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NOAA TECHNICAL MEMORANDUM NWSTM PR-37



1991 TROPICAL CYCLONES - CENTRAL NORTH PACIFIC

Honolulu, HI
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**U.S. DEPARTMENT OF
COMMERCE**

National Oceanic and
Atmospheric Administration

National Weather
Service

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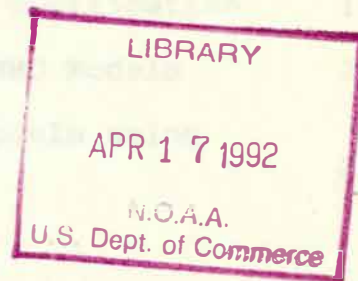


TABLE OF CONTENTS

1991 TROPICAL CYCLONES - Central Pacific

	<u>PAGE</u>
Preface	1
Central North Pacific Tropical Cyclone Data, 1991	2
Tropical Depression ENRIQUE	3
Fig. 1 - Best Track Plot of Hurricane FEFA and Hurricane KEVIN	4
Hurricane FEFA - Narrative	5-6
Hurricane FEFA - Actual versus Best Track	7
Hurricane FEFA - CPHC/NMC/NHC 24 Hour Forecast Verification	8
Hurricane FEFA - CPHC/NMC/NHC 36 Hour Forecast Verification	9
Hurricane FEFA - CPHC/NMC/NHC 48 Hour Forecast Verification	10
Hurricane FEFA - FNOC 24 Hour Forecast Verification	11
Hurricane FEFA - FNOC 48 Hour Forecast Verification	12
Hurricane KEVIN - Narrative	13
Hurricane KEVIN - Actual versus Best Track	14
Hurricane KEVIN - CPHC/NMC/NHC 24 Hour Forecast Verification	15
Hurricane KEVIN - CPHC/NMC/NHC 36 Hour Forecast Verification	16
Hurricane KEVIN - CPHC/NMC/NHC 48 Hour Forecast Verification	17
Hurricane KEVIN - FNOC 24 Hour Forecast Verification	18
Hurricane KEVIN - FNOC 48 Hour Forecast Verification	19
Verification Summary - CPHC versus NHC/NMC Models	20
Verification Summary of FNOC Forecast Models using CPHC Best Track	21

PREFACE

The Central Pacific Hurricane Season ended with just three tropical systems in the area. All three systems had been hurricanes in the eastern Pacific with ENRIQUE weakening to the depression state before entering the central Pacific.

The season started out rather slowly with very little activity in June and early July. ENRIQUE was the first system to reach the central Pacific and continued to be an unusual system after developing into a hurricane for a short six hour period over the eastern Pacific on July 17.

CENTRAL NORTH PACIFIC TROPICAL CYCLONE DATA SUMMARY, 1991*

<u>Name</u>	<u>Dates</u>	<u>Highest Classification in Central Pacific</u>	<u>Max Winds</u>	<u>Min SLP</u>	<u>Hours Observed per class</u>
ENRIQUE	20-21 Jul	Tropical Depression	E25 SFSS	N/A	24 (TD)
FEFA	05-08 Aug	Hurricane	E90G115 SFSS	N/A	30 (H), 30 (TS) 12 (TD)
KEVIN	09-12 Oct	Hurricane	E65G70 SFSS	N/A	12 (H), 30 (TS) 24 (TD)

Key

H - Hurricane

TS - Tropical Storm

TD - Tropical Depression

Example: 36(H), 84(TS), 12(TD)

Total Hours per class: H 36 hrs

TS 84 hrs

TD 12 hrs

NOTES:

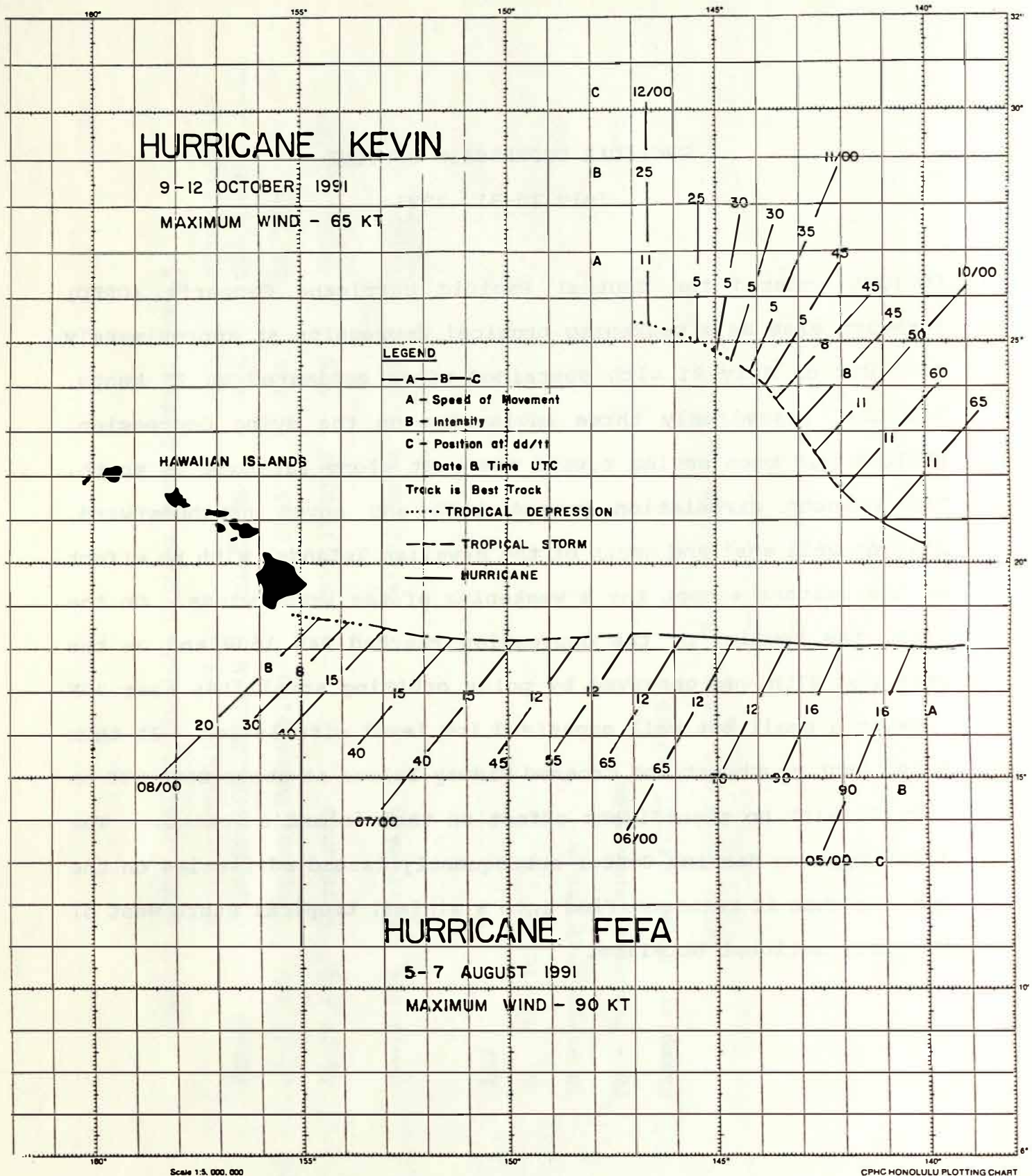
* Data pertains only to period when tropical cyclone was in the Central Pacific.

