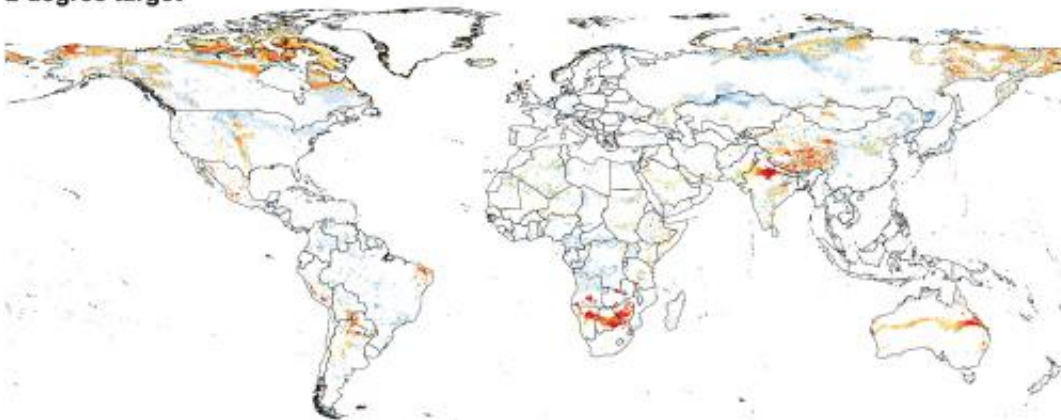


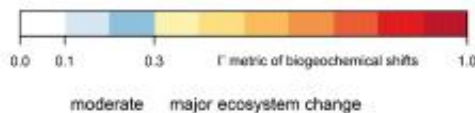
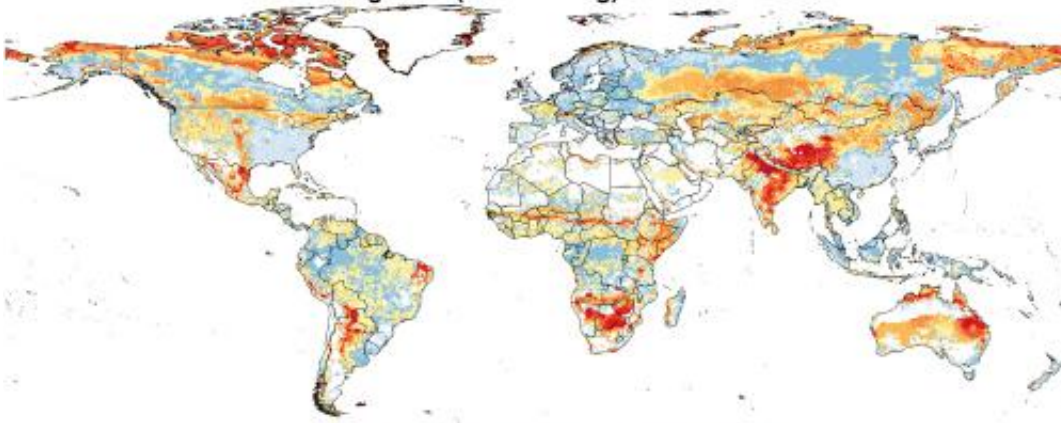
Terrestrial ecosystems at risk of major shifts as temperatures increase

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2 degree target



business-as-usual emissions growth (5 K warming)



This image shows simulated ecosystem change by 2100, depending on the degree of global temperature increase: 2 degrees Celsius (upper image) or five degrees Celsius (lower image) above preindustrial levels. The parameter Γ (Gamma) measures how far apart a future ecosystem under climate change would be from

the present state. Blue colours (lower Γ) depict areas of moderate change, yellow to red areas (higher Γ) show major change. The maps show the median value of the Γ parameter across all climate models, meaning at least half of the models agree on major change in the yellow to red areas, and at least half of the models are below the threshold for major change in the blue areas. Credit: Ostberg et al., 2013

Over 80 percent of the world's ice-free land is at risk of profound ecosystem transformation by 2100, a new study reveals. "Essentially, we would be leaving the world as we know it," says Sebastian Ostberg of the Potsdam Institute for Climate Impact Research, Germany. Ostberg and collaborators studied the critical impacts of climate change on landscapes and have now published their results in *Earth System Dynamics*, an open access journal of the European Geosciences Union (EGU).

The researchers state in the article that "nearly no area of the world is free" from the risk of climate change transforming landscapes substantially, unless mitigation limits warming to around 2 degrees Celsius above preindustrial levels.

Ecosystem changes could include boreal forests being transformed into temperate savannas, trees growing in the freezing Arctic tundra or even a dieback of some of the world's rainforests. Such profound transformations of land ecosystems have the potential to affect food and water security, and hence impact human well-being just like [sea level rise](#) and direct damage from [extreme weather events](#).

The new *Earth System Dynamics* study indicates that up to 86% of the remaining natural land ecosystems worldwide could be at risk of major change in a business-as-usual scenario (see note). This assumes that the

global mean temperature will be 4 to 5 degrees warmer at the end of this century than in pre-industrial times – given many countries' reluctance to commit to binding emissions cuts, such warming is not out of the question by 2100.

"The research shows there is a large difference in the risk of major ecosystem change depending on whether humankind continues with business as usual or if we opt for effective climate change mitigation," Ostberg points out.

But even if the warming is limited to 2 degrees, some 20% of land ecosystems – particularly those at high altitudes and high latitudes – are at risk of moderate or major transformation, the team reveals.

The researchers studied over 150 climate scenarios, looking at ecosystem changes in nearly 20 different climate models for various degrees of global warming. "Our study is the most comprehensive and internally consistent analysis of the risk of major ecosystem change from climate change at the global scale," says Wolfgang Lucht, also an author of the study and co-chair of the research domain Earth System Analysis at the Potsdam Institute for Climate Impact Research.

Few previous studies have looked into the global impact of raising temperatures on ecosystems because of how complex and interlinked these systems are. "Comprehensive theories and computer models of such complex systems and their dynamics up to the global scale do not exist."

To get around this problem, the team measured simultaneous changes in the biogeochemistry of terrestrial vegetation and the relative abundance of different vegetation species. "Any significant change in the underlying biogeochemistry presents an ecological adaptation challenge, fundamentally destabilising our natural systems," explains Ostberg.

The researchers defined a parameter to measure how far apart a future ecosystem under [climate change](#) would be from the present state. The parameter encompasses changes in variables such as the vegetation structure (from trees to grass, for example), the carbon stored in the soils and vegetation, and freshwater availability. "Our indicator of ecosystem change is able to measure the combined effect of changes in many ecosystem processes, instead of looking only at a single process," says Ostberg.

He hopes the new results can help inform the ongoing negotiations on climate mitigation targets, "as well as planning adaptation to unavoidable change."

More information: This research is presented in the paper 'Critical impacts of global warming on land ecosystems' to appear in the EGU open access journal *Earth System Dynamics* on 08 October 2013.

Provided by European Geosciences Union

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