

1 rgugik: Search and Retrieve Spatial Data from the Polish 2 Head Office of Geodesy and Cartography in R

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Software

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
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5 Introduction

6 Currently, the open data market size is estimated at about 185 billion Euros in the European
7 Union and is expected to grow in the coming years ([Huyer & Knippenberg, 2020](#)). It includes
8 spatial data that can  cost savings and create new, innovative products and services for
9 the benefit of the society, environment, and economy. The public sector is one of the primary
10 providers of vast amounts of valuable spatial data resources.

11 [The Head Office of Geodesy and Cartography](#) (*Główny Urząd Geodezji i Kartografii, GUGiK*)
12 is the central government agency responsible for collecting spatial data in Poland. Their
13 resources include various datasets, such as orthophotomaps, register of borders, 3D models
14 of buildings, digital elevation models, and point clouds. Until July 31, 2020, spatial data
15 acquisition was time-consuming, required filling-in forms, and paying a fee. However, the
16 recent amendment of the Geodetic and Cartographic Law in Poland in mid-2020 made all of
17 the current and future spatial datasets publicly available.

18 Poland's spatial data is released on a dedicated website, [Geoportal](#), which allows t  use and
19 download it. The Geoportal is one of the most popular government websites in the country,
20 currently ranked 3rd with 5.5 million unique visits in 2020¹. Although the data is related to
21 Poland's area only, visits from other countries can also be noted (e.g., Germany with 52,000,
22 Great Britain with 40,000, and United States with 15,000 unique visits this year)². In the first
23 month after the change of law, 69 TB of data was downloaded³, and by the end of October,
24 this value grew to over 240 TB⁴.

25 Statement of need

26 While the Geoportal gives access to some of the *GUGiK* data resources, it has several practical
27 disadvantages. Datasets can only be downloaded individually and manually, limiting their
28 practical use for studies over large areas or for many points in time. It is also problematic
29 for the reproducible research process. Additionally, some *GUGiK* data is located on other
30 associated websites or in the form of dedicated services, which makes finding and downloading
31 certain datasets more difficult. Therefore, there is a need to make all *GUGiK* data sources
32 available in one place and to automate the data downloading and preprocessing.

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¹<https://widok.gov.pl/statistics/>

²<https://widok.gov.pl/statistics/geoportal-krajowy/>

³<http://www.gugik.gov.pl/aktualnosci/2021/03.09.2020-sierpniowe-statystyki-pobierania-uwolnionych-danych-przest>

⁴<http://www.gugik.gov.pl/aktualnosci/03.11.2020-statystyka-pobierania-danych-w-pazdzierniku>

33 Summary

34 **rgugik** is an R package (R Core Team, 2020) that attempts to tackle all of the shortcomings
 35 listed above by providing consistent tools for searching and retrieving of spatial data from
 36 *GUGiK*. It integrates multiple data sources (i.e., HTML websites, FTP servers, API services),
 37 allows for data search and download, and gives the ability to create reproducible scripts. In
 38 total, it provided access to ten datasets of various types, such as numeric, vector, and raster
 39 [Table 1].

40 The package contains 15 functions, including three functions dedicated exclusively to digital
 41 terrain models. The functions can be divided into three main groups indicated by their suffixes:

- 42 ▪ `_request()` to obtain metadata and links to the data based on the provided location.
 43 It allows to understand what sort of data is available, select only some of the metadata,
 44 and use the result as an input in the `_download()` functions.
- 45 ▪ `_download()` to download the data files to a hard drive and unzip it.
- 46 ▪ `_get()` to retrieve selected spatial datasets as R object of classes, such as *sf/data.frame*.

47 It is also possible to geocode addresses or objects located in Poland with **rgugik**. Additionally,
 48 the package includes objects containing names of the administrative units and their IDs to
 49 facilitate data retrieval.

Table 1: A list of datasets from *GUGiK* supported by the **rgugik** package.

Polish	English
Ortofotomapa	Orthophotomap
Baza Danych Obiektów Ogólnogeograficznych	General Geographic Database
Baza Danych Obiektów Topograficznych	Topographic Database
Ewidencja Miejscowości, Ulic i Adresów	Register of Towns, Streets and Addresses
Państwowy Rejestr Nazw Geograficznych	State Register of Geographical Names
Państwowy Rejestr Granic	State Register of Borders
Lokalizacja działek katastralnych	Location of cadastral parcels
Modele 3D budynków	3D models of buildings
Cyfrowe modele wysokościowe	Digital elevation models
Chmury punktów	Point clouds

50 **rgugik** uses `jsonlite` (Ooms, 2014) for parsing JSON to R objects and `sf` (Pebesma, 2018)
 51 for processing spatial data in a user-friendly way. The package is released under the MIT open-
 52 source license and can be directly installed from CRAN, or from GitHub using the `remotes`
 53 (Hester et al., 2020) package. This package’s source code is thoroughly tested, with about
 54 [redacted] lines of the code executed using automated tests. The package also has an associated
 55 website at <https://kadyb.github.io/rgugik>, which contains installation instructions and three
 56 articles presenting different use cases of downloading and processing of orthophotomaps, digital
 57 elevation models, and topographic databases.

