



# Visualizing Spatial Data in R: from Basic Mapping to Web Applications

## GIS 610 – GeoVisualization –

Francesco Tonini  
Center for Geospatial Analytics  
North Carolina State University

10/01/2015

\*Ordered by scheduled international passenger kilometres flown in 2010 (source Wikipedia).  
Only routes in the OpenFlights database are plotted.

Center for  
**Geospatial** Analytics

# The R software for Statistical Computing

[www.r-project.org](http://www.r-project.org)



The R Project for Statistical Computing

PCA 5 vars  
princomp(x = data[, -c(1:2)])

(1-3) 60%

Clustering 4 groups

Factor 1 [41%]

Factor 3 [19%]

V. De Genne

Groups: 1 2 3 4

Getting Started:

- R is a free software environment for statistical computing and graphics. It compiles and runs on a wide variety of UNIX platforms, Windows and Mac OS. To [download R](#), please choose your preferred [CRAN mirror](#).
- If you have questions about R like how to download and install the software, or what the license terms are, please read our [answers to frequently asked questions](#) before you send an email.

News :

- [The R Journal Volume 6/2](#) is available.
- R version 3.1.2 (Pumpkin Helmet) has been released on 2014-10-31.

# The R software for Statistical Computing

Companies using R:



...and many more!

# The R software for Statistical Computing



## Some PROS:

- ¶ Free, open source ([GNU General Public License](#)), cross-platform
- ¶ Flexible & extensible
- ¶ Most powerful statistical programming language
- ¶ Huge community, brilliant developers (1800+ hosted projects on R-Forge, 6000+ packages on CRAN)
- ¶ Improved geospatial data handling

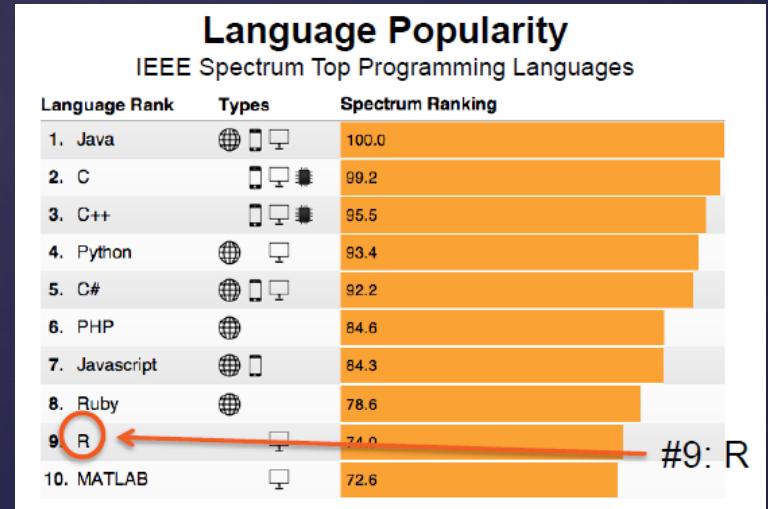
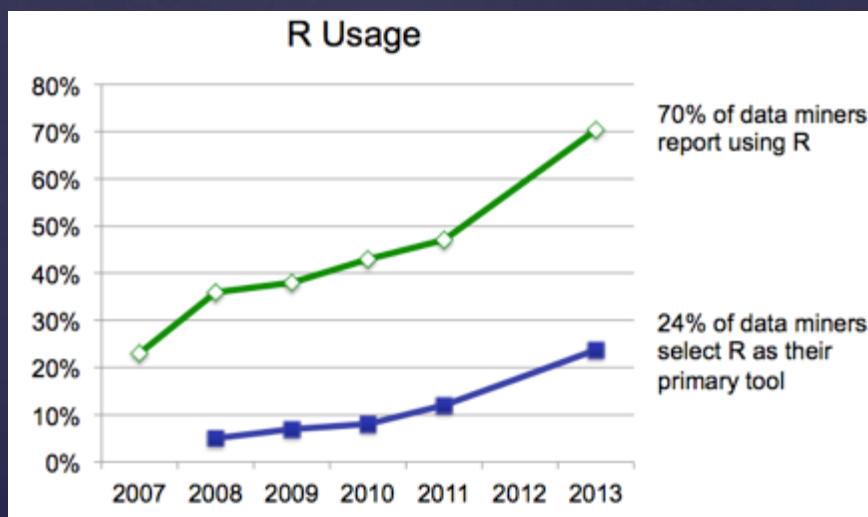
## Some CONS:

- ¶ Not as efficient and fast compared to lower-level languages (C/C++ 100-1000x faster, Python 2-10x faster)
- ¶ Syntax sometimes not as “user-friendly”

# The R software for Statistical Computing



R's popularity is growing fast!:  
[blog.revolutionanalytics.com/popularity](http://blog.revolutionanalytics.com/popularity)



# The R software for Statistical Computing



<http://www.revolutionanalytics.com>

The Revolution R product suite:

## Revolution R Open

- Free and open source R distribution
- Enhanced and distributed by Revolution Analytics



## Revolution R Plus

- Open-source distribution of R, packages, and other components
- Enhanced, supported and indemnified by Revolution Analytics



## Revolution R Enterprise

- Secure, Scalable and Supported Distribution of R
- With proprietary components created by Revolution Analytics



# The R software for Statistical Computing

## Open Source at Revolution Analytics:



### Revolution R Open

Revolution R Open is an enhanced distribution of open source R from Revolution Analytics.



### DeployR Open

DeployR offers simple, secure R integration for application developers.



### Reproducible R Toolkit

RRT provides tools to ensure that the results of R code are repeatable over time by anyone.



### RHadoop

RHadoop is a collection of packages for connecting R to Hadoop and running R on Hadoop nodes.



### ParallelR

ParallelR is a collection of R packages for parallel and distributed programming.

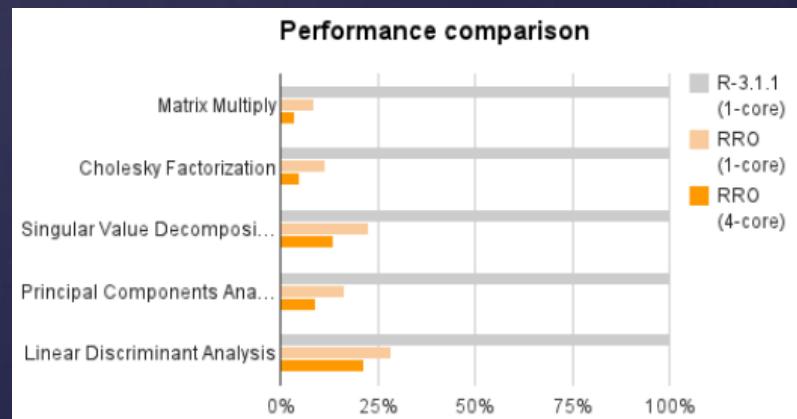
<http://projects.revolutionanalytics.com/>

# The R software for Statistical Computing

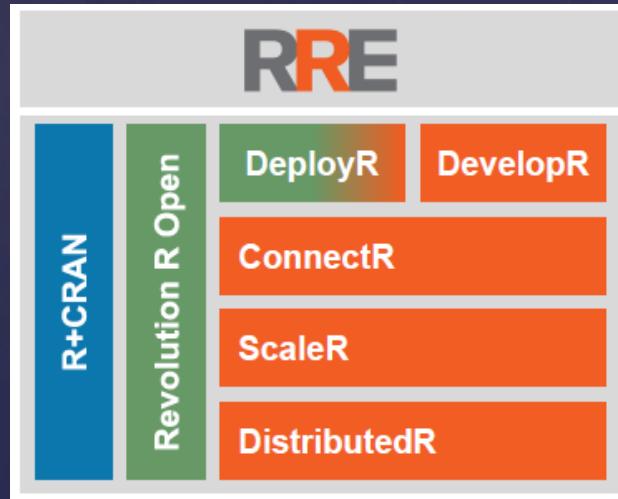


Revolution R Open (RRO) is the enhanced distribution of R from Revolution Analytics:

- Multi-threaded math libraries that brings multi-threaded computations to R.
- A high-performance default CRAN repository
- The Reproducible R Toolkit that make it easy to share R code and replicate results



# The R software for Statistical Computing



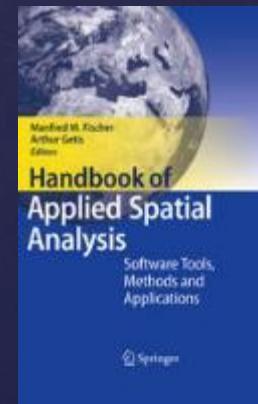
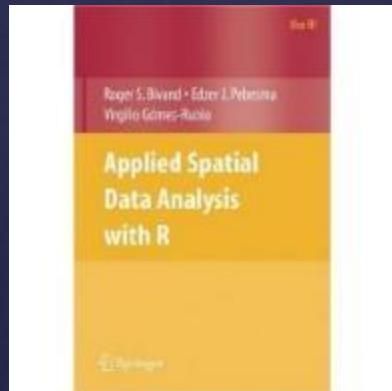
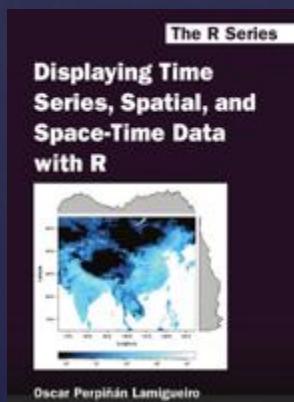
Free Revolution R Enterprise Academic Edition!

# Using R with GIS: useful resources

## WEB:

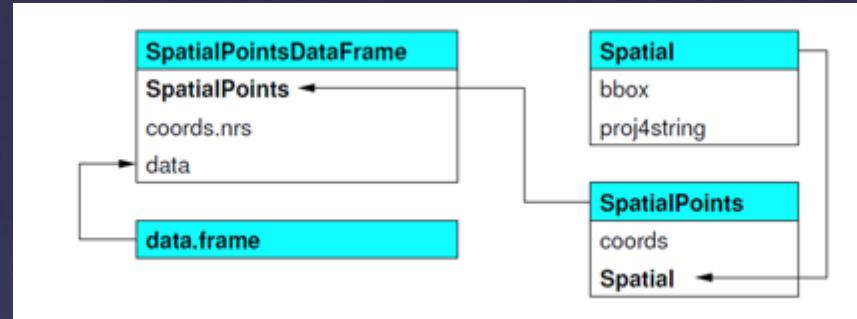
- CRAN TASK VIEW: <http://cran.r-project.org/web/views/>
- Spatial Analyst Wiki: <http://spatial-analyst.net/wiki/index.php?title=Software>
- Spatial Data in R: <http://pakillo.github.io/R-GIS-tutorial/>
- R Spatial Tips: <http://spatial.ly/r/>
- Displaying SpatioTemporal data: <http://oscarperpinan.github.io/spacetime-vis/>

## BOOKS:

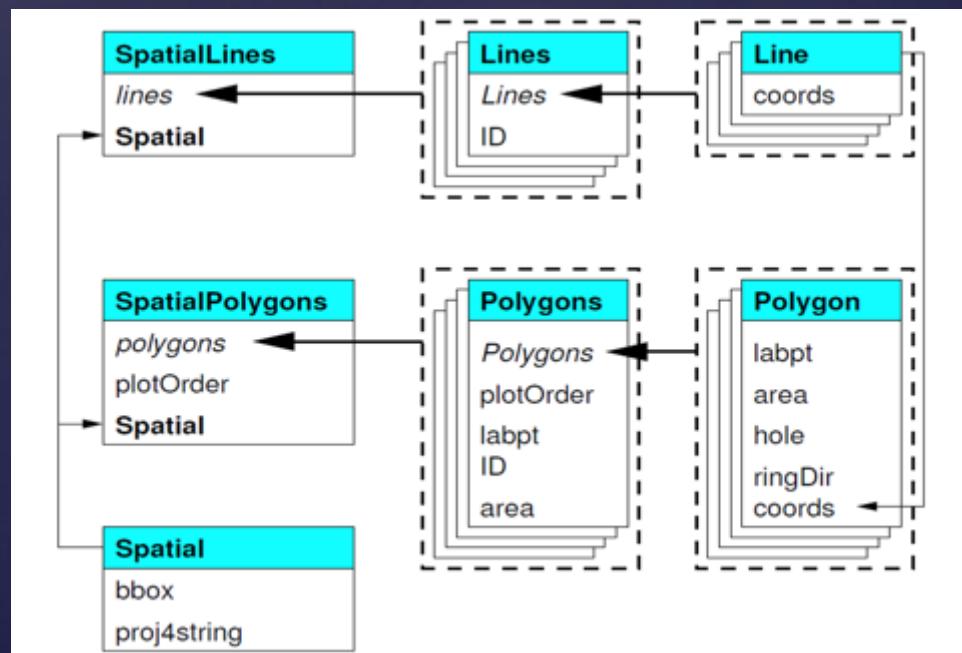


# Spatial Classes in R

- Spatial Points Diagram (class name = blue, slots = white, inheritance = arrows)

