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TAKING THE PULSE OF OUR PLANET FROM SPACE

EUMETSAT ECMWF EUSPA

E1.02.1 Strengthening Industrial Competitiveness Exploiting Novel Systems and Capabilities

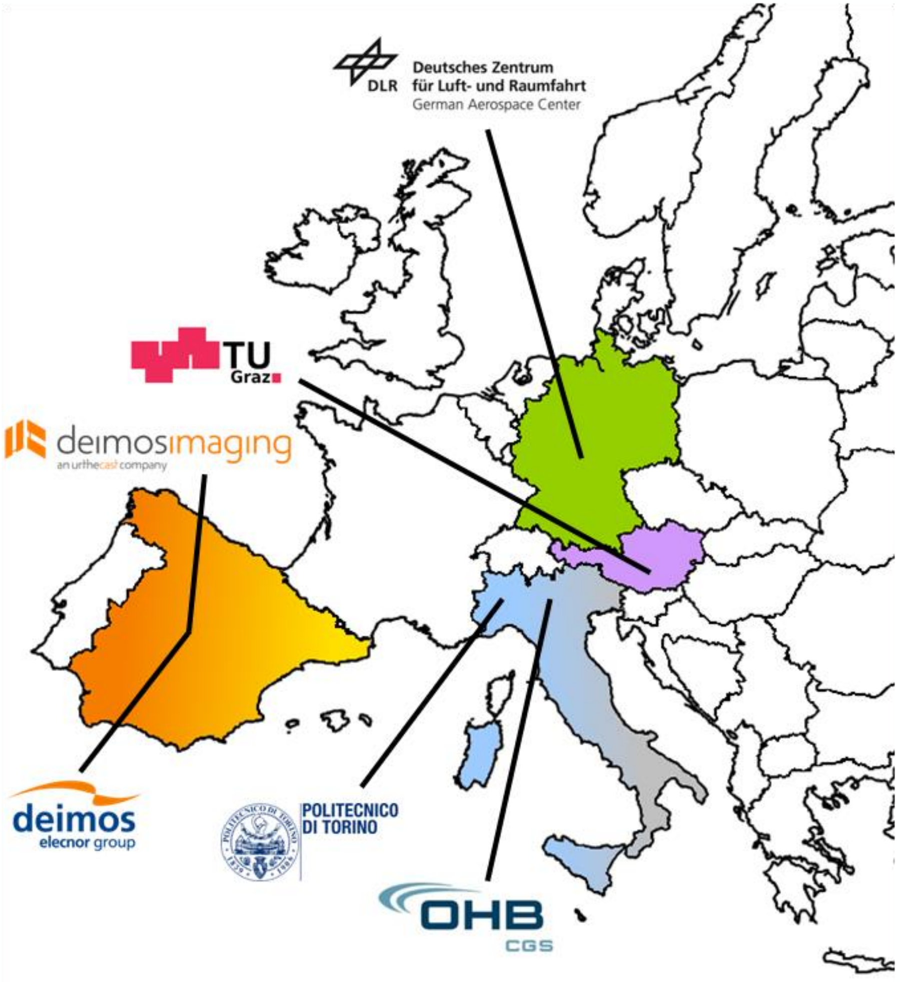
End-to-End Results for Almost-Real-Time Earth Observation from the EO-ALERT Project

Presenter: Murray Kerr (DEIMOS)
Authors: DEIMOS, DLR, TUGRAZ, OHB-I, POLITO, AEMET

27/05/2022

EO-ALERT Project Overview

- **H2020 European Union research activity**
  - Started early-2018; Finished late-2021
- **Partners:**
  - Deimos Space (Spain) – lead and coordinator
  - DLR (Germany)
  - Technische Universitaet Graz (Austria)
  - Politecnico di Torino (Italy)
  - OHB Italia (Italy)
  - Deimos Imaging (Spain)
- **3rd party:**
  - AEMET (Spanish Meteorological Agency)



