

## Future land carbon removals in China consistent with national inventory

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### Motivation

- **China's commitment to carbon neutrality by 2060** is largely dependent on the Land Use, Land-Use Change, and Forestry (LULUCF) sector, with several **forestation targets** designed to enhance carbon removal<sup>1</sup>. Yet, discrepancies exist in carbon accounting between national inventories and scientific evaluations<sup>2</sup>, leading to uncertainty about the true potential of these forestation efforts.
- **How much carbon could potentially be sequestered in the future**, should the national forestation targets be followed?

### Methods

- **OSCAR-China**: a **0.5° gridded version** of OSCAR v3.2, specifically designed for China.
- **Historical land-use change**: an **improved reconstruction** for China, integrating multiple observations<sup>3</sup>
- **Future scenarios**: **aligned with national forestation targets**, taking into account potential forest distribution, and exploring various policy implementation assumptions.

### Historical LULUCF fluxes: bridge the gap

LULUCF direct effect ( $E_{LUC}$ ) ▶ bookkeeping models and IAMs  
LULUCF net flux ( $F_{NET(man)} = E_{LUC} + S_{LAND(man)}$ ) ▶ national inventories

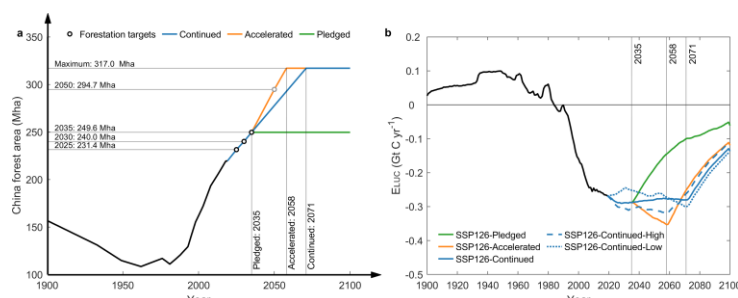
- OSCAR-China: past forestation efforts created a **carbon sink of  $-0.24 \pm 0.03$  Gt C yr<sup>-1</sup> over 1994-2018**, following national inventory accounting, to which the **direct effect contributed  $-0.20 \pm 0.03$  Gt C yr<sup>-1</sup>**.
- Bookkeeping models in GCB (*direct effect*): exhibit large biases mainly due to inaccuracies in their input dataset.
- IAMs in IPCC AR6 (*direct effect*): fail to capture current forestation-induced carbon removal, casting doubts on their projections for China.
- **Our model reproduces the Chinese national inventory and observed biomass carbon densities** (not shown).

### Future LULUCF removals

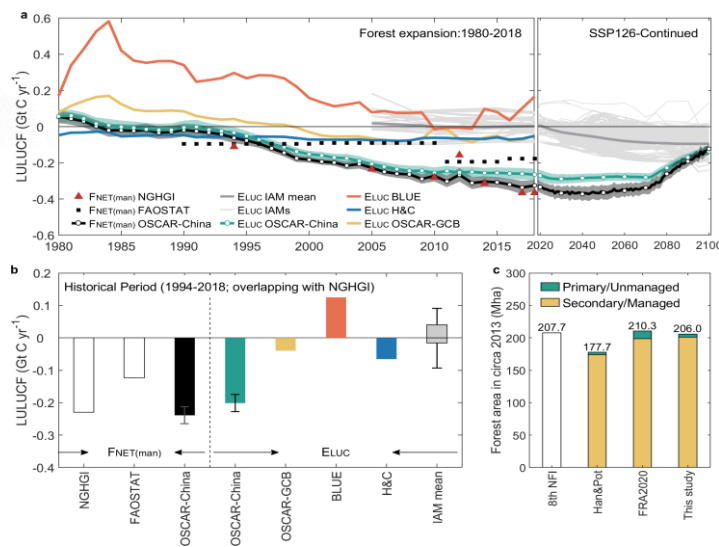
- We project a **net LULUCF flux of  $-0.35 \pm 0.04$  Gt C yr<sup>-1</sup> in 2060**, assuming continued policy implementation under SSP1-2.6, with a **direct effect of  $-0.28 \pm 0.02$  Gt C yr<sup>-1</sup>**.
- These could **offset  $43 \pm 4$  % or  $34 \pm 3$  % (respectively) of China's hard-to-abate fossil CO<sub>2</sub> emissions<sup>4</sup>**, although including the indirect effect requires precautions because of incompatibility with remaining carbon budgets<sup>2</sup>.
- These results are impacted by management choices and the climate scenario, although **the potential for carbon capture on land in China is finite: ~20 Gt C (direct effect) and ~25 Gt C (net flux, SSP1-2.6) over 2019-2100**.

### References

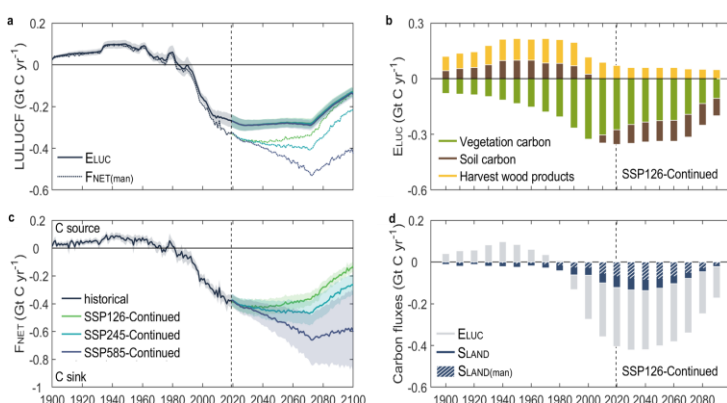
1. Liu, Z. et al. Challenges and opportunities for carbon neutrality in China. Nat. Rev. Earth Environ. 3, 141–155 (2022)
2. Gidden, M. J. et al. Aligning climate scenarios to emissions inventories shifts global benchmarks. Nature 624, 102–108 (2023).
3. Yu, Z. et al. Forest expansion dominates China's land carbon sink since 1980. Nat. Commun. 13, 5374 (2022).
4. Yu, G. et al. Discussion on Action Strategies of China's Carbon Peak and Carbon Neutrality. Bull. Chinese Acad. Sci. 37, 423–434 (2022).



▲ Forest expansion trajectories and corresponding LULUCF direct fluxes



▲ Comparison of LULUCF fluxes estimated by different methods



▲ Historical and future trajectories of China's land carbon dynamics