

Recent Advancements in Geovisualization, with a Case Study on Chinese Religions

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--- with contributions from ---

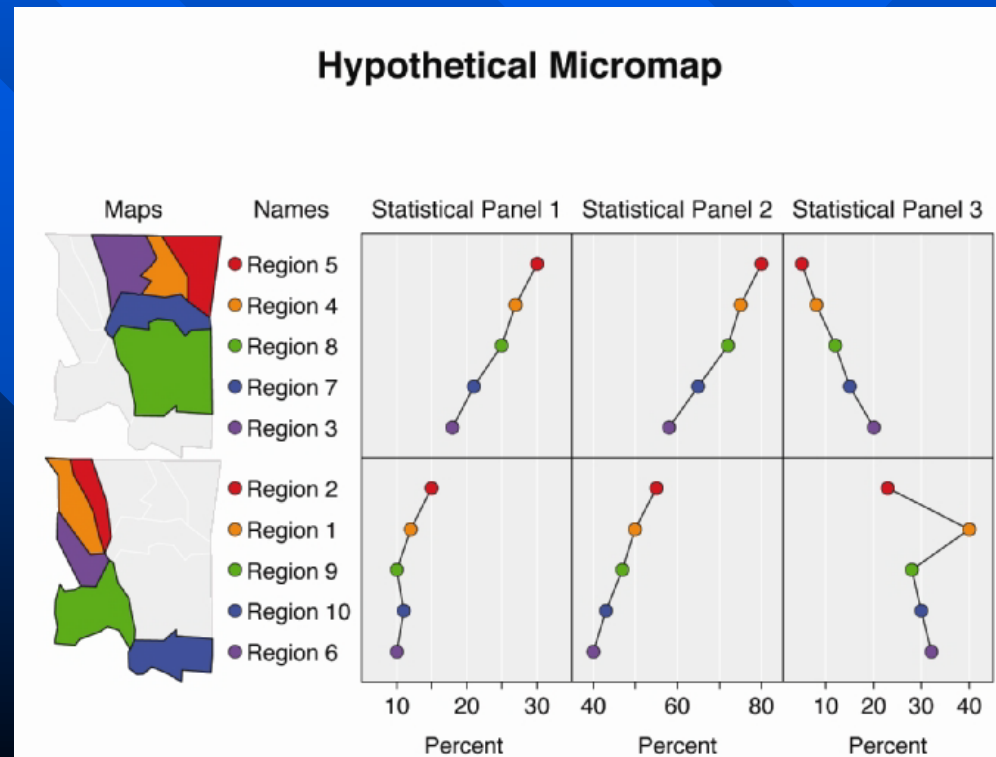
XiaoTian Dai, Miao Shui, Jeong Yong Ahn, Se-jin Park

Contents

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 - Overview
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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



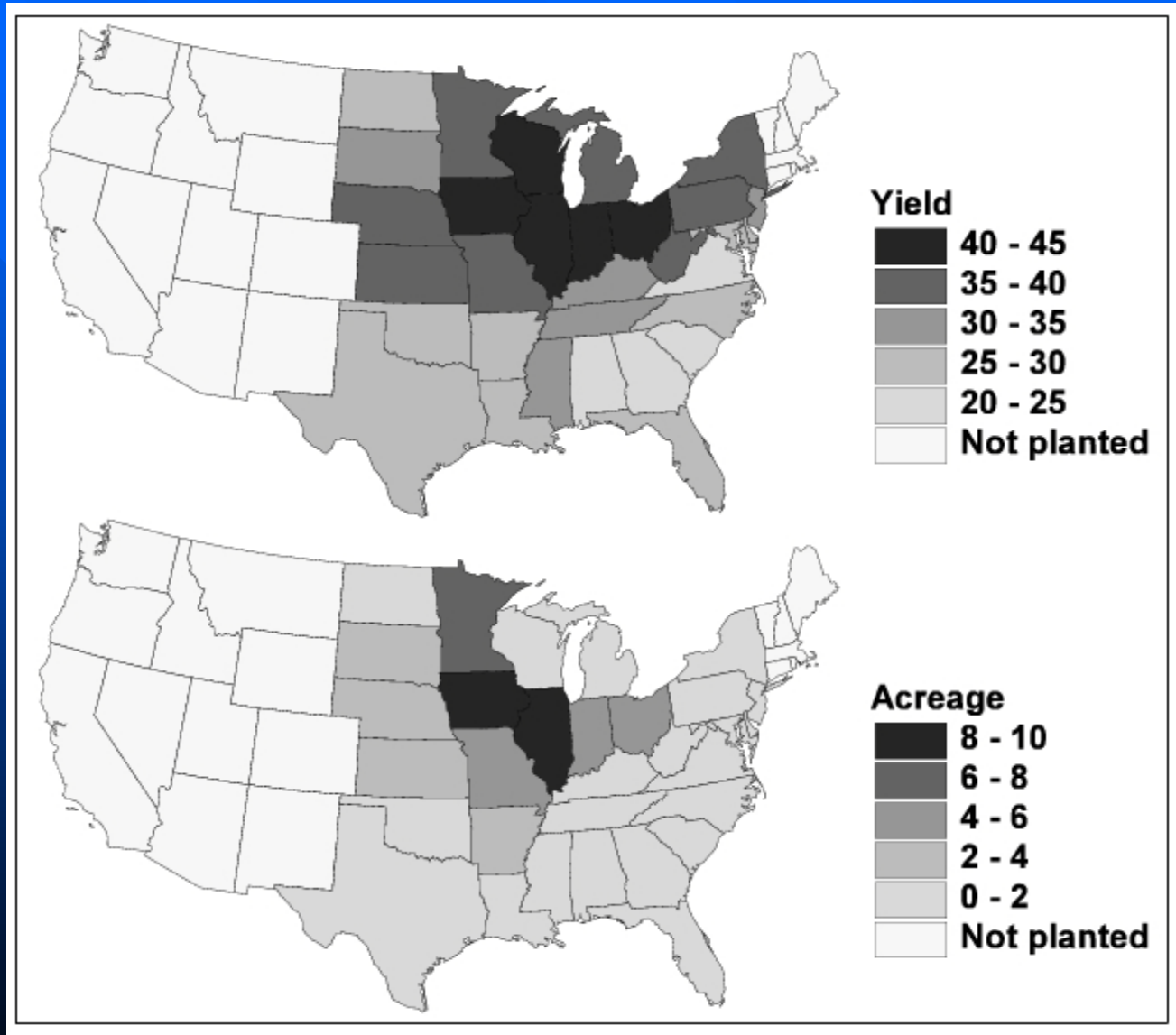
History of Micromaps

- First presented at 1996 American Statistical Association's annual meeting (Olsen, Carr, Courbois, Pierson)
- Initial references:
 - Carr, Pierson (1996) Emphasizing Statistical Summaries ...with Micromaps, SCSG*, Vol.7, No.3
 - Carr, Olsen, Courbois, Pierson, Carr (1998) Linked Micromap Plots ..., SCSG, Vol. 9, No.1

*Statistical Computing & Statistical Graphics Newsletter:

