Geo-Information and Zero-Inflated Poisson Regression Analysis for showing risk areas of Schistosomiasis mansoni in Rwanda

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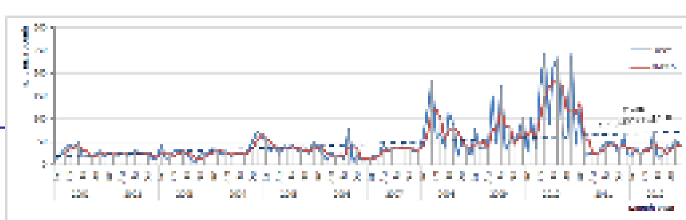
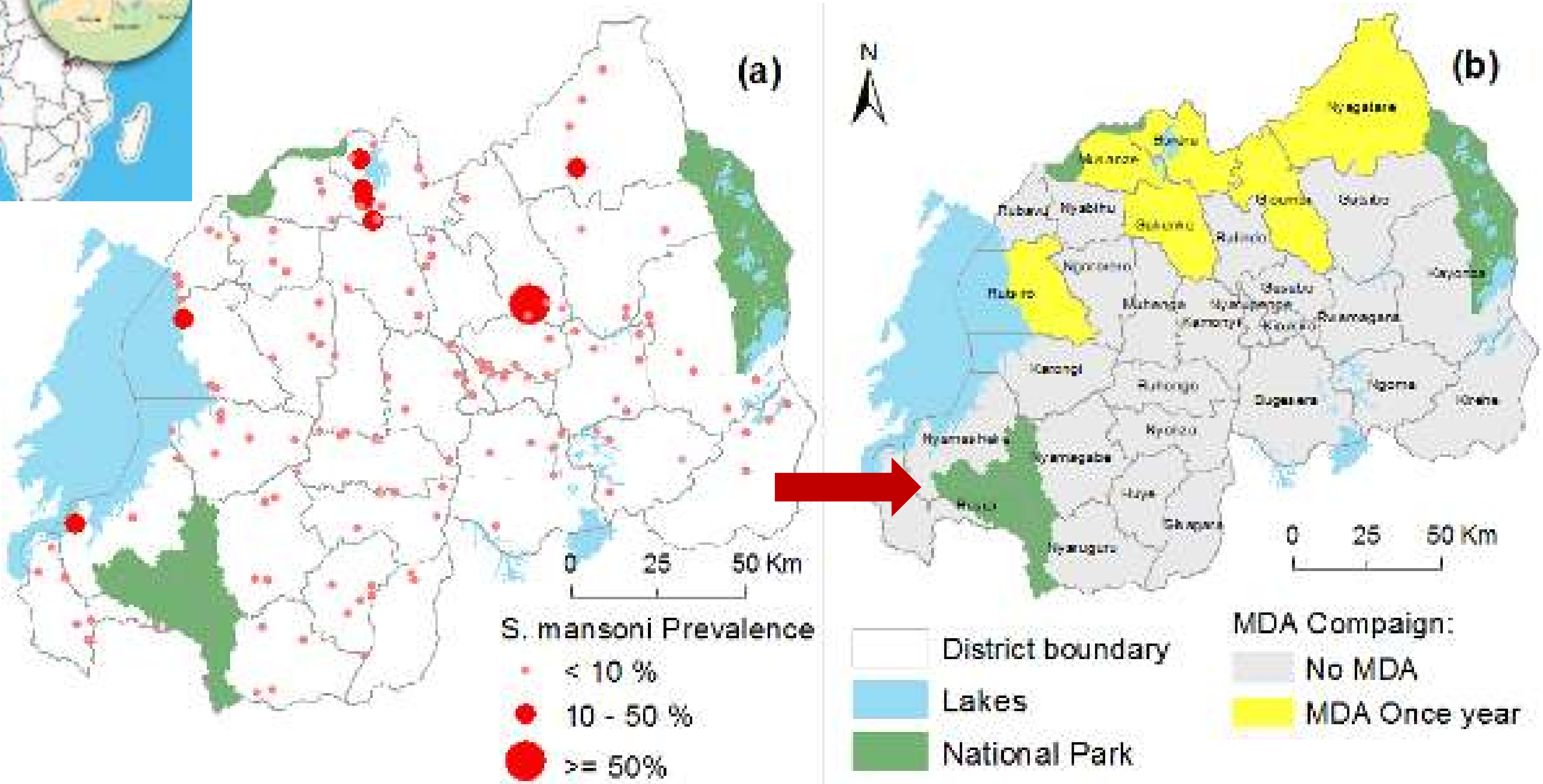


SCHISTOSOMIASIS & NTD CONTROL IN RWANDA

Low Spatial and Low Temporal Resolution



Prevalence map from 2007/2008 school based prevalence survey (a), Districts prioritized for Mass Drug Administration (MDA)(b).

