Protocol - Manhiça atlas of health and wealth

Contents

Introduction

There has been a great deal of academic work on the geospatial analysis of the incidence and prevalence of diseases. However, few projects have addressed the spatial components of *protective* and *risk* factors for disease at the granular lvel. The lack of geographic analyses relating to the disease's preventive and risk-related components is a notable missing piece of the puzzle, as it has important implications for disease control, management, and elimination.

Objectives and context

Primary objective

This project has one primary objective: to calculate and visualize area-specific rates educational attainment, migratory flow, hygiene and socioeconomic status throughout the district of Manhiça.

Secondary objectives

Secondary objectives include:

- Understand the temporal and spatial components of disease risk and protective factors through the application of geospatial smoothing/interpolation and time series analysis.

- Facilitate an understanding of the association between public health campaigns, disease control behavior, and the incidence of disease
- Identify exemplary and underperforming, as well as underserved, areas of public health resources expenditure.
- Disseminate knowledge via both digital and printed media for use by other research, health care workes and policy-makers.
- Build an open-source software "toolkit" to enable both the future reporducibility of this atlas as well as to facilitate the production of similar projects elsewhere.

Potential implications

In addition to its specific scientific objectives and knowledge products (above), this project has the potential to have important implications for public health. These include:

- The opening of new pathways of research in epidemiology and economics, enabled by the standardization and accessibility of granular but anonymized area- and time-specific data.
- Improved targeting of public health interventions and government allocation of resources, as a result of a better understanding of the behavioral and social components of disease control campaigns.
- The establishment of historical "benchmarks" to gauge the effectiveness of both past and future disease control campaigns.
- The validation of external demographic data sources in regards to representative estimates (ie, USAID's DHS) versus direct counts (census).

Methods and approach

Data

The datasets required for the carrying out of this project are:

- The Manhiça health district census data from 1996 to present
- Spatial datasets from the GADM (open access / already obtained)

Methodology

Analysis

In order to understand the spatial and temporal components and distribution of disease risk and protective factors, we will conduct descriptive, model-based, and visualization-oriented analyses.

- **Descriptive**: We will aggregate data into gridded areas at the most granular level possible (while remaining large enough to preserve anonymity) and calculate year-specific rates of all available and relevant indicators provided in the census (use of WC, migratory in- and out-flows, etc.).
- **Model-based**: We will generate estimates for areas and periods with missing, incomplete or unreliable data using Krieging and multi-dimensional kernel density estimation (interpolation), so as to construct a unitary "surface" and contiguous dataset for the whole of the district.

- **Visualization**: In order to observe trends in both time and space, we will compile an "atlas" of all relevant indicators, containing visualizations (maps and charts) of specific indicators, as well as composite "indices" (ie, a hygiene index, an HIV susceptibility index, etc.).

Products

The products of this research project will be academic, informational, and computational:

- **Academic**: We will produce a research paper, for review and publication in an academic journal, and in partnership with those who carry out and direct the cesus in Manhiça, describing the methodology employed for spatial interpolation, and discussing its generalizability.
- **Informational**: We will produce, in both electronic (online) and printed (booklets) formats, the "Manhiça Atlas of Health and Weatlh". This will consist of maps and charts visualizing the last 20 years of data collection in the district.
- **Computational**: In order to make our work accessible and efficiently reproducible, we will build an API which allows public health practitioners, clinicians and researchers to supply geographic coordinates, and programatically/automatically get a time-indexed rates for all indicators for that area. This will not only help guide clinical decision-making, it may also influence health promotion campaigns, and should help facilitate future research in the area. This will include cascading access credentials, from "open" to "authorized clinician", so that the appropriate balance between information-sharing and data-protection is achieved.

Research team

- **Elisa Sicuri** is a health economist and assistant research professor at ISGlobal. Her research focuses on the economic dimensions of infectious disease, specifically malaria. She has ample work experience in Manhiça.
- **Joe Brew** is an epidemiologist and statistician. He is carrying out his PhD in Transdisciplinary Global Health at ISGlobal.

