GADMTools - Manipulating Shapefiles

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Epiconcept is made up of a team of doctors, epidemiologists, data scientists and digital specialists. For more than 20 years, Epiconcept has been contributing to the improvement of public health programs by providing software, epidemiological studies, counseling, evaluation and training to better prevent, detect and treat people.

Epiconcept delivers software and services in the following areas :

- Software for managing public health programs,
- Secure cloud solutions for health data collection, reporting and processing,
- The implementation of research projects on measuring the effectiveness and impact of vaccines,
- Services in the field of epidemiology (protocols, analyzes, training, etc.),
- Expertise in data analysis,
- Counseling, coaching and assistance to project owners for public health programs,
- Training (short introductory modules, training through long-term practice).

To achieve such goals Epiconcept :

- Recognized research organization,
- Certified datacenter for hosting personal health data,
- Training organisation.

Epiconcept relies on :

- Its expertise in epidemiology
- Its IT expertise,
- Ethical values rooted in practice (responsibility and quality of services, data security and confidentiality, scientific independence, etc.),
- Capabilities to answer and anticipate tomorrow's challenges (Research - evaluation, e-health, Big Data, IoT, etc.),
- A desire to build long-term relationships with its clients and partners.

Its current customers and partners include some of the greatest names in the world such as : Santé Publique France (and many public health organizations around the world), WHO, eCDC, AFD, MSF, World Bank, etc.

What is GADM?

GADM, the Database of Global Administrative Areas, is a high-resolution database of country administrative areas, with a goal of "all countries, at all levels, at any time period. The database has a few export formats, including shapefiles that are used in most common GIS applications.[2] Files formatted for the programming language R are also available, allowing the easy creation of descriptive data plots that include geographical maps. Although it is a public database, GADM has a higher spatial resolution than other free databases and also higher than commercial software such as ArcGIS. GADM is not freely available for commercial use. The GADM project created the spatial data for many countries from spatial databases provided by national governments, NGO, and/or from maps and lists of names available on the Internet (e.g. from Wikipedia).

The GADM website and data repository is hosted at UC Davis in the Hijmans Lab. The Hijman lab is run by Robert Hijmans an Environmental Science and Policy faculty member in the Geography Graduate Group. [source Wikipedia - https://en.wikipedia.org/wiki/GADM]

What is GADMTools?

GADMTools is an R package to manipulate shapefiles from GADM and to make geo-statistical representations easily.

GADMTools can use 2 shapefile formats, *SpatialPolyonsDataFrame (SP)* and *Simple Features (SF)*, both provided by GADM as .rds files.

NB: the SF format is supported only from version 3.5 of GADMTools.

Manipulating shapefiles

functions

SpatialPolygons	Simple Features	Description
gadm_sp_loadCountries	gadm_sf_loadCountries	downloads or loads one or more shapefiles
_____	gadm_sf_import_shp	load a .shp file and convert it to gadm_sf object
gadm_getBackground	gadm_getBackground	Gets tiles with 'rosm' from OpenStreetMap
gadm_loadStripped		Load a GADM stripped shapefile
gadm_remove	gadm_remove	Removes one or more regions from a map in a GADMWrapper/GT2 object
gadm_removeBackground	gadm_removeBackground	Removes the background of a map
gadm_saveStripped		Save a stripped GADM object
gadm_subset	gadm_subset	Extract regions. "subset" does not work since release 3.5-1
gadm_union	gadm_union	Merges regions
listNames	listNames	List the region names for an administrative level
saveAs	saveAs	Save your own GADM shapefile as a .rds file
stripSP		Strip a GADMWrapper object

Added in version 3.6

SpatialPolygons	Simple Features	Description
gadm_getBbox	gadm_getBbox	get the bounding box of the map
gadm_crop	gadm_crop	crop a region to a specific rectangle
gadm_longTo360	gadm_longTo360	Converts longitudes from -180° - 0° - 180° to 0° - 360°
gadm_removeBackground	gadm_removeBackground	Removes the background of a map

CAUTION: Functions whose names were previously prefixed by "gadm." are now prefixed by "gadm_" for compliance with the R language coding conventions. Older functions are still availables for this release but will be removed in the next release. Generally all the "." in the function names have been replaced by "_".

Function *gadm.loadCountries* has been removed.

Format SP : gadm_sp_loadCountries()

This is a main function of GADMTools, with it, you can load or download one or more shapefiles. If you load many shapefiles, the function assembles the shapefiles into one.

The old function *gadm_loadCountries* has been removed.

gadm_sp_loadCountries(

```
fileNames,

level = 0,

basefile=GADM_BASE,

baseurl=GADM_URL,

simplify=NULL

)
```

Parameter	Description
fileNames	**Character vector** of named regions. An ISO-3166-1 code or a custom name. You don't have to specify the suffix (admX) nor the file extension (.rds).
level	**Integer** - the level of the administrative boundaries (0 is the country, higher values equal finer divisions)
basefile	**Character** - the path of the directory where shapefiles are stored. Default is "./GADM"
baseurl	**Character** - the url of GADM files. Default is http://biogeo.ucdavis.edu/data/gadm_.8/rds/
simplify	**Numeric** numerical tolerance value to be used by the Douglas-Peuker algorithm. Higher values use less polygon points (and less memory) and lower values use more polygon points (and more memory). We suggest not going higher than 0.025 in order for intra-country boundaries to align.

