iCyclone Chase Report

storm	**Hurricane ODILE**		
location	**Cabo San Lucas, Baja California Sur, Mexico**		
date	**14-15 September 2014**		
chasers	**Josh Morgerman, Steve Crighton**	**author**	**Josh Morgerman**

Overview

Hurricane ODILE was a violent, destructive cyclone that directly impacted **Cabo San Lucas**. We were in the city, very close to the landfall point.

Following are **key observations.** All times in this document are local (**MDT**) time—which is UTC minus 6 hours:

- **Eyewall.** The eyewall seemed symmetric and well-defined on the ground, with distinct (and very destructive) wind maxima both preceding **and** following the eye. These very destructive winds lasted ~**9:30–10:35 pm** and ~**11:45 pm–1:30 am**. However, the winds **after** the eye seemed a bit more violent (see **Backside**, below).

- **Eye & Lowest Pressure.** A relative calm lasted a little over 1 hour (~**10:35–11:45 pm**), with the pressure hitting a low of **943.1 mb** at **11:05, 11:07, and 11:08 pm**. Since we were 3-4 n mi from the center of the eye, this supports a sub-940 landfall pressure. I don't remember ever having a dead calm. It stopped raining and winds reduced to maybe 10 or 15 kt—not totally calm, but enough so we could venture outside to inspect damage.

- **Core Gradient.** The pressure fell 40 mb in ~2 hours (~9–11 pm) as the center approached, and **rose 30 mb in ~1 hour** (~11 pm–12 midnight) as the center moved away. Since the cyclone was moving ~15 kt, it obviously had a very steep core gradient—certainly well over 2 mb/n mi and approaching 3 mb/n mi in places. This perhaps explains why the winds were so violent. It's interesting to note that this steep gradient extended from the inner eyewall **well into the eye**, so that great pressure changes occurred even during the calm.

- **Backside.** As the eye passed, the backside winds ramped up suddenly at ~11:45 pm—with very little build-up—becoming violent and extremely destructive within just a few minutes. Explosive winds inflicted very heavy damage to our (already damaged) hotel at this time, tearing apart the lobby. Interestingly, this high-energy burst coincided with the extremely rapid pressure rise (noted above), when we were apparently in the part of the cyclone with the steepest pressure gradient.

- **Damage.** I was unable to do a thorough damage survey, but my overall impression—from witness accounts and my own eyes—is that Hurricane ODILE's impact was mostly wind-related. There was definitely freshwater and storm-surge flooding—in some areas significant—but it was the wind that devastated the city, airport, and infrastructure.

The rest of this report provides more detail Re: the above points.

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Chase Location

We observed the passage of **Hurricane ODILE** in **Cabo San Lucas, Baja California Sur, Mexico**, at **22.90231N 109.88354W**. We rode out the storm in the Holiday Inn Express Hotel, which is on Bahia San Lucas, ~2 n mi ENE of the city center.

The center of the eye crossed the S coast of Baja California Sur very near our location. The National Hurricane Center's operational track puts the **landfall point ~4 n mi ENE of our location.**

The **Chase Map** shows our location (**green diamond**) in relation to **ODILE's center positions** (**orange markers**), as per the NHC's operational track (times converted to MDT). **Chase Map (Detailed)** and **Chase Map (Detailed 2)** are closer views.