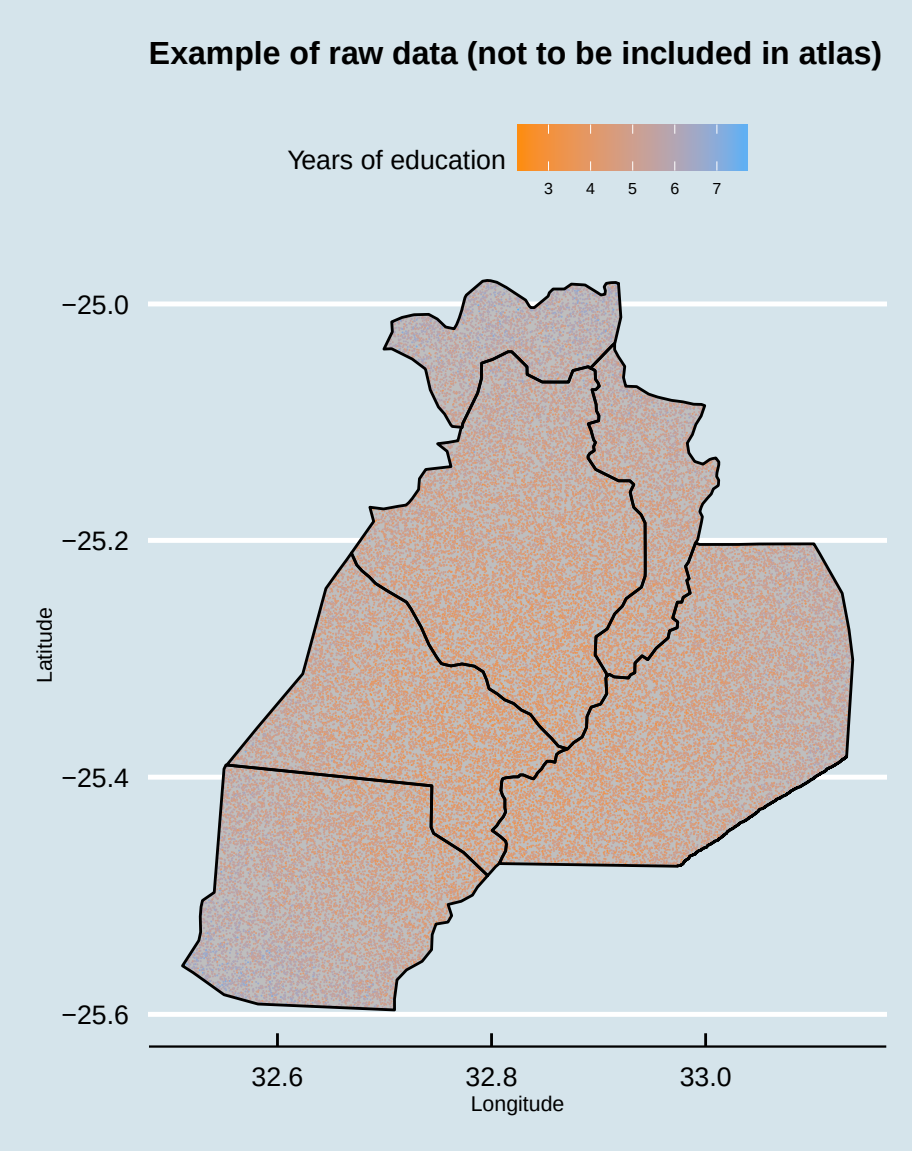
Ethical considerations

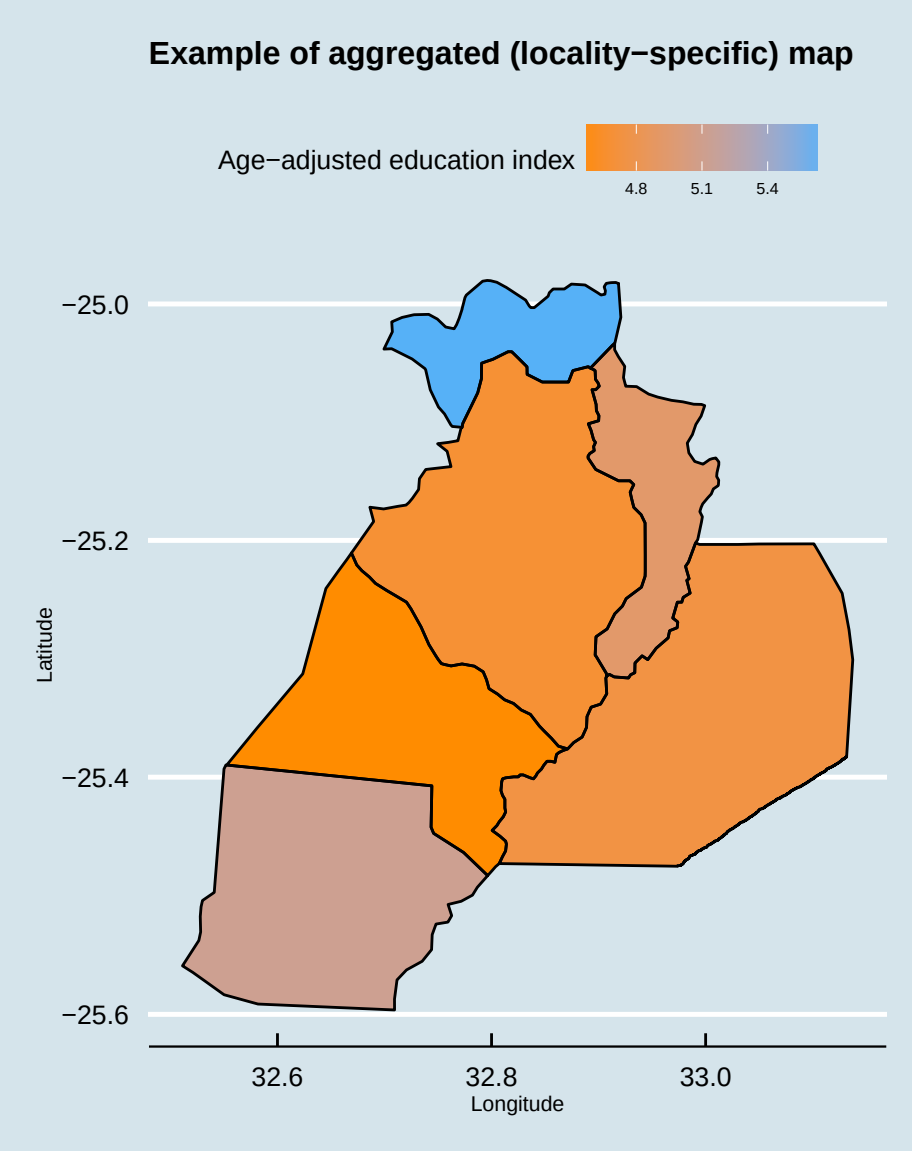
Ths project relies exclusively on retrospective data. Though identifiable in its raw form, the analysis will deal entirely in its non-identifiable components. All analysis will be at the aggregate level. Accordingly, informed consent is not necessary.

