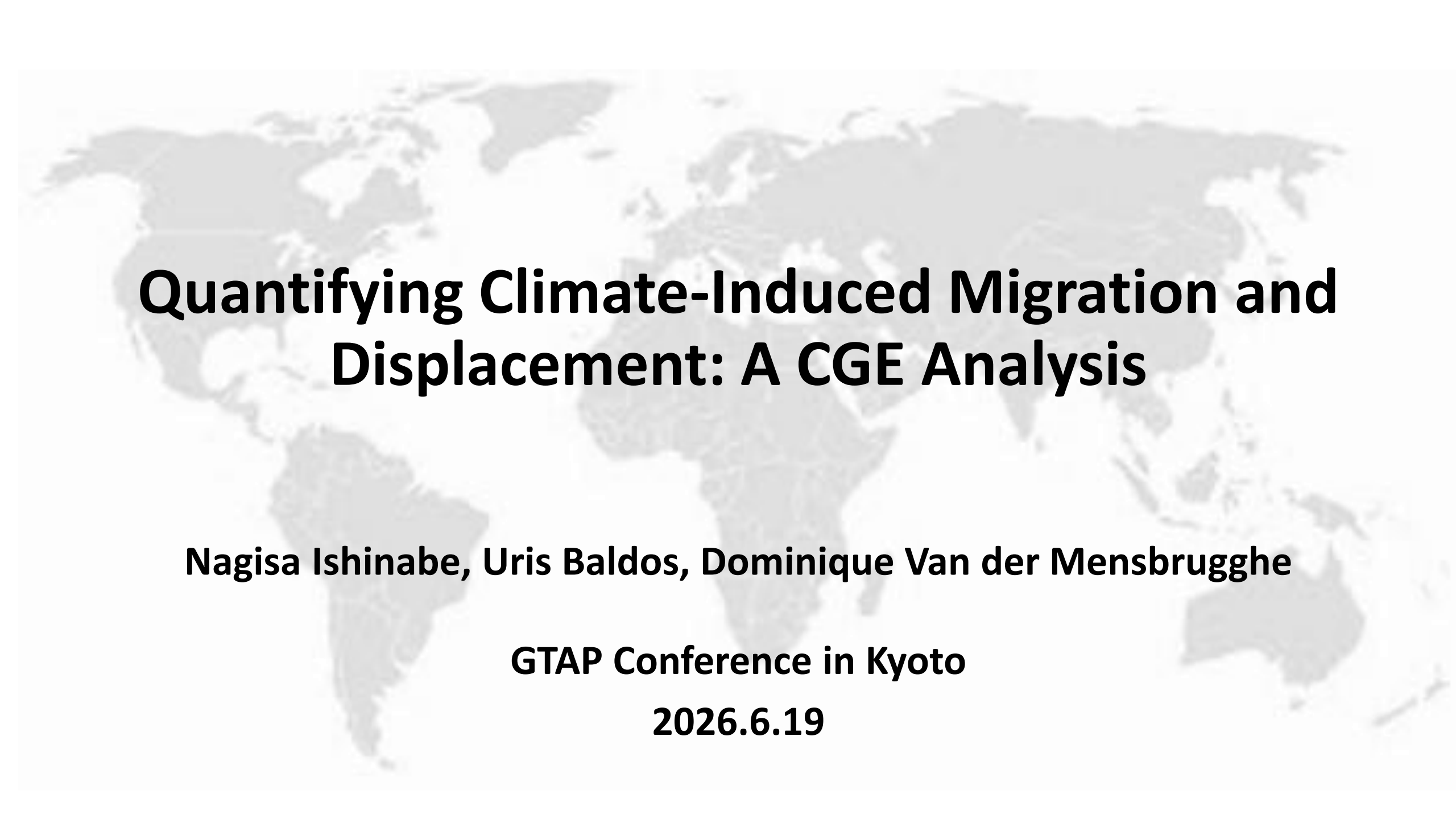


A faint, light gray world map is visible in the background of the slide, centered behind the text.

Quantifying Climate-Induced Migration and Displacement: A CGE Analysis

Nagisa Ishinabe, Uris Baldos, Dominique Van der Mensbrugghe

GTAP Conference in Kyoto

2026.6.19

Background:

Climate mobility enters the global agenda

- ✓ **Paris Agreement (2015)**
Established a taskforce to develop integrated approaches to prevent, minimize and address future climate-induced displacement
- ✓ **Global Compact for Safe, Orderly and Regular Migration (2018)**
First UN General Assembly-endorsed global migration framework, with Objective 2 explicitly recognizing climate change as a driver of migration
- ✓ **Fund for Responding to Loss and Damage (2023)**
First dedicated climate finance mechanism explicitly covering displacement and relocation

Growing literature, but estimates remain contested

- ✓ **World Bank Groundswell II (Clement et al., 2021)**
44–216M internal migrants by 2050
- ✓ **IMF Working Paper (Cattaneo et al., 2024)**
88–121M additional international emigrants/decade by 2050s
- ✓ **IEP Ecological Threat Register (2020)**
1.2B at ecological risk (exposure index, not migration)
- ✓ **Estimates are not comparable**
differ by region, method, scopes (internal vs. international; flow vs. exposure; climate shocks)
- ✓ **Three critical blind spots remain**
destination information absent in many studies; trapped populations underrepresented; interplay between climate-induced economic migration and displacement largely unexplored

Overview:

■ Scope of the analysis

- Quantify global climate-induced migration and displacement, with spatially explicit origin–destination flows across all migration pathways (South–South, South–North, etc.) using 103 x 103 origin–destination matrices
- Capture complex interactions among economic activities, migration, explicitly linking climate shocks to wages and labor demand within a CGE framework
- Derive displacement figures from poverty headcounts and model scenarios where displaced populations are granted or denied labor market access — enabling joint assessment of humanitarian, fiscal, and development implications for origin and destination countries
- Conduct scenario analyses over 2–3°C warming scenarios and different human mobility assumptions: Baseline (economic migration only), Displacement, Displacement with work option.

■ Model & Data

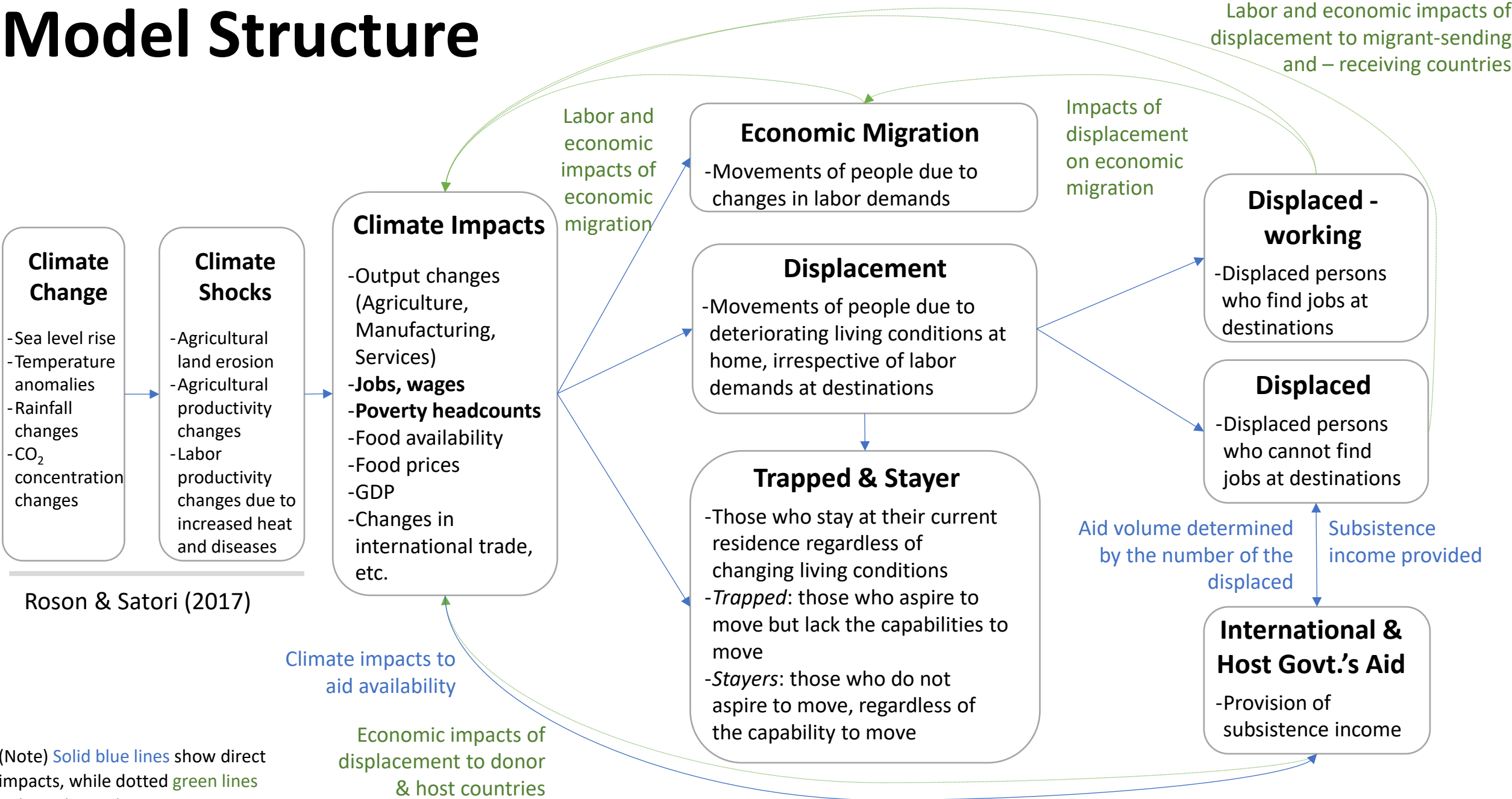
- Extended GMIG2 with poverty and displacement
- GTAP v11

