Orientation paper prepared in connection with the FP7 2013 Work Programme in the area of Space

Important notice:

This paper is made public at an early stage in the adoption process of the work programme to provide potential applicants with the currently expected main lines of the 2013 work programme. It is a working document not yet endorsed by the Commission and its content does not in any way prejudge the subsequent modifications by the Commission nor the final decision of the Commission.

The final adoption and the publication of the work programme by the Commission are expected in mid-July 2012. Only the adopted work programme will have legal value.

Information and topic descriptions indicated in this orientation paper may not appear in the final work programme; and likewise, new elements may be introduced at a later stage. No essential information, such as indicative budgets, will be provided by the Commission until the final work programme is adopted. Any such information disclosed by any other party shall not be construed as having been endorsed by or affiliated to the Commission.

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THEME 9: SPACE

Objective:

The objective of the FP7 space work programme is to support a European Space Policy focusing on applications such as GMES (*Global Monitoring for Environment and Security*), with benefits for citizens, but also other space foundation areas for the competitiveness of the European space industry. This will contribute to fulfil the overall objectives of the European Space Policy, complementing efforts of Member States and of other key players, including the European Space Agency.

I. CONTEXT

Policy context

Europe has been active in the space sector for several decades, and activities encompass a wide spectrum ranging from launchers to applications and satellites. Space activities, through scientific research and especially through their direct applications, are acknowledged as strategic for their contribution to the construction of Europe and the competitiveness of the European Union.

The **Treaty on the Functioning of the European Union** (TFEU) has strengthened the European Union's competence in the area of space and confirms the strategic importance of space for the European Union. The Treaty gives the European Union the responsibility to draw up a European space policy and, to this end, to promote joint initiatives, **to support research and technological development**, and to coordinate space related efforts.

Besides its strategic relevance, the space sector provides a stimulus to innovation and growth in the European economy, and thus space research is expected to contribute significantly to the **Europe 2020 priorities**, especially with regard to **Smart and Sustainable Growth** and **Innovation**. Support to the space sector is crucial if the EU wants to remain competitive at global level.

Furthermore, Europe is increasingly dependent on space infrastructure and applications thereof for the daily functioning of our society and proper policy development and implementation at European and national level. Space research thus **supports EU policies** and contributes to **addressing major societal challenges**, e.g. in climate change, resource efficiency, transport, citizen's security, natural and man-made disasters. Space technologies are supported with a view to generate applications and services that benefit European citizens (e.g. environmental monitoring, security), and to stimulate technology spin-offs that benefit other industrial sectors. Given the size of investments needed to develop these sectors, there is a clear added value of common and coordinated EU-level action.

Addressing Innovation Union aspects

Against the backdrop of the current economic situation and increased global competition, the Union has defined a strategy to support growth and job creation, Europe 2020. The Innovation

Union Flagship initiative supports this strategy through specific commitments. Research and innovation are key drivers of competitiveness, jobs, sustainable growth and social progress.

The work programme 2013 aligns with, and contributes towards, the objectives of Europe 2020, the Innovation Union Flagship, and other EU policies. There is a determined focus on fostering new ideas, supporting world class teams tackling significant societal challenges, and on ensuring that the fruits of our investments can be properly exploited.

In this way the work programme provides for a smooth transition towards the new research and innovation programme for 2014-2020, Horizon 2020.

The Innovation Union initiative underlines that research and innovation are key drivers of competitiveness, jobs, sustainable growth and social progress. The work programme 2013 will be designed keeping the implementation of the Innovation Union initiative in mind, and in particular to bring together research and innovation to address major challenges.

The work programme can contribute to the innovation objective in two ways:

- By supporting more topics aimed at generating knowledge to deliver new and more innovative products, processes and services: This is particularly relevant for Activity 9.1 supporting **space based applications**. The focus on development of services, with a goal of reaching self-sustainability, is reflected in the objectives and scope of the specific topics open for participation. A specific focus on innovative products is placed on **space technology developments** in the context of **SME actions** under Activity 9.3.
- By identifying and addressing exploitation issues, like capabilities for information and dissemination, and by enhancing the use of the generated knowledge: This aspect is taken up specifically in Activity 9.2, Area 1, which addresses **exploitation of European space science and exploration data.**

Underpinning a European space policy

The Commission has adopted in 2011 a Communication on the EU space strategy[1] to state its priorities. These include: safeguarding European access to space, contributions of space to global/societal challenges (e.g. climate change, resource efficiency, energy, health), security in and from space, space exploration, space science, space as a driver for innovation and competitiveness, and the EU's participation in international space projects.

The work programme will contribute to these objectives in the following ways:

- European **access to space** has to be safeguarded through a non-dependence of Europe on critical space technologies. This recurring theme in FP7 annual calls will be supported again in 2013 in Activity 9.2, Area 2, Research to support critical space technologies.
- Contributions of space to the **global/societal challenges** are addressed through Activity 9.1 of space based applications at the service of European Society.

[1] COM(2011) 152 final, 4 April 2011, "Towards A Space Strategy for the European Union that Benefits its Citizens"

- Research and development in Activity 9.2 "Strengthening Space Foundations" will address the priorities of **space exploration, space science**, and **foster space as a driver for innovation and competitiveness**.
- As regards the **security of space assets**, and their associated ground facilities, these are sensitive to external events that can endanger their proper functioning, such as space debris, jamming, viruses, natural or men-made electro-magnetic disturbances. Specific research to reduce the vulnerability of such space assets will be addressed.

Global Monitoring for Environment and security (GMES)

The strategic role of GMES in the development of the EU's role as a global actor has been outlined already in the February 2004 Communication[2] of the Commission, which also identifies the **major EU policies to be addressed by GMES services and the R&D projects** to be undertaken in FP7.

With the entering into force of the Regulation (EU) No 911/2010 of the European Parliament and Council[3] on the European Earth monitoring programme (GMES) and its initial operations (2011-2013), the R&D build-up phase of GMES now will direct research funding to those service domains which have not yet reached the required maturity to be operational, to complete the transition phase to operations.

In order to optimise the available resources (both from the GMES Regulation and from theme Space of the Specific Programme Cooperation), funding from the GMES Regulation budget will support initially:

- the land monitoring and emergency management themes of the service component of the GMES programme;
- the GMES space component;
- GMES policy measures set out by the Regulation.

In the 2011-2013 period the other four GMES services (marine, atmosphere, climate change and security) are mainly financed by FP7 funds. Marine, atmosphere and security services have already been prioritised in the 2011 and 2012 work programmes. The 2013 work programme will now continue this build-up objective by prioritising developments which are prerequisites for a **climate change service**.

International Cooperation

In the context of international cooperation, a diversified approach is a key element in Europe's space policy. Candidates for cooperation among other established or emerging space powers are the United States, Russia, Canada, People's Republic of China, India, Japan, and the Ukraine. Following bilateral consultations with Ukraine during 2011, topics which are of mutual interest and benefit for European industry and the Ukraine will be highlighted in the call.

In general, the participation of countries for which a specific Space dialogue (e.g. South Africa) or S&T cooperation agreements (e.g. Brazil) are in place, or third countries included

[2] COM(2004)65 final, 3 February 2004
[3] OJ, L 276, 20.10.2010, p. 1.

under the ICPC[4] list, is particularly welcome. The use of space applications can contribute to their economic and social development and support environmental protection.

Furthermore, for GMES to become the main European contribution to the global 10-year implementation plan for the Global Earth Observation System of Systems (GEOSS), FP7 GMES projects will also provide opportunities for data exchange with international partners, in the area of environment monitoring (especially in areas such as global climate change), and will encourage the increased use of Earth observation, as well as the development of a system of worldwide observation systems.

