UAS for Environmental Assessments & Response Activities: Lessons Learned and Next Steps

Michele Jacobi, Peter Murphy,
Jordan Stout, Laurie Sullivan

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OR&R Mission

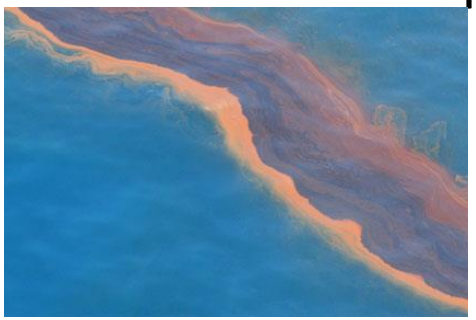
To protect and restore ocean and coastal resources from the impacts of oil, chemicals, marine debris, and other hazards.




OR&R's Interests in UAS

Need to survey broad area types for specific targets, generally on very short notice:

- Oil & contaminant- mapping of extent
- Trust Resource observations & documentation
- Target identification & mapping for debris or facilities
- Species – identification, counts, documentation impacts
- Visual Observation of remote or hard to access areas
- Recreational use and Socio-Economic sites
- Base mapping of sensitive habitats and restoration



Field Tests with Partners

- Coordination with OAR UAS, National Marine Sanctuaries, CA Fish and Wildlife, USCG, BSEE, Chevron, and Vandenberg Air Force Base staff
- Pilot projects testing both land & sea based scenarios for evaluating VTAL and fix winged platforms
  - "Oil" targets for SCAT
  - Fluorescent dye targets
  - Decoy placements
  - Debris identification

Oil Spill UAS deployment

- NRDA wanted to test deployment during real event due to prior successful UAS demos.
- Trustees agreed primarily due to hard to access shorelines & potential wildlife impacts documentation.
- OAR/ NMS supportive of deployment with vessel & staffing capacity.
- Response did not have the operational need for UAS due access to manned craft.

Scope

- Wildlife abundance/ distribution near the spill
  - Location and extent of offshore kelp beds for qualification/ indication of exposure
  - Counts and species observations of potentially impacted wildlife
  - Presence of plankton blooms (feeding grounds)
- Extent and characterization of oil slick
  - Shoreline observations for extent and level of oil
  - Sighting of beach wrack
  - Exposed wildlife observations and counts
  - Oil streaks and tar balls

Implementation

Deliverables requested:

- –Geo Tiffs ready for input into COP within 30 minutes of a shore-based flight landing
- –Derivative products available within 4 hours of a flight landing
- –Copies of data for potential litigation hold for NRDA

Logistics

- –Heavy staff coordination with AV for all field needs
- –NMS *Shearwater* for deployment
- –Response Operations approval and Air Boss coordination requirements
- –NRDA bandwidth/ priority concerns relative to core ephemeral data collection and data in-take needs

Standard Puma Flown

- Covered broad area in single day
- ~180 Images
- 5 videos
- No live wildlife observed
- Could not spatially rectify outputs in time
- Resolution not adequate for operational need

PUMA High Resolution

Spill Outcomes

- Approval to operate when manned aircraft in response area makes UAS deployment *extremely* difficult.
- Footprint of personnel and level of effort required vs products was not optimal with standard Puma.
- Need appropriate camera resolution & target identification (annotation) to map footprint.
- Delays in post processing- need mapped results within ~ 4hrs time for operational decisions.
- Transfer of images, products, and sharing of raw data was difficult with command post due to size and security constraints.
- Directed visual operations or video could be of interest to Response SCAT teams in the future.

