

1998 NATIONAL HURRICANE CENTER FORECAST VERIFICATION

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Introduction

Every six hours, the National Hurricane Center issues a 72-hour track and intensity forecast for all tropical cyclones in the north Atlantic and east Pacific basins. Official forecasts are verified by comparison with the final best-track, derived from a post-storm analysis of all available position and intensity data. The best-track data used for verification excludes extratropical and tropical (subtropical) depression stages. Climatology and persistence forecasts are used as standards for skill in comparing forecasts: the CLIPER model forecasts for track and the SHIFOR model forecasts for intensity.

Track forecast errors are the great circle distance between a forecast position and a best-track position for the same time. A tropical cyclone's intensity is defined as the maximum one-minute wind speed ten meters above the ground. This maximum speed can occur anywhere within the cyclone's circulation. Forecast and best-track intensities are rounded to the closest five knots. Intensity forecast errors are the absolute difference between the forecast wind speed and the best-track wind speed for the same time.

Model objective track guidance is of two types, late or early. Late models require the completion of global numerical models. They are run every six or twelve hours. These models are initialized about three hours after synoptic time, about the same time the official forecast is issued. Therefore, their forecasts arrive too late for the forecaster to use. Various strategies are employed to provide the forecaster with more timely guidance derived from the late models. These are the early models and are available at any time. [Table 1](#) defines model and other abbreviations used in this report.

North Atlantic

The 1998 north Atlantic hurricane season had 14 named tropical cyclones. This is more than the annual average of 10 and double the number which occurred in 1997. There were 314 official forecasts issued for tropical storms and hurricanes. This is more than three times the number issued last year and about the same number as were issued for 1996. The average official forecast track errors by storm are listed in [Table 2.1](#). [Table 2.2](#) gives the average official and CLIPER track error for 1998 and the previous ten-year average. The 1998 official errors are near the ten-year average at the 12-hour and 24-hour forecast periods and smaller thereafter. In fact, the 72-hour track error for 1998 is the second smallest on record. The corresponding 1998

CLIPER errors are, also, near their ten-year average values for all time periods, except smaller at the 72-hour forecast period. The 1998 departures for the official and CLIPER forecasts from their ten-year average error by forecast period are most easily seen in the latter portion of [Table 2.2](#).

[Table 3.1](#) and [Table 3.2](#) are homogeneous comparisons of the late and early Atlantic track guidance models, respectively. Of the late models, the UKMET model has the smallest forecast errors at all time periods. The GFDL model is a close second for all forecast periods, except the 72-hour period where NOGAPS is the second best. For the early models, LBAR is the best performer at the 12-hour and 24-hour forecast periods. The UKMI has the smallest error for the 36-hour and 48-hour forecast periods with the NGPI best at the 72-hour period. Note that the official forecast track error is smaller than all the early guidance, except for UKMI at the 36-hour forecast period.

The average official absolute wind speed errors by storm are listed in [Table 4.1](#). [Table 4.2](#) gives the average official and SHIFOR absolute wind speed errors for 1998 and the previous eight-year average. The 1998 official and SHIFOR intensity forecast errors are larger than their long-term average for all forecast periods. Thus, while the 1998 official absolute intensity forecast are skillful, the errors being less than the SHIFOR errors, they are unusually large in comparison to their long-term average.

[Table 5](#) displays the absolute wind speed errors for the objective guidance from early and late models. The official forecast errors are smaller than these for all forecast periods, except the for the GFDL model at the 48-hour and 72-hour forecast periods. SHIPS was the most consistent of the early intensity forecast models, averaging nearly 15 percent better than SHIFOR for all time periods past the 12-hour.

East Pacific

The 1998 east Pacific hurricane season had 13 named tropical cyclones, three less than the long-term average. There were 214 official forecasts issued for tropical storms and hurricanes in the basin this year, about the same as 1997. The average official forecast track errors by storm are listed in [Table 6.1](#). [Table 6.2](#) gives the average official and CLIPER track errors for 1998 and the previous ten years. This year's error departures from the long-term average are given in the latter portion of the table. Like the Atlantic, the East Pacific official forecast track errors are smaller than their ten-year average for all forecast periods. However, unlike the Atlantic, the corresponding 1998 CLIPER errors average nearly 12 percent better than their ten-year average for all time periods.

