

Package ‘ceramic’

April 22, 2023

Title Download Online Imagery Tiles

Version 0.8.0

Description Download imagery tiles to a standard cache and load the data into raster objects. Facilities for 'AWS' terrain <<https://registry.opendata.aws/terrain-tiles/>> terrain and 'Mapbox' <<https://www.mapbox.com/>> servers are provided.

Depends R (>= 3.5.0), terra

License GPL-3

Encoding UTF-8

RoxygenNote 7.2.3

Imports curl, dplyr, fs (>= 1.3.0), glue, graphics, purrr, rappdirs, rlang, sp, slippymath (>= 0.3.0), stats, tibble, utils, crsmeta, vapour, stringr, wk

Suggests covr, spelling, testthat (>= 3.0.0)

URL <https://github.com/hypertidy/ceramic>

BugReports <https://github.com/hypertidy/ceramic/issues>

Language en-US

LazyData true

Config/testthat/edition 3

NeedsCompilation no

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Repository CRAN

Date/Publication 2023-04-22 00:42:33 UTC

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ceramic-package	<i>Obtain imagery tiles</i>
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Description

The ceramic package provides tools to download raster tiles from online servers.

Details

Any process that can trigger downloads will first check the `ceramic_cache()` in case the tile already exists.

It can also load raster data from online servers to obtain imagery, but we let GDAL manage that.

If you want to deal with the tiles downloaded directly, see `ceramic_tiles()`.

The main functions are for downloading tiles and each accepts a spatial object for the first argument, alternatively a raster extent, or location:

<code>get_tiles</code>	Download tiles for a given service for an extent and resolution
<code>get_tiles_buffer</code>	Download tiles based on location and buffer (width, height) in metres
<code>get_tiles_dim</code>	Download tiles based on extent and output dimension in pixels
<code>get_tiles_zoom</code>	Download tiles base on extent and zoom level

Two helper functions will load imagery into a raster object:

<code>cc_location</code>	Download tiles and build a raster object of imagery
<code>cc_elevation</code>	Download tiles and build a raster object of elevation data

Administration functions for handling the file cache and required API key for on online service:

<code>get_api_key</code>	Return the stored key for online API, or NULL
<code>ceramic_cache</code>	Report the location of the tile cache
<code>clear_ceramic_cache</code>	Delete all files in the tile cache (use with caution!)

Other functions that are either rarely used or considered subject to change:

<code>ceramic_tiles</code>	Find particular tiles from the cache
<code>mercator_tile_extent</code>	Abstract raster-extent form of the spherical Mercator tile system, expressed in tile-index and zoom
<code>plot_tiles</code>	Plot the tiles from <code>ceramic_tiles</code>
<code>tiles_to_polygon</code>	Convert <code>ceramic_tiles</code> to simple features format
<code>cc_heard</code>	Specific location hardcoded form of <code>cc_location</code>
<code>cc_kingston</code>	Specific location hardcoded form of <code>cc_location</code>
<code>cc_macquarie</code>	Specific location hardcoded form of <code>cc_location</code>

<code>cc_location</code>	<i>Obtain tiled imagery by location query</i>
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Description

Obtain imagery or elevation data by location query. The first argument `loc` may be a spatial object (sp, raster, sf) or a 2-column matrix with a single longitude and latitude value. Use `buffer` to define a width and height to pad around the raw longitude and latitude in metres. If `loc` has an extent, then `buffer` is ignored.

Usage

```
cc_location(
  loc = NULL,
  buffer = 5000,
  type = "mapbox.satellite",
  ...,
  zoom = NULL,
  max_tiles = NULL,
  debug = FALSE,
  dimension = NULL
)

cc_macquarie(
  loc = c(158.93835, -54.49871),
  buffer = 5000,
  type = "mapbox.satellite",
  ...,
  zoom = NULL,
  max_tiles = NULL,
```

```
    debug = FALSE,
    dimension = NULL
)

cc_davis(
  loc = c(77 + 58/60 + 3/3600, -(68 + 34/60 + 36/3600)),
  buffer = 5000,
  type = "mapbox.satellite",
  ...,
  zoom = NULL,
  max_tiles = NULL,
  debug = FALSE,
  dimension = NULL
)

cc_mawson(
  loc = c(62 + 52/60 + 27/3600, -(67 + 36/60 + 12/3600)),
  buffer = 5000,
  type = "mapbox.satellite",
  ...,
  zoom = NULL,
  max_tiles = NULL,
  debug = FALSE,
  dimension = NULL
)

cc_casey(
  loc = cbind(110 + 31/60 + 36/3600, -(66 + 16/60 + 57/3600)),
  buffer = 5000,
  type = "mapbox.satellite",
  ...,
  zoom = NULL,
  max_tiles = NULL,
  debug = FALSE,
  dimension = NULL
)

cc_heard(
  loc = c(73 + 30/60 + 30/3600, -(53 + 0 + 0/3600)),
  buffer = 5000,
  type = "mapbox.satellite",
  ...,
  zoom = NULL,
  max_tiles = NULL,
  debug = FALSE,
  dimension = NULL
)
```

```

cc_kingston(
  loc = c(147.2901, -42.98682),
  buffer = 5000,
  type = "mapbox.satellite",
  ...,
  zoom = NULL,
  max_tiles = NULL,
  debug = FALSE,
  dimension = NULL
)

cc_elevation(
  loc = NULL,
  buffer = 5000,
  type = NULL,
  ...,
  zoom = NULL,
  max_tiles = NULL,
  debug = FALSE,
  dimension = NULL
)

