

REAL-TIME EARTH OBSERVATION FOR RESPONSIVE DISASTER MANAGEMENT

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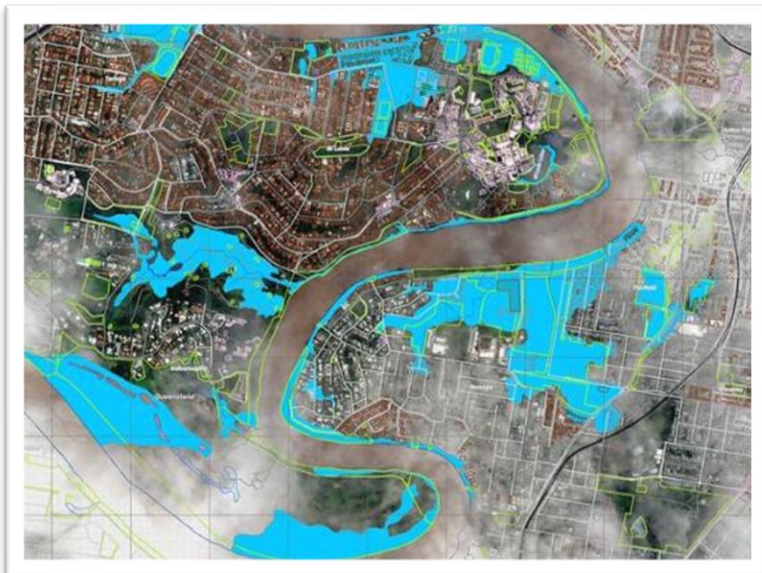
EXTREME EVENTS REQUIRE RESPONSIVE CIVIL SERVICES

Scenarios requiring responsive services include:

- **DISASTER MANAGEMENT AND EMERGENCY RESPONSE** (e.g. Floods, Fires, Earthquakes, Oil slicks, ..)
- **FORECASTING** (e.g. extreme weather nowcasting)
- **MONITORING AND SECURITY** (e.g. maritime smuggling, illegal fishing, illegal immigration, ...)

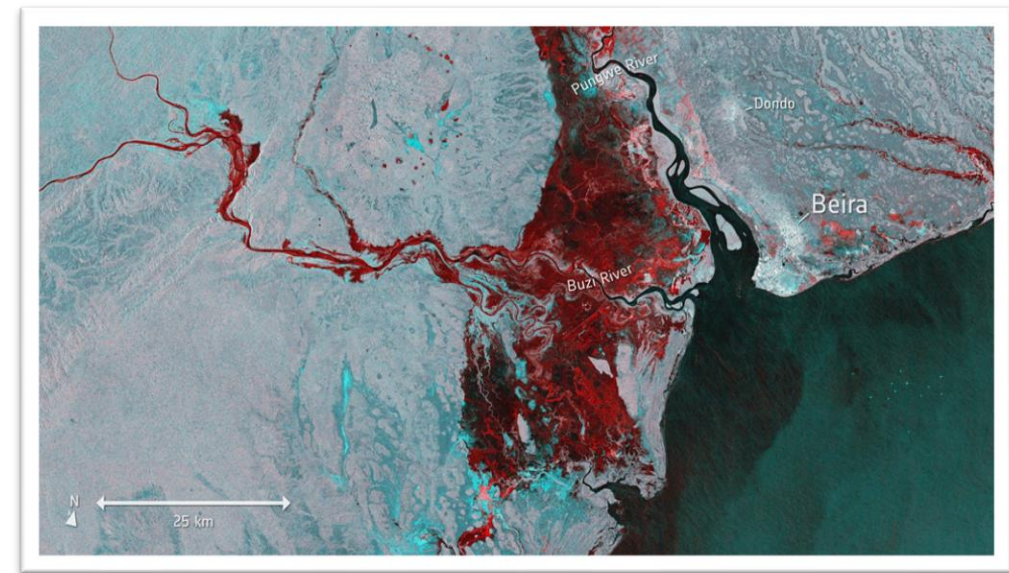
Current latencies of Earth Observation civil emergency products are **BETWEEN 20 MINUTES AND SEVERAL HOURS**

