NOAA Technical Report EDS 25

GATE Convection Subprogram Data Center: Final Report on Ship Surface Data Validation

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U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
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U.S. DEPARTMENT OF COMMERCE
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GATE CONVECTION SUBPROGRAM DATA CENTER: FINAL REPORT ON SURFACE DATA VALIDATION

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Abstract. This report describes the results of validation of the surface meteorological data collected by the ships in the A/B-, B-, and C-scale arrays during the 1974 GARP Atlantic Tropical Experiment (GATE). Mean meteorological fields for each of the three GATE observation Phases were analyzed in order to determine the average biases in the measurement of each variable on each ship. Charts of resulting mean values and tabulations of the biases are presented. Included also are updates and corrections to earlier reports issued as part of the GATE Convection Subprogram Data Center, and documentation pertaining to the archived data.

1. INTRODUCTION

This is the second of two reports on the analysis and validation of the ship surface meteorological data acquired during the 1974 GARP Atlantic Tropical Experiment (GATE). The first, NOAA Technical Report EDS 17 (Godshall et al., 1976), dealt with GATE Intercomparison data, specifically with an analysis of the average bias of each data set for each of the participating ships. This report contains the results of an analysis of the data obtained during the three GATE observation Phases, and, again, main emphasis is given to the determination of average biases of each variable measured on each ship.

These analyses have been carried out as part of the tasks of the GATE Convection Subprogram Data Center (CSDC), the function of which, as well as of all other GATE Subprogram Data Centers, is defined in GATE Report No. 20 (WMO, 1976). This report also represents the final CSDC product pertaining to the ship surface data sets. To date, the CSDC has placed in the World Data Center archives (WDC-A, Asheville, North Carolina, USA, and WDC-B, Moscow, USSR) two data sets: the Intercomparison data set and the Phase data set. Both are described in appendix B.

In addition to NOAA Technical Report EDS 17 and this report, the CSDC has published NOAA Technical Report EDS 18 (Seguin and Sabol, 1976), which contains tabulated precipitation amounts derived from WMO observations on each ship. Appendix A of this report updates both of the previous reports by revising earlier bias calculations and presenting the Phase precipitation data for the ship *Bidassoa*.

The CSDC has analyzed and validated ship surface data for the fixed stations (A/B-, B-, and C-scale ships) only. A-scale and roving ships have not been considered.

2. VALIDATION OF THE GATE PHASE DATA

Two surface data sets were acquired by the A/B-, B-, and C-scale ships during the three Phases of GATE: Type 1 observations, which were made by automatic sensing and recording systems; and Type 2 observations, which were made using standard WMO marine observation procedures and sensors. The Type 1 sensors were typically mounted on special bow booms of the kind described by Seguin et al. (1977). On the ship Meteor, Type 1 data were acquired by sensors mounted on a meteorological profile buoy rather than a ship bow boom. A brief description of these sensors and their heights above sea level are given in NOAA Technical Report EDS 17.

The surface data were processed by the individual GATE National Processing Centers and sent to the World Data Centers as well as to the CSDC on magnetic tape in time-series form. The Type 2 WMO observations were hourly. Included in each data record were pressure, temperature, wind velocity, cloud amount and type, present weather, and other standard synoptic meteorological variables. The Type 1 observations varied from ship to ship in their frequency. Appendix B gives the time resolution of these data and the variables included.

The pressures, dry-bulb temperatures, wet-bulb temperatures, sea-surface temperatures, wind speeds, and wind directions were reviewed and validated at the CSDC on an interactive graphics and minicomputer system. This system, which has been described in detail by Anderson and Crayton (1978), enables the analyst to plot time series of each meteorological variable on a TV screen in color and to visually review each data value. Multiple variables can be plotted on the screen simultaneously for comparison. Quality data flags can be added "by the press of a button" to the data for points that are deemed questionable or erroneous.

Individual data points were deemed valid if they appeared reasonable in relation to values immediately adjacent to them in time, if they appeared reasonable based upon other variables including present weather, and if they compared favorably with data of the same variable measured by a second system in cases where both Type 1 and Type 2 observations were available. One of four flags was assigned to each data value: 0, 7, 8, or 9. A flag of 0 means the data value is good, a flag of 7 means it is questionable, a flag of 8 means it is obviously bad, and a flag of 9 means the data value is missing. These flags were copied to the archive tape discussed in appendix B.

The present weather, visibility, and cloud information in the Type 2 WMO observations were examined automatically by computer for consistency. The tests were developed from procedures adopted by the GATE Synoptic Subprogram (Parker, 1976). Appendix B lists the tests performed on the data. The greatest number of errors occurred because missing observations were recorded on computer punch cards as zeros, which in the synoptic code have specific meanings other than missing data for these variables.

The ship positions, which were included as part of the WMO records, were also edited by computer. There were few errors in these data, and most could be corrected by examining adjacent positions in time. Appendix C gives the average positions.

Further validation was carried out by computing Phase means for each variable, correcting the variable using the Intercomparison biases given in NOAA Technical Report EDS 17, and plotting the means on charts containing the A/B-, B-, and C-scale arrays. The charts were then analyzed and the biases of individual ships examined in light of the mean fields. These analyses and the resulting biases are discussed in section 3.

Finally, diurnal variations as well as Phase variations were decomposed into their principal modes of variation or principal components by the method of Asymptotic Singular Decomposition (ASD) developed by Jalickee (1977). This method, which is closely related to the method of empirical orthogonal functions (Lorenz, 1956), made it possible to compare the principal components from ship to ship.

3. PHASE MEANS

One of the main goals of the CSDC analysis was the estimation of biases in pressures, temperatures, and wind velocities. To arrive at these estimates, averages were calculated for each Phase and were adjusted using the Intercomparison biases (Godshall et al., 1976). The adjusted averages were plotted on maps showing the A/B-, B-, and C-scale ship arrays and were then analyzed to generate smooth, reasonable fields.

The averaging periods for each Phase were chosen so that most of the ships were on station for most of the time. Table 1 shows these periods. Appendix C gives the actual dates and times individual ships were on station. Because the Gilliss was off station for half of Phase II, averages were calculated for a short Phase II in order to assess the ship's data biases.

Table 1.--Time periods for which the Phase data were averaged

Phase	Beginning		Ending	
	Date	Time (GMT)	Date	Time (GMT)
I	June 29	1100	July 15	1700
II	Aug. 1	0800	Aug. 15	0000
II (short)	Aug. 6	2100	Aug. 15	0000
III	Aug. 31	0900	Sept. 18	0100

By linear interpolation between the Intercomparisons, biases corresponding to the center of the averaging periods given in table 1 were used to correct the Phase averages. Of the five Intercomparison

(IC) periods listed in table 2, IC 1, IC 2, and IC 3B were used as references. The Researcher Kollsman Type 1 pressure data and the temperature and wind velocity Type 1 data obtained on the Meteor buoy were considered the reference data sets.

The Korolov Type 2 data served as the reference for IC A1A; the Musson Type 2 pressure data and the Oceanographer Type 1 bow boom temperature and wind velocity data served as the reference for IC 3A. These data sets were chosen on the basis of their stability during the Intercomparison periods.

It was necessary to adjust the results of IC A1A and IC 3A to those of 1, 2, and 3B in order to have a basis for comparison throughout the three latter periods. The Korolov participated in IC 2 and IC 3B with the Researcher and Meteor. Based upon the Korolov biases during these two periods, an estimate was made of what its biases would have been if it had been compared with the Researcher and Meteor during IC A1A. The biases of the Priboy and Okean, both of which were compared with the Korolov during IC A1A, were adjusted by the amount the Korolov data differed from the Researcher and Meteor buoy data during IC 2 and IC 3B. The reference data sets from IC 3A were adjusted similarly. Again, based upon the biases of the Musson and Oceanographer data during IC 1 and IC 2, an estimate of the biases for these ships was calculated as if they had been compared with the Researcher and the Meteor buoy. The biases of the other ships that participated in IC 3A and were compared with the Musson and Oceanographer were adjusted for the biases of these two ships.

Table 2.--Intercomparison periods and locations

Intercomparison	Lat. N. (deg)	Long. W. (deg)	Dates
1	13.0	21.0	June 17 to 19
A1A	5.0	44.0	June 17 to 19
2	7.7	22.0	Aug. 16 to 18
3A	13.0	21.0	Sept. 21 to 23
3B	12.0	21.0	Sept. 21 to 23

Although the pressure, dry-bulb temperature, and wet-bulb temperature sensors were at different heights on the ships, no adjustments were made in the data for these differences. For temperatures, such a height correction would typically be less than 0.1°C. It was assumed that each nation had corrected its pressures to sea level according to the GATE

International Data Management Plan (WMO, 1974). For the pressure data sets that were not corrected to sea level, the pressure bias due to the sensor height was considered part of the instrument bias.

Only the wind speeds were adjusted for sensor height so that they could be compared with the winds measured by the Meteor buoy. These corrections were needed to properly interpret the biases for IC 1, IC 2, and IC 3, because of the varying average wind speeds (Godshall et al., 1976). Winds were corrected to 10 m using the logarithmic wind law. Stress in this relationship was computed from the bulk aerodynamic formula with a drag coefficient, $C_D = 1.5 \times 10^{-3}$.

Most of the wind speeds were measured by sensors mounted on the ships' foremasts between 18 and 36 m above sea level. Unfortunately, there is no one satisfactory scheme to adjust the winds with height. Recent research by Kidwell and Seguin (1978), based on data from identical wind speed sensors mounted on the bow booms and foremasts of the four U.S. ships Researcher, Gilliss, Dallas, and Oceanographer, has shown that wind speeds do not increase as rapidly with height (from boom to mast) as the log wind law, uncorrected for atmospheric stability, would predict. In addition, the rate of increase seems to be ship dependent. These differences are probably associated with the superstructure of the ship, the relative wind direction, and the sensor location on the mast. Further, the atmosphere during GATE was highly unstable at times, with air-sea temperature differences greater than $1^{o}C$ and wind speeds less than 1 m s^{-1}. For these conditions most corrections to the log wind law are inadequate. For all of these reasons, the neutral stability log wind law used in adjusting the wind speeds to 10 m, to conform with the Meteor buoy data, represents only a first approximation.

No adjustments were applied to the wind direction data. The absolute wind directions measured on the Meteor buoy changed from one Intercomparison to the next. The National Processing Center of the Federal Republic of Germany considers the buoy's absolute wind directions correct to within 5^{o}. In addition, in attempting to determine the bias of the Korolov and Oceanographer relative to the Meteor buoy so that the wind direction biases of IC A1A and IC 3A, respectively, could be properly interpreted, it was found that the wind direction biases of these ships relative to the buoy were too unstable for any conclusions to be drawn.

Once the Phase mean values for each variable had been calculated for the time periods given in table 1, they were corrected for the Intercomparison biases, plotted on charts, and analyzed as scalar fields. These smoothed analyzed fields were then compared with the average uncorrected Phase mean values to arrive at estimates of the biases of each data set for the Phase. For data sets that showed sensor drift or significant changes in calibrations, these bias estimates represent only a first approximation.

The ships Vanguard and Hecla did not participate in any of the Intercomparisons. For this reason, their average Phase values have not been corrected for either sensor height or any IC bias. The Planet, Bidossoa, and Fay participated only in one IC (3A, 3B, and 3A, respectively) and their biases were used to adjust the Phase data before analysis.

Figures 1, 2, and 3 show the ship positions for the A/B-, B-, and C-scale arrays during Phases I, II, and III, respectively. On the charts contained in the sections that follow, the mean values given correspond to the ship names shown in figures 1, 2, and 3. Where one station was occupied by two ships, two values are plotted. Several of the B- and C-scale ships acquired both Type 1 and Type 2 data. The Type 1 values are shown in parentheses.

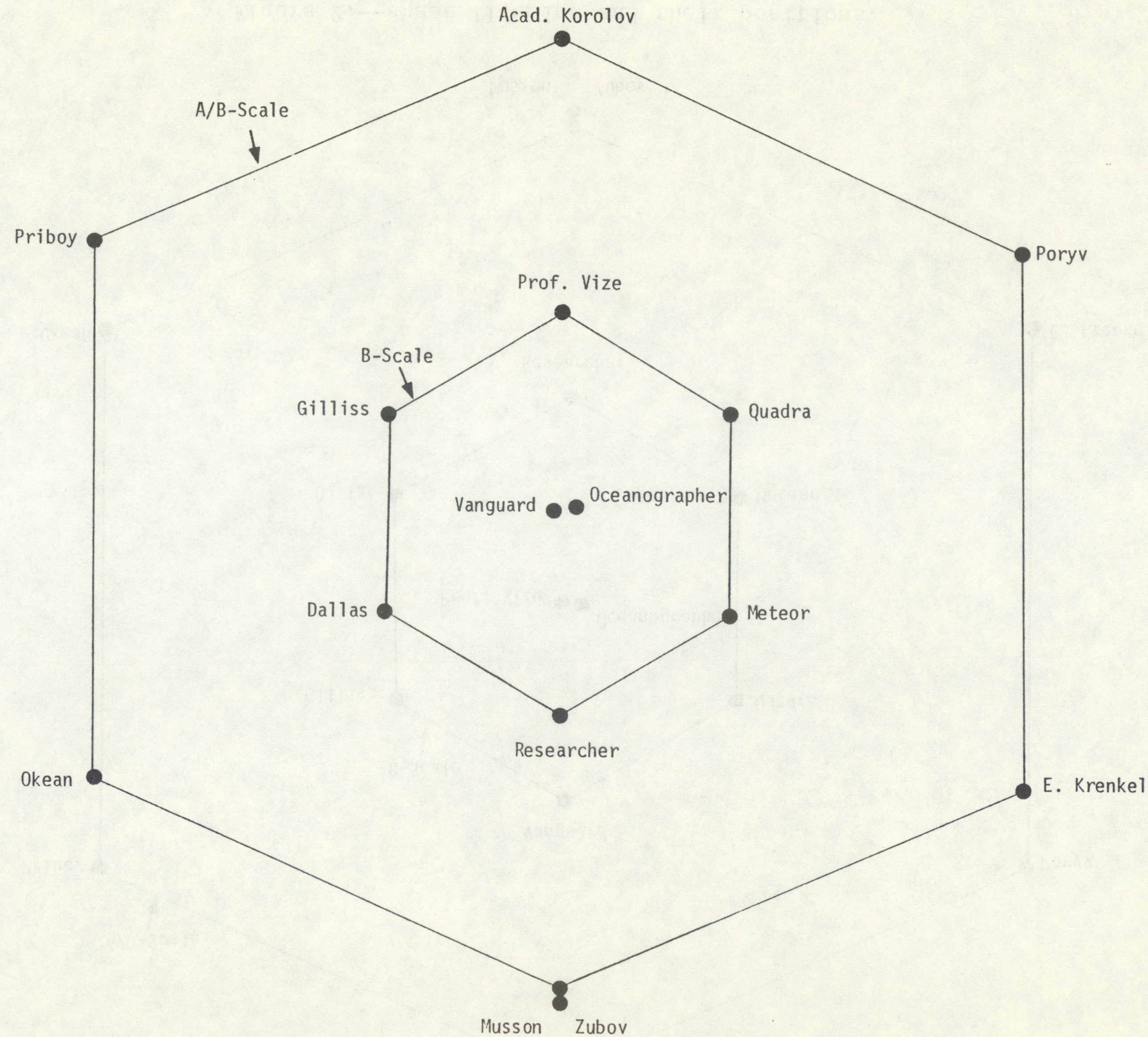

Figure 1.--Phase I ships and their positions.

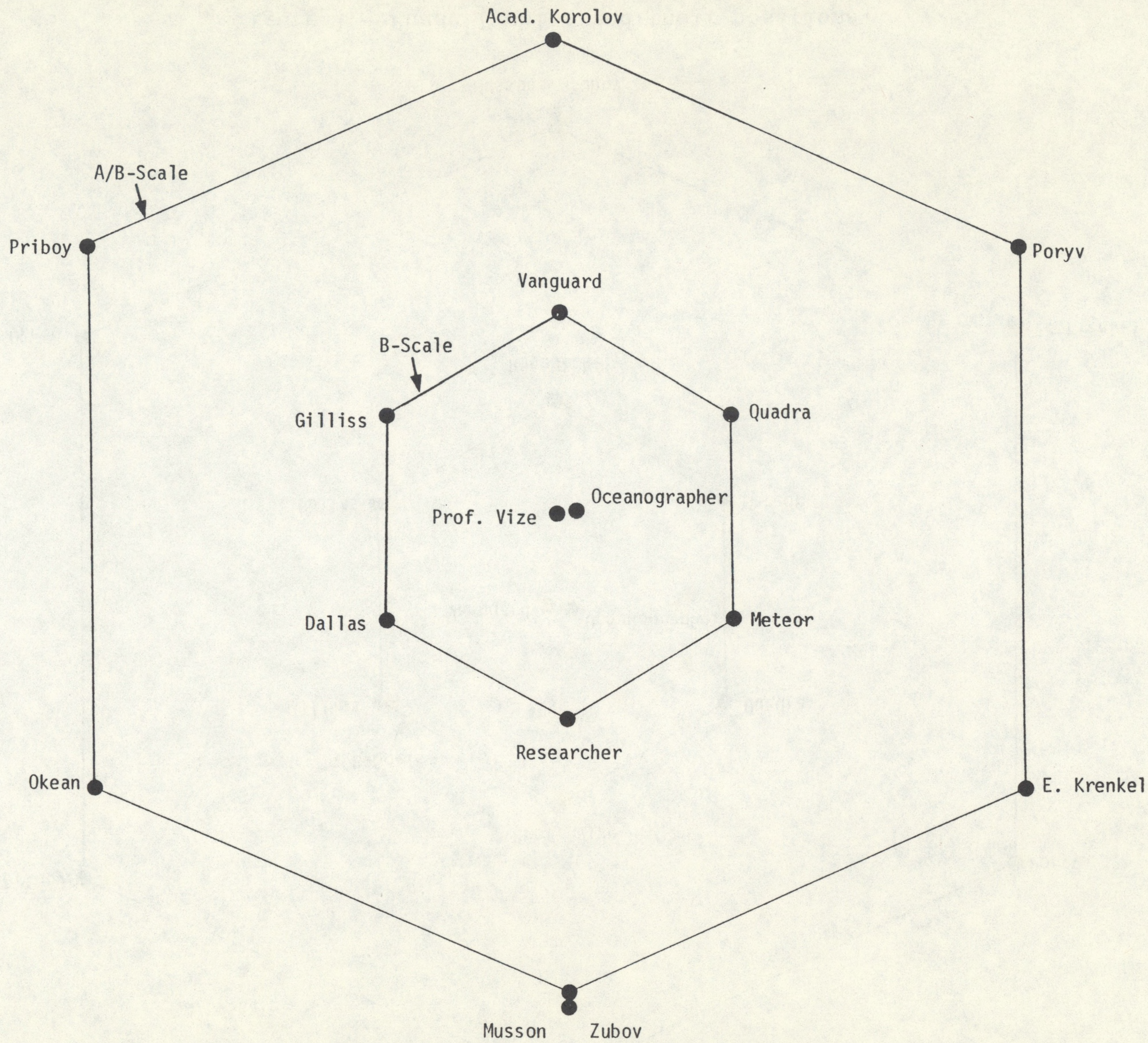

Figure 2.--Phase II ships and their positions.

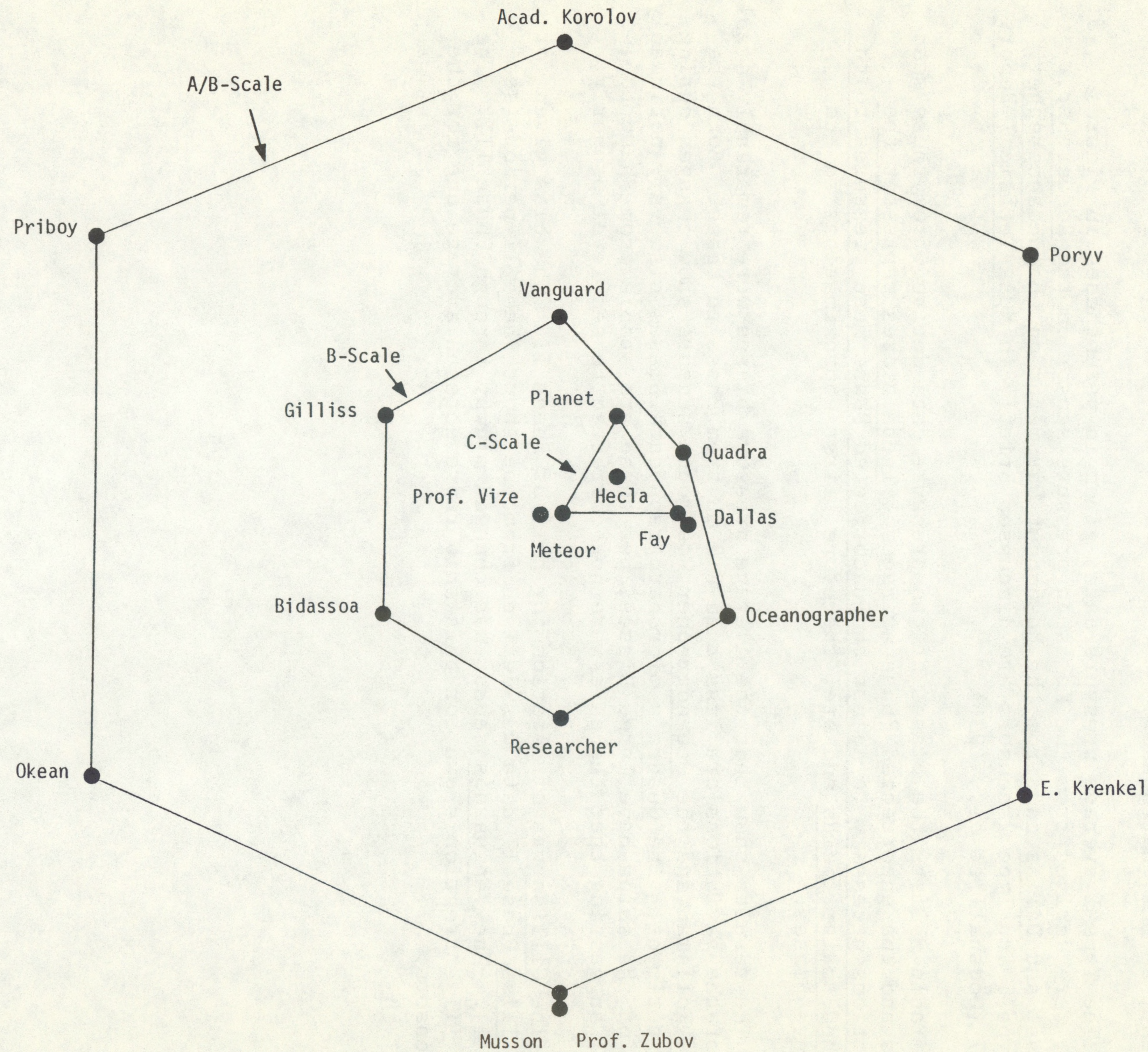

Figure 3.--Phase III ships and their positions.

