

Lao People's
Democratic Republic.

Thailand

Cambodia

Vietnam

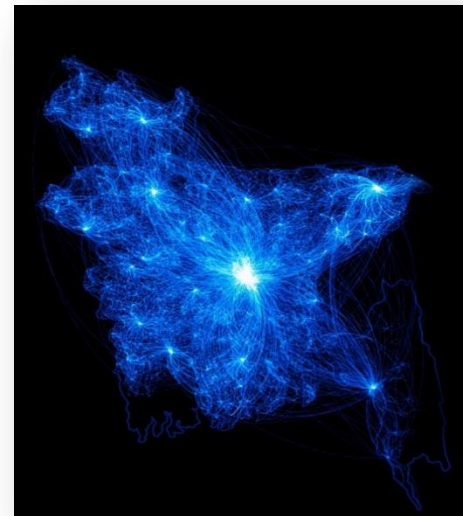
Modelling Subnational Migration Flows in and between Low and Middle Income Countries to Support Health Applications and Policies

**world
pop** 
FLOWMINDER.ORG

Alessandro Sorichetta

Kilometers
0 50 100

- **WorldPop: Research Program** in Dept Geography & Environment focused on methods for **improving the demographic evidence base** in low/middle income countries
- **Flowminder:** Non-profit foundation working with data providers and international/government agencies **to operationalize and scale research** in **support of vulnerable populations** and **sustainable development** in low/middle income countries
- 50+ staff; focus on data science and integration in fields of spatial demography and mobility to support disease, disaster and development applications



Partners and donors



Vodafone Foundation
Mobile for Good

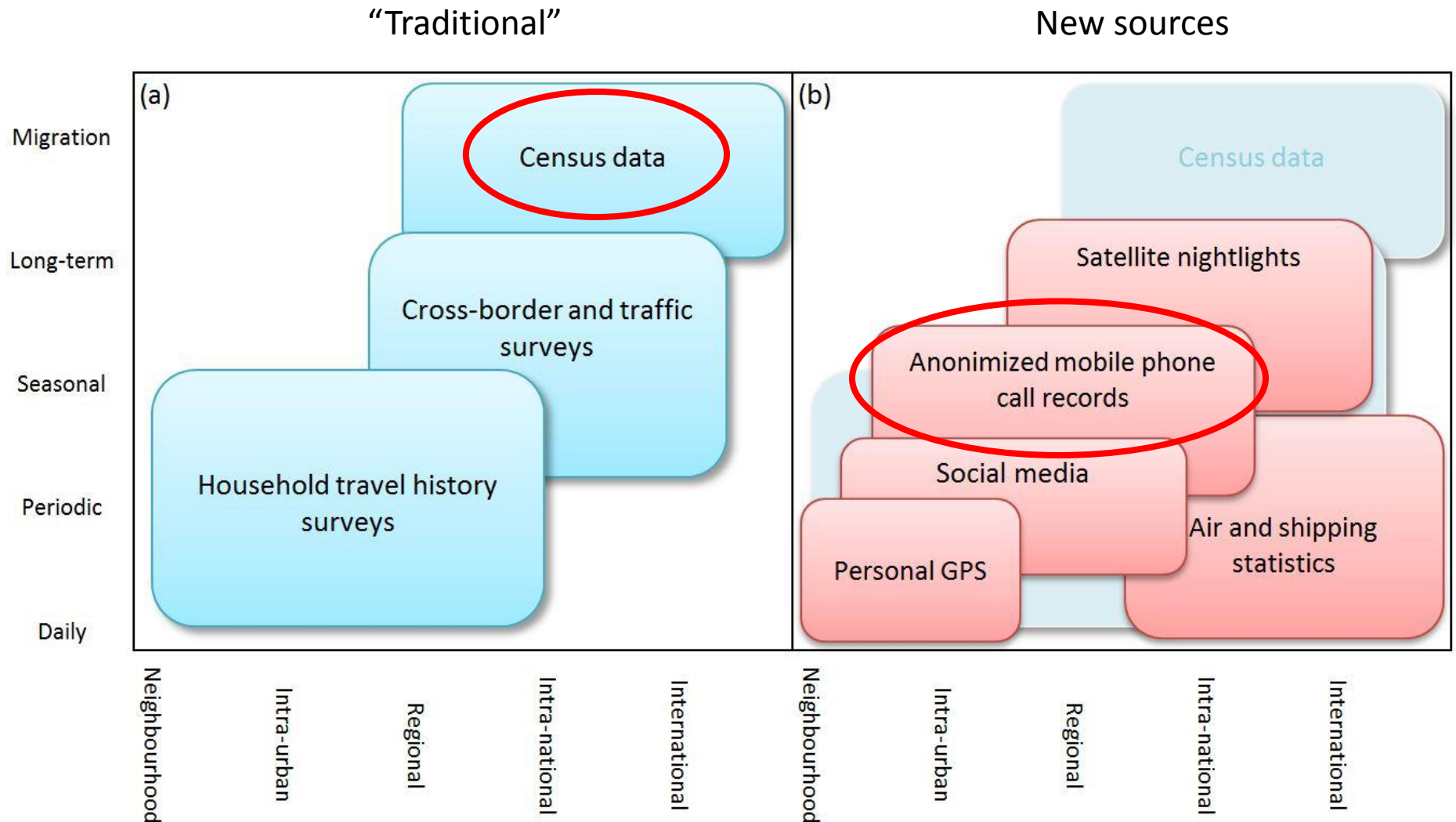


BILL & MELINDA
GATES foundation



Microsoft
Research wellcome trust

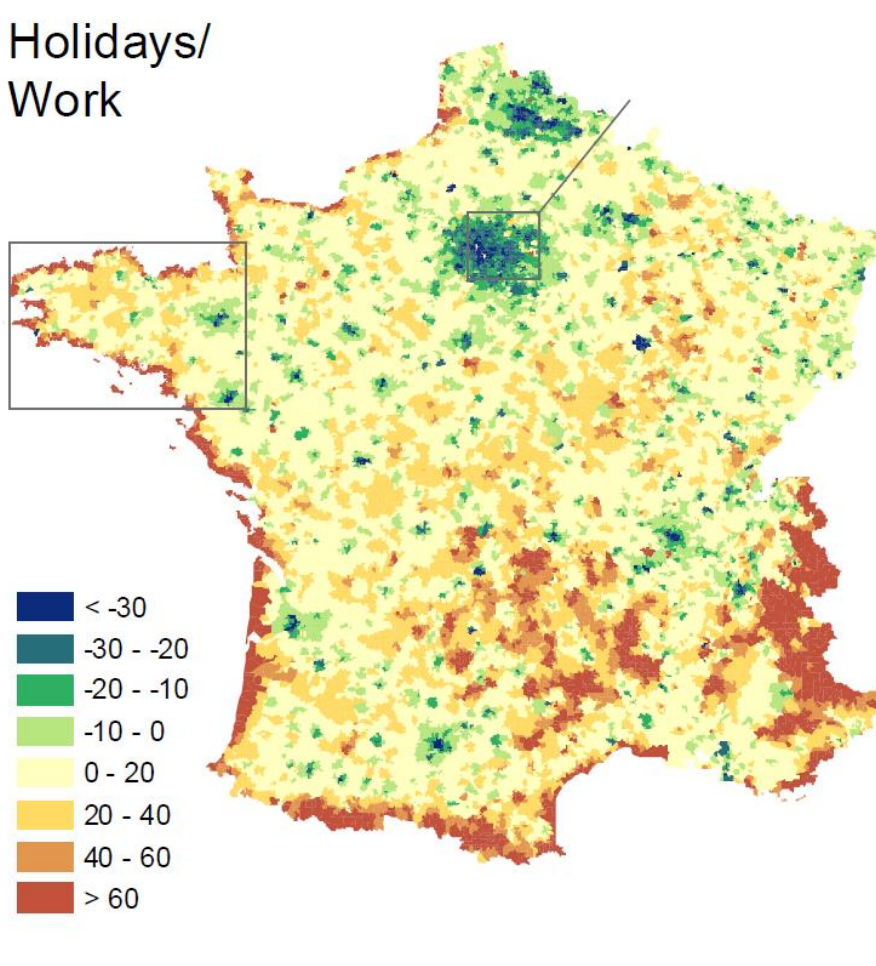
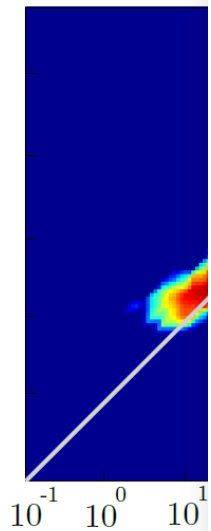
Modeling Human Mobility in Space and Time



