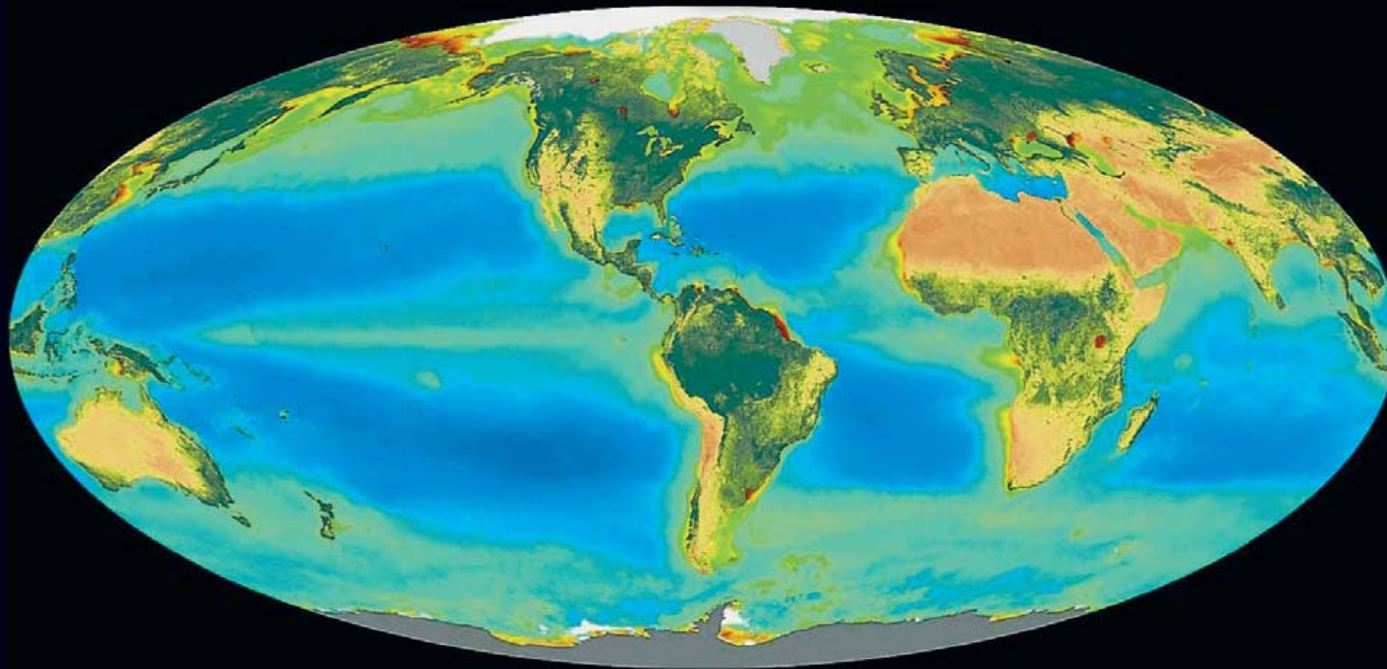


Carbon Budget & its Anthropogenic Perturbation in the Land–Ocean Aquatic Continuum

