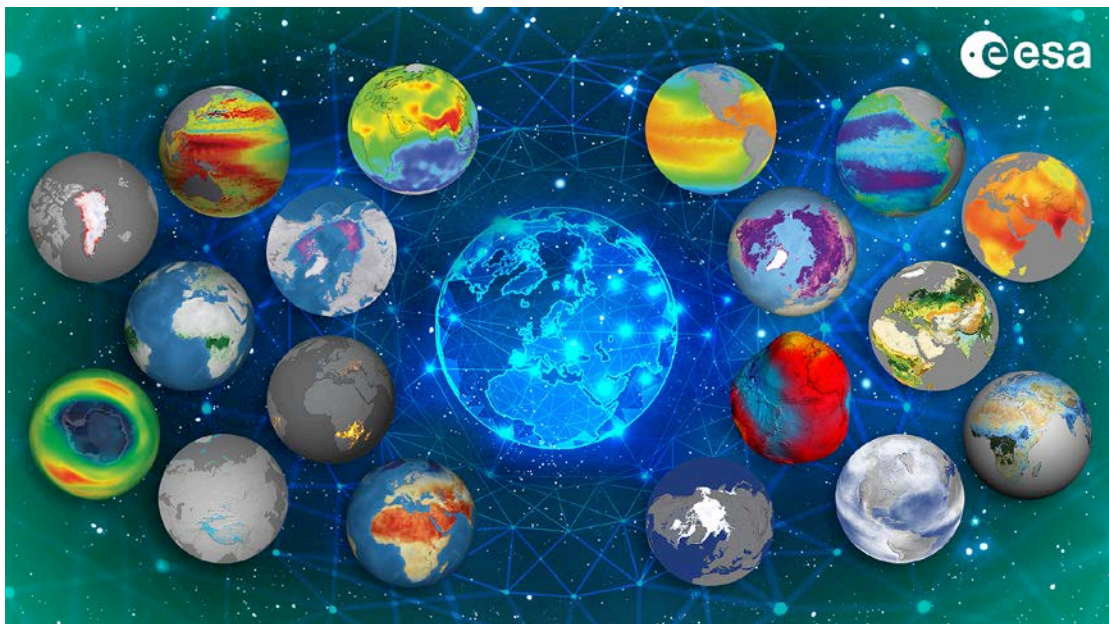


## The Future Earth Observation Programme FutureEO Period-1



### Call for Earth Explorer 11 Mission Ideas

25 May 2020

## Executive Summary

The European Space Agency is soliciting the scientific community for proposals for a large-class mission addressing EO science challenges to be launched in the 2031/2032 timeframe. The programmatic context for the call is described in Section 1 and the boundary conditions are described in Section 2. Full proposals need to be submitted in different phases, see Section 3. The evaluation approach is explained in Section 4. Selection criteria are listed in Section 5. The mission idea will be implemented according to the timeline indicated in Section 6.

## 1. Programmatic background

As part of its *Future Earth Observation Programme Period-1 (FutureEO-1)*, the European Space Agency (ESA) announces an opportunity for scientists from the Earth Observation (EO) community in ESA Member States and Canada and Slovenia to prepare proposals for ideas to be assessed as potential *Earth Explorer Missions*. These missions will be used to conduct research in the field of EO and/or to demonstrate the potential of new innovative EO techniques of relevance to both the scientific and the application-oriented user communities.

The Research Mission element of FutureEO-1 consists of a series of missions addressing critical Earth science issues. In the past, nine Earth Explorer missions have been selected for implementation, namely GOCE (Gravity field and steady-state Ocean Circulation Explorer), Aeolus (Atmospheric Dynamics Mission), EarthCARE (Clouds, Aerosols and Radiation Explorer), Biomass (Forest Carbon mission), CryoSat (Polar Ice Monitoring), SMOS (Soil Moisture and Ocean Salinity), Swarm (Earth's magnetic field and environment), and FLEX (Fluorescence Explorer), and FORUM (new insight into planet's radiation budget and climate). In addition, three Earth Explorer 10 candidates are currently being studied in Phase 0 and four Scout candidate missions are undergoing system consolidation studies.

