DISSERTATION DEFENSE

Spatial Generalized Linear Mixed Models with Application to Prevalence Mapping

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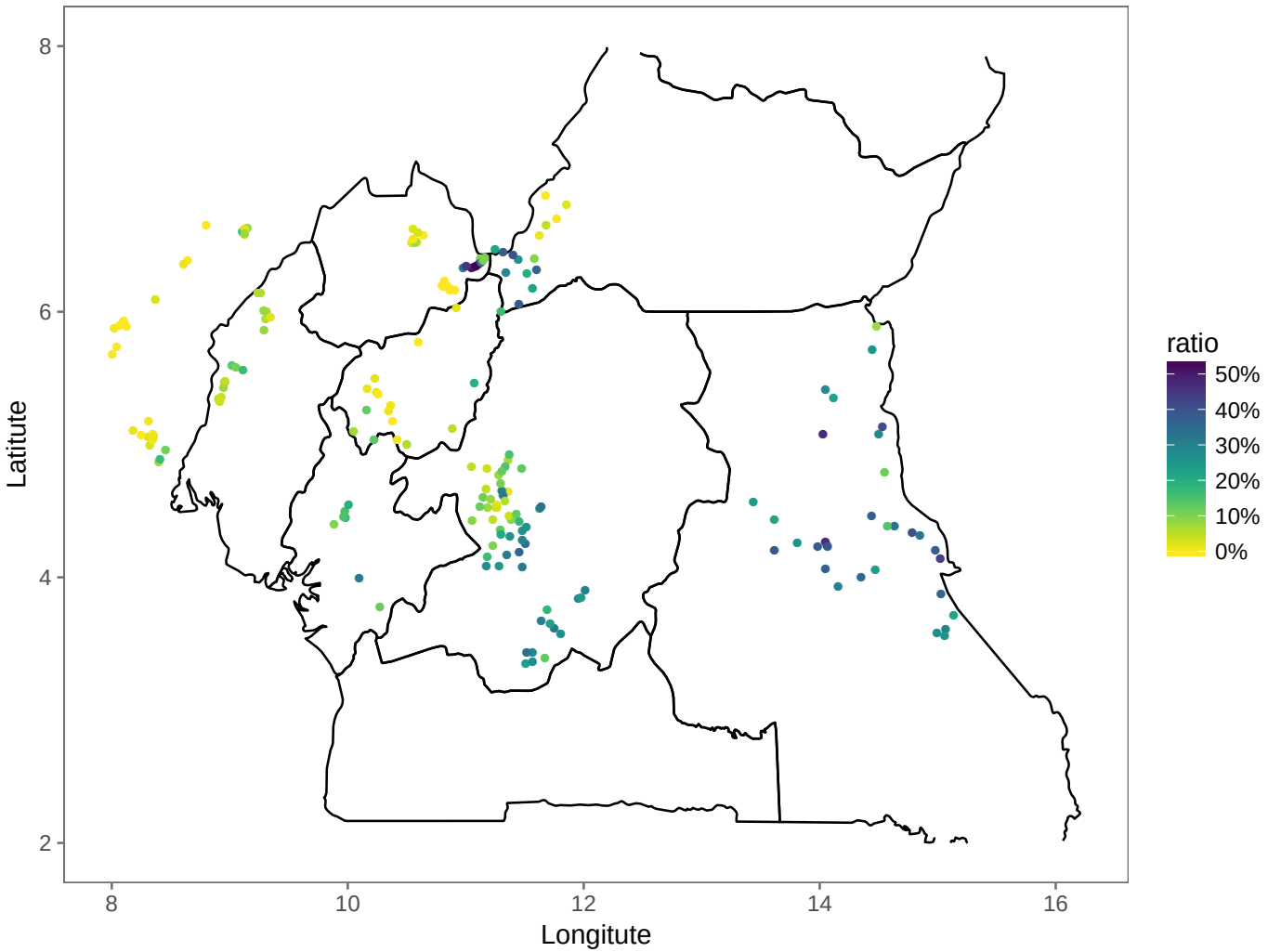
Outline

