



Sistemi Iperspettrali Avionici

Gianni Uda, Barbara Sereni

Imagers Programmes

Optronics Systems LoB

Land and Naval Defence Electronics Division

Primo Workshop Nazionale su: "Data Exploitation della missione PRISMA, precursore delle missioni iperspettrali nazionali", Roma 1,2,3 Marzo 2017



Outline

Experience

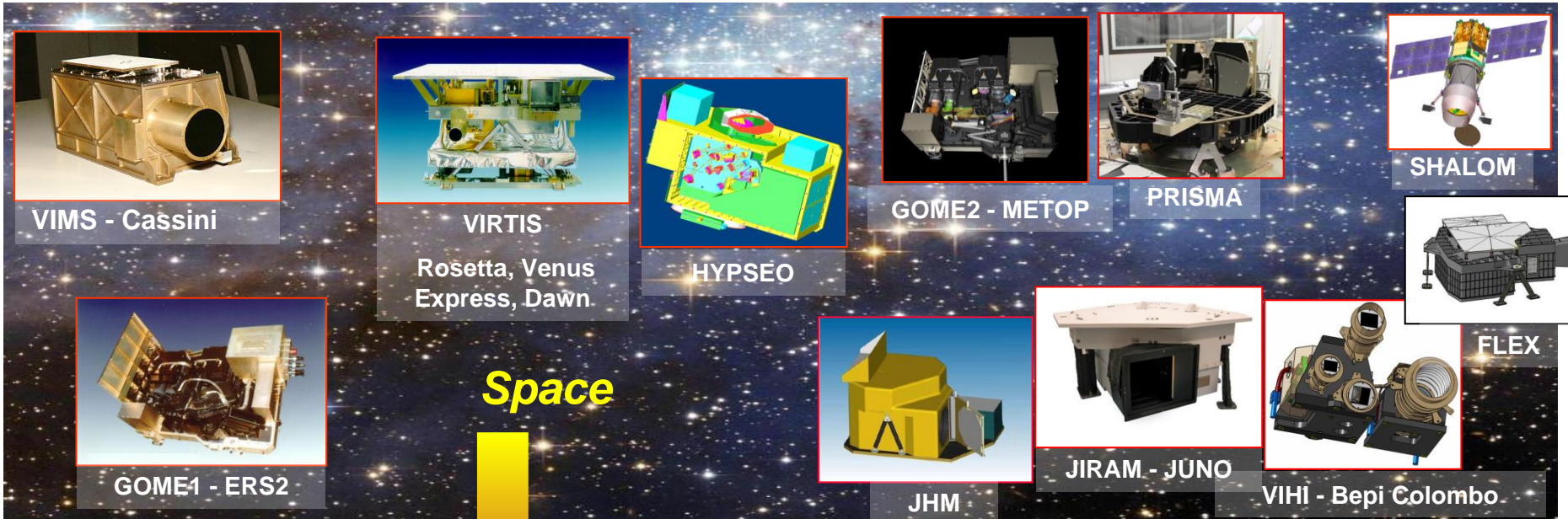
- Leonardo Heritage
- Examples of Acquisition Campaigns

New Product

- SPHYDER System
- Real Time Processing



Leonardo Hyperspectral Heritage

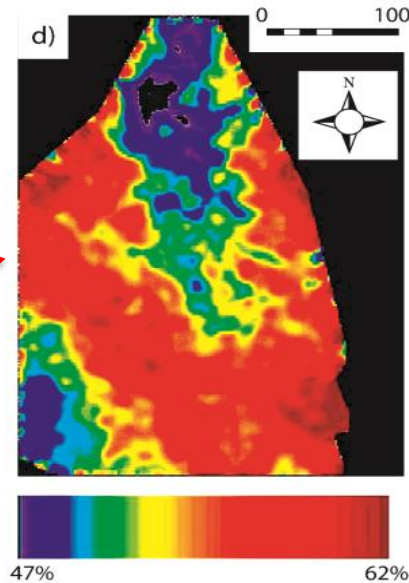
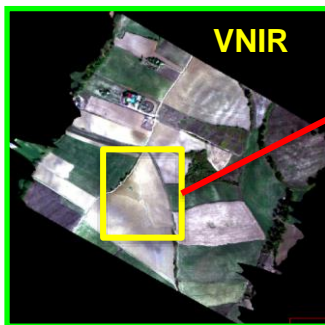
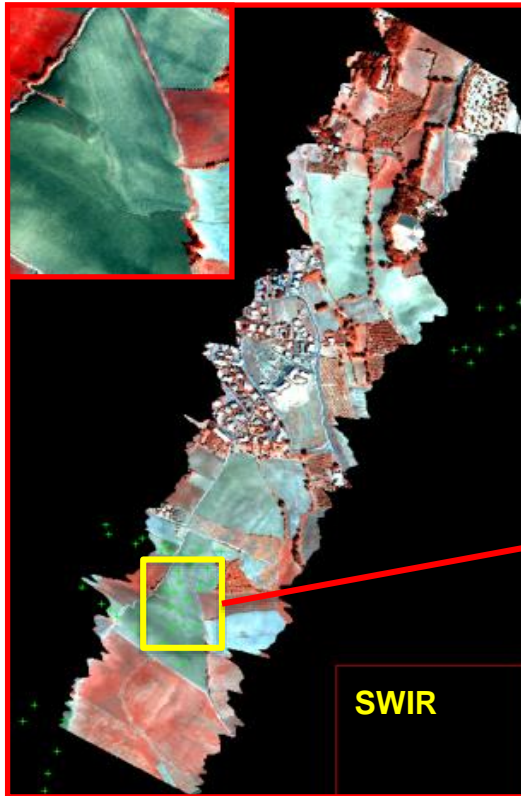




Examples of Acquisition Campaigns



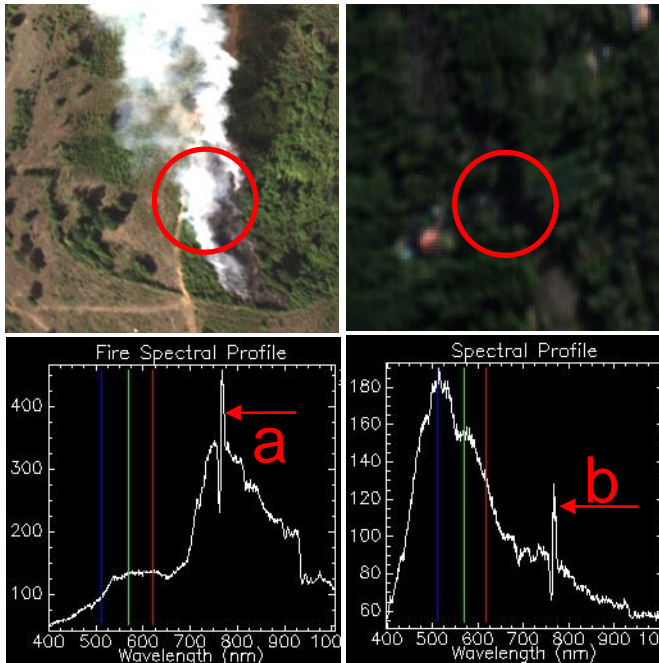
Content of soil argil (EC-Digisoil)



