



UNDERSTANDING OUR PLANET USING AIRLINER FLEETS



# NEED FOR DATA AND TELECOM SERVICES

CURRENT AND PROPOSED SOLUTIONS AND ISSUES



SATELLITES



Manufacturing, launch & operational costs



ALTERNATIVE PLATFORMS



Capital intensive, local/regional coverage, regulatory issues



REGULATORY ISSUES FACED DUE TO VERY BUSY AIRSPACE



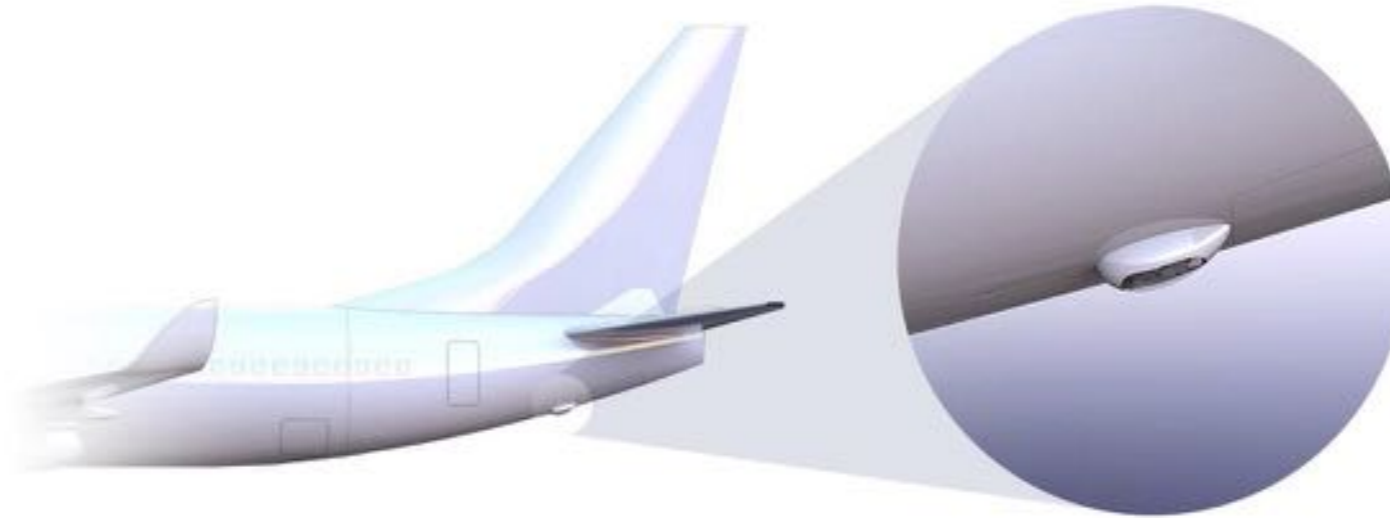
# INACCESSIBLE AIRSPACE FOR HAPS/DRONES

MORE THAN 30,000 FLIGHTS PER DAY OVER EUROPE



# SOLUTION: CREATE CONSTELLATIONS USING AIRPLANES

RE-USING THE MOST RELIABLE PLATFORM: CIVIL AIRCRAFT



## ORCA

OPTICAL AND RF CONSTELLATIONS ON AIRCRAFT



HIGH REVISIT  
MULTIPLE TIMES /DAY



HIGH  
RESOLUTION  
<1 METER



EXCELLENT  
COVERAGE



PAYLOAD  
SERVICEABILITY  
AND UPGRADING



LOW CAPEX &  
OPERATIONAL  
COST



# ESA SUPPORTS ORCA VIA PROJECT DOCS – ‘DEMONSTRATION OF ORCA CONSTELLATION SERVICES’

PHASE 1: EVALUATE ORCA TECHNICAL, BUSINESS, AND LEGAL ASPECTS OF ORCA



## Prime Contractor

Coordination, system architecture and design, simulations, business analysis, IPR



## Airliner

Provision of technical requirements, logistics, and access to fleet



## Aircraft Certification

Payload design, certification, and installations on aircraft

**SIGMA**  
GEOTECHNOLOGIE



## EO Marketing / Sales

Customer identification and contacts, market entry strategy, multi sensor data marketing



