Svalbard 22 April 2023
Svalsat

KSAT
KONGSBERG SATELLITE SERVICES

KONGSBERG SATELLITE SERVICES, KSAT

Spacebased Maritime Surveillance – need for joint development seen from the industry

SIGMUND DEHLI
DIR. BD, GOVERNMENT PROGRAMS

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Agenda

- Introduction
  - Who we are
  - The “Norwegian” Development Model
- Services
  - Maritime Surveillance today
  - Maritime Surveillance tomorrow
- Development Requirements

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Longyearbyen

Nuuk (Godthab)
Nuuk (Godthab)
Grønland

Tromsøya

Harstad

Island

Sverige

Finland

Norge

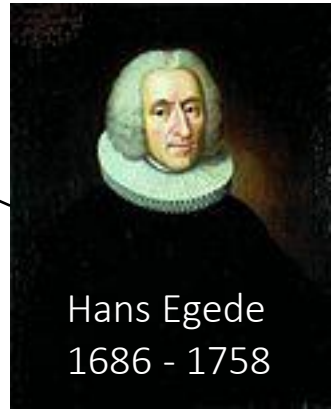
Belarus

Ukraina

Danmark

Polen

Data SIO, NOAA, U.S. Navy, NGA, GEBCO



Hans Egede
1686 - 1758

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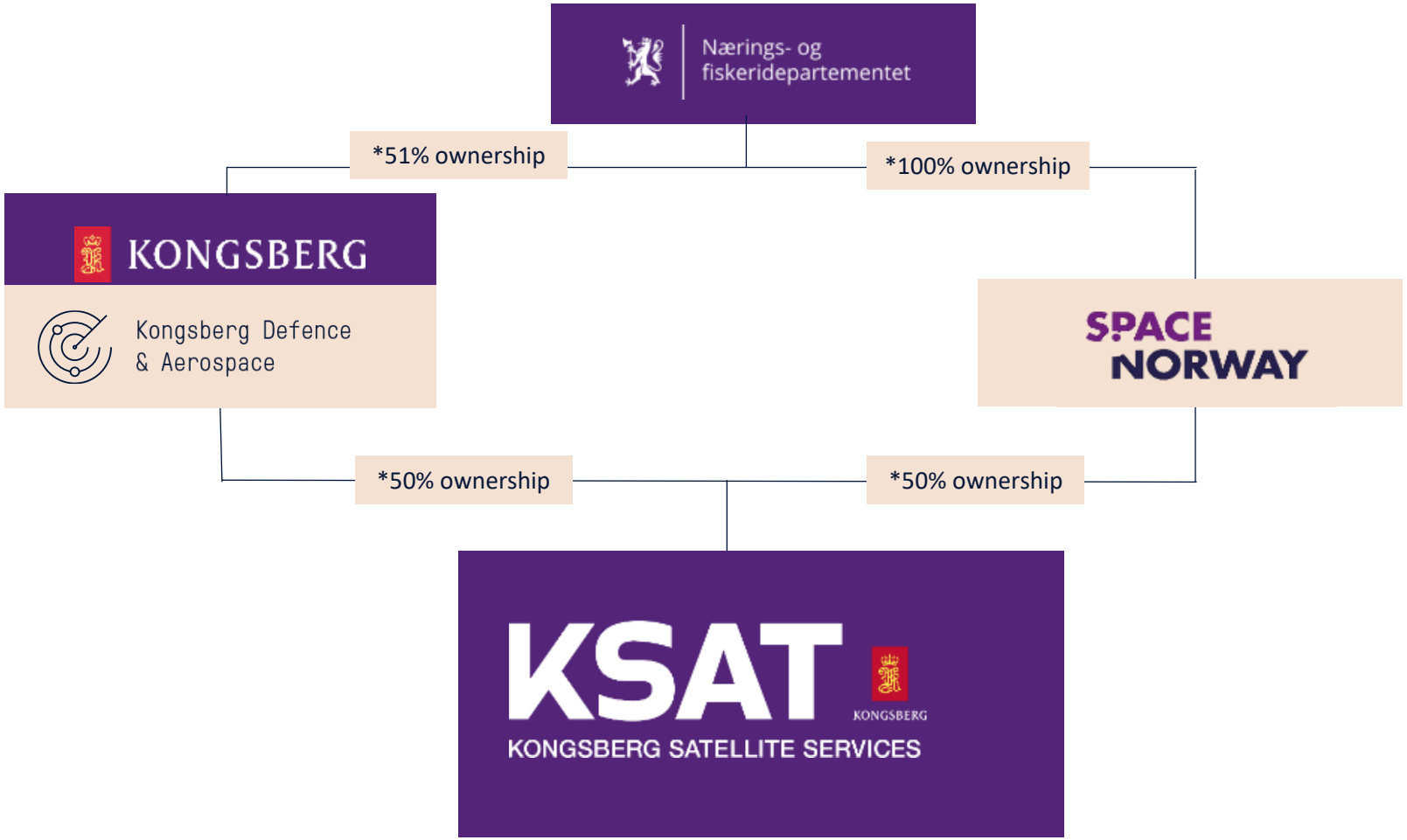
We Connect Space and Earth

KSAT is the leading provider of Ground Network Services and Earth Observation Services