Return: Object *gadm_sp*

Format SF : gadm_sf_loadCountries()

This is a main function of GADMTools, with it, you can load or download one or more shapefiles. If you load many shapefiles, the function assembles the shapefiles into one.

gadm_sf_loadCountries(

```
fileNames,

level = 0,

basefile=GADM_BASE,

baseurl=GADM_URL,

simplify=NULL

)
```

Parameter	Description
fileNames	**Character vector** of named regions. An ISO-3166-1 code or a custom name. You don't have to specify the suffix (admX) nor the file extension (.rds).
level	**Integer** - the level of the administrative boundaries (0 is the country, higher values equal finer divisions)
basefile	**Character** - the path of the directory where shapefiles are stored. Default is "./GADM"
baseurl	**Character** - the url of GADM files. Default is http://biogeo.ucdavis.edu/data/gadm_.8/rds/
simplify	**Numeric** numerical tolerance value to be used by the Douglas-Peuker algorithm. Higher values use less polygon points (and less memory) and lower values use more polygon points (and more memory). We suggest not going higher than 0.025 in order for intra-country boundaries to align.

Return: Object *gadm_sf*

Format SF : gadm_sf_import_shp()

Sometimes we need to import shapefiles different from those provided by GADM.org. It is possible to read and import a file in shapefile format (.shp,.dbf,.proj) and put it in gadm_sf format for use with GADMTools.

gadm_sf_import_shp(

```
              dir,

              name,

              level,

              del = NULL,

              renamed = NULL,

              keepall = FALSE

            )
```

Parameter	Description
dir	**Character** path to the directory where .shp file is located (eg. "./")
name	**Character** - name of the .shp file without the extension (example: "india"),
level	**Integer** - the administrative level
del	**Character vector** - the variables (columns) to be deleted (optional if keepall == FALSE)
renamed	**Character vector** - the variables to be renamed (eg. the administrative fields in GADM are named NAME_X where X is the level, and the ISO code(3)),
keepall	**Boolean** if it is FALSE (default), allows to keep only the columns useful for GADMTools.

Return: Object *gadm_sf*

Example

```
map <- gadm_sf_import_shp(dir="./", name = "india", level = 2,
                          del = c("DCODE", "NAME3", "SDCODE"),
                          renamed = c('ISO' = 'COUNTRY',
                                      'NAME_0' = 'COUNTRY_LO',
                                      'NAME_1' = 'NAME1',
                                      'NAME_2' = 'NAME2'),
                          keepall = FALSE
                          )
map$sf$ISO <- "IND"
map$sf$NAME_0 <- "India"
```

Loading a country

```
library(GADMTools)

# Loading country border (level=0 [default])
# ------------------------------------------------------------------
map <- gadm_sf_loadCountries("FRA", basefile = "./")
gadm_plot(map) + theme_light()
```

