Terrestrial Carbon Cycle Priorities from the Global Carbon Project

Pep Canadell & GCP SSC/Activity Leaders

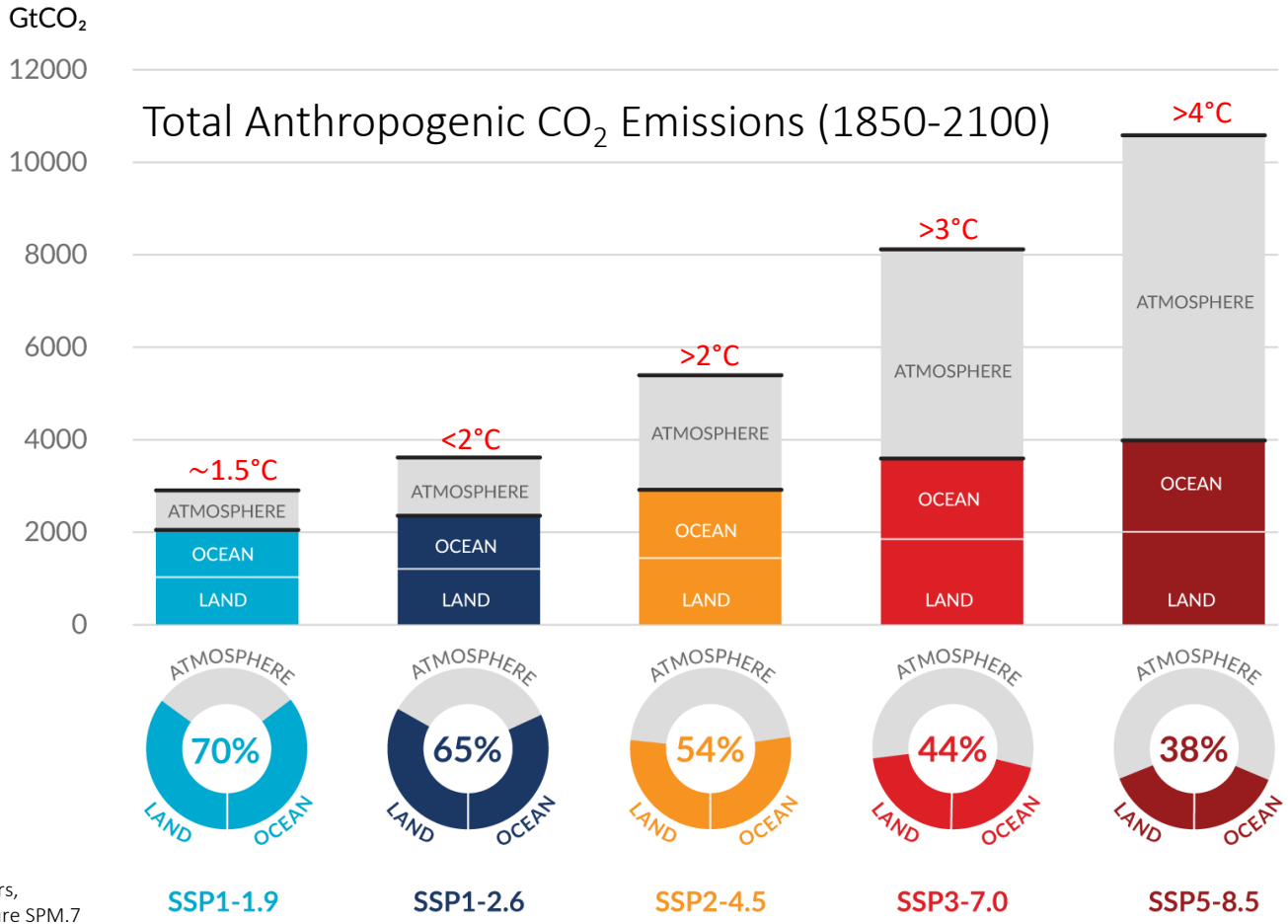
CSIRO Climate Science Centre

Canberra, Australia

4th Carbon from Space Workshop

25th October 2022

Efficacy of the Natural CO_2 Sinks



Summary for Policy Makers,
IPCC 2021, AR6, WGI, Figure SPM.7

Atmospheric Accumulation

CO_2 Sinks

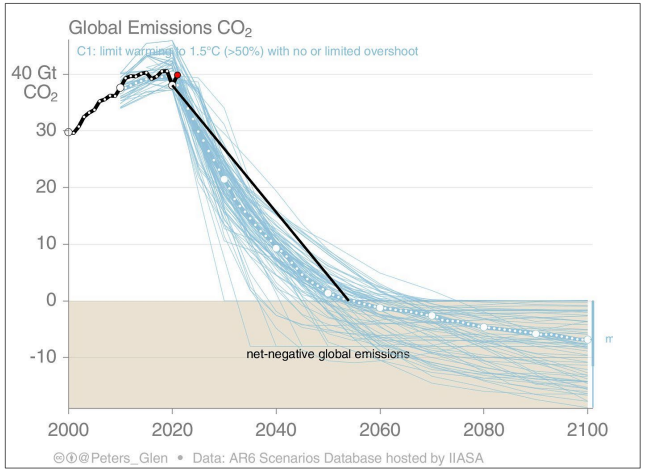
Fraction of cumulative CO_2 Emissions Removed by Sinks

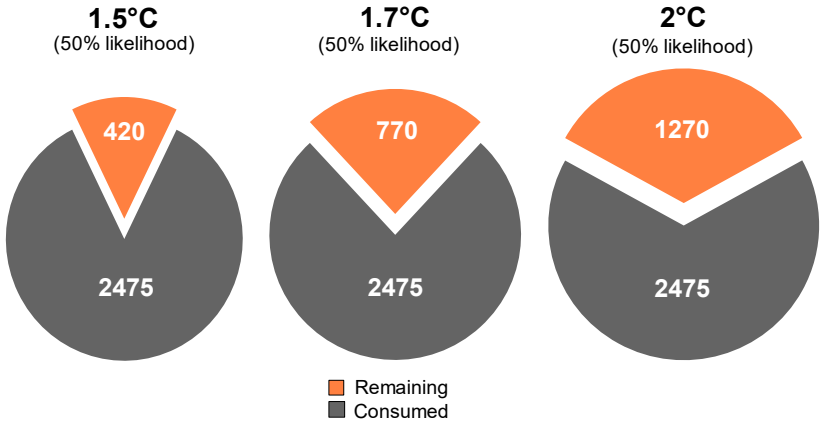
Appropriation of the Land Sinks

- Use of biomass for:
  - Bioenery to replace fossil fuels
  - Food production and meat alternatives
  - Wood products and steal replacement
  - Other plant-based materials for the green economy (e.g., plastics)
  - Biomass use versus forest conservation

