

# ICYCLONE CHASE REPORT

storm	Hurricane GRACE		
location	Quintana Roo, Mexico   Veracruz, Mexico		
date	18-21 August 2021		
chasers	Josh Morgerman, Erik Sereno	author	Josh Morgerman

## Overview

Hurricane GRACE struck the Mexican state of Quintana Roo (on the Yucatan Peninsula) early on the morning of 19 August, and then the Emerald Coast region of the Mexican state of Veracruz during the night of 20-21 August 2021.

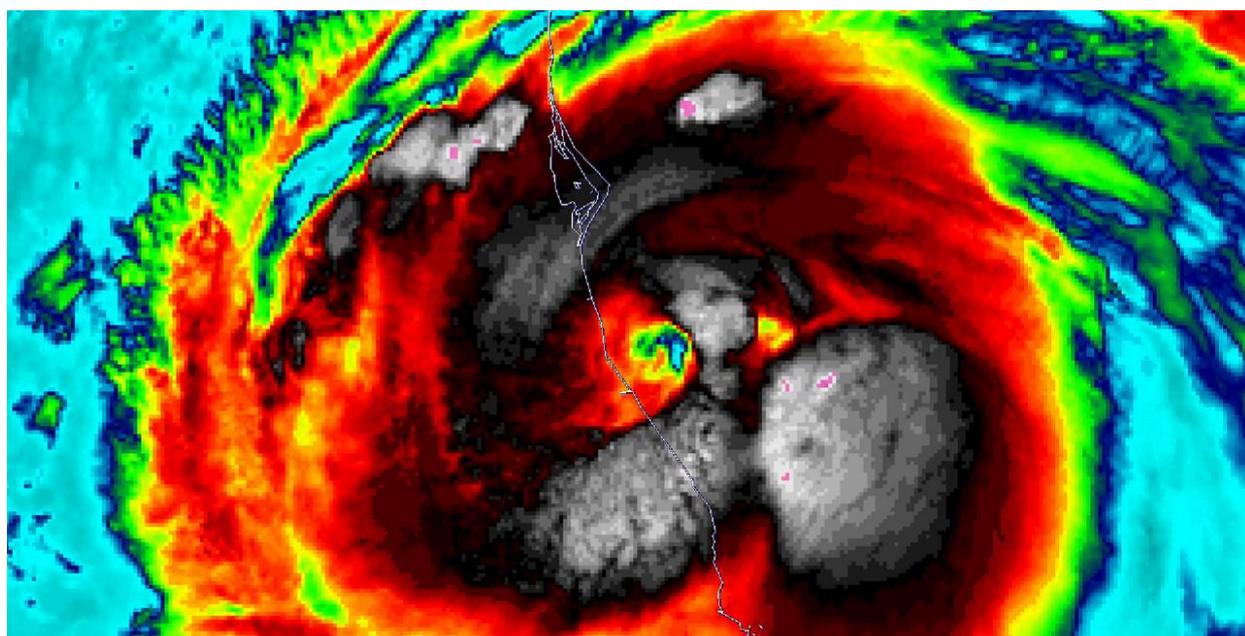
The author was in both impact zones to observe the cyclone's passage and collect data. **Highlights:**

### Quintana Roo (Yucatan Peninsula)

- The author was in **Tulum (20.2150N 87.4591W)**, close to the landfall point.
  - The **calm eye** passed over this location from ~4:35 to ~5:25 am EST 19 Aug.
  - Minimum sea-level pressure recorded here was **978.0 mb from 5:13 to 5:15 am EST (1013Z–1015Z) 19 Aug.** This was during the passage of the eye.
- Additional devices further NE, up the coast, measured minimums of **991.4 mb at 0928Z in Akumal (20.3980N 87.3205W)** and **999.7 mb at 0854Z in Playa del Carmen (20.6202N 87.0900W).**

### Veracruz (Emerald Coast)

- The author was in **La Guadalupe (20.3756N 96.9209W)**, ~15 n mi S of the track of the hurricane's center.
  - The **S edge of the large eye** brushed this location around 12 midnight CDT 21 Aug.
  - Minimum sea-level pressure recorded here was **981.4 mb at 11:55 pm CDT 20 Aug and 12:09 and 12:12 am CDT 21 Aug (0455Z, 0509Z, and 0512Z 21 Aug).**
- An additional device further SSE, down the coast, measured a minimum of **985.7 mb at 0500Z 21 Aug in La Vigüeta (20.3150N 96.8594W).**



*Hurricane GRACE nearing its second landfall—in Veracruz, Mexico—on 21 August.*

# iCYCLONE CHASE REPORT

## Locations

The author documented both of Hurricane GRACE's landfalls in Mexico.

### Quintana Roo (Yucatan Peninsula)

#### Chase Location A—Tulum

The author observed the passage of the hurricane—and collected data—at **20.2150N 87.4591W**. This location is on Avenida Satélite, a main street in the city center of **Tulum**. The NHC's operational (advisory) positions indicate this location was close to the track of the hurricane's center—and it went squarely through the hurricane's eye.

#### Sensor Location B—Akumal

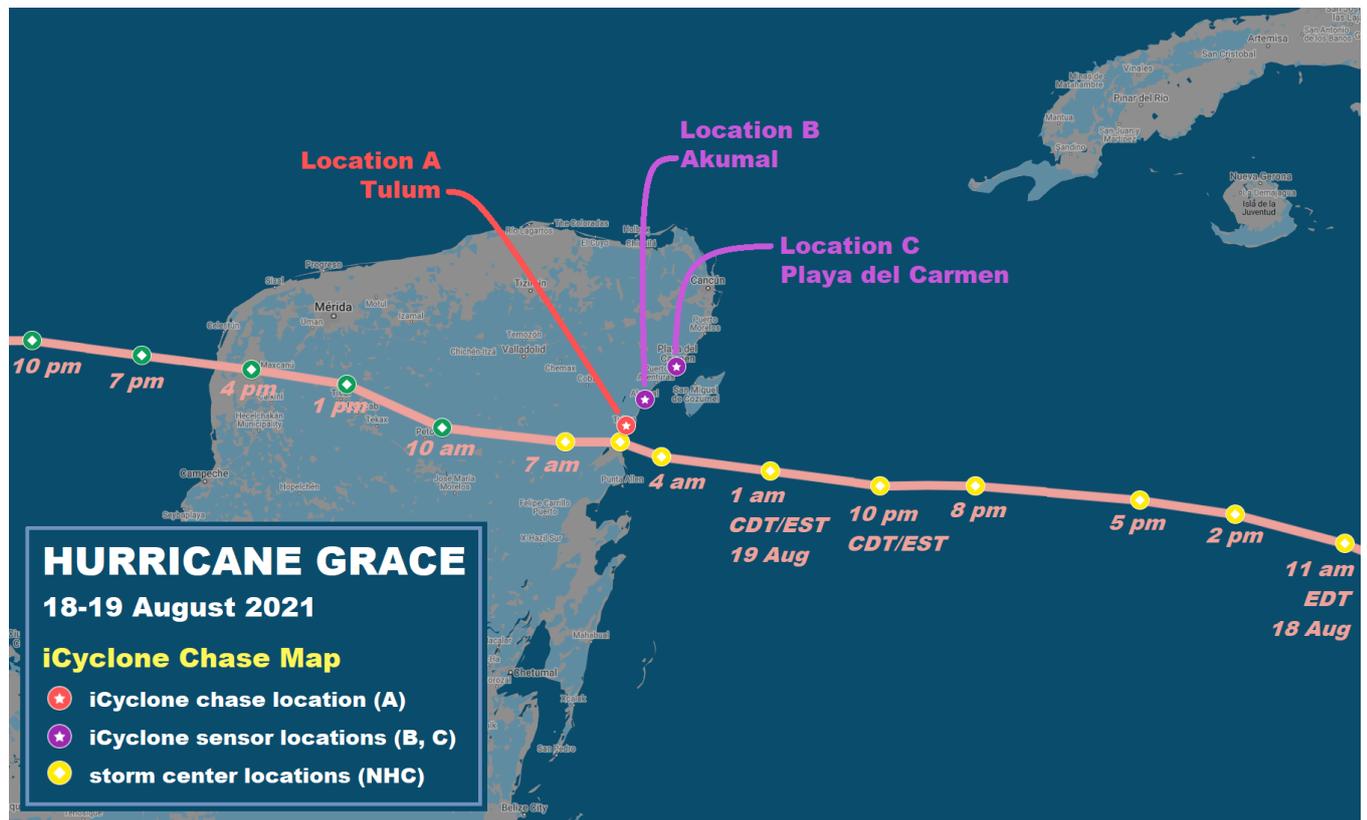
Before positioning at Location A (and before the hurricane struck), the author deployed a data sensor at **20.3980N 87.3205W**. This location is a gas station on Highway 307 in **Akumal**, ~13 n mi NE of Location A and ~20 n mi NNE of the track of the hurricane's center.

#### Sensor Location C—Playa del Carmen

Also before the hurricane, the author deployed a data sensor in his hotel, at **20.6202N 87.0900W**. This location is the City Express Suites in **Playa del Carmen**, ~32 n mi NE of Location A and ~37 n mi NNE of the track of the hurricane's center.