HQ in Tromsø, Norway, >350 Employees

Offices in Svalbard, Oslo, Stockholm, Colorado, Brazil and Aalborg

OWNERSHIP STRUCTURE



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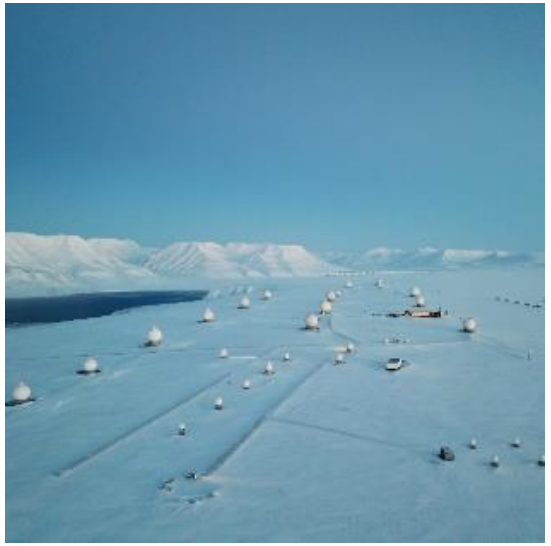
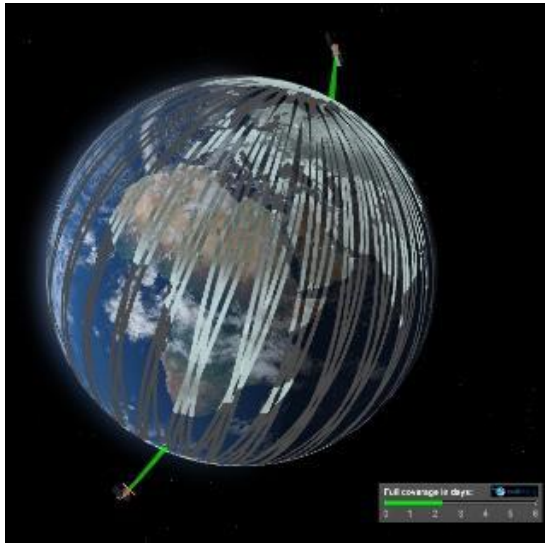
KSAT BUSINESS AREAS



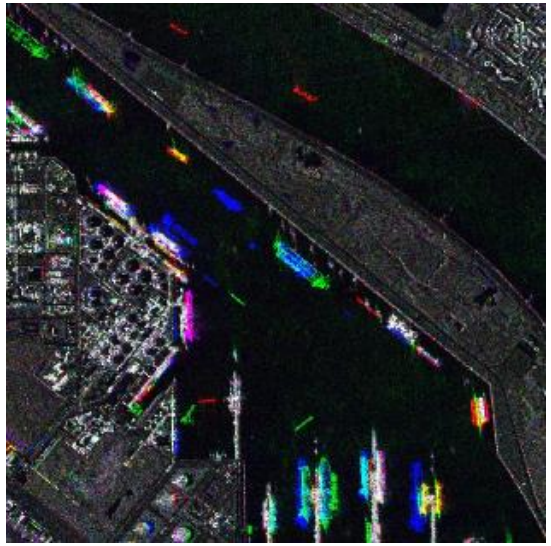
GROUND NETWORK

- Telemetry, tracking and command
- Data Acquisition services
- Launch and LEOP support
- Hosting and Maintenance



EARTH OBSERVATION

- Oil Slick Detection
- Vessel Detection
- Multi-Mission Near Real-Time data
- Planning & Ordering



GOVERNMENT PROGRAMS

- Vessel Detection
- Satellite Operations
- Data and Information services

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KSAT 24 / 7 OPERATION CENTER (Tromsø and Svalbard)

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- Control Center Global Ground Network
- Automatic scheduling of satellite passes
- > 100 000 passes per month
- Proficiency 99,8%

- Earth Observation Center
- Image processing and analysis
- NRT reporting to end users world-wide
- Emergency order support

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KSAT Ground Station

KSAT Partner Station

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THE WORLD´S NORTHERNMOST GROUND STATION

- 78°North
- Unique location,14 of 14 passes
- 24/7 operations
- Established 1997
- Redundant fiber cables (Tbps)
- > 150 antenna systems (3m to 13m diameter)
- > 45 employees

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KSAT Antarctic Troll Ground Station, 72´South

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Nuuk Ground Station

- KSAT built a Ground Station in Nuuk 2019/2020 (fully operational dec 2021)
- Customer : **Oneweb** – UK company
- From Oneweb Homepage:
  - global communications through a next generation satellite constellation - bringing seamless connectivity to everyone, everywhere.
  - connecting and empowering people by land, air, sea.
  - complete global connectivity solution.

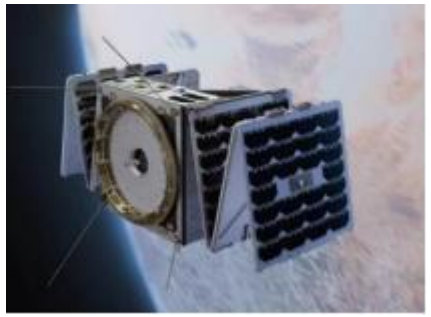
Team Norway - The complete value chain

(Arctic) Maritime Surveillance Services

Launch Support

Andøya Spaceport
- SmallSat launch from 2023

Satellite programs



Norwegian programs
AISSat-1, 2 and 3
NORSAT-2, 3 and TD
N3X
MicroSAR
AOS
ASBM (No/US)

