Package 'esd4all'

May 20, 2010

Version 1.0-4

Date May 11 2010

Title esd4all

Author Rasmus E. Benestad

Maintainer Rasmus E. Benestad <rasmus.benestad@met.no>

Depends clim.pact, cyclones, akima, ncdf, sgeostat, fields, spam, R (>= 2.2.0)

Description functions for post-processing and gridding empirical-statistical downscaled climate scenarios.

License GPL (>= 2)

URL http://www.r-project.org http://cran.r-project.org
http://noserc.met.no/grtools/esd4all.html

ZipData no

R topics documented:

constructESD 1

Index 7

`constructESD` *Empirical-Statistical Downsacling For All.*

Description

R-package for processing results from empirical-statistical downscaling (ESD).

The code has been taylored to post-process data derived through the `clim.pact` (http://cran.r-project.org/web/packages/clim.pact/index.html) and `met.no` packages (the latter is not posted on CRAN). The package uses the same ESD data as displayed in Google.Earth (http://home.broadpark.no/~rbene/esd.google.earthTemp.kml).

The R-package assumes that the ESD involves a fairly large multi-model ensemble, typically involving 40-50 different simulations. Each simulation produces one time series for each location,

typically over the period 1900-2100. The time series are the seasonal mean temperature (e.g. winter, spring, summer and autumn).

More details about the nature of the data can be found in met.no Notes 03/2009 (http://met.no/Forskning/Publikasjoner/?module=Files;action=File.getFile;ID=2319) and 15/2009 (http://met.no/Forskning/Publikasjoner/?module=Files;action=File.getFile;ID=2631).

data(esdsummary) retrieves ESD data generated by esdsummary() in the met.no-package. These data consist of coefficients of the best-fit polynomials to the 5-, and 95- percentiles as well as the mean of the set of time series (1900-2100) of downscaled multi-model ensemble (CMIP3).

constructESD constructs time series of the 5-, and 95- percentiles as well as the mean (1900-2100) of downscaled GCM (e.g from the CMIP3 data set). These reconstructions are constructed from coefficients describing the best-fit polynomials:

$$y(t) = c_0 + c_1 t + c_2 t^2 + c_3 t^3 + c_4 t^4 + c_5 t^5,$$

where t is the time.

pdfESD produces a pdf (Gaussian) of the seasonal temperature downscaled from the multi-model ensemble at a given location. Note, this pdf is not necessarily the same as the true pdf for the real temperature.

mapESDlocs produces a map showing the locations for which there are multi-model ESD results in the esd4all package.

queryLocations returns the name of the locations of the ESD locations.

get5mintopo retrieves a 5-minute resolution data file of the topography over Internet and saves the data locally in a suitable format for the use in the esd4all package.

fortegn a utility used internally - returns -1 or +1.

geo.inf is a function that uses a geographical regression model (GRM) to grid the results, and then adds the residuals through interpolation (kriging or 2D splines). This is an internal function.

gridESD is the main function that grids the coefficients used to describe the best-fit polynomials providing smooth approximations of the time series for 5- and 95-percentiles and the ensemble mean. The function uses geo.inf.

gridded.c is produced by gridESD. In the CRAN-version (1.0-3), a reduced version of this gridded data set is used due to size limitations, but a fuller version is available from http://noserc.met.no/grtools/esd4all.html.

mapESDquants constructs map of derived quantiles.

mapESDprobs construct map of the fraction of GCMs with value below/higher then threshold.

esdsummary contains coefficients describing the polynomials of the 5th and 95th percentiles as well as ensemble mean of ESD analysis for a large number of locations around the world, seen in http://eklima.met.no/metno/esd/esd.google.earthTemp.kmz. The list is created using esd2google.

gridded.c contains results from gridding the coefficients (stored in esdsummary) over northern Europe.

ESDinGoogle views the ESD results in GoogleEarth

ESDdetails provides details about the ESD results and explains how the figures should be interpreted. ESDreference provides a link to a proper reference for the ESD - Benestad, R.E. (2005) Climate change scenarios for northern Europe from multi-model IPCC AR4 climate simulations GRL, 32 doi:10.1029/2005GL023401 No. 17, L17704.

rda2cdf reads the gridded data in an rda-file and saves these as a netCDF file.

figures Makes figures showing maps of the 95-percentile for summer (JJA) mean temperature and probability of below freezing mean winter (DJF) temperatures.