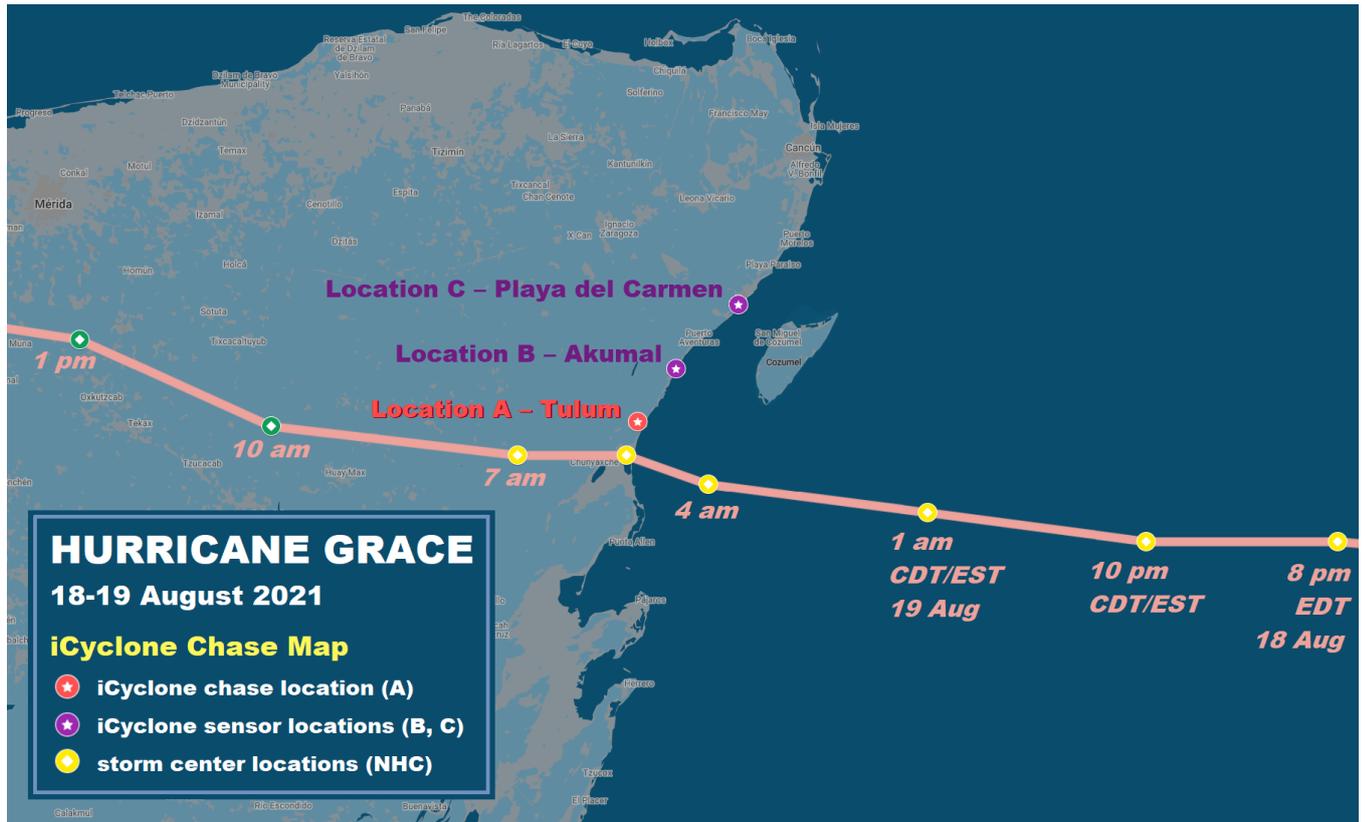
**Figure 1** shows the hurricane's track up to and after landfall on the Yucatan. **Figure 2** is a zoomed-in view. The **Chase Location (A)** (**red star**) and **Sensor Locations (B, C)** (**purple stars**) are marked.

**Figure 1: Chase Map—Quintana Roo (Yucatan Peninsula) Landfall**



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Figure 2: Chase Map—Quintana Roo (Yucatan Peninsula) Landfall (CLOSE)



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## Veracruz (Emerald Coast)

### Chase Location A—La Guadalupe

The author rode out the hurricane—and collected data—at **20.3756N 96.9209W**. This location is a hotel carport on the side of the main road (Highway 180) in the small town of **La Guadalupe**.

The NHC’s operational (advisory) positions indicate this location was ~15 n mi SSE of the track of the hurricane’s center—and it was brushed by the S edge of the hurricane’s eye.

### Sensor Location B—La Vigüeta

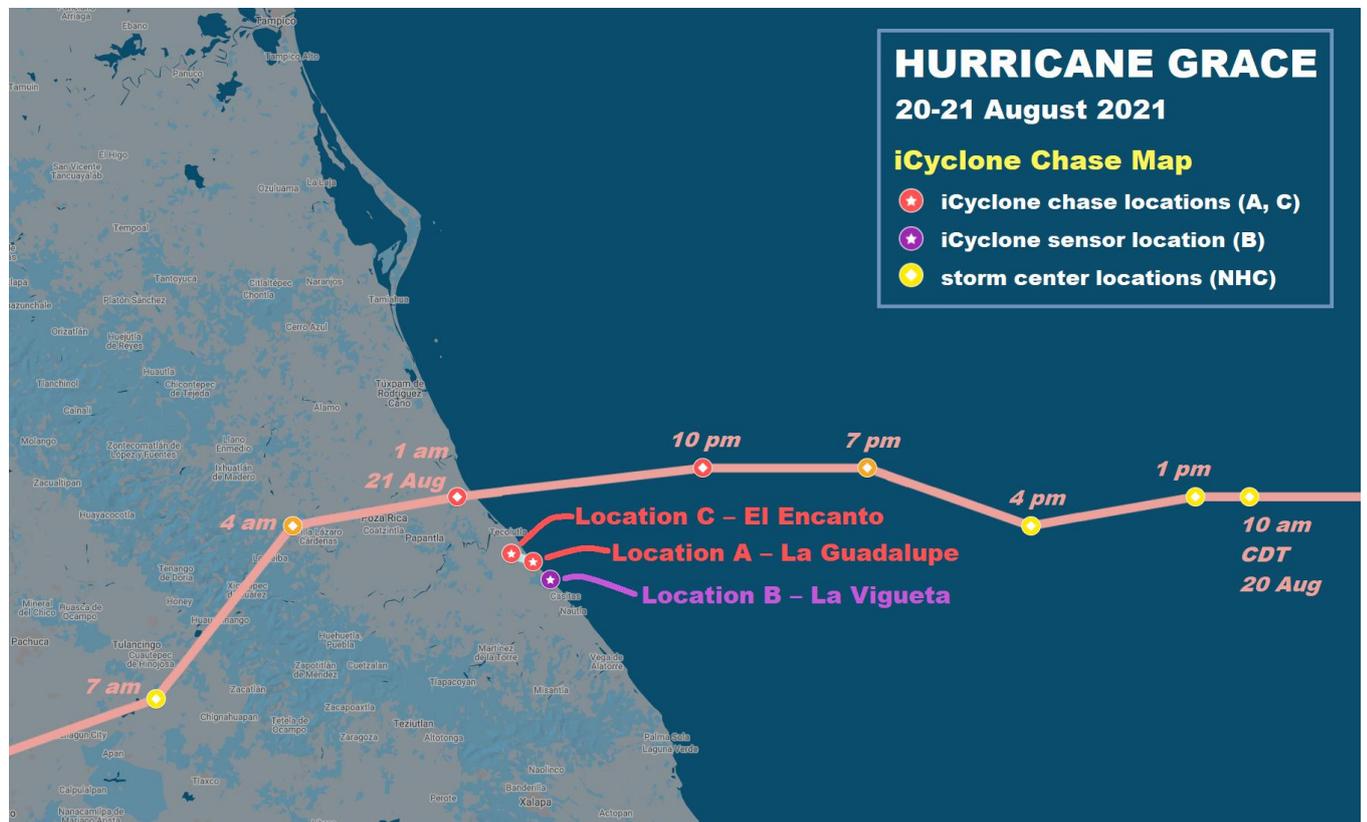
Before positioning at Location A (and before the hurricane struck), the author deployed a data sensor at **20.3150N 96.8594W**. This location is the Torre Molino Hotel in **La Vigüeta**, ~5 n mi SSE of Location A and ~19 n mi SSE of the track of the hurricane’s center.

### Chase Location C—El Encanto

While in the S portion of the hurricane’s eye, the author and his chase partner, Erik Sereno, drove NW on Highway 180 to penetrate deeper into the calm center. Their destination was Gutierrez Zamora, but they never made it. At about the halfway point (**20.4046N 97.0020W**)—near **El Encanto**, ~5 n mi NW of La Guadalupe (Location A)—fallen trees across the road forced them to turn around and head back down to La Guadalupe.

