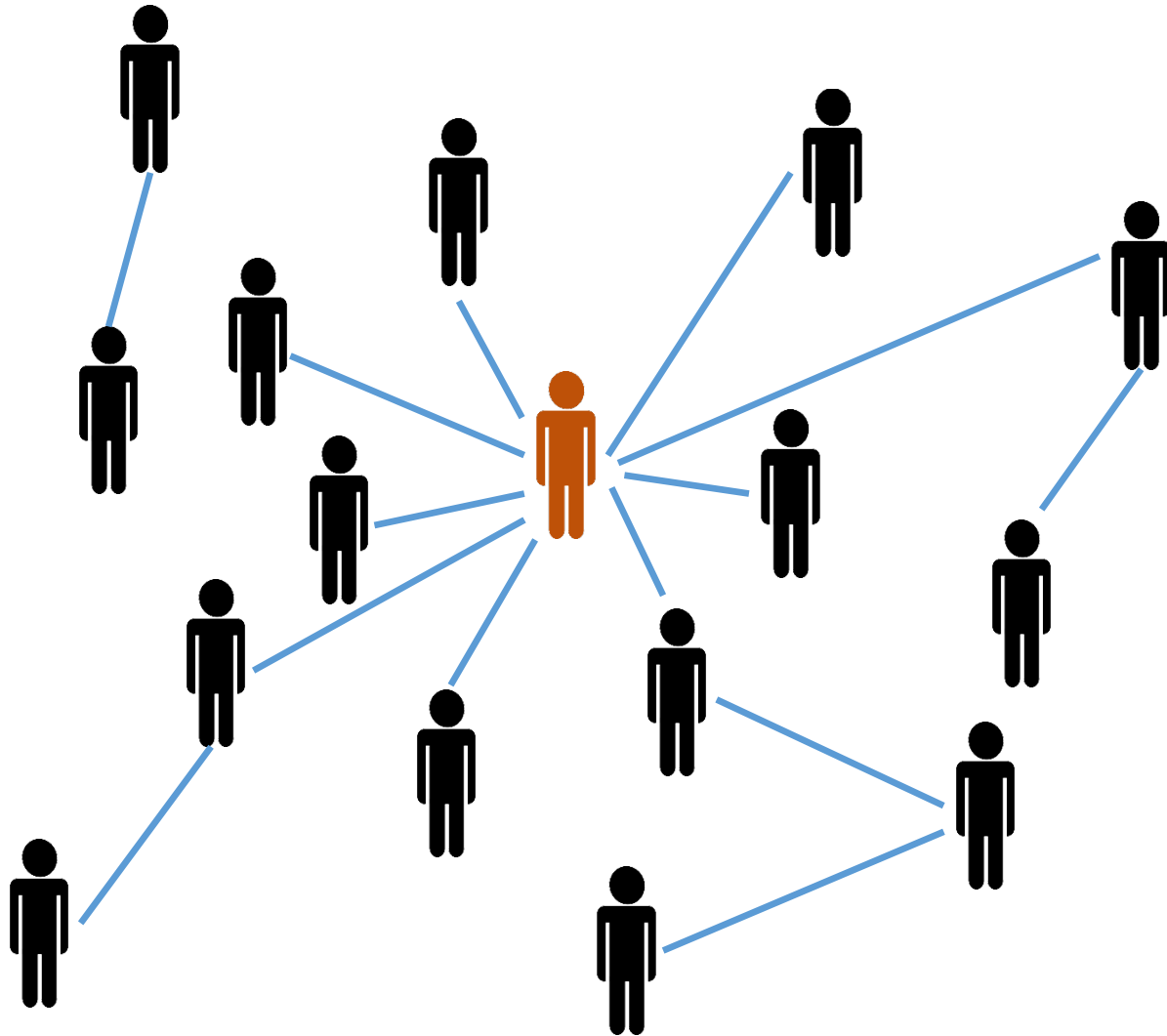


The HIV epidemic in sub-Saharan Africa: From social networks to maps

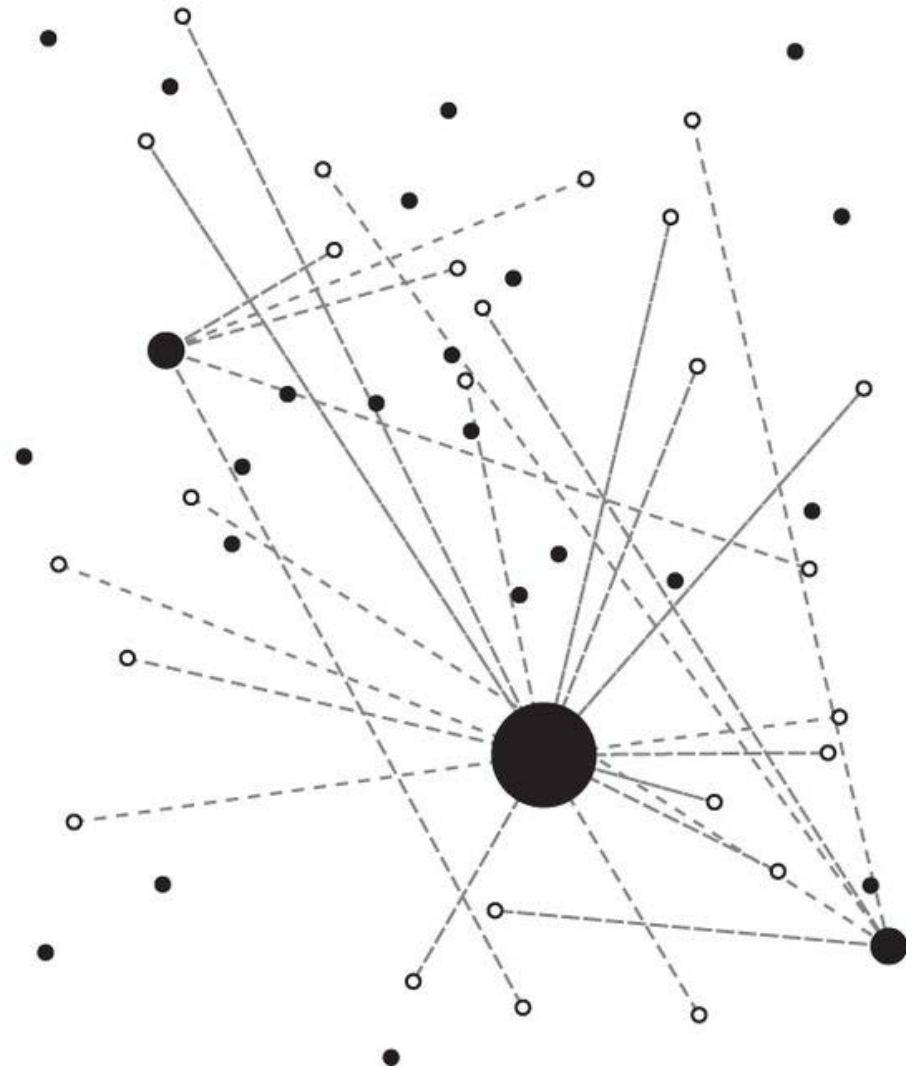
Diego F. Cuadros

Health Geography and Disease Modeling Laboratory
Department of Geography
University of Cincinnati

5th Annual Disease Modeling Symposium, 2017



Core groups (super spreaders): members that have high levels of risk behavior



The study of sexually transmitted infections such as **HIV** has focused on **social space**

Sexual networks: groups of persons connected to one another sexually

Characteristics:

- Number of partners (links)
- Number of sexual contacts
- Concurrent relationships
- Condom use

Sex work and long/steady partnerships

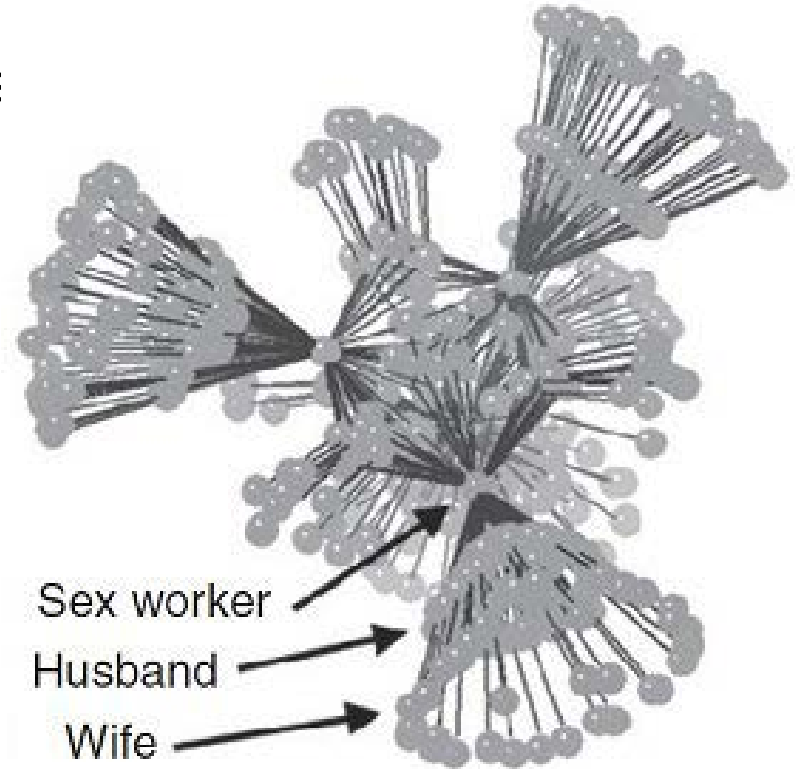
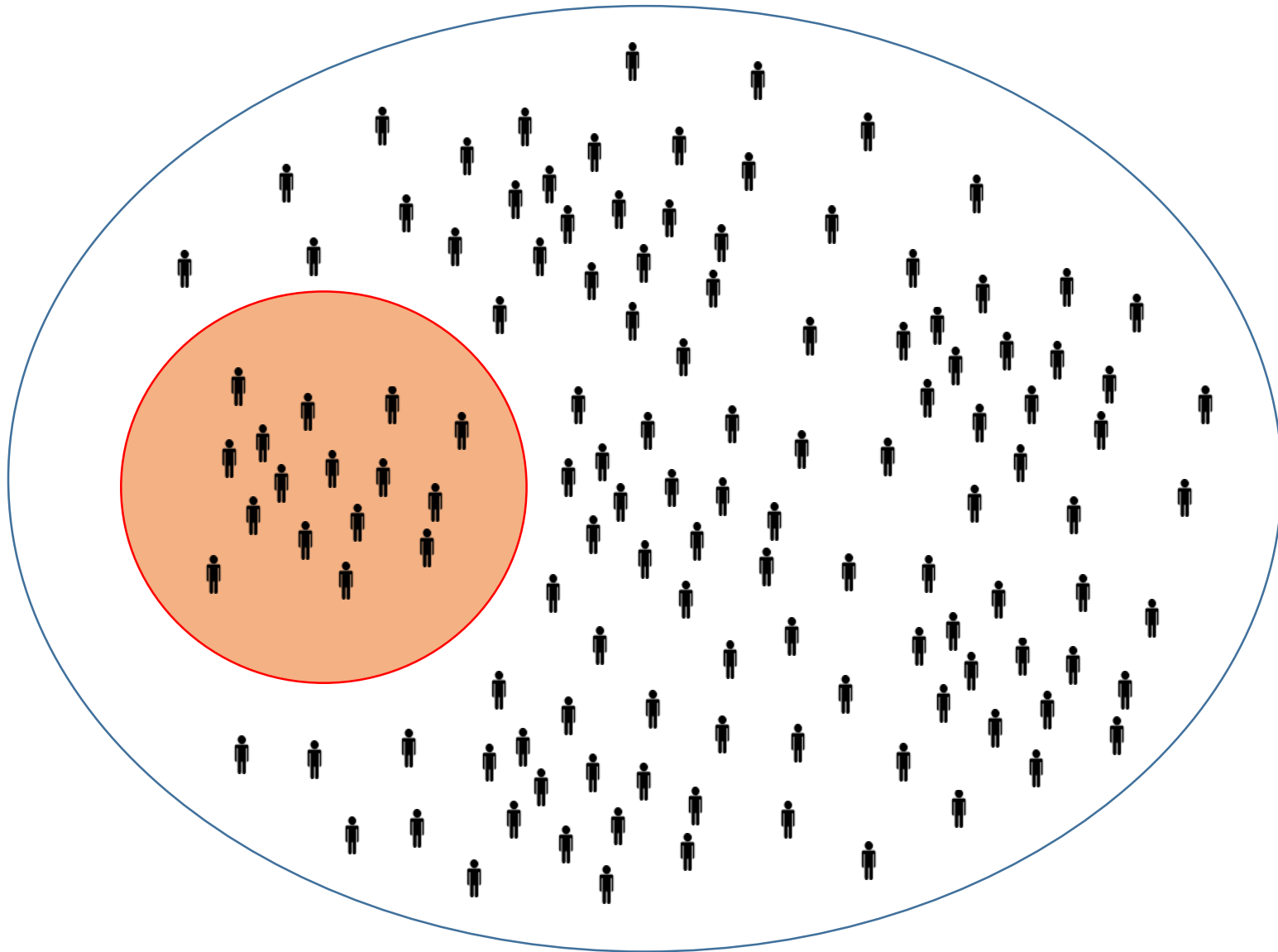
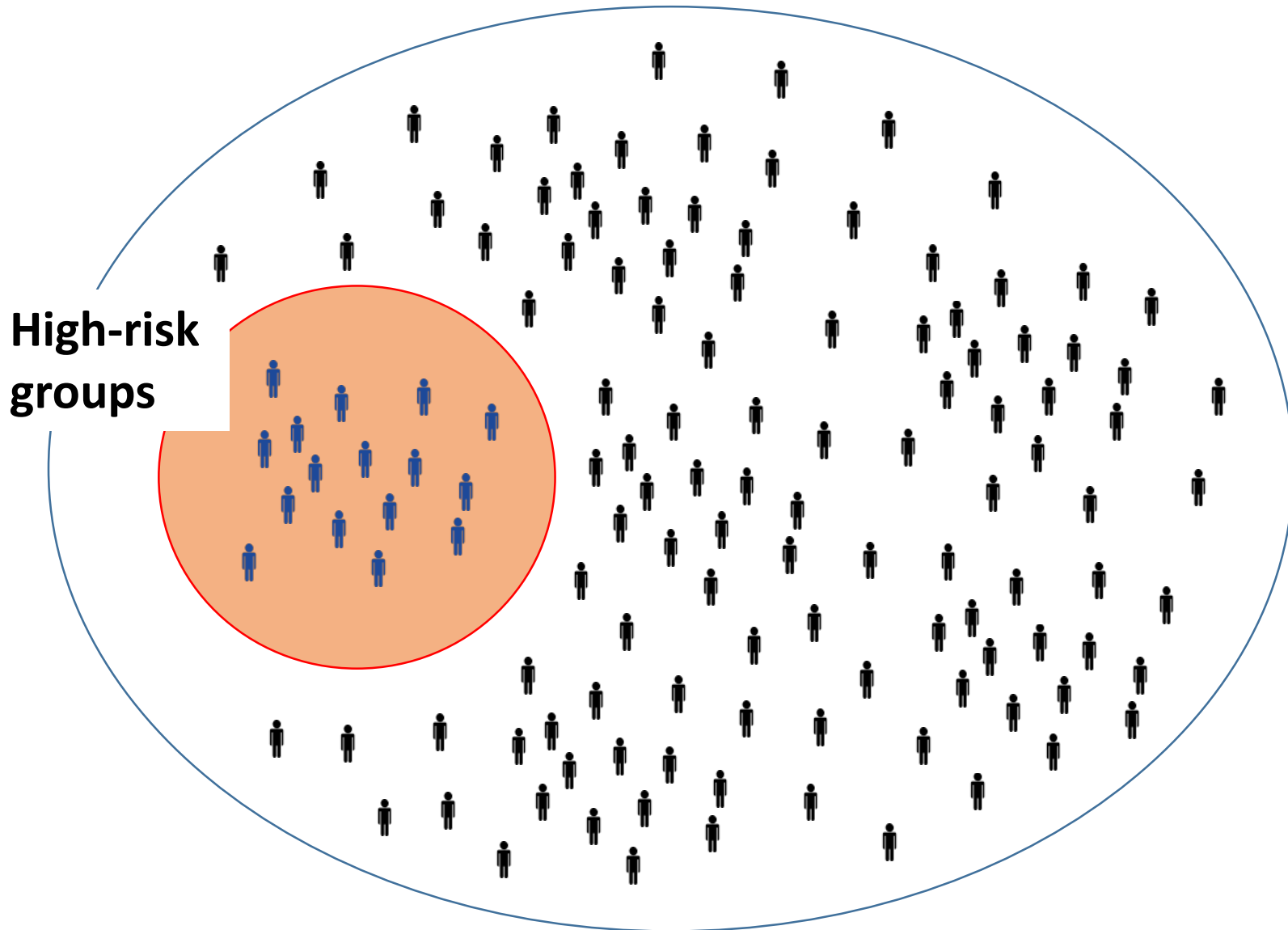


