

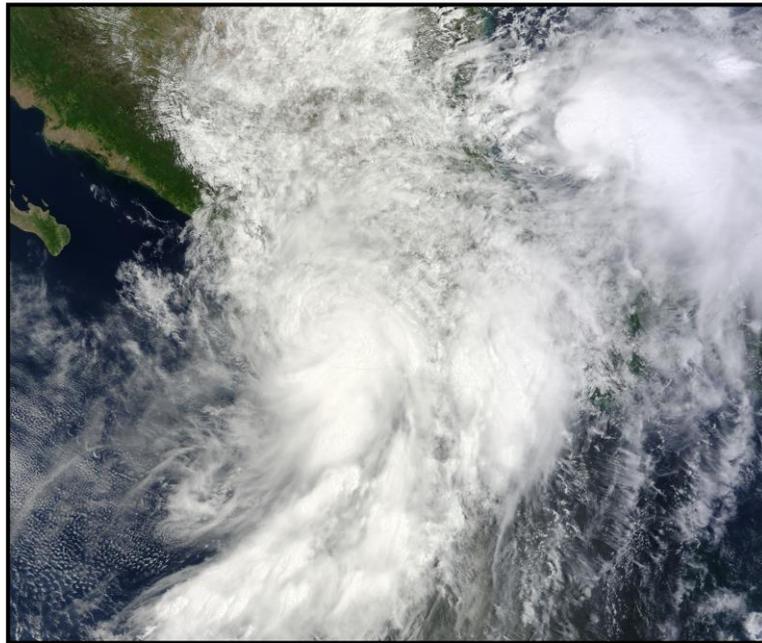


NATIONAL HURRICANE CENTER ANNUAL SUMMARY

2013 EASTERN NORTH PACIFIC HURRICANE SEASON

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NASA TERRA IMAGE OF TROPICAL STORM MANUEL AT 1729 UTC 15 SEPTEMBER 2013.

ABSTRACT

Tropical cyclone activity during the 2013 eastern North Pacific hurricane season was below average. Of the 18 tropical storms that formed, nine became hurricanes but only one reached major hurricane strength (category three or higher on the Saffir-Simpson Hurricane Wind Scale). In comparison, the 1981-2010 averages are about 15 tropical storms, 8 hurricanes and 4 major hurricanes. Although the numbers of named storms and hurricanes was near or above average, the number of major hurricanes was well below average. The Accumulated Cyclone Energy (ACE) index, a measure that takes into account both the strength and duration of the season's tropical storms and hurricanes, was also below average, with the 2013 season registering about 68% of the long-term median value. A larger number of cyclones than normal affected Mexico. Hurricane Barbara crossed the southeastern coast of Mexico in late May, bringing category 1 hurricane conditions. Heavy rains from Manuel inundated parts of southern and southwestern Mexico in September, causing mud slides and a large loss of life. Tropical Storms Juliette, Octave, and Sonia made landfall in Baja California or northwestern Mexico, with heavy rains and strong winds affecting these areas. Hurricane Erick, Tropical Storm Ivo, and Tropical Storm Lorena also brushed portions of the Mexican coast, but with less significant impacts.

OVERVIEW

The 2013 eastern North Pacific hurricane season was characterized by below normal tropical cyclone activity. A total of 18 tropical storms formed, of which eight became hurricanes. Only one of the hurricanes (Raymond) strengthened into a major hurricane (category 3 or higher on the Saffir-Simpson Hurricane Wind Scale). The numbers of tropical storms and hurricanes were near or above the long-term (1981–2010) averages of 15 and 8, respectively. The one major hurricane was below the long-term average of four. The Accumulated Cyclone Energy (ACE) index was well below normal, considering the total number of tropical storms and hurricanes that formed.