1. Introduction (Motivations and goals)
2. Literature reviews
3. Geostatistical model (SGLMM)
4. Computing details and simulations
5. Real data analysis (Applications)
6. Discussion


Latitute
8
6
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2
8
10
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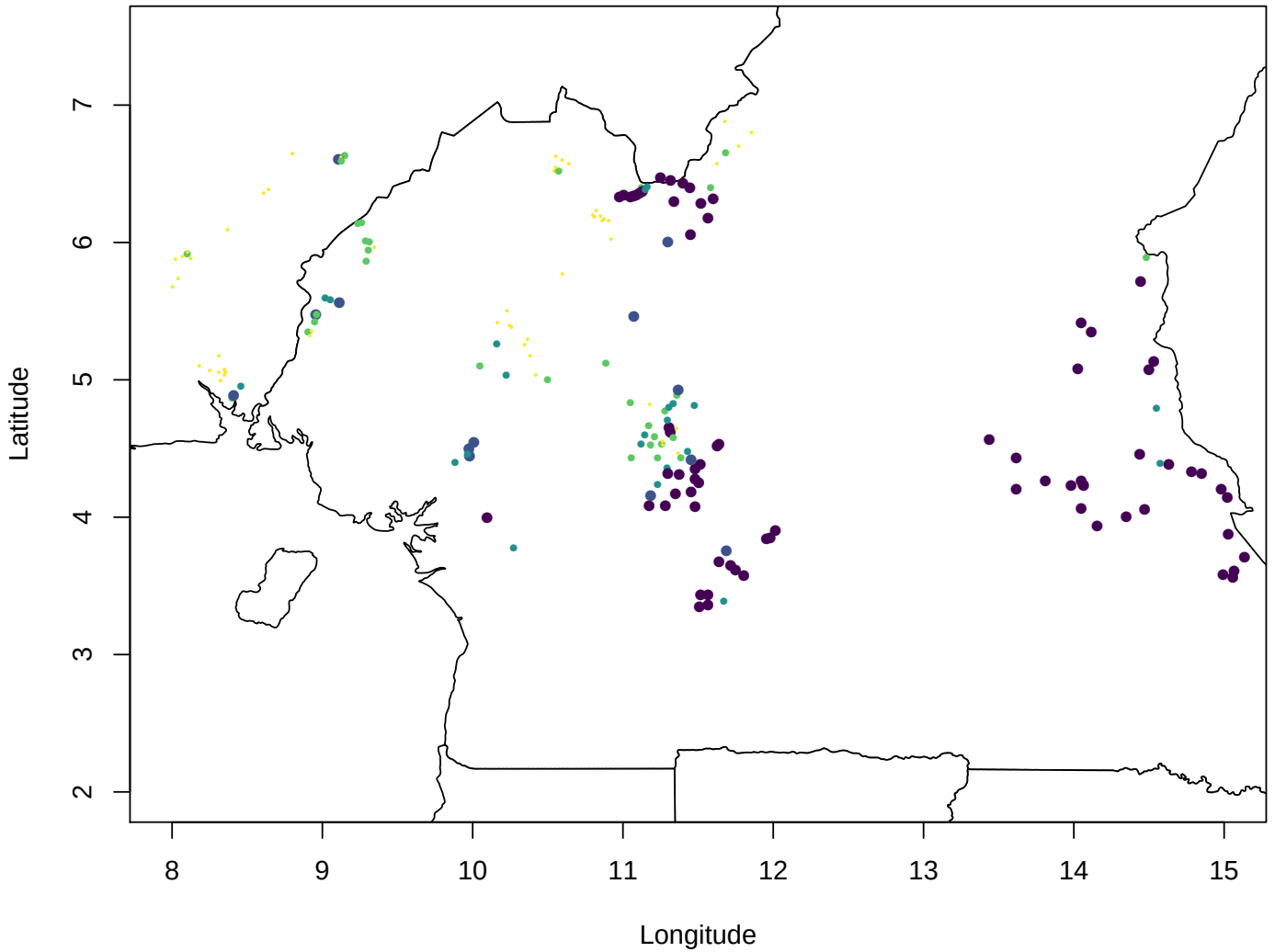
14
16
Longitute
ratio
50%
40%
30%
20%
10%
0%


