

# Package: pRecipe (via r-universe)

August 24, 2024

**Title** Precipitation R Recipes

**Version** 3.0.2

**Description** An open-access tool/framework to download, validate, visualize, and analyze multi-source precipitation data. More information and an example of implementation can be found in Vargas Godoy and Markonis (2023, <[doi:10.1016/j.envsoft.2023.105711](https://doi.org/10.1016/j.envsoft.2023.105711)>).

**Depends** R (>= 4.0.0)

**Imports** grDevices, methods, parallel, stats, utils, data.table, doParallel, foreach, ggplot2, ggpubr, lubridate, magrittr, ncd4, openair, raster, scales, sf, sp

**License** GPL-3

**Encoding** UTF-8

**LazyData** false

**URL** <https://github.com/MiRoVaGo/pRecipe>

**BugReports** <https://github.com/MiRoVaGo/pRecipe/issues>

**SystemRequirements** PROJ (>= 6, <https://proj.org/download.html>), GDAL (>= 3, <https://gdal.org/download.html>), NetCDF (>= 4, <https://www.unidata.ucar.edu/software/netcdf/>).

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**VignetteBuilder** knitr

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

**RemoteUrl** <https://github.com/mirovago/precipe>

**RemoteRef** HEAD

**RemoteSha** 8ac2710ae008baafb5caa3c1a90954ecbd38ba17

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crop_data	<i>Crop precipitation data sets</i>
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### Description

The function `crop_data` crops the data sets using a shapefile mask.

### Usage

```
crop_data(x, y)

## S4 method for signature 'Raster'
crop_data(x, y)

## S4 method for signature 'data.table'
crop_data(x, y)

## S4 method for signature 'character'
crop_data(x, y)
```

**Arguments**

x Raster\* object; data.table (see details); filename (character; see details)  
 y filename (character). Path to a \*.shp file

**Details**

If 'x' is a data.table, its columns should be named: "lon", "lat", "date", and "value"

If 'x' is a filename, it should point to a \*.nc file.

**Value**

Raster\* object; data.table

**Examples**

```
## Not run:
download_data("gldas-vic", tempdir(), timestep = "yearly")
r <- raster::brick(paste0(tempdir(),
"/gldas-vic_tp_mm_land_194801_201412_025_yearly.nc"))
s <- crop_data(r, "cze.shp")

## End(Not run)
```

---

csi	<i>Probability of Detection</i>
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---

**Description**

Function for calculating the critical success index.

**Usage**

```
csi(x, ref, th)
```

**Arguments**

x a data.table generated by [fldmean](#)  
 ref a data.table with data used for evaluation  
 th numeric. The value for detection threshold

**Value**

numeric

---

`download_data`*Download various precipitation data products*

---

**Description**

The function `download_data` downloads the selected data product.

**Usage**

```
download_data(  
  dataset = "all",  
  path = ".",  
  domain = "raw",  
  timestep = "monthly"  
)
```

**Arguments**

`dataset` a character string with the name(s) of the desired data set. Suitable options are:

- "all" for all of the below listed data sets (default),
- "20cr" for 20CR v3,
- "chirps" for CHIRPS v2.0,
- "cmap" for CMAP standard version,
- "cmorph" for CMORPH,
- "cpc" for CPC-Global,
- "cru-ts" for CRU\_TS v4.06,
- "em-earth" for EM-EARTH,
- "era20c" for ERA-20C,
- "era5" for ERA5,
- "fldas" for FLDAS,
- "ghcn" for GHCN-M v2,
- "gldas-clsm" for GLDAS CLSM,
- "gldas-noah" for GLDAS NOAH,
- "gldas-vic" for GLDAS VIC,
- "gpcc" for GPCC v2020,
- "gpcp" for GPCP v2.3,
- "gpm\_imergm" for GPM IMERGM Final v06,
- "jra55" for JRA-55,
- "merra2" for MERRA-2,
- "mswep" for MSWEP v2.8,
- "ncep-doe" for NCEP/DOE,
- "ncep-ncar" for NCEP/NCAR,
- "persiann" for PERSIANN-CDR,

