Geovisualization

Review of spatial data

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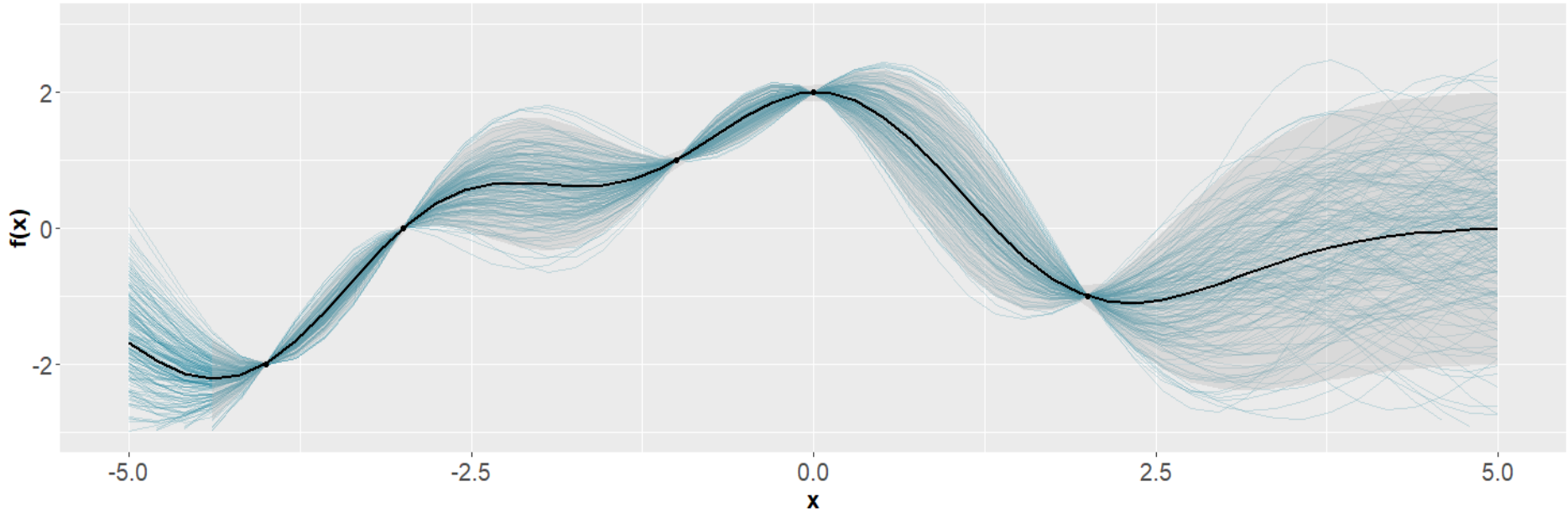

Outline

Spatial data

Spatial phenomena can be represented a discrete object (with clear boundaries) or as a continuous phenomenon that can be observed everywhere, but does not have natural boundaries.

Discrete spatial objects can be:

- River
- Road
- Country
- City
- Stations of monitoring
- etc...

Continuous spatial objects can be:

- Elevation
- Temperature
- Air quality
- Rain
- etc...

We can represent spatial objects as `vector` data (or *vector* data model). This representation allow us describe the geometry of shape of the objects, and also it can include additional attributes. For example, we can have a vector data describing the countries of the world (geometry) and also their names and the population in every country.

Vector data

The different types of vector data are:

- Points
- Lines
- Polygons

Considering the previous, the geometry of these data structures consists of sets of coordinate pairs (x, y) (longitude-latitude or easting and northing).

- Points are more simple case, where each point has one coordinate pair, and n associated variables (attributes).
- Lines are referred to a set of one or more polylines (connected series of line segments) and they are represented as ordered sets of coordinates (nodes).
- A polygon refers to a set of closed polylines. The geometry is very similar to that of lines, but to close a polygon the last coordinate pair coincides with the first pair.

By the "sp" package, we can represent:

- Points $\rightarrow$ `SpatialPoints`
- Lines $\rightarrow$ `SpatialLines`
- Polygons $\rightarrow$ `SpatialPolygons`

Besides, we can add attributes to a `SpatialPoints`, `SpatialLines` and `SpatialPolygons`, turning them in:

- `SpatialPointsDataFrame`
- `SpatialLinesDataFrame`
- `SpatialPolygonsDataFrame`

See the R example

Raster data

A raster divides the world into a grid of equally sized rectangles (referred to as cells or, in the context of satellite remote sensing, pixels) that all have one or more values (or missing values) for the variables of interest.

