

INCERTITUDES ET ADAPTATION AU CHANGEMENT CLIMATIQUE

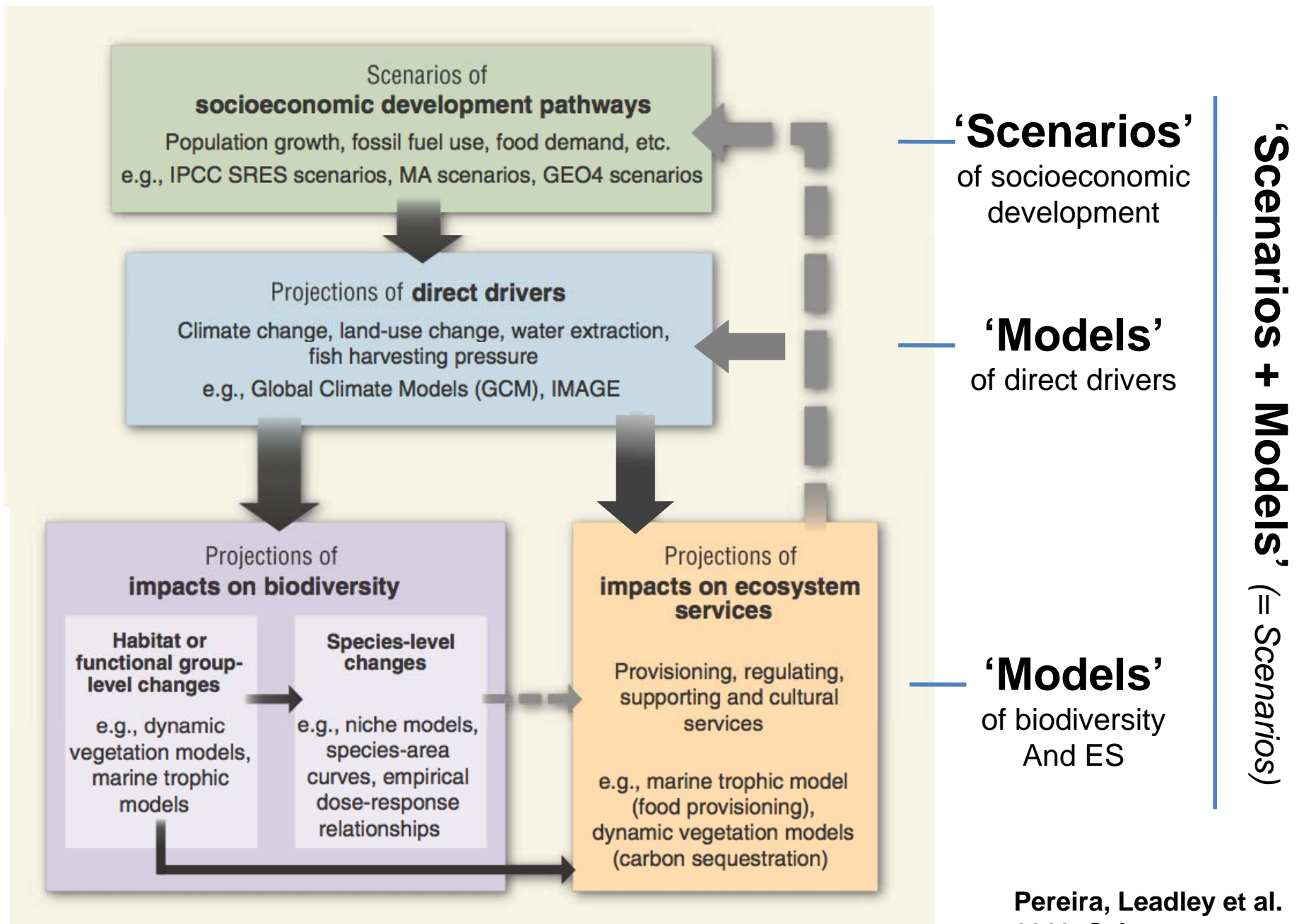


L'incertitude dans les modèles d'impact : Les modèles d'écosystèmes

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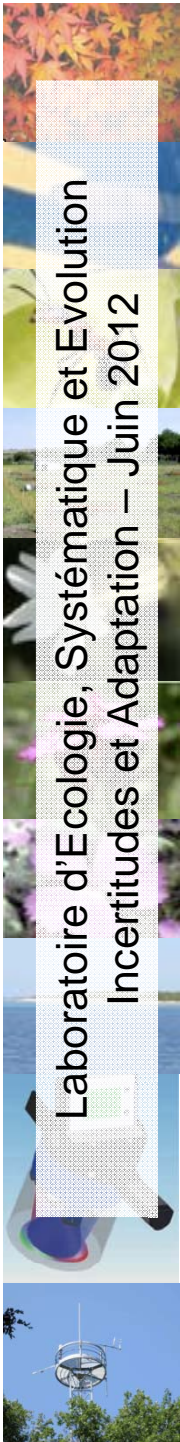




Pereira, Leadley et al. 2010. Science.

Sources of uncertainty

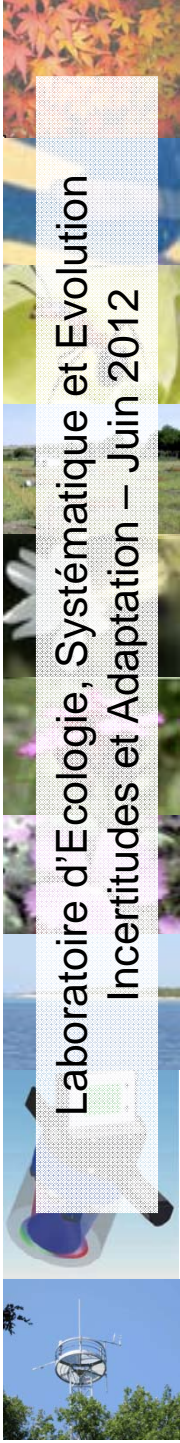
- **Socio-economic scenarios**
(e.g., IPCC SRES, IPCC RCP, MA, etc.)
- **Models of direct drivers (e.g., AOGCMs, RCMs, etc.)**
- **Models of impacts on ecosystems:**
 - Lack of understanding of underlying processes
 - Hypotheses underlying model formulation
 - Mathematical formulation & resolution
 - Parameterization
 - Choice of indicators
 - Surprises
 - Feedbacks to drivers
 - etc...



