



Pest Risk Modelling in Australasia

Darren Kriticos | Principal Research Scientist
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Australia has produced many bioclimatic modelling packages



Australia and New Zealand have developed a rich variety of biosecurity analytical models and methods

- SOMS
- CLIMEX
- DYMEX
- Spread models
- Network models
- Bioeconomic models
- Area freedom
- Post-border weed risk management
- Etc.

Why put the effort into biosecurity modelling?

- Australia and New Zealand form a geographically-isolated archipelago
- Both have high levels of agricultural production
- History of biosecurity threats
- Keep the continent free of invasive species
- Well known for its high standards of biosecurity



Biosecurity Incursion Management



Invasive pest
assemblage (SOMS)

Climate similarity

Niche modelling

Network Analysis

Niche modelling

Invaded Range
Species Distribution
modelling

Spread modelling
(very simple)

Spread modelling
(simple)

Modelling in relation to ISPMs



FAO, 1996

- Prioritise pests
 - **Which species?**
- Prioritise pathways
 - **Where?**
- Assess potential distribution
 - **Where?**
- Estimate economic impacts
 - **What costs?**

Self-Organising Maps

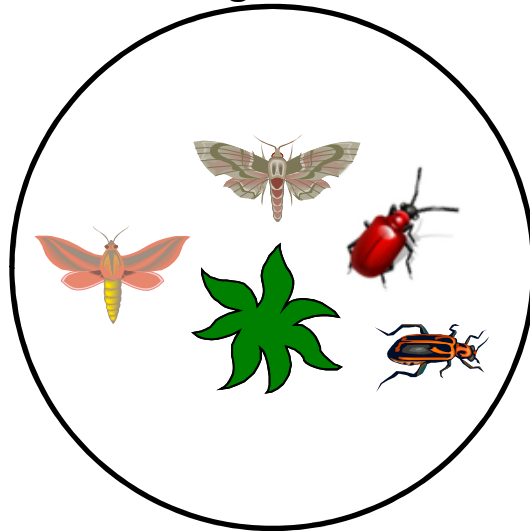
Which species?

Interrogating Invasive Pest Assemblages

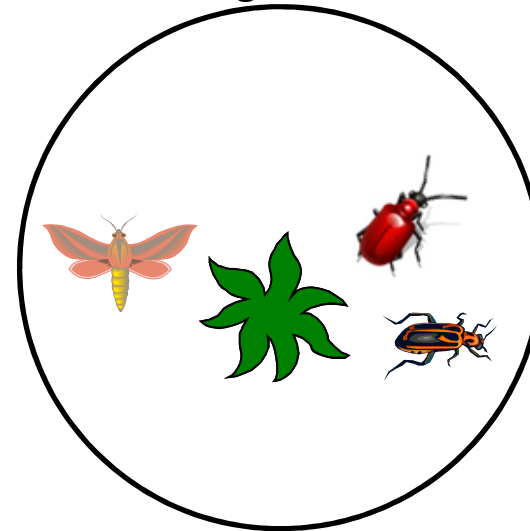
- Apply self organising map models to estimate risk of establishment
 - **Worner SP & Gevrey M** (2005) Journal of Applied Ecology 43, 858-867
 - **Paini DR, Worner SP, Cook DC, De Barro PJ and Thomas MB** (2010) Using a self organising map to predict invasive species: sensitivity to data errors and a comparison with expert opinion. J. Appl. Ecol. 47: 290-298
- Identifies patterns of association in the distribution of invasive pests
- Integrates across biological invasion patterns and processes
 - Trade and natural pathways
 - Climate suitability
 - Cropping patterns

Self Organising Map (SOM)

Region A



Region B



= high likelihood

Pests listed by estimated invasion potential

rank	Insect pest species	risk index
1	<i>Scirpophaga incertulas</i>	0.7924
2	<i>Oryctes rhinoceros</i>	0.7722
3	<i>Sesamia inferens</i>	0.7695
4	<i>Scrobipalpa heliopa</i>	0.7128
5	<i>Marasmia exigua</i>	0.6856
6	<i>Diaphorina citri</i>	0.6807
7	<i>Aleurocanthus woglumi</i>	0.6801
8	<i>Leucinodes orbonalis</i>	0.6748

Paini et al. (2010)