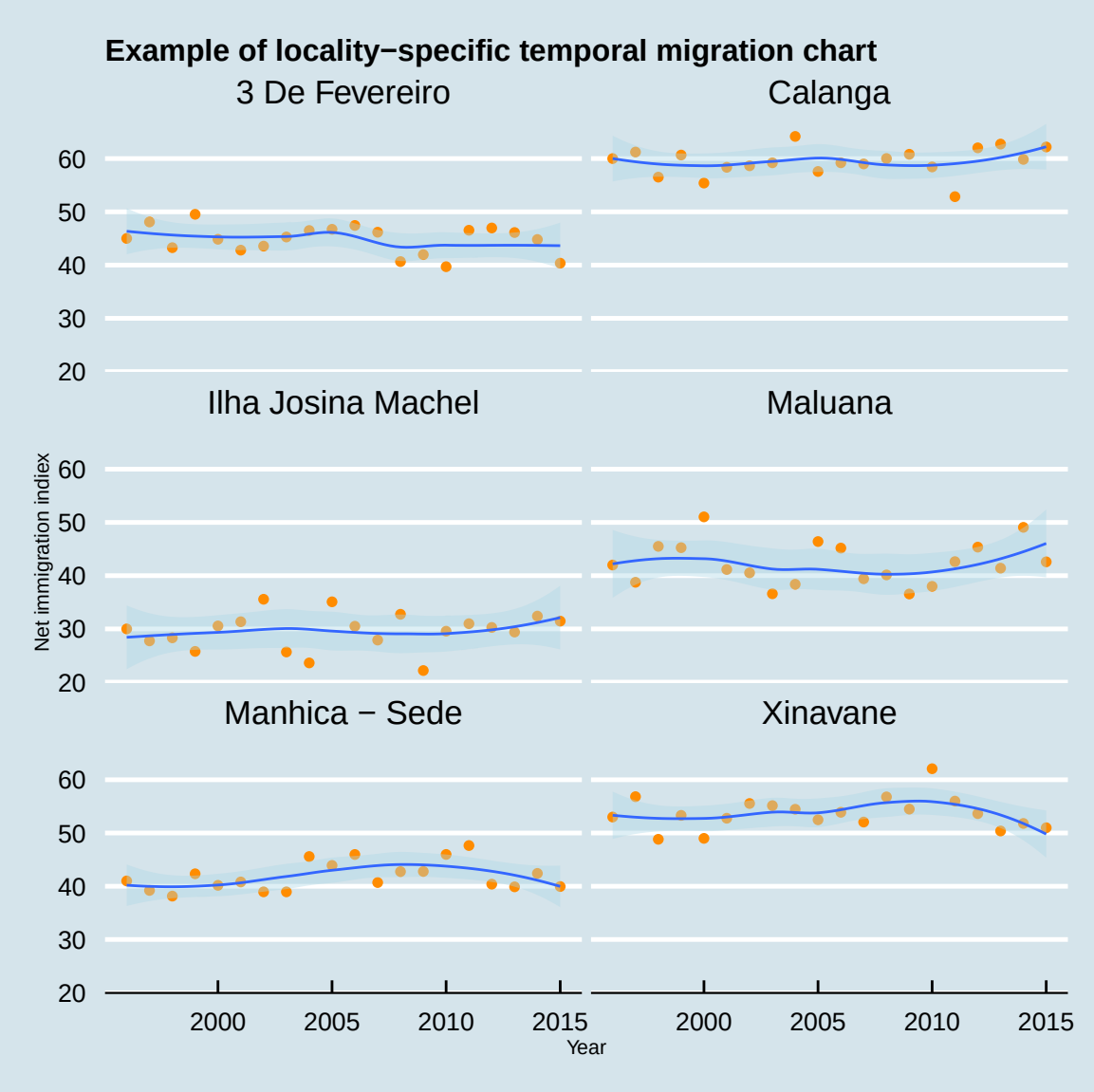
Appendix

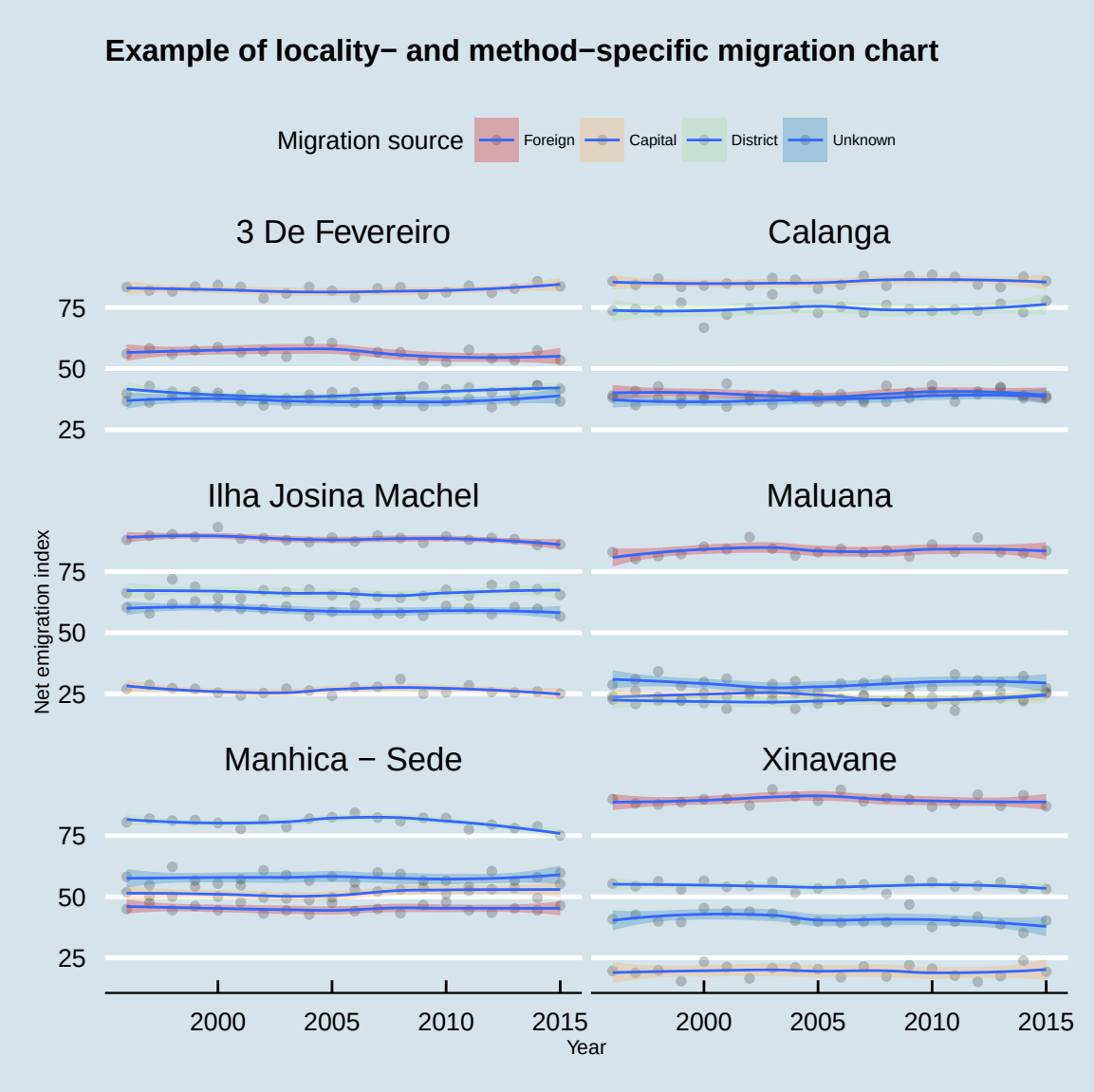
Examples of product

