The GREEN RICE-MED

Natural capital in a regional integrated assessment model for the Mediterranean

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Valuing nature raises the social cost of carbon 2.4-fold and turns a consumption loss from optimal climate policy into a welfare gain, but the gains are unevenly shared.

1 Why natural capital?

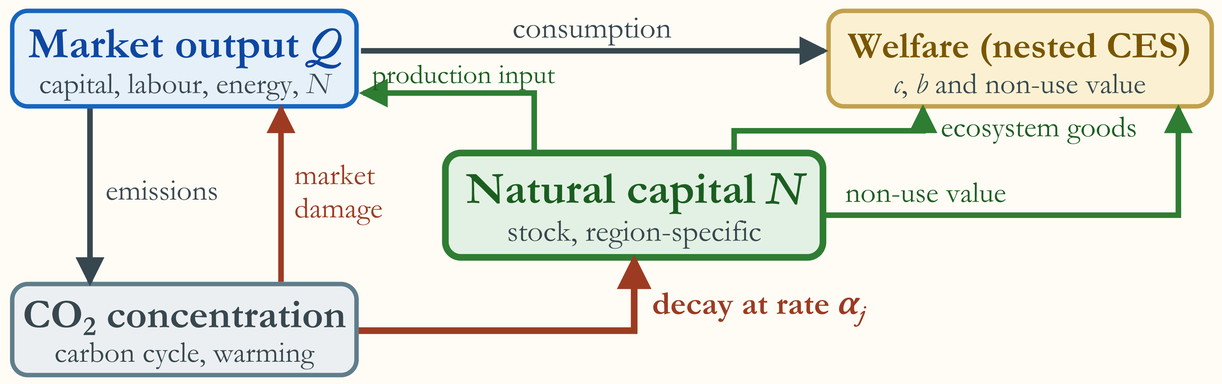
- Standard IAMs treat nature as a backdrop: it matters only through **market damages**.
- Ecosystems also provide **non-market welfare**, and climate change erodes them unevenly.
- The **Mediterranean** is a climate hotspot, rich in natural assets.

We ask

1. How does nature change the price of carbon?
2. Does optimal policy still pass a welfare test?
3. Who gains and who loses?

Setting. 28 regions (8 macro-regions, 20 Mediterranean countries); scenarios BAU, OPT (welfare-optimal) and TEMP (warming below 2 °C). The decay rate α_j is calibrated to each region's benchmark climate damage.

2 The model



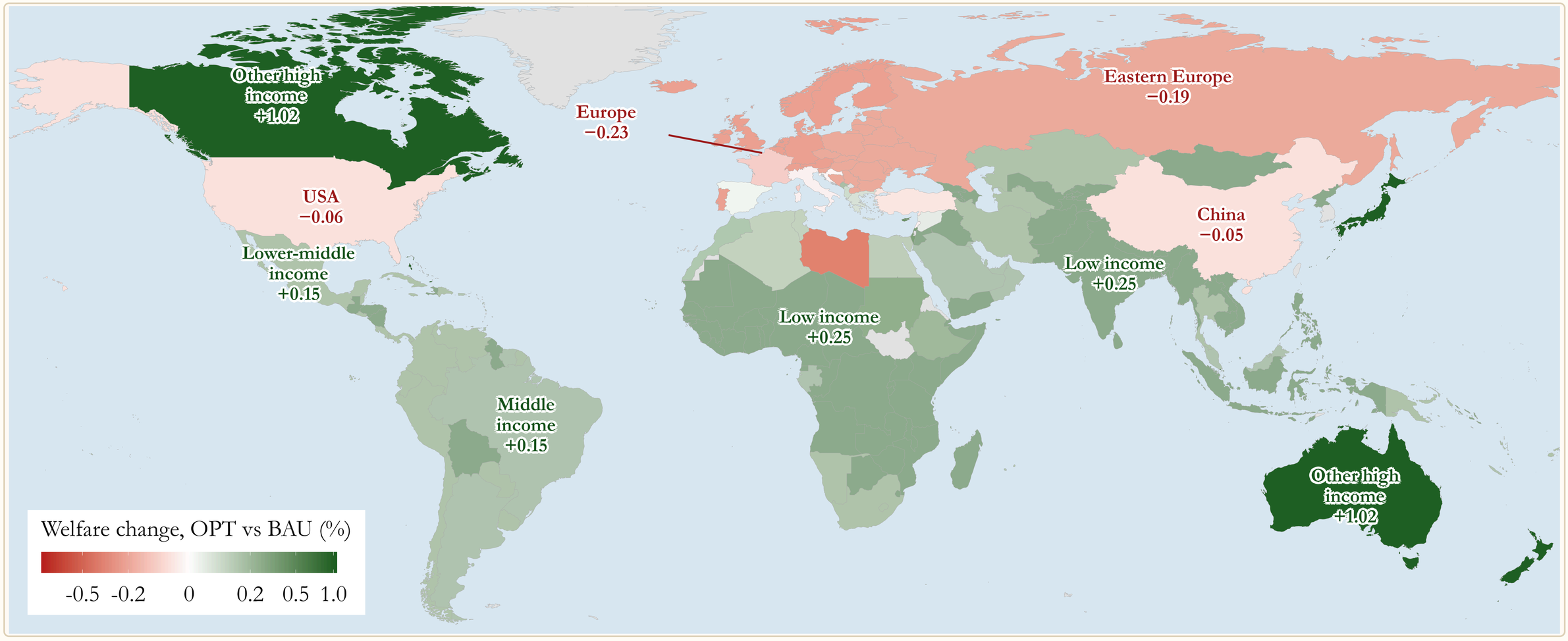
OUTPUT $Q_j = \Omega_j \left[A_j K_j^{\gamma-\nu} L_j^{1-\beta-\gamma} N_j^{\nu} ES_j^{\beta} - c_j^{E} ES_j \right]$

