

# ICYCLONE CHASE REPORT

storm	Hurricane ROSLYN		
location	Santa Cruz, Nayarit, Mexico		
date	23 October 2022		
chasers	Josh Morgerman, Erik Sereno	author	Josh Morgerman

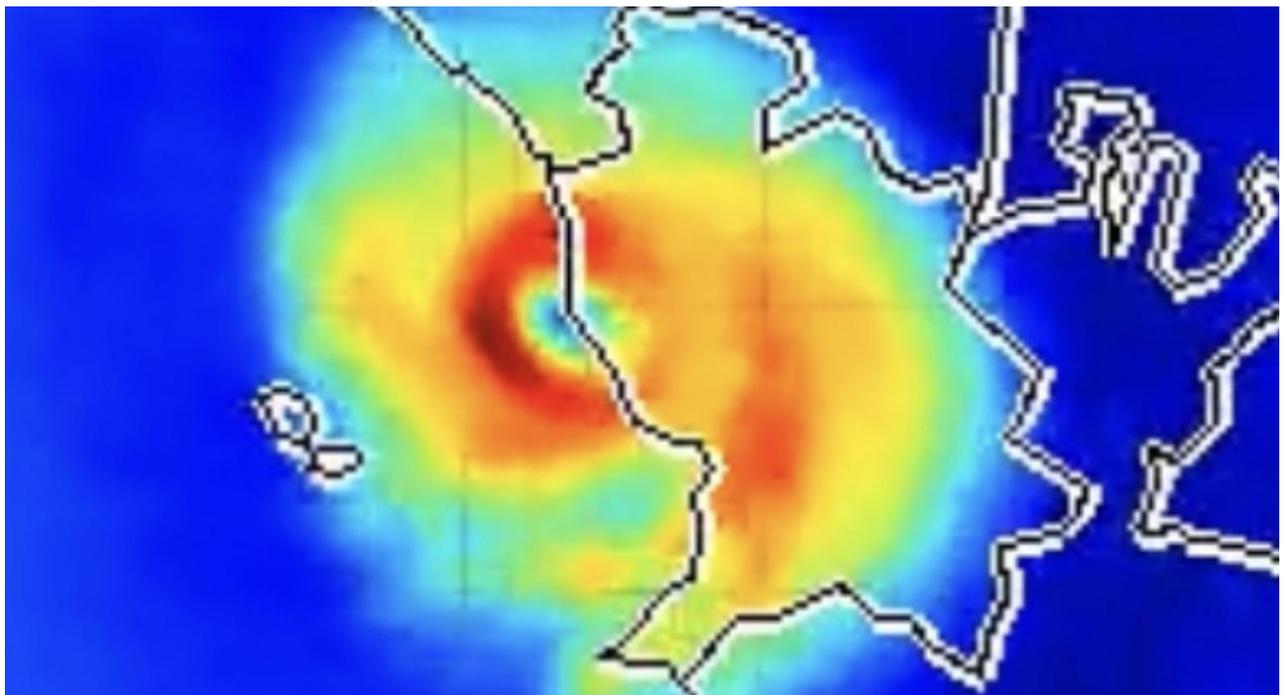
## Overview

Hurricane ROSLYN was a small, violent Category-3 hurricane that struck the Pacific coast of Mexico, in the state of Nayarit, just before dawn on 23 October 2022.

The author was in **Santa Cruz** (21.9796N 105.6009W), at the landfall point, to collect data and document the impact.

### Highlights:

- **Eye Passage.** The hurricane's small eye passed directly over the author's location, bringing a distinct 5-minute lull (~5:30 to ~5:35 am MDT) embedded within a longer ~20-minute period of calming (~5:20 to ~5:39 am).
- **Minimum Pressure.** The minimum sea-level pressure at this location was **962.4 mb at 5:30 am MDT (1130Z) 23 October**—measured in the eye.
- **Core Gradients.** In postanalysis of the collected data, the author **calculated extreme air-pressure gradients** in ROSLYN's core. Assuming the cyclone's forward speed was 14 kt, the rate of pressure change measured in Santa Cruz suggests a core gradient up to **~8.9 mb/n mi**.
- **Structure.** ROSLYN was a **tiny cyclone**. The author estimates the entire event (marked by the start and end of tropical storm winds) lasted **less than 1 hour 40 minutes**, and the hurricane's core (including the calm eye) lasted only **about 1 hour**. A damage survey afterward suggested a **radius of maximum winds (RMW) of ~7 n mi**.
- **Impact.** Although ROSLYN was small and passed through quickly, it was very destructive, inflicting extensive wind damage on the small town of Santa Cruz and areas to the E.



*Microwave shot of Hurricane ROSLYN making landfall in Nayarit, Mexico.*

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## Location

The author observed the passage of **Hurricane ROSLYN** in **Santa Cruz, Nayarit, Mexico**.

**Data** were collected at **21.9796N 105.6009W**. This is a covered patio area near the entrance to a restaurant at the town's main intersection (where the Nayarit El Tamarindo-Santa Cruz highway meets Avenida Lazaro Cardenas). In addition to collecting data, the author made **observations** from this vantage point.

Per National Hurricane Center advisory positions, this location **was almost exactly at ROSLYN's landfall point**—just 0.5 n mi from the vector connecting the 3 am and 5:20 am MDT positions.

The author arrived at this location at 4:29 am MDT—just before tropical storm winds started—and remained there until after the cyclone had passed.

**Figure 1** shows the **chase location (star)** in relation to **ROSLYN's center (colored points)**, per NHC advisory positions. (**Figures 2** and **3** are closer views.)

