Package 'geodata'

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Description Functions for downloading of geographic data for use in spatial analysis and mapping. The package facilitates access to climate, crops, elevation, land use, soil, species occurrence, accessibility, administrative boundaries and other data.

License GPL (>= 3)

BugReports https://github.com/rspatial/geodata/issues/

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R topics documented:

`geodata-package` *Download Geographic Data*

Description

Functions for downloading of geographic data for use in spatial analysis and mapping. The package facilitates access to climate, crops, elevation, land use, soil, species occurrence, accessibility, administrative boundaries and other data.

Function	Description
`bio_oracle`	Marine data from bio-oracle
`cmip6_world`	Downscaled and calibrated CMIP6 projected future climate data
`cmip6_tile`	Downscaled and calibrated CMIP6 data by tile
`country_codes`	Country codes
`crop_calendar_sacks`	Sachs crop calendar data
`crop_monfreda`	Monfreda crop data (area, yield)
`crop_spam`	SPAM crop data (area, yield, value)
`cropland`	Cropland density for the world from three sources
`elevation_3s`	Elevation data for tile (3 seconds resolution)
`elevation_30s`	Elevation data for by country (30 seconds resolution)
`elevation_global`	Global elevation data (various resolutions)
`gadm`	Administrative boundaries for any country in the world
`world`	Boundaries for the countries in the world
`landcover`	Global landcover data
`footprint`	Human footprint data
`osm`	OpenStreetMap data by country
`population`	Download population density data
`soil_af`	Chemical and physical soil properties data for Africa for different soil depths
`soil_af_water`	Physical soil properties for Africa for water balance computations
`soil_af_elements`	Soil element concentration data for Africa

soil_af_isda	Soil data for Africa derived from the iDSA data set
soil_world_vsi	Virtually connect to the global soilgrids data
soil_world	Global soils data
sp_occurrence	Species occurrence data from the Global Biodiversity Information Facility
travel_time	Travel time to cities and ports
worldclim_global	Global climate data
worldclim_country	Climate data by country
worldclim_tile	Climate data by tile

`bio_oracle` *Marine data*

Description

Marine data from Bio-Oracle

Usage

```
bio_oracle(path, var, stat, benthic=FALSE, depth="Mean", time="Present", rcp, ...)
```

Arguments

path	character. Path for storing the downloaded data. See geodata_path
var	character. Variable of interest. One of 'Calcite', 'Chlorophyll', 'Cloud.cover', 'Current.Velocity', 'Diffuse.attenuation', 'Dissolved.oxygen', 'Ice.cover', 'Ice.thickness', 'Iron', 'Light.bottom', 'Nitrate', 'Par', 'pH', 'Phosphate', 'Phytoplankton', 'Primary.productivity', 'Salinity', 'Silicate', 'Temperature'
stat	character. Statistic of interest. One of 'Lt.max', 'Lt.min', 'Max', 'Mean', 'Min', 'Range'. It should be "" if var is "pH"
benthic	logical. If FALSE surface data are returned
depth	character. Either "Min", "Mean", or "Max". Only relevant if benthic is TRUE
time	character. Either "Present", "2150" or "2100"
rcp	character. Either "26", "45", "60", or "85"
...	additional arguments passed to download.file

Value

SpatRaster

References

Assis, J., Tyberghein, L., Bosh, S., Verbruggen, H., Serrão, E.A., & De Clerck, O. (2017). Bio-ORACLE v2.0: Extending marine data layers for bioclimatic modelling. Global Ecology and Biogeography 27: 277-284.

See Also

https://bio-oracle.org/

Examples

```
x <- bio_oracle(path=tempdir(), "Salinity", "Max", benthic=TRUE, depth="Mean", time="Present")

y <- bio_oracle(path=tempdir(), "Temperature", "Mean", benthic=FALSE, time=2100, rcp=45)
```

---

cmip6 *CMIP6 climate model data*

Description

Download downscaled and calibrated CMIP6 climate data for projected future climates. Either for the entire world or for a 30 degrees tile. For more information see https://www.worldclim.org/

Usage

```
cmip6_world(model, ssp, time, var, res, path, ...)

cmip6_tile(lon, lat, model, ssp, time, var, path, ...)
```

Arguments

model	character. Climate model abbrevation. One of "ACCESS-CM2", "ACCESS-ESM1-5", "AWI-CM-1-1-MR", "BCC-CSM2-MR", "CanESM5", "CanESM5-CanOE", "CMCC-ESM2", "CNRM-CM6-1", "CNRM-CM6-1-HR", "CNRM-ESM2-1", "EC-Earth3-Veg", "EC-Earth3-Veg-LR", "FIO-ESM-2-0", "GFDL-ESM4", "GISS-E2-1-G", "GISS-E2-1-H", "HadGEM3-GC31-LL", "INM-CM4-8", "INM-CM5-0", "IPSL-CM6A-LR", "MIROC-ES2L", "MIROC6", "MPI-ESM1-2-HR", "MPI-ESM1-2-LR", "MRI-ESM2-0", "UKESM1-0-LL"
ssp	character. A valid Shared Socio-economic Pathway code: "126", "245", "370" or "585".
time	character. A valid time period. One of "2021-2040", "2041-2060", or "2061-2080"
var	character. Valid variables names are "tmin", "tmax", "tavg", "prec" and "bioc"
res	numeric. Valid resolutions are 10, 5, 2.5 (minutes of a degree)
path	character. Path for storing the downloaded data. See geodata_path
...	additional arguments passed to download.file
lon	numeric. Longitude
lat	numeric. Latitude

Value

SpatRaster

See Also

vrt to combine tiles

Examples

```
bio10 <- cmip6_world("CNRM-CM6-1", "585", "2061-2080", var="bioc", res=10, path=tempdir())
```

---

country_codes *Get country codes*

Description

Get country codes for all countries in the world.

