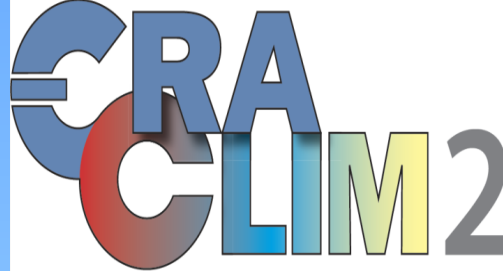




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INSTITUTO
DOM LUIZ

Quality Control for Observations

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Work Package 4 ERA-CLIM2

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Contents

1 – Visualisation tool for surface data QC (D4.4)

2 – Breakpoint detections using Homogeneity tests (D4.3)

3 – Conclusions

1 - A visualization tool for QC

CQ_SURFACE 2.0

CQ_SURFACE is a tool (originally written in Fortran and using GNUPLOT) that

1. Performs the Quality Control tests described in WP3 presentation
2. Delivers products – Error files, Formatted data, QC flags, stats
3. Permits Visualization of ECV series (graphics)

- Installing the QC tool

Unzip CQ_surface.zip and Install in Windows or Linux and use GNUPLOT version 4.6.6 to run the program **CQ_Surface.exe**

modify **datapaths.nam** with adequate file paths

We have included as an example input data for Luanda 1915.

There is also the full .DB (output file obtained previously) Luanda database for 1915-1946 so that long time series can be plotted.

Follow instructions in the **User Guide** provided by FFCUL , to input the data in the correct format.

USER GUIDE

In this document we will describe the procedure for using the Quality Control program with visualisation, CQ_SURFACE.

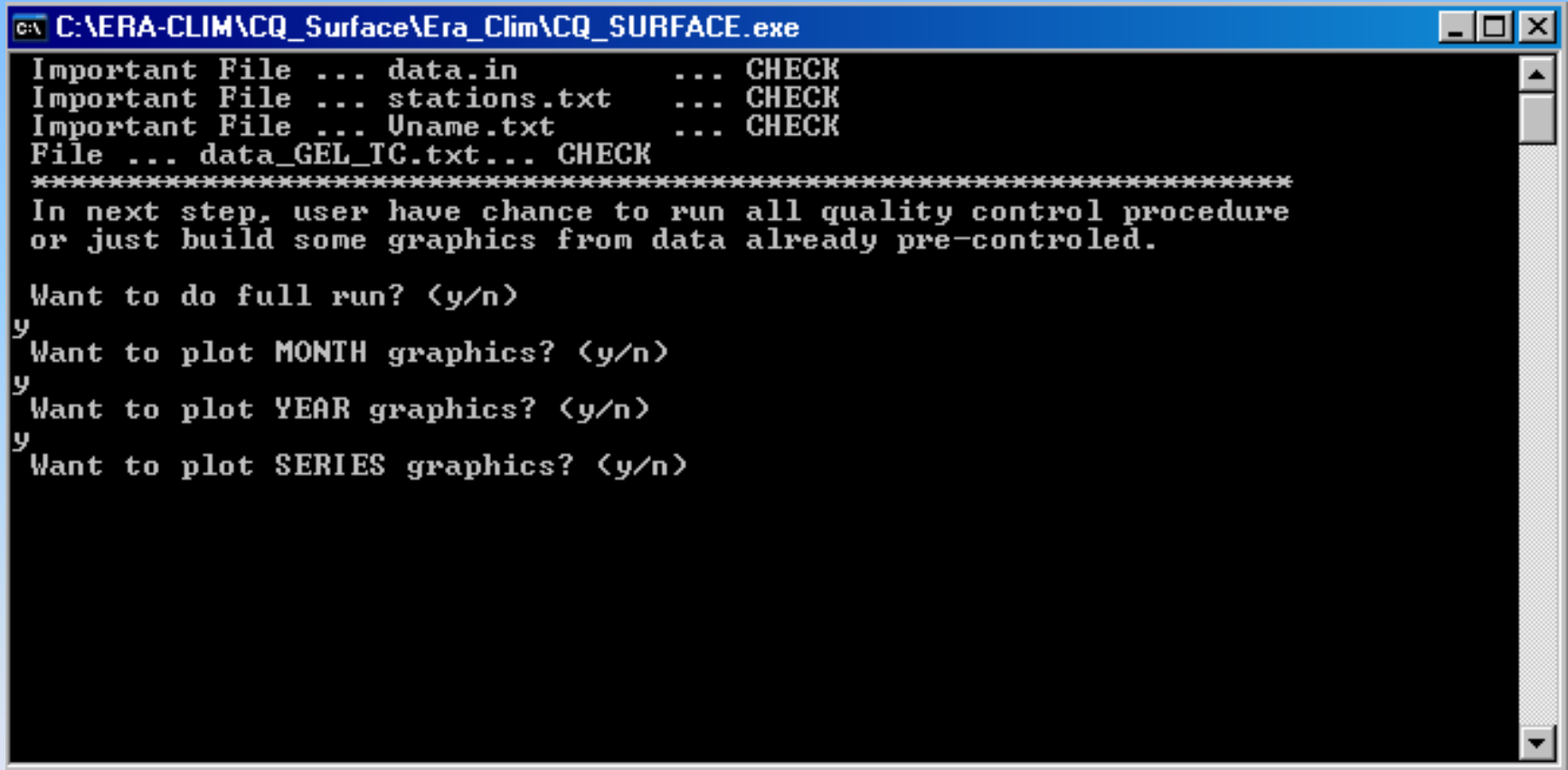
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pmvg1977@gmail.com

1 - A visualization tool for QC

CQ_SURFACE 2.0

- Running in DOS



```
C:\ERA-CLIM\CQ_Surface\Era_Clim\CQ_SURFACE.exe
Important File ... data.in ... CHECK
Important File ... stations.txt ... CHECK
Important File ... Uname.txt ... CHECK
File ... data_GEL_TC.txt... CHECK
*****
In next step, user have chance to run all quality control procedure
or just build some graphics from data already pre-controlled.

Want to do full run? <y/n>
y
Want to plot MONTH graphics? <y/n>
y
Want to plot YEAR graphics? <y/n>
y
Want to plot SERIES graphics? <y/n>
```

Choose the several options given by the program. It is possible to do only graphics from complete .BD (database files). Monthly and Annual graphics, as well as series of several years can be chosen.

