U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE
NATIONAL METEOROLOGICAL CENTER

OFFICE NOTE 197

Objective Verifications of the NMC Data Assimilation Cycle

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MARCH 1979

This is an unreviewed manuscript, primarily intended for informal exchange of information among NMC staff members.

I. Introduction

The National Meteorological Center (NMC) data assimilation cycle is a global analysis--6-hour forecast cycle performed upon the data avialable 10 hours after the standard synoptic observation times and 4 hours after the 0600 GMT and 1800 GMT observation times. During 1977, a project was initiated to monitor the behavior of the data assimilation cycle analyses and forecasts. The motivation for the project was, in part, to provide one method with which to evaluate the anticipated change from the Hough Function to the Optimum Interpolation analysis method (this change occurred in the data assimilation cycle at 1200 GMT on September 21, 1978). As a part of the project, an objective verification system developed by personnel of the Systems Evaluation Branch of the Development Division of NMC was applied to the data assimilation cycle. This note is intended to document both the methodology and results of that verification system since its inception in September, 1977.

The details of the computations are given in the next section. The statistics themselves then follow without interpretation. Several interesting features of the statistics may, however, be the subject of future documentation.

II. Methodology of the Computations

The verification system is built upon the concept of comparing the standard pressure-level value of a certain parameter (either analyzed or forecast) with its observational counterpart obtained from radiosonde data. The radiosonde reports are combined into groups of stations (the groups chosen for this project will be described shortly). The

statistics at a particular observation time are averaged over all the stations in a group and all the 0000 GMT and 1200 GMT observation times in a month (for which data is available). No verifications are done at 0600 GMT or 1800 GMT because there are too few radiosonde reports at those times. The station statistics averaged in both space and time are the basic output of the verification package.

There are three statistics computed: the mean error (Me), the root-mean-square error (RMSe), and the Teweles/Wobus gradient error (S1) (Teweles, S. and Wobus, H.B., 1954). The S1 score is computed with respect to neighboring observation stations, rather than with respect to particular grid points. For a parameter f and a specific group of stations, the formulas for these statistics are the following:

$$M_e(f) = \frac{1}{T+S} \sum_{t=1}^{T} \sum_{i=1}^{S} [(f_g)_i - (f_o)_i]_t \qquad (1)$$

$$RMS_e(f) = \left\{\frac{1}{T+S} \sum_{t=1} \sum_{i=1} [(f_g)_i - (f_o)_i]_t^2\right\}^{\frac{1}{2}} \qquad (2)$$

$$S1(f) = \frac{1}{T} \sum_{t=1}^{T} 100 \sum_{i=1}^{SP} \left\{ \frac{[f_g(SP_1)_i - f_g(SP_2)_i] - [f_o(SP_1)_i - f_o(SP_2)_i]}{\max\{[f_g(SP_1)_i - f_g(SP_2)_i], [f_o(SP_1)_i - f_o(SP_2)_i]\}} \right\}_t \qquad (3)$$

Here, f_g is either the analyzed or forecast value of the parameter f interpolated bilinearly to the location of station i, f_o is the observed value of f at that station, S is the total number of stations in the group, and T is the number of time period in the month (0000 GMT and 1200 GMT) for which data were available for the parameter f. In

the formula for the S1 score, $(SP_1)_i$ and $(SP_2)_i$ are the ith pair of stations, and SP is the total number of pairs of stations in the group. To form an acceptable pair, the two stations must be nearest neighbors conforming to the following rules:

a. Be a unique pair

b. Not be closer together than 100 km

c. Not be farther apart than 2,360 km

Five parameters are verified:

1. Height of an isobaric surface (h, in meters).
2. Temperature at an isobaric surface (T, in ^{o}K).
3. Relative Humidity at an isobaric surface (RH, in percent).
4. Wind speed at an isobaric surface (S, in ms^{-1}).
5. Wind vector at an isobaric surface ($\vec{V}$, in ms^{-1}).

The error formulas for the last two quantities are

$$S_e = (u_g^2 + v_g^2)^{\frac{1}{2}} - (u_o^2 + v_o^2)^{\frac{1}{2}} \tag{4}$$

$$\vec{V}_e = [(u_g - u_o)^2 + (v_g - v_o)^2]^{\frac{1}{2}} \tag{5}$$

where u_g and v_g are the horizontal wind components of either the analyzed or forecast wind, and u_o and v_o are the observed horizontal wind components. The relation for S_e given by (4) is substituted for the quantity $(f_g)_i - (f_o)_i$ in (1) and (2) (no S1 score is calculated for S_e). Likewise, the formula for $\vec{V}_e$ given by (5) is substituted into (1) (no RMS_e or S1 score is calculated for $\vec{V}_e$). In this project, the pressure levels chosen for verification were 850, 500, 250, and 100 mb.

Originally, three groups of stations were selected for verification. These were a 102 station Northern Hemisphere network (NH102), a 110 station North American network (NA110), and a 31 station Southern Hemisphere network (SH31). Beginning with February, 1978, two additional groups of stations were added; isolated station networks in the Northern (6 stations - NHISOL06) and Southern (7 station - SHISOL07) Hemispheres. The criteria for including a station in either of these two groups were that it be at least 1000 Km from any other radiosonde station, and that it report at least three levels of information a minimum of half the time at both 0000 GMT and 1200 GMT. The stations in the five groups are listed in tables 1-5.

Before any statistics are calculated, the observations are examined for erroneous values, The first step in the procedure is to calculate the RMS deviation (station value - analysis value) separately for every variable and pressure level to be verified. The expression for this step is

$$X_T = \left\{\frac{1}{S'} \sum_{i=1}^{S'} [(f_g)_i - (f_o)_i]^2\right\}^{\frac{1}{2}} \qquad (6)$$

where f_g is the analyzed value, f_o is the observed value, and S' is the total number of stations in the automatic data processing (ADP) file. The "toss-out" criterion (TOSS) for a certain variable and pressure level is then

(7) $\quad TOSS = X_T \cdot X_S,$

where

$$X_S = \begin{cases} 3.9 & \text{for heights} \\ 3.75 & \text{for temperatures} \\ 3.0 & \text{for relative humidities} \\ 3.5 & \text{for wind speed} \end{cases}$$

Note that the toss-out criteria for winds is based only on wind speed. Also, note that X_S does not vary in the vertical, even though X_T does. Finally, the absolute value of the deviation (D) from the analysis of each station intended to be used in the verification is compared to the value of TOSS for that variable and level. Whenever D>TOSS, that observation is considered to be erroneous and is not included in the verification.

III. The Statistics

The above statistics calculated since September 1977 for networks NH102, NA110, and SH31, and since February 1977 for groups NHISOL06 and SHISOL07 are presented in tables 6-23. The statistics on the left side of each table are verifications of the analyses valid 0000 GMT and 1200 GMT, while those on the right side are verifications of the first guesses for those analyses -- 6-hour 9L global model forecasts valid at either 0000 GMT or 1200 GMT. When examining these statistics, it should be remembered that the analysis system was changed from the global spectral (Hough function) method to the optimum interpolation approach at 1200 GMT on September 21, 1978. Although an occasional Hough function analysis was run after that date, it was not included in the verifications. For this reason, the statistics for September 1978 are broken into two time periods -- 1-20 and 23-30. The statistics for the first half of July 1978 were not included in that month's scores due to an error.

One other fact must be mentioned. Due to an unfortunate coding oversight noticed only recently, the NHISOL06 group of stations includes any Northern Hemisphere radiosonde report from a moving ship. Some of these reports may not fit the criteria for this group, thus compromising the controlled nature of the original station selection. The number of uncontrolled reports typically amounts to three-fourths of the total number from the six stations listed in Table 3.

IV. Summary

Objective verifications of the NMC data assimilation cycle analyses and forecasts have been done since September 1977. The methodology of the computations and the results of the program are documented in this note.

Acknowledgments

We wish to express our gratitude to John D. Stackpole and John Horodeck for helping us to modify their verification programs for our use in this project.

Reference

Teweles, S., and Wobus, H. B., 1954: "Verification of Prognostic Charts." Bulletin of the American Meteorological Society, Vol. 35, No. 10, pp. 455-463.

Table 1 - Group NH102

Block-Station Number	Location	Name
01001	70.93°N, 8.67°W	Jan Mayen, Norway
01028	74.52°N, 19.02°E	Bjornoya, Norway
01384	60.20°N, 11.10°E	Oslo/Gardermoen, Norway
02935	62.40°N, 25.67°E	Luometjarvi, Finland
03005	60.13°N, 1.18°W	Lerwick, United Kingdom
03322	53.55°N, 2.92°W	Aughton, United Kingdom
03953	51.93°N, 10.25°W	Valentia, Ireland
04018	63.97°N, 22.60°W	Keflavik, Iceland
04202	76.52°N, 68.83°W	Thule AFB, Greenland
08509	38.73°N, 27.08°W	Lajes, Terceira Is.,Azores
08521	32.68°N, 16.77°W	Funchal, Madeira
08536	38.77°N, 9.13°W	Lisboa, Portugal
10338	52.47°N, 9.70°E	Hannover, Germany
12982	46.25°N, 20.10°E	Szeged, Hungary
16242	41.80°N, 12.23°E	Roma/Fiumicino, Italy
20046	80.62°N, 58.05°E	Ostrov Khesia, USSR
20292	77.72°N, 104.28°E	Mys Cheliuskin, USSR
20744	72.38°N, 52.73°E	Malye Karmakuly, USSR
21824	71.58°N, 128.92°E	Bukhta Tiksi, USSR
21965	70.63°N, 162.40°E	Ostrov Chetyrekhstolbovoy(US:
21982	70.97°N, 178.53°W	Ostrov Vrangelya, USSR
23472	65.78°N, 87.95°E	Turukhansk, USSR
25677	63.05°N, 179.32°E	Ugolnaja, USSR
25954	60.35°N, 166.00°E	Korf, USSR
26702	54.70°N, 20.62°E	Kalingrad, USSR
27037	59.28°N, 39.87°E	Vologda, USSR
28661	55.47°N, 65.40°E	Kurgan, USSR
29612	55.37°N, 78.40°E	Barabinsk, USSR
29865	53.72°N, 91.40°E	Abakan, USSR
30230	57.77°N, 108.12°E	Kirensk, USSR
31088	59.37°N, 143.20°E	Okhotsk, USSR
31329	53.07°N, 132.93°E	Ekimchan, USSR
31960	43.12°N, 131.90°E	Vladivostok, USSR
32540	52.97°N, 158.75°E	Petropavlovsk, USSR
33837	46.48°N, 30.63°E	Odessa, USSR
34009	51.65°N, 36.18°E	Kursk, USSR
35108	51.25°N, 51.40°E	Uralsk, USSR
36177	50.35°N, 80.25°E	Semipalatinsk, USSR
38062	44.77°N, 65.53°E	Kyzyl-Orda, USSR
38750	37.47°N, 53.97°E	Gazan-Kuli, USSR
42647	23.07°N, 72.63°E	Ahmedabad, India
42809	22.65°N, 88.45°E	Calcutta/Dum Dum,, India
44292	47.93°N, 106.98°E	Ulan Bator, Mongolia
45004	22.32°N, 114.17°E	King's Park, Hong Kong

Table 1 (continued)

47412	43.05°N, 141.33°E	Sapporo, Japan
47646	36.05°N, 140.13°E	Tateno, Japan
47827	31.63°N, 130.58°E	Kagoshima, Japan
47971	27.08°N, 142.18°E	Chichi Jima, Japan
47991	24.30°N, 153.97°E	Marcus Island
50527	49.22°N, 119.75°E	Hailar, China
51709	39.47°N, 75.98°E	Su Lo, China
52418	40.13°N, 94.78°E	Tunh Wang, China
54511	39.80°N, 116.47°E	Peking, China
57127	33.07°N, 107.03°E	Hanchung, China
57679	28.20°N, 112.97°E	Chang Sha, China
58367	31.17°N, 121.43°E	Shanghai, China
59758	20.03°N, 110.35°E	Haikow, China
60680	22.78°N, 5.52°E	Tamanrasset, Algeria
60715	36.83°N, 10.23°E	Tunis/El Aouina, Tunisia
70086	70.13°N, 143.63°W	Barter Island, Alaska
70133	66.87°N, 162.63°W	Kotzebue, Alaska
70326	58.68°N, 156.65°W	King Salmon, Alaska
70361	59.52°N, 139.67°W	Yakutat, Alaska
70414	52.72°N, 174.10°E	Shemya, Alaska
71072	76.23°N, 119.33°W	Mould Bay, Northwest Terr.
71600	43.93°N, 60.02°W	Sable Island, Nova Scotia
71815	48.55°N, 58.55°W	Stephenville, Newfoundland
71836	51.27°N, 80.65°W	Moosonee, Ontario
71909	63.75°N, 68.55°W	Frobisher, Northwest Terr.
71913	58.75°N, 94.07°W	Churchill, Manitoba
71925	69.10°N, 105.12°W	Cambridge Bay, Northwest Te:
72203	26.68°N, 80.10°W	West Palm Beach, Florida
72208	32.90°N, 80.03°W	Charleston, South Carolina
72232	29.33°N, 89.40°W	Boothville, Louisiana
72250	25.90°N, 97.43°W	Brownsville, Texas
72290	32.82°N, 117.13°W	San Diego/Montgomery, Cal.
72304	35.27°N, 75.55°W	Hatteras, North Carolina
72340	34.83°N, 92.25°W	Little Rock, Arkansas
72363	35.23°N, 101.70°W	Amarillo, Texas
72403	38.98°N, 77.47°W	Washington/Dulles, D.C.
72469	39.75°N, 104.87°W	Denver/Stapleton, Colorado
72493	37.75°N, 122.22°W	Oakland, California
72532	40.67°N, 89.68°W	Peoria, Illinois
72606	43.65°N, 70.32°W	Portland, Maine
72747	48.57°N, 93.38°W	International Falls, Minnes
72775	47.48°N, 111.37°W	Great Falls, Montana
72795	47.95°N, 124.55°W	Quillayute, Washington Nort
76151	28.88°N, 118.30°W	Isla Guadalupe, Baja Calif.
76458	23.20°N, 106.42°W	Mazatlán, Sinaloa
76644	20.95°N, 89.67°W	Mérida, Yucatan
78016	32.37°N, 64.68°W	Kindley Field, Bermuda
78954	13.07°N, 59.50°W	Bridgetown/Seawell, Barbado:
91066	28.22°N, 177.37°W	Midway Island