Usage

```
country_codes(query=NULL)
```

Arguments

query	character. A single word that can be used to subset the returned data.frame

Value

data.frame

Examples

```
cc <- country_codes()
head(cc)

p <- country_codes(query="Per")
p
```

cropland *Cropland distribution data*

Description

Cropland distribution data at a 30-seconds spatial resolution from three sources:

`worldcover` is derived from the ESA WorldCover data set at 0.3-seconds resolution. (License CC BY 4.0), see https://esa-worldcover.org/en. Values were aggregated and represent the fraction cropland in each cell.

`glad` is derived from the "Global cropland expansion in the 21st century" (Potatov et al) data available here. Values were aggregated and resampled. They represent the fraction cropland in each cell. There are five layers representing the following years: 2003, 2007, 2011, 2015, and 2019.

`QED` has cropland distribution data for Africa. The values are probabilities of cropland presence estimated with a neural network that was trained on an initial 1-million point Geosurvey conducted in 2015. License: CC-BY-SA 4.0; https://about.maps.qed.ai/

Usage

```
cropland(source, path, year, ...)
```

Arguments

`source`	character. One of "WorldCover", "GLAD", or "QED"
`path`	character. Path for storing the downloaded data. See `geodata_path`
`year`	numeric. Optional for the GLAD dataset to get data for a single year. One of 2003, 2007, 2011, 2015, and 2019
`...`	additional arguments passed to `download.file`

Value

SpatRaster

References

WorldCover: Zanaga, D., Van De Kerchove, R., De Keersmaecker, W., Souverijns, N., Brockmann, C., Quast, R., Wevers, J., Grosu, A., Paccini, A., Vergnaud, S., Cartus, O., Santoro, M., Fritz, S., Georgieva, I., Lesiv, M., Carter, S., Herold, M., Li, Linlin, Tsendbazar, N.E., Ramoino, F., Arino, O., 2021. ESA WorldCover 10 m 2020 v100. doi:10.5281/zenodo.5571936.

GLAD: Potapov, P., S. Turubanova, M.C. Hansen, A. Tyukavina, V. Zalles, A. Khan, X.-P. Song, A. Pickens, Q. Shen, J. Cortez, 2021. Global maps of cropland extent and change show accelerated cropland expansion in the twenty-first century. Nature Food. doi:10.1038/s43016-021-00429-z

See Also

`landcover`

Examples

```
#x <- cropland("WorldCover", path=tempdir())
```

`crop_calendar_sacks` *Sacks crop calendar data*

Description

Download Sacks crop calendar data. The crops available are returned by `sacksCrops`

Usage

```
crop_calendar_sacks(crop="", path, ...)

sacksCrops()
```

Arguments

`crop`	character. Crop name. See `sacksCrops` for valid names
`path`	character. Path for storing the downloaded data. See `geodata_path`
`...`	additional arguments passed to `download.file`

Value

SpatRaster

References

Sacks, W.J., D. Deryng, J.A. Foley, and N. Ramankutty, 2010. Crop planting dates: an analysis of global patterns. Global Ecology and Biogeography 19: 607-620. doi:10.1111/j.1466-8238.2010.00551.x.

See Also

https://sage.nelson.wisc.edu/data-and-models/datasets/crop-calendar-dataset/

Examples

```
cas <- crop_calendar_sacks("cassava", path=tempdir())
```

`crop_monfreda` *Monfreda crop data*

Description

Monfreda global crop data (area, yield) for 175 crops.

Data may be freely used for research, study, or teaching, but must be cited appropriately (see below). Re-release of the data, or incorporation of the data into a commercial product, is allowed only with explicit permission.

Usage

```
monfredaCrops()
crop_monfreda(crop="", var="area_ha", path, ...)
```

Arguments

`crop`	character. Crop name(s). See `monfredaCrops` for valid names
`var`	character. The variable(s) of interest. Choose from "area_ha" (crop area in ha per cell), "area_f" (crop area as a fraction of each cell), "area_q" (quality of the crop area data), "yield" (crop yield in Mg/ha), "yield_q" (quality of the yield data), "prod" (production per grid cell in Mg), or "all"
`path`	character. Path for storing the downloaded data. See `geodata_path`
`...`	additional arguments passed to `download.file`

Value

SpatRaster

References

Monfreda, C., N. Ramankutty, and J. A. Foley (2008), Farming the planet: 2. Geographic distribution of crop areas, yields, physiological types, and net primary production in the year 2000, Global Biogeochem. Cycles, 22, GB1022, doi:10.1029/2007GB002947.

