

VENμS

Vegetation and Environment New Micro Satellite

Research Announcement

Deadline: February 15th, 2021

Centre National d'Etudes Spatiales – France

Israeli Space Agency - Israel

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1 Introduction

VENμS is a joint space system venture of the Israeli and French governments for Earth observation (EO).

VENμS was launched on August 1st, 2017, and the regular acquisitions started in March 2018.

VENμS mission consists of 3 main phases:

- From August 2017 to October 31st, 2020, the so-called ‘scientific mission’ dealt with the acquisition of 5 m resolution images over about 150 worldwide scientific sites, from the altitude of 720 km, in 12 shortwave spectral bands, and two days revisit time with constant view angle and overpass time.
- From November 2020 to October 2021, the so-called ‘technological mission’ aims at qualifying an Israeli electric propulsion technology (IHET) and demonstrate its mission enhancement capabilities, at the altitude of 410 km. No scientific imaging will occur during this period.
- From November 2021 and for at least one year, the satellite will acquire images for the scientific community every day from the altitude of 560 km. This phase is called VM5. Its execution needs to be confirmed.

The purpose of this call jointly issued by CNES, the French space agency, and ISA, the Israel space agency, is to select the sites to be acquired by the VENμS mission during the VM5 phase.

VENμS unique features during VM5 will be to acquire high resolution (4 m), multi-spectral images every day, with constant view angles over sites located worldwide. Besides, acquisitions with three different along-track viewing angles from the same pass will be achieved for a limited number of sites.

VENμS is aimed at demonstrating the relevance of the combination of such high temporal observation capabilities with a high ground resolution for science and applied studies. The aim is also to prepare the specifications of the next generation of EO missions.

Although VENμS was primarily designed for vegetation studies, the results of the VM1 phase show that VENμS is also useful for a range of topics, such as water quality, glacier movements, coastal erosion monitoring, and the atmosphere. Therefore, the proposals will not be restricted to any research topic.

The selection of the sites that will be imaged every day by VENμS starting from November 2021 is the subject of this Research Announcement.

2 Who can submit a proposal?

The call is open to researchers from educational institutions, research institutes, government institutions, non-profit organizations, and to any type of organization, including private and commercial companies, provided they conform the [CC BY-NC 4.0](#) license of the data (no commercial

use).

Proposals for this VENμS Research Announcement will be processed in a one-stage procedure. Applicants may submit their proposal any time before **January 31st, 2021**. The proposals will be evaluated first by a technical committee in charge of checking the feasibility of the required image acquisitions. Then, a scientific committee will establish the final list of sites to be acquired by VENμS.

The proponents of the selected sites are called Co-PIs. The main advantages of being selected as a Co-PI are to have the proposed site(s) included among the VENμS VM5 sites and to be associated with the community of VENμS' users.

Funds for Co-PIs are not available under this research announcement.

3 Summary of the VM5 VENμS mission and products

3.1 Mission

The VM5 phase of VENμS will start in November 2021 and last at least one year. The mission will possibly continue to the second year, depending on the performance of the systems.

The satellite carries a super-spectral camera characterized by 12 narrow spectral bands (B1 – B12).

VENμS Band	Centre λ (nm)	Sentinel-2 Band	Centre λ (nm)	Landsat-8 Band	Centre λ (nm)
1	423.9				
2	446.9	1	443	1	443
3	491.9	2	490	2	482
4	555.0	3	560	3	561
				8	590
5	619.7				
6	619.5				
7	666.2	4	665	4	655
8	702.0	5	705		
9	741.1	6	740		
10	782.2	7	783		
		8	842		
11	861.1	8a	865	5	865
12	908.7				
		9	945		
		10	1375	9	1373
		11	1610	6	1609
		12	2190	7	2201

The satellite will fly in a near-polar sun-synchronous orbit at 560 km height, leading to a 1-day revisit time under a constant view angle. The VENμS camera will provide a ground resolution of 4.1 m over a 21 km swath at nadir. The whole system will be able to be tilted up to 30 degrees along and across the track. The system will cross the equator at around 10:30 AM.

