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NATIONAL WEATHER SERVICE
Silver Spring, Md. 20910

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Reply to Attn. of: W111x1

To : Recipients of Technical Procedures Bulletin Series

From : Duane S. Cooley, Chief, Technical Procedures Branch
Weather Analysis and Prediction Division, NWS

Subject: Technical Procedures Bulletin No. 101: EXPERIMENTAL FORECASTS OF FREEZING LEVEL(S), CONDITIONAL PRECIPITATION TYPE, SURFACE TEMPERATURE, AND 50-METER WIND, PRODUCED BY THE PLANETARY BOUNDARY LAYER(PBL) MODEL

This bulletin was prepared by Robert Derouin from information supplied by Mr. Edward Gross of the Aviation Branch at National Weather Service Headquarters, and Mr. Paul Polger of the Development Division at the National Meteorological Center (NMC). It describes the new, experimental PBL products which will be transmitted on FOFAX. These products will replace the experimental PBL products which have been transmitted since last fall. The exact date the new products will be implemented will be announced by a GENOT.

An addition to Technical Procedures Bulletin No. 100 is attached to this bulletin (101).

EXPERIMENTAL FORECASTS OF FREEZING LEVEL(S), CONDITIONAL PRECIPITATION TYPE, SURFACE TEMPERATURE, AND 50-METER WIND, PRODUCED BY THE PLANETARY BOUNDARY LAYER (PBL) MODEL

1. INTRODUCTION

The PBL model has eight levels in the vertical including the surface, and 50, 150, 300, 600, 900, 1200, and 1600 meters above the surface. This model uses the same grid as the Limited-Area Fine Mesh (LFM) model (1). A complete description of the PBL model is given in Technical Procedures Bulletin No. 85(2), and NMC Office Notes 75(3) and 77(4).

Products have been developed which take advantage of the detail of the low level structure of the PBL model. Some of the products are transmitted on an experimental basis over facsimile. Forecasts of freezing level(s), conditional precipitation type, surface temperature, and 50-meter wind will soon be transmitted. These products will replace the PBL time cross-section charts and the PBL stability index chart.

2. GENERATION OF FORECASTS

The forecasts are made at each grid point. A brief description follows describing how each forecast is generated.

2.1 FREEZING LEVEL(S) AND CONDITIONAL PRECIPITATION TYPE

A prognostic vertical temperature profile is constructed by merging temperature forecast values from the eight levels of the PBL model and the three tropospheric levels of the LFM model. One advantage of the PBL model is its ability to forecast the low level temperature profile.

Forecasts of the freezing level(s) are made from the prognostic temperature profile. Temperatures of 0°C are located on the prognostic sounding and the corresponding heights are obtained by interpolation from the LFM pressure fields. A maximum of three freezing levels can be found in this manner.

The criteria for determining the conditional precipitation type were subjectively derived by analyzing soundings taken in different types of precipitation. These results are then applied to the prognostic sounding. The forecasts discriminate between rain (R), snow (S), freezing rain (Z), sleet (E), and mixed rain/snow (M).

Figure 1 shows how the freezing level(s) and conditional precipitation type are obtained from different prognostic soundings.