See Also

http://www.earthstat.org/harvested-area-yield-175-crops/

Examples

```
mcas <- crop_monfreda("cassava", path=tempdir())
mcas
names(mcas)
```

`crop_spam` *SPAM crop data*

Description

SPAM crop data

Usage

```
spamCrops()
crop_spam(crop="", var="area", path, africa=FALSE, ...)
```

Arguments

`crop`	character. See `spamCrops` for valid names
`var`	character. variable of interest. Must be one of "yield", "harv_area" (harvested area), "phys_area" (physical area), "prod" (production) or "val_prod" (value of production)
`path`	character. Path for storing the downloaded data. See `geodata_path`
`africa`	logical. retrieve the (updated) data for Africa instead of global data
`...`	additional arguments passed to `download.file`

Value

SpatRaster

References

International Food Policy Research Institute, 2020. Spatially-Disaggregated Crop Production Statistics Data in Africa South of the Sahara for 2017. https://doi.org/10.7910/DVN/FSSKBW, Harvard Dataverse, V2

See Also

https://www.mapspam.info/data/

Examples

```
cas <- crop_spam("cassava", "area", path=tempdir(), TRUE)
```

`elevation` *Elevation*

Description

Get elevation data for any country in the world. The main data source is Shuttle Radar Topography Mission (SRTM) , specifically the hole-filled CGIAR-SRTM (90 m resolution) from https://srtm.csi.cgiar.org/. These data are only available for latitudes between -60 and 60.

The 1 km (30 arc seconds) data were aggregated from SRTM 90 m resolution data and supplemented with the GTOP30 data for high latitudes (>60 degrees).

Usage

```
elevation_3s(lon, lat, path, ...)
elevation_30s(country, path, mask=TRUE, subs="", ...)
elevation_global(res, path, ...)
```

Arguments

`lon`	numeric. Longitude
`lat`	numeric. Latitude
`path`	character. Path for storing the downloaded data. See `geodata_path`
`country`	character. Country name or code
`mask`	logical. set grid cells outside of the country boundaries to NA
`subs`	character
`res`	numeric. Valid resolutions are 10, 5, 2.5, and 0.5 (minutes of a degree)
`...`	additional arguments passed to `download.file`

Value

SpatRaster

Examples

```
## Not run:
elevation_30s(country="FRA", path=tempdir() )

## End(Not run)
```

`footprint` *Human footprint*

Description

The "human footprint" is an estimate of the direct and indirect human pressures on the environment. The human pressure is measured using eight variables including built-up environments, population density, electric power infrastructure, crop lands, pasture lands, roads, railways, and navigable waterways. It is expressed on a scale of 0 (low) to 50 (high footprint). See https://www.nature.com/articles/sdata201667 for the details. And the original data is available here: https://sedac.ciesin.columbia.edu/data/collection/wildareas-v3

Data are available for two years: 1993 and 2009, for all terrestrial areas except Antarctica. The footprint of seas and oceans was set to zero. The original data was in the Mollweide projection at a 1000 m spatial resolution. The data available through this function was transformed to a longitude/latitude grid at 30-seconds resolution.

Usage

```
footprint(year=2009, path, ...)
```

Arguments

`year`	character. "1993" or "2009"
`path`	character. Path for storing the downloaded data. See `geodata_path`
`...`	additional arguments passed to `download.file`

Value

SpatRaster

References

Venter, O., E. W. Sanderson, A. Magrach, J. R. Allan, J. Beher, K. R. Jones, H. P. Possingham, W. F. Laurance, P. Wood, B. M. Fekete, M. A. Levy, and J. E. Watson. 2016. Sixteen Years of Change in the Global Terrestrial Human Footprint and Implications for Biodiversity Conservation. Nature Communications 7:12558. https://doi.org/10.1038/ncomms12558.

See Also

`landcover`

gadm *Administrative boundaries*

Description

Get administrative boundaries for any country in the world. Data are read from files that are downloaded if necessary.

Usage

```
gadm(country, level=1, path, version="latest", resolution=1, ...)
```

Arguments

country	character. Three-letter ISO code or full country name. If you provide multiple names they are all downloaded and rbind-ed together
level	numeric. The level of administrative subdivision requested. (starting with 0 for country, then 1 for the first level of subdivision)
path	character. Path for storing the downloaded data. See geodata_path
version	character. Either "latest" or GADM version number (can be "3.6", "4.0" or "4.1")
resolution	integer indicating the level of detail. Only for version 4.1. It should be either 1 (high) or 2 (low)
...	additional arguments passed to download.file

Details

The data are from https://gadm.org

Value

SpatVector

See Also

world

Examples

```
fra <- gadm(country="FRA", level=1, path=tempdir())
```

geodata_path *Set the data path*

Description

This function allows you set or get the default download path for the geodata package. By setting this path you can avoid downloading the same data many times over. This also guards against service interruptions.

The default path is ignored if you use the path variable in a function.

To save the default path across sessions, you can add a line like this `options(geodata_default_path="c:/your/geodata/p` to the file returned by this command `file.path(R.home(), "etc/Rprofile.site")`

Usage

```
geodata_path(path)
```

Arguments

`path`	character. Path name where the data should be downloaded to. If missing, the current default path is returned

Value

character

Examples

```
geodata_path()
```

landcover *Landcover data*

Description

Landcover data at 30-seconds spatial resolution for (most of) the world. Values are the fraction of a landcover class in each cell. The values are derived from the ESA WorldCover data set at 0.3-seconds resolution. (License CC BY 4.0). See https://esa-worldcover.org/en for more information.

Usage

```
landcover(var, path, ...)
```

Arguments

var	character. One of "trees", "grassland", "shrubs", "cropland", "built", "bare", "snow", "water", "wetland", "mangroves", "moss"
path	character. Path for storing the downloaded data. See geodata_path
...	additional arguments passed to download.file

Value

SpatRaster

References

Zanaga, D., Van De Kerchove, R., De Keersmaecker, W., Souverijns, N., Brockmann, C., Quast, R., Wevers, J., Grosu, A., Paccini, A., Vergnaud, S., Cartus, O., Santoro, M., Fritz, S., Georgieva, I., Lesiv, M., Carter, S., Herold, M., Li, Linlin, Tsendbazar, N.E., Ramoino, F., Arino, O., 2021. ESA WorldCover 10 m 2020 v100. doi:10.5281/zenodo.5571936.

