



Into Space

EU Space Research

*Space Research projects under the
7th Framework Programme for Research
(6th call)*

*Enterprise
and Industry*

INTO SPACE

The European Union (EU) has been 'into space' for a long time, however the interest in space has grown in recent years with the long-term aim of ensuring the security, well-being and high standards of living of citizens inside and outside the EU. The space projects funded under the EU's 7th Framework Programme for Research (FP7) have been playing a vital role in contributing to this goal. With Horizon 2020, the new EU Framework Programme for Research, the EU is committed to continue those efforts by financing a large number of space-related projects in a variety of domains.

The 6th, and last, FP7 Space research brochure – through the presentation of **58 projects divided into 4 categories:** Copernicus-related Applications and Data; Space Technologies; Space Science and Data Exploitation; Space Weather and Space Situational Awareness – presents Europe's efforts to utilise space technology and space-based capabilities to serve the needs of the civil society. Many of these projects also help to strengthen the competitiveness of the European industry and support the leading position of Europe's scientific community in the space field.

In the domain of **Copernicus-related Applications and Data**, the FP7 6th call for proposals covered environmental topics such as climate change, monitoring of polar regions, volcanic and seismic activities, but also specific research fields like archaeological investigations in coastal waters. In addition, the further development of Copernicus downstream services for EU-wide and local needs is supported. One example of international cooperation aims at the validation of space-based and *in situ* measurements for the monitoring of air quality in China.

The 6th call for proposals aimed also to strengthen the space foundations by offering funding to research in **Space Science and Data Exploitation, Space Weather and Space Situational Awareness**. Technology development supporting space transportation and non-dependence in critical technologies, research into reducing the vulnerability of space assets and space weather events are also important programme elements. In the field of space science and data exploitation there are a number of projects which analyse data from deep space missions, looking for instance at exoplanets and star formations in the Milky Way. The questions surrounding Solar-Earth interactions as well as the problem of space debris and its removal, that are receiving more and more attention from the science community, are also supported.

You are invited to discover 58 space projects funded under the 6th call for proposals of the EU's FP7 touching upon the above-mentioned subjects. Almost 260 projects have been presented in the brochure series and all publications are available in the EU bookshop (<https://bookshop.europa.eu/en/home/>).

This overview is expected to be followed by a publication presenting the space projects funded under the 1st call for proposals of the Horizon 2020.

Listed below are the projects co-financed by the European Commission and managed by the Research Executive Agency (REA) under the 6th call for proposals of the 7th Framework Programme for Space Research in the domains of Copernicus - related Applications and Data, Space Technologies, Space Science and Data Exploitation, Space Weather and Space Situational Awareness.

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“Into Space” is the 6th in series of brochures featuring EU Space Research projects funded under the FP7.

In a view of continuity, this publication is produced to include the projects supported under the 6th FP7 Space call for proposals.

All electronic versions of the brochure series are available on the EU bookshop website: www.bookshop.europa.eu

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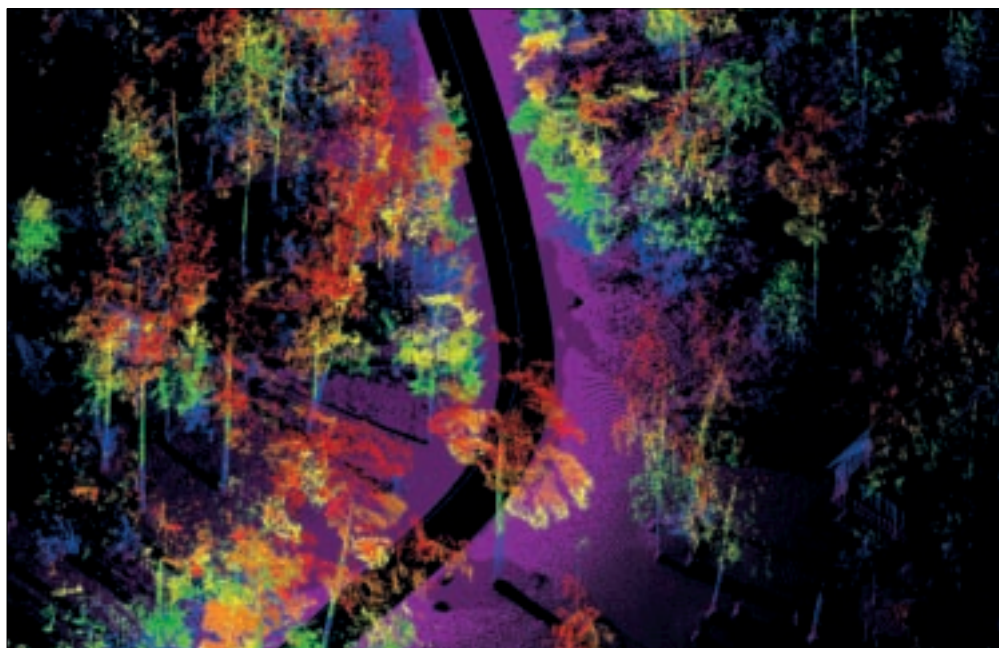
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Advanced_SAR

Advanced Techniques for Forest Biomass and Biomass Change Mapping Using Novel Combination of Active Remote Sensing Sensors



© FRI/Antero Kukko

Mobile Laser Scanning data showing accurate information about forest biomass.



Juha HYYPPÄ
Project Coordinator

ABSTRACT

The aim of the Advanced_SAR project is to provide high-quality, beyond state-of-the-art techniques for mapping forest canopy height, biomass and biomass change by achieving the best possible cost-efficiency performance out of the given SAR satellite imagery, and terrestrial and airborne remote sensing data.

ADVANCED 3D DATA EXTRACTION TECHNIQUES FOR FOREST RESOURCES MAPPING, COMBINING TERRESTRIAL, AIRBORNE AND SATELLITE SENSORS

The amount of carbon bound in forests is currently a salient climate political issue at the global level. A major share of the total forest carbon is stored in the forest growing stock. Thus, one of the biggest challenges currently in the forest inventory research is an effective and accurate measurement of forest above ground biomass and its changes.

Recently, Airborne Laser Scanning (ALS) data has shown that the key to accurately map forest resources is to measure the 3D structure of the forest canopy. Similar 3D measurement techniques should be developed for satellite data as well. Therefore, the overarching goal of the Advanced_SAR project is to provide high-quality, beyond state-of-the-art satellite techniques for mapping of forest canopy height, biomass and biomass change. The objective is to achieve the best possible cost-efficient performance out of the given SAR (Synthetic Aperture Radar) satellite imagery, which is used together with terrestrial and airborne remote sensing data.

In the Advanced_SAR project, key players in Europe in the field of SAR data processing, airborne and terrestrial laser scanning, forestry, and physical modelling are brought together to: 1) develop methods to extract 3D data from forested areas in order, to influence the planning of future operational EO (Earth Observation) programmes; 2) establish Europe's leading position in forest biomass and biomass change mapping, and 3) take part in the expected market growth in precision forestry in Europe, by creating new techniques for forest resources mapping.

QUESTIONS & ANSWERS

What is the project designed to achieve?

The project aims to improve forest biomass estimation using SAR satellite data, by developing methods to create accurate 3D forest canopy height models and using satellite data, together with terrestrial and airborne measurements. The project is expected to establish a basis for the development of innovative EO products and services, combining existing and upcoming satellite, airborne and in-situ data.

Why is this project important for Europe and how does it benefit European citizens?

The goal is to establish the EU's leading position in forest biomass and biomass change mapping and significantly contribute to the creation of the market growth in precision forestry business, which would benefit all European forest owners. The project will also contribute to enhancing of the competitiveness of the European industry by closing the gap between research and business.

How does the project exceed the current state of knowledge?

ALS is a remote sensing technique that produces accurate 3D models of forest canopies and therefore has revolutionized the forest inventories in Nordic countries. The way forward in satellite-based forest inventory is to create 3D models, similar to ALS. This project aims at developing novel 3D data extraction techniques for SAR satellite data, therefore, creating more accurate forest resources maps than before.

Advanced_SAR

Advanced Techniques for Forest Biomass and Biomass Change Mapping Using Novel Combination of Active Remote Sensing Sensors

LIST OF PARTNERS

- Finnish Geodetic Institute, Finland
- Swedish University of Agricultural Sciences, Sweden
- Vienna University of Technology, Austria
- TreeMetrics Ltd., Ireland
- Chalmers University of Technology, Sweden

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PROJECT INFORMATION

Advanced Techniques for Forest Biomass and Biomass Change Mapping Using Novel Combination of Active Remote Sensing Sensors (Advanced_SAR)

Contract N°: 606971
Starting Date: 01/10/2013
Duration: 48 months
EU Contribution: € 1.993.062,00
Estimated total cost: € 2.668.482,40

APhoRISM

Advanced PRocedures for volcanic and Seismic Monitoring



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APhoRISM project is focused on the investigation of volcanic gas emissions (volcanic plume) and surface effects of earthquakes (damage).

ABSTRACT

The main objective of APhoRISM is to develop, implement, test and validate a novel method for the mitigation and management of volcanic and seismic crises. Two methods to combine in a fruitful way satellite and ground data are proposed. The goals are the detection, retrieval and the full characterisation of volcanic ash clouds; the generation of a probability damage index at building block and/or single building scale and for infrastructures.

NOVEL METHODS FOR VOLCANIC AND SEISMIC CRISIS MANAGEMENT BY REMOTE SENSING AND GROUND DATA INTEGRATION

Satellite remote sensing has demonstrated to have unique capabilities in terms of spatial coverage, spatial density of measurements and synoptic view of the investigated area. Conversely, ground based techniques are better suited for point measurements with high accuracy, and generally better time repetition, but provide scarce density and limited coverage.

APhoRISM is aimed at the development of innovative products based on space and ground sensors to support the management of seismic and volcanic crises. The objective is to demonstrate that remote sensing and ground data, appropriately managed, can provide better performance in terms of accuracy and quality of information. Two methods will be developed in the APhoRISM project, one concerning volcanic risk and one dealing with seismic risk: MACE and APE respectively. The Multi-platform volcanic Ash Cloud Estimation (MACE), involves the development of remote sensing methods related to monitoring volcanic crisis. The MACE method will exploit the complementarities between

Geosynchronous and Sunsynchronous satellites and ground measurements to improve the ash detection and retrieval and to fully characterise the volcanic ash clouds.

The A-Priori information for Earthquake damage product (APE) concerns the generation of products dealing with seismic crises. The a-priori information is derived by combining Synthetic Aperture Radar time series, measuring surface movements in the study area, and ground shaking data. The algorithm merges this a-priori information with satellite change detection map. The outcome is a Likelihood Index Damage Map (LIDaM), a probability index showing collapsed or strongly damaged buildings and infrastructures.



Salvatore STRAMONDO
Project Coordinator

QUESTIONS & ANSWERS

What is the project designed to achieve?

APhoRISM is aimed at improving capabilities to investigate the volcanic ash and the surface effects (damage) due to an earthquake. Using novel algorithms the project will manage a huge amount of multisource data (satellite and ground data) in order to generate innovative outcomes for the mitigation of volcanic and seismic crises.

Why is this project important for Europe and how does it benefit European citizens?

APhoRISM will help to enforce the European capabilities to face the effects of volcanic emissions and earthquakes. The increased accuracy to estimate the ash content in volcanic plumes will allow civil aviation authorities to improve the capability to decide about the awareness level. APhoRISM will also benefit from the forthcoming Sentinel missions.

How does the project exceed the current state of knowledge?

The multidisciplinary approaches proposed in APhoRISM involve an unprecedented range of sensors and instruments, thus providing a range of information coming from multisource data and multifrequency measurements. Such variety and amount of data is expected to allow a step forward in characterising the investigated and measured parameters.

LIST OF PARTNERS

- Istituto Nazionale di Geofisica e Vulcanologia, Italy
- Centre Tecnològic De Telecomunicacions De Catalunya, Spain
- Bureau De Recherches Geologiques Et Minières, France
- Università Degli Studi di Roma La Sapienza, Italy
- Gamma Remote Sensing Research and Consulting Ag, Switzerland
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PROJECT INFORMATION

Advanced PRocedures for volcanic and Seismic Monitoring (APhoRISM)

Contract N°: 606738
Starting Date: 01/12/2013
Duration: 36 months
EU Contribution: € 1.915.452,00
Estimated total cost: € 2.477.694,00

AQUA-USERS

AQUAculture USEr driven operational Remote Sensing information services



Supporting the aquaculture industry with services based on Earth Observation and in-situ data.

ABSTRACT

AQUA-USERS will provide the aquaculture industry with user-relevant and timely information based on the most up-to-date satellite data and innovative optical in-situ measurements. The key purpose is to develop a web portal and mobile application that bring together satellite information on water quality and temperature with in-situ observations, as well as relevant weather prediction and met-ocean data.

LEVERAGING EARTH OBSERVATION DATA INTO SERVICES PROVIDING USER-RELEVANT AND TIMELY INFORMATION FOR THE AQUACULTURE INDUSTRY

With global population expansion, the demand for high-quality protein is rising dramatically. As global fish stocks are being depleted, fish farming is gaining importance to ensure food security. Aquaculture is the fastest growing food production sector worldwide. Environmental conditions determine the growth and health of the produced species, while the production often releases large amounts of nutrients to the surrounding environment.

To support the growth of efficient and sustainable aquaculture production, AQUA-USERS aims at providing the aquaculture industry with user-relevant and timely information based on the most up-to-date satellite data and innovative optical in-situ measurements. The key purpose is to develop a web portal and mobile application that bring together satellite information on water quality and temperature with in-situ observations, as well as relevant weather prediction and met-ocean data.

A decision support system underlying the applications will link this information to a set of user-determined management decisions. Specific focus during the project will be put on the development of indicators based on Earth Observation data for aquaculture management, including indicators for harmful algal bloom events.

AQUA-USERS is a highly user-driven project with a user board consisting of companies and organisations from 5 countries representing different European aquaculture production systems. Together with the user board, the project partners will demonstrate the applicability of the developed methods and tools in three case studies: site characterisation and selection based on historic satellite data; daily management using in-situ measurements; daily management using near real-time satellite data and in-situ measurements.



Marnix LAANEN
Project Coordinator

QUESTIONS & ANSWERS

What is the project designed to achieve?

The key purpose is to develop a web portal and mobile application that combine up-to-date satellite information on water quality and temperature with in-situ observations and relevant weather and met-ocean data. The applications will link to a decision support system based on multi-criteria analysis to help the aquaculture industry in making use of these data for management decisions.

Why is this project important for Europe and how does it benefit European citizens?

As global fish stocks are being depleted, fish farming is gaining importance for food security. Aquaculture production in the EU has stagnated since 2000. Due to growing consumer demand, imports now represent more than 60% of EU seafood consumption. The AQUA-USERS services support the European aquaculture industry in making their production more efficient and sustainable.

How does the project exceed the current state of knowledge?

Currently information relevant to aquaculture is disparate, inconsistent and often of low quality. AQUA-USERS collects data from diverse sources including Earth Observation (EO), in-situ measurements and ecosystem modelling and integrates them into a consistent and quality-controlled data base. With an interactive web portal and a mobile application, AQUA-USERS project makes this database easily accessible to the users.

AQUA-USERS

AQUAculture USEr driven operational Remote Sensing information services

LIST OF PARTNERS

- Water Insight, the Netherlands
- Stichting VU/Vumc, the Netherlands
- Plymouth Marine Laboratory, United Kingdom
- Fundação da Faculdade de Ciências da Universidade de Lisboa, Portugal
- Norsk Institutt for Vannforskning (NIVA), Norway
- DHI Geographic Resource Analysis & Science AS (GRAS), Denmark
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PROJECT INFORMATION

AQUAculture USEr driven operational Remote Sensing information services (AQUA-USERS)

Contract N°: 607325
Starting Date: 01/11/2013
Duration: 36 months
EU Contribution: € 2.496.485,10
Estimated total cost: € 3.133.606,48

CLIPC

Climate Information Portal for Copernicus



Salt Marshes, Norfolk, United Kingdom.

© Martin Juckes, 2013



Martin JUCKES
Project Coordinator

ABSTRACT

CLIPC will develop a data service infrastructure to provide harmonised access to climate information from in-situ and satellite observations and also from climate models and re-analyses. CLIPC will also provide a toolkit to generate, compare, aggregate and rank indicators of climate change and climate change impacts. Clear provenance information and uncertainty guidance will be provided with all data products.

A DATA SERVICE INFRASTRUCTURE FOR THE COPERNICUS CLIMATE CHANGE SERVICE

Climate change is impacting the environment, society and policy decisions. Information about climate change is available from many sources, not all of which are reliable. CLIPC will provide a single point of access for authoritative scientific information on climate change with services driven by user requirements. This ambitious objective is made possible through the Copernicus Earth Observation Programme for Europe, which will deliver a new generation of environmental measurements of sufficient length, consistency, and continuity to support climate services.

Observations of the physical environment relevant to climate change policy and risk assessments come from several major categories: satellite measurements, terrestrial observing systems, model projections and simulations and from re-analyses (syntheses of constrained observations with numerical weather prediction systems). These different data categories are managed by different communities and distributed through multiple outlets and protocols. CLIPC will provide a single point of access for the whole range of data.

Information on data value and limitations will be provided as part of a knowledge base of authoritative climate information.

Indicators of climate change and climate change impact and a toolkit to update and extend the collection of indicators will be provided. The toolkit, integrated into the portal, will provide an interactive climate impact indicator interface supporting scenario-based exploration and integrated uncertainty assessment. A generic visualisation service will enable comparing and ranking of the indicators. CLIPC will exploit recent research on graphic design choices and user consultation to develop an effective method of visualising uncertainty.

QUESTIONS & ANSWERS

What is the project designed to achieve?

The project will develop a single point of access for authoritative information on climate change, to support decision making and planning. A flexible data service infrastructure will provide transparent access to data held in distributed national and domain specific archives. A climate impacts toolkit will provide for the efficient generation, ranking and aggregation of climate impact indicators.

Why is this project important for Europe and how does it benefit European citizens?

Europe needs a single source of climate information to ensure that policy decisions are taken on a common basis. The transparent data access will support a transparent decision making process, in which all citizens have access to the data, either to participate in the policy development process or plan their own lives.

How does the project exceed the current state of knowledge?

The project will develop new capabilities in the integration of environmental data services. Delivering the necessary information on data value and limitations will require new approaches to expressing uncertainty and other issues surrounding data value. Efficient generation of climate impact indicators will exploit new developments in climate impact functions.

LIST OF PARTNERS

- Science and Technology Facilities Council (STFC), United Kingdom
- Alterra, the Netherlands
- Royal Netherlands Meteorological Institute (KNMI), the Netherlands
- Mariene Informatie Service (MARIS), the Netherlands
- Potsdam Institute for Climate Impact Research, Germany
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- TU Dortmund University, Germany
- Natural Environment Research Council, United Kingdom
- Centre Européen de Recherche et de Formation Avancée en Calcul Scientifique, France
- Centre National de la Recherche Scientifique (CNRS), France
- Centro Euro-Mediterraneo sui Cambiamenti Climatici, Italy
- Ilmatieteen Laitos, Finland
- Helmholtz-Zentrum Geesthacht, Germany
- Joint Research Centre (JRC), European Commission, Belgium
- Linköping University, Sweden
- Magellium Ltd, United Kingdom
- Norwegian Meteorological Institute (MI), Norway
- University of Reading, United Kingdom
- Finnish Environment Institute (SYKE), Finland
- Tourisme, Transports, Territoires, Environnement Conseil, France
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PROJECT INFORMATION

Climate Information Portal for Copernicus (CLIPC)

Contract N°: 607418
Starting Date: 01/12/2013
Duration: 36 months
EU Contribution: € 5.985.067,75
Estimated total cost: € 7.836.472,80

DECUMANUS

DEvelopment and Consolidation of sUustainable geo-spatial services
for adaptation to cliMAte chaNge related environmental Urban impactS



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The aim of Decumanus at a glance: cleaner and more efficient sustainable cities.