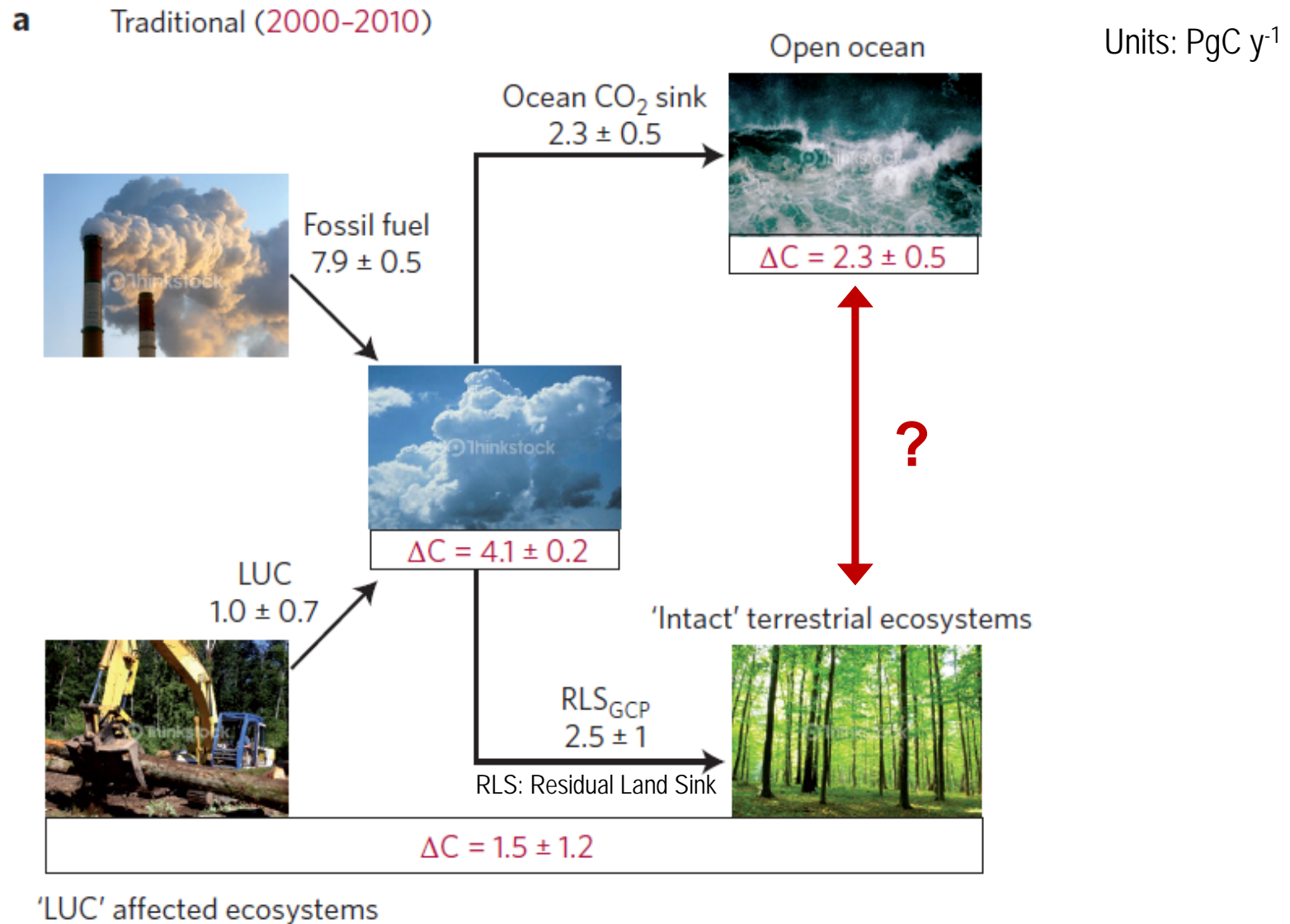


- A. Andersson
- S. Arndt
- C. Arnosti
- A. Borges
- A. Dale
- A. Gallego-Sala
- Y. Godd ris
- F. Joos
- T. Ilyina
- J. Hartmann
- C. Heinze
- I. Janssens
- G. Laruelle
- D. LaRowe
- J. Leifeld
- R. Lauerwald
- S. Luyssaert
- F. Meysman
- G. Munhoven
- P. Raymond
- R. Spahni
- P. Suntharalingam
- M. Thullner

