

DRAFT for discussion**WP 2013 Strategy paper – FP7 Cooperation Theme 9 “SPACE”****1. Links with the political agenda of the Commission**

Europe has been active in the space sector for several decades, and activities encompass a wide spectrum ranging from launchers to application 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 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, 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.

1.1 Addressing Innovation Union aspects

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**.

1.2 Underpinning a European space policy

The Commission has adopted in 2011 a Communication on the EU space strategy¹ to state its priorities. Those include: safeguarding European access to space, contributions of space to global/societal challenges (e.g. climate change, 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.
- 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.

1.3 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 Communication² 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 Council³ 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

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

² COM(2004)65 final, 3 February 2004

³ OJ, L 276, 20.10.2010, p. 1.

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 the 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. The total FP7 budget foreseen for the 3-years period for each of these 4 domains is in the order of EUR 20-30 M€. 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**.

1.4 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 under the ICPC⁴ 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.

2. Rationale and process for defining priorities of this work programme

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

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"

Resolutions of the Space Council⁵, 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 specific operational 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 and harmonising the response of the three institutions. Particular attention has also been given to the upstream research needs of Galileo.

3. 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 application of climate change or environmental character, actions should also be relevant to the goal that enterprises are to adapt to a low-carbon, climate-resilient, energy and resource-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.

4. Overall structure of the Theme/Part of the work programme

The overall budget in 2013 is likely to be in the order of 331M€ of which about 198M€ are foreseen for the GMES Space Component, implemented through the *EC-ESA Delegation Agreement*, and around 4M€ are foreseen for management related actions such as *horizontal*

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

activities (Cordis, Cost, Eureka, ERA-Net) managed centrally by DG Research and cost for evaluation and communication.

Hence **the budget for the Call is in the order of 126€**

A rough indication of budgets could be as follows:

– GMES area:	73 M€
– Space Foundations:	41 M€
– Cross-cutting activities GMES & SSF	<u>12 M€</u>
<i>Sum for Calls for proposal</i>	<i>126 M€</i>
<i>Sum for GMES Space Component</i>	<i>198 M€</i>
– Project evaluations, reviews (REA):	2 M€
– Communication, studies (DG ENTR):	1 M€
– Horizontal activities (DG RTD):	<u>4 M€</u>
<i>Sum of FP management related actions</i>	<i>7 M€</i>
TOTAL 2013 SUM	331 M€

As regards GMES, this overall budgetary information should be seen in conjunction with the *GMES Regulation Initial Operations WP 2013*, which makes available about 54 M€ for **operational** activities.

For the FP7 Space Theme, the 2013 work programme is foreseen to include activities as defined previously in FP7 calls, with a two-fold research objective:

- To **strengthen further GMES** developments through R&D;
- To further strengthen action areas covered in **Strengthening of Space Foundations**, through covering **space science and exploration, space technologies and transportation** and **security of space assets**.

The following sections set out the various proposed topics within these activities.

Additionally to the topic areas implemented through *competitive calls for proposals*, FP7 funding will again be used for the GMES Space Component implementation as well as data access activities supporting the GMES services.

Following the second amendment of the ESA-EU Delegation Agreement in 2011, the overall FP7 contribution to the GMES Space Component will amount to 715M€(including the Data Access grant of 2007), corresponding to 50% of the overall FP7 Space Theme budget of 1.43 bn€

5. Topics to be published:

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

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

Three subject areas are being considered, based firstly on the need to cover the 6th thematic service domain of climate change in GMES, and secondly on the wish by Member States to open 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 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.

A fully coupled Earth system reanalysis capability will have to be developed in steps i.e. by first introducing a coupled atmosphere-land-ocean forecast model to produce the background estimates for the re-analysis, followed by the introduction of a fully coupled analysis step to make optimal use of observations.

The following topics have been identified to strengthen reanalysis capabilities

- **A global 20th century re-analysis** covering all components of the earth system is to be undertaken. Scientific approaches should be employed which considerably enhance the description of interactions between different components of the earth system (e.g. improved coupling). Improved coupling should be introduced in the background estimates, to make the better global reanalysis feasible within the time frame of the project. The goal of the activity should be improved and consistent historical climate records from 1900 onwards.

Links should be made to existing projects which are improving the quality of existing 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, as well as versatile visualisation services will have to be realised.

Proposals will have to include efforts to liaise with other ongoing projects in order to avoid duplications and exploit synergies.

Funding schemes and project size to be considered: One Collaborative project of upper eligibility limit of 5 million Euro requested EU contribution.

- **Capacity for long term integration of re-analyses** - re-analysis method developments should be undertaken which could lead to an integrated re-analysis incorporating full exchange and interaction between land, ocean and atmosphere.

This topic is to address the long-term reanalysis goal. Proposals should advance the scientific methodology needed for a fully coupled Earth system re-analysis capability. This development constitutes a significant and long term research activity and is not expected to generate the long term historical records needed for policy development & implementation within the time frame of the current project. However, activities should be started in parallel with re-analysis efforts as described above in order to improve the re-analysis technique on the long term and to prepare the next generation re-analysis. The focus of the project should be on preparing the research and development needed in particular for ocean- atmosphere coupling and the representation of land processes.

