

*Spatial Information Day, 9 August 2011*

# Meta-modelling of ecological and climatic systems dynamics

**Professor Barry W. Brook**

*Sir Hubert Wilkins Chair of Climate Change*

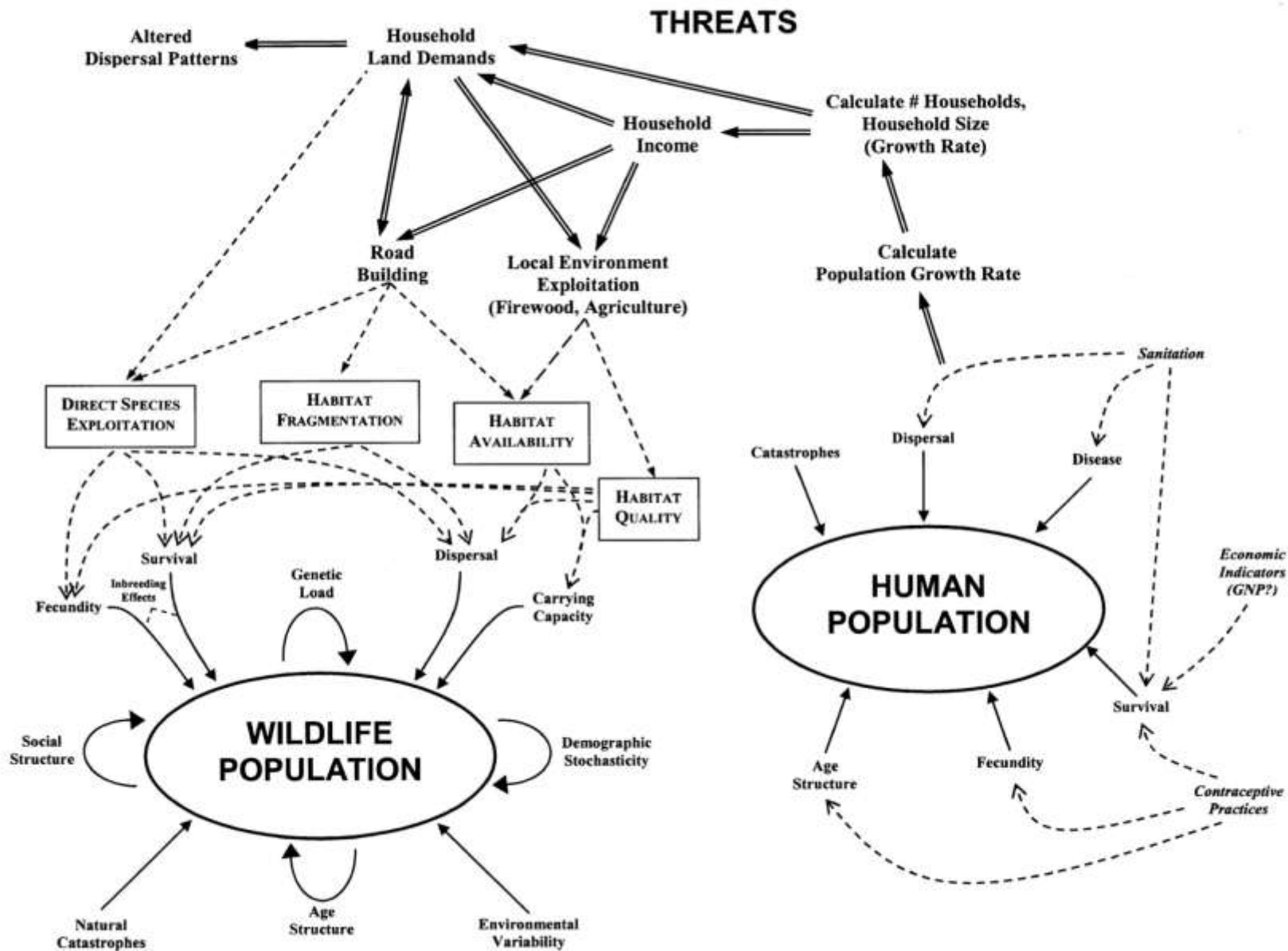
*ARC Future Fellow (Level 3)*

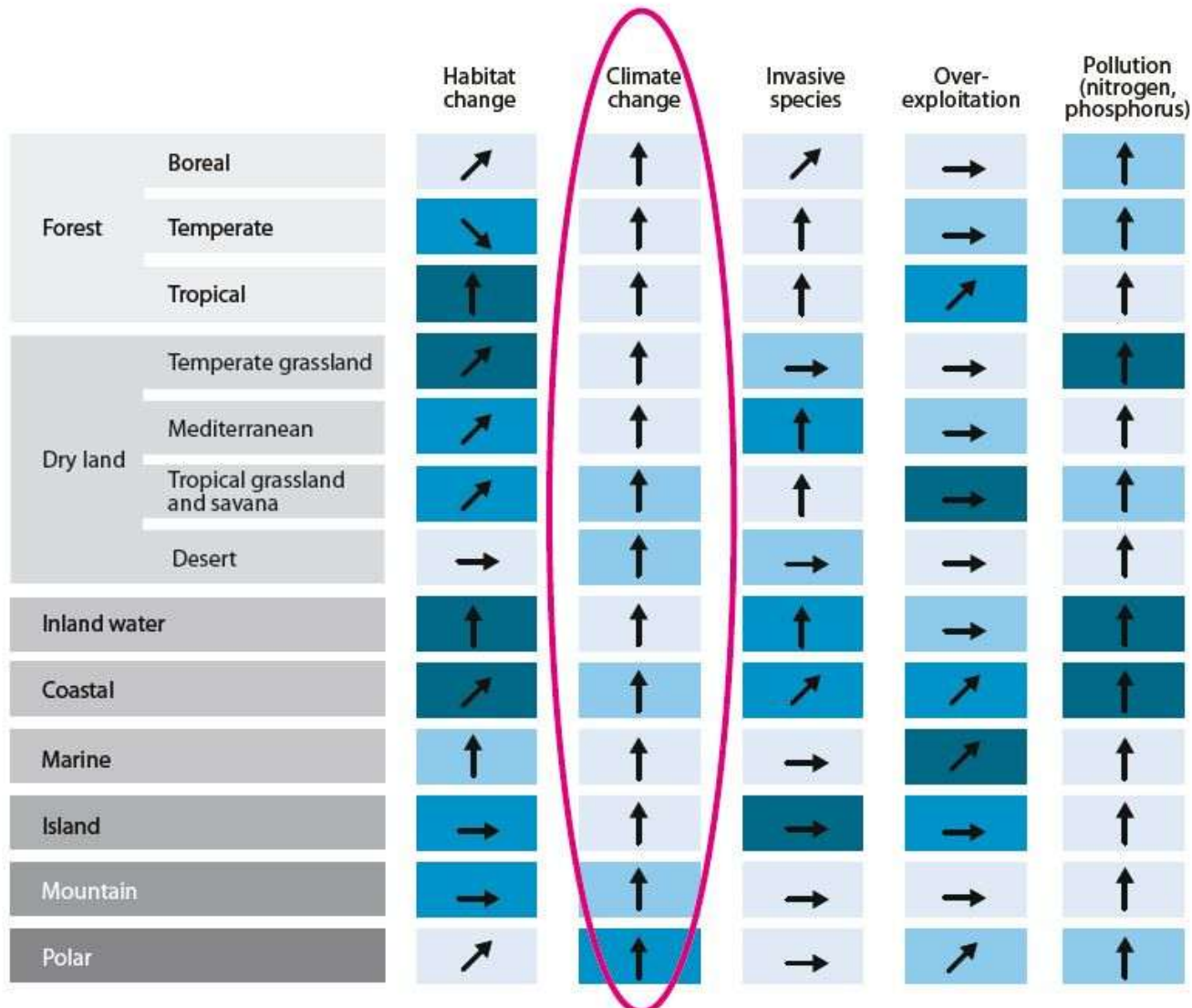
**Director of Climate Science, Environment Institute**

**School of Earth and Environmental Sciences**

**The University of Adelaide**

Contact: <http://bravenewclimate.com>

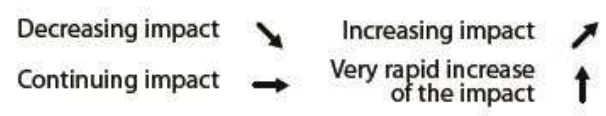




Driver's impact on biodiversity over the last century

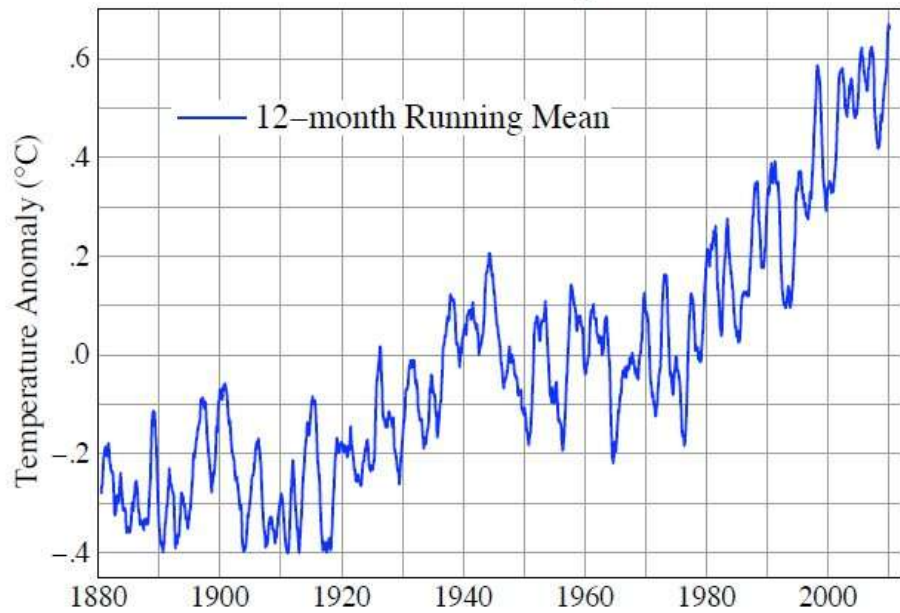


Drivers current trends

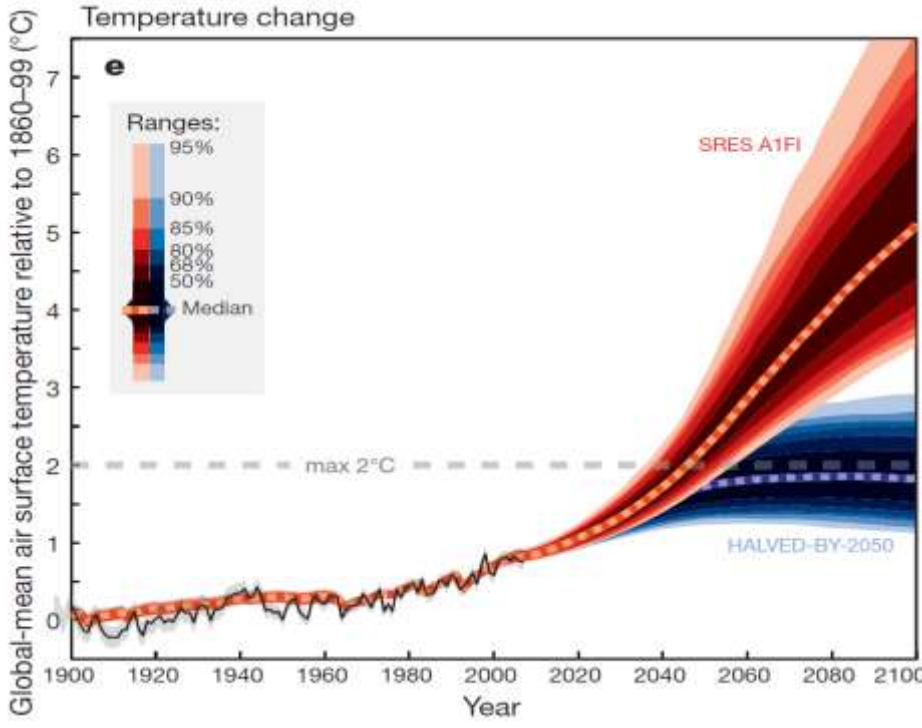
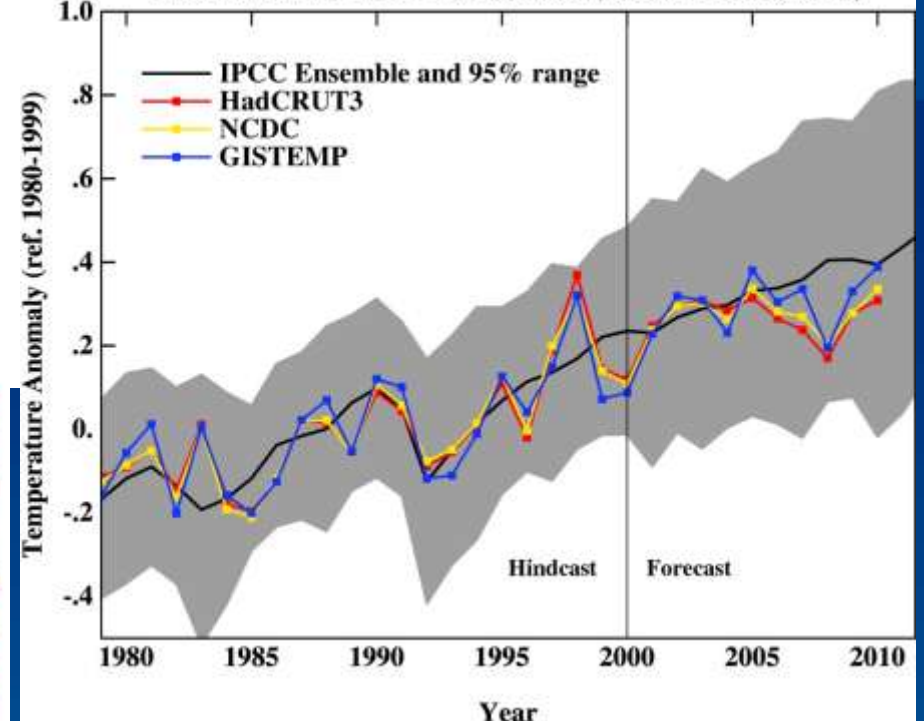


