

Package ‘metScanR’

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Title Find, Map, and Gather Environmental Data and Metadata

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Description A tool for locating, mapping, and gathering environmental data and metadata, world-wide. Users can search for and filter metadata from > 157,000 environmental monitoring stations among 219 countries/territories and >20 networks/organizations via elevation, location, active dates, elements measured (e.g., temperature, precipitation), country, network, and/or known identifier. Future updates to the package will allow the user to obtain datasets from stations within the database.

Depends R (>= 3.3.0)

Imports geosphere, matlab, leaflet, grDevices, plyr, RCurl, utils

License GPL-3

Encoding UTF-8

LazyData no

RoxygenNote 6.1.1

URL <https://github.com/jaroberti/metScanR>

Suggests testthat

NeedsCompilation no

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dbLog	<i>metScanR_DB Update Log</i>
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Description

A simple log file for the version and date of database revisions. More information on specific updates to the database can be found at <https://jaroberti.github.io/metScanR/>.

Usage

dbLog

Format

(data frame) Version number and publication dates.

getCountry	<i>Filter environmental monitoring stations by country</i>
------------	--

Description

Return metadata of environmental monitoring stations from specific country(ies)/territory(ies) within the metScanR database.

Usage

getCountry(country, ...)

Arguments

country (character) Country(ies)/territory(ies) to filter environmental stations.
 ... auto-populates when called from `siteFinder()` wrapper

Value

A list comprising metadata of environmental monitoring stations from country(ies)/territory(ies) specified in `country`

Author(s)

Josh Roberti <jaroberti87@gmail.com>

See Also

[siteFinder](#) [mapResults](#) [metScanR_DB](#)

Examples

```
## Not run:
#returns metadata from all environmental sites within the database from the United States
  getCountry(country="United States")
#returns metadata from all environmental sites within the database from the Italy and Portugal
  getCountry(country=c("Italy", "Portugal"))
## End(Not run)
```

getDates

Filter environmental monitoring stations by active date(s)

Description

Return metadata of environmental monitoring stations that were/are active during specified dates.

Usage

```
getDates(startDate, endDate, includeUnk = FALSE, ...)
```

Arguments

startDate (character) "YYYY-MM-DD" used to filter start dates of environmental stations within the metScanR database. Optional if endDate is initialized. Required if endDate is missing.

endDate (character) "YYYY-MM-DD" used to filter end dates of environmental stations within the metScanR database. Optional if startDate is initialized. Required if startDate is missing.

includeUnk (logical) Defaults to FALSE and excludes sites with unknown start dates. Setting to TRUE will include sites with unknown start dates. Sites with unknown start dates account for ~71 percent of the metScanR database. This is a result of undocumented, government (or network/governing body) metadata. Nearly all stations within the database have a known end date, however. Initializing endDate (while leaving startDate uninitialized) and setting includeUnk=TRUE will more than likely return results than if startDate is also initialized.

... auto-populates when called from siteFinder() wrapper

Value

A list comprising metadata of environmental monitoring sites that were/are active between the startDate and/or endDate

Author(s)

Josh Roberti <jaroberti87@gmail.com>
Lee Stanish

References

see reference links above

See Also

[siteFinder](#) [mapResults](#) [metScanR_DB](#)

Examples

```
## Not run:
#return metadata of sites that were active from at least 1940-01-01 through 1970-04-18
  getDates(startDate="1940-01-01",endDate = "1970-04-18")
#return metadata of sites that were active up through at least 1950-07-08
  getDates(endDate = "1950-07-08")
#return metadata of sites that were active up through at least 1950-07-08
#and have an unknown start date:
  getDates(endDate = "1950-07-08", includeUnk=TRUE)
## End(Not run)
```

getElevation

Filter environmental monitoring stations by elevation

Description

Return metadata of environmental monitoring stations that have a specific elevation.

