

Homogenization of a few precipitation and extreme temperature series of Angola and calculation of their Standard Climatological Normals 1991-2020

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1 Introduction

This brief example of homogenization and generation of the Standard Climatological Normals 1991-2020 has been done as a contribution to the Angolan Instituto Nacional de Meteorologia e Geofísica (INAMET) following a request by António Manuel Lameira Gaspar, meteorologist of that institution.

Only 5 stations and three variables are used in this example, which will be enough for explanatory purposes.

2 Data

Series of daily precipitation and extreme temperatures are provided in RCLimDex format for the five stations included in the tab separated text file `SIstation.txt`:

```
CODE LONGITUDE LATITUDE ALTITUDE NAME
LU66160 13.235278 -8.848056 70 LUANDA
HU66318 15.74959 -12.802619 1705 HUAMBO
CA66104 12.18995 -5.586754 21 CABINDA
ME66410 17.714651 -14.657672 1414 MENONGUE
DU66152 20.816667 -7.4 775 DUNDO
```

The data files have names composed by the station code and extension `txt`. To apply the `climatol` R package for quality control, homogenization and data infilling of these daily series, we must convert these files to the `climatol` input format. The function `rclimdex2climatol` will be the right tool for this, but the first column of the stations file must contain the complete name of the data files:

```
library(climatol) #load the climatol package
setwd('CLINO/Angola') #set working directory as needed in every case
sta=read.table('SIstation.txt',sep='\t',header=TRUE) #read the stations file
sta$CODE=sprintf('%s.txt',sta$CODE) #add extension txt to the file names
write.table(sta,'stations.txt',sep='\t',row.names=FALSE) #write new stations file
rclimdex2climatol('stations.txt',stcol=c(1,3,2,4,5),kvar=1,chrnod=c(1,7))
rclimdex2climatol('stations.txt',stcol=c(1,3,2,4,5),kvar=2,chrnod=c(1,7))
rclimdex2climatol('stations.txt',stcol=c(1,3,2,4,5),kvar=3,chrnod=c(1,7))
```

Now that we have created the input files for `climatol`, we can proceed with the homogenization, variable by variable.

3 Homogenization of the series

3.1 Precipitation

```
dd2m('RR',1981,2021,valm=1) #generate monthly aggregates
homogen('RR-m',1981,2021,std=2,dz.max=9,annual='total') #monthly homogenization
#series appear as complete and homogeneous, so go for the daily series:
homogen('RR',1981,2021,dz.max=99,metad=T) #(dz.max=99: accept all values)
```

3.2 Maximum temperature

```
dd2m('TX',1981,2021) #generate monthly aggregates
homogen('TX-m',1981,2021,dz.max=9) #monthly homogenization
#series appear as complete and homogeneous, so go for the daily series:
homogen('TX',1981,2021,dz.max=99,metad=T) #(dz.max=99: accept all values)
```

3.3 Minimum temperature

```
dd2m('TN',1981,2021) #generate monthly aggregates
homogen('TN-m',1981,2021,dz.max=9) #monthly homogenization
#series appear as complete and homogeneous, so go for the daily series:
homogen('TN',1981,2021,dz.max=99,metad=T) #(dz.max=99: accept all values)
```

4 Calculation of the Standard Climatological Normals 1991-2020

In order to use the CLINO tool, we must copy some of its files to our current working directory. After uncompressing the CLINO_tool.tgz archive, the files to be copied are CLINO.R and the four CLINO_*.csv. Two of the csv files must be edited to instruct the software which are the variables to process and the names of the homogenized data files. These are the contents after the editing:

- CLINO_stations.csv :

```
StCode,WMOid,WIGOSid,Latitude,Longitude,Elevation,StName,Country
"LU66160",0-20000-0-66160,13.235278,-8.848056,70,"LUANDA",Angola
"HU66318",0-20000-0-66318,15.74959,-12.802619,1705,"HUAMBO",Angola
"CA66104",0-20000-0-66104,12.18995,-5.586754,21,"CABINDA",Angola
"ME66410",0-20000-0-66410,17.714651,-14.657672,1414,"MENONGUE",Angola
"DU66152",0-20000-0-66152,20.816667,-7.4,775,"DUNDO",Angola
```

- CLINO_variables.csv :

```
Variable,Daily_data_file,Parameters
Precipitation,RR_1981-2021.rda,1-2-160-161-162-163-164-24
Maximum_temperature,TX_1981-2021.rda,3-120-121-122-123-14-22-610-991
Minimum_temperature,TN_1981-2021.rda,4-15-23-990
```

Now we are ready to load the CLINO function into R memory and run it to calculate the Standar Climatological Normals for 1991-2020 and write them into CSV files with the format required by WMO:

```
source('CLINO.R')
CLINO()
```

5 Conclusions

- The analyzed series were complete and quite homogeneous, so the role of *climatol* was to check them and to generate the `*.rda` files for the three considered variables.
 - The homogenization process would benefit from a higher number of stations, even if they are incomplete. The 1991-2020 normal values of the stations that do not exceed 80% of data in that period would not be sent to the WMO, but these normal values would serve internally to INAMET for climate monitoring tasks.
 - For the other variables required by the WMO, the same procedure would be followed, except that the preparation of the input files would be done by a different method. In case more stations and or variables are processed, the CLINO function should be applied again for all of them.
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