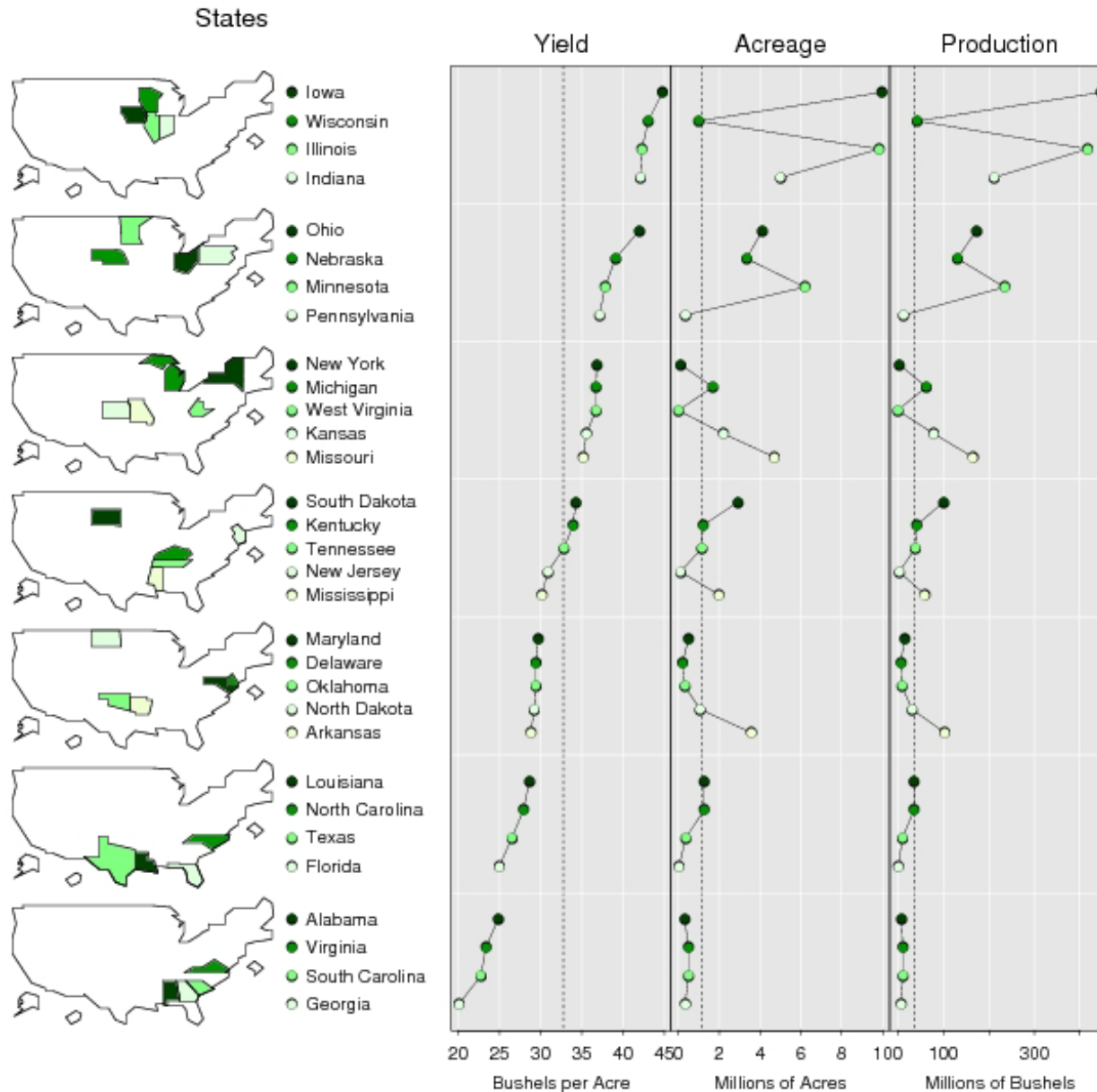
<http://stat-computing.org/newsletter/archive.html>

Choropleth Maps vs Micromaps (1)



Choropleth Maps vs Micromaps (2)

Soybean Statistics by State, 1997 Census of Agriculture



Micromaps in R

- Two recently developed R Packages:
 - “micromap”: general purpose
 - “micromapST”: focus on the 50 U.S. states

Regional Micromaps

- Micromaps that are related to subregions within a particular country
- Previously:
 - National level: United States and Korea
 - Provincial level: United States and France
- Recent developments:
 - National level: most countries of South America, Korea (advanced), and China
 - Provincial level: most provinces of Korea

Regional Micromap Construction

- Modification of existing shapefiles
 - Simplification of boundaries (via Douglas-Peucker 1973 algorithm) [previously solved]
 - Removal of tiny islands [previously solved]
 - Enlarge small areas such as capital regions, e.g., Washington DC in the United States
 - Shift and resize (enlarge or shrink) regions that are far away from the main area, e.g., Alaska or Hawaii in the United States
 - Create R code for the remaining tasks