Climate similarity modelling

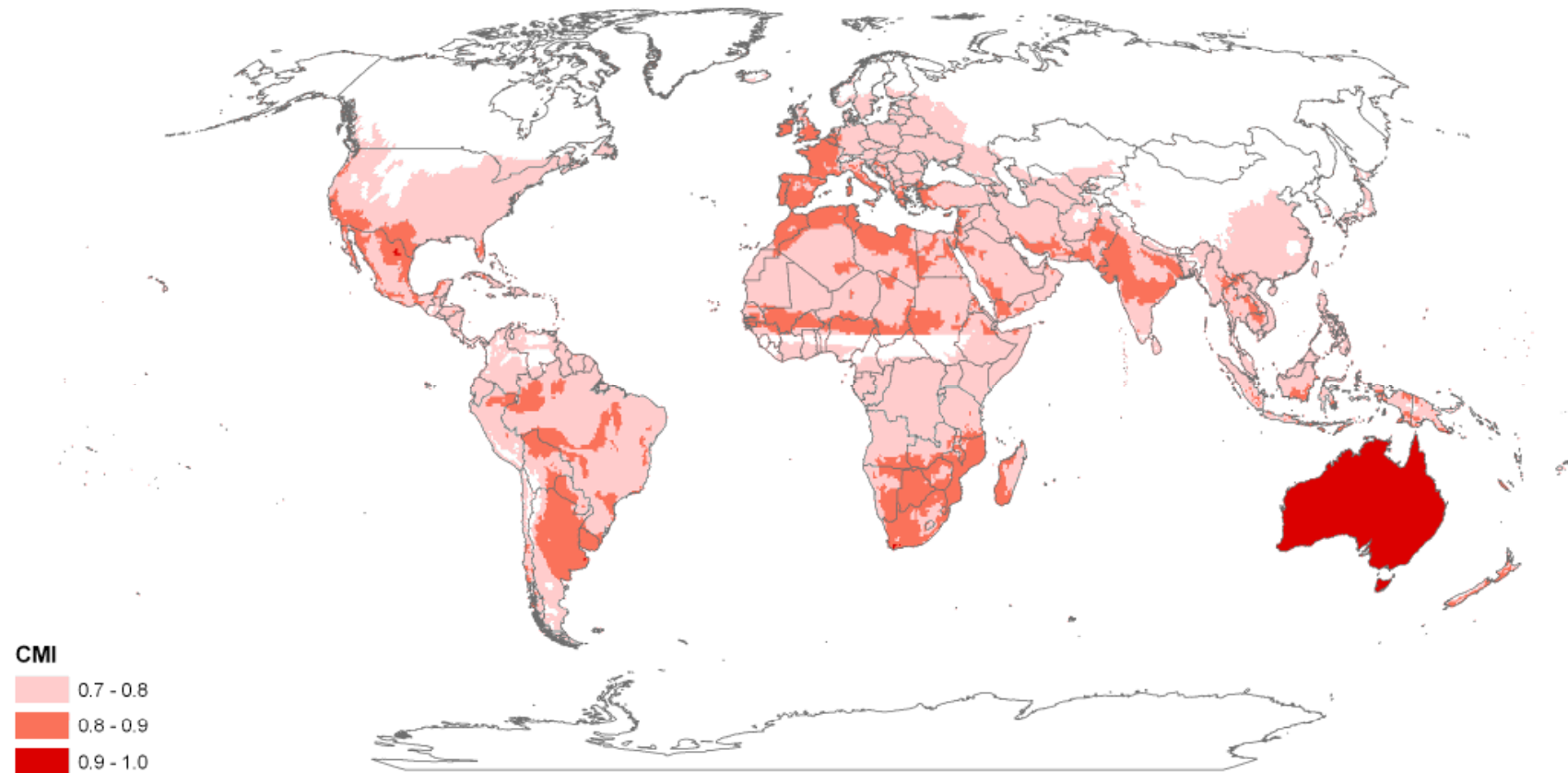
Which source areas?

Which pest species?