The motivation behind this Call is the Agency's wish to engage the scientific community as far as possible in determining and advancing the content of *Future-EO-1*. The Earth Observation Strategy and its challenges (see [Earth Observation Science Strategy for ESA: A New Era for Scientific Advances and Societal Benefits, ESA SP-1329/1](#) and [ESA's Living Planet Programme: Scientific Achievements and Future Challenges – Scientific Context of the Earth Observation Science Strategy for ESA, ESA SP-1329/2](#), European Space Agency, Noordwijk, the Netherlands, 2015) was established in 2015 on the basis of a bottom-up process that started with a consultation of the broad scientific community and contains the wide-ranging and ambitious scientific challenges to be addressed.

Taking into account the experience from previous calls, and in line with the spirit of the programme, the Agency is soliciting ideas to be implemented as ESA-led Earth Explorer missions. Mission candidates will be selected from the proposed ideas on the basis of their innovation and scientific excellence.

A response to the Call may be made by scientists from ESA Member States and Canada and Slovenia, or teams of scientists, where proposing teams may also include scientists from non-ESA member states.

Copies of this announcement and key reference documents will be found linked from the Agency's Living Planet website <http://www.esa.int/livingplanet> and this call website <http://explorercall.esa.int>.

## 2. Boundary conditions

The boundary conditions to which proposals will have to comply to be considered feasible under the present Call are spelled out in the present section.

Responses to the Call can potentially cover any Earth Science topic relevant to the FutureEO Programme, in accordance with the Earth Observation Science Strategy for ESA. Proposals must demonstrate scientific excellence and innovative technologies by employing novel approaches to provide new scientific insights.

The Call is open to all areas of Earth science, and the mission idea will be selected among feasible proposals on the basis of its scientific merit. Addressing innovative approaches as part of this Call, including small satellite formations and constellations, taking advantage of existing and future space infrastructure, e.g. flying in coordinated manner with a long-term operational mission, in order to address new science issues, is encouraged.

### 2.1 Cost

The present Call solicits proposals for a large mission with a cap of **450 M€ Cost at Completion (CaC)** to ESA at 2020 economic conditions (e.c.) covering the whole development of the mission after selection up to the end of the commissioning phase once the satellite is in orbit (Phase B1 to E1).

This implies that a strict target of **250 M€, e.c. 2020**, has been set for all industrial development costs for the space segment, including Level 1 Ground Processing Prototype, excluding launch services, operations, ground segment, Level 2 processor and ESA internal costs.

With respect to the launcher selection, the Payload Allocation Policy for European Institutional missions launched on Ariane 6 or Vega shall be followed, see Section 2.4 for further detail. Any alternative option, e.g. a launch opportunity fully committed through a collaborative partnership, shall not impact the overall budget. In case of in-kind contributions of the launch service, parts of the space segment such as the instrument or platform or sub-sets of either, the Level 2 processor, or other elements of the ground segment, the industrial development costs can be increased according to these in-kind contributions minus some adaptation costs that occur on the side of ESA to integrate them.

Annex 1 contains Cost Estimate Breakdown guidelines.

### 2.2 Technology and Scientific Readiness level

To achieve the targeted launch date with the attendant short preparation phase, the mission concept and the spacecraft design must rely on demonstrated basic technologies and scientific readiness.

Proposal level: Evidence for the current Science Readiness Level (SRL) and Technology Readiness Level (TRL) shall be provided in the proposal as well as a roadmap to achieve higher readiness levels in the next Phases.

End of Phase 0: By the end of Phase 0, compliance with SRL of 4 and compliance with programmatic aspects needs to be assessed to progress to the next phase.

End of Phase A: A minimum of SRL 5 must be achievable by the end of Phase A. Evidence shall be provided that TRL of 5 can be achieved at the end of phase B1.