Ground stations

KSAT GS - Tromsø and Svalbard
- Satellite Operation
- Mission Operation

Maritime services

Analytics/value adding
Time Critical services

Integration and Presentation

Norwegian Governmental Agencies
NOFO
Oil Companies + + +

KSAT uses every relevant earth observation satellite

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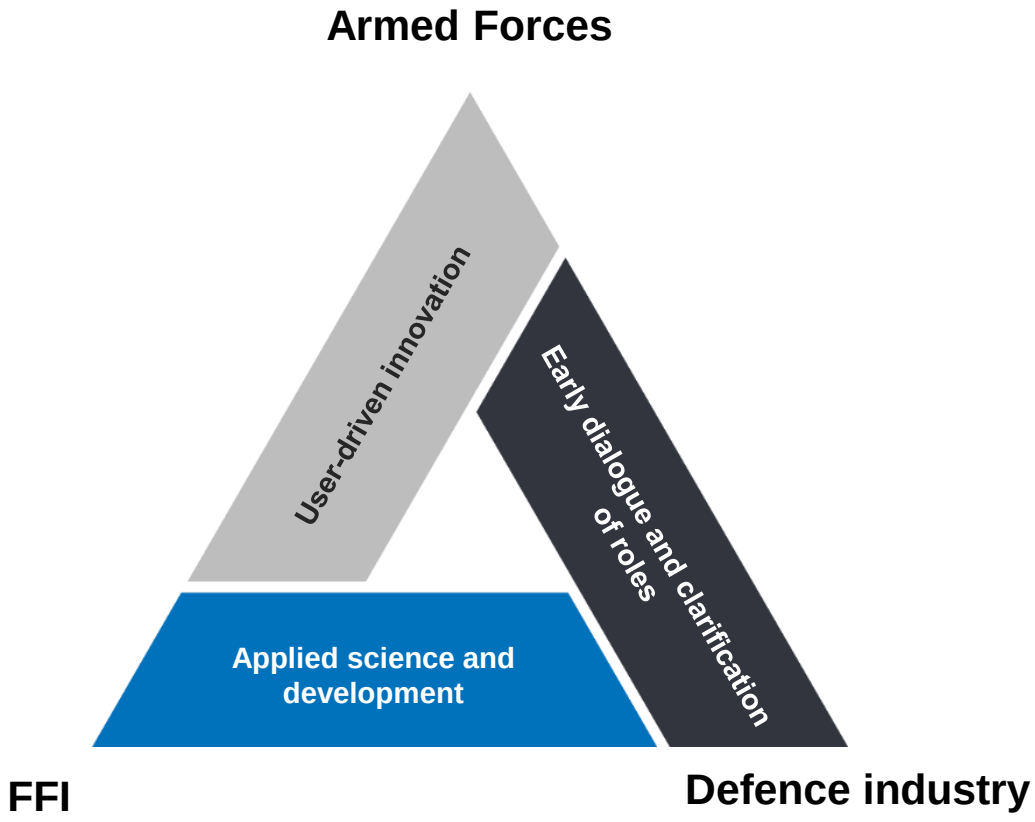
The «defence triangle model»
– innovation through interaction



Hugin

NSM

Remote Weapon Station

PD 100, Black Hornet

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Satellite-based sensors:

The Full Picture for Maritime Surveillance

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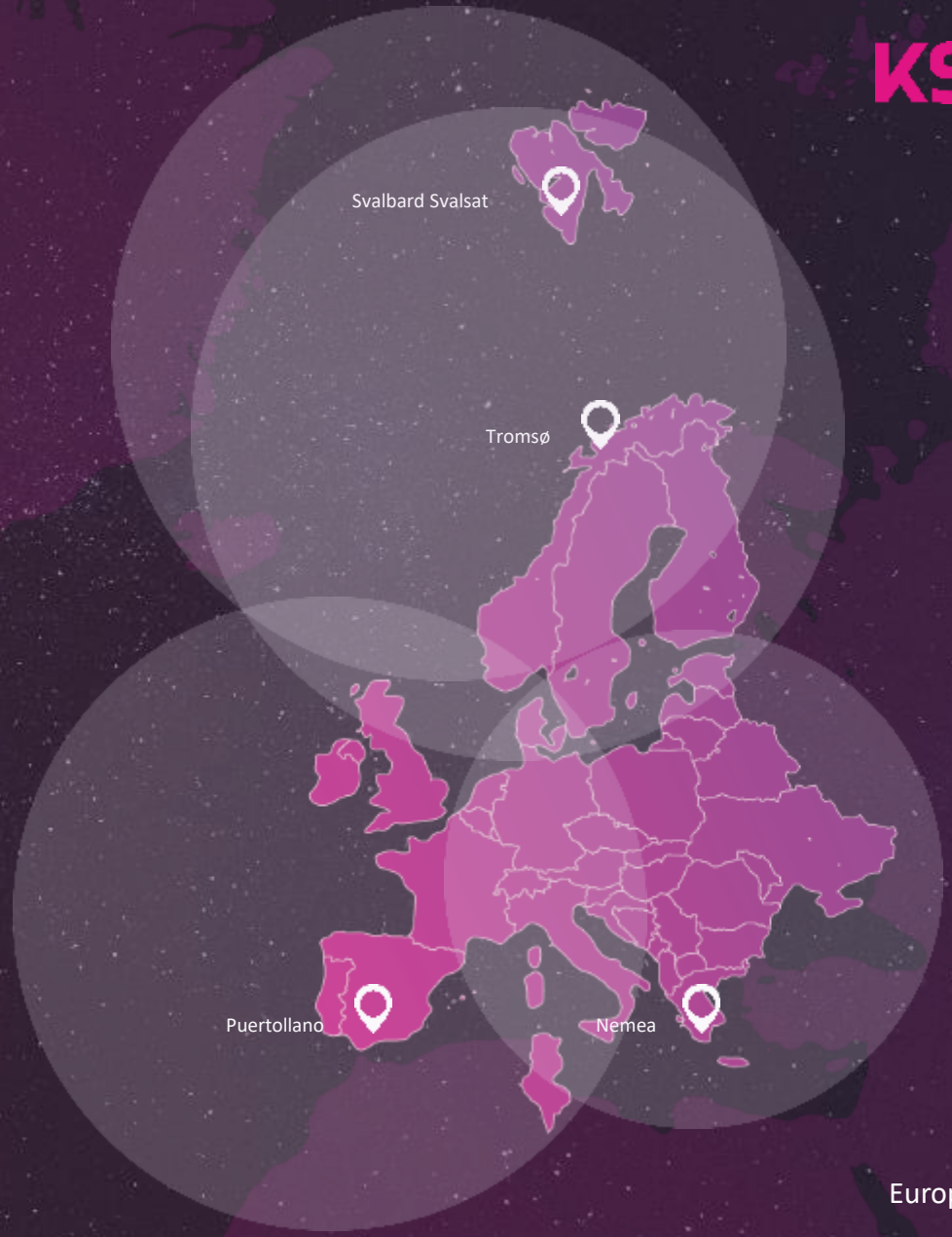
European Maritime Safety Agency