Monitoring of
Sliding down movements

Forest fire monitoring (ESA AIRFIRE)

Identification of covered by smoke outbreaks (flame) using VNIR channels and complete identification of the warm front of the fire and its temperature using the SWIR data channel

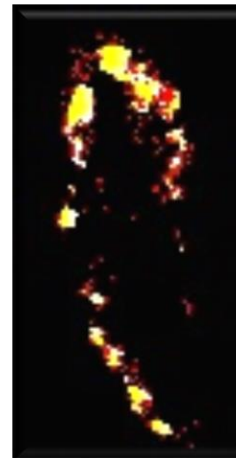


Spectral signature of a pixel corresponding to:

- a) flame covered by smoke
- b) outbreak is not visible to the naked eye



Flame zones identified on the basis of emission peak from the VNIR data;

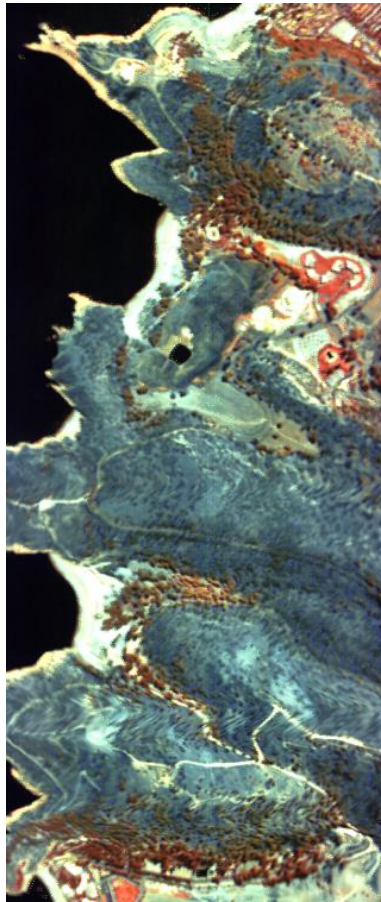


Warm front of the fire based on data SWIR

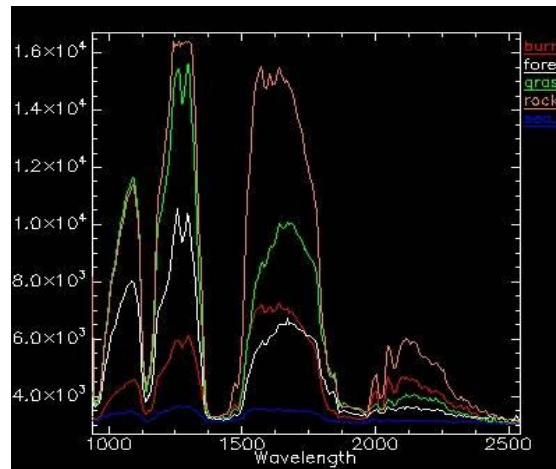
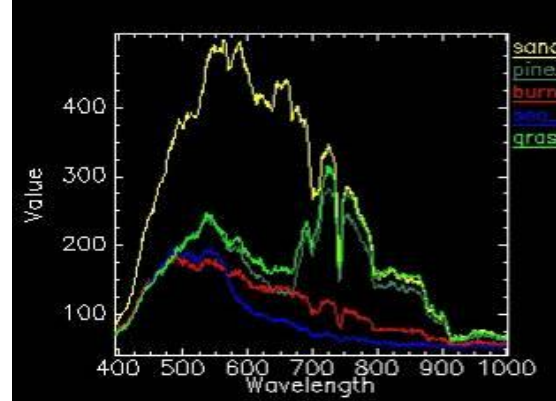
Burned Areas Monitoring (Telaer)