Figure by Roel Bakker, Erasmus MC, Rotterdam (in *An Introduction to Infectious Disease Modelling*, Vynnycky and Whithe, 2014)

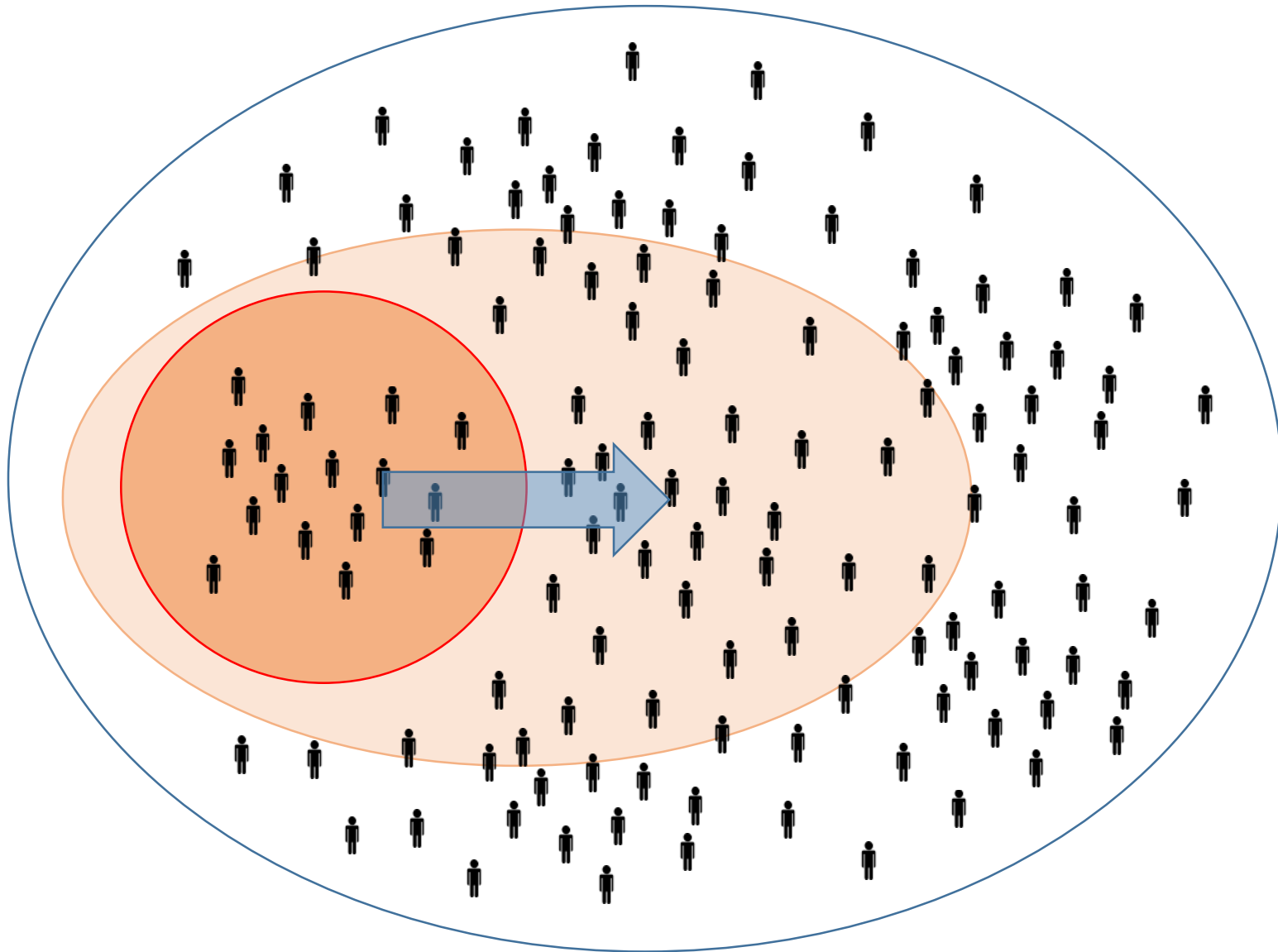
Concentrated epidemic



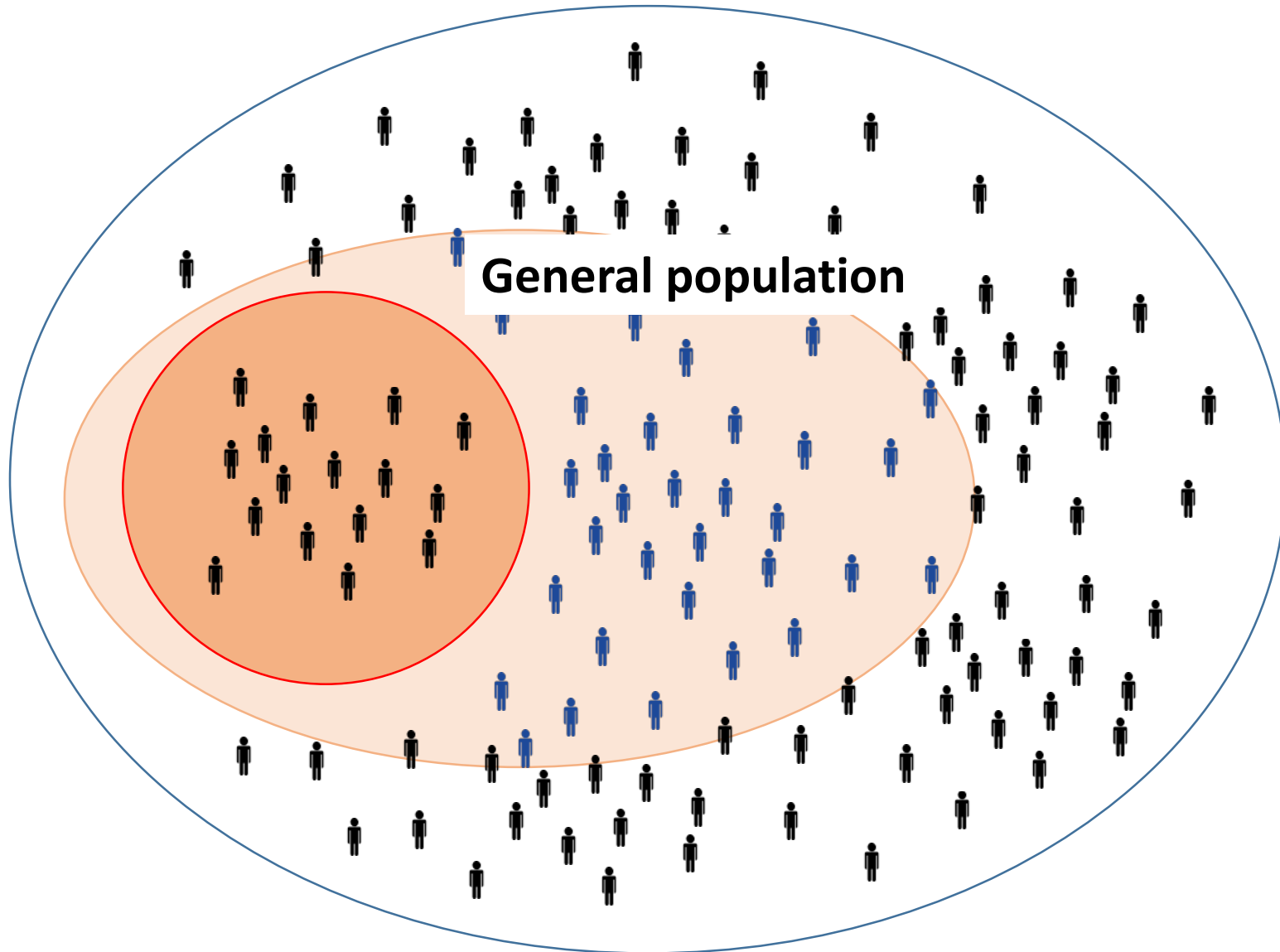
Concentrated epidemic

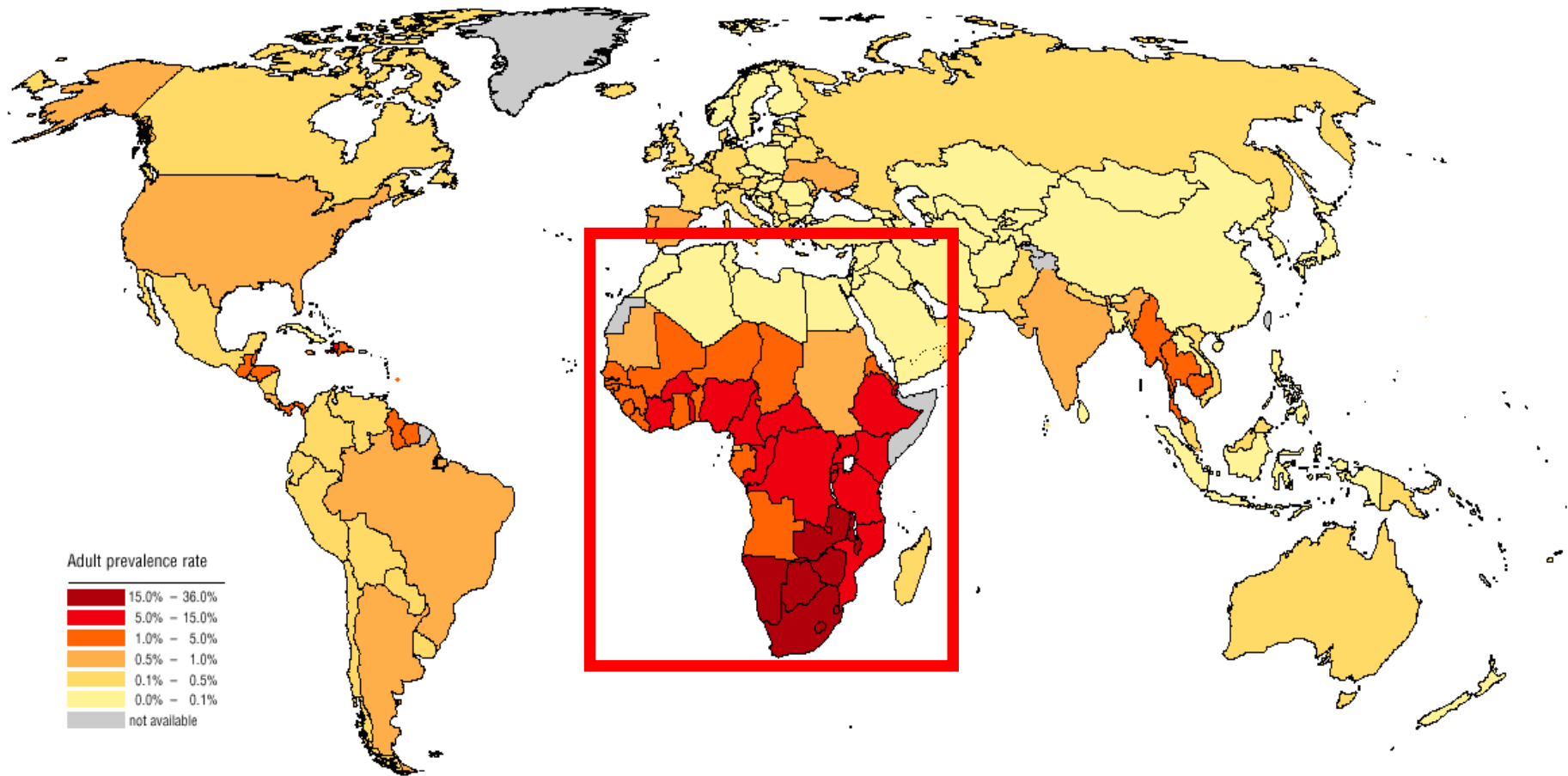


Generalized epidemic



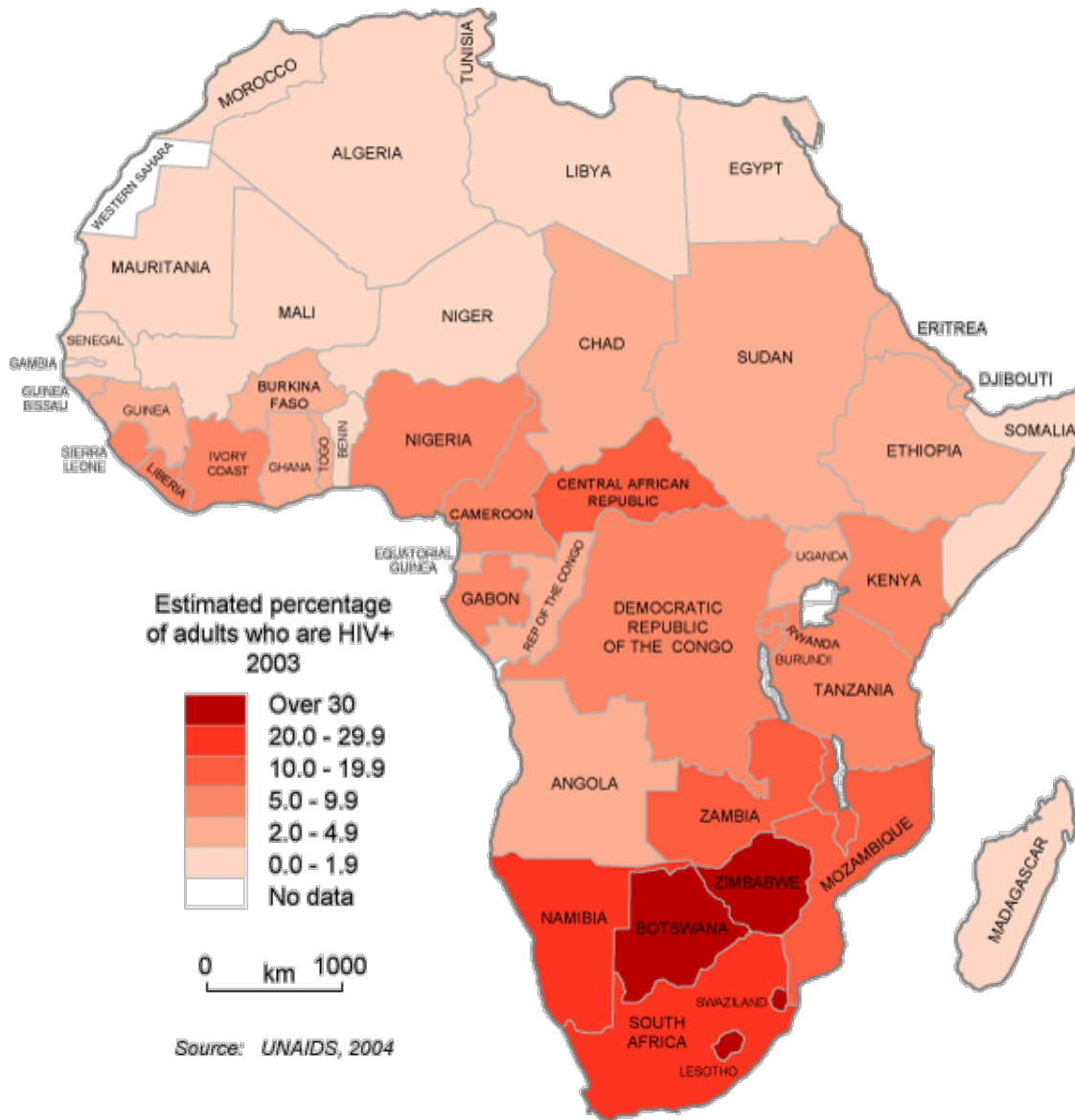
Generalized epidemic





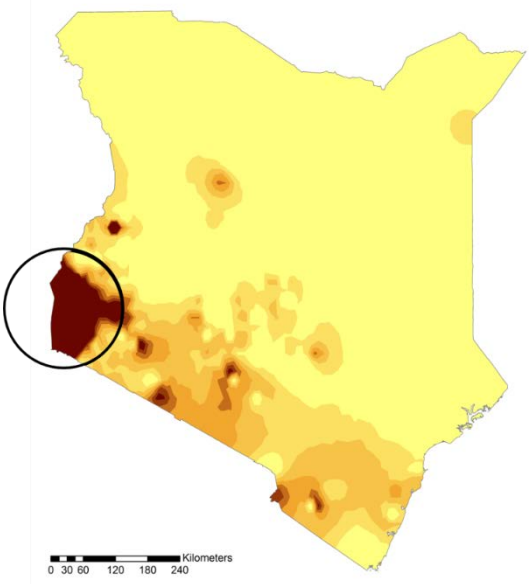
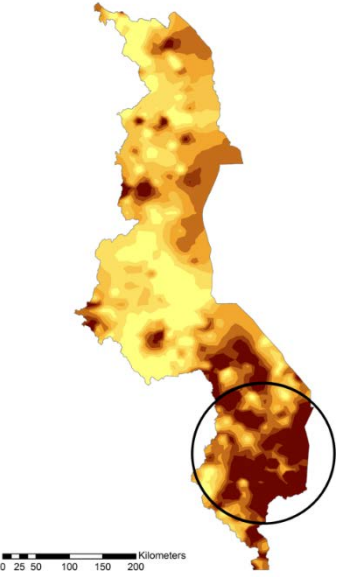
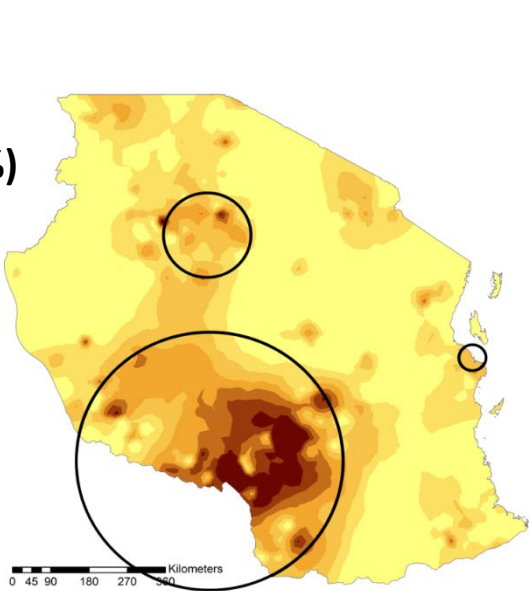
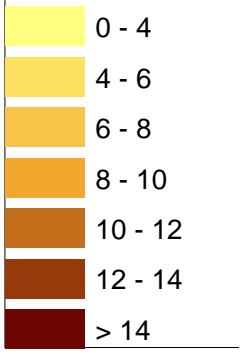
