Package 'Rsagacmd'

October 12, 2022

Type Package

Title Linking R with the Open-Source 'SAGA-GIS' Software

Version 0.2.0

Date 2022-04-01

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Description Provides an R scripting interface to the open-source 'SAGA-GIS'
(System for Automated Geoscientific Analyses Geographical Information
System) software. 'Rsagacmd' dynamically generates R functions for every
'SAGA-GIS' geoprocessing tool based on the user's currently installed
'SAGA-GIS' version. These functions are contained within an S3 object
and are accessed as a named list of libraries and tools. This structure
facilitates an easier scripting experience by organizing the large number
of 'SAGA-GIS' geoprocessing tools (>700) by their respective library.
Interactive scripting can fully take advantage of code autocompletion tools
(e.g. in 'Rstudio'), allowing for each tools syntax to be quickly
recognized. Furthermore, the most common types of spatial data (via the
'raster', 'terra', 'sp', and 'sf' packages) along with non-spatial data are
automatically passed from R to the 'SAGA-GIS' command line tool for
geoprocessing operations, and the results are loaded as the appropriate R
object. Outputs from individual 'SAGA-GIS' tools can also be chained using
pipes from the 'magrittr' and 'dplyr' packages to combine complex
geoprocessing operations together in a single statement. 'SAGA-GIS' is
available under a GPLv2 / LGPLv2 licence from
<https://sourceforge.net/projects/saga-gis/> including Windows x86/x64
binaries. SAGA-GIS is also included in Debian/Ubuntu default software
repositories and is available for macOS using homebrew (<https://brew.sh/>)
from the osgeo/osgeo4mac (<https://github.com/OSGeo/homebrew-osgeo4mac>)
formula tap, as well as being bundled within the 'QGIS' application bundle
for macOS. Rsagacmd has currently been tested on 'SAGA-GIS' versions
from 2.3.1 to 8.0.1 on Windows, Linux and macOS.

License GPL-3

Encoding UTF-8

SystemRequirements SAGA-GIS (>= 2.3.1)

RoxygenNote 7.1.2

Depends R (>= 2.10)

Imports generics, sf, raster, terra (>= 1.5.21), stars, tools, utils,
     rgdal, foreign, stringr, rlang, tibble, processx, rvest

Suggests dplyr, testthat (>= 3.0.0), covr

Config/testthat/edition 3

URL https://stevenpawley.github.io/Rsagacmd/

BugReports https://github.com/stevenpawley/Rsagacmd/issues

NeedsCompilation no

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Repository CRAN

Date/Publication 2022-04-04 04:10:02 UTC

R topics documented:

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mrvbf_threshold	*Calculate the t_slope value based on DEM resolution for MRVBF*

Description

Calculates the t_slope value for the Multiresolution Index of Valley Bottom Flatness (Gallant and Dowling, 2003) based on input DEM resolution. MRVBF identified valley bottoms based on classifying slope angle and identifying low areas by ranking elevation in respect to the surrounding topography across a range of DEM resolutions. The MRVBF algorithm was developed using a 25 m DEM, and so if the input DEM has a different resolution then the slope threshold t_slope needs to be adjusted from its default value of 16 in order to maintain the relationship between slope and DEM resolution. This function provides a convenient way to perform that calculation.

Usage

```
mrvbf_threshold(res)
```

Arguments

res   numeric, DEM resolution

Value

numeric, t_slope value for MRVBF

Examples

```
mrvbf_threshold(res = 10)
```

---

print.saga_tool	*Generic function to display help and usage information for any SAGA-GIS tool*

Description

Displays a tibble containing the name of the tool's parameters, the argument name used by Rsagacmd, the identifier used by the SAGA-GIS command line, and additional descriptions, default and options/constraints.

Usage

```
## S3 method for class 'saga_tool'
print(x, ...)
```

Arguments

x	A 'saga_tool' object.
...	Additional arguments to pass to print. Currently not used.

Examples

```
## Not run:
# Initialize a saga object
saga <- saga_gis()

# Display usage information on a tool
print(saga$ta_morphometry$slope_aspect_curvature)

# Or simply:
saga$ta_morphometry$slope_aspect_curvature

## End(Not run)
```

---

read_srtm   *Get path to the example DEM data*

Description

Rsagacmd comes bundled with a small tile of example Digital Elevation Model (DEM) data from
the NASA Shuttle Radar Topography Mission Global 1 arc second V003. This data is stored in
GeoTIFF format in 'inst/extdata'.

