

An aerial photograph of a coastal landscape, likely a river delta or wetland area. The image shows a complex network of water channels and landmasses. The water is a deep teal color, while the land is a mix of light tan, green, and brown, indicating different vegetation and soil types. The overall scene is a detailed view of a natural environment.

**International Workshop on High-Resolution Thermal EO**

**10-12 May 2023**

**ESA-ESRIN, Frascati, Italy**

**The US-Italy Surface Biology and Geology (SBG)  
Thermal Infrared (TIR) Joint Project**

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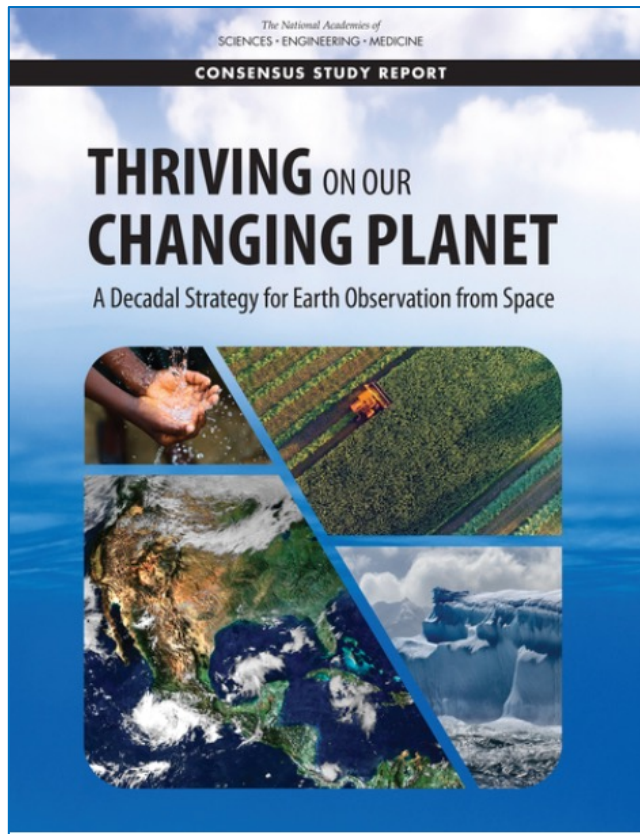
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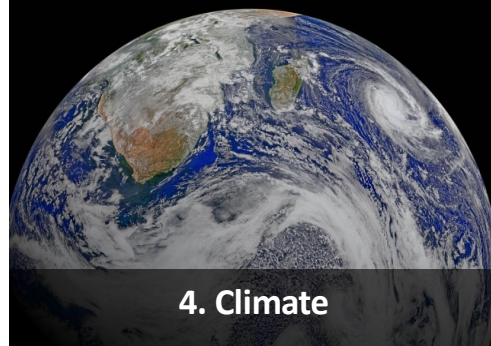
[Credit: National Academies of Science, Engineering, and Medicine (NASEM)]

- The US National Academies completed a decadal survey, Earth Science and Applications from Space (ESAS) 2017
  - The report helps establish priorities for Earth science
  - Defines an integrated and sustainable approach for research, environmental monitoring, and data applications through a set of designated observables
  - Surface Biology and Geology (SBG) is one of these designated observables





# SBG Focus Areas



[Credit: NASA/Caltech-JPL]



