EWTD 76-04

AWSTL
FILE COPY

02354
02362
01934

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL WEATHER SERVICE
SYSTEMS DEVELOPMENT OFFICE
TECHNIQUES DEVELOPMENT LABORATORY

TDL Office Note 76-7

COMPARATIVE VERIFICATION OF LOCAL AND GUIDANCE SURFACE WIND FORECASTS--NO. 4

Gary M. Carter and George W. Hollenbaugh

March 1976

COMPARATIVE VERIFICATION OF LOCAL AND GUIDANCE SURFACE WIND FORECASTS--NO. 4

Gary M. Carter and George W. Hollenbaugh

We have verified TDL's automated forecasts of surface wind for the months of April through September 1975. These forecasts were based on the warm season (April-September) regression equations described in National Weather Service (NWS) Technical Procedures Bulletin No. 86 (NWS, 1973a) during April through July, and the new warm season equations described in NWS Technical Procedures Bulletin 137 (NWS, 1975) during August and September.

This verification study was conducted in conjunction with the NWS combined aviation/public weather verification system (NWS, 1973b). Scores for the objective guidance forecasts are presented here along with corresponding scores for local forecasts prepared at Weather Service Forecast Offices (WSFO's). Table 1 shows the 94 stations which were used. The Technical Procedures Branch of the Office of Meteorology and Oceanography furnished the local forecasts.

Since the local forecasts were recorded as calm if the wind speed was expected to be less than 8 knots, the comparison was conducted in two ways. First, for all those cases where both the local and guidance wind speed forecasts were at least 8 knots, the mean absolute error (MAE) of speed was computed. Cases where the observed wind was calm were then eliminated from that sample and the MAE of direction was computed. Secondly, for all cases where both local and guidance forecasts were available, skill score, percent correct, and bias by category (i.e., the number of forecasts in a particular category divided by the number of observations in that category) were computed from contingency tables of wind speed. The seven categories were; less than 8, 8-12, 13-17, 18-22, 23-27, 28-32, and greater than 32 knots. Tables 2-6 show the comparative verification scores for the 6-month period April through September 1975, while tables 7-11 show the corresponding contingency tables. Scores are given for three projections. These are 18, 30, and 42 hours for the guidance forecasts which were made from 0000 GMT data. However, the local forecasts were not released until 1000 GMT, so about 9 hours later data were available for their preparation. It should also be noted that the objective speed forecasts were enhanced by the method described in NWS Technical Procedures Bulletin No. 102 (NWS, 1973c) during April through July. Beginning in August all our speed forecasts were "inflated" by the technique illustrated in NWS Technical Procedures Bulletin No. 137 (NWS, 1975).

Statistics for all 94 stations combined are shown in Table 2. The MAE scores for direction reveal an advantage for the guidance that increases from 3° at 18 hours to 6° at 42 hours. The mean error, skill score, and percent correct of speed forecasts are better for guidance forecasts at all three projections, but in general these scores do not exhibit the relative improvement of guidance with longer projections that is shown for the direction forecasts. The individual biases by category from the contingency tables show that both guidance and locals tend to underforecast the higher wind speeds.

Tables 2-6 and 7-11 show results for the NWS Eastern, Southern, Central, and Western Regions, respectively. Category two (8-12 knots) is overforecast by the objective system for all three projections in each region, while the frequencies of occurrence of categories four (18-22 knots) and five (23-27) are generally underforecast.

Except for the 18-hr and 30-hr percents correct for the Western Region (see Tables 6 and 11), the MAE's, skill scores, and percents correct for TDL's objective guidance forecasts are better than those for the NWS local forecasts. However, our objective forecasts still have undesirable bias characteristics, although not nearly as severe as was the case in a previous warm season verification study (Carter, et. al., 1975). Now that we are using the inflation technique on a regular basis, we feel that future results will show that this aspect of our system has been improved.

Table 12 shows the distribution of wind direction MAE's by categories--0-30°, 40-60°, 70-90°, 100-120°, 130-150°, and 160-180°--for all 94 stations combined. Here we see that the guidance had fewer errors of 40 degrees or more than the local estimates for all three projections.

The distribution of direction MAE's for each region are given in Tables 13-16. These results are similar to those in Table 12 except for the Western Region 18-hr forecasts where the local forecasts had slightly fewer errors of 40 degrees or more (see Table 16).

ACKNOWLEDGMENT

We wish to thank the Technical Procedures Branch of the Office of Meteorology and Oceanography for providing us with the local forecasts, and especially Gerry Cobb of that Branch who processed the data.

