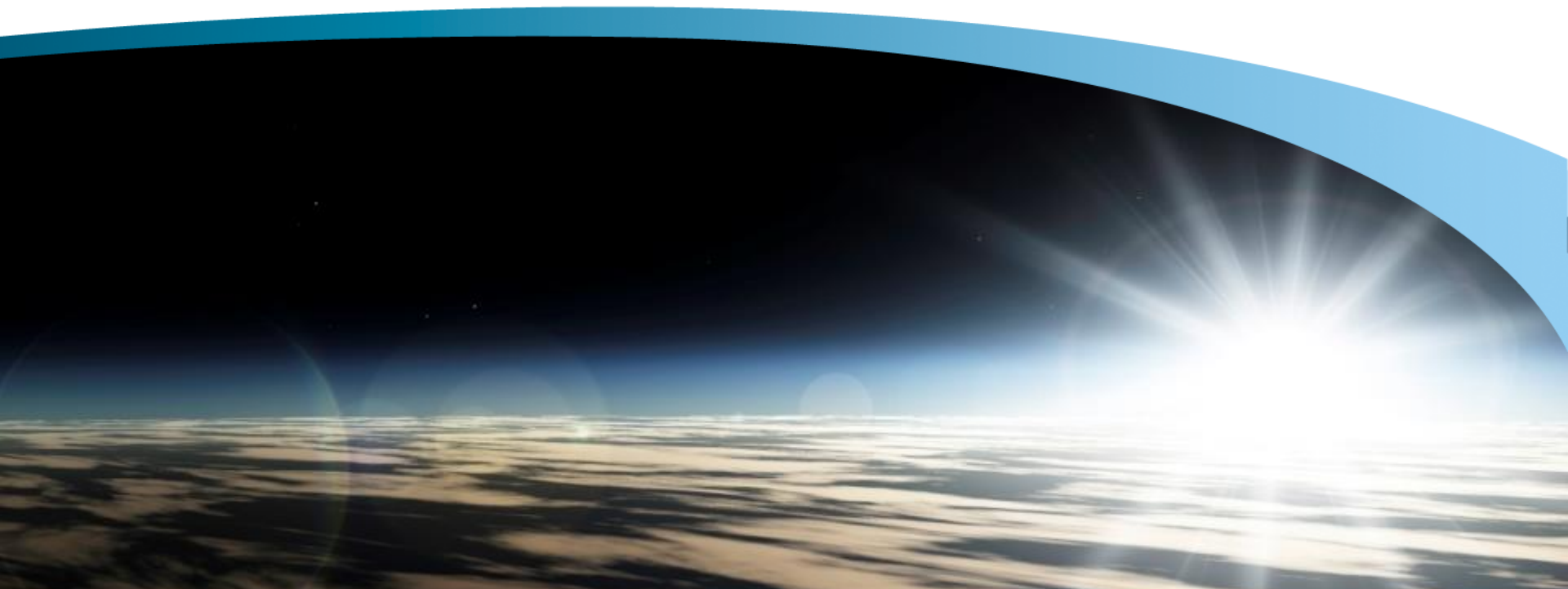


02.03.2017
ASI, RM



SPACE SYSTEMS

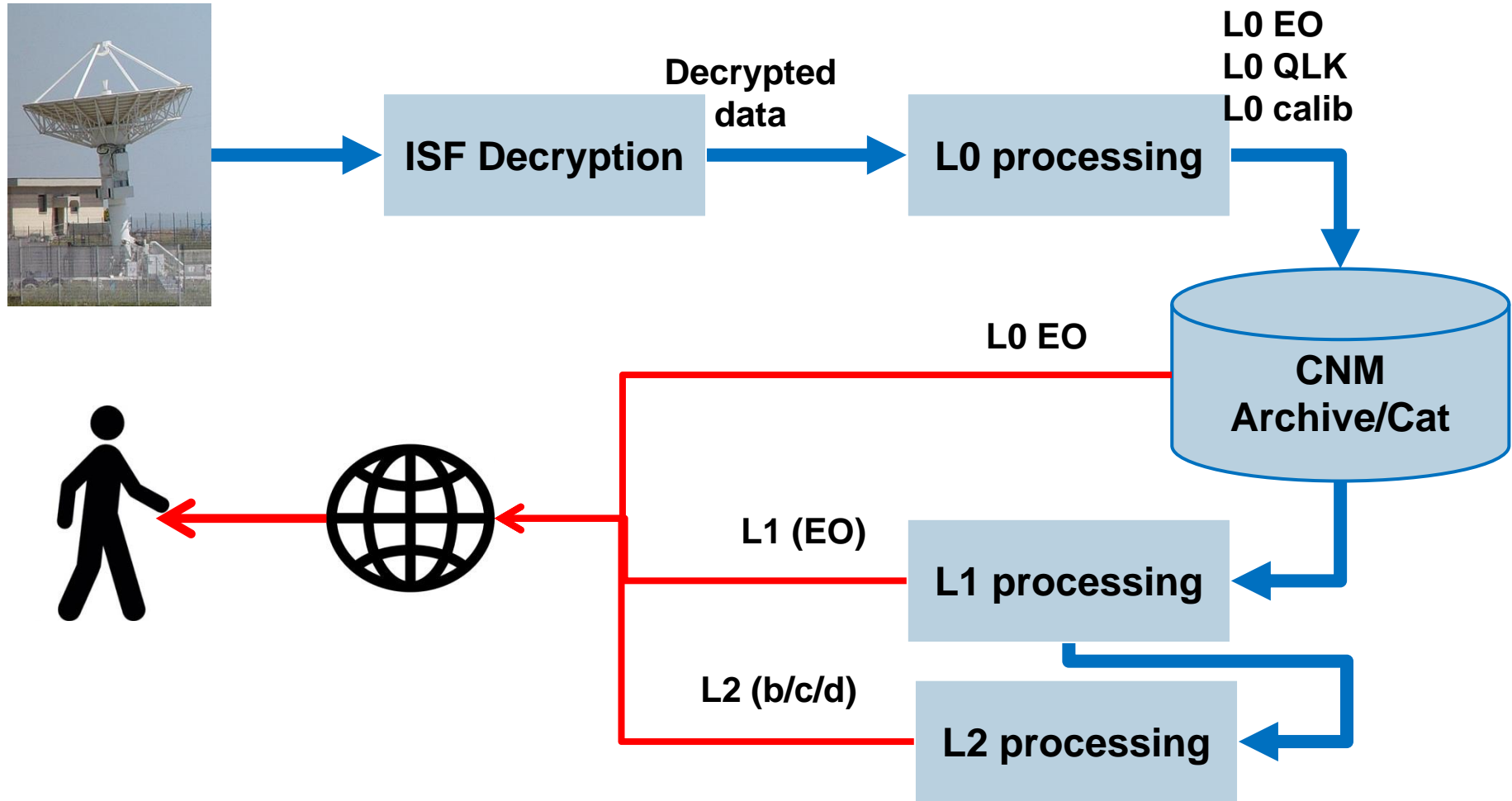
PRISMA: Prodotti

Data Exploitation della missione PRISMA, precursore delle missioni iperspettrali nazionali
Agenzia Spaziale Italiana (ASI)
Roma, 1-2 e 3 marzo 2017

Summary

- **PRISMA Processing Chain (short summary)**
- **PRISMA Products Description**
 - **Level 0**
 - **Level 1**
 - **Level 2 (b/c/d)**
- **Products Validation activities**

PRISMA Processing Chain Summary



PRISMA Products Description

- PRISMA products based on Agency requirement drafted in the Program Mission Requirements Document (ASI MRD)
- Program requirements define:
 - Main products types and their content (both data layer and metadata)
 - Products formats (in term of compliance with commonly used SW tools)
 - Main products features (e.g. in term of spatial and spectral features) and accuracy
 - Using of catalogue of existing algorithms for products generation (when possible)
- Products detailed description is provided in the PRISMA Products Specification Document