Table 1 (continued)

91165	21.98°N, 159.35°W	Lihue, Kauai, Hawaii
91245	19.28°N, 166.65°E	Wake Island
99195	52.75°N, 35.50°W	Ocean Station Charlie
99200	38.00°N, 71.00°W	Ocean Station Hotel
99211	57.00°N, 20.00°W	Ocean Station Lima
99212	66.00°N, 2.00°E	Ocean Station Mike
99215	50.00°N, 145.00°W	Ocean Station Papa
99217	47.00°N, 17.00°W	Ocean Station Romeo
99227	29.00°N, 135.00°W	Ocean Station Tango

Table 2 - Group NAll0

Block-Station Number	Location		Name
70361	59.52°N,	139.67°W	Yakutat, Alaska
70398	55.03°N,	131.57°W	Annette Island, Alaska
71109	50.68°N,	127.37°W	Port Hardy, British Columbi
71115	50.23°N,	119.28°W	Vernon, British Columbia
71119	53.55°N,	114.10°W	Edmonton, Alberta
71399	43.72°N,	65.25°W	Shelburne, Nova Scotia
71600	43.93°N,	60.02°W	Sable Island, Nova Scotia
71701	45.83°N,	66.43°W	Camp Gagetown, New Brunswic
71722	46.37°N,	75.98°W	Maniwaki, Quebec
71801	47.62°N,	52.75°W	St. Johns, Newfoundland
71811	50.22°N,	66.27°W	Sept-Iles, Quebec
71815	48.55°N,	58.55°W	Stephenville, Newfoundland
71816	53.32°N,	60.42°W	Goose Bay, Newfoundland
71826	53.20°N,	70.90°W	Nitchequan, Quebec
71836	51.27°N,	80.65°W	Moosonee, Ontario
71848	53.83°N,	89.87°W	Trout Lake, Ontario
71853	49.82°N,	99.65°W	Camp Shilo, Manitoba
71867	53.97°N,	101.10°W	The Pas, Manitoba
71896	53.88°N,	122.68°W	Prince George,British Columb
71906	58.10°N,	68.42°W	Fort Chimo, Quebec
71907	58.45°N,	78.12°W	Inoucdjouac, Quebec
71913	58.75°N,	94.07°W	Churchill, Manitoba
71934	60.02°N,	111.97°W	Fort Smith, Northwest Terr.
71945	58.83°N,	122.58°W	Fort Nelson, British Columb
72201	24.58°N,	81.70°W	Key West, Florida
72203	26.68°N,	80.10°W	West Palm Beach, Florida
72208	32.90°N,	80.03°W	Charleston, South Carolina
72210	27.70°N,	82.38°W	Tampa, Florida
72213	31.25°N,	82.40°W	Waycross, Georgia
72220	29.73°N,	84.98°W	Apalachicola, Florida
72225	32.33°N,	84.83°W	Fort Benning, Georgia
72229	32.90°N,	87.25°W	Centreville, Alabama
72232	29.33°N,	89.40°W	Boothville, Louisiana
72235	32.32°N,	90.08°W	Jackson, Mississippi
72240	30.12°N,	93.22°W	Lake Charles, Louisiana
72247	32.35°N,	94.65°W	Longview, Texas
72250	25.90°N,	97.43°W	Brownsville, Texas
72255	28.85°N,	96.92°W	Victoria, Texas
72257	31.10°N,	97.33°W	Fort Hood, Texas
72260	32.22°N,	98.18°W	Stephenville, Texas
72261	29.37°N,	100.92°W	Del Rio, Texas
72265	31.95°N,	102.18°W	Midland, Texas

Table 2 - Group NAll0 (Continued)

Block-Station Number	Location	Name
72270	31.80°N,106.40°W	El Paso, Texas
72274	32.12°N,110.93°W	Tucson, Arizona
72290	32.82°N,117.13°W	San Diego/Montgomery, California
72291	33.25°N,119.45°W	San Nicolas Island, California
72304	35.27°N, 75.55°W	Hatteras, North Carolina
72311	33.95°N, 83.32°W	Athens, Georgia
72317	36.08°N, 79.95°W	Greensboro, North Carolina
72327	36.25°N, 86.57°W	Nashville/Berry, Tennessee
72340	34.83°N, 92.25°W	Little Rock, Arkansas
72349	36.88°N, 93.90°W	Monett, Missouri
72353	35.40°N, 97.60°W	Oklahoma City/W. Rogers, Oklahom
72355	34.60°N, 98.40°W	Fort Sill, Oklahoma
72363	35.23°N,101.70°W	Amarillo, Texas
72365	35.05°N,106.62°W	Albuquerque, New Mexico
72374	35.02°N,110.73°W	Winslow, Arizona
72381	34.92°N,117.90°W	Edwards Air Force Base, Californ
72385	36.95°N,116.05°W	Yucca Flats, Nevada
72391	34.12°N,119.12°W	Point Mugu Naval Air Station, Ca
72393	34.75°N,120.57°W	Vandenberg Air Force Base, Ca.
72402	37.85°N, 75.48°W	Wallops Island, Virginia
72403	38.98°N, 77.47°W	Washington/Dulles, D.C.
72425	38.37°N, 82.55°W	Huntington, West Virginia
72429	39.87°N, 84.12°W	Dayton, Ohio
72433	38.65°N, 88.97°W	Salem, Illinois
72451	37.77°N, 99.97°W	Dodge City, Kansas
72456	39.07°N, 95.63°W	Topeka, Kansas
72468	38.70°N,104.77°W	Fort Carlson, Colorado
72469	39.75°N,104.87°W	Denver/Stapleton, Colorado
72476	39.12°N,108.53°W	Grand Junction, Colorado
72486	39.28°N,114.85°W	Ely, Nevada
72493	37.75°N,122.22°W	Oakland, California
72518	42.75°N, 73.80°W	Albany, New York
72520	40.53°N, 80.23°W	Pittsburg, Pennsylvania
72528	42.93°N, 78.73°W	Buffalo, New York
72532	40.67°N, 89.68°W	Peoria, Illinois
72553	41.37°N, 96.02°W	Omaha, Nebraska
72562	41.13°N,100.68°W	North Platte, Nebraska
72572	40.77°N,111.97°W	Salt Lake City, Utah
72576	42.82°N,108.73°W	Lander, Wyoming

Table 2 - Group NA110 (continued)

Block-Station Number	Location	Name
72583	40.90°N, 117.80°W	Wimmemucca, Nevada
72597	42.37°N, 122.87°W	Medford, Oregon
72606	43.65°N, 70.32°W	Portland, Oregon
72637	42.97°N, 83.73°W	Flint, Michigan
72645	44.48°N, 88.13°W	Green Bay, Wisconsin
72654	44.38°N, 98.22°W	Huron, South Dakota
72655	45.55°N, 94.07°W	St. Cloud, Minnesota
72662	44.05°N, 103.07°W	Rapid City, South Dakota
72681	43.57°N, 116.22°W	Boise, Idaho
72694	44.92°N, 123.02°W	Salem, Oregon
72712	46.87°N, 68.02°W	Caribou, Maine
72734	46.47°N, 84.37°W	Sault St. Marie, Michigan
72747	48.57°N, 93.38°W	International Falls, Minnesot
72764	46.77°N, 100.75°W	Bismarck, North Dakota
72768	48.22°N, 106.62°W	Glasgow, Montana
72775	47.48°N, 111.37°W	Great Falls, Montana
72785	47.63°N, 117.53°W	Spokane, Washington
72797	47.95°N, 124.55°W	Quillayute, Washington
74207	47.08°N, 122.58°W	Fort Lewis/Gray, Washington
74486	40.78°N, 73.77°W	New York/Kennedy, New York
74494	41.67°N, 69.97°W	Chatham, Massachusetts
74794	28.47°N, 80.55°W	Cape Kennedy, Florida
76151	28.88°N, 118.30°W	Isla Guadalupe, Baja Ca. Nort
76225	28.70°N, 106.07°W	Chihuahua, Chihuahua
76255	27.92°N, 110.88°W	Guaymas, Sonora
76394	25.87°N, 100.20°W	Monterrey Aeropuerto, Nueva I
78016	32.37°N, 64.68°N	Kindley Field, Bermuda
99200	38.00°N, 71.00°W	Ocean Station Hotel
99215	50.00°N, 145.00°W	Ocean Station Papa

Table 3 - Group NHISOL06

Block-Station Number	Location	Name
47991	24.30°N, 153.97°E	Marcus Island
78016	32.37°N, 64.68°W	Kindley Field, Bermuda
91066	28.22°N, 177.37°W	Midway Island
91245	19.28°N, 166.65°W	Wake Island
91275	16.73°N, 169.52°W	Johnson Island
99215	50.00°N, 145.00°W	Ocean Station Papa

Table 4 - Group SH31

Block-Station Number	Location	Name
63723	0.47°S, 39.63°E	Garissa, Kenya
63741	1.30°S, 36.75°E	Nairobi/Dagoretti, Kenya
68112	22.48°S, 17.47°E	Strijdom Airport, Namibia
68263	25.92°S, 28.22°E	Pretoria/Irene, South Africa
68406	28.57°S, 16.53°E	Kort Dorn, South Africa
68424	28.40°S, 21.27°E	Upington, South Africa
68442	29.10°S, 26.30°E	Bloemfontein/Hertzog, South Afri
68588	29.97°S, 30.95°E	Durban/Louis Botha, South Africa
68816	33.97°S, 18.60°E	Capetown/Malan, South Africa
68842	33.59°S, 25.36°E	Port Elizabeth, South Africa
68906	40.35°S, 9.88°W	Gough Island
68994	46.88°S, 37.87°W	Marion Island
83378	15.87°S, 47.93°W	Brasilia Aeroporto, Brazil
83612	20.47°S, 54.67°W	Campo Grande, Brazil
83746	22.82°S, 43.25°W	Rio de Janeiro/Galeao, Brazil
83780	23.62°S, 46.65°W	Sao Paulo, Brazil
83840	25.52°S, 49.17°W	Curitiba, Brazil
83971	30.00°S, 51.18°W	Porto Alegre, Brazil
85543	32.78°S, 71.53°W	Quintero, Chile
89571	68.58°S, 77.98°W	Davis Base, Antarctica
89611	66.25°S,110.53°W	Casey, Antarctica
91765	14.33°S,170.72°W	Pago Pago/Tafuna, American Samoa
93119	37.02°S,174.80°E	Auckland Airport, New Zealand
93844	46.40°S,168.33°E	Invercargill,New Zealand
93997	29.25°S,177.92°W	Raoul/Kermadec Island
94610	31.92°S,115.97°W	Perth, Australia
94672	34.95°S,138.53°W	Adelaide Airport, Australia
94776	32.82°S,151.83°E	Williamtown, Australia
94865	38.78°S,144.75°E	Laverton, Australia
94975	42.83°S,147.50°E	Hobart Airport, Australia
94986	67.60°S, 62.88°E	Mawson Base, Antarctica

Table 5 - Group SHISOL07

Block-Station Number	Location	Name
61996	37.80°S, 77.53°E	Ile Nouvelle Amsterdam
61998	49.33°S, 70.22°E	Port Aux Francais
68906	40.35°S, 9.88°W	Gough Island
68994	46.88°S, 37.87°W	Marion Island
89009	90.00°S, 0.00°W	Amundsen Scott, Antarctica
89664	77.85°S, 166.67°W	McMurdo, Antarctica
93997	29.25°S, 177.92°W	Raoul/Kermadec Island

NOAA FORM 59-4
(3-72)

Table 8

Analysis Error

850 mb RMS He(m)

Month		NH102	NA110	NH ISO06	SH31	SH ISO07
Oct., 1977		11.8	10.1		17.1	
Nov., 1977		12.1	9.8		17.0	
Dec., 1977		11.1	10.1		14.1	
Jan., 1978		11.7	10.6		11.9	
Feb., 1978		12.4	10.6		13.5	
Mar., 1978		12.2	9.9	15.4	11.8	13.0
Apr., 1978		11.4	9.7	13.9	10.7	13.2
May, 1978		11.0	10.8	13.3	13.1	16.5
June, 1978		11.2	10.5	11.4	12.6	17.6
July, 1978	(15-31)	11.0	10.3	10.7	12.3	15.7
Aug., 1978		11.0	10.1	11.5	13.0	13.4
Sept., 1978	(1-20)	10.5	9.5	12.2	14.9	19.8
Sept., 1978	(23-30)	10.5	9.5	10.7	12.9	12.7
Oct., 1978		14.2	11.7	24.8	15.1	24.3
Nov., 1978		13.4	11.9	15.4	17.1	20.9
Dec., 1978		14.8	12.9	18.7	16.2	21.6
		13.9	12.7	15.9	15.2	20.5

850mb Mean He(m)

Sept., 1977		1.3	2.3		2.1	
Oct., 1977		1.2	1.9		1.8	
Nov., 1977		0.7	1.3		0.3	
Dec., 1977		1.0	1.5		-0.3	
Jan., 1978		0.3	0.7		-0.9	
Feb., 1978		0.7	0.4	-3.4	-0.7	-1.2
Mar., 1978		0.7	1.3	-2.4	-0.9	-1.0
Apr., 1978		1.3	1.8	-1.2	0.7	3.0
May, 1978		1.2	1.7	-1.1	0.8	7.7
June, 1978		1.7	2.4	0.6	0.7	5.8
July, 1978	(15-31)	1.0	2.1	-2.1	0.8	4.4
Aug., 1978		1.0	2.0	0.8	2.9	6.5
Sept., 1978	(1-20)	1.4	2.3	-0.6	0.7	4.3
Sept., 1978	(23-30)	-1.9	1.8	-2.2	1.6	-7.8
Oct., 1978		-0.8	0.2	1.0	-1.0	-9.3
Nov., 1978		-0.4	-0.8	2.1	0.1	-4.6
Dec., 1978		0.3	-1.0	-2.0	-0.0	-6.5