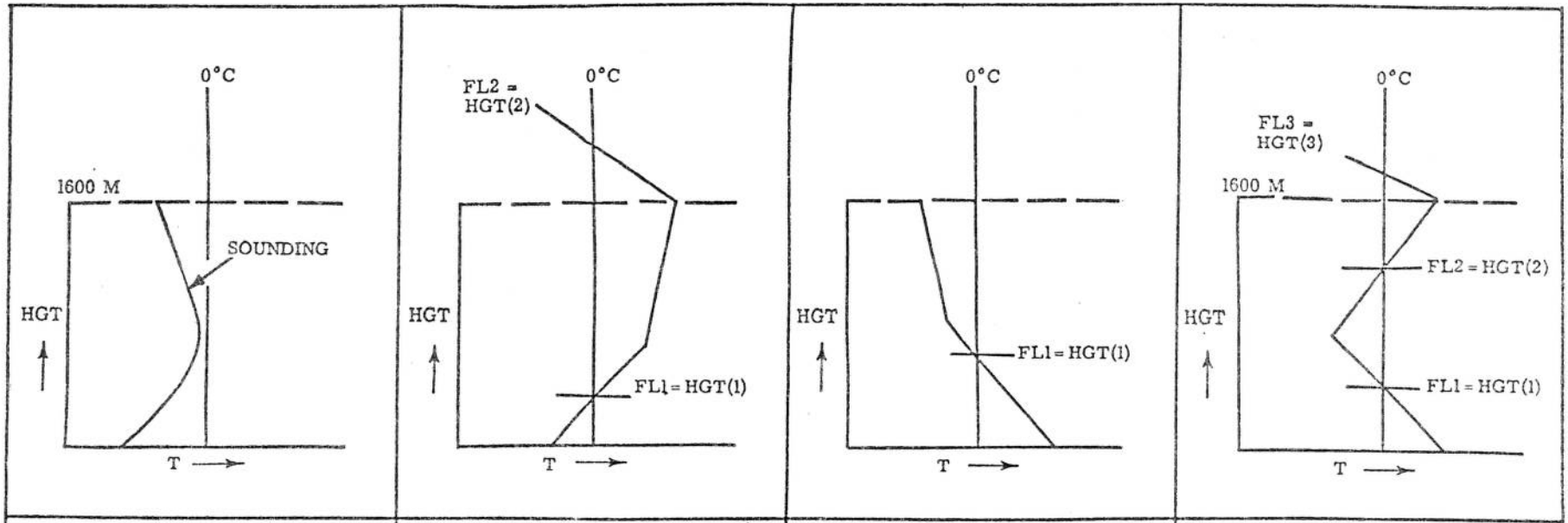
2.2 SURFACE TEMPERATURE AND 50-METER WIND

The surface (actually instrument shelter height) temperature is calculated by using the first law of thermodynamics. Allowance is made for advective, adiabatic, and radiational temperature changes. The radiational changes are calculated as an empirically determined function of the season and are scaled down according to cloudiness which is predicted in the upper(lower) level by the LFM(PBL) model.

The details of the wind profile in the boundary layer are based on an Ekman Spiral modified by a mean thermal wind between 1600 meters and 50 meters above the surface. Both wind speed and direction are predicted at 50 meters above the surface.

3. FACSIMILE CHARTS

Three, two-panel charts will be transmitted daily on FOFAX. The forecasts on the panels will be for 18 and 24 hours from 0000Z and will cover southeast Canada, the eastern half of the conterminous United States, and the Gulf of Mexico.



FREEZING LEVEL	SFC Below Freezing (BF)	Freezing Level 2 = FL2 = HGT(2) Freezing Level 1 = FL1 = HGT(1) SFC BF	Freezing Level 1 = FL1 = HGT(1)	Freezing Level 3 = FL3 = HGT(3) Freezing Level 2 = FL2 = HGT(2) Freezing Level 1 = FL1 = HGT(1)

PRECIP TYPE	Snow (S)	If FL1 > 1000' and (FL2-FL1) > 500' = Sleet (E)
		If FL1 < 1000' and (FL2 − FL1) > 500' = Freezing Rain (Z)
		If (FL2-FL1) < 500' = Snow (S)
			If FL1 < 2000 FT = Mixed Rain/Snow (M)
			If FL1 > 2000 FT = Rain (R)
				If (FL3-FL2) < 500' and FL1 < 1200 FT and SFC Temp < 36°F = Snow (S)
				If (FL3-FL2) > 1000' and (FL2-FL1) > 500' and FL1 < 1000' = Sleet (E)
				If (FL3-FL2) < 500' and FL1 > 1200' = Rain (R)
				If (FL3-FL2) > 500' and <1000' and (FL2-FL1) < 500' and FL1 > 1000' = Mixed Rain/Snow (M)

Figure 1. Derivation of the freezing level(s) and conditional precipitation type.

