

**Tim Craig
Sam Houston
Wes Browning**

TABLE OF CONTENTS

- [Tropical Depression Cosme](#)
 - [Hurricane Flossie](#)

**TROPICAL DEPRESSION COSME
19 – 24 July 2007**

HISTORY: The Central Pacific Hurricane Center (CPHC) assumed forecast responsibility of Tropical Depression Cosme at 0000 UTC 19 July, with the first official position at 15.2N 140.7W. Cosme was moving to the west at 12kt, with maximum winds estimated at 30kt.

While in the Tropical Prediction Center (TPC) area of responsibility east of 140W, Cosme was a hurricane at 1800 UTC 16 July, only to weaken to a tropical storm at 0600 UTC 17 July. Cosme remained a tropical storm until just prior to crossing 140W, when it weakened to a tropical depression at 1800 UTC 18 July. Maximum winds at that time were estimated at 35kt.

Tropical Depression Cosme proceeded to move to the west across the Central North Pacific, passing 65nm south of NOAA Buoy 51004 at 2000 UTC 20 July. The buoy reported maximum winds of 27kt and seas to 13ft. Cosme passed 160nm south of South Point on the Island of Hawaii at about 0400 UTC 21 July, where there was no appreciable increase in the winds. Cosme then passed about 60 nm south of NOAA Buoy 51002 at 1300 UTC 21 July. The buoy recorded maximum winds of 28kt for a short period of time and seas to 18ft.

The last CPHC advisory was written at 0000 UTC 23 July, when the system was near 16.1N 168.3W, or about 40nm south southeast of Johnston Island. Four hours later, at 0400 UTC 23 July, a weakening Cosme passed about 6nm south of Johnston Island. The persistent remnant low with estimated maximum winds of 25kt was tracked by WFO Honolulu to 15.8N 179.4W at 1800 UTC 24 July, whereupon it weakened into an open trough.

SYNOPTIC SITUATION. (19 July – 24 July 2007)

LOWER LEVELS: From its genesis to demise, Cosme was a “west mover”, thanks to east winds south of an unseasonably large 1032mb surface high centered north of Hawaii near 35N. Ridges extended far to the southwest and southeast of the high, effectively surrounding Cosme to the northwest, north and northeast. The high and ridges changed little in location and intensity throughout the time Cosme was in the Central North Pacific. With steady trade winds at its back, Cosme moved an average of 16kt, taking six hours short of six days to move from 140W to 180W.

MIDDLE LEVELS: As in the lower levels, Cosme was situated south of a large 500mb high with an average geopotential height of 5970m. Unlike the stationary surface high, the mid-level high moved to the southwest from near 35N 160W on 19 July to near 33N 165W on 21 July, where it stayed through 24 July. Both highs absolutely prevented Cosme from assuming anything other than a due westerly course.

In fact, Cosme, upon entering the Central North Pacific near 15.2N and exiting near 15.8N, gained less than one degree of latitude, or less than 60nm.

UPPER LEVELS: As discussed below, the eventual demise of Cosme can be attributed to an upper level low that developed near 24N 152W, or about 300nm northeast of the Island of Hawaii, on 20 July. The low moved to the southwest to near 22N 156W, or about 100nm north of Maui, on 22 July, then to the west to near 22N 167W, or about 300 nm west of Kauai, by 24 July. The low deepened during this time with the 300mb mean geopotential height lowering from 9690m to 9630m and 9610m on these three dates.

DISCUSSION: Cosme did not weaken during the first two days it was in the Central North Pacific, in spite of somewhat cool 25degc sea surface temperatures. It may have remained a depression because the easterly wind shear of 5 to 10kt it was encountering (as calculated by UW-CIMSS) was too weak. Also possibly favoring the maintenance of Cosme was the slightly unstable environmental air, as depicted on satellite imagery, which was entraining into the system.

Over the last four days of its life, Cosme was over warmer water, with sea surface temperatures of 26.5degc. Cosme did not strengthen, however, probably because of the increasing northwest wind shear associated with the upper level low described above. The two lows moved in tandem to the west, with the upper low situated northeast of Cosme. The wind shear started out at about 15kt on 21 July (UW-CIMSS data), having no discernable effect on Cosme. With the wind shear increasing to 20kt on 22 July and 23 July, the low level circulation finally separated from the couple of remaining thunderstorms, making Cosme no longer classifiable.

IMPACTS: Showers and thunderstorms north of Cosme reached the east and southeast slopes of the Big Island during the afternoon of 20 July, and persisted through the morning of 21 July. Highest rainfall totals were 6.94in at Hakalau, 6.68in at Glenwood, 4.77in at Waiakea Uka, and 4.37in at Mountain View. Hawaii County Civil Defense did not report any significant flooding as a result of Cosme's passage.