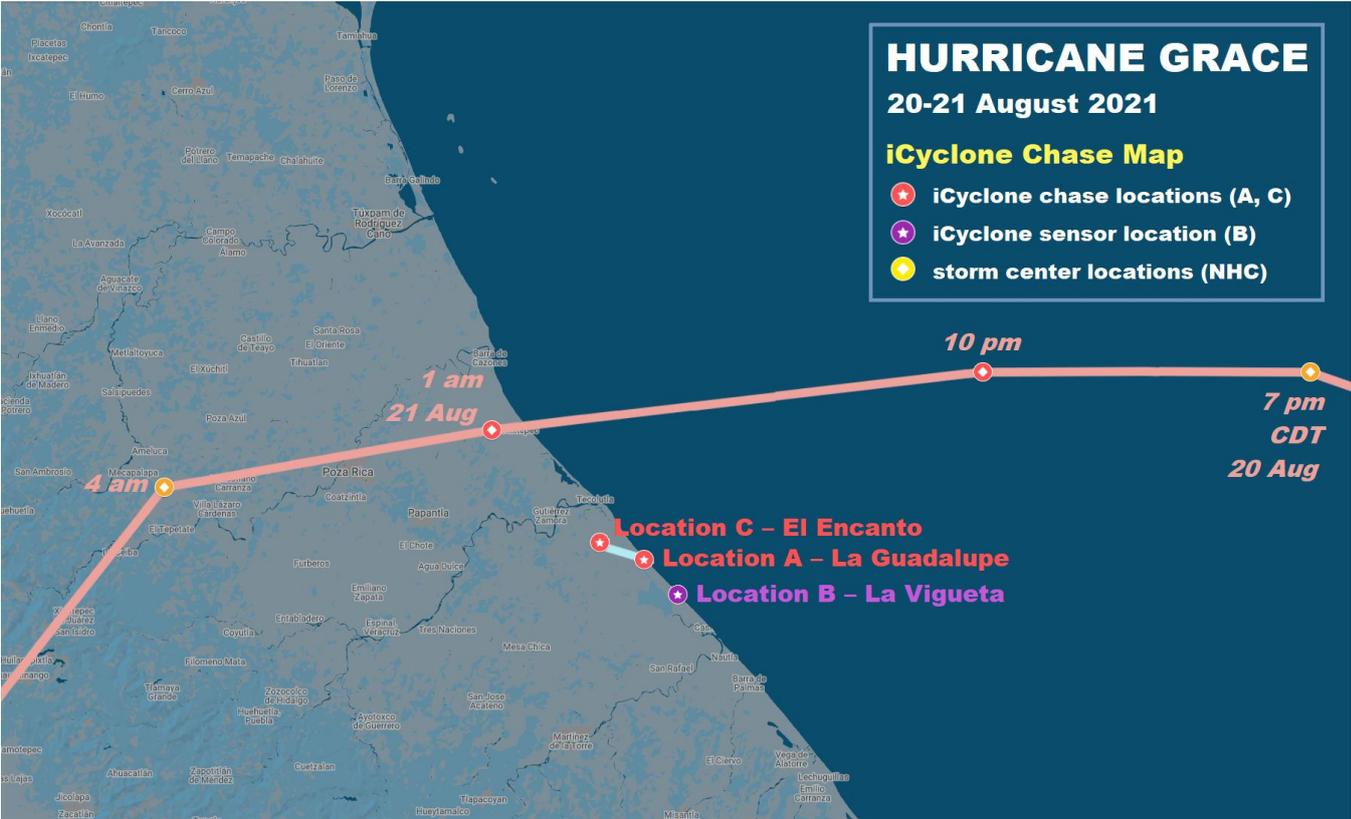
**Figure 3** shows the hurricane’s track up to and after landfall in Veracruz. **Figure 4** is a zoomed-in view. The **Chase Locations (A, C) (red stars)** and **Sensor Location (B) (purple star)** are marked.

### Figure 3: Chase Map—Veracruz (Emerald Coast) Landfall



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Figure 4: Chase Map—Veracruz (Emerald Coast) Landfall (CLOSE)



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## Observations

As follows:

### Quintana Roo (Yucatan Peninsula)

The author observed the hurricane's passage in **Tulum (Location A)**, near the landfall point:

- **The calm eye passed over this location**—from ~4:35 to ~5:25 am EST 19 August. The eye was sharply defined—with the wind and rain ceasing quite suddenly as the eye arrived and starting up again just as suddenly when it passed.
  - **Figure 5** is a radar shot of the hurricane's center crossing the coast near Tulum.
- **Minimum sea-level pressure in Tulum was 978.0 mb, a value that held steady from 5:13 to 5:15 am EST (1013Z–1015Z) 19 August.** This was during the passage of the calm eye.
- **The wind did an almost perfect, 180-degree reversal after the eye passed**—suggesting the exact center passed very close.
- **The cyclone's structure was symmetric**—with distinct periods of powerful winds and heavy rain both preceding **and** following the passage of the eye.
- **The cyclone seemed small.** Including the eye, the core—i.e., the part with destructive winds and very heavy rain—took less than 3 hours to pass—from ~4 am to ~6:30 am EST.

### Veracruz (Emerald Coast)

The author started observing the hurricane's passage in **La Guadalupe (Location A)**, ~15 n mi SSE of the track of the hurricane's center. As the S edge of the eye brushed this location and conditions calmed, the author and Erik Sereno drove NW on Highway 180 to penetrate deeper into the eye. Around **El Encanto (Location C)**, ~5 n mi NW of La Guadalupe, they had to turn around due to fallen trees in the road. As they neared La Guadalupe, the hurricane's back eyewall suddenly swept in with dangerous winds.

- **The S edge of the eye brushed this region (La Guadalupe to El Encanto) for about a half hour—from ~11:55 pm CDT 20 August to ~12:30 am CDT 21 August.** This was not a dead calm, but more of a relative, “dirty” calm.
  - **Figure 6** is a radar shot of the hurricane's center crossing the Veracruz coast. **Figure 7** is a closer radar shot that labels the chase and sensor locations.
- **Minimum sea-level pressure in La Guadalupe was 981.4 mb at 11:55 pm CDT 20 August and 12:09 and 12:12 am CDT 21 August (0455Z, 0509Z, and 0512Z 21 August)**—recorded when the S edge of the hurricane's eye was apparently brushing this location.
- **The back eyewall was sharply defined.** As the eye passed, conditions went from breezy and drizzly to a full-on hurricane with howling winds and heavy rain in a matter of minutes—from ~12:29 to 12:38 am CDT. Destructive winds occurred in this back eyewall. At ~1 am, a concrete-composite patio roof near the author exploded into flying debris that almost struck him.

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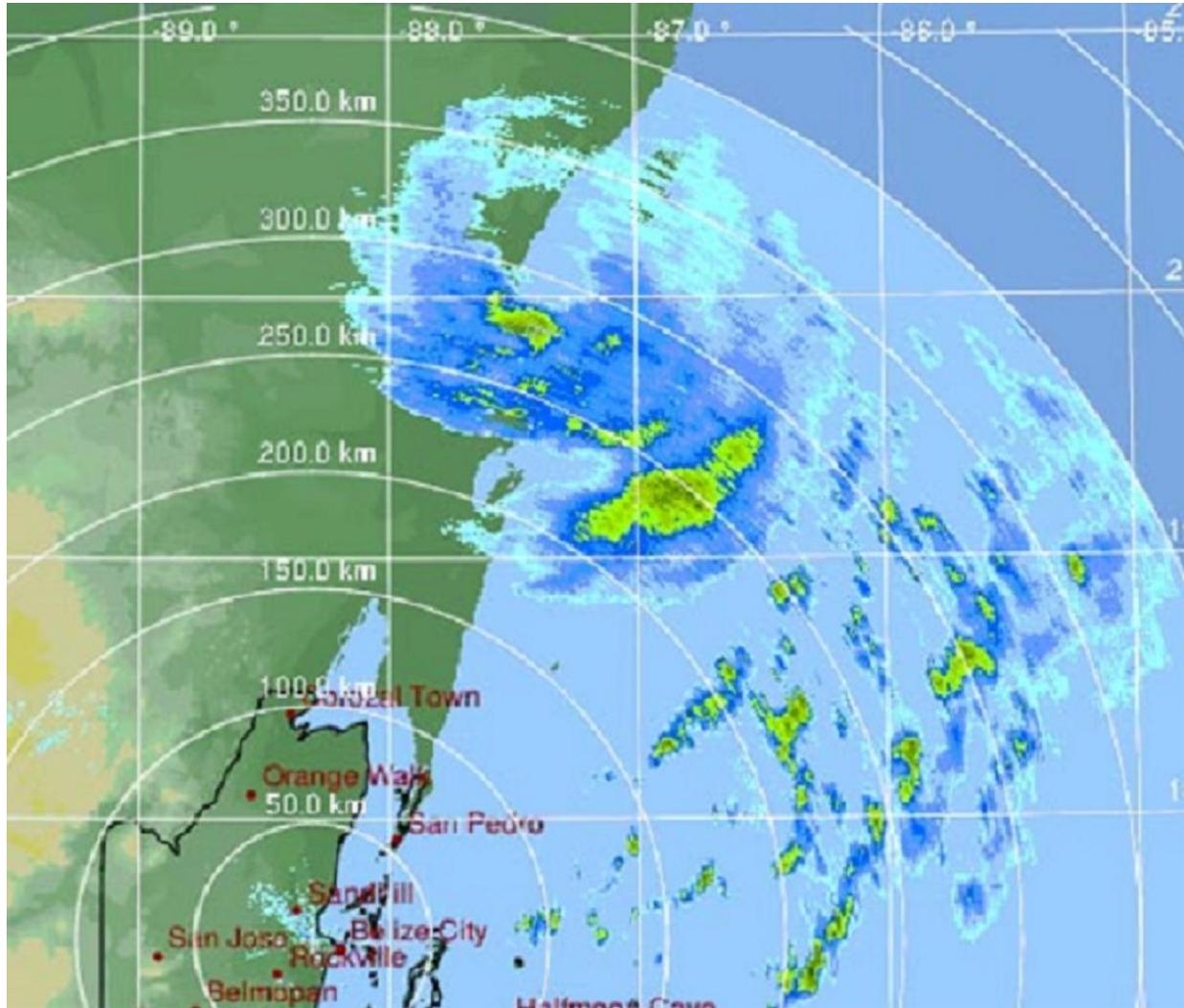
The conditions described here are captured in the author's video of both the Quintana Roo and Veracruz impacts: <https://youtu.be/w-AE7CmXqwl>.

