

The mapmisc package

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This document will be incomplete if `rgdal` is unavailable or there is no internet connection when this document is compiled. The full document is at <http://diseasemapping.r-forge.r-project.org/>.

1 Introduction

This package provides a few utilities for making nice maps in R, with an emphasis on enabling maps in short tidy code chunks which are suitable for Sweave and knitr documents. The package duplicates the capabilities of packages such as `classInt`, `geonames`, and `OpenStreetMap`, and the price of having tidier code is much of the flexibility from these other packages has been lost here.

The `meuse` data from the `sp` package

```
library('sp')
data('meuse')
coordinates(meuse) <- ~x+y
class(meuse)

## [1] "SpatialPointsDataFrame"
## attr(,"package")
## [1] "sp"
```

```
library('rgdal')
proj4string(meuse) <- CRS("+init=epsg:28992")
meuseLL = spTransform(meuse, CRS("+init=epsg:4326"))
```

Get elevation data with

```
library('raster')
nldElev = raster::getData("alt", lon=raster::xmin(meuseLL),
  lat=raster::ymin(meuseLL), path=tempdir() )
raster::getData("SRTM", lon=raster::xmin(meuseLL),
```

```
lat=raster::ymin(meuseLL), path=tempdir() )
nldElev = raster(file.path(tempdir(), "srtm_38_02.tif"))
nldElev = crop(nldElev, extent(meuseLL))
nldElev = projectRaster(nldElev, crs=proj4string(meuse))
```

Or simply do

```
library('mapmisc')
data('netherlands')
```

The elevation data is a Raster.

```
class(nldElev)

## [1] "RasterLayer"
## attr(,"package")
## [1] "raster"

nldElev = crop(nldElev, extend(extent(meuse), 1000))

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
## datum Unknown_based_on_Bessel_1841_ellipsoid in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
## datum Unknown_based_on_Bessel_1841_ellipsoid in CRS definition
```

2 Downloading background maps and city locations

Get a background map covering the extent of the meuse data

```
library('mapmisc')
if(haveRgdal)
  nldTiles = openmap(meuse)

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
## datum Unknown_based_on_Bessel_1841_ellipsoid in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
## datum WGS_1984 in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
## datum WGS_1984 in CRS definition
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## datum WGS_1984 in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
## datum WGS_1984 in CRS definition
```



```
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum WGS_1984 in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
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datum WGS_1984 in CRS definition
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datum WGS_1984 in CRS definition
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datum WGS_1984 in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum WGS_1984 in CRS definition
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datum WGS_1984 in CRS definition
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datum WGS_1984 in CRS definition
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datum WGS_1984 in CRS definition
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datum WGS_1984 in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_Bessel_1841_ellipsoid in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum WGS_1984 in CRS definition
## Warning in rgdal::rawTransform(projfrom, projto, nrow(xy), xy[, 1], xy[, :
NOT UPDATED FOR PROJ >= 6
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_Bessel_1841_ellipsoid in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_Bessel_1841_ellipsoid in CRS definition
```

`nldTiles` is a Raster with the same projection as `meuse`

```
class(nldTiles)

## [1] "RasterLayer"
## attr(,"package")
## [1] "raster"
```

```
projection(nldTiles)

## [1] "+proj=sterea +lat_0=52.1561605555556 +lon_0=5.38763888888889 +k=0.9999079 +x_0=1

projection(meuse)

## [1] "+proj=sterea +lat_0=52.1561605555556 +lon_0=5.38763888888889 +k=0.9999079 +x_0=1
```

Maps which can be downloaded are shown at <http://diseasemapping.r-forge.r-project.org/openmap/>

`GNcities` is a wrapper for the function of the same name in the `geonames` package.

```
nldCities = GNcities(meuse, maxRows=6)
```

A `SpatialPointsDataFrame`, with same map projection.

```
class(nldCities)

## [1] "SpatialPointsDataFrame"
## attr(,"package")
## [1] "sp"

names(nldCities)

## [1] "lng"          "geonameId"    "countrycode" "name"         "fclName"
## [6] "toponymName" "fcodeName"    "wikipedia"    "lat"          "fcl"
## [11] "population"   "fcode"

projection(nldCities)

## [1] "+proj=sterea +lat_0=52.1561605555555 +lon_0=5.38763888888889 +k=0.9999079 +x_0=1
```

3 Making maps

The `map.new` function sets up a map in the current plot window with the correct limits and aspect ratio for the object supplied, and without margins or white space. `scaleBar` adds a scale and north arrow. It uses the map projection of the argument supplied to calculate distances and find north.

