Universitat de les Illes Balears

DOCTORAL THESIS
2024

Theoretical and data-driven models in Ecology

Àlex Giménez Romero

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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

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

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Resumen

El resumen va aquí.

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IV Modelling the risk of vector-borne plant diseases

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1. Susana Flecha et al. "pH trends and seasonal cycle in the coastal Balearic Sea reconstructed through machine learning". In: *Scientific Reports* 12.1 (July 2022), page 12956. ISSN: 2045-2322. DOI: 10.1038/s41598-022-17253-5. URL: https://doi.org/10.1038/s41598-022-17253-5

2. Àlex Giménez-Romero et al. "Spatial effects in parasite-induced marine diseases of immobile hosts". In: *Royal Society Open Science* 9.8 (2022), page 212023. DOI: 10.1098/rsos.212023. eprint: https://royalsocietypublishing.org/doi/pdf/10.1098/rsos.212023. URL: https://royalsocietypublishing.org/doi/abs/10.1098/rsos.212023

3. Àlex Giménez-Romero, Rosa Flaquer-Galmés, and Manuel A. Matías. "Vector-borne diseases with nonstationary vector populations: The case of growing and decaying populations". In: *Phys. Rev. E* 106 (5 Nov. 2022), page 054402. DOI: 10.1103/PhysRevE.106.054402. URL: https://link.aps.org/doi/10.1103/PhysRevE.106.054402

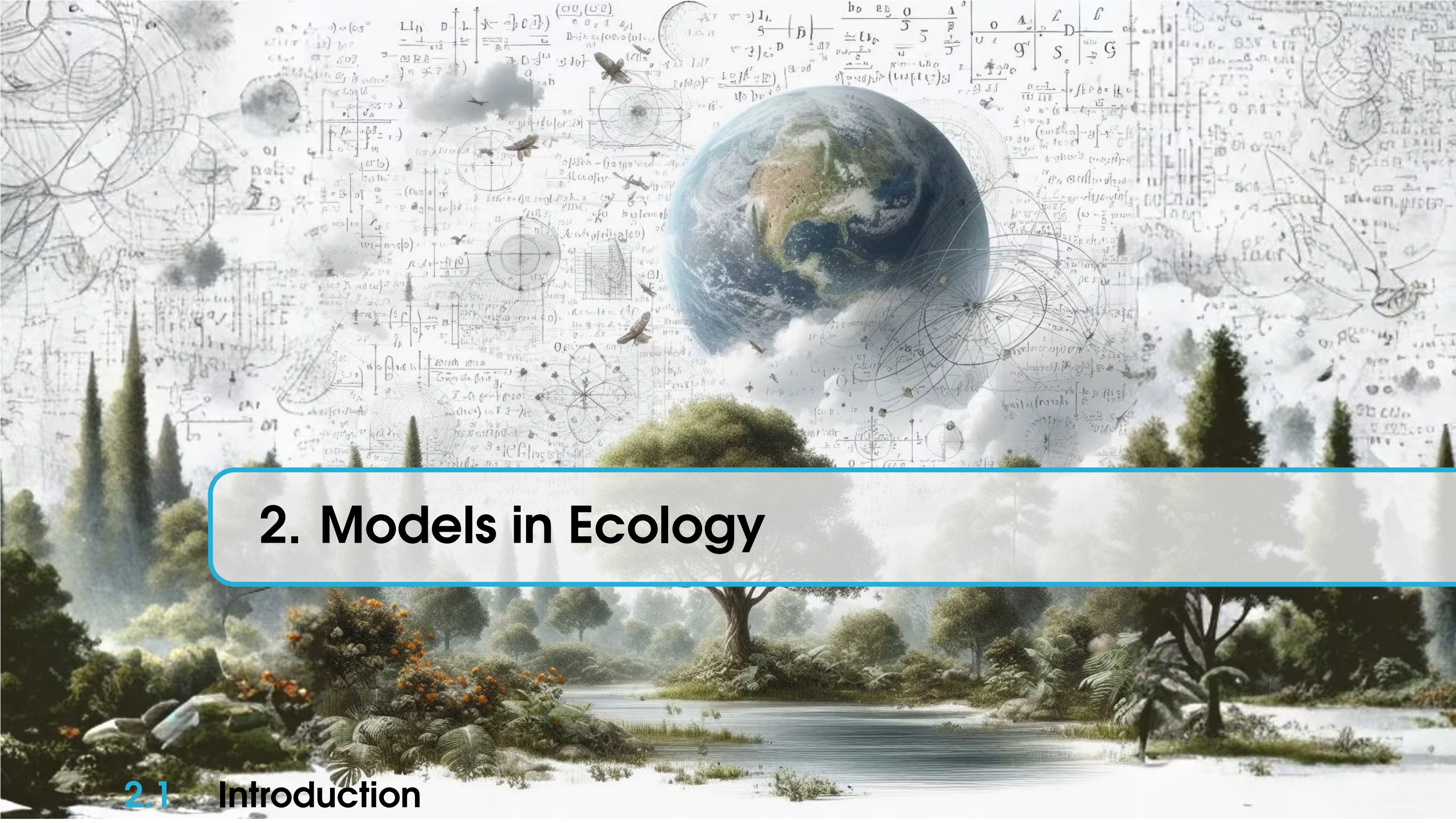
4. Alex Giménez-Romero et al. "Global predictions for the risk of establishment of Pierce's disease of grapevines". In: *Communications Biology* 5.1 (Dec. 2022), page 1389. ISSN: 2399-3642. DOI: 10.1038/s42003-022-04358-w. URL: https://doi.org/10.1038/s42003-022-04358-w