Understanding and quantifying uncertainty

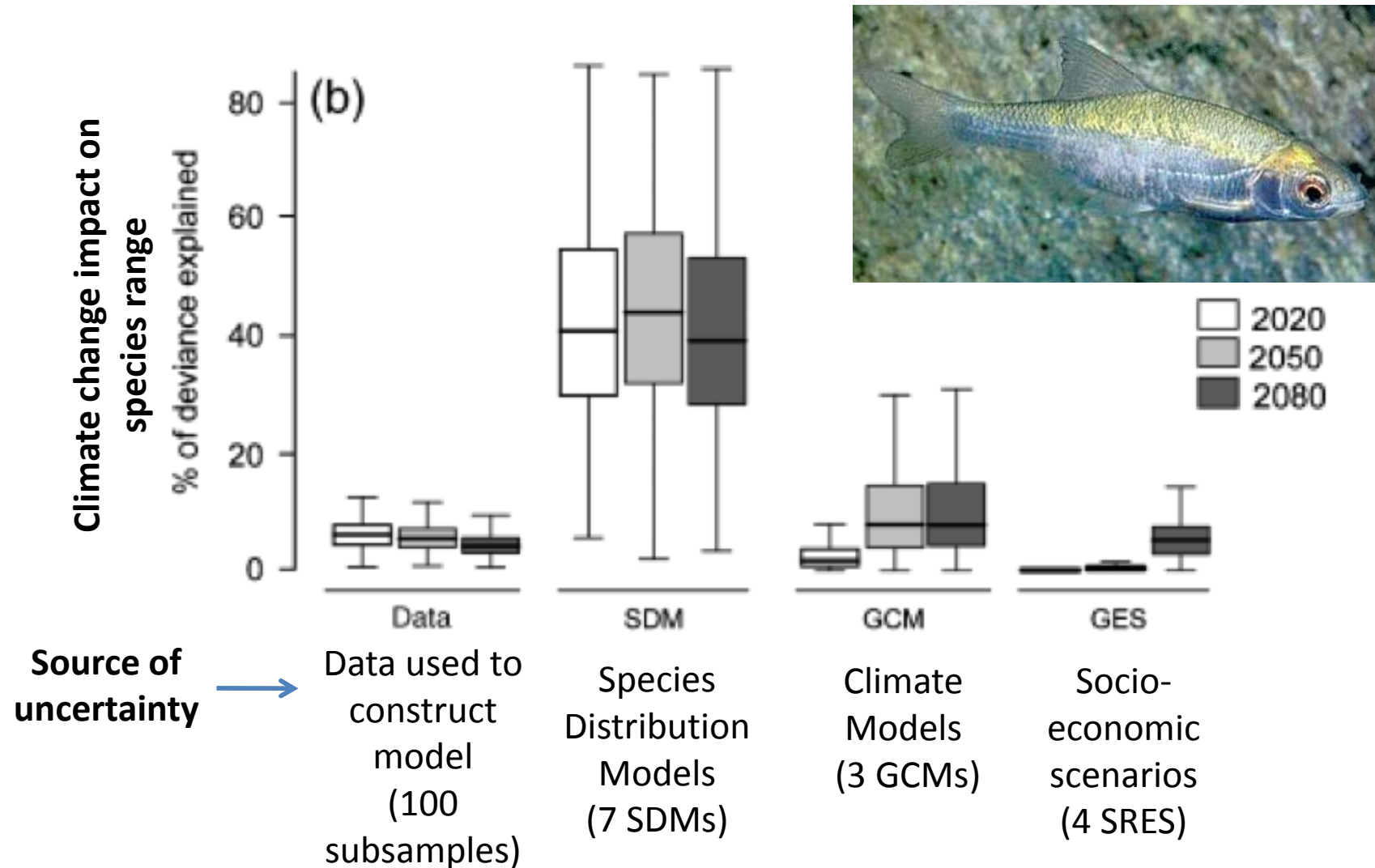
- Sensitivity analysis
- **Multi-model & multi-scenario comparison**
- **Model-data comparison (\approx 'validation')**
- **Expert assessment (including stakeholders)**
- etc...

Examples using climate change impacts on biodiversity and ecosystem function



Climate change impacts on biodiversity

Sources of uncertainty in projecting climate change impacts on fish species distributions



Validation using contemporary data



A comparison of observations and niche models of UK bird response to contemporary climate change suggests that:

- 1) Model ensembles do better than individual models
- 2) Niche models work reasonably well for some species, but not for others

Araujo & Rahbek 2006
Science

Model intercomparison to help quantify uncertainty in climate change impacts on trees: Beech

European Beech

Current distribution



■ Presence
□ Absence

BIOMOD



N-NBM



STASH



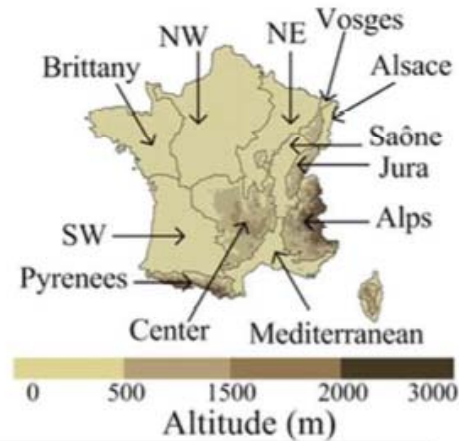
PHENOFIT



CASTANEA



LPJ



Predicted future distribution (2055)

