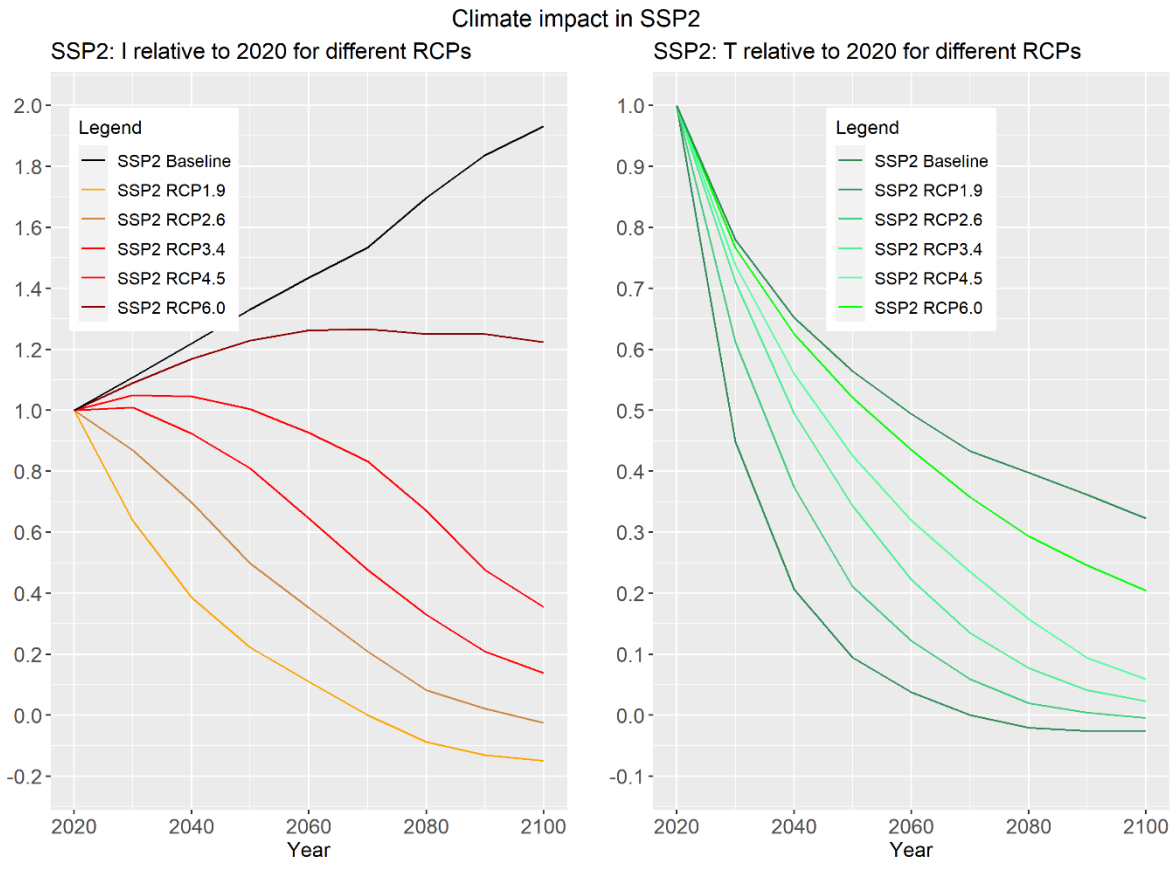
Supplementary material

Supplement to: Engström E. and Kolk. M. (2024). Projecting Environmental Impacts with Varying Population, Affluence and Technology Using IPAT – Climate Change and Land Use Scenarios. *Vienna Yearbook of Population Research*, 22. https://doi.org/10.1553/p-n5en-z38a

S1. Climate impact for different RCPs given projections of *P* and *A* in the SSP2

Figure S.1 shows the climate impact projections as inferred from six RCPs, given the SSP2 (IPCC, 2022), using 2020 as the base year. All of these projections assume the same development for P and A, while I varies according to the RCPs. The right panel displays the corresponding T curves, calculated assuming $T = I/(P \times A)$. It considers that all the RCPs, given the SSP2, have the same assumptions for P and A. For both panels, data were downloaded from the © SSP Public Database, hosted by IIASA (2023).

