

Tropical Cyclone Report
Hurricane Neki
(CP032009)
18-27 October 2009

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Neki was the final tropical cyclone and only category three hurricane within the Central Pacific in 2009. After developing south of the main Hawaiian Islands, Neki moved to northwest, then turned to the north, passing through the Papahānaumokuākea Marine National Monument as a tropical storm and impacting French Frigate Shoals and Necker Island. Neki degenerated into a remnant low over the open waters of the Central Pacific.

a. Synoptic History

Neki originated within a broad, persistent, approximately west-to-east oriented near-equatorial trough spanning a vast portion of the Central Pacific. This surface trough had been a prominent feature in the Central Pacific since 11 October, and weak disturbances had been identified within the trough as early as 15 October. By 0000 UTC on 18 October, weakly curved bands of deep convection began to focus to the north and south of the western terminus of the trough, forming a rather large gyre not typically observed in the Central Pacific.

Shortly after 1200 UTC on 18 October, deep convection started to develop and organize around an elongated low-level center near the middle of the gyre, and it was estimated that a tropical depression formed around 1800 UTC on 18 October about 635 n mi south of South Point on the island of Hawaii. Neki was moving toward the west northwest at less than 10 kt, steered by deep easterly flow to the south of a subtropical ridge. The “best track” chart of Neki’s track is given in Fig. 1, and the best track positions and intensities are listed in Table 1.

Deep convection gradually consolidated around the low-level center through early 19 October, and it was estimated that the system reached tropical storm intensity by 1200 UTC on 19 October. The large circulation encompassing the tropical cyclone was slow to develop and break away from the near-equatorial surface trough where it originated, and QuikSCAT data, which detected an area of 35 kt winds near the low-level center at 0426 UTC and at 1709 UTC, provided critical information. During the last half of 19 October, Neki took a turn to the northwest as the subtropical ridge north of the system was being rapidly eroded by an approaching upper level trough to the northwest.

Organization improved rapidly on 20 October as Neki continued to move to the northwest around 15 kt toward a forming weakness in the subtropical ridge, and it was estimated that Neki became a hurricane by 0000 UTC on 21 October while centered 545 n mi of Honolulu and 290 n mi east southeast of Johnston Atoll. An intermittent banding eye had been developing late in the day on 20 October, and an Aqua AMSR-E pass at 0006 UTC on 21 October (Fig. 2) confirmed the presence of a partial eye wall. In an environment of low vertical wind shear and sea surface temperatures of 28 degrees Celsius, Neki continued to rapidly intensify through 21 October, reaching a peak intensity of 110 kt at 0000 UTC on 22 October. Around this time, Neki assumed a due north heading as a broad, North Pacific upper level trough steadily eroded ridging at the surface and aloft to the north, weakening the steering flow and leading to a decrease in the forward speed to less than 10 kt. As Neki moved to the north on 22 October, a slow weakening process began as increasing southwest winds aloft associated with the nearby upper level trough restricted outflow in the western quadrant and created vertical wind shear up to 25 kt according to analyses from the Cooperative Institute for Meteorological Satellite Studies/University of Wisconsin-Madison (UW-CIMSS). Continued interaction with the upper level trough prompted a turn to the northeast and led to steady weakening as vertical wind shear increased on 23 October.

Neki weakened to a tropical storm around 1800 UTC on 23 October as the system neared the Papahānaumokuākea Marine National Monument (PMNM). Strong southwesterly vertical wind shear slowly weakened Neki on 24 October as it passed through the PMNM coming within 60 n mi of French Frigate Shoals at 0000 UTC and within 11 n mi of uninhabited Necker Island at 0600 UTC. Neki's advance to the northeast was abruptly halted on 25 October as a transient high passed to the north, likely causing Neki to undertake an anticyclonic loop between 0600 and 1800 UTC. Neki resumed a slow motion to the northwest on 26 October as the surface high passed to the east. Continued westerly vertical wind shear caused the low-level circulation to decouple from the circulation aloft, and Neki became a tropical depression around 1800 UTC on 26 October. Thereafter, the low level center emerged to the northwest of an area of deep convection and quickly became indistinguishable as an elongated and rapidly dissipating surface trough 350 n mi southeast of an approaching cold front. The system dissipated by 0600 UTC on 27 October.

b. Meteorological Statistics

Observations in Neki include subjective satellite-based Dvorak technique intensity estimates from the Central Pacific Hurricane Center, Joint Typhoon Warning Center, and the Satellite Analysis Branch (SAB) and objective Dvorak intensity estimates from UW-CIMSS. Data and imagery from NOAA polar-orbiting satellites including the Advanced Microwave Sounding Unit (AMSU) instrument, NASA's Tropical Rainfall Measuring Mission (TRMM) and QuikSCAT satellites, EUMETSAT's ASCAT, the U.S. Navy's WindSat, and Defense Meteorological Satellite Program (DMSP) satellites, among others, were also useful in constructing the best track of Neki.

