Package ‘wrv’

September 25, 2014

Version 0.1-6

Date 2014-09-25

Title Wood River Valley Groundwater Flow Model

Author Jason C. Fisher

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

Depends R (>= 3.1.0), sp, rgdal, rgeos, raster

Imports igraph

Suggests RCurl, knitr, xtable

SystemRequirements MODFLOW-USG (>= 1.2)

Description Pre- and post-processing program for the groundwater-flow model of the Wood River Valley aquifer system, south-central Idaho.

License file LICENSE

Copyright This software is in the public domain because it contains materials that originally came from the United States Geological Survey (USGS), an agency of the United States Department of Interior. For more information, see the official USGS copyright policy at http://www.usgs.gov/visual-id/credit_usgs.html#copyright

URL https://github.com/jfisher-usgs/wrv

BugReports https://github.com/jfisher-usgs/wrv/issues

ByteCompile yes

LazyData yes

LazyDataCompression xz

VignetteBuilder knitr
### R topics documented:

- alluvium.bottom .................................................. 3
- aquifer.extent ....................................................... 4
- aquitard.extent ..................................................... 4
- basalt.extent ....................................................... 5
- BumpDisconnectedCells ............................................. 6
- bwr.sc .............................................................. 7
- canal.seep .......................................................... 8
- canals ............................................................... 8
- cities ................................................................. 9
- comb.sw.irr ......................................................... 9
- CreateModflowInputFiles ........................................ 10
- div.gw ............................................................. 12
- div.sw ............................................................. 13
- div.ww ............................................................. 14
- DownloadFile ....................................................... 14
- drains ............................................................... 15
- efficiency .......................................................... 16
- entity.components ................................................ 16
- et ................................................................. 17
- et.method .......................................................... 18
- ExcludeSmallCellChunks ......................................... 19
- ExportRasterStack ................................................ 19
- ExtractAlongTransect ............................................. 20
- GetSeasonalMultiplier ........................................... 22
- GetWellConfig ..................................................... 23
- hailey.discharge .................................................. 24
- hill.shading ....................................................... 24
- infil.basins ....................................................... 25
- infiltration ....................................................... 25
- irr.entities ....................................................... 26
- irr.lands ........................................................... 27
- irr.lands.year ..................................................... 27
- lakes .............................................................. 28
- land.surface ....................................................... 29
- map.labels ........................................................ 30
- PlotMap ............................................................ 30
- pod.gw ............................................................ 33
- pod.wells .......................................................... 34
- precip.zones ..................................................... 35
- precipitation ..................................................... 36
- priority.cuts ...................................................... 36
- ProcessRecharge .................................................. 37
- public.parcel ..................................................... 38
- r.canals ........................................................... 38
- ReadModflowBinaryFile ......................................... 39
- ReadModflowListFile ............................................ 40
- rivers ............................................................. 41
- rs.entities ........................................................ 41
- rs.rech.non.irr ................................................... 42
- SetPolygons ........................................................ 42
Pre-Quaternary Bedrock Surface and Top of Quaternary Basalt

Description

Estimated elevation of the pre-Quaternary bedrock surface and top of Quaternary basalt in the Wood River Valley aquifer system, South-Central Idaho.

Usage

`alluvium.bottom`

Format

An object of class `RasterLayer`. Each cell on the surface grid represents an elevation in meters above the North American Vertical Datum of 1988 (NAVD 88). Geographic coordinates are in units of meters, in conformance with the North American Datum of 1983 (NAD 83), and placed in a Idaho Transverse Mercator projection (IDTM). The spatial grid is composed of 565 rows and 429 columns, and has cell sizes that are constant at 100 meters by 100 meters.

Source

This dataset is a revised version of Plate 1 in Bartolino and Adkins (2012).

References


Examples

```r
plot(alluvium.bottom)
summary(alluvium.bottom)
```
aquifer.extent  
Extent of Aquifer System

**Description**

Estimated extent of the Wood River Valley aquifer system, south-central Idaho.

**Usage**

aquifer.extent

**Format**

An object of `SpatialPolygonsDataFrame-class` containing 1 polygons. Geographic coordinates are in units of meters, in conformance with the North American Datum of 1983 (NAD 83), and placed in an Idaho Transverse Mercator projection (IDTM).

**Source**

Extent defined by Bartollino and Adkins (2012, Plate 1).

**References**


**Examples**

```r
plot(aquifer.extent)
str(aquifer.extent)
```

aquitard.extent  
Extent of Aquitard

**Description**

The estimated extent of the confining unit (aquitard) separating the unconfined aquifer from the underlying confined aquifer in the Wood River Valley.

**Usage**

aquitard.extent

**Format**

An object of `SpatialPolygonsDataFrame-class` containing 2 polygons. Geographic coordinates are in units of meters, in conformance with the North American Datum of 1983 (NAD 83), and placed in an Idaho Transverse Mercator projection (IDTM).
Source
Extent defined by Moreland (1977, fig. 3 in USGS Open-File report). Moreland shows an outlier by Picabo that is assumed to indicate confined conditions in the basalt and not the lake sediments.

References

Examples
plot(aquitard.extent)
str(aquitard.extent)

basalt.extent   Extent of Basalt

Description
The estimated extent of the basalt underlying the alluvial Wood River Valley aquifer system.

Usage
basalt.extent

Format
An object of SpatialPolygonsDataFrame-class containing 1 Polygons. Geographic coordinates are in units of meters, in conformance with the North American Datum of 1983 (NAD 83), and placed in an Idaho Transverse Mercator projection (IDTM).

Source
Extent defined by Bartollino and Adkins (2012, Plate 1).

References

Examples
plot(basalt.extent)
str(basalt.extent)
BumpDisconnectedCells  
Adjustment for Vertically Disconnected Cells

Description
Decrease model cell values in the lower raster layer if they violate a minimum vertical overlap between adjacent cells.

Usage
BumpDisconnectedCells(rs, min.overlap = 2, bump.by = 0.1, max.itr = 1e+04)

Arguments
rs  
RasterStack: a raster stack with two layers, the first and second layers represent the top and bottom of a model layer.

min.overlap  numeric; the minimum vertical overlap between adjacent cells.

bump.by  numeric; the amount to decrease a cell value by during each iteration of the algorithm.

max.itr  numeric; the maximum number of iterations.

Details
During each iteration of the algorithm: (1) Cells are identified that violate the minimum vertical overlap between adjacent cells; that is, the bottom of cell $i$ is greater than or equal to the top of an adjacent cell $j$ minus the minimum overlap specified by the `min.overlap` argument. (2) For cells violating the minimum vertical overlap, lower raster layer ($rs[[2]]$) values are decreased by the value specified in the `bump.by` argument.

Value
Returns a RasterLayer that can be added to $rs[[2]]$ to ensure connectivity between cells. Cell values in the returned raster grid represent vertical adjustments in meters.

Author(s)
J.C. Fisher

Examples
```r
set.seed(0)
r.top <- raster(ncols = 10, nrows = 10)
r.bot <- raster(ncols = 10, nrows = 10)
r.top[] <- rnorm(ncell(r.top), mean = 12)
r.bot[] <- rnorm(ncell(r.bot), mean = 10)
summary(r.top - r.bot)

r <- BumpDisconnectedCells(stack(r.top, r.bot), min.overlap = 0.1)
plot(r.bot + r)
```
**Description**

Reaches of the Big Wood River and Silver Creek, Wood River Valley, Idaho.