### ***2.3 In-kind contributions from ESA Member States and Canada and Slovenia***

Mission ideas with potential in-kind contributions may be proposed. Mission ideas with substantial contributions of international partners outside ESA member states and Canada and Slovenia are considered as Missions of Opportunity, and as such are considered outside the scope of this Call.

In the case of a proposed in-kind contribution e.g. guest (contributed) payload, the proposal shall provide evidence of the credibility of the in-kind contribution including a letter from the prospective partner entity confirming the estimated cost of the commitment and signed at the appropriate level of budgetary authority. Furthermore, partnership cooperation based on an instrument exchange shall be considered only when the full instrument to be exchanged is already developed at a TRL equal to or exceeding 5, in accordance with the ‘Guidelines for the use of TRL’s in ESA programmes’. A letter from the prospective partner entity confirming their programmatic and financial commitment shall be included. In addition, the detailed schedule, the potential contributions, and the different programmatic/budgetary approval cycles shall be clearly detailed in the proposal in order to substantiate compliance to the programmatic/budgetary requirements of the Call.

The Agency reserves the right to contact the prospective partner mentioned in the proposal to verify the feasibility of the proposed scheme.

### ***2.4 Launcher and launch timeframe***

With respect to the launcher selection, the Payload Allocation Policy for European Institutional missions launched on Ariane 6 or Vega (i.e. Chapter II within the ESA Council “Resolution on the Institutional Exploitation of ESA-Developed Launchers and supporting Competitiveness”, ref. ESA/C(2019)48”) shall be followed. In case the mission would require an Ariane 6 launcher, the additional launcher cost shall be offset by a corresponding reduction of the space segment industrial cost.

The Agency foresees a launch of the EE11 in the **2031/32 timeframe**. Decision on implementation of the EE11 mission is scheduled to be taken in 2025.

### ***2.5 ESA rules and standards***

The mission selected as EE11 will be implemented in accordance with a tailored approach of the ESA rules and standards for ‘Earth Explorer’ Missions, with particular regard to the approaches for project reviews and documentation, applicable standards, industrial organisation with a cost-effective structure.

## **3. Proposal submission phases**

Concerning the proposals for Earth Explorer Core mission ideas, submission will be performed according to the following compulsory steps:

1. Submission of a Letter of Intent and list of team members
2. Letter of Intent Workshop
3. Submission of a full Proposal

### ***3.1 Submission of a Letter of intent and list of team members***

Prospective proposers are required to submit, by the deadline reported in Section 6, a Letter of Intent (LoI) stating their intention to submit a proposal in response to the present Call. It shall

provide a brief overview of the scientific objective of the mission idea and its assessment containing evidence that the concept of the proposed mission idea has been scientifically validated.

LoIs are accepted exclusively in electronic form, in PDF format (unlocked), using the interface available from the Call web site.

The LoIs shall have a maximum length of 4 A4 pages, minimum font size 11 pt.

The LoIs shall contain:

- a) the name and contact information of the Lead Proposer;
- b) the proposal title;
- c) the names and institutions of the team members. The entire team **shall not exceed 12 persons** (the LoI may not contain additional names from industry nor names mentioned though support or endorsement statements);
- d) Executive Summary, summarising the mission idea, its objectives;
- e) Scientific Objectives of the idea, describing the research objectives of the mission together with their relevance to ESA's EO Science Strategy and expected deliverables;
- f) Characteristics of the mission idea, identifying the main features, together with an indication of the related scientific and application-oriented user demands, together with a brief assessment of its expected feasibility;
- g) References.

Submission of a LoI is mandatory. Proposals not proceeded by a corresponding LoI will not be considered. The purpose of the LoI will be to allow ESA to make the necessary preparation for the proposal evaluation process. No support or endorsement letters may be attached to the LoIs.

Proposers shall indicate their involvement and role in the proposed idea, using the Excel spreadsheet that can be downloaded from the Call web site. Lead Proposers may identify qualified independent candidates for the scientific peer review of their proposals to ESA, in the LoI.

The Lead Proposer, the listed proposal team and the proposal's title identified in the LoI shall remain the same throughout the process.

Any further communication between ESA and the proposing team will only take place through the Proposer.

