- 247: Implications of Central America Hydroclimatic Changes on Water Security III Online Discussion Session
- Online Session - Online Session IV

11:00am - 12:00pm. Tue, Jun 21 GMT-04:00

- Primary Convener:

Hugo Hidalgo, University of Costa Rica

Convener:

Iris Stewart, Santa Clara University

Edwin Maurer, Santa Clara University

Eric Alfaro, University of Costa Rica

Chair:

Iris Stewart, Santa Clara University

Adolfo Quesada-Román, University of Costa Rica

Eric Alfaro, University of Costa Rica

Smallholder livelihoods throughout Central America are built on rain-fed agriculture and depend on seasonal variations in temperature and precipitation. The effects of global change in this highly diverse region are not well understood due to sparse observations and complex interactions between the land and seas bounding the isthmus. We invite presentations that focus on the causes, signals, measurement, and impacts of changes in precipitation, aridity and drought in the region. We are particularly interested in connecting hydrologic changes to implications for water access, water resources, and water conflict at the local scale.

Index Terms

1812 Drought

1833 Hydroclimatology

1834 Human impacts

1854 Precipitation

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Tropical Cyclones Losses by Economic Sector in Costa Rica, Central America

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Tropical cyclones normally affect Central America and Costa Rica. Population growth and inefficient land use planning increases the exposure to natural hazards related to tropical cyclones such as landslides and floods. The Ministry of National Planning and Economic Policy of Costa Rica gathered all the economic impacts by municipality in every economic sector since Hurricane Joan in 1988. Our results indicate that road infrastructure, agriculture, sewerage, and housing were the most affected economic sectors in the last three decades in the country. Normally, the Pacific basin municipalities are the most affected units due to the indirect impact of tropical cyclones in Costa Rica. These results unravel the most affected municipalities and economic sectors by tropical cyclones in the country and is a useful approach that can be applied to other countries and regions affected by these phenomena throughout the tropics.

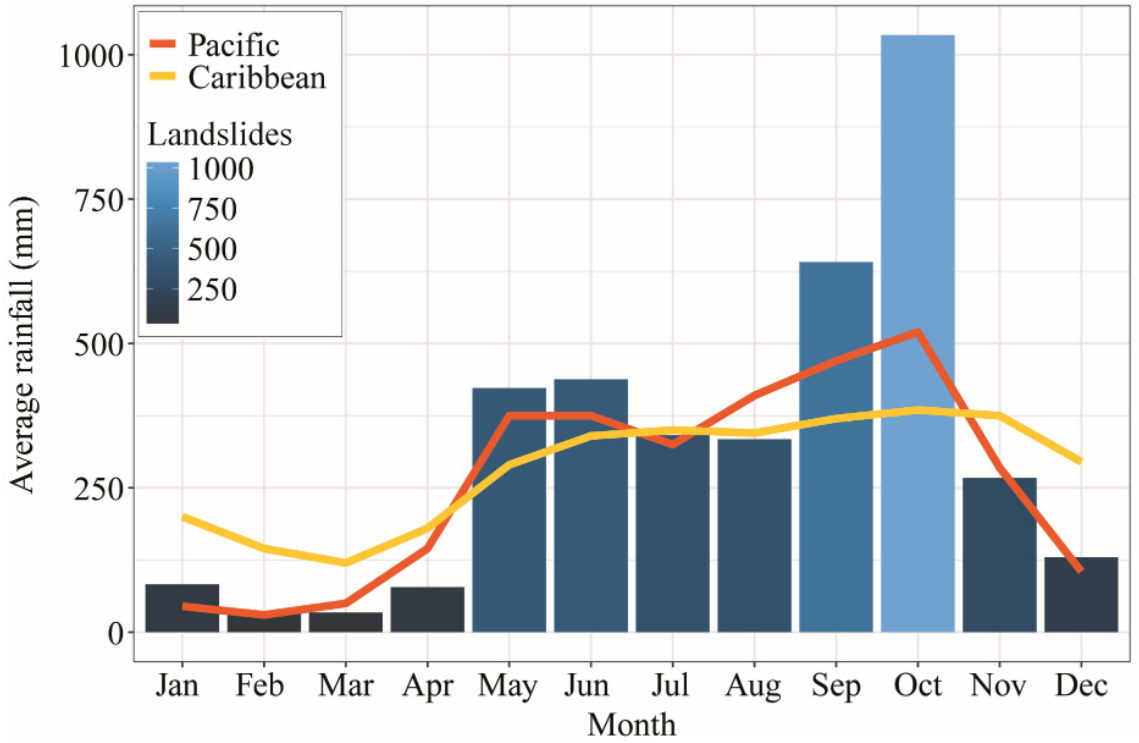
Tropical cyclone impacts in Costa Rica

>90% disasters
1970-2019

(DesInventar, 2020)

