Package 'PWFSLSmoke'

July 2, 2020

Type Package

Version 1.2.111

Title Utilities for Working with Air Quality Monitoring Data

Author Jonathan Callahan [aut, cre],
Hans Martin [aut],
Spencer Pease [aut],
Helen Miller [aut],
Zach Dingels [aut],
Rohan Aras [aut],
Jon Hagg [aut],
Jimin Kim [aut],
Rex Thompson [aut],
Alice Yang [aut]

Maintainer Jonathan Callahan <jonathan.s.callahan@gmail.com>

Depends R (>= 3.3.0), dplyr (>= 0.8.3), maps, MazamaCoreUtils (>= 0.4.3), MazamaSpatialUtils (>= 0.6.3)

Imports curl, cluster, dygraphs (>= 1.1.1.4), geosphere, ggmap, glue, httr, jsonlite, leaflet (>= 1.0.0), lubridate, magrittr, mapproj, maptools, methods, openair, png, purrr, raster, RColorBrewer, rgdal, RgoogleMaps, readr, reshape2, rlang, sf, slippymath, sp, stringr, tibble, tidyr, xts

Suggests knitr, lintr, rmarkdown, testthat (>= 2.1.0)

Description Utilities for working with air quality monitoring data with a focus on small particulates (PM2.5) generated by wildfire smoke. Functions are provided for downloading available data from the United States 'EPA' <https://www.epa.gov/outdoor-air-quality-data> and it's 'AirNow' air quality site <https://www.airnow.gov>. Additional sources of PM2.5 data made accessible by the package include: 'AIRSIS' (password protected) <https://www.oceaneering.com/data-management/> and 'WRCC' <https://wrcc.dri.edu/cgi-bin/smoke.pl>. Data compilations are provided by 'PWFSL' <https://www.fs.fed.us/pnw/pwfsl/>.

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VignetteBuilder knitr

Repository CRAN

URL https://github.com/MazamaScience/PWFSLSmoke

BugReports https://github.com/MazamaScience/PWFSLSmoke/issues

Encoding UTF-8

LazyData true

RoxygenNote 7.1.0

NeedsCompilation no

Date/Publication 2020-07-02 10:30:02 UTC

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`addAQILegend` *Add an AQI Legend to a Map*

Description

This function is a convenience wrapper around `graphics::legend()`. It will show the AQI colors and names by default if `col` and `legend` are not specified.

Usage

```
addAQILegend(
  x = "topright",
  y = NULL,
  col = rev(AQI$colors),
  legend = rev(AQI$names),
  pch = 16,
  title = "Air Quality Index",
  ...
)
```

Arguments

x	x coordinate passed on to the legend() command
y	y coordinate passed on to the legend() command
col	the color for points/lines in the legend
legend	a character vector to be shown in the legend
pch	plotting symbols in the legend
title	title for the legend
...	additional arguments to be passed to legend()

---

addAQILines *Add AQI Lines to a Plot*

Description

This function is a convenience for:
abline(h = AQI$breaks_24,col = AQI$colors)

Usage

```
addAQILines(...)
```

Arguments

...	additional arguments to be passed to abline()

---

addAQIStackedBar *Create Stacked AQI Bar*

Description

Draws a stacked bar indicating AQI levels on one side of a plot

Usage

```
addAQIStackedBar(width = 0.01, height = 1, pos = "left")
```

Arguments

width	width of the bar as a fraction of the width of the plot area (default = .02)
height	height of the bar as a fraction of the height of the plot area (default = 1)
pos	position of the stacked bar. Either 'left' or 'right'

Value

Stacked AQI Bar

addBullseye *Add a Bullseyes to a Map or RgoogleMap Plot*

Description

Draws a bullseye with concentric circles of black and white.

Usage

```
addBullseye(longitude, latitude, map = NULL, cex = 2, lwd = 2)
```

Arguments

longitude	vector of longitudes
latitude	vector of latitudes
map	optional RgoogleMaps map object
cex	character expansion
lwd	line width of individual circles

Examples

```
wa <- monitor_subset(Northwest_Megafires, stateCodes='WA', tlim=c(20150821,20150828))
monitor_map(wa, cex=4)
addBullseye(wa$meta$longitude, wa$meta$latitude)
```

addIcon *Add Icons to a Map or RgoogleMap Plot*

Description

Adds an icon to map – an RgoogleMaps map object. The following icons are available:

- orangeFlame – yellow-orange flame
- redFlame – orange-red flame

You can use other .png files as icons by passing an absolute path as the icon argument.

Usage

```
addIcon(icon, longitude, latitude, map = NULL, expansion = 0.1, pos = 0)
```

Arguments

icon	object to be plotted
longitude	vector of longitudes
latitude	vector of latitudes
map	optional RgoogleMaps map object
expansion	icon expansion factor
pos	position of icon relative to location (0=center, 1=bottom, 2=left, 3=top,4=right)

Note

For RgoogleMaps, the expansion will be ~ 0.1 while for basic plots it may need to be much smaller, perhaps ~ 0.001.

Examples

```
## Not run:
ca <- loadLatest() %>% monitor_subset(stateCodes='CA')
# Google map
map <- monitor_esriMap(ca)
addIcon("orangeFlame", ca$meta$longitude, ca$meta$latitude, map=map, expansion=0.1)
# line map
monitor_map(ca)
addIcon("orangeFlame", ca$meta$longitude, ca$meta$latitude, expansion=0.002)

## End(Not run)
```

---

addMarker *Add Icons to a Map or RgoogleMap Plot*

Description

Adds a marker to a plot or map – an RgoogleMaps map object or Raster* object.

Usage

```
addMarker(longitude, latitude, color = "red", map = NULL, expansion = 1, ...)
```

Arguments

longitude	vector of longitudes
latitude	vector of latitudes
color	marker color: 'red', 'green', 'yellow', 'orange', or 'blue'. Also includes AQI category colors, specified 'AQI[number]' eg. 'AQI1'
map	optional RgoogleMaps map object or Raster* object
expansion	icon expansion factor. Ignored if width and height are specified.
...	arguments passed on to rasterImage

Examples

```
## Not run:
ca <- loadLatest() %>% monitor_subset(stateCodes='CA')
# Google map
map <- monitor_esriMap(ca)
addMarker(ca$meta$longitude, ca$meta$latitude, map=map)
# line map
monitor_map(ca)
addMarker(ca$meta$longitude, ca$meta$latitude, color = "blue", expansion = 1)

## End(Not run)
```

---

addPolygon *Add a Colored Polygon to a Plot*

Description

Add a multi-sided polygon to a plot.

Usage

```
addPolygon(
  x = 0,
  y = 0,
  sides = 72,
  radius = 1,
  rotation = 0,
  border = NULL,
  col = NA,
  ...
)
```

Arguments

x	x location of center
y	y location of center
sides	number of sides
radius	radius
rotation	amount to rotate the polygon in radians
border	border color (see ?polygon)
col	fill color (see ?polygon)
...	additional arguments to be passed to polygon()

Examples

```
# Create AQI dots
plot(1:6, rep(0,6), xlim=c(-1,7), ylim=c(-1,3),
    axes=FALSE, xlab='', ylab='', col='transparent')
for (i in 1:6) {
  addPolygon(i, 2, 72, 0.4, 0, col=PWFSLSmoke::AQI$colors[i])
  addPolygon(i, 1, 4, 0.4, pi/4, co=PWFSLSmoke::AQI$colors[i])
  addPolygon(i, 0, 3, 0.4, pi/2, col=PWFSLSmoke::AQI$colors[i])
}
```

---

addShadedBackground *Add Shaded Background to a Plot*

Description

Adds vertical lines to an existing plot using any variable that shares the same length as the time axis of the current plot. Line widths corresponds to magnitude of values.

Usage

```
addShadedBackground(
  param,
  timeAxis,
  breaks = stats::quantile(param, na.rm = TRUE),
  col = "blue",
  maxOpacity = 0.2,
  lwd = 1
)
```

Arguments

param	vector of data to be represented
timeAxis	vector of times of the same length as param
breaks	set of breaks used to assign colors
col	color for vertical lines
maxOpacity	maximum opacity
lwd	line width

addShadedNight *Add Nighttime Shading to a Plot*

Description

Draw shading rectangles on a plot to indicate nighttime hours.

Usage

```
addShadedNight(timeInfo, col = adjustcolor("black", 0.1))
```

Arguments

timeInfo	dataframe with local time, sunrise, and sunset
col	color used to shade nights – defaults to adjustcolor('black',0.2)

See Also

timeInfo

addWindBarbs *Add wind barbs to a map*

Description

Add a multi-sided polygon to a plot.

Usage

```
addWindBarbs(
  x,
  y,
  speed,
  dir,
  circleSize = 1,
  circleFill = "transparent",
  lineCol = 1,
  extraBarbLength = 0,
  barbSize = 1,
  ...
)
```

Arguments

x	vector of longitudes
y	vector of latitudes
speed	vector of wind speeds in knots
dir	wind directions in degrees clockwise from north
circleSize	size of the circle
circleFill	circle fill color
lineCol	line color (currently not supported)
extraBarbLength	add length to barbs
barbSize	size of the barb
...	additional arguments to be passed to lines

References

https://commons.wikimedia.org/wiki/Wind_speed

Examples

```
maps::map('state', "washington")
x <- c(-121, -122)
y <- c(47.676057, 47)
addWindBarbs(x, y, speed = c(45,65), dir = c(45, 67),
             circleSize = 1.8, circleFill = c('orange', 'blue'))
```

---

airnow_createDataDataframes

Return reshaped dataframes of AirNow data

Description

This function uses the airnow_downloadParseData function to download monthly dataframes of AirNow data and restructures that data into a format that is compatible with the PWFSLSmoke package *ws_monitor* data model.

AirNow data parameters include at least the following list:

1. BARPR
2. BC
3. CO
4. NO
5. NO2
6. NO2Y

7. NO2X
8. NOX
9. NOOY
10. OC
11. OZONE
12. PM10
13. PM2.5
14. PRECIP
15. RHUM
16. SO2
17. SRAD
18. TEMP
19. UV-AETH
20. WD
21. WS

Setting `parameters=NULL` will generate a separate dataframe for each of the above parameters.

Usage

```
airnow_createDataDataframes(
  parameters = NULL,
  startdate = strftime(lubridate::now(tzone = "UTC"), "%Y%m%d00", tz = "UTC"),
  hours = 24
)
```

Arguments

`parameters`	Vector of names of desired pollutants or NULL for all pollutants.
`startdate`	Desired start date (integer or character representing YYYYMMDD[HH]).
`hours`	Desired number of hours of data to assemble.

Value

List of dataframes where each dataframe contains all data for a unique parameter (e.g: "PM2.5", "NOX").

Note

As of 2016-12-27, it appears that hourly data are available only for 2016 and not for earlier years.

See Also

airnow_downloadParseData

airnow_qualityControl

Examples

```
## Not run:
airnowList <- airnow_createDataDataframes("PM2.5", 2019062500)

## End(Not run)
```

`airnow_createMetaDataframes`

Create dataframes of AirNow site location metadata

Description

The `airnow_createMetaDataframes()` function uses the `airnow_downloadSites()` function to download site metadata from AirNow and restructures that data into a format that is compatible with the PWFSLSmoke package *ws_monitor* data model.

The `meta` dataframe in the *ws_monitor* data model has metadata associated with monitoring site locations for a specific parameter and must contain at least the following columns:

- monitorID – per deployment unique ID
- longitude – decimal degrees E
- latitude – decimal degrees N
- elevation – height above sea level in meters
- timezone – olson timezone
- countryCode – ISO 3166-1 alpha-2
- stateCode – ISO 3166-2 alpha-2

The `meta` dataframe will have rownames matching `monitorID`.

This function takes a dataframe obtained from AirNowTech's `monitoring_site_locations.dat` file, splits it up into separate dataframes, one for each parameter, and performs the following cleanup:

- convert incorrect values to `NA` e.g. longitude=0 & latitude=0
- add timezone information

Parameters included in AirNow data include at least the following list:

1. BARPR
2. BC
3. CO
4. NO
5. NO2
6. NO2Y
7. NO2X

8. NOX
9. NOOY
10. OC
11. OZONE
12. PM10
13. PM2.5
14. PRECIP
15. RHUM
16. SO2
17. SRAD
18. TEMP
19. UV-AETH
20. WD
21. WS

Setting `parameters=NULL` will generate a separate dataframe for each of the above parameters.

Usage

```
airnow_createMetaDataframes(
  parameters = NULL,
  pwfslDataIngestSource = "AIRNOW",
  addGoogleMeta = TRUE
)
```

Arguments

`parameters`	vector of names of desired pollutants or NULL for all pollutants
`pwfslDataIngestSource`	identifier for the source of monitoring data, e.g. `'AIRNOW'`
`addGoogleMeta`	logicial specifying wheter to use Google elevation and reverse geocoding services

Value

List of 'meta' dataframes with site metadata for unique parameters (e.g: "PM2.5", "NOX").

See Also

airnow_downloadSites

Examples

```
## Not run:
metaList <- airnow_createMetaDataframes(parameters = "PM2.5")

## End(Not run)
```

`airnow_createMonitorObjects` *Obain AirNow data and create ws_monitor objects*

Description

This function uses the airnow_downloadParseData function to download monthly dataframes of AirNow data and restructures that data into a format that is compatible with the PWFSLSmoke package *ws_monitor* data model.

AirNow data parameters include at least the following list:

1. BARPR
2. BC
3. CO
4. NO
5. NO2
6. NO2Y
7. NO2X
8. NOX
9. NOOY
10. OC
11. OZONE
12. PM10
13. PM2.5
14. PRECIP
15. RHUM
16. SO2
17. SRAD
18. TEMP
19. UV-AETH
20. WD
21. WS

Setting `parameters=NULL` will generate a separate *ws_monitor* object for each of the above parameters.

Usage

```
airnow_createMonitorObjects(
  parameters = NULL,
  startdate = strftime(lubridate::now(tzone = "UTC"), "%Y%m%d", tz = "UTC"),
  hours = 24,
  zeroMinimum = TRUE,
  addGoogleMeta = TRUE
)
```

Arguments

parameters	vector of names of desired pollutants or NULL for all pollutants
startdate	desired start date (integer or character representing YYYYMMDD[HH])
hours	desired number of hours of data to assemble
zeroMinimum	logical specifying whether to convert negative values to zero
addGoogleMeta	logicial specifying wheter to use Google elevation and reverse geocoding services

Value

List where each element contains a *ws_monitor* object for a unique parameter (e.g: "PM2.5", "NOX").

Note

As of 2017-12-17, it appears that hourly data are available only for 2016 and not for earlier years.

See Also

airnow_createDataDataframes

airnow_createMetaDataframes

Examples

```
## Not run:
monList <- airnow_createMonitorObjects(c("PM2.5"), 20190625)
pm25 <- monList$PM2.5
o3 <- monList$O3

## End(Not run)
```

---

airnow_downloadHourlyData

Download hourly data from AirNow

Description

The https://airnowtech.org site provides both air pollution monitoring data as well as monitoring site location metadata. This function retrieves a single, hourly data file and returns it as a dataframe.

Usage

```
airnow_downloadHourlyData(
  datestamp = strftime(lubridate::now(tzone = "UTC"), "%Y%m%d00", tz = "UTC"),
  baseUrl = "https://files.airnowtech.org/airnow"
)
```

Arguments

`datestamp`	Integer or character representing YYYYMMDDHH.
`baseUrl`	Base URL for archived hourly data.

Value

Dataframe of AirNow hourly data.

Note

As of 2016-12-27, it appears that hourly data are available only for 2016 and not for earlier years.

Data from locations whose timezones have a fractional offset from UTC are removed as the PWFSLSmoke data model only supports data reported on hour boundaries. As of 2019-06-26, this only applies to US Department of State monitors in Myanmar, Sri Lanka, India and Nepal.

See Also

airnow_createDataDataframes

airnow_downloadParseData

Examples

```
## Not run:
df <- airnow_downloadHourlyData(2018070112)

## End(Not run)
```

`airnow_downloadParseData` *Download and aggregate multiple hourly data files from AirNow*

Description

This function makes repeated calls to airnow_downloadHourlyData to obtain data from AirNow. All data obtained are then combined into a single tibble and returned.

Parameters included in AirNow data include at least the following list:

1. BARPR
2. BC
3. CO
4. NO
5. NO2
6. NO2Y
7. NO2X

8. NOX
9. NOOY
10. OC
11. OZONE
12. PM10
13. PM2.5
14. PRECIP
15. RHUM
16. SO2
17. SRAD
18. TEMP
19. UV-AETH
20. WD
21. WS

Passing a vector of one ore more of the above names as the `parameters` argument will cause the resulting tibble to be filtered to contain only records for those parameters.

Usage

```
airnow_downloadParseData(
  parameters = NULL,
  startdate = strftime(lubridate::now(tzone = "UTC"), "%Y%m%d00", tz = "UTC"),
  hours = 24
)
```

Arguments

`parameters`	vector of names of desired pollutants or NULL for all pollutants
`startdate`	desired start date (integer or character representing YYYYMMDD[HH])
`hours`	desired number of hours of data to assemble

Value

Tibble of aggregated AirNow data.

Note

As of 2016-12-27, it appears that hourly data are available only for 2016 and not for earlier years.

See Also

airnow_createDataDataframes

airnow_downloadHourlyData

Examples

```
## Not run:
tbl <- airnow_downloadParseData("PM2.5", 2016070112, hours = 24)

## End(Not run)
```

`airnow_downloadSites` *Download AirNow Site Location Metadata*

Description

The https://airnowtech.org site provides both air pollution monitoring data as well as monitoring site location metadata. This function retrieves the most recent version of the site location metadata file and returns it as a dataframe.

A description of the data format is publicly available at the Monitoring Site Fact Sheet.

Usage

```
airnow_downloadSites(
  baseUrl = "https://files.airnowtech.org/airnow/today/",
  file = "monitoring_site_locations.dat"
)
```

Arguments

`baseUrl`	location of the AirNow monitoring site locations file
`file`	name of the AirNow monitoring site locations file

Value

Tibble of site location metadata.

Note

As of December, 2016, the `monitoring_site_locations.dat` file has an encoding of "CP437" (aka "Non-ISO extended-ASCII" or "IBMPC 437") and will be converted to "UTF-8" so that French and Spanish language place names are properly encoded in the returned dataframe.

See Also

airnow_createMetaDataframes

Examples

```
## Not run:
sites <- airnow_downloadSites()

## End(Not run)
```

airnow_load *Load Processed AirNow Monitoring Data*

Description

Please use `airnow_loadAnnual` instead of this function. It will soon be deprecated.

Usage

```
airnow_load(
  year = 2017,
  month = NULL,
  parameter = "PM2.5",
  baseUrl = "https://haze.airfire.org/monitoring/AirNow/RData/"
)
```

Arguments

`year`	desired year (integer or character representing YYYY)
`month`	desired month (integer or character representing MM)
`parameter`	parameter of interest
`baseUrl`	base URL for AirNow meta and data files

Value

A *ws_monitor* object with AirNow data.

airnow_loadAnnual *Load annual AirNow monitoring data*

Description

Loads pre-generated .RData files containing annual AirNow data.

If `dataDir` is defined, data will be loaded from this local dirctory. Otherwise, data will be loaded from the monitoring data repository maintained by PWFSL.

The annual files loaded by this function are updated on the 15'th of each month and cover the period from the beginning of the year to the end of the last month.

For data during the last 45 days, use `airnow_loadDaily()`.

For the most recent data, use `airnow_loadLatest()`.

AirNow parameters include the following:

1. PM2.5

Available AirNow RData and associated log files can be seen at: https://haze.airfire.org/monitoring/AirNow/RData

Usage

```
airnow_loadAnnual(
  year = NULL,
  parameter = "PM2.5",
  baseUrl = "https://haze.airfire.org/monitoring",
  dataDir = NULL
)
```

Arguments

year	Desired year (integer or character representing YYYY).
parameter	Parameter of interest.
baseUrl	Base URL for 'annual' AirNow data files.
dataDir	Local directory containing 'annual' data files.

Value

A *ws_monitor* object with AirNow data.

See Also

airnow_loadDaily

airnow_loadLatest

Examples

```
## Not run:
airnow_loadAnnual(2017) %>%
  monitor_subset(stateCodes='MT', tlim=c(20170701,20170930)) %>%
  monitor_dailyStatistic() %>%
  monitor_timeseriesPlot(style = 'gnats', ylim=c(0,300), xpd=NA)
  addAQIStackedBar()
  addAQILines()
  title("Montana 2017 -- AirNow Daily Average PM2.5")

## End(Not run)
```

---

airnow_loadDaily *Load recent AirNow monitoring data*

Description

Loads pre-generated .RData files containing recent AirNow data.

If `dataDir` is defined, data will be loaded from this local dirctory. Otherwise, data will be loaded from the monitoring data repository maintained by PWFSL.

The daily files loaded by this function are updated once a day, shortly after midnight and contain data for the previous 45 days.

For the most recent data, use `airnow_loadLatest()`.

For data extended more than 45 days into the past, use `airnow_loadAnnual()`.

AirNow parameters include the following:

1. PM2.5

Available AirNow RData and associated log files can be seen at: https://haze.airfire.org/monitoring/AirNow/RData/latest

Usage

```
airnow_loadDaily(
  parameter = "PM2.5",
  baseUrl = "https://haze.airfire.org/monitoring/latest/RData",
  dataDir = NULL
)
```

Arguments

`parameter`	Parameter of interest.
`baseUrl`	Base URL for 'daily' AirNow data files.
`dataDir`	Local directory containing 'daily' data files.

Value

A *ws_monitor* object with AirNow data.

See Also

`airnow_loadAnnual`

`airnow_loadLatest`

Examples

```
## Not run:
airnow_loadDaily() %>%
  monitor_subset(stateCodes=CONUS) %>%
  monitor_map()

## End(Not run)
```

`airnow_loadLatest` *Load most recent AirNow monitoring data*

Description

Loads pre-generated .RData files containing the most recent AirNow data.

If `dataDir` is defined, data will be loaded from this local dirctory. Otherwise, data will be loaded from the monitoring data repository maintained by PWFSL.

The files loaded by this function are updated multiple times an hour and contain data for the previous 10 days.

For daily updates covering the most recent 45 days, use `airnow_loadDaily()`.

For data extended more than 45 days into the past, use `airnow_loadAnnual()`.

AirNow parameters include the following:

1. PM2.5

Avaialble RData and associated log files can be seen at: https://haze.airfire.org/monitoring/AirNow/RData/latest

Usage

```
airnow_loadLatest(
  parameter = "PM2.5",
  baseUrl = "https://haze.airfire.org/monitoring/latest/RData",
  dataDir = NULL
)
```

Arguments

`parameter`	Parameter of interest.
`baseUrl`	Base URL for 'daily' AirNow data files.
`dataDir`	Local directory containing 'daily' data files.

Value

A *ws_monitor* object with AirNow data.

See Also

`airnow_loadAnnual`

`airnow_loadDaily`

Examples

```
## Not run:
airnow_loadLatest() %>%
  monitor_subset(stateCodes=CONUS) %>%
  monitor_map()

## End(Not run)
```

`airnow_qualityControl` *Apply Quality Control to AirNow dataframe*

Description

Perform range validation on AirNow data. This function also replaces values of `-999` with `NA`.

Usage

```
airnow_qualityControl(df, limits = c(-Inf, Inf))
```

Arguments

`df`	multi-site restructured dataframe created within `airnow_createDataDataframe()`
`limits`	lo and hi range of valid values

Value

Cleaned up dataframe of AIRSIS monitor data.

See Also

airnow_createDataDataframes

`AIRSIS` *AIRSIS Unit Types*

Description

AIRSIS provides access to data by unit type at URLs like: http://usfs.airsis.com/vision/common/CSVExport.aspx?utid=38&S
11-06&EndDate=2017-11-07

The `AIRSIS` objectis a list of lists. The element named `unitTypes` is itself a list of named unit types:

Unit types include:

- DATARAM 21 = Dataram
- BAM1020 24 = Bam 1020

- EBAM_NEW 30 = eBam-New
- EBAM 38 = Iridium - Ebam
- ESAM 39 = Iridium - Esam
- AUTOMET 43 = Automet

Usage

```
AIRSIS
```

Format

A list of lists

Details

AIRSIS monitor types and codes

Note

This list of monitor types was created on Feb 09, 2017.