[Table 7.1](#) and [Table 7.2](#) are homogeneous comparisons of various track guidance for the east Pacific late and early models, respectively. Of the late models, the UKMET, as in the Atlantic, has the smallest error at all forecast periods. For the early models, [Table 7.2](#) shows NHC91, the east Pacific statistical-dynamical model, has the smallest error for all forecast periods, except at the 48-hour period where the UKMI is slightly better. Again the forecasters appear to be using the early model guidance optimally, having forecast errors nearly the same as the best guidance.

[Table 8.1](#) gives the average official absolute wind speed errors by storm. The average official and SHIFOR absolute wind speed errors for 1998 and the previous eight-year average are in [Table 8.2](#). The official intensity forecast errors are smaller than their long-term averages at all time periods, but this year's official intensity forecasts have skill over SHIFOR only at the 12-hour and 24-hour periods. Notice that for the long-term average, the official intensity error has

skill over SHIFOR at all forecast periods. As clearly shown in the departure portion of the table, this year's SHIFOR errors are unusually small in comparison to the corresponding eight-year average SHIFOR error at all forecast periods.

The absolute wind speed errors for the objective guidance from early and late models are given in [Table 9](#). SHIFOR and SHIPS are comparable in their forecasts of intensity and have the smallest errors.

Additional Results

This is the first year that the objective tracking system used in the MRF model for tracking tropical cyclones was applied to the ETA and NGM models. These models are classified as late since their results are not available to the forecaster until after advisory transmission. These are limited-area models and provide forecasts to 48 hours. A homogeneous comparison with the other late models for the Atlantic and east Pacific is given in [Table 10.1](#) and [Table 10.2](#), respectively. For the Atlantic, both models have errors larger than the Aviation Run of the MRF for all time periods. For the east Pacific, the ETA model has errors nearly double those of the other models while the NGM has errors larger than the AVNO, except at 72 hours where its error is smaller than the AVNO and NGPS. Note that the number of cases is small for each basin and time period.

Conclusions

1. The official 1998 track forecasts have skill over CLIPER and are better than their 10-year average for the north Atlantic and east Pacific for all forecast periods.
2. Of the late models, the UKMET global model produced the best track forecasts of tropical cyclones for 1998 for the north Atlantic and east Pacific.
3. For the north Atlantic early models, LBAR produced the best track forecasts for the forecast early periods and the UKMET model for the latter forecast periods.
4. For the east Pacific early models, NHC91 produces the best track forecasts for all forecast periods.
5. The early objective track guidance appears to be used to good advantage by the forecasters since their average track forecast errors are smaller or very near the best early guidance for the north Atlantic and east Pacific basins at all forecast periods.
6. For intensity, climatologically speaking, 1998 was a very different year in the north Atlantic and east Pacific basins. The 1998 Atlantic SHIFOR error departures averaged +20 percent larger than its long-term average for all forecast periods. Thus, while the official intensity forecasts showed skill over this year's SHIFOR forecasts, they were larger than their long-term average. The 1998 Pacific SHIFOR error departures averaged -20 percent smaller than its long-term for all forecast time periods. Thus, while the official intensity forecasts were better than their long-term average, little skill was found over this year's SHIFOR forecast.
7. Given the small number of cases, the NGM and ETA models did not provide useful tropical cyclone guidance for 1998.

TABLE 1

MODEL ABBREVIATIONS

[\(Click here for model descriptions\)](#)