	<ul style="list-style-type: none"> <li>• "precl" for PREC/L,</li> <li>• "terraclimate" for TerraClimate,</li> <li>• "trmm-3b43" for TRMM 3B43 v7,</li> <li>• "udel" for UDEL v501.</li> </ul>
path	a character string with the path where the database will be downloaded.
domain	a character string with the desired domain data set. Suitable options are: <ul style="list-style-type: none"> <li>• "raw" for default available spatial coverage,</li> <li>• "global" for data sets with global (land and ocean) coverage,</li> <li>• "land" for data sets with land only coverage,</li> <li>• "ocean", for data sets with ocean only coverage.</li> </ul>
timestep	a character string with the desired time resolution. Suitable options are: <ul style="list-style-type: none"> <li>• "monthly",</li> <li>• "yearly".</li> </ul>

**Value**

No return value, called to download the required data sets.

**Examples**

```
download_data("gldas-vic", tempdir(), timestep = "yearly")
```

---

download_e_obs	<i>E-OBS data downloader</i>
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---

**Description**

Function for downloading E-OBS.

**Usage**

```
download_e_obs(folder_path = ".", time_res = "monthly")
```

**Arguments**

folder_path	a character string with the path where the data will be downloaded.
time_res	a character string with the desired time resolution. Suitable options are: <ul style="list-style-type: none"> <li>• "monthly",</li> <li>• "yearly".</li> </ul>

**Value**

No return value, called to download the data set.

---

far	<i>False Alarm Rate</i>
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---

### Description

Function for calculating the false alarm rate.

### Usage

```
far(x, ref, th)
```

### Arguments

x	a data.table generated by <a href="#">fldmean</a>
ref	a data.table with data used for evaluation
th	numeric. The value for detection threshold

### Value

numeric

---

fldmean	<i>Field mean</i>
---------	-------------------

---

### Description

The function fldmean computes the spatial weighted average for each timestep.

### Usage

```
fldmean(x)

## S4 method for signature 'Raster'
fldmean(x)

## S4 method for signature 'data.table'
fldmean(x)

## S4 method for signature 'character'
fldmean(x)
```

### Arguments

x	Raster* object; data.table (see details); filename (character, see details)
---	---

**Details**

If 'x' is a data.table, its columns should be named: "lon", "lat", "date", and "value"

If 'x' is a filename, it should point to a \*.nc file.

**Value**

data.table

**Examples**

```
## Not run:
download_data("gldas-vic", tempdir(), timestep = "yearly")
r <- raster::brick(paste0(tempdir(),
"/gldas-vic_tp_mm_land_194801_201412_025_yearly.nc"))
s <- fldmean(r)

## End(Not run)
```

---

infoNC

*Show data content*

---

**Description**

The function infoNC displays the specification of the desired file.

**Usage**

```
infoNC(x)

## S4 method for signature 'Raster'
infoNC(x)

## S4 method for signature 'character'
infoNC(x)
```

**Arguments**

x                    Raster\* Object; character

---

label	<i>Labeling</i>
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---

### Description

The function `label` adds data set name and source type.

### Usage

```
label(x, y)
```

### Arguments

<code>x</code>	data.table (see details)
<code>y</code>	character (see details)

### Details

columns in `'x'` should be named (if present): "lon", "lat", "date", and "value"

Available options are:

- "20cr" for 20CR v3,
- "chirps" for CHIRPS v2.0,
- "cmap" for CMAP standard version,
- "cmorph" for CMORPH,
- "cpc" for CPC-Global,
- "cru-ts" for CRU\_TS v4.06,
- "em-earth" for EM-EARTH,
- "era20c" for ERA-20C,
- "era5" for ERA5,
- "fldas" for FLDAS,
- "ghcn" for GHCN-M v2,
- "gldas-clsm" for GLDAS CLSM,
- "gldas-noah" for GLDAS NOAH,
- "gldas-vic" for GLDAS VIC,
- "gleam" for GLEAM v3.7a,
- "gpcc" for GPCC v2020,
- "gpcp" for GPCP v2.3,
- "gpm\_imerg" for GPM IMERG Final v06,
- "jra55" for JRA-55,
- "merra2" for MERRA-2,