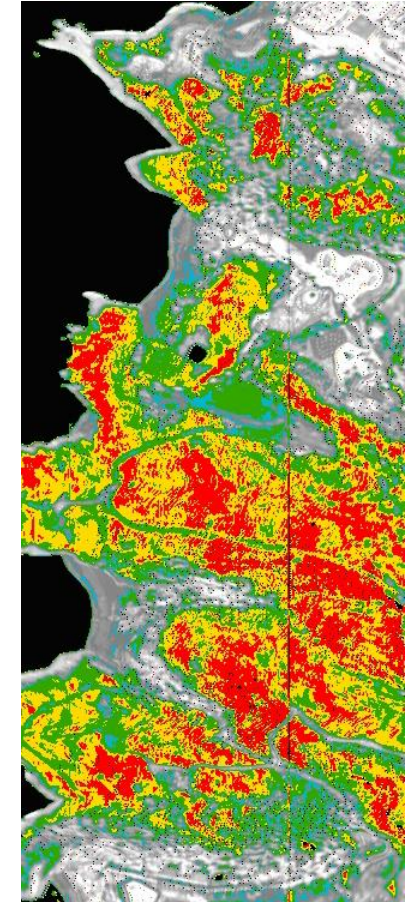
VNIR



SWIR

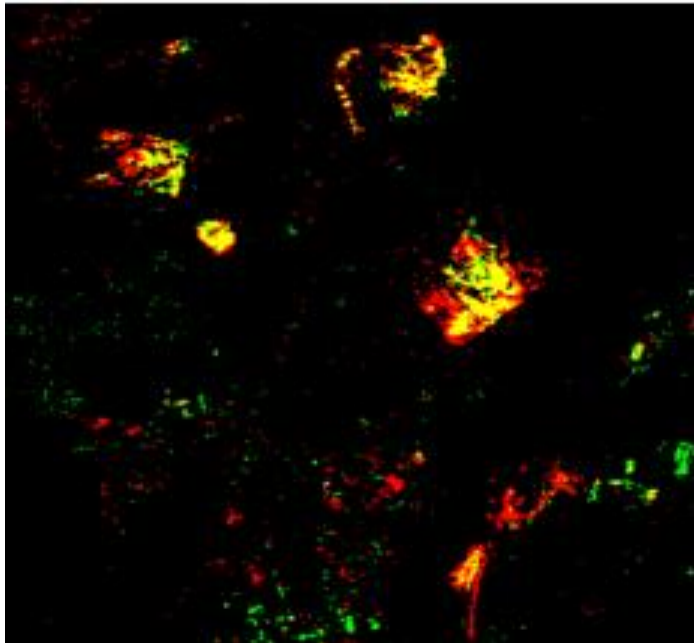


Spectral Signature



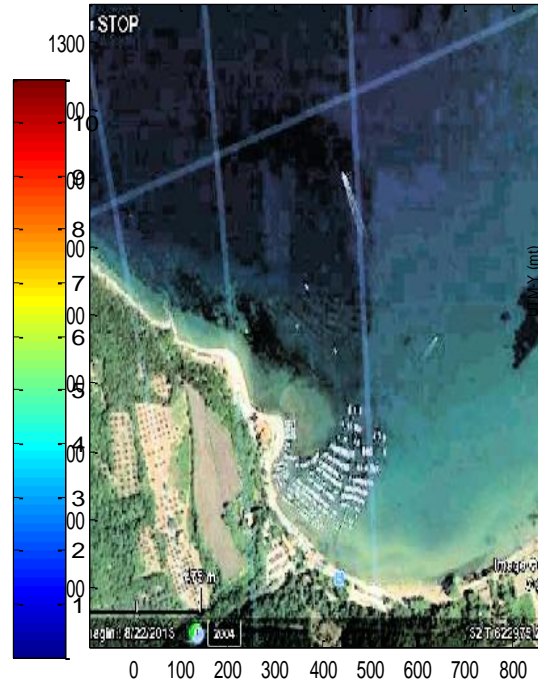
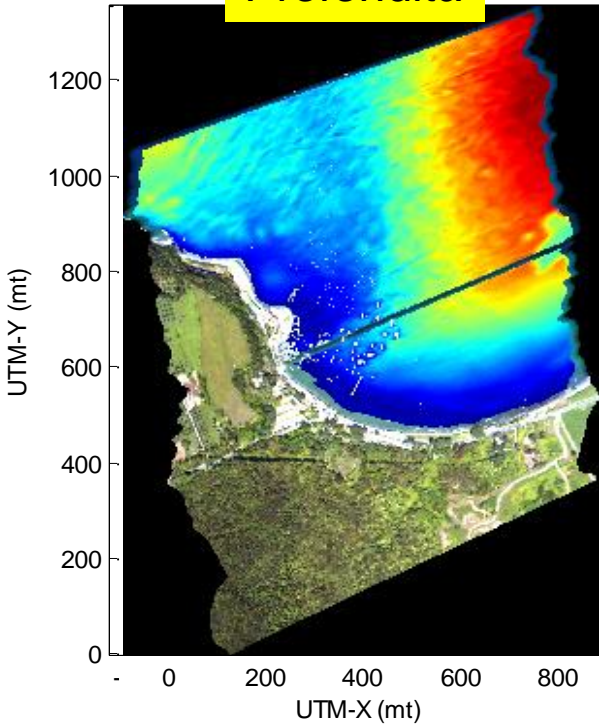
Burned Index

Ground classification to evaluate the ambient impact

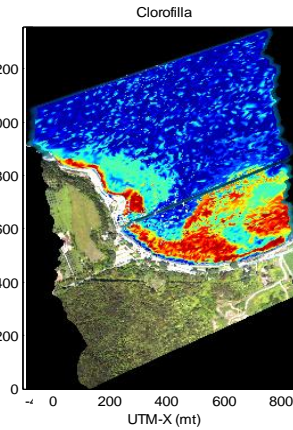


Bathymetry (< 10 m)

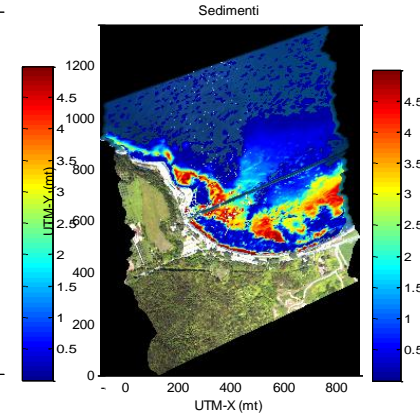
Profondità



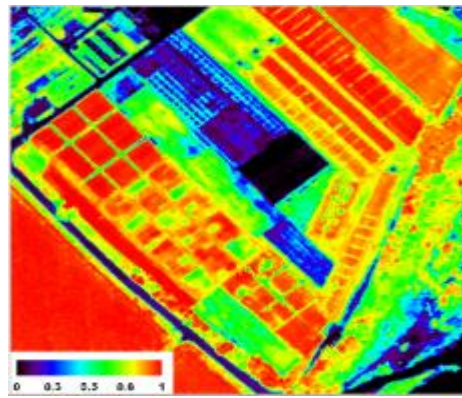
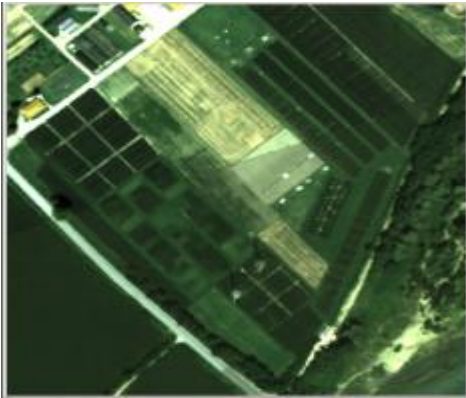
Clorofilla



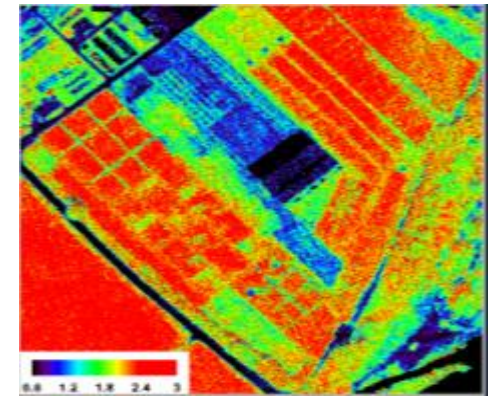
Sedimenti



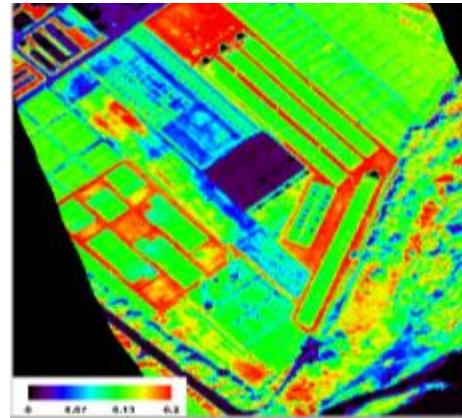
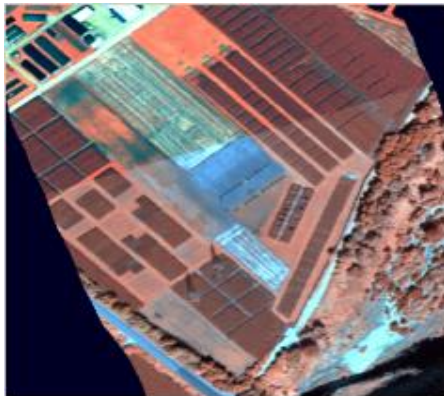
Precision farming (SMAT F2)



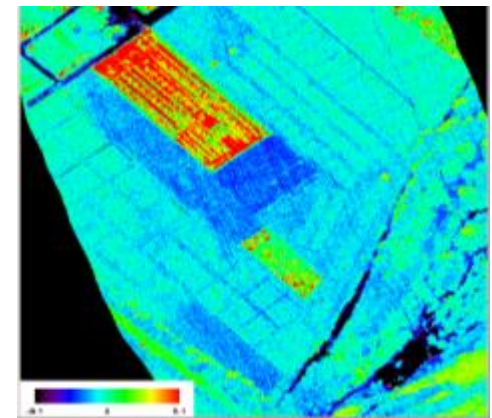
MRENDVI – Modified Red Edge Normalised Vegetation Index