The estimated peak intensity of 110 kt at 0000 UTC on 22 October is based on an average of the subjective satellite-based Dvorak technique intensity estimates as well as peak objective Dvorak intensity estimates.

There were no ship reports of tropical storm force winds in association with Neki.

c. Casualty and Damage Statistics

There were no reports of damage or casualties associated with Neki. However, due to the extreme vulnerability of the low-lying islands and atolls within the PMNM, evacuations were conducted at two locations. Ten personnel were evacuated from Tern Island within French Frigate Shoals by a United States Coast Guard C-130 at approximately 2230 UTC on 21 October. To the northwest at Laysan Island, several individuals were removed by NOAA R/V Sette at approximately 0130 UTC on 22 October.

d. Forecast and Warning Critique

The genesis of Neki was fairly well anticipated. Neki originated within a broad, persistent, approximately west-to-east oriented near-equatorial trough that had been a prominent feature in the Central Pacific since 11 October. Disturbances within this trough were first mentioned in the Tropical Weather Outlook at 0200 UTC on 15 October.

A verification of CPHC official track forecasts is provided in Table 2. Average official track errors for Neki (with the number of cases in parentheses) were 41 (32), 69 (30), 103 (28), 149 (26), 265 (22), 393 (18), and 436 (14) n mi for the 12, 24, 36, 48, 72, 96, and 120 hour forecasts, respectively. Neki's erratic track proved difficult to forecast, causing errors in the official forecast and nearly all of the model guidance to be much higher than the CPHC long term average through 48 hours and nearly double the CPHC long term average beyond 48 hours. The GFSI, HWFI, GFDI, and the GUNA, TCON, and TVCN had average errors lower than the official forecasts during most time periods.

Average official intensity errors (Table 3) were 7, 11, 14, 16, 22, 26, and 34 kt for the 12, 24, 36, 48, 72, 96, and 120 hour forecasts, respectively. While CPHC intensity forecasts had lower errors than the GFSI, NGPI, HWFI, and GFDI for nearly all time periods, CPHC intensity forecasts were out-performed by DSHP and LGEM beyond 24 hours and by the ICON consensus model beyond the 12 hour forecast time period.

Watches and warnings associated with Neki are given in Table 4, while a map displaying the affected areas is provided in Figure 3. A hurricane watch was issued for the PMNM from French Frigate Shoals to Maro Reef to Lisianski Island at 0900 UTC on 21 October, approximately 45 hours prior to the 34 kt wind radius reaching the area, and was expanded southeastward from French Frigate Shoals to Nihoa Island at 1500 UTC on

21 October, approximately 39 hours prior to the 34 kt wind radius reaching the area. A hurricane warning was issued from Nihoa Island to French Frigate Shoals to Maro Reef at 2100 UTC on 21 October, approximately 33 hours prior to the 34 kt wind radius reaching the area.

A hurricane watch was issued for Johnston Island at 0300 UTC on 21 October, but no warnings were issued for this location.