- "mswep" for MSWEP v2.8,
- "ncep-doe" for NCEP/DOE,
- "ncep-ncar" for NCEP/NCAR,
- "persiann" for PERSIANN-CDR,
- "precl" for PREC/L,
- "terraclimate" for TerraClimate,
- "trmm-3b43" for TRMM 3B43 v7,
- "udel" for UDEL v501.

### Value

data.table

### Examples

```
## Not run:
r <- data.table::data.table("date" = as.Date("2000-01-01"), "value" = 42)
s <- label(r, "mswep")

## End(Not run)
```

---

muldpm	<i>Multiply by days per month</i>
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### Description

The function muldpm multiplies the value by days per month.

### Usage

```
muldpm(x)

## S4 method for signature 'Raster'
muldpm(x)

## S4 method for signature 'data.table'
muldpm(x)

## S4 method for signature 'character'
muldpm(x)
```

### Arguments

x Raster\* object; data.table (see details); filename (character, see details)

**Details**

'x' object with monthly data in [units/day]

If 'x' is a data.table, its columns should be named: "lon", "lat", "date", and "value"

If 'x' is a filename, it should point to a \*.nc file.

**Value**

Raster\* object; data.table

**Examples**

```
## Not run:
tavg_brick <- raster::brick('terraclimate_tavg.nc')
pet_od <- pet(method = "od", tavg = tavg_brick)
pet_od <- muldpm(pet_od)

## End(Not run)
```

---

nse

*Nash–Sutcliffe Efficiency*

---

**Description**

Function for calculating the Nash–Sutcliffe efficiency.

**Usage**

```
nse(x, ref)
```

**Arguments**

x	a data.table generated by <a href="#">fldmean</a>
ref	a data.table with data used for evaluation

**Value**

numeric

---

plot_box	<i>Boxplot ggplot</i>
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---

### Description

Convenient and aesthetic visualization of data in a boxplot.

### Usage

```
plot_box(x, var = "Precipitation", unit = "mm")

## S4 method for signature 'Raster'
plot_box(x, var = "Precipitation", unit = "mm")

## S4 method for signature 'data.table'
plot_box(x, var = "Precipitation", unit = "mm")

## S4 method for signature 'character'
plot_box(x, var = "Precipitation", unit = "mm")
```

### Arguments

x	Raster* object; data.table (see details); filename (character, see details)
var	character (see details)
unit	character (see details)

### Details

If ‘x’ is a data.table, its columns should be named: "lon", "lat", "date", and "value"

If ‘x’ is a filename, it should point to a \*.nc file.

‘var’ is a character string describing the variable to be used for the plot title

‘unit’ is a character string describing the unit of measurement to be used for the plot title

### Value

ggplot object

### Examples

```
## Not run:
download_data("gldas-vic", tempdir(), timestep = "yearly")
r <- raster::brick(paste0(tempdir(),
"/gldas-vic_tp_mm_land_194801_201412_025_yearly.nc"))
s <- plot_box(r)

## End(Not run)
```

---

plot_density	<i>Histogram ggplot</i>
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---

### Description

Convenient and aesthetic visualization of data in a histogram.

### Usage

```
plot_density(x, var = "Precipitation", unit = "mm")

## S4 method for signature 'Raster'
plot_density(x, var = "Precipitation", unit = "mm")

## S4 method for signature 'data.table'
plot_density(x, var = "Precipitation", unit = "mm")

## S4 method for signature 'character'
plot_density(x, var = "Precipitation", unit = "mm")
```

### Arguments

x	Raster* object; data.table (see details); filename (character, see details)
var	character (see details)
unit	character (see details)

### Details

If ‘x’ is a data.table, its columns should be named: "lon", "lat", "date", and "value"

If ‘x’ is a filename, it should point to a \*.nc file.