SME relevant research

All actions are open to the participation of all security stakeholders: industry, including Small and Medium Enterprises (SMEs), research organisations, universities, as well as public authorities, non-governmental organisations and public and private organisations in the security domain. Considering the Security theme's objective of increasing the competitiveness of industry, the broad **involvement of SMEs** in consortia is highly encouraged.

As in 2012, and in order to further promote the participation of SMEs in the Space theme, the topic "SME space technology research and technology transfer" (Activity 9.3 – Cross cutting activity) will be reserved for proposals where more than 50% of the requested EU contribution goes to SMEs and where SMEs are present preferably in a leading or coordinating role. This will be implemented as strict eligibility criteria.

Bridging with Horizon 2020

Horizon 2020 emphasises the need to enable European competitiveness, non-dependence and innovation in space. Contributing to Europe's non-dependence from imports of critical space technologies is one of the objectives addressed directly in the 2013 call by calling for specific R&D which has been identified as urgent actions by a Joint task force of EC-EDA-ESA. Such concerted and coordinated action is also in line with the Horizon 2020 objective to prioritise areas that could not be effectively realised by Member States acting alone.

Ensuring more extensive utilisation of space data from existing and future generations of Union space systems is another priority identified by Horizon 2020, which is to be addressed in the 2013 Work Programme, as are the demonstration and validation of new technologies and concepts in the space and terrestrial analogue environments.

In Horizon 2020, it is expected that all societal challenges and industrial technologies shall contribute in their actions to sustainable development and climate related issues. Apart from actions related directly towards climate change issues, actions should also be relevant to the goal that enterprises are to adapt to a low-carbon, climate-resilient, energy and resource-

[4] International Cooperation Partner Country (ICPC) is a third country which the Commission classifies as low-income, lower-middle-income or upper-middle-income country and which is identified as such in the work programmes, see list in Annex 1 to the Work Programme "Cooperation"

efficient economy. In this respect, also research and development towards sustainable products, e.g. “green fuels”, which will conform to more stringent environmental standards and regulation, is being taken up in the 2013 work programme.

Approach for 2013

The action plan underlying the Space Work programme is based on the European Space Policy. The Work programme responds directly to policy needs expressed in the Communication on EU Space strategy, the European Space Policy Communication, the Resolutions of the Space Council[5], and follows the recommendations of the Space Advisory Group.

As regards GMES Services, consolidated user requirements established in user consultation processes linked to GMES implementation are also instrumental in providing guidance to the Commission in the annual update of the Work Programme and of emerging needs, including for GMES information by policy makers. As regards the specific topic of climate and climate change monitoring, space based observations provide a key source of data at global scales of the Earth’s environment, climate change, and the provision of climate services. A conference "GMES for climate change" was held in Helsinki on 16 and 17 June. It explored whether there are still any gaps, and which of these need to be addressed by GMES and should be considered as components of a future GMES climate change service. Following this consultation, the call for 2013 will be prepared to address this important thematic service domain of GMES.

As regards Critical Technologies for European Non-Dependence, the joint task force group (EC, ESA, EDA) has reviewed and updated the list of the most urgent critical technologies thus harmonising the response of the three institutions.

Modalities of Implementation: Research Executive Agency, European Space Agency

Calls for proposals under this work programme Theme Space will be implemented by the **Research Executive Agency** (REA) according to the provisions of Commission Decision C/2008/3980 final of 31 July 2008 “delegating powers to the Research Executive Agency with a view to performance of tasks linked to implementation of specific European Union programmes People, Capacities and Cooperation in the field of research comprising, in particular, implementation appropriations entered in the Community budget”. The management of all projects to be funded as a result of this work programme will be implemented by REA, with the exception of:

- actions implemented on the basis of calls for tenders
- identified beneficiary actions (being in support of policy)
- other specific topics explicitly identified as being of a strategic nature for the European Commission.

[5] 4th Space Council Resolutions [also COM(2007) 212 final], 22 May 2007; 5th Space Council Resolutions, 25-26 September 2008; 6th Space Council Resolutions, 29 May 2009; 7th Space Council Resolutions, 25 November 2010

The **European Space Agency** will not participate in consortia of FP7 proposals submitted under the FP7 "Cooperation" Space Theme to this call for proposals.

Gender dimension

The pursuit of scientific knowledge and its technical application towards society requires the talent, perspectives and insight that can only be assured by increasing diversity in the research workforce. Therefore, all proposals are encouraged to have a balanced participation of women and men in their research activities and to raise awareness on combating gender prejudices and stereotypes. When human beings are involved as users, gender differences may exist. These will be addressed as an integral part of the research to ensure the highest level of scientific quality. In addition, specific actions to promote gender equality in research can be financed as part of the proposal, as specified in Appendix 7 of the Negotiation Guidance Notes [ftp://ftp.cordis.europa.eu/pub/fp7/docs/negotiation_en.pdf]".

Activities

Two main activities, complemented by a set of cross-cutting activities, will be undertaken to achieve the policy objectives expressed above, and several specific action areas are prioritised within these activities. However, not all specific action areas will be open for specific call topics in the call during 2012, covering commitment appropriations of 2013.

Activity 9.1. Space-based applications at the service of European Society

The **first activity**, the development of GMES (Global Monitoring for Environment and Security) being central to this activity, covers five main *action areas*:

1. Support to the **(pre-)operational validation of GMES services and products** based on the integration and harmonisation of related observation data (both satellite-based and in-situ, including ground-based, ship-borne and airborne), starting with the funded GMES Services.
2. Integrated use and application of **satellite communication and satellite navigation solutions with space-based observation systems**, and with related non-space systems.
3. **Support to the coordinated provision of observation data**, both from space-based infrastructure and from in-situ observation systems. [6]
4. Development of **Earth observation satellites**, which relate to the management of the environment and security, and which complement in-situ systems.
5. Continuity of **GMES services,** ensuring complementarity and consistency with the GMES Regulation on the European Earth observation programme (GMES) and its initial operations (2011-2013)[7]

During 2013, **four of the five specific *action areas* above will be prioritised** (namely area 1, 2, 3 and 4), following a strategic approach as follows.

[6] Coordination and Support Actions for these activities are regarded as policy related actions and will not be managed by the Research Executive Agency (REA)

[7] OJ, L 276, 20.10.2010, p. 1.

The Work programme 2011 for the FP7 space theme allocated resources already with high priority to the Marine and Atmosphere domains, resulting in service projects aiming at continuity (action area 5), as well as a number of smaller projects meeting R&D needs in these two domains. The Security monitoring service was the main focus of the Work Programme 2012 in action area 1. Research and development activities undertaken in the FP7 work programmes 2013 under action area 1 will thus focus thematically on R&D needs for the build up of **climate change monitoring services**, stimulating the development of d**ownstream services and service evolution** and other **earth observation/remote sensing research** to further strengthen the GMES implementation.

As regards **climate and climate change monitoring,** discussions during 2011 and the Helsinki conference have highlighted priorities in the climate change service context. These are to improve Earth System reanalyses to include the hydrological cycle, coupling the ocean and atmosphere, and feedback mechanisms. Issues such as data archiving, integration and access to data through a central clearing house mechanism should also be tackled, as well as implementing a gridded approach to impact indicators. Research topics of the Work Programme 2013 will be tailored to meet the priorities expressed above.

Support to the coordinated provision of observation data (action area 3) will be addressed in 2013, by making available additional resources through the EC/ESA Delegation Agreement for space data supply to services.

Action area 3 and Action area 4 of development of **Earth observation satellites** will be supported in 2012 and 2013 with a payment transfer from FP7 under the ESA-EU Delegation Agreement.

Activity 9.2. Strengthening the foundations of Space science and technology

For the **second activity**, the strengthening of foundations of Space science and technology, the support is to be maximised through synergies with initiatives of ESA or other European, national or regional entities. This activity comprises three more *action areas*:

1. Support to research activities related to **space science** and **exploration**,
2. New concepts in **space transportation**, and **key technologies** including **critical components**,
3. Research to reduce the vulnerability **of space assets**.