Figure 1: Chase Map

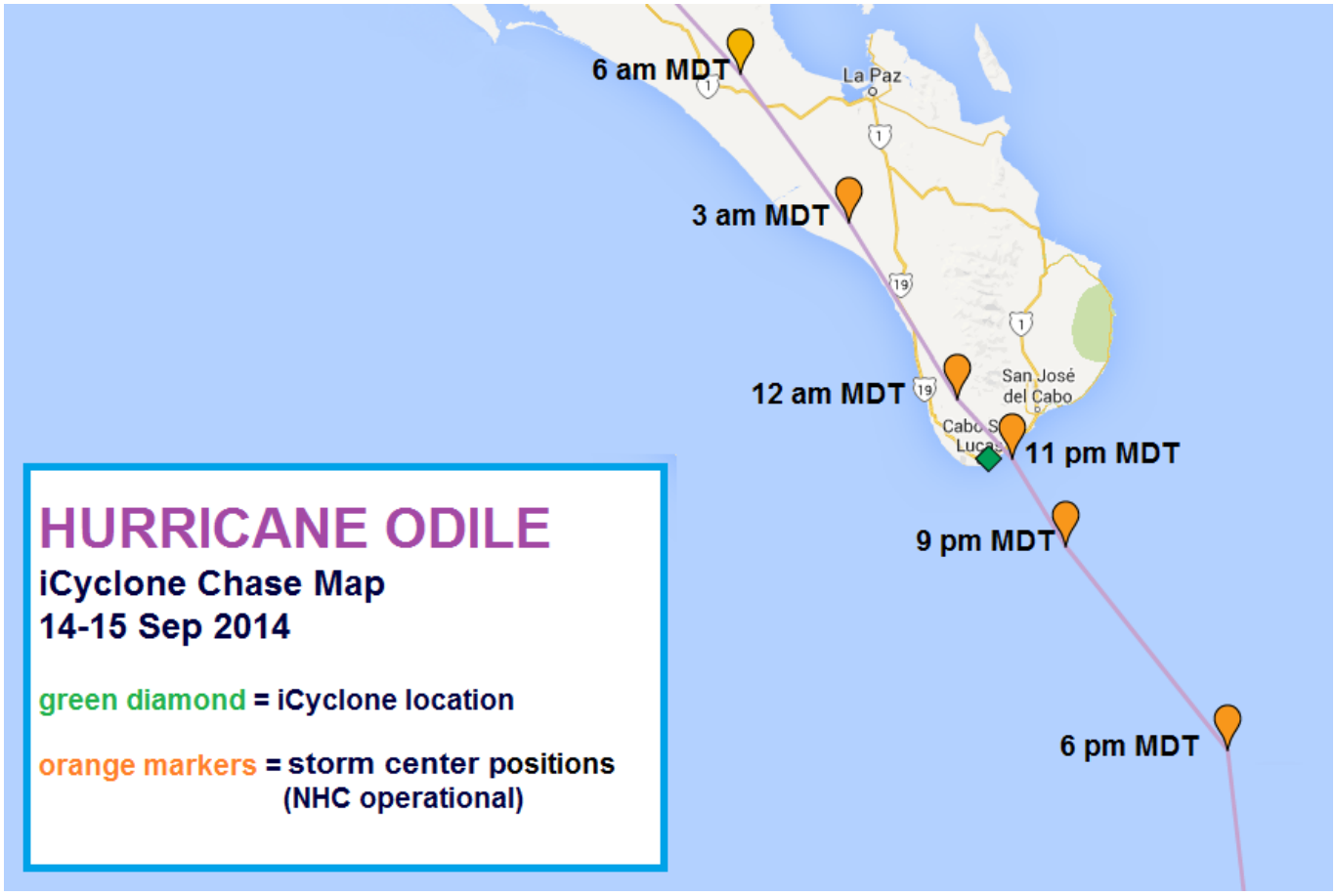


Figure 2: Chase Map (Detailed)

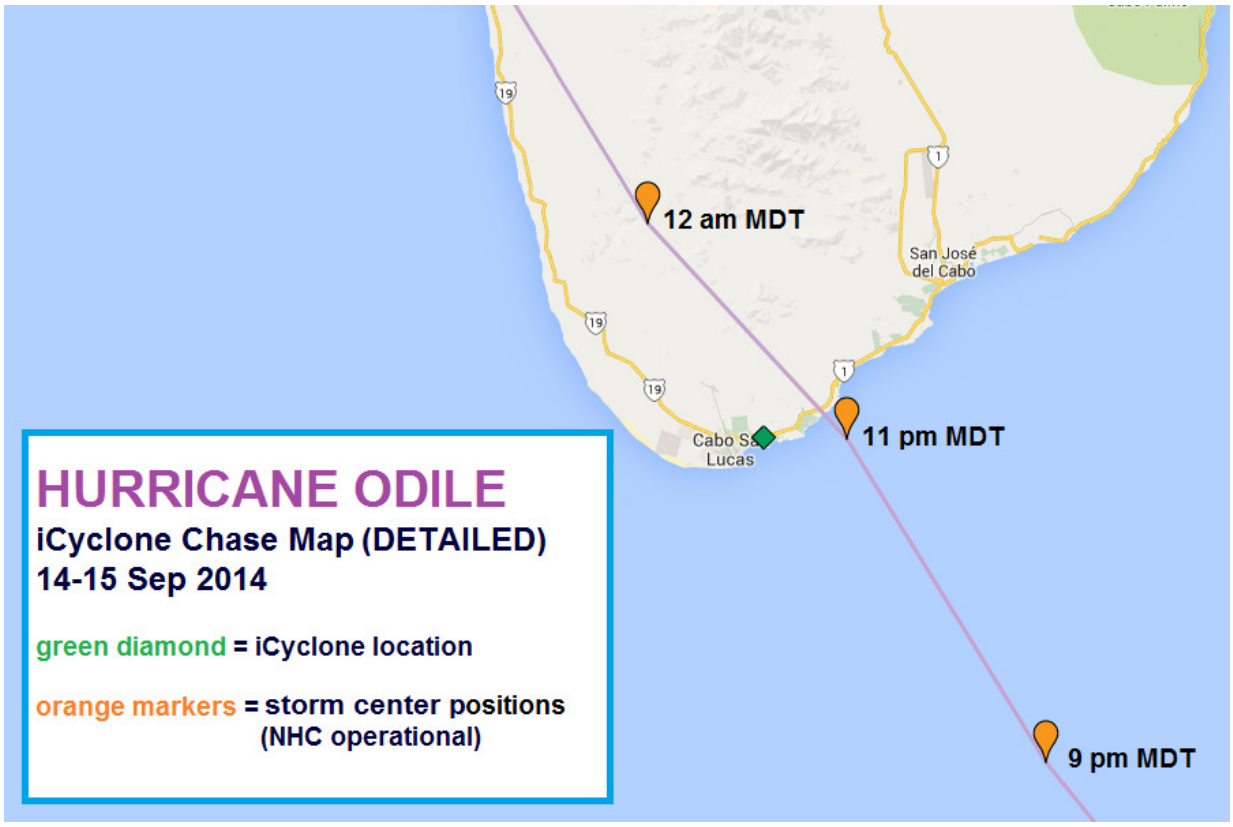
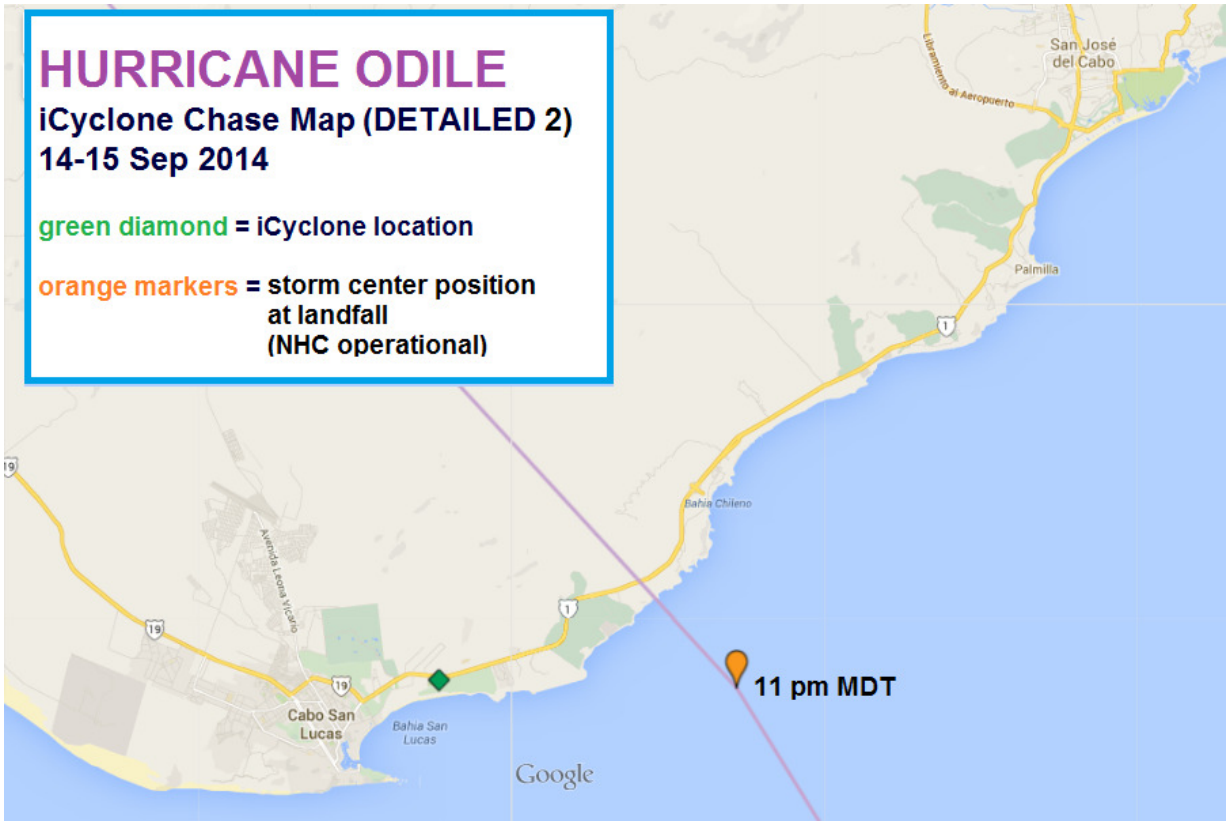
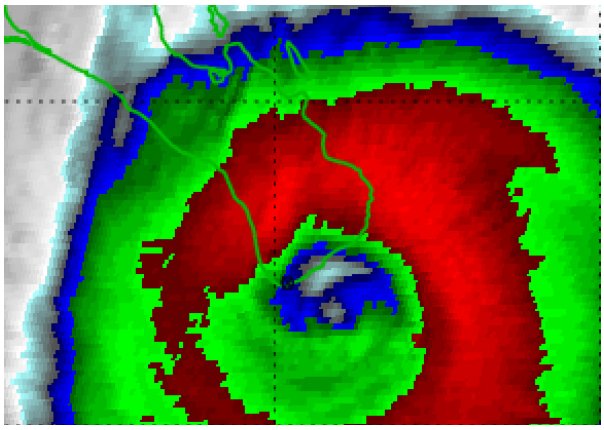


