Package ‘nhdR’

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Title  Tools for working with the National Hydrography Dataset

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Depends  R (>= 3.3), maps

License  GPL

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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_d1 = FALSE,
  ...
)
extract_network

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

```r
# 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

```r
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

```r
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

```r
## 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**

```r
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**

```r
## 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**

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

**Arguments**

- `state` character
- `dsn` character

**Examples**

```r
## 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**

```r
## 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

```r
## 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**

```r
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

```r
## 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

```r
## 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
```r
## 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
```r
nhd_plus_load(
  vpu,
  component = "NHDSnapshot",
  dsn,
  file_ext = NA,
  approve_all_d1 = 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

```r
## 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

```r
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**

```r
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**

```r
## 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

```r
## 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

```r
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

```r
## 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

```r
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

```r
## 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
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