



Department of Geography and the Environment Villanova University

Villanova University PA View Grant Project 2023 – Tracking sources and sinks of marine debris in southwest Puerto Rico before and after Hurricane Fiona

Faculty Member: Dr. Lisa Rodrigues

The Department of Geography & the Environment would like to use the 2022/2023 PA View grant funding to purchase satellite imagery for the following project of interest.

Abstract:

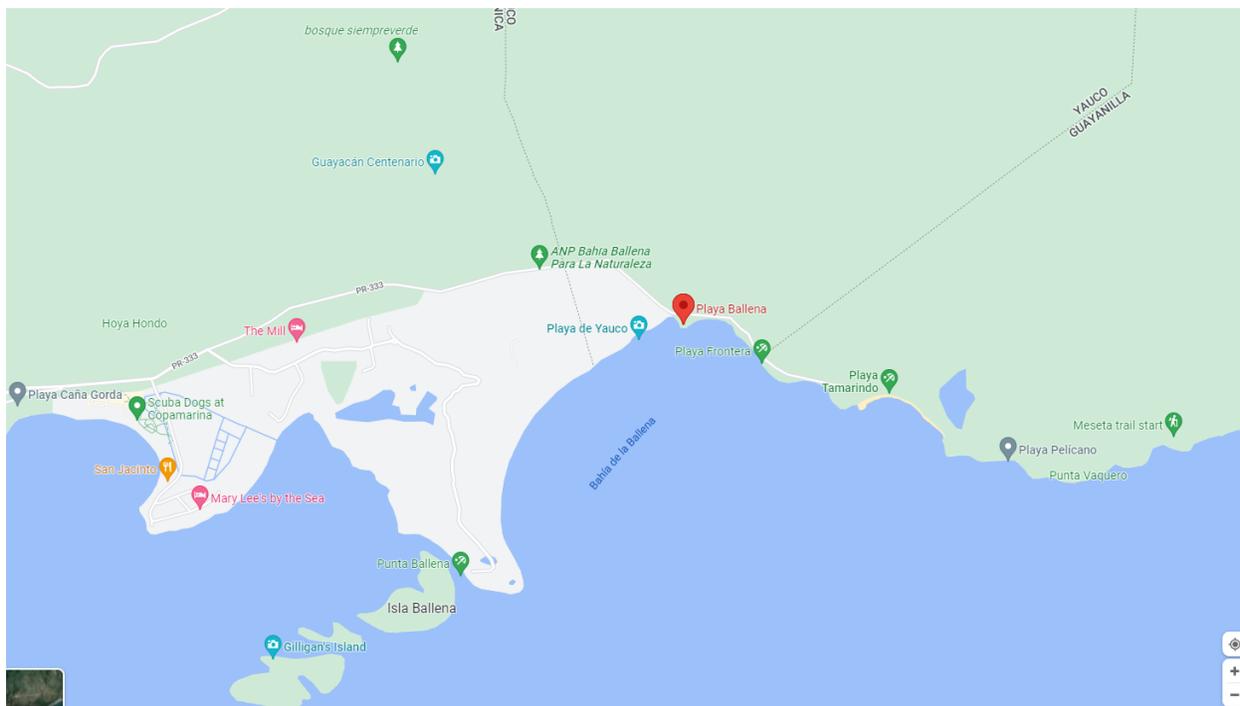
Project: Tracking sources and sinks of marine debris in southwest Puerto Rico before and after Hurricane Fiona

Marine debris (MD) is a major threat to ecosystems, biodiversity, and human health because it is prevalent in the environment, resistant to degradation, and easily transported for long distance dispersal. MD includes any human-made items that are intentionally or unintentionally discarded in the ocean, including plastics, metals, glass, fishing gear, lumber, etc. In the tropics, hurricanes and other tropical storms are anecdotally considered sources of MD, but their impact is difficult to assess. Combining remote sensing imagery before and after a hurricane with on-the-ground collections of marine debris in the impacted coastal area will greatly improve our understanding of tropical storms as accumulators and depositors of MD along the coast. On 18 September 2022 at 2:00 pm local time, Hurricane Fiona had reached a wind speed of 75 knots and was passing the coastal area of southwest Puerto Rico adjacent to Playa Ballena, a beach that accumulates large quantities of MD throughout the year. Hurricane Fiona made landfall just 26 km west of Playa Ballena at 3:20 pm the same day. We have been studying MD in this region and collected MD samples in a 500-m² transect at Playa Ballena before the hurricane season on 28 May 2022 and shortly after Hurricane Fiona passed the area on 8 October 2022. We will acquire satellite imagery for this area at the highest resolution possible, on or near to the dates the Hurricane was in the region and for the dates of our MD collection. Previous studies have noted that 3 m to 30 m resolution can identify the presence of MD in the coastal and marine environment. We will compare the imagery to our on-site collections of MD to more accurately assess the impact of tropical storms to MD accumulation and deposition along the coast. The results of this analyses and the images will be used to support graduate and undergraduate research projects and incorporated into relevant environmental science lectures at Villanova University.

Total Budget: \$950.

Summary of PA View Grant Imagery Use

Marine debris (MD) is a major threat to ecosystems, biodiversity, and human health because it is prevalent in the environment, resistant to degradation, and easily transported for long distance dispersal. MD includes any human-made items that are intentionally or unintentionally discarded in the ocean, including plastics, metals, glass, fishing gear, lumber, etc. In the tropics, hurricanes and other tropical storms are anecdotally considered sources of MD, but their impact is difficult to assess. We obtained satellite imagery for a beach in southwest Puerto Rico, called Playa Ballena that is located 26 km west of where Hurricane Fiona made landfall on 18 September 2022 at 2:00 pm local time. To assess the influence of Hurricane Fiona on MD accumulation at Playa Ballena, we compared imagery collected on 20 May 2022 (“before”) to imagery collected on 18 November 2022 (“after”). While the resolution was 50 cm before and 30 cm after, it was not possible to estimate the location or presence of MD in either image. We know from ground-truthing at the site that MD ranges from the microscale (< 5 cm) up to several meters in length, with the many MD pieces around 20 cm to 60 cm. Possibly any MD appearing on the imagery may be obscured by the location of seaweed on the beach, shrubs along the dune, and/or partially buried by sand. We observed some differently colored pixels in the imagery along the water line that may be large pieces of MD (e.g., tires, which are often found in the location); however, they may equally be exposed rocks that occur in similar places and have a different appearance depending on the tide cycle. Aside from differences in seaweed occurrence (substantially more seaweed present in the before than after image) there are no other differences between the two images. We have since incorporated drone flights over the beach location flying at multiple heights to assess the effectiveness of photographic images in capturing MD. We plan to compare the drone to satellite imagery to assess other potential differences before and after the hurricane. The images will also be used to support graduate and undergraduate research projects and incorporated into relevant GIS and environmental science lectures at Villanova University.



Map of Playa Ballena Study Area



Pleiades Imagery 50cm 2022-05-20



PNeo Imagery 30cm 2022-11-18

Grant Purchased Pleiades & PNeo Archive Satellite Imagery:

Pre-Hurricane Imagery

- Pleiades 50cm from 2022-05-20

Post-Hurricane Imagery

- PNeo 30cm from 2022-11-18

Submitted By:

Mr. John Kelley, Adjunct
Remote Sensing and the Environment
Department of Geography & the Environment
G-67 Mendel Science Center
800 Lancaster Avenue
Villanova, PA 19085
Phone: 610-226-5460
john.l.kelley@villanova.edu

