

Spatial analysis of carbon dioxide removal (CDR) implications for global biodiversity refugia

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Background

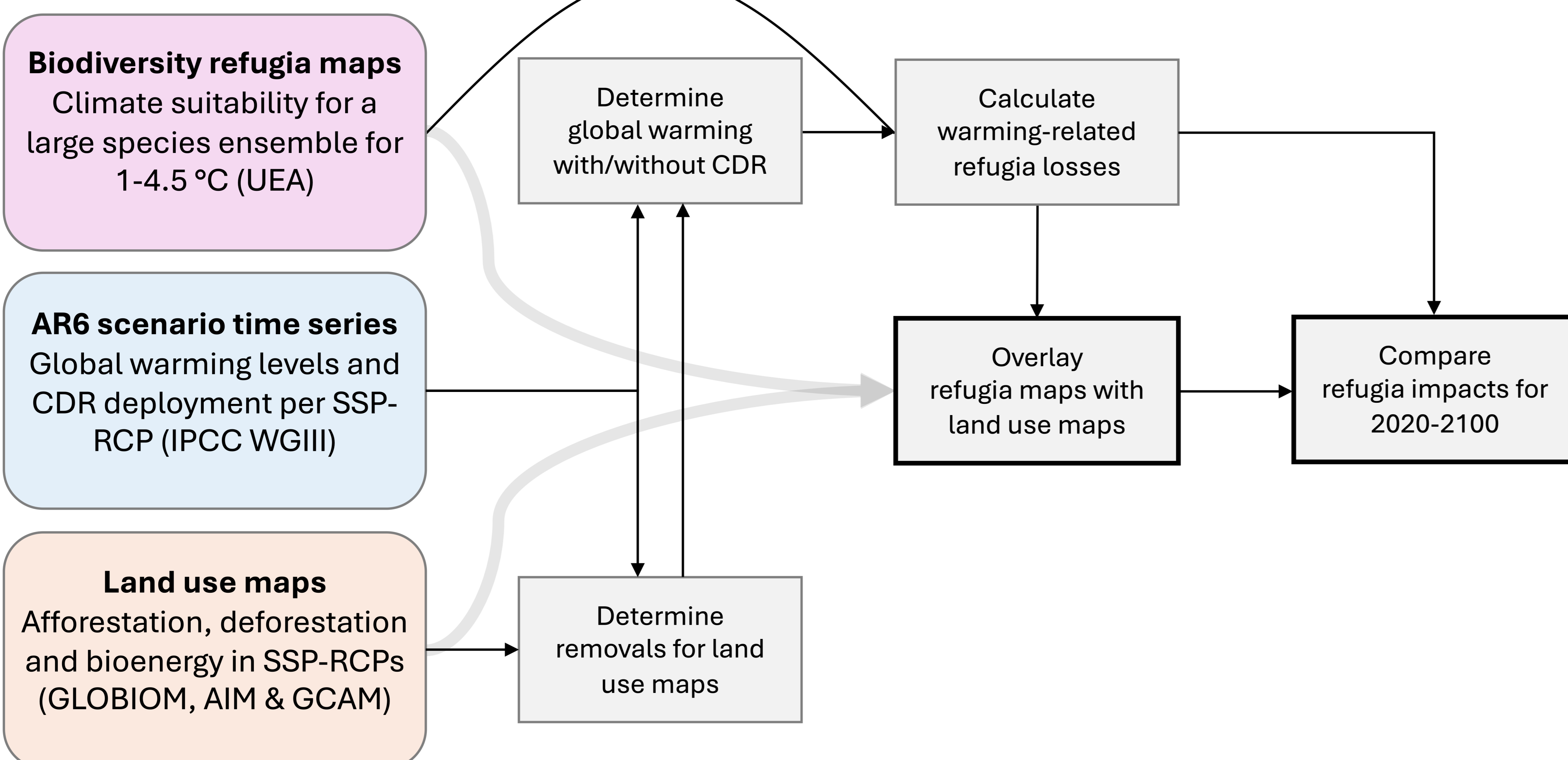
“Biodiversity loss will continue to escalate with every increment of global warming (*very high confidence*).”

