

Package ‘ClimDatDownloadR’

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Type Package

Title Climate Data Download of Chelsa and WorldClim

Version 1.0.0

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Description Climate Data DownloadR provides functions to download, pre-process and manage CHELSA and WorldClim climate data sets in respective available spatial and temporal resolutions. The output is provided as GEOTIFF, ASCII, or netCDF format. The package's main purpose is to simplify and automate the downloading and pre-processing workflows.

We are not redistributing the climate data sets.

This work is based on work by

Karger et al. (2017) <[doi:10.1038/sdata.2017.122](https://doi.org/10.1038/sdata.2017.122)> (CHELSA),

Hijmans et al. (2005) <[doi:10.1002/joc.1276](https://doi.org/10.1002/joc.1276)> (WorldClim 1.4),

and Fick and Hijmans (2017) <[doi:10.1002/joc.5086](https://doi.org/10.1002/joc.5086)> (WorldClim 2.1).

A applied comparison of the two data sets is given by

Bobrowski & Schickhoff 2017 <[doi:10.1016/j.ecolmodel.2017.05.021](https://doi.org/10.1016/j.ecolmodel.2017.05.021)>.

URL <[doi:10.5281/zenodo.7924343](https://doi.org/10.5281/zenodo.7924343)>, <https://github.com/HelgeJentsch/ClimDatDownloadR>

BugReports <https://github.com/HelgeJentsch/ClimDatDownloadR/issues>

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Encoding UTF-8

Depends R (>= 3.6),
terra (>= 1.7-18)

Imports curl (>= 4.3.2),
httr (>= 1.4.1),
ncdf4 (>= 1.17),
RCurl (>= 1.98),
RefManageR (>= 1.2.12),
stringr (>= 1.4.0),
sf (>= 0.9-4),
sp (>= 1.4-1),
utils

RoxygenNote 7.3.3

Suggests knitr,
testthat (>= 3.0.0),
usethis,
rmarkdown

VignetteBuilder knitr

SystemRequirements Tested with at least 4 GB RAM.

NeedsCompilation no

Config/testthat/edition 3

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Chelsa.Clim.download	<i>Function for downloading the CHELSA climate dataset (1979-2013)</i>
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Description

This function supports the download, pre-processing and management of CHELSA climate data comprising of monthly precipitation sums in mm, monthly temperature (average, minimum, maximum) in degrees Celsius, and annual characteristics (19 bioclimatic variables). The spatial resolution of the downloaded data is 30 arc-seconds.

To allow pre-processing, clipping and buffering, conversion to ASCII-grids and stacking options are included.

Optional an output of a .bib-file of the cited literature can be retrieved.

For user convenience, saving directories will be created automatically. Also options to "zip" and/or delete the RAW-files are included.

Usage

```
Chelsa.Clim.download(
  save.location = "./",
  parameter = c("prec", "temp", "tmax", "tmin", "bio"),
  bio.var = c(1:19),
  month.var = c(1:12),
  version.var = c("1.2", "2.1"),
```

```

clipping = FALSE,
clip.shapefile = NULL,
clip.extent = c(-180, 180, -90, 90),
buffer = 0,
convert.files.to.asc = FALSE,
stacking.data = FALSE,
combine.raw.zip = FALSE,
delete.raw.data = FALSE,
save.bib.file = TRUE,
save.download.table = TRUE
)

```

Arguments

save.location	string. Input where the datasets will be saved. Default: Working Directory.
parameter	string (vector). Input of parameters which should be downloaded. Default: c("prec", "temp", "tmax", "tmin", "bio")
bio.var	integer (vector). Input which monthly data should be downloaded. Only applicable to BIOCLIM variables. For further information see: https://www.chelsa-climate.org/bioclim/ . Default: c(1:19)
month.var	integer (vector). Input which monthly data should be downloaded. Only applicable to precipitation and temperature (average, maximum, minimum). Default: c(1:12)
version.var	string (vector). Input which version of the dataset should be downloaded. Multiple selection is possible. Default: c("1.2")
clipping	logical. Input whether the downloaded data should be clipped. If FALSE: clip.shapefile, buffer, clip.extent will be ignored. Default: FALSE
clip.shapefile	string. Input which shapefile should be used for clipping. Default: NULL
clip.extent	numeric (vector). Input vector with four numeric values. This is following the input order c("xleft", "xright", "ybottom", "ytop"). Default: c(-180, 180, -90, 90)
buffer	numeric. Input of decimal degrees of buffer around the shapefile and/or extent. Default: 0
convert.files.to.asc	logical. Input whether files should be converted into the ASCII format. If TRUE: a new subdirectory is created and the rawdata is saved there. If clipping is TRUE: the clipped raster files are also saved as ASCII grids. Default: FALSE
stacking.data	logical. Input whether the downloaded data should be stacked as a netCDF-rasterstack. Default: FALSE
combine.raw.zip	logical. Should the downloaded raw-data be "zipped". Default: FALSE

```

delete.raw.data      logical. Should the downloaded raw-data be deleted.
                     If combine.raw.zip is TRUE: raw-data is still available in the zipped file.
                     Default: FALSE

save.bib.file        logical. Whether a BibTex-citation file of the dataset should be provided in the
                     Working directory.
                     Default: TRUE

save.download.table  logical. Whether a table containing the download infos should be saved.
                     Default: TRUE

```

Value

CHELSEA climate datasets for the period of 1979 - 2013

Note

Please note that the downloaded data for temperature and the first eleven bioclim-variables are processed to °C with one significant decimal without offset and factor. Processing and conversion to other file-formats on a global dataset may take some time.

Author(s)

Helge Jentsch

References

D. N. Karger, O. Conrad, J. Böhner , et al. _Climatologies at high resolution for the earth's land surface areas_. In: _Scientific Data_ 4.1 (Sep. 2017). DOI: 10.1038/sdata.2017.122. <URL: <https://doi.org/10.1038/sdata.2017.122>>.

D. N. Karger, O. Conrad, J. Böhner , et al. _Data from: Climatologies at high resolution for the earth's land surface areas_. En. 2018. DOI: 10.5061/DRYAD.KD1D4. <URL: <https://datadryad.org/stash/dataset/doi:10.5061/DRYAD.KD1D4>>.

D. N. Karger, O. Conrad, J. Böhner , et al. _Climatologies at high resolution for the earth's land surface areas_ EnviDat. (2021) DOI: 10.16904/envodat.228. <URL: <https://www.doi.org/10.16904/envodat.228>>.

Examples

```

## Not run:
# Bioclim
Chelsa.Clim.download(parameter = "bio", bio.var = c(1,19))
# Precipitation
Chelsa.Clim.download(parameter = "prec", month.var = c(1,12))

## End(Not run)

```

Chelsa.CMIP_5.download

Function for downloading CHELSA CMIP 5 future climatologies for the years 2041-2060 and 2061-2080

Description

This function supports the download of CHELSA CMIP5 future climate scenarios comprising of monthly precipitation sums in mm, monthly temperature (average, minimum, maximum) in degrees Celsius, and annual characteristics (19 bioclimatic variables).

To allow pre-processing, clipping and buffering, conversion to ASCII-grids and stacking options are included.

Optional an output of a .bib-file of the cited literature can be retrieved.

For user convenience, saving directories will be created automatically. Also options to "zip" and/or delete the RAW-files are included.