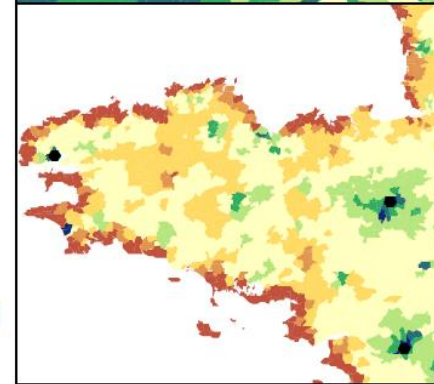
More Accurate and Dynamic Assessments of Population Distributions

*The com
covariate
are relat*

Holidays/
Work



that



ion density
(/km²)

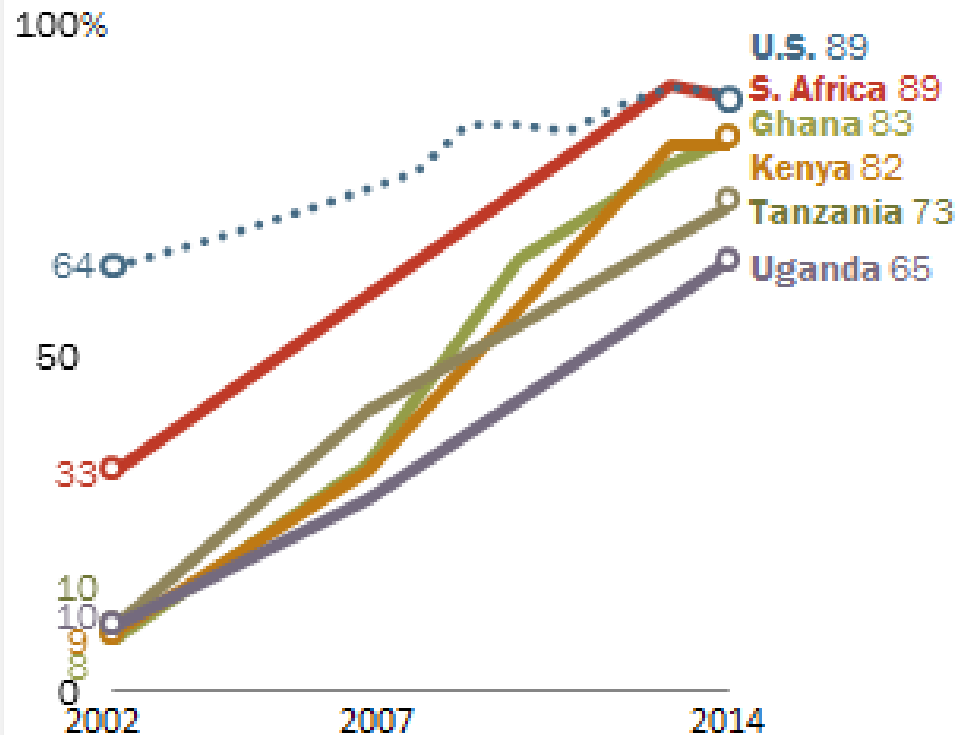
0
10,000
5,000
0



Cell Phone Ownership

Cell Phone Ownership Surges in Africa

Adults who own a cell phone

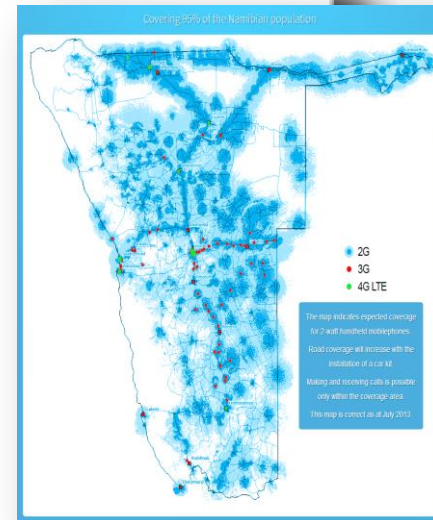
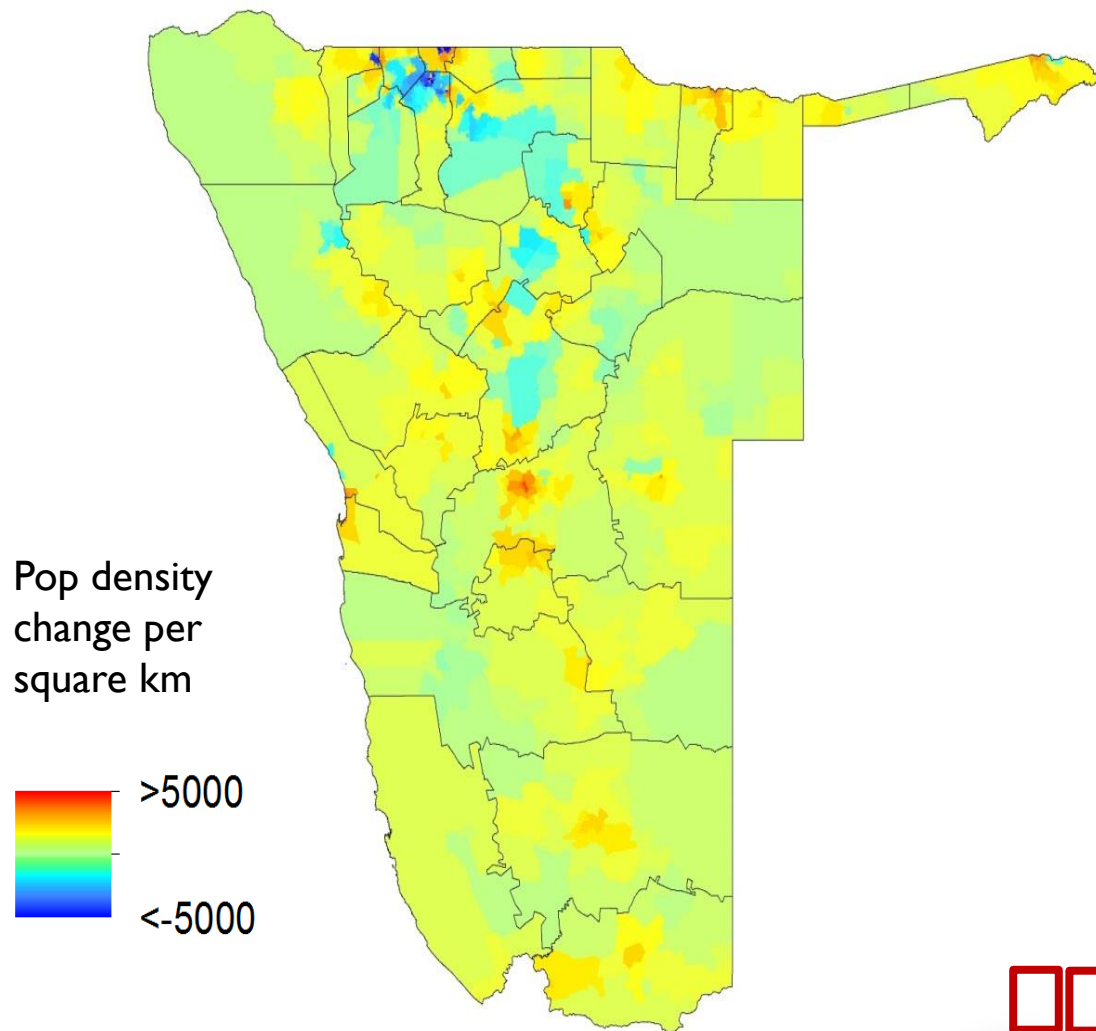


Note: U.S. data from Pew Research Center surveys.

Source: Spring 2014 Global Attitudes survey. Q68.

