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Climate change, desertification and internal migration: Evidence from global census data

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The Vienna Institute for International Economic Studies (WIIW)

Research Centre International Economics (FIW)

Outline

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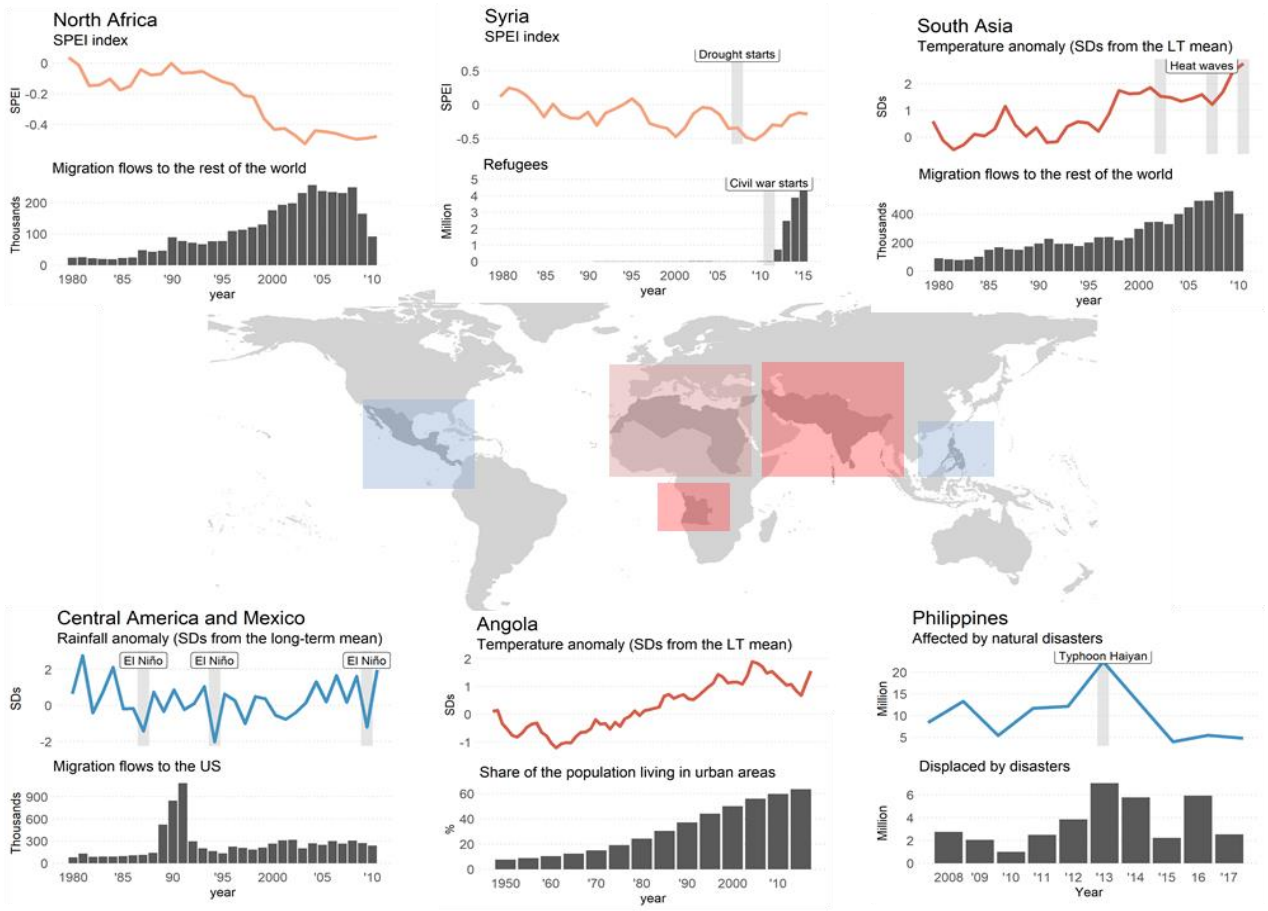
1. Introduction
2. Conceptual framework and background
3. Research design and methods
4. Results
5. Conclusion and discussion

1. Introduction

Environmental change and mobiliity



In many regions of the world, changes in environmental and climatic conditions are linked to migration dynamics and human mobility

Strength and direction of the relationship depend on local conditions and type and intensity of the experienced environmental influences

Source: Hoffmann et al. (2020), Nature Climate Change

Motivation

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- Environmental change and **hazards can be an important migration driver**, depending on local conditions (Hunter et al. 2015)
- **Challenges in previous empirical research**
  - Dearth of data on internal migration. Focus mostly on urbanization
  - Limited comparative longitudinal data
  - Research mostly focused on short-term events and anomalies. Limited evidence on the impact of gradual processes of environmental change
- **Desertification and land degradation** as two global issues of increasing relevance, yet limited understanding of their impacts on migration (Wiederkehr 2018)

Aims and contribution

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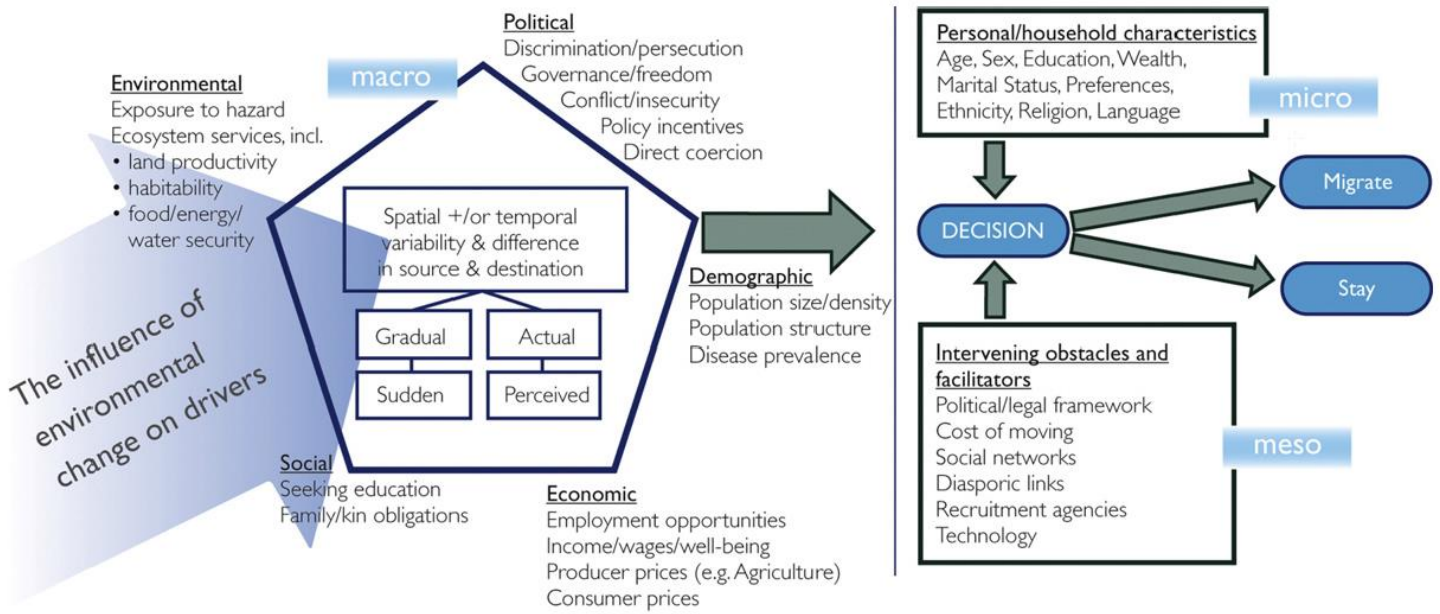
- Estimating the **impact of gradual desertification processes on internal migration** flows worldwide
- **Using novel data source on bilateral internal migration flows** from 68 countries based on harmonized IPUMS International census data
- **Exploring mechanisms and differences across contexts** to understand who migrates, under which conditions, and to which locations

Approach closely related to Garcia et al. 2015: “Modeling internal migration flows in sub-Saharan Africa using census microdata”, Migration Studies

2. Conceptual framework and background

Conceptual framework

Various individual and contextual factors influence migration decisions, outcomes and related risks. Migration is embedded in social processes and closely related to other population dynamics