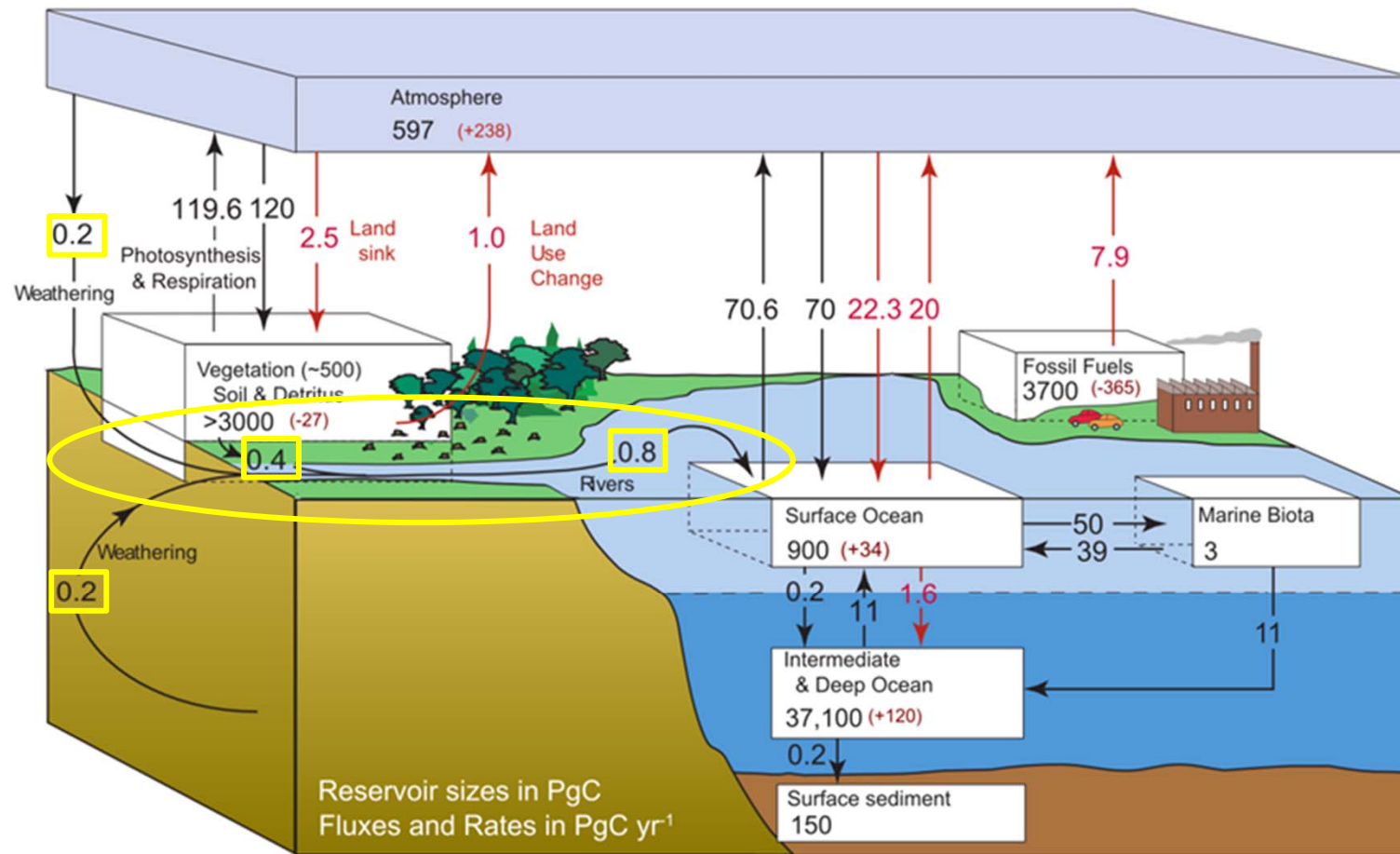
P. Regnier, P. Friedlingstein, P. Ciais, F. Mackenzie, N. Gruber et al.



The GCP carbon budget



The present-day global C cycle (IPCC)



