Statistical analysis of cyclone activity for Guadeloupe

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First International Caribbean Waves: Risk Evaluation of Natural Hazards in the Caribbean, Pointe-a-Pitre, Guadeloupe, 9 – 10 December 2008

Introduction

The French West Indies located in the Lesser Antilles, North Atlantic have a huge experience of tropical cyclones.

Cyclones produce some harm by terrific wind speed, abnormal precipitations and sea action. Historically, storm surge inundation has been the most destructive.

Damage caused in Sainte-Anne (Guadeloupe) by hurricane Hugo, 1989

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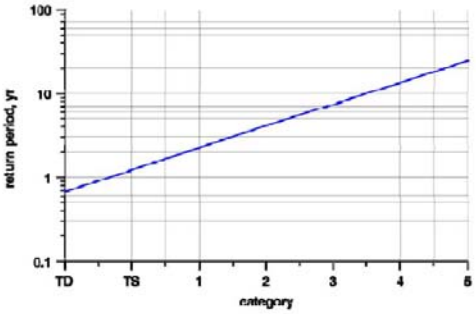
Introduction

Recently, (Zahibo et al., 2007) has studied the cyclone activity in Guadeloupe for 1635–2000, and evaluated the return period of cyclones:

$$T = 0.67 \cdot \exp\left(0.60 \cdot C\right)$$

where C is category, and T is measured in years.

In average, the cyclone, which can be categorized, occurred almost each year. Cyclone with category more than 1 occurs each 2.3. The strongest cyclones with category more 2, 3 and 4 occur where C is category, and T is measured in years each 4, 7.6 and 13.4 years, respectively



Return period versus cyclone categories (Zahibo et al., 2007)

Introduction

The most disastrous hurricane occurred in Guadeloupe on September, 17, 1989. Hurricane Hugo category 4 having maximum wind speed of 240 km/h, killed 5, injured 80 and left 11. 000 homeless.

Gosier (Guadeloupe) after hurricane Hugo; September 1989

Hurricane track: September, 10 – 25, 1989

Damage in Ste-Anne (Guadeloupe); September, 1989

Extreme waves induced by Hurricane Dean

Cyclone general information

Hurricane Dean on August 20 at 18:41 UTC, NOAA

About 80 % of bananas were damaged in Guadeloupe

Dean crossed the Antillean arc in August, 16-17, 2007. After traversing the channel Sainte-Lucie, Dean reached to the 3rd stage of SSS, its average wind speed was in the order of 160-180 km/h with blasts of 200 km/h.

Two deaths were caused by Dean in Martinique.

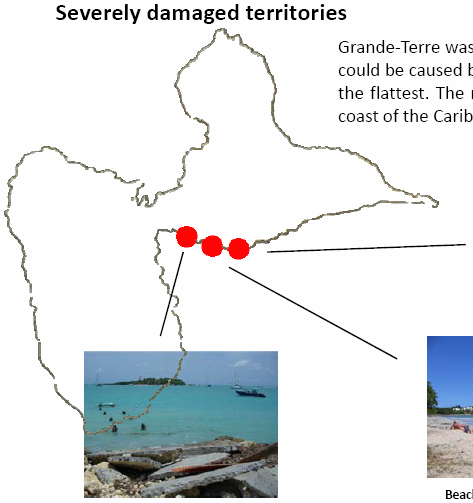
Great damage occurred in the French territories: trees were overthrown and root out; roads were destroyed. Some beaches of white sand disappeared under the water.

But the most considerable damage occurred to bananas (100% of production in Martinique and 80% in Guadeloupe), tropical fruits and sugar-cane (70% of production in Martinique).

Extreme waves induced by Hurricane Dean

Severely damaged territories

Grande-Terre was especially damaged by storm-surges. This amplification could be caused by bottom topography as the beaches in Grand-Terre are the flattest. The most damaged territories were located in the northern coast of the Caribbean shore, St Anne, St Félix and Petit-Havre.



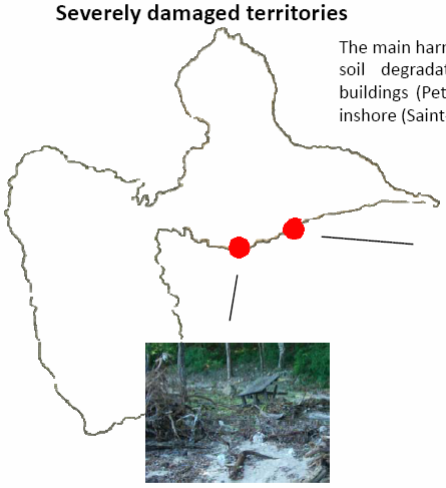
Destroyed berth, Petit Havre

Destroyed berth, Gosier

Beach of Saint-Felix: before the hurricane, February 2007 (left); after the Hurricane Dean, August 2007 (right)

Extreme waves induced by Hurricane Dean

Severely damaged territories



The main harm observed in Grande-Terre during the field survey included soil degradation, inundation (Sainte-Anne), destruction of littoral buildings (Petit Havre), and debris of marine origin up to 50-60 meters inshore (Saint-Felix).