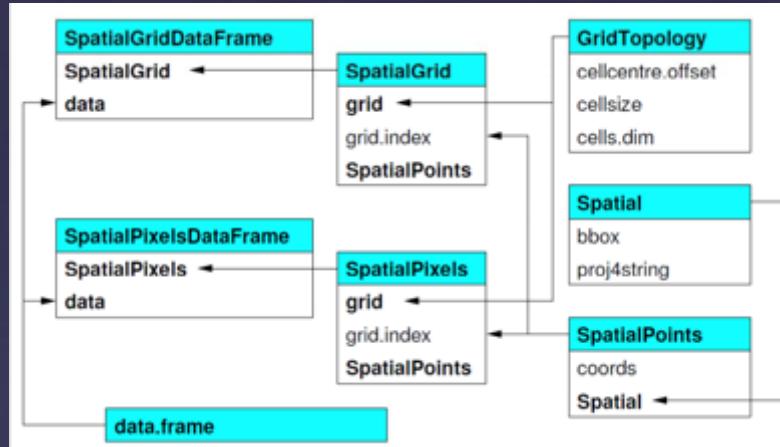


- Spatial Polygons & Lines Classes



# Spatial Classes in R

- Spatial Grid and Pixels Classes/Slots

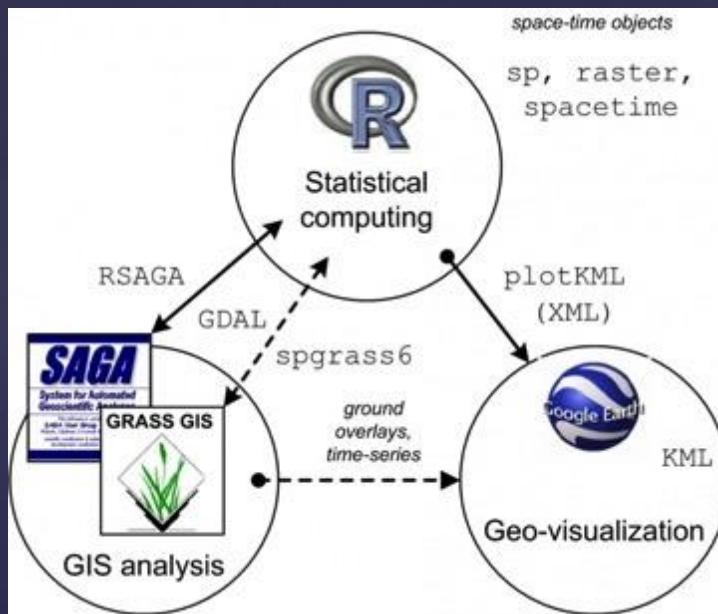


- Recap

data type	class	attributes	extends
points	SpatialPoints	none	Spatial
points	SpatialPointsDataFrame	data.frame	SpatialPoints
pixels	SpatialPixels	none	SpatialPoints
pixels	SpatialPixelsDataFrame	data.frame	SpatialPixels SpatialPointsDataFrame
full grid	SpatialGrid	none	SpatialPixels
full grid	SpatialGridDataFrame	data.frame	SpatialGrid
line	Line	none	
lines	Lines	none	Line list
lines	SpatialLines	none	Spatial, Lines list
lines	SpatialLinesDataFrame	data.frame	SpatialLines
polygon	Polygon	none	Line
polygons	Polygons	none	Polygon list
polygons	SpatialPolygons	none	Spatial, Polygons list
polygons	SpatialPolygonsDataFrame	data.frame	SpatialPolygons

# Using R with GIS

R + GIS analysis + Geo-visualization



- SAGA GIS: Use ‘**RSAGA**’ R package
- GRASS GIS: Use ‘**spgrass6**’ R package
- GOOGLE EARTH: Use ‘**plotKML**’ R package

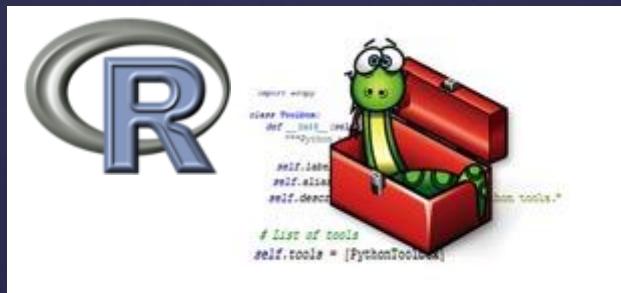
# Using R with (Arc)GIS

& R + ArcGIS:



<http://www.spatialecology.com/gme/>

& R + ArcGIS + Python:



<https://github.com/Esri/R-toolbox-py>

# R as a GIS

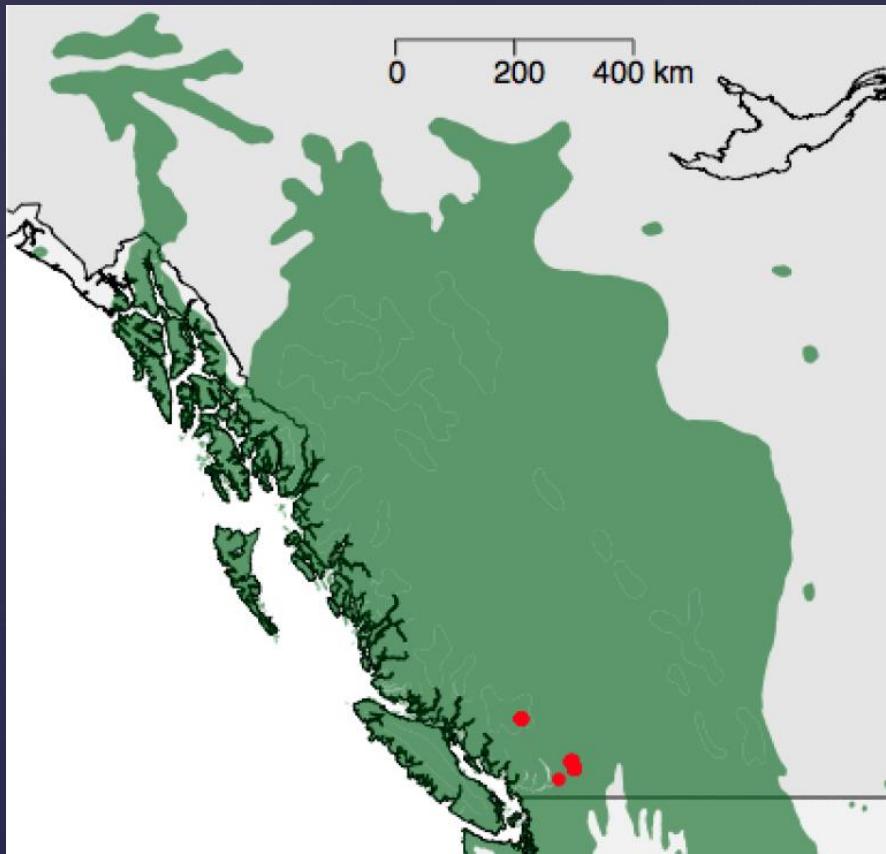
## Some Basic Tools:

- & `library(maps)` #for creating geographical maps
- & `library(maptools)` #tools for handling spatial objects
- & `library(mapproj)` #for creating projected maps
- & `library(raster)` #tools to deal with raster maps
- & `library(rasterVis)` #visualization of raster layers
- & `library(ggplot2)` #to create maps
- & `library(gpclib)` #general polygon clipper
- & `library(rgdal)` #read/write GDAL raster/OGR vectors

...more

# R as a GIS

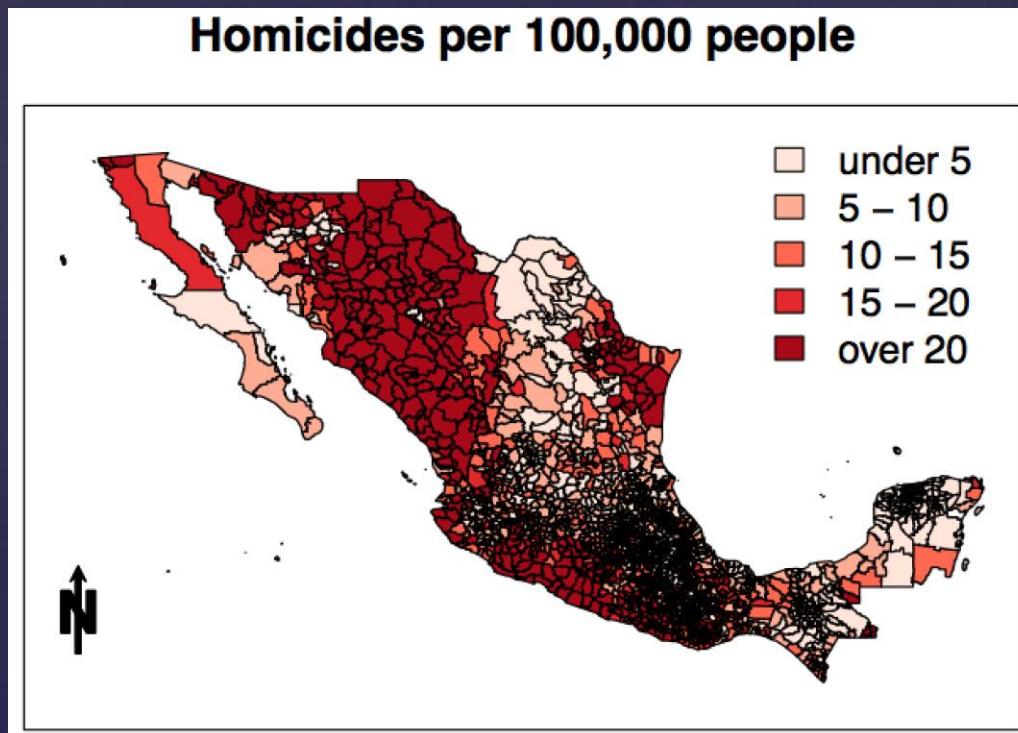
## (Very) Simple Maps:



Credits: <http://www.nyu.edu/projects/politicsdatalab/workshops/GISwR.pdf>

# R as a GIS

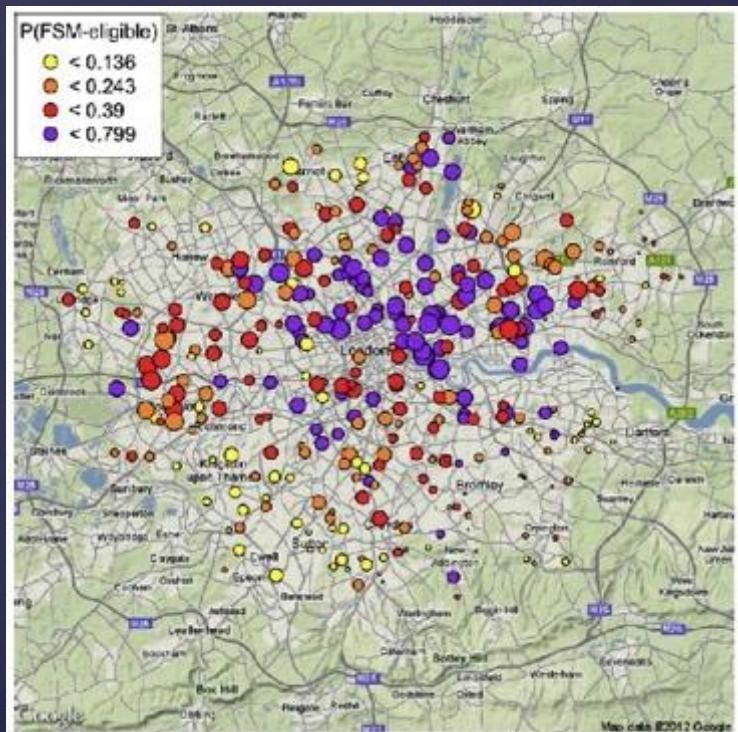
More Involved Maps:



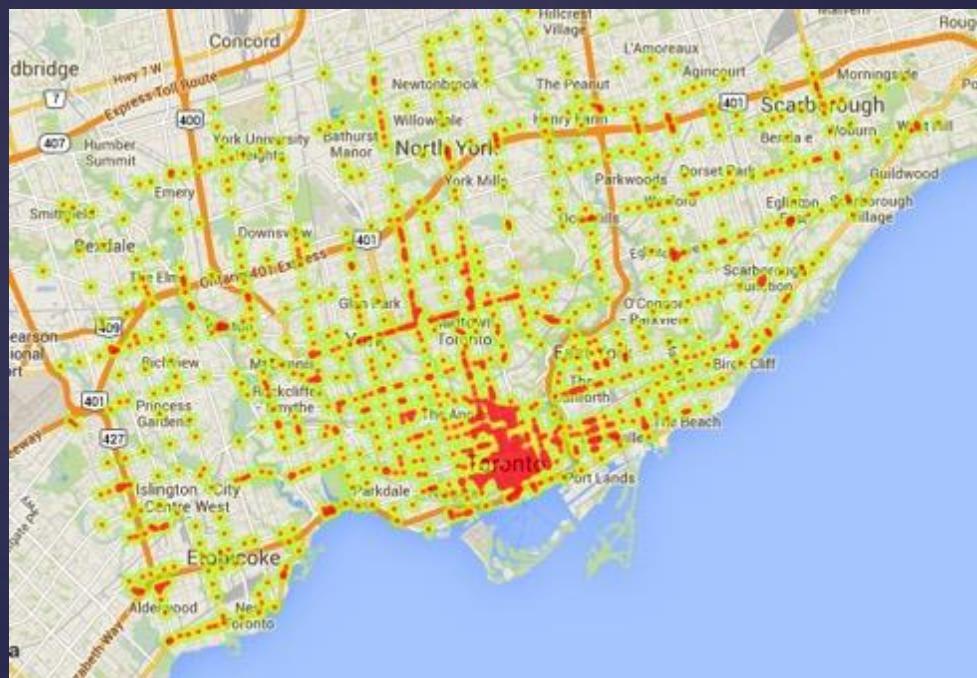
Credits: <http://www.nyu.edu/projects/politicsdatalab/workshops/GISwR.pdf>

# R as a GIS

Google Maps: R package ‘RgoogleMaps’ to map your data onto Google Map tiles



Credits: <http://spatial.ly>

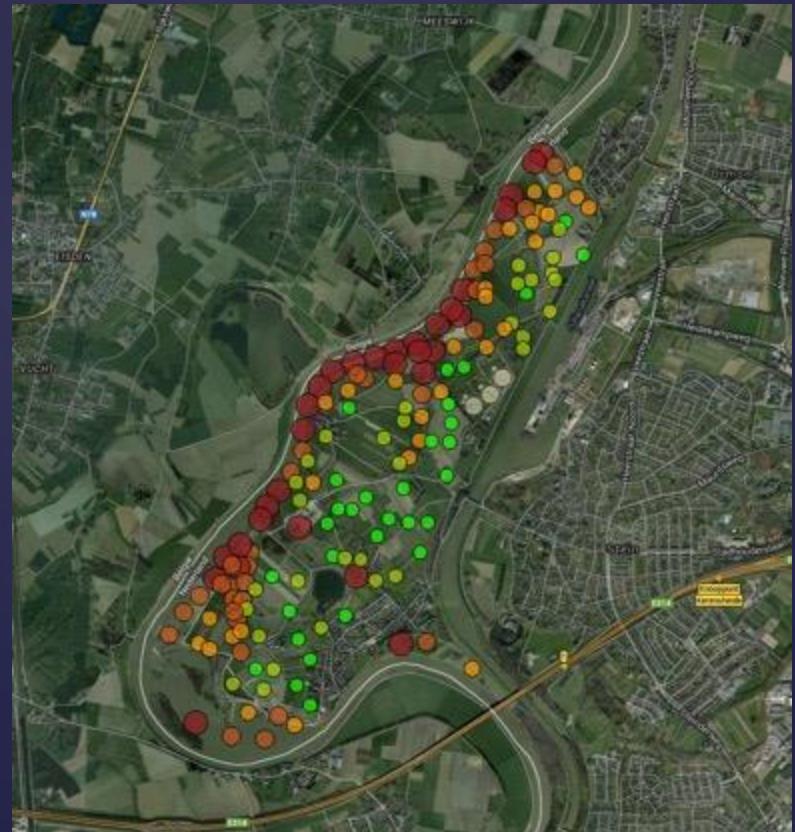
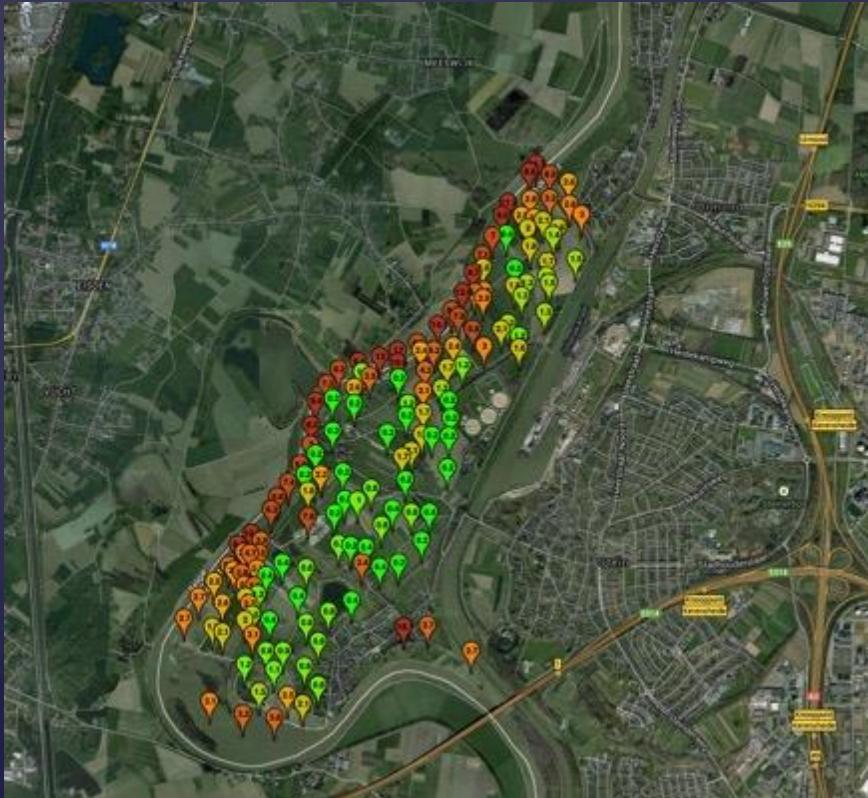