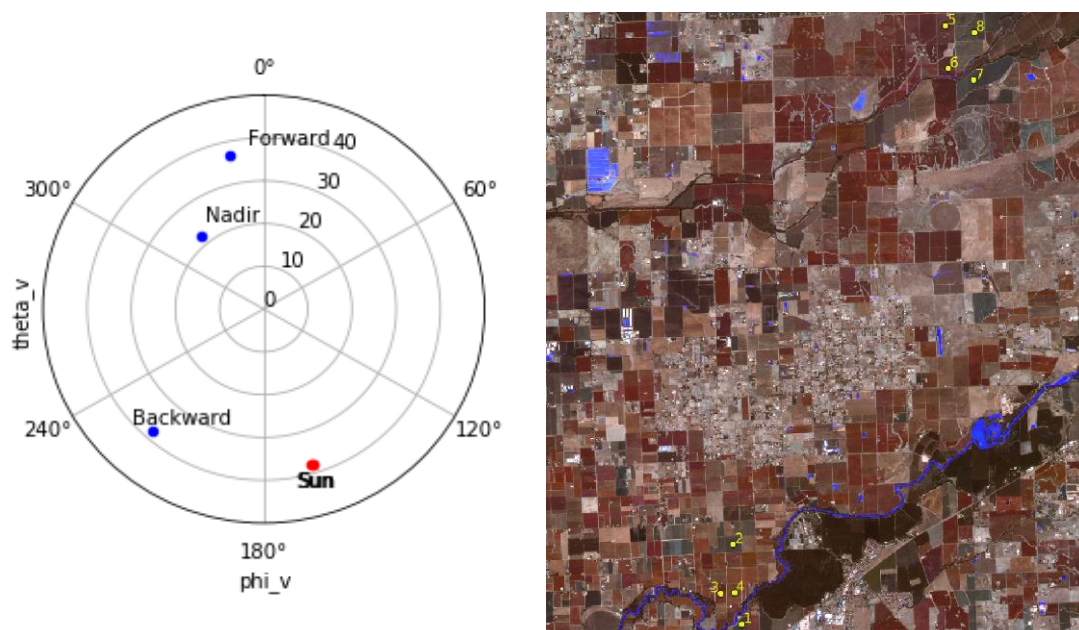
3.2 Stereoscopy and multi-angular acquisitions

The B5 and B6 bands (620 nm) acquire images with a difference in viewing angle of 1.43° and a time lag of 2.7 s. This feature is used to detect clouds from their altitude. It was also used for [deriving Digital Elevation Models](#) (DEMs), monitoring ice cliff migration ([Altena & Kääh EGU 2020](#)), and bathymetry retrieving.



Example of information derived from stereoscopic and time lag features: left a RGB composite of B7, B4, B3) where the green and red small dots are the same airplane within a few tenth of seconds. On the right, a combination of bands B6 and B5 enhance the change in the location of the plane and its contrails (an additional effect is the rotation of the Earth).

During VM1 multi-angular acquisitions were carried out for only one site. From every single pass, forward, nadir, and backward images were acquired every second day over the [Gallo](#) site in California.



Example of multi-angular acquisitions acquired from the same orbit in a few minutes. On the left geometric configuration, on the right RGB colored composition using the same spectral band (B6 = 620 nm) acquired in three directions. Forward sight in blue, “nadir” green, backward sight in red. Water appears blue due to specular reflection. The vines whose rows are oriented East-West appear in burgundy color, those oriented North-South appear in gray. (more [here](#))

During VM5, we plan to increase the number of sites that will benefit from multi-angular acquisitions.

Proposals that will use multi-angular daily acquisitions, and/or the small stereoscopic feature, and/or time lag of B5 and B6, are welcome.

