

Northwestern Hawaiian Islands Marine Debris Project



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About the Presenter

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Presentation Overview

- Background Information on the Hawaiian Islands and Marine Debris
- Project History
- Survey and Removal Methods
- 2018 Field Mission
- Research
- Future
- Questions

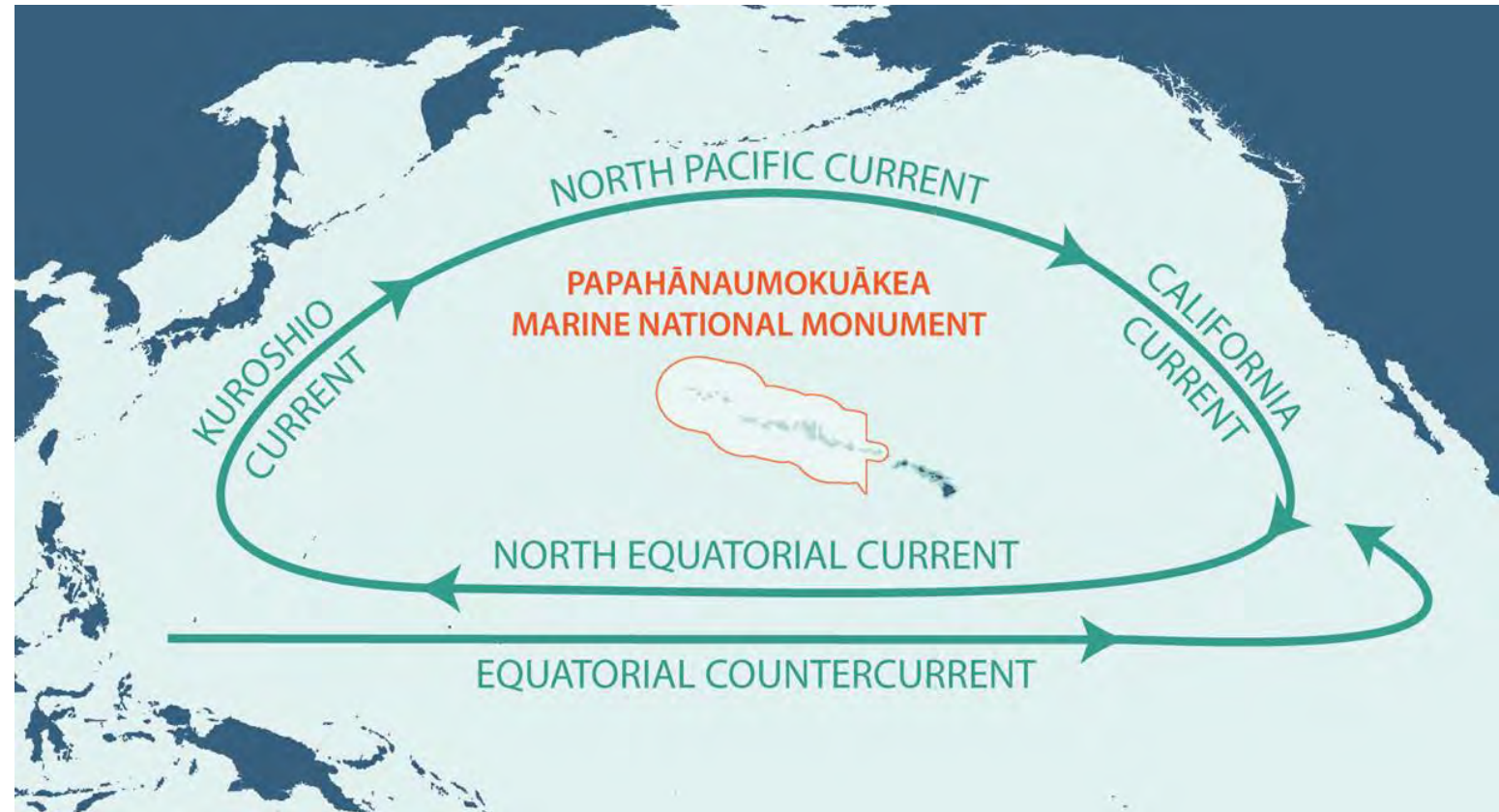


Project Partners

- NOAA Pacific Islands Fisheries Science Center (PIFSC)
- Joint Institute for Marine and Atmospheric Research (JIMAR)
- NOAA Marine Debris Program (MDP)
- NOAA Damage Assessment Remediation and Restoration Program (DARRRP)
- National Fish and Wildlife Foundation (NFWF)
- Fishing for Energy – Schnitzer Steel Co. and H-Power/Covanta Energy
- University of Hawaii
- NOAA Papahānaumokuākea Marine National Monument Program (PMNM)
- U.S. Fish and Wildlife Services (USFWS)
- National Marine Sanctuaries Foundation (NMSF)
- Satlink Global
- Co-trustees of the Papahānaumokuākea Marine National Monument

Background Information

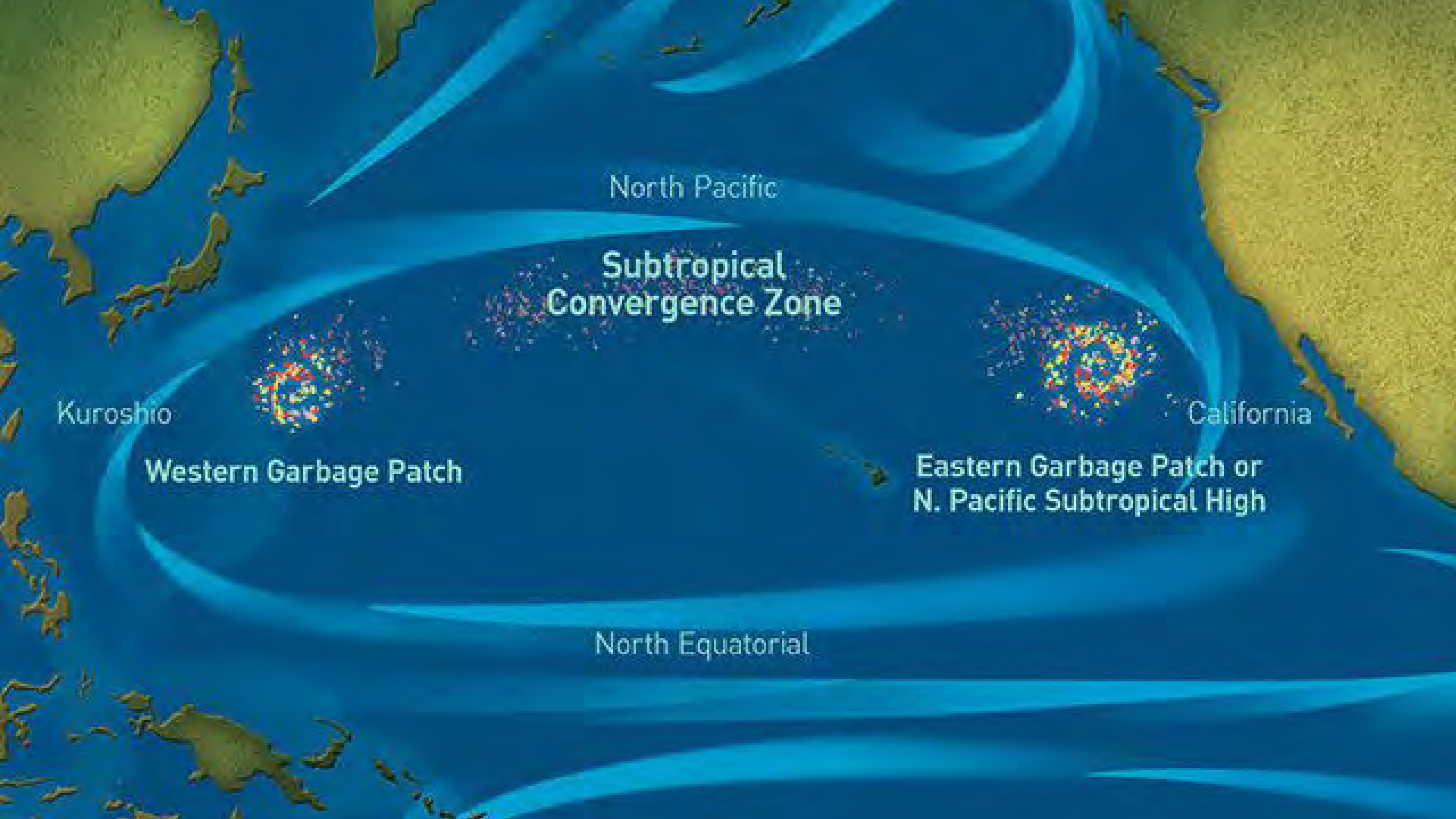
- Hawaiian archipelago centrally located in N. Pacific Gyre
- Northwestern Hawaiian Islands (NWHI) - uninhabited islands and atolls
- 70% of shallow water coral reef habitats in U.S.
- More than 7,000 marine species (25% endemic)