2022, Australian Floods



Credit: ESA/Sentinel, Copernicus EMS – CC BY-SA IGO 3.0

2019, Cyclone Idai (Mozambique)



Credit: ESA/Sentinel – CC BY-SA IGO 3.0

CLIMATE CHANGE AMPLIFIES THE IMPORTANCE OF DISASTER MANAGEMENT SERVICES

Global citizens require **IMPROVED SYSTEMS** to support rapid detection and distribution of information

Motivated by UN SDGs, UN-SPIDER, WMO, among others

- **SDG goals on disaster risk reduction (SDGs 11 and 13)**
- **SDG targets 13.1 and 13.3 to combat climate change**

Consistent with recent major agency targets

- **ESA Vision accelerator on “RAPID AND RESILIENT CRISIS RESPONSE”**

Known that improved responsiveness reduces the negative effects of extreme events

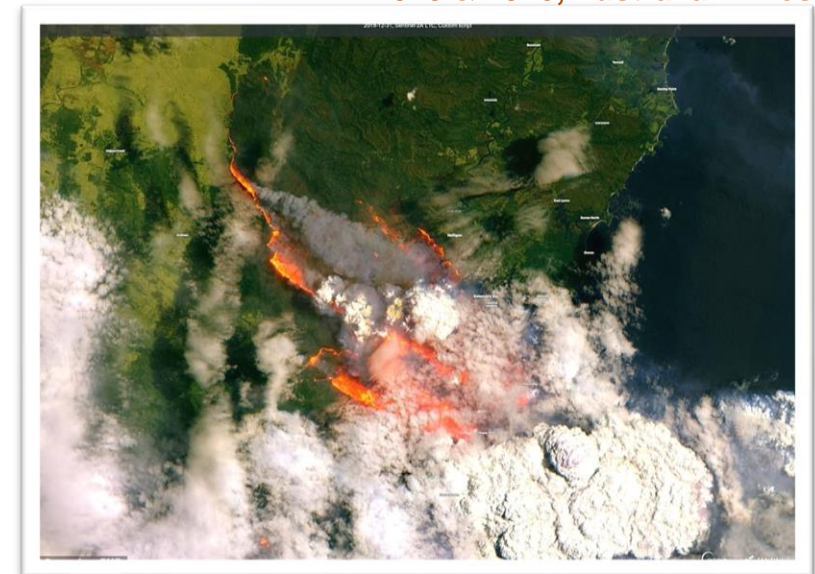
Timely Earth Observation products can **SAVE LIVES & PROPERTY**

