

# Linked Micromap Plots: Design Principles, Past Uses, and New Perspectives via the “rmapshaper” R Package

Jürgen Symanzik\* & Braden Probst

Utah State University

Logan, UT, USA

[\\*symanzik@math.usu.edu](mailto:symanzik@math.usu.edu)

<http://www.math.usu.edu/~symanzik>

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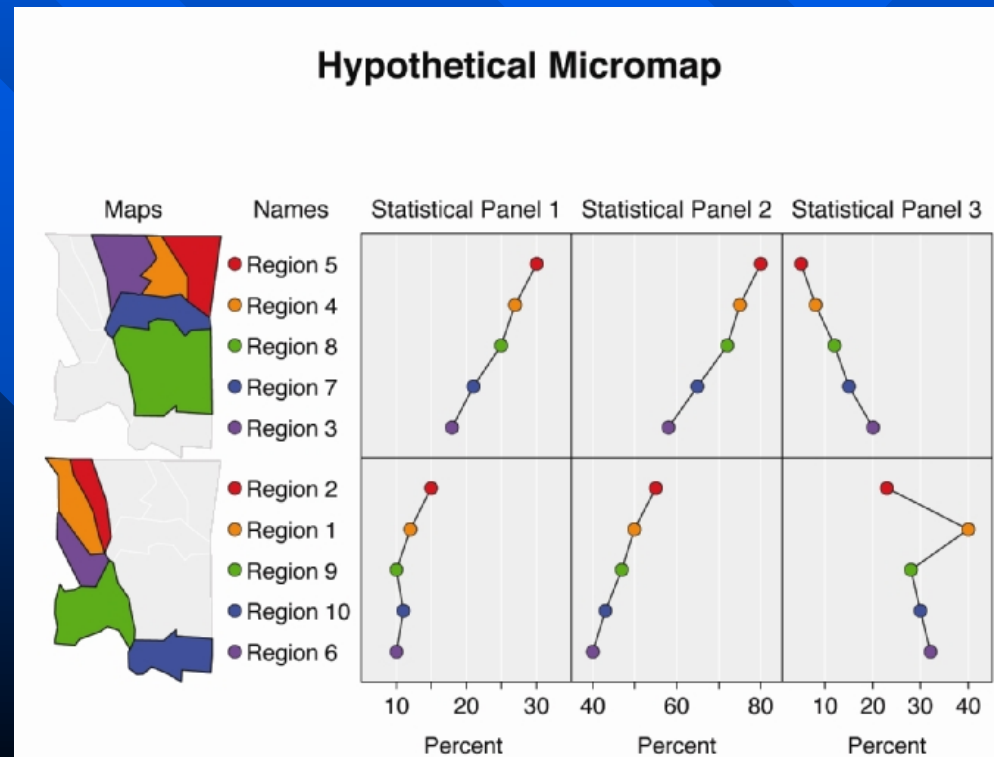


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# Concept of Micromaps

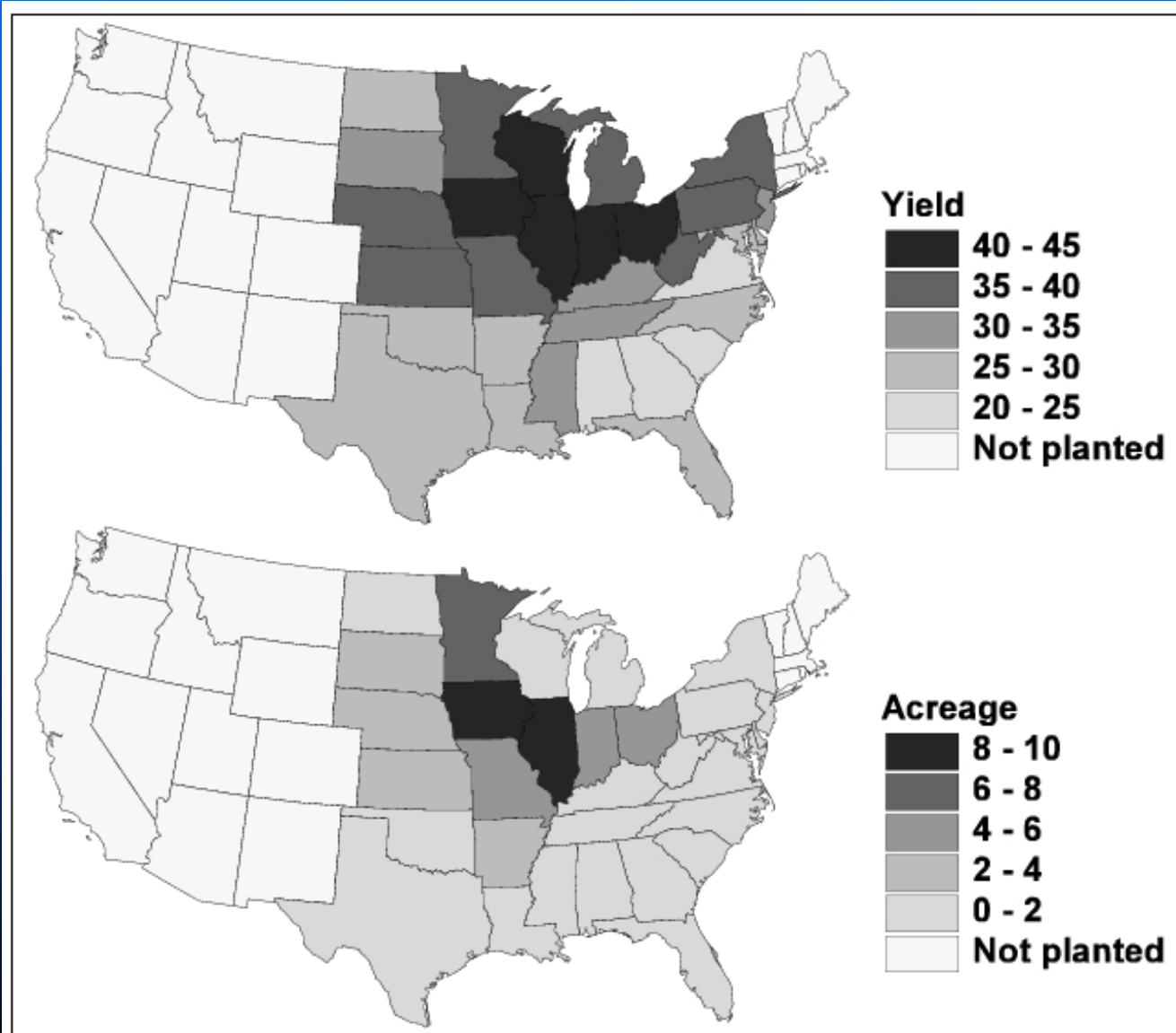
- Link of row-labeled univariate (or multivariate) statistical summaries to corresponding geographical region
- Focus on statistical display and not on maps
- Useful for
  - environmental data
  - agricultural data
  - medical data
  - public health data
  - economical data