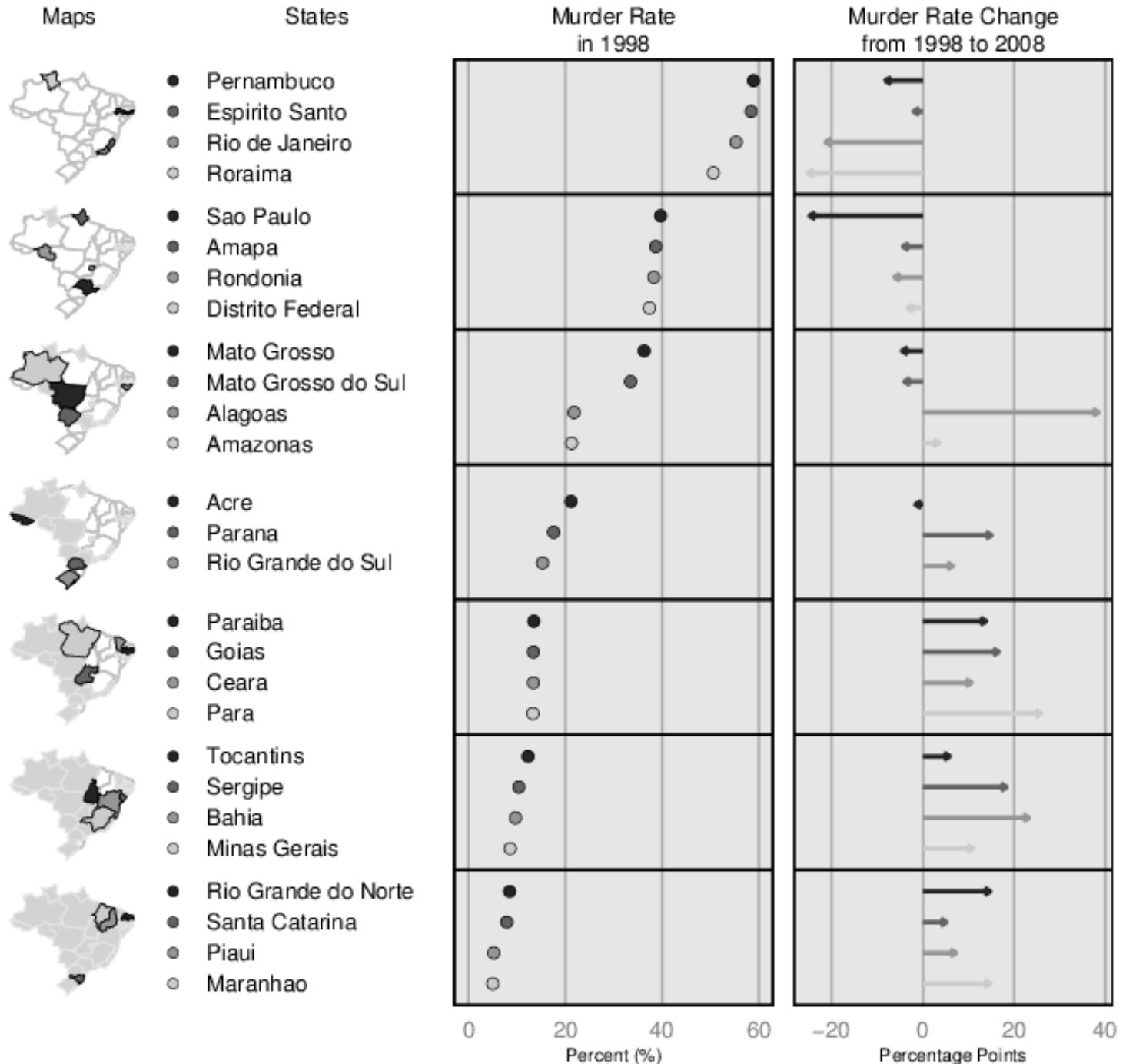
Brazil

Simplification

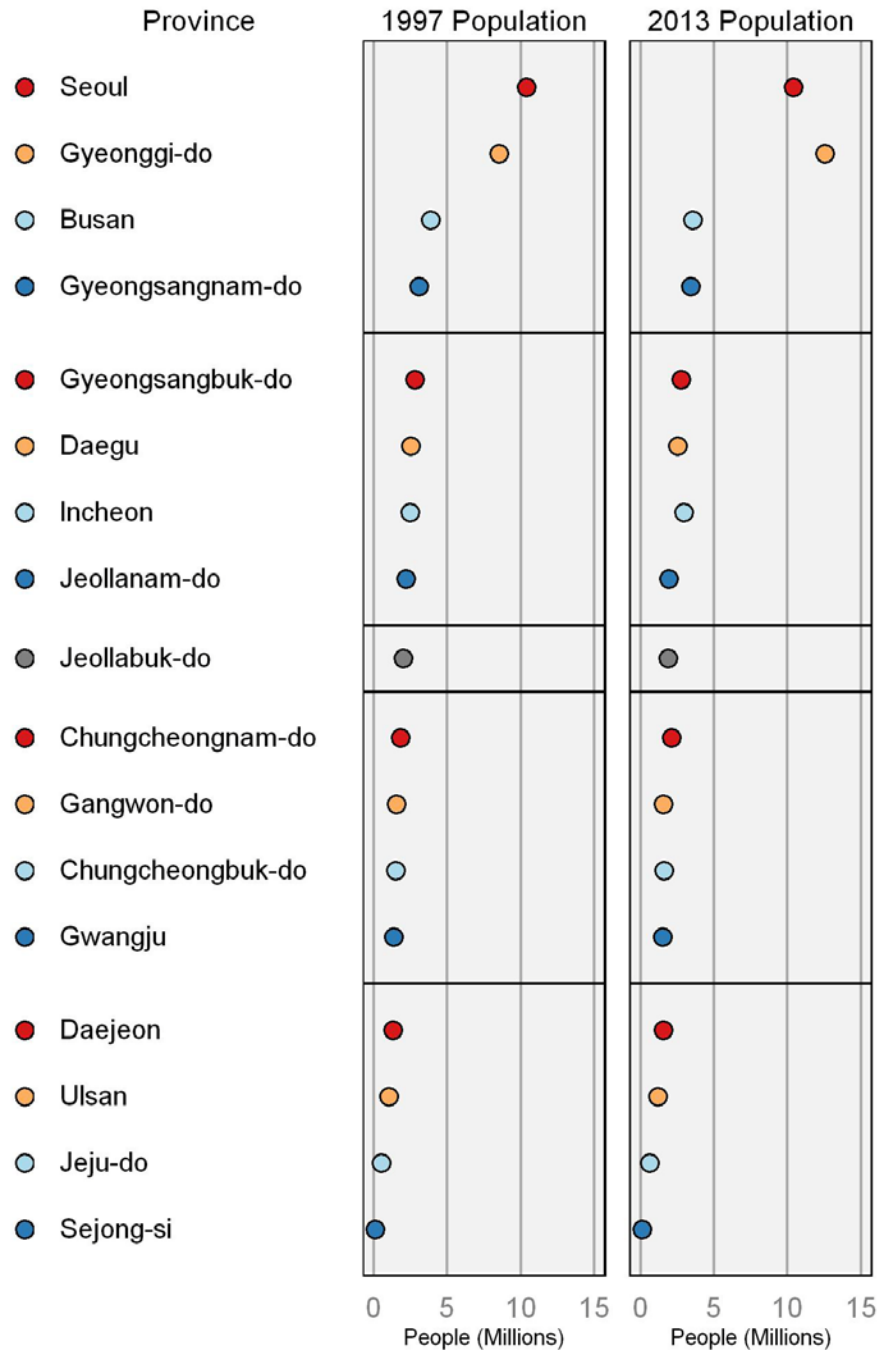
- UL: Raw
- UR: Thinned boundaries
- LL: Capital region enlarged
- LR: Capital region enlarged & shifted



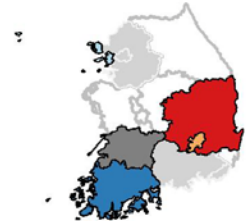
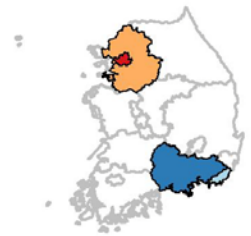
Brazil Example



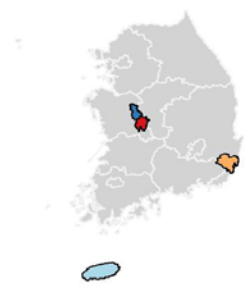
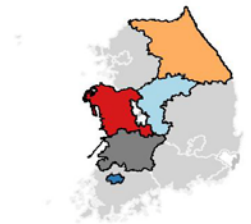
Korea Example (raw)