Raster data is commonly used to represent spatially continuous phenomena.

The geometry in the raster data is not explicitly stored as coordinates. It is implicitly set by knowing the spatial extent and the number or rows and columns in which the area is divided.

By the "raster" package, we can define the following classes:

- `RasterLayer`
- `RasterStack`
- `RasterBrick`

Besides, we can do operations on raster data.

See the R example

Basic examples

The representation of spatial data in R can be done by:

- Numbers
- Characters
- Logical
- Factor values

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- Characters
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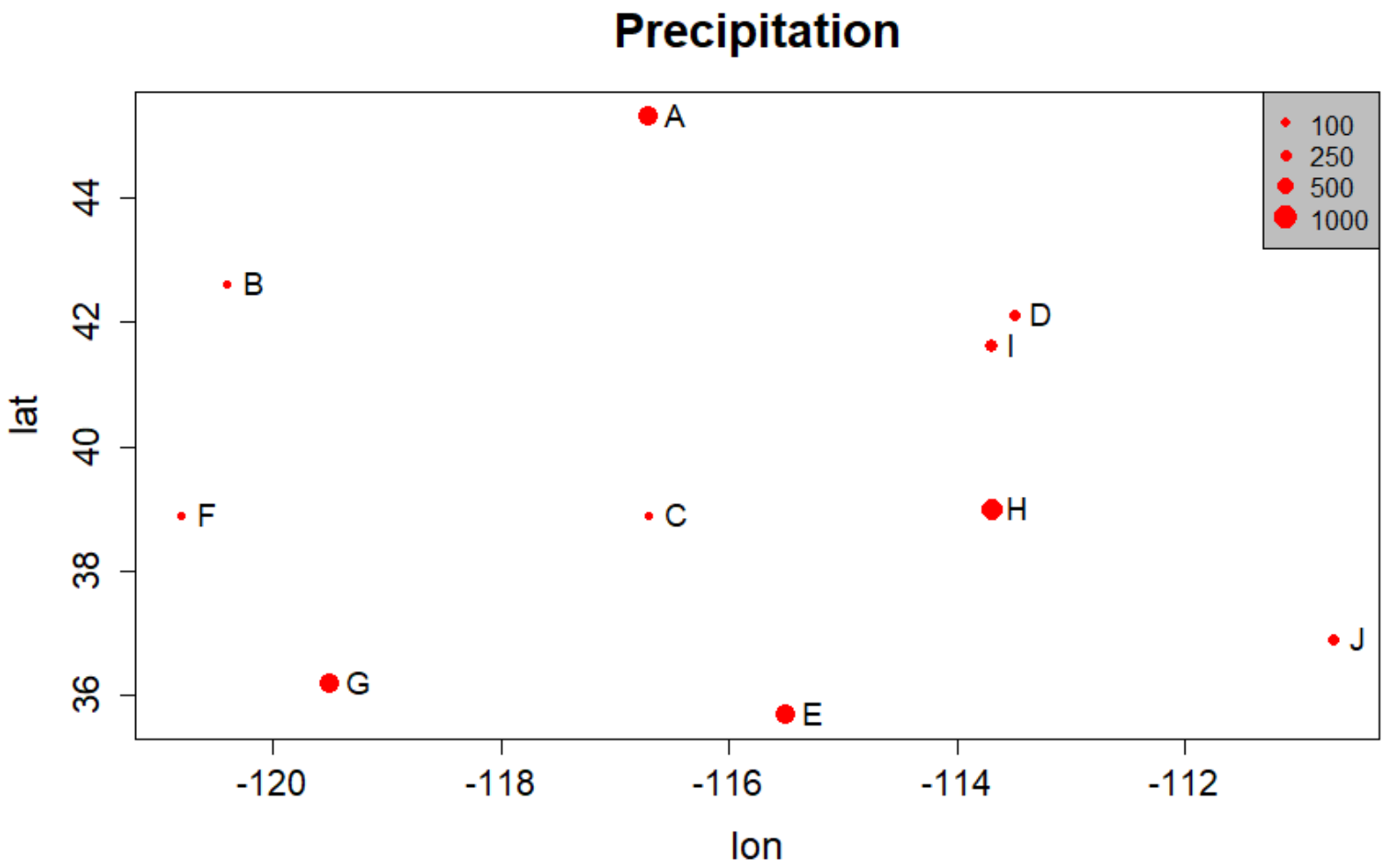

Figure: Precipitations in the locations "A" to "I".

