When can Environmental Impacts be Mitigated through Changes in Population and Affluence? Comparing IPAT-Models on Climate Change and Land-Use Change

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We revisit the IPAT-identity (Ehrlich & Holdren, 1971)

I (Impact) = **P** (Population) * **A** (Affluence) * **T** (Technology)

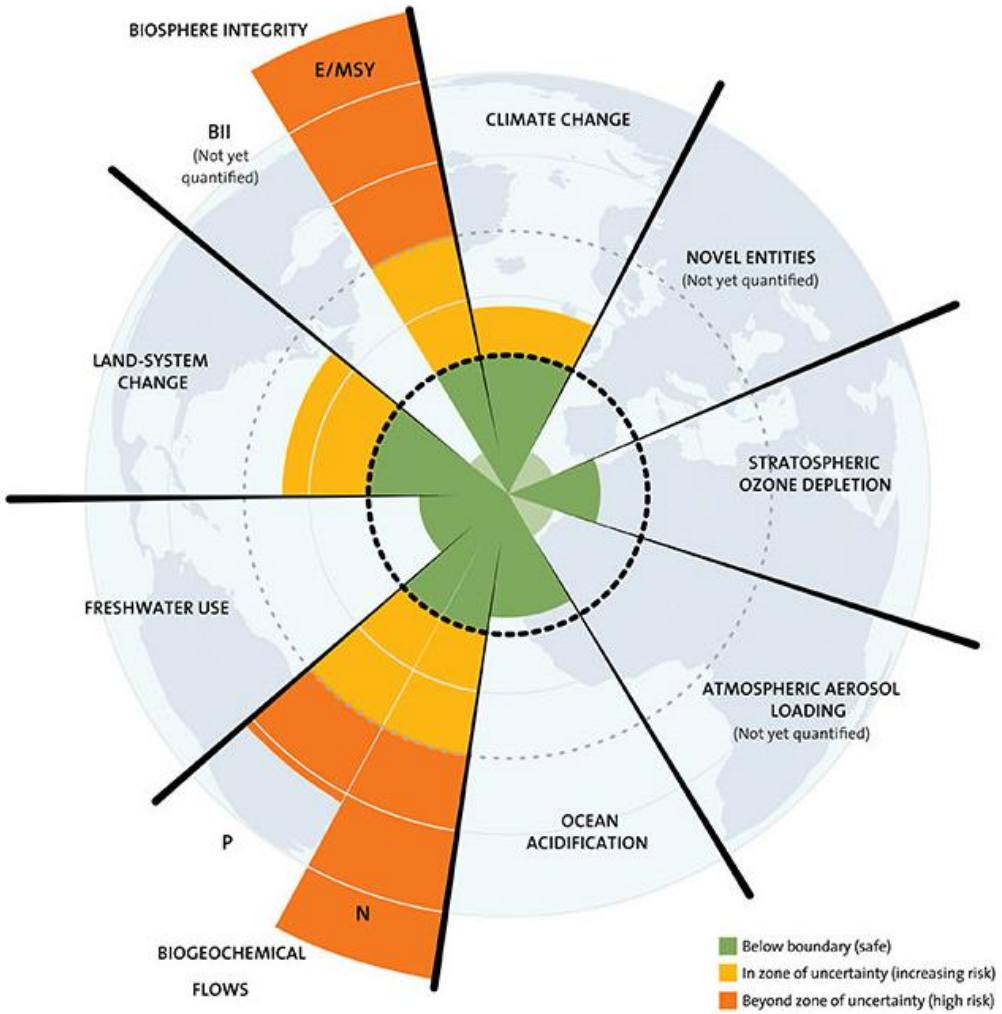
- **I**mpact: environmental impact, e.g., measured by GHG-emissions [CO2e]
- **P**opulation [-]
- **A**ffluence: economic output [GDP per capita]
- **T**echnology: environmental impact per unit of production, e.g., [CO2e per GDP]

We use ”business-as-usual” projections until 2100 for

- P: UN’s Medium variant in WPP 2022
- A: IPCC’s SSP2 middle-of-the-road projections (OECD; Dellink et al., 2017)
- T: Literature review of historical developments, and projections inferred from IPCC’s SSP2_4.5 (middle-of-the-road)