→ Natural fluxes

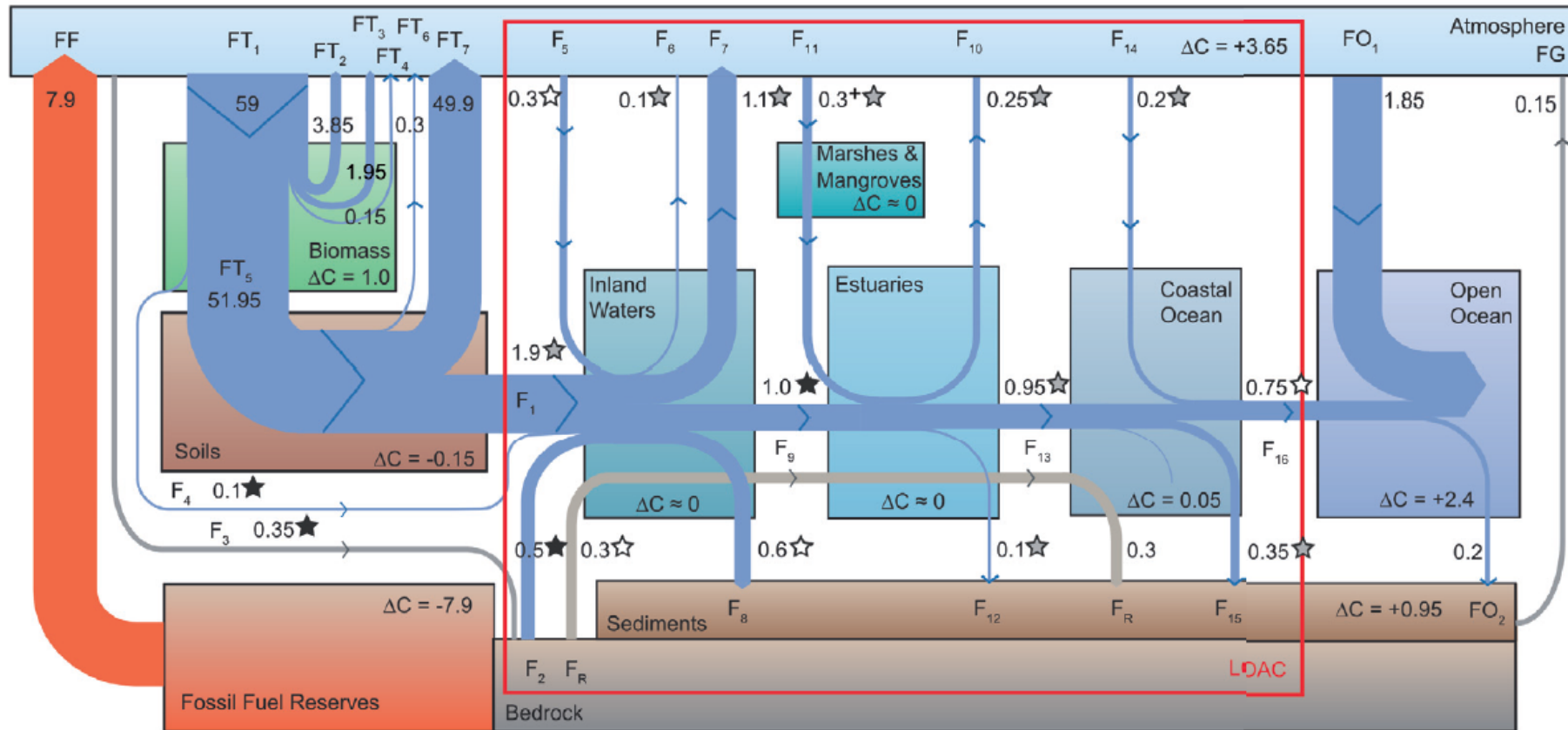
→ Anthropogenic perturbation



Land-ocean fluxes

Modified from N. Gruber; pers. com

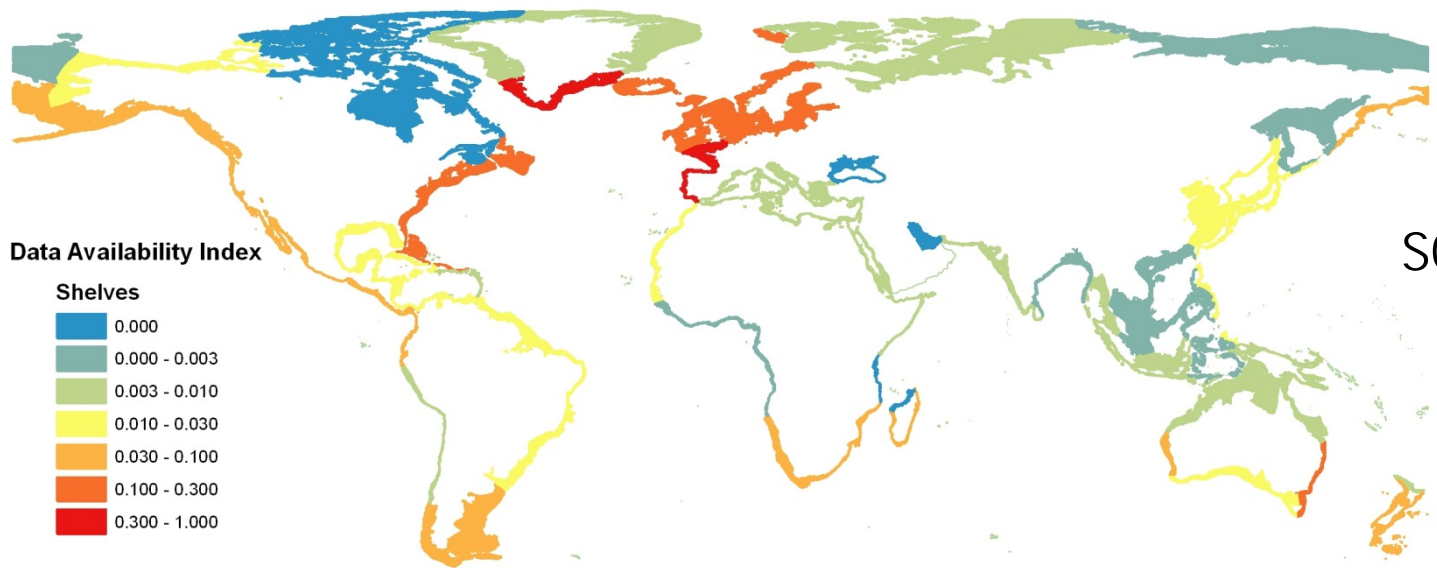
The carbon budget for the land-ocean continuum (LOAC)



