19. Analysing the quality and reconstructing daily weather data for crop growth simulation models

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Crop simulation models can be used to estimate the impact of current and future climate on crop yields and food security. For this, long-term historical daily weather data are required. The accuracy of the simulated yields is dependent upon the quality of the weather data. For many regions available daily weather data show irregularities or missing values. The objective of this study is to develop a methodology for analysing errors and reconstruct missing values on weather data based on statistical functions in R.3.0.0. This approach is illustrated for Monze Farmer Training Centre in Zambia. Weather data analysed were minimum and maximum air temperature, precipitation and solar radiation. Visual data exploration allowed initial identification of outliers and systematic errors due to sensor or transcription problems. For minimum and maximum temperature and rainfall outlier detection, thresholds were defined for different times in a year. The singular spectrum analysis (SSA) method was used to fill data gaps resulting from removal of the anomalies. By detecting the general signal trend, the SSA extrapolates it to the period of missing data, allowing filling the data gaps. Visual data exploration showed signs of repeated coping and pasting of the solar radiation data. The Mountain Climate Simulator (MT-CLIM) was used to estimate solar radiation using daily maximum temperature, maximum temperature and precipitation. Comparison of the observed and simulated solar radiation showed a 'good' RMSE of 19.7%. Our methodology, based on statistical and graphical approaches improves weather data quality for long term series and it will increase the ability of researchers in sub-Saharan Africa, and elsewhere, to make the best use of local weather data, although with irregularities or missing values, for cropping systems modelling.