Country prevalence: 2.7%, District: 0-70% (school children)

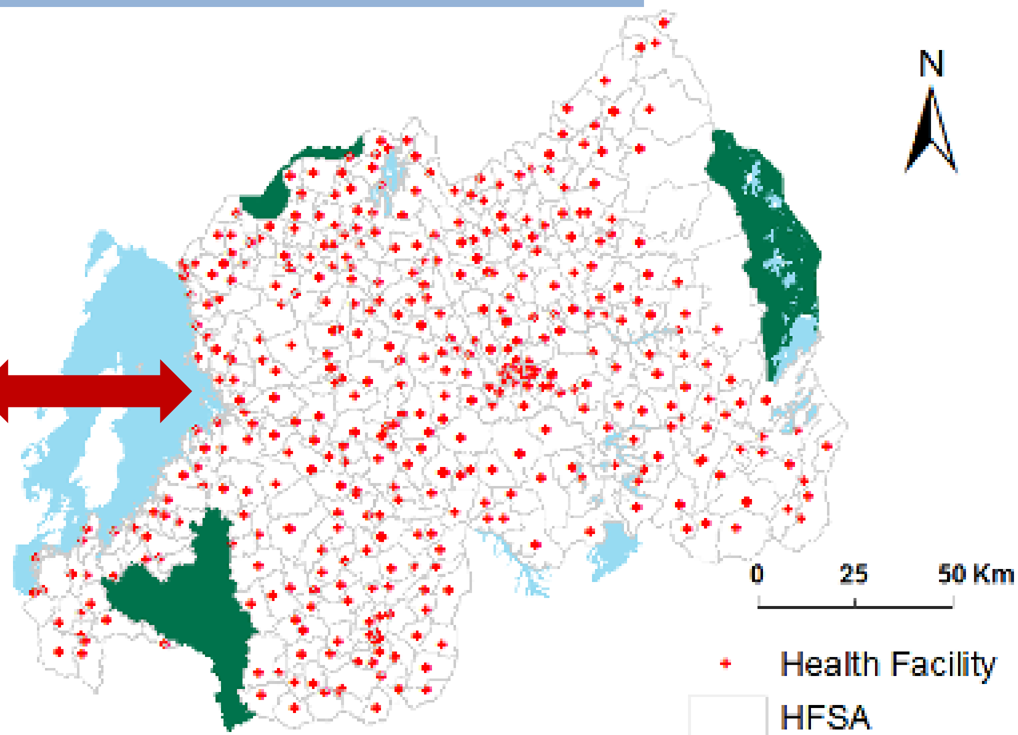
Objectives

- To model the dynamic spatial pattern of schistosomiasis risk in Rwanda using a geostatistical model accounting for false zero cases,
- To develop a scenario for identification of potential future risk areas: should the current trends of the risk factors continue up to 2050, what would be the future spatial distribution of the risk of schistosomiasis?

NOVELTY: USE OF ROUTINELY COLLECTED CASE DATA

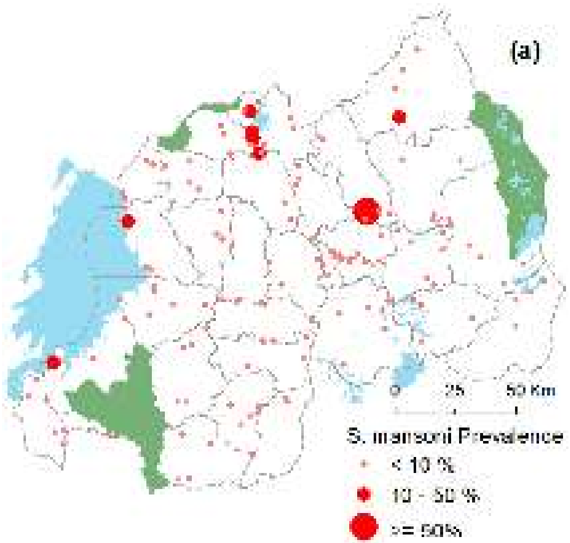
High Spatial and High Temporal Resolution

