

# Draft report from the Short Term Scientific Mission 'Homogenisation of Wind Direction and Speed Data', 12<sup>th</sup>-21<sup>st</sup> May 2009, Belgrade, Serbia

## Organisation

The Short Term Scientific Mission was organised in Republic Hydrometeorological Service of Serbia. The host was Predrag Petrović (RHMS of Serbia), while other participants were Guido Fioravanti (ISPRA, Italy) and Pavel Zahradníček (CHMI, Czech Republic).

The STSM started on 12th May 2009 and ended on 21st May 2009.

## Objectives

The main objectives of the STSM were:

- to code a procedure for the ReDistribution method for detection of inhomogeneities in wind direction and speed data for 'R' software package
- to analyse and compare results from methods used in Czech Meteorological Institute and the ReDistribution method used for detection of inhomogeneities in wind speed data
- to review and evaluate procedures for Real Precision method calculations featured in ProClimDB software

## Results

All results were obtained using available subdaily data, calculated daily data and monthly averages of wind speed. Metadata were available only for a limited number of series used during the STSM. The length of these series varied from 39 to 65 years. However, due to limited time of the STSM, many series were not examined yet, but left for future work.

### ***The procedure coded in 'R' for the ReDistribution method***

The procedure for the ReDistribution method was coded for 'R' software package and completed for the basic results: daily distribution frequency tables, moving window relative distribution tables and RDI series for both wind direction and speed data. The results were thoroughly compared to the results of the procedure coded as existing Microsoft Excel macro and verified through step-by-step calculations and thus verified. The 'R' code was tested for different wind data series (selection of one from more stations in a single file, series with/without gaps, series with varying number of observations per day) and for different initial settings (moving window length, various number of distribution classes). The output results are certified with no errors in calculation.

Advantages of the 'R' code over the Excel macro (VBA) of the method were recognised as follows:

- The 'R' code is practically not limited, while the limit of Excel macro was 65534 records. This enables processing longer files with hourly data, while Excel macro is unable to process more than eight years of hourly data.

- The 'R' code for ReDistribution method can be easily re-used in ad-hoc scripts with different settings for the input parameters allowing efficient result comparisons.
- The usage of graphical representation of the results is much easier in 'R', which saves a lot of time. Also, it has a possibility to save graphs in a picture format (i.e. .jpeg, .png).

In addition, there is a necessity of optimising the 'R' code for faster runs. The ReDistribution method is sometimes time consuming due to its large output. The 'R' code was made by Guido Fioravanti, while the verification of the code was performed with Predrag Petrović.

### ***The analysis and comparison of the results from methods used in Czech Meteorological Institute and the ReDistribution method***

Czech Meteorological Institute uses the relative method combined of Alexandersson SNHT and Bivariate test, using monthly average values. The ReDistribution method is an absolute method, but based on distributions of observed values. Although such synthesis of approaches seems unlogical, the results are encouraging.

Most of the break points are detected from both approaches. The rest of break points are detected by one of the approaches, revealing its advantages over the other method that was not able to detect these break points.

The advantage of Alexandersson-Bivariate test is in its ability to determine and apply corrections to homogenise the examined series. Also, its results are derived in relatively short time, which makes this method convenient for quick and sufficiently efficient use. As an absolute one, the ReDistribution method advantage is in its ability to process data from one station only, without good (or any) reference series. Also, this method is able to detect the quality of data series, which can be helpful in selecting reference series. Finally, the ReDistribution method output contains a lot of information that might be used for diagnostics of the detected break point. Verification of the diagnostics was performed through available metadata. On the other hand, using the ReDistribution method might be time consuming, due its large output.

The runs of Alexandersson-Bivariate test and comparison of their results to metadata records were performed by Pavel Zahradníček, while the runs of the ReDistribution method and diagnostics of the break points were performed by Predrag Petrović.

### ***The review and evaluation of Real Precision method procedures featured in ProClimDB software package***

ProClimDB is probably the most complete software package for assessment of homogeneity of climate datasets. Thus, it also features most of the known methods for this assessment.

The Real Precision method is useful for evaluation of data quality by indicating measurement precision performed in observations. Also, a form of ReDistribution method using observed decimal values returns good information on changing the precision features of the examined datasets, indicating possible metadata break points (i.e. changes of observer, instruments, measurement units).

The evaluation of the featured code has verified and confirmed the correct calculations of RPI and RDI of decimal values. However, the review has shown the necessity for

improvement of the ProClimDB software by joining all observation terms of the same element into one data subset (not by terms of observations).

## **Conclusions**

The success of the STSM is best described in its conclusions:

1. The 'R' code for the ReDistribution method is a good way to disseminate the use of the method. The wider use of the method will bring more return information that might help in improvement of both software and the method.
2. The comparison of two basically different approaches to homogeneity assessment showed more valuable results. Thus, it is recommended to use both approaches for better detection of break points.
3. Also, the quality assessment of the series by using the ReDistribution method is supposed to indicate better choice of reference series, it is yet to be examined through further use.

This STSM has only started a long productive work on the homogenisation of wind direction and speed data. It is recommended to continue with this work.