See **Air Pressure Data** (below) Re: instrument calibration and data collection. See **Figures 8-14** for various visualizations of the data and impacts at both landfalls.

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**Figure 5: Radar Image—Landfall in Quintana Roo (Yucatan Peninsula)**

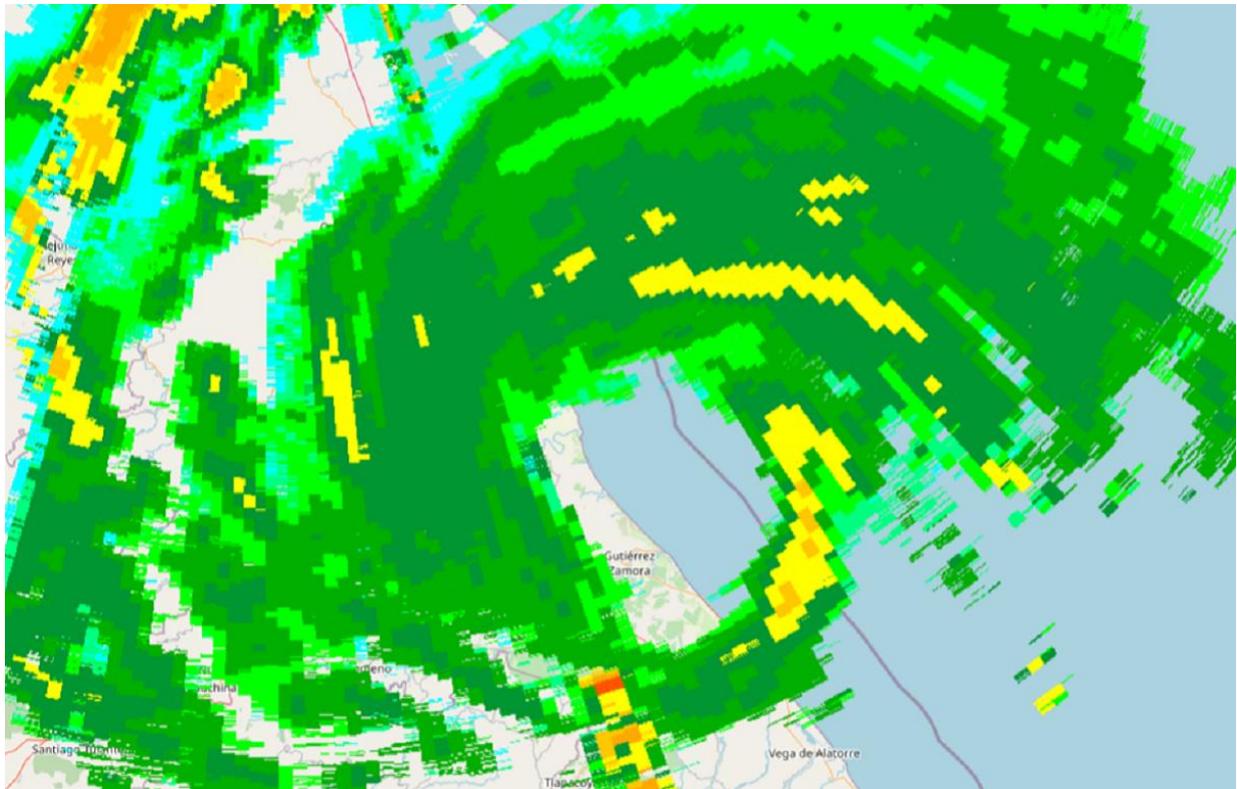
*Radar image from BZE at 4:45 am EST (0945Z) 19 August. The image is attenuated due to distance, but GRACE's eye is clearly visible crossing the E coast of the Yucatan Peninsula near Tulum. (Image: National Meteorological Service of Belize)*



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**Figure 6: Radar Image—Landfall in Veracruz (Emerald Coast)**

*Radar image showing GRACE's large eye crossing the Veracruz coast very early on 21 August. (Image: Servicio Meteorológico Nacional de México)*



**Figure 7: Radar Image—Landfall in Veracruz (with Locations)**

*Another shot of GRACE making landfall in Veracruz, with Chase Locations A and C—and Sensor Location B—labeled. As can be seen, the S edge of the eye passed over Locations A and C, but apparently passed just N of Location B. (Image: Servicio Meteorológico Nacional de México)*



# iCYCLONE CHASE REPORT

## Air Pressure Data

The author collected quality-controlled air-pressure data in Hurricane GRACE's eye during both landfalls in Mexico. All data were collected using Kestrel 4500s.

### Quintana Roo (Yucatan Peninsula)

Data were collected in three locations:

#### Chase Location A—Tulum

- **Coordinates:** 20.2150N 87.4591W
- **Reference elevation:** 39 ft (*This was incorrect—see **Important Note**, below.*)
  - **Note:** 44 ft was used for calibration—to account for device's height above ground.
- **Sampling rate:** 1 reading per 30 seconds (2/min)

The minimum recorded sea-level pressure was **978.0 mb**, which held steady from **5:13 to 5:15 am EST (1013Z–1015Z) 19 August**. This was measured in the eye, very near the hurricane's exact center.

**This minimum is considerably lower than the NHC's operational value of 986 mb** (shared in the landfall advisory), suggesting the cyclone may have been stronger than assessed in real time.

One interesting aspect of the data from this location: the pressure did not “flatten out” once the eye arrived, but continued to fall significantly (another ~6 mb) inside the eye, during the lull. (See the barogram in **Figure 8**.)

**Important Note:** *The device actually indicated a minimum value of 978.4 mb. Afterward, geographer James Hyde analyzed topographical data and determined the elevation at this location is likely ~28 ft—somewhat lower than the reference elevation value used to calibrate the device. To account for this discrepancy, the minimum reading for this location has been **adjusted** to 978.0 mb.*

#### Sensor Location B—Akumal

- **Coordinates:** 20.3980N 87.3205W
- **Reference elevation:** 12 ft
- **Sampling rate:** 1 reading per 30 seconds (2/min)

The minimum recorded sea-level pressure was **991.4 mb** at **4:28 am EST (0928Z) 19 August**. This was most likely measured **outside** of the eye.

The pressure data show a standard “hurricane V” with no distinct features to mention.

#### Sensor Location C—Playa de Carmen

- **Coordinates:** 20.6202N 87.0900W
- **Reference elevation:** 35 ft
  - **Note:** 40 ft was used for calibration—to account for device's height above the floor.
- **Sampling rate:** 1 reading per 30 seconds (2/min)

The minimum recorded sea-level pressure was **999.7 mb** at **3:54 am EST (0854Z) 19 August**. Again, this was most likely measured **outside** of the eye.

Again, the pressure data show a standard “hurricane V” with no distinct features to mention.

# iCYCLONE CHASE REPORT

## Comparison of Data from All Three Locations

To recap the minimum values:

- Tulum (in eye): **978.0 mb**
- Akumal (20 n mi from center): **991.4 mb**
- Playa del Carmen (37 n mi from center): **999.7 mb**

This pressure profile—lowest pressure in the center, with higher minimum values as you move away from the center—makes perfect sense.

One interesting feature is a slight pressure spike in the N eyewall, registered in Playa del Carmen (Location C) at ~3:02 am and Akumal (Location B) at ~3:28 am CDT, as the cyclone moved W. (See the barograms in **Figures 10** and **9**.)

## Core Gradient

The pressure gradient across the hurricane's core was steep but not remarkable.

From 5:13 to 5:15 am EST, Tulum (Location A) was experiencing its minimum sea-level pressure of **978.0 mb**.