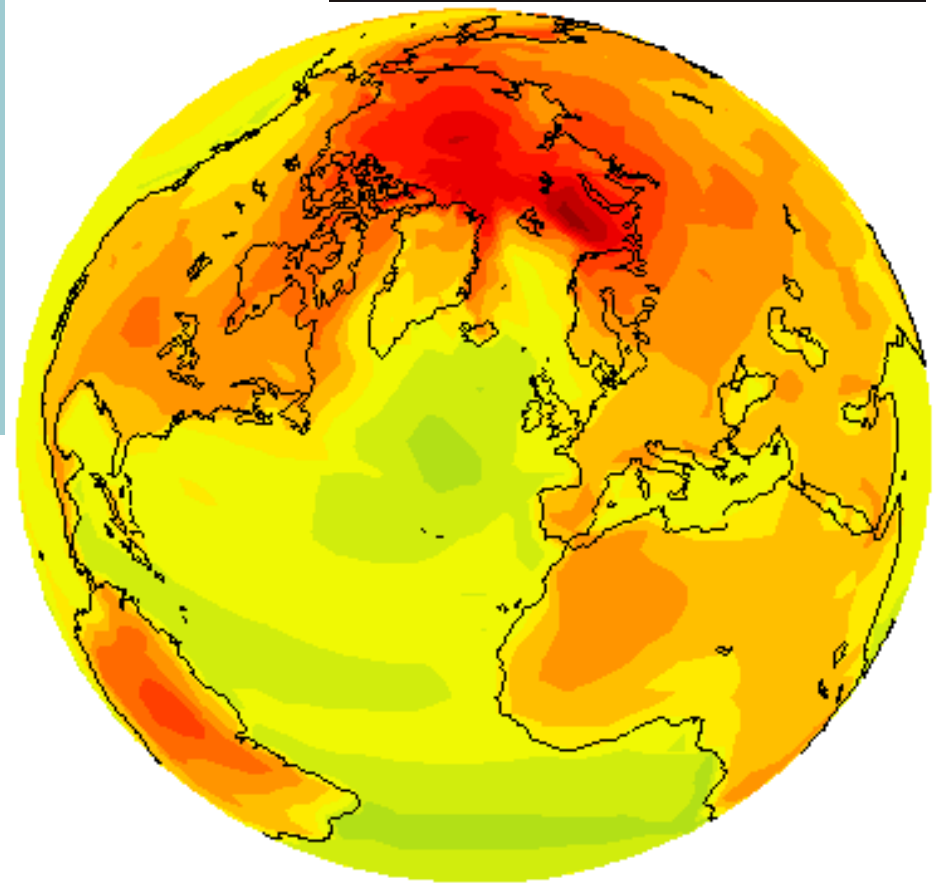
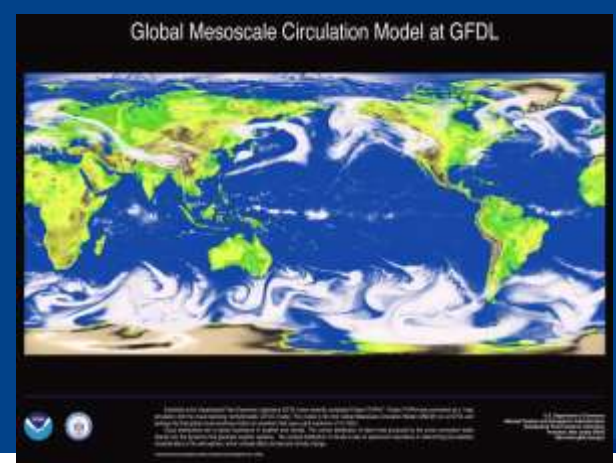
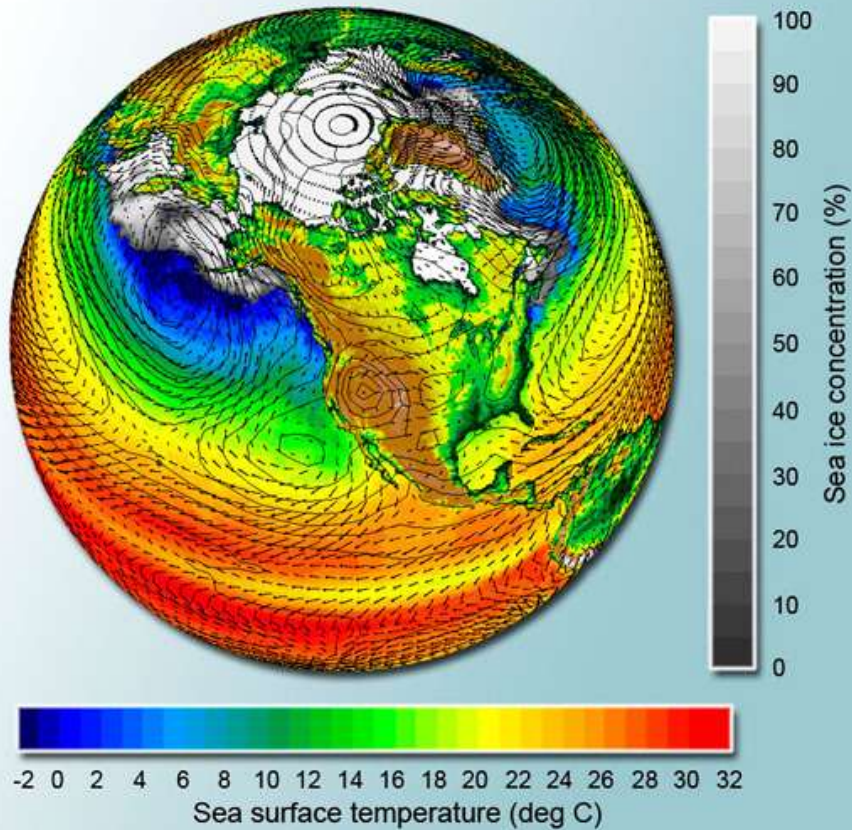
# Incorporating climate change in population dynamics models