**Figure 1: Chase Map**

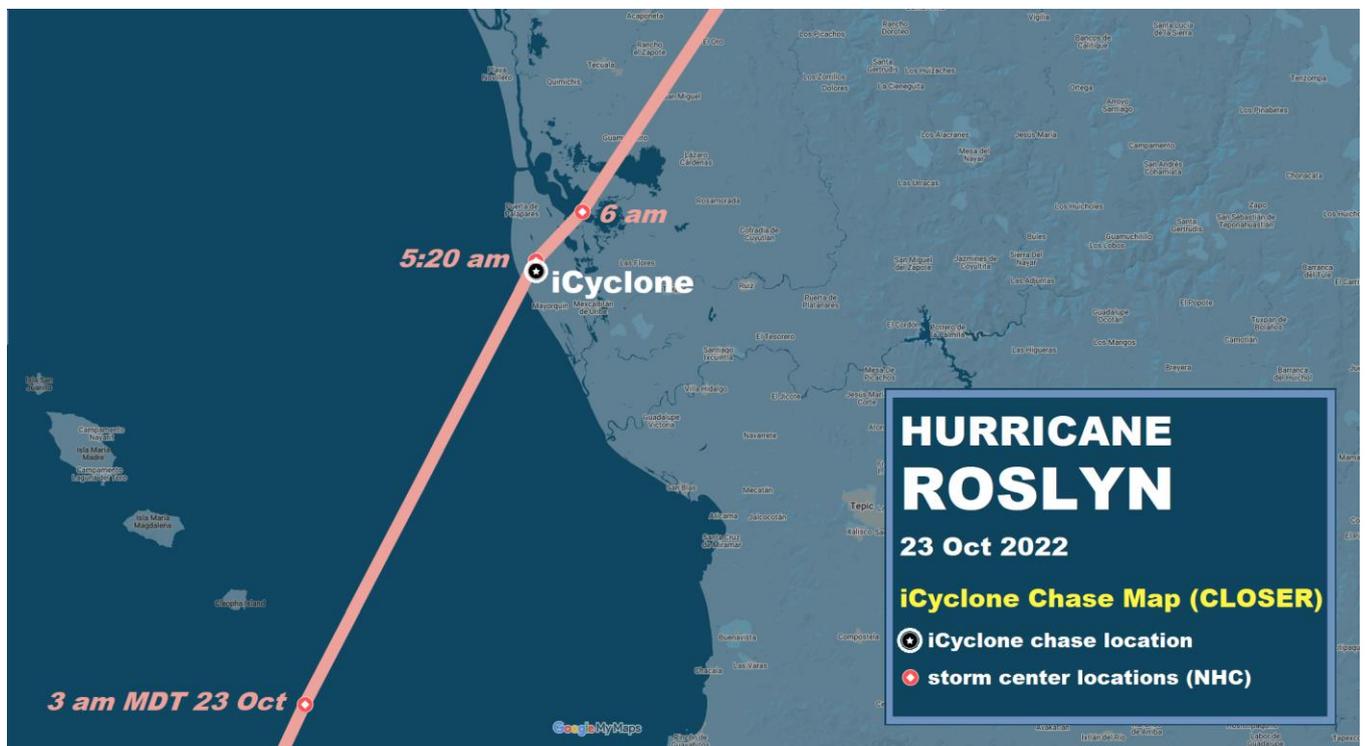


# ICYCLONE CHASE REPORT

Figure 2: Chase Map (Close)



Figure 3: Chase Map (Closer)



# iCYCLONE CHASE REPORT

## Observations

The center of ROSLYN passed directly over the author’s location—a perfect, direct hit.

The most notable characteristics of the hurricane were 1) its violence and 2) its **extremely short duration**:

- **Storm Duration.** The author’s video footage first shows apparent tropical-storm winds at 4:34 am MDT. Footage shot from 6:13 am onward suggests winds have once again dropped below tropical-storm strength. Counting these times as the start and end points of the storm, ROSLYN lasted **less than 1 hour 40 minutes** in Santa Cruz.
- **Core Duration.** The video footage suggests the town entered the hurricane’s front eyewall at about 5:03 am MDT and exited the back eyewall by around 6:05 am. This means the hurricane’s destructive core was only over the town for **about 1 hour**.

The author can’t recall having experienced a hurricane of shorter duration (when going through the center).

Given ROSLYN’s forward motion at the time was 14 kt—a brisk but not unusual speed—the event’s very short duration in Santa Cruz suggests the hurricane was extremely small.

Despite its tiny size, the hurricane was violent and destructive.

## Chronology

Following is a chronology of ROSLYN’s passage through Santa Cruz, reconstructed from the author’s timestamped video footage and air-pressure data.

Color key:

- **Pink** = tropical-storm winds
- **Red** = eyewall
- **Purple** = transition
- **Blue** = eye
- **Yellow highlight** = minimum air pressure

Please note that the start and end times of these phases were subjectively determined (without wind data) and should be considered **approximate**. All times are **local (MDT)**:

<b>TIME (MDT)</b>	<b>MB</b>	<b>WIND DIR</b>	<b>CONDITIONS</b>
4:28 am	--	--	Author arrives in Santa Cruz. Windy. Moderate rain.
4:29 am	--	--	Windy. Lightning. Moderate rain.
4:34 am	--	--	Winds rapidly increasing—now apparently tropical-storm strength. Howling sound. Moderate rain.
4:47 am	994.7	--	Very strong winds. Some tree branches in street. Heavy rain.
4:48 am	994.7	--	Very strong winds. Brilliant lightning. Very heavy rain.
4:55 am	991.5	--	Very strong winds. More branches in street. Some flying debris. Heavy rain.
5:00 am	988.1	E/ESE	Winds roaring—approaching hurricane force. Heavy rain.