Usage

```
Chelsa.CMIP_5.download(
  save.location = "./",
  parameter = c("prec", "temp", "tmax", "tmin", "bio"),
  bio.var = c(1:19),
  month.var = c(1:12),
  emission.scenario.var = c("rcp26", "rcp45", "rcp60", "rcp85"),
  time.interval.var = c("2041-2060", "2061-2080"),
  model.var = c("ACCESS1-0", "bcc-csm1-1", "BNU-ESM", "CanESM2", "CCSM4", "CESM1-BGC",
    "CESM1-CAM5", "CMCC-CESM", "CMCC-CM", "CMCC-CMS", "CNRM-CM5", "CSIRO-Mk3-6-0",
    "CSIRO-Mk3L-1-2", "EC-EARTH", "FGOALS-g2", "FIO-ESM", "GFDL-CM3", "GFDL-ESM2G",
    "GFDL-ESM2M", "GISS-E2-H", "GISS-E2-H-CC", "GISS-E2-R", "GISS-E2-R-CC", "HadGEM2-A0",
    "HadGEM2-CC", "HadGEM2-ES", "inmcm4", "IPSL-CM5A-LR", "IPSL-CM5A-MR", "MIROC-ESM",
    "MIROC-ESM-CHEM", "MIROC5", "MPI-ESM-LR", "MPI-ESM-MR", "MRI-CGCM3", "MRI-ESM1",
    "NorESM1-M", "NorESM1-ME"),
  clipping = FALSE,
  clip.shapefile = NULL,
  clip.extent = c(-180, 180, -90, 90),
  buffer = 0,
  convert.files.to.asc = FALSE,
  stacking.data = FALSE,
  combine.raw.zip = FALSE,
  delete.raw.data = FALSE,
  save.bib.file = TRUE
)
```

Arguments

save.location	string. Input where the datasets should be saved. Default: Working Directory.
parameter	string (vector). Input of parameters which should be downloaded. Default: c("prec", "temp", "tmax", "tmin", "bio")

bio.var	integer (vector). Input which monthly data should be downloaded. Only applicable to BIOCLIM variables. For further information see: https://www.chelsa-climate.org/bioclim/ . Default: c(1:19)
month.var	integer (vector). Input which monthly data should be downloaded. Only applicable to Precipitation and Temperature (average, maximum, minimum). Default: c(1:12)
emission.scenario.var	string (vector). Input which emission scenario dataset should be downloaded. Provided are the representative concentration pathways (RCP) 2.6, 4.5, 6.0, and 8.5. Default: c("rcp26", "rcp45", "rcp60", "rcp85")
time.interval.var	string (vector). Input for which time interval data should be downloaded. CHELSA provides downscaled CMIP5 climatologies for 2050 and 2070. Multiple inputs possible. Default: c("2041-2060", "2061-2080")
model.var	string (vector). Input which future model dataset should be downloaded. For more information see: https://www.chelsa-climate.org/future/ . For some of the datasets not all downloads are available. For the ones that are not supported the data will not be downloaded and a warning will be prompted. For an overview please try "warnings()" after execution. Default: c("ACCESS1-0", "bcc-csm1-1", "BNU-ESM", "CanESM2", "CCSM4", "CESM1-BGC", "CESM1-CAM5", "CMCC-CESM", "CMCC-CM", "CMCC-CMS", "CNRM-CM5", "CSIRO-Mk3-6-0", "CSIRO-Mk3L-1-2", "EC-EARTH", "FGOALS-g2", "FIO-ESM", "GFDL-CM3", "GFDL-ESM2G", "GFDL-ESM2M", "GISS-E2-H", "GISS-E2-H-CC", "GISS-E2-R", "GISS-E2-R-CC", "HadGEM2-A0", "HadGEM2-CC", "HadGEM2-ES", "inmcm4", "IPSL-CM5A-LR", "IPSL-CM5A-MR", "MIROC-ESM", "MIROC-ESM-CHEM", "MIROC5", "MPI-ESM-LR", "MPI-ESM-MR", "MRI-CGCM3", "MRI-ESM1", "NorESM1-M", "NorESM1-ME")
clipping	logical. Input whether the downloaded data should be clipped. If FALSE clip.shapefile, buffer, clip.extent will be ignored. Default: FALSE
clip.shapefile	string. Input which shapefile should be used for clipping. Default: NULL
clip.extent	numeric (vector). Input vector with four numeric values. This is following the input order c("xleft", "xright", "ybottom", "ytop"). Default: c(-180, 180, -90, 90)
buffer	numeric. Input of decimal degrees of buffer around the shapefile and/or extent. Default: 0
convert.files.to.asc	logical. Input whether files should be converted into the ASCII format. If TRUE: a new subdirectory is created and the rawdata is saved there. If clipping is TRUE: the clipped raster files are also saved as ASCII grids. Default: FALSE
stacking.data	logical. Input whether the downloaded data should be stacked as a netCDF-rasterstack. Default: FALSE

```

combine.raw.zip
    logical. Should the downloaded raw-data be "zipped".
    Default: FALSE
delete.raw.data
    logical. Should the downloaded raw-data be deleted. If the combine.raw.zip
    is TRUE: raw-data is still available in the zipped file.
    Default: FALSE
save.bib.file
    logical. Whether a BibTex-citation file of the dataset should be provided in the
    Working directory.
    Default: TRUE

```

Details

"The downscaled data has been produced using climatological aided interpolation based on the 1979-2013 reference climatologies from CHELSA." (CHELSA Climate 2020: <https://www.chelsa-climate.org/future/>)

Value

Downscaled CHELSA CMIP5 climatologies for 2050 and 2070.

Note

Please note that the downloaded data for temperature and the therefore also the first eleven bioclim-variables are processed to °C with one significant decimal without offset and factor. Processing and conversion to other file-formats on a global dataset may take some time.

For some of the datasets not all models and rcps are available. For the ones that are not supported the data will not be downloaded and a warning will be prompted. See parameter `model.var` for more information or check the website of CHELSA Climate (<https://www.chelsa-climate.org/future/>). Please note, that the downloaded data for temperature and the therefore also the first eleven bioclim-variables are processed to °C without offset and factor. Processing and conversion to other file-formats on a global dataset may take some time.

Author(s)

Helge Jentsch

References

D. N. Karger, O. Conrad, J. Böhner , et al. "Climatologies at high resolution for the earth's land surface areas". In: *_Scientific Data_* 4.1 (Sep. 2017). DOI: 10.1038/sdata.2017.122. <URL: <<https://doi.org/10.1038/sdata.2017.122>>».

D. N. Karger, O. Conrad, J. Böhner , et al. *_Data from: Climatologies at high resolution for the earth's land surface areas_*. En. 2018. DOI: 10.5061/DRYAD.KD1D4. <URL: <<https://datadryad.org/stash/dataset/doi:10.5061/DRYAD.KD1D4>>».

Examples

```

## Not run:
# Bioclim
Chelsa.CMIP_5.download(parameter = "bio",
    bio.var = c(1,19),
    emission.scenario.var = "rcp26",
    time.interval.var = "2041-2060",
    model.var = "MPI-ESM-LR")

```

```
# Precipitation
Chelsa.CMIP_5.download(parameter = "prec",
                        month.var = c(1,12),
                        emission.scenario.var = "rcp26",
                        time.interval.var = "2041-2060",
                        model.var = "MPI-ESM-LR")

## End(Not run)
```

Chelsa.CMIP_6.download

Function for downloading CHELSA CMIP 6 future climatologies for the years 2011-2040, 2041-2070, and 2071-2100

Description

This function supports the download of CHELSA CMIP6 future climate scenarios comprising of monthly precipitation sums in mm, monthly temperature (average, minimum, maximum) in degrees Celsius, and annual characteristics (19 bioclimatic variables).

To allow pre-processing, clipping and buffering, conversion to ASCII-grids and stacking options are included.

Optional an output of a .bib-file of the cited literature can be retrieved.

For user convenience, saving directories will be created automatically. Also options to "zip" and/or delete the RAW-files are included.