REFERENCES

Carter, G. M., H. R. Glahn, and G. W. Hollenbaugh, 1975: Comparative verification of local and guidance surface wind forecasts--No. 2. TDL Office Note, No. 75-1, Techniques Development Laboratory, Silver Spring, Md. 7 pp.

National Weather Service, 1973a: Surface wind forecasts based on model output statistics (MOS)--No. 1. Technical Procedures Bulletin, No. 86, 11 pp.

National Weather Service, 1973b: Combined aviation/public weather forecast verification. National Weather Service Operations Manual, Chapter C-73, 15 pp.

National Weather Service, 1973c: Surface wind forecasts based on model output statistics (MOS)--No. 4. Technical Procedures Bulletin, No. 102, 4 pp.

National Weather Service, 1975: Warm season surface wind forecasts based on MOS--No. 4. Technical Procedures Bulletin, No. 137, 6 pp.

Table 1. Ninety-four stations used for comparative verification of guidance and local surface wind forecasts.

PWM	Portland, Maine	TCC	Tucumcari, New Mexico
BTV	Burlington, Vermont	SSM	Sault Ste Marie, Michigan
CON	Concord, New Hampshire	DTW	Detroit, Michigan
BOS	Boston, Massachusetts	SBN	South Bend, Indiana
PVD	Providence, Rhode Island	IND	Indianapolis, Indiana
BUF	Buffalo, New York	LEX	Lexington, Kentucky
SYR	Syracuse, New York	SDF	Louisville, Kentucky
ALB	Albany, New York	MSN	Madison, Wisconsin
JFK	New York, New York	MKE	Milwaukee, Wisconsin
ACY	Atlantic City, New Jersey	ORD	Chicago, Illinois
EWR	Newark, New Jersey	SPI	Springfield, Illinois
ERI	Erie, Pennsylvania	STL	St. Louis, Missouri
PIT	Pittsburgh, Pennsylvania	MCI	Kansas City, Missouri
PHL	Philadelphia, Pennsylvania	TOP	Topeka, Kansas
CLE	Cleveland, Ohio	DDC	Dodge City, Kansas
CMH	Columbus, Ohio	DEN	Denver, Colorado
BKW	Beckley, West Virginia	GJT	Grand Junction, Colorado
CRW	Charleston, West Virginia	SHR	Sheridan, Wyoming
DCA	Washington, D.C.	CYS	Cheyenne, Wyoming
ORF	Norfolk, Virginia	BIS	Bismarck, North Dakota
RDU	Raleigh-Durham, North Carolina	FAR	Fargo, North Dakota
CLT	Charlotte, North Carolina	RAP	Rapid City, South Dakota
CAE	Columbia, South Carolina	FSD	Sioux Falls, South Dakota
GSP	Greenville, South Carolina	BFF	Scottsbluff, Nebraska
ATL	Atlanta, Georgia	OMA	Omaha, Nebraska
SAV	Savannah, Georgia	MSP	Minneapolis, Minnesota
MIA	Miami, Florida	DSM	Des Moines, Iowa
JAX	Jacksonville, Florida	BRL	Burlington, Iowa
BHM	Birmingham, Alabama	INL	International Falls, Minneso
MOB	Mobile, Alabama	FLG	Flagstaff, Arizona
TYS	Knoxville, Tennessee	PHX	Phoenix, Arizona
MEM	Memphis, Tennessee	CDC	Cedar City, Utah
MEI	Meridian, Mississippi	SLC	Salt Lake City, Utah
JAN	Jackson, Mississippi	LAS	Las Vegas, Nevada
MSY	New Orleans, Louisiana	RNO	Reno, Nevada
SHV	Shreveport, Louisiana	SAN	San Diego, California
IAH	Houston, Texas	LAX	Los Angeles, California
SAT	San Antonio, Texas	FAT	Fresno, California
DFW	Forth Worth, Texas	SFO	San Francisco, California
ABI	Abilene, Texas	PDX	Portland, Oregon
LBB	Lubbock, Texas	PDT	Pendleton, Oregon
ELP	El Paso, Texas	SEA	Seattle, Washington
LIT	Little Rock, Arkansas	GEG	Spokane, Washington
FSM	Fort Smith, Arkansas	BOI	Boise, Idaho
TUL	Tulsa, Oklahoma	PIH	Pocatello, Idaho
OKC	Oklahoma City, Oklahoma	MSO	Missoula, Montana
ABQ	Albuquerque, New Mexico	GTF	Great Falls, Montana

Table 2. Verification of subjective local and objective guidance surface wind forecasts for 94 stations across the United States during April through September 1975.