1 - A visualization tool for QC

CQ_SURFACE 2.0

- Products – Error files and formatted data

After running the program, the output is constituted by several ASCII data files and **graphics**:

- ✓ Log (.log) file with all details from the tests containing types of errors found and the date, and other verifications
- ✓ .BD files, data base with all meteorological information in long time series format
- ✓ Flag file – containing the QC files attributed by all Checks and the chosen final flag
- ✓ **ERA_CLIM and ISPD formatted files**
- ✓ Statistics files (mean, std, mod, cov, etc.)
- ✓ **Graphics**

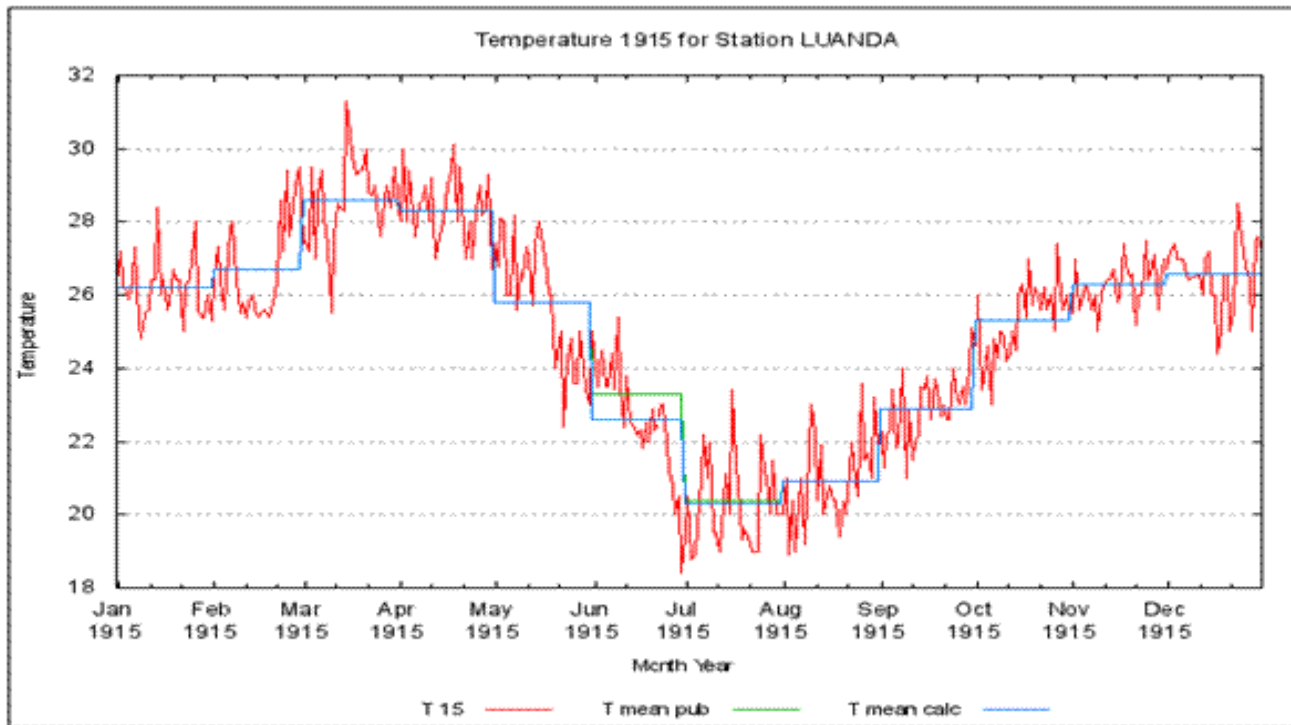
All ASCII files can be opened as text files, regardless of the extension.

1 - A visualization tool for QC

CQ_SURFACE 2.0

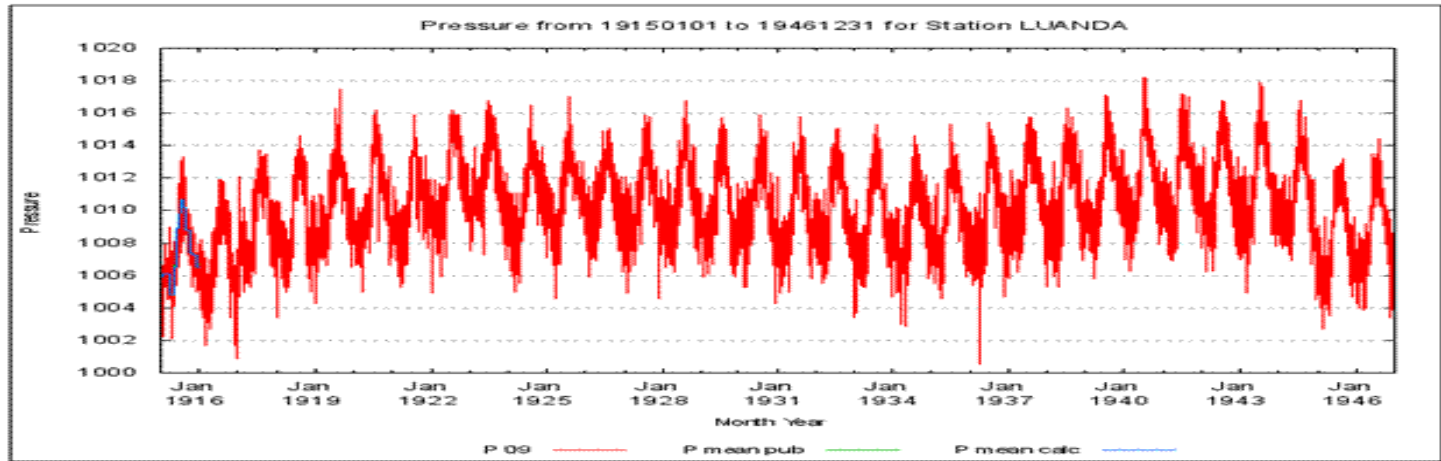
- Visualization (graphics)
 - In this module we use GNUPLOT to build graphics for the different variables. They allow us to **check visually for outliers and other problems**, comparing with the errors found by QC. They can also indicate **possible breakpoints in series**, which have to be checked with metadata.
 - Allows us to track some possible **major weather changes**, viewing some **extremes values** and cross-check between different plotted variables.
 - Usefull to detect suspicious values, that should be verified in the original imaged data, and the behaviour of short or long term series.

Visualization (graphics)

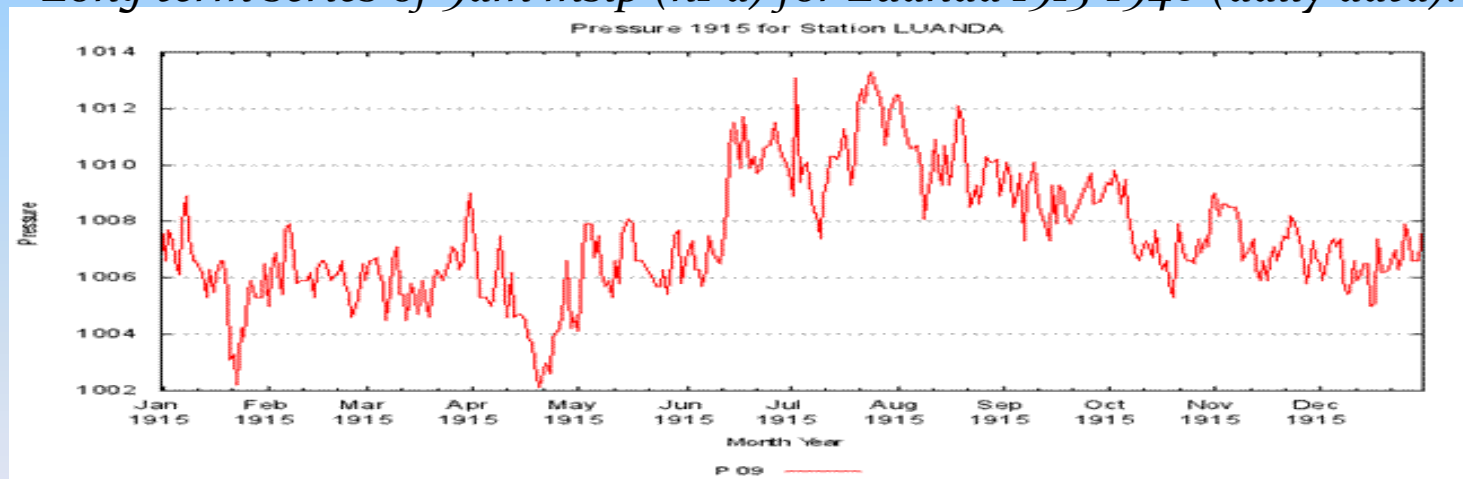


Luanda 1915 series of daily 15pm Temperature (°C). Monthly means published are shown in green and computed means by the program in blue.