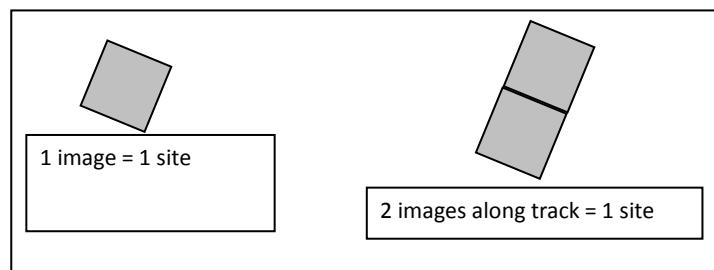
3.3 Products

At the camera level, each spectral line of an image is made of 5200 pixels. At nadir, the field of view is 21 km, with a ground resolution of 4.1 m. Note that when an image is acquired with an oblique viewing, the native ground resolution slightly decreases and the field of view increases.

The following definitions apply in the rest of the text:

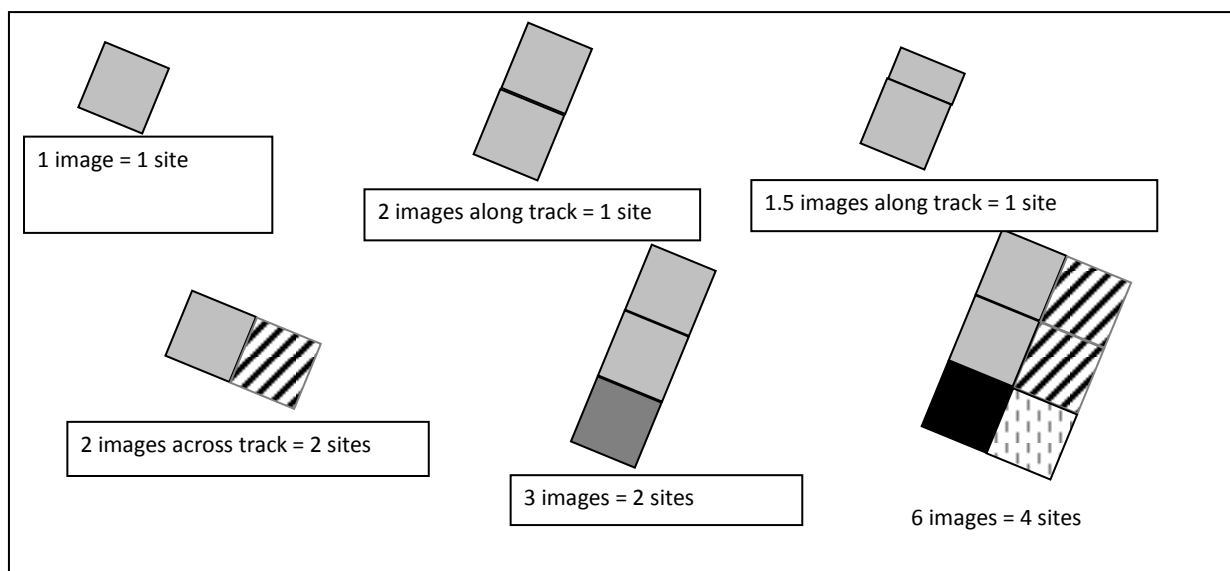
An **image** corresponds to the acquisition of 5200 rows by 5200 pixels in the twelve spectral bands. At nadir, it corresponds to an area on the ground of approximately $21 \times 21 \text{ km}^2$. This is the minimal product size that will be delivered to the users.

The baseline definition of a **site** is: "an area on the Earth covered by one to two along-track contiguous images". A site corresponds to 5200×5200 pixels (1 image) or 5200×10400 pixels (2 consecutive images) in the focal plane. Therefore, the minimum size of a site is $21 \times 21 \text{ km}^2$ while the maximum size being $21 \times 42 \text{ km}^2$, at nadir.