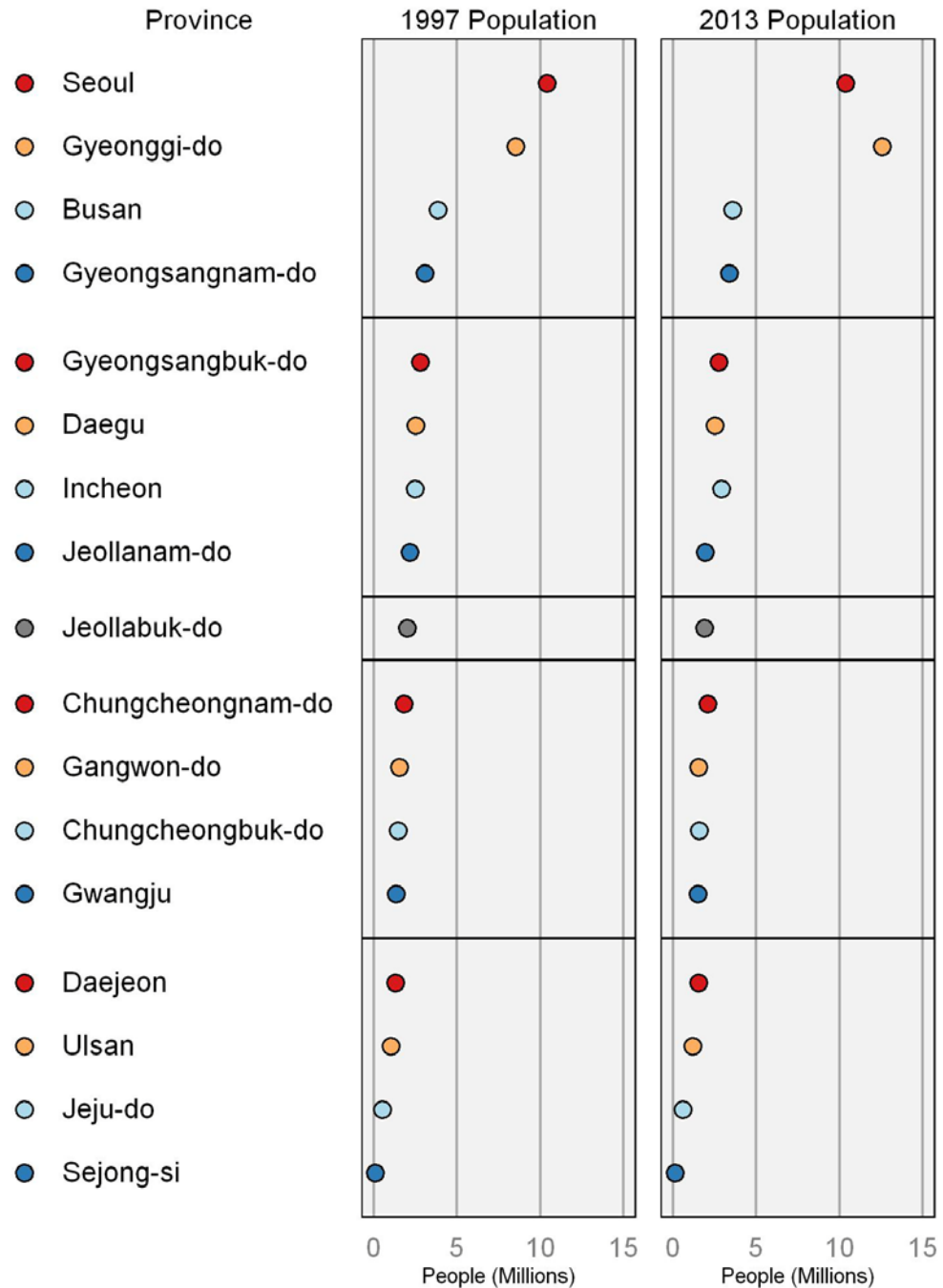
Maps



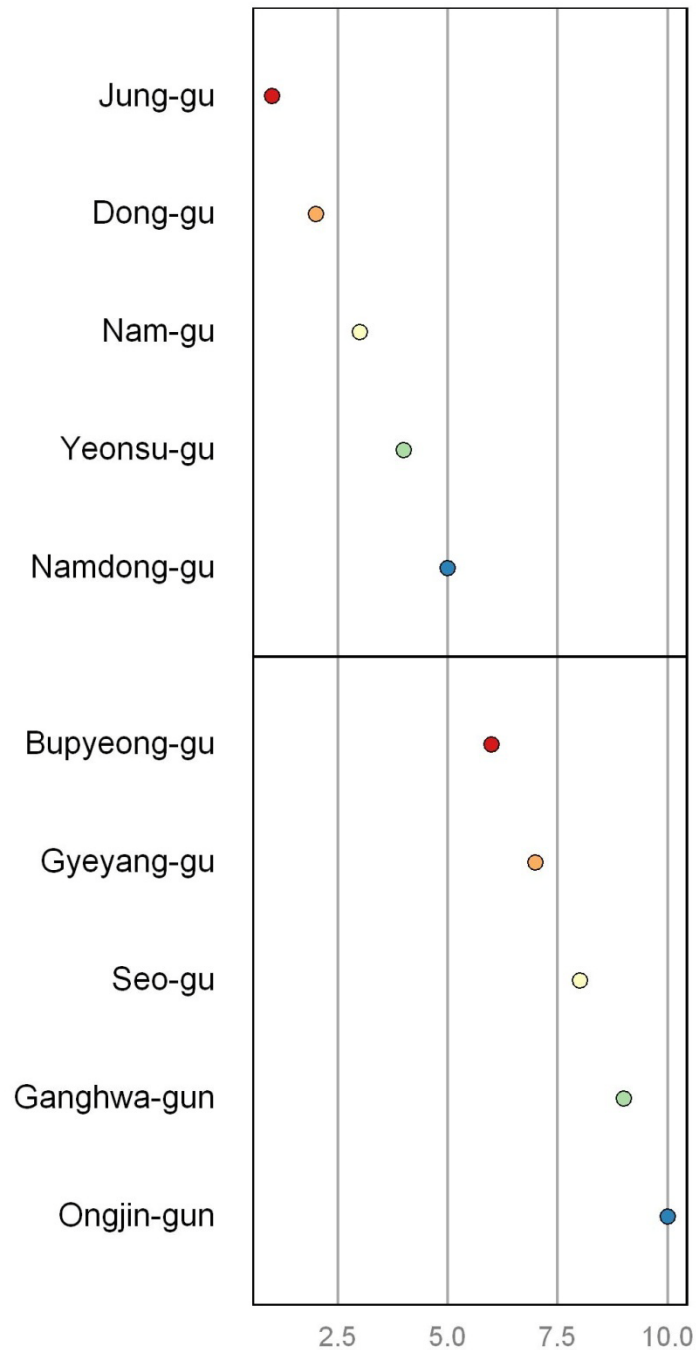
Median



Korea Example (refined)



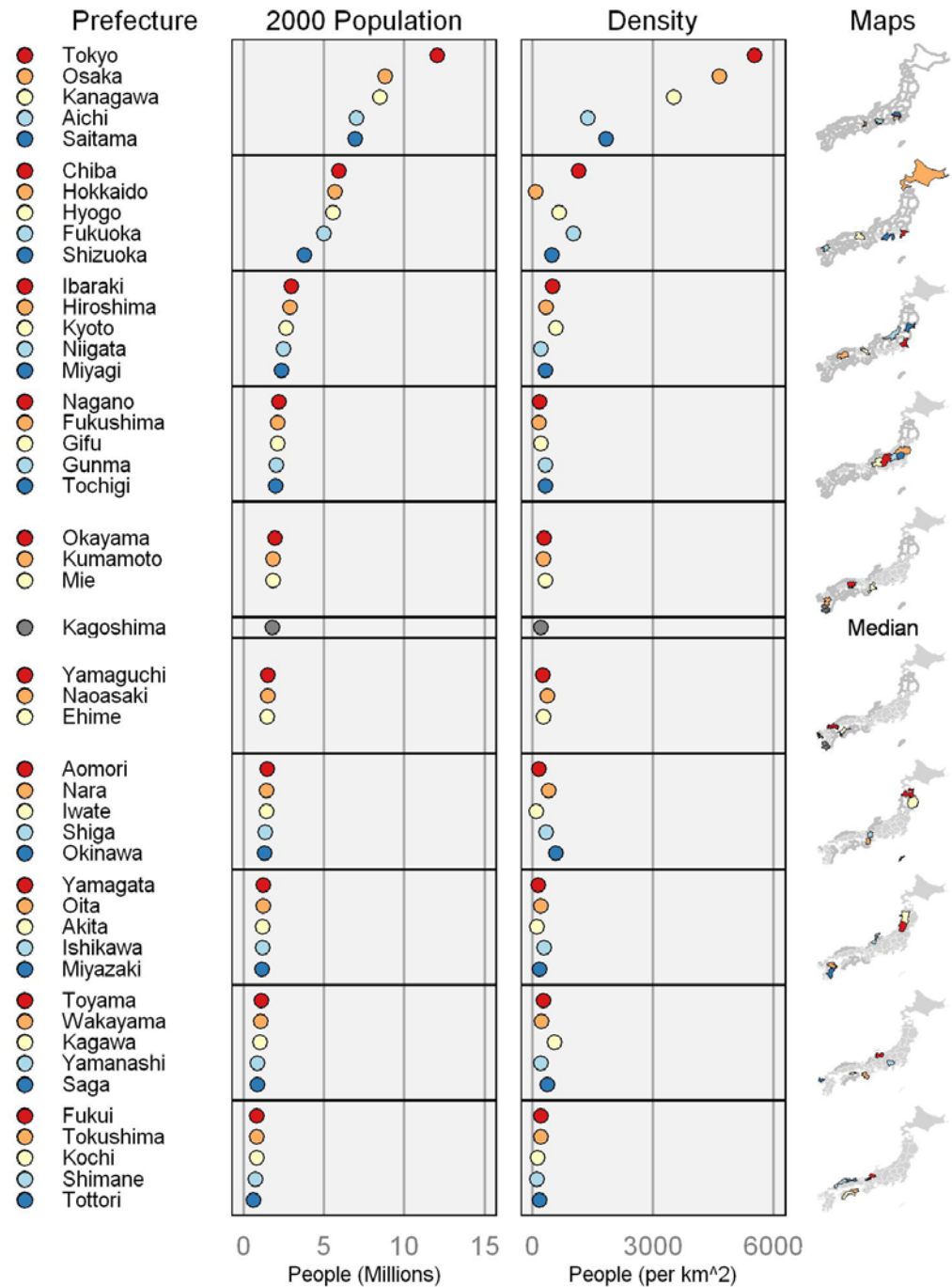
Korea / Incheon Example (template - raw)



Korea / Incheon Example (template - refined)



Japan Example



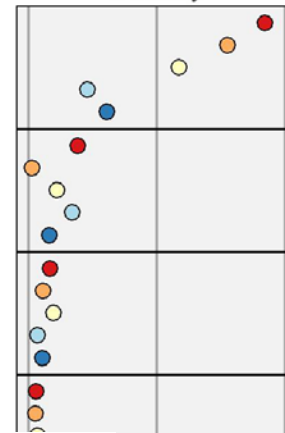
Japan Example

- Prefecture
- Tokyo
 - Osaka
 - Kanagawa
 - Aichi
 - Saitama
 - Chiba
 - Hokkaido
 - Hyogo
 - Fukuoka
 - Shizuoka
 - Ibaraki
 - Hiroshima
 - Kyoto
 - Niigata
 - Miyagi
 - Nagano
 - Fukushima

2000 Population



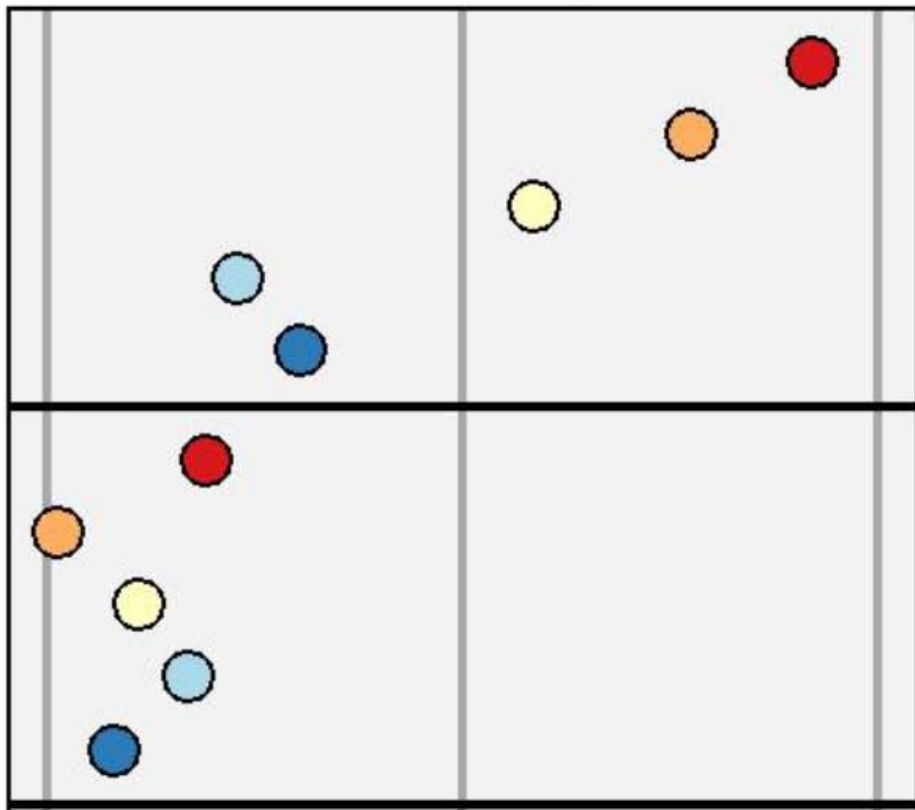
Density



Maps



Density



Maps



Median

3000 6000
le (per km²)

China Example (1)