# History of Micromaps

- First presented at the 1996 American Statistical Association's annual meeting (Olsen, Carr, Courbois, Pierson)
- Initial references:
  - Carr, Pierson (1996)
  - Carr et al. (1998)

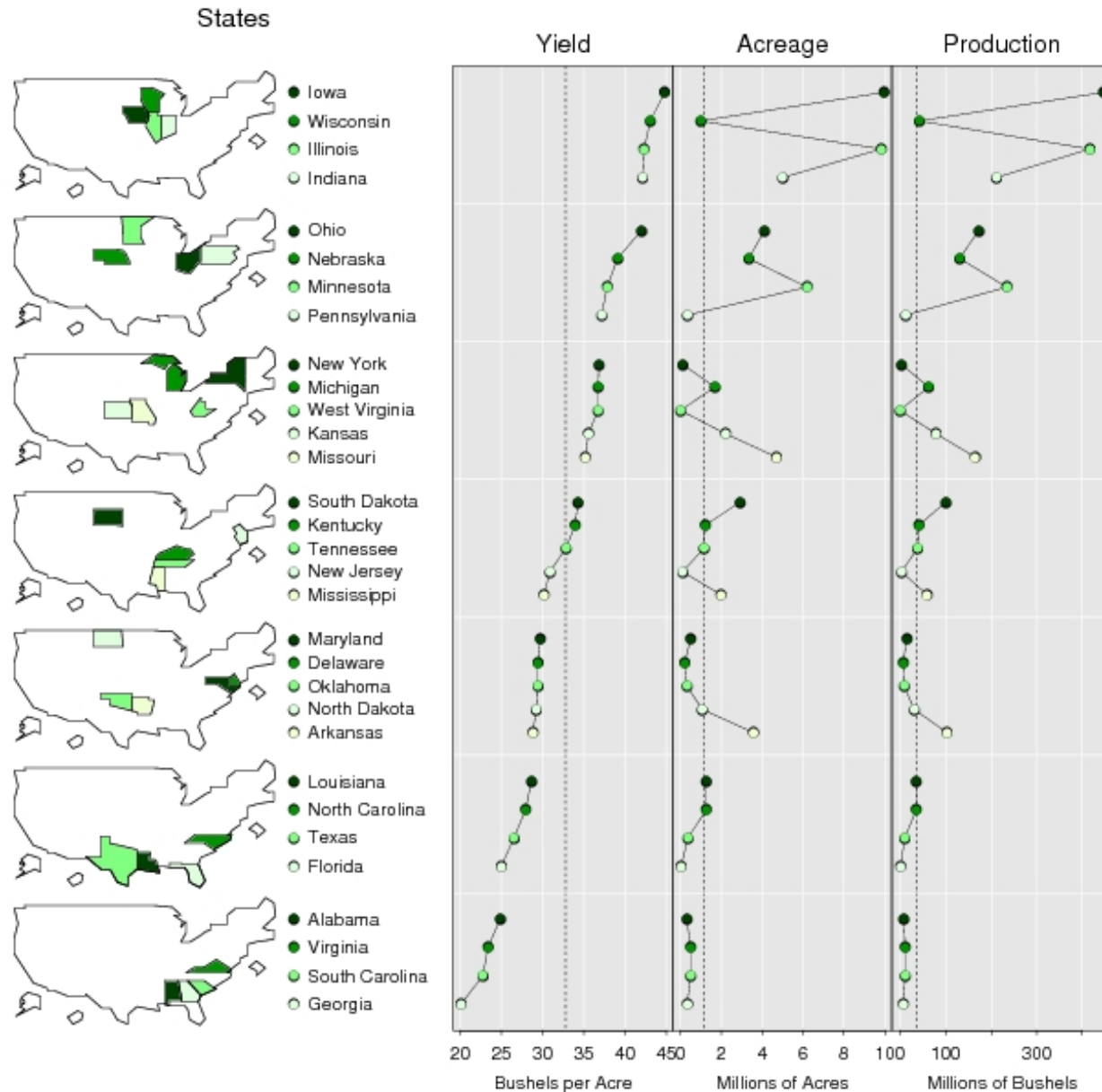
# Choropleth Maps vs Micromaps (1)



From:  
Symanzik &  
Carr (2008)