PEW RESEARCH CENTER

Seasonal Population Mapping

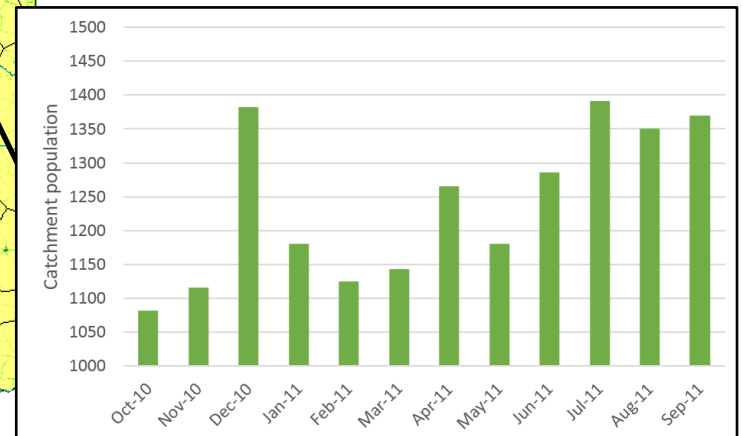
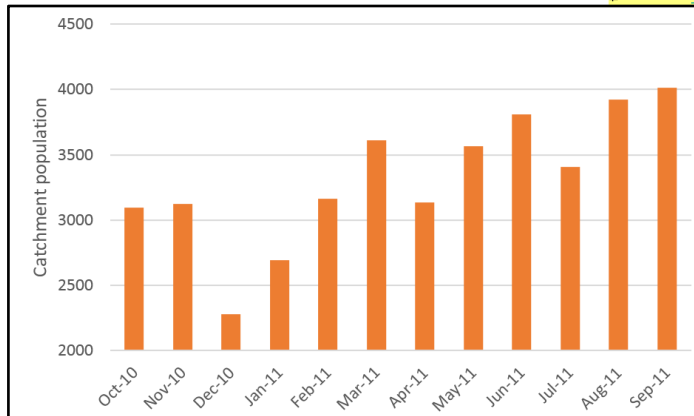
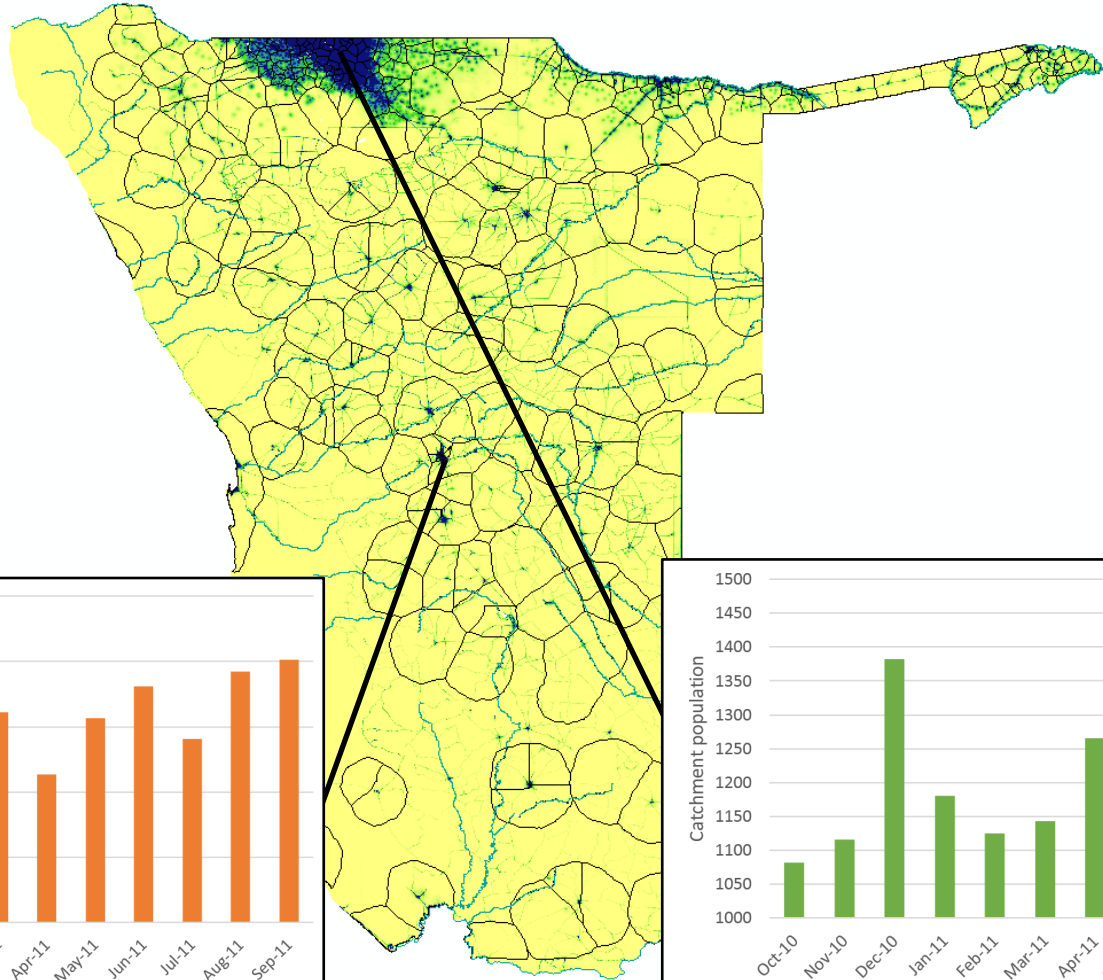


Namibia Pop:
2.3 mill
MTC active
subscriptions:
2.1 mill

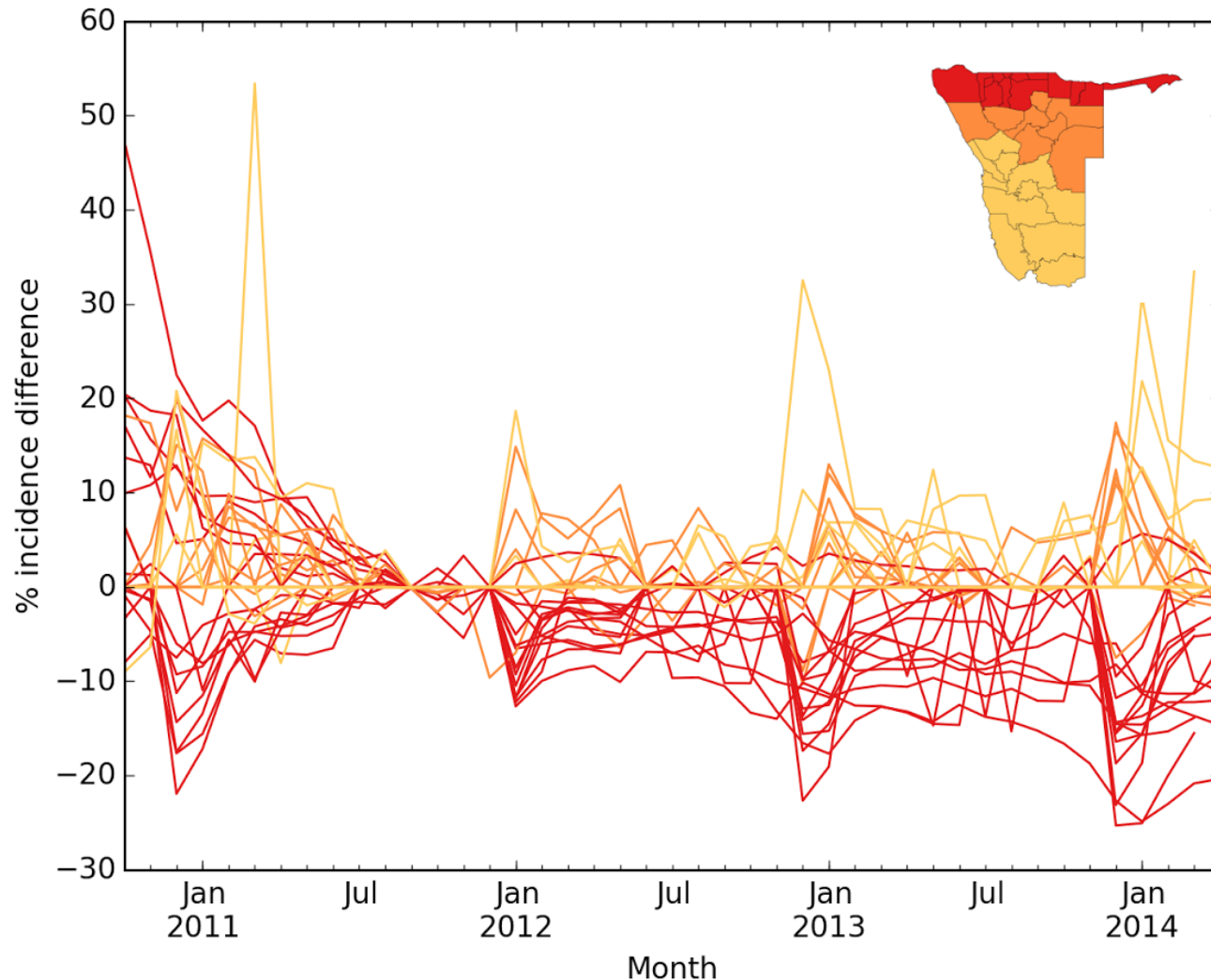


NOV_12
DEC_12
JAN_13
FEB_13
MAR_13
APR_13
MAY_13
JUN_13
JUL_13
AUG_13
SEP_13

Dynamic facility catchment populations



Namibia closer to elimination than previously assumed?