See Also

landcover

---

osm *OpenStreetMap data*

Description

Get OpenStreetMap (OSM) data

Usage

```
osm(country, var, path, proxy=FALSE, ...)
```

Arguments

country	character. Three-letter ISO code or full country name
var	character. Currently it can be one of "places", "highways", or "railway"
path	character. Path for storing the downloaded data. See geodata_path
proxy	logical. Return a SpatVectorProxy?
...	additional arguments passed to download.file

Details

tbd

License: Open Data Commons Open Database License (ODbL). See https://www.openstreetmap.org/copyright

Value

SpatVector

Examples

```
aruba <- osm(country="Aruba", "places", path=tempdir())
```

`population` *population density*

Description

Download population density data.

Source: Gridded Population of the World (GPW), v4 Documentation: http://sedac.ciesin.columbia.edu/data/collection/gpw-v4/documentation

Usage

```
population(year, res, path, ...)
```

Arguments

`year`	numeric. One of 2000, 2005, 2010, 2015, 2020
`res`	numeric. Valid resolutions are 10, 5, 2.5, and 0.5 (minutes of a degree)
`path`	character. Path for storing the downloaded data. See `geodata_path`
`...`	additional arguments passed to `download.file`

Value

SpatRaster

References

Center for International Earth Science Information Network - CIESIN - Columbia University. 2018. Gridded Population of the World, Version 4 (GPWv4): Population Density, Revision 11. Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC). doi:10.7927/H49C6VHW. Accessed 6 July 2021.

Examples

```
pop <- population(2020, 10, path=tempdir())
```

rice_calendar *crop calendar for rice*

Description

Get crop calendar and production data for rice

Usage

```
rice_calendar(path, ...)
```

Arguments

path	character. Path for storing the downloaded data. See geodata_path
...	additional arguments passed to download.file

Value

SpatVectorCollection

References

Laborte, A.G.; Gutierrez, M.A.; Balanza, J.G.; Saito, K.; Zwart, S.J.; Boschetti, M.; Murty, MVR; Villano, L.; Aunario, J.K.; Reinke, R.; Koo, J.; Hijmans, R.J.; Nelson, A., 2017. RiceAtlas, a spatial database of global rice calendars and production. Scientific Data 4: 170074. https://doi.org/10.1038/sdata.2017.74

Examples

```
rice <- rice_calendar(path=tempdir())
cal <- rice[1]
```

soil_af *Soil data for Africa*

Description

Download chemical soil properties data for Africa for different soil depths. The spatial resolution is 30 arc-seconds (about 1 km2), aggregated from the original 250m resolution.

There are more recent estimations for some of the properties available in other data sets. See soil_af_isda and soil_world.

For more info, see https://www.isric.org/projects/soil-property-maps-africa-250-m-resolution

The data have a CC-BY 4.0 NC license

Usage

```
soil_af(var, depth, path, ...)
```

Arguments

var	character. Variables name such as "pH" or "clay". See Details
depth	numeric. One of 5, 15, 30, 60, 100, 200. This is shorthand for the following depth ranges: 0-5, 5-15, 15-30, 30-60, 60-100, 100-200 cm. Or one of 20, 50 for 0-20 or 20-50 cm
path	character. Path for storing the downloaded data. See geodata_path
...	additional arguments passed to download.file

Details

var	description	unit
clay	Soil texture fraction clay	%
sand	Soil texture fraction sand	%
silt	Soil texture fraction silt	%
coarse	Coarse fragments volumetric	%
SOC	Organic carbon	$g \cdot kg^{-1}$ (%■)
BLKD	Bulk density (fine earth)	$kg \cdot m^{-3}$
poros	Porosity (volum. fraction) based on PTF	-
AWpF2.0	Avail. soil water capacity (volum. frac.) for FC = pF 2.0	-
AWpF2.3	Avail. soil water capacity (volum. frac.) for FC = pF 2.3	-
AWpF2.5	Avail. soil water capacity (volum. fract.) for FC = pF 2.4	-
AWpF4.2	Avail. soil water capacity (volum. fract.) at wilting point (pF 4.2)	-
BDR	Depth to bedrock	cm
.	.	.
pH	pH (H_2O)	-
ECN	Electrical conductivity	mS/m (?)
acid-exch	Exchangeable acidity	$cmol(+) \cdot kg^{-1}$
bases-exch	Sum of exchangeable bases	$cmol(+) \cdot kg^{-1}$
CEC	Cation Exchange Capacity	$cmol(+) \cdot kg^{-1}$
Al-extr	Extractable Aluminum (Mehlich 3)	$mg \cdot kg^{-1}$ (ppm)
Al-exch	Exchangeable Aluminum	$cmol(+) \cdot kg^{-1}$
Ca-exch	Exchangeable Calcium	$cmol(+) \cdot kg^{-1}$
K-exch	Exchangeable Potassium	$cmol(+) \cdot kg^{-1}$
Mg-exch	Exchangeable Magnesium	$cmol(+) \cdot kg^{-1}$
Na-exch	Exchangeable Sodium	$cmol(+) \cdot kg^{-1}$
Ntot	Total nitrogen	$g \cdot kg^{-1}$

Value

SpatRaster

References

Hengl T, Heuvelink GBM, Kempen B, Leenaars JGB, Walsh MG, Shepherd KD, et al. (2015) Mapping Soil Properties of Africa at 250 m Resolution: Random Forests Significantly Improve Current Predictions. PLoS ONE 10(6): e0125814. doi:10.1371/journal.pone.0125814

See Also

soil_af_elements, soil_af_isda, soil_world_vsi

Examples

```
aph <- soil_af(var="ph", depth=5, path=tempdir())
```

---

soil_af_elements *Soil elements data for Africa*

Description

Connect to or download chemical soil element concentration (for the 0-30 cm topsoil) data for Africa. The spatial resolution is 30 arc-seconds (about 1 km2), aggregated from the original 250 m spatial resolution.