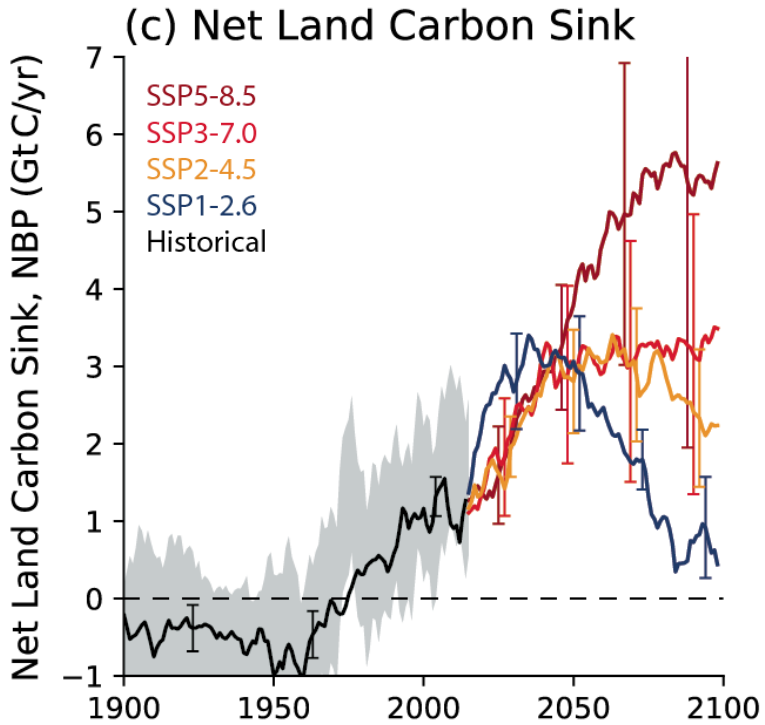
- What is the net C balance of different or combination of uses?
- What are the climate change impacts on different uses?
- What are the implications for reaching net-zero emissions?

Implications for Reaching Nez-Zero CO_2 emissions





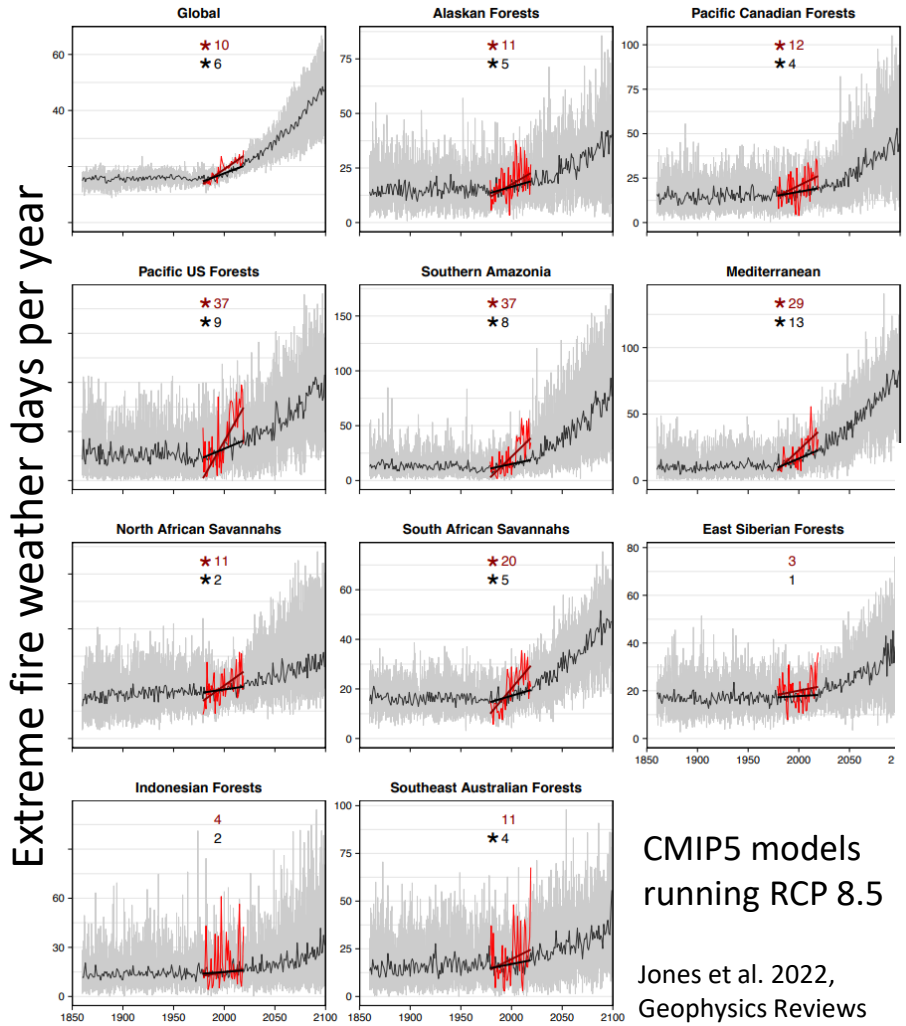
GCP - Global Carbon Budget
Friedlingstein et al. 2022, ESSD



