



# Marine Debris Program

## Debris Detection: *Background, Efforts, & Lessons Learned*

Peter Murphy

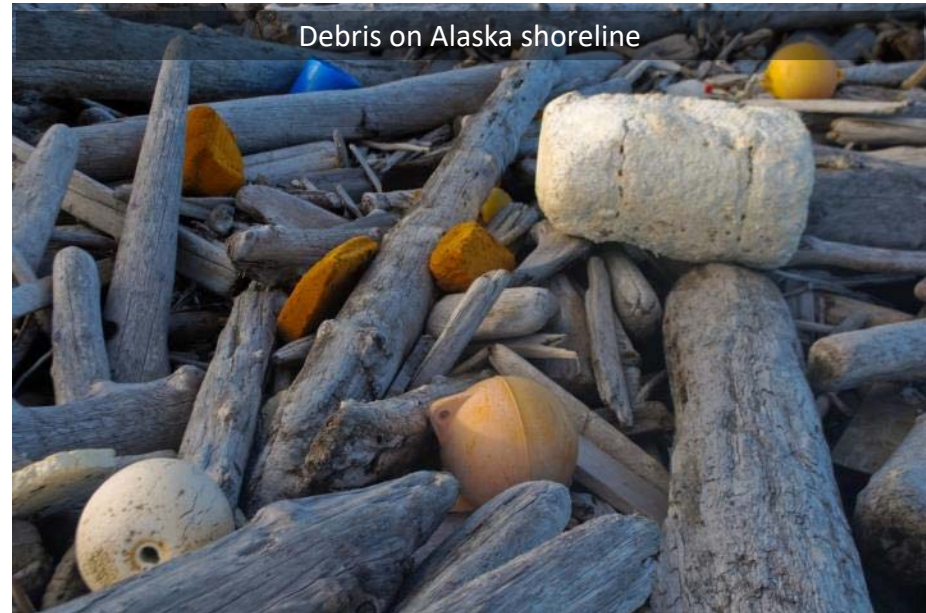
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# Outline

1. Detection Goals / Needs
2. Detection Efforts
  - UAS
  - Aerial
  - Satellite
3. Overall Detection Challenges / Gaps





# Detection Goals / Needs

- **Assessment & Quantification**
  - Composition
  - Concentration
- **Distribution**
  - Spatial
  - Temporal
- **Cleanup Prioritization**
  - Debris types
  - Concentrations
  - Logistics





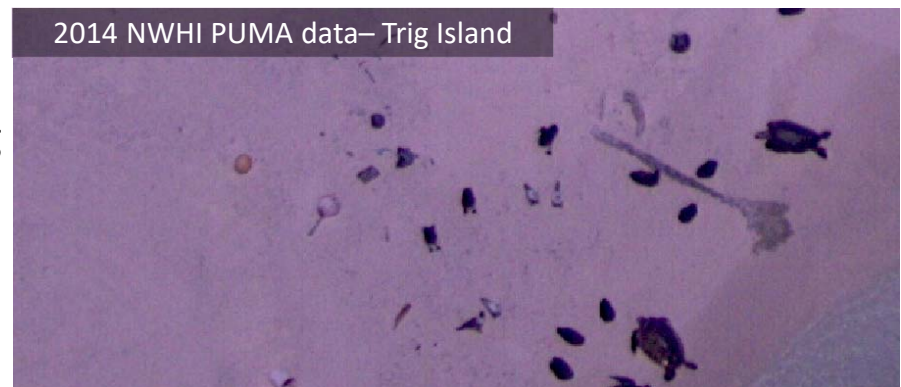
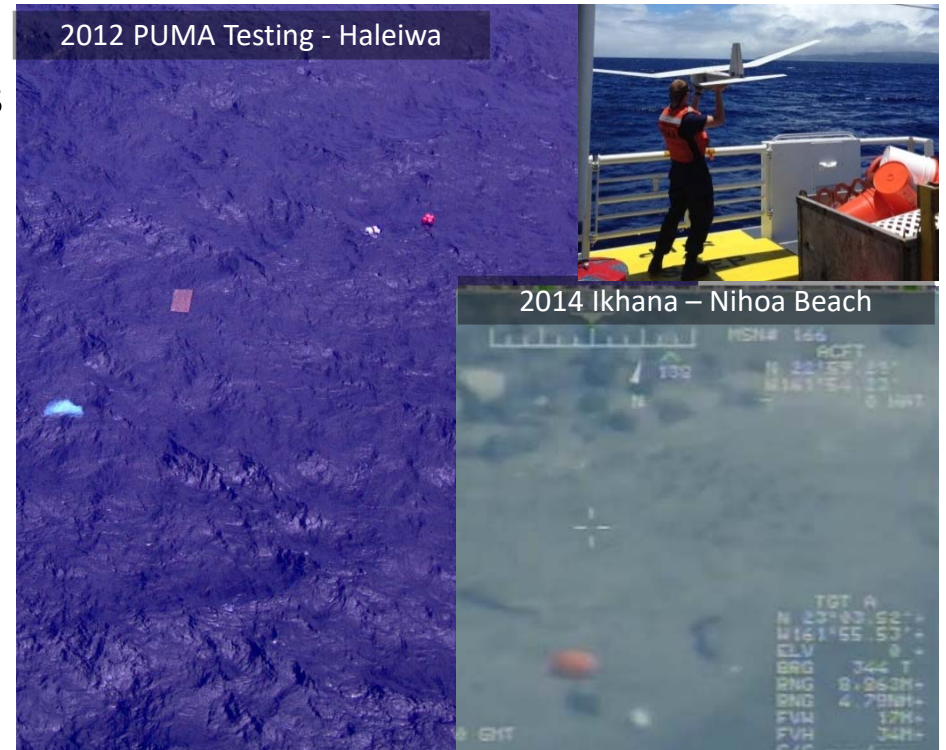
# UAS Testing Efforts