Usage

```
getElevation(elevMin, elevMax, ...)
```

Arguments

elevMin	(numeric) defines the minimum elevation to filter metadata. Units are in meters (m) Above Sea Level.
elevMax	(numeric) defines the maximum elevation to filter metadata. Units are in meters (m) Above Sea Level.
...	auto-populates when called from siteFinder() wrapper

Value

A list comprising metadata of environmental monitoring stations that have elevations conforming to the criteria specified in elevThresh

Author(s)

Josh Roberti <jaroberti87@gmail.com>

See Also

[siteFinder](#) [mapResults](#) [metScanR_DB](#)

Examples

```
## Not run:  
#return metadata of sites that have elevations above 1500 (m) Above Sea Level  
  getElevation(elevMin=1500)  
#return metadata of sites that have elevations less than 35 (m) Above Sea Level  
  getElevation(elevMax=35)  
## End(Not run)
```

getId

Filter environmental monitoring stations by identifier type

Description

Return metadata of environmental monitoring stations that have specific identifier types.

Usage

```
getId(id, ...)
```

Arguments

id (character) identifier(s) of interest. Metadata are available for stations with any of the identifiers listed below. It should be noted that a station may have multiple, associated identifiers. For instance, a single station may have COOP, GHCND, and FAA identifiers. See reference links for further information.

AIRMon: Atmospheric Integrated Research Monitoring Network

<http://nadp.slh.wisc.edu/AIRMoN/>

Ameriflux

<http://ameriflux.lbl.gov/sites/site-search/#filter-type=all>

AMNet: Atmospheric Mercury Network

<http://nadp.slh.wisc.edu/amn/>

AMoN: Ammonia Monitoring Network

<http://nadp.slh.wisc.edu/AMoN/>

BOR: Bureau of Reclamation

<https://www.wcc.nrcs.usda.gov/wsf/wsf-reservoir.html>

COOP: Cooperative Observer Network

<https://www.ncdc.noaa.gov/data-access/land-based-station-data/land-based-datasets/cooperative-observer-network-coop>

FAA: Federal Aviation Administration

<https://www.faa.gov/>

GHCND: Global Historical Climatology Network - Daily

<https://www.ncdc.noaa.gov/data-access/land-based-station-data/land-based-datasets/global-historical-climatology-network-ghcn>

GHCNMLT: Global Historical Climatology Network - Monthly Land Temperature v4

<https://www.ncdc.noaa.gov/ghcnm/>

ICAO: International Civil Aviation Organization

<http://www.icao.int/Pages/default.aspx>

MDN: Mercury Deposition Network

<https://nadp.slh.wisc.edu/MDN/>

MPRC: Manual Precipitation Network

MSNT: Non-Telemetered Snow Telemetry Network

NCDCSTNID: National Climatic Data Center

<https://www.ncdc.noaa.gov/homr/>

NEON: National Ecological Observatory Network

<http://www.neonscience.org/science-design/field-sites>

NWSLI: National Weather Service Location Identifier

<https://www.weather.gov/arh/stationlist>

NTN: National Trends Network

<http://nadp.slh.wisc.edu/NTN/>

OTHER: Telemetered Natural Resource Conservation Service (NRCS) Stations that do not meet criteria for SNOTEL, SNOLITE, SCAN, or NRCS Experimental hydromet

SCAN: Soil Climate Analysis Network

https://www.wcc.nrcs.usda.gov/about/mon_scan.html

SNOW: Snow Course and Aerial Marker Network

https://www.wcc.nrcs.usda.gov/about/mon_manual.html

SNTL: Snow Telemetry Network

https://www.wcc.nrcs.usda.gov/about/mon_automate.html

SNTLT: Snow Telemetry Network, Limited Sensors

https://www.wcc.nrcs.usda.gov/about/mon_automate.html

TRANS: *miscellaneous IDs that do not fall into National Centers for Environmental Information(NCEI) support

<https://www.ncei.noaa.gov/>

USGS: Streamflow Network (United States Geological Survey)

<https://water.usgs.gov/nsip/>

WBAN: Weather Bureau Army Navy

http://rredc.nrel.gov/solar//old_data/nsrdb/1961-1990/hourly/1990/WBAN1s.html

WMO: World Meteorological Organization

https://www.wmo.int/pages/index_en.html

...

auto-populates when called from siteFinder() wrapper

Value

A list comprising metadata of environmental monitoring stations having identifier types specified in `id`

Author(s)

Josh Roberti <jaroberti87@gmail.com>

References

see reference links above

See Also

[siteFinder](#) [mapResults](#) [metScanR_DB](#)

Examples

```
## Not run:
#return a list of sites that have an WBAN identifier
getId(id="WBAN")
#return a list of sites that have either an FAA, ICAO, or NWSLI identifier
getId(id=c("FAA","ICAO","NWSLI"))
## End(Not run)
```

getNearby

Filter environmental monitoring stations by POI

Description

Return metadata of environmental monitoring stations nearby a specific environmental station (see `siteID`) or near a a Latitude/Longitude pair (see `lat`, `lon`).