2011 Floods, (Ayutthata, Thailand)

“NASA Space Data Can Cut Disaster Response Times, Costs”, NASA, 2019

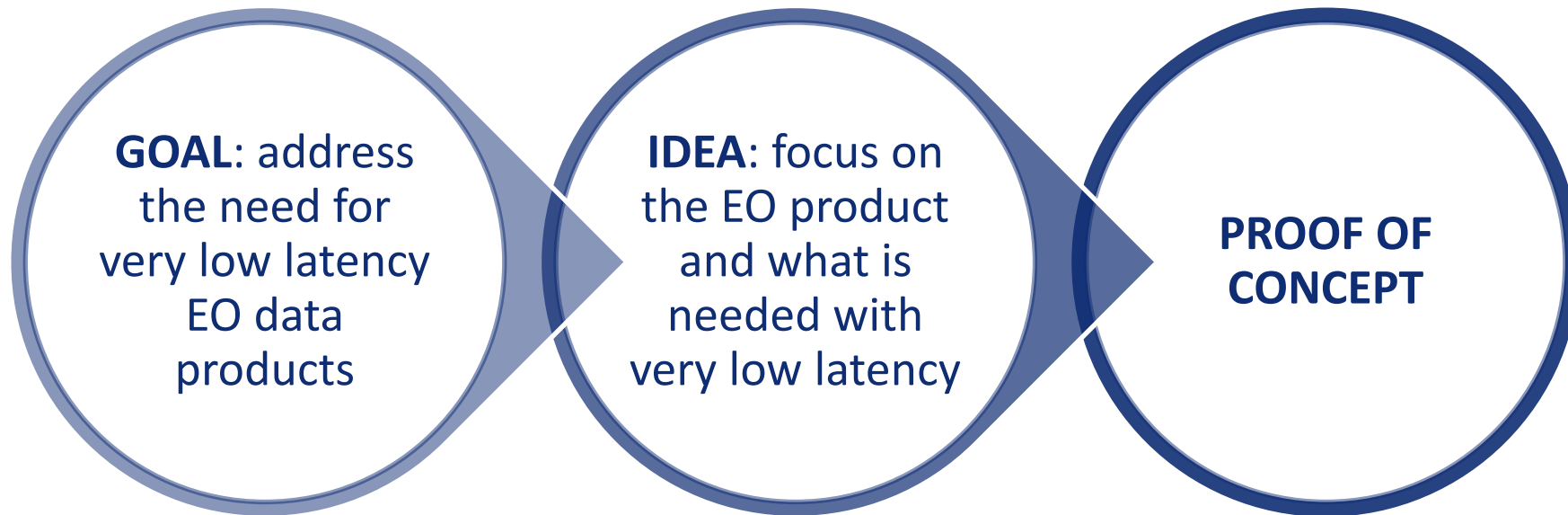


2019 & 2020, Australian Fires



Credit: ESA/Sentinel -2 , Copernicus EMS – CC BY-SA IGO 3.0

EU H2020 EO-ALERT SOLUTION FOR REAL-TIME SERVICES



- Develop a new approach exploiting the flight segment processing capabilities

- Move EO data processing elements from the ground segment to the satellite

- Using 2 real VHR Optical and SAR instruments
 - **TerraSAR-X (SAR)** VHR satellite (1)
 - **DEIMOS-2 (OPT)** VHR satellite (2)
 - Also for **MSG SEVIRI** (Multi-spectral) (3)

LATENCY GOAL: < 1 MINUTE



NEW MISSION ARCHITECTURE FOR REAL-TIME EARTH OBSERVATION

WE CAN PROVIDE PERSISTENT REAL-TIME MONITORING

Existing EO architectures are **limited**. Three basic problems arise:

TIME FOR SATELLITE TASKING (UPLINK)