ABSTRACT

The goal of DECUMANUS is the development and consolidation of sustainable decision support services that help city managers to develop and implement climate change strategies aimed at a sustainable urban development. Four categories of DECUMANUS service products will be implemented: urban climate atlas; land monitoring information and tools; improving energy efficiency in cities and citizen health, analysing the impacts of the air quality in relation to population.

PROVIDING URBAN GEOSPATIAL INFORMATION SERVICES FOR CLIMATE CHANGE ADAPTATION, HEALTH IMPACT ASSESSMENT, ENERGY EFFICIENCY AND LAND-USE MONITORING

Urban planning aims to manage the territory in order to address the key political concerns of European citizens, including climate change, greenhouse gas emissions, uncontrolled urban sprawl, urban health and biodiversity loss etc. However, this presents major challenges for urban planners and politicians, as cities are extremely complex systems and the various drivers of change, impacts and responses are strongly interrelated, supporting, altering or competing with each other.

Indeed, the effective governance of the cities and city regions of Europe today is fundamentally undermined by this urban complexity, whereby the high degree of interconnectedness and multiple interactions between socio-economic and environmental factors in a territorial context create major barriers to the effective implementation of sustainable urban development.

Information and Communication Technologies (ICT)-enabled governance of cities offers substantial opportunity for the application of enhanced intelligence in urban management to overcome barriers to sustainable development. This can be achieved by enhanced assessment of urban complexity, improved decision-making support, all facilitating the delivery of more sustainable compact cities. Moreover, the wider potential of ICT-enabled urban governance is evident in the ability to simultaneously achieve effective management of the complexity of a city and engage citizens in defining their urban futures.

This is exactly what DECUMANUS project intends to do and the aim of the project is the development and consolidation of a set of sustainable decision support services that allow city managers to deploy geo-spatial products in the development and implementation of their energy efficiency and climate change strategies, in meeting the diverse challenges of sustainable urban planning and development.



Antonio GARZON
Project Coordinator

QUESTIONS & ANSWERS

What is the project designed to achieve?

The development and consolidation of sustainable geo-information decision support services, based on the Earth observation that will help city managers, looking for a sustainable urban development, in the development and implementation of their climate change strategies. Furthermore, there will be a commercially-oriented website to test business models in order to analyse the financing of the updated information services through the time.

Why is this project important for Europe and how does it benefit European citizens?

Use of DECUMANUS service products for urban management appears to offer significant opportunity to improve decision-making, creating more sustainable cities.

In order to fully meet the needs of the end-users, user needs are explored to meet the challenges of managing cities and, in particular, to minimise urban sprawl and associated climate change, energy efficiency, environmental, economic, and social impacts.

How does the project exceed the current state of knowledge?

Sustainable urban planning and management demand innovative concepts and techniques to obtain up-to-date and area-wide information on the characteristics and development of the urban system.

DECUMANUS will bridge the gap between the results offered by the Earth Observation community and their application by urban planners and decision makers involved in developing, implementing and demonstrating geo-information products and services for the urban environment.

DECUMANUS

DEvelopment and Consolidation of sUustainable geo-spatial services
for adaptation to cliMAte chaNge related environmental Urban impactS

LIST OF PARTNERS

- Indra Sistemas S.A. (Indra), Spain
- Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Germany
- University of the West of England, Bristol (UWE), United Kingdom
- Universidad Politecnica de Madrid (UPM), Spain
- The Royal Borough of Kensington and Chelsea (RBKC), United Kingdom
- Comune di Milano (MIL), Italy
- Stad Antwerpen (ANT), Belgium
- HSY Helsingin Seudun Ympäristöpalvelut -Kuntayhtymä (HSY), Finland
- Eurosense Belfotop BVBA (EUR), Belgium
- GeoVille Information Systems GmbH (Geo), Austria
- Controlware (CWe), Belgium
- Direccion General de Sostenibilidad – Agencia de la Energia de la Ciudad de Madrid, Spain (end-user)

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PROJECT INFORMATION

DEvelopment and Consolidation of sUustainable geo-spatial services for adaptation to cliMAte chaNge
related environmental Urban impacts (DECUMANUS)

Contract N°: 607183
Starting Date: 01/12/2013
Duration: 27 months
EU Contribution: € 2.402.802,65
Estimated total cost: € 3.391.474,30



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Ground based GNSS-Reflectometer testing campaign in the Tagus river.

ABSTRACT

The E-GEM project proposes, by means of development and testing of new instrumentation and algorithms, a synergy between different approaches and platforms at European level. Ground-based, air-borne, and space-borne instruments will be developed jointly and incorporate innovative concepts: the GNSS-R concept with the new Galileo signals; a flexible system allowing operation with conventional, interferometric and reconstructed-code approaches; and a novel GNSS-R approach leading to a reduction of the platform's size.

EVOLVING THE CURRENT STATUS OF GNSS REFLECTOMETRY (GNSS-R) METHODS FOR THE PURPOSE OF EARTH OBSERVATION

The potential use of L-band navigation signals for remote sensing has been investigated since the mid nineties. Consolidated remote sensing applications of Global Navigation Satellite System (GNSS) signals of opportunity already exist in the form of Radio-Occultation (RO) techniques, used to monitor thermodynamic variables of the planetary atmosphere with fine vertical resolution, as well as with ground-based GNSS meteorology, which uses propagation features of the signals to infer atmospheric parameters.

An underdeveloped approach to extract geophysical variables from GNSS signals is based on reflectometry (GNSS-R), that is, the analysis of GNSS signals after they scatter over the Earth surface, akin to a bi-static radar. As such, the E-GEM project brings together European's leading institutions in the field, to explore the GNSS-R technology and applications in a coordinated way.

E-GEM will study, engineer and implement three different approaches and platforms at European level.

A ground-based, an air-borne, and a space-borne instrument will be developed and studied jointly. In addition to the platforms' development, the GNSS-R underlying techniques shall be developed for each of the three instruments. The different platform-technique pairs have been selected taken into account the platform restrictions, as well as the inherent characteristics of the signal processing (e.g. the interferometric approach allows to use the full bandwidth of the signals, at the expense of noisier waveforms, which can only be overcome by using large steerable antennas).

The E-GEM project has also a strong link with other related projects, namely with respect to integration of data into downstream, higher-value products services.



Nuno CATARINO
Project Coordinator

QUESTIONS & ANSWERS

What is the project designed to achieve?

GNSS-R technologies can definitely help to improve our knowledge of the water cycle at global scale, especially if the extraction of information from this new generation of remote sensing products is improved from the combined use of different sensors. The main objective of E-GEM will be to greatly advance the state-of-the-art in this critical domain.

Why is this project important for Europe and how does it benefit European citizens?

GNSS reflected data products for ocean, ice and land will provide further inputs into downstream chains, and increase the availability and reliability of EO-based services. Based on this emerging technology, innovative methodologies and services can be foreseen, such as the detection of tsunamis and precise estimates of carbon emissions, as well as the improvement of existing systems, which will allow tracking phenomena that today pass unnoticed.

How does the project exceed the current state of knowledge?

The development of GNSS-R technology will present improved performances with respect to existing systems, namely through the swath size increase provided by GNSS-R when compared to classic radar altimetry. Moreover, the low cost of GNSS-R technology, when compared to traditional radar sources, will also have an important impact on the definition of the next generation of observation satellites.

LIST OF PARTNERS

- DEIMOS Engenharia S.A. (DME), Portugal
- Universitat Politècnica de Catalunya (UPC), Spain
- Agencia Estatal Consejo Superior de Investigaciones Científicas (CSIC), Spain
- Universidad de Salamanca (USAL), Spain
- Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER), France
- Stiftelsen Nansen Senter For Fjernmaaling (NERSC), Norway
- Northern Research Institute Tromsø AS (NORUT), Norway
- Università degli Studi di Roma Tor Vergata (TOV-DICII), Italy
- Università degli Studi di Roma La Sapienza (DIET), Italy
- Helmholtz-Zentrum Potsdam Deutsches GeoForschungsZentrum (GFZ), Germany

COORDINATOR

DEIMOS Engenharia S.A. (DME), Portugal

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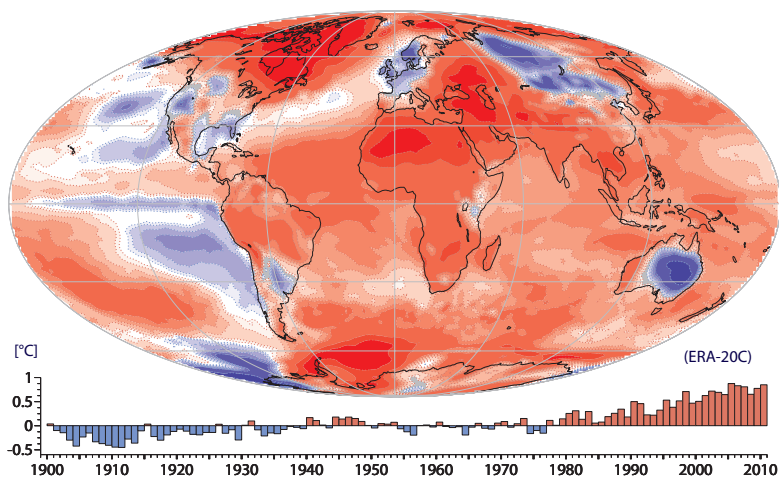
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PROJECT INFORMATION

European GNSS Reflectometry Environmental Monitoring (E-GEM)

Contract N°: 607126
Starting Date: 01/12/2013
Duration: 36 months
EU Contribution: € 1.999.999,00
Estimated total cost: € 2.838.962,20

2010 global temperature relative to the 20th-century average



© ECMWF

Change in annual mean surface air temperature (relative to 20th-century mean), for the year 2010 (top) and for all years (bottom), as estimated by reanalysis of surface observations.

ABSTRACT

The goal is to develop improved climate data sets using reanalysis techniques, with consistent descriptions of the atmosphere, ocean, land-surface, cryosphere, and the carbon cycle. This involves data rescue and reprocessing activities for in-situ and satellite observations, and development of new methods for assimilating observations in coupled Earth-system models. Data services will be improved to support climate service providers and European policy makers.

CONSISTENT REANALYSES OF THE GLOBAL ATMOSPHERE, OCEAN, LAND SURFACE, CRYOSPHERE AND CARBON CYCLE FOR THE 20TH CENTURY

Adaptation to climate change requires access to accurate, consistent and current data on a range of essential climate variables in the atmospheric, terrestrial, cryospheric and oceanic domains, covering time scales from sub-daily to decadal and beyond. Such data can be provided using reanalysis techniques, which combine models with observations to generate a physically consistent description of the evolution of the climate system.

The core objective for ERA-CLIM2 is to apply and extend the current global reanalysis capability in Europe, in order to meet the challenging requirements for climate monitoring, climate research, and development of climate services. The project will produce new multi-decadal reanalyses of the climate system including atmosphere, land, ocean, and cryosphere, with consistent estimates of carbon fluxes.

Two types of reanalysis will be produced: an extended climate reanalysis spanning the entire 20th century at moderate resolution and a higher-resolution reanalysis of the satellite era, suitable for near-real time monitoring of climate variables.

The project contains an ambitious research programme to develop new methods for data assimilation in coupled climate models. It includes various activities in data rescue, satellite data reprocessing and quality control of observations, in order to improve and extend the usable satellite climate data record as well as the in-situ instrumental record. Productions of ERA-CLIM2 coupled reanalyses will use ensemble techniques to generate meaningful information about uncertainties in climate variables. The project will conduct detailed quality assessments of input observations and reanalysis products, and will provide users with open and transparent access to data products and visualisation tools.



Dick DEE
Project Coordinator

QUESTIONS & ANSWERS

What is the project designed to achieve?

ERA-CLIM2 will develop new global reanalysis products suitable for climate monitoring and climate research. This will be done by improving the input observations (e.g. through data rescue and reprocessing), the assimilating models (e.g. by coupling the atmosphere with the ocean) and the data assimilation techniques (e.g. by using ensemble techniques to generate information about uncertainties).

Why is this project important for Europe and how does it benefit European citizens?

The tools and data sets to be developed in this project will be important resources for the implementation of an operational Climate Change Service within the EU's Copernicus Earth Observation Programme. Public and private providers of climate services in Europe will have access to shared and reliable information about climate change based on the best available models and observations. European citizens will benefit from improved climate information products and services in many impact areas, including transportation, agriculture, health and safety.

How does the project exceed the current state of knowledge?

Many aspects of climate change during the recent past (100-200 years) are still highly uncertain. The ERA-CLIM2 project will help to reduce these uncertainties by improving the observational record and, by data assimilation in coupled models, extracting more accurate and consistent information about the evolution of the climate in the recent past. The project will produce several major new data sets for climate research and climate change assessment.

LIST OF PARTNERS

- European Centre for Medium-range Weather Forecasts (ECMWF), United Kingdom
- Met Office, United Kingdom
- European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), Germany
- Universität Bern, Switzerland
- Universität Wien, Austria
- Fundação da Faculdade de Ciências da Universidade de Lisboa, Portugal
- All-Russian Research Institute of Hydrometeorological Information, Russia
- Mercator Océan, France
- Météo-France (MF), France
- Deutscher Wetterdienst, Germany
- Centre Européen de Recherche et de Formation Avancée en Calcul Scientifique, France
- Centro Euro-Mediterraneo Sui Cambiamenti Climatici SCaRL, Italy
- Ilmatieteen Laitos, Finland
- University of Reading, United Kingdom
- Institut National de Recherche en Informatique et en Automatique, France
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PROJECT INFORMATION

European Reanalysis of the Global Climate System (ERA-CLIM2)

Contract N°: 607029
Starting Date: 01/01/2014
Duration: 36 months
EU Contribution: € 6.996.159,48
Estimated total cost: € 15.280.778,58

ERMES

An Earth Observation Model Based Rice Information Service



From top to bottom: © CNR-IREA, Italy; COSMO-SkyMed Product - ©ASI - Agenzia Spaziale Italiana - (2013). All rights reserved; Credits: Landsat 8 (2013) - NASA/USGS

Rice agricultural landscape in Italy: field, multitemporal SAR and multispectral optical satellite views.



Mirco BOSCHETTI
Project Coordinator

ABSTRACT

ERMES aims to develop a prototype of downstream services based on the assimilation of Earth Observation (EO) and in-situ data within crop model. Two services are foreseen: Regional Rice Service (RRS) customised for providing public authorities with an agro-monitoring system for crop mapping, yield estimating and risk forecast and Local Rice Service (LRS) for the private sector (farmers, agro-services) providing added value information on yield variability, risk alert and crop damage at farm scale.

INNOVATIVE SPACE BASED SERVICES DEDICATED TO RICE SECTOR

The agricultural sector is facing important global challenges due to the pressure of food demand, increased price-competition produced by market globalisation and food price volatility (G20 Agriculture Action Plan) and needs of more environmentally and economically sustainable farming. Earth Observation (EO) systems can significantly contribute to these topics by providing reliable real time information on crop distribution, status and seasonal dynamics.

ERMES aims to assimilate EO and in-situ data in crop modelling for building a prototype of downstream services dedicated to the rice sector.

The tasks of the EO component are: to perform rice mapping and monitoring by exploiting the synergetic use of Synthetic Aperture Radar (SAR) and optical data, to customise existing biophysical EO-products and to derive meteorological variables from geo-stationary satellite data to be used in model simulations of rice growth and development. Smart technologies will be the basis for in-situ data collection and return of added value information to the users.

ERMES services are aiming at supporting regional authorities in the implementation of agro-environmental policies; promoting solutions for sustainable management practices in farming activities and providing independent reliable information to the agro-business sector.

The prototype will be tested in Europe with the long-term goal of extending it to Asian and African markets, in order to boost European competitiveness and contribute to sustainable development.

The maturity of the Copernicus core products and the advent of the Sentinel missions are the proper framework to develop EO-based services, targeted at the agriculture sector, to make regional agro-monitoring feasible and local agro-consulting possible.

QUESTIONS & ANSWERS

What is the project designed to achieve?

ERMES aims to create added-value information for the agrosector by integrating in crop models, operational Copernicus core products, maps derived from SAR and optical data processing and in-situ observations. Two services will be created for regional authorities and local agro-business. Advanced smart technologies will be used to collect in-situ observations and return customised information to end-users.

Why is this project important for Europe and how does it benefit European citizens?

The agricultural sector in Europe is facing the challenge to maintain and improve its competitiveness by reducing production costs and minimising environmental impact of agricultural practices. ERMES will contribute to achieve the objective of sustainable agriculture needs by developing operational methods able to monitor crop status during the season and to capture field spatial variability of the production.

How does the project exceed the current state of knowledge ?

ERMES takes advantage of Copernicus Land Services and proposes innovative approaches for the integration of optical and SAR data provided by Sentinel missions. Such high temporal/spatial resolution satellite products and in-situ observations, acquired by smart technologies, are assimilated into crop yield model to provide added value information customised to public and private stakeholders of the agrosector.

LIST OF PARTNERS

- Consiglio Nazionale delle Ricerche, Istituto per il Rilevamento Elettromagnetico dell'Ambiente, Italy
- Università degli Studi di Milano, Italy
- SARMAP SA, Switzerland
- Universitat De Valencia, Spain
- Universitat Jaume I De Castellon, Spain
- Aristotelio Panepistimio Thessalonikis, Greece
- Demeter, Cereal Institute, Greece

COORDINATOR

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PROJECT INFORMATION

An Earth Observation Model Based Rice Information Service (ERMES)

Contract N°: 606983
Starting Date: 01/03/2014
Duration: 36 months
EU Contribution: € 2.477.583,00
Estimated total cost: € 3.356.866,11



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A storm in Porthleven, Cornwall.

ABSTRACT

The main objective of EUCLEIA is to develop a quasi-operational attribution system, well calibrated on a set of test cases for European extreme weather. The system will provide to targeted groups of users, well-verified, well-understood assessments on the extent to which certain weather-related risks have changed due to human influence on climate. Moreover, those types of weather events where the science is still too uncertain to make robust assessments will be identified.

PROVIDING DECISION-MAKERS WITH TIMELY AND RELIABLE ASSESSMENTS ON HOW EXTREME WEATHER RISK IN EUROPE IS CHANGING DUE TO HUMAN INFLUENCE

Climate change is expected to impact extreme weather in Europe. Recent heat waves, floods and droughts have demonstrated the vulnerability of European citizens to extreme weather and have highlighted the need to adapt effectively to climate change. At the same time, information is often lacking, in the aftermath of such events, as to what extent these events can be linked to anthropogenic climate change. This could lead to poor adaptation decisions if, for example, events are assumed to be a harbinger of things to come when they are associated largely with natural variability.

EUCLEIA is a three-year project that brings together eleven partners with an outstanding scientific profile in climate research. The project aims to develop a quasi-operational event attribution system for Europe to provide reliable information about weather and climate risks and how they are changing.