Visualization (graphics)



Long term series of 9am mslp (hPa) for Luanda 1915-1946 (daily data).



Annual series of mslp (hPa) for Luanda 1915. Daily data for 9am (local time).

QC software is also available for LINUX, the input is more user friendly, and will provide directly formatted output for homogeneity tests HOMER, RHtestsV4.

Will be rewritten in R for the C3S Data Rescue Services.

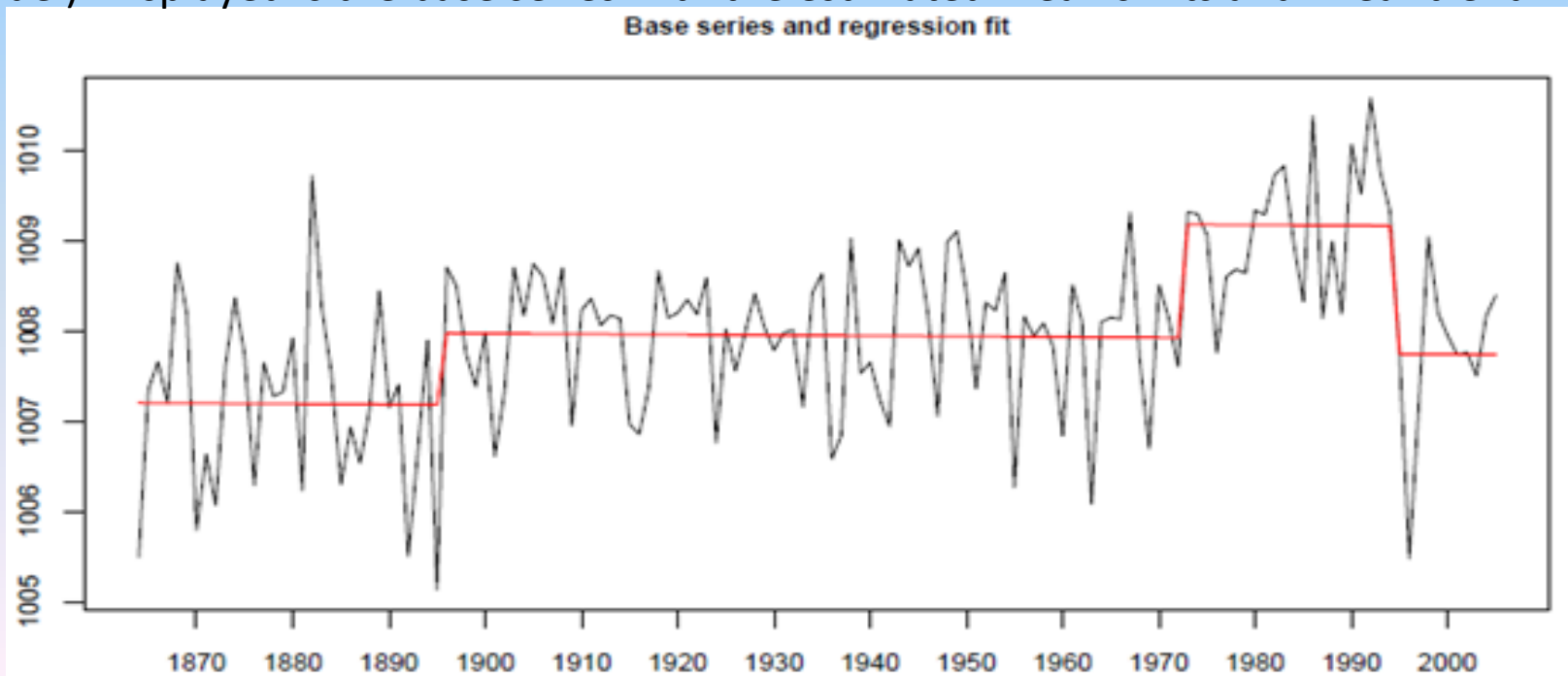
2 – Breakpoint detections using Homogeneity tests

Land surface Variables Assimilated – mslp or surface pressure

In ISPD V3 we have contributed with sub-daily data for

- 1863-2006 Lisbon pressure series
- 1893-2007 Porto pressure series
- 1946-1996 Coimbra pressure series

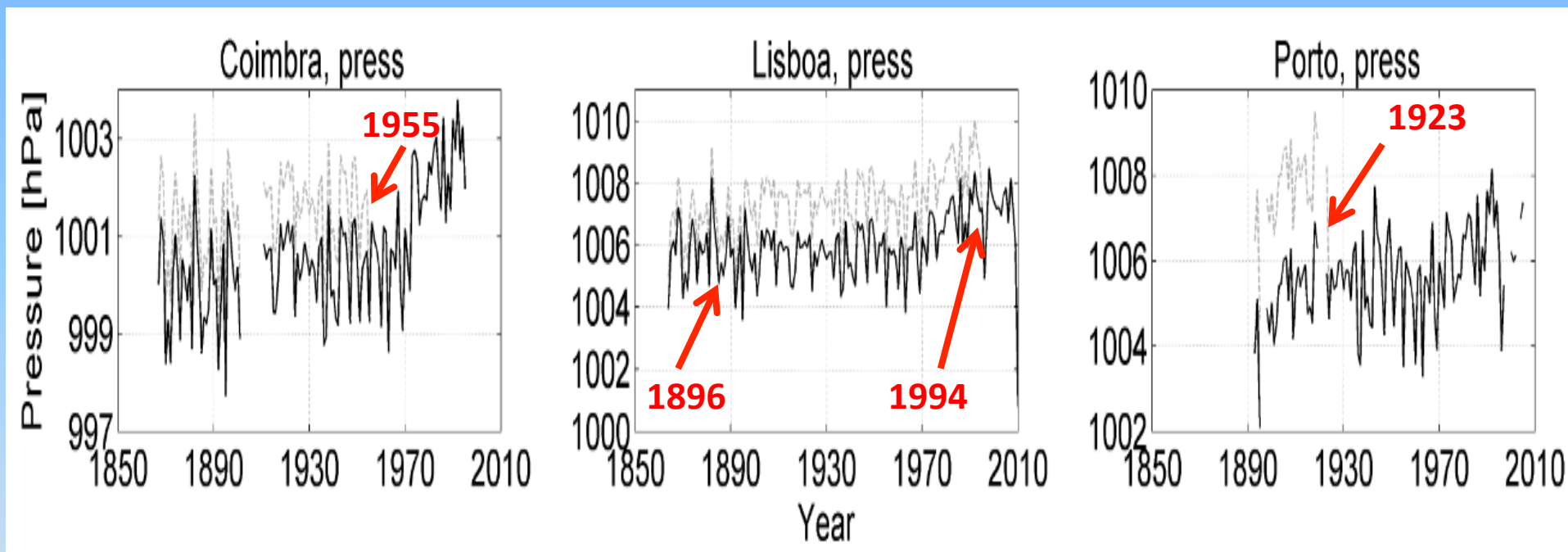
Lisbon annual pressure series tested by RHtestsV3 without reference series (PMFred model). Displayed is the base series with the estimated mean shifts and linear trend.