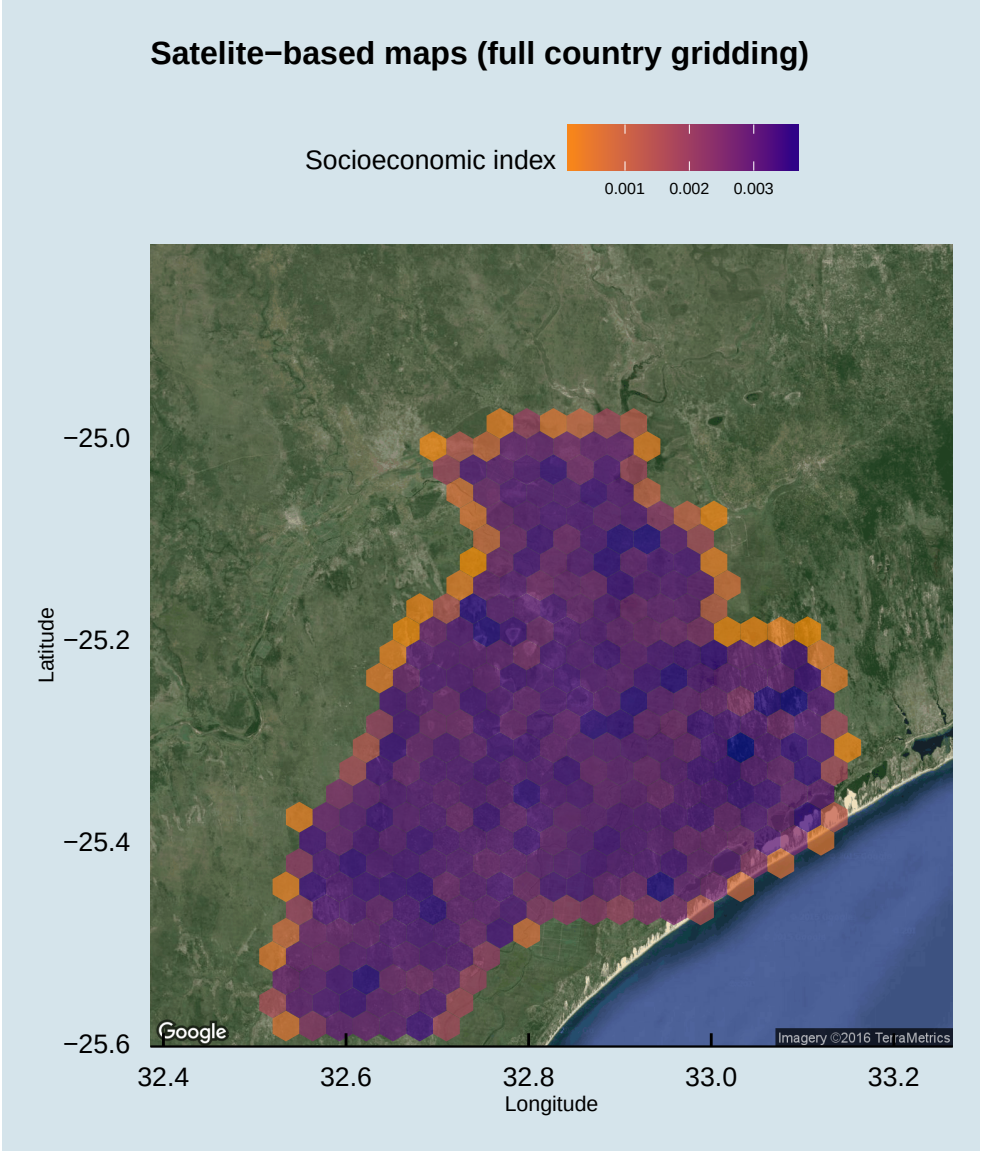
The following maps and charts are intended to show examples of the kinds of visualizations which will eventually constitute the body of the atlast. These use entirely fake data.