Sub-Saharan Africa (SSA) has by far the largest HIV epidemic in the world, with an estimated **25 million infected individuals** over the past two decades

- The '***Know your epidemic, know your response***', a Joint United Nation Programme on HIV/AIDS (UNAIDS), has become one of the first calls to modify the current strategy by recognition of the fact that **there is not a single global HIV epidemic**
- This strategy highlighted the significant role that **geographical space** could play in the identification of populations at **higher risk**

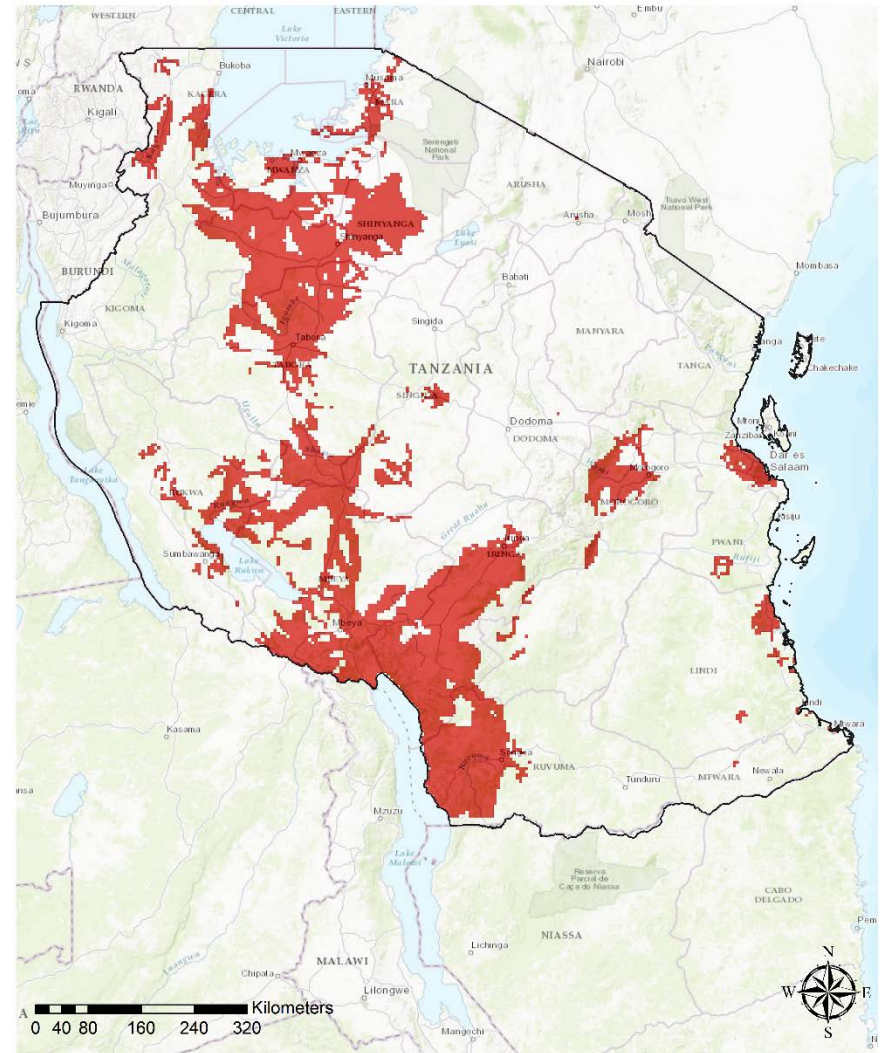
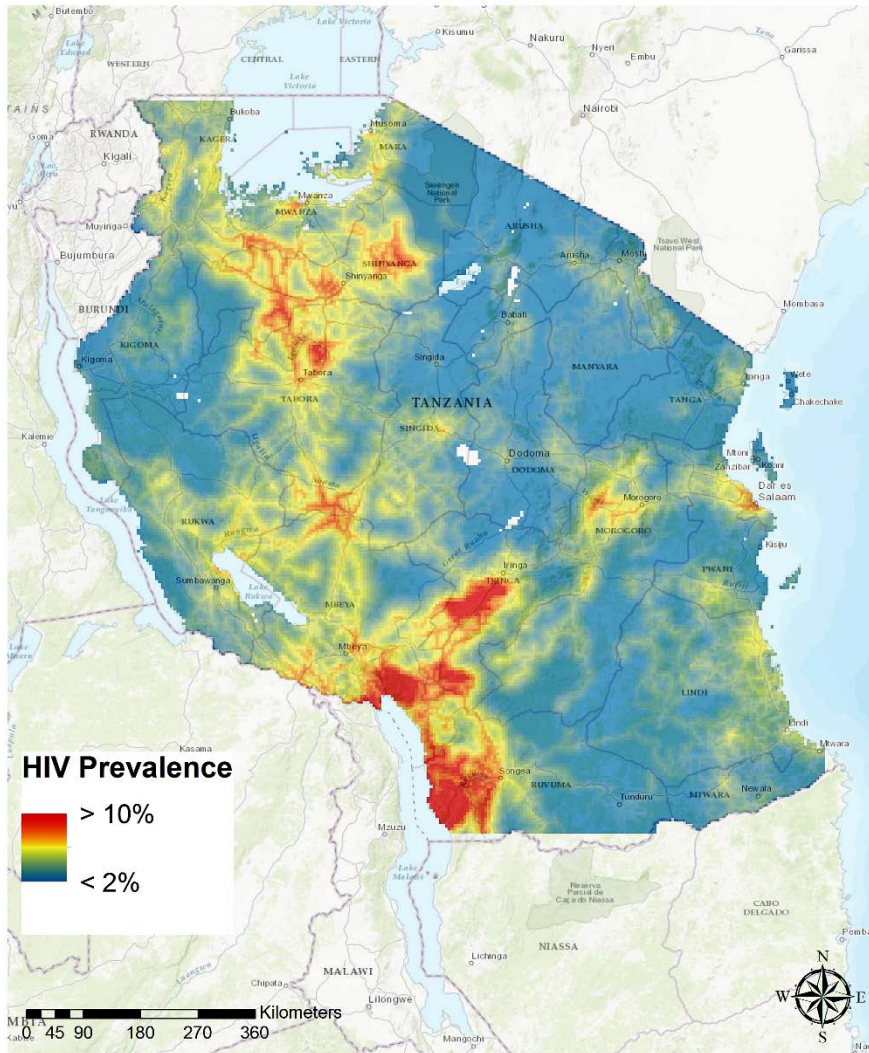


Geographical hotspots of HIV

HIV Prevalence (%)

