Package 'nhdR'

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Title Tools for working with the National Hydrography Dataset

Version 0.5.2

Description Tools for working with the National Hydrography Dataset, with functions for querying, downloading, and networking both the NHD <https://www.usgs.gov/core-science-systems/ngp/national-hydrography> and NHDPlus <http://www.horizon-systems.com/nhdplus> datasets.

URL https://github.com/jsta/nhdR

BugReports https://github.com/jsta/nhdR/issues

Depends R (>= 3.3), maps

License GPL

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R topics documented:

nhdR-package . . . 2
bbox2poly . . . 3
extract_network . . . 3
find_vpu . . . 5
great_lakes . . . 5
gull . . . 6
gull_flow . . . 6
leaf_reaches . . . 6
mendota . . . 7
mendota_network . . . 7
nhd_get . . . 8
nhd_info . . . 8
nhd_list . . . 9
nhd_load . . . 9
nhd_plus_get . . . 10
nhd_plus_info . . . 11
nhd_plus_list . . . 11
nhd_plus_load . . . 12
nhd_plus_query . . . 13
nhd_query . . . 15
select_point_overlay . . . 15
select_poly_overlay . . . 16
sunapee . . . 16
sunapee_network . . . 17
terminal_reaches . . . 17
toUTM . . . 18
vpu_shp . . . 19

Index **20**

`nhdR-package` *R interface to the National Hydrography Dataset*

Description

R interface to the National Hydrography Dataset

Author(s)

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bbox2poly *Convert a bounding box to polygon*

Description

Convert a bounding box to polygon

Usage

```
bbox2poly(bbox)
```

Arguments

bbox	object of class bbox from sf

Examples

```
## Not run:
library(sf)
wk <- wikilake::lake_wiki("Gull Lake (Michigan)")

pnt <- st_as_sf(wk, coords = c("Lon", "Lat"), crs = 4326)
pnt <- st_transform(pnt, st_crs(vpu_shp))
qry <- nhd_plus_query(wk$Lon, wk$Lat,
         dsn = c("NHDWaterbody"), buffer_dist = 0.05)
wbd <- qry$sp$NHDWaterbody[which.max(st_area(qry$sp$NHDWaterbody)),]
bbox2poly(st_bbox(wbd))

## End(Not run)
```

extract_network *Return nhd plus stream network upstream of a waterbody*

Description

Return nhd plus stream network upstream of a waterbody

Usage

```
extract_network(lon = NA, lat = NA, lines = NA, buffer_dist = 0.01,
  maxsteps = 3, approve_all_dl = FALSE, ...)
```

Arguments

lon	numeric decimal degree longitude
lat	numeric decimal degree latitude
lines	sf spatial lines object to limit the extent of the network search
buffer_dist	numeric buffer around lat-lon point in dec. deg.
maxsteps	maximum number of stream climbing iterations
approve_all_dl	logical blanket approval to download all missing data. Defaults to TRUE if session is non-interactive.
...	parameters passed on to sf::st_read

Details

The lon and lat arguments are used for querying the corresponding lake polygon layer which is then used to climb its intersecting stream network.

Examples

```
## Not run:
library(mapview)
library(sf)

# headwater lakes have no upstream network
coords <- data.frame(lat = 46.32711, lon = -89.58893)
res <- extract_network(coords$lon, coords$lat, maxsteps = 9)

# fails if no lake nhdp lake found within the buffer at the query point
coords <- data.frame(lat = 43.62453, lon = -85.47164)
res <- extract_network(coords$lon, coords$lat, maxsteps = 9)

coords <- data.frame(lat = 20.79722, lon = -156.47833)
# use a non-geographic (projected) buffer size
res <- extract_network(coords$lon, coords$lat, maxsteps = 9,
        buffer_dist = units::as_units(5, "km"))

# use a projected buffer size
res <- extract_network(coords$lon, coords$lat, maxsteps = 9)

# no upstream network for lakes intersecting the Great Lakes
coords <- data.frame(lat = 44.6265, lon = -86.23121)
res <- extract_network(coords$lon, coords$lat, maxsteps = 3)

coords <- data.frame(lat = 42.96523, lon = -89.2527)
res <- extract_network(coords$lon, coords$lat, maxsteps = 9)

mapview(res)


## End(Not run)
```

find_vpu *Find VPU*

Description

Find Vector Processing Unit from sf object

Usage

```
find_vpu(pnt)
```

Arguments

pnt	sf object

Examples

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

vpu_centers <- st_cast(st_point_on_surface(nhdR::vpu_shp),
                       "POINT")

find_vpu(vpu_centers[1,])
find_vpu(vpu_centers)

find_vpu(nhdR::gull$sp$NHDWaterbody[1,])
find_vpu(nhdR::gull$sp$NHDWaterbody)