Source: Black et al (2011), Global Environmental Change

Previous research

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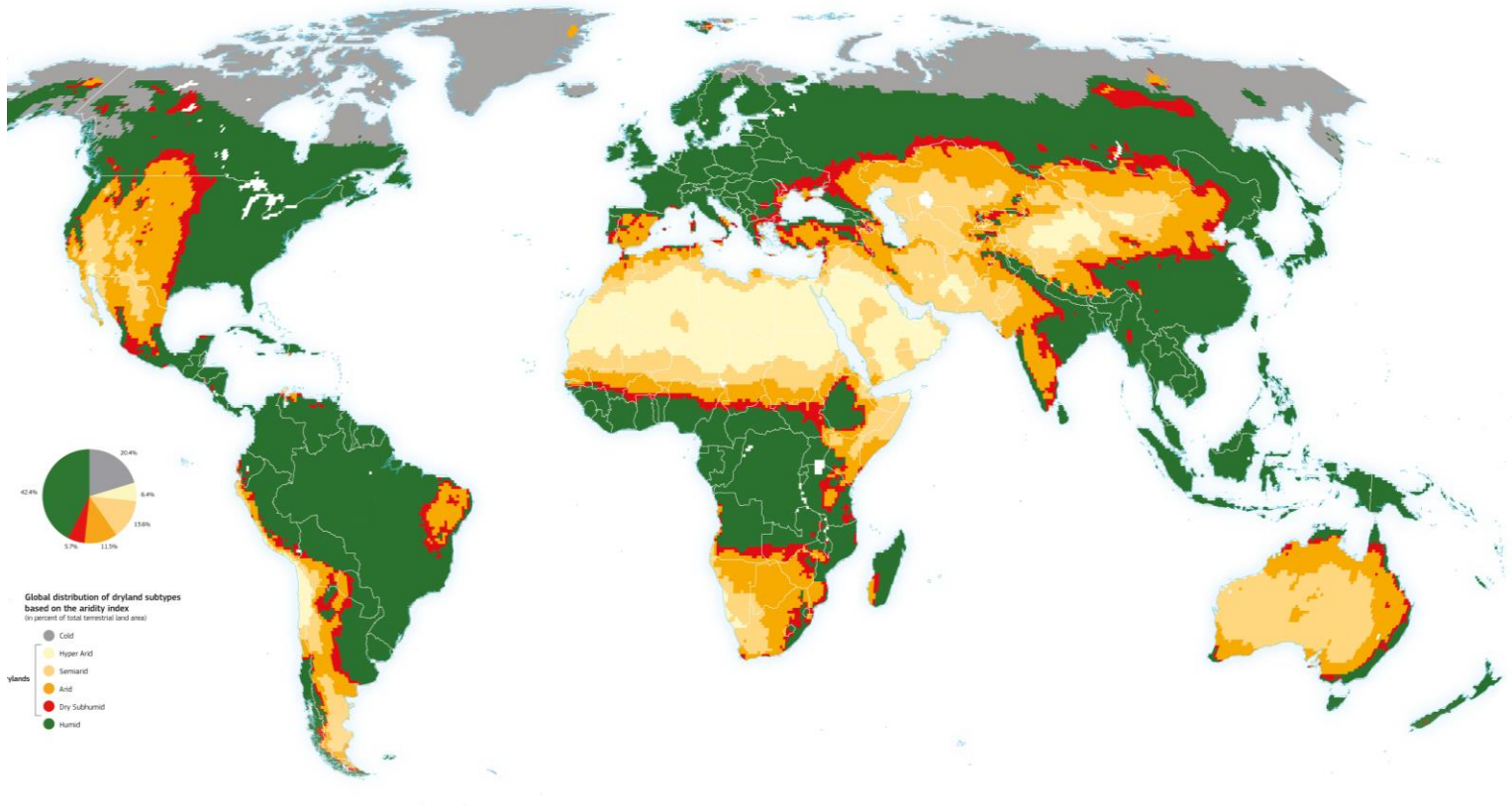
- A number of **case studies** estimate the impact of climatic changes and anomalies on internal migration, e.g., in South Africa (Mastrorillo et a. 2016), the US (Feng et al. 2012), Bangladesh (Hassani-Mahmooei & Parris 2012) and the Philippines (Bohra-Mishra et al 2017)
- Also, **evidence at the regional level**, e.g., on urbanization processes in Africa (Barrios et al 2006, Brückner 2012, Marchiori et al. 2012, 2017)
- Research shows strong but **differentiated links** between climate and internal migration/urbanization. Importance of understanding mechanisms and moderating factors
  - Increased internal migration in **middle-income contexts** (Peri & Sasahara 2019, Cattaneo & Peri 2016) and origin areas with medium-level of adaptive capacity (Niva et al. 2021)
  - Urban migration only if rural areas in proximity to cities with **manufacturing** (Henderson et al 2017)
  - **Migration chains**: Climatic anomalies increase internal migration, which in turn influences international migration flows (Marchiori et al. 2012, 2017)

Desertification and land degradation



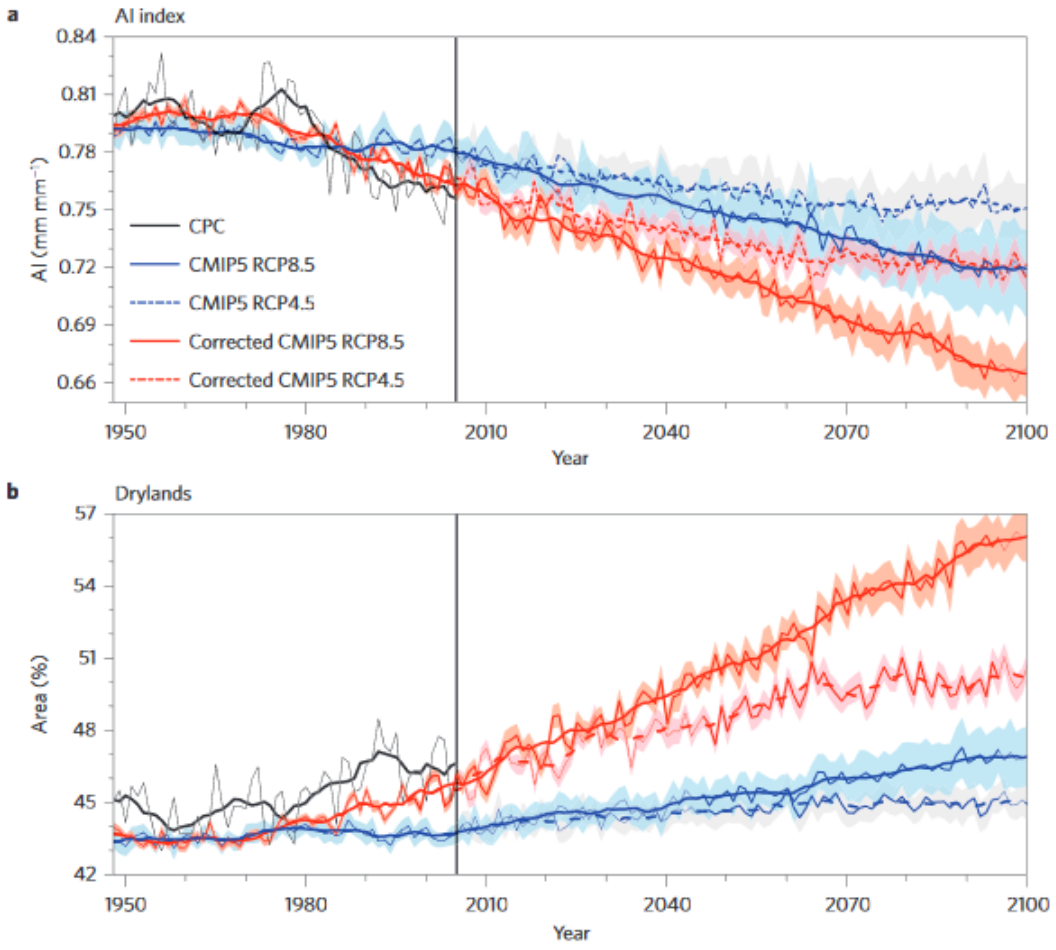
Desertification is land degradation in arid, semi-arid, and dry sub-humid areas (drylands)

Drylands comprise more than **40% of the global terrestrial area** and are home to around 3 billion people or one third of the global population

Ecosystems characterized by high temporal and spatial **rainfall variability and aridity**

Source: World Atlas of Desertification, https://wad.jrc.ec.europa.eu/patternsaridity

