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### RIGA: A Rich Internet Geospatial Analytics Application for Area-based Data

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# **RIGA: A Rich Internet Geospatial Analytics Application for Area-based Data**

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# Content

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- Motivations
- RIGA design architecture
- RIGA in action
- Q & A

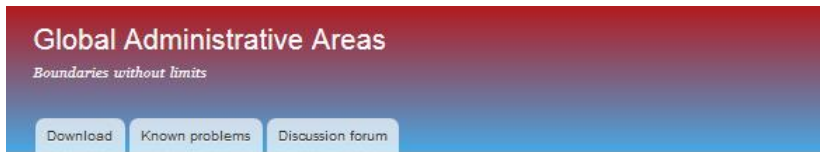
# What are Area-based Geospatial Data

- A representation of geographical features in the form of polygon or lattice.
- Formal
  - political boundary, administrative boundary, election boundary.
- Informal
  - analytical grid, hexagon, etc



# Motivation 1: data.gov initiative

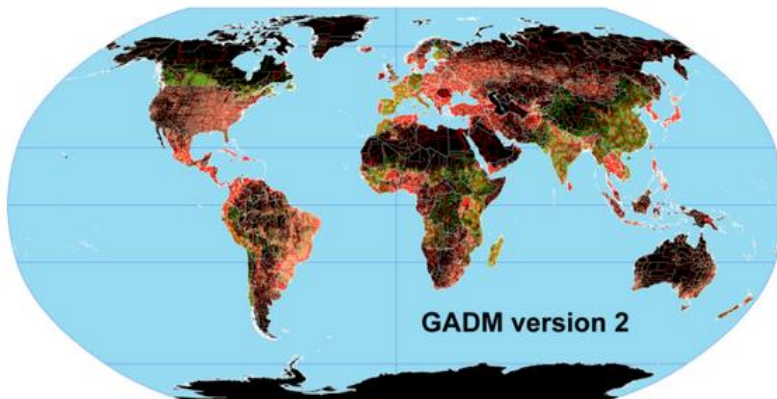
- Availability and easy accessible to highly disaggregated public and government data.



## GADM database of Global Administrative Areas

GADM is a spatial database of the location of the world's administrative areas (or administrative boundaries) for use in GIS and similar software. Administrative areas in this database are countries and lower level subdivisions such as provinces, departments, bibhag, bundeslander, daerah istimewa, fivondronana, krong, landsvæðun, opština, sous-préfectures, counties, and thana. GADM describes where these administrative areas are (the "spatial features"), and for each area it provides some attributes, such as the name and variant names.

The current version is 2.0 (January 2012)



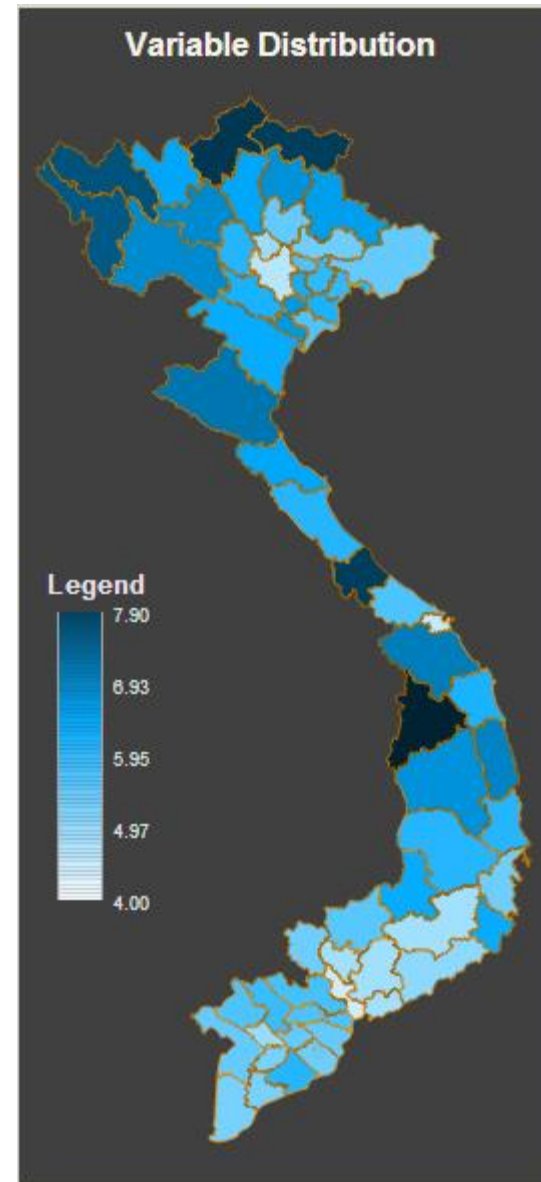
# Motivation 2: The Myth of Geography matters!