“Deployment of afforestation, or bioenergy, with or without carbon capture and storage, can compound risks to biodiversity (*high confidence*).” [AR6 WGII SPM]

Study objective

Spatial analysis of warming and land-related biodiversity refugia implications of afforestation and bioenergy (with carbon capture and storage) across future scenarios

Datasets and workflow

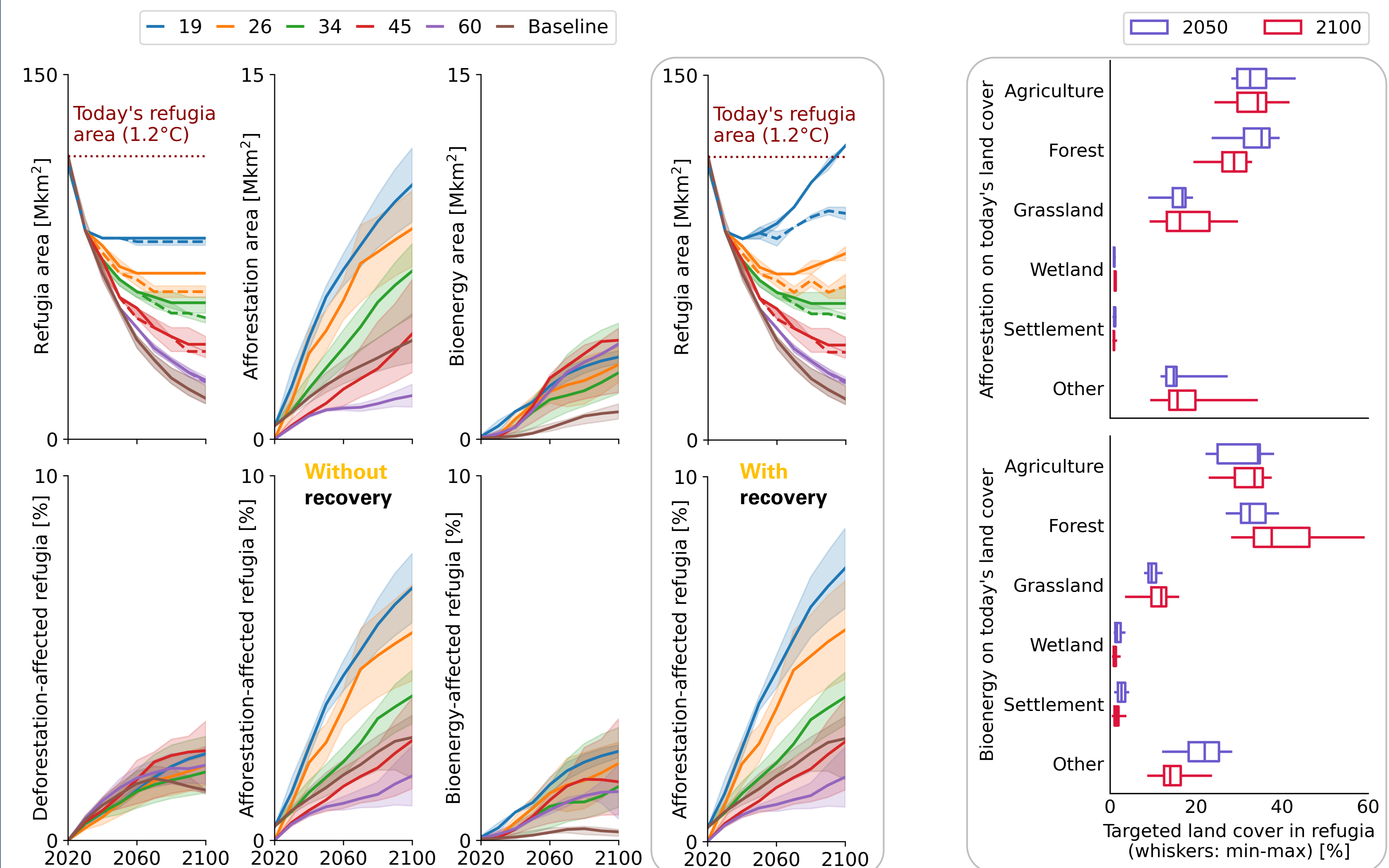


Key messages

- More ambitious RCPs with more CDR increase land-related refugia impacts but reduce warming-related refugia loss.
- Recovery assumptions strongly influence warming-related refugia loss but merely affect land-related refugia impacts.
- Desirability and size of land-related refugia impacts vary across models, RCPs, SSPs, regions, and baseline land uses.