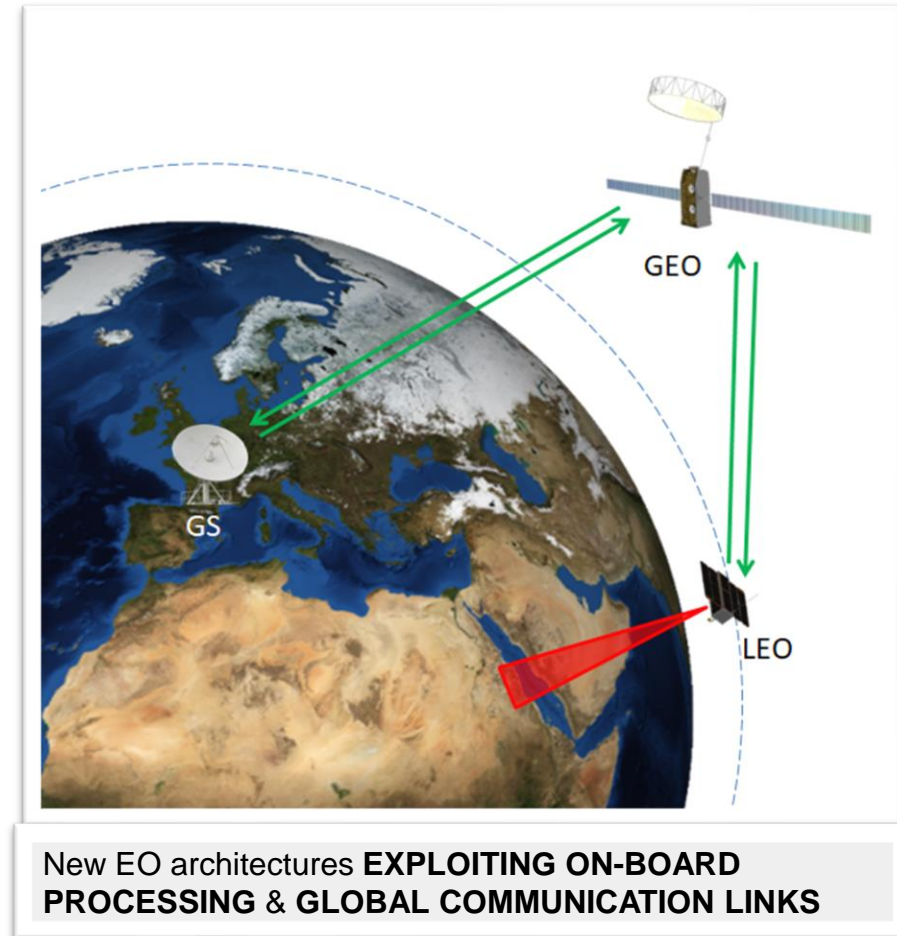
TIME TO ARRIVE AT THE GROUND STATION FOR DOWNLINK

TIME FOR DATA DOWNLOAD

Solved using new architectures based on **low-cost constellations** of small-sats performing **edge computing** and with **global communications links**

