

Regional vs. Global Perspectives for Modeling Climate Change-Migration Impacts

Paolo D'Odorico

(University of California, Berkeley)

Acknowledgements

Sinafekesh Wolde (Politecnico di Milano, Italy)

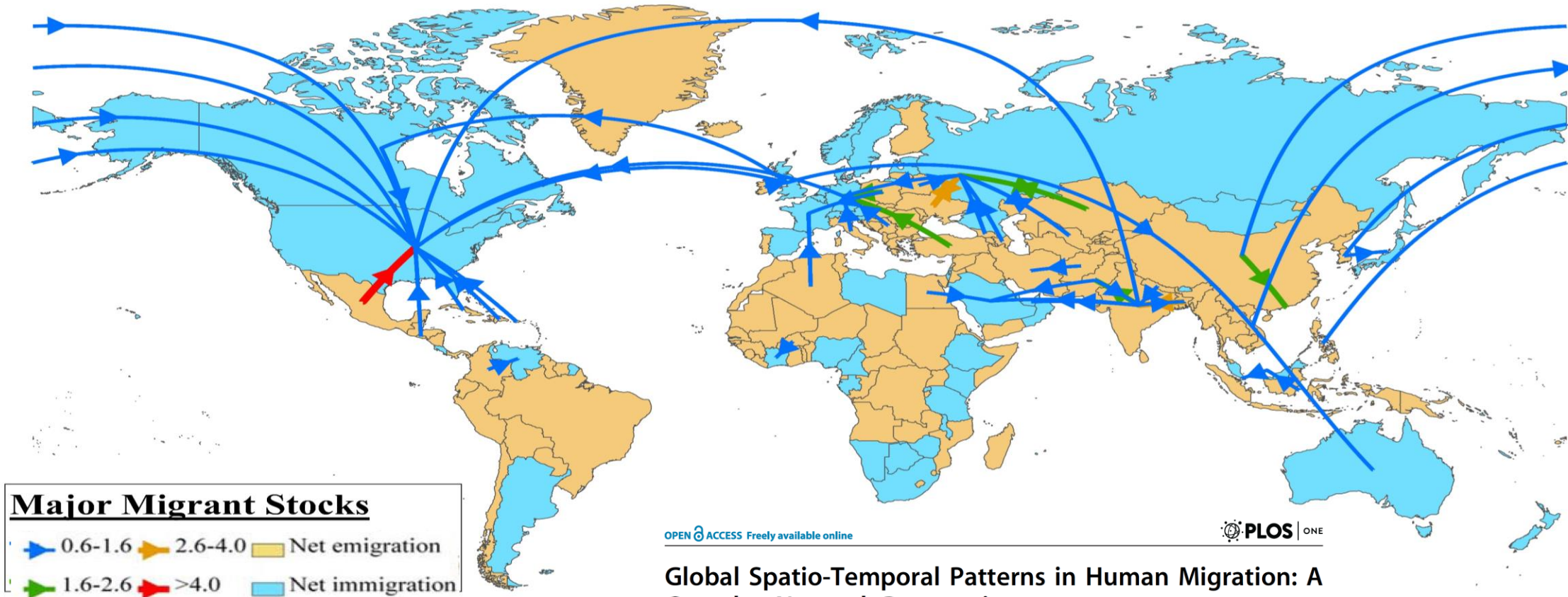
Maria Cristina Rulli (Politecnico di Milano, Italy)

Kyle Davis (University of Delaware, USA)

Samir Suweis (University of Padua, Italy)

The Global Network of Migrations

Based on National Census Data: Almost every country reports the number of people living in that country but who were born in another country by country of origin



Global Spatio-Temporal Patterns in Human Migration: A Complex Network Perspective

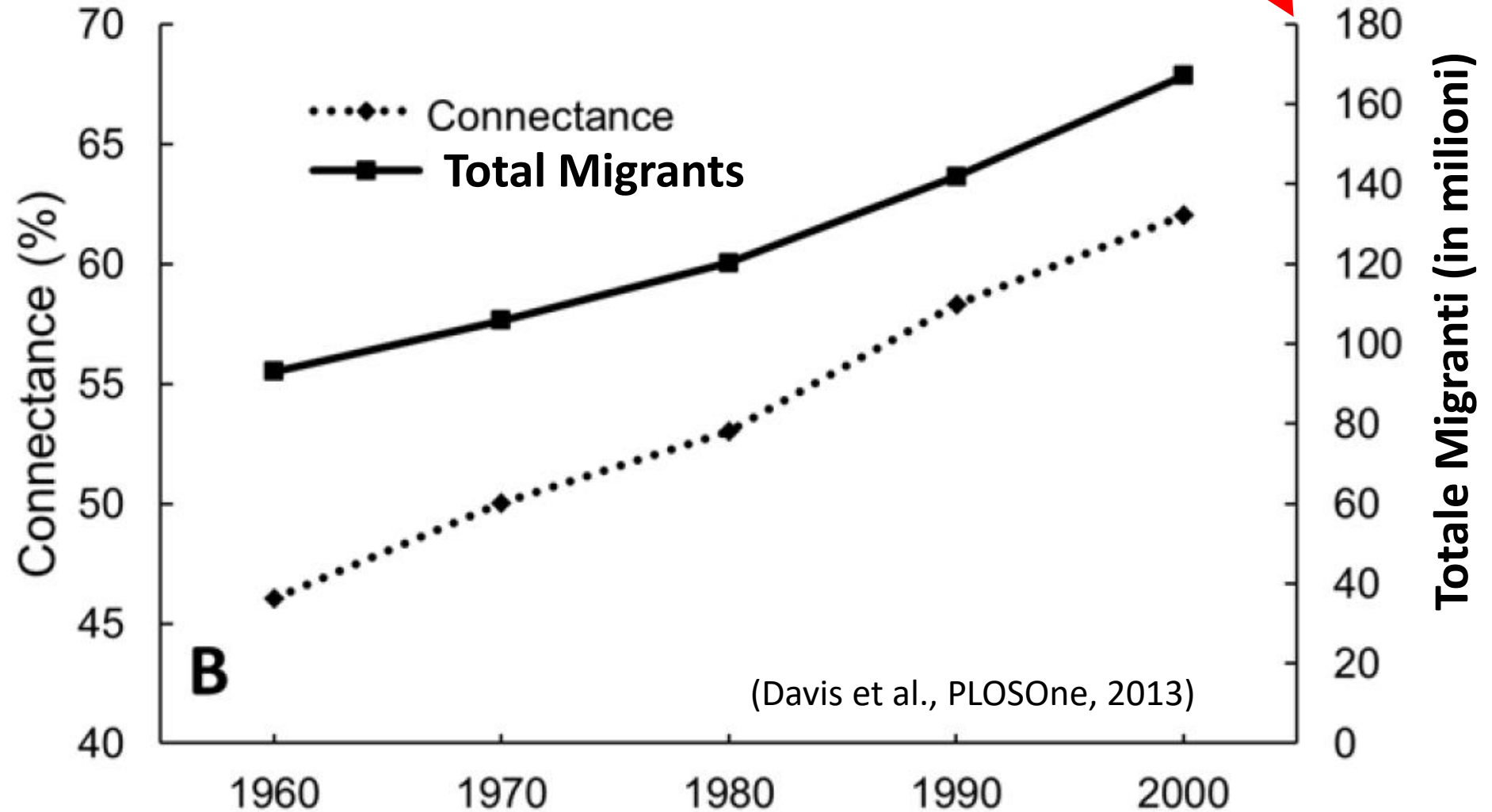
Kyle F. Davis^{1*}, Paolo D'Odorico¹, Francesco Laio², Luca Ridolfi²