FCST. PROJ. (HRS)	TYPE OF FCST	DIRECTION (DEG) MEAN ABS. ERROR	DIRECTION (DEG) NO. OF CASES	SPEED (KTS) MEAN ABS. ERROR	SPEED (KTS) MEAN FCST	SPEED (KTS) MEAN OBS	SPEED (KTS) NO. OF CASES	CONTINGENCY TABLE SKILL SCORE	CONTINGENCY TABLE PERCENT FCST. CORRECT	BIAS BY CATEGORY CAT1	CAT2	CAT3	CAT4	CAT5	CAT6	CAT7	NO. OF CASES
18	GUIDANCE	36	8110	3.0	11.4	10.9	8173	0.27	53	0.81	1.30	0.82	0.65	0.63	0.91	0.50	15281
	LOCAL	39		3.3	12.2			0.24	50	0.80	1.21	1.06	0.91	0.76	0.78	0.17	
30	GUIDANCE	36	3185	3.4	10.2	9.6	3274	0.30	68	0.99	1.19	0.53	0.16	0.12	0.0	0.0	15335
	LOCAL	40		4.0	11.3			0.25	64	0.92	1.28	0.94	0.64	0.35	0.86	0.0	
42	GUIDANCE	45	8001	3.2	10.9	10.6	8076	0.22	51	0.80	1.40	0.70	0.37	0.18	0.35	0.29	15233
	LOCAL	51		3.7	11.7			0.17	46	0.79	1.30	0.97	0.55	0.29	0.23	0.0	

Table 3. Verification of subjective local and objective guidance surface wind forecasts for 24 stations in the Eastern Region of the NWS during April through September 1975.

FCST. PROJ (HRS)	TYPE OF FCST	DIRECTION (DEG) MEAN ABS. ERROR	DIRECTION (DEG) NO. OF CASES	SPEED (KTS) MEAN ABS. ERROR	SPEED (KTS) MEAN FCST	SPEED (KTS) MEAN OBS	SPEED (KTS) NO. OF CASES	CONTINGENCY TABLE SKILL SCORE	CONTINGENCY TABLE PERCENT FCST. CORRECT	BIAS BY CATEGORY CAT1	BIAS BY CATEGORY CAT2	BIAS BY CATEGORY CAT3	BIAS BY CATEGORY CAT4	BIAS BY CATEGORY CAT5	BIAS BY CATEGORY CAT6	BIAS BY CATEGORY CAT7	NO. OF CASES
18	GUIDANCE	36	2195	2.9	11.6	10.7	2202	0.26	53	0.75	1.24	0.91	0.86	1.22	2.40	2.00	3783
	LOCAL	40		3.0	11.9			0.24	51	0.82	1.15	1.06	0.79	0.91	1.00	0.0	
30	GUIDANCE	35	641	3.2	10.2	9.6	655	0.32	73	1.03	1.01	0.52	0.55	0.67	0.0	0.0	3808
	LOCAL	37		3.7	11.4			0.28	68	0.91	1.29	1.09	0.97	0.67	0.0	0.0	
42	GUIDANCE	45	2174	3.0	11.0	10.5	2180	0.21	51	0.74	1.37	0.70	0.46	0.27	1.17	2.00	3759
	LOCAL	51		3.4	11.6			0.16	47	0.79	1.23	0.97	0.54	0.36	0.17	0.0	

Table 4. Verification of subjective local and objective guidance surface wind forecasts for 24 stations in the Southern Region of the NWS during April through September 1975.