We can add multiple sets of points to the plot, and even draw lines and polygons:

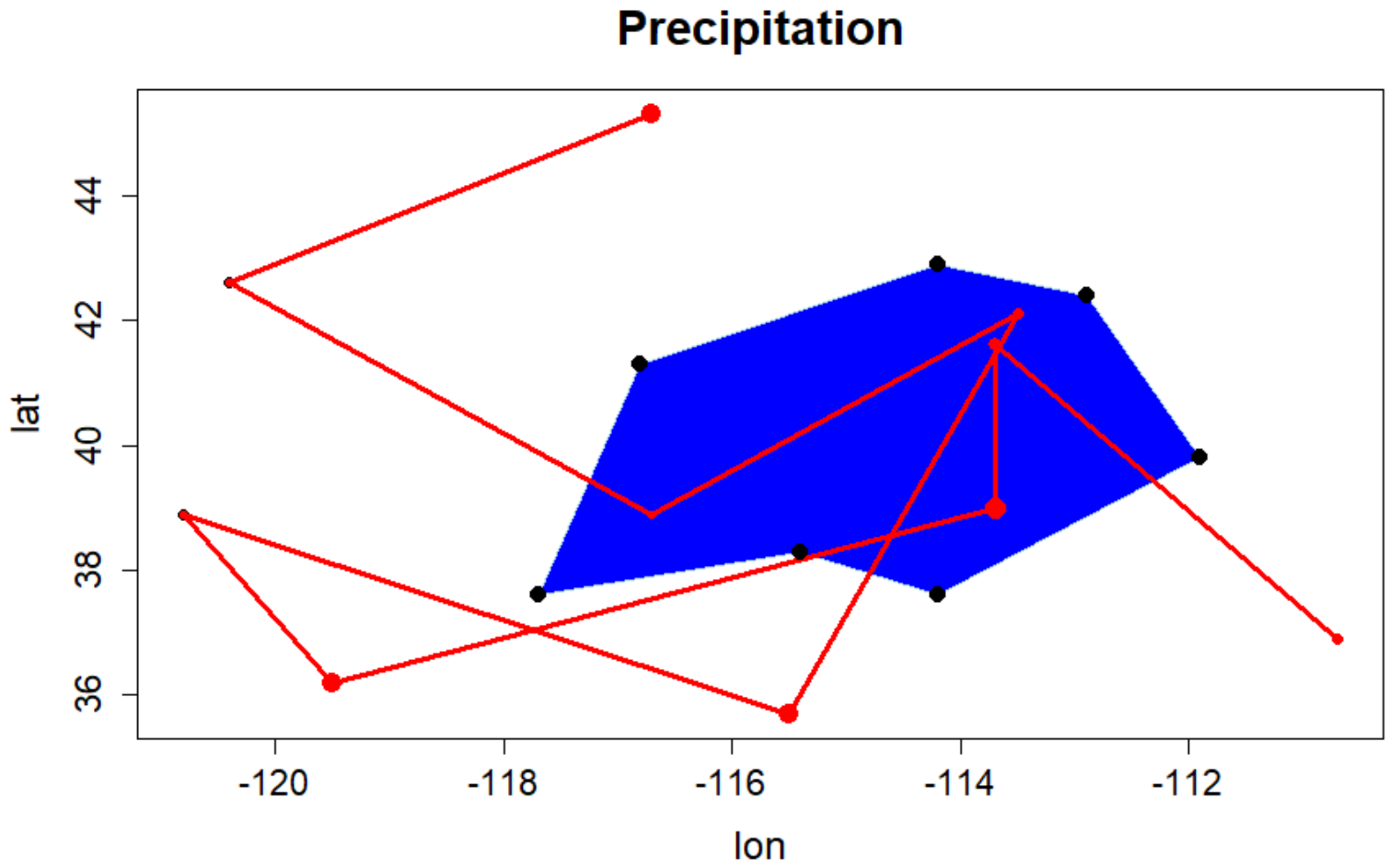

Figure: Precipitations in the locations "A" to "I".