3.1 Pressure

Figures 4, 5, and 6 show the mean pressure analyses for Phases I, II, and III, respectively. The equatorial trough seen here migrates northward and is located just to the north of the wind asymptote of confluence (cf. figs 19, 20, and 21, sec. 3.6). Phase III had the largest north-south pressure gradient, as the charts show.

The Type 1 average pressure data, given in parentheses in figures 4, 5, and 6, were derived from the Kollsman pressure sensor on the Researcher, Gilliss, and Dallas and from the Rosemount barometer on the Oceanographer. All Type 1 and Type 2 sensors are discussed briefly in NOAA Technical Report EDS 17 (Godshall et al., 1976).

Table 3 lists the biases of the pressure data derived from these mean fields and the uncorrected Phase averages. These biases represent the corrections necessary to adjust the uncorrected Phase mean pressures to the smoothed scalar fields and are, therefore, first approximations to the pressure biases.

The results show that the average pressure biases were remarkably stable. Most of the variations are less than 0.2 mb from Phase to Phase. Both the Dallas Kollsman and the Oceanographer Rosemount sensors show changes during the experiment. The Quadra's microbarograph data biases also vary noticeably. A few of the ships have large biases, but these are stable from Phase to Phase, suggesting that the data were not corrected to sea level properly.

The Gilliss was off station for half of Phase II. The bias given for the Gilliss Phase II data was derived from the short Phase II period (see table 1). The Vanguard's sensor was changed midway through Phase III. The Phase III correction shown for this ship represents an average one for the two sensors.

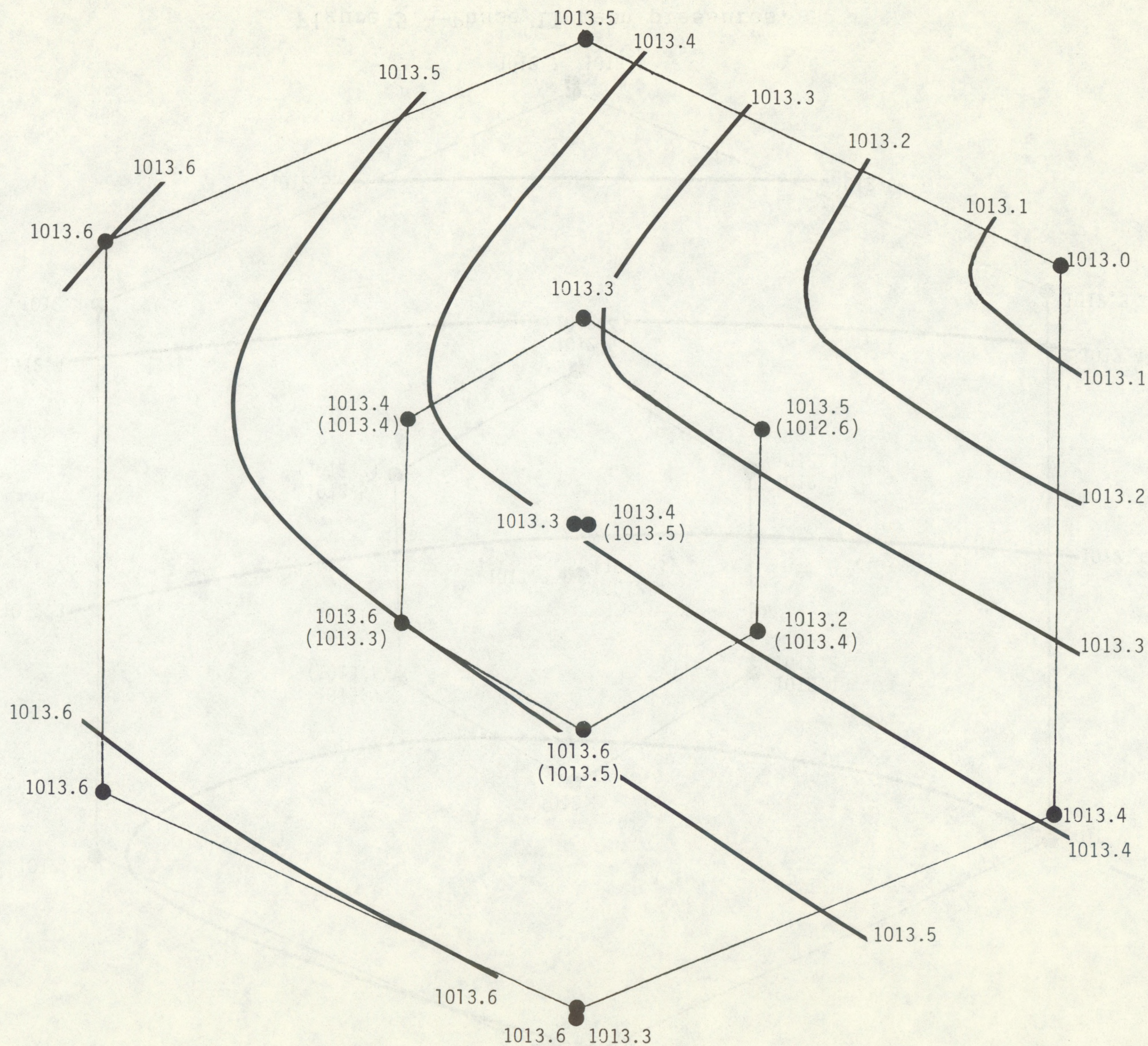

Figure 4.--Phase I mean pressures.

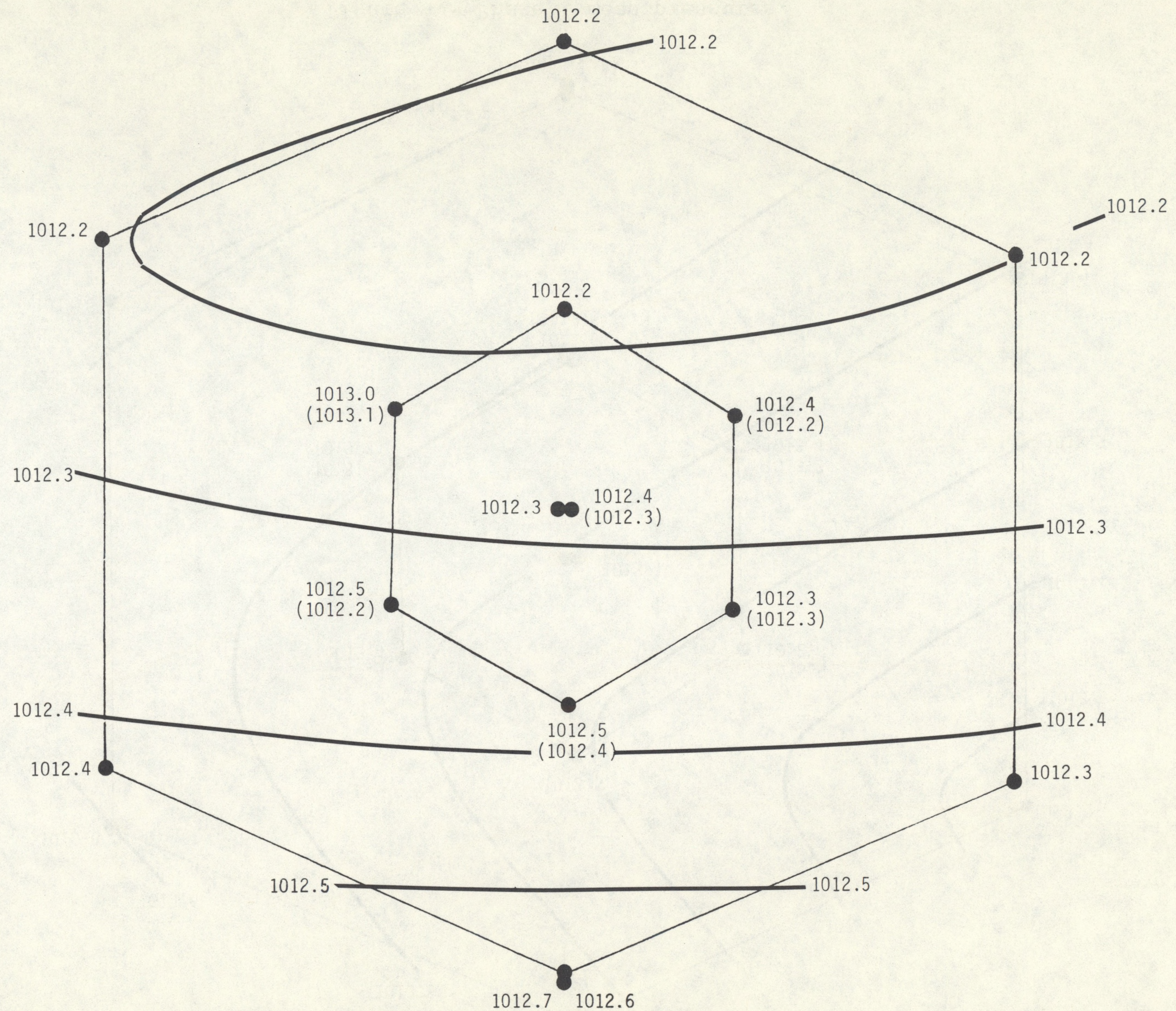

Figure 5.--Phase II mean pressures.

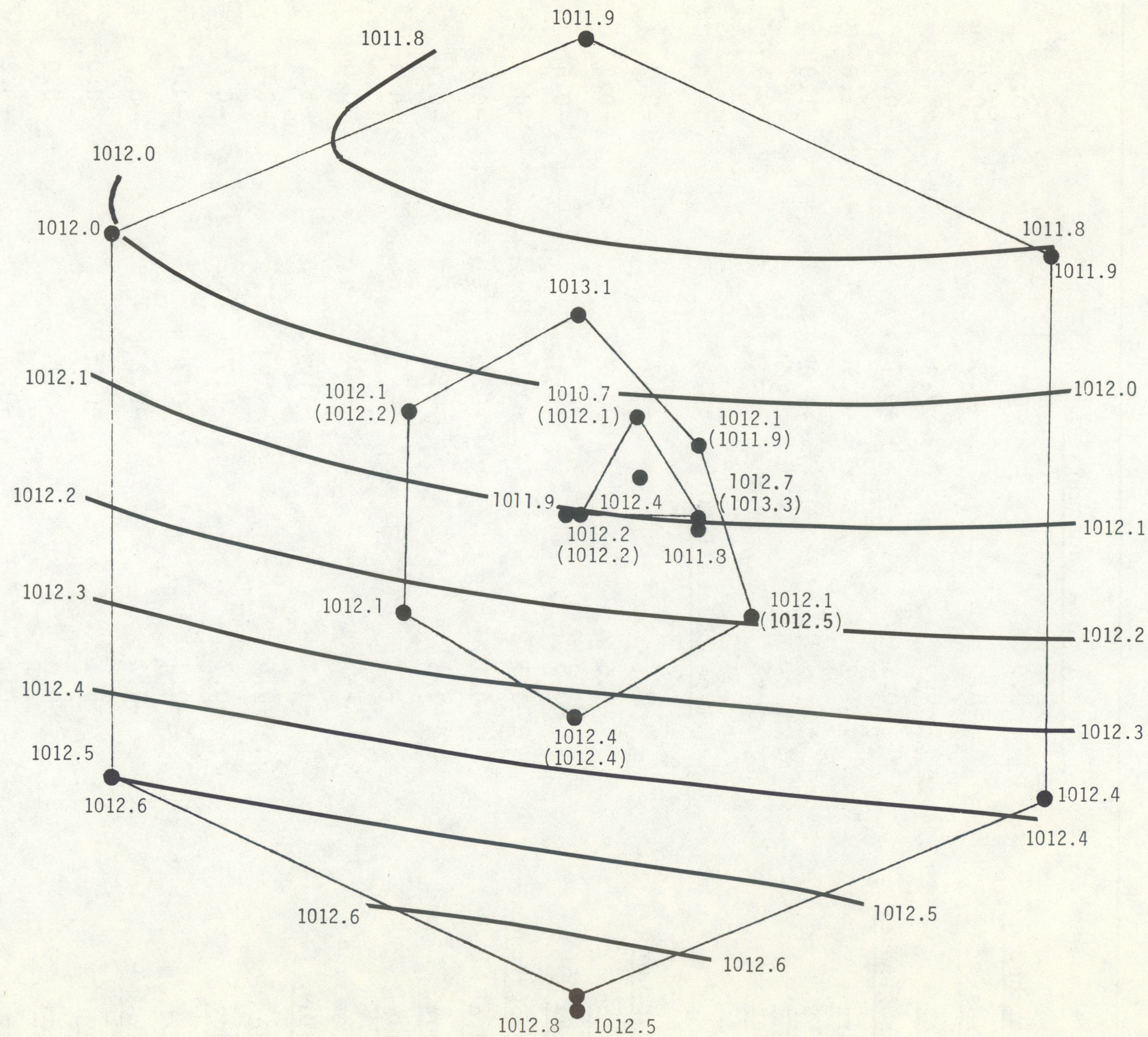

Figure 6.--Phase III mean pressures.

Table 3.--Pressure biases (corrections necessary to adjust uncorrected Phase mean pressures to smoothed scalar fields)

Ship	Phase I	Phase II	Phase III
	Type 1 data (automatic)		
Researcher	0.0	0.0	-0.1
Gilliss	-0.3	-0.3	-0.4
Dallas	-0.3	-0.6	-1.2
Oceanographer	-0.1	+0.4	+0.4
Quadra	-1.2	-1.9	-1.8
Meteor	+1.2	+1.0	1.0
Planet	--	--	-0.4
	Type 2 data (WMO)		
Researcher	-0.7	-0.7	-0.7
Gilliss	-0.6	-0.6	-0.7
Dallas	-0.5	-0.4	-0.6
Oceanographer	-0.5	-0.7	-0.7
Quadra	+0.1	-0.1	-0.2
Meteor	-0.3	-0.4	-0.4
Planet	--	--	-0.3
Fay	--	--	0.0
Korolov	-1.1	-1.0	-1.1
Okean	-0.6	-0.6	-0.7
Priboy	-0.7	-0.7	-0.6
Vize	-0.2	-0.3	-0.1
Krenkel	-0.2	-0.2	-0.2
Zubov	+0.1	-0.1	0.0
Musson	0.0	-0.1	0.0
Poryv	-0.1	-0.1	-0.2
Bidassoa	--	--	+0.5
Vanguard	+0.1	0.0	-1.3
Hecla	--	--	-0.3

3.2 Dry-Bulb Temperature

The mean dry-bulb temperature analyses for Phases I, II, and III are shown in figures 7, 8, and 9, respectively. Phases II and III have very little temperature gradient compared with Phase I. The warm temperatures at the *Poryv* on the Phase I chart are consistent with the warm sea-surface temperatures for Phase I (fig. 13, sec. 3.4) and the Phase I pressure trough (fig. 4, sec. 3.1). The cooler temperatures located over the southern half of the B-scale array are most probably a reflection of the pronounced convective overturning and the large amount of precipitation in this area during Phase I. Where both Type 1 and Type 2 information is available, the analyses are based upon the Type 1 data.

Table 4 gives the biases of the dry-bulb temperature data derived from the mean fields and the Phase averages. The Type 1, and many of the Type 2, average biases exhibit 0.2°C or less variation from Phase to Phase. Some of the data, notably the Type 2 data for the *Gilliss*, *Dallas*, *Oceanographer*, and *Vanguard*, have large Phase-to-Phase biases and the biases themselves are large. This is due in part to heating of the ships' decks, which modified the temperature where the observations were taken. The *Gilliss* Phase II biases were derived from the special short Phase II analysis (see table 1).

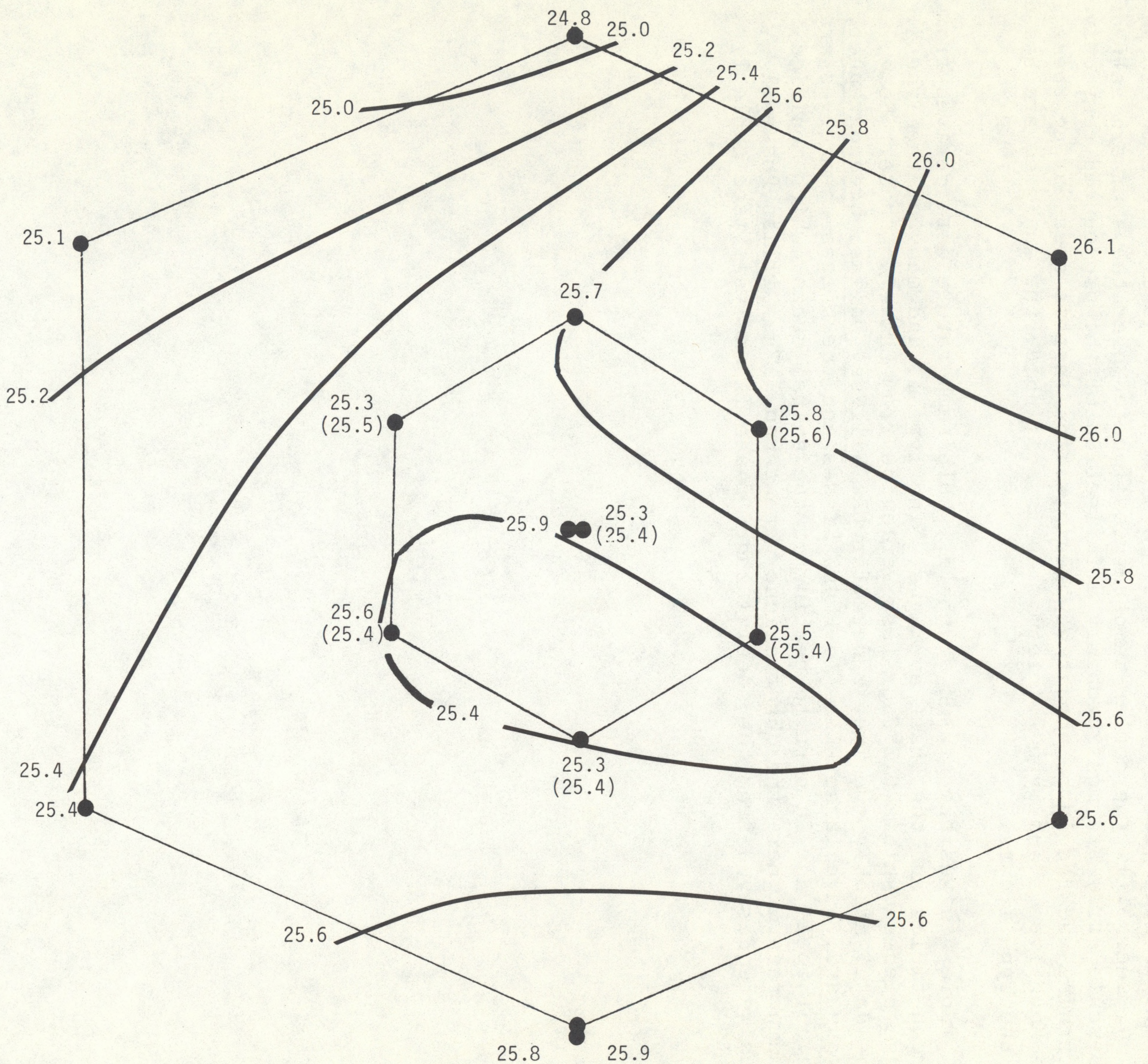

Figure 7.--Phase I mean dry-bulb temperatures.