850mb S1 He(m)

Sept., 1978		40.4	44.2		54.7	
Oct., 1978		39.0	38.8		52.8	
Nov., 1978		37.3	33.9		54.1	
Dec., 1978		35.9	34.1		51.9	
Jan., 1978		37.9	36.6		51.6	
Feb., 1978		40.3	39.4	36.5	59.3	14.3
Mar., 1978		37.4	37.6	28.6	54.4	18.7
Apr., 1978		37.6	38.3	34.5	53.6	10.6
May, 1978		43.7	43.4	27.6	46.1	10.3
June, 1978		42.2	43.3	27.8	48.1	6.0
July, 1978	(15-31)	44.0	47.1	25.4	49.3	9.0
Aug., 1978		41.9	44.0	32.9	48.1	11.8
Sept., 1978	(1-20)	40.0	40.5	30.2	47.8	12.7
Sept., 1978	(23-30)	45.7	45.1	53.9	51.1	25.2
Oct., 1978		39.8	39.9	40.0	55.5	14.5
Nov., 1978		35.9	37.8	35.5	54.2	12.4
Dec., 1978		35.8	33.9	34.5	59.8	25.1

First Guess Error

850mb RMS He(m)

18.9	18.6		32.7		
19.5	18.0		29.9		
19.5	20.5		25.7		
22.1	25.0		22.3		
22.7	26.9		25.4		
21.7	21.4	26.8	24.1	36.4	
20.6	21.5	25.6	25.2	34.9	
19.4	21.8	21.9	29.0	37.5	
18.3	19.0	20.6	27.6	39.1	
17.6	17.5	20.5	30.4	45.9	
18.2	17.7	21.1	28.8	42.1	
18.3	17.8	20.9	32.2	47.1	
19.7	19.8	22.1	30.4	37.2	
24.3	18.2	32.0	26.0	45.0	
23.0	20.7	22.5	29.1	41.8	
25.0	22.1	24.3	33.8	45.6	
26.6	26.0	29.9	26.4	40.7	

850mb Mean He(m)

0.6	8.0		-0.8	
2.3	6.4		-0.1	
2.4	7.8		-3.6	
5.4	15.3		-9.1	
4.6	17.7		-11.3	
5.1	10.2	-4.5	-10.0	-16.4
3.6	11.4	-4.8	-10.5	-12.4
2.3	8.9	-6.1	-5.3	-2.7
2.2	6.5	-4.1	-1.3	15.9
2.2	4.5	-3.4	-3.5	9.0
0.8	4.3	-9.3	-2.2	-3.7
0.7	2.1	-2.6	0.9	8.0
1.2	6.2	-4.3	-0.7	2.4
-8.1	-1.4	-9.4	-3.3	-11.1
-9.2	-5.4	-5.4	-6.5	-8.2
-8.8	-5.3	-3.5	-8.6	-1.9
-9.7	-7.0	-11.0	-6.2	-8.9

850mb S1 He(m)

47.0	53.0		70.6	
46.2	46.5		63.1	
44.0	42.2		65.5	
42.6	42.6		64.1	
43.8	44.6		63.5	
47.4	48.4	46.4	72.0	28.2
44.5	45.6	42.0	70.1	37.6
45.4	48.2	45.1	67.8	25.5
50.5	52.0	38.3	56.5	25.3
50.0	52.8	37.5	58.2	22.5
51.9	56.7	35.5	62.2	26.5
50.8	53.6	46.5	60.9	30.9
49.3	50.8	43.4	62.6	32.6
50.0	50.8	54.5	62.2	38.2
44.3	48.1	44.3	66.2	35.2
42.1	46.0	41.8	66.1	32.1
43.1	44.0	47.6	68.4	46.4

NOAA FORM 59-4
(2-72)

Analysis Error

500mb RMS Ht(m)

Month	NH102	NA110	NH ISOL06	SH31	SH ISOL07
pt., 1977	17.4	12.4		25.7	
t., 1977	17.2	12.9		24.7	
v., 1977	18.2	13.6		22.7	
c., 1977	18.5	13.0		20.5	
n., 1978	19.6	14.0		18.3	
b., 1978	17.9	13.3	26.1	26.5	24.2
r., 1978	17.7	13.8	24.3	19.2	27.5
r., 1978	17.6	13.1	21.0	23.1	27.8
y, 1978	17.8	13.3	24.4	21.7	35.1
ne, 1978	16.9	12.1	18.3	25.5	30.1
ly, 1978 (15-31)	16.8	11.9	19.0	26.0	40.2
g., 1978	16.3	11.4	17.9	20.4	27.9
pt., 1978 (1-20)	16.0	11.3	15.1	20.0	16.9
pt., 1978 (23-30)	19.3	15.3	22.1	20.4	30.1
t., 1978	20.0	15.4	20.6	23.0	41.8
v., 1978	19.0	15.2	20.6	22.1	31.5
c., 1978	20.1	16.4	22.4	19.5	31.2

500mb Mean Ht(m)

pt., 1977	-1.6	-1.4		-2.4	
t., 1977	-1.0	-0.8		-1.1	
v., 1977	-1.7	-1.4		-1.9	
[redacted] 1977	-1.7	-1.3		-3.0	
n., 1978	-2.4	-1.8		-4.3	
b., 1978	-1.3	-1.1	-10.2	-3.5	-4.5
r., 1978	-2.0	-2.0	-11.8	-4.1	-2.6
r., 1978	-2.8	-1.7	-9.4	-4.1	-2.2
y, 1978	-2.6	-2.2	-11.5	-3.3	6.7
ne, 1978	-2.8	-3.1	-5.1	-1.8	7.7
ly, 1978 (15-30)	-2.2	-3.1	-7.6	-0.4	3.1
g., 1978	-2.8	-2.1	-5.4	-1.1	6.5
pt., 1978 (1-20)	-2.1	-1.4	-4.6	-2.2	2.5
pt., 1978 (23-30)	-1.1	3.4	-2.2	1.8	-11.6
t., 1978	0.5	2.6	2.7	-0.4	-18.1
v., 1978	0.7	1.2	1.9	1.1	-11.8
c., 1978	1.8	1.0	2.0	0.3	-12.1

500mb S1 Hc (m)

pt., 1977	40.2	33.1		36.8	
t., 1977	36.4	28.9		32.6	
v., 1977	35.3	24.1		39.5	
c., 1977	31.7	22.7		44.0	
n., 1978	33.9	25.2		45.6	
b., 1978	34.1	26.8	29.0	52.1	11.6
r., 1978	32.3	25.8	23.5	46.7	12.5
r., 1978	35.8	29.1	29.5	47.1	13.6
y, 1978	39.6	33.3	27.4	36.6	10.4
[redacted] 1978	40.8	34.1	29.5	41.7	7.4
[redacted] 1978 (15-30)	44.6	37.3	26.6	35.7	10.8
g., 1978	42.0	36.8	33.3	32.6	10.4
pt., 1978 (1-20)	40.7	33.0	39.4	32.4	10.2
pt., 1978 (23-30)	39.1	32.5	44.9	32.0	16.6
t., 1978	37.2	28.5	31.4	37.2	20.5
v., 1978	32.2	24.4	28.0	44.9	14.4
c., 1978	31.7	23.1	30.7	46.9	21.4

First Guess Error

500mb RMS Ht(m)

NH102	NA110	NH ISOL06	SH31	SH ISOL07
28.4	21.3		56.7	
27.3	24.0		53.5	
29.3	26.3		47.6	
29.9	26.3		43.8	
32.2	28.2		47.2	
30.4	25.7	46.3	48.3	66.9
29.0	24.4	39.6	44.0	63.2
29.2	25.6	37.6	47.2	66.4
28.9	24.5	37.5	44.6	69.8
28.3	22.9	32.4	50.0	83.1
27.0	22.9	34.9	49.4	96.8
28.6	24.2	32.5	50.0	86.6
29.3	25.6	36.4	49.1	59.5
31.1	23.3	32.3	42.5	70.5
30.4	26.0	29.9	42.8	68.1
31.1	26.5	34.6	43.4	67.0
32.9	33.6	38.0	38.5	56.2

500mb Mean Ht(m)

-10.4	-4.5		-20.7	
-6.5	-4.1		-20.0	
-5.4	-2.3		-20.3	
-4.6	4.7		-25.9	
-6.0	5.7		-31.5	
-4.1	0.1	-24.7	-28.5	-34.3
-5.8	0.6	-23.2	-27.2	-18.1
-9.0	-6.2	-22.4	-22.2	-3.6
-9.1	-8.3	-19.8	-13.9	7.7
-10.3	-9.1	-13.8	-16.3	10.3
-10.4	-9.8	-21.1	-13.6	-6.5
-11.3	-11.3	-15.3	-13.8	11.7
-8.9	-8.1	-14.5	-16.4	-7.0
-12.8	-8.0	-16.4	-13.7	-18.6
-12.9	-10.6	-14.1	-15.3	-22.1
-12.2	-9.6	-13.6	-13.6	-8.5
-13.3	-13.6	-14.6	-12.6	-13.2

500mb S1 Hc (m)

45.4	38.6		48.3	
41.5	35.0		42.3	
40.4	29.4		49.4	
36.5	27.6		52.6	
39.1	31.0		55.3	
39.1	32.4	35.8	61.2	23.2
36.9	30.7	32.4	57.0	26.3
40.9	35.3	39.0	55.8	28.6
44.5	39.3	37.0	47.0	20.2
47.1	40.0	40.5	52.0	22.5
49.8	43.2	36.7	46.9	23.2
48.3	42.8	44.0	43.8	27.6
46.9	39.8	49.3	42.7	27.6
41.9	36.3	47.2	38.9	25.4
40.4	33.4	37.0	45.1	28.9
35.8	27.8	32.9	53.5	28.9
35.3	26.7	35.2	55.5	37.8

Table 6

OAA FORM 59-4

Analysis Error

250mb RMS He(m)

		NH102	NA110	NH ISOL06	SH31	SH ISOL07
North						
st.,	1977	28.5	18.0		34.4	
.,	1977	28.6	19.2		35.6	
.,	1977	29.7	18.8		33.5	
.,	1977	30.1	18.4		41.8	
.,	1978	29.9	19.1		36.1	
.,	1978	26.8	17.3	34.6	37.5	36.0
.,	1978	28.1	18.7	32.3	31.8	32.0
.,	1978	28.4	18.8	31.2	42.0	51.1
.,	1978	28.9	20.9	28.0	36.9	38.4
ec.,	1978	29.2	19.4	24.9	35.9	29.1
.,	1978 (15-31)	29.3	19.2	32.2	39.7	36.9
.,	1978	28.2	18.0	35.4	35.9	34.7
.,	1978 (1-20)	28.8	19.3	28.4	33.7	23.3
.,	1978 (23-30)	27.8	20.3	28.0	30.3	38.8
.,	1978	28.3	21.1	23.7	33.2	47.0
.,	1978	27.7	20.4	23.1	29.0	37.8
.,	1978	27.6	20.2	32.4	29.2	41.8

250mb Mean He(m)

pt., 1977	-1.5	-1.0		-4.7	
., 1977	-1.8	-1.1		-2.3	
., 1977	-2.2	-1.9		-2.0	
., 1977	-1.0	-1.9		-1.7	
., 1978	-1.0	-2.1		-4.6	
., 1978	0.1	-1.2	-0.9	-5.2	-9.2
., 1978	-0.5	-2.2	-0.3	-4.7	-1.5
., 1978	-1.5	-1.9	-0.8	-5.5	-5.2
., 1978	-2.2	-2.1	-7.3	-2.5	2.6
., 1978	-1.2	-1.8	-2.6	0.2	1.3
., 1978 (15-31)	-1.1	-1.5	-3.6	-1.0	-4.3
., 1978	-1.6	-0.4	-0.8	0.1	2.4
., 1978 (1-20)	0.4	-0.2	0.1	-1.7	-1.1
., 1978 (23-30)	-0.6	2.5	-1.9	1.8	-19.1
., 1978	2.0	3.0	3.7	-0.1	-22.7
., 1978	1.3	1.3	1.4	1.9	-16.0
., 1978	3.1	1.0	0.1	1.8	-17.6

250mb SI He(m)

pt., 1977	42.0	28.9		36.4	
., 1977	39.5	27.0		34.9	
., 1977	38.6	23.0		41.0	
., 1977	34.5	20.5		43.2	
., 1978	36.9	22.1		43.7	
., 1978	36.3	22.7	27.3	48.9	11.7
., 1978	36.4	22.7	23.2	43.1	15.1
., 1978	40.5	27.5	28.9	43.4	17.7
., 1978	42.9	31.4	26.7	40.4	7.6
., 1978	44.0	31.3	31.4	40.2	7.2
., 1978 (15-31)	46.2	35.0	32.3	36.3	8.5
., 1978	44.0	34.0	35.1	32.9	8.8
., 1978 (1-20)	43.1	32.1	40.0	33.4	6.5
., 1978 (23-30)	41.7	30.3	42.2	33.0	12.8
., 1978	39.4	26.2	23.7	33.7	23.8
., 1978	34.7	22.5	24.1	41.6	13.4
., 1978	33.0	20.0	28.7	43.5	19.4

First Guess Error

250mb RMS He(m)

NH102	NA110	NH ISOL06	SH31	SH ISOL07
50.0	36.7		75.0	
47.0	37.0		70.7	
46.8	36.7		67.7	
48.5	37.3		71.2	
48.9	39.1		75.4	
45.8	34.9	63.3	75.5	100.3
45.1	33.8	55.0	67.2	92.2
46.5	36.7	56.8	71.8	104.7
46.9	41.9	53.1	64.0	92.5
48.0	41.8	46.5	69.1	112.8
48.0	42.5	59.1	72.5	120.3
50.6	44.8	55.4	76.4	124.6
50.9	47.9	54.9	71.3	88.8
48.6	38.2	52.8	64.2	92.7
47.1	41.2	48.3	66.7	92.1
46.1	41.3	49.8	66.9	90.3
47.0	45.5	61.2	62.7	77.3

250mb Mean He(m)

