e-geos
AN ASI / TELESPAZIO COMPANY

YOUR HUB
FOR GEOSPATIAL
APPLICATIONS

Consiglio Nazionale delle Ricerche

INGV terremoti vulcani ambiente
ISTITUTO NAZIONALE DI GEOFISICA E VULCANOLOGIA

ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

LEONARDO
AIRBORNE & SPACE SYSTEMS

TELESPAZIO
a LEONARDO and THALES company

space 4 environment

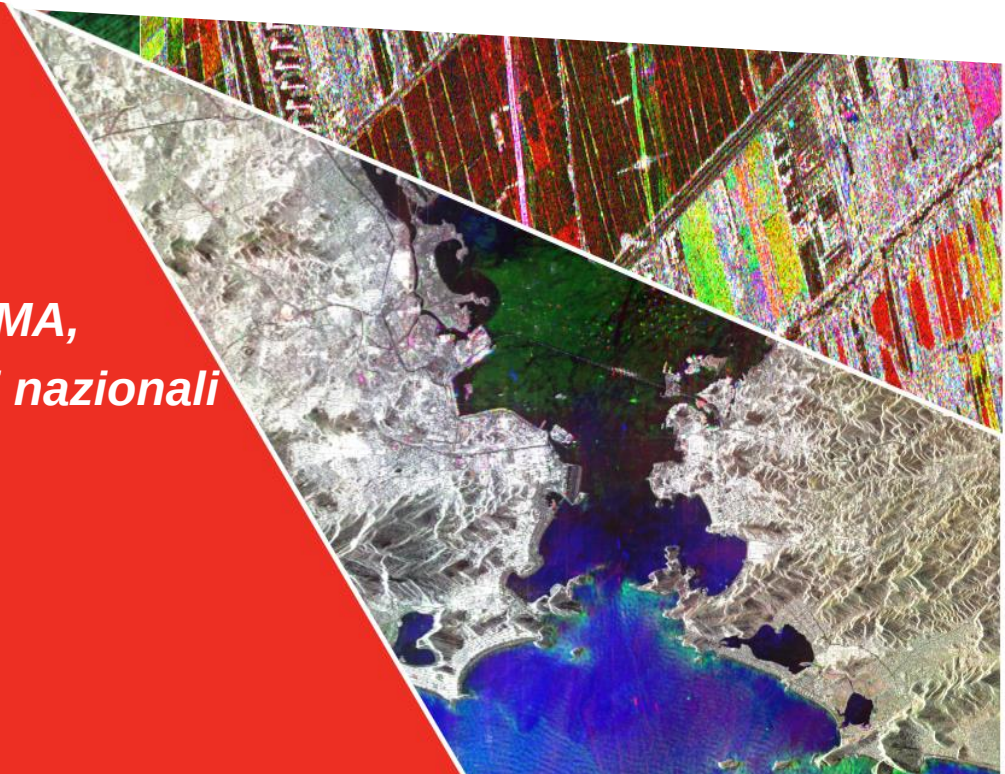
planetek hellas

OHB CGS

Copernicus Hyperspectral Mission

Primo Workshop Nazionale

Data Exploitation della missione PRISMA, precursore delle missioni iperspettrali nazionali



Agenzia Spaziale Italiana (ASI)
Roma, 2 Marzo 2017

Introduction

- Brief description of ESA Tender
- Presentation of the work to be performed
- Our Consortium

Brief description of the ESA Tender
Hyperspectral Imaging Mission Concepts

- Hyperspectral imaging can resolve bio-physical, bio-chemical and geo-chemical variables in detail thanks to its “electromagnetic fingerprinting” skill
- The main application advantage consists in its capability to detect, classify and monitor natural and man-made elements of land surfaces, ranging from vegetation to soil to (raw) materials, and including waste, contaminated land, water quality, to name a few, as well as coastal areas and inland water bodies