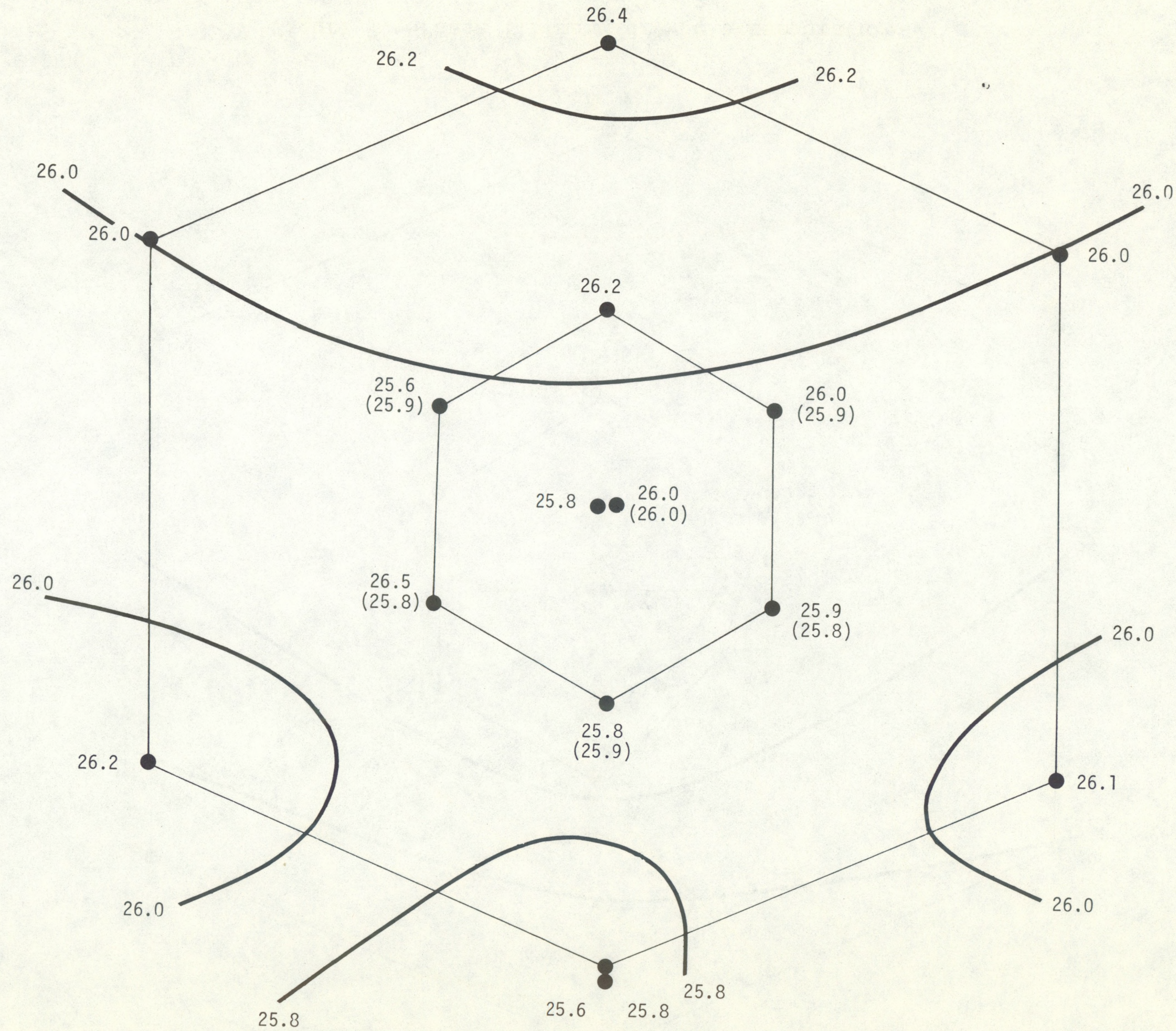

Figure 8.--Phase II mean dry-bulb temperatures.

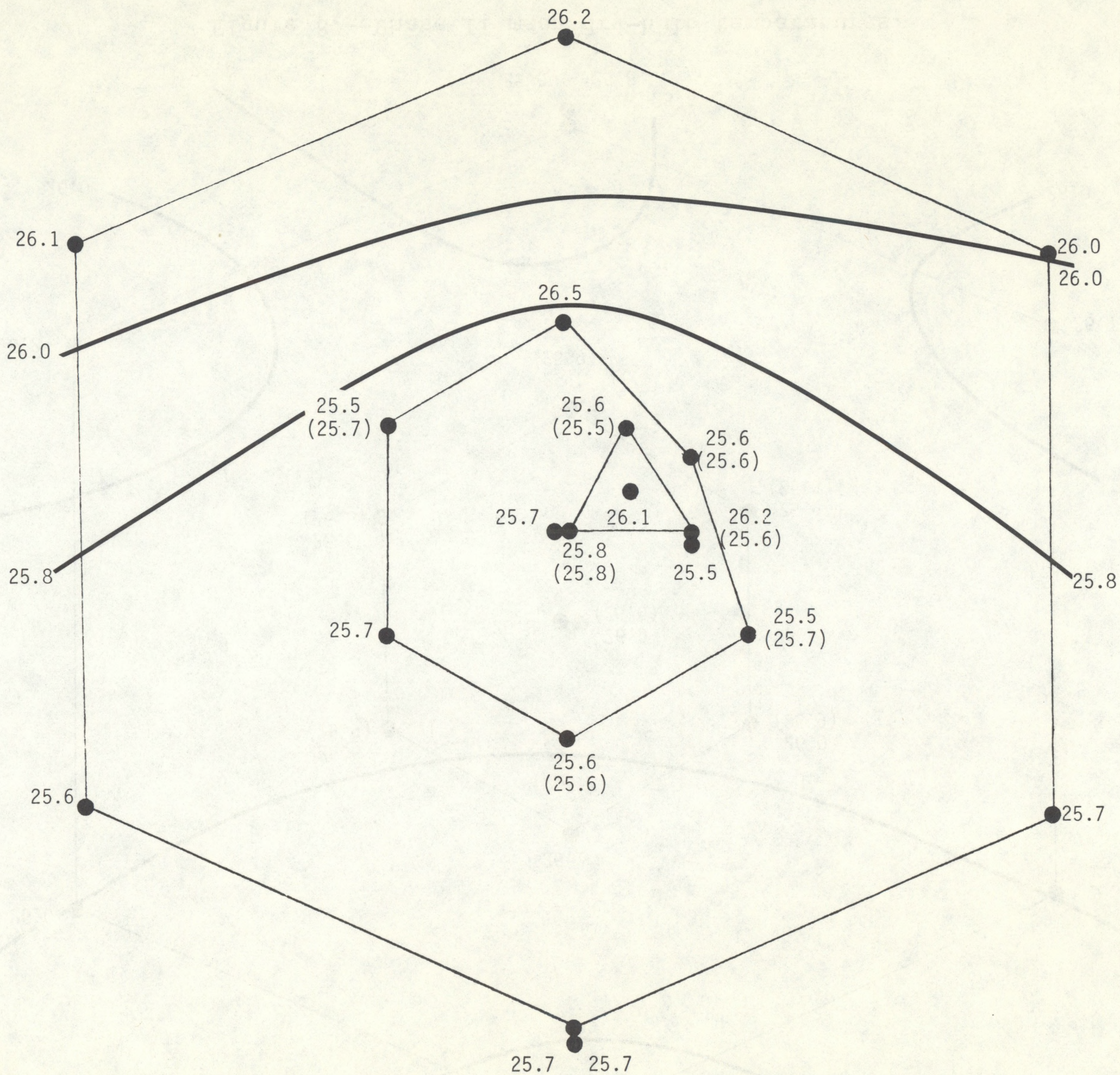

Figure 9.--Phase III mean dry-bulb temperatures.

Table 4.--Dry-bulb temperature biases (corrections necessary to adjust uncorrected Phase mean dry-bulb temperatures to smoothed scalar fields)

Ship	Phase I	Phase II	Phase III
	Type 1 data (automatic)		
Researcher	-0.1	0.0	0.0
Gilliss	-0.2	0.0	-0.1
Dallas	0.0	0.0	+0.1
Oceanographer	+0.1	0.0	+0.1
Quadra	0.0	-0.1	-0.1
Meteor	0.0	0.0	-0.1
Planet	--	--	+0.1
	Type 2 data (WMO)		
Researcher	-0.1	-0.1	-0.2
Gilliss	-0.3	0.0	-0.2
Dallas	-0.6	-0.9	-0.5
Oceanographer	-0.6	-0.7	-0.4
Quadra	-0.2	-0.2	-0.3
Meteor	0.0	0.0	-0.1
Planet	--	--	-0.2
Fay	--	--	+0.1
Korolov	0.0	0.0	0.0
Okean	-0.1	-0.1	0.0
Priboy	-0.1	-0.2	0.0
Vize	-0.1	+0.1	+0.1
Krenkel	0.0	+0.1	+0.1
Zubov	-0.2	-0.1	0.0
Musson	-0.1	+0.1	-0.1
Poryv	0.0	-0.1	-0.1
Bidassoa	--	--	-0.3
Vanguard	-0.5	-0.1	-0.7
Hecla	--	--	-0.4

3.3 Wet-Bulb Temperature

Phases I, II, and III mean wet-bulb temperature fields are shown in figures 10, 11, and 12. As in the case of the dry-bulb temperatures, these analyses were based on the Type 1 wet-bulb temperatures when both Type 1 and Type 2 information was available. Note that the highest wet-bulb temperatures coincide with the asymptote of confluence during Phases I and II.

Table 5 lists the biases of the average wet-bulb temperatures for Phases I, II, and III. The ship wet-bulb temperatures were generally higher than those measured by the *Meteor* buoy both during the Intercomparisons and the Phases, although some of the Type 1 wet-bulb temperatures recorded aboard ship averaged only 0.1°C higher than the buoy data. There is very little variation from Phase to Phase, typically 0.1°C to 0.2°C. Although deck heating does influence wet-bulb temperature measurements, the effect is not as strong as in the case of dry-bulb temperatures.

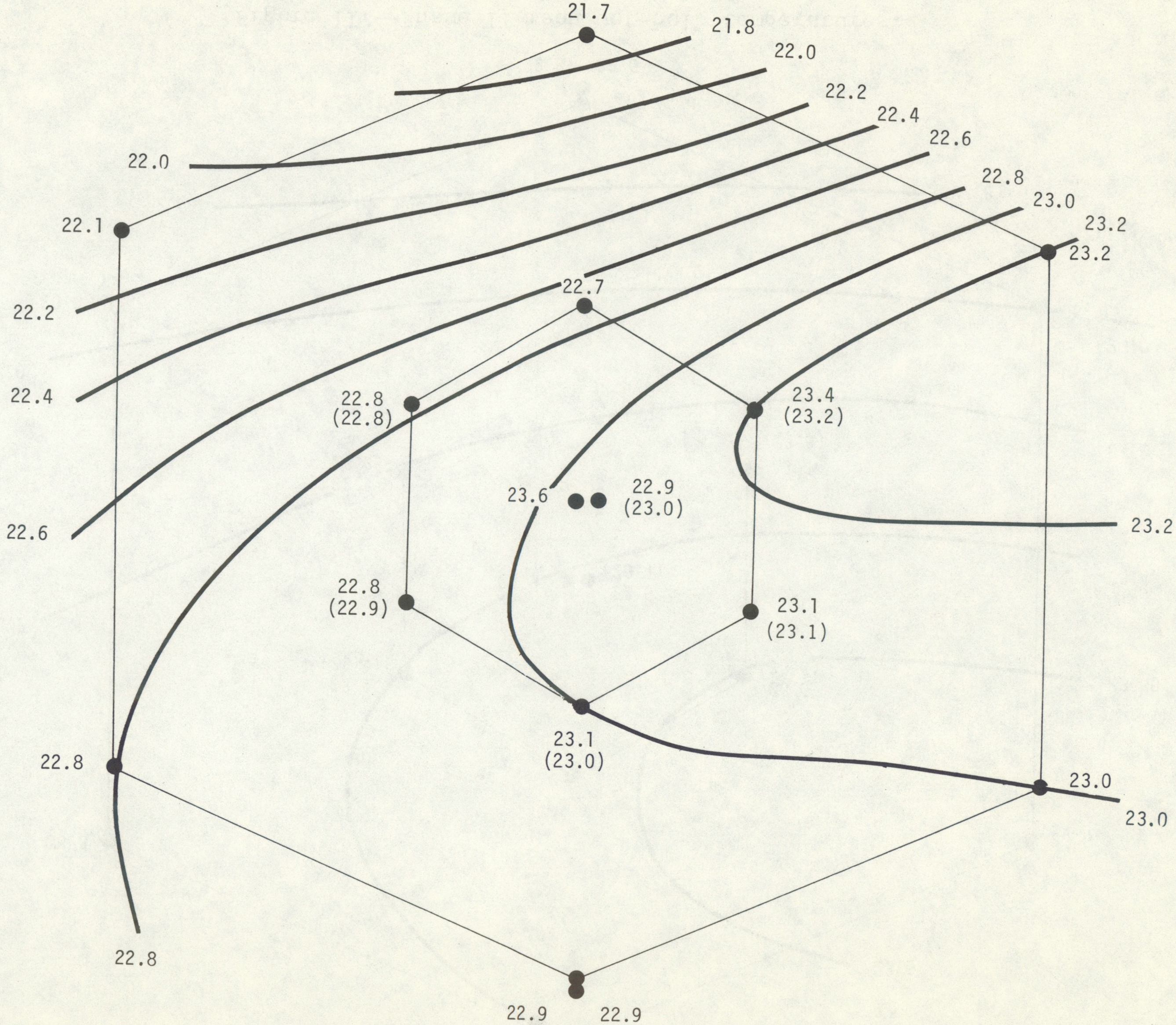

Figure 10.--Phase I mean wet-bulb temperatures.

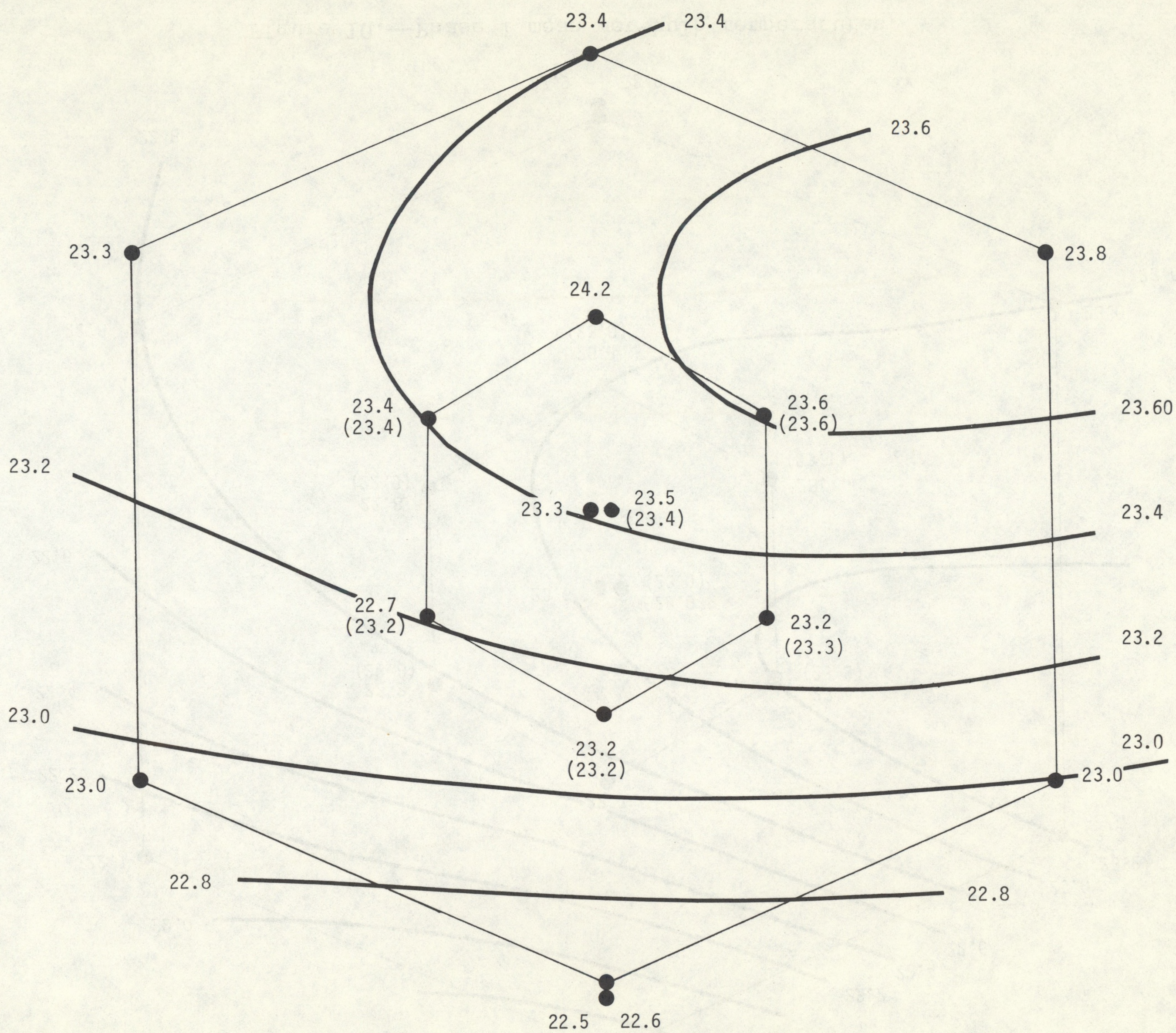

Figure 11.--Phase II mean wet-bulb temperatures.

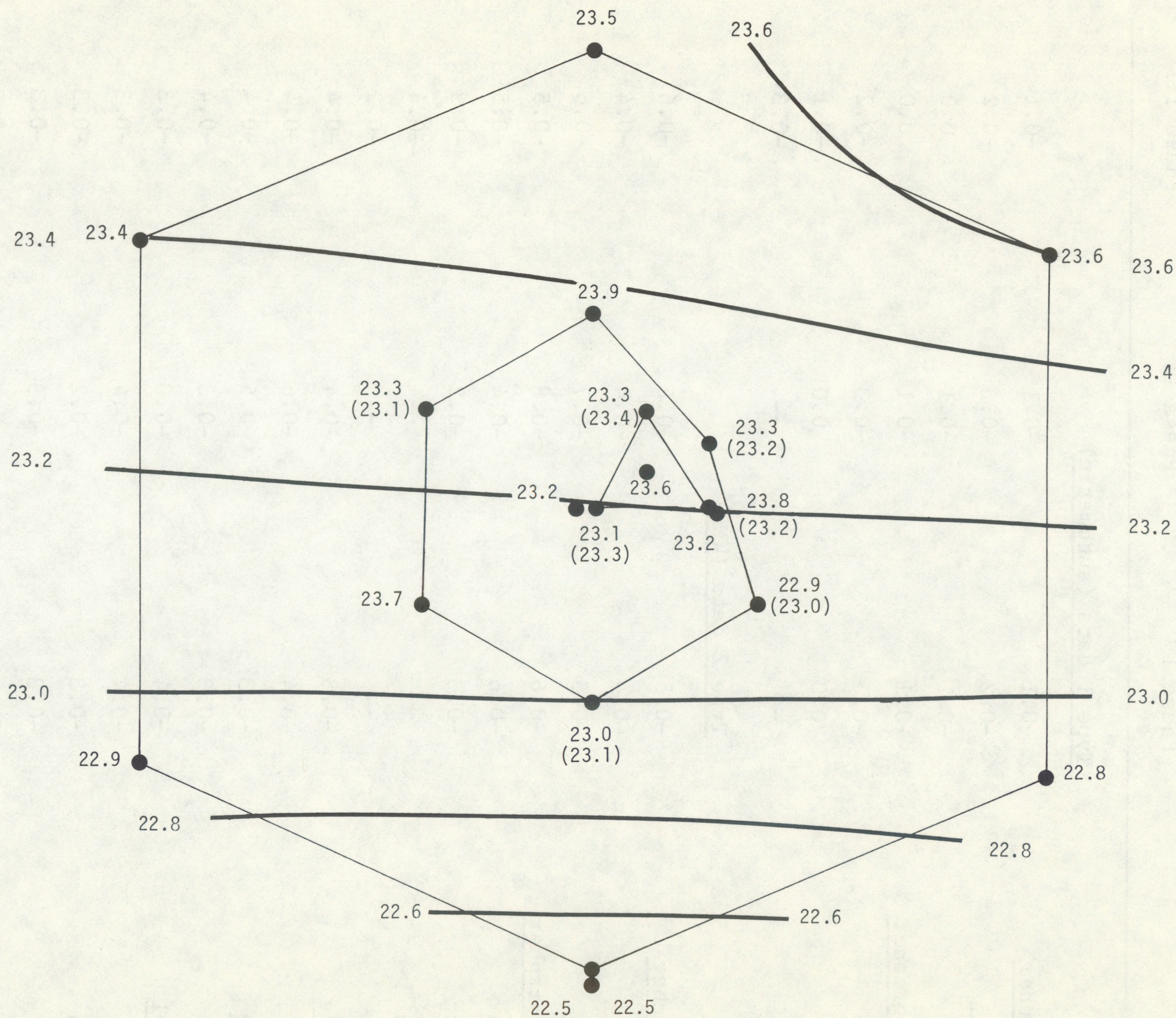

Figure 12.--Phase III mean wet-bulb temperatures.

Table 5.--Wet-bulb temperature biases (corrections necessary to adjust uncorrected Phase mean wet-bulb temperatures to smoothed scalar fields)

Ship	Phase I	Phase II	Phase III
	Type 1 data (automatic)		
Researcher	-0.1	-0.1	-0.1
Gilliss	-0.2	-0.3	-0.2
Dallas	-0.1	-0.1	0.0
Oceanographer	-0.1	-0.1	0.0
Quadra	-0.3	-0.3	-0.2
Meteor	0.0	0.0	-0.1
Planet	--	--	-0.3
	Type 2 data (WMO)		
Researcher	-0.5	-0.6	-0.6
Gilliss	-0.4	-0.4	-0.4
Dallas	-0.5	-0.7	-0.6
Oceanographer	-0.6	-0.8	-0.5
Quadra	-0.6	-0.4	-0.5
Meteor	-0.3	-0.2	-0.2
Planet	--	--	-0.4
Fay	--	--	-0.2
Korolov	-0.3	-0.4	-0.4
Okean	-0.4	-0.6	-0.4
Priboy	-0.3	-0.5	-0.4
Vize	-0.3	-0.3	-0.4
Krenkel	-0.4	-0.3	-0.3
Zubov	-0.4	-0.4	-0.3
Musson	-0.3	-0.2	-0.3
Poryv	-0.3	-0.3	-0.3
Bidassoa	--	--	-1.3
Vanguard	-0.6	-0.7	-0.5
Hecla	--	--	-0.4

3.4 Sea-Surface Temperatures

The sea-surface temperature analyses for Phases I, II, and III are shown in figures 13, 14, and 15. The relatively pronounced gradients in Phase I decrease during Phases II and III. In fact, figure 15 shows little or or no gradient across the A/B array in Phase III. As already mentioned, the warm sea temperatures at the Poryv during Phase I are consistent with the warm air temperatures at this station. As in the case of the dry- and wet-bulb temperatures, these analyses were drawn from the Type 1 data when both Type 1 and 2 data were available. However, most of the Type 2 sea temperature data are also of high quality.