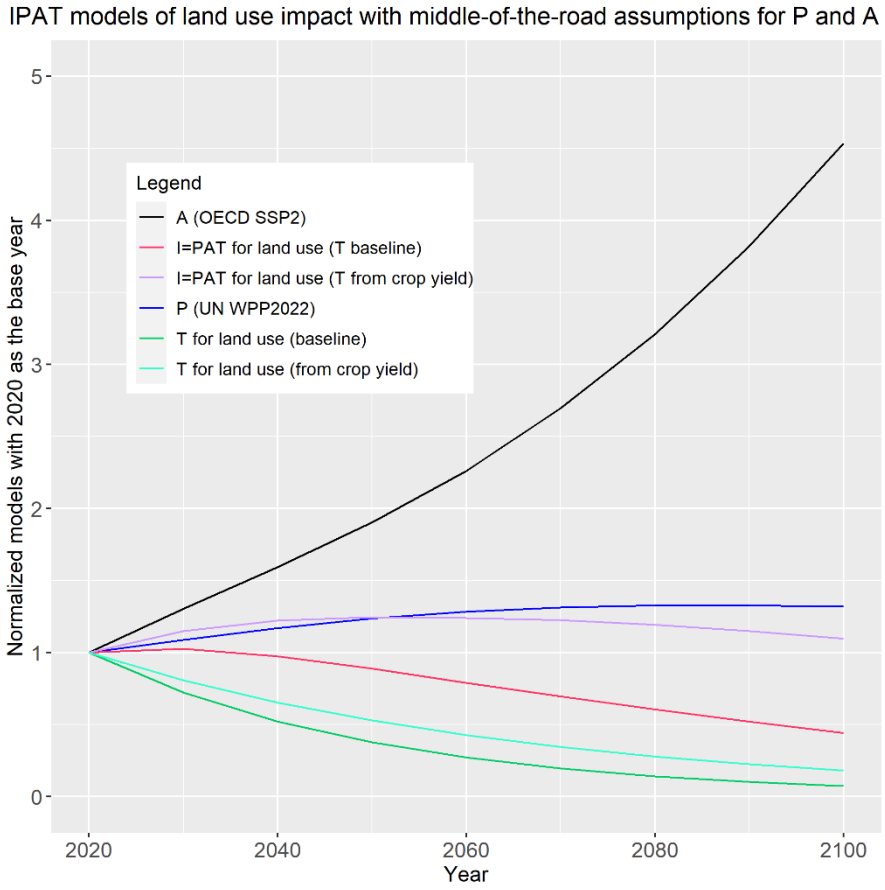
Figure S.1 The left panel shows emissions of Kyoto gases for each of the RCPs given the SSP2 (impact I), and the right panel accounts for the corresponding T curves



S2. Land use impact assuming the continuation of historical trends

Land use impact adopting historical developments, with different assumptions for *T* (Figure S.2, Approach 1). The lower *T* curve (green) and the corresponding *I* (light red) assume *T* reductions of 3.2% per year; that is, the same as in Figure 1 (Table 3) (Alexandratos and Bruinsma, 2012). The upper *T* curve (cyan) and the corresponding *I* (light purple) are based on the global average cereal yield in 1960 (1.3 tonnes/ha) vs. in 2005 (3.3 tonnes/ha); that is, a reduction in *T* of 2.1% per year (Popp et al., 2017).

Figure S.2 Land use impact in the middle-of-the-road scenario with different assumptions for *T* (Approach 1)



S3. Environmental impacts as related to variations in population

Figure S.3 (climate) and Figure S.4 (land use) depict environmental impacts as related to the three population prospects in the UN WPP (2022).

Figure S.3 Climate impact for the three population prospects in the UN WPP (2022) in the three modelling approaches described in Table 1