A larger than average number of storms affected Mexico during the 2013 season. Five named storms made landfall, of which two were hurricanes. Hurricane Barbara crossed the Mexican coast in the Gulf of Tehuantepec in late May, bringing category 1 hurricane conditions to this region and flooding rains as far east as Guatemala (Fig. 3). Its landfall point was the easternmost recorded for the basin during the satellite era. Manuel made landfall near Manzanillo as a strong tropical storm in mid-September and made a second landfall in the northwestern Mexican state of Sonora after regenerating in the southern Gulf of California several days later (Fig. 4). Tropical storms Juliette and Octave made landfall along the Baja California peninsula, causing heavy rains and high winds to this region. Tropical Storm Sonia affected northwestern Mexico, becoming only the third named storm to make landfall in Mexico in November during the satellite era. Three other storms (Erick, Ivo and Lorena) brushed portions of the Mexican coast, prompting watches or warnings and causing some effects. Remnant moisture from Tropical Storm Ivo also caused flash flooding and mud slides over parts of the Desert Southwest of the United States. The season's cyclones are listed in Table 1, with the tracks shown in Figures 1 and 2.

Heavy rains triggered by moisture associated with Manuel and an anomalously strong southwesterly low-level flow resulted in devastating flash flooding and mud slides in parts of southwestern Mexico, especially in the Mexican state of Guerrero. The small village of La Pintada to the northwest of Acapulco suffered a tremendous loss of life when a landslide engulfed the town with many feet of mud. According to CENAPRED, Mexico's National Center for the Prevention of Disasters, Manuel ranks as one of the deadliest and costliest tropical cyclones for Mexico since Pauline of 1997.

Environmental and oceanic conditions were generally less favorable for development than average during the July-to-October peak development period across the typical areas for tropical cyclone formation in the eastern Pacific. Easterly vertical wind shear was slightly higher than average, primarily due to enhanced low-level westerly winds and slightly enhanced easterly winds at 200 hPa (Fig. 5). Furthermore, sea surface temperatures were below average west and southwest of the Baja California peninsula (Fig. 6), which reduced the overall longevity and intensity of many tropical cyclones traversing this region. The preponderance of short-lived and weaker systems contributed to the below-average ACE.

The following section highlights the two most significant cyclones of the season. More detailed information on these storms, as well as information on the other tropical cyclones that formed in 2013, can be found at <http://www.nhc.noaa.gov/2013epac.shtml>.

SELECTED STORM SUMMARIES

Hurricane Manuel

Manuel became a tropical depression about 275 n mi southeast of Manzanillo, Mexico, on the morning of September 13, forming from the tropical wave that spawned Atlantic Hurricane Ingrid in the Bay of Campeche a day before. Becoming a tropical storm later that afternoon, Manuel moved slowly northwestward before slowing down and turning toward the north-northeast the next day, in response to weakening steering currents over central Mexico and the proximity of Hurricane Ingrid. A gradual turn back toward the northwest at a faster forward speed followed while Manuel steadily strengthened. The tropical storm reached an intensity of 60 kt before making landfall in the state of Michoacán, near Pichilinguillo, early on September 15. The tropical storm then moved nearly parallel to the coast for several hours, passing very near Manzanillo. Manuel quickly weakened while a substantial portion of the circulation interacted with the high terrain of the states of Jalisco and Colima, and it degenerated into a weak low-level trough by early on September 16. Very heavy rains, largely related to Manuel and moist southwesterly winds, occurred over a large portion of south-central and southwestern Mexico, resulting in deadly flash flooding and mud slides that persisted even as the circulation of the storm weakened. Rainfall totals in excess of 10 inches were observed in many locations and there was one total, measured in the vicinity of Acapulco near higher terrain, of 43.6 inches.

The mid-level circulation and low-level remnants of the tropical cyclone emerged over the southern Gulf of California on the afternoon of September 16. Thunderstorm activity began to increase, and Manuel became a tropical depression again while it moved slowly northwestward over very warm waters and into an environment of low vertical wind shear. A period of rapid intensification ensued, and Manuel reached its peak intensity of 65 kt late on September 18. The period of rapid intensification ended as Manuel approached land, and Manuel made landfall just west of Culiacán, Mexico on the morning of September 19. The hurricane quickly weakened after landfall, and degenerated into a broad area of low pressure over the Sierra Madre Occidental mountain range that afternoon.

