Package 'rmet'

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Type Package

Title Download and Read Brazilian Meteorological Data from INMET

Version 0.3.0

Description Automates the download and processing of historical hourly weather data from automatic stations of the Brazilian National Institute of Meteorology (INMET). It provides the official station catalogue with an offline snapshot and nearest-station search, validated and resumable downloads that detect updated archives, and a fast parser for the formatting and encoding inconsistencies of raw CSV files across years. It returns analysis-ready data frames with standardized column names and UTC timestamps. It flags implausible values with transparent quality-control checks, reports data completeness, and builds daily summaries in each station's local time with explicit rules for incomplete days. Data are retrieved from <https://portal.inmet.gov.br/dadoshistoricos> and <https://apitempo.inmet.gov.br/estacoes/T>.

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`inmet_as_sf` *Convert stations or data to spatial points*

Description

Turns any data frame with `latitude` and `longitude` columns, such as the output of `inmet_stations()`, `inmet_nearest()`, `inmet_read()` or `inmet_daily()`, into an `sf` object for mapping and spatial joins. Requires the **sf** package.

Usage

```
inmet_as_sf(x, remove = FALSE)
```

Arguments

`x`	A data frame with numeric `latitude` and `longitude` columns.
`remove`	Drop the coordinate columns from the attributes.

Value

An `sf` data frame with point geometries in WGS 84 (EPSG:4326). Rows with missing coordinates are dropped with a warning.

Examples

```
if (requireNamespace("sf", quietly = TRUE)) {
  rs <- inmet_stations(state = "RS", source = "bundled")
  points <- inmet_as_sf(rs)
  plot(points["elevation"])
}
```

`inmet_cache_clear` *Clear the rmet cache*

Description

Clear the rmet cache

Usage

```
inmet_cache_clear(
  years = NULL,
  dest_dir = tools::R_user_dir("rmet", "cache"),
  ask = interactive(),
  catalog = FALSE
)
```

Arguments

`years`	Integer years to remove, or `NULL` for every archive.
`dest_dir`	Cache directory.
`ask`	Ask for confirmation before deleting.
`catalog`	Also remove the cached official station catalogue.

Value

Invisible `NULL`.

Examples

```
inmet_cache_clear(dest_dir = file.path(tempdir(), "rmet"), ask = FALSE)
```

inmet_cache_status *Inspect downloaded INMET archives*

Description

Inspect downloaded INMET archives

Usage

```
inmet_cache_status(dest_dir = tools::R_user_dir("rmet", "cache"))
```

Arguments

dest_dir	Cache directory used by inmet_download().

Value

A data frame with one row per cached year: archive path, size in MB, whether the ZIP is valid, whether a partial download exists, and when the archive was downloaded (UTC, if recorded). Returned invisibly when the cache is empty.

Examples

```
inmet_cache_status(dest_dir = file.path(tempdir(), "rmet"))
```

inmet_completeness *Data completeness by station and period*

Description

Summarises how complete hourly data are, to choose stations and periods before an analysis.

Usage

```
inmet_completeness(x, by = c("month", "year"), variables = NULL)
```

Arguments

x	A data frame as returned by inmet_read().
by	Period length: "month" (default) or "year". Periods are UTC calendar months or years.
variables	Measurement columns to assess. Defaults to all numeric measurement columns.

Details

The expected number of hours is the full length of the period, so periods only partly covered by `x` (for example, the current month, or a period cut by `start_date` in `inmet_read()`) show low completeness. Global radiation is missing at night at most stations, so its completeness is usually around 50 %.

Value

A data frame with one row per station and period: `station_code`, `period` (`"YYYY-MM"` or `"YYYY"`), `hours_expected` (hours in the period), `hours_present` (hourly records in `x`), and, for each variable, the percentage of the expected hours with a valid value. Values flagged by `inmet_qc()` do not count as valid.

See Also

`inmet_qc()`, `inmet_daily()`

Examples

```
inmet_completeness(rmet_example, variables = c("temp_dry_c", "precip_mm"))
```

---

inmet_daily *Daily summaries of hourly INMET data*

Description

Aggregates the hourly output of `inmet_read()` or `inmet_get()` into one row per station and local calendar day, handling the conventions of the source data correctly.