Figure 3: Chase Map (Detailed 2)

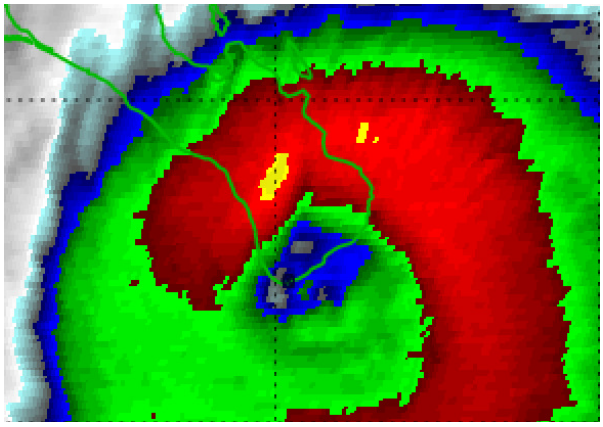


Landfall Location

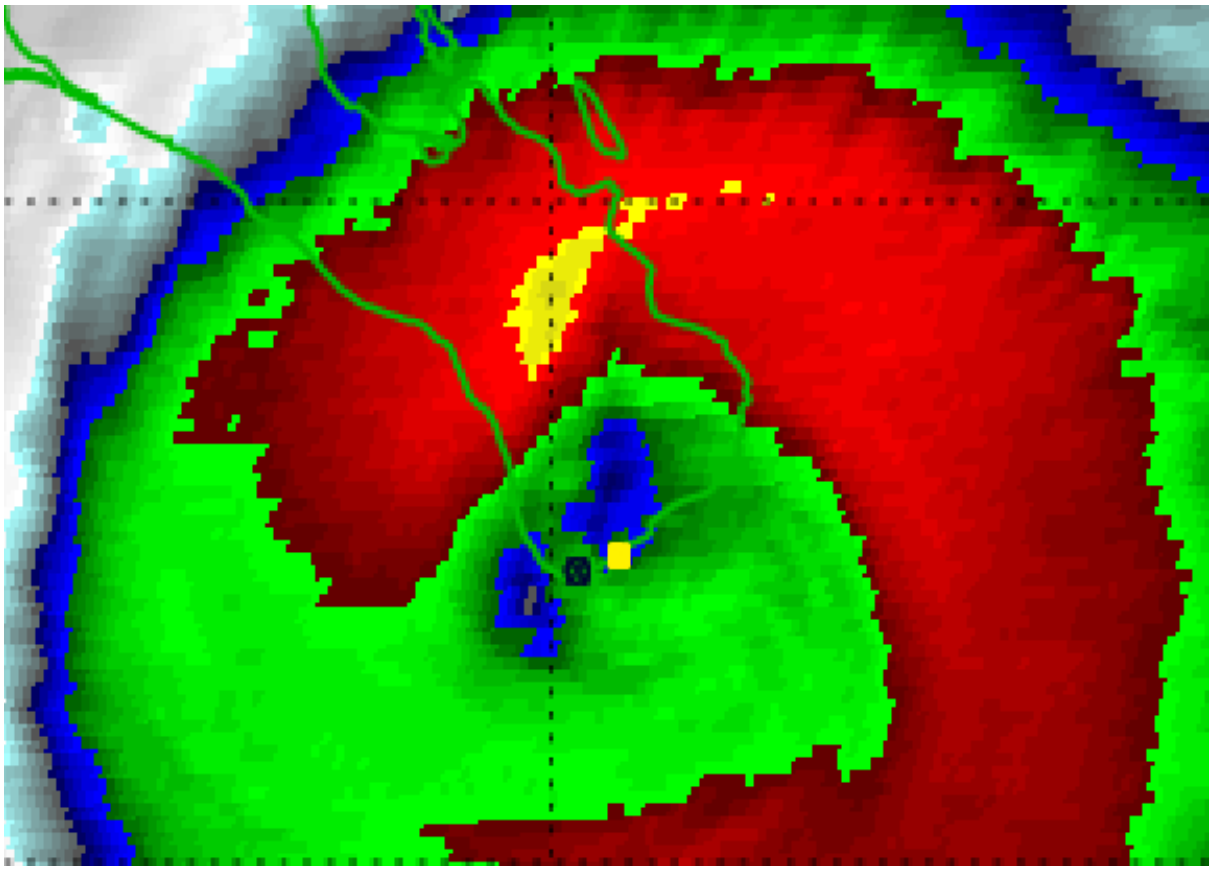
Unfortunately there are no radar images from the time of landfall. However, a close review of **infrared imagery** leading up to landfall seems to support the NHC's operational **landfall point** (22.9N 109.8W) and **time** (10:45 pm MDT).