At least 123 deaths in Mexico have been attributed to Manuel. At least 104 direct deaths occurred, nearly all in the state of Guerrero, when a mud slide destroyed nearly half of the village of La Pintada. Based on credible reports, estimates of total insured losses due to Manuel range from \$200 to 685 million (US), and the total economic impact is estimated to be around \$4.2 billion (US), with the biggest losses occurring in Guerrero. Manuel was one of the deadliest and costliest eastern Pacific tropical cyclones in Mexico in modern times.

Hurricane Raymond

Raymond became a tropical depression late on October 19 about 190 n mi south-southwest of Acapulco, Mexico, and strengthened into a tropical storm shortly thereafter. The storm moved slowly northwestward in a very favorable environment characterized by sea surface temperatures near 30°C and low shear. Raymond rapidly intensified from a 30-kt tropical depression to a 110-kt category 3 hurricane over a period of 42 hours, reaching its peak intensity while centered about 80 n mi south-southwest of Zihuatanejo, Mexico. The hurricane drifted erratically on October 21 and 22, making a small clockwise loop off of the southern coast of Mexico. Although there were no reports of tropical-storm-force winds, they likely occurred over a small portion of the coast in the Mexican state of Guerrero during this time. Heavy rainfall occurred for several days over Guerrero while Raymond was nearly stationary off of the coast of Mexico. Most areas within the state received at least 4 inches of rain, with the greatest totals occurring near the coast. The highest available rainfall total was 14.20 inches from Ixtapa-Zihuatanejo, but several other locations reported totals greater than 10 inches.

The cyclone upwelled colder water when it stalled and there was an increase in shear, both of which contributed to Raymond's weakening on October 22. In fact, the cyclone weakened almost as rapidly as it strengthened, becoming a weak tropical storm by the afternoon of October 23. Raymond then accelerated west-southwestward and westward away from the Mexican coast through October 26. When the vertical shear decreased again on 24 October, the cyclone began to restrengthen. Raymond regained hurricane strength during the morning of October 27 about 630 n mi south-southwest of the southern tip of the Baja California peninsula and reached a secondary peak intensity of 90 kt late that day. The hurricane then turned abruptly northwestward and northward on October 28 due to a trough to the north of the cyclone. Southwesterly shear increased that day, and Raymond weakened back to a tropical storm late on October 28 and continued weakening into the following day. The storm turned northeastward on October 30 and weakened to a tropical depression, finally degenerating into a remnant low about 320 n mi west-southwest of the southern tip of the Baja California peninsula later that morning. The remnant low dissipated a couple of days later.

There were no reported deaths associated with Raymond. Hundreds of people were evacuated in Guerrero, particularly from those areas that had been affected by severe flooding and landslides in Tropical Storm Manuel in mid-September. Heavy rains did cause some flooding, including in Acapulco, but the damage from Raymond was significantly less than the damage caused by Manuel.

FORECAST VERIFICATION

There were 288 forecasts issued for the eastern Pacific basin in 2013, which was about average for the eastern Pacific basin. The mean NHC track errors were lower than the 5-yr means at all times except for 120 h, but no records were set for forecast accuracy in 2013. Little bias was present in the official forecast through 48 h, with a moderate northeastward bias present from 72 to 120 h. Forecast skill in 2013 set a new record high at 24 h and was near all-time highs at the 48-, 72-, and 96-h forecast times. FSSE and TVCE were the only two models that consistently outperformed the official forecast. EMXI was the best individual model, but it had a little less than TVCE and the FSSE. GSFI, HWFI, and AEMI made up the second tier of



models, with GHMI not too far behind. CMCI was a poor performer and had similar skill to the simple BAMB and BAMS models.