## End(Not run)
```

great_lakes *Data and spatial polygons of the Great Lakes*

Description

Data and spatial polygons of the Great Lakes

Usage

```
great_lakes(spatial = FALSE)
```

Arguments

spatial	logical, return Great Lakes polygons?

Examples

```
gl <- great_lakes()
## Not run:
gl <- great_lakes(spatial = TRUE)

## End(Not run)
```

`gull` *List of simple features lake polygons and flowlines within a buffer around Gull Lake Michigan.*

Description

Data from NHD Plus

Details

gull

`gull_flow` *Flowlines within a buffer around Gull Lake Michigan including flow information.*

Description

Data from NHD Plus

Details

gull_flow

`leaf_reaches` *Return leaf reaches from a network or query intersecting lake*

Description

A leaf reach is a stream flowline that has upstream connections but is not in the focal set.

Usage

```
leaf_reaches(lon = NA, lat = NA, network = NA,
  approve_all_dl = FALSE, ...)
```

Arguments

lon	numeric decimal degree longitude. optional. See Details section.
lat	numeric decimal degree latitude. optional. See Details section.
network	sf lines collection. optional. See Details section.
approve_all_dl	logical blanket approval to download all missing data. Defaults to TRUE if session is non-interactive.
...	parameters passed on to sf::st_read

Examples

```
## Not run:
coords <- data.frame(lat = 20.79722, lon = -156.47833)
leaf_reaches(coords$lon, coords$lat)

coords  <- data.frame(lat = 41.42217, lon = -73.24189)
l_reach <- leaf_reaches(coords$lon, coords$lat)

network <- nhd_plus_query(lon = coords$lon, lat = coords$lat,
                          dsn = "NHDFlowline", buffer_dist = 0.02)$sp$NHDFlowline
l_reach <- leaf_reaches(network = network)

plot(network$geometry)
plot(l_reach$geometry, col = "red", add = TRUE)

## End(Not run)
```

---

mendota — *List of simple features lake polygons and flowlines within a buffer around Lake Mendota.*

Description

Data from NHD Plus

Details

mendota

---

mendota_network — *Upstream flowlines connected to Lake Mendota.*

Description

Data from NHD Plus

Details

mendota_network

nhd_get *Download and cache NHD data by state*

Description

Download and cache NHD data by state

Usage

```
nhd_get(state = NA, force_dl = FALSE, force_unzip = FALSE)
```

Arguments

state	character state abbreviation includes "DC", "PR", and "VI"
force_dl	logical force a re-download of the requested data
force_unzip	logical force an unzip of downloaded data

Examples

```
## Not run:
nhd_get(state = c("DC"))
nhd_get(state = c("RI", "CT"))

## End(Not run)
```

nhd_info *Return NHD layer metadata and field listing*

Description

Return NHD layer metadata and field listing

Usage

```
nhd_info(state, dsn)
```

Arguments

state	character
dsn	character

Examples

```
## Not run:
nhd_info("DC", "NHDWaterbody")

## End(Not run)
```

nhd_list *List available locally cached NHD layers per state*

Description

List available locally cached NHD layers per state

Usage

```
nhd_list(state)
```

Arguments

state	character state abbreviation

Examples

```
## Not run:
nhd_list(state = "DC")

## End(Not run)
```

nhd_load *Load NHD layers into current session*

Description

Load NHD layers into current session

Usage

```
nhd_load(state, dsn, file_ext = NA, approve_all_dl = FALSE, ...)
```

Arguments

state	character state abbreviation
dsn	character name of a NHD layer
file_ext	character choice of "shp" for spatial data and "dbf" or "gpkg" for non-spatial. optional
approve_all_dl	logical blanket approval to download all missing data. Defaults to TRUE if session is non-interactive.
...	arguments passed to sf::st_read

Details

This function will ask the user to approve downloading missing data unless approve_all_dl is set to TRUE.

Value

Spatial simple features object or data frame depending on the dsn type and value passed to file_ext

Examples

```
## Not run:
dt <- nhd_load(c("RI"), c("NHDWaterbody"))
dt <- nhd_load(c("CT", "RI"), "NHDWaterbody")
dt <- nhd_load(c("CT", "RI"), "NHDWaterbody", quiet = TRUE)
dt <- nhd_load("MI", "NHDFlowline")
dt <- nhd_load("RI", "NHDReachCrossReference")
dt <- nhd_load("RI", "NHDWaterbody", file_ext = "dbf")
dt <- nhd_load(c("RI", "DC"), "NHDWaterbody", file_ext = "gpkg")