The system will be used to investigate heat waves, cold spells, floods, droughts and storm surges and will provide well-verified assessments of the extent to which such weather-related risks have changed due to human and natural influences on climate. The system will also identify those types of weather events where the science is still too uncertain to make a robust assessment of attributable risk. Information will become available on a range of time scales, from a fast-track basis in the aftermath of extreme events, to a seasonal and annual basis.



Peter STOTT
Project Coordinator

QUESTIONS & ANSWERS

What is the project designed to achieve?

EUCLEIA will develop an attribution system that will be used to quantify the link between climate change and European climate and weather extreme events. Scientifically robust, timely and reliable assessments of attributable changes in the risk of extremes will become available to stakeholders in a way that effectively meets the requirements of different user groups.

Why is this project important for Europe and how does it benefit European citizens?

Attribution assessments from EUCLEIA will form the scientific basis of effective adaptation to climate-related changes in extreme weather in Europe. The project will provide information that will help improve the ability of European businesses, regional and national authorities and citizens to make effective decisions in climate- and weather- sensitive sectors, enabling better adaptation for European citizens to on-going climate change.

How does the project exceed the current state of knowledge ?

EUCLEIA will combine for the first time a set of statistical and model-based methodologies into a single quasi-operational service that will provide regular attribution assessments, together with well calibrated confidence levels. Moreover, EUCLEIA will demonstrate the value of attribution products for European decision makers, by engaging with targeted groups of stakeholders throughout the project.

LIST OF PARTNERS

- Met Office, United Kingdom
- Eidgenössische Technische Hochschule Zurich, Switzerland
- Centre National de la Recherche Scientifique (CNRS), France
- University of Edinburgh, United Kingdom
- Fundacio Institut Catala de Ciencies del Clima, Spain
- Danmarks Meteorologiske Institut, Denmark
- Royal Netherlands Meteorological Institute (KNMI), the Netherlands
- University of Reading, United Kingdom
- The Chancellor, Masters and Scholars of the University of Oxford, United Kingdom
- Helmholtz-Zentrum Geesthacht - Zentrum für Material und Küstenforschung GMBH, Germany
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PROJECT INFORMATION

EUropean Climate and weather Events: Interpretation and Attribution (EUCLEIA)

Contract N°: 607085
Starting Date: 01/01/2014
Duration: 36 months
EU Contribution: € 2.990.915,16
Estimated total cost: € 4.061.705,86

FAST

Foreshore Assessment using Space Technology



Visual representation of the FAST project, in which satellite images and field data will be combined to create a software tool together with end-users.

ABSTRACT

Typically, effects of vegetated foreshores are not included in flood risk analyses. Their inclusion may reduce costs for flood risk mitigation and adaptation measures. The objective of FAST is to develop a software tool based on satellite data and field measurements from eight different foreshore case study areas in four different countries. This tool will allow end-users to determine the contribution of vegetated foreshores to flood hazard.

ASSESSMENT OF EFFECTS OF VEGETATED FORESHORES ON FLOOD HAZARD

The aim of the FAST project is to develop a software tool for water managers and consultants allowing them to determine the role of vegetated foreshores in reducing flood hazard by wave attenuation and soil stabilization. This may reduce future investments for flood risk mitigation and adaptation measures. The FAST consortium will generate a standardised tool for integrating ecosystem properties into flood risk management strategies. To achieve this objective, EO data from satellites such as Sentinel and field measurements will be combined in case studies.

The development of the FAST tool requires estimating physical and biological characteristics of foreshore ecosystems from satellite images. To do so, it will need field data calibration, the development of relationships between ecosystem and flood safety properties of foreshores and the translation of science into engineering and economic language.

A key aspect of FAST is the involvement of end-users during the design, development and validation of the software.

The end-user groups included different stakeholders, such as: government agencies, market parties and non-governmental organisations. Close contact with end-users will help to produce tailored tools for regional end-user needs, ensuring commercial uptake and long-term continuation of services.



Mindert DE VRIES
Project Coordinator

QUESTIONS & ANSWERS

What is the project designed to achieve?

The FAST project will further the integration of vegetated foreshores in flood hazard assessments, by advancing quantitative information on their functioning. This will allow inclusion of vegetated foreshores for flood risk mitigation, possibly in combination with other measures, resulting in multifunctional solutions that are cost-effective and enhance other ecosystem services, such as biodiversity and recreation.

Why is this project important for Europe and how does it benefit European citizens?

The FAST project will address the European Flood Directive, the Habitat Directive and the Water Framework Directive, by working towards multifunctional designs that reduce flood risk, while also conserving and restoring natural habitats. These habitats are of vital importance for the well-being of European citizens that depend on these habitats for recreation, fresh air and clean water.

How does the project exceed the current state of knowledge?

Currently, effects of vegetation on flood hazard are not accounted for in flood risk analyses. Although many studies investigated the contribution of vegetation to wave attenuation, there are no general rules for quantification derived yet, especially when making comparisons between different vegetation types. FAST will focus on formulating general rules on how vegetated foreshores contribute to the reduction of flood hazard.

LIST OF PARTNERS

- Stichting Deltares (Deltares), the Netherlands
- The Chancellor, Masters and Scholars of the University of Cambridge, United Kingdom
- Institutul National de Cercetare-Dezvoltare pentru Geologie si Geoecologie Marina, National Institute for Research and Development of Marine Geology and Geoecology (GeoEcoMar), Romania
- Stichting Koninklijk Nederlands Instituut voor Zeeonderzoek, Royal Netherlands Institute for Sea Research (NIOZ), the Netherlands
- Universidad de Cádiz, University of Cádiz (UCA), Spain

COORDINATOR

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PROJECT INFORMATION

Foreshore Assessment using Space Technology (FAST)

Contract N°: 607131
Starting Date: 01/01/2014
Duration: 48 months
EU Contribution: € 2.224.160,00
Estimated total cost: € 2.796.545,43

FLOODIS

Integrating Copernicus Emergency Services with satellite navigation and communications for establishing a flood information service



© Leah Henkel/Calgary Herald

Floods alerting and management, from the citizens, for the citizens.

ABSTRACT

The main goal of FLOODIS project is to develop a platform that will alert professional users and citizens of an impending disaster and subsequently provide them with regular updates and additional information, such as geographical information (map layers via a mobile mapping application) concerning the disaster. Under this project, the disaster alert and information will focus on flood events, but the system can be extended to other types of disasters.

INTEGRATION OF COPERNICUS EMERGENCY SERVICES WITH GNSS AND COMMUNICATIONS TO DELIVER FLOODING ALERTS AND INFORMATIONS

Recent events in different EU member states show that floods are becoming a growing concern and cost for citizens.

The goal of FLOODIS is to respond to this challenge and provide a flood information service that aims at better addressing and mitigating crises arising before, during and after heavy flooding.

FLOODIS will integrate the existing European Copernicus Services, i.e. GIO-EMS and EFAS, with high-accuracy, location-based information from Disaster Management teams, Civil Protection Agencies and citizens, acting as “human sensors”, to produce alerting and management information on the occurring flood events. The FLOODIS solution aims to close a critical gap for Disaster Management teams and Emergency Response Units by providing a centralized comprehensive platform to collect, store and elaborate the information related to the emergency events coming from different sources, including user generated content and social networks analysis.

In order to achieve this the FLOODIS system will depend on four key components: a web-based data management and support system that will act as the system back-end, to ingest and elaborate information and precisely geo-locate users’ information through the EGNOS/EDAS services; an interface system to receive Earth Observation (EO) imagery and data from the Emergency Management Systems and a novel flood forecast model based on EO data and on-field user-generated information; a professional application for emergency response teams to support the emergency event management and a smart phone application for citizens, with which users can contribute to the system (“human sensors”) and receive alerting information.



Fabrizio DOMINICI
Project Coordinator

QUESTIONS & ANSWERS

What is the project designed to achieve?

FLOODIS will provide a centralized cloud-based platform for flood alerts and management. The proposed solution closes a critical gap for disaster management teams/civil protection field/emergency response units to enable them to better manage situations arising during heavy flooding. Furthermore, it will provide a mobile application for citizens, with which users can contribute to the system and receive alerts.

Why is this project important for Europe and how does it benefit European citizens?

In many countries in Europe, the re-occurring flood events cause deaths and great economic damages. FLOODIS is expected to impact significantly on disaster preparedness and damage/accident reduction by alerting professional users and citizens of an impending disaster and subsequently provide them with regular updates and additional information.

How does the project exceed the current state of knowledge?

The operational functioning of the FLOODIS platform will integrate with and enhance on-field procedures for flood alerting and management. It will analyse the flood maps from existing EC services (i.e. GIO-EMS) and their ancillary data, assimilating them into a dedicated geographic information system, and then it will upload them for dissemination to mobile devices of professional users in the field and citizens living in the affected areas.

FLOODIS

Integrating Copernicus Emergency Services with satellite navigation and communications for establishing a flood information service

LIST OF PARTNERS

- Istituto Superiore Mario Boella sulle Tecnologie dell'Informazione e delle Telecomunicazioni (ISMB), Italy
- GEOVILLE Informationssysteme und Datenverarbeitung GMBH, Austria
- United Nations Educational, Scientific and Cultural Organization (UNESCO), France
- ALPHA Consultants S.R.L., Italy
- ND Consult LTD, United Kingdom
- Terranea UG (Haftungsbeschränkt) GMBH, Germany
- EOXPLORE UG (Haftungsbeschränkt) GMBH, Germany

COORDINATOR

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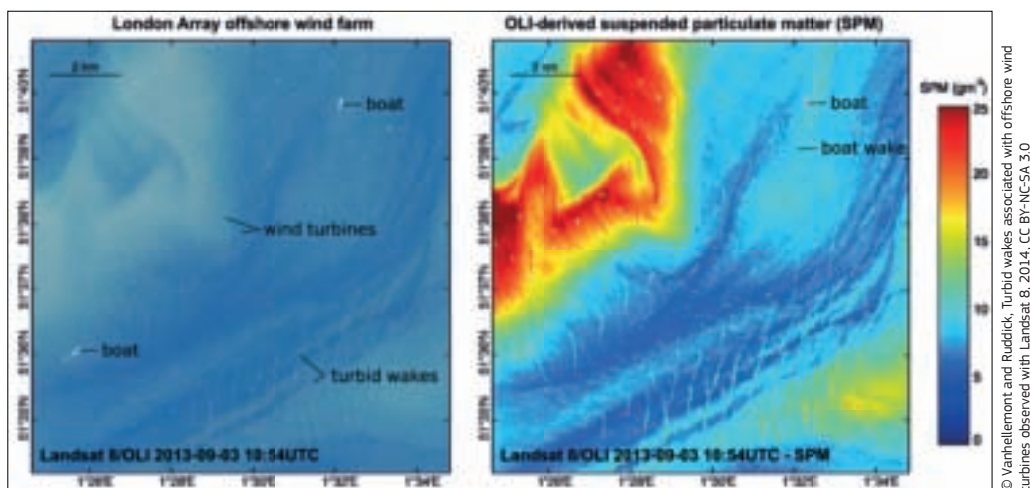
PROJECT INFORMATION

Integrating GMES Emergency Services with satellite navigation and communications for establishing a flood information service (FLOODIS)

Contract N°: 607220
Starting Date: 01/10/2013
Duration: 21 months
EU Contribution: € 1.543.145,00
Estimated total cost: € 2.004.942,60

HIGHROC

HIGH spatial and temporal Resolution Ocean Colour coastal water products and services



Sediments disturbed by the tidal current around the base of offshore wind turbines can be seen from space.

ABSTRACT

The goal of HIGHROC is to improve the spatial and temporal resolution of satellite-derived environmental information in coastal waters, thus creating new satellite applications and strengthening existing ones. The Sentinel-2 and SEVIRI sensors are designed for observing land and clouds. However, with suitably innovative data processing techniques these sensors could be used also for coastal waters. New products from these sensors will be generated, validated and tested by end-users.

DEVELOP NEW PRODUCTS AND SERVICES FROM EARTH OBSERVATION DATA FOR COASTAL WATER APPLICATIONS

The HIGHROC (“HIGH spatial and temporal Resolution Ocean Colour”) project will carry out the R&D necessary for the next generation coastal water products and services from ocean colour space-borne data, giving an order of magnitude improvement in both spatial and temporal resolution.

Services for marine end-users now routinely use data from ocean colour remote sensors such as MODIS and MERIS, to be followed by Sentinel-3 OLCI. Despite their improved coverage with respect to in situ monitoring, these sensors have critical limitations of spatial and temporal resolution (typically 300m, 1/day) with respect to user requirements.

HIGHROC will derive coastal water quality parameters from a) Sentinel-2 (S2) at 10-20m resolution and b) SEVIRI at 15 min resolution, thus complementing OLCI data with a more than 10-fold improvement in spatial and temporal resolutions.

Theoretical work will consist of developing algorithms for the S2 and SEVIRI sensors and for multi-temporal and synergistic exploitation of the new products with existing products. Images will be processed for full mission historical and near real time products, for local areas including the dedicated test sites. In situ measurements will be carried out to validate the new S2 and SEVIRI products.

Exploitation of the products will be supported by interaction with user partners and potential user groups with particular focus on the opportunities offered by the new HIGHROC products, both for entirely new application areas and for significantly improved spatial and temporal resolution for existing applications, e.g. WFD monitoring and reporting.



Kevin RUDDICK
Project Coordinator

QUESTIONS & ANSWERS

What is the project designed to achieve?

Satellite data is already being used to support environmental management of coastal waters. Imagery is available once per day giving information at a spatial resolution of 300m. By using innovative data processing techniques, the HIGHROC project will exploit new satellites (designed for other purposes) to obtain much more detailed information: every 15 minutes and down to space scales of 10m.

Why is this project important for Europe and how does it benefit European citizens?

Coastal waters are used and affected by humans in many ways: fishing, shipping and associated dredging, recreation, sand and gravel extraction, wind energy, waste water, etc. Legislation and monitoring ensures that these activities do not damage severely the environment. Satellite data can be used to monitor coastal waters at the European scale. HIGHROC will make this monitoring more effective.

How does the project exceed the current state of knowledge?

Currently, satellite-derived information in coastal waters giving the concentration of chlorophyll (indicating algae) and suspended particulate matter (small particles in the water) is limited to about once per day (if cloud-free) and space scales down to 300m. The HIGHROC project will greatly improve the frequency of such data to every 15 minutes and the spatial resolution, down to 10m.

HIGHROC

HIGH spatial and temporal Resolution Ocean Colour coastal water products and services

LIST OF PARTNERS

- Royal Belgian Institute for Natural Sciences (RBINS), Operational Directorate Natural Environment (OD Nature), Belgium
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- Norsk Institutt for Vannforskning (NIVA), Norway
- Brockmann Consult (BC), Germany
- Flemish Institute for Technological Research (VITO), Belgium
- Centre for Environment, Fisheries and Aquaculture Science (CEFAS), United Kingdom

COORDINATOR

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PROJECT INFORMATION

HIGH spatial and temporal Resolution Ocean Colour coastal water products and services (HIGHROC)

Contract N°: 606797
Starting Date: 01/01/2014
Duration: 48 months
EU Contribution: € 2.497.909,10
Estimated total cost: € 3.315.293,14

ICOS-INWIRE

Integrated Carbon Observation System improved sensors, network and interoperability for Copernicus



© Michel RAMONET

Frost-covered instruments at the ICOS station in Puy-de-Dôme, France. Requirements on robust measurement systems in ICOS-INWIRE are based on extreme environmental conditions.

ABSTRACT

In a changing climate, long-term integrated observations are needed to monitor the carbon cycle. Surface-observing networks form the backbone of the observation infrastructure while satellite measurements provide global coverage. Both data streams are ultimately combined by data assimilation approaches. ICOS-INWIRE develops research to improve the robustness of the surface network (including ICOS and TCCON), enabling better data provision to the users of combined surface, and satellite measurements in Copernicus.

IN-SITU MONITORING OF FLUXES AND CONCENTRATIONS OF GHG FOR COPERNICUS

Greenhouse gases (GHG) are the primary drivers of climate change. Accurate quantification of their fluxes is needed to tackle the climate challenge. The required observations include Essential Climate Variables (ECVs), such as carbon dioxide (CO₂) and methane (CH₄), as well as complementary parameters describing the biogeochemical and dynamic environment. Measurements started in the 1950's in Mauna Loa, Hawaii; now large surface networks and spaceborne missions document the global GHG distribution. High precision surface measurements act as primary data source and metrological reference, whereas satellite observations provide a complete geographical mapping of the key variables.

Copernicus atmospheric pre-operational services include a greenhouse gas component. To better serve this component, ICOS-INWIRE helps the European Integrated Carbon Observing System (ICOS) research ways to improve the robustness of, and further expand, its distributed network.

State-of-the-art GHG monitoring networks have a good coverage over Western Europe, North America and China, but show an insufficient density over regions with vulnerable carbon pools, such as Arctic permafrost covered regions, or tropical ecosystems in Africa and South-America. Data-assimilation models and satellite retrievals are poorly constrained and validated in these regions. ICOS-INWIRE addresses the challenge by conceiving, developing and testing intelligent, robust sensor systems that can be deployed at remote locations, and transmit high-quality, near-real-time processed data.

ICOS-INWIRE enables and extends the provision of GHG data by merging new, in-situ GHG observations (ICOS) and surface remote sensing (Total Carbon Column Observing Network, TCCON) to validate satellite retrievals and data assimilation results within the Copernicus Atmosphere and Land modelling communities.



Jean-Daniel PARIS
Project Coordinator

QUESTIONS & ANSWERS

What is the project designed to achieve?

The project will help make available more and better greenhouse gas data to users, based on more robust measurement systems and from an expanding network of surface stations. The project is designed to meet the particular needs of pre-operational users in the context of Copernicus and notably the atmospheric component MACC-II.

Why is this project important for Europe and how does it benefit European citizens?

Climate change is one of the most challenging problems that humanity will have to cope with in the coming decades. Deeper understanding of the driving forces of climate change requires full quantification of the greenhouse gas emissions and sinks. Besides remarkable technological externalities, the project will enable European citizens and decision makers to have access to improved greenhouse gas data.

How does the project exceed the current state of knowledge?

ICOS-INWIRE contributes to the convergence of spaceborne and in-situ network data, which so far has not been achieved for carbon data. ICOS-INWIRE also develops sensor and data systems required for the ICOS research infrastructure. Lidar-based estimation of the atmospheric boundary layer height, for example, is now being turned into a robust, multi-parameter, physics-based method useful for data assimilation users.