Importance of Latency in EO

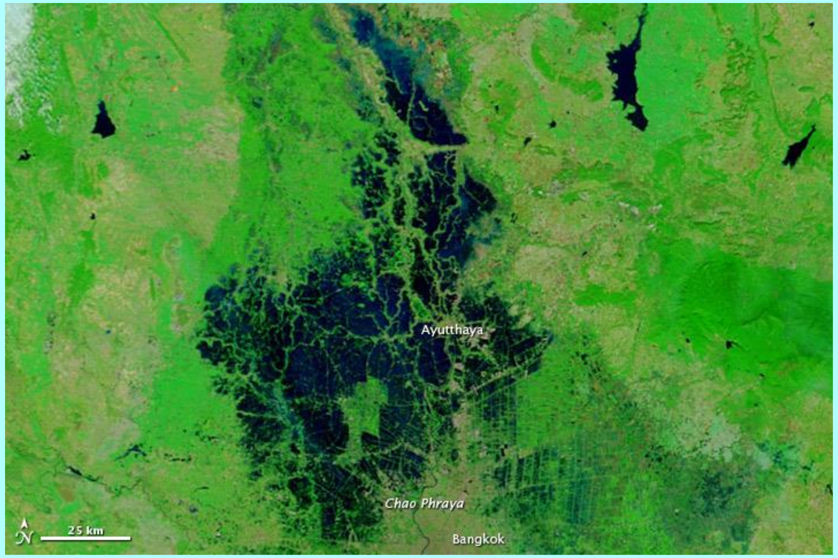
- System **Responsiveness** is a driver for time-critical Earth Observation (EO) services (e.g. disasters, emergency response, forecasting, financial, security), both for near-real time (NRT) and real-time services

- As part of this responsiveness, **EO Product latency** is an important contributor
  - e.g. current latencies of civil emergency products are between 10 minutes and several hours

- Improved systems are required to improve citizen services

Timely Earth Observation
Products Can
SAVE LIVES & PROPERTY

2011 Floods, (Ayutthaya, Thailand)
"**NASA Space Data Can Cut Disaster Response Times, Costs**", NASA, 2019



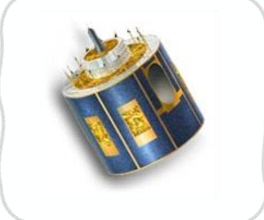
Credits: LANCE/EOSDIS MODIS Rapid Response Team, NASA's Goddard Space Flight Center

EO-ALERT Project Goals

- **Goal: to address the need for increased data chain throughput and real-time products**

Global latency goal of < 1 minute

- **Idea: focus on the EO product and what is needed with very low latency**
  - Move key EO data processing elements from the ground segment to the satellite
  - Prove this for various EO instruments
    - TerraSAR-X (SAR) Very High Resolution satellite
    - DEIMOS-2 (OPTICAL VIS/NIR) Very High Resolution satellite
    - MSG SEVIRI (Multi-spectral VIS/TIR)
  - Test in two scenarios
    - ship detection/classification
    - extreme weather detection/tracking