Canadell et al. 2021, Chapter 5, IPCC AR6 WGI

Extreme Fire Weather Trends Growing Faster than ESMs Output

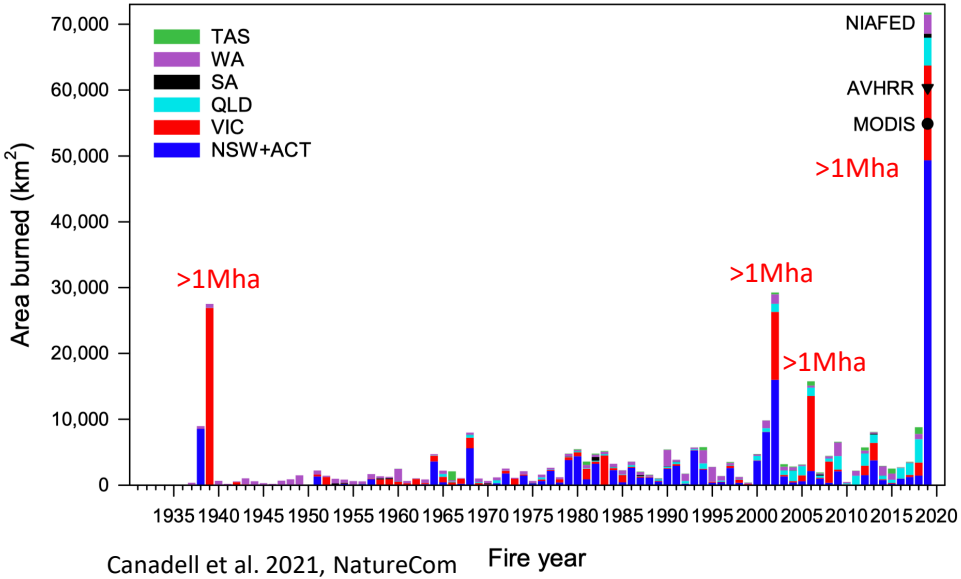
GLOBAL CARBON project



CMIP5 models running RCP 8.5

Jones et al. 2022, Geophysics Reviews

Wildfire Regime Shift in Australian Forests after yr 2000

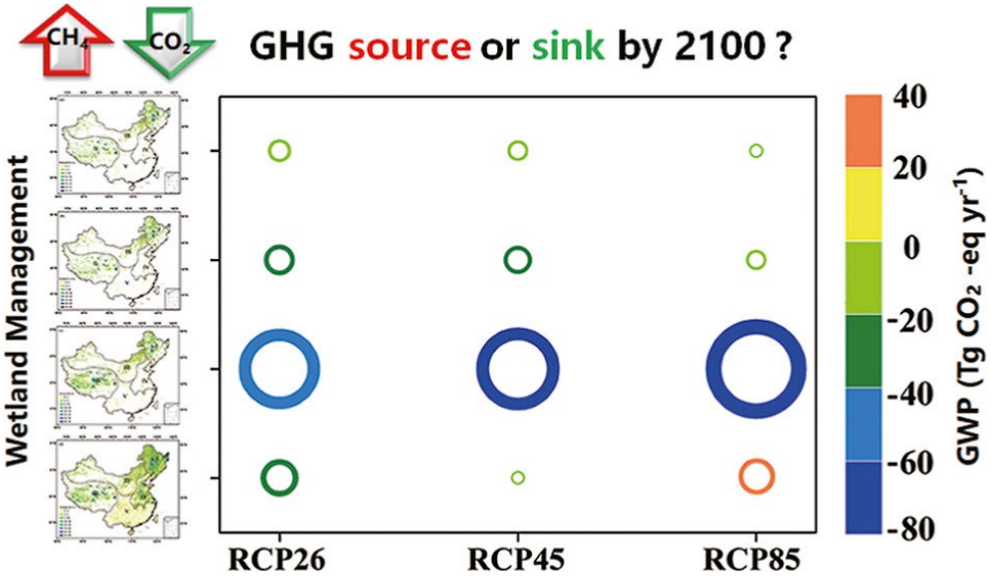


Canadell et al. 2021, NatureCom

Beyond Afforestation and Reforestation

- The role of nature-based solutions and integration of GHGS w/ co-benefits, trade-offs, barriers:
  - Peatland and wetland conservation/restoration
  - Soil carbon in managed lands
  - Urban NBS
  - Blue Carbon

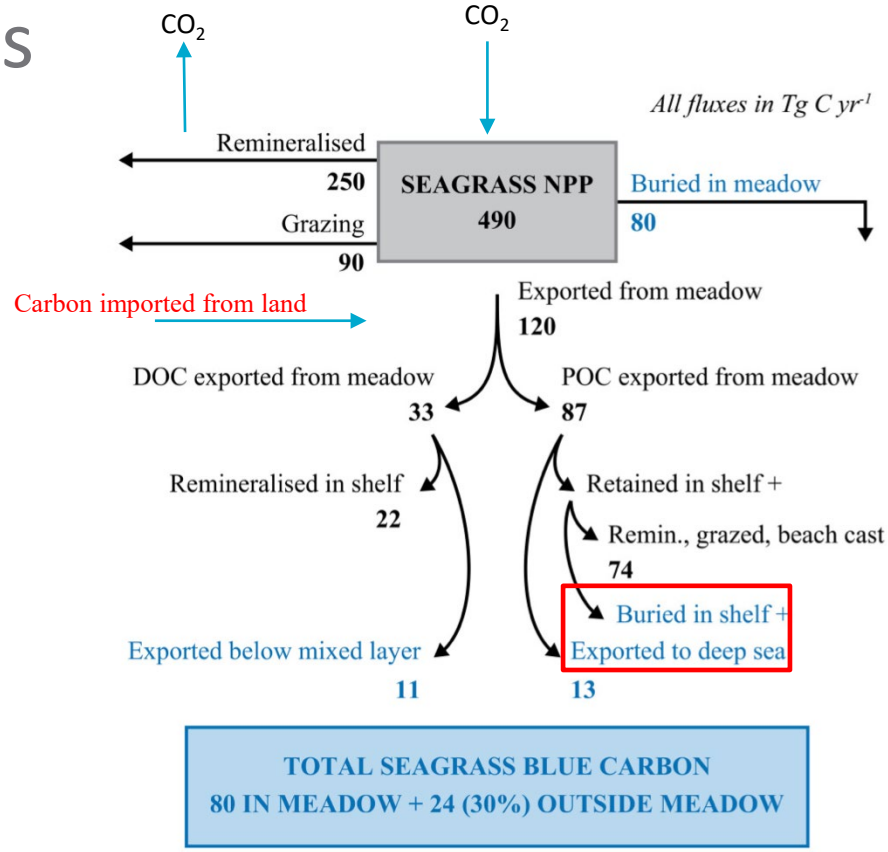
Wetland Restoration in China
(largest program in the world: 1.4 Mha by 2030)



Li et al. 2022, Env.Sci.Tech

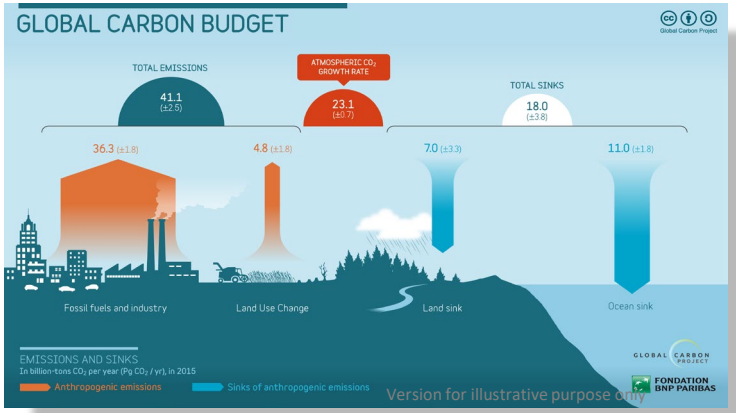
Not Yet Able to Close the Carbon Budget of Coastal Ecosystems