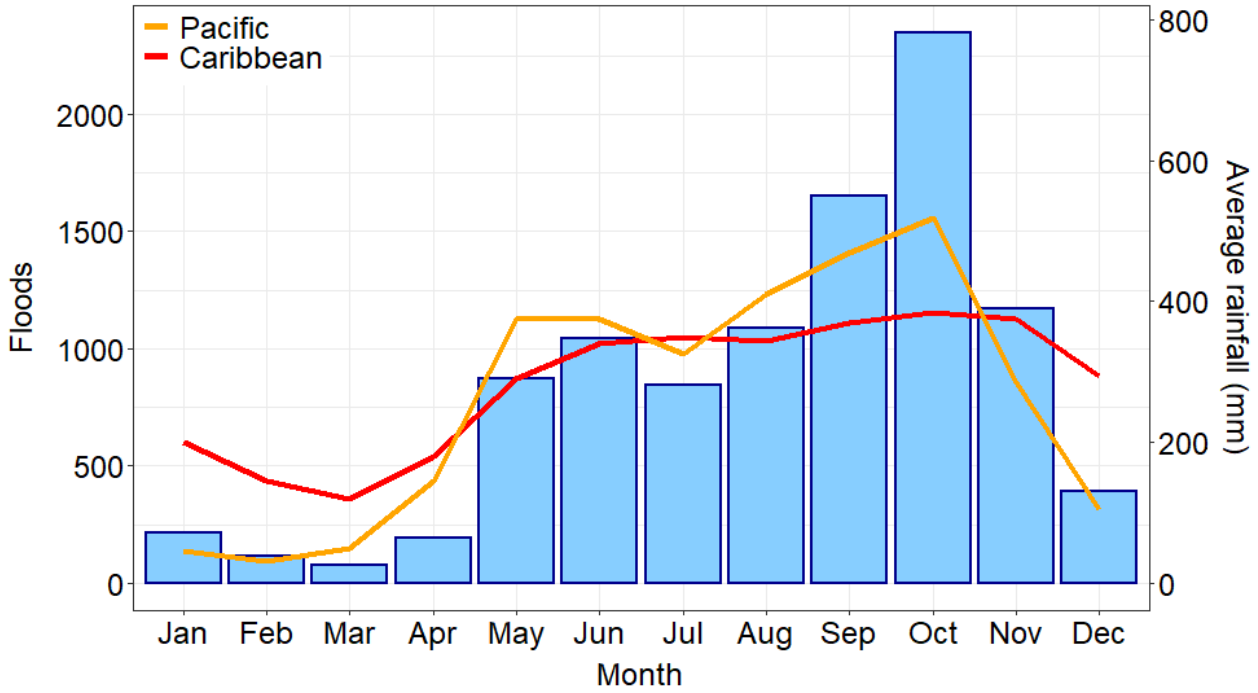
- Landslides

- Floods



Landslides

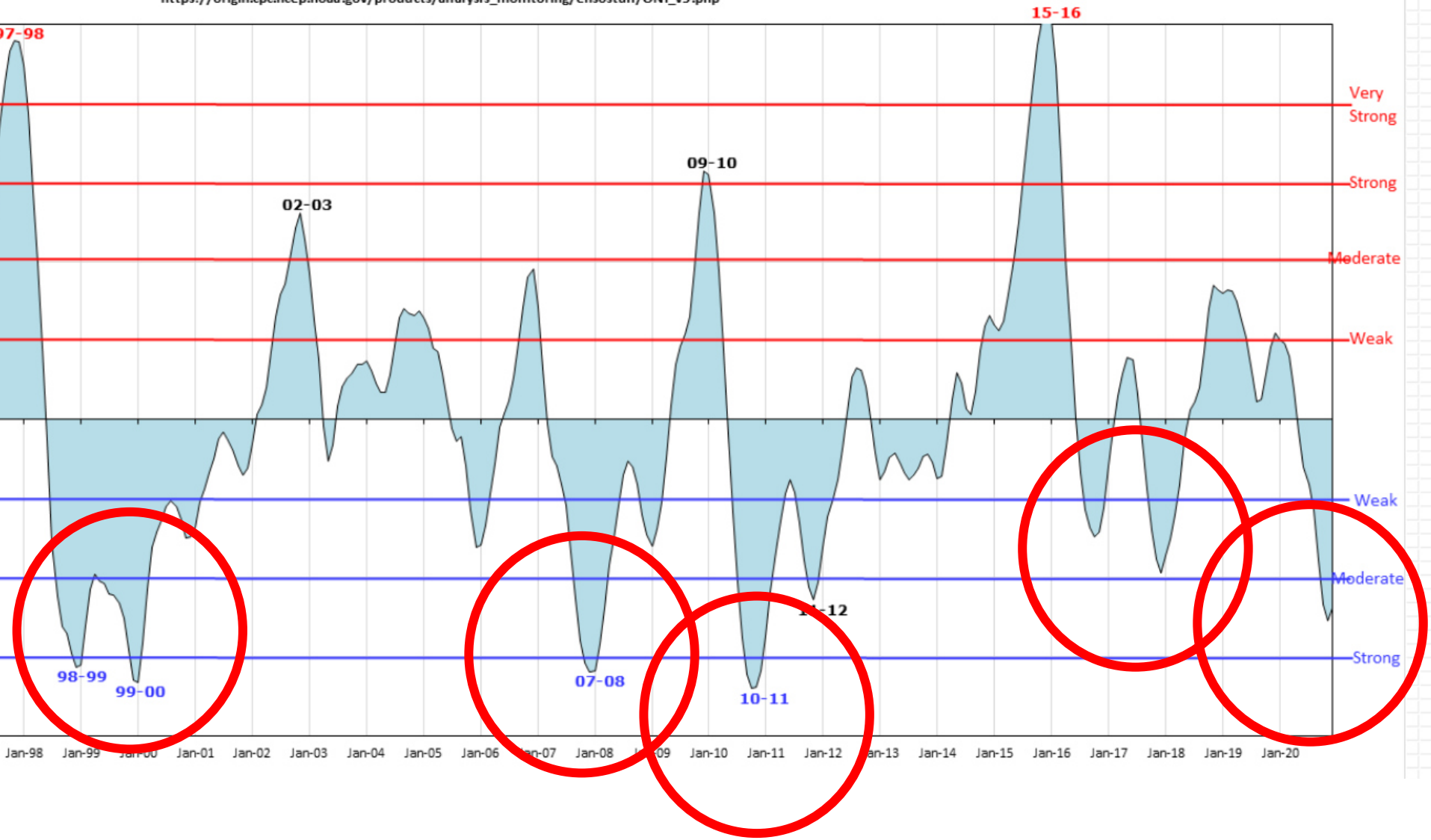
Floods



Source: 1970-2020 DesInventar

Oceanic Niño Index (ONI) - 1990-present

https://origin.cpc.ncep.noaa.gov/products/analysis_monitoring/ensostuff/ONI_v5.php



How much does it cost a tropical cyclone for Costa Rica?

Every year ~1% of the national GDP is used in repair and rehabilitation from the effects of disasters.

Otto 2016 (0.4% GDP).

Nate 2017 (1.3% GDP).

Which economic sector is more affected?

Official information by MIDEPLAN: Ministry of National Planning and Economic Policy

All the values were transformed into 2015 US Dollars.

16 tropical cyclones from 1988-2020.

Main economic sectors affected by tropical ciclones in Costa Rica

Health	Agricultural	River rehabilitation	Road infrastructure	Housing
5.63%	10.61%	14.83%	58.56%	6%

95.64%

Which variables control economic losses by municipality (local government)?

