# Temperature, rainfall, and extreme events

CLIMATE CHANGE COUNCIL
PUERTO RICO

**IX**

**REUNIÓN CUMBRE**

**DEL CCCPR**

USDA
CARIBBEAN CLIMATE HUB
for Tropical Forestry and Agriculture

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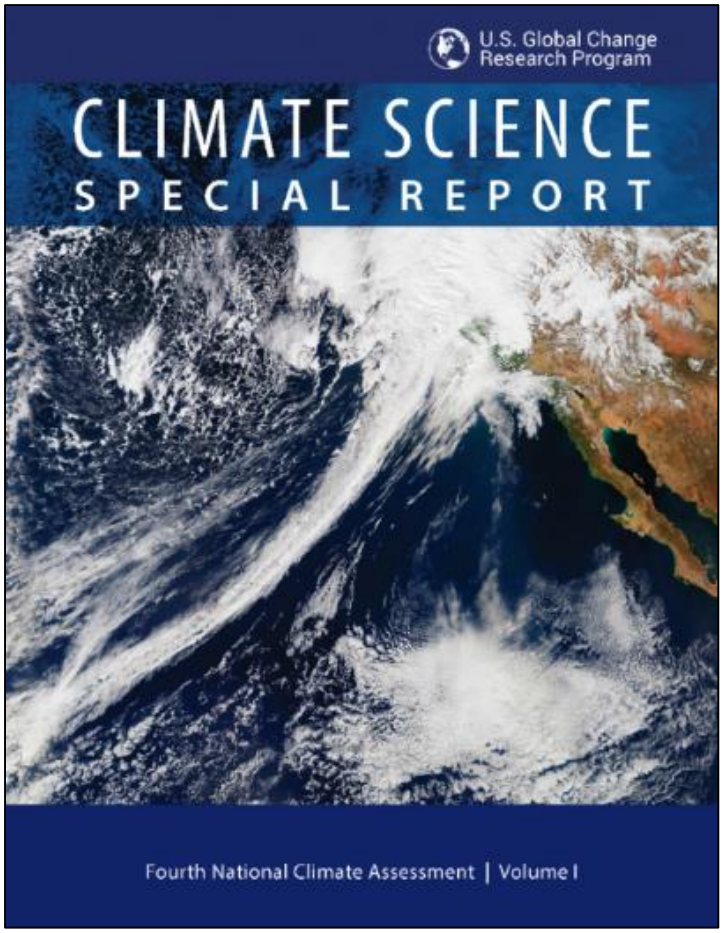
# NCA4 Vol. I: Climate Science Special Report

- NCA4 is being developed in two volumes
- NCA4 Vol. I was released Nov 3, 2017, after clearance through the same process being used for NCA4 Vol. II
- Key advances:
  - Detection and attribution
  - Extreme events (tropical cyclones, tornadoes, atmospheric rivers)
  - Downscaled information
  - Sea-level rise
  - Potential surprises
- Summarized in Our Changing Climate chapter of NCA4 Vol. II




Read and download the report at
**science2017.globalchange.gov**

# NCA4 Vol. II chapters

**I. Overview**

**II. Our Changing Climate**

**III. National Topics**

- Water
- Energy Supply, Delivery, and Demand
- Land Cover and Land Use Change
- Forests
- Ecosystems, Ecosystem Services, and Biodiversity
- Coastal Effects
- Oceans and Marine Resources
- Agriculture and Rural Communities
- Built Environment, Urban Systems, and Cities
- Transportation
- Air Quality
- Human Health
- Tribes and Indigenous Peoples
- Climate Effects on U.S. International Interests
- Sector Interactions, Multiple Stressors, and Complex Systems

**IV. Regional Chapters**

- Northeast
- Southeast
- U.S. Caribbean
- Midwest
- Northern Great Plains
- Southern Great Plains
- Northwest
- Southwest
- Alaska
- Hawai`i and U.S. Affiliated Pacific Islands

**V. Response**

- Near-term Adaptation Needs and Increased Resiliency
- Reducing Risks through Emissions Mitigation

**VI. Appendices**

- Process
- Information Quality Act
- Data Tools and Scenarios
- International
- Frequently Asked Questions