TROPICAL DEPRESSION ENRIQUE

July 20-31, 1991

ENRIQUE entered the Central Pacific Hurricane Center's (CPHC) forecast area as a weakening tropical depression at approximately 0000 UTC on July 21 with sustained winds estimated at 25 knots. The CPHC issued only three advisories on the dying depression. ENRIQUE had been moving toward the west along latitude 16 North. The remnant circulation passed 140W and moved northwestward, staying well east and north of the Hawaiian Islands, with no effect on the weather except for a weakening of the trade winds. On the 24th, the remains of the depression reached 24N 150W and on the 26th and 27th was observed by polar orbiting satellites near 32N 160W as a small but well organized low level circulation. It then moved west southwest and crossed Midway Island at about 0600 UTC on July 31 with no significant effect on that island's weather. The Joint Typhoon Warning Center subsequently issued advisories on the cyclone when it reintensified into a minimal tropical storm west of the International Dateline.

Fig. 1



HURRICANE FEFA

August 4-7, 1991

FEFA was still an intense hurricane with sustained winds estimated at 90 knots when it crossed 140W into the Central Pacific Hurricane Center's area of responsibility at 0600 UTC on August 5. FEFA moved west at 15 knots along 18N in a rather straight trajectory as it approached the Hawaiian Islands (Fig.1). Wave trains moving out ahead of FEFA measured 15 feet as they passed NOAA Buoy 51004 and headed toward the east-facing beaches of the Big Island of Hawaii. Sea water and debris washed onto the coastal roads near Punaluu Harbor on the Big Island's Kau coast and resulted in their closure. Forecast guidance suggested that FEFA would curve west northwest up the windward side of the islands. A slight northerly component in the westward movement did occur as FEFA approached the islands early on August 7 as a minimal tropical storm. The center of FEFA passed close to or over the Big Island at 0000 UTC on August 8 as the sea level pressure at Hilo dropped to 1005 MB with its intensity judged as a tropical depression and dissipating. Remnants of FEFA were now interacting with the islands' terrain and a cold core upper trough, which had been present near the islands for several days. This trough was largely responsible for the quick demise of FEFA due to strong vertical wind shear over the area with strong easterly winds near the surface and westerly winds aloft. Nevertheless, locally strong winds did occur on the north side of the remnant circulation. Wind gusts ranged between 40 and 50 knots at some localities, mainly over the counties of Hawaii and

Maui. Some very heavy downpours occurred, particularly on the Big Island of Hawaii, as thunderstorms developed in the northeast quadrant of the circulation. These thunderstorms formed offshore to the northeast of the Big Island and then built rapidly southwestward over the slopes of Mauna Kea and the Kohala mountains. Localized flash flooding was reported in the Kohala and Hamakua districts including the Waipio valley during the forenoon hours of the 7th.

Leaving the Big Island, the remnant circulation moved west northwest and passed south of Oahu and Kauai on August 8. On the 9th, FEFA dissipated over the waters northwest of Kauai.

Lightning caused injury to two persons on the Big Island. In the Hilo area, a man suffered burns from a telephone as a discharge moved through the wires. The second injury occurred at the Volcanoes National Park where a person walking between two buildings was injured when lightning struck nearby.

U.S. Air Force Hurricane Hunters were tasked to fly aerial reconnaissance on FEFA due to its threat to the Hawaiian Islands. Reconnaissance crews flew three missions on FEFA and made seven fixes on the weakening tropical cyclone as it neared the islands.