Table 6 gives the average biases for each of the Phases derived from the smoothed fields and the uncorrected Phase means. The Type 1 and 2 observations are in very close agreement with the Meteor buoy's sea-surface temperatures. With only two exceptions the average bias is 0.2^{o}C or less for all the ships. The Gilliss Phase II biases were derived from the short interval (see table 1).

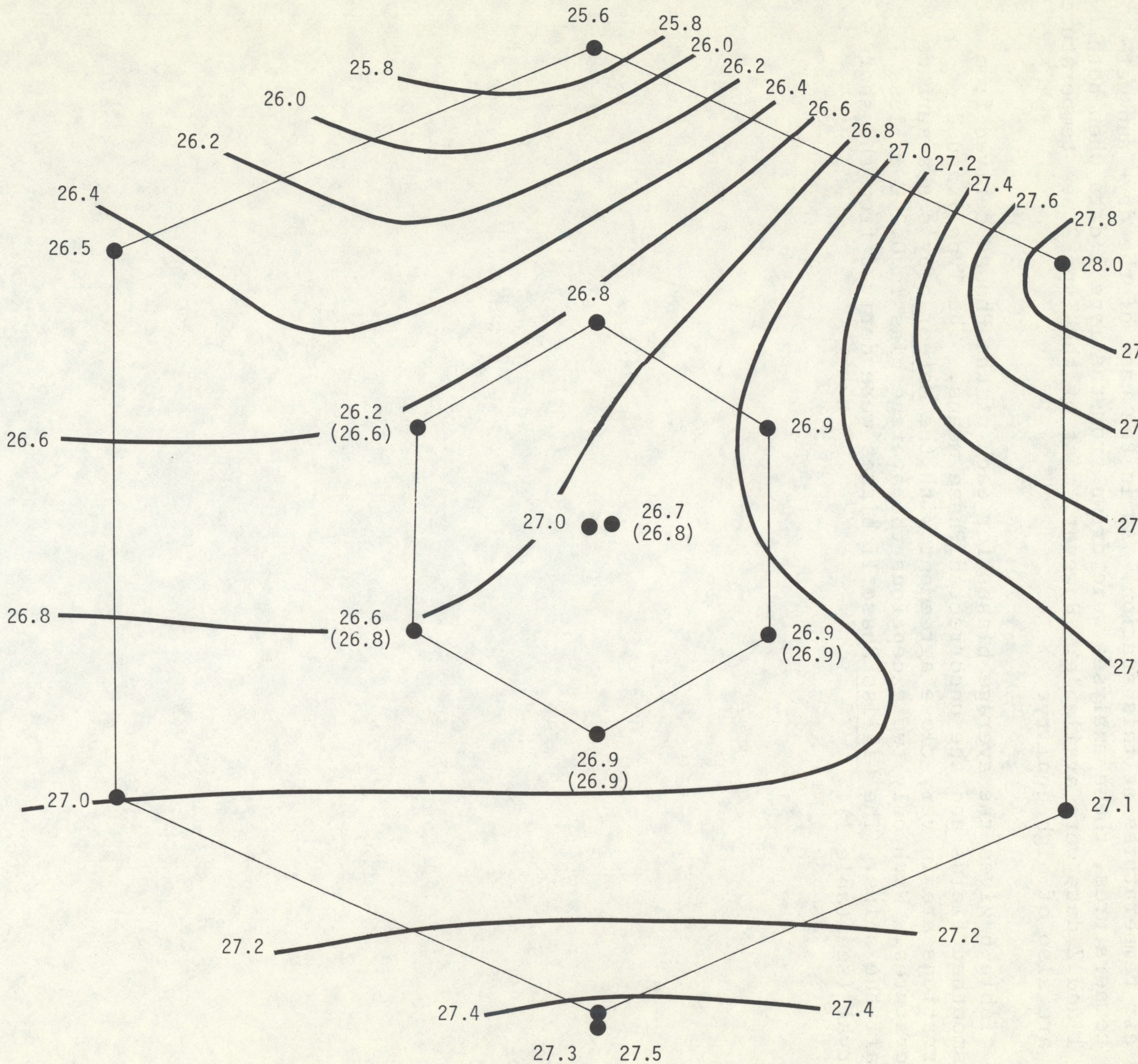

Figure 13.--Phase I mean sea-surface temperatures.

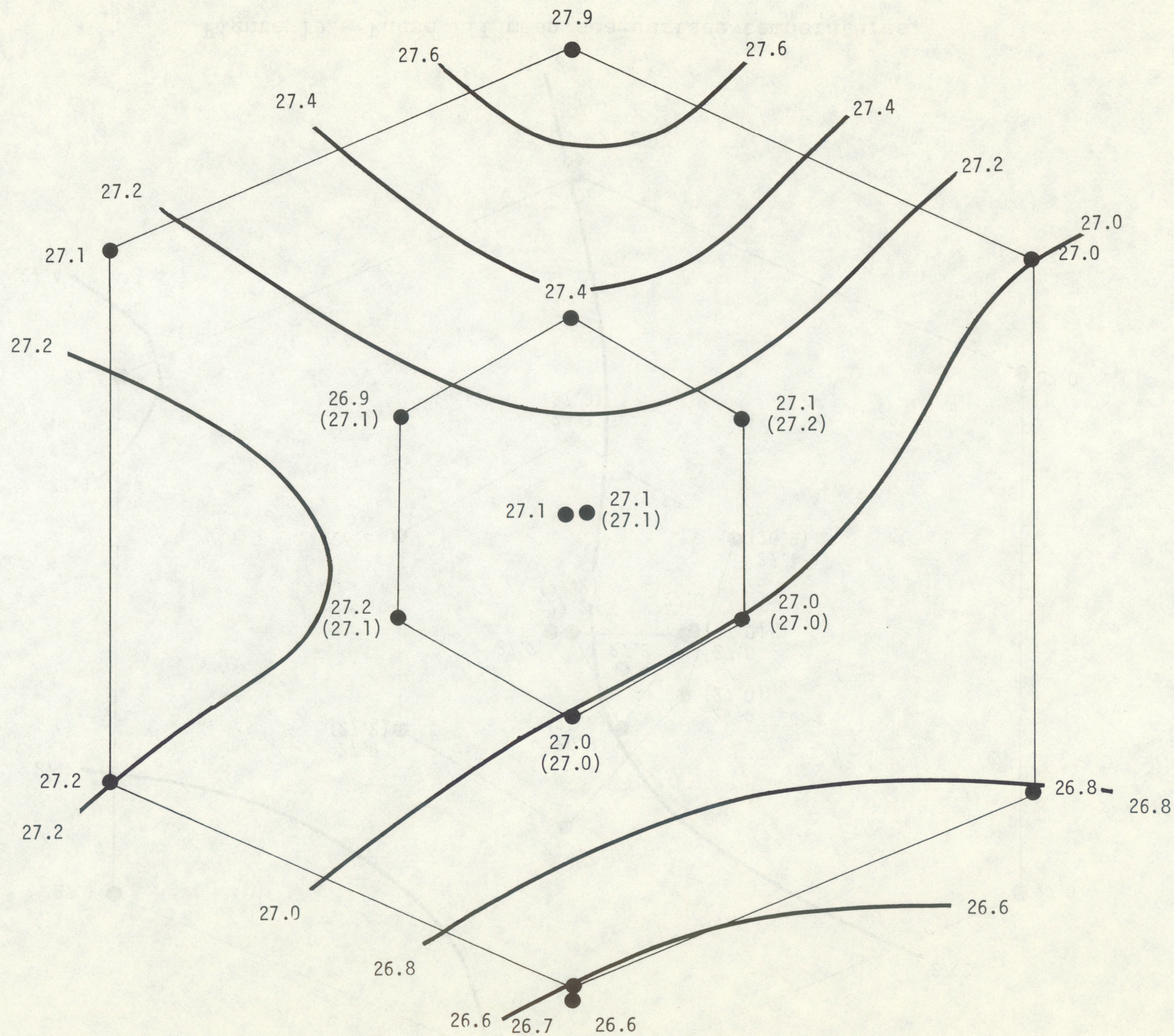

Figure 14.--Phase II mean sea-surface temperatures.

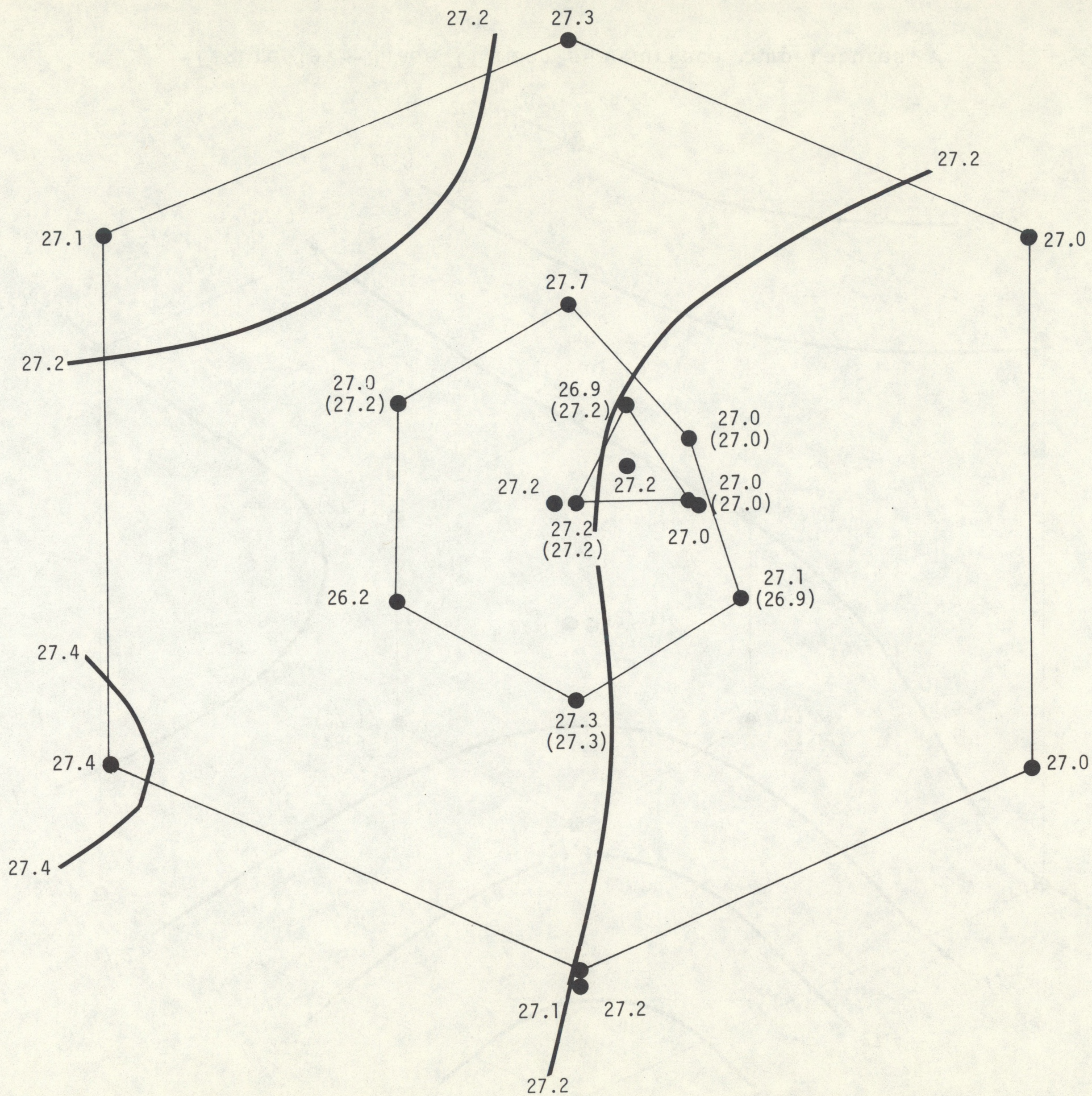

Figure 15.--Phase III mean sea-surface temperatures.

Table 6.--Sea-surface temperature biases (corrections necessary to adjust Phase mean temperatures to smoothed scalar fields)

Ship	Phase I	Phase II	Phase III
Type 1 data (automatic)			
Researcher	+0.1	+0.2	+0.2
Gilliss	0.0	0.0	0.0
Dallas	+0.1	+0.1	+0.1
Oceanographer	0.0	0.0	+0.2
Quadra	--	+0.2	+0.3
Meteor	0.0	0.0	0.0
Planet	--	--	0.0
Type 2 data (WMO)			
Researcher	-0.1	-0.2	-0.1
Gilliss	+0.3	+0.2	+0.2
Dallas	+0.2	-0.1	+0.1
Oceanographer	+0.1	0.0	+0.1
Quadra	+0.1	+0.1	0.0
Meteor	+0.1	+0.1	+0.1
Planet	--	--	+0.1
Fay	--	--	0.0
Korolov	+0.1	0.0	0.0
Okean	0.0	0.0	0.0
Priboy	-0.1	0.0	+0.1
Vize	-0.1	0.0	0.0
Krenkel	0.0	-0.1	0.0
Zubov	0.0	+0.2	0.0
Musson	+0.1	0.0	+0.1
Poryv	0.0	0.0	+0.1
Bidassoa	--	--	-0.1
Vanguard	-0.2	-0.1	-0.4
Hecla	--	--	0.0

3.5 Wind Speed

The wind speed analyses for Phases I, II, and III are shown in figures 16, 17, and 18, respectively. All Type 2 wind speeds plotted were acquired by mast sensors. The Type 1 bow boom wind speeds, shown in parentheses, are occasionally degraded because the boom sensor was sheltered from the wind by the ship's superstructure. All mast speeds were corrected to 10 m using the log wind law. As mentioned earlier, this scheme tends to overcorrect, so that the mast wind speeds appear lower than the speeds measured on the bow booms. Because the mast wind speeds required the correction to 10 m, the boom winds were given first consideration in the analyses. The Meteor buoy tended to overestimate the true wind speed due to the accelerating and decelerating motions of the cups with the buoy's motion. No corrections for either the Vanguard or Hecla winds were made because these ships did not participate in the Intercomparisons.

In the GATE area, one expects minimum wind speed to coincide with the equatorial trough, just north of the asymptote of confluence in the wind field, which in Phases II and III was oriented west-southwest to east-northeast at the northern extreme of the A/B array. These analyses support such minima, although there is very little information. For Phase I, the speed minimum should be over the northern half of the B-scale array, but it is not apparent. Two explanations are possible: first, both the equatorial trough and the asymptote of confluence were migrating northward in this Phase, blurring the definition of the wind speed minimum; and, second, the enhanced convective activity in the B-scale as evidenced by radar (M. Hudlow, personal communication) may have obscured the speed minimum during this Phase in this area. The Phase I data do support a relatively strong speed gradient over the northern half of the B-scale array, with maximum wind speeds along the asymptote of confluence.

Table 7 gives the biases for each of the Phases. As seen, in the Type 1 data they are generally smaller than in the Type 2 data, reflecting the fact that the latter include both instrument bias and height corrections.

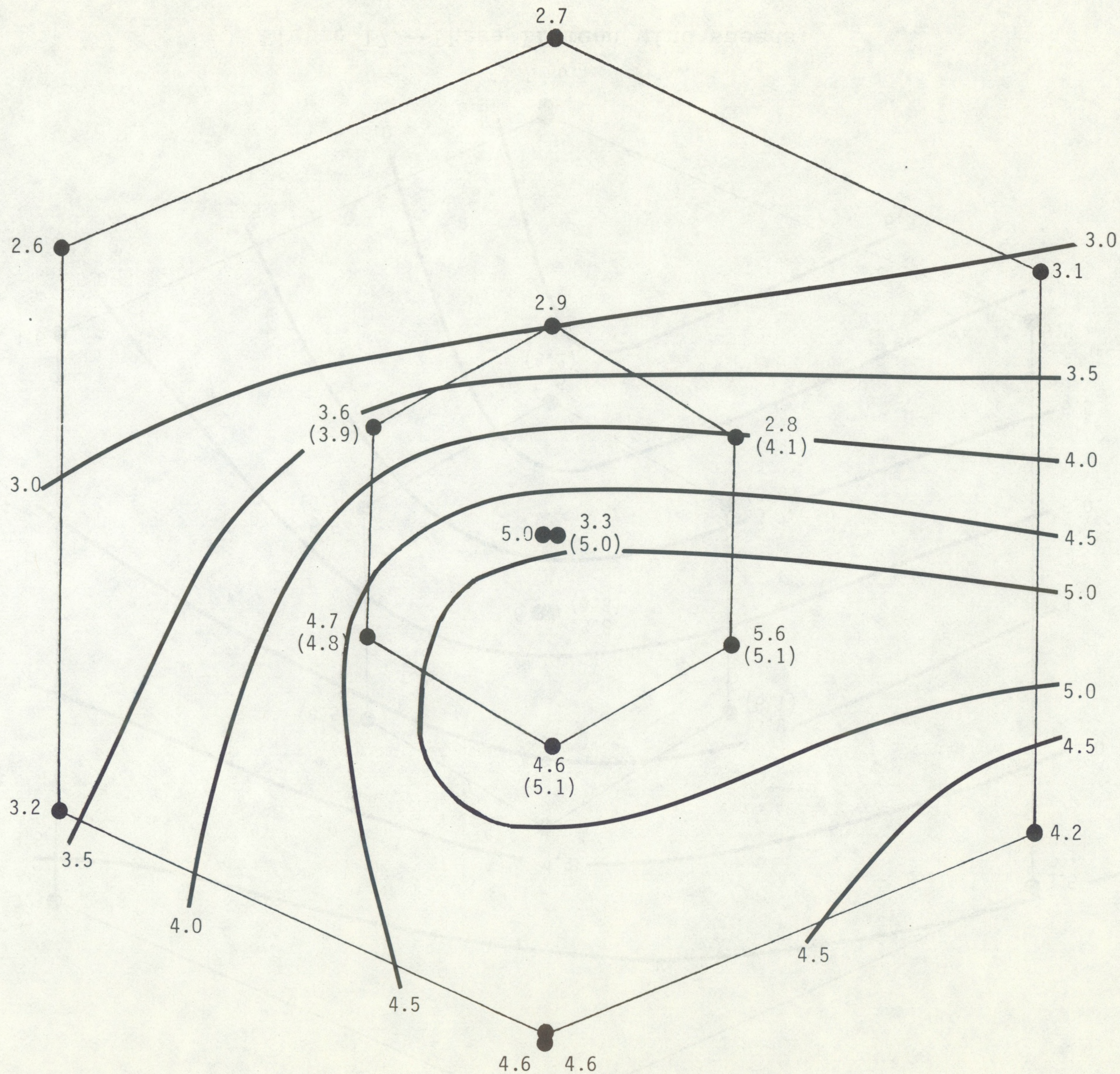

Figure 16.--Phase I mean wind speeds.

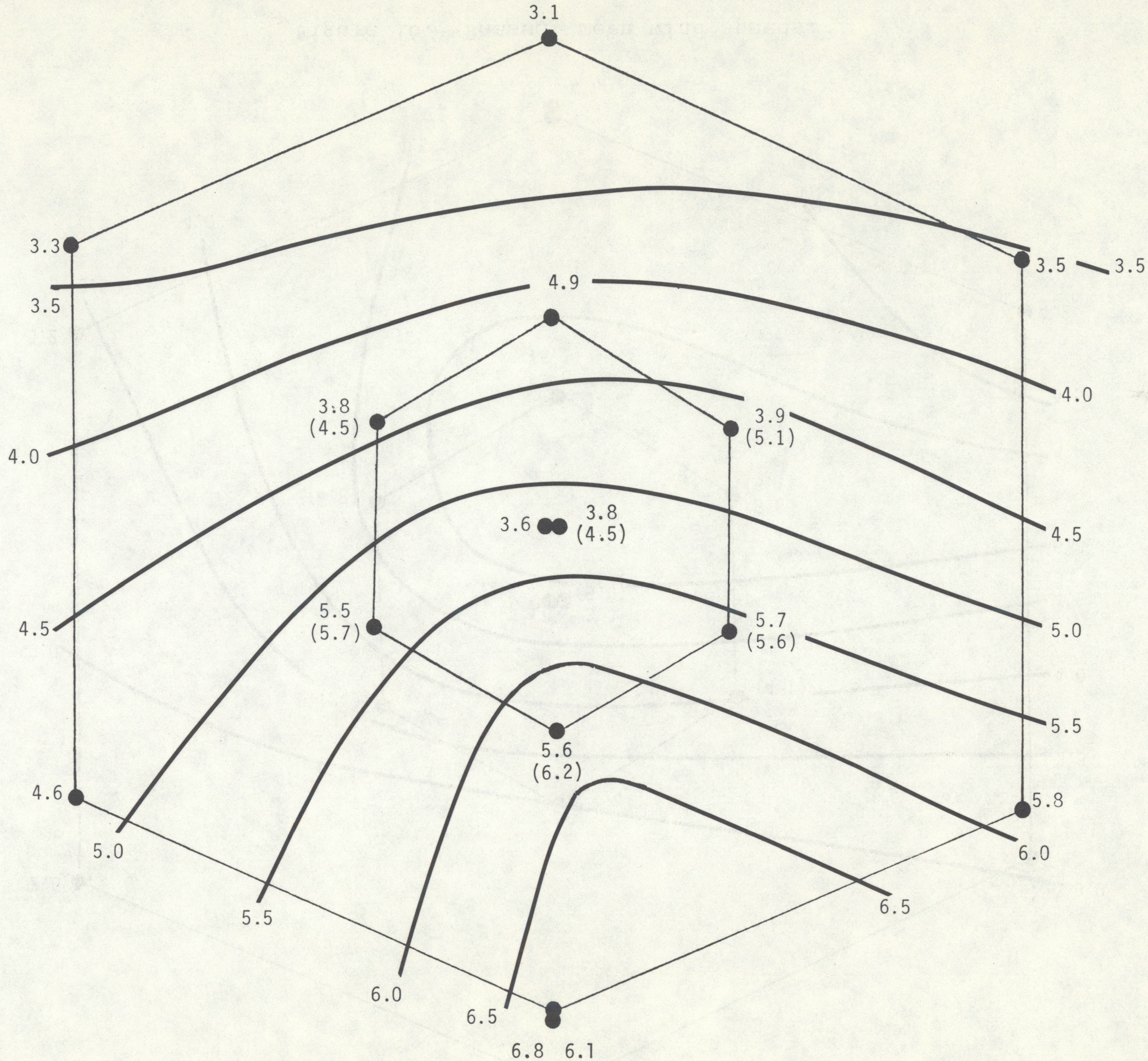

Figure 17.--Phase II mean wind speeds.