- About 80% of all data maintained by organizations around the world has a location component (source: BusinessWeek Research Services, 2006)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	
1	Country	Exchange	Name	Forex	Symbol	ISIN	SEDOL	Close	Open	High	Low	Volume	Market Cap	Industry	Supersector	1 Day	1 Week	1 Month	2 Month	3 Month	1 Day Ch	1 Week Ch	1 Week Ck	2 Week C	2 Week Ck	1 Month	1 Month	2 Month	2 Month	3 Month	
2	AT	VIE	Erete Gr	EUR	ERST.VI	AT000005283631		12.75	3E+09	3E+09	Financial	Bank	13.75	13.69	10.27	7.75	11.84	16.2	-0.073	-0.075	-0.069	-0.0886	0.2415	0.2663	0.6452	0.7131	0.0769	0.1157	-0.2		
3	AT	VIE	Rudolf Redl	EUR	RIED.VI	AT000005107471		21.21	1E+09	1E+09	Financial	Bank	22.65	25	19.35	14.62	16	19.3	-0.064	-0.066	-0.152	-0.1638	0.0632	0.0961	0.4508	0.5107	0.3256	0.3134	0.4		
4	AT	VIE	voestalpine	EUR	VOES.VI	AT000005143401		3.95	1E+09	1E+09	Basic M	Basic Pr	10.11	10.47	11.13	12.4	12.22	15.04	-0.026	-0.028	-0.059	-0.0794	-0.12	-0.101	-0.206	-0.173	-0.355	-0.229	-0.3		
5	AT	VIE	Voestalpine	EUR	WBSV.VI	AT000005639373		5.93	5E+08	7E+08	Industria	Coatret	6.15	5.6	5.5	6.57	10.06	11.9	-0.036	-0.038	0.0589	0.03622	0.0782	0.1015	-0.037	-0.06	-0.411	-0.383	-0.91		
6	AT	VIE	Intercell	EUR	ICEL.VI	AT0000050671M5		23.2	9E+08	1E+09	Health C	Health C	21.22	21.48	21.43	22.92	25.68	21.84	0.0933	0.0903	0.0801	0.05931	0.0796	0.1029	0.0122	0.054	-0.037	-0.064	0.06		
7	AT	VIE	Andritz	EUR	ANDR.VI	AT0000051V6VF6		23.16	9E+08	1E+09	Industria	Industria	21.47	21.51	19.79	24	23.3	18.16	0.0767	0.0764	0.0767	0.05362	0.1703	0.1555	-0.035	0.0048	-0.006	0.0238	0.27		
8	AT	VIE	Vienna I	EUR	VIGR.VI	AT0000050BK3S3		21.63	8E+08	1E+09	Financial	Insurance	22.05	21.3	18.23	19.17	24.6	24.12	-0.019	-0.021	0.0155	-0.0063	0.1865	0.2121	0.1283	0.1743	-0.121	-0.689	-0.4		
9	AT	VIE	OMV AC	EUR	OMV.VI	AT0000054514S9		25.2	4E+09	5E+09	Oil & Gas	Oil & Gas	24.29	23.84	21.23	22.33	18.72	18.72	0.0375	0.0352	0.057	0.03438	0.187	0.2126	0.2162	0.2664	0.1255	0.1661	0.344		
10	AT	VIE	Telekom	EUR	TELA.VI	AT000005435008		11.4	4E+09	5E+09	Telecom	Telecom	10.86	10.43	10.43	9.35	11	10.3	0.0437	0.0474	0.0867	0.06344	0.0867	0.1102	0.1457	0.193	0.0364	0.0737	0.104		
11	AT	VIE	Verbund	EUR	VERB.VI	AT000005461607		28.59	2E+09	3E+09	Utilities	Utilities	28.96	29.32	26.12	25	29.37	32.56	-0.013	-0.015	-0.044	-0.0649	0.0346	0.1182	0.1436	0.1908	-0.046	-0.012	-0.1		
12	AT	VIE	Atrium E	EUR	ATRV.VI	AT000005158664		2.27	5E+08	7E+08	Financial	Real Est	2.32	2.02	2.15	1.47	2.18	2.58	-0.022	-0.024	0.1238	0.09366	0.0558	0.1298	0.5442	0.6843	0.0413	0.1001	-0.		
13	AU	ASX	Bendigo	AUD	BEN.AX	AU000005091293		8.19	2E+09	1E+09	Financial	Bank	7.92	7.4	6.3	6.84	10	11.1	0.0341	0.0346	0.0668	0.03956	0.03	0.413	0.1974	0.3737	-0.181	-0.035	-0.21		
14	AU	ASX	National	AUD	NAT.AX	AU000005091294		4.6	9E+09	5E+09	Financial	Bank	6.14	6.11	5.4	5.2	7.5	8.31	-0.023	-0.022	-0.028	0.24187	0.111	0.593	0.8532	0.5785	-0.2	0.107	-0.2		
15	AU	ASX	National	AUD	NAB.AX	AU000005624601		20.1	4E+10	3E+10	Financial	Bank	21.09	19.79	19.35	17.51	19.93	20.86	-0.047	-0.046	0.0157	0.00306	0.0854	0.1802	0.1479	0.2532	0.016	0.1833	-0.2		
16	AU	ASX	Bank of A	AUD	BOA.AX	AU000005076242		6.44	1E+09	1E+09	Financial	Bank	8.3	7.94	7.04	6.84	7.4	9.45	0.0169	0.0174	0.063	0.2260	0.1	0.0085	0.0067	-0.007	-0.052	0.0361	-0.1		
17	AU	ASX	Australia	AUD	ANZ.AX	AU000005065586		15.75	3E+10	2E+10	Financial	Bank	16.55	15.26	14.92	13.05	15.27	15.25	-0.048	-0.048	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
18	AU	ASX	Westpac	AUD	WBA.AX	AU000005071616		13.09	6E+10	4E+10	Financial	Bank	13.14	13.95	17.13	16.65	15.64	16.63	0.003	-0.002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
19	AU	ASX	Common	AUD	CBA.AX	AU000005210355		34.13	5E+10	4E+10	Financial	Bank	35	36.88	31	23.9	26.3	28.9	-0.008	-0.007	-0.01	-0.0164	0.1203	0.2417	0.1654	0.3078	0.2311	0.4875	0.22		
20	AU	ASX	BlelScop	AUD	BSL.AX	AU0000053323C3		2.57	2E+09	2E+09	Basic M	Basic Pr	2.15	2.55	2.23	2.33	3.33	3.45	-0.019	-0.078	-0.0078	0.00129	0.1422	0.2514	0.103	0.2235	-0.272	-0.171	-0.2		
21	AU	ASX	CSR Ltd	AUD	CSR.AX	AU000005238641		1.2	2E+09	1E+09	Basic M	Basic Pr	1.2	1.145	1.17	1.02	1.425	1.9	-0.053	-0.058	0.048	0.04122	0.0256	0.3614	0.1765	0.5812	-0.158	0.162	-0.1		
22	AU	ASX	Iluka Res	AUD	ILU.AX	AU000005187575		4.13	1E+09	1E+09	Basic M	Basic Pr	4.1	4.4	4.3	4.32	4.25	4.44	-0.017	-0.017	-0.014	-0.03	-0.04	0.0085	-0.067	-0.007	-0.052	0.0361	-0.01		
23	AU	ASX	OneSteel	AUD	OST.AX	AU000005237321		2.28	2E+09	1E+09	Basic M	Basic Pr	2.28	2.18	1.905	1.8	2.43	2.39	-0.055	-0.054	-0.054	-0.054	-0.054	0.3102	0.25	0.3302	-0.074	0.0117	-0.01		
24	AU	ASX	Alkermis I	AUD	ALV.AX	AU000005354858		1.26	2E+09	1E+09	Basic M	Basic Pr	1.26	1.21	1.21	1.195	1.14	1.28	0.0323	0.0323	0.0323	0.0323	0.0323	0.0323	0.0323	0.0323	0.0323	0.0323	0.0323		
25	AU	ASX	Nuvera	AUD	NMVA.AX	AU000005637101		22.33	2E+09	1E+09	Basic M	Basic Pr	22.33	22.33	22.33	22.33	22.33	22.33	22.33	22.33	22.33	22.33	22.33	22.33	22.33	22.33	22.33	22.33	22.33	22.33	
26	AU	ASX	BHP Bill	AUD	BHP.AX	AU00000514463C		31.2	1E+10	1E+10	Basic M	Basic Pr	31.2	31.2	31.2	31.2	31.2	31.2	31.2	31.2	31.2	31.2	31.2	31.2	31.2	31.2	31.2	31.2	31.2	31.2	
27	AU	ASX	Lihir Gold	AUD	LGL.AX	PG000005189396		1.0	1E+09	1E+09	Basic M	Basic Pr	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
28	AU	ASX	Fortescue	AUD	FMG.AX	AU000005086251		1.0	1E+09	1E+09	Basic M	Basic Pr	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
29	AU	ASX	Paladin E	AUD	PDN.AX	AU000005668461		1.0	1E+09	1E+09	Basic M	Basic Pr	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
30	AU	ASX	Rio Tinto	AUD	RIO.AX	AU000005220103		1.0	1E+09	1E+09	Basic M	Basic Pr	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
31	AU	ASX	Ilcores PI	AUD	IPL.AX	AU000005673042		1.0	1E+09	1E+09	Basic M	Basic Pr	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
32	AU	ASX	Orica Ltd	AUD	ORL.AX	AU000005458001		1.0	1E+09	1E+09	Basic M	Basic Pr	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
33	AU	ASX	Leighton	AUD	LEL.AX	AU000005112227		1.0	1E+09	1E+09	Basic M	Basic Pr	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
34	AU	ASX	Boral Ltd	AUD	BOL.AX	AU000005219610		1.0	1E+09	1E+09	Basic M	Basic Pr	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
35	AU	ASX	James H	AUD	JHX.AX	AU000005442971		4.6	1E+09	1E+09	Basic M	Basic Pr	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
36	AU	ASX	Lead Les	AUD	LLC.AX	AU000005121004		6.49	1E+09	1E+09	Basic M	Basic Pr	6.49	6.49	6.49	6.49	6.49	6.49	6.49	6.49	6.49	6.49	6.49	6.49	6.49	6.49	6.49	6.49	6.49	6.49	6.49
37	AU	ASX	Downer I	AUD	DOW.AX	AU000005455573		4.45	1E+09	1E+09	Basic M	Basic Pr	4.45	4.45	4.45	4.45	4.45	4.45	4.45	4.45	4.45	4.45	4.45	4.45	4.45	4.45	4.45	4.45	4.45	4.45	
38	AU	ASX	United Q	AUD	UGL.AX	AU000005314871		3.18	2E+09	1E+09	Basic M	Basic Pr	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	3.18	
39	AU	ASX	Perpetua	AUD	PPT.AX	AU000005682939		26.34	1E+09	1E+09	Basic M	Basic Pr	26.34	26.34	26.34	26.34	26.34	26.34	26.34	26.34	26.34	26.34	26.34	26.34	26.34	26.34	26.34	26.34	26.34	26.34	26.34
40	AU	ASX																													