The data have an Open Data Commons Open Database License (ODbL)

For more information, see https://www.isric.org/projects/soil-property-maps-africa-250-m-resolution

Usage

```
soil_af_elements(var, path, ...)
```

Arguments

var	character. Variables name. One of: "Al", "B", "Ca", "Cu", "Fe", "K", "Mg", "Mn", "N", "Na", "P", "Ptot", "Zn". See Details
path	character. Path for storing the downloaded data. See geodata_path
...	additional arguments passed to download.file

Details

var	description	unit
Al	Extractable aluminum	$mg \cdot kg^{-1}$ (ppm)
B	Extractable boron	$mg \cdot kg^{-1}$ (ppm)
Ca	Extractable calcium	$mg \cdot kg^{-1}$ (ppm)
Cu	Extractable copper	$mg \cdot kg^{-1}$ (ppm)
Fe	Extractable iron	$mg \cdot kg^{-1}$ (ppm)
K	Extractable potassium	$mg \cdot kg^{-1}$ (ppm)

Mg	Extractable magnesium	$mg \cdot kg^{-1}$ (ppm)
Mn	Extractable manganese	$mg \cdot kg^{-1}$ (ppm)
N	Organic nitrogen	$mg \cdot kg^{-1}$ (ppm)
Na	Extractable sodium	$mg \cdot kg^{-1}$ (ppm)
P	Extractable phosphorus	$mg \cdot (100 \cdot kg^{-1})$
Ptot	Total phosphorus	$mg \cdot (100 \cdot kg^{-1})$
Zn	Extractable zinc	$mg \cdot kg^{-1}$ (ppm)

Value

SpatRaster

References

Hengl T, Heuvelink GBM, Kempen B, Leenaars JGB, Walsh MG, Shepherd KD, et al. (2015) Mapping Soil Properties of Africa at 250 m Resolution: Random Forests Significantly Improve Current Predictions. PLoS ONE 10(6): e0125814. doi:10.1371/journal.pone.0125814

See Also

soil_af, soil_af_isda, soil_world

Examples

```
fe <- soil_af_elements("Fe", path=tempdir(), quiet=TRUE)
```

---

soil_af_isda *iSDA soil data for Africa*

Description

Download soil data for Africa derived from the iDSA data set. The original data were aligned and aggregated to 30 arc-seconds (about 1 km2). The original spatial resolution was 30m.

For more info see:

https://envirometrix.nl/isdasoil-open-soil-data-for-africa/

https://zenodo.org/search?page=1&size=20&q=iSDAsoil

Usage

```
soil_af_isda(var, depth=20, error=FALSE, path, virtual=FALSE, ...)
```

Arguments

var	character. The variables name, one of: "Al", "bdr", "clay", "C.tot", "Ca", "db.od", "eCEC.f", "Fe", "K", "Mg", "N.tot", "oc", "P", "pH.H2O", "sand", "silt", "S", "texture", "wpg2", "Zn".see Details
depth	numeric. One of 20 (for 0-20 cm) and 50 (for 20-50 cm). Ignored if var="bdr" for which the depth is always 0-200 cm
error	logical. If TRUE the error estimates are returned
path	character. Path for storing the downloaded data. See geodata_path
virtual	logical. If TRUE a virtual connection to the file is returned. This is useful if you want to extract a small area without downloading the entire raster
...	additional arguments passed to download.file

Details

var	description	unit
Al	extractable aluminum	$mg \cdot kg^{-1}$
bdr	bed rock depth	cm
clay	clay content	$\%$
C.tot	total carbon	kg^{-1}
Ca	extractable calcium	$mg \cdot kg^{-1}$
db.od	bulk density	$kg \cdot m^3$
eCEC.f	effective cation exchange capacity	$cmol(+)\dot{k}g^{-1}$
Fe	extractable iron	$mg \cdot kg^{-1}$
K	extractable potassium	$mg \cdot kg^{-1}$
Mg	extractable magnesium	$mg \cdot kg^{-1}$
N.tot	total organic nitrogen	$g \cdot kg^{-1}$
OC	Organic Carbon	$g \cdot kg^{-1}$
P	Phosphorus content	$mg \cdot kg^{-1}$
pH.H2O	pH (H_2O)	-
sand	Sand content	$\%$
silt	Silt content	$\%$
S	Extractable sulfer	$mg \cdot kg^{-1}$
texture	texture class	-
wpg2	stone content	$\%$
Zn	Extractable zinc	$mg \cdot kg^{-1}$

Value

SpatRaster

References

Tomislav Hengl, Matthew A. E. Miller, Josip Križan, Keith D. Shepherd, Andrew Sila, Milan Kilibarda, Ognjen Antonijevic, Luka Glušica, Achim Dobermann, Stephan M. Haefele, Steve P. McGrath, Gifty E. Acquah, Jamie Collinson, Leandro Parente, Mohammadreza Sheykhmousa, Kazuki Saito, Jean-Martial Johnson, Jordan Chamberlin, Francis B. T. Silatsa, Martin Yemefack, John Wendt, Robert A. MacMillan, Ichsani Wheeler & Jonathan Crouch, 2021. African soil properties and nutrients mapped at 30 m spatial resolution using two-scale ensemble machine learning. Scientific Reports 11: 6130.