Table 1. Best Track Data

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage/Notes
19/0000	15.2	140.7	1008	30	Tropical Depression
19/0600	15.3	142.0	1010	30	"
19/1200	15.5	143.6	1010	30	"
19/1800	15.7	145.0	1010	30	"
20/0000	16.0	146.6	1010	30	"
20/0600	16.0	148.3	1010	30	"
20/1200	16.1	149.9	1010	30	"
20/1800	16.5	151.8	1010	30	"
21/0000	16.5	153.8	1010	30	"

21/0600	16.3	155.7	1010	30	"
21/1200	16.1	157.4	1010	30	"
21/1800	16.2	159.1	1010	30	"
22/0000	16.4	161.0	1010	30	"
22/0600	16.4	162.6	1010	30	"
22/1200	16.3	164.5	1010	30	"
22/1800	16.1	166.5	1010	25	Disturbance
23/0000	16.1	168.3	1011	25	"
23/0600	15.9	170.0	1011	25	"
23/1200	15.8	171.7	1011	25	"
23/1800	15.7	173.3	1011	25	"
24/0000	15.7	175.0	1011	25	"
24/0600	15.7	176.8	1011	25	"
24/1200	15.8	178.3	1010	25	"
24/1800	15.8	179.4	1009	25	"

Table 2. Track Verification Table entries are track forecast errors, measured in nautical miles. Values in parentheses indicate the number of forecasts. Values in bold represent guidance forecast errors equal to or less than the office CPHC forecast.

Forecast	12-hr	24-hr	36-hr	48-hr	72-hr	96-hr	120-hr
CPHC	25 (13)	41 (11)	74 (9)	111 (7)	177 (3)	n/a	n/a
CLP5	31 (13)	66 (11)	130 (9)	208 (7)	385 (3)	n/a	n/a
BAMD	66 (13)	139 (11)	227 (9)	318 (7)	494 (3)	n/a	n/a
BAMM	48 (13)	103 (11)	171 (9)	239 (7)	330 (3)	n/a	n/a
BAMS	35 (13)	68 (11)	119 (9)	185 (7)	272 (3)	n/a	n/a
GFDL	36 (13)	46 (11)	56 (9)	100 (7)	262 (3)	n/a	n/a
AVNO	46 (12)	50 (9)	68 (8)	117 (6)	209 (3)	n/a	n/a
NOGAPS	23 (9)	28 (8)	26 (6)	52 (5)	128 (2)	n/a	n/a

GUNS	27 (12)	64 (10)	95 (8)	110 (6)	264 (3)	n/a	n/a
GUNA	28 (12)	58 (10)	95 (8)	108 (6)	231 (3)	n/a	n/a
CONU	29 (13)	58 (11)	99 (9)	123 (7)	211 (3)	n/a	n/a
UKMET	57 (6)	147 (5)	194 (4)	185 (3)	439 (1)	n/a	n/a

Figure 1. GOES-11 visible image at 1800 UTC 20 July.