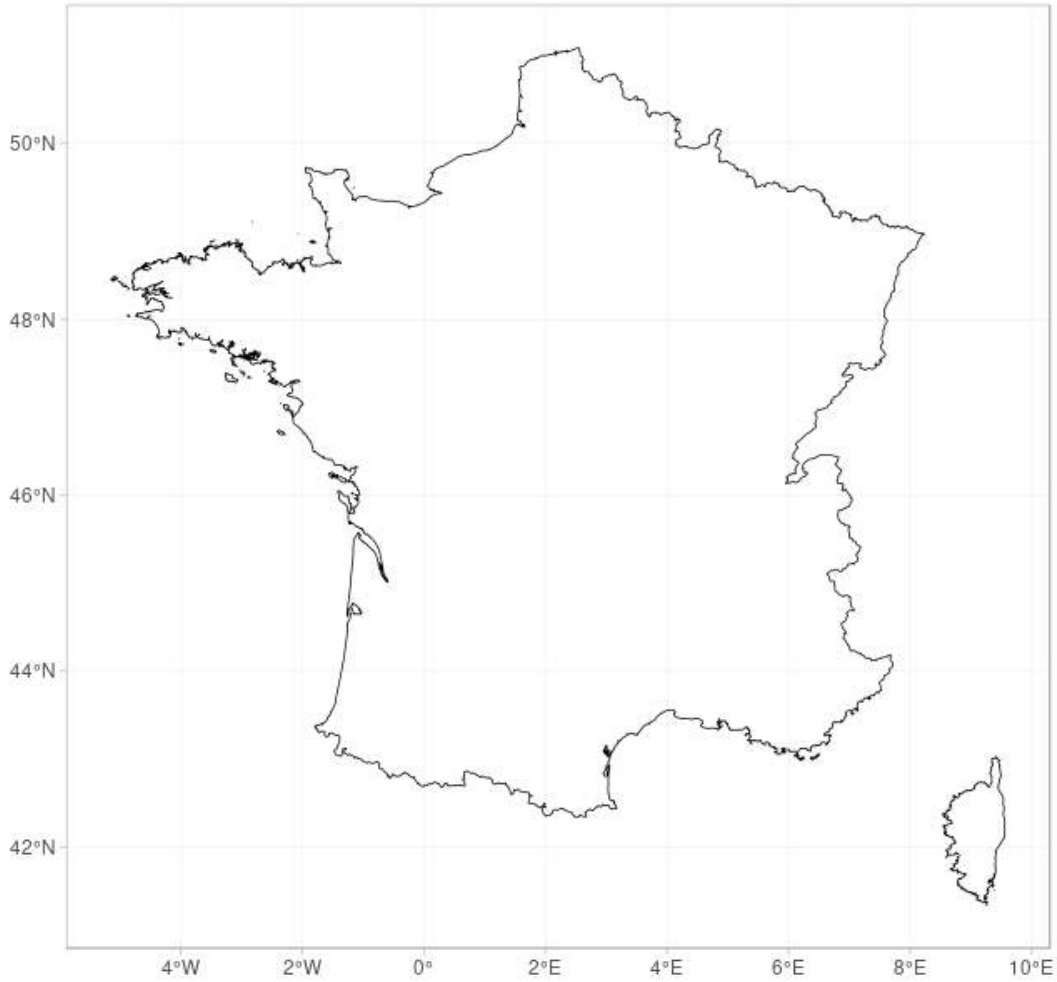


Figure 1: Loading a single country (level = 0)

Loading a country at an administrative level

```
library(GADMTools)
data("Corsica")


# Loading regions @ level = 2])
# ------------------------------------------------------------------
map <- gadm_sp_loadCountries(c("FRA"), level=2, basefile = "./")
gadm_plot(map)
```