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TIME (MDT)	MB	WIND DIR	CONDITIONS
5:03 am	984.6	E/ESE	Powerful winds coming in big pulses. High-pitched howl. Whistling sounds. Some lightning. Very heavy rain.
5:07 am	979.4	E/ESE	Powerful winds. Big gusts accompanied by high-pitched howl. Lightning. Very heavy rain.
5:10 am	977.3	E/ESE	Winds becoming violent. Patio roof starts to break apart & blow away. Lightning. Very heavy rain.
5:16 am	974.2	E/ESE	Powerful winds. Big, destructive gusts accompanied by high-pitched howl. Intermittent whistling sounds. More destruction—more roof debris raining down. Heavy rain.
5:20 am	971.0	--	Winds lessening <b>slightly</b> . Still loud howling. Rain lighter.
5:27 am	966.9	--	Significant calming. Erratic fluctuations in wind speed, with some big gusts. Moderate rain.
5:29 am	965.8	--	Erratic winds. Still some big gusts; debris flying. Still loud howling. Moderate rain.
5:30 am	962.4	--	Sudden calming. Much quieter. Light or no rain.
5:31 am	966.1	--	Almost completely calm. Distant howling. Distant lightning. Light or no rain.
5:33 am	966.4	--	Breezy. Distant howling. Frequent, distant lightning. Light rain.
5:35 am	965.6	--	Howling sound getting closer & louder.
5:38 am	968.7	WNW/NW	Strong winds blowing from opposite direction as before—picking up rapidly. Moderate/heavy rain.
5:39 am	969.5	WNW/NW	Some big gusts. Tin & other debris blowing down street—some of it becoming airborne. Heavy rain.
5:41 am	970.5	WNW/NW	Winds full force again. Lots of blowing wreckage & debris. Lots of clanking of tin. Very heavy rain—near whiteout.
5:48 am	980.0	WNW/NW	Winds full force—maybe the strongest of the storm. Roaring. Very heavy rain—near whiteout.
5:56 am	989.0	WNW/NW	Winds still full force. Big, pulsing gusts. Lots of turbulence. Blowing debris. Very heavy rain—near whiteout.
6:01 am	992.7	WNW/NW	Winds still full force. Big, pulsing gusts. Lots of turbulence. Very heavy rain—near whiteout.
6:05 am	996.2	WNW/NW	Winds lessening—not quite as intense.
6:13 am	998.5	--	Much calmer. Still windy, but below tropical-storm strength. Moderate rain.
6:23 am	1000.3	--	Windy. Moderate rain.
6:49 am	1003.7	--	Breezy. Moderate rain.

Figure 4 (below) visualizes these storm phases against the air-pressure data.

# ICYCLONE CHASE REPORT

## Air Pressure Data

The author collected quality-controlled air-pressure data with two Kestrel 4500s.

The devices were placed in a flowerpot in a storefront at the town's main intersection, where the author rode out the storm. The devices were relatively protected and remained essentially undisturbed the whole time they were collecting data.

The sampling rate for both devices was one reading **every 30 seconds (2/min)**.

### Calibration

To calibrate the devices to correct for sea-level pressure, the author used a reference altitude of 10 ft—which is the elevation indicated by an elevation app. The location is ~2 n mi from the coast in a region with relatively flat terrain, so the author has reasonable confidence in this value.

After the hurricane, the author discussed the device location with geographer James Hyde, who estimated the actual elevation may be closer to 14 ft.

This 4-ft discrepancy would have had a negligible impact on the pressure readings—likely ~0.1 mb, which is well within the accuracy range of the instrument (+/- 1.5 mb). Therefore, the data are considered representative sea-level pressure readings.

### Minimums

The devices' minimums occurred at about the same time as ROSLYN's eye reached the observation point:

- **Device A: 962.4 mb at 5:30 am MDT (1130Z)**
- **Device B: 964.4 mb at 5:30 am MDT (1130Z)**

Notice the minimum values are 2 mb apart. There's a simple explanation for this. The pressure changes in ROSLYN's core were rapid and volatile, with significant fluctuations happening within seconds—in multiple instances well over 2 mb in 30 seconds. Since the two devices were not perfectly in sync—and therefore they didn't sample at exactly the same moments—it's likely **Device A's** samples were simply better timed to catch the true minimum, which in itself happened during extreme pressure volatility. To illustrate this point: **Device A's** minimum value was the result of an extreme 3.2-mb drop in 30 seconds (from 965.6 mb at 5:29:30 am to 962.4 mb at 5:30:00 am).