**Usage**

bwr.sc

**Format**

An object of `SpatialLinesDataFrame-class` containing 21 lines and a `data.frame` with the following variables:

- **Reach** is the name of the subreaches measured in U.S. Geological Survey (USGS) seepage survey.
- **BigReach** is the name of the reaches for which time series targets are available for part or all of the calibration period.
- **GainLoss** is the flow type, specified as “Gaining”, “Losing”, or “Seasonal”.
- **DrainRiver** is the model boundary assignment, either “drain” or “river”.
- **RchAvg** is the estimated average reach gain in cubic meters per day for 1995-2010 based on a combination of gage data and the USGS seepage survey.
- **BigRAv** is the estimated average reach gain in cubic meters per day for 1995-2010 based on gage data.
- **ReachNo** is the reach number identifier.
- **Depth** is the estimated average depth in meters of water in reach, measured from the air-water interface to the top of the riverbed sediments.
- **BedThk** is the estimated thickness in meters of the saturated riverbed sediments.

Geographic coordinates are in units of meters, in conformance with the North American Datum of 1983 (NAD 83), and placed in a Idaho Transverse Mercator projection (IDTM).

**Source**

Idaho Department of Water Resources

**Examples**

```r
plot(bwr.sc)
str(bwr.sc@data)
```
canal.seep  

**Canal Seepage**

**Description**

Canal seepage as a fraction of diversions for irrigation entities in the Wood River Valley.

**Usage**

```r
canal.seep
```

**Format**

A `data.frame` object with 13 records and the following variables:

- **EntityName** is the name of the irrigation entity served by the canal system.
- **SeepFrac** is the estimated canal seepage as a fraction of diversions.

**Source**

Idaho Department of Water Resources

**See Also**

- `canals`

**Examples**

```r
str(canal.seep)
```

---

canals  

**Canals**

**Description**

Canal systems in the Wood River Valley and surrounding areas.

**Usage**

```r
canals
```

**Format**

An object of `SpatialLinesDataFrame-class` containing 114 lines and a `data.frame` with the following variable:

- **EntityName** is the name of the irrigation entity served by the canal system.

**Source**

Idaho Department of Water Resources (IDWR)
cities

See Also
canal.seep

Examples

plot(canals)
str(canals@data)

---

cities  Cities and Towns

Description

Cities and towns in the Wood River Valley and surrounding areas.

Usage
cities

Format

An object of SpatialPointsDataFrame-class containing 9 points. Geographic coordinates are in units of meters, in conformance with the North American Datum of 1983 (NAD 83), and placed in a Idaho Transverse Mercator projection (IDTM).

Source

Idaho Department of Water Resources (IDWR)

Examples

spplot(cities)
str(cities)

---

comb.sw.rr  Combined Surface Water Irrigation Diversions

Description

Supplemental groundwater rights and associated surface water rights.

Usage

comb.sw.rr
CreateModflowInputFiles

Format

A data.frame object with 1,213 records and the following variables:

**WaterRight** is the name of the supplemental groundwater right.

**CombWaterRight** is the name of the surface water right that shares a combined limit with the groundwater right.

**Source** is the river or stream source name for the surface water right.

**WaterUse** is the authorized beneficial use for the surface water right.

**MaxDivRate** is the authorized maximum diversion rate for the surface water right, in cubic meters per day.

**Pdate** is the priority date of the surface water right.

Source

Idaho Department of Water Resources (IDWR); derived from combined limit comments in IDWR water rights database.

Examples

`str(combNswNirrI)`

---

CreateModflowInputFiles

*Create MODFLOW Input Files*

Description

Generate and write input files for a MODFLOW simulation of groundwater flow in the Wood River Valley (WRV) aquifer system.

Usage

`CreateModflowInputFiles(rs.model, rech, well, id, dir.run, perlen)`

Arguments

- **rs.model**: RasterStack; a collection of RasterLayer objects with the same extent and resolution, see 'Details' for required raster layers.
- **rech**: RasterStack; something...
- **well**: data.frame; something...
- **id**: character; a short identifier for the model run.
- **dir.run**: character; the path name of the directory to write model input files.
- **perlen**: integer; the period length for the simulation, in days.
CreateModflowInputFiles

Details

Steady-state flow in the WRV aquifer is simulated using the MODFLOW-USG groundwater flow model. This numerical model was chosen for its ability to solve complex unconfined groundwater flow simulations. The solver implemented in MODFLOW-USG incorporates the Newton-Raphson formulation for improving solution convergence and avoiding problems with the drying and rewetting of cells (Niswonger and others, 2011). A structured finite-difference grid was implemented in the model to (1) simplify discretization, (2) keep formats and structures for the MODFLOW-USG packages identical to those of MODFLOW-2005, and (3) allow any MODFLOW post-processor to be used to analyze the results of the MODFLOW-USG simulation (such as Model Viewer).

Model input files are written to dir.run and include the Name (‘.nam’), Basic (‘.bae’), Discretization (‘.dis’), Zone (‘.zon’), Layer-Property Flow (‘.lfp’), Flow and Head Boundary (‘.fhp’), Drain (‘.drn’), River (‘.riv’), Connected Linear Network (‘.cln’), Well (‘.wel’), Sparse Matrix Solver (‘.sms’), and Output Control (‘.oc’) files. See the users guide (Description of Model Input and Output) included with the MODFLOW-USG software for details on input file formats and structures. The Layer-Property Flow file includes options for the calculation of vertical flow in partially dewatered cells. For the WRV model, where there is no indication that perched conditions exist, CONSTANTcv and NOVFC options are used to create the most stable solution (Panday and others, 2013, p. 15-16). Options for the Sparse Matrix Solver were set for unconfined simulations by implementing an upstream-weighting scheme with Newton-Raphson linearization, Delta-Bar-Delta under-relaxation, and the χMD solver of Ibaraki (2005).

The required raster layers in the raster stack rs.model include the following:

- **lay1.ibound** is the boundary variable in model layer 1 where values < 0 is a constant hydraulic head, = 0 is inactive, and > 0 is active.
- **lay2.ibound** is the boundary variable in model layer 2.
- **lay3.ibound** is the boundary variable in model layer 3.
- **lay1.strt** is the initial (starting) hydraulic head in model layer 1, in meters above the North American Vertical Datum of 1988 (NAVD 88).
- **lay2.strt** is the initial hydraulic head in model layer 2.
- **lay3.strt** is the initial hydraulic head in model layer 3.
- **lay1.top** is the elevation at the top of model layer 1 (land surface), in meters above the NAVD 88.
- **lay1.bot** is the elevation at the bottom of model layer 1, in meters above the NAVD 88.
- **lay2.bot** is the elevation at the bottom of model layer 2.
- **lay3.bot** is the elevation at the bottom of model layer 3.
- **lay1.zones** is the hydrogeologic zones in model layer 1 where values = 1 is unconfined alluvium, = 2 is basalt, = 3 is clay (aquitard), and = 4 is confined alluvium.
- **lay2.zones** is the hydrogeologic zones in model layer 2.
- **lay3.zones** is the hydrogeologic zones in model layer 3.
- **riv.reach** is the stream reach number identifier.
- **riv.bottom** is the elevation of the bottom of the riverbed sediments.
- **riv.stage** is the stage elevation of the stream.