# Team effort



## 20. U.S. Caribbean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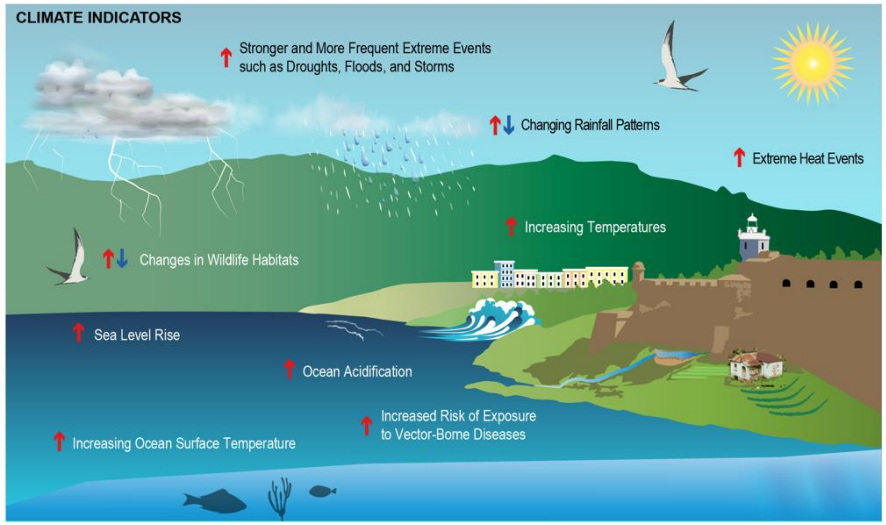
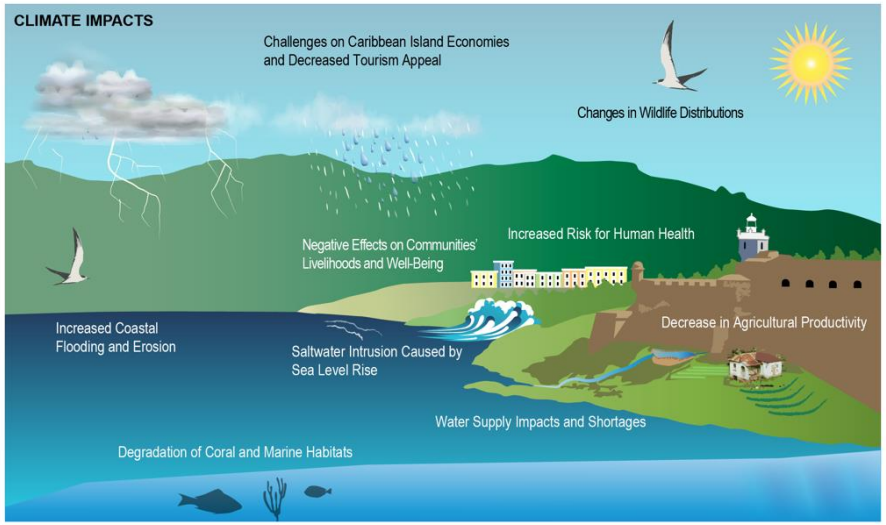
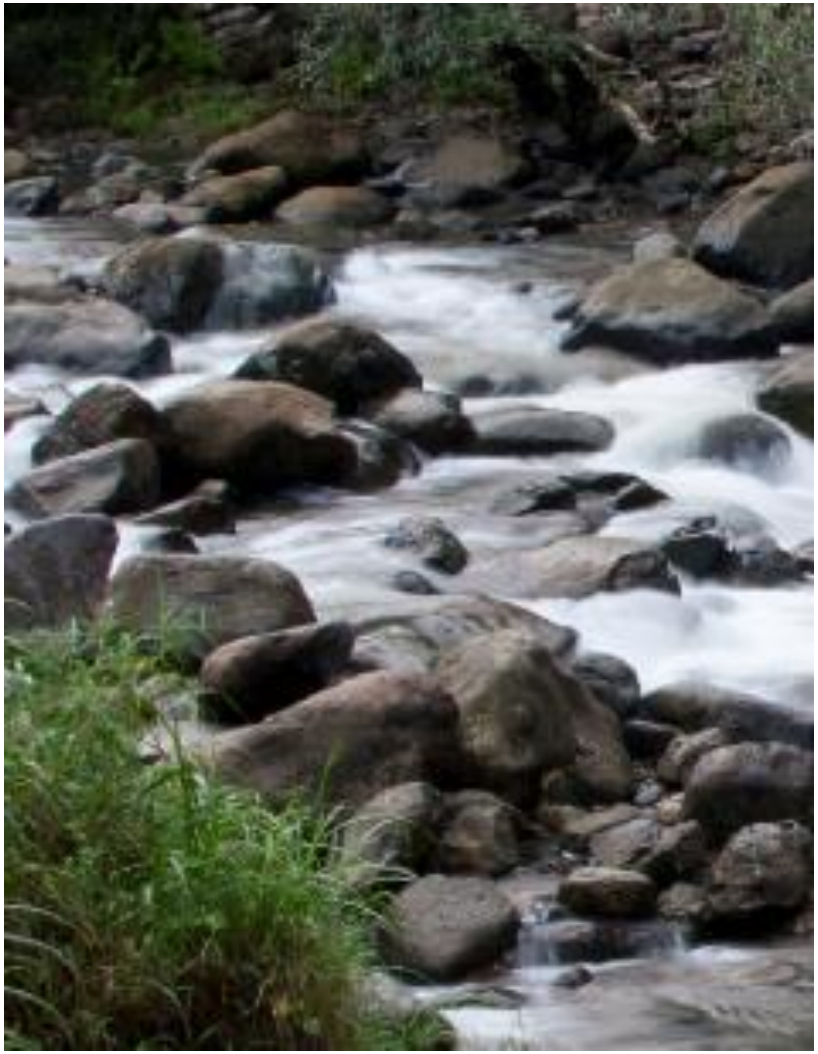


# Freshwater availability



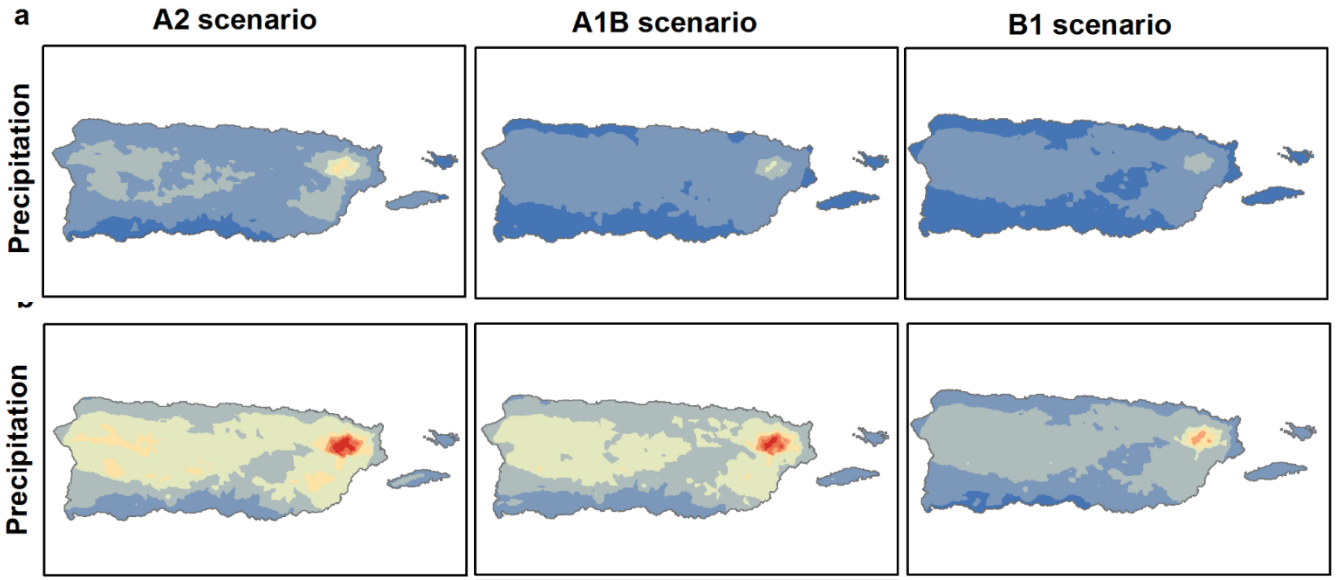
**Key Message 1:**

- *Critical to life.*
- *Projected reduction in average rainfall by the end of the century.*
- *Extreme rainfall events expected to increase in intensity.*
- *Saltwater intrusion associated with sea level rise will reduce the quantity and quality of freshwater in coastal aquifers.*
- *Increasing variability in rainfall events and increasing temperatures will likely alter the distribution of ecological life zones and exacerbate existing problems in water management, planning, and infrastructure capacity.*

# Freshwater availability

## Statistically downscaled projections

Regional climate models project between 18 to > 50% decline in mean annual precipitation through the end of the century, with increasing variability being marked by a general drying trend and more frequent and profound drought events (Hayhoe, 2013; Karmalkar et al. 2013; Khalyani et al., 2016).