North Pacific

Subtropical
Convergence Zone

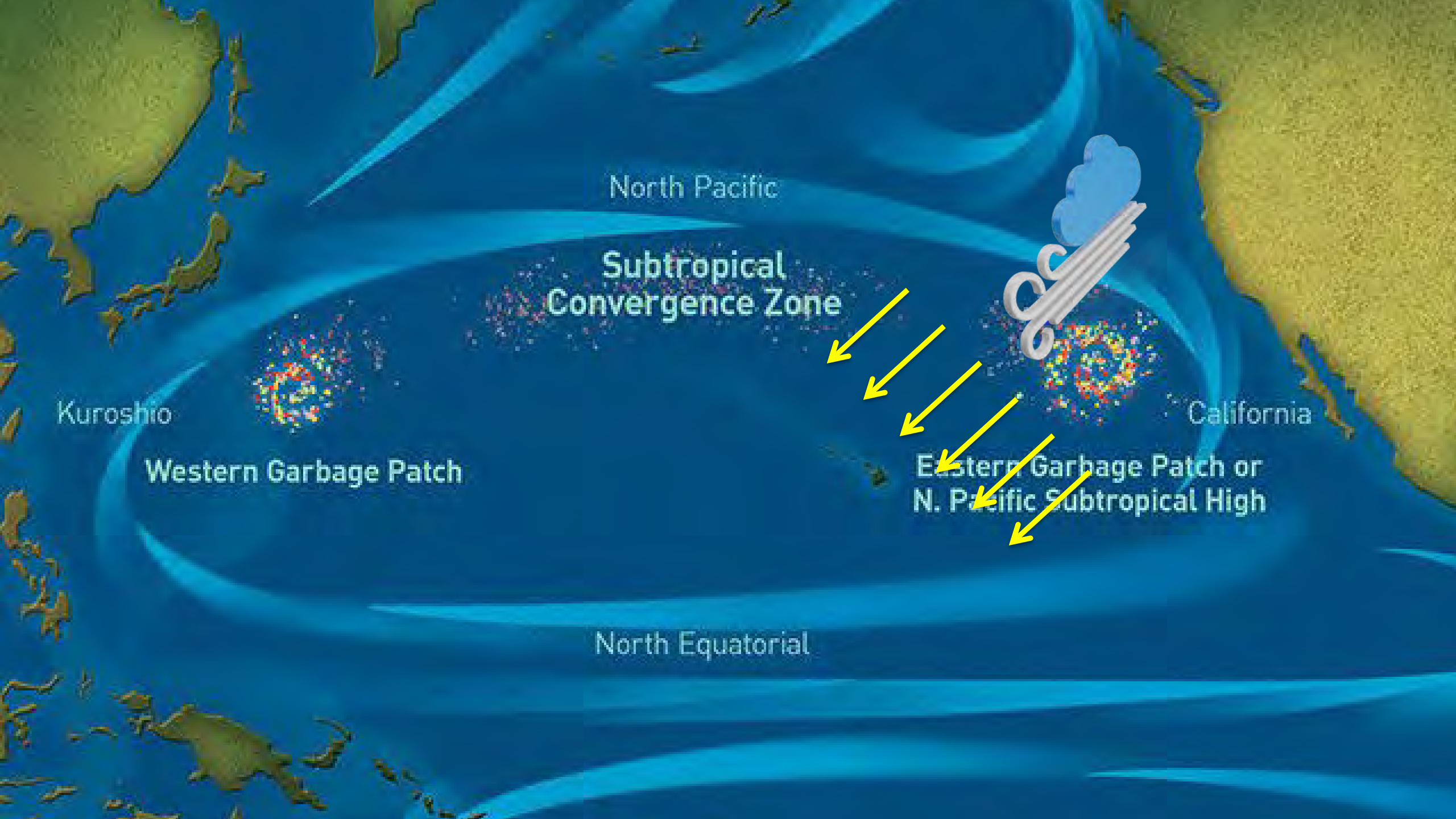
Kuroshio

California

Western Garbage Patch

Eastern Garbage Patch or
N. Pacific Subtropical High

North Equatorial



North Pacific

Subtropical
Convergence Zone

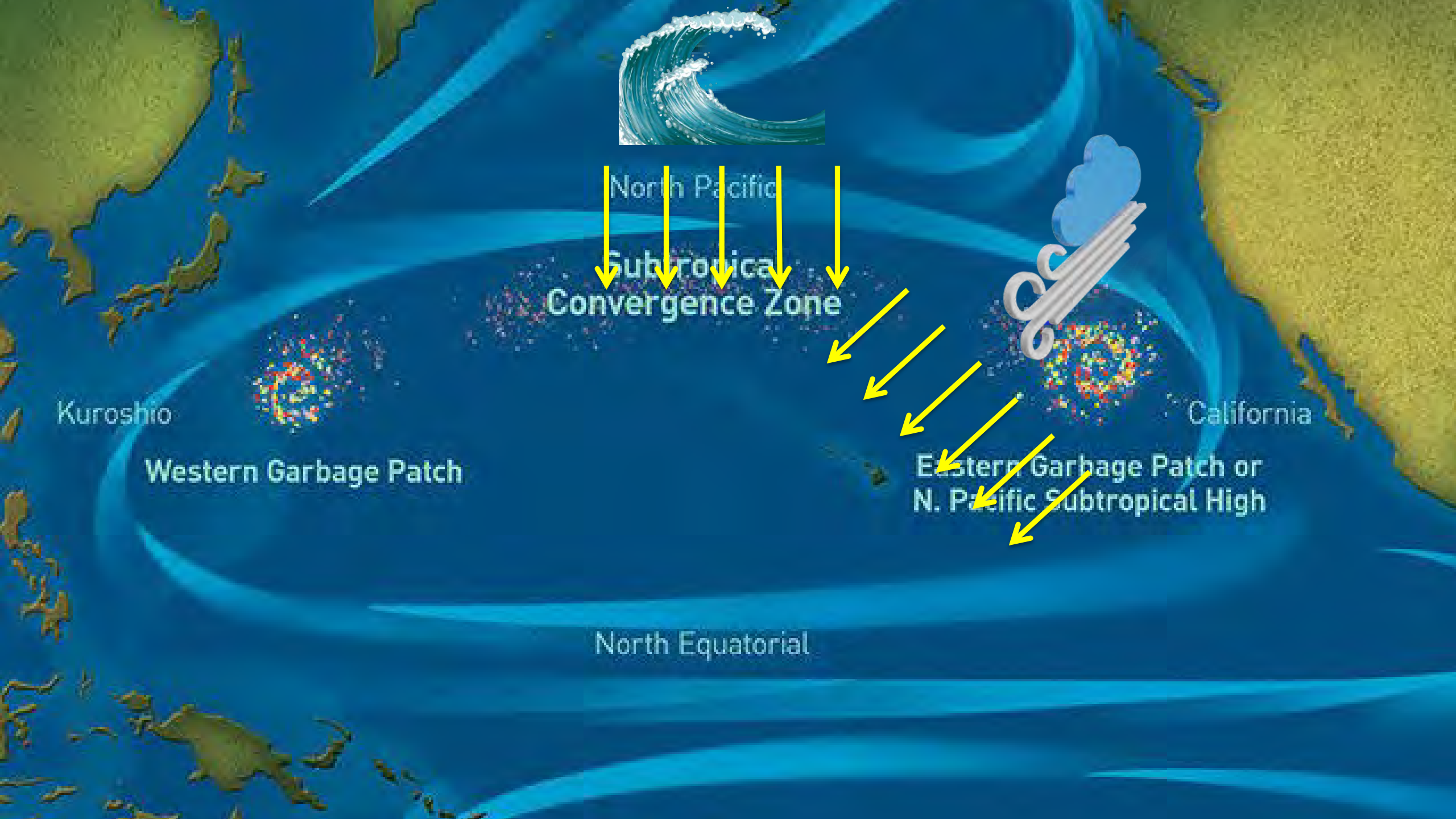
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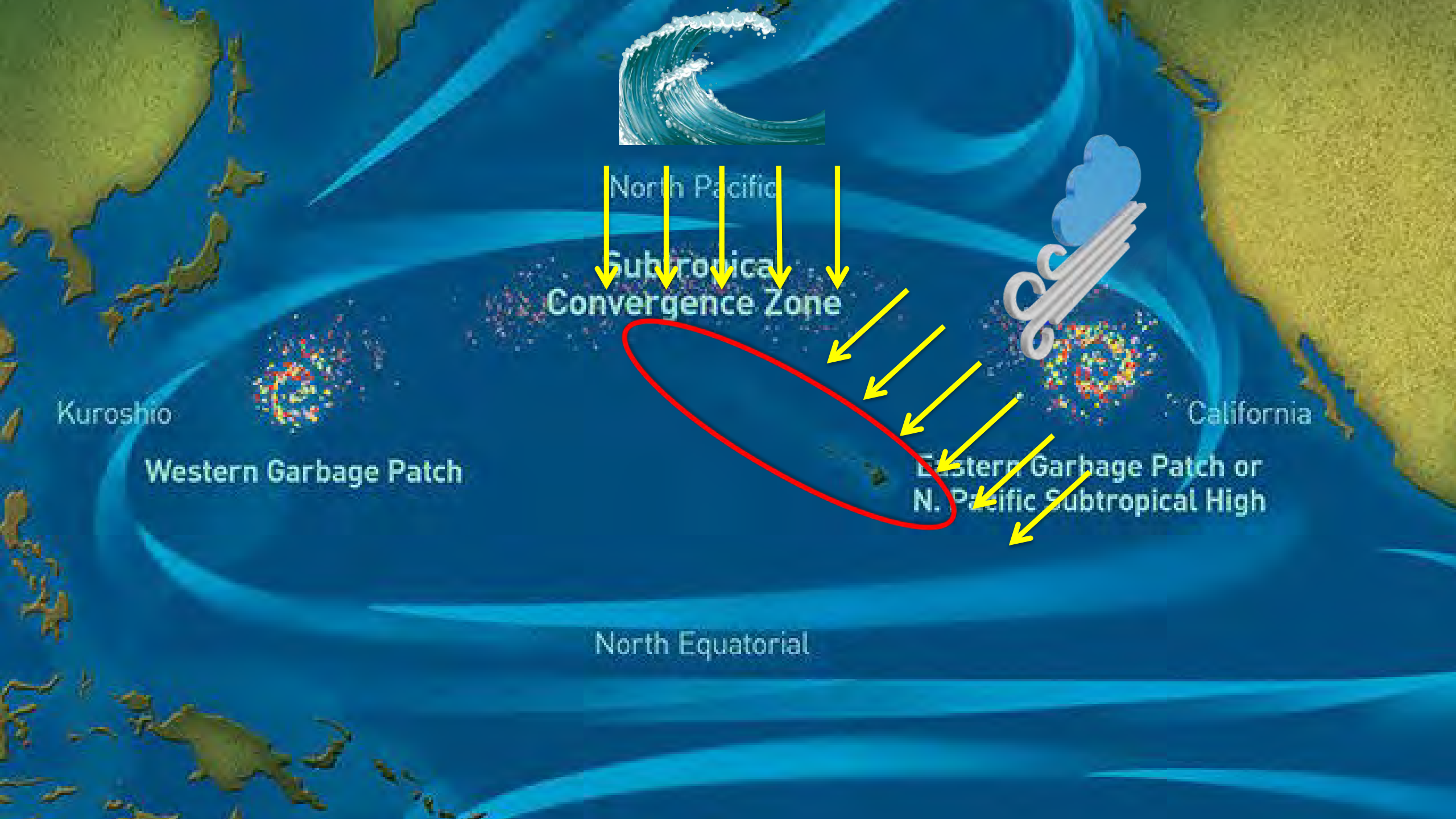
Kuroshio

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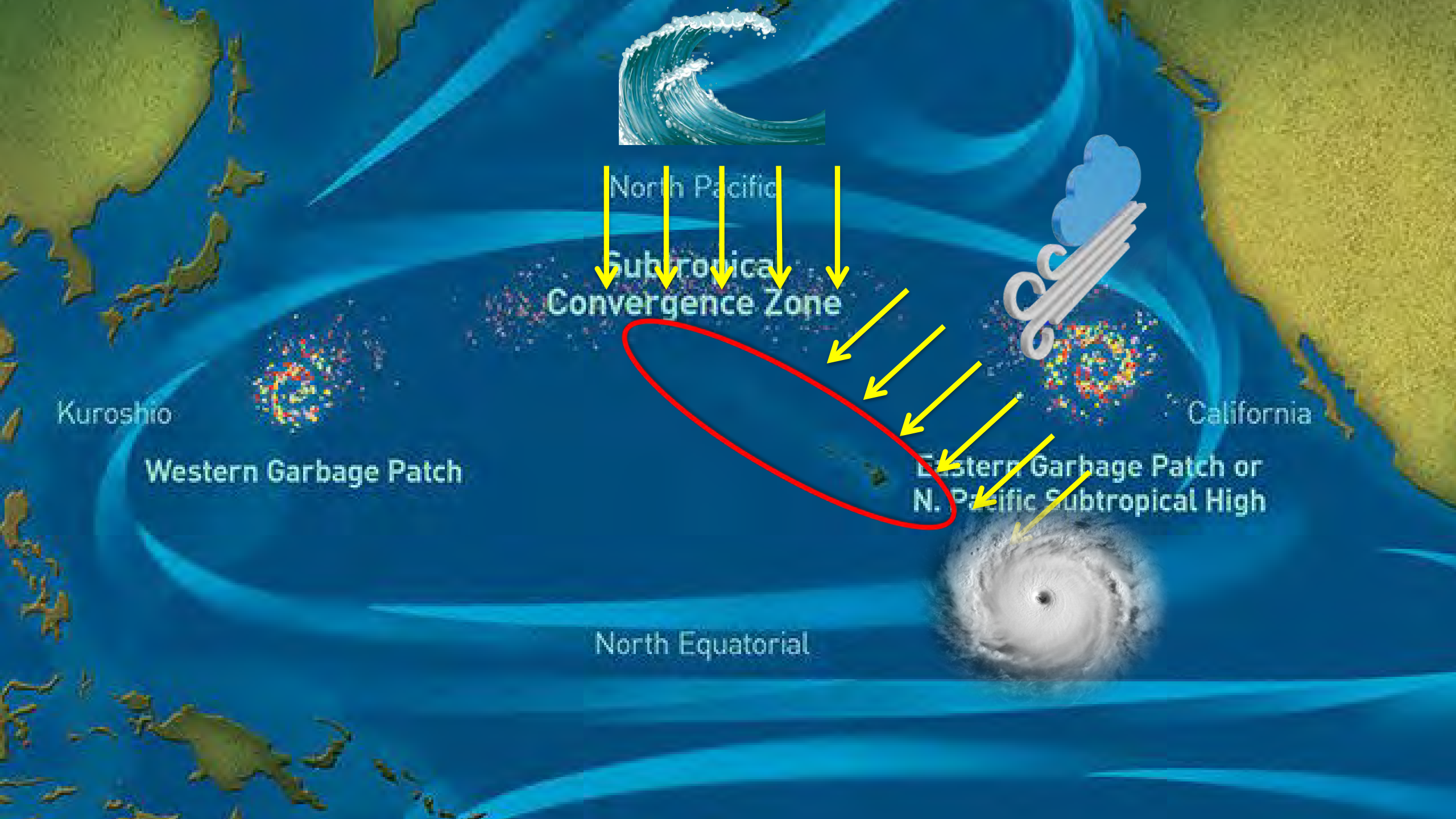
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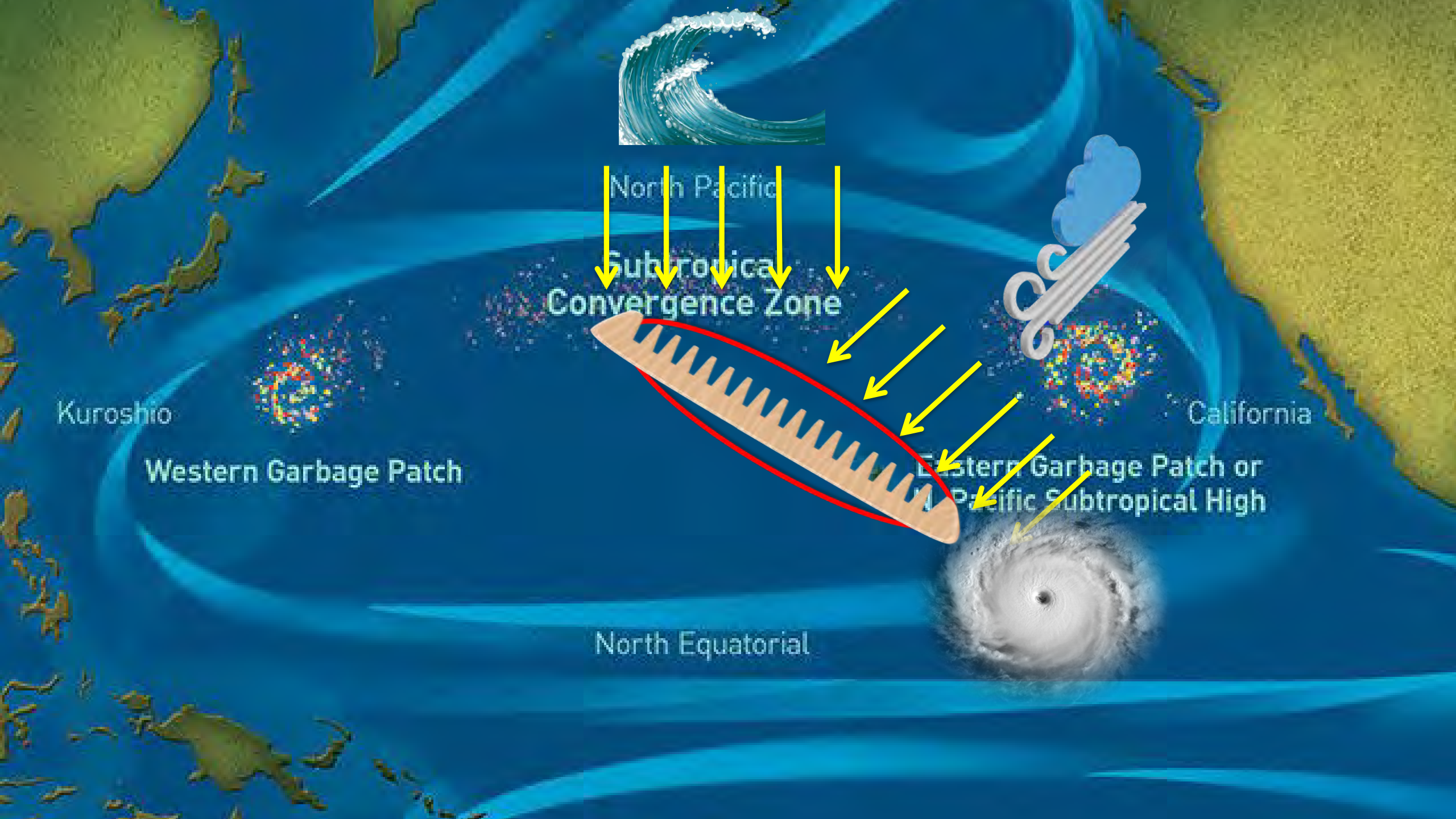
Kuroshio