```

Arguments

loc	a longitude, latitude pair of coordinates, or a spatial object
buffer	with in metres to extend around the location, ignored if 'loc' is a spatial object with extent
type	character string of provider imagery type (see Details)
...	deprecated arguments that <i>used_to_be</i> passed to internal function now ignored since v 0.8.0 (see get_tiles())
zoom	deprecated (use dimension)
max_tiles	deprecated
debug	deprecated
dimension	one or two numbers, used to determine the number of pixels width, height - set one to zero to let GDAL figure it out, or leave as NULL to get something suitable

Details

cc_elevation does extra work to unpack the DEM tiles from the RGB format.

Available types are 'elevation-tiles-prod' for AWS elevation tiles, and 'mapbox.satellite', and 'mapbox.terrain-rgb'.

Note that arguments max_tiles and zoom are mutually exclusive. One or both must be NULL. If both are NULL then max_tiles = 16L.

Currently must be considered in-development.

Value

A `terra::rast()` object, either with three layers (Red, Green, Blue) or with a single layer in the case of `cc_elevation()`.

Examples

```
if (!is.null(get_api_key())) {
  img <- cc_location(cbind(147, -42), buffer = 1e5)

  ## this source does not need the Mapbox API, but we won't run the example unless it's set
  dem <- cc_kingston(buffer = 1e4, type = "elevation-tiles-prod")
  terra::plot(dem, col = grey(seq(0, 1, length = 94)))

  ## Mapbox imagery
  im <- cc_macquarie()
  plotRGB(im)
}
```

ceramic_cache

Ceramic file cache

Description

File system location where ceramic stores its cache.

Usage

```
ceramic_cache(force = FALSE)
```

Arguments

`force` set to TRUE to create the location without asking the user

Details

If allowed, the cache will be created at `file.path(rappdirs::user_cache_dir(), ".ceramic")`, which corresponds to `~/cache/ceramic` for a given user.

If the file cache location does not exist, the user will be asked in interactive mode for permission. For non-interactive mode use the `force` argument.

It is not currently possible to customize the cache location. To clear the cache (completely) see `clear_ceramic_cache()`.

Value

A character vector, the file path location of the cache.

Examples

```
if (interactive()) {  
  ceramic_cache()  
}
```

ceramic_tiles	<i>Tile files</i>
---------------	-------------------

Description

Find existing files in the cache. Various options can be controlled, this is liable to change pending generalization across providers.

Usage

```
ceramic_tiles(  
  zoom = NULL,  
  type = "mapbox.satellite",  
  source = "api.mapbox.com",  
  glob = NULL,  
  regexp = NULL  
)
```

Arguments

zoom	zoom level
type	imagery type
source	imagery source
glob	see <code>fs::dir_ls</code>
regexp	see <code>fs::dir_ls</code>

Value

A data frame of tile file paths with tile index, zoom, type, version, source and spatial extent.

Examples

```
if (interactive() && !is.null(get_api_key())) {  
  tiles <- ceramic_tiles(zoom = 0)  
}
```

cities	<i>Cities locations</i>
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Description

Dataset from package maps.

Details

Data frame with columns "name" "country.etc" "pop" "lat" "long" "capital".

clear_ceramic_cache	<i>Clear ceramic cache</i>
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Description

Delete all downloaded files in the [ceramic_cache\(\)](#).