Upper. All model Ensemble:
A2: 29.80
A1B: 20.69
B1: 18.24

Lower. Bimodal Ensemble:
A2: 53.81
A1B: 49.49
B1: 36.39

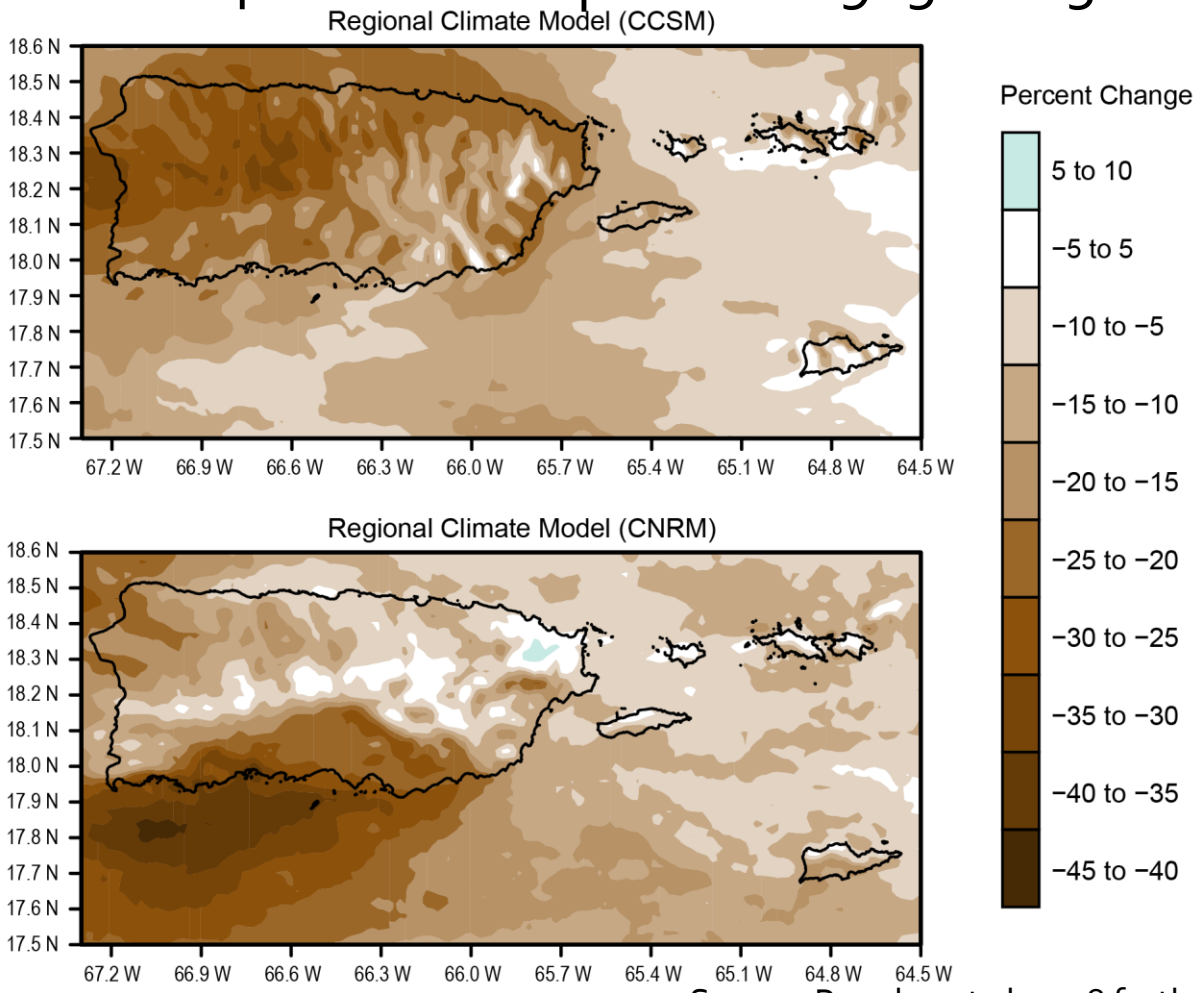
# Freshwater availability

## Projected percent change in annual precipitation over the U.S. Caribbean for the period 2040–2060 compared to 1985–2005

Based on the results of two regional climate model simulations (Wootten et al 2016; Bowden et al. 2018 forthcoming).

Simulations downscale two global models for the higher scenario, RCP8.5 (USGCRP 2017)