FCST. PROJ. (HRS)	TYPE OF FCST	DIRECTION (DEG) MEAN ABS. ERROR	DIRECTION (DEG) NO. OF CASES	SPEED (KTS) MEAN ABS. ERROR	SPEED (KTS) MEAN FCST	SPEED (KTS) MEAN OBS	SPEED (KTS) NO. OF CASES	CONTINGENCY TABLE SKILL SCORE	CONTINGENCY TABLE PERCENT FCST. CORRECT	BIAS BY CATEGORY CAT1	BIAS BY CATEGORY CAT2	BIAS BY CATEGORY CAT3	BIAS BY CATEGORY CAT4	BIAS BY CATEGORY CAT5	BIAS BY CATEGORY CAT6	BIAS BY CATEGORY CAT7	NO. OF CASES
18	GUIDANCE	34	1939	2.9	10.9	10.4	1954	0.27	55	0.85	1.28	0.78	0.58	0.52	1.00	0.0	3940
	LOCAL	37		3.3	12.0			0.20	49	0.72	1.28	1.17	1.09	0.86	1.00	0.0	
30	GUIDANCE	33	670	3.4	10.2	10.0	690	0.34	73	1.00	1.20	0.55	0.05	0.10	0.0	0.0	3960
	LOCAL	38		3.9	11.0			0.27	69	0.95	1.32	0.72	0.36	0.50	2.00	0.0	
42	GUIDANCE	44	1973	3.1	10.6	10.0	1997	0.22	52	0.81	1.38	0.71	0.32	0.14	0.0	0.0	3918
	LOCAL	48		3.6	11.7			0.16	47	0.67	1.38	1.16	0.73	0.38	2.00	0.0	

Table 5. Verification of subjective local and objective guidance surface wind forecasts for 28 stations in the Central Region of the NWS during April through September 1975.

FCST. PROJ (HRS)	TYPE OF FCST	DIRECTION (DEG) MEAN ABS. ERROR	DIRECTION (DEG) NO. OF CASES	SPEED (KTS) MEAN ABS. ERROR	SPEED (KTS) MEAN FCST	SPEED (KTS) MEAN OBS	SPEED (KTS) NO. OF CASES	CONTINGENCY TABLE: SKILL SCORE	CONTINGENCY TABLE: PERCENT FCST. CORRECT	BIAS BY CATEGORY CAT1	BIAS BY CATEGORY CAT2	BIAS BY CATEGORY CAT3	BIAS BY CATEGORY CAT4	BIAS BY CATEGORY CAT5	BIAS BY CATEGORY CAT6	BIAS BY CATEGORY CAT7	NO. OF CASES
18	GUIDANCE	36	2967	3.0	11.6	11.2	2999	0.24	50	0.77	1.34	0.80	0.66	0.59	0.57	0.33	4538
	LOCAL	40		3.4	12.4			0.22	48	0.64	1.29	1.05	0.86	0.65	0.64	0.33	
30	GUIDANCE	37	1185	3.5	10.2	9.8	1223	0.27	64	1.00	1.23	0.51	0.16	0.0	0.0	0.0	4547
	LOCAL	42		4.0	11.4			0.21	57	0.83	1.51	0.90	0.65	0.15	0.40	0.0	
42	GUIDANCE	45	2941	3.3	11.1	11.0	2975	0.18	47	0.75	1.44	0.71	0.38	0.09	0.13	0.0	4531
	LOCAL	52		3.7	11.8			0.12	43	0.63	1.41	0.93	0.46	0.21	0.13	0.0	

Table 6. Verification of subjective local and objective guidance surface wind forecasts for 18 stations in the Western Region of the NWS during April through September 1975.

FCST. PROJ (HRS)	TYPE OF FCST	DIRECTION (DEG) MEAN ABS. ERROR	DIRECTION (DEG) NO. OF CASES	SPEED (KTS) MEAN ABS. ERROR	SPEED (KTS) MEAN FCST	SPEED (KTS) MEAN OBS	SPEED (KTS) NO. OF CASES	CONTINGENCY TABLE SKILL SCORE	CONTINGENCY TABLE PERCENT FCST. CORRECT	BIAS BY CATEGORY CAT1	BIAS BY CATEGORY CAT2	BIAS BY CATEGORY CAT3	BIAS BY CATEGORY CAT4	BIAS BY CATEGORY CAT5	BIAS BY CATEGORY CAT6	BIAS BY CATEGORY CAT7	NO. OF CASES
18	GUIDANCE	37	1009	3.4	11.2	11.1	1018	0.26	55	0.86	1.40	0.80	0.48	0.19	0.0	*	3020
	LOCAL	38		3.8	12.4			0.23	55	1.02	1.01	0.94	0.93	0.71	1.00	*	
30	GUIDANCE	38	689	3.4	10.2	9.1	706	0.22	61	0.92	1.31	0.56	0.05	0.0	*	*	3020
	LOCAL	41		4.1	11.5			0.21	62	1.02	0.94	1.16	0.79	0.43	**	*	
42	GUIDANCE	46	913	3.6	10.9	10.5	924	0.23	54	0.88	1.44	0.64	0.30	0.30	0.0	*	3025
	LOCAL	50		4.1	11.9			0.15	51	1.05	1.05	0.78	0.56	0.30	0.33	*	

* This category was neither forecast nor observed.
** This category was forecast once but was never observed.