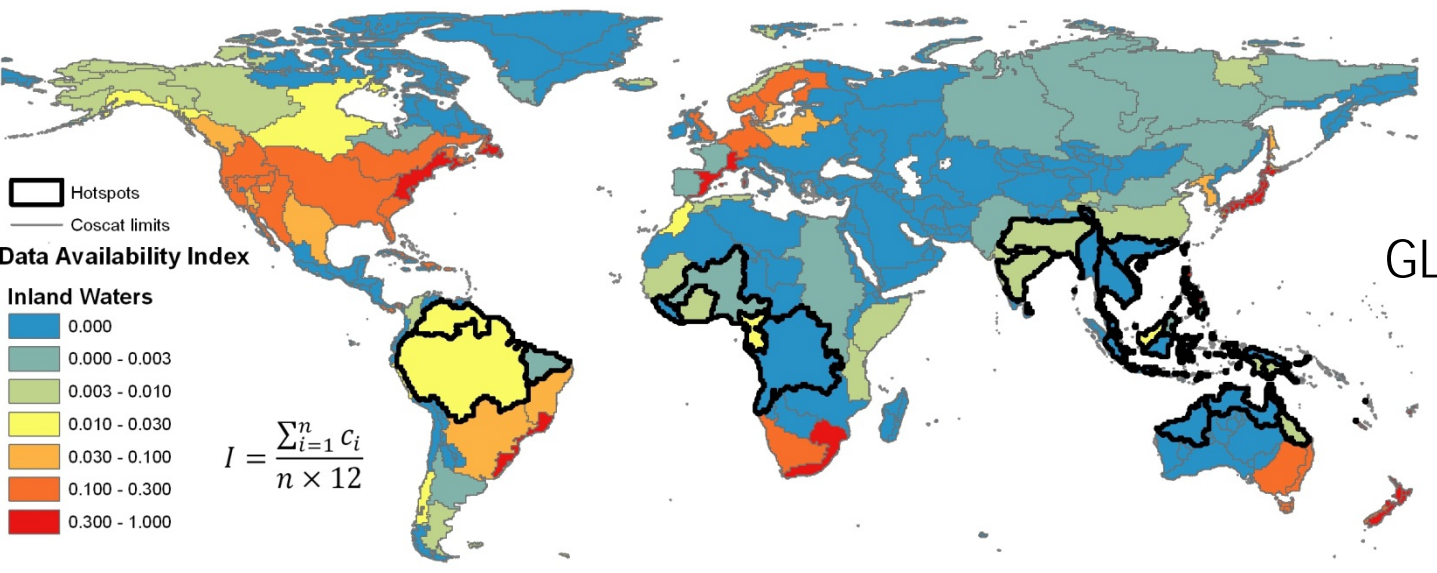
The stars in panel a indicate the confidence interval associated to the flux estimates, based on *The First State of the Carbon Cycle Report*⁹⁹. A black star means 95% certainty that the actual estimate is within 50% of the estimate reported; a grey star means 95% certainty that the actual value is within 100% of the estimate reported; a white star corresponds to an uncertainty greater than 100%.