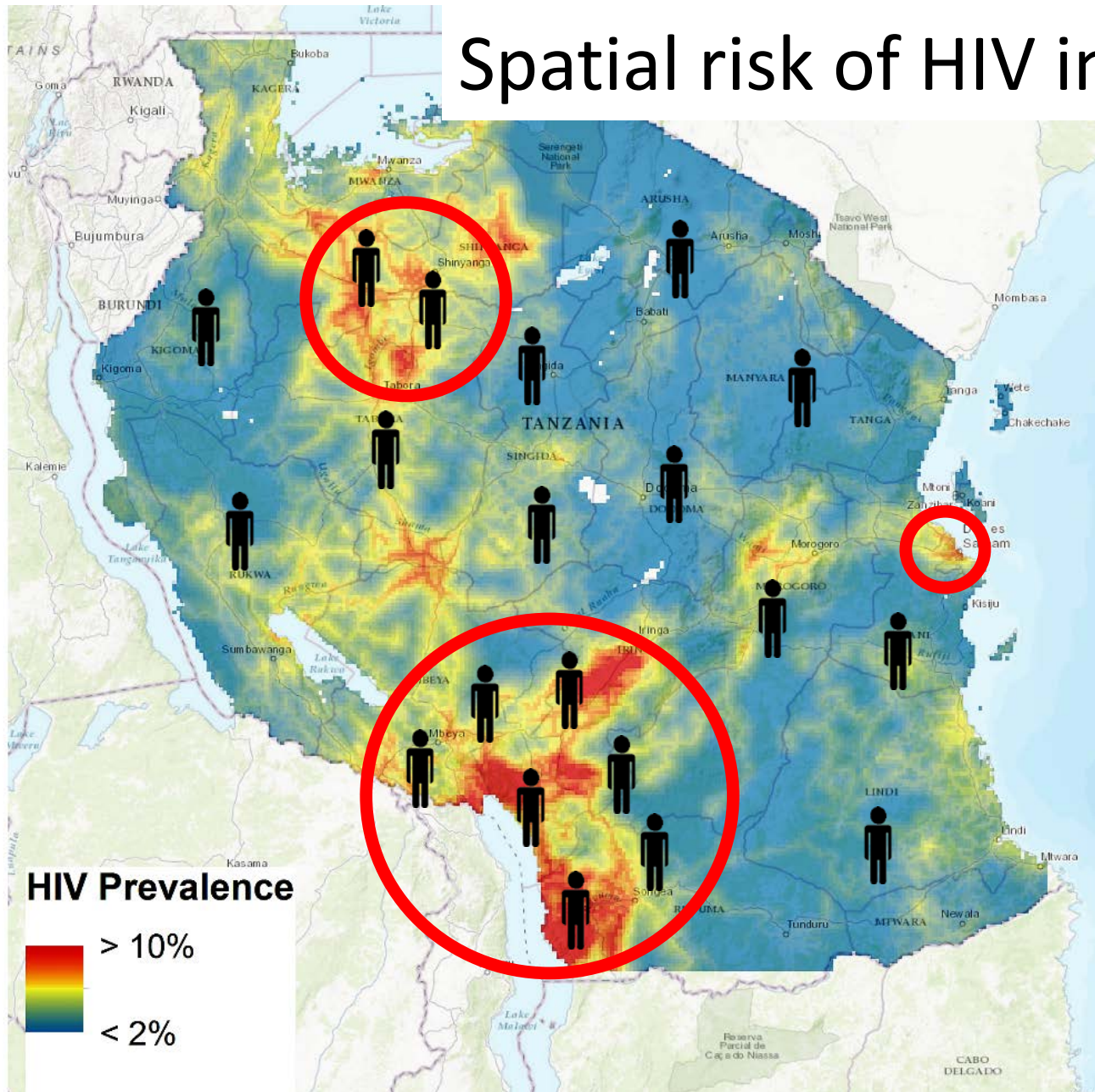


Spatial distribution of HIV

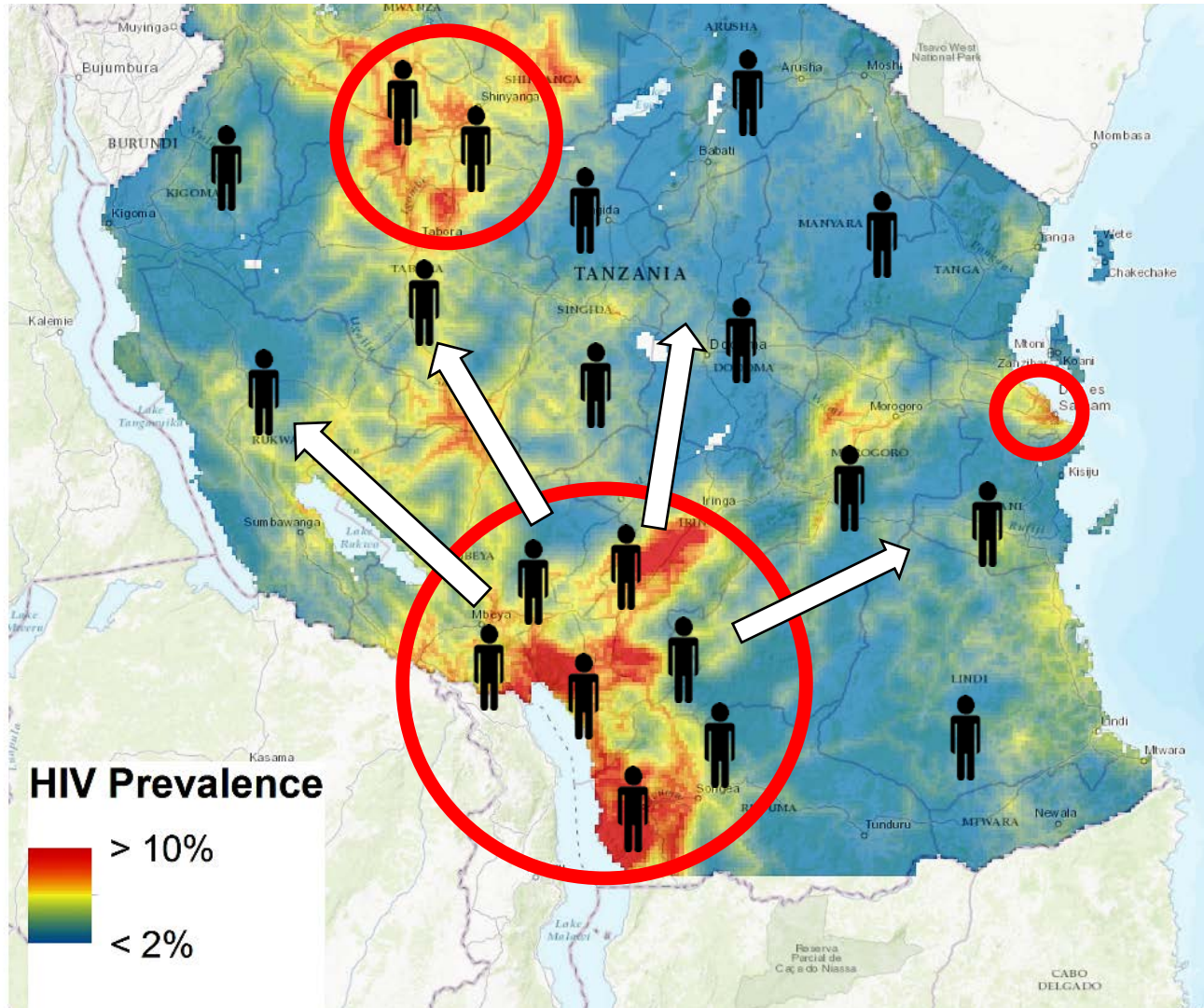


Why do we need to know the spatial distribution of HIV?

Spatial risk of HIV infection



What is the contribution of the HIV hotspot in the transmission network?





We improve population health by conducting high quality research focused on eliminating new HIV infections, reducing TB transmission and improving local health systems.

↓ DATA REPOSITORY

Since January 2000, the Africa Centre For Population Health has built up an extensive longitudinal database of demographic, social, medical and economic information about the members of its Demographic Surveillance Area, which is situated in a rural area of northern KwaZulu-Natal. It has developed from this database, the following

TWITTER FEED



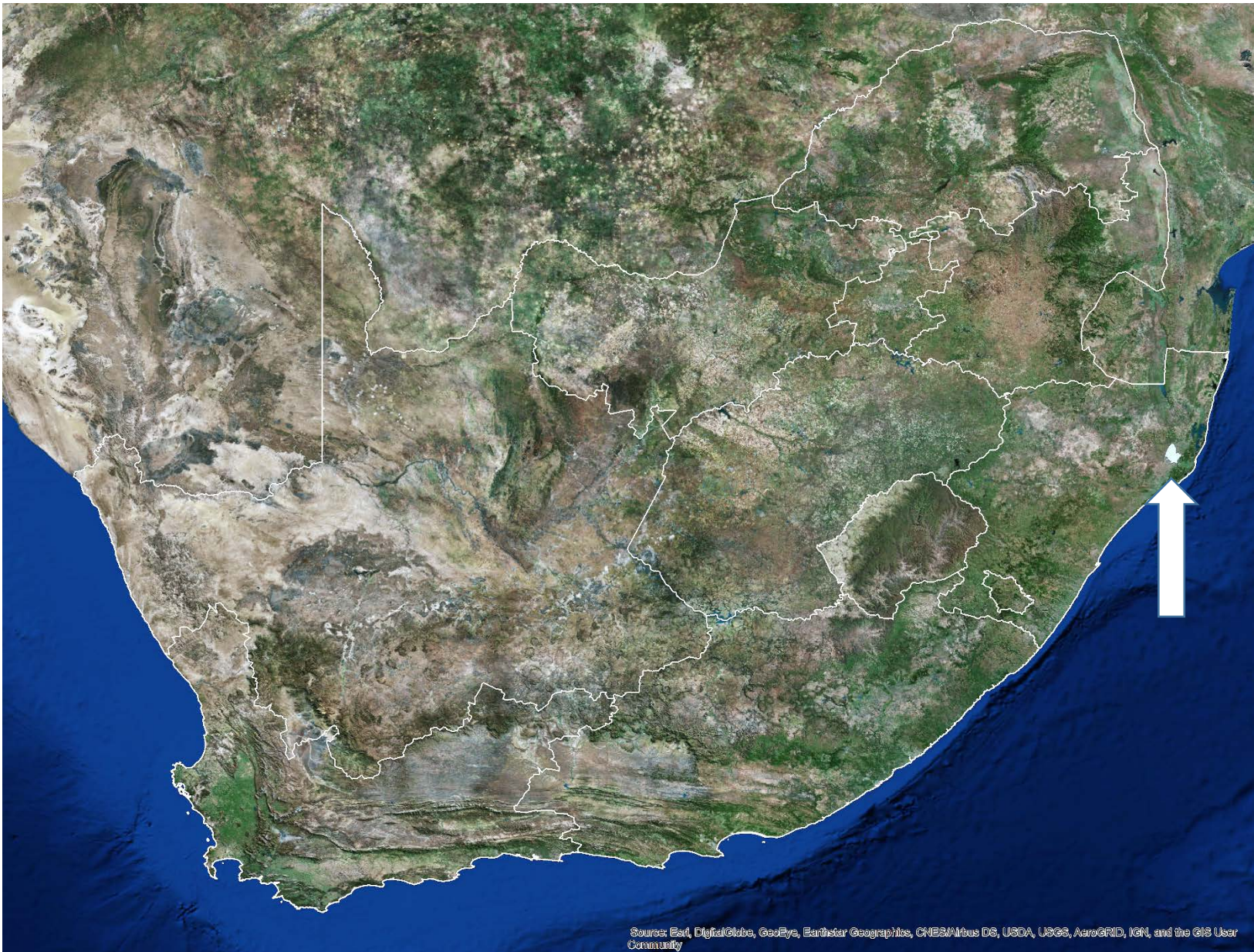
Thanks to @CellC for proving bags for learners.hope to repeat career day next yr at AHRI (@africacentreza + @Kriith)

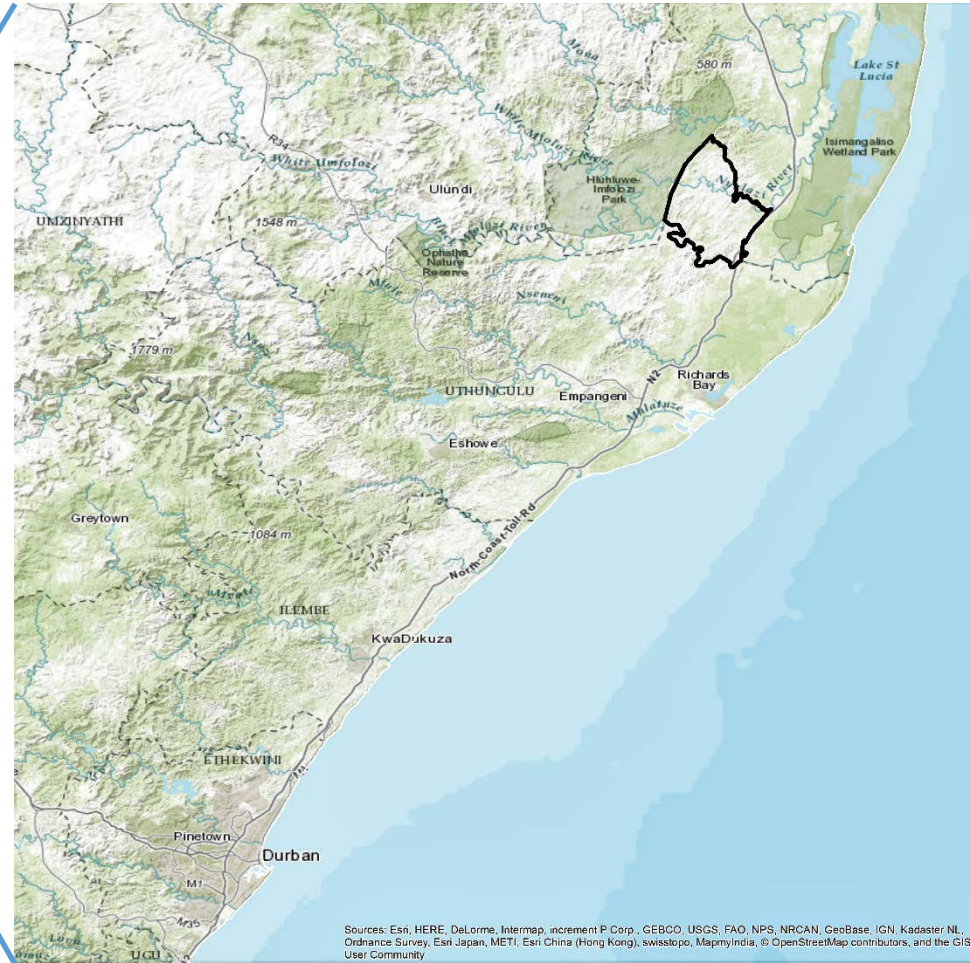


YOUTUBE A.C. CHANNEL

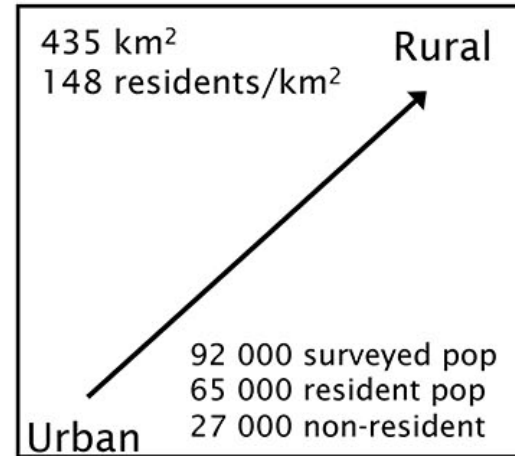
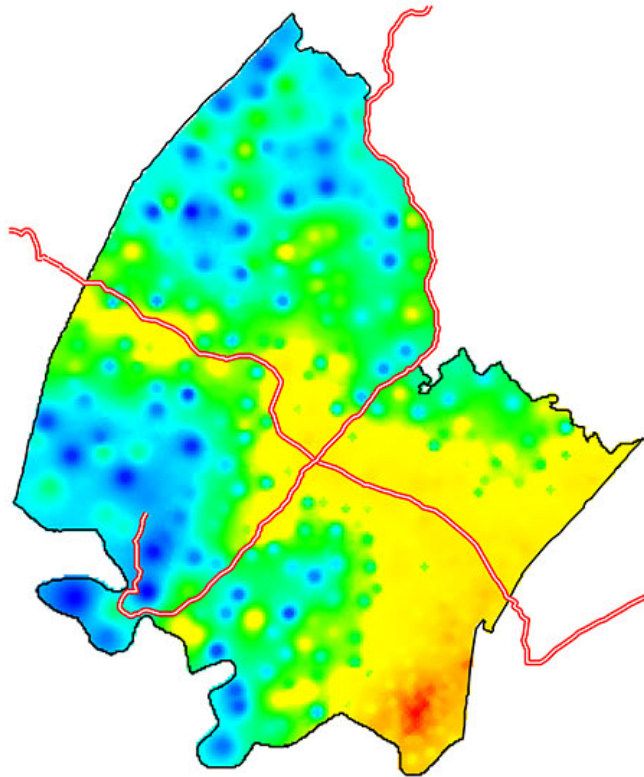
AUDIO BROADCASTS