9:45 pm MDT (0345Z)



10:15 pm MDT (0415Z)



10:45 pm MDT (0445Z). Cabo San Lucas is marked with the black box; the estimated landfall point is marked with the yellow box.

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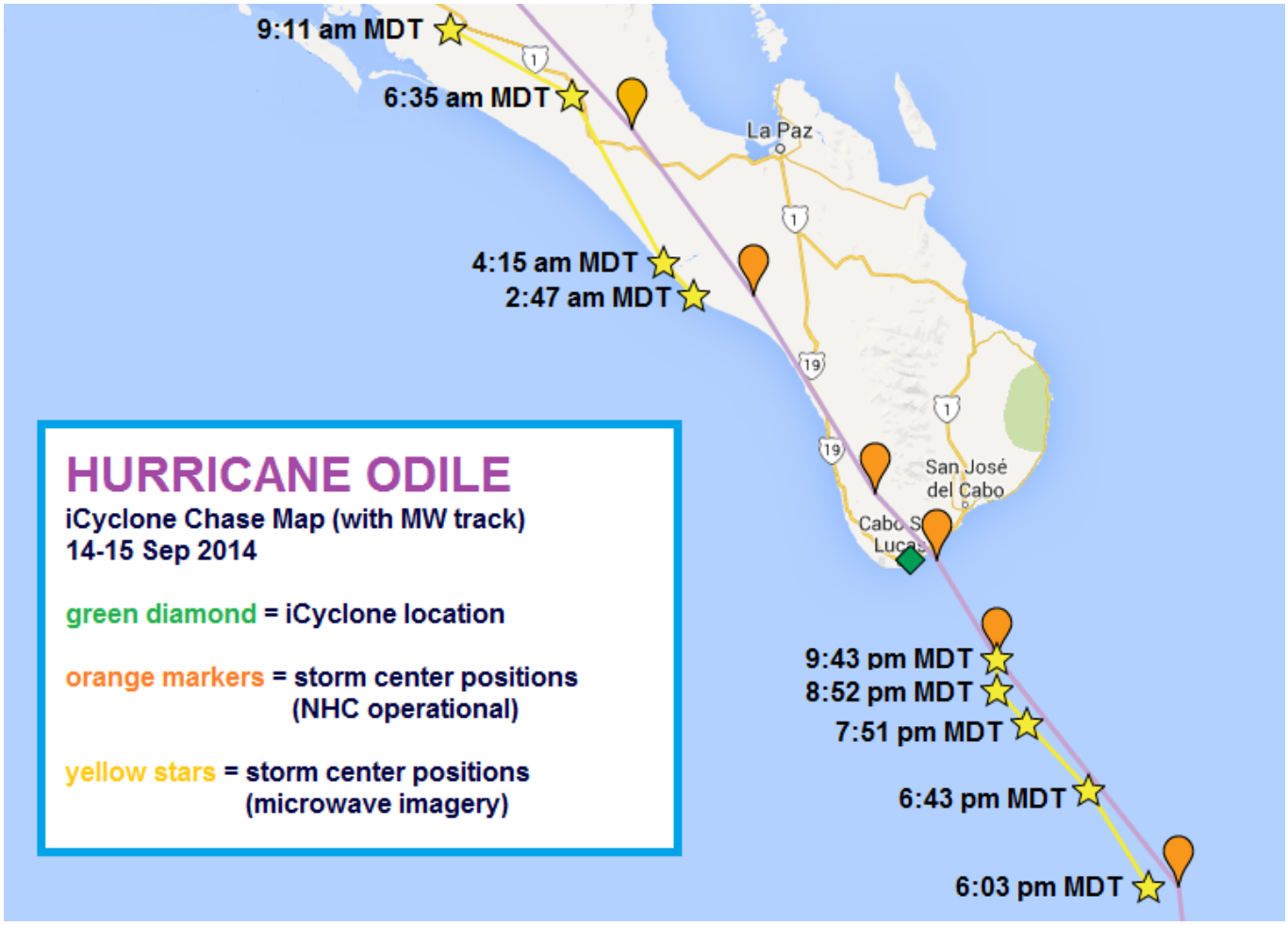
Microwave Imagery—Track at Landfall

Plotting the center positions shown by microwave imagery (**yellow stars**) creates a track just a hair W of the NHC's operational track.