Usage

```
getNearby(siteID, lat, lon, radius, ...)
```

Arguments

<code>siteID</code>	(character) in the form of: [NETWORK]:[ID]. Environmental monitoring network to use as your Point of Interest (POI). Required if <code>lat</code> & <code>lon</code> are missing.
<code>lat</code>	(numeric) Latitude of (POI). <code>lat</code> and <code>lon</code> are required if <code>siteID</code> is missing.
<code>lon</code>	(numeric) Longitude of POI. <code>lat</code> and <code>lon</code> are required if <code>siteID</code> is missing.
<code>radius</code>	(numeric) Search radius outward from POI for finding environmental monitoring stations. Defined in kilometers (km); Required
<code>...</code>	auto-populates when called from <code>siteFinder()</code> wrapper

Value

A list comprising metadata of environmental monitoring stations located within `radius` from the user-entered `siteID` or `Lat/Lon` POI.

Author(s)

Josh Roberti <jaroberti87@gmail.com>

See Also

[siteFinder](#) [mapResults](#) [metScanR_DB](#)

Examples

```
## Not run:
#returns metadata from all sites within 50 km of NEON site 'CPER'
  getNearby(siteID="NEON:CPER", radius=50)
#return metadata of sites within 10 km of Lat=41.7821 & Lon = -71.4204 (Cranston, RI, USA)
  getNearby(lat=41.7821, lon = -71.4204, radius=40)
## End(Not run)
```

getNetwork

Filter environmental monitoring stations by network

Description

Return metadata of environmental monitoring stations from networks/platforms within the metScanR database.

Usage

```
getNetwork(network, ...)
```

Arguments

network (character) Network(s)/platform(s) to filter environmental monitoring stations. Metadata are available for stations in the networks below. See reference links for further information.

AL USRCRN: United States Regional Climate Reference Network - Alabama
<https://catalog.data.gov/dataset/al-usrcrn-station-information>

Ameriflux
<http://ameriflux.lbl.gov/sites/site-search/#filter-type=all>

ASOS: Automated Surface Observing System
<https://www.ncdc.noaa.gov/data-access/land-based-station-data/land-based-datasets/automated-surface-observing-system-asos>

AWOS: Automated Weather Observing System
<https://www.ncdc.noaa.gov/data-access/land-based-station-data/land-based-datasets/>

automated-weather-observing-system-awos

BOR: Bureau of Reclamation

<https://www.wcc.nrcs.usda.gov/wsf/wsf-reservoir.html>

COCORAHS: Community Collaborative Rain, Hail & Snow Network

<https://www.cocorahs.org/>

COOP: Cooperative Observer Network

<https://www.ncdc.noaa.gov/data-access/land-based-station-data/land-based-datasets/cooperative-observer-network-coop>

NEON: National Ecological Observatory Network

<http://www.neonscience.org/>

NADP: National Atmospheric Deposition Program

<http://nadp.slh.wisc.edu/airmon/>

NRCS: Natural Resources Conservation Service

https://www.wcc.nrcs.usda.gov/web_service/NRCS_Station_Networks.pdf

UKN: *unknown* (unidentified network)

UPPERAIR: Upper Air network

https://www.weather.gov/upperair/nws_upper

USCRN: United States Climate Reference Network

<https://www.ncdc.noaa.gov/crn/>

USGS: Streamflow Network (United States Geological Survey)

<https://water.usgs.gov/nsip/>

USRCRN: United States Regional Climate Reference Network

<https://www.ncdc.noaa.gov/crn/>

... auto-populates when called from siteFinder() wrapper

Value

A list comprising metadata of environmental monitoring sites from network(s)/platform(s) specified in network

Author(s)

Josh Roberti <jaroberti87@gmail.com>

Derek Smith

References

see reference links above

See Also

[siteFinder](#) [mapResults](#) [metScanR_DB](#)

Examples

```
## Not run:
#returns metadata from all NRCS sites within the database
getNetwork(network="NRCS")
#returns metadata from ASOS, USCRN, and NEON sites within the database
getNetwork(network=c("ASOS","USCRN","NEON"))
## End(Not run)
```

getStation	<i>return metadata for selected environmental station(s)</i>
------------	--

Description

Return metadata of user specified environmental monitoring stations. This is a standalone function.