- **Gradient from A to B.** At that time (5:15 am), Akumal (Location B) had 996.8 mb. That's a **difference of 18.8 mb across 13 n mi**.
  - **Gradient between Locations A & B: 1.4 mb/n mi**
- **Gradient from B to C.** At that time (5:14 am), Akumal (Location B) had 995.9 mb and Playa del Carmen (Location C) had 1002.9 mb. That's a **difference of 7.0 mb across 19 n mi**.
  - **Gradient between Locations B & C: 0.4 mb/n mi**
- **Gradient from A to C.** At that time (5:13 am), Playa del Carmen (Location C) had 1003.0 mb. That's a **difference of 25.0 mb across 32 n mi**.
  - **Gradient between Locations A & C: 0.8 mb/n mi**

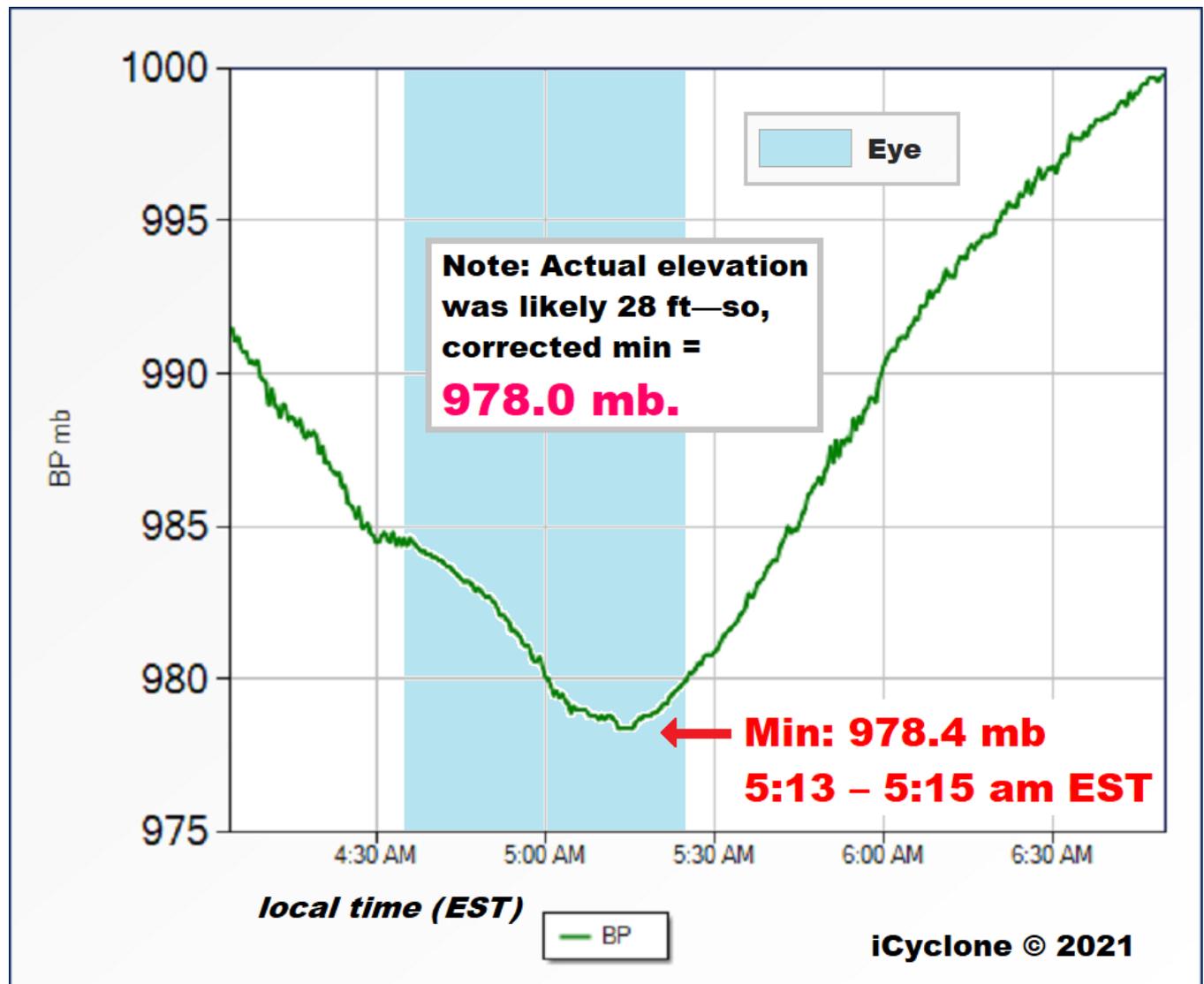
Not surprisingly, the gradient was steepest in the inner portion of the core (Location A to B) and flattened out further from the center (Location B to C).

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Figure 8: Barogram—Chase Location A—Tulum, Quintana Roo

The minimum value of 978.0 mb\* occurred from 5:13 to 5:15 am EST, as the eye passed over Tulum. The calm period is indicated in blue. Notice the significant pressure fall inside the eye.

\* This minimum is corrected from the measured value of 978.4 mb due to the device having been calibrated with the wrong elevation (see above for full explanation).



## HURRICANE GRACE: 19 Aug 2021

Tulum, Quintana Roo, Mexico

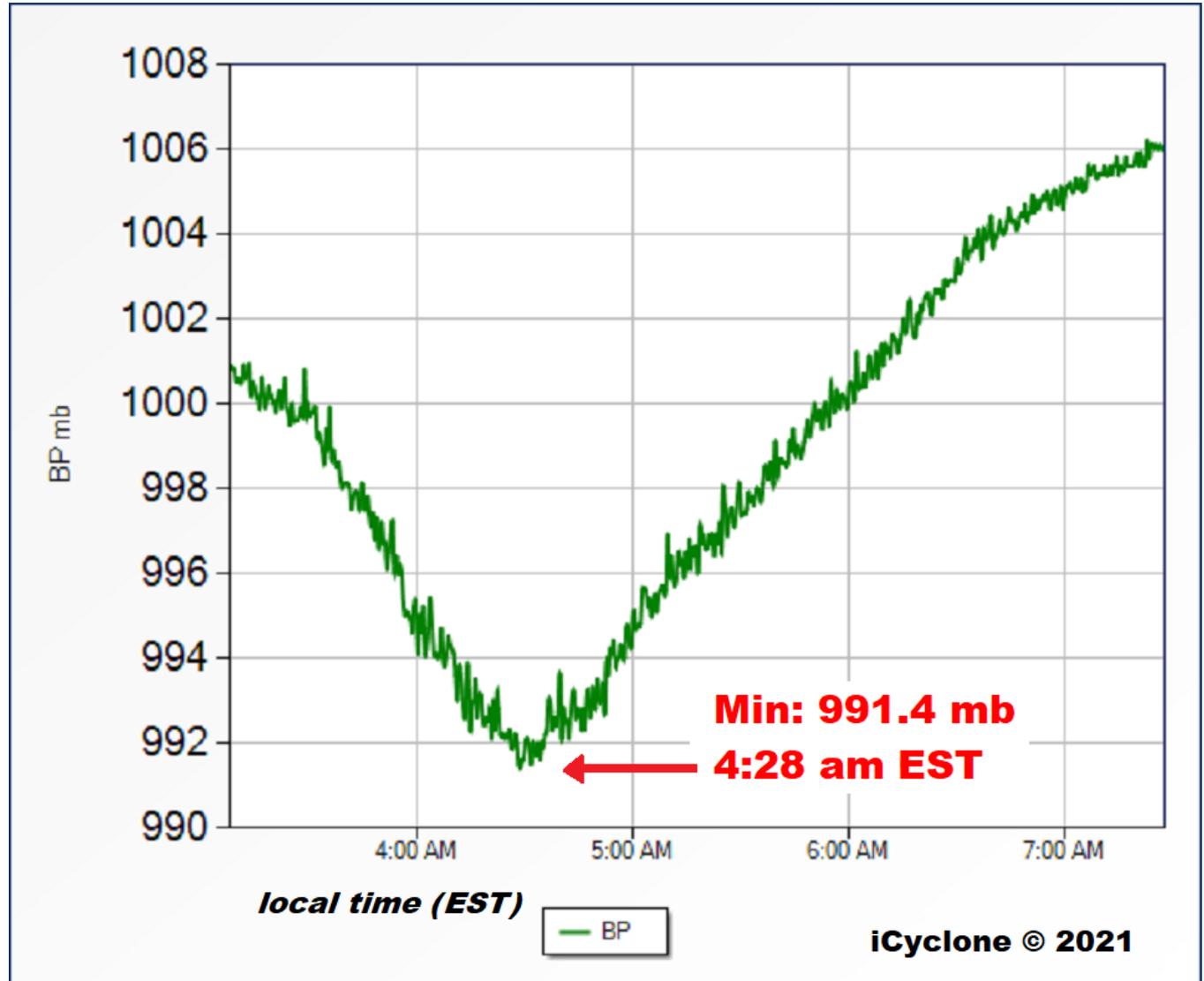
20.21497N 87.45911W – ref el 39 ft

**LOCATION A**

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**Figure 9: Barogram—Sensor Location B—Akumal, Quintana Roo**