■ Climate impacts

- Agricultural land losses due to sea level rise
- Agricultural productivity changes due to temperature increase
- Heat effects on labor productivity & disease impacts on human health

from Roson & Sartori. 2017. “Estimation of climate change damage functions for 140 regions in the GTAP 9 database”

Model Structure

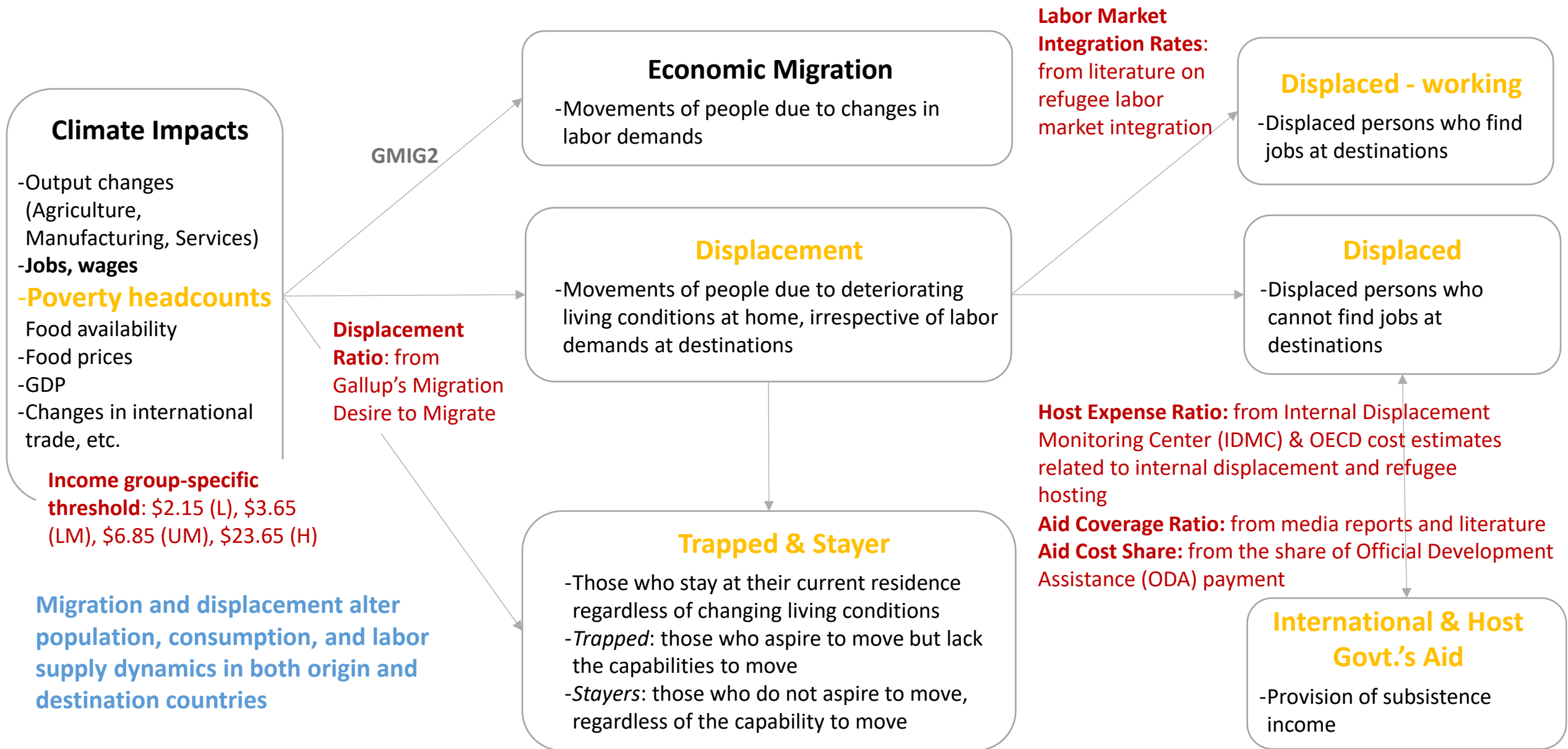


Roson & Satori (2017)

(Note) Solid blue lines show direct impacts, while dotted green lines indicate key indirect impacts captured in the new GMIG2

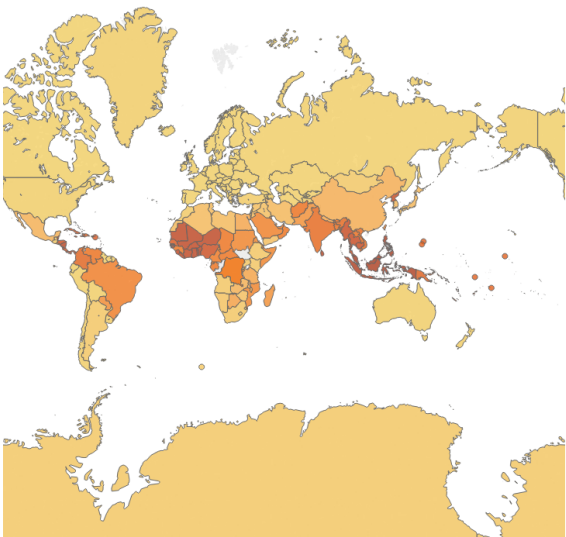
Socio-economic changes captured in this study using the extended GMIG2

