Understanding the representation of climate impacts and adaptation in integrated assessment models

OptimESM-ISIMIP workshop 2025 – May 6th

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- Integrated assessment models (IAMs) widely used in climate policy research
  - Mitigation well represented
  - Climate impacts typically less

- 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 (last study: 2009)
  - Process IAMs typically do not include impacts and adaptation in assessments (Van Maanen et al., 2023)
  - Aim: understand how IAMs can benefit from impact model knowledge (e.g. Holman et al, 2019)

- This study
  - Aims to understand in detail how IAMs represent impact and adaptation
  - Potential for future improvement
  - Which mechanisms and feedbacks

Approach

- Survey: Questionnaire sent out to 100 IAM teams

- Results from 29 teams:
  - AIM, AIMTech, BLUES, C3IAM, CCEM, E4SMA-EU-TIMES 1.0, ENV-Linkages, ENVISAGE, GCAM-KSA, GEMINI-E3, GRACE, ICES-EMF, ICES, IMACLIM, IMAGE, IU-VNUHCM, MAgPIE, MEDEAS, MESSAGEix-GLOBIOM, MIMOSA, MUSE, NEMESIS, PROMETHEUS, REMIND, REMod, RICE50+, TIMES_PT, TIMES_Sweden, WITCH

- Analysis included in overview table: 17 teams: AIM, AIMTech, BLUES, CCEM, GCAM-KSA, GEMINI-E3, GRACE, IMAGE, IU-VNUHCM, MAgPIE, MESSAGEix, MIMOSA, PROMETHEUS, REMIND, RICE50+, TIMES_Sweden, WITCH

