



## Committed ecosystem changes and contributions to climate recovery

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Future climate change and the carbon cycle are tightly coupled. Many studies have now shown positive feedbacks which amplify climate change, reduce the natural uptake of carbon and influence global emissions pathways to stabilisation. On the timescale of 1 or 2 centuries, this feedback is mainly due to the terrestrial biosphere. Here we assess to what extent the biosphere contributes to recovery of CO<sub>2</sub> levels after a cessation of carbon emissions. We find that when significant climate change has weakened natural terrestrial carbon sinks, these sinks do not recover after a stop of emissions and thus recovery of CO<sub>2</sub> (and hence climate) is slow. Further, we find that the terrestrial biosphere exhibits significant inertia and can continue to respond to climate changes decades after stabilisation of climate. This has serious implications for definitions of dangerous climate change based simply on stabilisation temperature as the absence of significant biome changes at the time of stabilisation does not preclude significant and potentially detrimental changes in subsequent decades.

Assessments of targets for stabilising climate change often consider the impacts of different levels of global warming. These assessments usually consider impacts that would occur at the time of reaching a particular level of warming. However, global terrestrial ecosystems continue to respond over longer timescales. Here we introduce the concept of "committed ecosystem changes" analogous to climate warming commitments and committed sea-level rise due to thermal inertia. The true impact of climate change on ecosystems will not be revealed for many decades after stabilising temperatures. Further, we suggest that ecosystems may become committed to substantial damage long before any is observable. For example, significant loss of forest cover in Amazonia may become inevitable significantly below a global warming of 2K. When defining dangerous climate change, and forming policy to avoid it, such committed ecosystem changes, rather than realised changes, must be considered.