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Convergence Zone

Kuroshio

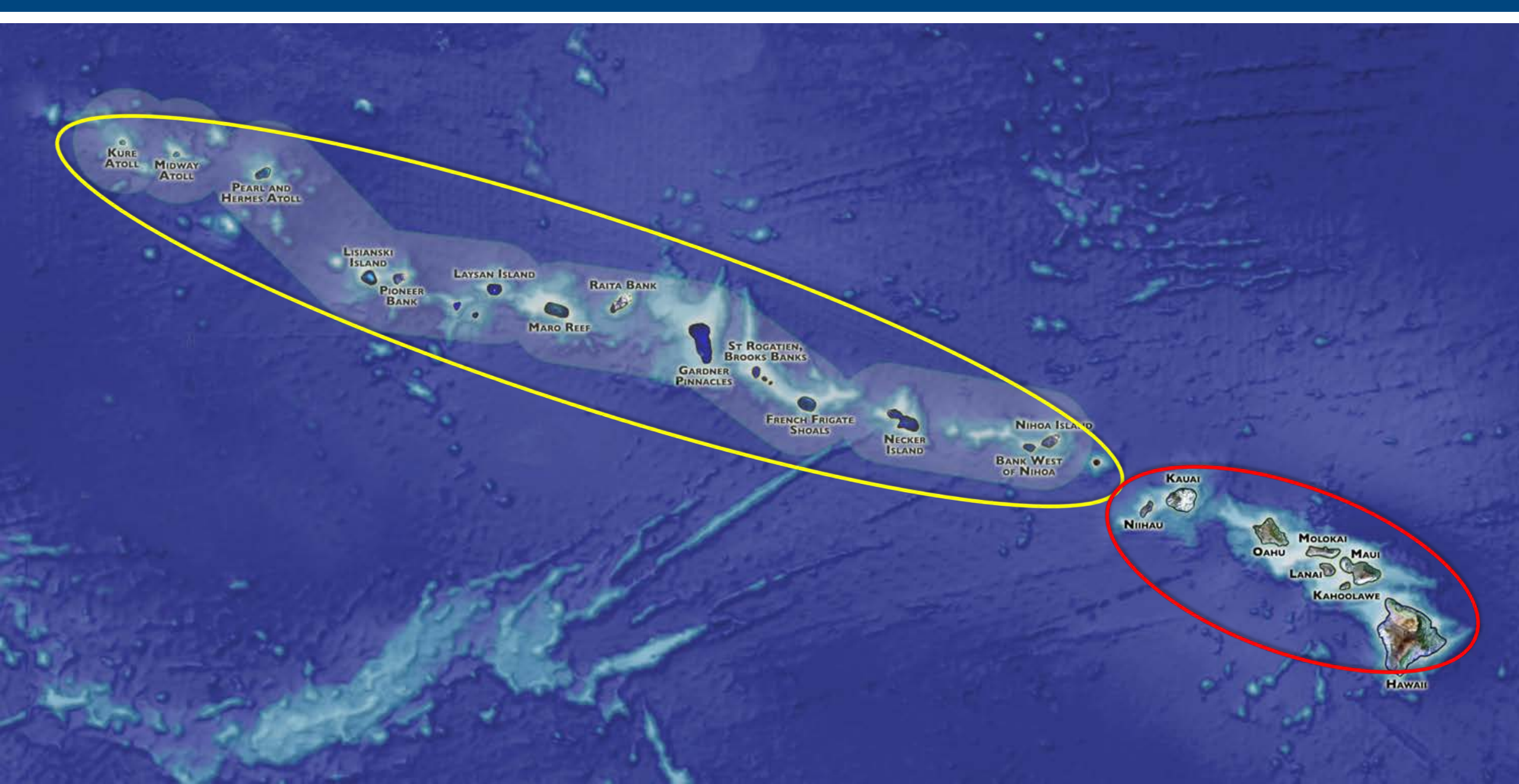
Western Garbage Patch

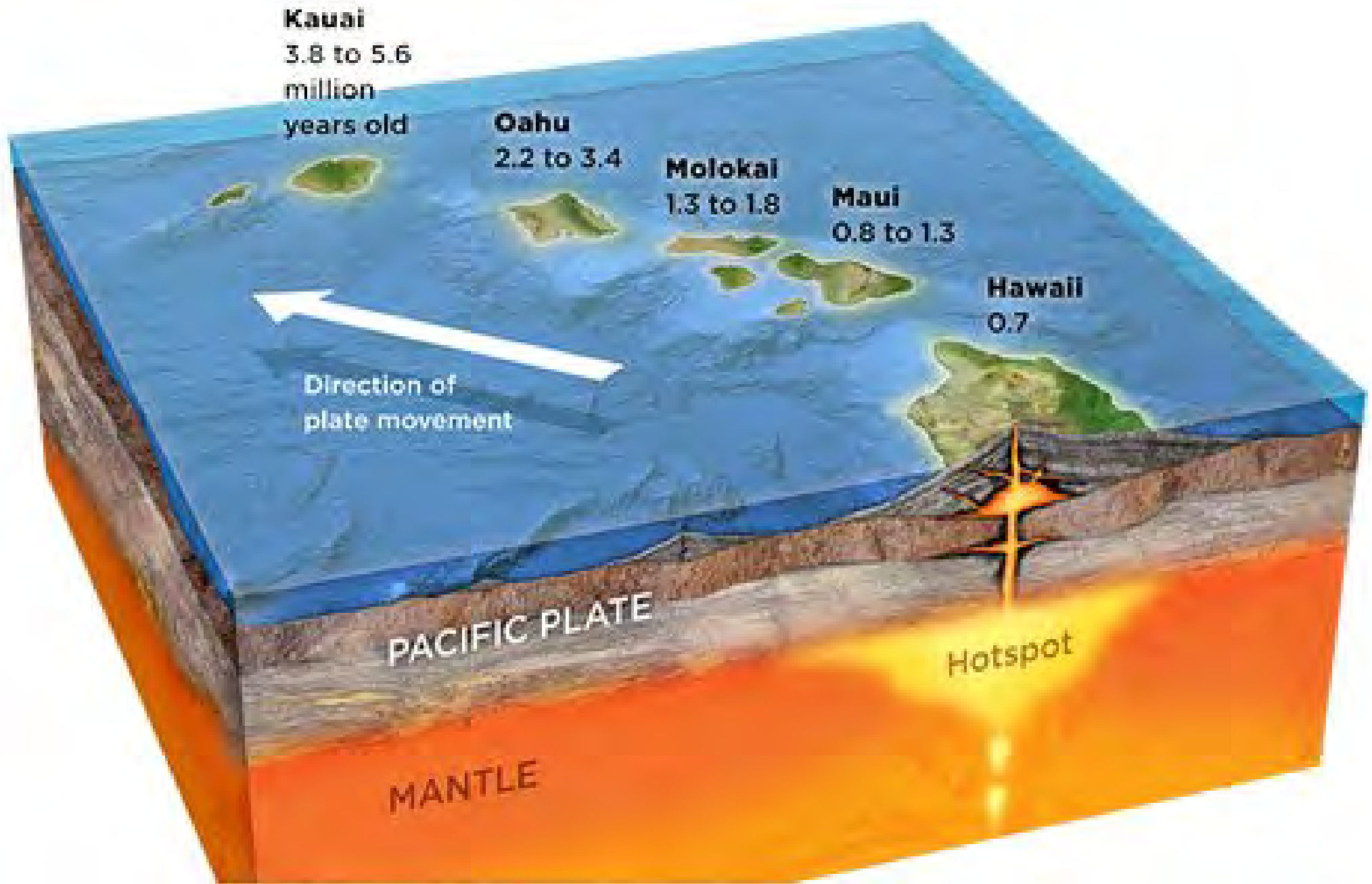
California

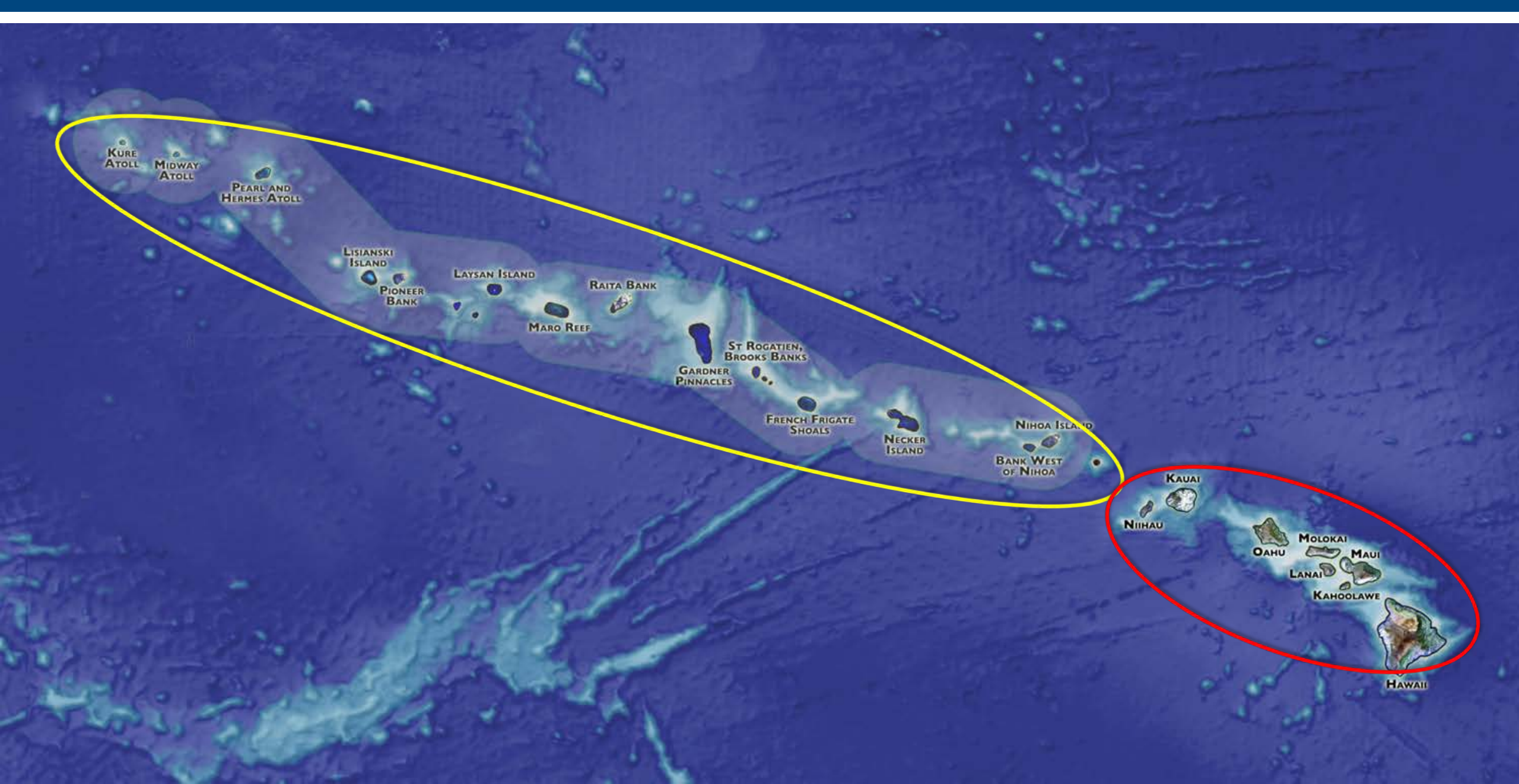
Eastern Garbage Patch or
N. Pacific Subtropical High

North Equatorial



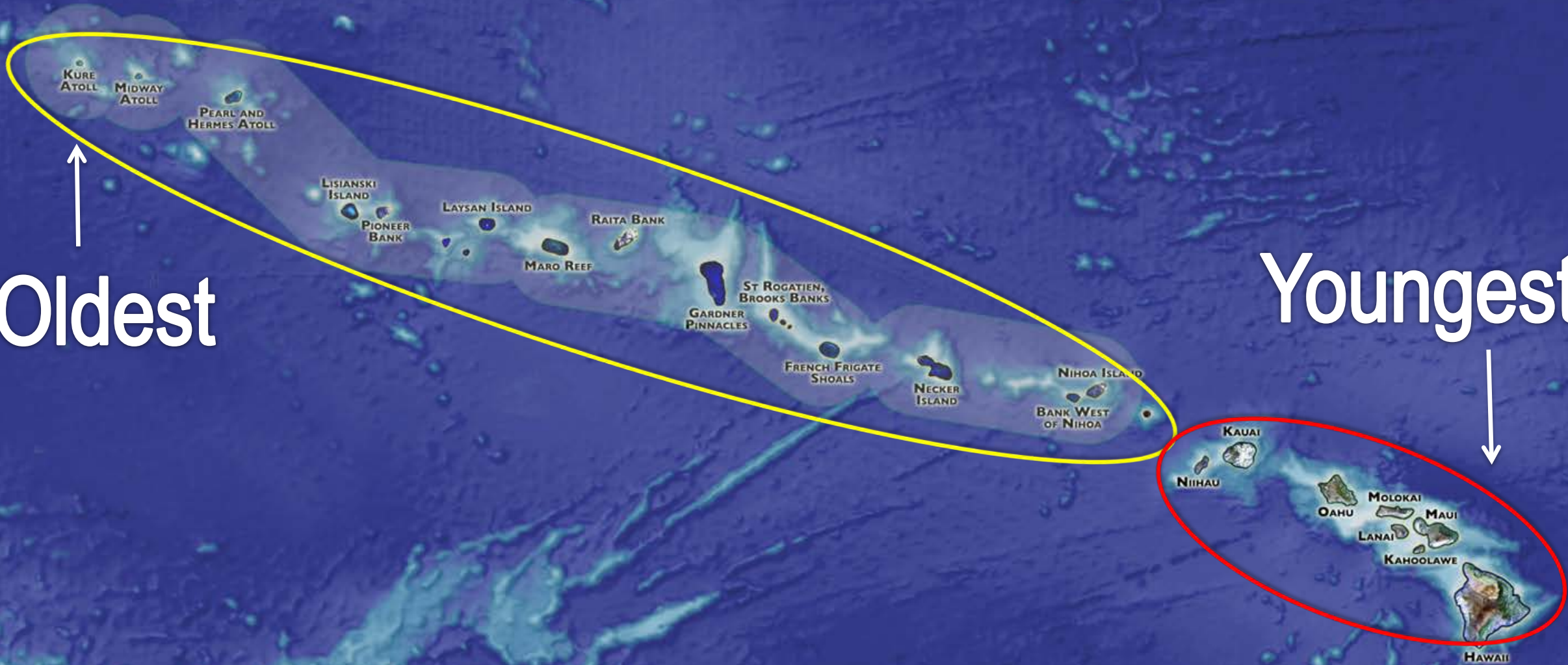




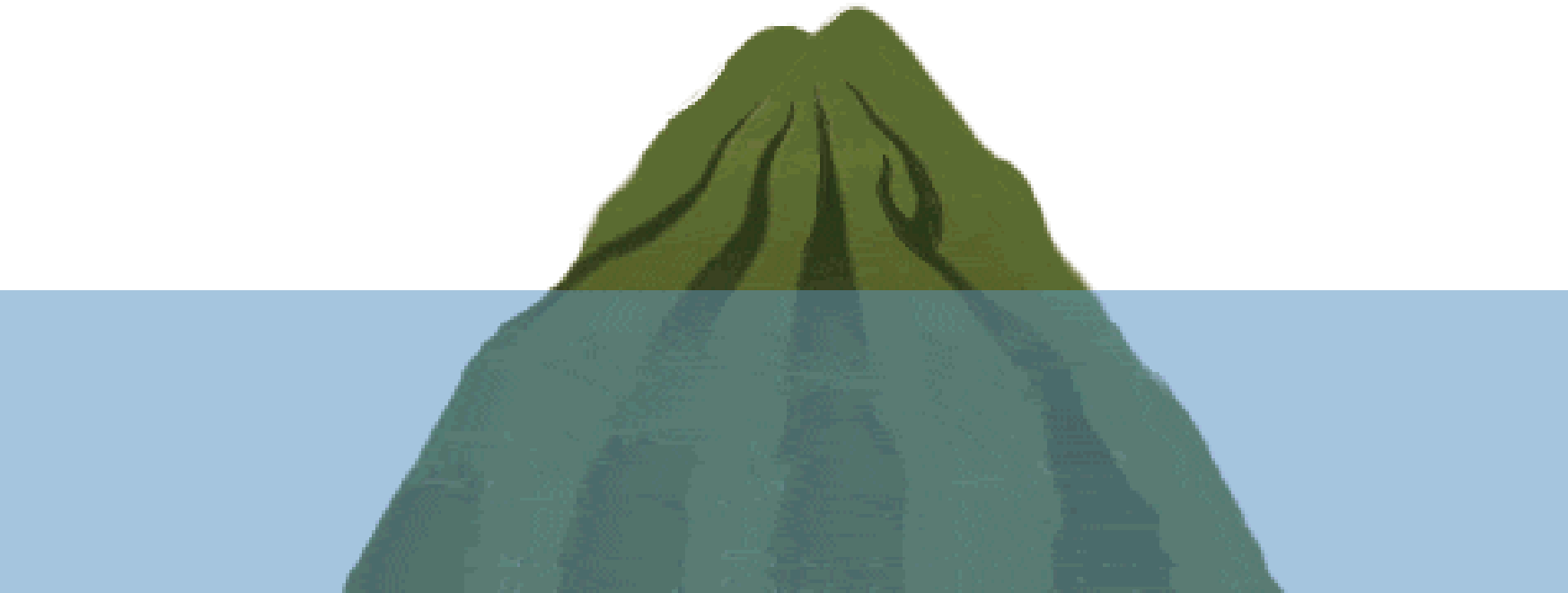


Oldest

Youngest



Atoll Formation



1. An underwater volcano pierces the surface of the ocean.



2. A coral reef forms around the volcanic island.



3. Fringing reef surrounds the subsiding (sinking) island.



4. Barrier reef protects a lagoon as the island completely sinks.





52 metric tons of DFG
accumulate in NWHI annually

Marine Debris Impacts

- Refuse, Reduce, Reuse, Recycle, Remove
- How is marine debris affecting the NWHI?
 - Entanglement
 - Ingestion
 - Habitat damage
 - Non-native species







Project History

- 1996 – Project founded in NWHI
- 1999 – First full marine debris season
- 2006 – Papahānaumokuākea Marine National Monument established
- 2006 – Maintenance mode (annual)
- 1996 – 2018: 922 metric tons (over 2 million lbs) removed from NWHI



Marine Debris Removal Impacts

- 1,400 Hawaiian monk seals left in the world
- 28% of Hawaiian monk seals alive today are because of marine debris removals, disentanglements, and rehabilitation efforts (Harting et al., 2014)



Survey and Removal Methods

- Coral reef survey (in-water)
 - Tow-board (towed diver)
 - Swim

VS.

