Package 'inldata'

May 18, 2024

Title Collection of Datasets for the USGS-INL Monitoring Networks

Version 1.2.1

Description A collection of analysis-ready datasets for the U.S. Geological Survey - Idaho National Laboratory (USGS-INL) groundwater and surface-water monitoring networks, administered by the USGS-INL Project Office in cooperation with the U.S. Department of Energy. The data collected from wells and surface-water stations at the Idaho National Laboratory and surrounding areas have been used to describe the effects of waste disposal on water contained in the eastern Snake River Plain aquifer, located in the southeastern part of Idaho, and the availability of water for long-term consumptive and industrial use. The package includes long-term monitoring records dating back to measurements from 1922. Geospatial data describing the areas from which samples were collected or observations were made are also included in the package. Bundling this data into a single package significantly reduces the magnitude of data processing for researchers and provides a way to distribute the data along with its documentation in a standard format. Geospatial datasets are made available in a common projection and datum, and geohydrologic data have been structured to facilitate analysis.

Depends R (>= 4.1)

Imports checkmate, sf, stats, stringi, terra, tools, utils

Suggests archive, arrow, connectapi, covr, dataRetrieval, DiagrammeR, DiagrammeRsvg, dm, fontawesome, htmltools, htmlwidgets, httr, inlcolor, jsonlite, knitr, pkgload, pkgbuild, pkgdown, plotrix, rappdirs, rcmdcheck, reactable, renv, rmarkdown, roxygen2, rsconnect, tinytest, V8, webmap, writexl, xml2

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BugReports https://code.usgs.gov/inl/inldata/-/issues

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LazyDataCompression xz

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Author Jason C. Fisher [aut, cre] (<https://orcid.org/0000-0001-9032-8912>), Allison R. Trcka [aut] (<https://orcid.org/0000-0001-8498-4737>), Kerri C. Treinen [aut] (<https://orcid.org/0000-0003-0645-6810>)

Maintainer Jason C. Fisher <jfisher@usgs.gov>

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R topics documented:

`background` *Background Concentrations*

Description

Water-quality background concentrations for selected radionuclides, organic compounds, and chemical constituents that were analyzed for in water from the eastern Snake River Plain aquifer at and near the Idaho National Laboratory (INL). The background concentrations are defined as groundwater influenced by western tributary recharge in the western INL and by eastern regional recharge in the eastern INL. These concentrations are either naturally occurring or anthropogenic (substances present in the environment as a result of human activities) and are not influenced by waste and wastewater disposal at the INL, according to Bartholomay and Hall (2016).

Usage

```
background
```

Format

A data frame with columns:

`parm_nm` Long parameter name, such as "Strontium-90, water, unfiltered, picocuries per liter".

`pcode` U.S. Geological Survey 5-digit parameter code used to identify the constituent measured, see `parameters` dataset for details. For example, the parameter code for Tritium is "07000".

`bkgrd_min` Minimum limit of background concentration.

`bkgrd_max` Maximum limit of background concentration.

`reference` Source of background concentration limits. Reference citations are as follows: "Bartholomay and Hall (2016)", "Knobel and others (1992)", "Michel (1989)", and "Orr and others (1991)".

Source

Idaho National Laboratory Project Office

References

Bartholomay, R.C., and Hall, L.F., 2016, Evaluation of background concentrations of selected chemical and radiochemical constituents in groundwater in the eastern Snake River Plain aquifer at and near the Idaho National Laboratory, Idaho: U.S. Geological Survey Scientific Investigations Report 2016–5056, (DOE/ID–22237), 19 p., doi:10.3133/sir20165056.

Knobel, L.L., Orr, B.R., and Cecil, L.D., 1992, Summary of background concentrations of selected radiochemical and chemical constituents in groundwater from the Snake River Plain aquifer, Idaho:

estimated from an analysis of previously published data: Journal of the Idaho Academy of Science, v. 28, no. 1, p. 48–61.

Michel, R.L., 1989, Tritium deposition in the continental United States, 1953–83: U.S. Geological Survey Water Resources Investigations Report 89–4072, 46 p., doi:10.3133/wri894072.

Orr, B.R., Cecil, L.D., and Knobel, L.L., 1991, Background concentrations of selected radionuclides, organic compounds, and chemical constituents in ground water in the vicinity of the Idaho National Engineering Laboratory: U.S. Geological Survey Water-Resources Investigations Report 91–4015 (DOE/ID–22094), 52 p., doi:10.3133/wri914015.

Examples

```
str(background)
```

`benchmarks` *Benchmark Concentrations*

Description

Water-quality benchmark concentrations of selected radionuclides, organic compounds, and chemical constituents. These benchmarks include the United States Environmental Protection Agency (EPA) Maximum Contaminant Levels (MCLs), Human Health Benchmarks for Pesticides (HHBPs), and U.S. Geological Survey (USGS) Health-Based Screening Levels (HBSLs).

Usage

```
benchmarks
```

Format

A data frame with columns:

`parm_nm` Long parameter name, such as "Strontium-90, water, unfiltered, picocuries per liter".

`pcode` U.S. Geological Survey 5-digit parameter code used to identify the constituent measured, see `parameters` dataset for details. For example, the parameter code for Tritium is "07000".

`mcl` Maximum Contaminant Levels (MCLs), a standard set by the EPA for drinking water quality. An MCL is the legal threshold limit on the amount of a substance that is allowed in public water systems under the Safe Drinking Water Act.

`hhbp_noncancer` EPA Chronic Noncancer HHBPs.

`hhbp_cancer_min` EPA Carcinogenic HHBPs for a one-in-one million cancer risk.

`hhbp_cancer_max` EPA Carcinogenic HHBPs for a one-in-ten thousand cancer risk.

`hbsl_noncancer` USGS Noncancer HBSLs.

`hbsl_cancer_min` USGS Cancer HBSLs for a one-in-one million cancer risk.

`hbsl_cancer_max` USGS Cancer HBSLs for a one-in-ten thousand cancer risk.

`remark` Benchmark remarks that provide additional information about some MCLs, HHBPs, and HBSLs.

Source

Many of the water-quality benchmarks were accessed from the U.S. Geological Survey Health-Based Screening Levels database, accessed on April 4, 2023, from https://water.usgs.gov/water-resources/hbsl/. Benchmarks for total Trihalomethanes, Tritium, and Strontium-90 were provided by the U.S. Environmental Protection Agency (2015). Note that MCL benchmark values reported in millirem per year were substituted with a 50 picocuries per liter screening level.

References

U.S. Environmental Protection Agency, 2015, Protection of environment—Code of Federal Regulations 40, Part 141, Subpart G, National Primary Drinking Water Regulations, Maximum Contaminant Levels and Maximum Residual Disinfectant Levels: Washington, D.C., Office of the Federal Register, National Archives and Records Administration.

Examples

```
str(benchmarks)
```

---

cities *Cities and Towns*

Description

Cities and towns (populated places) in the vicinity of Idaho National Laboratory, eastern Idaho.