During 2013 **all three specific *action areas*** above will be supported, placing the priorities on topic areas which have seen either a high oversubscription in 2012, or topic domains which have not been covered yet in previous years. Earth-analogue research preparing for space exploration is for instance an important area allowing thorough performance validations to be conducted economically on earth before engaging in costly in-orbit validations. As regards Critical Technologies for European Non-Dependence, this topic has not been covered in the Work Programme 2012. The joint task force group (EC, ESA, EDA) has now reviewed and updated the list of the most urgent critical technologies thus harmonising the response of the three institutions. Regarding the vulnerability of space assets, specifically to space weather interference, particular attention has been given to the upstream research needs of Galileo.

Activity 9.3. Cross-cutting activities

The **third activity** comprises a number of horizontal issues:

1. Activities in **SME relevant research** will be embedded *in all the action areas* mentioned. Applications of GMES and other space infrastructures, including GNSS, typically require very sophisticated, state-of-the-art processing, which are often the result of research and developments done in specialised academic organisations and commercial spin-offs. Typical opportunities for SME participation in GMES may be found in the development and/or adaptation of methodologies and tools for services tailored for specific applications. Concerning space science, exploration, space transportation and space technologies spin-in and spin-off activities are encouraged. Additionally to this general approach, collaborative projects will be *specifically supported in 2013* under this action area, which bring together SMEs not traditionally working in space projects with Space industry or space research organisations.
2. **International cooperation** with third countries (ICPC) will be supported in view of expanding the use of earth observation data, and the corresponding data processing and management methods in third countries, and enhancing the relations with established space powers, with a view to facilitating wider space research alliances. Candidates for cooperation among other established or emerging space powers include the United States, Russia, Canada, Japan, the People's Republic of China, India, Brazil, South Africa, and the Ukraine. The European Neighbourhood Policy governs relations with Eastern and Southern neighbours (i.e. Black and Caspian Sea region) and countries of North Africa and the Middle East (i.e. Mediterranean region).

   All projects conducted in the Theme Space are open for such participation of third countries under the normal participation rules, with the topics mentioned above being of particular interest for international participation. Participants are eligible to participate and to be funded in the context of the Space Theme calls described in this Work Programme. A specific priority is given in 2013 to cooperation with the Ukraine and China in the specific cross-cutting actions under Activity 9.3.
3. Effective **dissemination actions** are of importance as significant wider benefits are expected to arise from the research projects and actions supported under this programme.
4. **Cross-thematic approaches:** in this work programme, complementarity is ensured with other Themes of the Cooperation Programme. In particular, the topics in Activity 9.1 relating to GMES in this work programme are complemented by work in the Theme 'Environment (including climate change)'. Also the 'Space technologies' topic in this work programme is complemented by activities in the Themes 'Nanosciences, Nanotechnologies, Materials and new Production Technologies', 'Energy', 'Transport' and 'Information and Communication Technologies'.

Actions in order to better understand the opportunities and challenges associated with the **European Space Policy implementation** process will be undertaken, together with road-mapping activities identifying future Framework programme research needs.

II. CONTENT OF CALLS

The current planning foresees one call in 2012 covering an annual work programme, for projects to be funded from the 2013 Space theme budget. No further call on these activities is currently planned based on the commitment appropriations of 2013.

Activity: 9.1 Space-based applications at the service of European Society

Area 9.1.1 (Pre-)operational validation of GMES services and products

Three subject areas are being considered, firstly meeting the need to cover the 6th thematic service domain of climate change in GMES, and secondly opening up competition again to downstream service communities.

Towards a GMES Climate change service – preparatory activities

Discussions during 2011 and the Helsinki conference have highlighted priorities in climate change service context. These are to improve Earth System reanalyses to include the hydrological cycle, coupling the ocean and atmosphere, and feedback mechanisms. Issues such as data archiving, integration and access to data through a central clearing house mechanism should be tackled, as well as implementing a gridded approach to impact indicators.

SPA.2013.1.1-01: Global 20th century re-analysis and future coupling methods

A global 20th century re-analysis covering all components of the earth system is to be undertaken. This will require data recovery and data rescue efforts for early space-based and in-situ observations, as well as the preparation of these observations for inclusion in a climate reanalysis. In parallel, scientific approaches should be employed which considerably enhance the description of interactions between different components of the earth system (e.g. improved coupling of atmosphere, land, ocean, cryosphere, carbon cycle, etc.). The goal of the activity should be to provide consistent historical climate data records from 1900 onwards at improved spatial and temporal resolutions, spanning the satellite and pre-satellite era records in a consistent manner.

Links should be made to existing projects which are improving the quality of in-situ and space-based observational data sets (reprocessing) as well as providing new data from sometimes non-digital sources (data rescue). Reanalysis starting in 1900 has to rely on uncertain input data subject to various data correction schemes, and hence activities must be included to quantify the resulting uncertainty in the resulting historical records, e.g. by using an ensemble approach.

Such a reanalysis will generate an archive containing potentially several petabytes of gridded data, and these must be made easily accessible to a large number of users. Efficient web-based data services and versatile visualisation services will have to be realised.

Proposals will have to include efforts to liaise with other ongoing projects, in particular for processing of space data such as the ESA Climate Change Initiative (CCI) and EUMETSAT satellite application facility for climate monitoring (CM_SAF), as well as in the context of data access and formatting, in order to avoid duplications and exploit synergies.

- Expected impact:

The project is expected to significantly contribute toward capacities in the climate change context of GMES by providing consistent datasets of climate relevant parameters on a global scale for all of the 20th century. This 4D data set will support (in combination with climate model predictions) climate change impact and adaptation action assessments, policy development and policy monitoring for global, European and national users. It will also be an important asset for the development of downstream sector specific climate application services.

SPA.2013.1.1-02: Ensemble system of regional re-analyses

An ensemble system of regional re-analyses should be developed, together with the necessary tools to statistically assess the information content of resulting probabilities, and how best to utilise this additional information for understanding past climates and climate change.

The ensemble technique is a well accepted simulation approach to quantify uncertainties in atmospheric modelling. It is being used in order to quantify the spread related to uncertainties inherent in historic data sets, which in turn provide an improved set of boundary conditions. At the same time, different regional reanalysis data sets are being developed by European consortia (for example EURO4M and other FP7 projects) and also through national activities. Both are providing a wealth of information reflecting uncertainties, which are crucial for the interpretation of the reanalysis output or derived indicators. An ensemble of regional reanalyses should be developed in order to optimally exploit the results of different regional reanalyses for best describing uncertainties in the historic records at regional levels.

To enhance quality, statistical uncertainty methods need to be developed to improve exploitation and account for sparse observations in the pre-satellite era. Based on the results of uncertainty levels, efforts should also be included how to quantify uncertainties of impact indicators which are most relevant to the development and assessment of policies.

Overall, such a re-analysis will generate an archive with large amounts of gridded data; these must be easily accessible by a large number of users, for scientific and policy use. Efficient web-based data services, as well as versatile visualisation services will have to be realised.

Proposals will have to include efforts to liaise with other ongoing projects, in particular in the context of data access and formatting, in order to avoid duplications and exploit synergies.

- Expected impact:

The project is expected to significantly contribute towards capacities in the climate change context of GMES by providing consistent long term datasets of climate relevant parameters on a regional scale. This will substantially support (in combination with climate model predictions) climate change impact and adaptation action assessments, policy development and policy monitoring for European and national users. It will also be an important asset for the development of downstream sector specific climate application services.