- Shoreline survey (land)



Survey and Removal Methods - Towboard

- Coral reef survey
 - Tow-board
 - Back-reef
 - Free-dive





Fore-reef

Back-reef



An aerial photograph of a coral reef system. The reef is divided into two main zones. The upper zone, labeled 'Back-reef', is a relatively flat, light-colored area with sparse coral. The lower zone, labeled 'Fore-reef', is a steep, dark-colored slope with dense, textured coral. A white, foamy line of surf separates the two zones. The text 'Back-reef' is centered in the upper half, and 'Fore-reef' is centered in the lower half, both in white sans-serif font.

Back-reef

Fore-reef



Back-reef





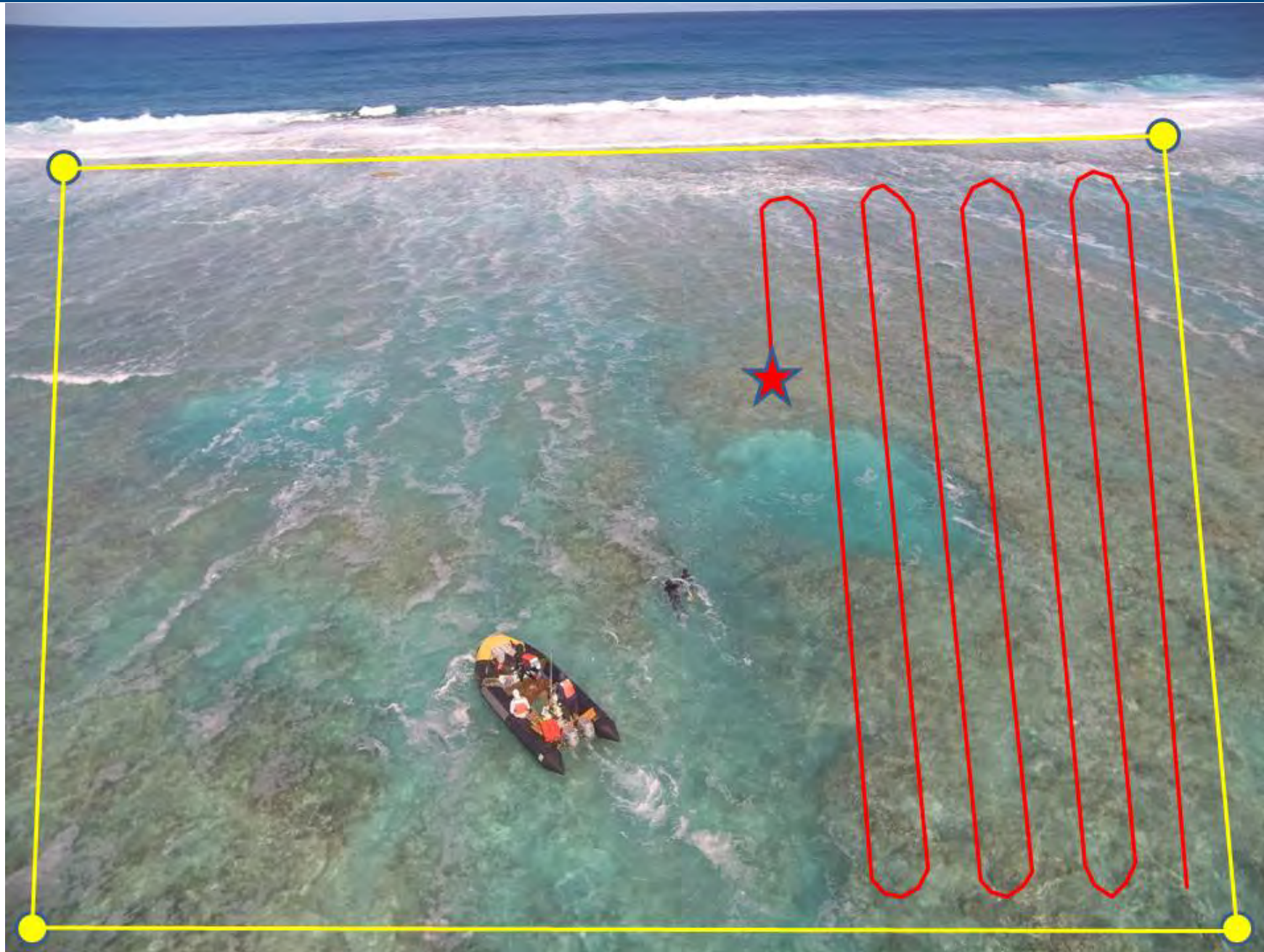


0.25 km²

*Not to scale

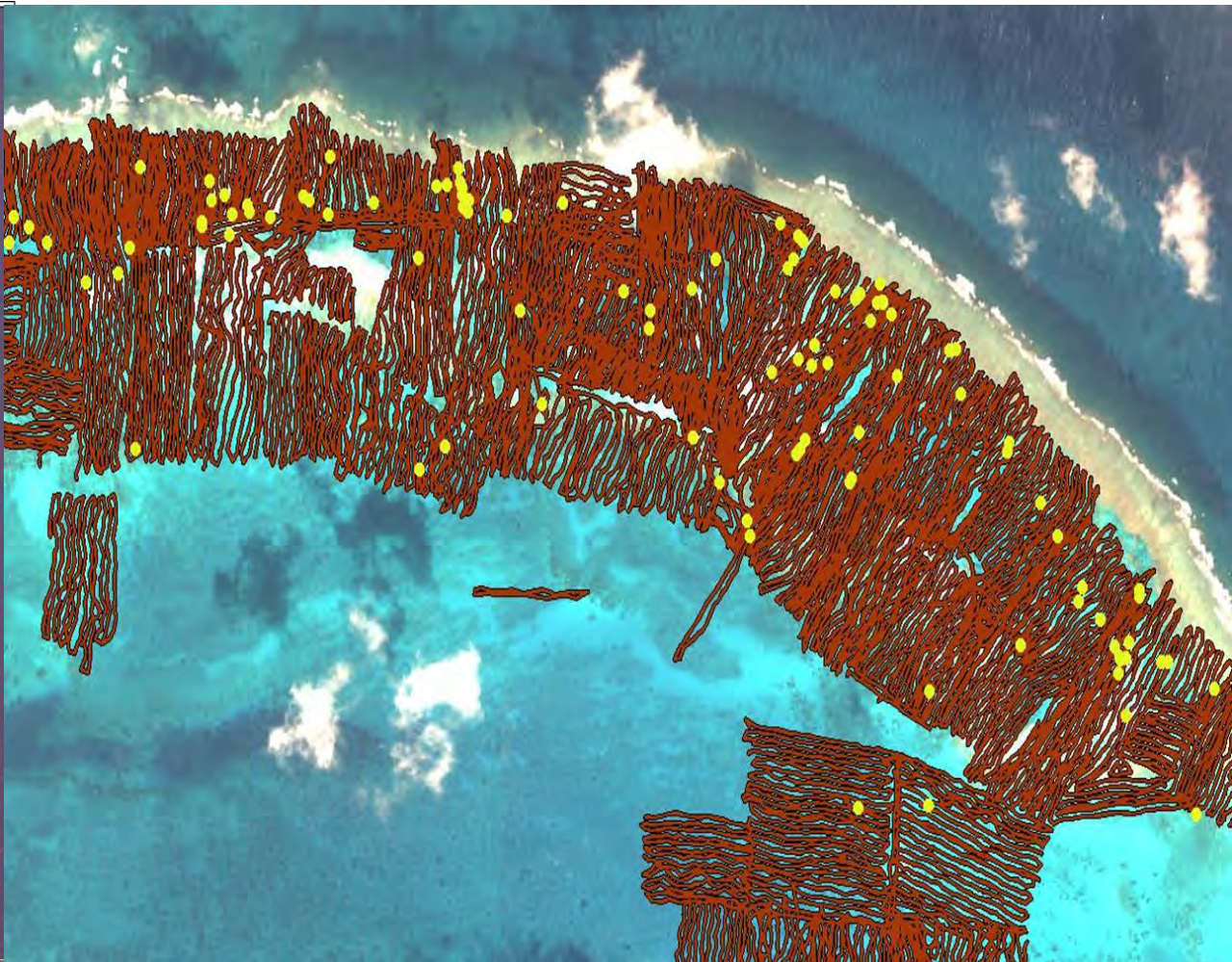
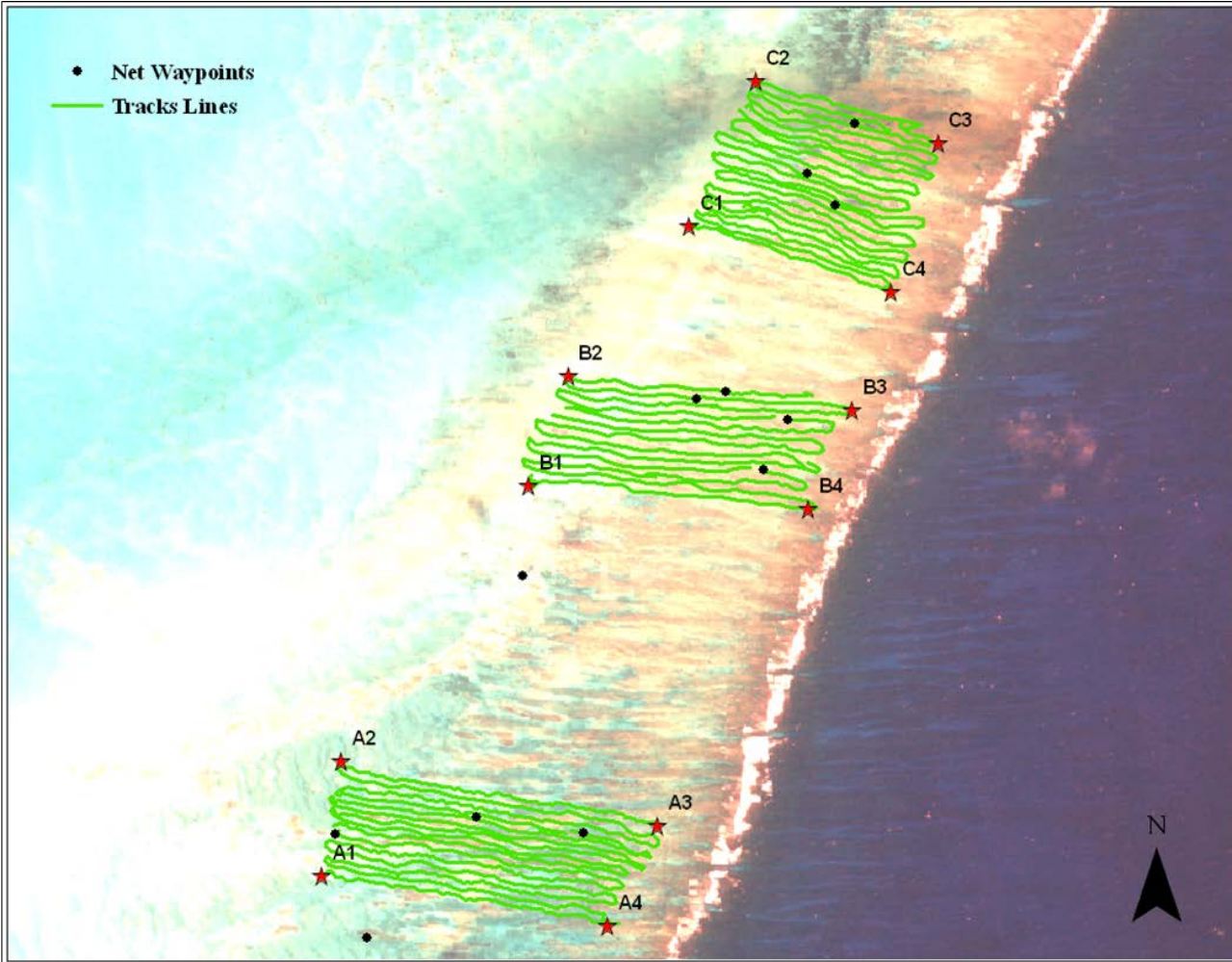