The baseline definition of a site and standard VENUS image acquisitions

However, this definition must be extended to more complex situations since the same area can also be observed with different view angles, for example, nadir, forward, and backward viewing from the same orbit and/or from different orbits at high latitudes. In that case, the area of interest is covered by several **acquisitions** of one to two images, each with different view angles over the same area.



Site definitions for nonstandard VENμS image acquisitions

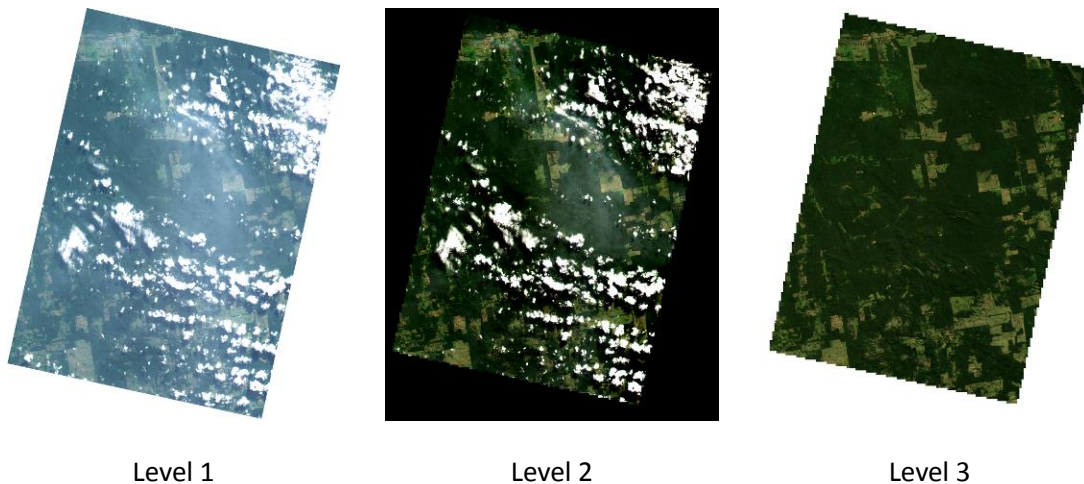
When a project requires images that depart from the baseline definition of a site, several sites of one to two images have to be defined. This could occur in the following situations:

- More than two along-track contiguous images are needed to cover the area of interest
- Two or more across-track images are needed. In that case, the images are acquired with different viewing angles, possibly from different orbits.
- Two or three images of the same area are acquired from different viewing angles. Each viewing direction corresponds to one site (e.g., 3 viewing directions = 3 sites)

In order to allow CNES and ISA to serve a large number of scientific investigations and due to the limits of the VENμS capabilities, the proponents are kindly requested to limit as far as possible their demand to one site, i.e., the acquisition of one to two consecutive images from the same orbit. Best efforts will be made to satisfy more demanding requests, such as areas larger than two contiguous images or acquisitions with different view angles. Such requests should rely on sound scientific justifications.

The three levels of products that will be made available to the selected Co-PIs are summarized in the table below.

Product level	Temporal characteristic	Content	Ground resolution
Level 1	single date and single viewing angle acquisition	Top of the Atmosphere reflectances, map-projected (orthorectified image)	4 m
Level 2	single date and single viewing angle acquisition	Surface reflectances, map-projected (orthorectified image), cloud and cloud shadow masks, aerosol optical depth, atmospheric water vapour content	4 m
Level 3	10 days time composites of single viewing angle acquisition	Surface reflectances, map-projected (orthorectified image)	4 m



KENIA (Bolivia), June 13th 2020

Since the VENμS ground segment will only manage and deliver sites of one or two images, the mosaicking of several sites to cover the project area of interest shall be done by the proponents.