*The minimum value of 991.4 mb occurred at 4:28 am EST, as the hurricane's center was passing well S of this location. The trace is a standard "hurricane V."*



## **HURRICANE GRACE: 19 Aug 2021**

**Akumal, Quintana Roo, Mexico**

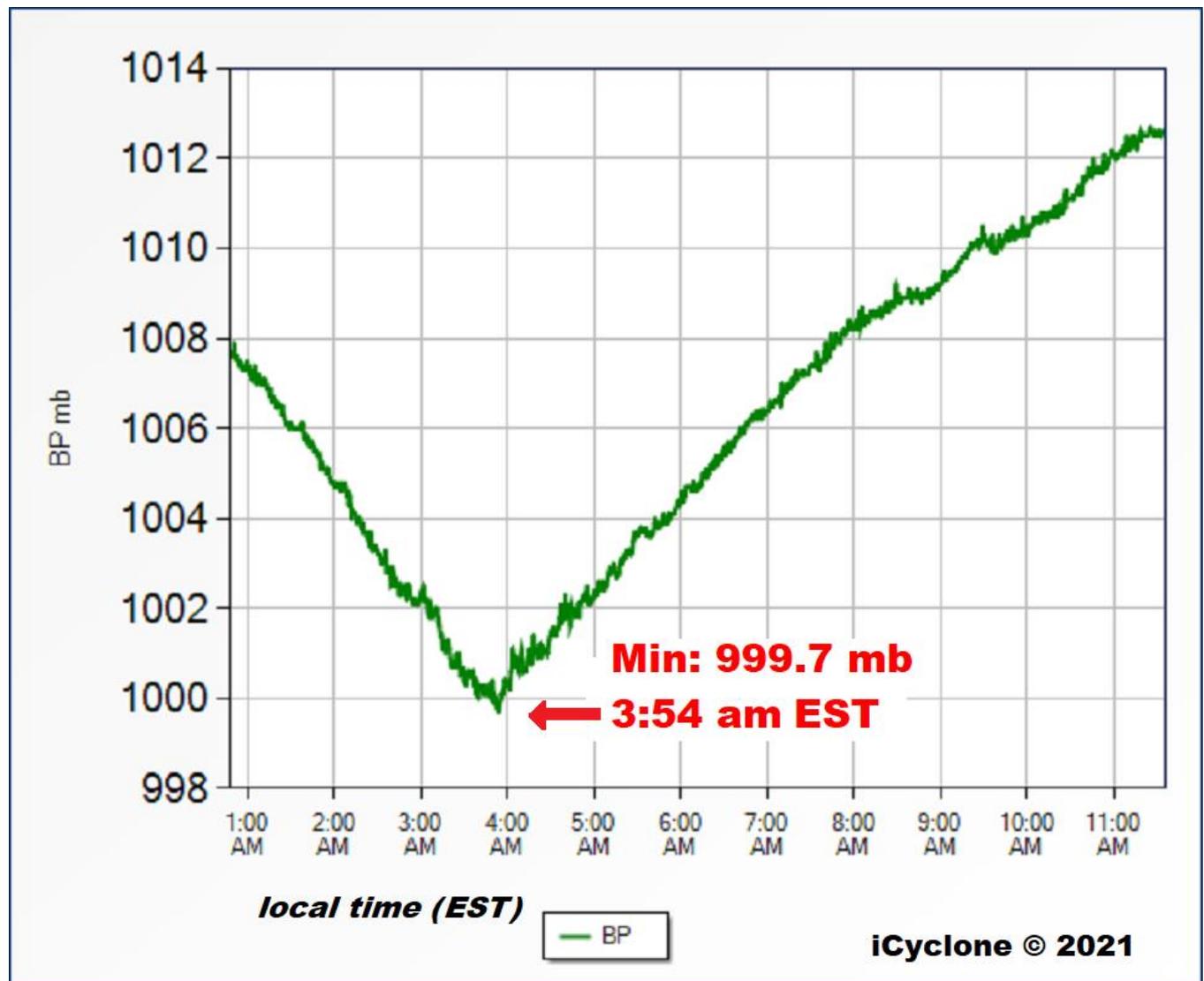
**20.3980N 87.3205W – ref el 12 ft**

**LOCATION B**

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Figure 10: Barogram—Sensor Location C—Playa del Carmen, Quintana Roo

The minimum value of 999.7 mb occurred at 3:54 am EST, as the hurricane's center was passing well S of this location. Again, the trace is a standard "hurricane V," with only minor deviations.



## HURRICANE GRACE: 19 Aug 2021

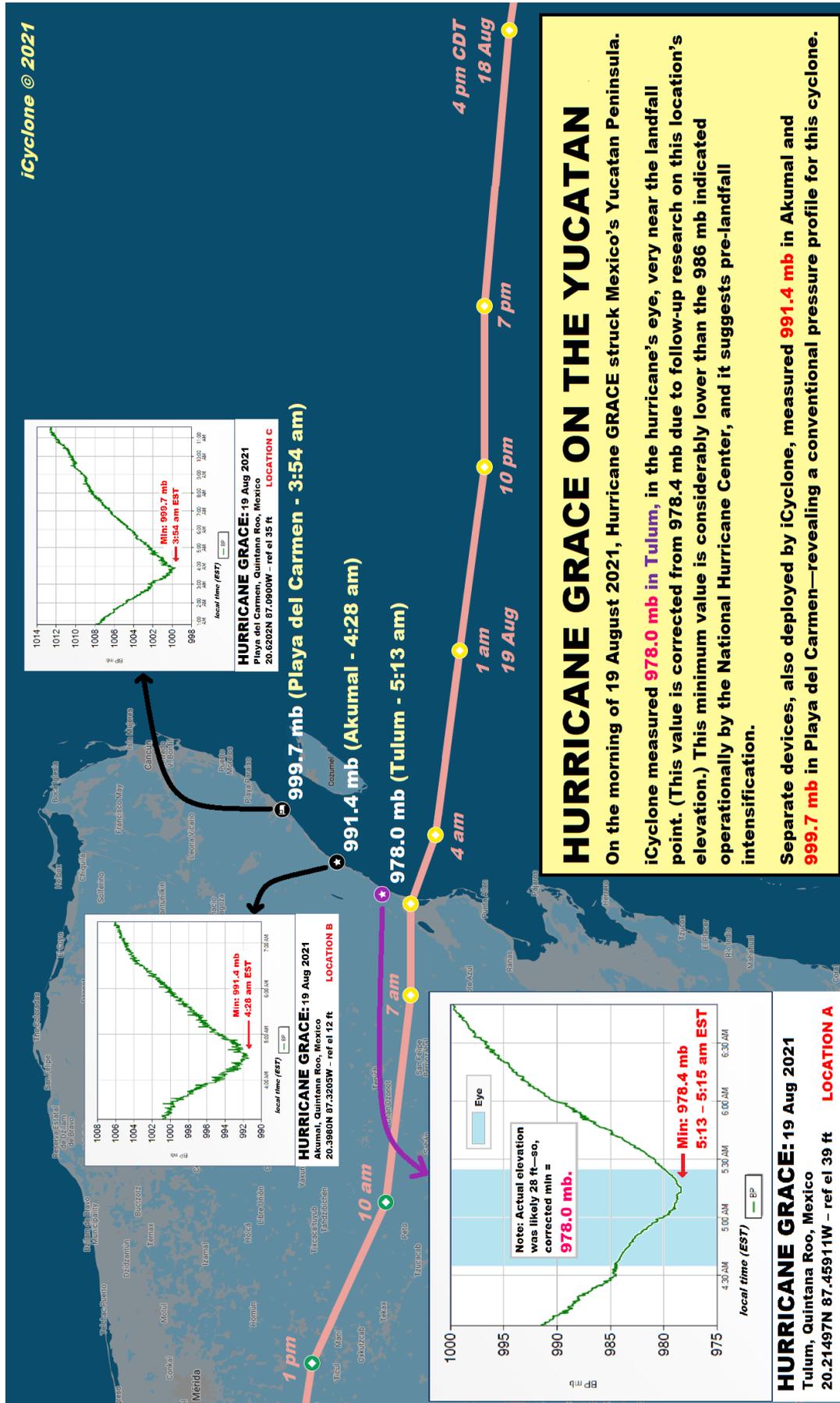
Playa del Carmen, Quintana Roo, Mexico

20.6202N 87.0900W – ref el 35 ft

**LOCATION C**

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Figure 11: Infographic of Quintana Roo (Yucatan Peninsula) Landfall



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## Veracruz (Emerald Coast)

Data were collected in two locations:

### Chase Location A—La Guadalupe

- **Coordinates:** 20.3756N 96.9209W
- **Reference elevation:** 7 ft
  - **Note:** 10 ft was used for calibration—to account for device’s height above ground.
- **Sampling rate:** 1 reading per 30 seconds (2/min)

The minimum recorded sea-level pressure was **981.4 mb** at **11:55 pm CDT 20 August and 12:09 and 12:12 am CDT 21 August (0455Z, 0509Z, and 0512Z 21 August)**. This was measured in the S edge of the hurricane’s eye.

