s2dverification

Hands on session

Objectives

- Install and learn how to use s2dverification

1 Install s2dverification

1.1 Install R

If you don't have R installed on your own computer you will find here some tutorial to install it:

- **Linux**: `http://cran.r-project.org/bin/linux/`
- **Mac**: `http://cran.r-project.org/bin/macosx/`
- **Windows**: `http://cran.r-project.org/bin/windows/`

1.2 Install s2dverification

- Open R.
- If you want to install the package in the standard location, just type the following command line in R (you can eventually change the CRAN Mirrors: `http://cran.r-project.org/mirrors.html`):

```
install.packages("s2dverification", repos="http://mirror.ibcp.fr/pub/CRAN/")
```

- If you want to install the new libraries in a specific location you need to install the dependancies one by one. You can use the following command lines by replacing **PathRlibrary** with the path you want:

```
install.packages("ncdf", lib="PathRlibrary", repos="http://cran.us.r-project.org"
    )
install.packages("GEOmap", lib="PathRlibrary", repos="http://cran.us.r-project.
    org")
install.packages("geomapdata", lib="PathRlibrary", repos="http://cran.us.r-
    project.org")
install.packages("maps", lib="PathRlibrary", repos="http://cran.us.r-project.org"
    )
install.packages("mapproj", lib="PathRlibrary", repos="http://cran.us.r-project.
    org")
install.packages("s2dverification", lib="PathRlibrary", repos="http://cran.us.r-
    project.org")
```

and then you should copy the following line in your **.bashrc**:

```
R_LIBS="PathRlibrary:$R_LIBS"
export R_LIBS
```

2 Compute basic statistics, plot map and time series for decadal forecast

This part will show you how to calculate and plot skill scores for a subset of the decadal climate prediction experiment run at IC3 in the context of the CMIP5 project. This dataset, included by default in the package, is very small (only 5 start dates), so the results you will obtain are not really meaningfull. Nevertheless, this tutorial will show you briefly the possibilities of s2dverification.

Exercise 1 – First steps with s2dverification

- Open R (typing R in the terminal).
- Load the needed library, with the following command:

```
library(s2dverification)
```

- The documentation of s2dverification is available online here:
  `http://ic3.cat/wikicfu/img_auth.php/S2dverification.pdf`
- You can see the list of available functions in the package by typing:

```
help(package=s2dverification)
```

- To see the help of a specific function, you can type:

```
help(Corr)
```

- There are two small datasets included by defaults in the package:

```
help(sampleMap)
help(sampleTimeSeries)
```

  These dataset provide data for the variable 'tos', i.e. sea surface temperature, in the the mediteranean sea (0E30E-40N45N) from the decadal climate prediction experiment run at IC3 in the context of the CMIP5 project. Only 5 stardates are included: November of 1985, 1990, 1995, 2000, 2005. Originaly, for each stardate the experiment has been run for 10 years, but in this reduced dataset you have only the first 5 years. The corresponding observational dataset used for verification is the 'ERSST' observational.

  - sampleMap is the 2D SST field in the mediterranean region (0E30E-40N45N).
  - sampleTimeSeries is the SST averaged in the mediterranean region (0E30E-40N45N).

Exercise 2 – Calculate and plot RMS and spread

1. Have a look at the dimension and help of sampleTimeSeries, by typing:

```
dim(sampleTimeSeries$obs)
dim(sampleTimeSeries$mod)
help(sampleTimeSeries)
```

   What are the different dimensions of these matrices ?

2. Have a look at the help of the functions **Clim** and **Ano**. Calculate the anomalies for model and observations.
3. Use the function **PlotClim** to plot the climatology.
4. With the function **Mean1Dim** calculate the ensemble mean for the model. Use the same function to remove the ensemble dimension for the observation.
5. Calculate the spread of the model for the members and start dates with the **Spread** function. To do it, you need first to substract the ensemble mean to the anomalies (Use **InsertDim** to create a matrix of the same size as the anomalies)
6. Plot the spread with **PlotVsLTime**.

7. Calculate the Root Mean Square Error of the ensemble mean, using the **RMSE** function. Plot the results with **PlotVsLTime**.
8. Plot on the same figure the Root Mean Square Error and the spread with **Plot2VarsVsLTime**.
9. **Solution**:

```
library(s2dverification)
#calculate the clim
clim <- Clim(sampleTimeSeries$mod, sampleTimeSeries$obs)

#calculate the anomalies
anomod <- Ano(sampleTimeSeries$mod, clim$clim_exp)
anoobs <- Ano(sampleTimeSeries$obs, clim$clim_obs)

#plot the clim
PlotClim(clim$clim_exp, obs_clim=clim$clim_obs, fileout = "output_plotclim.eps")

#ensemble mean
ensmeanmod <- Mean1Dim(anomod,2)
ensmeanobs <- Mean1Dim(anoobs,2)

anoensmean <- (anomod - InsertDim(ensmeanmod 2, dim(anomod)[2]))
#calculate the spread
spread <- Spread(anoensmean, posdim = c(2, 3), narm = TRUE)$sd

#plot spread
PlotVsLTime(spread, fileout = "spread.ps")



#RMSE
rmse <- RMS(ensmeanmod,ensmeanobs)
PlotVsLTime(rmse, fileout = "rmse.ps")

#remove obs dimension in rmse
rmse <- Mean1Dim(rmse,2)

#RMSE and spread
Plot2VarsVsLTime(rmse,spread, listvars = c("rmse","spread"), fileout = "rmse-
    spread.ps")
```

Exercise 3 – Plot your first map of score

1. Have a look at the dimension and help of sampleMap, by typing:

```
dim(sampleMap$obs)
dim(sampleMap$mod)
help(sampleMap)
```

   What are the different dimensions of these matrices ?

2. With the function **SelIndices**, select the forecast time year2 to year5, which correspond to months 12 to month 60, for both model and observations.
3. Have a look at the help of the **Season** function. With this function select all winters (December-January-February) for both model and observations.
4. Calculate the ensemble mean and the averaged of all winters between year 2 to year 5 for both model and observations (Use the **Mean1Dim** function).
5. With the function **Corr**, calculate the correlation between the observation and the model.
6. Plot the map of correlation with the **PlotEquiMap** function.

7. **Possible extra questions**:
   - Add the significance level with contour or dots (If you have some issues try to transpose your second matrix with **t**).
   - Calculate and plot the RMSE.
   - Change the colorbar.
   - Do the same calculation for year 1 only.
   - Make the calculation for summer instead of winter.
8. **Solution**: library(s2dverification)

```
#select year 2 to 5
mody25 <- SelIndices(sampleMap$mod,4,c(12,60))
obsy25 <- SelIndices(sampleMap$obs,4,c(12,60))

#select winter
modDJF <- Season(mody25, posdim = 4, 11, 12, 2)
obsDJF <- Season(obsy25, posdim = 4, 11, 12, 2)

#seasonal and ensemble mean
seasmodDJF <- MeanListDim(modDJF,c(2,4))
seasobsDJF <- MeanListDim(obsDJF,c(2,4))

#correlation
cor <- Corr(seasmodDJF,seasobsDJF)

brks <- seq(-1,1,0.1)
cols <- rev(colorRampPalette(brewer.pal(11, "RdBu"))(20))
PlotEquiMap(cor[1,1,2,,], sampleMap$lon, sampleMap$lat,
            brks=brks, cols = cols)
```