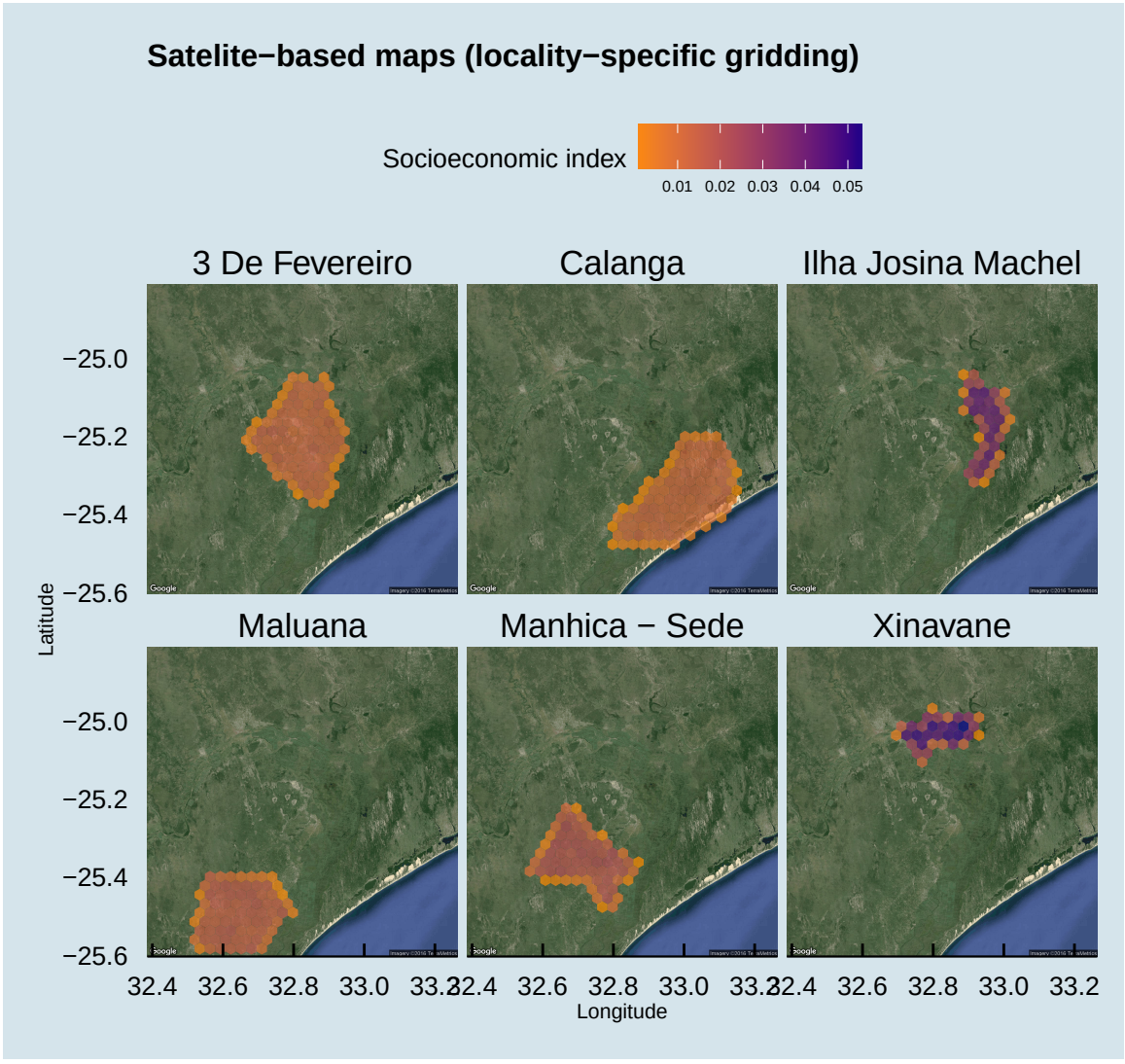

Example of raw data (not to be included in atlas)
Years of education
3
4
5
6
7
−25.0
−25.2
−25.4
−25.6
Latitude
32.6
32.8
33.0
Longitude