WBI – Water Band Index



NDNI – Normalised Difference Nitrogen Index



CAI – Cellulose Absorption Index

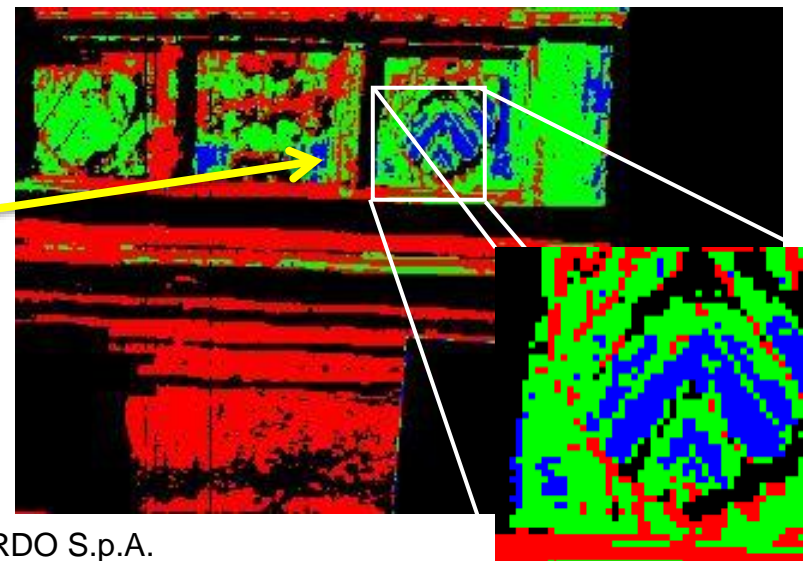
Georeferentiation



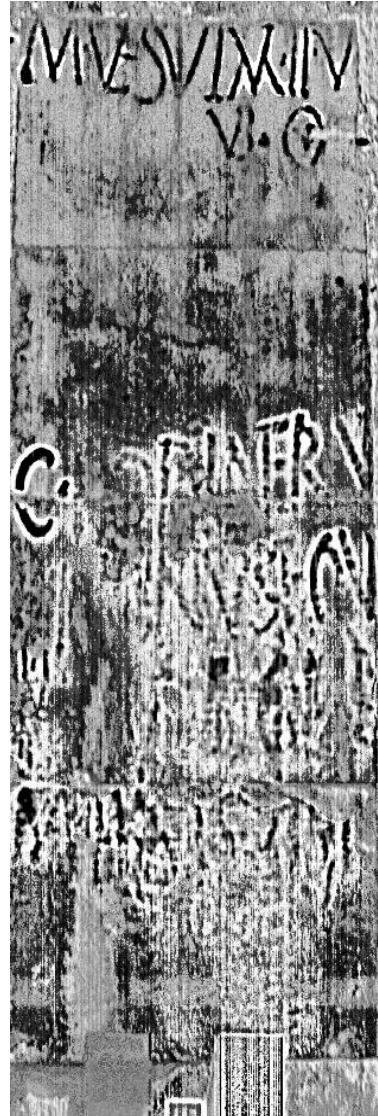
Ground based: damage observation, prevention and conservation



- 100% calcite
- 50% calcite
50% gypsum
- 100% gypsum



Roman inscriptions

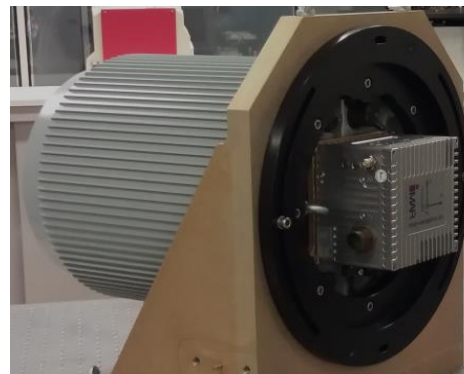


SPHYDER (Smart Processing HYperspectral DEtection and Reconnaissance) was designed to respond to specific applications and to be installed on various platforms.

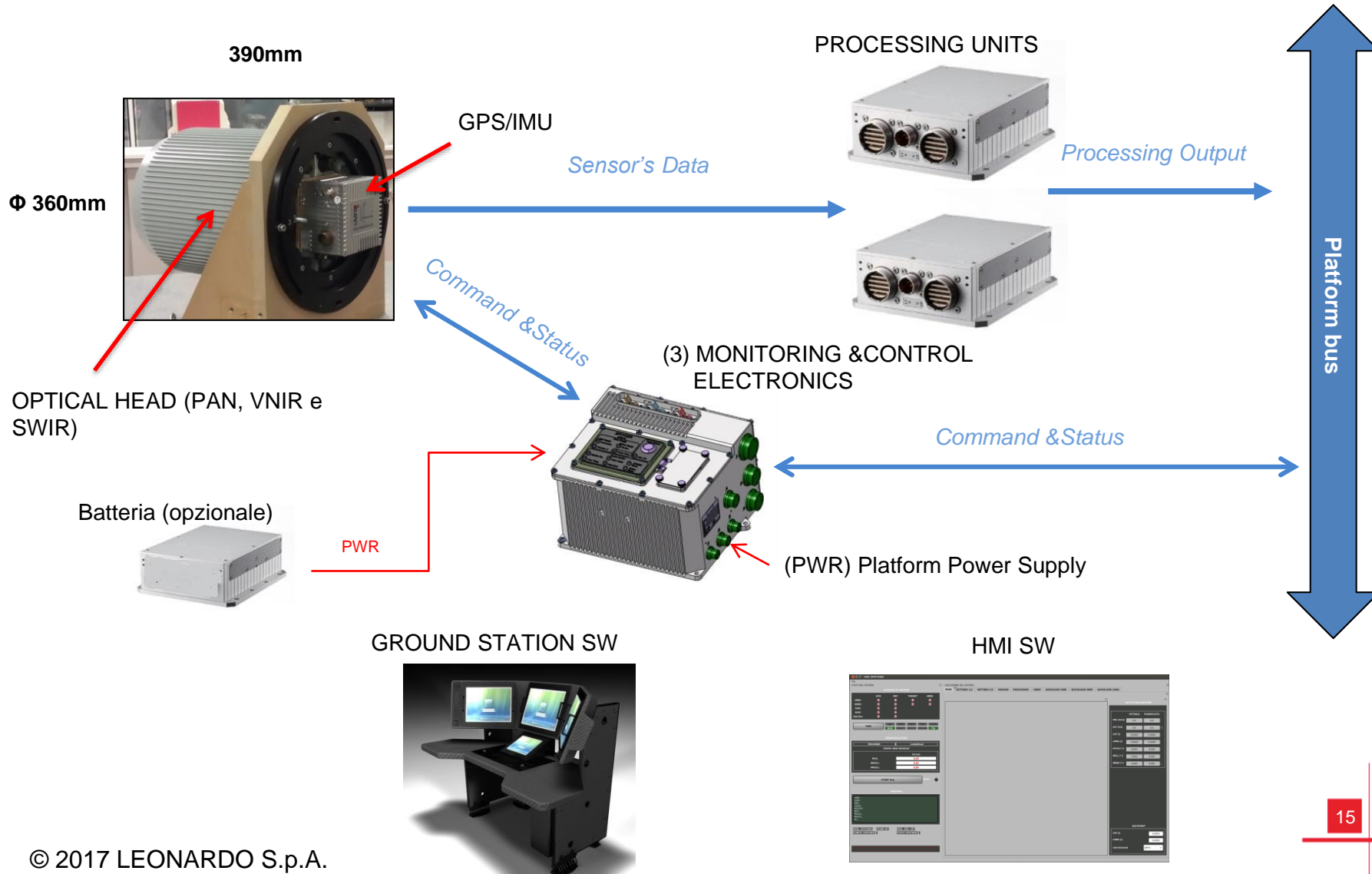
During the development and after discussions with potential end-users it appeared the need of obtaining **Real-Time** information during the mission.