PRISMA Products Main Features

- ‘Standard Images’ dimensions:
 - HYP 1000 x 1000 x 239 (max) samples
 - PAN 6000 x 6000 samples
 - Swath width: 30 Km @ Nadir
 - Spectral range: 0.4-2.5 μm (Hyp) / 0.4-0.7 μm (PAN);
 - Continuous coverage of spectral range with spectral bands of 10 nm
- GSD:
 - 30 m (HYP @ Nadir)
 - 5 m (PAN @ Nadir)
- HYP and PAN overlapped (all products) and co-registered (Level 1 and 2)

Level 0-1 products

PRISMA Products Description: Level 0 Product File

- **List of L0a Product file** : binary file (.dat) file + CATALOGUE METADATA FILE(CC% info)
- Each L0a file includes **30km** of uninterrupted acquisition: if the commanded acquisition lasts more than 30km, several L0a_EO files are produced.
- Each L0a file is made by a list of UTC time consecutive frames collected together according to the frame type as in the following table:

L0A FILETYPE	FRAME_TYPES	COMMANDED ACQUISITION TYPE	COMMANDED ACQUISITION PURPOSE
L0_DC (Dark_Calibration_File)	DARK-OBS	EARTH-OBSERVATION	NOT SPECIAL PRODUCT
L0_EO (Earth_Observation_File)	EO		
L0_DC (Dark_Calibration_File)	DARK-OBS		
L0_DC (Dark_Calibration_File)	DARK-OBS	EARTH-OBSERVATION	SPECIAL PRODUCT FOR VALIDATON
L0_EOS (Earth_Observation_Special_File)	EOS		
L0_DC (Dark_Calibration_File)	DARK-OBS		
L0_DC (Dark_Calibration_File)	DARK-OBS	DARK CALIBRATION	NOT SPECIAL PRODUCT
L0_IC (Internal_Calibration_File)	All frame types: DARK_INT BACKGROUND, LAMP, LED	INTERNAL-CALIBRATION	NOT SPECIAL PRODUCT
L0_ICS (Internal_Calibration_Special_File)	All frame types: DARK_INT BACKGROUND, LAMP, LED	INTERNAL-CALIBRATION	SPECIAL PRODUCT FOR CALIBRATION
L0_SUN (Sun_Calibration_File)	SUN-OBS	SUN CALIBRATION	SPECIAL PRODUCT FOR CALIBRATION
L0_SUN_FLUX (Sun_Flux_Calibration_File)	SUN-FLUX	SUN FLUX CALIBRATION	SPECIAL PRODUCT FOR CALIBRATION
L0_MOON (Moon_Calibration_File)	MOON	MOON CALIBRATION	SPECIAL PRODUCT FOR CALIBRATION
L0_FF (Flat_Field_Special_File)	FF	FLAT-FIELD SPECIAL	SPECIAL PRODUCT FOR CALIBRATION

L1 Processing chain for KDP Updating

SOI-B1 Internal Calibration

- DefectivePixelUpdating() ⇒ DEFECTIVE PIXEL KDP
- DarkUpdating() ⇒ DARK-KDP
- BkgUpdating() ⇒ BKG-KDP
- FFUpdating() ⇒ FF-KDP, ELECTRONIC CONVERSION GAIN CDP
- AlignmentKDPUpdating() ⇒ ABSOLUTE ALIGNMENT CDP
- CWUpdating() ⇒ CW-KDP

SOI-B2 Sun Calibration

- DefectivePixelUpdating() ⇒ DEFECTIVE PIXEL KDP
- BkgUpdating() ⇒ BKG-KDP
- FFUpdating() ⇒ FF-KDP, ELECTRONIC CONVERSION GAIN CDP
- AlignmentKDPUpdating() ⇒ ABSOLUTE ALIGNMENT CDP
- CWUpdating() ⇒ CW-KDP
- ITFUpdatingSun() ⇒ CW-KDP
- SunProductGeneration()