Marine Debris Overall Detection Challenges/ Needs

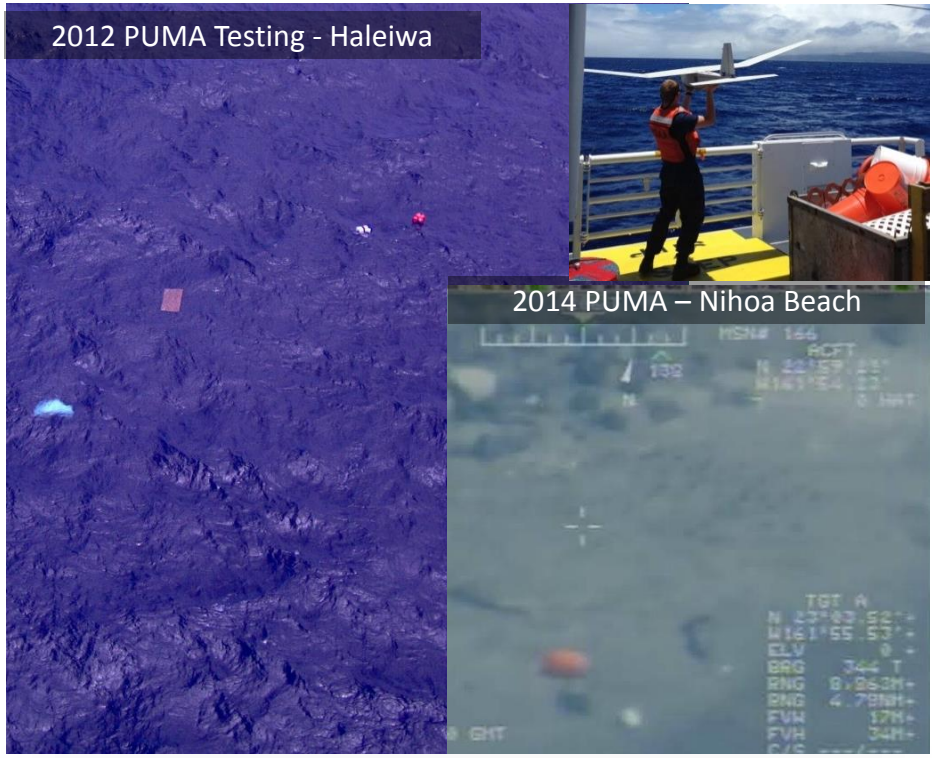
- **Encounter Rate** – Debris concentration is often unpredictable and variable, particularly at-sea
- **Debris Size –** Most debris is relatively small (<1m in long dimension, often <0.3m)
- **Debris Visibility** – Debris often awash or partially sub-surface, reducing target size. Many platforms and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

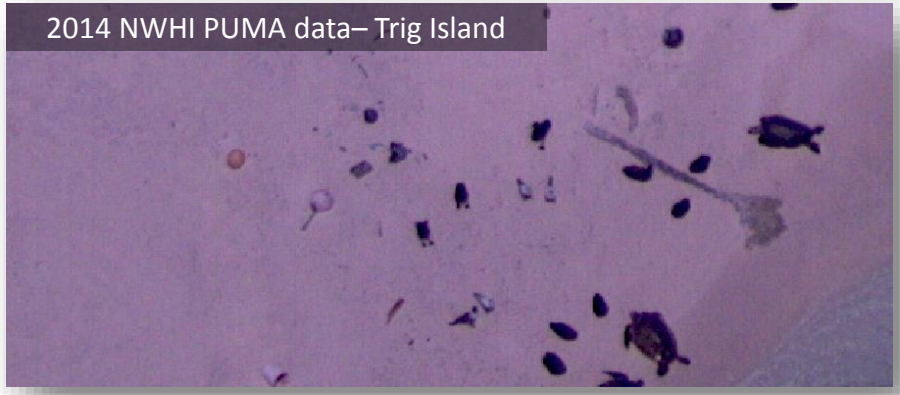
Pluses / Opportunities

- Access to sensitive or unsafe areas
- Launch/flight from remote areas without fields
- Breadth of coverage
- Clear documentation