Credits: <http://www.blogto.com/city/>

# R as a GIS

## Google Maps: R package ‘plotGoogleMaps’

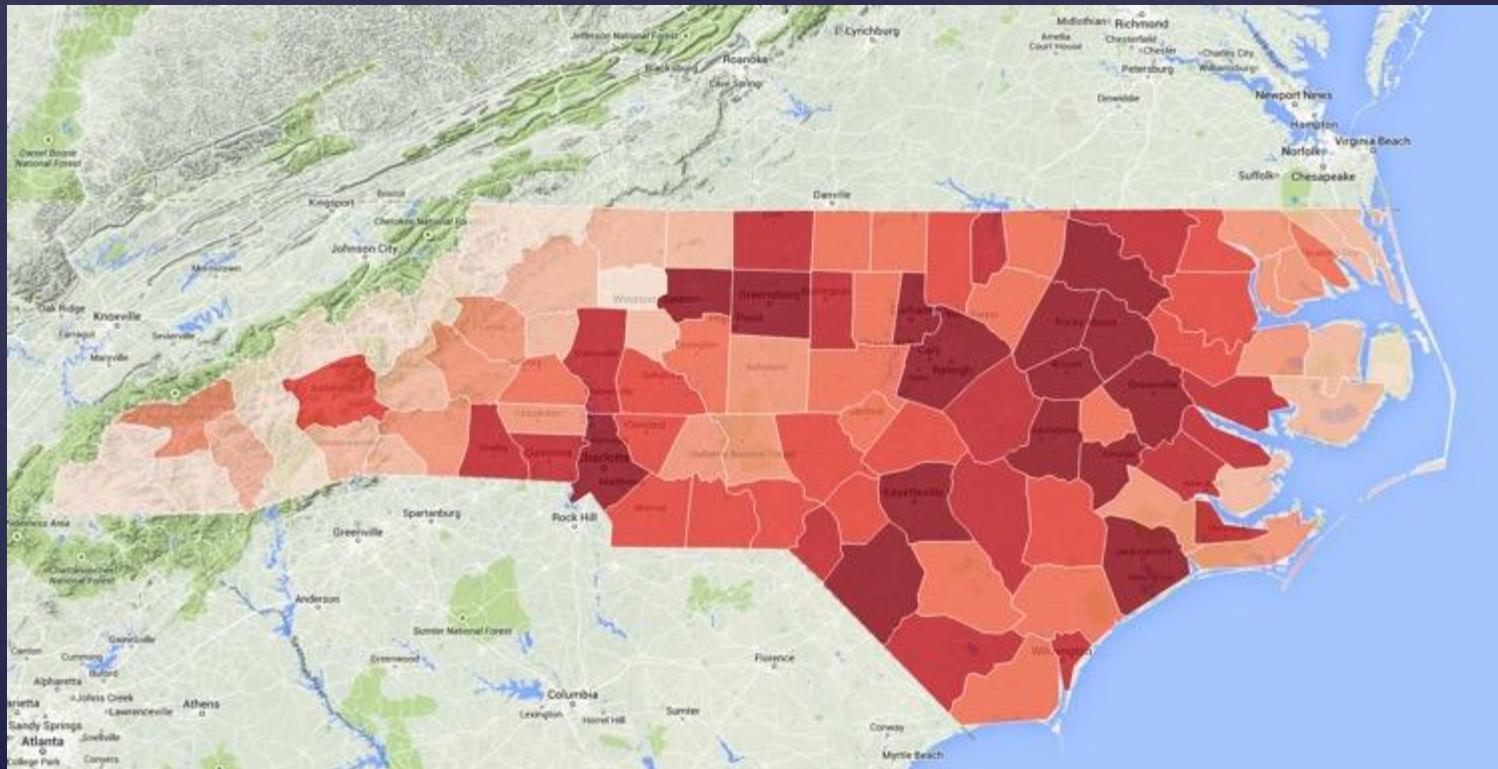
↳ Creating web map of point data (click hyperlink to .html files)



# R as a GIS

## Google Maps: R package ‘plotGoogleMaps’

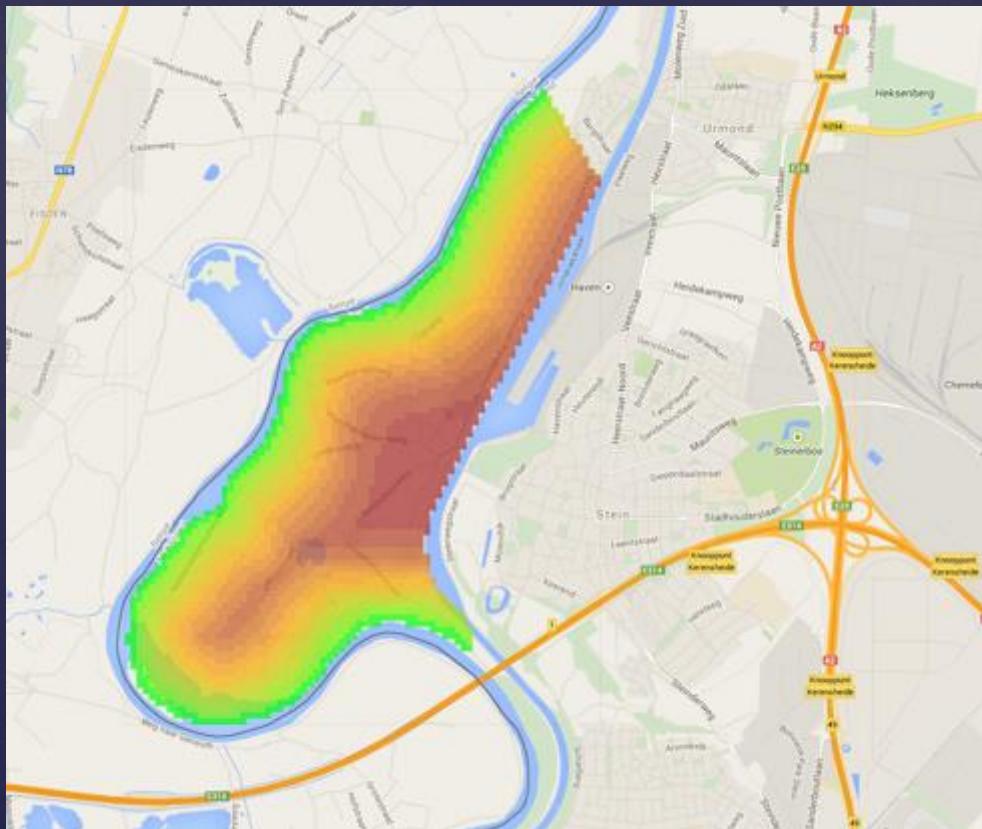
- Creating web map of spatial polygons (click hyperlink to .html files)