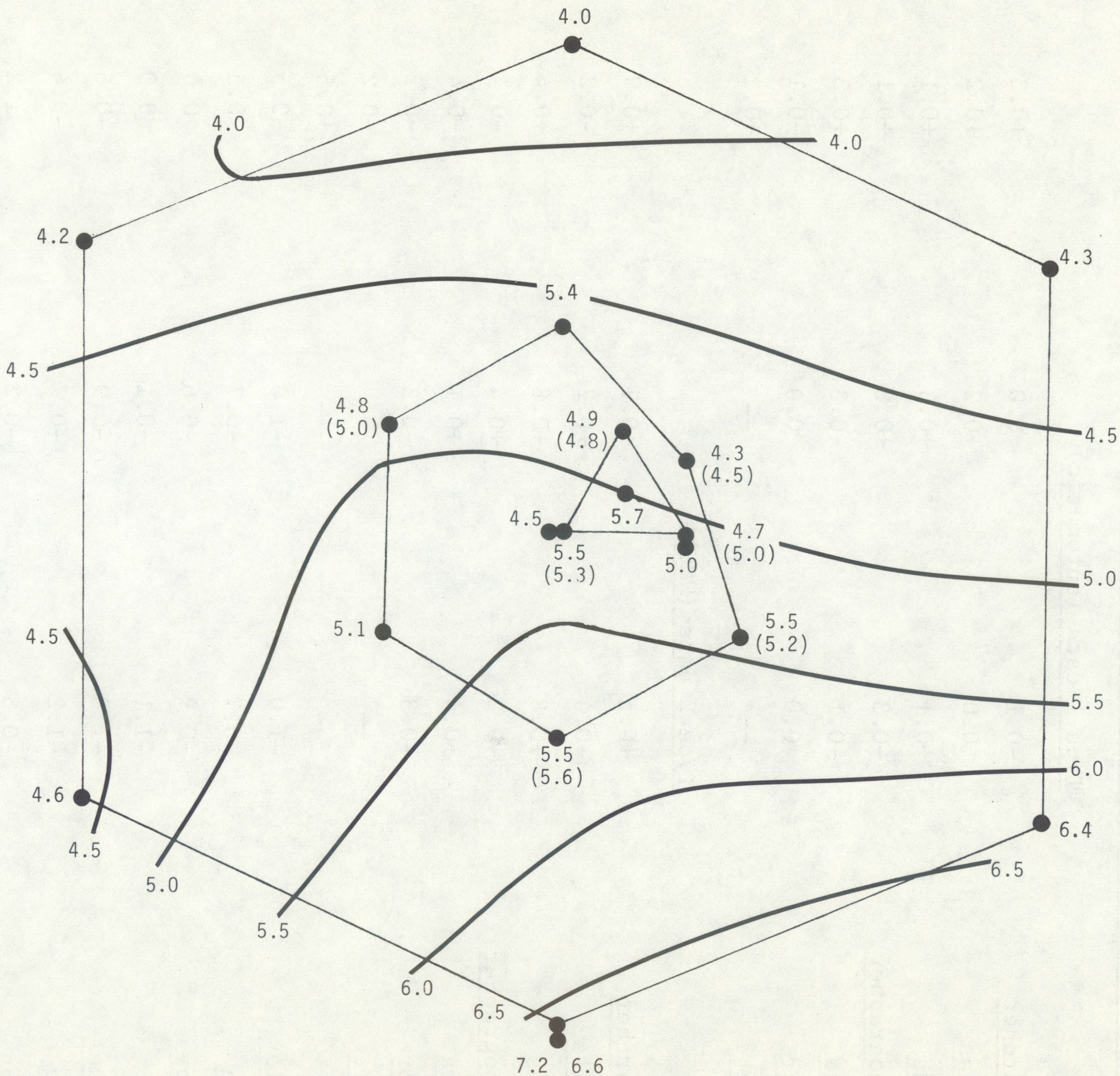

Figure 18.--Phase III mean wind speeds.

Table 7.--Wind speed biases (corrections necessary to adjust uncorrected Phase mean wind speeds to smoothed scalar fields)

Ship	Phase I	Phase II	Phase III
	Type 1 data (automatic)		
Researcher	-0.1	0.0	+0.3
Gilliss	0.0	+0.2	+0.2
Dallas	+0.1	+0.3	+0.1
Oceanographer	-0.3	+0.8	+0.1
Quadra	-0.1	-0.3	+0.3
Meteor	0.0	0.0	-0.1
Planet	--	--	+0.2
	Type 2 data (WMO)		
Researcher	+0.5	+0.7	+0.9
Gilliss	-0.4	+0.2	-0.2
Dallas	+0.8	+0.8	+0.4
Oceanographer	+0.2	+0.4	-0.4
Quadra	+0.4	+0.1	+0.4
Meteor	-0.3	-0.3	-0.2
Planet	--	--	-0.2
Fay	--	--	+0.5
Korolov	-1.0	-1.0	-0.5
Okean	-0.7	-0.7	-0.5
Priboy	-0.9	-0.6	0.0
Vize	-1.1	-0.1	0.0
Krenkel	-1.3	-0.9	-0.6
Zubov	-1.2	-0.7	-0.4
Musson	-0.5	-0.2	-1.2
Poryv	-0.9	-0.7	-0.4
Bidassoa	--	--	-0.4
Vanguard	-0.2	-0.7	-0.8
Hecla	--	--	-0.7

3.6 Wind Direction

Figures 19, 20, and 21 show the mean streamline analyses for Phases I, II, and III, respectively. These have been drawn for the mast sensors only, and no corrections have been applied to the data. The Intercomparison biases are given in NOAA Technical Report EDS 17 (Godshall et al., 1976). Table 8 gives the average wind directions for both Type 1 and Type 2 sensors to permit comparison not shown in the figures.

The wind directions were not corrected, and biases were not established based on the analysis for several reasons. First, the fact that the *Meteor* buoy's absolute calibration varied from Phase to Phase by 5°, coupled with the fact that not all ships participated in the same Intercomparisons, made it impossible to interpret one IC bias in terms of another. Second, in some cases it was found that when the biases were applied to the boom and mast wind directions, the resulting corrected wind directions compared no better than the uncorrected values, and in some cases worse. The average wind directions are meaningless in very light winds because the wind vane wanders over the whole compass. For those stations which were in light wind regimes a large part of the time, the mean wind directions are even more questionable. Finally, IC 3A and IC 3B were characterized by very light winds and at times nearly calm conditions. Because of this, the averages for these two periods should be used with caution.

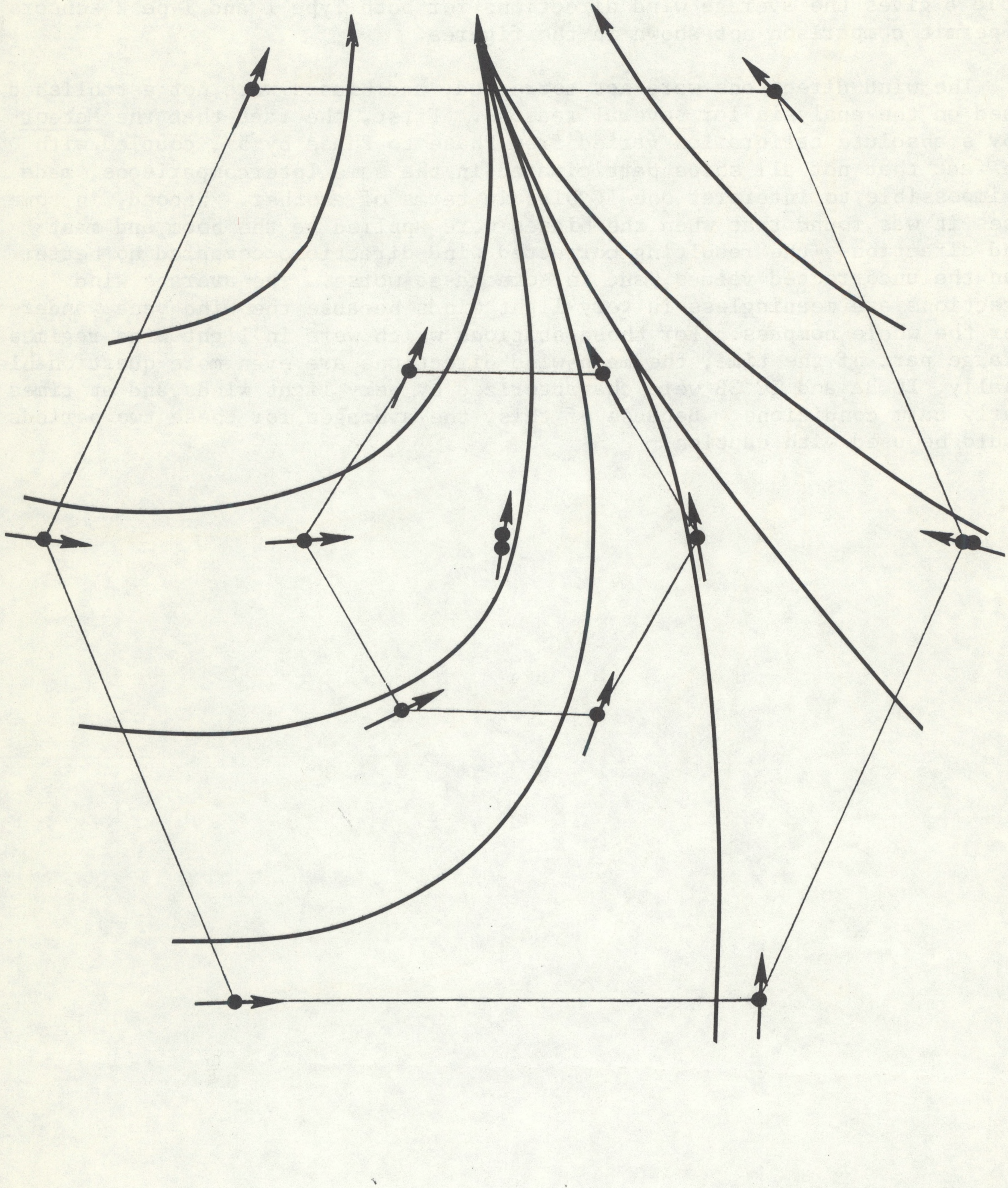

Figure 19.--Phase I mean uncorrected wind directions.

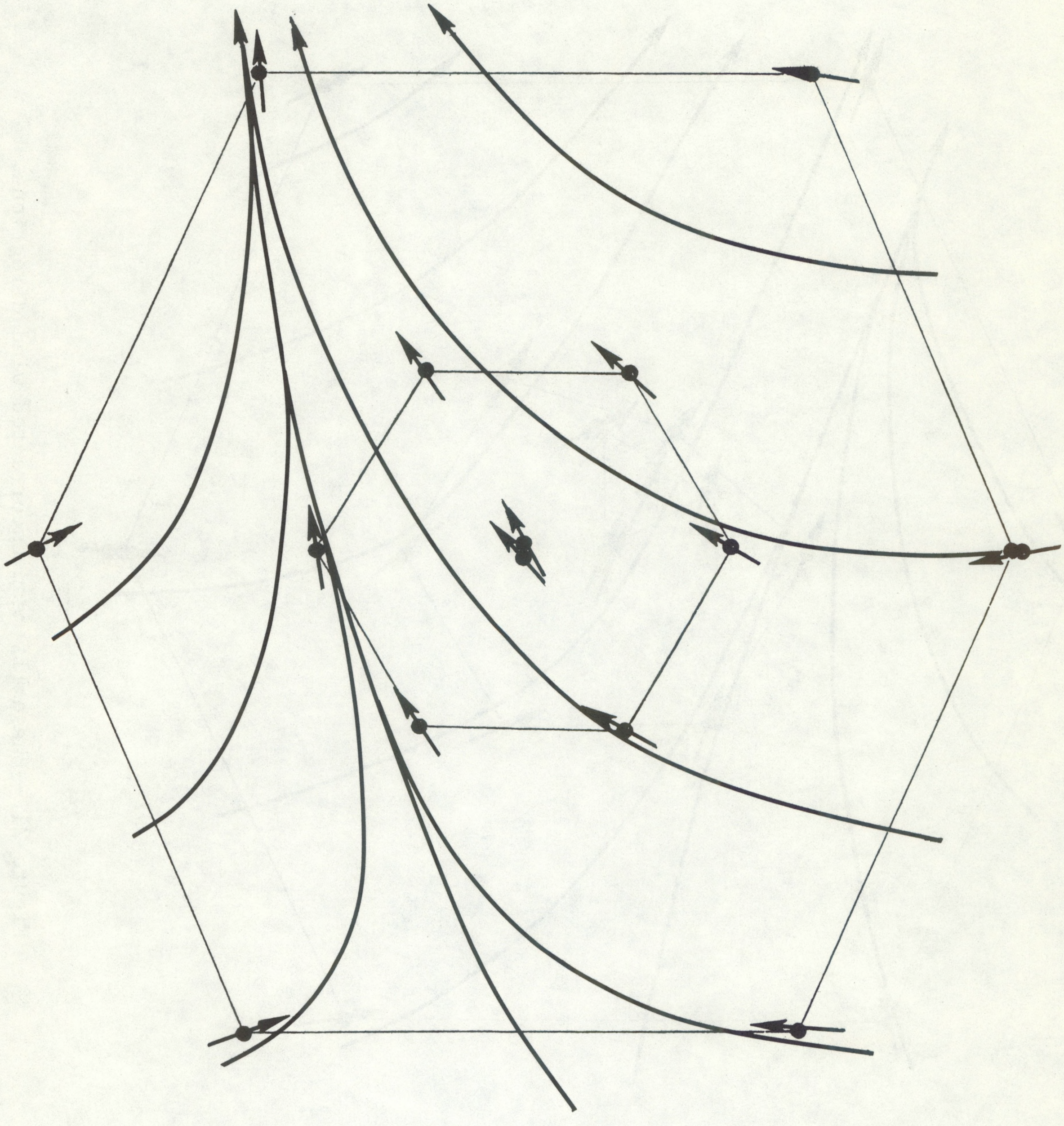

Figure 20.--Phase II mean uncorrected wind directions.

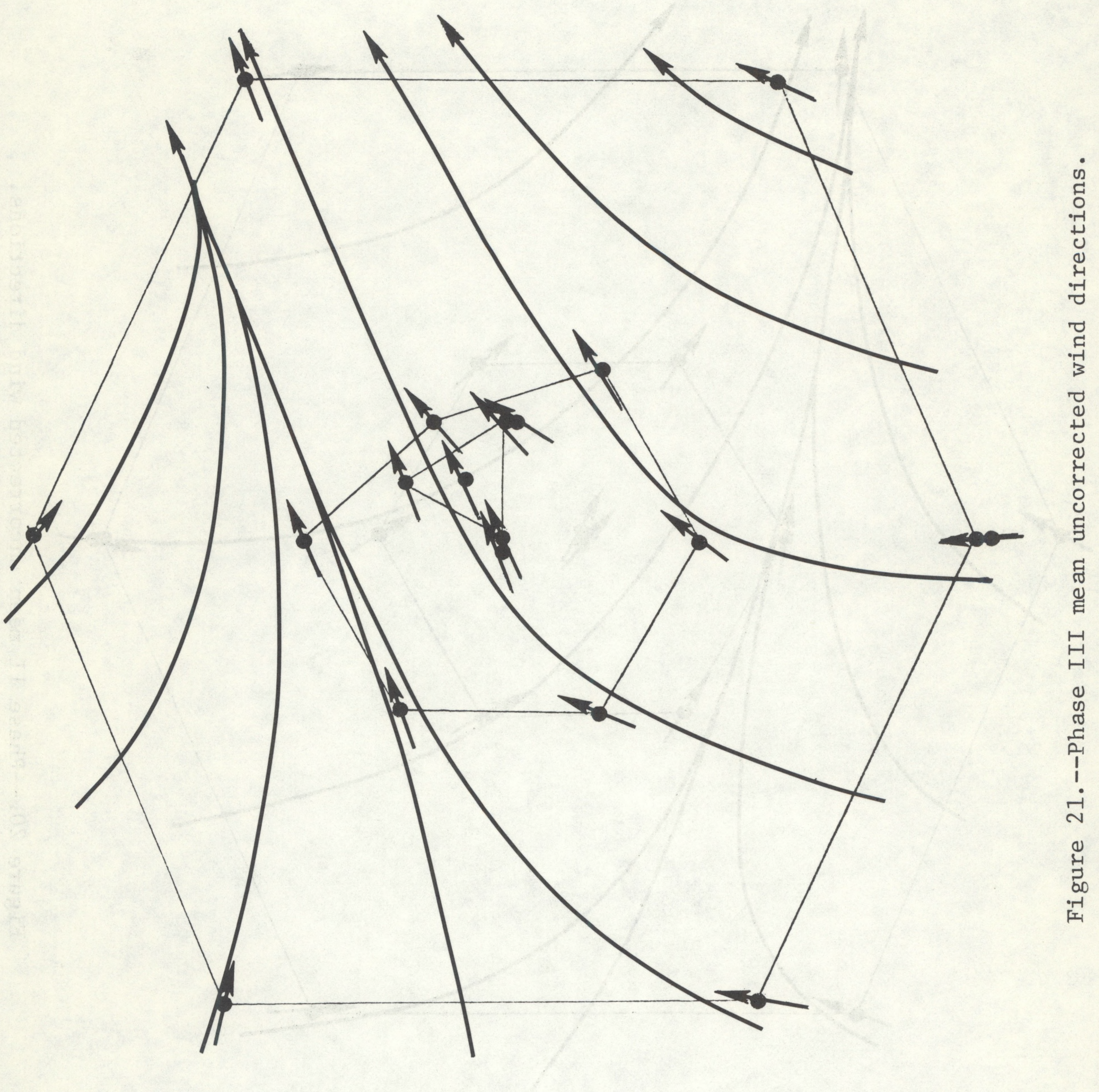

Figure 21.--Phase III mean uncorrected wind directions.

Table 8.--Average wind directions

Ship	Phase I	Phase II	Phase III
	Type 1 data (automatic)		
Researcher	258	204	221
Gilliss	240	236	251
Dallas	282	212	232
Oceanographer	283	229	225
Quadra	288	218	243
Meteor	253	206	251
Planet	---	---	256
	Type 2 data (WMO)		
Researcher	259	209	216
Gilliss	336	230	247
Dallas	288	211	228
Oceanographer	286	238	233
Quadra	295	230	234
Meteor	245	214	244
Planet	---	---	252
Fay	---	---	215
Korolov	6	332	311
Okean	274	182	196
Priboy	5	332	283
Vize	355	232	244
Krenkel	215	186	202
Zubov	205	161	176
Musson	200	172	174
Poryv	290	266	249
Bidassoa	---	---	210
Vanguard	283	257	250
Hecla	---	---	249

4. SUMMARY OF DATA VALIDATION AND ANALYSIS

This report was prepared in order to show the average bias of each variable measured on each GATE A/B-, B-, and C-scale ship during each Phase, to summarize the general quality of the data, and to describe various data sets that can be ordered from the archive (see app. B). Because the preceding tables list average biases during each Phase, they represent only a first approximation of the bias in any individual measurement, although they do show some long-term drifts of a particular measurement from Phase to Phase. A study is currently being performed at the University of Oklahoma of the variation in the biases during each Phase.

Based on the data review and validation done in preparing the archive tapes for the three Phases, we can make some brief recommendations concerning the use of the data, and point out potential problem areas. This summary should not, however, serve as a substitute for careful examination of the data before their use, but merely as a preliminary introduction to the data.

4.1 Pressure

Several of the Type 1 pressure data sets have their own unique problems, and therefore it is difficult to generalize. The Researcher, Gilliss, and Dallas Kollsman pressure data have been placed on the CSDC archive tape. The Dallas Kollsman data are known to have drifted during Phase II. The Quadra Type 1 pressure data were derived from a microbarograph and these data are known to be noisy. The Kollsman sensor on the Oceanographer functioned erratically during the experiment, and for this reason Rosemount data were copied onto the archive tape. However, the Rosemount data are known to contain sensor drifts. Figure 22 shows that the Oceanographer Rosemount data have distinctly lower afternoon minima than morning minima in the semidiurnal oscillations. This figure also shows the Oceanographer Type 2 pressure data for comparison. For the few periods when the Kollsman pressure data are missing for the Researcher, Gilliss, and Dallas, the Rosemount data have been substituted on the archive tape. These data have been flagged as 7's to distinguish them from the Kollsman data.

In the Type 2 data, two problems were noted as a result of the ASD analysis (see sec. 2), which showed that a few of the data sets contain a phase shift of 1 hr. Figure 23 gives an example of this effect in the Korolov Phase II data. Other ships exhibiting this tendency are the Okean and Priboy during Phase III. We have no explanation for this, and, unfortunately, these ships did not have two sensors for comparison. Also, the magnitude of the semidiurnal osccillations vary considerably from ship to ship. The Dallas and Fay data for Phase III are compared in figure 24, where the discrepancy is apparently related to sensor problems.