ALLOW FOR CONTINUOUS DETECTION AND MONITORING OF EXTREME EVENTS IN REAL-TIME

DEPLOYED GLOBALLY OR REGIONALLY



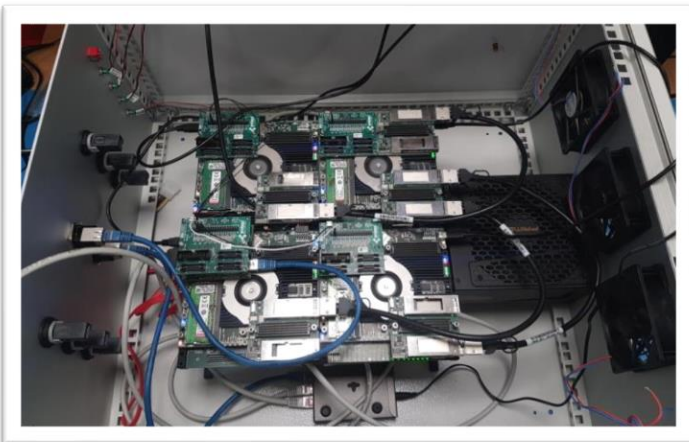
FINAL TEST RESULTS CONFIRM PERFORMANCES

Avionics Test Bench used for End-to-End Hardware system tests

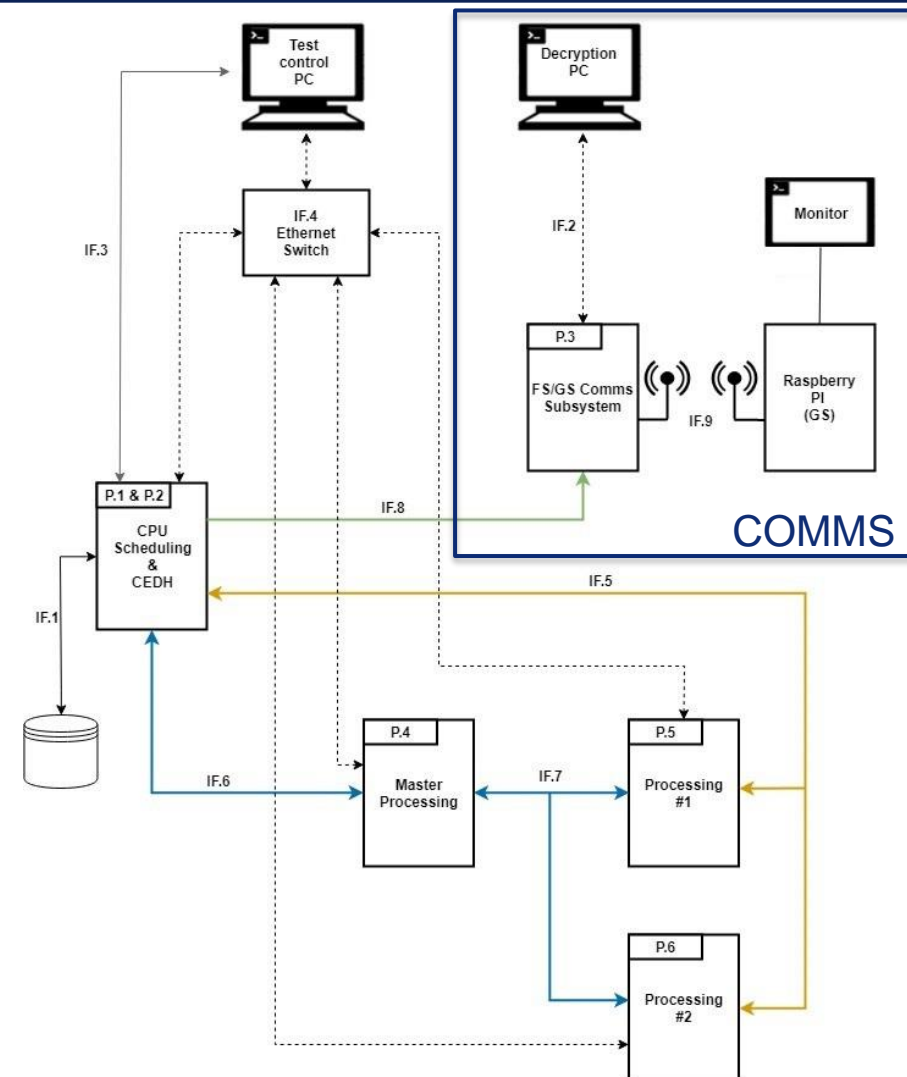
Representative of the complete Flight-Ground system

