**Rpackage: StreamNetworkTools**

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**Abstract:**

Rivers and streams are among the most impacted ecosystems and several monitoring initiatives are currently underway be local national govenments… Rivers and streams are closely coupled with the terrestrial compartments and often features of the basin can predict instream dissect terrestrial drainage basinsBasin features can often be used to predict instream Linking monitoring efforts to a spatially explicit framework More fully understanding the spatial extent of impacted rivers requires a set of tools designed to Rivers and streams are among the most impacted ecosystems but more fully understanding the extent of these impacts requires a spatially explicit framework. Several monitoring efforts are currently underway to assess the Several monitoring initiatives are targeted as assessing the quality of our waterways. NHDPlus provides a spatial framework to contextualize water quality problems. We present a new R package designed to intecrate National scale datasets. Monitoring locations. Covariates. Predictive models. Watershed integritiy. Impared waters… R-package. We currently lack tools to facilitate large-scale analsysis of water monitoring efforts.

**Purpose:** an R package to derive covariates from NHDPlusV2 dataset and facilitate continental scale analyses of river networks and national scale monitoring efforts.

**Status:** V1.0

**Data Requirements**:

StreamNetworkTools works with NHDPlusV2. Users should become familiar with NHDPlusV2 documentation (<http://www.horizon-systems.com/NHDPlus/NHDPlusV2_documentation.php>)

**Installing StreamNetworkTools\***

1. install.packages(devtools)
2. library("devtools")
3. install\_git("https://github.com/dkopp3/StreamNetworkTools\_git.git", subdir = "StreamNetworkTools")
4. library(StreamNetworkTools)
5. help(package="StreamNetworkTools")

**OR\***

1. download StreamNetworkTools\_1.0.0.000.tar.gz from github
2. install.packages (/StreamNetworkTools\_1.0.0.000.tar.gz", repos = NULL, type="source")

\*if reinstalling after update, remember to:

1. remove.packages("StreamNetworkTools")
2. restart R
3. repeat above

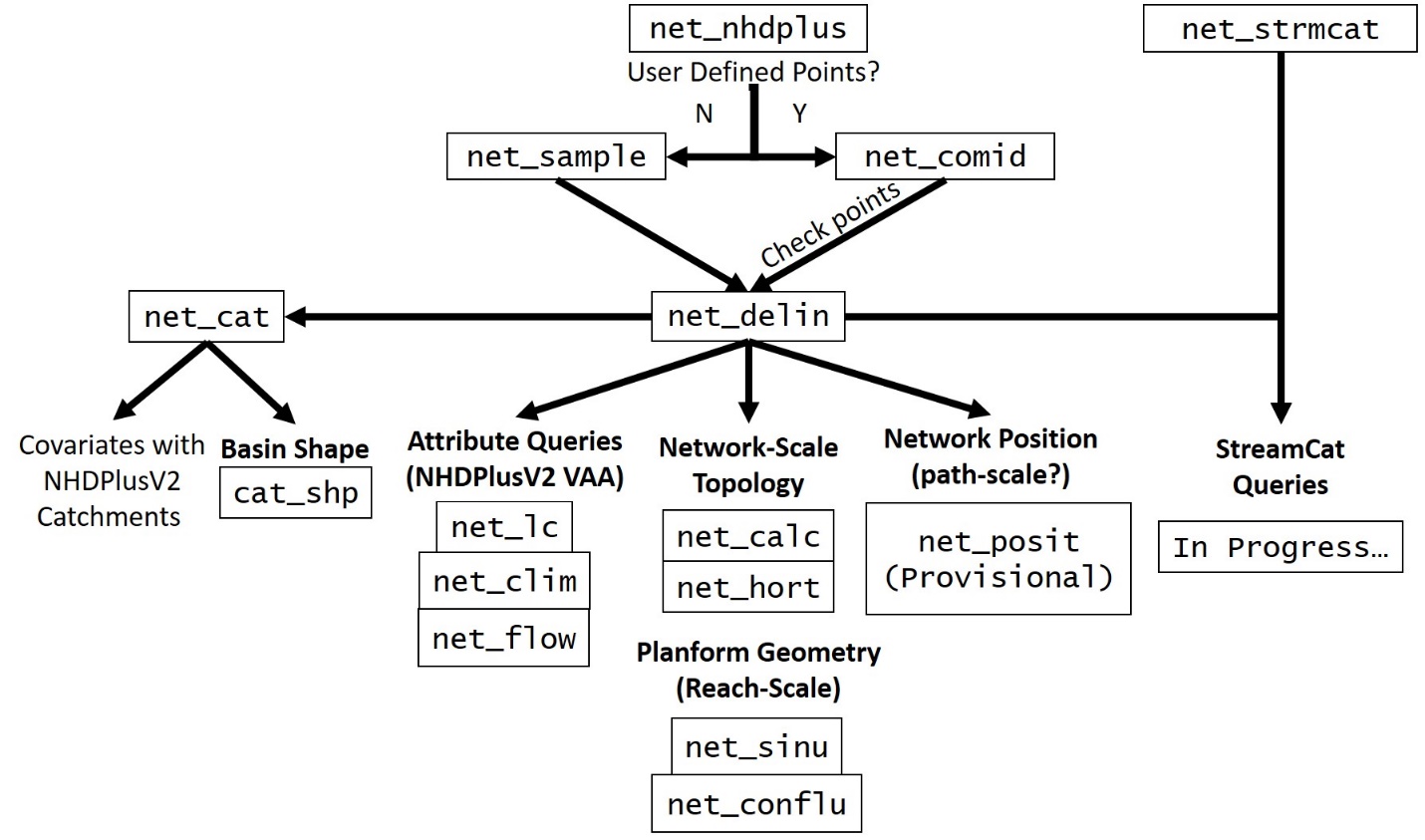


Figure 1: Workflow of StreamNetworkTools. Lines connecting boxes show relationships between functions. See StreamNetworkTools for descriptions.