Present-day

CO₂ data coverage for the LOAC



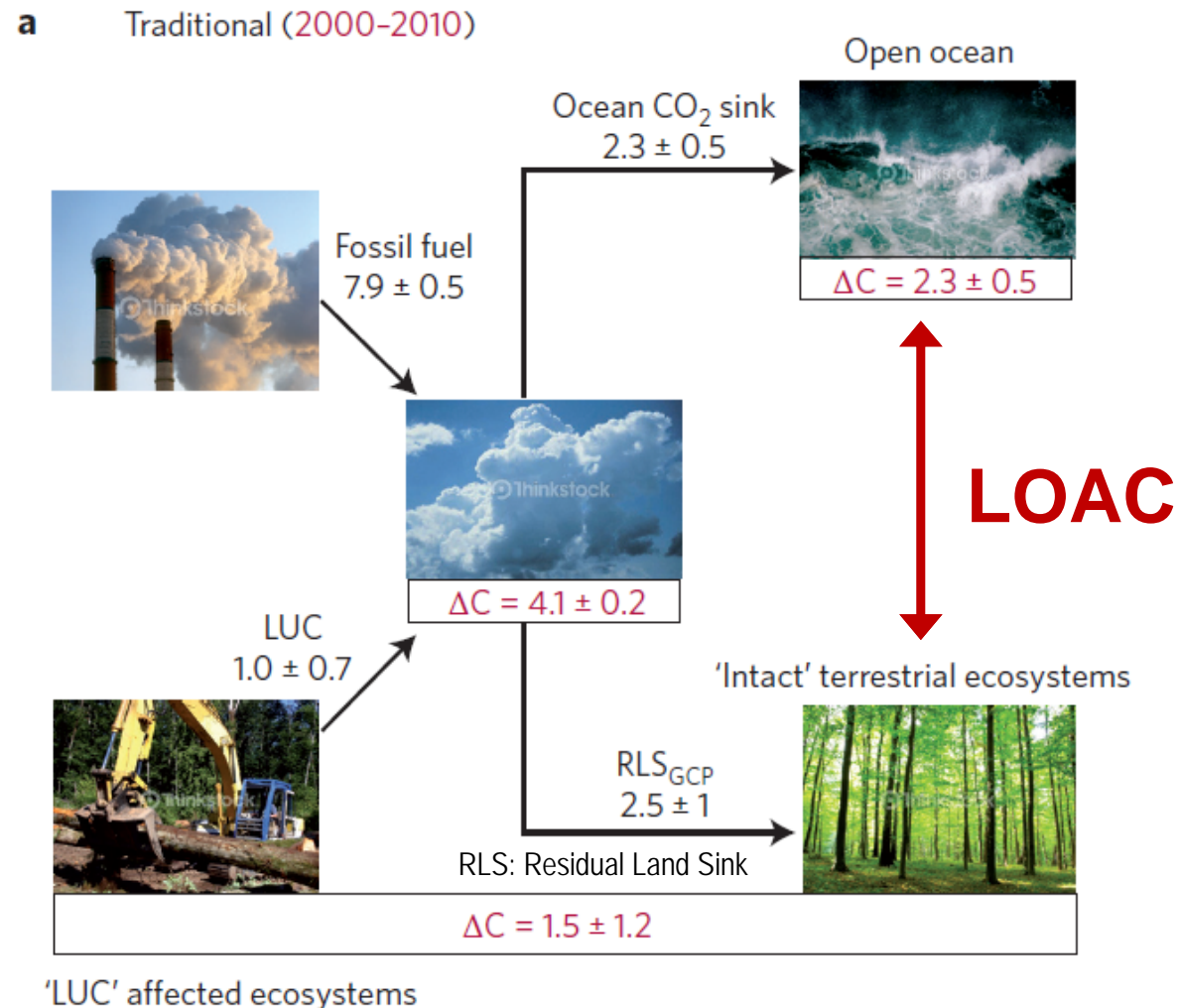
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