

# Package: BrazilMet (via r-universe)

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**Type** Package

**Title** Download and Processing of Automatic Weather Stations (AWS) Data of INMET-Brazil

**Version** 0.2.0

**Language** en-US

**Description** A compilation of functions to download and processing AWS data of INMET-Brazil, with the purpose of reference evapotranspiration (ETo) estimation. The package aims to make meteorological and agricultural data analysis more parsimonious.

**License** GPL-3

**Encoding** UTF-8

**Depends** R (>= 3.2.0)

**Imports** stringr, readxl, dplyr(>= 0.3.0.1)

**BugReports** <https://github.com/FilgueirasR/BrazilMet/issues>

**RoxygenNote** 7.1.1

**Repository** <https://filgueirasr.r-universe.dev>

**RemoteUrl** <https://github.com/filgueirasr/brazilmet>

**RemoteRef** HEAD

**RemoteSha** 66ce1f25834a078f1396886658f1dec744037731

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daily_eto_FAO56	<i>Eto calculation based on FAO-56 Penman-Monteith methodology, with data from automatic weather stations (AWS) downloaded and processed in function *daily_download_AWS_INMET*</i>
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## Description

This function will calculate the reference evapotranspiration (ET<sub>o</sub>) based on FAO-56 (Allen et al., 1998) with the automatic weather stations (AWS) data, downloaded and processed in function \*daily\_download\_AWS\_INMET\*.

## Usage

```
daily_eto_FAO56(lat, tmin, tmax, tmean, Rs, u2, Patm, RH_max, RH_min, z, date)
```

## Arguments

lat	A numeric value of the Latitude of the AWS (decimal degrees).
tmin	A dataframe with Minimum daily air temperature (°C).
tmax	A dataframe with Maximum daily air temperature (°C).
tmean	A dataframe with Mean daily air temperature (°C).
Rs	A dataframe with mean daily solar radiation (MJ m <sup>-2</sup> day <sup>-1</sup> ).
u2	A dataframe with Wind speed at meters high (m s <sup>-2</sup> ).
Patm	A dataframe with atmospheric Pressure (mB).
RH_max	A dataframe with Maximum relative humidity (percentage).
RH_min	A dataframe with Minimum relative humidity (percentage).
z	A numeric value of the altitude of AWS (m).
date	A data.frame with the date information (YYYY-MM-DD).

**Value**

Returns a data.frame with the AWS data requested

**Author(s)**

Roberto Filgueiras, Luan P. Venancio, Catariny C. Aleman and Fernando F. da Cunha

**Examples**

```
## Not run:  
eto<-daily_eto_FA056(lat, tmin, tmax, tmean, Rs, u2, Patm, RH_max, RH_min, z, date)  
  
## End(Not run)
```

---

download\_AWS\_INMET\_daily

*Download of hourly data from automatic weather stations (AWS) of INMET-Brazil in daily aggregates*

---

**Description**

This function will download the hourly AWS data of INMET and it will aggregate the data in a daily time scale, based on the period of time selected (start\_date and end\_date).The function only works for downloading data from the same year.

**Usage**

```
download_AWS_INMET_daily(station, start_date, end_date)
```

**Arguments**

station	The station code (ID - WMO code) for download. To see the station ID, please see the function *see_stations_info*.
start_date	Date that start the investigation, should be in the following format (1958-01-01 /Year-Month-Day)
end_date	Date that end the investigation, should be in the following format (2017-12-31 /Year-Month-Day)

**Value**

Returns a data.frame with the AWS data requested

**Author(s)**

Roberto Filgueiras, Luan P. Venancio, Catariny C. Aleman and Fernando F. da Cunha

**Examples**

```
## Not run:  
df<-download_AWS_INMET_daily(station = "A001", start_date = "2001-01-01", end_date = "2001-12-31")  
  
## End(Not run)
```

---

ea\_dew\_calculation      *Actual vapour pressure (ea) derived from dewpoint temperature*

---

**Description**

Actual vapour pressure (ea) derived from dewpoint temperature

**Usage**

```
ea_dew_calculation(tdew)
```

**Arguments**

tdew                    A dataframe with dewpoint temperature (°C).

**Value**

Returns a data.frame object with the ea from dewpoint data.

**Author(s)**

Roberto Filgueiras, Luan P. Venancio, Catariny C. Aleman and Fernando F. da Cunha.