Latitude
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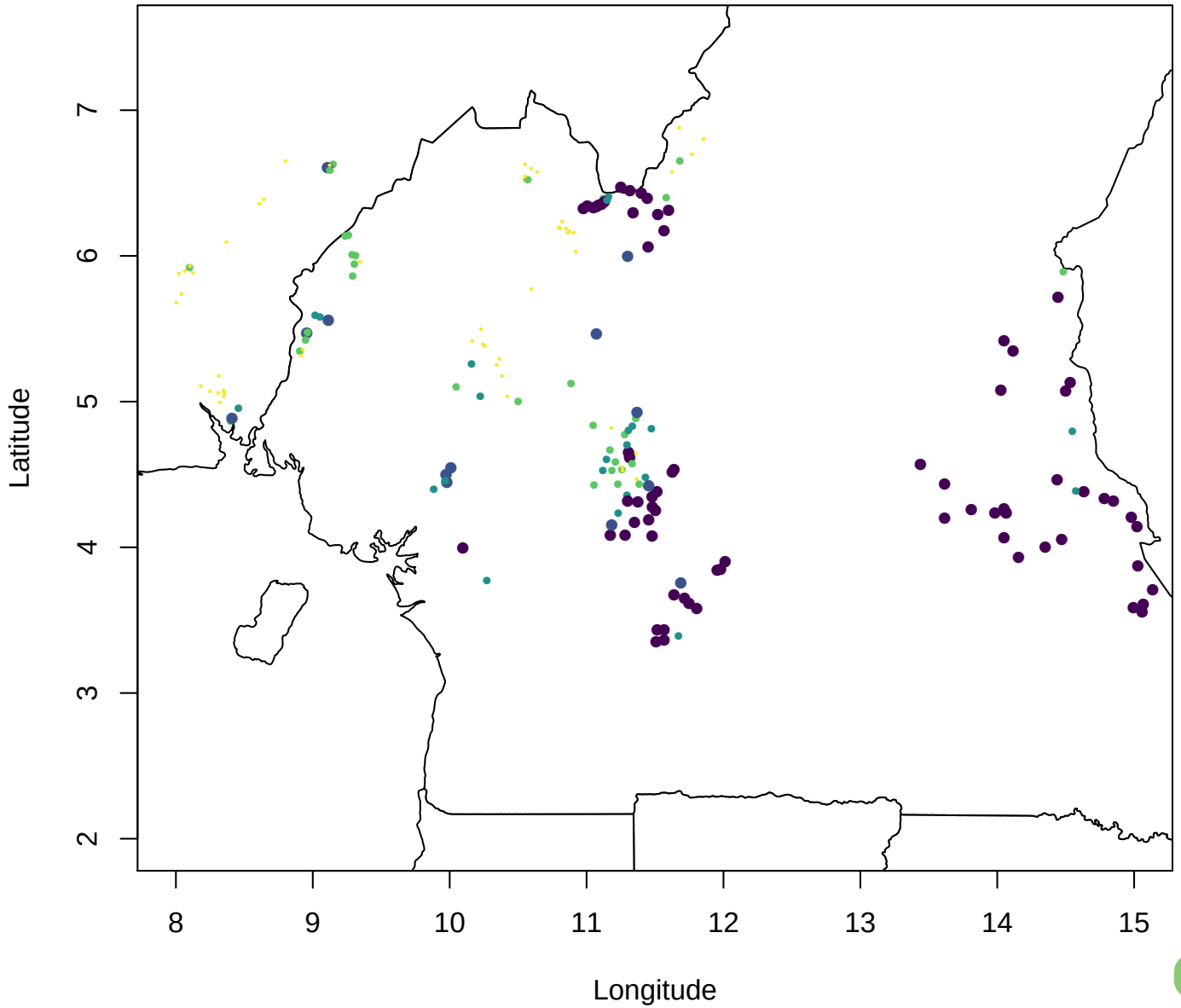
Longitude


