



## European Space Sciences Committee

# RECOMMENDATIONS TO THE EUROPEAN SPACE AGENCY MINISTERIAL COUNCIL 2016

***Summary of Recommendations and Findings***

*3 November 2016*

## The European Space Sciences Committee input to ESA Ministerial Council 2016

The European Space Sciences Committee (ESSC - www.esf.org/space) of the European Science Foundation is an independent body that regularly provides expert advice to European and national research organisations and agencies that support space sciences in Europe. ESSC members are drawn from experts active in all fields of space research on the basis of scientific expertise and recognition within the community; they are nominated *ad-personam* and therefore do not represent any organisation or country.

The ESSC covers the whole spectrum of space-related sciences and is structured around four panels:

- Astronomy and Fundamental Physics,
- Earth Sciences,
- Life and Physical Sciences,
- Solar System and Exploration

The mission of the ESSC is to facilitate, support and foster space sciences at the European level by providing unbiased and expert advice on European space research and policy via recommendations or reports directly to decision makers, stakeholders and all interested parties at national and international level. Furthermore, ESSC provides a unique focal point to assist national European councils and agencies to achieve optimal science return and harmonise strategic priorities in space activities.

The European Space Sciences Committee has taken note of the ESA programme proposals and has interacted with ESA representatives and the science community to produce the inputs and recommendations summarised in this document. The science programmes proposed aim to maintain and reap the benefits from current strengths and big successes. They plan to pursue efforts in science and technology excellence by augmenting the portfolio and the scientific themes represented with new calls and opportunities.

**Overall, the ESSC strongly supports the scientific programmes proposed to the ESA Ministerial Council 2016. In a situation of global economic torpor, it urges Member State delegations not to overlook or underestimate the unique potential space science has on triggering not only socio-economic benefits and wellbeing for European citizens as well as industrial innovation processes and growth, but also on inspiring interest, enthusiasm and vocations in its citizens. Space science is not a cost, it is a high-return investment with a broad and exciting leverage effect on the people and the economy.**

**Studies that measure the socio-economic impact of space activities in Europe have shown that there is a positive return on investment for states that fund such areas. Acknowledging and catalysing the role and potential that space science has for innovation in Europe would strengthen these links between research and application and facilitate industry uptake and appropriation of investigations performed in and from space. The ESSC notes that the development of 'New Space' activities may allow for faster and cheaper access to space for observing systems, experiments and humans. Eventually these new actors may lead to a more diversified set of opportunities for the European space sciences community, society and the European private sector. In particular, the ESSC recognises and commends the ESA's continuous improvement in public relations over the past years.**

## ESSC positions and recommendations on ESA Science Programme Proposal

The ESSC recognises the structuring effect of the scientific programme on the European scientific community and the involvement of this community in defining science priorities. The ESSC strongly believes that ESA is effectively pursuing the guidelines of the Cosmic Vision 2015-2025, aimed at addressing fundamental scientific questions concerning planetary system formation and evolution, emergence of life, solar system, origin of the Universe and its fundamental physical laws.

- **The ESSC recommends that ESA continues to develop the scientific programme along the fundamental science questions of the Cosmic Vision programme. This would ensure continuity of the space programme in these areas while at the same time paving the way for new fields and new ideas to emerge within the European scientific community.**
- **The ESSC recommends maintaining a regular cadence of small, medium and large missions. It also recommends supplementing this cadence by investing in the technologies required to meet new challenges associated with promising emerging science concepts. This would ensure Europe's competitiveness and open new perspectives in the different space research areas.**
- **The ESSC recommends that a long-term strategic vision and planning of the scientific programme be further developed. Such a strategic vision, also addressing the risk element and being developed in consultation with the scientific community, would complement and/or update the Cosmic Vision programme.**
- **The ESSC notes that the level of resources requested in the mandatory programme proposal (increase of 2% on top of constant purchasing power) is fully consistent with its successful furtherance and ambitions. The Committee recommends that the Member States fully subscribe to the budget requested.**
- **The ESSC highlights that strengthening the level of control on the expected cost and schedule of missions, in particular during the study phases, would permit better management of the (financial) risk associated with any given mission and would eventually protect the mandatory programme and its outcomes.**
- **The ESSC supports the programmatic and feasibility pre-assessment of proposals submitted in response to a call; however, it recommends that the preliminary cost and technology assessment procedure be made more transparent and more independent and encourages ESA to pursue a more interactive approach so that all stakeholders involved are convinced of the robustness of the process and better proposals are produced in follow-up calls.**