Usage

```
Chelsa.CMIP_6.download(
  save.location = "./",
  parameter = c("prec", "temp", "tmax", "tmin", "bio"),
  bio.var = c(1:19),
  month.var = c(1:12),
  emission.scenario.var = c("ssp126", "ssp370", "ssp585"),
  time.interval.var = c("2011-2040", "2041-2070", "2071-2100"),
  model.var = c("gfdl-esm4", "ukesm1-0-ll", "mpi-esm1-2-hr", "ipsl-cm6a-lr",
    "mri-esm2-0"),
  clipping = FALSE,
  clip.shapefile = NULL,
  clip.extent = c(-180, 180, -90, 90),
  buffer = 0,
  convert.files.to.asc = FALSE,
  stacking.data = FALSE,
  combine.raw.zip = FALSE,
  delete.raw.data = FALSE,
  save.bib.file = TRUE
)
```

Arguments

save.location string. Input where the datasets should be saved.
 Default: Working Directory.

parameter	string (vector). Input of parameters which should be downloaded. Default: c("prec", "temp", "tmax", "tmin", "bio")
bio.var	integer (vector). Input which monthly data should be downloaded. Only applicable to BIOCLIM variables. For further information see: https://www.chelsa-climate.org/bioclim/ . Default: c(1:19)
month.var	integer (vector). Input which monthly data should be downloaded. Only applicable to Precipitation and Temperature (average, maximum, minimum). Default: c(1:12)
emission.scenario.var	string (vector). Input which SSP (Shared Socioeconomic Pathways) scenario dataset should be downloaded. Provided are the SSP scenarios 1 (SSP126), 3 (SSP370), and 5 (SSP585). Default: c("ssp126", "ssp370", "ssp585")
time.interval.var	string (vector). Input for which time interval data should be downloaded. CHELSA provides downscaled CMIP6 climatologies for 2050 and 2070. Multiple inputs possible. Default: c("2041-2060", "2061-2080")
model.var	string (vector). Input which future model dataset should be downloaded. For more information see: https://www.chelsa-climate.org/future/ . For some of the datasets not all downloads are available. For the ones that are not supported the data will not be downloaded and a warning will be prompted. For an overview please try "warnings()" after execution. Default: c("gfdl-esm4", "ukesm1-0-11", "mpi-esm1-2-hr", "ips1-cm6a-lr", "mri-esm2-0")
clipping	logical. Input whether the downloaded data should be clipped. If FALSE clip.shapefile, buffer, clip.extent will be ignored. Default: FALSE
clip.shapefile	string. Input which shapefile should be used for clipping. Default: NULL
clip.extent	numeric (vector). Input vector with four numeric values. This is following the input order c("xleft", "xright", "ybottom", "ytop"). Default: c(-180, 180, -90, 90)
buffer	numeric. Input of decimal degrees of buffer around the shapefile and/or extent. Default: 0
convert.files.to.asc	logical. Input whether files should be converted into the ASCII format. If TRUE: a new subdirectory is created and the rawdata is saved there. If clipping is TRUE: the clipped raster files are also saved as ASCII grids. Default: FALSE
stacking.data	logical. Input whether the downloaded data should be stacked as a netCDF-rasterstack. Default: FALSE
combine.raw.zip	logical. Should the downloaded raw-data be "zipped". Default: FALSE
delete.raw.data	logical. Should the downloaded raw-data be deleted. If the combine.raw.zip is TRUE: raw-data is still available in the zipped file. Default: FALSE


```

time.interval.var = "2071-2100",
model.var = "gfdl-esm4")

## End(Not run)

```

Chelsa.CRUts.download *CHELSA CRU Timeseries Download*

Description

This function supports a download of the CHELSA CRU Timeseries dataset (Jan. 1901 - Dec. 2016). This includes precipitation sums in mm and temperature (maximum, minimum) in degree Celsius. For further information, please regard <https://www.chelsa-climate.org/chelsacruts/>. To allow pre-processing, clipping and buffering, conversion to ASCII-grids and stacking options are included.

Optional an output of a .bib-file of the cited literature can be retrieved.

For user convenience, saving directories will be created automatically. Also options to "zip" and/or delete the RAW-files are included.

Usage

```

Chelsa.CRUts.download(
  save.location = "./",
  parameter = c("prec", "tmax", "tmin"),
  start.year.var = 1901,
  start.month.var = 1,
  end.year.var = 2016,
  end.month.var = 12,
  include.month.var = c(1:12),
  clipping = FALSE,
  clip.shapefile = NULL,
  buffer = 0,
  clip.extent = c(-180, 180, -90, 90),
  convert.files.to.asc = FALSE,
  stacking.data = FALSE,
  combine.raw.zip = FALSE,
  delete.raw.data = FALSE,
  save.bib.file = TRUE
)

```

Arguments

save.location	string. Input where the datasets should be saved. Default: Working Directory.
parameter	string (vector). Input of parameters which should be downloaded. Default: c("prec", "tmax", "tmin")
start.year.var	integer. Input year the download timeseries starts. Default: 1901 (minimum)
start.month.var	integer. Input month the download timeseries starts. Default: 1 (minimum)

<code>end.year.var</code>	integer. Input year the download timeseries ends. Default: 2016 (maximum)
<code>end.month.var</code>	integer. Input month the download timeseries ends. Default: 12 (maximum)
<code>include.month.var</code>	integer (vector). Input which monthly data should be downloaded. Default: <code>c(1:12)</code>
<code>clipping</code>	logical. Input whether the downloaded data should be clipped. If FALSE: <code>clip.shapefile</code> , <code>buffer</code> , <code>clip.extent</code> will be ignored. Default: FALSE
<code>clip.shapefile</code>	string. Input which shapefile should be used for clipping. Default: NULL
<code>buffer</code>	numeric. Input of decimal degrees of buffer around the shapefile and/or extent. Default: 0
<code>clip.extent</code>	numeric (vector). Input vector with four numeric values. This is following the input order <code>c("xleft", "xright", "ybottom", "ytop")</code> . Default: <code>c(-180, 180, -90, 90)</code>
<code>convert.files.to.asc</code>	logical. Input whether files should be converted into the ASCII format. If TRUE: a new subdirectory is created and the rawdata is saved there. If clipping is TRUE: the clipped raster files are also saved as ASCII grids. Default: FALSE
<code>stacking.data</code>	logical. Input whether the downloaded data should be stacked as a netCDF-rasterstack. Default: FALSE
<code>combine.raw.zip</code>	logical. Should the downloaded raw-data be "zipped". Default: FALSE
<code>delete.raw.data</code>	logical. Should the downloaded raw-data be deleted. If <code>combine.raw.zip</code> is TRUE: raw-data is still available in the zipped file. Default: FALSE
<code>save.bib.file</code>	logical. Whether a BibTex-citation file of the dataset should be provided in the Working directory. Default: TRUE

Value

Custom dataset of CHELSA CRU Timeseries for a chosen timeseries.

Note

Please note that the downloaded data for temperature is processed to °C with one significant decimal without offset and factor. Processing and conversion to other file-formats on a global dataset may take some time.

Author(s)

Helge Jentsch

References

D. N. Karger, O. Conrad, J. Böhrner, et al. "Climatologies at high resolution for the earth's land surface areas". In: *_Scientific Data_* 4.1 (Sep. 2017). DOI: 10.1038/sdata.2017.122. <URL: <<https://doi.org/10.1038/sdata.2017.122>>.

D. N. Karger, O. Conrad, J. Böhrner, et al. *_Data from: Climatologies at high resolution for the earth's land surface areas_*. En. 2018. DOI: 10.5061/DRYAD.KD1D4. <URL: <<https://datadryad.org/stash/dataset/doi:10.5061/DRYAD.KD1D4>>.

D. N. Karger and N. E. Zimmermann. *_CHELSAcruts - High resolution temperature and precipitation timeseries for the 20th century and beyond_*. 2018. DOI: <<https://dx.doi.org/10.16904/envdatat.159>>.