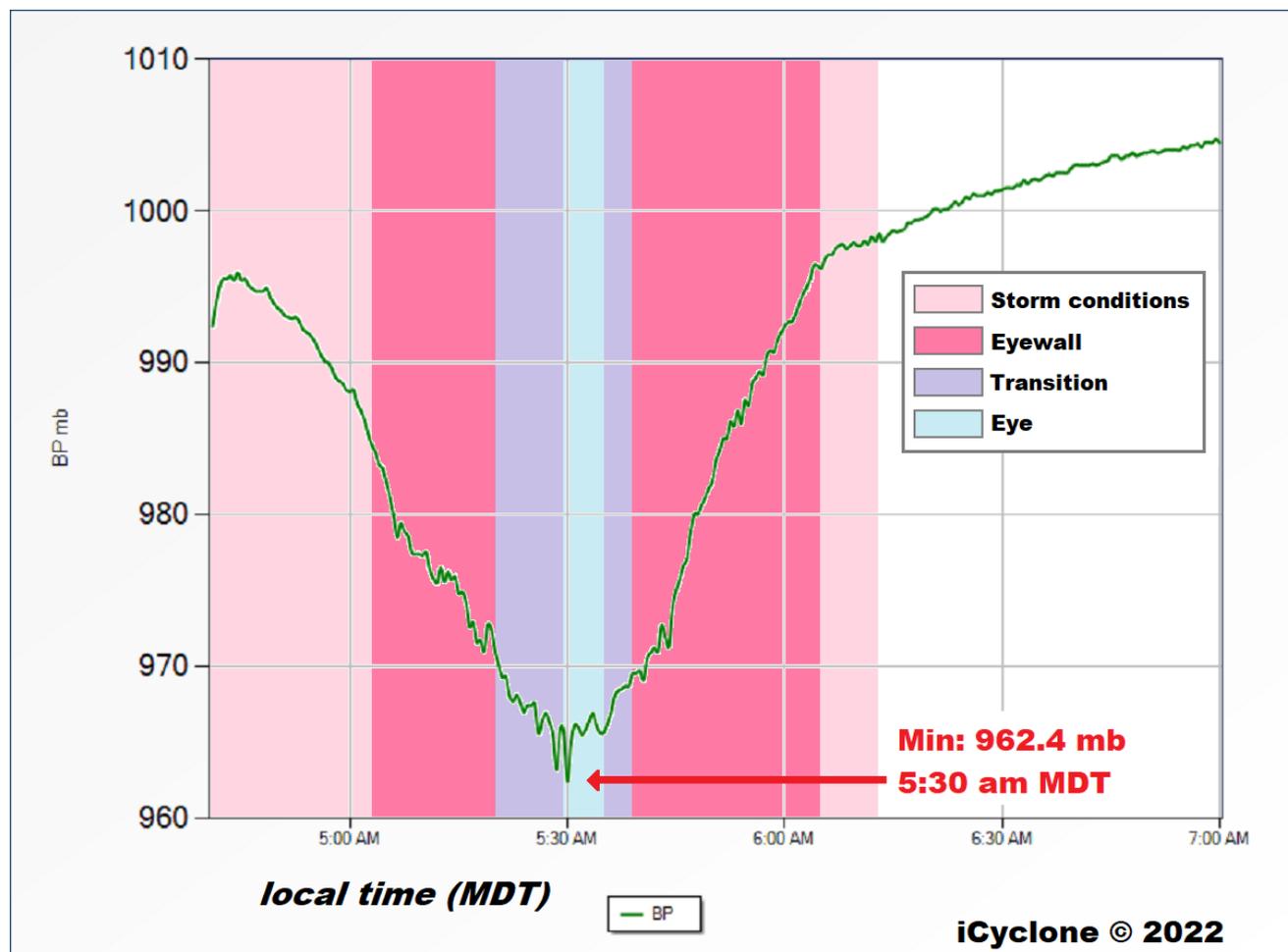
From these minimums, the air pressure recovered rapidly. **Device A** showed an explosive rise of **30 mb in 30 minutes**.

The complete data are graphed in **Figures 4** and **5**, below.

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**Figure 4: Barogram—Device A**

The air-pressure trace for Device A. The minimum value of 962.4 mb occurred at 5:30 am (1130Z), as Hurricane ROSLYN's eye reached Santa Cruz. Also indicated are the storm's main phases at this location.