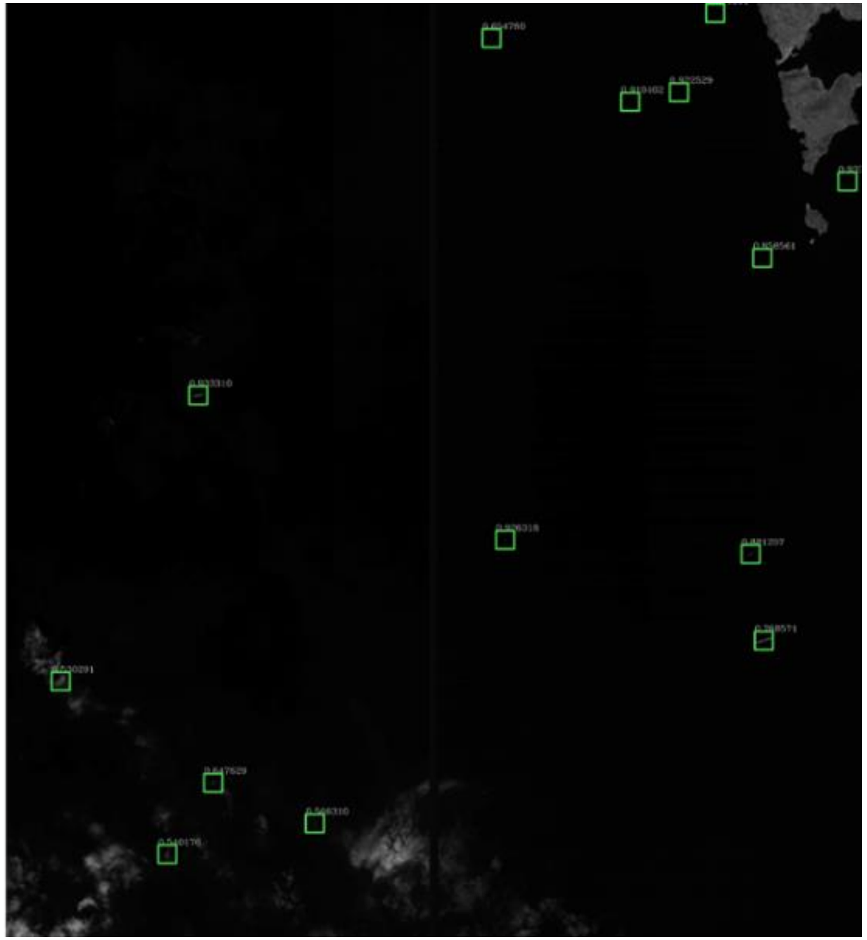
EO-ALERT Test Scenarios

- **Maritime EMSA VDS-like services**
  - Vessel detection and classification
  - Wind and wave products

- **Extreme weather EUMETSAT RDT-like services**
  - Convective storm cell detection and tracking