Usage

```
read_srtm()
```

Details

The dataset contains the land surface elevation of an area located near Jasper, Alberta, Canada,
with the coordinate reference system (CRS) EPSG code of 3402 (NAD83(CSRS) / Alberta 10-TM
(Forest)).

To access the data, use the convenience function of 'read_srtm()' to load the data as a 'terra::SpatRaster'
object.

Examples

```
library(Rsagacmd)
library(terra)

dem <- read_srtm()
plot(dem)
```

| Rsagacmd | *Rsagacmd: Linking R with the open-source SAGA-GIS software.* |

Description

Rsagacmd provides an R scripting interface to the open-source System for Automated Geoscientific Analyses Geographical Information System software SAGA-GIS. The current version has been tested using SAGA-GIS versions 2.3.1 to 8.0.1 on Windows (x64), macOS and Linux. Rsagacmd provides a functional approach to scripting with SAGA-GIS by dynamically generating R functions for every SAGA-GIS tool based on the user's current SAGA-GIS installation. These functions are generated by the `saga_gis` function and are included within an S3 object as a named list of libraries and tools. This structure facilitates an easier scripting experience by organizing the large number of SAGA-GIS tools (>700) by their respective library. Interactive scripting can also fully take advantage of code autocompletion tools (e.g. in Rstudio), allowing for each tool's syntax to be quickly recognized. Furthermore, the most common types of spatial data (rasters using the **raster** package, and vector data using the **sp** or simple features **sf** packages) along with non-spatial data are seamlessly passed from R to the SAGA-GIS command line tool for geoprocessing operations, and the results are automatically loaded as the appropriate R object. Outputs from individual SAGA-GIS tools can also be chained using pipes from the **magrittr** and **dplyr** packages to chain complex geoprocessing operations together in a single statement.

Handling of geospatial and tabular data

Rsagacmd aims to facilitate a seamless interface to the open-source SAGA-GIS by providing access to all SAGA-GIS geoprocessing tools in a 'R-like' manner. In addition to generating R functions that correspond to each SAGA-GIS tool, Rsagacmd automatically handles the passing of geospatial and tabular data contained from the R environment to SAGA-GIS.

Rsagacmd uses the SAGA-GIS command line interface to perform geoprocessing operations. Therefore, spatial data can be passed to any Rsagacmd function as a path to the input data, assuming that the data is stored in the appropriate file formats (e.g. GDAL-supported single-band rasters, OGR supported vector data, and comma- or tab-delimited text files for tabular data). In addition, Rsagacmd also supports the following R object classes to pass data to SAGA-GIS, and to load the results back into the R environment:

- Raster data handling is provided by the R **raster** package Raster-based outputs from SAGA-GIS tools are loaded as RasterLayer objects. For more details, see the 'Handling of raster data'.

- Vector features that result from SAGA-GIS geoprocessing operations are output in ESRI Shapefile format and are loaded into the R environment as simple features objects

- Tabular data from SAGA-GIS tools are loaded as data frames

The results from tools that return multiple outputs are loaded into the R environment as a named list of the appropriate R object classes.

Multi-band raster data and RasterStack/RasterBrick objects

SAGA-GIS does not handle multi-band rasters and the native SAGA GIS Binary file format (.sgrd) supports only single band data. Therefore when passing raster data to most SAGA-GIS tools using Rsagacmd, the data should represent single raster bands, specified as either the path to the single raster band, or when using the R **raster** package, a RasterLayer (or less commonly a RasterStack or RasterBrick) object that contains only a single layer. Subsetting of raster data is performed automatically by Rsagacmd in the case of when a single band from a RasterStack or RasterBrick object is passed to a SAGA-GIS tool. This occurs in by either passing the filename of the raster to the SAGA-GIS command line, or by writing the data to a temporary file. A few SAGA-GIS functions will accept a list of single band rasters as an input. In this case if this data is in the form of a RasterStack or RasterLayer object, it is recommended to use pass the output from the unstack function in the **raster** package, which will return a list of RasterLayer objects, and then Rsagacmd will handle the subsetting automatically.