Maps

There are different ways to make maps in `R`. We can use tuhe base `plot()` function, or uses other functions as:

- `levelplot()` from the "spplot" package
- Via the "rasterVis" package

Examples of maps

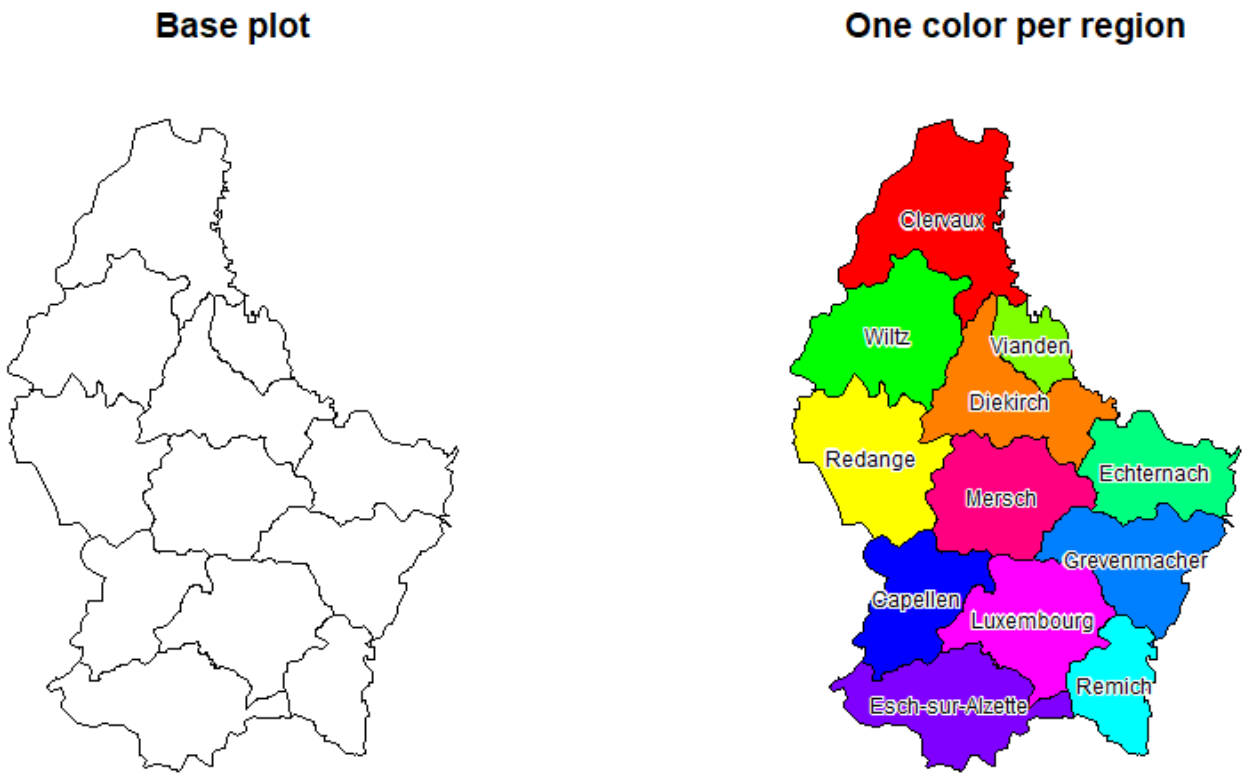

Figure: Map of Luxembourg using the `plot()` function.