Value

Returns an object of class NULL.
Groundwater Diversions

Description

Groundwater diversions recorded by Water District 37 or municipal water providers.

Usage

div.gw

Format

A data.frame object with 7,095 records and the following variables:

- **YearMonth** is the year and month during which diversions were recorded, with a required date format of YYYYMM.
- **Diversion** is the name of the well.
- **Reach** is the name of the river subreach into which the well water is discharged; only applicable to exchange wells.
- **BigReach** is the name of the river reach into which the well water is discharged; only applicable to exchange wells.
- **EntityName** is the name of the irrigation entity which the well supplies water.
- **WMISNumber** is the well number in the Idaho Department of Water Resources (IDWR) Water Measurement Information System.
- **GWDiv** is the volume of water diverted during the month, in cubic meters.
**Source**

IDWR; compiled data records from Water District 37 and 37M, City of Ketchum, Sun Valley Water and Sewer District, City of Hailey, and City of Bellevue.

**Examples**

```
str(div.gw)
```

---

<table>
<thead>
<tr>
<th>div.sw</th>
<th>Surface Water Diversions</th>
</tr>
</thead>
</table>

**Description**

Surface water diversions recorded by Water District 37 or municipal water providers.

**Usage**

`div.sw`

**Format**

A data.frame object with 14,941 records and the following variables:

- **YearMonth** is the year and month during which diversions were recorded, with a required date format of `YYYYMM`.
- **Diversion** is the name of the surface-water diversion.
- **Reach** is the river subreach from which the water is diverted.
- **BigReach** is the river reach from which the water is diverted.
- **EntityName** is the name of the irrigation entity which the diversion supplies water.
- **SWDiv** is the volume of water diverted during the month, in cubic meters.

**Source**

Idaho Department of Water Resources; compiled data records from Water District 37 and 37M, City of Hailey, and City of Bellevue.

**Examples**

```
str(div.sw)
```
div.ww  Wastewater Treatment Plant Diversions

Description
Recorded discharge from wastewater treatment plants.

Usage
div.ww

Format
A data frame object with 1,080 records and the following variables:

- **YearMonth** is the year and month during which diversions were recorded, with a required date format of YYYMM.
- **Return** is the name of the wastewater treatment plant.
- **Reach** is the name of the river subreach to which treated effluent is discharged; only applicable to wastewater treatment plants that discharge to the river.
- **BigReach** is the name of the river reach to which treated effluent is discharged; only applicable to wastewater treatment plants that discharge to the river.
- **EntityName** is the name of the irrigation entity served by the wastewater treatment plant.
- **WWDiv** is the volume of wastewater discharged during the month, in cubic meters.

Source
Idaho Department of Water Resources and U.S. Geological Survey; compiled data records from the U.S. Environmental Protection Agency for plants that discharge to the river, and from records of the Idaho Department of Environmental Quality for plants that discharge to land application.

Examples
str(div.ww)

---

DownloadFile  Download File from the Internet

Description
This function downloads a file from the Internet.

Usage
DownloadFile(url, dest.dir = tempdir(), mode = NULL, extract = TRUE, max.attempts = 10L, wait.time = 30)
Arguments

url character; the URL of a resource to be downloaded.

dest.dir character; the directory where the downloaded file is saved.

mode character; The mode with which to write the file, such as "w", "wb" (binary), "a" (append) and "ab".

extract logical; if TRUE, an attempt is made to extract files from the file archive.

max.attempts integer; the maximum number of attempts to download a file.

wait.time numeric; the time in seconds to wait between download attempts.

details

This function requires the suggested package RCurl.

Value

Returns the file path(s) to the downloaded file (or uncompressed files).

Author(s)

J.C. Fisher

See Also

CFILE, curlPerform

Examples

files <- DownloadFile(url)
unlink(files)

drains

Drain Locations

Description

Polygons used to define the locations of drain boundaries in the model domain. The polygons clip the line segments along the aquifer boundary (see aquifer.extent), and model cells intersecting these clipped-line segments are defined as boundary cells.

Usage

drains

Format

An object of SpatialPolygonsDataFrame-class containing a set of 2 Polygons and a data.frame with the following variable:

Name is an identifier for the polygon.

Geographic coordinates are in units of meters, in conformance with the North American Datum of 1983 (NAD 83), and placed in an Idaho Transverse Mercator projection (IDTM).
Source

A Keyhole Markup Language (KML) file created in Google Earth with polygons drawn by hand in areas of known drains.

Examples

plot(drains)
str(drains)

<table>
<thead>
<tr>
<th>efficiency</th>
<th>Irrigation Efficiency</th>
</tr>
</thead>
</table>

Description

Irrigation efficiency for each irrigation entity.

Usage

efficiency

Format

A data.frame object with 89 records and the following variables:

EntityName  is the name of the irrigation entity which the irrigation efficiency is applied.
Eff  is the estimated irrigation efficiency, the ratio of the amount of water consumed by the crop to the amount of water supplied through irrigation.

Source

Idaho Department of Water Resources

Examples

str(efficiency)

<table>
<thead>
<tr>
<th>entity.components</th>
<th>Irrigation Entity Components</th>
</tr>
</thead>
</table>

Description

Something...

Usage

entity.components
**Format**

A list object with components of `SpatialPolygonsDataFrame-class`. There are a total of 192 components, one `SpatialPolygonsDataFrame` for each month in the 1995-2010 time period. Linked `data.frame` objects have the following variables:

- **EntitySrce** is a concatenation of the `EntityName` and `Source` character strings.
- **mean.et** something...
- **area** something...
- **PrecipZone** is the name of the precipitation zone. See `precip.zones` dataset for details.
- **et.vol** something...
- **precip.vol** something...
- **cir.vol** something...
- **EntityName** is the name of the irrigation entity served by a group of diversions.
- **Source** is the water source: “Mixed” for a mixture of surface water and groundwater, “SW Only” for surface water only, and “GW Only” for groundwater only.

**Source**

Something...

**Examples**

```r
names(entity.components)
print(entity.components[["199506"]])
```

---

### Evapotranspiration

**Description**

Evapotranspiration (ET) in the Wood River Valley and surrounding areas. Defined as the amount of water lost to the atmosphere via direct evaporation, transpiration by vegetation, or sublimation from snow covered areas.

**Usage**

```r
et
```

**Format**

An object of class `RasterStack`, a collection of raster layers. There are a total of 192 layers, one layer for each month in the 1995-2010 time period. Each cell on a layers surface grid represents the monthly depth of ET in meters. Geographic coordinates are in units of meters, in conformance with the North American Datum of 1983 (NAD 83), and placed in a Idaho Transverse Mercator projection (IDTM).

**Source**

Idaho Department of Water Resources
et.method

See Also

et.method

Examples

rasterOptions(standardnames = FALSE)
print(et)
plot(et[["199505"]])

et.method

Method Used to Calculate Evapotranspiration

Description

The methods used to estimate evapotranspiration (ET) values.

Usage

et.method

Format

A data.frame object with 122 records with the following variables:

YearMonth The year and month during which the method was applied, with a required date format of YYYYMM.