## ESSC Positions and recommendations on the ESA E3P proposal

The ESA exploration strategy is well reflected in the E3P proposal. We note the outstanding outcome of the ELIPS programme in increasing European knowledge, capacity and capability in fundamental and applied sciences as well as on exploration-related research. Overall, the programme proposed is well balanced in terms of scientific content, as well as between science, technology and exploration-driven activities. The programme proposed builds on current strengths and big successes and coherently connects the continued efforts on ISS with a promising exploration programme going from the Moon (including CisLunar Space) to Mars (and its moons).

- **The ESSC strongly supports the concept of an envelope programme for European robotic exploration and human spaceflight in LEO and beyond. The ESSC particularly welcomes the coherent long(er)-term vision of the E3P approach, as it is forward-orientated, integrative, adaptive, and well balanced. The envelope approach should permit getting the most out of each individual programmatic element and contribute to making E3P a highly competitive programme overall on the international scene.**

- **The ESSC notes that the level of resources requested in the programme proposal is fully consistent with the ambitions it carries. The requested funding should permit implementation of the scientific and technology-driven elements of the programme proposed while providing adequate resources to plan and be well prepared for future achievements.**
- **The ESSC therefore recommends that the participating Member States subscribe to the E3P at the level of resources requested in the programme proposal.**
- **The ESSC recommends that the overall programmatic balance, philosophy and diversity (at programme completion) be preserved; in this context, the interplay of budget decisions and their consequences should be carefully considered. The ESSC also recommends that budgetary decisions on any of the science-orientated programmatic elements be governed by scientific excellence, based on a transparent and independent (peer) review process, as can be expected in the context of a science-led programme.**

### *SciSpacE - Science in Space Environment*

The SciSpacE element is well integrated within the ambitions of the E3P programme and ESSC recognises that, if supported at the adequate level, it will become a strong and leading pillar of this programme.

- **In order to permit the achievement of SciSpacE's ambitions, the ESSC supports the ISS Extension to 2024 and the two long-duration ESA astronaut missions proposed in the E3P programme.**
- **The ESSC welcomes the balanced share of experiments within the proposed SciSpacE (1/3 application orientated, 1/3 exploration orientated and 1/3 fundamental research) and strongly recommends that this balance be kept as bottom line and guiding principle in the years to come.**
- **The ESSC strongly recommends starting to prepare for the future and in particular for the post-ISS era. It would be sensible to develop prioritised scientific roadmaps that will take into consideration key scientific challenges and objectives as well as the platforms (including commercial) and technology required to achieve these.**
- **In order to reap the full scientific benefits of the effort and investment made in ELIPS, as well as to maintain the knowledge capitalisation and transfer processes, the ESSC recommends that all possible effort be made to implement the experiments currently in the pool ensuring continuity of the programme.**
- **The ESSC recommends that an Announcement of Opportunity be issued in the E3P period and that the Topical Team scheme (as vector to define, develop and bring to maturity new innovative concepts) should be continued.**

### *Exploration - Mars*

*ExoMars* is the first astrobiology programme to the red planet and an important milestone in performing science operations on the Martian surface. The 2016 mission has seen the impeccable orbit insertion of the Trace Gas Orbiter in October 2016, and the entry and descent phases - but not a successful landing - of the Schiaparelli module.