### ***3.2 Letter of Intent Workshop***

Lead Proposers will be requested to attend a Letter of Intent Workshop, see Section 6 for the schedule. The purpose of the workshop will be an opportunity to present the mission idea. The workshop will provide an opportunity to answer questions related to the Call and selection process, and to the various elements that should be addressed in a proposal. Furthermore, scientific matters can be clarified and potential industrial/scientific partners working in the same domain can be identified with whom a joint proposal could be prepared (if applicable). In addition to improving the possibilities for proposal consolidation, at this workshop the Executive, supported by ESA's Advisory Committee for Earth Observation (ACEO) members, may provide suggestions to the proposers for showing compliance with the scientific, technical and programmatic criteria.

### ***3.3 Proposal Submission***

The following guidelines for the proposal shall be followed:

- Proposals shall identify a Lead Proposer, who is a national from one of the Agency's Member States or Canada and Slovenia. The proposal shall be prepared by scientists (individually or in cooperation with other individuals and/or scientific institutes), supported by technical experts in industry or other expert entities.
- The team members listed on the proposal shall be justified by their respective contribution to the content of the proposal. The entire team shall not exceed 12 persons and shall not differ from the team members listed in the LoI.
- No support or endorsement letters may be attached.
- For mission ideas with an in-kind contribution from an ESA member state or Canada and Slovenia, a letter of commitment signed at appropriate management level shall be attached.
- The proposal shall be submitted in English language.
- The proposal format shall be in Adobe Acrobat PDF (unlocked), A4 page format, single-line spacing, font to be used: Times New Roman or Times, font size 11. All proposals must be submitted via the Call website.

The proposal shall have the following structure (not exceeding 30 pages, excluding references):

- Cover Page (1 page) is the title page of the Response to the Call with name and full address and affiliation (plus phone, fax and e-mail) of the Respondent plus list (names and affiliations) of associated team members. The reference number provided by ESA (following submission of the LOI) shall be entered on the top right corner of the proposal cover page).
- Executive Summary (1-2 pages) describing the mission idea in a nutshell.
  - A concise resumé describing: the scientific objectives, the science-context and requirements in terms of the geo-biophysical variables or parameters to be retrieved, the targeted accuracy and the relevant spectral, spatial and temporal scales, as well as a broad justification for the realisation of the mission.
  - An outline of the envisaged mission implementation concept addressing the required observation concepts and the associated main requirements, together with the main elements of the mission idea.
  - The Agency shall be allowed to use the Executive Summary for public distribution. The rest of the proposal will be treated confidentially.
- Scientific Objectives, Requirements and Justification (<10 pages) is a description of the mission objectives with justification.
  - A description of the objectives of the mission and their rationale, including the status of the scientific knowledge and the identification of the gaps and open issues that the mission intends to respond to.
  - The required mission duration and the relation to other planned or existing missions.
  - The identification of the geophysical variables and data products required to fulfil the objectives of the mission and the relevant observation requirements (e.g. accuracy, spatial and temporal scales).

- The SRL status in the associated area and the status of potentially available geophysical retrieval algorithms. Supporting peer-reviewed references validating the concept idea shall specifically refer to the details of the proposed concept, and include the methods for achieving the required geophysical measurement in relation to the specific instrumentation and observation technique proposed.
- Technical Concept (<15 pages) is an outline of envisaged technical concept with some indication of its heritage and potential feasibility.
  - This section of the proposal presents the general characteristics of the mission and the associated measurement requirements, including a justification of how these allow the fulfilment of the scientific objectives of the mission. This section shall include:
    - The observation techniques relevant to the mission idea.
    - The relevant observation requirements (e.g. observation geometry, required observing conditions, temporal, spatial, spectral and radiometric requirements, spatial and temporal co-registration requirements, measurement accuracy requirements).
    - Other general requirements (e.g. synergy with other missions and relevant co-registration requirements).
    - TRL roadmap to achieve higher readiness levels in the next Phases.
    - Engineering and performance budgets (including mass and power budgets).
    - A high level estimated cost breakdown, addressing the cost of the space segment and of the Level 1 processor prototype, to be presented following the guidelines provided in Annex 1.
- Relevance to Evaluation Criteria (<5 pages) is a response to the selection criteria outlined in Section 5.
- References - relevant publications shall be included.

