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NAVIGATE/ENGAGE expert workshop session 2: Designing assessment frameworks for joint impact-mitigation studies

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Assessment of climate impact scenarios in the IMAGE framework

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Introduction

Knowledge gaps in the current literature

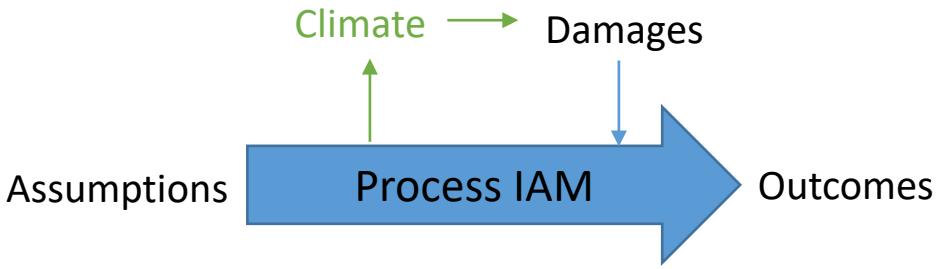
- Climate impact assessments (ISIMIP) focus on individual sectors, less on interactions
- Cost Benefit Analyses (CBA IAMs), integrate mitigation, adaptation, impacts, however aggregated, stylized and based on older data.
- Process IAMs typically do not include impacts and adaptation in assessments

Ambition: bridge gap

- Include climate impacts/feedbacks in IAMs,

account for adaptation (more as proof as concept)

- Assess:
  - Differences between scenarios with/without impacts
  - What are the key interactions/feedbacks?
  - Added value?