The FOFAX schedule will be rearranged as follows:

Time	Slot	Description
1026Z	FO65C	Experimental 18-Hour Forecasts of Freezing Level(s) and Conditional Precipitation Type
1037Z	FO66C	Experimental 24-Hour Forecasts of Freezing Level(s) and Conditional Precipitation Type
1048Z	FO67C	Experimental 18- and 24-Hour Forecasts of Surface Temperature and 50-Meter Wind

To accomplish this rearrangement, the following experimental PBL products will be dropped:

Time	Slot	Description
1018Z	FA64A	Boston Time Cross-Section
1029Z	FD64A	New York Time Cross-Section
1029Z	FE64P	Sioux Falls Time Cross-Section
1040Z	FF64C	Stability Indices
1051Z	FG64P	Kansas City Time Cross-Section

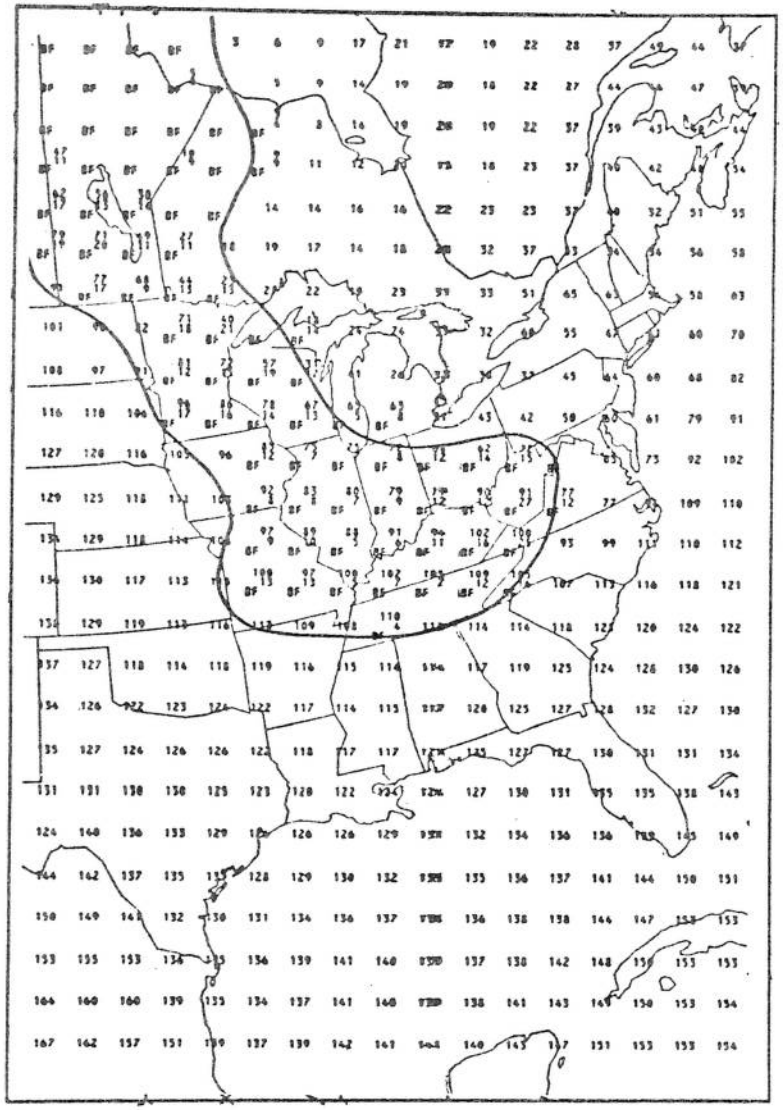
The forecasts will be displayed at each grid point (except for temperatures) on the new PBL charts. A brief description of each new PBL chart follows.

3.1 FREEZING LEVEL(S) AND CONDITIONAL PRECIPITATION TYPE

The left panel will display the freezing level(s). Below freezing at the surface is indicated by BF, while 120 indicates a freezing level of 12,000 feet. The arrangement $\begin{matrix} 090 \\ 042 \\ BF \end{matrix}$ means below freezing at the surface, and freezing at 4,200 feet and 9,000 feet. The area between 4,200 feet and 9,000 feet is above freezing. See figure 1. Temperatures of 32°F at the surface will be depicted by an isopleth.

