

NATIONAL HURRICANE CENTER VERIFICATION FOR 1991

Miles B. Lawrence

Abstract

The National Hurricane Center issues a 72-hour track and intensity forecast, every six hours, for all tropical cyclones in the Atlantic and eastern Pacific basins. Forecasts are verified by comparison with a best-track post analysis of all available track and intensity data. Verification statistics for 1991 are presented.

1. Atlantic

Table 1.1 lists average official track forecast errors by storm for the Atlantic for 1991 for tropical storms and hurricanes and Table 1.2 compares 1991 with the previous ten-year average. The 1991 averages at 12 and 24 hours are somewhat larger than the previous ten years, while the 0-, 48- and 72-hour errors are less than the previous ten-year average. The small number of cases (only 21 at 72 hours) for 1991 precludes making any meaningful generalizations about this year's errors. Table 1.3 shows that 72-hour track forecast errors for tropical depressions for 1991 are 30 percent larger than those of tropical storms and hurricanes.

Track forecast errors for all forecasts for operational guidance models are given in Table 1.4 and model comparisons for homogeneous data sets are given in Tables 1.5 and 1.6. The QLM model has the smallest errors at 24, 36 and 48 hours and NHC90 has the smallest at 72 hours, although the number of cases is very small when the QLM is included. Also, The QLM is not available as guidance until after the Aviation Model run is complete. It is of interest that the CLIPER errors for 1991 in Table 1.4 are the largest for this model since 1978. This suggests a high difficulty level for this year's track forecasts. VICBAR track forecast errors are not available for this report, but are reported on by Aberson and DeMaria in the research presentations.

Official wind speed forecast errors are listed in Table 1.7. The mean wind speed errors show a positive bias at all forecast periods while the previous ten-year average is a negative bias. The mean absolute errors for 1991 beyond 12 hours are larger than the corresponding previous ten-year averages.

2. Eastern Pacific

Statistics similar to those described above are given for the eastern Pacific in Tables 2.1 through 2.6. This is the fourth season that the National Hurricane Center has been responsible for issuing advisories for the eastern Pacific. Track forecast errors for 1991 compare nicely with the previous three years with only the 72-hour errors for 1988 being smaller than this year's errors (Table 2.2).

Homogeneous model comparisons (Tables 2.4 and 2.5) show that the old PSDE and PSS (statistical-dynamical and statistical-synoptic) models compete favorably with CLIPER, as do the deep and medium BAM after 24 hours. The new statistical-dynamical P91E also improves on CLIPER.

The official mean wind speed errors (Table 2.6) continue to show a negative bias, but not quite as much as the previous three years. Mean absolute errors show little change from the previous three years.

it

pe nd

Bob

)

(

ly

ib

med

T

Table 1.2. Comparison of 1991 Atlantic Official track forecast errors (nautical miles) with previous 10-year average.

	forecast period (hours)					
	0	12	24	36	48	72
1991 average	15	59	119	162	193	263
(no. of cases)	(87)	72)	(61	(48)	(35)	(21
1981-1990 average	18	56	107		212	328
1981-1990 (average no. of cases)	(152)	149)	(130)		(98)	71
1990 departure from 1980-1989 average	-17%	+05%	+11%		-09%	-20%
1991 range	0-92	0-158	5-332	30-466	35-334	24-494

Table 1.3. 1991 Official track forecast errors, Atlantic: tropical depression stage vs. tropical storm and hurricane stage.

	forecast period (hours)				
	12	24	36	48	72
tropical depression stage	67	112	170	211	341
(no. of cases)	(25)	(27)	(28)	(27)	(26)
tropical storm and hurricane stage	59	119	162	193	263
(no. of cases)	72)	(61)	(48)	(35)	(21
error ratio TD/(TS+H)	1.14	0.94	1.05	1.09	1.30

Table 1.4. Track model forecast errors (average in nautical miles), Atlantic, 1991, all cases.