See Also

soil_af_elements, soil_af, soil_world

Examples

```
afph <- soil_af_isda("ph.h2o", path=tempdir(), quiet=TRUE)
```

---

soil_af_water *Soil data for water balance computation (Africa only)*

Description

Download physical soil properties data for Africa that can be used in water balance computation. The values are for a soil depth of 0 to 30 cm. The spatial resolution is 30 arc-seconds (about 1 km2), aggregated from the original 250m resolution.

For other properties see soil_af, soil_af_elements, soil_af_isda.

For more info, see https://www.isric.org/projects/soil-property-maps-africa-250-m-resolution

The data have a CC-BY 4.0 NC license

Usage

```
soil_af_water(var, depth = "30cm", path, ...)
```

Arguments

var	character. Variables name such as "awcpf23" or "pwp". See Details
depth	character. Either "30cm" or "erzd" (the effective rooting zone depth of maize)
path	character. Path for storing the downloaded data. See geodata_path
...	additional arguments passed to download.file

Details

var	description	unit
awcpf23	Available water capacity of the fine earth with field capacity defined at pF 2.3	volumetric %
pwp	Moisture content of the fine earth at permanent wilting point, with PWP defined at pF 4.2	volumetric %
tetas	Moisture content of the fine earth at saturation	volumetric %
tawcpf23	Absolute total available water capacity	cm?
tawcpf23mm	Absolute total available water capacity in mm	mm
erzd	Effective root zone depth (for maize)	cm

Value

SpatRaster

See Also

soil_af_elements, soil_af_isda, soil_world

Examples

```
tetaS <- soil_af_water(var="tetas", depth="erzd", path=tempdir())
```

---

soil_world *Global soil data*

Description

Download global soils data. The data are derived from the SoilGRIDS database. The data were aggregated and transformed to a longitude/latitude coordinate reference system with 30-second spatial resolution.

See https://www.isric.org/explore/soilgrids for more info.

data license: CC-BY 4.0

Usage

```
soil_world(var, depth, stat="mean", name="", path, ...)
```

Arguments

var	character. Variables name. One of: "bdod", "cfvo", "clay", "nitrogen", "ocd", "ocs", "phh2o", "sand", "silt", "soc", "wrb". See Details
depth	numeric. One of 5, 15, 30, 60, 100, 200. This is shorthand for the following depth ranges: 0-5, 5-15, 15-30, 30-60, 60-100, 100-200 cm. Ignored if var="wrb"
stat	character. One of "mean", "uncertainty", "Q0.05", "Q0.5", "Q0.95". Ignored if var="wrb"
name	character. One of "Acrisols", "Albeluvisols", "Alisols", "Andosols", "Arenosols", "Calcisols", "Cambisols", "Chernozems", "Cryosols", "Durisols", "Ferralsols", "Fluvisols", "Gleysols", "Gypsisols", "Histosols", "Kastanozems", "Leptosols", "Lixisols", "Luvisols", "Nitisols", "Phaeozems", "Planosols", "Plinthosols", "Podzols", "Regosols", "Solonchaks", "Solonetz", "Stagnosols", "Umbrisols", "Vertisols". Only used when var="wrb"
path	character. Path for storing the downloaded data. See geodata_path
...	additional arguments passed to download.file

Details

var	description	unit
bdod	Bulk density of the fine earth fraction	$kg \cdot dm^{-3}$
cec	Cation Exchange Capacity of the soil	$cmol(+)\dot{k}g^{-1}$
cfvo	Vol. fraction of coarse fragments (> 2 mm)	%
nitrogen	Total nitrogen (N)	$g \cdot kg^{-1}$
phh2o	pH (H_2O)	-
sand	Sand (> 0.05 mm) in fine earth	%
silt	Silt (0.002-0.05 mm) in fine earth	%
clay	Clay (< 0.002 mm) in fine earth	%
soc	Soil organic carbon in fine earth	$g \cdot kg^{-1}$
ocd	Organic carbon density	$kg \cdot m^{-3}$
ocs	Organic carbon stocks	$kg \cdot m^{-2}$

Value

SpatRaster

References

Poggio L., de Sousa L.M., Batjes N.H., Heuvelink G.B.M., Kempen B., Ribeiro E., Rossiter D., 2021. SoilGrids 2.0: producing soil information for the globe with quantified spatial uncertainty. Soil 7:217-240, 2021. doi:10.5194/soil-7-217-2021

See Also

For virtual access to the original data: soil_world_vsi For Africa: soil_af_isda, soil_af, soil_af_elements

Examples

```
gph <- soil_world(var="phh2o", depth=5, path=tempdir())
```

---

soil_world_vsi *soil grids_vsi*

Description

Virtually connect to the global soilgrids data. See https://www.isric.org/explore/soilgrids for more info.

