

Package ‘damAOI’

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Title Create an 'Area of Interest' Around a Constructed Dam for Comparative Impact Evaluations

Version 0.1

Description Define a spatial 'Area of Interest' (AOI) around a constructed dam using hydrology data. Dams have environmental and social impacts, both positive and negative. Current analyses of dams have no consistent way to specify at what spatial extent we should evaluate these impacts. 'damAOI' implements methods to adjust reservoir polygons to match satellite-observed surface water areas, plot upstream and downstream rivers using elevation data and accumulated river flow, and draw buffers clipped by river basins around reservoirs and relevant rivers. This helps to consistently determine the areas which could be impacted by dam construction, facilitating comparative analysis and informed infrastructure investments.

License GPL (>= 3)

URL <https://github.com/chrislittleboy/damaoi>

BugReports <https://github.com/chrislittleboy/damaoi/issues>

Depends R (>= 4.0)

Imports dplyr, FNN, magrittr, sf, units, smoothr, terra, tibble, tidy, shiny, leaflet, shinydashboard

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adjustreservoirpolygon

adjust polygon of reservoir to reference surface water extent map

Description

adjust polygon of reservoir to reference surface water extent map

Usage

```
adjustreservoirpolygon(
  reservoir,
  water_bodies,
  dem,
  poss_expand = 20000,
  wbjc = 0
)
```

Arguments

reservoir	An sf polygon, with an unstandardised raw reservoir
water_bodies	A rast, where 1 indicates water, NA otherwise
dem	A rast, showing elevation
poss_expand	A number, indicating the number of meters away from the raw reservoir the reservoir may expand to. Default is 20000 (20km).
wbjc	A number indicating a "water body join correction". This is a small buffer zone for the reservoir polygon to ensure that it is contiguous (important where there are small channels connecting different parts of the same water body). Default is 0 but it is necessary for some dams to include a small buffer, particularly if the reservoir has areas which are less wide than the resolution of the underlying DEM.

Value

An sf polygon with an adjusted reservoir polygon

autogetpourpoints *autogetpourpoints*

Description

autogetpourpoints

Usage

autogetpourpoints(reservoir, fac)

Arguments

reservoir An sf polygon, with an unstandardised raw reservoir
fac A rast, showing accumulated water flow along river

Value

An sf multipoint where rivers flow into and out of the reservoir

basinandbuffers *Buffers the reservoir and the river, and clips to basin areas*

Description

Buffers the reservoir and the river, and clips to basin areas

Usage

```
basinandbuffers(  
  reservoir,  
  upstream,  
  downstream,  
  basins,  
  streambuffersize,  
  reservoirbuffersize  
)
```

Arguments

reservoir	An sf polygon, with a reservoir
upstream	An sf line, following the river upstream of the reservoir
downstream	An sf line, following the river downstream of the reservoir
basins	An sf multipolygon, with the basins in the area around the dam
streambuffersize	A number indicating the distance around the upstream and downstream river to consider as impacted. Defaults to 2000 (2km).
reservoirbuffersize	A number indicating the distance around the reservoir to consider as impacted. Defaults to 5000 (5km)

Value

A two element list. Element 1 is an sf multipolygon with the reservoir buffer, upstream and downstream areas. Element 2 is the same, but clipped to river basin polygons.

basins_tehri	<i>Polygon for river basins around tehri dam</i>
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Description

Polygon for river basins around alquva dam

Usage

```
basins_tehri
```

Format

An sf polygon

Source

HydroBasins

```
getimpactedarea      getimpactedarea
```

Description

Performs 1) standardisation of reservoir extent, 2) calculation of river course upstream and downstream and 3) clipping to river basins

Usage

```
getimpactedarea(  
  reservoir,  
  water_bodies = NULL,  
  dem,  
  fac,  
  basins,  
  pourpoints,  
  toprocess = TRUE,  
  espg = 4326,  
  toadjust = FALSE,  
  poss_expand = 20000,  
  river_distance = 1e+05,  
  nn = 100,  
  ac_tolerance = 2,  
  e_tolerance = 5,  
  streambufferize = 2000,  
  reservoirbufferize = 5000,  
  wbjc = 0  
)
```

Arguments

reservoir	An sf polygon, with an unstandardised raw reservoir
water_bodies	A rast, where 1 indicates water, NA otherwise. Required if toadjust == TRUE.
dem	A rast, showing elevation
fac	A rast, showing accumulated water flow along river
basins	An sf multipolygon, with the basins in the area around the dam
pourpoints	An sf multipoint, showing the points where rivers flow in and out of reservoirs
toprocess	Whether to reprocess input data from 4326 to UTM (the default for consistency)
espg	In case processing to UTM or other CRS has been done (not making use of preprocessing) the espg code to include
toadjust	A true/false parameter whether to adjust the reservoir to surrounding water bodies
poss_expand	A number, indicating the number of meters away from the raw reservoir the reservoir may expand to. Default is 20000 (20km).

river_distance	A number, indicating the number of meters downstream and upstream for the area of interest. Defaults to 100000 (100km)
nn	A number, indicating the number of nearest neighbours to consider in the algorithm to determine river course. Higher can be more accurate but is slower. Default 100.
ac_tolerance	A number, indicating the tolerance to changes in flow accumulation. Default 2, which means that if accumulated flow changes by a factor of 2 (halved or doubled) the area of interest should not include any further downstream or upstream. This is to account for confluences.
e_tolerance	A number indicating the tolerance to changes in elevation. Rivers flow downstream. But DEMs can show downstream areas of the river as higher, due to averaging nearby pixels. This is particularly true when rivers run through gorges. If there is no downstream lower river point nearby, the elevation tolerance allows the algorithm to select a point at a higher elevation, up to the threshold defined here.
streambuffersize	A number indicating the distance around the upstream and downstream river to consider as impacted. Defaults to 2000 (2km).
reservoirbuffersize	A number indicating the distance around the reservoir to consider as impacted. Defaults to 5000 (5km)
wbjc	A number, the water body join correction. This indicates the buffer zone for the reservoir, to ensure that it is contiguous (important where there are small channels connecting different parts of the same water body). Default is 0, but is necessary for some dams depending on the context.