Projections of climate impacts



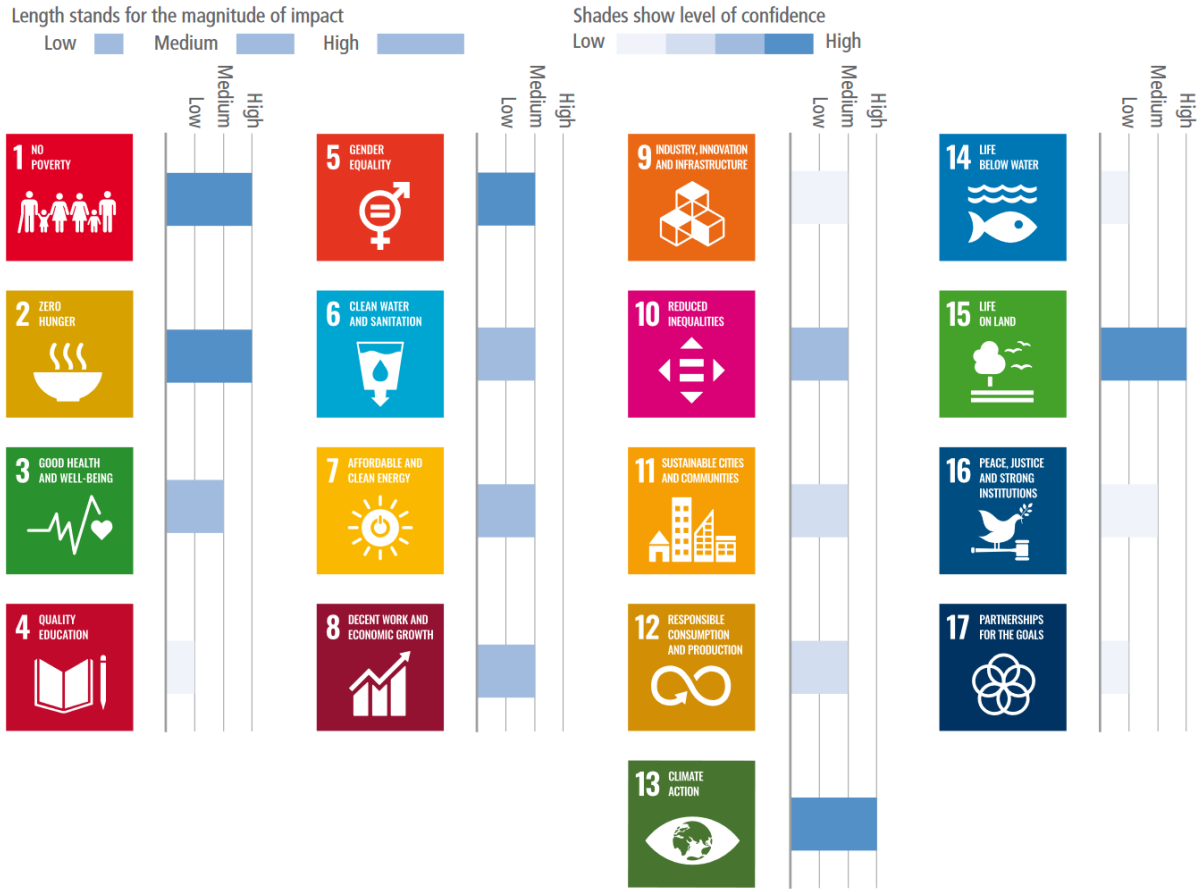
Climate change is expected to have **major impacts on drylands**, potentially contributing to their further expansion (together with human factors)

Drylands are projected to increase by 11% and 23% by the end of the twenty-first century under a moderate (RCP 4.5) and high (RCP8.5) scenario of climate change

See also: Berg & McColl 2021, "No projected global drylands expansion under greenhouse warming", Nature

Source: Huang et al. (2015), Nature Climate Change

Potential socioeconomic impacts



Severe socioeconomic impacts of desertification expected under future climate change (IPCC 2019)

High impacts expected on **food security, poverty, and and biodiversity** (all with high confidence)

Socioeconomic changes can influence migration as an indirect channel (Thalheimer et al. 2021)

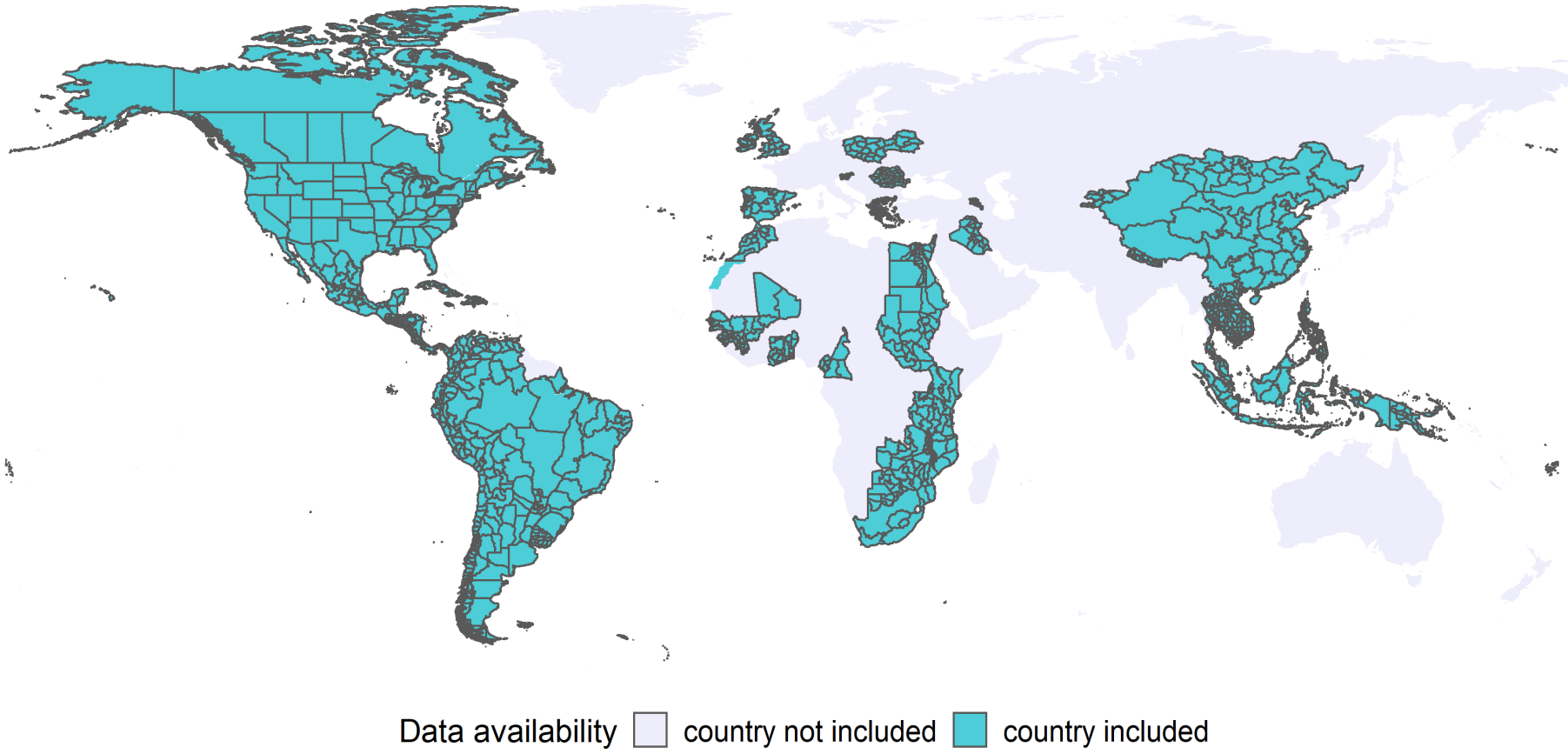
Source: IPCC (2019), Special Report on Climate Change and Land

3. Research design and methods

Data

- **IPUMS International** as primary data source providing harmonized census data from more than 100 countries worldwide
- **Construction of migration measure**:
  - Information on subnational region of residence
  - Census question: Which region did you live in 1/5 years ago?
  - How many people have migrated from region A to B in past 1/5 years?
- **Unit of analysis**: Geo1 census regions over time. In total, 68 countries, 188 censuses, 1284 regions, ~98000 bilateral migration flows
- **Climate data** on desertification trends from CGIAR, the Copernicus Programme, and CRU