Usage

```
cities
```

Format

A simple feature with fields:

`name` City name.

`id` Unique identifier.

`geometry` Zero-dimensional geometry containing a single point.

Source

Spatial point extracts were obtained from the Master Address File / Topologically Integrated Geographic Encoding and Referencing (MAF/TIGER) Database (MTDB), 2023 data collection, released November 22, 2023. Which is a part of the U.S. Department of Commerce, U.S. Census Bureau, Geography Division/Cartographic Products Branch. The centroids of these extracts were cropped to the study area, and any non-essential data was removed.

Examples

```
print(cities)

plot(cities["name"], pch = 19)
```

`counties` *County Boundaries*

Description

County boundaries in the vicinity of Idaho National Laboratory, eastern Idaho.

Usage

```
counties
```

Format

A simple feature with fields:

`name` County name.

`id` Unique identifier.

`geometry` Polygon geometry with a positive area (two-dimensional); sequence of points that form a closed, non-self-intersecting ring; the first ring denotes the exterior ring, zero or more subsequent rings denote holes in this exterior ring.

Source

Spatial polygon extracts were obtained from the Master Address File / Topologically Integrated Geographic Encoding and Referencing (MAF/TIGER) Database (MTDB), 2023 data collection, released November 22, 2023. Which is a part of the U.S. Department of Commerce, U.S. Census Bureau, Geography Division/Cartographic Products Branch. These polygons were cropped to study area, and any non-essential data was removed.

Examples

```
print(counties)

plot(counties["name"])
```

crs *Coordinate Reference System*

Description

Coordinate reference system (CRS) used by the U.S. Geological Survey Idaho National Laboratory Project Office. The CRS is based on the following attributes: Albers equal-area conic projection; latitude of first and second standard parallel is 42.83 and 44.16 decimal degrees, respectively; latitude and longitude of false origin is 41.5 and -113 decimal degrees, respectively; easting and northing of false origin is 200,000 and 0 meters, respectively; Clarke (1966) reference ellipsoid; North American Datum of 1983; and units of meters. The CRS is represented using an updated version of the well-known text (WKT2) strings.

Usage

```
crs
```

Format

A list with the following elements representing the CRS: `input` is the PROJ.4 string, and `wkt` is the WKT2 strings.

Source

Idaho National Laboratory Project Office

Examples

```
print(crs)
```

dem *Digital Elevation Model*

Description

The digital elevation model (DEM) for the Idaho National Laboratory and its vicinity in eastern Idaho. A DEM is a representation of the land surface that uses a digital grid to describe the elevation values of the terrain.

Usage

```
dem
```

Format

A compressed SpatRaster class object with layer:

`elevation` Land-surface elevations in feet above the North American Vertical Datum of 1988 (NAVD 88).

Source

The National Map (TNM) 1/3-arc-second DEM (Gesch, 2007; Gesch and others, 2002), accessed on August 4, 2020. This dataset can be downloaded in a Esri ArcGRID TM format using TNM Download. Elevation datasets are distributed in geographic coordinates in units of decimal degrees, and in conformance with the NAD 83. Elevation values are in feet above the NAVD 88.

References

Gesch, D.B., 2007, The National Elevation Dataset, in Maune, D., ed., Digital Elevation Model Technologies and Applications—The DEM User's Manual, 2nd ed.: Bethesda, Maryland, American Society for Photogrammetry and Remote Sensing, p. 99–118.

Gesch, D., Oimoen, M., Greenlee, S., Nelson, C., Steuck, M., and Tyler, D., 2002, The National Elevation Dataset: Photogrammetric Engineering and Remote Sensing, v. 68, no. 1, p. 5–11.

See Also

`make_shade` function for computing the hill shade from the DEM.

Examples

```
elevation <- terra::unwrap(dem)
print(elevation)

col <- inlcolor::get_colors(n = 256, scheme = "dem2", bias = 0.9)
terra::plot(elevation, col = col)
```

---

dl *Laboratory Detection Limits*

Description

Analytical method detection limits of selected radionuclides based on laboratory procedures.

Usage

```
dl
```

Format

A data frame with columns:

`parm_nm` Long parameter name, such as "Strontium-90, water, unfiltered, picocuries per liter".

`pcode` U.S. Geological Survey 5-digit parameter code used to identify the constituent measured, see `parameters` dataset for details. For example, the parameter code for Tritium is "07000".

`lab_det_lim_va` Laboratory detection limit concentration.

`min_dt` Date that the detection limit went into effect.

`reference` Source of detection limit. Reference citations are as follows: "Bartholomay and others (2003, table 9)", "Bartholomay and others (2014, table D1)", "Bartholomay and others (2021, table 4.1)", and "Bodnar and Percival (1982)"

Source

Idaho National Laboratory Project Office

References

Bartholomay, R.C., Knobel, L.L., and Rousseau, J.P., 2003, Field methods and quality-assurance plan for quality-of-water activities, U.S. Geological Survey, Idaho National Engineering and Environmental Laboratory, Idaho: U.S. Geological Survey Open-File Report 03–42 (DOE/ID–22182), 45 p. doi:10.3133/ofr0342.

Bartholomay, R.C., Maimer, N.V., and Wehnke, A.J., 2014, Field methods and quality-assurance plan for water-quality activities and water-level measurements, U.S. Geological Survey, Idaho National Laboratory, Idaho: U.S. Geological Survey Open-File Report 2014–1146 (DOE/ID–22230), 64 p. https://pubs.usgs.gov/of/2014/1146/.

Bartholomay, R.C., Maimer, N.V., Wehnke, A.J., and Helmuth, S.L., 2021, Field methods, quality-assurance, and data management plan for water-quality activities and water-level measurements, Idaho National Laboratory, Idaho: U.S. Geological Survey Open-File Report 2021–1004, 76 p., doi:10.3133/ofr20211004.

Bodnar, L.Z., and Percival, D.R., eds., 1982, Analytical Chemistry Branch procedures manual—Radiological and Environmental Sciences Laboratory: U.S. Department of Energy Report IDO–12096 [variously paged].

Examples

```
str(dl)
```

esrp *Eastern Snake River Plain Boundary*

Description

Boundary of the eastern Snake River Plain (ESPR), Idaho. The ESPR is a structural basin that extends about 200 miles in a northeast direction and is 50-70 miles wide. The basin is bounded by faults on the northwest and by down warping and faulting on the southeast. It has been filled with basaltic lava flows interbedded with terrestrial sediments. The combination of basaltic rock and sedimentary deposits forms the ESRP aquifer, which is the primary source of groundwater in the basin

Usage

```
esrp
```

Format

A simple feature with fields:

`geometry` Polygon geometry with a positive area (two-dimensional); sequence of points that form a closed, non-self-intersecting ring; the first ring denotes the exterior ring, zero or more subsequent rings denote holes in this exterior ring.