Combining SAGA-GIS tools with pipes

For convenience, outputs from SAGA-GIS tools are automatically saved to tempfiles if outputs are not explicitly stated as arguments when calling the function. This was implemented so that the user can create complex workflows based on little code. It is also means that several processing steps can be combined or chained in a convenient manner using pipes from the **magritrr** package. When using pipes, all of the intermediate processing steps are dealt with automatically by saving the outputs as tempfiles, and then in turn passing the output to the next function in the chain. Note that when dealing with high-resolution and/or larger raster data, these tempfiles can start to consume a significant amount of disk space during a session. If required, these temporary files can be cleaned during the session in a similar way to the raster package, using the saga_remove_tmpfiles function.

Author(s)

Steven Pawley, <dr.stevenpawley@gmail.com>

Examples

```
## Not run:
library(Rsagacmd)
library(magrittr)

# initialize a saga object
saga <- saga_gis(opt_lib = c("grid_calculus", "ta_morphometry"))

# example of executing a tool using a tempfile to store the tool outputs
dem <- saga$grid_calculus$random_terrain(radius = 100, iterations = 500)

# Example of chaining operations using pipes and using tempfile to
# store tool outputs
tri <- dem %>%
  saga$ta_morphometry$terrain_ruggedness_index_tri()

# Remove tempfiles generated by Rsagacmd during a session
saga_remove_tmpfiles(h = 0)
```

```
## End(Not run)
```

---

saga_configure   *Generates a custom saga_cmd configuration file*

Description

Creates and edits a saga_cmd configuration file in order to change saga_cmd settings related to file caching and number of available processor cores. Intended to be used internally by [saga_gis](#)

Usage

```
saga_configure(
  senv,
  grid_caching = FALSE,
  grid_cache_threshold = 100,
  grid_cache_dir = NULL,
  cores = NULL,
  saga_vers
)
```

Arguments

senv   A saga environment object. Contains the SAGA-GIS environment and settings.

grid_caching   Whether to use file caching. The default is FALSE.

grid_cache_threshold

                 Any number to use as a threshold (in Mb) before file caching for loaded raster data is activated.

grid_cache_dir   Optionally specify a path to the used directory for temporary files. The default uses 'base::tempdir'.

cores   An integer specifying the maximum number of processing cores. Needs to be set to 1 if file caching is activated because file caching in SAGA-GIS is not thread-safe.

saga_vers   A 'numeric_version' that specifies the version of SAGA-GIS. The generation of a saga_cmd configuration file is only valid for versions > 4.0.0.

Value

A character that specifies the path to custom saga_cmd initiation file.

---

saga_docs   *Browse the online documentation for a saga_tool*

Description

Browse the online documentation for a saga_tool

Usage

```
saga_docs(saga_tool)
```

Arguments

saga_tool   a saga_tool object

Examples

```
## Not run:
library(Rsagacmd)

saga <- saga_gis()

saga_docs(saga$ta_morphometry$slope_aspect_curvature)

## End(Not run)
```

---

saga_env   *Parses valid SAGA-GIS libraries and tools into a nested list of func-
                           tions*

Description

Establishes the link to SAGA GIS by generating a SAGA help file and parsing all libraries, tools
and options from the help files into a nested list of library, module and options, that are contained
within an saga environment object object. Intended to be used internally by saga_gis

Usage

```
saga_env(
  saga_bin = NULL,
  opt_lib = NULL,
  raster_backend = "raster",
  vector_backend = "sf"
)
```

Arguments

saga_bin	An optional character vector to specify the path to the saga_cmd executable. Otherwise the function will perform a search for saga_cmd.
opt_lib	A character vector of a subset of SAGA-GIS tool libraries to generate dynamic functions that map to each tool. Used to save time if you only want to import a single library.
raster_backend	A character vector to specify the library to use for handling raster data. Currently, either "raster", "terra" or "stars" is supported. The default is "raster".
vector_backend	A character to specify the library to use for handling vector data. Currently, either "sf", "SpatVector" or "SpatVectorProxy" is supported. The default is "sf".

Value

A saga environment S3 object containing paths, settings and a nested list of libraries tools and options.