-16.8	-12.4		-31.4	
-11.7	-6.8		-31.9	
-7.7	-5.3		-32.6	
-4.8	8.7		-35.0	
-5.7	7.4		-45.0	
-4.2	2.6	-32.6	-47.9	-50.6
-5.4	3.3	-27.6	-41.4	-22.8
-12.1	-10.5	-29.5	-32.7	-15.2
-15.0	-17.8	-29.2	-19.0	-0.7
-17.5	-20.9	-24.1	-19.6	4.6
-19.4	-23.0	-29.5	-24.1	-19.8
-18.7	-25.1	-21.8	-15.4	14.2
-14.1	-21.2	-18.2	-25.1	-20.5
-19.7	-18.7	-30.4	-21.0	-29.7
-18.4	-19.0	-30.2	-29.4	-34.9
-16.7	-18.1	-26.7	-28.1	-22.1
-17.0	-20.4	-29.3	-25.6	-26.9

250mb SI He(m)

47.9	34.6		44.4	
45.1	32.7		42.2	
43.7	28.1		49.2	
39.5	25.8		52.7	
41.8	27.3		51.9	
41.0	28.0	32.9	56.0	26.0
40.7	27.2	30.3	53.2	25.0
45.2	32.8	36.3	50.8	35.5
47.8	37.7	35.6	48.3	18.7
50.1	38.8	42.3	49.5	22.2
52.2	42.3	43.1	44.5	19.6
51.2	41.7	52.4	45.2	25.1
49.6	39.6	50.8	43.7	27.8
45.7	34.0	46.4	44.5	22.9
43.9	31.4	32.5	43.2	30.7
38.9	26.1	32.2	53.4	24.8
38.1	24.6	37.2	55.5	36.3

Table 1

NOAA FORM 59-4
(2-72)

Analysis Error

100mb RMS Ht (m)

Month		NH102	NA110	NH ISOLOG	CH31	SH ISOLOT
Oct., 1977		40.0	28.5		52.1	
Nov., 1977		46.4	26.2		55.1	
Dec., 1977		42.5	24.9		47.5	
Jan., 1977		45.0	24.7		58.2	
Feb., 1978		44.8	24.9		59.6	
Mar., 1978		39.9	24.8	51.2	60.8	55.0
Apr., 1978		42.7	28.2	43.3	51.4	40.6
May, 1978		44.1	30.5	41.3	48.2	43.4
June, 1978		44.9	33.8	41.6	48.3	43.7
July, 1978		44.3	35.6	39.8	48.8	33.8
Aug., 1978	(15-31)	45.1	32.2	44.6	62.6	37.3
Sept., 1978		43.6	30.2	40.2	51.1	43.3
Oct., 1978	(1-20)	40.9	29.3	43.6	52.1	33.1
Nov., 1978	(23-30)	45.2	33.8	38.8	40.9	40.7
Dec., 1978		44.9	33.9	41.5	46.9	49.1
Jan., 1978		44.6	36.7	37.7	42.7	46.1
Feb., 1978		45.1	37.2	49.3	42.3	47.3

100mb Mean Ht (m)

Oct., 1977	-13.1	-13.2		-16.9	
Nov., 1977	-9.8	-7.9		-16.0	
Dec., 1977	-6.8	-5.6		-13.3	
Jan., 1977	-4.2	-3.5		-18.5	
Feb., 1978	-4.2	-3.7		-24.0	
Mar., 1978	-5.2	-6.4	-16.7	-20.5	-27.5
Apr., 1978	-7.3	-10.5	-11.5	-15.3	-14.3
May, 1978	-10.6	-14.9	-12.6	-12.6	-4.3
June, 1978	-14.6	-20.8	-13.6	-8.9	-10.6
July, 1978	-16.4	-23.4	-6.2	-9.2	-19.8
Aug., 1978	-15.6	-20.7	-13.5	-4.9	-17.4
Sept., 1978	-14.1	-16.9	-8.9	-8.5	-14.5
Oct., 1978	-10.6	-12.9	-2.3	-9.0	-17.2
Nov., 1978	-0.7	-3.1	-10.0	-0.5	-11.0
Dec., 1978	1.4	0.1	-0.3	-1.1	-19.9
Jan., 1978	2.6	-1.1	-1.2	-3.5	-18.0
Feb., 1978	4.6	0.7	-5.4	-2.9	-17.0

100mb S1 Ht (m)

Sept., 1977	71.5	54.6		60.6	
Oct., 1977	66.6	50.3		56.0	
Nov., 1977	61.5	46.0		63.7	
Dec., 1977	55.8	36.2		71.8	
Jan., 1978	55.9	38.1		70.3	
Feb., 1978	52.5	36.9	43.2	71.7	16.4
Mar., 1978	57.7	40.0	38.5	71.9	33.9
Apr., 1978	69.1	53.8	42.9	65.8	25.4
May, 1978	73.8	60.2	50.1	58.4	14.0
June, 1978	76.4	64.2	62.7	58.0	10.1
July, 1978	77.2	67.7	64.5	54.3	9.8
Aug., 1978	73.9	63.7	58.1	53.1	11.2
Sept., 1978	71.0	59.4	56.3	60.2	10.8
Oct., 1978	72.3	58.9	60.3	59.8	34.9
Nov., 1978	67.2	53.9	45.3	57.9	38.4
Dec., 1978	57.1	44.5	37.5	59.1	22.6
Jan., 1978	54.9	42.7	47.9	65.4	26.6

First Guess Error

100mb RMS Ht (m)

NH102	NA110	NH ISOLOG	CH31	SH ISOLOT
61.3	38.8		76.4	
59.2	37.1		93.5	
59.1	38.5		80.9	
62.5	43.2		78.7	
64.3	43.9		94.5	
57.0	42.3	70.0	88.5	104.1
56.1	39.8	63.3	79.0	89.5
57.9	43.6	62.9	78.1	102.7
57.9	46.2	60.4	75.5	90.8
60.5	46.4	56.5	86.0	89.4
62.3	45.8	67.3	94.7	98.8
62.1	44.1	57.4	94.7	131.4
60.6	44.5	66.0	92.1	101.7
65.0	48.8	63.6	88.5	113.4
64.9	51.5	64.8	93.9	110.0
63.9	50.4	75.2	90.0	104.5
65.5	52.0	86.0	91.6	97.8

100mb Mean Ht (m)

-21.4	-14.3		-38.0	
-12.2	-4.9		-34.1	
-5.3	1.3		-28.4	
-0.4	13.7		-34.7	
-3.9	8.7		-50.5	
-5.5	-8.2	-21.2	-43.7	-63.7
-5.7	0.1	-14.9	-32.9	-32.7
-13.5	-16.8	-16.7	-27.1	0.1
-20.3	-23.8	-14.4	-16.5	-20.6
-24.4	-27.0	-6.4	-23.0	-49.8
-25.4	-27.0	-22.1	-14.2	-49.0
-23.4	-23.5	-11.4	-18.1	-34.5
-15.0	-17.2	-6.3	-22.9	-46.9
-17.3	-21.8	-36.6	-19.1	-42.7
-19.4	-25.3	-25.5	-32.5	-41.8
-13.4	-17.2	-24.3	-36.9	-41.8
-15.2	-14.3	-32.2	-38.5	-35.7

100mb S1 Ht (m)

77.3	59.9		69.2	
72.4	55.0		66.3	
67.4	50.6		75.6	
60.9	41.4		84.8	
61.7	43.1		79.8	
57.9	42.6	53.0	81.2	30.6
62.7	44.3	48.9	83.8	42.5
75.1	59.1	53.8	76.2	43.1
81.6	66.2	62.7	68.1	22.5
84.5	70.9	78.5	68.4	22.2
84.5	73.8	75.1	64.6	19.8
82.7	70.8	75.6	68.1	28.2
79.0	66.6	71.3	72.9	24.3
76.4	59.3	78.0	78.2	28.5
71.8	55.5	57.0	72.2	40.5
58.8	43.3	50.1	78.8	38.0
58.3	42.0	64.2	82.0	49.8

Table 10

NOAA FORM 59-4
(2-72)

Analysis Error
850mb RMS Te(°K)

Month		NH102	NA110	NH ISOL06	SH31	SH ISOL07
pt., 1977		1.6	1.5		1.9	
t., 1977		1.6	1.6		1.9	
v., 1977		1.7	1.8		1.8	
c., 1977		2.0	2.1		1.8	
n., 1978		2.0	2.2		2.1	
b., 1978		1.9	2.0	2.1	2.3	2.8
r., 1978		1.8	1.8	2.1	1.8	2.0
r., 1978		1.7	1.7	1.7	2.1	1.8
y, 1978		1.7	1.6	1.7	1.7	1.7
ne, 1978		1.6	1.6	1.6	1.5	2.0
ly, 1978	(15-31)	1.4	1.4	1.5	2.1	2.3
g., 1978		1.5	1.4	1.7	1.9	1.8
pt., 1978	(1-20)	1.5	1.4	2.0	1.6	1.5
pt., 1978	(23-30)	2.4	2.5	2.6	2.5	2.2
t., 1978		2.5	2.4	2.8	2.7	2.5
v., 1978		2.5	2.5	2.7	2.8	2.5
c., 1978		2.5	2.5	2.9	2.5	2.1

850mb Mean Te(°K)

pt., 1977		0.6	0.4		0.8	
t., 1977		0.7	0.6		0.9	
v., 1977		0.6	0.5		0.9	
[redacted] 1977		0.7	0.6		0.7	
n., 1978		0.7	0.9		0.6	
b., 1978		0.7	0.8	1.4	0.7	1.4
r., 1978		0.5	0.5	1.3	0.7	1.4
r., 1978		0.5	0.5	1.1	0.7	1.3
y, 1978		0.4	0.3	1.0	0.6	1.0
ne, 1978		0.5	0.4	1.0	0.6	0.9
ly, 1978	(15-31)	0.3	0.2	0.8	0.6	1.2
g., 1978		0.4	0.3	1.0	0.7	1.0
pt., 1978	(1-20)	0.5	0.3	1.1	0.6	0.8
pt., 1978	(23-30)	1.3	1.3	1.9	1.4	0.7
t., 1978		1.1	0.9	2.1	1.0	0.0
v., 1978		0.7	0.2	1.8	1.2	0.5
c., 1978		0.6	0.1	1.8	0.9	0.6

850mb S1 Te(°K)

pt., 1977		58.4	52.6		43.2	
t., 1977		53.0	50.3		41.0	
v., 1977		53.5	49.6		42.0	
c., 1977		52.1	46.1		42.5	
n., 1978		52.3	45.5		44.6	
b., 1978		53.3	48.8	41.7	48.8	22.4
r., 1978		52.0	45.7	39.6	51.2	24.3
r., 1978		52.7	51.7	45.0	51.9	24.5
y, 1978		55.2	53.8	42.6	47.1	15.4
ne, 1978		55.6	54.4	42.7	51.3	18.9
[redacted] 1978	(15-31)	57.5	54.8	47.0	53.8	16.7
g., 1978		57.1	54.5	50.0	49.0	20.2
pt., 1978	(1-20)	56.3	50.4	53.3	47.2	14.1
pt., 1978	(23-30)	57.3	52.7	57.7	53.0	22.7
t., 1978		58.8	53.7	46.2	51.8	28.9
v., 1978		53.9	51.0	52.1	49.9	25.6
c., 1978		53.2	50.1	49.2	54.6	33.8

First Guess Error
850mb RMS Te(°K)

NH102	NA110	NH ISOL06	SH31	SH ISOL07
2.7	3.0		3.7	
2.6	2.9		3.8	
2.7	2.9		3.4	
3.1	3.1		3.0	
3.2	3.1		3.5	
2.9	2.9	3.2	3.2	3.8
2.7	2.8	2.8	3.1	3.3
2.5	2.8	2.5	3.3	3.4
2.6	2.7	2.5	3.2	3.6
2.6	2.8	2.5	3.1	5.0
2.6	2.8	2.6	3.5	5.1
2.5	2.6	2.8	3.7	4.6
2.5	2.7	2.9	3.2	3.9
2.8	2.7	2.7	2.7	3.7
2.7	2.7	2.6	3.2	3.2
2.9	3.1	3.1	3.2	4.0
3.3	3.4	3.3	3.1	4.2

850mb Mean Te(°K)

0.2	0.2		-0.2	
0.5	0.2		-0.3	
0.2	0.3		-0.2	
0.0	0.4		-0.8	
-0.1	0.5		-1.2	
-0.1	0.4	1.2	-0.5	0.0
-0.2	0.0	1.0	-0.3	1.0
-0.0	0.0	0.7	0.2	0.9
0.0	0.2	1.0	0.5	1.1
0.1	0.3	0.9	0.4	0.9
0.2	0.2	0.4	0.3	0.4
0.3	0.3	1.1	0.6	1.3
0.5	0.4	1.1	0.4	0.4
0.8	0.7	1.4	0.7	1.1
0.6	0.2	1.5	0.2	-0.2
0.2	-0.4	1.4	0.5	-0.1
-0.1	-1.1	1.3	0.4	0.0

850mb S1 Te(°K)

69.0	65.4		63.1	
62.2	61.2		58.7	
62.2	58.6		60.0	
60.8	55.6		57.0	
61.9	54.0		60.9	
61.0	57.3	53.8	61.0	34.3
58.6	53.2	57.6	66.0	40.8
61.4	60.8	62.6	70.4	35.1
63.9	63.5	54.8	65.4	34.3
64.4	64.5	62.8	72.9	33.8
66.4	65.7	64.4	77.5	35.2
66.4	65.1	67.0	68.6	38.3
65.0	63.2	69.9	65.9	32.8
62.7	56.6	69.7	59.1	34.4
63.8	58.6	56.5	61.7	37.7
58.6	54.6	60.7	58.0	32.8
57.9	54.4	57.0	62.6	50.7

Table II

NOAA FORM 59-4
(2-72)

Analysis Error
500 mb RMS Te (°K)

