Historical Persistence

Applied Economics Research Course

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2023-12-07

Some Common Data Wrangling Operations

Import `.h5` nightlights data

- Some nightlights data is structured as `.h5` data
- These are "layered" raster files that contain a potentially large amount of variables
- I will demonstrate how this works
- Furthermore, I will also show how to *combine* different raster files

Import `.h5` data

- A `.h5` dataset can be imported in the following way:
  - Load the `rhdf5` library:

```
if (!require("BiocManager", quietly = TRUE))
    install.packages("BiocManager")

BiocManager::install("rhdf5")
```

- Extract the metadata, and read where the latitude, longitude data are contained

```
library(rhdf5)
meta ← rhdf5::h5ls('VNP46A4.A2022001.h18v03.001.2023082112129.h5')
lat ← rhdf5::h5read('VNP46A4.A2022001.h18v03.001.2023082112129.h5',
                    name='/HDFEOS/GRIDS/VIIRS_Grid_DNB_2d/Data Fields/lat')
lon ← rhdf5::h5read('VNP46A4.A2022001.h18v03.001.2023082112129.h5',
                    name='/HDFEOS/GRIDS/VIIRS_Grid_DNB_2d/Data Fields/lon')
```

Import `.h5` data

- Then, select one layer of the map you are interested in
  - I also import a shapefile of the Netherlands because I want to pay attention to this part
  - Set the `extent` of a raster to the latitude and longitude data
  - Set the `crs` of a raster to WGS84 (the default projection of the NASA VIIRS data)

```
netherlands ← geodata::gadm("Netherlands", path="./") ▷ st_as_sf()
raster ← terra::rast('VNP46A4.A2022001.h18v03.001.2023082112129.h5') ▷
  terra::subset("AllAngle_Composite_Snow_Covered")

ext(raster) ← c(min(lon), max(lon), min(lat), max(lat))
crs(raster) ← crs('wgs84')
```

Import the `.h5` data

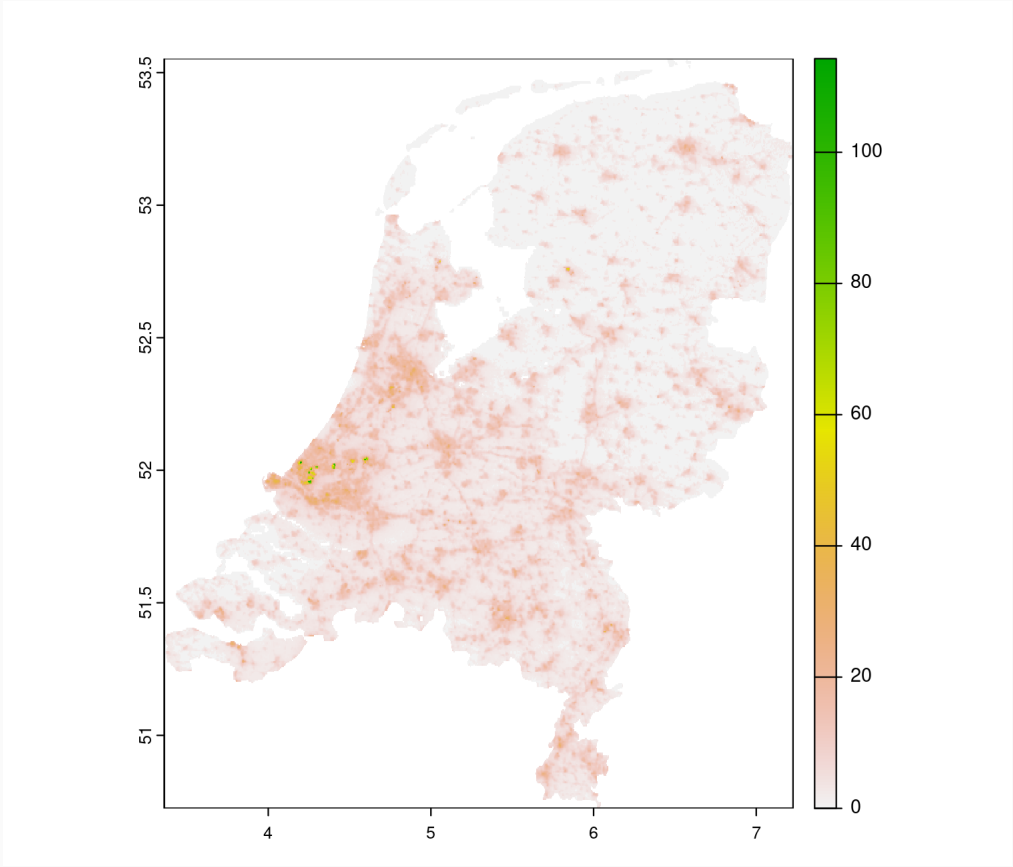
- Now, the data is usable in principle
- However, we do some post-processing:
  - We first mask (confine) the data set to the extent (overlap) with the Netherlands
  - Then we crop it so as to remove unnecessary `NA` data
  - Finally, we filter out the default sea level

```
masked_raster ← terra::mask(raster, netherlands)
netherlands_nightlights ← crop(masked_raster, netherlands)
netherlands_nightlights[netherlands_nightlights == 65535] = NA
```