Value

An sf multipolygon with the reservoir buffer, upstream and downstream areas

getriverpoints	<i>Calculation of river points</i>
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Description

Calculation of river points

Usage

```
getriverpoints(
  reservoir,
  pourpoints,
  ppid,
  river_distance,
  ac_tolerance,
  e_tolerance,
```

```

    nn,
    fac = fac,
    dem = dem
  )

```

Arguments

reservoir	An sf polygon, with an unstandardised raw reservoir
pourpoints	An sf multipoint, showing the points where rivers flow in and out of reservoirs
ppid	An integer to index through the pourpoints dataframe
river_distance	A number, indicating the number of meters downstream and upstream for the area of interest. Defaults to 100000 (100km)
ac_tolerance	A number, indicating the tolerance to changes in flow accumulation. Default 2, which means that if accumulated flow changes by a factor of 2 (halved or doubled) the area of interest should not include any further downstream or upstream. This is to account for confluences.
e_tolerance	A number indicating the tolerance to changes in elevation. Rivers flow downstream. But DEMs can show downstream areas of the river as higher, due to averaging nearby pixels. This is particularly true when rivers run through gorges. If there is no downstream lower river point nearby, the elevation tolerance allows the algorithm to select a point at a higher elevation, up to the threshold defined here.
nn	A number, indicating the number of nearest neighbours to consider in the algorithm to determine river course. Higher can be more accurate but is slower. Default 100.
fac	A rast, showing accumulated water flow along river
dem	A rast, showing elevation

Value

A three-element list, where the first element contains the data produced by the algorithm for all points along the river, and the second element is the sf LINESTRING object for the river, and the third denotes whether the river goes upstream (0) or downstream (1)

getshinyparams	<i>getshinyparams</i>
----------------	-----------------------

Description

getshinyparams

Usage

```
getshinyparams(res)
```

Arguments

res An sf polygon, with an unstandardised raw reservoir

Value

Parameters to start the shiny app for determining pour points manually for a given reservoir

makesystem *makesystem*

Description

makesystem

Usage

```
makesystem(
  names,
  aois,
  dem = NULL,
  betweenthreshold = 1,
  bwru = TRUE,
  uprivers = NULL,
  downrivers = NULL,
  systemname = NULL
)
```

Arguments

names The names of dams within the same system

aois An sf polygon, containing all AOI areas for all dams which are part of the system

dem An elevation raster covering the extent of the system. This is used to determine the uppermost and lowest dams in the system.

betweenthreshold The minimum area in km2 considered significant for between areas (to avoid small adjoining polygons already mostly contained in other AOI polygons)

bwru Whether the areas between a dam system (i.e. connecting rivers) are within the bounding box of the reservoirs in that system. They will mostly be, though for some dam systems rivers can travel, for example, far to the east then back again to the west to rejoin another dam in the same system.

uprivers An optional parameter whether to specify the upriver dams rather than determine it based on elevation (i.e. for a 2 reservoirs meet one reservoir at a confluence).

downrivers An optional parameter whether to specify the downriver dams rather than determine it based on elevation (i.e. for a 2 reservoirs meet one reservoir at a confluence).

systemname An optional parameter to name the system, for example if the largest reservoir is not at the top of the system

Value

A set of AOI polygons for the entire system, when dams are part of a system of dams.

pointstolines	<i>pointstolines</i>
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Description

pointstolines

Usage

```
pointstolines(riverpoints, espg)
```

Arguments

riverpoints	list of dataframes returned by the riverpoints function.
espg	espg code of UTM zone

Value

An list of upstream lines (multilinestring) and downstream line (linestring)

preprocessing	<i>preprocessing</i>
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Description

preprocessing

Usage

```
preprocessing(  
  reservoir,  
  dem = NULL,  
  fac = NULL,  
  water_bodies = NULL,  
  basins = NULL,  
  pourpoints = NULL,  
  river_distance  
)
```

Arguments

reservoir	An sf polygon, with an unstandardised raw reservoir
dem	A rast, showing elevation
fac	A rast, showing accumulated water flow along river
water_bodies	A rast, where 1 indicates water, NA otherwise
basins	An sf multipolygon, with the basins in the area around the dam
pourpoints	An sf multipoint, showing the points where rivers flow in and out of reservoirs
river_distance	A number, indicating the number of meters downstream and upstream for the area of interest. Defaults to 100000 (100km)

Value

A list with utm transformed input data

system	<i>Polygons for the 'Areas of Interest' around two dams which form a system together.</i>
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Description

Upper and Lower Paunglaung in Myanmar.

Usage

system

Format

An sf polygon

Source

GRanD v1.3 for the reservoir polygons

tehri

Polygon for Tehri dam in India

Description

This data gives the reservoir area for tehri dam in India

Usage

tehri

Format

An sf polygon

Source

GRanD v1.3

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