GIS-based temperature interpolation for distributed modeling of reference evapotranspiration

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Surface air temperature is an important meteorological input in most formulas for point-specific reference evapotranspiration calculation. To model the spatially distributed reference evapotranspiration, interpolation of temperature accounting for topography is necessary. In this paper we evaluated four interpolation schemes using the leave-one-out cross-validation method with the measured temperature data at 139 climate stations in the state of Utah. The interpolation schemes evaluated were respectively (1) inverse distance weighting (IDW) without consideration of elevation effects, (2) ordinary Kriging without consideration of elevation effects, (3) a hybrid scheme that combined a constant lapse rate with ordinary Kriging, (4) an elevationally detrended kriging approach which is a combination of regression against elevation and ordinary Kriging. Cross-validation results show that the 4th scheme has the least root-mean-square error. The steps involved in applying this scheme are: (1) develop a regression relationship between the ground measurements of temperature and site elevations at each calculation step, then (2) interpolate the residual difference between the measured temperature and the temperature obtained from the regression at each station using ordinary Kriging, (3) estimate the temperature at non-station locations by adding the interpolated residuals to the temperature obtained from the regression using elevation from a digital elevation model (DEM). This interpolation scheme was implemented within ArcGIS using the programming capability provided through ArcObjects.

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