Table 7. Contingency tables for subjective local and objective surface wind forecasts for 94 stations across the United States during April through September 1975.

18-Hr Forecasts

GUIDANCE FCST

OBS	1	2	3	4	5	6	7	T
1	3468	2718	181	7	0	0	0	6374
2	1538	3736	637	47	4	0	0	5962
3	173	1172	777	132	20	2	0	2276
4	7	134	249	110	23	6	0	529
5	4	11	27	40	19	9	1	111
6	0	2	6	8	3	2	2	23
7	0	1	0	2	1	2	0	6
T	5190	7774	1877	346	70	21	3	15281

LOCAL FCST

OBS	1	2	3	4	5	6	7	T
1	3306	2704	332	31	1	0	0	6374
2	1573	3359	943	79	6	2	0	5962
3	205	982	863	200	19	7	0	2276
4	10	126	240	119	32	2	0	529
5	1	13	34	40	18	5	0	111
6	0	1	4	10	7	1	0	23
7	0	1	2	0	1	1	1	6
T	5095	7186	2418	479	84	18	1	15281

30-Hr Forecasts

GUIDANCE FCST

OBS	1	2	3	4	5	6	7	T
1	8615	1972	68	1	0	0	0	10656
2	1762	1642	151	5	1	0	0	3561
3	182	511	160	7	2	0	0	862
4	25	101	59	14	1	0	0	200
5	4	18	16	5	0	0	0	43
6	1	4	2	1	0	0	0	8
7	0	3	1	0	1	0	0	5
T	10589	4251	457	33	5	0	0	15335

LOCAL FCST

OBS	1	2	3	4	5	6	7	T
1	7958	2448	230	18	2	0	0	10656
2	1628	1571	313	45	3	1	0	3561
3	185	441	190	39	5	2	0	862
4	30	86	61	17	3	3	0	200
5	6	14	12	8	2	1	0	43
6	1	4	2	1	0	0	0	8
7	0	2	3	0	0	0	0	5
T	9808	4566	811	128	15	7	0	15335

42-Hr Forecasts

GUIDANCE FCST

OBS	1	2	3	4	5	6	7	T
1	3285	2908	185	5	0	0	0	6383
2	1584	3796	519	29	1	0	0	5929
3	215	1369	602	75	4	1	0	2266
4	15	218	220	53	8	2	0	516
5	2	28	42	23	6	4	1	106
6	0	7	12	4	0	2	1	26
7	1	1	3	2	0	0	0	7
T	5102	8327	1583	191	19	9	2	15233

LOCAL FCST

OBS	1	2	3	4	5	6	7	T
1	3002	2906	446	27	2	0	0	6383
2	1641	3368	847	68	5	0	0	5929
3	324	1159	651	118	11	3	0	2266
4	49	216	196	44	9	2	0	516
5	7	32	42	21	3	1	0	106
6	1	11	9	4	1	0	0	26
7	0	2	3	2	0	0	0	7
T	5024	7694	2194	284	31	6	0	15233

Table 8. Contingency tables for subjective local and objective guidance surface wind forecasts for 24 stations in the Eastern Region of the NWS during April through September 1975.

18-Hr. Forecasts

GUIDANCE FCST

OBS	1	2	3	4	5	6	7	T
1	675	674	53	1	0	0	0	1403
2	351	1079	220	14	1	0	0	1665
3	32	291	204	40	9	0	0	576
4	0	19	46	30	10	5	0	110
5	0	0	0	8	8	6	1	23
6	0	0	1	2	0	1	1	5
7	0	1	0	0	0	0	0	1
T	1058	2064	524	95	28	12	2	3783

LOCAL FCST

OBS	1	2	3	4	5	6	7	T
1	685	647	71	0	0	0	0	1403
2	409	988	257	10	1	0	0	1665
3	53	249	229	39	5	1	0	576
4	1	26	50	23	9	1	0	110
5	0	0	4	12	5	2	0	23
6	0	0	0	3	1	1	0	5
7	0	1	0	0	0	0	0	1
T	1148	1911	611	87	21	5	0	3783

30-Hr. Forecasts

GUIDANCE FCST

OBS	1	2	3	4	5	6	7	T
1	2421	382	8	0	0	0	0	2811
2	438	333	31	1	0	0	0	803
3	32	89	31	3	2	0	0	157
4	1	10	9	8	1	0	0	29
5	0	0	2	4	0	0	0	6
6	0	0	1	0	0	0	0	1
7	0	0	0	0	1	0	0	1
T	2892	814	82	16	4	0	0	3808