HURRICANE: FEFA
 DATE: 5 - 8 AUGUST 1991

DTG UTC	<u>BEST</u> TRACK		<u>ACTUAL</u> TRACK		DIST ERROR NM
	LAT NORTH	LONG WEST	LAT NORTH	LONG WEST	
0506	18.1	140.3	18.1	140.3	0
0512	18.1	142.0	18.0	142.0	6
0518	18.2	143.3	18.2	143.2	6
0600	18.3	144.6	18.2	144.6	6
0606	18.4	145.8	18.3	145.9	8
0612	18.4	147.0	18.4	147.0	0
0618	18.3	148.3	18.3	148.2	6
0700	18.2	149.8	18.2	149.9	6
0706	18.3	151.3	18.4	151.4	8
0712	18.5	152.9	18.5	153.0	6
0718	18.6	153.8	18.7	154.1	18
0800	18.7	154.6	19.4	154.0	54
AVERAGE ERROR IN NM =>					10

HURRICANE: FEFA

FROM: 5 AUGUST 1991

TO: 8 AUGUST 1991 UTC

CPHC Forecaster and NMC/NHC Models Forecast

DTG UTC	BEST TRACK		24 HOUR FORECAST POSITION																			
	LAT	LONG	CPHC		XTRP		HURN		CLIP		BAMD		BAMM		BAMS		PSS		PSDE		QLM	
	NORTH	WEST	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG
0506	18.1	140.3																				
0512	18.1	142.0																				
0518	18.2	143.3																				
0600	18.3	144.6																				
0606	18.4	145.8	19.0	146.0	18.1	146.5	18.3	146.3	18.2	146.5	18.6	144.2	18.9	144.9	18.9	145.2	18.3	146.4				
0612	18.4	147.0	18.4	148.0	17.8	148.6	18.2	148.0	18.2	148.2	18.4	145.8	18.7	146.5	18.7	147.1	18.1	148.1	18.0	147.8		
0618	18.3	148.3	18.5	149.0	18.4	149.0	18.5	148.8	18.3	149.0	18.5	146.5	18.8	147.0	19.0	147.8	18.2	148.9				
0700	18.2	149.8	18.3	149.7	18.2	149.8	18.3	149.5	18.3	149.6	18.6	147.7	18.7	148.4	18.9	149.1	18.3	149.5	18.2	150.0	18.1	149.0
0706	18.3	151.3	18.6	150.3	18.5	151.3	18.5	150.7	18.4	150.9	18.4	148.6	18.3	149.5	18.5	150.5	18.4	150.8				
0712	18.5	152.9	18.7	151.0	18.8	151.8	18.5	151.8	18.4	152.0	18.4	149.6	18.5	150.6	18.7	151.5	18.6	151.9	18.6	151.9	19.0	150.8
0718	18.6	153.8	18.5	153.2	18.4	156.9	18.4	153.5	18.3	153.6	18.0	150.1	18.6	151.4	18.9	152.7	18.4	153.5				
0800	18.7	154.6	18.0	154.7	18.0	155.7	18.0	155.0	17.8	155.3	17.8	151.3	18.6	152.7	18.6	153.8	18.0	155.2	19.0	155.3	18.3	154.4

CPHC Forecaster and NMC/NHC Model Errors

CPHC	XTRP	HURN	CLIP	BAMD	BAMM	BAMS	PSS	PSDE	QLM	DTG UTC
-	-	-	-	-	-	-	-	-	-	0506
-	-	-	-	-	-	-	-	-	-	0512
-	-	-	-	-	-	-	-	-	-	0518
-	-	-	-	-	-	-	-	-	-	0600
38	43	29	41	91	59	45	34	-	-	0606
56	97	58	69	68	33	19	65	51	-	0612
41	40	31	40	102	79	51	34	-	-	0618
8	0	18	13	121	85	58	18	11	46	0700
59	12	36	23	153	102	47	29	-	-	0706
108	65	62	51	187	130	80	57	57	122	0712
34	176	21	21	212	136	65	21	-	-	0718
42	75	48	67	194	108	46	54	58	26	0800
48	63	38	41	141	91	51	39	44	65	

AVERAGE ERROR IN NM =>

HURRICANE: FEFA

FROM: 5 AUGUST 1991

TO: 8 AUGUST 1991 UTC

CPHC Forecaster and NMC/NHC Models Forecast

DTG UTC	BEST TRACK		36 HOUR FORECAST POSITION																				
	LAT	LONG	CPHC		XTRP		HURN		CLIP		BAMD		BAMM		BAMS		PSS		PSDE		QLM		
	NORTH	WEST	NORTH	WEST	NORTH	WEST	NORTH	WEST	NORTH	WEST	NORTH	WEST	NORTH	WEST	NORTH	WEST	NORTH	WEST	NORTH	WEST	NORTH	WEST	
0506	18.1	140.3																					
0512	18.1	142.0																					
0518	18.2	143.3																					
0600	18.3	144.6																					
0606	18.4	145.8																					
0612	18.4	147.0																					
0618	18.3	148.3	19.7	148.3	18.1	149.6	18.5	149.0	18.3	149.4	18.9	145.7	19.3	146.8	19.3	147.5	18.5	148.9					
0700	18.2	149.8	19.0	150.7	17.7	151.9	18.4	150.6	18.3	151.2	18.8	147.1	19.1	148.3	19.0	149.5	18.3	150.6	18.5	148.6			
0706	18.3	151.3	19.0	151.5	18.5	151.9	18.7	151.4	18.4	151.6	18.9	147.9	19.1	148.9	19.3	150.0	18.4	151.1					
0712	18.5	152.9	18.6	151.5	18.2	152.4	18.5	151.7	18.4	151.8	19.0	149.1	19.2	150.2	19.2	151.4	18.6	151.6	18.7	150.7	19.4	151.1	
0718	18.6	153.8	18.9	152.0	18.6	154.0	18.7	152.9	18.5	153.2	18.4	149.8	18.5	151.2	18.8	152.7	18.6	152.8					
0800	18.7	154.6	19.4	153.0	19.0	154.2	18.8	153.9	18.5	154.4	18.5	150.8	18.7	152.3	19.0	153.7	18.8	154.0	19.1	152.7			

