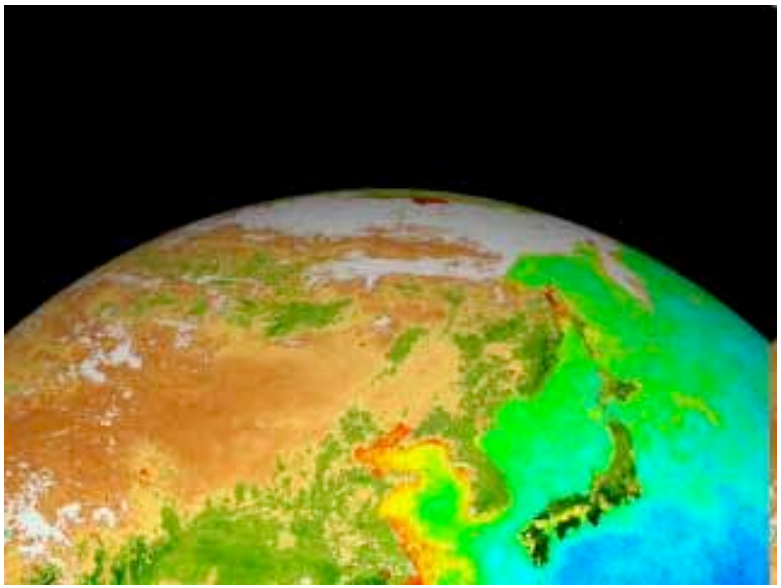
# Climate Information Systems for Biodiversity & Natural Resource Management



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THE AUSTRALIAN NATIONAL UNIVERSITY

Source: svs.gsfc.nasa.gov/vis

# White Paper

UNEP (2009) *Climate information and capacity needs for Ecosystem Management under a Changing Climate*. Prepared for the World Climate Conference – 3 Geneva, Switzerland [Core writing team, R Munang, M Rivington, G Takle, B Mackey, & J Liu (eds)] Climate Change Adaptation Unit, UNEP, Nairobi, Kenya.

Available from URL: http://www.wcc3.org/sessions.php?session_list=WS-7

# Loss of Biodiversity is a Climate Change Problem

"Earth is a complex, non-linear system"

Feedback from biosphere is a primary source of system non-linearity

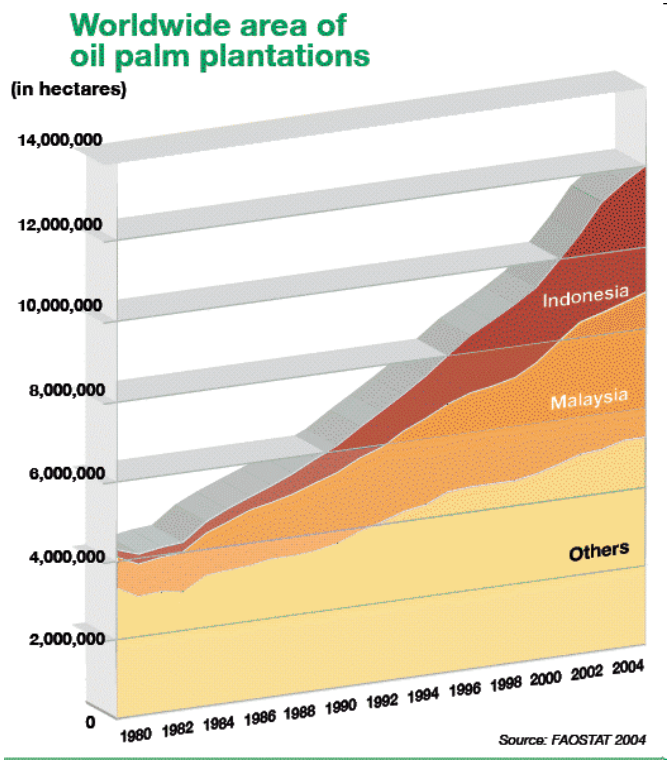
Biosphere strongly influences global energy balance (*albedo*), strength of greenhouse affect ($CO_2$), and the water cycle (*Et*)

Biodiversity regulates ecosystem functions in ways that are (a) optimal w.r.t. prevailing conditions and (b) confer resilience and adaptive capacity

Loss of biodiversity results in loss of ecosystem function and degradation of ecosystem processes, and of life support systems and associated ecosystem services

# Mental Experiment

"What would affect on climate system be of converting the world's tropical forests to a monoculture?"