Survey and Removal Methods - Swim

- Coral reef survey
 - Swim / Snorkel
 - Free-dive



Patch reefs











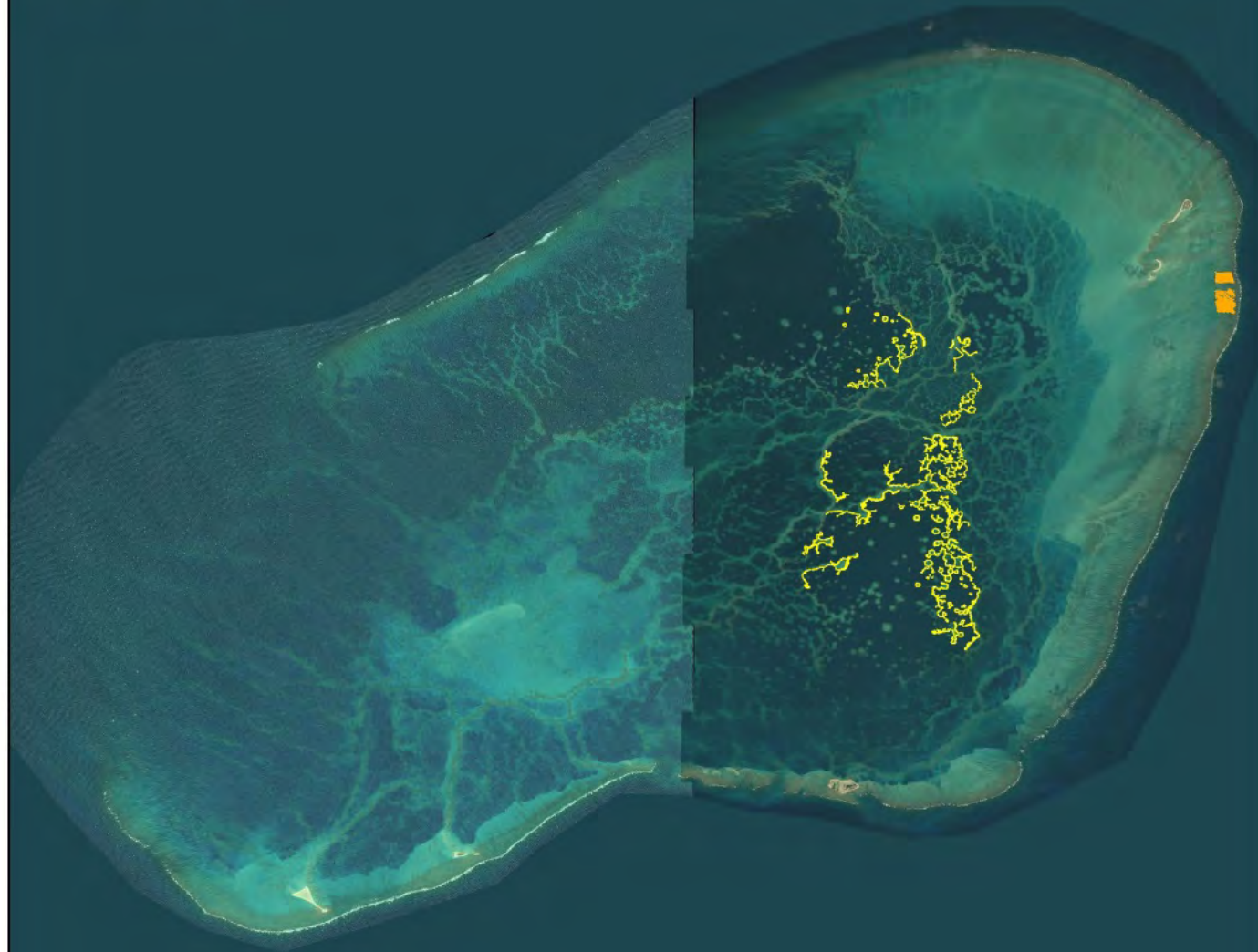


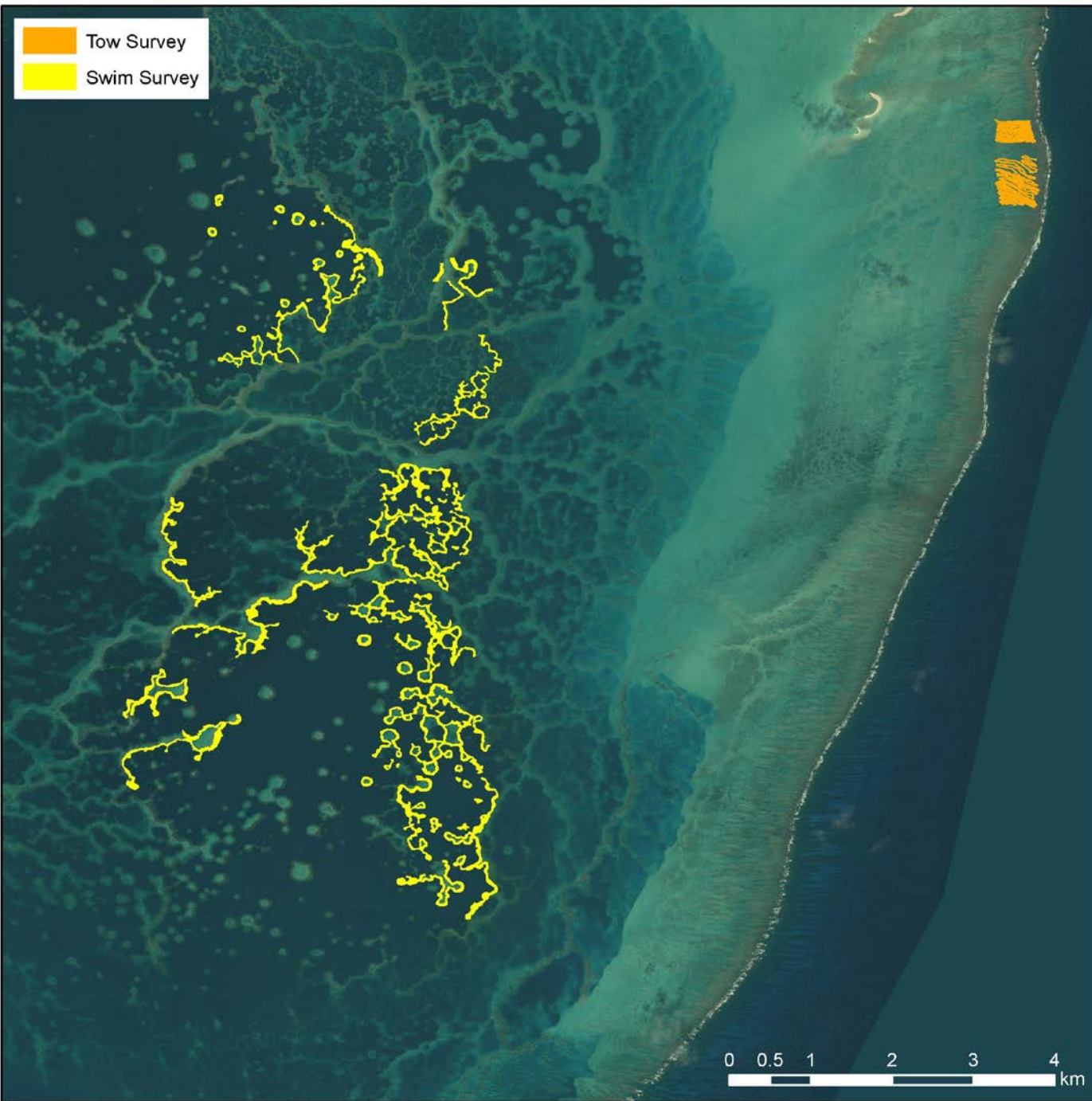


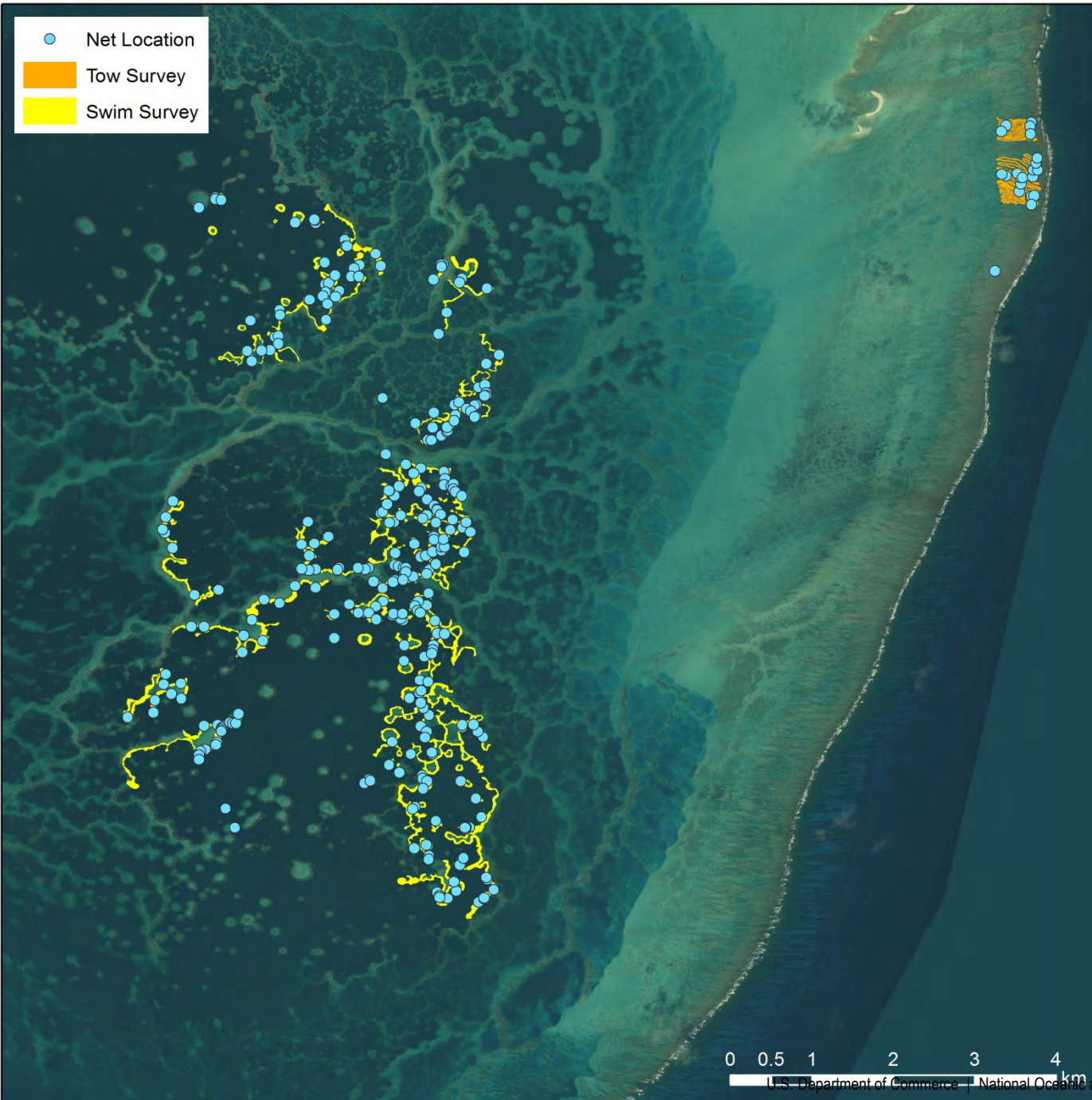




Tow Survey
Swim Survey







Survey and Removal Methods – In-water

- Net is visually identified and GPS marked
- Data is collected on the nets
- Dive teams breath-hold dive to cut and remove net (<30 ft depth)
- Nets are manually hauled into small boats
- Net loads are craned out of boats onto ship





Survey and Removal Methods – Land

- Nets and plastics are removed from the shoreline
 - Priority is to remove entanglement hazards to Hawaiian monk seals, green sea turtles, and sea birds
- Debris is loaded manually into bulk bags on small boats
- Debris is craned out of the boat onto ship



Play debris survey video

- Play debris survey video

2018 Field Mission

- 41-day mission (September 19 – October 30, 2018)
 1. NOAA R/V *Oscar Elton Sette* (September 19 – October 11)
 - 51,504 lbs removed
 2. Midway Atoll shore-based (October 5-25)
 - 63,240 lbs removed
 3. M/V *Imua* (October 13-30)
 - 49,269 lbs removed
- Total: 164,013 lbs (74 metric tons) removed

2018 Field Mission – Leg 1 – R/V *Oscar Elton Sette*

- September 19 – October 11, 2018
 - 19 staff (17 divers/coxswains + 1 UAS pilot + 1 data manager)
- In-water removal operations
- 2.23 km² reef area surveyed and cleaned
- 51,504 lbs removed





2018 Field Mission – Leg 2 – Midway Atoll

- October 5-25, 2018
 - 15 staff (14 divers/coxswains + 1 UAS pilot) – October 5-12
 - 5 staff (5 divers/coxswains) – October 13-25
- In-water and shoreline removal operations
- 1.35 km² reef area surveyed and cleaned
- 0.41 km² shoreline surveyed and cleaned
- 63,240 lbs removed



- Swim Survey
- Tow Survey
- Shoreline Survey
- Shoreline Non Survey





2018 Field Mission – Leg 3 – M/V *Imua*

- October 13-30, 2018
 - 10 staff (9 coxswains + 1 UAS pilot)
- Shoreline removal operations
- 0.18 km² shoreline surveyed and cleaned
- 49,269 lbs removed





2018 Field Mission – Outreach/Media Event

- 906 people directly reached through outreach and education
- 10 elementary/intermediate school outreach events pre-mission
- 3 high schools attended outreach events post-mission
- Information about project shared on blogs, local TV, magazine articles, CBS 60 Minutes



2018 Field Mission – Debris Disposal

- Nets-to-Energy Program down-cycles all nets to electricity for Oahu, Hawaii
- Clean, usable plastic is used by non-profit organizations and artists for outreach and education
- Plastic is donated to a non-profit to recycle and create new products
- Remainder is incinerated to create electricity using Waste-to-Energy Program



On-going Research

- Shoreline Accumulation Study
 - Midway Atoll (2013-2018)
 - Kure Atoll, Pearl and Hermes Atoll, Lisianski Island, Laysan Island, French Frigate Shoals (2018)
- Structure-from-Motion (SFM) Benthic Habitat Impact Pilot Study
 - Satellite Buoy Net Tagging Pilot Study
- Unmanned Aerial Systems (UAS) Pilot Study



On-going Research – Shoreline Accumulation

- Midway Atoll (2013-2018)
- Kure Atoll, Pearl and Hermes Atoll, Lisianski Island, Laysan Island, French Frigate Shoals (2018)