#### 4. Evaluation approach

The following steps will be performed in the evaluation of proposals:

Valid proposals (i.e., those received by the deadline indicated in Section 6 and having submitted a LoI and participated to the LoI workshop) will be subject to a detailed scientific, technical and programmatic assessment, aiming at ascertaining the compatibility of the proposed mission idea with the Call's boundary conditions and Selection Criteria (see Section 5).

Proposals will be submitted to a scientific peer review process conducted under the responsibility of the ACEO according to the Selection criteria in Section 5. For the scientific evaluation, scientific panels will be established. Each scientific panel will be chaired by members of ACEO and comprises non-ACEO external scientific experts and ESA internal scientific experts. Each scientific panel will be asked to scientifically assess a sub-set of proposals. Technical panels will be set up by the Executive, involving technical experts and senior staff from the Directorate of Earth Observation Programmes and the Directorate of Technology, Engineering and Quality, who will perform the technical and programmatic evaluation of the proposals. The technical panels will provide inputs for the relevant

technical/programmatic evaluation criteria and support the scientific panels in the preparation of the evaluation reports.

Based on the evaluations of the individual proposals, ACEO will then undertake an overall evaluation and recommend to the Director of Earth Observation Programmes **three candidate missions** for study at Phase-0 level, without any order of priority. The candidate mission ideas recommended for Phase 0 will be presented by the Executive to the Programme Board for Earth Observation (PB-EO) for approval.

A written debriefing will be provided to all proposers, comprising in all cases a scientific, technical and programmatic assessment of the proposal. No face-to-face debriefing meetings are planned.

A Mission Assessment Group (MAG) will be established for each candidate selected for assessment and all contributors to an idea will, in principle, be regarded as candidates for the respective MAG. This MAG will be tasked with presenting the scientific maturity and feasibility of the mission concept at the end of Phase 0 as well as preparing a Mission Requirements Document (MRD), as necessary to start Phase A.

At the end of the Phase 0, a Mission Definition Review will be held. ACEO will review the scientific aspects of each mission concept (including compliance with SRL 4) whilst the Executive will review the technical maturity and programmatic aspects. The mission concepts will be ranked by ACEO according to the selection criteria, and a selection recommendation made to PB-EO for the decision on which mission concepts to proceed to Phase A.

At completion of the Phase A, the MAG will be tasked with producing a Report for Selection for each candidate mission. The intention is to present the results of the studies to the community in a User Consultation Meeting (UCM), which will contribute to the recommendation of one mission to be implemented as EE11.

A decision on the full implementation (Phase B/C/D/E1) of one of the two missions will be taken by PB-EO at the end of Phase A, based upon demonstration that the mission respects all the necessary conditions, supported by the above-mentioned public User Consultation Meeting (UCM) and scientific review under the auspices of ACEO.

It should be noted that responses to the Call that do not lead to selection might still be further investigated by the Agency. All commended ideas that are not selected will be reviewed to identify potential new areas where the science or technology aspects remain insufficiently mature to initiate development of a mission and where further scientific or technological development is needed.

## **5. Selection criteria**

Following PB-EO's acknowledgement of the new Earth Observation Science Strategy for ESA – A new Era for Scientific Advances and Societal Benefits (ESA-SP-1329/1) and ESA's Living Planet Programme: Scientific Achievements and Future Challenges – Scientific Context of the Earth Observation Science Strategy for ESA (ESA-SP-1329/2) and discussion at PB-EO level, the applicable Earth Explorer selection criteria are as follows (ESA/PB-EO(2015)44, REV.1):