**Examples**

```
## Not run:  
ea <-ea_dew_calculation(tdew).  
  
## End(Not run)
```

---

ea_rh_calculation	<i>Actual vapour pressure (ea) derived from relative humidity data</i>
-------------------	--

---

**Description**

Actual vapour pressure (ea) derived from relative humidity data

**Usage**

```
ea_rh_calculation(tmin, tmax, rh_min, rh_mean, rh_max)
```

**Arguments**

tmin	A dataframe with minimum daily air temperature (°C)
tmax	A dataframe with maximum daily air temperature (°C)
rh_min	A dataframe with minimum daily relative air humidity (percentage).
rh_mean	A dataframe with mean daily relative air humidity (percentage).
rh_max	A dataframe with maximum daily relative air humidity (percentage).

**Value**

Returns a data.frame object with the with ea from relative humidity data.

**Author(s)**

Roberto Filgueiras, Luan P. Venancio, Catariny C. Aleman and Fernando F. da Cunha

**Examples**

```
## Not run:  
ea <- ea_rh_calculation(tmin, tmax, rh_min, rh_mean, rh_max)  
  
## End(Not run)
```

---

es_calculation	<i>Mean saturation vapour pressure (es)</i>
----------------	---

---

**Description**

Mean saturation vapour pressure (es)

**Usage**

```
es_calculation(tmin, tmax)
```

**Arguments**

tmin            A dataframe with Minimum daily air temperature (°C).  
 tmax            A dataframe with Maximum daily air temperature (°C).

**Value**

Returns a data.frame object with the es data.

**Author(s)**

Roberto Filgueiras, Luan P. Venancio, Catariny C. Aleman and Fernando F. da Cunha.

**Examples**

```
## Not run:
es <- es_calculation(tmin, tmax)

## End(Not run)
```

---

es\_ea\_calculation      *Vapour pressure deficit (es - ea)*

---

**Description**

Vapour pressure deficit (es - ea)

**Usage**

```
es_ea_calculation(tmin, tmax, tdew, rh_min, rh_mean, rh_max, ea_method)
```

**Arguments**

tmin            A dataframe with minimum daily air temperature (°C).  
 tmax            A dataframe with maximum daily air temperature (°C).  
 tdew            A dataframe with dewpoint temperature (°C).  
 rh\_min          A dataframe with minimum daily relative air humidity (percentage).  
 rh\_mean        A dataframe with mean daily relative air humidity (percentage).  
 rh\_max          A dataframe with maximum daily relative air humidity (percentage).  
 ea\_method      The methodology to calculate the actual vapour pressure. Assume the "rh" (default) for relative humidity procedure and "dew" for dewpoint temperature procedure.

**Value**

Returns a data.frame object with the ea from relative humidity data.

**Author(s)**

Roberto Filgueiras, Luan P. Venancio, Catariny C. Aleman and Fernando F. da Cunha

**Examples**

```
## Not run:  
ea <- es_ea_calculation(tmin, tmax, tdew, rh_min, rh_mean, rh_max, ea_method)  
  
## End(Not run)
```

---

eto\_hs

*Hargreaves - Samani ETo*

---

**Description**

Hargreaves - Samani ETo

**Usage**

```
eto_hs(tmin, tmean, tmax, ra)
```

**Arguments**

tmin	A dataframe with Maximum daily air temperature (°C)
tmean	A dataframe with Minimum daily air temperature (°C)
tmax	A dataframe with Maximum daily air temperature (°C)
ra	A dataframe of extraterrestrial radiation (MJ m <sup>-2</sup> day <sup>-1</sup> )

**Value**

Returns a data.frame object with the ETo HS data

**Author(s)**

Roberto Filgueiras, Luan P. Venancio, Catariny C. Aleman and Fernando F. da Cunha

**Examples**

```
## Not run:  
eto_hs <- eto_hs(tmin, tmean, tmax, ra)  
  
## End(Not run)
```

Patm                      *Atmospheric pressure (Patm)*

---

**Description**

Atmospheric pressure (Patm)

**Usage**

Patm(z)

**Arguments**

z                      Elevation above sea level (m)

**Value**

Returns a data.frame object with the atmospheric pressure calculated.

**Author(s)**

Roberto Filgueiras, Luan P. Venancio, Catariny C. Aleman and Fernando F. da Cunha

**Examples**

```
## Not run:  
Patm <- Patm(z)  
  
## End(Not run)
```

---

psy\_const                      *Psychrometric constant*

---

**Description**

Psychrometric constant (kPa/°C) is calculated in this function.