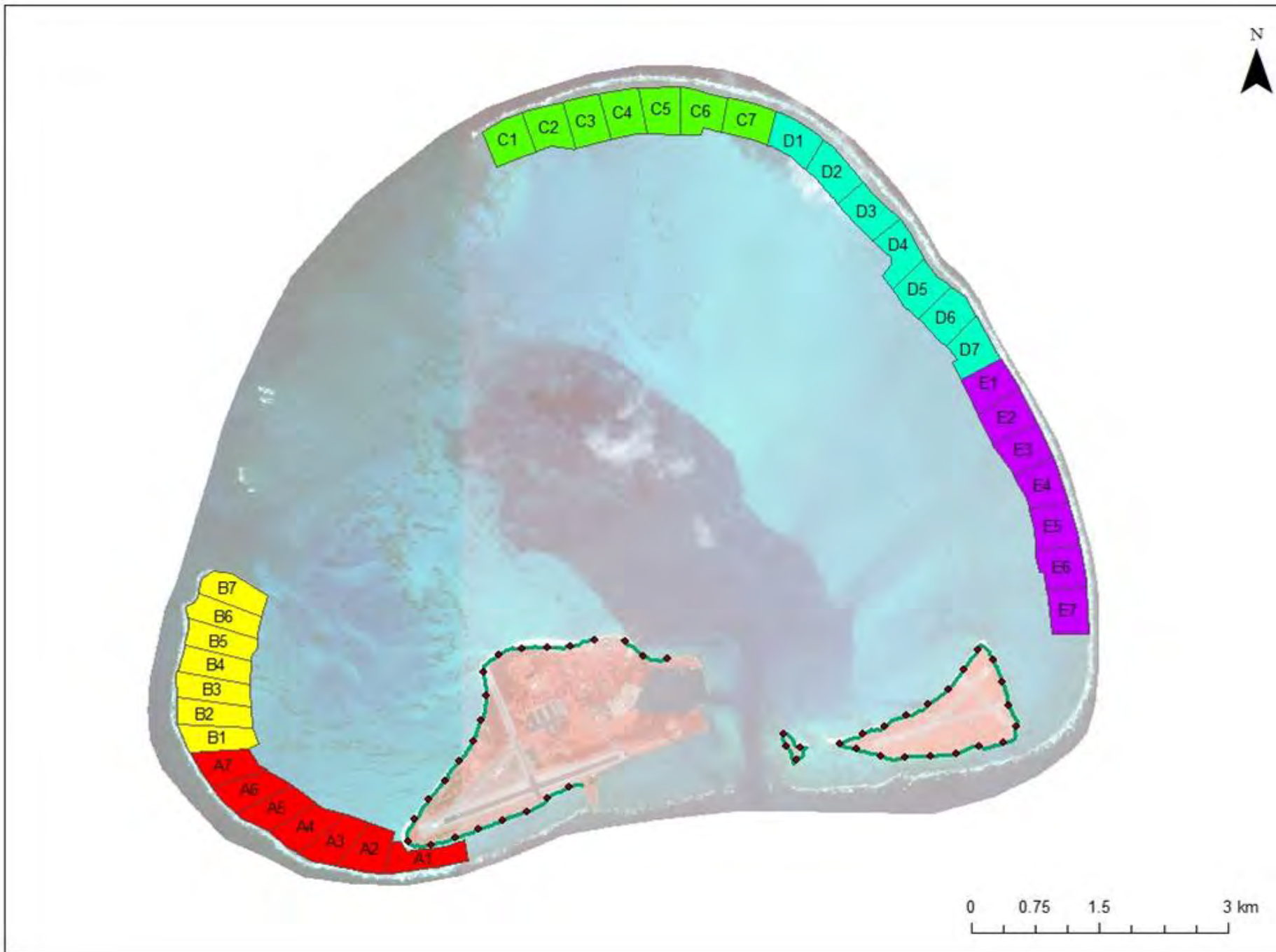


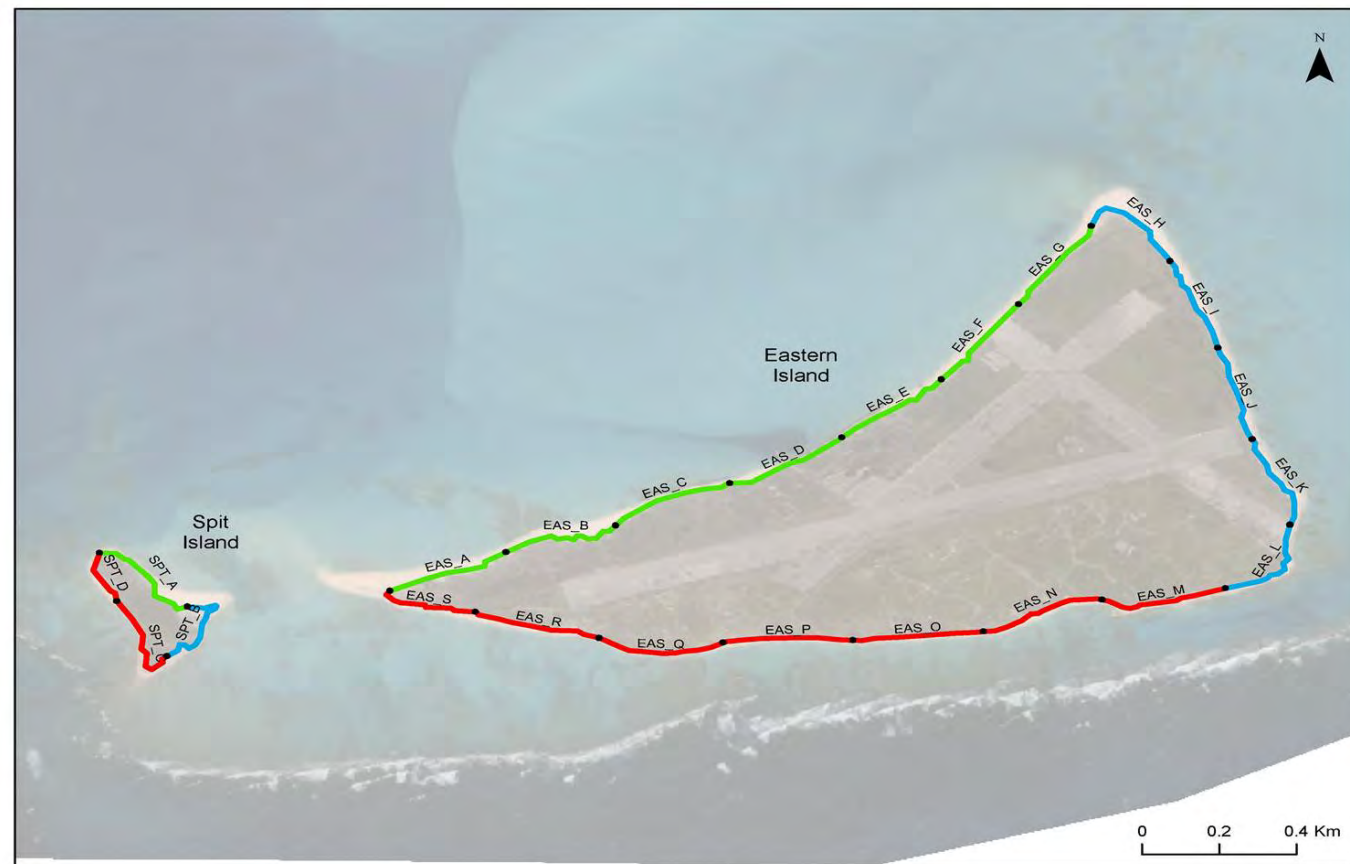
Midway Atoll

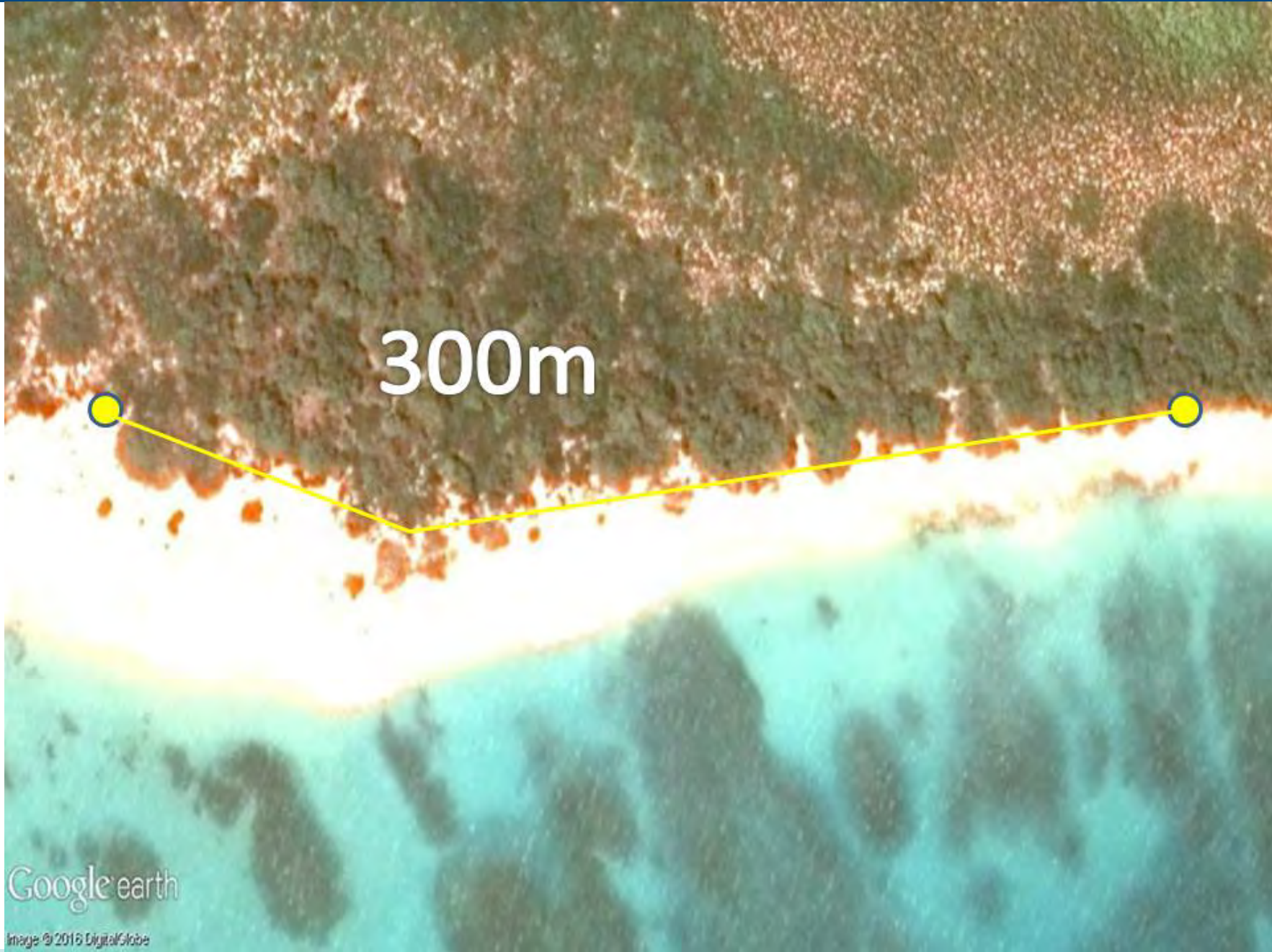
Data LDEO-Columbia, NSF, NOAA
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2014 DigitalGlobe
Data NOAA

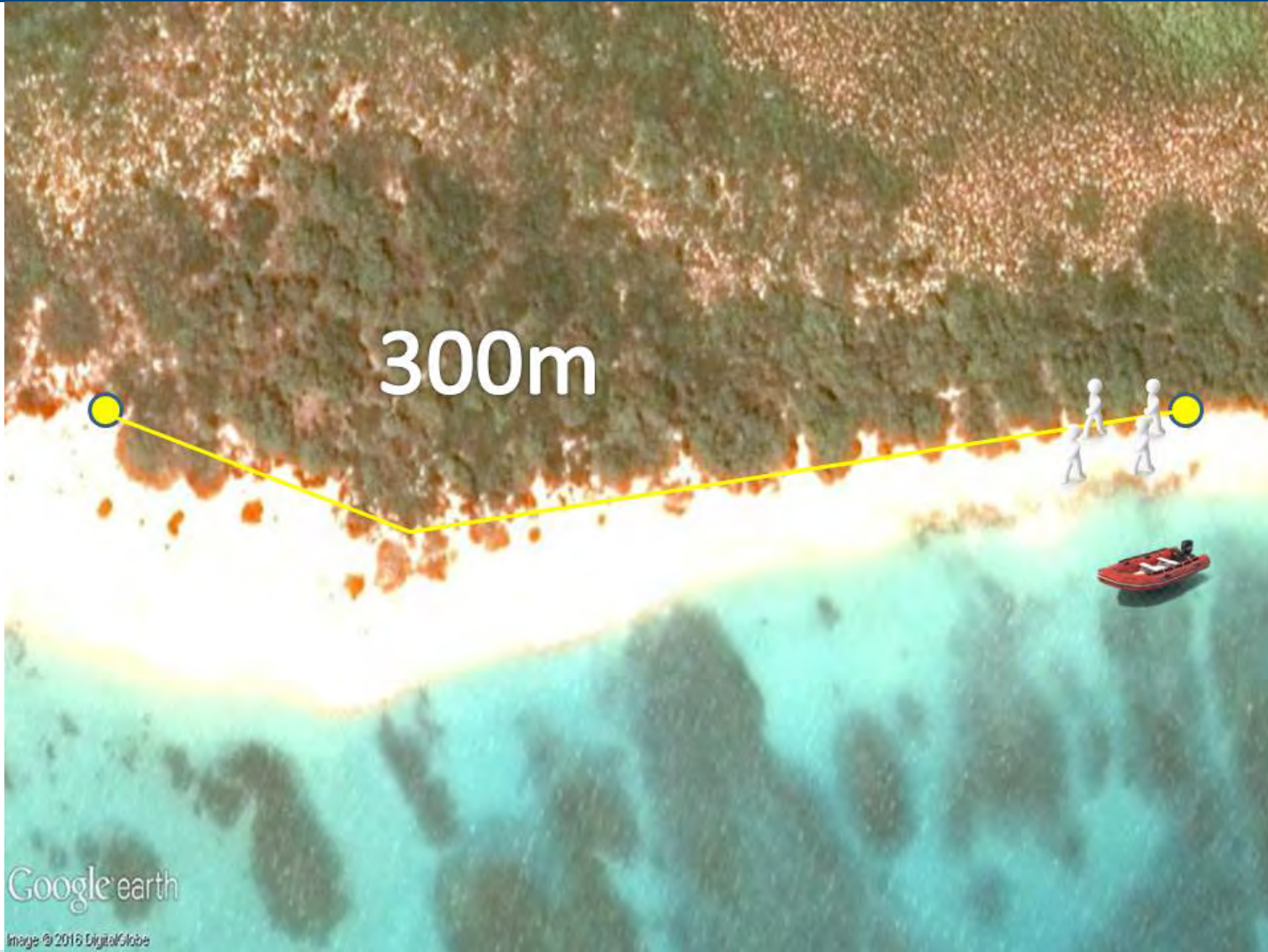
Google earth

Imagery Date: 12/29/2013 28°14'03.18" N 177°22'01.14" W elev -10 ft eye alt 10.28 mi











