Land Carbon Modeling for the Global Carbon Budget
Friedlingstein et al. (2023), "Global Carbon Budget 2023", Earth System Science Data
(https://doi.org/10.5194/essd-15-5301-2023)

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Science Question
- How can we accurately (and annually) assess the global carbon cycle and anthropogenic CO2 emissions in support of climate policies?
- In particular, how can we quantify global and national land-use emissions and the land sink?

Analysis
- Land-Use Harmonization 2 dataset (LUH2) – a global dataset of historical and future land-use change and management that has contributed annually-updated land-use forcing data to GCB for 10 years. Uses Landsat data on forest area change.
- EDv3.0 model – an ecosystem demography model included for the first time in the GCB as one of 20 DGVMs used to compute land carbon sinks and emissions. ED followed TRENDY protocol and passed all criteria of model inclusion. Uses GEDI and ICESat-2 data. Includes all gross transitions of LUH2

Result
- Net land use emissions (1.2 Gt C/yr in 2022) are decreasing slightly, but are still too high to be offset by current levels of reforestation and afforestation
- Land-use emissions estimates continue to have a large uncertainty associated with them
- Improved estimates of LU emissions in Brazil and Indonesia via use of MapBiomas data

Significance
- Although developed for use in global-scale climate models, the LUH2 dataset is becoming more relevant for national-scale reporting for carbon budgets
- ED simulations demonstrate capability for global-scale land carbon modeling and potential for incorporating GEDI and ICESat-2 observations to improve future GCB estimates.

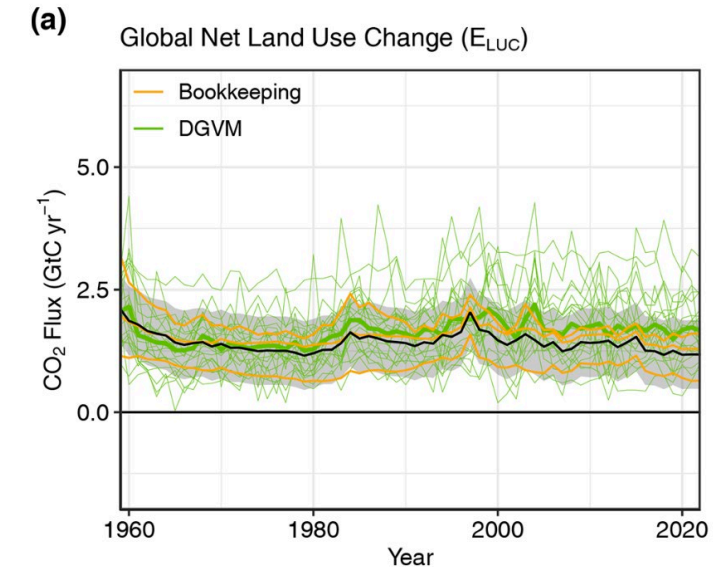## Acknowledgements

(a) Global Net Land Use Change (E_{LUC})

Figure (a)

Net global CO_2 emissions from land-use change, via book-keeping models (yellow), budget estimate (black) and DGVMs (green).

(b) National Net Land Use Change (E_{LUC})

Figure (b)

Net CO_2 emissions from land-use change for specific countries of interest, from book-keeping model averages