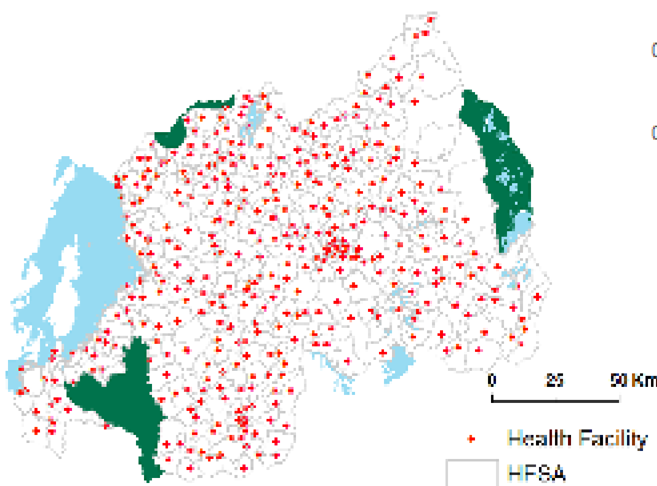
Laboratory confirmed Schistosomiasis cases collected monthly at health facility level, 2001 – 2012

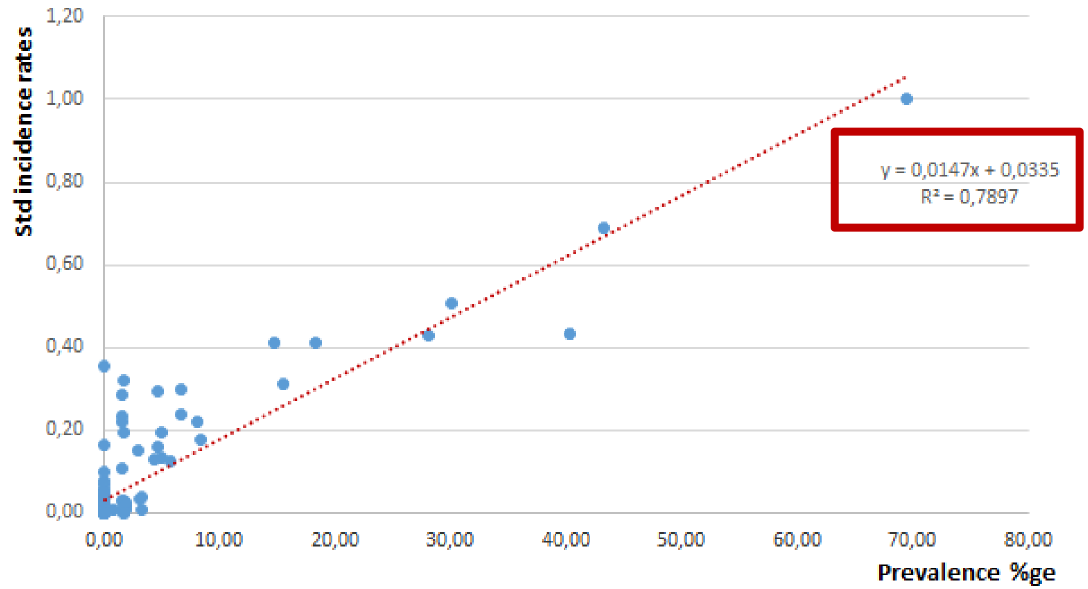


Health Facility Service Areas accurately delineated and fused with population data from 2002 and 2012 Census