**Usage**

psy\_const(Patm)

**Arguments**

Patm                      Atmospheric pressure (kPa)



**Value**

A data.frame object with the psychrometric constant calculated.

**Author(s)**

Roberto Filgueiras, Luan P. Venancio, Catariny C. Aleman and Fernando F. da Cunha

**Examples**

```
## Not run:  
psy_df <- psy_const(Patm)  
  
## End(Not run)
```

---

radiation\_conversion    *Conversion factors for radiation*

---

**Description**

Function to convert the radiation data. The conversion name can be understand as follow:

- conversion\_1 = MJ m<sup>-2</sup> day<sup>-1</sup> to J cm<sup>-2</sup> day<sup>-1</sup>;
- conversion\_2 = MJ m<sup>-2</sup> day<sup>-1</sup> to cal cm<sup>-2</sup> day<sup>-1</sup>;
- conversion\_3 = MJ m<sup>-2</sup> day<sup>-1</sup> to W m<sup>-2</sup>;
- conversion\_4 = MJ m<sup>-2</sup> day<sup>-1</sup> to mm day<sup>-1</sup>;
- conversion\_5 = cal cm<sup>-2</sup> day<sup>-1</sup> to MJ m<sup>-2</sup> day<sup>-1</sup>;
- conversion\_6 = cal cm<sup>-2</sup> day<sup>-1</sup> to J cm<sup>-2</sup> day<sup>-1</sup>;
- conversion\_7 = cal cm<sup>-2</sup> day<sup>-1</sup> to W m<sup>-2</sup>;
- conversion\_8 = cal cm<sup>-2</sup> day<sup>-1</sup> to mm day<sup>-1</sup>;
- conversion\_9 = W m<sup>-2</sup> to MJ m<sup>-2</sup> day<sup>-1</sup>;
- conversion\_10 = W m<sup>-2</sup> to J cm<sup>-2</sup> day<sup>-1</sup>;
- conversion\_11 = W m<sup>-2</sup> to cal cm<sup>-2</sup> day<sup>-1</sup>;
- conversion\_12 = W m<sup>-2</sup> to mm day<sup>-1</sup>;
- conversion\_13 = mm day<sup>-1</sup> to MJ m<sup>-2</sup> day<sup>-1</sup>;
- conversion\_14 = mm day<sup>-1</sup> to J cm<sup>-2</sup> day<sup>-1</sup>;
- conversion\_15 = mm day<sup>-1</sup> to cal cm<sup>-2</sup> day<sup>-1</sup>;
- conversion\_16 = mm day<sup>-1</sup> to W m<sup>-2</sup>.

**Usage**

```
radiation_conversion(data_to_convert, conversion_name)
```

**Arguments**

`data_to_convert` A data.frame with radiation values to convert.

`conversion_name` A character with the conversion\_name summarize in the description of this function.

**Value**

A data.frame object with the converted radiation.

**Author(s)**

Roberto Filgueiras, Luan P. Venancio, Catariny C. Aleman and Fernando F. da Cunha

**Examples**

```
## Not run:
radiation_conversion_df <- radiation_conversion(data_to_convert = df$rad,
                                              conversion_name = "conversion_1")

## End(Not run)
```

---

<code>ra_calculation</code>	<i>Extraterrestrial radiation for daily periods (ra)</i>
-----------------------------	--

---

**Description**

ra is expressed in MJ m<sup>-2</sup> day<sup>-1</sup>

**Usage**

```
ra_calculation(latitude, date)
```

**Arguments**

`latitude` A dataframe with latitude in decimal degrees that you want to calculate the ra.

`date` A dataframe with the dates that you want to calculate the ra.

**Value**

A data.frame with the extraterrestrial radiation for daily periods

**Author(s)**

Roberto Filgueiras, Luan P. Venancio, Catariny C. Aleman and Fernando F. da Cunha

**Examples**

```
## Not run:  
ra <- ra_calculation(latitude, date)  
  
## End(Not run)
```

---

rh_calculation	<i>Relative humidity (rh) calculation</i>
----------------	---

---

**Description**

Relative humidity is calculated in this function based on minimum air temperature of the day and the air temperature of the moment.

**Usage**

```
rh_calculation(tmin, tmean)
```

**Arguments**

tmin	A dataframe with minimum daily air temperature (°C)
tmean	A dataframe with mean air temperature (°C) that you want to calculate the relative humidity.