CPHC Forecaster and NMC/NHC Model Errors

CPHC	XTRP	HURN	CLIP	BAMD	BAMM	BAMS	PSS	PSDE	QLM	DTG
										UTC
-	-	-	-	-	-	-	-	-	-	0506
-	-	-	-	-	-	-	-	-	-	0512
-	-	-	-	-	-	-	-	-	-	0518
-	-	-	-	-	-	-	-	-	-	0600
-	-	-	-	-	-	-	-	-	-	0606
-	-	-	-	-	-	-	-	-	-	0612
84	74	41	62	151	104	75	36	-	-	0618
70	122	47	79	157	100	51	46	70	-	0700
43	36	25	18	195	144	95	13	-	-	0706
79	33	68	62	217	158	95	74	125	115	0712
103	11	51	34	226	147	63	56	-	-	0718
100	29	40	16	215	130	54	34	110	-	0800
80	51	45	45	194	131	72	43	102	115	

AVERAGE ERROR IN NM =>

HURRICANE: FEFA

FROM: 5 AUGUST 1991

TO: 8 AUGUST 1991 UTC

CPHC Forecaster and NMC/NHC Models Forecast

DTG UTC	BEST TRACK		48 HOUR FORECAST POSITION																			
	LAT	LONG	CPHC		XTRP		HURN		CLIP		BAMD		BAMM		BAMS		PSS		PSDE		QLM	
	NORTH	WEST	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG
0506	18.1	140.3																				
0512	18.1	142.0																				
0518	18.2	143.3																				
0600	18.3	144.6																				
0606	18.4	145.8																				
0612	18.4	147.0																				
0618	18.3	148.3																				
0700	18.2	149.8																				
0706	18.3	151.3	20.7	150.5	18.1	152.7	18.8	151.2	18.5	152.0	19.4	146.8	19.8	148.5	19.6	149.8	18.9	151.1				
0712	18.5	152.9	20.5	153.0	17.6	155.2	18.8	152.9	18.4	153.9	19.6	148.1	19.8	149.9	19.5	151.9	18.7	152.8	17.9	151.4		
0718	18.6	153.8	19.7	153.1	18.6	154.8	19.1	153.6	18.7	154.0	19.5	149.2	19.7	150.5	19.8	152.2	18.8	153.0				
0800	18.7	154.6	19.5	153.5	18.2	155.0	18.8	153.7	19.0	153.7	19.9	150.3	19.9	151.8	19.6	153.3	19.1	153.2	18.6	153.0	19.2	152.9

CPHC Forecaster and NMC/NHC Model Errors

-10-

DTG UTC	48 HOUR FORECAST ERROR IN NAUTICAL MILES									
	CPHC	XTRP	HURN	CLIP	BAMD	BAMM	BAMS	PSS	PSDE	QLM
0506	-	-	-	-	-	-	-	-	-	-
0512	-	-	-	-	-	-	-	-	-	-
0518	-	-	-	-	-	-	-	-	-	-
0600	-	-	-	-	-	-	-	-	-	-
0606	-	-	-	-	-	-	-	-	-	-
0612	-	-	-	-	-	-	-	-	-	-
0618	-	-	-	-	-	-	-	-	-	-
0700	-	-	-	-	-	-	-	-	-	-
0706	151	80	30	41	263	182	115	38	-	-
0712	120	141	18	58	279	187	82	13	92	-
0718	77	56	32	13	265	198	115	47	-	-
0800	78	38	51	54	252	174	91	83	91	101
AVERAGE ERROR IN NM =>	106	79	33	41	265	185	101	45	91	101

HURRICANE: FEFA

FROM: 5 AUGUST 1991

TO: 8 AUGUST 1991 UTC

FNOC Monterey Forecast Models

DTG UTC	BEST TRACK		24 HOUR FORECAST POSITION																		
	LAT	LONG	CLIP		CLIM		XTRP		HPAC		OTCM		TOTL		FBAM		SBAM		MBAM		
	NORTH	WEST	NORTH	WEST	NORTH	WEST	NORTH	WEST	NORTH	WEST	NORTH	WEST	NORTH	WEST	NORTH	WEST	NORTH	WEST	NORTH	WEST	
0506	18.1	140.3																			
0512	18.1	142.0																			
0518	18.2	143.3																			
0600	18.3	144.6																			
0606	18.4	145.8	18.0	144.5	18.5	144.9	18.1	145.1	18.3	145.0	19.0	145.2	18.6	144.9							
0612	18.4	147.0	17.7	147.3	18.5	145.6	17.8	148.6	18.1	147.1	18.8	148.0	18.5	146.8							
0618	18.3	148.3	18.3	148.0	18.6	146.1	18.4	149.0	18.5	147.6	18.5	148.7	18.8	147.8	20.2	146.5					
0700	18.2	149.8	18.2	149.1	18.6	147.4	18.2	149.8	18.4	148.6	19.0	149.5	18.7	149.0	19.8	148.3					
0706	18.3	151.3																			
0712	18.5	152.9																			
0718	18.6	153.8	18.3	152.5	18.4	152.4	18.3	152.8	18.4	152.6	18.6	152.5	18.8	152.3	20.3	149.5					
0800	18.7	154.6	17.6	156.2	18.4	154.3	18.0	157.9	18.2	156.1	18.1	157.0	18.9	154.0	19.7	152.8					