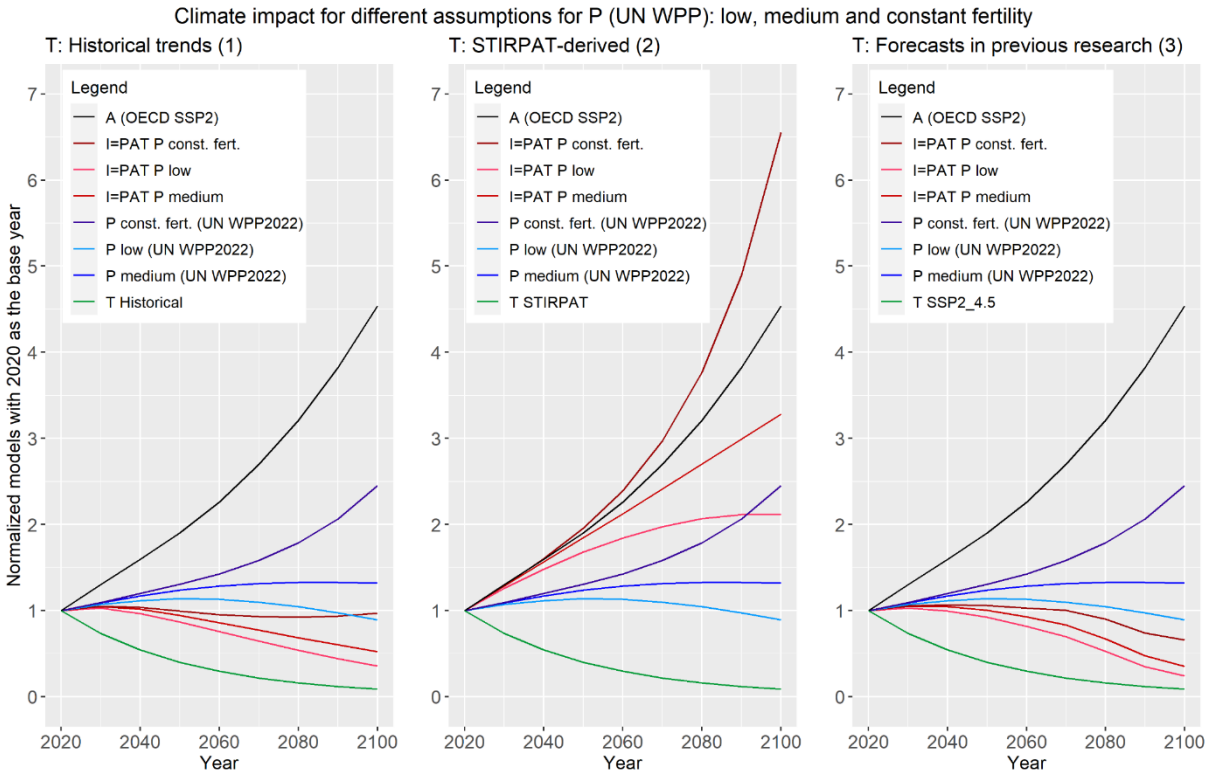


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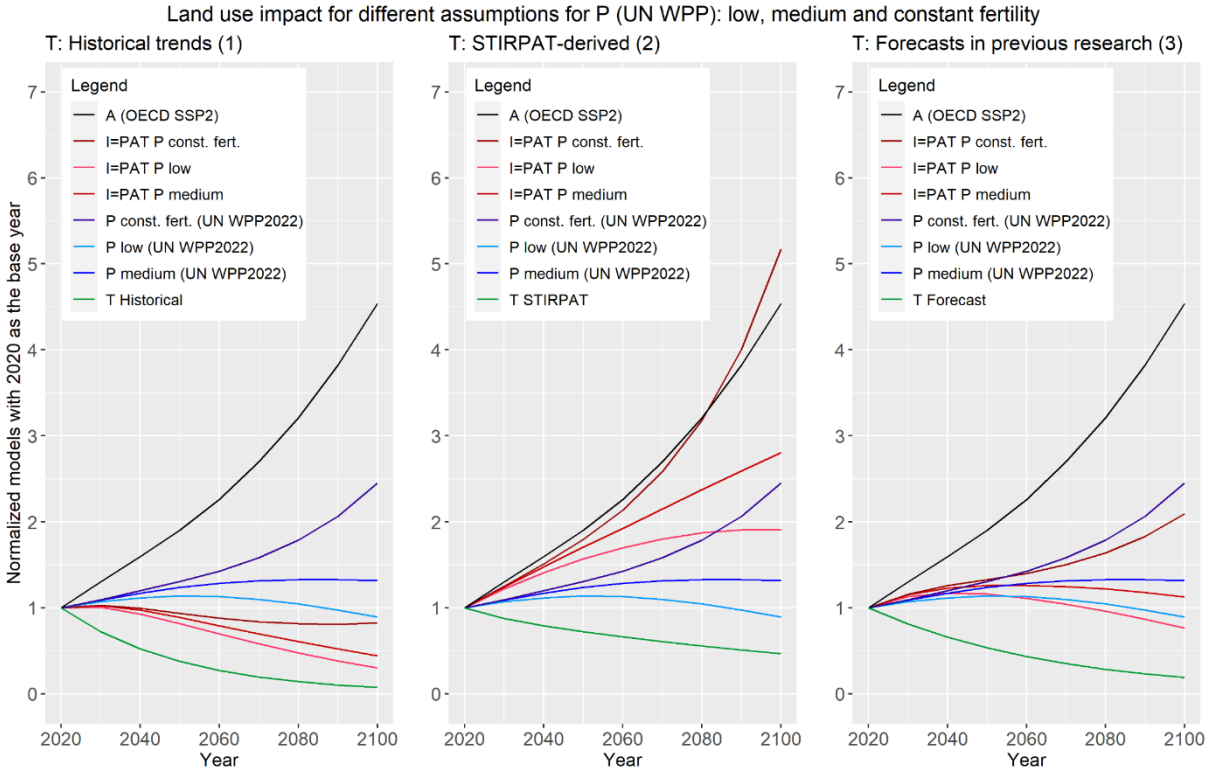