## • Pluses / Opportunities

- Access to sensitive or unsafe areas
- Launch/flight from remote areas without fields
- Reduction in costs
- Improved flexibility in regulatory requirements (USA)

## • Challenges

- Regulatory requirements for operation (USA)
- Wide range of systems – challenge of choice
- Difficulty of reacquisition of targets
- Imagery resolution
  - Can be limitation, though improving rapidly
- Imagery not always set up for ease or speed of processing
  - Video, non-georectification





# Aerial Surveys

- **Efforts**

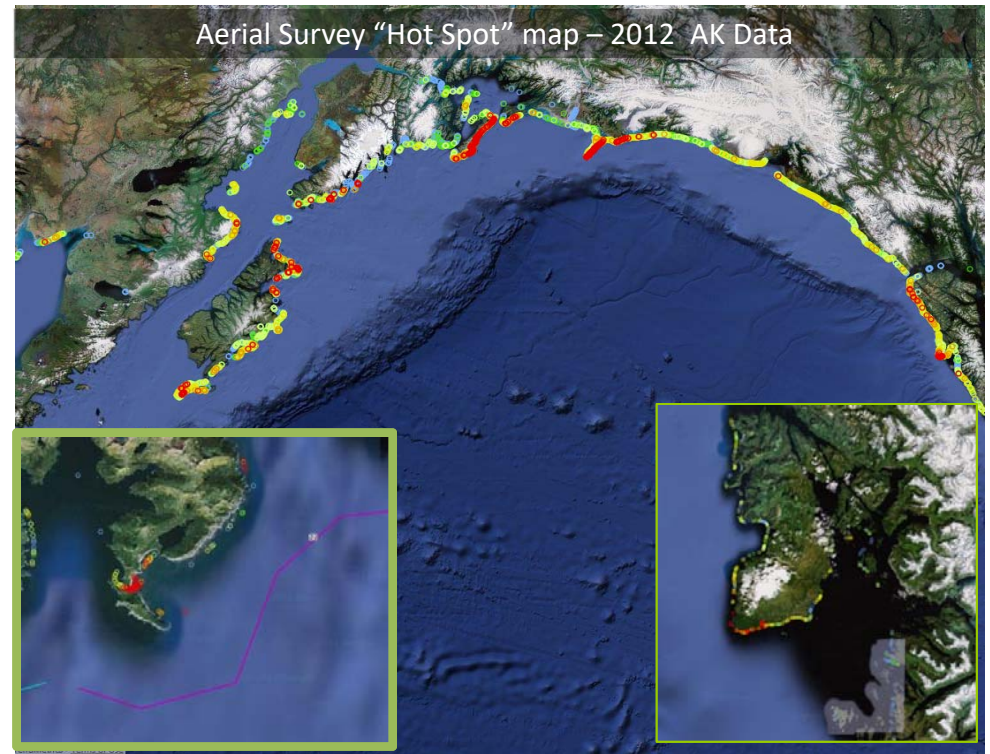
- Shoreline Aerial Surveys
  - Alaska – 2012, 2014, 2015
    - Oblique, qualitative
  - Hawaii – 2015 – 2016
    - Nadir, quantitative
- At-Sea Detection
  - Individual, ad-hoc surveys