Values expressed as Millions people
The figure shows only migration fluxes with > 600,000 people

Properties of the global migration network

Connectance=% of connection links out of all the possible pairs of countries

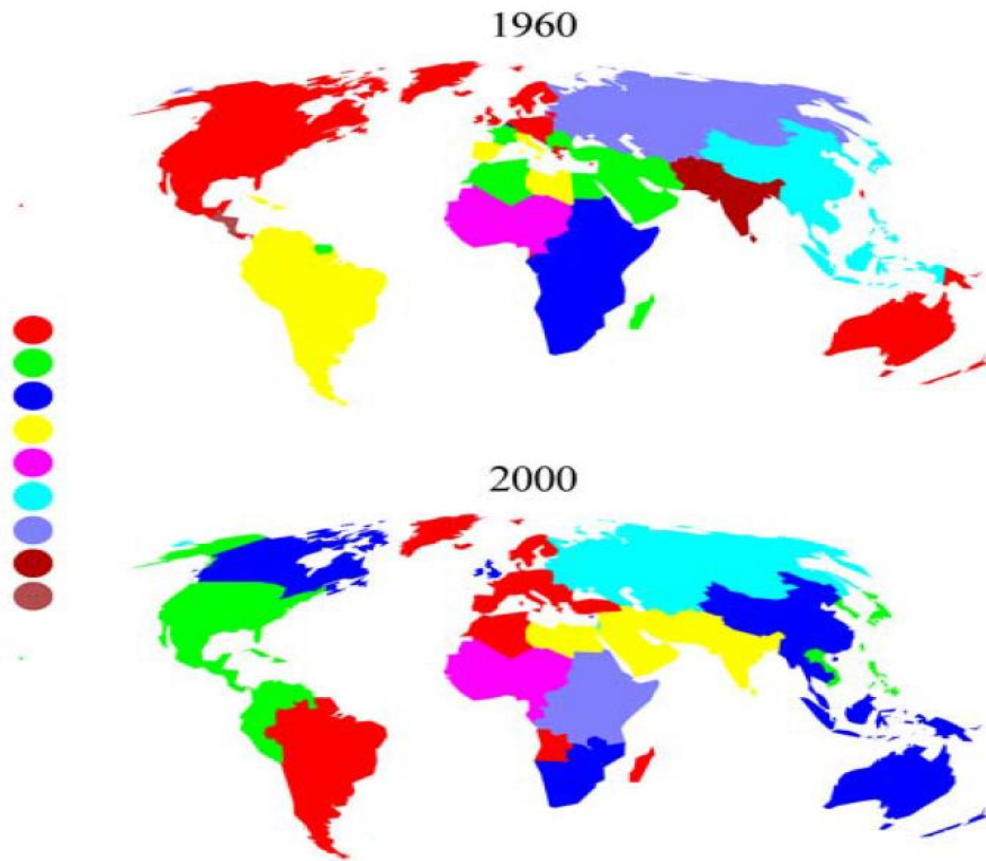
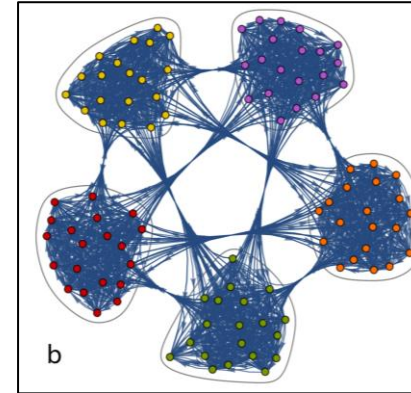
According to these official records international migrants account for 2-3% of global population



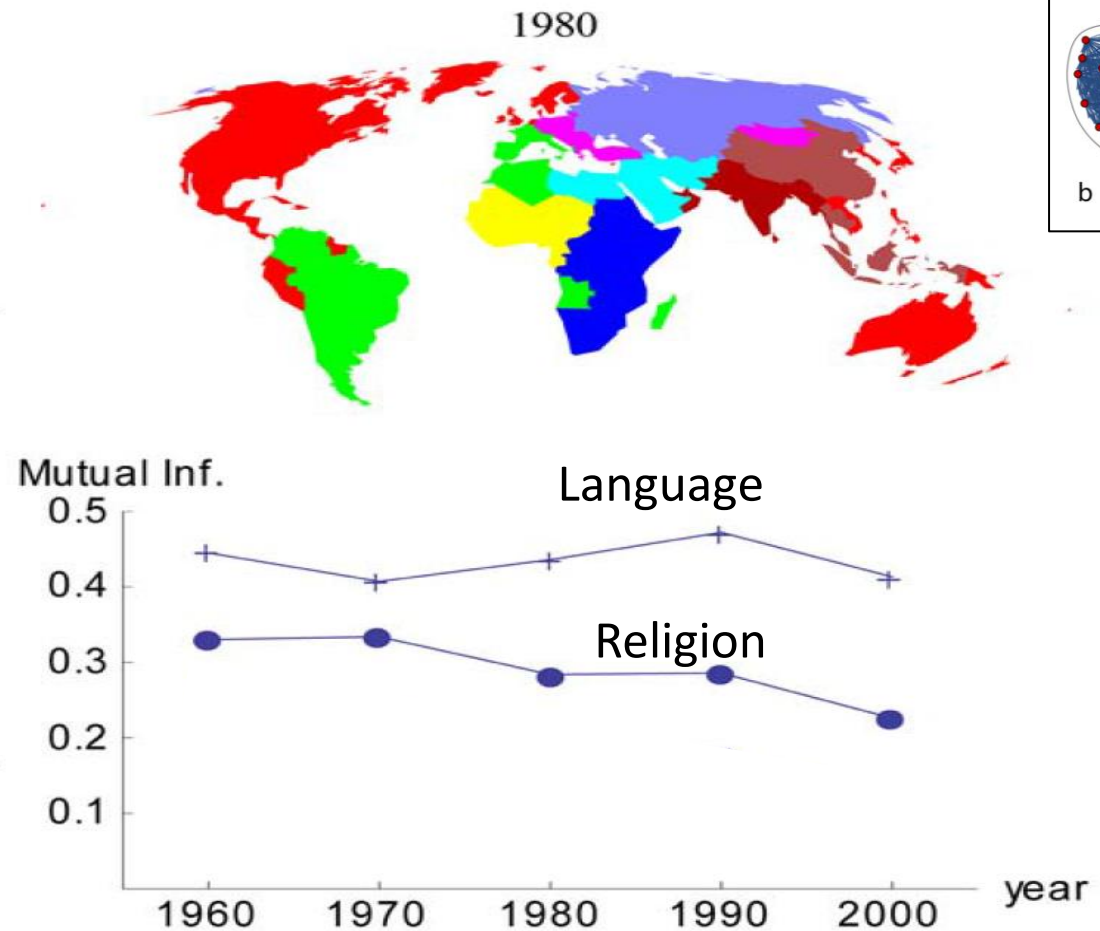
“Community structure” of the migration network