## End(Not run)
```

---

nhd_plus_get *Download and cache NHDplus data by vector processing unit*

Description

Download and cache NHDplus data by vector processing unit

Usage

```
nhd_plus_get(vpu = NA, component = "NHDSnapshot", force_dl = FALSE,
  force_unzip = FALSE)
```

Arguments

vpu	numeric vector processing unit
component	character component name
force_dl	logical force a re-download of the requested data
force_unzip	logical force an unzip of downloaded data

Examples

```
## Not run:
# Spatial
nhd_plus_get(vpu = 4)
nhd_plus_get(vpu = "10L")
nhd_plus_get(vpu = 1, component = "NHDPlusAttributes")
```

```
# Non-spatial
nhd_plus_get(vpu = "National", component = "V1_To_V2_Crosswalk")
nhd_plus_get(vpu = 4, component = "EROMExtension")

## End(Not run)
```

---

nhd_plus_info *Return NHDplus layer metadata and field listing*

Description

Return NHDplus layer metadata and field listing

Usage

```
nhd_plus_info(vpu, component, dsn, file_ext = NA)
```

Arguments

vpu	numeric vector processing unit
component	character component name
dsn	character data source name
file_ext	character choice of "shp" for spatial data and "dbf" for non-spatial. optional

Examples

```
## Not run:
nhd_plus_info(vpu = 4, component = "NHDSnapshot", dsn = "NHDWaterbody")
nhd_plus_info(vpu = 1, component = "NHDPlusAttributes", dsn = "PlusFlow")

## End(Not run)
```

---

nhd_plus_list *List available locally cached NHDplus layers per state*

Description

List available locally cached NHDplus layers per state

Usage

```
nhd_plus_list(vpu, component = "NHDSnapshot", file_ext = NA, ...)
```

Arguments

vpu	numeric vector processing unit
component	character component name
file_ext	character choice of "shp" for spatial data and "dbf" for non-spatial. optional
...	arguments passed to list.files. optional.

Examples

```
## Not run:
nhd_plus_list(vpu = 4)
nhd_plus_list(vpu = 4, full.names = TRUE)

nhd_plus_list(vpu = 1, component = "NHDPlusAttributes")
nhd_plus_list(vpu = "National", component = "V1_To_V2_Crosswalk")


## End(Not run)
```

---

nhd_plus_load *Load NHDplus layers into current session*

Description

Load NHDplus layers into current session

Usage

```
nhd_plus_load(vpu, component = "NHDSnapshot", dsn, file_ext = NA,
  approve_all_dl = FALSE, force_dl = FALSE, pretty = FALSE, ...)
```

Arguments

vpu	numeric vector processing unit
component	character component name
dsn	data source name
file_ext	character choice of "shp" for spatial data and "dbf" for non-spatial. optional
approve_all_dl	logical blanket approval to download all missing data. Defaults to TRUE if session is non-interactive
force_dl	logical force a re-download of the requested data
pretty	more minimal pretty printing st_read relative to "quiet"
...	parameters passed on to sf::st_read

Details

This function will ask the user to approve downloading missing data unless approve_all_dl is set to TRUE. Output of this function is saved in active memory (memoized) to speed up repeated function calls.

Value

spatial object

Examples

```
## Not run:
# Spatial
dt <- nhd_plus_load(4, "NHDSnapshot", "NHDWaterbody")
dt <- nhd_plus_load(c(1,2), "NHDSnapshot", "NHDWaterbody")
dt <- nhd_plus_load(4, "NHDSnapshot", "NHDFlowline")
dt <- nhd_plus_load(4, "NHDPlusCatchment", "Catchment")

# Quieter printing
dt <- nhd_plus_load(4, "NHDSnapshot", "NHDWaterbody", pretty = TRUE)
# Quietest printing
dt <- nhd_plus_load(4, "NHDSnapshot", "NHDWaterbody", quiet = TRUE)

# Non-spatial
dt <- nhd_plus_load(1, "NHDPlusAttributes", "PlusFlow")
dt <- nhd_plus_load("National", "V1_To_V2_Crosswalk",
 "NHDPlusV1Network_V2Network_Crosswalk")
gridcode      <- nhd_plus_load(1, "NHDPlusCatchment", "featuregridcode")
flowline_vaa  <- nhd_plus_load(1, "NHDPlusAttributes", "PlusFlowlineVAA")
eromflow      <- nhd_plus_load(4, "EROMExtension", "EROM_010001")

