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# Climate Change Vulnerability in Dominican Republic

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## Abstract

Climate change is an issue that affects us on a global scale, but one of the most critical places to watch out for in terms of the consequences of climate change is the Latin American and Caribbean region, also known as the LAC [1]. The LAC is made up of several countries in South and Central America, and many have been classified as having "high" or "extreme" risks due to climate change-related events, particularly tropical storms. The Dominican Republic is located in the LAC, and has been subjected to several detrimental hurricanes throughout the course of history. The objective was to assess whether the vulnerability of the Dominican Republic to effects of climate change can be quantified by using the climate change vulnerability index (CCVI) formula. The index uses exposure, sensitivity and adaptive capacity of a country to predict how vulnerable it is to future natural disasters. For this analysis, the CCVI was determined for the eastern region of the Dominican Republic. Exposure and sensibility values were generated based on available data, however adaptive capacity had to be estimated. the
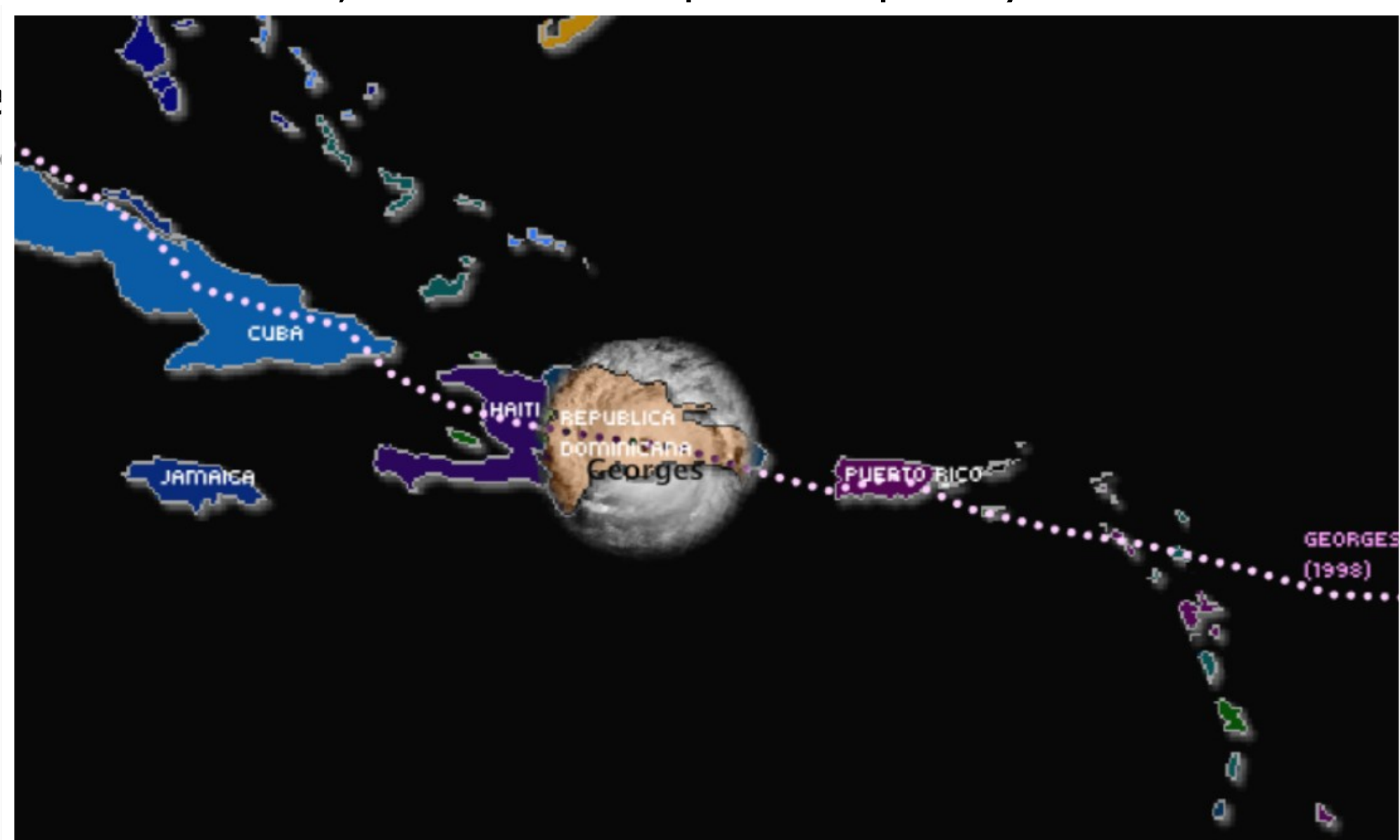effe
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Figure 1. A rough diagram of the path of Hurricane Georges, a Category 4 hurricane that caused extensive damage to several countries in the Caribbean, particularly the island of Hispaniola [2].
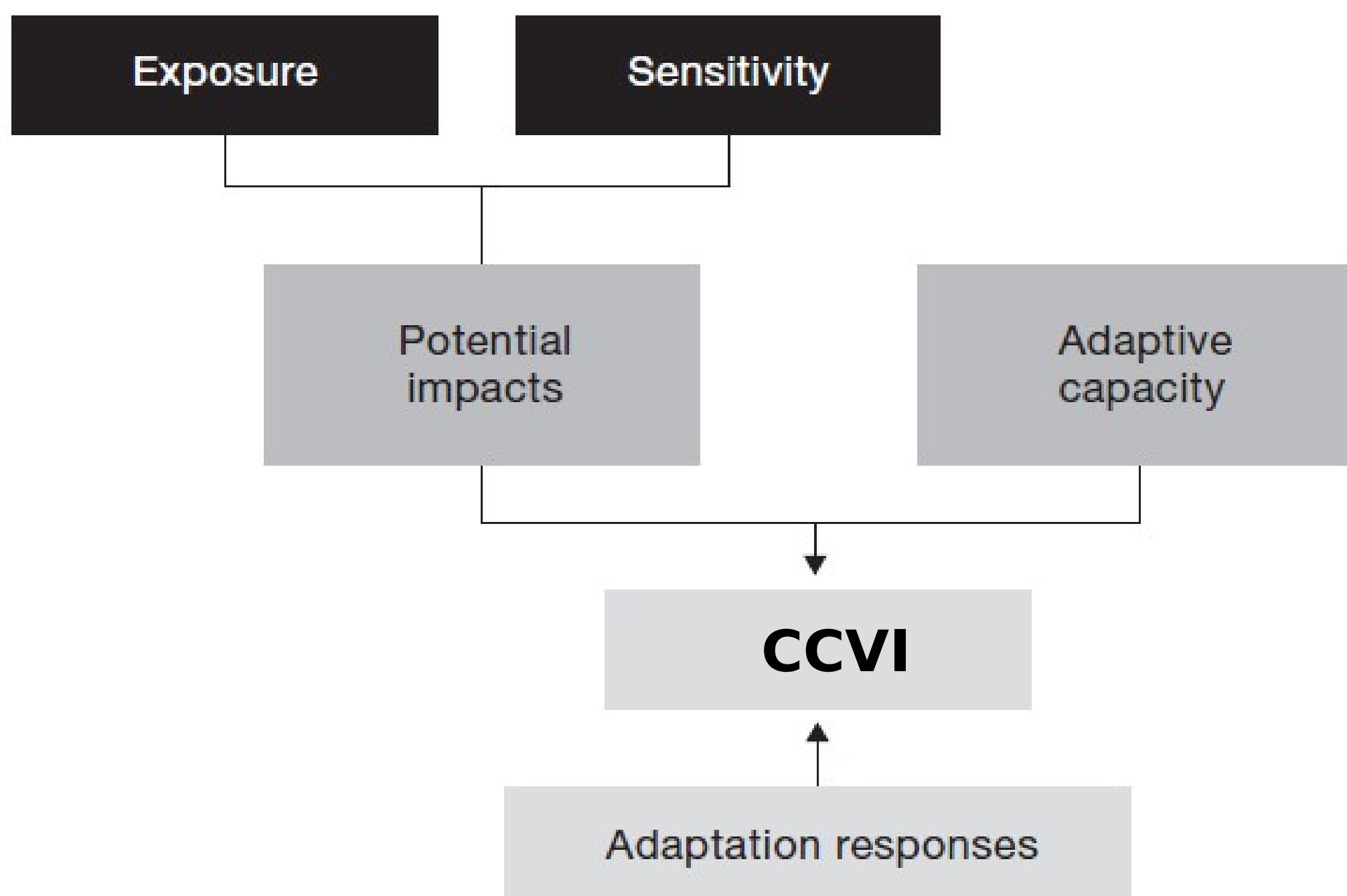
## Data Collection