Plot the outcome

- Finally, we can plot the outcome

```
terra::plot(sqrt(netherlands_nightlights))
```



Combine various raster datasets

- By writing a function, you can also combine several datasets:

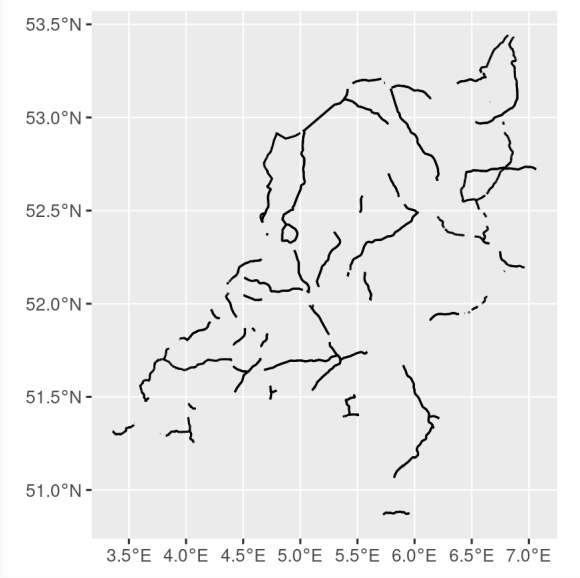
```
combine_and_clean_rasters ← function(directory_with_rasters,
                                     type="AllAngle_Composite_Snow_Covered"){
  # Find all the datasets in the directory
  nms ← list.files(directory_with_rasters, pattern='\\.h5')
  files ← paste0(directory_with_rasters, nms)
  # Pick one type of map
  rasters ← map(files, ~ terra::rast(.x) ▷
                  terra::subset(type))
  # Extract lat, lon
  lat ← map(files, ~ rhdf5::h5read(.x,
                    name='/HDFEOS/GRIDS/VIIRS_Grid_DNB_2d/Data Fields/lat'))
  lon ← map(files, ~ rhdf5::h5read(.x,
                    name='/HDFEOS/GRIDS/VIIRS_Grid_DNB_2d/Data Fields/lon'))
  rasters ← imap(rasters, ~ {
  ext(.x) ← c(min(lon[[.y]]), max(lon[[.y]]), min(lat[[.y]]), max(lat[[.y]]))
  .x  })
  # Convert to correct CRS
  rasters ← map(rasters, ~ { crs(.x) ← crs('wgs84'); .x })
  out ← do.call(terra::mosaic, rasters)
  return(out)
}
```

Road Density

- Now, I show how to combine the `roads` data to construct density

```
netherlands ← geodata::gadm("Netherlands", level=2, path="./") ▷ st_as_sf()
roads ← st_read('./nwb_hoofdwegen.gpkg') ▷ st_transform(crs=crs(netherlands)) ▷
```

```
roads ▷ ggplot() + geom_sf()
```

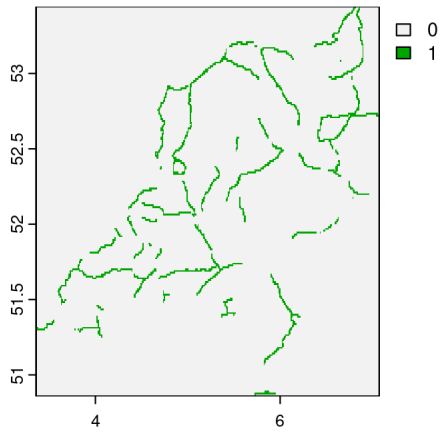


Buffer the roads

- I build a buffer of 10 meters around each road
  - Rasterize it
  - Then set all values where there is a road to 1 (all roads are equal)
- Finally, plot it:

```
roads_buffer ← st_buffer(roads, dist=10)
roads_raster ← st_rasterize(roads_buffer,
                            options = "ALL_TOUCHED=TRUE")

roads_raster[roads_raster > 0] = 1; roads_raster[is.na(roads_raster)] = 0
final_raster ← rast(roads_raster); terra::plot(final_raster)
```



Aggregate the roads to a shapefile

- We already know how to do this - we can use the `extract` function from `terra`

```
values ← terra::extract(final_raster, netherlands)
road_density ← values ▷
  group_by(ID) ▷
  summarize(mean_roads = mean(lyr.1, na.rm=T))
```

- Finally, we merge the road density to the shapefile:

```
nl_roads ← netherlands ▷
  mutate(ID=row_number()) ▷
  left_join(road_density, by="ID")
```

Plot the output

- We end up with a road density per municipality:

```
nl_roads ▷
  ggplot(aes(fill=mean_roads)) +
  geom_sf() +
  scale_fill_viridis_c(option='F')
```