% change in health district incidence through the year after accounting for dynamic catchment populations

Areas in red may have lower incidence than currently assumed using static catchment denominators

CDRs Pros and Cons

Advantages

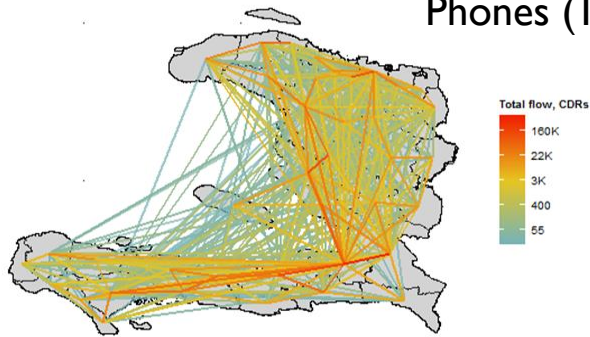
- Massive sample size, impossible to achieve with travel history surveys
- Multiple scales
- Relatively reliable
- Length of stay

**Alternative datasets are
required in order to quantify and
map mobility across continental
scales**

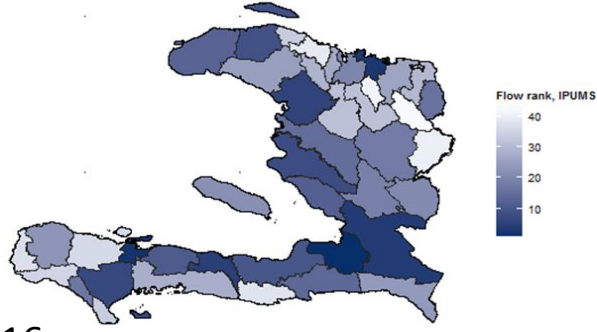
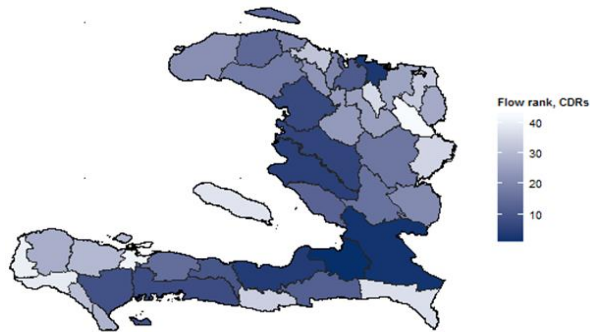
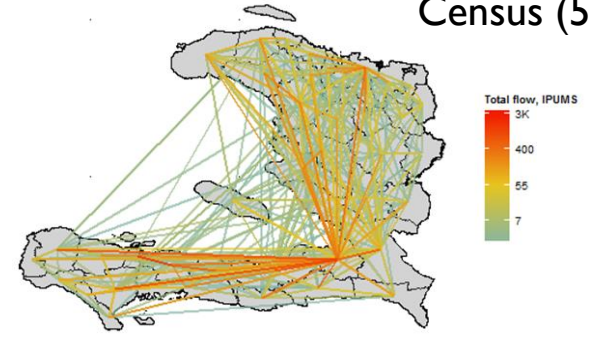
- Bias in representation
- Coverage of areas
- No demographic information
- Cross-border measurements feasible but not easy
- Difficulties in sharing and accessing (mostly due to commercial and privacy concerns)

A comparison of the ranked estimates of movement (II)

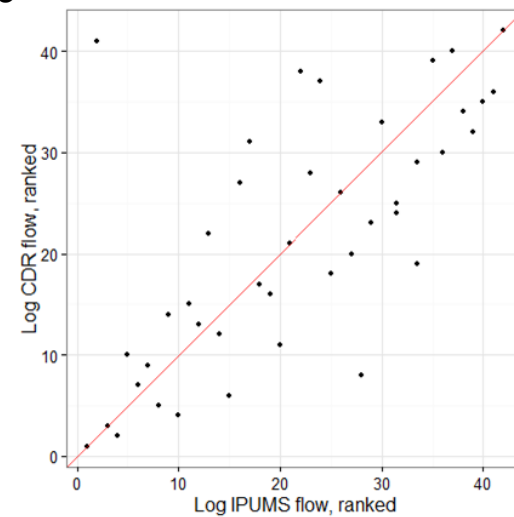
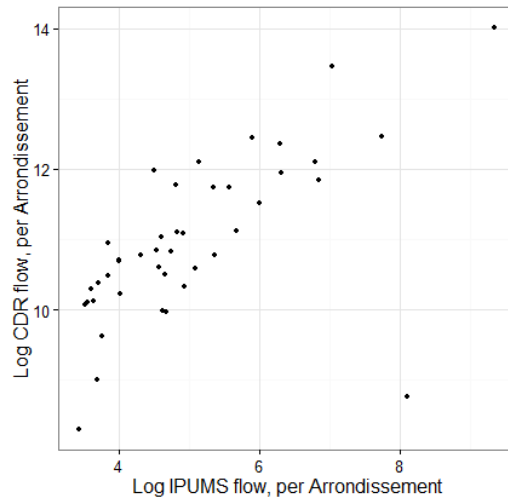
Phones (1 month)



Census (5 years)



Ruktanonchai et al., 2016
(Malaria Journal)



Modelling Internal Migration Using IPUMSI Census Microdata

MINNESOTA POPULATION CENTER, UNIVERSITY OF MINNESOTA



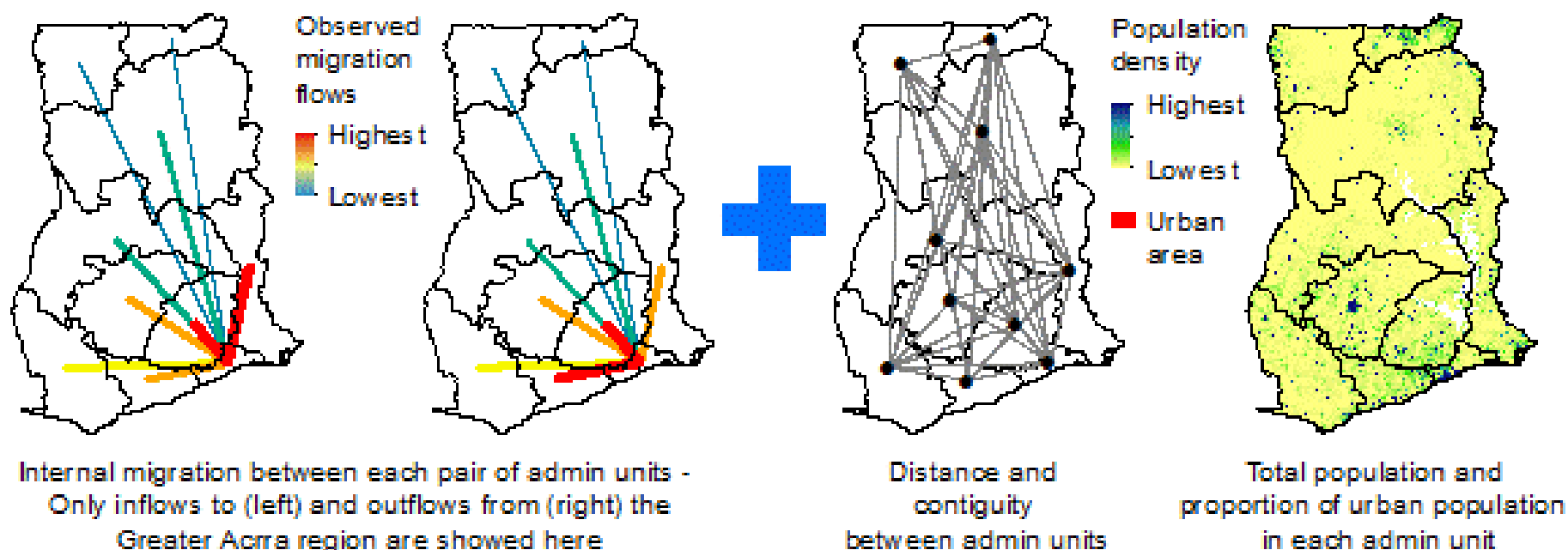
[Home](#) | [Select Data](#) | [FAQ](#) | [Contact](#) | [Login](#)

PROJECT	Integrated Public Use Microdata Series, International census microdata for social and economic research IPUMS-International is a project dedicated to collecting and distributing census data from around the world. Its goals are to: • Collect and preserve data and documentation • Harmonize data • Disseminate the data absolutely free! 62 countries - 185 censuses - 397 million person records	IPUMSI News
About IPUMS-I How to Cite IPUMS-I User Registration and Login		June 2011 data release 2010 award winners Improved web interface IPUMS Havana workshop June 2010 data release Mortality and fertility data NIH extends IPUMS-I ... All news items
DATA		
Browse and Select Data Download Your Data Extract GIS and Other Data Files		
SAMPLES		
Sample Descriptions Variance Estimation Source Documents	MPC Data Projects	
RESOURCES	IPUMS-USA and others	
International Partners World Data Inventory Microdata Handbook Bibliography		