data license: CC-BY 4.0

Usage

```
soil_world_vsi(var, depth, stat="mean", name="")
```

Arguments

var	character. Variables name. One of: "bdod", "cfvo", "clay", "nitrogen", "ocd", "ocs", "phh2o", "sand", "silt", "soc", "wrb". See Details
depth	numeric. One of 5, 15, 30, 60, 100, 200. This is shorthand for the following depth ranges: 0-5, 5-15, 15-30, 30-60, 60-100, 100-200 cm. Ignored if var="wrb"
stat	character. One of "mean", "uncertainty", "Q0.05", "Q0.5", "Q0.95". Ignored if var="wrb"
name	character. One of 'Acrisols', 'Albeluvisols', 'Alisols', 'Andosols', 'Arenosols', 'Calcisols', 'Cambisols', 'Chernozems', 'Cryosols', 'Durisols', 'Ferralsols', 'Fluvisols', 'Gleysols', 'Gypsisols', 'Histosols', 'Kastanozems', 'Leptosols', 'Lixisols', 'Luvisols', 'Nitisols', 'Phaeozems', 'Planosols', 'Plinthosols', 'Podzols', 'Regosols', 'Solonchaks', 'Solonetz', 'Stagnosols', 'Umbrisols', 'Vertisols'. Only used when var="wrb"

Details

The below table lists the variable names, a description, and the units of the variables. Note that these units are not standard units, and are different from the data for other soil data available through this package.

var	description	unit

bdod	Bulk density of the fine earth fraction	$cg \cdot cm^{-3}$
cec	Cation Exchange Capacity of the soil	$mmol(+)\dot{k}g^{-1}$
cfvo	Vol. fraction of coarse fragments (> 2 mm)	%■
nitrogen	Total nitrogen (N)	$cg \cdot kg^{-1}$
phh2o	pH (H_2O)	-
sand	Sand (> 0.05 mm) in fine earth	%■
silt	Silt (0.002-0.05 mm) in fine earth	%■
clay	Clay (< 0.002 mm) in fine earth	%■
soc	Soil organic carbon in fine earth	$dg \cdot kg^{-1}$
ocd	Organic carbon density	$hg \cdot m^{-3}$
ocs	Organic carbon stocks	$hg \cdot m^{-2}$

Value

SpatRaster

References

Poggio, L., de Sousa, L.M., Batjes, N.H., Heuvelink, G.B.M., Kempen, B., Ribeiro, E., and Rossiter, D., 2021. SoilGrids 2.0: producing soil information for the globe with quantified spatial uncertainty. Soil 7:217-240, 2021. doi:10.5194/soil-7-217-2021

See Also

soil_world to download these data at 30-seconds spatial resolution.

For Africa: soil_af_isda, soil_af, soil_af_elements

Examples

```
ph <- soil_world_vsi(var="phh2o", depth=5)
plot(ph, maxcell=10000)
```

---

sp_occurrence *Download species occurrence data from GBIF*

Description

Download data from the Global Biodiversity Information Facility (GBIF) data portal.

sp_genus returns a data.frame with all the species names associated with a genus.

sp_occurrence downloads species occurrence records. You can download data for a single species or for an entire genus by using species="". Note that the maximum number of records that can be downloaded for a single search is 100,000.

You can check the number of records returned by using the option download=FALSE.

To avoid getting more than 100,000 records, you can do separate queries for different geographic areas. This has been automated in `sp_occurrence_split`. This function recursively splits the area of interest into smaller areas until the number of records in an area is less than 50,000. It then downloads these records and saves them in a folder called "gbif". After all areas have been evaluated, the data are combined into a single file and returned as a data.frame). If the function is interrupted, it can be run again, and it will resume where it left off.

If you want to download data for an entire genus, first run `sp_genus` and then download data for the returned species names one by one.

Before using this function, please first check the GBIF data use agreement and see the note below about how to cite these data.

Usage

```
sp_genus(genus, simple=TRUE, ...)

sp_occurrence(genus, species="", ext=NULL, args=NULL, geo=TRUE, removeZeros=FALSE,
       download=TRUE, ntries=5, nrecs=300, start=1, end=Inf, fixnames=TRUE, ...)

sp_occurrence_split(genus, species="", path=".", ext=c(-180,180,-90,90), args=NULL,
geo=TRUE, removeZeros=FALSE, ntries=5, nrecs=300, fixnames=TRUE, prefix=NULL, ...)
```

Arguments

`genus`	character. genus name
`species`	character. species name. Use '*' to download the entire genus. Append '*' to the species name to get all naming variants (e.g. with and witout species author name) and sub-taxa
`ext`	Extent object to limit the geographic extent of the records. An extent can be created using functions like `ext` and `draw`
`args`	character. Additional arguments to refine the query. See query parameters in http://www.gbif.org/developer/occurrence for more details
`geo`	logical. If `TRUE`, only records that have a georeference (longitude and latitude values) will be downloaded
`removeZeros`	logical. If `TRUE`, all records that have a latitude OR longitude of zero will be removed if `geo==TRUE`, or set to `NA` if `geo==FALSE`. If `FALSE`, only records that have a latitude AND longitude that are zero will be removed or set to `NA`
`download`	logical. If `TRUE`, records will be downloaded, else only the number of records will be shown
`ntries`	integer. How many times should the function attempt to download the data, if an invalid response is returned (perhaps because the GBIF server is very busy)
`nrecs`	integer. How many records to download in a single request (max is 300)?
`start`	integer. Record number from which to start requesting data
`end`	integer. Last record to request

fixnames	If TRUE a few unwieldy and poorly chosen variable names are changed as follows. "decimalLatitude" to "lat", "decimalLongitude" to "lon", "stateProvince" to "adm1", "county" to "adm2", "countryCode" to "ISO2". The names in "country" are replaced with the common (short form) country name, the original values are stored as "fullCountry"
path	character. Where should the data be downloaded to (they will be put in a subdirectory "gbif")?
prefix	character. prefix of the downloaded filenames (best left NULL, the function will then use "genus_species"
simple	logical. If TRUE, a vector the accepted species names are returned. Otherwise a data.frame with much more information is returned
...	additional arguments passed to download.file

Value

data.frame

Note

Under the terms of the GBIF data user agreement, users who download data agree to cite a DOI. Citation rewards data-publishing institutions and individuals and provides support for sharing open data [1][2]. You can get a DOI for the data you downloaded by creating a "derived" dataset. For this to work, you need to keep the "datasetKey" variable in your dataset.