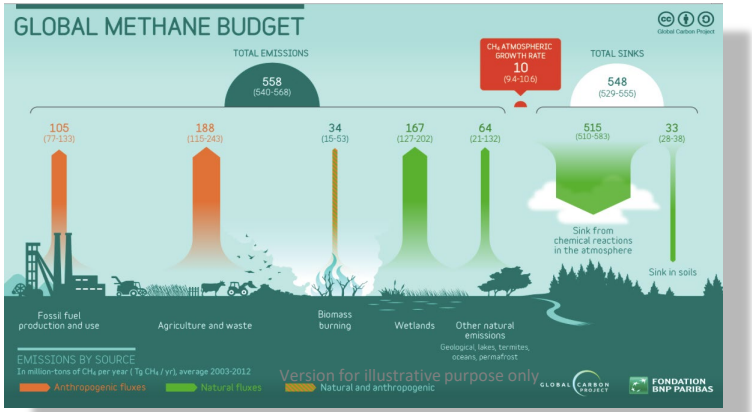
- Seaweed meadows
- Mangrove forests
- Kelp forests
- Coastal wetlands
- …

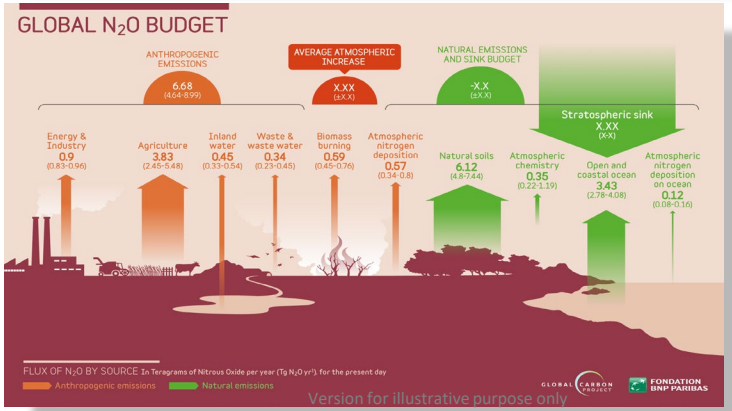


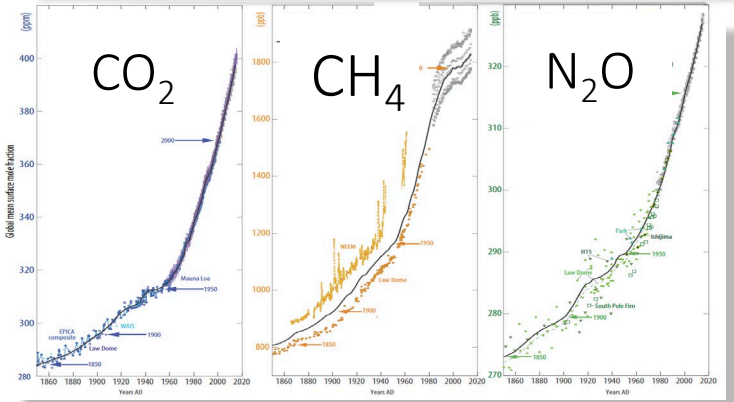
modified from Duarte & Krause-Jensen 2017, FMS

Improving & Integrating Global GHGs Budgets w/trade-offs and synergies of climate impacts and/or management