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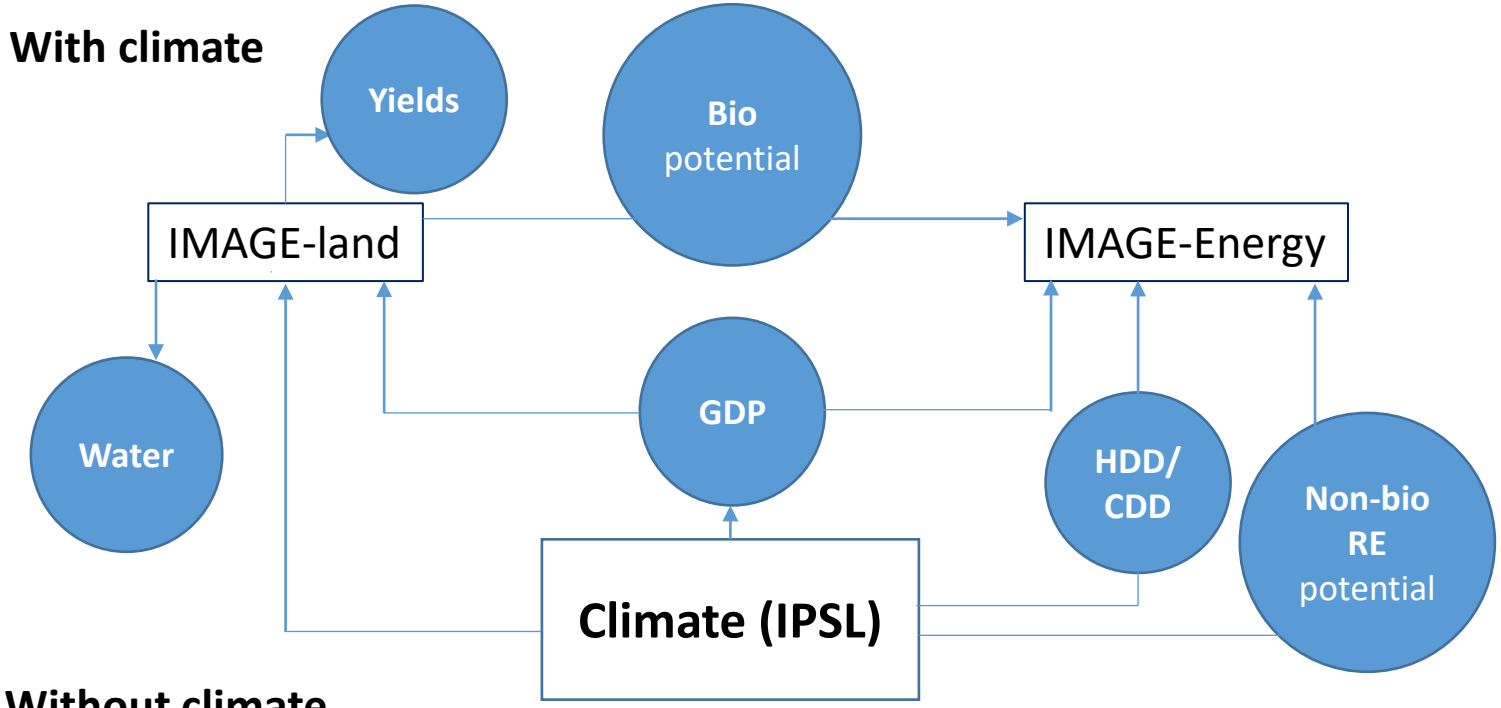
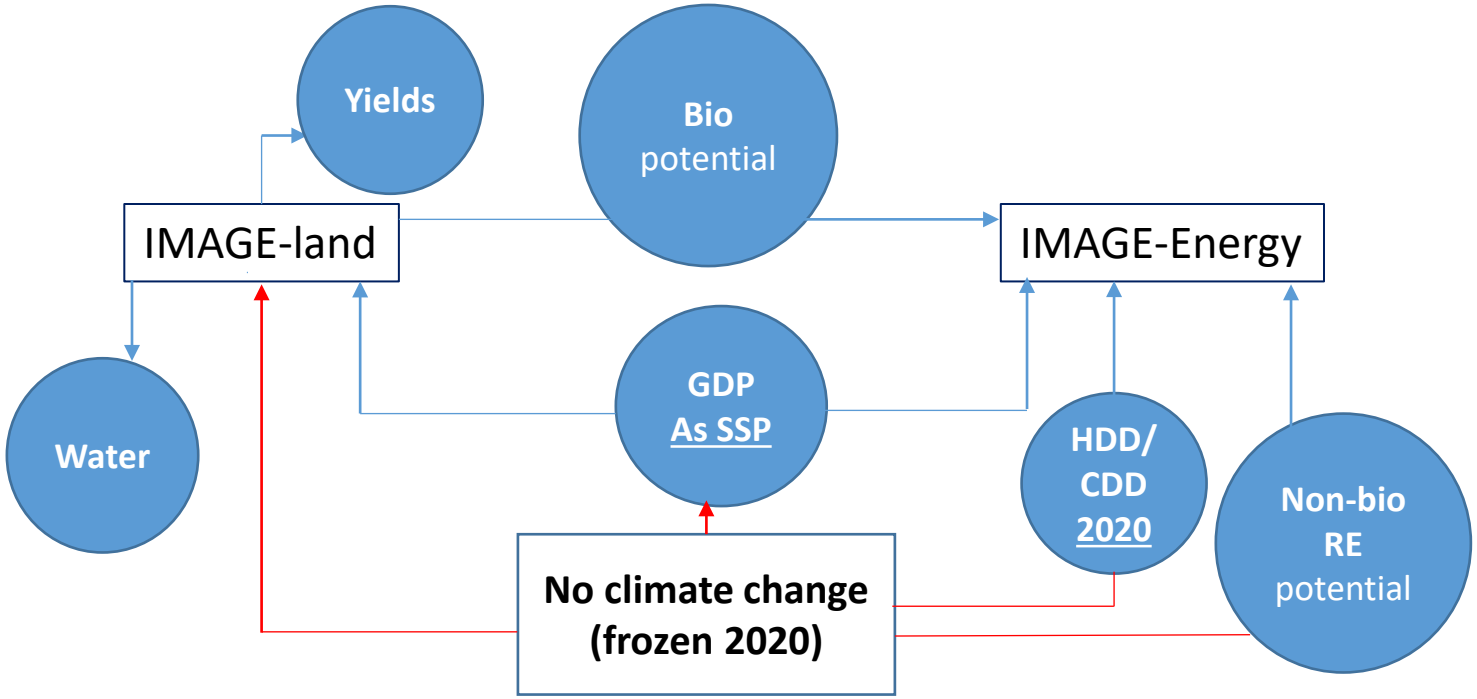
Implementation in IMAGE