Usage

```
clear_ceramic_cache(clobber = FALSE, ...)
```

Arguments

clobber	set to TRUE to avoid checks and delete files
...	reserved for future arguments, currently ignored

Value

This function is called for its side effect, but also returns the file paths as a character vector whether deleted or not, or NULL if the user cancels.

get-tiles-constrained *Get tiles with specific constraints*

Description

Get tiles by zoom, by overall dimension, or by buffer on a single point.

Usage

```
get_tiles_zoom(x, zoom = 0, ..., format = "png")
```

```
get_tiles_dim(x, dim = c(512, 512), ..., format = "png")
```

```
get_tiles_buffer(x, buffer = NULL, ..., max_tiles = 9, format = "png")
```

Arguments

x	a spatial object with an extent
zoom	desired zoom for tiles, use with caution - cannot be unset in get_tiles_zoom
...	passed to get_tiles()
format	defaults to "png", also available is "jpg"
dim	for get_tiles_dim the overall maximum dimensions of the image (padded out to tile size of 256x256)
buffer	width in metres to extend around the location, ignored if 'x' is a spatial object with extent
max_tiles	maximum number of tiles - if NULL is set by zoom constraints

Details

Each function expects an extent in longitude latitude or a spatial object with extent as the first argument.

get_tiles_zoom() requires a zoom value, defaulting to 0

get_tiles_dim() requires a dim value, default to c(512, 512), a set of 4 tiles

get_tiles_buffer() requires a single location (longitude, latitude) and a buffer in metres

Value

A list with files downloaded in character vector, a data frame of the tile indices, the zoom level used and the extent in xmin,xmax,ymin,ymax form.

See Also

get_tiles

Examples

```

if (!is.null(get_api_key())) {
  ex <- ext(146, 147, -43, -42)
  tile_infoz <- get_tiles_zoom(ex, zoom = 1)

  tile_infod <- get_tiles_dim(ex, dim = c(256, 256))

  tile_infob <- get_tiles_buffer(cbind(146.5, -42.5), buffer = 5000)
}

```

`get_api_key`*Get API key for Mapbox service*

Description

Mapbox tile providers require an API key. Other providers may not need a key and so this is ignored.

Usage

```
get_api_key(api = "mapbox", ..., silent = FALSE)
```

Arguments

<code>api</code>	character string denoting which service ("mapbox" only)
<code>...</code>	currently ignored
<code>silent</code>	run in completely silent mode, default is to provide a warning

Details

The [mapdeck package](#) has a more comprehensive tool for setting the Mapbox API key, if this is in use ceramic will find it first and use it.

To set your Mapbox API key obtain a key from <https://account.mapbox.com/access-tokens/>

1) Run this to set for the session `'Sys.setenv(MAPBOX_API_KEY=<yourkey>'`

OR,

2) To set permanently store `'MAPBOX_API_KEY=<yourkey>'` in `'~/.Renvirom'`.

There is a fairly liberal allowance for the actual name of the environment variable, any of `'MAPBOX_API_KEY'`, `'MAPBOX_API_TOKEN'`, `'MAPBOX_KEY'`, `'MAPBOX_TOKEN'`, or `'MAPBOX'` will work (and they are sought in that order).

If no key is available, NULL is returned, with a warning.

Value

The stored API key value, see Details.

Examples

```
get_api_key()
```

get_tiles

Download imagery tiles

Description

Obtain imagery or elevation tiles by location query. The first argument `loc` may be a spatial object (`sp`, `raster`, `sf`) or a 2-column matrix with a single longitude and latitude value. Use `buffer` to define a width and height to pad around the raw longitude and latitude in metres. If `loc` has an extent, then `buffer` is ignored.

Usage

```
read_tiles(  
  x,  
  buffer,  
  type = "mapbox.satellite",  
  crop_to_buffer = TRUE,  
  format = NULL,  
  ...,  
  zoom = NULL,  
  debug = FALSE,  
  max_tiles = NULL,  
  base_url = NULL,  
  verbose = TRUE,  
  filename = ""  
)
```

```
get_tiles(  
  x,  
  buffer,  
  type = "mapbox.satellite",  
  crop_to_buffer = TRUE,  
  format = NULL,  
  ...,  
  zoom = NULL,  
  debug = FALSE,  
  max_tiles = NULL,  
  base_url = NULL,  
  verbose = TRUE  
)
```