Brief description of the ESA Tender
Hyperspectral Imaging Mission Concepts

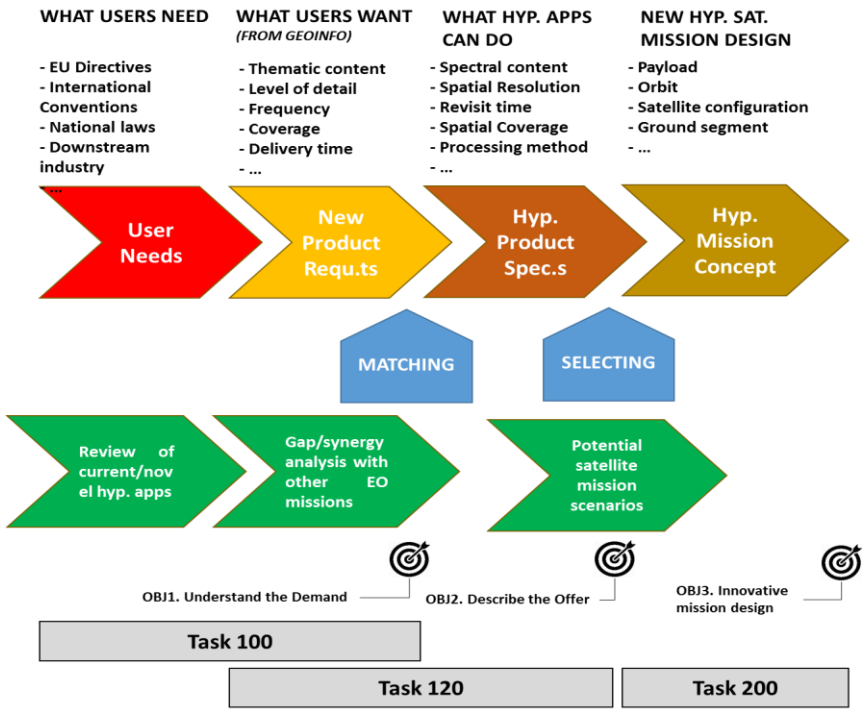
- In Europe there is vast experience from airborne hyperspectral imagers covering the visible to shortwave infrared
- However, only two Earth Observation hyperspectral imagers have flown in space
- Heritage in Europe derives from CHRIS (Compact High Resolution Imaging Spectrometer), embarked on the PROBA-1 demonstration mission (launched in 2001)
- Two missions are under development at national level, the Italian PRISMA mission and the German EnMAP
- At international level, the NASA mission EO-1 (launched in 2000) and Shalom (funded by ASI and ISA)

Brief description of the ESA Tender
Hyperspectral Imaging Mission Concepts

- The main objective of the study is to define the mission and technical requirements for future operational hyperspectral imaging systems assessing future needs of hyperspectral imaging data and related products and services

- Duration: 12 months
- EOC: Q4 Y2017

- OBJ1: Understand the demand
- OBJ2: Describe the offer
- OBJ3: Innovative mission design



Funded by the EU and ESA

Presentation of the work to be performed
Requirements Elaboration

The following activities are foreseen:

- **User Requirements Collection and Analysis**: Collection and analysis of European Commission User requirements and EU policies in order to elaborate a full set of user needs that support the policies of the EU in the area of agriculture, forestry, food security, water management, energy, environment, sustainable development, natural resources, biodiversity, etc)
- **Hyperspectral Applications Review**: Generation of a list of current and novel applications based on hyperspectral data based on literature analysis
- **Gap/Synergy Analysis of current/future EO missions**: Perform a gap analysis to identify user requirements not covered by already existing or multispectral and hyperspectral missions in Europe and worldwide at the time scale 2025-2035 (approximately), emphasize the added value of the future hyperspectral data-based services. The analysis will also identify synergies with other missions.

