TEMPERATURE RETRIEVALS FROM TYPICAL SHAPE FUNCTIONS

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1. Introduction

Temperature retrievals from satellite measurements of the earth's spectral radiances are frequently reliant upon some statistical relation between the measurements and known temperature profiles. Examples may be found in the statistical regression procedure employed with TOVS operation and statistical inversion methods, which combine the statistical behavior of profiles with the optical properties of the atmosphere. Mathematical methods, which make use only of the atmospheric transmittances are handicapped by the vertical dimensions of the weighting functions.

2. Typical Shape Functions

Statistical data are normally selected in large sets with little attention to loss of knowledge regarding the physical nature of the data. Figure 1 illustrates a histogram of TOVS MSU channel 2 data taken from a global set. Stratification of these data by latitude would produce a group of histograms, each having less variability, but the significant meteorological implication would still be obscured.

To retain the physical structure of temperature profiles, the sample must be divided in such a way that the means retain the structures, the distributions about the means are Gaussian, and the variance is small.

From a large set of radiosonde/rocketsonde profiles, Uddstrom and Wark (1983) have proposed an approach based on the work of Jalickee and Ropelewski (1979). The Typical Shape Functions (TSFs), which were developed, are sub-classes of the set which satisfies the conditions. Figure 2 illustrates four of the TSFs (of 13 in the study), covering the range 10-450 mb over which the data were fit.

This separation of data would not be useful unless the various subclasses could be distinguished using the satellite radiances. By means of discriminate functions, appropriate TSFs can be identified to levels of confidence dependent upon how well a particular profile fits as a member of any subclass.

3. Results

Results from a sample of 61 independent samples are shown in Figure 3. RMS differences were obtained for these solutions: TSF physical retrieval (solid); TSF regression (dotted); and zonal regression (dashed). The results reveal that TSFs have an advantage over zonally stratified statistics, particularly around the tropopause, and are well suited to physical retrieval methods.

References

M. J. Uddstrom and D. Q. Wark, "A Classification Scheme for Satellite Temperature Retrievals," to be submitted to J. Atmos. Sci., 1983.

J. B. Jalickee and C. F. Ropelenski, "An Objective Analysis of the Boundary-Layer Thermodynamic Structure During GATE, Part I: Method, Mon. Weather Rev., 107, 68, 1979.