Latitude
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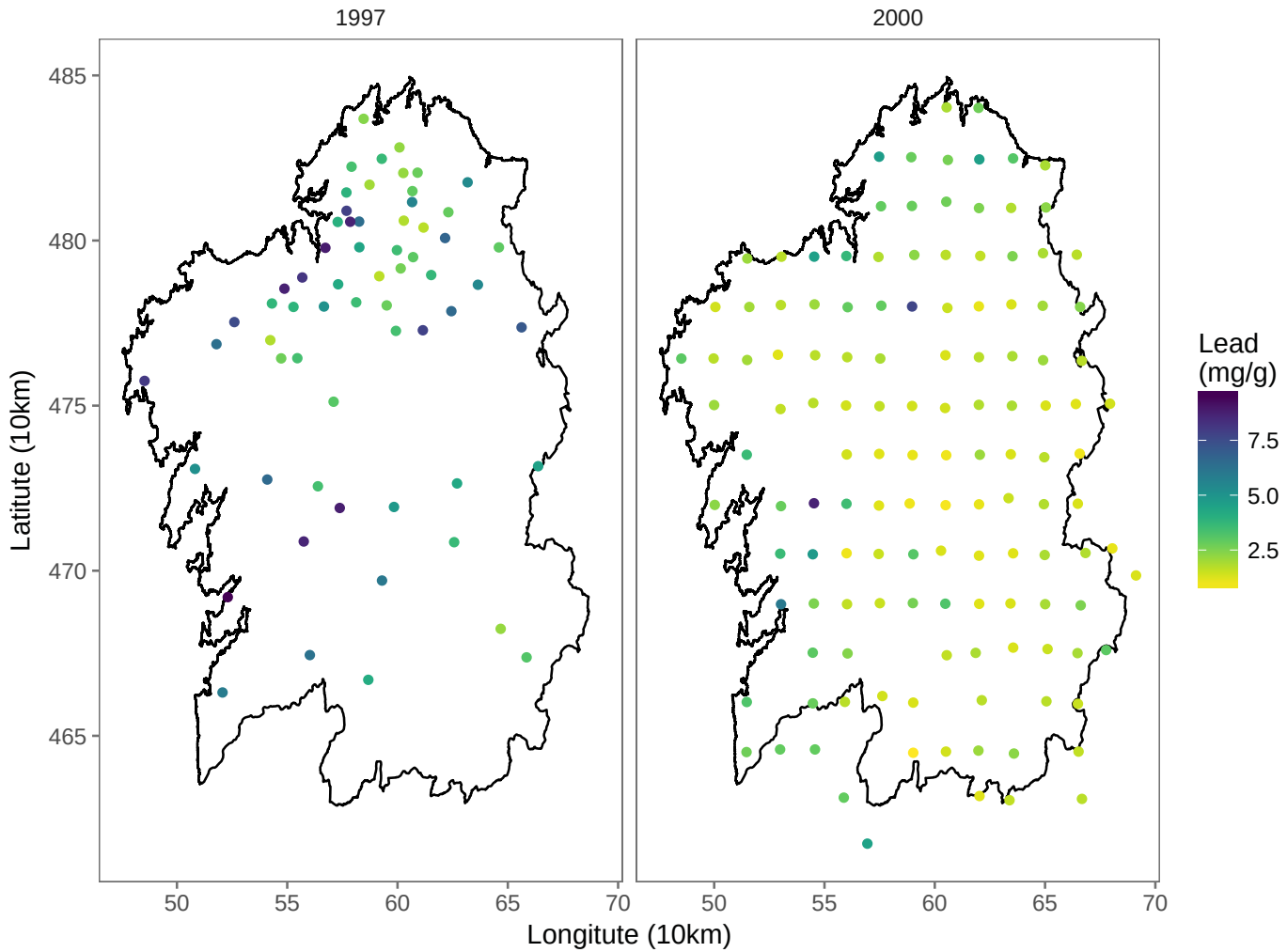
Longitude