---

saga_execute	*Function to execute SAGA-GIS commands through the command line tool*

Description

Intended to be used internally by each function

Usage

```
saga_execute(
  lib,
  tool,
  senv,
  .intern = NULL,
  .all_outputs = NULL,
  .verbose = NULL,
  ...
)
```

Arguments

lib	A character specifying the name of SAGA-GIS library to execute.
tool	A character specifying the name of SAGA-GIS tool to execute.
senv	A saga environment object.
.intern	A logical specifying whether to load the outputs from the SAGA-GIS geoprocessing operation as an R object.

.all_outputs   A logical to specify whether to automatically output all results from the selected
                  SAGA tool and load them results as R objects (default = TRUE). If .all_outputs
                  = FALSE then the file paths to store the tool's results will have to be manually
                  specified in the arguments.

.verbose   Option to output all message during the execution of saga_cmd. Overrides the
                  saga environment setting.

...   Named arguments and values for SAGA tool.

Value

output of SAGA-GIS tool loaded as an R object.

---

saga_gis   *Initiate a SAGA-GIS geoprocessor object*

Description

Dynamically generates functions to all valid SAGA-GIS libraries and tools. These functions are
stored within a saga S3 object as a named list of functions

Usage

```
saga_gis(
  saga_bin = NULL,
  grid_caching = FALSE,
  grid_cache_threshold = 100,
  grid_cache_dir = NULL,
  cores = NULL,
  backend = "raster",
  raster_backend = "raster",
  vector_backend = "sf",
  raster_format = "SAGA",
  vector_format = c("ESRI Shapefile", "GeoPackage"),
  all_outputs = TRUE,
  intern = TRUE,
  opt_lib = NULL,
  temp_path = NULL,
  verbose = FALSE
)
```

Arguments

saga_bin   The path to saga_cmd executable. If this argument is not supplied then an auto-
                   matic search for the saga_cmd executable will be performed.

grid_caching   A logical whether to use file caching in saga_cmd geoprocessing operations for
                   rasters that are too large to fit into memory.

grid_cache_threshold

         A number to act as a threshold (in Mb) before file caching is activated for loaded raster data.

grid_cache_dir   The path to directory for temporary files generated by file caching. If not provided then the result from 'base::tempdir()' is used.

cores   An integer for the maximum number of processing cores. By default all cores are utilized. Needs to be set to 1 if file caching is activated.

backend   A character vector to specify the library to use for handling raster data. Currently, "raster", "terra" or "stars" is supported. The default is "raster". Will be deprecated in the future in favour of 'raster_backend'.

raster_backend A character vector to specify the library to use for handling raster data. Currently, "raster", "terra" or "stars" is supported. The default is "raster".

vector_backend A character to specify the library to use for handling vector data. Currently, "sf", "SpatVector" or "SpatVectorProxy" is supported. The default is "sf", however for large vector datasets, using the "SpatVectorProxy" backend from the 'terra' package has performance advantages because it allows file-based which can reduce repeated reading/writing when passing data between R and SAGA-GIS.

raster_format A character to specify the default format used to save raster data sets that are produced by SAGA-GIS. Available options are one of "SAGA", "SAGA Compressed" or "GeoTIFF". The default is "SAGA".

vector_format A character to specify the default format used for vector data sets that are produced by SAGA-GIS, and also used to save in-memory objects to be read by SAGA-GIS. Available options are of of "ESRI Shapefile", "GeoPackage", or "GeoJSON". The default is "ESRI Shapefile" for SAGA versions < 7.0 and GeoPackage for more recent versions. Attempting to use anything other than "ESRI Shapefile" for SAGA-GIS versions < 7.0 will raise an error.

all_outputs   A logical to indicate whether to automatically use temporary files to store all output data sets from each SAGA-GIS tool. Default = TRUE. This argument can be overridden by the '.all_outputs' parameter on each individual SAGA-GIS tool function that is generated by 'Rsagacmd::saga_gis()'.

intern   A logical to indicate whether to load the SAGA-GIS geoprocessing results as an R object, default = TRUE. For instance, if a raster grid is output by SAGA-GIS then this will be loaded as either as 'RasterLayer' or 'SpatRaster' object, depending on the 'raster_backend' setting that is used. Vector data sets are always loaded as 'sf' objects, and tabular data sets are loaded as tibbles. The 'intern' settings for the 'saga' object can be overridden for individual tools using the '.intern' argument.

opt_lib   A character vector with the names of a subset of SAGA-GIS libraries. Used to link only a subset of named SAGA-GIS tool libraries, rather than creating functions for all available tool libraries.

temp_path   The path to use to store any temporary files that are generated as data is passed between R and SAGA-GIS. If not specified, then the system 'base::tempdir()' is used.

verbose   Logical to indicate whether to output all messages made during SAGA-GIS commands to the R console. Default = FALSE. This argument can be overriden by using the '.verbose' argument on each individual SAGA-GIS tool function that is generated by 'Rsagacmd::saga_gis()'.