The main requirements to be fulfilled for SPHYDER design and development:

- Compact and lightweight
- Custom
- Real Time Processing



SPHYDER: architecture



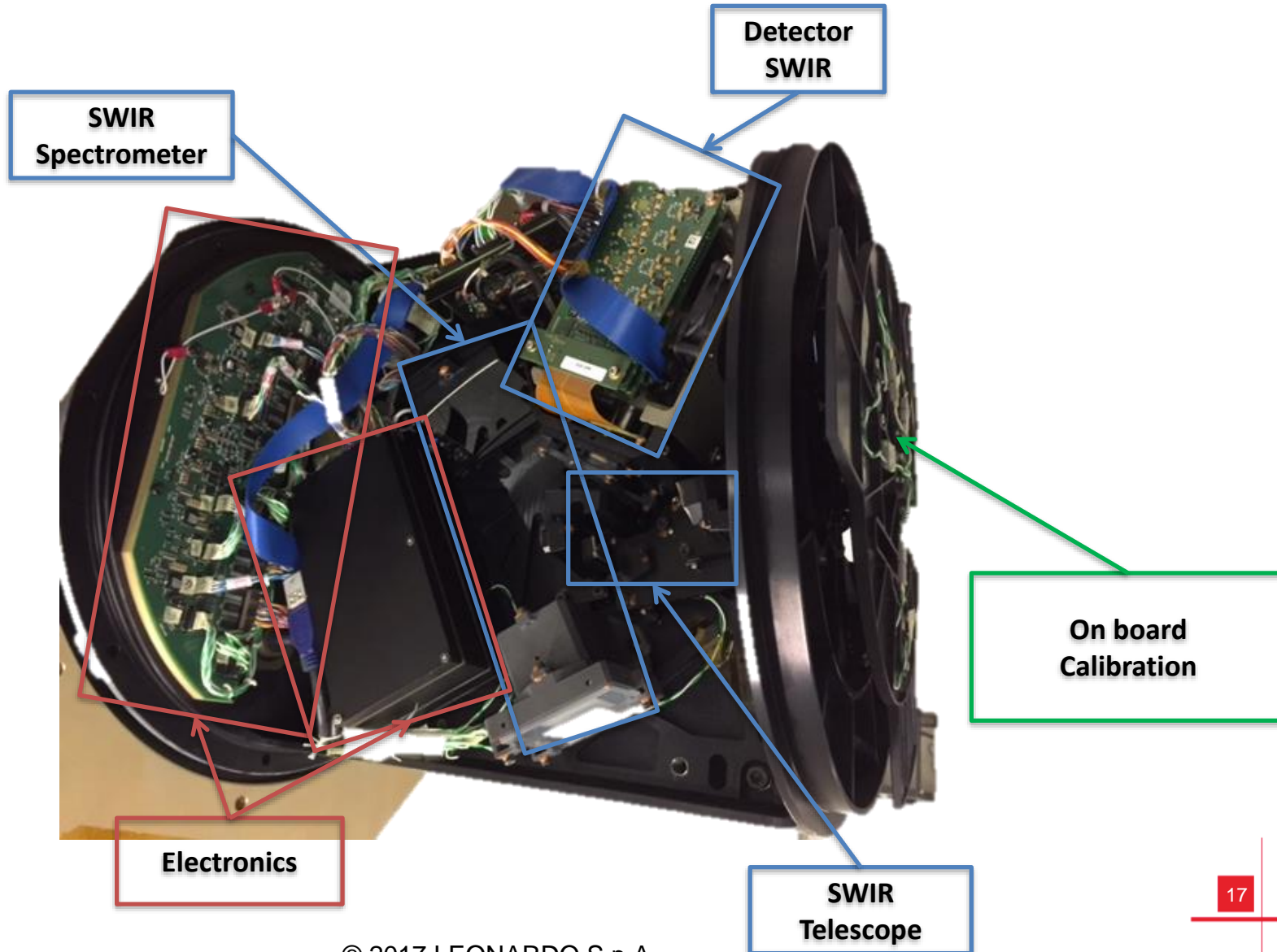
SPHYDER: technical characteristics

SPHYDER: Optical Head

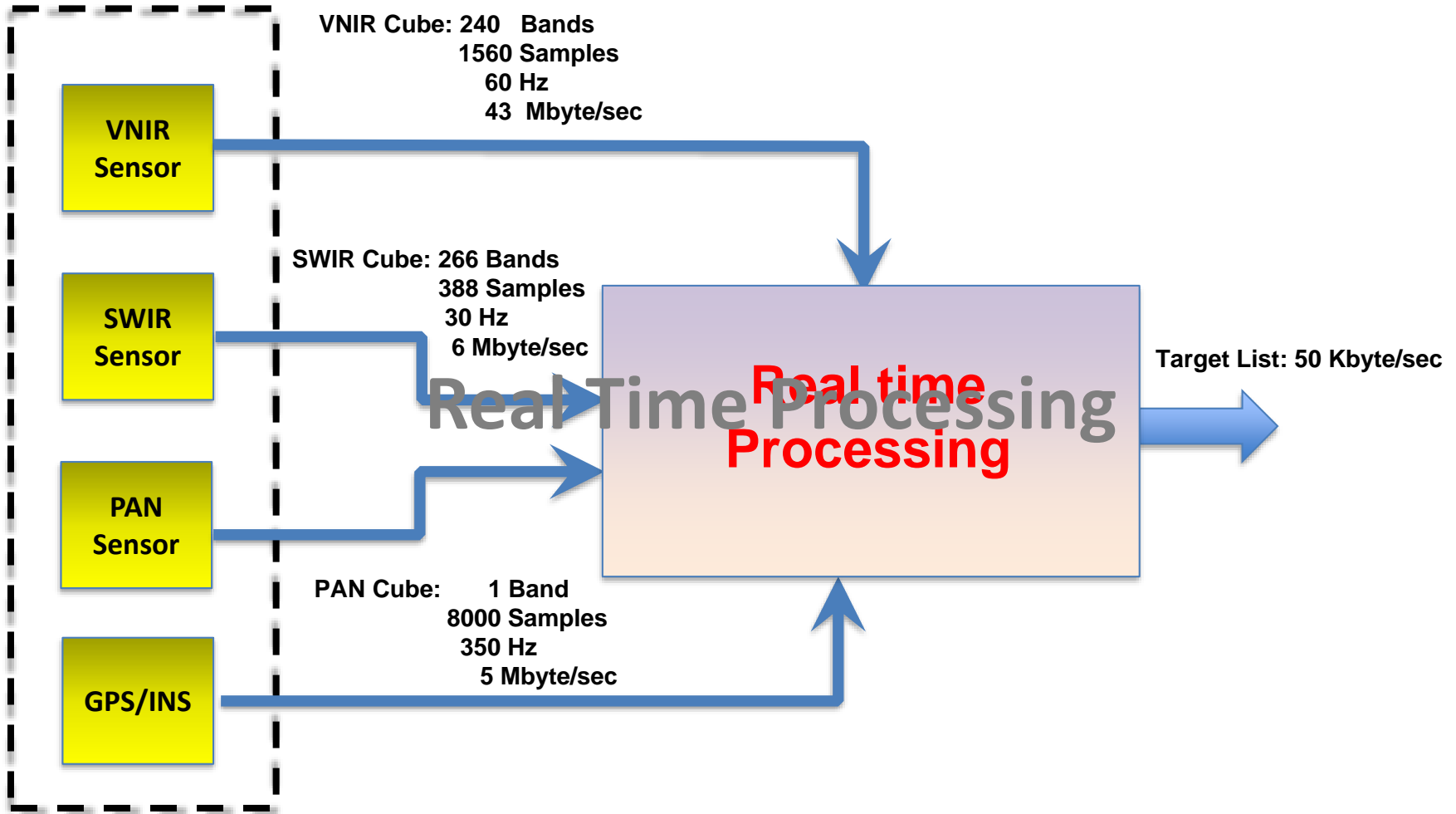
	PAN	VNIR	SWIR
Spectral Range	PAN [400, 1000] nm	[400, 1000] nm	[900, 2500] nm
Spectral Sampling	Monocromatico +RGB alta risoluzione	2.5 nm	6 nm
Spectral Bands		240	266
IFOV	0.066 mrad	0.33 mrad	1.0 mrad
FOV	±14.5°	±14.5°	±10.8°
GSD @ H=1000 m	0.066m	0.33 m	1 m
Swath @ H=1000 m	520 m	520 m	384 m

- Temperature secondo MIL-STD-810E Metodo 502.4
- Stoccaggio [-40,+71]°C
- Operativo [-40,+50]°C
- EMC secondo MIL-STD-461F
- Alimentazione secondo MIL-STD-704D

SWIR Channel