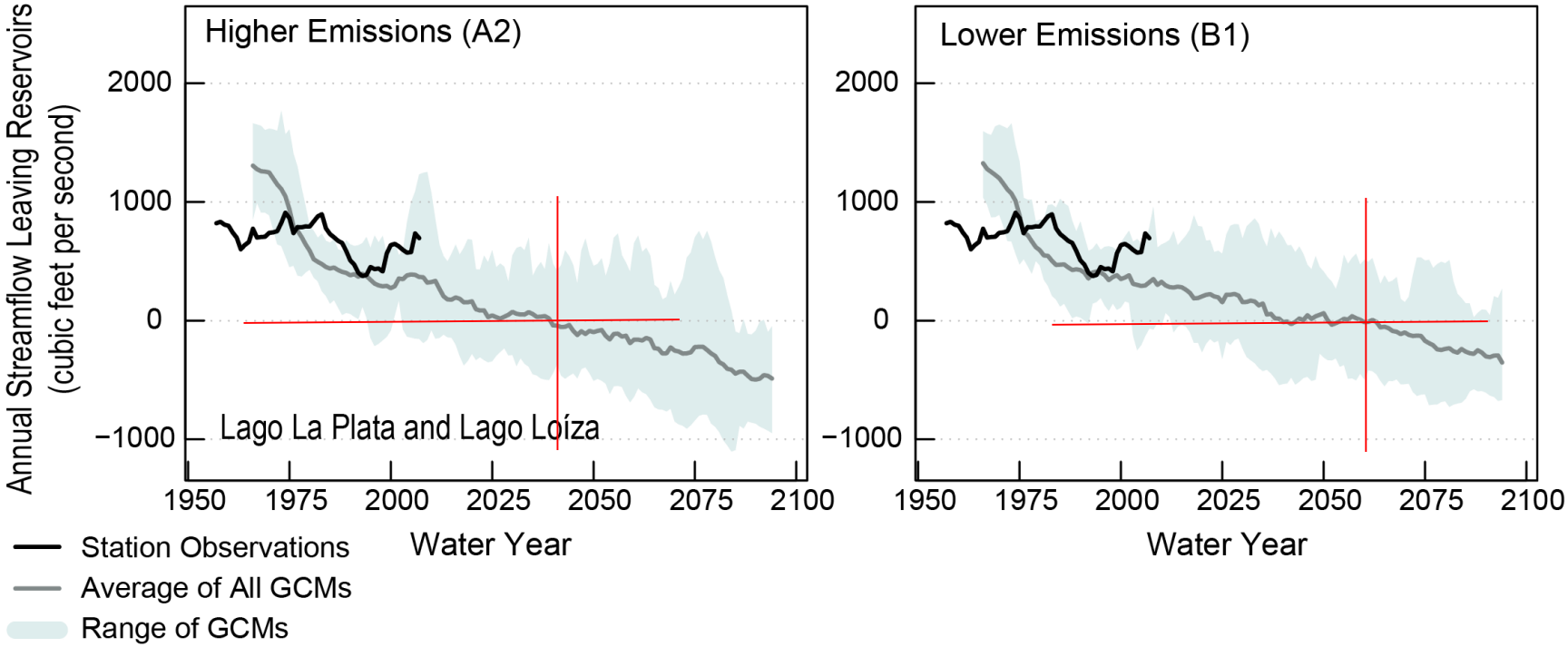
Within-island changes are projected to exceed a 10% reduction in annual rainfall. Uncertainty remains as to the location of the largest reductions within the islands.




Source: Bowden et al. 2018 forthcoming

# Freshwater availability

## Projected changes in annual streamflow




Ten year moving averages of annual streamflow leaving Lago La Plata and Lago Loiza. Projections were developed using an estimation of water supply entering the reservoir and an estimation of withdrawals (Van Beusekpm 2016).

# Freshwater availability

## At Risk - Tropical montane cloud forests in the Luquillo Mountains of Puerto Rico

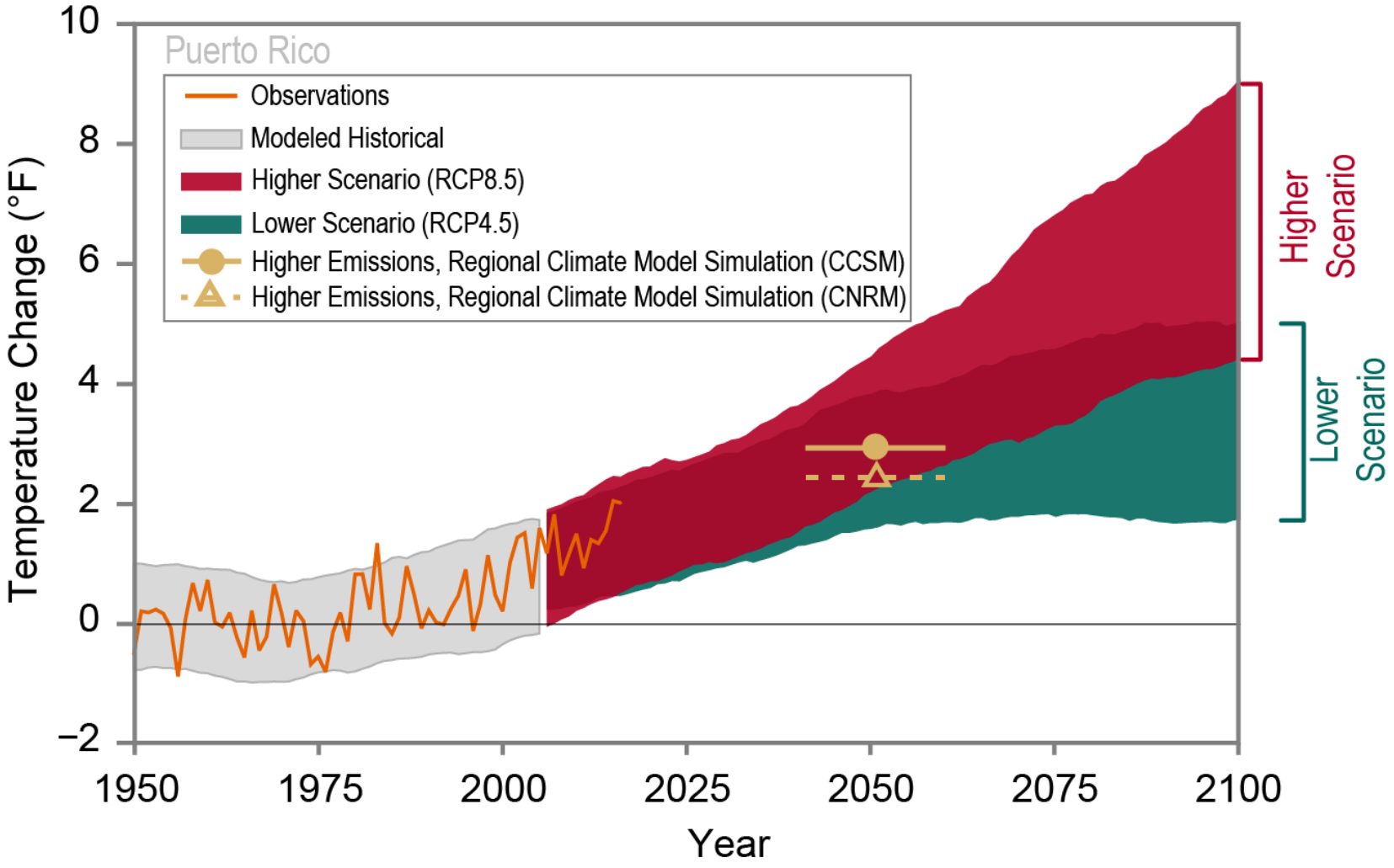
Characterized by frequent clouds, reduced tree height, a high number of endemic and endangered species, and high water content of the soil due reduced solar radiation.