---

airsis_availableUnits *Get AIRSIS available unit identifiers*

Description

Returns a list of unitIDs with data during a particular time period.

Usage

```
airsis_availableUnits(
  startdate = strftime(lubridate::now(tzone = "UTC"), "%Y010100", tz = "UTC"),
  enddate = strftime(lubridate::now(tzone = "UTC"), "%Y%m%d23", tz = "UTC"),
  provider = "USFS",
  unitTypes = c("BAM1020", "EBAM", "ESAM"),
  baseUrl = "http://xxxx.airsis.com/vision/common/CSVExport.aspx?"
)
```

Arguments

startdate	desired start date (integer or character representing YYYYMMDD[HH])
enddate	desired end date (integer or character representing YYYYMMDD[HH])
provider	identifier used to modify baseURL ['APCD'|'USFS']
unitTypes	vector of unit types
baseUrl	base URL for data queries

Value

Vector of AIRSIS unitIDs.

References

Interagency Real Time Smoke Monitoring

Examples

```
## Not run:
unitIDs <- airsis_availableUnits(20150701, 20151231,
                                 provider = 'USFS',
                                 unitTypes = c('EBAM','ESAM'))

## End(Not run)
```

---

airsis_BAM1020QualityControl

Apply Quality Control to raw AIRSIS BAM1020 dataframe

Description

Perform various QC measures on AIRSIS BAM1020 data.

A `POSIXct` `datetime` column (UTC) is also added based on `DateTime`.

Usage

```
airsis_BAM1020QualityControl(
  tbl,
  valid_Longitude = c(-180, 180),
  valid_Latitude = c(-90, 90),
  remove_Lon_zero = TRUE,
  remove_Lat_zero = TRUE,
  valid_Flow = c(0.834 * 0.95, 0.834 * 1.05),
  valid_AT = c(-Inf, 45),
  valid_RHi = c(-Inf, 45),
  valid_Conc = c(-Inf, 5000),
  flagAndKeep = FALSE
)
```

Arguments

`tbl`	single site tibble created by `airsis_parseData()`
`valid_Longitude`	range of valid Longitude values
`valid_Latitude`	range of valid Latitude values

remove_Lon_zero	flag to remove rows where Longitude == 0
remove_Lat_zero	flag to remove rows where Latitude == 0
valid_Flow	range of valid Flow values
valid_AT	range of valid AT values
valid_RHi	range of valid RHi values
valid_Conc	range of valid ConcHr values
flagAndKeep	flag, rather than remove, bad data during the QC process

Value

Cleaned up tibble of AIRSIS monitor data.

See Also

airsis_qualityControl

---

airsis_createDataDataframe

Create AIRSIS data dataframe

Description

After quality control has been applied to an AIRSIS tibble, we can extract the PM2.5 values and store them in a data dataframe organized as time-by-deployment (aka time-by-site).

The first column of the returned dataframe is named 'datetime' and contains a POSIXct time in UTC. Additional columns contain data for each separate deployment of a monitor.

Usage

```
airsis_createDataDataframe(tbl, meta)
```

Arguments

tbl	single site AIRSIS tibble created by airsis_clustering()
meta	AIRSIS meta dataframe created by airsis_createMetaDataframe()

Value

A data dataframe for use in a *ws_monitor* object.

`airsis_createMetaDataframe` *Create AIRSIS site location metadata dataframe*

Description

After an AIRSIS tibble has been enhanced with additional columns generated by `addClustering` we are ready to pull out site information associated with unique deployments.

These will be rearranged into a dataframe organized as deployment-by-property with one row for each monitor deployment.

This site information found in `tbl` is augmented so that we end up with a uniform set of properties associated with each monitor deployment. The list of columns in the returned `meta` dataframe is:

```
> names(p$meta)
 [1] "monitorID"             "longitude"             "latitude"
 [4] "elevation"             "timezone"              "countryCode"
 [7] "stateCode"             "siteName"              "agencyName"
[10] "countyName"            "msaName"               "monitorType"
[13] "monitorInstrument"     "aqsID"                 "pwfslID"
[16] "pwfslDataIngestSource" "telemetryAggregator"   "telemetryUnitID"
```

Usage

```
airsis_createMetaDataframe(
  tbl,
  provider = as.character(NA),
  unitID = as.character(NA),
  pwfslDataIngestSource = "AIRSIS",
  existingMeta = NULL,
  addGoogleMeta = FALSE,
  addEsriMeta = FALSE
)
```

Arguments

`tbl`	single site AIRSIS tibble after metadata enhancement
`provider`	identifier used to modify baseURL `['APCD'|'USFS']`
`unitID`	character or numeric AIRSIS unit identifier
`pwfslDataIngestSource`	identifier for the source of monitoring data, e.g. `'AIRSIS'`
`existingMeta`	existing 'meta' dataframe from which to obtain metadata for known monitor deployments
`addGoogleMeta`	logicial specifying wheter to use Google elevation and reverse geocoding services
`addEsriMeta`	logicial specifying wheter to use ESRI elevation and reverse geocoding services

Value

A `meta` dataframe for use in a *ws_monitor* object.

See Also

`addMazamaMetadata`

`airsis_createMonitorObject`

Obain AIRSIS data and create ws_monitor object

Description

Obtains monitor data from an AIRSIS webservice and converts it into a quality controlled, metadata enhanced *ws_monitor* object ready for use with all `monitor_~` functions.

Steps involved include:

1. download CSV text
2. parse CSV text
3. apply quality control
4. apply clustering to determine unique deployments
5. enhance metadata to include: elevation, timezone, state, country, site name
6. reshape AIRSIS data into deployment-by-property `meta` and and time-by-deployment `data` dataframes

QC parameters that can be passed in the `...` include the following valid data ranges as taken from `airsis_EBAMQualityControl()`:

- `valid_Longitude=c(-180,180)`
- `valid_Latitude=c(-90,90)`
- `remove_Lon_zero = TRUE`
- `remove_Lat_zero = TRUE`
- `valid_Flow = c(16.7*0.95,16.7*1.05)`
- `valid_AT = c(-Inf,45)`
- `valid_RHi = c(-Inf,45)`
- `valid_Conc = c(-Inf,5.000)`

Note that appropriate values for QC thresholds will depend on the type of monitor.

Usage

```
airsis_createMonitorObject(
  startdate = strftime(lubridate::now(tzone = "UTC"), "%Y010100", tz = "UTC"),
  enddate = strftime(lubridate::now(tzone = "UTC"), "%Y%m%d23", tz = "UTC"),
  provider = NULL,
  unitID = NULL,
  clusterDiameter = 1000,
  zeroMinimum = TRUE,
  baseUrl = "http://xxxx.airsis.com/vision/common/CSVExport.aspx?",
  saveFile = NULL,
  existingMeta = NULL,
  addGoogleMeta = FALSE,
  addEsriMeta = FALSE,
  ...
)
```

Arguments

`startdate`	desired start date (integer or character representing YYYYMMDD[HH])
`enddate`	desired end date (integer or character representing YYYYMMDD[HH])
`provider`	identifier used to modify baseURL `['APCD'|'USFS']`
`unitID`	character or numeric AIRSIS unit identifier
`clusterDiameter`	diameter in meters used to determine the number of clusters (see `addClustering()`)
`zeroMinimum`	logical specifying whether to convert negative values to zero
`baseUrl`	base URL for data queries
`saveFile`	optional filename where raw CSV will be written
`existingMeta`	existing 'meta' dataframe from which to obtain metadata for known monitor deployments
`addGoogleMeta`	logicial specifying wheter to use Google elevation and reverse geocoding services
`addEsriMeta`	logicial specifying wheter to use ESRI elevation and reverse geocoding services
`...`	additional parameters are passed to type-specific QC functions

Value

A *ws_monitor* object with AIRSIS data.

Note

The downloaded CSV may be saved to a local file by providing an argument to the `saveFile` parameter.

See Also

airsis_downloadData

airsis_parseData

airsis_qualityControl

addClustering

airsis_createMetaDataframe

airsis_createDataDataframe

Examples

```
## Not run:
library(PWFSLSmoke)
initializeMazamaSpatialUtils()

usfs_1072 <- airsis_createMonitorObject(20200601, 20200620, 'USFS', unitID='1072')
monitor_timeseriesPlot(usfs_1072)

## End(Not run)
```

---

airsis_createRawDataframe

Obain AIRSIS data and parse into a raw tibble

Description

Obtains monitor data from an AIRSIS webservice and converts it into a quality controlled, metadata enhanced "raw" tibble ready for use with all `raw_~` functions.

Steps involved include:

1. download CSV text
2. parse CSV text
3. apply quality control
4. apply clustering to determine unique deployments
5. enhance metadata to include: elevation, timezone, state, country, site name

Usage

```
airsis_createRawDataframe(
  startdate = strftime(lubridate::now(tzone = "UTC"), "%Y010100", tz = "UTC"),
  enddate = strftime(lubridate::now(tzone = "UTC"), "%Y%m%d23", tz = "UTC"),
  provider = NULL,
  unitID = NULL,
  clusterDiameter = 1000,
  baseUrl = "http://xxxx.airsis.com/vision/common/CSVExport.aspx?",
  saveFile = NULL,
  flagAndKeep = FALSE
)
```

Arguments

startdate	Desired start date (integer or character representing YYYYMMDD[HH]).
enddate	Desired end date (integer or character representing YYYYMMDD[HH]).
provider	Identifier used to modify baseURL ['APCD'|'USFS'].
unitID	Character or numeric AIRSIS unit identifier.
clusterDiameter	Diameter in meters used to determine the number of clusters (see addClustering).
baseUrl	Base URL for data queries.
saveFile	Optional filename where raw CSV will be written.
flagAndKeep	Flag, rather then remove, bad data during the QC process.

Value

Raw tibble of AIRSIS data.

Note

The downloaded CSV may be saved to a local file by providing an argument to the saveFile parameter.

See Also

airsis_downloadData

airsis_parseData

airsis_qualityControl

addClustering

Examples

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

raw <- airsis_createRawDataframe(startdate = 20160901,
                                 provider = 'USFS',
                                 unitID = '1033')
raw <- raw_enhance(raw)
rawPlot_timeseries(raw, tlim = c(20160908,20160917))

## End(Not run)
```

`airsis_downloadData` *Download AIRSIS data*

Description

Request data from a particular station for the desired time period. Data are returned as a single character string containing the AIRIS output.

Usage

```
airsis_downloadData(
  startdate = strftime(lubridate::now(tzone = "UTC"), "%Y0101", tz = "UTC"),
  enddate = strftime(lubridate::now(tzone = "UTC"), "%Y%m%d", tz = "UTC"),
  provider = "USFS",
  unitID = NULL,
  baseUrl = "http://xxxx.airsis.com/vision/common/CSVExport.aspx?"
)
```

Arguments

`startdate`	desired start date (integer or character representing YYYYMMDD[HH])
`enddate`	desired end date (integer or character representing YYYYMMDD[HH])
`provider`	identifier used to modify baseURL `['APCD'|'USFS']`
`unitID`	unit identifier
`baseUrl`	base URL for data queries

Value

String containing AIRSIS output.

References

Interagency Real Time Smoke Monitoring

Examples

```
## Not run:
fileString <- airsis_downloadData( 20150701, 20151231, provider='USFS', unitID='1026')
df <- airsis_parseData(fileString)

## End(Not run)
```

`airsis_EBAMQualityControl` *Apply Quality Control to raw AIRSIS EBAM tibble*

Description

Perform various QC measures on AIRSIS EBAM data.

The following columns of data are tested against valid ranges:

- `Flow`
- `AT`
- `RHi`
- `ConcHr`

A `POSIXct` `datetime` column (UTC) is also added based on `Date.Time.GMT`.

Usage

```
airsis_EBAMQualityControl(
  tbl,
  valid_Longitude = c(-180, 180),
  valid_Latitude = c(-90, 90),
  remove_Lon_zero = TRUE,
  remove_Lat_zero = TRUE,
  valid_Flow = c(16.7 * 0.95, 16.7 * 1.05),
  valid_AT = c(-Inf, 45),
  valid_RHi = c(-Inf, 45),
  valid_Conc = c(-Inf, 5),
  flagAndKeep = FALSE
)
```

Arguments

`tbl`	single site tibble created by `airsis_parseData()`
`valid_Longitude`	range of valid Longitude values
`valid_Latitude`	range of valid Latitude values
`remove_Lon_zero`	flag to remove rows where Longitude == 0
`remove_Lat_zero`	flag to remove rows where Latitude == 0
`valid_Flow`	range of valid Flow values
`valid_AT`	range of valid AT values
`valid_RHi`	range of valid RHi values
`valid_Conc`	range of valid ConcHr values
`flagAndKeep`	flag, rather than remove, bad data during the QC process

Value

Cleaned up tibble of AIRSIS monitor data.

See Also

airsis_qualityControl

`airsis_EBAM_MULTI2QualityControl` *Apply Quality Control to raw AIRSIS EBAM MULTI2 tibble*

Description

Perform various QC measures on AIRSIS EBAM MULT2 data. This data format began appearing in December, 2019 and is associated with data available at https://arb3.airsis.com.

The following columns of data are tested against valid ranges:

- `Flow`
- `AT`
- `RHi`
- `ConcHr`

A `POSIXct` `datetime` column (UTC) is also added based on `Date.Time.GMT`.

Usage

```
airsis_EBAM_MULTI2QualityControl(
  tbl,
  valid_Longitude = c(-180, 180),
  valid_Latitude = c(-90, 90),
  remove_Lon_zero = TRUE,
  remove_Lat_zero = TRUE,
  valid_Flow = c(16.7 * 0.95, 16.7 * 1.05),
  valid_AT = c(-Inf, 45),
  valid_RHi = c(-Inf, 45),
  valid_Conc = c(-Inf, 5),
  flagAndKeep = FALSE
)
```

Arguments

`tbl`	single site tibble created by `airsis_parseData()`
`valid_Longitude`	range of valid Longitude values
`valid_Latitude`	range of valid Latitude values

remove_Lon_zero	flag to remove rows where Longitude == 0
remove_Lat_zero	flag to remove rows where Latitude == 0
valid_Flow	range of valid Flow values
valid_AT	range of valid AT values
valid_RHi	range of valid RHi values
valid_Conc	range of valid ConcHr values
flagAndKeep	flag, rather than remove, bad data during the QC process

Value

Cleaned up tibble of AIRSIS monitor data.

See Also

airsis_qualityControl

---

airsis_EBAM_PLUS_MULTIQualityControl

Apply Quality Control to raw AIRSIS EBAM PLUS_MULTI tibble

Description

Perform various QC measures on AIRSIS EBAM PLUS_MULTI data. This data format began appearing in December, 2019 and is associated with data available at https://apcd.airsis.com.

The following columns of data are tested against valid ranges:

- Flow
- AT
- RHi
- ConcHr

A POSIXct datetime column (UTC) is also added based on Date.Time.GMT.

Usage

```
airsis_EBAM_PLUS_MULTIQualityControl(
  tbl,
  valid_Longitude = c(-180, 180),
  valid_Latitude = c(-90, 90),
  remove_Lon_zero = TRUE,
  remove_Lat_zero = TRUE,
  valid_Flow = c(16.7 * 0.95, 16.7 * 1.05),
  valid_AT = c(-Inf, 45),
```

```
  valid_RHi = c(-Inf, 45),
  valid_Conc = c(-Inf, 5),
  flagAndKeep = FALSE
)
```

Arguments

tbl	single site tibble created by airsis_parseData()
valid_Longitude	range of valid Longitude values
valid_Latitude	range of valid Latitude values
remove_Lon_zero	flag to remove rows where Longitude == 0
remove_Lat_zero	flag to remove rows where Latitude == 0
valid_Flow	range of valid Flow values
valid_AT	range of valid AT values
valid_RHi	range of valid RHi values
valid_Conc	range of valid ConcHr values
flagAndKeep	flag, rather than remove, bad data during the QC process

Value

Cleaned up tibble of AIRSIS monitor data.

See Also

airsis_qualityControl

---

airsis_ESAMQualityControl

Apply Quality Control to raw AIRSIS E-Sampler dataframe

Description

Perform various QC measures on AIRSIS E-Sampler data.

The following columns of data are tested against valid ranges:

- Flow
- AT
- RHi
- ConcHr

A POSIXct datetime column (UTC) is also added based on TimeStamp.

Usage

```
airsis_ESAMQualityControl(
  tbl,
  valid_Longitude = c(-180, 180),
  valid_Latitude = c(-90, 90),
  remove_Lon_zero = TRUE,
  remove_Lat_zero = TRUE,
  valid_Flow = c(1.999, 2.001),
  valid_AT = c(-Inf, 150),
  valid_RHi = c(-Inf, 55),
  valid_Conc = c(-Inf, 5000),
  flagAndKeep = FALSE
)
```

Arguments

`tbl`	single site tibble created by `airsis_downloadData()`
`valid_Longitude`	range of valid Longitude values
`valid_Latitude`	range of valid Latitude values
`remove_Lon_zero`	flag to remove rows where Longitude == 0
`remove_Lat_zero`	flag to remove rows where Latitude == 0
`valid_Flow`	range of valid Flow.l.m values
`valid_AT`	range of valid AT.C. values
`valid_RHi`	range of valid RHi... values
`valid_Conc`	range of valid Conc.mg.m3. values
`flagAndKeep`	flag, rather then remove, bad data during the QC process

Value

Cleaned up tibble of AIRSIS monitor data.

See Also

`airsis_qualityControl`

`airsis_ESAM_MULTIQualityControl` *Apply Quality Control to raw AIRSIS E-Sampler dataframe*

Description

Perform various QC measures on AIRSIS E-Sampler data.

The following columns of data are tested against valid ranges:

- `Flow`
- `AT`
- `RHi`
- `ConcHr`

A `POSIXct` `datetime` column (UTC) is also added based on `TimeStamp`.

Usage

```
airsis_ESAM_MULTIQualityControl(
  tbl,
  valid_Longitude = c(-180, 180),
  valid_Latitude = c(-90, 90),
  remove_Lon_zero = TRUE,
  remove_Lat_zero = TRUE,
  valid_Flow = c(1.999, 2.001),
  valid_AT = c(-Inf, 150),
  valid_RHi = c(-Inf, 55),
  valid_Conc = c(-Inf, 5000),
  flagAndKeep = FALSE
)
```

Arguments

`tbl`	single site tibble created by `airsis_downloadData()`
`valid_Longitude`	range of valid Longitude values
`valid_Latitude`	range of valid Latitude values
`remove_Lon_zero`	flag to remove rows where Longitude == 0
`remove_Lat_zero`	flag to remove rows where Latitude == 0
`valid_Flow`	range of valid Flow.l.m values
`valid_AT`	range of valid AT.C. values
`valid_RHi`	range of valid RHi... values
`valid_Conc`	range of valid Conc.mg.m3. values
`flagAndKeep`	flag, rather then remove, bad data during the QC process

Value

Cleaned up tibble of AIRSIS monitor data.

See Also

airsis_qualityControl

`airsis_identifyMonitorType` *Identify AIRSIS monitor type*

Description

Examine the column names of the incoming dataframe (or first line of raw text) to identify different types of monitor data provided by AIRSIS.

The return is a list includes everything needed to identify and parse the raw data using `readr::read_csv()`:

- `monitorType` – identification string
- `rawNames` – column names from the data (including special characters)
- `columnNames` – assigned column names (special characters repaced with '.')
- `columnTypes` – column type string for use with `readr::read_csv()`

The `monitorType` will be one of:

- `"BAM1020"` – BAM1020 (e.g. USFS #49 in 2010)
- `"EBAM"` – EBAM (e.g. USFS #1026 in 2010)
- `"ESAM"` – E-Sampler (e.g. USFS #1002 in 2010)
- `"UNKOWN"` – ???

Usage

```
airsis_identifyMonitorType(df)
```

Arguments

`df`	dataframe or raw character string containing AIRSIS data

Value

List including `monitorType`, `rawNames`, `columnNames` and `columnTypes`.

References

Interagency Real Time Smoke Monitoring

Examples

```
## Not run:
fileString <- airsis_downloadData( 20150701, 20151231, provider='USFS', unitID='1026')
monitorTypeList <- airsis_identifyMonitorType(fileString)

## End(Not run)
```

`airsis_load` *Load Processed AIRSIS Monitoring Data*

Description

Please use `airsis_loadAnnual` instead of this function. It will soon be deprecated.

Usage

```
airsis_load(
  year = 2017,
  baseUrl = "https://haze.airfire.org/monitoring/AIRSIS/RData/"
)
```

Arguments

`year`	desired year (integer or character representing YYYY)
`baseUrl`	base URL for AIRSIS meta and data files

Value

A *ws_monitor* object with AIRSIS data.

`airsis_loadAnnual` *Load annual AIRSIS monitoring data*

Description

Loads pre-generated .RData files containing annual AIRSIS data.

If `dataDir` is defined, data will be loaded from this local dirctory. Otherwise, data will be loaded from the monitoring data repository maintained by PWFSL.

The annual files loaded by this function are updated on the 15'th of each month and cover the period from the beginning of the year to the end of the last month.

For data during the last 45 days, use `airsis_loadDaily()`.

For the most recent data, use `airsis_loadLatest()`.

AIRSIS parameters include the following:

1. PM2.5

Available AIRSIS RData and associated log files can be seen at: https://haze.airfire.org/monitoring/AIRSIS/RData

Usage

```
airsis_loadAnnual(
  year = NULL,
  parameter = "PM2.5",
  baseUrl = "https://haze.airfire.org/monitoring",
  dataDir = NULL
)
```

Arguments

year	Desired year (integer or character representing YYYY).
parameter	Parameter of interest.
baseUrl	Base URL for 'annual' AIRSIS data files.
dataDir	Local directory containing 'annual' data files.

Value

A *ws_monitor* object with AIRSIS data.

See Also

airsis_loadDaily

airsis_loadLatest

Examples

```
## Not run:
airsis_loadAnnual(2017) %>%
  monitor_subset(stateCodes='MT', tlim=c(20170701,20170930)) %>%
  monitor_dailyStatistic() %>%
  monitor_timeseriesPlot(style = 'gnats', ylim=c(0,300), xpd=NA)
  addAQIStackedBar()
  addAQILines()
  title("Montana 2017 -- AIRSIS Daily Average PM2.5")

## End(Not run)
```

---

airsis_loadDaily *Load recent AIRSIS monitoring data*

Description

Loads pre-generated .RData files containing recent AIRSIS data.

If `dataDir` is defined, data will be loaded from this local dirctory. Otherwise, data will be loaded from the monitoring data repository maintained by PWFSL.

The daily files loaded by this function are updated once a day, shortly after midnight and contain data for the previous 45 days.

For the most recent data, use `airsis_loadLatest()`.

For data extended more than 45 days into the past, use `airsis_loadAnnual()`.

AIRSIS parameters include the following:

1. PM2.5

Avaialble AIRSIS RData and associated log files can be seen at: https://haze.airfire.org/monitoring/AIRSIS/RData/latest

Usage

```
airsis_loadDaily(
  parameter = "PM2.5",
  baseUrl = "https://haze.airfire.org/monitoring/latest/RData",
  dataDir = NULL
)
```

Arguments

`parameter`	Parameter of interest.
`baseUrl`	Base URL for 'daily' AirNow data files.
`dataDir`	Local directory containing 'daily' data files.

Value

A *ws_monitor* object with AIRSIS data.

See Also

`airsis_loadAnnual`

`airsis_loadLatest`

Examples

```
## Not run:
airsis_loadDaily() %>%
  monitor_subset(stateCodes=CONUS) %>%
  monitor_map()

## End(Not run)
```

`airsis_loadLatest` *Load most recent AIRSIS monitoring data*

Description

Loads pre-generated .RData files containing the most recent AIRSIS data.

If `dataDir` is defined, data will be loaded from this local dirctory. Otherwise, data will be loaded from the monitoring data repository maintained by PWFSL.

The files loaded by this function are updated multiple times an hour and contain data for the previous 10 days.

For daily updates covering the most recent 45 days, use `airsis_loadDaily()`.

For data extended more than 45 days into the past, use `airsis_loadAnnual()`.

AIRSIS parameters include the following:

1. PM2.5

Avaialble RData and associated log files can be seen at: https://haze.airfire.org/monitoring/AIRSIS/RData/latest

Usage