Table 1. Best track for Hurricane Neki, 18 – 27 October 2009.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
18 / 1800	8.4	156.2	1008	25	tropical depression
19 / 0000	8.5	156.5	1007	30	"
19 / 0600	8.9	157.3	1007	30	"
19 / 1200	9.4	158.0	1006	35	tropical storm
19 / 1800	10.3	159.1	1006	35	"
20 / 0000	11.1	160.4	1006	35	"
20 / 0600	11.9	161.7	1005	40	"
20 / 1200	12.8	162.8	1001	55	"
20 / 1800	13.9	163.7	996	60	"
21 / 0000	15.0	164.8	992	65	hurricane
21 / 0600	15.9	165.7	985	75	"
21 / 1200	16.6	166.4	975	90	"
21 / 1800	17.6	166.6	960	100	"
22 / 0000	18.3	166.7	950	110	"
22 / 0600	19.0	166.7	956	105	"
22 / 1200	19.7	166.6	965	100	"
22 / 1800	20.4	166.4	970	90	"
23 / 0000	21.1	166.2	975	85	"
23 / 0600	21.9	165.9	980	80	"
23 / 1200	22.5	165.6	990	70	"
23 / 1800	22.9	165.4	995	60	tropical storm
24 / 0000	23.3	165.2	998	55	"
24 / 0600	23.6	164.9	999	55	"
24 / 1200	24.0	164.4	1001	50	"
24 / 1800	24.5	164.0	1001	50	"
25 / 0000	24.7	163.9	1001	50	"
25 / 0600	24.7	163.9	1002	50	"
25 / 1200	24.6	164.0	1003	45	"
25 / 1800	24.7	164.2	1003	45	"
26 / 0000	24.8	164.7	1006	40	"
26 / 0600	25.3	164.9	1008	35	"

26 / 1200	25.9	165.0	1009	35	"
26 / 1800	27.1	165.6	1010	30	tropical depression
27 / 0000	28.8	165.3	1010	30	"
22 / 0000	18.3	166.7	950	110	minimum pressure/ maximum wind

Table 2. Track forecast evaluation for Hurricane Neki, 18 – 27 October 2009. Forecast errors (n mi) are followed by the number of forecasts in parentheses. Errors smaller than the CPHC official forecast are shown in bold.

Forecast Technique	Forecast Period						
	12-hr	24-hr	36-hr	48-hr	72-hr	96-hr	120-hr
OFCL	41 (32)	69 (30)	103 (28)	149 (26)	265 (22)	393 (18)	436 (14)
CLP5	54 (32)	106 (30)	166 (28)	225 (26)	361 (22)	535 (18)	781 (14)
BAMD	51 (32)	95 (30)	154 (28)	231 (26)	390 (22)	605 (18)	718 (14)
BAMM	38 (52)	61 (30)	87 (28)	121 (26)	210 (22)	407 (18)	511 (14)
BAMS	54 (32)	89 (30)	127 (28)	164 (26)	228 (22)	327 (18)	461 (14)
GFSI	45 (32)	64 (29)	92 (28)	126 (26)	216 (22)	360 (18)	413 (13)
NGPI	46 (31)	80 (29)	110 (27)	138 (25)	204 (21)	314 (17)	467 (13)
HWFI	31 (32)	49 (30)	78 (28)	114 (26)	202 (22)	371 (18)	415 (14)
GFDI	33 (32)	54 (30)	84 (28)	131 (26)	218 (22)	378 (18)	438 (14)
GUNA	35 (30)	62 (27)	95 (26)	131 (24)	218 (20)	356 (16)	458 (8)
TCON	33 (30)	56 (27)	88 (26)	124 (24)	212 (20)	358 (16)	435 (8)
TVCN	36 (32)	60 (30)	87 (28)	119 (26)	198 (22)	337 (18)	429 (14)

Table 3. Intensity forecast evaluation for Hurricane Neki, 18 – 27 October 2009. Forecast errors (kt) are followed by the number of forecasts in parentheses. Errors smaller than the CPHC official forecast are shown in bold.

Forecast Technique	Forecast Period						
	12-hr	24-hr	36-hr	48-hr	72-hr	96-hr	120-hr
OFCL	7 (32)	11 (30)	14 (28)	16 (26)	22 (22)	26 (18)	34 (14)
DSHP	7 (30)	11 (29)	12 (28)	13 (26)	15 (21)	9 (15)	13 (14)
SHF5	9 (32)	13 (30)	17 (28)	20 (26)	41 (14)	28 (12)	13 (14)
LGEM	6 (30)	11 (29)	12 (28)	14 (26)	15 (22)	14 (18)	22 (14)
GFSI	9 (32)	18 (29)	25 (28)	32 (26)	41 (22)	41 (18)	27 (13)
NGPI	10 (31)	19 (29)	27 (27)	34 (25)	38 (21)	33 (17)	24 (13)
HWFI	8 (32)	13 (30)	14 (28)	16 (26)	18 (22)	28 (18)	41 (14)
GFDI	8 (32)	14 (30)	19 (28)	25 (26)	31 (22)	36 (18)	39 (14)
ICON	7 (27)	10 (26)	12 (25)	13 (23)	15 (18)	22 (13)	30 (12)

Table 4. Watch and warning summary for Hurricane Neki, 18 – 27 October 2009.