1997
2000
485
480
475
470
465
Latitute (10km)
50
55
60
65
70
Longitute (10km)
Lead
(mg/g)
7.5
5.0
2.5

Frameworks, Packages and Softwares (1)

R: geoR geoRglm spatial PrevMap
Ribeiro Jr & Diggle (2016); Christensen & Ribeiro Jr (2015); Ripley (2015); Giorgi & Diggle (2016)

Stan: Stan [1] interfaces with R (RStan) ,Python (PyStan) , MATLAB (MatlabStan) and more
Gelman *et al.* (2015); Bob *et al.* (2017)

PyMC3: Probabilistic programming in Python using PyMC3
Salvatier *et al.* (2016)

Frameworks, Packages and Softwares (2)

JAGS: **J**ust **A**nother **G**ibbs **S**ampler [2]
Bayesian hierarchical models using Markov chain Monte Carlo (MCMC)

BUGS: **B**ayesian inference **U**sing **G**ibbs **S**ampling , such as winBUGS, OpenBUGS

R-INLA: **I**ntegrated **N**ested **L**aplace **A**pproximations
Rue *et al.* (2009, 2016); Gómez-Rubio & Rue (2017)

[1] http://mc-stan.org/

[2] https://en.wikipedia.org/wiki/Just_another_Gibbs_sampler

Bob, Carpenter, Andrew, Gelman, Matthew, Hoffman, & et al. 2017. Stan: A Probabilistic Programming Language. *Journal of Statistical Software*, **76**(1), 1–32.

Christensen, Ole F., & Ribeiro Jr, Paulo J. 2015. *geoRglm: A Package for Generalised Linear Spatial Models*. R package version 0.9-8.

Gelman, Andrew, Lee, Daniel, Guo, Jiqiang, & et al. 2015. Stan: A Probabilistic Programming Language for Bayesian Inference and Optimization. *Journal of Educational and Behavioral Statistics*, **40**(5), 837–840.

Giorgi, Emanuele, & Diggle, Peter J. 2016. PrevMap: an R package for prevalence mapping.(In press). *Journal of Statistical Software*.

Gómez-Rubio, Virgilio, & Rue, Håvard. 2017. Markov Chain Monte Carlo with the Integrated Nested Laplace Approximation. *ArXiv e-prints*.

Ribeiro Jr, Paulo J., & Diggle, Peter J. 2016. *geoR: Analysis of Geostatistical Data*. R package version 1.7-5.2.

Ripley, Brian. 2015. *spatial: Functions for Kriging and Point Pattern Analysis*. R package version 7.3-11.

Rue, Håvard, Martino, Sara, Chopin, Nicolas, & et al. 2009. Approximate Bayesian inference for latent Gaussian models by using integrated nested Laplace approximations. *Journal of the Royal Statistical Society: Series B (Statistical Methodology)*, **71**(2), 319–392.

Rue, Håvard, Martino, Sara, Lindgren, Finn, Simpson, Daniel, & et al. 2016. *INLA: Functions which Allow to Perform Full Bayesian Analysis of Latent Gaussian Models using Integrated Nested Laplace Approximations*. R package version 0.0-1468872408.

Salvatier, John, Wiecki, Thomas V., & Fonnesbeck, Christopher. 2016. Probabilistic programming in Python using PyMC3. *PeerJ Computer Science*, **2**(55).