Regional sample



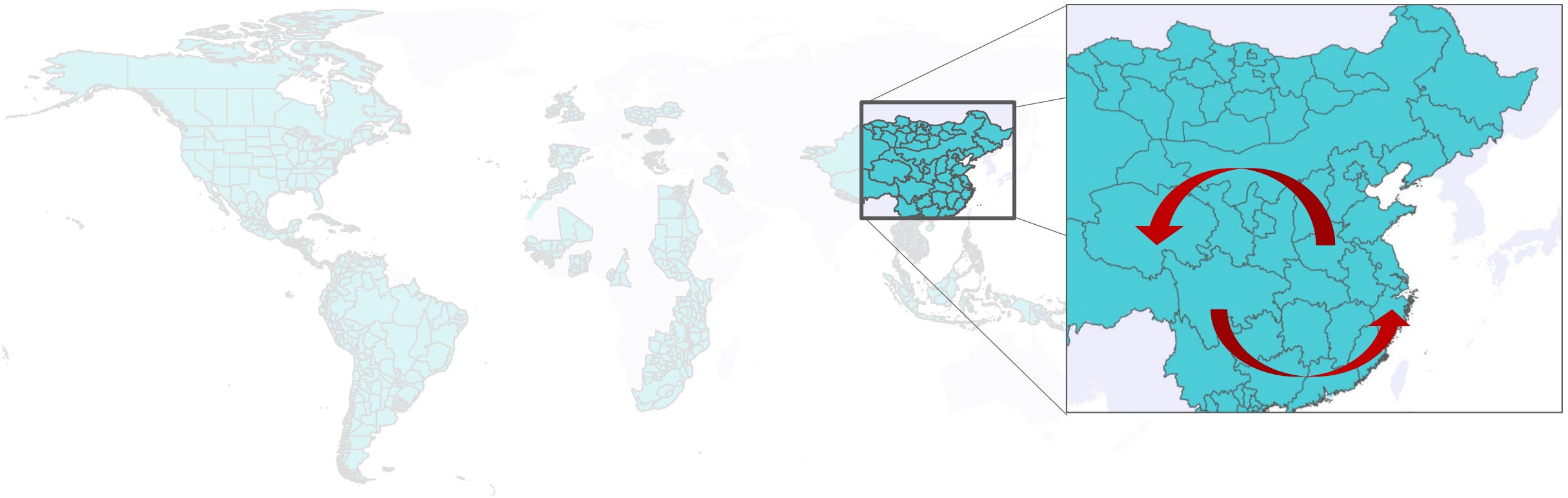
1284 Geo1 census regions

68 countries

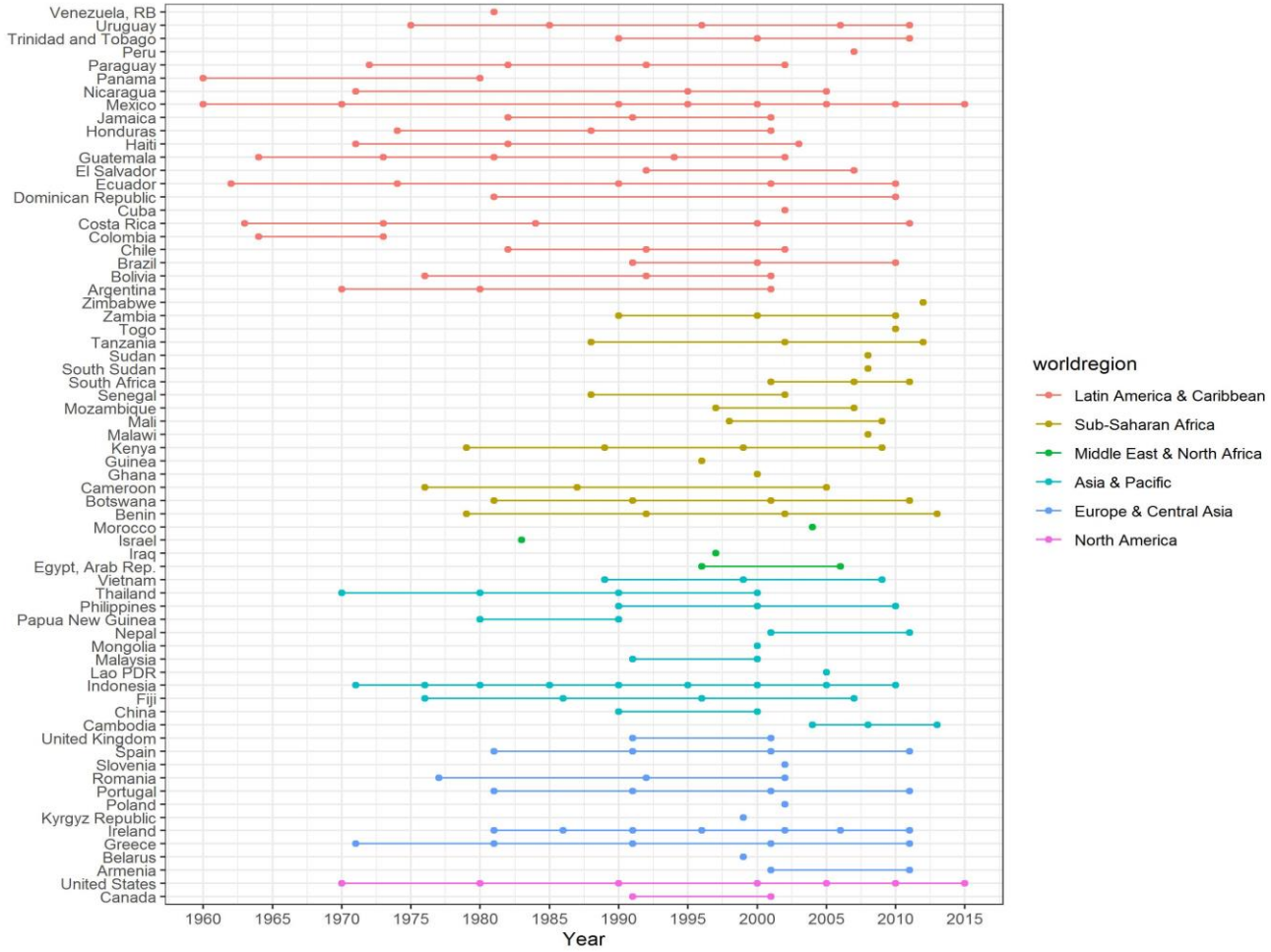
188 censuses

~98000 bilateral flows

Regional sample



Data availability over time



Census data available
from 1960 to 2015
Unbalanced time series

Measurement

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- **Outcome:** Annual out-migration rate
- **Input:**
  - Aridity Index (AI), average past 5 years
  - Normalized Density Vegetation Index (NDVI), average past 5 y
  - Standardised Precipitation Evapotranspiration Index (SPEI), average past 5 y
- **Controls:**
  - Population size (origin and destination)
  - Census interval for migration measurement (1 vs 5 years)
  - Number of regions

Poisson fixed effects estimation (PPML)

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$$ln\left(\frac{N_{ij,t}}{N_{ii,t}}\right) = \beta C_{it} + \theta C_{jt} + \gamma Z_{ij,t} + \alpha_i + \delta_j + \theta_t + \varepsilon_{\mathrm{ij},t}$$

$\frac{N_{ij,t}}{N_{ii,t}}$: Annual outmigration rate (relative to origin population)

C_{it}: Climatic conditions in origin in past 5 years (standardized)

$C_{\mathrm{j}t}$: Climatic conditions in destination in past 5 years (standardized)