prevalence - incidence data: high correlation

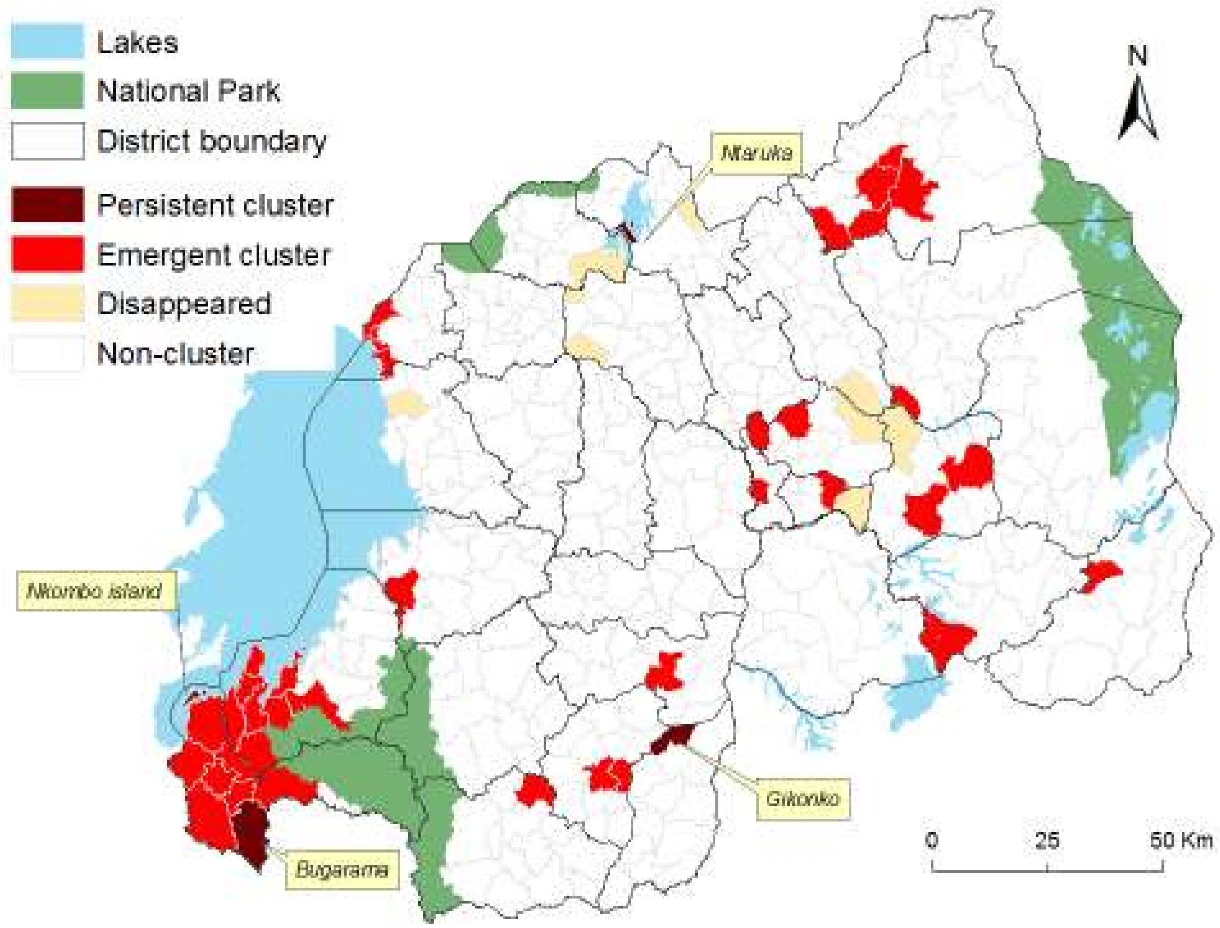






Prevalence at surveyed schools compared to incidence in corresponding HFSA

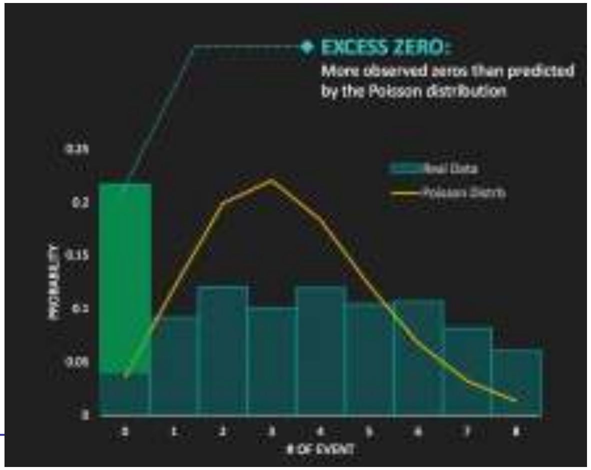
SPATIO-TEMPORAL DYNAMICS OF SCHISTOSOMIASIS TRANSMISSION 2001 – 2012 (SATSCAN)