## HURRICANE ROSLYN: 23 Oct 2022

Santa Cruz, Nayarit, Mexico

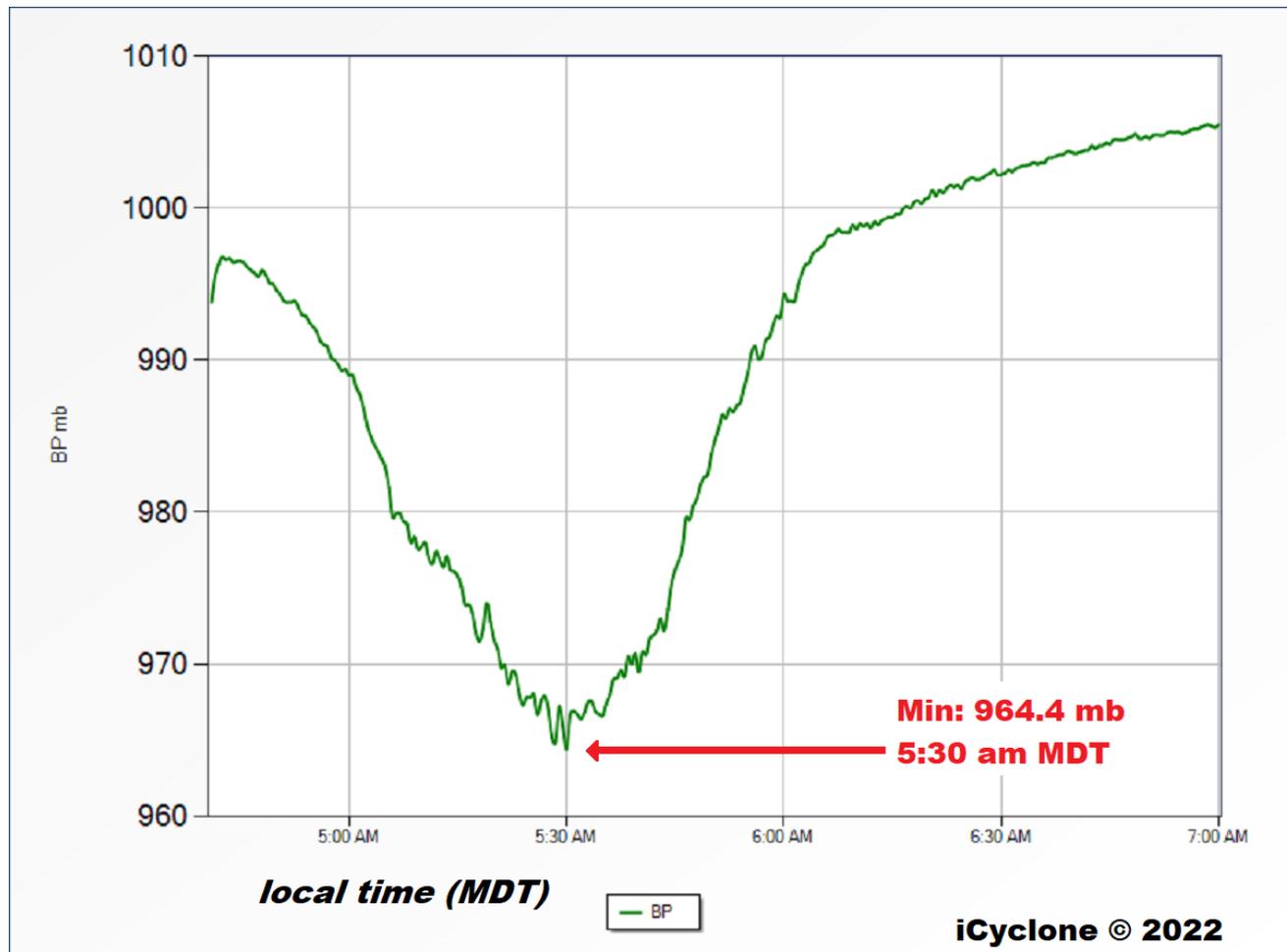
21.9796N 105.6009W – ref el 10 ft

**DEVICE A**

# ICYCLONE CHASE REPORT

**Figure 5: Barogram—Device B**

The trace for Device B. The minimum of 964.4 mb occurred at 5:30 am MDT (1130Z)—as the eye arrived. This minimum is 2 mb higher than Device A's, probably because pressure changes in the core were rapid, and the two devices did not sample at exactly the same moments.



## HURRICANE ROSLYN: 23 Oct 2022

Santa Cruz, Nayarit, Mexico

21.9796N 105.6009W – ref el 10 ft

**DEVICE B**

# ICYCLONE CHASE REPORT

## Core Gradient

The data show extremely steep air-pressure gradients in ROSLYN's inner core—great pressure changes over small distances that are some of the highest this author has measured.

### Methodology

The cyclone's forward speed was used to calculate how much time it took for each nautical mile of the cyclone to pass the author's fixed location. Gradients were then calculated by noting the change in pressure across these 1-n-mi samples of the cyclone:

1. Per NHC advisories, ROSLYN was moving at **14 kt** at the time of landfall in Mexico.
2. This forward speed suggests a sensor's fixed location sampled **1 n mi** of the cyclone every **4.2857 minutes** (60 minutes/14 n mi).
3.  $4.2857 \text{ minutes} = 4.5 \text{ minutes} \times 0.9524$ .
4. Therefore, pressure changes over 4.5-minute periods multiplied by 0.9524 are assumed to **approximately** represent pressure differences across 1-n-mi samples of the cyclone.

### Peak Gradients

Applying this methodology, data from both devices suggest extremely steep gradients on both the front and back sides of the hurricane's eyewall:

#### **Device A**

- **Front Side (as center approached): 7.3 mb/n mi** (derived from **7.7-mb drop** over 4.5 minutes, from 5:02:00 to 5:06:30 am MDT).
  - This peak gradient was sampled as the leading edge of the eyewall reached the observation location.
- **Backside (as center moved away): 8.9 mb/n mi** (derived from **9.3-mb rise** over 4.5 minutes, from 5:44:00 to 5:48:30 am MDT).
  - This peak gradient was sampled deep in the back eyewall, when the apparent peak winds were occurring.

#### **Device B**

The peak gradients calculated from **Device B** were similar to **Device A's**, and they were sampled at about the same times:

- **Front Side (as center approached): 7.6 mb/n mi** (derived from **8.0-mb drop** over 4.5 minutes, from 5:01:30 to 5:06:00 am MDT).
- **Backside (as center moved away): 8.3 mb/n mi** (derived from **8.7-mb rise** over 4.5 minutes, from 5:43:30 to 5:48:00 am MDT).

**Figure 6** shows the **Device A** data again, this time with the passage of these peak gradients marked with **dark-red bars**. **Figure 7** is a closer, more detailed view.

### Conclusion

Of course, these calculations are rough, with limitations to their accuracy. They assume the cyclone was moving at a perfectly steady forward speed, in a straight line, directly toward the observation point—which may be unrealistic. Also, it's possible extremely localized eyewall features—or even powerful wind gusts passing over the building—caused pressure spikes and dips that weren't representative of the overall pressure profile of the cyclone's core.

Even in light of these limitations, these calculations are a good proxy indicator of the extreme gradients in ROSLYN's small, violent core—and **they're among the steepest this author has measured**.