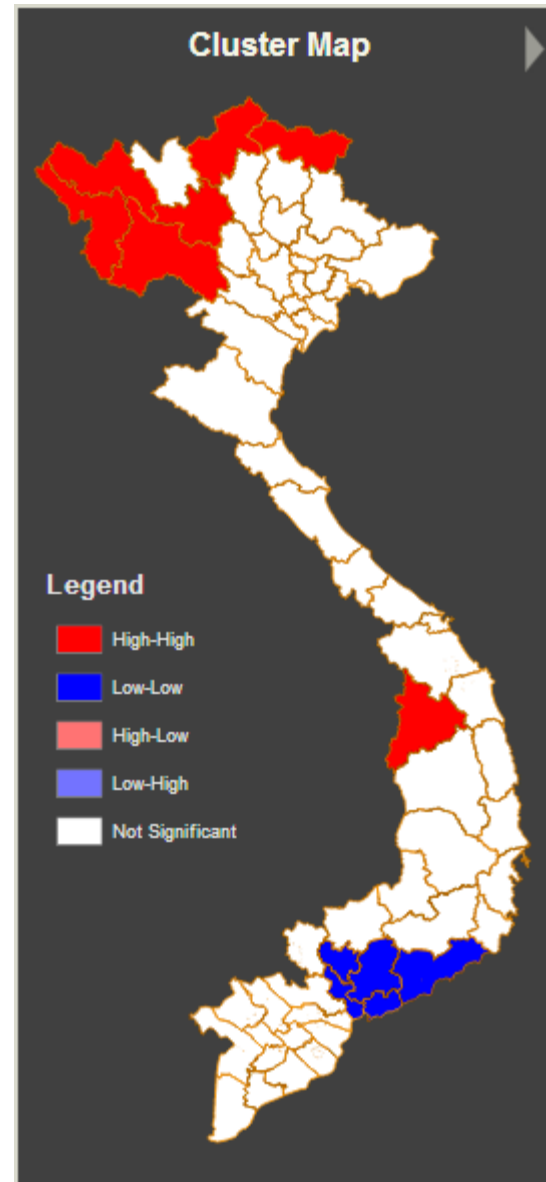
# GIS map

- A choropleth map showing the distribution of a geographical theme.
  - For example, where are the provinces with high crude death rate.



# Geospatial Analytics map

- A hotspot area map identify spatial association of the geographical theme
  - For example, where are the clusters of provinces with high crude death rates.