- **The ESSC is convinced that both ExoMars missions (2016 TGO and 2020) will produce novel and excellent new science.**
- **The Committee highlights the strategic requirement for European non-dependence to continue developing Europe's capability in EDM technology, building on lessons learned from the 2016 EDM failed last stage.**
- **The ESSC considers it critical that funding decisions be made during the ESA Ministerial Council 2016 to remove any remaining uncertainty on the mission implementation and urges**

**participating Member States to fully fund the 2016 TGO operations and the ExoMars 2020 mission.**

- **In the future, Mars Sample Return is definitively considered by the ESSC as a longer-term investment with presumably the highest value in scientific, technological and cooperation levels.**
- **The ESSC strongly supports further development of the MREP-2 programme, as this will enable technologies for Europe to play a major role in the future sample return programme with the ultimate goal of Mars Sample Return, including the timely design, building and commissioning of sample receiving and curation facilities.**

### *Exploration - Moon*

The continuity between Rosetta, ExoMars and Luna Resource Lander to foster specific European technology and science elements (precise and safe landing, end-to-end sampling including drilling) is considered as a sustainable and efficient approach by the ESSC.

- **The ESSC supports efforts by the ESA Executive to secure funding for Europe's continued participation in the Luna-Resource and Luna Glob missions. These, along with the proposed Lunar Polar Sample Return (and Phobos Sample Return) mission with Russia should be an integral part of ESA's wider exploration strategy.**
- **The ESSC also recommends widening collaboration in this area to include other international partners with expertise in lunar and other small body exploration, in the spirit of the recently formulated Global Exploration Roadmap.**

### *ExPeRT*

- **The approach proposed in the Exploration Preparation, Research and Technology (ExPeRT) element is considered valid and promising in providing coherent longer-term planning, well integrated and incorporated into the broader human space and robotic exploration programme.**

## ESSC Positions and recommendations on the ESA Earth Observation programme proposal

The ESSC commends the achievements of ESA's Earth Observation programme as well as its coherency and consistency. This programme has delivered a large number of original and ambitious missions, including the unique *Copernicus Sentinel Satellites* that produce excellent data for scientific research. Moreover, there is a large number of Earth Explorers and Sentinels in the pipeline.

- **The ESSC strongly endorses the EOEP-5 envelope programme and recommends that it be fully supported by the EOEP Member States.**
- **For the Sentinels, ESSC recommends that ESA discuss the bottlenecks to validation of the Sentinel Satellites with the European Commission, to achieve a sustainable programme covering all scientific and operational requirements.**
- **'Bringing the users to the data, instead of the data to the users' is an important concept that is part of EOEP-5 and the ESSC supports this approach. ESSC recommends the implementation of supporting platforms as a continuous activity that starts small but with a scalable design. Furthermore, users should be actively involved in the development of the platforms from the beginning.**
- **For implementing a Sentinel $CO_2$ precursor around 2025, the ESSC recommends developing a small mission to demonstrate the technology.**

- **The Altius mission in the Earth Watch programme is important for the continuation of occultation and limb measurements of the stratosphere; this has been identified in several gap analyses. Because of the urgency of the stratospheric observations, the ESSC recommends following the timeline with a delivery in 2020 and actively investigating a launch opportunity.**
- **ESSC recommends designing a strategy for developing satellite missions in less than five years and demonstrating this strategy using micro satellites and/or high-altitude platforms.**

## ESSC Positions and Recommendations on ESA Space Situational Awareness Programme Proposal

### Space weather

The more dependent our civilisation becomes on the availability of navigation, Internet, and other modern amenities, the more vulnerable we are becoming to what occurs in space. Improving our understanding of these effects and improving our resilience to them is thus crucial to modern society.