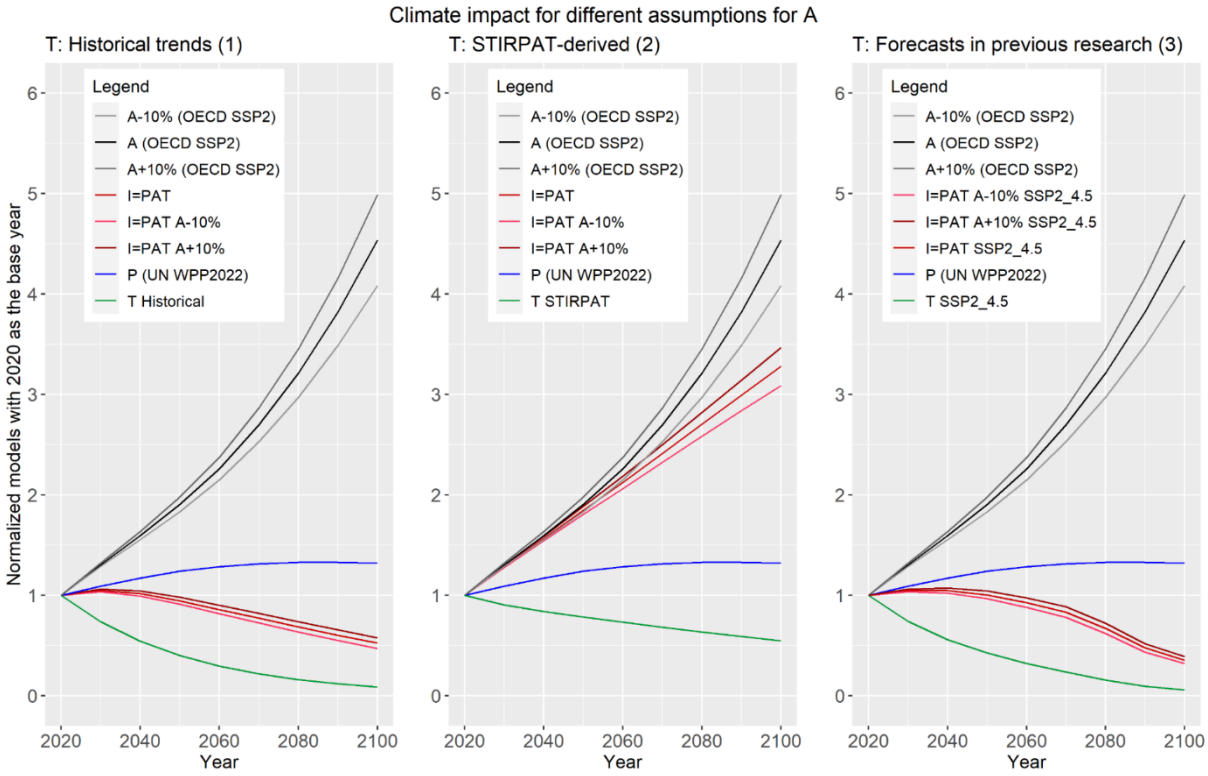
Figure S.4 Land use impact for the three population prospects in UN WPP (2022) in the three modelling approaches described in Table 1



