Using NASA Earth Observations to Monitor Land-use Change and Map At-risk Coastal Habitats in the US Virgin Islands

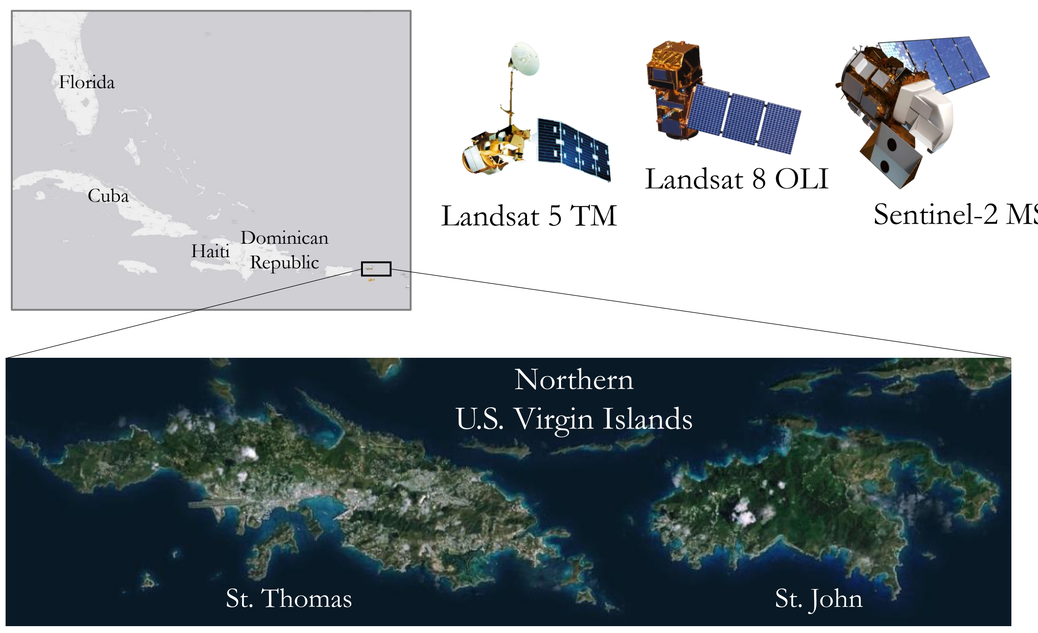
Abstract

The United States Virgin Islands (USVI) are home to an array of diverse and stunning habitats. The beauty of the islands has continued to attract visitors and residents, which over time has increased human development and impact. The resulting land-use change increases sediment loads and the flow of pollutants into surrounding nearshore environments such as coral reefs, mangroves, and seagrass beds. Coral reefs, the most diverse marine habitats on Earth, are particularly susceptible to these inputs. Compounded with regional climate-related processes such as rising ocean temperatures and acidification, future land-use change poses a formidable threat to the marine environment. Without a healthy environment, the USVI economy also becomes endangered because it is mainly supported by tourism and recreation. In order to assess land-use change in the USVI, we utilized Landsat 5 TM, Landsat 8 OLI and TIRS, and Sentinel-2 MSI data to map land-use and analyze land cover change dating back to 1985. We then extrapolated the models to the year 2025. Our work will provide the USVI Department of Planning and Natural Resources, Division of Coastal Zone Management (CZM) with a tool to better understand land-use trends, identify at-risk coastal habitats, and strengthen existing knowledge of the link between land use and coastal ecosystem health.

Objectives

- **Analyze** satellite imagery to fill gaps in current knowledge of historical land use and land cover
- **Compare** imagery to identify areas of land-use change over time and identify watersheds under stress
- **Predict** future land-use change trends using machine learning
- **Identify** coastal zone areas that are at risk due to land-use change

Study Area



Earth Observations

Landsat 5 TM

Landsat 8 OLI

Sentinel-2 MSI

Team Members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Acknowledgements

Dr. Juan Torres-Perez – Bay Area Environmental Research Institute
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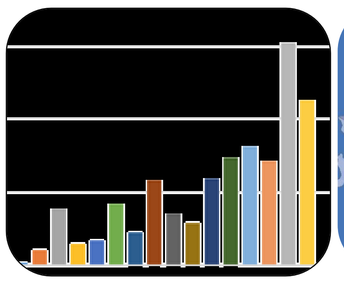
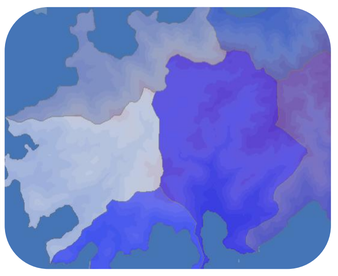
Leslie Henderson – Coral Reef Initiative Coordinator