ETMethod An identifier that indicates the method used to estimate ET values. Identifiers include: “MET”, the Mapping Evapotranspiration at high Resolution and with Internalized Calibration (METRIC) evapotranspiration model. “NET”, the correlation between Normalized Difference Vegetation Index (NDVI) and historic ET values. “INT”, interpolating form historic ET values. “ADJ”, interpolating form historic ET values and adjusted to remove outliers. “WNT”, the Allen and Robison method.

Source

Idaho Department of Water Resources

References

ET Idaho: http://data.kimberly.uidaho.edu/ETIdaho/

Examples

str(et.method)
Exclude Small Cell Chunks

Description

A cell chunk is defined as a group of connected cells with non-missing values. This function identifies cell chunks in a single raster grid layer. The chunk with the largest surface area is preserved and all others removed.

Usage

`ExcludeSmallCellChunks(r)`

Arguments

- `r`: RasterLayer; a raster grid layer with cell values.

Value

The raster grid layer `r` with cell values in the smaller cell chunks set to NA.

Author(s)

J.C. Fisher

See Also

`clump`

Examples

```r
set.seed(0)
r <- raster(ncols = 10, nrows = 10)
r[] <- round(runif(ncell(r)) * 0.7)
r <- clump(r)
plot(r)

r.new <- ExcludeSmallCellChunks(r)
plot(r.new, zlim = range(r[,], na.rm = TRUE))
```

Export Raster Stack

Description

Write raster-stack layers to a local directory in multiple formats (such as Text, PNG, and GeoTIFF).

Usage

`ExportRasterStack(p, rs, NAflag = -999)`
Extract Along Transect

Arguments

- \( p \) character; path name to write raster stack.
- \( rs \) \texttt{RasterStack}; a collection of \texttt{RasterLayer} objects with the same extent and resolution.
- \( \text{NAflag} \) numeric; to overwrite the default value used to represent NA in a file.

Details

Three directories (‘Text’, ‘PNG’, and ‘GeoTIFF’) are created in the path \( p \) and named after the intended data format for files it will contain. A file is written for each raster layer in the raster stack \( rs \) and for each format type. Base names for files are a concatenation of layer order in the raster stack, layer name, and an extension consistent with its data format (‘.txt’, ‘.png’, and ‘.tif’). An external representation of the \texttt{RasterStack} object is also written to path \( p \) and given the name ‘raster.stack.rda’.

Value

Returns an object of class \texttt{NULL}.

Author(s)

J.C. Fisher

Examples

```r
## Not run
load(file = file.path(getwd(), "20130926130613", "Data", "raster.stack.rda"))
ExportRasterStack(tempdir(), rs)
## End(Not run)
```

Extract Along Transect

Extract Raster Values Along Transect

Description

Extract values from raster layer(s) along a user defined transect line.

Usage

\( \text{ExtractAlongTransect}(r, v, \text{rtn.polygon = FALSE}) \)

Arguments

- \( r \) \texttt{RasterLayer} or \texttt{RasterStack}; the raster layer(s).
- \( v \) \texttt{SpatialPoints}; the transect line vertices.
- \( \text{rtn.polygon} \) logical; if TRUE, a polygon is returned. See ‘Value’ for additional information.

Details

The transect line is described using a simple polygonal chain. Transect line vertices and raster layer(s) must be specified in a coordinate reference system.
Value

If \( r \) is a \texttt{RasterLayer} or \texttt{rtn.poly} is FALSE, a list is returned with components of class \texttt{SpatialPointsDataFrame}. These components represent continuous line segments along the transect line. The following variables are specified for each coordinate point in the line segment:

- \texttt{d} numeric; the distance along the transect line.
- \texttt{z1} numeric; the value of raster layer \( r1 \).
- \texttt{z2} numeric; the value of raster layer \( r2 \).

Alternatively, if \( r \) is a \texttt{RasterStack} and \texttt{rtn.poly} is TRUE, a polygon of class \texttt{gpc.poly} is returned. Georeferencing is absent from the polygon with \( x \) representing the distance along the transect line and \( y \) representing the raster layer value.

Author(s)

J.C. Fisher

Examples

```r
coords <- rbind(c(-100, -90), c(80, 90), c(80, 0), c(40, -40))
crs <- CRS("+proj=longlat +datum=WGS84")
v <- SpatialPoints(coords, proj4string = crs)
R1 <- raster(nrows = 10, ncols = 10, ymn = -80, ymx = 80)
set.seed(1)
R1[] <- runif(ncell(R1))
R1[1, 6] <- NA
plot(R1, xlab = "x", ylab = "y")
lines(SpatialLines(list(Lines(list(Line(coords)), ID = "Transect")), proj4string = crs))
points(v, pch = 21, bg = "grey")
segs <- extractalongtransect(R1, v = v)
for (i in 1:length(segs))
points(segs[[i]], col = "blue")
xlab <- "Distance along transect"
ylab <- "Value"
xlim <- range(vapply(segs, function(seg) range(seg@data["d"])), c(0, 0))
ylim <- range(vapply(segs, function(seg) range(seg@data["z1"])), c(0, 0))
dev.new()
plot(NA, type = "n", xlab = xlab, ylab = ylab, xlim = xlim, ylim = ylim)
for (i in 1:length(segs))
lines(segs[[i]]@data[, c("d", "z1")], col = rainbow(length(segs))[i])
n <- length(v)
d <- cumsum(c(0, as.matrix(dist(coordinates(v)))[cbind(1:(n - 1), 2:n)]))
abline(v = d, col = "grey", lty = 2)
mtext(paste("d", paste(head(coordinates(v), 1), collapse = ", ", ")", adj = 0)
mtext(paste("d", paste(tail(coordinates(v), 1), collapse = ", ", ")", adj = 1)
r2 <- sum(R1, 2.0, na.rm = TRUE)
ply <- ExtractAlongTransect(stack(R1, r2), v = v, rtn.poly = TRUE)
dev.new()
plot(ply, asp = 100, xlab = xlab, ylab = ylab, poly.args = list(col = "lightblue"))
abline(v = d, col = "grey", lty = 2)
mtext(paste("Cross sectional area =", format(area.poly(ply))))
```

"ExtractAlongTransect" 21
GetSeasonalMultiplier  Get Seasonal Multiplier

Description

This function determines the seasonal fraction of the mean.

Usage

GetSeasonalMultiplier(x, reduction, d.in.mv.ave, dlim)

Arguments

- x: data.frame; a time series with date and numeric components.
- reduction: numeric; a factor in the signal amplitude reduction algorithm. Its magnitude should be greater than or equal to 1, where a value of 1 indicates no reduction in the signal amplitude.
- d.in.mv.ave: numeric; the number of days in the moving average subset.
- dlim: Date; a vector of length 2 giving the start and end dates for the time period of interest.

Details

A simple moving average is first calculated for each month using the previous data. The seasonal average of the monthly moving average is then passed through a signal amplitude reduction algorithm. The reduced values are then divided by the mean of the seasonal reduced data to give the seasonal fraction of the mean (seasonal multiplier).

Value

An object of class data.frame with date and numeric components; that is, the starting date and multiplier for each season.