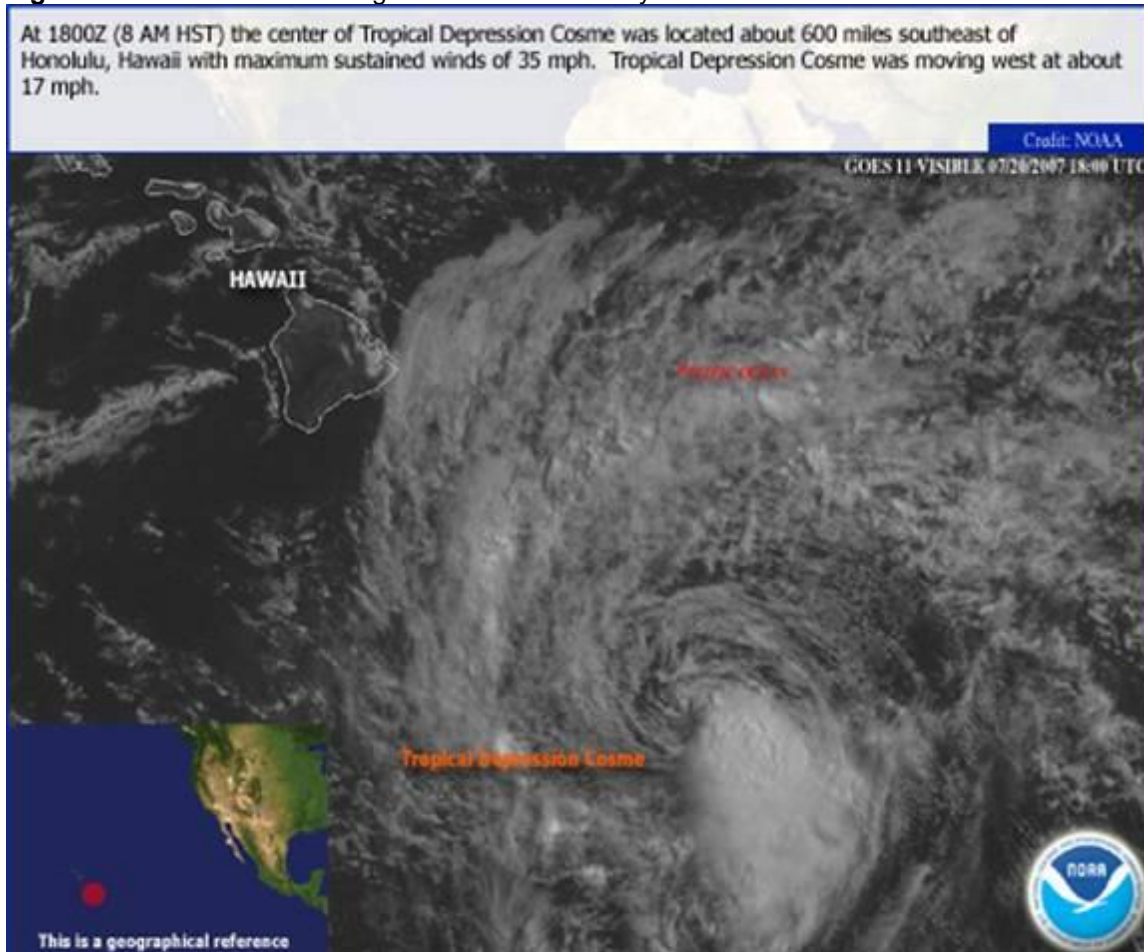
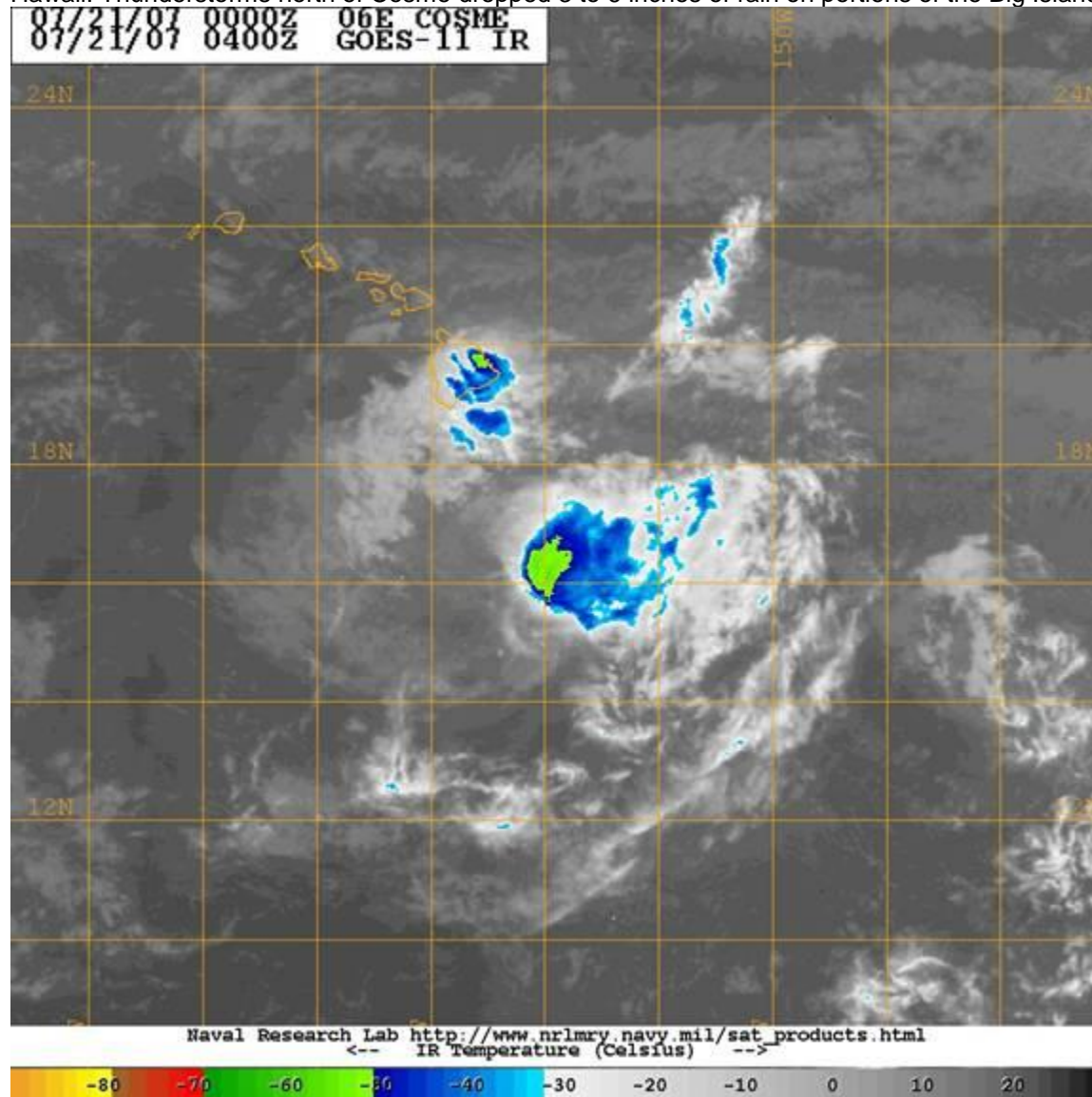