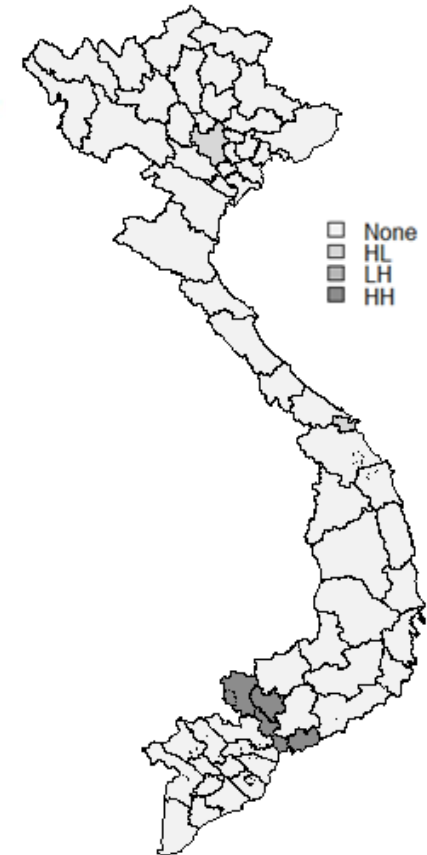
- spdep, spgwr



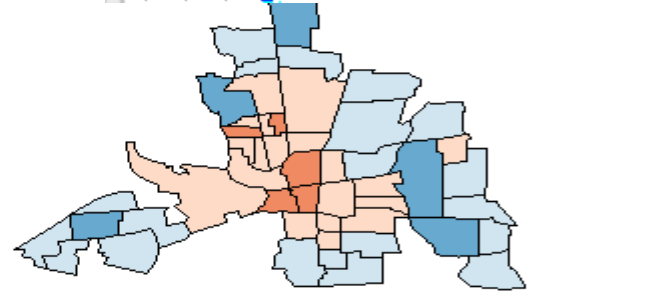
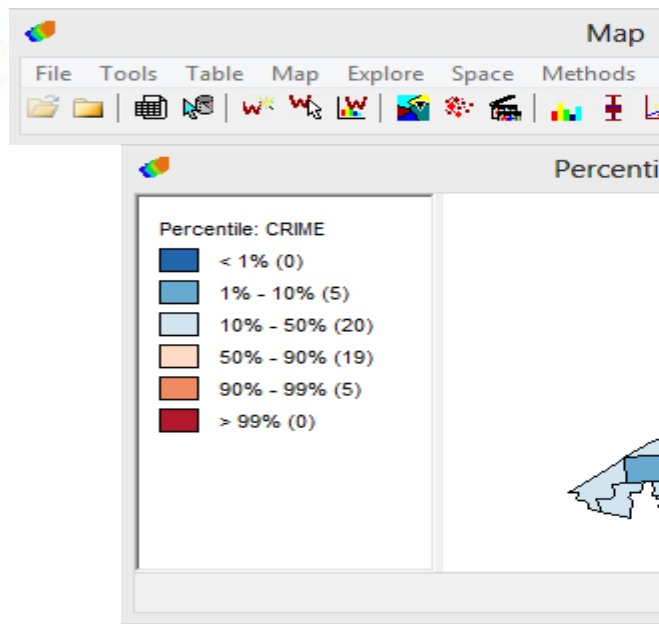
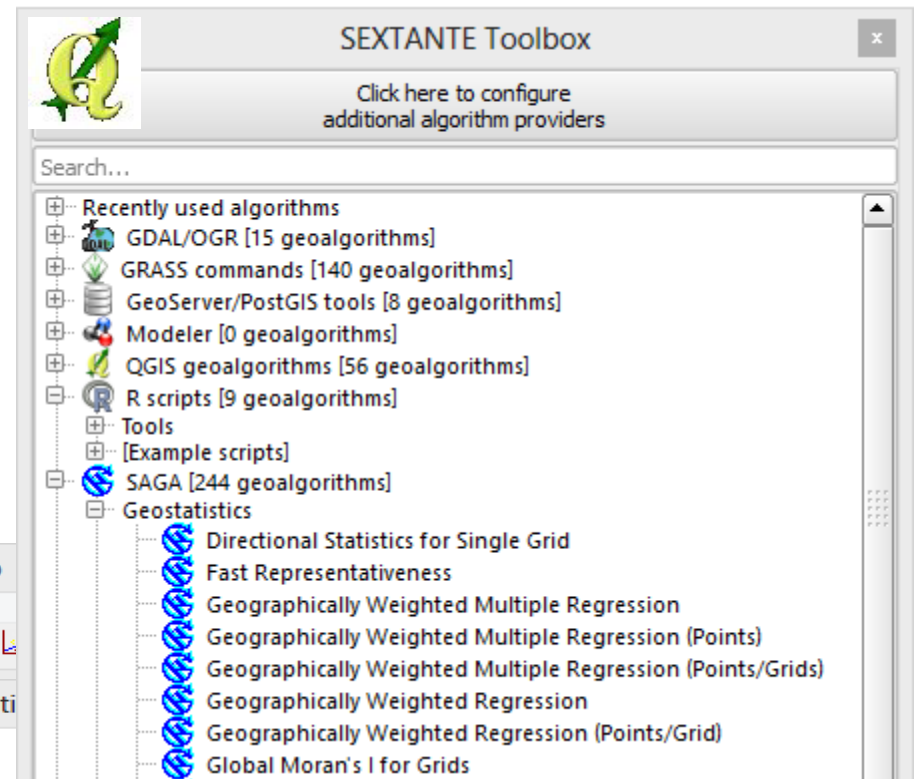
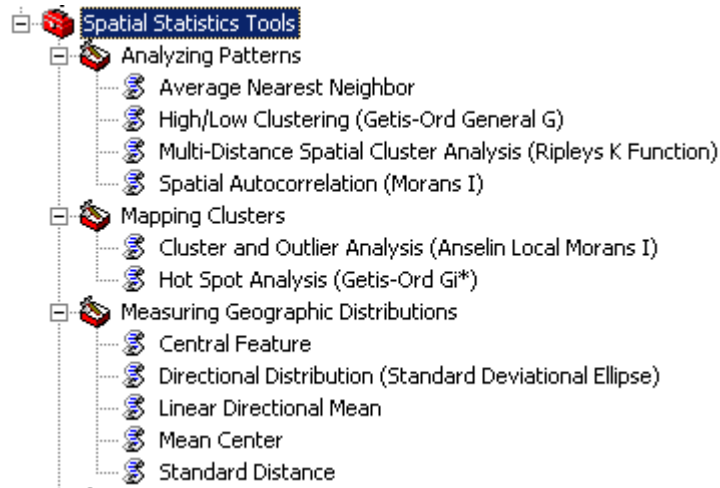
## Local Moran

```
> fips <- order(vnminc$FIPSNO)
> nclocI <- localmoran(vnminc$IPC04_AVG, listw=vnm_cnq_w)
> printCoefmat(data.frame(nclocI[fips,],
row.names=vnminc$ADM2CODE[fips]), check.names=FALSE)
```

	Ii	E.Ii	Var.Ii	Z.Ii	Pr.z...0.
101	-0.61846060	-0.01612903	0.09705275	-1.93344442	0.9734
103	0.32286480	-0.01612903	0.27842097	0.64245220	0.2603
104	-0.05436380	-0.01612903	0.20587368	-0.08426710	0.5336
106	0.22572253	-0.01612903	0.20587368	0.53302610	0.2970
107	0.04587465	-0.01612903	0.13332640	0.16980849	0.4326
109	-0.00298277	-0.01612903	0.16234531	0.03262739	0.4870
111	-0.05206503	-0.01612903	0.13332640	-0.09841734	0.5392
113	0.06614244	-0.01612903	0.27842097	0.15591874	0.4380
115	-0.01154417	-0.01612903	0.16234531	0.01137906	0.4955
117	0.22770252	-0.01612903	0.20587368	0.53738987	0.2955

