# Land Mass Mapping and Obstacle Avoidance

Annie Cardinal

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Background Information

- Wave Gliders lack autonomous ability to avoid land masses and other obstacles

- Wave Gliders require 20 m deep water for safe navigation

- Many different types of obstacles (MPAs, shorelines, rocks, kelp)

- Gliders need a reliable way to avoid obstacles without human planning to avoid oversight
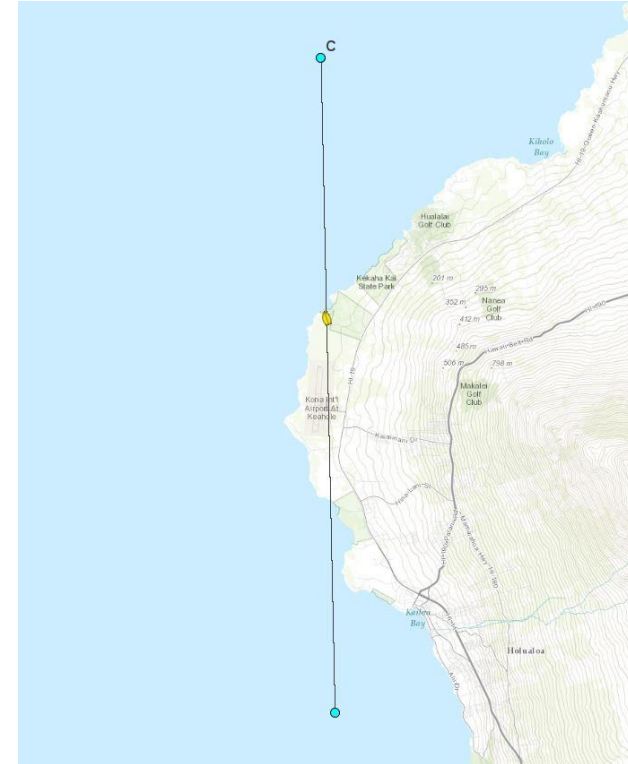
A Wave Glider unaware of Hawaii

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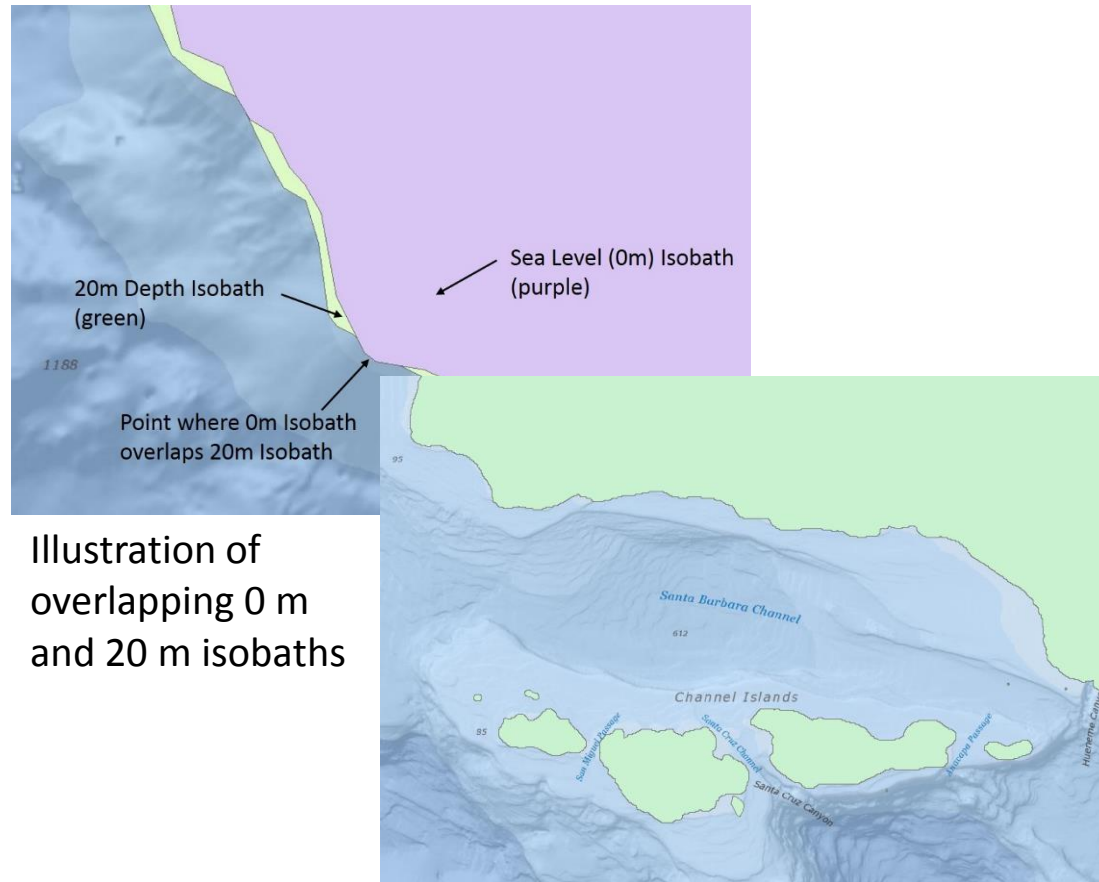
Processing Bathymetry Data using ArcPy

