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Performance of Statistical Temporal Downscaling Techniques of Wind Speed Data Over Aegean Sea

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Wind speed data is a key input for many meteorological and engineering applications. Many institutions provide wind speed data with temporal resolutions ranging from one hour to twenty four hours. Higher temporal resolution is generally required for some applications such as reliable wave hindcasting studies. One solution to generate wind data at high sampling frequencies is to use statistical downscaling techniques to interpolate values of the finer sampling intervals from the available data.
In this study, the major aim is to assess temporal downscaling performance of nine statistical interpolation techniques by quantifying the inherent uncertainty due to selection of different techniques. For this purpose, hourly 10-m wind speed data taken from 227 data points over Aegean Sea between 1979 and 2010 having a spatial resolution of approximately 0.3 degrees are analyzed from the National Centers for Environmental Prediction (NCEP) The Climate Forecast System Reanalysis database. Additionally, hourly 10-m wind speed data of two in-situ measurement stations between June, 2014 and June, 2015 are considered to understand effect of dataset properties on the uncertainty generated by interpolation technique. In this study, nine statistical interpolation techniques are selected as w0 (left constant) interpolation, w6 (right constant) interpolation, averaging step function interpolation, linear interpolation, 1D Fast Fourier Transform interpolation, 2nd and 3rd degree Lagrange polynomial interpolation, cubic spline interpolation, piecewise cubic Hermite interpolating polynomials. Original data is down sampled to 6 hours (i.e. wind speeds at 0th, 6th, 12th and 18th hours of each day are selected), then 6 hourly data is temporally downscaled to hourly data (i.e. the wind speeds at each hour between the intervals are computed) using nine interpolation technique, and finally original data is compared with the temporally downscaled data. A penalty point system based on coefficient of variation root mean square error, normalized mean absolute error, and prediction skill is selected to rank nine interpolation techniques according to their performance. Thus, error originated from the temporal downscaling technique is quantified which is an important output to determine wind and wave modelling uncertainties, and the performance of these techniques are demonstrated over Aegean Sea indicating spatial trends and discussing relevance to data type (i.e. reanalysis data or in-situ measurements). Furthermore, bias introduced by the best temporal downscaling technique is discussed.
Preliminary results show that overall piecewise cubic Hermite interpolating polynomials have the highest performance to temporally downscale wind speed data for both reanalysis data and in-situ measurements over Aegean Sea. However, it is observed that cubic spline interpolation performs much better along Aegean coastline where the data points are close to the land.

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