Objective: Detect breakpoints in the series and send a list to ECMWF

- We have applied several homogeneity tests to these pressure series
 - Tests have been performed in absolute and relative mode (RhtestsV3 & 4, HOMER)
 - With neighbouring stations, gridded observations or reanalyses data, including 20CR, ERA-20C, ICOADS.
-
- We also have compiled metadata related to these stations
 - Listed the dates with metadata changes
 - Confronted them with the homogeneity tests results i.e. the dates with breakpoints

Surface Pressure Breakpoints



Coimbra: 1955 – Change of barometer

Lisbon: 1896, 1994 – Change of barometer

Porto: 1923 – Station closed during 1920-1922 – probable change of barometer

The list contains the breakpoints that coincide with metadata changes and one for which we can make a case for a non-documented metadata change (1923 in Porto is not documented).

We have continued to send new pressure series to ISPD which appear in more recent versions (V4 and forthcoming V5).

1915-1946 former Portuguese colonies pressure dataset

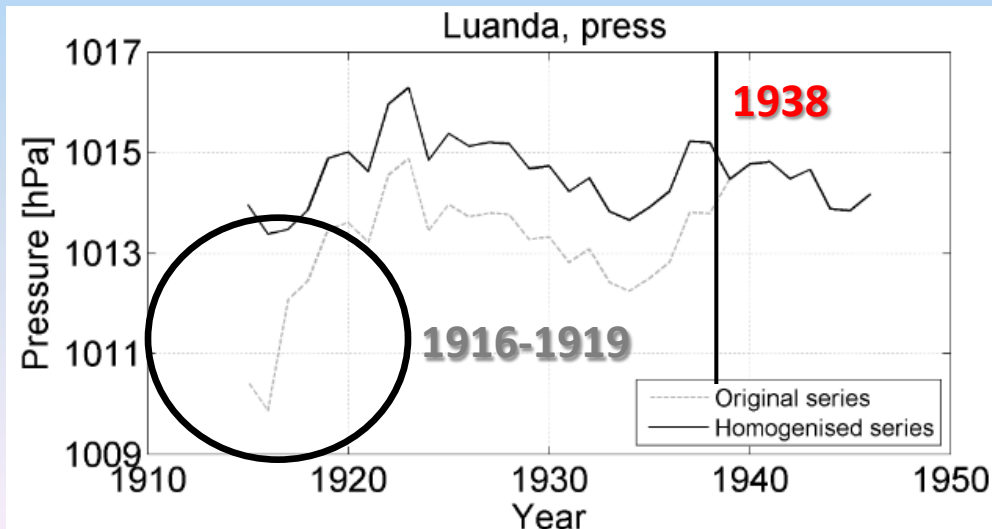
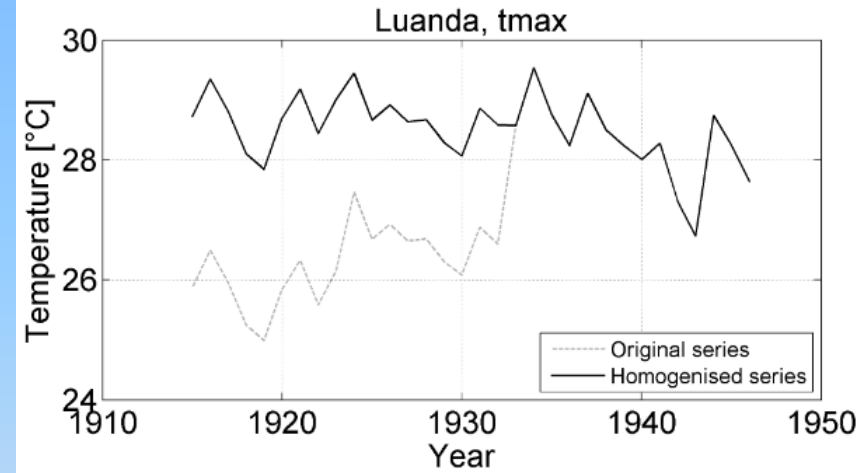
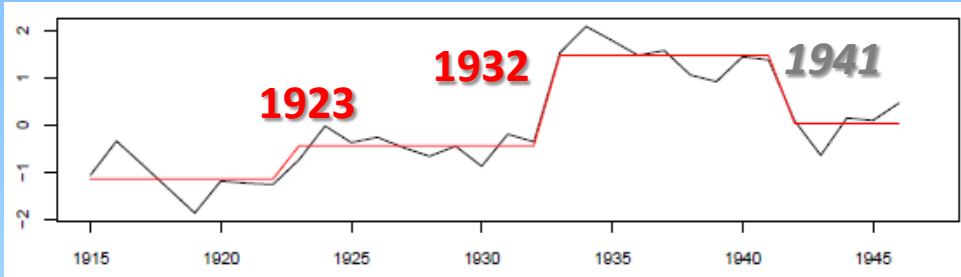
- ❖ Cape Verde – Cidade da Praia, São Vicente
- ❖ Angola – Luanda
- ❖ Mozambique – Maputo (Lourenço Marques), Inhambane, Beira, Quelimane
- ❖ Guiné-Bissau
- ❖ São Tomé
- ❖ India – Goa
- ❖ China Macau

1894-1941 South China Sea complete surface pressure/mslp data set (1894-1917 is already in V3.2.6 having an impact on ERA-20C results for the region – Broennimann et al., 2017)

Chilean pressure for 1950-1956 (1956 was a blank year in V3.2.6)

Angola – Luanda (1915-1946)