FNOC Monterey Model Errors

-11-

DTG UTC	24 HOUR FORECAST ERROR IN NAUTICAL MILES								
	CLIP	CLIM	XTRP	HPAC	OTCM	TOTL	FBAM	SBAM	MBAM
0506	-	-	-	-	-	-	-	-	-
0512	-	-	-	-	-	-	-	-	-
0518	-	-	-	-	-	-	-	-	-
0600	-	-	-	-	-	-	-	-	-
0606	77	51	43	46	49	52	-	-	-
0612	45	79	97	19	61	13	-	-	-
0618	17	126	40	41	26	41	153	-	-
0700	40	138	0	69	51	54	128	-	-
0706	-	-	-	-	-	-	-	-	-
0712	-	-	-	-	-	-	-	-	-
0718	76	80	59	69	73	86	263	-	-
0800	112	25	191	90	140	36	118	-	-
AVERAGE ERROR IN NM =>	61	83	72	56	67	47	165	#N/A!	#N/A!

HURRICANE: FEFA

FROM: 5 AUGUST 1991

TO: 8 AUGUST 1991 UTC

FNOC Monterey Forecast Models

DTG UTC	BEST TRACK		48 HOUR FORECAST POSITION																	
	LAT NORTH	LONG WEST	CLIP		CLIM		XTRP		HPAC		OTCM		TOTL		FBAM		SBAM		MBAM	
			LAT NORTH	LONG WEST	LAT NORTH	LONG WEST	LAT NORTH	LONG WEST	LAT NORTH	LONG WEST	LAT NORTH	LONG WEST	LAT NORTH	LONG WEST	LAT NORTH	LONG WEST	LAT NORTH	LONG WEST	LAT NORTH	LONG WEST
0506	18.1	140.3																		
0512	18.1	142.0																		
0518	18.2	143.3																		
0600	18.3	144.6																		
0606	18.4	145.8																		
0612	18.4	147.0																		
0618	18.3	148.3																		
0700	18.2	149.8																		
0706	18.3	151.3	17.5	146.4	18.7	149.0	18.1	145.1	18.4	149.4	21.7	148.9	19.4	147.8						
0712	18.5	152.9	16.9	151.8	18.5	148.7	17.6	155.2	18.0	151.9	21.2	152.1	19.2	150.0						
0718	18.6	153.8	17.8	151.9	18.6	151.8	18.6	154.8	18.6	152.4	20.2	153.1	19.6	151.1	23.7	149.8				
0800	18.7	154.6	17.8	152.4	18.5	151.6	18.2	155.0	18.3	153.3	21.8	153.5	19.4	151.9	23.4	151.5				

FNOC Monterey Model Errors

48 HOUR FORECAST ERROR IN NAUTICAL MILES										DTG UTC
CLIP	CLIM	XTRP	HPAC	OTCM	TOTL	FBAM	SBAM	MBAM		
-	-	-	-	-	-	-	-	-	-	0506
-	-	-	-	-	-	-	-	-	-	0512
-	-	-	-	-	-	-	-	-	-	0518
-	-	-	-	-	-	-	-	-	-	0600
-	-	-	-	-	-	-	-	-	-	0606
-	-	-	-	-	-	-	-	-	-	0612
-	-	-	-	-	-	-	-	-	-	0618
-	-	-	-	-	-	-	-	-	-	0700
281	132	350	108	245	208	-	-	-	-	0706
114	237	141	64	168	169	-	-	-	-	0712
118	113	56	79	104	164	380	-	-	-	0718
135	170	38	77	196	158	331	-	-	-	0800
AVERAGE ERROR IN NM =>										
162	163	146	82	178	175	356	#N/A!	#N/A!		

AVERAGE ERROR IN NM =>

HURRICANE KEVIN

OCTOBER 9-11, 1991

KEVIN had been a moderately strong hurricane for well over a week while moving slowly but steadily in a generally northwestward direction into the central Pacific. KEVIN crossed 140W early on the 9th near 21N (Fig. 1), which is rather far north and thus was not considered much of a threat to Hawaii. Storms which move northwestward, parallel to the Hawaiian chain while remaining well offshore, as a rule cause an interruption of the normal trades and bring generally sunny and fair weather to the state. This proved to be the case, as a weakening KEVIN continued on a northwesterly path with its center staying almost 900 miles off the windward coasts of the Hawaiian Islands. KEVIN was barely at hurricane strength as it entered the central Pacific. It was subsequently downgraded to a tropical storm at 091800 UTC near 22N 142W and to a tropical depression at 111200 UTC near 25N 145W. Final advisory on dissipating tropical depression KEVIN was issued at 120000 UTC near 25N 147W. The remnant circulation however did persist a while longer as it slowly drifted northward to finally lose its identity late on the 14th near 35N 150W.

HURRICANE: KEVIN
 DATE: 9 - 12 OCTOBER 1991

DTG UTC	BEST TRACK		ACTUAL TRACK		DIST ERROR NM
	LAT NORTH	LONG WEST	LAT NORTH	LONG WEST	
0912	21.0	141.0	21.0	141.0	0
0918	21.7	142.0	21.6	141.8	13
1000	22.5	143.6	22.6	142.7	51
1006	23.2	143.0	23.2	142.9	6
1012	23.7	143.5	23.8	143.6	8
1018	24.0	143.8	24.2	144.1	21
1100	24.3	144.2	24.6	144.6	29
1106	24.6	144.6	24.6	144.6	0
1112	24.8	145.0	24.7	145.0	6
1118	25.0	145.4	24.8	145.4	12
1200	25.4	146.6	25.4	146.6	0
AVERAGE ERROR IN NM =>					13