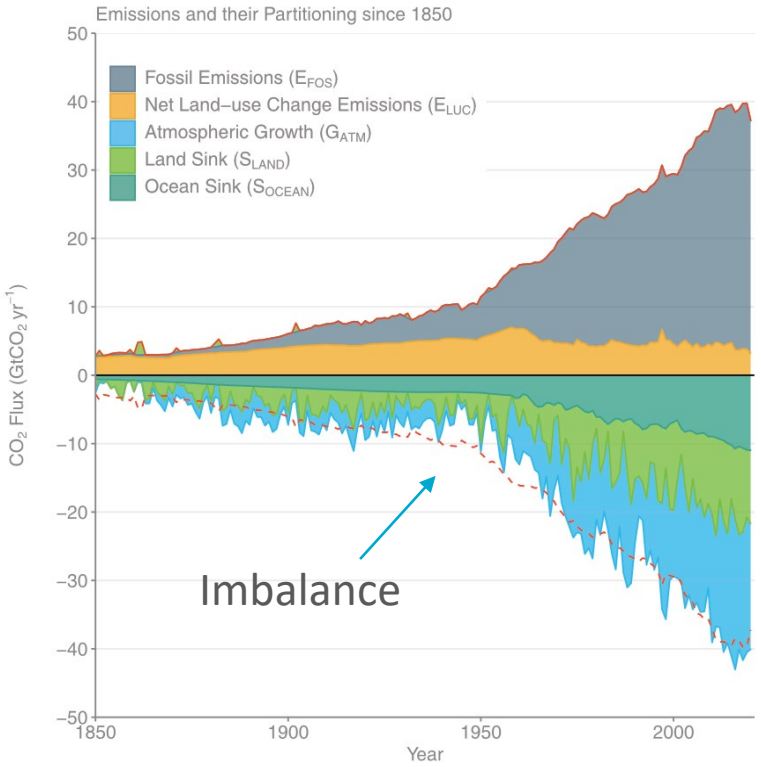




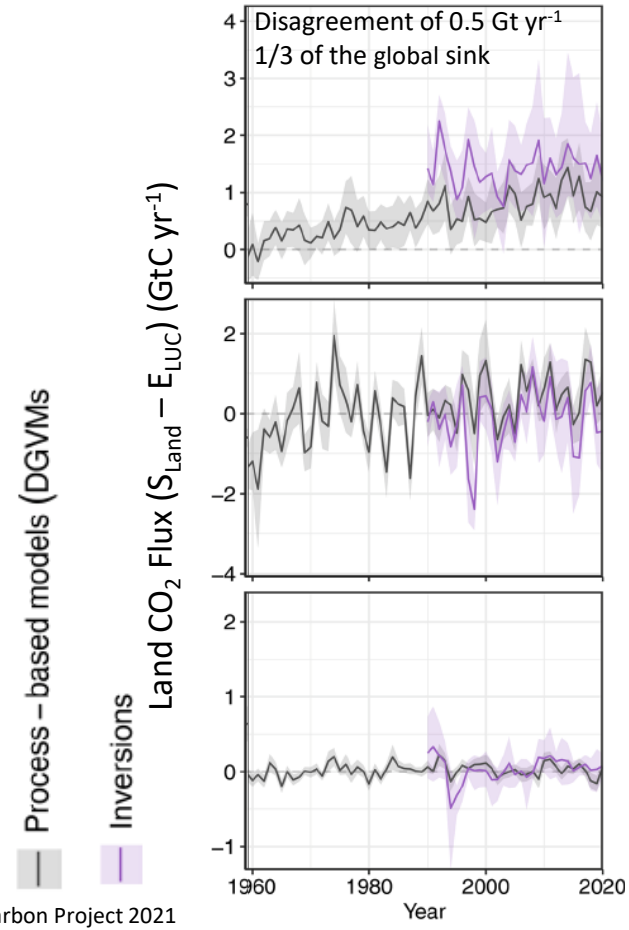
Some Priorities Global Carbon Budget

GLOBAL CARBON project

Close the Budget Imbalance



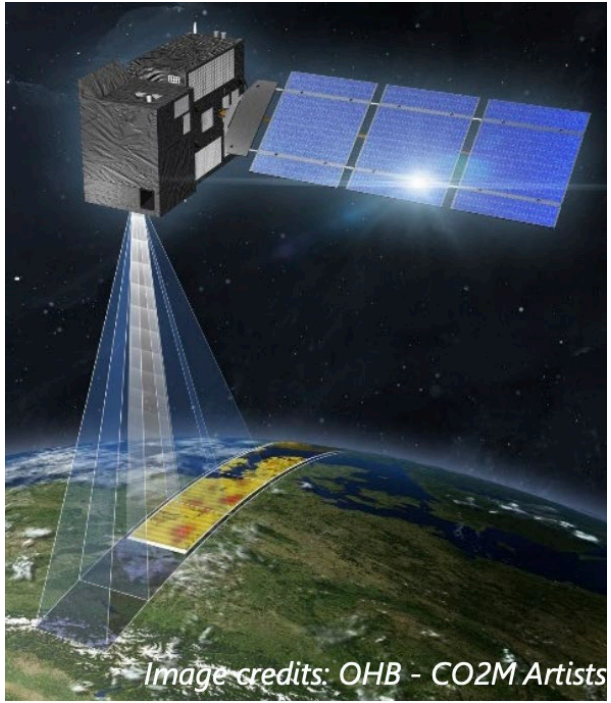
Resolve Latitudinal Discrepancy



Friedlingstein et al 2022; Global Carbon Project 2021

From Global GHG Budgets to National GHG Budgets and Inventories

- GCP Global Budgets and GCP-RECCAP1&2 Regional Carbon Budgets (RECCAP2 providing some of the first comprehensive national GHG budgets).
- NASA OCO2-MIP some national carbon budgets (annual).
- Several research groups soon to provide some budgets at sub-annual scales.
- CO2Mission - Copernicus – global data assimilation (near real time) to assess national emissions and carbon balance/budget.
- JAXA/NIES Japan – GHG global data assimilation (near real time) based on GOSAT-GW
- WMO: Coordinated Global Greenhouse Gas Monitoring Infrastructure (RS and in situ) to provide near-real-time.



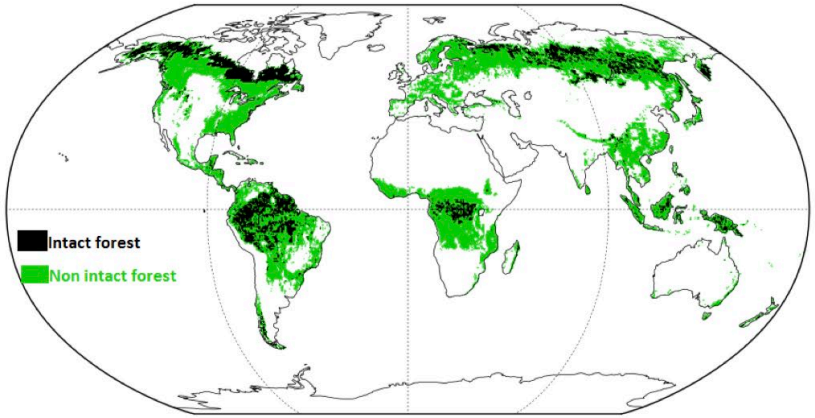
Challenges and Opportunities of new GHG Systems

- To bring state of the art of carbon and other biogeochemical cycles science to support the development of new platforms, choices of input data, processes to include,…

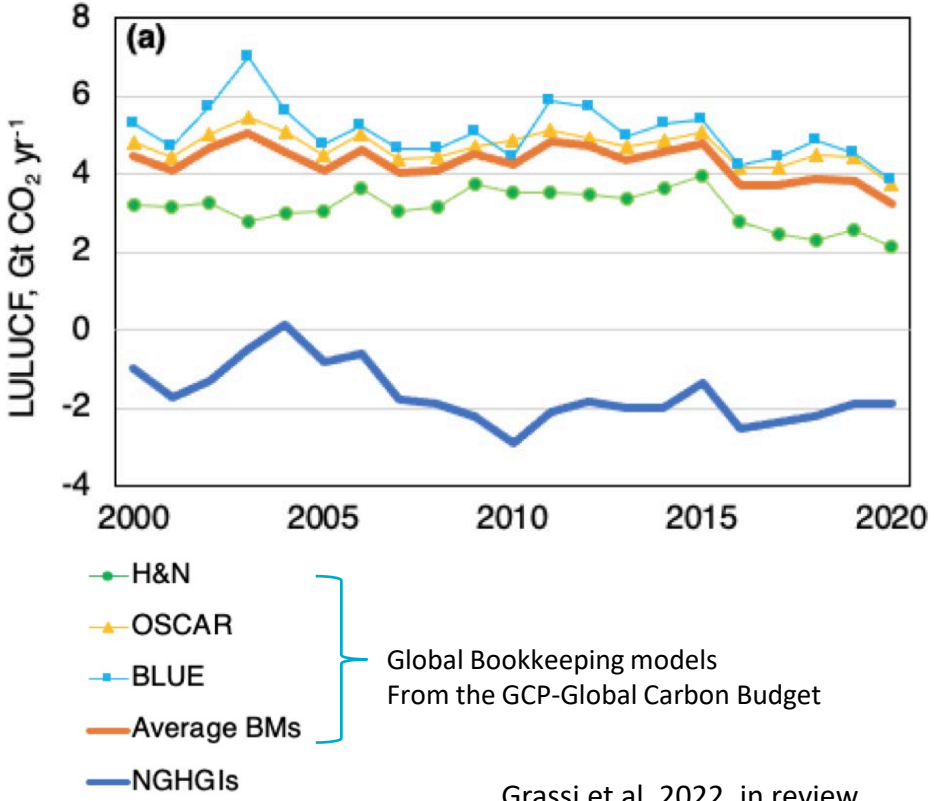
- The different platforms need to be cross-operational to some degree (we want more than one system, but we don't want as many answers as systems there are).