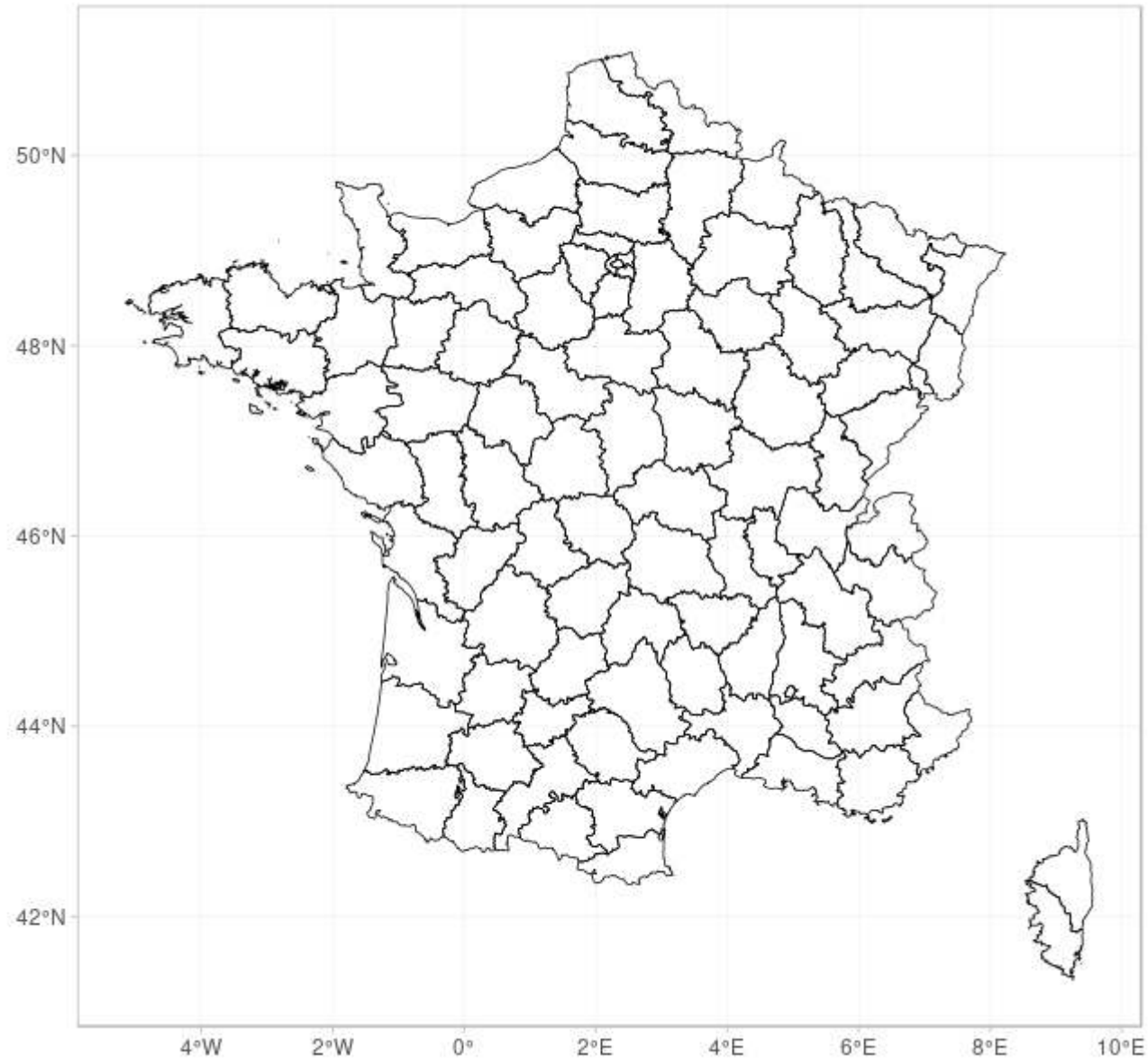


Figure 2: loading regions of a country @ level = 2

NB: you can use *gadm_sf_loadCountries* instead of *gadm_sp_loadCountries*

Assembling many countries

```
library(GADMTools)

# Assemble administrative boundaries (country level = 0)
# ------------------------------------------------------------------
map <- gadm_sp_loadCountries(c("BEL","LUX","NLD"),  basefile = "./")
gadm_plot(map + theme_light()
```

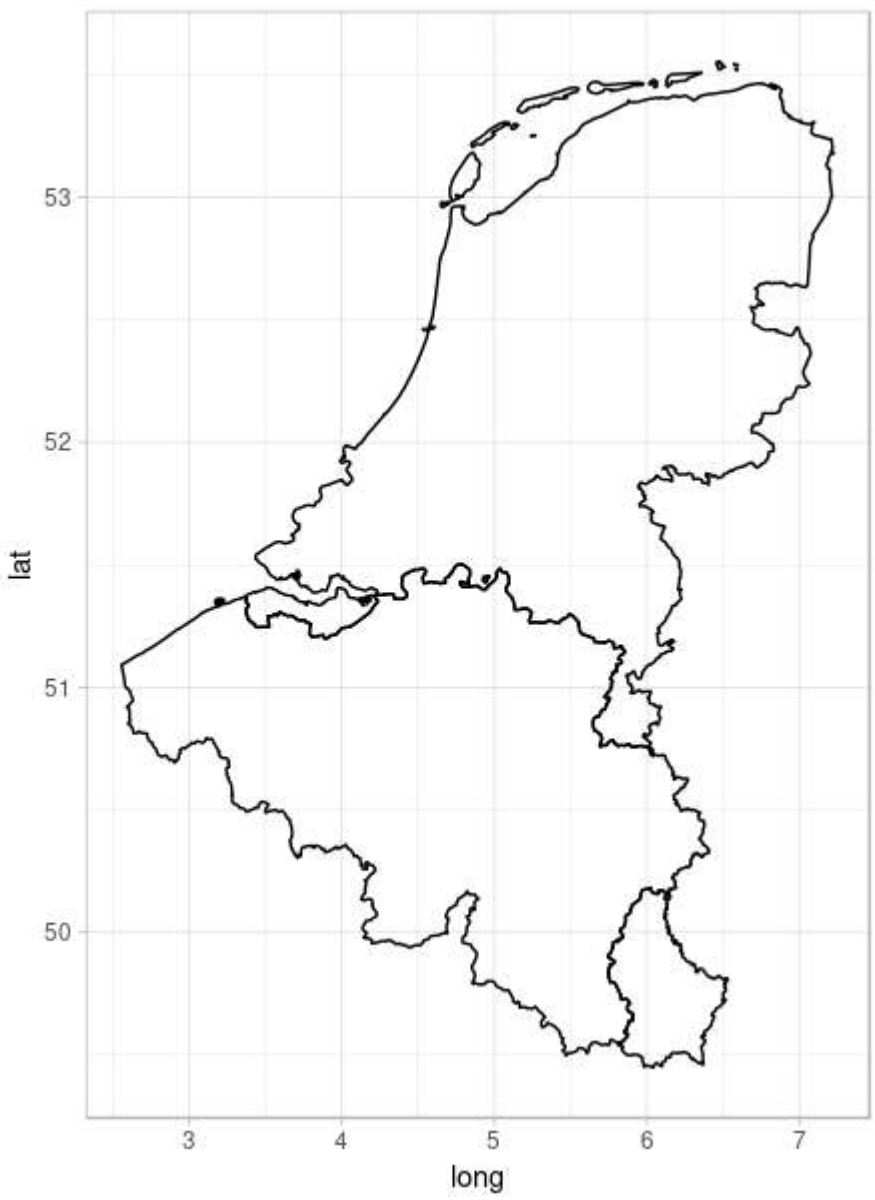


Figure 3: Benelux = Belgium + Luxembourg + Netherlands @ level = 0

NB: you can use *gadm_sf_loadCountries* instead of *gadm_sp_loadCountries*

Extracting regions

First extracting "Corse" from France @ level 4

```
FRA <- gadm_sf_loadCountries("FRA", level = 4, basefile = "./")
Corsica <- gadm_subset(FRA, level=1, regions="Corse")
```

```
gadm_plot(Corsica) %>% gadm_showNorth("tl") %>% gadm_showScale('bl')
```

In order to extract some regions of a map we need to know them. The *listNames()* function allows this. The subset function is then used to extract the desired regions.