With climate



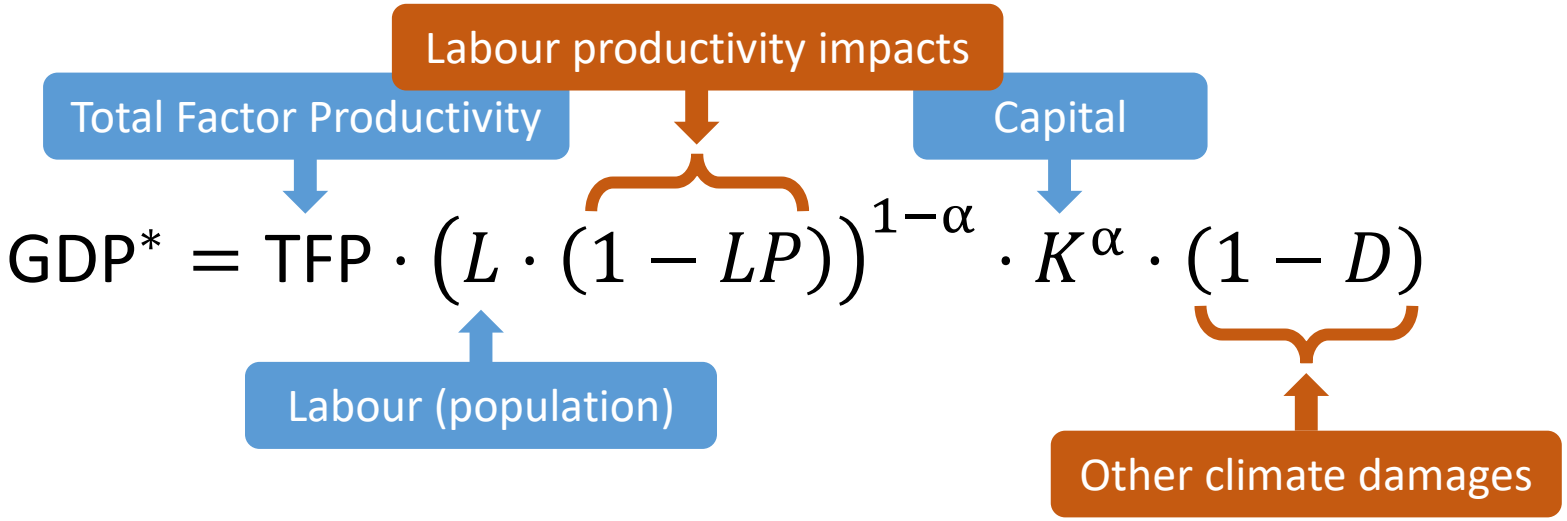
Without climate



Other impacts

- Sea-level rise
- Biodiversity
- Policy costs
- GHG emissions

GDP impacts, incl labour productivity: method



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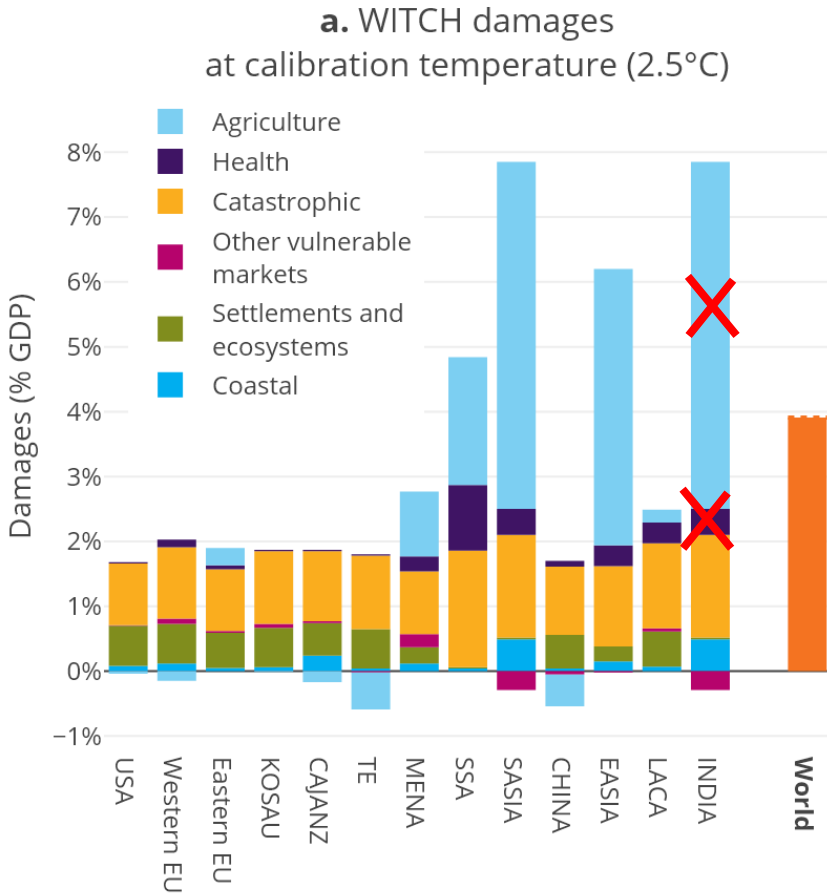
Economic damages