# SBG Sensor Specifications

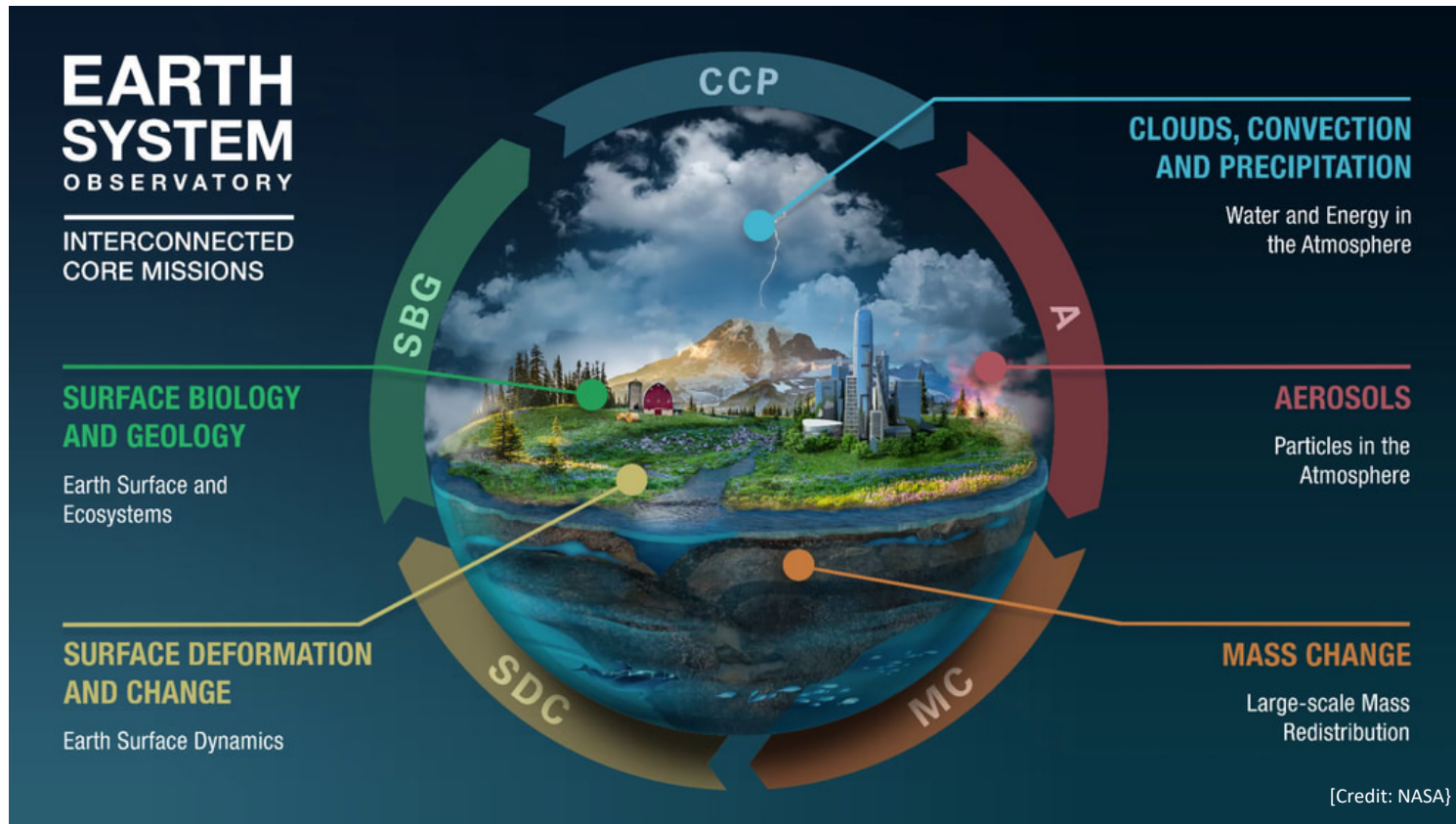


**ESAS 2017 defines the implementation as two sensors**  
***“Hyperspectral imagery in the visible and shortwave infrared; multi- or hyperspectral imagery in the thermal IR”:***

1. “....a moderate spatial resolution (30-45 m GSD), hyperspectral resolution (10 nm; 400-2500 nm), high fidelity (SNR = 400:1 VNIR/250:1 SWIR) imaging spectrometer is needed for characterizing land, inland aquatic, coastal zone, and shallow coral reef ecosystems”
2. “....30-60 m TIR observations in the 10.5-11.5  $\mu\text{m}$  and 11.5-12.5  $\mu\text{m}$  spectral regions are needed with a 2-4 day revisit frequency”