$Z_{ij,t}$: Further census specific controls

α_i: Origin fixed effects

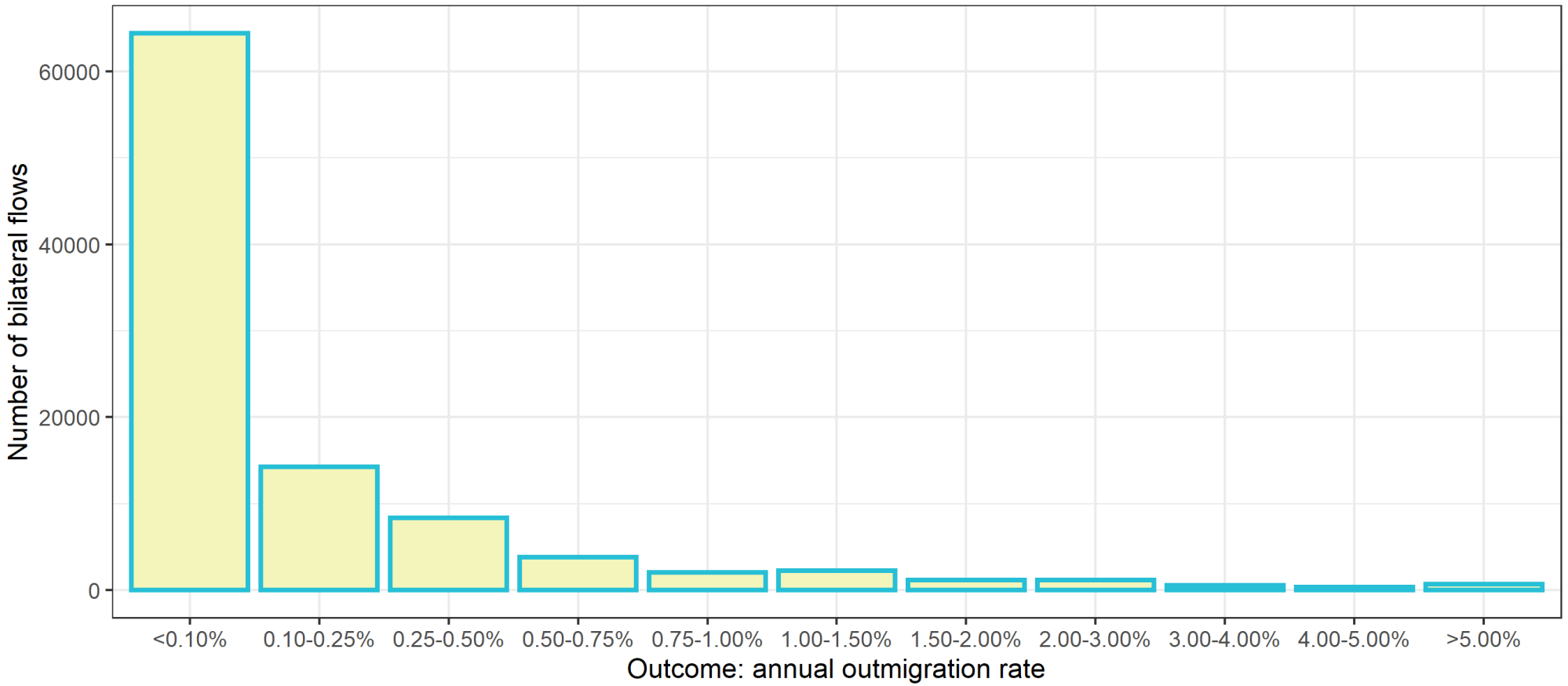
δ_j: Destination fixed effects

θ_t: Time period effects (5 year intervals)

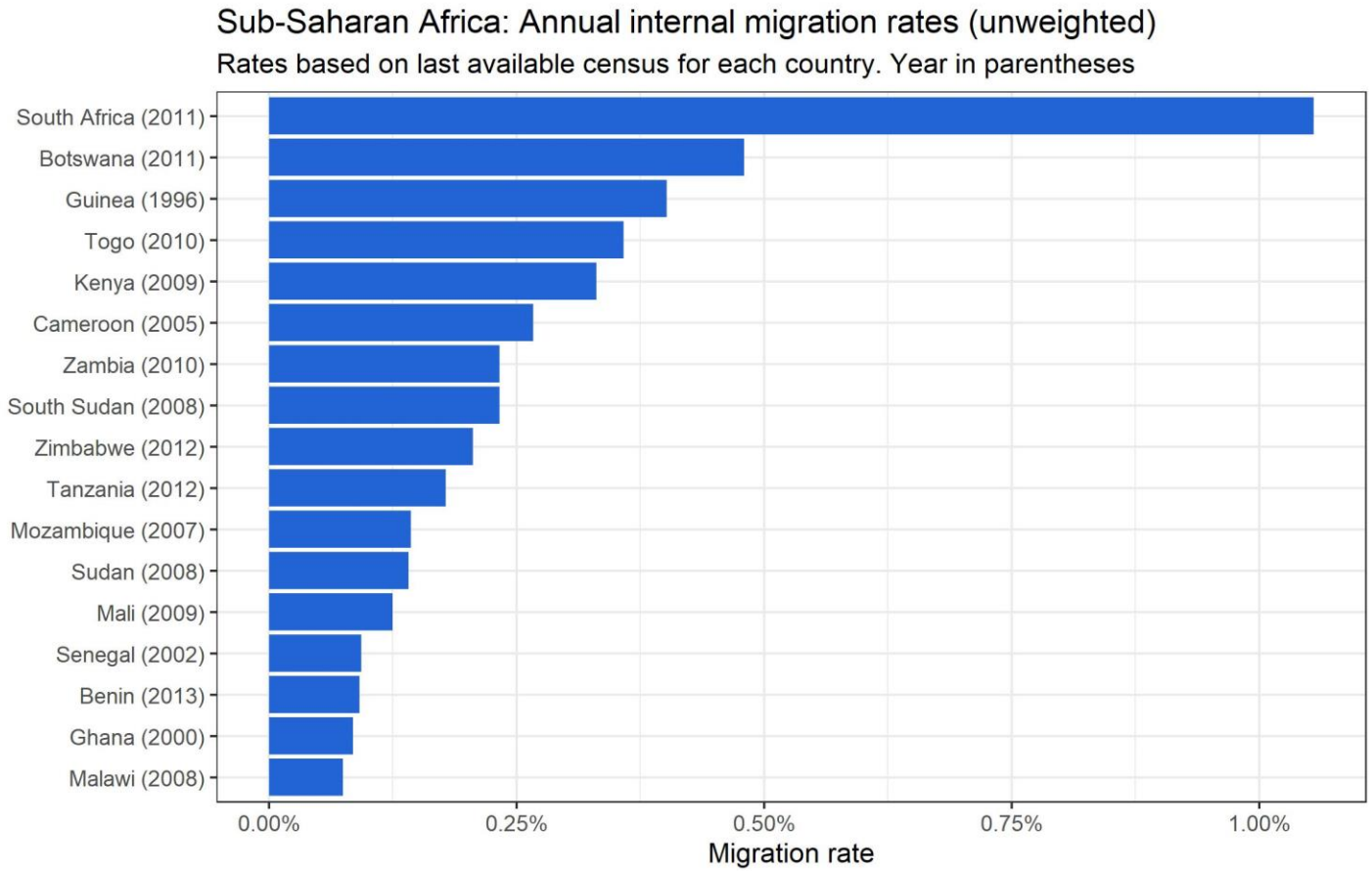
$\varepsilon_{\mathrm{ij},t}$: Random error term