Unfortunately, landfall occurred during the long (5-hour) gap in microwave imagery—between the 9:43 pm (0343Z) and 2:47 am (0847Z) images. Given this, microwave imagery can't be used to help determine the exact landfall point. Note that no vector connects the 9:43 pm and 2:47 am positions, as a vector wouldn't accurately indicate the motion between two such widely-spaced points.



Center Positions as Derived from Microwave Imagery

- 6:03 pm (0003Z): 21.9N 109.1W
- 6:43 pm (0043Z): 22.2N 109.3W
- 7:51 pm (0151Z): 22.4N 109.5W
- 8:52 pm (0252Z): 22.5N 109.6W
- 9:43 pm (0343Z): 22.6N 109.6W
- 2:47 am (0847Z): 23.7N 110.6W
- 4:15 am (1015Z): 23.8N 110.7W
- 6:35 am (1235Z): 24.3N 111.0W
- 9:11 am (1511Z): 24.5N 111.4W

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Detailed Chronology

Following is a detailed chronology of observed conditions in Cabo San Lucas on 14-15 September, reconstructed from my **time-stamped video footage** and **real-time social-media postings**. Please note that nighttime darkness limited observations mostly to sounds and effects on our hotel.

The periods of the most powerful, destructive winds—probably corresponding with the eyewall—are **coded red;** but please note that the start and end times of these periods were subjectively determined (without wind data) and should be considered approximate. The period of relative calm in the eye is **coded blue.** All times are local (MDT):

/1 – Front Side

- **2:30 pm.** Strong but quick rainband brings torrential downpour & gusty winds.
- **7:25 pm.** Rainy; windy.
- **7:50 pm.** Heavy rain. Trees waving. Wind making whistling sound in hotel lobby. Front doors (facing N) pulsing inward—enough so hotel staff move sofa in front of them.
- **8 pm.** Lights flickering. 991 mb.
- **8:45 pm.** Wind goes from whistle to roar. Front doors start to shake badly.
- **9:20 pm.** Wind making screaming, roaring sounds—hotel getting hammered. Front doors push out of their frames, letting wind & rain into lobby. We pile mountain of furniture against doors to keep them in place.
- **9:35 pm.** High-energy blasts of wind pound hotel. Front doors completely blow in again, despite furniture piled against them.
- **10 pm.** Ears popping. Front entrance of hotel completely destroyed. Debris blowing by entrance at great speeds. Car alarms going off. Wind & rain enveloping lobby.
- **10:10 pm.** Sounds of train going by, with whistling. Ears hurt from pressure. Large, thick, N-facing plate-glass window on 2nd floor of lobby explodes. Interior walls vibrating from pressure.

/2 – Eye

- **10:35 pm.** Starting to calm—quieter. 949 mb.
- **11:05 pm.** Relative calm—winds maybe 15 or 20 kt, light or no rain. Some guests peeking outside, walking around in parking lot. Heavy damage to front of hotel—looks like it went through blender. 942.8 mb. *(**Note:** Device 2 indicated 943.1—see **Air Pressure Discussion**.)*
- **11:25 am.** Hissing sounds & low howl. Piece of tin tumbling across parking lot. Storm seems to be starting up again. 952 mb.

/3 – Backside

- **11:45 pm.** Winds suddenly ramp up to very high speed—with little build up—now from a generally S direction. Debris flying past hotel's battered front entrance. Banging sounds—which hotel worker compares to gunshots.
- **11:50 pm.** Entire back wall of lobby (made of thick glass) instantaneously explodes—like bomb going off—blasting lobby with flying debris. Guests and staff run, duck, hide. Mayhem. Lobby becomes wind tunnel for next hour, with violent winds gutting interior.
- **1 am.** Interior of lobby mostly destroyed; winds still roaring, but **maybe** starting to ease slightly.
- **1:30 am.** Winds easing.
- **2 am.** Winds much less—storm seems to have mostly passed.

Given the above, the destructive core of the cyclone took ~**4 hours** to pass our location—as follows:

- **Front eyewall: ~9:30–10:35 pm**
- **Eye: ~10:35–11:45 pm**
- **Back eyewall: ~11:45 pm–1:30 am**

Video footage showing these events will be posted on the **iCyclone YouTube channel** (http://www.youtube.com/cyclonejosh) by November 2014.

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Air Pressure Discussion

Devices

I had two devices—both Kestrel 4500s. The sampling rate was one reading per 30 seconds.

The pressure trace is below (**Chase Map (Device 2)**), and the complete data (in Excel format) accompany this report.

Calibration

USGS data and other sources indicate the ground elevation at our location was ~80-86 ft. Unfortunately, given our distance from the ocean, it was impossible to "eyeball" it, and I couldn't visually assess our elevation with confidence. Given the available information, I used 86 ft.

Device 1 was kept on a lanyard around my neck for most of the evening. I used this device to "spot check" the air pressure during the storm. Since I stayed in the ground-floor lobby during most of the storm—and that's where I took readings—this device was calibrated (for sea-level readings) using a **reference altitude of 86 ft.**

Device 2 was deployed in a safe place in my third-floor room, and it was left undisturbed during the storm. To calibrate this device, I used the air pressure measured on the ground floor as a reference, setting the device's altitude on the third floor to make the air-pressure match the reading just taken on the ground floor. **The reference altitude used was 105 ft.**

Device 2 wasn't moved or touched during the entire storm and is considered the more accurate source.