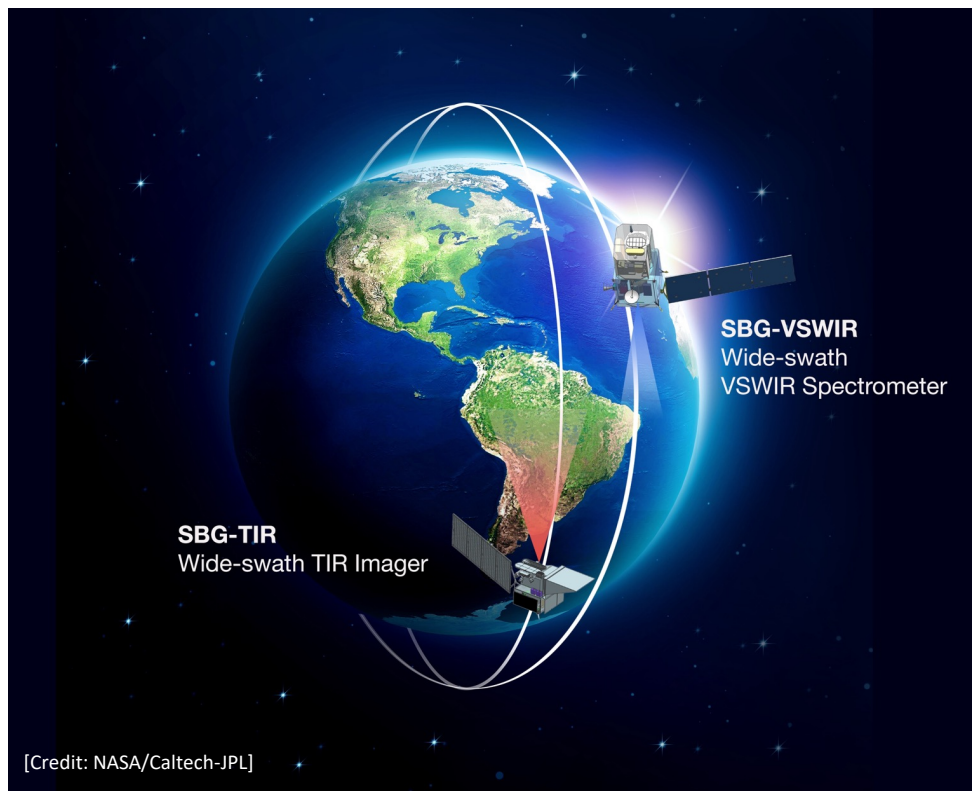


# SBG is Part of the NASA ESO

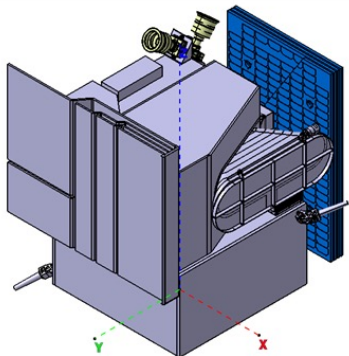




SBG is comprised of two complementary primary instruments manifest on separate satellite systems operating in different orbit planes



# The SBG-TIR Satellite System



**SBG-TIR satellite system in the stowed/launch configuration**

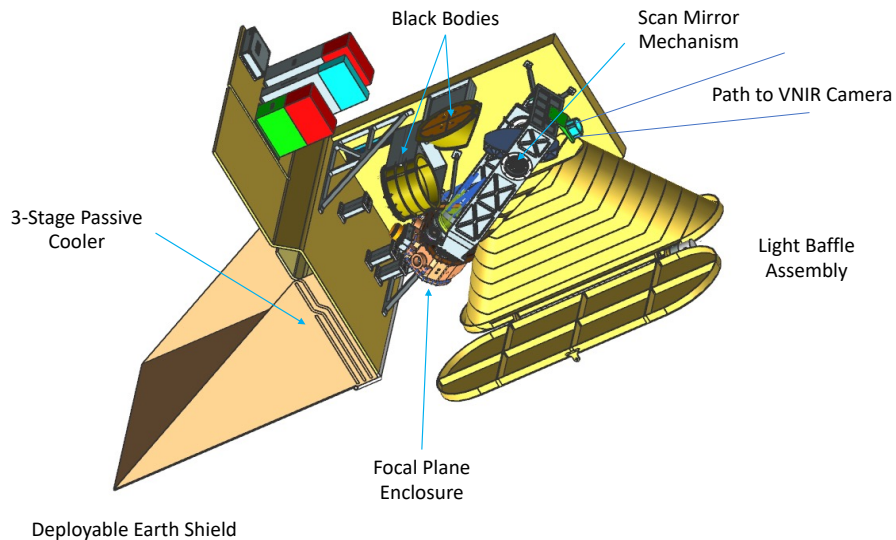


**An artist rendition of the SBG-TIR satellite system in flight**

- Local time of data acquisition is 12:30 pm
- Ground Sampling Distance (GSD) of 60 m
- Swath width of 935 km
- Orbit altitude of 665 km
- Repeat time of 3 days
- Launch as early as 2027
- Prime mission of 3 years