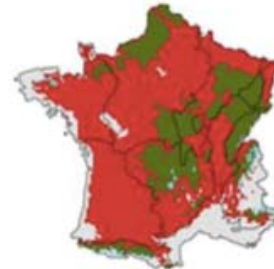
BIOMOD



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PHENOFIT



CASTANEA



LPJ



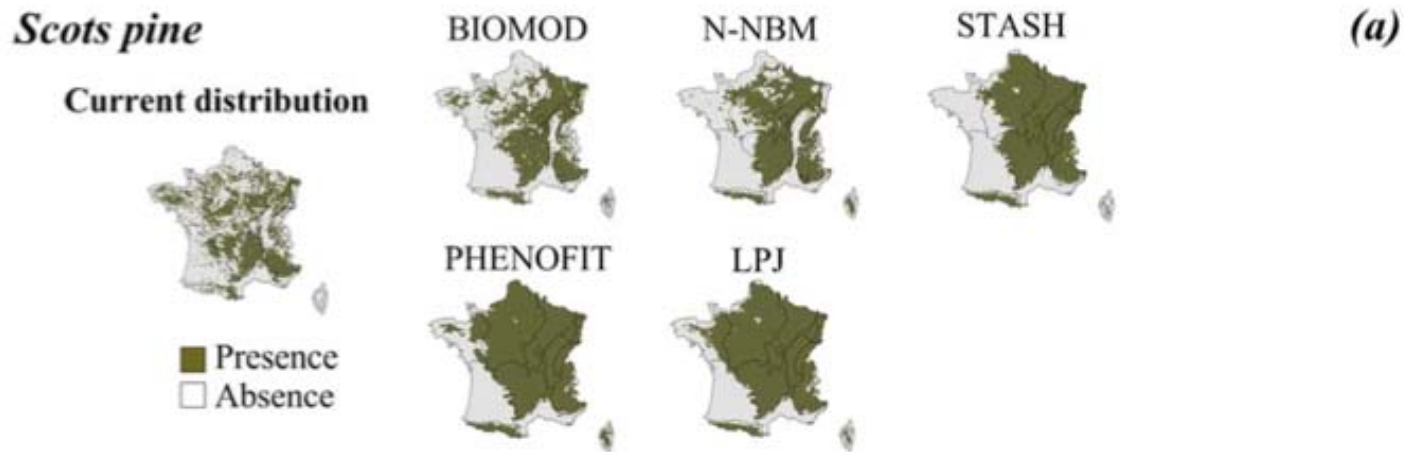
(b)

□ Stable unsuitable area
■ Stable suitable area
■ Loss of suitable area
■ Gain of suitable area

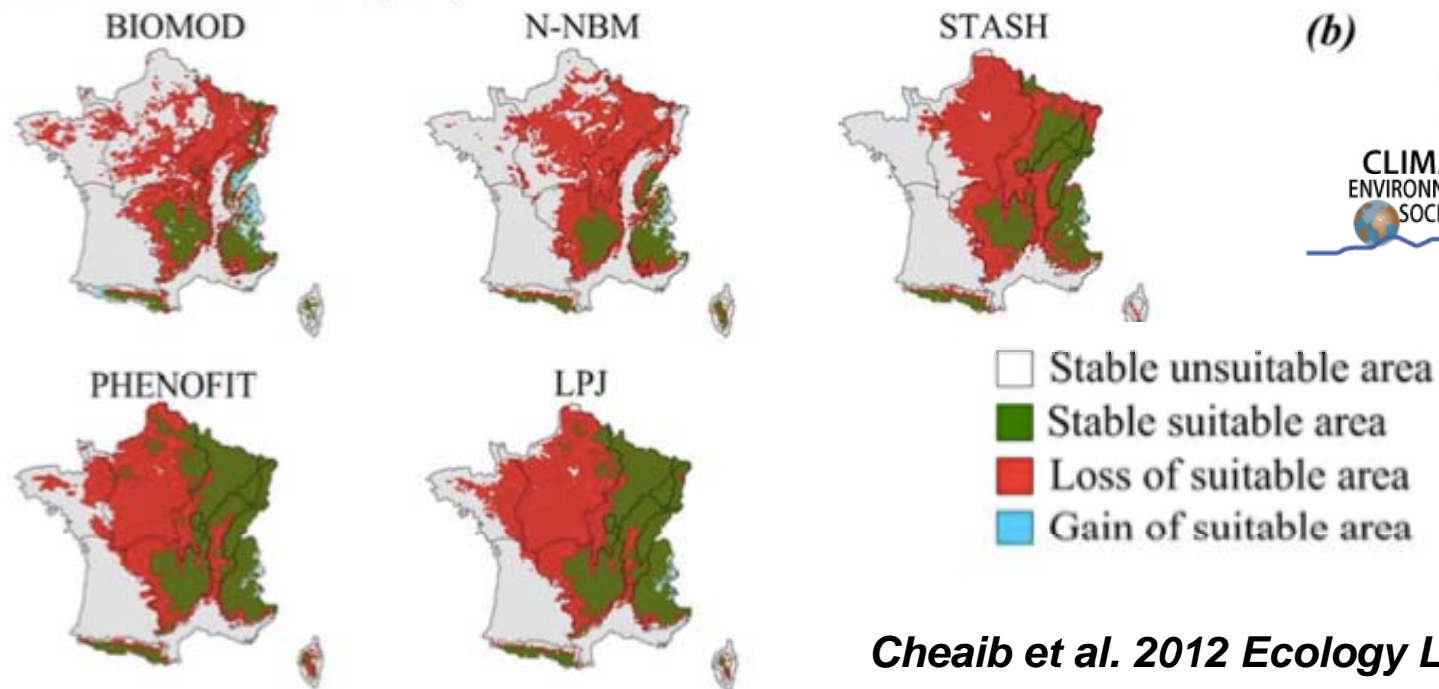


*Cheai et al. 2012
Ecology Letters*

Model intercomparison to help quantify uncertainty in climate change impacts on trees: Scots pine



Predicted future distribution (2055)