- Reconcile and be cross-operational between scales (global budgets, to regional to national budgets, to National GHG inventories, and even to cross-national boundary corporations).

Reconciling Global LUC Bookkeeping Models with UNFCCC National GHG Inventories

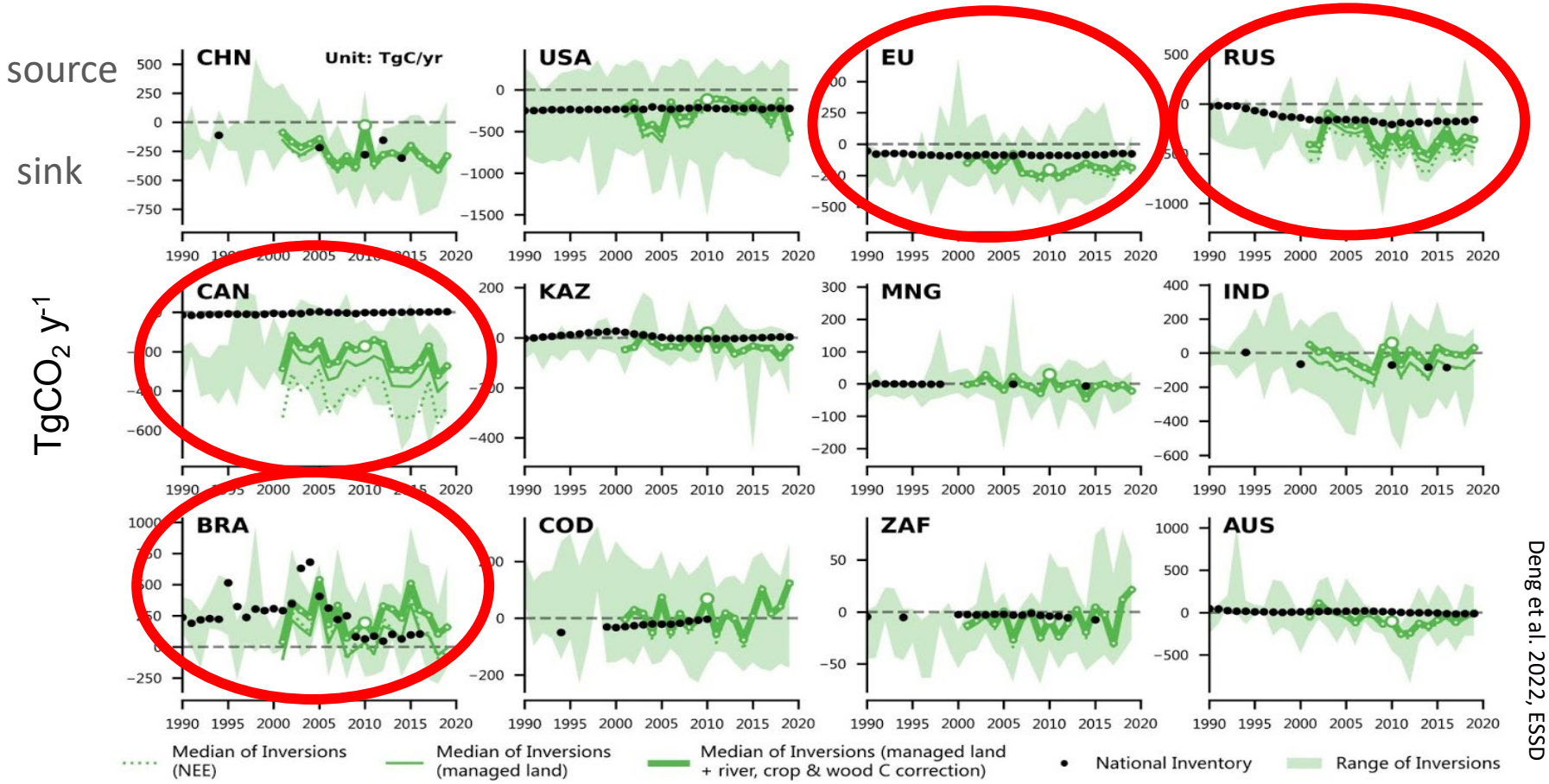


- Managed lands (NGHGIs) versus non-managed lands. Solving - priority
- Direct effects of LULUCF (eg, reforestation) vs. indirect (eg, elevated CO_2 effects)