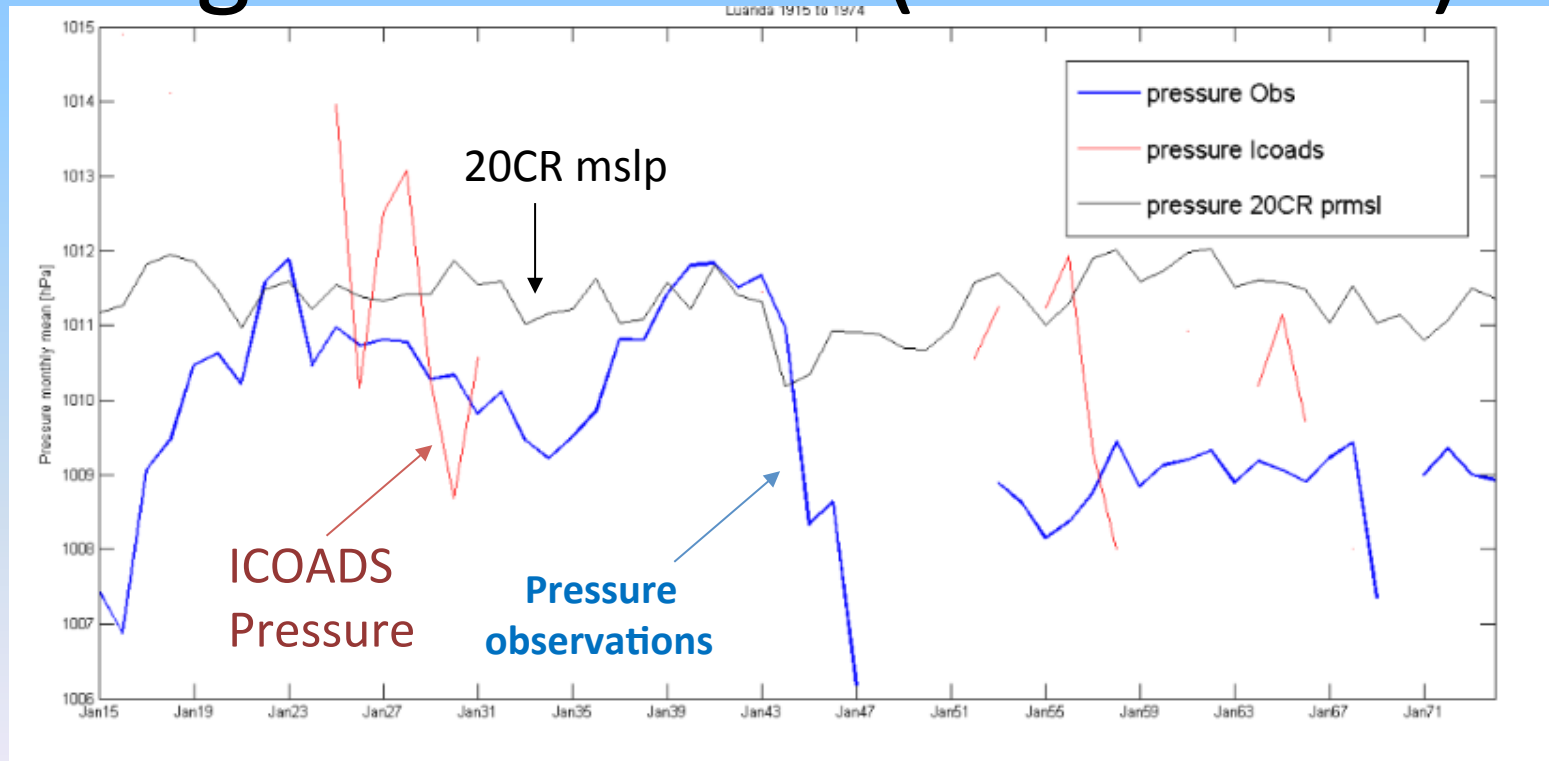
Base minus reference series with regression fit



1923, 1932, 1938 – change of station location

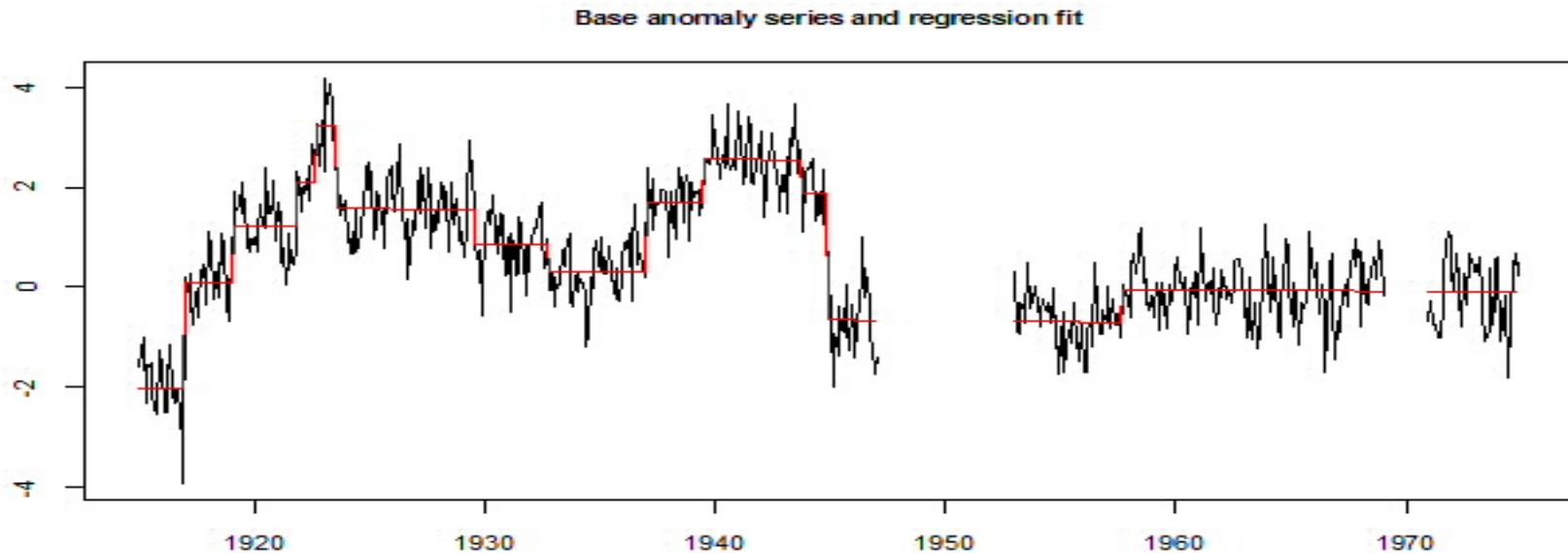
- ❖ The digitisation of new pressure data for **Luanda 1947-1974** extends the series length and sheds new light on the causes of some breakpoints.

Angola – Luanda (1915-1974)