1. **Relevance to the ESA research objectives for Earth Observation** – for this criterion reference must be made to the general and specific objectives and scientific challenges set forth in the document Earth Observation Science Strategy for ESA – A New Era for Scientific Advances and Societal Benefits and ‘ESA’s Living Planet Programme: Scientific Achievements and Future Challenges’ – Scientific Context of the Earth Observation Science Strategy for ESA (ESA SP-1329/1+2, 2015). Here account shall be taken of how scientific advances anticipated from the mission contribute to addressing major societal issues.
2. **Need, usefulness and excellence** – this must take account not only of scientific requirements and/or the importance of a mission viewed as a precursor but also the extent to which the requirements, including those of space/time sampling, can be met by the proposed mission.
3. **Uniqueness and complementarity** – this must take account of other (i.e. not space) means of addressing the mission requirements as well as the activities and plans of other national and international bodies for space missions.
4. **Degree of innovation and contribution to the advancement of European Earth Observation capabilities** – this relates to technical/industrial aspects as well as to user interests.
5. **Feasibility and level of maturity** – this encompasses the technical constraints with a particular emphasis on the technology readiness and the scientific readiness, as well as the status of the associated user community within ESA member states and the maturity of its requirements.
6. **Timeliness** – this must take account not only of the timeliness of a mission from the point of view of user needs but also with regard to implementation constraints.
7. **Programmatics** – in addition to the considerations of development schedule, cost, risk, etc., (set within the overall Earth Explorer Programme) this addresses the implications of possible cooperation with other bodies, including synergies with other national and international developments, and taking account of the planned availability of relevant data from other observing systems.

## 6. Deadlines and Schedule

Activity	Date
Release of the EE11 Call	25 May 2020
Letter of Intent deadline	18 September 2020, 12:00 CET
Letter of Intent Workshop	5 October 2020
Proposal submission deadline	4 December 2020, 12:00 CET
Evaluation of submitted proposals via peer-review panels	December 2020-April 2021
ACEO EE11 recommendation	April/May 2021
PB-EO – selection of three candidates to enter Phase 0	June 2021
ACEO EE11 recommendation	Q3 2023
PB-EO – selection of two candidates to enter phase A	Q4 2023
EE11 User Consultation Meeting	Q2 2025
ACEO EE11 recommendation	Q2 2025
PB-EO – selection for implementation	Q2 2025
EE11 launch	2031/2032

**Any response that misses the deadline for submissions will be discarded.**

## **7. References**

ESA (2015a) Earth Observation Science Strategy for ESA: A New Era for Scientific Advances and Societal Benefits, ESA SP-1329/1.

ESA (2015b) ESA's Living Planet Programme: Scientific Achievements and Future Challenges – Scientific Context of the Earth Observation Science Strategy for ESA, ESA SP-1329/2.

ESA (2015). Scientific Readiness Levels (SRL) Handbook. Mission Science Division. Reference EOP-SM/2776/MDru-mdru.

ESA (2017). Technology Readiness Level (TRL) Guidelines. ECSS-E-HB-11A, March 2017  
VEGA C User's Manual, Is. 0.0 – Arianespace May 2018

Ariane 6 User's Manual Is. 1.0 – Arianespace March 2018

Annex 1 – Cost Estimate Breakdown guidelines

Cost Element	Cost (MEuro)
<b>Spacecraft Level</b>	
Project Office <sup>(1)</sup>	
AIV/T	
Facilities/GSE	
<b>Platform Level</b>	
Project Office	
AIV/T	
Facilities/GSE	
Platform HW/SW <sup>(2)</sup>	
Subsystem 1	
...	
Subsystem n	
<b>Instrument Level</b>	
Project Office	
AIV/T	
Facilities/GSE	
Instrument HW/SW <sup>(2)</sup>	
Subsystem 1	
...	
Subsystem n	
<b>Level 1 Ground Processor Prototype</b>	
<b>Total Cost Estimate</b>	

General: at least the level 1 and level 2 cost elements shall be provided;

(1) Management, Product Assurance, Engineering

(2) Breakdown per main subsystems, mission specific or critical subsystems shall be outlined (e.g. “standard” subsystems Hardware/Software (HW/SW) cost can be grouped under “other”)