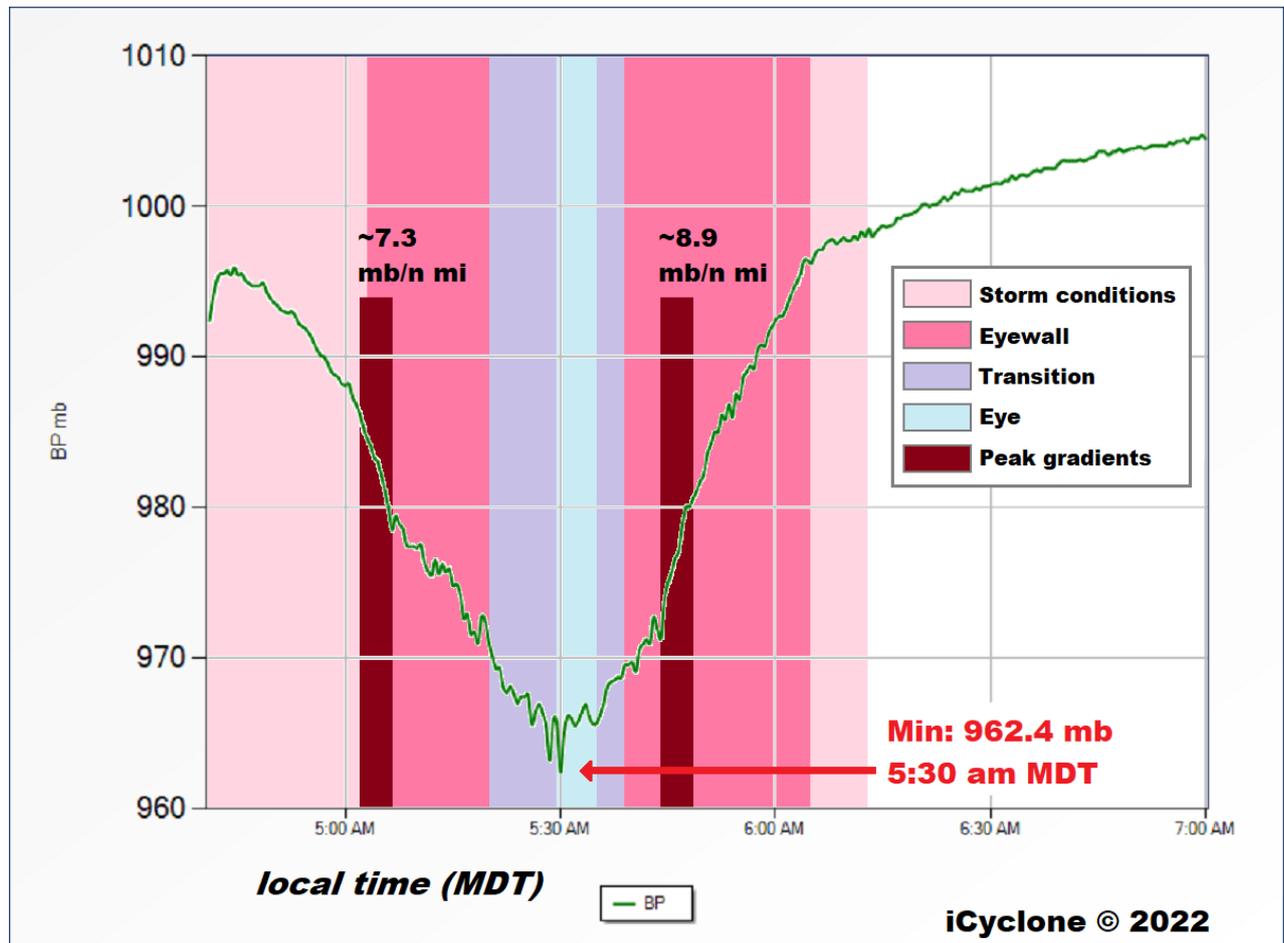
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Following is a list of selected intense cyclones in which the author collected core data, ranked by calculated peak gradient. ROSLYN is third on this distinguished list:

CYCLONE	DATE	LOCATION	WIND	PEAK GRADIENT
DORIAN	Sep 2019	Marsh Harbour, Bahamas	160 kt	12.4 mb/n mi
PATRICIA	Oct 2015	Emiliano Zapata, JAL, MX	130 kt	10.5 mb/n mi
<b>ROSLYN</b>	<b>Oct 2022</b>	<b>Santa Cruz, NAY, MX</b>	105 kt	<b>8.9 mb/n mi</b>
MICHAEL	Oct 2018	Callaway, FL, USA	140 kt	8.1 mb/n mi
MARIA	Sep 2017	Palmas Del Mar, PR, USA	135 kt	7.1 mb/n mi
SALLY	Sep 2020	Gulf Shores, AL, USA	95 kt	6.4 mb/n mi
HARVEY	Aug 2017	Rockport, TX, USA	115 kt	6.3 mb/n mi
IRMA	Sep 2017	Naples, FL, USA	100 kt	5.9 mb/n mi
ODILE	Sep 2014	Cabo San Lucas, BCS, MX	110 kt	4.6 mb/n mi
IAN	Sep 2022	Punta Gorda, FL, USA	130 kt	4.6 mb/n mi
LAURA	Aug 2020	Sulphur, LA, USA	130 kt	4.4 mb/n mi

**Figure 6: Barogram—Device A (Peak Gradients)**

The pressure trace for Device A, showing when the peak gradients were sampled.