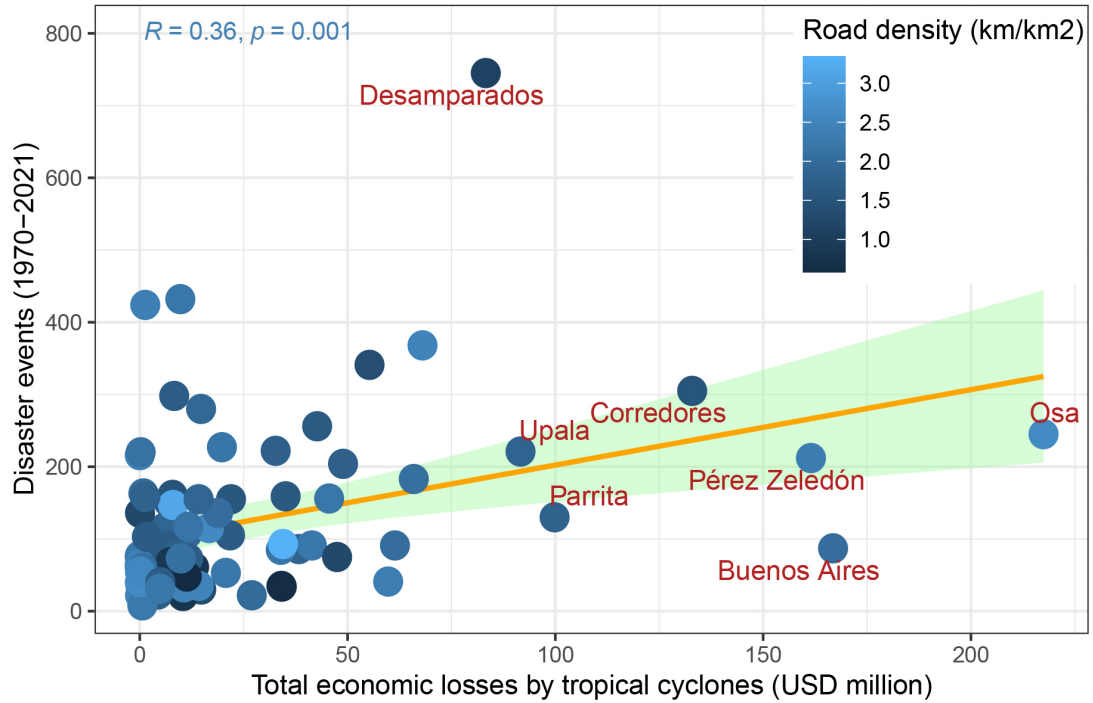
We used a Generalized Linear Model (GLM)

Variables:
Disaster events
Population density
Slope
Rainfall intensity-duration-frequency curves
Flood-prone hazard areas
Non-forested areas
Average road density per municipality

Model NULL (FULL):
glm(formula = T ~ 1, family = gaussian, data = data): AIC: 3107.7

MODEL FINAL (REDUCED BY STEPWISE-BACKWARD):
glm(formula = T ~ DIS + SDI + RD, family = gaussian, data = data): AIC: 3079.6

T (Total losses by municipality) are best explained by the interaction of disaster events between 1970-2020 (DIS), social development index (SDI), and road density (RD).