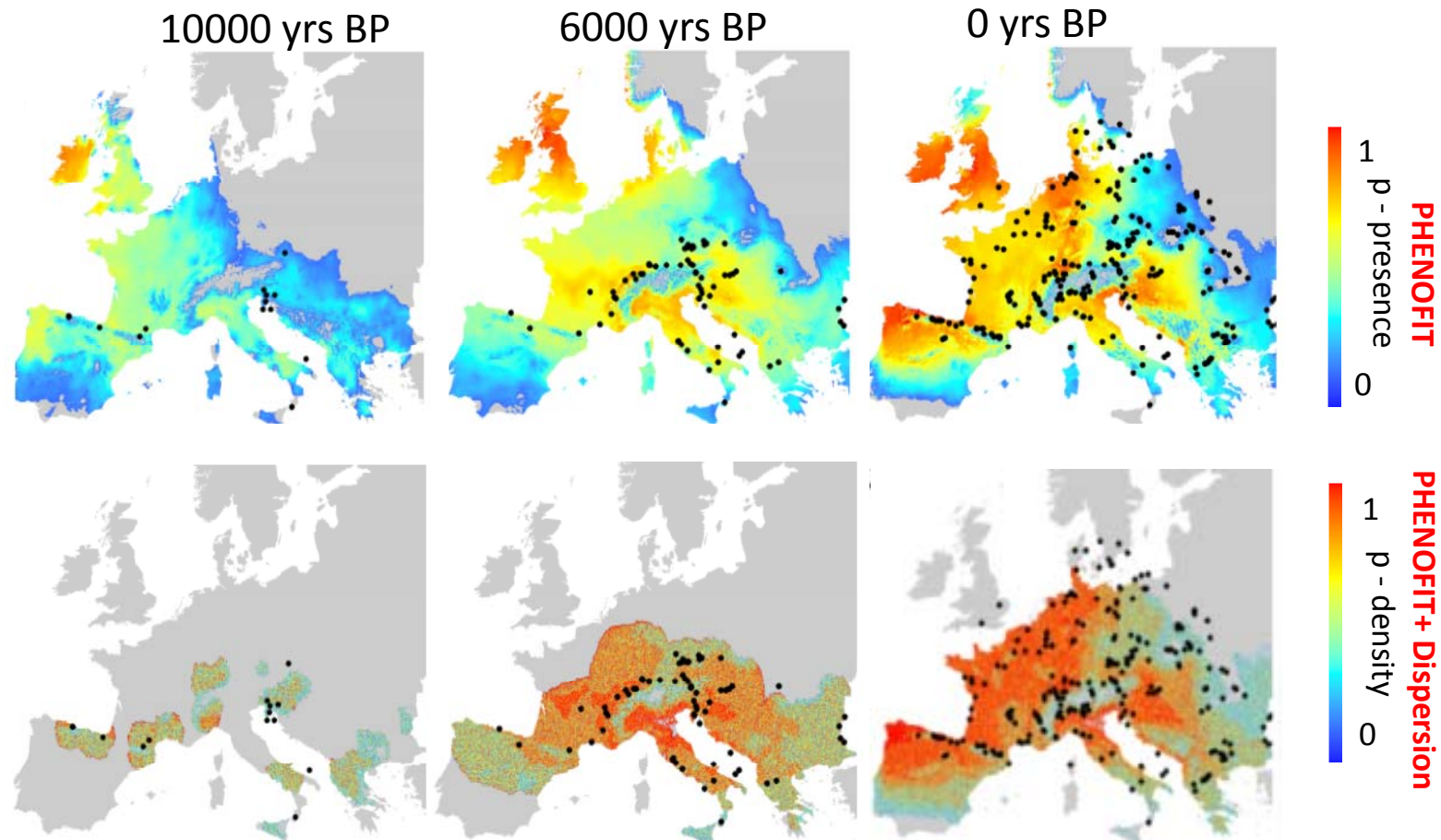
ANR



Validation using paleo data

Développement du modèle PHENOFIT : Intégration d'une migration réaliste à grande échelle - Dir. Isabelle Chuine, CEFE