Mean intensity errors were lower than the 5-yr means at all times, by up to 25%. The Decay-SHIFOR5 forecast errors were also lower than their 5-yr means, implying that forecast difficulty in 2013 was lower than normal. The official forecasts performed better than all of the guidance at 12 and 24 h, but was outperformed by the consensus aids IVCN and FSSE at 36 h and beyond. HWFI and DSHP were skillful throughout the forecast period and made up the second tier of models; the LGEM and GHMI had little skill in 2013. It is worth noting that GFSI and especially EMXI were not competitive with the intensity guidance in this basin.



Table 1. 2013 Eastern North Pacific hurricane season statistics.

Storm Name	Class ^a	Dates ^b	Max. Winds (kt)	Min. Pressure (mb)	Deaths
Alvin	TS	May 15 – 17	50	1000	
Barbara	H	May 28 – 30	70	983	3
Cosme	H	June 23 – 27	75	980	
Dalila	H	June 29 – 7 July	70	984	
Erick	H	July 4 – 9	70	983	
Flossie	TS	July 25 – 30	60	994	
Gil	H	July 30 – 6 August	75	985	
Henriette	H	August 3 - 11	90	976	
Ivo	TS	August 22 – 25	40	997	
Juliette	TS	August 28 - 29	55	997	
Kiko	H	August 30 – September 2	65	989	
Lorena	TS	September 5 - 7	45	1002	
Manuel	H	September 13 - 19	65	983	123
Narda	TS	October 6 – 10	55	997	
Octave	TS	October 12 – 15	55	994	
Priscilla	TS	October 14 – 16	40	1001	
Raymond	MH	October 20 – 30	110	951	
Sonia	TS	November 1 – 4	40	1002	

^a Tropical depression (TD), maximum sustained winds 33 kt or less; tropical storm (TS), winds 34-63 kt; hurricane (H), winds 64-95 kt; major hurricane (MH), winds 96 kt or higher.

^b Dates begin at 0000 UTC and include all tropical and subtropical cyclone stages; non-tropical stages are excluded.