Figure 2. A flow chart simplifying the main components of the CCVI [2].

## Methodology

The CCVI allowed us to quantify the vulnerability of the eastern region of the Dominican Republic by calculating the three risk factors – exposure, sensitivity and adaptive capacity.

$$CCVI = 0.5*E + 0.25*S - 0.25*AC$$

| Range | Vulnerability index CCVI |
|---|---|
| | Low |
| 1 - 1.5 | High |
| 1.5 - 2 | Extreme |

Figure 3. The CCVI equation, along with a table for interpreting CCVI values into risk statements.

**Exposure(E)**: The nature and degree to which a system is exposed to significant climatic variations. This variable was measured by taking the number of hurricanes in the eastern region of the Dominican Republic as a percent of all the Hurricanes to hit the island in the past century.

**Sensitivity(S)**: The degree to which a system is affected, either adversely or beneficially, by climate-related stimuli. This variable was measured by finding the percent of eastern homes that were damaged by Hurricane Georges.

**Adaptive Capacity(AC)**: The ability of a system to adjust to climate change to moderate potential damages, to take advantage of opportunities, or to cope with the consequences. Adaptive capacity would be measured by figuring out what

These variables were then plugged into the CCVI equation, shown below.

## Challenges

Data collection was a challenge on a local scale. Originally, we planned on finding the CCVI of only the province of San Pedro de Macoris, which proved to be difficult due to the lack of small-scale hurricane statistics. This is the reason why we decided to focus on the entire eastern region of the Dominican Republic. The main challenges using this methodology include finding:

- Satellite images and land class/land use data at high resolutions.
- Geospatial images suitable for quantifying sensitivity of the region.
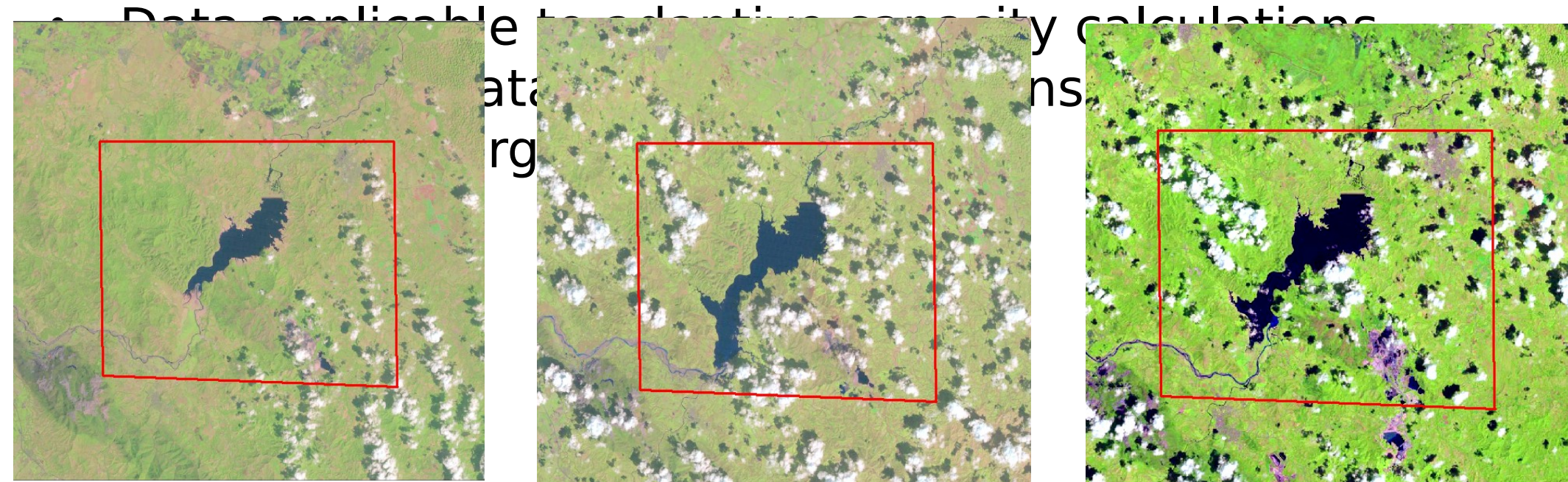- Data applicable to adaptive capacity calculations.



Figure 4. GIS images showing a body of water in the eastern Dominican Republic before and after Hurricane Georges, as well as how it is today [4].

The Landsat images (above) highlight a change in a water body in the Dominican Republic before, a month after and 17 years after Hurricane Georges. At this 30m resolution, only large features could be observed. Other changes were noticed, such as a decrease in vegetation in some areas but many images were either cloudy or unavailable for years of interest and the changes could not consistently be observed

## Results

| Range | Exposure Degree | Score |
|---|---|---|
| 0 - 25 % | Low risk | 1 |
| 25 - 50 % | Medium risk | 2 |
| 50 - 75 % | High risk | 3 |
| 75 - 100 % | Extreme risk | 4 |

| Range | Sensitivity Degree | Score |
|---|---|---|
| 0 - 10 % | Very Low | 1 |
| 10 - 30 % | Low | 2 |
| 30 - 75 % | High | 3 |
| 75 - 100 % | Extreme | 4 |

| Range | Adaptive Degree | Score |
|---|---|---|
| 0 - 25 % | Very Low | 1 |
| 25 - 50 % | Low | 2 |
| 50 - 75 % | Adequate | 3 |
| 75 - 100 % | High | 4 |

Because data was unavailable to calculate adaptive capacity, a general range for the CCVI was determined to range from 0.25 to 1. In other words, **the eastern region of the Dominican Republic is at low risk for climate change [5].**

## Conclusions and Future

The main reason why the CCVI ended up having a low range was because of the exposure variable. Although the eastern region had been impacted by 7 out of 30 hurricanes in the last century, the exposure range qualifies as "low risk." This tended to skew results to a lower score.

Future work includes:
- Researching another way to determine exposure so it better reflects the magnitude and impact of natural hazards; perhaps similar to sensitivity
- Use other accessible satellite data products, such as sea level change, in combination with other variables to determine exposure and adaptive capacity

## Acknowledgments

## References

[1] Intergovernmental Panel on Climate Change (2012), Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation: A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change. http://ipcc-wg2.gov/SREX/report/full-report/.
[2] http://www.coast.noaa.gov/hurricanes/
[3] L. Bizikova, J. Bellali, Z. Habtezion, M. Diakhite and L. Pinter, Vulnerability and impact assessments for adaptation to climate change (VIA module), UNEP, 2009.
[4] http://earthexplorer.usgs.gov/
[5] http://reliefweb.int/report/antigua-and-barbuda/caribbean-dominican-republic-haiti-hurricane-georges-fact-sheet-6