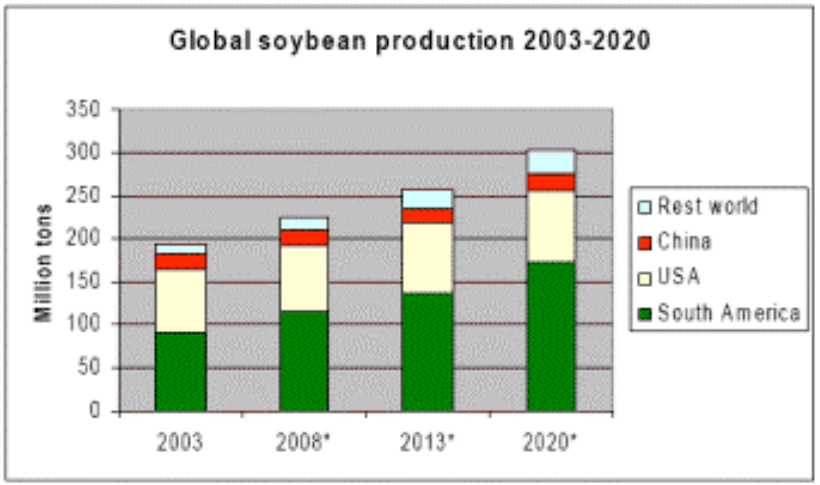




**Figure 3.1**
Global soy production per producer region. *indicates forecasts. Sources: AIDEnvironment, ISTA Mielke

Sources: FACSTAT 2004; AIDE Environment

# Likely Result of Mental Experiment?

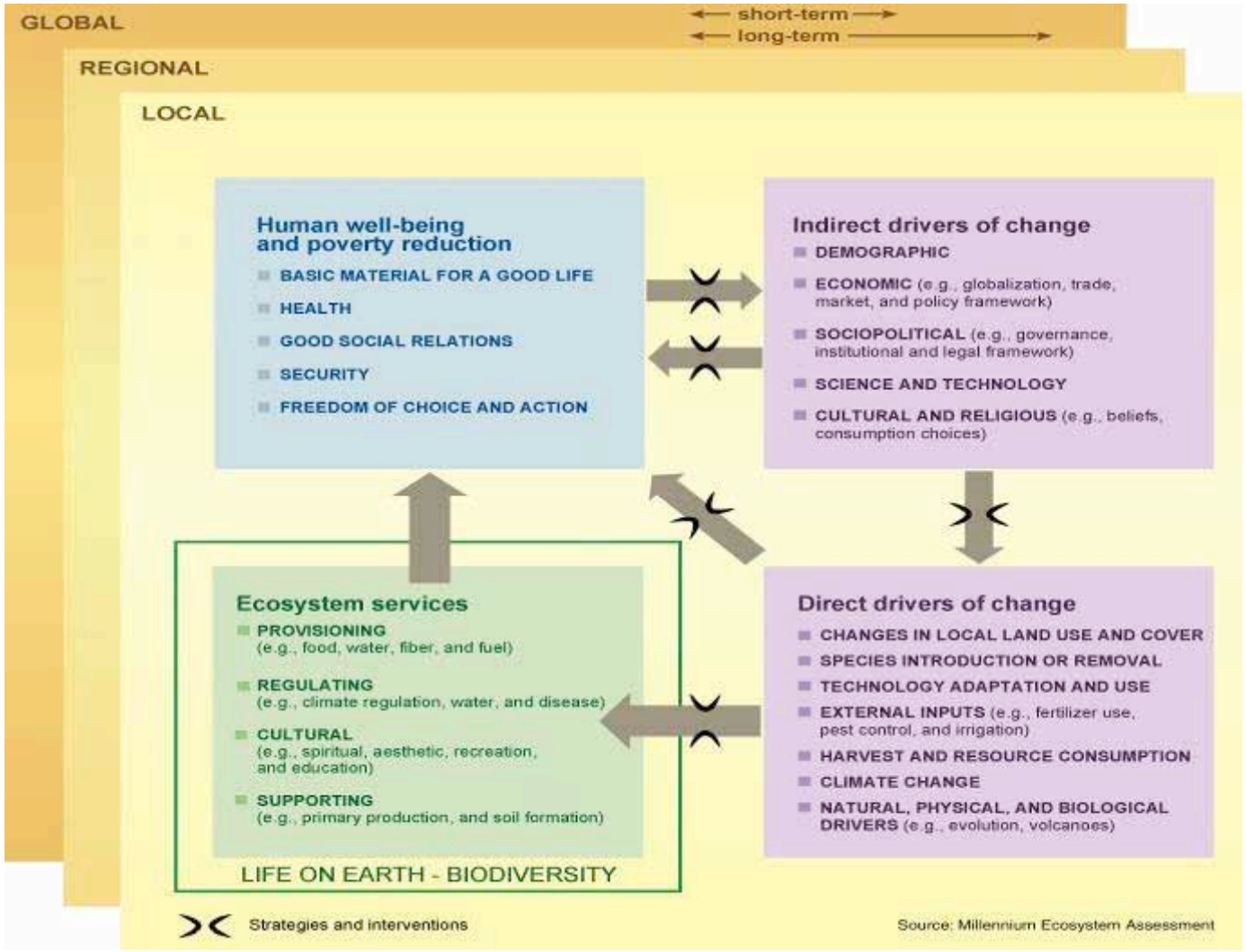
Complete conversion of bio-rich natural ecosystems to cultivate monocultures would result in:

- *Massive $CO_2$ emissions (~400+ Gt C in tropical forests) probably causing breach of $2^0$ guardrail irrespective of fossil fuel emission reductions*

- *Significant changes to water regimes, in particular run-off*

- *Loss of other ecosystem services vital to sustainable livelihoods for local communities including the provision of food, fibre, buffering of environmental hazards*

# Relationship between ecosystem services and human wellbeing




Source: Millennium Ecosystem Assessment Chapter 1 Conceptual Framework

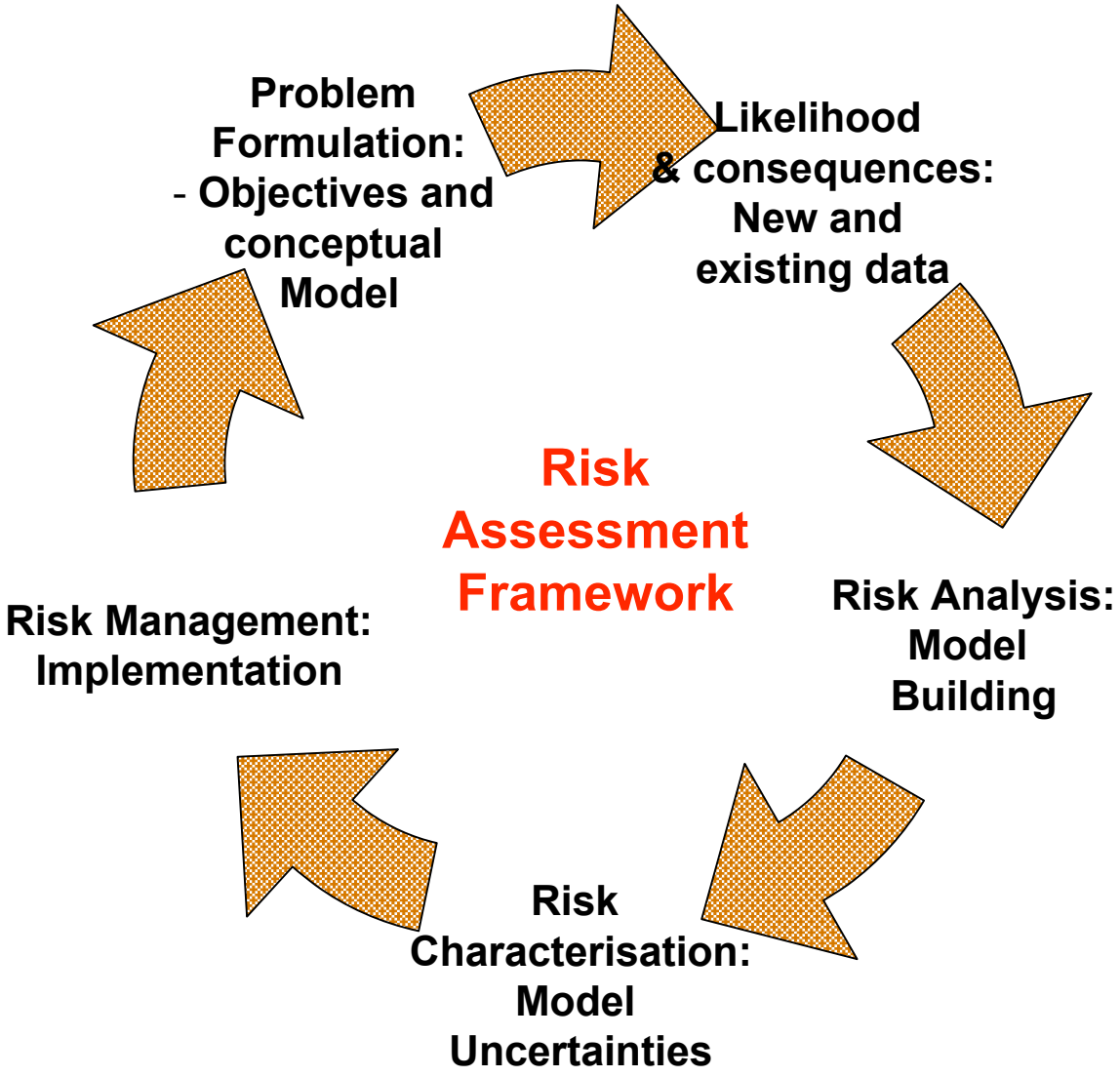
# Ecosystem Management is the Key

Biodiversity, natural resource management and climate change are best addressed through the lens of ecosystem management

Ecosystems are an expression of biodiversity, but the kind of biodiversity characterizing an ecosystem determines the value of the ecosystem services

As humans can degrade ecosystems causing loss of ecosystem services, improving how we interact and make use of ecosystems is necessary; hence “the ecosystem approach” (CBD); “ecosystem-based adaptation” (UNFCCC); “ecosystem-based management” (IUCN); “ecosystem management” (UNEP)