# Global Land–Ocean Temperature Index

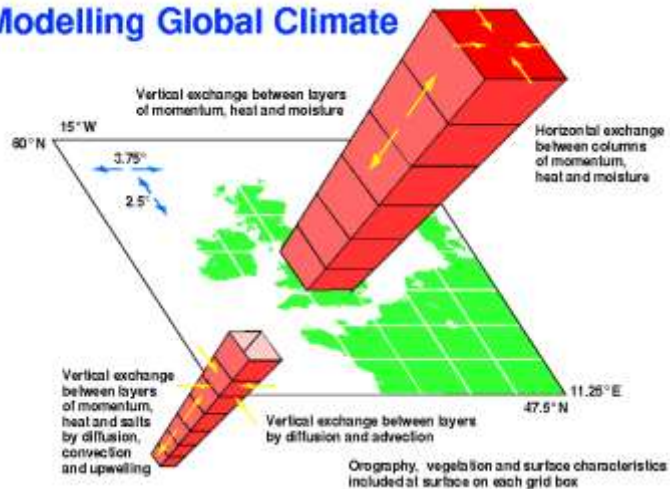


## IPCC AR4 individual realisations (20C3M+SRES A1B)

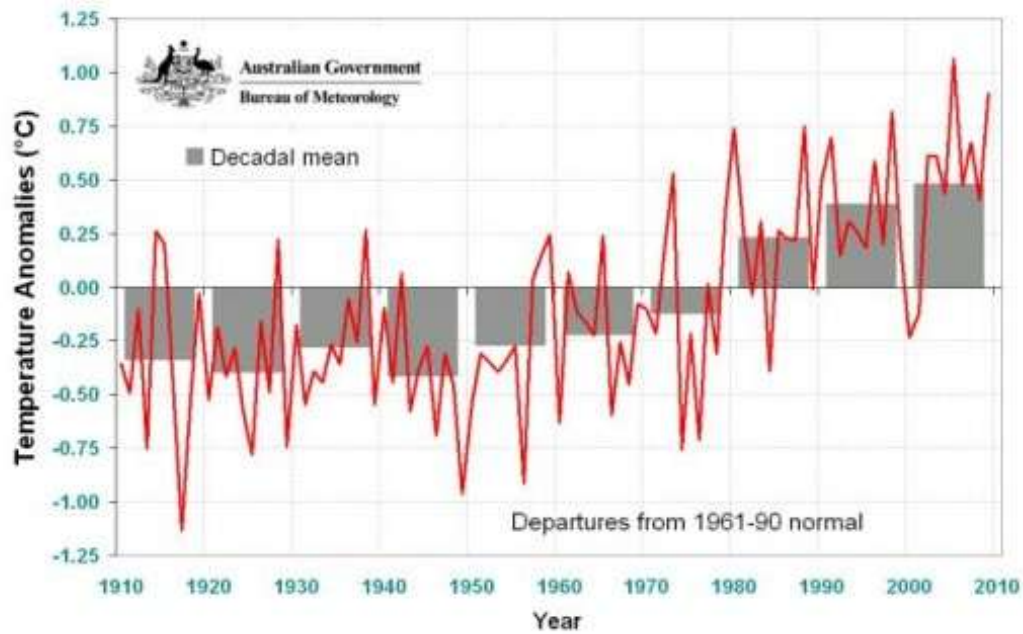




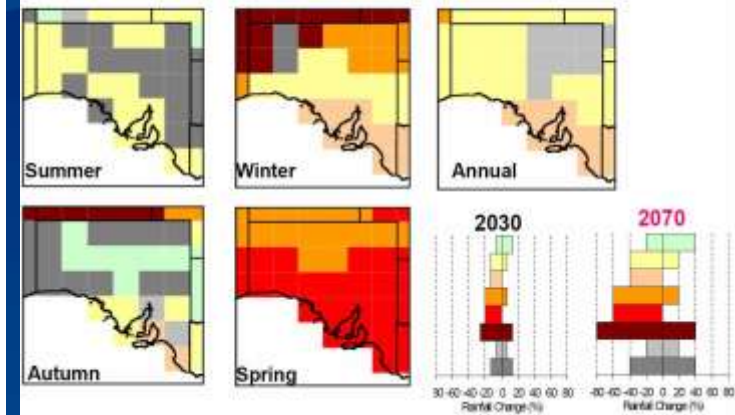
## Modelling Global Climate

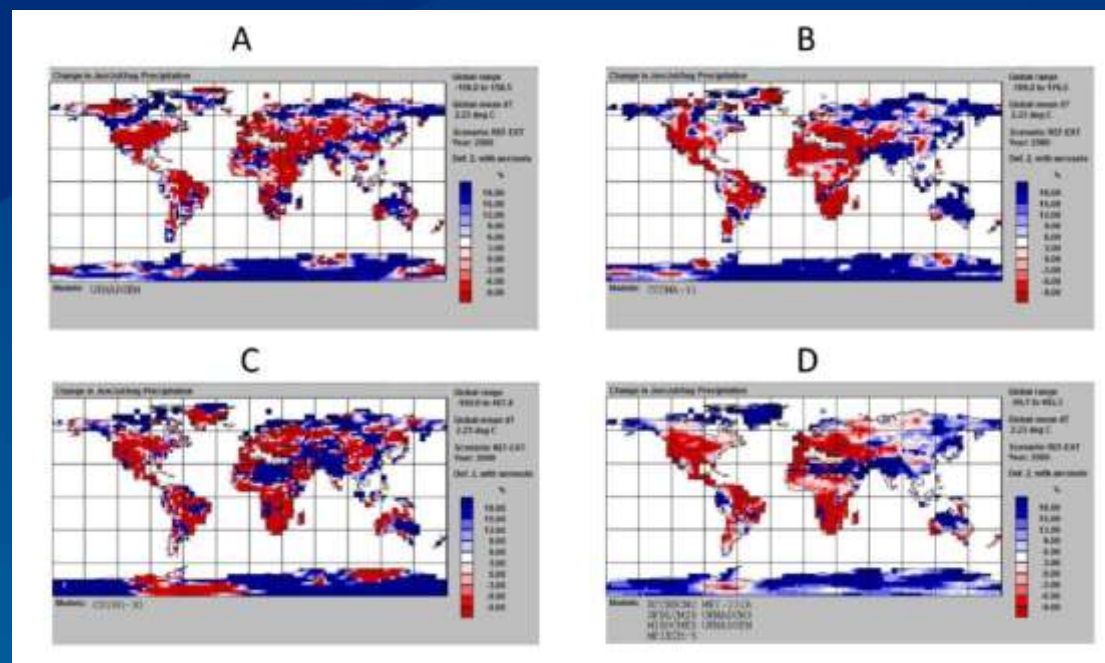
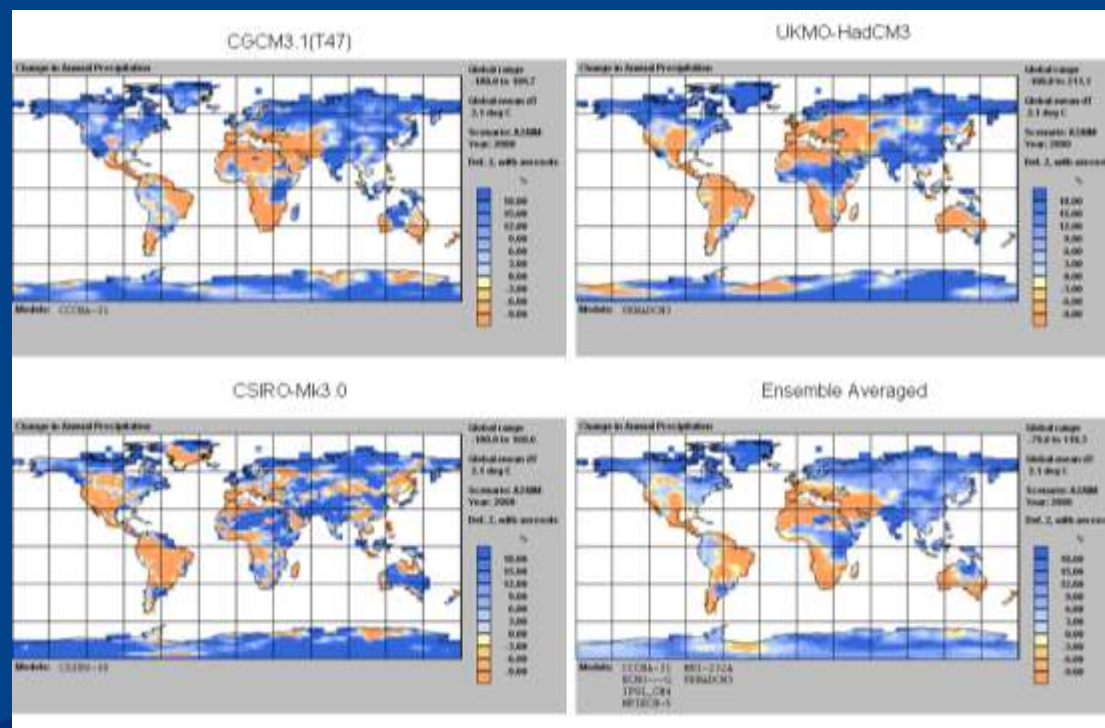


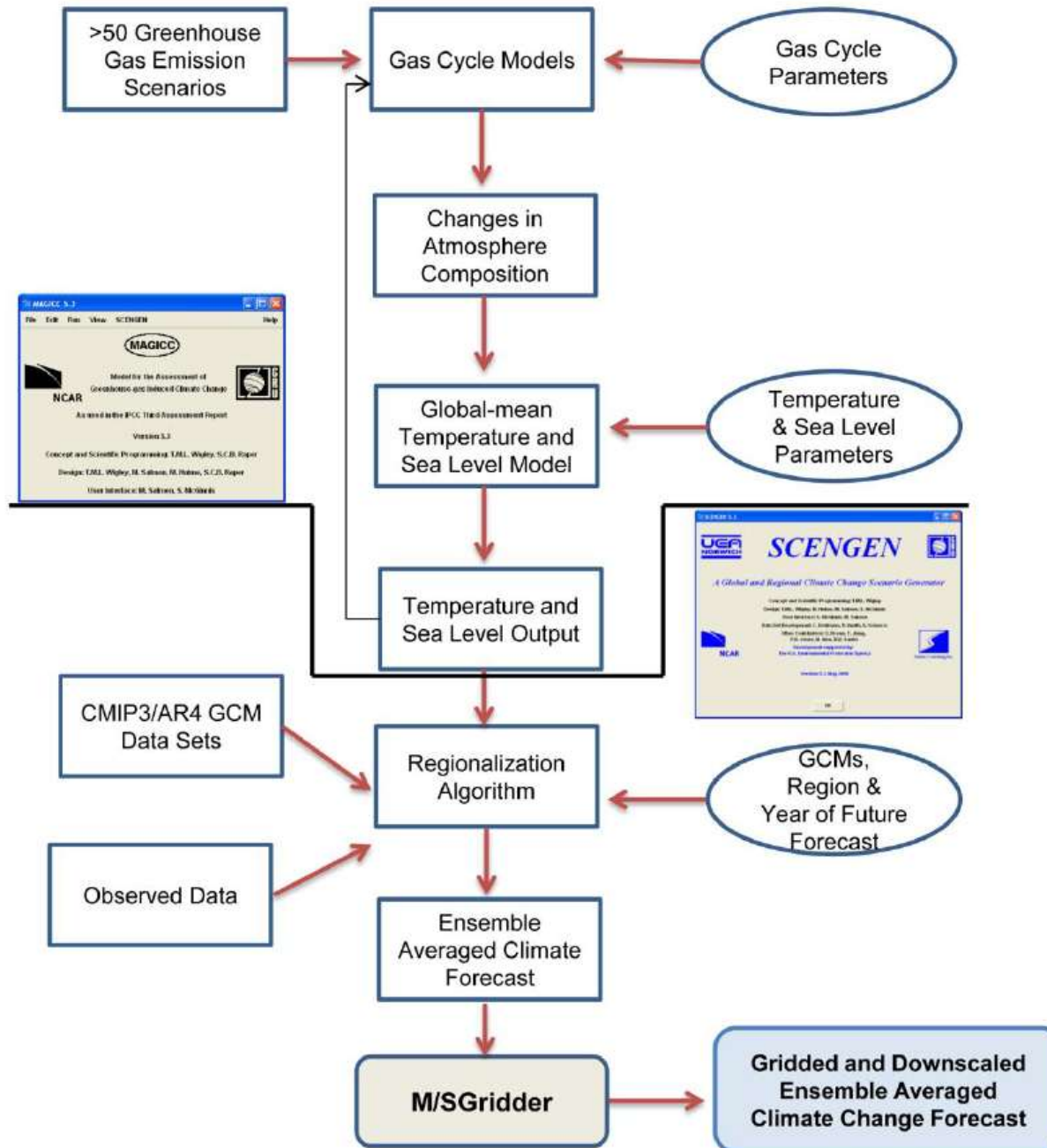
Annual and Decadal Mean Temperature Anomalies For Australia



Projected Rainfall Change







# Rainfall

# Temperature

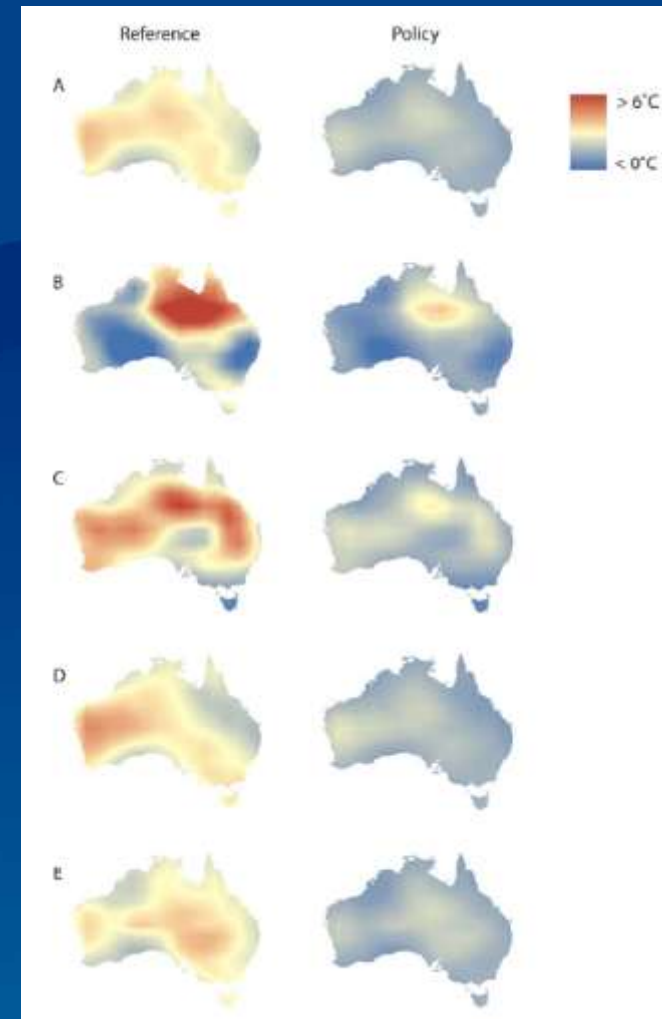
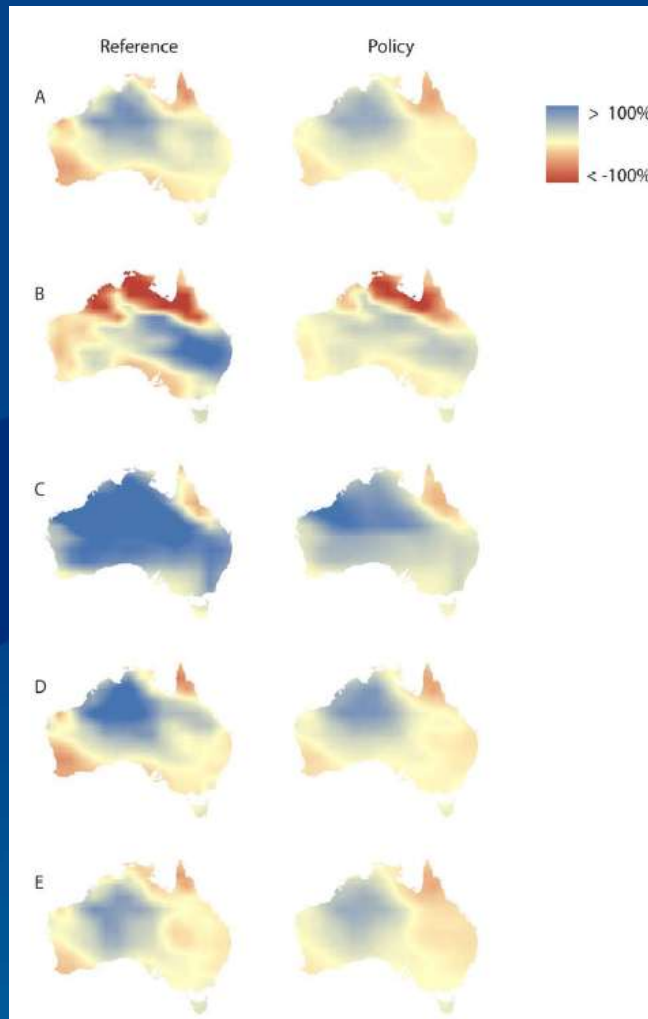
Ensemble