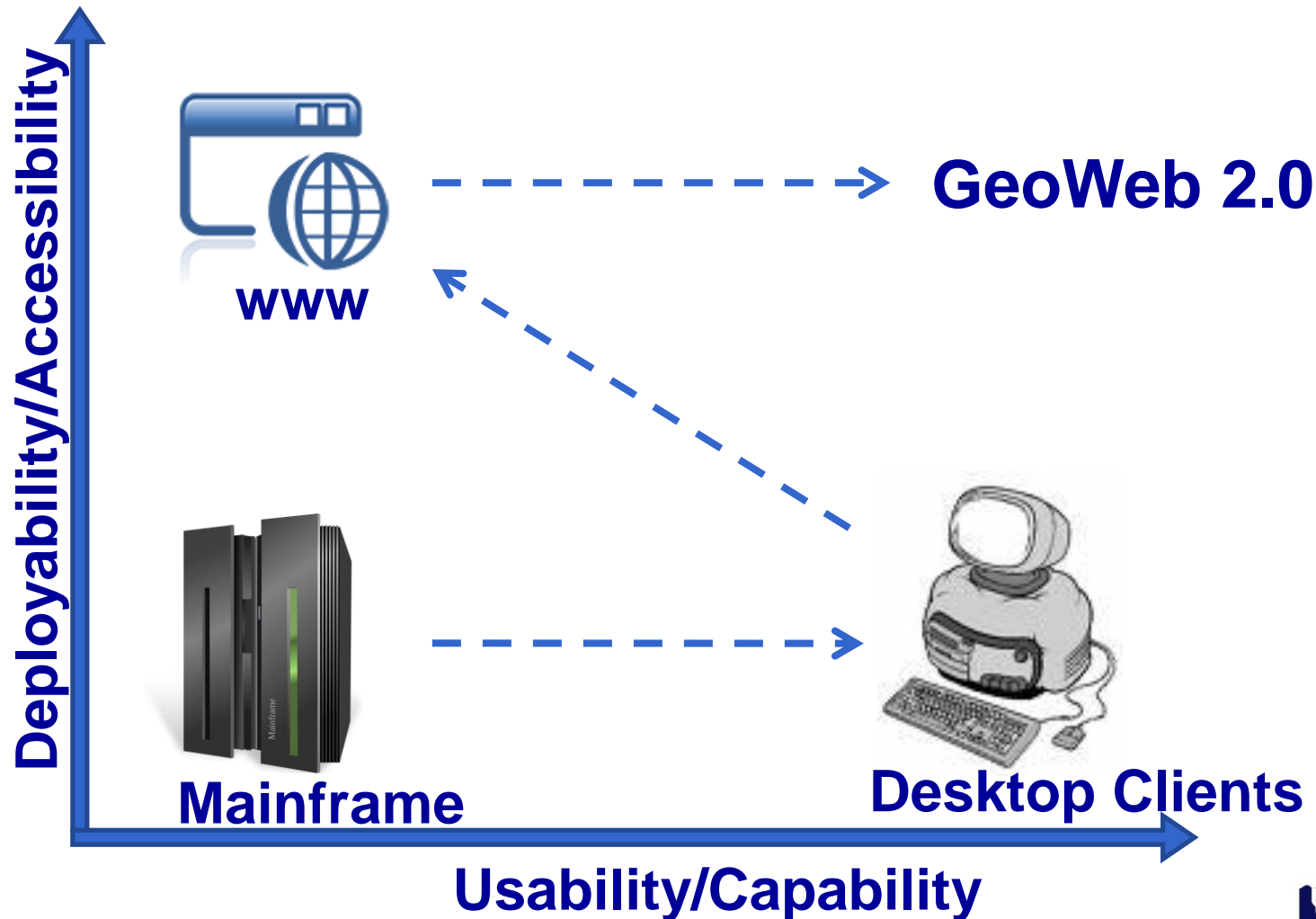


# Geospatial Analytics Toolkit - desktop

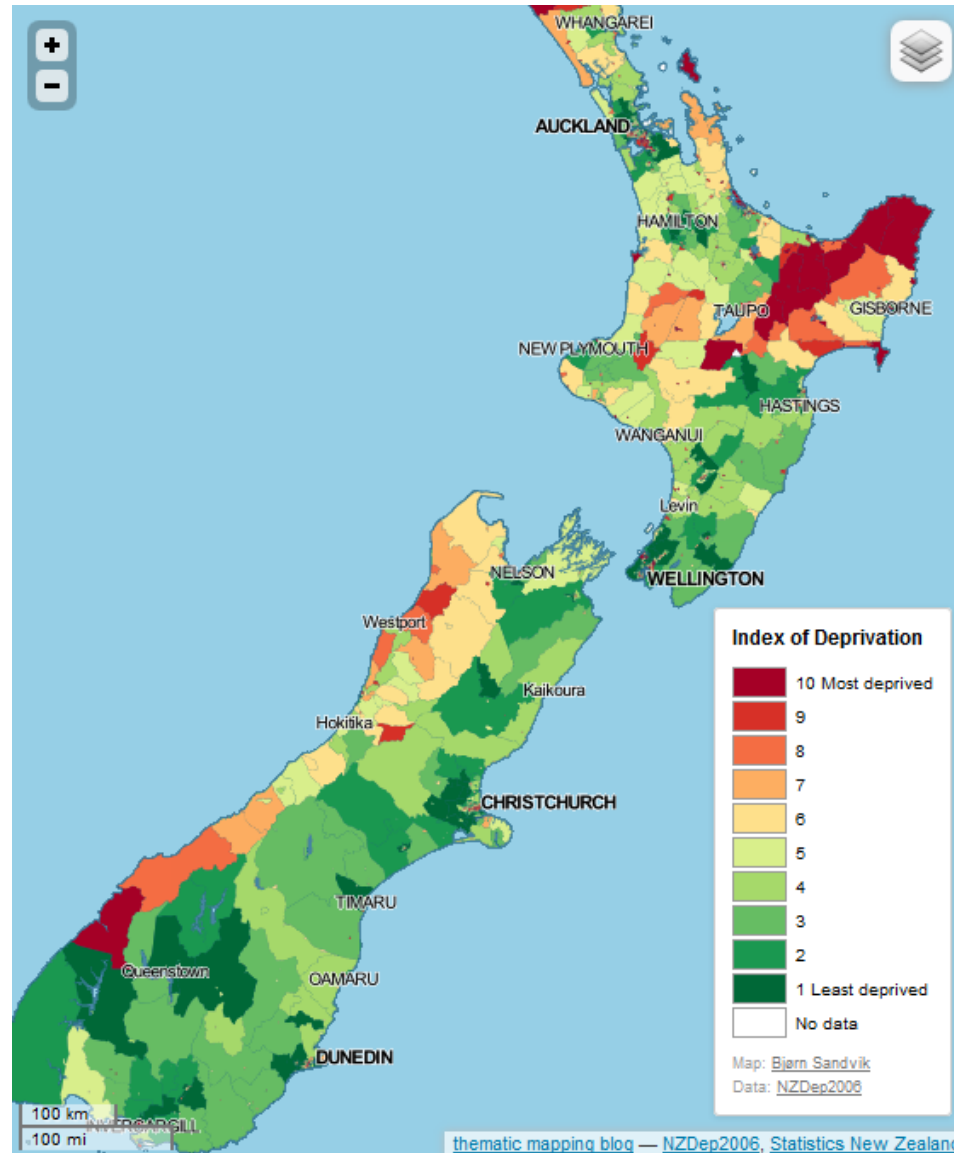


# Motivation 3: GeoWeb 2.0