SOI-B3 Moon Calibration

- DefectivePixelUpdating() ⇒ DEFECTIVE PIXEL KDP
- BkgUpdating() ⇒ BKG-KDP
- AlignmentKDPUpdating() ⇒ ABSOLUTE ALIGNMENT CDP
- CWUpdating() ⇒ CW-KDP
- ITFUpdatingMoon() ⇒ ITF-MOON-CDP

SOI-B4 Flat Field Special Calibration

- DefectivePixelUpdating() ⇒ DEFECTIVE PIXEL KDP
- BkgUpdating() ⇒ BKG-KDP
- AlignmentKDPUpdating() ⇒ ABSOLUTE ALIGNMENT CDP
- CWUpdating() ⇒ CW-KDP
- ExternalFFUpdating() ⇒ EXTERNAL FF-CDP

SOI = Scene of Interest

PRISMA Products Description: L1 Product Files

L1 EO/EOS Product file : includes 4 list of frames (hypercubes), organized according to different layers:

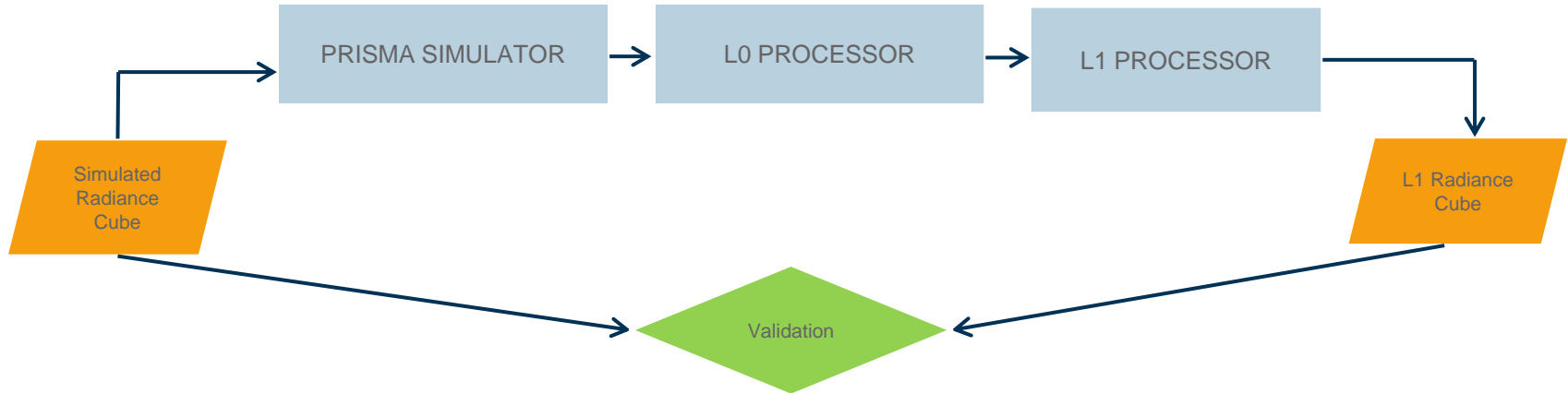
- Radiometrically corrected VNIR+SWIR frames list, with relevant Product Attribute ($w/m^2/nm/sr$)
- Corrected PAN frames list, with relevant Product Attribute : the PAN signal in DN is NON –LINEARITY, DARK and FF corrected. Then it is divided by Area_pixel and by Omega_pixel (solid angle) : $DN/(m^2/sr)$
- Spatially and Spectrally Coregistered VNIR +SWIR frames list, with relevant Product Attribute (SWIR on VNIR)
- Spatially Coregistered PAN frames list, with relevant Product Attribute (PAN on VNIR).

