SOME NEW MATHEMATICAL METHODS FOR VARIATIONAL OBJECTIVE ANALYSIS

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RESEARCH OBJECTIVES

The overall objective of the work is to develop and test some new mathematical methods for variational objective analysis of meteorological information, which include provision for simultaneous analysis of data from different observational systems and the direct merging of satellite and radiosonde data using tropopause/inversion height.

CURRENT RESEARCH

We have developed an overall theory for the estimation of relative weights to be given to observation and forecast, or to observations from qualitatively different observing systems (such as radiosonde and satellite data), from the data at hand (Wahba(1989a,b)). A pilot study to compare the accuracy and assess the efficiency of these methods in realistic examples is continuing (Wahba, Reames and Johnson(1989)). Some improvements in the details of the cross validation method have been made based on early numerical results, and have been incorporated into the pilot study computer programs. Preliminary results are encouraging and suggest that quantitatively useful results may be available for realistic data sets which are large, but still numerically manageable. The pilot study is approaching the production stage, and we expect to demonstrate the properties of the methods under a range of circumstances. These and other methods for merging information from diverse sources will, in practice, require the efficient numerical solution of large variational problems with multiple smoothing/tuning parameters. New numerical methods for doing this appear in Gu, Bates, Chen and Wahba(1988), Gu and Wahba(1988). Gu(1989) has implemented some of these methods in publicly available code.

FUTURE PLANS

We expect to complete demonstration programs involving height fields and to expand the work to include joint analysis of satellite radiance and other data. This expansion will require the ability to simultaneously analyze very large data sets, and we plan to extend our results to allow this to be done.

PUBLICATIONS

G. Wahba(1989a), On the dynamic estimation of relative weights for observations and forecast in numerical weather prediction, in Remote Sensing Retrieval Methods, A. Deepak, H. E. Fleming and J. S. Theon, eds, A. Deepak Publishing, Hampton, VA, pp.347-358 See also G. Wahba's discussion on p. 166 of this volume.

C. Gu, D. Bates, Z. Chen and G. Wahba(1988), The computation of GCV functions through Householder tridiagonalization with application to the fitting of interaction spline models, University of Wisconsin-Madison TR 823, to appear, SIMAX

C. Gu and G. Wahba(1988), Minimizing GCV/GML scores with multiple smoothing parameters via the Newton method, University of Wisconsin-Madison Statistics Dept. TR No. 847, tentatively accepted SISSC

C. Gu(1989), RKPACK and its applications: Fitting smoothing spline models, Dept. of Statistics, University of Wisconsin TR 857. Code available through netlib.

G. Wahba, F. Reames and D. R. Johnson(1989), Simulation studies of the merging of observation and forecast with dynamic estimation of relative weights, in preparation.

G. Wahba(1989b), On the dynamic estimation of the relative accuracy of different sources of data, in preparation.