## Data Analysis

Earth observation expertise, data processing infrastructure & algorithms



## Connectivity

Evaluate various real-time and non-real-time connectivity options

Dr. Mendes de Leon



## Legal / Regulatory

Evaluate national and EU regulatory and legal issues

# DOCS OUTLINE ARCHITECTURE



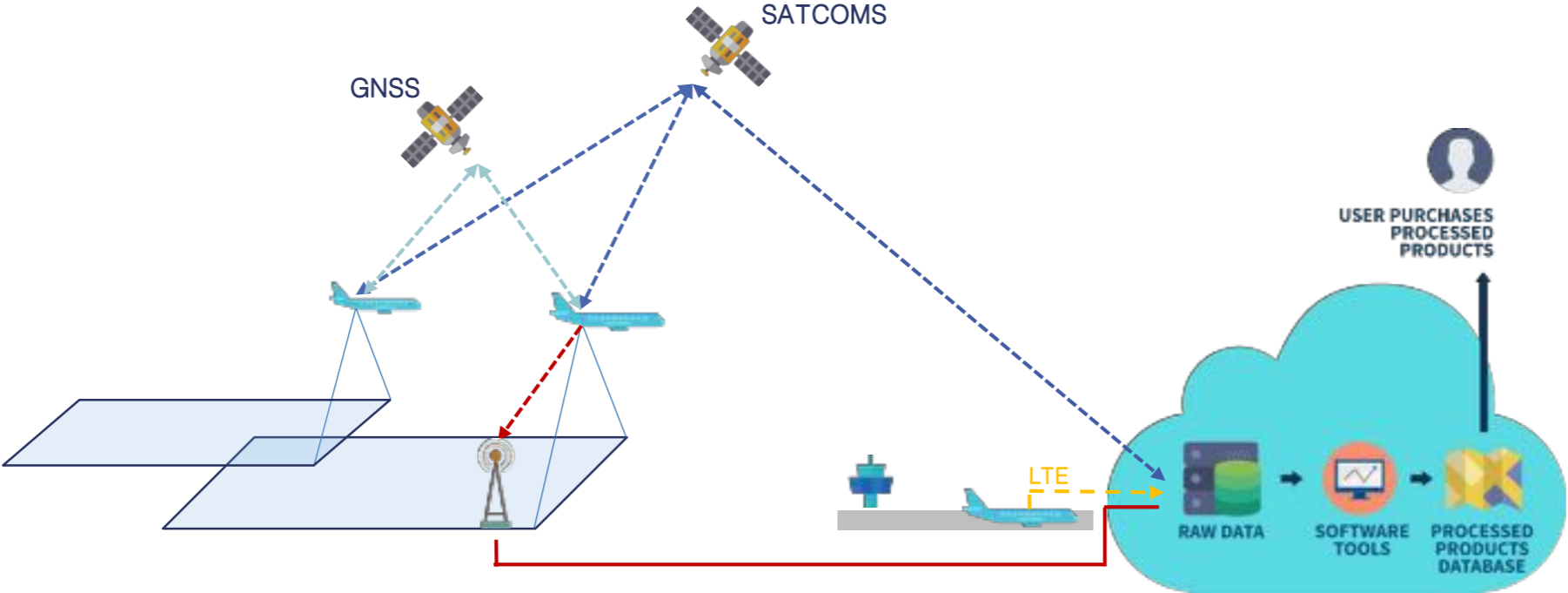
NEAR-REAL-TIME

REAL-TIME

➤ Airport Connectivity

➤ Terrestrial network

➤ Satellite network

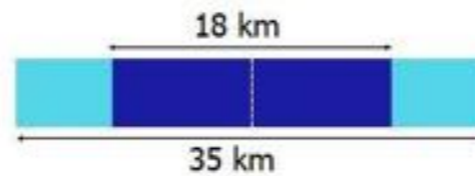
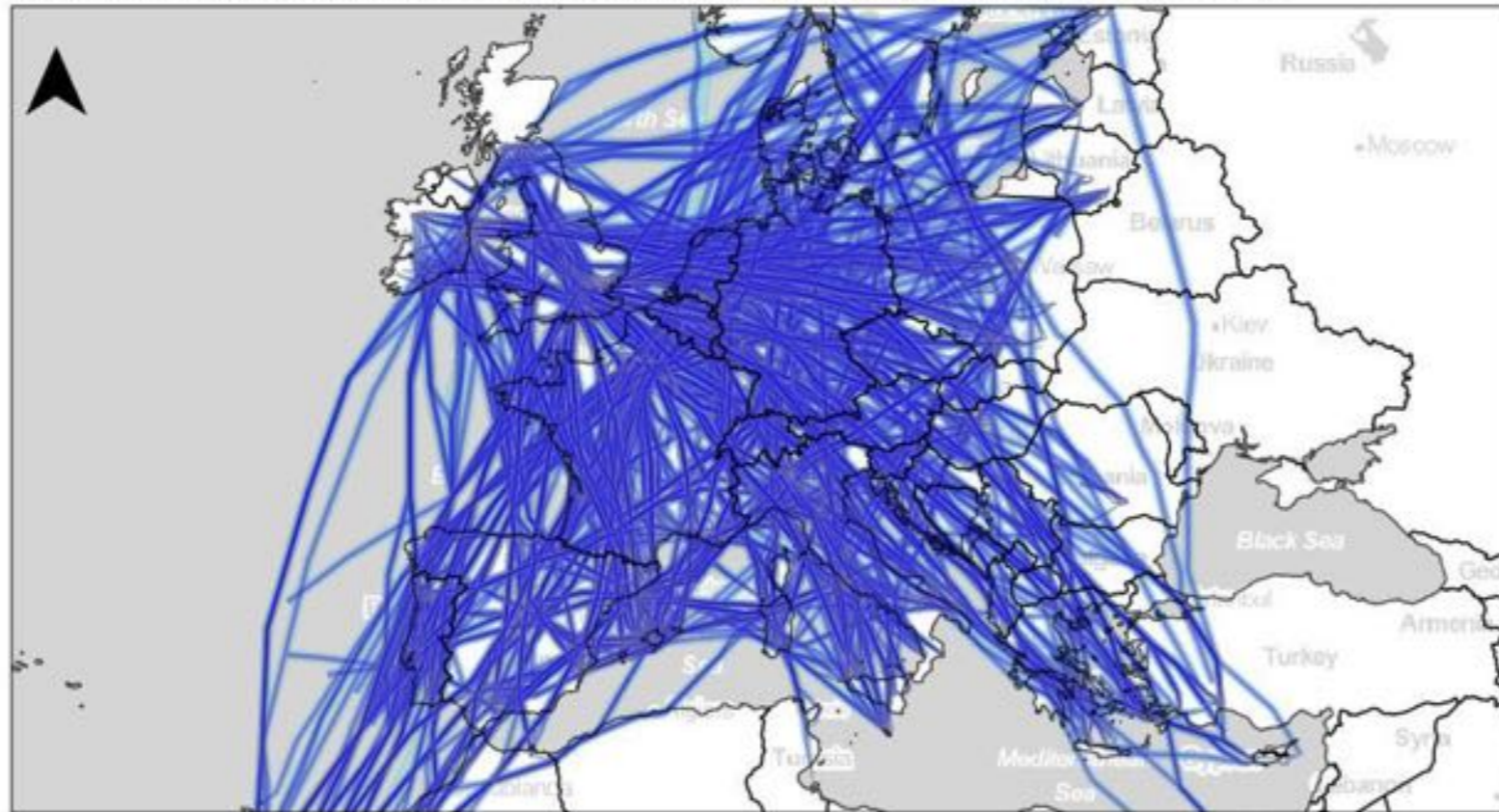