The main goal of VENμS scientific mission is to demonstrate the value of high-resolution multitemporal measurements. It is expected that the baseline product for most proposals will be level 2 and 3 products, supplied to Co-PIs on a regular basis to monitor the seasonal evolution of the surfaces. However, Level 1 will also be available, for instance, for aerosol studies.

Due to algorithmic constraints to register the images, we are often not able to deliver the images if their cloud cover is above 75%.

Each site will be observed during the whole period of 1 year, and possibly 2 years, and will be imaged every day, except under some circumstances such as during high-latitude nights.

This call for proposals assumes nominal system operation (satellite, instrument and ground segment) and that image quality performance will be a continuation of VM1. A key point at the end of VM3 in 2021 will allow better anticipation of performances.

4 Data Distribution

4.1 Data Policy

Our free and open data policy allows anyone anywhere in the world to access and use the data and information.

The following applies:

- 3.1.1. VENμS Scientific Mission data are the property of CNES and are subject to the French and European Intellectual Property laws. The use of data is limited to peaceful, scientific or R&D activities.
- 3.1.2. Results of the Scientific Mission data analysis will be made available to the scientific

community through publication in appropriate journals or other established channels as soon as practicable and consistent with good scientific practice. Publications shall include a suitable acknowledgment of the services afforded by CNES and ISA.

3.1.3. All raw Scientific Mission data obtained from the VEN μ S Scientific Mission will be archived in an appropriate CNES centre for at least ten years after completing the VEN μ S Scientific Mission, unless otherwise agreed by CNES and ISA.

3.1.4. The Creative Commons **CC BY-NC 4.0** applies. The users of VEN μ S data

- **are free to:**
 - **Share** — copy and redistribute the material in any medium or format;
 - **Adapt** — remix, transform, and build upon the material;
- **Must** give appropriate credit to CNES and ISA;
- **And shall not** use the material for commercial purposes.

CNES and ISA shall not be liable for data loss, deterioration in data quality, or delay of data supply resulting from VEN μ S or ground facilities problems, or for not providing VEN μ S data due to bad weather or matters beyond CNES and ISA control.

4.2 Data available before VEN μ S VM5

All the VEN μ S data acquired and processed during the VM1 phase, from March 2018 to October 2020, for worldwide sites except Israel, are available for download from the Theia Web Site:

<https://theia.cnes.fr>

Similarly, for the Israeli sites:

<https://venus.bgu.ac.il/venus/>

More information on the algorithms, products, and uses can be found on the dedicated blog:

<https://labo.obs-mip.fr/multitemp/category/ven%c2%b5s/>

The distribution of VEN μ S products is not quasi real-time, though best efforts will be made to shorten delays.

5 Funding

No funds will be provided to PIs.

6 Benefits and Responsibilities of PIs

6.1 Benefits

CNES and ISA will make their best effort to acquire, process, and deliver the data to the Co-PIs of the selected sites. Priority will be given to Co-PIs inquiries for information.

6.2 Responsibilities

The Co-PIs will send to CNES and ISA a copy of any published article dealing with VEN μ S data.

The selected scientific Co-PIs working over the study sites should do their best to attend VEN μ S scientific meetings. It is expected that the CNES and ISA will jointly organize at least one international workshop in order to present and share the results.

7 Proposal Submission

7.1 General Conditions

Proposals must be submitted by e-mail using the format defined in the annex.

Applicants may submit proposals any time before January 31st, 2021. The core of the proposals, that is, the description of the proposed work and facilities, should not exceed five pages.

7.2 Where to Send Proposal

Please send your proposal by e-mail before February 15th, 2021 to:

venusRA@cnes.fr

With compulsory copy to the VEN μ S scientific PI's:

gerard.dedieu@cesbio.cnes.fr

karnieli@bgu.ac.il

olivier.hagolle@cnes.fr

7.3 Where ask for further information

Question regarding this RA should be sent to the PI's.