Source

The ESPR boundary was digitized from 7.5' quads within and in the vicinity of the Idaho National Laboratory by the U.S. Geological Survey Idaho National Laboratory Project Office The digitized polygons were made into shapefiles and converted into GeoJSON files.

Examples

```
print(esrp)

plot(esrp, col = "grey")
```

facilities *Idaho National Laboratory Facilities*

Description

Federal research facilities at the Idaho National Laboratory (INL). The INL facilities have been the primary source of radioactive and chemical waste constituents in the water from the eastern Snake River Plain aquifer and in perched groundwater zones at or near the INL. This is due to the wastewater disposal practices at the INL facilities.

Usage

```
facilities
```

Format

A simple feature with fields:

`name` Facility name.

`id` Facility identifier. Facility abbreviations and descriptions are as follows: "TAN" Test Area North, "NRF" Naval Reactors Facility, "MRF" Materials and Fuels Complex, "ATRC" Advanced Test Reactor Complex, "INTEC" Idaho Nuclear Technology and Engineering Center, "CFA" Central Facilities Area "RWMC" Radioactive Waste Management Complex.

`geometry` Set of polygons, where a polygon is a geometry with a positive area (two-dimensional).

Source

A GeoJSON file of the facilities was created by the U.S. Geological Survey Idaho National Laboratory Project Office

Examples

```
print(facilities)

plot(facilities["id"])
```

---

gwl *Groundwater Levels*

Description

Groundwater levels in wells in the U.S. Geological Survey (USGS) water-level monitoring network, Idaho National Laboratory and vicinity, Idaho. The purpose of this network is to document the changes in storage and the general direction of groundwater flow within the eastern Snake River Plain (ESRP) aquifer. The data collected from this network have been used to determine changes in hydraulic-gradient that affect the rate and direction of groundwater and waste-constituent movement. It can also help identify sources of recharge and measure its effects. The groundwater measurements are taken from both the ESRP aquifer and the perched groundwater zones above the aquifer.

Usage

```
gwl
```

Format

A data frame with columns:

`site_nm` Local site name.

`site_no` USGS site number.

`lev_dt` Date and time the water level was measured, in "America/Denver" time zone. Missing values of time were substituted with "12:00".

`lev_meth_cd` Code indicating the method used to determine the water level. The codes and their meanings are as follows: "A" airline measurement, "B" analog or graphic recorder, "F" transducer, "G" pressure-gage measurement, "L" interpreted from geophysical logs, "O" observed, "S" steel-tape measurement, "T" electric-tape measurement, "V" calibrated electric tape—accuracy of instrument has been checked, "W" calibrated electric cable, and "Z" other.

`lev_status_cd` Code indicating the status of the site at the time the water level was measured. The codes and their meanings are as follows: "1" static, "3" true value is above the reported water level value due to local conditions, "5" groundwater level affected by surface water, "P" site was being pumped.

`lev_age_cd` Code indicating the water-level approval status. The codes and their meanings are as follows: "A" approved for publication—processing and review completed, and "P" provisional data subject to revision.

`lev_va` Depth to water level, in feet below the land surface reference point.

`sl_lev_va` Groundwater level above North American Vertical Datum of 1988 (NAVD 88), in feet.

`lev_acy_va` Accuracy of depth to water-level measurement (`lev_va`), in feet.

`sl_lev_acy_va` Accuracy of groundwater level above NAVD value (`sl_lev_va`), in feet. Does not account for vertical datum shift.

Source

Data was obtained from the National Water Information System (NWIS) (U.S. Geological Survey, 2023). Groundwater level data was retrieved from NWIS by using the USGS R-package dataRetrieval (DeCicco and others, 2023). Data was retrieved for each site number listed in the samples dataset and removed any non-essential columns.

References

DeCicco, L.A., Hirsch, R.M., Lorenz, D., Watkins, W.D., Johnson, M., 2023, dataRetrieval: R packages for discovering and retrieving water data available from Federal hydrologic web services, v.2.7.13, doi:10.5066/P9X4L3GE.

U.S. Geological Survey, 2023, National Water Information System—web services, accessed April 7, 2023, from doi:10.5066/F7P55KJN.

Examples

```
str(gwl)

poi <- as.POSIXct(c("2000-01-01", "2001-01-01")) # period of interest
site_no <- "432700112470801" # well USGS 1
```

```
is <- gwl$lev_dt >= poi[1] & gwl$lev_dt < poi[2] & gwl$site_no == site_no
d <- gwl[is, ]
plotrix::plotCI(
  x = d$lev_dt,
  y = d$sl_lev_va,
  li = d$sl_lev_va - d$sl_lev_acy_va,
  ui = d$sl_lev_va + d$sl_lev_acy_va
)
```

---

idaho *State of Idaho Boundary*

Description

A simplified representation of the boundary of Idaho, a state located in the northwestern region of the United States.

Usage

```
idaho
```

Format

A simple feature with fields:

`geometry` Polygon geometry with a positive area (two-dimensional); sequence of points that form a closed, non-self-intersecting ring; the first ring denotes the exterior ring, zero or more subsequent rings denote holes in this exterior ring.

Source

Spatial extract was obtained from the Master Address File / Topologically Integrated Geographic Encoding and Referencing (MAF/TIGER) Database (MTDB), 2023 data collection, released November 22, 2023. Which is part of the U.S. Department of Commerce, U.S. Census Bureau, Geography Division/Cartographic Products Branch. The polygon's geospatial features were simplified by removing the vertices and any non-essential data was removed.

Examples

```
print(idaho)

plot(idaho, col = "grey")
```

inl *Idaho National Laboratory Boundary*

Description

Geographic limits of the Idaho National Laboratory (INL). The INL is located on the west-central part of the eastern Snake River Plain and covers an area of approximately 890 square miles. It was established in 1949 to develop atomic energy, nuclear safety, defense programs, environmental research, and advanced energy concepts.

Usage

```
inl
```

Format

A simple feature with fields:

`geometry` Polygon geometry with a positive area (two-dimensional); sequence of points that form a closed, non-self-intersecting ring; the first ring denotes the exterior ring, zero or more subsequent rings denote holes in this exterior ring.

Source

The INL boundary was digitized from 7.5' quads within and in the vicinity of the Idaho National Laboratory by the U.S. Geological Survey Idaho National Laboratory Project Office The digitized polygons were made into shapefiles and converted into GeoJSON files.

Examples

```
print(inl)

plot(inl, col = "grey")
```

iwd *Industrial Waste Ditch*

Description

An industrial waste ditch located near the Naval Reactors Facility (NRF) in eastern Idaho. The NRF discharges its wastewater to this 1.65-mile-long waste ditch. The waste ditch was initially used in 1953 to dispose of non-radioactive, non-sewage industrial wastewater.

Usage

```
iwd
```

Format

A simple feature with fields:

`geometry` Sequence of points connected by straight, non-self-intersecting line pieces, one-dimensional geometry.