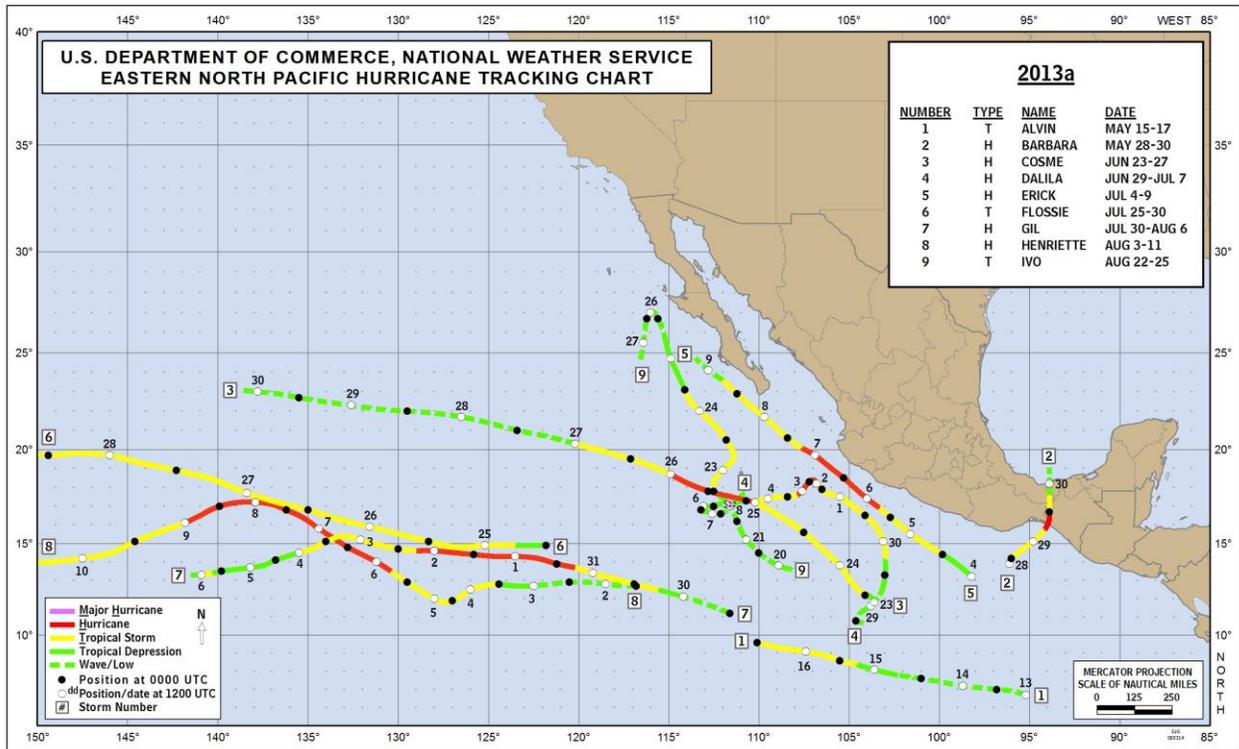


Figure 1. Tracks of the first nine eastern North Pacific tropical storms and hurricanes of 2013.