Figure 2. GOES-11 infrared image of Tropical Depression Cosme as it passed south of the Island of Hawaii. Thunderstorms north of Cosme dropped 3 to 6 inches of rain on portions of the Big Island.



HURRICANE FLOSSIE 11-16 August 2007

OVERVIEW: Hurricane Flossie crossed longitude 140°W into the Central North Pacific during the morning of 11 August 2007 (Fig. 3). The National Hurricane Center in Miami, FL had been issuing advisories on this tropical cyclone starting on 8 August. Flossie was a very impressive hurricane with a distinct eye embedded within a solid eye wall and a very impressive upper level outflow pattern as it entered the CPHC Area of Responsibility (AOR). The hurricane maintained maximum 1-minute sustained wind speeds of 130 to 140 mph for the next two days (Table 4). Flossie was a relatively small tropical cyclone with sustained winds speeds of 39 mph of greater extending out about 100 miles from the center in the northern semicircle time period during this same time period.

hurricane watch was issued for the Big Island of Hawaii early on the morning of 13 August (Fig. 4) due to the close proximity of the projected track to that island, as well as the intensity forecast maintaining Flossie as a hurricane when it arrived in the vicinity of that island within 36 hours. A tropical storm warning was hoisted for the Big Island later that same morning. Fortunately, the long anticipated increase in vertical wind shear took its toll on Flossie during 14 August (Fig. 5). As a result, Flossie weakened to a tropical storm later that night. As it was passing south of the islands of Oahu and Kauai late on 15 August, Flossie weakened to a tropical depression due to the very strong vertical wind shear. CPHC issued the final advisory on dissipating tropical depression Flossie during the early morning hours on 16 August.

SYNOPTIC SITUATION: Flossie moved toward the west northwest at about 13 mph south of a strong middle and upper tropospheric subtropical ridge as it approached the Hawaiian Islands. Vertical wind shear was minimal in the vicinity of this hurricane during the first few days it was over the Central North Pacific Ocean. Also, the system was able to derive sufficient heat energy from the ocean to maintain its intensity.

The global models all indicated an upper tropospheric trough would develop near the Hawaiian Islands within 48 hours after Flossie crossed 140°W. The strength of this trough were critical in determining how much southwesterly vertical wind shear would develop in the vicinity of Flossie as it continued churning toward the west-northwest?

Based on the sea surface temperature analyses, Flossie's forecast track at the time it moved into the CPHC AOR suggested it would be crossing the 26.5°C isotherm within about 48 hours. As a result of the anticipated cooler ocean temperatures and increasing vertical wind, the intensity forecast was for steady weakening to take place within two days or so. Therefore, Flossie was forecast to weaken to a tropical storm within about three days after crossing 140°W.

By the late afternoon of 13 August, the CPHC forecast discussion indicated "...Hurricane Flossie is beginning to feel the effects of slightly cooler ocean temperatures and increasing southerly shear. While outflow remains good to the north, outflow appears to be hampered to the south and we are beginning to see weakening along the southern flank of the eye wall". The weakening trend continued through that night and Flossie's eye became obscured by cloud cover. Later on 14 August, Flossie's eye "briefly cleared in visible and warmed in infrared imagery earlier today." This was despite the estimate of 30 mph (26 kt) of southwesterly environmental vertical wind shear in the vicinity of the hurricane at that time.