Examples

```
## Not run:
Chelsa.CRUTs.download(parameter = "prec",
                      start.year.var = 2000,
                      start.month.var = 1,
                      end.year.var = 2002,
                      end.month.var = 12,
                      include.month.var = c(1,12))

## End(Not run)
```

Chelsa.lgm.download *Function for downloading CHELSA Last Glacial Maximum datasets*

Description

This function supports a download of the CHELSA Last Glacial Maximum Climate datasets (21.000 BP). This includes monthly precipitation sums in mm, monthly temperature (average, maximum, minimum) in degree Celsius, annual characteristics (19 bioclimatic parameters), and a global digital elevation model. For further information, please regard <https://www.chelsa-climate.org/last-glacial-maximum-climate/>.

To allow pre-processing, clipping and buffering, conversion to ASCII-grids and stacking options are included.

Optional an output of a .bib-file of the cited literature can be retrieved.

For user convenience, saving directories will be created automatically. Also options to "zip" and/or delete the RAW-files are included.

Usage

```
Chelsa.lgm.download(
  save.location = "./",
  parameter = c("prec", "temp", "tmax", "tmin", "bio"),
  bio.var = c(1:19),
  month.var = c(1:12),
  model.var = c("CCSM4", "MRI-CGCM3", "CNRM-CM5", "FGOALS-g2", "IPSL-CM5A-LR",
               "MIROC-ESM", "MPI-ESM-P"),
  download.dem = FALSE,
  clipping = FALSE,
  clip.shapefile = NULL,
  clip.extent = c(-180, 180, -90, 90),
```

```

buffer = 0,
convert.files.to.asc = FALSE,
stacking.data = FALSE,
combine.raw.zip = FALSE,
delete.raw.data = FALSE,
save.bib.file = TRUE
)

```

Arguments

save.location	string. Input where the datasets should be saved. Default: Working Directory.
parameter	string (vector). Input of parameters which should be downloaded. Default: c("prec", "temp", "tmax", "tmin", "bio")
bio.var	integer (vector). Input which bioclim data should be downloaded. Only applicable to BIOCLIM variables. For further information see: https://www.chelsa-climate.org/bioclim/ . Default: c(1:19)
month.var	integer (vector). Input which monthly data should be downloaded. Only applicable to Precipitation and Temperature (average, maximum, minimum). Default: c(1:12)
model.var	string (vector). Input which future model dataset should be downloaded. For more information see: https://www.chelsa-climate.org/last-glacial-maximum-climate/ . For some of the datasets not all downloads are available. For the ones that are not supported the data will not be downloaded and a warning will be prompted. For an overview please try "warnings()" after execution. Default: c("CCSM4", "MRI-CGCM3", "CNRM-CM5", "FGOALS-g2", "IPSL-CM5A-LR", "MIROC-ESM", "MPI-ESM-P")
download.dem	logical. Input whether a LGM digital elevation model should be downloaded. Default: FALSE
clipping	logical. Input whether the downloaded data should be clipped. If FALSE; clip.shapefile, buffer, clip.extent will be ignored. Default: FALSE
clip.shapefile	string. Input which shapefile should be used for clipping. Default: NULL
clip.extent	numeric (vector). Input vector with four numeric values. This is following the input order c("xleft", "xright", "ybottom", "ytop"). Default: c(-180, 180, -90, 90)
buffer	numeric. Input of decimal degrees of buffer around the shapefile and/or extent. Default: 0
convert.files.to.asc	logical. Input whether files should be converted into the ASCII format. If TRUE: a new subdirectory is created and the rawdata is saved there. If clipping is TRUE: the clipped raster files are also saved as ASCII grids. Default: FALSE
stacking.data	logical. Input whether the downloaded data should be stacked as a netCDF-rasterstack. Default: FALSE
combine.raw.zip	logical. Should the downloaded raw-data be "zipped". Default: FALSE

`delete.raw.data` logical. Should the downloaded raw-data be deleted. If the "combine.raw.zip"-option is TRUE, raw-data is still available in the zipped file.
Default: FALSE

`save.bib.file` logical. Whether a BibTex-citation file of the CHELSA dataset should be provided in the Working directory.
Default: TRUE

Details

"The CHELSA LGM data is based on a implementation of the CHELSA algorithm on PMIP3 data."
(CHELSA Climate 2020: <https://www.chelsa-climate.org/last-glacial-maximum-climate/>)

Value

Downscaled global climatological data from the last glacial maximum.

Note

Please note that the downloaded data for temperature and the therefore also the first eleven bioclim-variables are processed to °C with one significant decimal without offset and factor. Processing and conversion to other file-formats on a global dataset may take some time.

For some of the datasets not all models are available. For the ones that are not supported the data will not be downloaded and a warning will be prompted. See parameter `model.var` for more information or check the website of CHELSA Climate (<https://www.chelsa-climate.org/last-glacial-maximum-climate/>).

Author(s)

Helge Jentsch

References

D. N. Karger, O. Conrad, J. Böhner , et al. "Climatologies at high resolution for the earth's land surface areas". In: *_Scientific Data_* 4.1 (Sep. 2017). DOI: 10.1038/sdata.2017.122. <URL: <<https://doi.org/10.1038/sdata.2017.122>>.

D. N. Karger, O. Conrad, J. Böhner , et al. *_Data from: Climatologies at high resolution for the earth's land surface areas_*. En. 2018. DOI: 10.5061/DRYAD.KD1D4. <URL: <<https://datadryad.org/stash/dataset/doi:10.5061/DRYAD.KD1D4>>.

Examples

```
## Not run:
# Bioclim
Chelsa.lgm.download(parameter = "bio",
                    bio.var = c(1,19),
                    model.var = "MPI-ESM-P")

# Precipitation
Chelsa.lgm.download(parameter = "prec",
                    month.var = c(1,12),
                    model.var = "MPI-ESM-P")

## End(Not run)
```

Chelsa.timeseries.download

CHELSA Timeseries Download

Description

This function supports a download of the CHELSA Timeseries dataset (Jan. 1979 - Dec. 2013). This includes precipitation sums (mm) and temperature (average, maximum, minimum; °C) parameters. For further information, please regard <https://www.chelsa-climate.org/timeseries/>. To allow pre-processing, clipping and buffering, conversion to ASCII-grids and stacking options are included.

Optional an output of a .bib-file of the cited literature can be retrieved.

For user convenience, saving directories will be created automatically. Also options to "zip" and/or delete the RAW-files are included.

This function supports a download of the CHELSA Timeseries dataset (Jan. 1979 - Dec. 2013). This includes precipitation sums (mm) and temperature (average, maximum, minimum; °C) parameters. For further information, please regard <https://www.chelsa-climate.org/timeseries/>. To allow pre-processing, clipping and buffering, conversion to ASCII-grids and stacking options are included.

Optional an output of a .bib-file of the cited literature can be retrieved.

For user convenience, saving directories will be created automatically. Also options to "zip" and/or delete the RAW-files are included.