EMSA

DELIVERY TIME

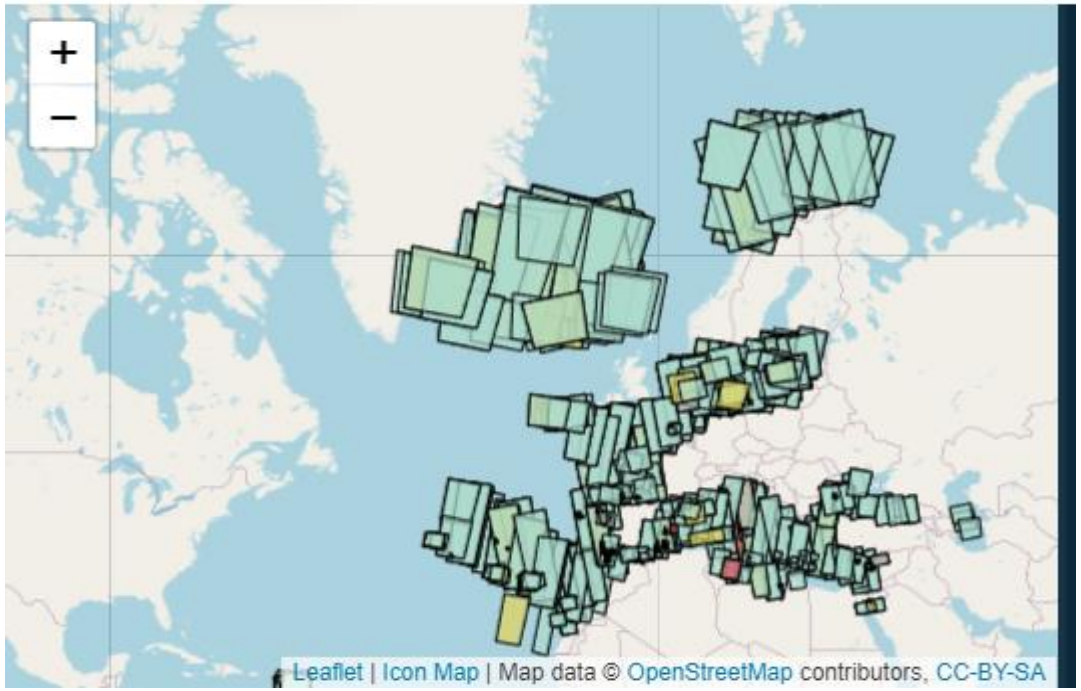
<20 min

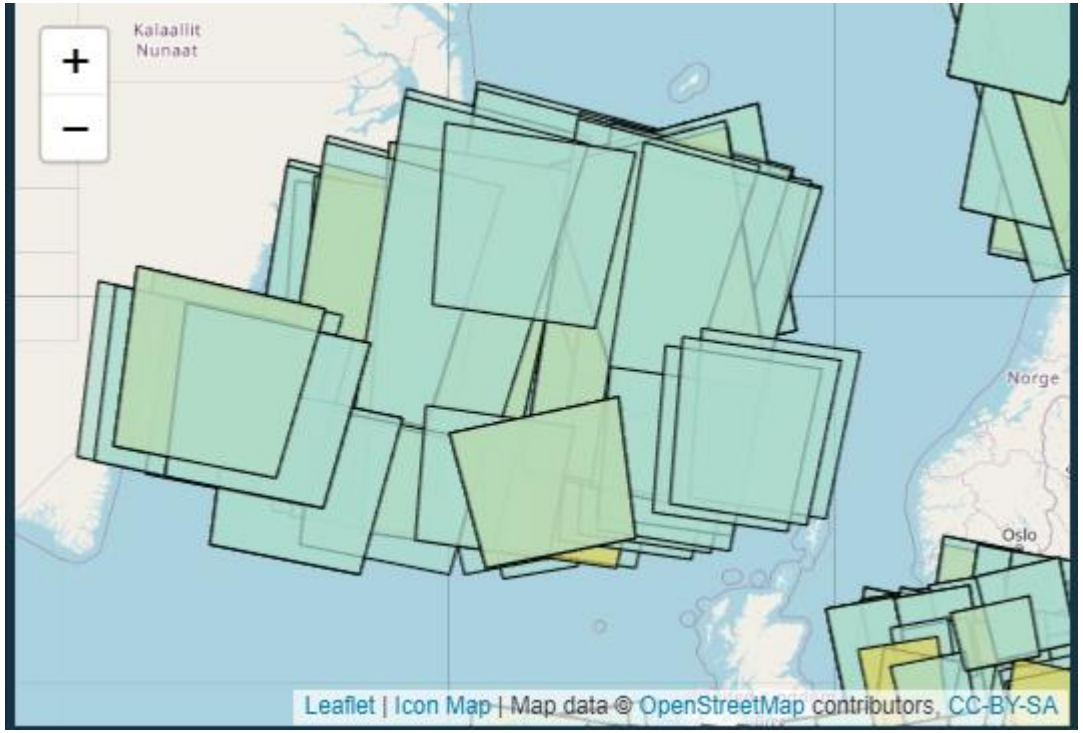


Europe

March 2023

Ca 4 000 products (oil and vessel) from Jan 1 till May 31