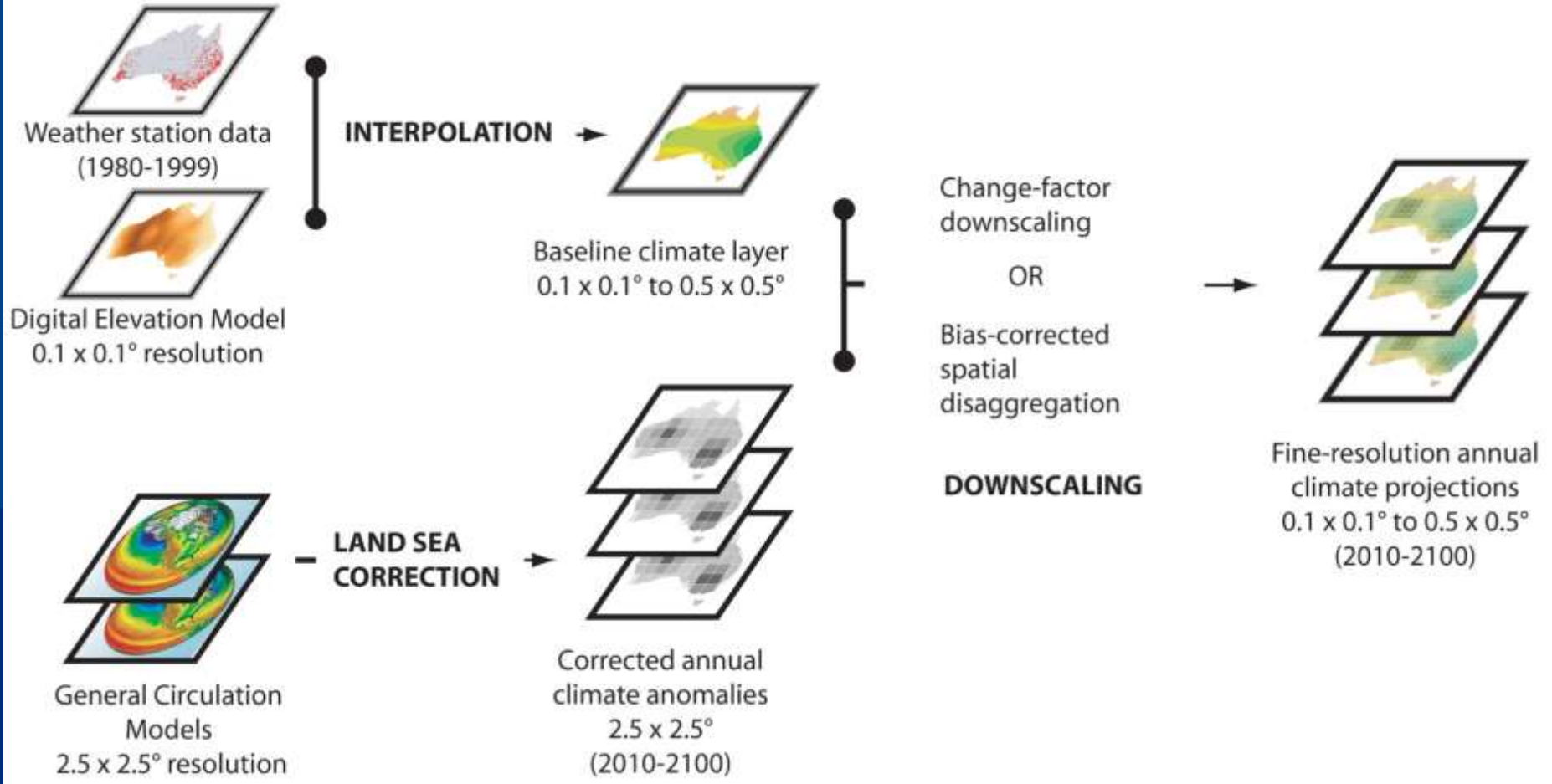
CSIRO Mk3

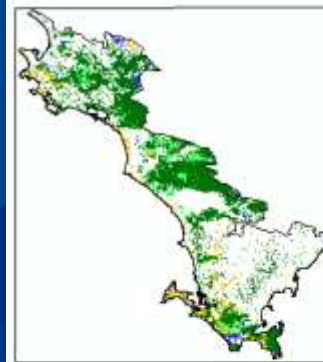
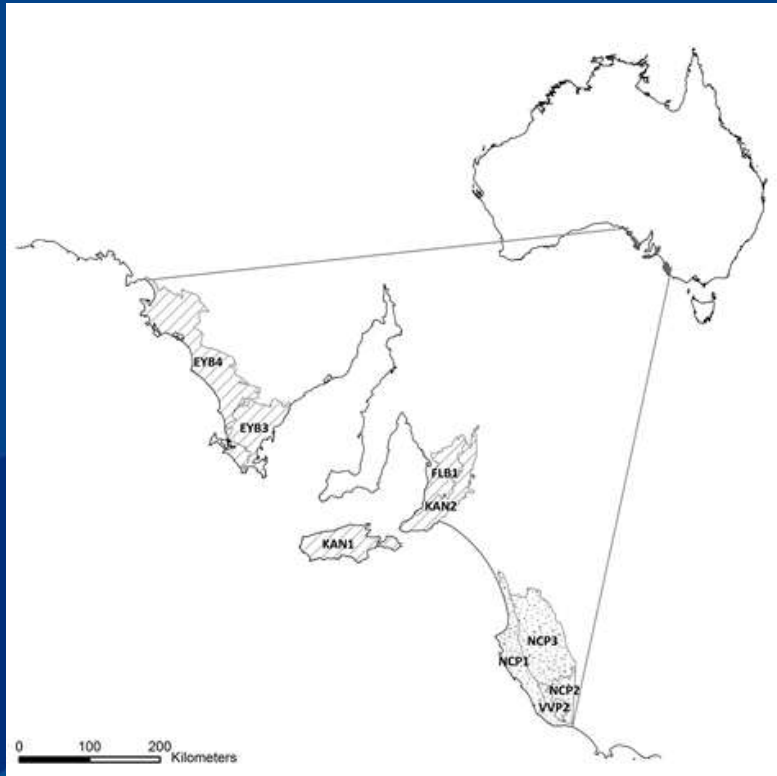
Poor skill

5M-E

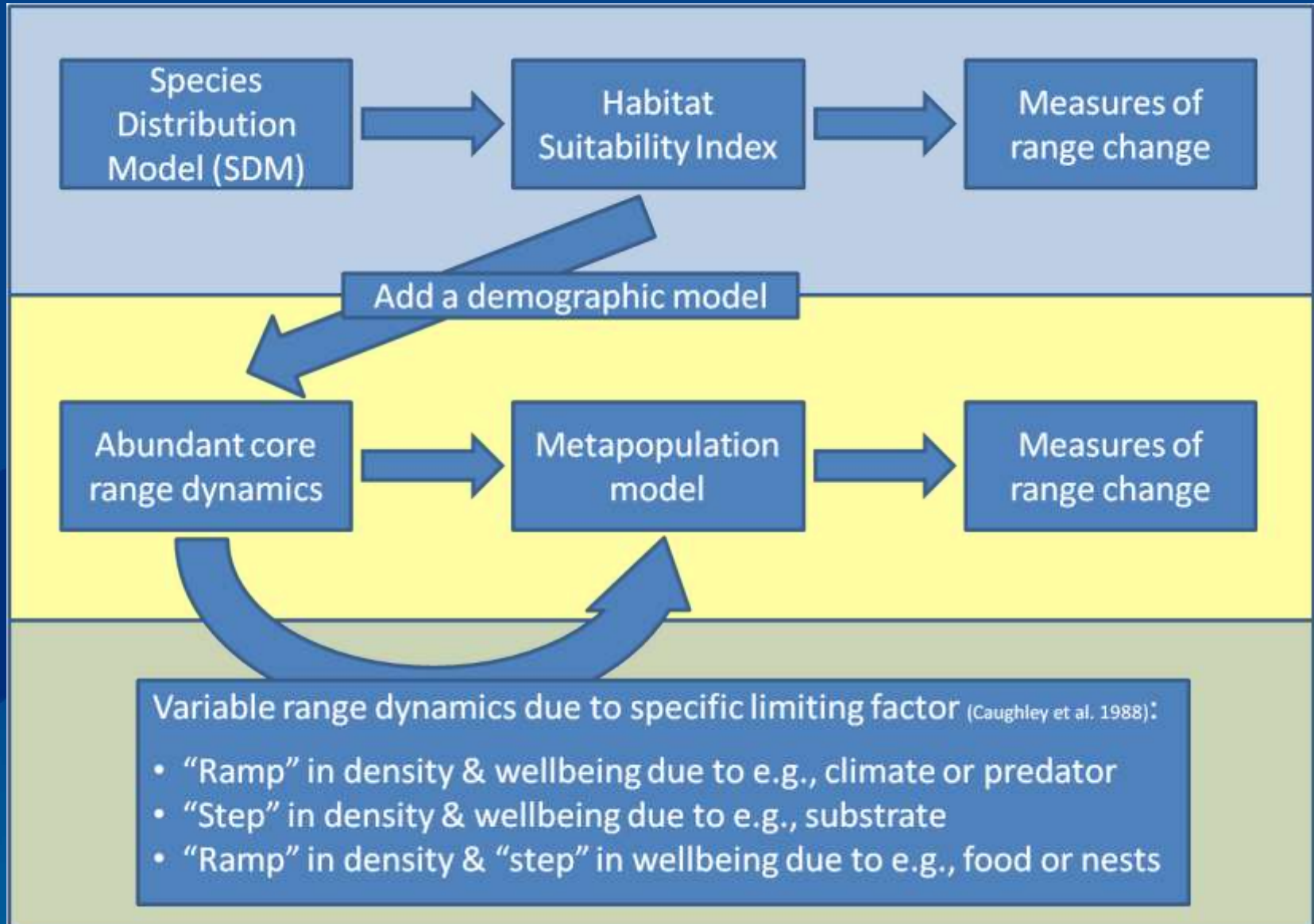
10M-E

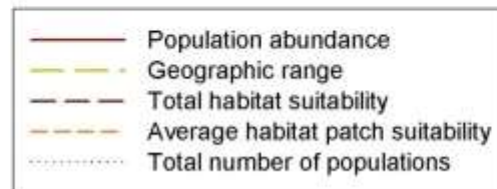
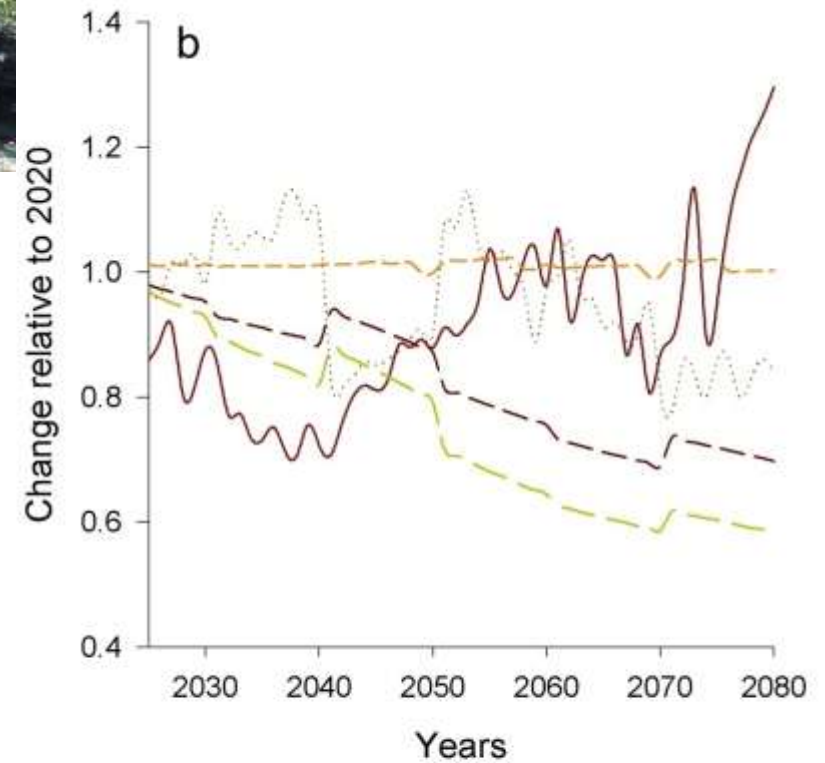
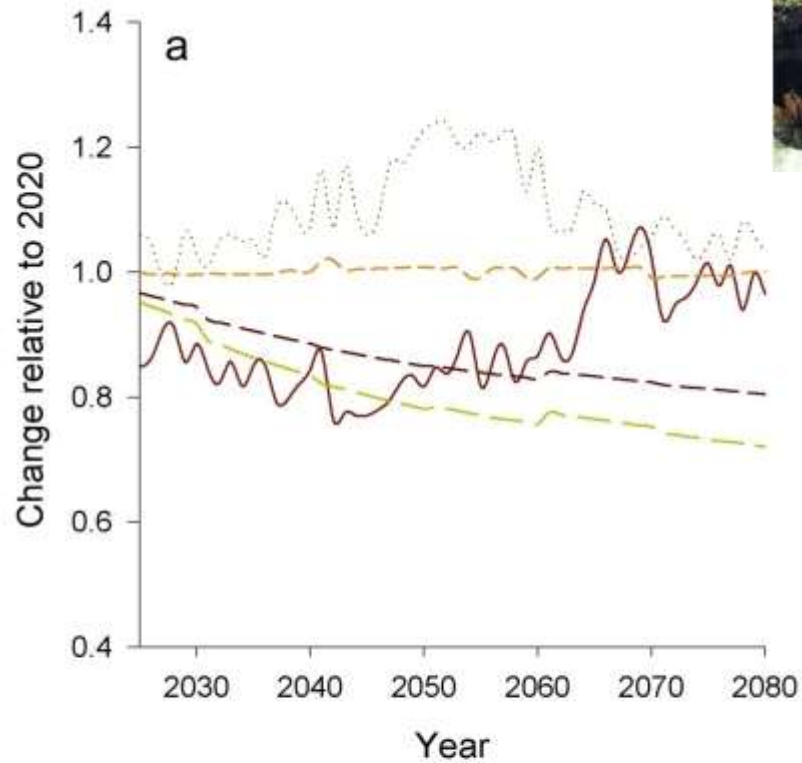