- The international migration network has modular structure
- Migrants tend to move more within communities than across them

Modularity



(Davis et al., PLOSOne, 2013)



Modeling Environmental Migrations

- What sets people on the move? When? Where? How?
- Where do these people go?

Environmental Migrations

The displacement of people by environmental drivers.

- *climate change refugees or migrants*
- *environmental refugees or migrants*
- *environmental migration,*
- *climate mobility or climate migration*
- *disaster displacement*



Definitions

Disaster displacement	'The movement of persons who have been forced or obliged to leave their homes or places of habitual residence because of a disaster or to avoid the impact of an immediate and foreseeable natural hazard'.	IOM (2019); The Nansen initiative (2015)
Climate migration (working definition)	'The movement of a person or groups of persons who, predominantly for reasons of sudden or progressive change in the environment due to climate change, are obliged to leave their habitual place of residence, or choose to do so, either temporarily or permanently, within a State or across an international border'.	Chazalnoël and Ionesco (2016); IOM (2016)
Environmental migration	'The movement of persons or groups of persons who, predominantly for reasons of sudden or progressive changes in the environment that adversely affect their lives or living conditions, are forced to leave their places of habitual residence, or choose to do so, either temporarily or permanently, and who move within or outside their country of origin or habitual residence'.	IOM (2019)
Climate/environmental refugee	Refer to environmental migrant, displaced persons. A category of environmental migrants whose movement is clearly of a forced nature. Individuals forced to leave their country because of environmental or climatic processes or events would not necessarily meet the definition of a refugee under (Convention and Protocol Relating to the Status of Refugees, 1951). Most of those who flee environmental degradation or disaster, including when due to climate change, do not cross an international border, which is an additional requirement for the application of the refugee definition.	McAdam (2009)

The nexus between migration and environmental conditions

- Dearth of empirical research on migration–environment relations despite the increasing number of publications on environmental refugees.
- The nexus between migration and environmental conditions is complex
 - ✓ multi-causality (e.g., Bates, 2002),
 - ✓ existence of time lapses in causation
 - ✓ drivers of environmental migration also vary with country/region.

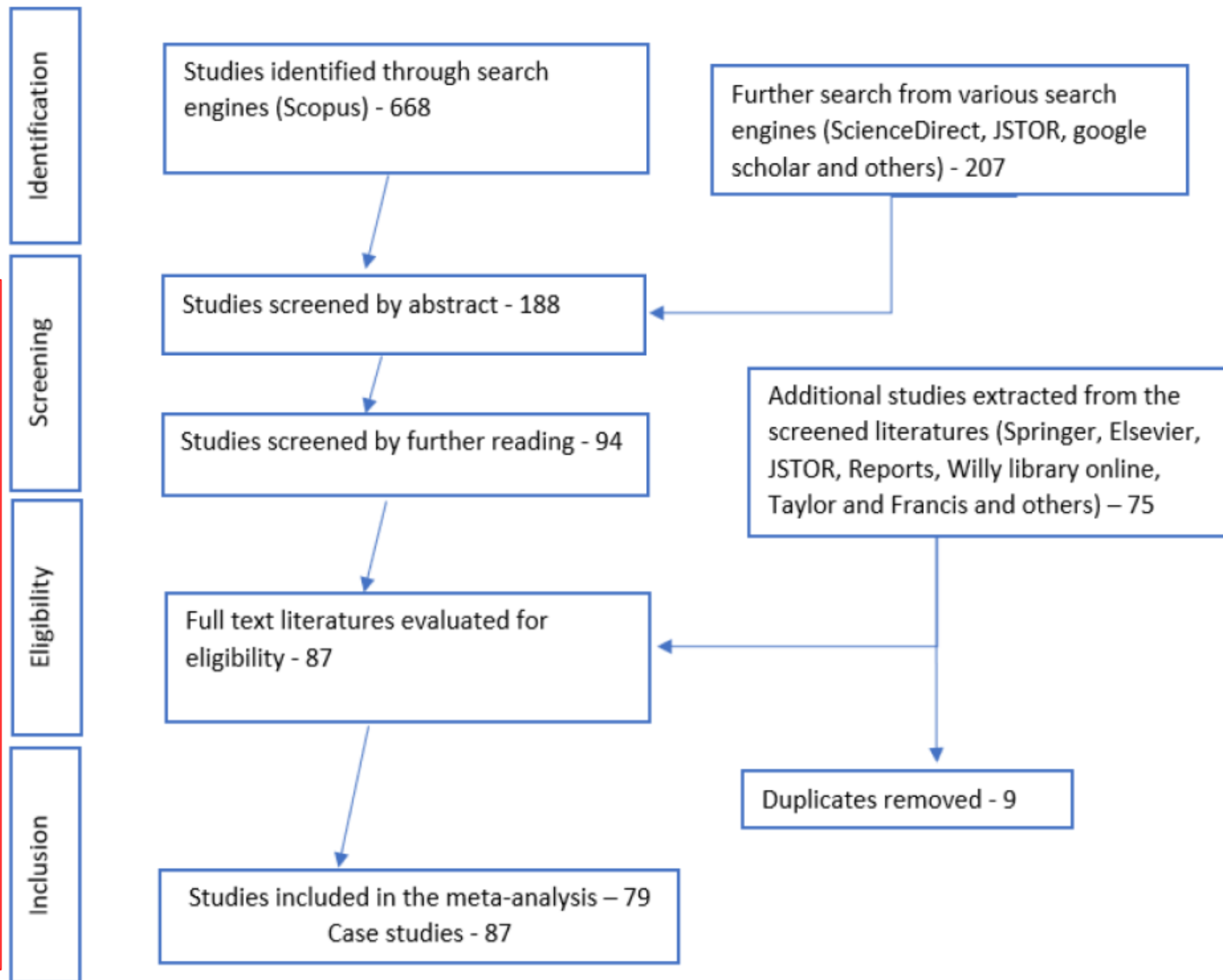
Meta- analysis

Environmental drivers of human migration in Sub-Saharan Africa

Sinafekesh Girma Wolde¹, Paolo D'Odorico² and Maria Cristina Rulli¹

Global Sustainability, 2023

- **87 case studies from the literature (environmental science, development economics and migration research), reports, and international disaster datasets from 32 SSA countries.**
- **Information on magnitude of human displacement, direct and underlying environmental drivers, timing, number of people displaced, and geographic patterns.**