SPA.2013.1.1-03: Traceable quality assurance system for multi-decadal ECVs

R&D towards traceable multi-decadal ECV records is to be performed. The goal of this activity is to develop rigorous quality assurance methodologies for satellite-derived ECV products. These methodologies, which may be specific to individual ECVs or groups of ECVs, should be based on the concept of traceability as it is used in metrology. Furthermore, the methodologies should be applied to a small number of satellite-derived ECV records, which are to be generated in a consistent manner across timescales close to or exceeding 30 years in length, in order to assess compliance with the GCOS quality criteria. Proposals should not duplicate efforts currently addressed by ESA's CCI initiative or EUMETSAT Central applications and distributed Satellite Application Facilities including Climate Monitoring (CM-SAF). Proposals will have to address both parts of the problem, which are closely interlinked.

1. Developing traceable quality assurance methods for ECVs:

   The reference quality standards for ECVs are formulated (and updated) by the Global Climate Observing System (GCOS). Compliance of ECV datasets with these accuracy criteria is crucial and must be verified independently. The goal of this activity is to develop traceable approaches (whether building on modelling efforts or by other means) that allow to evaluate the quality of satellite-derived and in situ-measured ECV products and algorithms – ideally at the level of individual pixels or in situ locations, respectively – via an unbroken chain of comparisons to certified reference standards. Of particular interest here (although not limited to) are ECVs that are the result of a combination of parameters or algorithms rather that being directly measurable with satellite and in situ observations.

   In addition to adhering to sound metrological practices, the proposed quality assurance methodologies should adapt to whatever ECV definitions are being used by satellite and in situ retrieval algorithms. Ideally, they should also be capable to deliver reliable assessments on the merit of a given ECV retrieval algorithm prior to its implementation and the (re-)processing of large volumes of satellite data. Physical measured parameters should wherever possible be traced to reference standards of SI derived units (derived from the International System of Units). As a practical test, the proposed quality assurance methodologies should be applied to the ECV records delivered under item 2 below in order to assess their compliance with the GCOS criteria.

   This activity should aim at providing information on the quality and "fit for purpose" nature of the respective climate dataset as potential important metadata for policy relevant information in the context of the DG CLIMA clearinghouse.

2. Generating multi-decadal satellite-derived global ECV records:

   Consistent quality-assured satellite-derived global ECV products spanning multiple decades are essential to improve our knowledge about climate change, its causes and consequences, as well as to optimise not well understood process descriptions in models. These climate records may also serve in the validation of models and as basis for the development of reliable impact indicators for policy makers. The goal of this part of the activity is to generate new long-term ECV records on the basis of satellite observations. As such, proposals should focus on ECVs that fall outside the products generated by ESA's CCI initiative and that are not covered by the EUMETSAT Central applications and distributed Satellite Application Facilities including Climate Monitoring (CM-SAF).

   More specifically, historical records of a few quality-assured ECV products should be generated in a consistent manner on the basis of appropriately (cross-)calibrated satellite observations and ideally operational retrieval algorithms that can be customised to multiple space sensors including those of the upcoming sentinels. The generated ECV records should be global in scope and close to (or exceed) 30 years in length. The emphasis of this activity lies with the quality (and not the quantity) of long term ECV data records that are to be generated within the project. The final ECV products and retrieval algorithms should be verified with the traceable quality assurance methodologies described under item 1 above and made available via dedicated web-interfaces and visualisation tools.

Proposals will have to include efforts to liaise with other ongoing projects both for data access and data format definitions in order to avoid duplications and exploit synergies.

- Expected impact:

Projects are expected to contribute toward the (pre-)operational capacities in the climate change context of GMES, by augmenting the number of currently available quality-assured long term ECV records and by providing methodologies suitable for reliable assessments of the climate quality of ECV products. This will substantially support (in combination with climate model predictions) climate change impact and adaptation action assessments, policy development and policy monitoring for global, European and national users.

Projects are furthermore expected to contribute towards the standardisation aspect of Europe2020, namely by delivering robust and cost-effective quality assurance procedures for satellite-derived EO products and their in situ validation efforts.

SPA.2013.1.1-04: Provision of access to simulated and observed climate datasets and climate indicator toolbox

This activity is to perform R&D towards a climate indicator service. The goal of this activity is to develop a web-based platform in support of impact indicator developments, comparisons and rankings on the basis of direct access to in situ, satellite-derived and model-generated data and products. Proposals will have to address both parts of the problem, which are closely interlinked:

1. Provision of access to simulated and observed climate datasets – building on existing efforts and on-going initiatives, an internet based one-stop-shop is required that provides access to model generated as well as satellite and in-situ based INSPIRE-compliant climate relevant data sets. This activity should account for the considerable increase in climate relevant data volumes which are being generated due to better resolutions and the increasing use of ensemble techniques. Such climate data derives from both in-situ and remotely-sensed observations as well as through numerical modelling for all components of the earth system.

   Hence efforts should be made to technically facilitate the access to the observation and modelling results, including data formats, compression techniques, condensed description of ensemble information, and their visualisation. At the same time the activity should provide a knowledge base for the academic world as well as for policy makers in support of mitigation and adaptation, both in terms of system concept and the access provided to data repositories within the time span of the project.

   The final system should allow for climate model output, re-analysis datasets, impact indicators, as well as in-situ and satellite data and products to be extracted from their respective locations via a single interface – containing advanced geospatial and temporal search tools – and made available to the user in a common grid format. The final system should enable the climate indicator toolbox described below. Furthermore, metadata describing the quality or "fit for purpose" nature of information should be included in this activity. In addition, the activity should explore how to best link the wealth of climate data sets to the EU Clearinghouse Mechanism on Adaptation (CHM) and provide practical solutions.

2. Developing a climate impact indicator toolbox – the overall goal of this part of the activity is to develop efficient and user-friendly statistics tools for the generation, comparison and ranking of gridded INSPIRE-compliant climate impact indicators at local, regional and European scales on the basis of satellite, in situ and re-analysis datasets, as well as auxiliary (e.g. socio-economic) information (if available in suitable data formats). Software tools for improved characterisations of extreme events (e.g. their likelihood, intensity and change in frequency) should be developed. At the same time it should be possible to build new indicators, compare them to existing ones and identify the strengths and weaknesses of each method. Ideally, these efforts should make use of the uncertainty information associated with the input datasets whether these were obtained from in situ measurements, satellite observations or model simulations/re-analyses. The goal should be to generate, compare and deliver robust indicators - having well

documented associated uncertainties - that are relevant for the development and assessment of policies.

The activity should apply the developed tools to indicators defined in the context of existing EU and/or national adaptation strategies, in order to closely link the activity to the demands of policy users. Appropriate provision of this information to the EU Clearinghouse Mechanism on Adaptation (CHM) should also be addressed.

Proposals will have to include efforts to liaise with other ongoing projects, both for data access and data format definitions as well as for the generation of climate indicators, in order to avoid duplications and exploit synergies. The overall impact of the system should be measured by users, in particular regarding ease of access, generation of new indicators and the ranking of existing ones.

- Expected impact:

Projects are expected to significantly contribute toward the (pre-)operational capacities in the climate change context of GMES, in particular, by delivering a one-stop-access point to EO products, re-analysis data, climate model output and in situ observations, and thereby enabling the development, generation, comparison and ranking of climate impact indicators. It will also ensure that the expanding climate-relevant data volumes can be readily accessed and processed into higher level information products by a broad interdisciplinary community.

SPA.2013.1.1-05: Attribution products

A series of attribution products are to be developed by using a climate model to determine the expected response to a particular climate forcing. Model projections are to be performed with different climate forcings; i) with natural forcings (solar radiation and geological factors) only; ii) with natural and anthropogenic forcings. Differences in the projections can then be attributed in a probabilistic manner to the effect of anthropogenic forcing. This activity should study a number of historical cases, related to flooding, droughts and storm surge events, and identify as to whether (and what) anthropogenic factors may have contributed to their occurrences. The activity should provide evidence as to whether the risk for a similar event has increased, decreased or remained stable. It should also list areas where the science, or observables (their coverage, or precision), are still too uncertain to make a robust assessment of the change in risk. Where there are gaps identified, an identification of the observation concepts required would be valuable.