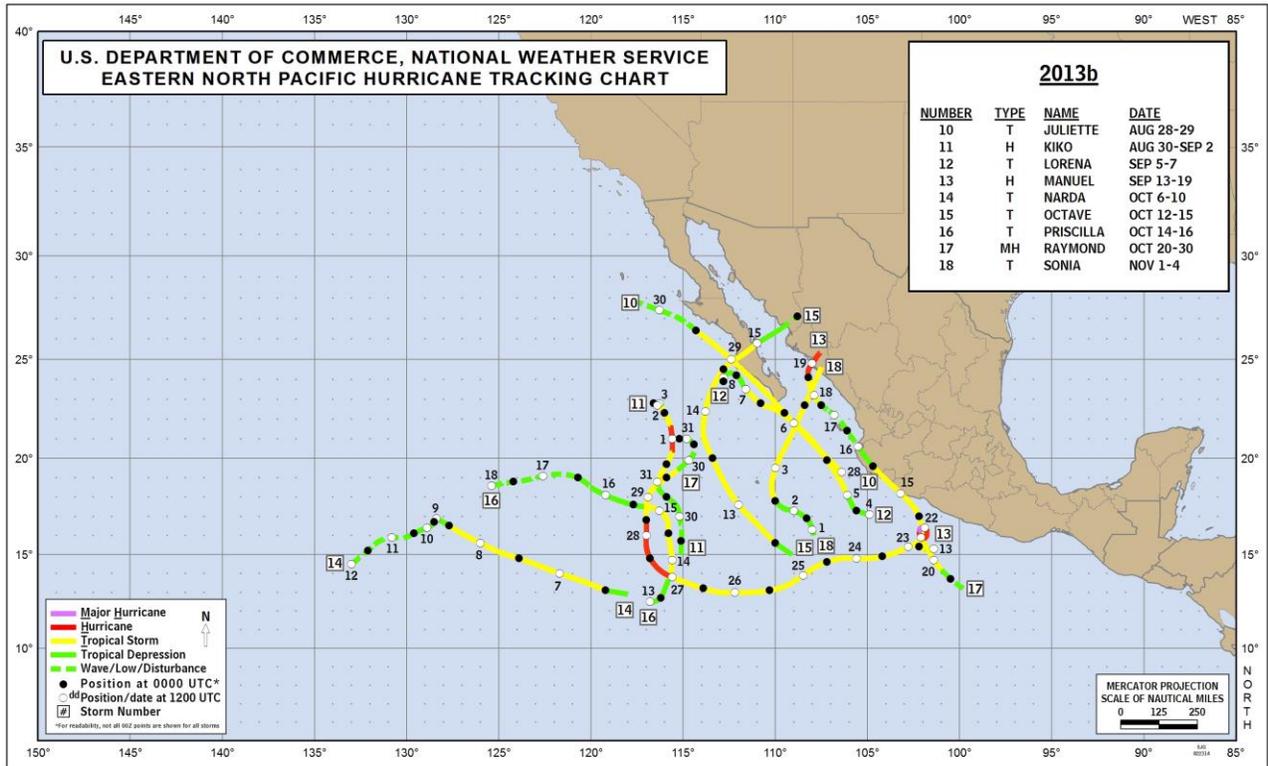


Figure 2. Tracks of the final nine eastern North Pacific tropical storms and hurricanes of 2013.