Month		NH102	NA110	NH ISOL06	SH131	SH ISOL07
Ft., 1977		1.0	0.9		1.2	
t., 1977		1.0	1.0		1.2	
v., 1977		1.1	1.1		1.0	
c., 1977		1.1	1.1		1.0	
n., 1978		1.2	1.1		1.7	
b., 1978		1.1	1.0	1.4	1.1	1.0
r., 1978		1.1	1.0	1.2	1.0	1.0
r., 1978		1.1	1.0	0.9	1.0	1.3
y., 1978		1.1	1.0	0.8	1.0	0.9
ne, 1978		1.0	0.9	1.3	1.3	1.8
ly, 1978	(15-31)	1.0	0.9	1.0	1.1	0.9
g., 1978		1.0	0.9	1.1	1.2	0.8
pt., 1978	(1-20)	1.1	1.0	1.3	1.1	0.8
pt., 1978	(23-30)	1.4	1.1	1.5	1.4	1.2
t., 1978		1.4	1.2	1.3	1.4	1.8
v., 1978		1.3	1.3	1.6	1.3	1.4
c., 1978		1.5	1.5	1.7	1.3	1.6

First Guess Error
500 mb RMS Te (°K)

NH102	NH110	NH ISOL06	SH131	SH ISOL07
1.9	1.7		2.6	
2.0	1.9		2.4	
2.0	2.1		2.2	
2.1	2.1		2.0	
2.1	2.0		2.5	
2.1	1.9	2.5	2.1	2.6
2.0	1.8	2.2	2.1	3.0
2.1	2.0	2.2	2.2	3.2
2.0	2.0	1.9	2.3	2.9
1.9	1.8	1.9	2.5	3.5
1.9	1.8	1.9	2.5	3.6
1.9	1.8	2.0	2.6	3.4
2.0	2.1	2.3	2.4	3.1
1.9	1.6	1.9	2.2	2.6
1.8	1.7	1.9	2.2	3.2
1.9	1.8	2.4	2.2	3.2
2.0	2.2	2.2	2.0	3.2

500 mb Mean Te (°K)

pt., 1977		0.2	0.1		0.4	
t., 1977		0.2	0.3		0.5	
v., 1977		0.3	0.2		0.4	
c., 1977		0.3	0.3		0.3	
1978		0.4	0.4		0.3	
b., 1978		0.3	0.4	0.5	0.3	0.3
r., 1978		0.3	0.2	0.4	0.3	0.5
r., 1978		0.2	0.2	0.4	0.3	0.4
y, 1978		0.2	0.1	0.3	0.3	0.1
ne, 1978		0.2	0.1	0.5	0.5	0.3
ly, 1978	(15-31)	0.2	0.1	0.4	0.4	0.3
g., 1978		0.2	0.1	0.5	0.5	0.2
pt., 1978	(1-20)	0.2	0.1	0.5	0.5	0.1
pt., 1978	(23-30)	0.3	0.3	0.3	0.5	-0.1
t., 1978		0.1	0.3	0.2	0.4	-0.3
v., 1978		0.2	0.3	0.3	0.4	-0.2
c., 1978		0.1	0.2	0.3	0.4	-0.1

-0.5	-0.5		-1.0	
-0.7	-0.5		-0.9	
-0.5	-0.7		-0.7	
-0.5	-0.7		-0.4	
-0.5	-0.9		-0.4	
-0.6	-0.8	-1.1	-0.7	-1.0
-0.5	-0.6	-0.9	-0.6	-0.3
-0.7	-0.9	-1.0	-1.0	-0.7
-0.7	-0.9	-0.9	-1.0	-1.4
-0.5	-0.5	-0.5	-1.0	-0.9
-0.5	-0.4	-0.4	-0.8	-1.1
-0.5	-0.5	-0.6	-0.9	-0.4
-0.6	-0.9	-0.3	-0.9	-1.6
-0.3	-0.3	-0.4	-0.2	-0.8
-0.4	-0.3	-0.6	-0.4	-1.1
-0.3	-0.3	-0.6	-0.4	-0.7
-0.4	-0.5	-0.4	-0.3	-0.6

500 mb S1 Te (°K)

pt., 1977		52.0	47.4		40.2	
t., 1977		48.2	44.0		41.4	
v., 1977		48.0	41.2		40.3	
c., 1977		45.1	38.6		40.8	
n., 1978		48.1	41.3		43.1	
b., 1978		46.0	42.2	35.9	39.1	13.2
ar., 1978		46.8	40.2	32.0	41.9	15.6
2r., 1978		48.4	45.0	34.4	41.5	19.0
2y, 1978		51.5	49.6	35.8	35.9	12.4
ne, 1978		52.5	49.7	45.6	39.4	17.2
ly, 1978	(15-31)	55.5	55.2	39.8	37.6	16.8
g., 1978		53.1	54.4	42.0	36.6	15.8
pt., 1978	(1-20)	51.8	47.9	44.2	38.5	17.0
pt., 1978	(23-30)	55.4	52.8	49.8	50.5	21.6
t., 1978		52.5	48.1	39.2	48.2	29.9
v., 1978		49.8	44.3	40.6	56.3	21.5
c., 1978		50.4	43.8	44.9	55.9	28.2

63.1	57.1		60.1	
60.4	54.7		59.9	
59.3	51.0		64.7	
55.0	48.6		64.8	
57.6	50.8		66.4	
56.7	51.6	53.3	71.8	31.4
56.1	49.7	45.0	67.7	34.6
58.2	55.3	51.3	65.5	45.2
61.4	58.3	54.0	59.4	36.9
63.7	60.7	62.1	58.3	37.3
66.4	66.1	63.9	57.8	45.9
63.4	65.4	63.1	57.5	35.5
61.7	61.1	67.2	59.0	42.9
60.9	57.2	61.1	65.9	32.8
56.8	52.4	47.1	60.5	43.5
54.9	48.5	55.1	67.9	38.7
54.5	48.2	53.4	68.0	46.0

NOAA FORM 59-4
(2-72)

Analysis Error 250 RMS Te (°K)

Month		NH102	NA110	NH ISOL06	SH131	SH ISOL07
Sept., 1977		2.1	1.6		2.2	
Oct., 1977		2.1	1.7		2.1	
Nov., 1977		2.0	1.8		1.9	
Dec., 1977		2.2	2.0		1.7	
Jan., 1978		2.3	2.3		1.9	
Feb., 1978		2.3	2.3	2.6	1.9	2.5
Mar., 1978		2.3	2.1	2.6	1.8	2.5
Apr., 1978		2.2	2.1	2.3	1.9	2.3
May, 1978		2.2	1.8	1.9	2.1	2.2
June, 1978		2.2	1.7	1.9	2.1	2.1
July, 1978	(15-31)	2.4	1.6	2.3	2.0	2.3
Aug., 1978		2.2	1.6	2.0	2.2	2.3
Sept., 1978	(1-20)	2.2	1.6	2.0	2.0	2.3
Sept., 1978	(23-30)	2.1	1.7	2.2	1.9	2.3
Oct., 1978		2.0	2.0	1.9	1.9	1.7
Nov., 1978		1.9	1.8	1.8	1.9	1.6
Dec., 1978		2.0	1.9	2.1	1.9	1.8

First Guess Error 250 RMS Te (°K)

NH102	NA110	NH ISOL06	SH131	SH ISOL07
2.9	2.6		3.1	
2.9	2.9		3.1	
3.0	3.3		2.8	
3.1	3.8		2.4	
3.2	3.7		2.4	
3.2	3.5	3.2	2.4	3.3
3.2	3.4	3.7	2.5	3.6
3.1	3.3	3.4	2.9	3.3
2.9	2.8	2.8	3.3	3.3
3.0	2.6	2.9	3.1	3.2
3.1	2.7	3.4	2.8	2.9
3.1	2.7	3.0	3.4	3.7
3.1	2.6	3.1	3.0	3.0
2.7	2.3	2.7	2.8	3.2
2.6	2.4	2.5	2.6	3.3
2.6	2.5	2.6	2.7	3.7
2.6	2.7	2.8	2.6	3.3

250mb Mean Te (°K)

Sept., 1977		0.5	0.5		0.3	
Oct., 1977		0.5	0.5		0.6	
Nov., 1977		0.4	0.4		0.5	
Dec., 1977		0.5	0.7		0.1	
Jan., 1978		0.6	1.0		0.1	
Feb., 1978		0.7	0.9	0.3	0.1	-0.4
Mar., 1978		0.7	0.7	0.4	0.3	-0.6
Apr., 1978		0.6	0.8	0.1	0.3	-0.1
May, 1978		0.5	0.4	0.2	0.6	0.4
June, 1978		0.4	0.3	0.1	0.6	0.9
July, 1978	(15-31)	0.7	0.4	0.4	0.4	0.8
Aug., 1978		0.7	0.4	0.3	0.7	0.7
Sept., 1978	(1-20)	0.7	0.3	0.3	0.4	0.9
Sept., 1978	(23-30)	0.8	1.0	0.9	0.9	0.2
Oct., 1978		0.7	1.1	0.9	1.0	0.6
Nov., 1978		0.5	0.8	0.7	1.1	0.5
Dec., 1978		0.6	0.6	0.6	1.2	0.4

1.4	1.7		1.0	
1.3	1.6		1.2	
1.1	1.6		1.4	
1.2	2.3		0.8	
1.0	2.2		0.4	
1.0	1.5	0.9	0.5	-0.1
1.2	1.7	1.3	1.0	-0.3
1.2	2.1	1.2	1.3	1.0
1.1	1.6	1.5	1.8	1.1
1.1	1.5	1.5	1.7	0.9
1.5	1.7	1.9	0.8	0.7
1.7	1.9	1.7	1.7	0.2
1.4	1.4	1.5	0.8	0.5
0.9	1.1	0.7	0.9	-0.0
0.7	0.9	0.7	0.5	0.4
0.6	0.9	0.7	0.6	0.1
0.7	0.8	0.4	0.6	0.1

250mb S1 Te (°K)

Sept., 1977		74.8	65.0		68.0	
Oct., 1977		69.4	64.3		65.6	
Nov., 1977		70.3	67.1		66.7	
Dec., 1977		70.5	66.4		63.6	
Jan., 1978		70.0	65.5		59.3	
Feb., 1978		69.7	62.9	67.4	64.7	45.5
Mar., 1978		67.6	63.1	58.8	65.0	44.1
Apr., 1978		66.0	66.1	52.7	60.4	49.1
May, 1978		69.9	68.8	56.7	64.4	47.9
June, 1978		71.1	69.4	60.4	56.0	38.9
July, 1978	(15-31)	76.4	70.4	69.1	56.2	32.4
Aug., 1978		75.2	68.9	65.3	63.3	42.4
Sept., 1978	(1-20)	74.7	72.0	66.3	60.9	50.9
Sept., 1978	(23-30)	72.3	62.9	56.3	56.7	36.2
Oct., 1978		71.4	68.9	62.7	58.4	39.7
Nov., 1978		69.3	64.3	55.6	63.5	31.8
Dec., 1978		67.6	64.8	62.6	61.9	44.8

79.9	71.8		76.0	
75.7	72.4		77.0	
76.4	76.7		74.3	
77.3	76.1		74.7	
75.9	72.3		72.3	
75.4	71.6	77.6	76.2	51.4
74.4	70.7	70.1	76.7	47.9
72.0	71.7	63.2	71.8	68.7
76.7	75.5	68.3	72.1	67.0
77.6	76.4	76.3	66.3	61.1
81.0	77.3	78.6	64.7	40.1
80.4	77.1	79.5	74.1	60.2
82.2	80.6	78.5	70.5	50.3
77.2	67.3	67.7	74.5	45.3
76.1	75.3	71.5	75.5	57.8
73.7	69.6	71.0	79.2	61.9
72.1	72.2	73.2	75.9	68.3

NOAA FORM 59-4
(2-72)

Analysis Error

100mb RMS Tc (°K)

Month		NH102	NA110	NH ISOL06	SH31	SH ISOL07
Sept., 1977		2.2	1.9		3.4	
Oct., 1977		2.3	2.1		3.1	
Nov., 1977		2.2	2.0		3.1	
Dec., 1977		2.1	1.9		2.7	
Jan., 1978		2.2	1.7		3.0	
Feb., 1978		2.1	1.8	3.5	3.2	3.1
Mar., 1978		2.2	1.7	3.3	3.1	2.4
Apr., 1978		2.2	1.8	3.3	3.1	2.7
May, 1978		2.0	1.8	2.7	3.2	3.9
June, 1978		2.1	1.8	2.3	3.0	3.9
July, 1978	(15-31)	2.2	1.6	2.8	3.3	3.6
Aug., 1978		2.1	1.7	2.7	3.1	3.8
Sept., 1978	(1-20)	2.1	1.9	3.0	3.1	3.8
Sept., 1978	(23-30)	1.8	1.8	2.8	2.6	2.0
Oct., 1978		1.9	1.9	2.6	2.8	2.3
Nov., 1978		1.9	1.8	2.1	2.7	2.4
Dec., 1978		1.9	2.0	2.5	2.8	2.3

100mb Mean Te (°K)

Sept., 1977		0.1	0.3		0.3	
Oct., 1977		0.3	0.8		0.2	
Nov., 1977		0.4	0.6		-0.0	
Dec., 1977		0.4	0.5		0.5	
Jan., 1978		0.6	0.6		0.3	
Feb., 1978		0.3	0.3	1.9	0.8	-0.5
Mar., 1978		0.2	-0.0	1.6	1.0	-0.1
Apr., 1978		0.0	-0.4	1.6	0.9	-0.3
May, 1978		-0.2	-0.3	1.1	0.2	-0.7
June, 1978		-0.0	-0.3	0.8	0.0	-2.0
July, 1978	(15-31)	0.1	-0.1	0.6	0.5	-0.8
Aug., 1978		0.1	-0.0	0.7	0.7	-0.5
Sept., 1978	(1-20)	0.3	0.4	1.4	0.6	-0.7
Sept., 1978	(23-30)	0.4	0.9	1.2	1.3	0.8
Oct., 1978		0.3	0.7	0.8	1.1	0.4
Nov., 1978		0.4	0.6	0.6	0.7	-0.2
Dec., 1978		0.4	0.6	0.8	0.8	0.4

100mb SI Te (°K)