Illustration of overlapping 0 m and 20 m isobaths

Finalized shapefiles of the Channel Islands

- Extracted 20 m and 0 m isobaths from bathymetry data

- Added a 250 m safety buffer

- Smoothed and unioned the polygons

- Created a shapefile and .txt file with lat/lon points describing the outline of the colliders

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Integration with Regulus

- Previous: Negatively-Weighted Line Segments
  - Fine for quadrilaterals, but inefficient for thousand-sided polygons
- Current: Geometry Attractors
  - Find nearest point on the polygon and avoid it
  - Polygon itself is the attractor, not each individual line segment
  - Cuts processing time for Hawaii from 6 seconds to under 1 second
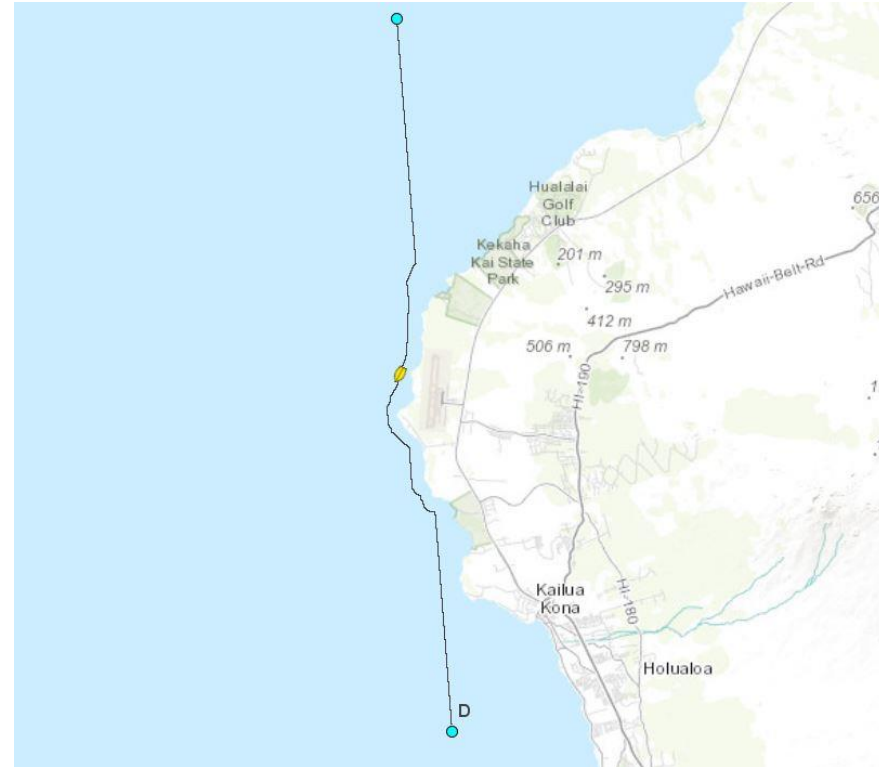
A Wave Glider successfully avoids Hawaii