Cloud forests around the world are vulnerable to warming and drying conditions expected with climate change.

Cloud forests on low mountains are especially vulnerable.

Drying and warming conditions can increase the elevation at which clouds form, thereby reducing or possibly eliminating the cloud cover shrouding the mountain peaks.

# Rising temperatures

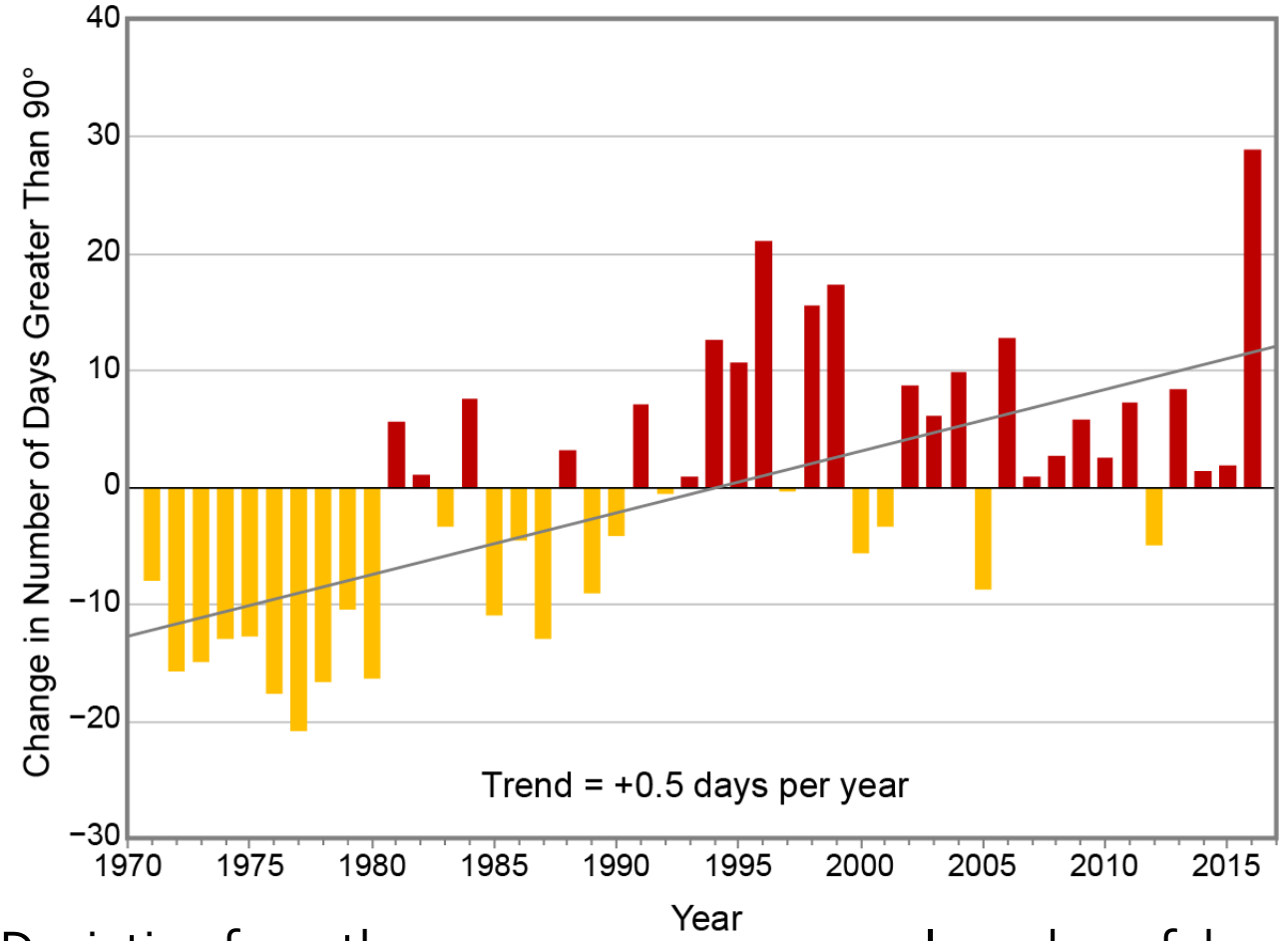


# Rising temperatures

Changes to average and extreme temperatures have direct and indirect effects on organisms and strong interactions with hydrological cycles, resulting in a variety of impacts.