# R as a GIS

## Google Maps: R package ‘plotGoogleMaps’

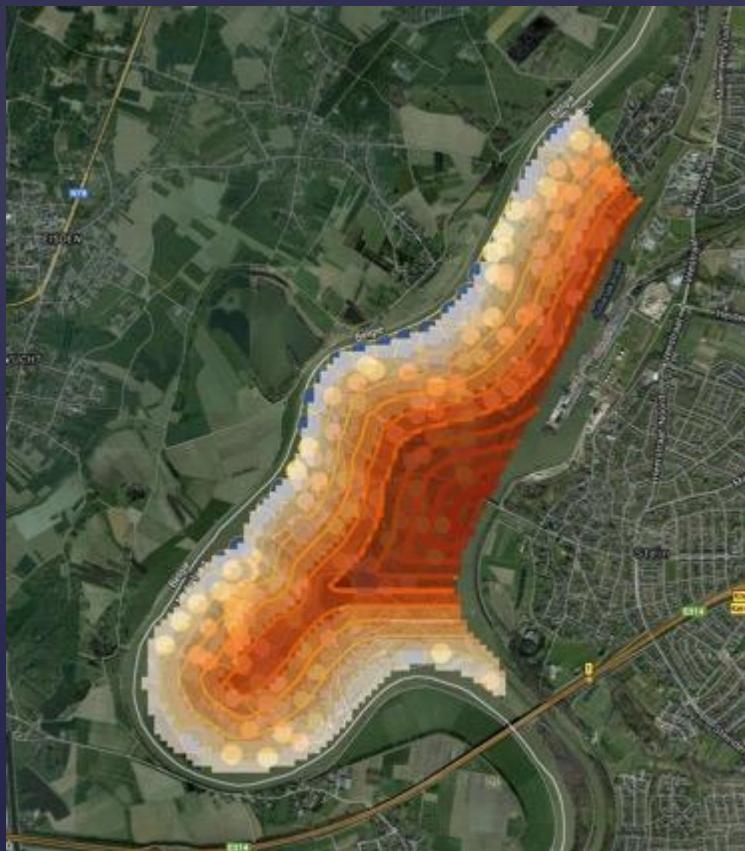
↳ Creating web map of spatial grid/pixels (click hyperlink to .html files)



# R as a GIS

## Google Maps: R package ‘plotGoogleMaps’

- ¤ Combine several layers (click hyperlink to .html files)



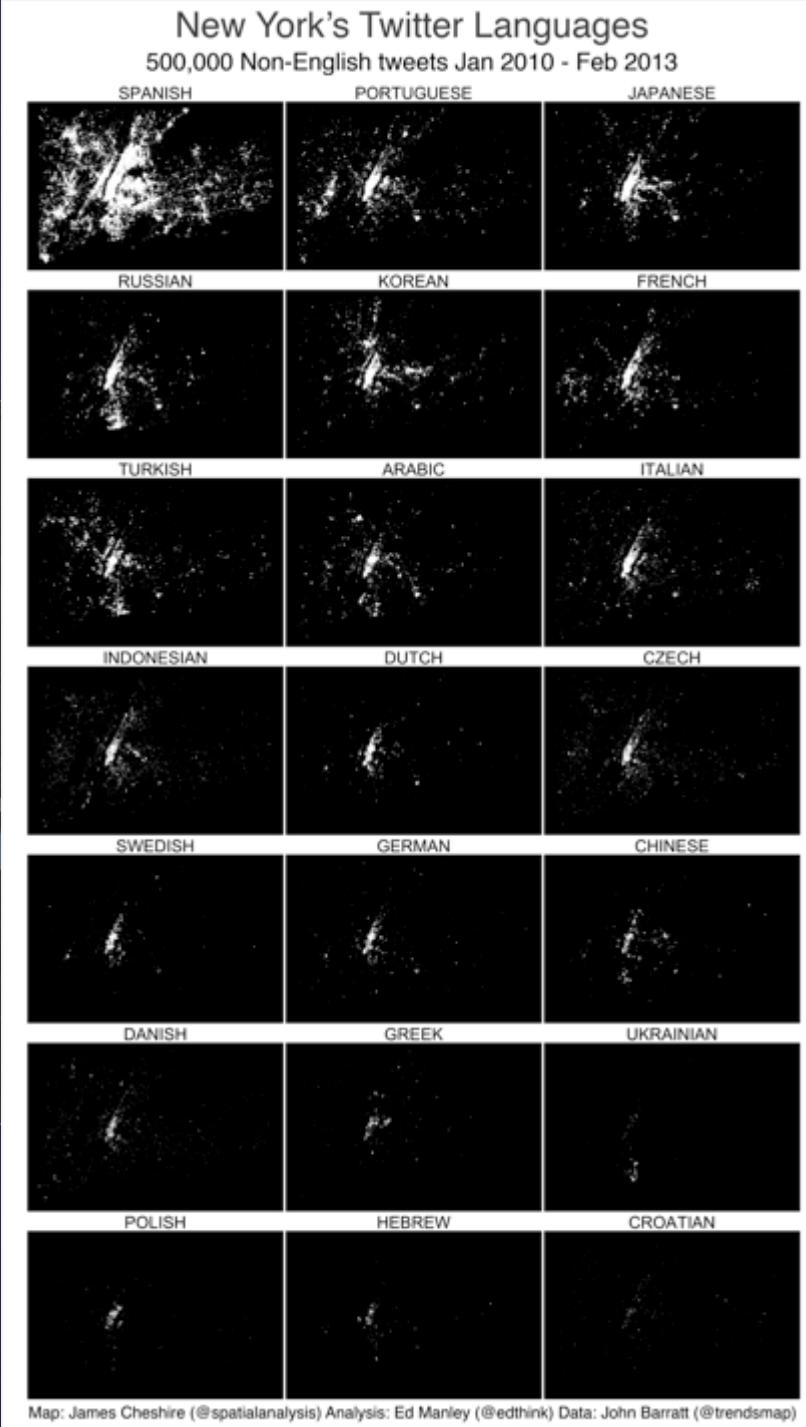
# R as a GIS

ggplot2: R package ‘**ggplot2**’