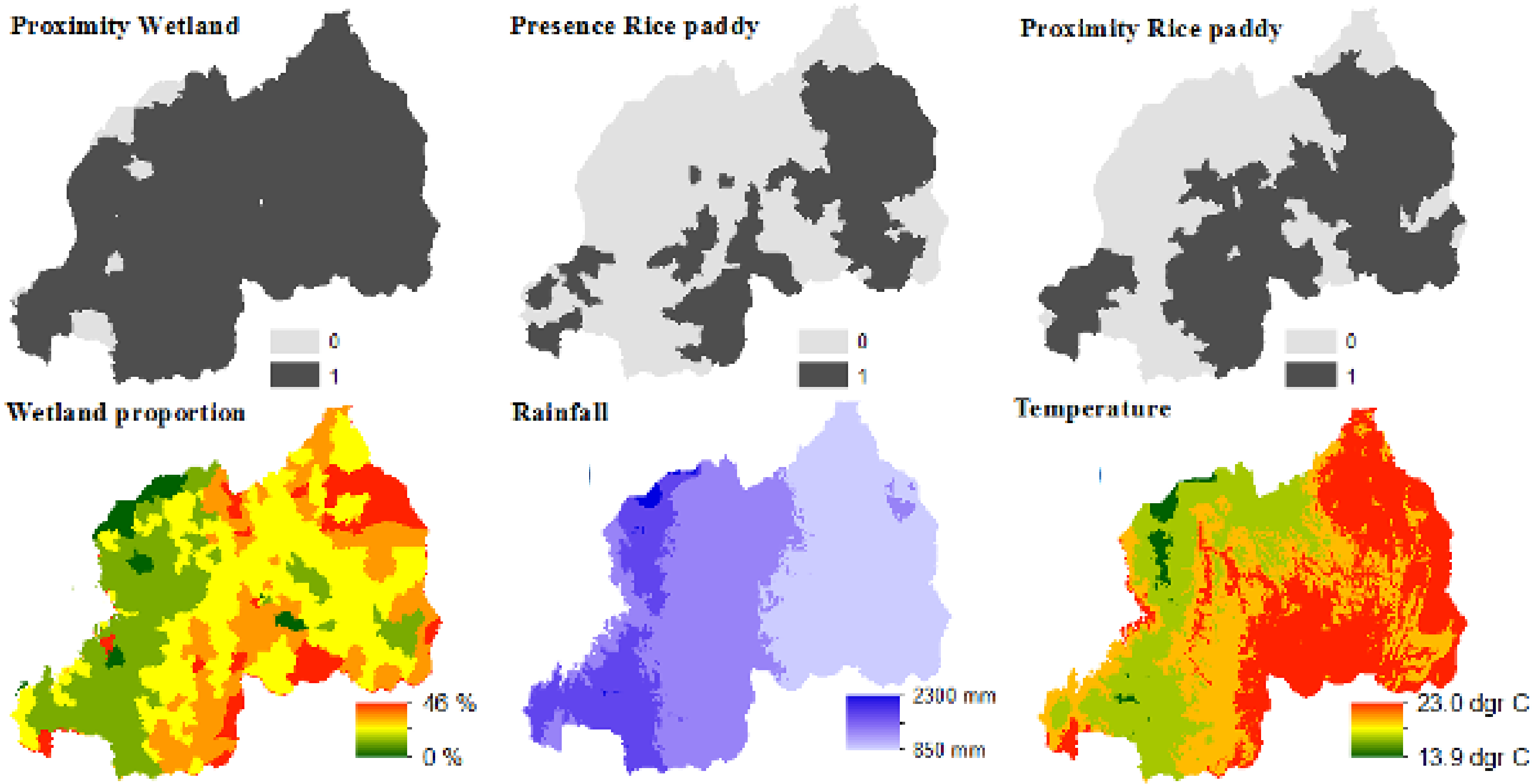
Modelling schistosomiasis risk areas

- Generate Zero Inflated Poisson (ZIP) regression model for 2001-2009 based on covariates identified by Nyandwi et al. 2017
- Use ZIP model to forecast schistosomiasis risk in 2050 accounting for
  - expected rainfall and temperature changes and their combined effect on spatial distribution of wetlands
  - planned expansion of intensified agricultural use of wetlands (*i.e.* rice cultivation)

Why ZIP: count data, over-dispersion, large number of zero counts at HFSA level



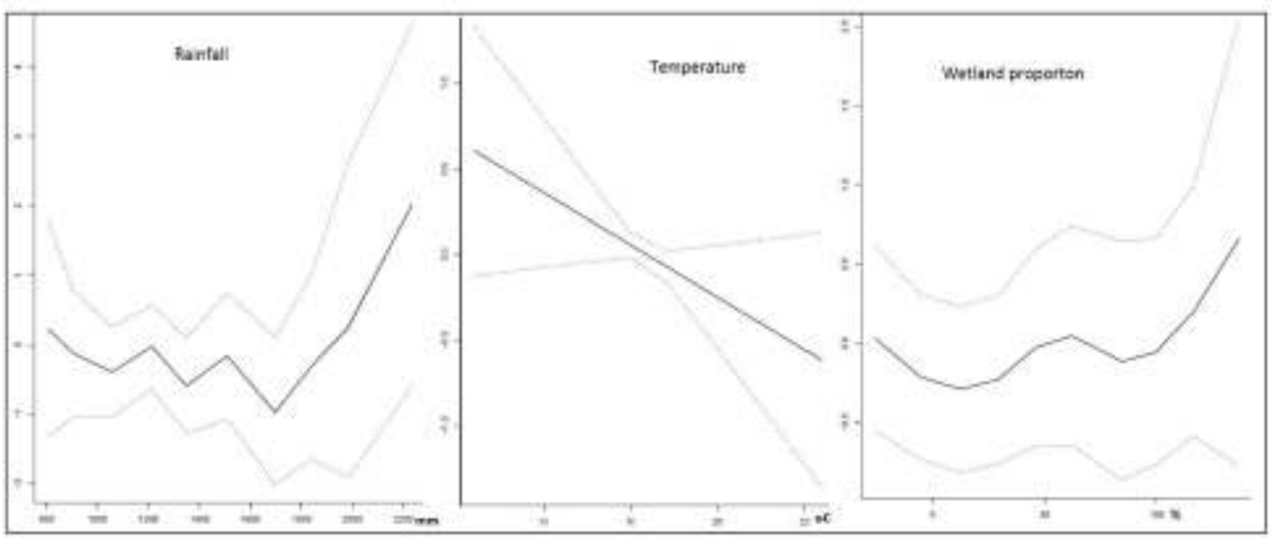
Schistosomiasis transmission – covariates