Some of the code in the following sections require the `rgdal` package to run.

```
# plot the data locations
map.new(meuse)
```

```

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_Bessel_1841_ellipsoid in CRS definition
plot(nldTiles, add=TRUE)

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_Bessel_1841_ellipsoid in CRS definition

points(meuse,col="red", cex=0.3)
scaleBar(crs=proj4string(meuse),pos="topleft", bg="white")

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_Bessel_1841_ellipsoid in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition,
## but +towgs84= values preserved
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition,
## but +towgs84= values preserved
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition,
## but +towgs84= values preserved
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition,
## but +towgs84= values preserved

# plot city names
map.new(meuse)

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_Bessel_1841_ellipsoid in CRS definition
plot(nldTiles, add=TRUE)

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_Bessel_1841_ellipsoid in CRS definition

points(nldCities)
text(nldCities, labels=nldCities$name, pos=3)
scaleBar(proj4string(meuse),pos="topleft", bg="white")

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_Bessel_1841_ellipsoid in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition,
## but +towgs84= values preserved
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition,
## but +towgs84= values preserved

```



```

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition,
## but +towgs84= values preserved
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition,
## but +towgs84= values preserved

# plot elevation
map.new(meuse, legendRight=TRUE)

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_Bessel_1841_ellipsoid in CRS definition

plot(nldTiles, add=TRUE)

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_Bessel_1841_ellipsoid in CRS definition

plot(nldElev, add=TRUE, col=terrain.colors(8), alpha=0.6, legend.mar=2, legend.line=0,)

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_Bessel_1841_ellipsoid in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_Bessel_1841_ellipsoid in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_Bessel_1841_ellipsoid in CRS definition

scaleBar(meuse, pos="topleft", bg="white")

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_Bessel_1841_ellipsoid in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition,
## but +towgs84= values preserved
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition,
## but +towgs84= values preserved
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition,
## but +towgs84= values preserved
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition,
## but +towgs84= values preserved