SPHYDER: Real Time Processing



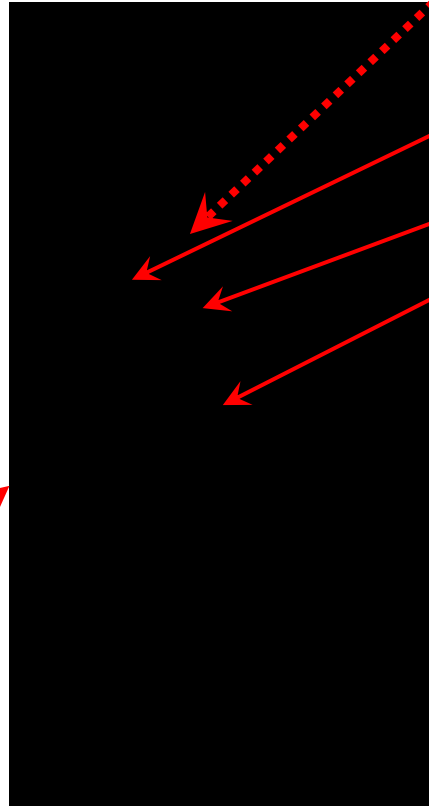
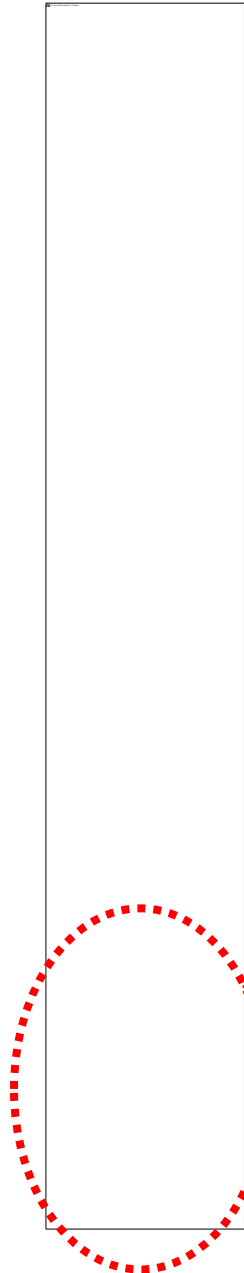
Applications

Market and Potential Customers	General Applications	Benefits
<p>Military and para-military:</p> <ul style="list-style-type: none"> • Navy • Air Force • Army • Coast Guards • Civilian Protection • Police 	<p>Search And Rescue</p> <p>Intelligence</p> <p>Mission Planning</p> <p>Law Enforcement</p> <p>Detection and Recognition</p> <p>Homogeneous areas Delimitation</p> <p>Homogeneous areas Classification</p>	<p>Survey of large areas in a short period of time and real time automatic signaling of «alarms»</p> <p>Detection of “known” targets on any type of surfaces, using their spectral signature.</p> <p>Using with other sensors can improve SPHYDER capability.</p>