Lowest Pressure

The two devices matched fairly well, showing lowest readings of ~943 mb just after 11 pm, during the passage of the eye:

- **Device 1: 942.8 mb a little after 11 pm, in the eye.** (The exact time wasn't recorded.)
- **Device 2: 943.1 mb at 11:05, 11:07, and 11:08 pm.**

As mentioned above, **Device 2** was left undisturbed in a controlled environment and is considered the more accurate and reliable source—therefore, this one is used to represent iCyclone's official minimum pressure during Hurricane ODILE: **943.1 mb**.

Gradient

My data indicate ODILE had a very steep pressure gradient in its core—and that this steep gradient extended from the inner eyewall well into the actual eye. For example:

The pressure fell **~40 mb in the final 2 hours** of the center's approach, dropping from 982.8 mb at 9:05 pm to 943.1 mb by 11:05 pm. Of that drop, 9 mb happened in the final 30 minutes, during the relative calm—showing that the steep pressure gradient extended well into the eye.

The recovery was even more dramatic. The pressure rose an incredible **~32 mb in just 1 hour** as the center moved away, rising from 943.1 mb at 11:08 pm to 975.1 mb by 12:08 am. Of this rise, 17 mb happened in the first 37 minutes, during the relative calm—again showing that the steep gradient extended into the eye. But as we went back into the eyewall, the recovery was even faster, rising **15 mb in just 23 minutes.** Interestingly, ***it was during this extremely rapid pressure rise in the cyclone's backside that we saw the most violent and destructive winds.*** Given that the cyclone was moving NNW at 14 or 15 kt, this suggests the pressure change was approaching **3 mb/n mi** in the inner eyewall.

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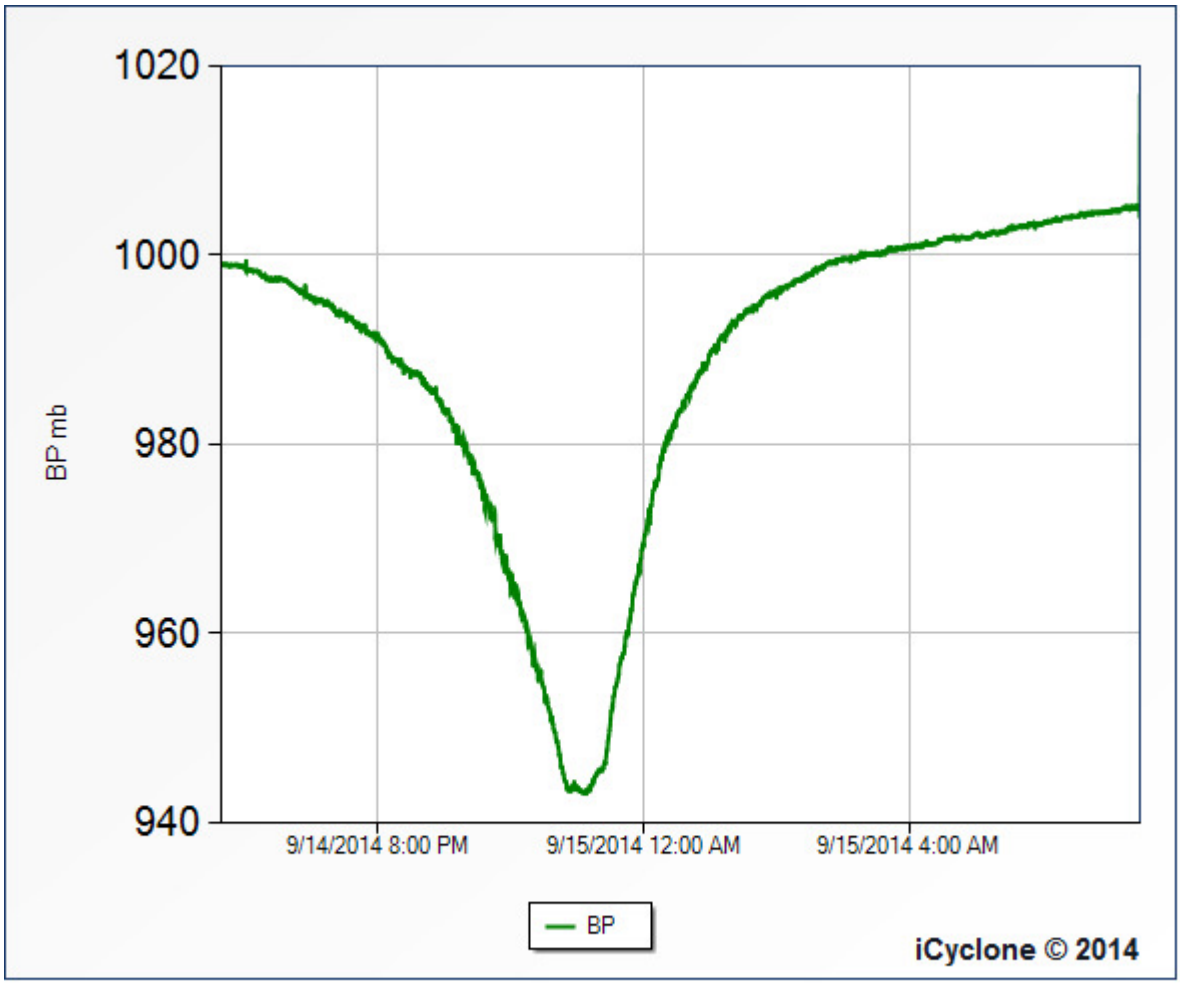
Central Pressure at Landfall

The NHC's operational landfall point and the infrared imagery bring ODILE's center **3 or 4 n mi ENE of our chase location** at its close approach (~11 pm).

Given that the above air-pressure data suggest a gradient of 1-2 mb/n mi in the eye, this suggests the hurricane's central pressure at landfall was likely between 3 and 8 mb lower than my observed pressure—or between **935 and 940 mb**.