By the evening of 14 August, this very strong vertical wind shear finally took its toll on Flossie and the tropical cyclone's low level circulation center emerged on the southwestern flank of the cirrus cloud shield. This resulted in the downgrading of Flossie to a tropical storm. The strengthening upper level trough northwest of the main Hawaiian Islands, which was responsible for the strong southwesterly vertical wind shear, was retrograding in tandem with Flossie's westward motion. Therefore, the tropical cyclone had little chance of intensifying again, despite slightly warmer ocean water temperatures southwest of the Hawaiian Islands.

The weakened tropical depression Flossie continued moving nearly due west in the low-level trade wind flow. By the early morning hours of 16 August, the tropical depression was devoid of deep convection and was just a low-level cloud swirl over the open ocean.

IMPACTS Even though the center of Flossie passed about 100 miles due south of South Point on the Big Island of Hawaii, it generated very large waves along the southeast facing shoreline of that island. The height of the largest wave faces was estimated to be near 20 feet. In fact, coincident with the passage of Flossie, a 44 acre lava bench slipped into the ocean during the night on 13 August (Fig. 4). According to the United States Geological Survey (USGS), it is possible this loss of shoreline was due to the large pounding surf generated by the hurricane, a 5.4 magnitude earthquake that occurred around the same time, or a combination of both events. Flossie weakened and remained far enough south of the Big Island during its closest approach on 14 August to prevent any excessive rainfall amounts over land. However,

sustained winds of at least 39 mph were recorded on South Point as Flossie passed by. No significant damage or injuries were reported on the Big Island.

Acknowledgements:

The 403rd wing of the US Air Force Reserve 53rd Weather squadron flew reconnaissance missions into Flossie while it was a threat to the Aloha State. The people of the State of Hawaii and the staff of CPHC wish to extend a big Mahalo to those who flew these critical missions, which provided important data in real-time to the forecasters at CPHC.

Table 4. Best Track Data

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage/Notes
11/1800	12.9	140.6	950	115	Hurricane
12/0000	13.2	141.7	949	120	"
12/0600	13.4	143.0	950	120	"
12/1200	13.5	144.0	953	120	"
12/1800	13.7	145.2	955	120	"
13/0000	13.9	146.4	958	115	"
13/0600	14.2	147.6	958	115	"
13/1200	14.6	148.9	955	120	"
13/1800	15.1	150.1	957	115	"
14/0000	15.7	151.4	960	110	"
14/0600	16.2	152.6	970	100	"
14/1200	16.6	153.6	973	95	"
14/1800	16.9	154.4	978	90	"
15/0000	17.3	155.2	980	85	"
15/0600	17.4	156.0	993	65	"
15/1200	17.3	157.0	1003	50	Tropical Storm
15/1800	17.4	158.0	1006	40	"
16/0000	17.4	159.0	1007	35	"
16/0600	17.1	160.2	1008	30	Tropical Depression

16/1200	17.1	161.5	1009	25	"
---------	------	-------	------	----	---

Table 5. Track Verification Table entries are track forecast errors, measured in nautical miles. Values in parentheses indicate the number of forecasts. Values in bold represent guidance forecast errors equal to or less than the office CPHC forecast.

Forecast	12-hr	24-hr	36-hr	48-hr	72-hr	96-hr	120-hr
CPHC	25 (18)	50 (16)	76 (14)	81 (12)	76 (8)	110 (4)	n/a
CLP5	25 (18)	54 (16)	87 (14)	99 (12)	79 (8)	45 (4)	n/a
BAMD	46 (18)	84 (16)	119 (14)	158 (12)	311 (8)	503 (4)	n/a
BAMM	29 (18)	53 (16)	69 (14)	88 (12)	136 (8)	217 (4)	n/a
BAMS	32 (18)	62 (16)	86 (14)	109 (12)	123 (8)	143 (4)	n/a
GFDL	30 (17)	55 (15)	73 (13)	79 (11)	142 (7)	258 (4)	n/a
AVNO	44 (18)	66 (16)	75 (14)	72 (12)	110 (8)	111 (4)	n/a
UKMET	17 (4)	20 (4)	43 (4)	77 (4)	131 (4)	209 (1)	n/a
GUNS	15 (8)	28 (8)	38 (8)	49 (8)	111 (8)	281 (2)	n/a
GUNA	12 (8)	20 (8)	29 (8)	42 (8)	81 (8)	219 (2)	n/a
CONU	22 (18)	39 (16)	53 (14)	60 (12)	79 (8)	196 (4)	n/a
NOGAPS	24 (15)	56 (13)	84 (11)	86 (9)	120 (6)	306 (3)	n/a