‘var’ is a character string describing the variable to be used for the axis title

‘unit’ is a character string describing the unit of measurement to be used for the axis title

### Value

ggplot object

### Examples

```
## Not run:
download_data("gldas-vic", tempdir(), timestep = "yearly")
r <- raster::brick(paste0(tempdir(),
"/gldas-vic_tp_mm_land_194801_201412_025_yearly.nc"))
s <- plot_density(r)

## End(Not run)
```

---

plot_heatmap	<i>Heatmap ggplot</i>
--------------	-----------------------

---

## Description

Convenient and aesthetic visualization of data in a heatmap.

## Usage

```
plot_heatmap(x, unit = "mm")

## S4 method for signature 'Raster'
plot_heatmap(x, unit = "mm")

## S4 method for signature 'data.table'
plot_heatmap(x, unit = "mm")

## S4 method for signature 'character'
plot_heatmap(x, unit = "mm")
```

## Arguments

x	Raster* object; data.table (see details); filename (character, see details)
unit	character (see details)

## Details

If ‘x’ is a data.table, its columns should be named: "lon", "lat", "date", and "value"

If ‘x’ is a filename, it should point to a \*.nc file.

‘unit’ is a character string describing the unit of measurement to be used for the axis title

## Value

ggplot object

## Examples

```
## Not run:
download_data("gldas-vic", tempdir(), timestep = "yearly")
r <- raster::brick(paste0(tempdir(),
"/gldas-vic_tp_mm_land_194801_201412_025_yearly.nc"))
s <- plot_heatmap(r)

## End(Not run)
```

---

plot\_line

*Line ggplot*

---

### Description

Convenient and aesthetic visualization of data in a line plot.

### Usage

```
plot_line(x, var = "Precipitation", unit = "mm")

## S4 method for signature 'Raster'
plot_line(x, var = "Precipitation", unit = "mm")

## S4 method for signature 'data.table'
plot_line(x, var = "Precipitation", unit = "mm")

## S4 method for signature 'character'
plot_line(x, var = "Precipitation", unit = "mm")
```

### Arguments

x	Raster* object; data.table (see details); filename (character, see details)
var	character (see details)
unit	character (see details)

### Details

If ‘x’ is a data.table, its columns should be named: "lon", "lat", "date", and "value"

If ‘x’ is a filename, it should point to a \*.nc file.

‘var’ is a character string describing the variable to be used for the axis title

‘unit’ is a character string describing the unit of measurement to be used for the axis title

### Value

ggplot object

### Examples

```
## Not run:
download_data("gldas-vic", tempdir(), timestep = "yearly")
r <- raster::brick(paste0(tempdir(),
"/gldas-vic_tp_mm_land_194801_201412_025_yearly.nc"))
s <- plot_line(r)

## End(Not run)
```

---

`plot_map`*Map ggplot*

---

## Description

Convenient and aesthetic visualization of data in a map

## Usage

```
plot_map(x, layer = 1, unit = "mm", timestamp = TRUE)

## S4 method for signature 'Raster'
plot_map(x, layer = 1, unit = "mm", timestamp = TRUE)

## S4 method for signature 'data.table'
plot_map(x, layer = 1, unit = "mm", timestamp = TRUE)

## S4 method for signature 'character'
plot_map(x, layer = 1, unit = "mm", timestamp = TRUE)
```

## Arguments

<code>x</code>	Raster* object; data.table (see details); filename (character, see details)
<code>layer</code>	numeric
<code>unit</code>	character
<code>timestamp</code>	logical

## Details

If ‘x’ is a data.table, its columns should be named: "lon", "lat", "date", and "value"

If ‘x’ is a filename, it should point to a \*.nc file.

‘unit’ is a character string describing the unit of measurement to be used for the legend title

‘layer’ is the layer number to be plotted.

‘timestamp’ if TRUE (default) the plot title is the layer’s date

## Value

ggplot object

---

`plot_summary`*Summary ggplot*

---

**Description**

Convenient and aesthetic visualization of data in a summary plot.