- **ESSC recommends that in order to safeguard the European technological systems in space and on the ground, and in order to ensure the highest level of safety for human flight and exploratory human missions, Europe and ESA cooperate and participate in the global/international development of a coordinated robust space system of sun-heliosphere monitoring in order to acquire exhaustive real-time data sets and improve space weather understanding and predictions.**
- **ESSC recommends that Europe participate in the global space weather monitoring effort by providing a spacecraft system composed of two or three elements, strategically distributed in space, to monitor solar activity, solar eruptions, and their effects on Earth.**
- **The ESSC recommends that the 'space weather enabling science' be preferably part of the science directorate activities within the normal background of the Cosmic Vision programme and in competition with other fields, based on scientific excellence.**
- **As for predictive services and a value-added combination of space weather data for European end-user needs, ESSC highlights that a broader European approach should be handled by the EU within the H2020 programme.**

### Near Earth Objects

The near-earth space harbours natural near-earth objects (NEOs) in their voyages through the inner solar system, and space-debris objects (SDOs), which are leftovers from artificial earth-orbiting satellites. Both NEOs and SDOs pose a significant threat to humans and our space-based and ground-based assets. From the purely scientific point of view, the primitive NEOs are also very interesting targets for exploration as they contain key information on chemical and physical processes pertaining to the early solar system.

- **ESSC recommends focused research on the physical and chemical properties of NEOs and SDOs in the near-earth space, increasing our knowledge-based preparedness for mitigating the threats posed by these objects. An increased understanding of the science and resource potential of NEOs as a result of these investigations would be an added benefit.**

## Transversal issues

### Data archiving, exploitation and dissemination

- **The ESSC strongly recommends that data produced through all ESA missions be made openly available in a fast and efficient way; a cross-directorate data policy should be established.**

### Cross-talk between science directorates

- **It is the ESSC's belief that enhanced consultation and discussion among different ESA science directorates would be beneficial to all parties and in particular could have a positive effect on scientific and financial optimisation.**

### Relations with EC and Horizon 2020 programme

- **The ESSC highlights that areas of common relevance between ESA and EU (e.g. data management, Space Situational Awareness, health, technology development) would benefit from better coordination between ESA and the European Commission. Such coordination could be defined and implemented through the work of a reinforced EU/ESA mechanism with improved tactical and operational capacity.**
- **The ESSC highlights that the ESA-EC *Joint Statement on Shared Vision and Goals for the Future of European Space* signed on 26 October 2016 should be used a basis for a stronger European space sector. It urges Member States not to underestimate the relevance and importance of space sciences and space research in achieving the objectives and goals announced for Earth observation and space exploration.**

### International collaboration and competition aspects

There is strong consensus on the importance of international cooperation in space missions as having both potential and, often, concrete benefits to the participants.

- **The ESSC recognises that ESA needs to establish a leading role in the space exploration landscape by developing and operating ESA-led missions. At the same time, the current portfolio in ESA's programme contains a large number of missions and concept studies that are performed in collaboration with other space agencies, essentially NASA but also JAXA and CAS. This is essential for ensuring a more efficient implementation and science return of elements of common interest in times where the resources worldwide do not abound.**
- **The science community urges ESA to envisage scientific exchanges and discussions with potential partners at the beginning of a mission's definition phase so as to ensure an optimised return of the mission within a bottom-up approach.**

### Space technology and relations with European industry

In space sciences, as well as in 'mainstream' science, the development of innovative technologies is of the utmost importance, as it opens new fields of research and provides sophisticated new tools for scientists.

- **The ESSC recommends that ESA continues to work towards a better synergy between space and non-space technology, identifying and putting forward best practices and promising technology transfer mechanisms in both sectors through a combined effort of interested parties in ESA, the Member States and the EU.**
- **The ESSC recommends using the stable and ambitious technology 'Overwhelming Drivers' throughout ESA's Directorates as a novel categorisation of programme concepts and useful**

**common strategy to guide reflection on future missions and related technological maturation.**

- **In order to keep control over the risks of financial cost and science loss in the period of a mission development, the ESSC recommends that ESA be vigilant in its relationships with industrial partners in order to share the risk appropriately between contractual partners.**

## Overall recommendation

**In order for Europe to maintain and enhance its position as a key player in the international space arena, to be competitive via excellent scientific and technological achievements and to maximise the return on investment into European society, economy and education, ESA needs to receive full support from its Member States at the level of resources requested on the occasion of the Lucerne 2016 Ministerial Council meeting.**

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