Author(s)

J.C. Fisher, A. Wylie, J.R. Bartolino, and J. Sukow

Examples

m <- GetSeasonalMultiplier(hailey.discharge, 2, 273.932, as.Date(c("1995-01-01", "2010-12-31")))
f <- vapply(tributaries$Flow, function(i) m$multiplier * i, rep(0, nrow(m)))
colnames(f) <- tributaries$ID
d <- cbind(m, f)
str(d)
Description
Something...

Usage
GetWellConfig(pod.rech, rs.model, lay2.hk.tol = 1e-02)

Arguments
pod.rech data.frame; something...
rs.model RasterStack; see CreateModflowInputFiles for details.
lay2.hk.tol numeric; something...

Details
Something...

Value
An object of class data.frame with the following components:

| WMISNumber | numeric; a unique number assigned to a water right point of diversion. |
| lay        | integer; layer number in model grid. |
| row        | integer; row number in model grid. |
| col        | integer; column number in model grid. |
| hk         | numeric; something... |
| thk        | numeric; something... |
| frac       | numeric; something... |
| 199501, ..., 201012 | numeric; something... |
| ss         | numeric; something... |

Author(s)
J.C. Fisher, and A. Wylie

Examples
print("something")
### hailey.discharge

**Mean Daily Discharge at Hailey Gaging Station**

**Description**
Mean daily discharge in the Big Wood River recorded at the USGS 13139510 stream gage, Big Wood River at Hailey Idaho. Daily values bracket the 1995-2010 modeling period to accommodate calculation of a moving average.

**Usage**
hailey.discharge

**Format**
A data.frame object with 7,671 records and the following variables:

- **Date** is the date during which discharge was recorded.
- **Disch** is the daily mean discharge in cubic meters per day.
- **Code** is a qualification code: ‘A’ is processed and reviewed data, ‘P’ is provisional data subject to revision, and ‘e’ is estimated data.

**Source**

**Examples**
str(hailey.discharge)

### hill.shading

**Land Surface Hill Shading**

**Description**
Something...

**Usage**
hill.shading

**Format**
Something...

**Source**
Something...

**Examples**
plot(hill.shading)
infil.basins  

**Description**

Something...

**Usage**

```r
infil.basins
```

**Format**

An object of `SpatialPolygonsDataFrame-class` containing 1 Polygons and a data.frame with the following variable:

- **RechSite** is the name of the recharge site.

**Source**

Something...

**Examples**

```r
plot(infil.basins)
print(infil.basins)
```

infiltration  

**Description**

Recharge from infiltration basins in the Wood River Valley.

**Usage**

```r
infiltration
```

**Format**

A data.frame object with 216 records and the following variables:

- **YearMonth** is the year and month during which recharge was recorded, with a required date format of `YYYYMM`.
- **RechSite** is the name of the recharge site, see `infil.basins` dataset for details.
- **Rech** is the monthly volume of recharge in cubic meters.

**Source**

Something...
References

Something...

Examples

str(infiltration)

<table>
<thead>
<tr>
<th>irr.entities</th>
<th>Irrigation Entities</th>
</tr>
</thead>
</table>

Description

Delineation of areas served by a group of surface water and (or) groundwater diversions.

Usage

irr.entities

Format

An object of SpatialPolygonsDataFrame-class containing 210 Polygons and a data.frame with the following variables:

- **EntityName** is the name of the irrigation entity served by a group of diversions.
- **Source** is the water source: “Mixed” for a mixture of surface water and groundwater, “SW Only” for surface water only, and “GW Only” for groundwater only.
- **EntitySrce** is a concatenation of the EntityName and Source character strings.
- **PrecipZone** is the name of the precipitation zone. See precip.zones dataset for details.

Source

Idaho Department of Water Resources (IDWR); derived from IDWR water rights database, Blaine County tax lot data, and IDWR irrigated land classification files.

Examples

plot(irr.entities)
print(irr.entities)
irr.lands

Irrigated Lands

Description


Usage

irr.lands

Format

A list object of length 7 with components of SpatialPolygonsDataFrame-class. The data.frame associated with each of the SpatialPolygons objects has the following variable:

Status is the status of land during the year reviewed, may be “irrigated”, “semi-irrigated”, or “non-irrigated”.

Source

Idaho Department of Water Resources; polygons derived from U.S. Department of Agriculture Common Land Unit polygons with some refinement of polygons. Irrigation status interpreted using satellite imagery and aerial photography.

See Also

irr.lands.year

Examples

spplot(irr.lands[["2010"]], "Status")
print(irr.lands)

irr.lands.year

Irrigation Lands for Year

Description

Land classification specifying irrigation practices is not available for all years. For missing years, this dataset provides substitute years when land-classification was available (see irr.lands).

Usage

irr.lands.year
**Format**

A data.frame object with 16 records and the following variables:

- **Year** is the year with a required date format of `YYYY`.
- **IL_Year** is the substitute year with a required date format of `YYYY`.

**Source**

Idaho Department of Water Resources

**Examples**

```r
str(irr.lands.year)
```

---

**Description**

Lakes and reservoirs of the Wood River Valley and surrounding areas.

**Usage**

```r
lakes
```

**Format**

An object of `SpatialPolygonsDataFrame-class` containing 55 Polygons. Geographic coordinates are in units of meters, in conformance with the North American Datum of 1983 (NAD 83), and placed in a Idaho Transverse Mercator projection (IDTM).

**Source**

Idaho Department of Water Resources (IDWR)

**Examples**

```r
plot(lakes)
str(lakes)
```
Description

The Wood River Valley (WRV) is a geologic feature located in south-central Idaho. This dataset gives the topography of the land surface in the WRV and vicinity.

Usage

land.surface

Format

An object of class `SpatialGridDataFrame-class`. Each cell on the surface grid represents an elevation in meters above the North American Vertical Datum of 1988 (NAVD 88). Geographic coordinates are in units of meters, in conformance with the North American Datum of 1983 (NAD 83), and placed in a Idaho Transverse Mercator projection (IDTM). The spatial grid is composed of 565 rows and 429 columns, and has cell sizes that are constant at 100 meters by 100 meters.

Source

The National Elevation Dataset (NED) 1/3-arc-second raster (Gesch, 2007; Gesch and others, 2002). This dataset was downloaded on September 22, 2013 in a Esri ArcGRID format using the National Map Viewer. NED data are distributed in geographic coordinates in units of decimal degrees, and in conformance with the NAD 83. Elevation values are in meters above the NAVD 88. The west, east, south, and north bounding coordinates for this dataset are -115, -114, 43, and 44 decimal degrees, respectively. Post-processing includes: (1) project the values of the NED dataset into the `alluvium.bottom` spatial grid using bilinear interpolation, and (2) set values in cells where the elevation of the alluvium bottom is missing to `NA`.

References


Examples

image(land.surface)
summary(land.surface)
map.labels  

**Map Labels**

**Description**

Map labels in the Wood River Valley and surrounding areas.

**Usage**

map.labels

**Format**

An object of `SpatialPointsDataFrame-class` containing 6 points. Geographic coordinates are in units of meters, in conformance with the North American Datum of 1983 (NAD 83), and placed in a Idaho Transverse Mercator projection (IDTM).

**Source**

Best estimates of label locations.