**Science data products and observations: Land surface temperature and emissivity; water stress in plants; soil moisture; minerals; wildfires; and volcanoes**



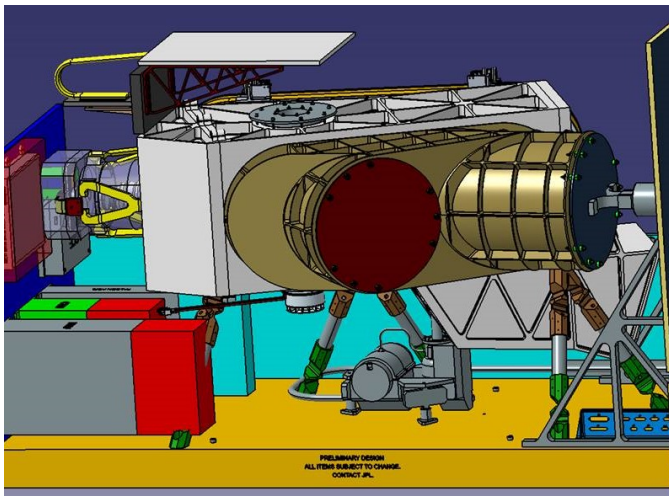


## Key Features

- Number of bands in the LWIR (8-12  $\mu\text{m}$ ): 6
- Number of bands in the MWIR (3-5  $\mu\text{m}$ ): 2
- Accuracy: 500 mK
- NeDT: 200 mK
- Field of View (FOV):  $\pm 34.4$  deg







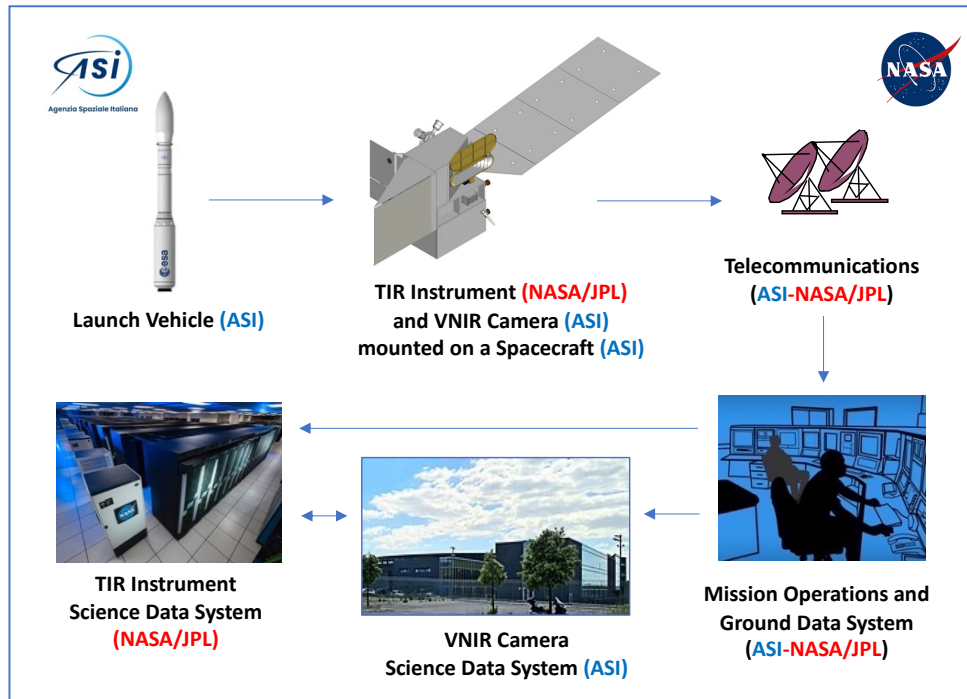
## Key Features

- 2 bands @655 and @835 nm
- Same scan mirror as TIR
- Spatial Sampling Distance  $\leq 30\text{m}$  @nadir
- SNR@Lref =100
- Absolute Radiometric Accuracy (%):10 with 5 as a goal