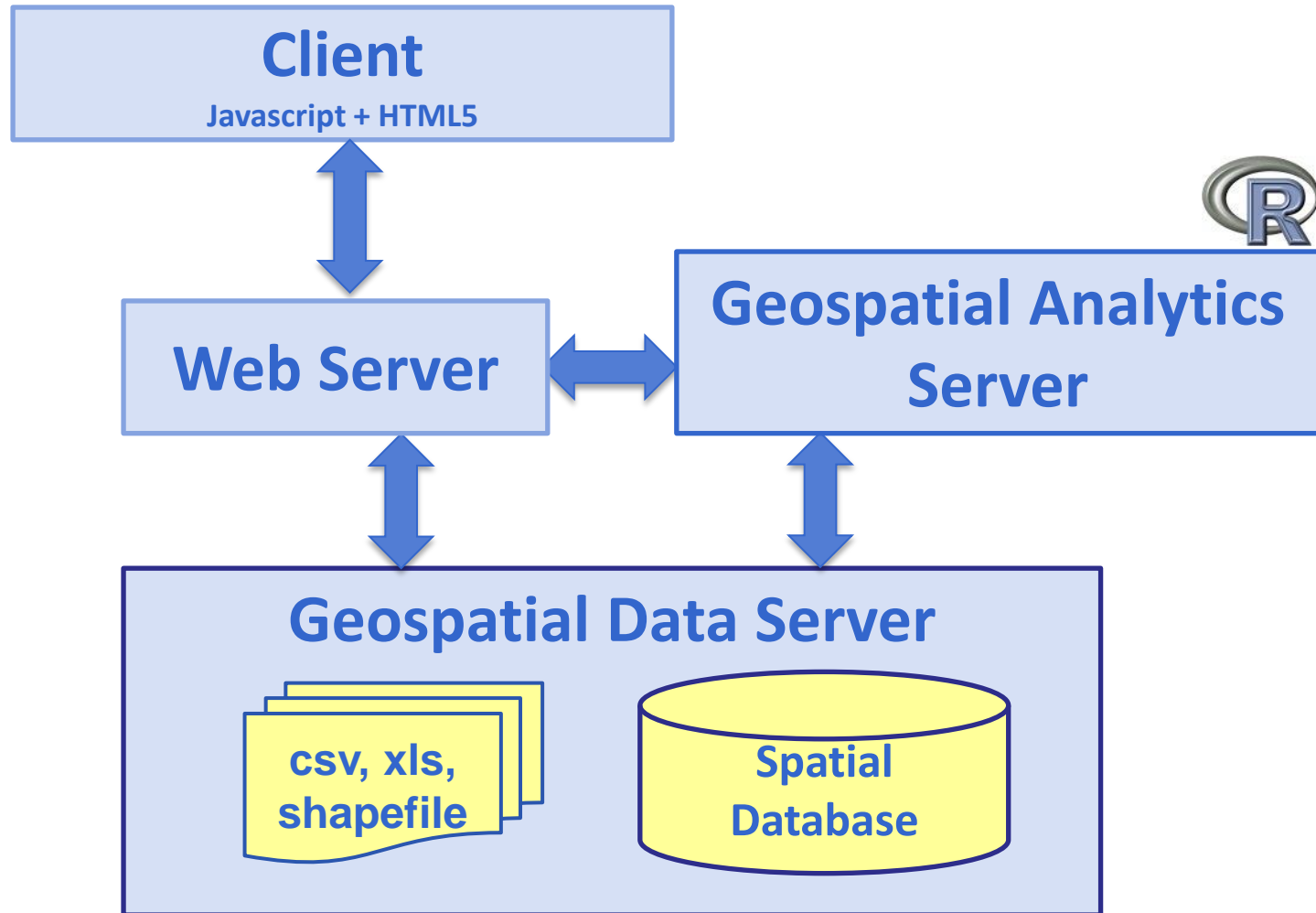
- From www GIS to GeoWeb 2.0



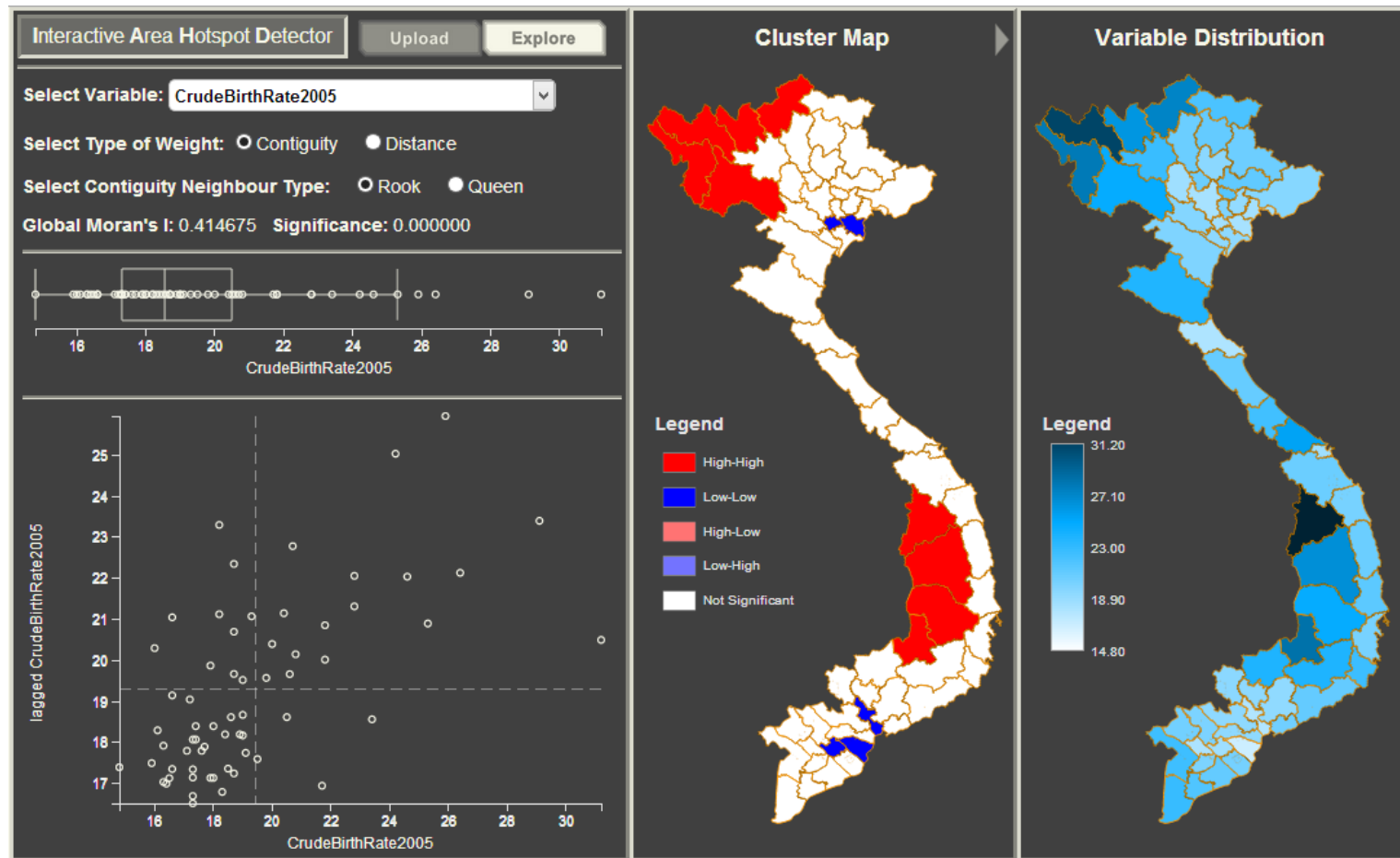
# Modern web map



# RIGA Architecture

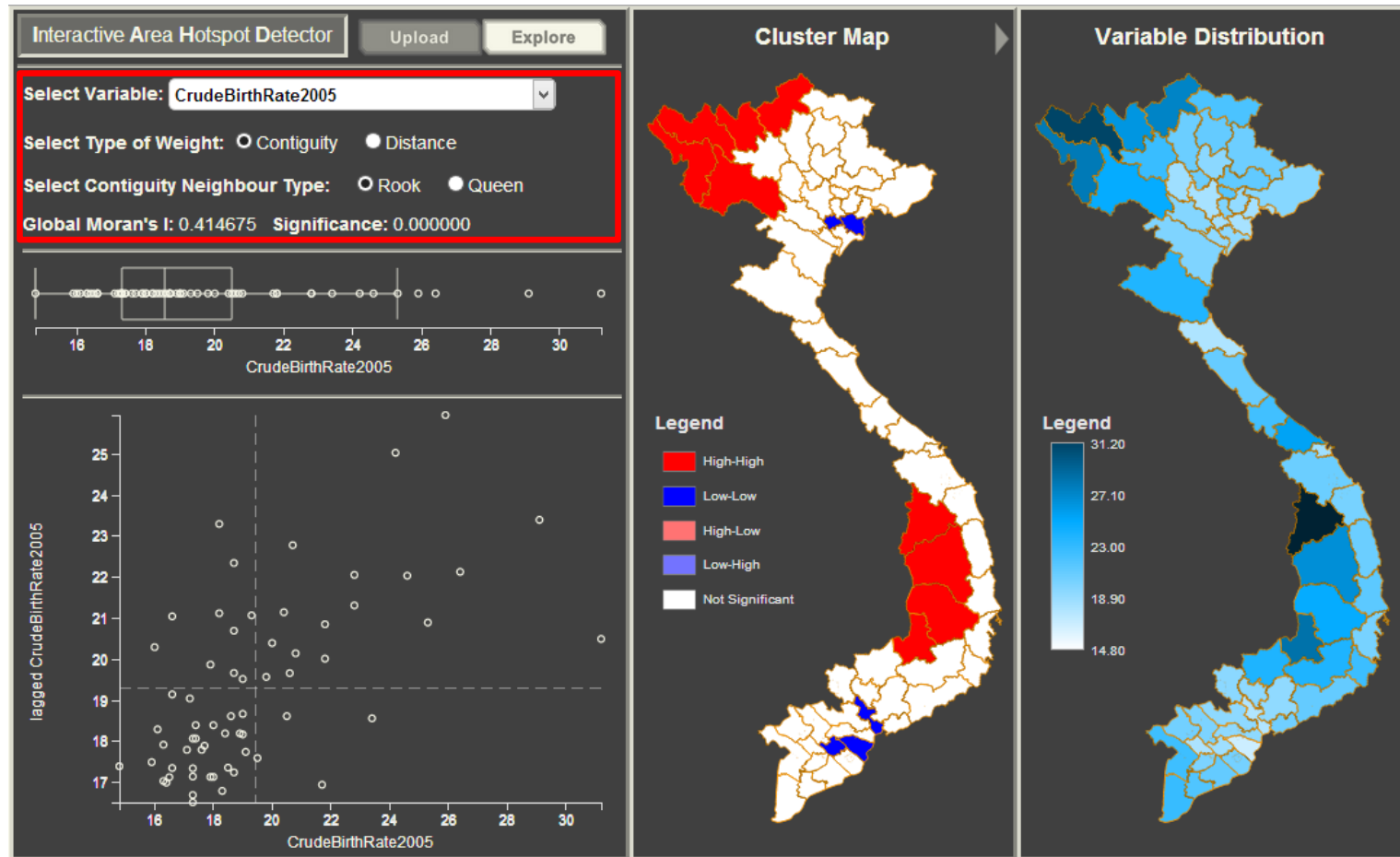