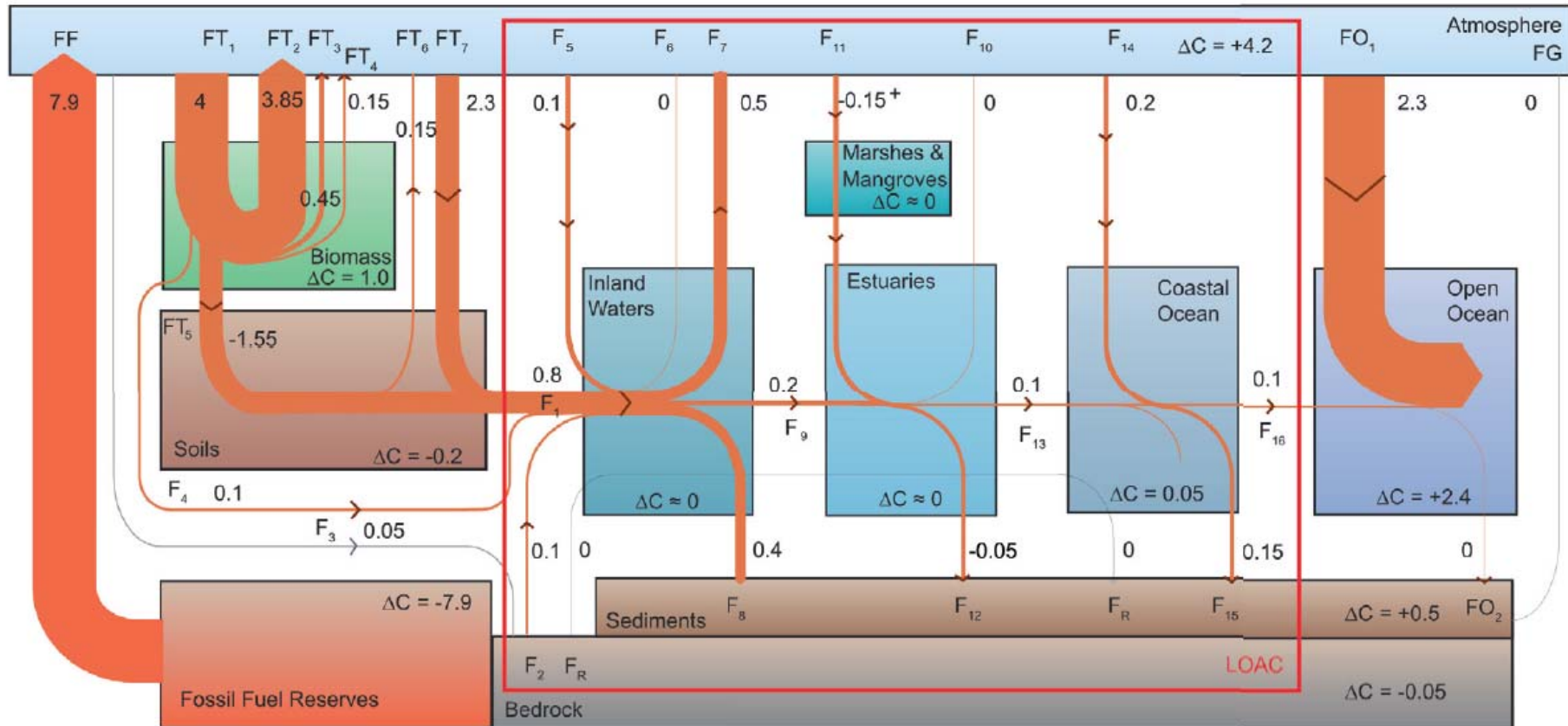
Closing the anthropogenic C budget: The land-ocean aquatic continuum (LOAC)