- OFCL** Official track or intensity forecasts
- OFCI** Official Track Forecast Interpolated from the previous 6 hours
- OHPC** Hydrometeorological or Marine Prediction Centers' track forecast
- CLIP** CLImatology and PERsistence track model - CLIPER (Atl and Pac)
- A90E** NHC90 Statistical-Dynamical Model...early version (Atl)
- P91E** NHC91 Statistical-Dynamical Model...early version (Pac)
- BAMD** Beta Advection Model Deep (Global)
- BAMM** Beta Advection Model Medium (Global)
- BAMS** Beta Advection Model Shallow (Global)
- LBAR** A simplified version of VICBAR (Atl and Pac)
- NGM** Nested Grid Model (Limited-area)
 - ETA** Non-nested grid model using eta vertical coordinate (Limited-area)
- GFDL** GFDL Model (Atl and Pac - track and intensity)
 - GFDI** GFDL Interpolated Track and Intensity (6- and 12-hour)
- MRF** Medium Range Forecast model (Global)
- AVNO** MRF Model Aviation Run (Global)
- UKM** UKMET Model (Global)
- UKMI** UKMET Interpolated Track Model (6- and 12-hour)
- NGPS** Navy Operational Global Atmospheric Prediction System - NOGAPS
- NGPI** NOGAPS Interpolated Track Model (6- and 12-hour)
- SHFR** Statistical Hurricane Intensity Forecast Model - SHIFOR (Atl and Pac)
- SHIP** Statistical Hurricane Intensity Prediction Scheme - SHIPS (Atl and Pac)

TABLE 2.1

**NORTH ATLANTIC
1998 OFFICIAL AVERAGE TRACK FORECAST ERRORS (NM) BY STORM**

	FORECAST ERRORS (NM) FOR AL0198 ALEX					
	00	12	24	36	48	72
OFCL	16.9	44.7	75.8	91.0	96.3	136.4
#CASES	17	17	15	13	11	7

FORECAST ERRORS (NM) FOR AL0298 BONNIE

	00	12	24	36	48	72
OFCL	12.4	44.7	85.0	126.0	163.4	241.9
#CASES	39	39	37	35	33	29

FORECAST ERRORS (NM) FOR AL0398 CHARLEY

	00	12	24	36	48	72
OFCL	14.8	31.0				
#CASES	2	2	0	0	0	0

FORECAST ERRORS (NM) FOR AL0498 DANIELLE

	00	12	24	36	48	72
OFCL	7.4	31.1	47.5	66.3	79.0	146.5
#CASES	39	39	37	35	33	29

FORECAST ERRORS (NM) FOR AL0598 EARL

	00	12	24	36	48	72
OFCL	38.1	84.3	156.7	261.7	296.2	
#CASES	10	10	8	6	4	0

FORECAST ERRORS (NM) FOR AL0698 FRANCES

	00	12	24	36	48	72
OFCL	29.4	101.3	145.0	188.2	136.3	
#CASES	7	7	5	3	1	0

FORECAST ERRORS (NM) FOR AL0798 GEORGES

	00	12	24	36	48	72
OFCL	9.8	29.0	50.1	71.6	87.5	117.5
#CASES	50	50	48	46	44	40

FORECAST ERRORS (NM) FOR AL0898 HERMINE

	00	12	24	36	48	72
OFCL	4.0	25.3				
#CASES	2	2	0	0	0	0

FORECAST ERRORS (NM) FOR AL0998 IVAN

	00	12	24	36	48	72
OFCL	12.8	53.6	115.0	179.6	241.6	305.5
#CASES	24	24	22	20	18	14

FORECAST ERRORS (NM) FOR AL1098 JEANNE

	00	12	24	36	48	72
OFCL	12.9	38.6	67.5	91.2	127.3	237.0
#CASES	35	35	33	31	29	25

FORECAST ERRORS (NM) FOR AL1198 KARL

	00	12	24	36	48	72
OFCL	12.6	66.8	138.2	187.4	229.6	472.8
#CASES	15	15	13	11	9	5

FORECAST ERRORS (NM) FOR AL1298 LISA

	00	12	24	36	48	72
OFCL	16.9	89.9	200.1	265.4	314.6	471.6
#CASES	15	15	13	11	9	5

FORECAST ERRORS (NM) FOR AL1398 MITCH

	00	12	24	36	48	72
OFCL	9.8	37.6	75.8	110.1	139.4	170.4
#CASES	39	38	35	32	28	24

FORECAST ERRORS (NM) FOR AL1498 NICOLE

	00	12	24	36	48	72
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OFCL	8.6	48.8	83.3	116.7	189.4	220.1
#CASES	23	21	17	14	11	10

TABLE 2.2

NORTH ATLANTIC
1998 OFFICIAL AND CLIPER AVERAGE TRACK ERRORS
FOR A HOMOGENEOUS SAMPLE

PERIOD	00	12	24	36	48	72	(hr)
OFCL	12.5	45.5	83.6	116.3	144.2	202.8	(nm)
CLIP	12.5	55.1	113.0	170.7	224.0	301.9	(nm)
#CASES	317	314	283	257	230	188	