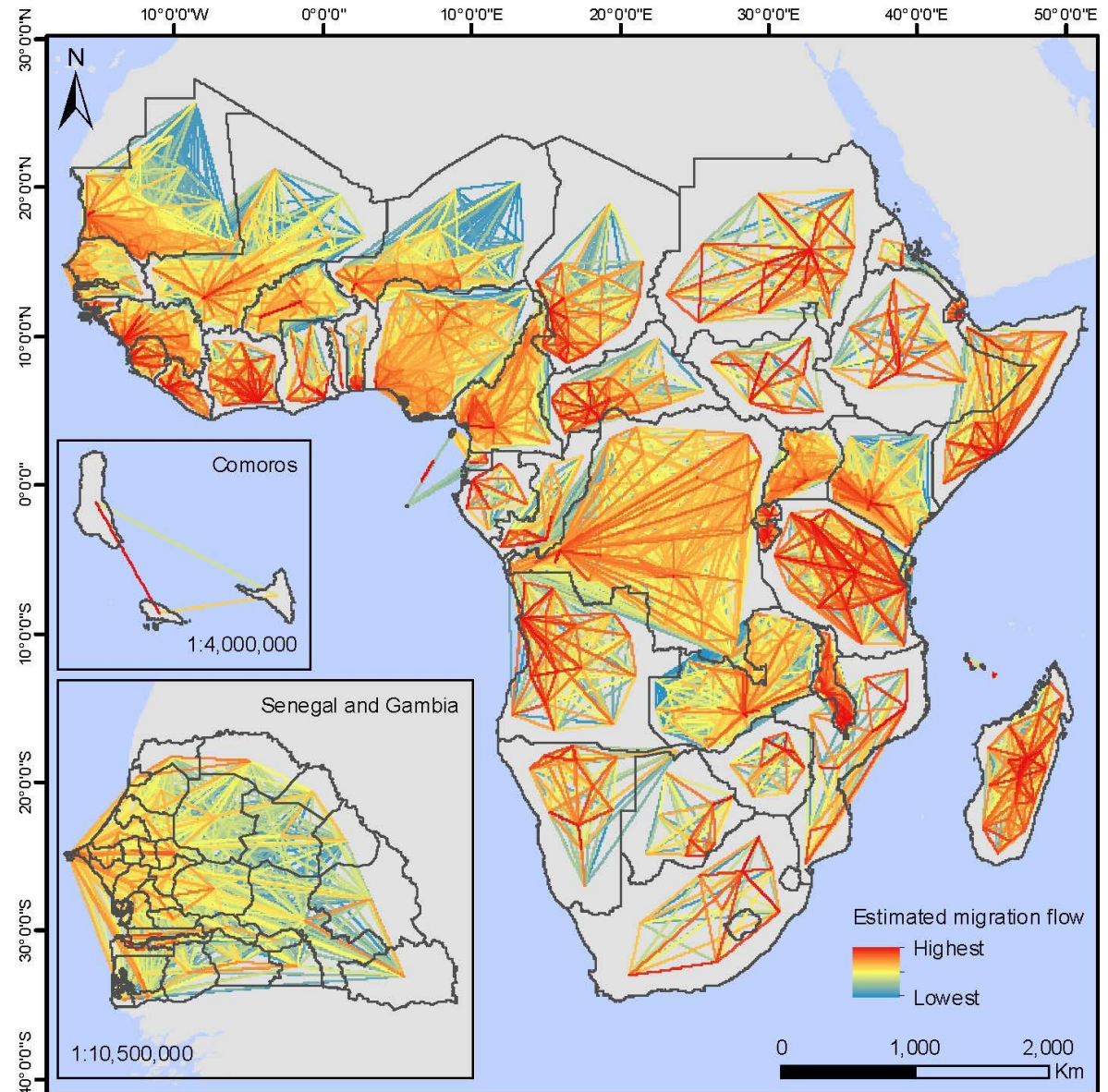
Funding provided by: [National Science Foundation](#), [National Institutes of Health](#), and [Sun Microsystems](#).
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Response Variable and Covariates

In order to consistently model internal migration across all countries only globally available datasets proving to be able to explain most of the variance in the gravity models of Garcia et al. were explored.