```

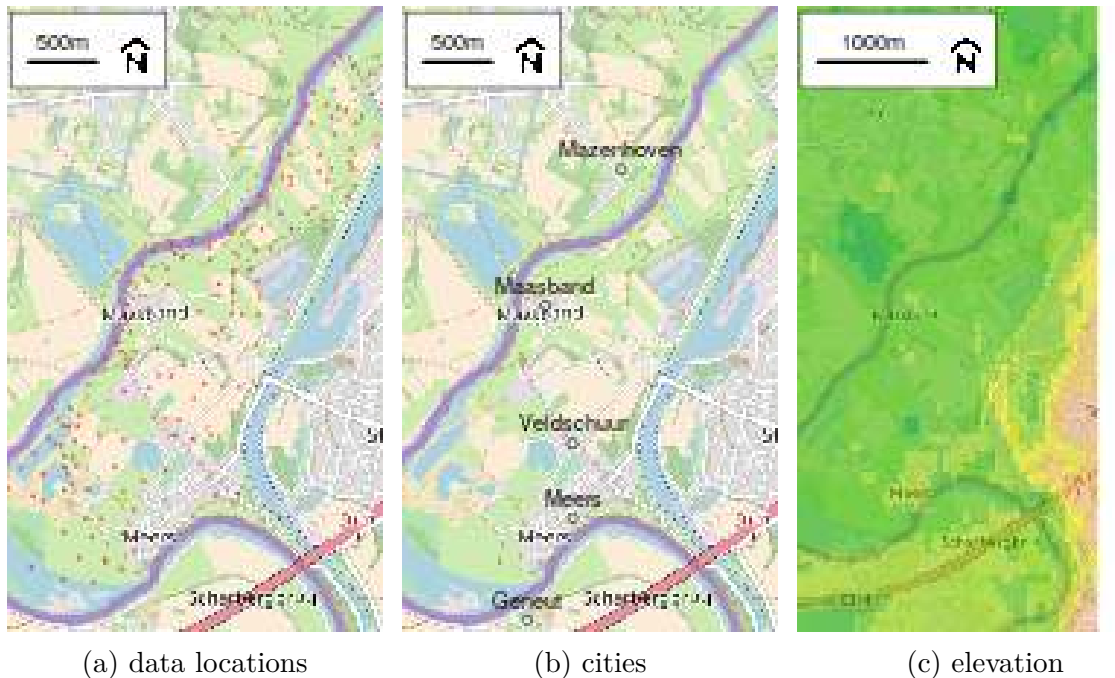


Figure 1: simple map

4 Legends

Create a colour scale for plotting copper concentrations

```
cuScale = colourScale(meuse$copper, breaks=5, style='equal',
  opacity=0.8, dec=-1, firstBreak=0)
```

and elevation, with transparency decreasing as elevation increases.

```
elevScale = colourScale(nldElev, style='equal',
  breaks=6, col=terrain.colors,
  firstBreak=0, dec=-1, opacity=c(0.2, 0.9))
```

Soil type is a categorical variable, create a factor and create a colour scale of unique values

```
meuse$soilFac = factor(meuse$soil, levels=c(1,2,3),
  labels=c("Calcareous", "Non-Calc's", "Red Brick"))
soilScale = colourScale(meuse$soilFac, col="Set2")
```

```
map.new(meuse)
```

```
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_Bessel_1841_ellipsoid in CRS definition
```

```

plot(nldTiles, add=TRUE)

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_Bessel_1841_ellipsoid in CRS definition

plot(meuse, col=cuScale$plot,add=TRUE,pch=16)
legendBreaks("bottomright", breaks=cuScale,
             title="gals/firkin")

map.new(meuse)

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_Bessel_1841_ellipsoid in CRS definition

plot(nldTiles, add=TRUE)

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_Bessel_1841_ellipsoid in CRS definition

plot(meuse, col=soilScale$plot,add=TRUE,pch=16)
legendBreaks("bottomright", breaks=soilScale,
             title="soil type", cex=0.7,bg="white")

map.new(meuse)

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_Bessel_1841_ellipsoid in CRS definition

plot(nldTiles, add=TRUE)

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_Bessel_1841_ellipsoid in CRS definition

image(nldElev, breaks=elevScale$breaks, col=elevScale$colOpacity,
      legend=FALSE,add=TRUE)

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_Bessel_1841_ellipsoid in CRS definition

legendBreaks("left", breaks=elevScale, title='Metres',bg="white")

```

5 More plots

Rotate the data 50 degrees clockwise with an oblique mercator projection.