4.2 Dry-Bulb Temperature

The Type 1 temperature measurements from the Meteor buoy and the bow booms on the Researcher, Gilliss, Dallas, Oceanographer, Quadra, and Planet are generally of very high quality. These observations contain very little or

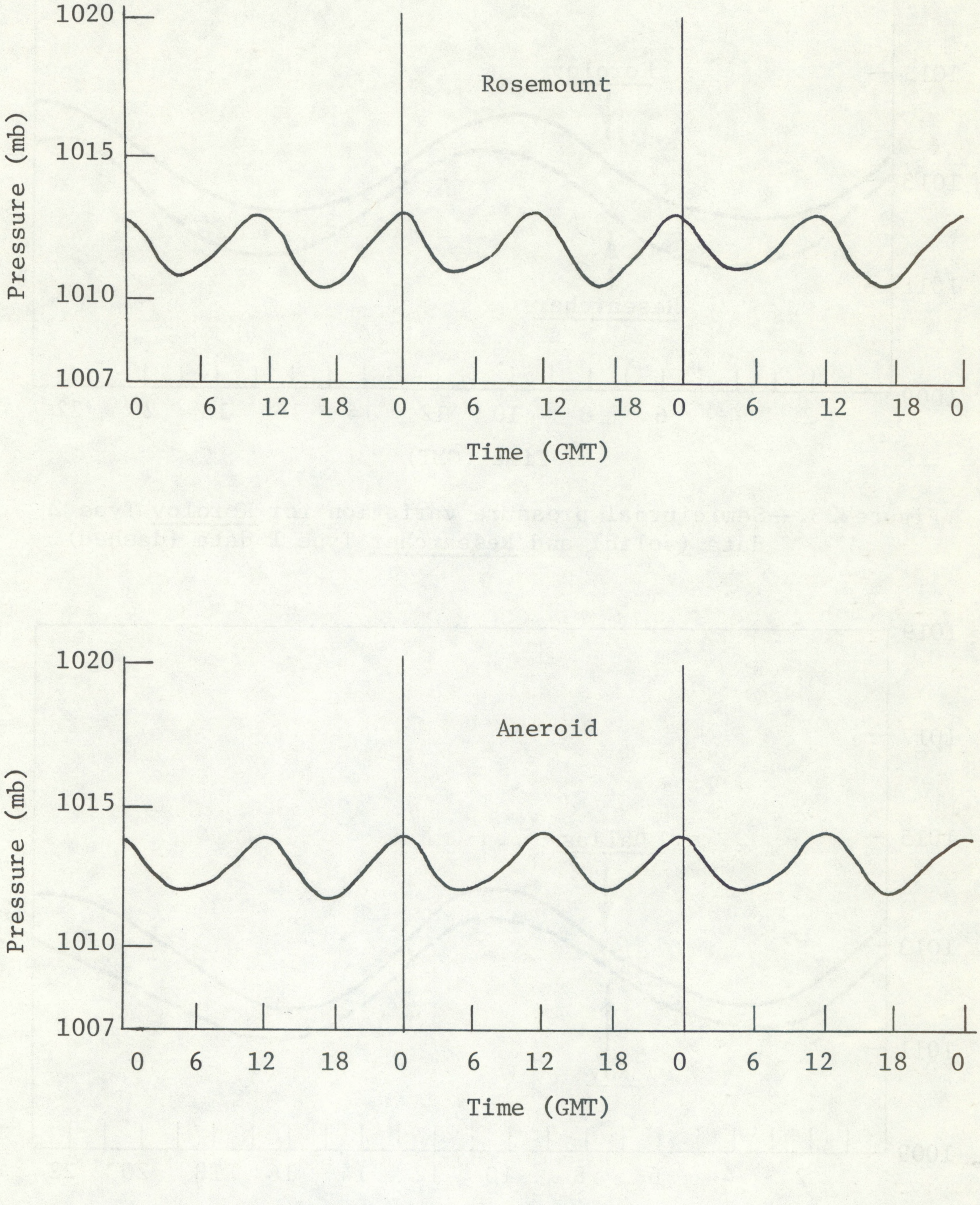

Figure 22.--Examples of Oceanographer semidiurnal pressure oscillations for the Rosemount (Type 1) and standard aneroid barometer (Type 2).

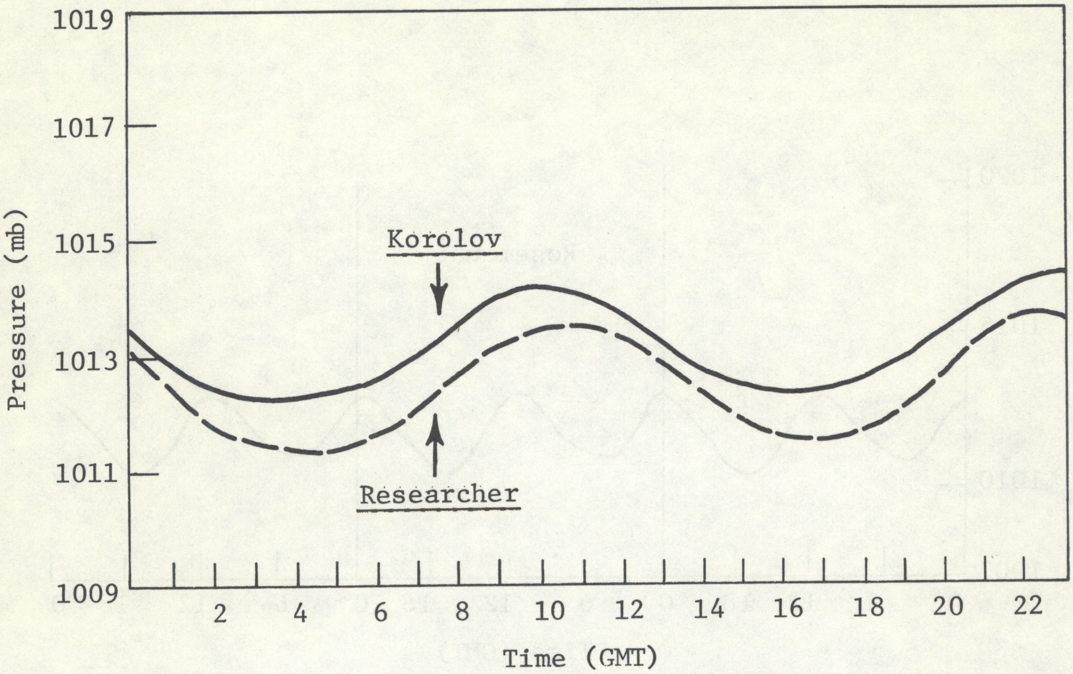

Figure 23.--Semidiurnal pressure variation for Korolov Type 2 data (solid) and Researcher Type 1 data (dashed).

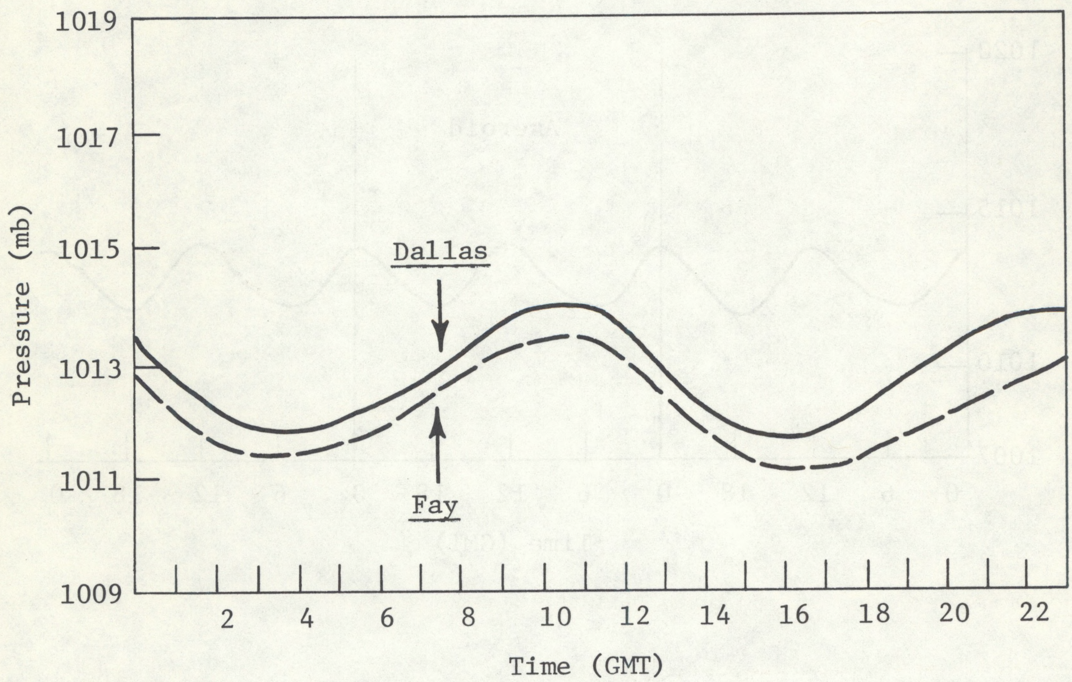

Figure 24.--Semidiurnal pressure variation for Dallas Type 2 data (solid) and Fay Type 2 data (dashed).

no deck heating bias. There are, however, gaps in the data due to sensor malfunctions and radio-frequency (RF) interference. Also, the calibration of the Planet sensor apparently changed at 0000 GMT on September 11, because the boom temperatures increased by approximately 1°C in comparison with the Planet Type 2 observations.

Almost all the Type 2 dry-bulb temperatures are biased by deck heating on undisturbed days with light wind speeds. Moderate to strong winds minimize the problem for most ships, and cloudy disturbed days nearly eliminate the problem for all ships. A fairly good linear correlation between incoming solar radiation and the deck heating bias does exist, and this correlation can be used to model the bias during the middle of the day. However, the model fails during the first one or two hours after sunrise and the last one or two hours before sunset.

The ships with the most severe deck heating problem were the Researcher, Gilliss, Dallas, Oceanographer, Quadra, Vanguard, Hecla, and Planet. All these ships, except the Hecla and Vanguard, had Type 1 systems and the data from these systems should be used instead of the Type 2 observations wherever possible. The Hecla data improved significantly at 1500 GMT on September 1 when the sensor's exposure was changed.

4.3 Wet-Bulb Temperature

Most of what was said about the Type 1 dry-bulb temperatures applies to the wet-bulb temperatures. The data are of high quality and suffer principally from gaps. The Quadra's dew-point sensor, from which the wet-bulb temperatures were derived, dried out between 0900 GMT, July 9 (Julian day 190), and 0000 GMT, July 13 (Julian day 194).

In the Type 2 data, the deck heating bias is also the principal problem, although the magnitude is much less than in the dry-bulb temperature data. D. Schriever (informal report on the GATE Boundary Layer Subprogram) has shown that the bias in the wet-bulb temperatures also correlates with the incoming solar radiation, and this correlation can be used to model the bias. However, it is recommended that Type 1 wet-bulb data be used wherever possible. The original archive tape of the Bidassoa WMO surface data contained dew-point temperatures and incorrect wet-bulb temperatures calculated from the dew points. The Bidassoa wet-bulb values shown in figures 10, 11, and 12 are based upon dew-point data, as are the wet-bulb temperatures contained in the CSDC archived data (see app. B).

4.4 Sea-Surface Temperature

The quality of both the Type 1 and Type 2 data sets is good, and generally one need not consider one data set in preference to the other. There are occasional gaps in the Type 1 time series due to loss of data. Some of the ships measured relatively large diurnal sea-surface temperature variations, which apparently reflect true variations.

4.5 Wind Direction and Wind Speed

The Type 1 wind speed and direction data placed on the archive tape were derived from the Meteor buoy and from sensors mounted on the bow booms and masts of the ships. All the Type 1 data are good, with some qualifications. Recent comparisons of boom and mast winds suggest that differences between these sensors is at a minimum when the relative wind direction is on the bow. The differences increase for relative wind directions normal or broadside to the ship, as the mast wind speeds apparently degrade more than the boom wind speeds as a result of the ship's superstructure. For relative wind directions approaching the stern of the ship, boom winds become increasingly influenced by the superstructure of the ship. Thus there are no "best" Type 1 wind speed data for the ships that had both boom and mast wind direction sensors, i.e., the Researcher, Gilliss, Dallas, and Oceanographer. However, because the boom wind sensors were sheltered by the superstructure of the ship for such a small percentage of the time, the data from these sensors may be more representative. Further, these data require no correction to 10 m for comparison with the Meteor buoy. Unfortunately, the Dallas boom wind speed data are degraded because of a faulty sensor during Phase III.

The Type 2 wind speeds and directions reported on the WMO observation forms were measured by the mast sensors. Despite the fact that these observations represent visual averaging for short periods, the graphics review (see sec. 2) indicated that they closely correspond to the automatic observations. However, for light wind speeds (less than 1 to 2 m s^{-1}) the wind speed sensors tend to stall, and both directions and speeds are reported as zero.

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APPENDIX A

Updates and Corrections to Earlier CSDC Reports

The purpose of this appendix is to update earlier CSDC reports (NOAA Technical Reports EDS 17 and EDS 18) and to correct a few errors.

In NOAA Technical Report EDS 17, p. 15, the Oceanographer Type 2, IC 2, pressure bias is reported as -0.28 mb. This should be -0.60 mb. On p. 13, the Planet Type 1, IC 3A, Digibar pressure bias is reported as -2.69 mb. This large bias applies to the German archive tape No. 4886 (see WDC-A GATE Data Catalog No. 3.30.21.101, tape No. 3). The German National Processing Center has since revised these data on tape (see WDC-A GATE Data Catalog No. 3.30.21.101, tape No. 4). The correct pressure bias applied to these data is -0.29 mb. Table A1 lists the sensor heights for the Hecla and Vanguard, which were not given in NOAA Technical Report EDS 17.

The dates individual ships were on station were given in NOAA Technical Report EDS 18. These have been slightly revised and are listed in appendix C. In particular, the Vanguard was required to leave station during Phase III to reposition the Dallas radar marker buoy. The Musson Phase II and Fay Phase III calendar dates for the last day on station have been corrected. Finally, table A2 gives the standard WMO precipitation data for the ship Bidassoa, which were not published earlier.

Table A1.--Sensor heights (m) for the Hecla and the Vanguard

Variable	Vanguard	Hecla
Dry-bulb temperature	19.2	16
Wet-bulb temperature	19.2	16
Pressure	16.3	1.5
Wind direction	41.5	20
Wind speed	41.5	20

Table A2.--Duration and amount of precipitation measured during Phase III on the ship <u>Bidassoa</u>, 7°45'N, 24°48'W

Date	Time (GMT)	Amount	Time (GMT)	Amount	Time (GMT)	Amount	Time (GMT)	Amount	Daily total
8/30/74	0000-0030	T	0640-0730	0.1	-	-	1845-1905	1.5	5.8
	0255-0520	4.2							
8/31/74	0255-0315	0.5	0650-0910	45.8	-	-	1830-1910	0.3	47.8
	0415-0440	0.1	0950-1035	1.1					
9/1/74	0205-0220	0.2	-	-	-	-	-	-	1.0
	0245-0310	T							
	0425-0545	0.8							
9/2/74	0045-0505	18.6	0950-1005	T	1230-1515	17.8	2025-2350	38.8	75.2
9/3/74	0020-0140	0.2	0920-1120	3.6	-	-	-	-	3.8
9/4/74	0020-0045	T	0630-0715	0.6	1215-1230	T	1800-1855	0.9	35.8
	0140-0520	33.4	1040-1125	0.8	1440-1455	0.1			
					1755-1800	T			
9/5/74	0120-0550	34.0	-	-	1625-1800	0.5	1800-1830	0.1	35.0
							2115-2220	0.4	
9/6/74	-	-	1115-1130	0.2	1630-1635	0.2	2120-2140	2.3	2.7
9/7/74	-	-	1045-1105	T	1200-1210	0.1	2140-2220	0.2	2.2
			1155-1200	T	1520-1540	1.9			
9/8/74	-	-	-	-	-	-	-	-	-
9/9/74	-	-	-	-	-	-	-	-	-
9/10/74	-	-	-	-	-	-	-	-	-
9/11/74	-	-	-	-	-	-	-	-	-
9/12/74	0115-0140	1.8	1120-1140	1.0	1630-1800	1.6	1800-1810	T	4.4

Table A2.--Duration and amount of precipitation measured during Phase III on the ship Bidassoa, 7°45'N, 24°48'W (continued)

Date	Time(GMT)	Amount	Time(GMT)	Amount	Time(GMT)	Amount	Time(GMT)	Amount	Daily total
9/13/74	-	-	0920-0940	T	1420-1435	1.4	-	-	1.4
9/14/74	0005-0020	0.4	0710-0845	10.8	1200-1215	0.1	-	-	12.3
	0330-0415	0.3	0910-1200	0.7					
9/15/74	0010-0030	T	-	-	-	-	-	-	
	0120-0315	1.4							1.4
9/16/74	0445-0600	4.4	0600-0650	0.2	-	-	-	-	11.3
			0715-0940	6.7					
9/17/74	-	-	0855-0920	5.4	1200-1300	1.6	1905-1915	0.1	
			1025-1030	T	1430-1530	2.6			
			1155-1200	T	1645-1720	0.3			10.0
9/18/74	-	-	-	-	-	-	2325-2330	T	T
9/19/74	0210-0230	0.3	-	-	-	-	1840-1905	T	1.4
							2110-2140	1.1	
9/21/74	0340-0355	1.4	0845-0940	T	-	-	2345-2400	1.7	3.1
9/22/74	0000-0120	12.1	-	-	-	-	-	-	12.1
9/23/74	-	-	-	Departed for Dakar at 0900			-	-	-

APPENDIX B

Archived Data

Two data sets were prepared by the CSDC according to the final plan given in GATE Report No. 20 (WMO, 1976). They are now archived at World Data Centers A and B (WDC-A, National Climatic Center, Asheville, North Carolina, USA, and WDC-B, Moscow, USSR, respectively). They were derived from data generated by individual National Processing Centers (NPC's) and include data that were recorded nearly continuously and automatically (Type 1) and the standard WMO marine observations (Type 2). One set consists of the Intercomparison data; the other, of the Phase data. Both contain the high time resolution Type 1 data and the low resolution Type 2 data. Tables B1 through B4 list the NPC input tapes by WDC-A GATE Data Catalog numbers and tape numbers.

Intercomparison Data

The Intercomparison data include pressure, dry-bulb temperature, wet-bulb temperature, sea-surface temperature, wind speed, and wind direction. These data were validated by comparing them with reasonable maximum and minimum meteorological values, by examining distributions of the data, and by comparing bivariate and time-series plots of similar variables measured by different ships and by the *Meteor* buoy or by a reference ship (see NOAA Technical Report EDS 17). The data were copied onto the archive tape in two formats: one for the low resolution data, and one for the high resolution data. The former is contained on a single file; the latter, on six files. The files on the tape are given in table B5.

In addition to the above variables, the longitude and latitude of the ship positions have been added to each file. For IC 1, IC 2, and IC 3A, the drifting positions of the *Oceanographer* were used as reference. The *Researcher* positions were used for IC 3B. Intercomparison A1A was held at 5.0° N. lat. and 44.0° W. long.

The low resolution data, including the WMO marine observations and the supplementary automatic data, have been grouped by Intercomparison period, ship, date, and Greenwich Mean Time (GMT). The high resolution data are grouped by variable, Intercomparison period, ship, and time. A few ships used two sensors to measure each variable and both sets are contained within the files.

The order of the ships on the archive tape by Intercomparison period is shown in table B6.

Table B1.--Low resolution Intercomparison data sets

Ship	Data set	WDC-A GATE Data Catalog data set No.	Tape No.	Intercomparison period
		A/B-scale ships		
Acad. Korolov	WMO	3.31.25.101	1	A1A, 2, 3B
Poryv	WMO	3.31.25.101	1	1, 3B
E. Krenkel	WMO	3.31.25.101	1	1, 3A
Prof. Zubov	WMO	3.31.25.101	1	1, 2, 3A
Musson	WMO	3.31.25.101	1	1, 2, 3A
Okean	WMO	3.31.25.101	1	A1A, 2, 3B
Priboy	WMO	3.31.25.101	1	A1A, 2, 3B
		B-scale ships		
Meteor	Bulk	3.30.21.101	1	1, 2, 3B
Prof. Vize	WMO	3.31.25.101	1	1, 2, 3A
Quadra	WMO	3.31.13.103	1	1, 2, 3A
Oceanographer	WMO	3.31.02.102	1	1, 2, 3A
Researcher	WMO	3.31.02.102	1	1, 2, 3B
Bidassoa	WMO	3.31.04.101	1	3B
Gilliss	WMO	3.31.02.102	1	1, 3B
		C-scale ships		
Planet	Bulk	3.30.21.101	1	3B
Dallas	WMO	3.31.02.102	1	1, 2
Fay	Bulk	3.30.21.101	1	3A

Table B2.--High resolution Intercomparison data sets

Ship	Data set	WDC-A GATE Data Catalog data set No.	Tape No.	Intercomparison period
Researcher	All variables	3.30.02.102	1	1, 2, 3B
Gilliss	All variables	3.30.02.102	1	1, 3B
Dallas	All variables	3.30.02.102	1	1, 2
Oceanographer	All variables	3.30.02.102	1	1, 2, 3A
Quadra	Hourly pressure (barograph)	3.30.13.101	1	1, 2, 3A
Quadra	Temperature	3.31.13.104	1	1, 2, 3A
Quadra	Wind	3.31.13.104	2	1, 2, 3A
Meteor	Pressure (Digibar)	3.30.21.101	4	1, 2, 3B
Meteor buoy	All variables except pressure	3.48.21.102	1	1, 2, 3B
Planet	Pressure (Digibar)	3.30.21.101	4	3A
Planet	All variables	3.30.21.101	2	3A

Table B3.--Low resolution Phase data sets

Ship	Data set	WDC-A GATE Data Catalog data set No.	Tape No.
		A/B-scale ships	
Acad. Korolov	WMO	3.31.25.101	3, 4, 5
Poryv	WMO	3.31.25.101	3, 4, 5
E. Krenkel	WMO	3.31.25.101	3, 4, 5
Prof. Zubov	WMO	3.31.25.101	3, 4, 5
Musson	WMO	3.31.25.101	3, 4, 5
Okean	WMO	3.31.25.101	3, 4, 5
Priboy	WMO	3.31.25.101	3, 4, 5
		B-scale ships	
Meteor	WMO	3.31.21.101	1
Meteor	Bulk	3.30.21.101	1
Prof. Vize	WMO	3.31.25.101	3, 4, 5
Vanguard	WMO	3.31.02.102	1
Quadra	WMO	3.31.13.103	1
Oceanographer	WMO	3.31.02.102	1
Researcher	WMO	3.31.02.102	1
Bidassoa *	WMO	3.31.04.101	1
Gilliss	WMO	3.31.02.102	1
		C-scale ships	
Planet *	WMO	3.31.21.101	1
Planet *	Bulk	3.30.21.101	1
Dallas	WMO	3.31.02.102	1
Fay *	Bulk	3.30.21.101	1
Hecla *	WMO	3.31.03.101	1

* Participated in Phase III only.