# COVERAGE POTENTIAL

OPTICAL COVERAGE SIMULATION EXAMPLES



European coverage by B737-800 of TUI and Ryanair Fleet in timeframe 07-19 hours



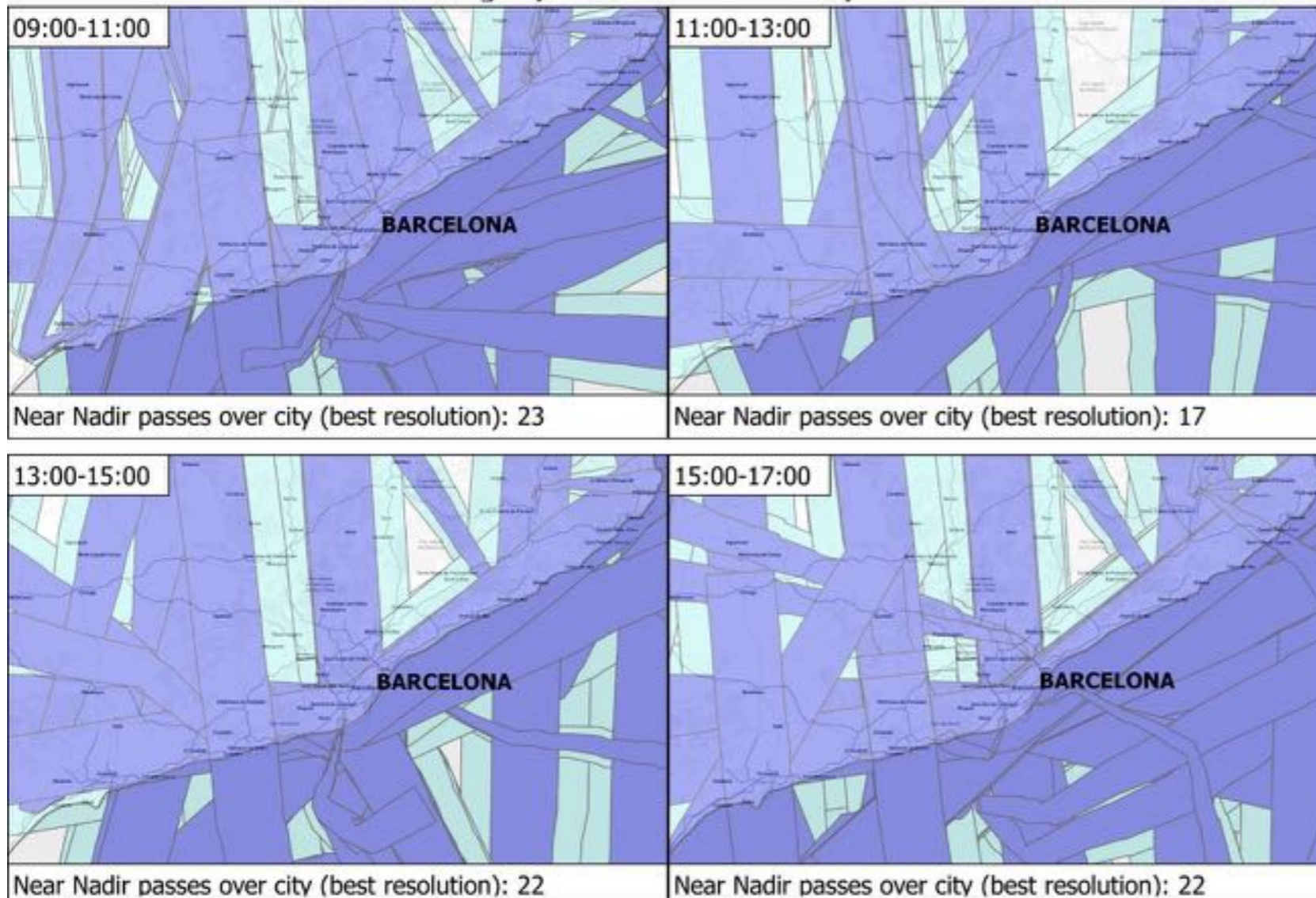


# COVERAGE POTENTIAL

COVERAGE SIMULATION EXAMPLES (OPTICAL)



**Barcelona coverage by B737-800 of TUI and Ryanair Fleet**



Simulations made with EUROCONTROL data under NDA



# COVERAGE POTENTIAL

## ATMOSPHERIC SENSOR COVERAGE SIMULATION EXAMPLES



Coverage by TUI Fleet B737-800s in timeframe 07-19 hours with FOV 140



DAYTIME coverage of **single** aircraft fleet and type (TUI Group)