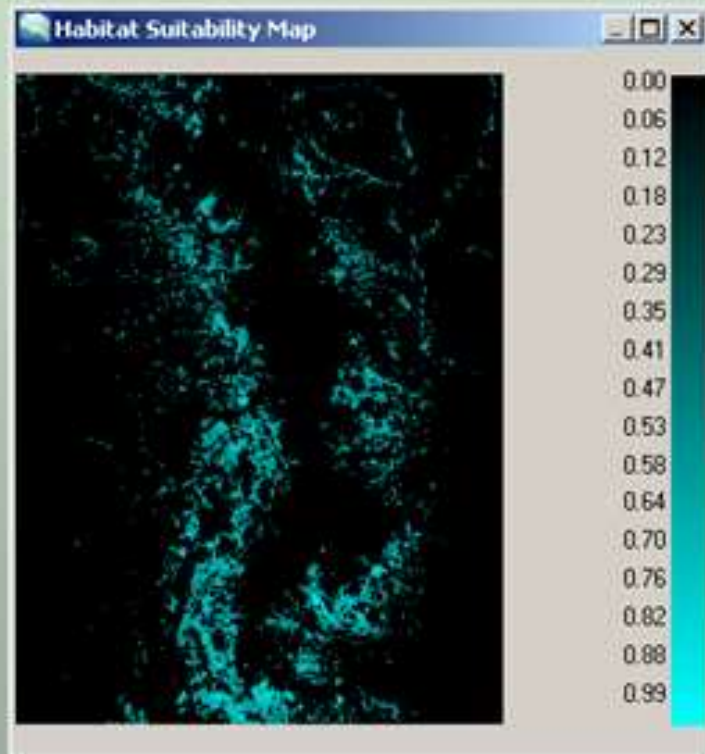




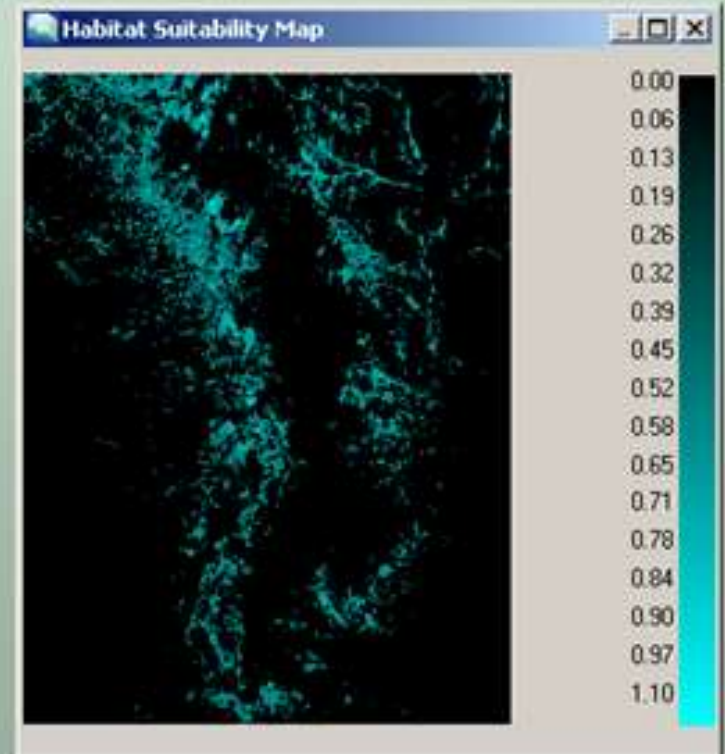
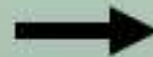
# Range shifts in rabbit metapopulation



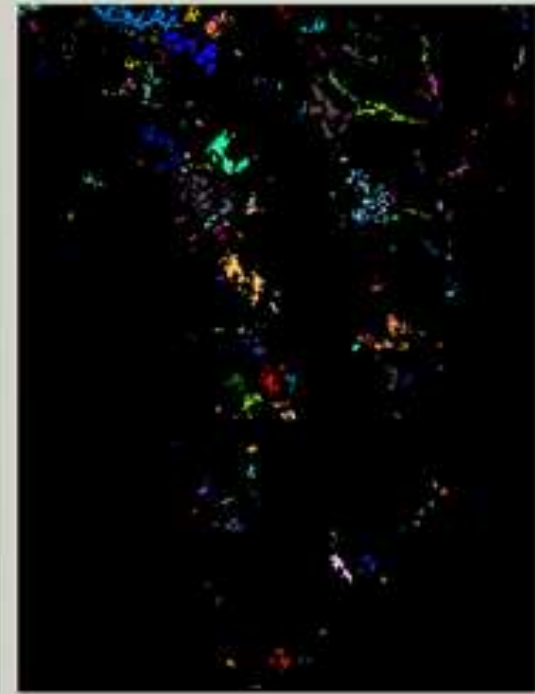
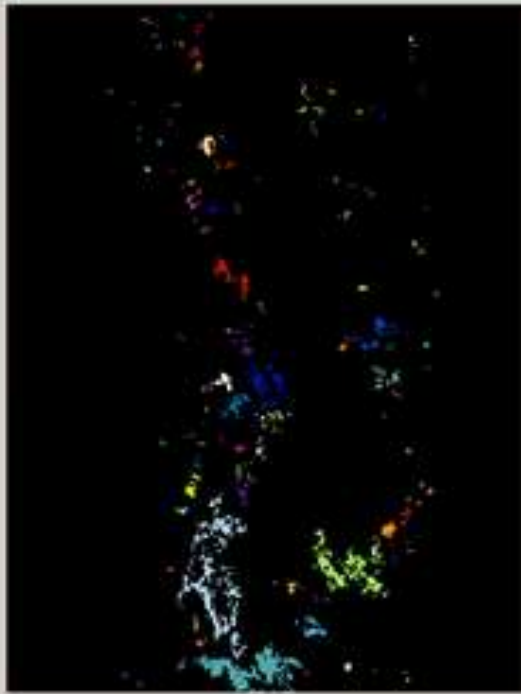




Time step 1 (Year 0)

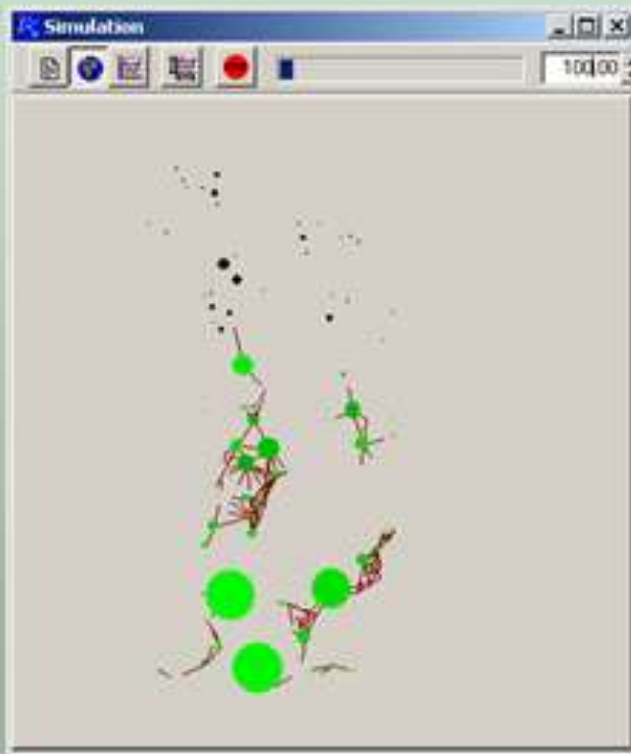


Time step 20 (Year 60)

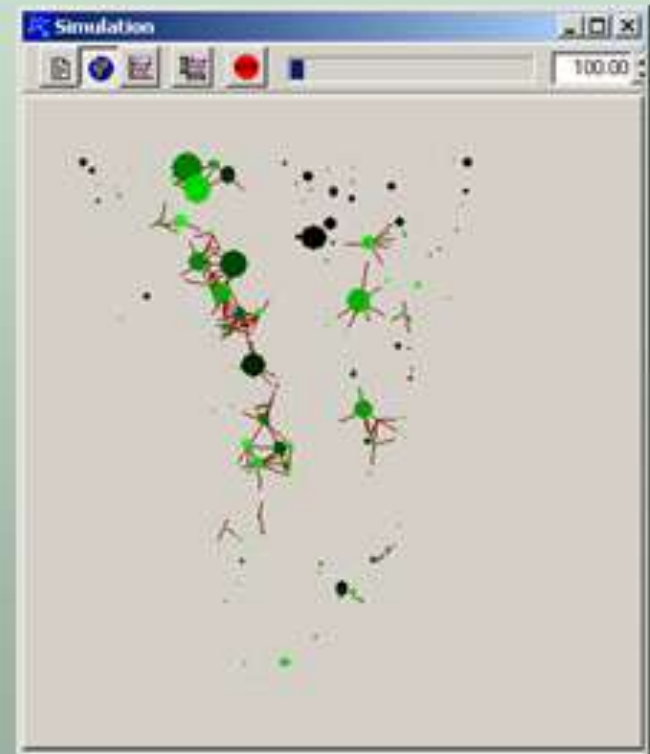
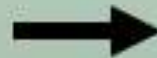


Time step 1 (Year 0)

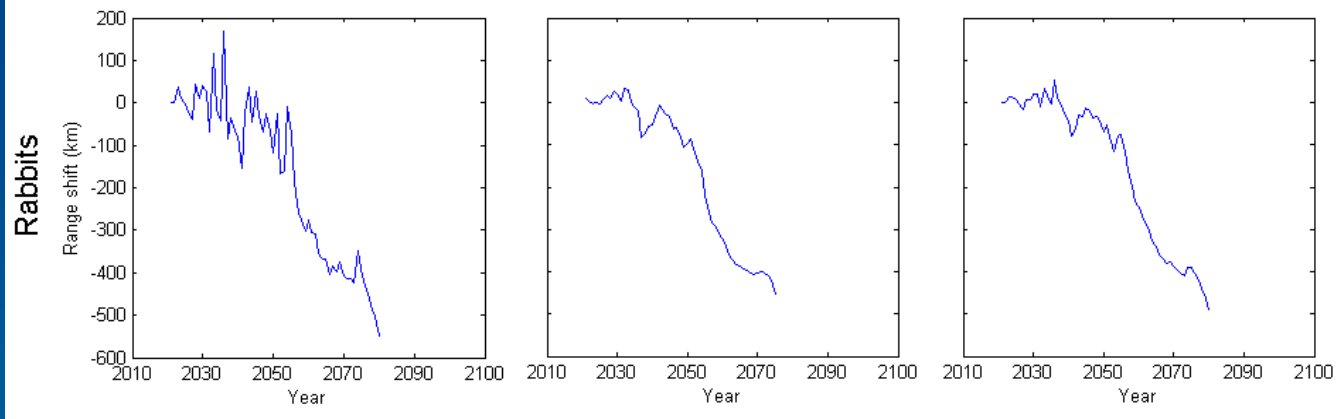
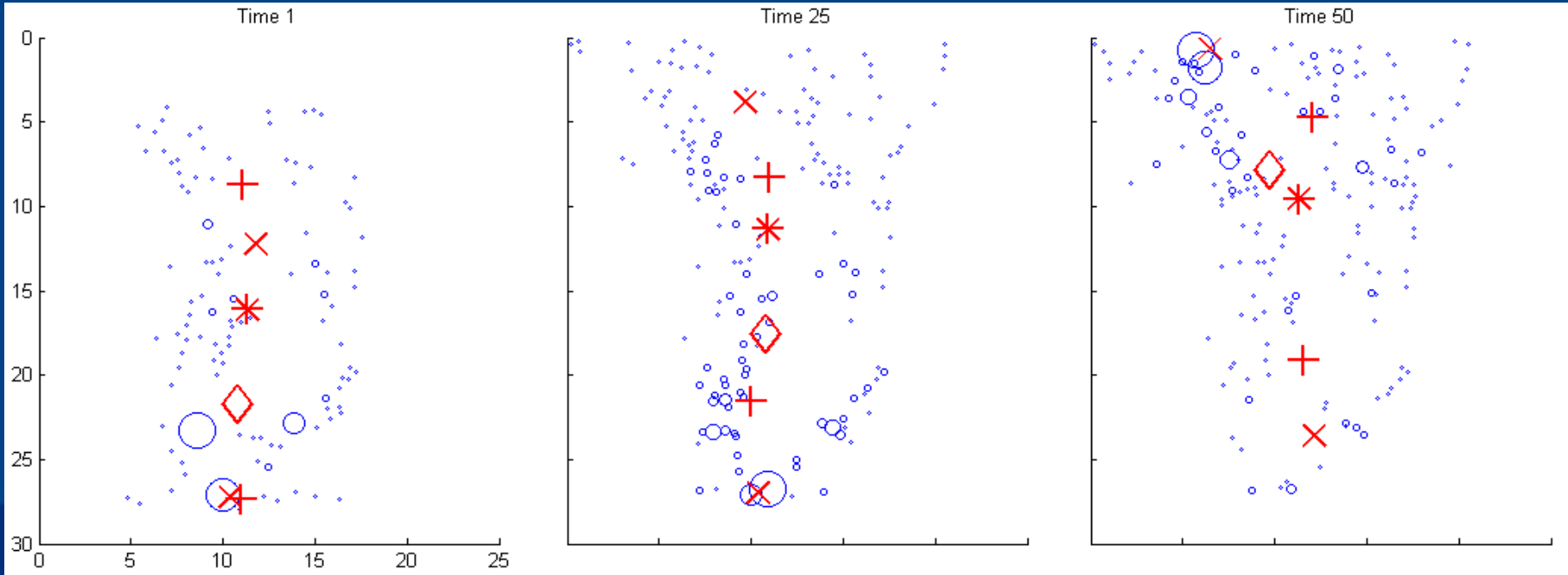
Time step 20 (Year 60)