Source

A GeoJSON file of the industrial waste ditch was created by the U.S. Geological Survey Idaho National Laboratory Project Office

Examples

```
print(iwd)

plot(iwd, col = "blue")
```

---

lakes *Lakes and Ponds*

Description

Perennial lakes and ponds in the vicinity of the Idaho National Laboratory (INL) in eastern Idaho.

Usage

```
lakes
```

Format

A simple feature with fields:

`gnis_nm` GNIS name.

`id` Unique identifier.

`reach_cd` Reach code, a unique 14-digit code that identifies a continuous piece of surface water with similar hydrologic characteristics.

`gnis_id` Geographic Names Information System (GNIS) identifier.

`feature_tp` USGS National Hydrography Dataset (NHD) feature type code. "LakePond" is a standing body of water with a predominantly natural shoreline surrounded by land; "Reservoir" is a constructed basin formed to contain water or other liquids; and "SwampMarsh" is a non-cultivated, vegetated area that is inundated or saturated for a significant part of the year.

`geometry` Polygon geometry with a positive area (two-dimensional); sequence of points that form a closed, non-self-intersecting ring; the first ring denotes the exterior ring, zero or more subsequent rings denote holes in this exterior ring.

Source

Spatial polygon extract files obtained from the U.S. Geological Survey (USGS) National Hydrography Dataset (NHD) Medium Resolution for Idaho, released August 4, 2014. Which is part of the National Geospatial Technical Operations Center. These extracts were cropped to eastern Idaho extent and unnecessary columns were removed.

Examples

```
print(lakes)

plot(lakes["id"], col = "lightblue", border = "blue")
```

`make_datasets` *Create Package Datasets*

Description

Create datasets for the **inldata** package and save each as an R-data file with the `.rda` extension, which is a format native to R. The **stats dataRetrieval**, and **stringi** packages must be available, and the 7z executable must be on your path. This function is intended for use by **inldata**-package developers.

Usage

```
make_datasets(
  path = getwd(),
  destdir = file.path(path, "data"),
  clean = FALSE,
  tz = "America/Denver",
  census_yr = 2023,
  buffer_dist = 1000,
  resolution = 100,
  warn = 1,
  timeout = 10,
  compress = "xz",
  seed = 0L,
  quiet = FALSE
)
```

Arguments

`path`	'character' string. Path to the package's source directory, with tilde-expansion performed. Defaults to the working directory. Ensure that under the `path` is a folder named `data-raw` that contains the raw data files required for the build process.
`destdir`	'character' string. Destination directory to write R-data files, with tilde-expansion performed. Defaults to the `data` directory located under `path`.

clean	'logical' flag. Whether to delete all pre-existing R-data files in the destination directory.
tz	'character' string. Time zone specification. Defaults to Mountain Standard Time (North America). See OlsonNames for time zone information.
census_yr	'integer' number. United States census year.
buffer_dist	'numeric' number. Buffer distance for the study area defined by the bounding of the sample sites dataset. Specified in units of the coordinate reference system (crs$units).
resolution	'numeric' number. Spatial resolution of the raster grid, in meters. Specify in units of the coordinate reference system (crs$units).
warn	'integer' value. Sets the handling of warning messages. Choose value of less than 0 to show no warnings, 1 to print warnings (default), and 2 to error on warnings.
timeout	'integer' number. Timeout for some of the internet operations, in minutes. Defaults to 10 minutes.
compress	'logical' flag or 'character' string. Whether compression should be used when saving a dataset to file. Character strings "auto", "gzip", "bzip2" and "xz" (default) are accepted. See the save function for details on compression types.
seed	'integer' count. Random number generator state, used to create reproducible results.
quiet	'logical' flag. Whether to suppress printing of debugging information.

Details

This function retrieves and parses datasets from local and remote sources. Access to the internet is required to download data from the following remote sources:

- National Elevation Dataset (NED) on Amazon's Cloud.
- Spatial data from the TIGER/Line Geodatabase that contains spatial extracts from the U.S. Census Bureau's MAF/TIGER database.
- National Hydrography Dataset (NHD) data from the USGS NHD file geodatabase on Amazon's Cloud.

Each of the package dataset's represents a snapshot of the data at a specified point in time. While geospatial datasets may change very little over time (such as the boundary of the Idaho National Laboratory), other datasets continue to grow as new data becomes available (such as water-quality data measured in samples collected from wells).

To ensure that the function retrieves the most recent data versions, it is recommended to periodically check the URLs of remote sources and update them within the function. It is also advisable to document any changes in the datasets and update their help documentation accordingly.

Files downloaded during intermediate stages of the build process are cached on your computer to speed up future builds. You can specify the path to the cache directory by setting an environment variable named CACHE_DIR. By default the location of the cache directory is determined by the get_cache_dir() command.

Value

Returns the paths to the newly created R Data files invisibly.

Author(s)

J.C. Fisher, U.S. Geological Survey, Idaho Water Science Center

Examples

```
# Example requires that the 'path' argument be specified as
# the top-level directory of the inldata package repository.
## Not run:
make_datasets(destdir = tempfile(""))

## End(Not run)
```

`make_data_release` *Create Data Release*

Description

Create U.S. Geological Survey (USGS) data release product from R-package datasets and their documentation. Requires that the **xml2** and **jsonlite** packages are available.

Usage

```
make_data_release(
  metadata,
  package,
  destdir = getwd(),
  ...,
  bounding = NULL,
  rngdates = NULL,
  validate = FALSE
)
```

Arguments

`metadata`	'character' string or named 'list'. Either the path to a JSON formatted metadata file that contains general information for the USGS data release (see *Examples* section), or a named list with the equivalent information.
`package`	'character' string. Name of a package.
`destdir`	'character' string. Destination directory to write files, with tilde-expansion performed.
`...`	Additional arguments to be passed to the `write_datasets` function. The `formats` argument, which is specified within the function, is the exception.

bounding	'bbox', 'sf', 'SpatRaster', or 'PackedSpatRaster' spatial feature. Object to compute spatial bounding coordinates from, see `sf::st_bbox` function.
rngdates	'Date' or 'POSIXct' vector. Object to compute the date range of observations from.
validate	'logical' flag. Whether to perform a metadata validation and stop execution if errors are found. See `validate_metadata` function for system requirements.

Details

Citation entries for the R package (software release) and accompanying data release should be included in the package CITATION file, and documented in that order.

Value

Named list of metadata created for spatial and non-spatial datasets.

Author(s)

J.C. Fisher, U.S. Geological Survey, Idaho Water Science Center

A.R. Trcka, U.S. Geological Survey, Idaho Water Science Center

See Also

`parse_rd_db` function for reading and parsing R-package documentation.

Examples

```
destdir <- tempfile("")
rngdates <- c(samples$sample_dt, gwl$lev_dt) |> range()
l <- make_data_release(
  metadata = system.file("extdata/metadata.json", package = "inldata"),
  package = "inldata",
  destdir = destdir,
  include = "crs",
  quiet = TRUE,
  bounding = sites,
  rngdates = rngdates
)
str(l, 1)

unlink(destdir, recursive = TRUE)
```

make_shade *Compute Hill Shade*

Description

Compute hill shade from a digital elevation model. A hill shade layer is often used as a backdrop on top of which another, semi-transparent, layer is drawn.