Sept., 1977		69.0	57.6		68.5	
Oct., 1977		68.8	57.8		66.9	
Nov., 1977		69.9	58.0		69.9	
Dec., 1977		65.5	57.1		69.3	
Jan., 1978		65.6	57.6		67.0	
Feb., 1978		67.2	60.1	58.8	70.4	37.2
Mar., 1978		66.8	60.2	56.1	66.5	45.1
Apr., 1978		68.1	60.8	54.7	66.3	41.3
May, 1978		68.2	59.7	48.9	66.2	42.7
June, 1978		64.5	57.3	57.5	61.8	62.1
July, 1978	(15-31)	65.4	57.6	59.0	64.8	67.7
Aug., 1978		66.7	59.0	63.8	59.0	52.5
Sept., 1978	(1-20)	65.5	58.3	63.5	60.8	36.8
Sept., 1978	(23-30)	64.4	55.2	71.7	57.9	19.1
Oct., 1978		67.0	59.6	59.4	60.0	33.2
Nov., 1978		68.3	66.7	58.1	62.8	30.1
Dec., 1978		68.1	65.7	59.5	64.5	41.3

First Guess Error

100mb RMS Te (°K)

NH102	NA110	NH ISOL06	SH31	SH ISOL07
2.4	2.1		3.4	
2.4	2.1		2.9	
2.5	2.2		3.1	
2.6	2.3		2.8	
2.8	2.2		3.1	
2.6	2.2	3.7	3.2	3.1
2.5	2.1	3.5	3.2	2.7
2.3	2.1	3.4	3.1	2.7
2.1	1.9	2.3	3.4	3.2
2.4	2.4	2.3	3.2	3.2
2.4	2.3	2.8	3.4	3.5
2.5	2.5	2.8	3.4	3.9
2.3	2.3	2.8	3.3	3.1
2.3	2.3	3.9	3.3	3.4
2.4	2.4	3.1	3.5	3.6
2.5	2.4	3.1	3.5	3.4
2.7	2.7	3.7	3.6	3.0

100mb Mean Te (°K)

-0.7	-0.6		0.3	
-0.2	0.2		0.0	
-0.0	0.3		-0.2	
0.1	0.3		0.3	
0.4	0.8		0.3	
0.2	0.2	1.9	0.7	0.1
0.1	0.1	1.5	1.0	-0.0
-0.0	-0.3	1.5	1.1	0.1
-0.4	-0.2	0.2	0.1	-0.9
-0.3	-0.6	-0.1	-0.1	-1.4
-0.5	-1.0	-0.9	0.4	-0.9
-0.7	-1.0	-0.6	0.3	-0.3
-0.3	-0.3	0.1	0.9	0.2
0.4	0.8	1.3	1.4	1.0
0.4	0.7	1.0	1.4	0.8
0.5	0.7	1.0	1.0	-0.5
0.5	1.0	1.6	1.1	0.5

100mb SI Te (°K)

70.8	60.0		66.7	
71.4	60.0		63.0	
73.0	60.9		67.4	
70.0	62.1		66.4	
71.3	62.4		65.0	
72.5	65.1	63.5	70.0	34.6
70.8	63.8	61.6	65.2	39.7
72.1	64.6	60.2	64.7	42.5
71.1	62.0	53.9	62.7	38.2
69.5	61.4	62.3	63.5	59.7
67.3	61.2	60.2	66.5	60.2
71.3	63.3	68.4	61.2	51.3
71.3	61.3	68.3	61.8	42.4
70.1	61.0	83.0	68.3	42.5
74.0	64.9	64.1	66.2	44.0
74.1	71.2	66.9	69.0	38.1
74.3	70.7	67.0	70.5	43.8

NOAA FORM 59-4
(2-72)

Table 14

Analysis Error

850mb RMS RHe (%)

Month		NH102	NA110	NH ISO@6	SH31	SH ISO@7
Sept., 1977		15.8	16.6		16.6	
Oct., 1977		16.4	17.0		16.9	
Nov., 1977		16.7	18.9		15.9	
Dec., 1977		17.6	20.8		16.0	
Jan., 1978		17.6	20.8		16.2	
Feb., 1978		17.6	21.5	18.3	15.8	14.0
Mar., 1978		17.9	21.2	18.7	16.0	15.1
Apr., 1978		17.5	19.5	17.4	16.9	16.3
May, 1978		16.6	17.9	16.7	16.7	13.9
June, 1978		15.9	17.1	16.1	17.7	13.7
July, 1978	(15-31)	14.4	15.5	14.6	16.5	14.5
Aug., 1978		14.6	15.9	13.1	17.2	15.0
Sept., 1978	(1-20)	15.0	16.0	12.9	16.5	17.6
Sept., 1978	(23-30)	16.6	18.5	15.7	17.2	13.7
Oct., 1978		18.3	19.7	16.6	18.8	18.1
Nov., 1978		19.0	21.5	18.7	17.3	17.0
Dec., 1978		19.6	21.1	20.5	16.7	16.5

850mb Mean RHe (%)

Sept., 1977		0.7	3.4		1.8	
Oct., 1977		0.4	4.2		2.2	
Nov., 1977		1.0	2.6		3.0	
Dec., 1977		1.1	1.0		2.1	
[illegible], 1978		0.4	-1.1		4.3	
Feb., 1978		0.6	0.1	-1.5	3.4	-2.0
Mar., 1978		0.6	2.7	-1.2	4.2	-1.4
Apr., 1978		1.0	2.4	0.0	5.3	0.4
May, 1978		1.0	3.3	-0.2	5.0	-1.4
June, 1978		1.8	3.6	0.1	5.6	-0.4
July, 1978	(15-31)	1.6	3.4	-0.6	5.3	-2.2
Aug., 1978		1.7	3.6	-1.3	3.6	-0.0
Sept., 1978	(1-20)	1.2	2.6	-2.0	2.1	-0.8
Sept., 1978	(23-30)	-3.2	0.1	-6.0	-2.4	-1.4
Oct., 1978		-2.7	1.9	-7.4	1.1	-0.1
Nov., 1978		-1.5	2.6	-7.1	1.2	-2.7
Dec., 1978		-1.4	2.6	-8.2	-1.0	-0.9

850mb S1 RHe (%)

Sept., 1977		83.5	82.3		67.9	
Oct., 1977		83.8	83.8		67.6	
Nov., 1977		84.4	84.0		64.2	
Dec., 1977		85.9	84.4		67.8	
Jan., 1978		86.7	86.4		71.0	
Feb., 1978		85.0	86.8	78.6	70.4	59.3
Mar., 1978		84.2	85.1	83.2	70.6	60.6
Apr., 1978		82.6	81.4	79.5	73.9	63.9
May, 1978		82.3	84.6	75.4	71.4	52.4
June, 1978		83.3	86.4	81.8	75.2	48.8
July, 1978	(15-31)	83.9	84.1	78.3	72.0	55.7
Aug., 1978		83.7	84.3	78.8	67.5	58.0
Sept., 1978	(1-20)	85.4	82.5	79.3	72.2	62.4
Sept., 1978	(23-30)	79.7	79.7	76.3	80.2	50.3
Oct., 1978		82.6	81.8	73.3	72.9	71.3
Nov., 1978		82.4	81.0	68.0	71.9	56.7
Dec., 1978		81.0	80.7	75.2	72.4	66.9

First Guess Error

850mb RMS RHe (%)

NH102	NA110	NH ISO@6	SH31	SH ISO@7
21.8	22.9		25.3	
22.7	25.5		26.0	
23.4	25.0		24.3	
23.8	26.9		24.5	
22.6	24.6		23.8	
21.9	25.2	24.4	23.2	23.7
22.8	25.8	23.1	23.5	24.5
21.9	23.8	21.6	25.2	27.0
21.1	23.2	21.5	26.2	24.3
20.0	21.9	20.1	26.5	24.9
19.1	20.3	18.4	26.3	25.3
18.8	20.6	16.1	26.2	27.2
19.9	21.3	16.9	25.6	31.1
22.2	23.8	22.2	25.2	24.2
23.0	24.5	23.2	27.6	31.8
23.8	25.3	26.3	24.8	30.1
24.6	25.2	26.4	24.5	29.8

850mb Mean RHe (%)

5.9	7.3		6.6	
3.4	7.1		7.7	
1.0	2.8		7.0	
1.4	2.1		7.0	
1.6	1.5		9.0	
1.6	2.2	-0.4	7.9	2.0
2.7	5.5	0.7	9.8	4.1
3.3	4.4	3.5	10.7	3.7
3.9	5.1	2.9	11.1	0.6
4.5	4.3	4.5	12.1	3.8
4.5	4.0	3.9	12.9	-4.0
4.7	5.2	2.9	8.9	1.7
4.1	4.1	1.0	6.7	-0.9
0.4	3.5	-1.6	2.5	-0.1
-0.2	5.4	-3.6	6.2	-2.0
0.1	4.7	-3.8	4.7	-6.0
0.1	5.1	-7.1	5.3	-1.8

850mb S1 RHe (%)

87.9	88.6		82.6	
88.1	90.2		85.3	
87.9	89.6		78.1	
89.6	88.7		80.4	
89.7	88.9		82.4	
87.4	89.0	87.2	82.5	81.0
88.0	88.3	88.4	81.3	68.4
85.9	85.6	84.7	86.8	72.1
86.0	89.7	83.3	85.3	72.4
87.9	91.6	88.8	89.3	69.9
89.8	89.2	86.7	80.7	94.2
88.6	88.9	87.1	83.9	85.5
88.6	87.7	87.0	88.2	96.1
85.1	84.7	88.2	92.1	76.8
88.6	87.1	86.6	90.9	91.8
87.2	84.5	81.5	88.9	79.5
84.9	84.0	86.9	86.6	92.7

Table 15

NOAA FORM 59-4
(3-72)

Analysis Error
500mb RMS RHe (%)

Month			NH 102	NA110	NH ISO106	SH31	SH ISO107
Sept.,	1977		16.7	18.7		15.2	
Oct.,	1977		15.7	17.7		17.6	
Nov.,	1977		15.2	17.7		15.6	
Dec.,	1977		14.2	17.3		16.1	
Jan.,	1978		15.1	17.6		15.2	
Feb.,	1978		15.1	17.6	15.9	16.2	16.5
Mar.,	1978		15.7	18.3	17.1	15.0	13.6
Apr.,	1978		15.8	18.5	17.5	15.6	16.3
May,	1978		16.1	18.1	18.9	14.8	14.7
June,	1978		17.3	18.8	18.4	13.7	14.4
July,	1978	(15-31)	18.4	19.8	18.6	14.8	12.7
Aug.,	1978		17.9	20.2	18.5	14.9	13.7
Sept.,	1978	(1-20)	16.4	18.5	17.6	16.0	15.4
Sept.,	1978	(23-30)	16.7	16.5	12.7	13.4	14.6
Oct.,	1978		16.9	17.5	14.0	15.1	13.0
Nov.,	1978		17.0	18.4	12.9	15.1	15.9
Dec.,	1978		17.0	18.9	13.2	14.2	14.8

First Guess Error
500mb RMS RHe (%)

NH102	NA110	NH ISO106	SH31	SH ISO107
25.6	26.1		32.8	
26.2	26.6		34.8	
25.8	28.7		33.4	
26.2	27.9		32.0	
26.5	28.1		32.7	
26.2	27.2	28.4	32.1	40.8
26.8	28.6	32.4	32.7	40.1
26.5	28.4	32.8	34.1	36.3
25.9	27.6	29.7	34.3	38.4
26.3	26.0	28.5	34.2	36.9
27.0	26.5	28.8	36.5	38.5
26.6	27.1	29.1	36.2	36.6
26.8	26.8	27.4	33.8	39.9
26.6	25.4	29.7	27.9	34.6
26.0	26.5	27.8	30.2	32.3
26.6	27.8	26.1	31.0	35.7
26.9	28.4	27.4	28.1	32.4

500mb Mean RHe (%)

Sept.,	1977	0.8	0.2		2.6	
Oct.,	1977	2.2	0.8		4.2	
Nov.,	1977	2.4	1.9		3.5	
Dec.,	1977	2.5	1.2		2.9	
Jan.,	1978	2.1	1.3		2.5	
Feb.,	1978	2.4	1.3	2.2	2.9	3.4
Mar.,	1978	2.6	2.4	4.7	2.4	1.3
Apr.,	1978	2.2	1.3	4.5	5.1	0.4
May,	1978	2.2	1.5	2.6	5.1	4.9
June,	1978	0.9	-0.4	1.1	4.3	1.7
July,	1978	0.4	-2.1	-2.0	3.9	2.7
Aug.,	1978	0.3	-1.8	0.5	4.3	4.2
Sept.,	1978	1.3	-1.1	-0.6	3.2	4.3
Sept.,	1978	2.6	3.1	1.7	3.8	3.9
Oct.,	1978	3.1	2.9	2.3	4.7	3.2
Nov.,	1978	2.5	2.4	1.9	4.9	3.8
Dec.,	1978	2.7	1.9	1.9	4.2	2.8

Sept.,	1977	10.4	9.1		17.0	
Oct.,	1977	12.1	10.0		19.4	
Nov.,	1977	11.8	12.8		19.7	
Dec.,	1977	13.0	12.4		18.9	
Jan.,	1978	12.9	14.3		19.4	
Feb.,	1978	13.1	13.4	15.8	19.2	25.3
Mar.,	1978	13.7	14.4	21.0	20.6	24.3
Apr.,	1978	12.6	13.2	20.1	22.0	21.6
May,	1978	12.1	12.3	15.0	22.3	24.4
June,	1978	10.8	8.5	12.9	21.5	18.3
July,	1978	11.0	6.4	8.0	23.9	20.2
Aug.,	1978	11.3	8.5	12.7	22.8	21.6
Sept.,	1978	12.6	11.0	11.8	19.4	22.3
Sept.,	1978	7.5	7.8	8.3	12.8	12.8
Oct.,	1978	8.2	8.4	7.3	13.8	10.6
Nov.,	1978	8.5	9.2	8.1	12.8	7.4
Dec.,	1978	8.8	9.3	5.7	10.7	7.9

500mb S1 RHe (%)