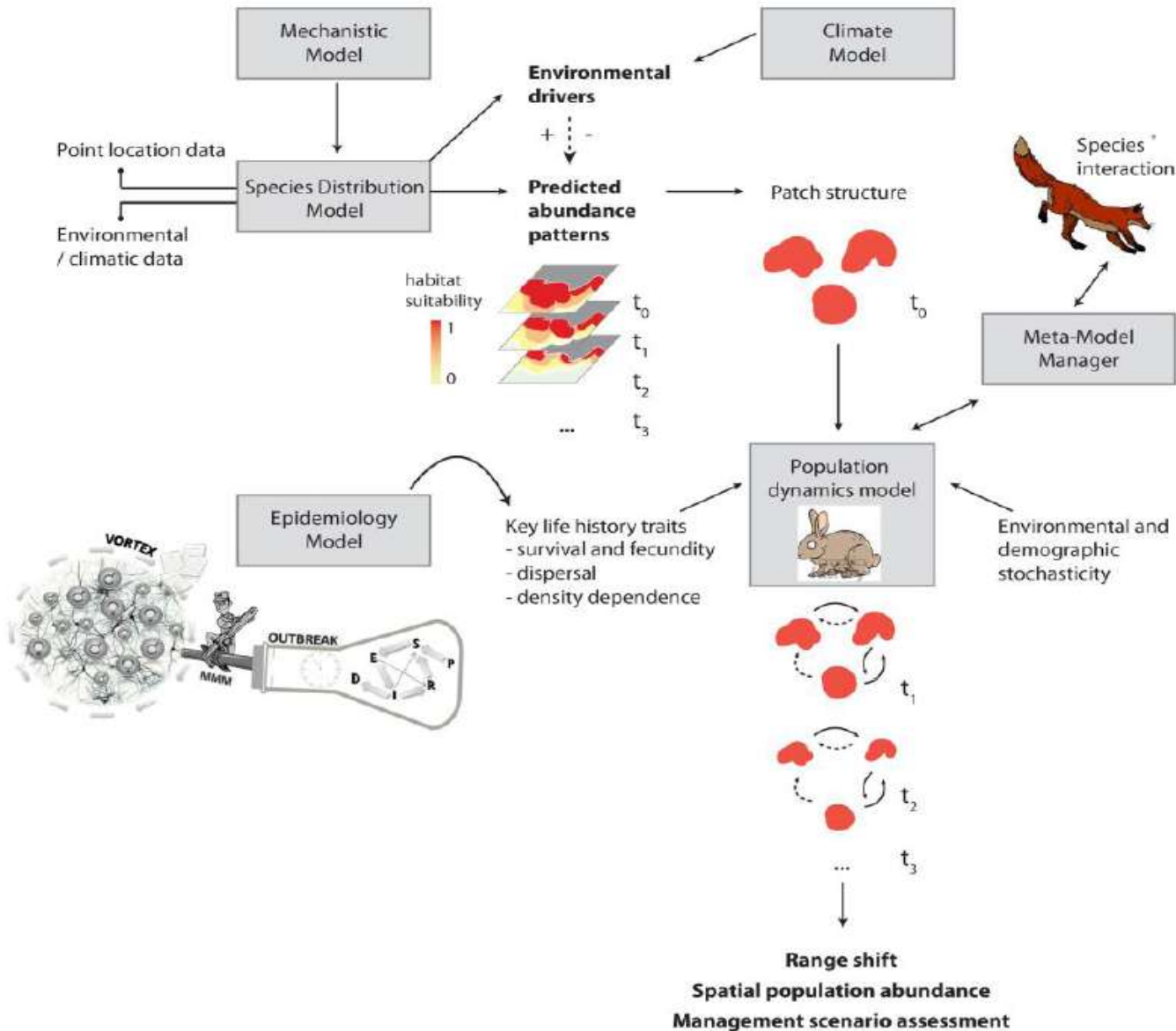


Time step 1 (Year 0)

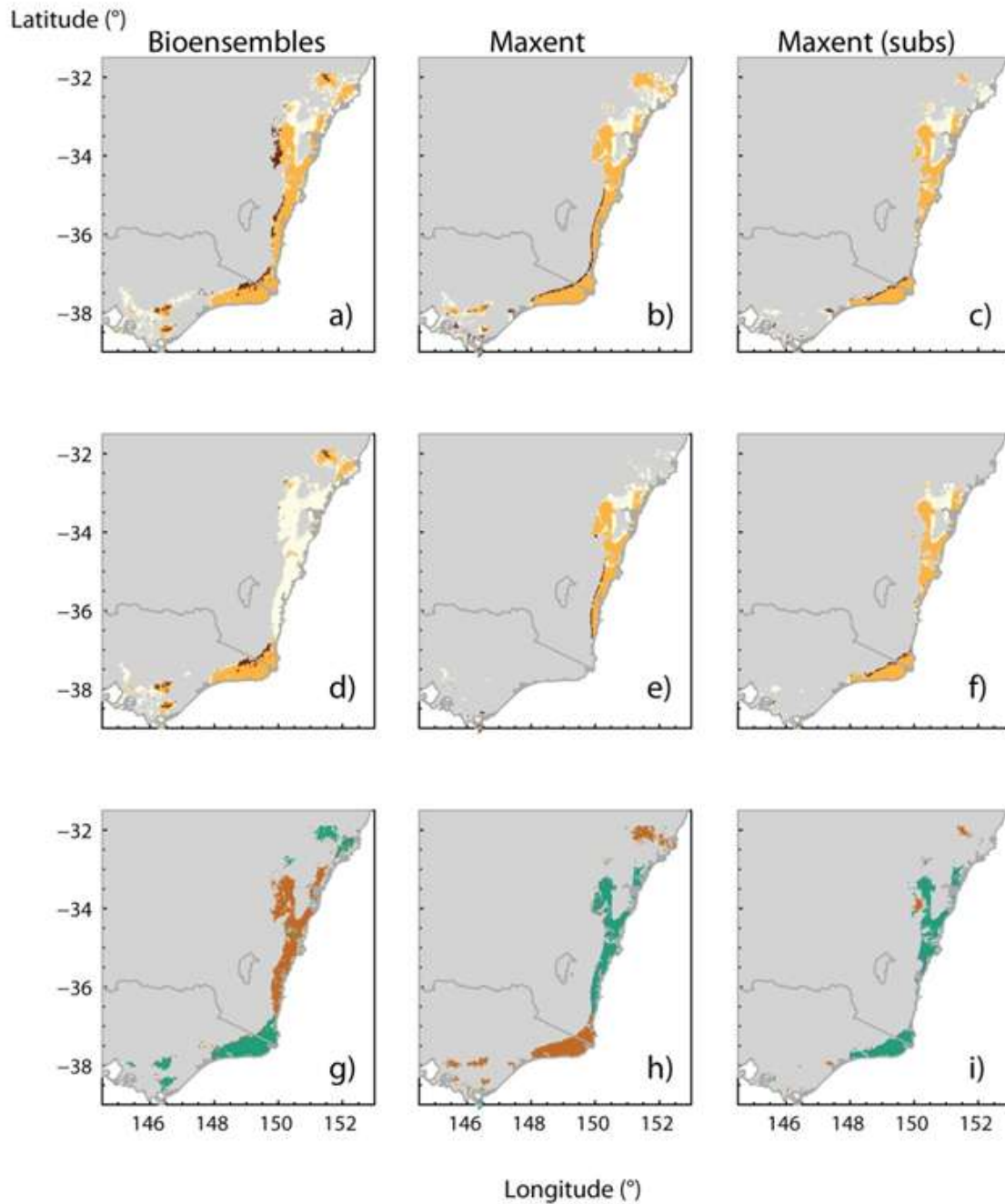


Time step 20 (Year 60)

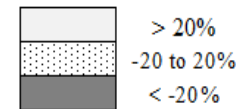


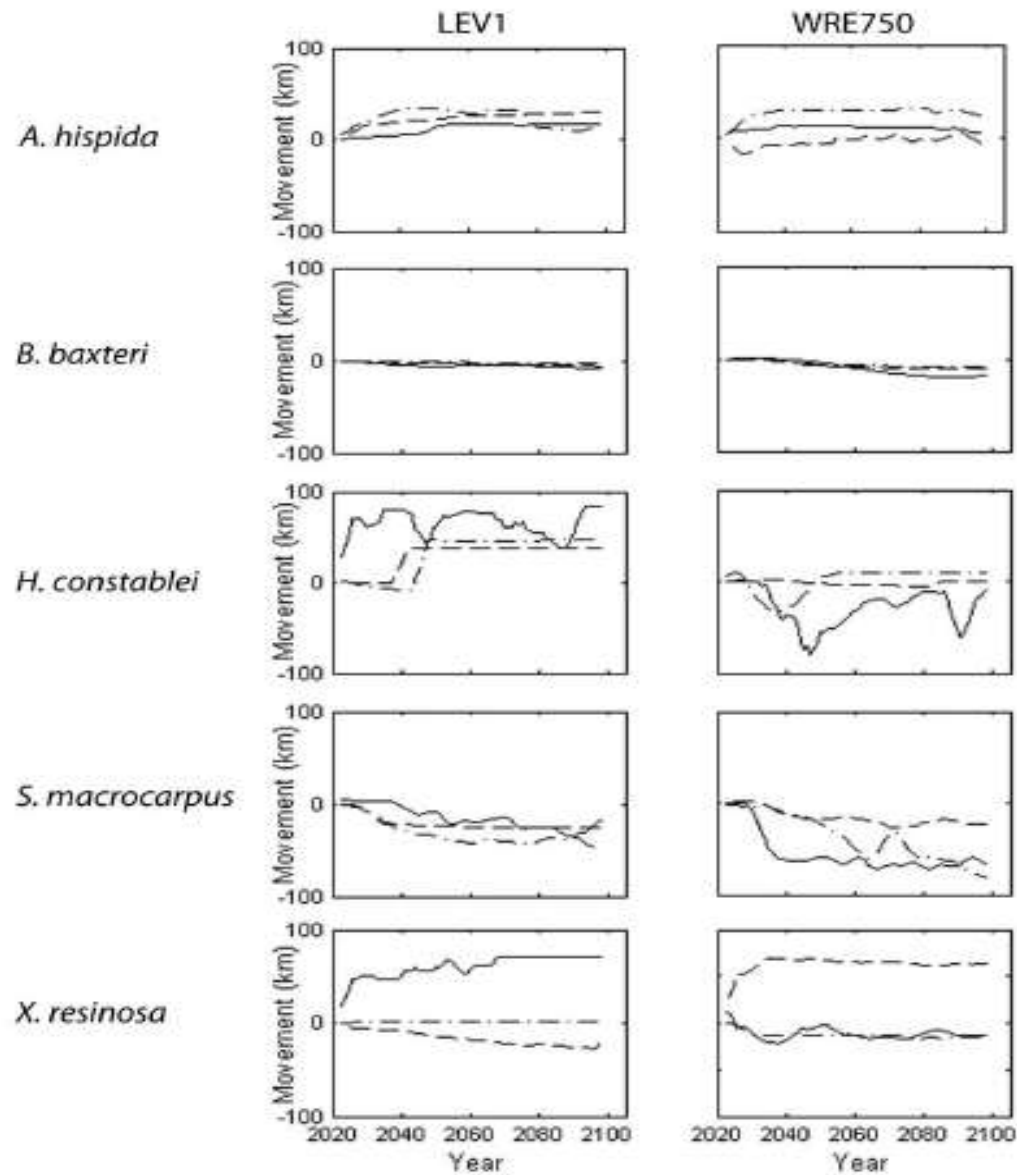
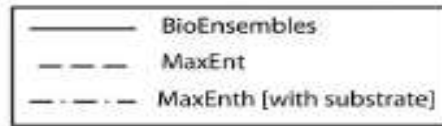