Usage

```
inmet_daily(x, tz = "auto", min_hours = 20L)
```

Arguments

`x`	A data frame as returned by `inmet_read()`, with at least a `datetime` column.
`tz`	Time zone defining the calendar day. `"auto"` (default) uses each station's own local time, from its state and longitude (see `inmet_timezone()`); this needs the `state` column. Otherwise, any name in `OlsonNames()`, for example `"America/Sao_Paulo"`, or `"UTC"` for UTC days.
`min_hours`	Minimum number of non-missing hourly values a variable needs on a given day; otherwise its daily value is `NA`. Local days have 24 hours (23 or 25 on daylight-saving transitions, which Brazil observed until 2019).

Details

INMET stamps every record with the end of the hour it describes, in UTC. A record is therefore assigned to the local day containing the *middle* of its hour (`datetime` minus 30 minutes): the value stamped 03:00 UTC, for example, describes 23:00 to 00:00 Brasilia time and belongs to the earlier day. Grouping with `as.Date(datetime)` instead would use UTC days, which in Brazil end at 21:00 or 22:00 local time.

Radiation is usually missing at night, so `radiation_mj_m2` does not use `min_hours`. It is the sum of the available values on days with at least `min_hours` hourly records, and `NA` otherwise; daytime gaps make it an underestimate.

The function does not itself check data quality, but values flagged by `inmet_qc()` (non-missing `<variable>_flag` columns) are left out of the daily statistics.

Value

A data frame with one row per station and day, sorted by station and date, containing the station identifiers, `date`, `time_zone`, `n_hours` (number of hourly records for that day) and the daily variables that can be computed from the columns present:

Column	Definition
`temp_max_c`	Maximum of `temp_max_prev_c` (or of `temp_dry_c` if absent)
`temp_min_c`	Minimum of `temp_min_prev_c` (or of `temp_dry_c` if absent)
`temp_mean_c`	Mean of `temp_dry_c`
`temp_dew_mean_c`	Mean of `temp_dew_c`
`humid_rel_mean_pct`	Mean of `humid_rel_pct`
`humid_rel_min_pct`	Minimum of `humid_rel_min_pct` (or of `humid_rel_pct`)
`precip_mm`	Sum of `precip_mm`
`pressure_station_mean_hpa`	Mean of `pressure_station_hpa`
`wind_speed_mean_ms`	Mean of `wind_speed_ms`
`wind_gust_max_ms`	Maximum of `wind_gust_ms`
`radiation_mj_m2`	Sum of positive `radiation_kjm2`, in MJ/m^2

Examples

```
daily <- inmet_daily(rmet_example)
head(daily[, c("date", "n_hours", "temp_max_c", "temp_min_c", "precip_mm")])

# after quality control, flagged hourly values are ignored
daily_qc <- inmet_daily(inmet_qc(rmet_example))
```

`inmet_download` *Download INMET historical data archives*

Description

Downloads annual ZIP archives (one per year, containing every automatic station) from INMET's historical data portal into a local cache.

Usage

```
inmet_download(
  years = .current_year(),
  dest_dir = tools::R_user_dir("rmet", "cache"),
  max_tries = 15L,
  quiet = FALSE,
  force = FALSE,
  check_updates = TRUE
)
```

Arguments

years	Integer vector of years to download. Archives start in 2000. Defaults to the current year.
dest_dir	Cache directory. It is created when necessary.
max_tries	Maximum attempts per year.
quiet	Suppress progress messages.
force	Download again even when a valid archive is cached.
check_updates	For cached archives of the current and previous year, ask the server whether a newer version exists and download it if so. INMET keeps appending data to these archives. Older years are never re-checked. Requires a (very small) request per recent year.

Details

Archives are written to `<year>.zip.part` and only renamed to `<year>.zip` after their size has been checked against the size reported by the server and the ZIP structure has been validated, so a partial file is never mistaken for a complete one. Interrupted downloads resume from where they stopped on the next call. A small `<year>.zip.meta` file records the server's version information.

The INMET server sends one archive at a time per client, so years are downloaded sequentially. Typical archives for recent years are 90 to 110 MB.

Value

Invisibly, a named character vector with the paths of the archives available after the call.

See Also

`inmet_get()`, `inmet_read()`, `inmet_cache_status()`

Examples

```
paths <- inmet_download(2023, dest_dir = file.path(tempdir(), "rmet"))
```

`inmet_extract` *Extract INMET archives*

Description

Copies the original station CSV files out of the annual archives, for use with other software.