S4. Environmental impacts as effects of variations in per capita affluence

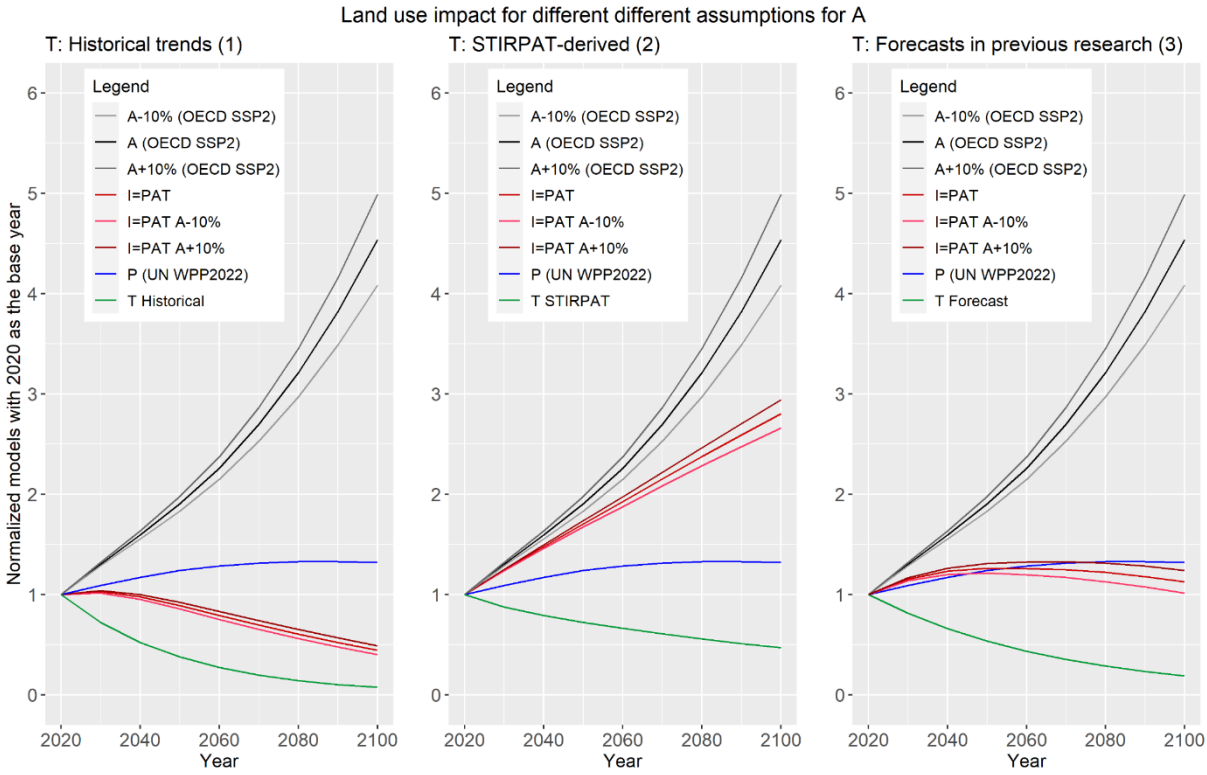
Climate and land use impacts as related to variations in per capita affluence *A* (± 10%) (Figure S.5 and Figure S.6).

Figure S.5 Climate impact, I, assuming variations in A by ± 10% in the three modelling approaches explained in Table 1



https://doi.org/10.1553/p-n5en-z38a

Figure S.6 Land use impact, I, in relation to variations in A by ± 10%



S5. Environmental impacts as related to variations in technology

Impacts, *I,* in 2100 as related to 2020 as an effect of different scenarios for *T* (Tables S.1-S.3). (Graphs of these data are shown in Figure 2 and Figure 3.)