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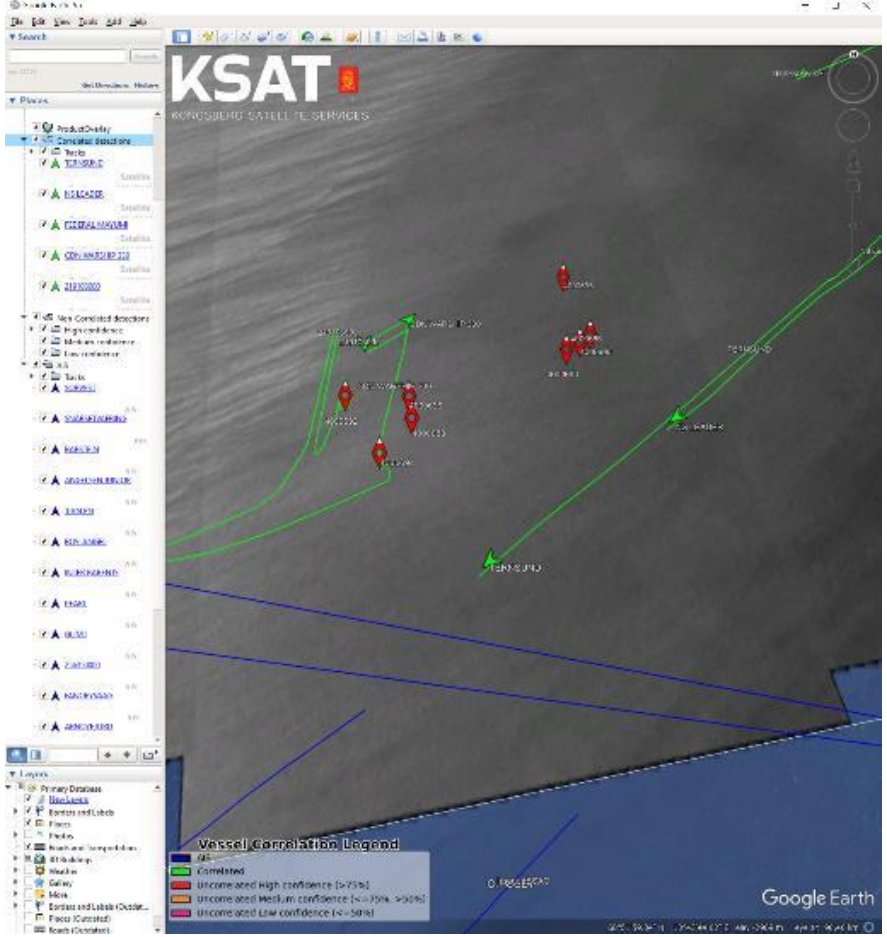
NATO ships participating in Exercise Formidable Shield 21. Photo: Norwegian navy