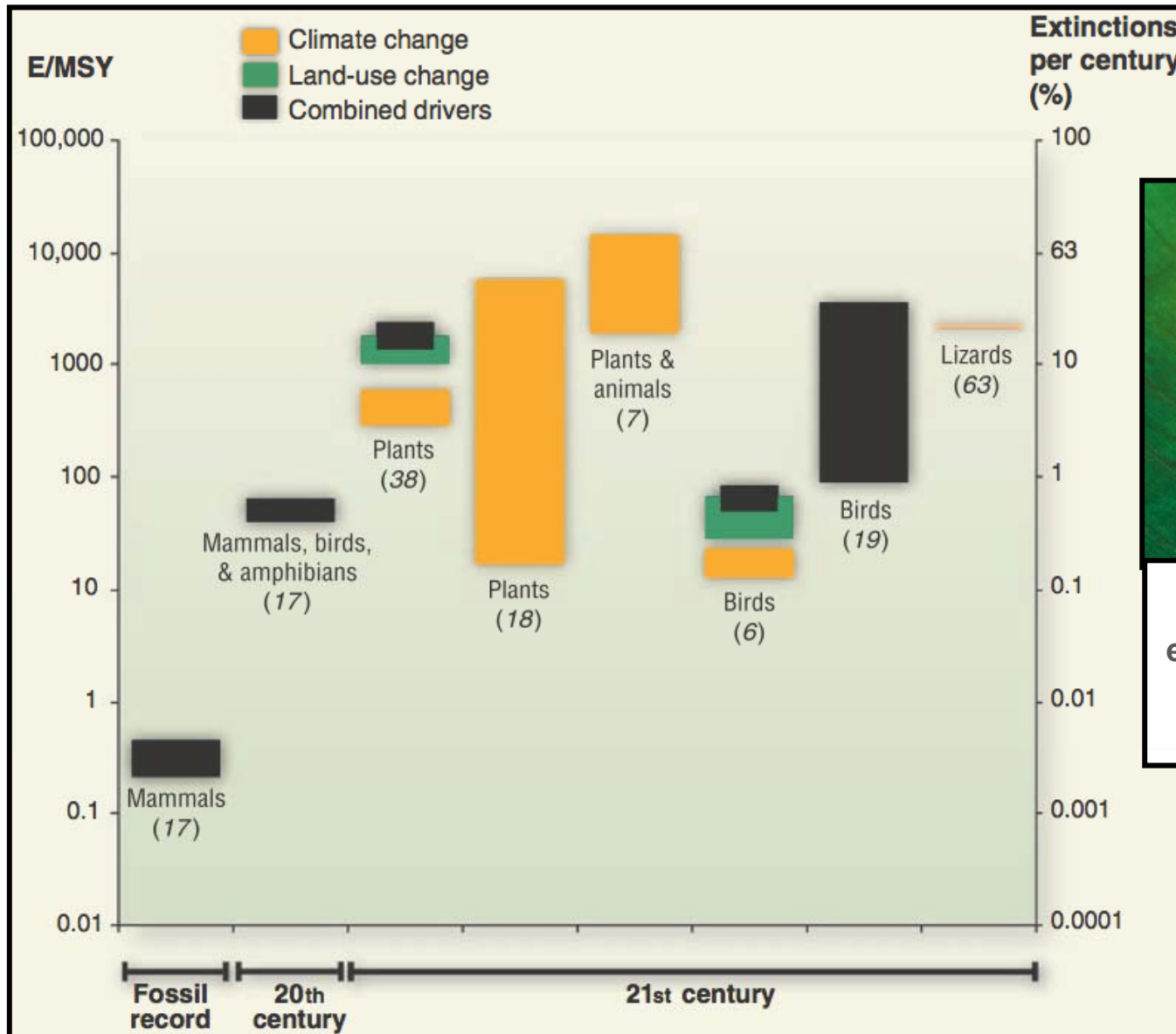
Simulation de la recolonisation post-glaciaire du hêtre en Europe