Key Parameters, Variables, Linkages

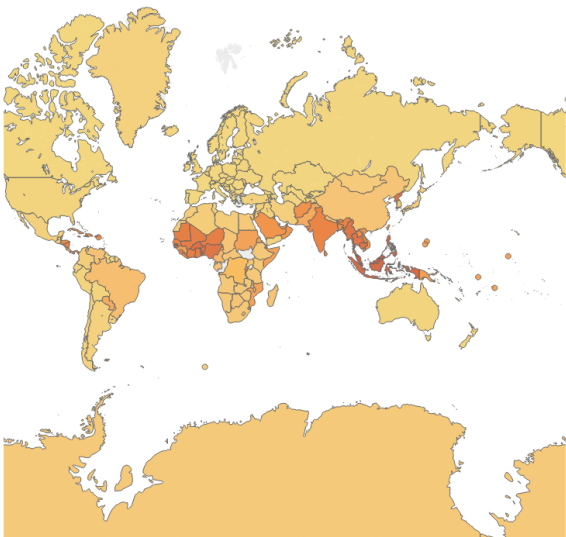


Climate shocks *from Roson & Sartori. 2017*

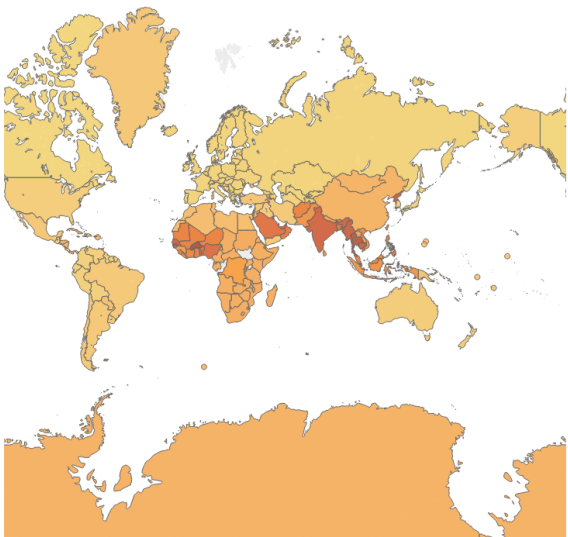
Heat & health impacts on labor productivity (Agriculture)



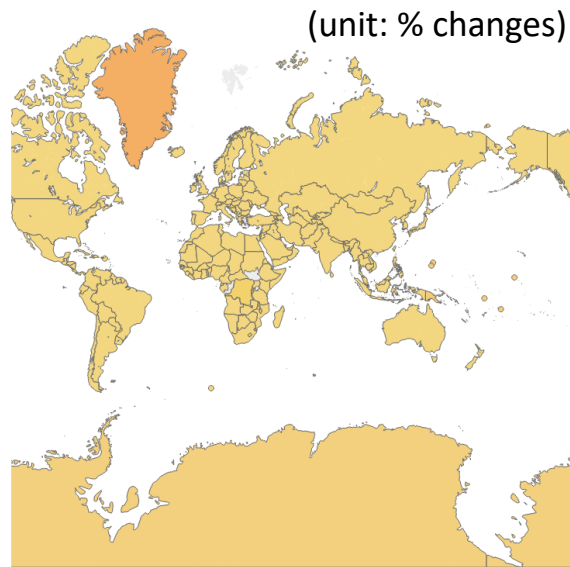
Heat & health impacts on labor productivity (Manufacturing)



Heat & health impacts on labor productivity (Services)



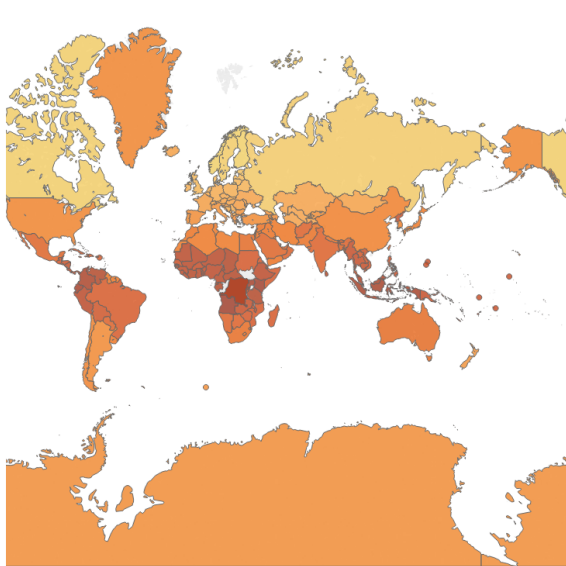
Sea Level Rise (Land Losses)



Wheat Yield



Maize Yield



Rice Yield

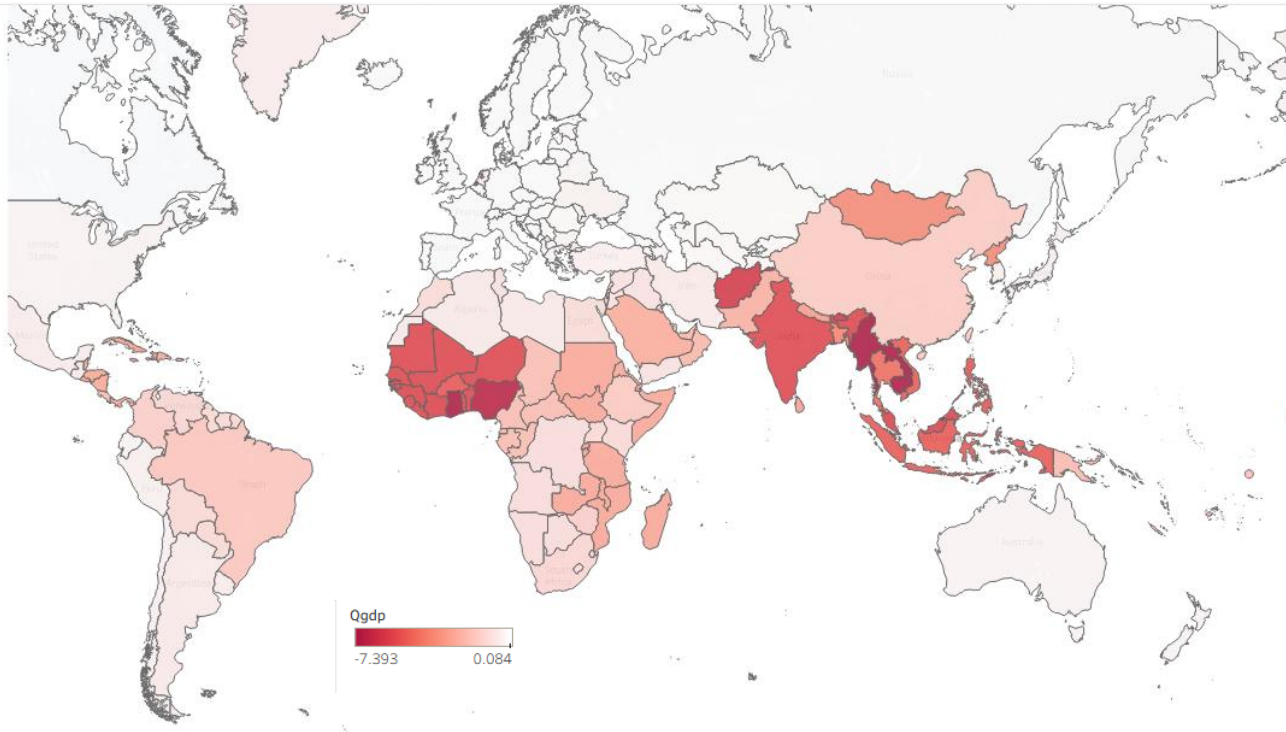


Summary Statistics (Climate Shocks)
(unit: % changes)