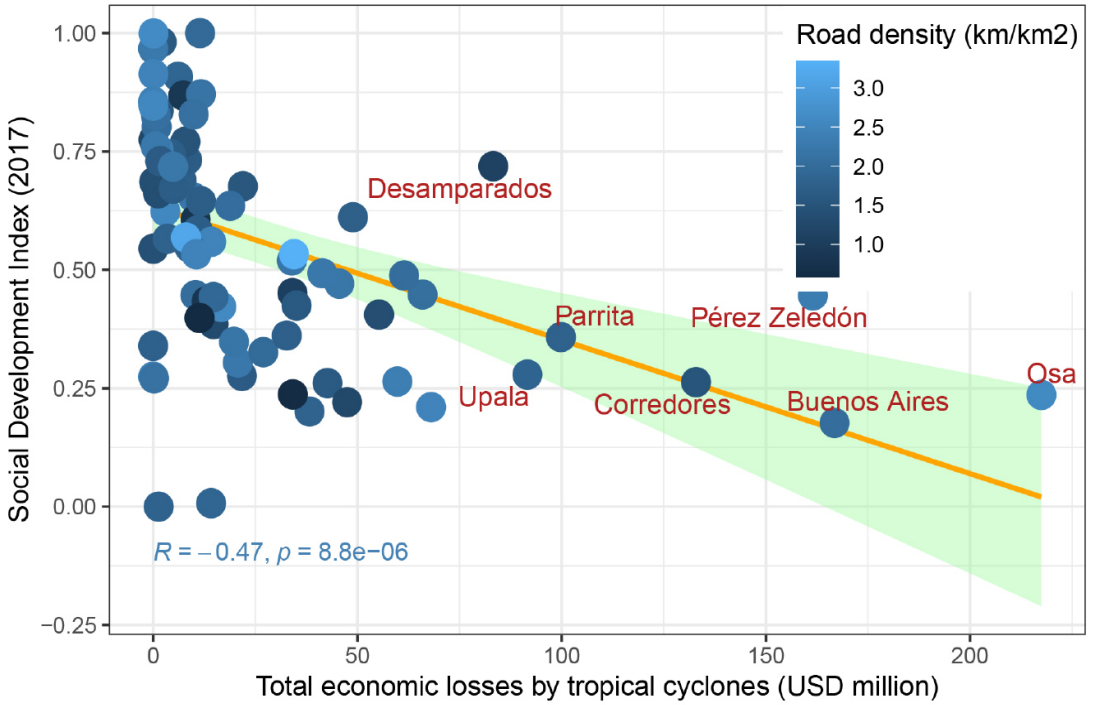


Most affected municipalities are rural, coastal, in borderlands, or its combination.

Most affected units are mostly located in the Pacific (indirect TC effect).

Normally, high road density.

Medium to low social development municipalities.



Disaster risk future decisions

Baseline information should be improved for studies of hazard, vulnerability, exposure and a better calculation of disaster risk in Costa Rica.

The use of low-cost technologies such as drones can improve the way baseline data is obtained and produce high-resolution landslide and flood zone maps.