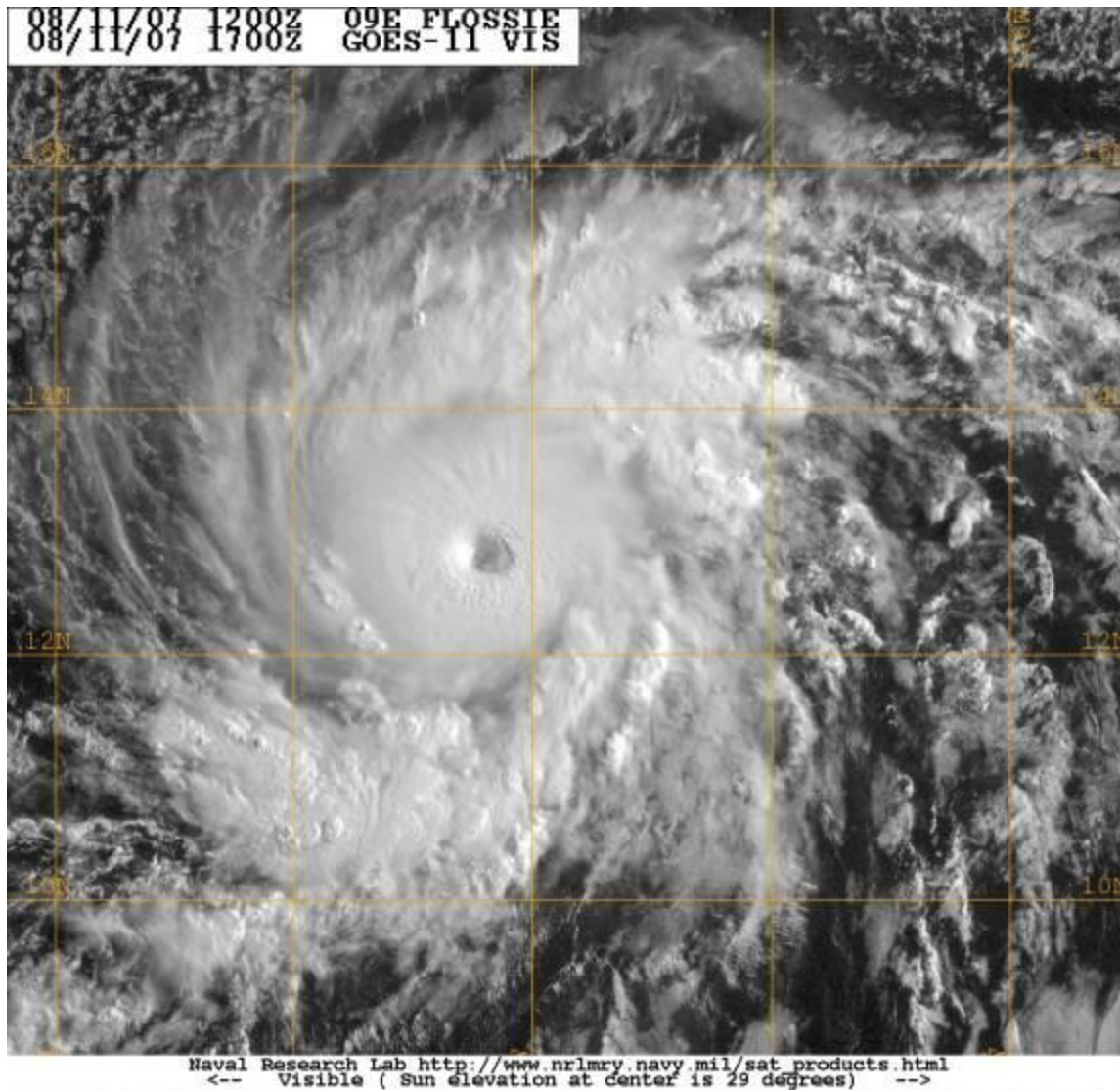


Figure 3. GOES-11 visible satellite image of Hurricane Flossie at 1700 UTC 11 August. This image is one of the first visible images after the tropical cyclone entered the CPHC AOR (image courtesy of the Naval Research Laboratory archive

(http://www.nrlmry.navy.mil/tc_pages/tc_home.html).

At 13/1500 UTC Category 4 Hurricane Flossie, located near 14.9N 145.5W, about 495 miles southeast of Hilo, was moving toward the west-northwest at 15 mph. Maximum sustained winds were near 140 mph with higher gusts.