Google earth

Image © 2016 DigitalGlobe







Google earth

Image © 2016 DigitalGlobe



NOAA FISHERIES



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NOAA FISHERIES





- Swim Survey
- Tow Survey
- Shoreline Survey
- Shoreline Non Survey



-  SURVEY AREA
-  REMOVAL SITE

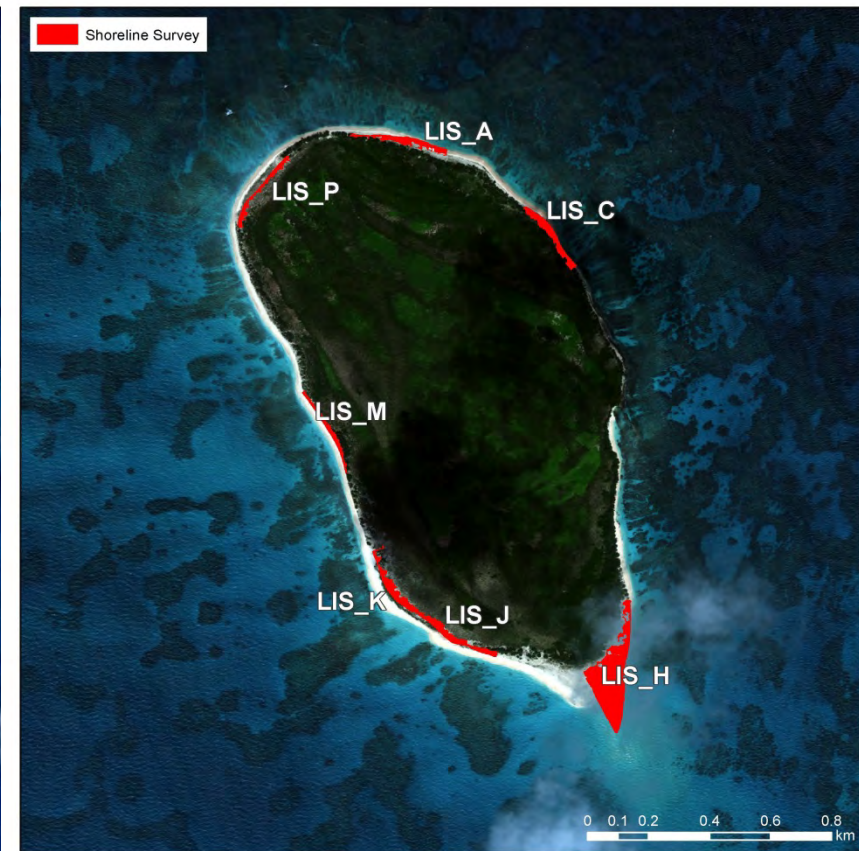


On-going Research – Shoreline Accumulation

- For every 300m shoreline segment surveyed:
 - Date of last survey (to calculate # days of accumulation)
 - Shoreline survey area (m²)
 - Weight of debris from survey area (lbs)
 - Tallies of each debris item

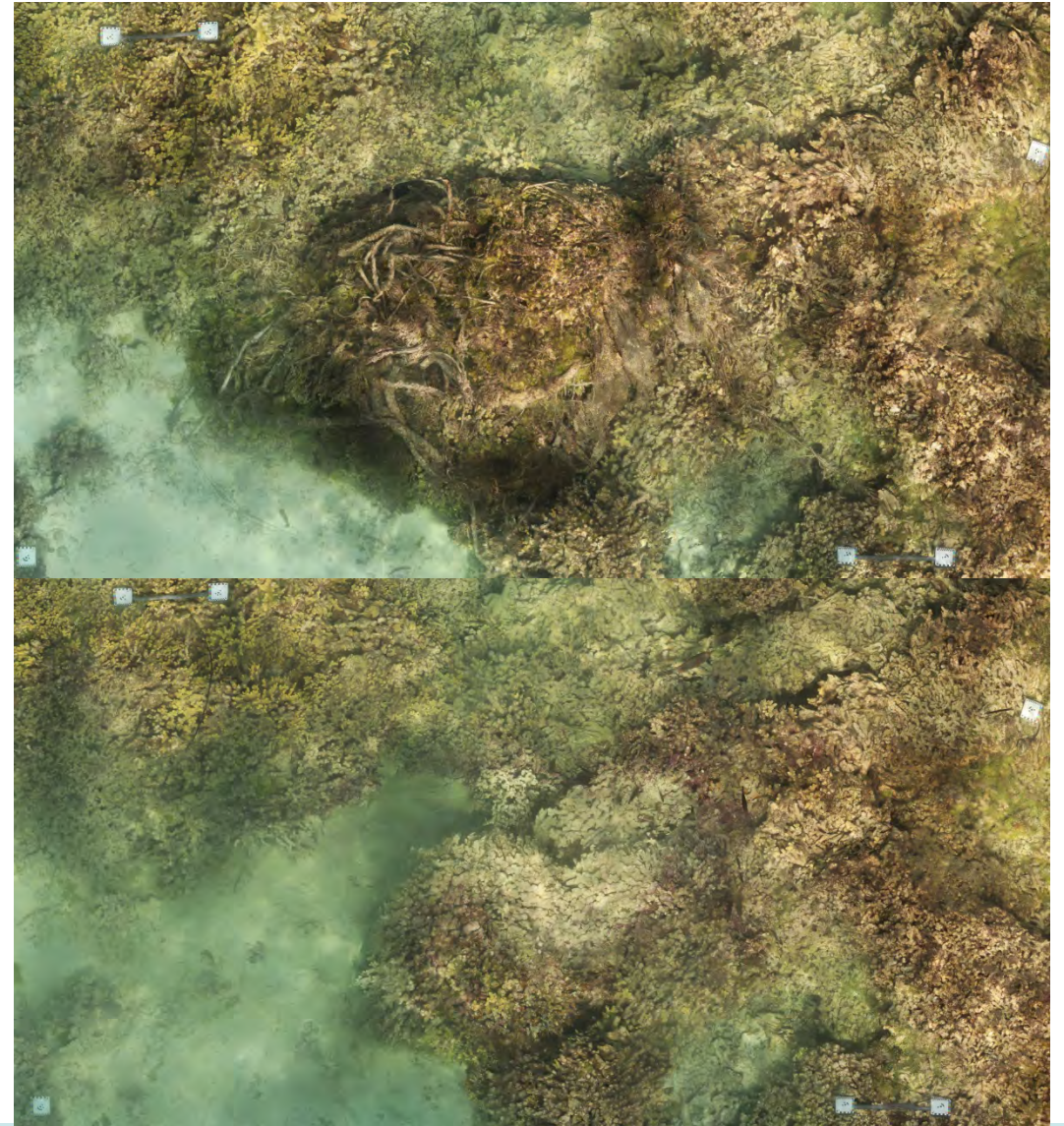


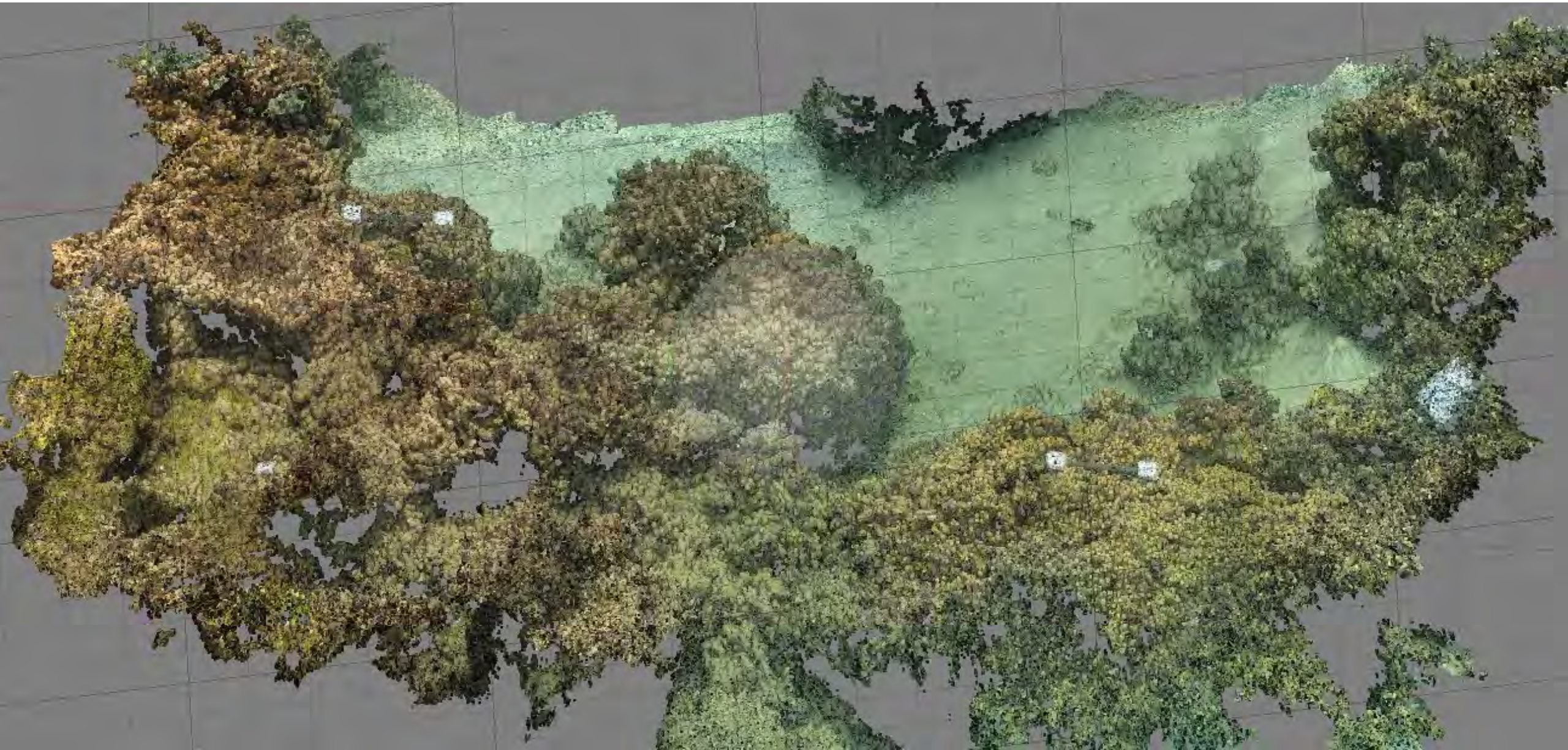




On-going Research – SFM Survey

- Structure-from-Motion 3-D technology to map the reef
- Goal is to quantitatively measure negative impact of net on coral reef ecosystems
 - Pearl and Hermes Atoll - Lagoon
 - 21 impact site mosaics (before and after net removal)
 - 21 control site mosaics
- Analysis and results are pending

