

Coral Reefs of the Caribbean at Risk

Rising Temperatures and Coral Bleaching

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Abstract

In accordance with the Reefs at Risk survey that was conducted in the Caribbean during the past decade, I explored the threat levels that Caribbean reefs are currently under as well as yearly air and sea temperature trends and documented coral bleaching events. Though I focused on the reefs of the Caribbean, it is important to recognize that coral reefs are under large amounts of stress worldwide. Despite a majority of reefs being located in Marine Protected Areas, most are under at least some stress. In the graphs provided, data demonstrating reef risk level is displayed, as well as charts with results showing a significant temperature rise in sea temperatures over the past decade.

I. Introduction

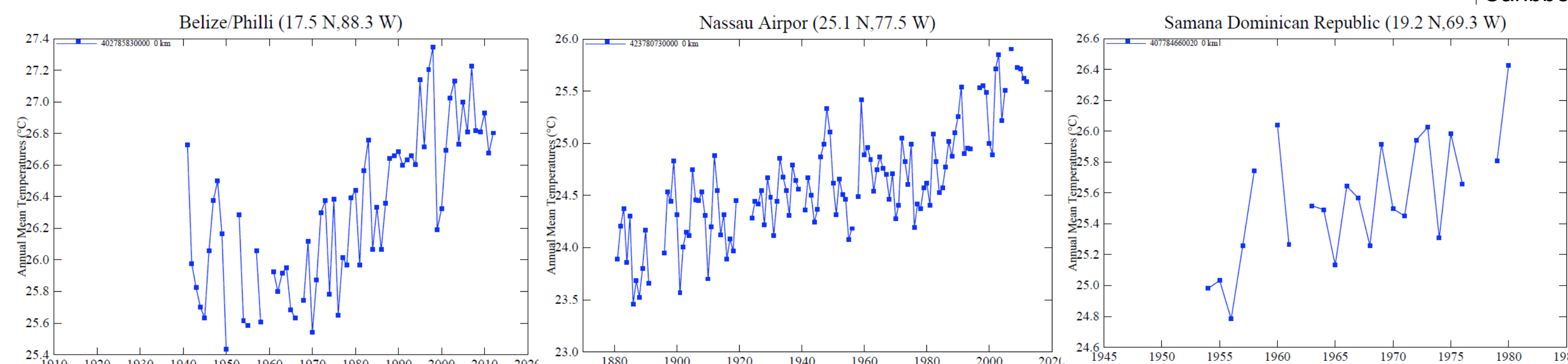
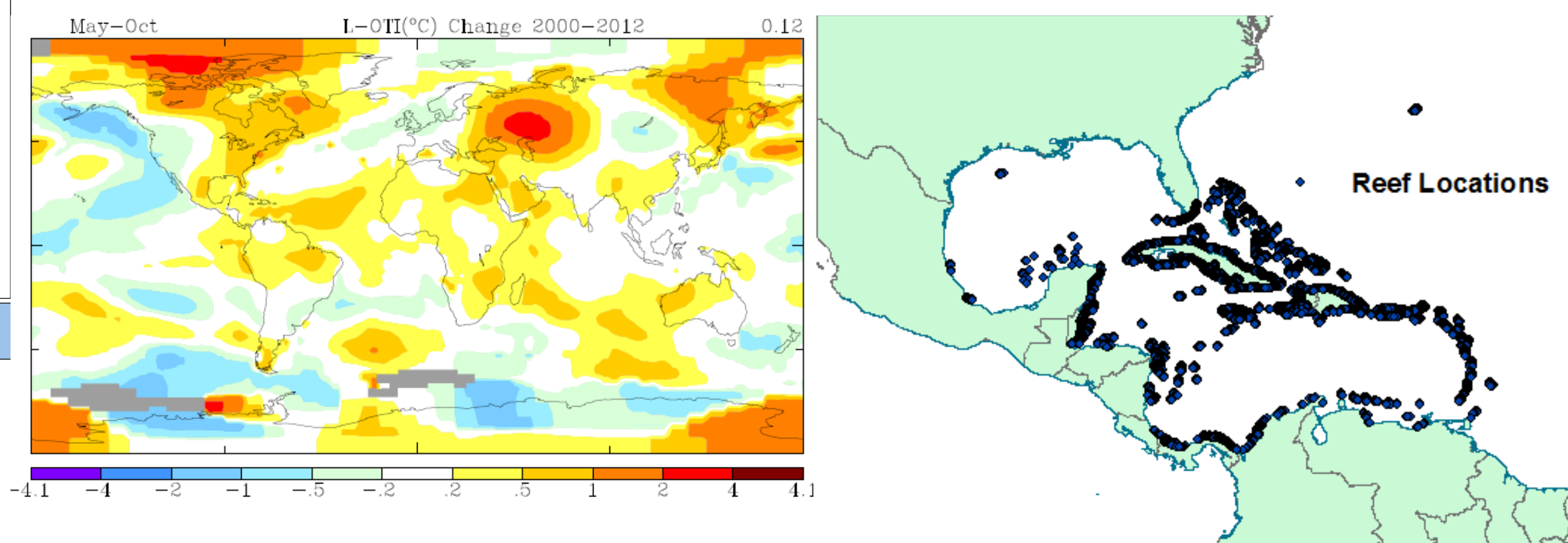
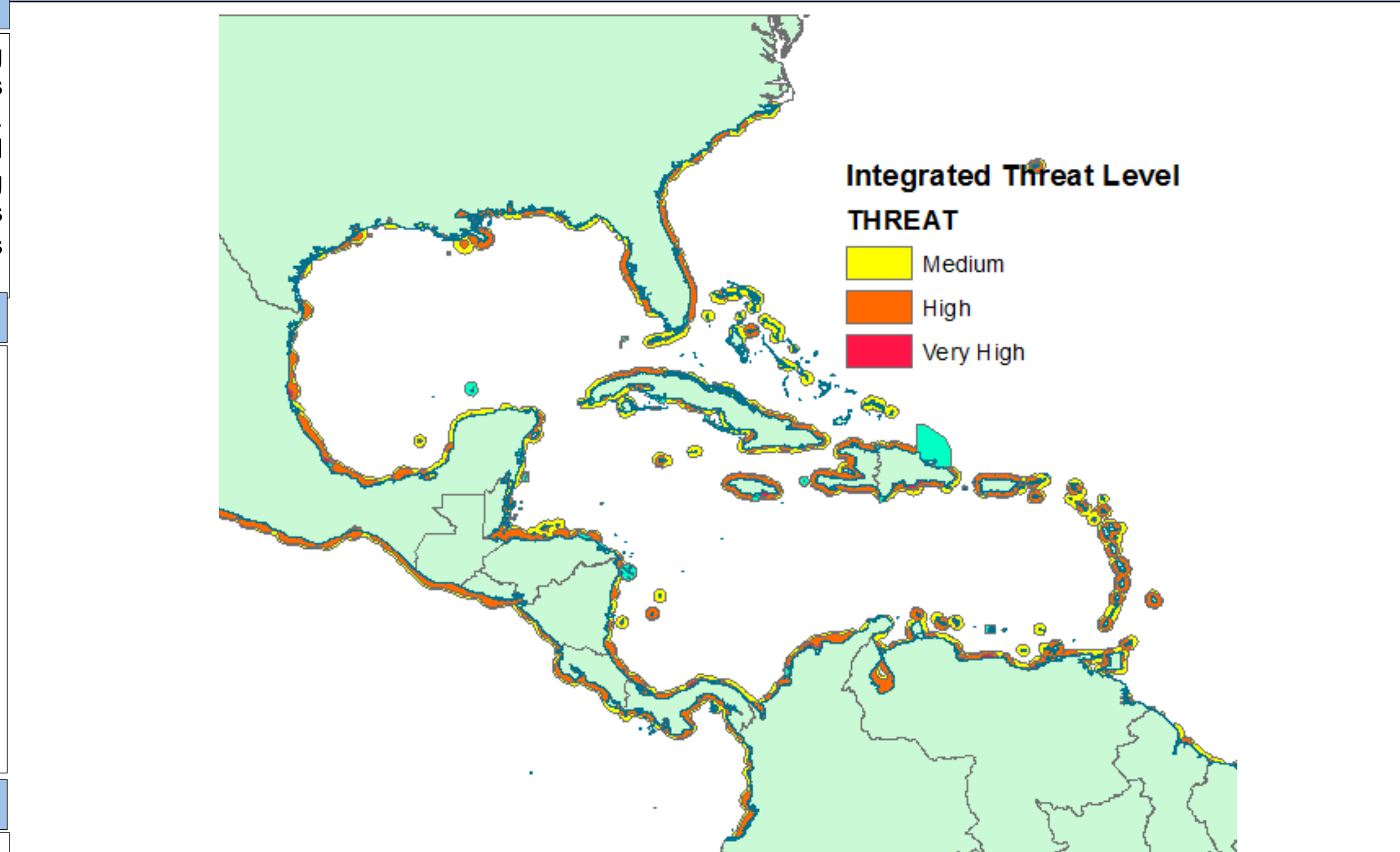
Over the past few decades, coral reefs have been placed under increasing amounts of stress, resulting in a rise in harm as well as large scale destruction of some of these ecosystems. Reefs are living systems, and in turn are very fragile. Though there are many factors that cause reefs to struggle to survive in high-stress environments, climate change has been a leading factor. Data that has been collected as early as 1900 demonstrates that sea temperatures have risen a considerable amount, and an average of .2-.5 degrees Celsius in the past decade alone. This is a problem because coral bleaching events will occur as a result of a number of different stresses, but most prominently will occur when temperatures rise (or fall) even 1 degree for a few days at a time. With the increased rise in temperature, there has been a rise in documented coral bleaching events. Though it is possible for coral to recover from a bleaching event, it is a very difficult process and makes it even more vulnerable, making it increasingly susceptible to future temperature changes.