# FLIGHT TEST CAMPAIGN

## TELECOMMUNICATIONS

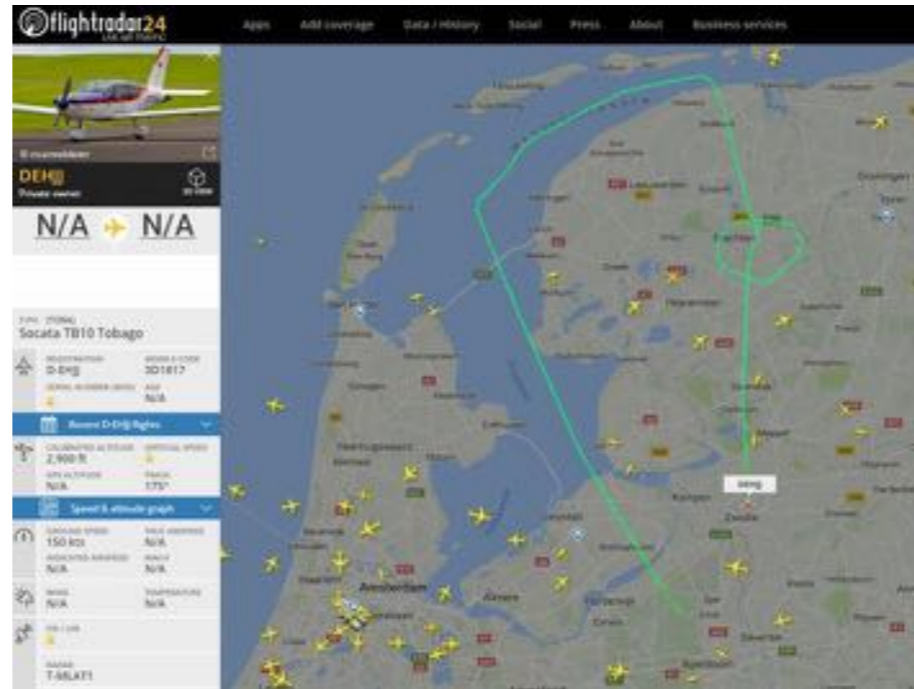


- Performed with TNO – Connectivity Sub-Contractor
- Collaboration with Mobile Network Operators (T-Mobile, Tele-2)
- Validating simulations model for in-flight connectivity (with terrestrial mobile network)
- LTE tests on tarmac at Rotterdam International Airport for ground connectivity evaluations

## TELCO PAYLOAD MOUNTED ON WING



## FLIGHT PATH



# FLIGHT TEST CAMPAIGN

## EARTH OBSERVATION



- Performed with VITO – Remote Sensing Partner
- Main purpose to evaluate optical and thermal imaging with low-cost COTS equipment
- Evaluate processing and fusion of thermal/optical data
- Images co-registered and time-position-orientation tagged via GNSS /INS

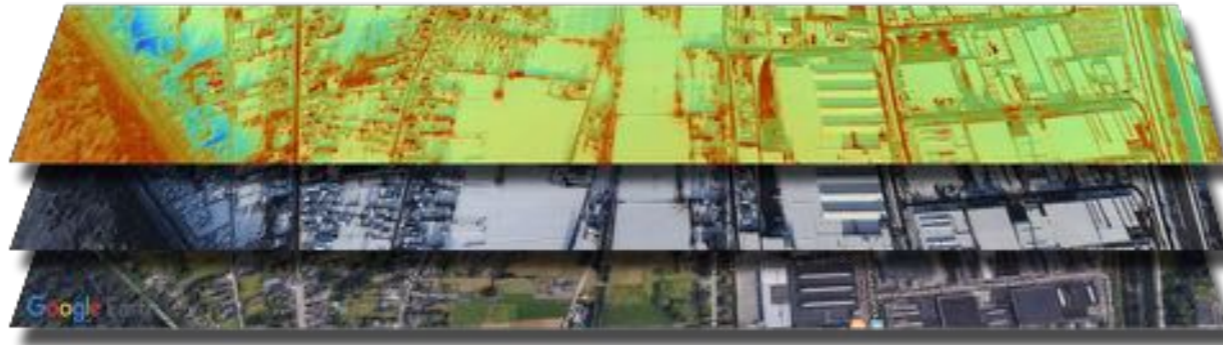
## EO PAYLOAD MOUNTED ON WING FLIGHT PATH