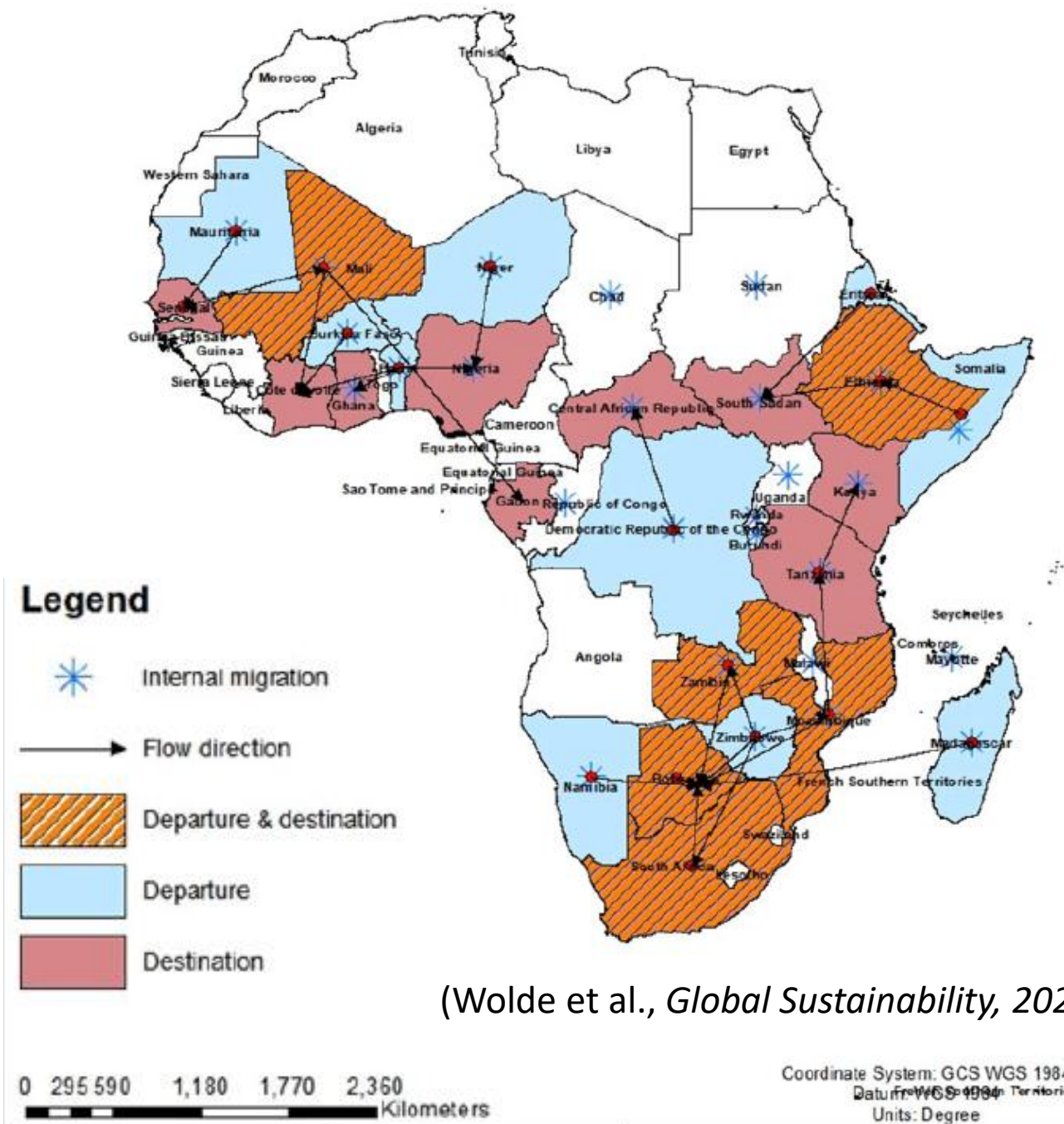
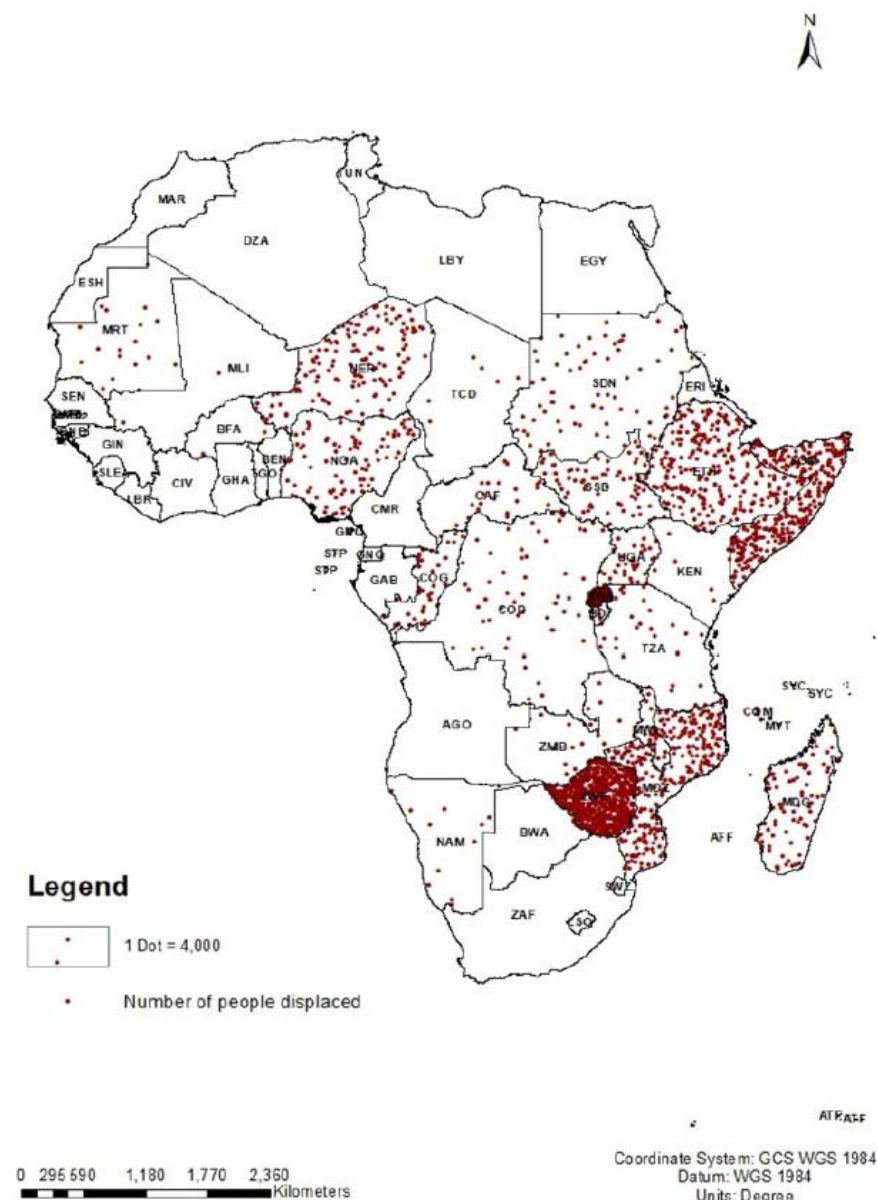
Results