HURRICANE: KEVIN

FROM: 9 OCTOBER 1991 TO: 12 OCTOBER 1991 UTC

CPHC Forecaster and NMC/NHC Models Forecast

DTG UTC	BEST TRACK		24 HOUR FORECAST POSITION																				
	LAT	LONG	CPHC		XTRP		HURN		CLIP		BAMD		BAMM		BAMS		PSS		P91E		QLM		
	NORTH	WEST	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	
0912	21.0	141.0																					
0918	21.7	142.0																					
1000	22.5	143.6																					
1006	23.2	143.0																					
1012	23.7	143.5	23.4	145.0	23.4	145.3	23.1	144.2	22.8	144.1	25.4	144.7	24.4	145.5	24.0	146.1	23.1	144.1	23.4	144.2	24.6	144.0	
1018	24.0	143.8	23.2	144.8	24.2	146.3	23.7	145.0	23.4	144.8	25.9	143.5	24.9	144.4	23.8	145.5	23.7	144.9	24.0	144.6			
1100	24.3	144.2	25.9	144.9	25.8	145.2			26.3	144.8	26.3	143.6	25.5	144.6	24.9	145.7	26.2	144.7	25.6	144.4	26.5	146.4	
1106	24.6	144.6	25.7	144.7	26.4	145.1	25.9	144.5	25.8	143.6	27.1	144.5	26.2	145.3	25.9	145.8	26.1	143.6	25.5	143.8			
1112	24.8	145.0	27.0	145.0	26.8	146.0	26.2	146.1	26.0	145.7	26.1	144.6	25.7	145.5	25.5	146.5	26.3	145.6	25.5	145.9	25.6	147.8	
1118	25.0	145.4	27.5	145.1	26.2	146.5	26.6	146.6	26.5	146.2	25.6	145.9	25.4	146.4	25.3	147.0	26.4	146.0	26.7	146.2			
1200	25.4	146.6	26.5	147.4	26.2	146.6	26.2	146.6	26.5	146.2	25.6	146.7	25.6	147.0	26.1	147.3			26.5	146.5			

CPHC Forecaster and NMC/NHC Model Errors

DTG UTC	24 HOUR FORECAST ERROR IN NAUTICAL MILES									
	CPHC	XTRP	HURN	CLIP	BAMD	BAMM	BAMS	PSS	P91E	QLM
0912	-	-	-	-	-	-	-	-	-	-
0918	-	-	-	-	-	-	-	-	-	-
1000	-	-	-	-	-	-	-	-	-	-
1006	-	-	-	-	-	-	-	-	-	-
1012	87	103	53	64	119	121	148	49	43	61
1018	74	142	70	67	115	64	97	65	45	-
1100	103	106	-	124	124	75	92	117	79	175
1106	66	111	78	89	150	103	100	104	68	-
1112	132	132	102	81	81	60	89	95	63	153
1118	151	95	114	99	44	57	85	89	110	-
1200	78	48	48	69	13	24	56	-	66	-
AVERAGE ERROR IN NM =>	98	105	78	85	92	72	95	87	68	130

-15-

HURRICANE: KEVIN

FROM: 9 OCTOBER 1991

TO: 12 OCTOBER 1991 UTC

CPHC Forecaster and NMC/NHC Models Forecast

DTG UTC	BEST TRACK		36 HOUR FORECAST POSITION																				
	LAT	LONG	CPHC		XTRP		HURN		CLIP		BAMD		BAMM		BAMS		PSS		P91E		QLM		
	NORTH	WEST	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	
0912	21.0	141.0																					
0918	21.7	142.0																					
1000	22.5	143.6																					
1006	23.2	143.0																					
1012	23.7	143.5																					
1018	24.0	143.8																					
1100	24.3	144.2	24.5	147.0	24.6	147.4	24.1	145.3	23.7	145.0	26.8	145.5	25.5	147.0	25.0	148.0	24.2	145.2	24.8	145.5	25.9	144.9	
1106	24.6	144.6	24.0	146.3	25.5	148.5	24.8	146.0	24.2	145.8	26.8	143.5	25.6	145.2	24.3	147.0	25.0	146.2	25.3	145.2			
1112	24.8	145.0	27.8	144.8	27.4	146.4			28.3	144.4	26.6	143.5	25.9	145.2	25.3	146.8	28.2	144.3	26.5	143.7	26.8	147.2	
1118	25.0	145.4	27.1	145.0	28.0	146.2	27.3	144.8	27.1	143.1	27.5	144.7	26.6	146.1	26.5	147.0	27.8	143.1	26.2	143.4			
1200	25.4	146.6	28.9	144.4	28.3	147.3	27.1	146.8	27.1	146.0	26.2	145.5	26.1	146.6	26.0	149.1	27.7	145.9	26.4	146.1	25.6	150.3	

CPHC Forecaster and NMC/NHC Model Errors

DTG UTC	36 HOUR FORECAST ERROR IN NAUTICAL MILES									
	CPHC	XTRP	HURN	CLIP	BAMD	BAMM	BAMS	PSS	P91E	QLM
0912	-	-	-	-	-	-	-	-	-	-
0918	-	-	-	-	-	-	-	-	-	-
1000	-	-	-	-	-	-	-	-	-	-
1006	-	-	-	-	-	-	-	-	-	-
1012	-	-	-	-	-	-	-	-	-	-
1018	-	-	-	-	-	-	-	-	-	-
1100	159	182	63	58	164	163	202	57	79	103
1106	103	227	80	72	144	68	137	87	52	-
1112	180	175	-	212	133	67	98	207	122	166
1118	127	185	141	174	154	103	123	206	127	-
1200	239	178	102	106	75	42	86	142	65	193
AVERAGE ERROR IN NM =>	161	189	97	124	134	88	129	140	89	154