Results: Impacts
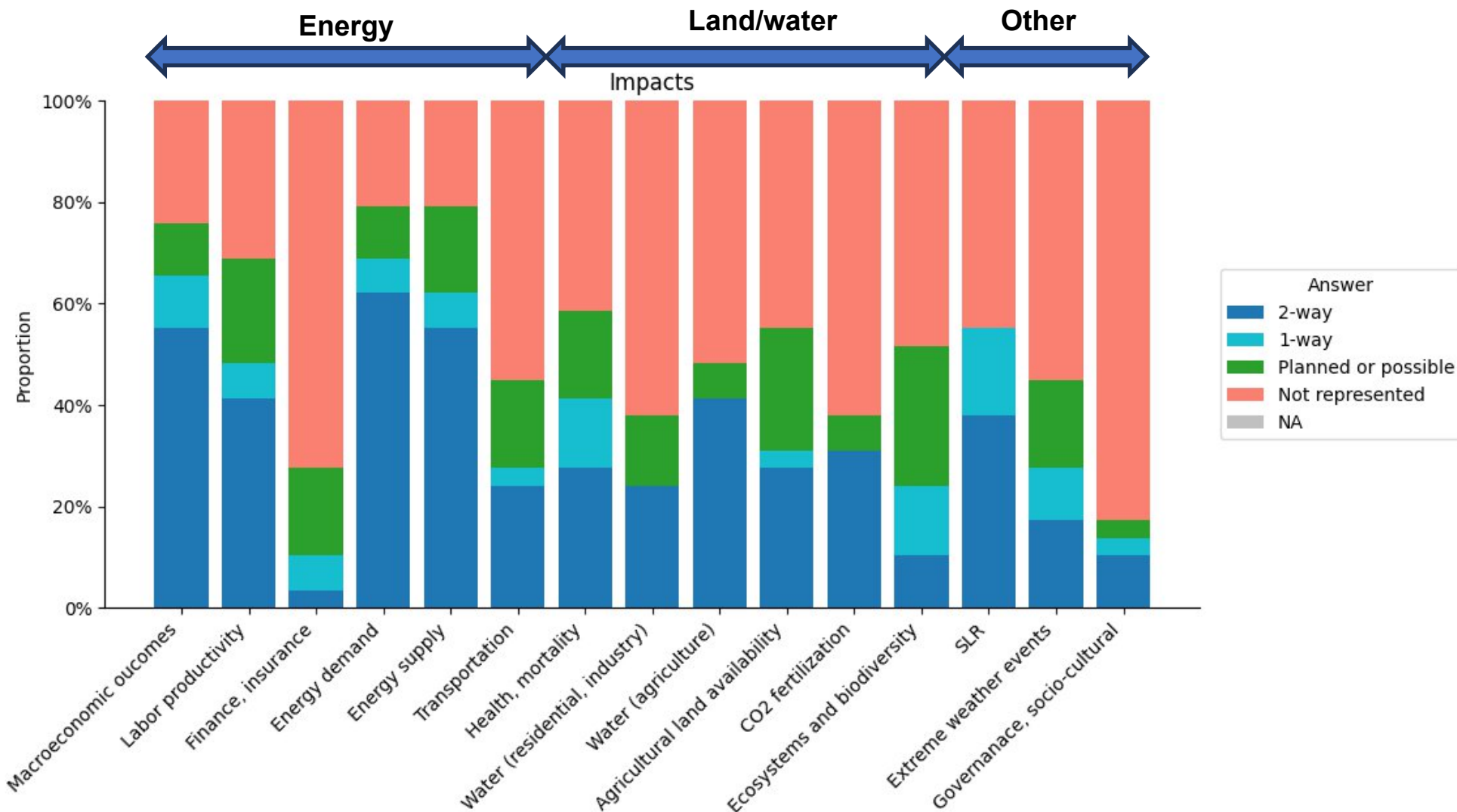
Results: Adaptation
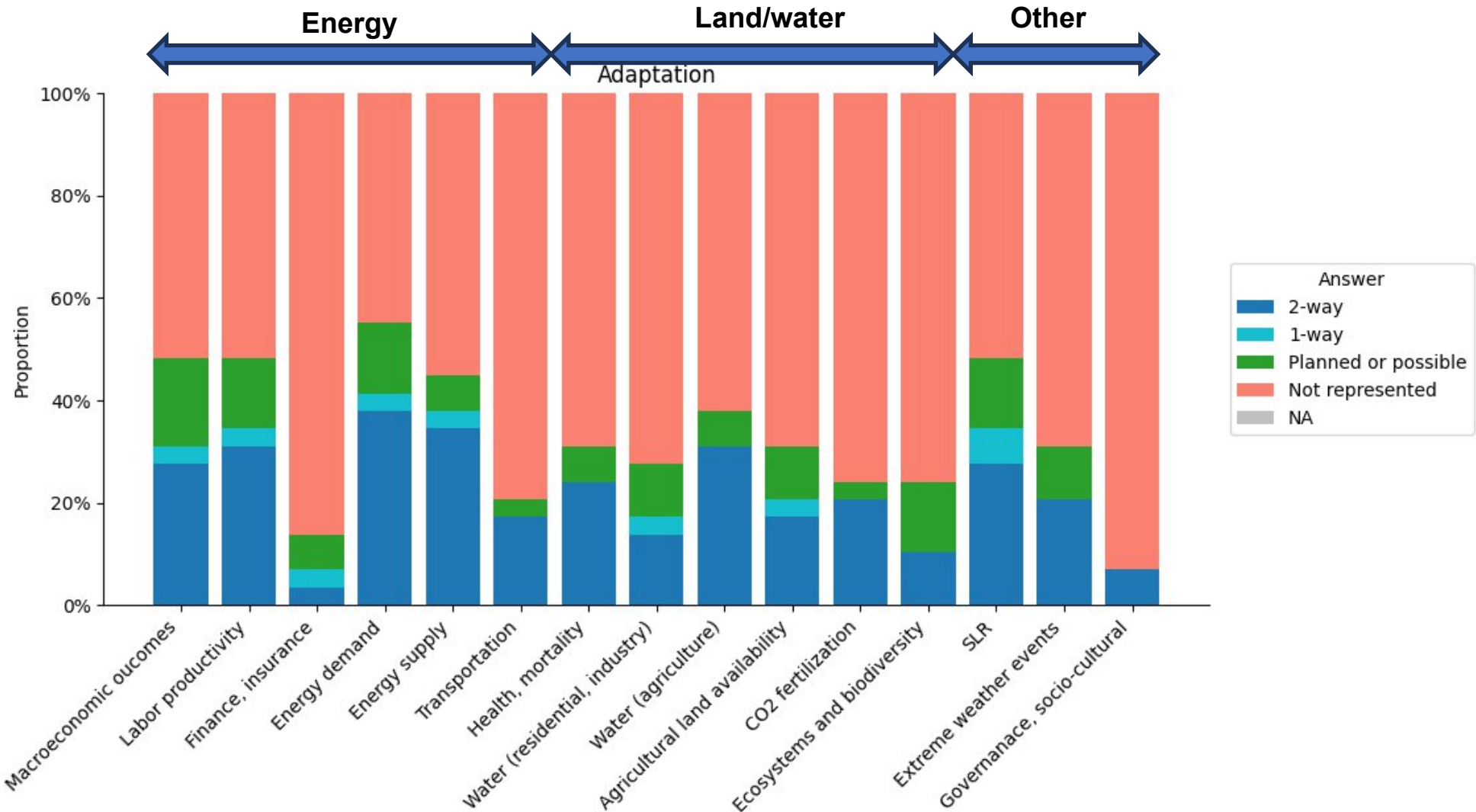
Legend: BM = Biophysical & monitary; B = Biophysical; NA; Default; Optional; Postprocessing