WELFARE $\tilde{c}_j = \left[(1-s_1)\, c_j^{\mu_1} + s_1\, b_j^{\mu_1} \right]^{1/\mu_1}$, plus non-use value of N_j

DECAY $N_j(t+1) = N_j(t) \exp\left[-\alpha_j \left(M_{AT}(t) - \bar{M}_{AT} \right) \right]$

3 Valuing nature flips the welfare verdict, and splits winners from losers

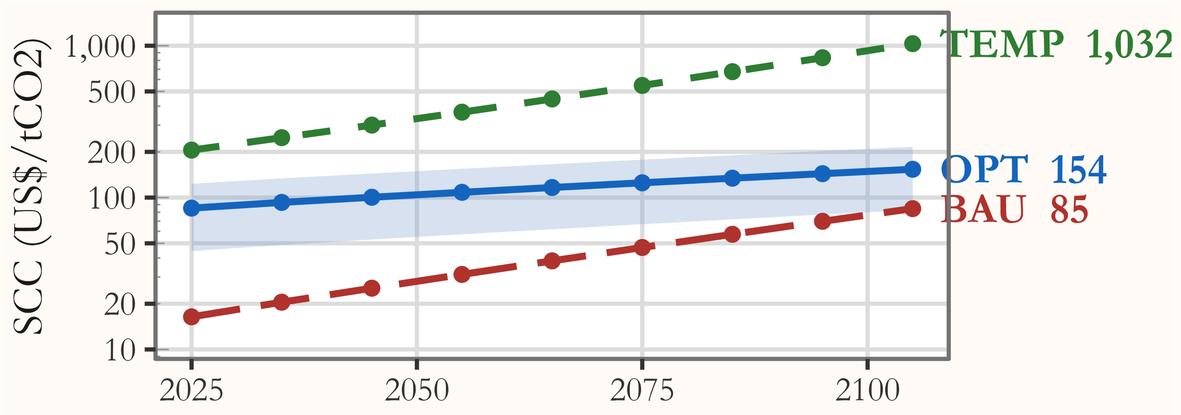
Change in full welfare (consumption + natural capital), optimal policy vs BAU (%)



Optimal policy **lowers market consumption by 0.09%** but **raises full welfare by 0.18%** (a permanent +1.00% of BAU consumption).

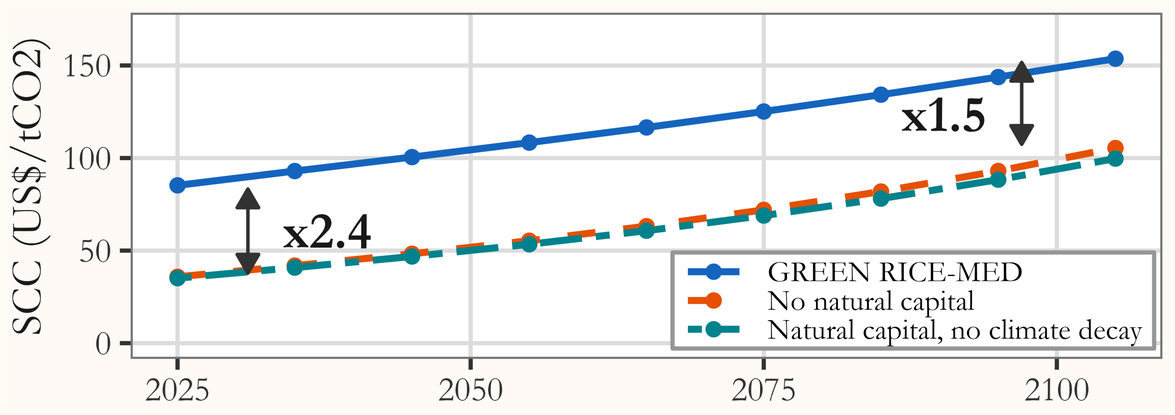
4 Natural capital raises the price of carbon

Social cost of carbon by scenario (US$ per tCO_2, log scale)



Single global carbon price. Shaded: OPT range across 12 climate-sensitivity and damage runs.

Role of natural capital in the optimal SCC (US$ per tCO_2)



With no climate decay of nature ($\alpha = 0$) the SCC is as low as without natural capital.

References. Bastien-Olvera & Moore (2021) *Nature Sustainability* 4, 101–108. Castellini, Castelli, Gusperti, Lupi & Vergalli (2025) *Energy Economics* 145, 108452. Golosov, Hassler, Krusell & Tsyvinski (2014) *Econometrica* 82, 41–88. Nordhaus & Boyer (2000) *Warming the World*, MIT Press. Roson & Sartori (2016) *J. Global Economic Analysis* 1, 78–115.