Environmental drivers of human migration in Sub-Saharan Africa *Global Sustainability, 2023*

Sinafekesh Girma Wolde¹ , Paolo D'Odorico²  and Maria Cristina Rulli¹

No.	Country	ISO	Departure region	Event start date	Event end date	Extreme event_1 (primary driver)	Extreme event_2 (secondary driver)	Exacerbated by	No. of people displaced	Destination country	Destination region	Reference	Remark
1	Benin	BEN	Bialaba – Dassari watershed	2013	2013	Soil infertility and high or low rainfall – crop failure	Heat wave and drought	Water scarcity and food insecurity	All 36 interviewed migrants	Nigeria, Benin, Ivory Coast, and Ghana	Benin (Borgou and Zou North, Ogun, Issangue and Adjuba, Abeokuta, oyo)	Dreier and Sow (2015)	
2	Benin	BEN	Northwest Atacora region	01.11.2000	01.05.2005	Environmental and soil degradation	Poor harvest and land scarcity	Subsistence farming, animal husbandry issues, and lack of access to fertilizers	250 HH ≈ 1250 people	Benin		Doevenspeck (2011)	3/4 migration caused by soil degradation
3	Botswana, South Africa, Zimbabwe, Zambia, and Madagascar			22.02.2000	01.03.2000	Cyclone	Flood	Drought	290,000		Southern African region	Brouwer and Nhassengo (2006); Holloway et al. (2013); NRC (2015); Parkinson (2013)	Specific country destination is hard to trace
4	Burkina Faso	BFA		1970	1998	Severe drought		Low rainfall	346	Côte d'Ivoire	Rural to rural and rural to urban	Henry et al. (2004)	4% of 8644 ppl
5	Burkina Faso	BFA	N: Soum and Oudalan provinces S: Nahouri and Bougouriba	1960	1998	Severe drought	Variable rainfall	Dry spell	Around 10,000	Burkina Faso	North-south and south-north	Henry et al. (2004)	Observed migrants flow and number is mapped in the source paper

Results



(Wolde et al., *Global Sustainability*, 2023)

Drivers

Push Factors (in the 'home region')

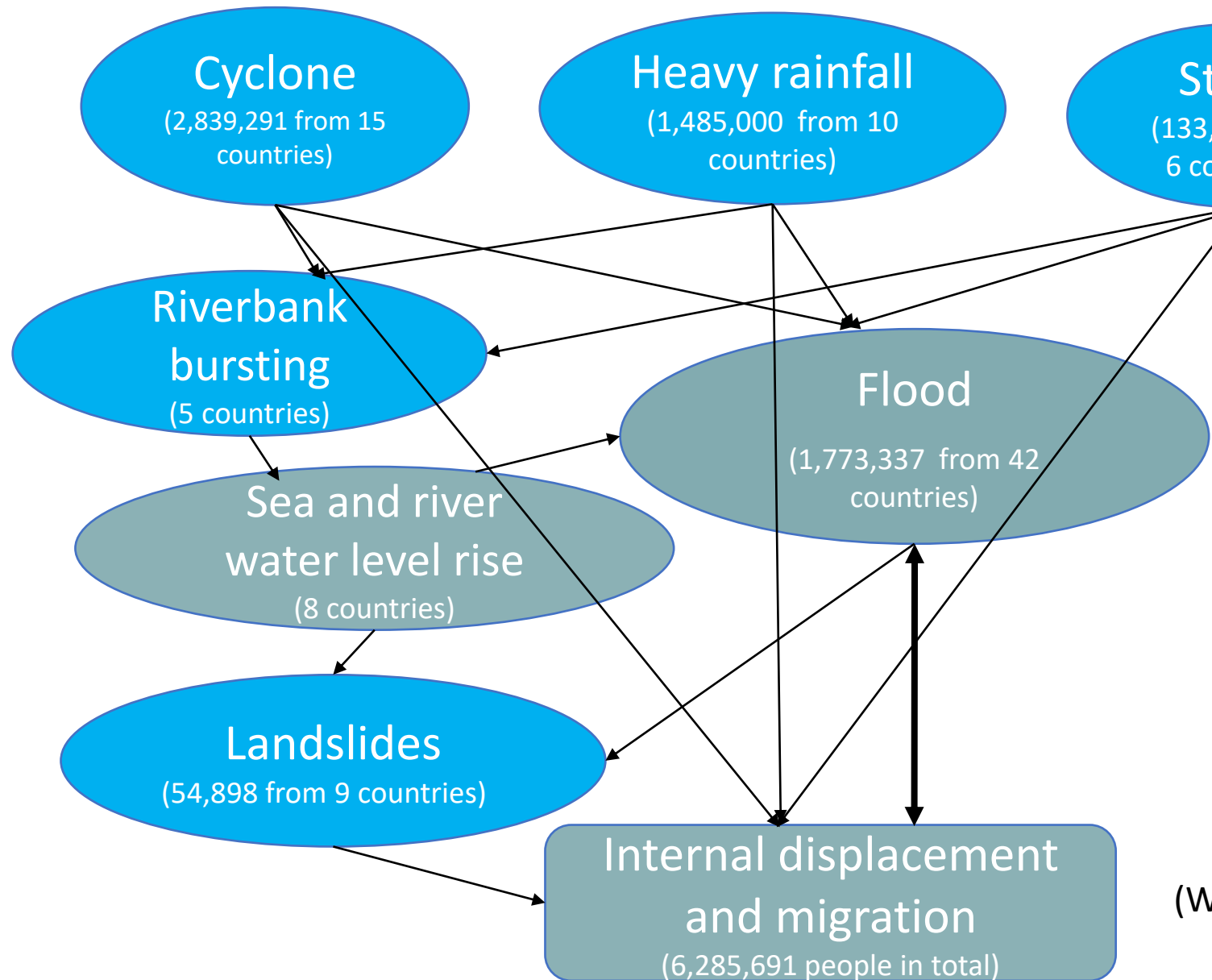
- **Drought, crop failure, pest outbreak**
- Unemployment, low wages
- Conflict, violence
- Limited opportunities for education
- Limited access to health care and 'good living conditions'