Barogram

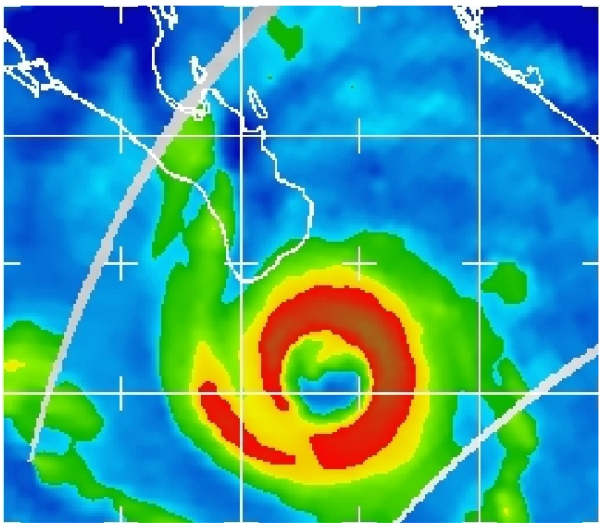


HURRICANE ODILE: 14-15 Sep 2014
Cabo San Lucas, Baja California Sur, Mexico (22.90231N 109.88354W)

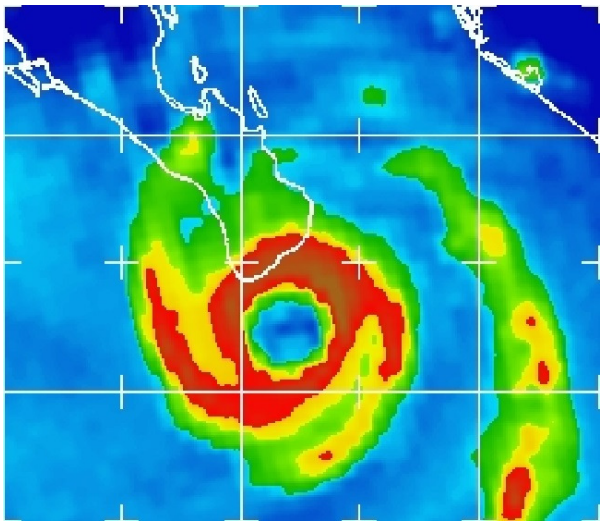
Intensity Trend at Landfall

Microwave images near the time of landfall suggest the hurricane was re-intensifying as it approached the coast.

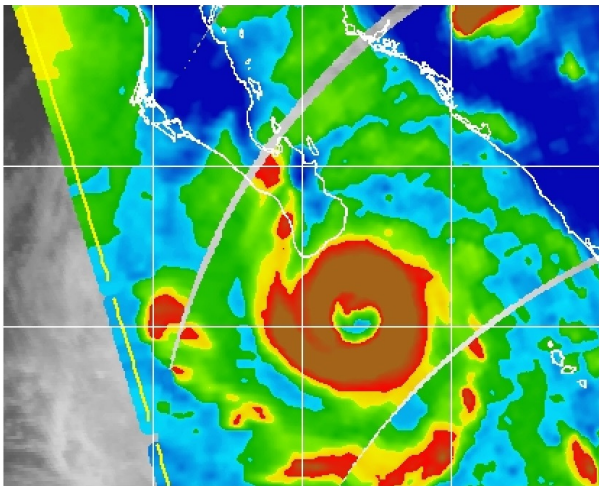
In the following image pairs—each with shots from **6:43 pm (0043Z)** and **8:52 pm (0252Z)**—one can see the eyewall closing off and strengthening, and the eye clearing out and becoming more symmetric, as time progresses:



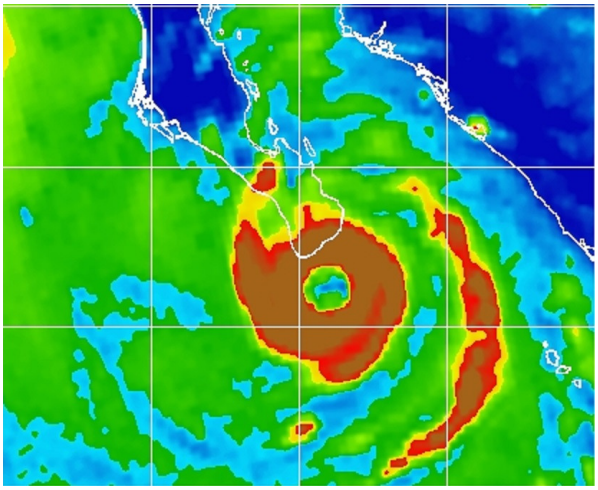
85 GHz H – SSMIS: 6:43 pm MDT (0043Z)



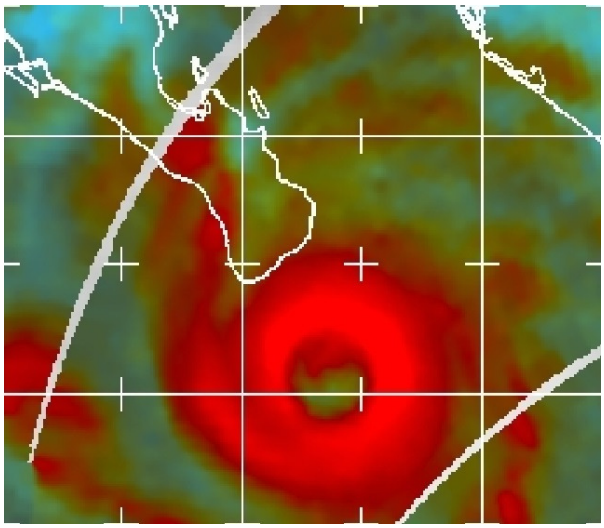
85 GHz H – SSMIS: 8:52 pm MDT (0252Z)