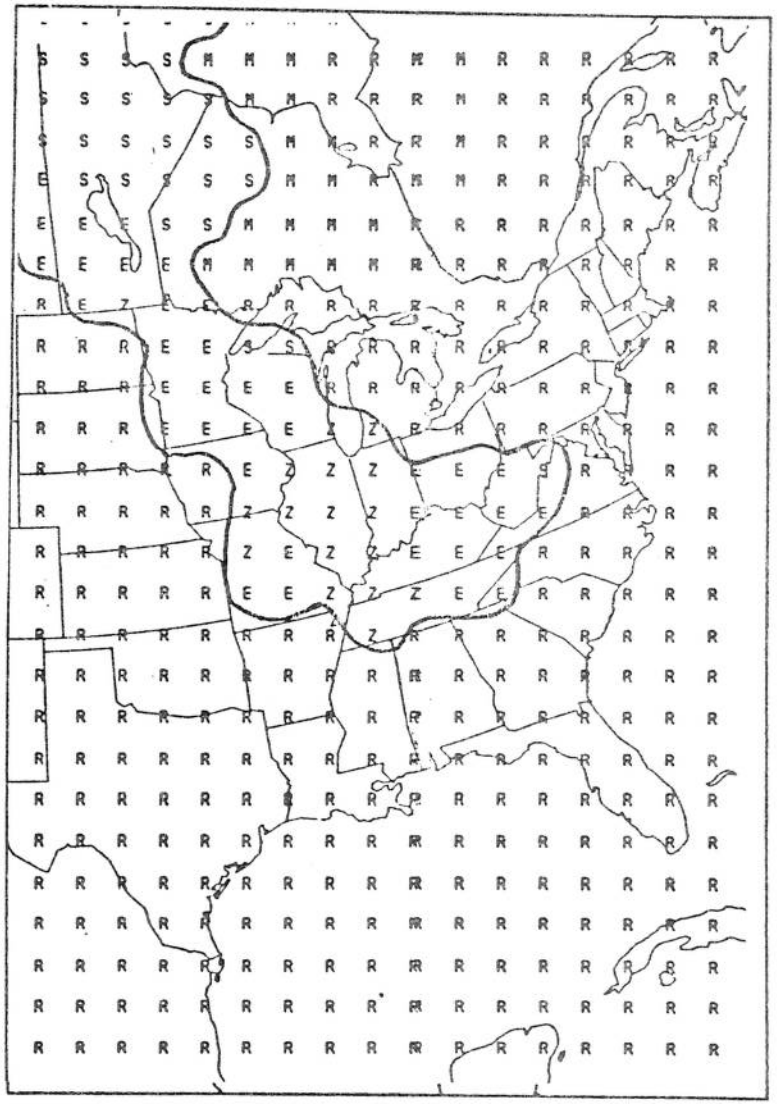
The right panel will display the conditional precipitation type as either R, S, Z, E, or M, even if precipitation is unlikely. (The letter indicates the type of precipitation should precipitation occur). Liquid precipitation (R,M) will be separated from solid precipitation (S, Z, E) by an isopleth.

Examples of the freezing level(s) and conditional precipitation type chart are shown in figures 2 and 3.