Table shows number of officially registered religious organizations in each province

Table 1 The number of Administration, Buddhism, Daoism, Islam, Christianity, 2004

<u>gbprov</u>	<u>ename</u>	<u>st0</u>	<u>st1</u>	<u>st3</u>	<u>st4</u>	<u>st5</u>	<u>sttotal</u>
11	Beijing	0	2	0	22	5	29
12	Tianjin	1	6	0	30	25	62
13	Hebei	0	98	31	246	399	774
14	Shanxi	3	280	25	29	411	748
15	Neimenggu	4	109	2	126	304	545
21	Liaoning	2	312	47	89	821	1271
22	Jilin	0	71	8	56	745	880
23	Heilongjiang	1	100	9	64	473	647
31	Shanghai	1	73	21	7	175	277
32	Jiangsu	7	415	62	35	1039	1558
33	Zhejiang	2	2956	1868	10	2830	7666
34	Anhui	3	675	40	98	2132	2948
35	Fujian	10	2745	1030	6	1804	5595
36	Jiangxi	9	1133	288	5	633	2068
37	Shandong	5	14	7	122	306	454
41	Henan	10	187	128	444	1988	2757
42	Hubei	9	756	205	31	198	1199
43	Hunan	5	763	178	36	160	1142
44	Guangdong	10	617	81	3	440	1151
45	Guangxi	1	61	0	14	101	177
46	Hainan	0	2	0	0	5	7
50	Chongqing	1	102	11	3	88	205
51	Sichuan	9	1412	124	116	196	1857
52	Guizhou	1	178	15	80	158	432
53	Yunnan	1	701	102	525	682	2011
54	Xizang	7	1320	0	2	1	1330
61	Shaanxi	2	186	131	69	464	852
62	Gansu	6	530	400	3680	202	4818
63	Qinghai	1	627	42	1266	16	1952
64	Ningxia	0	211	68	3416	22	3717
65	Xinjiang	8	47	1	23678	105	23839

China Example (2)

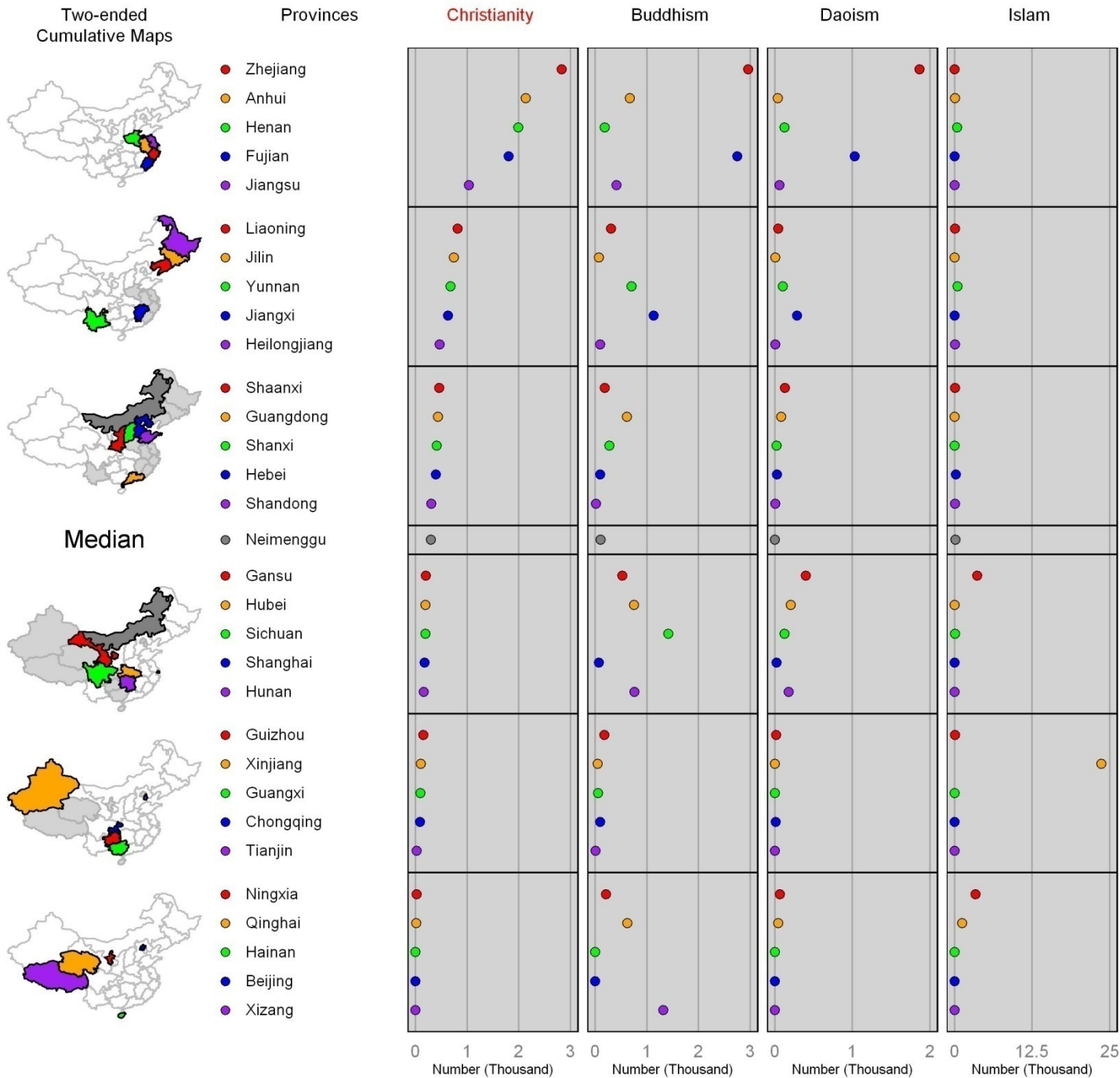
Questions:

1. What is the single biggest outlier? And is this also a spatial outlier?
2. Is there any association between Buddhism and Daoism? If so, is this positive or negative? Are there regional differences?
3. For the four provinces with the highest count of Christianity, how is Buddhism represented in those provinces?

China

Example:

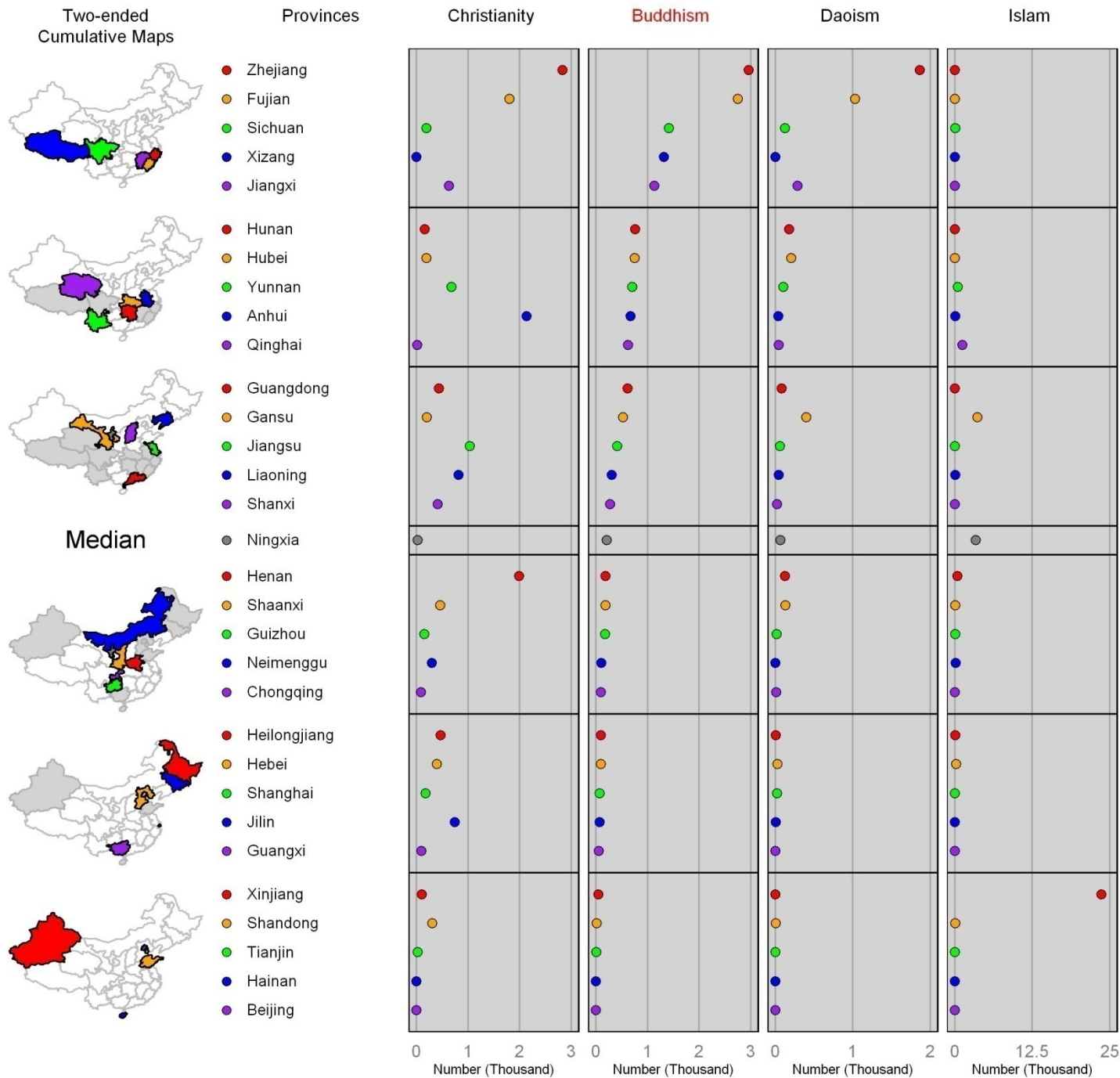
(3)