5. Àlex Giménez-Romero, Eduardo Moralejo, and Manuel A. Matías. "A Compartmental Model for Xylella fastidiosa Diseases with Explicit Vector Seasonal Dynamics". In: *Phytopathology®* 113.9 (2023). PMID: 36774557, pages 1686–1696. DOI: 10.1094/PHYTO-11-22-0428-V. eprint: https://doi.org/10.1094/PHYTO-11-22-0428-V. URL: https://doi.org/10.1094/PHYTO-11-22-0428-V

6. Clara Lago et al. "Degree-day-based model to predict egg hatching of Philaenus spumarius (Hemiptera: Aphrophoridae), the main vector of Xylella fastidiosa in Europe". In: *Environmental Entomology* 52.3 (Apr. 2023), pages 350–359. ISSN: 0046-225X. DOI: 10.1093/ee/nvad013. eprint: https://academic.oup.com/ee/article-pdf/52/3/350/50615564/nvad013.pdf. URL: https://doi.org/10.1093/ee/nvad013

Introduction

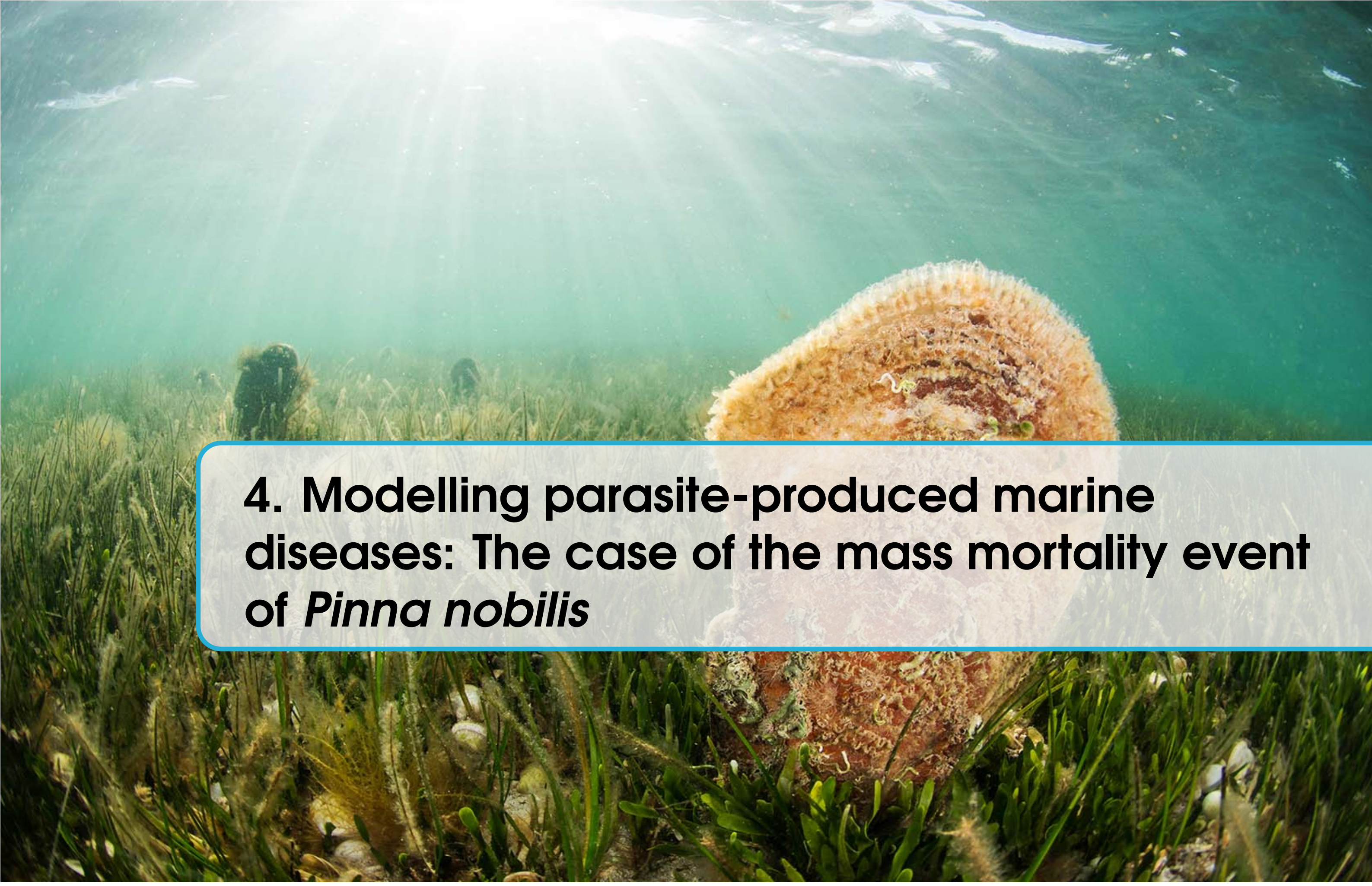
1. The global biodiversity crisis



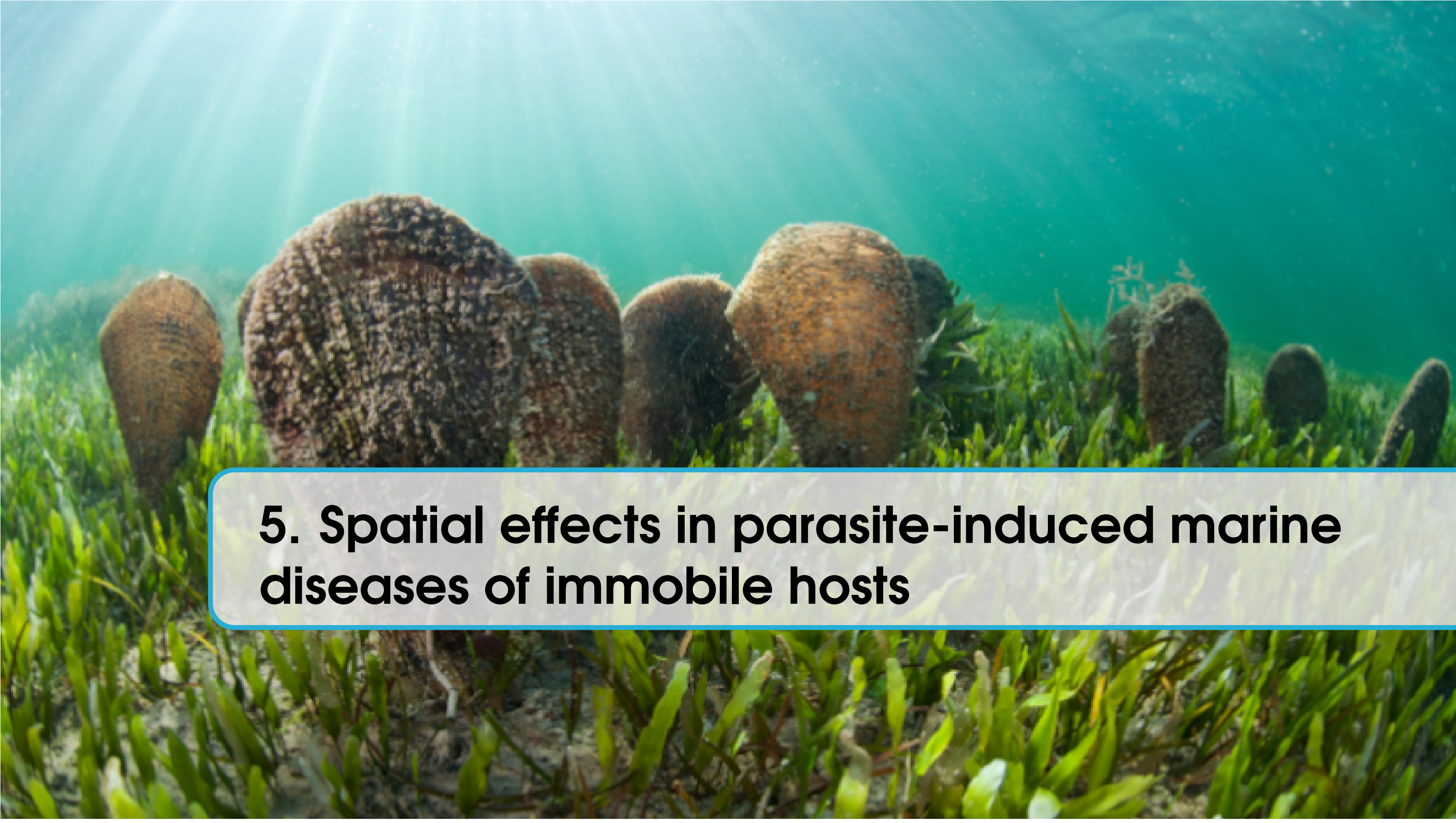
2. Models in Ecology

3. Main original contributions of this thesis

II Modelling parasite-produced marine diseases