1988 - 1997 OFFICIAL AND CLIPER AVERAGE TRACK ERRORS
FOR A HOMOGENEOUS SAMPLE

PERIOD	00	12	24	36	48	72	(hr)
OFCL	12.9	47.3	88.3	127.4	165.6	248.2	(nm)
CLIP	12.9	55.6	112.2	173.1	233.3	344.7	(nm)
#CASES	1855	1841	1638	1456	1288	1008	

1998 OFFICIAL AND CLIPER AVERAGE ERROR DEPARTURE
FROM THE 1988 - 1997 OFFICIAL AND CLIPER AVERAGE TRACK ERROR

PERIOD	00	12	24	36	48	72	(hr)
OFCL DEPARTURE	-03	-04	-05	-09	-13	-18	(%)
CLIP DEPARTURE	-03	-01	+01	-01	-04	-12	(%)

TABLE 3.1

NORTH ATLANTIC
1998 AVERAGE MODEL TRACK ERROR (NM) FOR A HOMOGENEOUS SAMPLE
(LATE*)

	00	12	24	36	48	72
OFCL	10.8	43.0	80.3	111.2	140.2	189.4
CLIP	10.8	52.7	113.2	174.7	224.8	285.4
GFDL	10.8	47.8	83.2	112.2	145.8	223.3
UKM	10.8	47.7	82.5	107.4	141.7	195.4
NGPS	10.8	58.9	86.3	120.7	161.7	203.0
AVNO	10.8	77.8	113.5	159.0	212.2	299.5
#CASES	116	116	101	85	76	54

* Although CLIPER is an early model, it is include here for reference.

TABLE 3.2**NORTH ATLANTIC
1998 AVERAGE MODEL TRACK ERRORS (NM) FOR A HOMOGENEOUS SAMPLE
(EARLY)**

	00	12	24	36	48	72
OFCL	11.7	43.0	78.7	113.1	138.7	180.7
CLIP	11.7	52.9	111.1	169.8	223.2	275.1
A98E	11.7	48.3	86.1	127.0	174.6	271.9
BAMD	11.7	47.7	82.8	124.5	165.5	289.8
BAMM	11.7	54.3	97.0	143.0	179.5	250.0
BAMS	11.7	70.4	129.1	186.5	235.9	310.7
LBAR	11.7	43.0	81.0	123.2	170.9	259.4
OFCL	11.7	47.3	83.4	118.6	145.3	202.0
GFDI	11.7	47.5	85.4	120.9	155.4	261.5
UKMI	11.7	50.0	85.5	112.3	139.8	213.1
NGPI	11.7	46.7	83.8	122.0	155.4	208.2
OHPC	11.7	59.3	87.0	118.1	160.4	225.3
#CASES	203	203	187	169	148	114

TABLE 4.1**NORTH ATLANTIC
1998 OFFICIAL AVERAGE ABSOLUTE WIND SPEED FORECAST ERROR (KT) BY
STORM**

	FORECAST ERRORS (KT) FOR AL0198 ALEX					
	00	12	24	36	48	72
OFCL	2.1	5.9	8.7	11.9	19.1	24.3
#CASES	17	17	15	13	11	7
	FORECAST ERRORS (KT) FOR AL0298 BONNIE					
	00	12	24	36	48	72
OFCL	3.6	5.1	6.4	8.0	8.8	11.2
#CASES	39	39	37	35	33	29
	FORECAST ERRORS (KT) FOR AL0398 CHARLEY					
	00	12	24	36	48	72
OFCL	7.5	7.5				
#CASES	2	2	0	0	0	0
	FORECAST ERRORS (KT) FOR AL0498 DANIELLE					
	00	12	24	36	48	72
OFCL	3.7	9.0	13.1	15.3	15.8	18.6
#CASES	39	39	37	35	33	29
	FORECAST ERRORS (KT) FOR AL0598 EARL					
	00	12	24	36	48	72
OFCL	5.5	10.5	9.4	15.8	17.5	