Challenges

- Regulatory requirements for operation
- Wide range of systems – challenge of choice & access to platform
- Difficulty of reacquisition of targets
- Imagery not always set up for ease or speed of processing
  - Video, non-georectification
  - Annotation

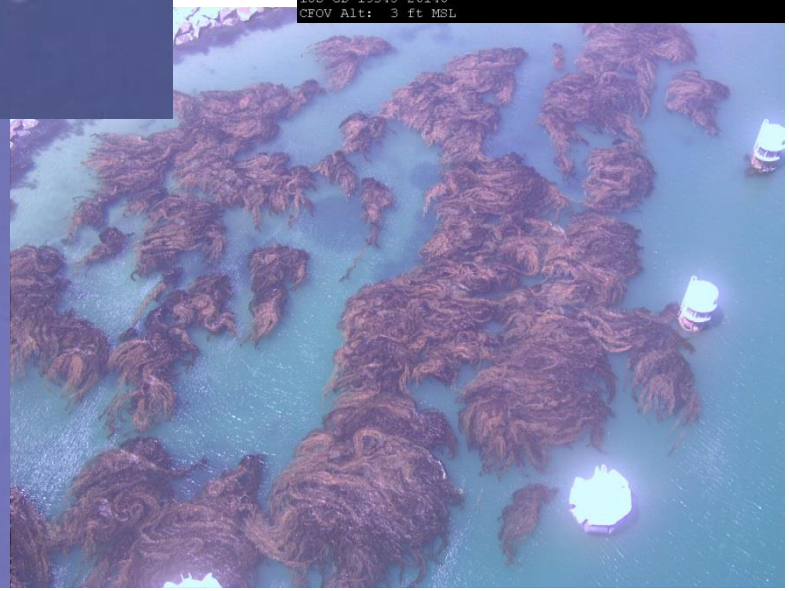




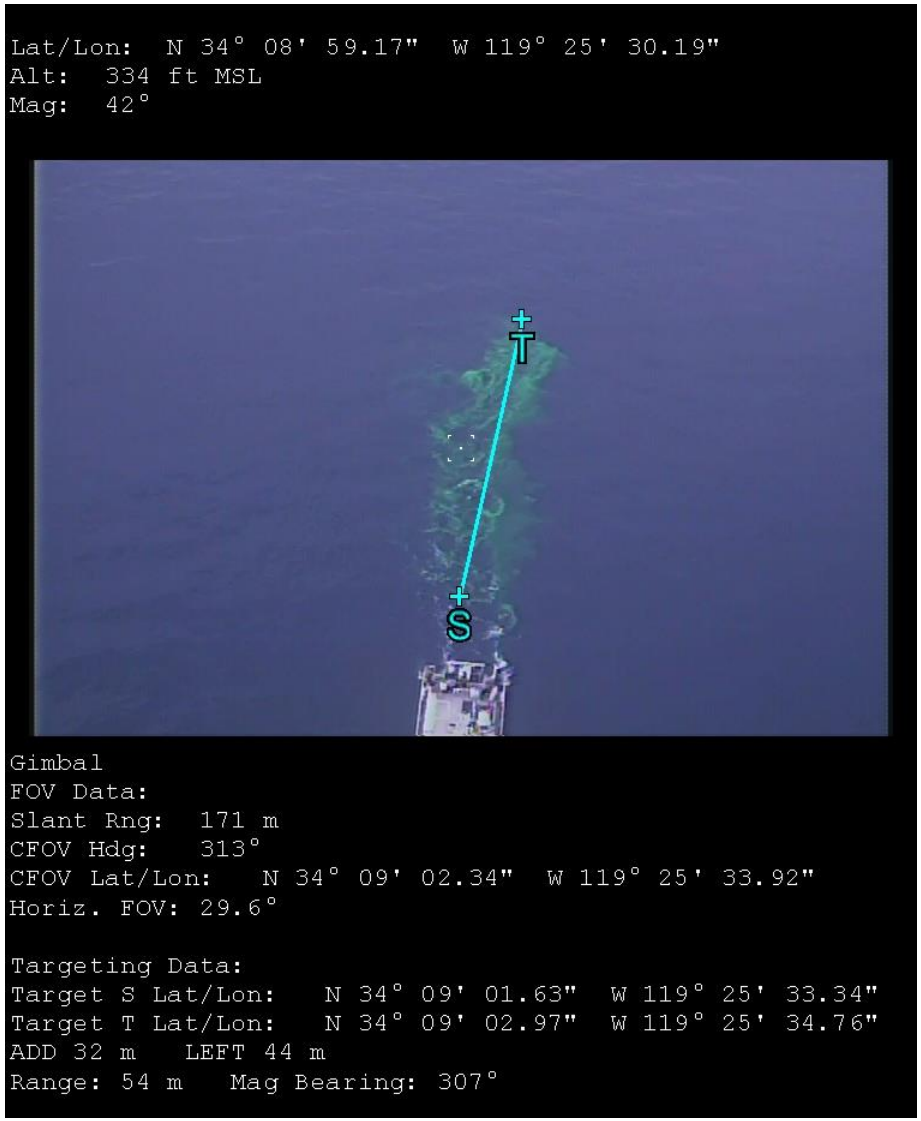
Future Needs

- Streamlined deployment options (FAA/ COA, Section 7, contracting, etc.)
- Geo- rectified processing of data needs to be faster and a standard product
- Additional platforms, sensors and cameras to be evaluated
  - Fixed winged vs VTAL
  - Nadir view and grids applied
  - Lidar, hyperspectral/multi-spectral, IR, mini SAR
- Image transfers and data plans
  - Chain of custody on Data (data erased on both our missions
  - Condensed videos
  - Proper archive