Date/Time (UTC)	Action	Location
20 / 0300	Hurricane Watch issued	Johnston Island
21 / 0300	Hurricane Watch changed to Tropical Storm Watch	Johnston Island
21 / 0900	Hurricane Watch issued	French Frigate Shoals to Maro Reef to Lisianski Island
21 / 1500	Hurricane Watch modified to	Nihoa Island to French Frigate Shoals to Maro Reef to Lisianski Island
21 / 2100	Hurricane Watch changed to Hurricane Warning	Nihoa Island to French Frigate Shoals to Maro Reef
21 / 2100	Tropical Storm Watch discontinued	Johnston Island
22 / 0300	Hurricane Watch changed to Tropical Storm Watch	Maro Reef to Lisianski Island
22 / 1200	Tropical Storm Watch discontinued	Maro Reef to Lisianski Island
23 / 1500	Hurricane Warning changed to Tropical Storm Warning	Nihoa Island to French Frigate Shoals to Maro Reef
24 / 1500	Tropical Storm Warning discontinued	French Frigate Shoals to Maro Reef
26 / 0300	Tropical Storm Warning discontinued	All

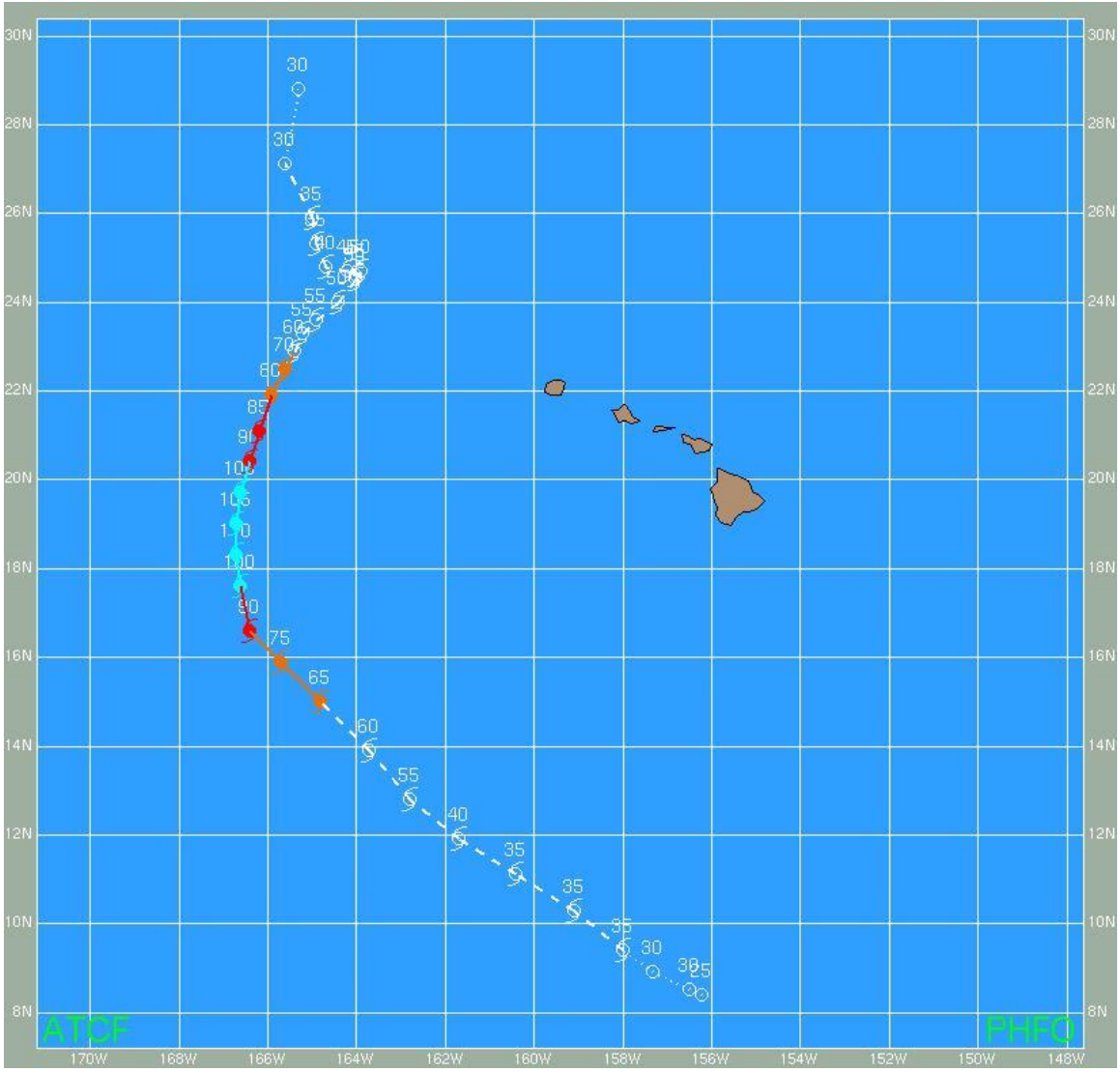


Figure 1. Best track positions for Hurricane Neki, 18 – 27 October 2009.

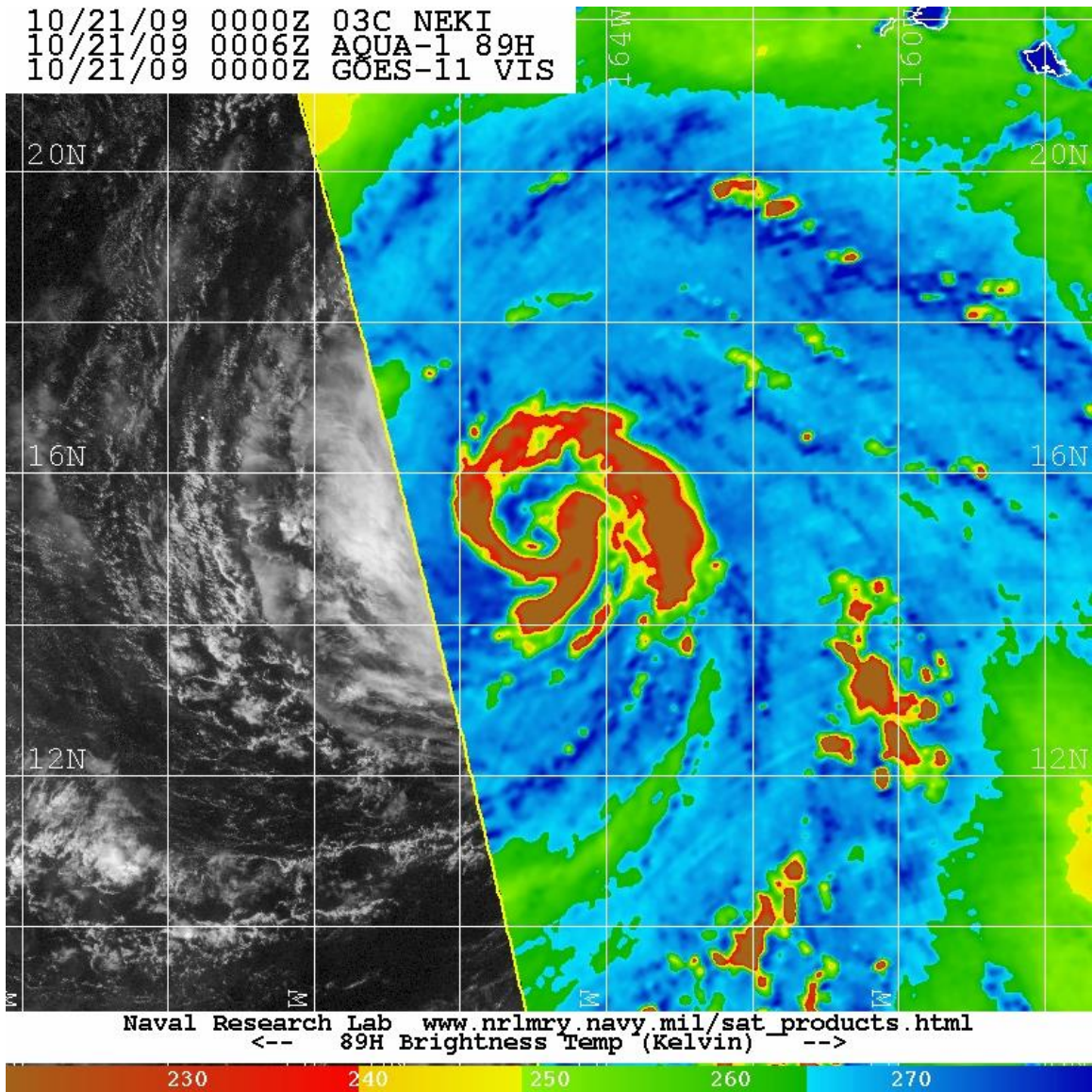


Figure 2. An 89 GHz channel pass over Neki from Aqua AMSR-E at 0006 UTC on 21 October. Image provided by the Naval Research Laboratory's Marine Meteorology Division in Monterey, CA.