CAUTION: only the administrative levels that have been loaded in the loadCountries object can be listed. For instance, with a map loaded @ level 4, the level for listNames can be one of [0, 1, 2, 3, 4]. Names are given in the country's language or English.

```
listNames(Corsica, 2)
```

```
## [1] "Corse-du-Sud" "Haute-Corse"
```

```
HCorse <- gadm_subset(Corsica, regions="Haute-Corse", level=2)
gadm_plot(HCorse)
```

Merging regions

```
UCorse <- gadm_union(Corsica, level=3, type="Arrondissements")
gadm_plot(UCorse)
```

Removing regions

```
listNames(Corsica, 3)
```

```
## [1] "Ajaccio" "Sartène" "Bastia"  "Calvi"   "Corte"
```

```
Corse_without_Corte <- gadm_remove(Corsica, regions="Corte", 3)
gadm_plot(Corse_without_Corte)
```

Cropping an area

First get the bounding box of Corsica

```
gadm_getBbox(Corsica)
```

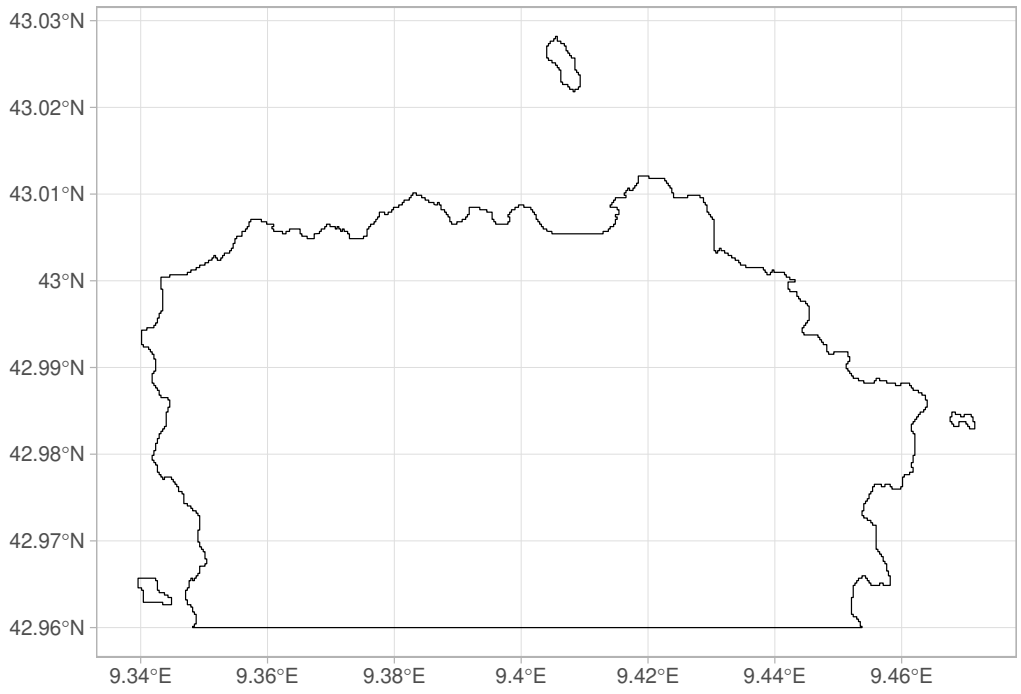
```
##      xmin      ymin      xmax      ymax
##  8.534306 41.333752  9.560416 43.028194
```

And now, cropping at ours custom coordinates

```
STUDY_AREA <- gadm_crop(Corsica, xmin=9.3, ymin=42.96, xmax=9.566, ymax=43.02819)
```

```
## although coordinates are longitude/latitude, st_intersection assumes that they are planar
```

```
gadm_plot(STUDY_AREA)
```



Converting longitudes to 0 - 360

```
library(GADMTools)
FJI = gadm_sp_loadCountries("FJI", 1, basefile = "./")
gadm_plot(FJI, title = "Fidji Island with bad coordinates")
```

```
FJI = gadm_longTo360(FJI)
gadm_plot(FJI, title = "Fidji Island with 0 - 360 coordinates")
```

Adding a background image from OpenstreetMap

```
library(GADMTools)
library(rosm)
FRA = gadm_sp_loadCountries("FRA", 2, basefile = "./")
BRE = gadm_subset(FRA, level=1, regions=c("Bretagne"))
BRE2 <- gadm_getBackground(BRE, "BRE", "osm")
gadm_plot(BRE2, title = "Map of Bretagne (FRANCE)")
```