## HURRICANE ROSLYN: 23 Oct 2022

Santa Cruz, Nayarit, Mexico

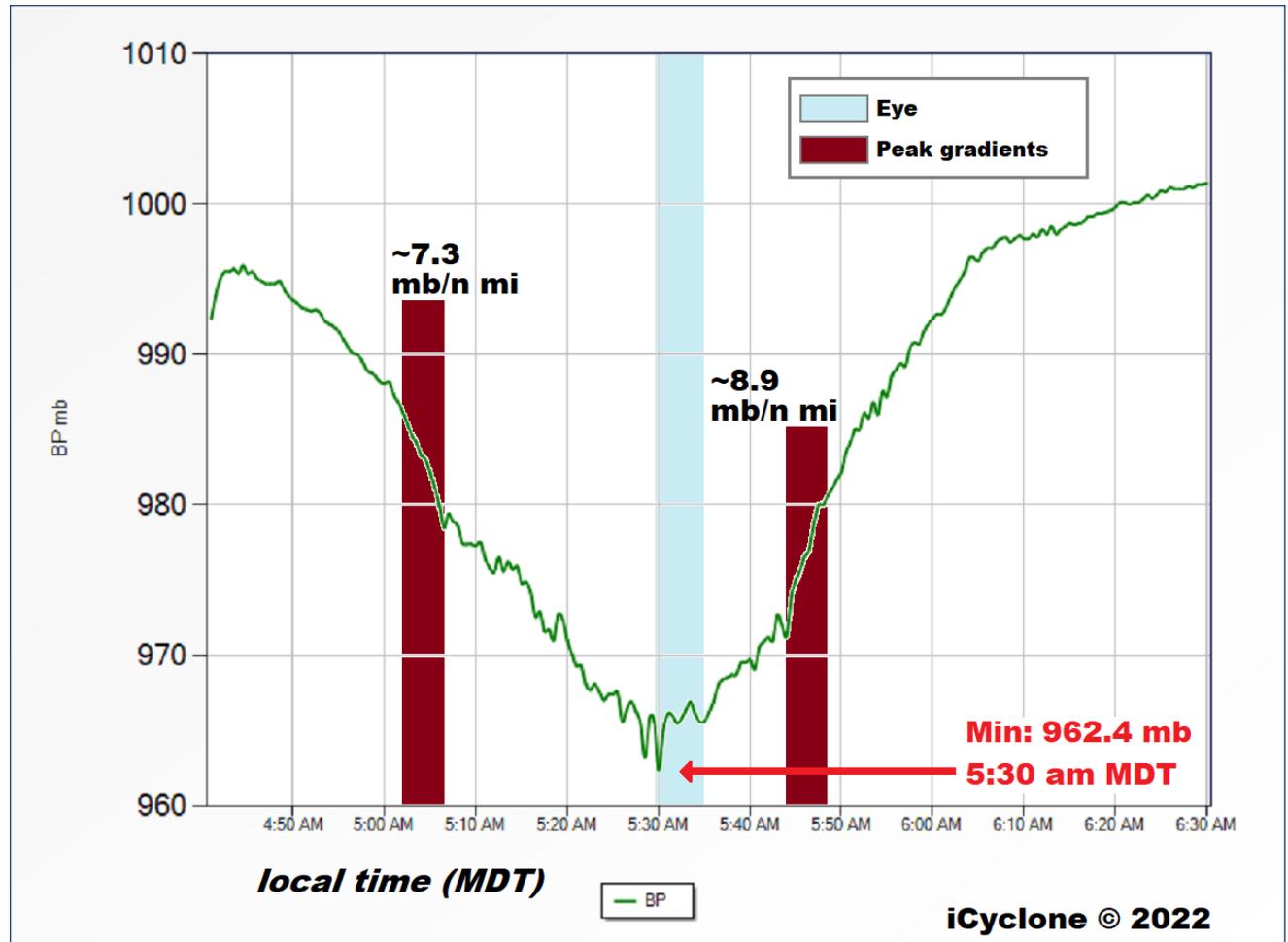
21.9796N 105.6009W – ref el 10 ft

**DEVICE A**

# ICYCLONE CHASE REPORT

Figure 7: Barogram—Device A (Peak Gradients—Close)

A closer, more detailed view of the pressure trace for Device A, showing when the peak gradients were sampled.



## HURRICANE ROSLYN: 23 Oct 2022

Santa Cruz, Nayarit, Mexico

21.9796N 105.6009W – ref el 10 ft

**DEVICE A**

# ICYCLONE CHASE REPORT

## Impact & Aftermath

Hurricane ROSLYN passed through **Santa Cruz** quickly—the core of the hurricane lasted barely an hour—but it was violent and destructive.

Wind damage across the small town was extensive. Scores of homes and businesses suffered major damage, many with roofs torn off. Many trees and power poles were felled, some falling onto houses and walls to inflict serious secondary damage. A tangle of fallen trees and branches, broken power poles, twisted metal, and smashed concrete littered the town and blocked all major roads. The roof of a large open-air athletic facility was mostly torn off, the metal sheets scattered across the neighborhood and caught in tree branches and wires. Power was out across Santa Cruz and the surrounding region.

Town residents described being frightened by the intensity of the hurricane—especially as damage happened to their homes. They seemed shocked by the extent of the destruction and predicted a long, arduous cleanup.

The E/W highway connecting Santa Cruz with the rest of Nayarit was left impassable by a thick tangle of fallen trees, power poles, and wires. (Fortunately, by midday a narrow path was cleared for traffic.)

Significant wind damage extended E of Santa Cruz and seemed especially heavy in and around **Pimientillo, ~7 n mi SE of the hurricane's center** (at its point of closest approach). Here, it seemed most of the trees and power poles fell the same way—generally toward the N—suggesting this location stayed in the E eyewall, never entering the eye and never seeing a significant shift in wind direction.

On the highway near **La Boquita, ~11 n mi SE of the hurricane's center** (at its point of closest approach), the wind damage appeared to be much less severe, suggesting this location was outside the hurricane's radius of maximum winds (RMW). But even here, the author estimated 90% of the papaya trees on a farm next to the highway were blown down.