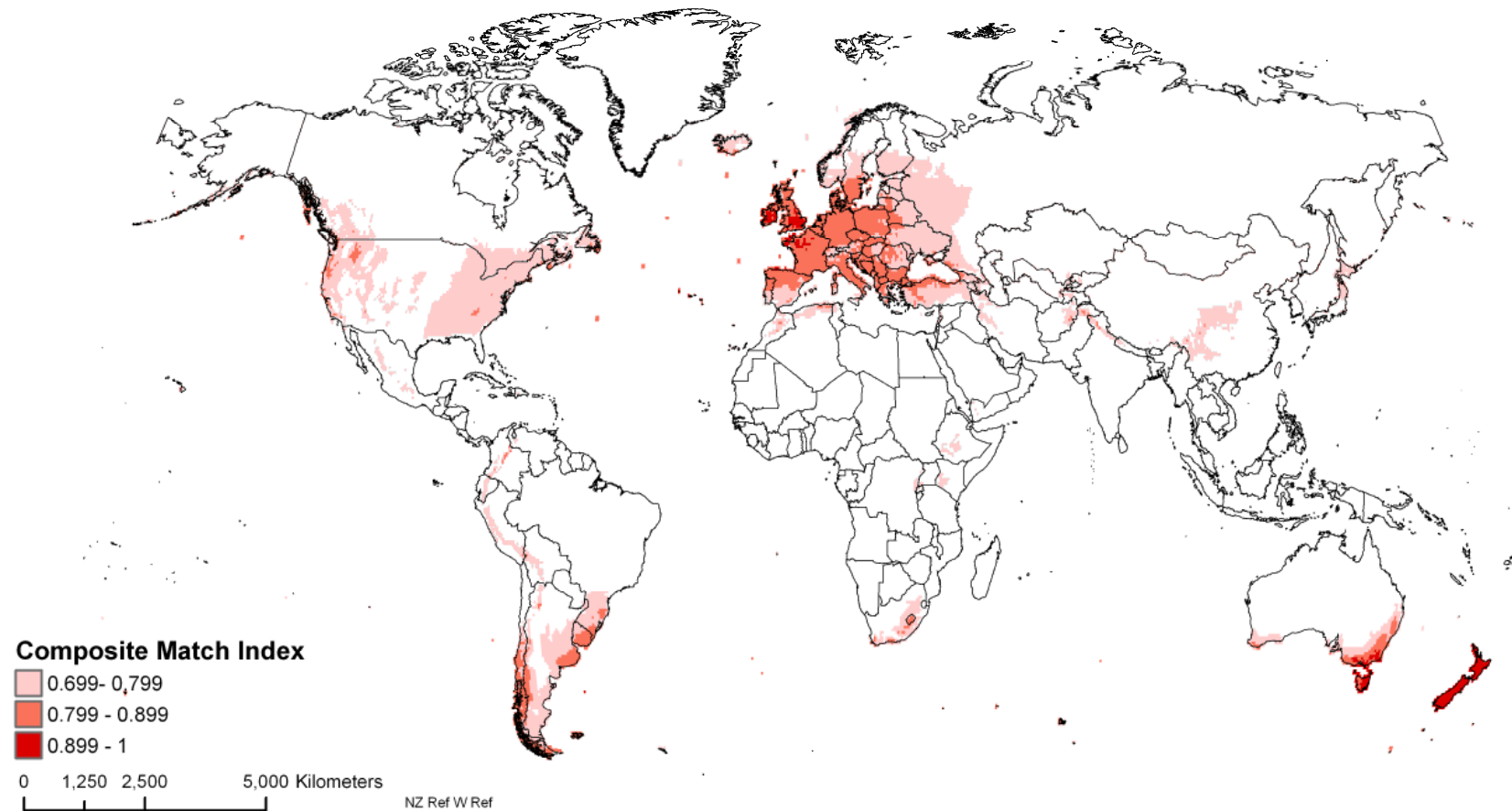
Climate-matching

- Identify areas that are bioclimatically-similar to a jurisdiction
 - Climatically-similar areas are likely to pose a higher pest risk threat than otherwise
 - High profile pests whose ranges overlap climatically-similar areas may pose a threat
- CLIMEX Match Climates (Regional)