Proposals will have to include efforts to liaise with other ongoing projects in order to avoid duplications and exploit synergies.

Funding schemes and project size to be considered: Two Collaborative projects of upper eligibility limit of 3 million Euro requested EU contribution.

- **An ensemble system of regional re-analyses** should be developed, together with the necessary tools to statistically assess the skill of resulting probabilities.

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 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 on regional levels.

Based on the results of uncertainty levels, efforts should also be included how to quantify also 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 order to avoid duplications and exploit synergies.

Funding schemes and project size to be considered: One Collaborative projects of upper eligibility limit of 5 million Euro requested EU contribution.

Furthermore, the following supportive R&D relating to climate change is to be undertaken:

- **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 computationally generated as well as satellite and in-situ based data sets. Such an activity would stimulate further use of GMES data both for scientific and policy use.

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. In order to facilitate access to diverse data, the project will have to include access to methods to provide data in a comparable way.

The final system should allow for climate model, impact indicators, as well as in-situ and satellite data 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. 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.

Proposals will have to include efforts to liaise with other ongoing projects in order to avoid duplications and exploit synergies.

Funding schemes and project size to be considered: One Collaborative project of upper eligibility limit of 3 million Euro requested EU contribution.

- **A climate impact indicator toolbox** – The overall goal of this activity is to develop efficient and user-friendly statistics tools for the generation, comparison and ranking of gridded 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. Software tools for improved characterisations of extreme events (e.g., their likelihood, intensity and change in frequency) as well as for the accounting of uncertainty information provided by model ensemble re-analysis efforts should be developed.

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 in order to avoid duplications and exploit synergies.

Funding schemes and project size to be considered: Two Collaborative projects of upper eligibility limit of 3 million Euro requested EU contribution.

- **R&D towards a traceable quality assurance system 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 standards and criteria is crucial and must be verified independently. The goal of this activity is to develop traceable approaches (whether building on modelling efforts or through other means) allowing to evaluate the quality of satellite-derived, model-simulated and in situ-measured ECV products (ideally at the level of individual pixels, model grid cells and in situ locations, respectively). Particular emphasis should be given to ECVs which are the result of combination of several parameters and algorithms, rather than being directly measurable with satellite and/or in situ observations. A toolbox of methodologies is to be developed.

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.

Funding schemes and project size to be considered: Two Collaborative projects of upper eligibility limit of 3 million Euro requested EU contribution.

- **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.

Funding schemes and project size to be considered: Two Collaborative projects of upper eligibility limit of 3 million Euro requested EU contribution.

- 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 policy, or commercial or for scientific use.

To realise innovative services, existing and validated experimental practices or methodologies need to be turned into viable products in close interaction and trade-off/validation processes with the service users. Possible users could be in small companies, national or local authorities and agencies, and universities. Projects should thus be strongly user driven and particularly take into account user needs concerning information and quality specifications.

Proposals should also include operationalisation aspects in their development, such as subsequent sustainability of services by defining and consolidating the economic model of their service provision (e.g. through a business plan).

For example, activities could target application areas of:

- Agriculture and agri-environment, crop monitoring, precision farming

- Monitoring of critical infra-structures, such as pipelines
- Renewable energy production
- Environmental and Climate change impacts and attribution
- Maritime and other transport activities
- Health services, or monitoring conditions for vector borne diseases

Proposals addressing other application areas are also welcome.

Funding schemes and project size proposed: Collaborative projects of upper eligibility limit of 3 million Euro requested EU contribution.

- Remote sensing methods

Progress in remote sensing applications can be made by combining information from different sensors in novel ways, an example being:

- Improved change detection from combined use of radar and optical imagery. 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 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 to measure 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 GNSS signals for non-navigation purposes represents a further domain in which novel sensing applications are possible. Satellite navigation signals have been utilised for atmospheric sounding to measure tropospheric temperature, pressure and humidity. Apart from these, they have the potential to be exploited to yield information on sea-surface roughness, ice characteristics, or soil moisture content.

Proposals are invited which investigate promising new application areas.

Funding schemes and project size to be considered: Collaborative projects of upper eligibility limit of 3 million Euro requested EU contribution.

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

It is considered to place the focus on the subject area of:

- 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. The validation of specific prototypes, based whenever 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 policy, or 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 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.

Funding schemes and project size to be considered: Collaborative projects of upper eligibility limit of 3 million Euro requested EU contribution.

**Area 9.1.3 Support to the coordinated provision of observation data &
Area 9.1.4 Development of Earth observation satellites**

- Funding support via EU-ESA Delegation Agreement (*so excluded from this competitive call mechanism*).