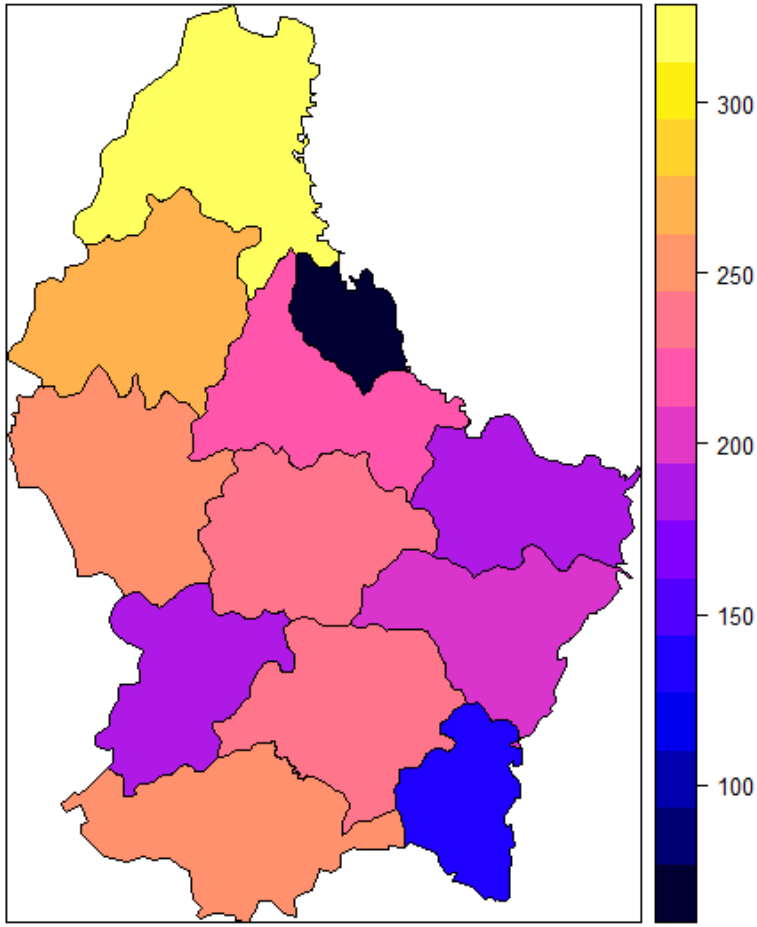

Figure: Map of Luxembourg using the `spplot()` function.

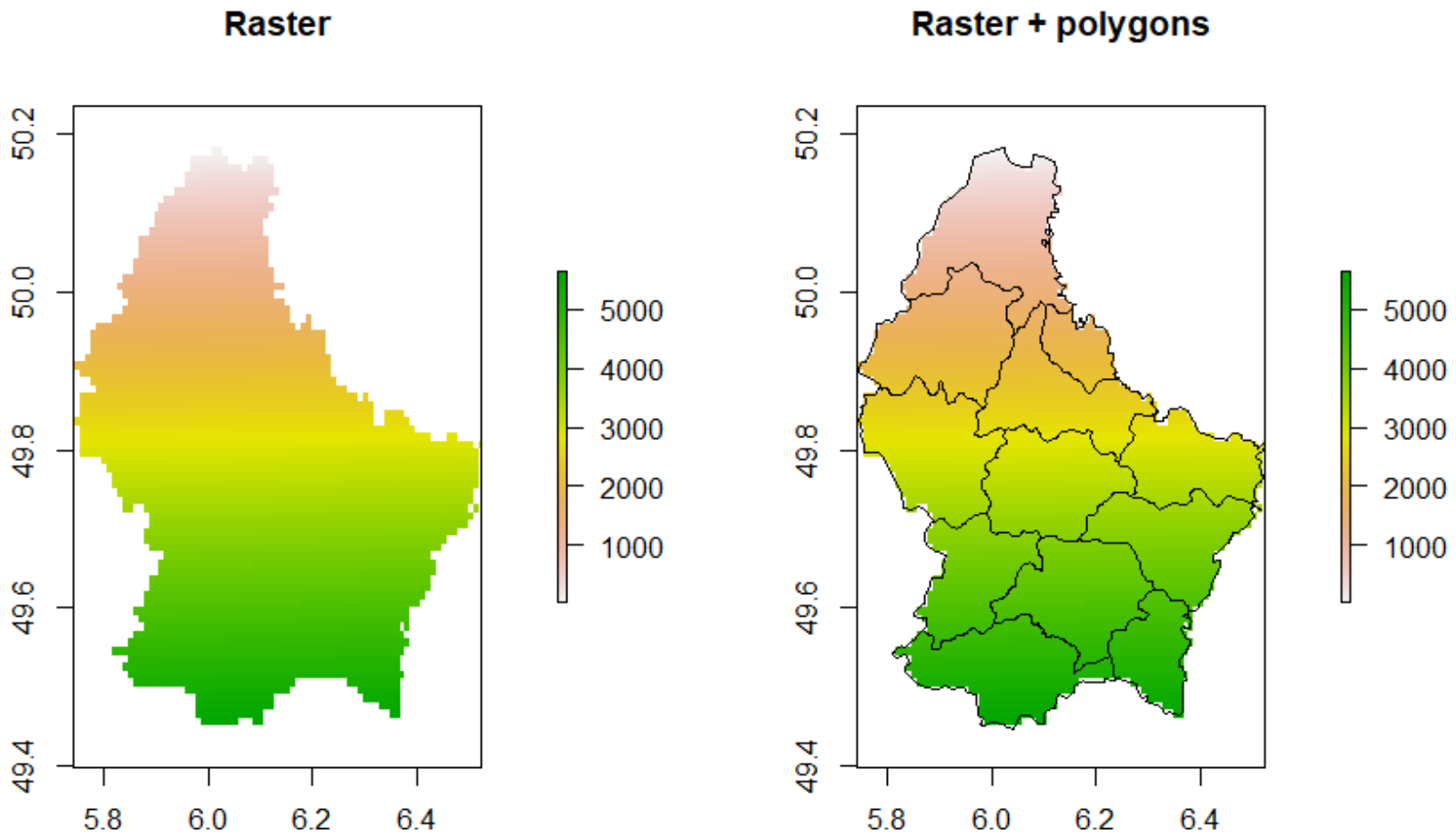

Figure: Map of Luxembourg as a raster data.