Arguments

x	a longitude, latitude pair of coordinates, or a spatial object
buffer	width in metres to extend around the location, ignored if 'x' is a spatial object with extent
type	character string of provider imagery type (see Details)
crop_to_buffer	crop to the user extent, used for creation of output objects (otherwise is padded tile extent)
format	tile format to use, defaults to "jpg" for Mapbox satellite imagery and "png" otherwise
...	arguments passed to internal function, specifically base_url (see Details)
zoom	desired zoom for tiles, use with caution - if NULL is chosen automatically
debug	optionally avoid actual download, but print out what would be downloaded in non-debug mode
max_tiles	maximum number of tiles - if NULL is set by zoom constraints
base_url	tile provider URL expert use only
verbose	report messages or suppress them
filename	purely for read_tiles() this is passed down to the terra package function 'merge'

Details

get_tiles() may be run with no arguments, and will download (and report on) the default tile source at zoom 0. Arguments type, zoom (or max_tiles), format may be used without setting loc or buffer and the entire world extent will be used. Please use with caution! There is no maximum on what will be downloaded, but it can be interrupted at any time.

Use debug = TRUE to avoid download and simply report on what would be done.

Available types are 'elevation-tiles-prod' for AWS elevation tiles, and 'mapbox.satellite', 'mapbox.terrain-rgb'. (The RGB terrain values are not unpacked.)

Function read_tiles() will match what get_tiles() does and actually build a raster object.

Value

A list with files downloaded in character vector, a data frame of the tile indices, the zoom level used and the extent in xmin,xmax,ymin,ymax form.

See Also

get_tiles_zoom get_tiles_dim get_tiles_buffer

Examples

```
if (!is.null(get_api_key())) {
  tile_info <- get_tiles(ext(146, 147, -43, -42), type = "mapbox.satellite", zoom = 5)
}
```

mercator_tile_extent *Tile extent*

Description

Calculate tile extent for a given x, y tile at a zoom level.

Usage

```
mercator_tile_extent(tile_x, tile_y, zoom, tile_size = 256)
```

Arguments

tile_x	x coordinate of tile
tile_y	y coordinate of tile
zoom	zoo level
tile_size	tile dimensions (assumed square, i.e. 256x256)

Details

Currently only spherical Mercator is supported.

Value

A numeric vector of the spatial extent, in 'xmin', 'xmax', 'ymin', 'ymax' form.

Examples

```
mercator_tile_extent(2, 4, zoom = 10)

global <- mercator_tile_extent(0, 0, zoom = 0)
plot(NA, xlim = global[c("xmin", "xmax")], ylim = global[c("ymin", "ymax")])
rect_plot <- function(x) rect(x["xmin"], x["ymin"], x["xmax"], x["ymax"])
rect_plot(mercator_tile_extent(1, 1, zoom = 2))
rect_plot(mercator_tile_extent(2, 1, zoom = 2))
rect_plot(mercator_tile_extent(1, 2, zoom = 2))

rect_plot(mercator_tile_extent(1, 1, zoom = 4))
rect_plot(mercator_tile_extent(2, 1, zoom = 4))
rect_plot(mercator_tile_extent(1, 2, zoom = 4))
```

plot_tiles

Plot slippy map tiles

Description

Create a new plot of tile rectangles, or add to an existing plot.

Usage

```
plot_tiles(
  x,
  ...,
  add = FALSE,
  label = TRUE,
  cex = 0.6,
  add_coast = TRUE,
  include_zoom = TRUE
)

tiles_to_polygon(x)
```

Arguments

x	tiles as create by ceramic_tiles()
...	arguments passed to graphics::rect()
add	add to an existing plot?
label	include text label?
cex	relative size of text label if drawn (see text())
add_coast	include a basic coastline on the plot?
include_zoom	include zoom level with text label if drawn?

Details

The extent ('xmin', 'xmax', 'ymin', 'ymax') is used directly to draw the tiles so must be in the native Mercator coordinate system used by most tile servers.

Value

`plot_tiles()` is called for its side-effect, a plot, and returns NULL invisibly. [tiles_to_polygon](#) returns a wk rct vector

Examples

```
if (!is.null(get_api_key())) {  
  get_tiles_zoom(zoom = 1)  
  tiles <- ceramic_tiles(zoom = 1)  
  plot_tiles(tiles)  
}
```

unpack_rgb

Unpack Mapbox terrain-RGB

Description

Mapbox terrain-rgb stores global elevation packed into Byte integers.

Usage

```
unpack_rgb(x, filename = "")
```

Arguments

x	three layer raster object
filename	optional, filename to store the output

Details

This function unpacks the three layers of a raster to give floating point elevation data.

Value

terra rast object with one numeric layer

Examples

```
if (interactive() && !is.null(get_api_key())) {  
  unpack_rgb(read_tiles(type = "mapbox.terrain-rgb"))  
}
```

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