AVERAGE ERROR IN NM =>

HURRICANE: KEVIN

FROM: 9 OCTOBER 1991

TO: 12 OCTOBER 1991 UTC

CPHC Forecaster and NMC/NHC Models Forecast

DTG UTC	BEST TRACK		48 HOUR FORECAST POSITION																			
	LAT	LONG	CPHC		XTRP		HURN		CLIP		BAMD		BAMM		BAMS		PSS		P91E		QLM	
	NORTH	WEST	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG
0912	21.0	141.0																				
0918	21.7	142.0																				
1000	22.5	143.6																				
1006	23.2	143.0																				
1012	23.7	143.5																				
1018	24.0	143.8																				
1100	24.3	144.2																				
1106	24.6	144.6																				
1112	24.8	145.0	25.5	149.0	25.7	149.6	25.3	146.0	24.3	146.2	27.3	145.8	26.1	148.2	25.6	149.7	25.1	146.2	25.4	147.4	25.7	145.3
1118	25.0	145.4	24.7	147.7	26.8	150.8	25.9	146.7	24.8	146.9	26.6	143.7	25.8	146.0	24.7	148.4	25.8	147.2	25.7	146.7		
1200	25.4	146.6	29.8	144.1	29.0	147.7			29.9	143.8	26.2	143.9	26.1	146.0	25.9	148.1	29.8	143.6	26.3	143.6	27.0	148.6

CPHC Forecaster and NMC/NHC Model Errors

-17-

DTG UTC	48 HOUR FORECAST ERROR IN NAUTICAL MILES									
	CPHC	XTRP	HURN	CLIP	BAMD	BAMM	BAMS	PSS	P91E	QLM
0912	-	-	-	-	-	-	-	-	-	-
0918	-	-	-	-	-	-	-	-	-	-
1000	-	-	-	-	-	-	-	-	-	-
1006	-	-	-	-	-	-	-	-	-	-
1012	-	-	-	-	-	-	-	-	-	-
1018	-	-	-	-	-	-	-	-	-	-
1100	-	-	-	-	-	-	-	-	-	-
1106	-	-	-	-	-	-	-	-	-	-
1112	213	265	60	74	155	184	249	65	130	56
1118	131	324	87	86	130	57	170	105	80	-
1200	294	224	-	306	149	52	84	306	165	142
AVERAGE ERROR IN NM =>	213	271	73	155	145	98	168	159	125	99

HURRICANE: KEVIN

FROM: 9 OCTOBER 1991

TO: 12 OCTOBER 1991 UTC

FNOC Monterey Forecast Models

DTG UTC	BEST TRACK		24 HOUR FORECAST POSITION																	
	LAT	LONG	CLIP		CLIM		XTRP		HPAC		OTCM		TOTL		FBAM		SBAM		MBAM	
	NORTH	WEST	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG
0912	21.0	141.0																		
0918	21.7	142.0																		
1000	22.5	143.6																		
1006	23.2	143.0																		
1012	23.7	143.5	22.6	143.6	23.1	145.0	23.4	145.3	23.2	145.1	23.1	144.6	23.0	144.3	23.9	143.2	23.0	144.9	23.2	144.4
1018	24.0	143.8	23.2	145.0			24.0	146.3			22.8	145.6	23.6	145.1						
1100	24.3	144.2	25.2	144.0	25.0	147.8	25.8	146.2	25.4	147.0	23.7	145.2	25.2	142.4	24.6	144.8	24.2	146.4	24.1	146.0
1106	24.6	144.6	26.2	143.0	25.7	148.0	26.4	145.1	26.1	146.6	24.3	145.0	25.9	143.1	25.0	144.6	24.9	146.3	24.8	145.6
1112	24.8	145.0							26.7	147.4	24.3	146.0	26.7	145.5	24.7	143.4	23.5	146.5	23.7	145.6
1118	25.0	145.4	25.7	144.9	27.4	149.4	26.2	146.5	26.8	148.0	24.2	146.3	25.9	143.1	25.4	146.5	25.5	147.7	25.3	147.2
1200	25.4	146.6	26.1	145.4	27.9	149.9	26.2	146.6	27.0	148.3	24.8	146.8	26.1	143.0	25.9	147.3	26.2	148.1	26.0	147.6

FNOC Monterey Model Errors

24 HOUR FORECAST ERROR IN NAUTICAL MILES										DTG UTC
CLIP	CLIM	XTRP	HPAC	OTCM	TOTL	FBAM	SBAM	MBAM		
-	-	-	-	-	-	-	-	-	-	0912
-	-	-	-	-	-	-	-	-	-	0918
-	-	-	-	-	-	-	-	-	-	1000
-	-	-	-	-	-	-	-	-	-	1006
66	92	103	95	72	62	21	90	59		1012
83	-	141	-	125	77	-	-	-		1018
55	208	138	160	67	108	38	124	102		1100
127	203	111	138	29	110	24	98	58		1106
-	-	-	169	64	117	91	115	74		1112
49	268	92	173	70	131	62	123	95		1118
75	239	48	130	38	192	47	92	63		1200
AVERAGE ERROR IN NM =>										
76	202	105	144	66	114	47	107	75		