LOCAL FCST

OBS	1	2	3	4	5	6	7	T
1	2176	589	46	0	0	0	0	2811
2	362	364	66	11	0	0	0	803
3	31	75	41	8	2	0	0	157
4	2	6	14	6	1	0	0	29
5	0	0	2	3	1	0	0	6
6	0	0	1	0	0	0	0	1
7	0	0	1	0	0	0	0	1
T	2571	1034	171	28	4	0	0	3808

42-Hr. Forecasts

GUIDANCE FCST

OBS	1	2	3	4	5	6	7	T
1	644	709	40	0	0	0	0	1393
2	351	1112	166	9	0	0	0	1638
3	39	376	150	20	1	1	0	587
4	2	43	46	15	4	2	0	112
5	0	1	8	8	1	3	1	22
6	0	1	3	0	0	1	1	6
7	1	0	0	0	0	0	0	1
T	1037	2242	413	52	6	7	2	3579

LOCAL FCST

OBS	1	2	3	4	5	6	7	T
1	607	687	95	4	0	0	0	1393
2	402	968	251	17	0	0	0	1638
3	84	309	169	20	4	1	0	587
4	8	50	39	11	4	0	0	112
5	1	4	10	7	0	0	0	22
6	0	1	4	1	0	0	0	6
7	0	1	0	0	0	0	0	1
T	1102	2020	568	60	8	1	0	3759

Table 9. Contingency tables for subjective local and objective guidance surface wind forecasts for 24 stations in the Southern Region of the NWS during April through September 1975.

18-Hr. Forecasts

GUIDANCE FCST

OBS	1	2	3	4	5	6	7	T
1	1059	716	41	1	0	0	0	1817
2	456	946	112	7	1	0	0	1522
3	33	258	145	24	2	0	0	462
4	2	27	57	22	7	0	0	115
5	0	2	6	12	0	1	0	21
6	0	0	1	0	0	0	0	1
7	0	0	0	1	1	0	0	2
T	1550	1949	362	67	11	1	0	3940

LOCAL FCST

OBS	1	2	3	4	5	6	7	T
1	861	868	79	9	0	0	0	1817
2	411	865	227	19	0	0	0	1522
3	34	195	172	58	2	1	0	462
4	0	17	56	30	12	0	0	115
5	0	4	5	9	3	0	0	21
6	0	0	1	0	0	0	0	1
7	0	0	1	0	1	0	0	2
T	1306	1949	541	125	18	1	0	3940

30-Hr. Forecasts

GUIDANCE FCST

OBS	1	2	3	4	5	6	7	T
1	2502	405	14	0	0	0	0	2921
2	381	350	32	1	1	0	0	765
3	34	121	46	1	0	0	0	202
4	10	31	16	1	0	0	0	58
5	2	5	3	0	0	0	0	10
6	0	2	0	0	0	0	0	2
7	0	2	0	0	0	0	0	2
T	2929	916	111	3	1	0	0	3960

LOCAL FCST

OBS	1	2	3	4	5	6	7	T
1	2345	541	29	6	0	0	0	2921
2	375	322	59	6	3	0	0	765
3	42	108	44	6	1	1	0	202
4	10	30	13	2	1	2	0	58
5	3	5	0	1	0	1	0	10
6	0	2	0	0	0	0	0	2
7	0	1	1	0	0	0	0	2
T	2775	1009	146	21	5	4	0	3960

42-Hr. Forecasts

GUIDANCE FCST

OBS	1	2	3	4	5	6	7	T
1	970	809	44	2	0	0	0	1825
2	463	931	99	6	0	0	0	1499
3	43	284	125	10	1	0	0	463
4	1	40	53	11	2	0	0	107
5	0	10	6	5	0	0	0	21
6	0	1	0	0	0	0	0	1
7	0	0	2	0	0	0	0	2
T	1477	2075	329	34	3	0	0	3918

LOCAL FCST

OBS	1	2	3	4	5	6	7	T
1	778	915	123	8	1	0	0	1825
2	399	883	197	19	1	0	0	1499
3	44	225	154	36	4	0	0	463
4	6	34	52	12	1	2	0	107
5	2	4	12	2	1	0	0	21
6	0	1	0	0	0	0	0	1
7	0	0	1	1	0	0	0	2
T	1229	2062	539	78	8	2	0	3918

Table 10. Contingency tables for subjective local and objective guidance surface wind forecasts for 28 stations in the Central Region of the NWS during April through September 1975.