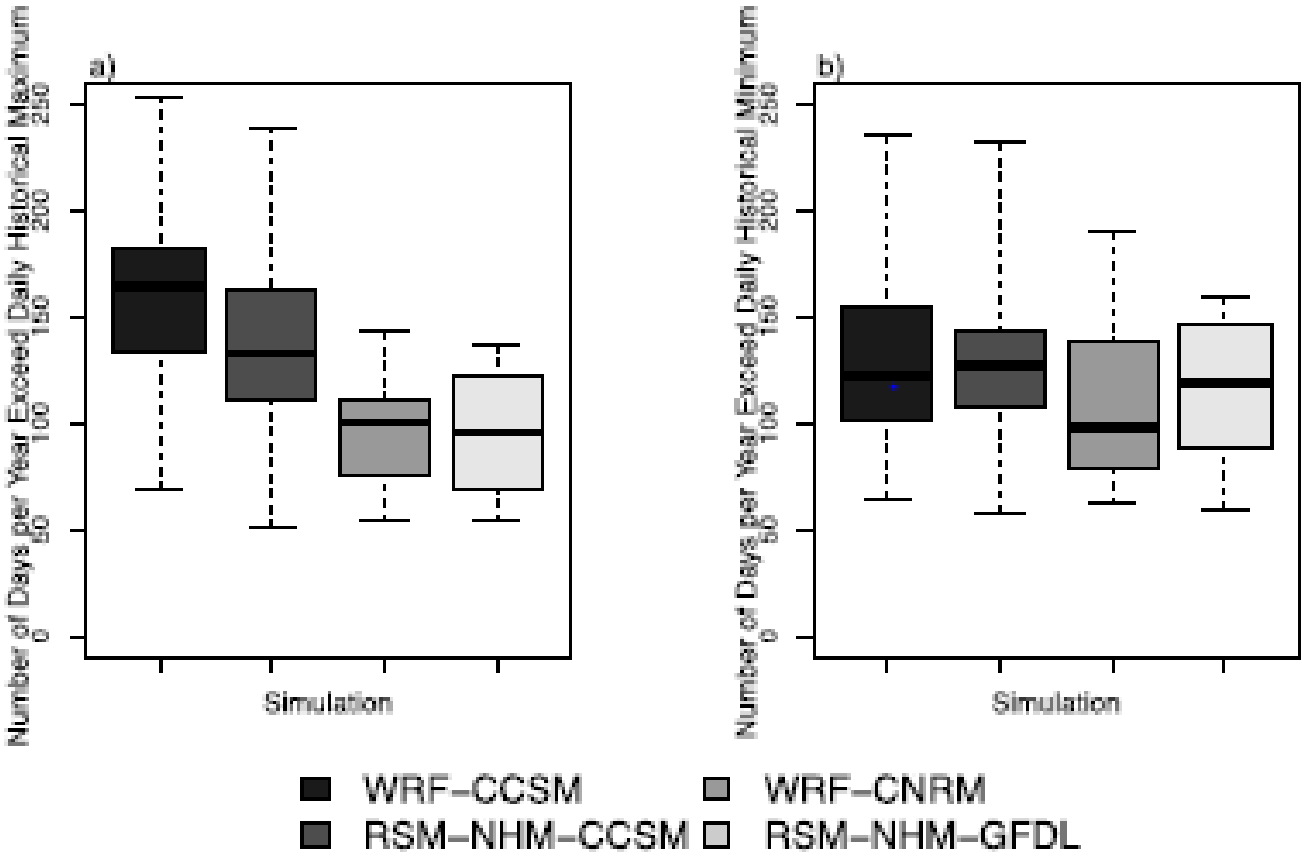
Increases in average temperatures will likely lead to decreases in agricultural productivity, changes in habitats and wildlife distributions, and risks to human health, especially in vulnerable populations.

As maximum and minimum temperatures increase, there are likely to be fewer cool nights and more frequent hot days, which will affect the quality of life in the U.S. Caribbean.




Deviation from the 45-year average annual number of days exceeding 90° F, based on data from 10 climate stations in Puerto Rico.

# Rising temperatures




Minimum of 1 day a week with record breaking heat compared to historical climate. Some years could experience high frequency (~4 days per week).

Source: Bowden et al. 2018 forthcoming

# Disaster risk response to extreme events

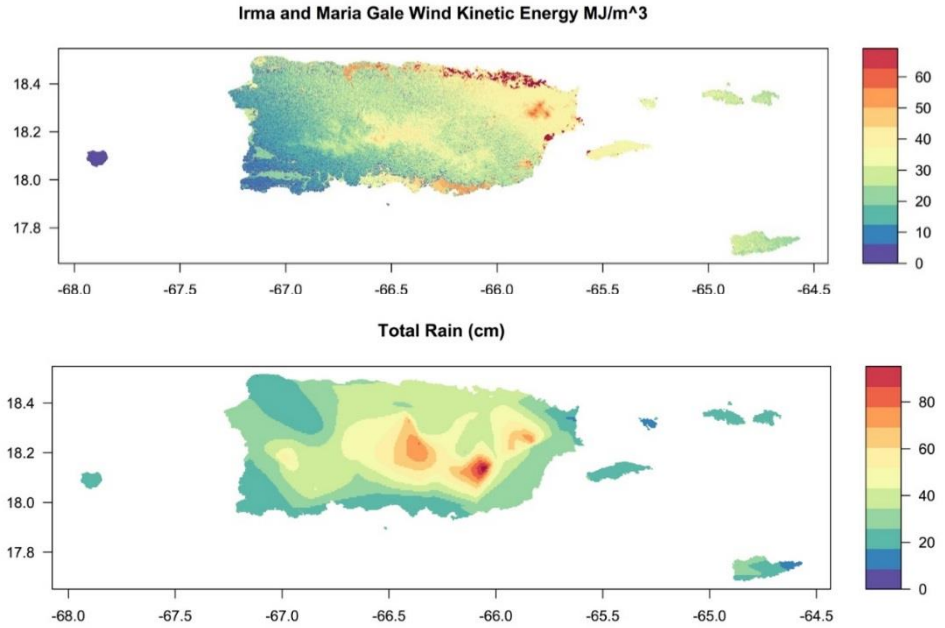
*Increasing frequency or intensity of extreme events threatens life, property, and economy in the Caribbean.*

*Extreme events such as flooding and droughts are projected to increase in frequency and intensity.*

*Increasing hurricane intensity and rainfall rates will affect human health and well-being, economic development, conservation, and agricultural productivity.*