1. Start with WITCH damage curves (most recent regional, sectoral curves)

2. Scale WITCH curves with best estimate of global damages (*Howard et al. 2017*)

3. Replace WITCH sectors by new estimates if available (labour prod. (*Van Maanen et al, 2021*), agriculture (*MAGNET model*)



Included other impacts

Energy	**Renewable supply** (wind, PV, CSP, hydro, bioenergy)	Different costs supply curves based on 0.5x0.5 grid calculations (*Gernaat et al., 2021*)
Land/natural	**Heating / cooling demand**	Impact via population weighted HDD, CDD based on 0.5 x 0.5 grid (*Byers et al., 2018*)
	Crop yields	Impact included via LPJ calculations in IMAGE (0.5 x 0.5 grid)
	Food consumption	Calculated via MAGNET model
	Drought/water scarcity	Impact via LPJml (at 0.5x0.5 grid) accounting for precipitation and agriculture impacts
	Sea-level rise (impact only)	MAGICC (global)
	Biodiversity (impact only)	GLOBIO
Aggregated impact	**GHGs / Policy costs**	IMAGE/FAIR

Scenarios

Name	RCP (= forcing in 2100 in W/m^2)	Climate feedbacks	Based on climate model
1) SSP2-noCF (ref)	6.0	Excluded	n.a.
2) SSP2-CF-IP (main run)	6.0	Included	IPSL
3) SSP2-CF-IP-noGDP (sens1)	6.0	Included (except GDP)	IPSL
4) SSP2-CF-H (sens2)	6.0	Included	Hadley
5) SSP2-26-noCF	2.6	Excluded	n.a.
6) SSP2-26-CF-IP	2.6	Included	IPSL

Q 1: What is the impact of climate change in a no-climate policy baseline scenario (comparison of scenario 1 and 2)

Q 2: What are the main sensitivities (role of GDP impacts, different climate pattern)(comparison of scenarios 3 / 4 to 2)

Q 3: Is this the same in a climate policy case (comparison of scenario 5 and 6)

Results

		World	Russia	Canada	W-Europe	USA	China	Brasil	India	Indonesia	West-Africa
Economy	Labour productivity	-6%	-1%	0%	-1%	-3%	-2%	-13%	-11%	-12%	-12%
	Total GDP	-15%	-5%	-6%	-7%	-8%	-6%	-19%	-32%	-29%	-24%
Energy	NonBio-RE	-16%	-5%	-3%	-6%	2%	-1%	-9%	-18%	-9%	-11%
	Bio-RE	-6%	-10%	-11%	-2%	-5%	-8%	5%	0%	-21%	-17%
	CDD	43%	302	291	222	470	596	767	888	794	997
	HDD	-23%	-1001	-873	-462	-571	-488	-53	-91	0	-1
	Final energy total	-8%	-8%	-3%	-2%	-3%	0%	-9%	-11%	-7%	1%
Land	Crop yields	-2%	37%	17%	1%	4%	-3%	-11%	-9%	-8%	-16%
	Food consumption	0%	10%	11%	-5%	5%	1%	3%	0%	-4%	0%
	Drought intensity		In progress								
	Water stress		In progress								
	Sea level rise	53 cm	Global only								
	Biodiversity	-7%	-8%	-8%	-5%	-7%	-6%	-8%	-5%	-9%	-7%
	Total GHG	-6%	-10%	-7%	2%	-4%	6%	-3%	-10%	-5%	3%

Impact indicators for largest and or noteworthy regions – Baseline – 2100 Values represent relative difference with No-Impact case. Red = most undesirable, note: green is usually still a negative impact

Conclusions

- Impacts generally correlate; temperate zones are generally less impacted, hot regions are also impact hot-spots
- Not shown: choice of climate pattern matters very little (IPSL shown, Hadley = similar)
- Not shown: impacts in a 2.6 case are obviously much smaller, but largely in line with baseline pattern)
- GDP impact is dominant (see next slide)