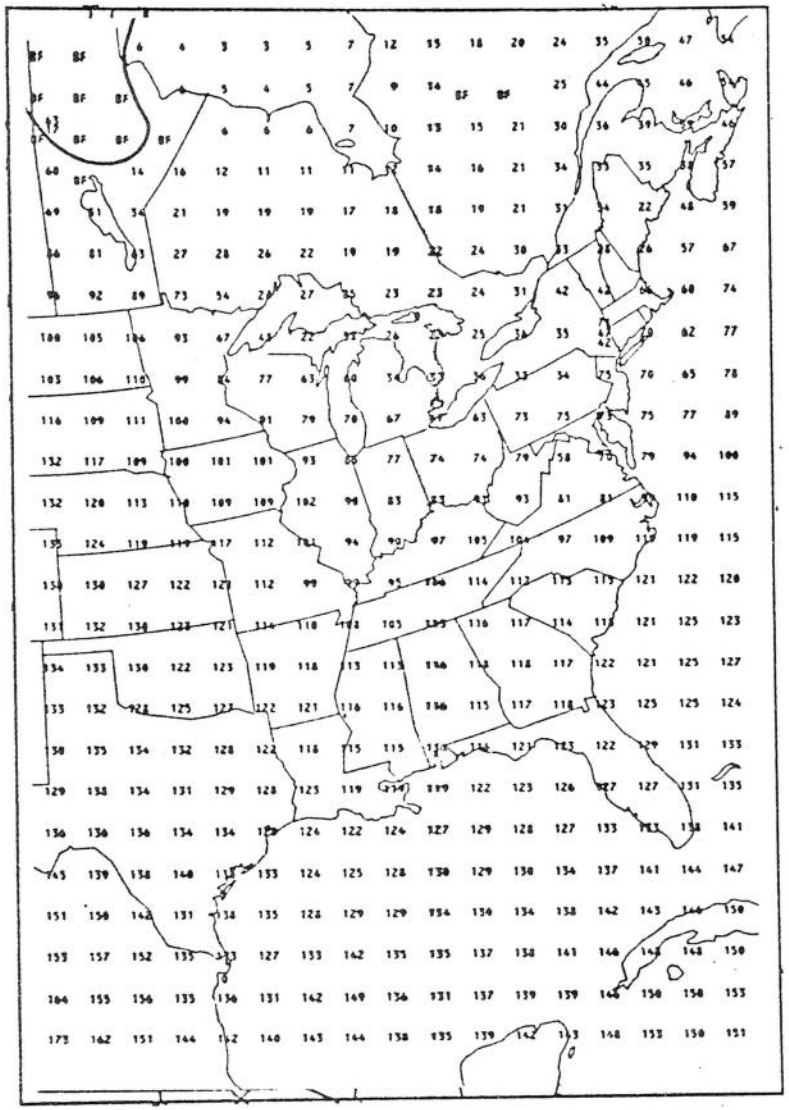
Multiple Freezing Level Sfc-Aloft
V.T. 18 Hrs After 73/10/17 00Z

EXPERIMENTAL



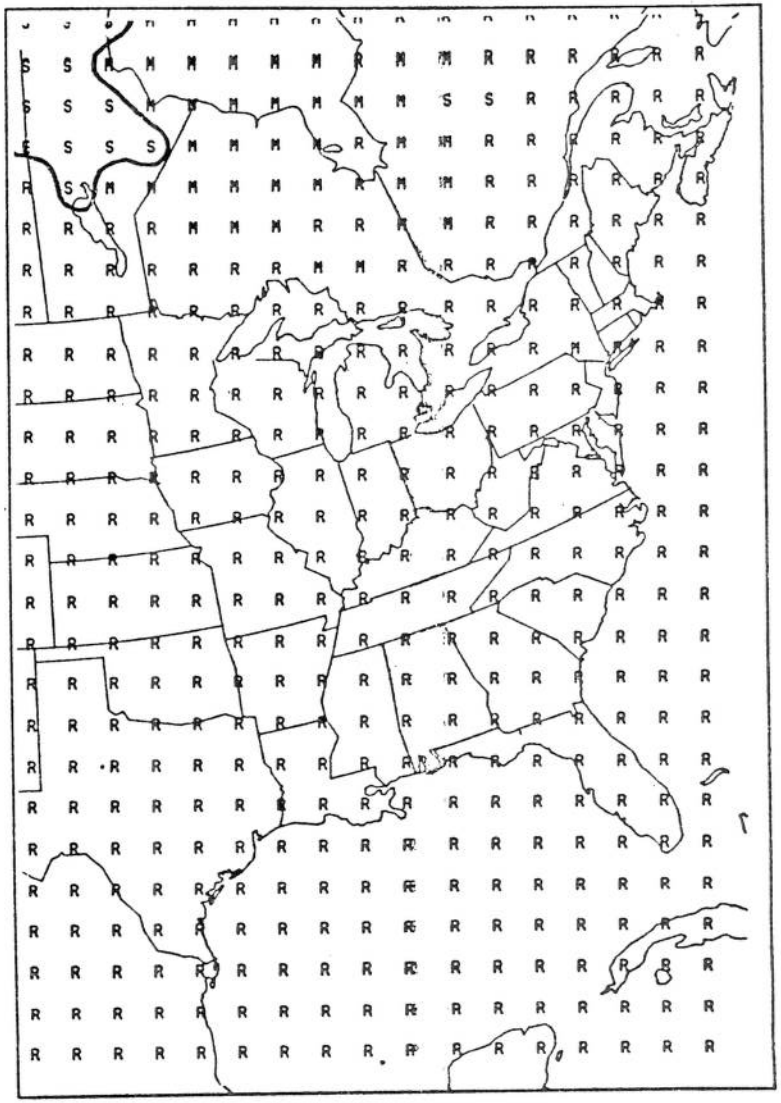
Conditional Precipitation Type
V.T. 18 Hrs After 73/10/17 00Z

Figure 2. Example of the chart showing the 18 hour forecasts of freezing level(s) and conditional precipitation type.