model	forecast period (hours)				
	12	24	36	48	72
Official (number of cases)	59 (72)	119 (61)	162 (48)	193 (35)	263 (21)
CLIPER	72 (78)	158 (66)	230 (53)	297 (42)	509 (28)
BAM(deep)	58 (78)	107 (66)	161 (53)	221 (42)	275 (28)
BAM(medium)	61 (78)	110 (66)	159 (53)	199 (42)	324 (28)
BAM(shallow)	86 (78)	169 (66)	237 (53)	270 (42)	494 (28)
QLM	58 (32)	95 (29)	133 (24)	188 (18)	283 (11)
NHC90	65 (78)	112 (66)	149 (53)	205 (42)	285 (28)

Table 1.5. Track model forecast errors (average in nautical miles), Atlantic, 1991, homogeneous set.

model	forecast period (hours)				
	12	24	36	48	72
Official	59	119	162	193	263
CLIPER	68	157	234	320	519
BAM(deep)	58	110	165	227	268
BAM(medium)	60	112	164	205	341
BAM(shallow)	86	176	252	278	434
NHC90	63	111	147	194	247
(number of cases)	72)	(61	(48)	(35)	(21

Table 1.6. Track model forecast errors (average in nautical miles), Atlantic, 1991, homogeneous set.

model	forecast period (hours)				
	12	24	36	48	72
CLIPER	63	155	233	284	523
BAM(deep)	55	105	176	263	313
BAM(medium)	58	106	157	218	338
BAM(shallow)	86	181	260	285	498
NHC90	56	109	161	211	232
QLM	58	95	133	188	283
(number of cases)	(32)	(29)	(24)	(18)	(11

Table 1.7. Official wind speed forecast errors (knots), Atlantic, 1991. Error = forecast - observed.

	forecast period (hours)					
	0	12	24	36	48	
1991 mean	-0.2	+1.1	+2.2	+4.0	+6.3	+16.9
1991 mean absolute	4.5	8.0	14.7	19.2	21.9	24.0
no. of cases	87	70	58	44	34	21
max. error	+20,-20	-35	+50	-55	-60	
1981-1990 mean	-1.1	-1.6	-2.5		-5.1	-3.7
1981-1990 avg. no. of cases	149	145	127		92	65
1981-1990 mean absolute	5.2	8.2	11.4		15.6	19.1
1991 departure from 1981-1990 mean absolute	-13%	-02%	+29%		+40%	+26%

Table 2.1. Official track forecast errors (nautical miles),
by storm, eastern Pacific, 1991.

storm	forecast period (hours)					
	0	12	24	36	48	72
Andres (no. of cases)	40 (11)	69 (9)	96 (7)	112 (5)	121 (3)	(0)
Blanca	47 (18)	66 (16)	102 (14)	126 (12)	148 (10)	202 (6)
Carlos	9 (40)	30 (38)	64 (36)	99 (34)	135 (32)	191 (28)
Delores	17 (16)	58 (14)	107 (12)	146 (10)	180 (8)	270 (4)
Enrique	12 (15)	44 (13)	69 (11)	96 (9)	138 (7)	185 (3)
Fefa	12 (36)	28 (26)	56 (26)	87 (26)	118 (26)	184 (24)
Guillermo	14 (19)	30 (17)	51 (15)	68 (13)	87 (11)	208 (7)
Hilda	14 (15)	37 (13)	69 (11)	136 (9)	221 (7)	365 (3)
Ignacio	25 (9)	95 (7)	227 (5)	427 (3)	665 (1)	(0)
Jimena	6 (38)	25 (36)	50 (34)	79 (32)	111 (30)	173 (26)
Kevin	7 (61)	29 (55)	60 (55)	93 (55)	129 (54)	188 (50)
Linda	8 (24)	30 (22)	59 (20)	97 (18)	136 (16)	211 (12)
Marty	11 (26)	37 (24)	65 (22)	94 (20)	132 (18)	218 (14)
Nora	10 (17)	39 (15)	65 (13)	97 (11)	121 (9)	172 (5)
Total	13 (345)	37 (305)	68 (281)	100 (257)	133 (232)	195 (182)