Remove a background previously loaded with gadm_getBackground

---

gadm_removeBackground(x)

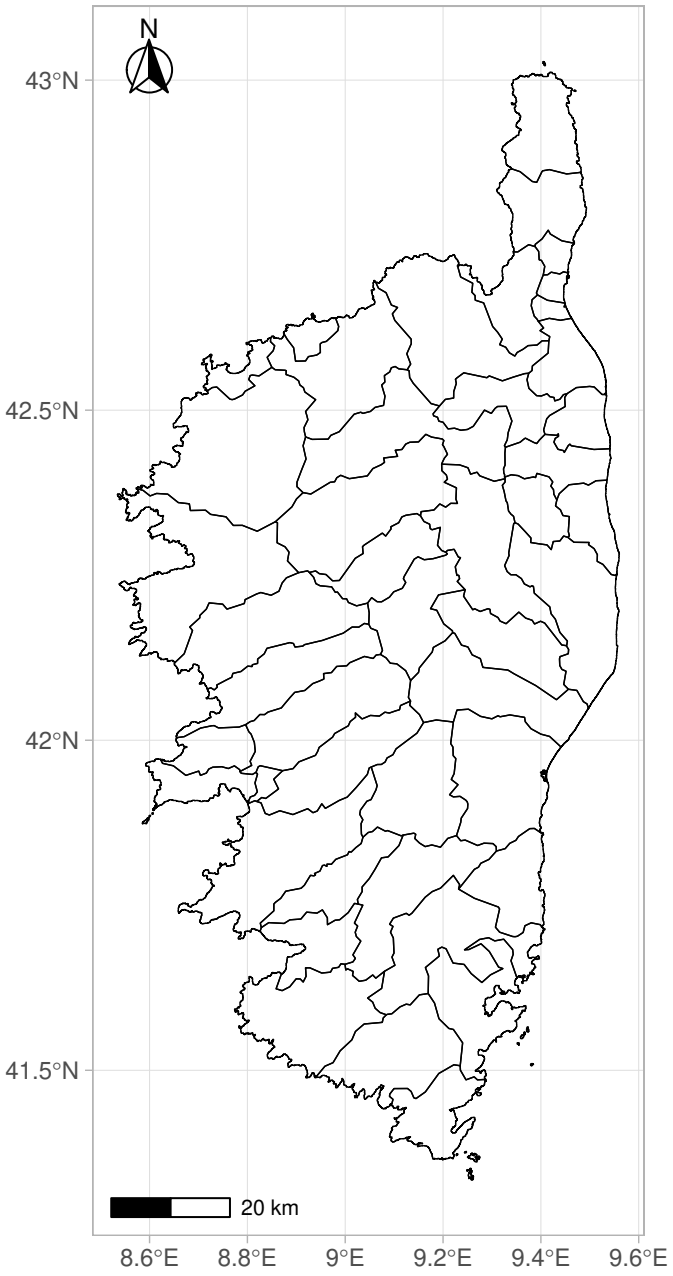


Figure 4: Corsica (Region of France) @ level 4

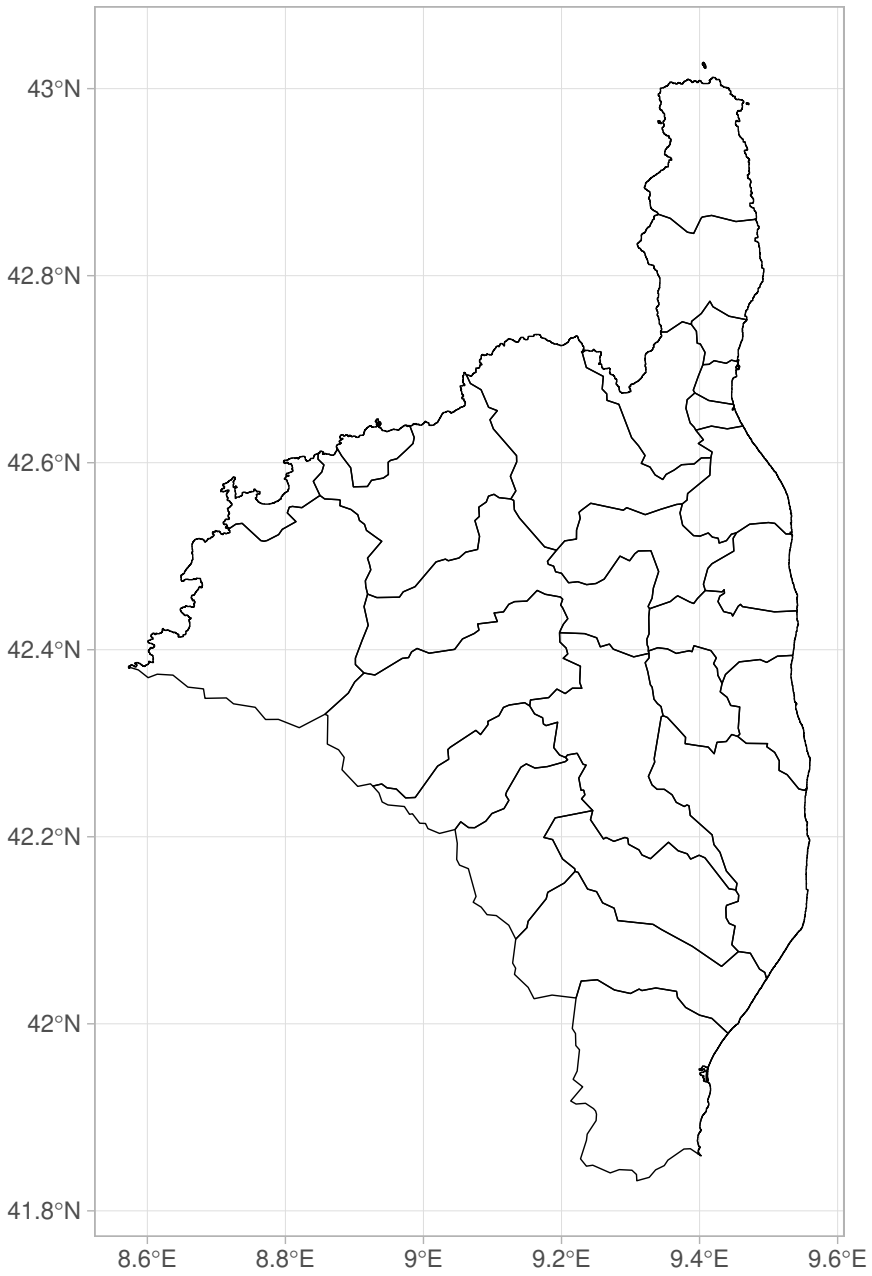