58 Three other products aimed at downloading data from *GUGiK* were recently developed —
 59 QGIS plugins by the **EnviroSolutions** and by **GIS Support** companies, and a commercial,
 60 general data acquisition purpose product made by **Globema**. However, all of them have certain
 61 limitations and offer a smaller subset of the *GUGiK* datasets compared to **rgugik**. They use
 62 graphical user interfaces, which, while [redacted] user-friendly, [redacted] make it more laborious to
 63 download many files and use the data in reproducible workflows. Moreover, the QGIS plugins
 64 are in Polish, restricting potential users to Polish speakers only.

65 **Example usage**

```
library(rgugik)
library(sf)
library(raster)
polygon = read_sf("search_area.gpkg")
```

66 The first example shows a search for available digital elevation models based on the input
67 polygon and downloading a selected digital terrain model [Figure 1]. The `DEM_request()`
68 function uses a dedicated API. As a result, a *data.frame* with available data and their metadata
69 is returned. The output *data.frame* can be easily filtered and used to download the desired
70 data from FTP.

```
# downloading a metadata of available digital elevation models
req_df = DEM_request(polygon)

# printing metadata
t(req_df)
#> sheetID      "M-33-58-A-d-1-1"
#> year         "2011"
#> format       "ARC/INFO ASCII GRID"
#> resolution   "1"
#> avgElevErr   "0.15"
#> CRS          "PL-1992"
#> VRS          "PL-KRON86-NH"
#> filename     "3982_154755_M-33-58-A-d-1-1"
#> product      "DTM"

# downloading DTM
tile_download(req_df)

# plotting the results
DTM = raster("3982_154755_M-33-58-A-d-1-1.asc")
plot(DTM)
```

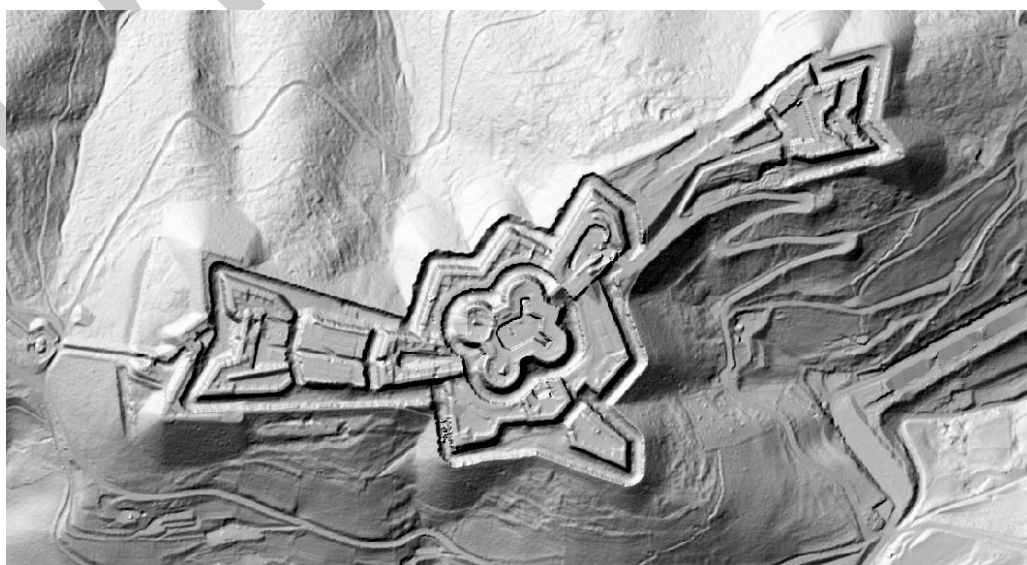


Figure 1: Fort Srebrna Góra (a mountain fortress hidden in the forest).

71 The second example presents how to get geometries of the highest-level administrative division
72 of Poland (voivodeships) [Figure 2]. The names of administrative units can be obtained
73 from the `voivodeship_names` object stored in the package. As a result, an object of class
74 `sf/data.frame` is returned.

```
# extracting names of voivodeships
voivodeships = voivodeship_names$NAME_PL

# downloading the data as sf object
voivodeships_geom = borders_get(voivodeships)

# plotting the results
plot(st_geometry(voivodeships_geom))
```



Figure 2: Voivodeships in Poland.

75 The third example shows the process of converting place names to spatial coordinates (geocod-
76 ing) [Table 2]. As a result, an object of class `sf/data.frame` is returned.

```
# geocoding of a provided name or address
geocodePL_get(address = "Dąbrowa")
```

Table 2: Geocoding results for the city of *Dąbrowa*.

city	teryt	voivodeship	county	commune	geometry_wkt
Dąbrowa	021302	dolnośląskie	milicki	Krośnice	c(387236.148, 403862.917)
Dąbrowa	061002	lubelskie	łęczyński	Ludwin	c(770342.296, 393839.750)
Dąbrowa	101709	łódzkie	wieluński	Wieluń	c(467414.612, 374431.514)
Dąbrowa	160402	opolskie	kluczborski	Kluczbork	c(445709.237, 351749.657)

77 References

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- ⁸⁶ Pebesma, E. (2018). Simple Features for R: Standardized Support for Spatial Vector Data.
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- ⁸⁸ R Core Team. (2020). *R: A language and environment for statistical computing*. R Foundation
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