Usage

```
inmet_extract(
  years,
  dest_dir = tools::R_user_dir("rmet", "cache"),
  out_dir = file.path(dest_dir, "csv"),
  stations = NULL,
  overwrite = FALSE,
  quiet = FALSE
)
```

Arguments

`years`	Integer years to extract.
`dest_dir`	Directory containing annual ZIP files.
`out_dir`	Destination directory.
`stations`	Optional station codes; only their files are extracted.
`overwrite`	Overwrite existing files.
`quiet`	Suppress progress messages.

Value

Invisibly, the paths of the extracted files.

Examples

```
cache <- file.path(tempdir(), "rmet")
inmet_download(2023, dest_dir = cache)
inmet_extract(2023, dest_dir = cache, out_dir = file.path(tempdir(), "csv"),
              stations = "A801")
```

inmet_get *Download and read INMET data in one call*

Description

The recommended high-level interface: downloads missing annual archives with `inmet_download()`, reuses valid cached files, and returns the result of `inmet_read()`.

Usage

```
inmet_get(
  years,
  stations = NULL,
  dest_dir = tools::R_user_dir("rmet", "cache"),
  tz = "UTC",
  variables = NULL,
  start_date = NULL,
  end_date = NULL,
  drop_empty = TRUE,
  max_tries = 15L,
  force = FALSE,
  check_updates = TRUE,
  quiet = FALSE
)
```

Arguments

`years`	Integer vector of years.
`stations`	Optional station codes, such as `"A801"`. Matching is case-insensitive. Use `inmet_stations()` or `inmet_nearest()` to find codes.
`dest_dir`	Directory containing `<year>.zip` archives.
`tz`	Output time zone. Defaults to `"UTC"`, the time standard used in the source files. Any name in `OlsonNames()` is accepted; only the display of the timestamps changes, not the instants they represent.
`variables`	Optional measurement columns to retain (see *Columns*). Identifier columns are always kept.
`start_date, end_date`	Optional inclusive date limits in `YYYY-MM-DD` format, interpreted in `tz`.
`drop_empty`	Drop hours in which every measurement is missing (default). INMET files contain such rows for periods when a station was not reporting. Use `FALSE` to keep them, for example to obtain a regular hourly grid.
`max_tries`	Maximum attempts per year.
`force`	Download again even when a valid archive is cached.

check_updates	For cached archives of the current and previous year, ask the server whether a newer version exists and download it if so. INMET keeps appending data to these archives. Older years are never re-checked. Requires a (very small) request per recent year.
quiet	Suppress progress messages.

Value

A data frame as documented in inmet_read().

See Also

inmet_daily(), inmet_stations(), inmet_nearest()

Examples

```
weather <- inmet_get(
  years = 2023,
  stations = "A801",
  variables = c("temp_dry_c", "precip_mm"),
  dest_dir = file.path(tempdir(), "rmet")
)
daily <- inmet_daily(weather)
```

---

inmet_nearest *Find the stations closest to a location*

Description

Ranks automatic stations by great-circle distance from a point.

Usage

```
inmet_nearest(latitude, longitude, n = 5L, ...)
```

Arguments

latitude, longitude	Coordinates of the location in decimal degrees (south and west are negative).
n	Number of stations to return.
...	Further arguments passed to inmet_stations(), for example status = "Operante" or source = "bundled".

Value

The rows of inmet_stations() for the n nearest stations, with an added distance_km column, closest first.

Examples

```
# Stations near Porto Alegre, from the bundled catalogue
inmet_nearest(-30.03, -51.23, n = 3, source = "bundled")
```

`inmet_qc` *Quality control of hourly INMET data*

Description

Flags implausible hourly values with simple, transparent checks. INMET publishes automatic-station data without consistency validation; these checks catch the most common errors (impossible values, sensor spikes, stuck sensors and internally inconsistent records) but are no substitute for checks tailored to an analysis.

Usage

```
inmet_qc(
  x,
  action = c("flag", "remove"),
  checks = c("range", "consistency", "spike", "persistence"),
  persistence_hours = 12L,
  quiet = FALSE
)
```

Arguments

`x`	A data frame as returned by `inmet_read()`.
`action`	`"flag"` (default) adds a `<variable>_flag` column for each checked variable, holding the names of the failed checks (separated by commas) or `NA`. `"remove"` sets flagged values to `NA` instead.
`checks`	Checks to run; any of `"range"`, `"consistency"`, `"spike"`, and `"persistence"` (see *Checks*).
`persistence_hours`	Minimum number of consecutive hours with an identical value for the persistence check.
`quiet`	Suppress the summary message.