Annual Mean Pressure 9am (1915-1974) Gap 1947-1952

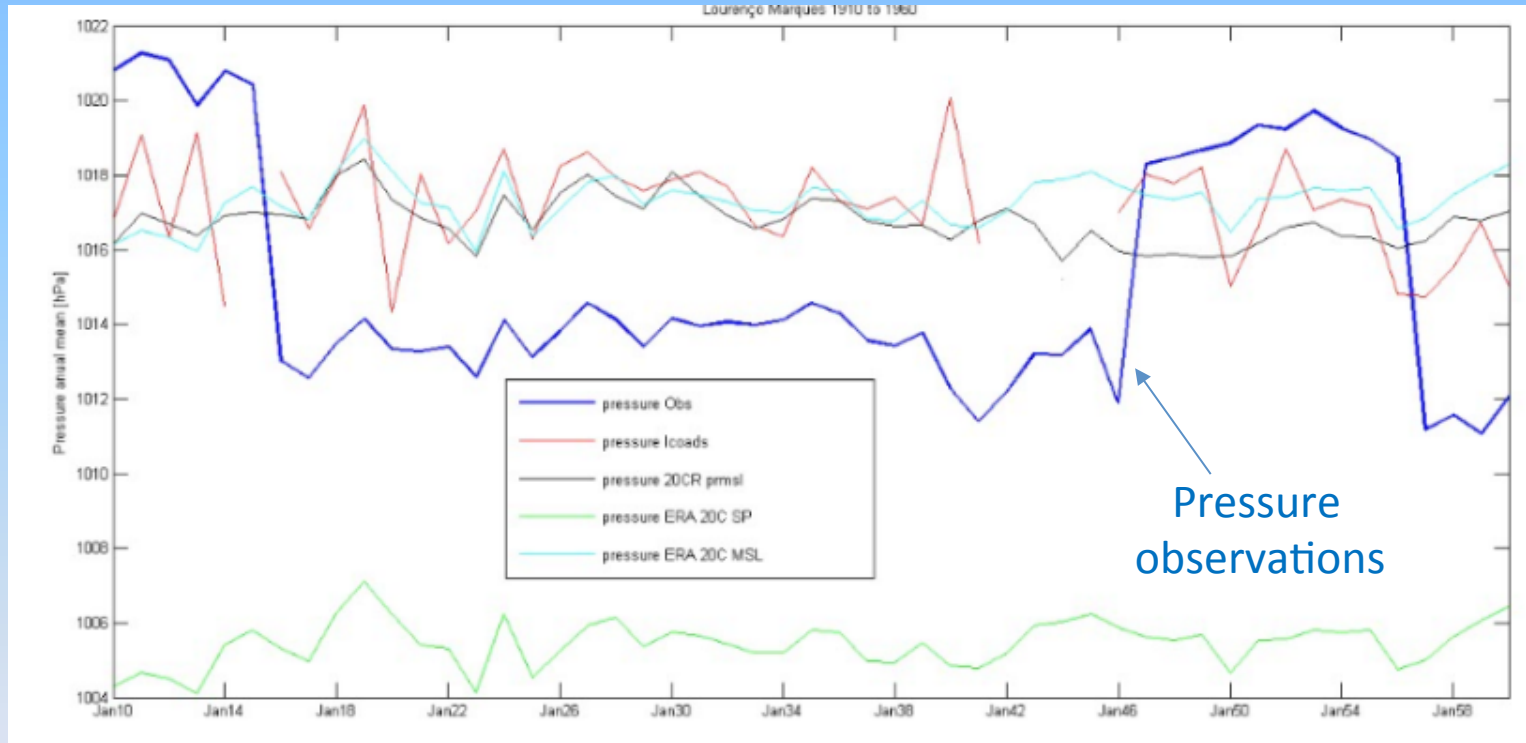
- ❖ It is found that during 1915-1916 and after 1945 the values recorded are those of surface pressure, whereas in the remaining years it was mslp that was published.



Monthly pressure 9am Angola – Luanda (1915-1974)
RHTestsV4 absolute mode

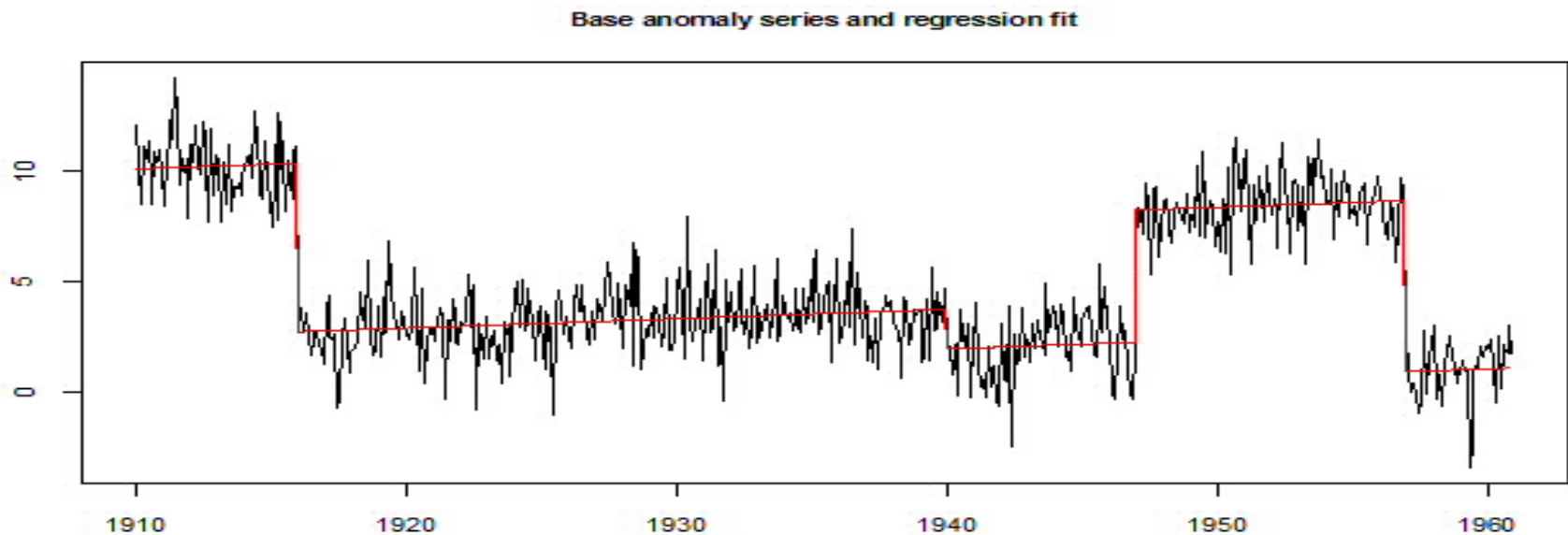
- ❖ The new Maputo pressure data for 1910-1914 and 1947-1960 digitised in ERA-CLIM2 can be joined to the previous 1915-1946 series.

Mozambique – Maputo (1910-1960)



Annual Mean Pressure 9am (1910-1960)

- ❖ Larger breakpoints are due to recording of mslp during the years of 1910-1915 and 1947-1957, whereas in the remaining years surface pressure was recorded. These differences between mslp values and surface values are larger than the jumps provoked by changes in location in Luanda and Maputo.