ICOS-INWIRE

Integrated Carbon Observation System improved sensors, network and interoperability for Copernicus

LIST OF PARTNERS

- Commissariat à l'Energie Atomique et aux Energies Alternatives (CEA), France
- Max-Planck-Gesellschaft zur Förderung der Wissenschaften (MPG), Germany
- Stichting VU-VUmc (VUA), the Netherlands
- Università degli Studi della Tuscia (UNITUS), Italy
- Helsingin yliopisto (UHEL), Finland
- Fundación Centro de Estudios Ambientales del Mediterráneo (CEAM), Spain
- Lunds universitet (ULUND), Sweden
- Universität Bremen (UBREMEN), Germany

COORDINATOR

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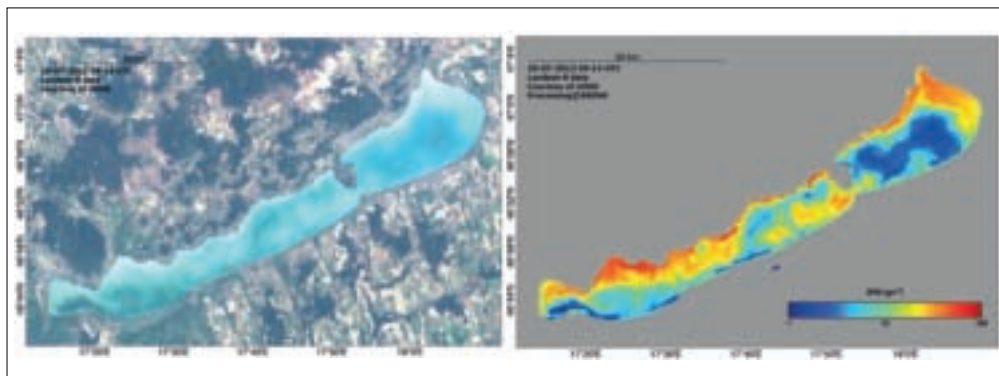
PROJECT INFORMATION

ICOS improved sensors, network and interoperability for Copernicus (ICOS-INWIRE) - 5th call project

Contract N°: 313169
Starting Date: 01/01/2013
Duration: 36 months
EU Contribution: € 1.999.898,00
Estimated total cost: € 2.599.697,40

INFORM

Improved Monitoring and Forecasting of Ecological Status of European Inland Waters by Combining Future Earth Observation data and Models



Picture left: Landsat 8 image acquired on 29th July 2013 of Lake Balaton, Hungary; Picture right: Suspended Particulate Matter (SPM) map of Lake Balaton, Hungary derived from Landsat 8 image acquired on 29th July 2013.



Ils REUSEN
Project Coordinator

ABSTRACT

The main objective of INFORM is to develop and demonstrate new and improved user-driven products for inland water quality monitoring and forecasting which fully exploit the improved spectral, spatial and temporal capabilities of upcoming Earth Observation (EO) missions.

NEW AND IMPROVED EARTH OBSERVATION PRODUCTS COUPLED WITH BIOGEOCHEMICAL MODELS FOR INLAND WATER QUALITY MONITORING AND FORECASTING

Nowadays, Earth Observation (EO) is underutilized for the monitoring of inland water quality mainly due to the complexity of these waters, the lack of adequate analysis methods to deal with this complexity and the lack of adequate low-cost EO data.

With the advent of the Sentinel-2, Sentinel-3 and the hyperspectral EnMAP and PRISMA satellites, a wealth of new EO data at improved spectral, spatial and temporal resolution becomes available in the coming years.

INFORM will explore and demonstrate how the improved capabilities of these upcoming sensors, combined with innovative methods and the coupling with biogeochemical models can be exploited to deliver new and improved products for inland water quality monitoring and forecasting addressing better the end-user needs.

To develop these products a large suite of in-situ data and airborne hyperspectral images of European inland waters is already available.

The airborne hyperspectral imaging sensor APEX with new in-situ measurements will be used for the simulation of the upcoming satellite data, algorithm development and validation.

At an early phase of the INFORM project and mid-term, end-users will be consulted to stimulate uptake of the INFORM results by modellers, water managers and policy makers.

INFORM will contribute to the development of inland water quality products to extend the Pan-European Inland Water Quality Service which is part of the proposed Copernicus Inland-Water Service and which will enable European access to inland water quality products.

Finally, INFORM developments will lead to recommendations for future EO missions taking into account requirements for inland water quality monitoring.

QUESTIONS & ANSWERS

What is the project designed to achieve?

INFORM aims to deliver, based on improved characteristics of upcoming satellite sensors, a new/improved set of inland water quality products better addressing the end-user needs. Once these sensors are operational, INFORM products could be integrated into a Copernicus Inland-Water Service.

In addition, INFORM aims to provide recommendations for future satellite missions dedicated to inland water quality monitoring.

Why is this project important for Europe and how does it benefit European citizens?

Water is an indispensable resource for the life of humans, plants and animals. The EU Water Framework Directive supported by the Blueprint communication to safeguard Europe's water resources is there to protect these valuable EU water resources. EO techniques can provide harmonized water quality products to complement in situ measurements for reporting water quality by the EU member states.

How does the project exceed the current state of knowledge?

Current EO based inland water quality retrieval is based on a limited set of sensors with shortcomings in spectral and spatial resolution. The improved spatial resolution and the new spectral bands of upcoming sensors allow new state-of-the-art analysis techniques to be used to study the water bodies in much higher level of detail.

INFORM

Improved Monitoring and Forecasting of Ecological Status of European Inland Waters by Combining Future Earth Observation data and Models

LIST OF PARTNERS

- Flemish Institute for Technological Research (VITO), Belgium
- Consiglio Nazionale delle Ricerche (CNR), Italy
- EOMAP GmbH & Co.KG, Germany
- University of Stirling, United Kingdom
- Royal Belgian Institute for Natural Sciences (RBINS), Operational Directorate Natural Environment (OD Nature), Belgium
- Stichting Deltares, the Netherlands
- Plymouth Marine Laboratory, United Kingdom
- Magyar Tudományok Akadémia Okológiai Kutatóközpont, Hungary
- Klaipėdos Universitetas, Lithuania

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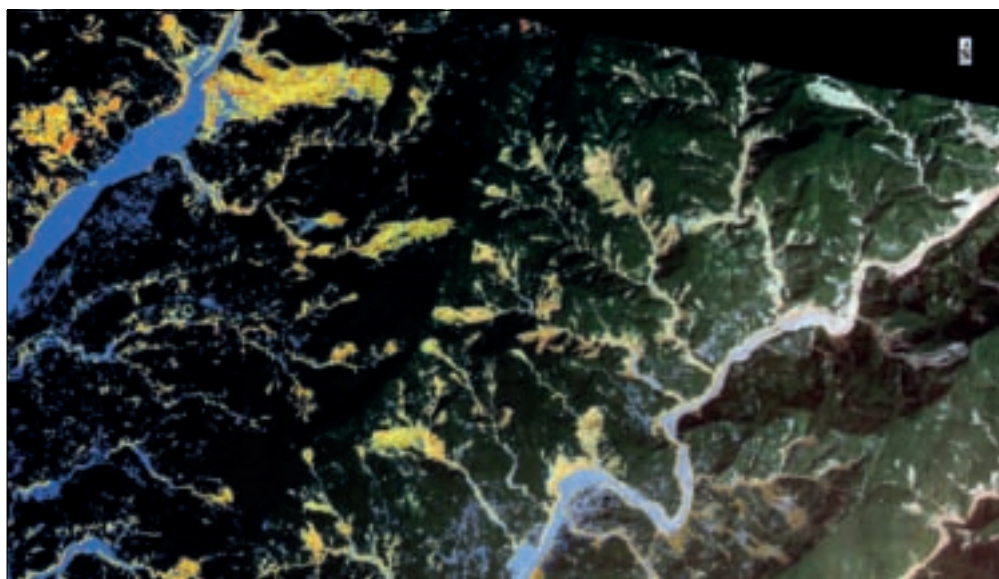
PROJECT INFORMATION

Improved Monitoring and Forecasting of Ecological Status of European Inland Waters by Combining Future Earth Observation Data and Models (INFORM)

Contract N°: 606865
Starting Date: 01/01/2014
Duration: 48 months
EU Contribution: € 1.991.902,97
Estimated total cost: € 2.609.191,52

LAMPRE

LAndslide Modelling and tools for vulnerability assessment
Preparedness and REcovery management



Transparency gradient of a probabilistic inventory map. Probability ranges from yellow (high) and blue (low).

ABSTRACT

LAMPRE exploits Earth Observation to improve the detection and mapping of landslides, and to assess the impact of landslide events. LAMPRE innovative research and technological developments will foster the Copernicus operational capacity to cope with triggered landslide events and their consequences in Europe and elsewhere. The products and services of LAMPRE will enhance landslide risk mitigation and preparedness efforts, and post-event recovery and reconstruction activities in vulnerable landslide regions.

MAPPING LANDSLIDES FROM SPACE TO REDUCE THE VULNERABILITY TO LANDSLIDES AND TO ENHANCE PREPAREDNESS AND RECOVERY EFFORTS

Landslides move rocks, debris or earth down a slope. Intense or prolonged rainfall, rapid snowmelt, earthquakes and human actions are the main triggers of landslides. A single storm or earthquake can generate tens of thousands of landslides, in areas of thousands of square kilometres. Landslides can be very destructive, and they claim lives and cause damages every year in Europe.

Our current ability to recognize and map landslides, and to evaluate the vulnerability to landslides of buildings, roads, railways and the population, is limited. Preparing landslide maps after a major triggering event, evaluating the propensity of a landscape to generate landslides, and assessing the risk posed by slope failures is important for land planning and for the design of effective mitigation strategies. However, these tasks are difficult, time consuming and expensive to accomplish.

LAMPRE exploits modern Earth Observation (EO) data and technologies to accelerate the production of accurate landslide maps, to assess the impact of landslide events and to facilitate the evaluation of the vulnerability to landslides. LAMPRE develops guidelines for the production of landslide inventory maps and software tools for landslide modelling and the design of vulnerability scenarios.

LAMPRE is tested in vulnerable landslide areas in Europe, Asia and Central America. We expect that this will facilitate adoption of the LAMPRE products and services, and will enhance landslide risk mitigation and preparedness efforts, as well as post-event recovery and reconstruction activities in highly vulnerable landslide regions in Europe and elsewhere.



Fausto GUZZETTI
Project Coordinator

QUESTIONS & ANSWERS

What is the project designed to achieve?

The current capability to recognize and map landslides over large areas, and to evaluate the vulnerability to landslides, is limited. LAMPRE exploits modern Earth Observation (EO) data and technologies to enhance our ability to detect and map slope failures, rapidly and accurately. LAMPRE products and services will foster the Copernicus operational capacity to cope with triggered landslide events and their consequences.

Why is this project important for Europe and how does it benefit European citizens?

Landslides claim lives every year in Europe and they represent a serious threat to public and personal properties, to environmental and economic assets and to the cultural heritage. Existing evaluations underestimate the impact of slope failures in Europe. LAMPRE will improve our ability to detect and map landslides, as well as to assess the impact of landslide events in Europe.

How does the project exceed the current state of knowledge?

Today, landslides are still mapped in the field or through the visual analysis of stereoscopic aerial photographs. These are time-consuming and error-prone operations. LAMPRE develops innovative techniques that exploit high and very-high resolution images captured by satellite and airborne sensors, together with geological and geomorphological information to facilitate the semi-automatic recognition and mapping of landslides.

LAMPRE

LAndslide Modelling and tools for vulnerability assessment Preparedness and REcovery management

LIST OF PARTNERS

- Consiglio Nazionale delle Ricerche (CNR), Italy
- Presidenza del Consiglio dei Ministri - Dipartimento della Protezione Civile, Italy
- King's College London, United Kingdom
- Altamira Information SL, Spain
- Instituto Geológico y Minero de España, Spain
- Università degli Studi di Firenze, Italy
- Booz & Company BV (Strategy&), the Netherlands
- Federal Department for Environment Transports Energy and Communication, Switzerland
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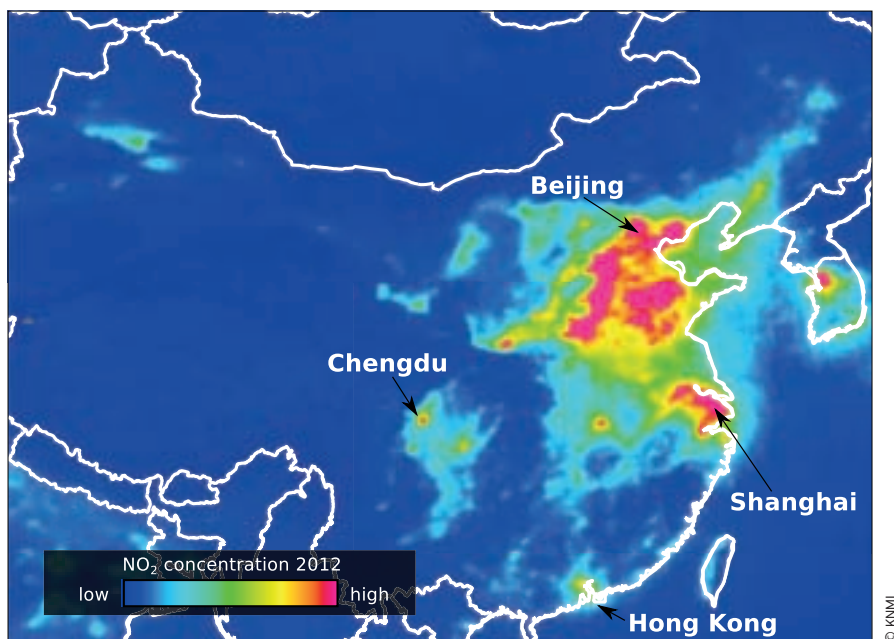
PROJECT INFORMATION

LAndslide Modelling and tools for vulnerability assessment Preparedness and REcovery management (LAMPRE) - 5th call project

Contract N°: 312384
Starting Date: 01/03/2013
Duration: 24 months
EU Contribution: € 1.964.196,00
Estimated total cost: € 2.488.007,40

MarcoPolo

Monitoring and Assessment of Regional air quality in China using space Observations – Project Of Long-term Sino-European co-Operation



NO2 concentrations over China in the year 2012 measured by the OMI satellite instrument.



Ronald VAN DER A
Project Coordinator

ABSTRACT

The main objective of MarcoPolo is to improve air quality monitoring, modelling and forecasting over China using satellite data. During the project a new emission inventory will be constructed, by combining Chinese and European expertise. It will be based on recent satellite data and GIS information. The new emission inventory will improve the air quality modelling and forecasts.

IMPROVEMENT OF AIR QUALITY MONITORING, MODELLING AND FORECASTING OVER CHINA USING SATELLITE DATA

Due to the strong economic growth in China in the past decade, air pollution has become a serious issue in many parts of the country. For this reason up-to-date regional air pollution information and means for emission control of the main pollutants are becoming more and more important.

Within the preceding FP6-project, 'Air Quality Monitoring and Forecasting in China', it was concluded that modelling of air quality, and therefore the forecast capabilities, are hampered by the rapidly changing emission data due to economic growth. In addition, there are no practical instruments to evaluate the effect of air quality measures on changes in emissions.

Therefore, Marco Polo, which is the follow-up project, will focus will on emission estimates from space and the refinement of these emission estimates by spatial downscaling and by source sector apportionment. A wide range of data will be used from various satellite instruments.

From these satellite data, emission estimates will be made for anthropogenic and biogenic sources. With various state-of-the-art techniques, up-to-date emission inventories will be created. By combining these emission data with known information from the ground, a new emission database for MarcoPolo will be constructed.

Central in the MarcoPolo project will be the improved emission inventory based on the latest satellite observations. The new emission inventory is an input to air quality models and is expected to improve the existing air quality modelling and forecasts considerably. We will demonstrate the resulting air quality information by running models on both regional and urban scale.

QUESTIONS & ANSWERS

What is the project designed to achieve?

The main objective of MarcoPolo is to improve air quality monitoring and modelling by constructing a new emission database over East China based on satellite data. Strengthening the Sino-European co-operation is vital for the success of constructing this emission inventory and for the validation activities. Another objective is the dissemination of MarcoPolo products to the identified end-users, including scientists, policy makers and the public.

Why is this project important for Europe and how does it benefit European citizens?

Air pollution is a global issue and crosses national boundaries. Knowledge gained about air quality in China can help improve the air quality worldwide. In addition, building on the existing cooperation from previous initiatives, strengthened and expanded within the MarcoPolo project, we expect an enduring cooperation between the involved groups from China and Europe.

How does the project exceed the current state of knowledge?

MarcoPolo aims at scientific progress in different domains: air quality monitoring, emission estimates from satellite data, source apportionment of emissions, air quality assessment and forecasts. For example, by combining proxy data and satellite data we get for the first time monthly updates of satellite-based emission data that directly reflect economic changes, technological measures and air quality policies.

MarcoPolo

Monitoring and Assessment of Regional air quality in China using space Observations – Project Of Long-term Sino-European co-Operation

LIST OF PARTNERS

- Royal Netherlands Meteorological Institute (KNMI), the Netherlands
- Aristotelio Panepistimio Thessalonikis, Greece
- Institut d'Aeronomie Spatiale de Belgique (IASB/BIRA), Belgium
- Danmarks Meteorologiske Institut, Danmark
- Democritus University of Thrace, Greece
- Ilmatieteen Laitos (FMI), Finland
- Institute of Atmosphere Physics, China
- IsardSAT, Spain
- National Observatory of Athens, Greece
- Hefei Institute of Physical Sciences, China
- Nederlandse organisatie voor toegepast natuurwetenschappelijk onderzoek (TNO), the Netherlands
- Peking University, China
- Tsinghua University, China
- Flemish Institute for Technological Research (VITO), Belgium
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PROJECT INFORMATION

Monitoring and Assessment of Regional air quality in China using space Observations – Project Of Long-term Sino-European co-Operation (MarcoPolo)

Contract N°: 606953
Starting Date: 01/01/2014
Duration: 36 months
EU Contribution: € 1.997.380,00
Estimated total cost: € 2.901.414,80

North State

Enabling Intelligent GMES Services for Carbon and Water Balance Modelling of Northern Forest Ecosystems



Boreal pine forest on peat land in Finland.

©Tuomas Häme



Tuomas HÄME
Project Coordinator

ABSTRACT

The objective of North State is to develop innovative data fusion methods that exploit the new generation of multi-source data from Sentinels and other satellites in an intelligent, self-learning framework that interfaces state-of-the-art carbon and water flux models with a view to monitor these fluxes over boreal Europe with the aim of reducing their current high uncertainty. This will provide a paradigm for the development of products for future Copernicus services.

MONITORING OF CARBON AND WATER FLUXES FOR PAN-BOREAL EUROPE THROUGH INNOVATIVE METHODS

One of the greatest sources of uncertainty in climate predictions is the feedback between climate and changes in land surface processes, with northern high latitudes being particularly important because of the vast store of carbon in northern forests and peat lands. Such feedback includes the following key land processes: modifications in the spatial and seasonal patterns of vegetation, snow and albedo alter the associated radiative and biogeochemical balances and have major land surface and atmospheric feedback; disturbances, particularly fire, are linked to climate through large-scale atmospheric circulation patterns, and contribute to the inter-annual variations in atmospheric carbon dioxide in the Northern Hemisphere.

A further key factor of change, with associated consequences for greenhouse gas (GHG) emissions, is increased Russian forest activity, with significantly more clear-felling.

Russian forest resources information is largely outdated and the development trend of forest biomass is not well known.

Knowledge on the carbon and water balances, how they change under climate warming and the effects on GHG fluxes is crucial to understanding the resulting feedback. Current estimates of flux rates, based on national forest inventories, are highly uncertain and lack spatial resolution. There is, therefore, an urgent need to develop a system to monitor high latitude changes and to assess their consequences.

Earth Observation (EO) techniques with the Sentinel satellites of the Copernicus program offer a great potential for the monitoring of carbon and water balances. However, more automated data analysis using intelligent algorithms needs to be developed to fully utilise the data and to ensure that European service providers remain competitive.

QUESTIONS & ANSWERS

What is the project designed to achieve?

Novel multi-sensor and multi-temporal approaches will be developed and demonstrated to provide information for the carbon and water balance models. A key output of the study will be recommendations for new Copernicus services and future space missions based on identified gaps in capabilities to serve the needs of carbon and water models.