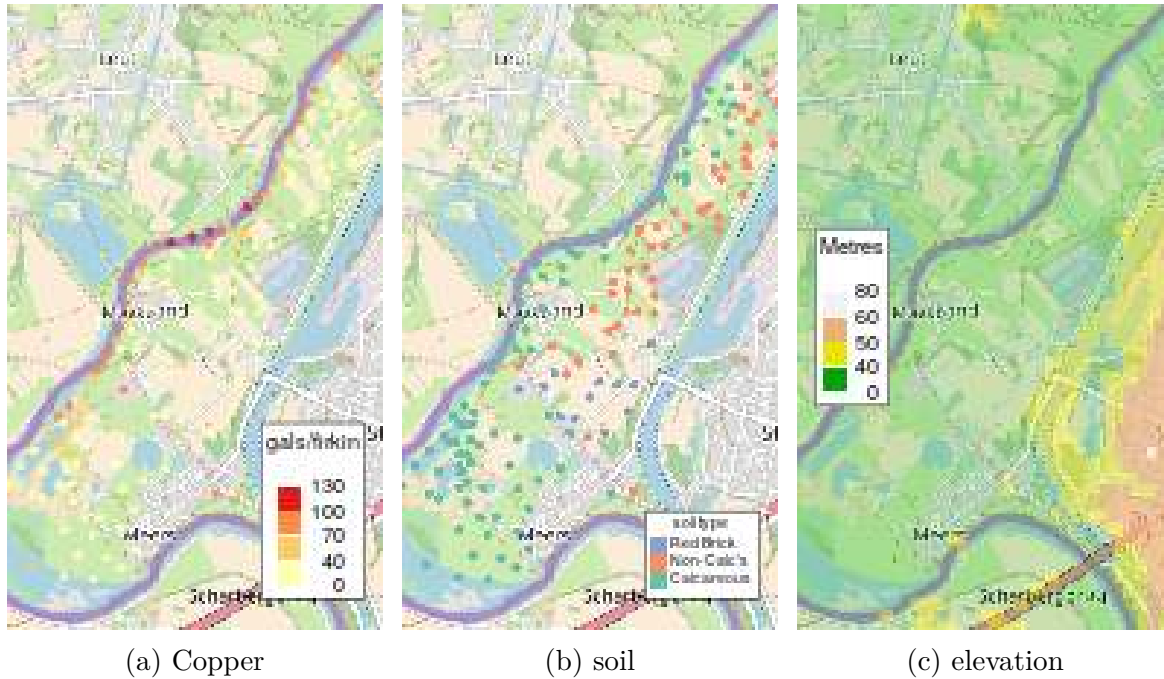


Figure 2: Meuse data again

```
if(requireNamespace('rgdal', quietly=TRUE)){
  meuseRot = spTransform(meuse, omerc(meuse, -50))
  tilesRot = openmap(meuseRot, fact=2)
  elevRot = projectRaster(nldElev, crs=projection(meuseRot))
  nldCitiesRot = spTransform(nldCities, CRS(projection(meuseRot)))
}
```

Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded datum Unknown_based_on_Bessel_1841_ellipsoid in CRS definition

Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded datum Unknown_based_on_WGS84_ellipsoid in CRS definition

Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded datum Unknown_based_on_WGS84_ellipsoid in CRS definition

Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded datum Unknown_based_on_WGS84_ellipsoid in CRS definition

Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded datum Unknown_based_on_WGS84_ellipsoid in CRS definition

Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded datum Unknown_based_on_WGS84_ellipsoid in CRS definition

Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded datum WGS_1984 in CRS definition

Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded datum WGS_1984 in CRS definition

[illegible]


```

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum WGS_1984 in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum WGS_1984 in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum WGS_1984 in CRS definition
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datum WGS_1984 in CRS definition
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datum WGS_1984 in CRS definition
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datum WGS_1984 in CRS definition
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datum WGS_1984 in CRS definition
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datum WGS_1984 in CRS definition
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datum WGS_1984 in CRS definition
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datum WGS_1984 in CRS definition
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datum WGS_1984 in CRS definition
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datum WGS_1984 in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum WGS_1984 in CRS definition
## Warning in rgdal::rawTransform(projfrom, projto, nrow(xy), xy[, 1], xy[, :
NOT UPDATED FOR PROJ >= 6
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_Bessel_1841_ellipsoid in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition

```



```
## Warning in rgdal::rawTransform(projfrom, projto, nrow(xy), xy[, 1], xy[, 2], :
NOT UPDATED FOR PROJ >= 6
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition
## Warning in rgdal::rawTransform(projection(obj), crs, nrow(xy), xy[, 1], xy[, 2], : NOT
UPDATED FOR PROJ >= 6
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition
## Warning in rgdal::rawTransform(projto_int, projfrom, nrow(xy), xy[, 1], xy[, 2], : NOT
UPDATED FOR PROJ >= 6
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_Bessel_1841_ellipsoid in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_Bessel_1841_ellipsoid in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_Bessel_1841_ellipsoid in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition
## Warning in spTransform(xSP, CRSobj, ...): NULL source CRS comment, falling
back to PROJ string
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition
```

And create new plots

```
# first elevation
map.new(meuseRot)

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition
plot(tilesRot, add=TRUE)

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition
plot(elevRot, add=TRUE, alpha=0.5, col=terrain.colors(8), legend=FALSE)

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition
```

```

points(nldCitiesRot)
text(nldCitiesRot, labels=nldCitiesRot$name, pos=3)

scaleBar(meuseRot, pos="topleft", bg="white")

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition,
## but +towgs84= values preserved
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition,
## but +towgs84= values preserved
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition,
## but +towgs84= values preserved
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition,
## but +towgs84= values preserved
# then data locations
map.new(meuseRot)

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition
plot(tilesRot, add=TRUE)

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition
points(meuseRot, col="red", cex=0.3)

scaleBar(proj4string(meuseRot), bg="white")

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition,
## but +towgs84= values preserved
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition,
## but +towgs84= values preserved
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition,
## but +towgs84= values preserved
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition,
## but +towgs84= values preserved