Usage

```
constructESD(location,plot=TRUE,get.data="data(esdsummary,envir=environment())",
             mfrow=c(2,2))
pdfESD(location,plot=TRUE,get.data="data(esdsummary,envir=environment())",
       year=2050,ref=NULL,mfrow=c(2,2),what="pdf")
mapESDlocs(get.data="data(esdsummary,envir=environment())")
queryLocations(nr=NULL,get.data="data(esdsummary,envir=environment())")
get5mintopo(browser = "firefox", url ="http://marine.rutgers.edu/po/tools/gridpa
fortegn(a,b)
geo.inf(g.obj,do.km=TRUE,x.scale=1000,
                    predict=TRUE,krig=TRUE,krig.Nx=NULL,krig.Ny=NULL,
                    x.rng=c(-10,32),y.rng=c(44,70),plot=FALSE,
                    krig.package="fields",
                    use.previous.estimates=TRUE,linear.intp=TRUE)
KrigFields(resid,lon.grd,lat.grd)
KrigSgeostat(resid,lon.grd,lat.grd,do.km)
gridESD(get.data = "data(esdsummary,envir=environment())",
                  plot = FALSE, x.rng = c(-30, 50), y.rng = c(40, 72),
                  x.scale = 1000, do.km = TRUE, krig = TRUE, new = TRUE,
                  krig.Nx = 30, krig.Ny = 30, use.previous.estimates =
                  TRUE, linear.intp = TRUE, krig.package = "fields",
                  fname = "gridded.c.rda")
mapESDquants(what="q95",season=3,year=2050,ref=NULL,
                         get.data1="data(gridded.c,envir=environment())",
                         get.data2="data(esdsummary,envir=environment())",
                         plot=TRUE)
mapESDprobs(thresh=0,season=1,year=2050,ref=NULL,
             get.data="data(gridded.c,envir=environment())",plot=TRUE)
data(esdsummary)
data(gridded.c)
data(gridded.ealat.c)
data(gridded.africa.c)
ESDinGoogle(browser = "firefox", url="http://eklima.met.no/metno/esd/esd.google.
ESDdetails(browser = "firefox", url="http://met.no/Forskning/Publikasjoner/")
rda2cdf(get.data="data(gridded.c,envir=environment())")
figures(get.data="data(gridded.c,envir=environment())",
                    season.1=3,season.2=1,year=2050,thresh=0,what="q95")
reduce.rda.size(get.data="data(gridded.c,envir=environment())",reduce.res=TRUE,
                           nx=100,ny=100)
```

Arguments

location	Name of site
plot	flag: TRUE or FALSE
get.data	Method for getting the data
year	Scenario year
nr	Station number
browser	Preferred browser
url	URLs of on-line reports or KML-files.
g.obj	List object holding ESD data for a number of sites. Used for gridding.

do.km	FLAG: TRUE use km rather than lon-lat coordinates.
x.scale	Spatila scale: 1000 implies units of km.
predict	FLAG: TRUE or FALSE
krig	FLAG: FALSE implies a bi-linear interpolation rather than kriging. Two kriging options are avialble, specified by the argument krig.package. Past tests have revealed some problems with the kriging options, however.
krig.package	Specify package for kriging analysis: "fields" or "sgeostat"
x.rng	x range for selection of sites in gridding
y.rng	y range for selection of sites in gridding
use.previous.estimates	FLAG: TRUE for avoiding repeating lengthy calculations
linear.intp	used for the linear argument in interp
ref	Reference year
fname	File name for gridded.c.
what	Specification of type
a	A value: a < b returns -1 in fortegn
b	A value: a < b returns -1 in fortegn
reduce.res	TRUE: use interp to reduce the spatial resolution, otherwise save only the land points.
nx	
ny	
mfrow	
krig.Nx	To specify coarser grid for residual gridding
krig.Ny	To specify coarser grid for residual gridding
new	FALSE: try to continue on a previous job
season	Season
season.1	Season
season.2	Season
get.data1	Method for getting the data
get.data2	Method for getting the data
thresh	Threshold value for estimating probabilities
resid	List object holding the residuals from GRM
lon.grd	longitude coordinates of grid
lat.grd	Latitude coordinates of grid

Author(s)

