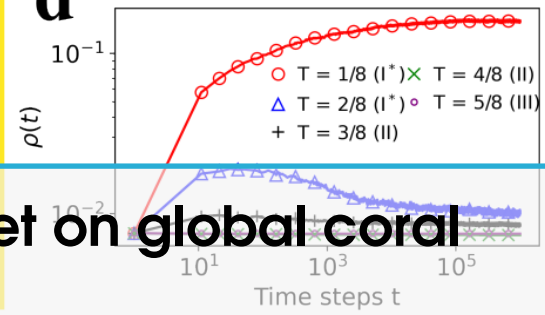
Data-driven methods for global ecological problems

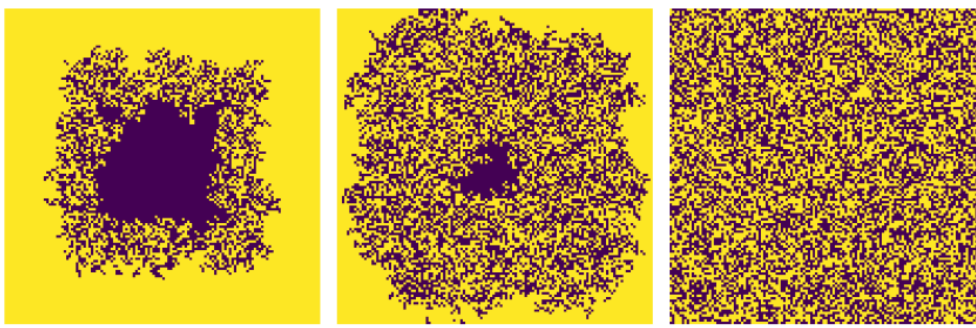
IV

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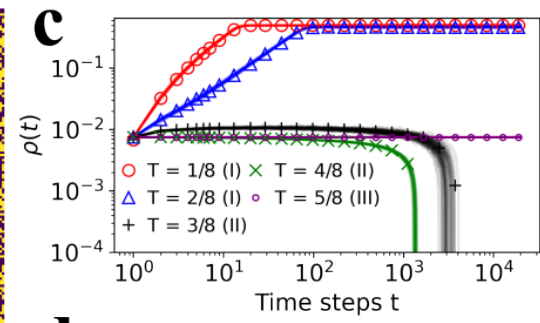
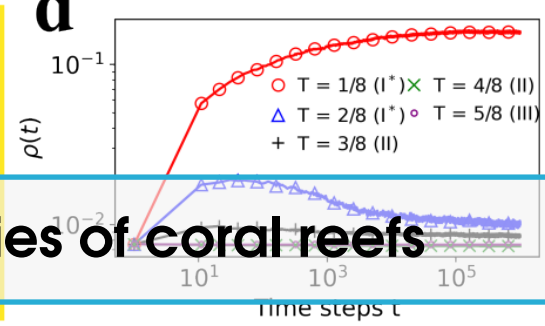
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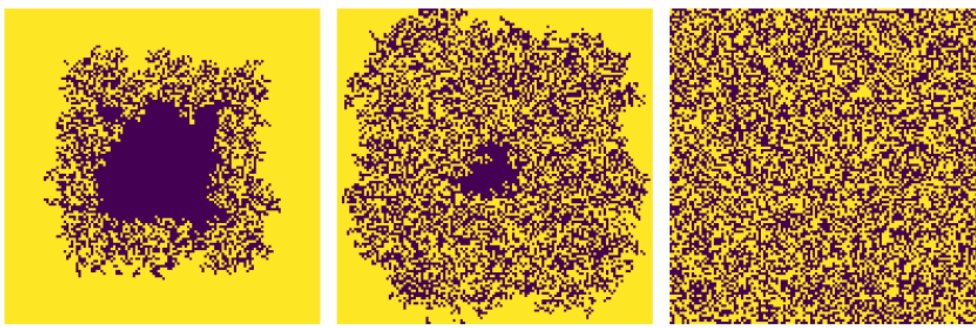
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c**d**

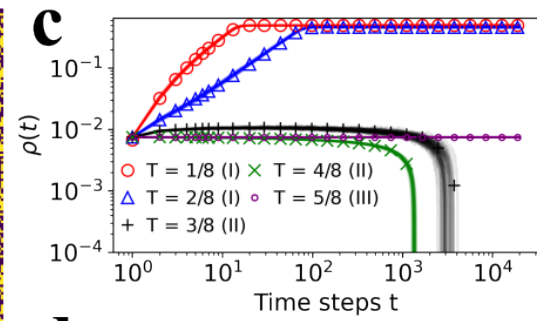
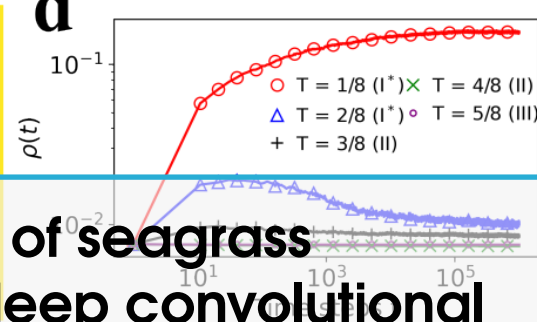
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11. Universal spatial properties of coral reefs

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12. Mapping the distribution of seagrass meadows from space with deep convolutional neural networks

c**d**

Bibliography