4. Results

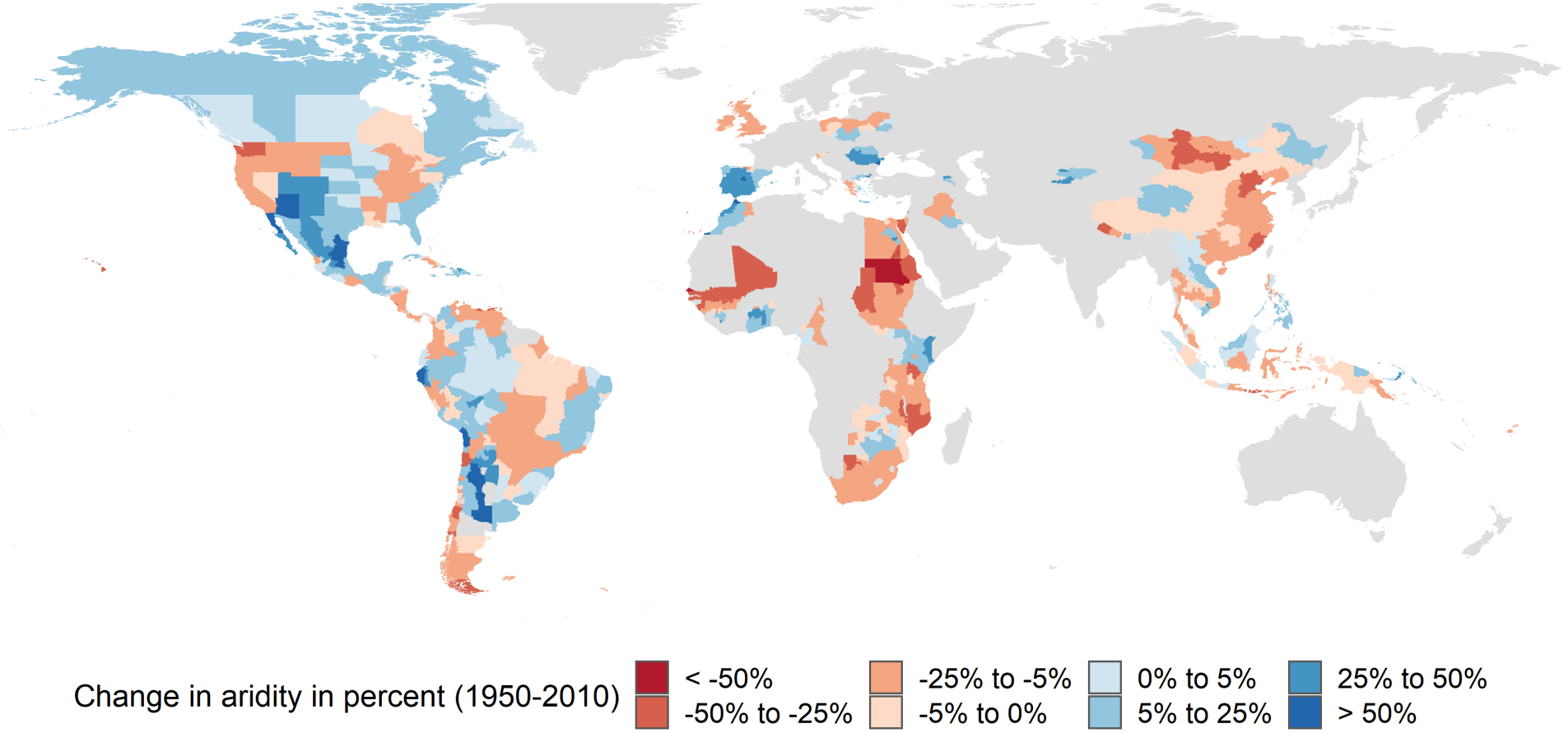
Internal migration rates



Example: Sub-Saharan Africa



Desertification trends



Baseline PPML models

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	Outcome: Annual out-migration rate			
	(1)	(2)	(3)	(4)
AI (mean past 10y)		-0.2245*** (0.0627)		
NDVI (mean past 10y)			-0.0966*** (0.0258)	
SPEI (mean past 10y)				-0.0334*** (0.0111)
log(population origin)	-0.8452*** (0.0706)	-0.7934*** (0.0666)	-0.5415*** (0.0613)	-0.7869*** (0.0615)
log(population destin)	0.1872*** (0.0590)	0.1138** (0.0537)	-0.3080*** (0.0585)	0.1237** (0.0508)
census interval	-0.1152*** (0.0094)	-0.1112*** (0.0100)	-0.2210*** (0.0150)	-0.1101*** (0.0096)
# origin regions	-0.0002 (0.0022)	-0.0103*** (0.0022)	0.0103** (0.0041)	-0.0099*** (0.0021)
Time FE	Yes	Yes	Yes	Yes
Origin FE	Yes	Yes	Yes	Yes
Destination FE	Yes	Yes	Yes	Yes
S.E.: Clustered	by: origin	by: origin	by: origin	by: origin
Observations	98,868	95,276	42,563	98,850
Pseudo R2	0.20017	0.16484	0.17398	0.16381
BIC	32,415.70	31,511.60	22,479.20	32,414.60

Poisson Fixed effects models. Coefficients in cells with clustered standard errors in parentheses. *** p< 0.01, ** p<0.05, * p<0.01

Robustness checks

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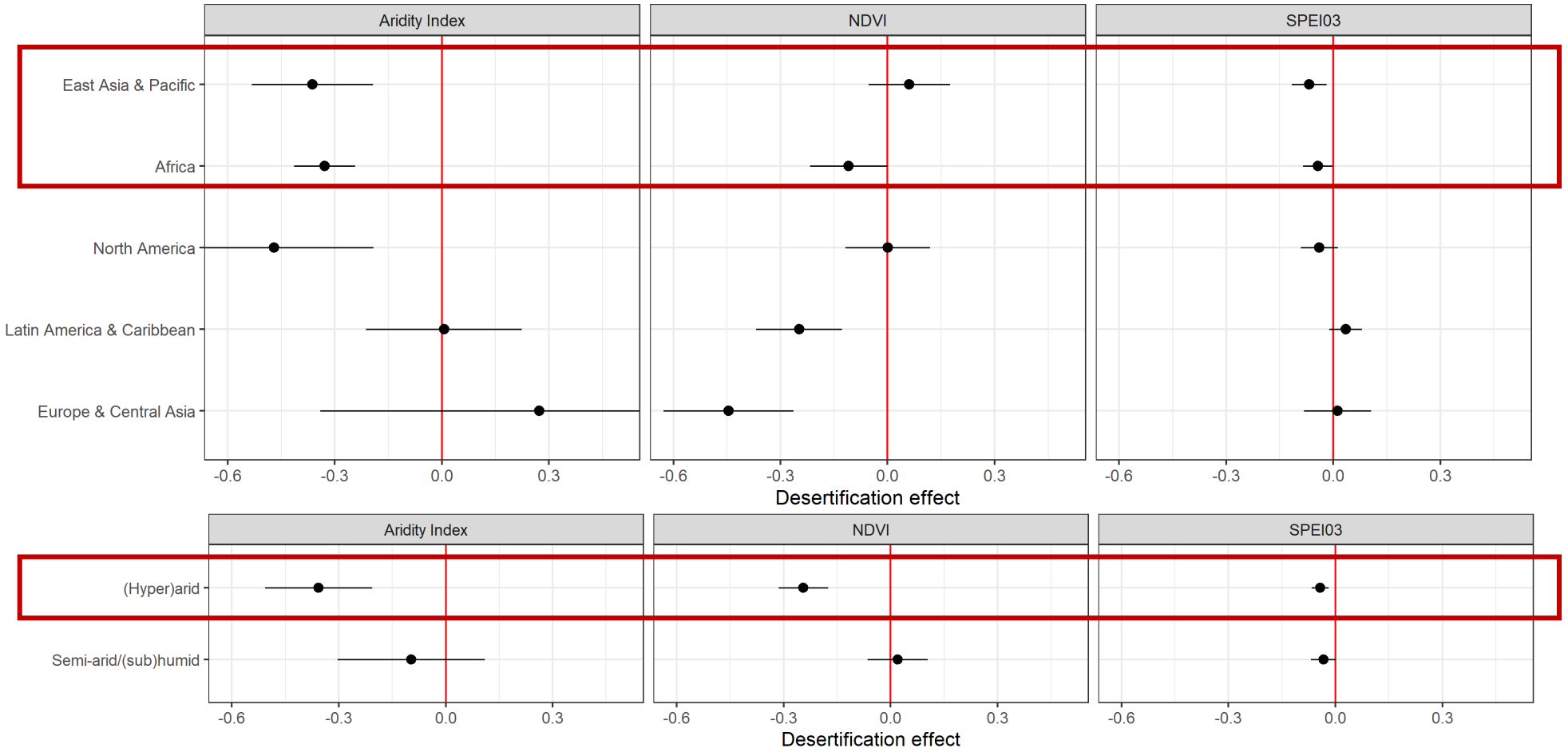
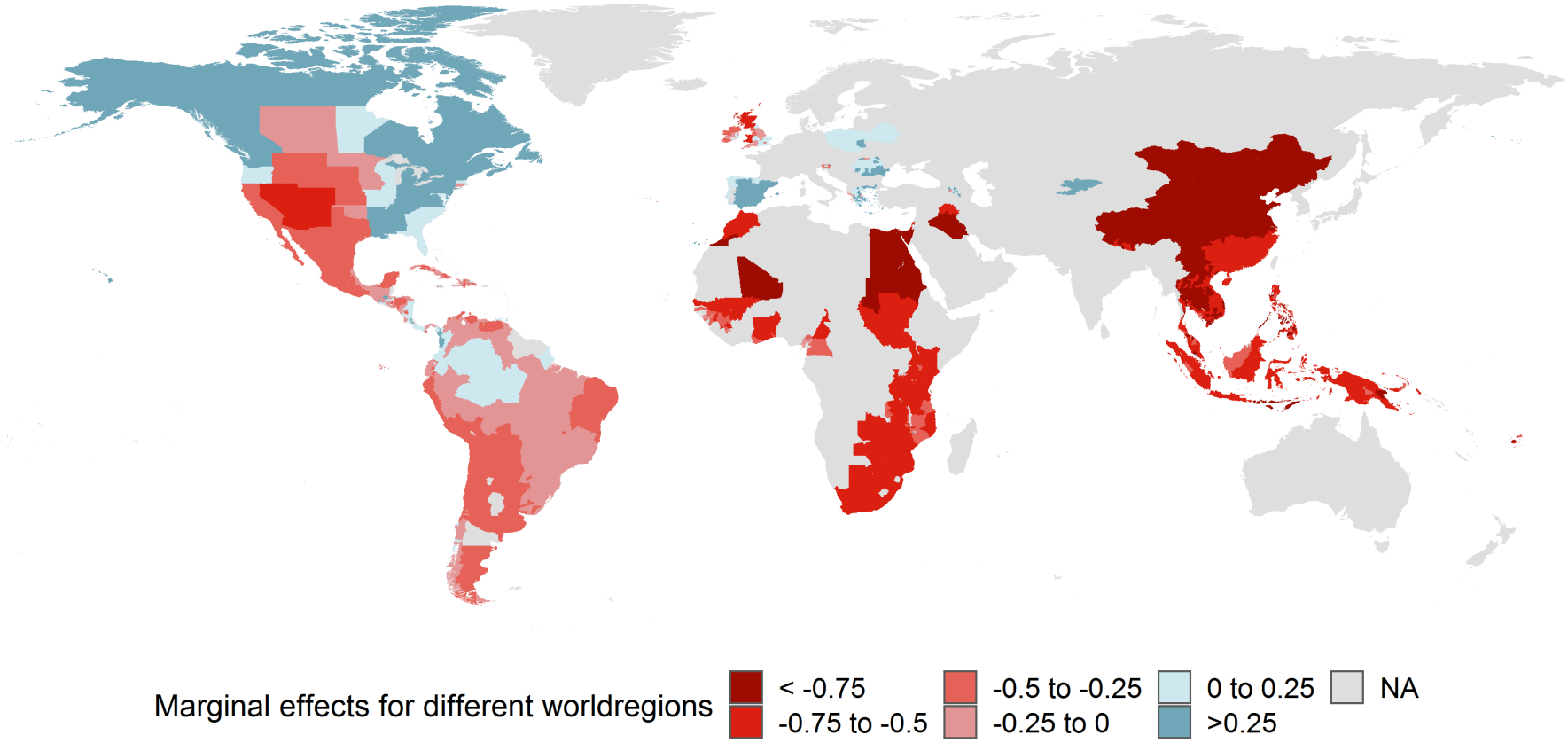
- Different weighting schemes
- Different climate reference periods
- Net migration rates accounting for inflows
- Controlling for short-term anomalies
- Estimating linear gravity models
- Estimating non-linear relationships
- Estimating long differences