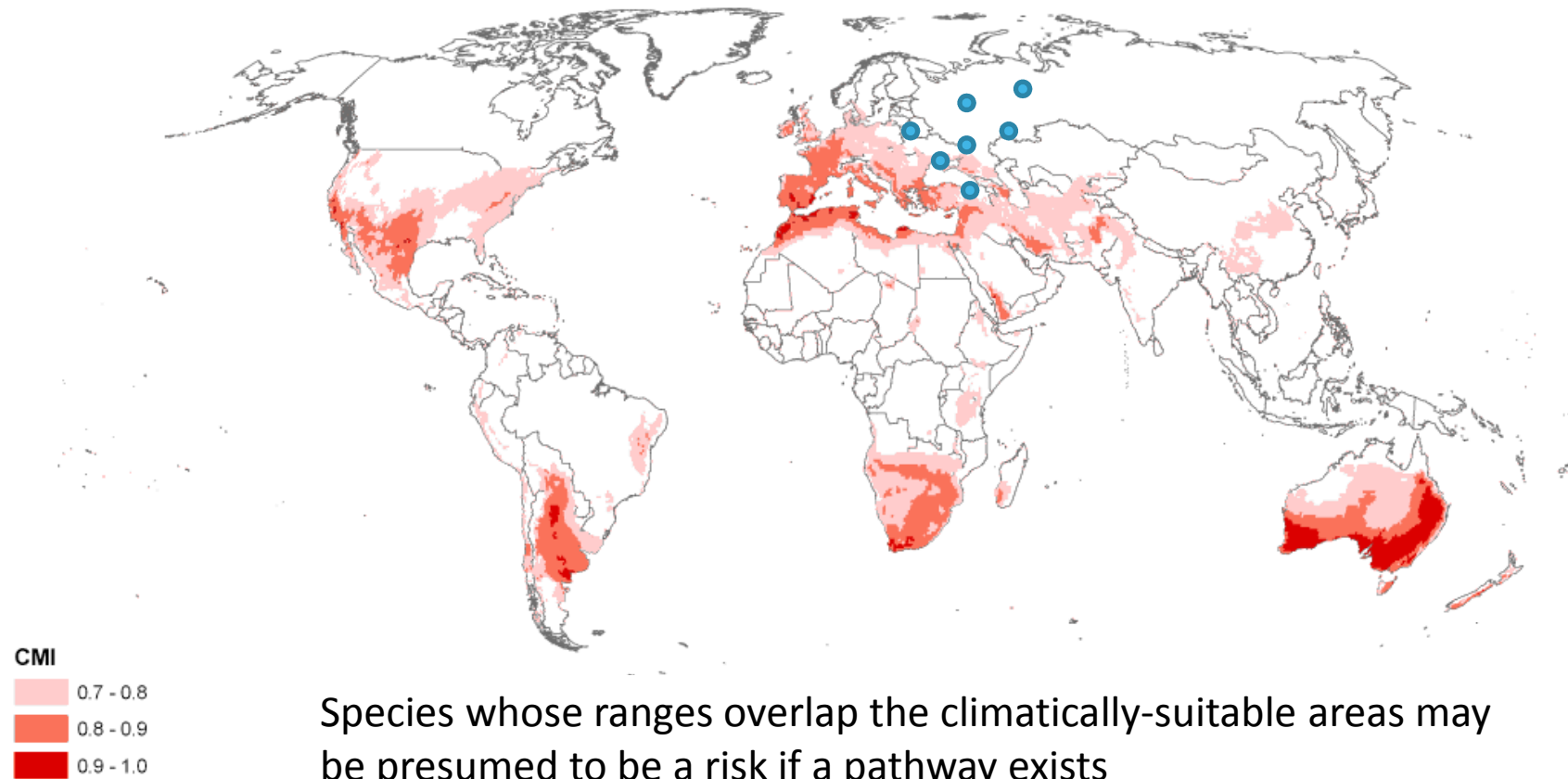
Australia has a diverse climate!