Why is this project important for Europe and how does it benefit European citizens?

The methodological development of the North State project will lead to the establishment of new Copernicus services. This will create job opportunities, especially in small, innovative service companies oriented on Earth Observation applications. The services will improve citizens' possibilities to stay up to date with the developments in the fragile boreal and arctic areas and potential negative effects of exploitation of their natural resources.

How does the project exceed the current state of knowledge?

The project will provide information that reduces the great uncertainty in climate predictions through providing novel information on the feedback between climate and changes in land surface processes. This will provide a paradigm for the development of products for future Copernicus services that will be applicable far beyond its specific application to the boreal zone.

North State

Enabling Intelligent GMES Services for Carbon and Water Balance Modelling of Northern Forest Ecosystems

LIST OF PARTNERS

- Technical Research Centre of Finland (VTT), Finland
- University of Helsinki, Finland
- University of Sheffield, United Kingdom
- Northern Research Institute Tromsø AS, Norway
- Simosol Oy, Finland
- Institute of Biology of Komi Science Centre of Ural Department of Russian Academy of Science, Russia
- University of Iceland, Iceland

COORDINATOR

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PROJECT INFORMATION

Enabling Intelligent GMES Services for Carbon and Water Balance Modeling of Northern Forest Ecosystems (North State)

Contract N°: 606962
Starting Date: 01/10/2013
Duration: 36 months
EU Contribution: € 1.993.022,00
Estimated total cost: € 2.600.875,00

PANDA

Partnership with chiNa on space DAta



Envisat satellite and NO2 tropospheric column over Asia.

ABSTRACT

Through the proposed scientific cooperation between Europe and China, the project will improve methods for monitoring air quality from space and from the surface, develop simple indicators for air quality in support of policies, produce toolboxes for easy access by the public of data on air quality and develop related educational activities. A comprehensive system for the prediction of air quality, including health hazards during pollution episodes, will be developed.

USING SPACE OBSERVATIONS, IN-SITU DATA AND ADVANCED NUMERICAL MODELS TO MONITOR, ANALYSE AND FORECAST GLOBAL AND REGIONAL AIR QUALITY

The objective of the PANDA project is to establish a team of European and Chinese scientists who will jointly use space observations and in-situ data, as well as advanced numerical models to monitor, analyse and forecast global and regional air quality. PANDA will provide to users and stakeholders knowledge, methodologies and toolboxes that will serve as a basis for global and regional air quality analysis and forecasts. It will provide science-based information that will improve air quality management by regional and local authorities. An education activity will be undertaken to train users in China to use the key products and data generated by the project.

Through the proposed cooperation between Europe and China, the following objectives will be reached before the completion of the project: improvement of methods for monitoring air quality from combined space and in-situ observations; elaboration of indicators for air quality, in support of European and Chinese policies;

development of toolboxes for air quality and emissions monitoring and dissemination of information and educational activities.

The PANDA project is organised around 7 work packages dealing with remote sensing data, in-situ observations, anthropogenic and natural emissions, integration of observations and models, toolbox development, cooperation, dissemination of knowledge and capacity building, and management and coordination.

The project will support the European Space Policy and specifically the Copernicus Programme (formerly GMES - Global Monitoring for Environment and Security). It will contribute to the development of the Global Earth Observation System of Systems (GEOSS).



Guy P. BRASSEUR
Project Coordinator

QUESTIONS & ANSWERS

What is the project designed to achieve?

The project will make use of European space observations and Chinese surface measurements of chemical pollutants to initialise a prediction model of air pollution on a global and regional scale. The emphasis will be on the analysis and predictions of ozone and particle matter in the atmosphere over Asia.

Why is this project important for Europe and how does it benefit European citizens?

This project will make full use of European space observations to better understand the chemical and physical mechanisms that govern the formation of air pollution in heavily industrialized and populated areas. It will help improve air pollution prediction in many parts of the world, including Europe, and will show the technical and scientific leadership of the European space activities.

How does the project exceed the current state of knowledge ?

This project will bring together for the first time European space and Chinese ground-based observations to improve air pollution predictions by an advanced regional chemical transport model operating at an unprecedented spatial resolution of a few kilometres. This prototype system, if adopted for operational predictions, will be at the forefront of air pollution prediction system.

LIST OF PARTNERS

- Max-Planck Gesellschaft/Max-Planck-Institute for Meteorology (MPI-M), Germany
- Laboratoire Atmosphères, Milieux, Observations Spatiales, Centre National de la Recherche Scientifique (CNRS), France
- European Centre for Medium-range Weather Forecasts (ECMWF), United Kingdom
- Institute for Environmental Physics of the University of Bremen, Germany
- Norwegian Meteorological Institute (MI), Norway
- University of Leicester, United Kingdom
- Université Libre de Bruxelles (ULB), Belgium
- Sun Yat-Sen University, Guangzhou, China
- Peking University, Beijing, China
- Institute of Atmospheric Physics of Chinese Academy of Sciences, Beijing, China
- National Satellite Meteorological Center, Beijing, China
- Nanjing University of Information Science and Technology, Nanjing, China
- Tsinghua University, Beijing, China
- Shanghai Center for Urban Environmental Meteorology and Fudan University, Shanghai, China

COORDINATOR

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PROJECT INFORMATION

Partnership with chiNa on space DAta (PANDA)

Contract N°: 606719
Starting Date: 01/01/2014
Duration: 36 months
EU Contribution: € 1.999.492,00
Estimated total cost: € 2.626.886,60

PHAROS

Project on a Multi-Hazard Open Platform for Satellite Based Downstream Services



© Deutsches Zentrum für Luft- und Raumfahrt (DLR)

PHAROS: Providing Satellite Based Downstream Services for Multi-Hazard Applications.

ABSTRACT

The main objective of PHAROS is to design and implement an innovative multi-hazard, open service platform, which integrates space-based observation, satellite communications and navigation (Galileo/GNSS) asset. It provides sustainable (pre-operational) services for a wide variety of users in multi-application domains, such as prediction/early detection of emergencies, population alerting, environmental monitoring, crisis management and risk management, targeting several users, such as crisis managers, operators of critical infrastructures, insurance companies and scientists and representatives of academia.

MULTI-HAZARD OPEN PLATFORM FOR SATELLITE-BASED DOWNSTREAM SERVICES

Satellite-based systems have become essential for disaster response and relief. On the one hand, Earth Observation (EO) satellites provide highly valuable data for forecast, monitoring and disaster impact evaluation. On the other hand, satellite communication systems, reliable and robust in emergency situations of natural and man-made disasters, can be used to rapidly restore communications for responders, but also for citizens. Furthermore, satellite navigation systems are indispensable for logistics, first aid resources deployment and rescue operations.

PHAROS focuses on developing a sustainable, pre-operational open service platform which integrates space-based observation, communications and navigation technologies to provide innovative services for a wide variety of users and application domains. Multi-hazard applications such as the prediction/early detection of emergencies, population alerting, environmental monitoring, crisis management and risk assessment are managed through a single, user-friendly interface, targeting several

users (crisis managers, operators of critical infrastructures, insurance companies, scientists and representatives of academia).

Through a flexible, scalable and modular architecture, the platform will integrate the following services: satellite EO data access and in-situ sensors and processing; decision support services, based on data fusion and situation assessment techniques; a simulation platform for hazard modelling and risk assessment and an alert message gateway providing warnings through a variety of communications means.

The project will culminate with a pre-operational demonstration of a realistic forest fire exercise, organised and controlled by fire brigades, during which the entire platform will be challenged and all services will be validated by the end-users.



Cristina PÁRRAGA NIEBLA
Project Coordinator

QUESTIONS & ANSWERS

What is the project designed to achieve?

The objective of PHAROS is to provide enhanced pre-operational services for a wide range of users in multi-application domains, such as prediction/early detection of emergencies, alerting, environmental monitoring, crisis and risk management, by designing and implementing an innovative multi-hazard, open service platform, which integrates space-based observation, satellite communications and navigation (Galileo/GNSS) and benefits from the synergies between the different technologies.

Why is this project important for Europe and how does it benefit European citizens?

The PHAROS concept can be applied at local, regional, national and international level, laying the foundations of a pan-European system which integrates disaster detection, monitoring, management and alerting of the population. The system will be a valuable asset for emergency services to help reduce the impact of crisis, both in terms of loss of lives and damages.

How does the project exceed the current state of knowledge?

Existing detection, monitoring, crisis management and alerting tools are operated in an independent fashion nowadays, making it impossible to have a general overview of the crisis situation. The PHAROS system provides an integrated approach that fulfils the gap between the different operational worlds and benefits from existing synergies.

PHAROS

Project on a Multi-Hazard Open Platform for Satellite Based Downstream Services

LIST OF PARTNERS

- Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Germany
- Tecnosylva, Spain
- Avanti Communications, United Kingdom
- Space Hellas, Greece
- IQ wireless, Germany
- Fundació d'Ecologia del Foc i Gestió d'Incendis Pau Costa Alcubierre, Spain
- Stichting Platform Mobile Messaging, the Netherlands
- Eutelsat, France

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PROJECT INFORMATION

Project on a Multi-Hazard Open Platform for Satellite Based Downstream Services (PHAROS)

Contract N°: 606982
Starting Date: 01/12/2013
Duration: 30 months
EU Contribution: € 2.499.440,00
Estimated total cost: € 3.422.706,40

POLAR ICE

Integrated Arctic & Antarctic sea-ice monitoring services



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POLAR ICE will put information about ice conditions into the hands of people working at sea.

ABSTRACT

POLAR ICE is focused on the economically and environmentally important Arctic and Antarctic regions and has three main aims: to establish an operational sea ice information service, integrating existing national and European infrastructure; to develop new products and services to meet known requirement gaps; to ensure POLAR ICE is end-user driven, thereby reducing risks for offshore operators, shipping and the environment, reducing costs and providing information for climate change monitoring.

STIMULATING ARCTIC & ANTARCTIC SEA ICE MONITORING SERVICES THROUGH END-USER ENGAGEMENT AND THE INTEGRATION OF NEW SERVICE LINES INTO GMES DOWNSTREAM SERVICES

Polar Ice will develop a next generation sea ice information service by integrating and building on a wide range of existing European and nationally funded activities.

Access to sea ice information is critical to support the increasing numbers of Arctic and Antarctic shipping and off-shore operations and to protect the rapidly changing polar environment. In the Arctic the retreat of the sea ice during the last two decades has facilitated an enormous increase in oil and gas exploration and development, accompanied by increased shipping activity. The Antarctic is also seeing increased ship traffic driven by fisheries, cruise ships and scientific research.

Past and current funding of European capability has reflected the critical importance of sea ice information for both the safety and efficiency of marine transportation, plus adaptation to regional climate change.

However previously funded projects have addressed distinct elements of the complete service chain. The Polar Ice project will link these together, fill in known gaps and ensure a robust operational service.

This project will also develop a number of new sea-ice monitoring services, specifically for the Arctic and Antarctic regions, including sea ice pressure, thickness and forecast products. The project will also investigate the transfer of current sea ice forecasting methods from the Baltic Sea to wider application in the Arctic and Antarctic.

POLAR ICE products and services will be delivered to a wide range of end-users through a new "single point of entry" web portal, which will meet a gap in current service provision, for which there is a known requirement.



Nick WALKER
Project Coordinator

QUESTIONS & ANSWERS

What is the project designed to achieve?

The project aims to establish an operational integrated polar sea ice information service, including new products to meet existing gaps. This will reduce risks for shipping and reduce operating costs. Polar Ice will also mitigate risks of environmental damage and provide information to assist in the understanding of climate change.

Why is this project important for Europe and how does it benefit European citizens?

POLAR ICE will ensure that European technology is equipped to meet the needs of an expanding market as an increasing number of vessels are operating in polar waters. This will improve the competitiveness of the European industry, providing leadership and sustainable growth. POLAR ICE will address important societal issues such as improving transportation security, reducing the risks of natural and man-made disasters and providing information that will feed into climate change monitoring.

How does the project exceed the current state of knowledge?

POLAR ICE will: provide an integrated service for delivery to Arctic and Antarctic marine operators; integrate products from the new Sentinel satellites and facilitate a wider engagement with users operating in the polar waters. This will improve the delivery and integration of information into users' on-board systems and develop new sea ice information products (sea ice pressure, sea ice thickness charts and sea ice forecasts).

POLAR ICE

Integrated Arctic & Antarctic sea-ice monitoring services

LIST OF PARTNERS

- eOsphere Limited, United Kingdom
- Natural Environmental Research Council (BAS), United Kingdom
- Danish Meteorological Institute (DMI), Denmark
- Polar View Earth Observation Limited, United Kingdom
- Finnish Meteorological Institute (FMI), Finland
- Technical Research Centre of Finland (VTT), Finland
- Norwegian Computing Centre (NR), Norway
- Norwegian Meteorological Institute (MI), Norway
- Swedish Meteorological and Hydrological Institute (SMHI), Sweden
- Technical University of Denmark (TUD), Denmark
- University of Bremen, Germany
- Kongsberg Satellite Services (KSAT), Norway
- C-Core, Canada
- Hickling Arthurs Low, Canada

COORDINATOR

eOsphere Limited, United Kingdom

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PROJECT INFORMATION

Integrated Arctic & Antarctic sea-ice monitoring services (POLAR ICE)

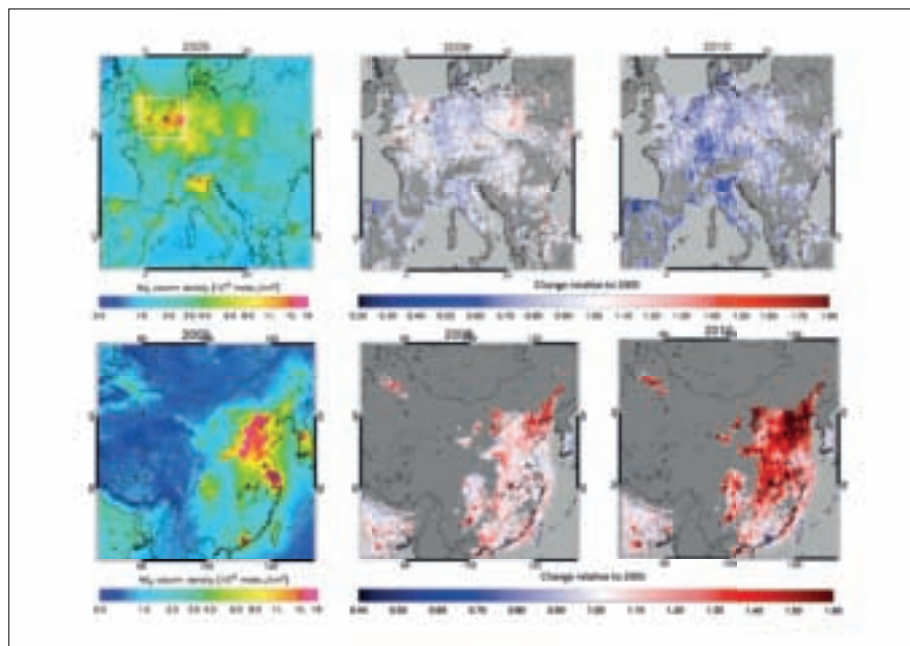
Contract N°: 606935

Starting Date: 01/01/2014

Duration: 24 months

EU Contribution: € 2.500.000

Estimated total cost: € 3.489.673,86



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OMI tropospheric NO₂ columns and their relative changes over Europe (upper panels) and eastern Asia (lower panels).

ABSTRACT

The main objective of QA4ECV is to develop a robust system for the quality assurance of satellite and in-situ algorithms that will be applied to Essential Climate Variables, in particular to 3 atmospheric ECV precursors (NO₂, HCHO, and CO) and 3 land ECVs (albedo, leaf area index, absorbed photosynthetically active radiation) that will be generated within the project. QA4ECV will facilitate satellite data users in judging the fitness-for-purpose of ECVs.

QUALITY ASSURANCE SYSTEM FOR SATELLITE DATA RECORDS AND GENERATION 3 ATMOSPHERE PRECURSOR AND 3 LAND ECVs

Although Earth Observation data is plentiful, it is still rare to have reliable, traceable, and understandable quality information on satellite data records. The situation is often further confused because various versions of the same product exist from data providers using different retrieval algorithms.

Users need an internationally acceptable Quality Assurance (QA) framework that establishes and provides understandable traceable quality information for the data products used in climate services. This will ensure that long-term data sets are historically linked and, in the future, automatically harmonised in an efficient and interoperable manner.

QA4ECV will address these issues by developing a robust generic system for the QA of satellite and in-situ algorithms that can be applied to all Essential Climate Variables in a prototype for future sustainable services in the frame of the Copernicus Climate Change Service.

Multi-use tools and SI/community reference standards will be developed.

QA4ECV will generate quality-assured multi-decadal climate data records for 3 atmospheric ECV precursors (nitrogen dioxide, formaldehyde, and carbon monoxide) and 3 land ECVs (albedo, leaf area index and absorbed photosynthetically active radiation), with full uncertainty metrics for every pixel. The generic QA framework will be applied to these ECVs. QA4ECV will engage with all stakeholders, including other ECV projects, governance bodies and end-users, developers of Climate Services and relevant projects. QA4ECV is a major step forward in providing quality assured long-term climate data records that are relevant for policy and climate change assessments.



Folkert BOERSMA
Project Coordinator

QUESTIONS & ANSWERS

What is the project designed to achieve?

The objective of QA4ECV is two-fold: to design and develop a generic quality assurance system that can be applied by users to evaluate whether a satellite data set is mature enough for a particular purpose. The second goal is to generate long-term (30-year) data records of atmosphere and land parameters relevant to air pollution and climate change.

Why is this project important for Europe and how does it benefit European citizens?

QA4ECV will help scientists and policy makers in judging the usefulness of satellite data. This is especially important for policy makers who are increasingly relying on Earth Observation (EO) data to make decisions on mitigating and adapting to climate change. These decisions need to be 'evidence-based' and this requires complete confidence in EO-derived products.

How does the project exceed the current state of knowledge?

Currently, there is no coherent and consistent framework for quality assurance of satellite data in place. QA4ECV will develop such a system for ECVs, tied to SI-standards. The project will also provide consolidated, multi-decadal ECVs for which no consistent long-term time series exists yet. These atmosphere and land ECVs will include the uncertainty information needed to make full use of them.