Table S.1 Impact I in 2100 as related to 2020 assuming the extrapolation of historical trends with varying T (± 10%) (Approach 1)

Dimension	Impact *I* (Approach 1)		
	T-10%	*T* middle-of-the-road	*T*+10%
Climate	0.47	0.52	0.58
Land use	0.40	0.44	0.49

Table S.2 Impact I in 2100 as related to 2020 for climate impact and land use impact assuming STIRPAT-derived T, varying from the first to the third quartile in the literature (Approach 2)

Dimension	Impact *I* (Approach 2)		
	First quartile	Median	Third quartile
Climate	2.22	3.28	5.45
Land use	2.50	2.80	3.14

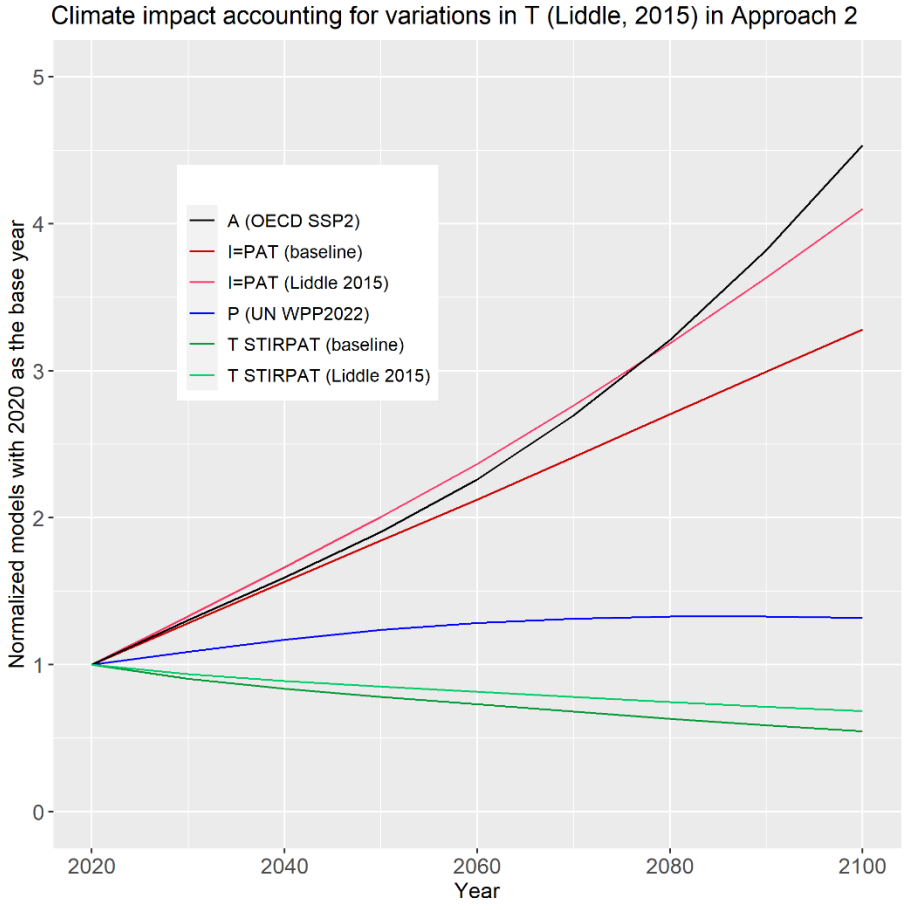
Table S.3 Impact I in 2100 as related to 2020 for climate impact with T derived from the IPCC's forecasts in the SSP2, varying with the different RCP forcings (Approach 3)

RCPs in SSP2	Impact *I* (Approach 3)
RCP 1.9	-0.15
RCP 2.6	-0.03
RCP 3.4	0.14
RCP 4.5	0.35
RCP 6.0	1.22
RCP Baseline	1.93

S6. Climate impact as an effect of variations of T in STIRPAT accounting for differences across OECD/non-OECD countries

Impacts, *I,* in 2100 as related to 2020 depending on different scenarios for *T* (Approach 2), as inferred from recommendations in Liddle (2015) (Figure F.1). The light red line reflects an income elasticity *c* = 0.58 for OECD countries (Table 4); *c* = 1.0 for non-OECD countries, in accordance with Liddle (2015); and a global population elasticity of *b* = 1.0 (Liddle, 2015). For comparison, the red line (baseline) shows impact, *I,* with *b* = 1.12 and *c* = 0.58 (Table 4).

Figure S.7 Climate impact, I, as an effect of assumptions for T based on Liddle (2015)



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