Value

`x` with flag columns added (or flagged values removed). The attribute `qc_summary` is a data frame with the number and percentage of flagged values per variable and check.

Checks

- **range**: outside physical limits for Brazil, e.g. air temperature outside -15 to 48 degC, relative humidity outside 1 to 100 %, hourly precipitation outside 0 to 150 mm, station pressure outside 650 to 1060 hPa, or wind direction outside 0 to 360 degrees.
- **consistency**: hourly maximum below minimum (temperature, humidity, pressure; both flagged); air temperature outside the extremes of the hour it ends; dew point above air temperature; gust below mean wind speed. A tolerance of 0.5 units allows for rounding.
- **spike**: a value that departs from *both* adjacent hours in the same direction by more than 8 degC (air and dew-point temperature), 5 hPa (pressure) or 45 % (relative humidity). Changes that persist, such as a cold front, are not flagged.
- **persistence**: the same value in at least `persistence_hours` consecutive hours, for temperatures, humidity, pressure, wind and precipitation. Zero wind speed, zero precipitation, humidity of 90 % or more (fog, persistent rain, sensors that saturate below 100 %), and wind direction during calm hours (speed below 0.5 m/s) are not checked.

Neighbouring hours are only compared within a station and when exactly one hour apart.

See Also

`inmet_daily()`, `inmet_completeness()`

Examples

```
checked <- inmet_qc(rmet_example)
attr(checked, "qc_summary")
table(checked$temp_dry_c_flag, useNA = "ifany")

# daily values ignore flagged hours
daily <- inmet_daily(checked)
```

---

inmet_read *Read cached INMET historical data*

Description

Parses the station CSV files inside annual INMET archives (downloaded with `inmet_download()`) into one data frame. Files are read directly from the ZIP archives; nothing is extracted to disk.

Usage

```
inmet_read(
  years,
  stations = NULL,
  dest_dir = tools::R_user_dir("rmet", "cache"),
  tz = "UTC",
  variables = NULL,
  start_date = NULL,
```

```
  end_date = NULL,
  drop_empty = TRUE,
  quiet = FALSE
)
```

Arguments

years	Integer vector of years.
stations	Optional station codes, such as "A801". Matching is case-insensitive. Use inmet_stations() or inmet_nearest() to find codes.
dest_dir	Directory containing <year>.zip archives.
tz	Output time zone. Defaults to "UTC", the time standard used in the source files. Any name in OlsonNames() is accepted; only the display of the timestamps changes, not the instants they represent.
variables	Optional measurement columns to retain (see *Columns*). Identifier columns are always kept.
start_date, end_date	Optional inclusive date limits in YYYY-MM-DD format, interpreted in tz.
drop_empty	Drop hours in which every measurement is missing (default). INMET files contain such rows for periods when a station was not reporting. Use FALSE to keep them, for example to obtain a regular hourly grid.
quiet	Suppress progress messages.

Value

A data frame with one row per station and hour, sorted by station code and time. Identifier columns come first: station_code, station_name, region, state, latitude, longitude, elevation (from each file's header) and datetime (POSIXct). Measurement columns are numeric; missing values are NA.

Repeated files

The archive of the current year contains several cumulative versions of each station file (for example, January to August and January to September). Each station and hour is returned once, taken from the most recent version that contains it.

Timestamps

Each row is stamped with the *end* of the hour it describes, in UTC. Values labelled "previous hour" (such as temp_max_prev_c and precip_mm) summarise the hour ending at datetime. Use inmet_daily() to build daily summaries in local time.