# Character VPU
plusflow <- nhd_plus_load(vpu = "10L", "NHDPlusAttributes", "PlusFlow")

## End(Not run)
```

---

nhd_plus_query — *Select NHDplus features via polygon or circular buffer of coordinate pair*

Description

Select NHDplus features via polygon or circular buffer of coordinate pair

Usage

```
nhd_plus_query(lon = NA, lat = NA, poly = NA, dsn,
  buffer_dist = 0.05, approve_all_dl = FALSE, ...)
```

Arguments

lon	numeric longitude. optional
lat	numeric latitude. optional
poly	sfc polygon. optional
dsn	character data source
buffer_dist	numeric buffer in units of coordinate degrees
approve_all_dl	logical blanket approval to download all missing data. Defaults to TRUE if session is non-interactive.
...	parameters passed on to sf::st_read

Examples

```
## Not run:
library(sf)
wk <- wikilake::lake_wiki("Gull Lake (Michigan)")

pnt <- st_as_sf(wk, coords = c("Lon", "Lat"), crs = 4326)
pnt <- st_transform(pnt, st_crs(vpu_shp))
# nhd_plus_list(nhdR::find_vpu(pnt))

# set a non-geographic (projected) buffer size
qry <- nhd_plus_query(wk$Lon, wk$Lat,
        dsn = c("NHDWaterbody", "NHDFlowLine"),
        buffer_dist = units::as_units(5, "km"))

qry <- nhd_plus_query(wk$Lon, wk$Lat,
         dsn = c("NHDWaterbody", "NHDFlowLine"), buffer_dist = 0.05)

plot(qry$sp$NHDWaterbody$geometry, col = "blue")
plot(qry$sp$NHDFlowLine$geometry, col = "cyan", add = TRUE)
plot(qry$pnt, col = "red", pch = 19, add = TRUE)
axis(1); axis(2)

library(ggplot2)
ggplot(qry$sp$NHDWaterbody) + geom_sf()

# query with a polygon
wbd <- qry$sp$NHDWaterbody[which.max(st_area(qry$sp$NHDWaterbody)),]
qry_lines <- nhd_plus_query(poly = st_as_sfc(st_bbox(wbd)),
                            dsn = "NHDFlowLine")
ggplot() +
  geom_sf(data = qry$sp$NHDWaterbody) +
  geom_sf(data = qry_lines$sp$NHDFlowLine, color = "red")

## End(Not run)
```

nhd_query *Select NHD features clipped by a circular buffer a coordinate pair*

Description

Select NHD features clipped by a circular buffer a coordinate pair

Usage

```
nhd_query(lon, lat, dsn, buffer_dist = 0.05)
```

Arguments

lon	numeric longitude
lat	numeric latitude
dsn	character data source
buffer_dist	numeric buffer in units of coordinate degrees

Examples

```
## Not run:
wk <- wikilake::lake_wiki("Worden Pond")
qry <- nhd_query(wk$Lon, wk$Lat, dsn = c("NHDWaterbody", "NHDFlowline"))

plot(sf::st_geometry(qry$sp$NHDWaterbody), col = "blue")
plot(sf::st_geometry(qry$sp$NHDFlowline), col = "cyan", add = TRUE)
plot(qry$pnt, col = "red", pch = 19, add = TRUE)
axis(1); axis(2)

## End(Not run)
```

select_point_overlay *Select features clipped by a point buffer around a point*

Description

Select features clipped by a point buffer around a point

Usage

```
select_point_overlay(pnt, sp, buffer_dist = 0.05)
```

Arguments

pnt	geographic point of class sfc
sp	list of sf data frames
buffer_dist	numeric buffer in units of coordinate degrees

Examples

```
## Not run:
wk <- wikilake::lake_wiki("Gull Lake (Michigan)")
pnt <- sf::st_sfc(sf::st_point(c(wk$Lon, wk$Lat)))
sf::st_crs(pnt) <- 4326
sp <- lapply(c("NHDWaterbody", "NHDFlowLine"),
          function(x) nhd_plus_load(vpu = 4, dsn = x))
names(sp) <- c("NHDWaterbody", "NHDFlowLine")
qry <- select_point_overlay(pnt = pnt, sp = sp, buffer_dist = 0.05)
plot(qry$NHDWaterbody$geometry)


## End(Not run)
```

---

select_poly_overlay *Select features clipped by a polygon*

Description

Select features clipped by a polygon

Usage

