More than CO2: the role of native vegetation in climate change mitigation and adaptation

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Why is the biosphere important in climate change?

1. Terrestrial ecosystems and the climate system are closely coupled, with multiple interactions and feedbacks.

2. Biospheric feedbacks account for 40-60% of the uncertainty climate models.

3. Biospheric feedbacks impact the GHG emissions/concentrations/sinks, but also on the physical climate response,
Climate Change Results from Interaction of Multiple Forcings
The Earth’s ecosystems have numerous possible pathways depending on the climate change mitigation actions undertaken decades prior.
Areas indicated by red are those most severely modified regions.

Model prescribed changes in vegetation fraction.
Summer Climate
November - March

Long-term mean climate response to land clearing

Amplified temperature response during drought 2002-2003 El Niño event
Hot days (t.max >35°C) - Summer

Probability distribution of % hot days during summer (DJF) with tmax ≥ 35°C over 1951-2003 of pre-European and modern day vegetation conditions

pre-European (blue)
modern-day (red)
Land clearing increases in climatic extremes, as shown by

a) increase in frequency of hot days, (stronger impact in summer)

b) increase in frequency of dry days,

c) reduced daily rainfall intensity,

c) reduced number of wet days

Note: red (increase), blue (decrease), closed (significant), open (not significant)

These changes coincide with areas of land cover change, and have occurred in the vicinity of Murray Darling Basin, Australia’s agricultural production zone.
Land clearing increases the severity of the 2002/03 drought.
Risks

1. Loss of agricultural productivity
2. Accelerated loss of ecosystem resilience & increased risk of ecosystem collapse
3. Declining environmental flows
4. Increasing stress on water resources
Feedbacks of Future Droughts on Vegetation Dynamics

(Source: Rod Fensham, Queensland Herbarium)

(Source: Jean-Charles Perquin)

(Source: Getty Images)
Anticipatory policies are required which recognise:

1. There are multiple processes and feedbacks (besides CO$_2$) impacting on Australia’s regional climate.

2. Climate change is the function of multiple influences such as greenhouse gases, stratospheric ozone depletion, aerosols, and land use /land cover change.

3. Historical land clearing appears to have a significant impact on the regional climate of eastern Australia.

4. Deserves greater recognition in climate mitigation and adaptation policy.
1. Reduction in greenhouse gas emissions is essential.

2. Recognise the limits to adaptation – land use and ecosystems.

3. Need to move to long-term and adaptive strategies which restore the favourable feedbacks between native vegetation cover and local-regional climate.
The Earth’s ecosystems have numerous possible pathways depending on the climate change mitigation actions undertaken decades prior.
A continent under stress: interactions, feedbacks and risks associated with impact of modified land cover on Australia’s climate

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Abstract

Global climate change is the major and most urgent global environmental issue. Australia is already experiencing climate change as evidenced by higher temperatures and more frequent and severe droughts. These impacts are compounded by increasing land use pressures on natural resources and native ecosystems. This paper provides a synthesis of the interactions, feedbacks and risks of natural climate variability, climate change and land use/land cover change (LUCC) impacting on the Australian continent and how they vary regionally. We review evidence of climate change and underlying processes resulting from interactions between global warming caused by increased concentration of atmospheric greenhouse gases and modification of the land surface. The consequences of ignoring the effect of LUCC on current and future droughts in Australia could have catastrophic consequences for the nation’s environment, economy and communities. We highlight the need for more integrated, long-term and adaptive policies and regional natural resource management strategies that restore the beneficial feedbacks between native vegetation cover and local-regional climate, to help ameliorate the impact of global warming.

Keywords: anticipatory policy, climate change, drought, ecosystem collapse, El Niño, land cover change, land surface feedbacks, land use pressures, landscape resilience, tipping points