# Choropleth Maps vs Micromaps (2)

Soybean Statistics by State, 1997 Census of Agriculture

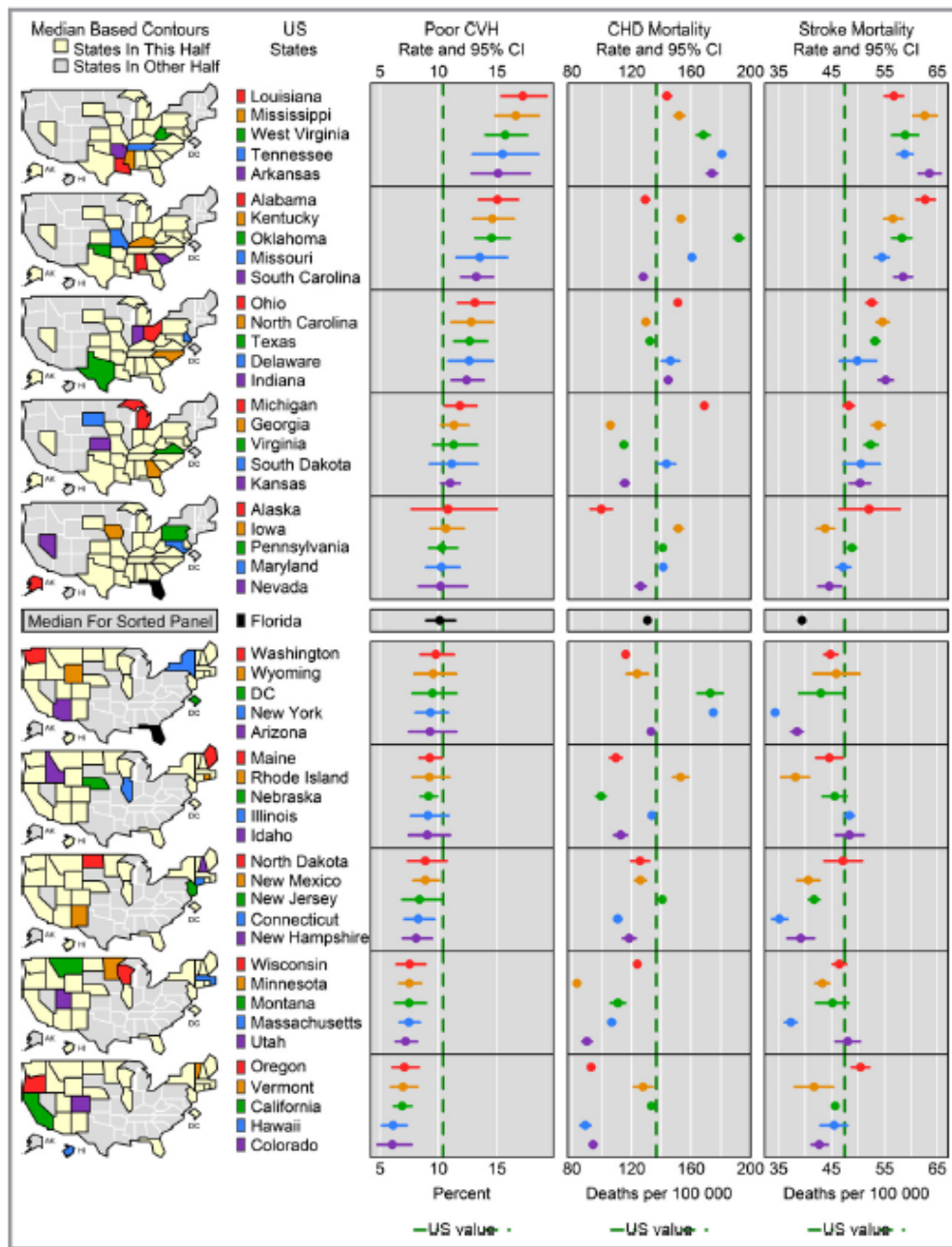


From:  
Symanzik &  
Carr (2008)

# Limitations of Choropleth Maps

- 1) Some map regions can be too small to effectively show color
- 2) Converting a continuous variable into a variable with a few ordered values results in an immediate loss of information
- 3) Difficult to show more than one variable in a choropleth map

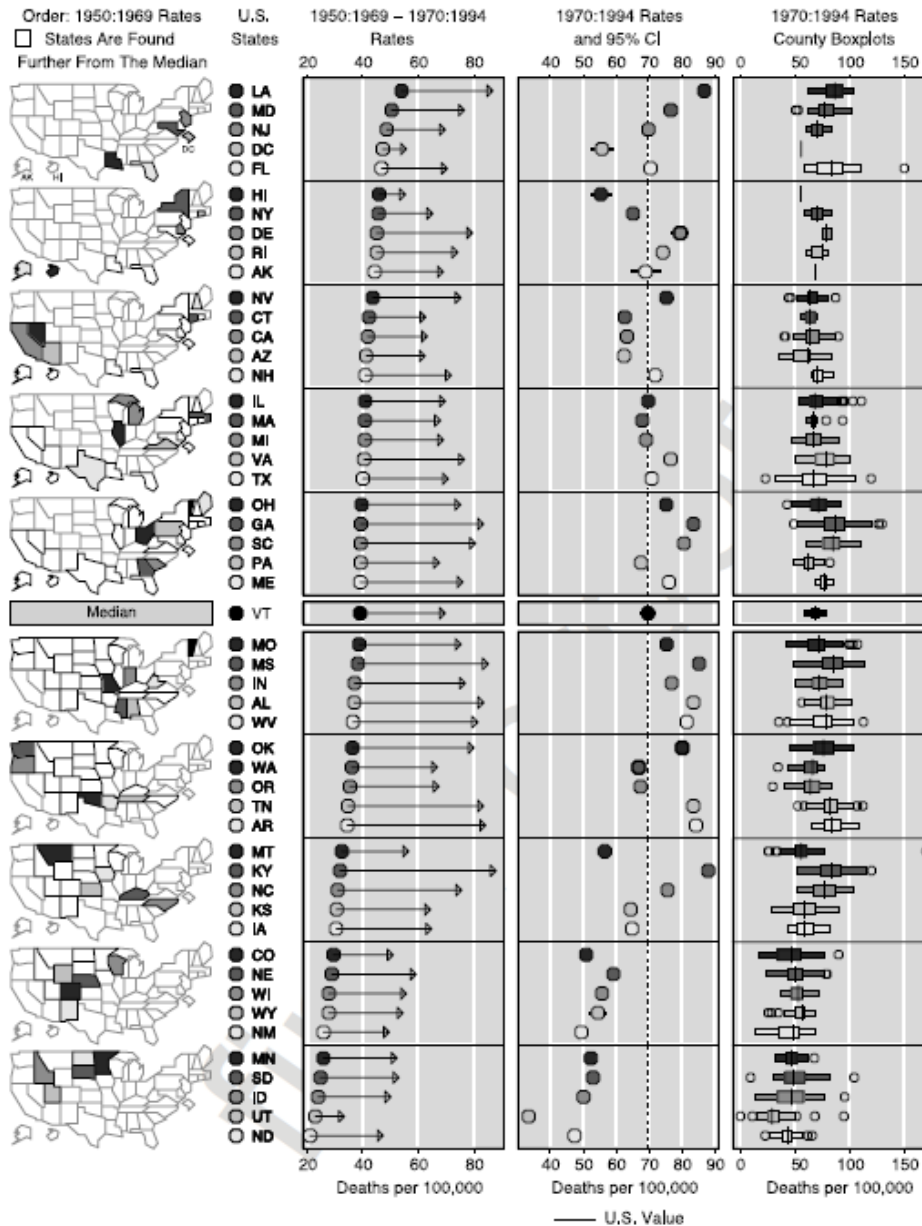
# Basic Examples of Linked Micromap Plots



**Figure.** Linked micromap plot showing age-adjusted prevalence of poor cardiovascular health (CVH) and mortality rates for coronary heart disease (CHD) and stroke by state in 2011. The green lines show the national average (i.e., mean) of the prevalence of poor CVH (10.4%), the CHD mortality rate (136.6 per 100 000), and the stroke mortality rate (47.5 per 100 000). Florida (black color) highlights the median of poor CVH among the states and the District of Columbia. AK indicates Alaska; DC, District of Columbia; HI, Hawaii.

