Spatial interpolation of high-frequency monitoring data

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Climate modelers generally require meteorological information on regular grids, but monitoring stations are in practice sited irregularly. Thus, there is a need to produce public data records that interpolate available data to a high density grid that can then be used to generate meteorological maps at a broad range of spatial and temporal scales. In addition to point predictions, quantifications of uncertainty are also needed. One way to accomplish this is to provide multiple simulations of the relevant meteorological quantities conditional on the observed data that take account of the various uncertainties in predicting a space-time process at locations with no monitoring data. Using a high-quality dataset of minute-by-minute measurements of atmospheric pressure in north-central Oklahama, this work describes a statistical approach to carrying out these conditional simulations. Based on observations at 11 stations, conditional simulations were produced at two other sites with monitoring stations. The resulting point predictions are very accurate and the multiple simulations produce well-calibrated prediction uncertainties for temporal changes in atmospheric pressure but are substantially overconservative for the uncertainties in the predictions of (undifferenced) pressure.