# RIGA- Exploratory Spatial Data Analysis (ESDA)



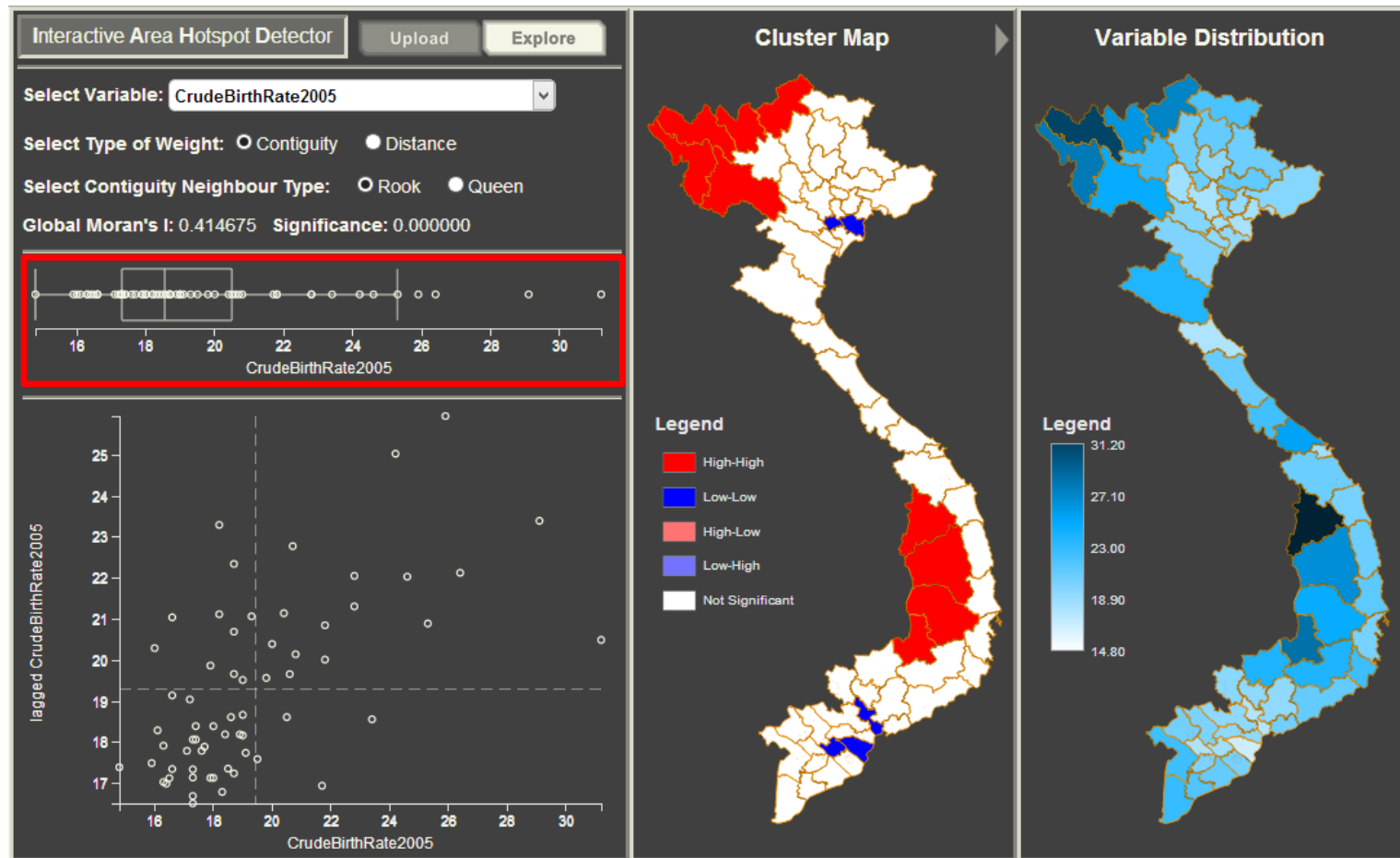
# RIGA- Exploratory Spatial Data Analysis (ESDA)