-18-

HURRICANE: KEVIN

FROM: 9 OCTOBER 1991

TO: 12 OCTOBER 1991 UTC

FNOC Monterey Forecast Models

DTG UTC	BEST TRACK		48 HOUR FORECAST POSITION																		
	LAT	LONG	CLIP		CLIM		XTRP		HPAC		OTCM		TOTL		FBAM		SBAM		MBAM		
	NORTH	WEST	NORTH	WEST	NORTH	WEST	NORTH	WEST	NORTH	WEST	NORTH	WEST	NORTH	WEST	NORTH	WEST	NORTH	WEST	NORTH	WEST	
0912	21.0	141.0																			
0918	21.7	142.0																			
1000	22.5	143.6																			
1006	23.2	143.0																			
1012	23.7	143.5																			
1018	24.0	143.8																			
1100	24.3	144.2																			
1106	24.6	144.6																			
1112	24.8	145.0	23.4	145.8			25.8	149.6			24.1	147.4	24.3	147.2	25.0	145.6	23.3	148.6	23.7	147.7	
1118	25.0	145.4	25.3	147.4			26.4	150.8			22.6	148.7	24.9	145.3							
1200	25.4	146.6	25.5	144.8	28.1	153.2	29.0	149.7	28.6	151.5	23.3	149.1	27.4	129.0	25.3	148.3	24.6	151.0	24.6	150.2	

FNOC Monterey Model Errors

48 HOUR FORECAST ERROR IN NAUTICAL MILES										DTG UTC
CLIP	CLIM	XTRP	HPAC	OTCM	TOTL	FBAM	SBAM	MBAM		
-	-	-	-	-	-	-	-	-	-	0912
-	-	-	-	-	-	-	-	-	-	0918
-	-	-	-	-	-	-	-	-	-	1000
-	-	-	-	-	-	-	-	-	-	1006
-	-	-	-	-	-	-	-	-	-	1012
-	-	-	-	-	-	-	-	-	-	1018
-	-	-	-	-	-	-	-	-	-	1100
-	-	-	-	-	-	-	-	-	-	1106
95	-	247	-	142	128	33	222	166	-	1112
106	-	293	-	235	8	-	-	-	-	1118
94	406	269	319	189	924	89	253	209	-	1200
98	406	270	319	189	354	61	238	188		

AVERAGE ERROR IN NM =>

1991 FORECAST VERIFICATION SUMMARY
NHC/NMC Models

Forecast Periods
(Average error in nautical miles (NM)/
number of forecasts)

<u>FORECASTER/MODEL</u>	<u>24-HR</u>	<u>36-HR</u>	<u>48-HR</u>	<u>72-HR</u>
CPHC FORECASTER	72/15	117/11	152/7	-
XTRP	83/15	114/11	161/7	-
HURN	55/14	66/10	46/6	-
CLIP	56/15	81/11	90/7	-
BAMD	118/15	166/11	213/7	-
BAMM	74/15	111/11	148/7	-
BAMS	72/15	98/11	129/7	-
PSS	59/14	87/11	94/7	-
PSDE	44/4	101/3	92/2	-
P91E	68/7	89/5	125/3	-
QLM	97/6	144/4	100/3	-

Acronym

Model Description

CPHC	Central Pacific Hurricane Center forecaster
XTRP	A pure extrapolation model
HURN	Hurricane analog (formerly EPAN85)
CLIP	Climatology and Persistence (formerly (EPCL84)
BAMD	Beta-Advection Model Deep Layer (mean layer averaged between 850 and 200 mb)
BAMM	Beta-Advection Model Medium Layer (mean layer averaged between 850 and 400 mb)
BAMS	Beta-Advection Model Shallow Layer (mean layer averaged between 850 and 700 mb)
PSS	Pacific Statistical Synoptic (formerly EPSS87)
PSDE	Pacific Statistical Dynamic Early Run
P91E	Pacific Statistical Dynamic Model (adapted from NHC90 for E. Pacific)
QLM	Quasi-Lagrangian Hurricane Model

1991 FORECAST VERIFICATION SUMMARY
Fleet Numerical Ocean Center Models

<u>FORECASTER/MODEL</u>	Forecast Periods (Average error in nautical miles (NM)/ number of forecasts)			
	<u>24-HR</u>	<u>36-HR</u>	<u>48-HR</u>	<u>72-HR</u>
CLIP	69/12	-	135/7	-
CLIM	137/11	-	199/7	-
XTRP	89/12	-	129/5	-
HPAC	100/12	-	183/7	-
OTCM	67/13	-	183/7	-
TOTL	77/13	-	251/7	-
FBAM	95/10	-	208/14	-
SBAM	107/6	-	238/2	-
MBAM	75/6	-	188/2	-

Acronym

Model Description

- CLIP - Forecast based on Climatology and Persistence Model
- CLIM - Forecast based on Climatology
- XTRP - Forecast based on extrapolation.
- HPAC - Forecast based on half persistence/half climatology
- OTCM - One-way Interactive Tropical Cyclone Model
- TOTL - Forecast based on analogs.
- FBAM - Beta-Advection Model Deep Layer (mean layer averaged between 850 and 200 mb)
- MBAM - Beta-Advection Model Medium Layer (mean layer averaged between 850 and 400 mb)
- SBAM - Beta-Advection Model Shallow Layer (mean layer averaged between 850 and 700 mb)

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- No. 33 1987 Tropical Cyclones - Central North Pacific. W. Au, A. Chun, H. Rosendal. April 1988. (PB88-188-081/AS)
- No. 34 1988 Tropical Cyclones - Central North Pacific. W. Au, A. Chun, H. Rosendal. May 1989. (PB89-195-945/AS)
- No. 35 1989 Tropical Cyclones - Central North Pacific. A. Chun, R. Martin, H. Rosendal. February 1990. (PB90-182-536/AS)
- No. 36 1990 Tropical Cyclones - Central North Pacific. A. Chun, R. Martin, H. Rosendal. April 1991. (PB91-184-564/AS)

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