```
airsis_loadLatest(
  parameter = "PM2.5",
  baseUrl = "https://haze.airfire.org/monitoring/latest/RData",
  dataDir = NULL
)
```

Arguments

`parameter`	Parameter of interest.
`baseUrl`	Base URL for 'daily' AirNow data files.
`dataDir`	Local directory containing 'daily' data files.

Value

A *ws_monitor* object with AIRSIS data.

See Also

`airsis_loadAnnual`

`airsis_loadDaily`

Examples

```
## Not run:
airsis_loadLatest() %>%
  monitor_subset(stateCodes=CONUS) %>%
  monitor_map()

## End(Not run)
```

`airsis_parseData` *Parse AIRSIS data string*

Description

Raw character data from AIRSIS are parsed into a tibble. The incoming `fileString` can be read in directly from AIRSIS using `airsis_downloadData()` or from a local file using `readr::read_file()`.

The type of monitor represented by this fileString is inferred from the column names using `airsis_identifyMonitorType()` and appropriate column types are assigned. The character data are then read into a tibble and augmented in the following ways:

1. Longitude, Latitude and any System Voltage values, which are only present in GPS timestamp rows, are propagated foward using a last-observation-carry-forward algorithm'
2. Longitude, Latitude and any System Voltage values, which are only present in GPS timestamp rows, are propagated backwords using a first-observation-carry-backward algorithm'
3. GPS timestamp rows are removed'

Usage

```
airsis_parseData(fileString)
```

Arguments

`fileString`	character string containing AIRSIS data as a csv

Value

Dataframe of AIRSIS raw monitor data.

References

Interagency Real Time Smoke Monitoring

Examples

```
## Not run:
library(PWFSLSmoke)
fileString <- airsis_downloadData(20150701, 20151231, provider='USFS', unitID='1026')
tbl <- airsis_parseData(fileString)
summary(tbl)

## End(Not run)
```

`airsis_qualityControl` *Apply Quality Control to raw AIRSIS dataframe*

Description

Various QC steps are taken to clean up the incoming raw tibble including:

1. Ensure GPS location data are included in each measurement record.
2. Remove GPS location records.
3. Remove measurement records with values outside of valid ranges.

See the individual `airsis_~QualityControl()` functions for details.

QC parameters that can be passed in the `...` include the following valid data ranges as taken from `airsis_EBAMQualityControl()`:

- `valid_Longitude=c(-180,180)`
- `valid_Latitude=c(-90,90)`
- `remove_Lon_zero = TRUE`
- `remove_Lat_zero = TRUE`
- `valid_Flow = c(16.7*0.95,16.7*1.05)`
- `valid_AT = c(-Inf,45)`
- `valid_RHi = c(-Inf,45)`
- `valid_Conc = c(-Inf,5.000)`

Note that appropriate values for QC thresholds will depend on the type of monitor.

Usage

```
airsis_qualityControl(tbl, ...)
```

Arguments

`tbl`	single site tibble created by airsis_downloadData()
`...`	additional parameters are passed to type-specific QC functions

Value

Cleaned up tibble of AIRSIS monitor data.

See Also

airsis_EBAMQualityControl

airsis_ESAMQualityControl

AQI *Official Air Quality Index Levels, Names and Colors*

Description

Official AQI levels, names and colors are provided in a list for easy coloring and labeling.

Usage

```
AQI
```

Format

A list with named elements

Details

AQI breaks and associated names and colors

The AQI object contains english language text.

AQI breaks and colors are defined at https://docs.airnowapi.org/aq101

Note

The low end of each break category is used as the breakpoint.

See Also

AQI_en AQI_es

aqiColors *Generate AQI Colors*

Description

This function uses the `leaflet::colorBin()` function to return a vector or matrix of colors derived from PM2.5 values.

Usage

```
aqiColors(
  x,
  palette = AQI$colors,
  domain = c(0, 1e+06),
  bins = AQI$breaks_24,
  na.color = NA
)
```

Arguments

`x`	vector or matrix of PM2.5 values or a *ws_monitor* object
`palette`	color palette (see `leaflet::colorBin()`)
`domain`	range of valid data (see `leaflet::colorBin()`)
`bins`	color bins (see `leaflet::colorBin()`)
`na.color`	missing value color (see `leaflet::colorBin()`)

Value

A vector or matrix of AQI colors to be used in maps and plots.

Examples

```
wa <- monitor_subset(Northwest_Megafires, stateCodes='WA', tlim=c(20150821,20150828))
colorMatrix <- aqiColors(wa)
time <- wa$data$datetime
pm25 <- wa$data[,-1]
plot(time, pm25[,1], col=colorMatrix[,1],
     ylim=range(pm25, na.rm=TRUE),
     xlab="2015", ylab="PM 2.5 (ug/m3)", main="Washington State Smoke")
for ( i in seq_along(pm25) ) {
  points(time, pm25[,i], col=colorMatrix[,i], pch=16)
}
```

aqiPalette *Color Palettes for Air Quality Monitoring Data*

Description

Creates a *leaflet* color palette function that can be used to convert monitoring data into vectors of colors.

Usage

```
aqiPalette(style = "aqi", reverse = FALSE)
```

Arguments

style	Palette style, one of 'aqi'.
reverse	Logicial specifying whether the colors (or color function) in palette should be used in reverse order.

Value

A function that takes a single parameter x; when called with a vector of numbers, #RRGGBB color strings are returned.

See Also

'leaflet::colorBin()'

Examples

```
pm25 <- PWFSLSmoke::Carmel_Valley$data[,2]
binned_colors <- aqiPalette("aqi")(pm25)
plot(pm25, col=binned_colors, pch=15, main='Binned Colors')
```

AQI_en *Official Air Quality Index Levels, Names and Colors*

Description

Official AQI levels, names and colors are provided in a list for easy coloring and labeling.

Usage

```
AQI_en
```

Format

A list with named elements

Details

AQI breaks and associated names and colors (english language)

The AQI_es object contains english language text. It is equalivalent to the AQI object and provided for consistency with other language versions.

AQI breaks and colors are defined at https://docs.airnowapi.org/aq101

Note

The low end of each break category is used as the breakpoint.

See Also

AQI AQI_es

AQI_es *Official Air Quality Index Levels, Names and Colors*

Description

Official AQI levels, names and colors are provided in a list for easy coloring and labeling.

Usage

```
AQI_es
```

Format

A list with named elements

Details

AQI breaks and associated names and colors (Spanish language)

The AQI_es object contains spanish language text.

AQI breaks and colors are defined at https://docs.airnowapi.org/aq101

Note

The low end of each break category is used as the breakpoint.

See Also

AQI_en AQI

Carmel_Valley *Carmel Valley Example Dataset*

Description

In August of 2016, the Soberanes fire in California burned along the Big Sur coast. It was at the time the most expensive wildifre in US history. This dataset contains PM2.5 monitoring data for the monitor in Carmel Valley which shows heavy smoke as well as strong diurnal cycles associated with sea breezes. Data are stored as a *ws_monitor* object and are used in some examples in the package documentation.

Format

A list with two elements

Details

Carmel Valley example dataset

CONUS *CONUS State Codes*

Description

State codes for the 48 contiguous states +DC that make up the CONtinental US

Usage

```
CONUS
```

Format

A vector with 49 elements

Details

CONUS state codes

distance *Calculate distances between points*

Description

This function uses the Haversine forumula for calculating great circle distances between points. This formula is purpoted to work better than the spherical law of cosines for very short distances.

Usage

```
distance(targetLon, targetLat, longitude, latitude)
```

Arguments

targetLon	longitude (decimal degrees) of the point from which distances are calculated
targetLat	latitude (decimal degrees) of the point from which distances are calculated
longitude	vector of longitudes for which a distance is calculated
latitude	vector of latitudes for which a distance is calculated

Value

Vector of distances in km.

Examples

```
# Seattle to Portland airports
SEA_lon <- -122.3088
SEA_lat <- 47.4502
PDX_lon <- -122.5951
PDX_lat <- 45.5898
distance(SEA_lon, SEA_lat, PDX_lon, PDX_lat)
```

epa_createDataDataframe *Create EPA data dataframe*

Description

After additional columns(i.e. datetime, and monitorID) have been applied to an EPA dataframe, we are ready to extract the PM2.5 values and store them in a data dataframe organized as time-by-monitor.

The first column of the returned dataframe is named datetime and contains a POSIXct time in UTC. Additional columns contain data for each separate monitorID.

Usage

```
epa_createDataDataframe(tbl)
```

Arguments

tbl	an EPA raw tibble after metadata enhancement

Value

A data dataframe for use in a *ws_monitor* object.

`epa_createMetaDataframe`

Create dataframe of EPA site location metadata

Description

After additional columns(i.e. datetime, and monitorID) have been applied to an EPA dataframe, we are ready to pull out site information associated with unique monitorID.

These will be rearranged into a dataframe organized as deployment-by-property with one row for each monitorID.

This site information found in tbl is augmented so that we end up with a uniform set of properties associated with each monitorID. The list of columns in the returned meta dataframe is:

```
> names(p$meta)
 [1] "monitorID"             "longitude"             "latitude"
 [4] "elevation"             "timezone"              "countryCode"
 [7] "stateCode"             "siteName"              "agencyName"
[10] "countyName"            "msaName"               "monitorType"
[13] "monitorInstrument"     "aqsID"                 "pwfslID"
[16] "pwfslDataIngestSource" "telemetryAggregator"   "telemetryUnitID"
```

Usage

```
epa_createMetaDataframe(
  tbl,
  pwfslDataIngestSource = "EPA",
  existingMeta = NULL,
  addGoogleMeta = TRUE
)
```

Arguments

`tbl`	an EPA raw tibble after metadata enhancement
`pwfslDataIngestSource`	identifier for the source of monitoring data, e.g. `'EPA_hourly_88101_2016.zip'`
`existingMeta`	existing 'meta' dataframe from which to obtain metadata for known monitor deployments
`addGoogleMeta`	logicial specifying wheter to use Google elevation and reverse geocoding services

Value

A `meta` dataframe for use in a *ws_monitor* object.

References

EPA AirData Pre-Generated Data Files

file format description

`epa_createMonitorObject` *Download and convert hourly EPA air quality data*

Description

Convert EPA data into a *ws_monitor* object, ready for use with all `monitor_~` functions.

Usage

```
epa_createMonitorObject(
  zipFile = NULL,
  zeroMinimum = TRUE,
  addGoogleMeta = TRUE
)
```

Arguments

`zipFile`	absolute path to monitoring data .zip file
`zeroMinimum`	logical specifying whether to convert negative values to zero
`addGoogleMeta`	logicial specifying wheter to use Google elevation and reverse geocoding services

Value

A *ws_monitor* object with EPA data.

Note

Before running this function you must first enable spatial data capabilities as in the example.

References

EPA AirData Pre-Generated Data Files

file format description

Examples

```
## Not run:
initializeMazamaSpatialUtils()
zipFile <- epa_downloadData(2016, "88101", downloadDir = '~/Data/EPA')
mon <- epa_createMonitorObject(zipFile, addGoogleMeta = FALSE)

## End(Not run)
```

---

epa_downloadData *Download EPA air quality data*

Description

This function downloads air quality data from the EPA and saves it to a directory.

Available parameter codes include:

1. 44201 – Ozone
2. 42401 – SO2
3. 42101 – CO
4. 42602 – NO2
5. 88101 – PM2.5
6. 88502 – PM2.5
7. 81102 – PM10
8. SPEC – PM2.5
9. WIND – Wind
10. TEMP – Temperature
11. PRESS – Barometric Pressure
12. RH_DP – RH and dewpoint
13. HAPS – HAPs
14. VOCS – VOCs
15. NONOxNOy

Usage

```
epa_downloadData(
  year = NULL,
  parameterCode = "88101",
  downloadDir = tempdir(),
  baseUrl = "https://aqs.epa.gov/aqsweb/airdata/"
)
```

Arguments

year	year
parameterCode	pollutant code
downloadDir	directoroy where monitoring data .zip file will be saved
baseUrl	base URL for archived daily data

Value

Filepath of the downloaded zip file.

Note

Unzipped CSV files are almost 100X larger than the compressed .zip files.

References

EPA AirData Pre-Generated Data Files

Examples

```
## Not run:
zipFile <- epa_downloadData(2016, "88101", '~/Data/EPA')
tbl <- epa_parseData(zipFile, "PM2.5")

## End(Not run)
```

---

epa_load *Load Processed EPA Monitoring Data*

Description

Please use airsis_loadAnnual instead of this function. It will soon be deprecated.

Usage

```
epa_load(
  year = strftime(lubridate::now(tzone = "UTC"), "%Y", tz = "UTC"),
  parameterCode = "88101",
  baseUrl = "https://haze.airfire.org/monitoring/EPA/RData/"
)
```

Arguments

year	desired year (integer or character representing YYYY)
parameterCode	pollutant code
baseUrl	base URL for EPA .RData files

Value

A *ws_monitor* object with EPA data for an entire year.

---

epa_loadAnnual *Load annual EPA monitoring data*

Description

Loads pre-generated .RData files containing annual EPA data.

EPA parameter codes include:

1. 88101 – PM2.5 FRM/FEM Mass (begins in 2008)
2. 88502 – PM2.5 non FRM/FEM Mass (begins in 1998)

Avaialble RData and associated log files can be seen at: https://haze.airfire.org/monitoring/EPA/RData/

Usage

```
epa_loadAnnual(
  year = NULL,
  parameterCode = NULL,
  baseUrl = "https://haze.airfire.org/monitoring",
  dataDir = NULL
)
```

Arguments

year	Desired year (integer or character representing YYYY).
parameterCode	Pollutant code.
baseUrl	Base URL for 'annual' EPA data files.
dataDir	Local directory containing 'annual' data files.

Value

A *ws_monitor* object with EPA data.

References

EPA AirData Pre-Generated Data Files

Examples

```
## Not run:
epa_loadAnnual(2000, "88502") %>%
  monitor_subset(stateCodes = 'WA', tlim=c(20000701,20000801)) %>%
  monitor_map()

## End(Not run)
```

`epa_parseData` *Parse EPA data*

Description

This function uncompress previously downloaded air quality .zip files from the EPA and reads it into a tibble.

Available parameters include:

1. Ozone
2. SO2
3. CO
4. NO2
5. PM2.5
6. PM10
7. Wind
8. Temperature
9. Barometric_Pressure
10. RH_and_Dewpoint
11. HAPs
12. VOCs
13. NONOxNOy

Associated parameter codes include:

1. 44201 – Ozone
2. 42401 – SO2
3. 42101 – CO
4. 42602 – NO2
5. 88101 – PM2.5
6. 88502 – PM2.5
7. 81102 – PM10
8. SPEC – PM2.5

9. WIND – Wind
10. TEMP – Temperature
11. PRESS – Barometric Pressure
12. RH_DP – RH and dewpoint
13. HAPS – HAPs
14. VOCS – VOCs
15. NONOxNOy

Usage

```
epa_parseData(zipFile = NULL)
```

Arguments

zipFile	absolute path to monitoring data .zip file

Value

Tibble of EPA data.

Note

Unzipped CSV files are almost 100X larger than the compressed .zip files. CSV files are removed after data are read into a dataframe.

References

EPA AirData Pre-Generated Data Files

file format description

Examples

```
## Not run:
zipFile <- epa_downloadData(2016, "88101", '~/Data/EPA')
tbl <- epa_parseData(zipFile, "PM2.5")

## End(Not run)
```

esriToken *Token used for ESRI Geocoding Requests*

Description

All package functions that interact with ESRI location services will use the token whenever a request is made.

Format

Character string.

See Also

addEsriAddress

generic_downloadData *Download generic data*

Description

This function takes a location to a delimited file, gets the file, and returns a string containing the file data.

Usage

```
generic_downloadData(filePath)
```

Arguments

filePath	Either a path to a file, or a connection (http(s)://, ftp(s)://).

Details

This function is essentailly a wrapper for read_file.

Value

A character vector of length 1, containing data from the file located at filePath.

Examples

```
## Not run:
# make current directory PWFSLSmoke package directory
filePath <- "./localData/airsis_ebam_example-clean.csv"

fileString <- generic_downloadData(filePath)

## End(Not run)
```

`generic_parseData` *Parse generic air quality files*

Description

Given a string of delimited file data, this function will parse the file as a table of data an apply some transformations and augmentations as specified by a given configuration list.

Usage

```
generic_parseData(fileString = NULL, configList = NULL)
```

Arguments

`fileString`	Character string of delimited data to parse.
`configList`	A `R list` or JSON file containing key-value pairs which affect how the parsing of `fileString` is handled. If `configList` is in JSON format, it can be passed in as a file, string, or URL.

Value

A tibble of the data contined in `fileString` parsed according to parameters in `configList`. The data is coerced into a format that is more easily convertable into a `ws_monitor` object at a later point.

Parsing data

Internally, this function uses `read_delim` to convert `fileString` into a tibble. If any lines of data cannot be properly parsed, and error will be thrown anf the problem lines will be printed.

Creating a configList

For more information on how to build a `configList`, see the Rmarkdown document "Working with Generic Data" in the `localNotebooks` directory.

Examples

```
filePath <- system.file(
  "extdata", "generic_data_example.csv",
  package = "PWFSLSmoke",
  mustWork = TRUE
)

configPath <- system.file(
  "extdata", "generic_configList_example.json",
  package = "PWFSLSmoke",
  mustWork = TRUE
)
```

```
configList <- jsonlite::fromJSON(configPath)
fileString <- generic_downloadData(filePath)
parsedData <- generic_parseData(fileString, configList)
```

`getEsriToken` *Get ESRI Token*

Description

Returns the current esriToken.

Usage

```
getEsriToken()
```

Value

String.

See Also

addEsriAddress

esriToken

setEsriToken

`getGoogleApiKey` *Get Google API Key*

Description

Returns the current Google API key.

Usage

```
getGoogleApiKey()
```

Value

String.

See Also

addGoogleAddress

addGoogleElevation

googleApiKey

setGoogleApiKey

googleApiKey *API Key used for Google Geocoding Requests*

Description

All package functions that interact with Google location services will use API key whenever a request is made.

Format

Character string.

See Also

addGoogleAddress

addGoogleElevation

initializeMazamaSpatialUtils *Initialize Mazama Spatial Utils*

Description

Convenience function that wraps:

```
logger.setup()
logger.setLevel(WARN)
setSpatialDataDir('~/Data/Spatial')
loadSpatialData('NaturalEarthAdm1')
```

If file logging is desired, these commands should be run individually with output log files specified as arguments to `logger.setup()`.

Usage

```
initializeMazamaSpatialUtils(
  spatialDataDir = "~/Data/Spatial",
  stateCodeDataset = "NaturalEarthAdm1"
)
```

Arguments

spatialDataDir	directory where spatial datasets are created
stateCodeDataset	MazamaSpatialUtils dataset returning ISO 3166-2 alpha-2 stateCodes

See Also

{link{logger.setup}

`loadDaily` *Load Recent PM2.5 Monitoring Data*

Description

Wrapper function to load and combine recent data from AirNow, AIRSIS and WRCC:

```
airnow <- airnow_loadDaily()
airsis <- airsis_loadDaily()
wrcc <- wrcc_loadDaily()
ws_monitor <- monitor_combine(list(airnow, airsis, wrcc))
```

The daily files are generated once a day, shortly after midnight and contain data for the previous 45 days.

For the most recent data, use `loadLatest()`.

Avaialble RData and associated log files can be seen at: https://haze.airfire.org/monitoring/latest/RData/

Usage

```
loadDaily()
```

Value

A *ws_monitor* object with PM2.5 monitoring data.

See Also

`loadLatest`

Examples

```
## Not run:
ca <- loadDaily() %>% monitor_subset(stateCodes='CA')

## End(Not run)
```

loadLatest *Load Recent PM2.5 Monitoring Data*

Description

Wrapper function to load and combine the most recent data from AirNow, AIRSIS and WRCC:

```
airnow <- airnow_loadLatest()
airsis <- airsis_loadLatest()
wrcc <- wrcc_loadLatest()
ws_monitor <- monitor_combine(list(airnow, airsis, wrcc))
```

Avaialble RData and associated log files can be seen at: https://haze.airfire.org/monitoring/latest/RData/

Usage

```
loadLatest()
```

Value

A *ws_monitor* object with PM2.5 monitoring data.

See Also

airsis_loadDaily

Examples

```
## Not run:
ca <- loadLatest() %>% monitor_subset(stateCodes='CA')

## End(Not run)
```

monitor_aqi *Calculate hourly NowCast-based AQI values*

Description

Nowcast and AQI algorithms are applied to the data in the ws_monitor object.

Usage

```
monitor_aqi(
  ws_monitor,
  aqiParameter = "pm25",
  nowcastVersion = "pm",
  includeShortTerm = FALSE
)
```

Arguments

ws_monitor	*ws_monitor* object
aqiParameter	parameter type; used to define reference breakpointsTable
nowcastVersion	character identity specifying the type of nowcast algorithm to be used. See ?monitor_nowcast for more information.
includeShortTerm	calcluate preliminary values starting with the 2nd hour

References

https://docs.airnowapi.org/aq101

Examples

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

ws_monitor <- monitor_subset(Northwest_Megafires, tlim=c(20150815,20150831))
aqi <- monitor_aqi(ws_monitor)
monitor_timeseriesPlot(aqi, monitorID=aqi$meta$monitorID[1], ylab="PM25 AQI")

## End(Not run)
```

---

monitor_asDataframe *Return Monitor Data in a Single Dataframe*

Description

Creates a dataframe with data from a *ws_monitor* object, essentially *flattening* the object. This is especially useful when monitoring data will be shared with non-R users working with spreadsheets. The returned dataframe will contain data from the monitor specified with monitorID.

The number of data columns in the returned dataframe can include all metadata as well as additional calculated values.

By default, the following, core columns are included in the dataframe:

- utcTime UTC datetime
- localTime local datetime
- pm25 PM2.5 values in ug/m3

Any column from ws_monitor$meta may be included in the vector of metaColumns.

The following additional columns of data may be included by adding one of the following to the vector of extraColumns{}

- aqi hourly AQI values as calculated with monitor_aqi()
- nowcast hourly Nowcast values as calcualted with monitor_nowcast()
- dailyAvg daily average PM2.5 values as calculated with monitor_dailyStatistic()

Usage

```
monitor_asDataframe(
  ws_monitor,
  monitorID = NULL,
  extraColumns = NULL,
  metaColumns = NULL,
  tlim = NULL
)
```

Arguments

ws_monitor	*ws_monitor* object
monitorID	monitor ID of interest (not needed if ws_monitor contains only one monitor)
extraColumns	optional vector of additional data columns to generate
metaColumns	optional vector of column names from ws_monitor$meta
tlim	optional vector with start and end times (integer or character representing YYYYMMDD[HH] or POSIXct)

Value

A dataframe version of a *ws_monitor* object.

Note

The tlim argument is interpreted as localtime, not UTC.

See Also

monitor_aqi

monitor_nowcast

monitor_dailyStatistic

Examples

```
library(PWFSLSmoke)

wa <- monitor_subset(Northwest_Megafires, stateCodes='WA')

Omak_df <- monitor_asDataframe(wa, monitorID='530470013_01',
                               extraColumns=c('nowcast','dailyAvg'),
                               metaColumns=c('aqsID','siteName','timezone'),
                               tlim=c(20150801,20150901))

dplyr::glimpse(Omak_df)
```

`monitor_collapse` *Collapse a ws_monitor Object into a ws_monitor Object with a Single Monitor*

Description

Collapses data from all the monitors in `ws_monitor` into a single-monitor *ws_monitor* object using the function provided in the `FUN` argument. The single-monitor result will be located at the mean longitude and latitude unless `longitude` and `latitude` parameters are specified.

Any columns of meta that are common to all monitors will be retained in the returned *ws_monitor* meta.

Usage

```
monitor_collapse(
  ws_monitor,
  longitude = NULL,
  latitude = NULL,
  monitorID = "generated_id",
  FUN = mean,
  na.rm = TRUE,
  ...
)
```

Arguments

`ws_monitor`	*ws_monitor* object.
`longitude`	Longitude of the collapsed monitoring station.
`latitude`	Latitude of the collapsed monitoring station.
`monitorID`	Monitor ID assigned to the collapsed monitoring station.
`FUN`	Function to be applied to all the monitors at a single time index.
`na.rm`	Logical specifying whether NA values should be ignored when FUN is applied.
`...`	additional arguments to be passed on to the `apply()` function.

Value

A *ws_monitor* object with meta and data that for the the collapsed single monitor

Note

After `FUN` is applied, values of `+Inf` and `-Inf` are converted to `NA`. This is a convenience for the common case where `FUN=min` or `FUN=max` and some of the timesteps have all missing values. See the R documentation for `min` for an explanation.