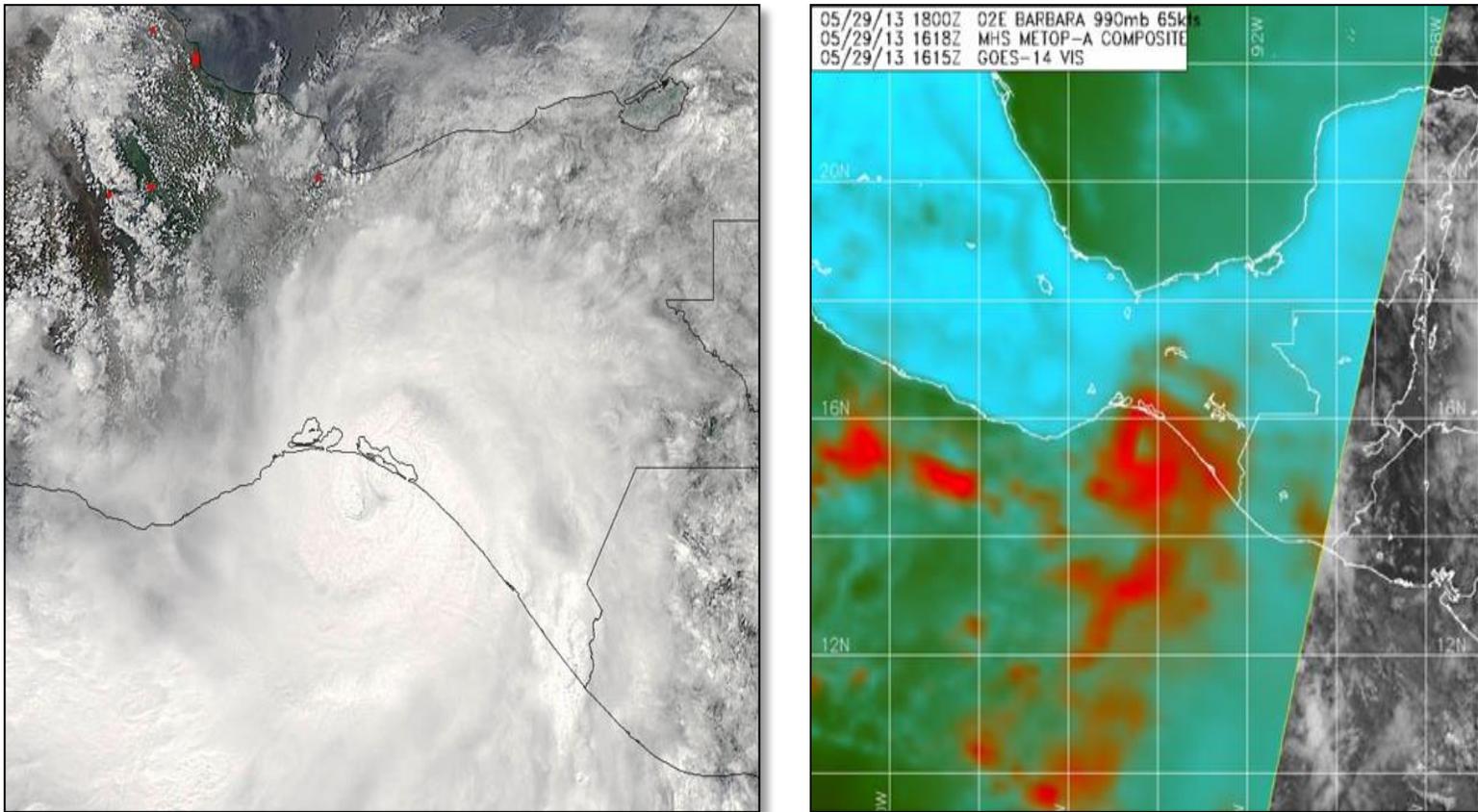


Figure 3. NASA MODIS satellite image showing the eye of Hurricane Barbara near the coast of Mexico at 2030 UTC UTC 29 May (left), and the eye of Barbara observed on a microwave image slightly earlier at 1618 UTC the same day (right). Microwave image is courtesy of the Naval Research Laboratory.



Figure 4. Image from the Mexican radar in Guasabe of Hurricane Manuel making landfall over northwestern Mexico. Image provided by CONAGUA.

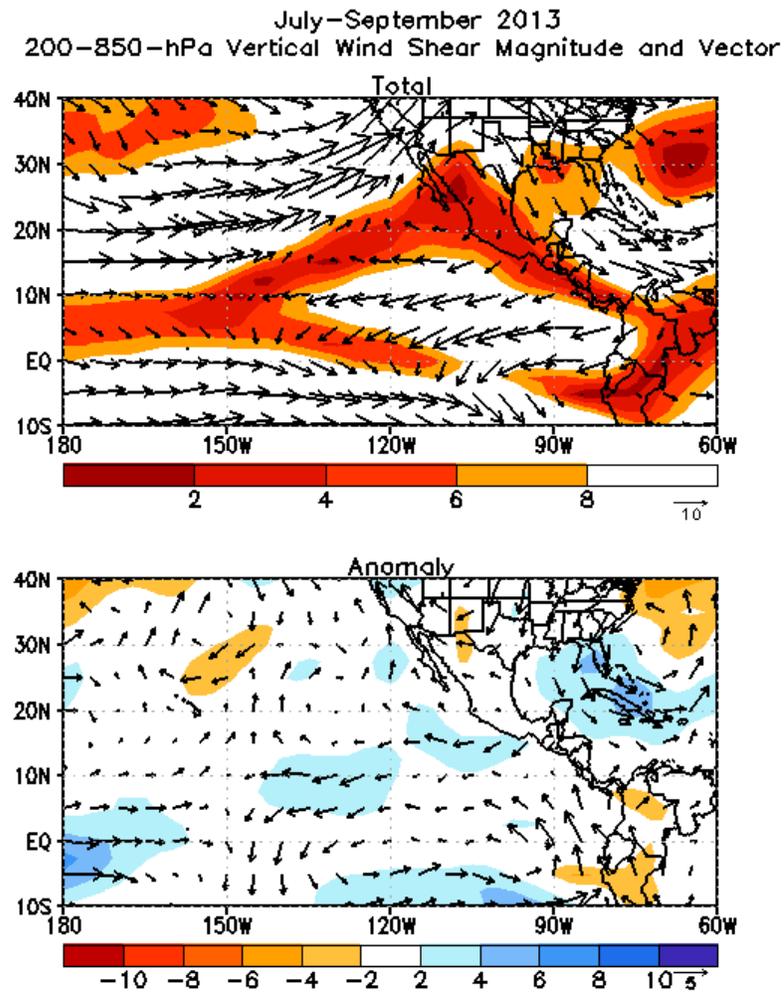


Figure 5. 850-200 mb vertical wind shear and vertical wind shear anomalies over the eastern North Pacific basin, July through September 2013. The vector indicates the shear direction and magnitude of the shear is in ms^{-1} .