- **Pluses / Opportunities**

- Established approach and technology
- Data can be applied to shoreline cleanup prioritization/targeting

- **Challenges**

- Small debris difficult to detect/identify
- Cost of survey and post processing
- Aligning survey design and post-processing to immediate and long term data needs





# JTMD Satellite Survey / Collection

- **Efforts**
  - JTMD Satellite Detection (*Led by NOAA NESDIS SAB*)
- **Background**
  - 2011 – Early initiation
    - Disaster Charter
    - Debris Fields
  - 2012 – Continued collection and analysis
  - 2014-2016 – Transition to ongoing analysis and support
- **Platforms / Sensors**
  - DigitalGlobe
    - Worldview-2, Worldview-3, Quickbird-2, Ikonos, and GeoEye
  - NGA requests through USGS

Platform/ Sensor	World- view 1	World-view 2	World- view 3
Revisit Time	1.7 d	1.1 d	< 1 d
Swath Width	17.7 km	16 km	13.1 km
Multispectral Resolution	n/a	0.46 m	0.31 m
Panchromatic Resolution	0.5 m	1.85 m	1.24 m

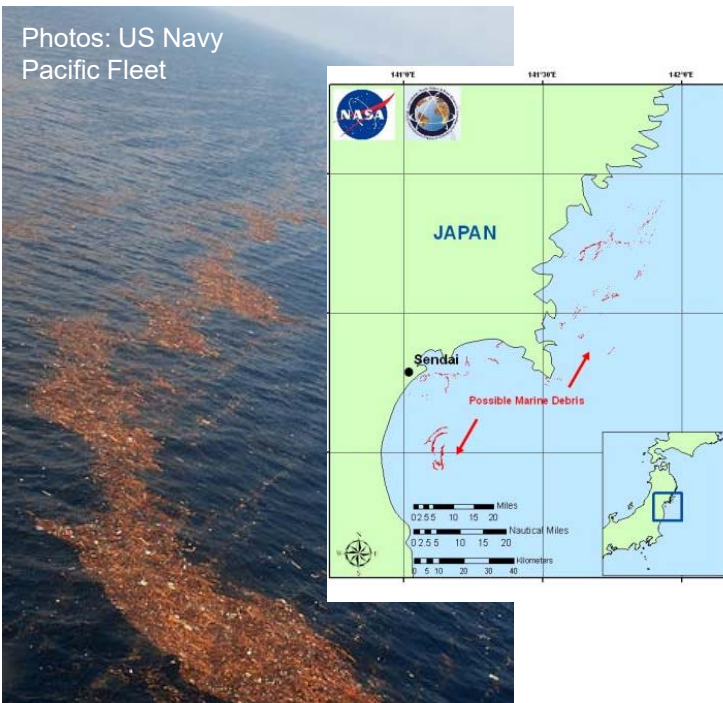


# Satellite Survey / Collection

Debris immediately offshore Japan – March 2011



Photos: US Navy Pacific Fleet



04/17/12  
WV2

Wave Crests

Anomalies

Wave Crests

- Bright anomalies are irregularly shaped
- Bright anomalies occur in wave troughs

Anomaly

Anomaly? Cloud?

08/02/12  
WV2

#1 Zoom [10x]

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# Satellite Survey / Collection

- **Pluses / Opportunities**
  - **Coverage Area** – ability to cover wider area than any other approach
  - **Developing Technology** – Ongoing advancements in sensor and analysis
- **Challenges**
  - **Weather dependency** – many applicable sensors for MD detection are impacted by cloud or sea-state
  - **Resolution limitation** – common debris size often below threshold for reliable identification/differentiation
  - **Processing Effort** – Data processing is labor intensive







# Overall Detection Challenges / Needs

- 1. Encounter Rate** – Debris concentration is often unpredictable and variable, particularly at-sea
- 2. Debris Size** – Most debris is relatively small (<1m in long dimension, often <0.3m)
- 3. Debris Visibility** – Onshore debris often mixed with wrack line or woody matter. Floating debris often awash or partially sub-surface, reducing target size. Many platforms and sensors are weather dependent.
- 4. Detection v. Identification** – Noting the presence of “something” versus identifying what the anomaly is
  - *Challenge increases as resolution decreases*
- 5. Resolution v. Coverage** – Trade-off between detail of imagery versus coverage of imagery
  - *Post-processing is often labor intensive*



# Thank You!

## *Any Questions?*



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