Pull Factors (from the 'destination region')

- **Less exposure to natural disasters and climate extremes**
- Employment opportunities, better salaries
- Access to education, healthcare
- Better living conditions, 'modern lifestyles'
-

Environmental Drivers

- **Direct Drivers** (e.g., a climate event destroying crops, homes, sources of livelihoods)
- **Indirect, "underlying" Drivers:**
 - Policies affecting economic development, climate change risk exposure, etc.
 - Lack of climate change policies
 - Limited infrastructure (grey, green, institutional) for resilience, response, preparedness and aid
 - Economic, political, technological, vulnerability
 - Direct exposure of rural livelihoods to climate shocks



Non-environmental underlying reasons

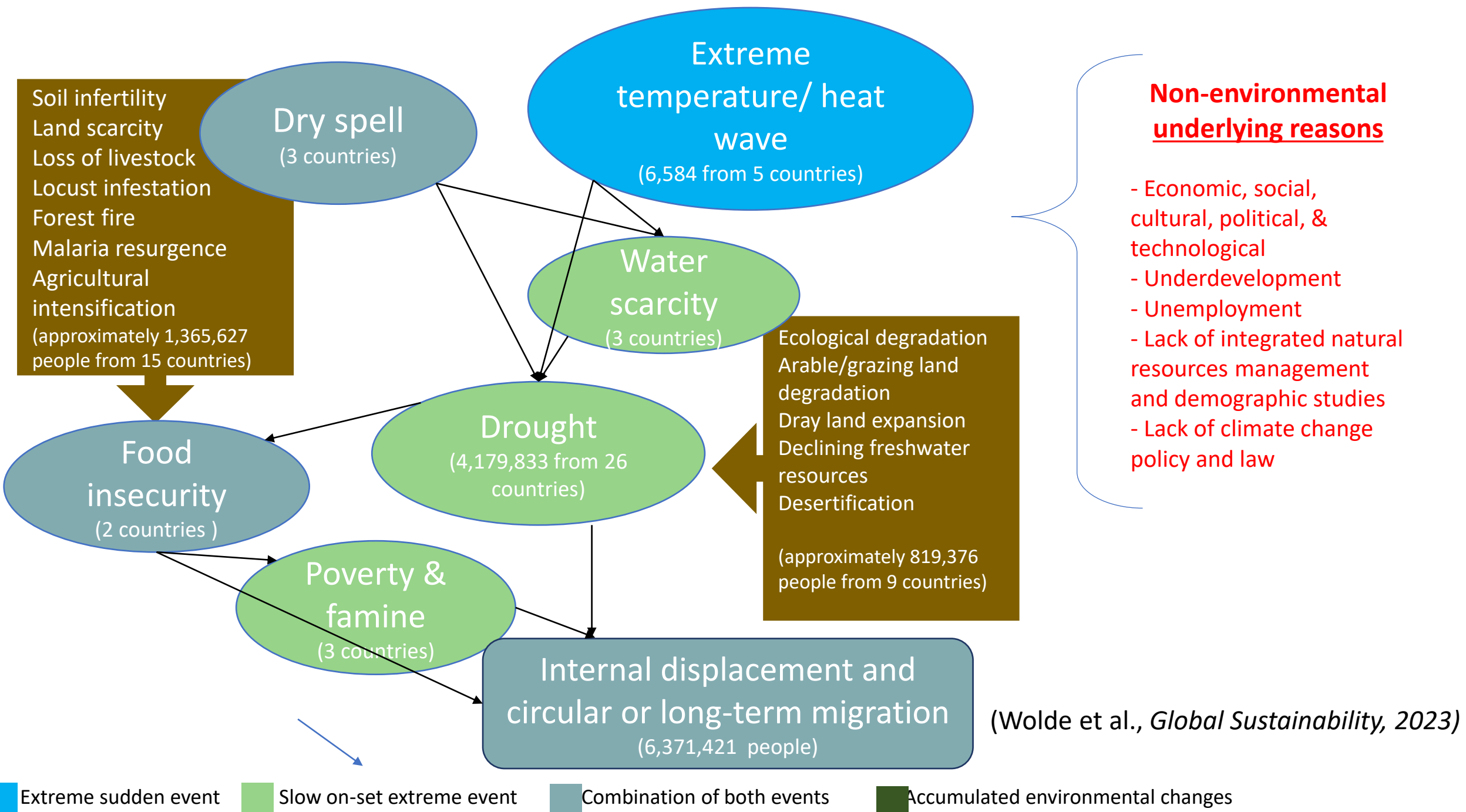
- Poorly constructed infrastructures
- Underdevelopment
- Lack of preparedness
- Economic, political, technological, and corruption
- Threat to livelihood
- Lack of climate change policy and law

(Wolde et al., *Global Sustainability*, 2023)