The product takes into account coregistration and defective pixel correction

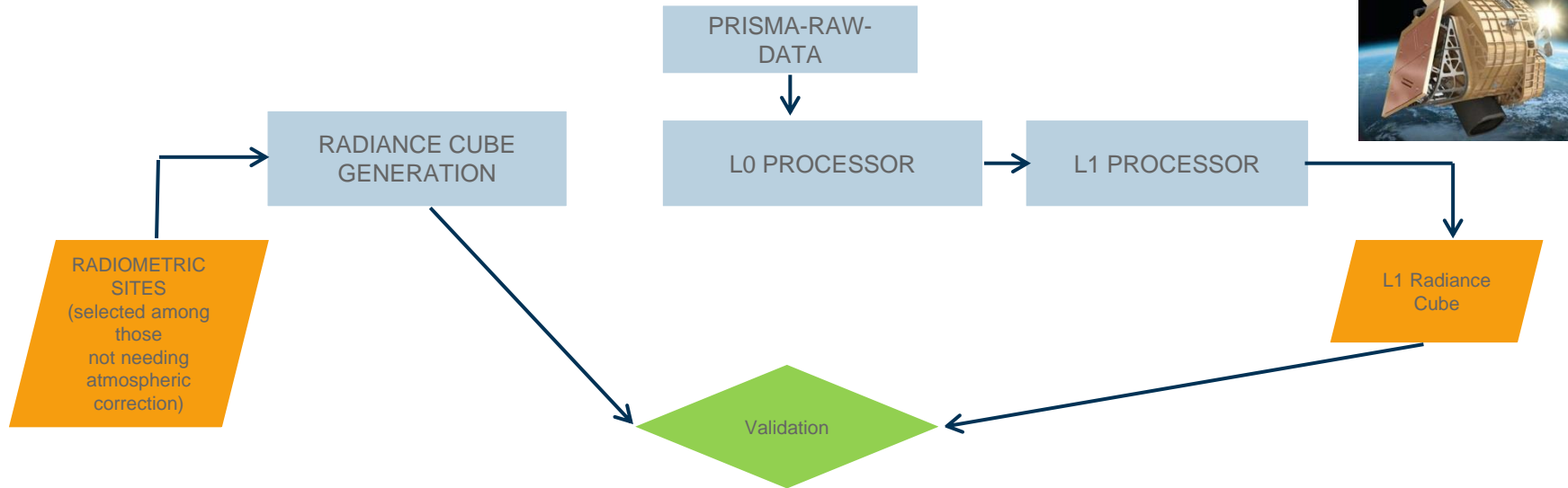
L1 Sun Product file : includes a list of frames (hypercubes), organized according to different layers:

- Radiometrically corrected VNIR+SWIR frames list, with relevant Product Attribute ($w/m^2/nm/sr$)
- Corrected PAN frames list, with relevant Product Attribute : the PAN signal in DN is NON –LINEARITY, DARK and FF corrected. Then it is divided by Area_pixel and by Omega_pixel (solid angle) : $DN/(m^2/sr)$

PRISMA L1 Products: Pre-launch Validation



PRISMA L1 Products: Validation during Commissioning



Level 2 products

PRISMA Products Description: Level 2 products

- **Level 2b Product**

- Hyperspectral/PAN at-ground spectral radiance product obtained by applying atmospheric correction (+ metadata + Quality Flag + geolocation coefficients)

- **Level 2c Product**

- Hyperspectral/PAN at-surface spectral reflectance product obtained by applying atmospheric correction (+ metadata + Quality Flag + geolocation coefficients)
 - water vapour map
 - cloud optical thickness map
 - aerosol optical thickness and Angstrom exponent maps (undesampled)

- **Level 2d Product**

- Geocoded version of the Hyperspectral/PAN at-surface spectral reflectance product obtained by applying atmospheric correction (+ metadata)

PRISMA Products Description: Level 2 products (cont'd)

- **Level 2b/2c Product format**

- HDF-EOS;
- Data layers in instrument Coordinates
- Geolocation obtained with/without GCP (if available, upon user request)
- Geolocation accuracy: 200m (without GCP) 0.5 GSD (with valid GCP)
- Full Spatial-Spectral resolution / Spatial-spectral undersampling (upon user request)
- HYP waveband full set/subset (upon user request)