**This minimum is much higher than the NHC’s operational value of 962 mb** (shared in the landfall advisory)—even when an allowance is made for the fact that GRACE had a large eye and this reading was collected at the edge of it.

### Sensor Location B—La Vigueta

- **Coordinates:** 20.3150N 96.8594W
- **Reference elevation:** 13 ft
- **Sampling rate:** 1 reading per 30 seconds (2/min)

The minimum recorded sea-level pressure was **985.7 mb** at **12:00 am CDT (0500Z) 21 August**. Based on radar imagery (see **Figure 7**, above) and an eyewitness account, this was likely measured **outside** of the eye.

The eyewitness told Erik Sereno there was never a true calm at this location—however, the winds **lessened** for a short period, after which they changed direction. This lessening and direction change likely occurred as this location penetrated through the inner eyewall and just **barely** scraped the outer edge of the eye.

The pressure data show a standard “hurricane V,” with some fluctuations at the time of the lowest pressure, when the cyclone’s center was no doubt making its closest approach. There’s also a minor deviation between 12:30 and 1 am CDT, as the pressure was recovering.

### Chase Location C—El Encanto

- **Coordinates:** 20.4046N 97.0020W
- **Reference elevation:** NA
- **Sampling rate:** NA

As described previously: while the hurricane’s eye brushed over this area, the author and Erik Sereno took advantage of the calm to drive NW, up Highway 180. They got as far as El Encanto, ~5 n mi NW of La Guadalupe (Location A), before fallen trees forced them to turn back.

No quality-controlled data were collected during this excursion—however, Erik had a Kestrel 5500 in the car, **and it never went below 979 mb**.

The device’s location was constantly changing, and furthermore, there were some minor elevation changes on this drive, so these data aren’t quality-controlled and can’t be used or analyzed in any meaningful way. That said, the fact that the device never went below 979 mb, even as we drove deeper into the eye, is telling—and it corroborates the surprisingly high 981.4 mb minimum in La Guadalupe (Location A).

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## Core Gradient

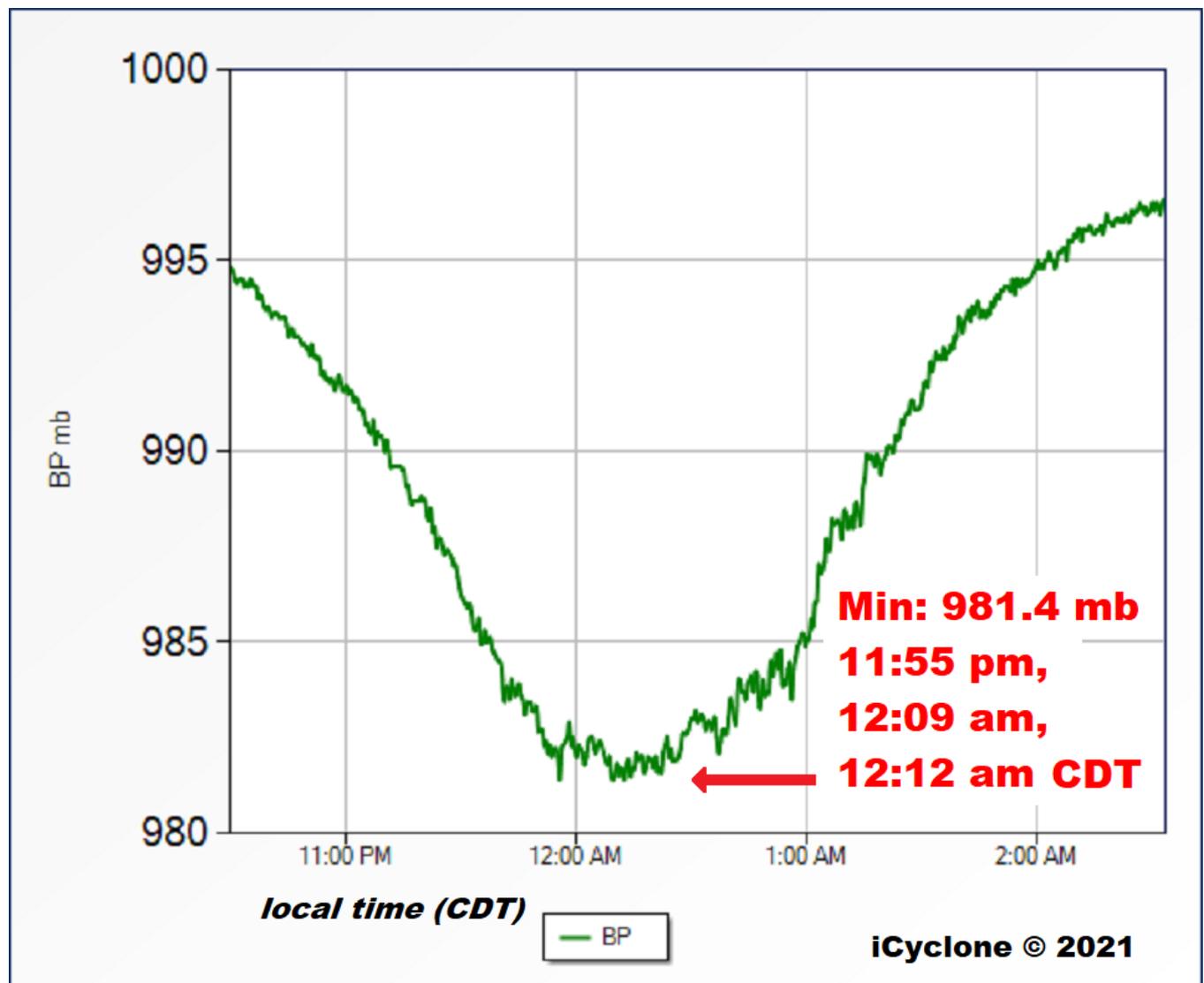
At 12:12 am CDT, La Guadalupe (Location A) had its minimum sea-level pressure of **981.4 mb**. At that same time, La Vigüeta (Location B) had 986.8 mb. That's a **difference of 5.4 mb across 5 n mi**.

- **Gradient between Locations A & B: 1.1 mb/n mi**

This is a surprisingly tepid gradient for the core of a major hurricane, especially when one considers that this portion of a tropical cyclone—the boundary between the eye and eyewall—will usually have the steepest gradient in the system.

### Figure 12: Barogram—Chase Location A—La Guadalupe, Veracruz

*The minimum value of 981.4 mb occurred multiple times around 12 midnight CDT 21 August, as the S edge of the eye brushed this location.*