18-Hr. Forecasts

GUIDANCE FCST

OBS	1	2	3	4	5	6	7	T
1	686	768	51	1	0	0	0	1506
2	405	1205	224	21	2	0	0	1857
3	66	438	335	55	7	2	0	903
4	2	61	99	41	5	1	0	209
5	3	7	10	14	10	2	0	46
6	0	1	3	5	3	1	1	14
7	0	0	0	1	0	2	0	3
T	1162	2480	722	138	27	8	1	4538

LOCAL FCST

OBS	1	2	3	4	5	6	7	T
1	592	783	117	13	1	0	0	1506
2	314	1154	353	31	3	2	0	1857
3	54	399	361	75	9	5	0	903
4	6	57	98	41	7	0	0	209
5	0	7	19	13	6	1	0	46
6	0	1	3	6	4	0	0	14
7	0	0	1	0	0	1	1	3
T	966	2401	952	179	30	9	1	4538

30-Hr. Forecasts

GUIDANCE FCST

OBS	1	2	3	4	5	6	7	T
1	2299	626	28	0	0	0	0	2953
2	555	540	52	3	0	0	0	1150
3	80	199	61	3	0	0	0	343
4	9	36	24	5	0	0	0	74
5	2	10	8	0	0	0	0	20
6	1	2	1	1	0	0	0	5
7	0	1	1	0	0	0	0	2
T	2946	1414	175	12	0	0	0	4547

LOCAL FCST

OBS	1	2	3	4	5	6	7	T
1	1919	930	97	6	1	0	0	2953
2	458	573	103	15	0	1	0	1150
3	60	186	80	16	1	0	0	343
4	14	32	20	7	0	1	0	74
5	2	7	7	3	1	0	0	20
6	1	2	1	1	0	0	0	5
7	0	1	1	0	0	0	0	2
T	2454	1731	309	48	3	2	0	4547

42-Hr. Forecasts

GUIDANCE FCST

OBS	1	2	3	4	5	6	7	T
1	626	816	65	1	0	0	0	1508
2	429	1235	192	11	1	0	0	1868
3	73	526	257	34	1	0	0	891
4	6	90	87	18	0	0	0	201
5	2	9	23	6	2	1	0	43
6	0	4	7	4	0	1	0	16
7	0	1	1	2	0	0	0	4
T	1136	2681	632	76	4	2	0	4531

LOCAL FCST

OBS	1	2	3	4	5	6	7	T
1	492	859	150	6	1	0	0	1508
2	354	1168	320	24	2	0	0	1868
3	95	488	265	39	2	2	0	891
4	9	100	78	13	1	0	0	201
5	2	18	15	6	2	0	0	43
6	0	9	3	3	1	0	0	16
7	0	1	2	1	0	0	0	4
T	952	2643	833	92	9	2	0	4531

Table 11. Contingency tables for subjective local and objective guidance surface wind forecasts for 18 stations in the Western Region of the NWS during April through September 1975.

18-Hr. Forecasts

GUIDANCE FCST

OBS	1	2	3	4	5	6	7	T
1	1048	560	36	4	0	0	0	1648
2	326	506	81	5	0	0	0	918
3	42	185	93	13	2	0	0	335
4	3	27	47	17	1	0	0	95
5	1	2	11	6	1	0	0	21
6	0	1	1	1	0	0	0	3
7	0	0	0	0	0	0	0	0
T	1420	1281	269	46	4	0	0	3020

LOCAL FCST

OBS	1	2	3	4	5	6	7	T
1	1168	406	65	9	0	0	0	1648
2	439	352	106	19	2	0	0	918
3	64	139	101	28	3	0	0	335
4	3	26	36	25	4	1	0	95
5	1	2	6	6	4	2	0	21
6	0	0	0	1	2	0	0	3
7	0	0	0	0	0	0	0	0
T	1675	925	314	88	15	3	0	3020

30-Hr. Forecasts

GUIDANCE FCST

OBS	1	2	3	4	5	6	7	T
1	1393	559	18	1	0	0	0	1971
2	388	419	36	0	0	0	0	843
3	36	102	22	0	0	0	0	160
4	5	24	10	0	0	0	0	39
5	0	3	3	1	0	0	0	7
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
T	1822	1107	89	2	0	0	0	3020