**Usage**

```
plot_summary(x, var = "Precipitation", unit = "mm")

## S4 method for signature 'Raster'
plot_summary(x, var = "Precipitation", unit = "mm")

## S4 method for signature 'data.table'
plot_summary(x, var = "Precipitation", unit = "mm")

## S4 method for signature 'character'
plot_summary(x, var = "Precipitation", unit = "mm")
```

**Arguments**

<code>x</code>	Raster* object; data.table (see details); filename (character, see details)
<code>var</code>	character (see details)
<code>unit</code>	character (see details)

**Details**

If ‘x’ is a data.table, its columns should be named: "lon", "lat", "date", and "value"

If ‘x’ is a filename, it should point to a \*.nc file.

‘var’ is a character string describing the variable to be used for the axis title

‘unit’ is a character string describing the unit of measurement to be used for the axis title

**Value**

ggplot object

**Examples**

```
## Not run:
download_data("gldas-vic", tempdir(), timestep = "yearly")
r <- raster::brick(paste0(tempdir(),
"/gldas-vic_tp_mm_land_194801_201412_025_yearly.nc"))
s <- plot_summary(r)

## End(Not run)
```



---

plot_taylor	<i>Taylor diagram</i>
-------------	-----------------------

---

## Description

Convenient and aesthetic visualization of data in a Taylor diagram.

## Usage

```
plot_taylor(x, y, groups = "source", ...)
```

## Arguments

x	data.table
y	data.table
groups	character
...	see details

## Details

‘x’ columns should be named: "lon", "lat", "date", "value", "dataset", and "source". The last two columns are added using the [label](#).

‘y’ columns should be named: "lon", "lat", "date", "value", "dataset", and "source". The last two columns are added using the [label](#).

‘groups’ character to define panels. Suitable options are:

- "source" (default)
- "seasons" (only works properly with monthly data)

‘...’ extra arguments passed on to `openair::TaylorDiagram`

## Value

plot object

---

pod	<i>Probability Of Detection</i>
-----	---------------------------------

---

**Description**

Function for calculating the probability of detection.

**Usage**

```
pod(x, ref, th)
```

**Arguments**

x	a data.table generated by <a href="#">fldmean</a>
ref	a data.table with data used for evaluation
th	numeric. The value for detection threshold

**Value**

numeric

---

pRecipe_masks	<i>Masks data</i>
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---

**Description**

Function for various masks.

**Usage**

```
pRecipe_masks()
```

**Value**

data.table

---

remap	<i>Spatial aggregation</i>
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---

## Description

The function `remap` aggregates data into a new grid resolution.

## Usage

```
remap(x, y)

## S4 method for signature 'Raster'
remap(x, y)

## S4 method for signature 'data.table'
remap(x, y)

## S4 method for signature 'character'
remap(x, y)
```

## Arguments

<code>x</code>	Raster* object; data.table (see details); filename (character, see details)
<code>y</code>	numeric

## Details

If `'x'` is a `data.table`, its columns should be named: "lon", "lat", "date", and "value"

If `'x'` is a filename, it should point to a \*.nc file.

## Value

Raster\* object; data.table

## Examples

```
## Not run:
download_data("gldas-vic", tempdir(), timestep = "yearly")
r <- raster::brick(paste0(tempdir(),
"/gldas-vic_tp_mm_land_194801_201412_025_yearly.nc"))
s <- remap(r, 1)

## End(Not run)
```

---

saveNC	<i>Save .nc file</i>
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---

**Description**

Function to save data compatible with pRecipe in .nc file

**Usage**

```
saveNC(x, file, name = "tp", longname = "Total precipitation", units = "mm")
```

**Arguments**

x	Raster* object
file	character
name	character
longname	character
units	character

**Value**

No return value, called to save a file

**Examples**

```
## Not run:  
save_nc(dummie_brick, "gpcp_tp_mm_global_197901_202205_025_monthly.nc")  
  
## End(Not run)
```

---

subset_data	<i>Subset data in space and time</i>
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---

**Description**

The function subset\_data subsets the data in space within a bounding box, and/or in time within a year range.