S1A_IW_GRDH_1SDV_20210630T164037_20210630T164135_038572_048D31_2DB7

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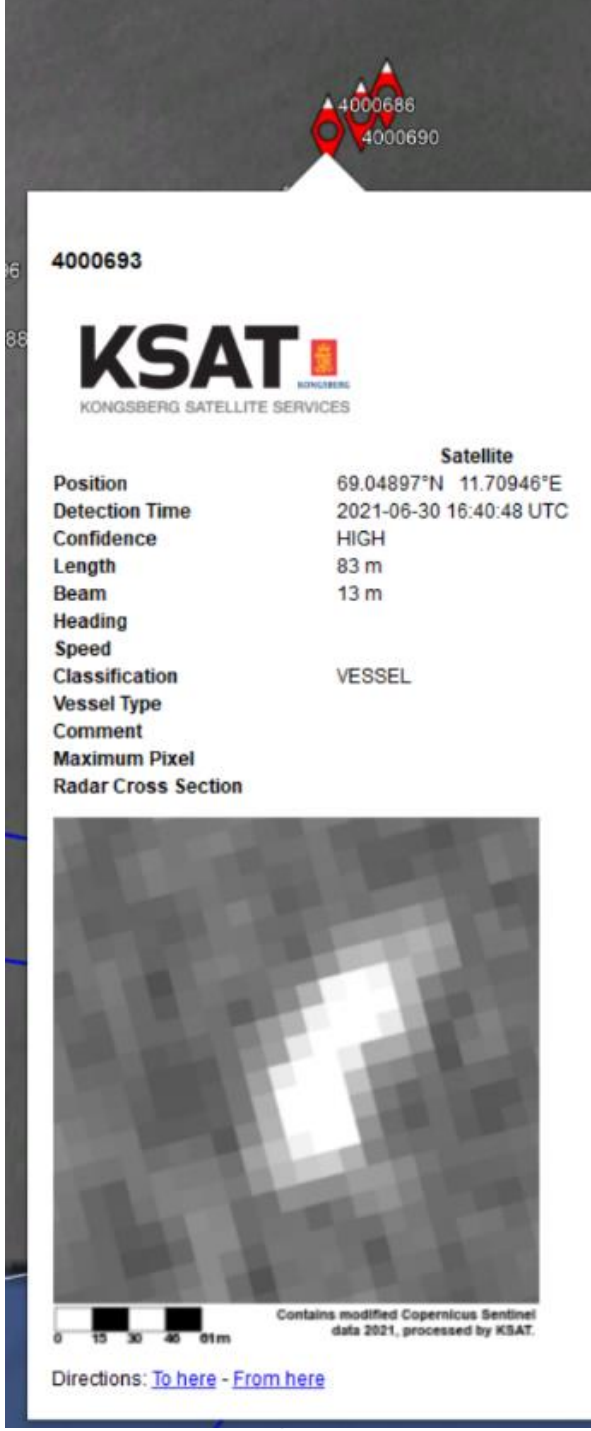
VESSEL CORRELATION REPORT

Aquisition Information	
Satellite:	SENTINEL-1A
Sensor:	SAR
Swath:	IW
Polarization:	VV VH
Resolution	22.0
Incidence angle:	Near: 30.3° Far: 45.5°
Aquisition time:	2021-06-30 16:40:37 UTC
Scene Coordinates:	71.46931°N 5.73282°E 72.01215°N 12.73051°E 68.61974°N 14.54359°E 68.13351°N 8.56011°E 71.46931°N 5.73282°E
13 vessels detected	
Correlated (Green)	5
Only in SAR (Red/Orange/Pink)	8

Contains modified Copernicus Sentinel data 2021, processed by KSAT.

Vessel Detection - Examples



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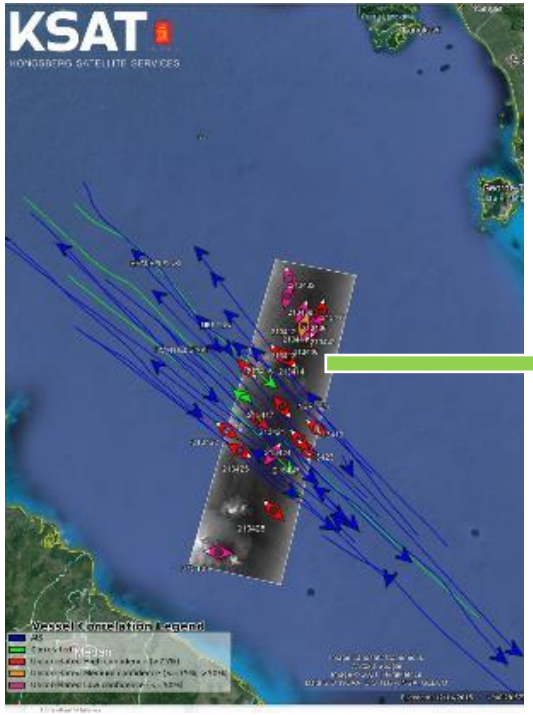
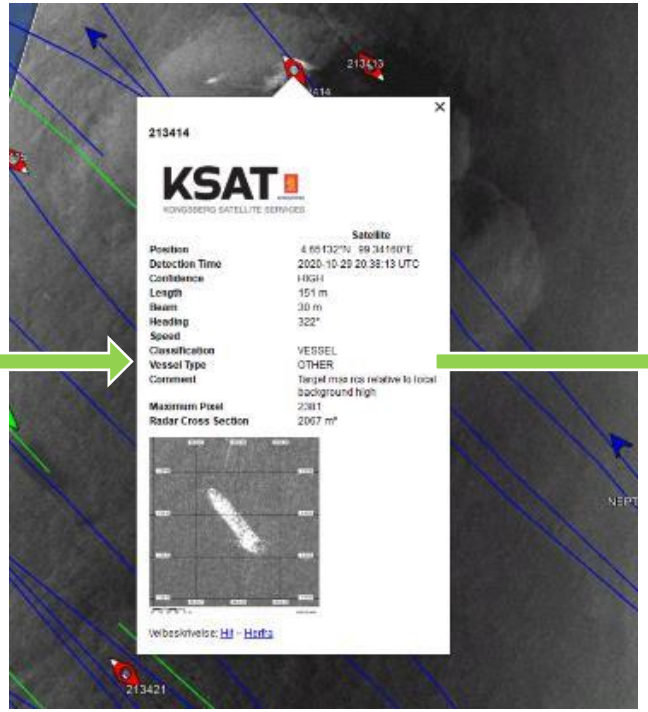
KSAT Vessel Detection Services