- Expected impact:

The project is expected to significantly contribute toward the (pre-)operational capacities in the climate change context of GMES by providing information on how likely high impact environmental disasters are attributable to natural climate variability or human-induced effects. This should enable the growth of a downstream service sector. Additionally, the methodology developed by this project in order to quantify the enhanced risks of extreme climate states and severe weather events is expected to contribute to the development of climate change adaptation strategies, both for commercial activities as well as policy initiatives.

GMES service activities

Apart from preparing the ground for a GMES climate change service, the Work Programme in 2013 further expands the development and evolution activities of downstream services, supporting also the development of up to date remote sensing algorithms and methodologies needed to enable future service products.

SPA.2013.1.1-06: Stimulating development of downstream services and service evolution

Apart from satisfying information needs by policy makers, innovative commercial geo-spatial products and geo-information services are key to economic return on the major space investments made in earth observation, and directly aim at enhancing the competitiveness of European value-adding and geo-information service industries. Creating innovative services not only leads to improvement of European competitiveness, but also enables sustainable development.

Research and development on next generation products and service lines derived from space-borne data in conjunction with in-situ data is to be targeted. Particular attention is to be given to the presence of the GMES investments in the Sentinel satellites expected to be launched on a 2013/2014 time horizon, and the presence of the GMES services in land, marine and atmosphere domains. Exploitation of GMES data should be considered in the widest context, for institutional, commercial or for scientific use.

Existing and validated experimental practices or methodologies need to be turned into operational prototypes in a close interaction and trade-off/validation process with the service users. Projects should be strongly user driven and take into account user needs concerning information and services, quality specifications, and orient themselves along existing guidelines established in previous GMES projects and by advisory bodies at European level. Successful integration into current user practices and their working environment need to be demonstrated. For example, activities could target application areas of:

- Agriculture and agri-environment, crop monitoring, precision farming
- Monitoring of critical infra-structures, vulnerable to man-made and natural hazards
- Renewable energy production and energy efficiency management
- Environmental and Climate change impacts and attribution
- Maritime and other transport activities
- Health services, or monitoring conditions for vector borne diseases
- Atmospheric pollution/air quality monitoring and forecast
- Soil organic carbon monitoring
- Water cycle monitoring

Proposals addressing other application areas are also welcome.

Downstream services strive to build up the pre-operational delivery capabilities, and hence proposals must demonstrate:

- **A structural capacity for providing a sustainable service on an operational basis (preferably supported through a proven record).**
- **A clear focus on the operationalization of services, and thus sustainability of the service during subsequent operations, by defining and further consolidating the economic model for service provision (e.g. through a business plan).**

Furthermore, evaluator feedback in GMES has shown repeatedly that the following topics need to be included in the proposal:

- Description of the organisation and service architecture, including interface / coordination to be assured with the GMES services providers if relevant.
- Demonstration of user-driven approach, with user representation appropriate to the targeted products and user communities, as well as a suitable mechanism to interact with these (service level agreements are an efficient tool in this respect[8]).
- A preliminary analysis of the added value of products derived from GMES services, in light of preliminary user requirements elaborated closely with the users, including specification of quality requirements and tolerance levels (explicit and well-defined precision, reliability, availability and integrity requirements for the products/service).
- A preliminary version of a clear and scientifically sound validation plan including detailed methods for measuring quality of products, their viability[9], and describing the test sites and their selection criteria.
- Description of the process for monitoring how activities (of research, development, demonstration, system implementation, service validation and data provision) trace back to the user requirements (user-driven approach).
- An unambiguous, detailed and realistic list of products to be delivered to the users: product description, time period and geographical coverage, delivery dates.
- Description of the process for feedback from and assessment of the service *by relevant end-users*, which demonstrates both the acceptance level of the products, the prototypical service, as well as scenarios for integration into the users' working methods and resulting decision-making processes.
- Description of the approach for achieving interoperability and interconnection of the data processing and delivery systems, taking into account harmonisation policies, directives such as INSPIRE, and standardisation initiatives (While demonstrating interoperability capabilities, also gaps and shortcomings may be identified which have then to be integrated in ongoing INSPIRE efforts. Furthermore, the impact of harmonisation and the INSPIRE implementation on the sustainability of the services could be examined). To

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[8] A template is available on Cordis web page, as part of the 3rd SPACE call documents (http://cordis.europa.eu/fp7/dc/index.cfm)

[9] It should be noted that activities designed to prove the viability of new technologies that offer a potential economic advantage, but which cannot be commercialised directly, **correspond to "Demonstration" activities rather than "Research and Development" activitie**s in the Framework Programme. Proposals should therefore provide a careful separation of these two types of activities in their work plan.

facilitate efficient acquisition and exploitation by both service providers and users, activities will have to include R&D[10] for:

- improved accessibility to long-term data archives, implementation of meta-data standards, actions to facilitate information retrieval and dissemination;
- improved accessibility to in-situ systems;
- adoption of open standards for data documentation, data models and services;
- integration of tools and services allowing anybody to query, view access and exchange the information held by distributed public and private bodies;
- establishment of a data policy and appropriate security framework.

- Description of selected methods for data validation and fusion from multiple sources; techniques for data assimilation into models, validation of space derived products by means of in-situ data.
- Description of procedures for observation data collection (satellite, in-situ) and delivery, under consideration of both organisational aspects, as well as technical solutions offered by state-of-the-art communication methods (via terrestrial or satellite communication channels). Account should be taken of possible mechanisms of coordinated data delivery.

Projects should include activities aiming at disseminating knowledge and increasing public awareness of the results achieved through the integration of space technology and in-situ observation systems. Project output could include an assessment of the type of data and level of spectral, spatial and time resolution expected from the next generation of satellites and in-situ data sources.

With regard to ***Earth observation data***, **the proposals should primarily build on the availability of Sentinel data**, which could be complemented by other earth observation data available through the EU funded data access mechanisms via ESA[11]. Concerning the latter, proposals should provide an overview of resources needed for space-based observation data, and data requirements beyond the existing agreement between the Commission and ESA will have to be covered by the budget of the project.

With regard to ***in-situ data*** necessary to the development of each service, the proposals will have to foresee dedicated efforts for their provision, allowing for an interface with coordination activities of the EEA in this respect.

In general in-situ data could include:

(i) data collected by networks of sensors deployed on land, sea, water and in the atmosphere aimed at measuring and providing a complete description of the Earth system.

(ii) surveys aimed at collecting socio-economic data, land cover and land-use data, geology, soil conditions, bio-diversity information and other topographic or geographical data such as elevation, administrative boundaries, transport and utility networks etc.

In particular in-situ data should meet the immediate needs of the specific proposed service and should cover, inter alia, the following requirements:

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[10] It should be noted that specific development and research on ICT for environmental management as well as mechanisms for rapid adoption of standards, protocols and open architectures are undertaken in FP7 theme 3 "Information and Communication Technologies" under Challenge 6 "ICT for Mobility and Environmental Sustainability".

[11] Data Warehouse Requirements Document v1.8 dated 30/05/2011

- Timeliness, in function of the service requirements;
- The provision schemes and their corresponding delivery interfaces (FTP, other internet protocols, dedicated communication schemes).

Specific needs for dedicated in-situ data for the development of each service should be detailed in the proposals.

The participation of SMEs is particularly encouraged for this topic of the call; this aspect will be taken into account in the evaluation.