From: Gebreab et al. (2015)

# White Male Lung Cancer Mortality Rates



**Figure I.6.** [This figure also appears in the color insert.] LM plots, based on data from the NCI Web page, showing summary values for the years 1950 to 1969 and for the years 1970 to 1994 in the *left data panel*, rates and 95% confidence intervals in the *middle data panel*, and boxplots for each of the counties of each state in the *right data panel*

From: Symanzik & Carr (2008)

# Korea

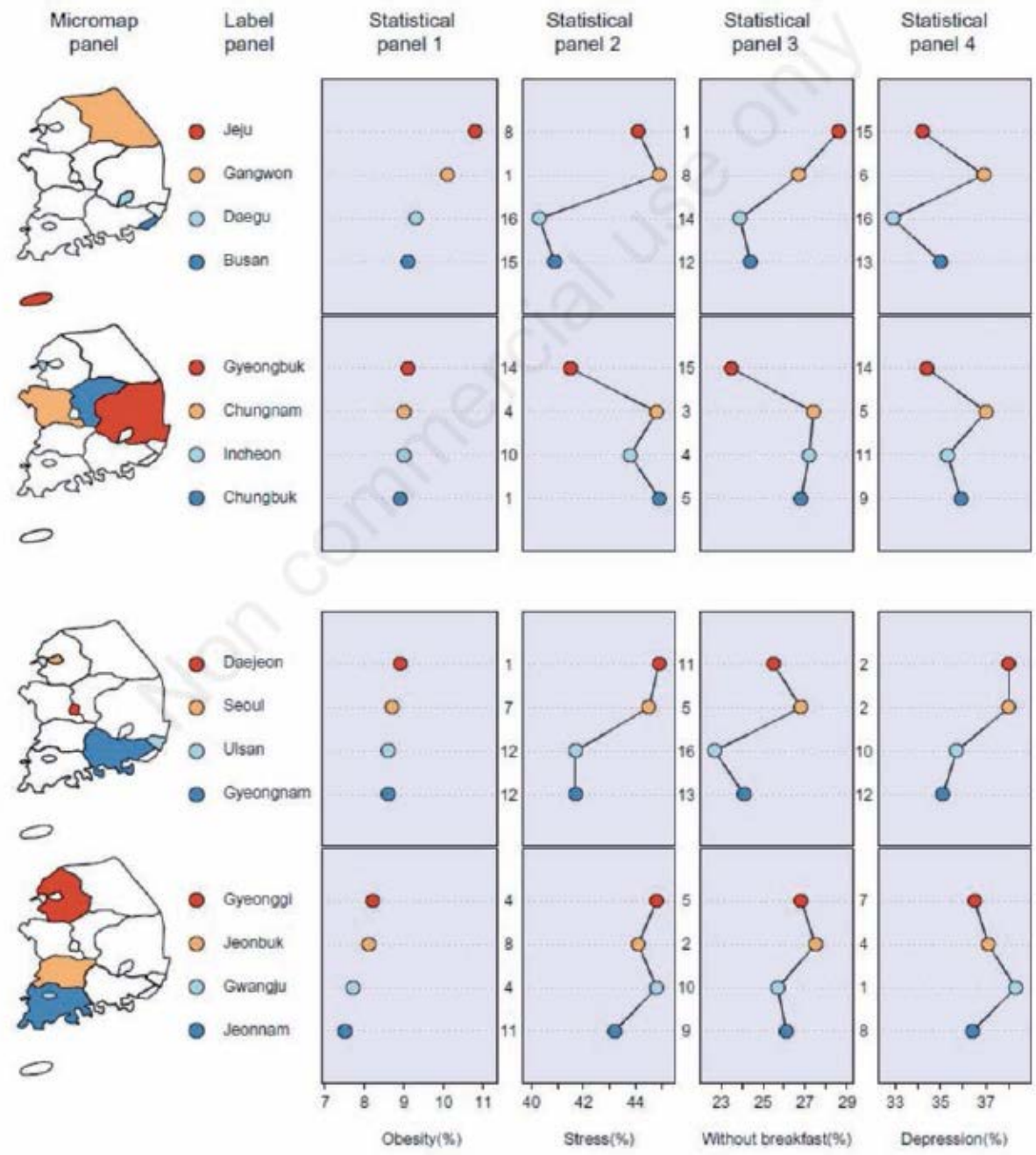
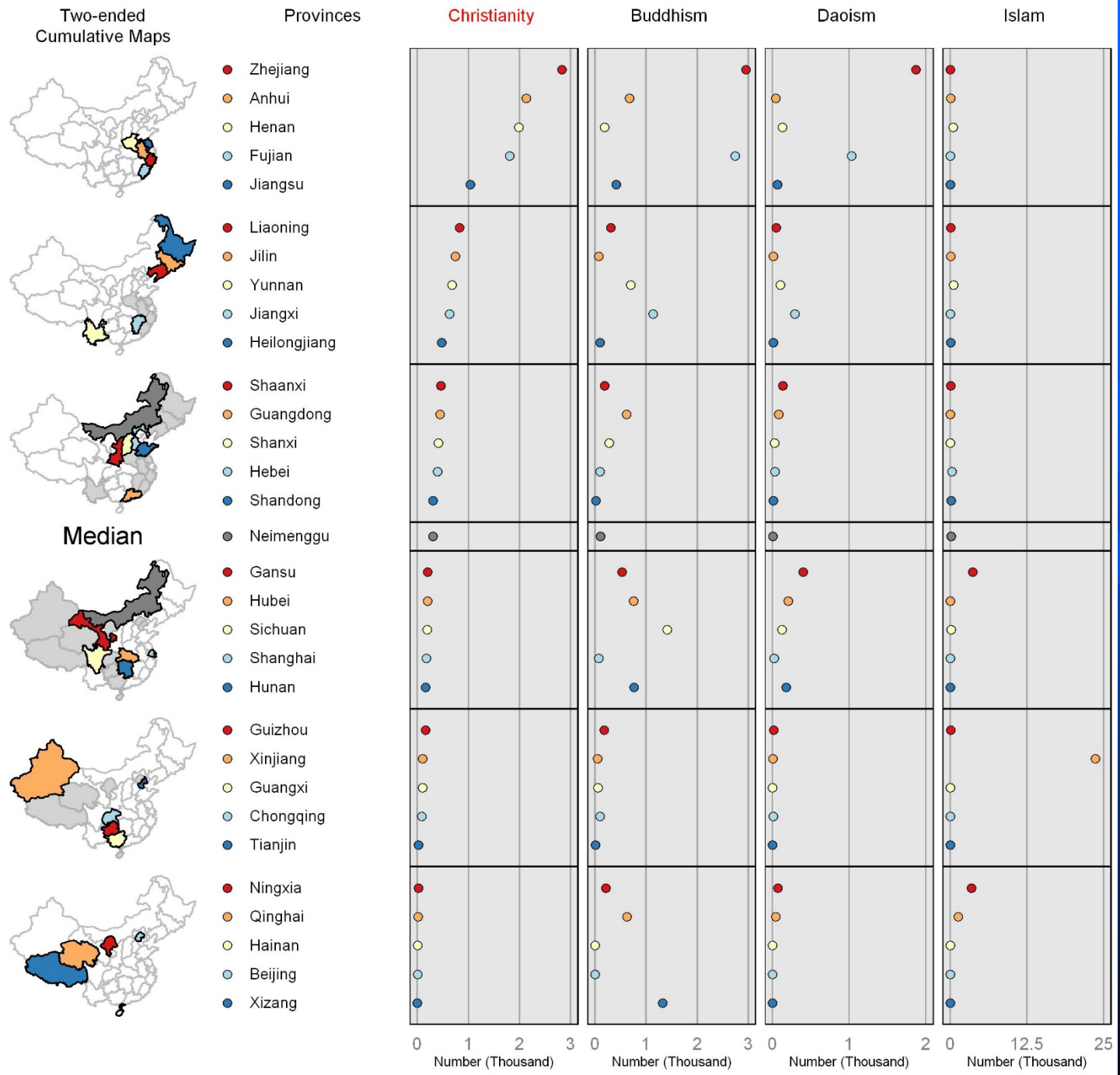