ONLINE PUBLICATIONS





Africa Centre Demographic Information System Surveillance



- The site has collected socio-demographic information on a population of 87,000 participants within a circumscribed geographic area (438 km²) for over a decade

Africa Centre Demographic Information System Surveillance

Data collection



Fieldworker deployment



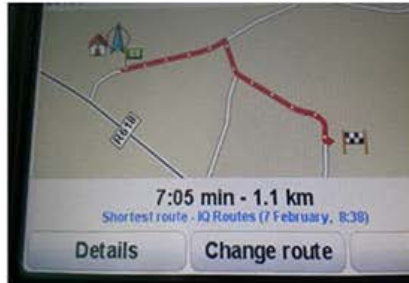
Map-based homestead identification



Paper-based interview



Tracker deployment

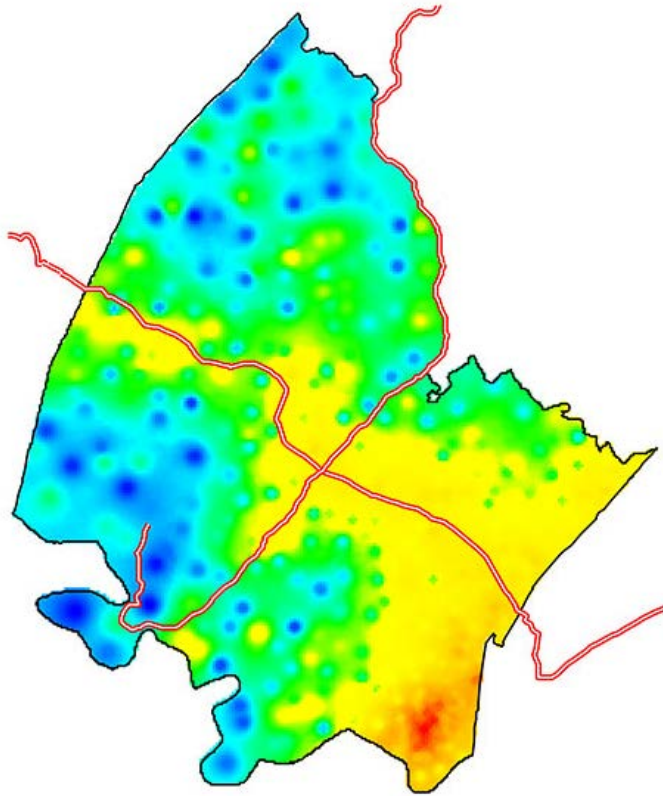


GPS-based homestead identification



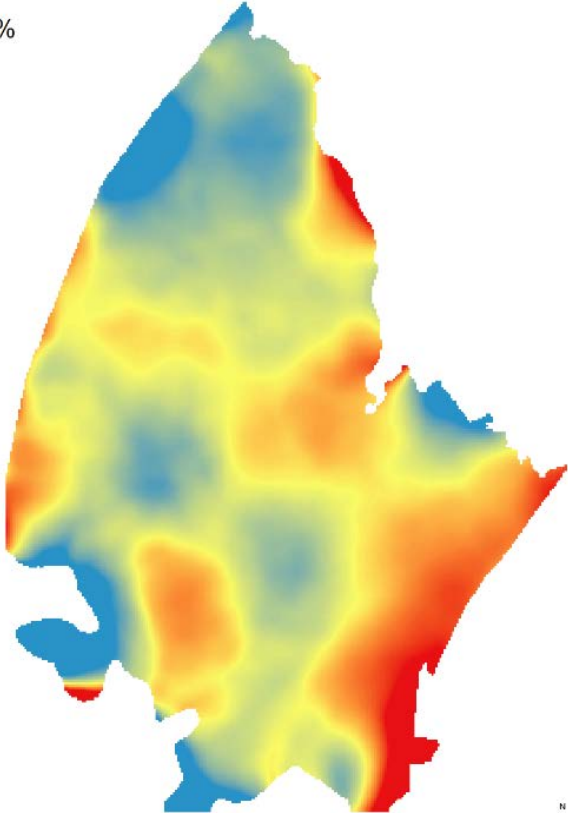
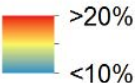
Dry Blood Spot (DBS) specimen collection

Africa Centre Demographic Information System Surveillance

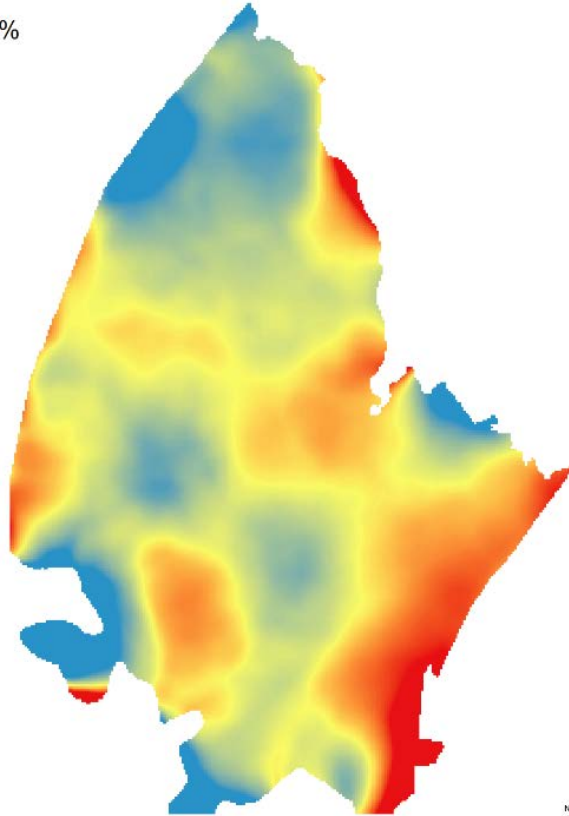
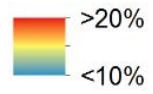


- All participants under surveillance are geo-located to their respective homesteads of residence (accuracy <math><2\text{m}</math>)

HIV prevalence



HIV prevalence

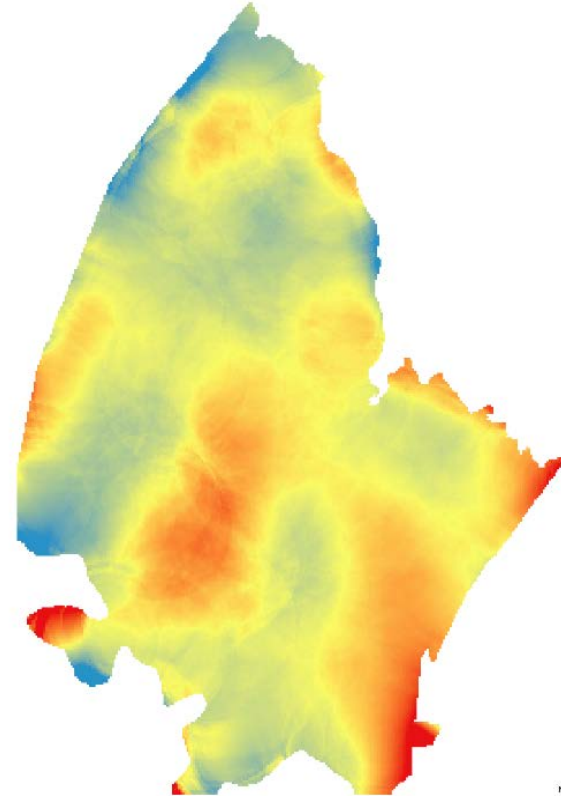
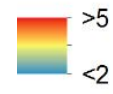


4 2 0 4 Kilometers

A horizontal scale bar with markings at 0, 2, and 4 kilometers.



HIV incidence

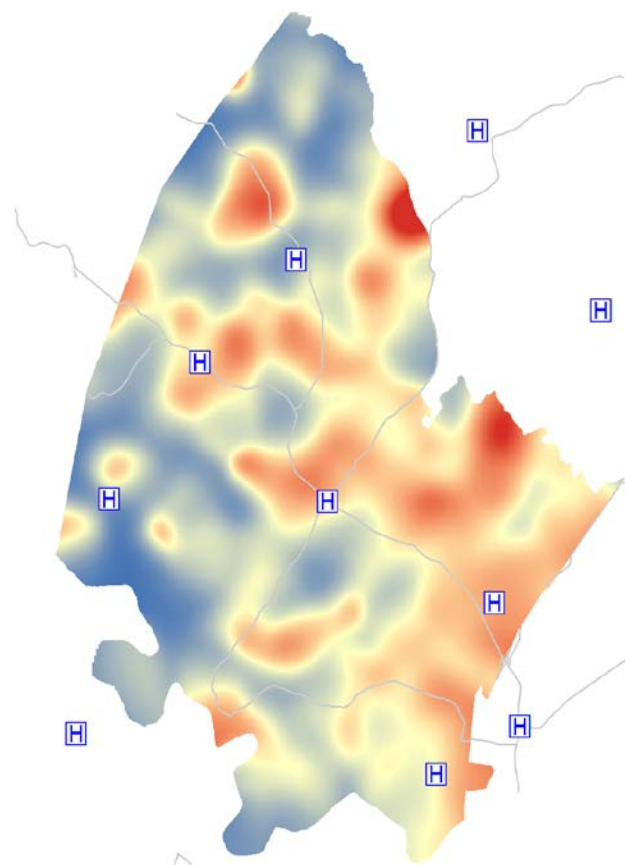
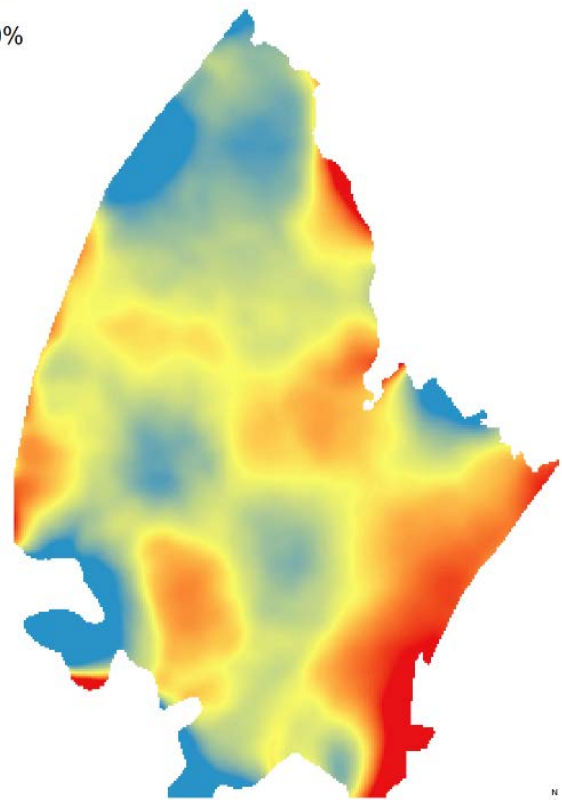
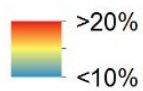


4 2 0 4 Kilometers

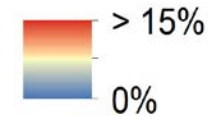
A horizontal scale bar with markings at 0, 2, and 4 kilometers.



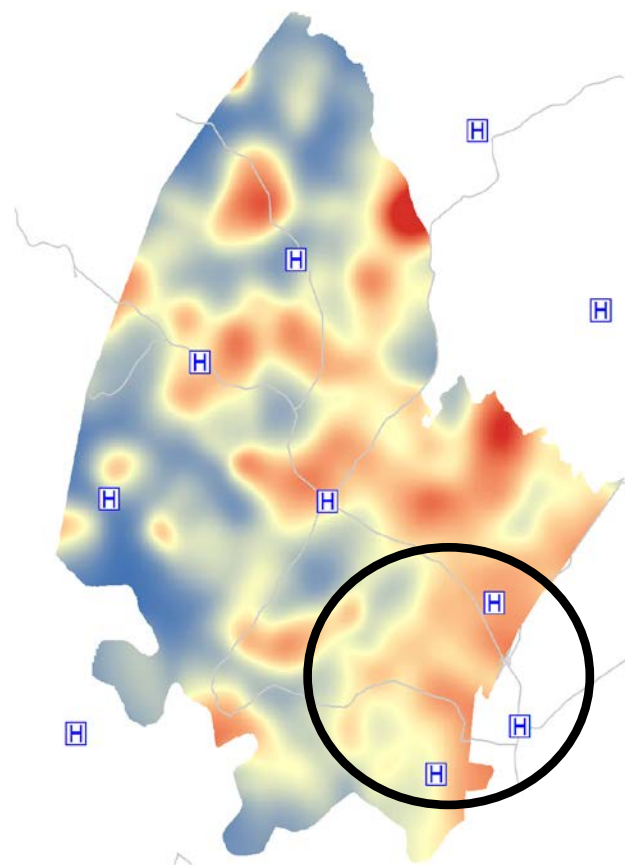
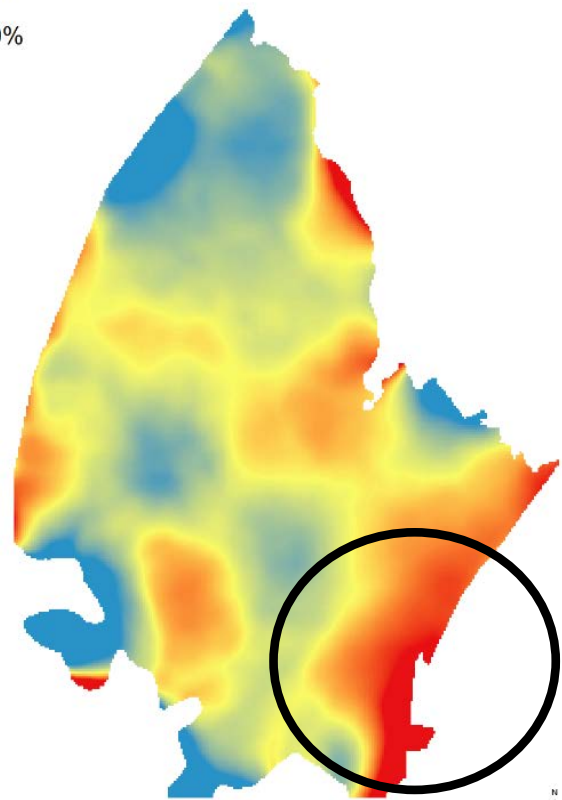
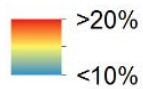
HIV prevalence