New Zealand's climatic pest risk

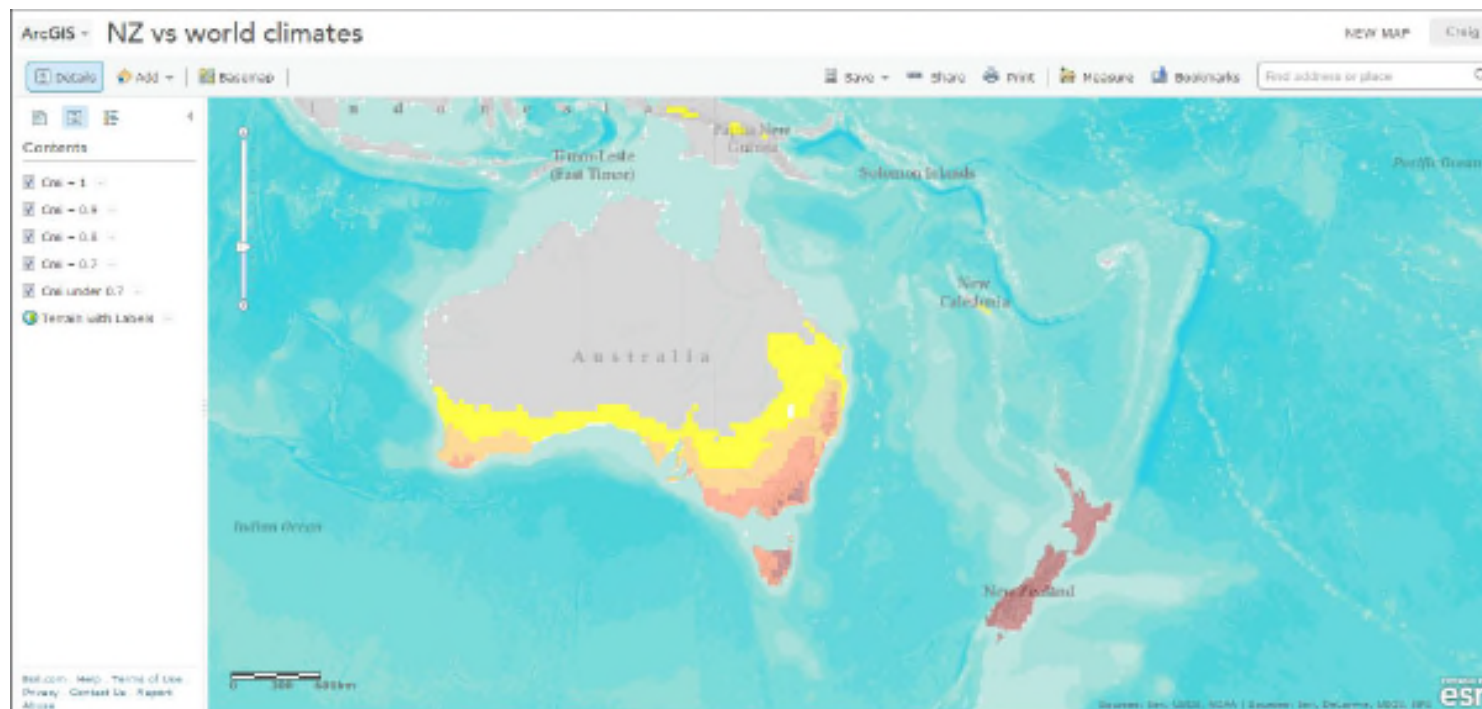


Climate match for Australian Cropping Areas



Adopted in New Zealand Biosecurity

- CLIMEX Climate similarity model made available as a GIS application



Bioclimatic Niche Models

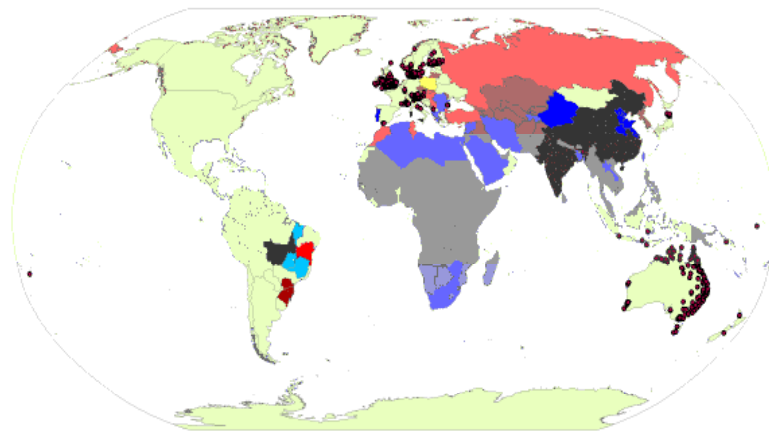
Where and when does a species pose a threat?