Figure 4. Linked micromap plot showing the relationships among obesity, stress, starting the day without breakfast, and depression based on regional averages in the period 2006-2013.

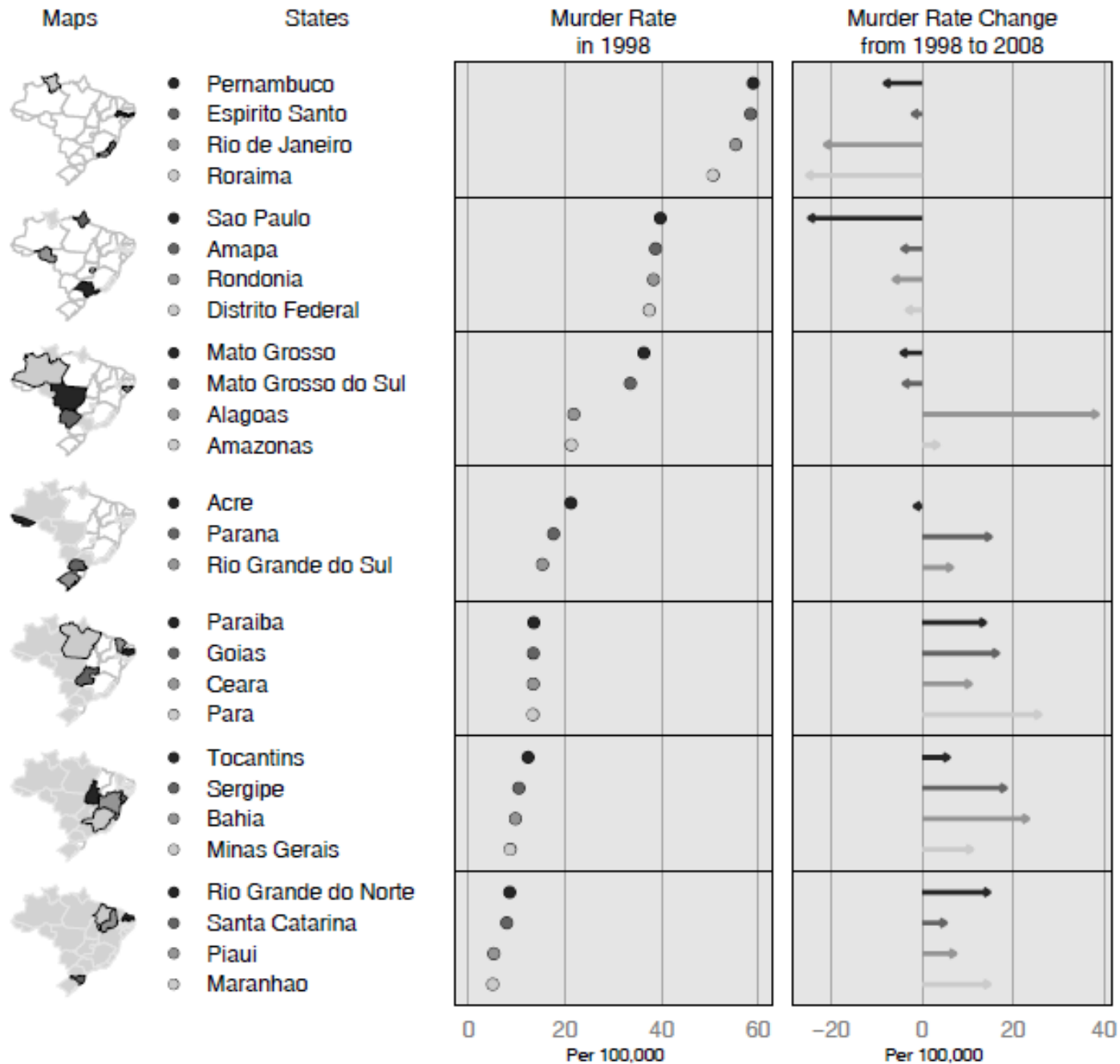
From:  
Han et al.  
(2016)