We compare IPAT-trajectories for two dimensions in the Planetary Boundaries' framework: Climate and Land use impact

- Land use relates to agriculture, deforestation, and biodiversity loss
- Both are in the zone of uncertainty: increasing risk for irreversible changes

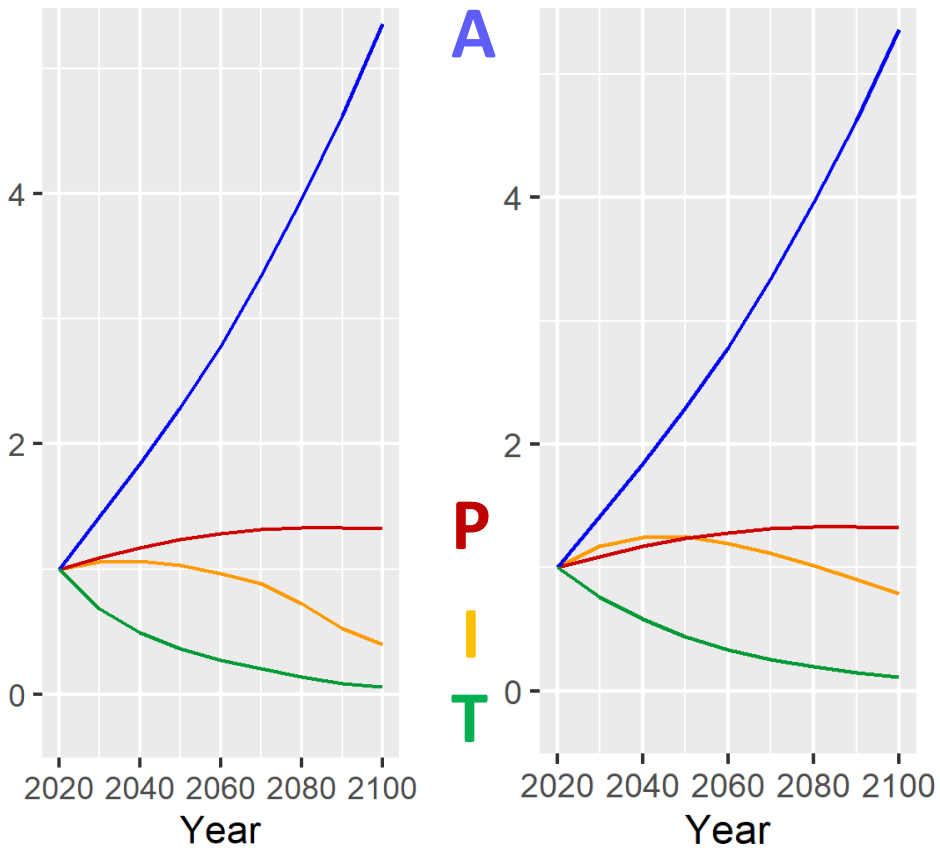


Steffen et al. (2015)

IPAT-analyses suggest insufficient developments in T to reduce impacts, I, particularly within Land use

Climate: T is inferred from SSP2 4.5 middle-of-the-road

Land use: T is historical extrapolation 2010-2017 (optimistic)



- Considering anticipated growth in **P** and **A**, improvements in **T** must be substantive
- For climate, there seems to be a consensus that **T** will improve substantively in the coming years, suggesting that **P** and **A** are less important factors
- The scientific community has not given the same attention to **T** for land use
- For land use, there is only a small improvement in levels in 2100 vs 2020, which many argue are already unsustainable

Final notes

- Original proponents of IPAT highlighted the negative effects of growth in consumption and population (Ehrlich & Holdren 1971) and were hence skeptical of improvements in T
- Contemporary environmentalists who argue for ‘degrowth’ instead focus on A
- Proponents of ‘green growth’ on the other hand put emphasis on mitigation through T
- Our IPAT-models highlights how substantive such improvements must be considering middle-of-the-road forecasts for P and A
- They also illustrate that P, ‘Population policy’, and A, ‘degrowth’, are less important measures if there are large expected improvements in T
- In particular, P and A seem to be more important factors for land use than climate change

Thank you!

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