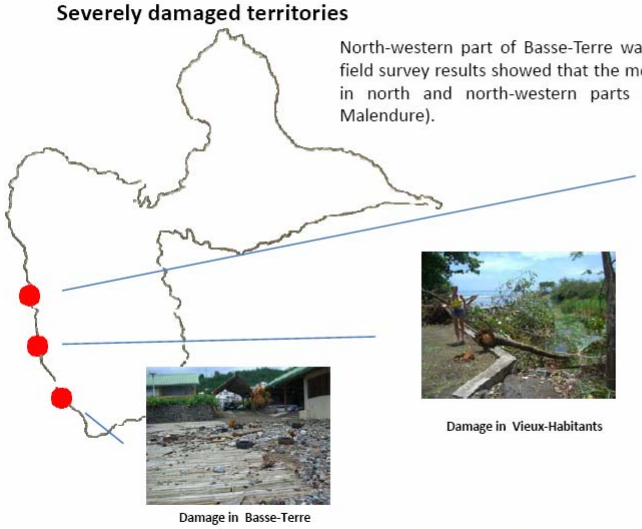
Beach of Sainte-Anne : before the hurricane, December 2005 (left); after the Hurricane Dean, August 2007 (right)

The beach of Petit Havre

Fallen palms, Sainte-Anne

Extreme waves induced by Hurricane Dean

Severely damaged territories



North-western part of Basse-Terre was damaged mainly by wind. The field survey results showed that the most significant damage was caused in north and north-western parts of Basse-Terre (Vieux-Habitants, Malendure).

The beach in Malendure was covered by sea-grass, placed out on several meters (on the photo: Ira Didenkulova)

Damage in Vieux-Habitants

Damage in Basse-Terre

Extreme waves induced by Hurricane Dean

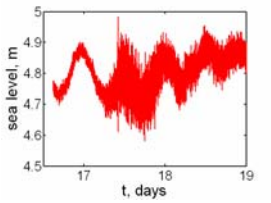
Tide-gauge data

In Guadeloupe 4 tide-gauges are located on average depth of 2 meters in Deshaies, Bouillante, Vieux-Habitants and Gourbeyre.

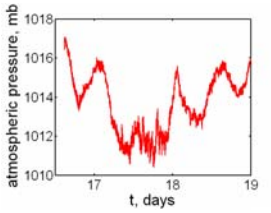
The field survey results mark that Deshaies was slightly damaged by wind, not by sea waves.

However there was some water inside the tide-gauges. This statement is in a good agreement with data of the western part of Basse-Terre (Vieux-Habitants), where storm surges of 3-4 meters height were observed. Apparently the amplitude of storm surges might have had the similar order in all Basse-Terre.

The atmospheric pressure is in an obvious correlation with sea waves; so-called rule of reverse barometer.



Records of sea, Deshaies; August, 2007



Records of atmospheric pressure, Deshaies; August, 2007

Extreme waves induced by Hurricane Dean

Locations and amplitude of storm surges produced by Hurricane Dean (run-up height: big underlined letters, run-up length: small letters)

Caribbean coast especially south of Grande-Terre and west of Basse-Terre were damaged significantly.

Storm surges in Vieux-Habitat

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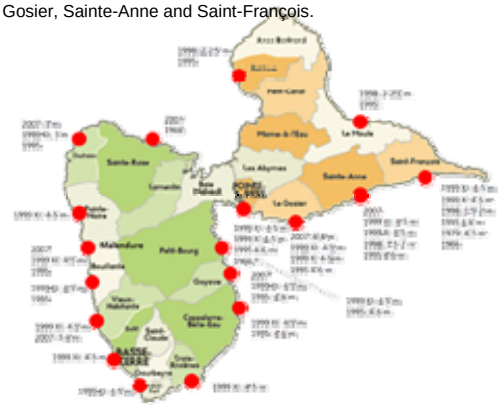
Historical data of storm surges

Table. Damaging cyclones in Lesser Antilles

Date	Cyclone	Category	Storm surge, m	Location
1928		4	15	coast
1966	Inez	3	"probable storm surge"	, Pointe-a-Pitre and Sainte-Rose
1979	David	4	4-5	
1989	Hugo	4	"minor storm surge"	coast
1995	Luis	4	"strong storm surge"	Moule, Port Louis, Malendure, Deshaies and Bouillante
1995	Marilyn	1	4-6	Caribbean coast of Grande-Terre and on the , between Capesterre and Petit Bourg
1998	Bonnie	TS	1,5-2	South-east of
1998	Danielle	2	2-2,5	Atlantic coast (east-north-east and north-east)
1999	Jose	2	4-5	South-east of .
1999	Lenny	TS	4-5	coast
			3	Deshaies
2000	Joyce	TS	2	coast
2001	Chantal	TS	"storm surge"	coast
2003	Fabian	4	4	coast
2003	Isabel	4	2,5	coast
2004	Ivan	3	"minor storm surge"	coast
2007	Dean	4	6-8	Petit Havre (Gosier)
			0,35	Deshaies
				Vieux-Habitants, Goyave, Sainte Rose, Malendure, Gosier

Both Atlantic and Caribbean coasts of the island exposed to extreme waves, the mean value of storm surge height for the Atlantic coast (2.2 meters) is twice lower than for the Caribbean one (4.4 meters). The most dangerous regions are observed in the southern shore of Grande-Terre: Gosier, Sainte-Anne and Saint-François.



Locations and dates of extreme waves in Guadeloupe in 1928-2007

Thank you for your attention.