

A METHOD FOR THE RECONSTRUCTION AND TEMPORAL EXTENSION OF CLIMATOLOGICAL TIME SERIES

F. VALERO, J. F. GONZALEZ, F. J. DOBLAS AND J. A. GARCÍA-MIGUEL

Universidad Complutense de Madrid, Departamento de Astrofísica y Física de la Atmósfera, Facultad de Ciencias Físicas, 28040 Madrid, España (Spain)

Received 6 June 1994

Accepted 3 May 1995

ABSTRACT

A method for the reconstruction and temporal extension of climatological time series is provided. This method was focused on a combination of methods, including harmonic analysis, seasonal weights, and the Durbin–Watson (DW) regression method. The DW method has been modified in this paper and is described in detail because it represents a novel use of the original DW method.

The method is applied to monthly means of daily wind-run data sets recorded in two historical observatories (M series and A series) within the Parque del Retiro in Madrid (Spain) and covering different time periods with an overlapping period (1901–1919). The aim of the present study is to fill up to and to construct a historical time series ranging from 1867 to 1992. The proposed model is developed for the 1906–1919 calibration period and validated over the 1901–1905 verification period, which includes the hypothesis of constant ratio of variances. The verification results are almost as good as those for the calibration period. Hence, the M series was extended back to 1867, which results in the longest climatological wind-run data-set in Spain. Also, the reconstruction is shown to be reliable.

KEY WORDS: reconstructing data; filling data; temporal extension; Durbin–Watson regression; time series; wind-run; Madrid

1. INTRODUCTION

When climatological time series are studied it is profitable to check data quality because it usually provides more reliable results. Unfortunately, we often find situations where data sets are too short to study long-term changes or where they show data gaps and so standard time series techniques cannot be used. The former problem may be addressed as a particular case of missing data (i.e. where data were lost or not recorded at the beginning or end of the data set). A number of methods have been proposed to deal with this concern. In general, they would be acceptable as far as the residuals could be considered as a white noise and their sum of squares (SSR) as small as possible.

This paper attempts to provide a simple method for filling and extending climatic data sets, different from those more commonly related with either the arithmetic mean or linear regression models, respectively. For the former, a method is proposed based on defining seasonal ratios (or weights) and a simple harmonic analysis. For the latter, a methodological approach for adjusting time series is specifically developed which makes a full use of station history information. Essentially, the Durbin–Watson (DW) regression (Durbin, 1953; Durbin and Watson, 1950, 1951, 1971) is used to reconstruct data. In this paper, this technique was modified. As an alternative to this method, there exist techniques focused on filtering dependent and independent variables once seasonal components have been filtered so as to obtain independent disturbances in the regression model; but this method involves acting on each of the variables (notice that it could also be applied in cases with more than one independent variable) with their respective coefficients, thereby complicating the procedure of obtaining the original predicted values once the regression is performed. We feel the proposed procedure is more compact and ‘acts’ directly on the residuals, this being the reason why this procedure has been chosen.