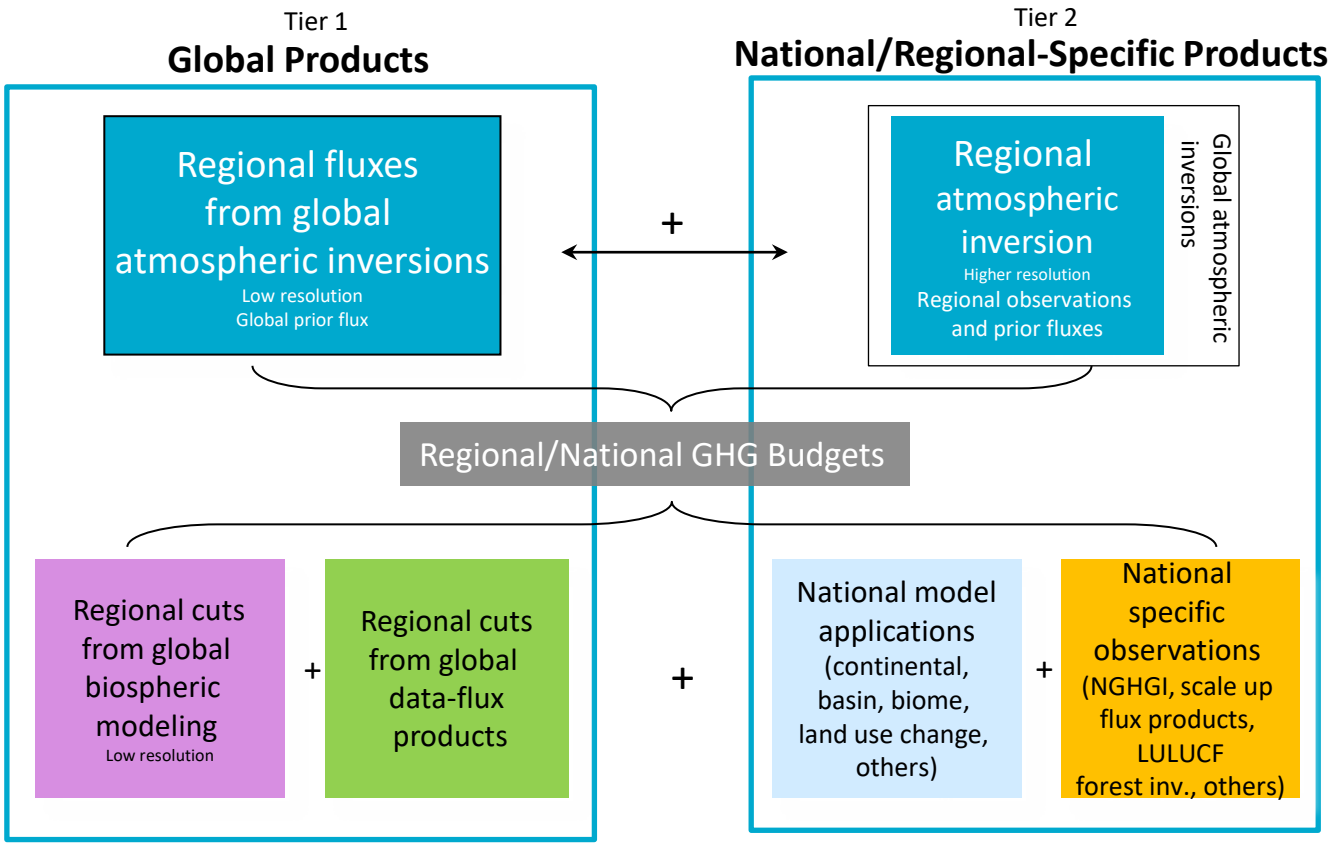
Grassi et al. 2022, in review

Reconciling UNFCCC NGHGIs with Atmospheric Inversions



Deng et al. 2022, ESSD

Two-tier approach for national/regional GHG budgets

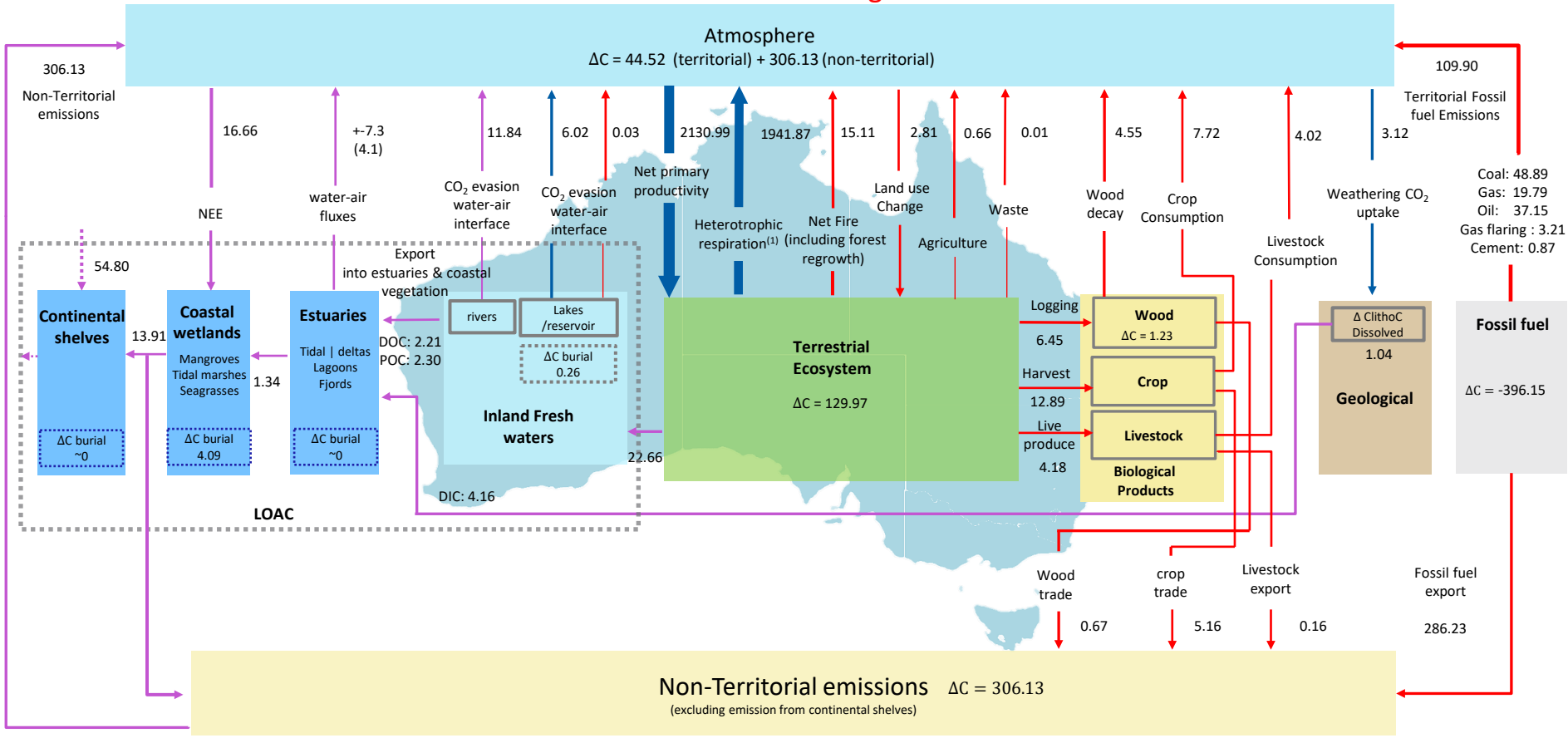


GCP, RECCAP1,2

Regional Australia carbon Budget (2010-2019) (Units Tg C yr^{-1})