- **Data:**
  - TSX payload data
  - DEIMOS-2 payload data
  - MSG L1C data

CMRE Ship

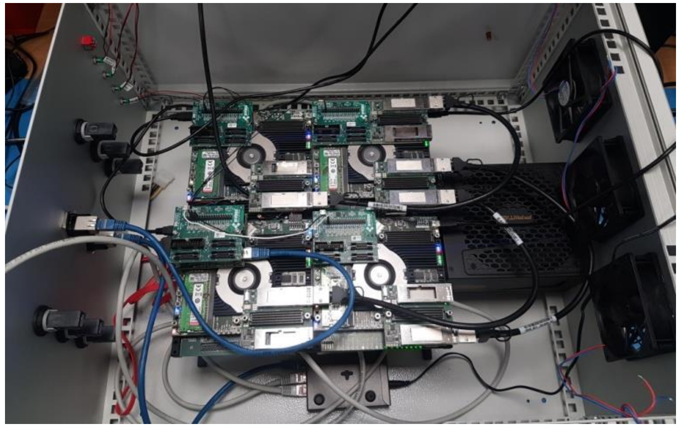


Maritime ship experiment

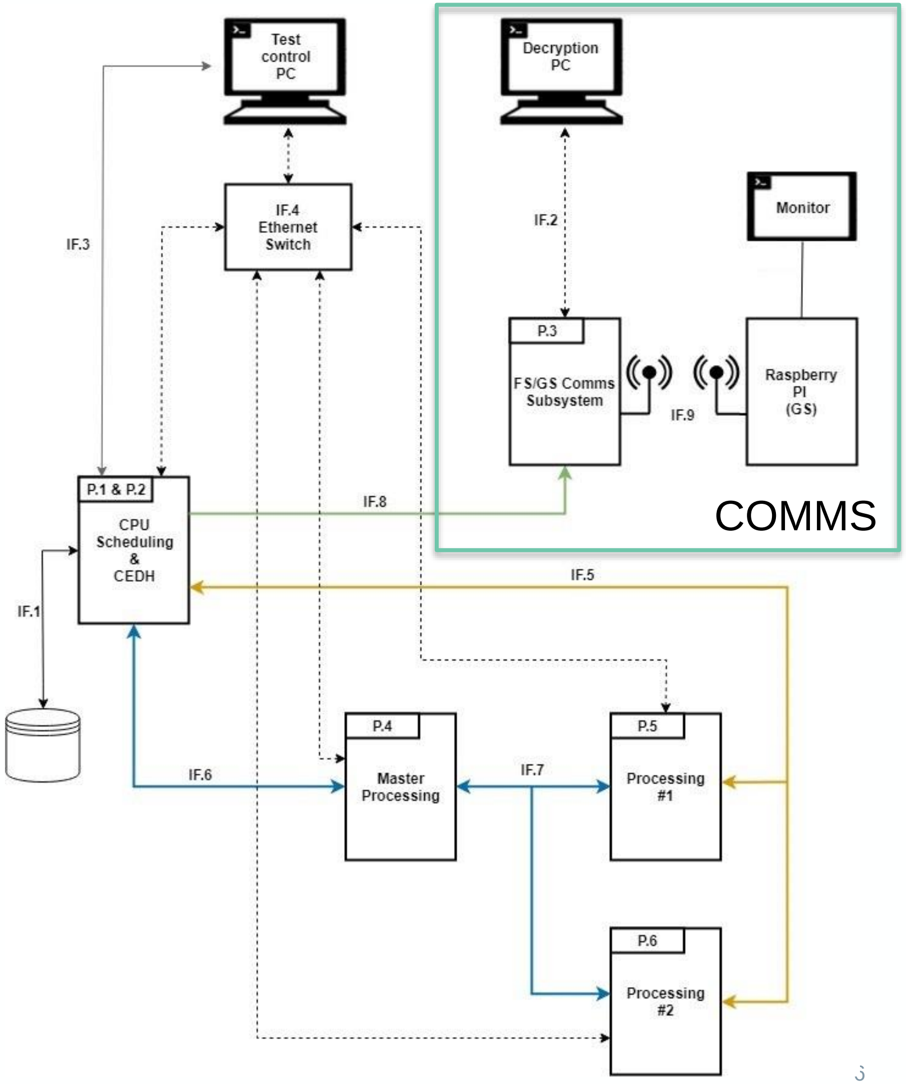
EO-ALERT Test Setup

- The Avionics Test Bench employed for end-to-end tests
- Representative subset of the complete FS-GS system, covering the critical elements
- Demonstrates the goals of the EO-ALERT project via a complete End-to-End demonstration integrating all the key technologies.

PDPU HW setup in the ATB



Geo-relay for persistent comms

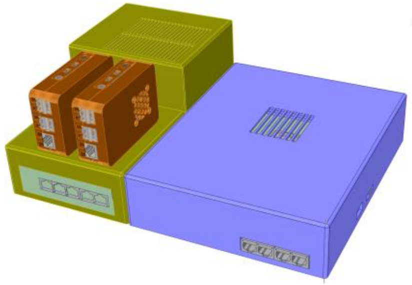


EO-ALERT Test Setup

Test control PC

OPTICAL or SAR Processing on PDPU Testbench

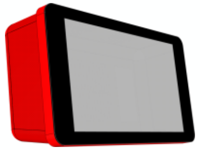
COMMS S/S Multiplexer



IDRS Terminal

Decryption PC

Ka-band Channel Simulation

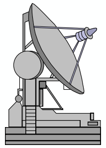


Handheld Device (S-band RX)

Set-up in Italy (OHB-I)

Set-up in Austria (TUGRAZ)