**Value**

A data.frame object with the relative humidity calculated

**Author(s)**

Roberto Filgueiras, Luan P. Venancio, Catariny C. Aleman and Fernando F. da Cunha

**Examples**

```
## Not run:  
rh <- rh_calculation(tmin, tmean)  
  
## End(Not run)
```

---

rnl_calculation	<i>Net longwave radiation (rnl)</i>
-----------------	-------------------------------------

---

**Description**

Net outgoing longwave radiation is calculate with this function

**Usage**

```
rnl_calculation(tmin, tmax, ea, rs, rso)
```

**Arguments**

tmin	A dataframe with Minimum daily air temperature (°C)
tmax	A dataframe with Maximum daily air temperature (°C)
ea	A dataframe with the actual vapour pressure (KPa).
rs	A dataframe with the incoming solar radiation (MJ m-2 day-1).
rso	A dataframe with the clear-sky radiation (MJ m-2 day-1)

**Value**

A data.frame object with the net longwave radiation.

**Author(s)**

Roberto Filgueiras, Luan P. Venancio, Catariny C. Aleman and Fernando F. da Cunha

**Examples**

```
## Not run:  
rnl_df <- rnl_calculation(tmin, tmax, ea, rs, rso)  
  
## End(Not run)
```

---

rns_calculation	<i>Net solar or net shortwave radiation (rns)</i>
-----------------	---

---

**Description**

The rns results form the balance between incoming and reflected solar radiation (MJ m-2 day-1).

**Usage**

```
rns_calculation(albedo, rs)
```

**Arguments**

albedo            Albedo or canopy reflectance coefficient. The 0.23 is the value used for hypothetical grass reference crop (dimensionless).

rs                The incoming solar radiation (MJ m<sup>-2</sup> day<sup>-1</sup>).

**Value**

A data.frame object with the net solar or net shortwave radiation data.

**Author(s)**

Roberto Filgueiras, Luan P. Venancio, Catariny C. Aleman and Fernando F. da Cunha

**Examples**

```
## Not run:  
ra <- rns_calculation(albedo, rs)  
  
## End(Not run)
```

---

rn_calculation	<i>Net radiation (rn)</i>
----------------	---------------------------

---

**Description**

The net radiation (MJ m<sup>-2</sup> day<sup>-1</sup>) is the difference between the incoming net shortwave radiation (rns) and the outgoing net longwave radiation (rnl).

**Usage**

```
rn_calculation(rns, rnl)
```

**Arguments**

rns                The incoming net shortwave radiation (MJ m<sup>-2</sup> day<sup>-1</sup>).

rnl                The outgoing net longwave radiation (MJ m<sup>-2</sup> day<sup>-1</sup>).

**Value**

A data.frame object with the net radiation data.

**Author(s)**

Roberto Filgueiras, Luan P. Venancio, Catariny C. Aleman and Fernando F. da Cunha

**Examples**

```
## Not run:  
rn <- rn_calculation(rns, rnl)  
  
## End(Not run)
```

---

rso\_calculation\_1      *Clear-sky solar radiation with calibrated values available*

---

**Description**

Clear-sky solar radiation is calculated in this function for near sea level or when calibrated values for as and bs are available.

**Usage**

```
rso_calculation_1(as, bs, ra)
```

**Arguments**

as	A dataframe with latitude in decimal degrees that you want to calculate the ra. The values of as = 0.25 is recommended by Allen et al. (1998).
bs	A dataframe with the dates that you want to calculate the ra. The values of bs = 0.50 is recommended by Allen et al. (1998).
ra	Extraterrestrial radiation for daily periods (ra).

**Value**

A data.frame object with the clear-sky radiation data

**Author(s)**

Roberto Filgueiras, Luan P. Venancio, Catariny C. Aleman and Fernando F. da Cunha

**Examples**

```
## Not run:  
rso_df <- rso_calculation_1(as, bs, ra)  
  
## End(Not run)
```

---

rso\_calculation\_2      *Clear-sky solar radiation when calibrated values are not available*

---

**Description**

Clear-sky solar radiation is calculated in this function for near sea level or when calibrated values for as and bs are available.

**Usage**

```
rso_calculation_2(z, ra)
```

**Arguments**

z	Station elevation above sea level (m)
ra	Extraterrestrial radiation for daily periods (ra).