The implementation of early warning systems with a basin perspective is key.

Decentralization of government and disaster management could improve disaster governance in the municipalities of Costa Rica.

Successful risk assessment, planning, and implementation of mitigation measures in Costa Rica depend on coordination across scales (national, regional, and local).

A Territorial Planning Law is necessary that integrates disaster risk management.

Thank you / Gracias

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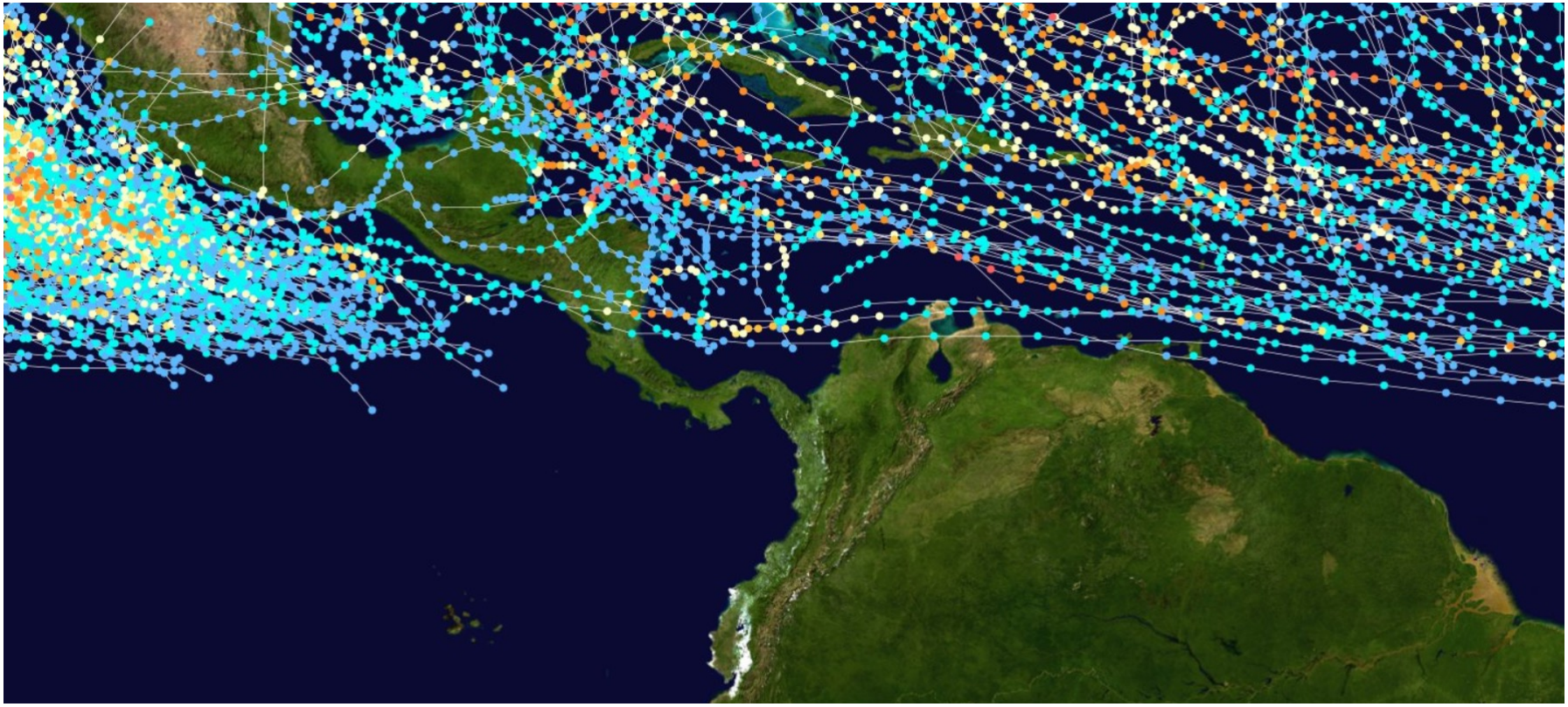
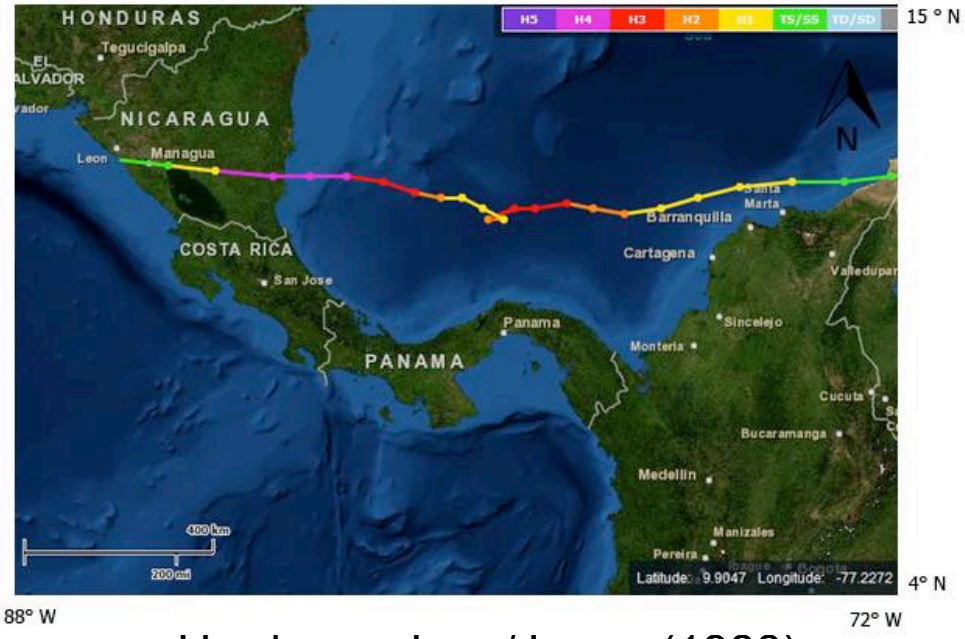
Adolfo Quesada-Román