Presentation of the work to be performed
User Req. An. & Consolidation

The following activities are foreseen:

- **Selection of hyperspectral applications/products**: establish a solid/agreed baseline of relevant (from User point of view) data products and services, matching the identified needs and gap analysis
- **Algorithm description and Products specification**:
  - Review of scientific literature
  - Algorithm description and estimation of algorithm readiness (SRL) in terms of maturity, preprocessing needs, auxiliary data needs and validation needs
  - Baseline specification of models and techniques in terms of: revisit time, GSD, geo-location accuracy, swath width, spectral resolution, SNR, radiometry accuracy, etc
- **Mission Scenarios Identification**: analysis of all products and services specifications to
  - identify different mission scenarios (e.g high spatial resolution & narrow swath VS. low spatial resolution & large swath, VS multiplatform), with preliminary mission specifications
  - provide a raw estimation of the costs (low, medium, high) for each mission scenario
  - provide a first draft version of the MATER document with the performed analysis

Presentation of the work to be performed
User Req. An. & Consolidation

- **Products and Mission Scenario Scoring**: for each identified mission scenarios, scoring the products and services. The scoring criteria will be based on the following key performance indicators:
  - Relevance for the Copernicus User Requirements (low, medium, high)
  - Fulfillment of the Copernicus User Requirements (low, medium, high)
  - Algorithm readiness
  - Technological feasibility, with respect to the preliminary mission specifications of the identified mission scenarios, for the Instrument (low, medium, high), Satellite (low, medium, high) and Ground Segment infrastructure (low, medium, high)

	Product Grades for N Mission				
Product Name	Mission 1	Mission 2	Mission 3	...	Mission N
Product 1	71%	65%	45%	...	68%
Product 2	63%	71%	68%	...	75%
...	...	...	...	...	...
Product M	64%	84%	71%	...	58%

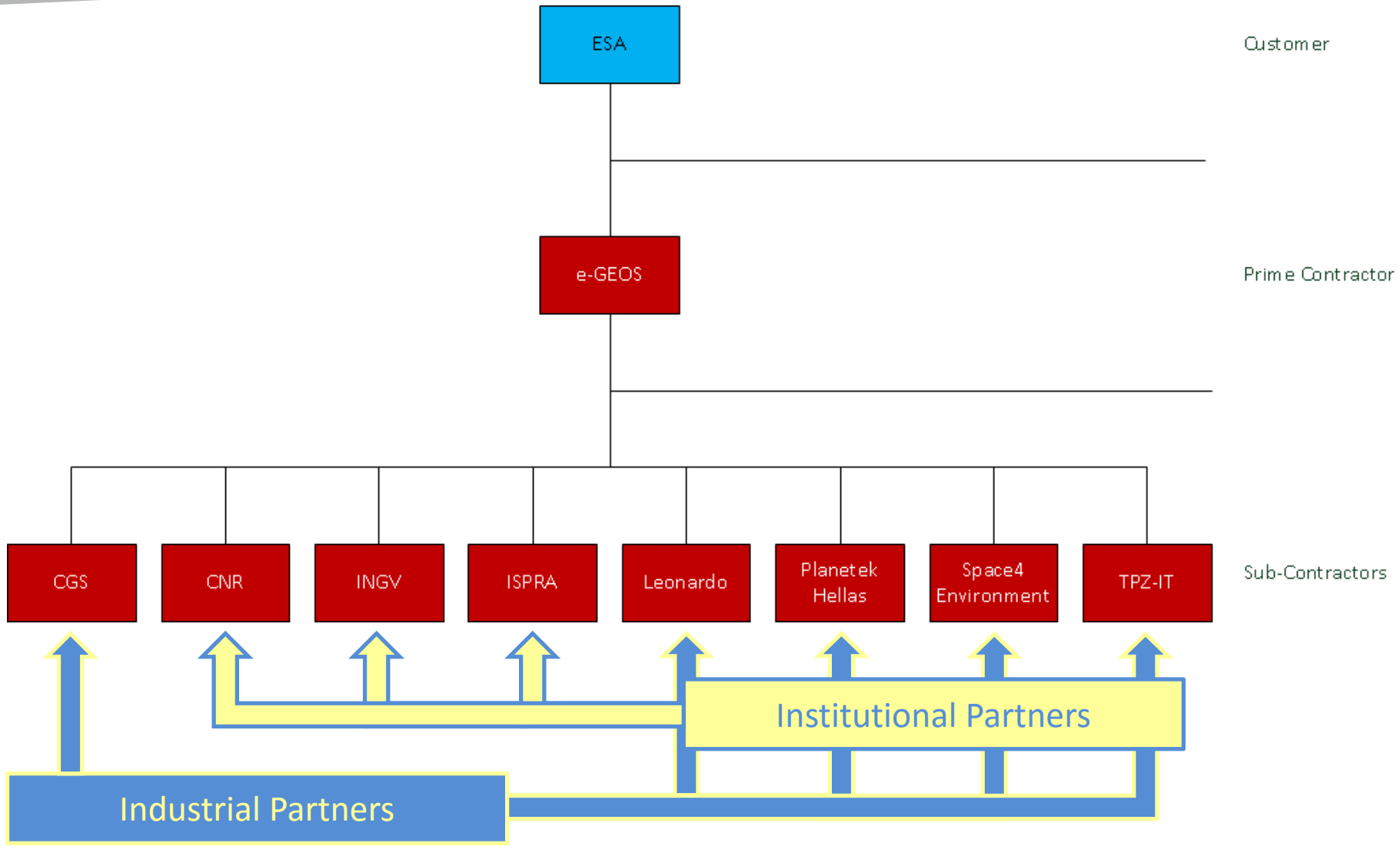
Mission Scenario k						
Product Name						
High Level Index	Low Level Index	Requirement Name	Product Needs	Score	Remarks	High Level Score
I_{UR}	I_{rel}	Relevance for Users	User needs description	1	example value only	75%
	I_{FU}	Fulfillment of Requirement	Product Specification	2	example value only	
I_{TF}	I_{RT}	Revisit time	on demand	1	example value only	64%
	I_{GSD}	GSD / Map scale	20 - 30 m	2	example value only	
	I_{GL}	Geo-location accuracy	1 - 3 GSD	1	example value only	
	I_{SW}	Swath width	> 15 km	0	example value only	
	I_{SRA}	Spectral resolution	≈ 10 nm	2	example value only	
	I_{SNR}	SNR	< 100	2	example value only	
	I_{RQ}	Radiometric Quantization	12 - 16 bit	1	example value only	
I_{AR}	I_{PL}	Pre-processing Level	radiance	2	example value only	75%
	I_A	Algorithm maturity	high	1	example value only	
					Overall Product Score	71%