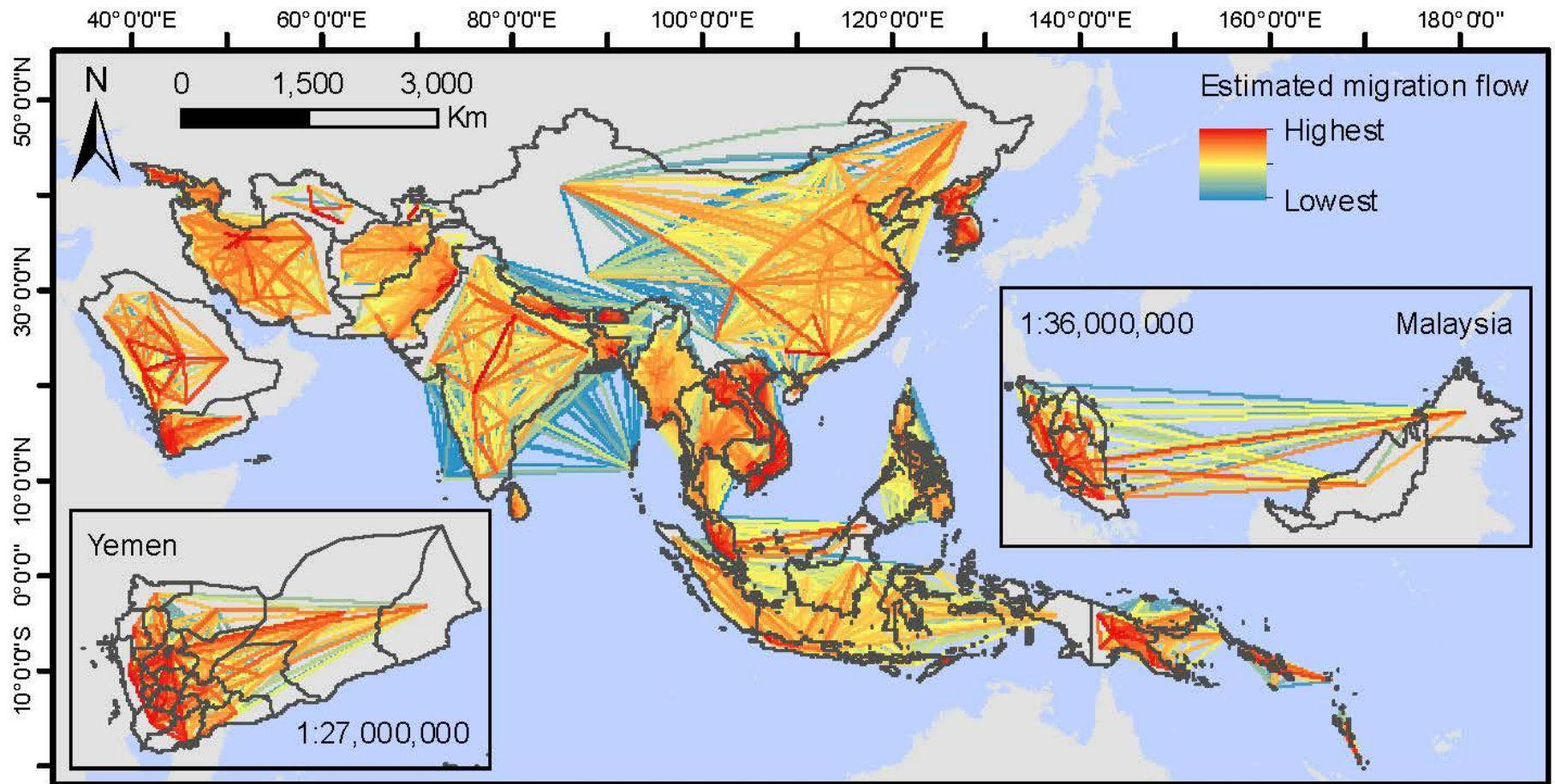


Internal Migration Flows in Africa

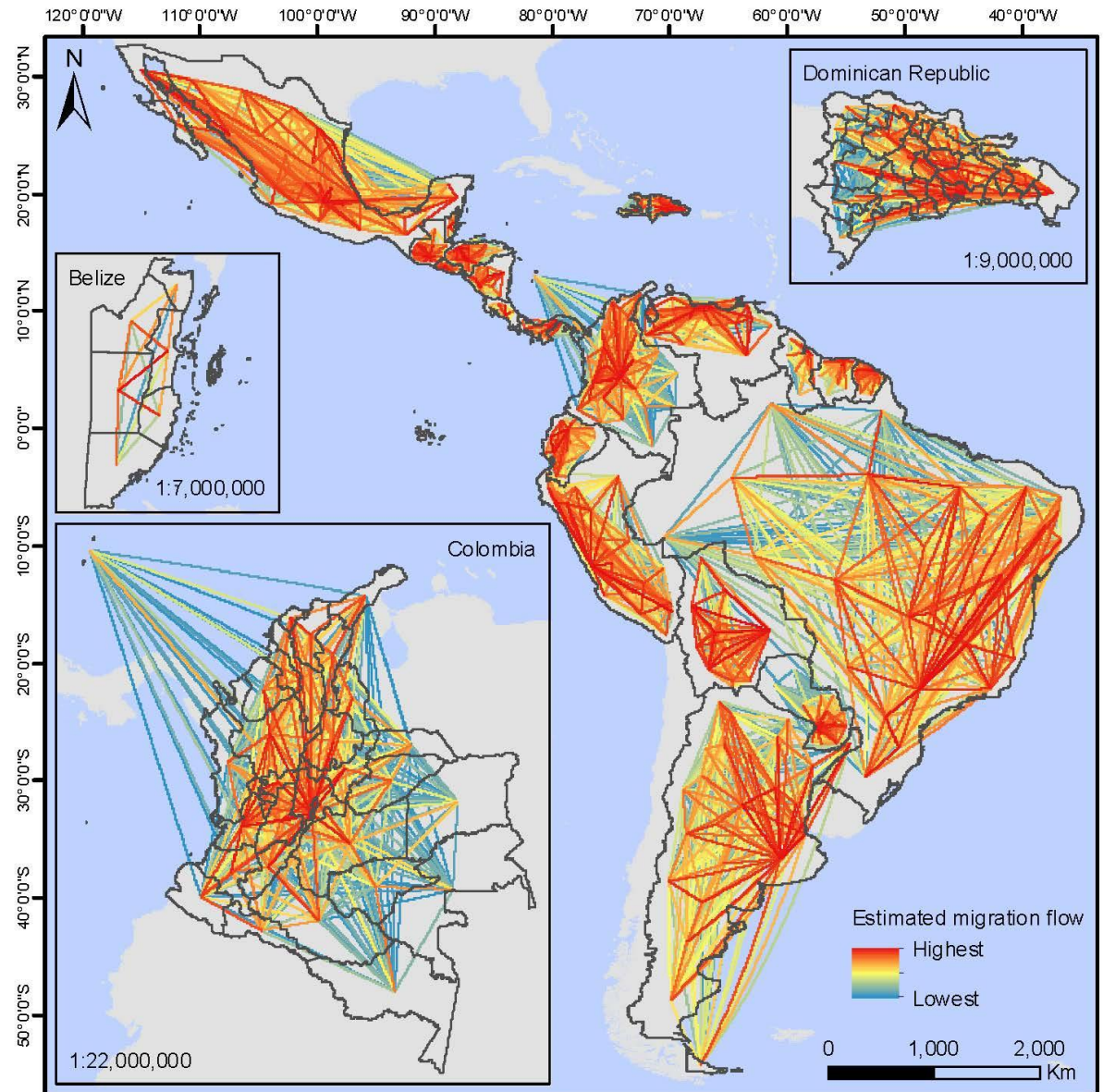


Sorichetta et al., 2016
(Nature Scientific Data)

Internal Migration Flows in Asia



Internal Migration Flows in LAC



Sorichetta et al., 2016
(Nature Scientific Data)

Validation/Uncertainty

Continent	ISO code	R ²	Error p-value
AFRICA	CMR	0.60	0.07
AFRICA	EGY	0.21	0.20
AFRICA	GHA	0.68	0.21
AFRICA	GIN	0.39	0.09
AFRICA	MAR	0.52	0.14
AFRICA	MLI	0.51	0.14
AFRICA	MWI	0.02	0.06
AFRICA	SEN	0.54	0.12
AFRICA	UGA	0.50	0.11
AFRICA	ZAF	0.49	0.23
AFRICA	ZMB	0.37	0.22
ASIA	ARM	0.11	0.16
ASIA	CHN	0.08	0.19
ASIA	FJI	0.16	0.28
ASIA	KGZ	0.23	0.08
ASIA	IND	0.11	0.15

Error p-value is here defined as the average probability that predicted migration values do not belong to the observed migration dataset.

Sorichetta et al., 2016 (Nature Scientific Data)

Limitations and Caveats (I)

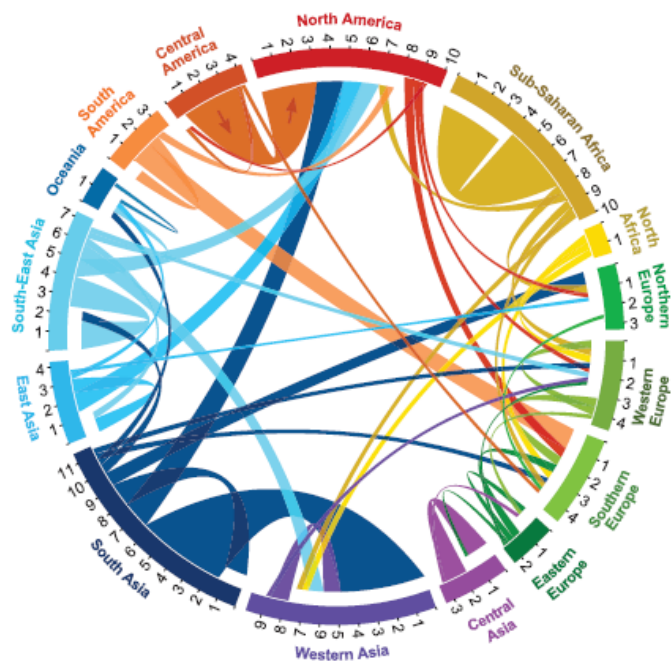
- For consistency, internal migration flows were estimated using a fixed set of pull and push factors common to all countries;
- The model fit varied between countries and could be improved by considering additional locally-specific migration drivers;
- The spatial detail at which migration is captured and summarized varies by country;

Limitations and Caveats (II)

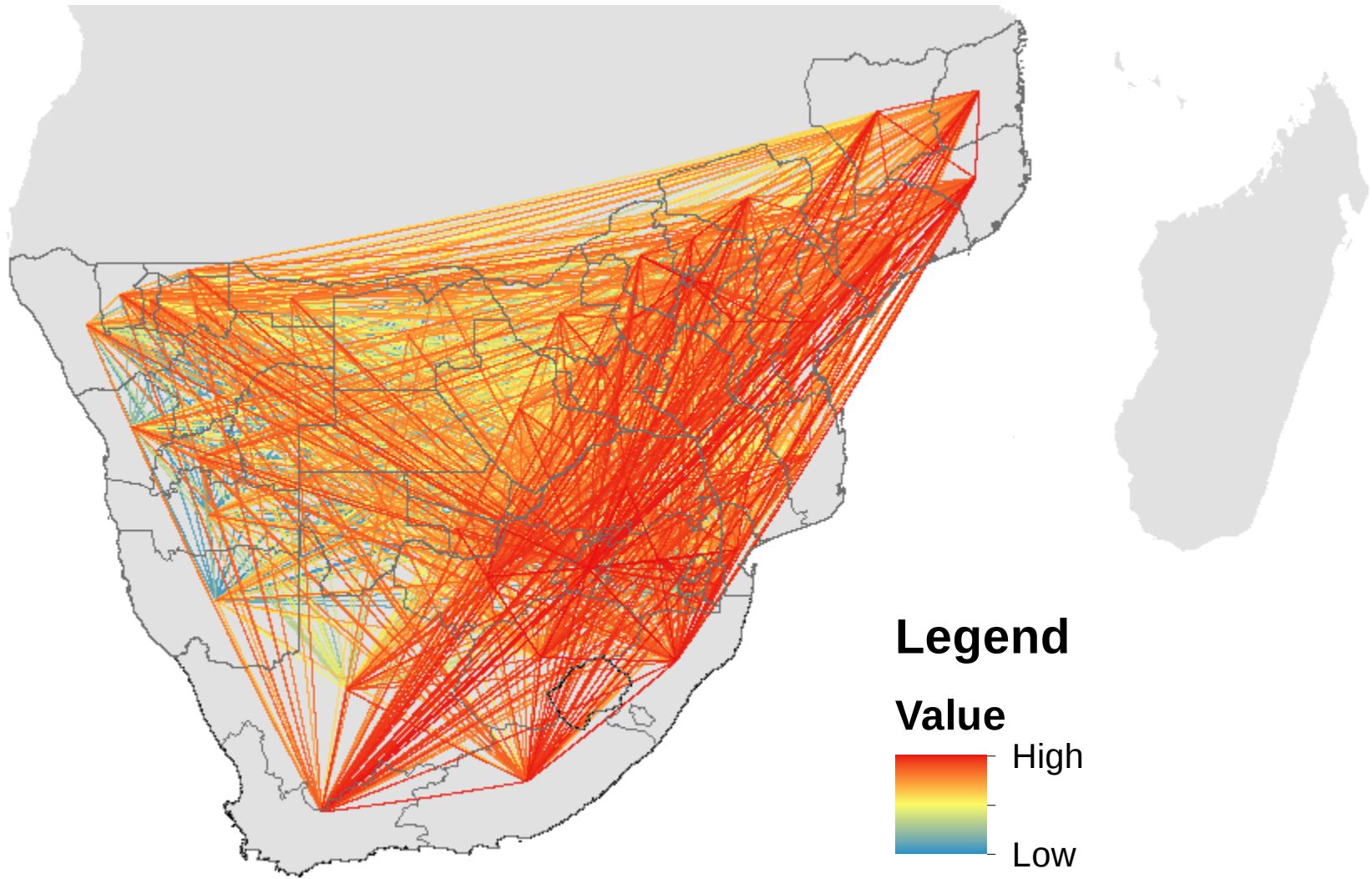
- The role of some of the pull and push factors, may not have been captured at the spatial level at which they influence internal migration as recorded in the census;
- Ancillary datasets used to represent pull and push factors are modelling outputs in themselves having a degree of uncertainty that will carry over into the migration estimates;
- Other types of migrations, such as seasonal movements and forced displacements, may be not captured by the model.