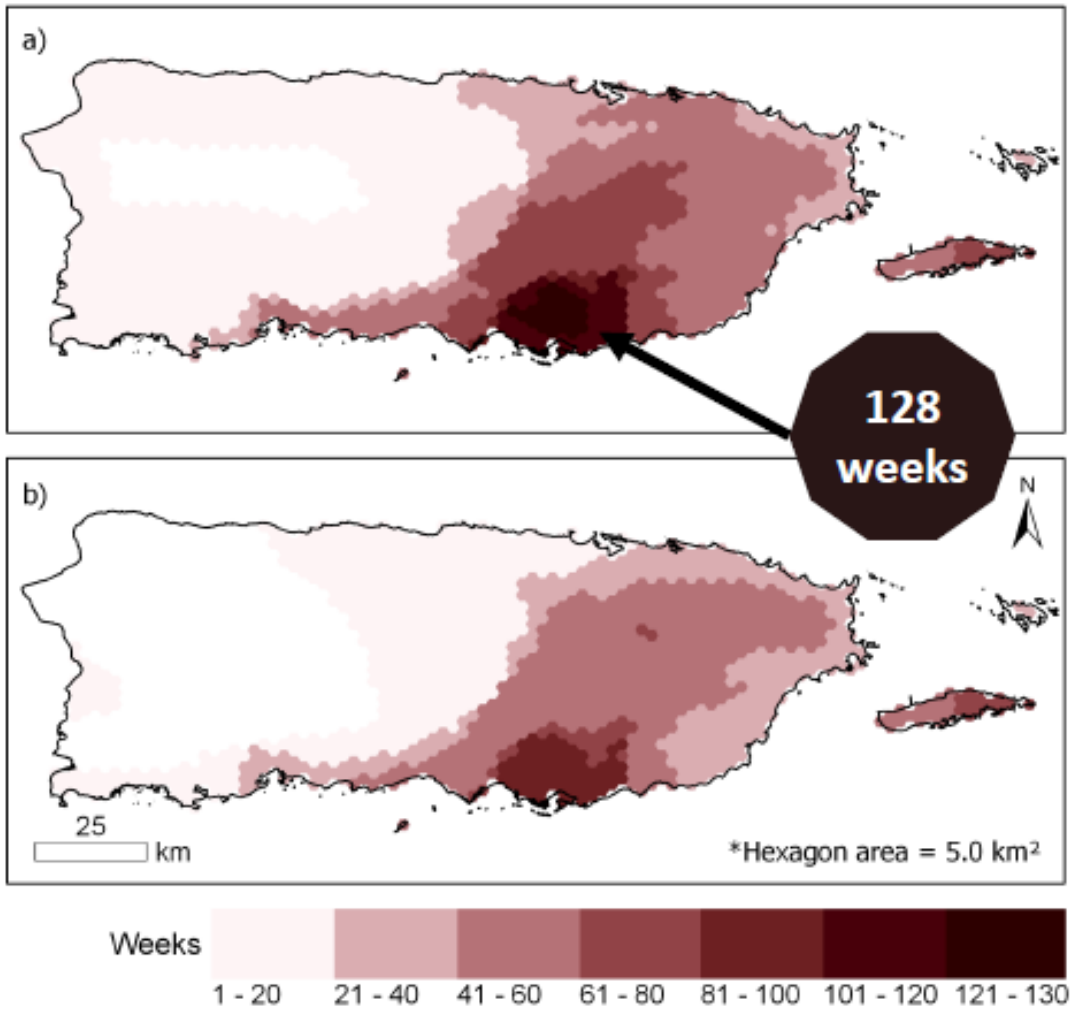
*Increased resilience will depend on collaboration and integrated planning, preparation, and responses across the region.*

## Irma and Maria combined Calculated Wind and Rain




Van Beusekom et al. in preparation

# Disaster risk response to extreme events




**2000-2016**

- 92.01% of Puerto Rico experienced periods of drought conditions.
- eastern Puerto Rico experienced more than 41 weeks of non-consecutive droughts
- the southeastern region: 128 non-consecutive weeks

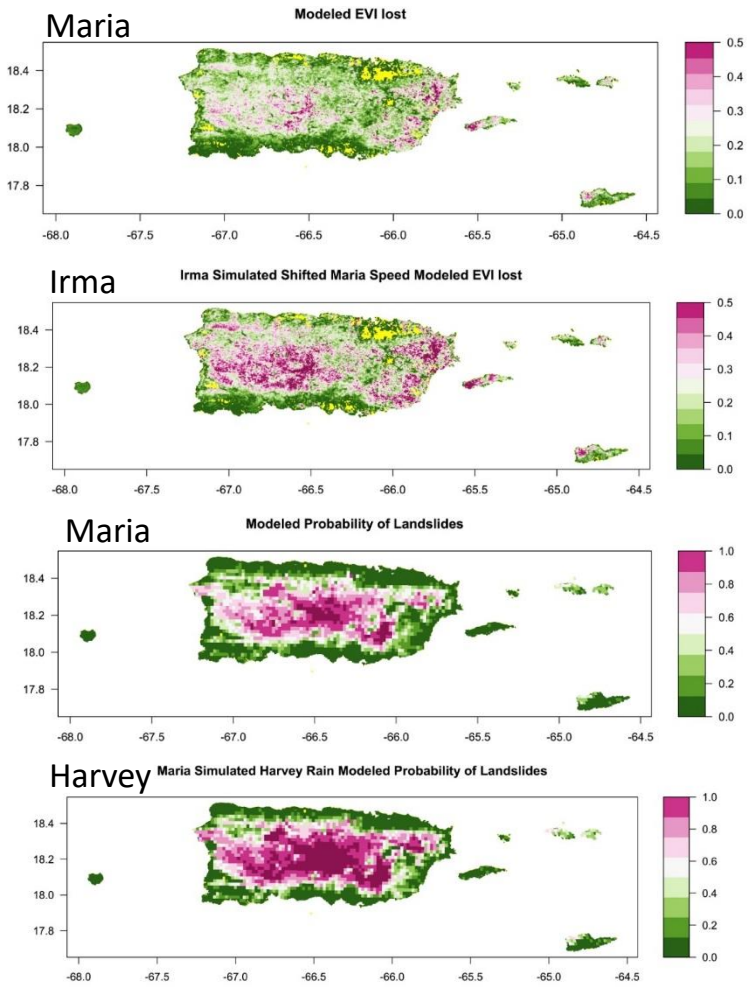
**2014-2016**

- 80 consecutive weeks of moderate drought, 48 of severe drought and 33 of extreme drought conditions in different regions of Puerto Rico
- severe drought in the southeast (42 weeks of Salinas and Vieques 40). extreme drought conditions within the southeast region, with 31 weeks of consecutive drought.

