## **KSAT - Kongsberg Satellite Services**

Avances en monitoreo satelital con entrega rápida de datos en soporte al sector Energético de México

**KSAT** 

Carles Debart – carlesd@ksat.no **Project Manager Energy, Environment & Security 10th of October 2019 - CDMX** 



# **Brief Introduction KSAT representatives in the workshop**





## **Carles Debart**

- Project and Business Development // Project Manager
- 10 years of combined experience in the Earth Observation field
- Focus on Oil&Gas majors // Onshore & Offshore // Mexico
- Nationality: Spanish // Languages: Spanish, English



## **Andreas Hay Kaljord**

- International Sales Manager
- 15 years of combined experience in Project Management and Software development
- Focus on vessel detection, oil spill detection and ice monitoring
- Nationality: Norwegian // Languages: English, Norwegian

## KSAT Introduction Company ownership





## **Business areas**



SATELLITE OPERATIONS



## KSAT Introduction HQ TROMSO – 69deg North





## **KSAT Introduction Svalbard Ground Station**





- Biggest Ground Station of its kind
- Allows for Near Real Time image delivery worldwide

## KSAT Introduction Employees – total of 240 and growing





# **KSAT Introduction Department of Energy, Environment & Security**





- Oil Spill Detection
- Natural Seepage detection
- 24/7/365 Ordering support
- Image post-processing
- Ice detection
- Pipeline monitoring
- Change detection

# KSAT KEY CAPABILITIES

# KSAT Key Capabilities 24/7/365 Support





- Control Center Global Ground Network
- Automatic scheduling of satellite passes
- 36.000 passes per month
- Proficiency 99,8%

- Earth Observation Center
- Image processing and analysis
- Near Real Time reporting to end users world-wide
- Emergency order support 365/24/7

# Operations room at KSAT is working 24/7 to support with Satellite imagery our customers around the world

# KSAT Key Capabilities Multi-mission – in theory





KSAT has Near Real Time processing equipment for delivery of nearly all operational SAR satellites & Superview

Also distributor of:











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A MAXAR COMPANY

## New SAR Satellites GAOFEN-3 (GF-3) in Near Real Time



#### **Applications:**

- INSAR (under evaluation)
- Change detection
- DEM generation
- Coherence estimation
- Flood detection
- Oil Spill detection

# Compatible modes with Radarsat-2

Mode	Nominal Size [km x km]	Spatial resolution [m]	Incidence angles [degrees]	Polarizations
Spot Light	10 x 10	1.0	20°-50°	Single
Ultra-Fine Strip	30 x 30	3.0	20°-50°	Single
Fine Strip I	50 x 50	5.0	19°-50°	Single, Dual
Full Polarized Strip I	30 x 30	8.0	20°-41°	Quad
Fine Strip II	100 x 100	10.0	19°-50°	Single, Dual
Wave Imaging	5 x 5	10.0	20°-41°	Single, Dual
Standard Strip	130 x 130	25.0	17°-50°	Single, Dual
Full Polarized Strip II	40 x 40	25.0	20°-38°	Quad
Extended - low	130 x 130	25.0	10°-20°	Single, Dual
Extended - high	80 x 80	25.0	50°-60°	Single, Dual
Narrow Scan	300 x 300	50.0	17°-50°	Single, Dual
Wide Scan	500 x 500	100.0	17°-50°	Single, Dual
Global	650 x 650	500	17°-53°	Single, Dual

## **New Optical Satellite**

## **SUPERVIEW 1/2/3/4 constellation – in Near Real Time**

- Distribution rights:
  - Worldwide except for China
  - Tasking, Downlink, Processing, Post-processing, Delivery
  - 24/7/365 Ordering Support
  - Available immediately
  - Available in Near Real Time
- Technical Specs.:
  - SuperView 1/2/3/4 Sensor Resolution:
    - At nadir 50-cm panchromatic & 2.0-m
      multispectral
    - 20° off-nadir 59-cm panchromatic & 2.36-m multispectral
    - 30° off-nadir 71-cm panchromatic & 2.84-m multispectral
    - 45° off-nadir 1.2-m panchromatic & 4.8-m multispectral

- 4 identical satellites 4 times more acquisition capabilities
- 50cm Resolution panchromatic
- Near Real Time delivery <2h</li>





# KSAT Key Capabilities Multi-mission – in practice





Image coverage with 1 satellite: poor revisit time, poor coverage, ineffective monitoring

KSAT Multi-mission: daily revisit time, total coverage, exhaustive monitoring, near real time (<2h)

# More satellites mean more possibilities of imaging an area both for preparedness and response

# KSAT Key Capabilities Near Real Time – in practice





- Green Area downlink to Svalbard
  - 30 minutes
- Brown Area on board storage and downlink to Svalbard/Troll
  - 1 hour
- Blue Area downlink to Troll
  - 30 45 minutes

# Delivery of Near Real Time SAR in less than 2 hours (guaranteed) from acquisition Worldwide

## KSAT Capabilities Summary



- KSAT doesn't own satellites, but offers the most extensive portfolio (Multi-mission)
- KSAT offers unrivaled delivery times (NRT) for 11 SAR and 4 Optical satellites
- KSAT operations provides 24 / 7 / 365 support
- 25 years of experience delivering Earth Observation services
- https://www.youtube.com/watch?v=NPcVViScLYI