# Climate information systems provide input to risk assessment



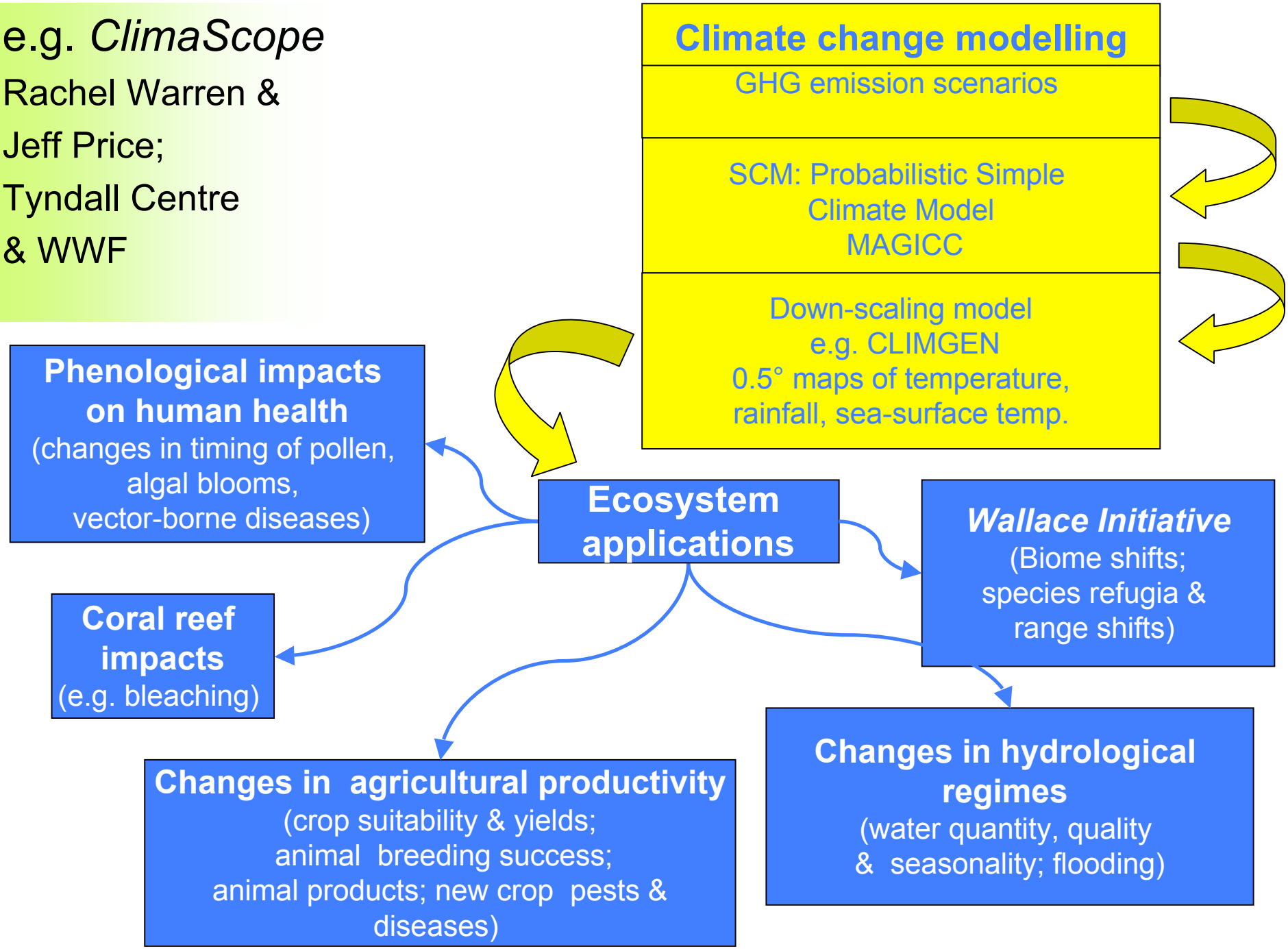
e.g. *ClimaScope*

Rachel Warren &

Jeff Price;

Tyndall Centre

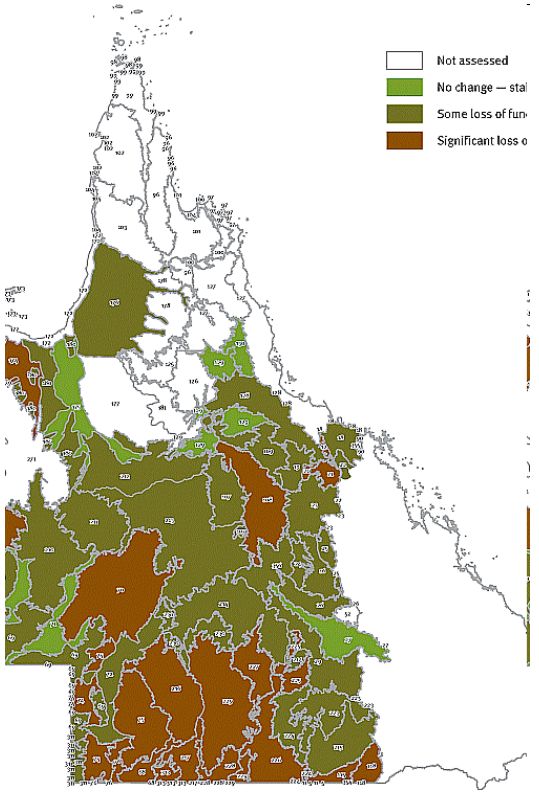
& WWF



# Ecosystem model e.g. Aussie Grass

The AussieGRASS project uses advanced spatial simulation techniques and supercomputing facilities to build on the research and experience of many of Australia's leading agronomists in developing a system for assessing and monitoring the condition of Australia's extensive grazing lands.

…integrates climate and natural resource data, remote sensing, historical agronomic research and simulation modelling… seasonal rainfall explained only 40% of the variation in seasonal pasture growth, while models of soil water and pasture growth could explain 50-70% of observed variation. The simulation work involved running a pasture growth model for tropical and sub-tropical grasses (GRASP) on a 5 km grid… calibrated for a broad range of pasture communities, soil types and climatic conditions




Source: Land: Pasture production and condition. Stone G. et al. Queensland Gov: https://www.epa.qld.gov.au

# Ecosystem model e.g. IHACRES CMD (Catchment Moisture Deficit)

- A major lesson learnt from flood assessment research is that stream flow response to climatic changes is non-linear. Therefore, a rainfall-runoff model must be employed to estimate the climate change impacts on stream flow regime. This is related to the estimation of greenhouse related effects as well as short-term climate variations (e.g. the El Niño cycle).

Challenge: to what exte nt can we isolate the im pacts of land use chang e on stream flow from t hose due to climate vari ation ?

Source: ICAM-ANU. Tony Jakeman and Carmel Pollina

# Integrated/Synchonized Ground Based Ecological Observations

We do not have biological monitoring observation systems equivalent to global/national meteorological networks or remote sensing platforms

Urgent need for systematic monitoring of (*inter alia*) species distributions, changes in population abundance, and changes in phenological responses

Examples of biological observation systems include:

- *European Phenological Network (citizen-based)*
- *Australian Bird Atlas (citizen-based)*
- *LTER Network (professional)*

# To conclude…

1.Ecosystems play a vital role in both ecosystem-based mitigation (carbon sequestration & storage) and ecosystem-based adaptation (i.e. societal adaptation to climate change impacts).

2. 1st-generation Earth system models need more finely tuned ecological data about the biodiversity characterizing different ecosystems, their role in ecological functions, and how species and ecosystem processes respond to climate change and variability

3. In addition to the importance of ecosystems for climate change, ecosystem management is essential for human wellbeing and the sustainability of the human endeavour