Usage

```
getStation(siteID, ...)
```

Arguments

siteID	(character) in the form of: [idType]:[ID]. Required.
...	auto-populates when called from <code>siteFinder()</code> wrapper

Value

A list comprising metadata for the entered environmental monitoring site(s)

Author(s)

Josh Roberti <jaroberti87@gmail.com>

See Also

[siteFinder](#) [mapResults](#) [metScanR_DB](#)

Examples

```
## Not run:
#return metadata for NEON's CPER site
  getStation(siteID="NEON:CPER")
#return metadata for a list of sites
  getStation(siteID=c("NEON:CPER", "COOP:140509", "NWSLI:LCON1"))
## End(Not run)
```

getTerritory	<i>Filter environmental monitoring stations by state/territory</i>
--------------	--

Description

Return metadata of environmental monitoring stations from a state/territory within the metScanR database.

Usage

```
getTerritory(territory, ...)
```

Arguments

`territory` (character) state/territory abbreviation (e.g., 'RI' = Rhode Island, United States; 'YT' = Yukon Territory, Canada) to filter environmental monitoring stations.

`...` auto-populates when called from `siteFinder()` wrapper

Value

A list comprising metadata of environmental monitoring sites from state/territory specified in network

Author(s)

Josh Roberti <jaroberti87@gmail.com>

References

see reference links above

See Also

[siteFinder](#) [mapResults](#) [metScanR_DB](#)

Examples

```
## Not run:
#returns metadata from all stations within Rhode Island (RI)
getTerritory(territory = "RI")
#returns metadata from stations within Colorado and Utah
getTerritory(territory=c("CO","UT"))
## End(Not run)
```

getVars

Filter environmental monitoring stations by reported elements

Description

Return metadata of environmental monitoring stations that collect specific element-level (environmental variables, e.g., air temperature) metadata via 'fuzzy search'.

Usage

```
getVars(vars, startVarsDate, endVarsDate, ...)
```

Arguments

vars	(character) Elements(s)/variables(s) of interest. The user can search for general, environmental terms, such as 'temperature,' or 'wind,' and the function will return environmental stations that collect the specified elements ('fuzzy search'). Keep in mind that the database contains ~107,000 stations, worldwide. Searching for a general term such as 'temperature' will return many stations. The user is advised to search for more granular terms, e.g., using sub terms such as 'air temperature,' or 'soil temperature,' if they wish to narrow their results.
startVarsDate	(character) start date in the form of "YYYY-MM-DD" for filtering environmental variables by active measurement dates. Optional
endVarsDate	(character) end date in the form of "YYYY-MM-DD" for filtering environmental variables by active measurement dates. Optional
...	auto-populates when called from siteFinder() wrapper

Value

A list comprising environmental monitoring sites that observe or collect the element(s)/variable(s) specified in vars

Author(s)

Josh Roberti <jaroberti87@gmail.com>

See Also

[siteFinder](#) [mapResults](#) [metScanR_DB](#)

Examples

```
## Not run:
#return a list of sites that collect humidity data
  getVars(vars="humidity")
#return a list of sites that collect soil temperature and/or wind data
  getVars(vars=c("soil temperature","wind"))
#return a list of sites that collected snow depth data during 1970-01-01 thru 1985-05-10
  getVars(vars = "snow depth",startVarsDate = "1970-01-01",endVarsDate = "1985-05-10")
## End(Not run)
```

mapResults

Map environmental monitoring stations

Description

A plotting tool to map environmental monitoring stations from the metScanR database. ****NOTE:** This function requires internet connection!**

Usage

```
mapResults(x, limit = 5000)
```

Arguments

x (list) Metadata of environmental monitoring stations.
limit (numeric) maximum number of stations to plot. Defaults to 5000. Setting this >5000 may result in wait times of up to minute if internet connection is slow.