**Examples**

```r
plot(map.labels, col = "red")
lab <- cbind(map.labels@coords, map.labels@data)
for (i in seq_len(nrow(lab))) {
  text(lab$x[i], lab$y[i], labels = lab$label[i], cex = lab$cex[i],
       col = lab$col[i], font = lab$font[i], srt = lab$srt[i])
}
```

---

**PlotMap**

**Plot Map**

**Description**

Map values of a raster layer. A key showing how the colors map to raster values is shown below the map.

**Usage**

```r
PlotMap(r, layer = 1, att = NULL, n, breaks, xlim = NULL, ylim = NULL,
        zlim = NULL, asp = 1, extend.xy = FALSE, extend.z = FALSE,
        reg. axs = TRUE, trim.r = TRUE, dms.tick = FALSE, bg.lines = FALSE,
        bg.image = NULL, bg.image.alpha = 1, pal = rainbow, col = NULL,
        max.dev.dim = c(43, 56), bw = NULL, scale.loc = "bottomleft",
        arrow.loc = NULL, explanation = NULL, credit = proj4string(r),
        shade = NULL, contour.lines = NULL, rivers = NULL, lakes = NULL,
        useraster = TRUE, dev.type = c("cur", "new", "pdf", "png"),
        file = "Rplot")
```
Arguments

- **r**: `RasterLayer`, `SpatialGridDataFrame`, or `CRS`; a raster layer with values to be plotted or a coordinate reference system (CRS).
- **layer**: integer; the column to use in the `SpatialGridDataFrame`.
- **att**: numeric or character; the variable identifying the levels attribute to use in the Raster Attribute Table (RAT). This argument requires `r` values that are of class factor.
- **n**: integer; the desired number of intervals to partition the range of raster values (or `zlim` if specified) (optional).
- **breaks**: numeric; a vector of break points used to partition the colors representing numeric raster values (optional).
- **xlim**: numeric; a vector of length 2 giving the minimum and maximum values for the x-axis.
- **ylim**: numeric; a vector of length 2 giving the minimum and maximum values for the y-axis.
- **zlim**: numeric; a vector of length 2 giving the minimum and maximum raster values for which colors should be plotted.
- **asp**: numeric; the y/x aspect ratio for spatial axes.
- **extend.xy**: logical; if TRUE, the spatial limits will be extended to the next tick mark on the axes beyond the grid extent.
- **extend.z**: logical; if TRUE, the raster value limits will be extended to the next tick mark on the color key beyond the measured range.
- **reg.axs**: logical; if TRUE, the spatial data range is extended.
- **trim.r**: logical; if TRUE, the outer rows and columns that consist of all NA values will be removed.
- **dms.tick**: logical; if TRUE, the axes tickmarks are specified in degrees, minutes, and decimal seconds.
- **bg.lines**: logical; if TRUE, the graticule is drawn in back of the raster layer using white lines and a grey background.
- **bg.image**: `RasterLayer`; an image to drawn in back of the main raster layer `r`.
- **bg.image.alpha**: numeric; the opacity of the background image from 0 to 1.
- **pal**: function; a color palette to be used to assign colors in the plot.
- **col**: character; a vector of colors to be used in the plot. This argument requires breaks specification for numeric values of `r` and overrides any palette function specification. For numeric values there should be one less color than breaks. Factors require a color for each level.
- **max.dev.dim**: numeric; a vector of length 2 giving the maximum width and height for the graphics device in picas. Suggested dimensions for single-column, double-column, and sidetitle figures are `c(21, 56)`, `c(43, 56)`, and `c(56, 43)`, respectively.
- **bw**: numeric; the width of the color key box in picas. This argument requires `r` values that are of class factor.
- **scale.loc**: character; the position of the scale bar: "bottomleft", "topleft", "topright", or "bottomright" to denote scale location.
- **arrow.loc**: character; the position of the north arrow: "bottomleft", "topleft", "topright", or "bottomright" to denote arrow location.
explanation character; a label explaining the raster value.

credit character; a label crediting the base map.

shade list; if specified, a semi-transparent shade layer is drawn on top of the raster layer. This layer is described using a list of arguments supplied to `hillshade`. Passed arguments include “angle” and “direction”. Additional arguments may also be passed that control the vertical aspect ratio (“z.factor”) and color opacity (“alpha”).

contour.lines list; if specified, contour lines are drawn. The contours are described using a list of arguments supplied to `contour`. Passed arguments include “drawlables”, “method”, and “col”.

rivers list; if specified, lines are drawn. The lines are described using a list of arguments supplied to the plot method for `SpatialLines`. Passed arguments include “x”, “col”, and “lwd”.

lakes list; if specified, polygons are drawn. The polygons are described using a list of arguments supplied to the plot method for `SpatialPolygons`. Passed arguments include “x”, “col”, “border”, and “lwd”.

useRaster logical; if TRUE, a bitmap raster is used to plot the image instead of polygons. Bitmap images require a regular grid.

dev.type character; the graphics device type. Defaults to the ‘active’ device (“cur”) and if it is unavailable a new device (“new”) is opened based on `getOption(“device”)`. Specification of a file argument is required to open a new graphic device for a PDF formatted file (“pdf”) or PNG formatted bitmap file (“png”).

file character; the name of the output file. Requires a dev.type of “pdf” or “png”.

Details

The dimensions of a new graphics device is dependent on the argument values of `max.dev.dim` and `asp`.

Value

Returns a list object with graphical parameters “din” and “usr”. See `par` for details.

Author(s)

J.C. Fisher

Examples

```r
r <- raster(system.file(“external/test.grd”, package=“raster”))
PlotMap(r, scale.loc = “topleft”, dms.tick = TRUE, trim.r = TRUE)
```