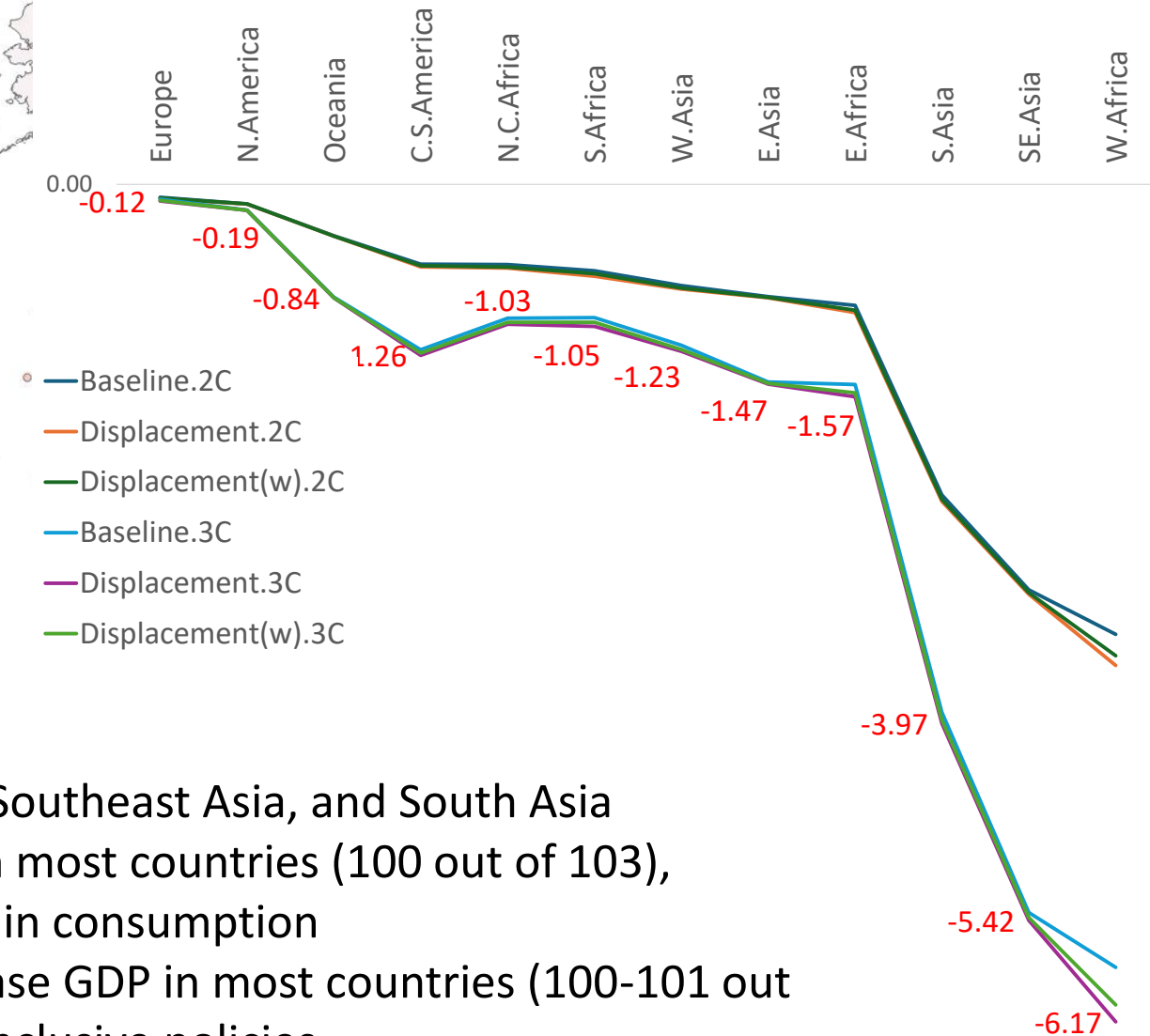
	Agric..	Mnfcs.	Servi..	SLR	Wheat	Maize	Rice
Min	-22.5	-12.6	-5.1	-2.7	-7.3	-8.0	-3.6
Max	0.0	0.0	0.0	0.0	-4.0	0.1	-2.0
Average	-5.3	-2.4	-1.1	0.0	-5.6	-4.1	-2.8
Median	-1.3	-0.8	-0.4	0.0	-5.6	-4.1	-2.8

Real GDP

Changes in Real GDP (Displacement, 3°C)



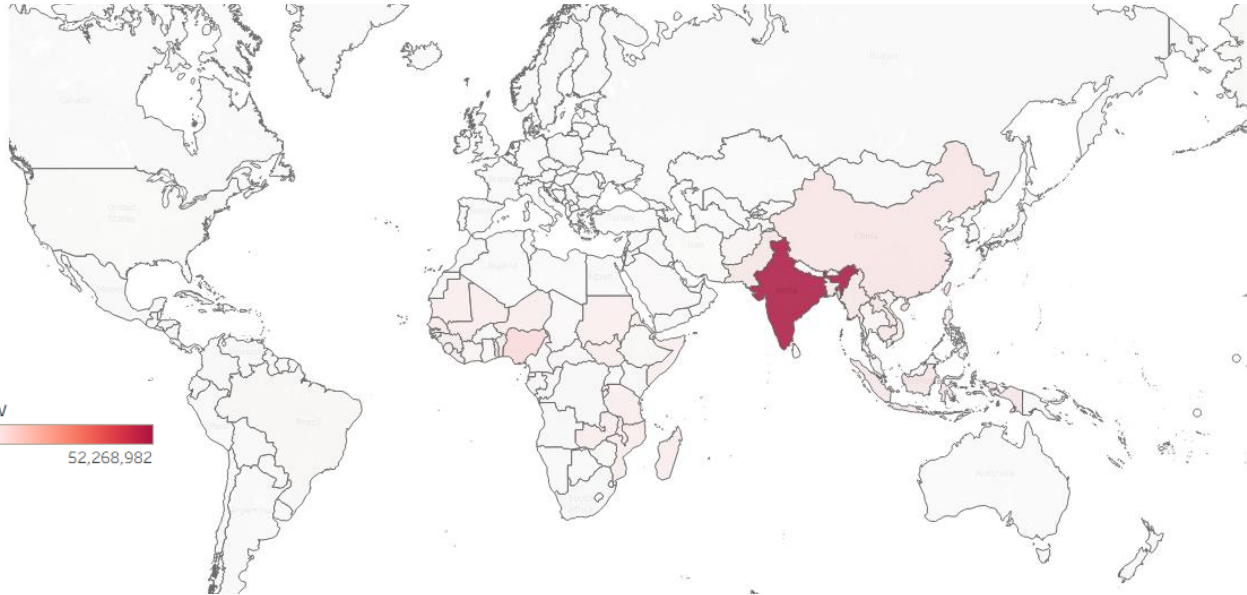
Changes in Real GDP across scenarios (Regional averages)



- ✓ Climate change reduces real GDP in nearly all economies
- ✓ The largest losses are projected to occur in West Africa, Southeast Asia, and South Asia
- ✓ Accounting for displacement increases real GDP losses in most countries (100 out of 103), likely reflecting reduction in the labor force and changes in consumption
- ✓ Granting displaced person access to labor markets increase GDP in most countries (100-101 out of 103), highlighting the potential economic gains from inclusive policies