**Value**

A data.frame object with the clear-sky solar radiation

**Author(s)**

Roberto Filgueiras, Luan P. Venancio, Catariny C. Aleman and Fernando F. da Cunha

**Examples**

```
## Not run:  
rso_df <- rso_calculation_2(z, ra)  
  
## End(Not run)
```

---

rs\_nearby\_calculation      *Solar radiation data from a nearby weather station*

---

**Description**

The solar radiation data is calculated based in a nearby weather station.

**Usage**

```
rs_nearby_calculation(rs_reg, ra_reg, ra)
```

**Arguments**

rs\_reg            A dataframe with the solar radiation at the regional location (MJ m<sup>-2</sup> day<sup>-1</sup>).  
ra\_reg            A dataframe with the extraterrestrial radiation at the regional location (MJ m<sup>-2</sup> day<sup>-1</sup>).  
ra                A dataframe with the extraterrestrial radiation for daily periods (ra).

**Value**

A data.frame object with the Solar radiation data based on a nearby weather station

**Author(s)**

Roberto Filgueiras, Luan P. Venancio, Catariny C. Aleman and Fernando F. da Cunha

**Examples**

```
## Not run:  
rs_nearby_df <- rs_nearby_calculation(rs_reg, ra_reg, ra)  
  
## End(Not run)
```

---

see\_stations\_info            *Localization of the automatic weather station of INMET*

---

**Description**

Function to see the localization of the automatic weather station of INMET.

**Usage**

```
see_stations_info()
```

**Value**

A data.frame with informations of OMM code, latitude, longitude and altitude of all AWS stations available in INMET.

**Author(s)**

Roberto Filgueiras, Luan P. Venancio, Catariny C. Aleman and Fernando F. da Cunha

**Examples**

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



---

sr\_ang\_calculation      *Solar radiation based in Angstrom formula (sr\_ang)*

---

### Description

If global radiation is not measure at station, it can be estimated with this function.

### Usage

```
sr_ang_calculation(latitude, date, n, as, bs)
```

### Arguments

latitude	A dataframe with latitude in decimal degrees that you want to calculate the ra.
date	A dataframe with the dates that you want to calculate the ra.
n	The actual duration of sunshine. This variable is recorded with Campbell-Stokes sunshine recorder.
as	A dataframe with latitude in decimal degrees that you want to calculate the ra. The values of as = 0.25 is recommended by Allen et al. (1998).
bs	A dataframe with the dates that you want to calculate the ra. The values of bs = 0.50 is recommended by Allen et al. (1998).

### Value

A data.frame object with solar radiation data

### Author(s)

Roberto Filgueiras, Luan P. Venancio, Catariny C. Aleman and Fernando F. da Cunha

### Examples

```
## Not run:  
sr_ang <- sr_ang_calculation(latitude, date, n, as, bs)  
  
## End(Not run)
```

---

sr\_tair\_calculation     *Solar radiation data derived from air temperature differences*

---

**Description**

If global radiation is not measure at station, it can be estimated with this function.

**Usage**

```
sr_tair_calculation(latitude, date, tmax, tmin, location_krs)
```

**Arguments**

latitude	A dataframe with latitude in decimal degrees that you want to calculate the ra.
date	A dataframe with the dates that you want to calculate the ra.
tmax	A dataframe with Maximum daily air temperature (°C)
tmin	A dataframe with Minimum daily air temperature (°C)
location_krs	Adjustment coefficient based in location. Please decide between "coastal or "interior". If coastal the krs will be 0.19, if interior the krs will be 0.16.

**Value**

A data.frame object with solar radiation data

**Author(s)**

Roberto Filgueiras, Luan P. Venancio, Catariny C. Aleman and Fernando F. da Cunha

**Examples**

```
## Not run:  
sr_tair <- sr_tair_calculation(latitude, date, tmax, tmin, location_krs)  
  
## End(Not run)
```

---

u2\_calculation     *Wind speed at 2 meters high*

---

**Description**

Wind speed at two meters high can be calculated with this function.

**Usage**

```
u2_calculation(uz, z)
```

**Arguments**

uz                    measured wind speed at z meters above ground surface  
z                      height of measurement above ground surface.

**Value**

A data.frame with the wind speed at 2 meters high calculated.

**Author(s)**

Roberto Filgueiras, Luan P. Venancio, Catariny C. Aleman and Fernando F. da Cunha

**Examples**

```
## Not run:  
u2_df <- u2_calculation(uz, z)  
  
## End(Not run)
```

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