Expected output from KSAT VDS based on Machine Learning





Category	Vessel Type Name
MERCHANT SHIP	Generic Merchant ship Bulk carrier Cargo Container carrier Oil tanker LNG/Chemical/Gas tanker Tug boat
PASSENGER SHIP	Generic Passenger ship Ferry Cruise boat
FISHING BOAT	Generic fishing Purse seiner Trawler Traditional fishing
WARSHIP	Generic Warship Aircraft carrier Patrol vessel Amphibious ship Submarine
LEISURE BOAT	Generic Leisure boat Yacht
SKIFF	Generic Skiff Yawl
SPEEDBOAT	SpeedBoat/Go-fast
RIB	Rubber inflatable boat
RHIV	Rigid-hulled Inflatable vessel
OTHER	Unknown

From detection to classification to identification!

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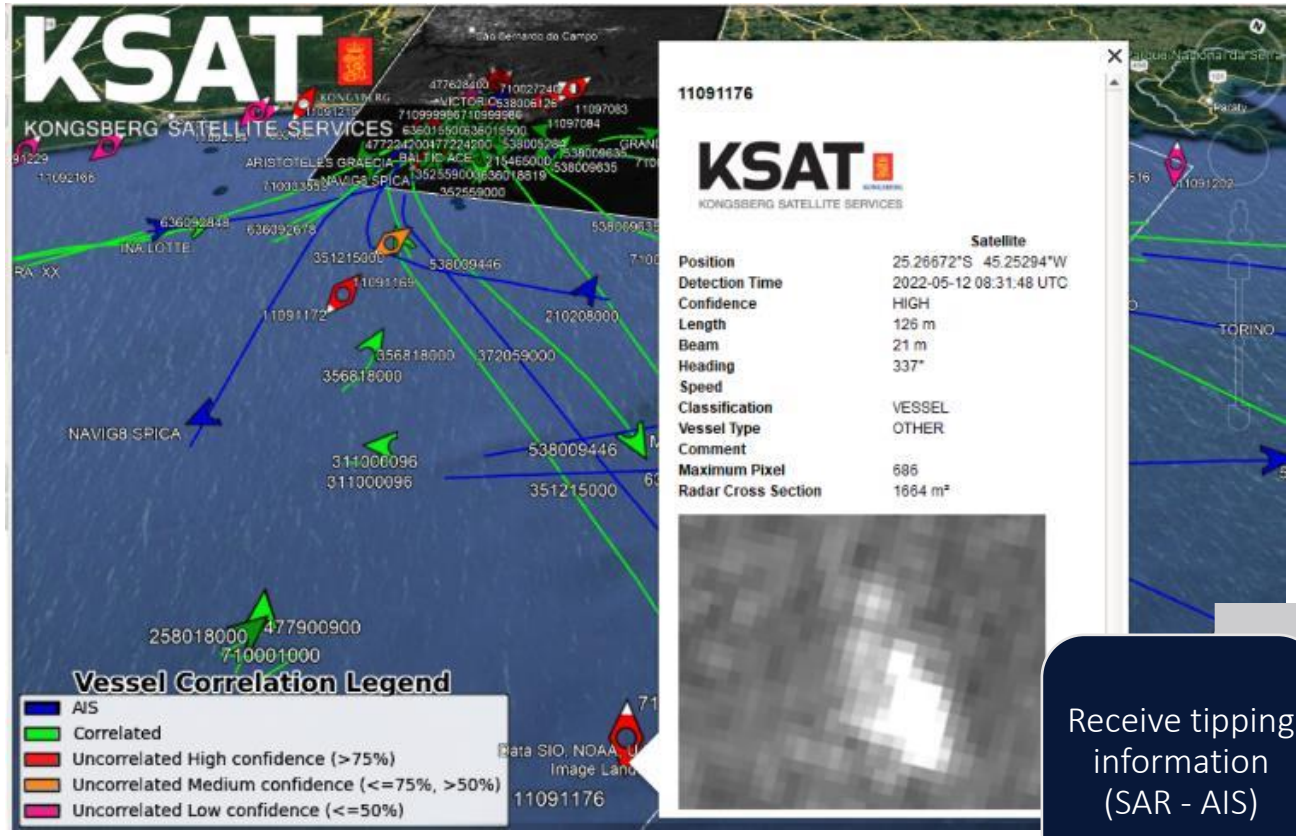
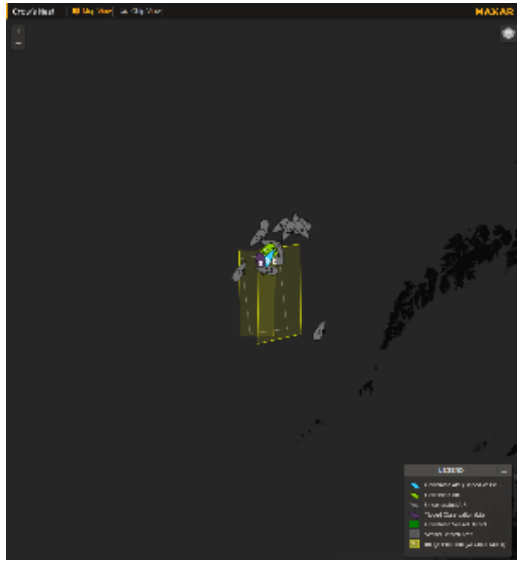
Tipping & cueing SAR, AIS and Optical