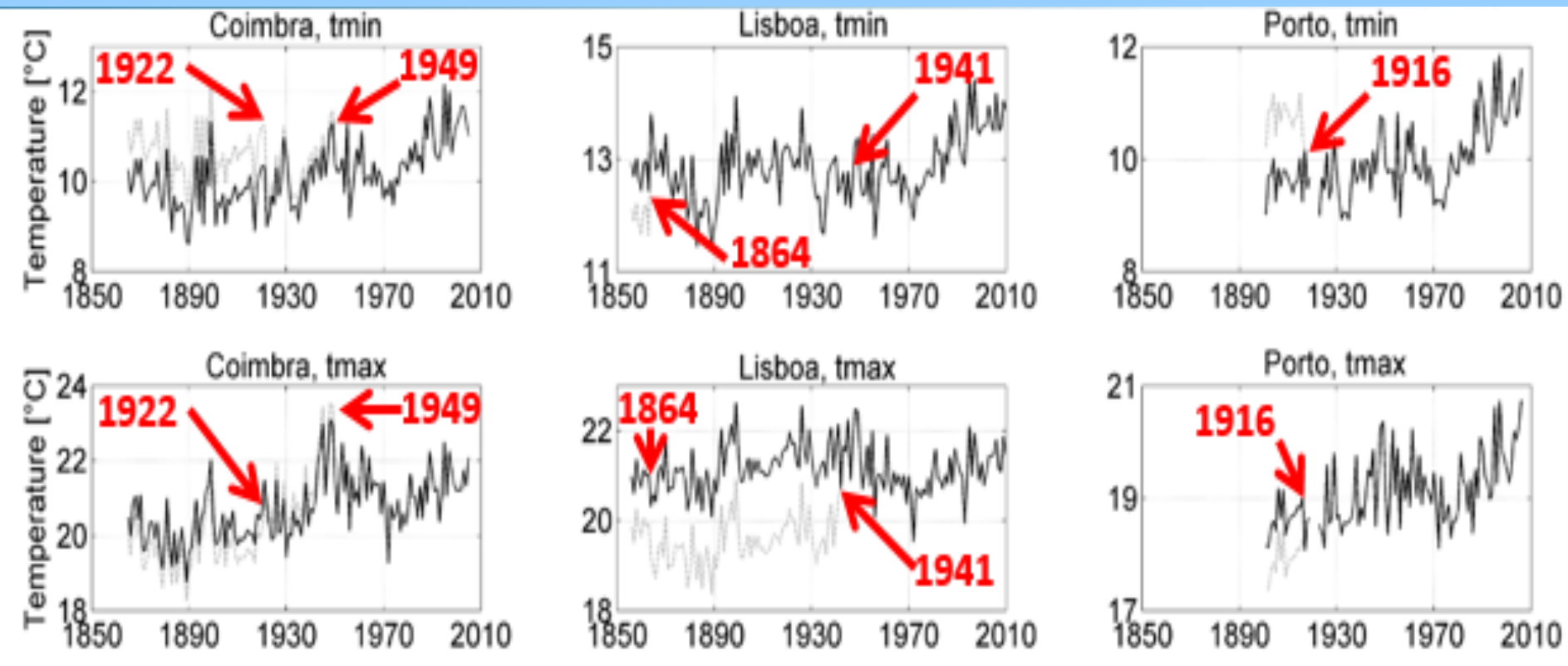


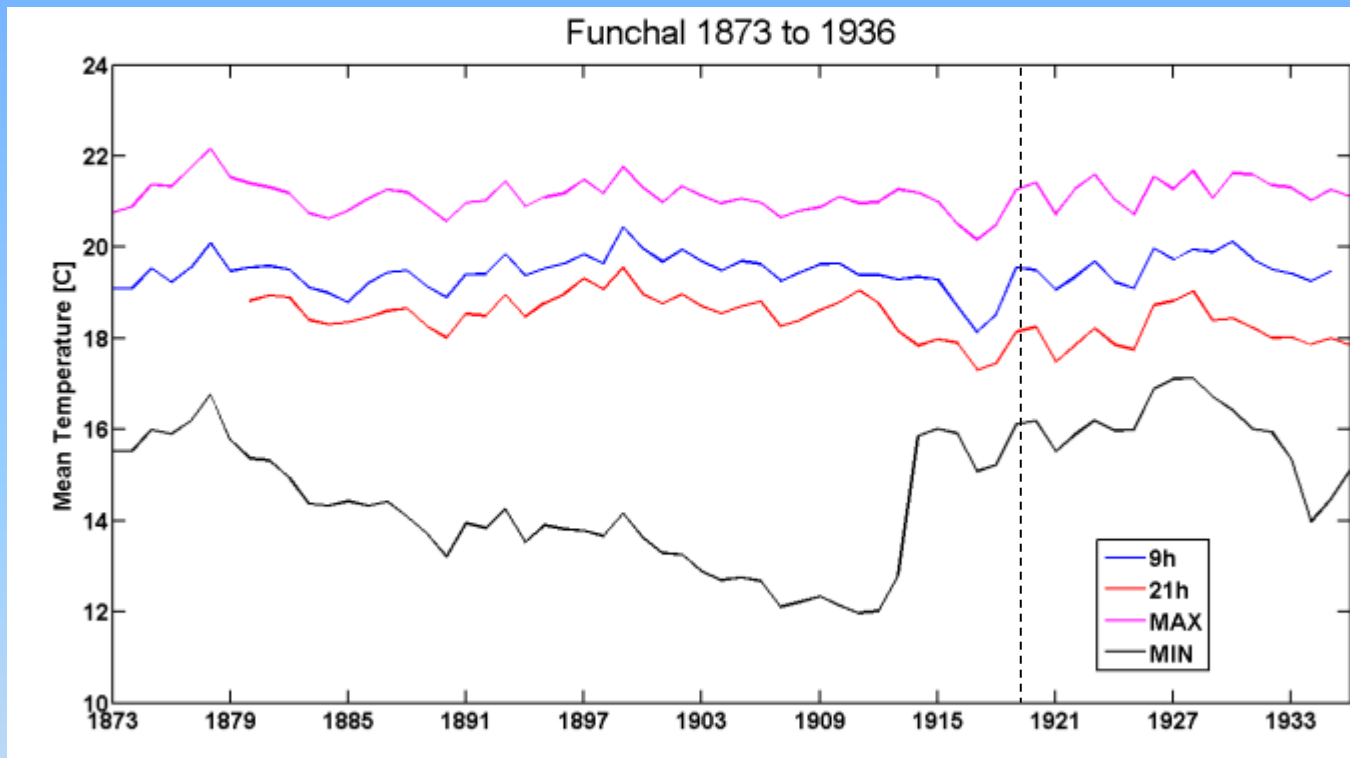
Mozambique – Monthly pressure 9am Maputo (1910-1960)
RHTestsV4 absolute mode

- We have also tested the homogeneity of temperature, precipitation and relative humidity series for the former colonies 1915-1946 (as could be seen in earlier plots)
- As we also did for mainland Portugal (Lisbon, Porto, Coimbra) and the Archipelagos of Azores and Madeira.

1922 – Relocation of the instrument park
 1864 – Change of station location
 1949 – Change of observation time
 1941 – Change of thermometer height