- Macrofossils + pollen (>2%) data

Saltré et al. soumis

SPECIES EXTINCTIONS

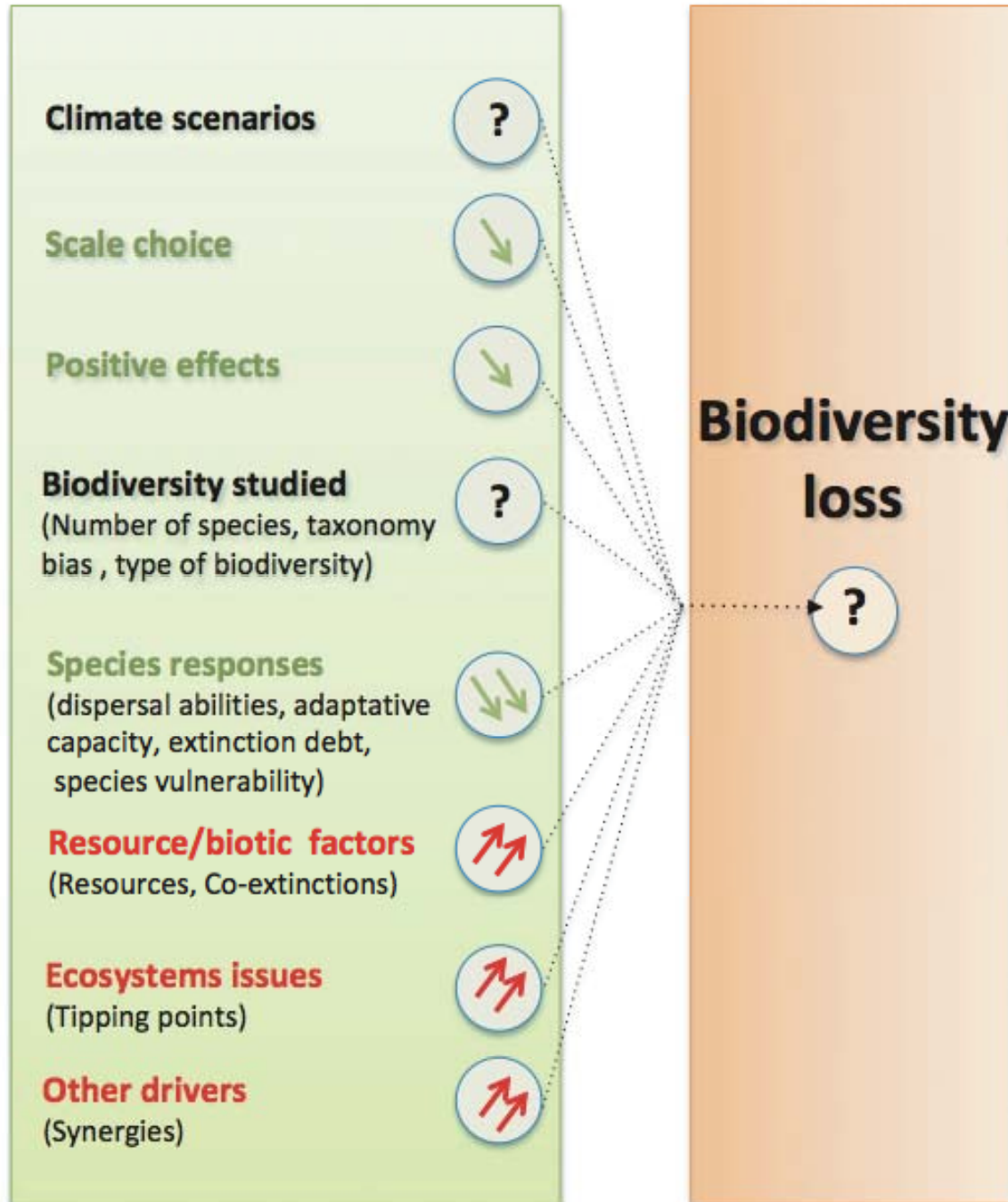


Golden toad, Costa Rica, extinct in the wild since 1989

See Pounds et al. 2006 Nature

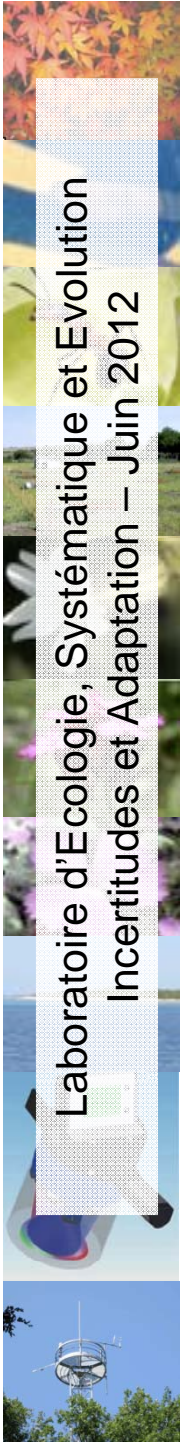
Pereira, Leadley et al. 2010 Science

Issues



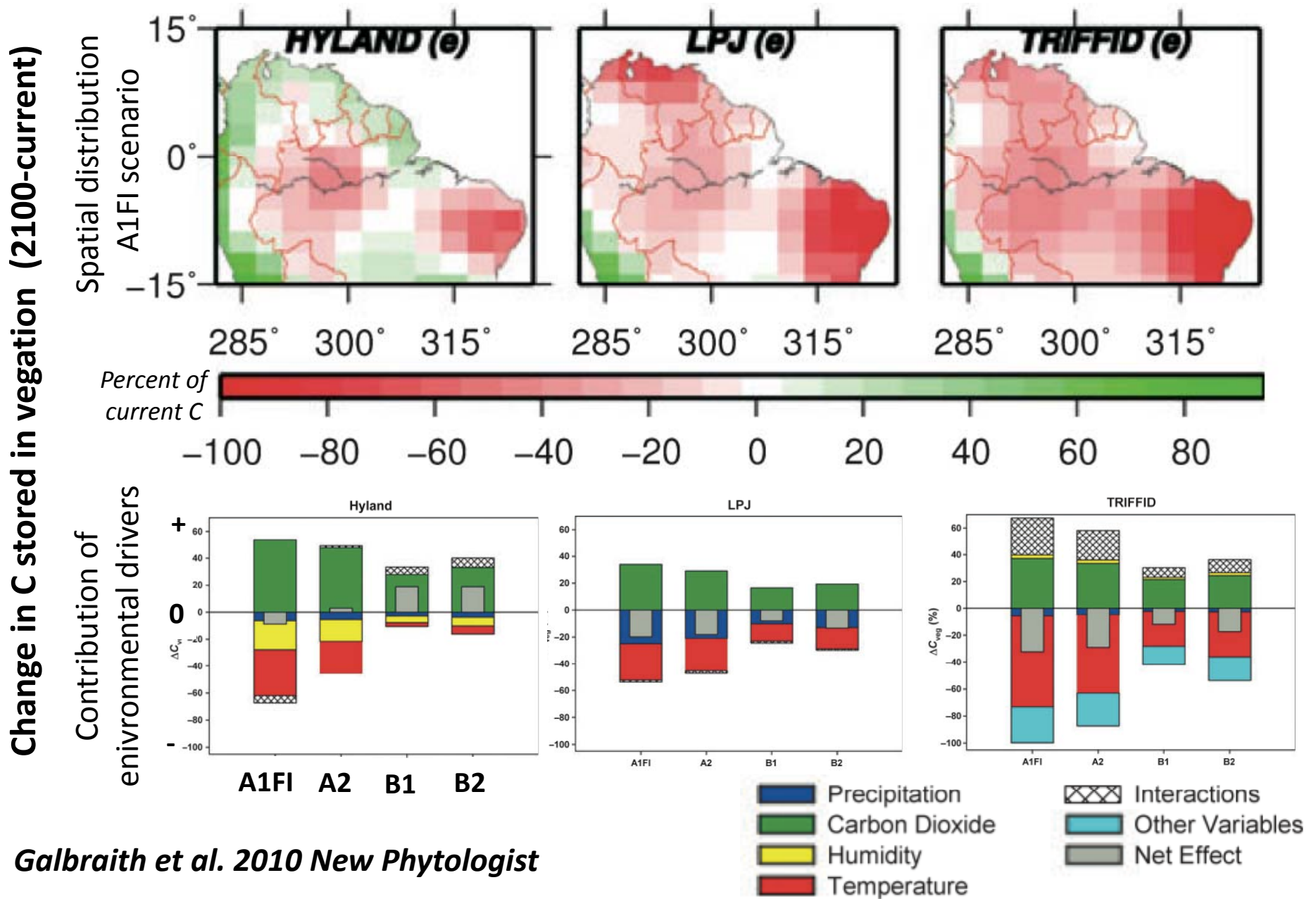
*Key sources
of uncertainty
in predicting
climate
change
impacts on
biodiversity*