Niche modelling

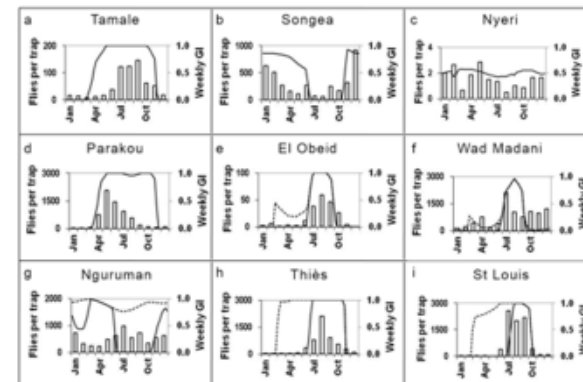
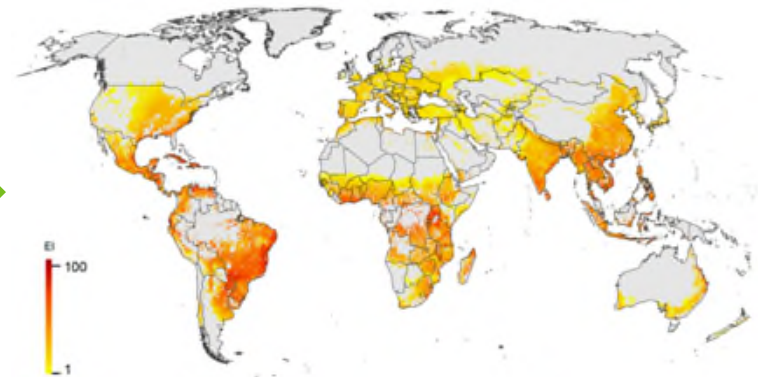
- Identifying the “endangered area” (ISPM 11)
- To persist at a location, a species needs to grow sufficiently during the favourable seasons to offset the population losses during the unfavourable seasons



Potential Distribution Modelling



GBIF • *Helicoverpa armigera*_GBIF_loc_recs
 Cab Country: Present, no further details Widespread Localised Occasional or few reports
 Sub-national unit: Present, no further details Widespread Localised
 Brazil with armigera.ppt blue red