**Usage**

```
subset_data(x, box = NULL, yrs = NULL)

## S4 method for signature 'Raster'
subset_data(x, box = NULL, yrs = NULL)

## S4 method for signature 'data.table'
subset_data(x, box = NULL, yrs = NULL)

## S4 method for signature 'character'
subset_data(x, box = NULL, yrs = NULL)
```

**Arguments**

x	Raster* object; data.table (see details); filename (character, see details)
box	numeric. Bounding box in the form: (xmin, xmax, ymin, ymax)
yrs	numeric. Time range in the form: (start_year, end_year)

**Details**

If 'x' is a data.table, its columns should be named: "lon", "lat", "date", and "value"

If 'x' is a filename, it should point to a \*.nc file.

If subsetting only in space or time then the arguments must be passed by name. I.e., subset\_data(x, box = ...) (space) or subset\_data(x, yrs = ...) (time)

**Value**

Raster\* object; data.table

**Examples**

```
## Not run:
download_data("gldas-vic", tempdir(), timestep = "yearly")
r <- raster::brick(paste0(tempdir(),
"/gldas-vic_tp_mm_land_194801_201412_025_yearly.nc"))
sd <- subset_data(r, c(12.24, 18.85, 48.56, 51.12), c(2000, 2010))
ss <- subset_data(r, box = c(12.24, 18.85, 48.56, 51.12))
st <- subset_data(r, yrs = c(2000, 2010))

## End(Not run)
```

---

tabular	<i>Transform raster into data.table</i>
---------	---

---

**Description**

Function to transform a raster brick into a data.table

**Usage**

```
tabular(x)

## S4 method for signature 'Raster'
tabular(x)

## S4 method for signature 'character'
tabular(x)
```

**Arguments**

x                    Raster\* object; filename (character, see details)

**Value**

data.table

**Examples**

```
## Not run:
download_data("gldas-vic", tempdir(), timestep = "yearly")
r <- raster::brick(paste0(tempdir(),
"/gldas-vic_tp_mm_land_194801_201412_025_yearly.nc"))
s <- tabular(r)

## End(Not run)
```

---

trend	<i>Trends</i>
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---

**Description**

The function trend computes linear slope.

**Usage**

```
trend(x)

## S4 method for signature 'Raster'
trend(x)

## S4 method for signature 'data.table'
trend(x)

## S4 method for signature 'character'
trend(x)
```

**Arguments**

x                      Raster\* object; data.table (see details); filename (character, see details)

**Details**

If 'x' is a data.table, its columns should be named: "lon", "lat", "date", and "value"

If 'x' is a filename, it should point to a \*.nc file.

**Value**

Raster\* object; data.table

---

yearstat	<i>Yearly &lt;stat&gt;</i>
----------	----------------------------

---

**Description**

The function yearstat aggregates the data from monthly to yearly.

**Usage**

```
yearstat(x, stat = "sum")

## S4 method for signature 'Raster'
yearstat(x, stat = "sum")

## S4 method for signature 'data.table'
yearstat(x, stat = "sum")

## S4 method for signature 'character'
yearstat(x, stat = "sum")
```

**Arguments**

`x` Raster\* object; data.table (see details); filename (character, see details)  
`stat` character

**Details**

If `'x'` is a data.table, its columns should be named: "lon", "lat", "date", and "value"

If `'x'` is a filename, it should point to a \*.nc file.

`'stat'` is a character string describing the desired aggregation function. Suitable options are:

- "max"
- "mean"
- "median"
- "min"
- "sum" (default)

**Value**

Raster\* object; data.table

**Examples**

```
## Not run:  
download_data("gldas-vic", path = tempdir())  
r <- raster::brick(paste0(tempdir(),  
"/gldas-vic_tp_mm_land_194801_201412_025_monthly.nc"))  
s <- yearstat(r, "mean")  
  
## End(Not run)
```



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