Using If we don't to provide a legend in the plot, the function `image` can be advantageous for this cases.

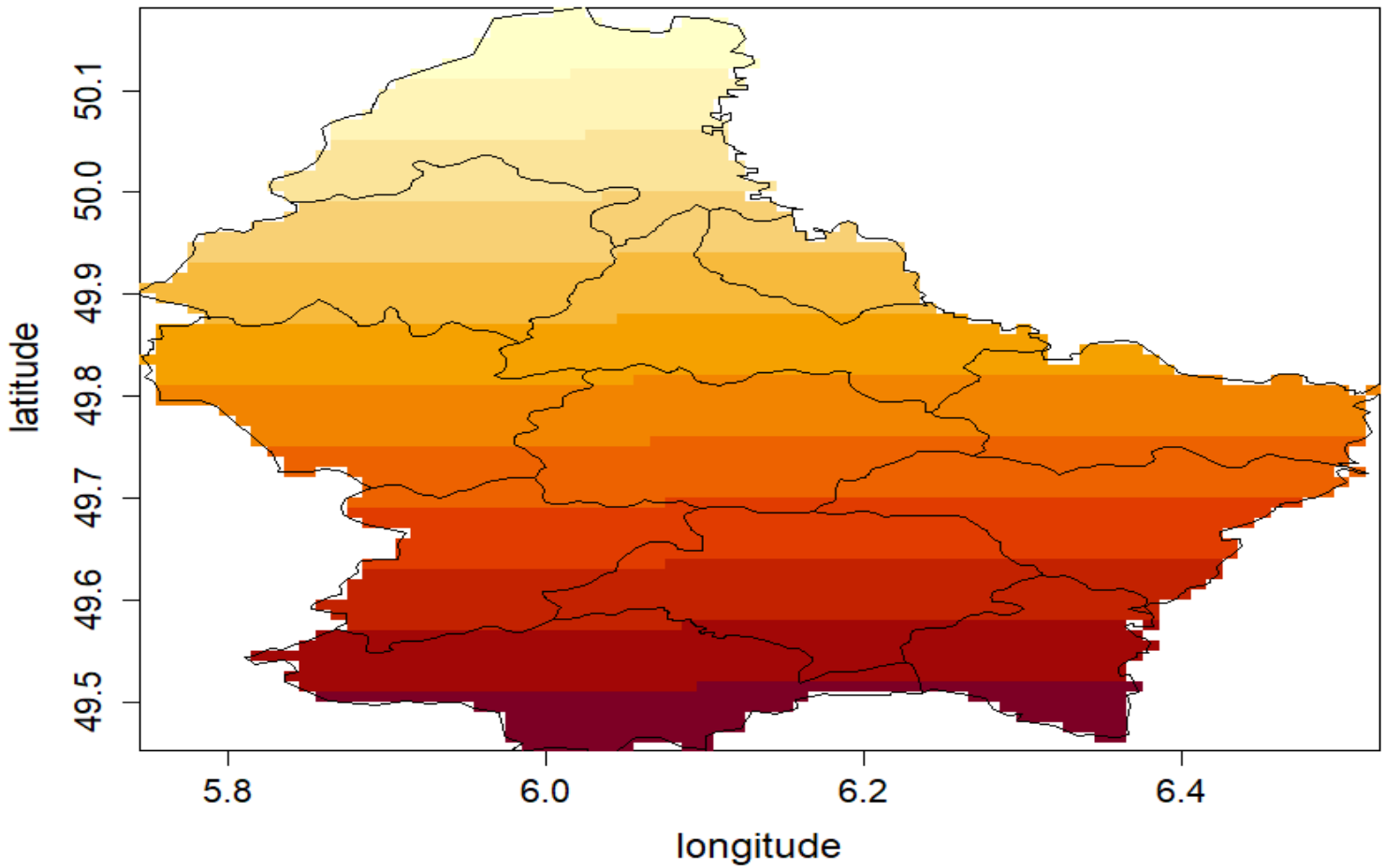

Figure: Map of Luxembourg as a raster data.

Spatial Data Science with R.

https://rspatial.org/raster/index.html