New advances

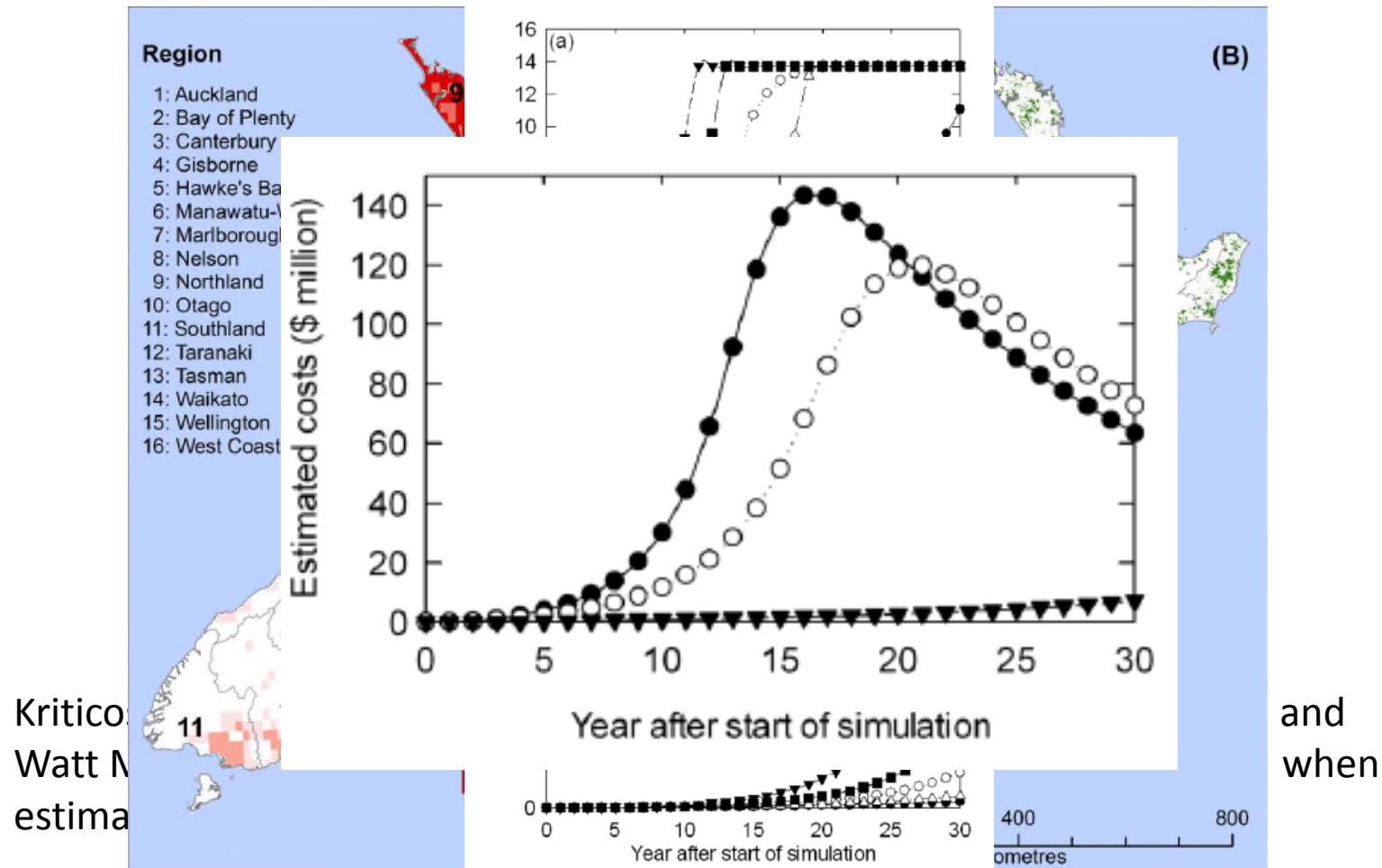
- Cropping areas – MapSpam
- Irrigation – Siebert et al. 2005
- Climate change
- Climate variability
 - Seasonal
 - Interannual

BioEconomic modelling

How much is it likely to cost?

**How much is it worth to
manage the risks?**

Combine Niche models, Spread models and Spatialised economic data



Adoption of Models in Biosecurity Management

Adoption of Models has been disappointing

- Separation between science and risk managers
- Science values truth, accuracy, novelty and publications
- Risk managers value speed, simplicity, and the ability to include consideration of political imperatives
- Reluctance of risk managers to pay for modelling expertise
- Research agencies sometimes slow to respond
- Greater adoption of models and model products in NZ than Australia

Emergency Plant Pest Response Deed

- In Australia (and soon in NZ)
- Legal agreement between Governments and Industry
- “The Deed”
 - The management and funding of responses to emergency plant pest (EPP) incidents
- EPP eradication responses are carried out by State Governments, paid for initially by the Federal Government
- The deed sets out a formula for transfers of money between “threatened” states and the “frontline” States
- Identifying the potential distribution of the EPP is a critical step to allocating costs
- The deed process is driven by a value of **consistency** of approach and pre-agreed formulae

CLIMATCH

- Is the modelling platform mandated in the Australian Intergovernmental Agreement to estimate “potential distribution” for cost-sharing because it is claimed to be *consistent*
- When used to estimate species potential ranges CLIMATCH has been demonstrated to be highly inaccurate
- There are many modelling decisions that influence CLIMATCH results – so not even consistent
- It is quick to run and easy to generate a colourful map

Summary

- Australasian scientists are developing world-leading scientific modelling methods
- Models and methods aren't always trusted sufficiently or (more usually) not fit for purpose
- Model quality and accuracy are valued less by managers than timeliness, ease of use and cheapness to run
- Need much closer engagement between scientists and risk managers
- Embed scientists within risk management agencies with a mandate to help them to develop better procedures and tools
- Tools and procedures need to be coevolved

International Pest Risk Research Group

- Next meeting
 - Tuesday 29th August - Friday 1st September 2017
 - Ottawa, Canada





International Pest Risk Research Group

Research to improve pest risk methods

Thank you

Darren Kriticos
Principal Research Scientist

t +61 2 6246 4252

e darren.kriticos@csiro.au



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