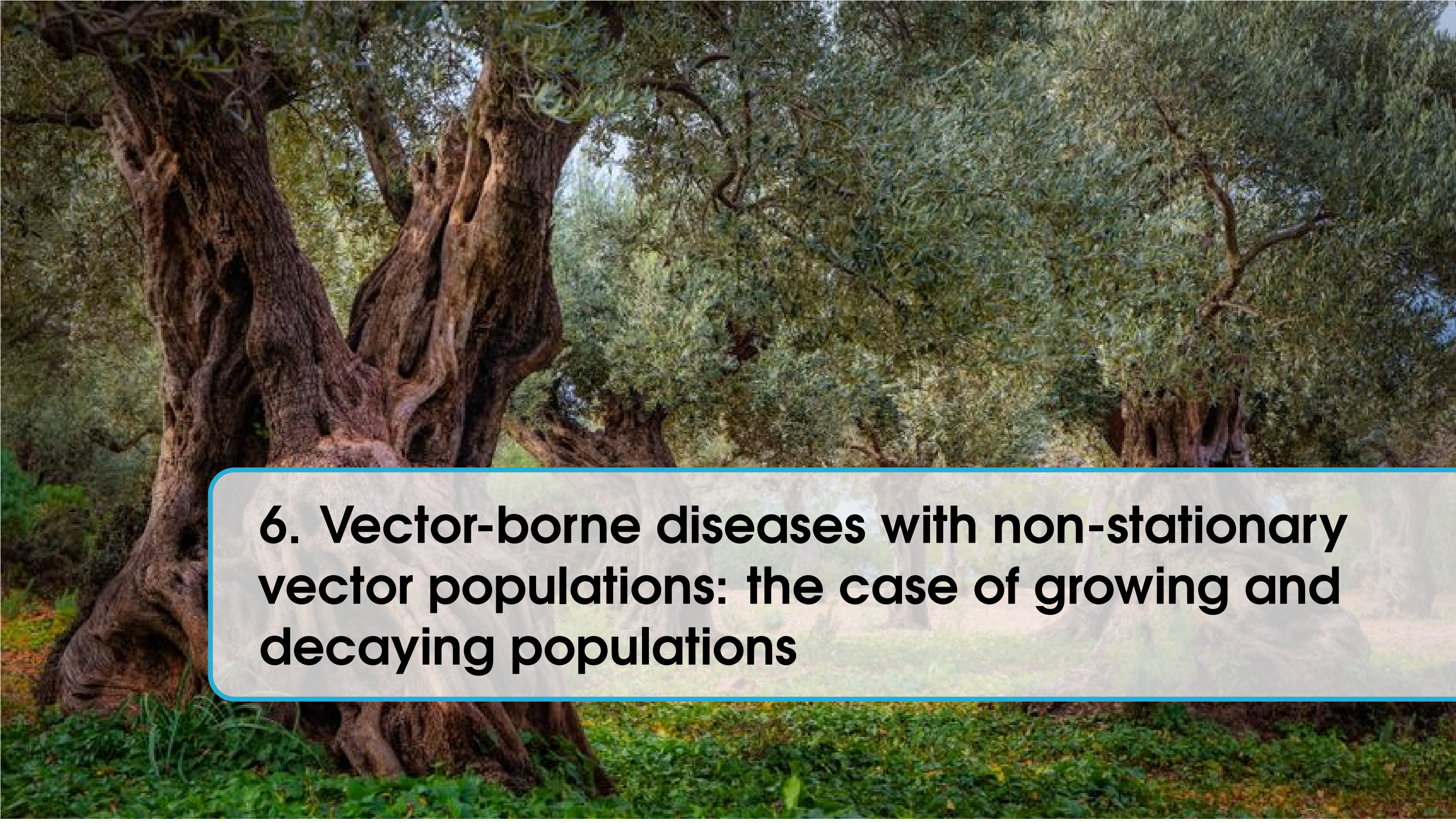


4. Modelling parasite-produced marine diseases: The case of the mass mortality event of *Pinna nobilis*

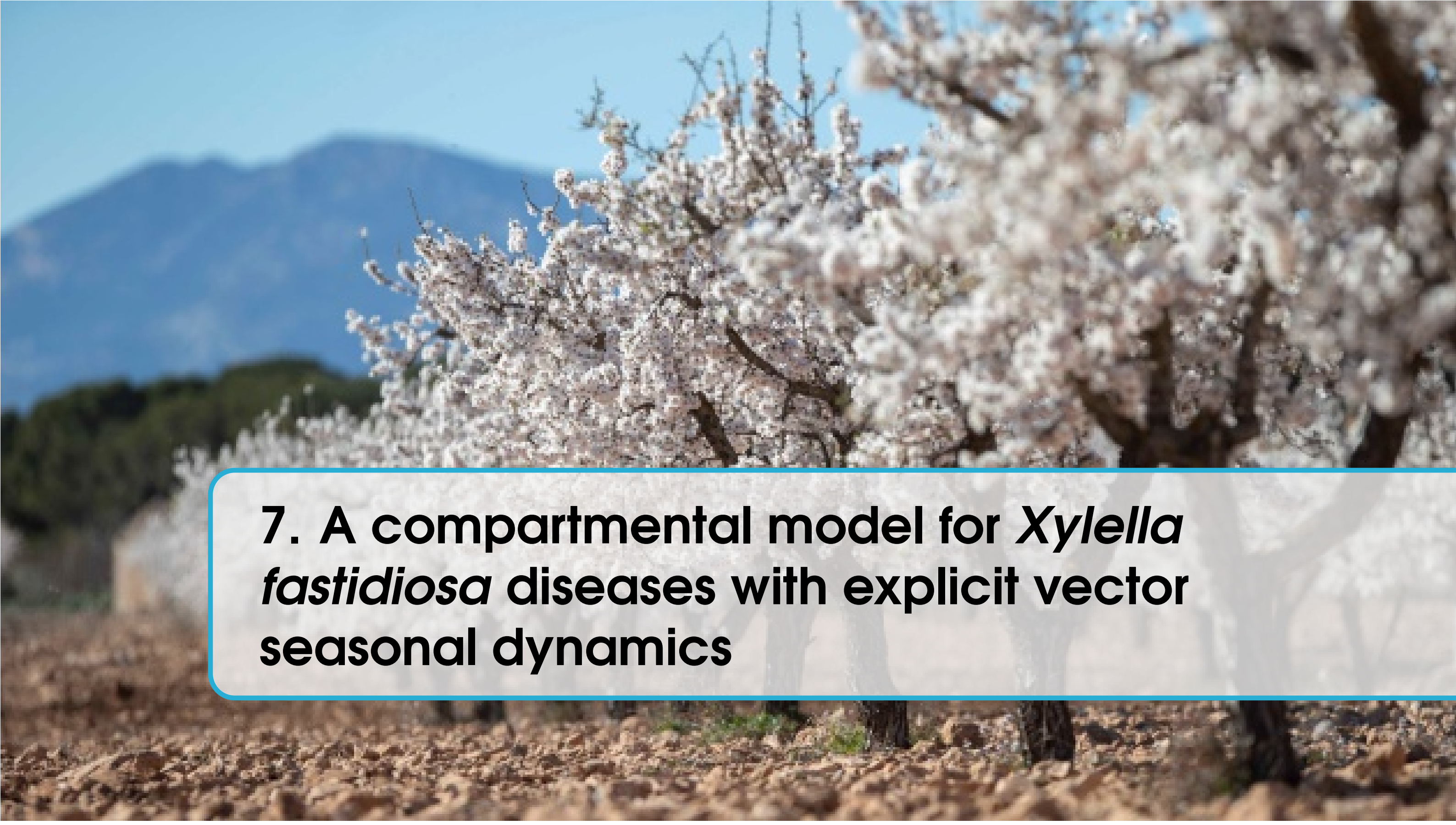


5. Spatial effects in parasite-induced marine diseases of immobile hosts

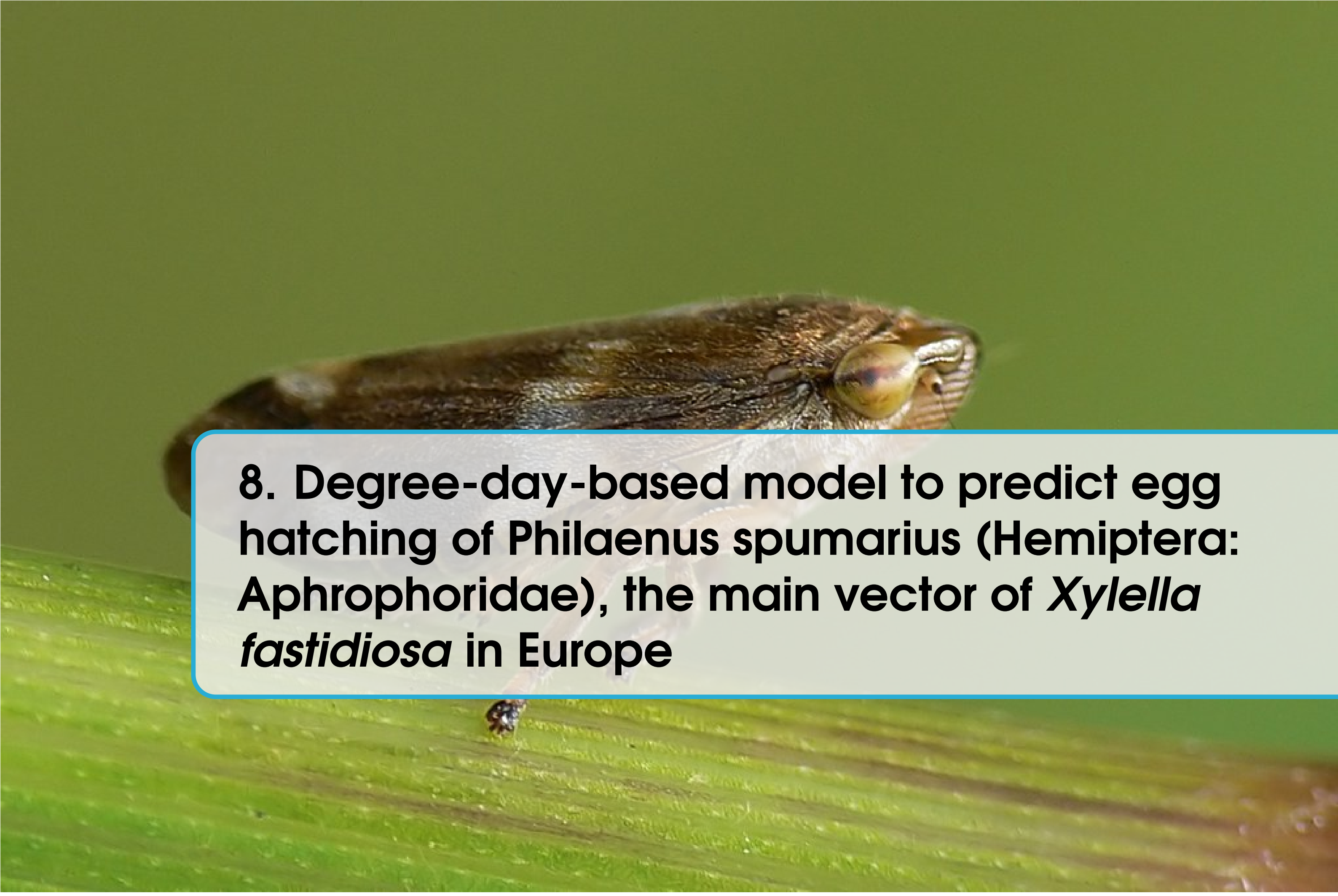
III Realistic models for vector-borne plant diseases