Usage

```
Chelsa.timeseries.download(
  save.location = "./",
  parameter = c("prec", "temp", "tmax", "tmin", "pet"),
  start.year.var = 1979,
  start.month.var = 1,
  end.year.var = 2013,
  end.month.var = 12,
  include.month.var = c(1:12),
  version.var = c("1.2"),
  clipping = FALSE,
  clip.shapefile = NULL,
  buffer = 0,
  clip.extent = c(-180, 180, -90, 90),
  convert.files.to.asc = FALSE,
  combine.raw.zip = FALSE,
  delete.raw.data = FALSE,
  save.bib.file = TRUE
)
```

```
Chelsa.timeseries.download(
  save.location = "./",
  parameter = c("prec", "temp", "tmax", "tmin", "pet"),
  start.year.var = 1979,
  start.month.var = 1,
  end.year.var = 2013,
```



```

end.month.var = 12,
include.month.var = c(1:12),
version.var = c("1.2"),
clipping = FALSE,
clip.shapefile = NULL,
buffer = 0,
clip.extent = c(-180, 180, -90, 90),
convert.files.to.asc = FALSE,
combine.raw.zip = FALSE,
delete.raw.data = FALSE,
save.bib.file = TRUE
)

```

Arguments

<code>save.location</code>	string. Input where the datasets should be saved. Default: Working Directory.
<code>parameter</code>	string (vector). Input of parameters which should be downloaded. Default: <code>c("prec", "tmax", "tmin")</code>
<code>start.year.var</code>	integer. Input year the download timeseries starts. Default: 1979 (minimum)
<code>start.month.var</code>	integer. Input month the download timeseries starts. Default: 1 (minimum)
<code>end.year.var</code>	integer. Input year the download timeseries ends. Default: 2013 (maximum)
<code>end.month.var</code>	integer. Input month the download timeseries ends. Default: 12 (maximum)
<code>include.month.var</code>	integer (vector). Input which monthly data should be downloaded. Default: <code>c(1:12)</code>
<code>version.var</code>	string (vector). Input which version of the dataset should be downloaded. Multiple selection is <code>_not_</code> possible. Select between version <code>_1.2_</code> and <code>_2.1_</code> . Default: <code>c("1.2")</code>
<code>clipping</code>	logical. Input whether the downloaded data should be clipped. If FALSE: <code>clip.shapefile</code> , <code>buffer</code> , <code>clip.extent</code> will be ignored. Default: FALSE
<code>clip.shapefile</code>	string. Input which shapefile should be used for clipping. Default: NULL
<code>buffer</code>	numeric. Input of decimal degrees of buffer around the shapefile and/or extent. Default: 0
<code>clip.extent</code>	numeric (vector). Input vector with four numeric values. This is following the input order <code>c("xleft", "xright", "ybottom", "ytop")</code> . Default: <code>c(-180, 180, -90, 90)</code>
<code>convert.files.to.asc</code>	logical. Input whether files should be converted into the ASCII format. If TRUE: a new subdirectory is created and the rawdata is saved there. If clipping is TRUE: the clipped raster files are also saved as ASCII grids. Default: FALSE

```

combine.raw.zip
    logical. Should the downloaded raw-data be "zipped".
    Default: FALSE
delete.raw.data
    logical. Should the downloaded raw-data be deleted. If combine.raw.zip is
    TRUE: raw-data is still available in the zipped file.
    Default: FALSE
save.bib.file
    logical. Whether a BibTex-citation file of the dataset should be provided in the
    Working directory.
    Default: TRUE

```

Value

Custom dataset of CHELSA Timeseries for a chosen timeseries.

Custom dataset of CHELSA Timeseries for a chosen timeseries.

Note

Please note that the downloaded data for temperature are processed to °C with one significant decimal without offset and factor. Processing and conversion to other file-formats on a global dataset may take some time.

Please note that the downloaded data for temperature are processed to °C with one significant decimal without offset and factor. Processing and conversion to other file-formats on a global dataset may take some time.

Author(s)

Helge Jentsch

References

D. N. Karger, O. Conrad, J. Böhner , et al. "Climatologies at high resolution for the earth's land surface areas". In: *_Scientific Data_* 4.1 (Sep. 2017). DOI: 10.1038/sdata.2017.122. <URL: <<https://doi.org/10.1038/sdata.2017.122>>.

D. N. Karger, O. Conrad, J. Böhner , et al. *_Data from: Climatologies at high resolution for the earth's land surface areas_*. En. 2018. DOI: 10.5061/DRYAD.KD1D4. <URL: <<https://datadryad.org/stash/dataset/doi:10.5061/DRYAD.KD1D4>>.

D. N. Karger, O. Conrad, J. Böhner , et al. "Climatologies at high resolution for the earth's land surface areas". In: *_Scientific Data_* 4.1 (Sep. 2017). DOI: 10.1038/sdata.2017.122. <URL: <https://doi.org/10.1038/sdata.2017.122>>.

D. N. Karger, O. Conrad, J. Böhner , et al. *_Data from: Climatologies at high resolution for the earth's land surface areas_*. En. 2018. DOI: 10.5061/DRYAD.KD1D4. <URL: <https://datadryad.org/stash/dataset/doi:10.5061/DRYAD.KD1D4>>.

Examples

```

## Not run:
Chelsa.timeseries.download(parameter = "prec",
                           start.year.var = 2000,
                           start.month.var = 1,
                           end.year.var = 2002,
                           end.month.var = 12,
                           include.month.var = c(1,12))

## End(Not run)

```

```
## Not run:
Chelsa.timeseries.download(parameter = "prec",
                           start.year.var = 2000,
                           start.month.var = 1,
                           end.year.var = 2002,
                           end.month.var = 12,
                           version.var = "1.2",
                           include.month.var = c(1,12))

## End(Not run)
```

clipping.tif

Clipping .tif-raster files in one specified directory

Description

This function clips all .tif-raster files at a defined extent (e.g., shapefile or coordinates). Additionally, a buffer can be specified and added to the clipping extent. For user convenience, clipped rasters will be saved to a specified directory (clip.save.location). Furthermore, an option for conversion to ASCII format is given.

Usage

```
clipping.tif(
  clip.save.location = "./",
  clip.shapefile = NULL,
  clip.extent = c(-180, 180, -90, 90),
  buffer = 0,
  convert.files.to.asc = FALSE,
  time.stamp.var = str_replace_all(str_replace_all(paste0(Sys.time()), pattern = ":"),
    replacement = "-"), pattern = " ", replacement = "_")
)
```

Arguments

clip.save.location	string (directory path). The directory where .tif-raster files are saved. Default: "." (Working directory)
clip.shapefile	string (file path to a ESRI shapefile with the file extension ".shp"). Extent of this shapefile is used to clip the .tif-raster files if no buffer is specified. Default: NULL
clip.extent	numeric (vector). Input vector with four numeric values. This is following the input order c("xleft", "xright", "ybottom", "ytop"). It is used if no shapefile input is specified. If also left unspecified, the maximum extent (of the raster file) is used. Default: c(-180, 180, -90, 90)
buffer	numeric. Input of decimal degrees of buffer around the shapefile and/or extent. Default: 0

```

convert.files.to.asc
    logical. Input whether the clipped output should be converted into ASCII-Grids.
    Default: FALSE

time.stamp.var string. Timestamp to create unique directories for multiple run outputs.
    Default: stringr::str_replace_all(stringr::str_replace_all(paste0(
    Sys.time()),pattern = ":",replacement = "-"))

```

Value

This function returns, depending on the parameter `convert.files.to.asc` whether it is ASCII or tif format, clipped raster files to a new directory. This directory is automatically created.

Author(s)

Helge Jentsch

Examples

```

## Not run:
clipping.tif(clip.save.location = terra::rast(
    paste(
      system.file("ex/meuse.tif",
        package = "terra")
    )
  )

## End(Not run)

```

combine.raw.in.zip	<i>Combines all .tif-raster files into a .zip-file</i>
--------------------	--

Description

Combines and saves all .tif-raster files to a .zip-file, whereas name and saving location can be specified.