Integrating International and Internal Migration Data

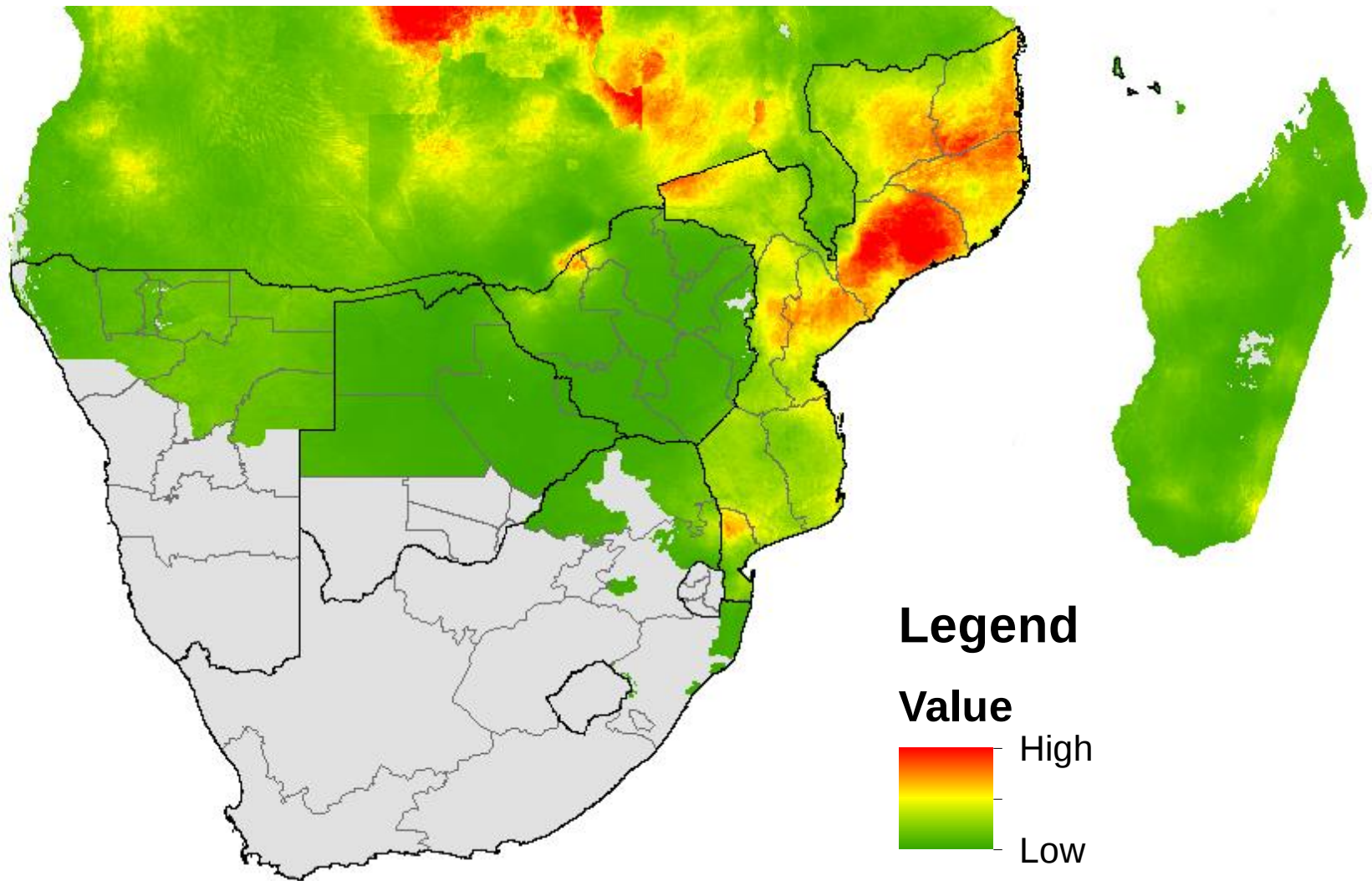
UN Stock Data



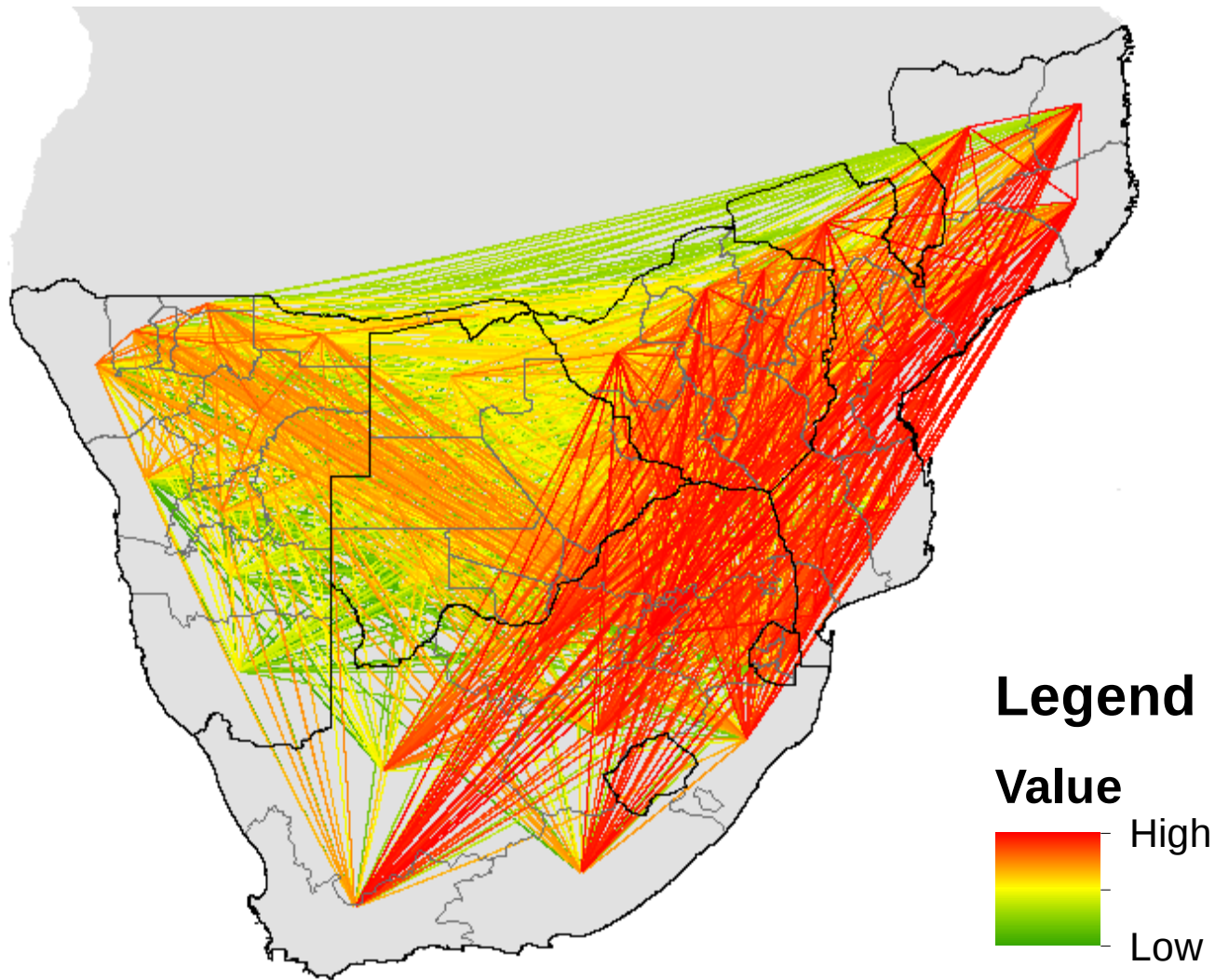
Subnational Cross-Border Migration Flows