Value

A map of environmental monitoring stations

Author(s)

Josh Roberti <jaroberti87@gmail.com>
Lee Stanish
Cody Flagg
Sam Weintraub
Derek Smith

See Also

[getNearby](#) [getElevation](#) [getDates](#) [getNetwork](#) [getVars](#) [getCountry](#) [getId](#) [siteFinder](#) [metScanR_DB](#)

Examples

```
## Not run:
#map environmental monitoring stations located in Italy
  mapResults(getCountry(country="Italy"))
#map environmental monitoring stations within 50 km of Boulder, CO, USA
  mapResults(getNearby(lat=40.0149,lon=-105.2705,radius=50))
## End(Not run)
```

mapSiteFinder	<i>Map environmental monitoring stations</i>
---------------	--

Description

A plotting tool to map environmental monitoring stations from the metScanR database. ****NOTE:** This function requires internet connection!**

Usage

```
mapSiteFinder(x, limit = 5000)
```

Arguments

x	(list) Metadata of environmental monitoring stations.
limit	(numeric) maximum number of stations to plot. Defaults to 5000. Setting this >5000 may result in wait times of up to minute if internet connection is slow.

Value

A map of environmental monitoring stations

Author(s)

Josh Roberti <jaroberti87@gmail.com>
Lee Stanish
Cody Flagg
Sam Weintraub
Derek Smith

See Also

[getNearby](#) [getElevation](#) [getDates](#) [getNetwork](#) [getVars](#) [getCountry](#) [getId](#) [siteFinder](#) [metScanR_DB](#)

Examples

```
## Not run:
#map environmental monitoring stations located in Italy
  mapSiteFinder(getCountry(country="Italy"))
#map environmental monitoring stations within 50 km of Boulder, CO, USA
  mapSiteFinder(getNearby(lat=40.0149,lon=-105.2705,radius=50))
## End(Not run)
```

metScanR_DB

Worldwide, Environmental Monitoring Station metadata

Description

Metadata from ~107,000 environmental monitoring stations among 219 countries/territories and 18 environmental networks. Metadata are gathered from a growing number of sources and the database is continually updated to reflect the increase of information.

Usage

```
metScanR_DB
```

Format

(list) Metadata from ~107,000 environmental monitoring stations, worldwide. The metadata for each site include:

namez (character) Name of environmental monitoring site as defined by governing network

identifiers (data.frame) Station identifiers of environmental monitoring site as defined by associated networks

platform (character) Station platform (type). A single station may be a specific platform but it might be associated with many networks / identifiers.

elements (data.frame) Elements (environmental phenomena) measured, along with associated start and end dates

location (data.frame) Spatial location information (latitude, longitude, country, elevation) of environmental monitoring site

metScanR_terms	<i>Environmental metadata terms used within metScanR_DB</i>
----------------	---

Description

Environmental metadata terms (e.g., air temperature, wind speed, etc.) and data product identifiers used by the environmental monitoring networks within the metScanR_DB. Terms are gathered from a growing number of sources and the terms database is continually updated to reflect the increase of information.

Usage

```
metScanR_terms
```

Format

(data frame) Environmental terms and data product identifiers from environmental monitoring networks, worldwide

siteFinder	<i>Filter environmental monitoring stations (wrapper)</i>
------------	---

Description

A wrapper function comprising all filtering functions within the metScanR package. The metScanR database contains metadata from roughly 107,000 stations among ~200 countries/territories and ~18 networks/platforms, worldwide. This function returns metadata for a subset of those stations, based on the criteria specified by a user.