```

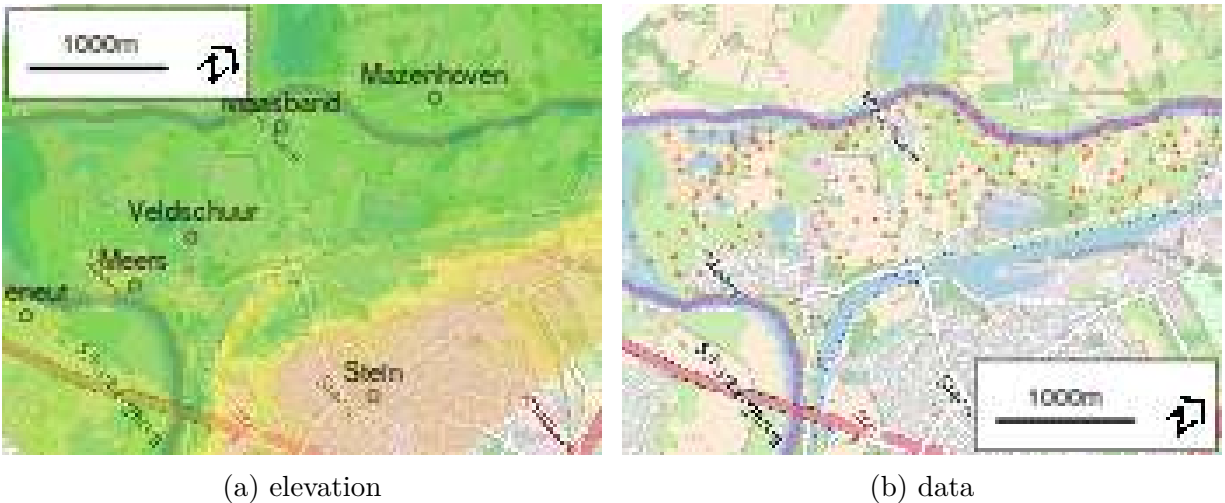


Figure 3: Rotated map

6 Inset maps

```
world = openmap(
    extent=(-10,30,40,60),
    path="osm-no-labels")
```

```
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum WGS_1984 in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum WGS_1984 in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
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datum WGS_1984 in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum WGS_1984 in CRS definition
```

[illegible]

[illegible]

[illegible]


```
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum WGS_1984 in CRS definition
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datum WGS_1984 in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum WGS_1984 in CRS definition
```

```
# not rotated
```

```
map.new(meuse, legendRight=TRUE)
```

```
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_Bessel_1841_ellipsoid in CRS definition
```

```
plot(nldTiles, add=TRUE)
```

```
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_Bessel_1841_ellipsoid in CRS definition
```

```
points(meuse)
```

```
if(requireNamespace('rgdal', quietly=TRUE)) {
  scaleBar(proj4string(meuse), pos="bottomright", bg="white")
  insetMap(crs=meuse, pos="topright", map=world)
}
```

```
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_Bessel_1841_ellipsoid in CRS definition
```

```
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition,
```

```
## but +towgs84= values preserved
```

```
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition,
```

```
## but +towgs84= values preserved
```

```
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition,
```

```
## but +towgs84= values preserved
```



```

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition,
## but +towgs84= values preserved
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_Bessel_1841_ellipsoid in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition,
## but +towgs84= values preserved
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition,
## but +towgs84= values preserved
## Warning in rgdal::rawTransform(projfrom, projto, nrow(xy), xy[, 1], xy[, :
NOT UPDATED FOR PROJ >= 6
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition,
## but +towgs84= values preserved
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition,
## but +towgs84= values preserved
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition,
## but +towgs84= values preserved
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum WGS_1984 in CRS definition
## Warning in rgdal::rawTransform(projfrom, projto, nrow(xy), xy[, 1], xy[, :
NOT UPDATED FOR PROJ >= 6
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum WGS_1984 in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum WGS_1984 in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum WGS_1984 in CRS definition
## Warning in fun(libname, pkgname): rgeos: versions of GEOS runtime 3.8.0-CAPI-1.13.1
## and GEOS at installation 3.7.0-CAPI-1.11.0differ
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum WGS_1984 in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum WGS_1984 in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum WGS_1984 in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum WGS_1984 in CRS definition
# rotated
map.new(meuseRot)