Based on these observations in and near Santa Cruz, Pimientillo, and La Boquita, **the author estimates the hurricane's RMW was likely ~7 n mi—and certainly no more than 10 n mi.**



*The author documenting ROSLYN's aftermath in Santa Cruz. (Photo: Erik Sereno)*

# ICYCLONE CHASE REPORT



***Santa Cruz. ROSLYN's winds felled many trees across town, and some inflicted secondary damage to homes, walls, and fences as they went down.***



***Santa Cruz. In the hours immediately following ROSLYN, most streets around town were blocked by fallen trees and power poles.***

# ICYCLONE CHASE REPORT



**Santa Cruz. ROSLYN's winds smashed many concrete power poles.**



**Santa Cruz. Many of the concrete power poles that went down snapped off at the base.**

# ICYCLONE CHASE REPORT



**Santa Cruz. ROSLYN's winds toppled this power pole, which very narrowly missed a house.**



**Santa Cruz. Streets all around town were blocked by fallen trees, power poles, and other debris.**

# ICYCLONE CHASE REPORT



***Santa Cruz. ROSLYN left large, tangled piles of fallen trees and wreckage.***



***Santa Cruz. A resident walks past a large tree that was felled by ROSLYN's winds.***

# ICYCLONE CHASE REPORT



**Santa Cruz. Stunned residents congregate in the street hours after ROSLYN's devastating impact.**



**Santa Cruz. Residents share their experiences riding our Hurricane ROSLYN. Many were surprised by the storm's violence.**

# ICYCLONE CHASE REPORT



**Santa Cruz. This large, open-air athletic facility lost almost all of its metal roofing. The wind scattered the pieces across the neighborhood.**



**Santa Cruz. Metal roofing from the nearby athletic facility was scattered across the neighborhood, with much of it tangled in powerlines and trees.**

# ICYCLONE CHASE REPORT



***Santa Cruz. Another look at the metal roofing from the nearby athletic facility. The pieces were scattered across the neighborhood, much of it tangled in powerlines and trees.***



***Santa Cruz. Hurricane ROSLYN's wind felled scores of concrete power poles—and many of them inflicted serious secondary damage as they struck houses, walls, and fences.***

# ICYCLONE CHASE REPORT



***Santa Cruz. ROSLYN's winds tore away this house's roof and also inflicted heavy damage to the walls.***



***Santa Cruz. Heavy wind damage to a house.***

# ICYCLONE CHASE REPORT



**Santa Cruz. ROSLYN's fierce winds uprooted many trees all across town.**



**Santa Cruz. A typical street scene just hours after Hurricane ROSLYN: downed trees, a felled power pole, and scattered debris.**

# ICYCLONE CHASE REPORT



**Santa Cruz. The author and his partner rode out Hurricane ROSLYN pressed against the front entrances of these buildings near the center of town.**



**Santa Cruz. As ROSLYN's violent eyewall arrived, the author and his partner stood on this restaurant's covered patio, pressed against the front entrance. When winds started tearing away the roof and dangerous wreckage rained down, they took cover under the counter on the right (beneath the religious statue). They remained in this tiny makeshift shelter until the eye arrived.**

# ICYCLONE CHASE REPORT



**Santa Cruz. View from inside the restaurant in front of which the author and his partner rode out the front side of Hurricane ROSLYN. Fierce winds tore away the entire roof.**



**Santa Cruz. The author and his partner, Erik, rode out Hurricane ROSLYN pressed against the entrance of a restaurant that lost much of its roof. The back of the building, which serves as residential quarters for the restaurants' owners, was also badly damaged: winds tore the entire roof off the second floor. Here, Erik surveys the damage.**

# ICYCLONE CHASE REPORT



***Santa Cruz. Another house that lost its roof to Hurricane ROSLYN's fierce winds.***



***Santa Cruz. Hurricane ROSLYN's winds inflicted heavy damage on trees. Many were uprooted and felled. Others, like this one, remained standing but were defoliated and brutally stripped of branches.***

# ICYCLONE CHASE REPORT



***Just E of Santa Cruz. Many power poles fell across the E/W highway connecting Santa Cruz with the rest of Nayarit.***



***Highway E of Santa Cruz. So many trees fell across the road, it resembled a jungle.***

# ICYCLONE CHASE REPORT



***Highway E of Santa Cruz. Massive tree blowdown occurred along the E/W highway connecting Santa Cruz with the rest of Nayarit.***



***Highway E of Santa Cruz. Another shot of massive tree blowdown along the E/W highway connecting Santa Cruz with the rest of Nayarit.***

# ICYCLONE CHASE REPORT



***Highway E of Santa Cruz. Hurricane ROSLYN's winds were cruel to trees along the highway. Those that remained standing were defoliated and stripped of branches.***



***Pimientillo. Damaged gas station. Wind damage seemed especially heavy near this town, which was ~7 n mi SE of the hurricane's center (at its point of closest approach).***

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***Pimientillo. Smashed concrete power pole, collapsed wall, and shredded trees. ROSLYN's winds were especially fierce in this town ~7 n mi SE of the hurricane's center (at its point of closest approach).***



***Pimientillo. More heavy damage to trees.***

# ICYCLONE CHASE REPORT



*Near La Boquita. Wind damage seemed less severe at this location ~11 n mi SE of ROSLYN's center, leading the author to believe it was likely outside of the hurricane's RMW. Even so, the winds here were powerful enough to mow down most of the papaya trees.*

## Video

The passage of Hurricane ROSLYN in Santa Cruz—as described in this report—will be documented in an upcoming video on the author's YouTube channel: <https://www.youtube.com/icyclone>.

For easy analysis, all the footage will be timestamped in local time (MDT).

## Questions or Feedback?

Get in touch:

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