Table B4.--High resolution Phase data sets

Ship	Data set	WDC-A GATE Data Catalog data set No.	Tape No.	Data resolution
Researcher	Temperature Pressure Wind	3.30.02.102	2, 3, 4	3-min avg.
Gilliss	Temperature Pressure Wind	3.30.02.102	2, 3, 4	3-min avg.
Dallas	Temperature Pressure Wind	3.30.02.102	2, 3, 4	3-min avg.
Oceanographer	Temperature Pressure Wind	3.30.02.102	2, 3, 4	3-min avg.
Quadra	Pressure (barograph)	3.30.13.101	1	Hourly avg.
Quadra	Temperature	3.31.13.104	1	30-min avg.
Quadra	Wind	3.31.13.104	2	10-min avg.
Meteor	Pressure (Digibar)	3.30.21.101	4	Hourly avg.
Meteor buoy	Temperature Wind	3.48.21.102 3.30.21.101	2, 3 5	3-min avg.
Planet	Pressure (Digibar)	3.30.21.101	4	10-min avg.
Planet	Temperature Wind	3.30.21.101	3	10-min avg.

Table B5.--Files on the CSDC surface meteorology Intercomparison tape

Tape No.	File	Description
B79217	1	Test file
"	2	Tape header file
"	3	Low resolution data
		High resolution files of:
"	4	Pressure
"	5	Dry-bulb temperature
"	6	Wet-bulb temperature
"	7	Sea-surface temperature
"	8	Wind-direction
"	9	Wind speed
"	10	Trailer file

Table B6.--Order of data on archive tape

Ship	Code	Supplementary data
	Intercomparison 1	
Researcher	WTER	Yes
Gilliss	WEWP	Yes
Dallas	NPCR	Yes
Oceanographer	WTEP	Yes
Meteor	DBBH	Yes
Quadra	CGDN	Yes
Musson	EREA	No
Korolov	UHQS	No
Prof. Vize	UPUI	No
Ernst Krenkel	EREU	No
Prof. Zubov	UMFW	No
Okean	EREI	No
Priboy	EREH	No
Poryv	ERES	No
	Intercomparison 2	
Researcher	WTER	Yes
Dallas	NPCR	Yes
Oceanographer	WTEP	Yes
Meteor	DBBH	Yes
Quadra	CGDN	Yes
Musson	EREA	No
Acad. Korolov	UHQS	No
Prof. Vize	UPUI	No
Prof. Zubov	UMFW	No
Okean	EREI	No
Priboy	EREH	No
	Intercomparison 3	
Researcher	WTER	Yes
Gilliss	WEWP	Yes
Oceanographer	WTEP	Yes
Meteor	DBBH	Yes
Quadra	CGDN	Yes
Musson	EREA	No
Acad. Korolov	UHQS	No
Prof. Vize	UPUI	No
Ernst Krenkel	EREU	No
Prof. Zubov	UMFW	No
Planet	DSCZ	Yes
Okean	EREI	No
Priboy	EREH	No
Bidassoa	FBEM	No
Poryv	ERES	No
H.J.W. Fay	WZFS	No

Phase Data

The low resolution Phase data placed on the CSDC archive tape include the variables listed in table B7. All pressure, temperature, and wind velocity values were reviewed by means of a computer and interactive graphics system that enabled the CSDC analyst to indicate erroneous and questionable data by assigning quality flags. For the ships on which both standard WMO marine observations and automatic observations were made by boom and mast sensors, the data were validated by comparing them. For the ships on which only WMO observations were made, validation was accomplished by examining the data in relation to variables on either side of the data value in question and in relation to other meteorological variables. Each data value was assigned a flag of 0, 7, 8, or 9, where 0 means the value is good, 7 means it is questionable, 8 means it is obviously bad, and 9 means the data value is missing.

Table B7.--Variables included in the low resolution data

Time and date
Ship call letters
Latitude and longitude
Pressure*
Air temperature*
Wet-bulb temperature*
Sea-surface temperature*
Wind speed*
Wind direction*
Present weather
Visibility
Cloud cover
Cloud amount
Convective code

*Derived from the bulk data for the Meteor, Planet, and Fay.

The present weather, visibility, and cloud information was also edited by computer, and inconsistencies were flagged on the archive tape. Each synoptic observation can contain a maximum of 10 different codes of the codes defined in table B8. The Synoptic Subprogram and German Weather Service procedures were used as guidelines in developing this flagging scheme, by which a limited amount of checking of temperatures, humidities, and winds was done. The ship latitude and longitude positions have also been validated, and obviously bad positions have been replaced by more reasonable ones.

There are 41 files on the CSDC archive tape, as shown in table B9. Files 3 through 21 consist of the low resolution observations. Each file contains all data for a particular ship for the three Phases of GATE when available. For the low resolution data, fixed start and stop times were used for each Phase (see table B10), and missing data, therefore, often appear at the beginning and end of each set of these data.

The high resolution data are available for all variables except present weather, visibility and cloud information. The data were reviewed on the computer and interactive graphics system, as were the low resolution data, and flags of 0, 7, 8, and 9 were assigned. The archive tape contains 19 files of these data at the time resolution supplied by the NPC (see tables B2 and B4). Each file is devoted to a single ship for a single Phase in a time series format. Each logical record contains each variable for the time of the observations.

General Archive Tape Format

These tapes have been written according to the specifications in GATE Report No. 13, Part 1, appendix E (WMO, 1974). Each data set has been written on 9-track, 800 BPI, odd-parity tape in EBCDIC, with the data blocked into fixed-length physical records of 1,920 characters. Each tape consists of six types of physical records separated by inter-record gaps and blocked into files (separated by end-of-file marks, EOFs; also called tape marks) in the following sequence:

Test file
EOF
Tape header record
EOF
Type 1 file header record } Meteorological data file No. 1
Type 2 file header record }
Data
EOF
Type 1 file header record } Meteorological data file No. 2
Type 2 file header record }
Data
EOF
.
.
.
.
(Additional meteorological and radiation data files)
EOF
End-of-tape record
EOF
EOF

Figures B1 and B2 give examples of the TYPE 1 and Type 2 data file header records for the low and high resolution data records.

Table B8.--Definitions of flags for present weather, visibility, cloud information, pressure, temperature, and winds

Code	Test	Explanation
1	Present weather validity check	An unlikely present weather event report. The following events (given in synoptic code) are consid-ed unlikely: 8, 22-24, 26, 30-39, 56, 57, 66-79, 83-88, 93 and 94.
2	Thunderstorm condition test	Present weather indicates a thunderstorm but cumulonimbus clouds are not reported.
3	Total sky cover amount test	Total sky cover is above (i.e. N>NHIGH) or below (i.e. N<NLOW) bounds established for the correspon-ding present weather. The bounds are given below.

Sky cover bounds for total and low sky cover, corresponding to the reported present weather conditions (NLOW, NHIGH)

Present weather (ww)	0	1	2	3	4	5	6	7	8	9
00	0,0	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8
10	0,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8
20	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8
30	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9
40	1,8	1,8	1,8	9,9	1,8	9,9	1,8	9,9	1,8	9,9
50	7,9	7,9	7,9	7,9	7,9	7,9	7,9	7,9	7,9	7,9
60	6,9	6,9	6,9	6,9	6,9	6,9	6,9	6,9	6,9	6,9
70	6,9	6,9	6,9	6,9	6,9	6,9	0,9	1,9	1,9	1,9
80	1,9	1,9	1,9	1,9	1,9	1,9	1,9	1,9	1,9	1,9
90	1,9	1,9	1,9	1,9	1,9	1,9	1,9	1,9	1,9	1,9

Table B8.--Definitions of flags for present weather, visibility, cloud information, pressure, temperature, and winds (continued)

Code	Test	Explanation
4	Low sky cover amount test	Low sky cover reported is above (i.e. N > NHIGH) or below (i.e. N < NLOW) bounds established for the corresponding present weather. The bounds are given above.
5	Visibility test	Visibility reported is above (i.e. VV>VHIGH) or below (i.e. VV<VLOW) bounds established for the corresponding present weather. The bounds are given below.
6	Past weather test	Snow was reported as a past weather event in the original WMO data.

Bounds for the visibility test corresponding to the reported present weather conditions (VLOW, VHIGH)

Visibility (VV)	0	1	2	3	4	5	6	7	8	9
00	97,99	97,99	97,99	97,99	90,97	94,96	90,93	94,97	94,97	94,97
10	94,96	90,95	90,95	94,99	94,99	96,99	94,96	90,99	94,99	94,99
20	94,99	94,99	94,99	94,99	94,99	94,99	94,99	94,99	94,99	94,99
30	90,97	90,97	90,97	90,92	90,92	90,92	90,99	90,99	90,97	90,92
40	94,96	90,96	90,93	90,93	90,93	90,93	90,93	90,93	90,93	90,93
50	90,96	90,96	90,93	90,93	90,92	90,92	90,99	90,93	90,99	90,99
60	90,97	90,97	90,96	90,96	90,95	90,95	90,99	90,97	90,99	90,93
70	90,97	90,97	90,93	90,93	90,92	90,92	90,97	90,97	90,99	90,93
80	90,99	90,97	90,93	90,99	90,97	90,99	90,93	90,99	90,97	90,99
90	90,97	90,97	90,97	90,99	90,93	90,99	90,99	90,95	90,95	90,95

Table B8.--Definitions of flags for present weather, visibility, cloud information, pressure, temperature, and winds (continued)

Code	Test	Explanation
7	$C_L \neq$ and $N = 0$	A low cloud is reported with zero sky cover.
8	$C_M \neq 0$ and $N = 0$	A middle cloud is reported with zero sky cover.
9	$C_H \neq 0$ and $N = 0$	A high cloud is reported with zero sky cover.
10	$h \neq 9$ and $N = 0$	The cloud base height is inconsistent with the reported sky cover.
11	$1 \leq N \leq 7$ and $C_L = C_M = C_H = 0$	A sky cover is reported with no cloud types given.
12	$1 \leq N \leq 7$ and $N_h = C_H = 0$	A sky cover is reported along low clouds but no low sky or middle sky cover is reported.
13	$1 \geq N \leq 6$, $C_H = 7$	The high cloud is reported as overcast cirrostratus but sky cover is not carried as overcast.
14	$N = 8$, $C_L = C_M = 0$, and $C_H \neq 1,2,3,7$	The high cloud cover reported cannot occur as an overcast or the sky cover is in error.
15	$N = 9$ and $N_h \neq 9$	Sky cover and low sky cover should both be reported as obscured.
16	$N = 9$ and $C_L \neq 0$	A low cloud is reported with an obscured sky.
17	$N = 9$ and $C_M \neq 0$	A middle cloud is reported with an obscured sky.
18	$N = 9$ and $C_H \neq 0$	A high cloud is reported with an obscured sky.
19	$N = 9$ and $h \neq 0$	An obscured sky is reported with a non zero cloud height.
20	$N = 9$ and $VV \geq 94$	The visibility reported should be obstructed or restricted for the obscured sky cover reported.
21	$N_h = 0$ and $C_L \neq 0$	A low cloud was reported with no low sky cover.

Table B8.--Definitions of flags for present weather, visibility, cloud information, pressure, temperature, and winds (continued)

Code	Test	Explanation
22	$N_h = 0$ and $C_M \neq 0$	A middle cloud was reported with no low sky cover.
23	$1 \leq N_h \leq 8$ and $C_L = C_M = 0$	A low sky cover was reported with no low or middle cloud type.
24	$7 \leq N_h \leq 8$, and $C_L = C_M \neq 0$	The low sky cover is inconsistent with the number of cloud layers reported.
25	$N_h = 9$ and $C_L \neq 0$	A low cloud is reported with an obscured sky.
26	$N_h = 9$ and $C_L \neq 0$	A middle cloud is reported with an obscured sky.
27	$N_h = 9$ and $C_H \neq 0$	A high cloud is reported with an obscured sky.
28	$N_h = 9$ and $h \neq 0$	The reported cloud height is too high for an obscuring phenomena.
29	$N = 9$ and $VV \geq 94$	Visibility and low sky cover are inconsistent.
30	$N < N_h$	The low sky cover exceeds the total sky cover.
31	$C_L \neq 0$ and $C_M \neq 0$ and $N = N_h$	The total sky cover amount equal to the amount of low cloud is inconsistent wth two cloud layers reported.
32	$N > N_h$ and $C_L = C_H = 0$ $C_M \neq 0$	The total sky cover exceeding the low sky cover is inconsistent with the single cloud layer, C_M, reported.
33	$N > N_h$ and $C_M = C_H = 0$ $C_L \neq 0$	The total sky cover exceeding the low sky cover is inconsistent with the single cloud layer, C_L, reported.
34	$h = 9$ and $C_L \neq 0$	The height of the low cloud reported is too high.

Table B8.--Definitions of flags for present weather, visibility, cloud information, pressure, temperature, and winds (continued)

Code	Test	Explanation
35	$h \neq 9$, $C_L = 0$, and $C_M \neq 2, 7$	The height of the cloud base is inconsistent with the absence of low clouds, thick altostratus, or nimbostratus.
51	Present weather, temperature and dew point check ($T_{dry} - T_{DP} > 2^oC$)	The reported present weather is fog, which is inconsistent with the temperature-dew point difference.
52	Present weather, temperature and dew point check ($T_{dry} - T_{DP} > 4^oC$)	The reported present weather is ground fog,which is inconsistent with the temperature-dew point difference.
53	Present weather and relative humidity check (R.H. $\geq$ 80%)	The reported present weather, dry haze, is inconsistent with the relative humidity,which is greater than 80%.
54	dd = 0 and ff $\neq$ 0	The wind speed is not zero; therefore, the reported wind direction should be 360.
55	dd $\neq$ 0 and ff = 0	The wind speed is zero so that the wind direction should be reported as 0.
56	$/\Delta P/ \geq$ 3 mb	The pressure change since the last observation is excessive.
57	$/\Delta T_{dry}/ \geq 7^oC$	The dry-bulb temperature change since the last observation is excessive.
58	$T_{dry} < T_{wet}$	The wet-bulb temperature exceeds the dry-bulb temperature.
59	$/\Delta T_{wet}/ > 5^oC$	The wet-bulb temperature change since the last observation is excessive.
60	$/\Delta T_{DP}/ > 5^oC$	The dew-point temperature change since the last observation is excessive.

Table B8.--Definitions of flags for present weather, visibility, cloud information, pressure, temperature, and winds (continued)

Code	Test	Explanation
61	R.H. $< 65\%$	The relative humidity, based upon the dry-and wet-bulb temperatures is too low for the GATE area.
62	$T_{DP} - T_{sea} \geq 1^o$	The dew-point temperature exceeds the sea surface temperature by at least 1^oC.

Symbols

$N \equiv$ total sky cover

$N_h \equiv$ low sky cover

$VV \equiv$ visibility

$C_L \equiv$ low cloud type

$C_M \equiv$ middle cloud type

$C_H \equiv$ high cloud type

$h \equiv$ height of the low cloud

$T_{dry} \equiv$ dry-bulb temperature

$T_{wet} \equiv$ wet-bulb temperature

$T_{sea} \equiv$ sea-surface temperature

$T_{DP} \equiv$ dew-point temperature

R.H. $\equiv$ relative humidity

$dd \equiv$ wind direction

$ff \equiv$ wind speed

$P \equiv$ pressure

Table B9.--CSDC Phase archive tape files

File No.	Description
1	Test file
2	Tape header file
	Low resolution data
	A/B-scale ships
3	Acad. Korolov
4	Poryv
5	E. Krenkel
6	Prof. Zubov
7	Musson
8	Okean
9	Priboy
	B-scale ships
10	Meteor
11	Prof. Vize
12	Vanguard
13	Quandra
14	Oceanographer
15	Researcher
16	Bidassoa
17	Gilliss
	C-scale ships
18	Planet
19	Dallas
20	Fay
21	Hecla
	High resolution data
22	Researcher (Phase I)
23	" (Phase II)
24	" (Phase III)
25	Gilliss (Phase I)
26	" (Phase II)
27	" (Phase III)

Table B9.--CSDC Phase archive tape files (continued)

File No.	Description
	High resolution data (continued)
28	Dallas (Phase I)
29	" (Phase II)
30	" (Phase III
31	Oceanographer (Phase I)
32	" (Phase II)
33	" (Phase III)
34	Quadra (Phase I)
35	" (Phase II)
36	" (Phase III)
37	Meteor (Phase I)
38	" (Phase II)
39	" (Phase III)
40	Planet (Phase III)
41	End of tape

Table B10.--Start and stop times for the low resolution Phase data

Phase	Start		Stop	
	Date (1974)	Time (GMT)	Date (1974)	Time (GMT)
I	June 26	0000	July 16	2300
II	July 28	0000	Aug. 16	2300
III	Aug. 30	0000	Sept.19	2300

```
1GATE 020410CSDC KORARC 9999977032601 0000UNITED STATES     CEDDA,EDS,NOAA    001
131SHIPUHQS     KOROLOV                    999999999TKACHENKO V. J.       1113002
19999999999999999999999999999999999999999999999999999999999999999999999999999003
11974062600000000099999999999999979999999999999999999999999999999999999999999004
119740919230000000999999999999999799999999999999999999970ASTRON.  99999       005
199999999999999999999999999999999999999999999999                              006
1 0 49        0     60.0M                                                     007
1(I1,I4,I10,I5,24X,14(I1,A4,I6,I4,2F5.1,6(F5.1,I1),8I2,I1,                    008
110I2,6(F5.1,I1)))                                                            009
1                                                                             010
1     THIS DATA FILE CONTAINS SELECTED HOURLY SYNOPTIC WEATHER INFORMATION   011
1  FOR THE GATE PHASES I,II, AND III. THE FILE CONTAINS WMO OBSERVATIONS      012
1  SUPPLEMENTED BY AUTOMATIC DATA ACQUIRED BY SHIP BOW BOOM MOUNTED SENSORS.  013
1  THESE DATA HAVE BEEN VALIDATED. ALL PRESSURES, TEMPERATURES, WIND SPEEDS,  014
1  AND WIND DIRECTIONS ARE ACCOMPANIED BY A DATA QUALITY FLAG OF 0,7,8, OR    015
1  9. A FLAG OF 0 MEANS THE DATA VALUE IS VALID, A FLAG OF 7 MEANS THE DATA   016
1  VALUE IS QUESTIONABLE, A FLAG OF 8 MEANS THE DATA VALUE IS ERRONEOUS AND   017
1  A FLAG OF 9 MEANS THE DATA VALUE IS MISSING. PRESENT WEATHER, VISIBILITY,  018
1  CLOUD COVER AND TYPES HAVE BEEN EXAMINED FOR CONSISTENCY AND FLAGS HAVE    019
1  BEEN ASSIGNED TO EACH OBSERVATION. THE DEFINITIONS OF THESE FLAGS ARE      020
1  GIVEN IN THE ACCOMPANYING DOCUMENTATION. MISSING DATA ARE INDICATED BY     021
1  ALL POSITIVE NINES(9) EXCEPT MISSING WMO CODED DATA ARE NEGATIVE NINES(-9)022
1                                                                             023
1                                                                             024

29900PHASE PERIOD    910INTEGER         1.0     0.0     0.0999999999          001
2999999                     000                                               002
29900SHIP DESIGNATOR 920WMO CODE        1.0     0.0     0.0999999999          003
2999999                     000                                               004
20100DATE            014YYMMDD          1.0     0.0     0.0999999999          005
2999999                     000                                               006
20000TIME            021HHMM            1.0     0.0     0.0999999999          007
2999999                     000                                               008
21200LATITUDE        125DEGREES         1.0     0.0     0.0999999999          009
```

Figure B1.--Type 1 and Type 2 data file header records for low resolution data

```
29999999                      001                                                   010
21300LONGITUDE        125DEGREES         1.0        0.0        0.0999999999          011
29999999                      001                                                   012
24000ATM. PRESSURE   400MILLIBARS        1.0        0.0        0.099    11.0 HGT,METERS013
29999999            ANEROID    001MANUALLY RECORDED                                 014
29000QUALITY FLAG     921INTEGER         1.0        0.0        0.0999999999          015
29999999                      100ATM. PRESSURE                                      016
25010AIR TEMPERATURE500DEG.CELSIUS       1.0        0.0        0.099    11.5 HGT,METERS017
29999999            MERCURY    001MANUALLY RECORDED                                 018
290000QUALITY FLAG    921INTEGER         1.0        0.0        0.0999999999          019
29999999                      100AIR TEMPERATURE                                    020
25020WET BULB TEMP. 500DEG.CELSIUS       1.0        0.0        0.099    11.5 HGT,METERS021
29999999            MERCURY    001MANUALLY RECORDED                                 022
29000QUALITY FLAG     921INTEGER         1.0        0.0        0.0999999999          023
29999999                      100WET BULB TEMP.                                     024

25030SEA SURF.TEMP.500DEG.CELSIUS        1.0        0.0        0.099    -1.0 HGT,METERS025
29999999            MERCURY    001MANUALLY RECORDED                                 026
29000QUALITY FLAG     921INTEGER         1.0        0.0        0.0999999999          027
29999999                      100SEA SURF. TEMP.                                    028
22010WIND DIR.-MAST 200DEG. TRUE         1.0        0.0        0.099    26.0 HGT,METERS029
29999999            VANE       001MANUALLY RECORDED                                 030
29000QUALITY FLAG     921INTEGER         1.0        0.0        0.0999999999          031
29999999                      100WIND DIR.-MAST                                     032
22590WIND SPEED-MAST210METERS/SEC.       1.0        0.0        0.099    26.0 HGT,METERS033
29999999            CUPS       001MANUALLY RECORDED                                 034
29000QUALITY FLAG     921INTEGER         1.0        0.0        0.0999999999          035
29999999                      100WIND SPEED-MAST                                    036
27300PRESENT WEATHER920WMO CODE          1.0        0.0        0.0999999999          037
29999999                      100                                                   038
27400VISIBILITY       920WMO CODE        1.0        0.0        0.0999999999          039
29999999                      100                                                   040
27000SKY COVER AMT.  920WMO CODE         1.0        0.0        0.0999999999          041
29999999                      100                                                   042
27000LOW CLOUD AMT.  920WMO CODE         1.0        0.0        0.0999999999          043
29999999                      100                                                   044
```

