



Homogenisation of daily wind gusts recorded at Auckland and Wellington airports during 1972 – 2017

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Using surface-layer wind speeds directly without correction for terrain and instrument response characteristics can introduce significant errors in climatological studies, particularly when dealing with long-term historical data. Usually, wind speeds collected at airports are of great importance to climatology studies due to good quality and length of available data. However, when looking at historical data there are inevitable discontinuities resulting from various factors, which have to be compensated for before carrying out any further analysis.

Daily wind gust measurements collected at Wellington and Auckland airports, New Zealand, are the focus of this study. At both stations, the daily gusts are available since 1972, however, in the 1990s the data were subjected to drastic changes, such as site relocation, changes in instruments and observing practice. In addition, there might be other sudden changes and artificial shifts, which have not been recorded in the metadata. Therefore, this study aims to detect all the biases in wind gust measurements by employing a statistical approach, and then correct the historical data to produce homogenised data series that can be used in future analyses.

The recently proposed statistical approach, penalised maximal F test, is used to detect shifts in the data series. The test uses iterative procedures to estimate the linear trend, first-order autocorrelation, and mean shifts of the time series in tandem. The algorithm is used to detect shifts in time series of a constant trend and identically and independently distributed (IID) Gaussian errors. Having detected the statistically significant shifts and the possible sources of the shifts, the data sets can be corrected. The main two bias sources considered in this study are the change in the instrument type and observing practice.

To correct the errors arising from the anemometer types, three different anemometers, which have been used in New Zealand during different periods, are tested and by using random process and linear systems theory, the dynamic response of anemometers are compared. Then, calculating parameters, such as effective gust duration and gust factor ratios between the anemometers, allows us to rationally compare wind data recorded on the former and current instruments. In addition, the effect of applying the WMO-recommended 3-s moving average to the sampled signal, which was introduced into New Zealand in the 1990s, is also investigated.