Multiple Freezing Level Sfc-Aloft
V.T. 24 Hrs After 73/10/17 00Z

EXPERIMENTAL



Conditional Precipitation Type
V.T. 24 Hrs After 73/10/17 00Z

Figure 3. Example of the chart showing the 24 hour forecasts of freezing level(s) and conditional precipitation type.

3.2 SURFACE TEMPERATURE AND 50-METER WIND

The left(right) panel will show the 18(24)-hour forecasts of both parameters. Temperatures will be depicted by isopleths at intervals of 10°F; temperatures of 32°F will be depicted by a thicker isopleth. Wind speed and direction will be depicted using the standard notation.

An example of the surface temperature and 50-meter wind chart is shown in figure 4.

4. FUTURE OF THE PBL PRODUCTS

The new PBL products will be transmitted until early next year. The National Weather Service's Committee on Analysis and Forecast Technique Implementation (CAFTI) will decide then if any of the PBL products will become operational later next year. Field stations should notify their Regional Scientific Services Division of their interest in the PBL products.

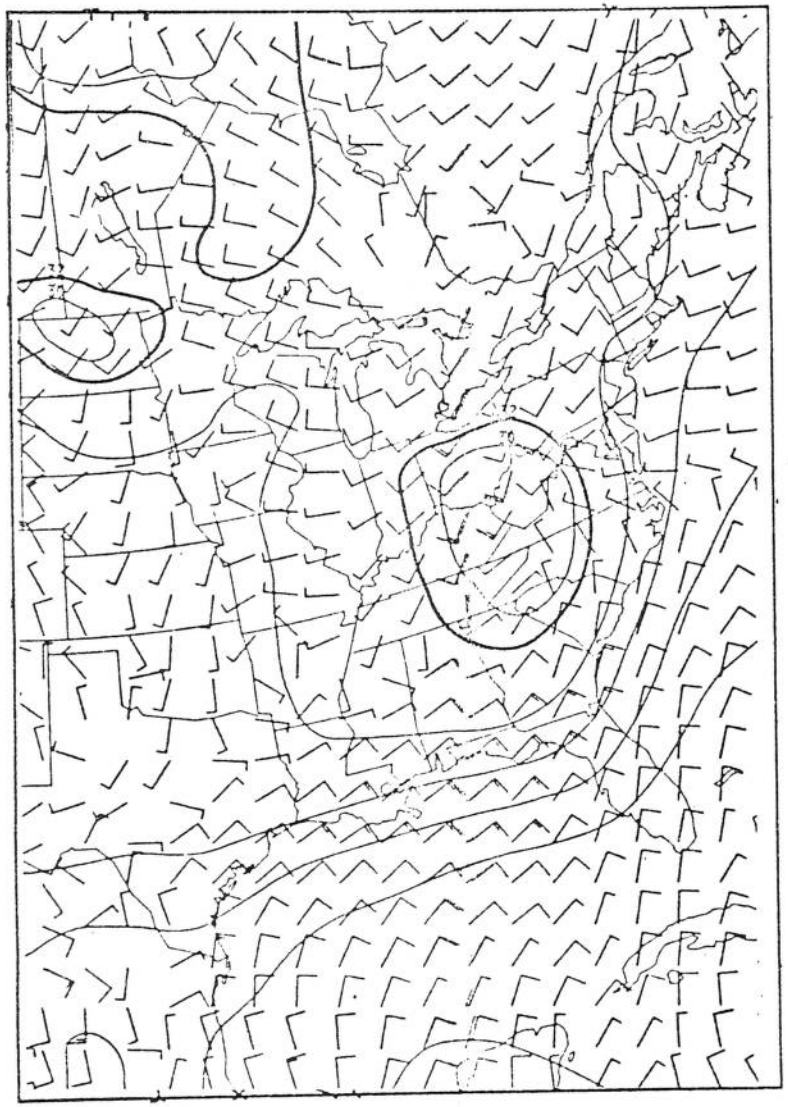
5. REFERENCES

1. Technical Procedures Bulletin No. 57: "The Limited-Area Fine Mesh (LFM) Model", November 22, 1971.

2. Technical Procedures Bulletin No. 85: "Stability Indices Produced by the Planetary Boundary Layer (PBL) Model", March 29, 1973.