1916 – Change of station location

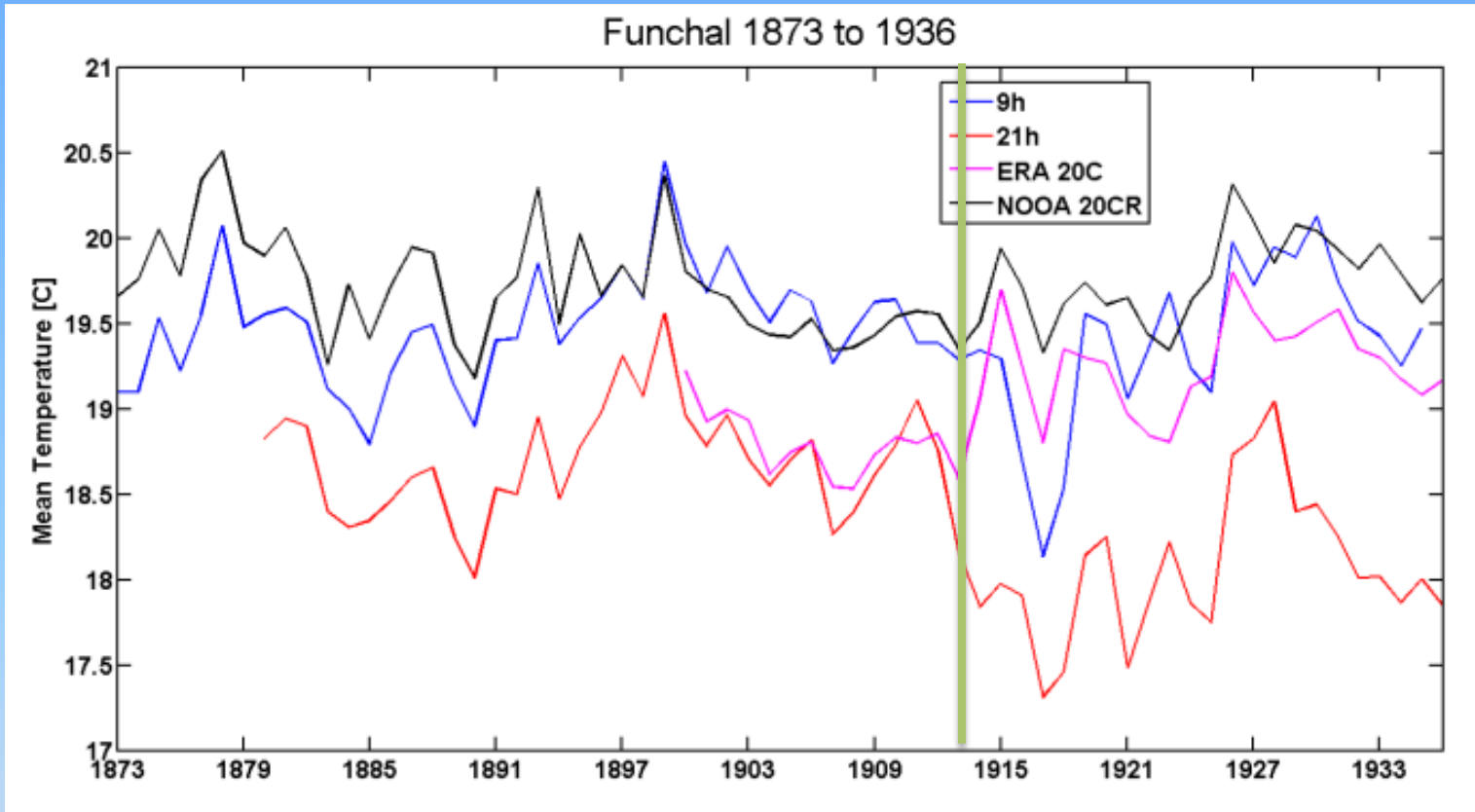




Surface Temperature series for Funchal, Tmax and Tmin

Just by visual inspection, a very clear breakpoint appears in the Tmin series in 1913 that needs to be corrected. The Tmin thermometer was changed in 1913.

Metadata information: The thermometers changed their height by 7m in 1920.



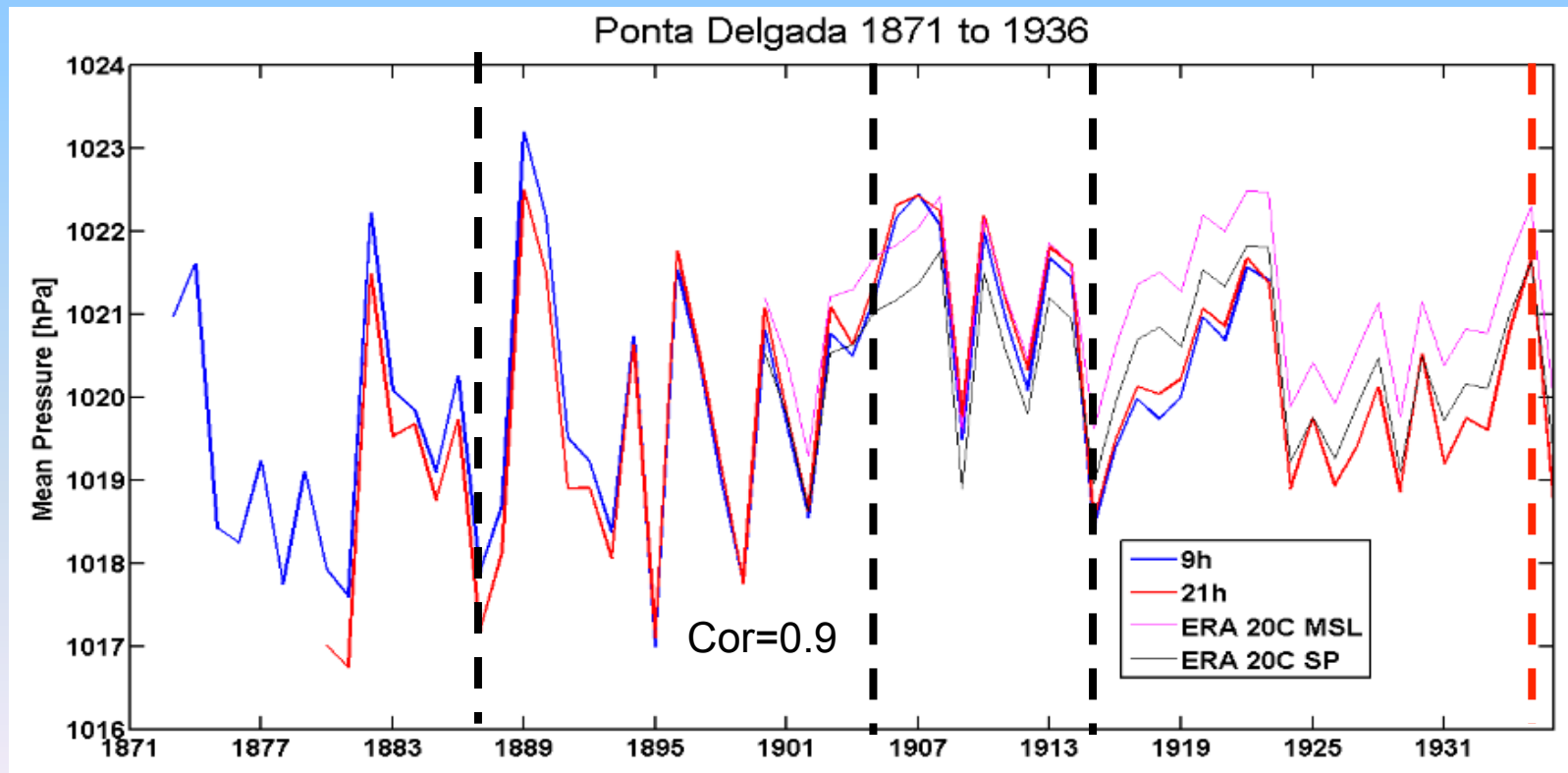
Testing the homogeneity of Funchal surface temperature

All tests with reference series (20CR and ERA-20C) detect a breakpoint in 1913 in the 9h and 21h series. Subsequent tests showed that the 1913 break is detected in Tmax also.

Conclusion: All thermometers were changed in 1913.

- The 1913 breakpoint appears in the Azores temperature series, when tested with reanalyses reference series.
- **It is therefore possible that the thermometers were changed in the Azores at the same time as in Funchal.**

Surface pressure and mslp for observations and ERA-20C (alt changes=20m,17m,22m,136m)



Ponta Delgada is one of the original NAO nodes

3 - Conclusions

We have found

- Breakpoints coincidental with metadata changes
 - Metadata changes that don't generate breakpoints
 - Breakpoints that do not coincide with metadata changes
- ❖ Sometimes we have inferred metadata changes from the breakpoints found
- Most of the data presented was subjected to Quality Control Procedures, with the former colonies (1915-1946) data being checked and formatted for ISPD and ERA-CLIM2 with our CQ_Surface QC tool, which we are making available for Copernicus.
 - We homogenised the annual Lisbon, Porto and Coimbra series, using the chosen breakpoints presented here.
- Hopefully ECMWF will update its ISPD version, so that it can contain the several pressure datasets we have been digitising.