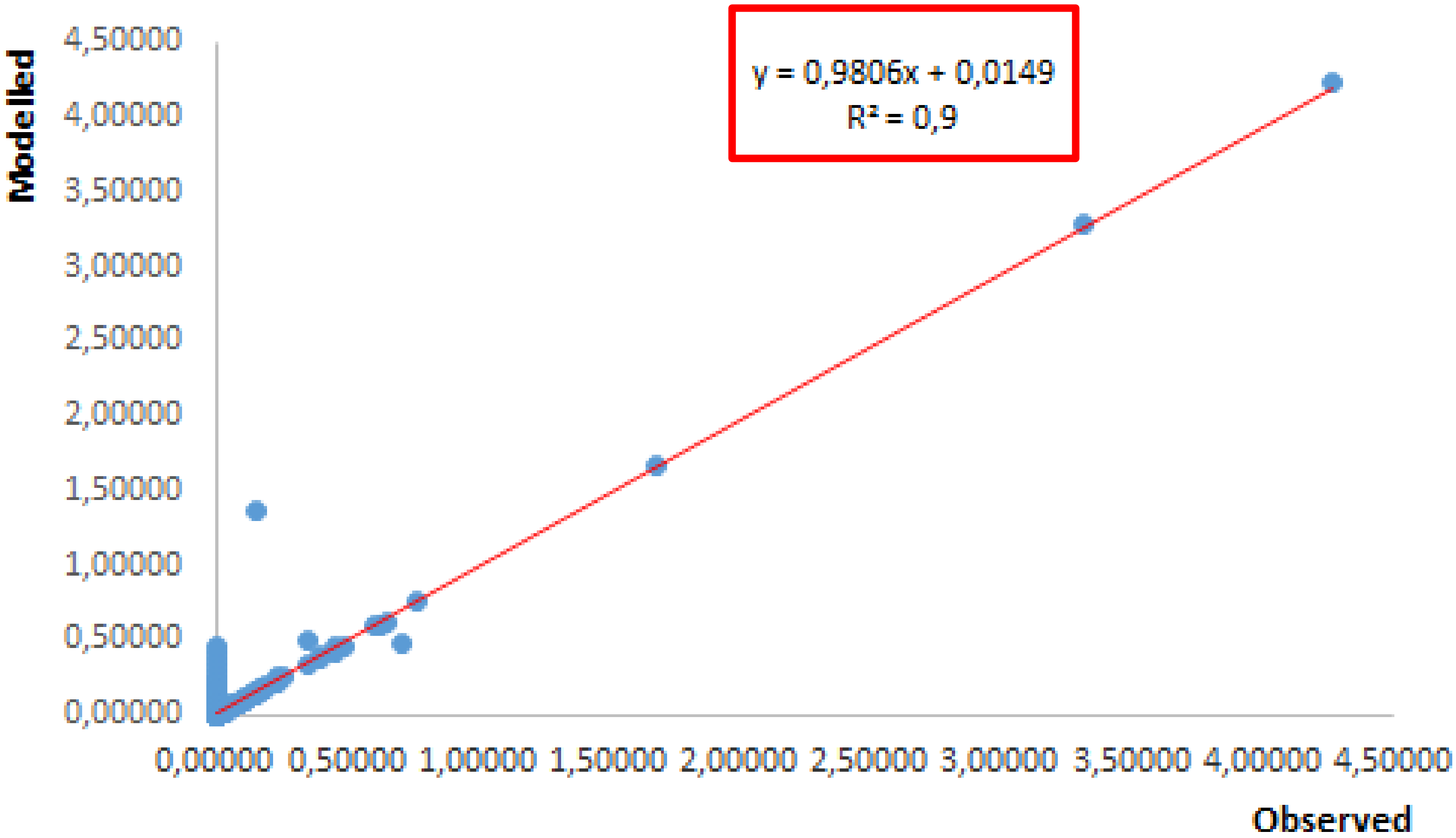
Covariates extracted for each Health Facility Service Area (HFSA)