#CASES	10	10	8	6	4	0
	FORECAST	ERRORS	(KT)	FOR	AL0698	FRANCES
	00	12	24	36	48	72
OFCL	4.3	6.4	10.0	15.0	10.0	
#CASES	7	7	5	3	1	0
	FORECAST	ERRORS	(KT)	FOR	AL0798	GEORGES
	00	12	24	36	48	72
OFCL	2.8	7.3	13.2	16.0	18.4	25.4
#CASES	50	50	48	46	44	40
	FORECAST	ERRORS	(KT)	FOR	AL0898	HERMINE
	00	12	24	36	48	72
OFCL	2.5	5.0				
#CASES	2	2	0	0	0	0
	FORECAST	ERRORS	(KT)	FOR	AL0998	IVAN
	00	12	24	36	48	72
OFCL	2.3	6.5	9.1	12.5	17.5	22.5
#CASES	24	24	22	20	18	14
	FORECAST	ERRORS	(KT)	FOR	AL1098	JEANNE
	00	12	24	36	48	72
OFCL	1.9	6.7	9.7	10.8	12.4	12.0
#CASES	35	35	33	31	29	25
	FORECAST	ERRORS	(KT)	FOR	AL1198	KARL
	00	12	24	36	48	72
OFCL	2.0	9.7	13.8	20.5	26.7	29.0
#CASES	15	15	13	11	9	5
	FORECAST	ERRORS	(KT)	FOR	AL1298	LISA
	00	12	24	36	48	72
OFCL	2.7	6.0	9.6	12.7	15.0	21.0
#CASES	15	15	13	11	9	5
	FORECAST	ERRORS	(KT)	FOR	AL1398	MITCH
	00	12	24	36	48	72
OFCL	8.3	9.6	14.0	21.4	29.1	35.4
#CASES	39	38	34	32	28	24
	FORECAST	ERRORS	(KT)	FOR	AL1498	NICOLE
	00	12	24	36	48	72
OFCL	2.8	9.0	17.9	20.4	20.9	22.5
#CASES	23	21	17	14	11	10

TABLE 4.2

**NORTH ATLANTIC
1998 AVERAGE ABSOLUTE WIND SPEED ERROR FOR A HOMOGENEOUS SAMPLE**

PERIOD	00	12	24	36	48	72	(hr)
OFCL	3.6	7.5	11.4	14.6	17.4	21.2	(kt)
SHFR	3.6	9.5	13.5	17.0	20.1	24.2	(kt)

#CASES 317 314 282 257 230 188

1990 - 1997 AVERAGE ABSOLUTE WIND SPEED ABSOLUTE ERROR FOR A HOMOGENEOUS SAMPLE

PERIOD	00	12	24	36	48	72	(hr)
OFCL	3.6	6.6	10.2	13.0	15.6	19.1	(kt)
SHFR	3.6	8.3	11.7	14.1	16.4	18.8	(kt)

#CASES 1466 1453 1290 1147 1010 790

1998 OFFICIAL AND SHIFOR AVERAGE ABSOLUTE WIND SPEED ERROR DEPARTURE FROM THE 1990 - 1997 OFFICIAL AND SHIFOR AVERAGE ABSOLUTE WIND SPEED ERROR

PERIOD	00	12	24	36	48	72	(hr)
OCFL DEPARTURE	00	+14	+12	+12	+12	+11	(%)
SHFR DEPARTURE	00	+14	+15	+21	+23	+29	(%)

TABLE 5

NORTH ATLANTIC 1998 AVERAGE MODEL ABSOLUTE WIND SPEED ERROR (KT) FOR A HOMOGENEOUS SAMPLE

	00	12	24	36	48	72
OFCL	3.9	7.4	11.2	14.4	16.9	20.5
SHFR	3.9	9.7	13.6	17.5	20.5	24.3
OFCL	3.9	8.6	12.3	14.6	17.7	20.9
SHIP	3.9	8.7	11.4	14.7	17.2	21.3
GFDI	3.9	10.0	12.5	15.4	17.9	21.7
GFDL	3.9	15.8	15.6	15.5	16.1	17.2
#CASES	234	234	211	191	168	137