```

```

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition

plot(tilesRot, add=TRUE)

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition

points(meuseRot,col="red", cex=0.3)

if(requireNamespace('rgdal', quietly=TRUE)) {
  scaleBar(proj4string(meuseRot), bg="white")
  insetMap(meuseRot, "bottomleft",map=world)
}

## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition,
## but +towgs84= values preserved
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition,
## but +towgs84= values preserved
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition,
## but +towgs84= values preserved
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition,
## but +towgs84= values preserved
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition,
## but +towgs84= values preserved
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition,
## but +towgs84= values preserved
## Warning in rgdal::rawTransform(projfrom, projto, nrow(xy), xy[, 1], xy[, :
NOT UPDATED FOR PROJ >= 6
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition,
## but +towgs84= values preserved
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition,
## but +towgs84= values preserved

```

```
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum Unknown_based_on_WGS84_ellipsoid in CRS definition,
## but +towgs84= values preserved
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum WGS_1984 in CRS definition
## Warning in rgdal::rawTransform(projfrom, projto, nrow(xy), xy[, 1], xy[, :
NOT UPDATED FOR PROJ >= 6
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum WGS_1984 in CRS definition
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datum WGS_1984 in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum WGS_1984 in CRS definition
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datum WGS_1984 in CRS definition
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datum WGS_1984 in CRS definition
## Warning in showSRID(uprojargs, format = "PROJ", multiline = "NO"): Discarded
datum WGS_1984 in CRS definition
```

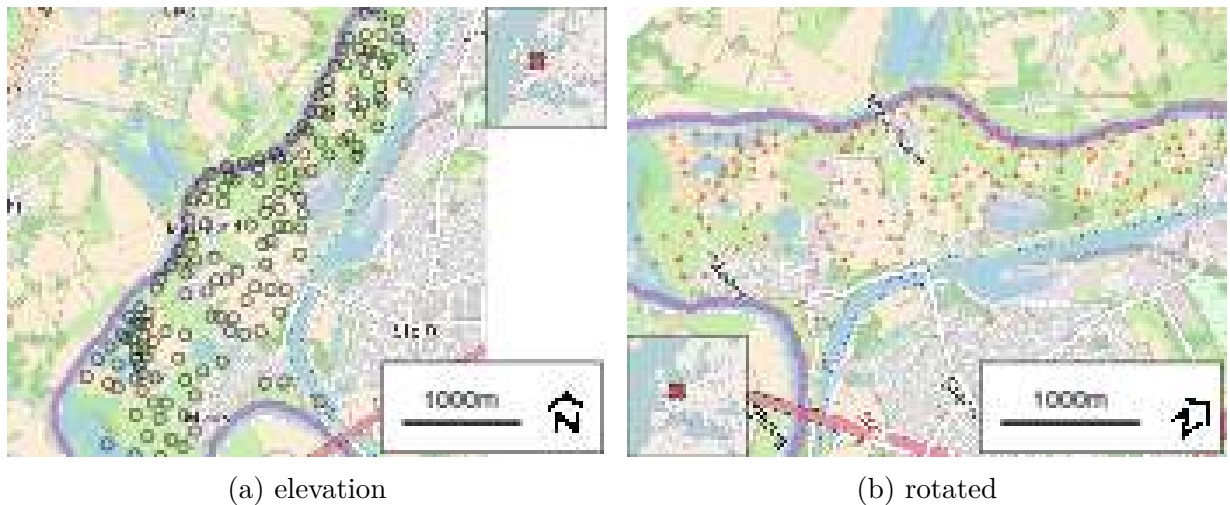


Figure 4: Inset map