*Bellard et al. 2012
Ecology Letters*



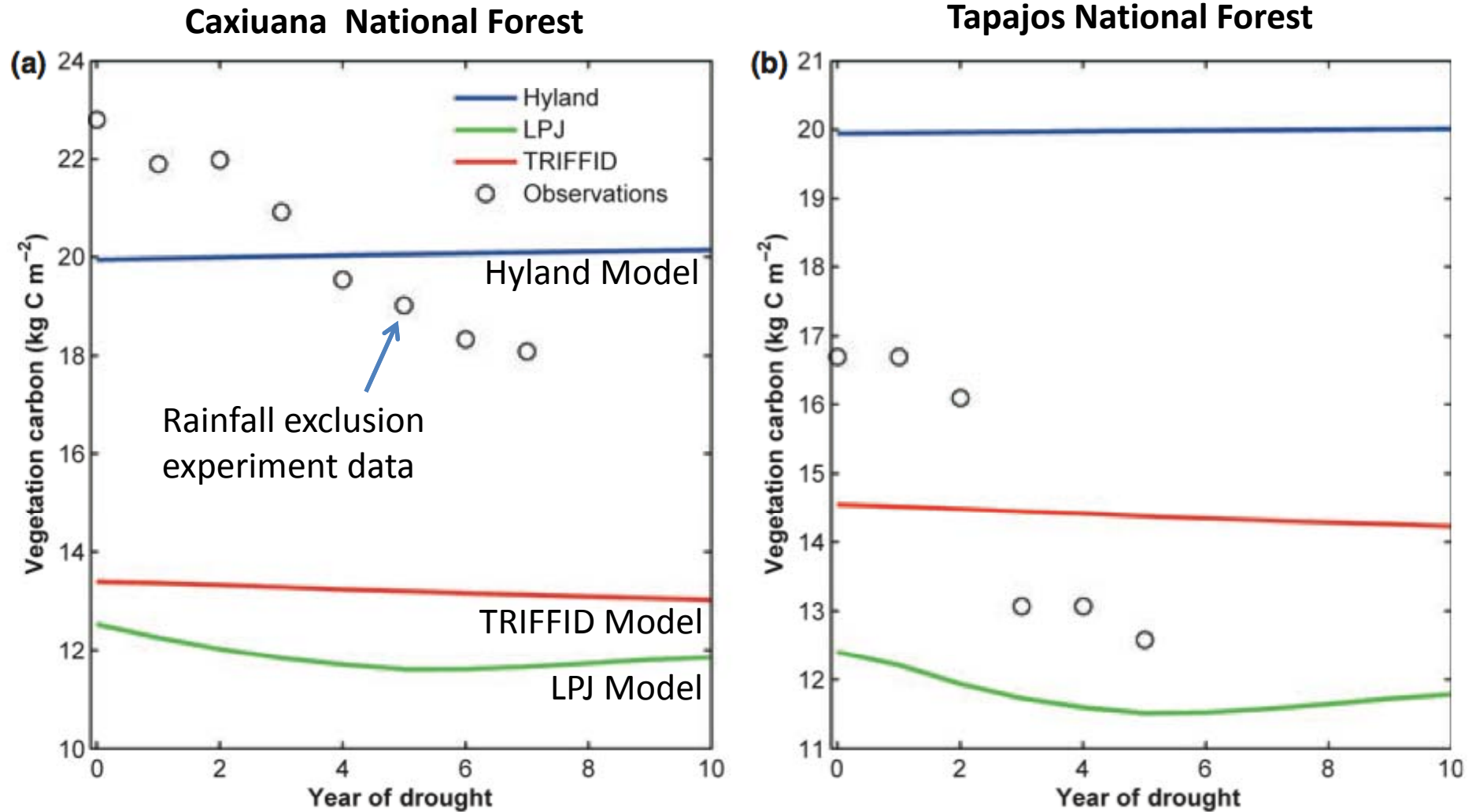
Climate change impacts on ecosystem function