ZIP Model: categorical and continuous covariates

		Model 1			Model 2	
Parameters	Mean	$Q_{0.025}$	$Q_{0.975}$	Mean	$Q_{0.025}$	$Q_{0.975}$
β_0	0.000134	0.000069	0.000263	0.0000785	0.00003	0.00019
γ_{Rice}	1.397	0.882	2.2071	1.688	0.989	2.891
$\gamma_{d_{Sw}}$	1.289	0.765	2.166	1.292	0.669	2.485
$\gamma_{d_{Riv}}$	1.322	0.828	2.098	1.498	0.837	2.693
DIC		4970.10			4547.91	
p_D		296.45			336.84	



Observed versus modelled RR 2001 - 2009



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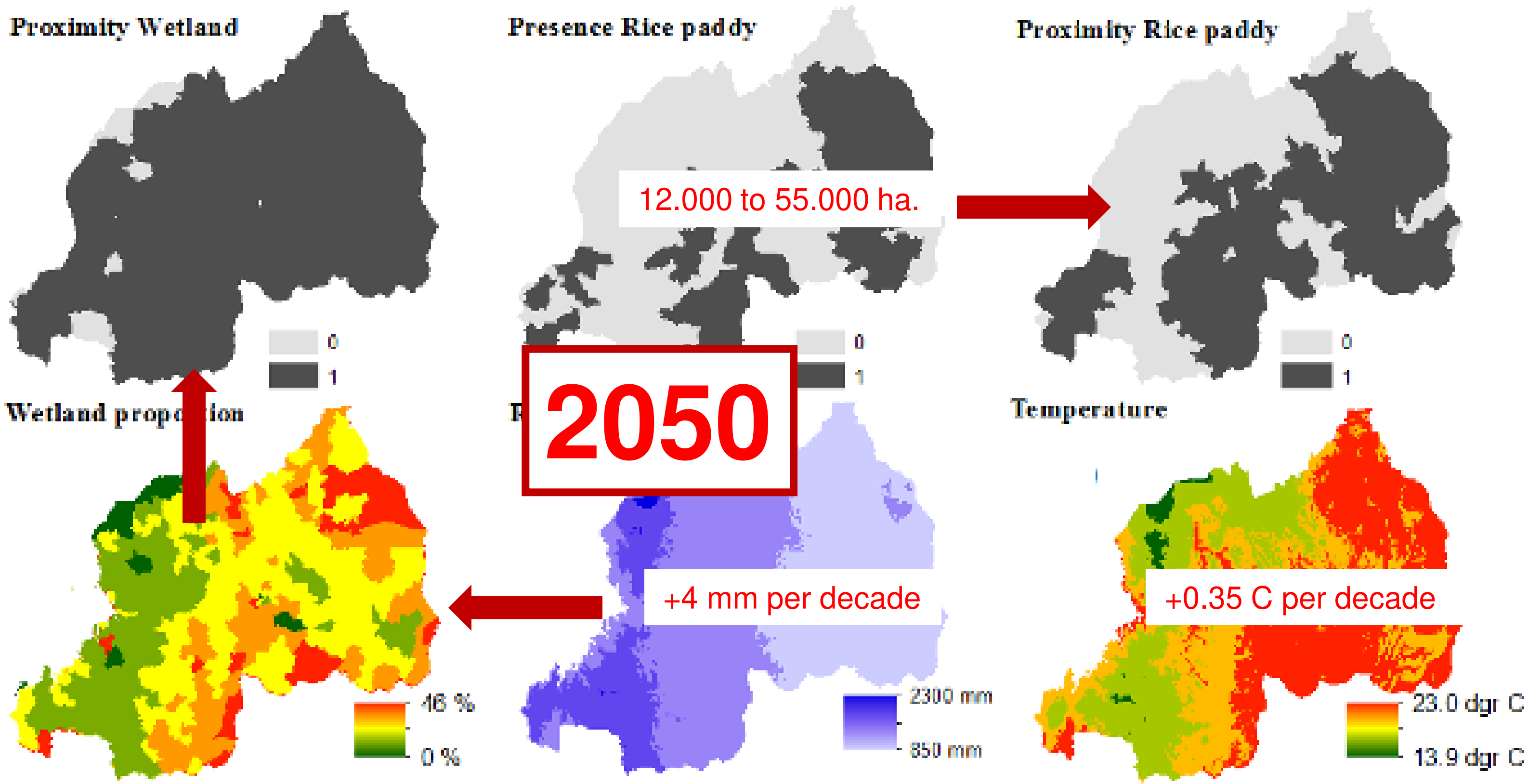
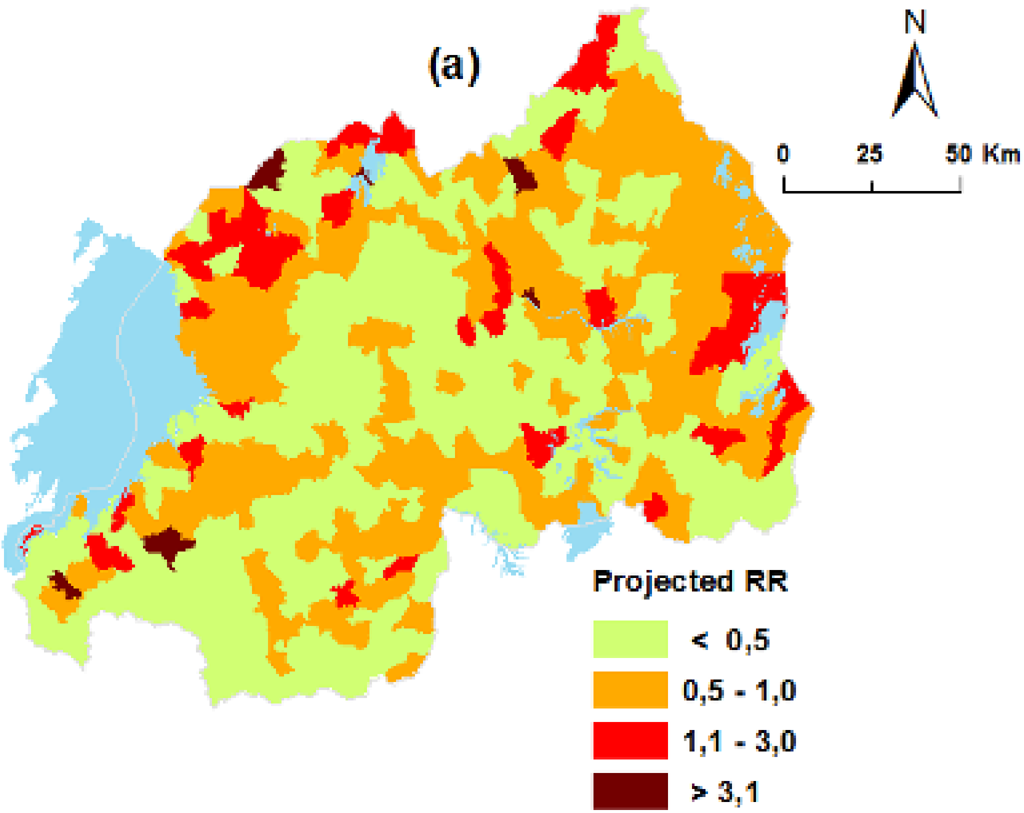
Schistosomiasis transmission – covariates 2050