graphics.off()
r <- raster(nrow = 10, ncol = 10)
r[1:5] <- 1L
r[51:100] <- 2L
r[3:6, 1:5] <- 8L
r <- ratify(r)
rat <- levels(r)[[1]]
rat$land.cover <- c(“Pine”, “Oak”, “Meadow”)
rat$code <- c(12, 25, 30)
```
Description

Points of diversion for groundwater within the Wood River Valley model study area.

Usage

`pod.gw`

Format

A data.frame object with 1,081 records and the following variables:

- **WMISNumber** is a unique number assigned to a water right point of diversion.
- **WaterRight** is a number identifying a specific authorization to use water in a prescribed manner.
- **EntityName** is the name of the irrigation entity the point of diversion is assigned to.
**EntitySrc** is the source of water for an irrigation entity. Possible sources of water include surface water, groundwater and mixed. Mixed source entities derive water from both groundwater and surface water.

**Pdate** is the priority date, the date the water right was established.

**IrrRate** is the irrigation rate in cubic meters per day, the maximum permitted water use rate associated with a water right.

**Source**

Idaho Department of Water Resources water rights database.

**See Also**

pod.wells

**Examples**

summary(pod.gw)

## pod.wells

### Groundwater Points of Diversion, Wells

**Description**

Groundwater points of diversion, wells, within the Wood River Valley model study area.

**Usage**

pod.wells

**Format**

An object of `SpatialPointsDataFrame-class` containing 563 points with the following variables:

- **WMISNumber** is a unique number assigned to a water right point of diversion.
- **WellUse** is the permitted use(s) for a groundwater well.
- **TopOpen1** is the depth to the top of the first open interval in a groundwater well, in meters below land surface.
- **BotOpen1** is the depth to the bottom of the first open interval in a groundwater well, in meters below land surface.
- **TopOpen2** is the depth to the top of the second open interval in a groundwater well, in meters below land surface.
- **BotOpen2** is the depth to the bottom of the second open interval in a groundwater well, in meters below land surface.
- **Pred** is a logical value indicating a completion report is not available for the well and values of `TopOpen1` and `BotOpen1` were predicted using opening information from the nearest irrigation well.

**Source**

Idaho Department of Water Resources water rights database.
precip.zones

See Also

pod.gw

Examples

plot(pod.wells)
str(pod.wells@data)

precip.zones  Precipitation Zones

Description

Precipitation zones specified for the Wood River Valley and surrounding areas. There are three precipitation zones, each containing a single weather station. Precipitation zones were distributed to maintain the geographic similarity between weather stations and zones.

Usage

precip.zones

Format

An object of SpatialPolygonsDataFrame-class containing 3 Polygons and a data.frame with the following variables:

ID  a numeric identifier assigned to the polygon.

PrecipZone  the name of the precipitation zone: “Ketchum”, the northernmost zone with data from the Ketchum National Weather Service coop weather station. “Hailey”, the central zone with data from the Hailey 3NNW National Weather Service coop weather station. “Picabo”, the southernmost zone with data from the Picabo AgriMet weather station.

Geographic coordinates are in units of meters, in conformance with the North American Datum of 1983 (NAD 83), and placed in a Idaho Transverse Mercator projection (IDTM).

Source

Idaho Department of Water Resources

See Also

precipitation

Examples

spplot(precip.zones, "PrecipZone")
print(precip.zones)
precipitation

**Description**

Precipitation data recorded at three weather stations in the Wood River Valley and surrounding areas.

**Usage**

precipitation

**Format**

A data.frame object with 576 records and the following variables:

- **YearMonth** is the year and month during which precipitation were recorded, with a required date format of **YYYYMM**.
- **PrecipZone** is the name of the precipitation zone, see `precip.zones` dataset for details.
- **Precip** is the monthly precipitation in meters.

**Source**

Idaho Department of Water Resources

**References**

National Oceanic and Atmospheric Administration’s National Weather Service (NWS) Cooperative Observer Program

U.S. Bureau of Reclamation’s Cooperative Agricultural Weather Network (AgriMet)

**Examples**

```R
str(precipitation)
```

---

priority.cuts

**Description**

Priority cut dates applied to Big Wood River above Magic Reservoir and Silver Creek by Water District 37 and 37M on the 16th of each month.

**Usage**

priority.cuts
ProcessRecharge

Format

A data.frame object with 112 records and the following variables:

- **YearMonth** is the year and month during of the priority cut date, with a required date format of **YYYYMM**.
- **Pdate_BWR** is the date of the priority cut applied to Big Wood River above Magic Reservoir by Water District 37.
- **Pdate_SC** is the date of the priority cut applied to Silver Creek by Water District 37M.

Source

Idaho Department of Water Resources compiled priority cut dates in effect on the 16th of each month from Water District 37 and 37M records.

Examples

```
str(priority.cuts)
```

---

### Description

Something...

### Usage

```
ProcessRecharge(tr.stress.periods, rs.model, write.summary = FALSE)
```

### Arguments

- **tr.stress.periods**
  
  Date; something...

- **rs.model**
  
  RasterStack; something...

- **write.summary**
  
  logical; if TRUE, tables summarizing water diversions are written to the working directory.

### Details

Something...

### Value

Returns a list object with RasterBrick and data.frame components.

### Author(s)

J.C. Fisher, J. Sukow, and M. McVay

### Examples

```
## Not run: # see wrv-process vignette
```
public.parcels  Public Land Parcels

Description
Public land parcels in the Wood River Valley and surrounding areas.

Usage
public.parcels

Format
An object of SpatialPolygons-class containing 638 Polygons.

Source
Idaho Department of Water Resources; derived from Blaine County tax lots.

Examples
plot(public.parcels)
print(public.parcels)

r.canals  Rasterized Canals

Description
Something...

Usage
r.canals

Format
An object of class RasterLayer.

Source
Something...

Examples
plot(r.canals)
summary(r.canals)
Description

Read binary output data from a MODFLOW run.

Usage

ReadModflowBinaryFile(f, data.type = c("array", "flow"))

Arguments

f character; the name of the binary file.
data.type character; a description of how the data is saved.

Details

This function reads binary head (`.hds`), drawdown (`.ddn`), and budget (`.bud`) files generated from a MODFLOW run.

Value

Returns a list object of length equal to the number of times the data type is written to the binary file. List components are list objects with the following components:

d matrix or data.frame; the data values.
kstp integer; the time step.
kper integer; the stress period.
desc character; the variable name.
ilay integer; the model-grid layer.
pertim numeric; the time in the stress period.
totim numeric; the total elapsed time.

Author(s)

J.C. Fisher

See Also

readBin

Examples

## Not run:
obj <- ReadModflowBinaryFile(file.path(getwd(), "Run", "wrv_ss_mfusg.hds"), "array")
str(obj)
## End(Not run)
ReadModflowListFile  Read Volumetric Budget from MODFLOW Listing File

Description

Reads and parses the volumetric budget for the entire model at the end of time step and stress period.

Usage

ReadModflowListFile(f)

Arguments

f  character; the name of the MODFLOW listing file.

Value

Returns a list object of length equal to the number of times the volumetric budget was written to the listing file. Each component is a list and represents a single volumetric budget with components:

caption  character; a title for the volumetric budget information.
time.step  integer; the time step in the model run.
stess.period  integer; the stress period in the model run.
inputs  matrix; the volume and rate for input components.
outputs  matrix; the volume and rate for output components.
discrepancy  matrix; the volume and rate for the discrepancy between inputs and outputs.

Author(s)

J.C. Fisher

See Also

readLines

Examples

## Not run:
budgets <- ReadModflowListFile(file.path(getwd(), "tr.lst"))
## End(Not run)
rivers

Rivers and Streams

Description
Rivers and streams of the Wood River Valley and surrounding areas.

Usage
rivers

Format
An object of `SpatialLinesDataFrame-class` containing 581 lines. Geographic coordinates are in units of meters, in conformance with the North American Datum of 1983 (NAD 83), and placed in a Idaho Transverse Mercator projection (IDTM).

Source
Idaho Department of Water Resources (IDWR)

Examples
```
spplot(rivers)
str(rivers)
```

rs.entities
Monthly Irrigation Entities

Description
Something...

Usage
rs.entities

Format
An object of class `RasterStack`.

Source
Something...

Examples
```
names(rs.entities)
plot(rs.entities[["199507"]])
```
### rs.rech.non.irr  
**Rasterized Monthly Recharge on Non-Irrigated Lands**

**Description**

Something...

**Usage**

```r
rs.rech.non.irr
```

**Format**

An object of class `RasterStack`.

**Source**

Something...

**Examples**

```r
names(rs.rech.non.irr)
plot(rs.rech.non.irr[["199507"]])
```

### SetPolygons  
**Analysis of Multi-Polygon Objects**

**Description**

Determines the intersection or difference between two multi-polygon objects.

**Usage**