Hurricane Joan/Juana (1988)

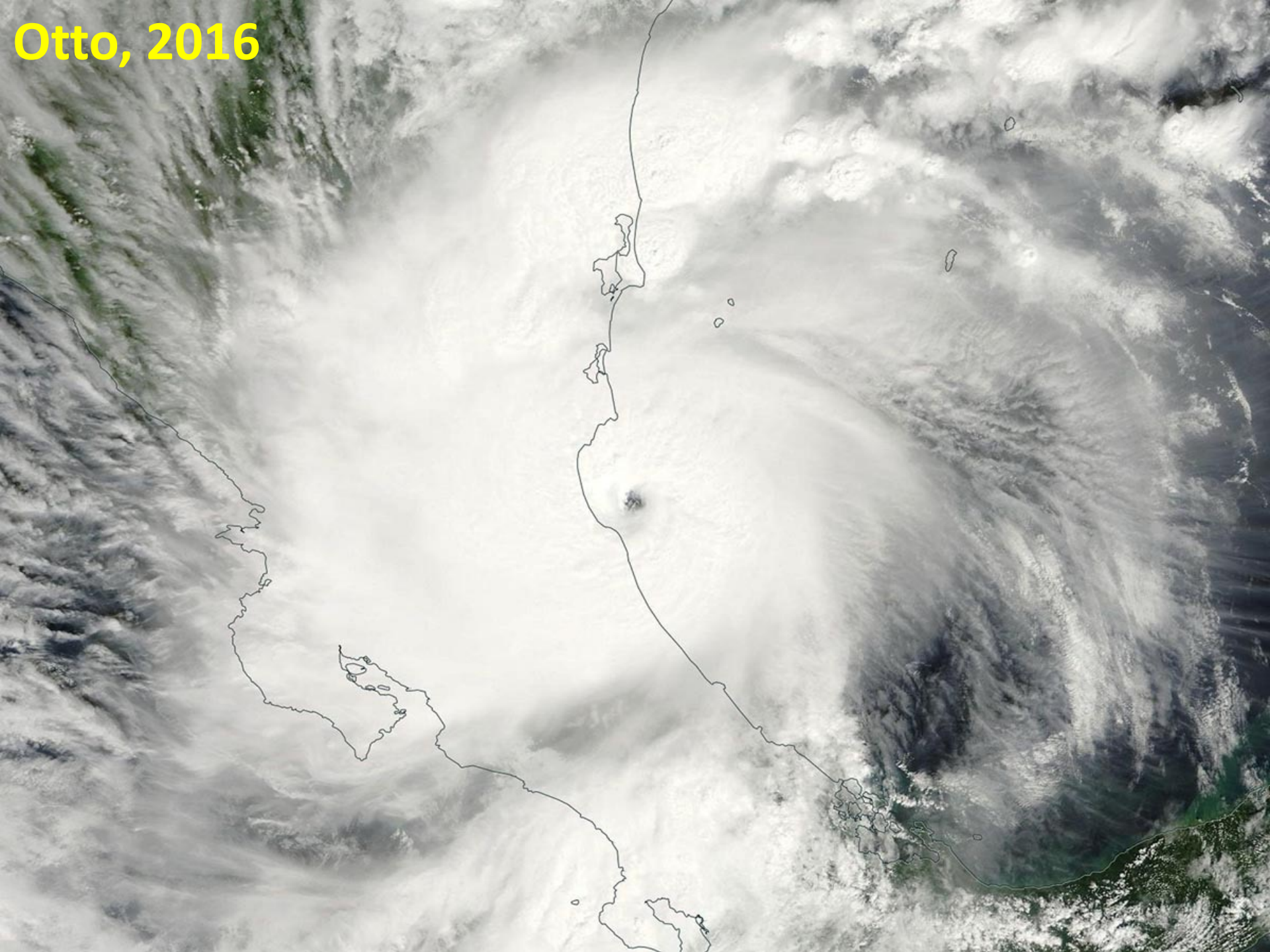