Extreme sudden event

Slow on-set extreme event

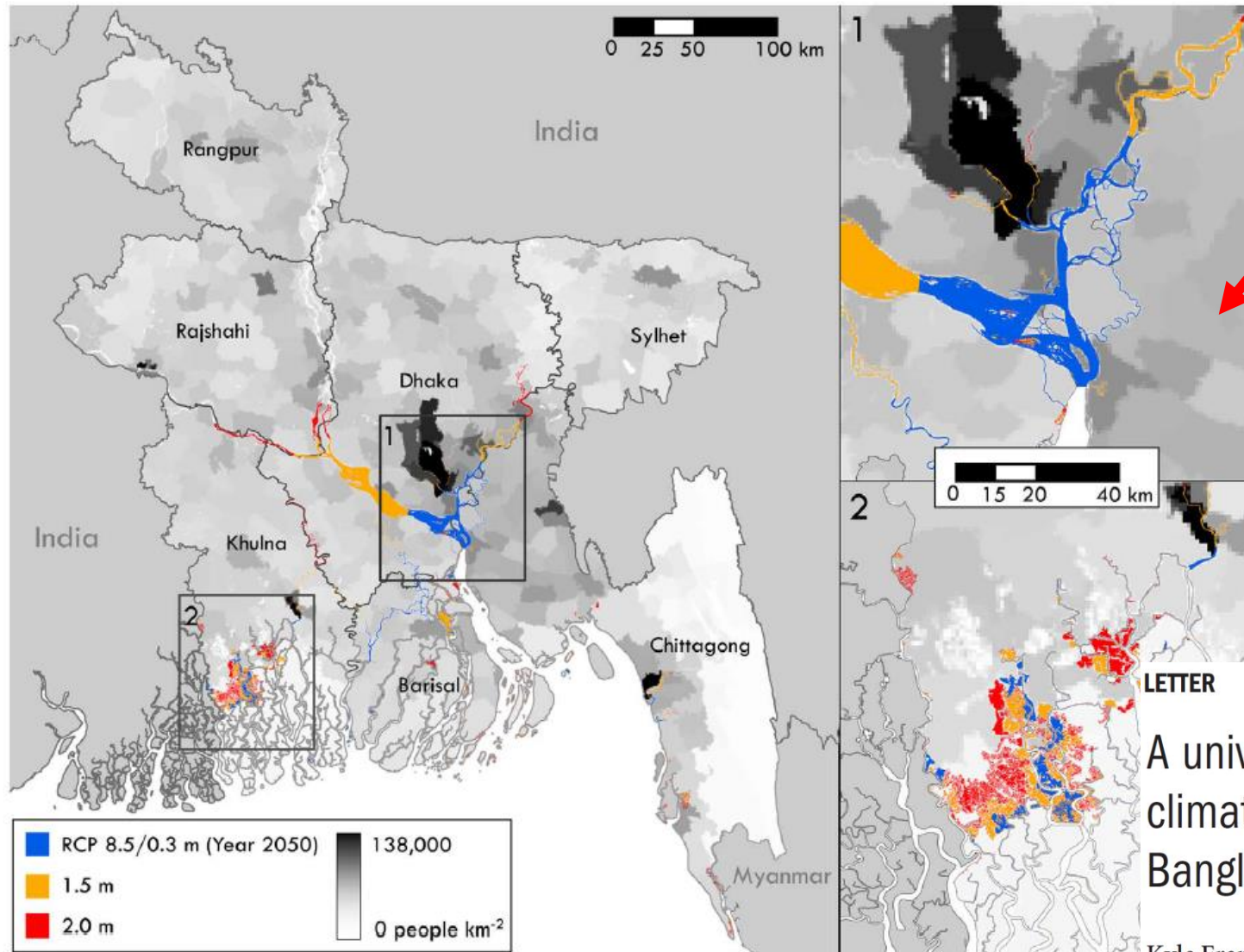
Combination of both events



Modeling environmental migrations/displacement

- The triggering of migration/displacement
 - assessing the causal link between environmental factors and migration
 - what sets people on the move?
- Where will these people go?
 - Radiation Models (Simini et al., *Nature*, 2012): An alternative parameter-free approach to gravitational models simulates push-pull factors based only on the spatial distribution of population.
 - Simini et al. (2012) did not consider that some regions are more likely to “emit” people and others to receive them because of different climate change exposure.
 - Davis et al. (2018) accounted for this effects and applied it to sealevel rise in Bangladesh

Environmental Migrations in Bangladesh under sea level rise



Areas prone to inundation according to various scenarios

Environ. Res. Lett. 13 (2018) 064030

A universal model for predicting human migration under climate change: examining future sea level rise in Bangladesh

Kyle Frankel Davis^{1,2,6}, Abinash Bhattachan³, Paolo D'Odorico⁴ and Samir Suweis⁵

Net migration under sea level rise. Difference between # arriving and departing migrants

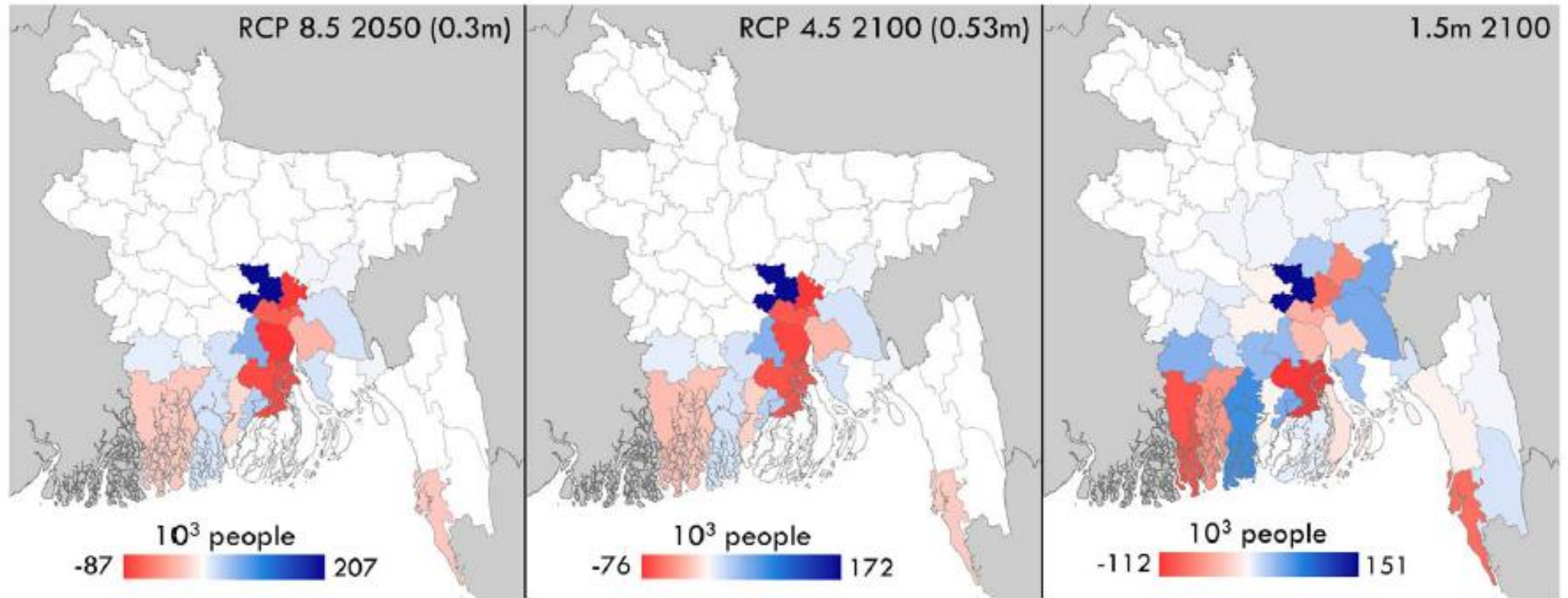
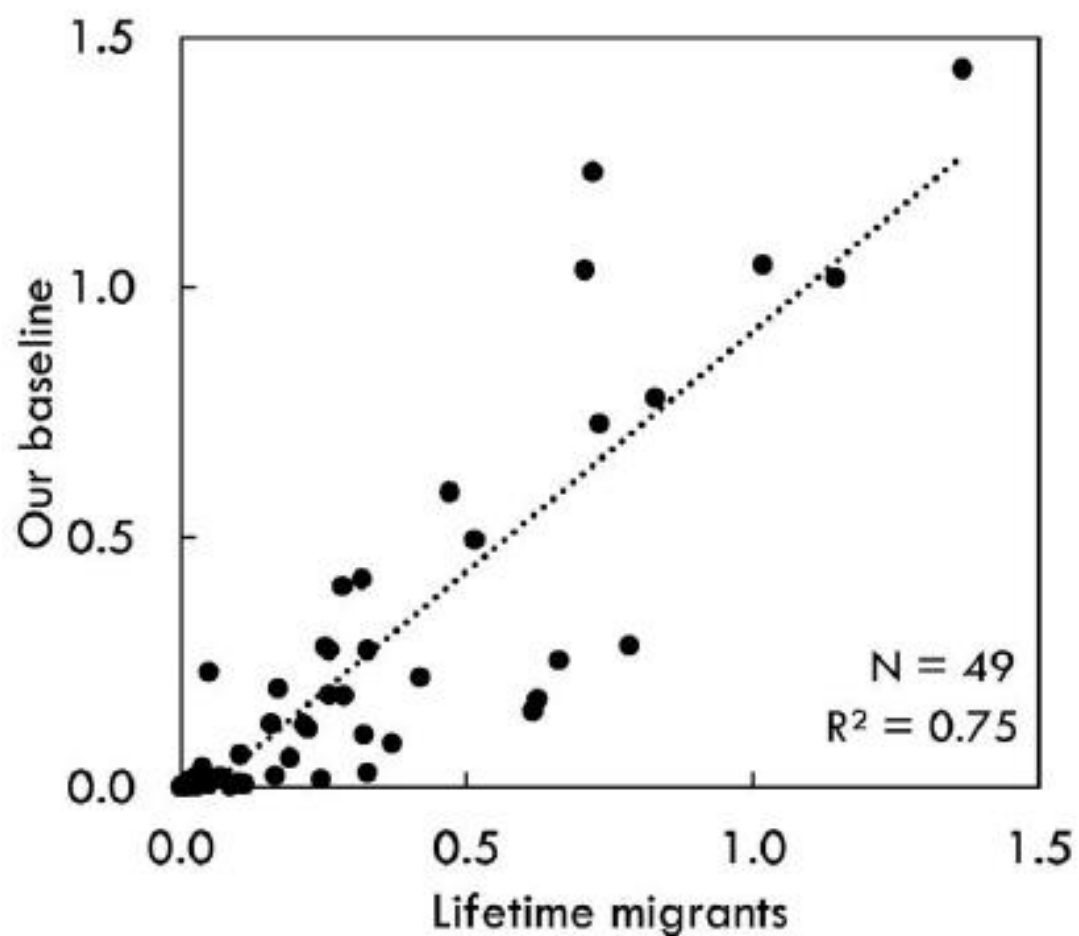