TABLE 6.1

EAST PACIFIC
1998 OFFICIAL AVERAGE TRACK FORECAST ERRORS (NM) BY STORM

	FORECAST ERRORS (NM) FOR EP0198 AGATHA					
	00	12	24	36	48	72
OFCL	11.4	45.4	86.1	88.1	80.6	
#CASES	8	8	6	4	2	0

	FORECAST ERRORS (NM) FOR EP0398 BLAS					
	00	12	24	36	48	72
OFCL	9.5	29.5	50.4	72.6	93.9	131.7
#CASES	28	28	26	24	22	18

	FORECAST ERRORS (NM) FOR EP0498 CELIA					
	00	12	24	36	48	72
OFCL	14.2	42.4	93.3	111.7	67.9	
#CASES	9	9	7	5	3	0
	FORECAST ERRORS (NM) FOR EP0598 DARBY					
	00	12	24	36	48	72
OFCL	5.5	23.5	43.5	61.3	78.2	111.0
#CASES	22	22	22	22	22	18
	FORECAST ERRORS (NM) FOR EP0698 ESTELLE					
	00	12	24	36	48	72
OFCL	7.0	33.9	60.0	71.1	70.9	90.2
#CASES	23	23	21	19	17	13
	FORECAST ERRORS (NM) FOR EP0798 FRANK					
	00	12	24	36	48	72
OFCL	9.6	32.1	67.2			
#CASES	4	4	2	0	0	0
	FORECAST ERRORS (NM) FOR EP0898 GEORGETTE					
	00	12	24	36	48	72
OFCL	7.3	48.3	87.2	126.4	149.8	194.1
#CASES	19	19	17	15	13	9
	FORECAST ERRORS (NM) FOR EP0998 HOWARD					
	00	12	24	36	48	72
OFCL	6.5	34.1	68.8	95.5	126.0	199.3
#CASES	32	32	30	28	26	22
	FORECAST ERRORS (NM) FOR EP1098 ISIS					
	00	12	24	36	48	72
OFCL	20.9	35.7	79.0	87.3		
#CASES	6	6	4	2	0	0
	FORECAST ERRORS (NM) FOR EP1198 JAVIER					
	00	12	24	36	48	72
OFCL	11.4	43.3	121.4	265.4		278.5
#CASES	7	6	4	2	0	1
	FORECAST ERRORS (NM) FOR EP1398 KAY					
	00	12	24	36	48	72
OFCL	6.4	38.1	84.3	143.9		
#CASES	6	6	4	2	0	0
	FORECAST ERRORS (NM) FOR EP1498 LESTER					
	00	12	24	36	48	72
OFCL	10.7	32.8	63.1	94.5	125.7	183.6
#CASES	39	39	37	35	33	29
	FORECAST ERRORS (NM) FOR EP1598 MADELINE					
	00	12	24	36	48	72
OFCL	10.8	38.5	81.2	137.2	186.3	314.0
#CASES	12	12	10	8	6	2

TABLE 6.2

EAST PACIFIC
1998 OFFICIAL AND CLIPER AVERAGE TRACK ERRORS FOR A HOMOGENEOUS
SAMPLE

PERIOD	00	12	24	36	48	72	(hr)
OFCL	9.0	34.8	66.7	92.3	110.1	159.9	(nm)
CLIP	9.0	34.9	71.0	104.1	135.2	201.9	(nm)
#CASES	215	214	190	166	144	112	

1988 - 1997 OFFICIAL AND CLIPER AVERAGE TRACK ERRORS FOR A
HOMOGENEOUS SAMPLE

PERIOD	00	12	24	36	48	72	(hr)
OFCL	12.7	38.5	70.9	104.6	137.4	195.4	(nm)
CLIP	12.7	41.0	77.2	117.5	157.2	227.0	(nm)
#CASES	2532	2527	2266	1998	1755	1337	

1998 OFFICIAL AND CLIPER AVERAGE ERROR DEPARTURE FROM THE 1988 - 1997
OFFICIAL AND CLIPER AVERAGE TRACK ERROR

PERIOD	00	12	24	36	48	72	(hr)
OFCL DEPARTURE	-30	-10	-06	-12	-20	-18	(%)
CLIP DEPARTURE	-30	-15	-08	-11	-14	-11	(%)