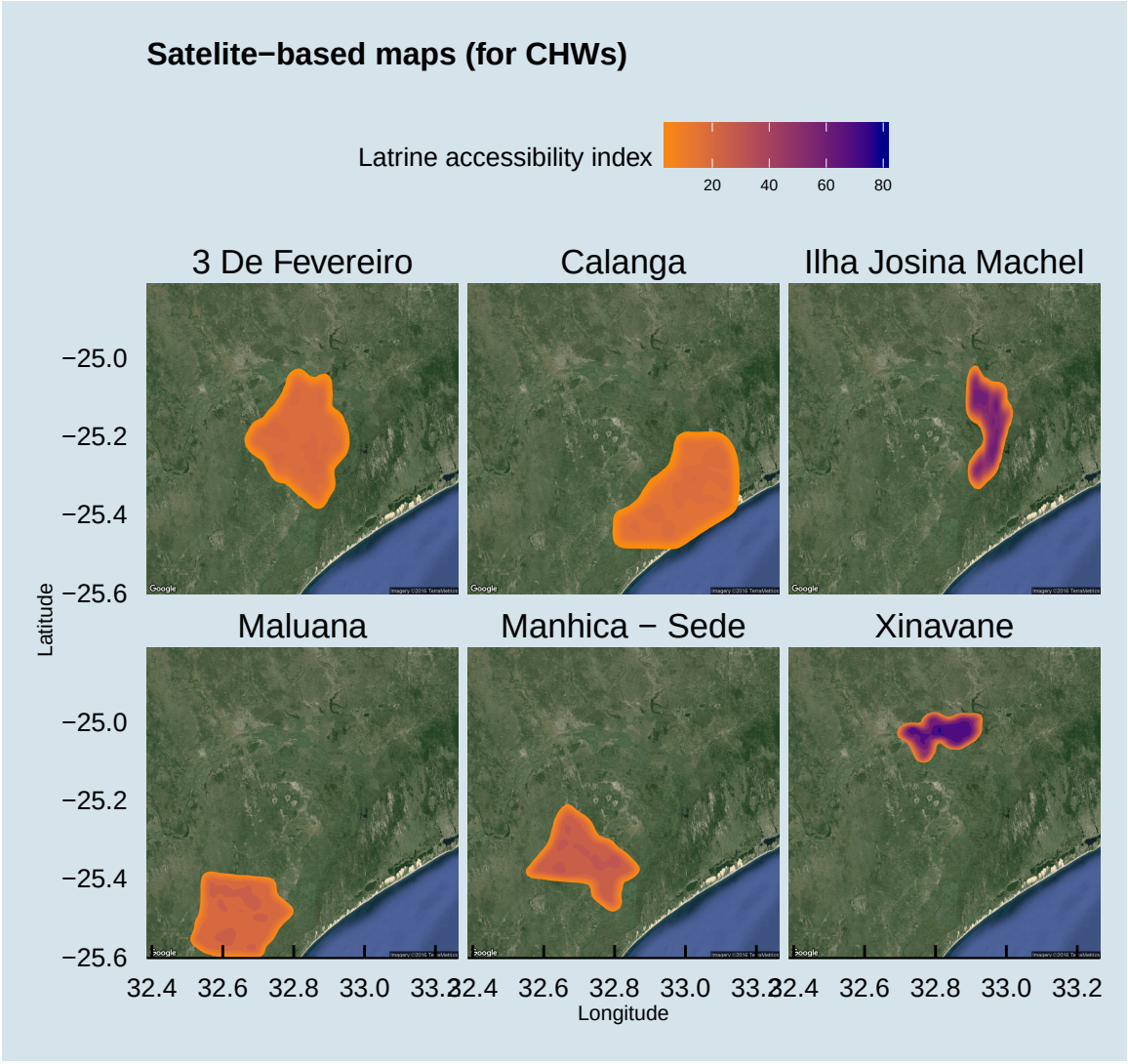

Example of aggregated (locality−specific) map
Age−adjusted education index
4.8
5.1
5.4
−25.0
−25.2
−25.4
−25.6
Latitude
32.6
32.8
33.0
Longitude