- Interactive GUIs



# RIGA- Exploratory Spatial Data Analysis (ESDA)

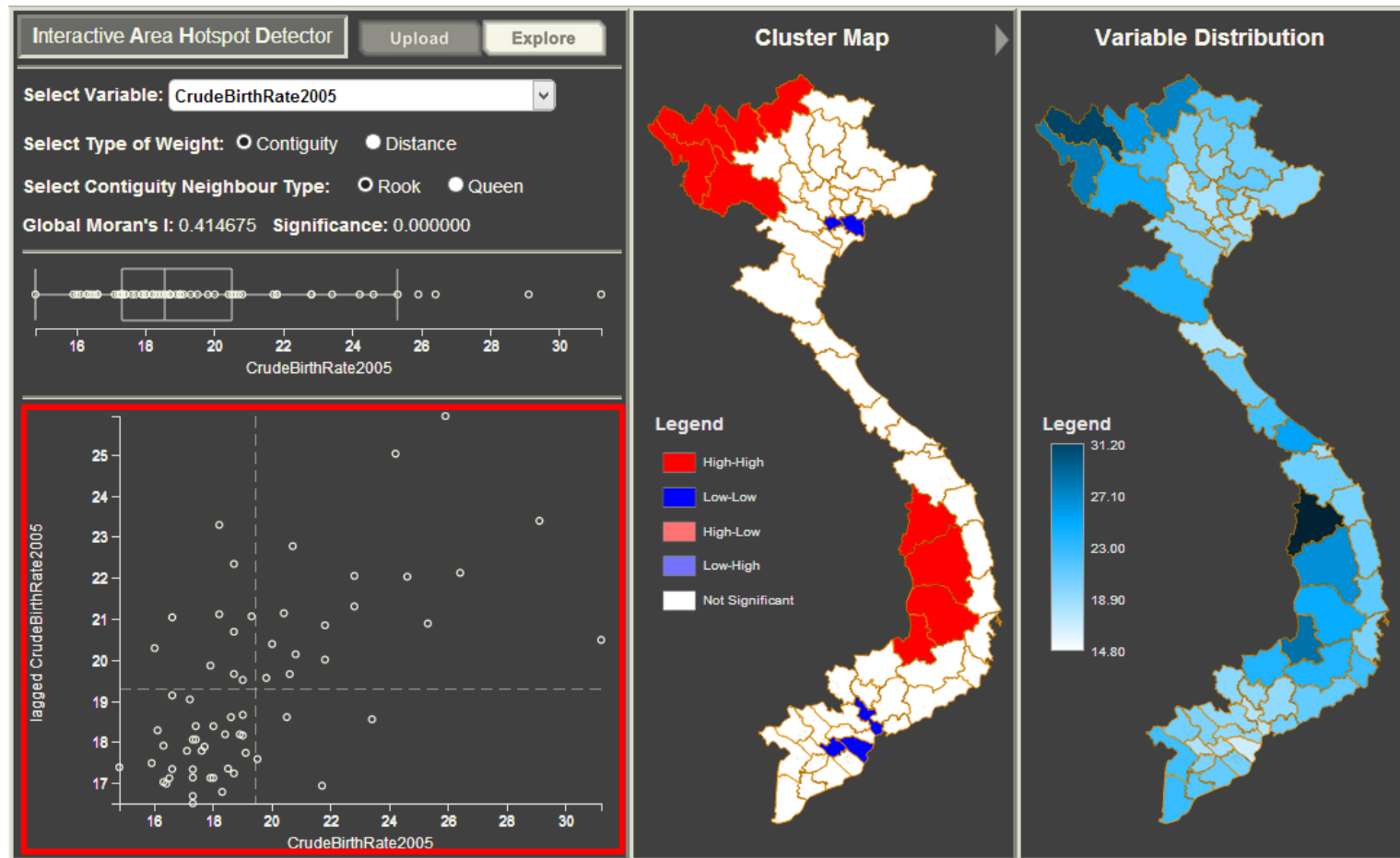
- Interactive boxplot





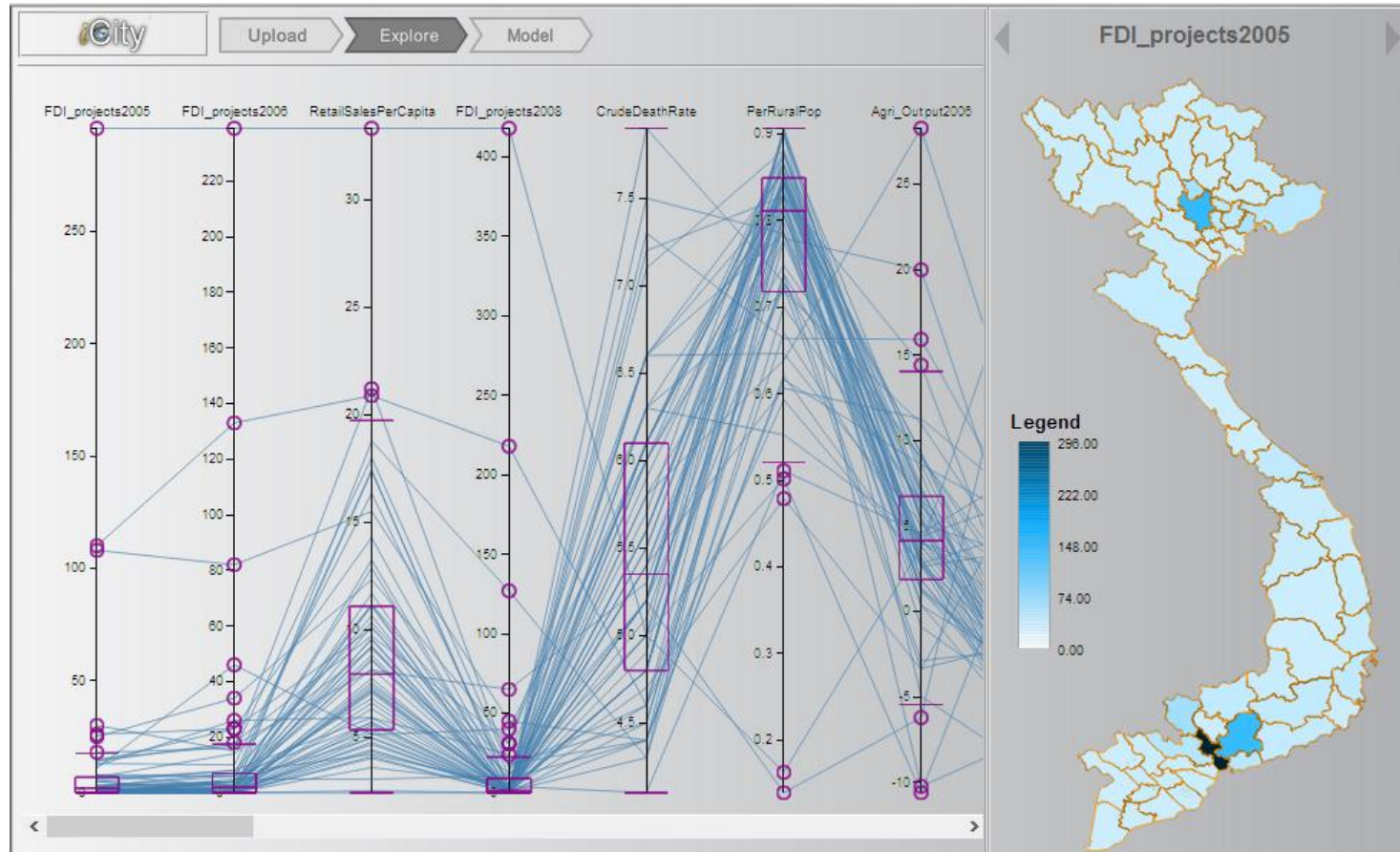
# RIGA- Exploratory Spatial Data Analysis (ESDA)

- Interactive Moran scatter plot



# RIGA – Exploratory Regression models

- Parallel coordinate plot and choropleth map for visualising and analysing multivariate data.



# RIGA – Exploratory Regression models

- Multiple regression models (OLS and GWR)

**City**    Upload    Explore    **Model**

Select Regression Type:  Ordinary Least-squares     Geographic Weighted

Select Dependant Variable: **NetMigration**    Run Regression

Select Independent Variable(s): [hide](#)

Available	Add All	Chosen	Remove All
FDI_Projects2007		PerUrbanPop	
FDI_Proj_05to08		RetailSalesPerCapita	
Ind_Output2007		PercentageEmployed	
Ind_Output2008		Ind_Output2006	
Agri_Output2007		Agri_Output2006	
Agri_Output2008			

**Regression Statistics:**    Save Model

R-Square: 0.083    Adjusted R-Square: 0.003

Sum of Squared Errors: 5.023    F-Statistic: 1.031 on 5 and 57 DF

**Akaike Information Criterion(AIC):** 389.852

**Parameter Coefficient Estimates:**

Term	Estimate	Std. Error	t value	Pr(> t )	VIF
(Intercept)	1.314730	15.100964	0.087063	0.930927	-
PerUrbanPop	-11.366434	7.618331	-1.491985	0.141217	3.365194
RetailSalesPerCapita	0.417163	0.194260	2.147449	0.036023	2.790345
PercentageEmployed	-0.074573	0.257927	-0.289124	0.773535	1.769059
Ind_Output2006	0.029183	0.050652	0.576148	0.566784	1.064788
Agri_Output2006	0.095363	0.114842	0.830389	0.409784	1.188174

**Residual (Fitting Error)**

**Legend**

- 22.5406
- 15.1497
- 7.7589
- 0.3680
- 7.0228
- Stat. Insignificant