Figure 4. Net migration under sea level rise. Maps show the difference between arriving migrants and departing migrants.

Division-level validation of the model

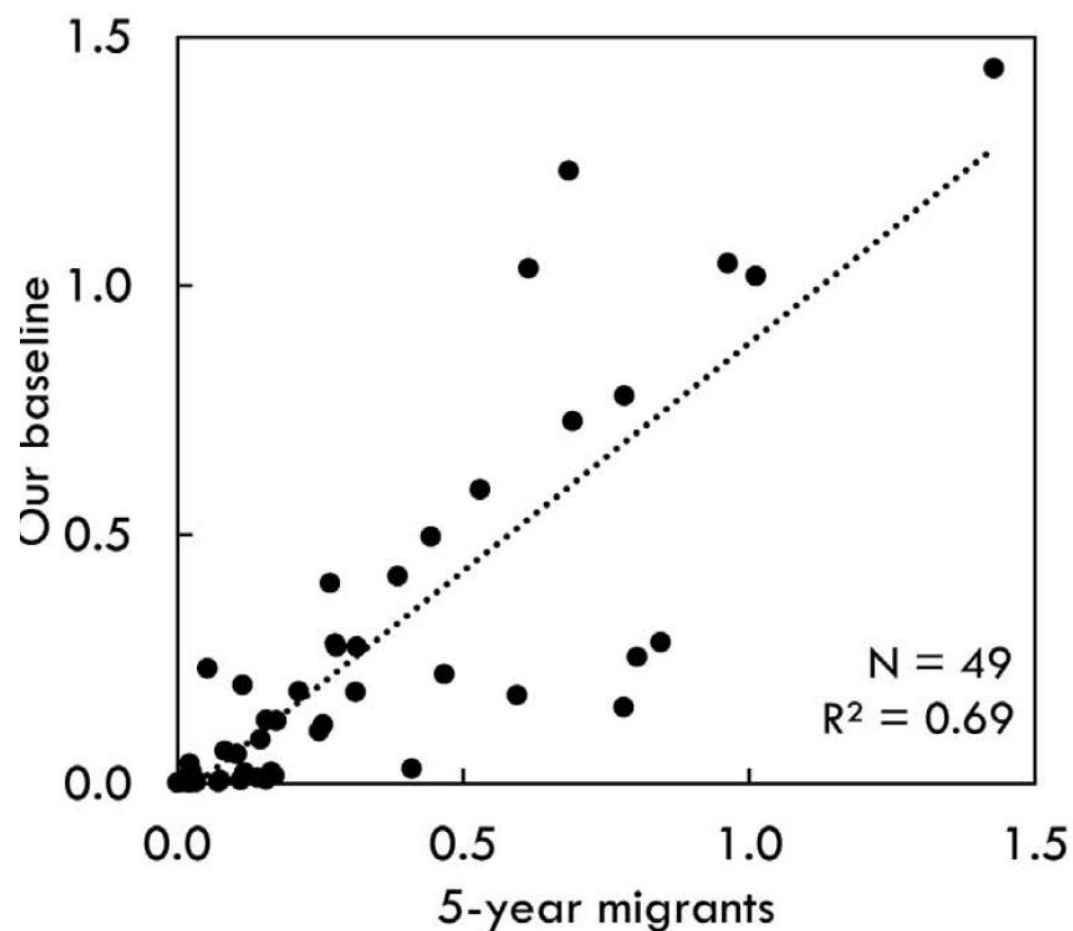


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CONCLUSIONS

- The nexus between migration and environmental drivers is complex
- Its modeling is needs to account for the different pathways through which heavy rain/flooding and drought/water scarcity can induce migrations/human displacement
- Where do migrants go? The radiation model, modified to account for stronger propension for some environmentally challenged regions to 'emit' (i.e., lose) people