R.E. Benestad

Examples

```
## Not run:
ESDinGoogle()
data(esdsummary)
mapESDlocs()
queryLocations() -> a
constructESD(a[1]) -> b
pdfESD(a[1])
mapESDquants() -> map.q95
mapESDprobs() -> map.pr.T.lt.0

# How to generate the gridded data
dsjobs(ele=101,scen="sresa1b")
bestESD()                       # to weed out multiple locations
allESD(path="ESD/")             # to weed out multiple locations
esd2google() -> esdsummary      # summarise all the ESD results
catESDsummary(esdsummary) -> esdsummary.tidy
gridded.c <- gridESD(get.data=esdsummary.tidy, x.rng=c(-12,45),y.rng=c(35,72),new=TRUE)
gridded.africa.c <- gridESD(get.data=esdsummary.tidy,x.rng=c(-20,50),y.rng=c(-40,37),new=
gridded.ealat.c <-
gridESD(get.data=esdsummary.tidy,x.rng=c(15,190),y.rng=c(60,80),new=TRUE)

#How to create the figures in publications:
figures(get.data="data(gridded.ealat.c,envir=environment())",year=2100,what="q05")
file.rename("Europe_ESD-q95map.nc","EALAT_ESD-q95map-2100.nc")
file.rename("Europe_ESD-p0map.nc","EALAT_ESD-p0map-2100.nc")
figures(get.data="data(gridded.ealat.c,envir=environment())",what="q05")
file.rename("Europe_ESD-q95map.nc","EALAT_ESD-q95map-2050.nc")
file.rename("Europe_ESD-p0map.nc","EALAT_ESD-p0map-2050.nc")
figures(get.data="data(gridded.ealat.c,envir=environment())",year=2010,what="q05")
file.rename("Europe_ESD-q95map.nc","EALAT_ESD-q95map-2000.nc")
file.rename("Europe_ESD-p0map.nc","EALAT_ESD-p0map-2000.nc")

figures(get.data="data(gridded.africa.c,envir=environment())",
        season.1=3,season.2=3,thresh=35)
file.rename("Europe_ESD-q95map.nc","Africa_ESD-q95map-2500.nc")
file.rename("Europe_ESD-p0map.nc","Africa_ESD-p0map-2500.nc")
figures(get.data="data(gridded.africa.c,envir=environment())",
        season.1=3,season.2=3,thresh=35,year=2010)
file.rename("Europe_ESD-q95map.nc","Africa_ESD-q95map-2000.nc")
file.rename("Europe_ESD-p0map.nc","Africa_ESD-p0map-2000.nc")
figures(get.data="data(gridded.africa.c,envir=environment())",
        season.1=3,season.2=3,thresh=35,year=2100)
file.rename("Europe_ESD-q95map.nc","Africa_ESD-q95map-2100.nc")
file.rename("Europe_ESD-p0map.nc","Africa_ESD-p0map-2100.nc")

figures(year=2100)
file.rename("Europe_ESD-q95map.nc","Europe_ESD-q95map-2100.nc")
file.rename("Europe_ESD-p0map.nc","Europe_ESD-p0map-2100.nc")
figures(year=2010)
file.rename("Europe_ESD-q95map.nc","Europe_ESD-q95map-2000.nc")
file.rename("Europe_ESD-p0map.nc","Europe_ESD-p0map-2000.nc")
figures()
file.rename("Europe_ESD-q95map.nc","Europe_ESD-q95map-2050.nc")
file.rename("Europe_ESD-p0map.nc","Europe_ESD-p0map-2050.nc")
```

```
# The papers used ferret (ferret.wrc.noaa.gov/) to make the final plots
# based on the netCDF files created...


## End(Not run)
```

Index

constructESD, 1

esd2google, *2*
ESDdetails *(constructESD)*, 1
ESDinGoogle *(constructESD)*, 1
ESDreference *(constructESD)*, 1
esdsummary *(constructESD)*, 1

figures *(constructESD)*, 1
fortegn *(constructESD)*, 1

geo.inf *(constructESD)*, 1
get5mintopo *(constructESD)*, 1
gridded.africa.c *(constructESD)*, 1
gridded.c *(constructESD)*, 1
gridded.ealat.c *(constructESD)*, 1
gridESD *(constructESD)*, 1

KrigFields *(constructESD)*, 1
KrigSgeostat *(constructESD)*, 1

mapESDlocs *(constructESD)*, 1
mapESDprobs *(constructESD)*, 1
mapESDquants *(constructESD)*, 1

pdfESD *(constructESD)*, 1

queryLocations *(constructESD)*, 1

rda2cdf *(constructESD)*, 1
reduce.rda.size *(constructESD)*, 1