Methodology





Created composite images on which to run supervised random forest classifications for each year

Analyzed trends over time using our classifications as well as existing land use maps

Analyzed trends by watershed boundaries to identify at-risk marine habitats

Project Partners

USVI Department of Planning and National Resources, Coastal Zone Management (CZM)

Results

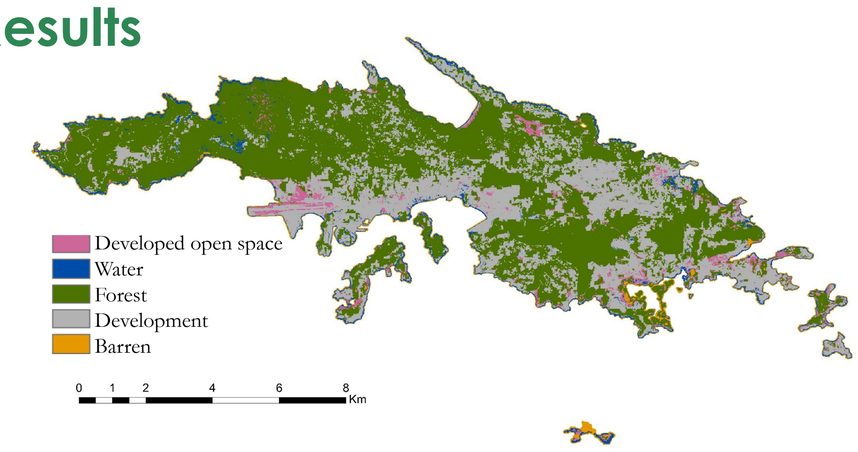


Figure 1. Land-use classification of St. Thomas using 2016 Sentinel-2 Imagery.

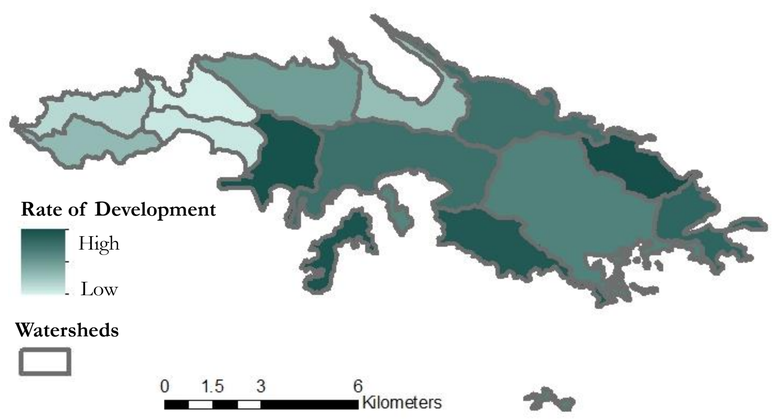


Figure 2. Intensity of development by watershed from 2013-2017 on St. Thomas. Analysis was completed using Landsat 8 imagery.

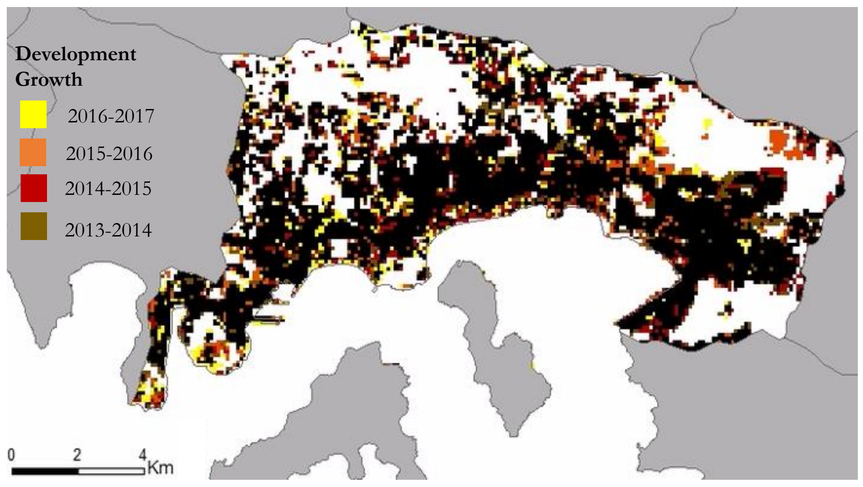


Figure 3. Development changes in the St. Thomas Bay watershed from 2013 to 2017. Analysis was completed using classified Landsat 8 imagery.

Conclusions

- Development intensity varies by watershed, which should be considered in the process of issuing permits for future development.
- Long-term data are are critical to seeing variation and intensity in development.
- Over time, development has increased and forest cover has decreased on St. Thomas.

US Virgin Islands Ecological Forecasting

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