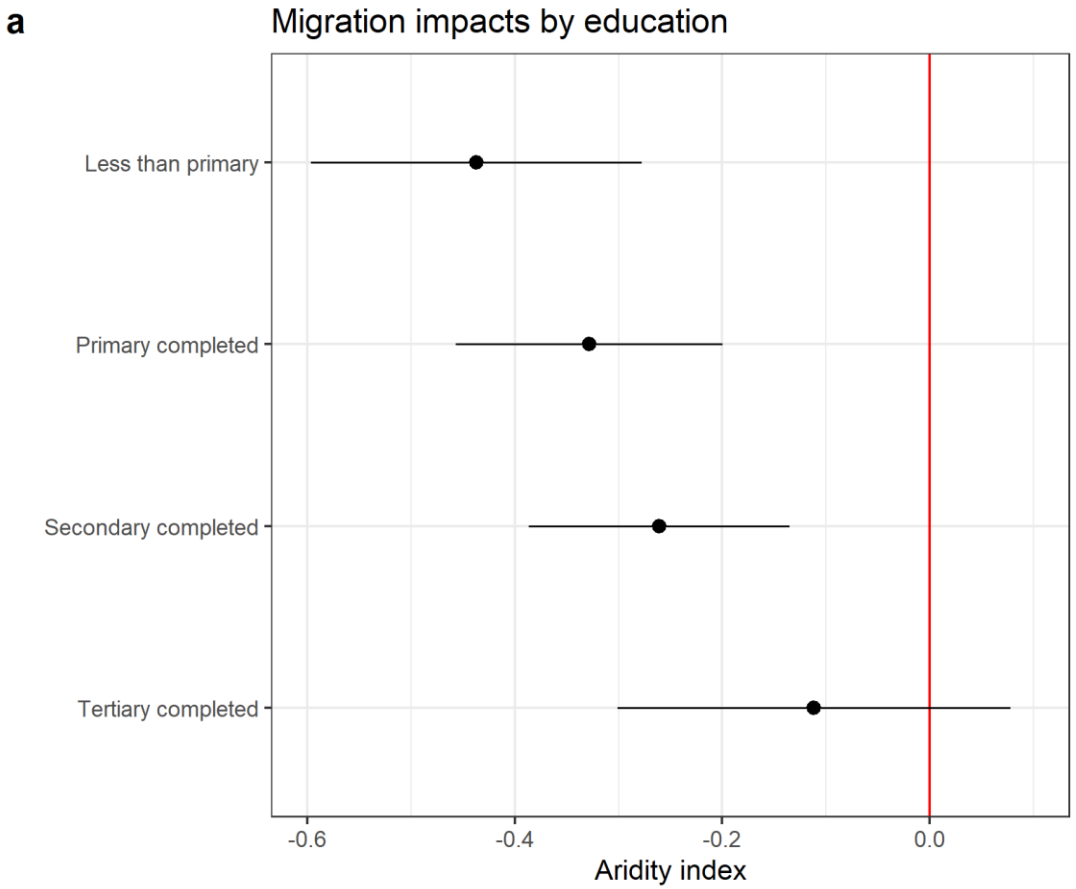
Effect size heterogeneity

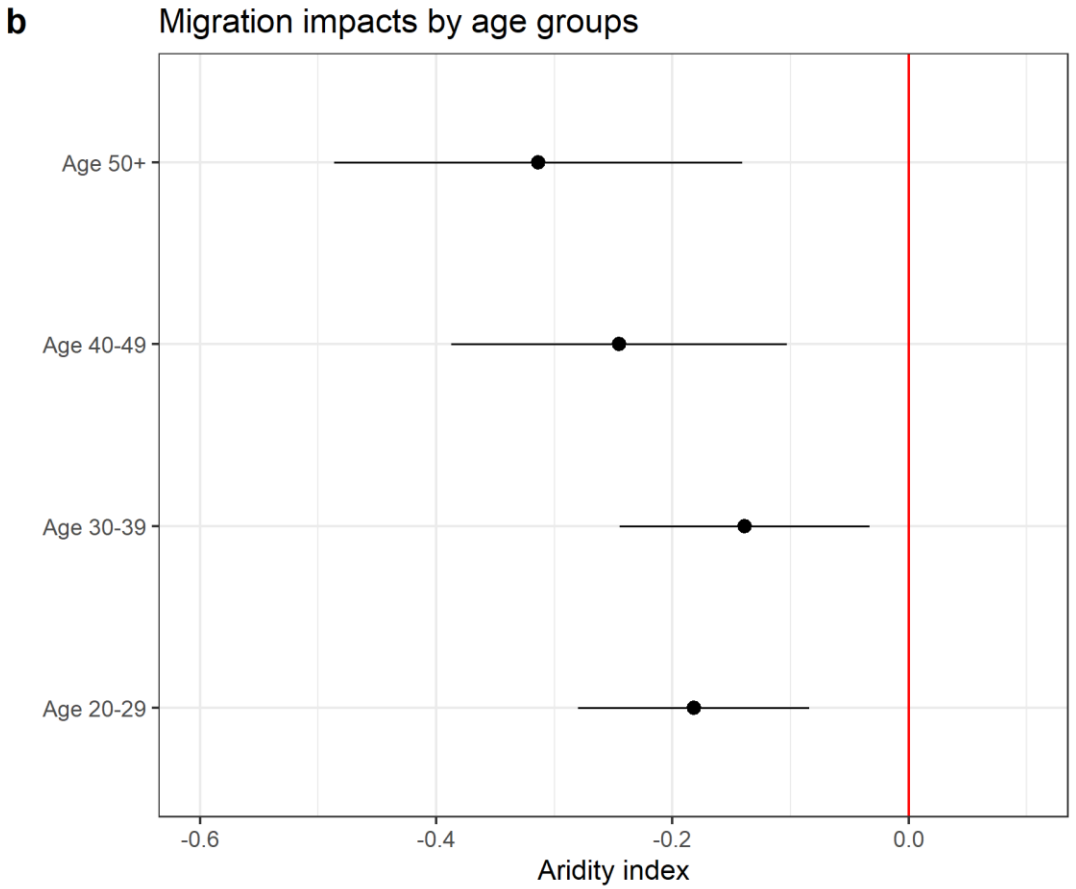


Spatial patterns in relationships

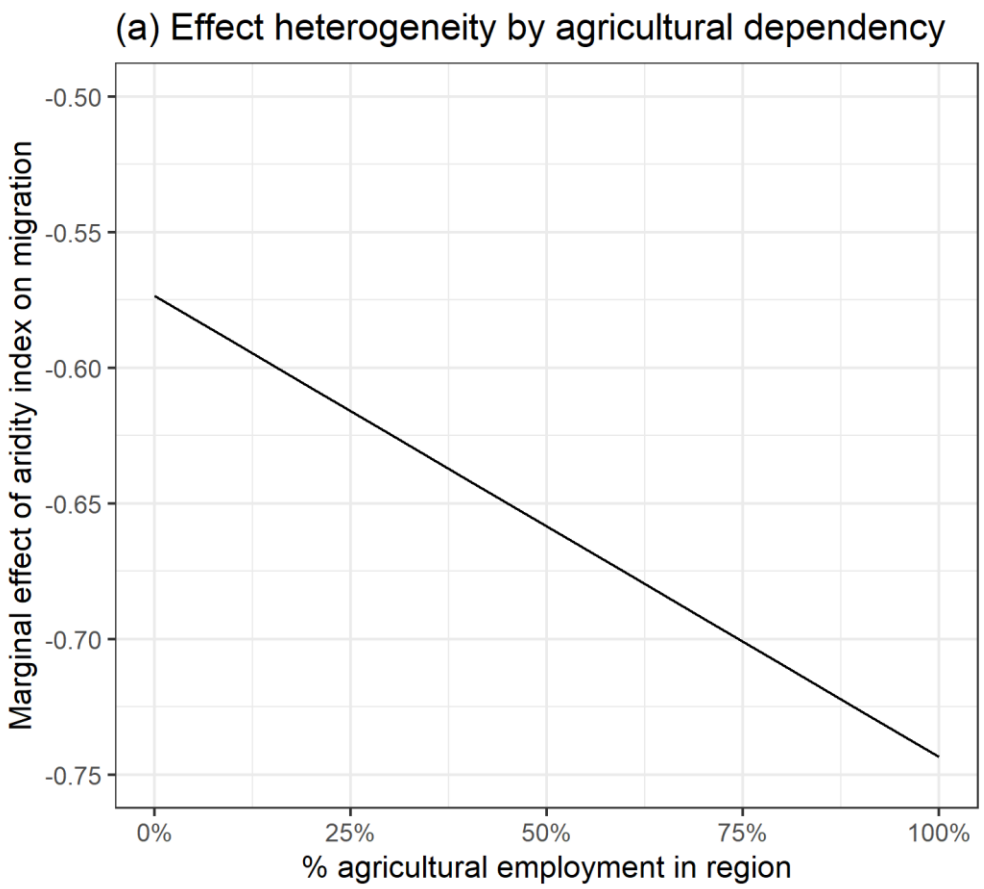


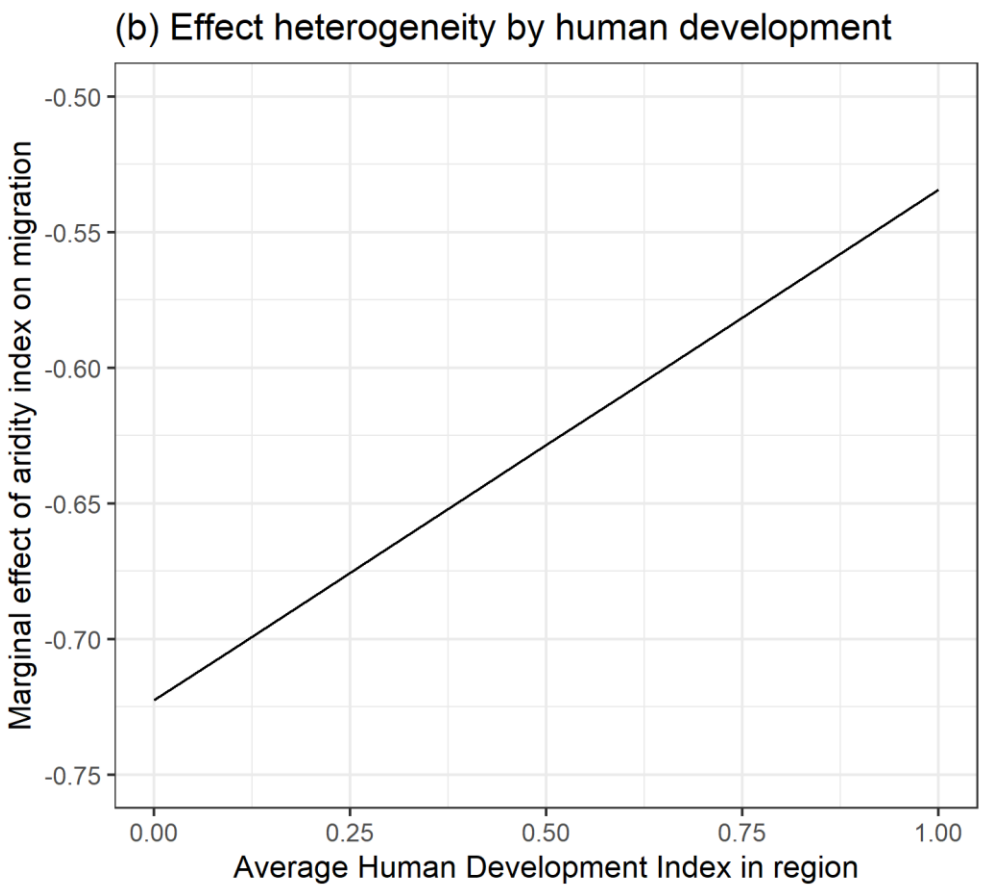
Differential migration impacts





Role of socioeconomic context





Next steps

- Adding further regional background information
- Predictions based on model results
- Differential impacts by multidimensional characteristics of migrants
- Stronger focus on shorter-term events (e.g. precipitation or temperature anomalies)

5. Conclusion and discussion

Conclusion and Discussion

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- Study on impacts of desertification as gradual environmental change on internal migration using novel global data on bilateral internal migration flows