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Interval Tree and Search Algorithms
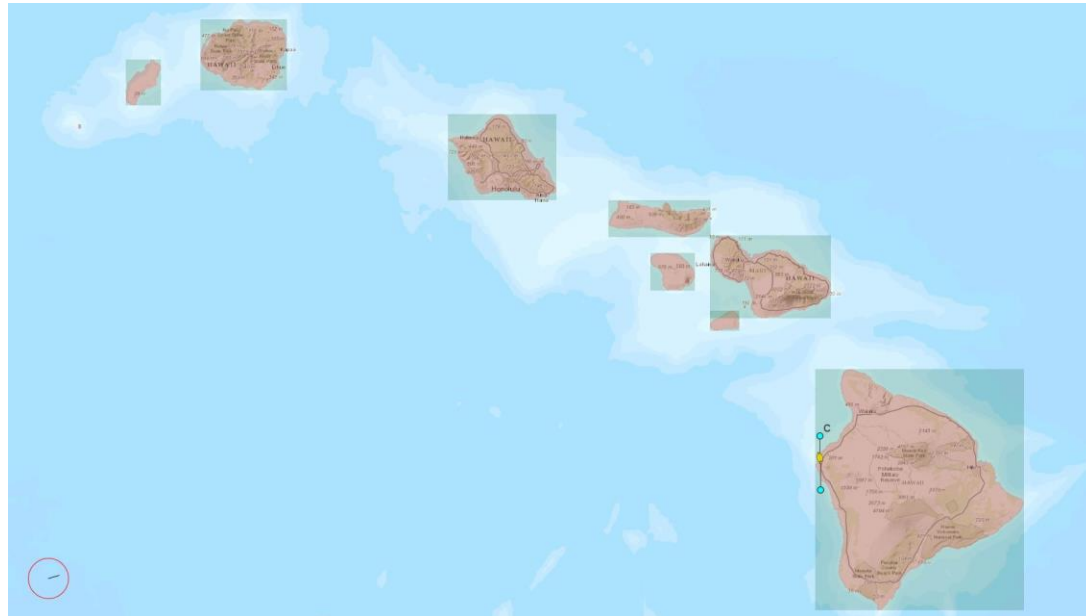
Bounding boxes surrounding each collider in Hawaii

- Problem: Thousands of islands is a time consuming calculation

- Solution: Interval Trees
  - Bounding boxes around each collider (polygon)
  - Check xmin-xmax interval vs Wave Glider's position
  - Scan along longitude with greatly reduced results
  - Only load maps whose bounding boxes are relevant

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Map Attractors

- Problem: With lots of map files, scanning all of them is inefficient

- Solution: Map Attractors
  - Created interval tree of maps that returns single closest point to Wave Glider
  - Maps are only loaded from file if their bounding box is relevant
  - Map stores interval tree of colliders and only returns single closest point to Wave Glider
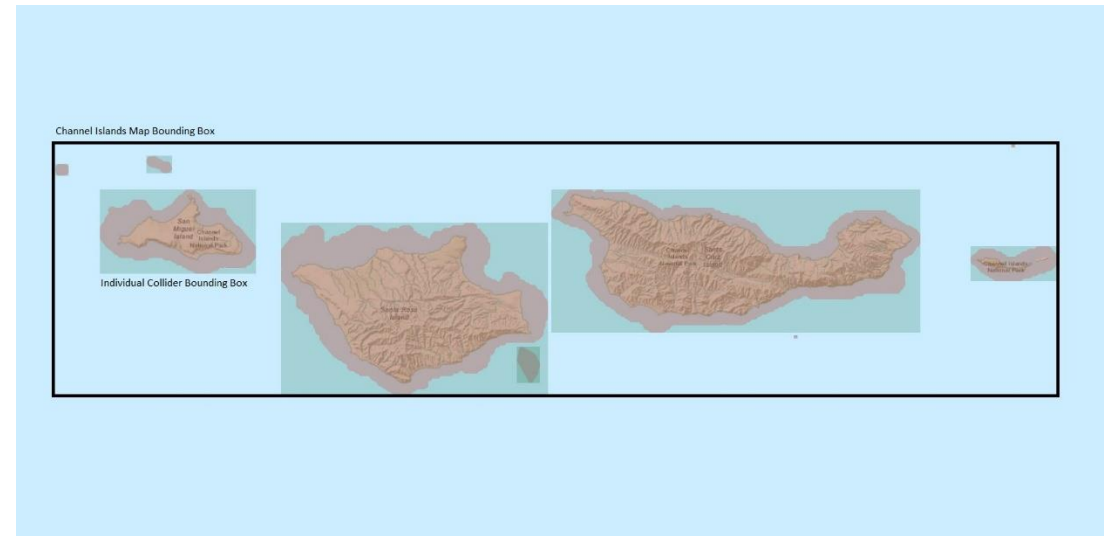
A bounding box around the Channel Islands map

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Integration with WGMS

A Wave Glider successfully avoids Anacapa Island in WGMS

- Run commands on the fly
  - Add map from URL
  - Delete map
  - Regenerate maps after updates
  - Clear maps
- Plan a path through an island and the Wave Glider avoids it automatically
- Successful safety precaution for Wave Glider navigation

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