- Expected impact:

The projects are expected to establish innovative new GMES service capacities targeting specified user communities. In the context of already existing capabilities, projects are expected to contribute to the integration of new service lines into service chains of GMES downstream services.

The proposals are expected to have a demonstrable impact of the proposed service on the operations and capacities of the involved user communities. The resulting projects are expected to show significant uptake of products and to conclude on suitable business models for long-tem operational supply. The developed services are consequently expected to be self-sustainable from an economic perspective when EU funding ends. Strong evidence that the involved user organisations are likely to pay for the service after the end of the project should therefore be given. Significant progress to establishing a directory of users likely to be willing and capable to pay for the service should also be demonstrated.

The evolution and trends of future sensor needs shall be demonstrated. The results obtained shall contribute directly to the sustainability and competitiveness of European value-adding services.

The proposals should also examine the impact that the products and services could have in a socio-economic context. The projects are expected to reflect the mutual dependency of technology, organisational dynamics, societal issues as well as related legal/economic aspects. This will enhance the European industry's potential to create and take advantage of important market opportunities and to establish leadership in the field. Furthermore, projects are expected to ensure sufficient awareness and understanding of all relevant issues for the take-up of their outcome.

In order to boost downstream service and business activity, close collaboration with representative user communities throughout Europe is essential. The projects are expected to take into account and build upon relevant past and ongoing activities in the field. Optimum use of existing products and services or other project results is therefore expected.

The impact of the validated system should also be demonstrated through pilot tests and exercises, based both on simulation data and on real events, where appropriate.

SPA.2013.1.1-07: Remote sensing methods

Progress in remote sensing applications can be made by improving object based analysis and automated interpretation processes, and/or combining information from different sensors in novel ways, examples being :

- Improved change detection from combined use of different sensors, such as radar, thermal infrared and/or optical imagery (from ultraviolet to shortwave infrared);

- Water cycle monitoring from combined use of different Sentinel data;

- Improvement of the geometric and radiometric matching between Sentinel data and previously launched similar missions (e.g. Landsat).

The operational availability from Sentinel satellites, expected to be launched on a 2014 time horizon, will be of particular significance in this respect.

Provision of next generation geo-information services and products also benefit greatly from new methods which exploit the physical observables accessible from space. In this respect, radiometry for soil moisture and ocean salinity, or novel use of Lidar measurements could be addressed.

The growing availability of hyper-spectral data allows better environmental observations from space, and activities could target for instance:

- The use of hyper-spectral based information for better ecosystem analysis. Progress has been made in recent years in combining various satellite-borne data for assessing ecosystem quality and functions, but fundamental gaps persist. Research is needed to explore which spectral and assessment methodologies can be successfully combined for receiving hitherto still inadequate information on the type, quality, state, degradation and restoration possibilities of ecosystems, and on how far ecosystem functions can also be assessed via satellite interpretation.

- The use of hyper-spectral information for remote geological analysis of soil quality. A large amount of soil samples have been collected in 2009 across Europe. For all of them, spectra have been obtained and correlated with lab measured soil properties, like soil organic carbon. These spectra are currently deposited in a spectral library that would then allow measuring directly soil properties by remote sensing in the field or from airborne or satellite platforms. There is now a need to verify whether they can indeed be correlated with the "ground truth" offered.

- The use of hyper-spectral imagery in water resources analysis, with particular attention to the proper integration with classification and modelling methods.

- The use of hyper-spectral information for detailed analysis of remote sensing data of natural vegetation and crops. A large amount of forest and crop data has been collected across Europe during the last decades. Furthermore, some airborne initiatives are being used. New hyper-spectral images, combined whenever possible with Lidar data, can be an enormous leap forward if properly modelled using the current “ground truth”.

With some 150 GNSS satellites to be available in the next future, the use of GNSS signals for non-navigation purposes represents a further domain in which novel sensing applications are possible, like GNSS Reflectometry (GNSS-R), GNSS Radio Occultation (GNSS-RO), GNSS tomography etc…., using both space and ground infrastructure. These new applications of GNSS have the potential to be exploited to yield information in many GMES areas, like marine (e.g. sea-surface roughness, ice characteristics), Climate change monitoring, Land

(e.g. soil moisture or biomass content), Atmosphere (e.g. water vapour) or even Emergency (e.g. Tsunami detection) etc...

New methodologies or service concepts demonstrating improved performances with respect to existing earth observation methods are particularly welcome.

Proposals are invited which investigate promising new application areas.

- Expected impact:

The projects will be expected to establish a basis for the development of innovative new GMES products or applications combining in a novel manner existing and upcoming sensor data and in-situ data. Projects are also expected to demonstrate that improved service performances are achievable by applying innovative remote sensing methods. Finally, project results are expected to substantiate the needs for new observation techniques to be implemented in the next generation of observation satellites. The impact of the validated system should also be demonstrated through pilot tests and exercises, based both on simulation data and on real events, when possible and appropriate.

Area 9.1.2 Integration of satellite communication and satellite navigation solutions with space-based observing systems

SPA.2013.1.2-01: Integrated downstream service activities and applications

The objective is to support the development of services which integrate satellite communication and/or satellite navigation solutions with space based observing systems in innovative products.

The target of this action should be a service platform, with the objective of validating the technological concepts and acknowledging the benefits of an integrated communication / navigation / observation infrastructure with the users, for instance in the areas of prediction/early detection of emergencies, alerting populations (e.g. Tsunami warning). The validation of specific prototypes, based wherever possible and appropriate on real situations, is encouraged. The overall objective is to provide the end-users with all the required information in a seamlessly integrated, timely, secure and user-friendly fashion. Exploitation of GMES data should be considered in the widest context, for institutional, commercial or for scientific use. Thus possible users could be in small companies, national or local authorities and agencies, and universities.

Complementarities of the satellite capabilities with terrestrial capabilities, where appropriate, should be assessed on the basis of a medium to long term view, based on the foreseeable evolution of space-borne and terrestrial communication (e.g. optical communications) and navigation technologies (in particular relevant developments in the Galileo system). Optimisation and customisation of service platforms and their interface with the Galileo/GNSS system and existing service centres will need to be addressed. The related economics should also be addressed as an integral part of the proposed action. This way, the already multifaceted and integrated nature of GMES, which brings together data from a

variety of space-based and in-situ measuring systems, will be further enhanced and enriched by complementary space techniques. To this purpose, account will be taken of the latest development in relevant communication and navigation technologies as identified before.

With regard to Earth observation data, **the proposals should primarily build on the availability of Sentinel data**, which could be complemented by other earth observation data available through the EU funded data access mechanisms via ESA[12]. Concerning the latter, proposals should provide an overview of resources needed for Space-based observation data, and data requirements beyond the existing agreement between the Commission and ESA will have to be covered by the budget of the project.

[12] Data Warehouse Requirements Document v1.8 dated 30/05/2011

- Expected impact:

  Projects will be expected to contribute to the development of a service platform, aiming at validating the technological concepts and demonstrating the benefits of an integrated communication / navigation / observation infrastructure with the users. Where novel communication technologies are integrated to upgrade existing service lines, significant advances in quick and inexpensive access to real-time EO data for governmental, civil protection management, and commercial end-users are expected. Projects will be expected to highlight the socio-economic impact of such integrated applications, their challenges and their benefits.

  The impact of the validated system must also be demonstrated through pilot tests and exercises, based both on simulation data and on real events, when possible and appropriate.

Area 9.1.3 Support to the coordinated provision of observation data

This part will **not be open** for specific call topics in 2013.

Area 9.1.4 Development of Earth observation satellites

This part will **not be open** for specific call topics in 2013, as this activity is covered by **the EU-ESA Delegation Agreement.** Specific funding support is provided by the theme Space of the 2013 Work Programme.