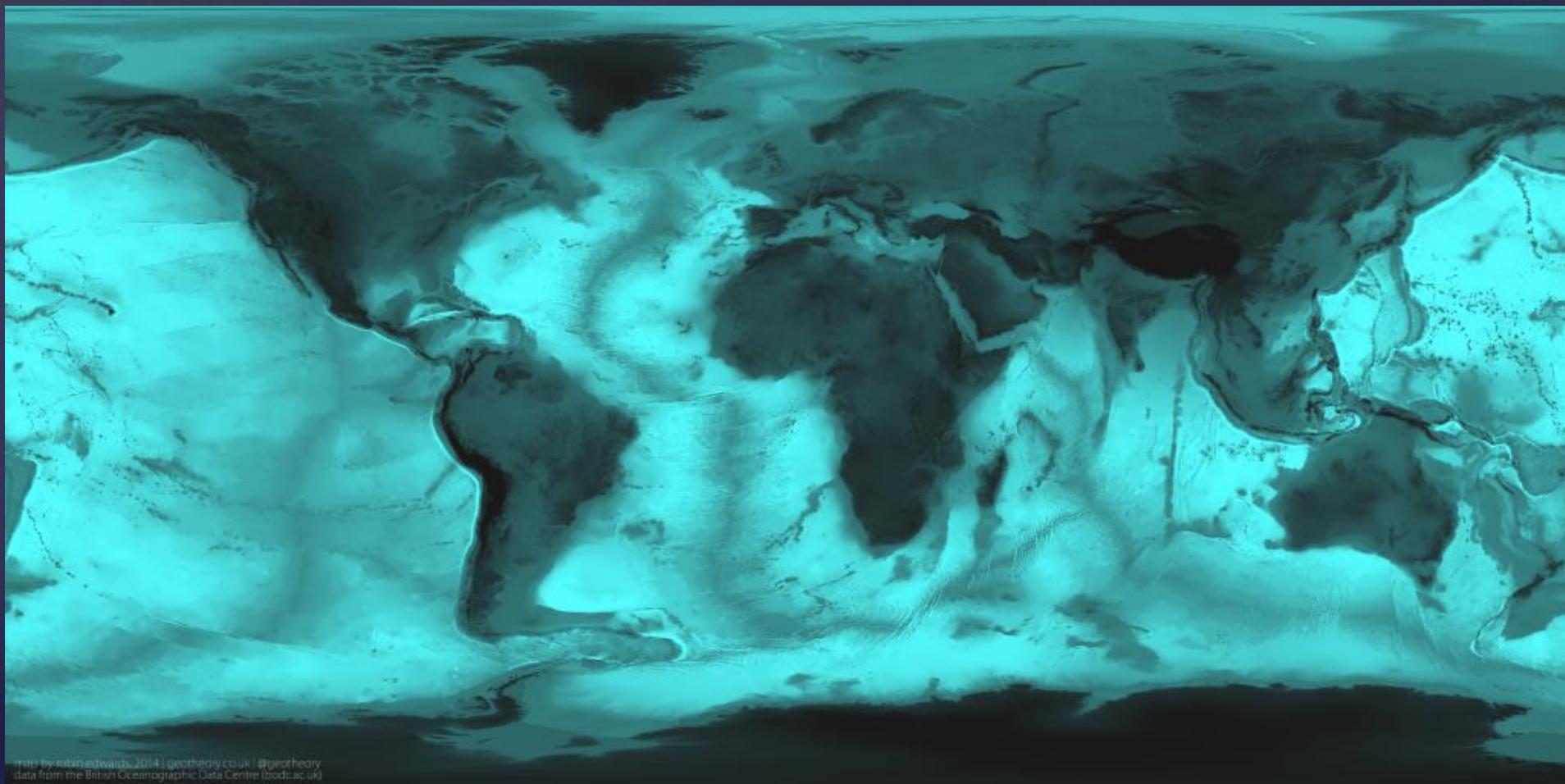
Credits: <http://spatial.ly>

Credits: <http://spatialanalysis.co.uk/2013/02/mapped-twitter-languages-york/>



# R as a GIS

Stunning Maps: world topography by Robin Edwards at UCL CASA (London, UK)



©R. Edwards, 2014 | gofrotherby.co.uk | gofrotherby  
data from the British Oceanographic Data Centre (bodt.ac.uk)

Credits: <http://spatial.ly>

# R as a GIS

Stunning Maps: world's biggest airlines by James Cheshire at UCL CASA (London, UK)



Credits: <http://spatial.ly>

# R as a GIS

Stunning Maps: visualizing FB friends by Paul Butler



Credits: <http://paulbutler.org/archives/visualizing-facebook-friends/>

# R as a GIS

Stunning Maps: from home to work in the UK by James Cheshire & Oliver Uberti

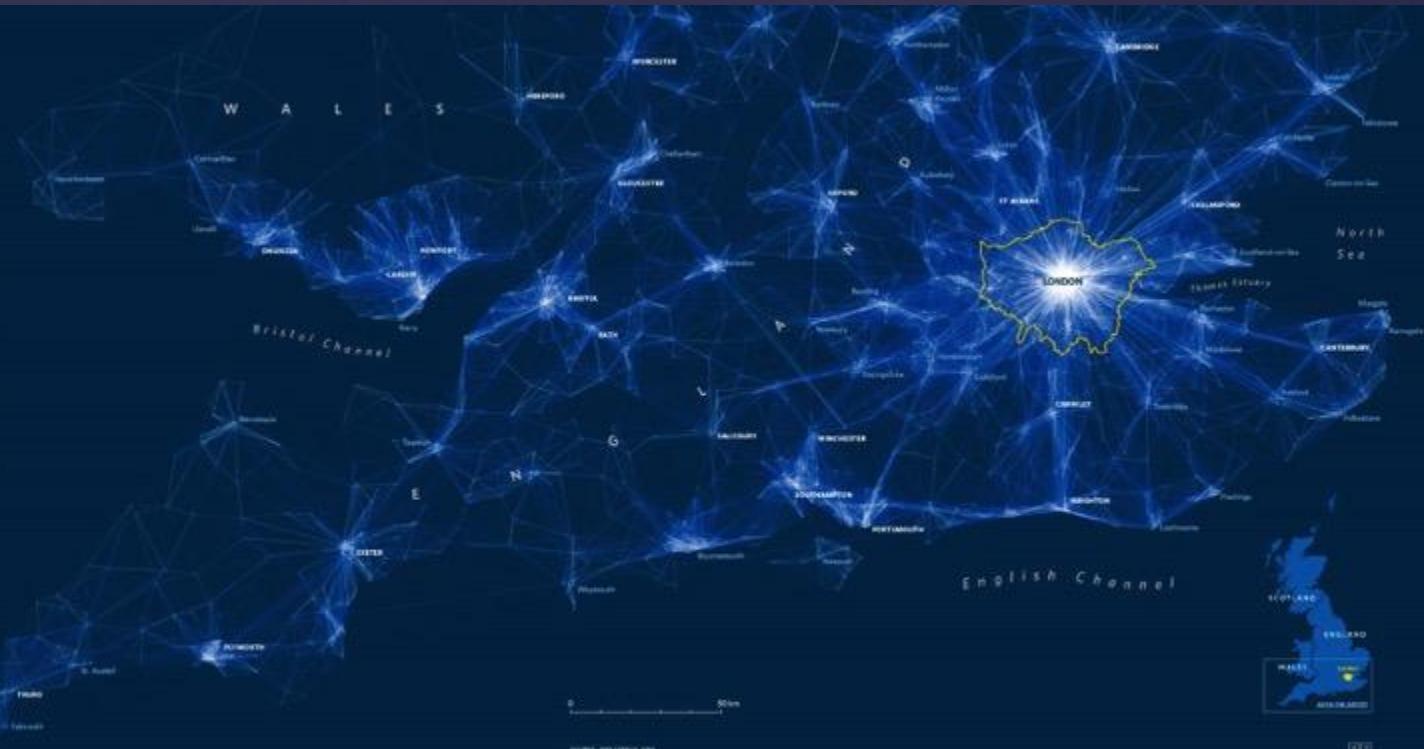
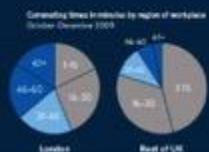
## From Home to Work

High-paying jobs draw workers from far, far away

In this depiction of daily commutes, London shines like the Sun in the constellation of Southern England. Like all stars, it has an immense gravitational pull. Whether by car, train or tube, thousands travel into the capital each day from all directions. Including this 'commuter belt' beyond the Greater London Authority boundary makes the capital one of the largest metropolitan areas in the EU with a population of more than 13 million.