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



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



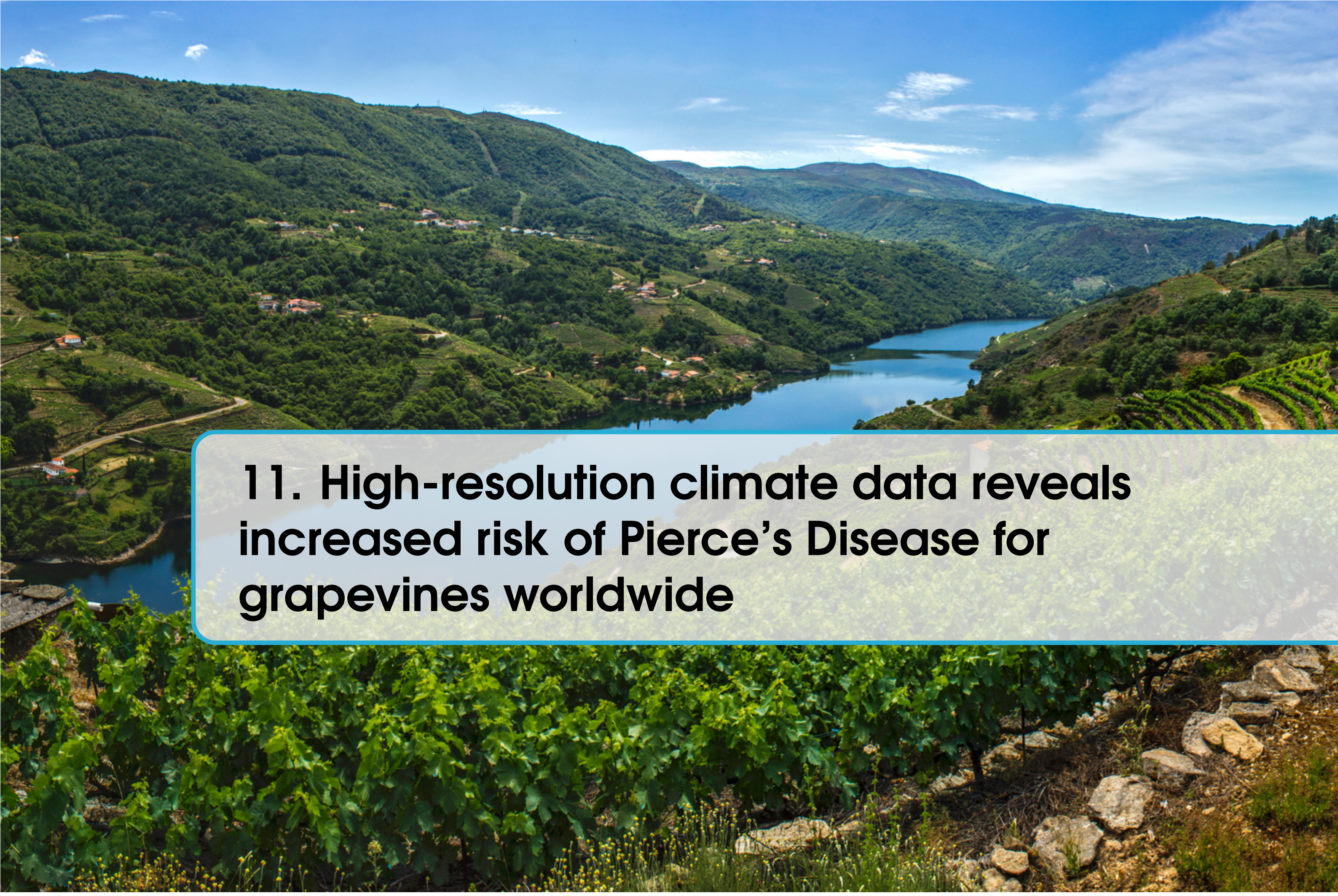
8. Degree-day-based model to predict egg hatching of Philaenus spumarius (Hemiptera: Aphrophoridae), the main vector of *Xylella fastidiosa* in Europe