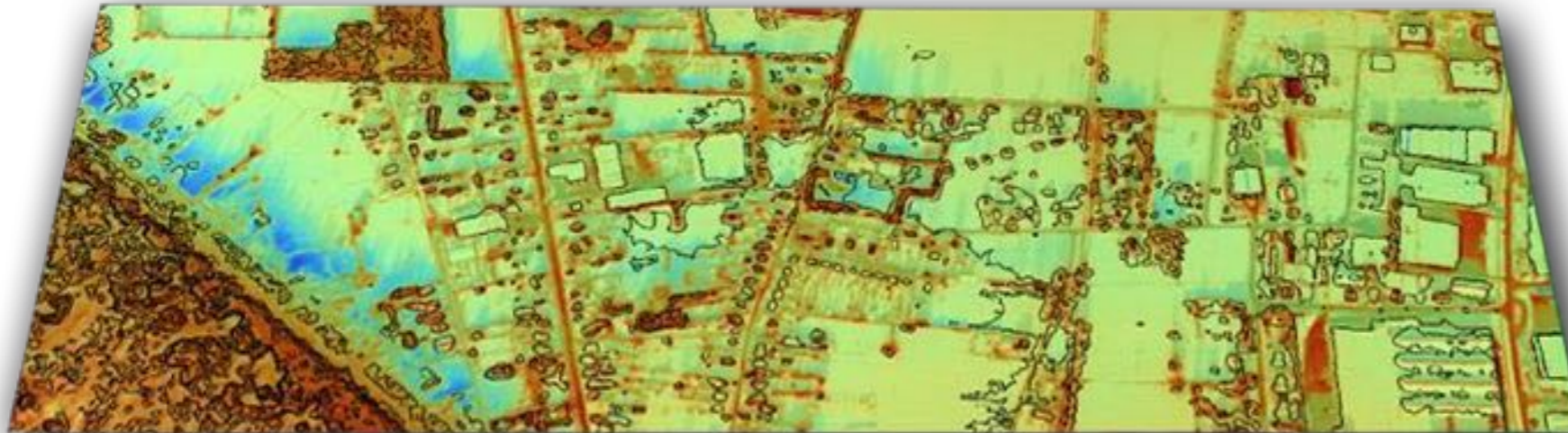


# FLIGHT TEST CAMPAIGN PRODUCT EXAMPLE

EO PRODUCT: FUSED DSM - THERMAL AND VECTOR-BASED INFORMATION



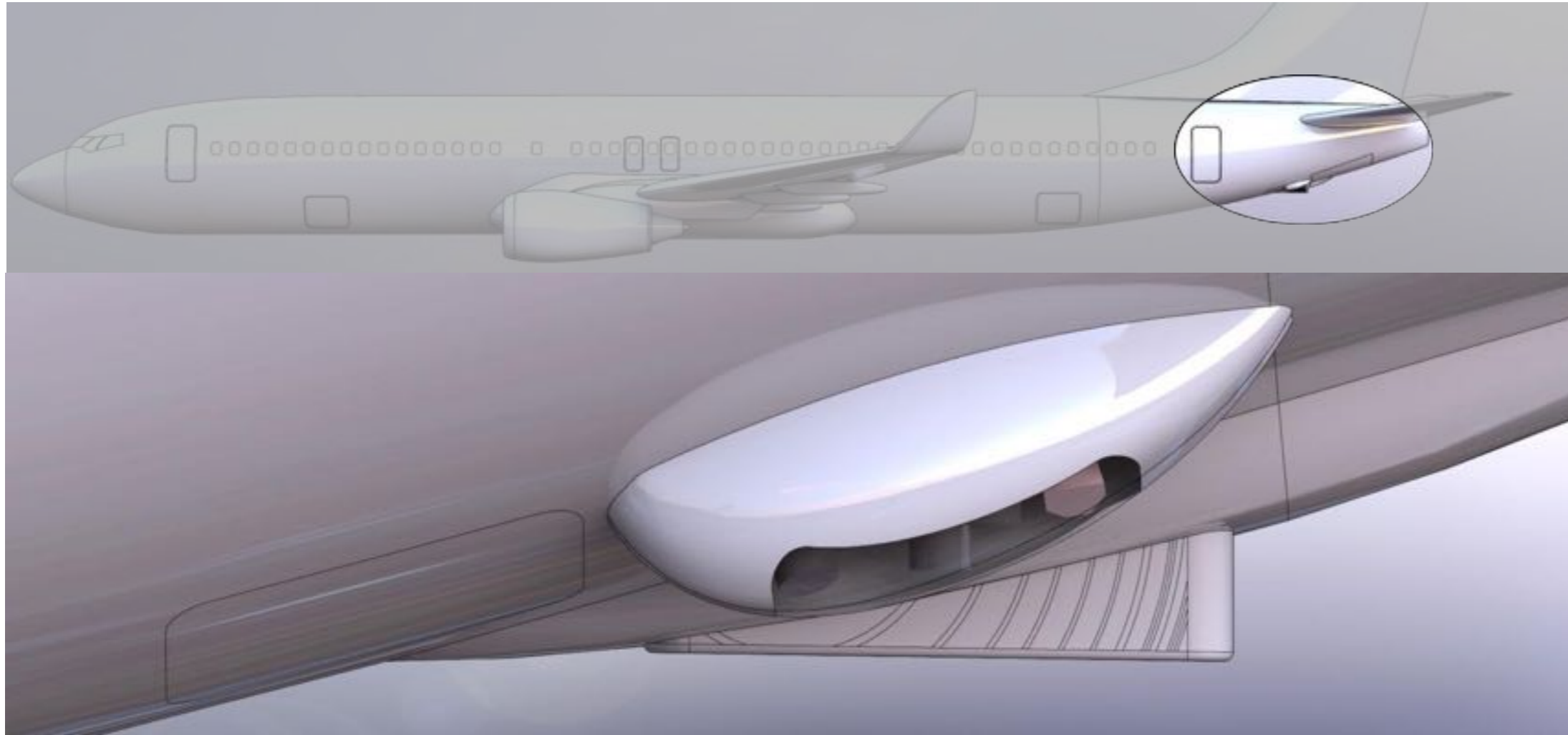
- THERMAL DATA
- OPTICAL DATA
- EARTH BASEMAP