LOCAL FCST

OBS	1	2	3	4	5	6	7	T
1	1518	388	58	6	1	0	0	1971
2	433	312	85	13	0	0	0	843
3	52	72	25	9	1	1	0	160
4	4	18	14	2	1	0	0	39
5	1	2	3	1	0	0	0	7
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
T	2008	792	185	31	3	1	0	3020

42-Hr. Forecasts

GUIDANCE FCST

OBS	1	2	3	4	5	6	7	T
1	1045	574	36	2	0	0	0	1657
2	341	518	62	3	0	0	0	924
3	60	183	70	11	1	0	0	325
4	6	45	34	9	2	0	0	96
5	0	8	5	4	3	0	0	20
6	0	1	2	0	0	0	0	3
7	0	0	0	0	0	0	0	0
T	1452	1329	209	29	6	0	0	3025

LOCAL FCST

OBS	1	2	3	4	5	6	7	T
1	1125	445	78	9	0	0	0	1657
2	486	349	79	8	2	0	0	924
3	101	137	63	23	1	0	0	325
4	26	32	27	8	3	0	0	96
5	2	6	5	6	0	1	0	20
6	1	0	2	0	0	0	0	3
7	0	0	0	0	0	0	0	0
T	1741	969	254	54	6	1	0	3025

Table 12. Distribution of mean absolute errors associated with subjective local and objective guidance forecasts of surface wind direction for 94 stations in the United States during April through September 1975.

FCST. PROJ. (HRS.)	TYPE OF FCST.	FREQUENCY OF MEAN ABSOLUTE ERRORS BY CATEGORY					
		0-30°	40-60°	70-90°	100-120°	130-150°	160-180°
18	Guidance	5238	1591	603	316	217	145
	Local	4960	1634	724	359	263	170
30	Guidance	2105	542	226	144	97	71
	Local	1961	581	281	148	122	92
42	Guidance	4435	1642	789	498	370	267
	Local	3956	1710	953	590	460	332

Table 13. Distribution of mean absolute errors associated with subjective local and objective guidance forecasts of surface wind direction for 24 stations in the Eastern Region of the NWS during April through September 1975.

FCST. PROJ. (HRS.)	TYPE OF FCST.	FREQUENCY OF MEAN ABSOLUTE ERRORS BY CATEGORY					
		0-30°	40-60°	70-90°	100-120°	130-150°	160-180°
18	Guidance	1407	446	152	98	54	38
	Local	1294	467	228	92	67	47
30	Guidance	416	133	45	23	14	10
	Local	408	115	67	22	19	10
42	Guidance	1192	460	233	125	88	76
	Local	1074	477	255	150	120	98

Table 14. Distribution of mean absolute errors associated with subjective local and objective guidance forecasts of surface wind direction for 24 stations in the Southern Region of the NWS during April through September 1975.

FCST. PROJ. (HRS.)	TYPE OF FCST.	FREQUENCY OF MEAN ABSOLUTE ERRORS BY CATEGORY					
		0-30°	40-60°	70-90°	100-120°	130-150°	160-180°
18	Guidance	1275	380	156	61	38	29
	Local	1241	380	155	78	52	33
30	Guidance	465	109	34	31	15	16
	Local	437	114	44	37	23	15
42	Guidance	1098	420	192	128	86	49
	Local	977	442	260	136	96	62

Table 15. Distribution of mean absolute errors associated with subjective local and objective guidance forecasts of surface wind direction for 28 stations in the Central Region of the NWS during April through September 1975.

FCST. PROJ. (HRS.)	TYPE OF FCST.	FREQUENCY OF MEAN ABSOLUTE ERRORS BY CATEGORY					
		0-30°	40-60°	70-90°	100-120°	130-150°	160-180°
18	Guidance	1905	590	221	107	90	54
	Local	1768	621	277	133	102	66
30	Guidance	751	216	103	57	38	20
	Local	675	257	109	60	54	30
42	Guidance	1622	615	274	177	145	108
	Local	1424	628	351	226	184	128

Table 16. Distribution of mean absolute errors associated with subjective local and objective guidance forecasts of surface wind direction for 18 stations in the Western Region of the NWS during April through September 1975.

FCST. PROJ. (HRS.)	TYPE OF FCST.	FREQUENCY OF MEAN ABSOLUTE ERRORS BY CATEGORY					
		0-30°	40-60°	70-90°	100-120°	130-150°	160-180°
18	Guidance	651	175	74	50	35	24
	Local	657	166	64	56	42	24
30	Guidance	473	84	44	33	30	25
	Local	441	95	61	29	26	37
42	Guidance	523	147	90	68	51	34
	Local	481	163	87	78	60	44