Results

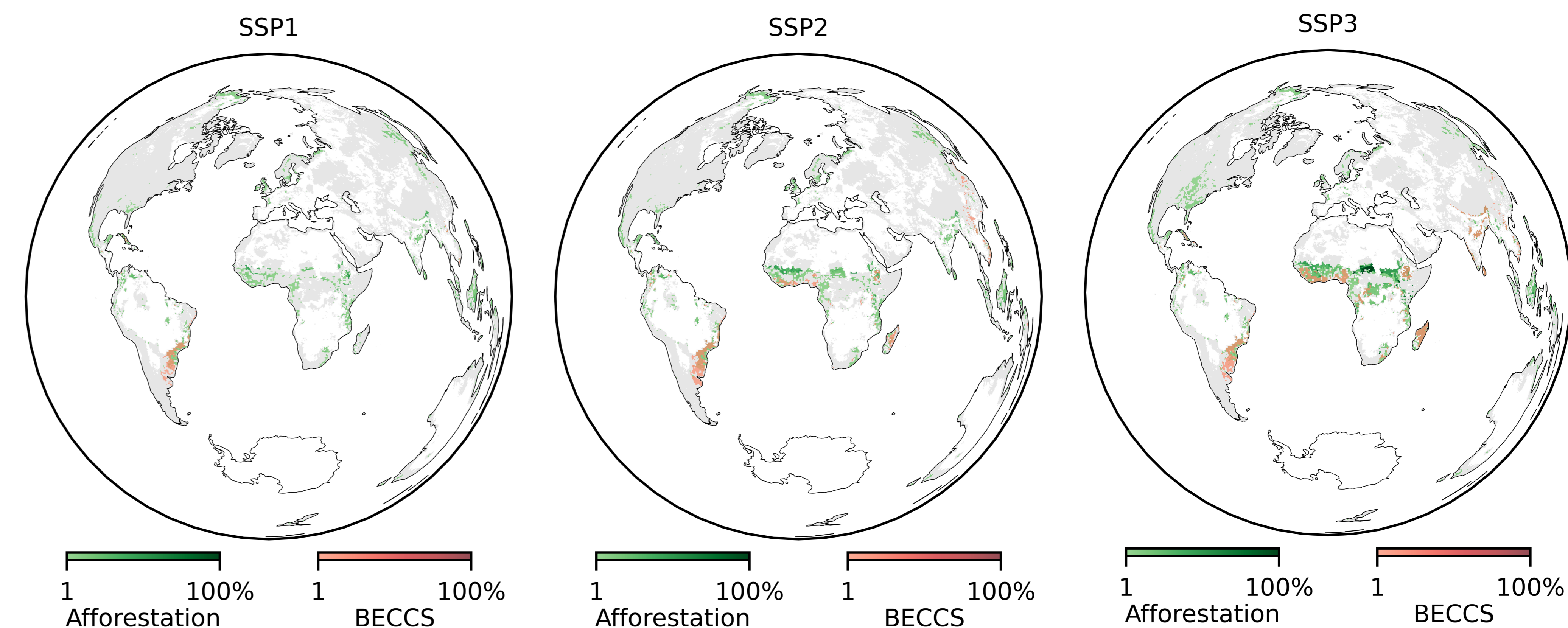
Model median across AIM, GCAM and GLOBIOM



Note: Solid: CDR included. Dashed: CDR excluded. Color: RCPs. Shading: SSP1-3 range.

Note: No recovery. Range across all SSP-RCPs.

Land impact of 5 GtCO₂ removal on remaining refugia at 1.5 °C of global warming (GLOBIOM)



Note: Grey: Unaffected refugia. CDR option split: 50/50.

Spatial analysis of carbon dioxide removal (CDR) implications for global biodiversity refugia: Supplementary material

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Supplementary notes

- **Deforestation:** In this analysis, deforestation is determined as the negative difference between the baseline forest cover in 2020 and future forest cover throughout the time series. Therefore, deforestation-affected refugia refers to future deforestation only.
- **Global maps:** The maps presented in the poster show the remaining refugia areas in grey for 1.5 °C of global warming and the extent (1-100%) to which these areas overlap with areas allocated for afforestation or bioenergy plantations for BECCS, assuming a total removal of 5 GtCO₂ (2.5 GtCO₂ via afforestation and 2.5 GtCO₂ via BECCS).
- **Refugia:** The spatially-explicit refugia data is based on an ensemble of more than 130 000 individual species range models across different taxa. Refugia are defined as areas where at least 75% of currently present species will remain for a given warming level. The ensemble serves as proxy for general biodiversity.
- **RCPs:** Representative concentration pathways
- **Scenario removal:** The warming-related refugia impact across scenarios, when including or excluding CDR, is calculated based on the AR6 scenario removals for BECCS plus the net-negative AFOLU CO₂ emissions, which serves as conservative proxy for removals via afforestation. This is necessary as removals via afforestation are only partly reported and therefore not fully available for all scenarios considered in this analysis.
- **SSPs:** Shared socioeconomic pathways

Key references and datasets

AIM-SSP/RCP Ver2018 Gridded Emissions and Land-use data. (2018).

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ESA. Land Cover CCI Product User Guide Version 2. Tech. Rep. (2017). Available at: maps.elie.ucl.ac.be/CCI/viewer/download/ESACCI-LC-Ph2-PUGv2_2.0.pdf

GCAM-Demeter land use dataset at 0.05-degree resolution:

<https://doi.org/10.25584/data.2020-07.1357/1644253>

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Krey et al. MESSAGEix-GLOBIOM Documentation – 2020 release. (2020).

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