## **KSAT Energy customers**



# Introduction to Earth Observation Satellites

# Introduction to Earth Observation satellites Geostationary vs Low Earth Orbit (Polar Orbit)





## KSAT operates the biggest ground station network for Polar Orbit satellites

## Introduction to Earth Observation satellites Polar Orbit Satellites – how do they work?



## **Svalbard Ground Stations enables Near Real Time delivery worlwide**

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# Introduction to Earth Observation satellites Sensors: Active vs Passive (RADAR vs OPTICAL)





## Introduction to Earth Observation satellites RADAR vs OPTICAL: in practice





# RADAR satellites (SAR) are not affected by clouds, fog or low light conditions, therefore are more suited to regular monitoring

# Introduction to Earth Observation satellites RADAR: bands, modes, resolution (adjustable)





## KSAT uses the best satellites/sensors for the given application

# Introduction to Earth Observation satellites RADAR: bands, modes, resolution (adjustable)



## Example of coverage and resolution between different modes



## Introduction to Earth Observation satellites RADAR: bands, modes, resolution (adjustable)





### TS-X Stripmap 30km wide At 3m resolution

TS-X ScanSAR 100km wide At 19m resolution

# Earth Observation for the Energy Sector









#### Source: EO4OG project



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Case studies for the Energy Sector in Mexico : Offshore

**Oil Spill Monitoring** 

## Case Study Offshore: Oil Spill Monitoring Theory of Oil Spill Detection with RADAR satellites



## What does the RADAR see?



## Case Study Offshore: Oil Spill Monitoring Theory of Oil Spill Detection with RADAR satellites

What does the RADAR see?





## Case Study Offshore: Oil Spill Monitoring Theory of Oil Spill Detection with RADAR satellites



### **Challenges - lookalikes**



Wind shadows

Natural dampening - algae

Natural seepage



## External data: AIS (Automatic Identification System) in vessels



SAR Image of Detected Slick



AIS track information then overlaid to find likely vessel-slick correlation

**Polluter Identified** 

## External data: Ocean Surface Wind (both from SAR and Models)



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## External data: Sea Surface Temperature and Chlorophyll









### External data: all sources are available and synchronized for analysis







### **Results: fully analysed Oil Spill Reports**



### **Results: fully analysed Oil Spill Reports**

#### **6 Spill Detection**

Detection Time	Central Position	Central Position				
2017-05-29 02:14:58.1	25° 20' 16.79" N / 053° 08' 1	25° 20' 16.79" N / 053° 08' 11.71" E				
Area	Length	Width	Orientation			
67.63 km <sup>2</sup>	53.85 km	11.72 km	235.05°			
-	-	-				
Classification						
Shape	linear	Contrast	strong			
Outline	fragmented	Edge	sharp			
Wind related	no match	Texture	variable			
Possible source	likely source	likely source				
Repeated observation	false					
Natural slicks in vicinity	false					
-	· · ·					
Met-ocean data						
Туре	Value	Source	Source			
remote	2.0 m/s from 293.9°	SARTool - SAR ocean	SARTool - SAR ocean wind			
model	4.6 m/s from 305.4°	ncep - Assimilated 10n	ncep - Assimilated 10m wind			

#### Comment

Detection

discrete linear slick. The wind direction at the time of the image, doesn't match any of the sources in the area. However, it looks like the slick originates from the south western parts of the image.

Possible sources						
	Position	Object Name	MMSI	Туре	Confidence	
	25° 11' 19.87" N / 052° 53' 06.17" E	Jasirat Das Oilfield (Abu Dhabi)	N/A	PLATFORM	1.0	

18 12 25 21 16 25 10 42 53 16 26 3800 7600 11400 1520 52 5 011 A 25 31, 49 Oil B Fnatie Coastline Linited < 1 n/s Moderate 1-2 m/s Good 2-7 m/s 6aod 7-12 n/s Moderate 12-15 m/s Limited > 15 m/s 5 21 16 25 21 16

an <sup>30</sup>.

25 31 4



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Frate

Coastline





### Real Scenario: August 2019 – well "kick" caused large oil spill in Asia







Real Scenario: August 2019 – well "kick" caused large oil spill in Asia KSAT delivered more than 50 reports in one month – average delivery 65 min



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Real Scenario: August 2019 – well "kick" caused large oil spill in Asia KSAT delivered more than 50 reports in one month – 90% under 2 hours





Real Scenario: August 2019 – well "kick" caused large oil spill in Asia KSAT delivered also Optical medium-resolution 10m imagery (Sentinel-2)





Real Scenario: August 2019 – well "kick" caused large oil spill in Asia KSAT delivered also Optical medium-resolution 3m imagery (Planet Labs)





Real Scenario: August 2019 – well "kick" caused large oil spill KSAT delivered also High Resolution 50cm imagery







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## **Advantages of proactive Oil Spill Detection**

### In Case of Spill

- Early detection and start clean up before hits shore
- Polluter/Source identification (with AIS)
  - Oil and gas related activity
  - Illegal discharges from vessels
- Threat assessment
- Support in clean-up operations
  - Documenting chain of events; before -during -after
  - Situational overview

## In Case of No Spill

- Demonstrate zero spill clean operations from O&G producers
- Identify natural seeps, other phenomenon (algae blooms etc)





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