	Economic Impacts	Labour productivity	Finance & Insurance	Energy demand	Energy supply	Health & mortality	Water residential industry	Water agriculture	Agricultural land availabiltiy	CO2 fertilisation	Sea level rise	Flooding, Extreme weather	Biodiversity	Transportation & infrastructure	Governance, policy, social/cultural
GCAM-KSA	BM			B	B	B	B	B	B	B					
IMAGE	BM	BM		B	B	B	B	B	B	B	B		B		
PROMETHEUS				BM	BM										
AIMTech				B	B									B	
BLUES				B	B		B	B					B		
MAgPIE					BM			BM	B	BM			BM		
MESSAGEix	BM			BM	B		B	B	B	B		B	B		
REMIND		B													
TIMES_Sweden									B						
WITCH					B					BM					
AIM		BM		BM	BM	BM			B	B			B		
CCEM	BM					B			BM				B		
GEMINI-E3							BM								
GRACE															
IU-VNUHCM	BM	BM		BM	BM	B	B	B	B	B					
MIMOSA		B				BM							BM		
RICE50+											B				

BM = Biophysical & monitary
B = Biophysical

NA	(gray)
Default	(green)
Optional	(light green)
Postprocessing	(blue)

PRISMA

Biophysical ↕ Economic

Model	Economic Impacts	Labour productivity	Finance & Insurance	Energy demand	Energy supply	Health & mortality	Water residential industry	Water agriculture	Agricultural land availabiltiy	CO2 fertilisation	Sea level rise	Flooding, Extreme weather	Biodiversity	Transportation & infrastructure	Governance, policy, social/cultural
GCAM-KSA				Mal	Mal		Mal	Mal	Mal	Mal					
IMAGE				Mal	Mal	(postproc)	Mal	Mal	Mal	Mal					
PROMETHEUS					(postproc)										
AIMTech				(default)											
BLUES				(optional)	(optional)			Mal					(optional)		
MAgPIE		(postproc)			Mal			Mal	(postproc)	Mal			(postproc)		
MESSAGEix	Mal				Mal		Mal				(optional)				
REMIND	Mal														
TIMES_Sweden															
WITCH	Mal										(postproc)				
AIM	Mal	Mal		Mal	Mal				Mal	Mal	Mal				
CCEM	Mal	Mal				Mal					Mal				Mal
GEMINI-E3		Mal		Mal	Mal		Mal	Mal		Mal					
GRACE	(postproc)	(postproc)	(postproc)	(postproc)	(postproc)	(postproc)	Mal	Mal	(optional)					(optional)	
IU-VNUHCM															
MIMOSA	Mal										Mal				
RICE50+	(postproc)										(postproc)	Mal			

Mal = Maladaptation / Adaptation side-effects

Discussion / conclusions

- Implicit impacts and adaption in default scenarios

- Adaptation less represented. When, then often binary (on or off)

- Somewhat "flattered" results. Partial representation of impacts and adaptation

- Missing information. Which impact mechanisms per category?

- **Call to impact community** (!):
    - Feedback on our results, opportunities for improvement
    - Suggestions for collaboration

Thank you!