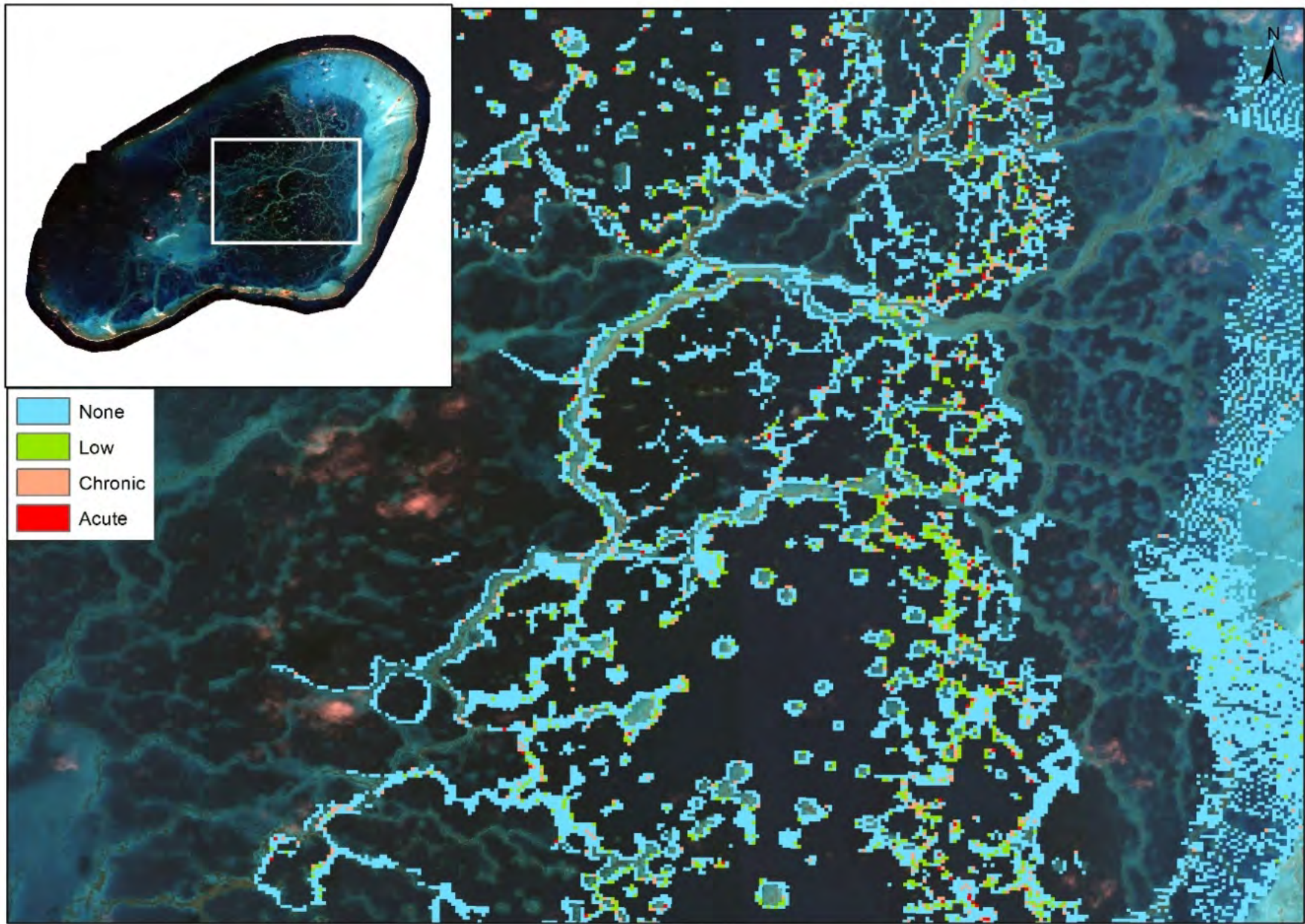




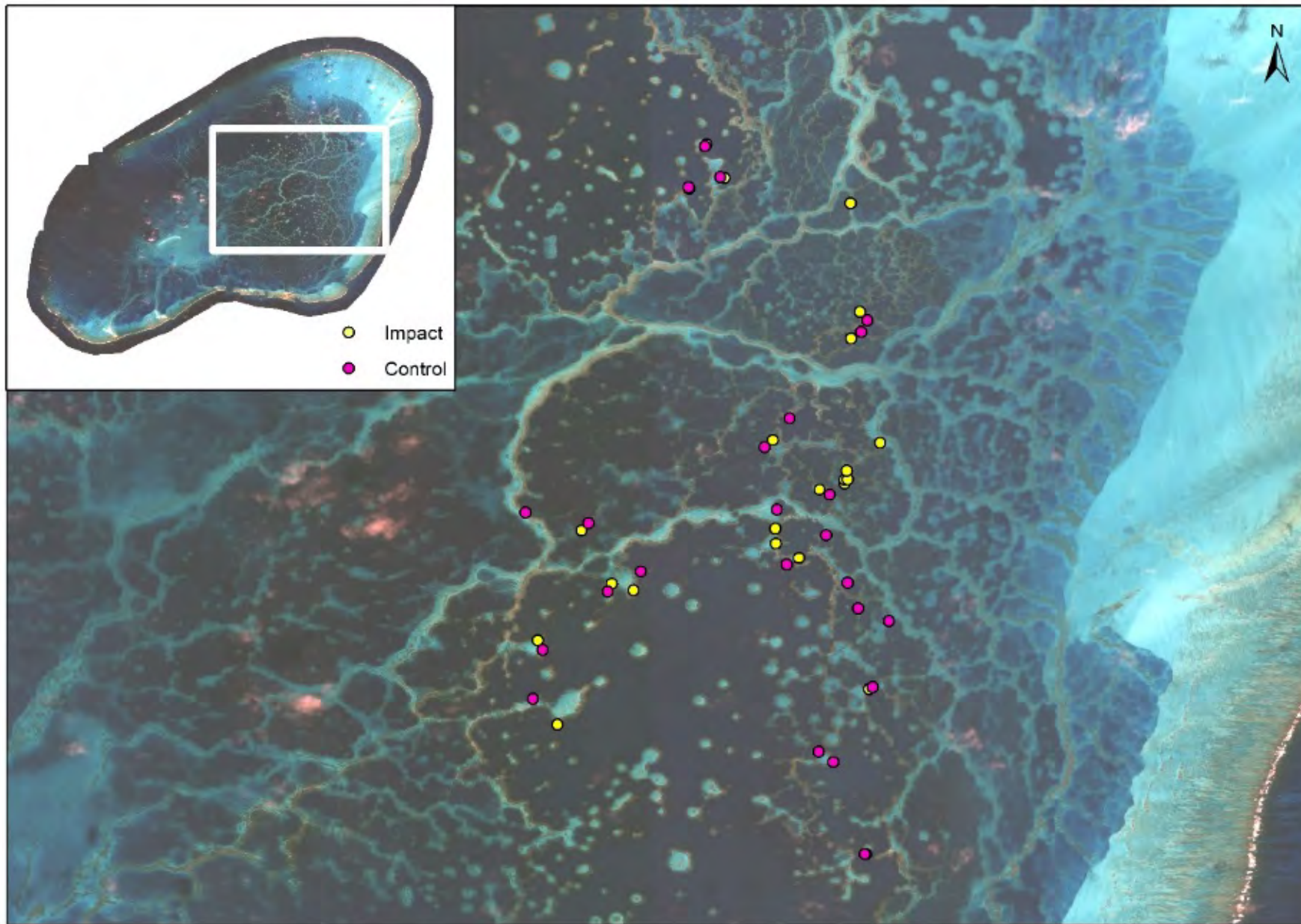
Play Sfm video

- Play Sfm marine debris video





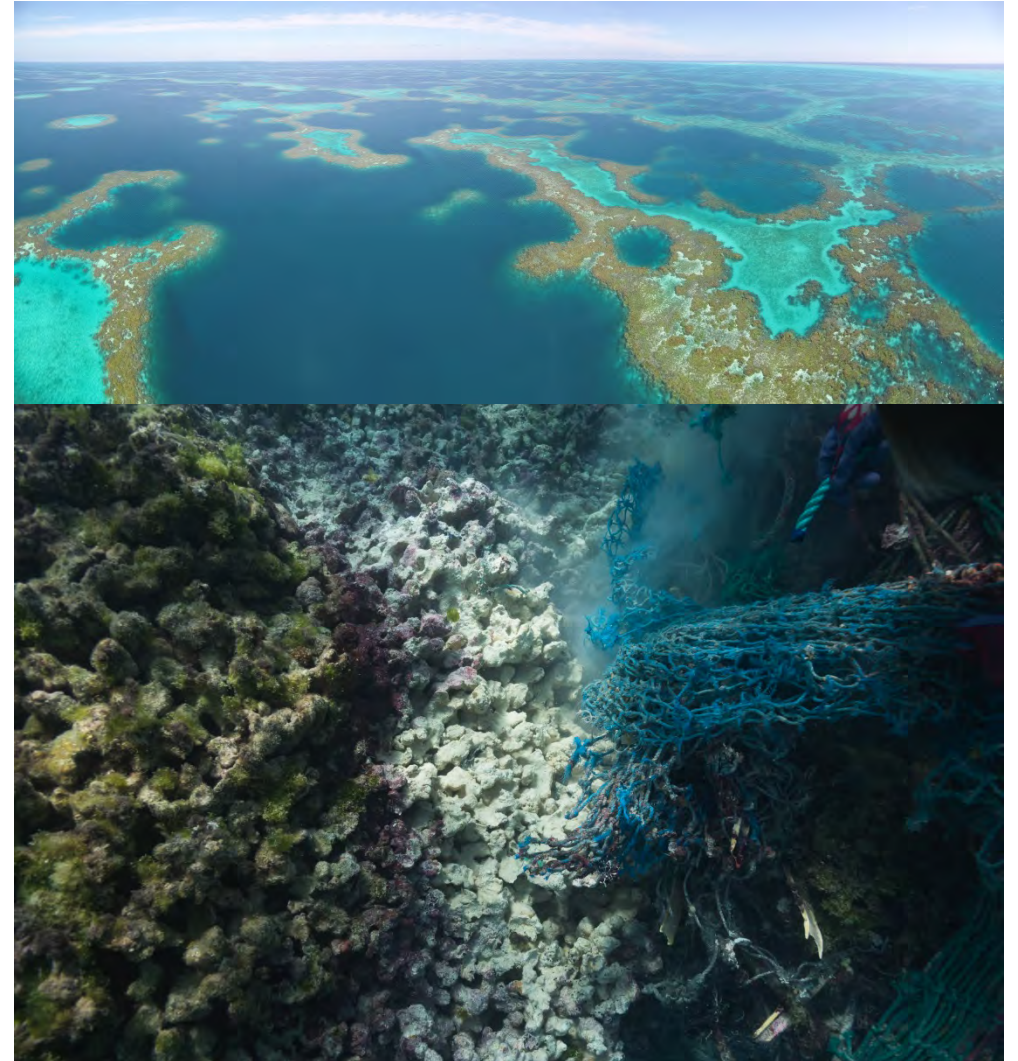
PHR Strata Map



PHR SfM Survey Locations

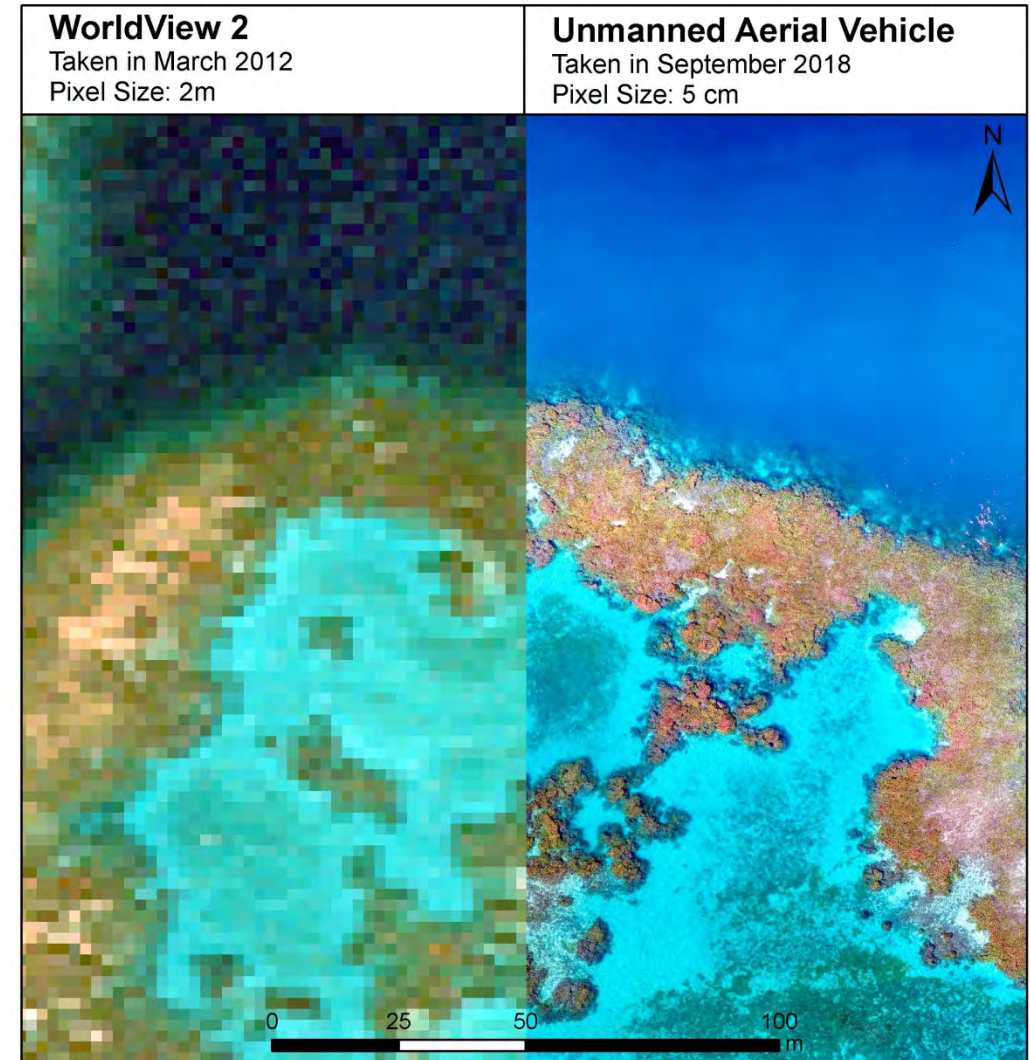
Recent Research – Satellite Buoy Survey

- Paired with SFM study
- Goal is to better understand how many reefs a single net impacts before settling
 - Pearl and Hermes Atoll Lagoon
 - 6 nets tagged
 - Criteria: >75% buoyant, level 1 (minimal) bio-fouling, minimum 0.5 m³
- Analysis and results are pending



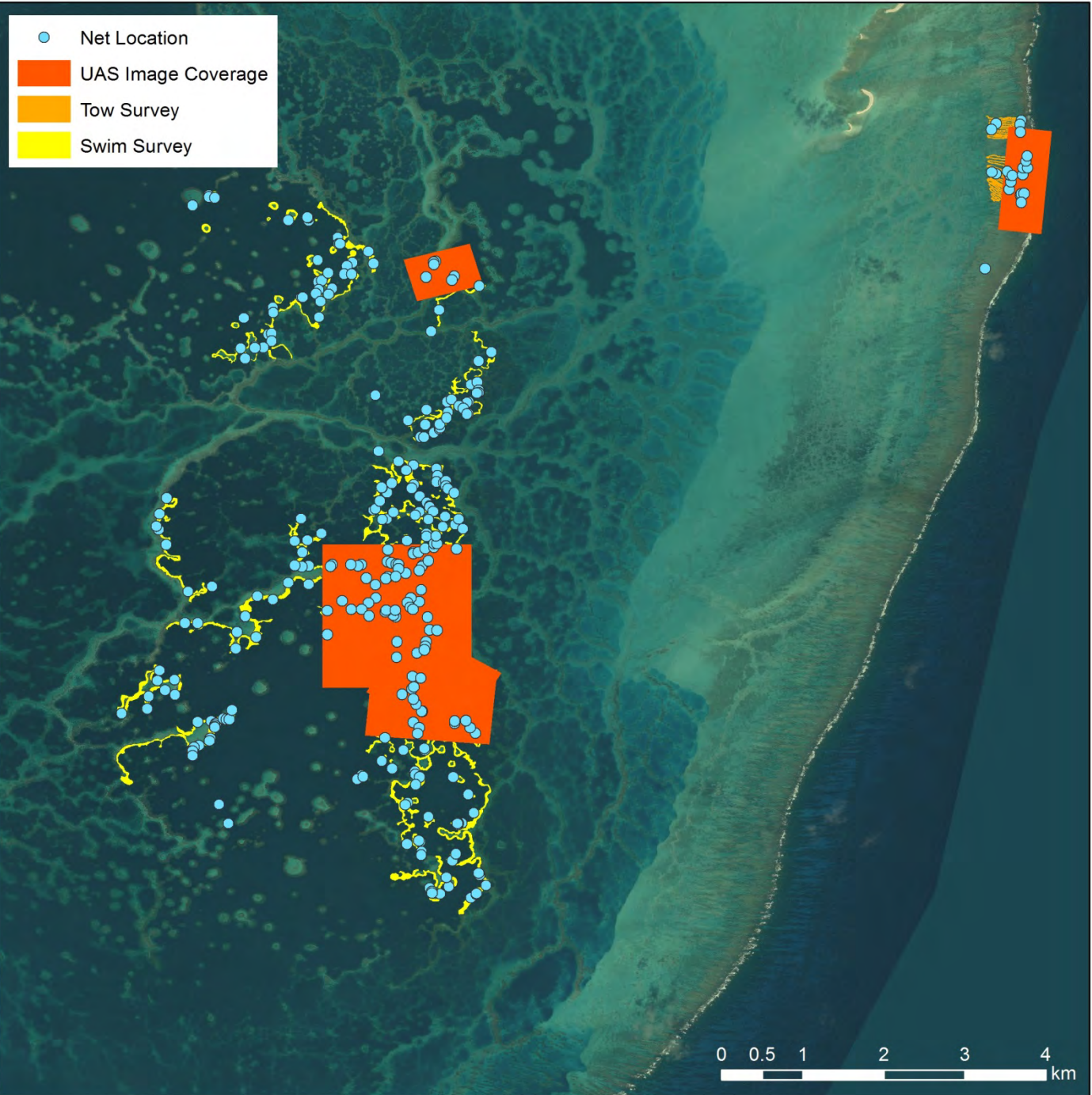
Recent Research – UAS Survey

- Used Fixed-wing UAS to determine if net detection was feasible
- Goal is to reduce in-water survey time and identify net accumulation hot-spots
 - Pearl and Hermes Atoll Lagoon
 - 60m altitude
 - Red-green-blue (RGB) and Infrared (IR) sensors
 - 3.39 km² mapped in <10 cm resolution
 - Mapped areas were ground-truthed via swim survey
- Analysis and results are pending









Future

- 2020 is a data analysis year
 - Analyze shoreline accumulation data
 - Sfm: Compare net size/weight (lbs) to impact area (m²)
 - UAS net detection assessment
- 2021 is next projected field mission
 - Large-scale removal mission (30-60 days)
 - Resurvey impact and control sites for successional change in benthic habitat composition



For more information on the project

- Visit www.marinedebris.noaa.gov
- Visit www.fisheries.noaa.gov/pacific-islands/marine-debris-research-and-removal-northwestern-hawaiian-islands
- Visit <https://marinesanctuary.org/blog/video-spotlighting-the-threat-marine-debris-poses-to-wildlife-in-papahanaumokuakea/>

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Questions?