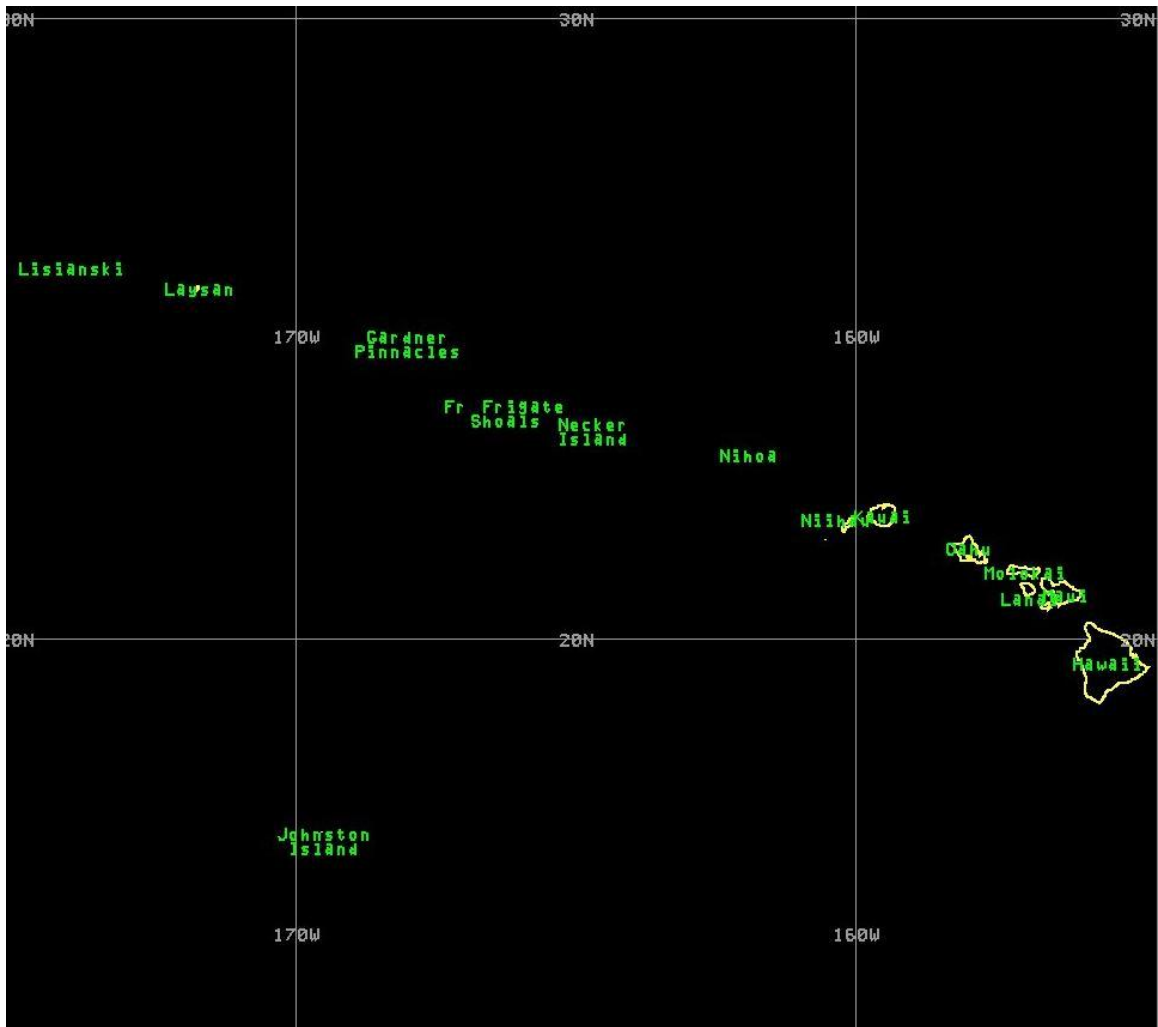


Figure 3. Map of the Central Pacific.