Demonstrates the **ACHIEVEMENT OF REAL-TIME SERVICES**

Payload Data Processing Unit Hardware Setup

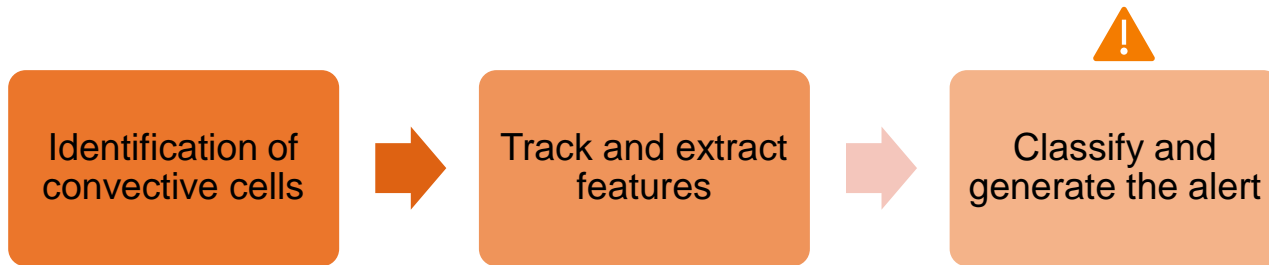


Geo-relay for persistent comms

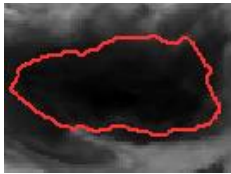


EXTREME WEATHER NOWCASTING PRODUCTS

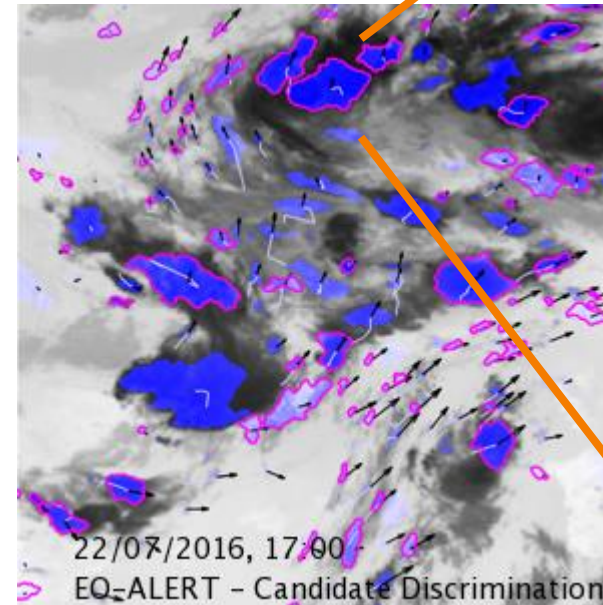
- Detect, Classify and Track Extreme Convective Storms
- Tested on MSG SEVIRI Data
- **WEATHER ALERTS DELIVERED GLOBALLY IN REAL-TIME: 40 - 60 SECONDS**



STORM ALERT

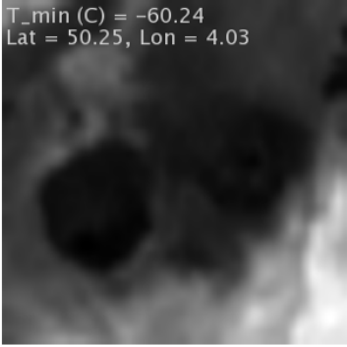


- LAT
- LON
- Extension
- Cooling Rate
- Min Temperature
- Max Temperature



Clipping Image

T_min (C) = -60.24
Lat = 50.25, Lon = 4.03



Storm Information

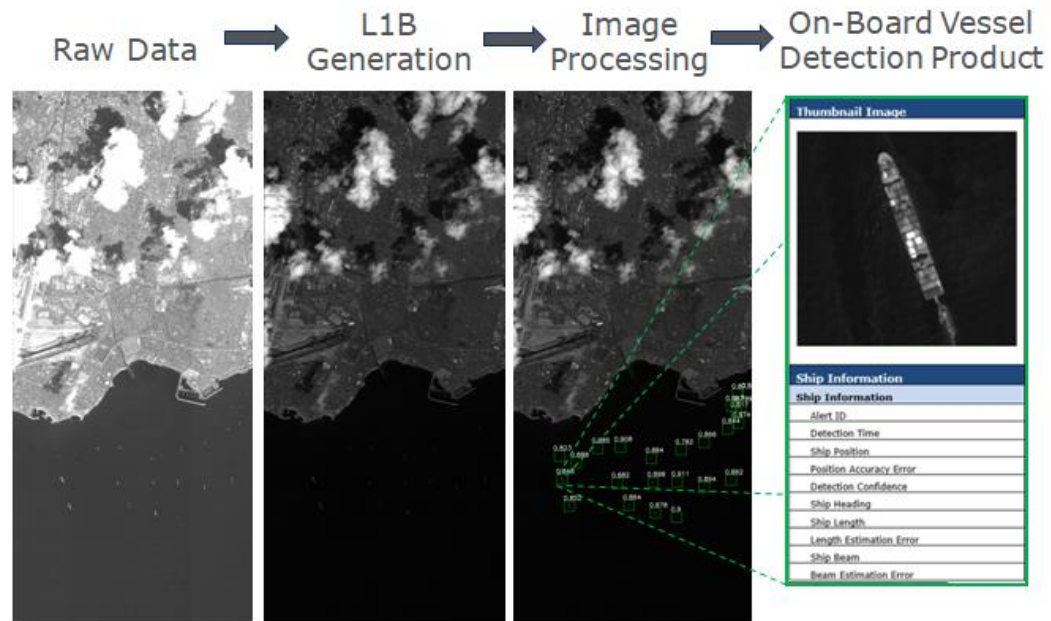
Storm Information
ID
Date/Time (UTC)
Lat
Area
Trajectory
Speed
Merging/splitting
Cloud top temperature
Cooling/warming rate