Usage

```
siteFinder(country, siteID, lat, lon, radius, network, vars, startVarsDate,
  endVarsDate, id, startDate, endDate, includeUnk, elevMin, elevMax,
  territory, ...)
```

Arguments

country	(character) Country(ies)/territory(ies) to filter environmental stations. See '?getCountry' for more information.
siteID	(character) in the form of: *idType:id*. Environmental monitoring network to use as your Point of Interest (POI). See '?getNearby' for more help.
lat	(numeric) Latitude of (POI). See '?getNearby' for more help.
lon	(numeric) Longitude of (POI). See '?getNearby' for more help.
radius	(numeric) Search radius outward from POI for finding environmental monitoring stations. Defined in kilometers (km). See '?getNearby' for more help.

network	(character) Network(s)/platform(s) to filter environmental monitoring stations. Metadata are available for stations in the networks below. See '?getNetwork' for more information.
vars	(character) Elements(s)/variables(s) of interest. The user can search for general, environmental terms, such as 'temperature,' or 'wind,' and the function will return environmental stations that collect the specified elements ('fuzzy search'). Keep in mind that the database contains ~107,000 stations, worldwide. Searching for a general term such as 'temperature' will return many stations. The user is advised to search for more granular terms, e.g., using sub terms such as 'air temperature,' or 'soil temperature,' if they wish to narrow their results. See '?getVarS' for more help.
startVarsDate	(character) start date in the form of "YYYY-MM-DD" for filtering environmental variables by active measurement dates. Optional
endVarsDate	(character) end date in the form of "YYYY-MM-DD" for filtering environmental variables by active measurement dates. Optional
id	(character) identifier(s) of interest. Metadata are available for stations with any of the identifiers listed below. It should be noted that a single station man have multiple, associated identifers. See '?getId' for more information.
startDate	(character) "YYYY-MM-DD" used to filter start dates of environmental stations within the metScanR database. Optional if endDate is initialized. Required if endDate is missing. See '?getDates' for more information.
endDate	(character) "YYYY-MM-DD" used to filter end dates of environmental stations within the metScanR database. Optional if startDate is initialized. Required if startDate is missing. See '?getDates' for more information.
includeUnk	(logical) Defaults to FALSE and excludes sites with unknown start dates. Setting to TRUE will include sites with unknown start dates. Sites with unknown start dates account for ~71 percent of the metScanR database. This is a result of undocumented, government (or network/governing body) metadata. Nearly all stations within the database have a known end date, however. Initializing endDate (while leaving startDate uninitialized) and setting includeUnk=TRUE will more than likely return results than if startDate is also initialized. See '?getDates' for more information.
elevMin	(numeric) defines minimum elevation (m) to filter metadata.
elevMax	(numeric) defines maximum elevation (m) to filter metadata.
territory	(character) state/territory abbreviation (e.g., 'RI' = Rhode Island, United States; 'YT' = Yukon Territory, Canada)to filter environmental monitoring stations.
...	Depracated terms from previous version of function.

Value

A list comprising metadata of environmental monitoring stations from country(ies)/territory(ies) specified in country

Author(s)

Josh Roberti <jaroberti87@gmail.com>
Cody Flagg
Lee Stanish
Sam Weintraub
Derek Smith

See Also

[getNearby](#) [getElevation](#) [getDates](#) [getNetwork](#) [getVars](#) [getCountry](#) [getId](#) [mapResults](#) [metScanR_DB](#)

Examples

```
## Not run:  
#Return metadata of sites within 50 km of NEON's HARV active from 1965-10-20 to 1986-09-02  
siteFinder(siteID="NEON:HARV",startDate="1965-10-20",  
endDate="1986-09-02",radius=50)  
  
#Return metadata of SCAN, SNTL, and ASOS sites active from at least 2000-01-05 onward  
siteFinder(network=c("SCAN","SNTL","ASOS"),startDate="2000-01-05")  
  
#Return metadata of sites in Brazil with elevations of 1500 +/- 250 (m) Above Sea Level  
siteFinder(minElev=1000,maxElev=1800,country="Brazil")  
## End(Not run)
```

updateDatabase

Update the metScanR database to the latest version.

Description

Updates the metScanR database to the latest version hosted on GitHub at: <https://github.com/jaroberti/metScanR>. When installed, the metScanR package contains only a small (subset) database comprising ~5300 environmental monitoring stations. This function will update the local version of the database to the most up-to-date version.

Usage

```
updateDatabase()
```

Author(s)

Robert Lee <rhlee@colorado.edu>

See Also

[metScanR_DB](#)

Examples

```
## Not run:  
updateDatabase()  
  
## End(Not run)
```

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