Figure 5: Corsica - Haute-Corse

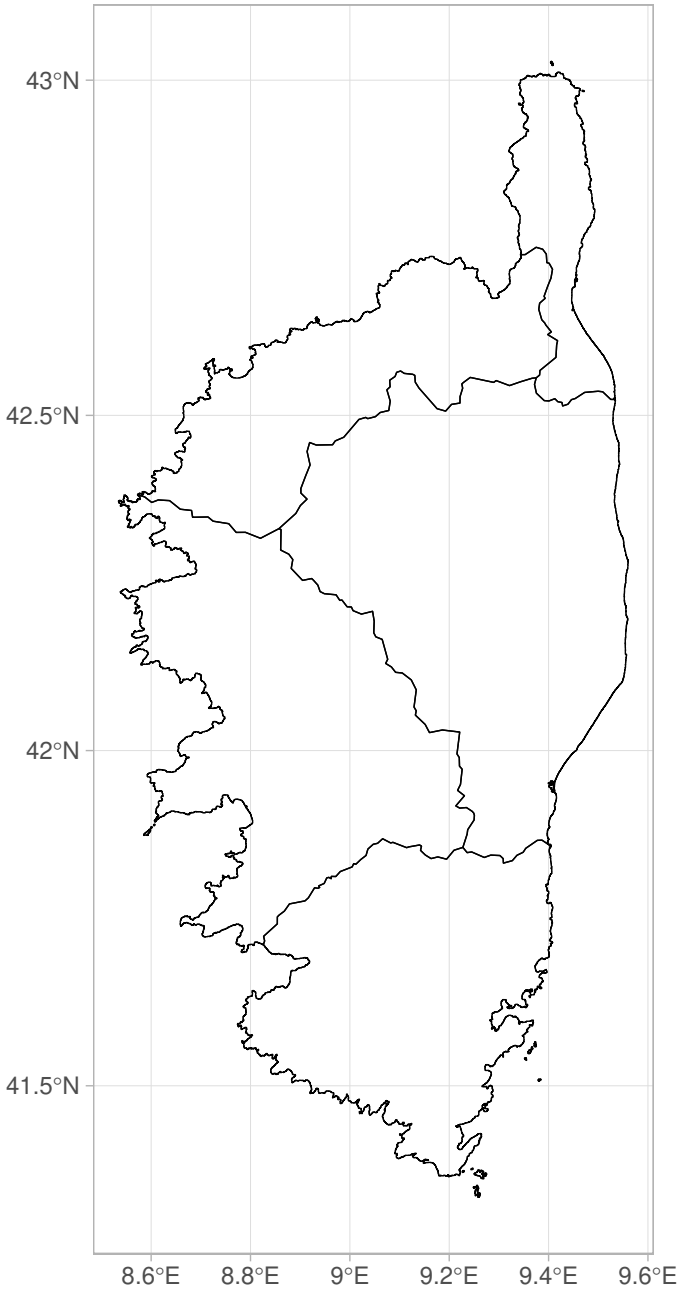


Figure 6: Corsica with districts only

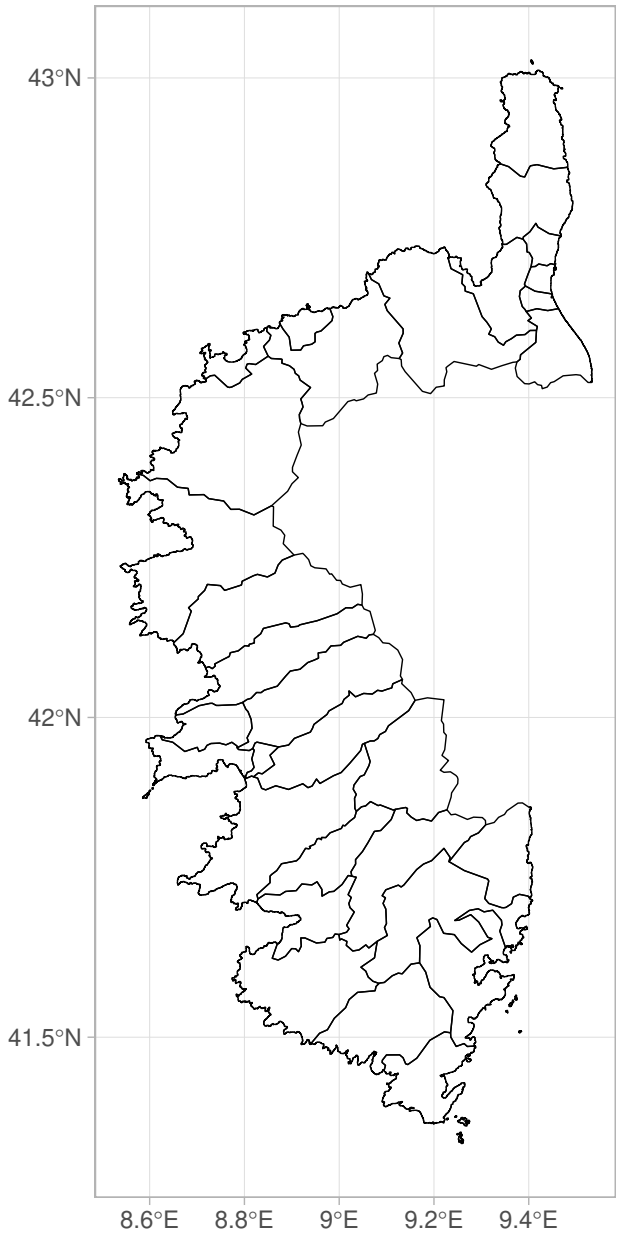


Figure 7: Corsica without district of Corte

Figure 8: Fiji Islands, with polygons crossing the Date Line