Usage

```

combine.raw.in.zip(
  save.location = "./",
  zip.name = "RAWDATA",
  unique.name = TRUE,
  time.stamp.var = stringr::str_replace_all(stringr::str_replace_all(paste0(Sys.time()),
    pattern = ":", replacement = "-"), pattern = " ", replacement = "_")
)

```

Arguments

save.location	string (directory path). The directory where .tif-raster files are saved and the created/updated .zip file will be saved. Default: "." (Working directory)
zip.name	string. Input how the .zip-file should be named. Default: "RAWDATA"
unique.name	logical. Should the .zip-file be named uniquely? If TRUE the current system time is added as a timestamp to create unique directories for multiple run outputs. Default: TRUE
time.stamp.var	string. Input of current system time or, if called within another function the initial time of the execution. Default: stringr::str_replace_all(stringr::str_replace_all(paste0(Sys.time()), pattern = ":", replacement = "-"))

Author(s)

Helge Jentsch

convert.to.asc

Converting .tif-raster files in one specified directory into ASCII-Grids

Description

This function converts and saves all .tif-raster files to ASCII-file format to a specified location and creates a new folder named "ASCII_files" with a unique timestamp of the current system time.

Usage

```
convert.to.asc(
  save.location = ".",
  time.stamp.var = str_replace_all(str_replace_all(paste0(Sys.time()), pattern = ":",
    replacement = "-"), pattern = " ", replacement = "_")
)
```

Arguments

save.location	string (directory path). The directory where .tif-raster files are saved. Default: "." (Working directory)
time.stamp.var	string. Timestamp to create unique directories for multiple run outputs. Default: stringr::str_replace_all(stringr::str_replace_all(paste0(Sys.time()), pattern = ":", replacement = "-"))

Value

This function returns ASCII-format raster files to a new directory. This directory is dynamically created.

Author(s)

Helge Jentsch

Examples

```
## Not run:
convert.to.asc(save.location = system.file("pictures/", package = "rgdal"))

## End(Not run)
```

getDownloadSize

Get Download Size

Description

Helper function that returns the download size of a vector of URLs

Usage

```
getDownloadSize(URLVector)
```

Arguments

URLVector Character vector. Multiple vectors of valid URLs.

Value

Download size as double numeric value

Author(s)

Helge Jentsch

process.raster.int.doub

Preprocessing data to get real values

Description

Takes input SpatRaster, processes the integer values into double values, and returns the SpatRaster.

Usage

```
process.raster.int.doub(raster.layer = NULL)
```

Arguments

raster.layer SpatRaster to be processed

Value

SpatRaster

Author(s)

Helge Jentsch

process.raster.offset *Preprocessing data to undo offsetting values*

Description

Takes input SpatRaster, deletes offset, and returns the SpatRaster.

Usage

```
process.raster.offset(raster.layer = NULL, offset = -273.15)
```

Arguments

raster.layer	SpatRaster to be processed.
offset	Numerical value to be offsetted. Default: -273.15.

Value

SpatRaster

Author(s)

Helge Jentsch

save.citation *Save the citation of the downloaded dataset*

Description

Saves the citation of the downloaded dataset into a BibTex-file in the working directory.

Usage

```
save.citation(
  save.location = "./",
  dataSetName = c("CHELSA", "WorldClim1.4", "WorldClim2.1")
)
```

Arguments

save.location	string (directory path). Where the BibTex-file will be saved. Default: "." (Working Directory)
dataSetName	string (vector). Specifies which dataset was downloaded or which citation should be saved. Default: c("Chelsa1.2", "WorldClim1.4", "WorldClim2.1") (all available datasets)

Value

BibTex-file with biliography of the downloaded dataset

Note

DISCLAIMER: No warranty or liability! The citations are provided without any warranty of any kind whatsoever, either expressed or implied, including warranties of merchantability and fitness for a particular purpose. The package author will not be responsible for any incomplete citation of datasets or climate data products downloaded through this package.

Author(s)

Helge Jentsch

Examples

```
## Not run:
save.citation(dataSetName = "Chelsa")
save.citation(dataSetName = "WorldClim1.4")
save.citation(dataSetName = "WorldClim2.1")

## End(Not run)
```

stacking.downloaded.data

Stacking .tif-raster files in one specified directory

Description

This function stacks all .tif-raster files of a specified directory and saves the stacked layers as a netCDF-file in that directory.

Usage

```
stacking.downloaded.data(
  stack.save.location = "./",
  stack.clipped = FALSE,
  parameter.var = NULL,
  variable.numbers = c(1:length(list.files("./", pattern = ".tif"))),
  stack.time.series = FALSE,
  time.series = NULL,
  time.stamp.var = stringr::str_replace_all(stringr::str_replace_all(paste0(Sys.time()),
    pattern = ":", replacement = "-"), pattern = " ", replacement = "_")
)
```

Arguments

stack.save.location	string (directory path). The directory where .tif-raster files are saved. Raster-files must be in a Geographic Coordinate System (in arc-degrees) Default: "./" (Working directory)
stack.clipped	logical. Input whether clipped data should be stacked and saved as netCDF as well. Default: FALSE

`parameter.var` string. Input whether bioclim or climatic parameters are the input for the stacking process.
Default: NULL

`variable.numbers` numeric (vector). Input how the stack variables should be called. By default just a sequence from 1 to the number of tif-raster files are used.
Default: `c(1:length(list.files("./", pattern = ".tif")))`

`stack.time.series` logical. Input whether a timeseries should be stacked.
Default: FALSE

`time.series` string (vector). String input of timeseries vector.
Default: NULL

`time.stamp.var` string. Timestamp to create unique directories for multiple run outputs.
Default: `stringr::str_replace_all(stringr::str_replace_all(paste0(Sys.time()), pattern = ":", replacement = "-"))`

Author(s)

Helge Jentsch

WorldClim.CMIP_5.download

Function for downloading the WorldClim v1.4 CMIP5 future climate dataset

Description

This function supports the download, pre-processing and management of the WorldClim v1.4 CMIP5 future climate dataset.

This comprises of monthly precipitation sums (mm), temperature (maximum, minimum; °C), and annual characteristics (19 bioclimatic variables).

To allow pre-processing, clipping and buffering, conversion to ASCII-grids and stacking options are included.

Optional an output of a .bib-file of the cited literature can be retrieved.

For user convenience, saving directories will be created automatically. Also options to "zip" and/or delete the RAW-files are included.

Usage

```
WorldClim.CMIP_5.download(
  save.location = "./",
  parameter = c("prec", "tmax", "tmin", "bio"),
  bio.var = c(1:19),
  month.var = c(1:12),
  resolution = c("10min", "5min", "2.5min", "30s"),
  model.var = c("ACCESS1-0", "BCC-CSM1-1", "CCSM4", "CESM1-CAM5-1-FV2", "CNRM-CM5",
    "GFDL-CM3", "GFDL-ESM2G", "GISS-E2-R", "HadGEM2-A0", "HadGEM2-CC", "HadGEM2-ES",
    "INMCM4", "IPSL-CM5A-LR", "MIROC-ESM-CHEM", "MIROC-ESM", "MIROC5", "MPI-ESM-LR",
    "MRI-CGCM3", "NorESM1-M"),
  emission.scenario.var = c("rcp26", "rcp45", "rcp60", "rcp85"),
```

```

time.interval.var = c("2050", "2070"),
clipping = FALSE,
clip.shapefile = NULL,
clip.extent = c(-180, 180, -90, 90),
buffer = 0,
convert.files.to.asc = FALSE,
stacking.data = FALSE,
keep.raw.zip = FALSE,
delete.raw.data = FALSE,
save.bib.file = TRUE
)