- Findings indicate **meaningful migration impacts**, but also considerable differences across regions depending on environmental and socio-economic conditions
- **Limitations:**
  - Broad migration measure
  - not accounting for circular migration
  - international migration flows not captured
- **More comparative evidence** needed that allows understanding some of the underlying mechanisms of environmental migration

Related work

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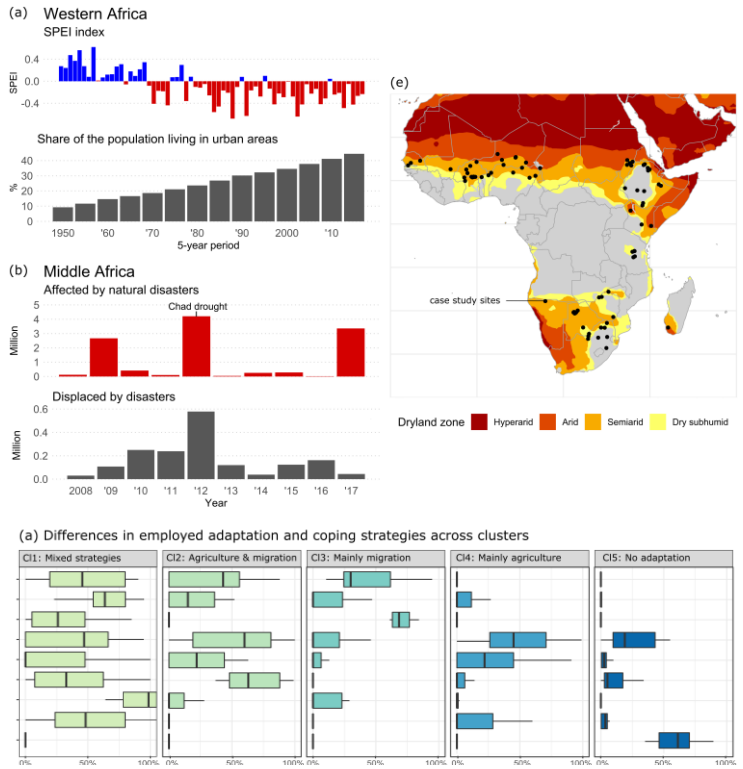
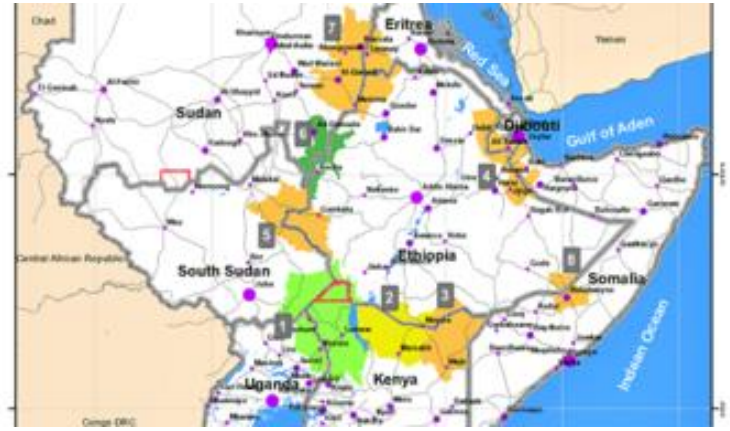
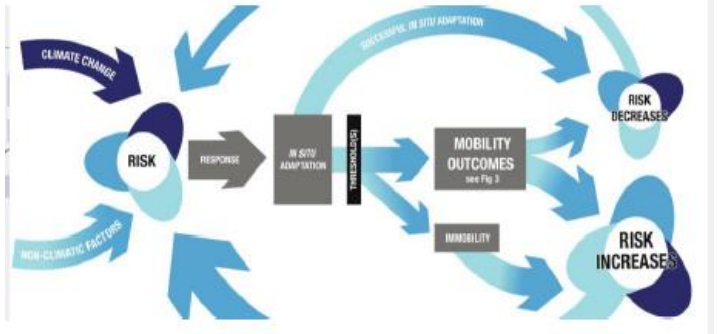
Agricultural livelihoods and migration



Climate migration in Tanzania

GIZ / IGAD Collaboration





Thank you for your attention!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