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J19.4: Algorithms for effective objective analysis of surface weather variables

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The Meteorological Development Laboratory uses a highly specialized form of the successive correction objective analysis method popularized by George Cressman in the 1950's. The successive correction method remains as one of the best procedures for analysis of surface weather elements–estimating values at gridpoints from quasi-random data. The method starts from a first guess grid, then corrects each gridpoint according to the data in its vicinity in a series of passes over the data; that is, more than one corrective passe can be made, usually each successive pass being made with a smaller radius of influence of the data points. However, there are many differences in data characteristics, geography, and topography that must be dealt with, including sparse data areas, land/water boundaries, rough terrain, and categorical variables rather than quasi-continuous variables.

This paper will describe methods we have devised to deal with these and other challenges. For instance, our BCDG analysis package can compute an expected change in elevation from either the surface data being analyzed, upper air data from a model forecast, or a combination of both. A different radius of influence can be used for each data point, or a constant one that depends only on pass number. There are four choices for the first guess, and several options, such as throw-out criteria in quality controlling the data, vary by first guess choice. Land and water can be treated together or separately. There are several options for smoothing the grid, including a terrain-following smoother, a spot remover, and a ray smoother for water areas that can variably smooth depending on distance from the coast. The number of corrective passes can vary, and there are three types of correction that can be made in combination with bi-linear, bi-quadratic, or terrain-related interpolation. Provision is made to give special emphasis to the range of values of interest to users; for instance, the careful analysis of ceiling heights below 1000 ft is much more important that a 1000-ft range up at 10,000 ft.

Grids of observations and of MOS and LAMP forecasts are provided in the National Digital Guidance Database. The techniques used to produce these grids will be presented.

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