Questions and answers of general interest will be sent to registered applicants and will also be published on the VEN μ S web site

<http://venus.cnes.fr>

<https://karnieli-rsl.com/ven%C2%B5s>

8 Selection of Proposals

8.1 Evaluation and Selection Procedures

Proposals will be reviewed and evaluated by experts of the Scientific Committee assigned by CNES and ISA based on the evaluation criteria shown in §8.2. Final decisions on the acceptance of proposals will be made by CNES and ISA, considering the overall balance of different proposals and their resource requirements as well as the evaluation result. Co-PIs will be notified of proposal acceptance before summer 2021.

8.2 Evaluation criteria

- Technical feasibility of acquiring VENμS images other the requested site(s) within the research period.
- Overall scientific, technical or social merit of the proposal or unique and innovative methods, approaches, or concepts demonstrated by the proposal.
- Relevance of the proposal to demonstrate the usefulness of VENμS high resolution, multi-spectral and frequent revisit capabilities.
- Relevance for the development of science and applications
- Relevance for the preparation of new EO missions
- Applicant's existing capabilities, related experience, dedicated ground facilities and techniques for achieving the proposal objectives.
- Availability of In-Situ data for the validation of products
- Ability to bring together multidisciplinary teams on the same site

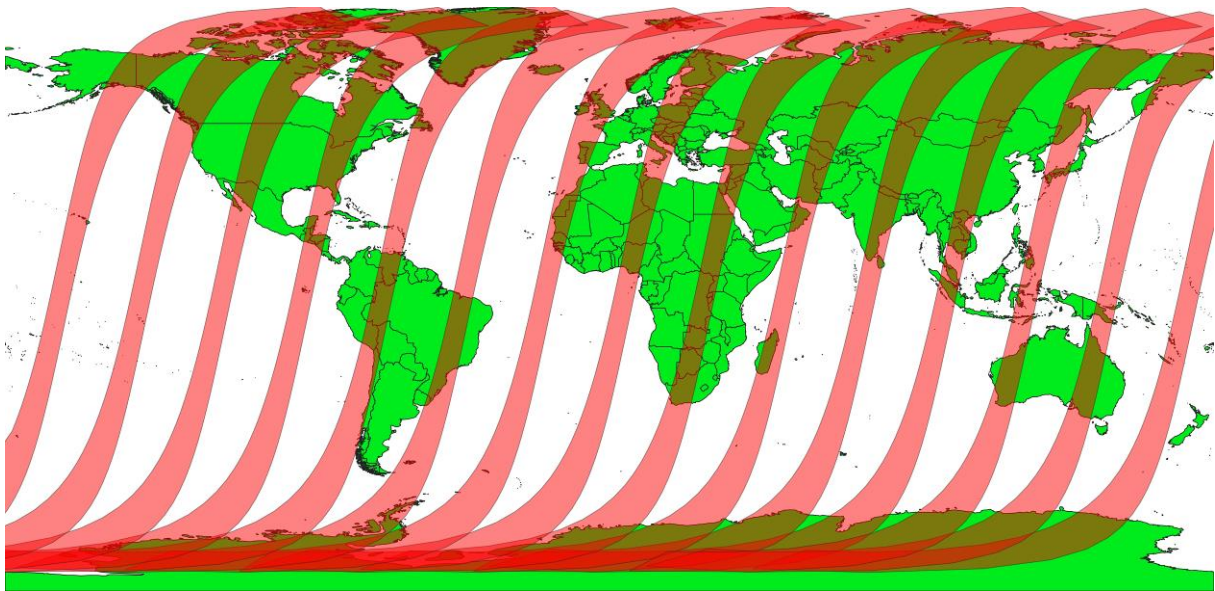
9 Cancellation and Postponement of RA

CNES and ISA reserve the right to cancel this RA upon notice delivered by CNES and ISA. CNES and ISA assume no liability for cancelling the RA, for postponing the RA schedule, or for anyone's failure to receive actual notice of cancellation.