LIST OF PARTNERS

- Royal Netherlands Meteorological Institute (KNMI), the Netherlands
- Institut d'Aeronomie Spatiale de Belgique (IASB/BIRA), Belgium
- Universität Bremen (IUP-UB), Germany
- Max Planck Gesellschaft zur Förderung der Wissenschaften E.V. (MPG), Germany
- Université Libre de Bruxelles (ULB), Belgium
- Aristotelio Panepistimio Thessalonikis (AUTH), Greece
- Agencia Estatal Consejo Superior de Investigaciones Cientificas (CSIC), Spain
- Wageningen University (WU), the Netherlands
- Science and Technology B.V. (S&T), the Netherlands
- University College London (UCL), United Kingdom
- Joint Research Centre (JRC), European Commission, Belgium
- European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), Germany
- Brockmann Consult GMBH (BC), Germany
- FastOpt GmbH (FO), Germany
- Rayference, Belgium
- NPL Management Limited (NPL), United Kingdom
- CGI IT UK Limited (CGI), United Kingdom

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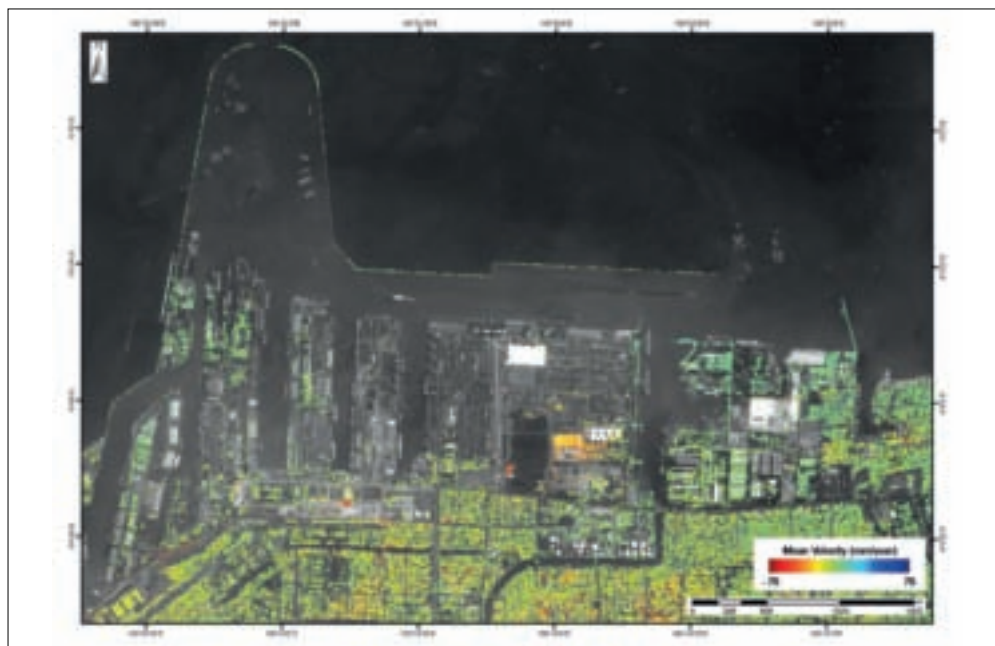
PROJECT INFORMATION

Quality Assurance for Essential Climate Variables (QA4ECV)

Contract N°: 607405
Starting Date: 01/01/2014
Duration: 48 months
EU Contribution: € 4.998.772,00
Estimated total cost: € 6.995.631,00

RASOR

Rapid Analysis and Spatialisation of Risk



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Subsidence rate measured by high resolution Synthetic Aperture Radar Satellite data overlaid on a hi-resolution optical satellite image - Jakarta, Indonesia.

ABSTRACT

RASOR will develop a platform to perform multi-hazard risk analysis for the full cycle of disaster management, including targeted support to critical infrastructure monitoring and climate change impact assessment. A scenario-driven query system simulates future scenarios based on existing or assumed conditions and compares them with historical scenarios. Initially available over five case study areas, RASOR will ultimately offer global services to support in-depth risk assessment and full-cycle risk management.

EMPOWERING RISK MANAGERS BY OFFERING UP-TO-DATE EO-BASED AND IN-SITU INFORMATION ON HAZARDS AND EXPOSURE

Climate change challenges our understanding of risk by modifying hazards and their interactions. Sudden increases in population and rapid urbanisation are changing exposure to risk around the globe, making impacts harder to predict. Despite the availability of operational mapping products, there is no single tool to integrate diverse data and products across hazards, update exposure data quickly and make scenario-based predictions to support both short and long-term risk-related decisions.

RASOR offers a single work environment that generates new risk information across hazards, across data types (satellite Earth Observation, in-situ), across user communities (global, local, climate, civil protection, insurance, etc.) and across the world. RASOR uses the 12m TanDEM-X Digital Elevation Model as a base layer, and then adds archived and near-real time very-high resolution optical and radar satellite data, combined with in-situ data.

A scenario-driven query system allows users to model multi-hazard risk both before and during an event. Managers can use actual scenarios when determining new mitigation or prevention measures, and integrate new, real-time data into their operational system during disaster response.

RASOR is structured along three tracks: a global risk assessment service, and SME-led national and local services through innovative partnering arrangements. These tracks are validated in five geographic locations with end users and practitioners, as well as with international organisations. A three-phase approach allows RASOR to: demonstrate the technological feasibility of the concept to develop a global tool and apply RASOR services to specific user segments and geographic areas.



Roberto RUDARI
Project Coordinator

QUESTIONS & ANSWERS

What is RASOR designed to achieve?

RASOR will improve risk assessment by serving as an information integrator for satellite and in-situ data at local, national and international levels. It will provide a robust backbone for multi-hazard, end-to-end, full-cycle disaster and risk management. RASOR acts on each element of the risk equation, offering regularly updated hazard information, up-to-date and complete exposure data and dynamic vulnerability evaluation.

Why is this project important for Europe and how does it benefit European citizens?

Within Europe, RASOR will allow for in-depth understanding of risk, integrating satellite and in-situ data in complex, scenario-driven, multi-hazard risk assessments, before an event, or as it unfolds. Outside Europe, especially in countries with little data, RASOR brings proven methodologies based on standardised satellite-EO data products that offer rapid, synoptic analyses to support European and global assistance before, during and after crises.

How does the project exceed the current state of knowledge?

RASOR is the first integrated platform to provide risk assessment across multiple hazards, using satellite EO and in-situ data. RASOR offers improved accuracy by using the 12m TanDEM-X DEM as a base layer. The ability to assess future impacts before and during crises, as events unfold, empowers risk and disaster managers supporting both immediate and long-term risk reduction.

LIST OF PARTNERS

- Centro Internazionale in Monitoraggio Ambientale - Fondazione CIMA, Italy
- Athena Global Europe SAS, France
- Acrotec SRL, Italy
- Universite de Strasbourg – SERTIT, France
- Deltares, the Netherlands
- Centro Europeo di Formazione e Ricerca in Ingegneria Sismica (EUCentre), Italy
- Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Germany
- Istituto Nazionale di Geofisica e Vulcanologia (INGV), Italy
- National Observatory of Athens (NOA), Greece
- Altamira Information SL (ALT), Spain

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PROJECT INFORMATION

Rapid Analysis and Spatialisation of Risk (RASOR)

Contract N°: 606888
Starting Date: 01/12/2013
Duration: 30 months
EU Contribution: € 2.459.756,00
Estimated total cost: € 3.218.916,00

SAFI

Support to Aquaculture and Fishery Industry



SAFI, by using last generation of satellites data, will support aquaculture and fishery industries.

ABSTRACT

The main objective of the SAFI project is to develop decision support tools and services based on satellite data (in particular the future Sentinel-2 and -3 products) and in-situ derived environmental indicators to assist aquaculture deployment, i.e. optimisation of cages location with respect to environmental and ecological context, and operations monitoring in near-real time. The project will also support fisheries operations and management.

SUPPORT OUR MARITIME ECONOMY'S FISHERIES AND AQUACULTURE SECTORS WITH SATELLITE-DERIVED INFORMATION AND SERVICES

The objective of SAFI project is to exploit Earth Observation (EO) resources to support fishery and aquaculture industries in marine coastal regions. The service, based on a value-added network of Small and Medium Enterprises (SMEs), is adapted to each category of targeted users. By making the best use of emerging EO products, the project aims at developing services to assist aquaculture deployment (optimisation of cages location with respect to environmental and ecological context) and environmental monitoring during operations as well as supporting fishery by providing indicators of recruitments, abundances, and shell/fish locations, and its variability due to the climate change.

In this perspective, SAFI fosters the use of the latest generation of satellite sensors and, in particular, those on-board the future European Space Agency (ESA) Sentinel missions (Sentinel 2 and 3).

The export capacity and acceptance of the developed services will be then evaluated on several pilot sites in Europe (Spain, Portugal, Ireland and France) and demonstrated in Morocco. Finally, SAFI also allows the set-up of a network of SMEs at different levels of expertise (and EO awareness), required by the service, in order to build a consistent and marketable offer.

The project will finally lead to the development, deployment and evaluation of integrated web-GIS, broadcasting SAFI indicators for the various users concerned (industrial, public administrations in charge of fishery or aquaculture planning, EO service providers, general public) that will be fed by a service of EO high-level data processing.



Antoine MANGIN
Project Coordinator

QUESTIONS & ANSWERS

What is the project designed to achieve?

By taking advantage of new operational products from Earth Observation (EO), the SAFI project addresses the need for tailored decision support tools by assisting fisheries and aquaculture management and operations. The developed services will be distributed through a service line, linking and relying on the expertise of SMEs and research institutes, brought together in the project consortium.

Why is this project important for Europe and how does it benefit European citizens?

SAFI promotes a respectful and sustainable exploitation of the environment, by giving advice to the fisheries and aquaculture actors. Services will indeed guide them towards a development and optimisation of their activities, improving their productivity and creating new opportunities for employment. Promotion of sustainable aquaculture will help to ensure a balanced fish stock and to address the growing demand for seafood.

How does the project exceed the current state of knowledge?

By applying a multidisciplinary approach joining oceanographers, data scientists and biologists, SAFI aims to analyse all relevant and available information gathered through the latest generation of satellite sensors, in-situ datasets and models to: derive relevant information for aquaculture and fishery stakeholders (administrations, farmers, advisors and researchers), and thus to provide a clearer picture of how these activities may be sustainably planned for finfish and bivalves.

LIST OF PARTNERS

- ACRI-ST, France
- University College Cork, National University of Ireland (UCC), Ireland
- COFREPECHE, France
- Instituto Portugues do Mar e da Atmosfera IP (IPMA), Portugal
- Instituto Andaluz de Investigacion y Formacion Agraria Pesquera Alimentaria y de la Produccion Ecologica (IFAPA), Spain
- Daithi O'Murchu Marine Research Station LTD (DOMMRS), Ireland
- Université Hassan II Ain Chock Casablanca (UH2C), Morocco

COORDINATOR

ACRI-ST, France

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PROJECT INFORMATION

Support to Aquaculture and Fishery Industry (SAFI)

Contract N°: 607155
Starting Date: 01/10/2013
Duration: 36 months
EU Contribution: € 1.959.025,00
Estimated total cost: € 2.509.843,60

SEN3APP

Processing Lines and Operational Services Combining Sentinel and In-Situ Data for Terrestrial Cryosphere and Boreal Forest Zone



Finnish National Satellite Data Reception Center in Sodankyla, Finland.



Ali Nadir ARSLAN
Project Coordinator

ABSTRACT

SEN3APP aims at the development, implementation, operationalisation and validation of Sentinel data processing lines for cryospheric (terrestrial) and land cover/phenology applications. Both global and regional applications are included, focusing on high latitudes of the Earth and other parts of the cryosphere. An essential aspect of the project is the development and harmonization of data processing modules/routines in order to facilitate new European satellite data processing capabilities for the European and global user community.

SENTINEL-SATELLITE DATA PROCESSING LINES FOR REGIONAL AND GLOBAL CRYOSPHERIC (TERRESTRIAL) AND LAND COVER / PHENOLOGY APPLICATIONS

The Sentinel satellites aim at frequent global coverage of the Earth surface. This enables the use of well-established satellite products, built up with earlier more research-oriented satellites, to be used for the benefit of users in six core areas of Copernicus: security, land, climate change, atmosphere, emergency and marine. The SEN3APP addresses three of these, namely climate change, land monitoring and security.

The SEN3APP processing lines will utilise Synthetic Aperture Radar (SAR) and medium/high resolution optical/IR-range data from Sentinels 1, 2 and 3. An essential aspect of the project is the development and harmonization of data processing modules/routines in order to facilitate new European satellite data processing capabilities for the European and global user community. For selected applications/products, the processing lines will also provide the automated validation tools.

Operational capabilities of FMI Sodankylä satellite data centre are applied to host part of the infrastructure and also complete processing lines. The overall objective of the proposed project is to provide end-users with products and services relevant to: Numerical Weather Prediction (NWP); land surface processes and albedo; local/regional scale climate change studies and planning of adaptation strategies; ecosystem studies and assessment of ecosystem services; evaluation of nutrient leaching, caused by different land use and management practices for implementation of Water Framework Directive objectives; hydrological forecasting and monitoring, including hydro-power industry; flood prevention and water resources assessment; carbon balance monitoring and assessment; environmental monitoring, including disasters, forest diseases and crop yield; construction and logistics related to soil frost and permafrost (roads, buildings, timber collection).

QUESTIONS & ANSWERS

What is the project designed to achieve?

SEN3APP project addresses the topic of continuous and accurate monitoring of snow, glaciers, lake ice, soil (frost) and land cover/forest changes in the Earth's cryosphere, and in the boreal forest zone.

SEN3APP is aimed at developing a standardized, fully validated and sustainable products and services on snow, glaciers, lake ice, soil and land cover change / phenology.

Why is this project important for Europe and how does it benefit European citizens?

SEN3APP will capitalise on the high investments in the space sector made in Europe and worldwide by utilising Sentinel satellites data. It will build upon, integrate and widen structural and technical capabilities of the European service providers, contributing to the project according to their respective operational public mandates or commercial ambitions. The services created in SEN3APP will further increase the utilisation of EO-data for public safety.

How does the project exceed the current state of knowledge?

The family of Sentinels will provide a new generation of data applicable to cryospheric and boreal area products and services. The recent advances in the remote sensing of cryosphere, phenology and land cover change assessment will be adapted to the family of Sentinels. In addition, fully automatised processing lines, system control and enhanced validation procedures will be established.

SEN3APP

Processing Lines and Operational Services Combining Sentinel and In-Situ Data for Terrestrial Cryosphere and Boreal Forest Zone

LIST OF PARTNERS

- Finnish Meteorological Institute (FMI), Finland
- Gamma Remote Sensing Research and Consulting AG, Switzerland
- Enveo Environmental Earth Observation Information Technology GMBH, Austria
- Finnish Environment Institute, Finland
- Technical Research Centre of Finland (VTT), Finland

COORDINATOR

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PROJECT INFORMATION

Processing Lines and Operational Services Combining Sentinel and In-Situ Data for Terrestrial Cryosphere and Boreal Forest Zone (SEN3APP)

Contract N°: 607052
Starting Date: 01/12/2013
Duration: 36 months
EU Contribution: € 2.212.191
Estimated total cost: € 2.916.586

SWARP

Ships and Waves Reaching Polar regions



© Timothy Williams, NERSC

Broken sea ice in the Fram Strait in September 2013, seen from the Norwegian icebreaker KV Svalbard.

ABSTRACT

SWARP aims at extending operational services supporting maritime transport safety in the Marginal Ice Zone (MIZ) to include forecasts of waves in ice-covered seas, forecasts of sea ice in the presence of waves, and remote sensing of both waves and sea ice conditions in the MIZ. These will enhance the Copernicus downstream services in Polar Regions. Besides maritime transport, SWARP also targets offshore operations, civil security, and coastal and environmental management in the Arctic.

MONITORING AND NUMERICAL PREDICTION OF WAVES IN THE MARGINAL ICE ZONE FOR SAFER NAVIGATION

The sea ice is retreating from the Arctic, stimulating dreams of industrial developments and touristic exploitation. But the ice-free ocean leaves room for generating long waves that penetrate the MIZ. These waves-in-ice are dangerous for human lives, material property and the environment (for example they represent a risk factor for oil spills).

However, there are currently no services providing any information about either the waves themselves or their effects on the ice state (in particular the distribution of ice floe sizes). The monitoring and forecasting systems developed in SWARP aim to become operational by the middle of the project, filling a gap in the present marine services of Copernicus.

A waves-in-ice model will be first validated and then included in the downstream forecasting services provided by MyOcean (Arctic Marine Forecasting Center) and as part of Prévimer (global wave forecasts).

In addition to wave and sea ice forecast models, the project will develop satellite observation methods for waves in-ice and other ice properties in the MIZ.

Existing and new satellite observing systems, especially Synthetic Aperture Radar (SAR) data, will be utilized for retrieval of waves and ice properties in the MIZ. The project will run operationally using data from future Copernicus satellites, such as Sentinel-1. The project will also integrate the new met-ocean services into state-of-the-art technology for onboard navigation and shore-based contingency planning. The maritime transport user group is directly involved in the project through the participation of an innovative SME, (NAVTOR AS) that is developing the navigation and planning software.



Laurent BERTINO
Project Coordinator

QUESTIONS & ANSWERS

What is the project designed to achieve?

The project is designed to bridge together three scientific disciplines: operational modelling of waves, operational modelling of sea ice, and satellite remote sensing. It will make extensive use of the new ESA Sentinel-1 satellite and of the MyOcean marine services. The project also anticipates the application of new regulations for "paperless navigation".

Why is this project important for Europe and how does it benefit European citizens?

Europe has ambitious plans to use the Arctic for navigation, while aiming at protecting its vulnerable ecosystem. SWARP will provide a dedicated waves-in-ice service onboard ships, by including the new waves and sea ice data into the Electronic Chart Display and Information System. This information will help in the planning of safe Arctic maritime voyages, taking into account risks of waves in ice.

How does the project exceed the current state of knowledge?

As of today there is no system capable of predicting or even providing information on the presence of waves in ice-infested waters over large areas. The project will therefore make new knowledge available through navigation technology, and also through public information systems –, such as those dealing with search and rescue operations and dispersion of oil spills.

LIST OF PARTNERS

- Nansen Environmental and Remote Sensing Center (NERSC), Norway
- Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER), France
- Scientific foundation Nansen International Environmental and Remote Sensing Centre (NIERSC), Russia
- Natural Environment Research Council (NOC), United Kingdom
- NAVTOR AS, Norway
- Université du Québec à Rimouski (ISMER), Canada
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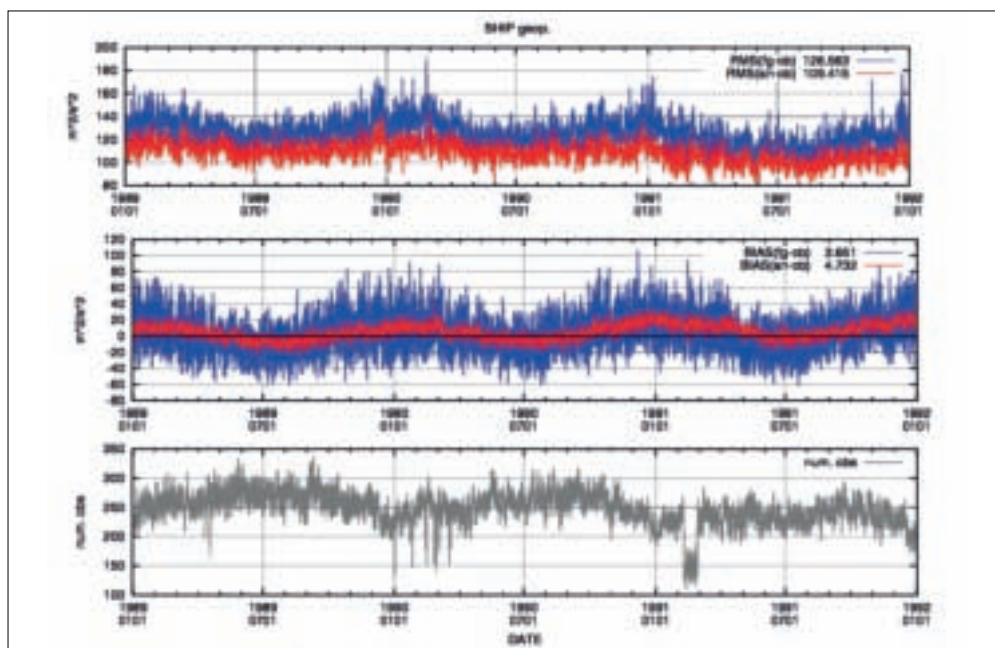
PROJECT INFORMATION

Ships and Waves Reaching Polar regions (SWARP)

Contract N°: 607476
Starting Date: 01/02/2014
Duration: 36 months
EU Contribution: € 2.152.918,97
Estimated total cost: € 2.919.076,30

UERRA

Uncertainties in Ensembles of Regional ReAnalyses



© FP7 UERRA project

Time series of first guess and analysis departure statistics for SHIP pressures during the FP7 EURO4M reanalysis at SMHI.