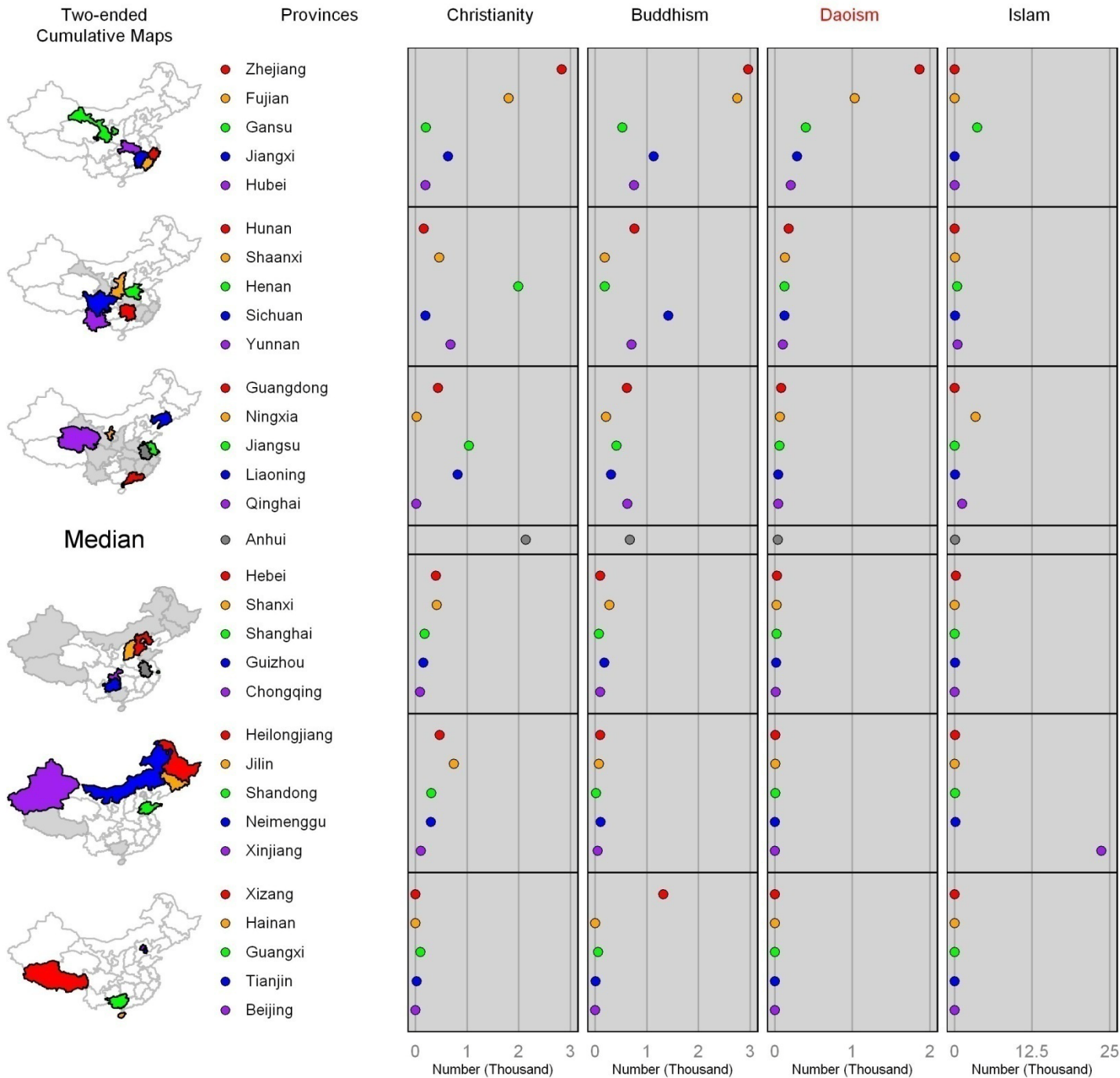
China

Example:

(4)



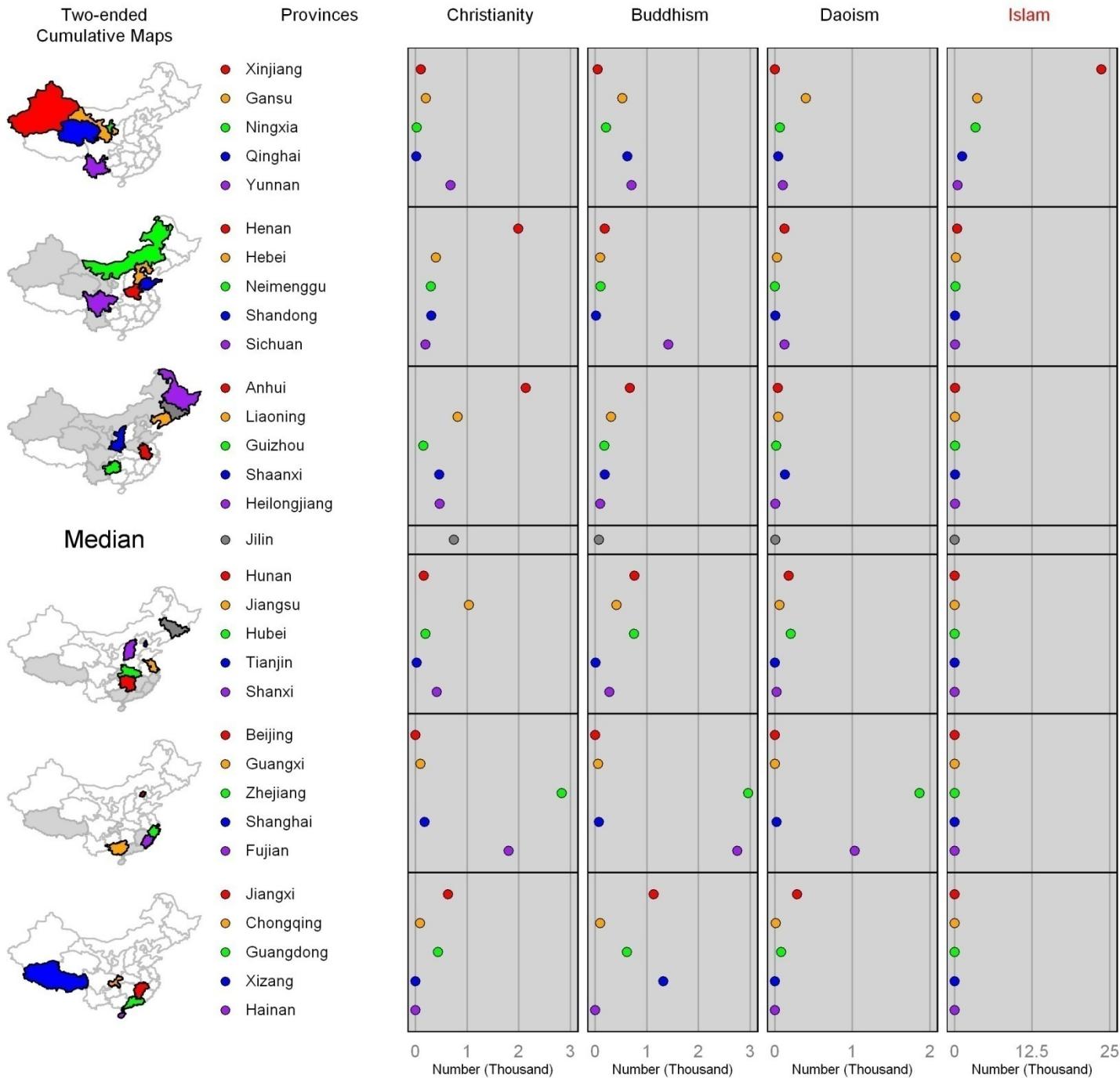
China Example: (5)