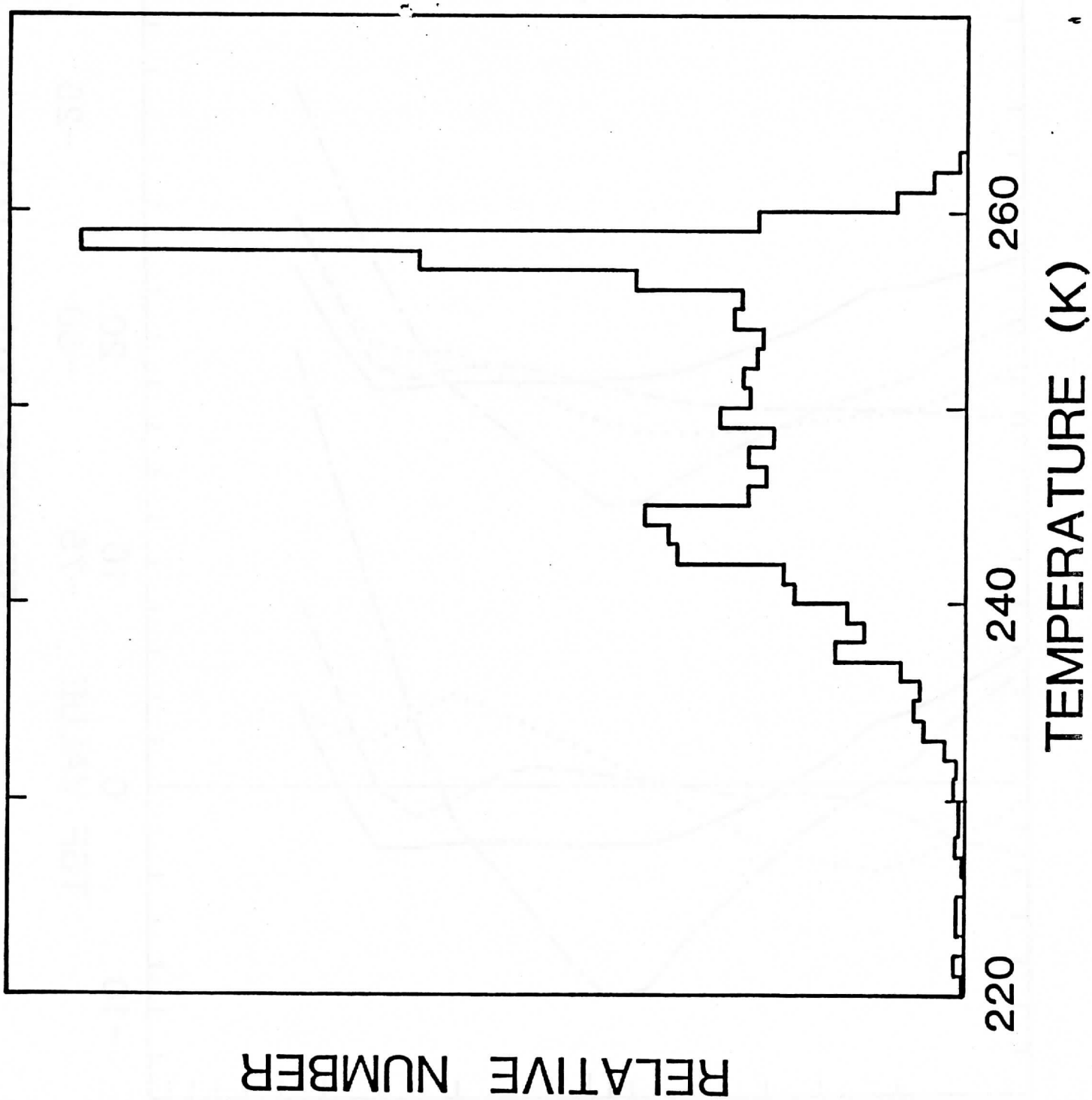

Figure 1

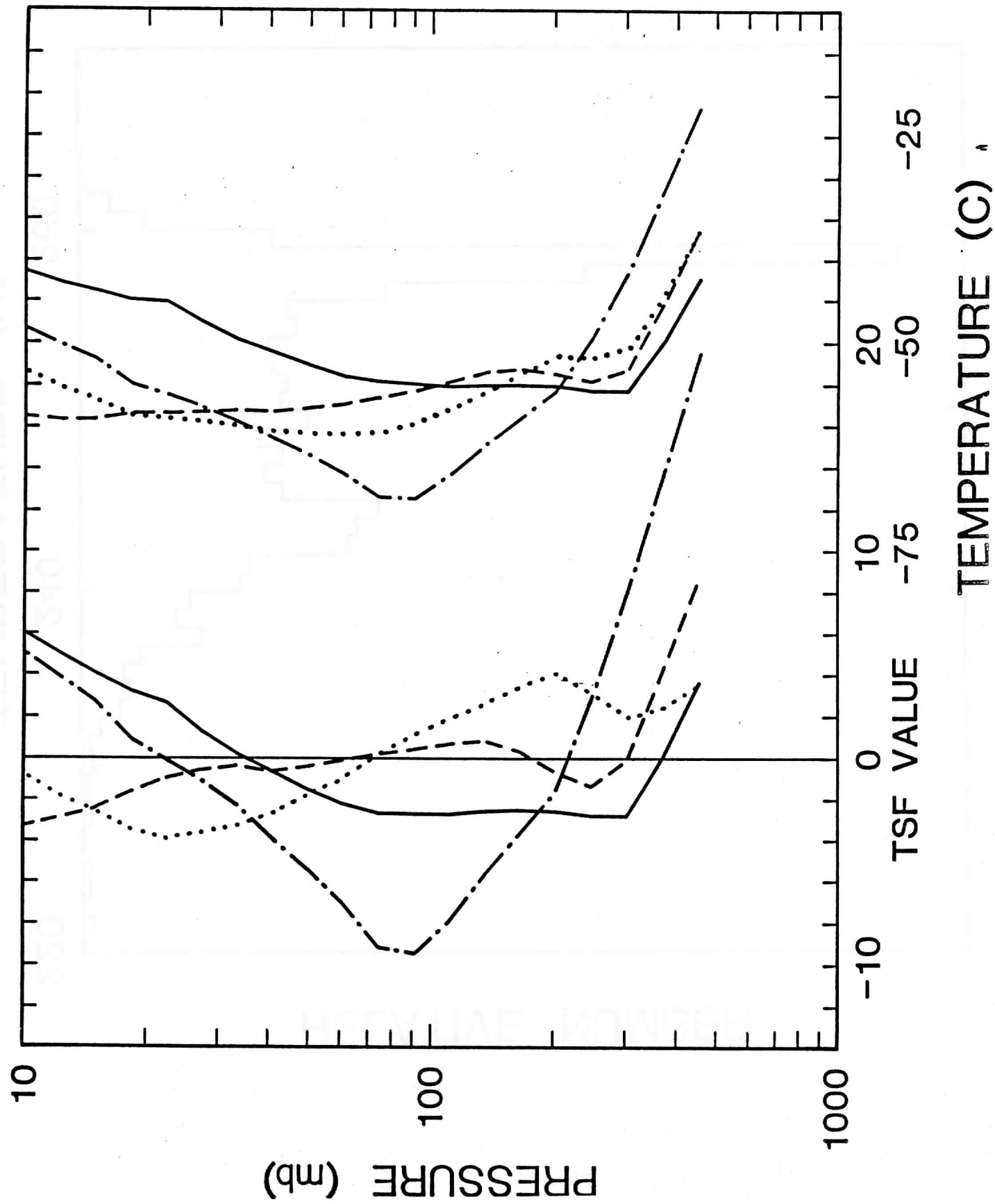
PRESSURE (mb)
10
100
1000
-10
0
10
20
TSF VALUE
-75
-50
-25
TEMPERATURE (C)

