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A hybrid downscaling procedure for estimating the vertical distribution of ambient temperature in local scale

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The vertical thermal structure of the atmosphere is defined by a combination of dynamic and radiation transfer processes and plays an important role in describing the meteorological conditions at local scales. The scope of this work is to develop and quantify the predictive ability of a hybrid dynamic-statistical downscaling procedure to estimate the vertical profile of ambient temperature at finer spatial scales. The study focuses on the warm period of the year (June – August) and the method is applied to an urban coastal site (Hellinikon), located in eastern Mediterranean. The two-step methodology initially involves the dynamic downscaling of coarse resolution climate data via the RegCM4.0 regional climate model and subsequently the statistical downscaling of the modeled outputs by developing and training site-specific artificial neural networks (ANN). The 2.5^ox2.5^o gridded NCEP-DOE Reanalysis 2 dataset is used as initial and boundary conditions for the dynamic downscaling element of the methodology, which enhances the regional representivity of the dataset to 20km and provides modeled fields in 18 vertical levels. The regional climate modeling results are compared versus the upper-air Hellinikon radiosonde observations and the mean absolute error (MAE) is calculated between the four grid point values nearest to the station and the ambient temperature at the standard and significant pressure levels. The statistical downscaling element of the methodology consists of an ensemble of ANN models, one for each pressure level, which are trained separately and employ the regional scale RegCM4.0 output. The ANN models are theoretically capable of estimating any measurable input-output function to any desired degree of accuracy. In this study they are used as non-linear function approximators for identifying the relationship between a number of predictor variables and the ambient temperature at the various vertical levels. An insight of the statistically derived input-output transfer functions is obtained by utilizing the ANN weights method, which quantifies the relative importance of the predictor variables in the estimation procedure. The overall downscaling performance evaluation incorporates a set of correlation and statistical measures along with appropriate statistical tests. The hybrid downscaling method presented in this work can be extended to various locations by training different site-specific ANN models and the results, depending on the application, can be used for assisting the understanding of the past, present and future climatology.

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