TABLE 7.1

EAST PACIFIC
1998 AVERAGE MODEL TRACK ERROR (NM) FOR A HOMOGENEOUS SAMPLE
(LATE*)

	00	12	24	36	48	72
OFCL	8.8	33.1	59.9	84.5	108.3	152.3
CLIP	8.8	34.1	68.2	100.3	131.0	185.6
GFDL	8.8	46.9	83.6	110.5	135.5	163.2
UKM	8.8	40.2	70.1	90.7	109.7	154.3
NGPS	8.8	45.6	75.4	116.5	157.8	247.9
AVNO	8.8	73.4	110.2	147.6	182.5	227.1
#CASES	90	90	75	65	54	36

* Although CLIPER is an early model, it is include here for reference.

TABLE 7.2

EAST PACIFIC
1998 AVERAGE MODEL TRACK ERRORS (NM) FOR A HOMOGENEOUS SAMPLE
(EARLY)

	00	12	24	36	48	72
OFCL	8.4	34.3	66.0	95.3	116.4	174.5
CLIP	8.4	34.2	71.7	104.5	130.9	198.1
P91E	8.4	33.5	67.5	93.4	119.0	179.9
BAMD	8.4	43.5	83.0	123.5	161.0	206.8
BAMM	8.4	52.7	102.6	153.6	205.4	274.1
BAMS	8.4	60.0	116.7	174.3	230.0	301.3
LBAR	8.4	36.3	80.5	133.8	186.5	281.3
OFCL	8.4	38.1	73.2	101.6	125.7	185.0
GFDI	8.4	52.1	100.2	130.3	148.8	203.4
UKMI	8.4	42.9	76.3	100.2	118.7	185.3
NGPI	8.4	42.9	83.1	120.0	157.7	234.9
#CASES	147	147	128	104	84	60

TABLE 8.1

**EAST PACIFIC
1998 OFFICIAL AVERAGE ABSOLUTE WIND SPEED FORECAST ERROR (KT) BY
STORM**

	FORECAST ERRORS (KT) FOR EP0198 AGATHA					
	00	12	24	36	48	72
OFCL	1.3	3.1	6.7	6.3	5.0	
#CASES	8	8	6	4	2	0
	FORECAST ERRORS (KT) FOR EP0398 BLAS					
	00	12	24	36	48	72
OFCL	2.1	4.3	7.5	11.7	17.5	16.4
#CASES	28	28	26	24	22	18
	FORECAST ERRORS (KT) FOR EP0498 CELIA					
	00	12	24	36	48	72
OFCL	4.4	3.9	5.0	7.0	10.0	
#CASES	9	9	7	5	3	0
	FORECAST ERRORS (KT) FOR EP0598 DARBY					
	00	12	24	36	48	72
OFCL	1.4	9.3	16.8	17.0	16.1	20.8
#CASES	22	22	22	22	22	18
	FORECAST ERRORS (KT) FOR EP0698 ESTELLE					
	00	12	24	36	48	72
OFCL	1.5	7.0	9.8	14.7	19.4	18.5
#CASES	23	23	21	19	17	13
	FORECAST ERRORS (KT) FOR EP0798 FRANK					
	00	12	24	36	48	72
OFCL	0.0	3.8	2.5			
#CASES	4	4	2	0	0	0
	FORECAST ERRORS (KT) FOR EP0898 GEORGETTE					
	00	12	24	36	48	72
OFCL	5.0	4.5	6.8	8.7	15.4	18.9
#CASES	19	19	17	15	13	9

	FORECAST	ERRORS	(KT)	FOR	EP0998	HOWARD
	00	12	24	36	48	72
OFCL	3.9	7.8	15.0	18.0	17.7	16.4
#CASES	32	32	30	28	26	22
	FORECAST	ERRORS	(KT)	FOR	EP1098	ISIS
	00	12	24	36	48	72
OFCL	0.8	6.7	7.5	7.5		
#CASES	6	6	4	2	0	0
	FORECAST	ERRORS	(KT)	FOR	EP1198	JAVIER
	00	12	24	36	48	72
OFCL	1.4	4.2	12.5	20.0		0.0
#CASES	7	6	4	2	0	1
	FORECAST	ERRORS	(KT)	FOR	EP1398	KAY
	00	12	24	36	48	72
OFCL	3.3	15.0	30.0	20.0		
#CASES	6	6	4	2	0	0
	FORECAST	ERRORS	(KT)	FOR	EP1498	LESTER
	00	12	24	36	48	72
OFCL	1.9	4.9	10.1	17.0	20.0	24.8
#CASES	39	39	37	35	33	29
	FORECAST	ERRORS	(KT)	FOR	EP1598	MADELINE
	00	12	24	36	48	72
OFCL	2.5	5.8	8.0	8.1	18.3	17.5
#CASES	12	12	10	8	6	2