Examples

```
library(PWFSLSmoke)

N_M <- Northwest_Megafires
# monitor_leaflet(N_M) # to identify Spokane monitorIDs

Spokane <- monitor_subsetBy(N_M, stringr::str_detect(N_M$meta$monitorID,'^53063'))
Spokane_min <- monitor_collapse(Spokane, monitorID='Spokane_min', FUN=min)
Spokane_max <- monitor_collapse(Spokane, monitorID='Spokane_max', FUN=max)

monitor_timeseriesPlot(Spokane, tlim=c(20150619,20150626),
                       style='gnats', shadedNight=TRUE)
monitor_timeseriesPlot(Spokane_max, col='red', type='s', add=TRUE)
monitor_timeseriesPlot(Spokane_min, col='blue', type='s', add=TRUE)
title('Spokane Range of PM2.5 Values, June 2015')
```

---

monitor_combine *Combine List of ws_monitor Objects into Single ws_monitor Object*

Description

Combines a list of one or more *ws_monitor* objects into a single *ws_monitor* object by merging the `meta` and `data` dataframes from each object in `monitorList`.

When `monitorList` contains only two *ws_monitor* objects the `monitor_combine()` function can be used to extend time ranges for monitorIDs that are found in both *ws_monitor* objects. This can be used to 'grow' a *ws_monitor* object by appending subsequent months or years. (Note, however, that this can be CPU intensive process.)

Usage

```
monitor_combine(monitorList)
```

Arguments

`monitorList`	list containing one or more *ws_monitor* objects

Value

A *ws_monitor* object combining all monitoring data from `monitorList`.

Examples

```
library(PWFSLSmoke)
initializeMazamaSpatialUtils()

monitorList <- list()
monitorList[[1]] <- airsis_createMonitorObject(20160701, 20161231, 'USFS', '1031')
```

```
monitorList[[2]] <- airsis_createMonitorObject(20160701, 20161231, 'USFS', '1032')
monitorList[[3]] <- airsis_createMonitorObject(20160701, 20161231, 'USFS', '1033')
monitorList[[4]] <- airsis_createMonitorObject(20160701, 20161231, 'USFS', '1034')
ws_monitor <- monitor_combine(monitorList)

if ( interactive() ) {
  monitor_leaflet(ws_monitor)
}
```

`monitor_dailyBarplot` *Create Daily Barplot*

Description

Creates a bar plot showing daily average PM 2.5 values for a specific monitor in a *ws_monitor* object. Each bar is colored according to its AQI category.

This function is a wrapper around `base::barplot` and any arguments to that function may be used.

Each 'day' is the midnight-to-midnight period in the monitor local timezone. When `tlim` is used, it is converted to the monitor local timezone.

Usage

```
monitor_dailyBarplot(
  ws_monitor,
  monitorID = NULL,
  tlim = NULL,
  minHours = 18,
  gridPos = "",
  gridCol = "black",
  gridLwd = 0.5,
  gridLty = "solid",
  labels_x_nudge = 0,
  labels_y_nudge = 0,
  ...
)
```

Arguments

`ws_monitor`	*ws_monitor* object
`monitorID`	monitor ID for a specific monitor in `ws_monitor` (optional if `ws_monitor` only has one monitor)
`tlim`	optional vector with start and end times (integer or character representing YYYYMMDD[HH] or `POSIXct`)
`minHours`	minimum number of valid data hours required to calculate each daily average
`gridPos`	position of grid lines either 'over', 'under' (" for no grid lines)

gridCol	color of grid lines (see graphical parameter 'col')
gridLwd	line width of grid lines (see graphical parameter 'lwd')
gridLty	type of grid lines (see graphical parameter 'lty')
labels_x_nudge	nudge x labels to the left
labels_y_nudge	nudge y labels down
...	additional arguments to be passed to barplot()

Details

The labels_x_nudge and labels_y_nudge can be used to tweak the date labeling. Units used are the same as those in the plot.

Examples

```
library(PWFSLSmoke)

N_M <- monitor_subset(Northwest_Megafires, tlim = c(20150715, 20150930))
main <- "Daily Average PM2.5 for Omak, WA"
monitor_dailyBarplot(N_M, monitorID = "530470013_01", main = main,
                         labels_x_nudge = 1)
addAQILegend(fill = rev(AQI$colors), pch = NULL)
```

---

monitor_dailyStatistic

Calculate daily statistics

Description

Calculates daily statistics for each monitor in ws_monitor.

Usage

```
monitor_dailyStatistic(
  ws_monitor,
  FUN = get("mean"),
  dayStart = "midnight",
  na.rm = TRUE,
  minHours = 18
)
```

Arguments

ws_monitor	*ws_monitor* object
FUN	function used to collapse a day's worth of data into a single number for each monitor in the ws_monitor object
dayStart	one of sunset|midnight|sunrise
na.rm	logical value indicating whether NA values should be ignored
minHours	minimum number of valid data hours required to calculate each daily statistic

Details

Sunrise and sunset times are calculated based on the first monitor encountered. This should be accurate enough for all use cases involving co-located monitors. Monitors from different regions should have daily statistics calculated separately.

Value

A *ws_monitor* object with daily statistics for the local timezone.

Note

Note that the incoming *ws_monitor* object should have UTC (GMT) times and that this function calculates daily statistics based on local (clock) time. If you choose a date range based on UTC times this may result in an insufficient number of hours in the first and last daily records of the returned *ws_monitor* object.

The returned *ws_monitor* object has a daily time axis where each `datetime` is set to the beginning of each day, 00:00:00, local time.

Examples

```
N_M <- monitor_subset(Northwest_Megafires, tlim=c(20150801,20150831))
WinthropID <- '530470010_01'
TwispID <- '530470009_01'
MethowValley <- monitor_subset(N_M,
                               tlim=c(20150801,20150831),
                               monitorIDs=c(WinthropID,TwispID))
MethowValley_dailyMean <- monitor_dailyStatistic(MethowValley,
                                                 FUN=get('mean'),
                                                 dayStart='midnight')
# Get the full Y scale
monitor_timeseriesPlot(MethowValley, style='gnats', col='transparent')
monitor_timeseriesPlot(MethowValley, monitorID=TwispID,
                       style='gnats', col='forestgreen', add=TRUE)
monitor_timeseriesPlot(MethowValley, monitorID=WinthropID,
                       style='gnats', col='purple', add=TRUE)
monitor_timeseriesPlot(MethowValley_dailyMean, monitorID=TwispID,
                       type='s', lwd=2, col='forestgreen', add=TRUE)
monitor_timeseriesPlot(MethowValley_dailyMean, monitorID=WinthropID,
                       type='s', lwd=2, col='purple', add=TRUE)
addAQILines()
addAQILegend("topleft", lwd=1, pch=NULL)
title("Winthrop & Twisp, Washington Daily Mean PM2.5, 2015")
```

`monitor_dailyStatisticList` *Calculate Daily Statistics*

Description

Calculates daily statistics for each monitor in `ws_monitor`.

Usage

```
monitor_dailyStatisticList(
  ws_monitor,
  FUN = get("mean"),
  dayStart = "midnight",
  na.rm = TRUE,
  minHours = 18
)
```

Arguments

`ws_monitor`	*ws_monitor* object
`FUN`	function used to collapse a day's worth of data into a single number for each monitor in the ws_monitor object
`dayStart`	one of `sunset|midnight|sunrise`
`na.rm`	logical value indicating whether NA values should be ignored
`minHours`	minimum number of valid data hours required to calculate each daily statistic

Details

Splits the `ws_monitor` object by `timezone` and applies the `monitor_dailyStatistic()` function separately for each timezone. See monitor_dailyStatistic for more details.

The results are returned as a list of *ws_monitor* objects with each element of the list named with the associated timezone. Note that each `ws_monitor$data$datetime` will be in local time. This is desirable as it ensures proper date formatting in tables and plots.

You should not attempt to reassemble a single *ws_monitor* object from the elements in this list.

Value

A list of *ws_monitor* objects with daily statistics for each local timezone.

References

monitor_dailyStatistic

Examples

```
library(PWFSLSmoke)

airnow <- airnow_loadLatest()
nw <- monitor_subset(airnow, stateCodes = c('WA','OR','ID','MT'))
dailyList <- monitor_dailyStatisticList(nw)

monitor_leaflet(dailyList[["America/Los_Angeles"]])

monitor_leaflet(dailyList[["America/Boise"]])

monitor_leaflet(dailyList[["America/Denver"]])
```

---

monitor_dailyThreshold

Calculate Daily Counts of Values At or Above a Threshold

Description

Calculates the number of hours per day each monitor in `ws_monitor` was at or above a given threshold

Usage

```
monitor_dailyThreshold(
  ws_monitor,
  threshold = "unhealthy",
  dayStart = "midnight",
  minHours = 0,
  na.rm = TRUE
)
```

Arguments

`ws_monitor`	*ws_monitor* object
`threshold`	AQI level name (e.g. `"unhealthy"`) or numerical threshold at or above which a measurement is counted
`dayStart`	one of `"sunset|midnight|sunrise"`
`minHours`	minimum number of hourly observations required
`na.rm`	logical value indicating whether NA values should be ignored

Details

NOTE: The returned counts include values at OR ABOVE the given threshold; this applies to both categories and values. For example, passing a `threshold` argument = "unhealthy" will return a daily count of values that are unhealthy, very unhealthy, or extreme (i.e. >= 55.5), as will passing a `threshold` argument = 55.5.

AQI levels for `threshold` argument = one of `"good|moderate|usg|unhealthy|very unhealthy|extreme"`

Sunrise and sunset times are calculated based on the first monitor encountered. This should be accurate enough for all use cases involving co-located monitors. Monitors from different regions should have daily statistics calculated separately.

The returned *ws_monitor* object has a daily time axis where each time is set to 00:00, local time.

Value

A *ws_monitor* object with a daily count of hours at or above `threshold`.

Examples

```
library(PWFSLSmoke)

N_M <- monitor_subset(Northwest_Megafires, tlim=c(20150801,20150831))
Twisp <- monitor_subset(N_M, monitorIDs='530470009_01')
Twisp_daily <- monitor_dailyThreshold(Twisp, "unhealthy", dayStart='midnight', minHours=1)
monitor_timeseriesPlot(Twisp_daily, type='h', lwd=6, ylab="Hours")
title("Twisp, Washington Hours per day Above 'Unhealthy', 2015")
```

---

monitor_distance *Calculate distances from monitors to a location of interest*

Description

This function returns the distances (km) between monitoring sites and a location of interest. These distances can be used to create a mask identifying monitors within a certain radius of the location of interest.

Usage

```
monitor_distance(ws_monitor, longitude, latitude)
```

Arguments

`ws_monitor`	*ws_monitor* object
`longitude`	longitude of the location of interest
`latitude`	latitude of the location of interest

Value

Vector of of distances (km).

See Also

distance

Examples

```
library(PWFSLSmoke)

N_M <- Northwest_Megafires
# Walla Walla
WW_lon <- -118.330278
WW_lat <- 46.065
distance <- monitor_distance(N_M, WW_lon, WW_lat)
closestIndex <- which(distance == min(distance))
distance[closestIndex]
N_M$meta[closestIndex,]
```

---

monitor_downloadAnnual

Download annual PM2.5 monitoring data

Description

Downloads 'annual' data files into `dataDir` for later use. Downloaded versions of PWFSL monitoring .RData files allow users to work with the package without access to the internet. Once data are downloaded to `dataDir`, any of the data loading functions can be called with the `dataDir` argument to replace internet downloads with local file access.

The recommended directory for PWFSL monitoring data is `"~/data/monitoring/RData"`.

For data during the last 45 days, use `monitor_downloadDaily()`.

For the most recent data, use `monitor_downloadLatest()`.

Currently supported parameters include the following:

1. PM2.5

Avaialble RData files can be seen at: https://haze.airfire.org/monitoring/latest/RData/

Usage

```
monitor_downloadAnnual(
  year = NULL,
  parameter = "PM2.5",
  baseUrl = "https://haze.airfire.org/monitoring",
  dataDir = "~/Data/monitoring/RData",
  ...
)
```

Arguments

year	Desired year (integer or character representing YYYY).
parameter	Parameter of interest.
baseUrl	Base URL for data files.
dataDir	Local directory in which to save the data file.
...	Additional arguments passed to download.file.

See Also

monitor_loadDaily

Examples

```
library(PWFSLSmoke)

monitor_loadAnnual(2018) %>%
  monitor_subset(stateCodes = "WA", tlim = c(20180701, 20181001)) %>%
  monitor_timeseriesPlot(style = 'gnats')
```

---

monitor_downloadDaily *Download recent PM2.5 monitoring data*

Description

Downloads 'daily' data files into dataDir for later use. Downloaded versions of PWFSL monitoring .RData files allow users to work with the package without access to the internet. Once data are downloaded to dataDir, any of the data loading functions can be called with the dataDir argument to replace internet downloads with local file access.

The recommended directory for PWFSL monitoring data is "~/data/monitoring/RData".

For the most recent data, use monitor_downloadLatest().

For data extended more than 45 days into the past, use monitor_downloadAnnual().

Currently supported parameters include the following:

1. PM2.5

Avaialble RData files can be seen at: https://haze.airfire.org/monitoring/latest/RData/

Usage

```
monitor_downloadDaily(
  parameter = "PM2.5",
  baseUrl = "https://haze.airfire.org/monitoring/latest/RData/",
  dataDir = "~/Data/monitoring/RData",
  ...
)
```

Arguments

parameter	Parameter of interest.
baseUrl	Base URL for data files.
dataDir	Local directory in which to save the data file.
...	Additional arguments passed to download.file.

See Also

monitor_loadDaily

Examples

```
library(PWFSLSmoke)

monitor_loadLatest() %>%
  monitor_subset(stateCodes=CONUS) %>%
  monitor_map()
```

---

monitor_downloadLatest

Download recent PM2.5 monitoring data

Description

Downloads 'latest' data files into dataDir for later use. Downloaded versions of PWFSL monitoring .RData files allow users to work with the package without access to the internet. Once data are downloaded to dataDir, any of the data loading functions can be called with the dataDir argument to replace internet downloads with local file access.

The recommended directory for PWFSL monitoring data is "~/data/monitoring/RData".

For daily updates covering the most recent 45 days, use monitor_downloadDaily().

For data extended more than 45 days into the past, use monitor_downloadAnnual().

Currently supported parameters include the following:

1. PM2.5

Avaialble RData files can be seen at: https://haze.airfire.org/monitoring/latest/RData/

Usage

```
monitor_downloadLatest(
  parameter = "PM2.5",
  baseUrl = "https://haze.airfire.org/monitoring/latest/RData/",
  dataDir = "~/Data/monitoring/RData",
  ...
)
```

Arguments

parameter	Parameter of interest.
baseUrl	Base URL for data files.
dataDir	Local directory in which to save the data file.
...	Additional arguments passed to download.file.

See Also

monitor_loadDaily

Examples

```
library(PWFSLSmoke)

monitor_loadLatest() %>%
  monitor_subset(stateCodes=CONUS) %>%
  monitor_map()
```

---

monitor_dygraph *Create Interactive Time Series Plot*

Description

This function creates interactive graphs that will be displayed in RStudio's 'Viewer' tab.

Usage

```
monitor_dygraph(
  ws_monitor,
  title = "title",
  ylab = "PM2.5 Concentration",
  tlim = NULL,
  rollPeriod = 1,
  showLegend = TRUE
)
```

Arguments

ws_monitor	*ws_monitor* object
title	title text
ylab	title for the y axis
tlim	optional vector with start and end times (integer or character representing YYYYMMDD[HH])
rollPeriod	rolling mean to be applied to the data
showLegend	logical to toggle display of the legend

Value

Initiates the interactive dygraph plot in RStudio's 'Viewer' tab.

Examples

```
library(PWFSLSmoke)

# Napa Fires -- October, 2017
ca <- airnow_load(2017) %>%
  monitor_subset(tlim=c(20171001,20171101), stateCodes='CA')

Vallejo <- monitor_subset(ca, monitorIDs='060950004_01')

Napa_Fires <- monitor_subsetByDistance(
  ca,
  longitude = Vallejo$meta$longitude,
  latitude = Vallejo$meta$latitude,
  radius = 50
)

if ( interactive() ) {
  monitor_dygraph(Napa_Fires, title='Napa Fires in California, Oct. 2017')
}
```

---

monitor_extractDataFrame

Extract dataframes from ws_monitor *objects*

Description

These functions are convenient wrappers for extracting the dataframes that comprise a *ws_monitor* object. These functions are designed to be useful when manipulating data in a pipe chain.

Below is a table showing equivalent operations for each function.

Function	Equivalent Operation
monitor_extractData(ws_monitor)	ws_monitor[["data"]]
monitor_extractMeta(ws_monitor)	ws_monitor[["meta"]]

Usage

```
monitor_extractData(ws_monitor)

monitor_extractMeta(ws_monitor)
```

Arguments

ws_monitor	*ws_monitor* object to extract dataframe from.

Value

A dataframe from the given *ws_monitor* object

Examples

```
library(PWFSLSmoke)

ws_monitor <- Northwest_Megafires

data <- ws_monitor %>%
  monitor_subset(
    stateCodes = "WA",
    tlim = c(20150801, 20150831)
  ) %>%
  monitor_extractData()

meta <- ws_monitor %>%
  monitor_subset(
    stateCodes = "WA",
    tlim = c(20150801, 20150831)
  ) %>%
  monitor_extractMeta()

dplyr::glimpse(meta)
dplyr::glimpse(data)
```

---

monitor_getCurrentStatus

Get current status of monitors

Description

This function augments the metadata from a *ws_monitor* object with summarized and aggregate data from the *ws_monitor* object.

Usage

```
monitor_getCurrentStatus(
  ws_monitor,
  endTime = NULL,
  monitorURLBase = "http://tools.airfire.org/monitoring/v4/#!/?monitors="
)
```

Arguments

ws_monitor	*ws_monitor* object.
endTime	Time to which the status of the monitors will be current. By default, it is the most recent time in ws_monitor. This time can be given as a POSIXct time, or a string/numeric value in ymd format (eg. 20190301). This time converted to UTC.
monitorURLBase	A URL prefix pointing to where more information about a monitor can be found. By default, it points to the AirFire monitoring site.

Value

A table containing the current status information for all the monitors in *ws_monitor*.

"Last" and "Previous"

The goal of this function is to provide useful information about what happened recently with each monitor in the provided *ws_monitor* object. Monitors sometimes don't consistently report data, however, and it's not useful to have NA's reported when there is still valid data at other times. To address this, monitor_getCurrentStatus uses *last* and *previous* valid times. These are the time when a monitor most recently reported data, and the most recent time of valid data before that, respectively. By reporting on these times, the function ensures that valid data is returned and provides information on how outdated this information is.

Calculating latency

According to https://docs.airnowapi.org/docs/HourlyDataFactSheet.pdf a datum assigned to 2pm represents the average of data between 2pm and 3pm. So, if we check at 3:15pm and see that we have a value for 2pm but not 3pm then the data are completely up-to-date with zero latency.

monitor_getCurrentStatus() defines latency as the difference in time between the given time index and the next most recent time index. If there is no more recent time index, then the difference is measured to the given endTime parameter. These differences are recorded in hours.

For example, if the recorded values for a monitor are [16.2,15.8,16.4,NA,14.0,12.5,NA,NA,13.3,NA], then the last valid time index is 9, and the previous valid time index is 6. The last latency is then 1 (hour), and the previous latency is 3 (hours).

Summary data

The table created by monitor_getCurrentStatus() includes summary information for the data part of the given *ws_monitor* object. The summaries included are listed below with a description:

yesterday_pm25_24hr Daily AQI value for the day prior to endTime

last_nowcast_1hr Last valid NowCast measurement

last_PM2.5_1hr Last valid raw PM2.5 measurement

last_PM2.5_3hr Mean of the last valid raw PM2.5 measurementwith the preceding two measurements

previous_nowcast_1hr Previous valid NowCast measurement

previous_PM2.5_1hr Previous valid raw PM2.5 measurement

previous_PM2.5_3hr Mean of the previous valid raw PM2.5 measurement with the preceding two measurements

It should be noted that all averages are "right-aligned", meaning that the three hour mean of data at time `n` will comprise of the data at times `[n-2,n-1,n]`. Data for `n-2` and `n-1` is not guaranteed to exist, so a three hour average may include 1 to 3 data points.

Event flags

The table created by `monitor_getCurrentStatus()` also includes binary flags representing events that may have occurred for a monitor within the bounds of the specified end time and data in the *ws_monitor* object. Each flag is listed below with its corresponding meaning:

last_nowcastLevel NowCast level at the last valid time

previous_nowcastLevel NowCast level at the previous valid time

NR6 Monitor not reporting for more than 6 hours

NEW6 New monitor reporting in the last 6 hours

USG6 NowCast level increased to Unhealthy for Sensitive Groups in the last 6 hours

U6 NowCast level increased to Unhealthy in the last 6 hours

VU6 NowCast level increased to Very Unhealthy in the last 6 hours

HAZ6 NowCast level increased to Hazardous in the last 6 hours

MOD6 NowCast level decreased to Moderate or Good in the last 6 hours

MAL6 Monitor malfunctioning the last 6 hours (not currently implemented)

Examples

```
library(PWFSLSmoke)

ws_monitor <- monitor_loadLatest() %>% monitor_subset(stateCodes = "WA")
statusTbl <- monitor_getCurrentStatus(ws_monitor)
```

`monitor_getDailyMean` *Calculate daily means for a ws_monitor object*

Description

Calculates and returns daily means for a monitor. If either `startdate` or `enddate` is `NULL`, a single value is returned for that date.

Usage

```
monitor_getDailyMean(
  ws_monitor,
  monitorID = NULL,
  startdate = NULL,
  enddate = NULL
)
```

Arguments

ws_monitor	*ws_monitor* object
monitorID	monitor ID of interest
startdate	desired start date (integer or character in Ymd format or POSIXct)
enddate	desired end date (integer or character in Ymd format or POSIXct)

Value

A dataframe of daily means.

Examples

```
library(PWFSLSmoke)

monitor_getDailyMean(PWFSLSmoke::Carmel_Valley,
                     startdate = "2016-08-01",
                     enddate = "2016-08-08")
```

---

monitor_hourlyBarplot *Create Hourly Barplot*

Description

Creates a bar plot showing hourly PM 2.5 values for a specific monitor in a *ws_monitor* object. Colors are assigned to one of the following styles:

- AQI – hourly values colored with AQI colors using AQI 24-hour breaks
- brownScaleAQI – hourly values colored with brownscale colors using AQI 24-hour breaks
- grayScaleAQI – hourly values colored grayscale colors using AQI 24-hour breaks

Usage

```
monitor_hourlyBarplot(
  ws_monitor,
  monitorID = NULL,
  tlim = NULL,
  localTime = TRUE,
```

```
  style = "AQI",
  shadedNight = TRUE,
  gridPos = "",
  gridCol = "black",
  gridLwd = 0.5,
  gridLty = "solid",
  labels_x_nudge = 0,
  labels_y_nudge = 0,
  dayCol = "black",
  dayLwd = 2,
  dayLty = "solid",
  hourCol = "black",
  hourLwd = 1,
  hourLty = "solid",
  hourInterval = 6,
  ...
)
```

Arguments

ws_monitor	*ws_monitor* object
monitorID	monitor ID for a specific monitor in ws_monitor (optional if ws_monitor only has one monitor)
tlim	optional vector with start and end times (integer or character representing YYYYMMDD[HH])
localTime	logical specifying whether tlim is in local time or UTC
style	named style specification ('AirFire')
shadedNight	add nighttime shading
gridPos	position of grid lines either 'over', 'under' ("" for no grid lines)
gridCol	grid color
gridLwd	grid line width
gridLty	grid line type
labels_x_nudge	nudge x labels to the left
labels_y_nudge	nudge y labels down
dayCol	day boundary color
dayLwd	day boundary line width (set to 0 to omit day lines)
dayLty	day boundary type
hourCol	hour boundary color
hourLwd	hour boundary line width (set to 0 to omit hour lines)
hourLty	hour boundary type
hourInterval	interval for hour boundary lines
...	additional arguments to be passed to barplot()

Details

The labels_x_nudge and labels_y_nudge can be used to tweak the date labeling. Units used are the same as those in the plot.