# China

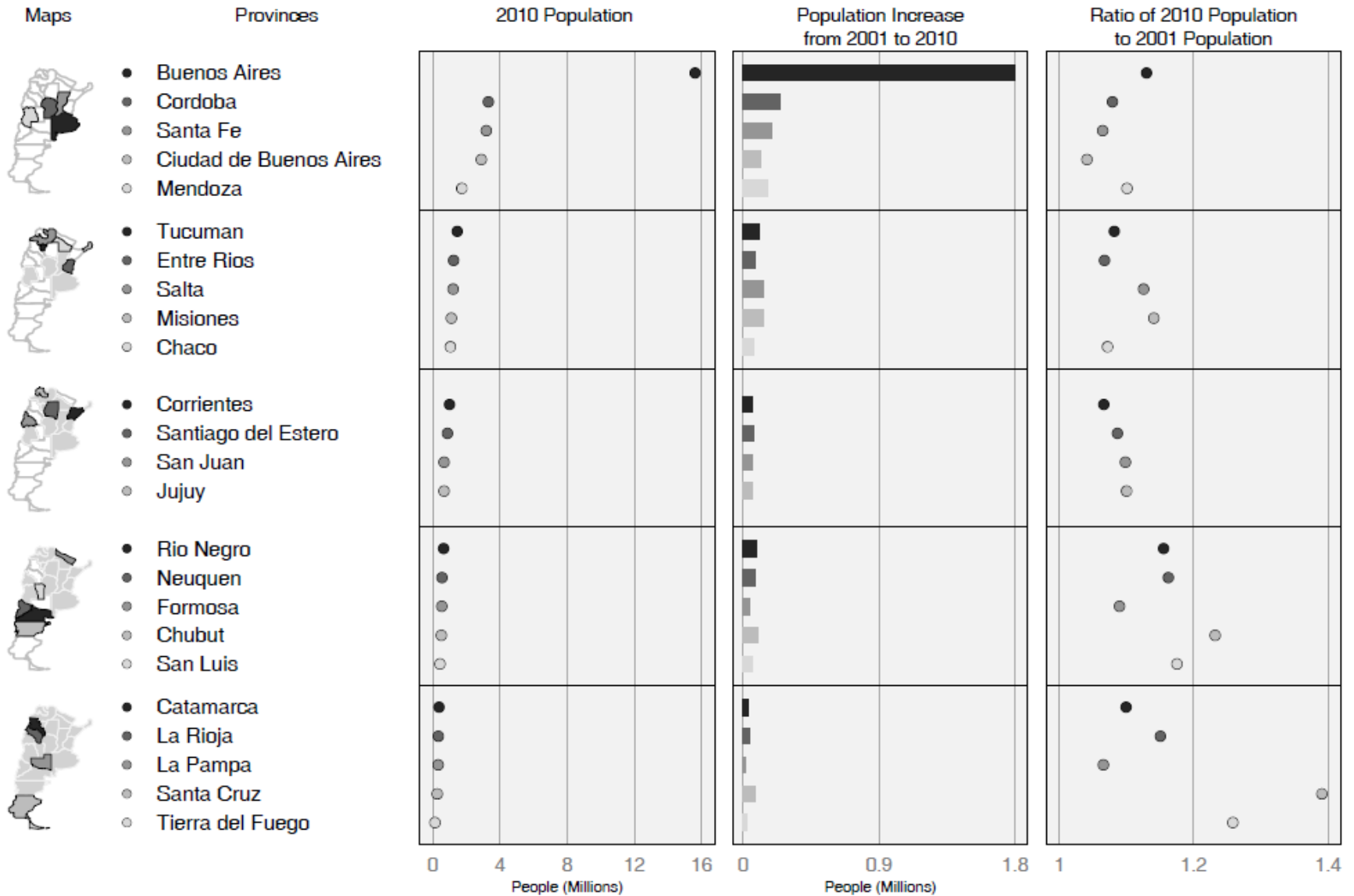


From:  
Symanzik  
et al. (2016)

# Brazil



From:  
Symanzik et al.  
(2014)



# **Shapefile Modifications & Micromap Construction**

# Micromaps in R

- Two recently developed R Packages:
  - “micromap”: general purpose; can handle arbitrary shapefiles from Geographic Information Systems (GIS)
  - “micromapST”: focus on the 50 U.S. states

# Shapefile Modifications

- Modification of existing shapefiles
  - Simplification of boundaries (via Douglas-Peucker 1973 algorithm)
  - Removal of tiny islands
  - Enlarging small areas such as capital regions, e.g., Washington DC in the United States
  - Shifting and resizing (enlarging or shrinking) regions that are far away from the main area, e.g., Alaska or Hawaii in the United States
  - Can be done in R, but tedious to do in the past!!!

# Simplification via Mapshaper and “rmapshaper”

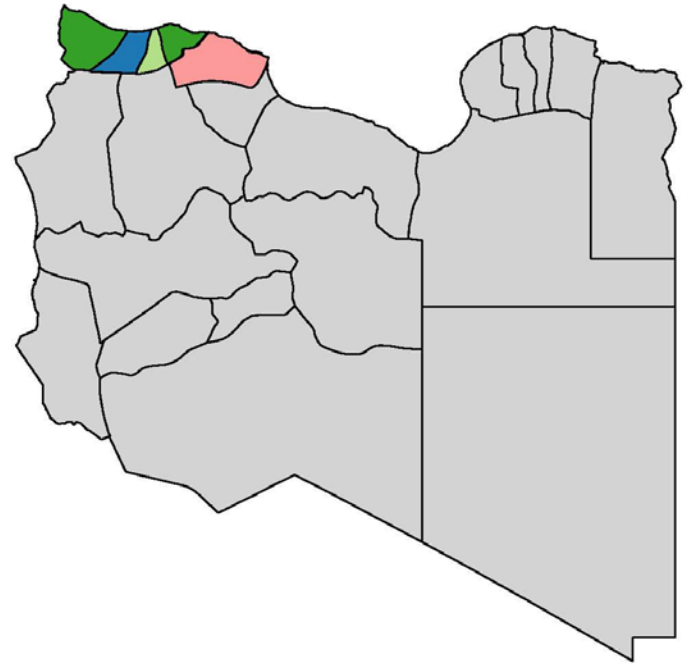
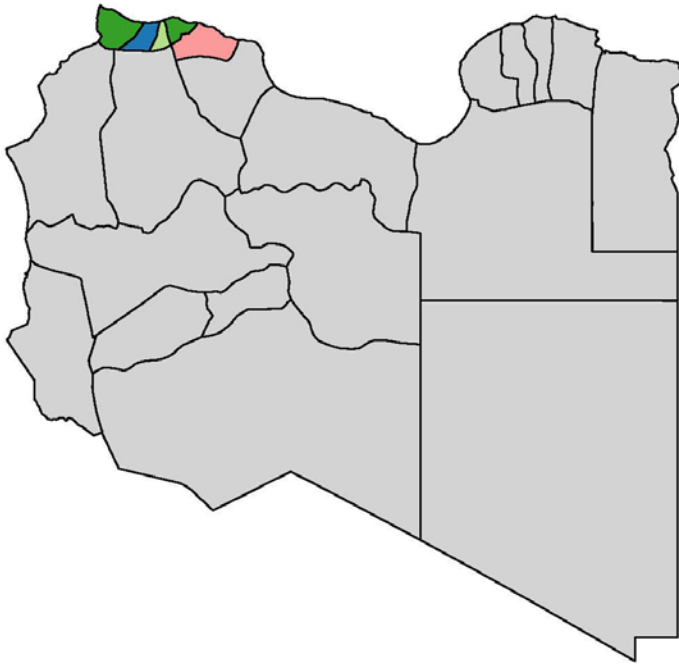
- Mapshaper (Harrower & Bloch, 2006):
  - Web-based tool for the simplification of shapefiles
- “rmapshaper” R Package (Teucher & Russell, 2018):
  - R wrapper for Mapshaper
  - Direct translation into R functions of some functionality
  - Remaining functionality can be obtained via console commands