TABLE 8.2

EAST PACIFIC

1998 AVERAGE ABSOLUTE WIND SPEED ERROR FOR A HOMOGENEOUS SAMPLE

PERIOD	00	12	24	36	48	72	(hr)
OFCL	2.5	6.1	10.9	14.4	17.6	19.6	(kt)
SHFR	2.5	7.4	11.4	14.0	16.1	17.2	(kt)
#CASES	215	214	190	166	144	112	

1990 - 1997 AVERAGE ABSOLUTE WIND SPEED ABSOLUTE ERROR FOR A HOMOGENEOUS SAMPLE

PERIOD	00	12	24	36	48	72	(hr)
OFCL	3.1	7.3	12.4	16.2	18.9	21.5	(kt)
SHFR	3.1	8.2	13.4	17.6	20.6	23.9	(kt)
#CASES	2148	2144	1932	1724	1521	1171	

1998 OFFICIAL AND SHIFOR AVERAGE ABSOLUTE WIND SPEED ERROR DEPARTURE FROM THE 1990 - 1997 OFFICIAL AND SHIFOR AVERAGE ABSOLUTE WIND SPEED ERROR

PERIOD	00	12	24	36	48	72	(hr)
OCFL DEPARTURE	-20	-16	-12	-11	-07	-09	(%)
SHFR DEPARTURE	-20	-10	-15	-20	-22	-28	(%)

TABLE 9

EAST PACIFIC
1998 AVERAGE MODEL ABSOLUTE WIND SPEED ERROR (KT) FOR A
HOMOGENEOUS SAMPLE

	00	12	24	36	48	72
OFCL	2.3	6.2	11.2	13.6	16.6	18.9
SHFR	2.3	7.4	11.6	13.7	15.4	17.7
OFCI	2.3	7.4	11.7	14.9	16.8	17.9
SHIP	2.3	7.6	11.3	13.5	15.6	18.7
GFDI	2.3	12.0	18.0	22.0	25.6	32.2
GFDL	2.3	24.8	29.5	32.5	33.6	34.9
#CASES	151	151	131	105	88	64

TABLE 10.1

NORTH ATLANTIC
1998 AVERAGE MODEL TRACK ERROR (NM) FOR A HOMOGENEOUS SAMPLE
(LATE*)

	00	12	24	36	48
OFCL	10.1	38.2	69.7	105.8	130.8
CLIP	10.1	47.2	97.5	153.5	200.3
GFDL	10.1	40.4	69.0	95.1	136.2
UKM	10.1	45.0	74.0	95.0	129.9
NGPS	10.1	45.4	63.5	88.8	121.5
AVNO	10.1	64.9	85.7	119.3	161.9
ETA	10.1	73.0	97.4	128.6	162.5
NGM	10.1	79.3	117.5	153.4	195.3
#CASES	61	61	53	45	40

* Although CLIPER is an early model, it is include here for reference.

TABLE 10.2

EAST PACIFIC
1998 AVERAGE MODEL TRACK ERROR (NM) FOR A HOMOGENEOUS SAMPLE
(LATE*)

	00	12	24	36	48
OFCL	8.5	31.3	58.5	88.9	121.9
CLIP	8.5	31.2	63.0	99.4	132.8
GFDL	8.5	44.6	70.6	100.8	130.9
UKM	8.5	36.4	62.4	81.1	95.4
NGPS	8.5	44.2	77.1	116.7	166.9
AVNO	8.5	70.9	94.9	128.7	164.5
ETA	8.5	134.8	208.9	257.6	295.9
NGM	8.5	88.2	112.6	148.7	154.1
#CASES	42	42	31	26	18

* Although CLIPER is an early model, it is include here for reference.