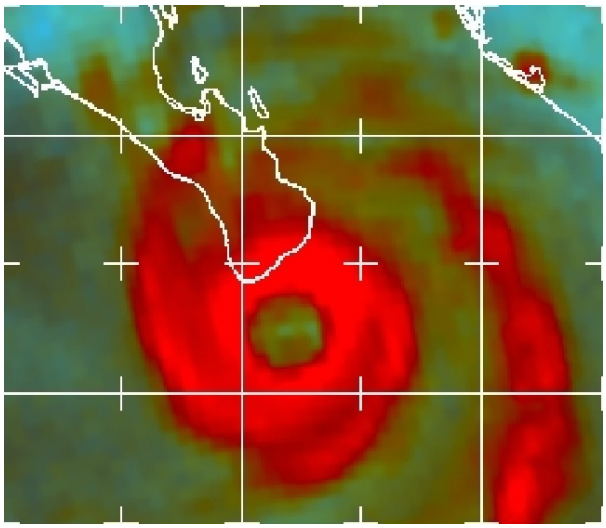
85 GHz Weak – SSMIS: 6:43 pm MDT (0343Z)



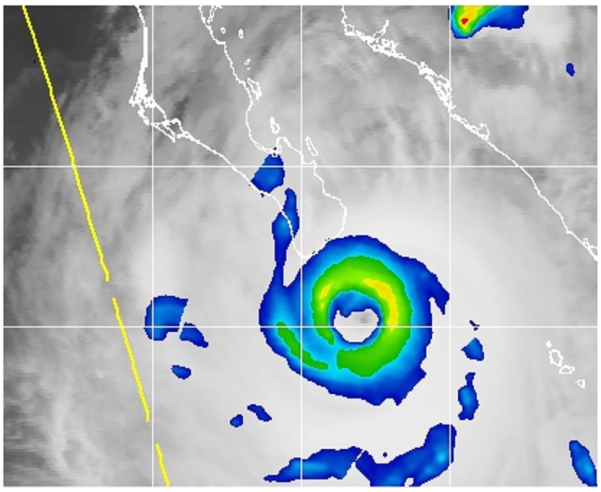
85 GHz Weak – SSMIS: 8:52 pm MDT (0252Z)



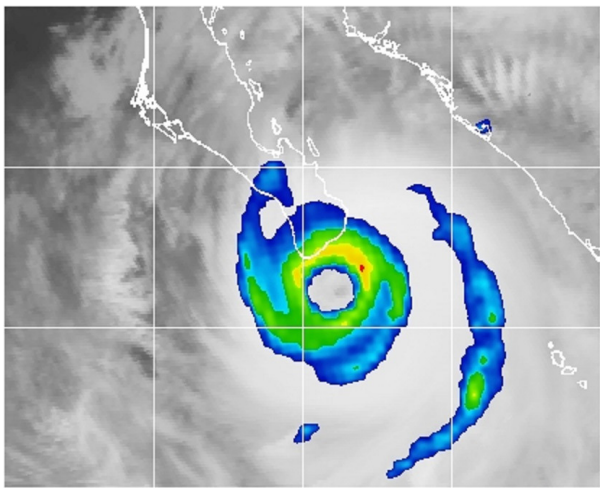
Color – SSMIS: 6:43 pm MDT (0343Z)



Color – SSMIS: 8:52 pm MDT (0252Z)



85 GHz PCT – SSMIS: 6:43 pm MDT (0043Z)



85 GHz PCT – SSMIS: 8:52 pm MDT (0252Z)

Wind Damage

Wind damage in Cabo San Lucas was widespread and severe in places, ranging from numerous broken windows and downed/shredded canopies to unroofings and major structural failures. In some places, palm trees were snapped off at mid-trunk, and metal lampposts and concrete utility poles were snapped or bent to the ground.

Storm surge and rainfall caused flooding in parts of the city—as per eyewitness reports—but I didn't survey these effects. **The widespread devastation to homes, businesses, and infrastructure seemed to be mostly caused by wind.**

Following are some representative photos of **wind damage** in and around the city.

Please note that Cabo San Lucas was a little **left** of the hurricane's center. **It's likely higher winds occurred several miles ENE—further up the coast, to the right of the landfall point.**

The interior of our hotel lobby the next morning. The front entrance (far end of this view) was blown out during the cyclone's front side. When the rear wall—made of glass—completely exploded during the backside, the lobby became a wind tunnel, resulting in heavy damage to the interior.

The interior of our hotel lobby—near the front entrance—just as the storm was moving away.

The rear glass wall of the lobby (facing S) completely blew out as the cyclone's backside swept in after the eye, turning the lobby into a wind tunnel. Powerful winds then gutted the interior.

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Exterior front entrance of our hotel the next morning. The hotel faces N, and most of the damage to the front of the building—smashed windows, destroyed entrance, collapsed facades, and shredded pillars and portico—happened during the cyclone's front side.

Exterior of our hotel. Front-side winds tore down a wall of the pool area on the top floor.

The Office Max next door to our hotel partially collapsed, burying nearby cars. The walls were made of cement blocks, with steel rods running through them.

Another view of the collapsed Office Max.

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Near our hotel, palm trees and utility poles were snapped-off mid-trunk. The trees and poles broke roughly toward the S or SW, suggesting they fell before the eye. Fronds of surviving trees (in the background) are pointing roughly N, as backside winds were roughly from the S.

This snapped utility pole was made of steel-reinforced concrete.

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A large canopy structure was blown down, with the wreckage blowing into the street.

The wreckage was thrown quite far (see heap in far background).

Some posts were bent in different directions, suggesting they fell at different times (during different phases of the storm) or the winds weren't totally straight-line.

Another view shows the posts and trees bent in different directions as well.

Smashed car dealership with damaged and snapped-off palm trees in foreground.

Major building failure in the heart of downtown.

Smashed windows were extremely common. It seemed as if almost every building had lost windows, and many eyewitnesses reported broken windows in their dwellings or hotel rooms. It wasn't uncommon to find businesses (like this one) with all of the glass completely blown out.

Even in the downtown area, some palm trees were snapped-off mid-trunk or near the base.

Questions or Feedback?

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