Sept.,	1977	78.4	80.6		68.4	
Oct.,	1977	76.4	79.7		66.6	
Nov.,	1977	75.9	78.5		64.3	
Dec.,	1977	75.8	76.5		65.0	
Jan.,	1978	77.9	77.7		65.4	
Feb.,	1978	76.9	79.8	67.8	67.7	64.3
Mar.,	1978	77.0	79.9	65.5	67.5	58.8
Apr.,	1978	77.0	80.1	66.8	68.6	63.9
May,	1978	77.0	80.3	60.5	63.3	49.0
June,	1978	79.1	83.0	66.9	67.4	47.3
July,	1978	79.9	80.8	66.2	66.0	41.6
Aug.,	1978	79.7	83.0	70.5	64.5	48.0
Sept.,	1978	79.5	79.6	72.4	71.5	51.1
Sept.,	1978	73.1	73.0	43.7	64.3	35.1
Oct.,	1978	76.5	77.5	53.3	64.8	48.1
Nov.,	1978	75.9	75.2	53.7	65.5	53.8
Dec.,	1978	77.4	78.6	62.1	63.0	54.0

500mb S1 RHe (%)

85.2	85.5		86.2	
83.6	85.7		85.3	
82.5	85.7		84.8	
84.5	82.5		79.6	
85.3	81.4		80.9	
83.7	82.7	79.0	81.7	76.8
83.2	83.5	78.3	83.9	77.7
82.5	85.0	75.6	86.6	78.9
83.4	86.3	67.5	80.4	75.3
85.0	88.9	78.4	84.9	82.3
85.8	87.0	80.8	85.1	83.2
85.1	87.7	81.8	87.9	74.9
86.0	84.3	81.1	87.6	83.7
82.1	81.0	68.5	83.9	72.7
85.3	85.3	69.9	89.4	70.8
84.4	83.1	76.5	87.7	86.6
84.8	84.9	84.5	82.1	83.1

Table 16

NOAA FORM 59-4
12-72)

Analysis Error

850mb RMS Se (ms^{-1})

Month		NH102	NA110	NH ISOL06	SH31	SH ISOL06
?t.,	1977	3.?	3.4		3.4	
t.,	1977	3.?	3.4		3.4	
v.,	1977	3.6	3.7		3.4	
?.,	1977	3.?	3.8		3.4	
n.,	1978	3.?	3.7		3.5	
6.,	1978	3.4	3.2	3.0	3.2	3.7
r.,	1978	3.5	3.4	2.9	2.9	3.2
r.,	1978	3.4	3.6	2.6	3.1	3.6
y,	1978	3.4	3.5	2.5	3.6	4.4
ne,	1978	3.2	3.4	2.4	3.2	3.5
ly,	1978 (15-31)	3.1	3.2	2.5	3.6	4.6
g.,	1978	3.1	3.1	2.2	4.2	4.6
pt.,	1978 (1-20)	3.3	3.3	2.5	3.4	3.9
t.,	1978 (23-30)	2.7	2.5	2.3	2.2	1.6
t.,	1978	2.7	2.6	2.3	2.5	3.1
v.,	1978	2.9	2.9	2.3	2.4	2.6
c.,	1978	3.2	3.2	2.5	2.3	2.3

First Guess Error

850mb RMS Se (ms^{-1})

NH102	NA110	NH ISOL06	SH31	SH ISOL07
3.7	3.8		4.7	
3.8	3.8		4.7	
4.1	4.3		4.7	
4.2	4.5		4.5	
4.3	4.5		4.4	
4.1	4.0	4.4	4.1	6.3
4.0	4.1	4.0	4.0	5.7
3.8	4.1	3.7	4.3	6.5
3.8	4.0	3.6	5.4	8.8
3.6	3.8	3.5	4.7	7.7
3.6	3.6	3.2	5.0	8.7
3.5	3.6	2.9	5.5	8.1
3.6	3.8	3.3	4.9	7.1
3.8	3.4	4.2	4.1	5.8
3.9	3.6	4.4	4.7	8.1
4.1	4.2	4.1	5.0	7.6
4.5	4.5	4.9	4.4	6.9

850mb Mean Se (ms^{-1})

pt., 1977	-1.4	-1.5		-1.3	
t., 1977	-1.4	-1.4		-1.2	
v., 1977	-1.4	-1.2		-1.4	
c., 1977	-1.4	-1.2		-1.3	
1978	-1.3	-1.0		-1.2	
6., 1978	-1.2	-0.7	-0.7	-1.3	-1.2
r., 1978	-1.3	-1.1	-1.0	-1.2	-0.7
r., 1978	-1.3	-1.4	-1.1	-1.2	-1.7
y, 1978	-1.3	-1.5	-0.9	-1.2	-1.9
ne, 1978	-1.3	-1.6	-0.7	-1.3	-1.3
ly, 1978 (15-31)	-1.4	-1.6	-0.9	-1.5	-2.2
g., 1978	-1.4	-1.4	-0.8	-1.3	-1.8
pt., 1978 (1-20)	-1.6	-1.5	-1.1	-1.3	-1.5
pt., 1978 (23-30)	-1.0	-0.8	-0.6	-0.5	-0.4
t., 1978	-0.9	-1.0	-0.7	-0.7	-0.5
v., 1978	-1.1	-1.0	-0.7	-0.6	-0.0
c., 1978	-1.1	-1.1	-0.9	-0.6	-0.0

850mb Mean Se (ms^{-1})

-1.1	-1.4		-0.4	
-1.0	-1.1		-0.4	
-0.9	-1.2		-0.7	
-1.0	-1.2		-0.9	
-0.9	-1.2		-0.7	
-0.8	-0.8	-0.6	-0.7	-2.0
-1.0	-1.2	-1.2	-0.7	-0.5
-1.0	-1.2	-1.3	-0.6	-2.3
-1.0	-1.2	-0.9	-0.8	-4.1
-1.1	-1.3	-0.7	-0.6	-2.8
-1.2	-1.4	-1.2	-1.3	-3.7
-1.1	-1.3	-0.7	-0.6	-2.6
-1.2	-1.3	-1.0	-0.5	-2.6
-0.6	-0.4	-1.5	0.6	0.1
-0.5	-0.6	-1.0	0.1	-0.5
-0.5	-0.8	-0.6	-0.1	-0.6
-0.5	-0.7	-1.5	0.2	-0.1

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12-72)

Table 17

Analysis Error

500mb RMS Se (ms^{-1})

Month		NH102	NA110	NH ISOL06	SH31	SH ISOL07
Sept., 1977		3.4	3.1		3.4	
Oct., 1977		3.6	3.4		3.3	
Nov., 1977		3.9	4.0		3.3	
Dec., 1977		4.0	4.1		3.4	
Jan., 1978		4.1	3.8		3.2	
Feb., 1978		4.1	3.9	3.6	3.0	3.7
Mar., 1978		4.1	3.8	3.5	2.8	3.6
Apr., 1978		3.7	3.6	2.9	3.2	4.4
May, 1978		3.6	3.4	2.7	3.8	4.8
June, 1978		3.4	3.2	2.7	3.5	4.2
July, 1978	(15-31)	3.1	3.0	2.5	3.6	4.8
Aug., 1978		3.1	2.8	2.6	3.8	4.3
Sept., 1978	(1-20)	3.4	3.2	2.7	3.4	4.4
Sept., 1978	(23-30)	3.1	2.7	1.9	2.3	2.4
Oct., 1978		3.1	3.0	2.2	2.5	2.8
Nov., 1978		3.3	3.3	2.6	2.4	2.8
Dec., 1978		3.6	3.9	2.7	2.4	3.1

500mb Mean Se (ms^{-1})

Sept., 1977		-0.7	-0.5		-0.5	
Oct., 1977		-0.8	-0.6		-0.6	
Nov., 1977		-0.5	-0.5		-0.5	
Dec., 1977		-0.6	-0.5		-0.6	
[illegible], 1978		-0.6	-0.6		-0.5	
Feb., 1978		-0.6	-0.6	-0.4	-0.6	-1.2
Mar., 1978		-0.6	-0.6	-0.4	-0.3	-0.5
Apr., 1978		-0.6	-0.6	-0.4	-0.6	-0.8
May, 1978		-0.7	-0.6	-0.4	-0.6	-1.3
June, 1978		-0.6	-0.7	-0.6	-0.5	-0.6
July, 1978	(15-31)	-0.6	-0.6	-0.2	-1.5	-1.6
Aug., 1978		-0.6	-0.6	-0.2	-0.5	-0.2
Sept., 1978	(1-20)	-0.6	-0.6	-0.7	-0.4	-0.8
Sept., 1978	(23-30)	-0.4	-0.4	0.1	-0.2	-0.5
Oct., 1978		-0.3	-0.2	-0.1	-0.1	-0.0
Nov., 1978		-0.4	-0.3	-0.2	-0.4	-0.0
Dec., 1978		-0.4	-0.2	-0.3	-0.3	0.1

First Guess Error

500mb RMS Se (ms^{-1})

NH102	NA110	NH ISOL06	SH31	SH ISOL07
4.5	4.1		6.1	
4.7	4.8		6.0	
4.9	5.6		5.8	
5.5	5.6		5.6	
5.4	5.3		5.1	
5.3	5.1	6.1	4.7	7.1
5.5	5.1	5.9	4.8	8.2
5.0	5.1	5.3	5.6	9.3
4.5	4.6	4.6	6.5	11.6
4.4	4.4	4.4	6.5	11.3
4.0	4.0	4.1	5.7	10.1
4.0	3.9	4.0	6.6	10.7
4.6	4.6	4.9	6.3	9.5
4.6	4.3	4.1	6.0	7.0
4.8	4.6	5.2	5.9	8.3
5.2	5.1	5.7	6.2	9.5
5.6	5.9	5.5	5.2	8.2

500mb Mean Se (ms^{-1})

-1.1	-0.9		-0.5	
-1.0	-1.1		-0.8	
-1.0	-1.0		-0.6	
-1.2	-0.9		-0.5	
-1.4	-0.9		-0.6	
-1.1	-0.8	-1.8	-0.2	-0.6
-1.2	-0.9	-1.2	-0.3	0.3
-1.1	-0.9	-0.6	-0.8	-1.9
-0.9	-0.8	-0.7	-0.9	-5.3
-0.9	-0.9	-0.8	-0.8	-4.3
-0.9	-0.7	-0.3	-1.0	-3.7
-0.7	-0.6	-0.3	-1.5	-2.8
-0.9	-0.7	-0.6	-0.9	-3.9
-0.6	-0.2	0.2	-0.4	-1.4
-0.5	-0.3	-0.6	-0.2	-2.2
-0.4	-0.3	-0.6	-0.4	-1.8
-0.5	0.1	-0.7	-0.1	-1.5

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(2-72)

Table 18

Analysis Error

250mb RMS Se (ms^{-1})

Month		NH 102	NA 110	NH ISOL06	SH 31	SH ISOL07
Sept., 1977		5.0	4.6		4.8	
Oct., 1977		5.0	5.2		4.6	
Nov., 1977		5.1	5.3		4.3	
Dec., 1977		5.4	5.7		4.1	
Jan., 1978		5.2	5.8		4.0	
Feb., 1978		5.1	5.3	4.4	4.1	4.8
Mar., 1978		5.0	5.3	5.1	3.9	5.7
Apr., 1978		4.8	5.0	3.9	4.3	4.6
May, 1978		4.7	5.1	4.2	4.9	8.0
June, 1978		4.6	4.6	3.6	4.5	4.7
July, 1978	(15-31)	4.8	4.7	3.8	4.9	6.9
Aug., 1978		4.5	4.4	4.2	4.6	5.0
Sept., 1978	(1-20)	4.8	4.9	3.9	4.6	4.9
Sept., 1978	(23-30)	5.0	4.6	5.2	5.5	6.3
Oct., 1978		5.1	5.3	4.5	5.2	5.6
Nov., 1978		4.9	3.2	5.4	4.8	5.3
Dec., 1978		5.2	5.5	5.7	5.1	5.5

250mb Mean Se (ms^{-1})

Sept., 1977		-0.8	-0.6		-0.9	
Oct., 1977		-0.8	-1.0		-0.6	
Nov., 1977		-0.6	-0.8		-0.6	
Dec., 1977		-0.9	-0.9		-0.6	
[illegible] 1978		-1.1	-1.2		-0.6	
Feb., 1978		-1.0	-1.2	-0.6	-0.5	-0.9
Mar., 1978		-0.8	-1.0	-0.1	-0.3	-0.3
Apr., 1978		-0.7	-1.2	-0.3	-0.8	-0.9
May, 1978		-0.7	-0.9	-1.0	-0.7	-1.7
June, 1978		-0.7	-0.3	-0.7	-0.6	-0.6
July, 1978	(15-31)	-0.9	-0.6	-0.4	-0.6	-1.4
Aug., 1978		-0.7	-0.6	-0.7	-0.4	-0.3
Sept., 1978	(1-20)	-0.8	-0.7	-1.3	-0.7	-1.0
Sept., 1978	(23-30)	-0.6	-0.6	-0.8	-1.1	-1.7
Oct., 1978		-0.6	-0.9	-0.8	-0.7	-1.2
Nov., 1978		-0.6	-0.0	-0.9	-1.1	-0.1
Dec., 1978		-0.7	-0.3	-1.3	-1.2	-0.0

First Guess Error

250mb RMS Se (ms^{-1})

NH 102	NA 110	NH ISOL06	SH 31	SH ISOL07
7.8	7.3		10.6	
8.2	8.6		10.4	
8.0	8.7		9.6	
8.7	8.1		8.4	
8.1	8.2		8.5	
7.9	7.8	8.8	8.6	12.5
7.6	7.7	8.8	8.3	13.7
7.0	7.0	8.6	9.8	13.4
6.6	7.2	8.0	10.3	16.5
6.5	6.8	6.1	10.7	15.5
6.6	7.0	6.5	11.2	15.4
6.5	6.3	7.4	10.7	15.6
7.0	7.4	7.4	10.4	12.3
6.9	6.6	7.4	10.1	14.1
7.2	7.7	7.1	9.3	12.8
7.1	7.4	7.0	9.0	12.7
7.4	7.9	8.1	8.3	12.2

250mb Mean Se (ms^{-1})