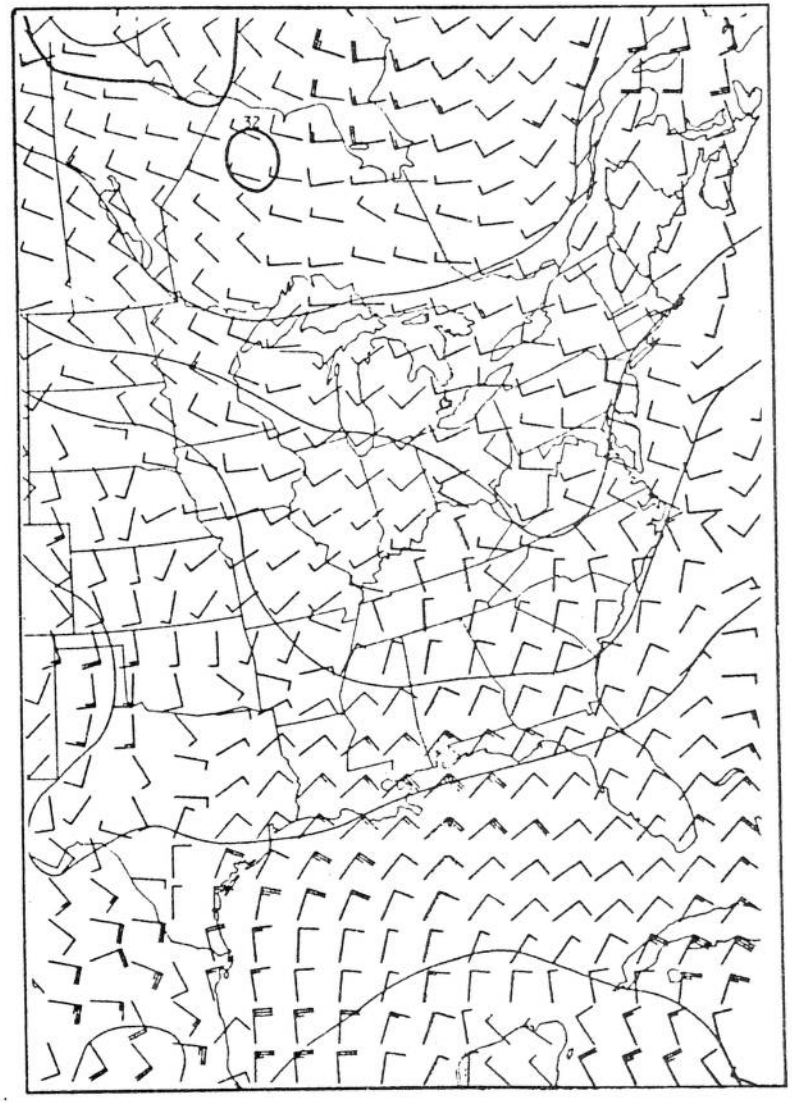
3. Gross, E.M., Jones, R., and McPherson, R.D., "A Description of the NMC Planetary Boundary Layer Model", NMC Office Note 75, NOAA, 1972.

4. Gerrity, J.P., Jr., Gross, E.M., and McPherson, R.D., "On the Feasibility of Integrating a Combined LFM-PBL Model", NMC Office Note 77, NOAA, 1972.



Surface Temperature and 50 M Wind
V. T. 18 Hrs After 73/10/17 00Z

EXPERIMENTAL



Surface Temperature and 50 M Wind
V.T. 24 Hrs After 73/10/17 00Z

Figure 4. Example of the chart showing the 18 and 24 hour forecasts of surface temperature and 50 meter wind.