Pf Malaria Prevalence

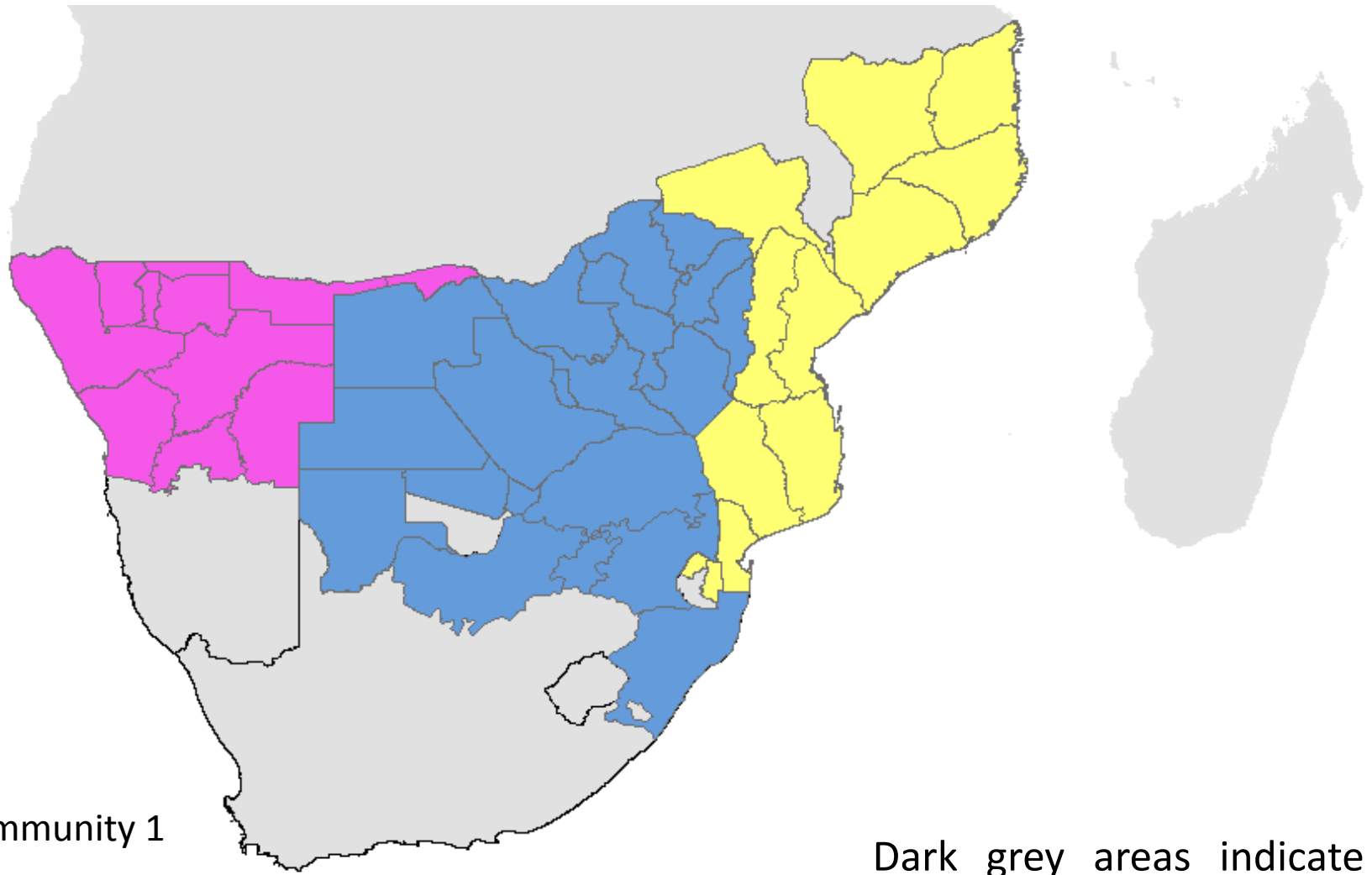


Pf Parasite Flows



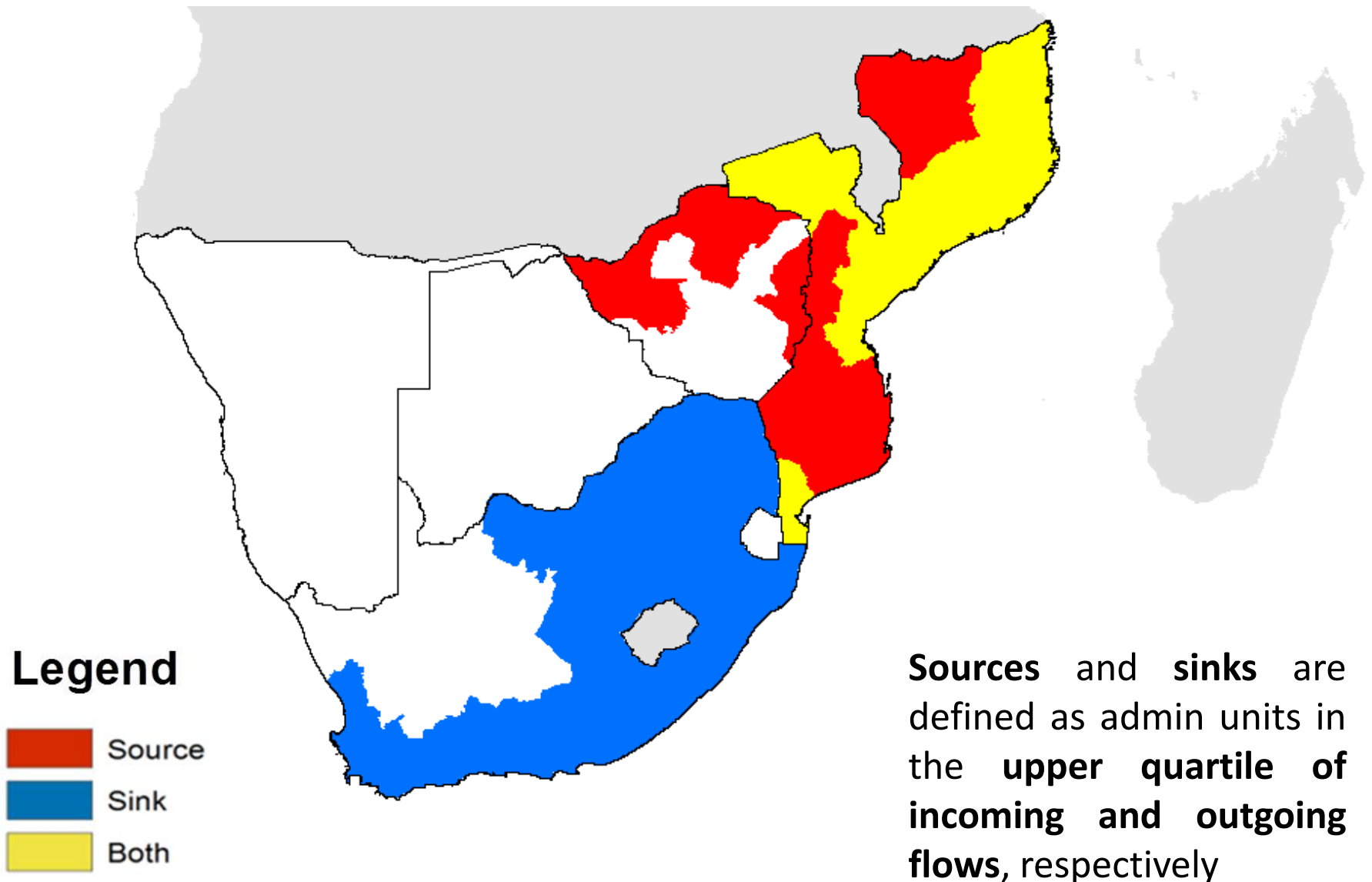
$$\text{ParFlow} = \text{MIG}_{ij} * \text{PfPrevi}$$

Parasite Communities



Dark grey areas indicate
admin units where malaria
is not endemic

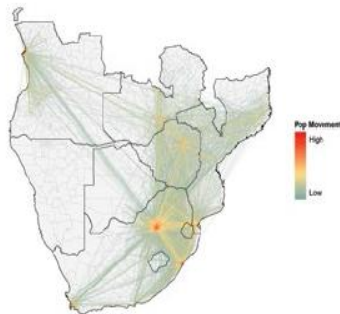
Malaria Sources and Sinks



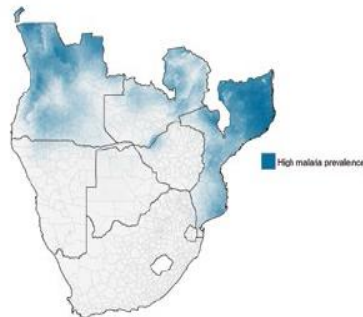
Current Applications



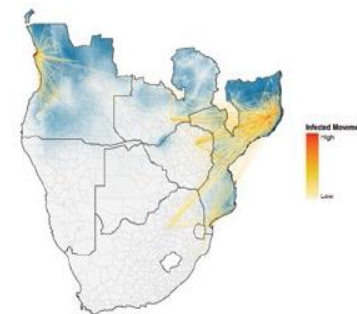
1. POPULATION MOVEMENT



2. PARASITE POSITIVITY



3. PARASITE MOVEMENT



Next Steps/Challenges

- How to validate the subnational cross-border migration estimates...
- Travel history surveys
- Geotagged social media data (eg, twitter data)?
 - Important to account for the selection bias in the Twitter population in order to generalize findings to the general population (Yildiz et al., Demographic Research 2017)

Thank You!



www.worldpop.org

 @WorldPopProject

www.flowminder.org

 @Flowminder