Figure 2

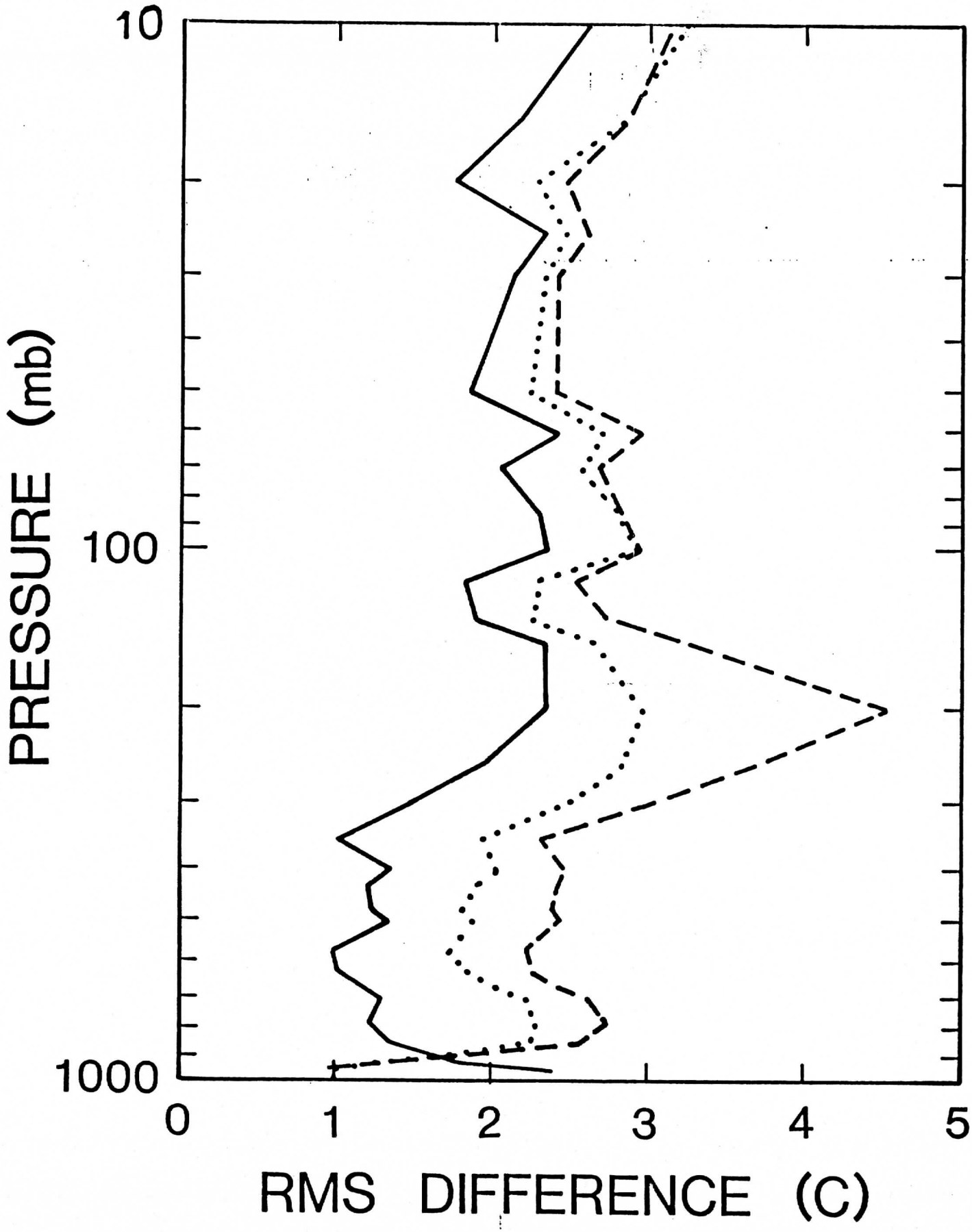

Figure 3

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