```
select_poly_overlay(poly, sp)
```

Arguments

poly	sf *polygon object
sp	list of sf data frames

---

sunapee *List of simple features lake polygons and flowlines within a buffer around Lake Sunapee.*

Description

Data from NHD Plus

Details

sunapee

sunapee_network *Upstream flowlines connected to Lake Sunapee.*

Description

Data from NHD Plus

Details

sunapee_network

terminal_reaches *Return terminal reaches from collection intersecting lake*

Description

In the case of a network query, a terminal reach is a stream flowline that has no downstream reaches in-network. In the case of a point query, a terminal reach is a flowline that exits the intersecting surface waterbody.

Usage

```
terminal_reaches(lon = NA, lat = NA, buffer_dist = 0.01,
  network = NA, lakepoly = NA, lakewise = FALSE,
  lakesize_threshold = 4, approve_all_dl = FALSE, ...)
```

Arguments

lon	numeric decimal degree longitude. optional. See Details section.
lat	numeric decimal degree latitude. optional. See Details section.
buffer_dist	numeric buffer around lat-lon point in dec. deg.
network	sf lines collection. optional. See Details section.
lakepoly	sf polygon. optional. See Details section.
lakewise	logical. If TRUE, return the terminal reaches of all lakes. in the stream network rather than a single terminal reach of the focal lake.
lakesize_threshold	numeric above which to count as a lake (ha).
approve_all_dl	logical blanket approval to download all missing data. Defaults to TRUE if session is non-interactive.
...	parameters passed on to sf::st_read

Details

There are multiple ways to execute terminal_reaches:

- Only providing lon + lat arguments - this will query the corresponding lake polygon layer and find the terminal reach of the lake intersecting a buffer around the specified point.
- Only providing a lake polygon - this is essentially the same as above except there is no preliminary lake polygon query.
- Only providing a network of stream lines - this provides the most downstream reach irrespective of lakes.

Examples

```
## Not run:
library(sf)
library(mapview)

coords <- data.frame(lat = 46.32711, lon = -89.58893)
t_reach <- terminal_reaches(coords$lon, coords$lat)

coords <- data.frame(lat = 20.79722, lon = -156.47833)
# use a non-geographic (projected) buffer size
t_reach <- terminal_reaches(coords$lon, coords$lat,
        buffer_dist = units::as_units(5, "km"))

coords  <- data.frame(lat = 42.96628 , lon = -89.25264)
t_reach <- terminal_reaches(coords$lon, coords$lat)

coords  <- data.frame(lat = 41.42217, lon = -73.24189)
t_reach <- terminal_reaches(coords$lon, coords$lat)

mapview(st_as_sf(coords, coords = c("lon", "lat"), crs = 4326)) +
mapview(t_reach$geometry, color = "red")

coords <- data.frame(lat = 41.859080, lon = -71.575422)
network <- nhd_plus_query(lon = coords$lon, lat = coords$lat,
                    dsn = "NHDFlowline", buffer_dist = 0.05)$sp$NHDFlowline
t_reach      <- terminal_reaches(network = network)
t_reach_lake <- terminal_reaches(network = network, lakewise = TRUE,
                                 lakesize_threshold = 1)

mapview(network) + mapview(t_reach_lake, color = "green") +
    mapview(t_reach, color = "red")

## End(Not run)
```

---

toUTM *Re-project to appropriate UTM zone*

Description

Re-project to appropriate UTM zone

Usage

```
toUTM(sf_object)
```

Arguments

sf_object	an sf object

Examples

```
## Not run:
data(gull)
gull_ <- gull$sp$NHDWaterbody
st_crs(gull_)
gull_ <- st_transform(gull_, 4326)
st_crs(gull_)
st_crs(toUTM(gull_[1,]))

## End(Not run)
```

---

vpu_shp *Low-res simple features data frame of the NHDPlus vector processing units*

Description

vpu_shp

Index

∗Topic **datasets**
gull, 6
gull_flow, 6
mendota, 7
mendota_network, 7
sunapee, 16
sunapee_network, 17
vpu_shp, 19

bbox2poly, 3

extract_network, 3

find_vpu, 5

great_lakes, 5
gull, 6
gull_flow, 6

leaf_reaches, 6

mendota, 7
mendota_network, 7

nhd_get, 8
nhd_info, 8
nhd_list, 9
nhd_load, 9
nhd_plus_get, 10
nhd_plus_info, 11
nhd_plus_list, 11
nhd_plus_load, 12
nhd_plus_query, 13
nhd_query, 15
nhdR *(*nhdR-package*)*, 2
nhdR-package, 2

select_point_overlay, 15
select_poly_overlay, 16
sunapee, 16
sunapee_network, 17

terminal_reaches, 17, *18*
toUTM, 18

vpu_shp, 19