Columns

Column	Description	Unit
precip_mm	Precipitation in the previous hour	mm
pressure_station_hpa	Station-level pressure	hPa

pressure_max_hpa, pressure_min_hpa	Pressure extremes, previous hour	hPa
radiation_kjm2	Global radiation, previous hour	kJ/m^2
temp_dry_c	Air (dry-bulb) temperature	degC
temp_dew_c	Dew-point temperature	degC
temp_max_prev_c, temp_min_prev_c	Air temperature extremes, previous hour	degC
temp_dew_max_c, temp_dew_min_c	Dew-point extremes, previous hour	degC
humid_rel_pct	Relative humidity	%
humid_rel_max_pct, humid_rel_min_pct	Humidity extremes, previous hour	%
wind_dir_deg	Wind direction	degrees
wind_gust_ms	Maximum gust	m/s
wind_speed_ms	Wind speed	m/s

Unrecognised source columns are kept under a snake_case version of their original title.

See Also

inmet_get(), inmet_download(), inmet_daily(), inmet_stations()

Examples

```
cache <- file.path(tempdir(), "rmet")
inmet_download(2023, dest_dir = cache)
poa <- inmet_read(2023, stations = "A801", dest_dir = cache)
```

---

inmet_stations *Search the INMET automatic-station catalogue*

Description

Returns automatic weather stations published by INMET. By default, the function uses a cached copy of the official API response and refreshes stale caches periodically. If the service is unavailable, it falls back to an older cache or to a snapshot of the official catalogue bundled with the package (its date is stored in the snapshot_date attribute).

Usage

```
inmet_stations(
  region = NULL,
  state = NULL,
  search = NULL,
  status = NULL,
  entity = NULL,
  source = c("auto", "remote", "bundled"),
  refresh = FALSE,
  max_age = 30,
```

```
  cache_dir = tools::R_user_dir("rmet", "cache"),
  quiet = FALSE
)
```

Arguments

region, state	Optional region or state abbreviations.
search	Optional literal text contained in the station name or code.
status	Optional operational status, such as "Operante" or "Pane".
entity	Optional station owner/provider, such as "INMET".
source	One of "auto", "remote", or "bundled". "auto" uses the cache, then the official API, then the bundled fallback.
refresh	Force a fresh request to the official API.
max_age	Maximum cache age in days before an automatic refresh.
cache_dir	Directory used for the catalogue cache.
quiet	Suppress informational messages.

Value

A data frame with station code, name, region, state, coordinates, altitude, operational dates (UTC calendar dates) and status, provider metadata, and the local time_zone (see inmet_timezone()). The legacy start_year column is retained for compatibility. The attribute catalog_source records where the data came from ("cache", "INMET API", "stale cache", or "bundled fallback").

See Also

inmet_nearest(), inmet_get(), inmet_read()

Examples

```
# Offline, reproducible example using the bundled fallback
inmet_stations(state = "RS", source = "bundled")


# Current official catalogue (downloaded once and then cached)
inmet_stations(state = "RS", refresh = TRUE, cache_dir = tempdir())
```

---

inmet_timezone *Local time zone of Brazilian stations*

Description

Returns the Olson time-zone name for each station from its state and, where a state spans more than one historical zone, its longitude. The zones carry Brazil's full history of offsets and daylight saving time, so they give correct local times for any year since 2000.

Usage

```
inmet_timezone(state, longitude = NA_real_)
```

Arguments

state	Two-letter state abbreviations, such as "RS".
longitude	Station longitudes in decimal degrees. Only used for Amazonas (west of 67.2 degrees W is UTC-5), Para (west of 52.5 degrees W was UTC-4 until 2008), and Pernambuco (Fernando de Noronha).

Details

Zone boundaries inside Amazonas and Para follow municipal borders; the longitude limits reproduce them for INMET's stations but are an approximation elsewhere.

Value

A character vector of time-zone names, NA for unknown states.

Examples

```
inmet_timezone(c("RS", "MT", "AC", "AM", "AM"),
               c(-51.2, -56.1, -67.8, -60.0, -69.9))
```

---

rmet_example *Hourly weather data from INMET station A801 (Porto Alegre), 2023*

Description

One year of hourly observations from the automatic station A801 (Porto Alegre - Jardim Botanico, RS), exactly as returned by `inmet_get(2023, stations = "A801")`. Timestamps are in UTC. Hours with no measurements at all are not included.

Usage

```
rmet_example
```

Format

A data frame with 8,663 rows and 25 columns. See `inmet_read()` for the description of each column.

Source

INMET (Instituto Nacional de Meteorologia), https://portal.inmet.gov.br/dadoshistoricos. Generated by `data-raw/rmet_example.R`.

Examples

```
range(rmet_example$datetime)
head(inmet_daily(rmet_example))
```

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