

Individual simulations and ensemble means

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R Markdown

This is an R Markdown document. Markdown is a simple formatting syntax for authoring HTML, PDF, and MS Word documents. For more details on using R Markdown see <http://rmarkdown.rstudio.com>.

Install the required R-packages

```
## Check if you need to get the devtools-package:
install.devtools <- ("devtools" %in% rownames(installed.packages()) == FALSE)

if (install.devtools) {
  print('Need to install the devtools package')
  ## You need online access.
  install.packages('devtools')
}

## Use the devtools-package for simple facilitation of installing esd from GitHub.
library('devtools')
install.esd <- ("esd" %in% rownames(installed.packages()) == FALSE)
if (install.esd) install_github('metno/esd')
```

This demonstration shows individual model simulations and their mean - the multi-model ensemble mean. The global mean temperature from the CMIP5 RCP4.5 simulations are available from the `esd` package.

```
library(esd)

## Loading required package: ncdf4
## Loading required package: zoo
##
## Attaching package: 'zoo'
## The following objects are masked from 'package:base':
##
##   as.Date, as.Date.numeric
##
## Attaching package: 'esd'
## The following object is masked from 'package:base':
##
##   subset.matrix

data("global.t2m.cmip5")
## Store the data in Y for convenience
Y <- global.t2m.cmip5
for (i in 1:dim(global.t2m.cmip5)[2])
Y[,i] <- global.t2m.cmip5[,i] - mean(window(global.t2m.cmip5[,i],start=1961,end=1990))
```

NCEP/NCAR reanalysis 1

Use reanalysis as the yard stick for the model data: the reanalysis are from weather forecasts and use results from one atmosphere model which has been fed all available observations (thermometer, barometric pressure, radiosondes/ballon data, satellite data, aviation data, measurements from buoys/ships, etc.). The reanalyses provide the most complete picture of the global atmosphere available, but do not differ vastly from thermometer data from irregularly spaced thermometers. Because the reanalyses are generated by atmospheric models, they are the closest to the climate model output.

```
if (!file.exists('air.mon.mean.nc'))
  download.file('ftp://ftp.cdc.noaa.gov/Datasets/ncep.reanalysis.derived/surface/air.mon.mean.nc', 'air.mon.mean.nc')
t2m <- retrieve('air.mon.mean.nc')

## [1] "Warning : Calendar attribute has not been found in the meta data and will be set automatically."
gst <- zoo(annual(aggregate.area(t2m,FUN='mean')))
gst <- gst - mean(window(gst,start=1961,end=1990))
```

Graph

```
plot(zoo(Y),plot.type='single',xlim=c(1970,2015),ylim=c(-0.5,1.25),col=rainbow(dim(Y)[2]),
     ylab=expression(degree*C),main='global mean temperature')
lines(gst,col='grey')
lines(zoo(rowMeans(Y),order.by=index(Y)),lwd=3)
```

global mean temperature