RX Anomaly Detection

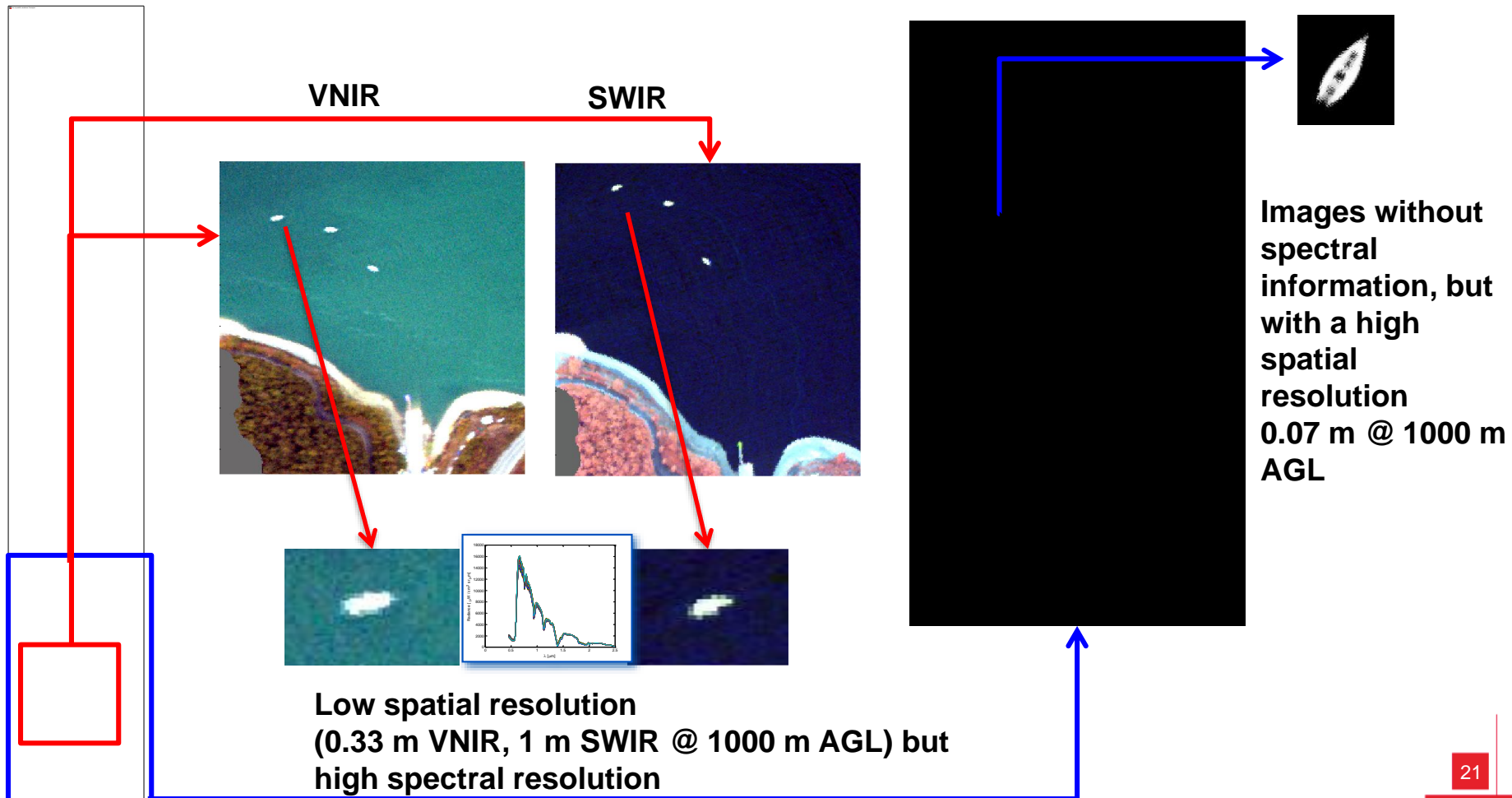
○ Anomalies detected with VNIR channel

○ Anomalies detected with VNIR and SWIR channels



The objects found are boats found in the proximity of the coast.

Processing of three channels (SWIR, VNIR, PAN)



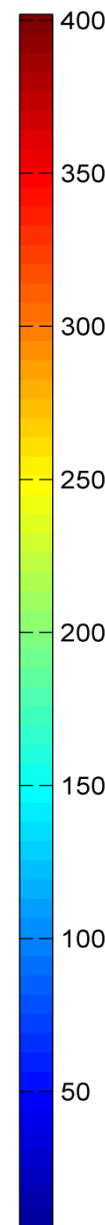
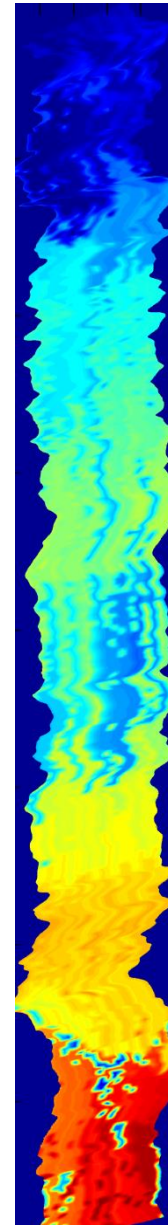
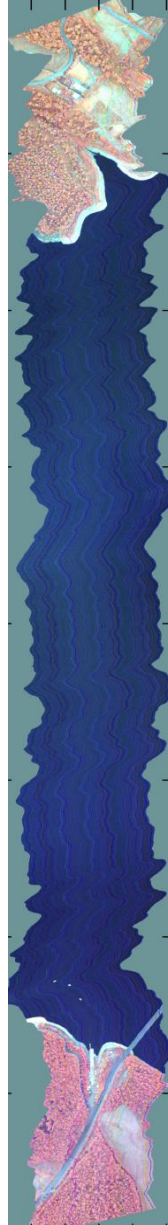
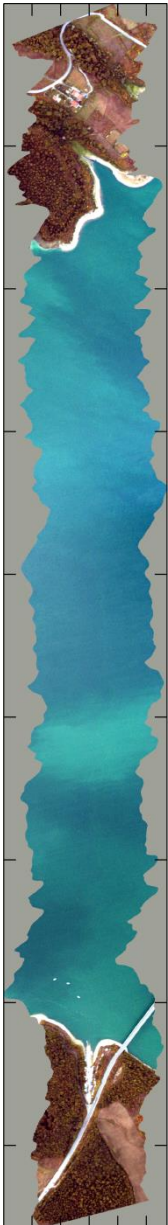
RGB VNIR