Area 9.1.5: Continuity of GMES services in the areas of Marine and Atmosphere

This part will **not be open** for specific call topics in 2013, as these topics were covered in 2011.

Activity: 9.2. Strengthening the foundations of Space science and technology

Area 9.2.1 Research to support space science and exploration

The Call will focus on two subject areas, namely the exploitation of space based data (space physics, astrobiology, planetary science, astronomy, astrophysics, health …) and Earth-analogue research preparing for space exploration.

SPA.2013.2.1-01 Exploitation of space science and exploration data

Space based observations play a leading role in Earth, Planetary, Universe, Environmental, Physical and Life sciences, providing a privileged vantage point of our planet and objects of the universe, especially when taken in synergy with ground based observations, data analysis and modelling tools and other research in laboratories. ESA has supported many science missions, but data analysis beyond the execution of the mission remains limited. Collaborative proposals in the field of further data analysis and data exploitation are of particular importance. Missions have produced in the past and are currently producing data sets of immense value for research, and the funding support from FP7 should add to this value through a more comprehensive interpretation.

A focus is to be given to **research, analysis and presentation of data obtained from space missions**, exploiting such space mission data in combination with data collected from ground based observations/data. Research and analysis projects are not only intended to strengthen cooperation on scientific problems, which are relevant to our understanding of space, and advance our ability to perform further activities in space, but could also address earth science issues for which the analysis of space collected data provides breakthroughs.

Proposals should clearly demonstrate how their proposed combination of data sets, from multiple instruments or mission sources, including combinations of space and non-space based data e.g. from terrestrial space observatories like ESO, leads to strong synergies, and adds value to the data obtained in space.

Projects should enhance the effectiveness and productivity of the European scientific community, and promote the contribution of space assets to scientific and technological knowledge, through:

- mobilising the best expertise, in particular academic researchers and scientists, in various fields of science for the analysis and interpretation of space data, selecting the most innovative and challenging objectives in emerging scientific fields;
- extending the usage of available space data (including archived data), also through comparative benchmarking of existing data collections;
- developing better tools to access, analyse, process, validate, archive and distribute data obtained from different sources such as space observatories;
- supporting the preparation of data exploitation of missions under development, which might need special tools for data processing, in light of the wealth and variety of data they will collect;

- developing comprehensive presentation and visualisation techniques, preferably in 3D, in order to better understand the interrelations between different sources (sensors) and modes (temporally, spatially).

This topic is open to international cooperation and should focus on downstream R&D activities complementing space missions, such as the effective scientific exploitation of existing data.

- Expected impact:

Projects are expected to add value to space missions and earth based observations by significantly contributing to the effective scientific exploitation of collected data. They are expected to enable space researchers to take full advantage of the potential value of data sets. Projects are expected to expand the use of data, and/or contribute to dissemination of space mission data on a global scale, and/or enhance the relations with established international space powers.

Projects are expected to contribute to the much needed coordination and exploitation of existing and future data collections from space missions, and thereby enhancing the possibility to base research on datasets providing comprehensive or full coverage, while at the same time addressing the potential need for further analysis of existing datasets. It is also expected that the projects will facilitate access to, and appropriate use of data for those scientists who were/are not part of the team having obtained the space mission data (e.g. principal investigators).

Furthermore, projects are expected to add value to existing activities on European and national levels, and to raise the awareness of coordination and synergy efforts among stakeholders.

SPA.2013.2.1-02: Earth-analogue research preparing for space exploration

A key development step needed in preparing technology for space use is the validation of systems and components and their functionality in space environments. In-orbit testing is however costly, and thorough performance validations are conducted as far as possible at an early stage in field tests here on Earth. Environments are chosen that have physical similarities to extreme space environments.

This is particularly applicable for complex robotic systems, where prototype rover configurations are exposed to challenges similar to those faced on planetary environments. Proposals are invited to address specific challenges which could encompass research and development including test facilities on representative fields and field campaigns in representative environments, to address for example:

- Precision landing, guidance, navigation and control, obstacle avoidance, path planning, stereo vision, autonomous manipulation (e.g. sampling tools, drilling for subsurface samples, containerisation), mother-slave cooperation between orbiters/rovers, robots/rovers or between human/robots, or power efficient motion;

- recycling, waste and water management or regenerative life support systems under simulated mission conditions.

The latter aspect of "earth analogue" is related to the research on life in extraterrestrial environments, which addresses the possible habitability of extraterrestrial environments, survivability of organisms in such environments and sustainability of life, including humans, beyond Earth.

Human performance in space is strongly affected by both biological health and psychological factors. Proposals are invited which look at multidisciplinary aspects such as psycho-physiological parameters determining human performance and well-being in space, and means to monitor these during space missions.

The long-term response of organisms to environmental parameters such as radiation levels, gravity levels, space vacuum, pressure and temperature, as well as different surrounding chemical compositions can be observed in extreme environments on Earth.

In order to prepare for instance for searches of life to be conducted in space, extreme environments on earth allow

- refinement of search methodologies and strategies including operational concepts in conditions similar to those expected on distant planets;
- detection of specific adaptations of life forms under extreme conditions to obtain further insights on what could be expected in life forms (including life forms other than those known to exist), or traces thereof, in space;
- search for bio-signatures of non earth-centric life forms;
- recognition of biogeomorphological features in data handling and exploitation.

Proposals focussing on such aspects are invited.

The inclusion of international partners is to be particularly encouraged for this topic of the call, as well as the interdisciplinary nature of the R&D to be undertaken. While addressing research valuable for space exploration, proposals should not only have an impact on future or ongoing space activities, but show to which extent they contribute with their results to earth science research.

- Expected impact:

Projects are expected to contribute to space readiness of technologies and validation of approaches taken for conducting space missions. A further impact is expected through their potential interdisciplinary nature, in bringing together researchers from different disciplines. A valuable impact is the enhancement and broadening of research partnerships, also beyond Europe in an international context. Projects should contribute to forging new research alliances, which could either be with established international space powers, or with other parts of the world offering access to environments with physical similarities to extreme space environments.

Furthermore, projects are expected to add value to existing activities on European and national levels, and to raise the awareness of coordination and synergy efforts among stakeholders.

Area 9.2.2: Research to support space transportation and key technologies

SPA.2013.2.2-01: Space critical technologies

The space sector is a strategic asset contributing to the independence, security and prosperity of Europe and its role in the world. Europe needs non-dependent access to critical space technologies, which is a conditio-sine-qua-non for achieving Europe's strategic objectives. "Non-dependence" refers to the possibility for Europe to have free, unrestricted access to any required space technology.

Critical Technologies for European Non-Dependence are not restricted only to specific electric or electronic components, but include all those technologies which are surveyed and monitored by the Joint EC-ESA-EDA task force on Critical Technologies encompassing platform, payload and launcher technologies. A number of priority technologies have been identified for FP7 support from which proposes can choose (see table below).

U1	Space qualification of low shock non-explosive actuators
U2	Advanced thermal control systems
U3	Propellant flow and distribution components for chemical propulsion
U4	Advanced materials and material technology for combustion chambers
U5	Alternative to Hydrazine in Europe
U6	FOG based IMU
U7	Power amplification: TWT materials
U8	Spacecraft charging analysis tool
U9	Cost-effective high quality Ge-substrates for multi - junction solar cells
U10	Core processors for DSP computers
U11	ASICS for Mixed Signal Processing
U12	High capacity Field-Programmable Gate Array (FPGA)
U13	Passive components
U14	Active discrete components
U15	Photonic components
U16	Space qualified GaN components and demonstrators

U17	High density (up to 1000 pins and beyond) assemblies on PCB

Table of urgent actions for R&D of EU dimension

Emphasis for these activities should be on the expected medium term impact for Europe to develop or regain the capacity to operate independently in space, e.g. by developing in a timely manner reliable and affordable space technologies that in some cases may already exist outside Europe or in European terrestrial applications. Nevertheless, projects should strive to go beyond the present state of the art. Clearly identified function and performance targets have been identified for each of the above topics by the Joint EC-ESA-EDA task force[13]. Proposals should address how to access the commercial market with a full range (preload) of recurring products. Where appropriate proposals should aim in their development activities to achieve flight heritage.