Tropical Storm Alma (2008)

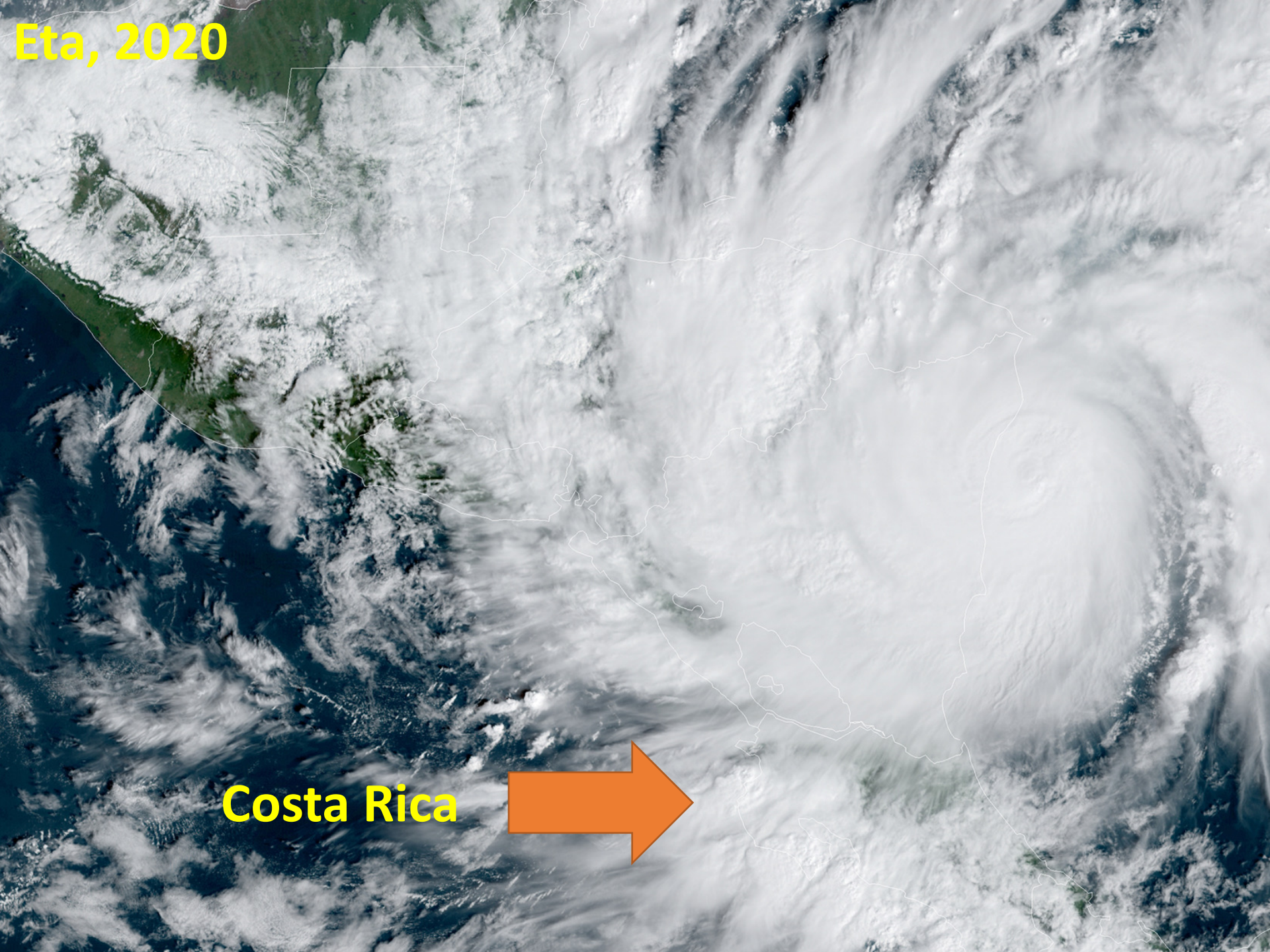
Hurricane César (1996)