Value

A S3 'saga' object containing a nested list of functions for SAGA-GIS libraries and tools.

Examples

```
## Not run:
# Initialize a saga object
library(Rsagacmd)
library(raster)

saga <- saga_gis()

# Alternatively initialize a saga object using file caching to handle large
# raster files
saga <- saga_gis(grid_caching = TRUE, grid_cache_threshold = 250, cores = 1)

# Example terrain analysis
# Generate a random DEM
dem <- saga$grid_calculus$random_terrain(radius = 100)

# Use Rsagacmd to calculate the Terrain Ruggedness Index
tri <- saga$ta_morphometry$terrain_ruggedness_index_tri(dem = dem)
plot(tri)

# Optionally run command and do not load result as an R object
saga$ta_morphometry$terrain_ruggedness_index_tri(dem = dem, .intern = FALSE)

# Initialize a saga object but do not automatically save all results to
# temporary files to load into R. Use this if you are explicitly saving each
# output because this will save disk space by not saving results from tools
# that output multiple results that you may be want to keep.
saga <- saga_gis(all_outputs = FALSE)

## End(Not run)
```

---

saga_remove_tmpfiles *Removes temporary files created by Rsagacmd*

Description

For convenience, functions in the Rsagacmd package create temporary files if any outputs for a SAGA-GIS tool are not specified as arguments. Temporary files in R are automatically removed at the end of each session. However, when dealing with raster data, these temporary files potentially can consume large amounts of disk space. These temporary files can be observed during a session by using the saga_show_tmpfiles function, and can be removed using the saga_remove_tmpfiles function. Note that this function also removes any accompanying files, i.e. the '.prj' and '.shx' files that may be written as part of writing a ESRI Shapefile '.shp' format

Usage

```
saga_remove_tmpfiles(h = 0)
```

Arguments

h   Remove temporary files that are older than h (in number of hours).

Value

Nothing is returned.

Examples

```
## Not run:
# Remove all temporary files generated by Rsagacmd
saga_remove_tmpfiles(h = 0)

## End(Not run)
```

---

saga_show_tmpfiles   *List temporary files created by Rsagacmd*

Description

For convenience, functions in the Rsagacmd package create temporary files if any outputs for a SAGA-GIS tool are not specified as arguments. Temporary files in R are automatically removed at the end of each session. However, when dealing with raster data, these temporary files potentially can consume large amounts of disk space. These temporary files can be observed during a session by using the saga_show_tmpfiles function, and can be removed using the saga_remove_tmpfiles function.

Usage

```
saga_show_tmpfiles()
```

Value

returns the file names of the files in the temp directory that have been generated by Rsagacmd. Note this list of files only includes the primary file extension, i.e. '.shp' for a shapefile without the accessory files (e.g. .prj, .shx etc.).

Examples

```
## Not run:
# Show all temporary files generated by Rsagacmd
saga_remove_tmpfiles(h = 0)

## End(Not run)
```

---

saga_version   *Return the installed version of SAGA-GIS*

Description

Intended to be used internally by saga_env. Uses a system call to saga_cmd to output version of installed SAGA-GIS on the console

Usage

```
saga_version(saga_cmd)
```

Arguments

saga_cmd   The path of the saga_cmd binary.

Value

A numeric_version with the version of SAGA-GIS found at the cmd path.

---

search_saga   *Automatic search for the path to a SAGA-GIS installation*

Description

Returns the path to the saga_cmd executable On windows, automatic searching will occur first in 'C:/Program Files/SAGA-GIS'; 'C:/Program Files (x86)/SAGA-GIS'; 'C:/SAGA-GIS'; 'C:/OSGeo4W'; and 'C:/OSGeo4W64'. On linux or OS X, saga_cmd is usually included in PATH, if not an automatic search is performed in the '/usr' folder. If multiple versions of SAGA-GIS are installed on the system, the path to the newest version is returned

Usage

```
search_saga()
```

Value

The path to installed saga_cmd binary.