ABSTRACT

The goal of UERRA is to develop a pre-operational regional (European) climate change service for Copernicus, of Essential Climate Variables. This entails the development and production of a multitude of reanalyses of the past atmospheric state over several decades at as high resolution as possible and the estimation of the uncertainties in the data sets. These will be in the form of gridded observational data sets, advanced model based data assimilation and ensemble data assimilation.

ENSEMBLES OF EUROPEAN REGIONAL METEOROLOGICAL REANALYSES OF ESSENTIAL CLIMATE VARIABLES WITH ESTIMATED UNCERTAINTIES

The meteorological conditions in Europe over a large part of the preceding decade will be reanalysed from all available observations. Data rescue of observations from manual archives through digitisation and quality processing will continue from EURO4M but with emphasis on the sub-daily time scale for reanalysis use. The reanalyses will both be made directly from observations (gridding) or, to a large extent, by assimilating comprehensive sets of many types of observations into meteorological models.

Uncertainties will be estimated in one way from the quality of observations. Most of the model assimilations will be run in ensemble mode and the spread of such reanalyses will provide another measure of uncertainty. The UERRA reanalyses will be made at quite high resolution, from 40 km of ensembles and 20 or 11 km and 5 km for the various model-based reanalyses. All data sets can then be compared with independent observations not used e.g. from space or from gridded climate observations and another estimate of uncertainty

can be obtained. The reanalyses will also be used in hydrological off-line models and give another independent measure. Statistical modelling and investigations of time and space dependencies will give further insight.

Large data sets of atmospheric and surface variables will be produced, archived and data services will be provided to facilitate wide use of the products both among scientists and policy makers.

User involvement and evaluation will take place through workshops in the beginning and at the end of the project.



Per UNDÉN
Project Coordinator

QUESTIONS & ANSWERS

What is the project designed to achieve?

UERRA is designed to deliver observations and atmospheric data sets of climate quality and to show the quality and uncertainty for climate research and applications in Europe. There will be a multitude of reanalyses (or ensembles) with different strengths. All the data sets shall be made available through user friendly data services.

Why is this project important for Europe and how does it benefit European citizens?

The project provides atmospheric multi-decadal climate data of an extent and quality that has never been available before. This will help meteorological climate research in terms of validating and calibrating models, as well as support climate adaptation.

How does the project exceed the current state of knowledge?

There will be several new European reanalysis data sets and the different uncertainty estimates are completely novel. Several methods will be developed and explored. The time period is much longer than before and the horizontal resolution of the analyses is much higher. There are novel ensemble-based data assimilation methods that will be developed and validated in UERRA.

LIST OF PARTNERS

- Swedish Meteorological and Hydrological Institute (SMHI), Sweden
- Météo-France (MF), France
- Royal Netherlands Meteorological Institute (KNMI), the Netherlands
- Met Office, United Kingdom
- University of East Anglia (UEA), United Kingdom
- Eidgenoessisches Departement des Innern (EDI), Meteoswiss, Switzerland
- Universitat Rovira i Virgili (URV), Spain
- Administratia Nationala De Meteorologie R.A. (NMA-RO), Romania
- European Centre For Medium-range Weather Forecasts (ECMWF), United Kingdom
- Deutscher Wetterdienst (DWD), Germany
- Norwegian Meteorological Institute (MI), Norway
- Rheinische Friedrich-Wilhelms-Universität Bonn (UB), Germany

COORDINATOR

Swedish Meteorological and Hydrological
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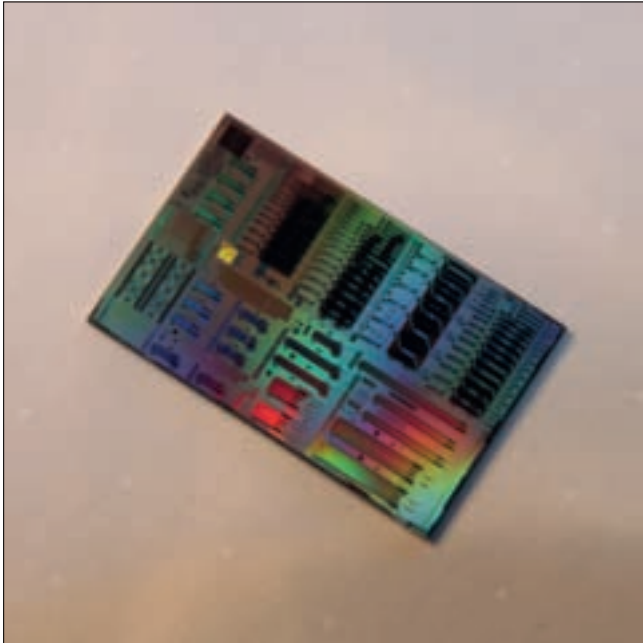
PROJECT INFORMATION

Project Name: Uncertainties in Ensembles of Regional Reanalyses (UERRA)

Contract N°: 607193
Starting Date: 1 January 2014
Duration: 4 years
EU Contribution: € 4.999.907,00
Estimated total cost: €7.072.124,00

BEACON

Scalable & Low-Power Microwave Photonics for Flexible, Terabit Telecom Payloads & High-speed Coherent Inter-satellite Links



© IHP silicon photonics technologies

Die with photonic integrated circuits in IHP technology.

ABSTRACT

BEACON is an application-driven, technology-intensive project. Exploiting the complete value chain in the consortium, BEACON develops the necessary photonic technology for realizing key elements that perform critical functionalities for next generation high capacity flexible telecom satellite payloads. Through functional integration of BEACON components, new photonic processing, amplification and beam-forming sub-systems are designed and developed for evaluating the technology capabilities in reducing cost, footprint and power consumption of next generation satellite telecommunication systems.

DEVELOPMENT OF PHOTONIC INTEGRATED COMPONENTS AND SUB-SYSTEMS FOR REALIZING NEW GENERATION TELECOM SATELLITE PAYLOADS

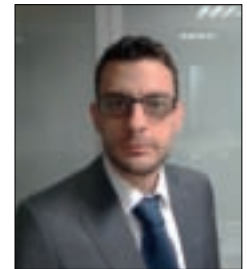
Europe's demand for high-speed broadband bandwidth is constantly increasing. Direct broadcast, broadband multimedia and broadband Internet access requirements are driving the development of next generation telecom satellites and are expected to be a key revenue generator.

First multi-beam multi-gigabit telecommunication satellites have made their debut demonstrating a total capacity approaching 100 Gbit/s. In order to provide such impressive throughputs, these satellites require more than 10kWatt of power to operate and weigh several tonnes during launch. Operators today are demanding increasing bandwidth with expected satellite payload capacities approaching 1Tbit/sec. Responding to these increasing capacity requirements, satellite manufacturers are now investing in new technology solutions that would be scalable in terms of size, weight and power consumption.

A promising solution currently being investigated by major satellite vendors worldwide is the

introduction of photonics into new generation of flexible payloads. High-capacity data signals are transmitted, processed and switched using light, through lightweight, compact and high-performance photonic systems without Electro-Magnetic Interference (EMI). The challenge ahead is the design of new flexible photonic payload architectures and the development of the corresponding key enabling technologies that would support the required functionalities within such new generation of satellites.

BEACON aims to provide this technology and disrupt the transition to multi-beam satellites. Addressing cost, performance and volume, BEACON invests in the right combination of 3 photonic technologies used in terrestrial telecommunications, i.e. electro-optics, fibre-optics and silicon photonics, and combines them to deliver a compact optical beam-forming technology delivering the massive amount of bandwidth.



Efstratios KEHAYAS
Project Coordinator

QUESTIONS & ANSWERS

What is the project designed to achieve?

BEACON aims to provide the missing enabling technologies for the development of a new generation practical, low-cost and high capacity, beam-forming payload system. The BEACON technology will enable the sustained entry of photonics inside satellites, disrupting the capacity upgrade of multi-beam telecommunication satellite payloads and at the same time leverage the R&D investment to address next generation coherent inter-satellite links with fully integrated and practical components.

Why is this project important for Europe and how does it benefit European citizens?

BEACON systematically works towards the development of the required technology for building future telecom satellites. Application of BEACON technology advancements will enable faster and efficient, high-speed satellite internet access and fuel new satellite-based services that require high-speed communication links between satellites and Earth.

How does the project exceed the current state of knowledge?

The introduction of photonics in spacecrafts has been in the spotlight with the prospect of reducing the mass, volume and power consumption of satellite systems with the associated performance improvement and cost reduction. BEACON develops low-voltage and compact GaAs modulator arrays for high speed, coherent, inter-satellite links. It is the world's first radiation-hard multi-core/micro-structured optical amplifier arrays and high speed, miniaturized silicon photonic integrated beam-formers based on novel architectures.

BEACON

Scalable & Low-Power Microwave Photonics for Flexible, Terabit Telecom Payloads & High-speed Coherent Inter-satellite Links

LIST OF PARTNERS

- Constelex Technology Enablers, Greece
- ASTRIUM/AIRBUS Defence & Space, United Kingdom
- U2t Photonics, United Kingdom
- InPhoTech, Poland
- IHP GmbH Innovations for High Performance Microelectronics, Germany
- Instituto de Telecomunicacoes Aveiro, Portugal

COORDINATOR

Constelex Technology Enablers, Greece

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PROJECT INFORMATION

Scalable & Low-Power Microwave Photonics for Flexible, Terabit Telecom Payloads & High-speed Coherent Inter-satellite Links (BEACON)

Contract N°: 607401
Starting Date: 01/02/2014
Duration: 36 months
EU Contribution: € 1.999.727,00
Estimated total cost: € 2.634.665,20

DIFFERENT

Digital beam Forming For low-cost multi-static spaceborne Synthetic aperture radars



DIFFERENT enables formation flight of one master and one small dual-band-satellite.



Anja BOELICKE
Project Coordinator

ABSTRACT

The aim of the DIFFERENT project is to demonstrate the feasibility of a low-cost, low-weight, highly integrated, digital beam-forming (DBF), compact, dual-band (Ka/X), dual polarized Synthetic Aperture Radar (SAR) instrument to overcome cost, weight, power consumption and performance limitations of the current SAR systems and to pave the way for small satellites formation flying missions. The ultimate goal is a highly reconfigurable and scalable satellite constellation for a broad spectrum of remote-sensing applications.

LOW-COST HIGHLY-INTEGRATED COMPACT RADAR FOR FORMATION FLYING MULTISTATIC SAR APPLICATIONS

Satellites used for Earth observation need to meet stringent requirements, such as: high compactness, low weight and size, low power consumption and cost effective operation.

For several future Synthetic Aperture Radar (SAR) missions a constellation of two or more satellites is required. DIFFERENT plans to operate in a formation flying configuration with a transmitter master satellite.

The imaging platform with the digital beam-forming (DBF) architecture at its core would enable the realization of multiple advanced operational modes, could overcome classical SAR limitations, providing high resolution wide swath images and would offer an enhanced overall SAR system performance thanks to innovative DBF techniques.

Radar compactness will be achieved by developing a fully integrated radar antenna where all chips will be integrated on the same board. Due to its simplified architecture and adoption of low-cost, printed circuit board (PCB) technologies the radar

costs will be lower than in the current solutions.

The application areas of the system are not limited to small satellites formation flying on Earth observation missions only. Thanks to its compact size and versatile operational flexibility, this instrument is a potential candidate for other applications, such as future in-orbit space debris collision avoidance systems, where it could be installed on board a spacecraft or airborne security systems for helicopters and Unmanned Aerial Vehicles, where the benefits of the compact SAR with DBF capabilities are crucial. The availability of digital beam forming radars with limited costs opens new possibilities to the creation of networks of multifunction radars, which share their functions between aircraft and weather surveillance.

QUESTIONS & ANSWERS

What is the project designed to achieve?

This project represents a unique opportunity for innovation and transfer of scientific and technological results into real applications on Earth observation missions and in-orbit space debris collision avoidance systems. The distributed functionality in bi- and multistatic SAR will strongly support the use of small, low-cost satellites. Reduced power demands of passive receivers enable an accommodation of the radar payload on micro-satellites.

Why is this project important for Europe and how does it benefit European citizens?

Thanks to its compactness and flexibility the resulting instrument is a candidate for a broad scope of applications, like Earth observation, in-orbit space debris collision-avoidance systems, airborne security systems for helicopters and UAVs, where the benefits of compact SARs are crucial. Furthermore, the DIFFERENT's SAR opens possibilities to new networks of radars which share their functions between aircraft and weather surveillance.

How does the project exceed the current state of knowledge?

The power, volume and cost of SAR systems need to be reduced significantly. Currently, the SAR systems which are used are based on phased-arrays or make use of mechanical steering, which has the problem of high cost, power consumption, size and complexity. DIFFERENT will solve the issue by using the digital beam-forming and passive radar concept and for the first time use a dual-band system instead of a single band system.

DIFFERENT

Digital beam Forming For low-cost multi-static space-borne Synthetic aperture radars

LIST OF PARTNERS

- Silicon Radar GmbH, Germany
- Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Germany
- Evatronix SA, Poland
- Innovative Solutions In Space BV (ISIS), the Netherlands
- IHP GmbH Innovations for High Performance Microelectronics, Germany
- Università della Calabria, Italy
- University of Kent, United Kingdom

COORDINATOR

Silicon Radar GmbH, Germany

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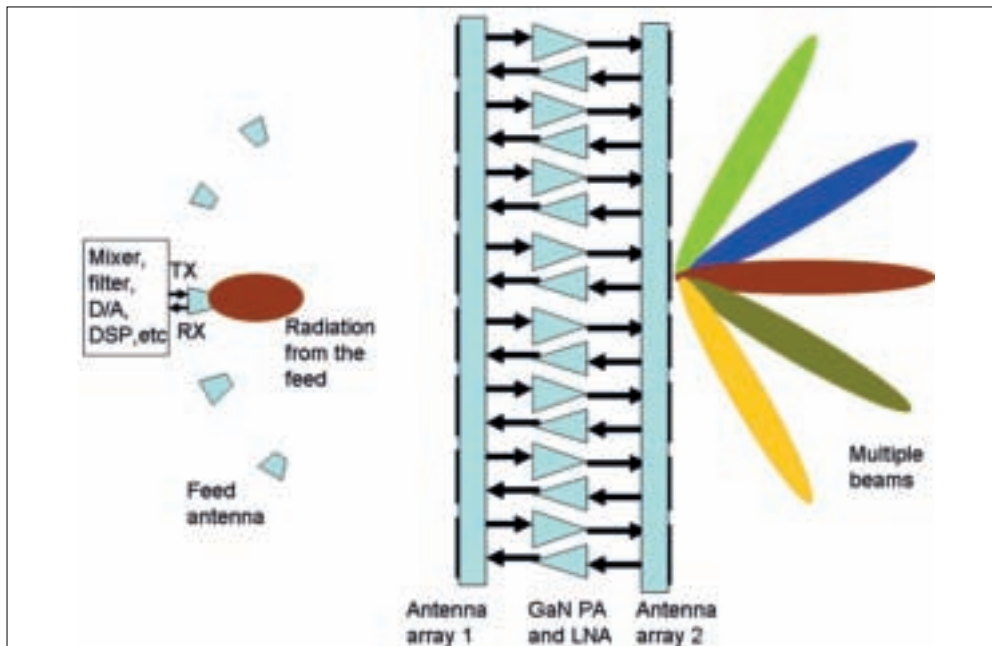
PROJECT INFORMATION

Digital beam Forming For low-cost multi-static space-borne Synthetic aperture radars (DIFFERENT)

Contract N°: 606923
Starting Date: 01/01/2014
Duration: 36 months
EU Contribution: € 1.984.559,00
Estimated total cost: € 2.624.948,60

GANSAT

GaN powered Ka-band high-efficiency multi-beam transceivers for SATellites



GaN-powered multi-beam high-power Tx/Rx radio transceiver concept.



Rodolfo MARTINS
Project Coordinator

ABSTRACT

The main objective of GANSAT is to design, develop, implement, test and validate the design of a high efficient Ka-band GaN RF front-end. In order to achieve this main goal the project addresses significant challenges in high-frequency satellite radio transceivers, namely: enhanced robustness and functionality of radio transceivers at Ka-band, space qualification and packaging of GaN MMICs, high-efficiency, high-power multi-beam active Tx/Rx antenna, high-efficiency high-linearity PA and new linearisation techniques.

DESIGN OF A HIGHLY EFFICIENT KA-BAND GAN RF FRONT-END

The project GANSAT is aiming at a new approach to satellite communication by utilising active antenna arrays in Ka-band and powering them with a multitude of individual GaN based power and low noise amplifiers. The microwave power level required for downlink communication will be obtained by constructively superimposing the power levels transmitted from individual small antennas in the far field of the whole antenna array.

This approach thus utilises the possibility to obtain considerable power levels from many, comparably small microwave transceivers. Such a concept is extremely flexible as it fully utilises the possibilities offered by modern solid state microwave power amplifiers and low noise receivers. GaN powered Ka-band MMICs are foreseen for the pixel amplifiers. They combine high power density, high efficiency and comparably high out power levels with the flexibility that is needed for active multi-pixel antenna arrays.

The targeted active antenna system will offer the possibility of multiple transmitting and receiving beams without the need of actively controlled phase shifters between the individual amplifiers. Thus, a robust system suitable for space-borne applications is proposed.

At the end of the project, the complete multiple beam Ka-band prototype transceiver system will be demonstrated. On the way to this prototype the consortium will have successfully elaborated a GaN Ka-band MMIC technology, its space flight qualification, the skills of low noise and high power amplifier design and realisation, the technique of active antenna design and, last but not least, the integration of all these features in a working prototype system.

QUESTIONS & ANSWERS

What is the project designed to achieve?

This project will for the first time demonstrate that GaN-based Solid State Power Amplifiers (SSPA) are able to provide high power at Ka band and be a true alternative to Travelling Wave Tube Amplifiers (TWTAs). This will be achieved by exploiting the recent development in GaN technologies, high-efficiency power amplifier design techniques and active array antenna technologies (the output beam is spatially combined).

Why is this project important for Europe and how does it benefit European citizens?

The European GaN technology space qualification is of paramount importance to ensure European supply independency. Additionally, due to high power density of GaN devices, the system will have advantages of compact size, low mass and low cost. The possibility to deploy low-cost, small satellites and the cost reduction of large satellites will lead to better and cheaper space services.

How does the project exceed the current state of knowledge?

It is expected that a power output of several hundreds of Watts at Ka band will be achievable by using the proposed approach. This will be a significant step beyond the state of the art, and will open the door for GaN-based SSPA into various space applications, such as satellite communications, direct broadcasting satellites (DBS) and synthetic aperture radars (SAR).