Credit: NOAA

This is a geographical reference

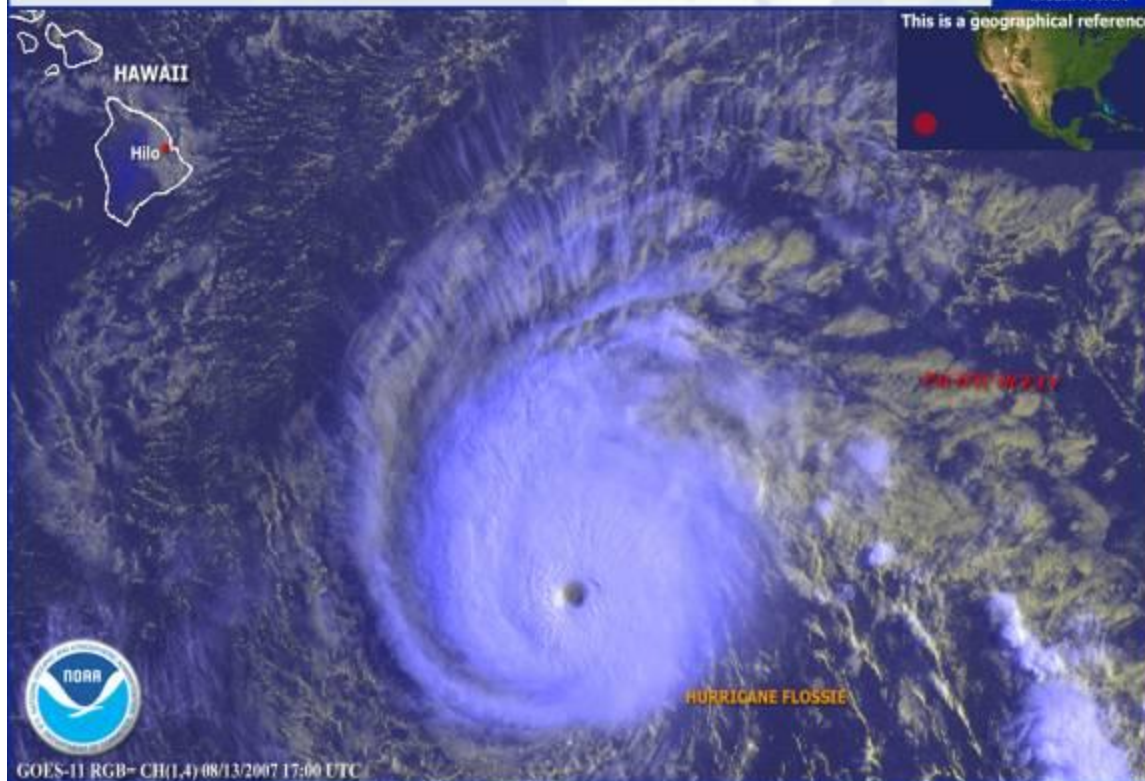


Figure 4. Hurricane Flossie GOES-11 image at 1500 UTC 13 August. Image courtesy of the NOAA Information and Satellite Information Service

(http://www.osei.noaa.gov/Events/Tropical/E_Pacific/2007/TRCflossie225_G11.jpg).