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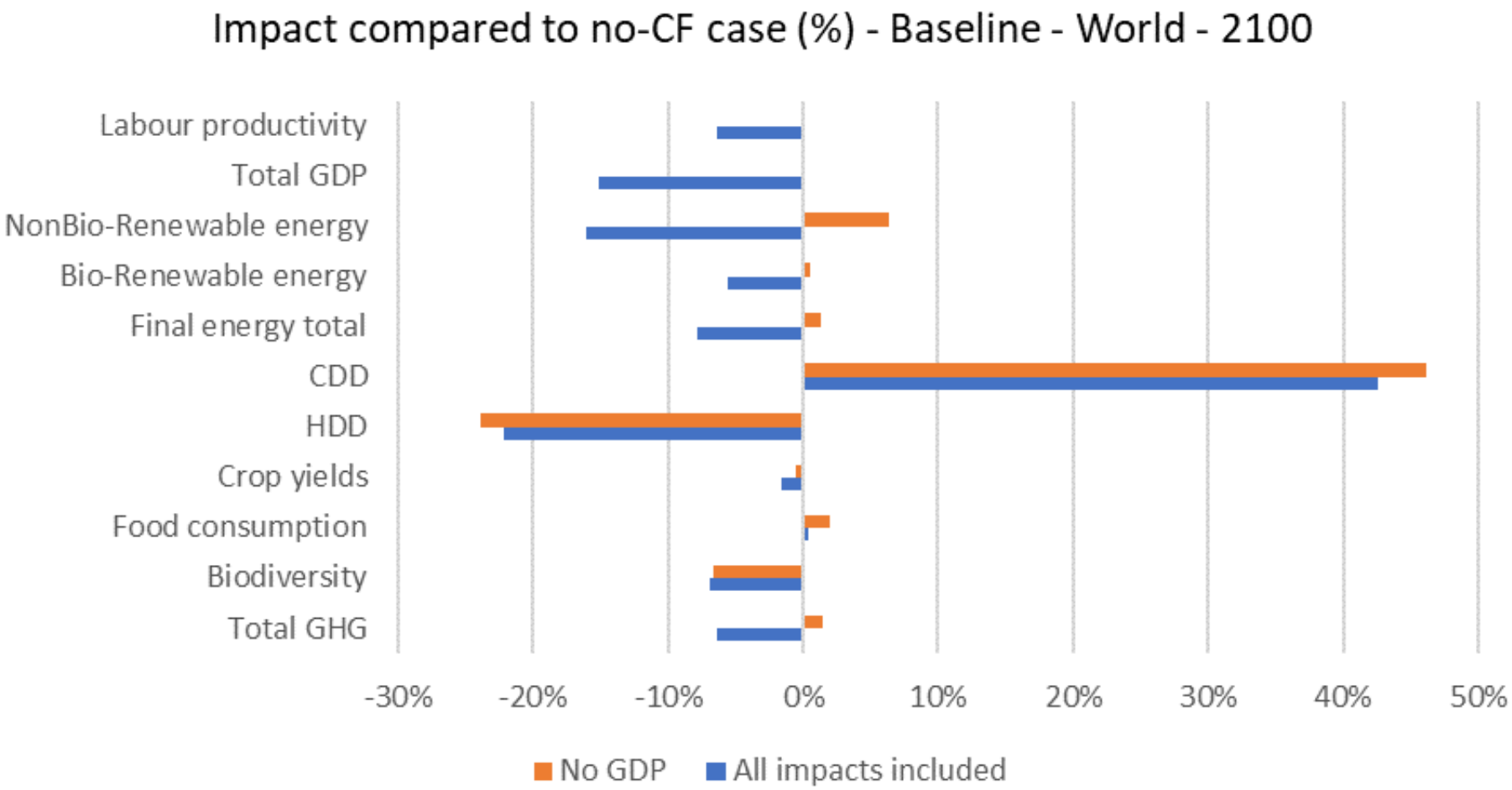
Dominance of GDP impact



- Total global impacts without GDP are generally smaller
- RE (+ final energy + GHGs): Increase if there were no GDP impact, but large net decrease due to gdp impact = lower demand
- CDD/HDD (+ biodiversity): Total impact large, but GDP-dependency small (only via global mean temperature)
- Crop yields + food consumption: small effects

Discussion

- Inconsistency issues:
  - Selection of specific impacts; partial picture
  - Adaptation only partly included, with feedbacks on main drivers (e.g. AC → Labour productivity)
  - Sectoral value-added impacts only partly based on endogenous processes

  - However, added consistency due to comprehensive framework and feedbacks?
  - & rich overview of impact indicators in a baseline-mitigation scenario setup

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