Half of London's workforce make their journey by public transport, compared with only 9% in the rest of the country. 500,000 need thirty minutes or more to get to work. Elsewhere in the UK, only 20% have commutes that long. Why do so many live so far away?

For one, London salaries go further in satellite towns like Berkley. As of May 2014, a five-bedrooms converted barn there was going for the price of two-bedroom flats along the Underground's Central Line (see pp. 66–7). It's only a matter of time before faster trains proper commuters into even wider orbits.



LONDON

The Information Capital

100 maps and graphics that will change how you view the city



James Cheshire and Oliver Uberti (Particular Books, 30 October 2014)

Credits: <http://theinformationcapital.com/>

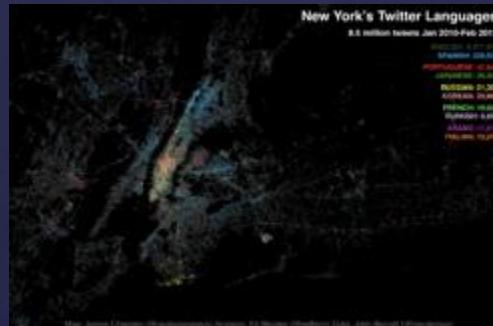
**LONDON** The Information Capital

100 maps and graphics that will change how you view the city

# (Interactive) Web Mapping

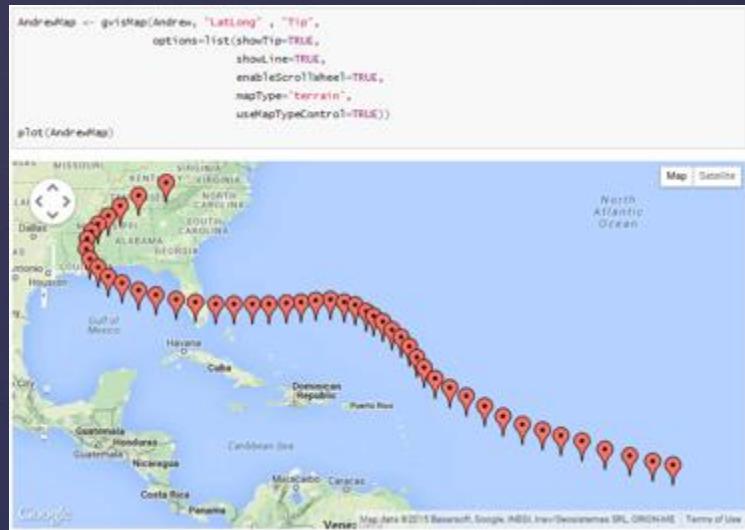


Mapbox



# (Interactive) Web Mapping with R

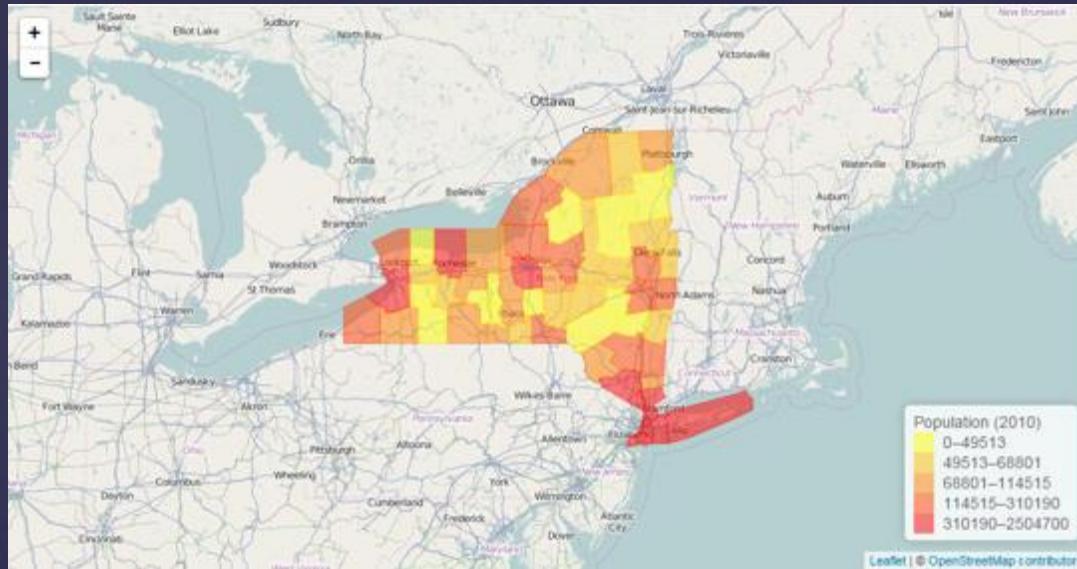
googleVis: R package for visualization of data in a web browser (Google Visualization API)



[http://cran.r-project.org/web/packages/googleVis/vignettes/googleVis\\_examples.html](http://cran.r-project.org/web/packages/googleVis/vignettes/googleVis_examples.html)

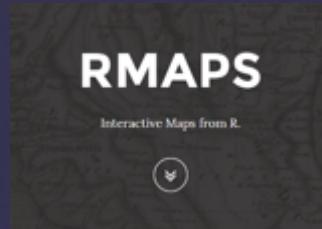
# (Interactive) Web Mapping with R

Leaflet Maps: R package ‘leafletR’ R package



<http://zevross.com/blog/2014/04/11/using-r-to-quickly-create-an-interactive-online-map-using-the-leaflet-package/>

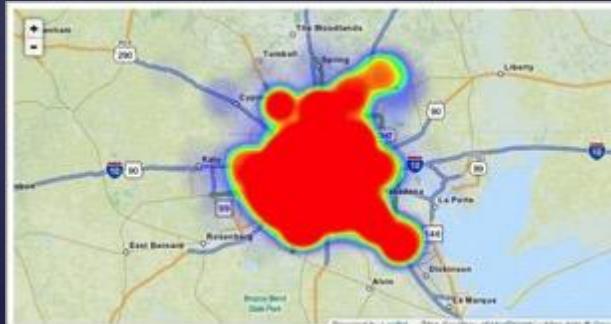
# (Interactive) Web Mapping with R



<http://rmaps.github.io/>

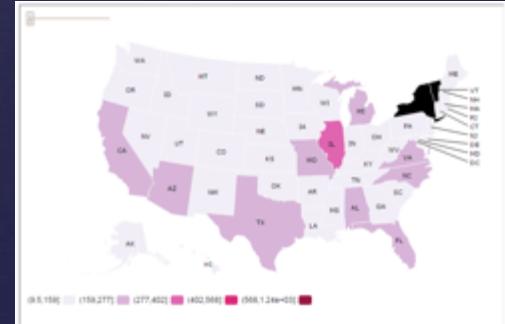
**rMaps** (still under development, can be installed from github using devtools) makes it easy to create, customize and share interactive maps from R, with a few lines of code. It supports several JavaScript based mapping libraries like **Leaflet**, **DataMaps** and **Crosslet**, with many more to be added

Leaflet Heat Maps



<http://rmaps.github.io/blog/posts/leaflet-heat-maps/index.html>

Animated Choropleths



<http://rmaps.github.io/blog/posts/animated-choropleths/index.html>

# Questions?