Presentation of the work to be performed
System Concept Identification

The following activities are foreseen:

- identification of possible system concepts fulfilling the mission requirements for the mission elaborated in Part 1 and of the corresponding architecture elements
- propose a feasible mission concept, taking into account current and imminent offerings from European industry in terms of e.g. platforms, systems for data storage and transmission, to identify relevant technology pre-development activities
- assess the preliminary programmatic aspects of the proposed mission concept

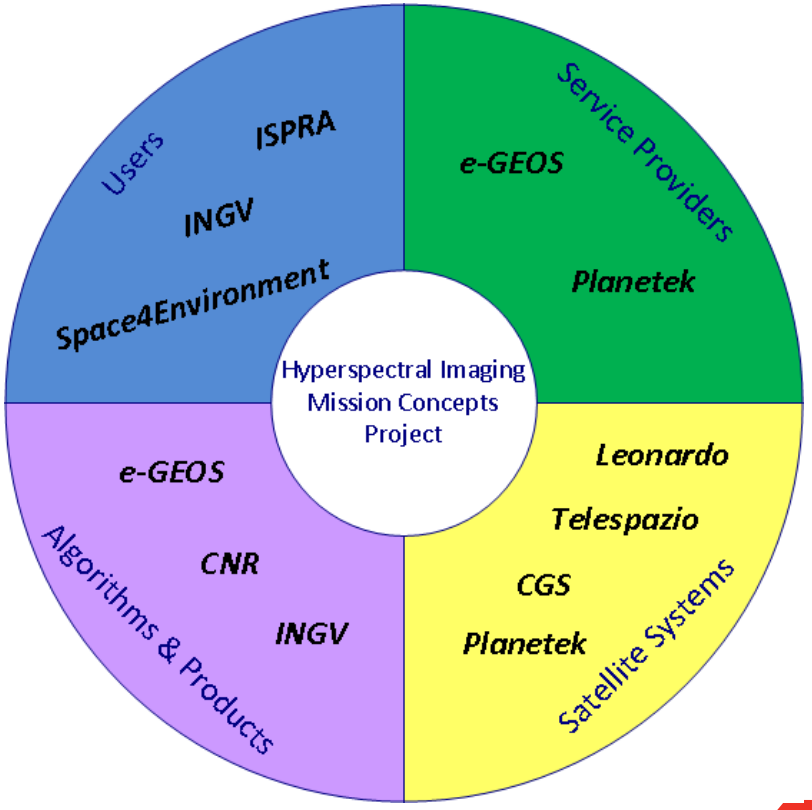
Our Consortium
Overall Consortium Organization