# PAYLOAD DESIGN AND INSTALLATION



PAYLOAD MOUNTED ON LOWER AFT FUSELAGE OF 737-800



**NOTE:** Design and placement of payload are the result of extensive evaluations (payload performance & certification related trade-offs) - performed by SkyfloX & Aircraft Design and Certification Ltd., in close cooperation with TUI fly The Netherlands. \*Payload is baselined to be placed next to tail skid structure of aircraft (which is not part of the orca payload itself)

# PERFORMANCE & APPLICATIONS

ORCA CAN SERVE MANY APPLICATIONS WITH HIGH PERFORMANCE



## FLIGHT TEST CAMPAIGN, COVERAGE EVALUTIONS, AND DESIGN CONCLUSIONS

The performed work indicates that the following performance characteristics (USPs) can be realised, which prove ORCA can serve a multitude of applications (some of which are displayed below)

### APPLICATIONS IN EARTH OBSERVATION\*



INSURANCE /  
INFRASTRUCTURE  
MONITORING



RESOURCE  
MONITORING



MARITIME  
APPLICATIONS



DISASTER  
RELIEF

### TELECOMMUNICATIONS\*



INTERNET OF  
THINGS



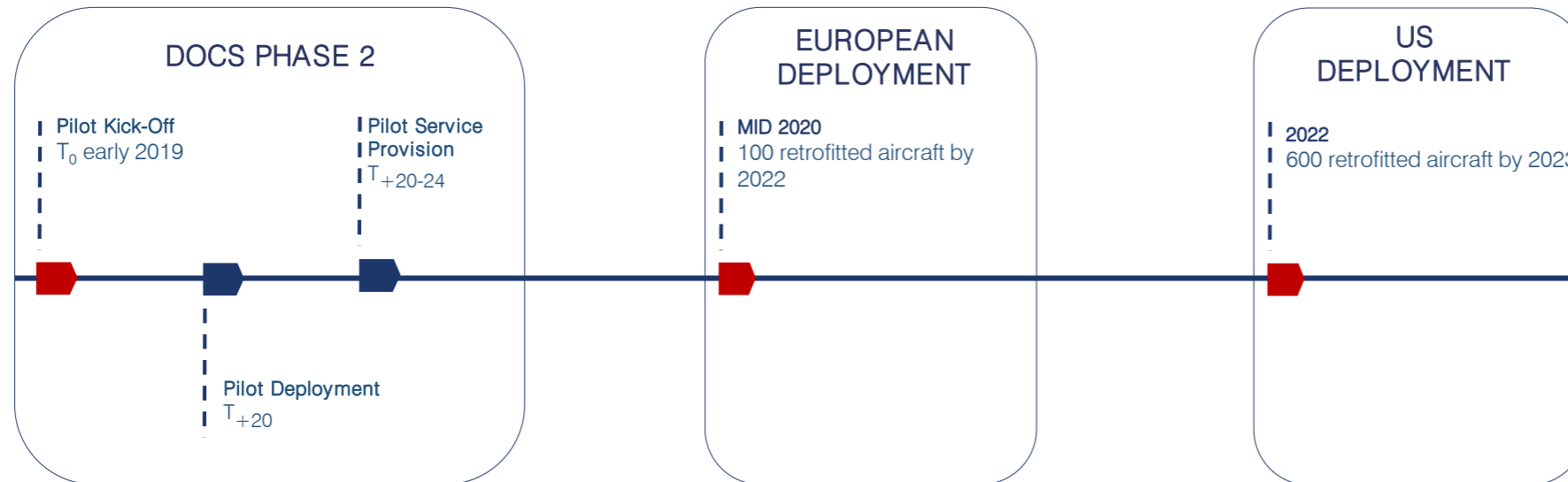
AUTOMATIC  
IDENTIFICATION SYSTEM

\*Other applications may include forest fire detection, precision farming, forestry, solar forecasting, asset tracking, meteorological, insurance, etc

\*\* Covering 90% of the populated areas of the globe (EU, USA, SE Asia, ...)