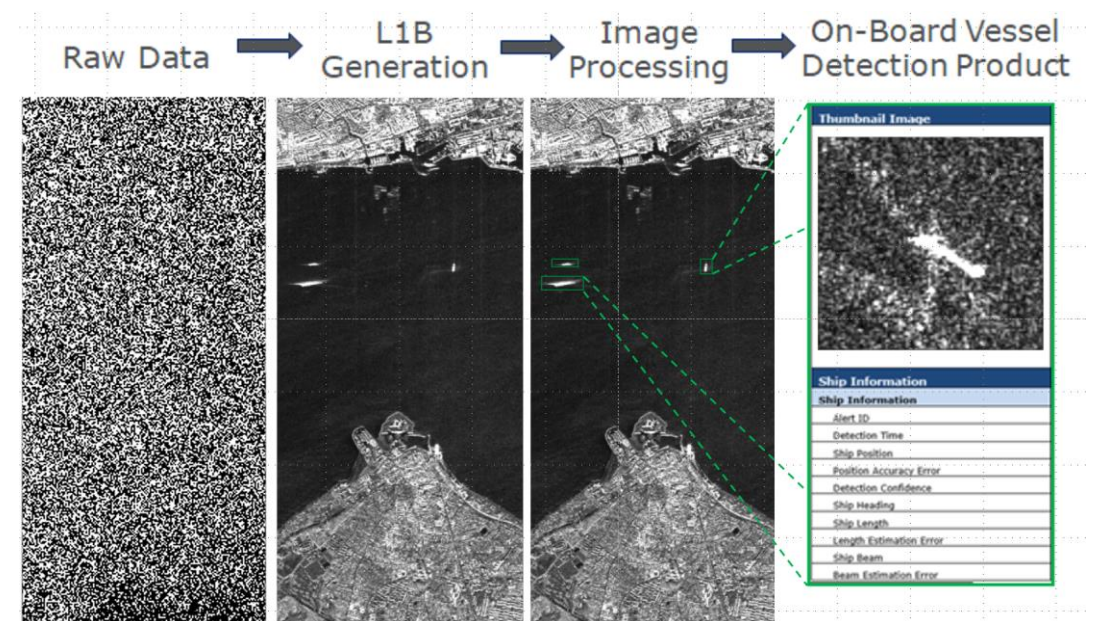
VESSEL DETECTION PRODUCTS

- Ship Detection, Classification, Positioning
- Tested On Terrasar-X (SAR) And DEIMOS-2 (OPT) VHR Payload Data
- VESSEL ALERTS DELIVERED GLOBALLY IN REAL-TIME: 1 – 2 MINUTES**

Optical VHR DEIMOS-2 Example Case



SAR VHR TerraSAR-X Example Case



WORLDWIDE PERSISTENT **REAL-TIME** EARTH OBSERVATION DISASTER MANAGEMENT SERVICES ARE **ACHIEVEABLE NOW**

Services are space based and thus can be deployed regionally or globally

Provides a democratic service to support disaster management, in both the pre disaster (mitigation, preparedness) and post disaster (response) phases

New missions should be **“FUTURE PROOFED”** to ensure they are capable of providing such services

Simply requires the inclusion of:

- High performance on-board processors (OBCs)
- Persistent communication solutions (DRS)





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

 EO ALERT H2020 Project

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