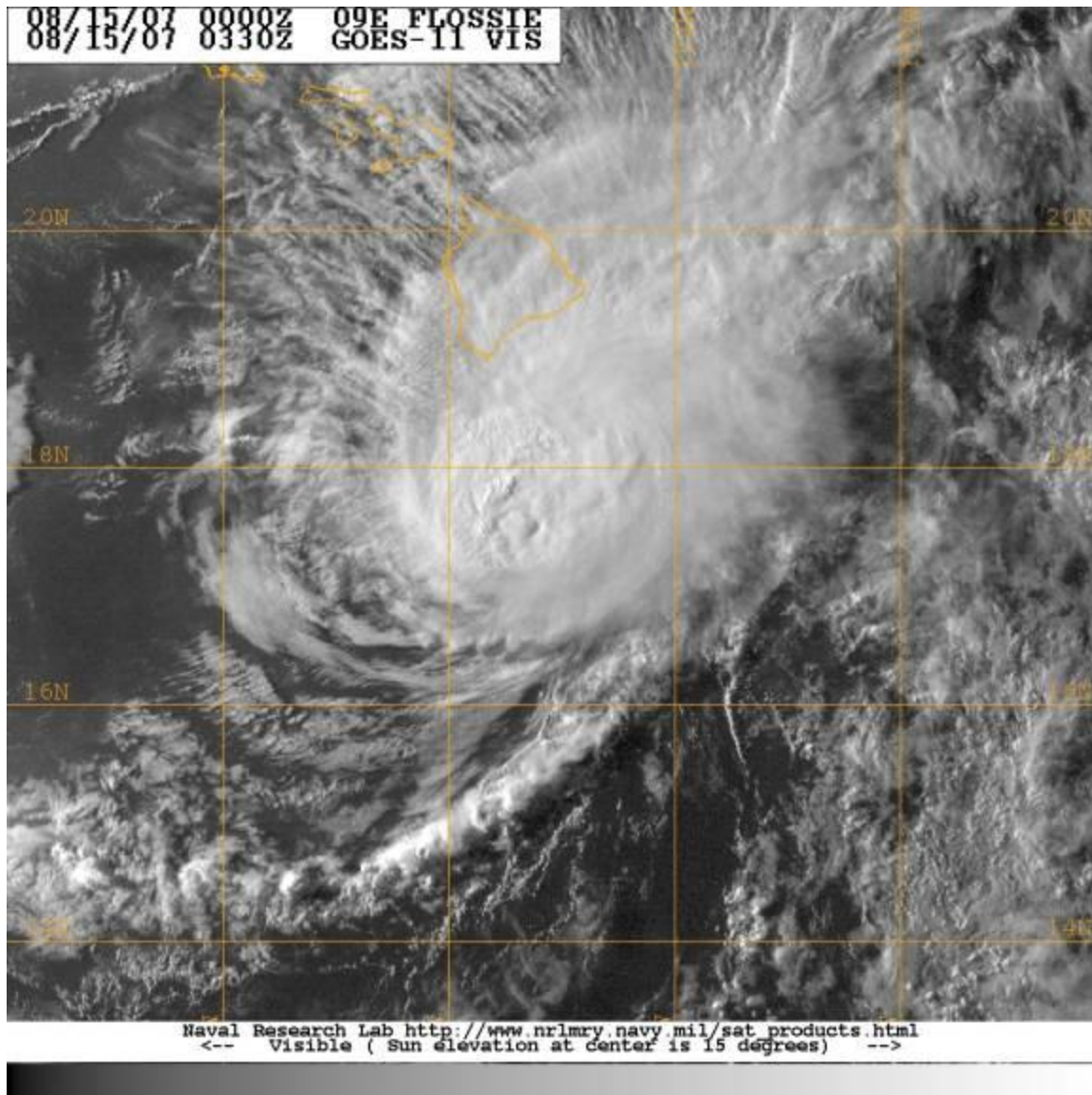


Figure 5. Same as Fig. 3, except at 0330 UTC 15 August when weakening Hurricane Flossie was south of the Big Island of Hawaii.

a



b



Figure 6. a) View of the East Lae`apuki bench on 15 May 2007 shortly after a small chunk of the bench had collapsed. This photo also shows the "shatter ring" that had developed just behind the sea cliff. b) View of the East Lae`apuki bench on 17 August 2007. Note the "shatter ring". The bench must have collapsed some time during the night of 13 August because National Park Service personnel reported it was there during the previous afternoon. However, a helicopter tour pilot reported it missing on the morning of 14 August. Photos courtesy of the USGS Hawaiian Volcano Observatory web site

(<http://hvo.wr.usgs.gov/>)

ACRONYMS that may have been used in this report.	
Acronym	Full Spelling/Definition
AOR	Area of Responsibility
AVNO	Operation global forecast system model

BAMD	Deep Layer Beta Advection Model (mean layer averaged between 850 hPa and 250 hPa)
BAMM	Medium Layer Beta Advection Model (mean layer averaged between 850 hPa and 400 hPa)
BAMS	Shallow Layer Beta Advection Model (mean layer averaged between 850 hPa and 700 hPa)
CLIP	Climatology and Persistence
CPHC	Central Pacific Hurricane Center
GFDL	Geophysical Fluid Dynamics Laboratory model
hPa	Hectopascal (formerly millibar)
ITCZ	Inter-tropical Convergence Zone
JTWC	Joint Typhoon Warning Center
kts	knots
LBAR	Barotropic limited area sine transform
mb	millibars
NA	Not Available
NGPS	NOGAPS (Navy Operational Global Atmospheric Prediction System) Vortex Tracking Routine
NHC	National Hurricane Center
nm	nautical miles
P91E	Pacific Statistical Dynamic Model (adapted from NHC90 for the Eastern Pacific)
SHIFR	Statistical Hurricane Intensity Forecast
SHIP	Statistical Hurricane Intensity Prediction
SST	Sea Surface Temperature
TD	Tropical Depression
TPC	Tropical Prediction Center, Miami, FL
TUTT	Tropical Upper Tropospheric Trough
UTC	Universal Time Coordinated
WFO	Weather Forecast Office