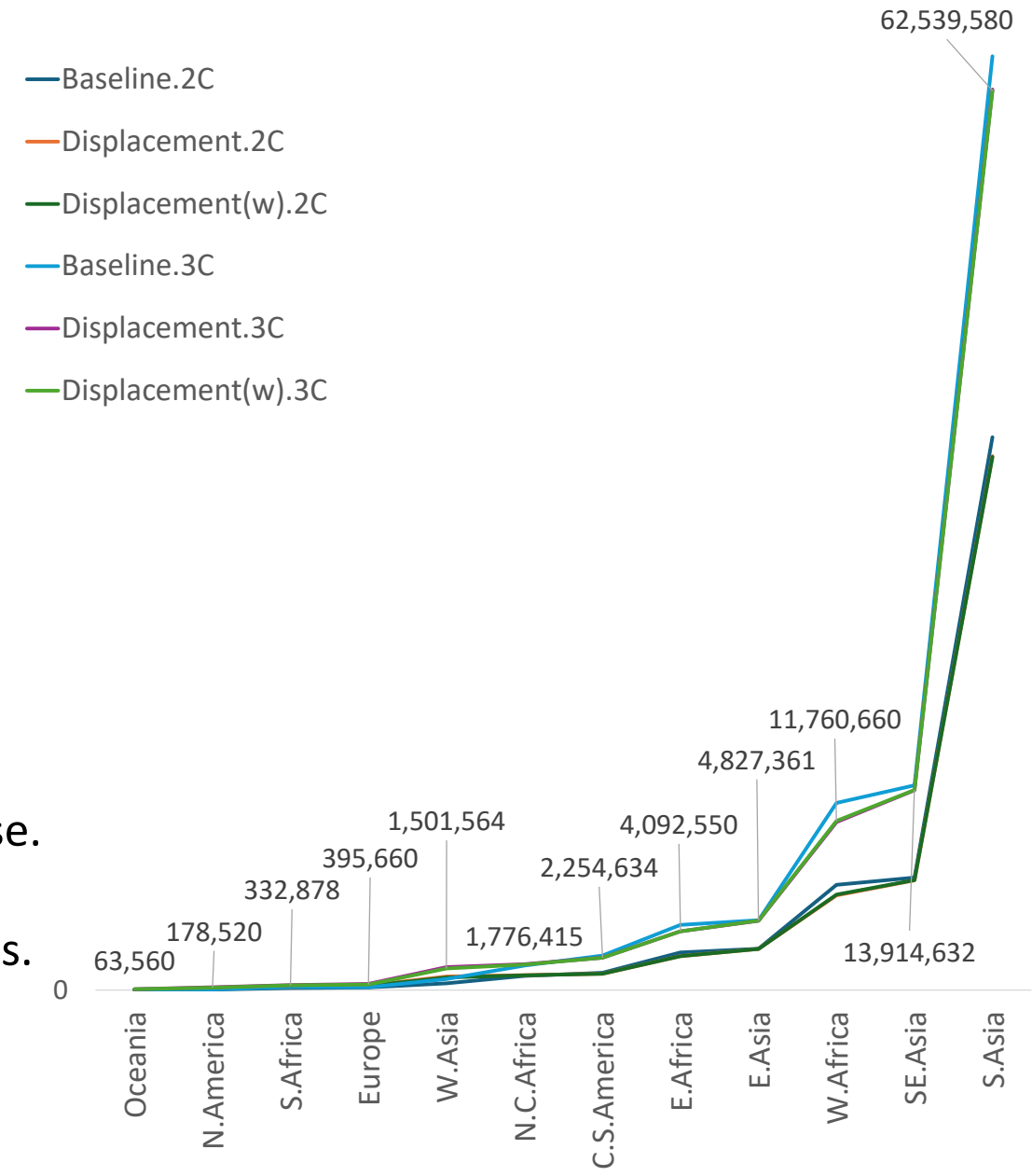
Poverty headcounts

Changes in Poverty headcounts (Displacement, 3°C)



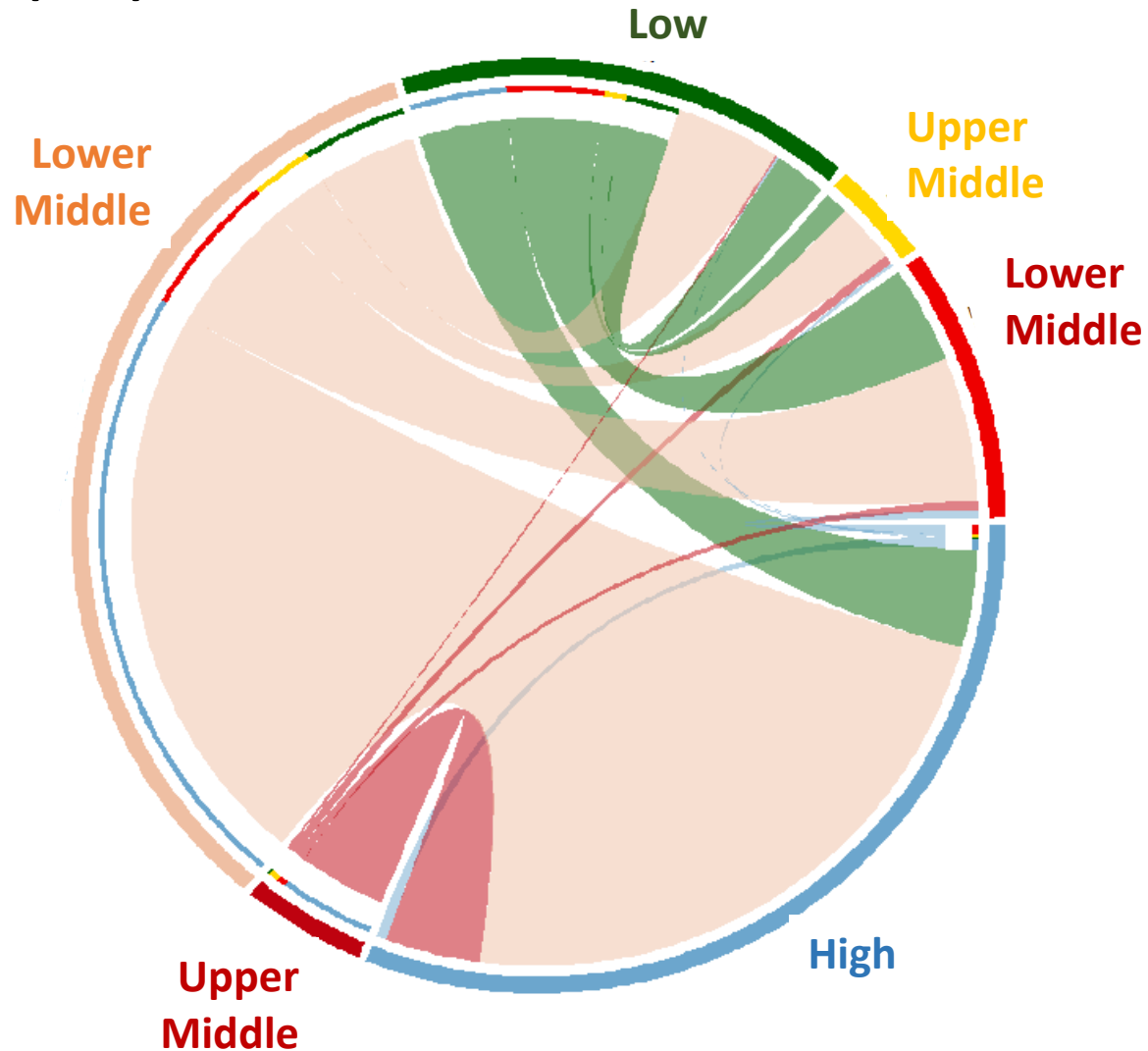
- ✓ South Asia faces the largest climate-induced poverty increase, followed by Southeast Asia and West Africa.
- ✓ South Asia accounts for over 60% of the additional poverty headcount, with India contributing 85% of the regional increase.
- ✓ Allowing displacement increases poverty relative to the baseline in 75 countries, while reducing poverty in 28 countries.
- ✓ Granting displaced persons access to labor markets reduces poverty in 83–84 locations, while increasing poverty in 19–20 locations, respectively.

Changes in Poverty headcounts across scenarios

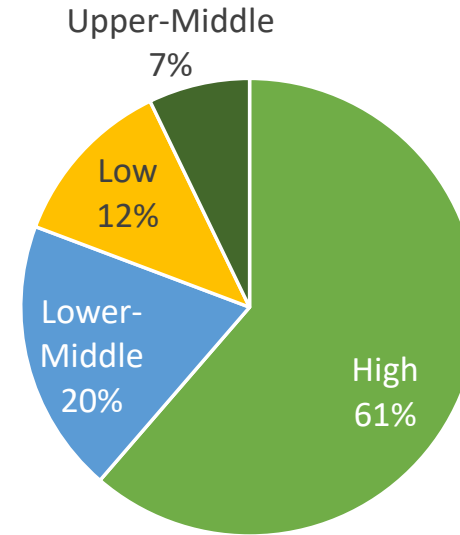


Displacement flows

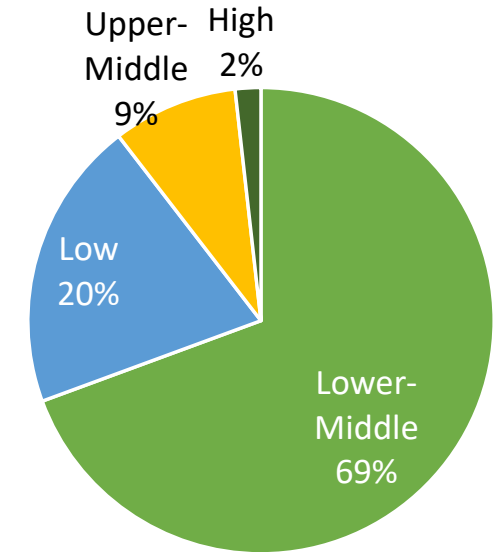
Displacement flows by Income Category (3°C)



