TACTICAL AIRBORNE OIL SPILL REMOTE SENSING AND BEYOND…. SEA-SPIRES

OSPR/Chevron Oil Spill Response Technology Workshop

February 26th – March 1st, 2019
Chevron Park, San Ramon, CA
The Needs

Since Deepwater Horizon multiple studies by Industry and Government have all led to the same conclusion: Improved use of remote sensing is critical to oil spill response. The conclusions suggested that for the oil responder community an effective airborne platform is a must.

The conclusions of several studies suggest that an effective remote sensing platform should feature:

- **Multiple sensors** for complementarity/redundancy;
- **Classification** of pollutants, no false-positive;
- **Identification** of oil targets as Recoverable or Non-recoverable;
- **Georeferencing** the targets and Tracking moving oil;
- **Expansion of the operating window** to low-light / bad weather conditions;
- **Real time information** - for tactical and strategic use;
- **Data suitable for the Common Operating Picture** and for Decision Makers;
- **Readiness of crew and platform.**
The conclusions of several studies suggest that an effective remote sensing platform should feature:

Poseidon I entered in service in July 2016 participating in a program coordinated by BSEE and NOAA to assess new technologies for aerial remote sensing. Is currently fully operational.

Poseidon II will enter in service in late 2019.
Intelligence on the Scene

POSEIDON MISSION SYSTEM

SENSORS

DATA PROCESSING

COMMUNICATIONS

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Intelligence on the Scene

MISSION PROFILE

STEP 1
Far Range Detection

3,000 ft

STEP 2
Near Range Analysis

1-3,000 ft

STEP 3
Data Processing

3,000 ft or higher

STEP 4
Data Transfer

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1-FAR RANGE DETECTION

SLAR – SIDE LOOKING AIRBORNE RADAR

CLOUD PENETRATING X-BAND (~9.3GHz) REAL APERTURE RADAR

PRIMARY TOOL FOR SYNOPTIC, WIDE COVERAGE OIL SPILL DETECTION. 50 NM SWATH – 7,500 Sq. NM / HOUR

FUSION OF AIS DATA, SATELLITE IMAGERY, SLAR DATA IN GIS ENVIRONMENT

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2-Near Range Analysis

Accurate analysis of the oil spill

- Multiple sensors for complementarity/redundancy
- Each sensor detects specific features of the spill

**VIS**

Oil Appearance codes

**UV**

Sensitive above 0.01 µm layers (UV) and 2 µm layers (IR).

**IR**

Mapping / Area / Position / Coverage % / Dimension / Relative Thickness / Drift / Spreading / Volume estimate

**Fusion IR/UV**

**MWIR**

Absolute Thickness Measurement

50 µm to 3 mm

**LFS**

Oil Classification / Weathering Absolute Thickness Measurement

0.1 µm to 20 µm

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3-DATA PROCESSING

RESPONDERS NEED INTELLIGENCE

- WHERE?
- WHAT TYPE?
- ACTIONABLE?
- HOW MUCH?
- HOW'S MOVING?
- MAP?

DATA ANALYSIS, FUSION AND GEOREFERENCING TO GENERATE INFORMATION

INFORMATION

- Area (NM²)
- Position (Lat, Lon)
- Coverage (%)
- Thickness Distribution (µm)
- Volume (Gal)
- Hot Spots
- Drift, Spreading (NM/h, NM²/h)
- Oil Classification
- Georeferencing
- AIS data fusion

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4-INFORMATION DELIVERY

COMMUNICATION NETWORK

- **MBR** - HIGH-SPEED AND HIGH CAPACITY MICROWAVE DIGITAL RADIO LINK
  - 15 Mbit
  - RANGE 70 NM @ 3,000FT
- **SATELLITE LINK**
Intelligence on the Scene

4-INFORMATION DELIVERY
WEB BASED GIS INFORMATION DISTRIBUTION

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4-INFORMATION DELIVERY
WEB BASED GIS INFORMATION DISTRIBUTION

VIS

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Intelligence on the Scene

4-INFORMATION DELIVERY
WEB BASED GIS INFORMATION DISTRIBUTION

- The thickness map is originated with data acquired with IR/UV, MWR (20Hz scan frequency) and LFS (10Hz repetition rate) that measured the absolute thickness.
- Thickness data point are acquired every 4-9m (12-30ft).
Projects

COASTAL MONITORING

- Focus on East Texas – route of 300 NM – TGLO Region I and II
  - Teams: Airborne (Fototerra), Oceanographic (Texas A&M), In-situ (TGLO), GIS (TGLO/Fototerra)
- Airborne Remote Sensing capabilities proven in a real scenario.
- Teams Coordination, Data/Voice Communication tested during the missions.
  - Several Oil Spills Detected

EARLY SPILL WARNING SYSTEM

- INTRODUCE RESPONDERS COMMUNITY TO PRO-ACTIVE SURVEILLANCE
- SUPPORT THE OIL AND GAS INDUSTRY IN CASE OF OIL SPILL RESPONSE
- DETER SHIP TRAFFIC DISCHARGES
- SAFEGUARD THE TX POPULATION AND THE VITAL COASTAL ECONOMY
- ENSURE TEXAS NATIONAL LEADERSHIP

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HARVEY DAMAGE ASSESSMENT

- 2 missions flown in the aftermath of Hurricane Harvey.
- Several findings reported to GLO and NOAA
- Coordination/ Communication
- Specialized Asset

August 31st

September 2nd
Projects

HARVEY DAMAGE ASSESSMENT

- Duration of the mission: 2h
- >10,000 Sq NM scanned.
- 12 target identified.
- 4 targets analyzed and confirmed as oil spill.
- HD Video of flooded area.
Projects

HARVEY DAMAGE ASSESSMENT

- Condensate spill – Aransas Bay

INFRARED IMAGE

ULTRAVIOLET IMAGE
Projects

**HARVEY DAMAGE ASSESSMENT**

- Duration of the mission: 1h
- >5,000 Sq NM scanned.
- 2 target identified.
- 1 targets analyzed and confirmed as oil spill.
- HD Video of flooded area and Crosby Facility

*September 2nd*
What’s Next

The Gulf Coast is extremely exposed to pollution due to either accidental or illegal discharge.