# Disaster risk response to extreme events

## Changing the scenario

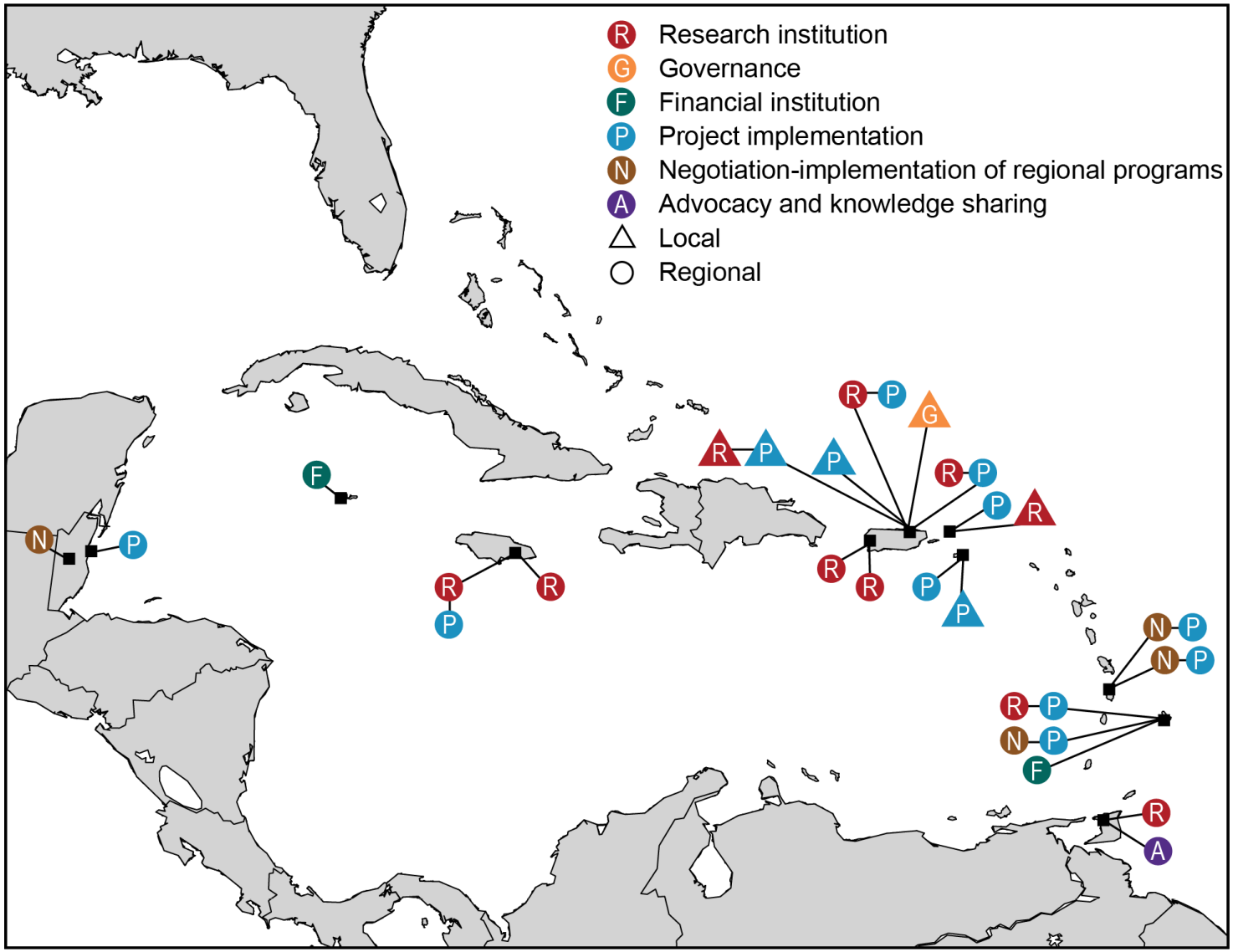
| | |
|---|---|
| Bigger hurricane - Irma winds | • More EVI loss |
| Slower hurricane – Mitch speed | • More EVI loss<br>• More loss of vegetation area |
| More rain – Harvey rains | • 9% more probability of landslides |
| Increase forest fragment ation | • More EVI loss<br>• More loss of vegetation area<br>• 3% more probability of landslides |




- Hurricane Maria (and Irma) caused 31% of the vegetation to be lost and Maria caused 34% of the area to have a landslide density of at least one in 1 km2.
- A storm with slower that average forward speed or more precipitation would have caused significantly more damage.
- The largest factor in the amount of damage was the the initial EVI for vegetation damage and slope for landslide damage.
- The second largest factor was the amount of energy doing the damage.
- This study does find evidence that increased fragmentation will increase damage.

Van Beusekom et al. in preparation

# Regional collaboration increases adaptive capacity



# Communicating best adaptive practices

## OUTREACH

ADAPTA
agricultura y cambio climático

**YouTube Channel 100**
subscribers
8,600 views

**FB Page**
730 followers
1 video = 4,000 views

**WEBSITE**

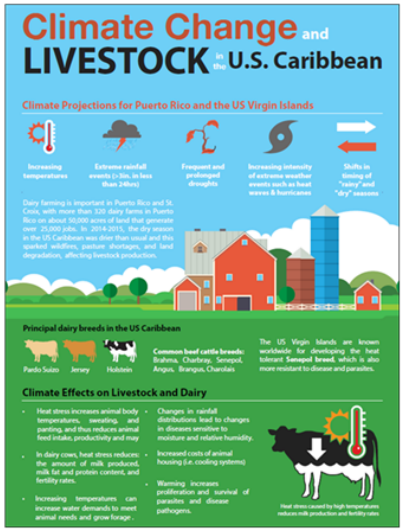
VIDEOS + FACTSHEETS + TRAININGS

Response to our stakeholder's requests and needs

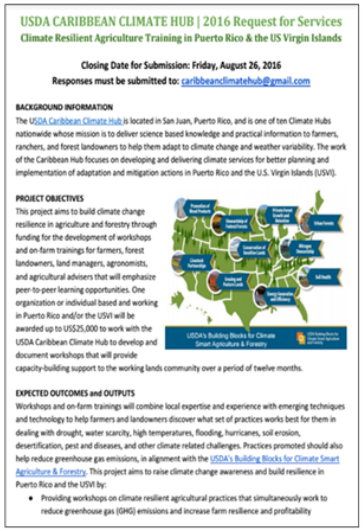
Series of four educational videos that highlight best adaptive practices

1. Cattle & Dairy Farming
2. Plantains & Vegetables
3. Permaculture, water & soil conservation
4. Coffee & forestry


2-page summary of climate change effects & adaptive practices per sector




Climate Resilient Trainings: Workshops & Webinars (2017)



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# ¡MUCHAS GRACIAS!

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