Displacement Inflows



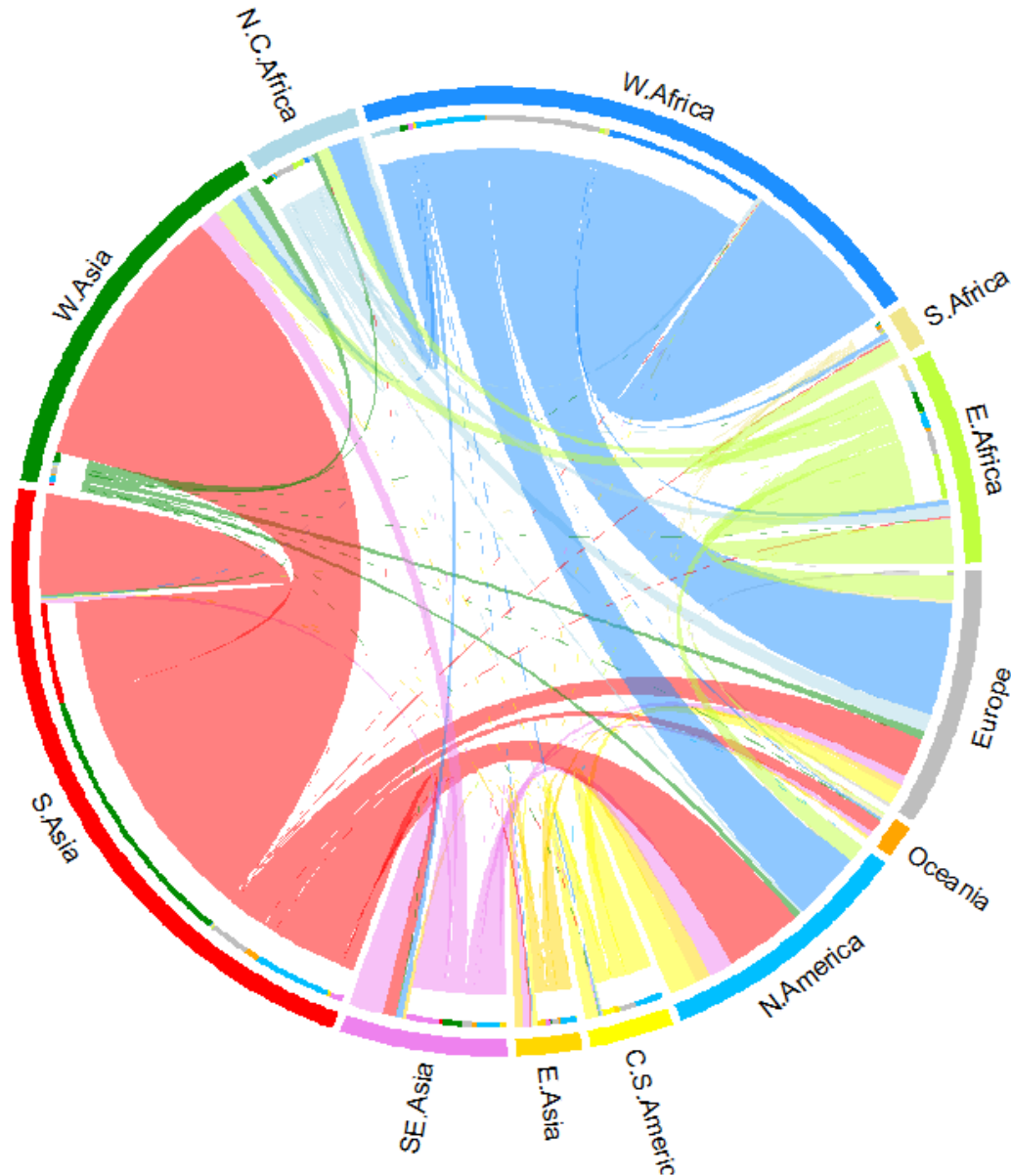
Displacement Outflows



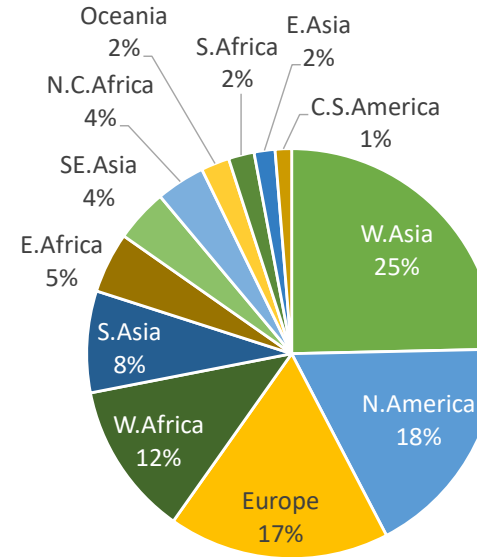
- ✓ Under a 3°C warming, displacement is projected to reach 13 million people.
- ✓ Most displaced people originate from lower-middle-income countries (69%), while high-income countries receive the largest share of displaced populations (60%).
- ✓ Lower-middle-income countries are the largest source of inflows across all destination income groups.
- ✓ High-income countries attract displaced people from all income groups, including 82% from upper-middle-income countries and 67% from lower-middle-income countries.

Displacement flows

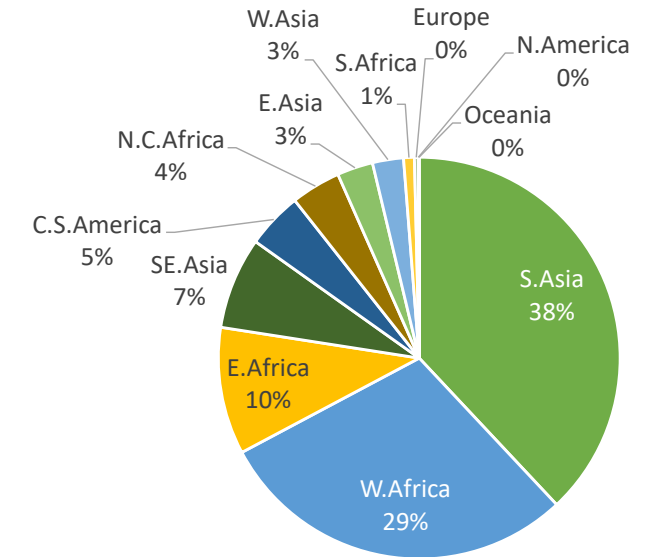
Displacement flows by Region (3°C)



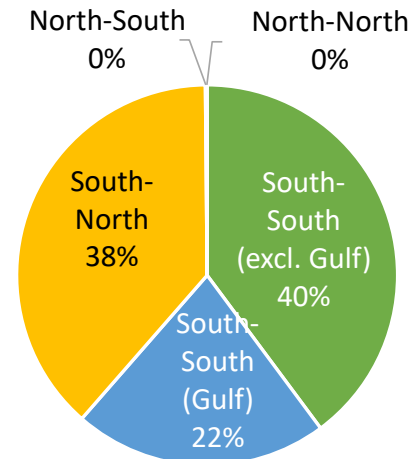
Displacement Inflows



Displacement Outflows



Displacement flows



- ✓ South–South displacement dominates, accounting for over 60% of total displacement, while South–North flows make up about 40%.
- ✓ Nearly 40% of displaced people originate from South Asia, followed by West Africa (29%) and East Africa (10%).
- ✓ Major destinations include West Asia (25%), North America (18%), Europe (17%), and West Africa (12%).