Usage

```
make_shade(
  x,
  scale = 2,
  neighbors = 8,
  angle = 40,
  direction = 270,
  normalize = TRUE
)
```

Arguments

x	'SpatRaster' object. Spatial raster of land-surface elevations, such as the dem dataset.
scale	'numeric' number. Scaling factor used to convert the elevation values. The default value is 2.
neighbors	'numeric' count. Number of neighboring cells to use to compute slope or aspect with. Either 8 (queen case) or 4 (rook case).
angle	'numeric' number. The sun's angle of elevation above the horizon, ranges from 0 to 90 degrees. A value of 0 degrees indicates that the sun is on the horizon. A value of 90 degrees indicates that the sun is directly overhead. Default is a 40 degree angle.
direction	'numeric' number. Direction (azimuth) angle of the light source (sun), in degrees. An direction of 0 degrees indicates north, east is 90 degrees, south is 180 degrees, and west is 270 degrees (default).
normalize	'logical' flag. Whether to set values below zero to zero and results normalized between 0 and 1.

Value

Spatial raster of hill shade values.

Author(s)

J.C. Fisher, U.S. Geological Survey, Idaho Water Science Center

Examples

```
elevation <- terra::unwrap(dem)
hillshade <- make_shade(elevation)
print(hillshade)

col <- inlcolor::get_colors(n = 256, scheme = "grayC")
mar <- c(2, 2, 1, 4)
terra::plot(hillshade, col = col, mar = mar)

terra::plot(hillshade, col = col, mar = mar, legend = FALSE)
terra::plot(elevation,
  col = inlcolor::get_colors(
    n = 256,
    scheme = "dem2",
    alpha = 0.7,
    bias = 0.9
  ),
  add = TRUE
)
```

---

parameters *Parameter Information*

Description

Parameter information for selected chemical constituents, organic compounds, and radionuclides measured for in water samples collected from monitoring sites in the U.S. Geological Survey (USGS) water-quality monitoring network, Idaho National Laboratory and vicinity, Idaho.

Usage

```
parameters
```

Format

A data frame with columns:

`pcode` USGS 5-digit parameter code.

`parm_group_nm` Parameter group name. Abbreviations and descriptions are as follows: "Information" includes information about the water sample such as the date and time of collection, the location of the sample, and the method of analysis used; "Inorganics, Major, Metals" includes major inorganic ions and metals, "Inorganics, Major, Non-metals" includes major inorganic non-metallic ions; "Inorganics, Minor, Metals" includes minor inorganic metallic ions; "Inorganics, Minor, Non-metals" includes minor inorganic non-metallic ions; "Nutrient" includes nutrients such as nitrogen and phosphorus that can be present in water samples; "Organics, Other" includes organic compounds that are not classified as pesticides or PCBs; "Organics, Pesticide" includes organic compounds that are used as pesticides, such as insecticides, herbicides, and fungicides; "Physical" includes physical characteristics of water; "Radiochemical"

includes radioactive isotopes that can be present in water samples; and "Stable Isotopes" includes non-radioactive isotopes of elements that can be used to trace the movement of water through the hydrologic cycle.

`parm_nm` Long parameter name, such as "Strontium-90, water, unfiltered, picocuries per liter".

`casrn` Chemical Abstracts Service (CAS) registry number, such as "10098-97-2" for Strontium-90.

`srsname` Substance Registry Services (SRS) name, such as "Strontium-90".

`unit_cd` Units of measurement, see `units` dataset for unit descriptions.

`min_dt` Collection date of first sample analyzed for the parameter.

`max_dt` Collection date of last sample analyzed for the parameter.

`nrecords` Number of records associated with the parameter.

`nsites` Number of sampling sites where the parameter was observed.

Source

USGS water data acquired from the National Water Information System (U.S. Geological Survey, 2023). The SRS name (`srsname`) for "Trihalomethanes (four), total, from SDWA NPDWR" was shorten to its preferred acronym "TTHM4".

References

U.S. Geological Survey, 2023, National Water Information System—web services, accessed April 7, 2023 from doi:10.5066/F7P55KJN.

Examples

```
str(parameters)
```

`percponds` *Percolation Ponds*

Description

Percolation ponds in the vicinity of Idaho National Laboratory (INL), eastern Idaho. Wastewater from facilities at the INL has been and is currently disposed of in percolation (infiltration), evaporation (lined and unlined), and infiltration ponds.

Usage

```
percponds
```

Format

A simple feature with fields:

`name` Name of the percolation ponds.

`facility_id` INL facility the percolation pond is located at. Abbreviations and descriptions are as follows: "ATRC" is the Advanced Test Reactor Complex, "CFA" is the Central Facilites Area, "INTEC" is the Idaho Nuclear Technology and Engineering Center, "MFC" is the Materials and Fuels Complex, "NRF" is the Nuclear Reactors Facility, "RWMC" is the Radioactive WAste Management Complex, and "TAN" is the Test Area North facility.

`min_dt` Approximate year when the percolation pond was activated, with missing values indicating that the information is not available.

`max_dt` Approximate year when the percolation pond was decommissioned, with missing values indicating that the pond is still in operation.

`geometry` Polygon geometry with a positive area (two-dimensional); sequence of points that form a closed, non-self-intersecting ring; the first ring denotes the exterior ring, zero or more subsequent rings denote holes in this exterior ring.

Source

U.S. Geological Survey Idaho National Laboratory Project Office. Polygons representing percolation ponds were digitized from historical Google Earth imagery, dating as far back as 1985.

Examples

```
print(percponds)

plot(percponds["name"], col = "lightblue", border = "blue")
```

---

roads *Road Network*

Description

Road network in the vicinity of Idaho National Laboratory, eastern Idaho.

Usage

```
roads
```

Format

A simple feature with fields:

`name` Street or road name.

`id` Unique identifier.

`prisec_fl` Whether a road is classified as primary or secondary.

`geometry` Sequence of points connected by straight, non-self-intersecting line pieces, one-dimensional geometry.

Source

Spatial line extracts were obtained from the Master Address File / Topologically Integrated Geographic Encoding and Referencing (MAF/TIGER) Database (MTDB), 2023 data collection, released November 22, 2023. Which is a part of the U.S. Department of Commerce, U.S. Census Bureau, Geography Division/Cartographic Products Branch. These lines were cropped to the study area, and any non-essential data was removed.

Examples

```
print(roads)

plot(roads["prisec_fl"])
```

---

samples *Discrete Sample Data*

Description

Water-quality information for both groundwater and surface water collected from monitoring stations in and around the Idaho National Laboratory, Idaho. The water samples were collected in the field and analyzed in a laboratory to obtain water-quality data. The dataset was obtained from the National Water Information System (NWIS), which is maintained by the U.S. Geological Survey. The NWIS is a comprehensive and distributed application that supports the acquisition, processing, and long-term storage of water data.