# Plants, climate and fire

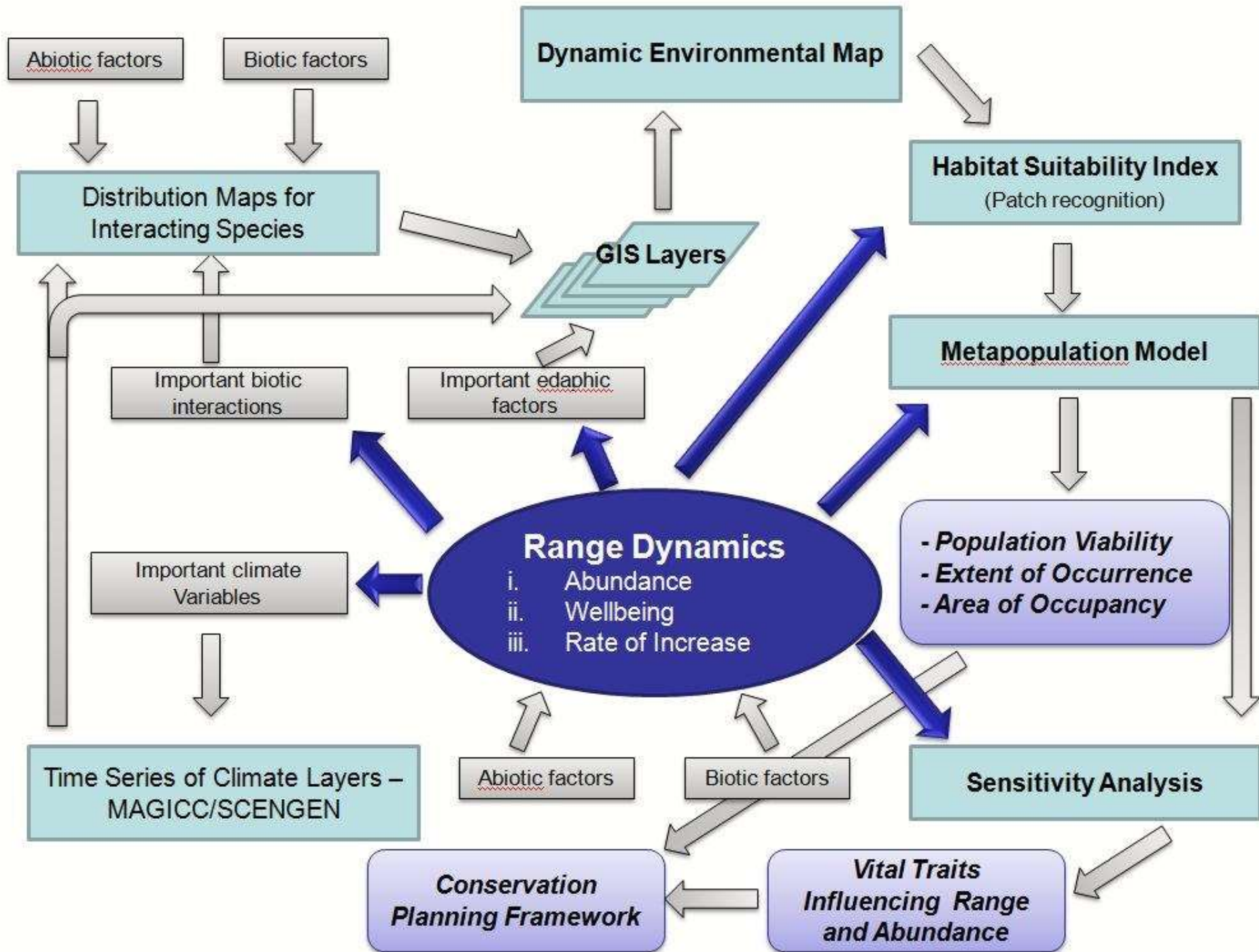


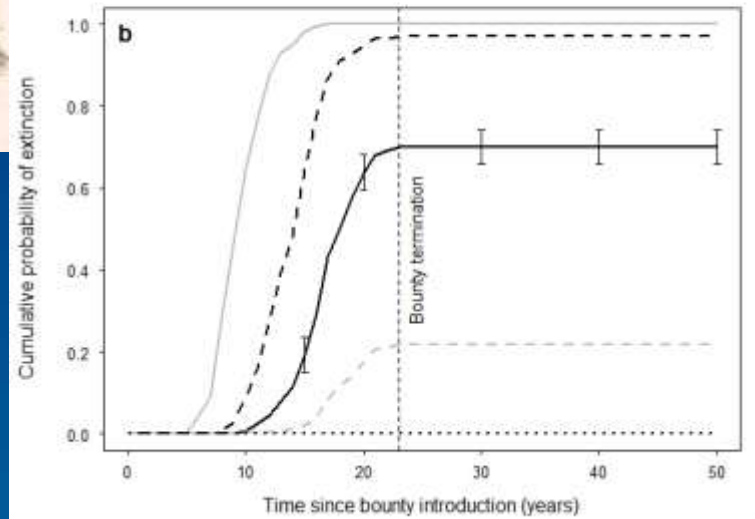
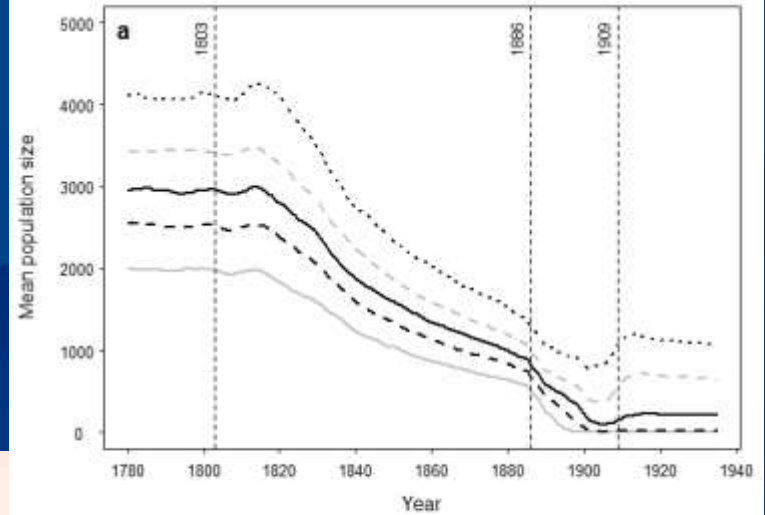
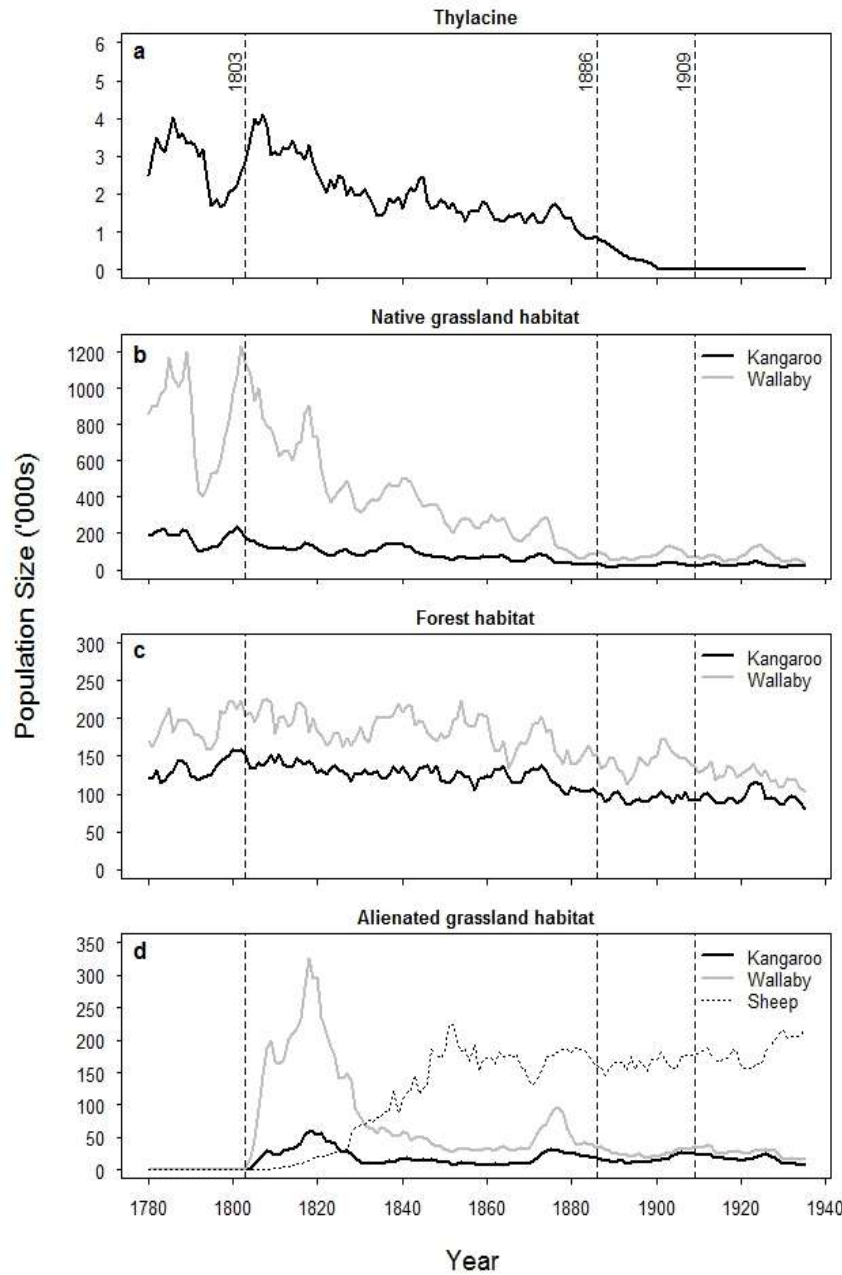
Species Name	SDM model	LEV1				WRE750			
		SDM		Metapop Model		SDM		Metapop Model	
		Range	Range	EMA	North	Range	Range	EMA	North
<i>Angophora hispida</i>	Bio-ensembles	▨	▨	▨	▨	■	■	■	▨
	Maxent	▨	▨	▨	▨	▨	▨	▨	▨
	Maxent (With Substrate)	▨	▨	▨	▨	▨	▨	■	▨
<i>Banksia Baxteri</i>	Bio-ensembles	■	■	■	▨	■	■	■	■
	Maxent	▨	▨	■	▨	■	■	■	▨
	Maxent (With Substrate)	▨	▨	■	▨	■	■	■	▨
<i>Hakea constablei</i>	Bio-ensembles	▨	▨	■	▨	▨	▨	■	▨
	Maxent	▨	▨	■	▨	■	■	■	▨
	Maxent (With Substrate)	■	■	■	▨	■	■	■	▨
<i>Senecio macrocarpus</i>	Bio-ensembles	▨	▨	■	▨	▨	▨	■	▨
	Maxent	■	▨	■	▨	■	■	■	▨
	Maxent (With Substrate)	■	■	■	▨	■	■	■	▨
<i>Xanthorrhoea resinosa</i>	Bio-ensembles	▨	■	■	▨	■	■	■	▨
	Maxent	■	■	■	▨	■	■	■	▨
	Maxent (With Substrate)	■	▨	▨	▨	■	■	■	▨