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

Topic	Expected outcome	Budget
Climate change - Provision of access to simulated and observed climate datasets	Collaborative project @3M€ max contribution	3M€
Climate change - A global 20th century re-analysis	Collaborative project @5M€ max contribution	5M€
Climate change - Long term integration of re-analyses	Collaborative projects @3M€max contribution	6M€
Climate change - An ensemble system of regional re-analyses	Collaborative project @5M€ max contribution	5M€
Climate change - A climate impact indicator toolbox	Collaborative projects @3M€max contribution	6M€
Climate change - R&D towards an SI-traceable ECVs	Collaborative projects @3M€max contribution	6M€
Climate change - Attribution products	Collaborative projects @3M€max contribution	6M€
Downstream services and service evolution	Collaborative projects @3M€max contribution	18M€
Remote sensing methods	Collaborative projects @3M€max contribution	12M€
Integrated satnav/satcom/observation service activities and applications	Collaborative projects @3M€max contribution	6M€
TOTAL		73M€
Number of projects expected to be funded		23

Activity 9.2 Strengthening Space Foundations

Area 9.2.1 Research to support space science and exploration

Two subject areas could be focused on in the call:

- Space Science – space based data exploitation (astrobiology, planetary science, astronomy, astrophysics, health ...)

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 currently in operation produce 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 and analysis 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, 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 process, access, archive and distribute data obtained from different sources such as space observatories.

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.

Funding schemes and project size to be considered: Collaborative projects of upper eligibility limit of 3 million Euro requested EU contribution.

- 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 field campaigns in extreme environments, to address for example

- 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 robots/rovers, or power efficient motion;
- waste and water management under simulated mission conditions.

Another 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 space 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 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 lifeforms (including lifeforms other than those known to exist), or traces thereof, in space;
- search for bio-signatures of non earth-centric lifeforms;
- 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 contribute with their results to earth science research.

Funding schemes and project size proposed: Collaborative projects of upper eligibility limit of 3 million Euro requested EU contribution.

Area 9.2.2: Research to support space transportation and key technologies

Following a pause in 2012, it is suggested to include critical technologies for non-dependence in 2013.

- Critical space component technologies for non-dependence

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. Furthermore, it takes into account the strong need to further advance navigation technologies covering the research essentials for future generations of EU space systems such as Galileo. Another aspect addressed is Europe's need to have access to propulsion fuels of low environmental impact and toxicity, providing suitable performances at acceptable cost. A number of priority technologies have been identified for FP7 support as summarised in the 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 (provisional – still to be confirmed)

Emphasis for these activities should not be on the advanced nature of their scientific innovation, but 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 force⁶. 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.

Funding schemes and project size to be considered: Collaborative projects of upper eligibility limit of 2 million Euro requested EU contribution.

⁶ Document reference to be provided.

Area 9.2.3: Research into reducing the vulnerability of space assets

The following two topic areas are under discussion:

- Space-weather events

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.

More accurate prediction, assessment and early-warning capabilities 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:

- early warning and forecasting methods to allow for a mitigation of space weather effects on humans in aerospace vehicles and on vulnerable technologies in space (in particular satellites, communication and navigation systems) and on the ground (communication and power nets).
- countermeasures to avoid or mitigate possible harmful space weather effects on humans and technological systems (including life science experimentation).
- space weather models to improve specification and prediction capabilities, with emphasis on the linkage of the different physical processes that occur simultaneously or sequentially in many domains.
- space mission concepts for space weather monitoring.

Funding schemes and project size to be considered: Collaborative projects of upper eligibility limit of 3 million Euro requested EU contribution.

- 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.

Proposals should develop a system demonstrator for active debris removal in space to high technological relevance level, i.e. including demonstration in-orbit. Apart from the mission concept, the proposal should could include how to deal with issues such as free floating object dynamics, uncooperative docking and manipulation/capture challenges (e.g. tumbling objects), and capture relevant technologies.

Funding schemes and project size to be considered: Collaborative projects of upper eligibility limit of 6 million Euro requested EU contribution.

Summary of Activity 9.2 Strengthening Space Foundations

Topic	Expected outcome	Budget
Space science and exploration data exploitation; earth analogue research	Collaborative projects @3M€max contribution	18M€
Critical space component technologies for non-dependence	Collaborative projects @2M€max contribution	8M€
Research into reducing the vulnerability of space assets: Space weather	Collaborative projects @3M€max contribution	9M€
Research into reducing the vulnerability of space assets : Debris removal/mitigation mission concepts	Collaborative projects @6M€max contribution	6M€
TOTAL		40M€
Number of projects expected to be funded		14

Activity 9.3 Cross-cutting Activities

Area 9.3.1: SME specific research

The following topic is being considered:

- 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. Activities may include geo-information services targeting legal and financial sectors.

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

Funding schemes and project size to be considered: Collaborative projects of upper eligibility limit of 2 million Euro requested EU contribution. Where appropriate, duration of less than three years should be considered.

Area 9.3.2: International cooperation

- 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.

Funding schemes and project size to be considered: Collaborative projects of upper eligibility limit of 2 million Euro requested EU contribution.

Summary of Activity 9.3 Cross-cutting Activities

Topic	Expected outcome	Budget
SME specific research	Collaborative projects @2M€max contribution	4M€
International Cooperation with Ukraine and China	Collaborative projects @2M€max contribution	8M€
TOTAL		12M€
Number of projects expected to be funded		6