Examples

```
library(PWFSLSmoke)

C_V <- monitor_subset(Carmel_Valley, tlim = c(2016080800,2016081023),
                      timezone = "America/Los_Angeles")

monitor_hourlyBarplot(C_V, main = "1-Hourly Average PM2.5",
                      labels_x_nudge = 1, labels_y_nudge = 0)
```

---

monitor_isEmpty *Test for an Empty ws_monitor Object*

Description

Convenience function for nrow(ws_monitor$meta) == 0. This makes for more readable code in the many functions that need to test for this.

Usage

```
monitor_isEmpty(ws_monitor)
```

Arguments

ws_monitor	*ws_monitor* object

Value

TRUE if no monitors exist in ws_monitor, FALSE otherwise.

Examples

```
monitor_isEmpty(Carmel_Valley)
```

monitor_isMonitor *Test for an correct structure of ws_monitor Object*

Description

The ws_monitor is checked for the 'ws_monitor' class name and presence of core metadata columns:

- monitorID – per deployment unique ID
- longitude – decimal degrees E
- latitude – decimal degrees N
- elevation – height above sea level in meters
- timezone – olson timezone
- countryCode – ISO 3166-1 alpha-2
- stateCode – ISO 3166-2 alpha-2

Usage

```
monitor_isMonitor(ws_monitor)
```

Arguments

ws_monitor	*ws_monitor* object

Value

TRUE if ws_monitor has the correct structure, FALSE otherwise.

Examples

```
monitor_isEmpty(Carmel_Valley)
```

monitor_isolate *Isolate Individual Monitors*

Description

Filters ws_monitor according to the parameters passed in. If any parameter is not specified, that parameter will not be used in the filtering.

After filtering, each monitorID found in ws_monitor is extracted and its data dataframe is restricted to the times from when that monitor first datapoint until its last datapoint.

This function is useful when *ws_monitor* objects are created for mobile monitors that are deployed to different locations in different years.

Usage

```
monitor_isolate(
  ws_monitor,
  xlim = NULL,
  ylim = NULL,
  tlim = NULL,
  monitorIDs = NULL,
  stateCodes = NULL,
  timezone = "UTC"
)
```

Arguments

ws_monitor	*ws_monitor* object
xlim	optional vector with low and high longitude limits
ylim	optional vector with low and high latitude limits
tlim	optional vector with start and end times (integer or character representing YYYYMMDD[HH] or POSIXct)
monitorIDs	optional vector of monitorIDs
stateCodes	optional vector of stateCodes
timezone	Olson timezone passed to parseDatetime when parsing numeric tlim

Value

A list of isolated ws_monitor objects.

See Also

monitor_subset

Examples

```
N_M <- Northwest_Megafires
# monitor_leaflet(N_M) # to identify Spokane monitorIDs
Spokane <- monitor_subsetBy(N_M, stringr::str_detect(N_M$meta$monitorID,'^53063'))
Spokane$meta$monitorID
monitorList <- monitor_isolate(Spokane)
names(monitorList)
```

monitor_isTidy *Check if data is tidy-formatted ws_monitor data*

Description

Verifies that the given data can be treated as tidy-formatted "ws_monitor" data. This is done by verifying that the data is a tibble data.frame object with columns for information in all ‘ws_monitor‘ objects.

Usage

```
monitor_isTidy(data = NULL)
```

Arguments

data	Data to validate.

Value

True if the data is in a recognized ’Tidy’ format, otherwise False.

Examples

```
ws_monitor <- monitor_subset(
  Northwest_Megafires,
  monitorIDs = c('530470009_01', '530470010_01')
)

ws_monTidy <- monitor_toTidy(ws_monitor)
monitor_isTidy(ws_monTidy)

## Not run:
monitor_isTidy(ws_monitor)

## End(Not run)
```

monitor_join *Merge Data for Monitors with Shared monitorIDs*

Description

For each monitor in monitorIDs, an attempt is made to merge the associated data from ws_monitor1 and ws_monitor2 and.

This is useful when the same monitorID appears in different *ws_monitor* objects representing different time periods. The returned *ws_monitor* object will cover both time periods.

Usage

```
monitor_join(ws_monitor1 = NULL, ws_monitor2 = NULL, monitorIDs = NULL)
```

Arguments

ws_monitor1	*ws_monitor* object
ws_monitor2	*ws_monitor* object
monitorIDs	vector of shared monitorIDs that are to be joined together. Defaults to all shared monitorIDs.

Value

A *ws_monitor* object with merged timeseries.

Examples

```
## Not run:
Jul <- monitor_subset(Northwest_Megafires,
                      tlim=c(2015070100,2015073123),
                      timezone='America/Los_Angeles')
Aug <- monitor_subset(Northwest_Megafires,
                      tlim=c(2015080100,2015083123),
                      timezone='America/Los_Angeles')
Methow_Valley <- monitor_join(Jul, Aug, monitorIDs=c('530470010_01','530470009_01'))

## End(Not run)
```

---

monitor_leaflet *Leaflet interactive map of monitoring stations*

Description

This function creates interactive maps that will be displayed in RStudio's 'Viewer' tab. The slice argument is used to collapse a *ws_monitor* timeseries into a single value. If slice is an integer, that row index will be selected from the ws_monitor$data dataframe. If slice is a function (unquoted), that function will be applied to the timeseries with the argument na.rm=TRUE (e.g. max(...,na.rm=TRUE)).

If slice is a user defined function it will be used with argument na.rm=TRUE to collapse the time dimension. Thus, user defined functions must accept na.rm as an argument.

Usage

```
monitor_leaflet(
  ws_monitor,
  slice = get("max"),
  breaks = AQI$breaks_24,
  colors = AQI$colors,
```

```
  labels = AQI$names,
  legendTitle = "Max AQI Level",
  radius = 10,
  opacity = 0.7,
  maptype = "terrain",
  popupInfo = c("siteName", "monitorID", "elevation")
)
```

Arguments

ws_monitor	ws_monitor object
slice	either a time index or a function used to collapse the time axis – defautls to get('max')
breaks	set of breaks used to assign colors
colors	a set of colors for different levels of air quality data determined by breaks
labels	a set of text labels, one for each color
legendTitle	legend title
radius	radius of monitor circles
opacity	opacity of monitor circles
maptype	optional name of leaflet ProviderTiles to use, e.g. "terrain"
popupInfo	a vector of column names from ws_monitor$meta to be shown in a popup window

Details

The maptype argument is mapped onto leaflet "ProviderTile" names. Current mappings include:

1. "roadmap" – "OpenStreetMap"
2. "satellite" – "Esri.WorldImagery"
3. "terrain" – "Esri.WorldTopoMap"
4. "toner" – "Stamen.Toner"

If a character string not listed above is provided, it will be used as the underlying map tile if available. See https://leaflet-extras.github.io/leaflet-providers/ for a list of "provider tiles" to use as the background map.

Value

Invisbly returns a leaflet map of class "leaflet".

Examples

```
## Not run:
# Napa Fires -- October, 2017
ca <- airnow_load(2017) %>%
  monitor_subset(tlim = c(20171001,20171101), stateCodes = 'CA')
v_low <- AQI$breaks_24[5]
```

```
CA_very_unhealthy_monitors <- monitor_subset(ca, vlim = c(v_low, Inf))
monitor_leaflet(CA_very_unhealthy_monitors,
                legendTitle = "October, 2017",
                maptype = "toner")

## End(Not run)
```

`monitor_load` *Load PM2.5 monitoring data*

Description

Loads monitoring data for a given time range. Data from AirNow, AIRSIS and WRCC are combined into a single *ws_monitor* object.

Archival datasets are joined with 'daily' and 'latest' datasets as needed to satisfy the requested date range.

Usage

```
monitor_load(
  startdate = NULL,
  enddate = NULL,
  monitorIDs = NULL,
  parameter = "PM2.5",
  baseUrl = "https://haze.airfire.org/monitoring",
  dataDir = NULL,
  aqsPreference = "airnow"
)
```

Arguments

`startdate`	Desired start date (integer or character in ymd[hms] format or `POSIXct`).
`enddate`	Desired end date (integer or character in ymd[hms] format or `POSIXct`).
`monitorIDs`	Optional vector of monitorIDs.
`parameter`	Parameter of interest.
`baseUrl`	Base URL for data files.
`dataDir`	Local directory containing monitoring data files.
`aqsPreference`	Preferred data source for AQS data when annual data files are available from both 'epa' and 'airnow'.

Value

A *ws_monitor* object with PM2.5 monitoring data.

Note

Joining datasets is a computationally expensive task when many monitors are involved. It is highly recommend that `monitorIDs` be specified when loading recent data with this function.

See Also

`loadDaily`

`loadLatest`

Examples

```
## Not run:
ca <- monitor_load(20170601,20171001) %>% monitor_subset(stateCodes='CA')

## End(Not run)
```

`monitor_loadAnnual` *Load annual PM2.5 monitoring data*

Description

Wrapper function to load and combine annual data from AirNow, AIRSIS and WRCC.

If `dataDir` is defined, data will be loaded from this local dirctory. Otherwise, data will be loaded from the monitoring data repository maintained by PWFSL.

The annual files loaded by this function are updated on the 15'th of each month and cover the period from the beginning of the year to the end of the last month.

For data during the last 45 days, use `monitor_loadDaily()`.

For the most recent data, use `monitor_loadLatest()`.

Currently supported parameters include the following:

1. PM2.5

Avaialble RData files can be seen at: https://haze.airfire.org/monitoring/

Usage

```
monitor_loadAnnual(
  year = NULL,
  parameter = "PM2.5",
  baseUrl = "https://haze.airfire.org/monitoring",
  dataDir = NULL,
  aqsPreference = "airnow"
)
```

Arguments

year	Desired year (integer or character representing YYYY).
parameter	Parameter of interest.
baseUrl	Base URL for data files.
dataDir	Local directory containing 'daily' data files.
aqsPreference	Preferred data source for AQS data when annual data files are available from both 'epa' and 'airnow'.

Value

A *ws_monitor* object with PM2.5 monitoring data.

See Also

monitor_loadDaily

monitor_loadLatest

Examples

```
## Not run:
monitor_loadAnnual(2014) %>%
  monitor_subset(stateCodes='MT', tlim=c(20140801,20140901)) %>%
  monitor_map()

## End(Not run)
```

---

monitor_loadDaily *Load recent PM2.5 monitoring data*

Description

Wrapper function to load and combine recent data from AirNow, AIRSIS and WRCC:

```
airnow <- airnow_loadDaily()
airsis <- airsis_loadDaily()
wrcc <- wrcc_loadDaily()
ws_monitor <- monitor_combine(list(airnow, airsis, wrcc))
```

If dataDir is defined, data will be loaded from this local dirctory. Otherwise, data will be loaded from the monitoring data repository maintained by PWFSL.

The daily files loaded by this function are updated once a day, shortly after midnight and contain data for the previous 45 days.

For the most recent data, use monitor_loadLatest().

For data extended more than 45 days into the past, use monitor_load().

Currently supported parameters include the following:

1. PM2.5

Avaialble RData files can be seen at: https://haze.airfire.org/monitoring/latest/RData/

Usage

```
monitor_loadDaily(
  parameter = "PM2.5",
  baseUrl = "https://haze.airfire.org/monitoring/latest/RData",
  dataDir = NULL
)
```

Arguments

parameter	Parameter of interest.
baseUrl	Base URL for 'daily' AirNow data files.
dataDir	Local directory containing 'daily' data files.

Value

A *ws_monitor* object with PM2.5 monitoring data.

See Also

monitor_load

monitor_loadLatest

monitor_loadAnnual

Examples

```
## Not run:
monitor_loadDaily() %>%
  monitor_subset(stateCodes=CONUS) %>%
  monitor_map()

## End(Not run)
```

---

monitor_loadLatest *Load most recent PM2.5 monitoring data*

Description

Wrapper function to load and combine recent data from AirNow, AIRSIS and WRCC:

```
airnow <- airnow_loadLatest()
airsis <- airsis_loadLatest()
wrcc <- wrcc_loadLatest()
ws_monitor <- monitor_combine(list(airnow, airsis, wrcc))
```

If `dataDir` is defined, data will be loaded from this local dirctory. Otherwise, data will be loaded from the monitoring data repository maintained by PWFSL.

The files loaded by this function are updated multiple times an hour and contain data for the previous 10 days.

For daily updates covering the most recent 45 days, use `monitor_loadDaily()`.

For data extended more than 45 days into the past, use `monitor_load()`.

Currently supported parameters include the following:

1. PM2.5

Avaialble RData files can be seen at: https://haze.airfire.org/monitoring/latest/RData/

Usage

```
monitor_loadLatest(
  parameter = "PM2.5",
  baseUrl = "https://haze.airfire.org/monitoring/latest/RData/",
  dataDir = NULL
)
```

Arguments

`parameter`	Parameter of interest.
`baseUrl`	Base URL for 'daily' AirNow data files.
`dataDir`	Local directory containing 'daily' data files.

Value

A *ws_monitor* object with PM2.5 monitoring data.

See Also

`monitor_load`

`monitor_loadAnnual`

`monitor_loadDaily`

Examples

```
## Not run:
monitor_loadLatest() %>%
  monitor_subset(stateCodes=CONUS) %>%
  monitor_map()

## End(Not run)
```

`monitor_map` *Static map of monitoring stations*

Description

Creates a map of monitoring stations in a given ws_monitor object. Individual monitor timeseries are reduced to a single value by applying the function passed in as `slice` to the entire timeseries of each monitor with `na.rm=TRUE`. These values are then plotted over a map of the United States. Any additional arguments specified in '...' are passed on to the `points()` function.

If `slice` is an integer, it will be used as an index to pull out a single timestep.

If `slice` is a function (not a function name) it will be used with argument `na.rm=TRUE` to collapse the time dimension. Thus, any user defined functions passed in as `slice` must accept `na.rm` as a parameter.

Usage

```
monitor_map(
  ws_monitor,
  slice = get("max"),
  breaks = AQI$breaks_24,
  colors = AQI$colors,
  pch = par("pch"),
  cex = par("cex"),
  stateCol = "grey60",
  stateLwd = 2,
  countyCol = "grey70",
  countyLwd = 1,
  add = FALSE,
  ...
)
```

Arguments

`ws_monitor`	*ws_monitor* object
`slice`	either a time index or a function used to collapse the time axis
`breaks`	set of breaks used to assign colors
`colors`	set of colors must be one less than the number of breaks
`pch`	Plot symbols used to draw points on the map.
`cex`	the amount that the points will be magnified on the map
`stateCol`	color for state outlines on the map
`stateLwd`	width for state outlines
`countyCol`	color for county outline on the map
`countyLwd`	width for county outlines
`add`	logical specifying whether to add to the current plot
`...`	additional arguments passed to `maps::map()` such as `'projection'` or `'parameters'`

Details

Using a single number for the `breaks` argument will result in the use of quantiles to determine a set of breaks appropriate for the number of colors.

Examples

```
library(PWFSLSmoke)

N_M <- monitor_subset(Northwest_Megafires, tlim = c(20150821,20150828))
monitor_map(N_M, cex = 2)
addAQILegend()
```

`monitor_nowcast` *Apply Nowcast Algorithm to ws_monitor Object*

Description

A Nowcast algorithm is applied to the data in in the ws_monitor object. The `version` argument specifies the minimum weight factor and number of hours to be considered in the calculation.

Available versions include:

1. `pm`: hours=12, weight=0.5
2. `pmAsian`: hours=3, weight=0.1
3. `ozone`: hours=8, weight=NA

The default, `version='pm'`, is appropriate for typical usage.

Usage

```
monitor_nowcast(ws_monitor, version = "pm", includeShortTerm = FALSE)
```

Arguments

`ws_monitor`	*ws_monitor* object
`version`	character identity specifying the type of nowcast algorithm to be used
`includeShortTerm`	calcluate preliminary NowCast values starting with the 2nd hour

Details

This function calculates the current hour's NowCast value based on the value for the given hour and the previous N-1 hours, where N is the number of hours corresponding to the `version` argument (see **Description** above). For example, if `version=pm`, then the NowCast value for Hour 12 is based on the data from Hours 1-12.

The function requires valid data for at least two of the three latest hours; NA's are returned for hours where this condition is not met.

By default, the funtion will not return a valid value until the Nth hour. If `includeShortTerm=TRUE`, the function will return a valid value after only the 2nd hour (provided, of course, that both hours are valid).

Calculated Nowcast values are truncated to the nearest .1 ug/m3 for 'pm' and nearest .001 ppm for 'ozone' regardless of the precision of the data in the incoming *ws_monitor* object.

Value

A *ws_monitor* object with data that have been processed by the Nowcast algorithm.

References

https://en.wikipedia.org/wiki/Nowcast_(Air_Quality_Index)

https://www3.epa.gov/airnow/ani/pm25_aqi_reporting_nowcast_overview.pdf

https://aqicn.org/faq/2015-03-15/air-quality-nowcast-a-beginners-guide/

https://airnow.zendesk.com/hc/en-us/articles/211625598-How-does-AirNow-make-the-Current-PM-Air-Qua

https://forum.airnowtech.org/t/the-nowcast-for-ozone-and-pm/172

https://forum.airnowtech.org/t/the-aqi-equation/169

https://forum.airnowtech.org/t/how-does-airnow-handle-negative-hourly-concentrations/143

Examples

```
library(PWFSLSmoke)

N_M <- monitor_subset(Northwest_Megafires, tlim=c(20150815,20150831))
Omak <- monitor_subset(N_M, monitorIDs='530470013_01')
Omak_nowcast <- monitor_nowcast(Omak, includeShortTerm=TRUE)
monitor_timeseriesPlot(Omak, type='l', lwd=2)
monitor_timeseriesPlot(Omak_nowcast, add=TRUE, type='l', col='purple', lwd=2)
addAQILines()
addAQILegend(lwd=1, pch=NULL)
legend("topleft", lwd=2, col=c('black','purple'), legend=c('hourly','nowcast'))
title("Omak, Washington Hourly and Nowcast PM2.5 Values in August, 2015")
# Zooming in to check on handling of missing values
monitor_timeseriesPlot(Omak, tlim=c(20150823,20150825))
monitor_timeseriesPlot(Omak_nowcast, tlim=c(20150823,20150825), pch=16,col='red',type='b', add=TRUE)
abline(v=Omak$data[is.na(Omak$data[,2]),1])
title("Missing values")
```

`monitor_performance` *Calculate Monitor Prediction Performance*

Description

This function uses *confusion matrix* analysis to calculate different measures of predictive performance for every timeseries found in `predicted` with respect to the observed values found in the single timeseries found in `observed`.

The requested metric is returned in a dataframe organized with one row per monitor, all available metrics are returned.

Usage

```
monitor_performance(
  predicted,
  observed,
  t1,
  t2,
  metric = NULL,
  FPCost = 1,
  FNCost = 1
)
```

Arguments

`predicted`	ws_monitor object with predicted data
`observed`	ws_monitor object with observed data
`t1`	value used to classify `predicted` measurements
`t2`	threshold used to classify `observed` measurements
`metric`	*confusion matrix* metric to be used
`FPCost`	cost associated with false positives (type II error)
`FNCost`	cost associated with false negatives (type I error)

Value

Dataframe of monitors vs named measure of performance.

See Also

monitor_performanceMap

skill_confusionMatrix

Examples

```
library(PWFSLSmoke)

# If daily avg data were the prediciton and Spokane were
# the observed, which WA State monitors had skill?

wa <- airnow_loadAnnual(2017) %>% monitor_subset(stateCodes='WA')
wa_dailyAvg <- monitor_dailyStatistic(wa, mean)
Spokane_dailyAvg <- monitor_subset(wa_dailyAvg, monitorIDs='530630021_01')

threshold <- AQI$breaks_24[4] # Unhealthy
performanceMetrics <- monitor_performance(wa_dailyAvg,
                                          Spokane_dailyAvg,
                                          threshold, threshold)

monitorIDs <- rownames(performanceMetrics)
mask <- performanceMetrics$heidkeSkill &
        !is.na(performanceMetrics$heidkeSkill)

skillfulIDs <- monitorIDs[mask]
skillful <- monitor_subset(wa_dailyAvg, monitorIDs=skillfulIDs)

monitor_leaflet(skillful)
```

---

monitor_performanceMap

Create map of monitor prediction performance

Description

This function uses *confusion matrix* analysis to calculate different measures of predictive performance for every timeseries found in `predicted` with respect to the observed values found in the single timeseries found in `observed`.

Using a single number for the `breaks` argument will cause the algorithm to use quantiles to determine breaks.

Usage

```
monitor_performanceMap(
  predicted,
  observed,
  threshold = AQI$breaks_24[3],
  cex = par("cex"),
  sizeBy = NULL,
  colorBy = "heidikeSkill",
  breaks = c(-Inf, 0.5, 0.6, 0.7, 0.8, Inf),
```

```
  paletteFunc = grDevices::colorRampPalette(RColorBrewer::brewer.pal(length(breaks),
    "Purples")[-1]),
  showLegend = TRUE,
  legendPos = "topright",
  stateCol = "grey60",
  stateLwd = 2,
  countyCol = "grey70",
  countyLwd = 1,
  add = FALSE,
  ...
)
```

Arguments

predicted	ws_monitor object with predicted values
observed	ws_monitor object with observed values
threshold	value used to classify predicted and observed measurements
cex	the amount that the points will be magnified on the map
sizeBy	name of the metric used to create relative sizing
colorBy	name of the metric used to create relative colors
breaks	set of breaks used to assign colors or a single integer used to provide quantile based breaks - Must also specify the colorBy paramater
paletteFunc	a palette generating function as returned by colorRampPalette
showLegend	logical specifying whether to add a legend (default: TRUE)
legendPos	legend position passed to legend()
stateCol	color for state outlines on the map
stateLwd	width for state outlines
countyCol	color for county outline on the map
countyLwd	width for county outlines
add	logical specifying whether to add to the current plot
...	additional arguments to be passed to the maps::map() funciton such as graphical parameters (see code?par)

Details

Setting either sizeBy or colorBy to NULL will cause the size/colors to remain constant.

See Also

monitor_performance

Examples

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

# Napa Fires -- October, 2017
ca <- airnow_load(2017) %>%
  monitor_subset(tlim=c(20171001,20171101), stateCodes='CA')
Vallejo <- monitor_subset(ca, monitorIDs='060950004_01')
Napa_Fires <- monitor_subsetByDistance(ca,
                                       longitude = Vallejo$meta$longitude,
                                       latitude = Vallejo$meta$latitude,
                                       radius = 50)
monitor_performanceMap(ca, Vallejo, cex = 2)
title('Heidke Skill of monitors predicting another monitor.')