# Task 1: Thinning Boundaries



Mexico

## Task 2: Resizing Regions



# Task 3: Moving Regions



Spain: *Canary Islands*

# Tasks 2 & 3: Moving & Resizing Regions



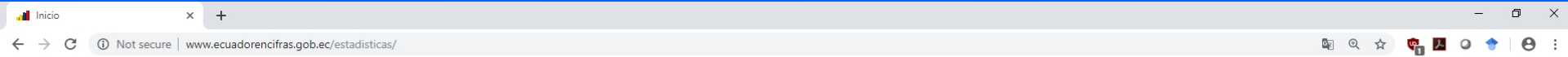
Benin: *Littoral*

# Ecuador: What to do with Galapagos? – INEC

The screenshot shows the INEC website with the following elements:

- Header:** INEC logo with the slogan "Buenas cifras, mejores vidas". Navigation icons for home, statistics, geography, data bank, specialized consultations, press room, and contact. A search bar labeled "Búsqueda".
- Navigation Menu:** Home, Estadísticas por tema, Estadísticas por fuente, Geografía Estadística, Banco de Datos, Consultas Especializadas, Sala de Prensa, Contacto.
- Main Banner:** "INEC publica las cifras de inflación de abril 2019" over an image of fresh vegetables.
- Population Counter:** "A las 14:39:18 somos 17.248.595 Ecuatorianos".
- Regional Data:** "Cifras por provincias" with a map of Ecuador.
- Information Categories:** Población y Vivienda, Estadísticas Laborales, Índice de Precios, Estadísticas Empresariales, Estadísticas Vitales, Estadísticas Hospitalarias, Cartografía Digital 2010, Consultas.

# Ecuador: What to do with Galapagos? – INEC

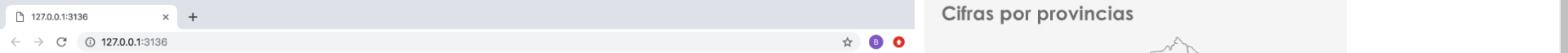



- Inicio
- Estadísticas por tema
- Estadísticas por fuente
- Geografía Estadística
- Banco de Datos
- Consultas Especializadas
- Sala de Prensa
- Contacto



**A las 14:39:18**  
somos  
**17.248.595**  
Ecuatorianos

**Contador Poblacional**



**Input Shapefile**  
Browse... 4 files  
Upload complete

**Upload Table**  
Browse... ECU\_mod\_ Use Blank Table  
Upload complete

**Thinning Value**  
0.004 Apply Thinning Level

**Select Region**  
Galápagos

**Scale Value** .5 **Degree of Rotation** 0

**Longitudinal Shift** 8.5 **Latitudinal Shift** .73

Add Command

Remove Row: 1

Remove Row

Apply Modifications Export Table

Command	Region	V1	V2	V3	V4
1	simplify	0.004	NA	NA	NA
2	affine	Galápagos	0.5	0	8.5 0.73



**Cifras por provincias**

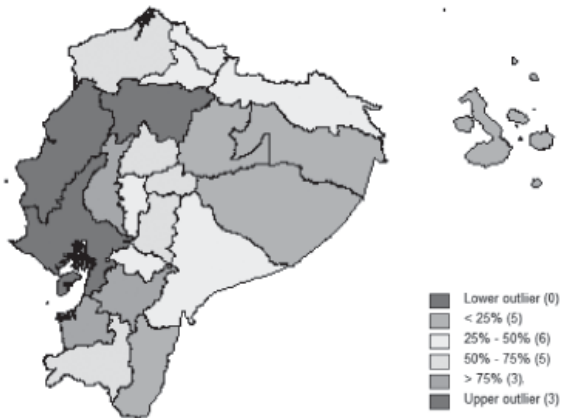
- Población total
- Nacimientos 2016
- Superficie
- Población por sexo
- Hogares con internet
- Empresas
- Proyecciones poblacionales 2018
- Tasa de Alfabetización
- Tasa de Analfabetización
- Población económica activa

# Ecuador: What to do with Galapagos? – Arias



**Tangya Tandazo Arias**  
 Maestrá en Economía Urbana y Regional. Instituto de Investigaciones Económicas de la Universidad Técnica Particular de Loja.

Figura 1. Box Map de la población. 2007



Fuente: Elaboración propia a partir del INEC y SIG de la UTPL

Figura 4. Regiones económicas funcionales. 2007



Fuente: Elaboración propia.

## La regionalización económica del Ecuador

# Ecuador: What to do with Galapagos? – Arias

1270.0.1:3136

Command Region V1 V2 V3 V4

1	simplify		0.004	NA	NA	NA
2	affine	Galapagos	1	0	17.5	0

Input Shapefile  
Browse... 4 files  
Upload complete

Upload Table  
Browse... Ecuador IV Use Blank Table  
Upload complete

Thinning Value  
0.004 Apply Thinning Level

Select Region  
Galapagos

Scale Value Degree of Rotation  
1 0

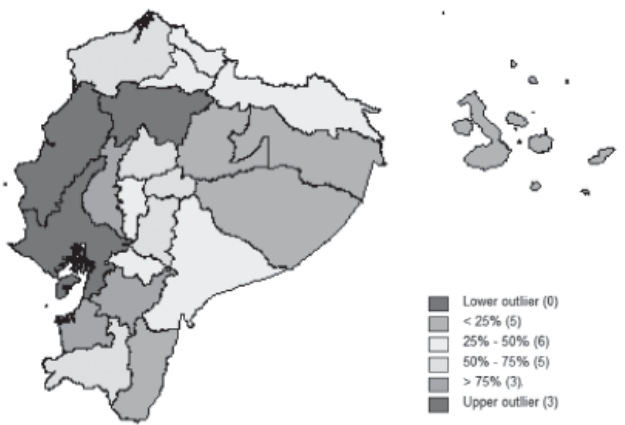
Longitudinal Shift Latitudinal Shift  
17.5 0

Add Command Remove Row:  
Remove Row 1

Apply Modifications Export Table



Figura 4. Regiones económicas funcionales. 2007



La

1270.0.1:3136

Command Region V1 V2 V3 V4

1	simplify		0.005	NA	NA	NA
2	affine	Galapagos	0.75	0	9	1.5

Input Shapefile  
Browse... 4 files  
Upload complete

Upload Table  
Browse... Ecuador IV Use Blank Table  
Upload complete

Thinning Value  
0.005 Apply Thinning Level

Select Region  
Galapagos

Scale Value Degree of Rotation  
.75 0

Longitudinal Shift Latitudinal Shift  
9 1.5

Add Command Remove Row:  
Remove Row 1

Apply Modifications Export Table

propia.

