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Chapter VI

On the Concept of Varying Influence Radii
for a Successive Corrections Objective Analysis

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ABSTRACT

There has been a long-standing concept by those who use successive corrections objective analysis that the way to obtain the most accurate objective analysis is first, to analyze for the long wavelengths and then to build in the details of the shorter wavelengths by successively decreasing the influence of the more distant observations upon the interpolated values. Using the Barnes method, we compared the filter characteristics for families of response curves that pass through a common point at a reference wavelength. It was found that the filter cutoff is a maximum if the filter parameters that determine the influence of observations are unchanged for both the initial and corrections passes. This

information was used to define and test the following hypothesis. If accuracy is defined by how well the method retains desired wavelengths and removes undesired wavelengths, then the Barnes method gives the most accurate analyses if the filter parameters on the initial and corrections passes are the same. This hypothesis does not follow the usual conceptual approach to successive corrections analysis.

Theoretical filter response characteristics of the Barnes method were compared for filter parameters set to retrieve the long wavelengths and then build in the short wavelengths with the method for filter parameters set to retrieve the short wavelengths and then build in the long wavelengths. The theoretical results and results from analyses of regularly spaced data show that the customary method of first analyzing for the long wavelengths and building in short wavelengths is not necessary for the single correction pass version of the Barnes method. Use of the same filter parameters for initial and corrections passes improved the analyses from a fraction of a percent for long wavelengths to about ten percent for short but resolvable wavelengths.

However, the more sparsely and irregularly distributed the data, the less the results are in accord with the predictions of theory. Use of the same filter parameters gave better overall fit to the wavelengths shorter than eight times the minimum resolvable wave and slightly degraded fit to the longer wavelengths. Therefore, in the application of the Barnes method to irregularly spaced data, successively decreasing the influence of the more

distant observations is still advisable if longer wavelengths are present in the field of data.

It also was found that no single selection of filter parameters for the two-pass Barnes method gives the best analysis for all wavelengths. A three-pass hybrid method is shown to reduce this problem.

REFERENCE

Achtemeier, G. L., 1987: On the Concept of Varying Influence Radii for a Successive Corrections Objective Analysis. Mon. Wea. Rev., 115, 1760-1771.