IV

Modelling the risk of vector-borne plant diseases

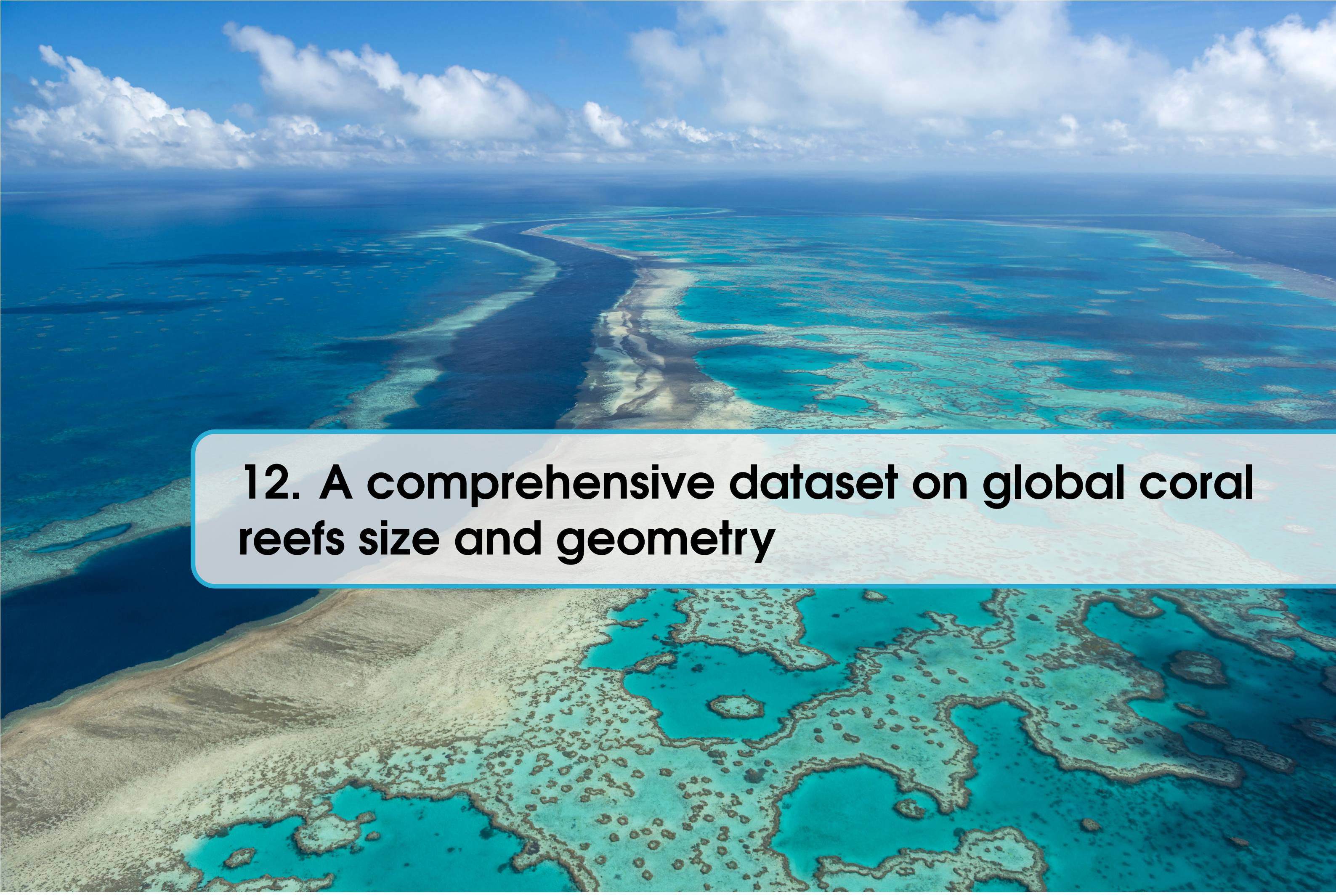
9. Global predictions for the risk of establishment of Pierce's disease of grapevines