INMARSAT Satellite

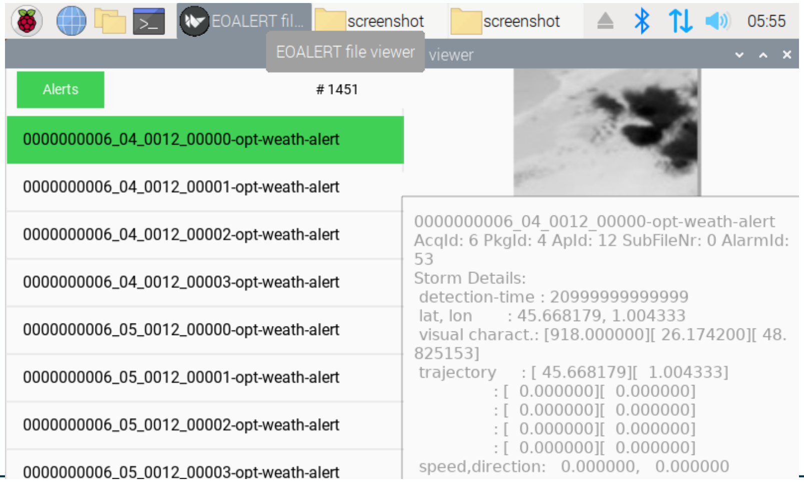


From INMARSAT Infrastructure Through the Internet

Decryption PC

Server @TUGRAZ

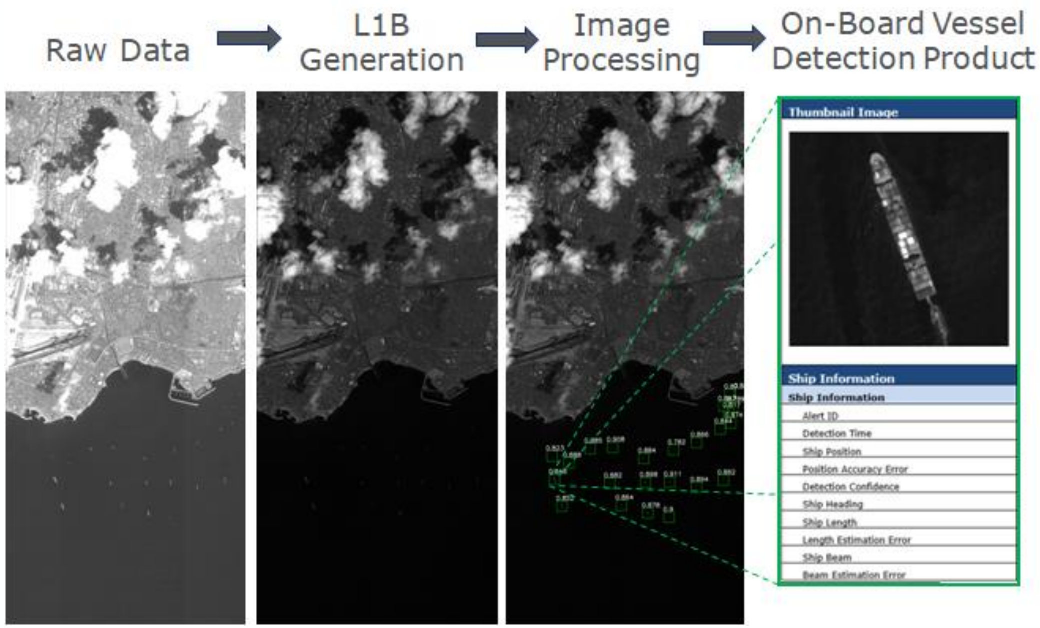
Alert Display at the end of the Chain



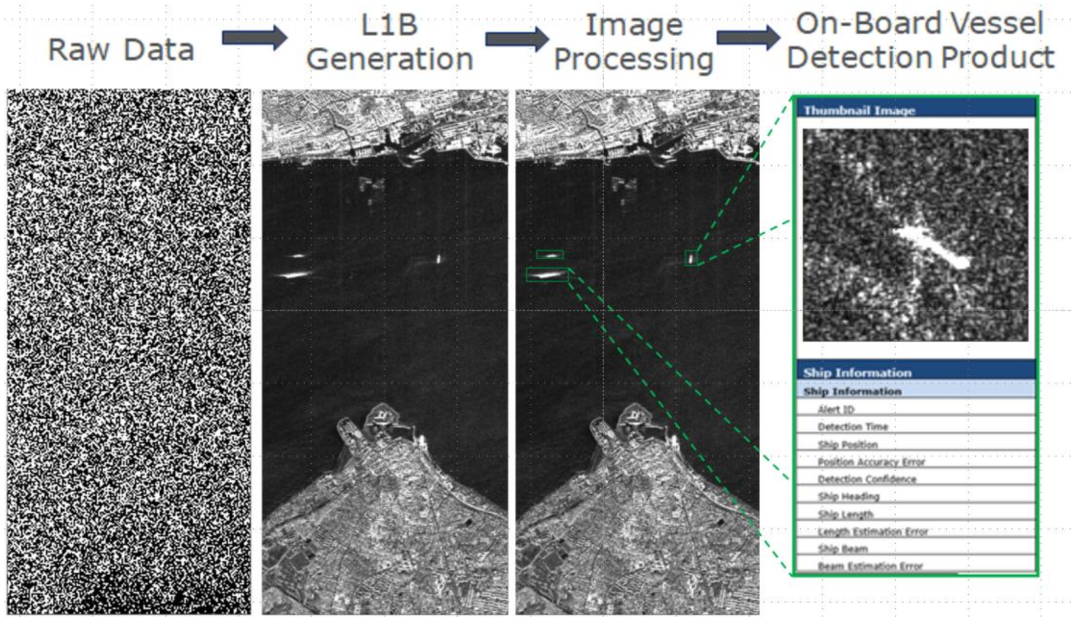
EO-ALERT Results Examples

- Maritime EMSA VDS-like services

DEIMOS-2 Example Case



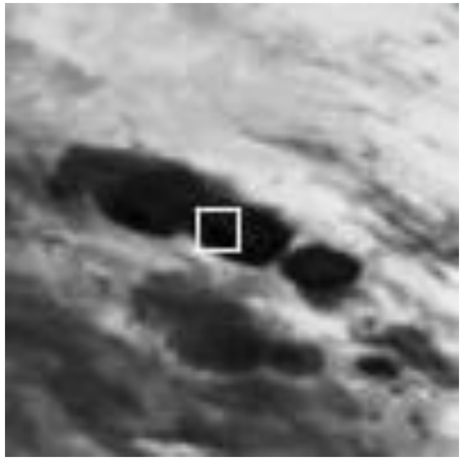
TerraSAR-X Example Case



EO-ALERT Results Examples

❑ EUMETSAT RDT-like services

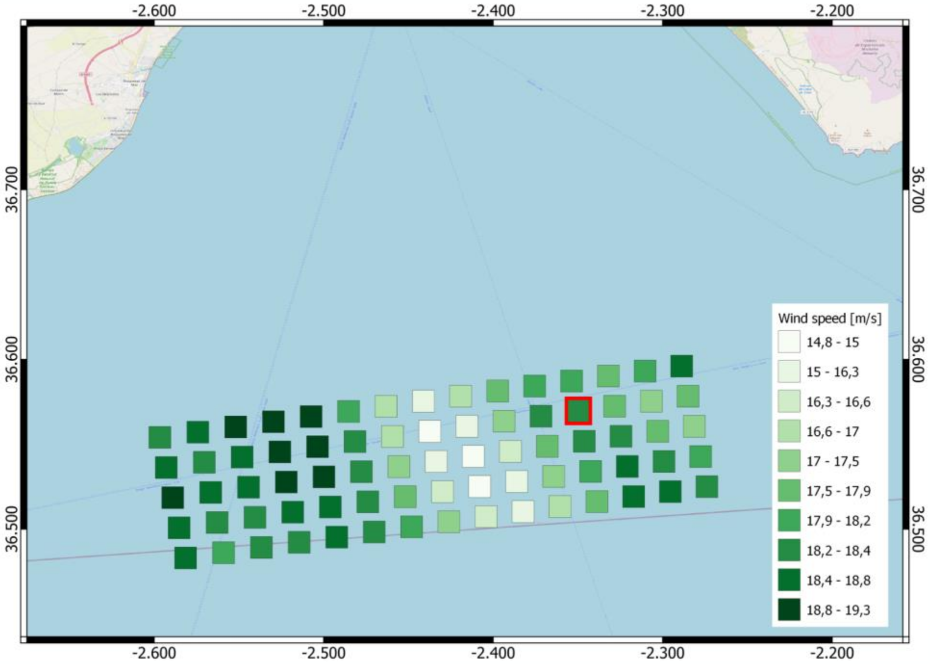
MSG Nowcasting Example Case



AcqId: 7 PkgId: 71 ApId: 12 SubFileNr: 11 AlarmId: -1379547229
Storm Details:
detection-time : 20130729155739
lat, lon : 48.408029, 13.828689
visual charact.: [1197.000000][28.083378][67.200920]
trajectory : [48.408028][13.828689]
: [48.412338][13.874491]
: [48.359085][13.813913]
: [48.287434][13.657416]
: [48.172142][13.802866]
speed,direction: 0.000000, 0.000000
cell-merg/split: 1
cloud top-temp.: -63.017426
cool/warm-rate : 1.240268
phase of life : 200
Overshooting Top:
lat, lon : -1.000000, -1.000000
date time : 20130729155739
updraft metric : 0.000000

❑ Maritime EMSA-like Wind services

TerraSAR-X Windspeed Example Case



EO-ALERT Results Overview

- **Global Product Latency**
  - <1 minute in **some** scenarios (SAR maritime, OPT nowcasting)
  - <5 minutes in **all** scenarios (SAR & OPT maritime, OPT nowcasting)
  - Almost-real-time is feasible

- **SWaP**
  - Cubesat / microsat compatible
    - Two US+ suitable for non-redundant VHR mission, with low duty cycle (<10%)
    - Three to Four US+ suitable for redundant mission architecture
  - Power in the range of 30W to 100W (at low duty cycle)

- **Detection / classification / tracking performances**
  - Maritime: close to ground performances
  - Extreme weather: as good as ground performance
  - tuning of ML/AI required to be operational

EO-ALERT Contributions

- Demonstrated edge computing for VHR SAR and OPT payloads
- Demonstrated end-to-end global almost-real-time latencies
- Demonstrated suitable for missions down to microsat class

- Motivates deployment of edge-computing and persistent comms for improved services
  - Disaster management; security; forecasting; etc
- Outcomes (architecture, design, software) available for future exploitation
  - Planned deployment in some upcoming commercial and institutional missions
- Would be great to see this employed in future missions, like Sentinels and Copernicus supporting missions

deimos

Visit us at Booth #6

EO-ALERT Contacts

http://www.eo-alert-h2020.eu/

EO ALERT H2020 Project

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