Fuente: Elaboración propia a partir del INEC y SIG de la UTPL

# Ecuador: What to do with Galapagos? – Lonely Planet

lonely planet

## Ecuador & the Galápagos Islands



The Galápagos Islands

p307

Isabel Albiston, Jade Bremner, Brian Kluepfel,  
MaSovaida Morgan, Wendy Yanagihara

# Ecuador: What to do with Galapagos? – Lonely Planet



## Ecuador & the Galápagos Islands



Isabel Albiston, Jade Bremner, Brian Kluepfel,  
MaSovaida Morgan, Wendy Yanagihara

1270.0.1:3136

1270.0.1:3136

Input Shapefile

Browse... 4 files

Upload complete

Upload Table

Browse... Ecuador M Use Blank Table

Upload complete

Thinning Value

0.004 Apply Thinning Level

Select Region

Galápagos

Scale Value Degree of Rotation

1 0

Longitudinal Shift Latitudinal Shift

8.5 -3.5

Add Command

Remove Row: 1

Remove Row

Apply Modifications Export Table

	Command	Region	V1	V2	V3	V4
1	simplify		0.004	NA	NA	NA
2	affine	Galápagos	1	0	8.5	-3.5

# Ecuador: What to do with Galapagos? – Four Suggestions So Far

The application interface consists of a control panel on the left, a command table at the top, and a map view on the right. The control panel includes sections for 'Input Shapefile', 'Upload Table', 'Thinning Value', 'Select Region', 'Scale Value', 'Degree of Rotation', 'Longitudinal Shift', and 'Latitudinal Shift'. The command table lists the sequence of operations performed. The map view shows the spatial result of these operations.

**Screenshot 1 (Top Left):**

Command	Region	V1	V2	V3	V4	
1	simplify	0.004	NA	NA	NA	
2	affine	Galapagos	0.5	0	8.5	0.73

**Screenshot 2 (Top Right):**

Command	Region	V1	V2	V3	V4	
1	simplify	0.005	NA	NA	NA	
2	affine	Galapagos	0.75	0	9	1.5

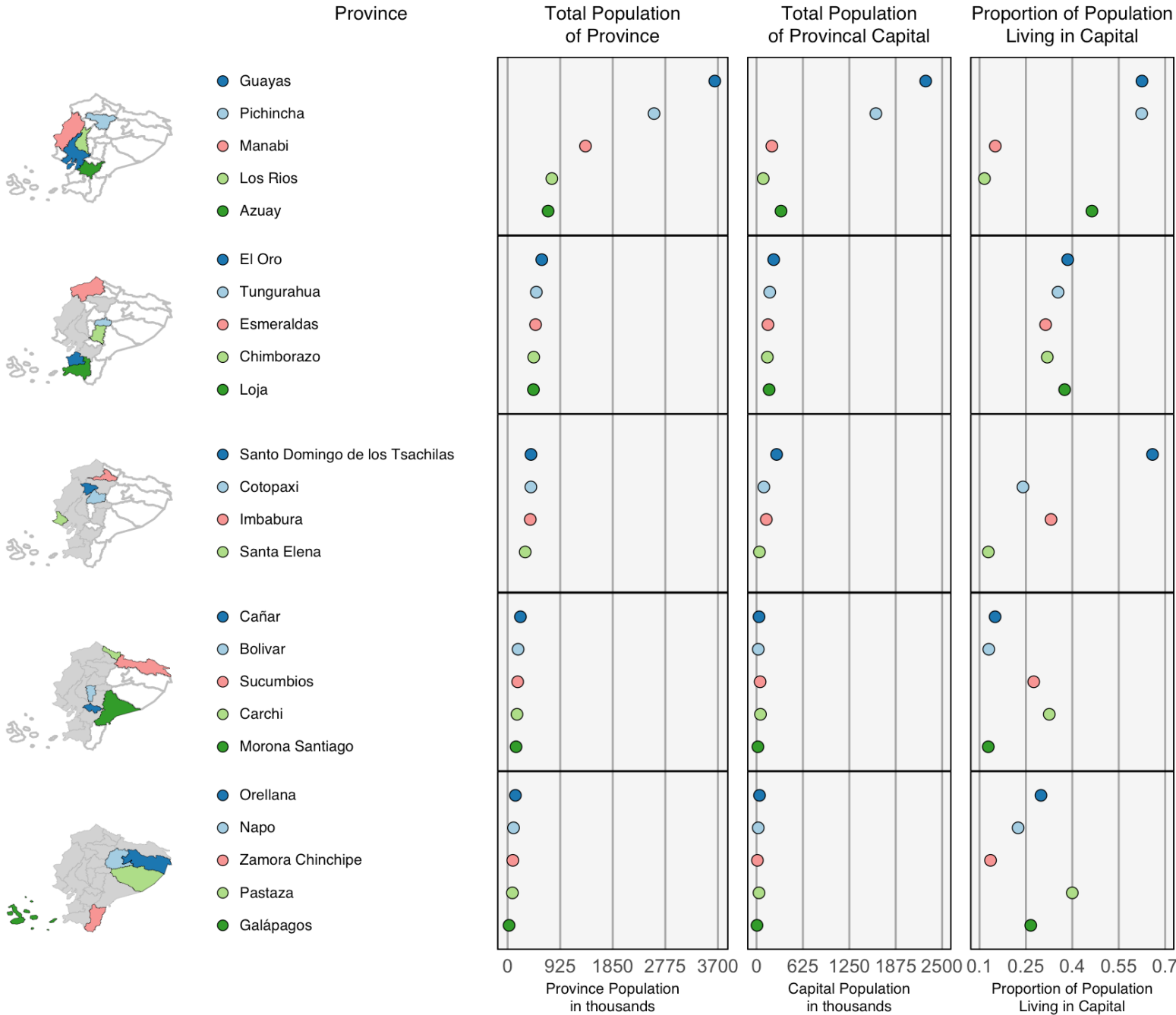
**Screenshot 3 (Bottom Left):**

Command	Region	V1	V2	V3	V4	
1	simplify	0.004	NA	NA	NA	
2	affine	Galapagos	1	0	17.5	0

**Screenshot 4 (Bottom Right):**

Command	Region	V1	V2	V3	V4	
1	simplify	0.004	NA	NA	NA	
2	affine	Galapagos	1	0	8.5	-3.5

# Ecuador: Using Lonely Planet Version



# Current / Future Work

- Finalization of recommendations for shapefile modifications for about 150 countries
- R package for the modification of shapefiles and shiny user interface to be finalized this summer
- **If interested before July/August 2019, please contact me via e-mail !!!**
- **Challenge: What to do with Chile ???**



# References

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*Questions ???*

*– or –*

*send e-mail to:*

*[symanzik@math.usu.edu](mailto:symanzik@math.usu.edu)*