Units: PgC y⁻¹



Perturbation

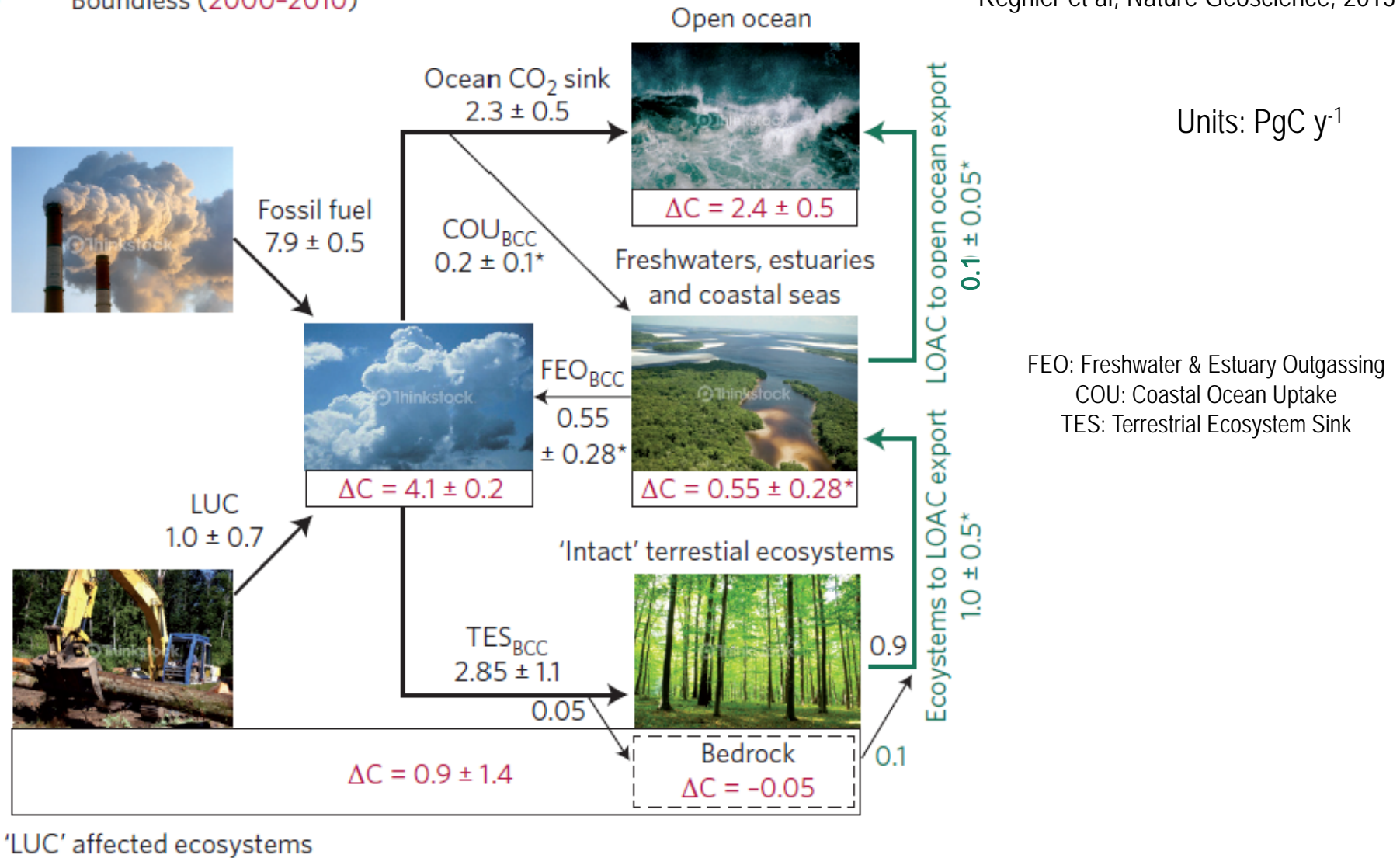
c ANTHROPOGENIC PERTURBATION



The anthropogenic CO₂ budget with the LOAC

b Boundless (2000-2010)

Regnier et al, Nature Geoscience, 2013



Uncertainties on fluxes are from the GCP, except for the LOAC fluxes (identified by an asterisk) where indicative estimates are given based on the categorization proposed in *The First State of the Carbon Cycle Report* (converted to values assuming Gaussian distribution)

Conclusions

- Substantial amounts (2.5 PgC yr^{-1}) of atmospheric carbon are transported laterally along the land-ocean aquatic continuum (LOAC) from upland terrestrial ecosystems into the ocean
- The anthropogenic perturbation may have increased the flux of C to the LOAC by as much as 1 PgC yr^{-1} .
- Most of this additional carbon input to upstream rivers is emitted back to the atmosphere as CO_2 (0.35 PgC yr^{-1}) or sequestered in sediments along the aquatic continuum (0.55 PgC yr^{-1}), leaving a small perturbation carbon input (0.1 PgC yr^{-1}) to the open ocean.

Conclusions

- According to our analysis, terrestrial ecosystems store ~ 0.9 Pg C yr^{-1} at present, which is in agreement with results from forest inventories (Pan et al, Science, 2011), but significantly differs from the 1.5 Pg C yr^{-1} previously estimated when ignoring changes in lateral carbon fluxes
- We suggest that carbon fluxes along the land–ocean aquatic continuum need to be included in global carbon dioxide budgets.