```

Arguments

save.location	string. Input where the datasets should be saved. Default: Working Directory.
parameter	string (vector). Input of parameters which should be downloaded. Default: c("prec", "tmax", "tmin", "bio")
bio.var	integer (vector). Input which monthly data should be downloaded. Only applicable to BIOCLIM variables. For further information see: https://www.worldclim.org/data/bioclim.html . Default: c(1:19)
month.var	integer (vector). Input which monthly data should be downloaded. Only applicable to precipitation and temperature (maximum, minimum). Default: c(1:12)
resolution	string (vector). Ranging from a 10 arc-minute resolution over 5 and 2.5 arc-minute to 30 arc-second resolution. Default: c("10m", "5m", "2.5m", "30s")
model.var	string (vector). Model used to calculate the dataset. Default: c("ACCESS1-0", "BCC-CSM1-1", "CCSM4", "CESM1-CAM5-1-FV2", "CNRM-CM5", "GFDL-CM3", "GFDL-ESM2G", "GISS-E2-R", "HadGEM2-AO", "HadGEM2-CC", "HadGEM2-ES", "INMCM4", "IPSL-CM5A-LR", "MIROC-ESM-CHEM", "MIROC-ESM", "MIROC5", "MPI-ESM-LR", "MRI-CGCM3", "NorESM1-M")
emission.scenario.var	string (vector). Input which emission scenario dataset should be downloaded. Provided are the representative concentration pathways (RCP) 2.6, 4.5, 6.0, and 8.5. Default: c("rcp26", "rcp45", "rcp60", "rcp85")
time.interval.var	string (vector). Time interval for which the dataset is calculated. The given intervals are 2040-2060 (represented by "2050"), and 2060 to 2080 (represented by "2070"). Default: c("2050", "2070")
clipping	logical. Input whether the downloaded data should be clipped. If FALSE; clip.shapefile, buffer, clip.extent will be ignored. Default: FALSE
clip.shapefile	string. Input which shapefile should be used for clipping. Default: NULL

<code>clip.extent</code>	numeric (vector). Input vector with four numeric values. This is following the input order <code>c("xleft", "xright", "ybottom", "ytop")</code> . Default: <code>c(-180, 180, -90, 90)</code>
<code>buffer</code>	numeric. Input of decimal degrees of buffer around the shapefile and/or extent. Default: 0
<code>convert.files.to.asc</code>	logical. Input whether files should be converted into the ASCII format. If TRUE a new subdirectory is created and the rawdata is saved there. If clipping is TRUE the clipped raster files are also saved as ASCII grids. Default: FALSE
<code>stacking.data</code>	logical. Input whether the downloaded data should be stacked as a netCDF-rasterstack. Default: FALSE
<code>keep.raw.zip</code>	logical. Should the downloaded raw-data be "zipped". Default: FALSE
<code>delete.raw.data</code>	logical. Should the downloaded raw-data be deleted. If the <code>combine.raw.zip</code> -option is TRUE, raw-data is still available in the zipped file. Default: FALSE
<code>save.bib.file</code>	logical. Whether a BibTex-citation file of the dataset should be provided in the Working directory. Default: TRUE

Value

WorldClim 1.4 CMIP5 Future climate datasets for the periods of 2041-2060 and/or 2061-2080.

Note

Please note that this dataset is regarded to as "outdated" by the WorldClim creators. The download of the current dataset "CMIP6" is also provided by this package with the [WorldClim.CMIP_6.download](#) function.

Please note also that the downloaded data for temperature and the therefore also the first eleven bioclim-variables are processed to °C with one significant decimal without offset and factor. Processing and conversion to other file-formats on a global dataset may take some time depending on the spatial resolution.

Author(s)

Helge Jentsch

References

R. J. Hijmans, S. E. Cameron, J. L. Parra, et al. "Very high resolution interpolated climate surfaces for global land areas". In: *International Journal of Climatology* 25.15 (2005), pp. 1965-1978. DOI: 10.1002/joc.1276. <URL: <https://doi.org/10.1002/joc.1276>>.

Examples

```
## Not run:
# Bioclim
WorldClim.CMIP_5.download(parameter = "bio",
                           bio.var = c(1,12),
                           resolution = "10min",
                           model.var = "MPI-ESM-LR",
                           emission.scenario.var = "rcp26",
                           time.interval.var = "2050")

# Precipitation
WorldClim.CMIP_5.download(parameter = "prec",
                           month.var = c(1,12),
                           resolution = "10min",
                           model.var = "MPI-ESM-LR",
                           emission.scenario.var = "rcp26",
                           time.interval.var = "2050")

## End(Not run)
```

WorldClim.CMIP_6.download

Function for downloading the WorldClim v2.1 CMIP6 future climate dataset

Description

This function supports the download, pre-processing and management of the WorldClim v2.1 CMIP6 future climate dataset.

This comprises of monthly precipitation sums (mm), temperature (maximum, minimum; °C), and annual characteristics (19 bioclimatic variables).

To allow pre-processing, clipping and buffering, conversion to ASCII-grids and stacking options are included.

Optional an output of a .bib-file of the cited literature can be retrieved.

For user convenience, saving directories will be created automatically. Also options to "zip" and/or delete the RAW-files are included.

Usage

```
WorldClim.CMIP_6.download(
  save.location = "./",
  parameter = c("prec", "tmax", "tmin", "bio"),
  bio.var = c(1:19),
  month.var = c(1:12),
  resolution = c("10min", "5min", "2.5min", "30s"),
  model.var = c("ACCESS-CM2", "BCC-CSM2-MR", "CMCC-ESM2", "CNRM-CM6-1", "CNRM-ESM2-1",
    "CanESM5", "EC-Earth3-Veg", "FIO-ESM-2-0", "GFDL-ESM4", "GISS-E2-1-G",
    "HadGEM3-GC31-LL", "INM-CM5-0", "IPSL-CM6A-LR", "MPI-ESM1-2-HR", "MRI-ESM2-0",
    "UKESM1-0-LL", "MIROC-ES2L", "MIROC6", "MRI-ESM2-0"),
  emission.scenario.var = c("ssp126", "ssp245", "ssp370", "ssp585"),
  time.interval.var = c("2021-2040", "2041-2060", "2061-2080", "2081-2100"),
  clipping = FALSE,
```

```

clip.shapefile = NULL,
clip.extent = c(-180, 180, -90, 90),
buffer = 0,
convert.files.to.asc = FALSE,
stacking.data = FALSE,
keep.raw.zip = FALSE,
delete.raw.data = FALSE,
save.bib.file = TRUE
)

```

Arguments

save.location	string. Input where the datasets should be saved. Default: Working Directory.
parameter	string (vector). Input of parameters which should be downloaded. Default: c("prec", "tmax", "tmin", "bio")
bio.var	integer (vector). Input which monthly data should be downloaded. Only applicable to BIOCLIM variables. For further information see: https://www.worldclim.org/data/bioclim.html . Default: c(1:19)
month.var	integer (vector). Input which monthly data should be downloaded. Only applicable to precipitation and temperature (maximum, minimum). Default: c(1:12)
resolution	string (vector). Ranging from a 10 arc-minute resolution over 5 and 2.5 arc-minute to 30 arc-second resolution. Default: c("10m", "5m", "2.5m", "30s")
model.var	string (vector). Model used to calculate the dataset. Default: c("BCC-CSM2-MR", "CNRM-CM6-1", "CNRM-ESM2-1", "CanESM5", "GFDL-ESM4", "IPSL-CM6A-LR", "MIROC-ES2L", "MIROC6", "MRI-ESM2-0")
emission.scenario.var	string (vector). Input which emission scenario dataset should be downloaded. Provided are the shared socio-economic pathways (SSPs) 126, 245, 370, and 585. Further information on SSPs: https://www.carbonbrief.org/cmip6-the-next-generation-of and https://www.carbonbrief.org/explainer-how-shared-socioeconomic-pathways-expl Default: c("ssp126", "ssp245", "ssp370", "ssp585")
time.interval.var	string (vector). Averaged monthly values over a 20 year period. Periodes available are: 2021-2040, 2041-2060, 2061-2080, 2081-2100. Default: c("2021-2040", "2041-2060", "2061-2080", "2081-2100")
clipping	logical. Input whether the downloaded data should be clipped. If FALSE; clip.shapefile, buffer, clip.extent will be ignored. Default: FALSE
clip.shapefile	string. Input which shapefile should be used for clipping. Default: NULL
clip.extent	numeric (vector). Input vector with four numeric values. This is following the input order c("xleft", "xright", "ybottom", "ytop"). Default: c(-180, 180, -90, 90)
buffer	numeric. Input of decimal degrees of buffer around the shapefile and/or extent. Default: 0

```

convert.files.to.asc
    logical. Input whether files should be converted into the ASCII format.
    If TRUE a new subdirectory is created and the rawdata is saved there. If "clipping"
    is TRUE the clipped raster files are also saved as ASCII grids.
    Default: FALSE

stacking.data
    logical. Input whether the downloaded data should be stacked as a netCDF-
    rasterstack.
    Default: FALSE

keep.raw.zip
    logical. Should the downloaded raw-data be "zipped".
    Default: FALSE

delete.raw.data
    logical. Should the downloaded raw-data be deleted. If the "combine.raw.zip"-
    option is TRUE, raw-data is still available in the zipped file.
    Default: FALSE

save.bib.file
    logical. Whether a BibTex-citation file of the dataset should be provided in the
    Working directory.
    Default: TRUE