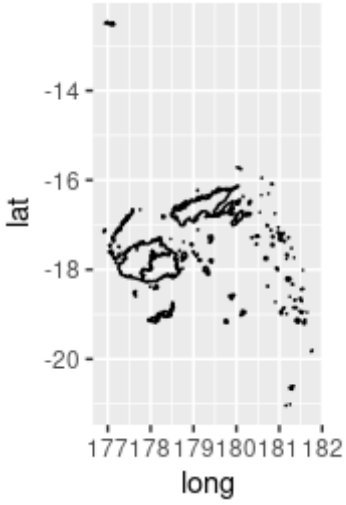


Figure 9: Fiji Islands, with polygons crossing the Date Line

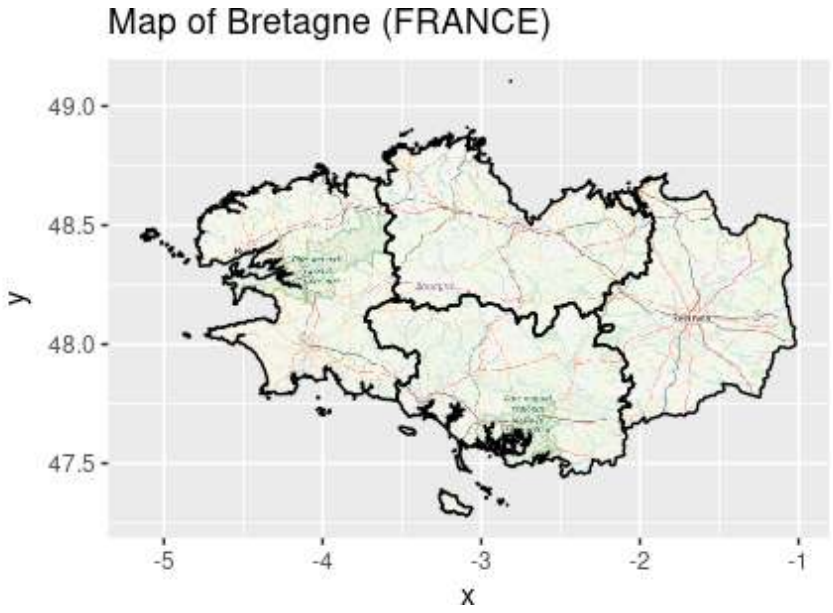


Figure 10: map of Bretagne with background from OSM @ level = 2