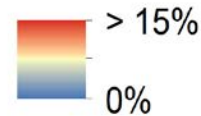
Prevalence of detectable viremia



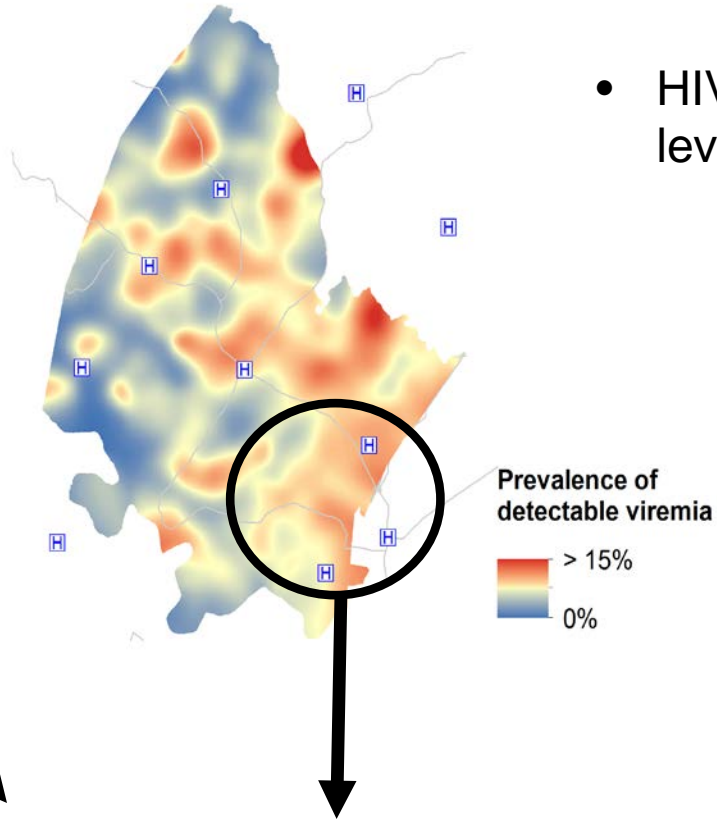
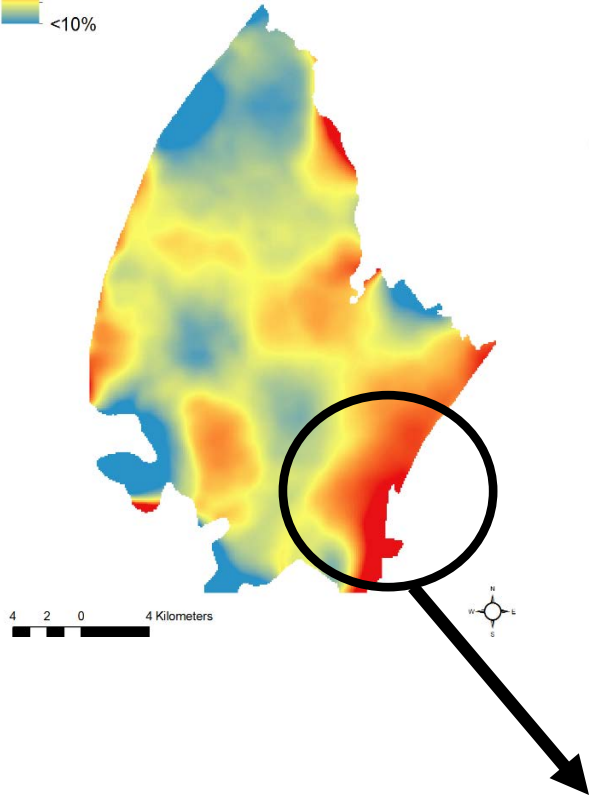
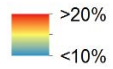
HIV prevalence



Prevalence of detectable viremia



HIV prevalence



- HIV hotspot sustains high levels of virus transmission

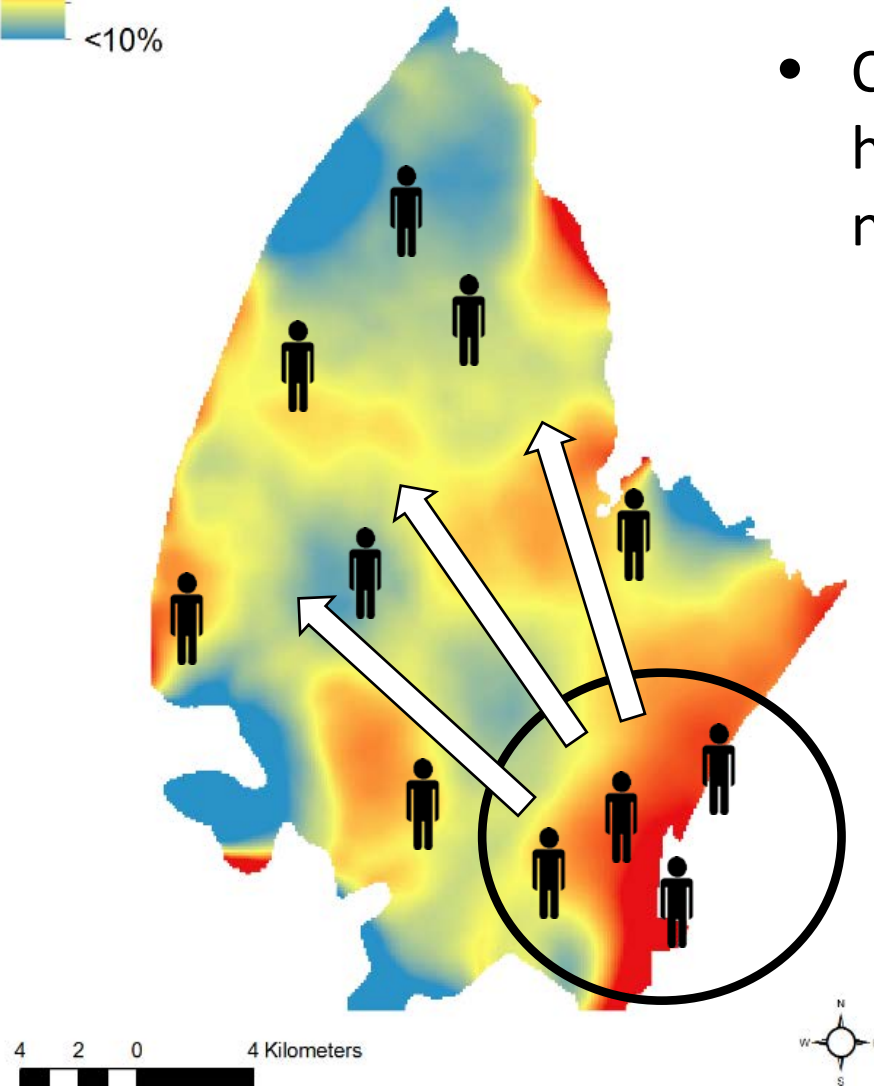
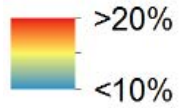
High Viral load



HIV Transmission

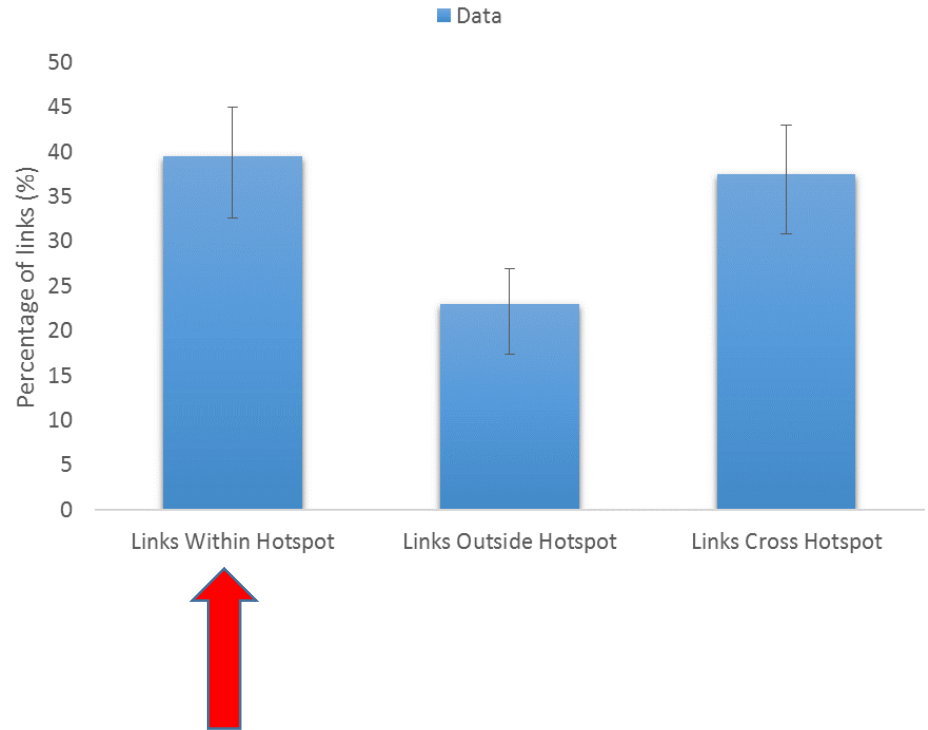
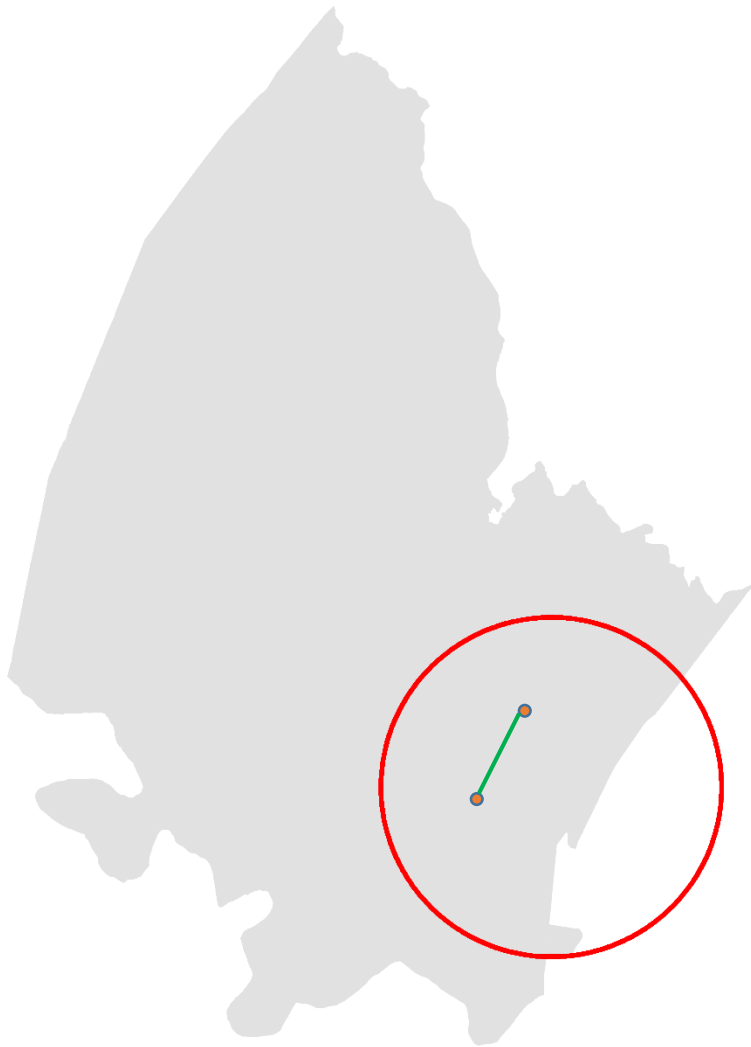


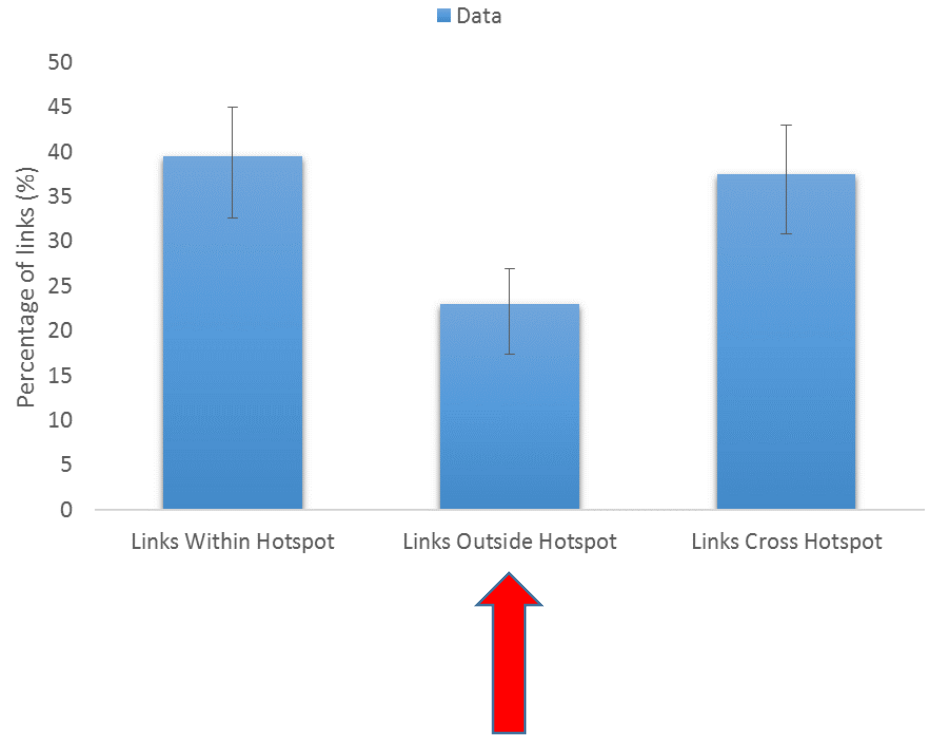
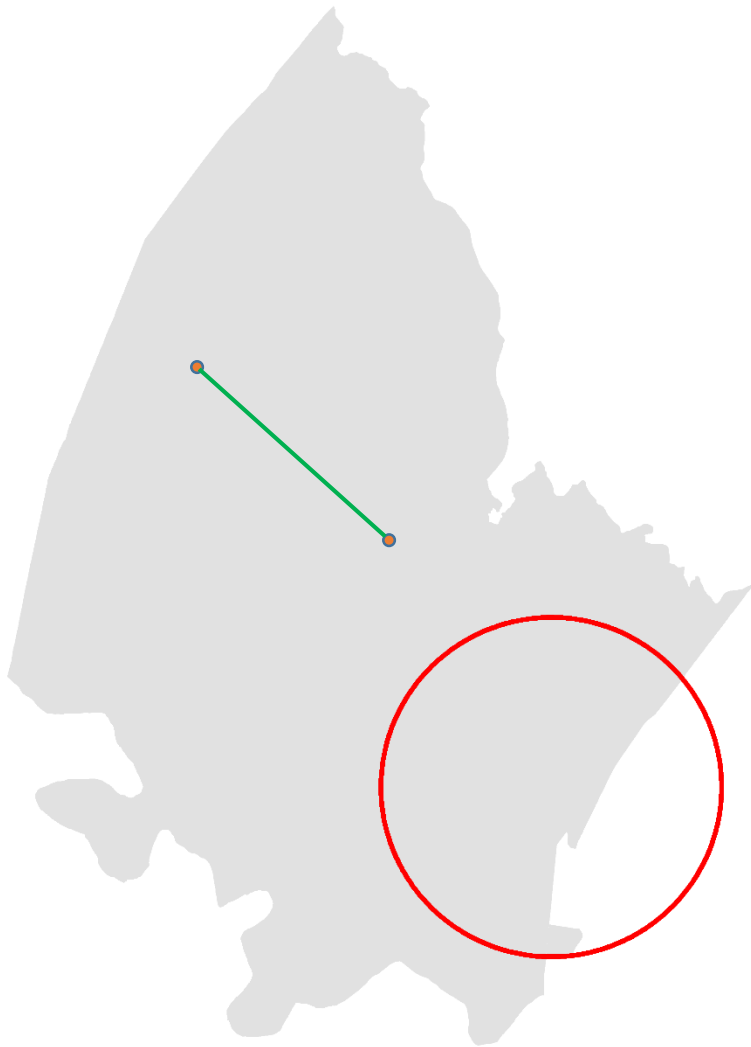
HIV prevalence