Variable descriptions

|  |  |  |  |
| --- | --- | --- | --- |
| **Category** | **Variable** | **Definition** | **StreamNetworkTools**  **Function** |
| Basin Shape | basin\_len | longest distance between two catchment verticies | net\_cat |
| Basin Shape | basin\_area | area of catchments | net\_cat |
| Basin Shape | basin\_width | efffective basin width  (basin\_area/basin\_len) | net\_cat |
| Topology | WS.order | strahler order for root node | net\_calc |
| Topology | head.h2o | number of headwater reaches | net\_calc |
| Topology | trib.jun | number of tributary junctions | net\_calc |
| Topology | reach.cnt | number of reaches in network | net\_calc |
| Topology | diver.cnt | count of divergent flow paths | net\_calc |
| Topology | AREASQKM | drainage area (km^2) | net\_calc |
| Topology | LENGTHKM | total lenght of network flowlines (km) | net\_calc |
| Topology | drain.den | drainage density (LENGTHKM / AREASQKM) | net\_calc |
| Climate | TEMPVC | mean annual temperature  (deg C) | net\_clim |
| Climate | seasonality\_t | Coefficient of variation of mean monthly temperatures | net\_clim |
| Climate | warm\_mo | 2-digit warmest month | net\_clim |
| Climate | warm\_mo\_t | mean temperature of warmest month | net\_clim |
| Climate | cold\_mo | 2-digit coldest month | net\_clim |
| Climate | cold\_mo\_t | mean temperature of coldest month | net\_clim |
| Climate | diff\_t | difference between warm and cold monthly temperatures | net\_clim |
| Climate | warm\_q\_t | mean temperature of warmest quarter | net\_clim |
| Climate | warm\_q | 2-digit warmest quarter | net\_clim |
| Climate | cold\_q\_t | mean temperature of coldest quarter | net\_clim |
| Climate | cold\_q | 2-digit coldest quarter | net\_clim |
| Climate | PRECIPVC | cumulative mean annual precipiration (mm) | net\_clim |
| Climate | wet\_mo | 2-digit wettest month | net\_clim |
| Climate | wet\_mo\_p | cumulative mean precipitation of wettest month | net\_clim |
| Climate | dry\_mo | 2-digit driest month | net\_clim |
| Climate | dry\_mo\_p | cumulative mean precipitation of driest month | net\_clim |
| Climate | seasonality\_p | coefficient of vatiation of mean monthly precipitation | net\_clim |
| Climate | wet\_q\_p | cumulaltive mean precipitation of wettest quarter | net\_clim |
| Climate | wet\_q | 2-digit wettest quarter | net\_clim |
| Climate | dry\_q\_p | cumulative mean precipitation of driest quarter | net\_clim |
| Climate | dry\_q | 2-digit driest quarter | net\_clim |
| Climate | dry\_q\_t | mean temperature of driest quarter | net\_clim |
| Climate | wet\_q\_t | mean temperature of wettest quarter | net\_clim |
| Climate | warm\_q\_p | cumulaltive mean precipitation of warmest quarter | net\_clim |
| Climate | cold\_q\_p | cumulaltive mean precipitation of coldest quarter | net\_clim |
| Topology | trib\_order | order of COMID downstream of confluence | net\_conflu |
| Topology | area\_ratio | darinage areas ratios  (i.e. Triburaty Drainage Area / Mainstem Drainage Area) | net\_conflu |
| Topology | trib\_area | drainage area upstream of  confluence | net\_conflu |
| Topology | junction\_num | Concatenation of stream orders of confluence reaches | net\_conflu |
| Topology | alpha | angle (degrees) of tributary junction | net\_conflu |
| Topology | complex | indicates complex tributary junction | net\_conflu |
| Flow | RUNOFFVC | cumulative mean annual runoff (mm) | net\_flow |
| Flow | MAQ0001E | Mean Annual EROM discharge | net\_flow |
| Flow | minMMQ0001E | minimum mean monthly discharge | net\_flow |
| Flow | maxMMQ0001E | maximum mean monthly  discharge (cf) | net\_flow |
| Flow | covMMQ0001E | coefficient of variation of mean monthly discharge | net\_flow |
| Flow | V0001E | mean annual velocity (cfs) | net\_flow |
| Flow | minMMV0001E | minimum mean monthly velocity (cfs) | net\_flow |
| Flow | maxMMV0001E | maximum mean monthly velocity | net\_flow |
| Flow | covMMV0001E | coefficient of variation in mean monthly velocity | net\_flow |
| Topology | str\_ord | stream order | net\_hort |
| Topology | str\_num | count of stream reaches of specified order | net\_hort |
| Topology | str\_len | mean length of stream reaches of specified order | net\_hort |
| Topology | str\_area | mean drainage area of stream reaches of specified order | net\_hort |
| Topology | ohm | order of the network - 1 | net\_hort |
| Topology | Rb | bifurcation Ratio | net\_hort |
| Topology | Rl | length Ratio | net\_hort |
| Topology | Ra | area Ratio | net\_hort |
| Landcover |  | NLCD2011 landcover percentages | net\_lc |
| Planform | tot.len | length of reach | net\_sinu |
| Planform | str.len | straight line length of reach | net\_sinu |
| Planform | sinuosity | total length / straight line length | net\_sinu |
| Planform | MaxElevSM | maximum elevation of reach | net\_sinu |
| Planform | MinElevSM | minimum elevtion of reach | net\_sinu |
| Planform | SlopeNHDPlus | slope of reach | net\_sinu |

**Error Log:**

Upon loading StreamNetworkTools: “package or namespace load failed for 'dplyr' in loadNamespace…” because of missing package “bindr” resolved with restarting R and install.packages(“bindr”) before loading StreamNetworkTools

NHDPlus stream Order Error: Group id = 17153302, vpu = 18 is listed as 4th order but contains 5th order network upstream. Error at Tributaty junction of COMID’s 17153404 (STREAMORDE = 3) and 948030237 (STREAMORDE = 5) yields 3 order stream, should be 5th order. Needs to be reported