Table 2.2 Official track forecast errors (nautical miles)
by year, eastern Pacific Ocean.

year	forecast period (hours)					
	0	12	24	36	48	72
1978			83		156	217
1979			86		182	269
1980			81		164	263
1981			100		178	267
1982			78		169	246
1983			86		172	237
1984			89		180	277
1985			85		161	227
1986			101		223	311
1987			85		177	214
1978-1987 average			84		173	
1988	20	45	75	103	138	176
(cases)	(175)	(175)	(150)	(128)	(108)	(74)
1989	15	43	82	125	164	237
(cases)	(215)	(215)	(182)	(150)	(119)	(77)
1990	13	38	71	108	143	200
(cases)	(451)	(418)	(383)	(345)	(308)	(237)
1988-1990 average	15	41	75	111	147	
1991	13	37	68	100	133	195
(cases)	(345)	(305)	(281)	(257)	(133)	(195)

Table 2.3. Track model forecast errors (average in nautical miles), eastern Pacific, 1990, all models, all cases.

model	forecast period (hours)				
	12	24	36	48	72
Official (number of cases)	37 (305)	68 (281)	100 (257)	133 (232)	195 (182)
BAM(deep)	47 (316)	83 (289)	115 (261)	138 (233)	189 (179)
BAM(medium)	46 (316)	83 (289)	117 (261)	144 (233)	200 (180)
BAM(shallow)	54 (317)	97 (290)	138 (262)	174 (234)	237 (180)
CLIPER	40 (317)	75 (290)	115 (262)	157 (234)	236 (182)
PSDE	38 (156)	68 (142)	123 (129)	140 (115)	190 (89)
	39 (311)	72 (284)	110 (258)	148 (230)	228 (179)
	49 (143)	87 (133)	124 (121)	160 (109)	250 (86)

Table 2.4. Track model forecast errors (average in nautical miles), eastern Pacific, 1991, quasi-homogeneous set of cases.

model	forecast period (hours)				
	12	24	36	48	72
Official	35	67	99	133	202
BAM(deep)	46	81	111	135	197
CLIPER	39	74	113	157	244
PSDE	37	69	125	141	194
PSS	38	72	110	151	234
QLM	48	87	124	160	250
(number of cases)	143	133	121	109	86

Table 2.5. Track model forecast errors (average in nautical miles), eastern Pacific, 1991, quasi-homogeneous set of cases.

model	forecast period (hours)				
	12	24	36	48	72
Official	30	59	91	125	190
P91E	32	61	93	122	196
CLIPER	34	69	111	158	247
(number of cases)	151	143)	(135)	(127)	(107)

Table 2.6. Official wind speed forecast errors (knots), eastern Pacific, 1988-1991. Error = forecast - observed.

	forecast period (hours)					
	0	12	24	36	48	
1991 mean	-0.9	0.0	-0.6	-1.6	-2.4	-4.6
1991 mean absolute	2.7	6.4	11.4	15.3	18.1	21.7
(no. of cases)	(345)	(305)	(281)	(257)	(232)	(182)
max. error	-20	+30	-50	+60	-55	
1990 mean	-1.1	-2.0	-3.2	-4.6	-6.0	
1990 mean absolute	3.6	7.1	11.2	15.1	17.8	20.6
(no. of cases)	(451)	(416)	(380)	(343)	(306)	(235)
max. error	+20	-30	-45	-60	-70	-85
1989 mean	-0.7	-1.7	-2.7	-4.1	-8.8	-11.6
1989 mean absolute	4.5	7.9	12.7	17.0	21.1	21.0
(no. of cases)	(215)	(215)	(182)	(150)	(118)	
1988 mean	-2.1	-2.7	-3.4	-4.5	-6.0	-2.7
1988 mean absolute	3.2	6.5	10.2	13.3	16.1	17.5
(no. of cases)	(170)	(170)	(147)	(126)	(108)	75