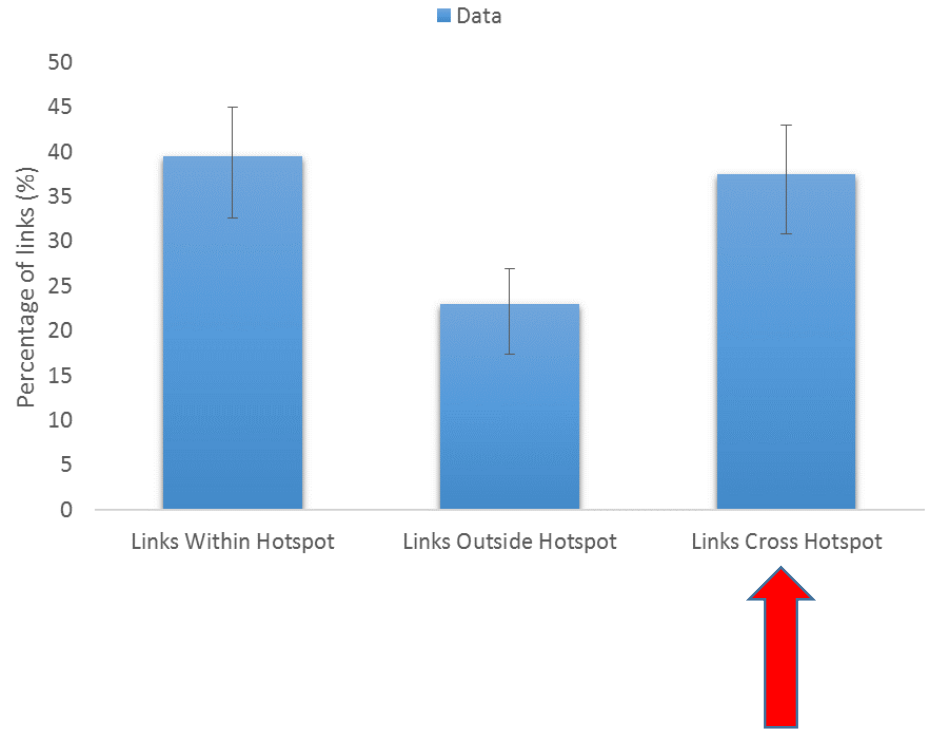
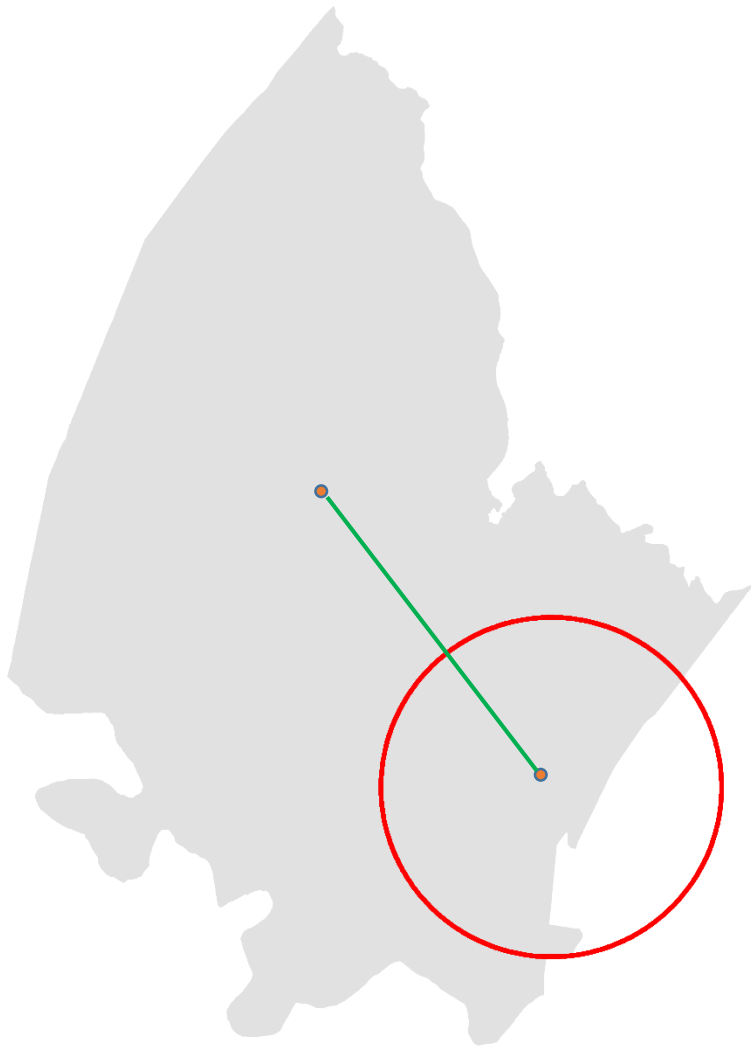


- Contribution of the HIV hotspot in the transmission network

Phylogeographical approach to reveal the geography of HIV transmission networks



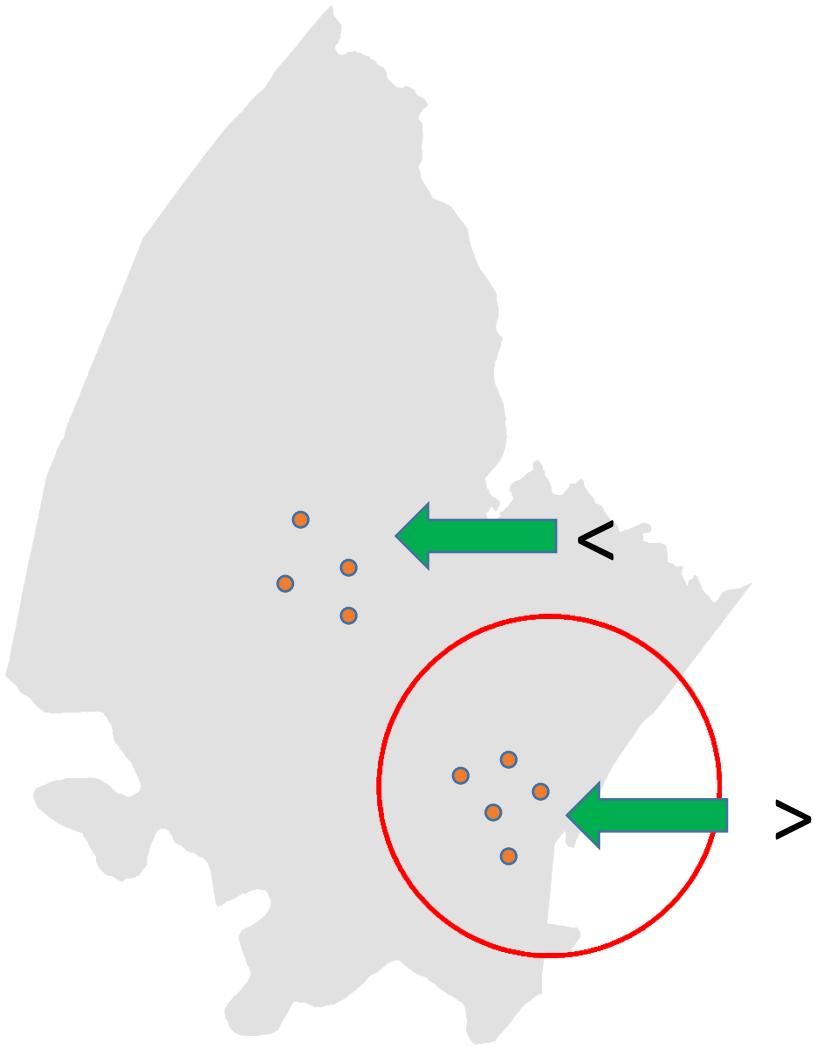




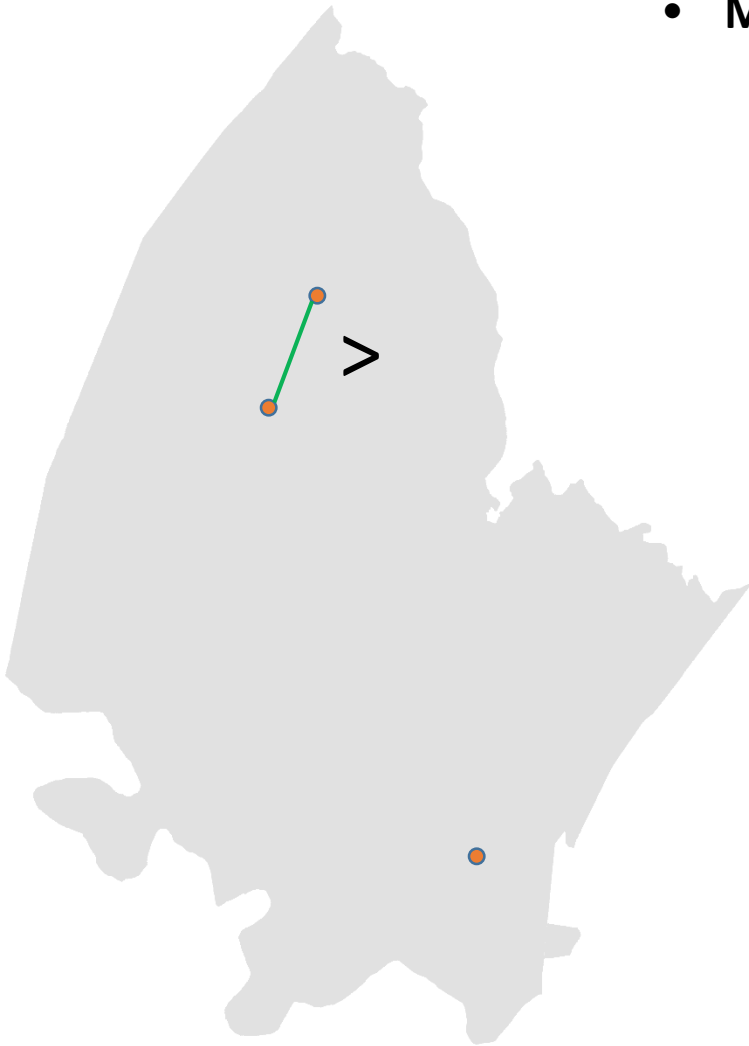
Three microsimulation models were generated to assess the association between the HIV hotspot and HIV transmission links

- **Model 1.** Epicenter model
- **Model 2.** Distance decay link formation model
- **Model 3.** Random links formation model

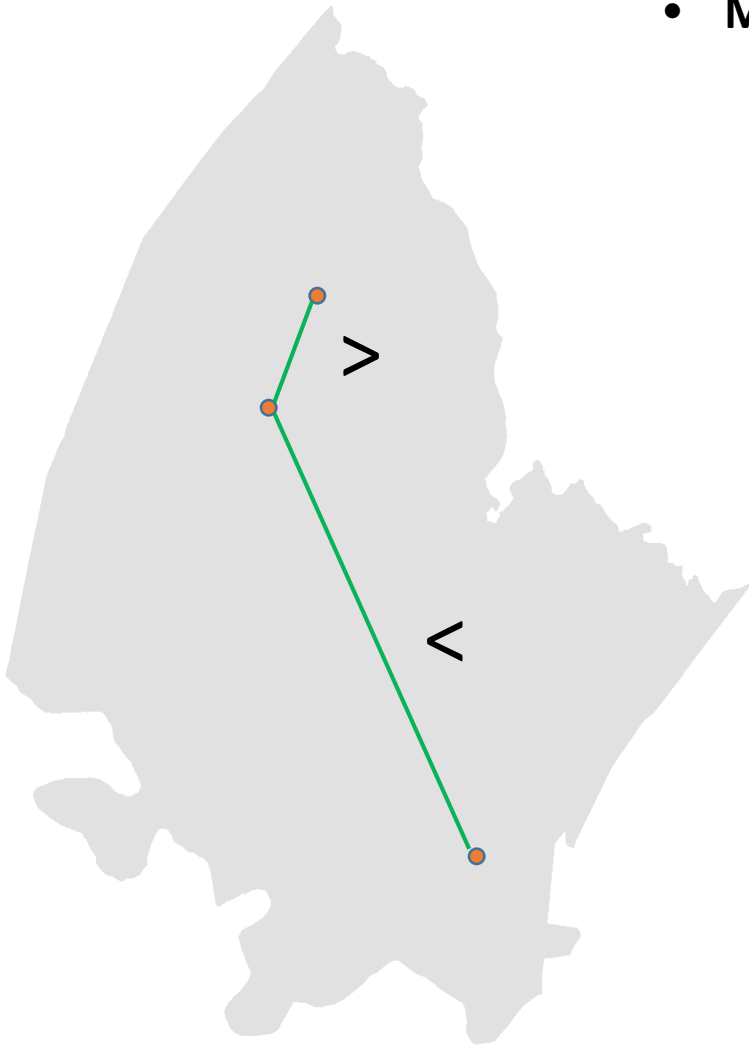
- **Model 1. Epicenter model**



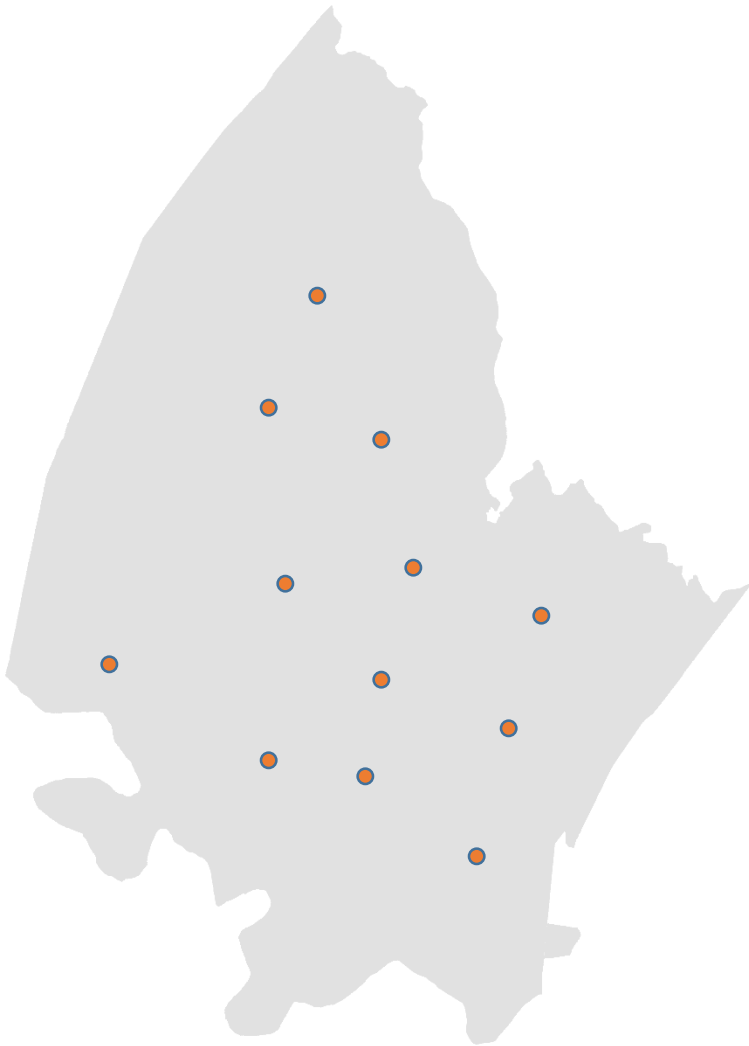
- **Model 2.** Distance decay link formation model