Climate change impacts on C storage in the Amazon



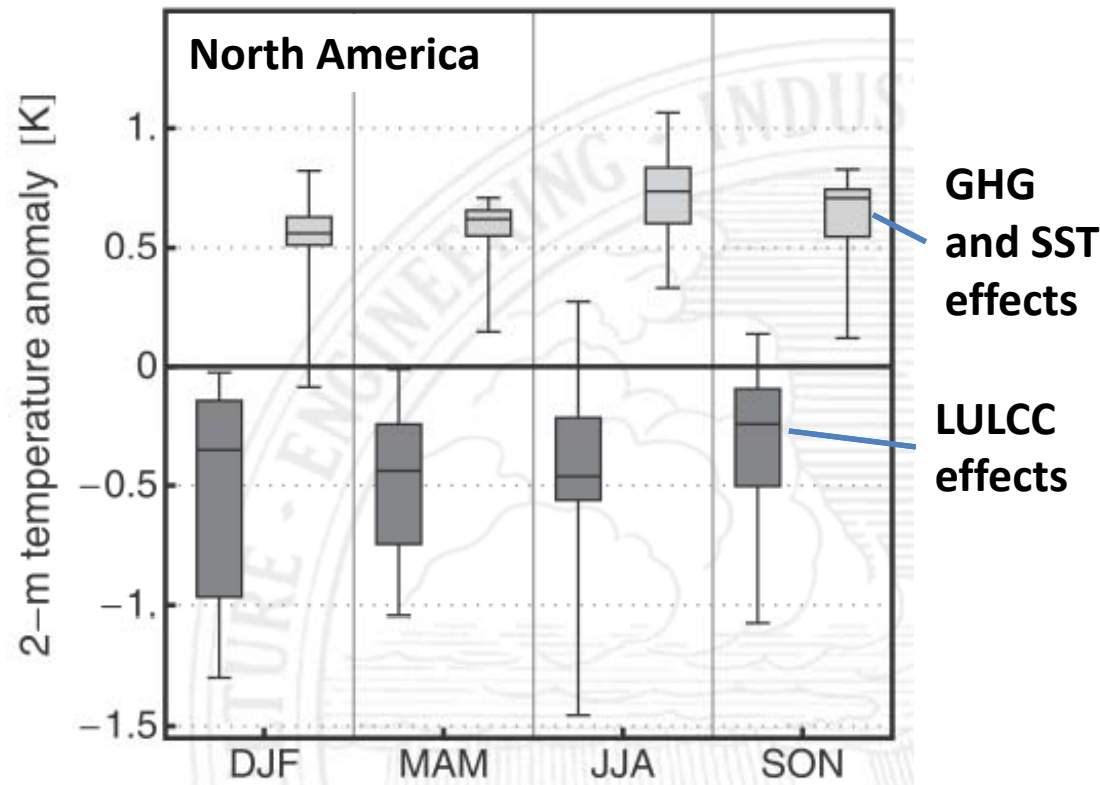
Galbraith et al. 2010 New Phytologist

Validation using experiments



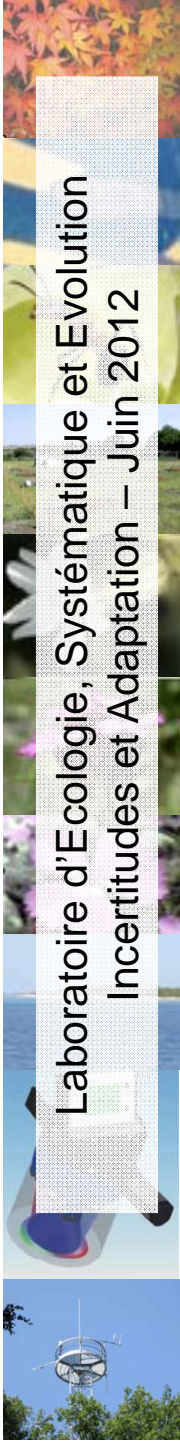
Galbraith et al. 2010 New Phytologist

Uncertainty in feedbacks to regional climate



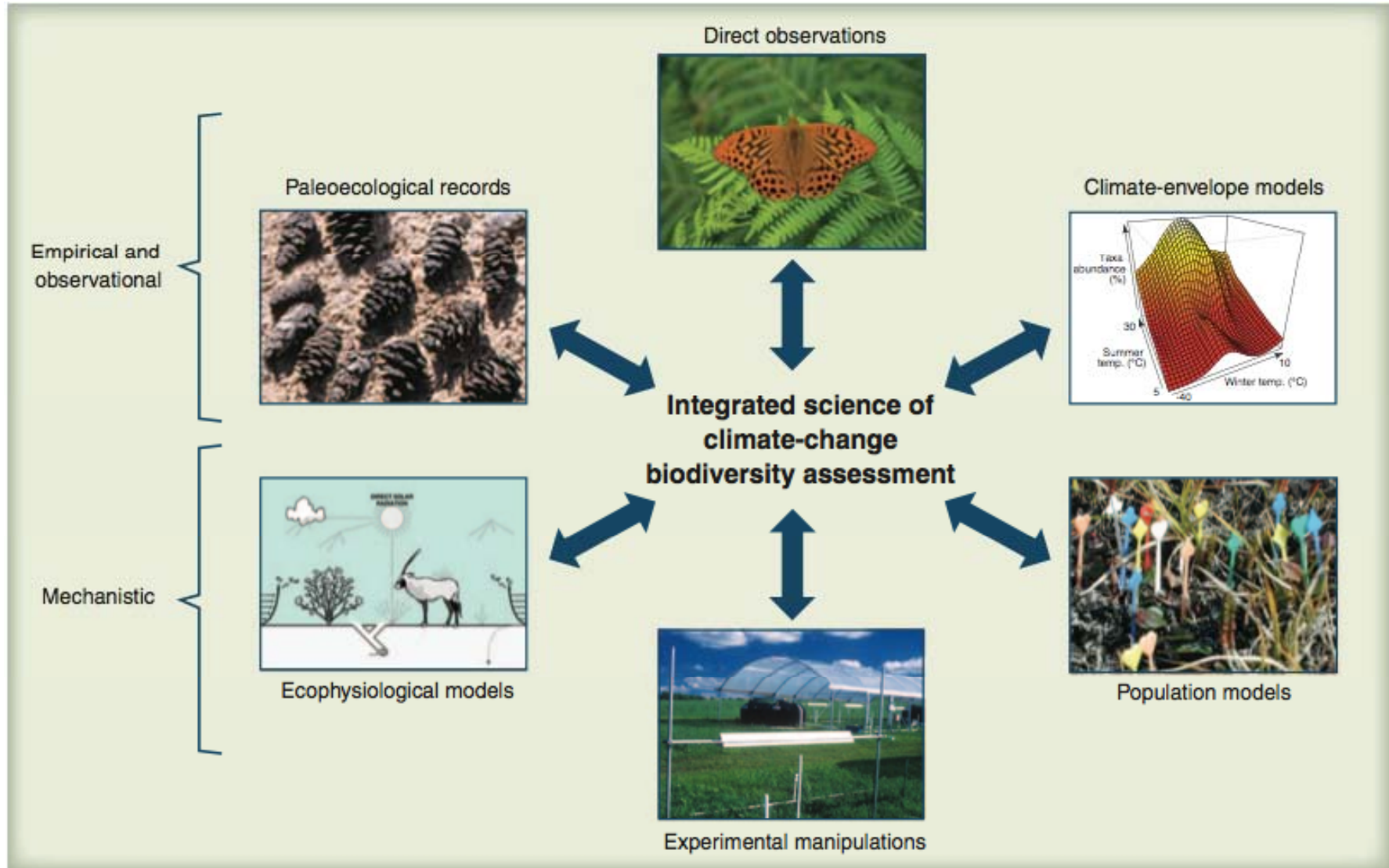
Climate/vegetation model	North America		
	1870	1992	Change
EC-EARTH-TESEL	3.36 (74)	1.54 (34)	1.82 (40)
SPEEDY-LPJmL	3.04 (67)	1.62 (36)	1.42 (31)
IPSL-ORCHIDEE	2.53 (56)	1.26 (28)	1.27 (28)
ARPEGE-ISBA	2.26 (50)	1.13 (25)	1.13 (25)
CCAM-CABLE	1.93 (43)	0.94 (21)	0.99 (22)
CCSM-CLM	1.74 (38)	1.13 (25)	0.61 (13)
ECHAM5-JSBACH	1.65 (36)	1.09 (24)	0.56 (12)

de Noblet-Ducoudré et al. 2012 J. Climate



Forward Look

Models of climate change impacts on biodiversity & ecosystems: a need for better integration of models and data



A long way to go, but a long way already travelled

International
Assessment
Mechanisms



International
Research
Programs



Future Earth
research for global sustainability



National
Research
Programs