H.A. VNIR

RGB SWIR

H.A. SWIR

Homogeneous Areas

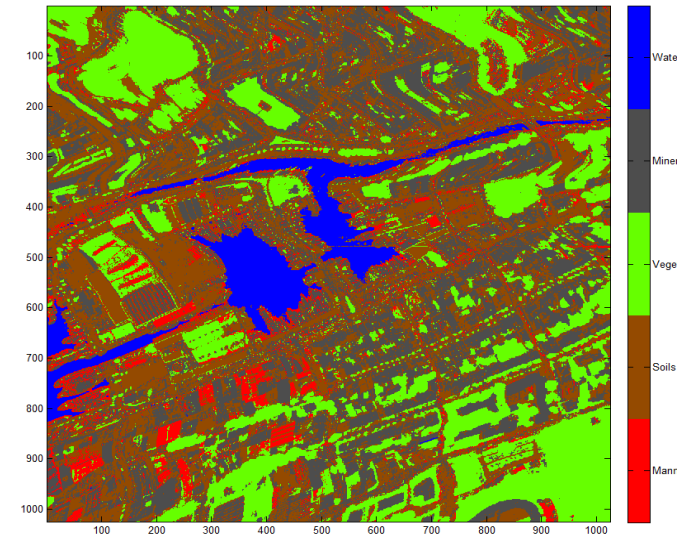
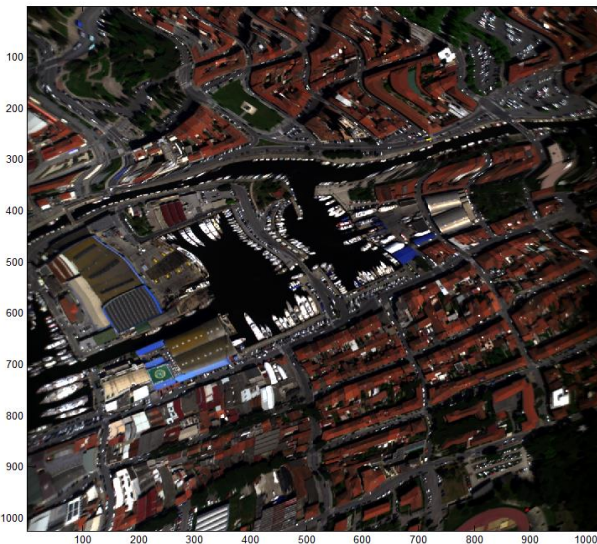
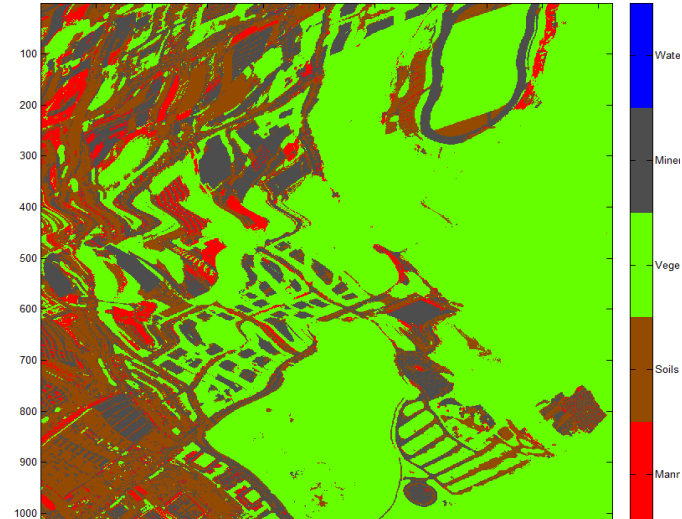
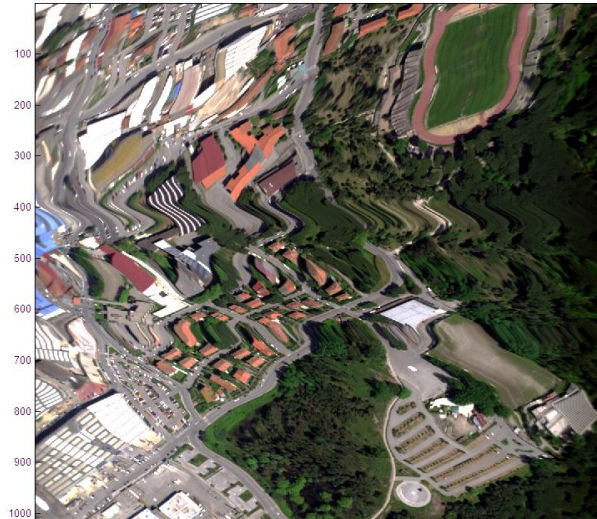


The classes are related to the different behaviours of the lake-bed.

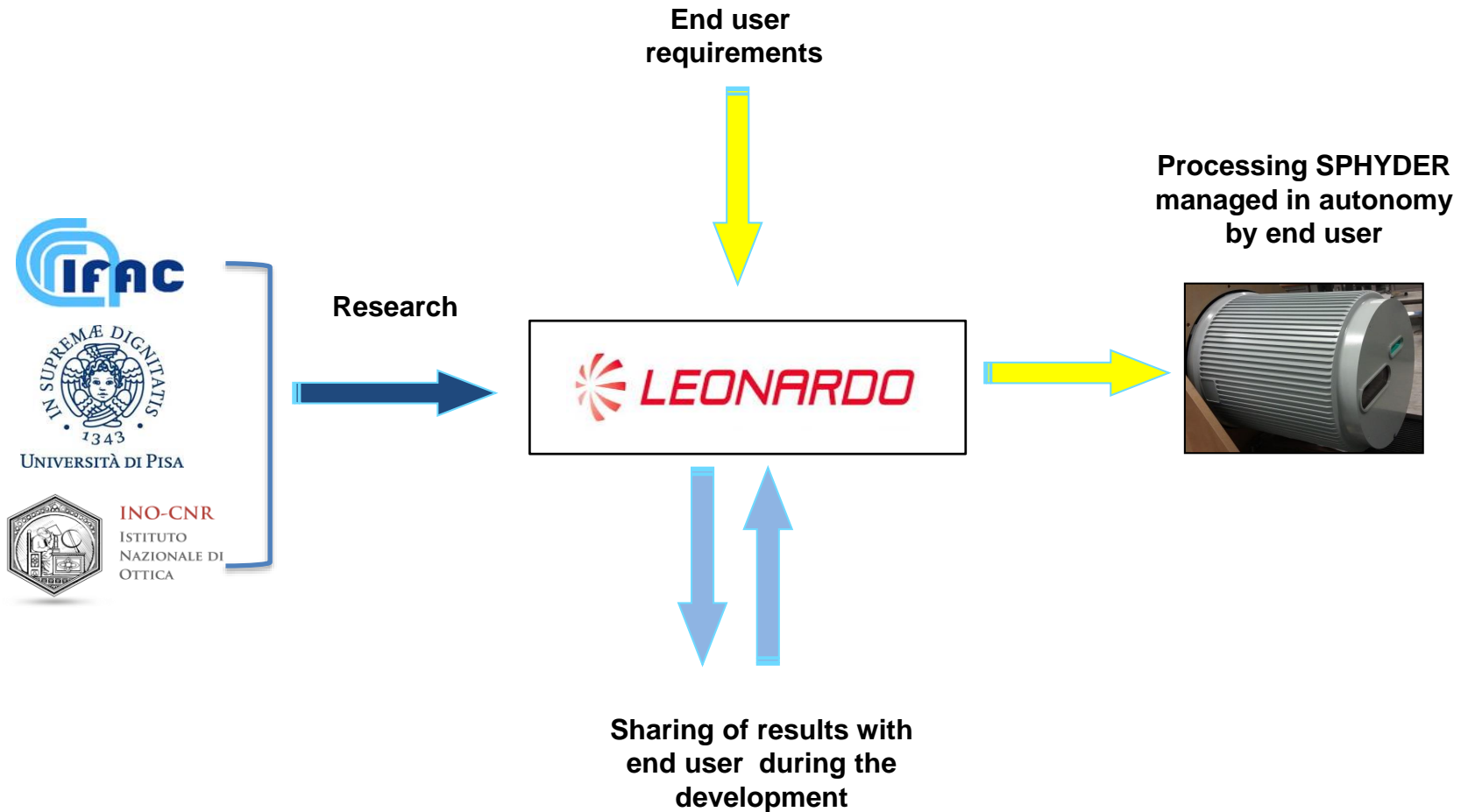
Through the elaboration of the spectrum associated to the class, information can be extracted on the deepness and the type of lake-bed.

Classification

Innovative Technics



Processing : Custom development



THANK YOU FOR YOUR ATTENTION

Gianni Uda

Head of Imagers Programmes

Optronics Systems

Land and Naval Defence Electronics

gianni.uda@leonardocompany.com