Covariates extracted for each Health Facility Service Area (HFSA)

Future relative risk of schistosomiasis 2050



Persisting and emerging areas with elevated risk of schistosomiasis transmission:
- HFSA’s with or with close proximity to rice cultivation
- HFSA’s close to waterbodies

Summary and conclusion

Routinely collected case data can be used as complement to prevalence survey data (high spatial and temporal resolution, low-cost, potentially generalizable to other diseases)

Analysis at HFSA level is a suitable spatial scale for modelling, monitoring and mapping of schistosomiasis transmission across space and over time

Acknowledgements

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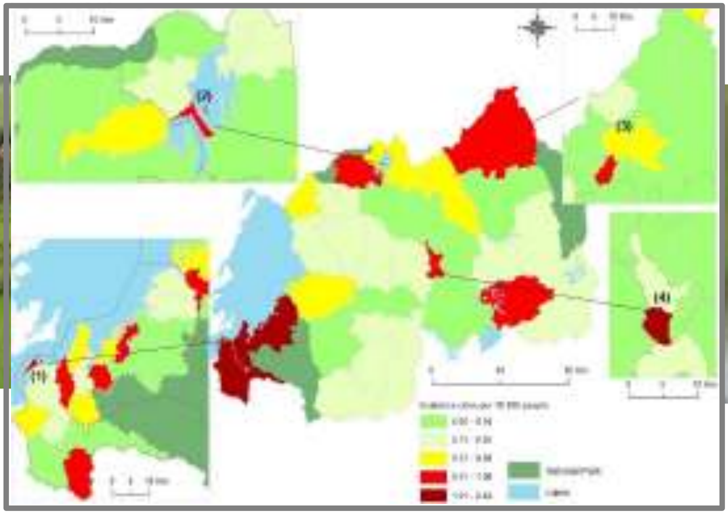
THANKS FOR YOUR ATTENTION



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