China

Example:

(6)

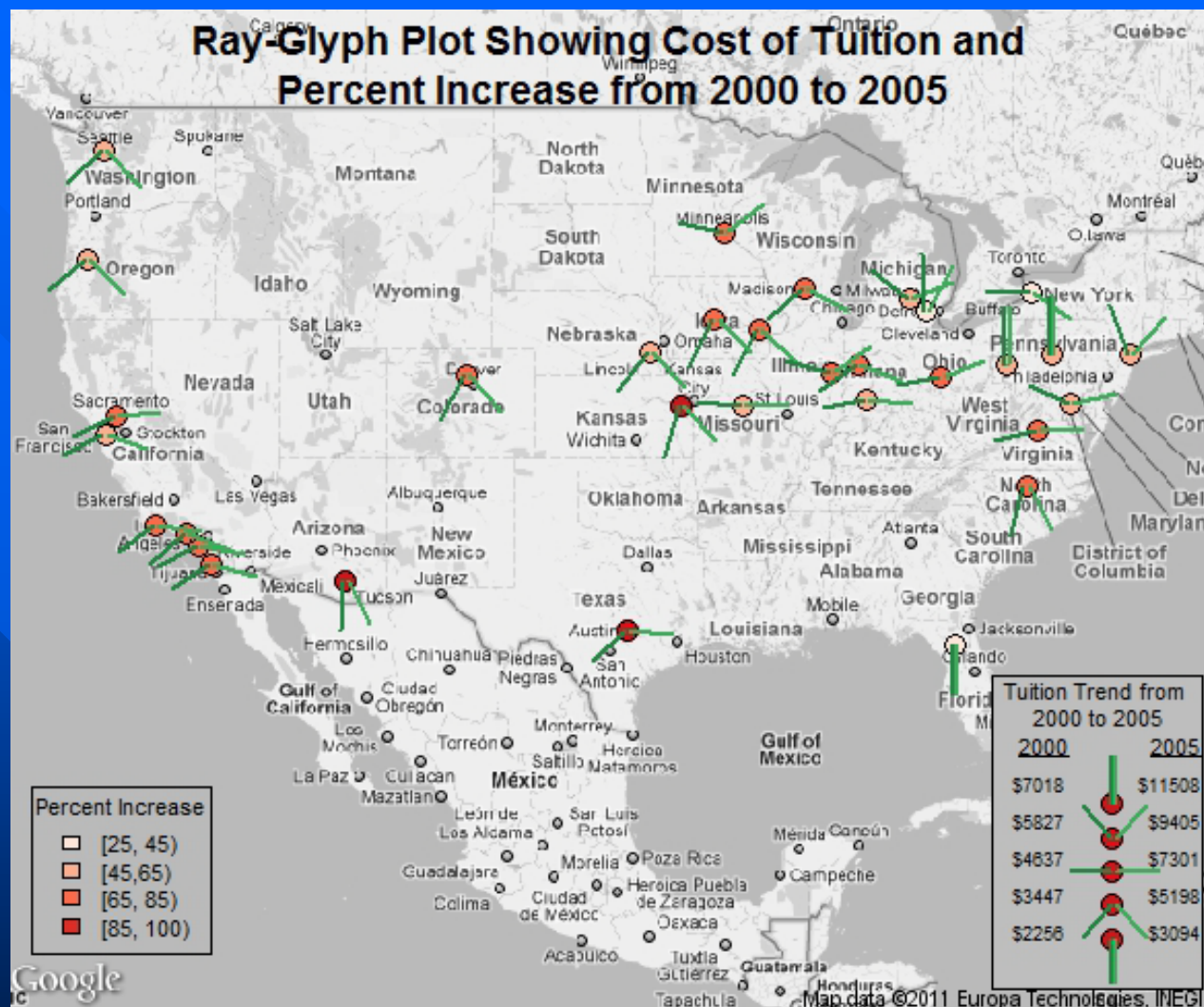


RgoogleMaps

- R package ``RgoogleMaps``:
- Two main purposes:
 - Provide a comfortable R interface to query the Google server for static maps
 - Use the map as a background image to overlay plots within R

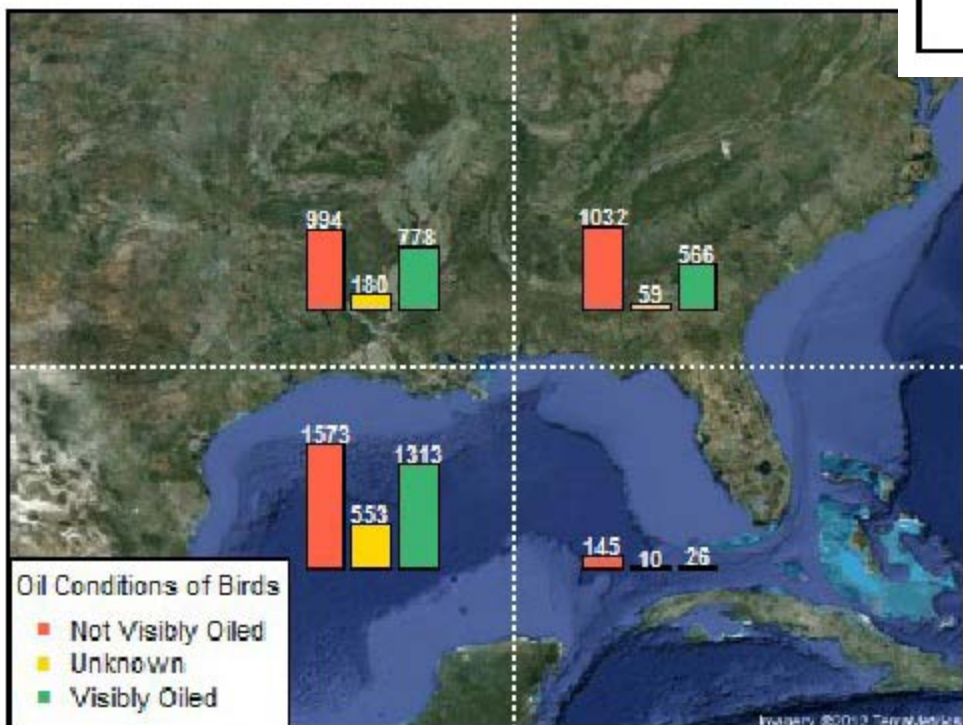
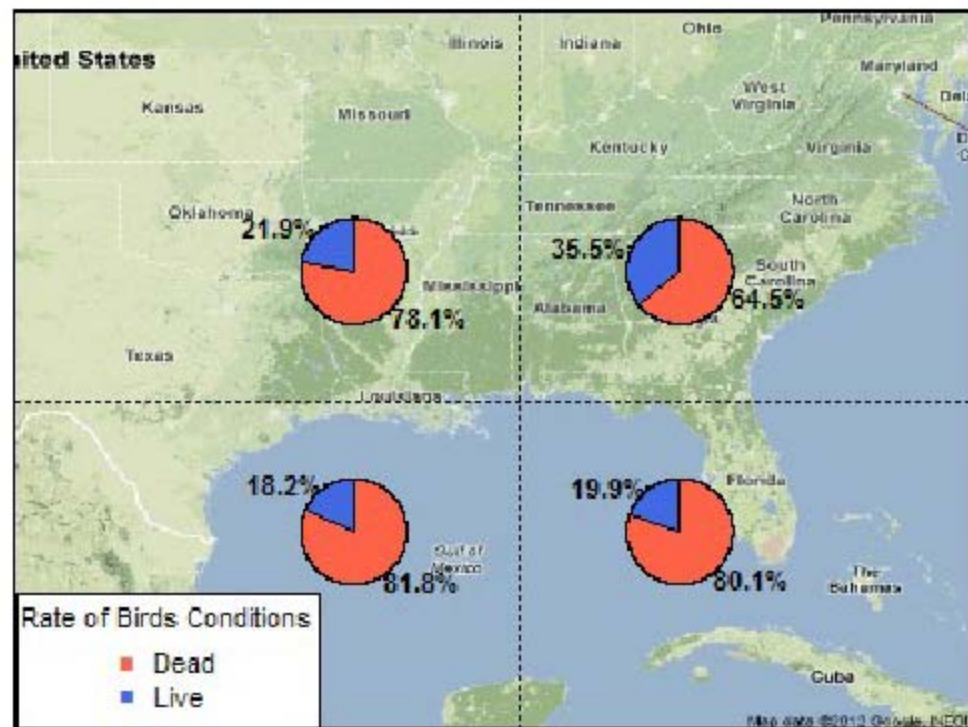
Google Map - Tuition