Summary Results

		2 degree C					
		Baseline		Displacement		Displacement(work)	
Quantity GDP	(% changes)	-0.559%		-0.571%		-0.566%	
Poverty headcounts	('000 ppl)	62,151.0		60,381.8		60,265.0	
Population movements incl. LF	('000 ppl)	265.8	0.4% *	7,509.4	12% *	6,442.8	11% *
Labor force inflows	('000 ppl)	265.8	100% **	198.0	3% **	201.2	3% **
Labor force outflows	('000 ppl)	265.8	100% **	3,564.0	47% **	2,503.5	39% **
Cost of accommodating the displaced	(billion \$)	0		113.4		96.5	
International aid	(billion \$)	0		1.4	1% ***	1.2	1% ***

		3 degree C					
		Baseline		Displacement		Displacement(work)	
Quantity GDP	(% changes)	-0.945%		-0.966%		-0.958%	
Poverty headcounts	('000 ppl)	106,988.3		103,836.0		103,638.0	
Population movements incl. LF	('000 ppl)	473.9	0.4% *	13,053.9	13% *	11,194.1	11% *
Labor force inflows	('000 ppl)	473.9	100% **	357.6	3% **	363.4	3% **
Labor force outflows	('000 ppl)	473.9	100% **	6,231.7	48% **	4,381.0	39% **
Cost of accommodating the displaced	(billion \$)	0		196.4		167.1	
International aid	(billion \$)	0		2.5	1% ***	2.1	1% ***

* % share to the poverty headcount

** % share to the population movements

*** % share to the total cost of accomodating the displaced

Key take-aways, Way forward

Key take-aways

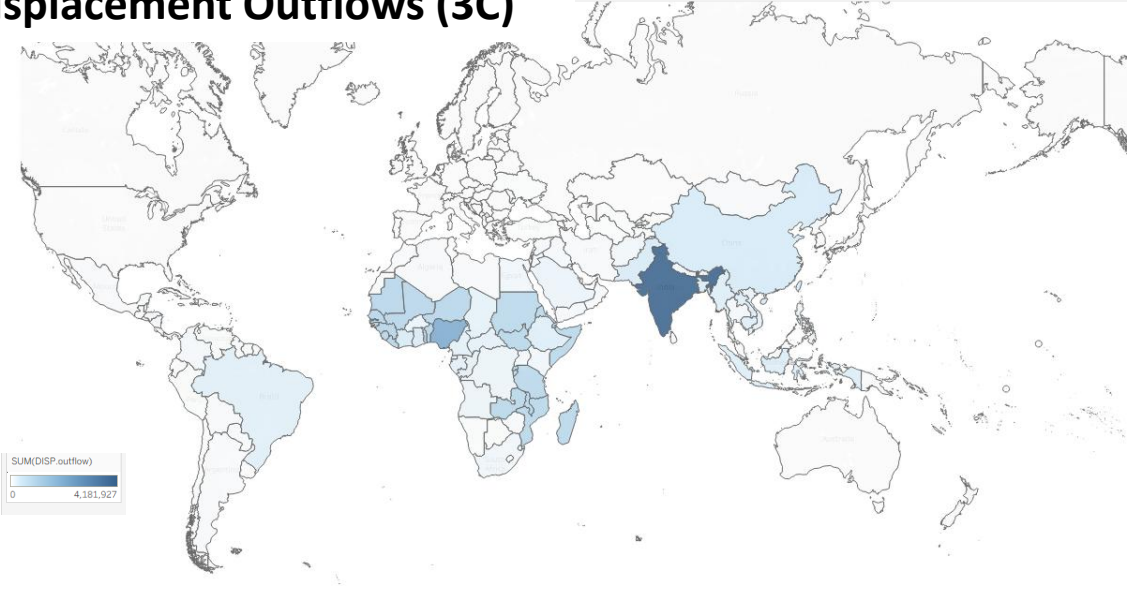
- ✓ Climate change is expected to push an additional **60–107 million people into poverty**. Using these figures as a proxy for migration pressure, an estimated **6–13 million people may choose to migrate**, based on observed migration aspiration rates. This implies that nearly **90% of those facing worsening living conditions are likely to remain in their countries of origin**, underscoring the importance of strengthening support and adaptation measures in affected countries.
- ✓ **Displacement financing:** As displacement to high-income countries increase, the costs of accommodating displaced populations will rise. Discussions on **Loss and Damage** should therefore consider not only support for displaced populations but also increased development assistance for adaptation and resilience-building in countries of origin.
- ✓ **Limited economic migration pathways:** Opportunities for economic migration remain highly constrained. While migration can serve as an important adaptation strategy, its overall impact is expected to be limited
- ✓ **Labor market access matters:** Granting displaced persons access to labor markets is expected to reduce global poverty and increase GDP, as more displaced people re-enter the workforce. Inclusive policy could benefit the economy. Migration models should account for changes in labor force participation and consumption.
- ✓ **Global and national impacts differ:** To understand climate change, migration, and displacement, both perspectives must be considered.

Way forward

- ✓ Introduce immigration restrictions into the modeling framework to capture the interactions between migration policies and climate-induced mobility responses.

Appendix

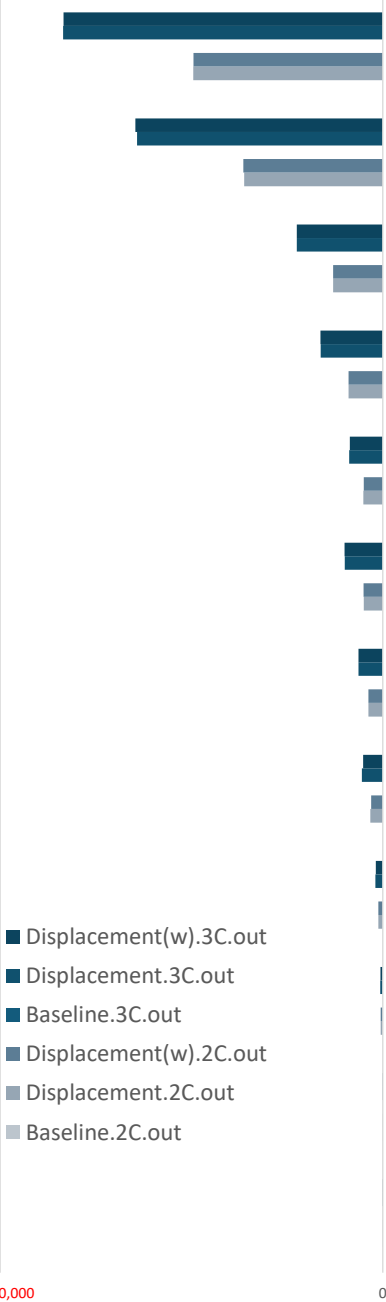
Displacement Outflows (3C)