10 APPENDIX A: MISSION OPERATIONS

During VM5 the satellite will fly in a near polar sun-synchronous orbit at 560 km height, leading to a 1-day revisit period. The inclination is about 98° , the local time of descending node is 10h30 am.

The orbit will be controlled such as to maintain the local time of overpass at ± 5 minutes. The corridors in which sites can be selected are displayed in the figure below (pink areas). A kml file is provided for a more accurate visualization, under google earth or on a GIS software.



VENμS VM5 scientific mission: orbits and areas which can be observed.

11 APPENDIX B: Outline Proposal Content and Application Form

This call and the application forms are available hereafter and can also be downloaded from:

<https://www.theia-land.fr/>

All proposals should be type-written in English, Arial font, size of 11 points.

Each page must have a page number in the middle of the bottom and the name of the applicant in the upper right corner.

File format should be Adobe PDF (preferred), MS Word, or Rich Text File (RTF).

The location of the site(s) proposed should be described using the provided Excel file and if possible by providing also a vector file (klm, shape, ...)

VEN μ S VM5 Research Announcement

Proposal

Proposal Title:

Acronym:

Principal Applicant:

Name, first name:

Official title:

Organization:

Department:

Address:

Country:

E-mail:

Telephone:

Website:

Co-applicants:

Name	Organization	E-mail

Research Category (check one or several)

- ☐ Validation of VEN μ S data products
- ☐ Improvement of VEN μ S products (algorithms for atmospheric correction, cloud screening, time compositing...)
- ☐ Scientific research
- ☐ Applied research

Date and Signature of principal applicant:

Suggested content and length of the proposal

1) Cover page (1 page with the above information)

2) Proposal (4 to 5 pages maximum):

2.1 Objectives and background

2.2 Project description

2.3 Ground experiment(s), in situ measurements

3) Data Requirements: see next page

Data Requirements: If several sites are requested, please provide the information for every site

1	Applicant's name	
2	Short site Name (8 characters)	
3	Country	
5	Latitude of the center of the area of interest (in decimal degrees)	
6	Longitude of the center of the area of interest (in decimal degrees)	
7	Site length along the along track direction (kilometers, "L" in the figure below)	
8	Site width across the along track direction (kilometers, "I" in the figure below)	
10	Name of the nearest town within the site (blank if none)	
11	Beginning of requested period(s) of observation (if different from continuous observation during mission VM5 phase)	
12	End of requested period(s) of observation (if different from continuous observation during mission VM5 phase)	
13	Do you wish your area of interest to be acquired every day under different view angles, for instance forward/as close as possible to nadir /backward (YES/NO)	
19	Additional comments and information	

Conventions and units

Latitude and longitude of the center of the area of interest

Latitude and longitude of the center of the site in decimal degrees, with the following convention:

"+" for northern latitude (0-90°N) and "–" for southern latitude (0-90°S), and "–" for longitude west of Greenwich (0-180°W) and "+" for longitude East of Greenwich (0-180°E).

For instance, with this convention:

- the coordinates of the *Inaccessible Island* (37°18'11.62" S / 12°40'36.18" W) are Latitude = - 37.303228 and Longitude = - 12.676717
- the coordinates of the *City of Carcassonne* (43°12'22.08" N / 2°21'50.81 E) are Latitude = + 43.206133 and Longitude = + 2.364114

A Kml/kmz or shape file can also be provided in addition to the above information

It is recalled that a standard site is an area on the Earth covered by one to two along track contiguous images. The minimum size of a site is 21x21 km², the maximum size being 21x42 km² at nadir. A site can also be observed with different view angles, for example nadir, forward and backward viewing from the same orbit and/or from different orbits at high latitudes.

The site will be observed every day, with similar viewing angles, during these periods, unless a different requirement is given.