## End(Not run)
```

`monitor_print` *Print monitor data as CSV*

Description

Prints out the contents of the `ws_monitor` object as CSV. By default, the output is a text string with "human readable" CSV that includes both `meta` and `data`. When saved as a file, this format is useful for point-and-click spreadsheet users who want to have everything on a single sheet.

To obtain machine parseable CSV strings you can use `metaOnly` or `dataOnly` which are mutually exclusive but which return CSV strings that can be automatically ingested.

By default, the CSV formatted text is printed to the console as well as returned invisibly but not saved to a file unless `saveFile` is specified.

Usage

```
monitor_print(
  ws_monitor,
  saveFile = NULL,
  metaOnly = FALSE,
  dataOnly = FALSE,
  quietly = FALSE
)
```

Arguments

`ws_monitor`	*ws_monitor* object
`saveFile`	optional filename where CSV will be written
`metaOnly`	flag specifying whether to return `ws_monitor$meta` only as a machine parseable CSV

dataOnly	flag specifying whether to return ws_monitor$data only as a machine parseable CSV
quietly	do not print to console, just return the string representation of the CSV

Note

The monitor_writeCSV function is an alias for this function but defaults to quietly = TRUE.

Examples

```
library(PWFSLSmoke)

data("Carmel_Valley")

Carmel_Valley <- monitor_subset(Carmel_Valley, tlim = c(20160802,20160803))

monitor_print(Carmel_Valley)
monitor_print(Carmel_Valley, metaOnly = TRUE)
monitor_print(Carmel_Valley, dataOnly = TRUE)
```

---

monitor_reorder *Reorder a ws_monitor bject*

Description

This function is a convenience function that merely wraps the monitor_subset function which reorders as well as subsets.

Usage

```
monitor_reorder(ws_monitor, monitorIDs = NULL, dropMonitors = FALSE)
```

Arguments

ws_monitor	*ws_monitor* object
monitorIDs	Optional vector of monitor IDs used to reorder the meta and data dataframes.
dropMonitors	Logical specifying whether to remove monitors with no data.

Value

A *ws_monitor* object reordered to match monitorIDs.

monitor_replaceData *Replace ws_monitor Data with Another Value*

Description

Use an R expression to identify values for replacement.

The RR expression given in `filter` is used to identify elements in `ws_monitor$data` that should be replaced. Typical usage would include

1. replacing negative values with 0
2. replacing unreasonably high values with `NA`

Expressions should use `data` for the left hand side of the comparison.

Usage

```
monitor_replaceData(ws_monitor, filter, value)
```

Arguments

`ws_monitor`	*ws_monitor* object
`filter`	an RR expression used to identify values for replacement
`value`	replacement value

Examples

```
library(PWFSLSmoke)

wa <- monitor_subset(Northwest_Megafires, stateCodes = 'WA')
wa_zero <- monitor_replaceData(wa, data < 0, 0)
```

monitor_rollingMean *Calculate Rolling Means*

Description

Calculates rolling means for each monitor in `ws_monitor` using the `openair::rollingMean()` function

Usage

```
monitor_rollingMean(ws_monitor, width = 8, data.thresh = 75, align = "center")
```

Arguments

ws_monitor	*ws_monitor* object
width	number of periods to average (e.g. for hourly data, width = 24 calculates 24-hour rolling means)
data.thresh	minimum number of valid observations required as a percent of width; NA is returned if insufficient valid data to calculate mean
align	alignment of averaging window relative to point being calculated; one of "left|center|right"

Details

- align = 'left': Forward roll, using hour of interest and the (width-1) subsequent hours (e.g. 3-hr left-aligned roll for Hr 5 will consist of average of Hrs 5, 6 and 7)
- align = 'right': Backwards roll, using hour of interest and the (width-1) prior hours (e.g. 3-hr right-aligned roll for Hr 5 will consist of average of Hrs 3, 4 and 5)
- align = 'center' for odd width: Average of hour of interest and (width-1)/2 on either side (e.g. 3-hr center-aligned roll for Hr 5 will consist of average of Hrs 4, 5 and 6)
- align = 'center' for even width: Average of hour of interest and (width/2)-1 hours prior and width/2 hours after (e.g. 4-hr center-aligned roll for Hr 5 will consist of average of Hrs 4, 5, 6 and 7)

Value

A *ws_monitor* object with data thaty have been processed by a rolling mean algorithm.

Examples

```
library(PWFSLSmoke)

N_M <- Northwest_Megafires
wa_smoky <- monitor_subset(N_M, stateCodes='WA', tlim=c(20150801, 20150808), vlim=c(100,Inf))
wa_smoky_3hr <- monitor_rollingMean(wa_smoky, width=3, align="center")
wa_smoky_24hr <- monitor_rollingMean(wa_smoky, width=24, align="right")

monitor_timeseriesPlot(wa_smoky, type='l', shadedNight=TRUE)
monitor_timeseriesPlot(wa_smoky_3hr, type='l', col='red', add=TRUE)
monitor_timeseriesPlot(wa_smoky_24hr, type='l', col='blue', lwd=2, add=TRUE)
legend('topright', c("hourly","3-hourly","24-hourly"),
       col=c('black','red','blue'), lwd=c(1,1,2))
title('Smoky Monitors in Washington -- August, 2015')
```

`monitor_rollingMeanPlot` *Create Rolling Mean Plot*

Description

Creates a plot of individual (e.g. hourly) and rolling mean PM2.5 values for a specific monitor.

Usage

```
monitor_rollingMeanPlot(
  ws_monitor,
  monitorID = NULL,
  width = 3,
  align = "center",
  data.thresh = 75,
  tlim = NULL,
  ylim = NULL,
  localTime = TRUE,
  shadedNight = FALSE,
  aqiLines = TRUE,
  gridHorizontal = FALSE,
  grid24hr = FALSE,
  grid3hr = FALSE,
  showLegend = TRUE
)
```

Arguments

`ws_monitor`	*ws_monitor* object
`monitorID`	Monitor ID for a specific monitor in the ws_monitor object (optional if only one monitor in the ws_monitor object).
`width`	Number of periods to average (e.g. for hourly data, `width = 24` plots 24-hour rolling means).
`align`	Alignment of averaging window relative to point being calculated; one of `"left|center|right"`.
`data.thresh`	Minimum number of valid observations required as a percent of `width`; NA is returned if insufficicnet valid data to calculate. mean
`tlim`	Optional vector with start and end times (integer or character representing YYYYMMDD[HH]).
`ylim`	y limits for the plot.
`localTime`	Logical specifying whether `tlim` is in local time or UTC.
`shadedNight`	Add nighttime shading.
`aqiLines`	Horizontal lines indicating AQI levels.
`gridHorizontal`	Add dashed horizontal grid lines.

grid24hr	Add dashed grid lines at day boundaries.
grid3hr	Add dashed grid lines every 3 hours.
showLegend	Include legend in top left.

Details

- align = "left": Forward roll, using hour of interest and the (width-1) subsequent hours (e.g. 3-hr left-aligned roll for Hr 5 will consist of average of Hrs 5, 6 and 7)
- align = "right": Backwards roll, using hour of interest and the (width-1) prior hours (e.g. 3-hr right-aligned roll for Hr 5 will consist of average of Hrs 3, 4 and 5)
- align = "center" for odd width: Average of hour of interest and (width-1)/2 on either side (e.g. 3-hr center-aligned roll for Hr 5 will consist of average of Hrs 4, 5 and 6)
- align = "center" for even width: Average of hour of interest and (width/2)-1 hours prior and width/2 hours after (e.g. 4-hr center-aligned roll for Hr 5 will consist of average of Hrs 4, 5, 6 and 7)

Note

This function attempts to provide a 'publication ready' rolling mean plot.

Examples

```
library(PWFSLSmoke)

N_M <- Northwest_Megafires
Roseburg <- monitor_subset(N_M, tlim = c(20150821, 20150831),
                           monitorIDs = c("410190002_01"))
monitor_rollingMeanPlot(Roseburg, shadedNight = TRUE)
```

---

monitor_scaleData *Scale ws_monitor Data*

Description

Scale the data in a *ws_monitor* object by mutiplying it with factor.

Usage

```
monitor_scaleData(ws_monitor, factor)
```

Arguments

ws_monitor	*ws_monitor* object
factor	numeric used to scale the data

Value

A *ws_monitor* object with scaled data.

Examples

```
library(PWFSLSmoke)

wa <- monitor_subset(Northwest_Megafires, stateCodes='WA')
wa_zero <- monitor_scaleData(wa, 3.4)
```

`monitor_stamenmap` *Create a static map of ws_monitor object*

Description

Plots amap showing *ws_monitor* locations and values.

#' Available `maptypes` include:

- terrain
- toner
- watercolor

See `staticmap_getStamenmapBrick` for details.

If `centerLon`, `centerMap` or `zoom` are not specified, appropriate values will be calcualted using data from the `ws_monitor$meta` dataframe.

Usage

```
monitor_stamenmap(
  ws_monitor,
  slice = get("max"),
  breaks = AQI$breaks_24,
  colors = AQI$colors,
  width = 640,
  height = 640,
  centerLon = NULL,
  centerLat = NULL,
  zoom = NULL,
  maptype = "terrain",
  grayscale = FALSE,
  rasterBrick = NULL,
  cex = par("cex") * 2,
  pch = 16,
  ...
)
```

Arguments

ws_monitor	*ws_monitor* object
slice	either a time index or a function used to collapse the time axis – defautls to get('max')
breaks	set of breaks used to assign colors
colors	a set of colors for different levels of air quality data determined by breaks
width	width of image, in pixels
height	height of image, in pixels
centerLon	map center longitude
centerLat	map center latitude
zoom	map zoom level
maptype	map type
grayscale	logical, if TRUE the colored map tile is rendered into a black & white image
rasterBrick	optional RGB rasterBrick object returned from staticmap_get~Brick)
cex	character expansion for points
pch	plotting character for points
...	arguments passed on to staticmap_plotRasterBrick() (*e.g.* destfile, cex, pch, etc.)

Value

Plots a map loaded from arcGIS REST with points for each monitor.

See Also

staticmap_getStamenmapBrick

staticmap_plotRasterBrick

Examples

```
library(PWFSLSmoke)

N_M <- Northwest_Megafires
# monitor_leaflet(N_M) # to identify Spokane monitorIDs
Spokane <- monitor_subsetBy(N_M, stringr::str_detect(N_M$meta$monitorID,'^53063'))
Spokane <- monitor_subset(Spokane, tlim=c(20150815, 20150831))
monitor_stamenmap(Spokane)
```

`monitor_staticmap` *Create a static map of ws_monitor object*

Description

Plots a map showing *ws_monitor* locations and values.

See `staticmap_getRasterBrick` for a list of available `maptype` options.

If `centerLon`, `centerMap` or `zoom` are not specified, appropriate values will be calcualted using data from the `ws_monitor$meta` dataframe.

Usage

```
monitor_staticmap(
  ws_monitor,
  slice = get("max"),
  breaks = AQI$breaks_24,
  colors = AQI$colors,
  width = 640,
  height = 640,
  centerLon = NULL,
  centerLat = NULL,
  zoom = NULL,
  maptype = "terrain",
  grayscale = FALSE,
  rasterBrick = NULL,
  cex = par("cex") * 2,
  pch = 16,
  ...
)
```

Arguments

`ws_monitor`	*ws_monitor* object
`slice`	either a time index or a function used to collapse the time axis – defautls to `get('max')`
`breaks`	set of breaks used to assign colors
`colors`	a set of colors for different levels of air quality data determined by `breaks`
`width`	width of image, in pixels
`height`	height of image, in pixels
`centerLon`	map center longitude
`centerLat`	map center latitude
`zoom`	map zoom level
`maptype`	map type

grayscale	logical, if TRUE the colored map tile is rendered into a black & white image
rasterBrick	optional RGB rasterBrick object returned from staticmap_get~Brick)
cex	character expansion for points
pch	plotting character for points
...	arguments passed on to staticmap_plotRasterBrick() (*e.g.* destfile, cex, pch, etc.)

Value

A plot with a basemap and colored dots for each monitor.

See Also

staticmap_getStamenmapBrick

staticmap_plotRasterBrick

Examples

```
library(PWFSLSmoke)

N_M <- Northwest_Megafires
# monitor_leaflet(N_M) # to identify Spokane monitorIDs
Spokane <- monitor_subsetBy(N_M, stringr::str_detect(N_M$meta$monitorID,'^53063'))
Spokane <- monitor_subset(Spokane, tlim=c(20150815, 20150831))
monitor_staticmap(Spokane)
```

---

monitor_subset *Subset ws_monitor Object*

Description

Creates a subset *ws_monitor* based on one or more optional input parameters. If any input parameter is not specified, that parameter will not be used to subset ws_monitor.

Usage

```
monitor_subset(
  ws_monitor,
  xlim = NULL,
  ylim = NULL,
  tlim = NULL,
  vlim = NULL,
  monitorIDs = NULL,
  stateCodes = NULL,
```

```
  countryCodes = NULL,
  dropMonitors = TRUE,
  timezone = "UTC"
)
```

Arguments

ws_monitor	*ws_monitor* object
xlim	optional vector with low and high longitude limits
ylim	optional vector with low and high latitude limits
tlim	optional vector with start and end times (integer or character representing YYYYMMDD[HH] or POSIXct)
vlim	optional vector with low and high data value limits
monitorIDs	optional vector of monitor IDs used to filter the data
stateCodes	optional vector of state codes used to filter the data
countryCodes	optional vector of country codes used to filter the data
dropMonitors	flag specifying whether to remove monitors with no data
timezone	Olson timezone passed to parseDatetime when parsing numeric tlim

Details

By default, this function will return a *ws_monitor* object whose data dataframe has the same number of columns as the incoming dataframe, unless any of the columns consist of all NAs, in which case such columns will be removed (*e.g.* if there are no valid data for a specific monitor after subsetting by tlim or vlim). If dropMonitors=FALSE, columns that consist of all NAs will be retained.

Value

A *ws_monitor* object with a subset of ws_monitor.

Examples

```
library(PWFSLSmoke)

N_M <- monitor_subset(Northwest_Megafires, tlim=c(20150701,20150731))
xlim <- c(-124.73, -122.80)
ylim <- c(47.20, 48.40)
Olympic_Peninsula <- monitor_subset(N_M, xlim, ylim)

monitor_map(Olympic_Peninsula, cex=2)
rect(xlim[1], ylim[1], xlim[2], ylim[2], col=adjustcolor('black',0.1))
```

monitor_subsetBy *Subset ws_monitor Object with a Filter*

Description

The incoming ws_monitor object is filtered according to `filter`. Either meta data or actual data can be filtered.

Usage

```
monitor_subsetBy(ws_monitor, filter)
```

Arguments

`ws_monitor`	*ws_monitor* object
`filter`	a filter to use on the ws_monitor object

Value

A *ws_monitor* object with a subset of the input ws_monitor object.

Examples

```
library(PWFSLSmoke)

N_M <- Northwest_Megafires
boise_tz <- monitor_subsetBy(N_M, timezone == 'America/Boise')
boise_tz_very_unhealthy <- monitor_subsetBy(boise_tz, data > AQI$breaks_24[5])
boise_tz_very_unhealthy$meta$siteName
```

monitor_subsetByDistance *Subset ws_monitor Object by Distance from Target Location*

Description

Subsets `ws_monitor` to include only those monitors (or grid cells) within a certain radius of a target location. If no monitors (or grid cells) fall within the specified `radius`, `ws_monitor$data` and `ws_monitor$meta` are set to `NULL`.

When `count` is used, a *ws_monitor* object is created containing **up to** `count` monitors, ordered by increasing distance from the target location. Thus, note that the number of monitors (or grid cells) returned may be less than the specified `count` value if fewer than `count` monitors (or grid cells) are found within the specified `radius` of the target location.

Usage

```
monitor_subsetByDistance(
  ws_monitor,
  longitude = NULL,
  latitude = NULL,
  radius = 50,
  count = NULL
)
```

Arguments

ws_monitor	*ws_monitor* object
longitude	target longitude from which the radius will be calculated
latitude	target latitude from which the radius will be calculated
radius	distance (km) of radius from target location – default=300
count	number of grid cells to return

Value

A *ws_monitor* object with monitors near a location.

See Also

monitorDistance

Examples

```
library(PWFSLSmoke)

# Napa Fires -- October, 2017
ca <- airnow_loadAnnual(2017) %>%
  monitor_subset(tlim=c(20171001,20171101), stateCodes='CA')
Vallejo <- monitor_subset(ca, monitorIDs='060950004_01')
Napa_Fires <- monitor_subsetByDistance(ca,
                                       longitude = Vallejo$meta$longitude,
                                       latitude = Vallejo$meta$latitude,
                                       radius = 50)

if ( interactive() ) {
  monitor_leaflet(Napa_Fires)
}
```

monitor_subsetData *Subset ws_monitor Object 'data' Dataframe*

Description

Subsets a *ws_monitor* object's data dataframe by removing any monitors that lie outisde the specified ranges of time and values and that are not mentioned in the list of monitorIDs.

If tlim or vlim is not specified, it will not be used in the subsetting.

Intended for use by the monitor_subset function.

Usage

```
monitor_subsetData(
  data,
  tlim = NULL,
  vlim = NULL,
  monitorIDs = NULL,
  dropMonitors = FALSE,
  timezone = "UTC"
)
```

Arguments

data	*ws_monitor* object data dataframe
tlim	optional vector with start and end times (integer or character representing YYYYMMDD[HH] or POSIXct)
vlim	optional vector with low and high data value limits
monitorIDs	optional vector of monitorIDs
dropMonitors	flag specifying whether to remove columns – defaults to FALSE
timezone	Olson timezone passed to parseDatetime when parsing numeric tlim

Details

By default, filtering by tlim or vlim will always return a dataframe with the same number of columns as the incoming dataframe. If dropMonitors=TRUE, columns will be removed if there are not valid data for a specific monitor after subsetting.

Filtering by vlim is open on the left and closed on the right, i.e.

x > vlim[1] & x <= vlim[2]

Value

A *ws_monitor* object data dataframe, or NULL if filtering removes all monitors.

`monitor_subsetMeta` *Subset ws_monitor Object 'meta' Dataframe*

Description

Subsets the `ws_monitor$data` dataframe by removing any monitors that lie outisde the geographical ranges specified (i.e. outside of the given longitudes and latitudes and/or states) and that are not mentioned in the list of monitorIDs.

If any parameter is not specified, that parameter will not be used in the subsetting.

Intended for use by the monitor_subset function.

Usage

```
monitor_subsetMeta(
  meta,
  xlim = NULL,
  ylim = NULL,
  stateCodes = NULL,
  countryCodes = NULL,
  monitorIDs = NULL
)
```

Arguments

`meta`	*ws_monitor* object `meta` dataframe
`xlim`	optional vector with low and high longitude limits
`ylim`	optional vector with low and high latitude limits
`stateCodes`	optional vector of stateCodes
`countryCodes`	optional vector of countryCodes
`monitorIDs`	optional vector of monitorIDs

Details

Longitudes must be specified in the domain [-180,180].

Value

A *ws_monitor* object `meta` dataframe, or `NULL` if filtering removes all monitors.

monitor_timeAverage *Calculate Time Averages*

Description

This function extracts the data dataframe from ws_monitor object and renames the 'datetime' column so that it can be processed by the **openair** package's timeAverage() function. (See that function for details.)

Usage

```
monitor_timeAverage(ws_monitor, ...)
```

Arguments

ws_monitor	*ws_monitor* object
...	additional arguments to be passed to openair::timeAverage()

Value

A *ws_monitor* object with data that have been proccessed by openair::timeAverage().

Examples

```
library(PWFSLSmoke)

C_V <- monitor_subset(Carmel_Valley, tlim=c(2016080800,2016081023),
                      timezone='America/Los_Angeles')
C_V_3hourly <- monitor_timeAverage(C_V, avg.time="3 hour")
head(C_V$data, n=15)
head(C_V_3hourly$data, n=5)
```

monitor_timeInfo *Get time related information for a monitor*

Description

Calculate the local time for the monitor, as well as sunrise, sunset and solar noon times, and create several temporal masks.

The returned dataframe will have as many rows as the length of the incoming UTC time vector and will contain the following columns:

- localStdTime_UTC – UTC representation of local **standard** time
- daylightSavings – logical mask = TRUE if daylight savings is in effect
- localTime – local clock time

- sunrise – time of sunrise on each localTime day
- sunset – time of sunset on each localTime day
- solarnoon – time of solar noon on each localTime day
- day – logical mask = TRUE between sunrise and sunset
- morning – logical mask = TRUE between sunrise and solarnoon
- afternoon – logical mask = TRUE between solarnoon and sunset
- night – logical mask = opposite of day

Usage

```
monitor_timeInfo(ws_monitor = NULL, monitorID = NULL)
```

Arguments

ws_monitor	*ws_monitor* object.
monitorID	Monitor ID for a specific monitor in ws_monitor – optional if ws_monitor only has one monitor.

Details

While the **lubridate** package makes it easy to work in local timezones, there is no easy way in R to work in "Local Standard Time" (LST) as is often required when working with air qualitiy data. EPA regulations mandate that daily averages be calculated based on LST.

The localStdTime_UTC is primarily for use internally and provides an important tool for creating LST daily averages and LST axis labeling.

Value

A dataframe with times and masks.

Examples

```
library(PWFSLSmoke)

carmel <- monitor_subset(Carmel_Valley, tlim = c(20160801,20160810))

# Create timeInfo object for this monitor
ti <- monitor_timeInfo(carmel)

# Subset the data based on day/night masks
data_day <- carmel$data[ti$day,]
data_night <- carmel$data[ti$night,]

# Build two monitor objects
carmel_day <- list(meta = carmel$meta, data = data_day)
carmel_night <- list(meta = carmel$meta, data = data_night)

# Plot them
monitor_timeseriesPlot(carmel_day, shadedNight = TRUE, pch = 8, col = 'goldenrod')
monitor_timeseriesPlot(carmel_night, pch = 16, col = 'darkblue', add = TRUE)
```

monitor_timeseriesPlot *Create Timeseries Plot*

Description

Creates a time series plot of PM2.5 data from a *ws_monitor* object (see note below). Optional arguments color code by AQI index, add shading to indicate nighttime, and adjust the time display (local vs. UTC).

When a named `style` is used, some graphical parameters will be overridden. Available styles include:

- `aqidots`– hourly values are individually colored by 24-hr AQI levels
- `gnats`– semi-transparent dots like a cloud of gnats

Usage

```
monitor_timeseriesPlot(
  ws_monitor,
  monitorID = NULL,
  tlim = NULL,
  localTime = TRUE,
  style = NULL,
  shadedNight = FALSE,
  add = FALSE,
  gridPos = "",
  gridCol = "black",
  gridLwd = 1,
  gridLty = "solid",
  dayLwd = 0,
  hourLwd = 0,
  hourInterval = 6,
  ...
)
```

Arguments

`ws_monitor`	*ws_monitor* object.
`monitorID`	Monitor ID for one or more monitor in the ws_monitor object.
`tlim`	Optional vector with start and end times (integer or character representing YYYYMMDD[HH]).
`localTime`	Logical specifying whether `tlim` is in local time or UTC.
`style`	Custom styling, one of `"aqidots"`.
`shadedNight`	Add nighttime shading.
`add`	Logical specifying whether to add to the current plot.

gridPos	Position of grid lines either "over", "under" ("" for no grid lines).
gridCol	Grid line color.
gridLwd	Grid line width.
gridLty	Grid line type.
dayLwd	Day marker line width.
hourLwd	Hour marker line width.
hourInterval	Interval for grid (max = 12).
...	Additional arguments to be passed to points().

Note

Remember that a *ws_monitor* object can contain data from more than one monitor, and thus, this function may produce a time series of data from multiple monitors. To plot a time series of an individual monitor's data, specify a single monitorID.

Examples

```
library(PWFSLSmoke)

N_M <- Northwest_Megafires
# monitor_leaflet(N_M) # to identify Spokane monitorIDs
Spokane <- monitor_subsetBy(
  N_M,
  stringr::str_detect(N_M$meta$monitorID, "^53063")
)

monitor_timeseriesPlot(Spokane, style = "gnats")
title("Spokane PM2.5 values, 2015")
monitor_timeseriesPlot(
  Spokane,
  tlim = c(20150801, 20150831),
  style = "aqidots",
  pch = 16
)
addAQILegend()
title("Spokane PM2.5 values, August 2015")
monitor_timeseriesPlot(
  Spokane,
  tlim = c(20150821, 20150828),
  shadedNight = TRUE,
  style = "gnats"
)
abline(h = AQI$breaks_24, col = AQI$colors, lwd = 2)
addAQILegend()
title("Spokane PM2.5 values, August 2015")
```

monitor_toTidy *Convert 'ws_monitor' data to a tidy format*

Description

Changes write-optomized 'ws_monitor' formatted data into a read-optomized 'tidy' format that is useful for 'tidyverse' functions. If the given data is already in a tidy format, it is returned as is.

Usage

```
monitor_toTidy(data = NULL)
```

Arguments

data	Data to potentially convert.

Value

'Tidy' formatted 'ws_monitor' data.

Examples

```
library(PWFSLSmoke)

ws_monitor <- monitor_subset(
  Northwest_Megafires,
  monitorIDs = c('530470009_01', '530470010_01')
)

ws_monTidy <- monitor_toTidy(ws_monitor)

## Not run:
ws_monTidy2 <- monitor_toTidy(ws_monTidy)

## End(Not run)
```

monitor_trim *Trim ws_monitor Time Axis to Remove NA Periods From Beginning and End*

Description

Trims the time axis of a *ws_monitor* object to exclude timestamps prior to the first and after the last valid datapoint for any monitor.

Usage

```
monitor_trim(ws_monitor)
```

Arguments

ws_monitor	*ws_monitor* object

Value

A *ws_monitor* object with missing data trimmed.

Examples

```
## Not run:
library(PWFSLSmoke)
library(MazamaSpatialUtils)

sm13 <- wrcc_createMonitorObject(20150101, 20151231, unitID = 'sm13')
sm13$meta[,c('stateCode','countyName','siteName','monitorID')]
Deschutes <- monitor_subset(sm13, monitorIDs='lon_.121.453_lat_43.878_wrcc.sm13')
Deschutes <- monitor_trim(Deschutes)
monitor_dailyBarplot(Deschutes)