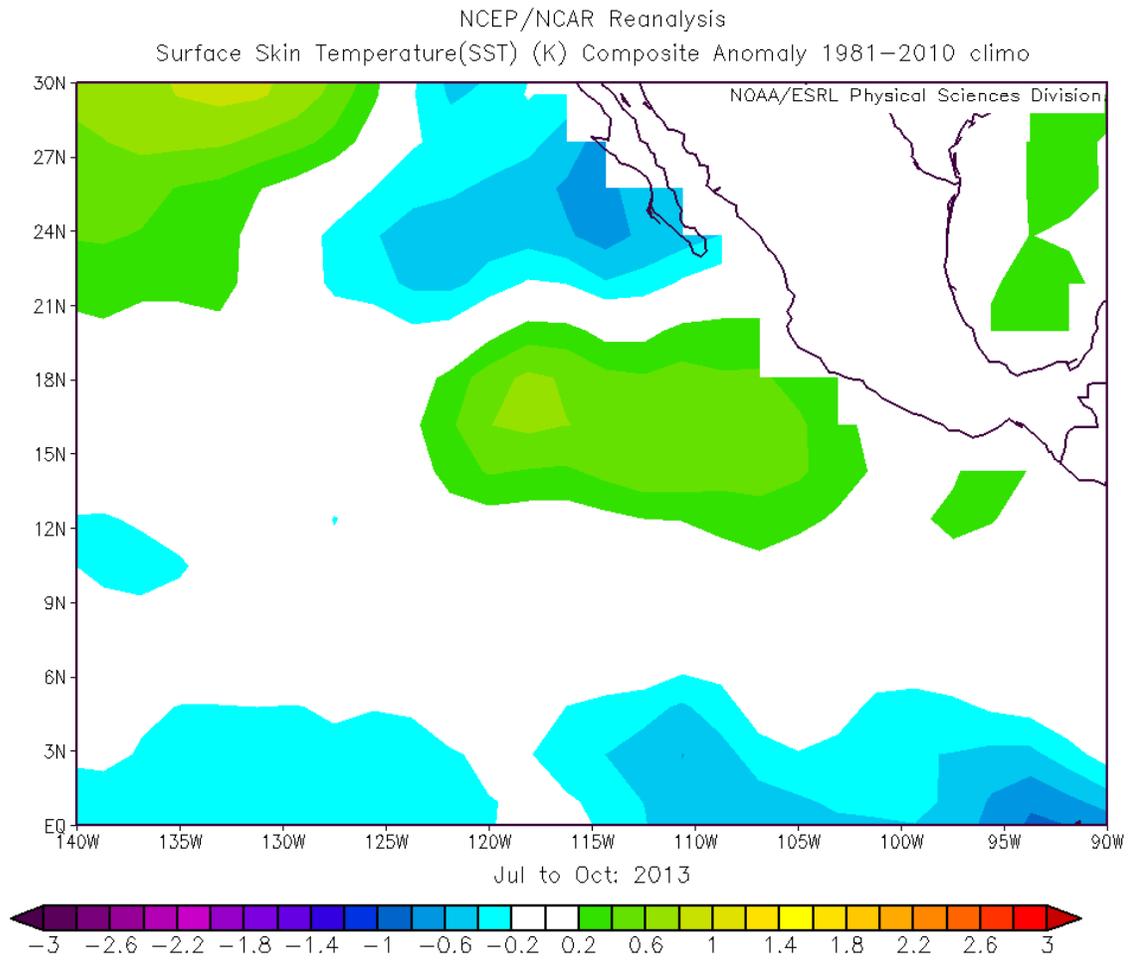


Figure 6. Sea surface temperature anomalies from July through October 2013 over the eastern Pacific basin. The magnitude of the anomalies is given by the color-coded legend below in 0.2° increments.