---

search_tools | *Search for a SAGA-GIS tool*

Description

Search for a SAGA-GIS tool

Usage

```
search_tools(x, pattern)
```

Arguments

x   saga object

pattern   character, pattern of text to search for within the tool name

Value

a tibble containing the libraries, names and parameters of the tools that match the pattern of the search text and their host library

Examples

```
## Not run:
# initialize Rsagacmd
saga <- saga_gis()

# search for a tool
search_tools(x = saga, pattern = "terrain")

## End(Not run)
```

---

show_raster_formats | *List the available raster formats that can be set as defaults for a 'saga' object.*

Description

List the available raster formats that can be set as defaults for a 'saga' object.

Usage

```
show_raster_formats()
```

Value

tibble

Examples

```
show_raster_formats()
```

---

show_vector_formats   *List the available vector formats that can be set as defaults for a 'saga' object.*

Description

List the available vector formats that can be set as defaults for a 'saga' object.

Usage

```
show_vector_formats()
```

Value

tibble

Examples

```
show_vector_formats()
```

---

tidy.saga   *Summarize the libraries that are available within a saga object and return these as a tibble.*

Description

Summarize the libraries that are available within a saga object and return these as a tibble.

Usage

```
## S3 method for class 'saga'
tidy(x, ...)
```

Arguments

x   a 'saga' object

...   additional arguments. Currently unused.

Value

a tibble that describes libraries, their descriptions and number of tools that are available in SAGA-GIS.

Examples

```
## Not run:
# Initialize a saga object
saga <- saga_gis()

# tidy the saga object's parameters into a tibble
tidy(saga)

## End(Not run)
```

---

tidy.saga_library	*Summarize the tools that are available within a saga library and return these as a tibble.*

Description

Summarize the tools that are available within a saga library and return these as a tibble.

Usage

```
## S3 method for class 'saga_library'
tidy(x, ...)
```

Arguments

x   a 'saga_library' object

...   additional arguments. Currently unused.

Value

a tibble that describes the tools and their descriptions within a particular SAGA-GIS library.

Examples

```
## Not run:
# Initialize a saga object
saga <- saga_gis()

# tidy the library's parameters into a tibble
tidy(saga$climate_tools)

## End(Not run)
```

tidy.saga_tool	*Summarize the parameters that are available within a SAGA-GIS tool and return these as a tibble.*

Description

Summarize the parameters that are available within a SAGA-GIS tool and return these as a tibble.

Usage

```
## S3 method for class 'saga_tool'
tidy(x, ...)
```

Arguments

x	a 'saga_tool' object
...	additional arguments. Currently unused.

Value

a tibble that describes tools, identifiers used by the saga_cmd command line tool, the equivalent argument name used by Rsagacmd, and other options and descriptions.

Examples

```
## Not run:
# Initialize a saga object
saga <- saga_gis()

# tidy the tools parameters into a tibble
tidy(saga$ta_morphometry$slope_aspect_curvature)

## End(Not run)
```

---

tile_geoprocessor	*Split a raster grid into tiles for tile-based processing*

Description

Split a raster grid into tiles. The tiles are saved as Rsagacmd temporary files, and are loaded as a list of R objects for further processing. This is a function to make the the SAGA-GIS grid_tools / tiling tool more convenient to use.

Usage

```
tile_geoprocessor(x, grid, nx, ny, overlap = 0, file_path = NULL)
```

Arguments

x	A 'saga' object.
grid	A path to a GDAL-supported raster to apply tiling, or a RasterLayer.
nx	An integer with the number of x-pixels per tile.
ny	An integer with the number of y-pixels per tile.
overlap	An integer with the number of overlapping pixels.
file_path	An optional file file path to store the raster tiles.

Value

A list of RasterLayer objects representing tiled data.

Examples

```
## Not run:
# Initialize a saga object
saga <- saga_gis()

# Generate a random DEM
dem <- saga$grid_calculus$random_terrain(radius = 15, iterations = 500)

# Return tiled version of DEM
tiles <- tile_geoprocessor(x = saga, grid = dem, nx = 20, ny = 20)

## End(Not run)
```

Index