## End(Not run)
```

---

monitor_writeCSV *Write monitor data as CSV*

Description

Prints out the contents of the `ws_monitor` object as CSV. By default, the output is a text string with "human readable" CSV that includes both `meta` and `data`. When saved as a file, this format is useful for point-and-click spreadsheet users who want to have everything on a single sheet.

To obtain machine parseable CSV strings you can use `metaOnly` or `dataOnly` which are mutually exclusive but which return CSV strings that can be automatically ingested.

By default, the CSV formatted text is returned invisibly but not saved to a file unless `saveFile` is specified.

Usage

```
monitor_writeCSV(
  ws_monitor,
  saveFile = NULL,
  metaOnly = FALSE,
  dataOnly = FALSE,
  quietly = TRUE
)
```

Arguments

ws_monitor	*ws_monitor* object
saveFile	optional filename where CSV will be written
metaOnly	flag specifying whether to return ws_monitor$meta only as a machine parseable CSV
dataOnly	flag specifying whether to return ws_monitor$data only as a machine parseable CSV
quietly	do not print to console, just return the string representation of the CSV

Note

This function wraps the monitor_print function but defaults to quietly = FALSE.

Examples

```
library(PWFSLSmoke)

data("Carmel_Valley")
Carmel_Valley <- monitor_subset(Carmel_Valley, tlim = c(20160802,20160803))

monitor_print(Carmel_Valley)
monitor_print(Carmel_Valley, metaOnly = TRUE)
monitor_print(Carmel_Valley, dataOnly = TRUE)
```

---

monitor_writeCurrentStatusGeoJSON

Write current monitor data to geojson file

Description

Writes a geoJSON file containing current monitor data. For details on what is included, see monitor_getCurrentStatus.

Usage

```
monitor_writeCurrentStatusGeoJSON(
  ws_monitor,
  filename,
  datetime = lubridate::now(tzone = "UTC"),
  properties = NULL,
  propertyNames = NULL,
  metadataList = list()
)
```

Arguments

ws_monitor	*ws_monitor* object.
filename	Filename where geojson file will be saved.
datetime	Time to which data will be 'current' (integer or character representing YYYYMMDDHH or POSIXct. If not POSIXct, interpreted as UTC time). So if datetime is 3 hours ago, a dataframe with the most current data from 3 hours ago will be returned.
properties	Optional character vector of properties to include for each monitor in geoJSON. If NULL all are included. May include any ws_monitor metadata and additional columns generated in monitor_getCurrentStatus.
propertyNames	Optional character vector supplying custom names for properties in geoJSON. If NULL or different length than properties defaults will be used.
metadataList	List of top-level foreign members to include. May include nested lists as long as they can be converted into JSON using jsonlite::toJSON(). For more information on what can be included see https://tools.ietf.org/html/rfc7946#section-6.1.

Value

Invisibly returns geoJSON string.

Examples

```
library(PWFSLSmoke)

wa <-
  monitor_loadLatest() %>%
  monitor_subset(stateCodes = "WA")

geojson_file <- tempfile(fileext = ".geojson")
wa_current_geojson <- monitor_writeCurrentStatusGeoJSON(wa, geojson_file)
wa_current_list <- jsonlite::fromJSON(wa_current_geojson)
wa_spdf <- rgdal::readOGR(dsn = geojson_file)
map("state", "washington")
points(wa_spdf)
```

Northwest_Megafires *Northwest Megafires Example Dataset*

Description

In the summer of 2015 Washington state had several catastrophic wildfires that led to many days of heavy smoke in eastern Washington, Oregon and northern Idaho. The Northwest_Megafires dataset contains AirNow ambient monitoring data for the Pacific Northwest from May 31 through November 01, 2015 (UTC). Data are stored as a *ws_monitor* object and are used in many examples in the package documentation.

Format

A list with two elements

Details

Northwest_Megafires example dataset

`rawPlot_pollutionRose` *Create Pollution Rose Plot from a Raw Dataframe*

Description

Create pollution rose plot from an enhanced raw dataframe. This function is based on `openair::pollutionRose()`. If normalized, black line indicates frequency by direction.

Usage

```
rawPlot_pollutionRose(
  df,
  parameter = "pm25",
  tlim = NULL,
  localTime = TRUE,
  normalize = FALSE,
  ...
)
```

Arguments

`df`	enhanced, raw dataframe as created by the `raw_enhance()` function
`parameter`	parameter to plot
`tlim`	optional vector with start and end times (integer or character representing YYYYMMDD[HH])
`localTime`	logical specifying whether `tlim` is in local time or UTC
`normalize`	normalize slices to fill entire area, allowing for easier comparison of counts of magnitudes by direction
`...`	additional arguments to pass on to openair::pollutionRose()

Note

If more than one timezone is found, `localTime` is ignored and UTC is used.

Examples

```
## Not run:
raw <- airsis_createRawDataframe(20160901, 20161015, 'USFS', 1012)
raw <- raw_enhance(raw)
rawPlot_pollutionRose(raw)

## End(Not run)
```

---

rawPlot_timeOfDaySpaghetti

Create Time of Day Spaghetti Plot from a Raw Dataframe

Description

Spaghetti Plot that shows data by hour-of-day.

Usage

```
rawPlot_timeOfDaySpaghetti(
  df,
  parameter = "pm25",
  tlim = NULL,
  shadedNight = TRUE,
  meanCol = "black",
  meanLwd = 4,
  meanLty = 1,
  highlightDates = c(),
  highlightCol = "dodgerblue",
  ...
)
```

Arguments

df	enhanced, raw dataframe as created by the raw_enhance() function
parameter	variable to be plotted
tlim	optional vector with start and end times (integer or character representing YYYYMMDD[HH])
shadedNight	add nighttime shading
meanCol	color used for the mean line (use NA to omit the mean)
meanLwd	line width used for the mean line
meanLty	line type used for the mean line
highlightDates	dates to be highlighted in YYYYMMDD format
highlightCol	color used for highlighted days
...	additional graphical parameters are passed to the lines() function for day lines

Examples

```
## Not run:
raw <- airsis_createRawDataframe(20160901, 20161015, 'USFS', 1012)
raw <- raw_enhance(raw)
rawPlot_timeOfDaySpaghetti(raw,parameter="temperature")

## End(Not run)
```

`rawPlot_timeseries` *Create Timeseries Plot from a Raw Dataframe*

Description

Creates a plot of raw monitoring data as generated using raw_enhance().

Other options for `parameter` include `"temperature"`,`"humidity"`,`"windSpeed"`,`"windDir"`,`"pressure"` or any of the other raw parameters (try `names(df)` to see list of options)

Usage

```
rawPlot_timeseries(
  df,
  parameter = "pm25",
  tlim = NULL,
  localTime = TRUE,
  shadedNight = TRUE,
  shadedBackground = NULL,
  sbLwd = 1,
  add = FALSE,
  gridPos = "",
  gridCol = "black",
  gridLwd = 1,
  gridLty = "solid",
  dayLwd = 0,
  hourLwd = 0,
  hourInterval = 6,
  ...
)
```

Arguments

`df`	enhanced, raw dataframe as created by the raw_enhance() function
`parameter`	raw parameter to plot
`tlim`	optional vector with start and end times (integer or character representing YYYYMMDD[HH])
`localTime`	logical specifying whether `tlim` is in local time or UTC
`shadedNight`	add nighttime shading

shadedBackground	add vertical lines for a second parameter
sbLwd	shaded background line width
add	logical specifying whether to add to the current plot
gridPos	position of grid lines either 'over', 'under' or '' for no grid lines
gridCol	grid line color
gridLwd	grid line width
gridLty	grid line type
dayLwd	day marker line width
hourLwd	hour marker line width
hourInterval	interval for grid (max=12)
...	additional arguments to pass to lines() function

Details

Note that for multiple deployments, shadedNight defaults to use the lat/lon for the first deployment, which in theory could be somewhat unrepresentative, such as if deployments have a large range in latitude.

Note

If more than one timezone is found, localTime is ignored and UTC is used.

---

rawPlot_windRose *Create Wind Rose Plot from a Raw Dataframe*

Description

Create wind rose plot from raw_enhance object. Based on openair::windRose().

Usage

```
rawPlot_windRose(df, tlim = NULL, localTime = TRUE, ...)
```

Arguments

df	enhanced, raw dataframe as created by the raw_enhance() function
tlim	optional vector with start and end times (integer or character representing YYYYMMDD[HH])
localTime	logical specifying whether tlim is in local time or UTC
...	additional arguments to pass on to openair::windRose()

Note

If more than one timezone is found, localTime is ignored and UTC is used.

Examples

```
## Not run:
raw <- airsis_createRawDataframe(20160901, 20161015, provider='USFS', unitID=1012)
raw <- raw_enhance(raw)
rawPlot_windRose(raw)

## End(Not run)
```

---

raw_enhance *Process Raw Monitoring Data to Create raw_enhance Object*

Description

Processes raw monitor data to add a uniform time axis and consistent data columns that can be handled by various raw~ functions. All original raw data is retained, and the following additional columns are added:

- dataSource
- longitude
- latitude
- temperature
- humidity
- windSpeed
- windDir
- pressure
- pm25

The datetime column in the incoming dataframe may have missing hours. This time axis is expanded to a uniform, hourly axes with missing data fields added for data columns.

Usage

```
raw_enhance(df)
```

Arguments

df	raw monitor data, as created by airsis_createRawDataframe or wrcc_createRawDataframe

Value

Dataframe with original raw data, plus new columns with raw naming scheme for downstream use.

Examples

```
## Not run:
library(PWFSLSmoke)
df <- airsis_createRawDataframe(startdate=20160901, enddate=20161015, provider='USFS', unitID=1012)
df <- raw_enhance(df)
rawPlot_timeseries(df, tlim=c(20160908,20160917))

## End(Not run)
```

---

raw_getHighlightDates *Return Day Stamps for Values Above a Threshold*

Description

Returna list of dates in YYYYMMDD format where the dataVar is within highlightRange.

Usage

```
raw_getHighlightDates(
  df,
  dataVar,
  tzone = NULL,
  highlightRange = c(1e+12, Inf)
)
```

Arguments

df	dataframe with datetime column in UTC
dataVar	variable to be evaluated
tzone	timezone where data were collected
highlightRange	range of values of to be highlighted

Examples

```
## Not run:
raw <- airsis_createRawDataframe(startdate = 20160901, provider = 'USFS',unitID = '1033')
raw <- raw_enhance(raw)
highlightRange <- c(50,Inf)
dataVar <- 'pm25'
tzone <- "America/Los_Angeles"
highlightDates <- raw_getHighlightDates(raw,dataVar,tzone,highlightRange)
rawPlot_timeOfDaySpaghetti(df=raw,highlightDates = highlightDates)

## End(Not run)
```

setEsriToken *Set ESRI Token*

Description

Sets the current esriToken.

Usage

```
setEsriToken(token)
```

Arguments

token	ESRI token used when interacting with ESRI location services

Value

Silently returns previous value of esriToken.

See Also

addEsriAddress

getEsriToken

esriToken

setGoogleApiKey *Set Google API Key*

Description

Sets the current Google API key.

Usage

```
setGoogleApiKey(key)
```

Arguments

key	Google API key used when interacting with Google location services

Value

Silently returns previous value of googleApiKey.

See Also

addGoogleAddress

addGoogleElevation

getGoogleApiKey

googleApiKey

`skill_confusionMatrix` *Confusion Matrix Statistics*

Description

Measurements of categorical forecast accuracy have a long history in weather forecasting. The standard approach involves making binary classifications (detected/not-detected) of predicted and observed data and combining them in a binary contingency table known as a *confusion matrix*.

This function creates a `confusion matrix` from predicted and observed values and calculates a wide range of common statistics including:

- TP (true postive)
- FP (false postive) (type I error)
- FN (false negative) (type II error)
- TN (true negative)
- TPRate (true positive rate) = sensitivity = recall = TP / (TP + FN)
- FPRate (false positive rate) = FP / (FP + TN)
- FNRate (false negative rate) = FN / (TP + FN)
- TNRate (true negative rate) = specificity = TN / (FP + TN)
- accuracy = proportionCorrect = (TP + TN) / total
- errorRate = 1 - accuracy = (FP + FN) / total
- falseAlarmRatio = PPV (positive predictive value) = precision = TP / (TP + FP)
- FDR (false discovery rate) = FP / (TP + FP)
- NPV (negative predictive value) = TN / (TN + FN)
- FOR (false omission rate) = FN / (TN + FN)
- f1_score = (2 * TP) / (2 * TP + FP + FN)
- detectionRate = TP / total
- baseRate = detectionPrevalence = (TP + FN) / total
- probForecastOccurance = prevalence = (TP + FP) / total
- balancedAccuracy = (TPRate + TNRate) / 2
- expectedAccuracy = (((TP + FP) * (TP + FN) / total) + ((FP + TN) * sum(FN + TN) / total)) / total
- heidkeSkill = kappa = (accuracy - expectedAccuracy) / (1 - expectedAccuracy)

- bias = (TP + FP) / (TP + FN)
- hitRate = TP / (TP + FN)
- falseAlarmRate = FP / (FP + TN)
- pierceSkill = ((TP * TN) - (FP * FN)) / ((FP + TN) * (TP + FN))
- criticalSuccess = TP / (TP + FP + FN)
- oddsRatioSkill = yulesQ = ((TP * TN) - (FP * FN)) / ((TP * TN) + (FP * FN))

Usage

```
skill_confusionMatrix(
  predicted,
  observed,
  FPCost = 1,
  FNCost = 1,
  lightweight = FALSE
)
```

Arguments

predicted	logical vector of predicted values
observed	logical vector of observed values
FPCost	cost associated with false positives (type I error)
FNCost	cost associated with false negatives (type II error)
lightweight	flag specifying creation of a return list without derived metrics

Value

List containing a table of confusion matrix values and a suite of derived metrics.

References

Simple Guide to Confusion Matrix Terminology

See Also

skill_ROC

skill_ROCPlot

Examples

```
predicted <- sample(c(TRUE,FALSE), 1000, replace=TRUE, prob=c(0.3,0.7))
observed <- sample(c(TRUE,FALSE), 1000, replace=TRUE, prob=c(0.3,0.7))
cm <- skill_confusionMatrix(predicted, observed)
print(cm)
```

skill_ROC *ROC Curve*

Description

This function calculates an ROC dataframe of TPR, FPR, and Cost for a range of thresholds as well as the area under the ROC curve.

Usage

```
skill_ROC(predicted, observed, t1Range = NULL, t2 = NULL, n = 101)
```

Arguments

predicted	vector of predicted values (or a *ws_monitor* object with a single location)
observed	vector of observed values (or a *ws_monitor* object with a single location)
t1Range	lo and high values used to generate test thresholds for classifying predicted data
t2	used to classify observed data
n	number of test thresholds in ROC curve

Value

List containing an roc matrix and the auc area under the ROC curve.

References

Receiver Operating Characteristic

See Also

skill_confusionMatrix

skill_ROCPlot

Examples

```
## Not run:
# Napa Fires -- October, 2017
ca <- airnow_loadAnnual(2017) %>%
  monitor_subset(tlim = c(20171001,20171101), stateCodes = 'CA')
Vallejo <- monitor_subset(ca, monitorIDs = '060950004_01')
Napa <- monitor_subset(ca, monitorIDs = '060550003_01')
t2 <- AQI$breaks_24[4] # 'Unhealthy'
rocList <- skill_ROC(Vallejo, Napa, t1Range = c(0,100), t2 = t2)
roc <- rocList$roc
auc <- rocList$auc
plot(roc$TPR ~ roc$FPR, type = 'S')
```

```
title(paste0('Area Under Curve = ', format(auc,digits = 3)))

## End(Not run)
```

`skill_ROCPlot` *ROC Plot*

Description

This function plots ROC curves for a variety of `observed` classification thresholds.

Usage

```
skill_ROCPlot(
  predicted,
  observed,
  t1Range = c(0, 100),
  t2s = seq(10, 100, 10),
  n = 101,
  colors = grDevices::rainbow(length(t2s))
)
```

Arguments

`predicted`	vector of predicted values (or a *ws_monitor* object with a single location)
`observed`	vector of observed values (or a *ws_monitor* object with a single location)
`t1Range`	lo and high values used to generate test thresholds for classifying `predicted` data
`t2s`	vector of thresholds used to classify `observed` data
`n`	number of test thresholds in ROC curve
`colors`	vector of colors used when plotting curves

References

Receiver Operating Characteristic

See Also

skill_confusionMatrix

skill_ROC

Examples

```
## Not run:
# Napa Fires -- October, 2017
ca <- airnow_loadAnnual(2017) %>%
  monitor_subset(tlim = c(20171001,20171101), stateCodes = 'CA')
Vallejo <- monitor_subset(ca, monitorIDs = '060950004_01')
Napa <- monitor_subset(ca, monitorIDs = '060550003_01')
skill_ROCPlot(Vallejo, Napa)

## End(Not run)
```

`staticmap_getEsrimapBrick` *Create a rasterBrick from an Esri tiled image server*

Description

Uses the input coordinates to fetch and composite a raster from the tile server. Returns a `raster::rasterBrick` object. This can then passed as the `rasterBrick` object to the `staticmap_plotRasterBrick()` function for plotting.

As of July 2019, this list is a handy reference to the freely available tile servers which can be previewed at the following URL:

https://leaflet-extras.github.io/leaflet-providers/preview/

Usage

```
staticmap_getEsrimapBrick(
  centerLon = NULL,
  centerLat = NULL,
  maptype = "world_topo",
  zoom = 12,
  width = 640,
  height = 640,
  bbox = NULL,
  maxTiles = 20,
  crs = sp::CRS("+init=epsg:4326"),
  tileCacheDir = tempdir()
)
```

Arguments

`centerLon`	Map center longitude.
`centerLat`	Map center latitude.
`maptype`	Selects the appropriate Esri tile server. Options include: • "world_topo"

- "world_imagery"
- "world_terrain"
- "de_Lorme"
- "world_grey"
- "world_streets"

zoom	map Zoom level.
width	Width of image, in pixels.
height	Height of image, in pixels.
bbox	Bounding box vector (lonLo, latLo, lonHi, latHi). If not null, centerLon, centerLat, and zoom are ignored.
maxTiles	Maximum number of tiles to be returned. The greater the number, the slower the performance – arbitrarily set to 20 by default.
crs	Object of class CRS. The Coordinate Reference System (CRS) for the returned map. If the CRS of the downloaded map does not match, it will be projected to the specified CRS using raster::projectRaster.
tileCacheDir	Optional location for cached tiles.

Value

A rasterBrick object which can be plotted with staticmap_plotRasterBrick() or raster::plotRGB() and serve as a base plot.

Note

The spatial reference of the image when it is downloaded is 3857. If the crs argument is different, projecting may cause the size and extent of the image to differ very slightly from the input, on a scale of 1-2 pixels or 10^-3 degrees.

If bbox is specified and the bbox aspect ratio does not match the width/height aspect ratio the extent is resized to prevent the map image from appearing stretched, so the map extent may not match the bbox argument exactly.

If both zoom and maxTiles are specified, maxTiles takes precedence. To get a specified zoom level, set maxTiles = NULL.

See Also

staticmap_getRasterBrick

staticmap_plotRasterBrick

Examples

```
## Not run:
rasterBrick <- staticmap_getEsrimapBrick(-122.3318, 47.668)
staticmap_plotRasterBrick(rasterBrick)

## End(Not run)
```

staticmap_getRasterBrick

Create a rasterBrick from a tiled image server

Description

Uses the input coordinates to select an appropriate method to build a `raster::rasterBrick` object. It will either use the `staticmap_getStamenmapBrick()` function or the `staticmap_getEsrimapBrick()` function This can then passed as the `rasterBrick` object to the `staticmap_plotRasterBrick()` function for plotting.

Usage

```
staticmap_getRasterBrick(
  centerLon = NULL,
  centerLat = NULL,
  maptype = "world_topo",
  zoom = 12,
  width = 640,
  height = 640,
  bbox = NULL,
  maxTiles = 40,
  crs = sp::CRS("+init=epsg:4326"),
  tileCacheDir = tempdir()
)
```

Arguments

`centerLon`	Map center longitude.
`centerLat`	Map center latitude.
`maptype`	Defaults to Esri Topographic Available to select between Stamen basemaps or Esri basemaps. **Stamen** • terrain • terrain-background • terrain-labels • terrain-lines • toner • toner-background • toner-hybrid • toner-labels • toner-labels • toner-lines

- toner-lite
- watercolor

Esri

- "world_topo"
- "world_imagery"
- "world_terrain"
- "de_Lorme"
- "world_grey"
- "world_streets"

`zoom` Map zoom level.

`width` Width of image, in pixels.

`height` Height of image, in pixels.

`bbox` If you are using the Esri maps, then the `bbox` parameter must be an `st_bbox` object as specificed in the `sf` package documentation https://www.rdocumentation.org/packages/sf/versions/0.7-4/topics/st_bbox. If using Stamen Maps, use a vector organized as (lonLo, latLo, lonHi, latHi) If not null, `centerLon`, `centerLat`, and `zoom` are ignored.

`maxTiles` Only utilized if selecting an esri basemap, specifies the maximum number of tiles to be returned. The greater the number, the slower the performance – arbitrarily set to 20 by default.

`crs` Object of class CRS. The Coordinate Reference System (CRS) for the returned map. If the CRS of the downloaded map does not match, it will be projected to the specified CRS using `raster::projectRaster`.

`tileCacheDir` Optional location for cached tiles.

Value

A rasterBrick object which can be plotted with `staticmap_plotRasterBrick()` or `raster::plotRGB()` and serve as a base plot.

Note

The spatial reference of the image when it is downloaded is 3857. If the crs argument is different, projecting may cause the size and extent of the image to differ very slightly from the input, on a scale of 1-2 pixels or 10^-3 degrees.

If bbox is specified and the bbox aspect ratio does not match the width/height aspect ratio the extent is resized to prevent the map image from appearing stretched, so the map extent may not match the bbox argument exactly.

See Also

`staticmap_getStamenmapBrick`

`staticmap_getEsrimapBrick`

`staticmap_plotRasterBrick`

Examples

```
## Not run:
rasterBrick <- staticmap_getRasterBrick(-122.3318, 47.668)
staticmap_plotRasterBrick(rasterBrick)

## End(Not run)
## Not run:
rasterBrick <- staticmap_getRasterBrick(-122.3318, 47.668, "world_streets", 12)
staticmap_plotRasterBrick(rasterBrick)

## End(Not run)
## Not run:
rasterBrick <- staticmap_getRasterBrick(-122.3318, 47.668, "watercolor", 12)
staticmap_plotRasterBrick(rasterBrick)

## End(Not run)
```

`staticmap_getStamenmapBrick`

Create a rasterBrick from stamenmap tiles

Description

Downloads a PNG from the stamenmap tile server and creates a `raster::rasterBrick` object with layers for red, green, and blue. This can then passed as the `rasterBrick` object to the `staticmap_plotRasterBrick()` function for plotting.

Stamen maps tiles are freely available (April, 2019) and are described at the following URL:

http://maps.stamen.com/#terrain/12/37.7706/-122.3782

"These tiles are made available as part of the CityTracking project, funded by the Knight Foundation, in which Stamen is building web services and open source tools to display public data in easy-to-understand, highly visual ways."

Usage

```
staticmap_getStamenmapBrick(
  centerLon = NULL,
  centerLat = NULL,
  maptype = "terrain",
  zoom = 12,
  width = 640,
  height = 640,
  bbox = NULL,
  crs = sp::CRS("+init=epsg:4326"),
  tileCacheDir = tempdir()
)
```

Arguments

centerLon	map center longitude
centerLat	map center latitude
maptype	map type
zoom	map zoom level; corresponds to ggmap::get_map() zoom level
width	width of image, in pixels
height	height of image, in pixels
bbox	bounding box vector (lonLo, latLo, lonHi, latHi). If not null, centerLon, centerLat, and zoom are ignored.
crs	object of class CRS. The Coordinate Reference System (CRS) for the returned map. If the CRS of the downloaded map does not match, it will be projected to the specified CRS using raster::projectRaster.
tileCacheDir	Optional location for cached tiles.

Value

A rasterBrick object which can be plotted with staticmap_plotRasterBrick() or raster::plotRGB() and serve as a base plot.

Note

The spatial reference of the image when it is downloaded is 3857. If the crs argument is different, projecting may cause the size and extent of the image to differ very slightly from the input, on a scale of 1-2 pixels or 10^-3 degrees.

If bbox is specified and the bbox aspect ratio does not match the width/height aspect ratio the extent is resized to prevent the map image from appearing stretched, so the map extent may not match the bbox argument exactly.

See Also

staticmap_getRasterBrick

staticmap_plotRasterBrick

Examples