PRISMA Products Description: Level 2 products (cont'd)

• Level 2c Product

- HDF-EOS;
- Data layers in instrument Coordinates
- Geolocation obtained with/without GCP (if available, upon user request)
- Geolocation accuracy: 200m (without GCP) 0.5 GSD (with valid GCP)
- Reflectance accuracy: +/-0.05 absolute reflectance @650nm for a 30% albedo at 30° SZA
- Full Spatial-Spectral resolution / Spatial-spectral undersampling (upon user request)
- HYP waveband full set/subset (upon user request)

PRISMA Products Description: Level 2 products (cont'd)

• Level 2d Product

- HDF-EOS;
- Data layers projected in UTM WGS84 cartographic frame
 - only HYP/PAN layers of Level 2c product
- Geolocation obtained with/without GCP (if available, upon user request)
- Projection over DEM
- Geolocation accuracy: 200m (without GCP) 0.5 GSD (with valid GCP)
- Full Spatial-Spectral resolution / Spatial-spectral undersampling (upon user request)
- HYP waveband full set/subset (upon user request)

PRISMA Products validation

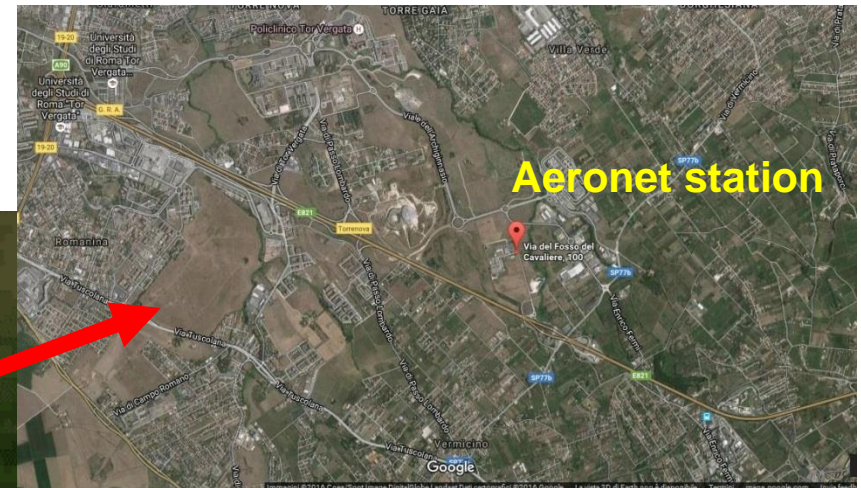
- Processors will be qualified before PRISMA Launch
- In addition, after launch, PRISMA products will be validated during mission commissioning according a specific products validation plan
- Parameters to be validated: as per defined in the ASI MRD
- Products validation will be achieved by performing data comparison among PRISMA measurements and external 'ground truth' data
 - Directly:
 - parameters contained in the product directly comparable with external measurement (e.g. surface reflectance of level 2c product)
 - Indirectly:
 - parameters contained product that cannot be directly compared with a ground truth measurement and that require a post-processing to be compared (e.g. TOA radiance)

PRISMA Products validation strategy

- Products validation will be defined in order to collect the larger number of comparison data as possible
- Comparison with in situ data:
 - Ground truth sites with continuous atmospheric measurement available -> surrounding on Aeronet stations
 - Target features: dimensions, accessibility, spectral stability, homogeneity
 - Acquire each possible image on in situ targets, discarding a posteriori images not suitable for validation (e.g. cloudy, rainy, etc.)
 - Collect periodically ground truth measurement
 - Compare measurements both on punctual and on statistical bases
- Comparison with other data
 - Additional comparison with ground and/or satellite colocated measurements may be taken into account

PRISMA Level 2 Products validation: test sites

- Aeronet sites in Italy
- Other additional test sites in Italy and abroad



Thank you for your kind attention