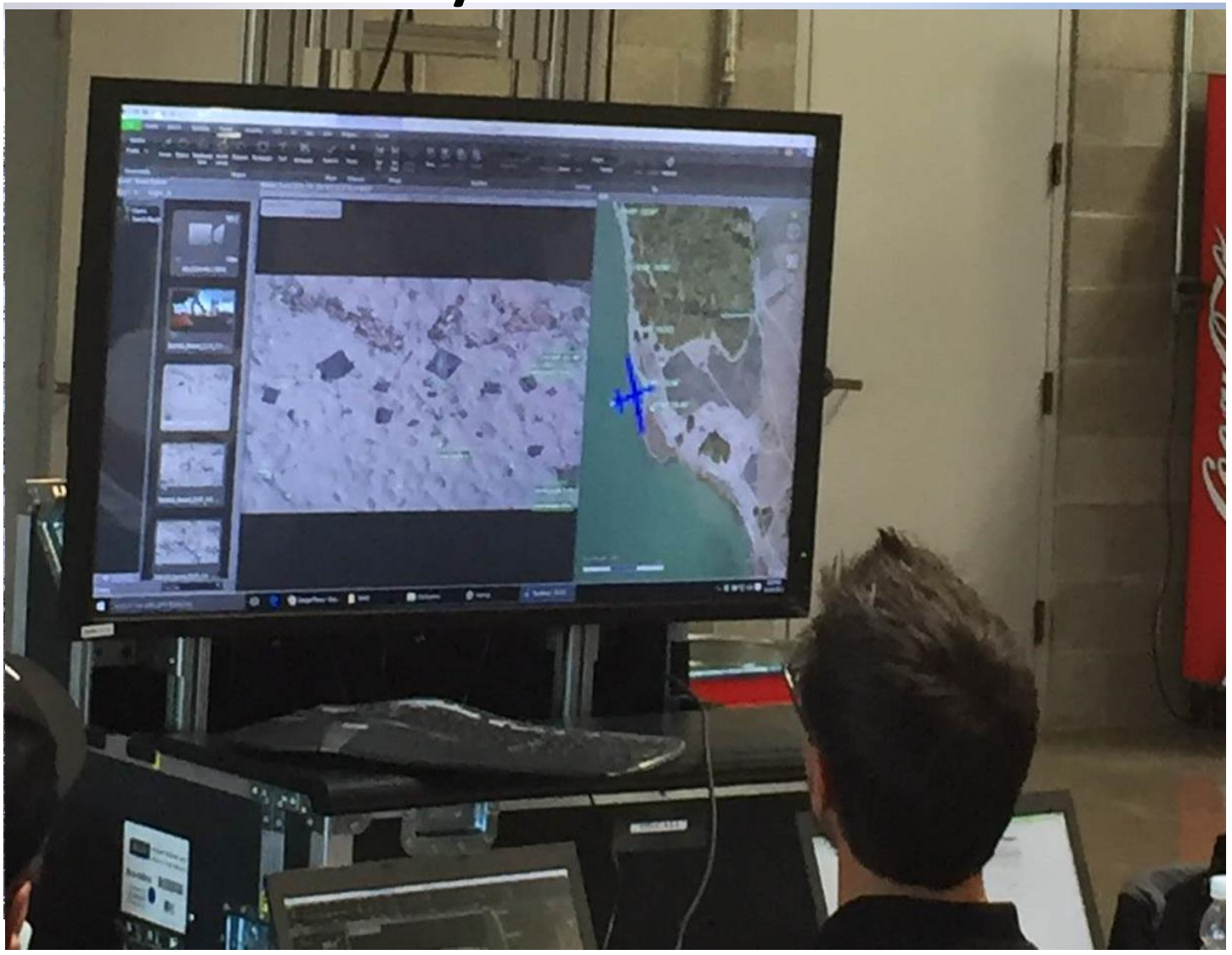
Refined Wildlife Observations



Calculations/ Annotations



Relay Information



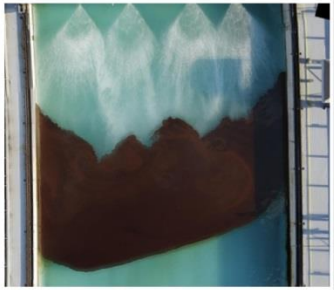
Future Sensor Evaluations

SAR Day 1. Oil Release

SAR Day 2. Emulsion Genesis

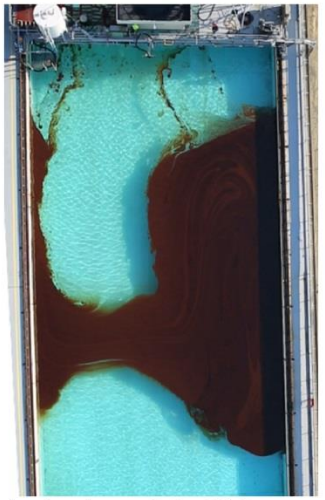
Wave action used to generate the formation of emulsions. Synoptic UAS-SAR image collected aproximately 8 hours after wave started inducing surface turbulence.

SAR Day 3. Emulsion Weathering



Oil and Emulsions weathering process. At this point oil has been exposed to photo-oxidation for about 100 hours, and aproximately 24 hours of wave action. Radiometric measurements showed a concentration of 60:40 of oil/water ratio. When wave action was stopped the de-emulsification was rapidily observed.

SAR Day 4. Emulsion Consolidation



At the time of the SAR snapshot we had already aproximately 48 hours of wave action. The emulsion consolidation starts showing more rigid structures on the surface .

SAR Day 5. Emulsion Establilization

At this point, strong emulsion consolidation is observed. Rough surface structures are observed with air bubbles. Thicknesses above to 2 cm measured with WM oil sampler. About 60 hours of wave action induced. Radiometric readings of 60:40 oil ratio