# SBG-TIR Architecture

[Credit: NASA/Caltech-JPL]



Legend: ■ NASA/JPL ■ ASI

## Primary Partners and Responsibilities & Contributions

- NASA/JPL
  - TIR Instrument
  - Mission Systems Elements, as appropriate
- ASI
  - Visible and Near-Infrared (VNIR) Camera
  - Spacecraft
  - Launch Vehicle
  - Mission Systems Elements, as appropriate

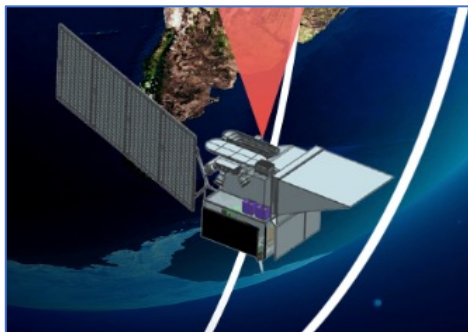


# The Extended Partnership





## SBG-TIR



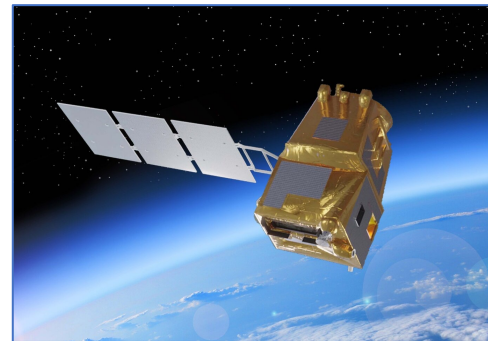
[Credit: NASA/Caltech-JPL]

## TRISHNA



[Credit: CNES and ISRO]

## LSTM



[Credit: ESA]

**SBG TIR will fly in a coordinated manner with the ESA LSTM and CNES/ISRO TRISHNA missions. Collectively they will reduce the revisit time of thermal-related quantities of interest to the research & applications community from 3 days to 1 day.**



# The SBG Two-Satellite System

## SBG-TIR



- Ground Sampling Distance (GSD) of 60 m
- Swath width of 935 km
- Orbit altitude of 665 km
- Repeat time of 3 days
- Launch as early as 2027
- Prime mission of 3 years

Land surface temperature and emissivity; water stress in plants; soil moisture; minerals; wildfires; and volcanoes

## SBG-VSWIR



- GSD of 30 m
- Swath width of 185 km
- Orbit altitude of 500 km
- Repeat time of 16 days
- Launch as early as 2028
- Prime mission of 3 years

Radiances, surface reflectance; ecosystems and plant identification; minerals; greenhouse emissions; and phytoplankton dynamics

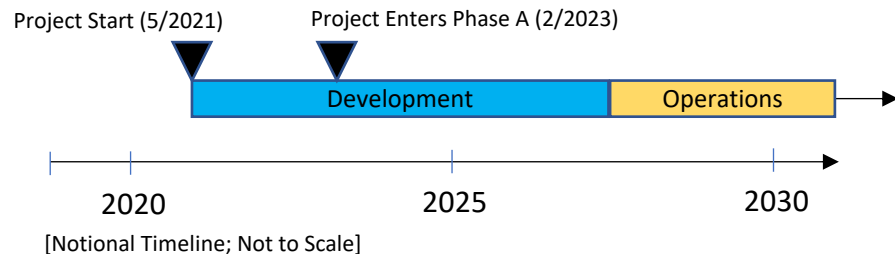
## Joint SBG-TIR and SBG-VSWIR Products

Surface composition and snow physics



# Closing Remarks

- SBG-TIR is responsive to objectives in ESAS 2017
- SBG-TIR is an excellent example of an international partnership that serves individual agency and mutual needs



- International collaboration with LSTM and TRISHNA enhances the value of each mission and maximizes the utility of the data set to the research & applications community



QR Code

**NASA Earth System  
Observatory (ESO)**