Receive tipping information (SAR - AIS)

Estimate future location of vessels of interest

Generate tasking of high resolution optical satellites

Collect, process and exploit imagery

Approx 4 hours

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KSAT vessel detection services in a while

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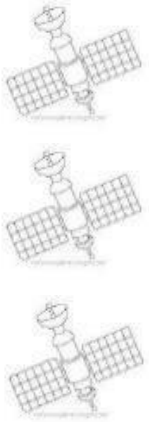
ComSAR

RadarSAT-2
CSK 1-4 / CSG
TSX / TDX / PAZ
TSX NG
Sentinel 1 a/b
IcEye X 1-n
MicroSAR 1-n

AISSAT

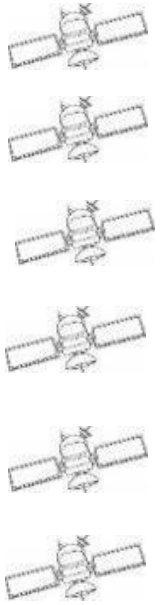
incl terrestrial + VMS etc



AisSAT-1,2
NorSAT-1,2,3
ExactEarth
OrbCOMM
Spire

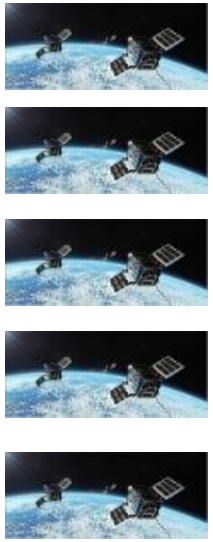
Optical

inkl LowLight



Sentinel-2
Planet (Scope)
Pleiades
Maxar WV + Legion
Pleiades
NeoPleiades
Spot
nn

RF-finding EllNt



NorSAT-3
SMART Duo
Unseenlabs
Kleos
HawkEye 360

Behavioural Analytics

Anomalies wrt:
- Heading
- Speed
- Position
- Rendezvous
- History

Dark targets will be ingested into Recognized Maritime Picture

MHT → Report SAR/AIS/EO + MHT → Report incl EllNT + MHT → Report incl NATO/other sources

Dots on the map → Finding dark targets → Activity and classification → Recognize dark targets (fingerprinting) → Early warning - anomalies → Sensor and data fusion

ML / AI → Improved processing → Other stuff - Imagination

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Requirements

Speed and accuracy

- **Evaluation of machine learning methods for maritime applications**
- KSAT focuses on continuous, scalable and stable delivery of ship, sea ice, and oil spill *detection* and *description* services.
- Machine learning methods can provide both high accuracy detections and descriptions, and are in the process of being implemented for the different services with ship detection being the most mature.
  (> 1 000 objects in one single SAR-image)

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Development and cooperation

Potential contributions from the scientific community:

- Review studies comparing different methods for **detecting** ships, ice, and oil spills.
- Benchmark datasets for **detecting** ships, ice, and oil spills.
- Review studies comparing different methods for **describing** ships, ice, and oil spills.
- Benchmark datasets for **describing** ships, ice, and oil spills.

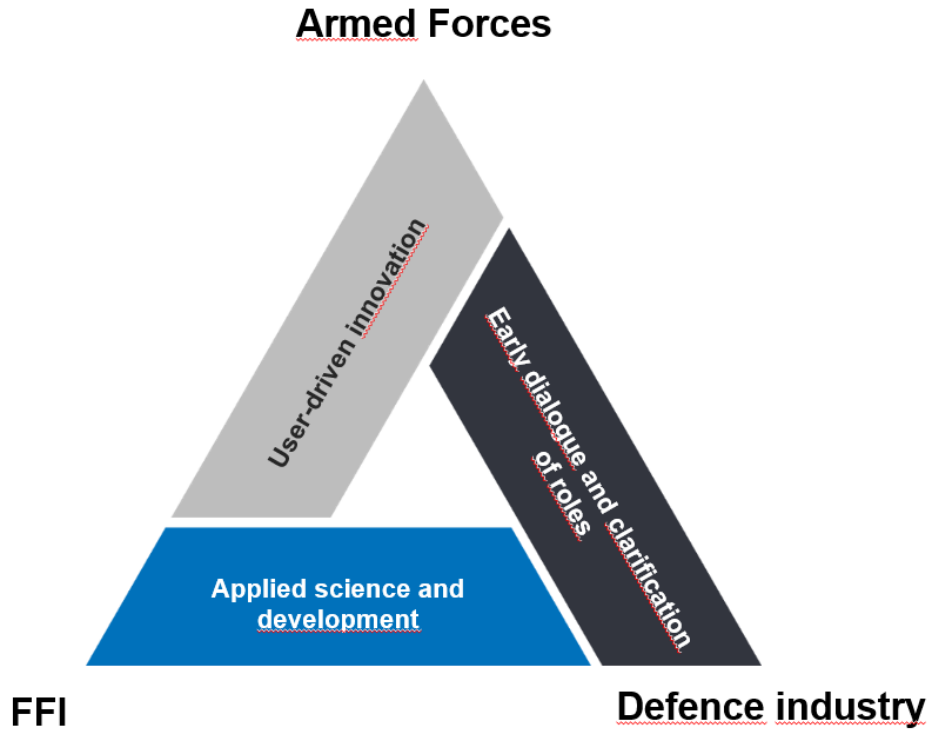

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Photo: Reuben Wu