## HURRICANE GRACE: 20-21 Aug 2021

La Guadalupe, Veracruz, Mexico

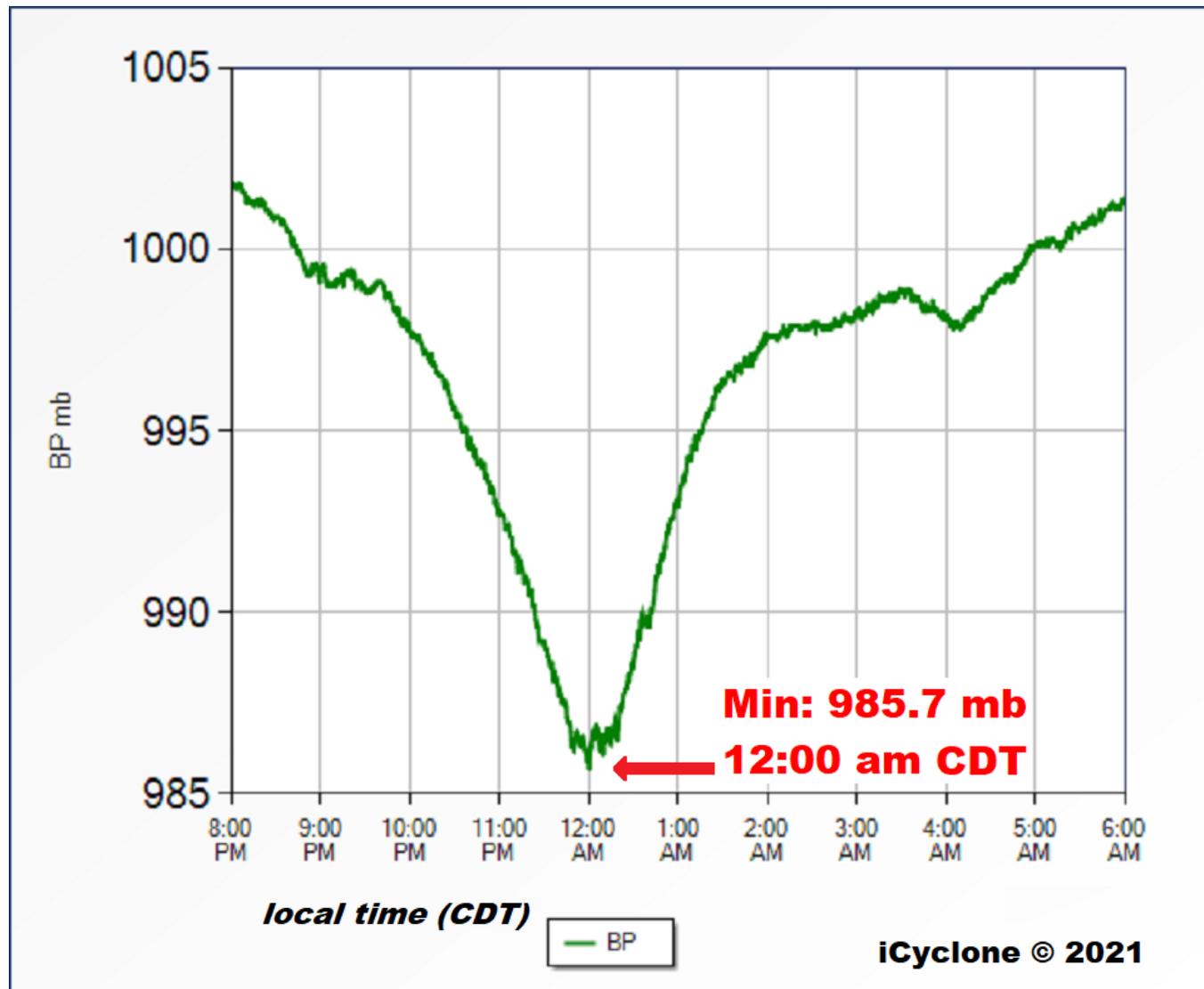
20.3756N 96.9209W – ref el 7 ft

**LOCATION A**

# ICYCLONE CHASE REPORT

**Figure 13: Barogram—Sensor Location B—La Viguetta, Veracruz**

*The minimum value of 985.7 mb occurred at exactly 12 midnight CDT 21 August. Based on an eyewitness account, it seems the eye just missed this location. This is a pretty standard “hurricane V” trace, with a minor deviation on the backside, between 12:30 and 1 am, as the pressure was recovering.*



## **HURRICANE GRACE: 20-21 Aug 2021**

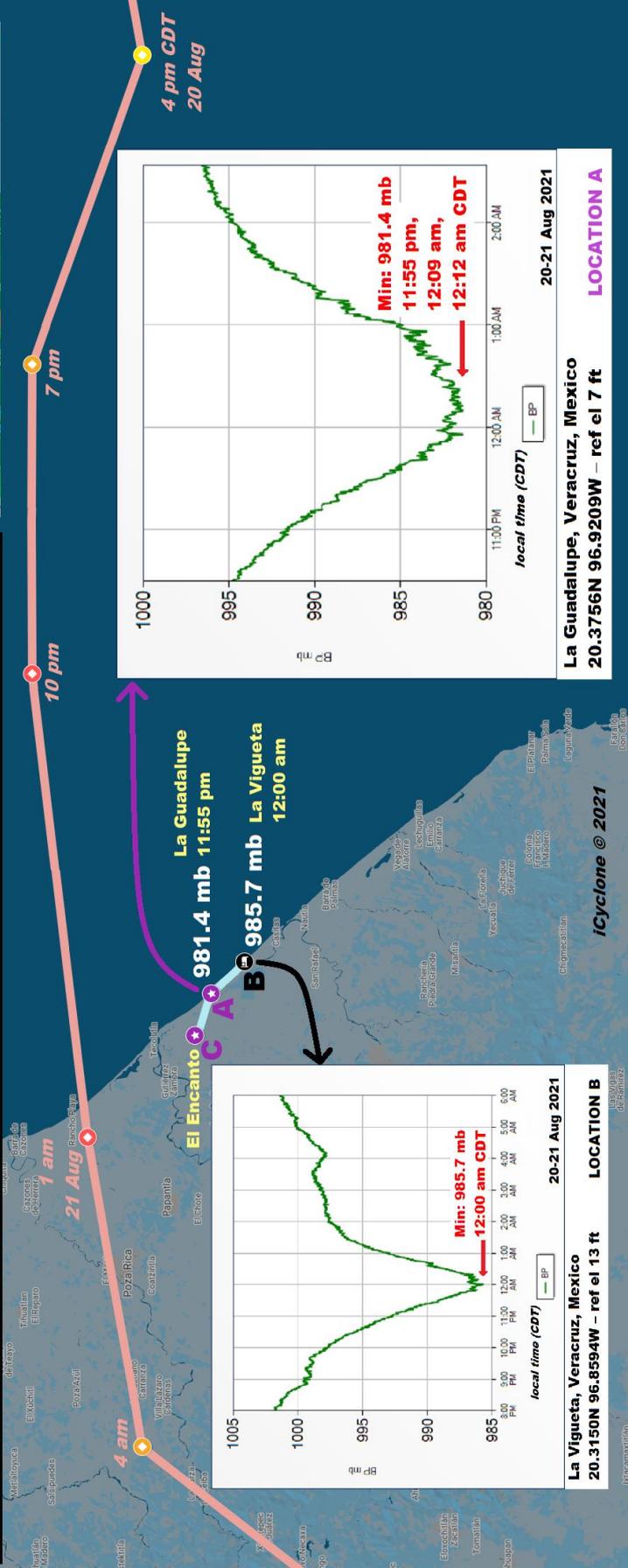
**La Viguetta, Veracruz, Mexico**

**20.3150N 96.8594W – ref el 13 ft**

**LOCATION B**

# HURRICANE GRACE IN VERACRUZ

On 20-21 August 2021, Hurricane GRACE made its second landfall in a sparsely-populated part of Mexico. iCyclone measured **981.4 mb** in La Guadalupe (A), which was at the S edge of the eye. During the relative calm, iCyclone drove ~5 mi WNW, deeper into the eye, to El Encanto (C). (While no quality-controlled data were collected at this location, the barometer in the car never went below 979 mb.) A separate device, deployed by iCyclone, measured **985.7 mb** in La Vigueta (B), which is ~5 mi SE of La Guadalupe (A). An eyewitness there described some lessening of the winds at the height of the storm, but never a real calm—suggesting this location brushed the eye but never fully entered it.



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## Aftermath – Quintana Roo (Yucatan Peninsula)

Hurricane GRACE’s impact on the Yucatan Peninsula was moderate. Between Tulum and Playa del Carmen, the author observed downed trees and branches, downed power lines, damaged signs and roofing, and moderate urban flooding.

In Playa del Carmen, debris patterns and residual flooding later in the day suggested storm surge had washed over the sand and onto some seaside streets at the height of the storm.



***Damage in Tulum was light to moderate, but the streets were strewn with debris—especially metal sheeting that tore off structures and flew around the city center during the storm.***



***Some trees blocked the highway en route back to Playa del Carmen.***

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*In some places along the highway leading back up to Playa del Carmen, power poles had been bent or toppled by the hurricane winds.*



*Moderate flooding and damaged signage in Playa del Carmen.*

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*Moderate urban flooding in Playa del Carmen.*



*Beachfront flooding in Playa del Carmen—apparently residual storm surge.*

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## Aftermath – Veracruz (Emerald Coast)

Hurricane GRACE’s impact in Veracruz was much more severe than it was in Quintana Roo. There was widespread, extensive wind damage to buildings and structures up and down the Emerald Coast—and one got the feeling it would take a while for things to get back to normal.



*Heavy wind damage to a building on the highway along the Emerald Coast of Veracruz.*



*Another view of the same building. Wind scattered the wreckage down the highway—wreckage that was no doubt airborne during the storm and extremely dangerous.*

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***In GRACE's back eyewall, this heavy concrete-composite patio roof (at a hotel in La Guadalupe) exploded into a thousand flying pieces—almost striking the author, who was observing the storm from the carport underneath.***



***The author amidst the debris that almost struck him during the storm.***

# **iCYCLONE CHASE REPORT**



***GRACE's winds felled utility poles along the highway...***



***...and in some cases just snapped them like toothpicks.***

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*The morning after Hurricane GRACE, men fix the shredded roofs of their businesses along the Emerald Coast of Veracruz.*



*Heavy wind damage to businesses along the Emerald Coast of Veracruz.*

# ICYCLONE CHASE REPORT



***GRACE's winds tore away the roof of this patio restaurant along the Emerald Coast of Veracruz.***



***Heavy wind damage to business along the Emerald Coast of Veracruz.***

# ICYCLONE CHASE REPORT



*Destroyed gas-station sign near La Guadalupe.*



*Mangled gas station canopy near La Guadalupe.*

# ICYCLONE CHASE REPORT



***GRACE's fierce winds completely shredded the roof of this hotel on the highway along the Emerald Coast of Mexico.***



***These kinds of tin roofs were no match for GRACE. The hurricane's winds tore them apart and scattered the pieces like confetti.***

# ICYCLONE CHASE REPORT



*Cruel GRACE: a devastated home along the Emerald Coast of Veracruz.*

## Video

The passage of the hurricane in both Quintana Roo and Veracruz—as described in this report—can be seen in the author’s 35-minute video of these impacts: <https://youtu.be/w-AE7CmXqwl>

For easy analysis, all the footage is timestamped in local time (EST in Quintana Roo and CDT in Veracruz).

## Questions or Feedback?

Get in touch:

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[info@icyclone.com](mailto:info@icyclone.com)