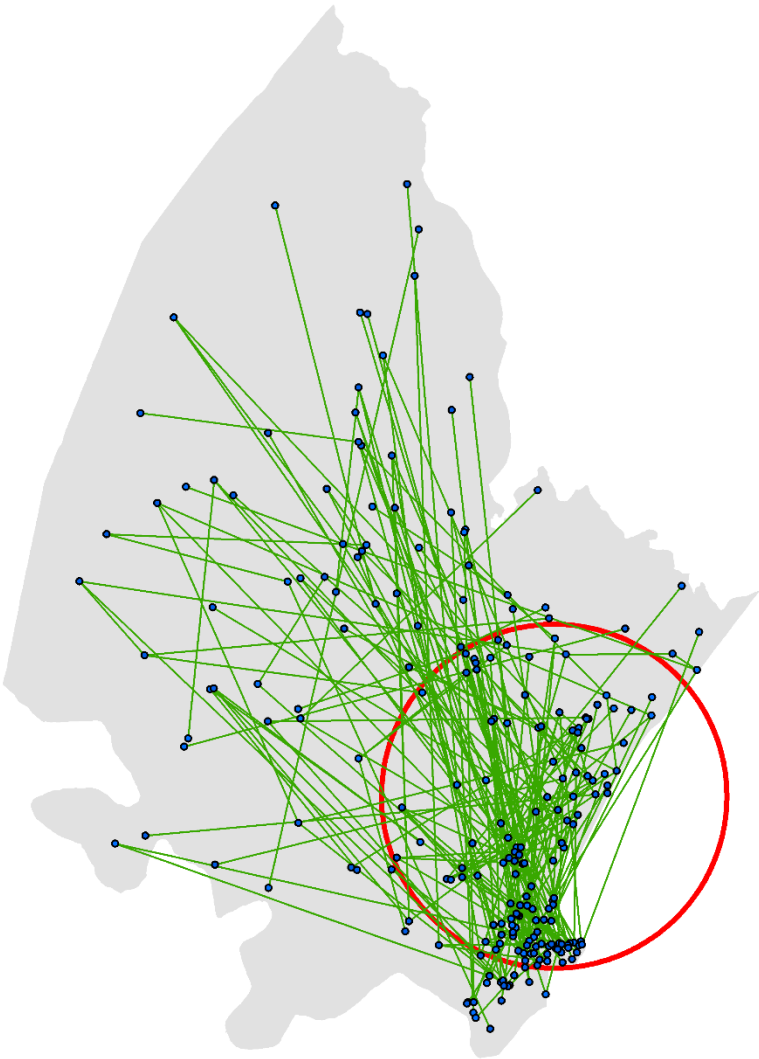


- **Model 2.** Distance decay link formation model

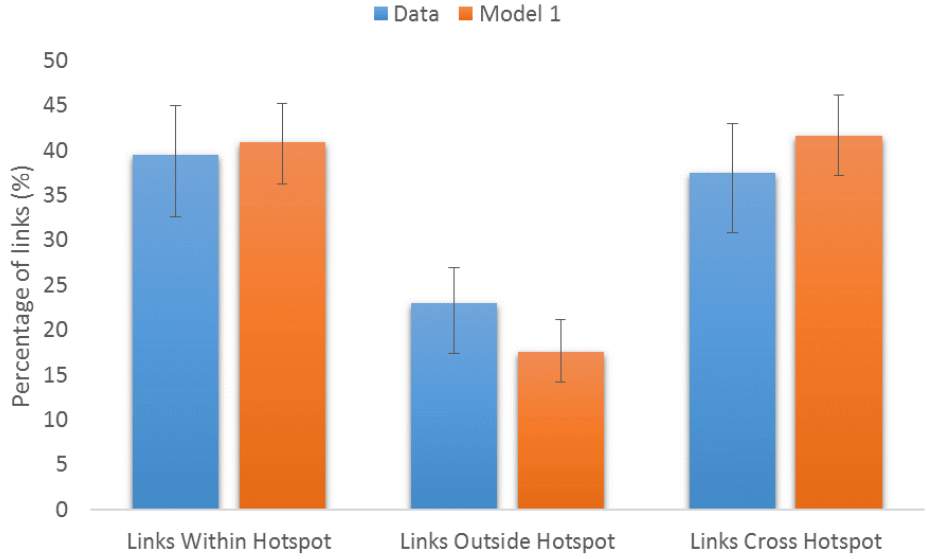


- **Model 3.** Random links formation model

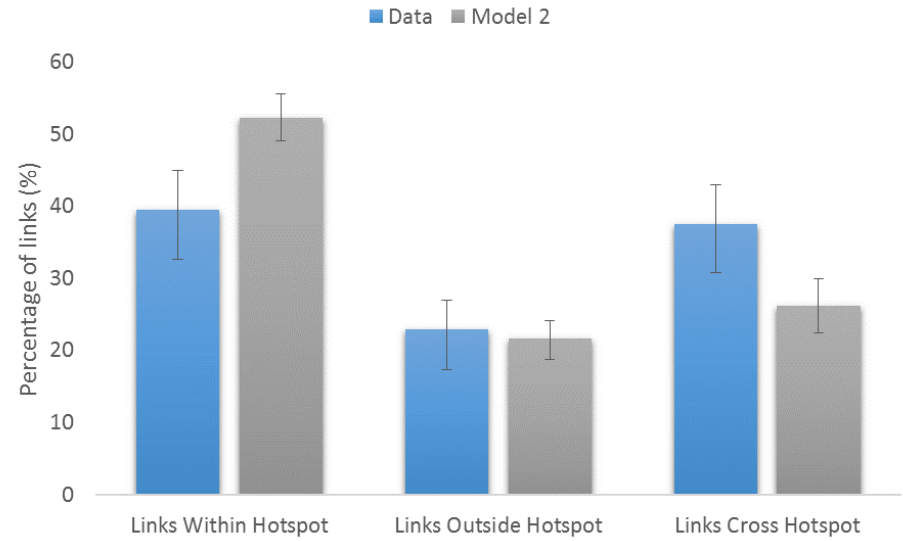
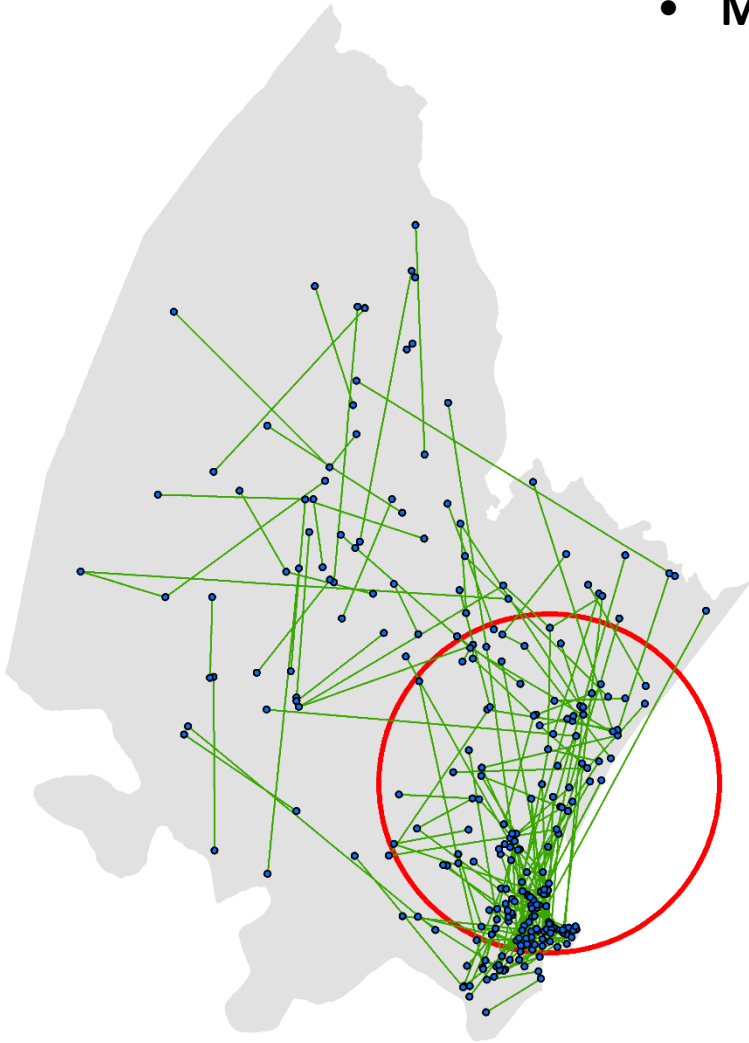




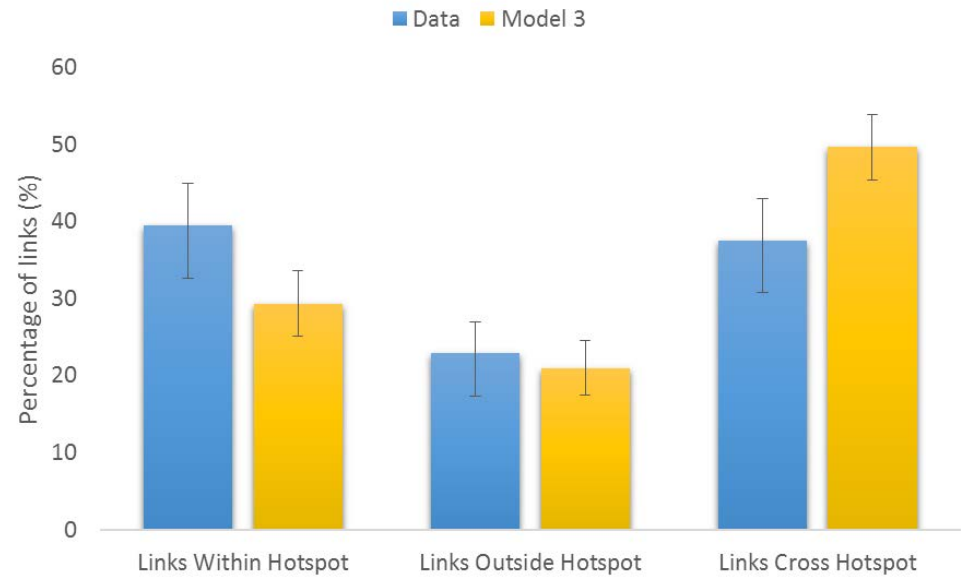
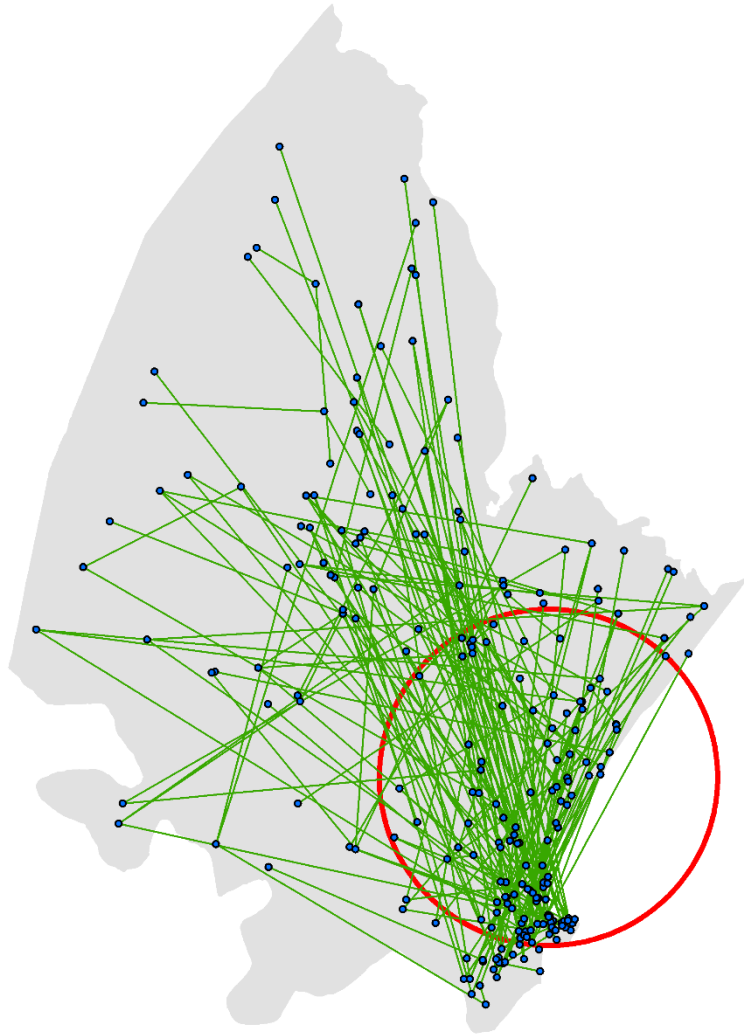
- **Model 1. Epicenter model**



- **Model 2.** Distance decay link formation model



- **Model 3.** Random links formation model



General Conclusions

- HIV hotspots evidence the location of populations at high risk if HIV infection
- These hotspots might play a key role in the HIV transmission network and could substantially contribute to the dispersion of the infection
- Disrupting the transmission network using geographically targeted interventions could be an effective strategy aimed to optimize resources and maximize the impact on the epidemic in SSA



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wellcometrust