10. Global warming significantly increases the risk of Pierce’s disease epidemics in European vineyards

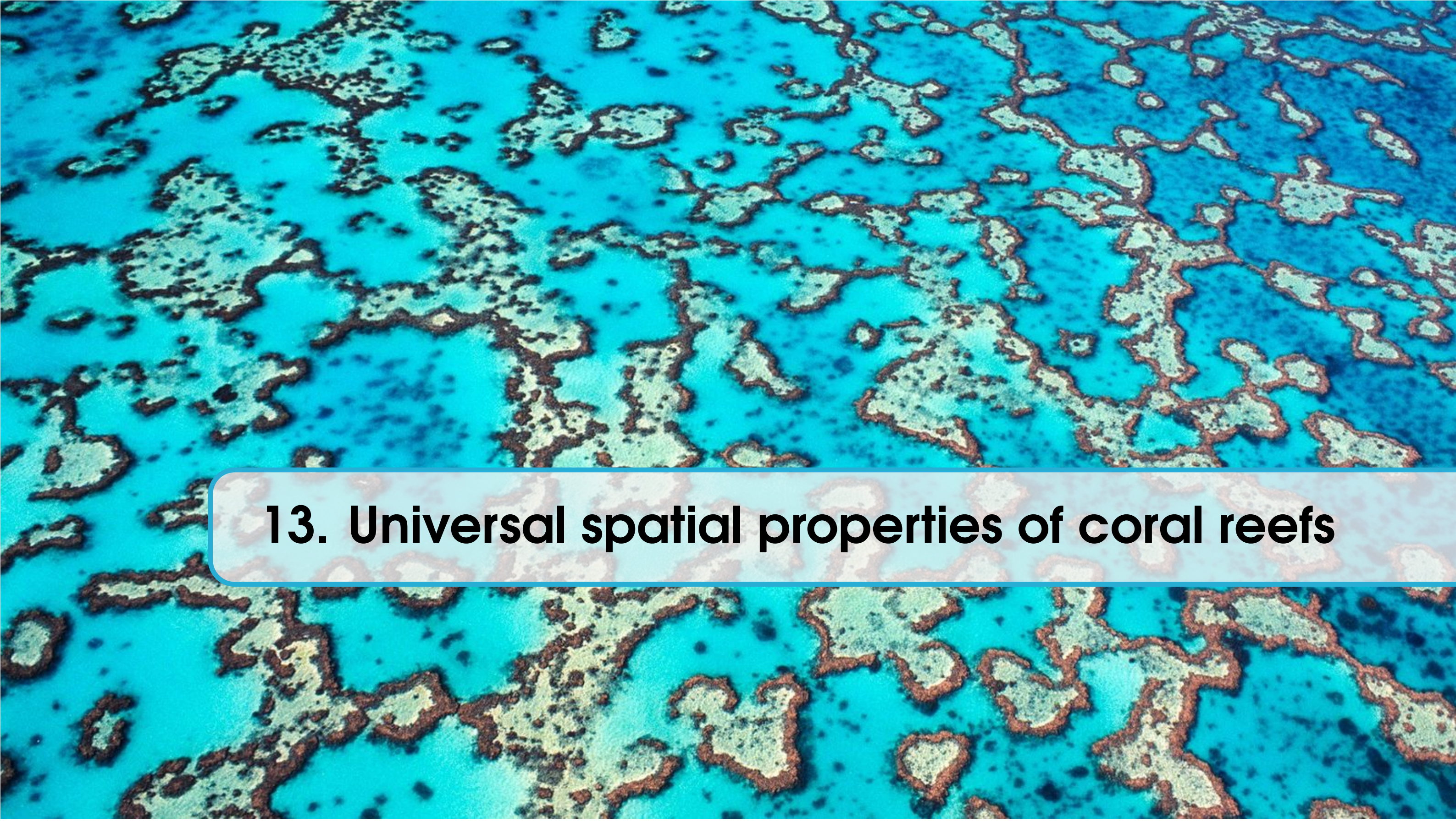


11. High-resolution climate data reveals increased risk of Pierce’s Disease for grapevines worldwide

V Data-driven methods for global ecological problems

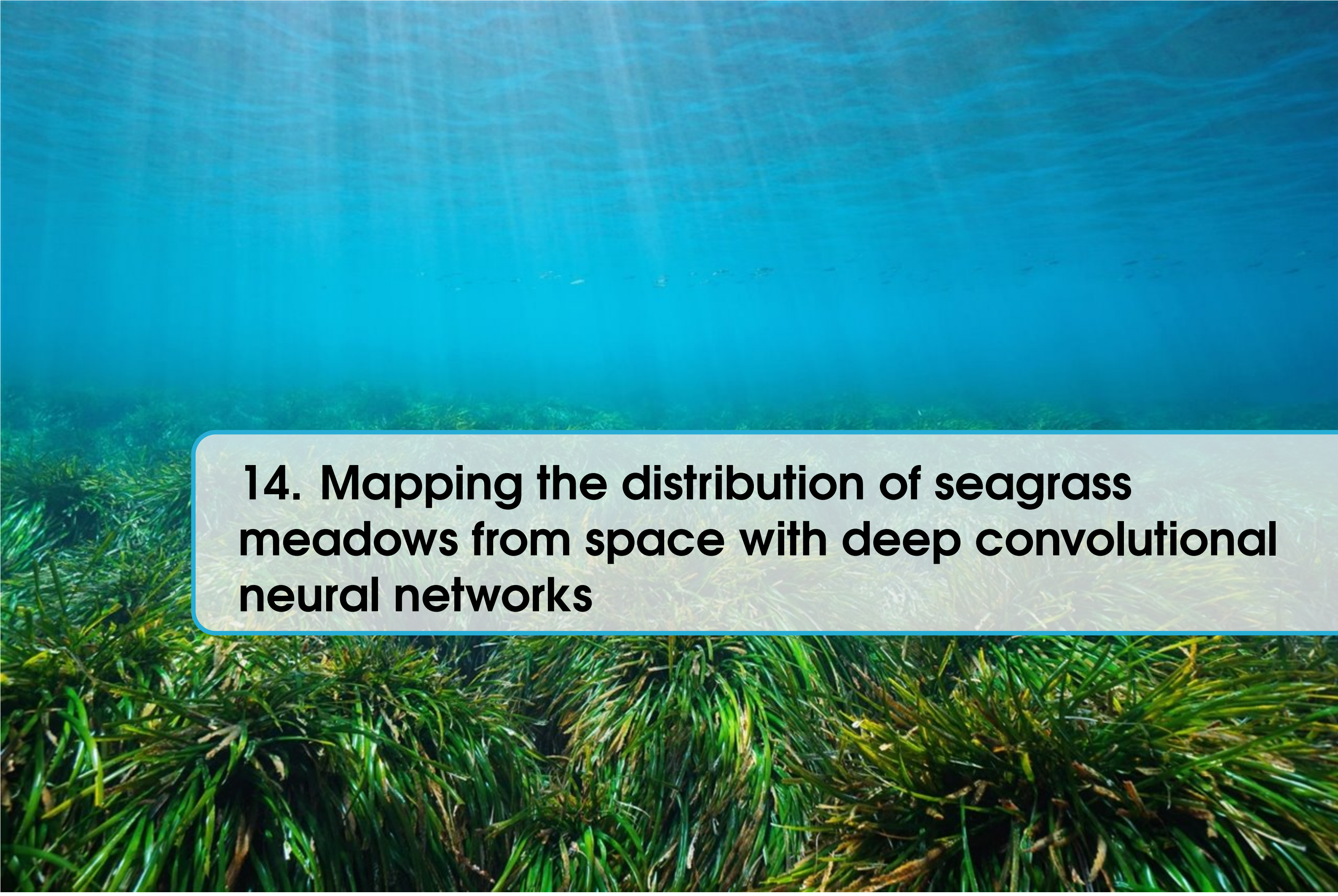


12. A comprehensive dataset on global coral reefs size and geometry



13. Universal spatial properties of coral reefs

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



Bibliography

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