```
## Not run:
rasterBrick <- staticmap_getStamenmapBrick(-122.3318, 47.668)
staticmap_plotRasterBrick(rasterBrick)

## End(Not run)
```

staticmap_plotRasterBrick *Plot an RGB rasterBrick*

Description

Plots the incoming `rasterBrick`.

Usage

```
staticmap_plotRasterBrick(rasterBrick = NULL, grayscale = FALSE, ...)
```

Arguments

`rasterBrick`	an RGB rasterBrick object. It is assumed that layer 1 represents red, layer 2 represents green, and layer 3 represents blue.
`grayscale`	logical specifying conversion to grayscale
`...`	arguments passed on to `raster::plot()` (for `grayscale = TRUE`) or `raster::plotRGB()` (for `grayscale = FALSE`)

See Also

`staticmap_getStamenmapBrick`

Examples

```
## Not run:
rasterBrick <- staticmap_getStamenmapBrick(-122.3318, 47.668)
staticmap_plotRasterBrick(rasterBrick)
staticmap_plotRasterBrick(rasterBrick, grayscale = TRUE)

## End(Not run)
```

---

tidy_toMonitor *Convert 'ws_tidy' data to a 'ws_monitor' object*

Description

Changes read-optomized 'tidy' formatted monitor data into a write-optomized 'ws_monitor' format. If the given data is already a 'ws_monitor' object, it is returned as is. This function is the inverse of `monitor_toTidy`.

Usage

```
tidy_toMonitor(data = NULL)
```

Arguments

data	Data to potentially convert.

Value

'ws_monitor' object

Examples

```
ws_monitor <- monitor_subset(
  Northwest_Megafires,
  monitorIDs = c('530470009_01', '530470010_01')
)

ws_monTidy <- monitor_toTidy(ws_monitor)
ws_monMon <- tidy_toMonitor(ws_monTidy)
head(ws_monMon$data)
head(ws_monitor$data)
```

---

timeInfo *Get time related information*

Description

Calculate the local time at the target location, as well as sunrise, sunset and solar noon times, and create several temporal masks.

If the `timezone` is provided it will be used. Otherwise, the **MazamaSpatialUtils** package will be used to determine the timezone from `longitude` and `latitude`.

The returned dataframe will have as many rows as the length of the incoming UTC `time` vector and will contain the following columns:

- `localStdTime_UTC` – UTC representation of local **standard** time
- `daylightSavings` – logical mask = TRUE if daylight savings is in effect
- `localTime` – local clock time
- `sunrise` – time of sunrise on each localTime day
- `sunset` – time of sunset on each localTime day
- `solarnoon` – time of solar noon on each localTime day
- `day` – logical mask = TRUE between sunrise and sunset
- `morning` – logical mask = TRUE between sunrise and solarnoon
- `afternoon` – logical mask = TRUE between solarnoon and sunset
- `night` – logical mask = opposite of day

Usage

```
timeInfo(time = NULL, longitude = NULL, latitude = NULL, timezone = NULL)
```

Arguments

time	POSIXct vector with specified timezone,
longitude	Longitude of the location of interest.
latitude	Latitude of the location of interest.
timezone	Olson timezone at the location of interest.

Details

While the **lubridate** package makes it easy to work in local timezones, there is no easy way in R to work in "Local Standard Time" (LST) as is often required when working with air qualitiy data. EPA regulations mandate that daily averages be calculated based on LST.

The localStdTime_UTC column in the returned dataframe is primarily for internal use and provides an important tool for creating LST daily averages and LST axis labeling.

Value

A dataframe with times and masks.

Examples

```
carmel <- monitor_subset(Carmel_Valley, tlim = c(20160801,20160810))

# Create timeInfo object for this monitor
ti <- timeInfo(
  carmel$data$datetime,
  carmel$meta$longitude,
  carmel$meta$latitude,
  carmel$meta$timezone
)

# Subset the data based on day/night masks
data_day <- carmel$data[ti$day,]
data_night <- carmel$data[ti$night,]

# Build two monitor objects
carmel_day <- list(meta = carmel$meta, data = data_day)
carmel_night <- list(meta = carmel$meta, data = data_night)

# Plot them
monitor_timeseriesPlot(carmel_day, shadedNight = TRUE, pch = 8, col = 'goldenrod')
monitor_timeseriesPlot(carmel_night, pch = 16, col = 'darkblue', add = TRUE)
```

upgradeMeta_v1.0 *Upgrade ws_monitor Metadata to Version 1.0*

Description

Upgrade a *ws_monitor* object to version 1.0 standards.

Usage

```
upgradeMeta_v1.0(ws_monitor)
```

Arguments

ws_monitor	*ws_monitor* object

Value

A *ws_monitor* object with version 1.0 metadata.

US_52 *US State Codes*

Description

State codes for the 50 states +DC +PR (Puerto Rico)

Usage

```
US_52
```

Format

A vector with 52 elements

Details

US state codes

WRCC *WRCC Monitor Names and Unit IDs*

Description

The WRCC https://wrcc.dri.edu/cgi-bin/smoke.plFire Cache Smoke Monitor Archive provides access to a variety of monitors that can be accessed with the wrcc_createMonitorObject function. Use of this funciton requires a valid unitID. The WRCC object is a list of lists. The element named unitIDs is itself a list of three named vectors, each containing the unitIDs and associated names for one of the categories of monitors available at WRCC:

- cache
- miscellaneous
- usfs_regional

Format

A list of lists

Details

WRCC monitor names and unitIDs

Note

This list of monitor IDs relfects unitIDs found on the WRCC site on June 12, 2019.

---

wrcc_createDataDataframe

Create WRCC data dataframe

Description

After quality control has been applied to an WRCC tibble, we can extract the PM2.5 values and store them in a data tibble organized as time-by-deployment (aka time-by-site).

The first column of the returned dataframe is named 'datetime' and contains a POSIXct time in UTC. Additional columns contain data for each separate deployment of a monitor.

Usage

```
wrcc_createDataDataframe(tbl, meta)
```

Arguments

tbl	single site WRCC tibble created by wrcc_clustering()
meta	WRCC meta datafra,e created by wrcc_createMetaDataframe()

Value

A data dataframe for use in a *ws_monitor* object.

`wrcc_createMetaDataframe`

Create WRCC site location metadata dataframe

Description

After a WRCC tibble has been enhanced with additional columns generated by `addClustering` we are ready to pull out site information associated with unique deployments.

These will be rearranged into a dataframe organized as deployment-by-property with one row for each monitor deployment.

This site information found in `tbl` is augmented so that we end up with a uniform set of properties associated with each monitor deployment. The list of columns in the returned `meta` dataframe is:

```
> names(p$meta)
 [1] "monitorID"             "longitude"             "latitude"
 [4] "elevation"             "timezone"              "countryCode"
 [7] "stateCode"             "siteName"              "agencyName"
[10] "countyName"            "msaName"               "monitorType"
[13] "monitorInstrument"     "aqsID"                 "pwfslID"
[16] "pwfslDataIngestSource" "telemetryAggregator"   "telemetryUnitID"
```

Usage

```
wrcc_createMetaDataframe(
  tbl,
  unitID = as.character(NA),
  pwfslDataIngestSource = "WRCC",
  existingMeta = NULL,
  addGoogleMeta = FALSE,
  addEsriMeta = FALSE
)
```

Arguments

`tbl`	single site WRCC tibble after metadata enhancement
`unitID`	character or numeric WRCC unit identifier
`pwfslDataIngestSource`	identifier for the source of monitoring data, e.g. `'WRCC'`
`existingMeta`	existing 'meta' dataframe from which to obtain metadata for known monitor deployments
`addGoogleMeta`	logicial specifying wheter to use Google elevation and reverse geocoding services
`addEsriMeta`	logicial specifying wheter to use ESRI elevation and reverse geocoding services

Value

A `meta` dataframe for use in a *ws_monitor* object.

See Also

`addMazamaMetadata`

`wrcc_createMonitorObject` *Obtain WRCC data and create ws_monitor object*

Description

Obtains monitor data from an WRCC webservice and converts it into a quality controlled, metadata enhanced *ws_monitor* object ready for use with all `monitor_~` functions.

Steps involved include:

1. download CSV text
2. parse CSV text
3. apply quality control
4. apply clustering to determine unique deployments
5. enhance metadata to include: elevation, timezone, state, country, site name
6. reshape data into deployment-by-property `meta` and and time-by-deployment `data` dataframes

QC parameters that can be passed in the `...` include the following valid data ranges as taken from `wrcc_EBAMQualityControl()`:

- `valid_Longitude=c(-180,180)`
- `valid_Latitude=c(-90,90)`
- `remove_Lon_zero = TRUE`
- `remove_Lat_zero = TRUE`
- `valid_Flow = c(16.7*0.95,16.7*1.05)`
- `valid_AT = c(-Inf,45)`
- `valid_RHi = c(-Inf,45)`
- `valid_Conc = c(-Inf,5000)`

Note that appropriate values for QC thresholds will depend on the type of monitor.

Usage

```
wrcc_createMonitorObject(
  startdate = strftime(lubridate::now(tzone = "UTC"), "%Y010100", tz = "UTC"),
  enddate = strftime(lubridate::now(tzone = "UTC"), "%Y%m%d23", tz = "UTC"),
  unitID = NULL,
  clusterDiameter = 1000,
  zeroMinimum = TRUE,
  baseUrl = "https://wrcc.dri.edu/cgi-bin/wea_list2.pl",
  saveFile = NULL,
  existingMeta = NULL,
  addGoogleMeta = FALSE,
  addEsriMeta = FALSE,
  ...
)
```

Arguments

startdate	desired start date (integer or character representing YYYYMMDD[HH])
enddate	desired end date (integer or character representing YYYYMMDD[HH])
unitID	station identifier (will be upcased)
clusterDiameter	diameter in meters used to determine the number of clusters (see addClustering)
zeroMinimum	logical specifying whether to convert negative values to zero
baseUrl	base URL for data queries
saveFile	optional filename where raw CSV will be written
existingMeta	existing 'meta' dataframe from which to obtain metadata for known monitor deployments
addGoogleMeta	logicial specifying wheter to use Google elevation and reverse geocoding services
addEsriMeta	logicial specifying wheter to use ESRI elevation and reverse geocoding services
...	additional parameters are passed to type-specific QC functions

Value

A *ws_monitor* object with WRCC data.

Note

The downloaded CSV may be saved to a local file by providing an argument to the saveFile parameter.

See Also

wrcc_downloadData

wrcc_parseData

wrcc_qualityControl

addClustering

wrcc_createMetaDataframe

wrcc_createDataDataframe

Examples

```
library(PWFSLSmoke)
initializeMazamaSpatialUtils()

sm13 <- wrcc_createMonitorObject(20150301, 20150831, unitID = 'sm13')
monitor_leaflet(sm13)
```

---

wrcc_createRawDataframe

Obtain WRCC data and parse into a tibble

Description

Obtains monitor data from a WRCC webservice and converts it into a quality controlled, metadata enhanced "raw" tibble ready for use with all raw_~ functions.

Steps involved include:

1. download CSV text
2. parse CSV text
3. apply quality control
4. apply clustering to determine unique deployments
5. enhance metadata to include: elevation, timezone, state, country, site name

Usage

```
wrcc_createRawDataframe(
  startdate = strftime(lubridate::now(tzone = "UTC"), "%Y010100", tz = "UTC"),
  enddate = strftime(lubridate::now(tzone = "UTC"), "%Y%m%d23", tz = "UTC"),
  unitID = NULL,
  clusterDiameter = 1000,
  baseUrl = "https://wrcc.dri.edu/cgi-bin/wea_list2.pl",
  saveFile = NULL,
  flagAndKeep = FALSE
)
```

Arguments

startdate	Desired start date (integer or character representing YYYYMMDD[HH]).
enddate	Desired end date (integer or character representing YYYYMMDD[HH]).
unitID	Station identifier (will be upcased).
clusterDiameter	Diameter in meters used to determine the number of clusters (see addClustering).
baseUrl	Base URL for data queries.
saveFile	Optional filename where raw CSV will be written.
flagAndKeep	Flag, rather then remove, bad data during the QC process.

Value

Raw tibble of WRCC data.

Note

The downloaded CSV may be saved to a local file by providing an argument to the saveFile parameter.

Monitor unitIDs can be found at https://wrcc.dri.edu/cgi-bin/smoke.pl.

References

Fire Cache Smoke Monitoring Archive

See Also

wrcc_downloadData

wrcc_parseData

wrcc_qualityControl

addClustering

Examples

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

tbl <- wrcc_createRawDataframe(20150701, 20150930, unitID = 'SM16')
dplyr::glimpse(tbl)

## End(Not run)
```

`wrcc_downloadData` *Download WRCC data*

Description

Request data from a particular station for the desired time period. Data are returned as a single character string containing the WRCC output.

Monitor unitIDs can be found at https://wrcc.dri.edu/cgi-bin/smoke.pl.

Usage

```
wrcc_downloadData(
  startdate = strftime(lubridate::now(tzone = "UTC"), "%Y010101", tz = "UTC"),
  enddate = strftime(lubridate::now(tzone = "UTC"), "%Y%m%d23", tz = "UTC"),
  unitID = NULL,
  baseUrl = "https://wrcc.dri.edu/cgi-bin/wea_list2.pl"
)
```

Arguments

`startdate`	desired start date (integer or character representing YYYYMMDD[HH])
`enddate`	desired end date (integer or character representing YYYYMMDD[HH])
`unitID`	station identifier (will be upcased)
`baseUrl`	base URL for data queries

Value

String containing WRCC output.

References

Fire Cache Smoke Monitoring Archive

Examples

```
## Not run:
fileString <- wrcc_downloadData(20150701, 20150930, unitID = 'SM16')
df <- wrcc_parseData(fileString)

## End(Not run)
```

`wrcc_EBAMQualityControl` *Apply Quality Control to raw WRCC EBAM tibble*

Description

Perform various QC measures on WRCC EBAM data.

The any numeric values matching the following are converted to `NA`

- `x < -900`
- `x == -9.9899`
- `x == 99999`

The following columns of data are tested against valid ranges:

- `Flow`
- `AT`
- `RHi`
- `ConcHr`

A `POSIXct` `datetime` column (UTC) is also added based on `DateTime`.

Usage

```
wrcc_EBAMQualityControl(
  tbl,
  valid_Longitude = c(-180, 180),
  valid_Latitude = c(-90, 90),
  remove_Lon_zero = TRUE,
  remove_Lat_zero = TRUE,
  valid_Flow = c(16.7 * 0.95, 16.7 * 1.05),
  valid_AT = c(-Inf, 45),
  valid_RHi = c(-Inf, 45),
  valid_Conc = c(-Inf, 5000),
  flagAndKeep = FALSE
)
```

Arguments

`tbl`	single site titbble created by `wrcc_parseData()`
`valid_Longitude`	range of valid Longitude values
`valid_Latitude`	range of valid Latitude values
`remove_Lon_zero`	flag to remove rows where Longitude == 0

remove_Lat_zero	flag to remove rows where Latitude == 0
valid_Flow	range of valid Flow values
valid_AT	range of valid AT values
valid_RHi	range of valid RHi values
valid_Conc	range of valid ConcHr values
flagAndKeep	flag, rather than remove, bad data during the QC process

Value

Cleaned up titbble of WRCC monitor data.

See Also

wrcc_qualityControl

---

wrcc_ESAMQualityControl

Apply Quality Control to raw WRCC E-Sampler tibble

Description

Perform various QC measures on WRCC EBAM data.

The any numeric values matching the following are converted to NA

- x < -900
- x == -9.9899
- x == 99999

The following columns of data are tested against valid ranges:

- Flow
- AT
- RHi
- ConcHr

A POSIXct datetime column (UTC) is also added based on DateTime.

Usage

```
wrcc_ESAMQualityControl(
  tbl,
  valid_Longitude = c(-180, 180),
  valid_Latitude = c(-90, 90),
  remove_Lon_zero = TRUE,
  remove_Lat_zero = TRUE,
  valid_Flow = c(1.999, 2.001),
  valid_AT = c(-Inf, 150),
  valid_RHi = c(-Inf, 55),
  valid_Conc = c(-Inf, 5000),
  flagAndKeep = FALSE
)
```

Arguments

`tbl`	single site tibble created by `wrcc_parseData()`
`valid_Longitude`	range of valid Longitude values
`valid_Latitude`	range of valid Latitude values
`remove_Lon_zero`	flag to remove rows where Longitude == 0
`remove_Lat_zero`	flag to remove rows where Latitude == 0
`valid_Flow`	range of valid Flow values
`valid_AT`	range of valid AT values
`valid_RHi`	range of valid RHi values
`valid_Conc`	range of valid ConcHr values
`flagAndKeep`	flag, rather than remove, bad data during the QC process

Value

Cleaned up tibble of WRCC monitor data.

See Also

`wrcc_qualityControl`

`wrcc_identifyMonitorType` *Identify WRCC monitor type*

Description

Examine the column names of the incoming character vector to identify different types of monitor data provided by WRCC.

The return is a list includes everything needed to identify and parse the raw data using `readr::read_tsv()`:

- `monitorType` – identification string
- `rawNames` – column names from the data (including special characters)
- `columnNames` – assigned column names (special characters repaced with '.')
- `columnTypes` – column type string for use with `readr::read_csv()`

The `monitorType` will be one of:

- `"WRCC_TYPE1"` – ???
- `"WRCC_TYPE2"` – ???
- `"UNKOWN"` – ???

Usage

```
wrcc_identifyMonitorType(fileString)
```

Arguments

`fileString`	character string containing WRCC data

Value

List including `monitorType`, `rawNames`, `columnNames` and `columnTypes`.

References

WRCC Fire Cache Smoke Monitor Archive

Examples

```
## Not run:
fileString <- wrcc_downloadData(20160701, 20160930, unitID='1307')
monitorTypeList <- wrcc_identifyMonitorType(fileString)

## End(Not run)
```

wrcc_load *Load Processed WRCC Monitoring Data*

Description

Please use `wrcc_loadAnnual` instead of this function. It will soon be deprecated.

Usage

```
wrcc_load(
  year = 2017,
  baseUrl = "https://haze.airfire.org/monitoring/WRCC/RData/"
)
```

Arguments

`year`	desired year (integer or character representing YYYY)
`baseUrl`	base URL for WRCC meta and data files

Value

A *ws_monitor* object with WRCC data.

wrcc_loadAnnual *Load annual WRCC monitoring data*

Description

Loads pre-generated .RData files containing annual WRCC data.

If `dataDir` is defined, data will be loaded from this local dirctory. Otherwise, data will be loaded from the monitoring data repository maintained by PWFSL.

The annual files loaded by this function are updated on the 15'th of each month and cover the period from the beginning of the year to the end of the last month.

For data during the last 45 days, use `wrcc_loadDaily()`.

For the most recent data, use `wrcc_loadLatest()`.

WRCC parameters include the following:

1. PM2.5

Available WRCC RData and associated log files can be seen at: https://haze.airfire.org/monitoring/WRCC/RData

Usage

```
wrcc_loadAnnual(
  year = NULL,
  parameter = "PM2.5",
  baseUrl = "https://haze.airfire.org/monitoring",
  dataDir = NULL
)
```

Arguments

year	Desired year (integer or character representing YYYY).
parameter	Parameter of interest.
baseUrl	Base URL for 'annual' WRCC data files.
dataDir	Local directory containing 'annual' data files.

Value

A *ws_monitor* object with WRCC data.

See Also

wrcc_loadDaily

wrcc_loadLatest

Examples

```
## Not run:
wrcc_loadAnnual(2017) %>%
  monitor_subset(stateCodes='MT', tlim=c(20170701,20170930)) %>%
  monitor_dailyStatistic() %>%
  monitor_timeseriesPlot(style = 'gnats', ylim=c(0,300), xpd=NA)
  addAQIStackedBar()
  addAQILines()
  title("Montana 2017 -- WRCC Daily Average PM2.5")

## End(Not run)
```

---

wrcc_loadDaily *Load recent WRCC monitoring data*

Description

Loads pre-generated .RData files containing recent WRCC data.

If `dataDir` is defined, data will be loaded from this local dirctory. Otherwise, data will be loaded from the monitoring data repository maintained by PWFSL.

The daily files loaded by this function are updated once a day, shortly after midnight and contain data for the previous 45 days.

For the most recent data, use `wrcc_loadLatest()`.

For data extended more than 45 days into the past, use `wrcc_loadAnnual()`.

WRCC parameters include the following:

1. PM2.5

Avaialble WRCC RData and associated log files can be seen at: https://haze.airfire.org/monitoring/WRCC/RData/latest

Usage

```
wrcc_loadDaily(
  parameter = "PM2.5",
  baseUrl = "https://haze.airfire.org/monitoring/latest/RData",
  dataDir = NULL
)
```

Arguments

`parameter`	Parameter of interest.
`baseUrl`	Base URL for 'daily' AirNow data files.
`dataDir`	Local directory containing 'daily' data files.

Value

A *ws_monitor* object with WRCC data.

See Also

`wrcc_loadAnnual`

`wrcc_loadLatest`

Examples

```
## Not run:
wrcc_loadDaily() %>%
  monitor_subset(stateCodes=CONUS) %>%
  monitor_map()

## End(Not run)
```

`wrcc_loadLatest` *Load most recent WRCC monitoring data*

Description

Loads pre-generated .RData files containing the most recent WRCC data.

If `dataDir` is defined, data will be loaded from this local dirctory. Otherwise, data will be loaded from the monitoring data repository maintained by PWFSL.

The files loaded by this function are updated multiple times an hour and contain data for the previous 10 days.

For daily updates covering the most recent 45 days, use `wrcc_loadDaily()`.

For data extended more than 45 days into the past, use `wrcc_loadAnnual()`.

WRCC parameters include the following:

1. PM2.5

Avaialble RData and associated log files can be seen at: https://haze.airfire.org/monitoring/WRCC/RData/latest

Usage

```
wrcc_loadLatest(
  parameter = "PM2.5",
  baseUrl = "https://haze.airfire.org/monitoring/latest/RData",
  dataDir = NULL
)
```

Arguments

`parameter`	Parameter of interest.
`baseUrl`	Base URL for 'daily' AirNow data files.
`dataDir`	Local directory containing 'daily' data files.

Value

A *ws_monitor* object with WRCC data.

See Also

`wrcc_loadAnnual`

`wrcc_loadDaily`

Examples

```
## Not run:
wrcc_loadLatest() %>%
  monitor_subset(stateCodes=CONUS) %>%
  monitor_map()

## End(Not run)
```

`wrcc_parseData` *Parse WRCC data string*

Description

Raw character data from WRCC are parsed into a tibble. The incoming `fileString` can be read in directly from WRCC using `wrcc_downloadData()` or from a local file using `readr::read_file()`.

The type of monitor represented by this fileString is inferred from the column names using `wrcc_identifyMonitorType()` and appropriate column types are assigned. The character data are then processed, read into a tibble and augmented in the following ways:

1. Spaces at the beginning and end of each line are moved.
2. All header lines beginning with ':' are removed.

Usage

```
wrcc_parseData(fileString)
```

Arguments

`fileString`	character string containing WRCC data

Value

Dataframe of WRCC raw monitor data.

References

Fire Cache Smoke Monitoring Archive

Examples

```
## Not run:
fileString <- wrcc_downloadData(20150701, 20150930, unitID = 'SM16')
tbl <- wrcc_parseData(fileString)

## End(Not run)
```

`wrcc_qualityControl` *Apply Quality Control to raw WRCC tibble*

Description

Various QC steps are taken to clean up the incoming raw tibble including:

1. Convert numeric missing value flags to `NA`.
2. Remove measurement records with values outside of valid ranges.

See the individual `wrcc_~QualityControl()` functions for details.

Usage

```
wrcc_qualityControl(tbl, ...)
```

Arguments

`tbl`	single site tibble created by `wrcc_downloadData()`
`...`	additional parameters are passed to type-specific QC functions

Value

Cleaned up tibble of WRCC monitor data.

See Also

`wrcc_EBAMQualityControl`

`wrcc_ESAMQualityControl`

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