- Possible oil discharges can cause significant damages to local coastal economies and to the energy industry and impacts to natural wildlife.

- The current approach to fighting oil spills in our Country is focused on REACTION at the expense of EARLY DETECTION and PROACTIVE ACTION. DWH showed that didn't work. Idea is to **SHIFT FROM DISASTER RECOVERY TO RESILIENCY.**

Gulf of Mexico Oil Production: **1.5 – 1.6 millions of barrels per day**, more than half billion of barrels per year.

About **2 billions of barrels** per year are transported by vessels in the Gulf of Mexico area.
What Happen Around Us?

The Bonn Agreement is the mechanism by which nine Governments of the Greater North Sea, and the European Union, cooperate in dealing with pollution of the North Sea. About 4,000 hrs flown every year.

Brazil started in 2018 an intense program of coastal surveillance based on airborne remote sensing.

Transport Canada operates a National Aerial Surveillance Program of the Coastal Waters with more than 4,000 hrs flown every year.

Reduction of number and consequences of the spills over the years
- Early Stage Detection
- Training and familiarity
- Deterrent for Illegal Discharge

... and the world's largest crude oil producer
The answer SEA-SPIRES

SEA-SPIRES is a partnership between commercial, agencies, and non-commercial stakeholders that provides integrated best available technology for oil spill remote sensing across the disaster cycle.

SEA SPIRES integrates satellite data with airborne remote sensing data, current and wind data, vessel information, and hindcast/forecast modeling in the SEA-SPIRES decision support system iDEMOSP (Integrated DECision Making for Oil Spills) providing informed output to support accurate and robust decisions across the disaster cycle: early detection, mitigation, recovery, resiliency.

The SEA-SPIRES consortium is jointly led by Bubbleology Research International and Fototerra Aerial Survey, supported by Texas A&M University and University of South Florida.
How SEA-SPIRES works

SATELLITE SEA-SPIRES acquires and analyzes repeat MODIS, COSMO-SkyMed SAR, Digital Globe, and other satellite imagery with unsupervised detection, mapping, and thickness algorithms. Data from all these sensors and their analysis are ingested into iDEMOS, which escalates or demotes anomalies, triggering actions or additional data requests, respectively.

TRAJECTORY Automated hindcast modeling uses data from a network of oceanographic/meteorological sensors, buoys, HF radar, etc., AIS vessel and infrastructure data to evaluate possible spills.

AIRBORNE POSEIDON flies the most extensive sensor suite in North America, providing the most effective and robust airborne solution for oil spill remote sensing bar none. Poseidon’s Mission Control Unit (MCU) integrates sophisticated communication including a high-speed high-band microwave radio data link for network connections with incident command, response vessels, clients, and consortium members. Satellite and airborne data are integrated and disseminated in near real time (<30 min) in a GIS environment to support spill response decision-making.
How SEA-SPIRES works

Satellite Imagery over Trinity Bay, TX

VIIRS – 375m resolution
No possible oil anomalies identifiable

MODIS Terra – 250m resolution
No possible oil anomalies identifiable

MODIS Aqua – 250m resolution
It's possible that the linear feature is oil, especially given your overflight, but the image resolution is too coarse to be confident.

Landsat-7 30m optical. Center of the Bay is too dark to discern an oil anomaly, if one even exists at this time.
Key Advantages

**SPOTTER PLANE VISUAL ASSESSMENT VS. MULTISENSOR REMOTE SENSING PLATFORM**

- Still several years after DWH, visual assessment is the most common way to ASSESS (?) spills and SUPPORT (?) responders.
- Based on Naked Eye / Digital Camera.
- Spotter plane, fixed or rotary wing, can be a blind $15,000/h asset.
- Often Vessels are deployed and stand-by (tens of thousand dollars per day).
Key Advantages

MULTISENSOR ENVIRONMENT enhances dramatically the capabilities to detect and analyze the spill.
Key Advantages

Surface COVERAGE

SPOTTER PLANE

Naked Eye Range 2NM (best conditions)
Coverage: 600 Sq.NM/hour

† 4NM

PRODUCTIVITY?
Key Advantages

- More than 12 TIMES MORE PRODUCTIVE
- Increases dramatically EFFICIENCY and COST SAVING

SLAR swath 50NM
Coverage: 7,500 Sq.NM/hr
Key Advantages

**SPOTTER PLANE**

- **NIGHT CONDITION**
- **CLOUD COVERAGE**
- **WEATHER?**

**POSEIDON**

- ALL-WEATHER/coverage operations
- NIGHT Operations
- Expands the OPERATION WINDOW
- SLAR / IR / EO/IR / MWR / LFS

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Key Advantages

**Spotter Plane**

- Common Operating Picture?

**Poseidon**

- REAL TIME DATA TRANSMISSION
- QUANTITATIVE INFORMATION
- GEOREFERENCED DATA / GIS
- EFFECTIVE PLATFORM FOR THE DECISION MAKERS
- DEFENDABLE DATA
- WEB BASED DATA DISTRIBUTION

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THANK YOU!

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