Usage

```
samples
```

Format

A data frame with columns:

`site_nm` Local site name.

`sample_dt` Date and time the sample was collected, in "America/Denver" time zone. Missing values of time were substituted with "12:00".

`parm_short_nm` Parameter short name assigned by the USGS, such as "pH".

`unit_cd` Units of measurement, see `units` dataset for unit descriptions.

`remark_cd` Remark code (result level) used to qualify the parameter value. The codes and their meanings are as follows: NA (missing value) is a quantified value; "<" is where the actual value is known to be less than the value reported, that is, the measured concentration is below the reporting limit (RL) and represented as a censored (or nondetection) value. For censored values, the value reported is the RL; "E" is an estimated value, that is, the actual value is greater than the minimum detection limit (MDL) and less than the laboratory reporting level (LRL); "R" is a nondetect, result less than sample-specific critical level; and "U" is a material specifically analyzed for but not detected.

`result_va` Parameter value.

`lab_sd_va` Laboratory standard deviation (SD). For radiochemical data, SD is typically determined from the counting error. Prior to January 1, 2008, counting error was reported as two SD (Bartholomay and others, 2020, p. 27), therefore, these values were divided by 2.

`lab_li_va` Lower confidence interval of the `result` value based on laboratory analysis.

`lab_ui_va` Upper confidence interval of the `result` value based on laboratory analysis. In cases where the upper and lower limits are identical, the parameter is expressed as an exact value.

`rpt_lev_va` Laboratory reporting limit in effect for the parameter and analytical method at the time the measurement was made.

`rpt_lev_cd` Reporting level code that identifies the analytical reporting level appropriate for the analytical method. The codes and their meanings are as follows: "DLBLK" detection limit by blank data; "DLDQC" detection limit by DQCALC, lowest concentration that with 90 percent confidence will be exceeded no more than 1 percent of the time when a blank sample is measured; "IRL" interim reporting level, a temporary reporting level; "LRL" laboratory reporting level, equal to twice the yearly-determined LT-MDL; "LT-MDL" long-term method detection limit, a detection level derived by determining the standard deviation of a minimum of 24 MDL spike sample measurements over an extended period of time; "MDL" method detection limit, minimum concentration of a substance that can be measured and reported with a 99 percent confidence that the analyte concentration is greater than zero; "PQL" practical quantitation limits; "MRL" minimum reporting level, smallest measured concentration that can be reliably measured using a given analytical method; "RLDQC" reporting limit by DQCALC, is greater than or equal to two times the DLDQC; "SSLC" sample-specific critical level, the calculated and reported value is below which the radiochemistry result is considered a non-detect; and "SSMDC" sample-specific minimum detectable concentration, a reporting level that varies for each sample and is primarily used in radiochemical analyses.

`medium_cd` Medium code that identifies the material type and quality assurance type of the sample. The codes and their meanings are as follows: "OAQ" is a blank sample collected for QC purposes; "WG" is water below land surface contained in the saturated zone (groundwater); "WGQ" is a groundwater quality-control (QC) sample; "WS" is water on the surface of the Earth (surface water); and "WSQ" surface water QC sample.

`anl_ent_cd` Analyzing entity code of the organizational unit that performed the sample analysis used to obtain the result.

`dqi_cd` Data quality indicator code that indicates the review status of a result. The codes and their meanings are as follows: "A" historical data, "R" reviewed and accepted, and "S" provisional (presumed satisfactory).

`meth_cd` Method code, the codes are documented in the NWIS Method Code Dictionary.

`sample_type_cd` Sample type code that identifies the quality-assurance (QA) type of a sample. The codes and their meanings are as follows: "2" is a blank sample; "6" is a reference material sample; "7" is a replicate sample taken from the environment; "9" is a regular sample taken from the environment; "B" is a unspecified QA sample; and "H" is a composite (time) sample.

`db_no` 2-digit NWIS database number. The codes and their meanings are as follows: "01" is the environmental database, and "10" is the QA database.

`sample_id` Unique identifier for the water sample. The sample code is a concatenation of the site number, medium code, and date-time the sample was collected.

`site_no` USGS site identification number.

`pcode` USGS 5-digit parameter code. For example, the parameter code for Tritium is "07000".

`rep_pair_id` Unique identifier used for matching pairs of replicate samples for a specific parameter. Replicate pairs are identified by matching a replicate sample (`sample_type_cd` equal to 7) with its corresponding regular environmental sample (`sample_type_cd` equal to 9).

`result_tx` Remark about the water quality result

`remark` Remarks pertaining to changes applied after the records were obtained from NWIS.

`anl_dt` Result analysis date.

Source

Data were obtained from the NWIS-QWDATA database on January 22, 2024, in tab-delimited output-format using the QWDATA system (U.S. Geological Survey, 2024). The following steps were taken to process the data:

- **Column Name Translation:** Column names were switched from NWIS alpha codes to NWIS parameter codes.
- **Class Conversion:** Classes for each column were converted to the appropriate type (numeric, POSIX, factor).
- **Column Removal:** Unnecessary columns were removed.
- **Duplicate Removal:** Duplicate records in the NWIS and QWDATA databases were removed.
- **Data Cleaning:** Corrupted results were removed. A column was added for data processing remarks. Zero and negative results were reported as nondetects.
- **Radiochemical Parameter Identification:** Radiochemical parameter codes were identified. Nondetects were reported as less than the reporting level.
- **Sample Type Reporting:** In the absence of a sample type code, results were classified as environmental samples. Data from blank, spiked, and reference samples, as well as composite samples (collected over a period of time), were excluded.
- **Sample Identifier Creation:** Site number and date/time were combined to create a unique sample identifier.
- **Error Conversion:** Counting error was converted to laboratory standard deviation. Data entered into NWIS with an uncertainty of twice the standard deviation (data entered before 2008), were converted to one standard deviation.
- **Record Removal:** Records associated with counting error parameter codes were removed.
- **Replicate Pairing:** Replicate samples were paired based on the parameter code, site number, and time difference between sample collection.
- **Data Adjustment:** The detection limit, left-censored values, and non-positive lower limit were accounted for. Interval censored data were represented using upper and lower limits of the 95-percent confidence interval of the parameter value.

References

Bartholomay, R.C., Maimer, N.V., Rattray, G.W., and Fisher, J.C., 2020, An update of hydrologic conditions and distribution of selected constituents in water, Eastern Snake River Plain Aquifer

and perched groundwater zones, Idaho National Laboratory, Idaho, emphasis 2016-18: U.S. Geological Survey Scientific Investigations Report 2019-5149 (DOE/ID-22251), 82 p., doi:10.3133/sir20195149.

U.S. Geological Survey, 2024, National Water Information System—Water-Quality System (QWDATA) data retrieval program.