Hurricane Thomas (2010)

Hurricane Otto (2016)

Tropical Storm Nate (2017)


Otto, 2016


Eta, 2020
Costa Rica

Year	Cyclone	Health	Infrastructure	Education	Sewerage	Agricultural	Rivers	Road Infrastructure	Housing	Total	Percentage
1988	Joan	54,77	0,00	0,67	0,00	6,50	0,00	26,53	11,53	141 363 620,99	6,82
1993	Gert	2,67	0,00	0,00	0,00	35,73	0,00	55,09	6,51	8 496 892,29	0,41
1996	Cesar	11,64	0,31	5,08	1,44	5,63	9,54	60,25	6,11	186 260 243,38	8,99
1998	Mitch	12,21	0,00	0,72	1,90	38,81	1,63	36,57	8,17	124 750 093,52	6,02
2001	Michelle	0,00	0,00	1,26	1,29	9,77	0,00	87,68	0,00	25 275 941,37	1,22
2002	Lili	0,00	0,00	0,00	2,38	0,00	3,53	78,99	15,09	19 224 321,76	0,93
2005	Rita	0,00	0,00	0,00	0,00	16,18	28,70	38,00	17,11	25 500 674,43	1,23
2008	Alma	0,00	5,38	0,12	0,40	1,98	16,01	76,08	0,03	29 632 904,91	1,43
2008	DT16	0,00	0,00	0,00	0,00	46,98	0,58	52,44	0,00	35 066 039,35	1,69
2008	Hannah	0,00	0,00	0,77	0,00	88,86	0,00	9,90	0,46	16 044 614,68	0,77
2010	Nicole	0,00	0,00	0,00	0,00	0,00	1,02	98,98	0,00	17 055 242,57	0,82
2010	Thomas	0,14	0,67	1,84	3,47	8,62	24,24	50,11	10,89	278 884 756,03	13,46
2011	DT12	0,00	0,00	0,00	11,60	0,45	4,53	73,46	9,96	9 641 562,64	0,47
2016	Otto	0,00	3,65	0,72	2,52	14,72	17,45	59,86	1,08	331 639 317,87	16,01
2017	Nate	0,29	0,14	1,29	3,11	6,25	12,10	71,88	4,94	606 526 953,18	29,27
2020	Eta	0,00	0,02	0,00	0,99	0,00	34,63	57,99	6,38	216 596 542,86	10,45
Percentage		5,63	0,82	1,31	2,22	10,61	14,83	58,56	6,01		

Economic losses in millions of US dollars per year/cyclone and economic sector

Percentages of losses by economic sector (lower sum) and cyclone (right sum)