```

Value

WorldClim 2.1 CMIP6 Future climate datasets for the periods of 2021-2040, 2041-2060, 2061-2080 and/or 2081-2100.

Note

Please note that the downloaded data for temperature and the therefore also the first eleven bioclim-variables are processed to °C with one significant decimal without offset and factor. Processing and conversion to other file-formats on a global dataset may take some time depending on the spatial resolution.

****The 30 arc-second resolution is not yet available. It was scheduled to be released by March 2020 but until March 2021 no data was released publicly.****

Author(s)

Helge Jentsch

References

S. E. Fick and R. J. Hijmans. "WorldClim 2: new 1-km spatial resolution climate surfaces for global land areas". In: *International Journal of Climatology* 37.12 (Okt. 2017), pp. 4302-4315. DOI: 10.1002/joc.5086. <URL:<https://doi.org/10.1002/joc.5086>>.

Examples

```

## Not run:
# Bioclim
WorldClim.CMIP_6.download(parameter = "bio",
                           bio.var = c(1,12),
                           resolution = "10min",
                           model.var = "MIROC6",
                           emission.scenario.var = "ssp126",
                           time.interval.var = "2021-2040")

# Precipitation
WorldClim.CMIP_6.download(parameter = "prec",

```

```

month.var = c(1,12),
resolution = "10min",
model.var = "MIROC6",
emission.scenario.var = "ssp126",
time.interval.var = "2021-2040")

## End(Not run)

```

WorldClim.HistClim.download

Function for downloading the WorldClim historical climate dataset

Description

This function supports the download, pre-processing and management of the WorldClim historical climate dataset.

This comprises of monthly precipitation sums (mm), temperature (average, maximum, minimum; °C), monthly solar radiation sums (kJ m⁻² day⁻¹), wind speed (m s⁻¹), water vapor pressure (kPa), and annual characteristics (19 bioclimatic variables). Also an elevation raster is provided.

To allow pre-processing, clipping and buffering, conversion to ASCII-grids and stacking options are included.

Optional an output of a .bib-file of the cited literature can be retrieved.

For user convenience, saving directories will be created automatically. Also options to "zip" and/or delete the RAW-files are included.

Usage

```

WorldClim.HistClim.download(
  save.location = "./",
  parameter = c("prec", "temp", "tmax", "tmin", "srad", "wind", "vapr", "bio", "elev"),
  bio.var = c(1:19),
  month.var = c(1:12),
  resolution = c("10min", "5min", "2.5min", "30s"),
  version.var = c("1.4", "2.1"),
  clipping = FALSE,
  clip.shapefile = NULL,
  clip.extent = c(-180, 180, -90, 90),
  buffer = 0,
  convert.files.to.asc = FALSE,
  stacking.data = FALSE,
  keep.raw.zip = FALSE,
  delete.raw.data = FALSE,
  save.bib.file = TRUE
)

```

Arguments

save.location string. Input where the datasets should be saved.
 Default: Working Directory.

parameter	string (vector). Input of parameters which should be downloaded. Default: c("prec", "temp", "tmax", "tmin", "srad", "wind", "vapr", "bio", "elev").
bio.var	integer (vector). Input which monthly data should be downloaded. Only applicable to BIOCLIM variables. For further information see: https://www.worldclim.org/data/bioclim.html . Default: c(1:19)
month.var	integer (vector). Input which monthly data should be downloaded. Default: c(1:12)
resolution	string (vector). Ranging from a 10 arc-minute resolution over 5 and 2.5 arc-minute to 30 arc-second resolution. Default: c("10m", "5m", "2.5m", "30s")
version.var	string (vector). Input which version of the dataset should be downloaded. Multiple selection is possible. Default: c("1.4", "2.1")
clipping	logical. Input whether the downloaded data should be clipped. See clipping.tif for more information. If FALSE: clip.shapefile, buffer, clip.extent will be ignored. Default: FALSE
clip.shapefile	string. Input which shapefile should be used for clipping. Default: NULL
clip.extent	numeric (vector). Input vector with four numeric values. This is following the input order c("xleft", "xright", "ybottom", "ytop"). Default: c(-180, 180, -90, 90)
buffer	numeric. Input of decimal degrees of buffer around the shapefile and/or extent. Default: 0
convert.files.to.asc	logical. Input whether files should be converted into the ASCII format. See convert.to.asc for more information. If TRUE: a new subdirectory is created and the rawdata is saved there. If the parameter clipping is also TRUE: the clipped raster files are also saved as ASCII grids. Default: FALSE
stacking.data	logical. Input whether the downloaded data should be stacked as a netCDF-rasterstack. See stacking.downloaded.data for more information. Default: FALSE
keep.raw.zip	logical. Should the downloaded raw-data be provided as "zip"-file. See combine.raw.in.zip for more information. Default: FALSE
delete.raw.data	logical. Should the downloaded raw-data be deleted. If the "combine.raw.zip"-option is TRUE: raw-data is still available in the zipped file. Default: FALSE
save.bib.file	logical. Whether a BibTex-citation file of the dataset should be provided in the Working directory. See save.citation for more information. Default: TRUE

Value

WorldClim climate datasets for the period of 1960-1990 (for v1.4) and/or 1970-2000 (for v2.1).

Note

Please note that solar radiation, wind speed, water vapor pressure, bioclimatic parameters, and elevation raster are only provided by the WorldClim Version 2.1 (current version).

Please note also that the downloaded data for temperature and the therefore also the first eleven bioclim-variables are processed to °C with one significant decimal without offset and factor. Processing and conversion to other file-formats on a global dataset may take some time depending on the spatial resolution.

Author(s)

Helge Jentsch

References

R. J. Hijmans, S. E. Cameron, J. L. Parra, et al. "Very high resolution interpolated climate surfaces for global land areas". In: *International Journal of Climatology* 25.15 (2005), pp. 1965-1978. DOI: 10.1002/joc.1276. <URL: <https://doi.org/10.1002/joc.1276>>.

S. E. Fick and R. J. Hijmans. "WorldClim 2: new 1-km spatial resolution climate surfaces for global land areas". In: *International Journal of Climatology* 37.12 (Okt. 2017), pp. 4302-4315. DOI: 10.1002/joc.5086. <URL: <https://doi.org/10.1002/joc.5086>>.

Examples

```
## Not run:
# Bioclim
WorldClim.HistClim.download(parameter = "bio",
                             bio.var = c(1,12),
                             resolution = "10min",
                             version.var = c("1.4", "2.1"))

# Precipitation
WorldClim.HistClim.download(parameter = "prec",
                             month.var = c(1,12),
                             resolution = "10min",
                             version.var = c("1.4", "2.1")
                             )

## End(Not run)
```

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