Examples

```
str(samples)

poi <- as.POSIXct(c("1989-01-01", "2019-01-01")) # period of interest
is_poi <- samples$sample_dt >= poi[1] & samples$sample_dt < poi[2]
is_stc <- samples$sample_type_cd %in% c("7", "9")

site_no <- "433253112545901" # well USGS 20
pcode <- "07000" # tritium, water, unfiltered, picocuries per liter
is <- is_poi & is_stc & samples$site_no == site_no & samples$pcode == pcode
d <- samples[is, ]
plotrix::plotCI(
  x = d$sample_dt,
  y = d$result_va,
  li = d$lab_li_va,
  ui = d$lab_ui_va
)

site_no <- "433322112564301" # well USGS 38
pcode <- "01030" # chromium, water, filtered, micrograms per liter
is <- is_poi & is_stc & samples$site_no == site_no & samples$pcode == pcode
d <- samples[is, ]
plotrix::plotCI(
  x = d$sample_dt,
  y = d$result_va,
  li = d$lab_li_va,
  ui = d$lab_ui_va
)
```

---

sites *Site Information*

Description

Information for sites in the U.S. Geological Survey (USGS) monitoring networks, Idaho National Laboratory (INL) and vicinity, Idaho. The monitoring networks at the INL have evolved to their current 2024 schedules of monitoring because groundwater and surface-water sites were installed for various reasons; for example, the need to estimate the volume of the eastern Snake River Plain aquifer, or to document and understand changes in water quality. The USGS compiled the list of sites monitored by the USGS using publications by Knobel and others (2005, table 1) and Bartholomay (2022, table 1). One well site (site no. 425812113271201) was omitted from the dataset because its geographical location falls outside the designated study area.

Usage

```
sites
```

Format

A simple feature with fields:

`site_nm` Local site name.

`station_nm` USGS station name with all extra spaces removed from text. Extra spaces include leading, trailing and in-between spaces except for a single space character between words.

`site_no` USGS site identification number.

`coord_meth_cd` Latitude/longitude coordinate method code. The codes and their meanings are as follows: "C" is surveyed; "D" is a differentially corrected Global Positioning System (GPS); "G" mapping grade GPS unit (handheld accuracy range 3.7 to 12.2 meters); "L" long range navigation system; "M" interpolated from topographic map; "N" is not surveyed; "S" is a transit, theodolite, or other surveying method; and "X" is not applicable.

`coord_acy_va` Accuracy of latitude/longitude value in seconds.

`alt_va` Elevation of the land surface reference point, in feet above the North American Vertical Datum of 1988 (NAVD 88).

`alt_meth_cd` Method code for measuring elevation. The codes and their meanings are as follows: "D" is a differentially corrected global positioning system, "L" is a level or other surveyed method, and "M" is interpolated from a topographic map; "N" is interpolated from a Digital Elevation Model; "X" is a GNSS2 - Level 2 Quality Survey Grade Global Navigation Satellite System; and "Y" is a GNSS3 - Level 3 Quality Survey Grade Global Navigation Satellite System.

`alt_acy_va` Accuracy of the elevation value (`alt_va`), in feet. Does not account for vertical datum shift.

`construction_dt` Date the well was completed.

`huc_cd` Hydrologic unit code (HUC). Hydrologic units are geographic areas representing part or all of a surface drainage basin or distinct hydrologic feature and are delineated on the Hydrologic Unit Map. The codes and their meanings are as follows: "17040201" is the Idaho Falls watershed; "17040206" is the Portneuf River; "17040209" is the Blackfoot River; "17040214" is Beaver-Camas; "17040215" is the Medicine Lodge Creek; "17040216" is the Big Lost River; "17040217" is the Little Lost River; and "17040218" is Birch Creek.

`reliability_cd` Reliability code for data available for the site. The codes and their meanings are as follows: "C" is data that have been checked by the reporting agency; "M" is minimal data; and "U" is unchecked data.

`nat_aqfr_cd` National aquifer code where "N600SKRVPB" is the Snake River Plain basin-fill aquifers, and "N600SKRVPV" is the Snake River Plain basaltic-rock aquifers.

`aqfr_cd` Aquifer code defined by the catalog of aquifer names and geologic unit codes used by the Water Mission Area. The codes and their meanings are as follows: "100CNZC" is the Cenozoic Erathem, and "110SKRV" is the Snake River Group.

`aqfr_type_cd` Aquifer type code. The codes and their meanings are as follows: "C" is a confined single aquifer, "M" is confined multiple aquifers, "U" is an unconfined single aquifer, and "X" is mixed (confined and unconfined) multiple aquifers.

`well_depth_va` Depth of the finished well, in feet below the land surface datum.

`hole_depth_va` Total depth of the borehole, in feet below the land surface datum.

`depth_src_cd` Source code for depth measurements. The codes and their meanings are as follows: "A" is reported by another government agency, "D" is from driller's log or report, "G" is reported by a private geologist-consultant or university associate, "L" is interpreted from geophysical logs by personnel of source agency, "O" is reported by owner of well, "R" is reported by person other than the owner, driller, or another government agency, "S" is measured by personnel of reporting agency; and "Z" is other source.

`completion_cd` Borehole completion code. The codes and their meanings are as follows: "M" is a multilevel completion, "O" is an open hole completion, and "P" is an open hole completion prior to multilevel completion.

`network_cd` Monitoring network code. The codes and their meanings are as follows: "A" is the aquifer-monitoring network, "P" is the perched-groundwater monitoring network, "S" is the surface-water monitoring network.

`pos` Position specifier for site-labels on a map. Values of 1, 2, 3 and 4, respectively indicate positions below (south), to the left (west) of, above (north), and to the right (east) of the site coordinates.

`min_dt` Date of first record.

`max_dt` Date of last record.

`nmeas` Number of measurments recorded at the site includes either groundwater-level or streamflow measurements.

`nsamples` Number of water-quality samples collected from the site.

`nreps` Number of replicate samples collected from the site.

`geometry` Zero-dimensional geometry containing a single point.

Source

USGS site data acquired from the NWIS (U.S. Geological Survey, 2023). The station name (`station_nm`) for the data was parsed for a more readable name. A borehole completion code (`completion_cd`), as well as an aquifer monitoring network code (`network_cd`) were created. A position specifier for site-labels on a map (`pos`) was also created. The classes of the columns were specified, and any unnecessary columns were removed.

References

Bartholomay, R.C., 2022, Historical development of the U.S. Geological Survey hydrological monitoring and investigative programs at the Idaho National Laboratory, Idaho, 2002-2020: U.S. Geological Survey Open-File Report 2022-1027 (DOE/ID-22256), 54 p., doi:10.3133/ofr20221027.

Knobel, L.L., Bartholomay, R.C., and Rousseau, J.P., 2005, Historical development of the U.S. Geological Survey hydrologic monitoring and investigative programs at the Idaho National Engineering and Environmental Laboratory, Idaho, 1949 to 2001: U.S. Geological Survey Open-File Report 2005-1223 (DOE/ID-22195), 93 p., doi:10.3133/ofr20051223.