- Colored dots represent percent-wise tuition increases
- Green lines represent tuition for 2000 and 2005, respectively, with a line pointing down as the lowest and up as the highest tuition in that year



Google Map – Oil Spill Data

- Bar charts and pie charts related to the 2010 Deepwater Horizon oil spill



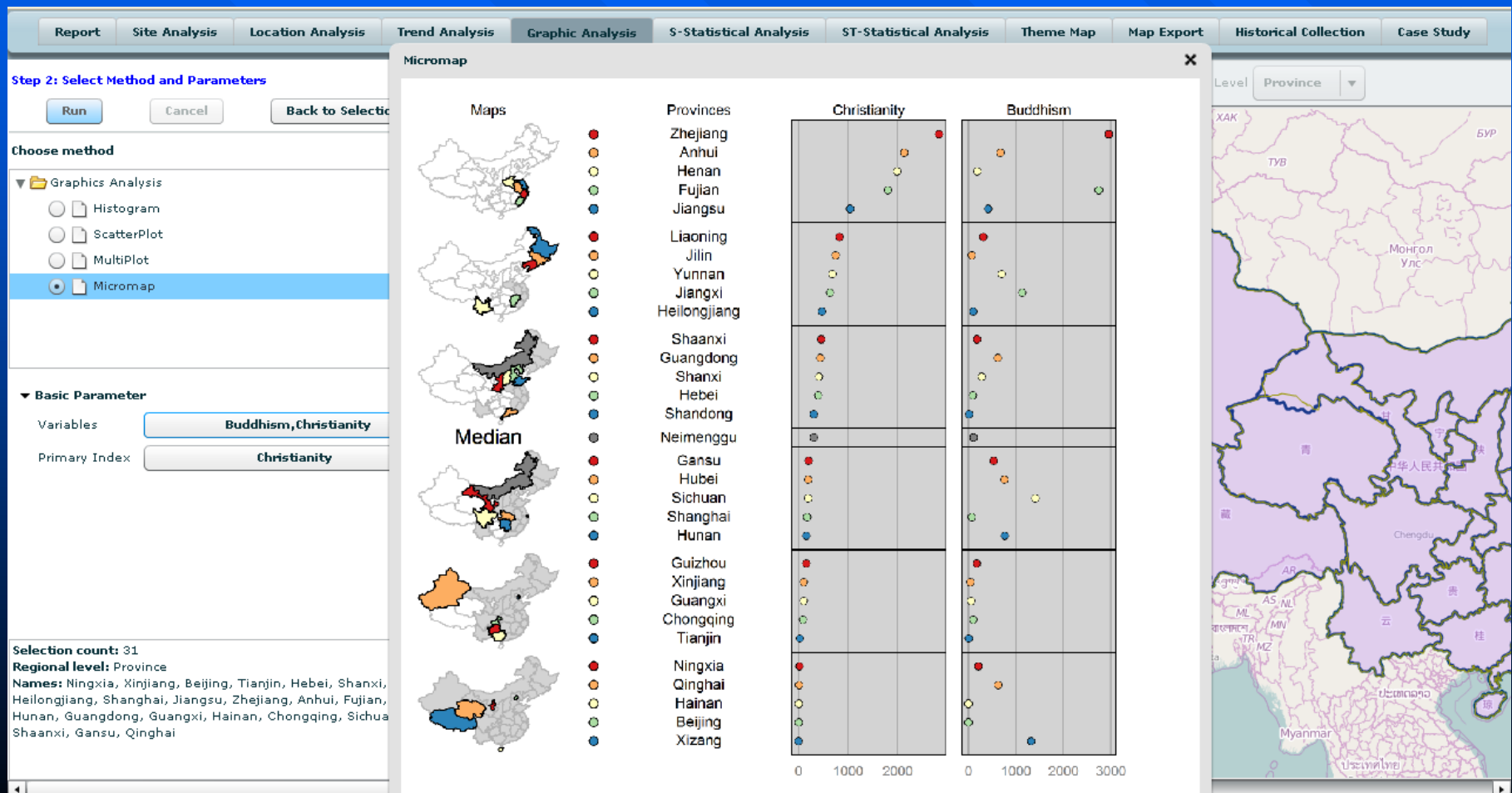
Religion in China – Relative Spatial Distribution



Current Work:

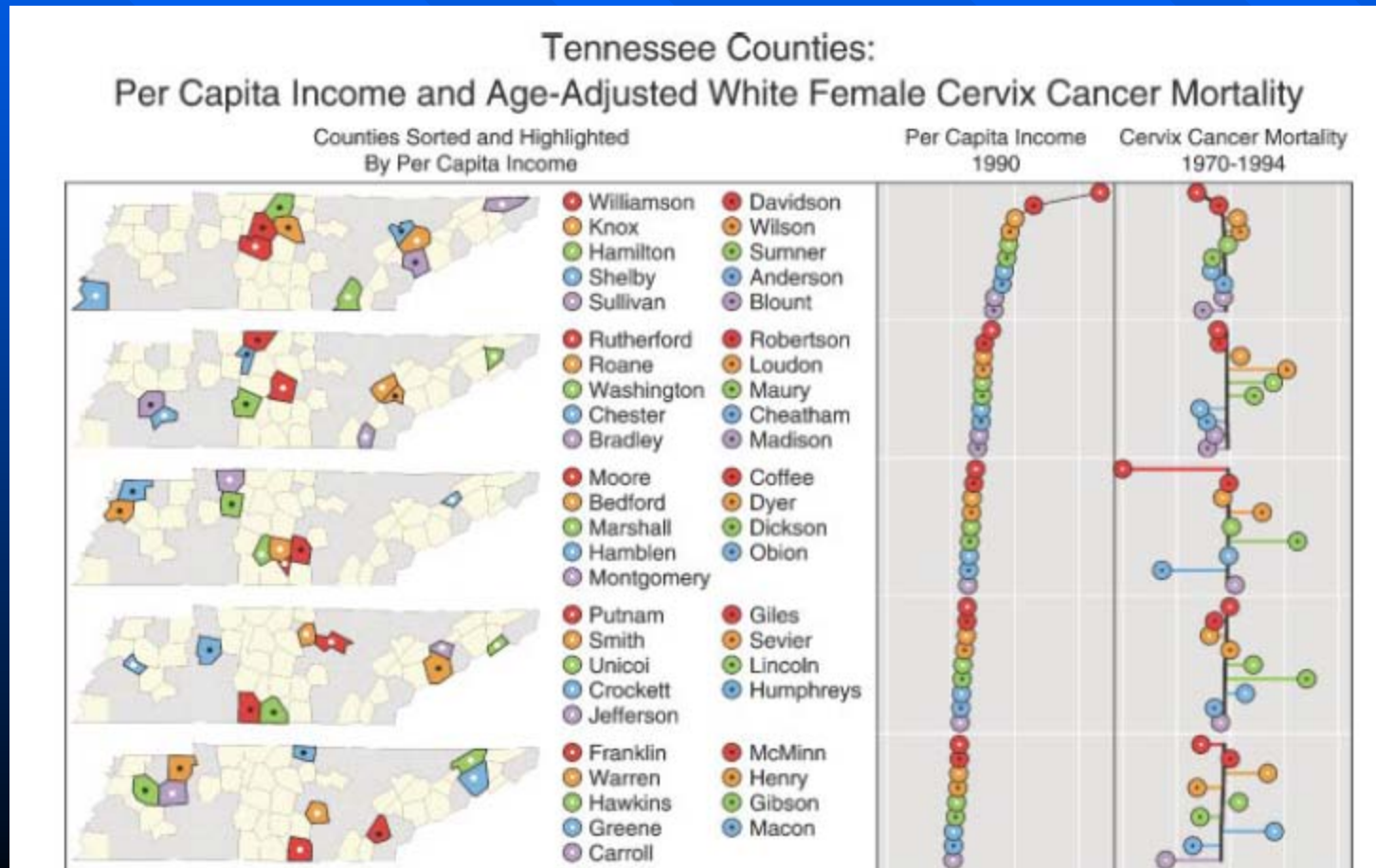
Interactive Link: Micromaps / Religion Explorer

- All provinces with variables Buddhism & Christianity
- See next presentation for additional details



Future Work (1)

- Reintroduce 2-column identifier layout to micromap R package, based on Carr (2001)



Future Work (2)

- Introduce additional data panels to micromap R package, such as line charts (time series plots) and scatterplots
- Further enhance, test, and debug R code for the creation of regional micromaps and add functionality to micromap R package once code is stable
- Fine-tune plot locations for RgoogleMaps
 - Avoid overplotting
 - Replace midpoints where needed (instead of using geographic median)

Questions ???

– or –

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