References

https://www.gbif.org/occurrence https://www.gbif.org/derived-dataset/about

Examples

```
## Not run:

sp_occurrence("solanum", download=FALSE)
sp_occurrence("solanum", "acaule", download=FALSE)

sp_occurrence("Batrachoseps", "" , down=FALSE)
sp_occurrence("Batrachoseps", "luciae", down=FALSE)
g <- sp_occurrence("Batrachoseps", "luciae", geo=TRUE)
plot(g[, c("lon", "lat")])


## args
a1 <- sp_occurrence("Elgaria", "multicarinata", args="recordNumber=RH-2")
a2 <- sp_occurrence("Batrachoseps", "luciae", args=c("year=2023", "identifiedBy=Anthony Ye"))
## year supports "range queries"
a3 <- sp_occurrence("Batrachoseps", "luciae", args=c("year=2020,2023", "identifiedBy=KW"))
table(a3[,c("year")])

## End(Not run)
```

`travel_time` *Travel time to a city or port*

Description

Download travel time to a city or port data on rasters at a 30 arc-seconds (about 1 km2) resolution.

Usage

```
travel_time(to="city", size=1, up=FALSE, path, ...)
```

Arguments

`to`	character. "city" or "port"
`size`	positive integer indicating the size of the city or port. Can be between 1 and 9 if `to="city"` or between 1 and 5 if `to="port"`. See Details
`up`	logical. If `TRUE` the travel time to a city of the size chosen **or larger** is returned
`path`	character. Path for storing the downloaded data. See `geodata_path`
`...`	additional arguments passed to `download.file`

Details

Description of the the `size` argument.

`to="city"`

size	Inhabitants
1	5,000,000 to 50,000,000
2	1,000,000 to 5,000,000
3	500,000 to 1,000,000
4	200,000 to 500,000
5	100,000 to 200,000
6	50,000 to 100,000
7	20,000 to 50,000
8	10,000 to 20,000
9	5,000 to 10,000

`to="port"`

size	Description	Number of ports
1	Large	160
2	Medium	361
3	Small	990
4	Very small	2,153
5	Any	3,778

Value

SpatRaster

References

Nelson, A., D.J. Weiss, J. van Etten, A. Cattaneo, T.S. McMenomy & J. Koo, 2019. A suite of global accessibility indicators. Scientific Data 6: 266. doi:10.1038/s41597-019-0265-5

Version 3 (2019-05-15) from https://figshare.com/articles/dataset/Travel_time_to_cities_and_ports_in_the_year_2015/7638134/3

Examples

```
ttime <- travel_time("city", 2, path=tempdir(), quiet=TRUE)
```

---

world *Administrative boundaries*

Description

Get the borders for all the countries in the world. Data are read from files that are downloaded if necessary.

Usage

```
world(resolution=5, level=0, path, version="latest", ...)
```

Arguments

resolution	integer between 1 and 5 indicating the level of detail. 1 is high 5 is low
level	numeric. The level of administrative subdivision requested. (starting with 0 for country, then 1 for the first level of subdivision). Only level 0 is currently available
path	character. Path for storing the downloaded data. See geodata_path
version	character. Only "3.6" is currently supported
...	additional arguments passed to download.file

Details

The data are from https://gadm.org

Value

SpatVector

See Also

gadm

Examples

```
w <- world(path=tempdir())
```

---

worldclim *WorldClim climate data*

Description

Download climate data from WorldClim version 2.1. See Details for variables and units.

Usage

```
worldclim_global(var, res, path, version="2.1", ...)
worldclim_country(country, var, path, version="2.1", ...)
worldclim_tile(var, lon, lat, path, version="2.1", ...)
```

Arguments

var	character. Valid variables names are "tmin", "tmax", "tavg", "prec", "wind", "vapr", and "bio"
res	numeric. Valid resolutions are 10, 5, 2.5, and 0.5 (minutes of a degree)
path	character. Path for storing the downloaded data. See geodata_path
country	character. Country name or code
lon	numeric. Longitude
lat	numeric. Latitude
version	character or numeric. WorldClim version number. Only "2.1" supported at the moment
...	additional arguments passed to download.file

Details

These are the WorldClim monthly average climate data.

Variable	Description	Unit
tmin	minimum temperature	°C
tmax	maximum temperature	°C
tavg	average temperature	°C
prec	total precipitation	mm
srad	incident solar radiation	$kJ \cdot m^{-2} \cdot day^{-1}$
wind	wind speed (2 m above the ground)	$m \cdot s^{-1}$
vapr	vapor pressure	kPa

Value

SpatRaster

See Also

https://www.worldclim.org/

Examples

```
lux <- worldclim_country("Luxembourg", var="tmin", path=tempdir())
```

Index