Figure B1.--Type 1 and Type 2 data file header records for low resolution data (continued).

```
27100LOW CLOUD TYPE 920WMO CODE         1.0      0.0     0.0999999999          045
29999999                        100                                            046
27200LOW CLOUD HT.  920WMO CODE         1.0      0.0     0.0999999999          047
29999999                        100                                            048

27100MID. CLOUD TYPE920WMO CODE         1.0      0.0     0.0999999999          049
29999999                        100                                            050
27100HIGH CLOUD TYPE920WMO CODE         1.0      0.0     0.0999999999          051
29999999                        100                                            052
27310CONVECTIVE CODE921INTEGER          1.0      0.0     0.0999999999          053
29999999                        100                                            054
29000QUALITY CODE   921INTEGER          1.0      0.0     0.0999999999          055
29999999                        100                                            056
29000QUALITY CODE   921INTEGER          1.0      0.0     0.0999999999          057
29999999                        100                                            058
29000QUALITY CODE   921INTEGER          1.0      0.0     0.0999999999          059
29999999                        100                                            060
29000QUALITY CODE   921INTEGER          1.0      0.0     0.0999999999          061
29999999                        100                                            062
29000QUALITY CODE   921INTEGER          1.0      0.0     0.0999999999          063
29999999                        100                                            064
29000QUALITY CODE   921INTEGER          1.0      0.0     0.0999999999          065
29999999                        100                                            066
29000QUALITY CODE   921INTEGER          1.0      0.0     0.0999999999          067
29999999                        100                                            068
29000QUALITY CODE   921INTEGER          1.0      0.0     0.0999999999          069
29999999                        100                                            070
29000QUALITY CODE   921INTEGER          1.0      0.0     0.0999999999          071
29999999                        100                                            072

29000QUALITY CODE   921INTEGER          1.0      0.0     0.0999999999          073
29999999                        100                                            074
24000ATM. PRESSURE  400MILLIBARS        1.0      0.0     0.0999999999          075
29999999                        001NO AUTOMATIC DATA                           076
29000QUALITY FLAG   921INTEGER          1.0      0.0     0.0999999999          077
29999999                        100ATM. PRESSURE                               078
```

Figure B1.--Type 1 and Type 2 data filed header records for low resolution data (continued).

```
25010AIR TEMPERATURE500DEG.CELSIUS     1.0      0.0     0.0999999999          079
29999999                    001NO AUTOMATIC DATA                               080
290000QUALITY FLAG   921INTEGER        1.0      0.0     0.0999999999          081
29999999                    100AIR TEMPERATURE                                 082
25020WET BULB TEMP.  500DEG.CELSIUS    1.0      0.0     0.0999999999          083
29999999                    001NO AUTOMATIC DATA                               084
29000QUALITY FLAG    921INTEGER        1.0      0.0     0.0999999999          085
29999999                    100WET BULB TEMP.                                  086
25030SEA SURF. TEMP.500DEG.CELSIUS     1.0      0.0     0.0999999999          087
29999999                    001NO AUTOMATIC DATA                               088
29000QUALITY FLAG    921INTEGER        1.0      0.0     0.0999999999          089
29999999                    100SEA SURF. TEMP.                                 090
22010WIND DIR.-BOOM 200DEG. TRUE       1.0      0.0     0.0999999999          091
29999999                    001NO AUTOMATIC DATA                               092
29000QUALITY FLAG    921INTEGER        1.0      0.0     0.0999999999          093
29999999                    100WIND DIR.-BOOM                                  094
22590WIND SPEED-BOOM210METERS/SEC.     1.0      0.0     0.0999999999          095
29999999                    001NO AUTOMATIC DATA                               096

29000QUALITY FLAG    921INTEGER        1.0      0.0     0.0999999999          097
29999999                    100WIND SPEED-BOOM                                 098
```

Figure B1.--Type 1 and Type 2 data file header records for low resolution data (continued).

```
1GATE 020410CSDC RESPH1 9999977011001000UNITED STATES     CEDDA,EDS,NOAA    001
131SHIPWTER    RESEARCHER                  999999999DR. JAMES K. SPARKMAN   1113002
19999999999999999999999999999999999999999999999999999999999999999999999999999003
119740627201500000  70600 -2330007999999999999999999999999999999999999999999004
119740716235700000  70600 -23300079999999999999999901BUOY/SAT 99999         005
19999999999999999999999999999999999999999999999                              006
1 0 20      0      3.0M                                                      007
1(I1,I4,I10,I5,10X,30(I1,A4,I6,I4,8(F5.1,I1)))                                008
1                                                                            009
1                                                                            010
1       THIS DATA FILE CONTAINS TIME SERIES OF SELECTED METEOROLOGICAL        011
1    VARIABLES FOR PHASE I    . THE DATA WERE ACQUIRED BY SENSORS MOUNTED ON  012
1    A  SHIP BOW BOOM, SHIP MAST, OR METEOROLOGICAL BUOY. THESE DATA HAVE     013
1    BEEN VALIDATED. EACH DATA VALUE IS ACCOMPANIED BY A DATA QUALITY FLAG    014
1    OF 0, 7, 8, OR 9. A FLAG OF 0 MEANS THE DATA VALUE IS VALID. A FLAG      015
1    OF 7 MEANS THE DATA VALUE IS QUESTIONABLE, A FLAG OF 8 MEANS THE DATA    016
1    DATA VALUE IS ERRONEOUS, AND A FLAG OF 9 MEANS THE DATA VALUE IS         017
1    MISSING.                                                                018
1                                                                            019
1                                                                            020
1                                                                            021
1                                                                            022
1                                                                            023
1                                                                            024

29900PHASE PERIOD    910INTEGER          1.0      0.0     0.0999999999      001
29999999                         000                                         002
29900SHIP DESIGNATOR 920WMO CODE         1.0      0.0     0.0999999999      003
29999999                         000                                         004
20100DATE           014YYMMDD            1.0      0.0     0.0999999999      005
29999999                         000                                         006
20000TIME           021HHMM              1.0      0.0     0.0999999999      007
29999999                         000                                         008
24000ATM. PRESSURE  400MILLIBARS         1.0      0.0     0.099     7.2 HGT,METERS009
```

Figure B2.--Type 1 and Type 2 data filed header records for high resolution data.

```
29999999            KOLLSMAN  001AUTOMATICALLY RECORDED                              010
29000QUALITY FLAG    921INTEGER           1.0      0.0     0.0999999999              011
29999999                      100ATM. PRESSURE                                       012
25010AIR TEMPERATURE500DEG.CELSIUS        1.0      0.0     0.099     9.5 HGT,METERS013
29999999            THERMISTOR001AUTOMATICALLY RECORDED                              014
29000QUALITY FLAG    921INTEGER           1.0      0.0     0.0999999999              015
29999999                       100AIR TEMPERATURE                                    016
25020WET BULB TEMP. 500DEG.CELSIUS        1.0      0.0     0.099     9.5 HGT,METERS017
29999999            THERMISTOR001AUTOMATICALLY RECORDED                              018
29000QUALITY FLAG    921INTEGER           1.0      0.0     0.0999999999              019
29999999                       100WET BULB TEMP.                                     020
25030SEA SURF. TEMP.500DEG.CELSIUS        1.0      0.0     0.099    -0.1 HGT,METERS021
29999999            THERMISTOR001AUTOMATICALLY RECORDED                              022
29000QUALITY FLAG    921INTEGER           1.0      0.0     0.0999999999              023
29999999                      100SEA SURF. TEMP.                                     024

22010WIND DIR.-MAST 200DEG. TRUE          1.0      0.0     0.099    24.1 HGT,METERS025
29999999            VANE      001AUTOMATICALLY RECORDED                              026
29000QUALITY FLAG    921INTEGER           1.0      0.0     0.0999999999              027
29999999                      100WIND DIR-MAST                                       028
22590WIND SPEED-MAST210METERS/SEC.        1.0      0.0     0.099    24.1 HGT,METERS029
29999999            CUPS      001AUTOMATICALLY RECORDED                              030
20000QUALITY FLAG    921INTEGER           1.0      0.0     0.0999999999              031
29999999                      100WIND SPEED-MAST                                     032
22010WIND DIR.-BOOM 200DEG. TRUE          1.0      0.0     0.099    10.0 HGT,METERS033
29999999            VANE      001AUTOMATICALLY RECORDED                              034
29000QUALITY FLAG    921INTEGER           1.0      0.0     0.0999999999              035
29999999                      100WIND DIR.-BOOM                                      036
22590WIND SPEED-BOOM210METERS/SEC.        1.0      0.0     0.099    10.0 HGT,METERS037
29999999            CUPS      001AUTOMATICALLY RECORDED                              038
29000QUALITY FLAG    921INTEGER           1.0      0.0     0.0999999999              039
29999999                      100WIND SPEED-BOOM                                     040
```

Figure B2.--Type 1 and Type 2 data file header records for high resolution data (continued).

APPENDIX C

On-Station Dates, Times, and Locations for GATE A/B-, B-, and C-Scale Ships

The dates and times the individual GATE ships were on their respective stations are given in tables C1, C2, and C3. These data were derived from the standard WMO marine weather logs for Phases I, II, and III. The averages and standard deviations of the ship positions were also calculated for the same dates and times, and the results are shown in tables C4, C5, and C6. The ship positions were reported in the WMO marine observations to the nearest 0.1°. The averages and standard deviations in these tables are given to the nearest 0.01°.

A few of the ships were forced to leave station for medical evacuation of personnel, and to assist in planting drifting marker buoys. The dates on which these ships were on station, as well as latitude and longitude, are indicated by two entries, (A) and (B).

Comparison of the average positions in these tables with those given in some of the GATE Report series, e.g., Nos. 14 and 16, shows slight differences in some cases. Some of the ships moved around their stations more than others, or adjusted their positions. As a result, a few of the standard deviations exceed 0.3°. Where more precise positions are needed, it may be desirable to use the positions reported in the archived WMO data.

Table C1.--On-station dates and times for Phase I

Ship	Beginning			Ending		
	Julian day	Date (1974)	Time (GMT)	Julian day	Date (1974)	Time (GMT)
			A/B-scale ships			
Acad. Korolov	179	June 28	0000	197	July 16	2300
Poryv	179	June 28	0000	197	July 16	2300
E. Krenkel	179	June 28	0500	196	July 15	1700
Prof. Zubov	179	June 28	0000	197	July 16	2300
Musson	180	June 29	1100	197	July 16	0000
Okean	179	June 28	0000	197	July 16	2300
Priboy	179	June 28	0000	197	July 16	2300
			B-scale ships			
Oceanographer	179	June 28	0000	197	July 16	2300
Vanguard	180	June 29	1100	197	July 16	1900
Prof. Vize	179	June 28	0000	197	July 16	2300
Quadra	179	June 28	0000	197	July 16	2300
Meteor	178	June 27	2100	197	July 16	2300
Researcher	179	June 28	0000	197	July 16	2300
Dallas	179	June 28	0000	197	July 16	2300
Gilliss	179	June 28	0000	197	July 16	2300

Table C2.--On-station dates and times for Phase II

Ship	Beginning Julian day	Beginning Date (1974)	Beginning Time (GMT)	Ending Julian day	Ending Date (1974)	Ending Time (GMT)
		A/B-scale ships				
Acad. Korolov	209	July 28	0000	227	Aug. 15	1900
Poryv (A)	209	July 28	1100	217	Aug. 5	2100
" (B)	219	Aug. 7	2200	227	Aug. 15	2300
E. Krenkel	211	July 30	0500	227	Aug. 15	2300
Prof. Zubov	209	July 28	0700	227	Aug. 15	0700
Musson	210	July 29	0900	227	Aug. 15	0000
Okean	209	July 28	0000	227	Aug. 15	1400
Priboy	209	July 28	0000	227	Aug. 15	1800
		B-scale ships				
Oceanographer (A)	209	July 28	0000	211	July 30	1800
" (B)	215	Aug. 3	0100	228	Aug. 16	0000
Prof. Vize	213	Aug. 1	0800	227	Aug. 15	2300
Vanguard	210	July 29	1200	227	Aug. 15	1900
Quadra	209	July 28	0600	227	Aug. 15	2300
Meteor	209	July 28	0000	228	Aug. 16	0500
Researcher (A)	209	July 28	0000	219	Aug. 7	1700
" (B)	222	Aug. 10	1100	228	Aug. 16	0000
Dallas	209	July 28	0000	227	Aug. 15	1900
Gilliss	218	Aug. 6	2100	229	Aug. 17	2300

Table C3.--On-station dates and times for Phase III

Ship	Beginning Julian day	Beginning Date (1974)	Beginning Time (GMT)	Ending Julian day	Ending Date (1974)	Ending Time (GMT)
		A/B-scale ships				
Acad. Korolov	242	Aug. 30	2000	261	Sept. 18	2300
Poryv (A)	242	Aug. 30	0000	260	Sept. 17	0900
" (B)	260	Sept.17	2000	261	Sept. 18	2300
E. Krenkel (A)	242	Aug. 30	0000	243	Aug. 31	1700
" (B)	245	Sept. 2	1000	261	Sept. 18	2300
Prof. Zubov	242	Aug. 30	0000	261	Sept. 18	1900
Musson	242	Aug. 30	2100	261	Sept. 18	2000
Okean	242	Aug. 30	0000	262	Sept. 19	1700
Priboy	243	Aug. 31	0900	261	Sept. 18	0400
		B-scale ships				
Meteor	243	Aug. 31	0200	261	Sept. 18	0100
Prof. Vize (A)	242	Aug. 30	2100	258	Sept. 15	2200
" (B)	259	Sept.16	1000	261	Sept. 18	0700
Vanguard (A)	242	Aug. 30	0000	249	Sept. 6	1800
" (B)	251	Sept. 8	0000	261	Sept. 18	2300
Quadra	242	Aug. 30	0000	262	Sept. 19	1900
Oceanographer	242	Aug. 30	0000	262	Sept. 19	1100
Researcher	242	Aug. 30	0000	261	Sept. 18	2300
Bidassoa	242	Aug. 30	0300	262	Sept. 19	2300
Gilliss	242	Aug. 30	0000	262	Sept. 19	1700
		C-scale ships				
Planet	243	Aug. 31	0000	262	Sept. 19	2000
Dallas	242	Aug. 30	0200	261	Sept. 18	2300
Fay	243	Aug. 31	1200	262	Sept. 19	2300
Hecla (A)	242	Aug. 30	0000	259	Sept. 16	1200
" (B)	260	Sept.17	1200	262	Sept. 19	1000

Table C4.--The average and standard deviation of the latitude and longitude positions held by the GATE ships during Phase I

Ship	Position	Average		Standard dev.		Sample size
		Lat. N. (deg)	Long. W. (deg)	Lat. N. (deg)	Long. W. (deg)	
		A/B-scale ships				
Acad. Korolov	8	11.99	23.42	0.03	0.04	456
Poryv	9	10.43	19.97	0.07	0.05	456
E. Krenkel	10	6.46	19.93	0.12	0.17	422
Prof. Zubov	11	5.00	22.94	0.00	0.46	456
Musson	11C	4.97	22.66	0.10	0.18	399
Okean	12	6.43	26.90	0.04	0.06	456
Priboy	13	10.32	26.94	0.04	0.05	454
		B-scale ships				
Oceanographer	1	8.50	23.49	0.02	0.04	456
Vanguard	1A	8.49	23.50	0.07	0.12	418
Prof. Vize	2	10.10	23.50	0.01	0.01	456
Quadra	3A	9.26	22.11	0.05	0.04	456
Meteor	4	7.80	22.12	0.02	0.04	459
Researcher	5	7.10	23.50	0.00	0.18	456
Dallas	6	7.73	24.80	0.04	0.00	454
Gilliss	7	9.27	24.78	0.04	0.07	456

Table C5.--The average and standard deviation of the latitude and longitude positions held by the GATE ships during Phase II

Ship	Position	Average Lat. N. (deg)	Average Long. W. (deg)	Standard dev. Lat. N. (deg)	Standard dev. Long. W. (deg)	Sample size
		A/B-scale ships				
Acad. Korolov	8	11.84	23.50	0.08	0.04	452
Poryv (A)	9	10.46	20.03	0.06	0.06	204
" (B)	9	10.45	20.02	0.05	0.05	194
E. Krenkel	10	6.36	19.86	0.06	0.08	403
Prof. Zubov	11	5.05	23.40	0.07	0.01	434
Musson	11C	4.93	23.32	0.42	0.12	208
Okean	12	6.40	26.72	0.02	0.05	447
Priboy	13	10.48	27.02	0.06	0.06	451
		B-scale ships				
Oceanographer (A)	1	8.50	23.50	0.00	0.01	68
" (B)	1	8.50	23.48	0.07	0.16	313
Prof. Vize	1A	8.49	23.50	0.05	0.11	352
Vanguard	2	9.98	23.50	0.09	0.06	416
Quadra	3A	9.26	22.11	0.05	0.04	451
Meteor	4	7.80	22.20	0.01	0.02	463
Researcher (A)	5	7.10	23.50	0.01	0.01	259
" (B)	5	7.10	23.50	0.00	0.01	135
Dallas	6	7.78	24.79	0.05	0.04	452
Gilliss	7	9.30	24.80	0.00	0.00	267

Table C6.--The average and standard deviation of the latitude and longitude positions held by the GATE ships during Phase III

Ship	Position	Average		Standard dev.		Sample size
		Lat. N. (deg)	Long. W. (deg)	Lat. N. (deg)	Long. W. (deg)	
		A/B-scale ships				
Acad. Korolov	8	11.98	23.44	0.08	0.11	460
Poryv (A)	9	10.49	19.92	0.05	0.06	443
" (B)	9	10.50	19.94	0.02	0.05	28
E. Krenkel (A)	10	6.37	19.80	0.14	0.08	43
" (B)	10	6.38	19.77	0.14	0.06	398
Prof. Zubov	11	4.89	23.40	0.13	0.02	477
Musson	11C	4.79	23.41	0.12	0.08	153
Okean	12	6.43	26.88	0.05	0.06	471
Priboy	13	10.50	27.00	0.01	0.01	428
		B-scale ships				
Meteor	1	8.48	23.45	0.24	0.08	414
Prof. Vize (A)	1A	8.43	23.46	0.07	0.09	387
" (B)	1A	8.49	23.42	0.16	0.12	47
Vanguard (A)	2	10.07	23.38	0.23	0.29	186
" (B)	2	10.01	23.47	0.07	0.10	263
Quadra	3C	8.98	22.54	0.06	0.08	481
Oceanographer	4	7.76	22.20	0.05	0.02	493
Researcher	5	7.10	23.50	0.02	0.01	481
Bidassoa	6	7.70	24.70	0.03	0.05	500
Gilliss	7	9.25	24.80	0.05	0.02	493
		C-scale ships				
Planet	27	9.14	22.98	0.40	0.04	477
Dallas	28	8.52	22.53	0.04	0.04	478
Fay		Not available				
Hecla (A)	29	8.80	23.10	0.01	0.03	422
" (B)	29	8.77	23.03	0.06	0.11	48

(Continued from inside front cover)

EDS 16 NGSDC 1 - Data Description and Quality Assessment of Ionospheric Electron Density Profiles for ARPA Modeling Project. Raymond O. Conkright, March, 1977. (PB269620)

EDS 17 GATE Convection Subprogram Data Center: Analysis of Ship Surface Meteorological Data Obtained During GATE Intercomparison Periods. Fredric A. Godshall, Ward R. Seguin, and Paul Sabol, October 1976. (PB263000)

EDS 18 GATE Convection Subprogram Data Center: Shipboard Precipitation Data. Ward R. Seguin and Paul Sabol, November 1976. (PB263820)

EDS 19 Separation of Mixed Data Sets into Homogenous Sets. Harold Crutcher and Raymond L. Joiner, January 1977. (PB264813)

EDS 20 GATE Convection Subprogram Data Center--Analysis of Rawinsonde Intercomparison Data. Robert Reeves, Scott Williams, Eugene Rasmusson, Donald Acheson, Thomas Carpenter, and James Rasmussen, November 1976. (PB264815)

EDS 21 GATE Convection Subprogram Data Center: Comparison of Ship-Surface, Rawinsonde and Tethered Sonde Wind Measurements. Chester F. Ropelewski and Robert W. Reeves, April 1977. (PB268848)

EDS 22 U.S. National Processing Center for GATE: B-Scale Surface Meteorological and Radiation System, Including Instrumentation, Processing, and Archived Data. Ward R. Seguin, Paul Sabol, Raymond Crayton, Richard S. Cram, Kenneth L. Ecatemacht, and Monte Poindexter, April 1977. (PB 268816)

EDS 23 U.S. National Processing Center for GATE: B-Scale Ship Precipitation Data. Ward R. Seguin and Raymond B. Crayton, April 1977. (PB270222)

EDS 24 A Note on a Gamma Distribution Computer Program and Computer Produced Graphs. Harold L. Crutcher, Grady F. McKay, and Danny C. Fulbright, May 1977. (PB269697)

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