U.S. Geological Survey, 2023, National Water Information System—web services, accessed April 7, 2023, from doi:10.5066/F7P55KJN.

Examples

```
print(sites)

plot(sites["network_cd"])
```

`streams` *Rivers and Streams*

Description

Stream segments in the vicinity of Idaho National Laboratory (INL), eastern Idaho. Surface water infiltrated to the eastern Snake River Plain aquifer through river and streams.

Usage

```
streams
```

Format

A simple feature with fields:

`gnis_nm` GNIS name.

`id` Unique identifier.

`reach_cd` Reach code, a unique 14-digit code that identifies a continuous piece of surface water with similar hydrologic characteristics.

`gnis_id` Geographic Names Information System (GNIS) identifier.

`feature_tp` USGS National Hydrography Dataset (NHD) feature type code. The codes and their meanings are as follows: "ArtificialPath" is a surrogate for general flow direction; "CanalDitch" is an artificial open waterway constructed to transport water, to irrigate or drain land, to connect two or more bodies of water, or to serve as a waterway for watercraft; "Connector"is a linear water feature that connects two or more waterbodies or other linear water features; and "StreamRiver" is a linear water feature that is a natural or man-made flowing body of water.

`geometry` Sequence of points connected by straight, non-self-intersecting line pieces, one-dimensional geometry.

Source

Spatial line extract files obtained from the U.S. Geological Survey (USGS) National Hydrography Dataset (NHD) Medium Resolution for Idaho, released August 4, 2014. Which is part of the National Geospatial Technical Operations Center. These extracts were cropped to eastern Idaho extent and unnecessary columns were removed.

Examples

```
print(streams)

plot(streams["id"], col = "blue")
```

swm *Surface-Water Measurements*

Description

Stage measurements and calculated discharge at gauging stations in the U.S. Geological Survey (USGS) surface-water monitoring network, Idaho National Laboratory and vicinity, Idaho. The purpose of this network is to provide information on the availability and distribution of surface water resources.

Usage

```
swm
```

Format

A data frame with columns:

`site_nm` Local site name.

`site_no` USGS site number.

`stage_dt` Date and time the water level was measured, in "America/Denver" time zone. Missing values of time were substituted with "12:00".

`stage_va` Gage height (stage) as shown on the inside staff gage at the site or read off the recorder inside the gage house in feet.

`disch_va` Computed discharge in cubic feet per second (cfs).

`stage_acy_va` Accuracy of stage measurment in feet.

`disch_acy_va` Accuracy of computed discharge in cfs.

Source

Data was obtained from the National Water Information System (NWIS) (U.S. Geological Survey, 2023). Groundwater level data was retrieved from NWIS by using the USGS R-package dataRetrieval (DeCicco and others, 2023). Data was retrieved for each site number listed in the samples dataset and removed any non-essential columns.

References

DeCicco, L.A., Hirsch, R.M., Lorenz, D., Watkins, W.D., Johnson, M., 2023, dataRetrieval: R packages for discovering and retrieving water data available from Federal hydrologic web services, v.2.7.13, doi:10.5066/P9X4L3GE.

U.S. Geological Survey, 2023, National Water Information System—web services, accessed January 10, 2024, from doi:10.5066/F7P55KJN.

Examples

```
str(swm)

poi <- as.POSIXct(c("2000-01-01", "2024-01-01")) # period of interest
site_no <- "13132500" # station BIG LOST RIVER NR ARCO ID
is <- swm$stage_dt >= poi[1] & swm$stage_dt < poi[2] & swm$site_no == site_no
d <- swm[is, ]
plotrix::plotCI(
  x = d$stage_dt,
  y = d$stage_va,
  li = d$stage_va - d$stage_acy_va,
  ui = d$stage_va + d$stage_acy_va
)
```

---

units *Units of Measurement*

Description

Descriptive information about the measurement units.

Usage

```
units
```

Format

A data frame with columns:

`unit_cd` Measurment abbreviation for units.

`unit_ds` Description for units of measurement.

`siunitx` Units formatted for LaTeX using the siunitx package notation.

Source

Idaho National Laboratory Project Office

Examples

```
str(units)
```

write_datasets *Write Package Datasets*

Description

Exports the content of package datasets into non-proprietary, open, and well-documented standard file formats, enhancing their accessibility for future use. It supports multiple formats: CSV, JSON (requires `jsonlite` package), Arrow Parquet (requires `arrow` package), Excel XLMS (requires `writexl` package), GeoJSON, Shapefile, and GeoTIFF.

Usage

```
write_datasets(
  package,
  destdir = getwd(),
  formats = NULL,
  gzip = NULL,
  overwrite = TRUE,
  include = NULL,
  exclude = NULL,
  pretty = TRUE,
  full_names = TRUE,
  quiet = FALSE
)
```

Arguments

`package`	'character' string. Name of a package.
`destdir`	'character' string. Destination directory to write files, with tilde-expansion performed.
`formats`	'character' vector. Formats for saving datasets. Choose from one or more of the following formats: `txt`, `json`, `csv`, `xlsx`, `parquet`, `geojson`, `shp`, and `tiff`. Please refer to the *Details* section for a description of each format. All file formats are saved to the disk by default.
`gzip`	'character' vector. File `formats` that are eligible for Gzip compression. At present, it accommodates `txt`, `json`, and `geojson` formats exclusively.
`overwrite`	'logical' flag. Whether to overwrite an existing file.
`include`	'character' vector. Names(s) of datasets to include. By default, a file is created for each package dataset.
`exclude`	'character' vector. Name(s) of datasets to exclude. By default, none are excluded.
`pretty`	'logical' flag. Whether to add indentation, whitespace, and newlines to JSON output (default is `TRUE`). See `prettify` function for details. The tradeoff for human-readable output is a much larger file size.
`full_names`	'logical' flag. Whether the full paths of the files are returned (default).
`quiet`	'logical' flag. Whether to suppress printing of debugging information.

Details

Different types of datasets are written to various file formats. For instance, a dataset in the form of a data table (`data.frame` class) is exported to a CSV (`csv`), JSON (`json`), Parquet (`parquet`), and Spreadsheet (`xlsx`) file. A dataset representing simple features (`sf` or `sfc` class) is exported to a GeoJSON (`geojson`) and Shapefile (`shp`) file. A spatial-raster dataset (`SpatRaster` or `PackedSpatRaster` class) is exported to a GeoTIFF (`tiff`) file. Lastly, a coordinate reference system (`crs` class) is exported to a text (`txt`) file.

Value

Invisibly returns the output file path(s).

Author(s)

J.C. Fisher, U.S. Geological Survey, Idaho Water Science Center

Examples

```
dir <- tempfile("")
write_datasets(
  package = "inldata",
  destdir = dir,
  formats = c("txt", "csv", "json", "geojson"),
  include = c("crs", "dl", "inl"),
  pretty = FALSE,
  quiet = TRUE
)

unlink(dir, recursive = TRUE)
```

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