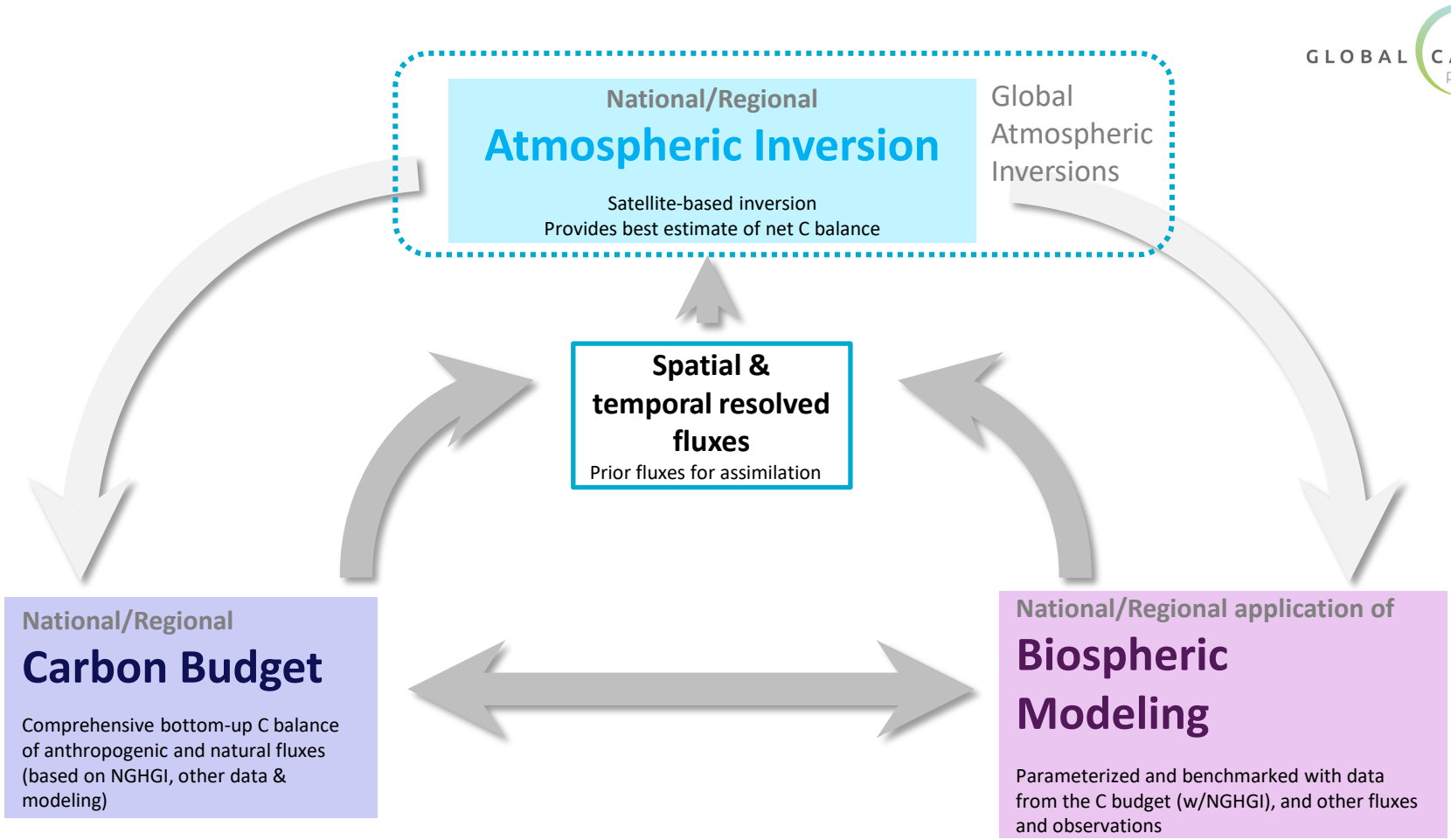
GLOBAL CARBON project

- RECCAP2 Work in Progress -



Villalobos et al. 2022, in progress, RECCAP2 Australasia team

(1) Heterotrophic respiration flux corrected by fires disturbances . Fires were taken from GFED dataset.



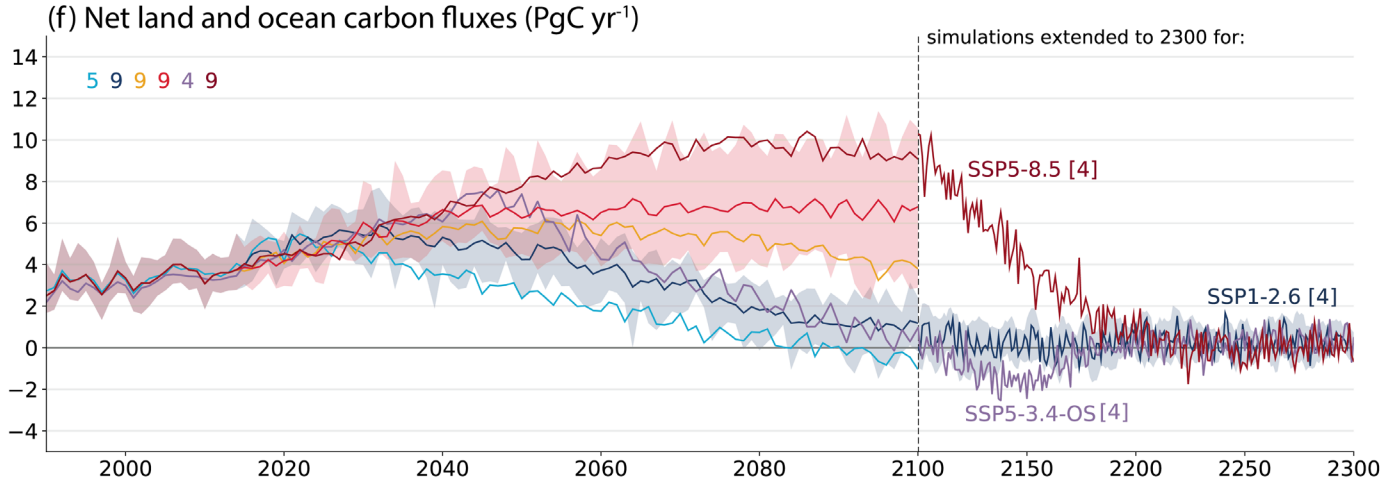
National Carbon Integrated System

Where Does the Carbon Go After Peaking Emissions?

Does the carbon cycle behave perfectly symmetric as
emissions go up, go down, and under (net-negative emissions) ?

IPCC AR6 said "NO"

both in response to management and carbon-climate feedbacks



Canadell et al. 2021, Chapter 5, IPCC AR6 WGI

End