Proposals should include a work package dedicated to development of a commercial evaluation of the technology.

- Expected impact:

  The projects are expected, first and foremost, to reduce the dependence on critical technologies and capabilities from outside Europe for future space applications*, as identified in the EC-ESA-EDA Critical Space Technologies for European Strategic Non-Dependence - List of Urgent Actions 2012/2013.*

  In addition, projects should enhance the technical capabilities and overall competitiveness of European space industry satellite vendors on the world wide market. The projects are expected to open new competition opportunities for European manufacturers by reducing the dependency on export restricted technologies that are of strategic importance to future European space efforts. They should enable the European industry to get non-restricted access to high performance technologies that will allow increasing its competitiveness and expertise in the space domain. Projects should improve the overall European space technology landscape and complement the activities of European and national space programmes.

  In this context, technological spin in and/or bilateral collaborations should be enhanced between European non-space and space industries and projects are expected to provide advanced critical technologies that are of common interest to different space application domains (e.g. telecom, Earth-observation, science, etc.).

  Research funding in this area should have a beneficial economic impact on SMEs in the space sector. A strong participation of SMEs in the project should help to realise this impact.

Area 9.2.3: Research into reducing the vulnerability of space assets

SPA.2013.2.3-01: Space-weather events

[13] Document reference to be provided.

Solar activity modulated effects on the Sun and in the helio- and magnetosphere affect the entire Earth environment from the magnetosphere down to the ionosphere and even to the lower atmosphere climate system. Space storms (particles, plasma or electromagnetic) are a recognised aerospace hazard and can cause major failures, e.g. onboard spacecraft, in electrical power grids, in telecommunications links (satellite, launcher and ground-based) and in navigation systems (e.g. recent peak in the solar activity have disturbed the performance of GNSS and satellite-based augmentation (SBAS) systems).

More accurate modelling and impact assessment on affected systems, in particular GNSS, of disruptive events that are to be expected as part of this cyclical phenomenon are particularly poignant.

Activities could focus on research areas such as:

- Modelling of ionospheric geographical and temporal gradients for different regions of the world (equatorial, mid-latitude and auroral regions)
- Modelling of ionospheric disturbances such as travelling depletion, solar storms or scintillation
- Assessment of effects of ionosphere on navigation signals in the context of single and dual frequency usage
- Definition of algorithms able to bound the maximum measurement errors caused by different ionospheric effects.
- Development of mitigation means.

- Expected impact:

*The project is expected to significantly contribute to the European capacity to **prevent damage / protect space assets** from space weather events. Projects are expected to significantly contribute to both identify **the impacts** of space weather events in particular on space-based navigation systems, including space- and ground-based infrastructures, and develop concrete solutions to mitigate these risks.*

SPA.2013.2.3-02: Security of space assets from in-orbit collisions – mission concepts

In recent years our reliance on space-based systems has grown to include different fields: satellite communication and earth observation are ubiquitous, as is satellite navigation. A serious threat is posed by the **alarming growth of space debris**, left from launch activities, break-ups in space and obsolete space objects.

Projects shall achieve the objective of performing an in-orbit demonstration, in a low cost manner, of active debris mitigation techniques using novel, realistic capture techniques (e.g. nets, grasping, tethers). Cubesats and small satellite technology are encouraged to be used to demonstrate removal of a piece of space debris. Apart from the mission concept, the proposal should include how to deal with issues such as free floating approach and proximity

operations, uncooperative docking and manipulation/capture challenges (e.g. tumbling objects), as well as debris capture and de-orbiting using contact and/or contactless techniques such as drag augmentation, sails, micro-propulsion.

The size of the space debris to be removed for the in orbit demonstration mission should be of the size of a Cubesats or larger. Proximity flight (rendezvous) should be limited in order to reduce mission complexity and cost. De-orbiting and mission completion from an orbit <450 km should take place within 1 to 2 years.

Demonstrated debris removal techniques should be designed to be scalable for future use/development, for a range of debris targets to be assessed in the proposal.

- Expected impact:

The project is expected to significantly contribute to the European capacity to detect and protect space assets from space debris. Results are expected to demonstrate in real environment technologies and processes ready to be used for future space missions, preferably with a limited need for continued R&D support for development of technology and processes when EC funding ends. Projects should also contribute to forging new research alliances, and enhancing the relations with established international space powers is regarded to add value to European space activities.

Activity: 9.3 Cross-cutting activities

Area 9.3.1: SME specific research

SPA.2013.3.1-01: SME space technology research and technology transfer

A major priority for the final years of FP7 implementation is the adaptation and response to the new orientations given by the Europe 2020 strategy and its Innovation Union flagship initiative, and building the bridge to Horizon 2020. The innovation dimension across the whole of FP7 is to be strengthened, also by continuing the efforts to increase the SME participation, in particular through defining SME relevant research areas in the calls.

Proposals are invited which allow SMEs to develop partnerships establishing their position in supply chains and markets with space related products and services. Newly established SMEs are particularly welcome. Projects should focus on space related research or service provision where SMEs play a central role in the value added chain. Activities can range from spacecraft technology research in various fields such as technology for in-space activities, technology for ground use of space data including, but not limited to the provision of navigation or geo-information services targeting various areas like environment, agriculture, legal and financial sectors, indoor positioning etc…

Proposals should demonstrate how the projects will lead to SMEs being fully integrated into the related activity area in a sustainable manner.

Proposals should include a work package dedicated to development of a commercial evaluation of the technology/service.

- Expected impact:

Projects are expected to promote the number of SMEs involved in the development of space activities, by initiating and/or reinforcing links between SMEs (not necessarily from the space sector) and other traditional actors in the space sector. SMEs are expected to be fully integrated into the value added chain in a sustainable way through the provision of their core expertise.
The results of research in this topic should clearly be of interest and potential benefit to SMEs. A strong participation of SMEs in the project itself should help contribute to the realisation of that benefit.
The mandatory SME participation is expected to contribute to enhancing the overall SME participation in FP7, and particularly in the Theme Space.

Area 9.3.2: International cooperation

SPA.2013.3.2-01: Cooperation with third countries

Recent developments in dialogues on space cooperation indicate that there is a good opportunity to benefit from **cooperation with the Ukraine**, and this could be inserted into the 2013 work programme as follows.

In the framework of the Joint working group on EU-Ukraine space cooperation, several activities for development have been identified. R&D proposals are invited which address one of the following three subject areas:

- GMES services for agricultural needs;
- Super light-weight materials and coating technologies for space-based systems;
- Methodologies and technologies for active removal of space debris.

It is expected that proposals provide the opportunity for R&D to the mutual benefit of EU and Ukrainian participants, with a balanced distribution of efforts between the EU and Ukrainian partners.

A further domain of interest for international cooperation is the validation and further refinement of monitoring methods of air-quality globally and at regional levels. In the framework of **cooperation with China,** proposals are invited which address the improvement of monitoring methods of air-quality (combining space and in-situ data), validation, elaboration of indicators and development of a remote-sensing toolbox for air-quality and emissions monitoring.

- Expected impact:

Projects are also expected to positively impact the international collaboration in this field beyond the timeframe of EC support.

Area 9.3.3: Dissemination: Transnational and international cooperation among NCPs

This part will **not be open** for specific call topics in 2013.

Area 9.3.5: Studies and events in support of European Space Policy

This part will **not be open** for specific call topics in 2013.