-2.1	-1.8		-0.8	
-2.4	-2.8		-0.6	
-2.3	-2.2		-1.0	
-2.6	-1.7		-1.2	
-2.4	-1.7		-2.0	
-1.9	-1.5	-2.3	-1.7	-0.6
-1.8	-1.4	-2.7	-1.5	-0.5
-1.7	-0.7	-2.8	-3.2	-2.7
-1.7	-2.0	-3.1	-1.6	-5.8
-1.6	-1.9	-2.0	-1.3	-3.6
-1.9	-2.0	-1.5	-2.3	-1.8
-1.6	-1.5	-2.5	-1.8	-0.5
-1.8	-2.0	-2.3	-1.5	-2.2
-1.2	-0.9	-1.3	-2.0	-3.9
-1.3	-1.2	-1.6	-1.2	-3.8
-1.5	-0.9	-1.5	-1.2	-1.0
-1.4	-0.6	-1.9	-1.8	-1.8

NOAA FORM 59-4
(2-72)

Analysis Error

100mb RMS Se (ms^{-1})

Month		NH102	NA110	NH ISOL06	SH31	SH ISOL07
Sept., 1977		2.6	2.3		3.5	
Oct., 1977		2.7	2.6		4.1	
Nov., 1977		3.2	3.0		3.3	
Dec., 1977		3.4	3.3		3.6	
Jan., 1978		3.6	2.9		4.0	
Feb., 1978		3.4	3.1	3.5	3.3	3.4
Mar., 1978		3.1	2.9	2.7	3.9	3.3
Apr., 1978		2.6	2.7	2.3	3.8	4.2
May, 1978		2.4	2.7	2.3	4.2	9.3
June, 1978		2.3	2.3	2.1	4.0	7.2
July, 1978	(15-31)	2.1	1.9	2.0	5.4	10.7
Aug., 1978		2.3	2.0	2.0	4.2	5.5
Sept., 1978	(1-20)	2.3	2.2	2.0	4.1	6.5
Sept., 1978	(23-30)	2.6	2.3	2.5	4.4	5.3
Oct., 1978		2.8	2.7	2.7	4.7	6.5
Nov., 1978		3.2	3.2	3.3	4.0	5.5
Dec., 1978		3.6	3.8	3.7	3.9	6.1

100mb Mean Se (ms^{-1})

Sept., 1977		-0.3	-0.3		-0.6	
Oct., 1977		-0.3	-0.1		-0.8	
Nov., 1977		-0.4	-0.3		-0.5	
Dec., 1977		-0.6	-0.4		-0.8	
Jan., 1978		-0.6	-0.3		-0.8	
Feb., 1978		-0.6	-0.4	-0.8	-0.7	-1.2
Mar., 1978		-0.5	-0.2	-0.2	-0.5	-0.6
Apr., 1978		-0.2	-0.3	-0.3	-0.8	-1.0
May, 1978		-0.3	-0.4	-0.3	-0.6	-2.9
June, 1978		-0.3	-0.3	-0.3	-0.6	-3.2
July, 1978	(15-31)	-0.2	-0.3	-0.2	-0.7	-2.9
Aug., 1978		-0.3	-0.3	-0.1	-0.6	-1.9
Sept., 1978	(1-20)	-0.3	-0.3	-0.3	-0.4	-2.4
Sept., 1978	(23-30)	0.1	0.1	0.5	-0.4	-2.2
Oct., 1978		0.1	0.1	0.3	-0.3	-0.0
Nov., 1978		0.1	-0.0	0.1	-0.3	-1.2
Dec., 1978		-0.1	-0.0	-0.7	-0.3	-1.4

First Guess Error

100mb RMS Se (ms^{-1})

NH102	NA110	NH ISOL06	SH31	SH ISOL07
4.0	3.7		7.6	
4.1	4.0		7.7	
4.6	4.5		6.8	
5.2	5.0		6.6	
5.3	4.2		7.8	
5.2	4.5	6.7	7.1	10.0
4.7	4.4	5.2	6.0	7.7
3.9	3.8	5.0	8.0	9.8
3.9	4.0	4.6	7.6	14.3
3.8	3.8	4.6	9.1	18.6
3.5	3.5	3.7	10.1	15.6
3.7	3.5	4.2	10.0	17.3
3.9	3.9	4.3	9.0	14.8
4.3	3.9	6.0	8.8	11.8
4.6	4.2	6.6	8.9	14.0
5.1	4.7	7.4	8.2	13.4
5.5	5.3	7.1	8.3	12.4

100mb Mean Se (ms^{-1})

0.2	0.7		-0.3	
-0.1	0.5		-0.5	
-0.4	0.3		-0.3	
-0.5	-0.3		-0.5	
-1.2	-0.7		-0.9	
-1.1	-0.5	-2.5	-0.9	-4.0
-0.6	-0.1	-0.2	-0.2	-1.9
-0.3	-0.0	-0.1	-1.7	-1.9
-0.2	0.2	-0.3	-1.7	-7.5
0.2	1.0	0.9	-1.7	-10.4
0.2	0.8	0.6	-1.9	-3.6
0.3	1.0	1.4	-2.1	-5.4
0.2	0.8	0.7	-1.5	-7.4
-0.5	-0.8	1.4	-1.6	-5.9
-0.2	-0.5	1.7	-2.0	-2.3
-0.4	-0.6	1.0	-0.7	-4.2
-1.1	-1.1	-1.3	-0.8	-4.7

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(2-72)

Table 20

Analysis Error
850 mb RMS $\vec{V}_e$ (ms^{-1})

Month		NH102	NA110	NH ISOLOG	SH31	SH ISOLOT
Jan	1977	4.5	4.5		4.6	
Feb	1977	4.5	4.6		4.6	
Mar	1977	4.9	5.2		4.5	
Apr	1977	4.9	5.4		4.5	
May	1978	5.0	5.1		4.5	
Jun	1978	4.8	4.7	4.3	4.3	4.5
Jul	1978	4.8	5.0	4.2	4.0	4.2
Aug	1978	4.8	5.1	3.6	4.2	4.8
Sep	1978	4.6	4.9	3.5	4.8	5.6
Oct	1978	4.3	4.6	3.4	4.2	4.7
Nov	1978 (15-31)	4.1	4.3	3.3	4.8	5.7
Dec	1978	4.1	4.2	3.2	5.5	5.8
Jan	1978 (1-20)	4.4	4.5	3.5	4.7	4.9
Feb	1978 (23-30)	3.8	3.4	3.2	3.3	2.5
Mar	1978	3.9	3.7	3.2	3.5	3.8
Apr	1978	4.0	4.0	3.4	3.4	3.6
May	1978	4.4	4.3	3.5	3.3	3.1

First Guess Error
850mb RMS $\vec{V}_e$ (ms^{-1})

NH102	NA110	NH ISOLOG	SH31	SH ISOLOT
5.3	5.5		7.3	
5.5	5.6		7.0	
5.9	6.3		7.0	
6.2	6.6		6.7	
6.2	6.3		6.5	
6.0	5.8	6.6	6.4	8.7
5.9	6.0	6.5	6.2	8.3
5.7	6.1	5.5	6.5	9.4
5.5	5.8	5.3	7.4	11.4
5.2	5.4	4.9	6.9	10.3
5.1	5.2	5.1	7.7	12.0
5.0	5.2	4.6	8.0	11.9
5.3	5.6	4.8	7.5	11.0
5.7	5.3	5.7	7.4	10.7
6.0	5.5	6.5	7.6	11.3
6.4	6.2	6.5	8.0	11.4
6.9	6.7	7.3	7.0	10.3

Table 21

NOAA FORM 59-4
(2-72)

Analysis Error
500mb RMS $\vec{V}_e$ (ms^{-1})

Month		NH102	NA110	NH ISOL06	SH31	SH ISOL06
Apr.	1977	4.8	4.2		4.9	
May	1977	5.0	4.8		4.6	
Jun.	1977	5.5	5.4		4.5	
Jul.	1977	5.6	5.5		4.5	
Aug.	1978	5.7	5.3		4.2	
Sep.	1978	5.7	5.3	5.1	4.1	4.4
Oct.	1978	5.7	5.2	5.3	4.0	5.2
Nov.	1978	5.2	5.0	4.4	4.4	6.2
Dec.	1978	5.0	4.9	4.1	5.0	6.3
Jan.	1978	4.7	4.5	3.8	5.3	6.5
Feb.	1978 (15-31)	4.3	4.1	3.4	5.8	9.0
Mar.	1978	4.3	3.9	3.6	5.4	6.5
Apr.	1978 (1-20)	4.7	4.4	3.7	4.9	7.4
May	1978 (23-30)	4.2	3.8	3.0	3.4	4.0
Jun.	1978	4.4	4.2	3.3	3.6	7.8
Jul.	1978	4.7	4.6	4.0	4.1	7.1
Aug.	1978	5.1	5.5	4.9	3.4	9.4

First Guess Error
500mb RMS $\vec{V}_e$ (ms^{-1})

NH102	NA110	NH ISOL06	SH31	SH ISOL07
6.3	5.7		9.4	
6.7	6.8		8.9	
7.1	7.6		8.5	
7.7	7.6		8.5	
7.8	7.5		7.5	
7.6	7.3	9.1	7.3	10.9
7.6	7.2	8.6	7.2	12.1
7.1	7.2	8.1	8.2	13.1
6.6	6.6	6.9	9.2	15.1
6.3	6.3	6.6	9.3	15.1
5.7	5.7	6.3	9.7	16.6
5.8	5.7	6.4	9.8	15.9
6.6	6.6	7.1	9.6	15.3
6.7	6.3	6.6	9.1	11.5
6.9	6.7	8.4	8.8	12.5
7.5	7.3	8.4	9.4	14.3
8.1	8.4	9.2	8.3	13.5

Table 2C

NOAA FORM 59-4
(2-72)

Analysis Error

250mb RMS $\vec{V}_e$ (ms^{-1})

Month			NH		SH	
		NH102	NA110	ISOL06	SH31	ISOL06
Oct. 1977		6.8	6.3		7.7	
Nov. 1977		6.7	7.0		6.3	
Dec. 1977		7.1	7.3		6.5	
Jan. 1978		7.4	7.8		5.8	
Feb. 1978		7.0	7.7		5.9	
Mar. 1978		7.0	7.2	6.3	5.5	5.9
Apr. 1978		6.8	7.2	8.4	5.2	8.0
May 1978		6.6	6.8	6.6	6.0	6.6
June 1978		6.4	7.0	5.6	6.5	10.1
July 1978		6.4	6.4	5.3	6.2	6.5
Aug. 1978	(15-31)	6.4	6.5	5.1	7.5	11.6
Sept. 1978		6.1	6.0	5.5	6.2	6.7
Oct. 1978	(1-20)	6.5	6.6	5.5	6.4	6.7
Oct. 1978	(23-30)	7.0	6.2	6.8	7.5	8.9
Nov. 1978		6.8	6.9	7.0	7.1	10.0
Dec. 1978		6.9	6.9	7.8	6.9	9.5
Jan. 1979		7.2	7.5	8.9	7.4	14.1

First Guess Error

250mb RMS $\vec{V}_e$ (ms^{-1})

		NH		SH	
NH102	NA110	ISOL06	SH31	ISOL07	
12.8	13.1		16.9		
13.4	14.2		15.7		
13.5	15.8		15.3		
13.0	13.7		13.6		
10.7	11.1		12.4		
10.3	10.4	12.6	11.8	17.0	
10.0	10.4	12.6	11.0	18.5	
9.4	9.7	12.3	13.2	17.8	
8.9	9.7	10.2	13.8	21.0	
9.0	9.7	9.1	14.2	19.6	
8.9	9.4	8.8	14.8	23.6	
8.8	8.7	10.3	14.2	21.4	
9.4	10.0	10.7	14.7	20.1	
9.6	8.9	11.2	13.8	20.3	
9.7	10.2	10.3	13.6	18.7	
9.8	10.1	11.1	13.5	18.5	
9.9	10.6	12.0	12.8	19.0	

NOAA FORM 59-4

Table 23

Month			100mb RMS $\vec{V}_e$ (ms^{-1}) NH102	NA110	NH ISOL06	SH31	SH ISOL06	100mb RMS $\vec{V}_e$ (ms^{-1}) NH102	NA110	NH ISOL06	SH31	SH ISOL06
ept.,	1977		3.7	3.3		5.4		5.9	5.1		11.0	
ct.,	1977		3.8	3.5		5.7		6.0	5.5		11.0	
ov.,	1977		4.5	4.1		4.6		6.7	6.1		9.7	
ec.,	1977		4.8	4.5		5.1		7.3	6.8		10.0	
n.,	1978		5.0	3.9		5.4		7.5	5.9		11.0	
b.,	1978		4.7	4.2	4.7	4.8	4.8	7.2	6.1	9.4	10.2	13.5
ar.,	1978		4.3	4.1	3.1	4.2	4.3	6.4	5.9	7.7	9.0	11.5
r.,	1978		3.6	3.7	3.6	4.9	5.3	5.5	5.4	7.5	10.6	12.6
ay.,	1978		3.4	3.6	3.8	5.8	12.9	5.4	5.6	6.9	10.2	17.6
une,	1978		3.2	3.2	3.0	5.0	8.2	5.4	5.4	6.8	11.4	20.6
uly,	1978	(15-31)	3.0	2.7	2.9	7.5	13.9	5.2	4.9	6.2	13.4	22.0
ug.,	1978		3.2	2.8	2.9	5.4	6.7	5.4	5.1	6.3	13.3	22.5
ept.,	1978	(1-20)	3.3	3.0	3.6	5.6	7.6	5.4	5.5	6.5	12.5	19.8
ept.,	1978	(23-30)	3.6	3.2	3.3	5.8	7.6	6.0	5.5	7.7	11.5	14.8
ct.,	1978		3.9	3.6	3.9	6.1	9.6	6.4	5.9	8.7	12.0	17.4
ov.,	1978		4.4	4.3	4.9	5.2	10.9	7.1	6.5	10.6	11.8	16.8
ec.,	1978		5.2	5.1	5.2	5.2	9.3	7.8	7.2	11.1	11.5	17.0