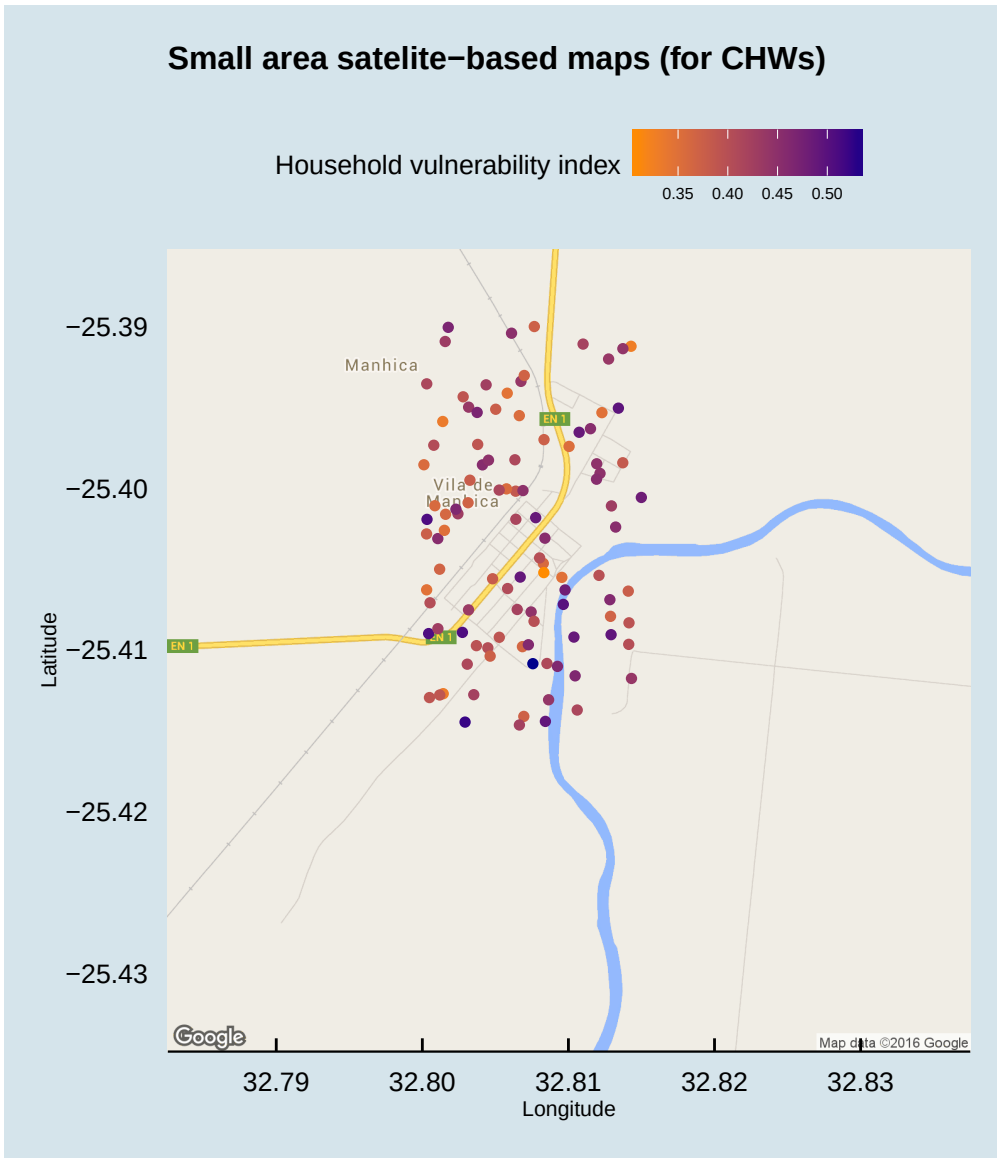

Example of locality−specific temporal migration chart
3 De Fevereiro
Calanga
Ilha Josina Machel
Maluana
Manhica − Sede
Xinavane
Net immigration indiex
Year
20
30
40
50
60
2000
2005
2010
2015


Example of locality− and method−specific migration chart
Migration source
Foreign
Capital
District
Unknown
3 De Fevereiro
Calanga
Ilha Josina Machel
Maluana
Manhica − Sede
Xinavane
Net emigration index
75
50
25
2000
2005
2010
2015
Year


Satelite−based maps (full country gridding)
Socioeconomic index
0.001
0.002
0.003
−25.0
−25.2
−25.4
−25.6
Latitude
32.4
32.6
32.8
33.0
33.2
Longitude
Google
Imagery ©2016 TerraMetrics


Satelite−based maps (locality−specific gridding)
Socioeconomic index
0.01 0.02 0.03 0.04 0.05
3 De Fevereiro
Calanga
Ilha Josina Machel
Maluana
Manhica − Sede
Xinavane
Latitude
−25.0
−25.2
−25.4
−25.6
32.4 32.6 32.8 33.0 33.2
Longitude


Satelite−based maps (for CHWs)
Latrine accessibility index
20
40
60
80
3 De Fevereiro
Calanga
Ilha Josina Machel
Maluana
Manhica − Sede
Xinavane
Latitude
−25.0
−25.2
−25.4
−25.6
32.4
32.6
32.8
33.0
33.2
Longitude


Small area satelite−based maps (for CHWs)
Household vulnerability index
0.35
0.40
0.45
0.50
−25.39
−25.40
−25.41
−25.42
−25.43
Latitude
Manhica
Vila de Manhica
EN 1
Google
Map data ©2016 Google
32.79
32.80
32.81
32.82
32.83
Longitude