```r
SetPolygons(x, y, cmd = c("gIntersection", "gDifference"), buffer.width = NA)
```

**Arguments**

- **x**: `SpatialPolygons*`; a multi-polygon object.
- **y**: `SpatialPolygons*`; a multi-polygon object.
- **cmd**: character; specifying "gIntersection", the default, cuts out portions of the x polygons that overlay the y polygons. If "gDifference" is specified, only those portions of the x polygons falling outside the y polygons are copied to the output polygons.
- **buffer.width**: numeric; expands or contracts the geometry of y to include the area within the specified width, see `gBuffer`. Specifying NA, the default, indicates no buffer.

**Details**

This function tests if the resulting geometry is valid, see `gIsValid`. 
soils

Value

Returns an object of class SpatialPolygons*

Author(s)

J.C. Fisher

See Also

gIntersection, gDifference

Examples

print("something...")

soils Soils

Description

Representation of mapped soil units created by the Idaho Office of the National Resource Conservation Service (NRCS). Soils have been assigned an infiltration rate based on the average, saturated hydraulic conductivity of the soils as classified using the Unified Soil Classification System (USCS).

Usage

soils

Format

An object of SpatialPolygonsDataFrame-class containing 288 Polygons and a data.frame with the following variables:

SoilLayer is an identifier used to differentiate the soil data source used to create the soils map. Data sources are either NRCS USCS or NRCS State Soil Geographic Data Base (STATSGO).

InfRate is the infiltration rate in meters per day.

Geographic coordinates are in units of meters, in conformance with the North American Datum of 1983 (NAD 83), and placed in a Idaho Transverse Mercator projection (IDTM).

Source

Idaho Department of Water Resources

Examples

spplot(soils, "InfRate")
str(soils@data)
### specified.floows  
*Specified Flow Locations*

**Description**

Polygons used to define the location of specified flow boundaries in the model domain. Model cells intersecting a polygon line segment are defined as specified flow cells. Cells within the body of the polygon but not a specified source cell are made inactive.

**Usage**

`specified.floows`

**Format**

An object of `SpatialPolygonsDataFrame-class` containing a set of 21 Polygons and a data frame with the following variable:

- **Name** is an identifier for the polygon, typically the abbreviated name of the gulch where the specified flow boundary is located.

Geographic coordinates are in units of meters, in conformance with the North American Datum of 1983 (NAD 83), and placed in a Idaho Transverse Mercator projection (IDTM).

**Source**

A Keyhole Markup Language (KML) file created in Google Earth with polygons drawn by hand in areas of known specified flow boundaries.

**Examples**

```r
plot(specified.floows)
str(specified.floows)
```

---

### tributaries  
*Estimated Annual Flows in the Tributaries*

**Description**

The estimated groundwater flow from tributary canyons into the Wood River Valley aquifer system, south-central Idaho.

**Usage**

`tributaries`
**Format**

A `data.frame` object with 22 records and the following variables:

- **Name** is the tributary name.
- **ID** is a unique tributary identifier.
- **BasinArea** is the basin area in square meters.
- **Flow** is the estimated volumetric flux in cubic meters per day.

**Source**

This dataset was derived by Darcian analysis of flux using an estimate of cross-sectional area of the saturated thickness in tributary canyons from well and geophysical data. Adjustments to these estimates were made for tributary canyons less than 2.6e+07 square meters (10 square miles) in area.

**Examples**

```r
str(tributaries)
```

---

**Description**

Wetlands in the Wood River Valley and surrounding areas.

**Usage**

`wetlands`

**Format**

An object of `SpatialPolygons-class` containing 3,024 Polygons.

**Source**

U.S. Fish and Wildlife Service National Wetlands Inventory

**Examples**

```r
plot(wetlands)
pdf(wetlands)
```
Index

*Topic IO
  DownloadFile, 14
  ExportRasterStack, 19
  ReadModflowBinaryFile, 39
  ReadModflowListFile, 40

*Topic datagen
  CreateModflowInputFiles, 10

*Topic datasets
  alluvium.bottom, 3
  aquifer.extent, 4
  aquitard.extent, 4
  basalt.extent, 5
  bwr.sc, 7
  canal.seep, 8
  canals, 8
  cities, 9
  comb.sw.rr, 9
  div.gw, 12
  div.sw, 13
  div.ww, 14
  drains, 15
  efficiency, 16
  entity.components, 16
  et, 17
  et.method, 18
  hailey.discharge, 24
  hill.shading, 24
  infill.basins, 25
  infiltration, 25
  irr.entities, 26
  irr.lands, 27
  irr.lands.year, 27
  lakes, 28
  land.surface, 29
  map.labels, 30
  pod.gw, 33
  pod.wells, 34
  precip.zones, 35
  precipitation, 36
  priority.cuts, 36
  public.parcel, 38
  r.canals, 38
  rivers, 41
  rs.entities, 41
  rs.reach.non.rr, 42
  soils, 43
  specified.flows, 44
  tributaries, 44
  wetlands, 45

*Topic hplot
  PlotMap, 30

*Topic manip
  GetSeasonalMultiplier, 22
  GetWellConfig, 23
  ProcessRecharge, 37

*Topic utilities
  BumpDisconnectedCells, 6
  ExcludeSmallCellChunks, 19
  ExtractAlongTranssect, 20
  SetPolygons, 42

  alluvium.bottom, 3, 29
  aquifer.extent, 4, 15
  aquitard.extent, 4
  basalt.extent, 5
  bwr.sc, 7
  canal.seep, 8, 9
  canals, 8, 8
  cities, 9
  clump, 19
  comb.sw.rr, 9
  contour, 32
  CreateModflowInputFiles, 10, 23
  CRS, 31
  div.gw, 12
  div.sw, 13
  div.ww, 14
  DownloadFile, 14
  drains, 15
  efficiency, 16
  entity.components, 16
  et, 17
  et.method, 18, 18
INDEX

ExcludeSmallCellChunks, 19
ExportRasterStack, 19
ExtractAlongTransect, 20

gBuffer, 42
gDifference, 43
getOption, 32
GetSeasonalMultiplier, 22
GetWellConfig, 23
gIntersection, 43
gIsValid, 42
gpc.poly, 21

hailey.discharge, 24
hill.shading, 24
hillShade, 32

infil.basins, 25, 25
infiltration, 25
irr.entities, 26
irr.lands, 27, 27
irr.lands.year, 27, 27

lakes, 28
land.surface, 29

map.labels, 30

par, 32
PlotMap, 30
pod.gw, 33, 35
pod.wells, 34, 34
Polygons, 35, 38, 43, 45
precip.zones, 17, 26, 35, 36
precipitation, 35, 36
priority.cuts, 36
ProcessRecharge, 37
public.parcel, 38

R.canals, 38
RasterLayer, 3, 6, 10, 19–21, 31, 38
RasterStack, 6, 17, 20, 41, 42
readBin, 39
readLines, 40
ReadModflowBinaryFile, 39
ReadModflowListFile, 40
rivers, 41
rs.entities, 41
rs.rech.non.irr, 42

SetPolygons, 42
soils, 43
SpatialGridDataFrame, 31
SpatialLines, 32

SpatialPoints, 20
SpatialPointsDataFrame, 21
SpatialPolygons, 32
SpatialPolygons*, 42
specified.flows, 44

tributaries, 44
wetlands, 45