Funded by the EU and ESA

Our Consortium
Consortium Rationale

- Cover all the activities identified within the SoW with teams that have proven expertise and background experience
- Cover all the actors involved in the Copernicus Programme:
  - Users' needs representatives and collectors
  - Algorithms & Products designers and developers
  - Satellite Systems & Sensors designers, developers and operators
  - GI Service Providers



Funded by the EU and ESA

Our Consortium
Consortium Rationale

- e-GEOS has a long story with Hyperspectral satellite sensors:
  - HYPSEO (Hyperspectral Earth Observer Mission), funded by ASI, responsible of products development and data processing
  - JHM-JDP (Joint Hyperspectral Mission), funded by ASI and CSA, for the identification, definition, and specifications of the value added products
  - PRISMA, funded by ASI, for the development of the hyperspectral image simulator
  - SHALOM-JDP (Spaceborne Hyperspectral Applicative Land And Ocean Mission Hyperspectral Mission), funded by ASI and ISA, for the identification, definition, and specifications of the value added products and in the market analysis
  - SAPERE-SAFE (Space Advance Project Excellence in Research and Enterprise), funded by MIUR, for the definition of user, applications and sensor requirements

Our Consortium
Consortium Rationale

e-geos
AN ASI / TELESPAZIO COMPANY

- Prime Contractor
- Leading the App. Analysis Survey task
- Leading Ranking task

- Leading the User Req. Analysis task
- SNPA involved
- Supporting the App. Analysis Survey task

ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

INGV
terremoti
vulcani
ambiente
ISTITUTO NAZIONALE DI GEOFISICA E VULCANOLOGIA

- Leading the Gap/Synergy task
- Supporting the App. Analysis Survey task
- Supporting the User Req. Analysis task
- Supporting the Algo. Identification task

Funded by the EU and ESA

Copernicus Europe's eyes on Earth
European Union
esa

Our Consortium
Consortium Rationale

- ISMAR, IMAA, IREA & IFAC
- UNIBI, UNIPI, UNIRM1 & UNITUSCIA involved
- Leading the Algo. Identification task
- Supporting the App. Analysis Survey task
- Supporting the Gap/Synergy task
- Supporting the Sys. Concept Identification task

Consiglio Nazionale delle Ricerche

planetek hellas

- Supporting the App. Analysis Survey task
- Supporting the Gap/Synergy task
- Supporting the Sys. Concept Identification task

- Supporting the User Req. analysis

space 4 environment

Funded by the EU and ESA

Copernicus Europe's eyes on Earth

European Union

esa

Our Consortium
Consortium Rationale

LEONARDO
AIRBORNE & SPACE SYSTEMS

- Supporting Sys. Concept Identification task
- Specific task on Sensor

TELESPAZIO
a LEONARDO and THALES company

- Leading Sys. Concept Identification task
- Specific task on Ground Segment

OHB
CGS

- Supporting Sys. Concept Identification task
- Specific task on Space Segment

Funded by the EU and ESA

Copernicus
Europe's eyes on Earth

European Union

esa

Thank you!

Andrea Bucarelli
Applications Programs
Project Manager

Andrea.Bucarelli@e-geos.it

e-geos
AN ASI / TELESPAZIO COMPANY