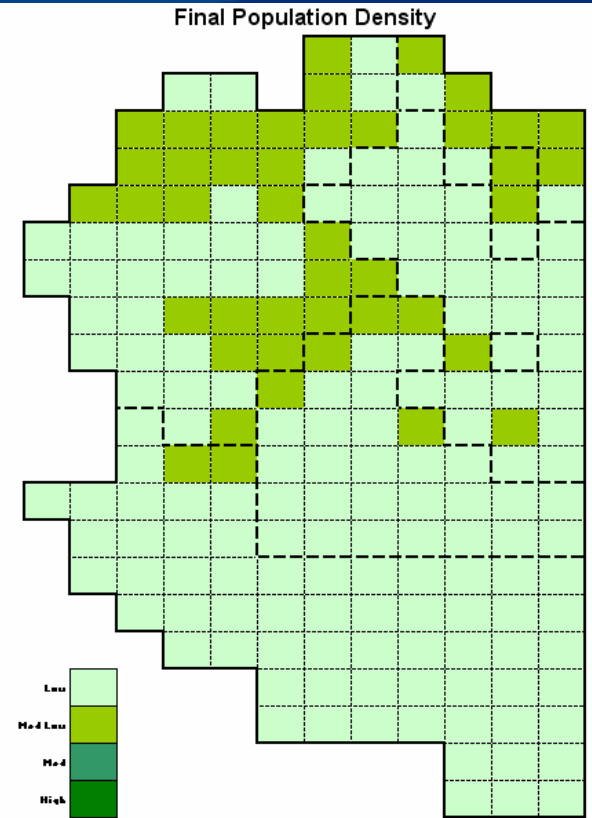
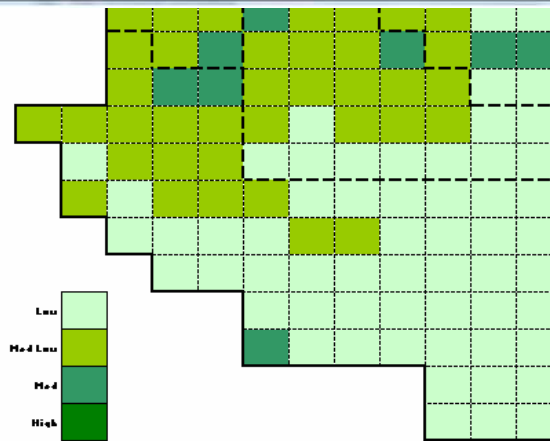
# Multi-factor, multi-species...

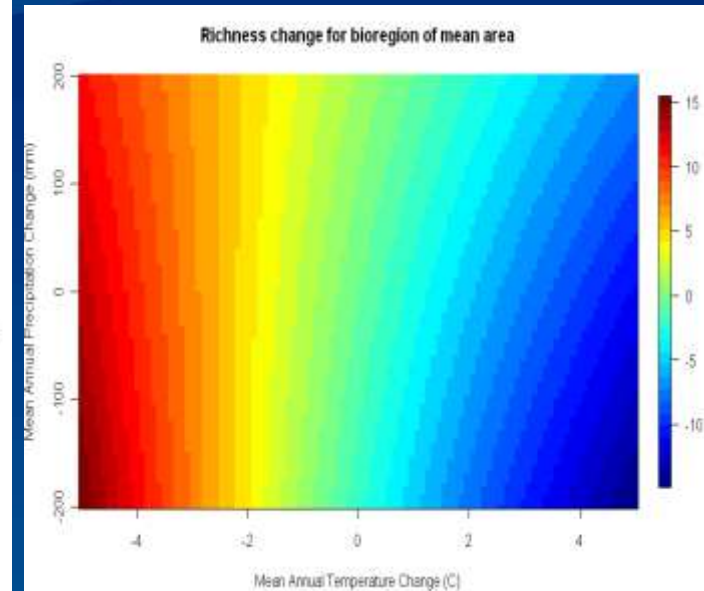
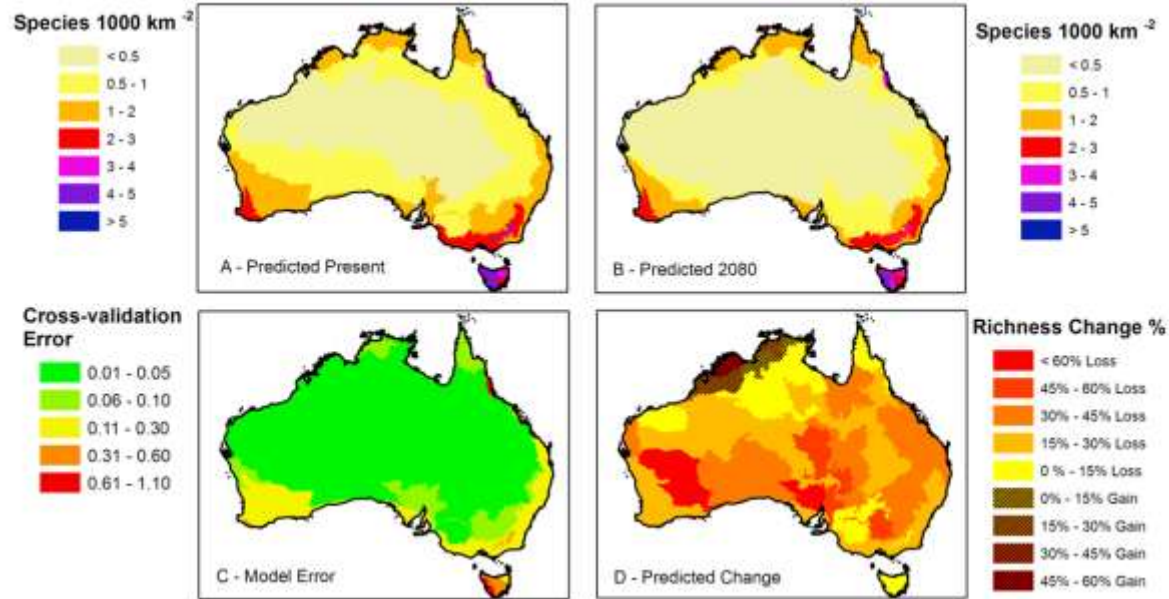


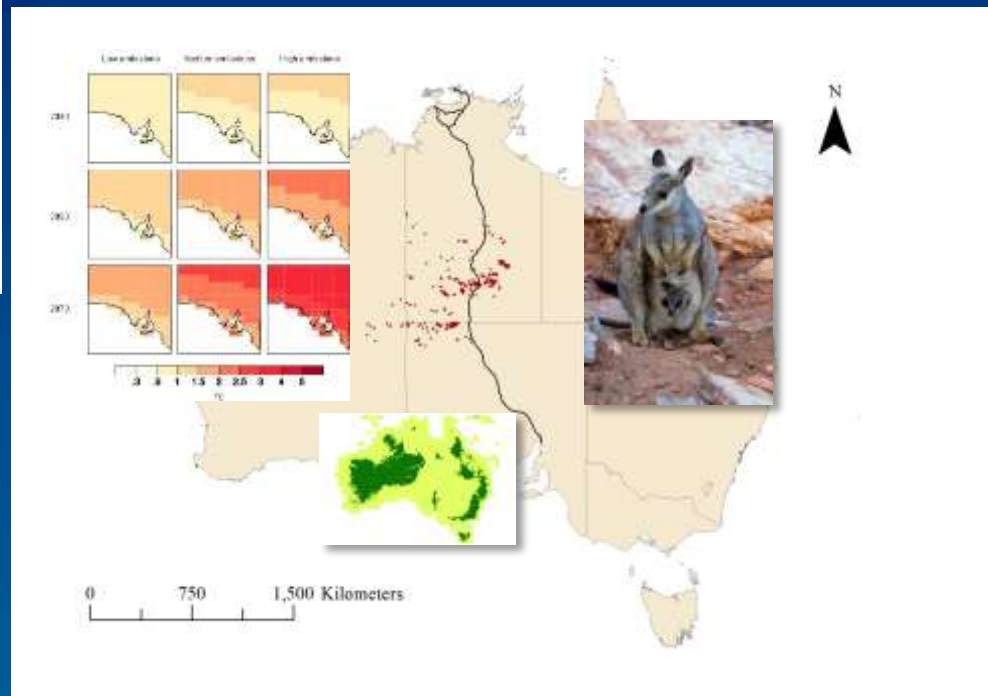
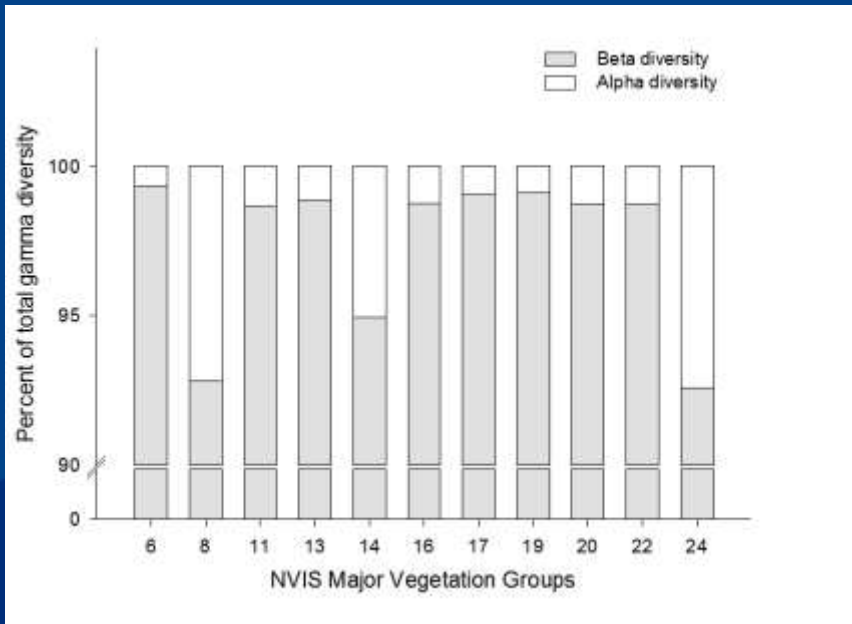


# Simpler spatial PVA methods

```
Tinn-R - [C:\Users\va1158085\NOTBACKEDUP\WORKING\ALL PAPERS\PUBLISHED\2008 J Appl Ecol - Fordham turtle matrix modelling\Turtle_model_LSA.r]
File Project Format Marks Insert Search Options Tools R View Window Web Help
R complex
Turtle_model_LSA.r
0139 if (Q < 0) Q <- "infinity"
0140
0141 ##### SIMULATION #####
0142 ## first specify the initial condition and length of simulation
0143 tlimit <- 30
0144
0145 ##set population size and year step vector
0146 pop.vec <- yr.vec <- rep(1,tlimit+1)
0147 pop.vec[1] <- sum(n)
0148 yr.vec <- 0:tlimit
0149
0150 ## Iteration
0151 n<-round(ssd*N)
0152 for (z in 1:tlimit)
0153 {
0154   n <- round(a %*% n) ## Matrix multiplication, rounded to whole animals
0155   if (sum(n) > K) n <- n*(K/sum(n)) ## Apply ceiling K
0156   pop.vec[z+1] <- sum(n)
0157 }
0158 log.pop.vec <- log10(pop.vec)
0159
0160 ##total population size after 'tlimit' years
0161 pop.st <- N
0162 pop.end <- sum(n)
```







The screenshot shows the BravenewClimate website interface. At the top, there are navigation tabs for Home, About, Action Plans, Renewable Limits, Scenarios, Sustainable Nuclear, and Top 10. Below this is a header section with a red 'BRAVENEWCLIMATE' logo on the left, a line graph in the center, and a 'Sustainable Nuclear' diagram on the right. A search bar is located at the bottom right of the header. The main content area is divided into three columns. The left column contains an 'Email Subscription' section, a 'Categories' list with links to various topics like 'Using CO2', 'Climate Change Q&A (61)', 'Economic Impacts (26)', 'Environmental Impacts (19)', 'Energy Policy (28)', 'Renewable Energy Sources (16)', 'Nuclear (4)', 'IPCC Facts and Economics (8)', 'International Climate Change (24)', 'Nuclear Crisis (14)', 'Open Access (4)', 'Solar (15)', 'Renewable Energy (8)', 'Climate Change (18)', and 'Miscellaneous (1)'. The middle column features a 'Renewable Limits' article with a book cover image and a list of links for 'Thinking critically about sustainable energy (TCASE series)', including 'Introduction', 'TCASE 1: Overview', 'TCASE 2: Energy demand', 'TCASE 3: The energy demand equation to 2050', and 'TCASE 4: How energy demand, supply and natural limits'. Below this is a 'Why renewable energy won't replace coal?' article with a 'Criticality of Growth in sustainable energy to 2050' link and a 'Key messages for realistic, small-scale, low-carbon energy grids' link. The right column includes a 'Now in book stores!' section with a book cover, a 'Blog Stats' section showing '642,415 hits', a 'Stat.Jobs' section, and a calendar for May 2010.



***More information, discussion, references  
for slides and presentation downloads:  
bravenewclimate.com***