Combination of EO and Telecommunication services (e.g. EO+AIS) may open new services / markets

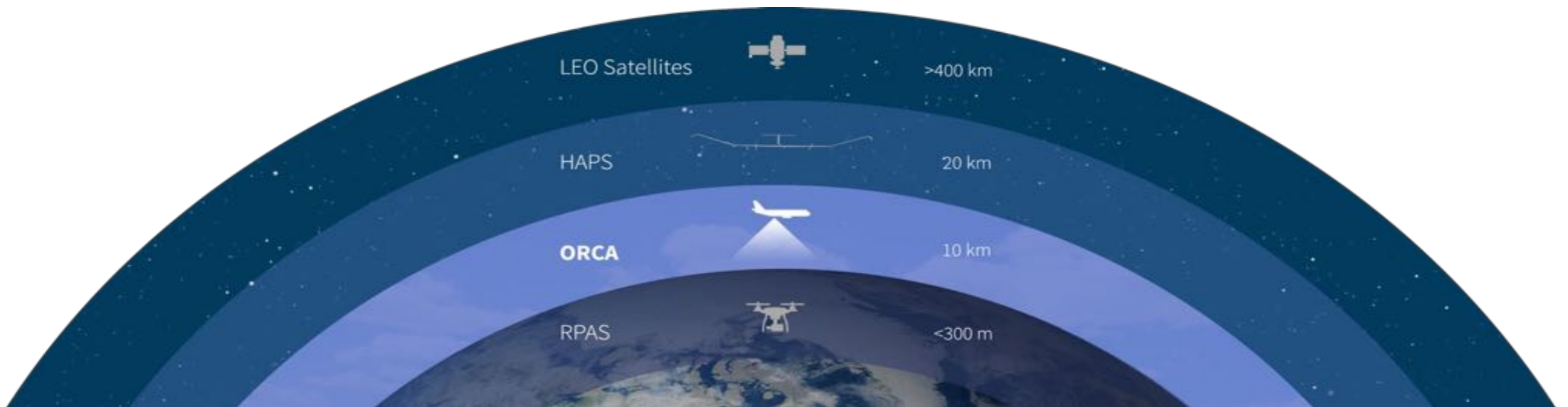




- **Imaging payload/services baselined for first pilot**
- **Interest in deploying atmospheric sensors (pending budget availability)**

# ORCA

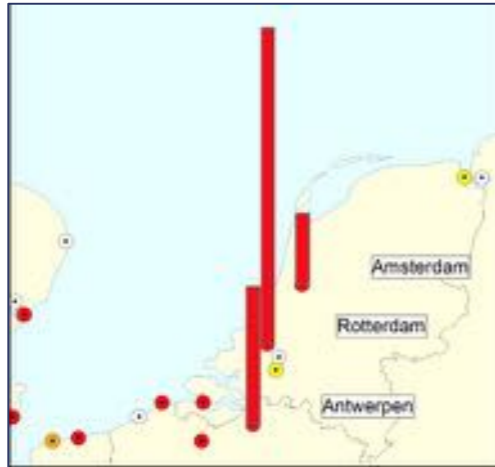
## THE MISSING LAYER



Fully in line with the Space 4.0 vision, integrating multiple layers of resources

# PILOT APPLICATION EXAMPLE: HIGH RESOLUTION IMAGING

WITH 5 TUI FLY 737 AIRCRAFT ONLY – COURSE OF 1 WEEK



LARGEST 4 PORTS EUROPE:

1. ROTTERDAM
  2. ANTWERP
  3. HAMBURG
  4. AMSTERDAM
- ACCOUNT FOR  $\pm 40\%$   
OF ALL EU CARGO



ROTTERDAM REVISITS: 55



ANTWERP REVISITS: 32



AMSTERDAM REVISITS: 101