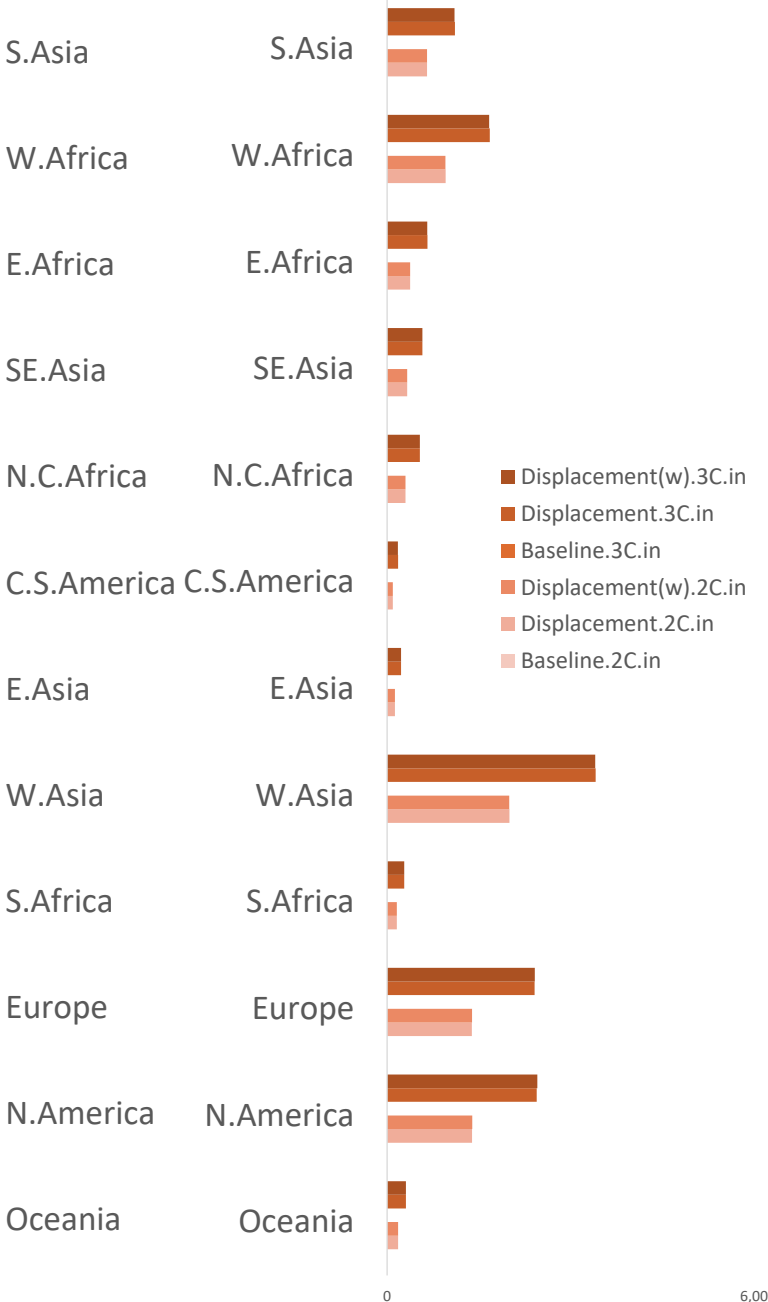
Displacement Inflows (3C)



Displacement outflows

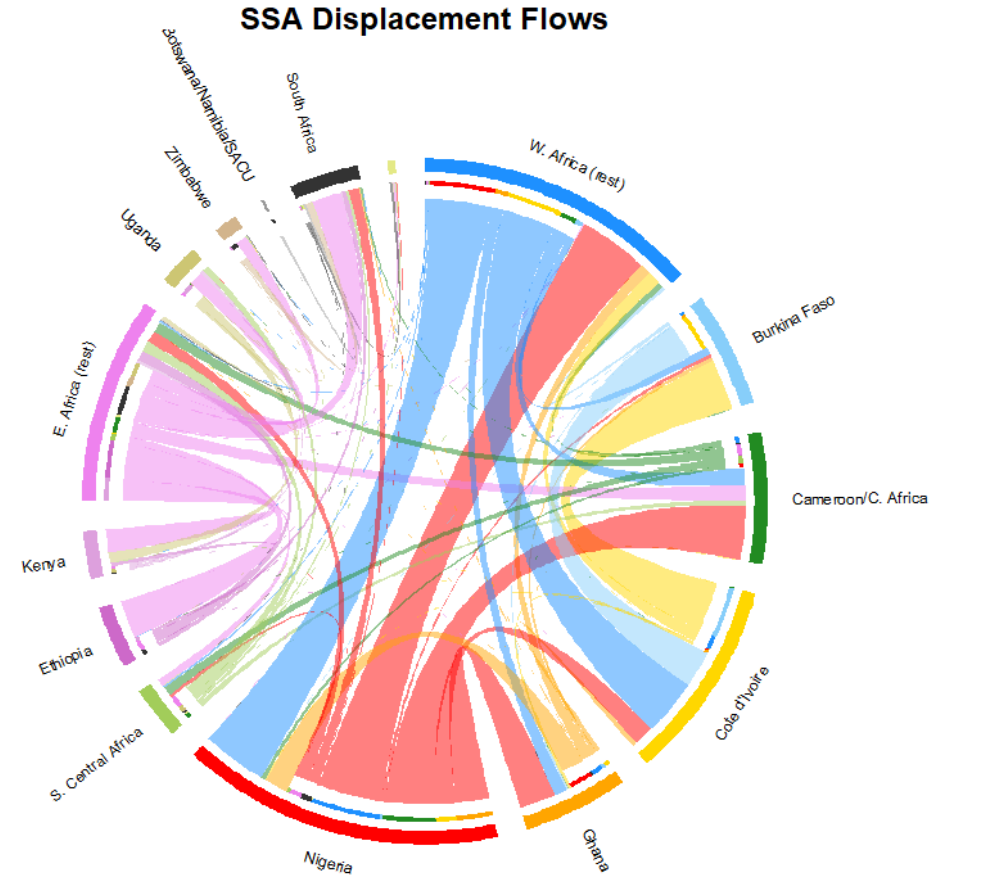


Displacement inflows



Appendix

- ✓ An estimated 95% of displaced people from Burkina Faso are expected to move to other Sub-Saharan African countries.
- ✓ Similarly, 92% from Botswana, Namibia, and the rest of the Southern African Customs Union; 80% from Côte d’Ivoire; 79% from Uganda; 74% from Zimbabwe; and 63% from Benin and other West African countries are expected to move within the Sub-Saharan African region.



Displacement flows in SSA (3C)

	Benin; Guini	Burkina Faso	Cameroon; Cent	Cote d'Ivoire	Ghana	Nigeria	South Central	Ethiopia	Kenya	Madagascar	Uganda	Zimbabwe	Botswana; N	South Africa	Regional sum	Global sum	Region %
Benin; Guinea; Senegal; Togo; Rest of Western Africa	-	27,128	59,970	204,866	46,779	232,792	7,494	1,099	639	5,943	731	1,770	816	1,596	591,623	937,413	63%
Burkina Faso	12,291	-	509	133,436	6,996	1,646	38	10	10	103	10	10	41	11	155,112	163,090	95%
Cameroon; Central Africa	20,382	192	-	219	299	13,693	31,136	268	194	38,452	206	363	756	6,519	112,679	215,091	52%
Cote d'Ivoire	48,046	187,472	874	-	11,481	3,376	77	31	31	309	31	31	122	436	252,317	315,325	80%
Ghana	41,738	13,603	1,755	17,198	-	85,789	131	37	37	423	37	37	161	3,074	164,018	319,236	51%
Nigeria	249,929	11,784	193,016	74,658	131,257	-	12,098	178	178	41,751	178	179	3,676	38,406	757,289	2,116,795	36%
South Central Africa	707	14	18,719	14	14	29	-	1,092	1,455	38,225	23,050	1,813	3,245	8,748	97,125	131,178	74%
Ethiopia	314	32	201	32	32	33	108	-	13,764	36,454	591	539	269	17,366	69,737	273,021	26%
Kenya	233	21	127	21	21	21	86	411	-	9,791	10,626	513	442	4,411	26,724	102,630	26%
Madagascar; Malawi; Mauritius; Mozambique; Rwanda; Tanzania; Zambia; Rest of Eastern Africa	3,181	131	58,368	132	169	287	27,378	136,263	83,703	-	51,676	40,927	6,698	106,874	515,787	869,877	59%
Uganda	328	9	59	9	9	9	1,236	812	35,342	11,929	-	1,300	233	1,446	52,721	66,869	79%
Zimbabwe	60	4	28	4	4	4	78	67	41	4,123	75	-	1,893	20,748	27,127	36,899	74%
Botswana; Namibia; Rest of South African Customs	38	5	34	5	6	10	87	7	8	284	9	117	-	9,139	9,752	10,604	92%
South Africa	138	11	134	14	29	85	1,144	210	109	4,399	87	3,324	8,317	-	18,001	104,035	17%
Regional sum	377,386	240,406	333,794	430,609	197,096	337,775	81,093	140,486	135,512	192,185	87,307	50,922	26,667	218,775	2,850,012	5,662,061	
Global sum	386,211	241,571	336,026	432,793	199,625	340,788	82,012	142,368	136,099	211,967	88,947	51,635	31,194	236,470	5,108,402		
Regional share of migration	98%	100%	99%	99%	99%	99%	99%	99%	100%	91%	98%	99%	85%	93%	56%		