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Estimating missing daily temperature extremes in Jaffna, Sri Lanka

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Abstract The accuracy of reconstructing missing daily temperature extremes in the Jaffna climatological station, situated in the northern part of the dry zone of Sri Lanka, is presented. The adopted method utilizes standard departures of daily maximum and minimum temperature values at four neighbouring stations, Mannar, Anuradhapura, Puttalam and Trincomalee to estimate the standard departures of daily maximum and minimum temperatures at the target station, Jaffna. The daily maximum and minimum temperatures from 1966 to 1980 (15 years) were used to test the validity of the method. The accuracy of the estimation is higher for daily maximum temperature compared to daily minimum temperature. About 95% of the estimated daily maximum temperatures are within ±1.5 °C of the observed values. For daily minimum temperature, the percentage is about 92. By calculating the standard deviation of the difference in estimated and observed values, we have shown that the error in estimating the daily maximum and minimum temperatures is ±0.7 and ±0.9 °C, respectively. To obtain the best accuracy when estimating the missing daily temperature extremes, it is important to include Mannar which is the nearest station to the target station, Jaffna. We conclude from the analysis that the method can be applied successfully to reconstruct the missing daily temperature extremes in Jaffna where no data is available due to frequent disruptions caused by civil unrests and hostilities in the region during the period, 1984 to 2000.

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1 Introduction

Serially incomplete climatic datasets create problems in many climatological studies and applications. Especially when large datasets are needed for the analysis of climatic parameters and other factors affected by climate conditions (Kiraly et al. 2006; Efstathiou et al. 2011; Varotsos et al. 2012), this becomes an issue. The existence of missing data may have been caused by a number of factors such as failure of equipment due to malfunctioning, extreme weather conditions such as hurricanes or floods, human-induced factors such as civil unrests or even accidental loss of data files in computers (Elshorbagy et al. 2000). A number of techniques have been developed in the past to estimate missing data based on regression analysis, time series analysis, artificial neural networks and interpolation techniques (Kemp et al. 1983; DeGaetano et al. 1995; Eischeid et al. 1995; Elshorbagy et al. 2000; Islam et al. 2000; Allen and DeGaetano 2001). The accuracy of these techniques may depend on the region, time of the year or spatial distribution of stations.

Estimation of missing temperature data is important for meteorologists, hydrologists and environment protection workers all over the world. The literature dealing with the estimation of missing daily temperature discusses a number of methods or procedures to resolve this problem. The methods adopted in the past can be classified into three broad categories: (1) within the station, (2) between stations and (3) regression-based techniques (Allen and DeGaetano 2001). The within-station method which can be considered as one of the simplest methods of estimating missing observations is based on taking the average of the temperature records of the previous and following days. The other two methods use data from one or more neighbouring stations to estimate the missing values at the

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