Land use and climate change

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MY LENSES

1. Fluxes and stocks
2. The offset risk
3. The tipping point risk
The global carbon cycle

**Fluxes**
- Atmospheric CO₂: 3.1 ± 0.6
- 1.1 ± 0.7
- 2.8 ± 0.4

**Stocks**
- Vegetation: 450 GtC
- Soils: 1700 GtC
- Permafrost: 115 GtC
- Gas reserves: 1400 GtC
- Oil reserves: 230 GtC
- Coal reserves: 560 GtC
- Coasts: 10-45 GtC
- Surface sediments: 1750 GtC
- Organic carbon: 700 GtC
- Marine biota: 3 GtC
- Dissolved inorganic carbon: 37,000 GtC

Anthropogenic fluxes 2011-2020 average GtC per year
- Fossil CO₂ Eₚₒₜ
- Land-uptake Sₗₐₜₐₜ
- Land-use change Eₚₑₜ
- Ocean-uptake Sₐₒₜₐₜ

Budget imbalance: -0.3

Global carbon budget 2021 (Friedlingstein et al)
LAND USE CHANGES

Deforestation

Reforestation

Forest conservation

Fluxes and stocks

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WHERE ARE TERRESTRIAL CARBON STOCKS?

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Brazil: Amazon sees worst deforestation levels in 15 years

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Deforestation increased in the Amazon by 22% during the 2020-21 period
BEWARE OF GEOPOLITICS

Source: Friedlingstein et al 2021; Global Carbon Budget 2021
Figure 1 | The Importance of Forests for Climate Change Mitigation

Griscom et al 2017. PNAS https://doi.org/10.1073/pnas.1710465114
Changes in the budget over time

The sinks have continued to grow with increasing emissions, but climate change will affect carbon cycle processes in a way that will exacerbate the increase of CO$_2$ in the atmosphere.

The budget imbalance is the total emissions minus the estimated growth in the atmosphere, land and ocean. It reflects the limits of our understanding of the carbon cycle. Source: Friedlingstein et al. 2021, Global Carbon Project 2021.
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Land Area (Million ha)


*BECCS currently in country climate pledges (81 million ha)
Ex-ante reforestation offsets


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Carbon uptake by mature Amazon forests has mitigated Amazon nations’ carbon emissions

Oliver L. Phillips\textsuperscript{a,*}, Roel J. W. Bijl\textsuperscript{e} and the RAINFOR collaboration
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RAISING THE ALARM
Evidence that tipping points are under way has mounted in the past decade. Domino effects have also been proposed.

https://earth.org/tipping-points-of-climate-change/

A. Amazon rainforest
Frequent droughts

B. Arctic sea ice
Reduction in area

C. Atlantic circulation
In slowdown since 1950s

D. Boreal forest
Fires and pests changing

E. Arctic sea ice
Reduction in area

F. Coral reefs
Large-scale die-offs

G. Greenland ice sheet
Ice loss accelerating

H. Permafrost
Thawing

I. West Antarctic ice sheet
Ice loss accelerating

J. Wilkes Basin
East Antarctica
Ice loss accelerating

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“It is unequivocal that human activities have heated our climate. Recent changes are rapid, intensifying, and unprecedented over centuries to thousands of years.”

BIOLOGICAL FEEDBACK LOOPS

Net carbon emissions from Canada's managed forests

Reported in megatonnes of CO₂ equivalent. Positive values mean net emissions, negative values mean net absorption. Click or tap to change between area types.

<table>
<thead>
<tr>
<th>All areas</th>
<th>Areas with forestry activity</th>
<th>Areas with natural disturbances</th>
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Chart: Robson Fletcher / CBC • Source: Natural Resources Canada

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Figure 1. A comparison of the emissions reductions from various individual actions. The height of the bar represents the mean of all studies identified in developed nations, while black lines indicate mean values for selected countries or regions (identified by ISO codes) where data were available from specific studies. We have classified actions as high (green), moderate (blue), and low (yellow) impact in terms of greenhouse gas emissions reductions. Note the break in the y-axis. See supplementary materials 5 for details.


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