II. Literature Review

The primary source for my research has been the Reefs at Risk project that was conducted by a number of universities, non-profit, and governmental organizations to categorize reefs in the Caribbean by threat levels, low to high. The survey took into account a number of different factors to compile an overall risk value to give each portion of reef. This included a number of human and environmental factors such as climate change, overfishing, coastal development, sedimentation, and disease. All of these are combined to generate an "integrated threat level". I was able to use the integrated threat level in conjunction with climate and oceanic data obtained from the NOAA and NASA sources to analyze the full extent of these threats and what major causes may be.

III. Methodology

The Reefs at Risk project compiled GIS data to display all the different facets of risk factors for the reefs. I was able to pull them apart and use just the data that I needed for my project, in this case, the reef risk levels data, reef locations, as well as marine protected areas. The Reefs at Risk project compiled the human and environmental risk factors listed above, each with different threat levels, and used this data to get the end result of the Integrated Threat Level, which is displayed in the figure at the top of the poster. The Integrated Threat Level was determined by using only regional data in order to achieve maximum accuracy. The areas were monitored and the various threats were recorded. Then, the distance between each threat and the specific reef was calculated. The closer the reef to the threat site, the higher the threat level. If an area received at least 3 out of 4 "high" threat rankings, it was deemed "high". This data was very comprehensive and helpful because it came hand in hand with specific reef locations as well as each specific threat area and level. I was then able to retrieve data from NASA and NOAA databases that displayed change in sea temperatures as well as overall global temperatures, and this allowed me to take into account the effect that climate change is currently having on Caribbean reefs. In addition, I was able to get access to data from a large number of different sites regarding temperature change over the past century. I chose three locations throughout the Caribbean to demonstrate that there has been a steady rise in sea temperature.



IV. Results and Discussion

The results of the data that I have collected demonstrate that the reefs in the Caribbean are almost entirely under at least a medium threat level. That being said, the steady rise in sea temperatures over the past century have certainly played a role in this, and will continue to negatively effect the reefs as the combination of human and environmental threats with temperature change make the already-fragile coral increasingly susceptible to disease and eventually could lead to their decline. As previously stated, even a slight rise in temperature for an extended period of time will lead to coral bleaching events. If these events continue, the reefs will continue to decline at an increasing and potentially alarming rate. The Integrated Threat Level index that was calculated by the Reefs at Risk project demonstrates that even without temperature increase being taken into consideration, coral reefs are currently under a large amount of stress, and have been for decades now. The temperature change that we are able to see displayed in the data contained in the included graphs and temperature change map is an added component to the stress situation in the Caribbean. Because the reefs are already vulnerable due to a wide range of human and environmental factors, the reefs are even more likely to have negative and sometimes even devastating reactions to even a slight change in their environment. In the future, this will become increasingly likely and it will begin to take less and less of a temperature change to cause stress enough to trigger bleaching events that they may not be able to bounce back from. In addition to the threat of bleaching events, the sea temperature also has an effect on the amount of dissolved oxygen in the water. The warmer the water, the less the amount of dissolved oxygen that is present. Abundant dissolved oxygen is critical because this is what sustains large amounts of life in the oceans. If there is too little available, organisms will not be able to survive, essentially being suffocated. If water temperatures raise too much permanently, the less the amount of large organisms that will be able to survive in these habitats will be, thus diminishing the biodiversity of the coral reef ecosystems of the Caribbean. The NOAA and NASA currently have monitoring stations all over the Caribbean, and daily measurements are made available online in regards to sea temperature, sea levels, as well as other data. Monitoring the state of the Caribbean waters is extremely important in predicting perilous events for reefs, and raising awareness is key in attempting to conserve these areas better.

VI. Future Research

Further studies like the Reefs at Risk project are being carried out currently around Australia and Asia in the Pacific and Indian Oceans. They are focusing on similar threat analyses, and currently it appears at a glance that they are collecting data that suggests that these reefs are facing far more perilous situations than the reefs of the Caribbean. Studies are also being carried out in these areas as well as the Caribbean focusing on economic effects that reef destruction is having as well as how economies are negatively impacting the reefs, taking into account tourism, agriculture, and other human activities. It would be interesting to do a follow-up in a few years to see how the threat levels have changed in certain areas, and if this economic stance has any effect on it.

V. Conclusion

The results of the Reefs at Risk project in conjunction with the acquired climate data suggest that an overall rise in sea temperatures have had a negative, destructive effect on the coral reef systems of the Caribbean, and will continue to be a major cause of their demise.

VIII. Acknowledgements

The Reefs at Risk Project has supplied a vast amount of information and data, allowing for extensive analysis and research on the subject of coral reef conservation.

VII. References

- Figure 1 Data Source: GIS data supplied by <http://www.wri.org/publication/reefs-risk-caribbean#data>
- Figure 2: http://www.osdpd.noaa.gov/data/sst/fields/FS_km10000.gif
- Figure 3:GIS data supplied by <http://www.wri.org/publication/reefs-risk-caribbean#data>
- Figures 4-6: http://data.giss.nasa.gov/gistemp/station_data/