GANSAT

GaN powered Ka-band high-efficiency multi-beam transceivers for SATellites

LIST OF PARTNERS

- Evoleo Technologies lda, Portugal
- Efacec Engenharia e Sistemas SA, Portugal
- Forschungsverbund Berlin e.V., Germany
- University of Kent, United Kingdom
- ASTRIUM SAS/AIRBUS Defence & Space, France
- Mier ComunicacionesSA, Spain
- Instituto de Telecomunicações, Portugal

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Evoleo Technologies lda, Portugal

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PROJECT INFORMATION

GaN powered Ka-band high-efficiency multi-beam transceivers for SATellites (GANSAT)

Contract N°: 606981

Starting Date: 01/10/2013

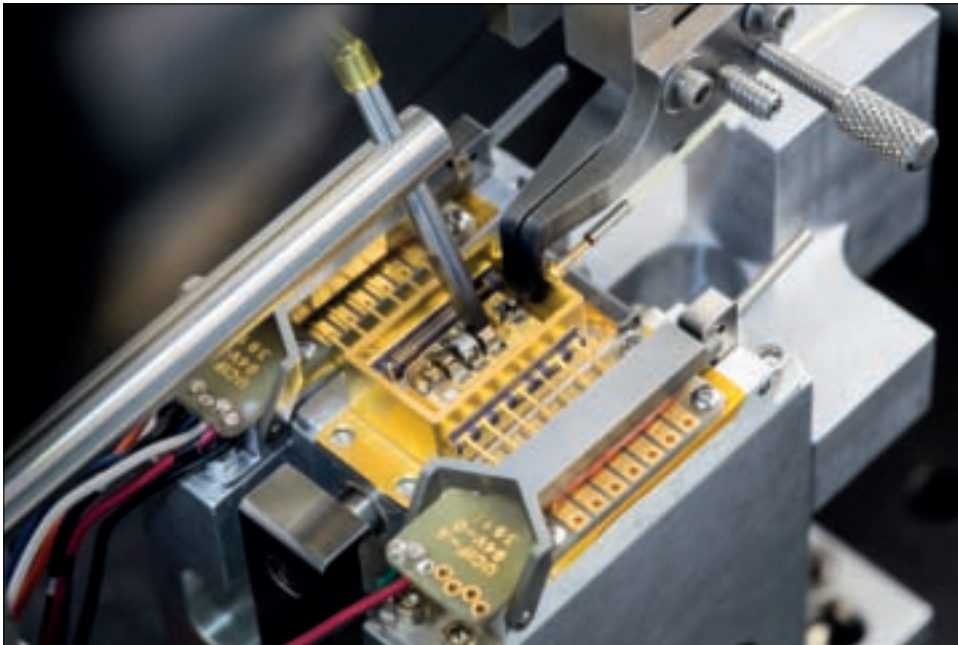
Duration: 36 months

EU Contribution: € 2.497.606,09

Estimated total cost: € 3.479.039,45

HIPPO

High-power Photonics for Satellite Laser Communications and on-board Optical Signal Processing



© Good & Housego

Manufacturing of high-reliability fibre-coupled laser at G&H (Torquay).



Andrew ROBERTSON
Project Coordinator

ABSTRACT

HIPPO develops the key functional building blocks required within laser-based satellite communication systems. New high-power transmission, amplification and receiver modules are designed and manufactured enabling high-speed laser links between satellites and optical signal processing within telecom satellites. The performance of HIPPO components and modules will be tested under thermal, vibration and radiation conditions, assessing the applicability of the technology for future space missions.

DEVELOPMENT OF KEY PHOTONIC COMPONENTS ENABLING HIGH-SPEED SATELLITE LASER COMMUNICATION

On the one hand, satellite communications need to provide higher capacity in order to remain competitive and deliver broadband multimedia services that drive satellite growth rates. On the other hand, Earth Observation (EO) satellites in Low Earth Orbits (LEO) need to deliver large volumes of data over the short period - usually 10-15 minutes - in which the satellite can maintain a link to the ground station. As the capacity requirements continue to grow, the method of transmitting data directly to ground is rapidly reaching its limit. This creates the need to relay the data from LEO satellites to a Geostationary (GEO) satellite through a high-capacity link.

A promising solution for facilitating high-speed connectivity with satellites is the introduction of photonics through a new generation of laser communication terminals, by leveraging the technology advancements in modern terrestrial networks. Fibre-optic technology can enable low-mass and high-speed systems that do not suffer from electromagnetic interference.

The challenge ahead is to demonstrate the capability to build space photonic systems that can operate under the stringent environmental conditions imposed by space flight environment, in terms of thermal, vibration, shock and radiation.

HIPPO project aims to develop the complete family of high-power optoelectronic and fibre-optic components required to build high-speed laser communication terminals. The technology developed can enable high-speed data transfer from telecom satellites, thus providing faster and cost-effective broadband internet access. When installed on EO satellites and deep space probes, information about the Earth and the planets of our solar system can be transferred faster and reliably using light.

QUESTIONS & ANSWERS

What is the project designed to achieve?

HIPPO focuses on development of the key components required within laser communication terminals installed in future telecom and EO satellites for delivering higher capacities and faster speeds. The project aims to demonstrate optical transmission systems that employ space-qualified high-power lasers, optical fibre amplifiers and photo-detectors, demonstrating that fiber-optic technology is a promising candidate for deployment in next generation space systems.

Why is this project important for Europe and how does it benefit European citizens?

A key strategic objective of HIPPO is the creation of a European supply chain of space photonics products, increasing the competitiveness of European industry and reducing dependencies on non-European technologies. HIPPO's new laser communication systems can enable high-capacity satellite broadband networks and high-capacity data links from satellites collecting information on Earth's vital signs.

How does the project exceed the current state of knowledge?

HIPPO advances the state-of-the-art in photonic component and module technology by fabricating space-qualified lasers and detectors, high-reliability fibre-optics and high-power optical fibre amplifiers with record high power scalability. Functional integration of these components into laser communication terminals can enable long-range links between satellites and the Earth and future deep space probes, exploring planets within our solar system.

HIPPO

High-power Photonics for Satellite Laser Communications and on-board Optical Signal Processing

LIST OF PARTNERS

- Gooch & Housego (Torquay) Limited, United Kingdom
- Constelex Technology Enablers, Greece
- Thales Alenia Space France, France
- III-V Lab, France
- Fiberware, Germany

COORDINATOR

Gooch & Housego (Torquay) Limited,
United Kingdom

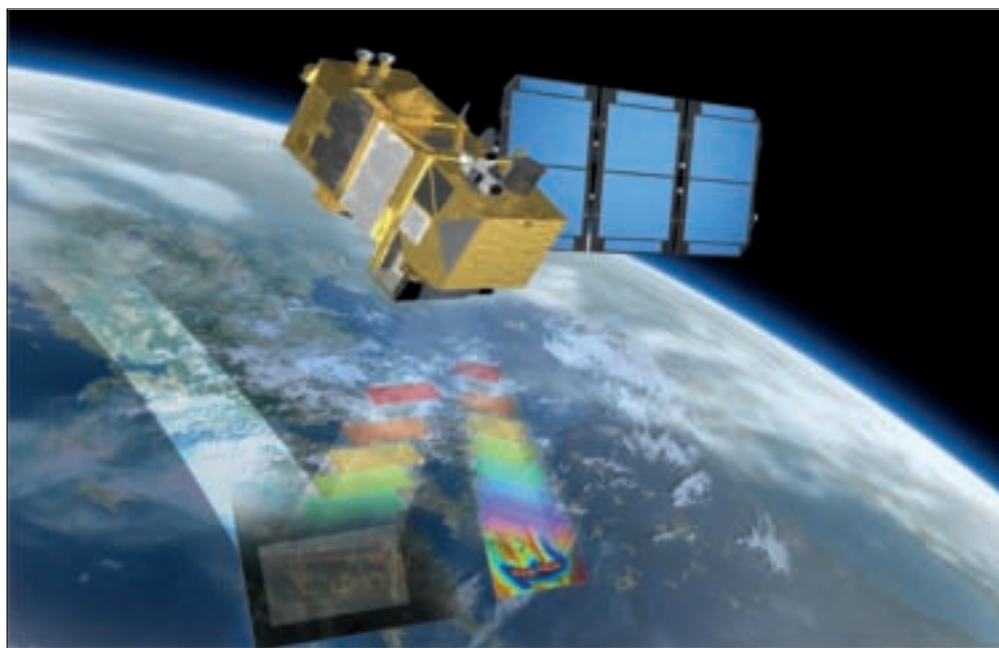
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PROJECT INFORMATION

High-power Photonics for Satellite Laser Communications and On-board Optical Signal Processing (HIPPO)

Requested EU Contribution:
Contract N°: 606915
Starting Date: 01/10/2013
Duration: 36 months
EU Contribution: € 2.498.057,00
Estimated total cost: € 3.965.908,60



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Illustration of satellite usage on archaeological sites and shipwreck monitoring.



Dimitrios BILIOURIS
Project Coordinator

ABSTRACT

The project aims at developing a set of applications integrated in a system that pursues the following objectives: search and location of ancient ship wrecks; monitoring of ship wrecks, ruins and historical artefacts that are now submerged; integration of resulting search and monitoring data with onsite data into a management tool for underwater sites; demonstration of the system's suitability to be used as a service.

MANAGING COASTAL UNDERWATER ARCHAEOLOGICAL SITES USING SATELLITE REMOTE SENSING

The monitoring of the underwater cultural heritage is a priority for public authorities that deal with conservation and restoration activities. These activities need cost effective, reliable and systematic survey methods.

The ITACA project aims to prove a management system for underwater archaeological sites in coastal regions. The discovering and monitoring service uses innovative satellite remote sensing techniques combined with image processing algorithms.

High resolution synthetic aperture radar (e.g. TerraSAR-X, Cosmo-SkyMed) and multispectral satellite data (e.g. WorldView-2) will be combined to map the relative bathymetry of the bottom of the sea up to the depth of 70 meters. The resulting data fusion will be processed using shape detection algorithms specific for identifying archaeological items.

The availability of the above remote sensing data, combined with innovative processing techniques and optimized for archaeological site, will enable the provision of a location and monitoring service for underwater archaeological sites in coastal zones.

The new algorithms, the physical modelling and the computational capabilities will be integrated into a Web-GIS environment together with data recorded from surface (2D and 3D modelling) and from underwater surveys. Additional specific archaeological layers will be included into the Web-GIS to facilitate the object identification through shape detection techniques and mapping.

The system will be verified and validated through an extensive on-ground (sea) campaign carried out with both cutting edge technologies (side-scan sonar, multi beam echo sounder) and traditional means (submarine exploration with professional scuba divers).

QUESTIONS & ANSWERS

What is the project designed to achieve?

ITACA aims to improve the capabilities to locate and monitor underwater archaeological sites in coastal zones by integrating remote sensing and image processing techniques. It will also develop and deploy a management and operation tool for underwater archaeological sites using a Web-GIS system, integrating remote sensing data with 3-D representations of the underwater reconstructed sites.

Why is this project important for Europe and how does it benefit European citizens?

The monitoring of underwater cultural heritage is a priority for public authorities that deal with conservation and restoration activities. These activities need cost effective, reliable and systematic survey methods. ITACA makes possible the production of a systematic survey of wide coastal areas without any destructive impacts, while enriching, protecting and making available to the citizens new underwater archaeological sites.

How does the project exceed the current state of knowledge?

The innovative character of ITACA enables remote sensing data processing methodologies which, at present, have not yet been analysed and exploited to consider the more complex underwater scenarios. These tapped into Web-GIS management and operation tools, integrating several information layers, can provide new observation products and tools enhancing the underwater archaeological domain.

LIST OF PARTNERS

- Planetek Hellas E.P.E (PKH), Greece
- KELL S.r.l. (KELL), Italy
- Nextant Applications & Innovative Solutions S.r.l. (NAIS), Italy
- Geographic Resource Analysis & Science A/S (GRAS), Denmark
- Instituto Enalio Archaologikon Ereynon Somateo (I.EN.A.E), Greece
- Fundação da Faculdade de Ciências da Universidade de Lisboa (FFCUL), Portugal
- ANESTI Ltd (ANESTI), United Kingdom
- Regione Sicilia (Regione Sicilia), Italy
- Alma Sistemi sas Di Iorio Alessio & C (ALMA), Italy
- Codevintec Italiana S.r.l (CODEVINTEC), Italy
- SME4SPACE VZW, Belgium

COORDINATOR

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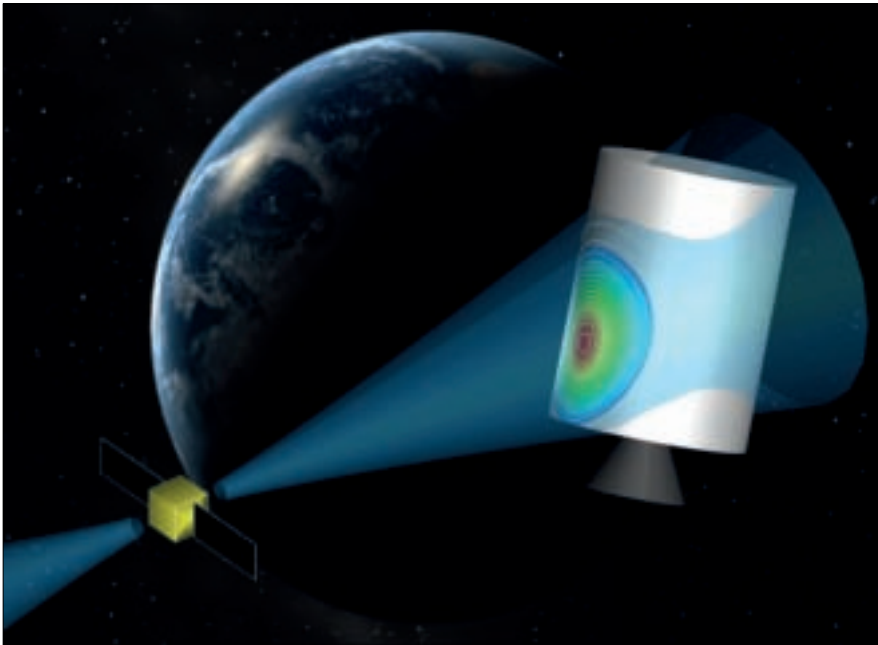
PROJECT INFORMATION

Innovation Technologies and Applications for Coastal Archaeological sites (ITACA)

Contract N°: 606805
Starting Date: 01/01/2014
Duration: 27 months
EU Contribution: € 1.645.279,20
Estimated total cost: € 2.210.380,40

LEOSWEEP

improving Low Earth Orbit Security With Enhanced Electric Propulsion



The Ion Beam Shepherd concept.

© UPM



Mercedes RUIZ
Project Coordinator

ABSTRACT

The LEOSWEEP project aims to develop and test key technology to a point that helps to demonstrate the feasibility of a first active removal mission of a Ukrainian launcher upper stage using the IBS concept. It also helps to prove its economic viability and propose a convincing legal and policy implementation to kick-start large-scale active debris removal activities in Europe, Ukraine and other space-faring nations in the future.

ION BEAM SHEPHERD (IBS) CONCEPT USE FOR LAUNCHER UPPER STAGES RELOCATION AND/OR DEORBITATION

The total mass of Space debris in the Low Earth Orbit area is around 2,500 tons, about half of this mass corresponding to launcher upper stages clustered in certain orbit regions. This represents a serious risk both for Space assets and Earth. Several studies confirm that acquiring the capability to relocate and/or deorbit just a few upper stage types would lead the way towards the elimination of hundreds of tons of debris material in the future.

Ion Beam Shepherd (IBS) concept is the baseline technological solution proposed by LEOSWEEP for this purpose. IBS is a 'contactless' actuation concept that allows modifying the orbit and/or the attitude of a generic debris object (the "target") using the momentum transferred to it by one or more ion beams produced by ion thrusters onboard a nearby spacecraft (the "shepherd"), and properly pointed towards the target by means of the shepherd's attitude control and, possibly, a thrust orientation mechanism.

In order to prove the feasibility of the IBS solution and prepare for its future implementation, LEOSWEEP will study in depth the physics underlying the concept to identify key technological challenges and specific solutions. The work will include the preliminary design of an IBS technology demonstration mission and its legal framework, the development of system simulators, including an advanced Guidance, Navigation and Control (GNC) system, and advanced ion beam models. A modified low divergence ion engine, required for this application, will also be manufactured and tested, together with representative targets, in different vacuum chamber facilities.

QUESTIONS & ANSWERS

What is the project designed to achieve?

LEOSWEEP intends to pave the way for large-scale active debris removal activities in the near future by using IBS as a key enabling technology. The proposed design, development and test activities will not only improve technical knowledge on IBS, but also set precedence, stimulate the international debate and promote international cooperation in the definition of launcher upper stages removal demonstration missions.

Why is this project important for Europe and how does it benefit European citizens?

Active debris removal is not only important but necessary to ensure the sustainability of space activities worldwide. LEOSWEEP will allow Europe to develop key technology that has the potential to reduce the serious risk that space debris poses not only to current and future space missions and infrastructures (ISS, communication, observation and navigation satellites, etc) but also to the Earth safety.

How does the project exceed the current state of knowledge?

The project is expected to generate progress beyond the state-of-the-art in different fields by introducing new developments such as: in-orbit contactless actuation (usually, grabbing techniques are employed), low divergence (50% less than current technologies) ion thrusters, proximity formation flying operations and associated Guidance, Navigation and Control techniques (not fully developed so far) as well as specific ion beam and ion beams-solid interaction characterisation.

LEOSWEEP

improving Low Earth Orbit Security With Enhanced Electric Propulsion

LIST OF PARTNERS

- SENER Ingeniería y Sistemas (SENER), Spain
- Universidad Politécnica de Madrid (UPM), Spain
- TransMIT Gesellschaft fuer Technologietransfer mbH (TransMIT), Germany
- Institute of Technical Mechanics of the National Academy of Sciences of Ukraine and the State Space Agency of Ukraine (ITM), Ukraine
- Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Germany
- Yuzhnoye Design Office named after Mikhail Yangel (YSDO), Ukraine
- DEIMOS Engenharia S.A. (DME), Portugal
- International Space Law Center to the Institute Of State And Law named after V.M. Koretsky of the National Academy of Sciences of Ukraine (ISLC), Ukraine
- University of Southampton (SOUTHAMPTON), United Kingdom
- Centre National de la Recherche Scientifique (CNRS), France
- Universidad Carlos III de Madrid (UC3M), Spain

COORDINATOR

SENER, Ingeniería y Sistemas, Spain

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PROJECT INFORMATION

improving Low Earth Orbit Security With Enhanced Electric Propulsion (LEOSWEEP)

Contract N°: 607457
Starting Date: 01/11/2013
Duration: 36 months
EU Contribution: € 1.999.447,00
Estimated total cost: € 2.906.707,19

LIGHT-TPS

Super Light-weight Thermal Protection System for Space Application



© DLR

Technology for future Thermal Protection Systems in SHEFEX.



María PARCO
Project Coordinator

ABSTRACT

LIGHT-TPS aims to develop innovative materials and manufacturing technologies for the fabrication of a new generation of thermal protection systems for future reusable space systems. The fundamental novelty of the project is to combine metallic and non-metallic heat/corrosion resistant materials in a particular way that allows a significant reduction of the weight of global system, while keeping the fundamental features of spacecraft components for atmosphere re-entry and hypersonic flights.

NEW MATERIALS AND CONSTRUCTION TECHNOLOGIES FOR SUPER LIGHT-WEIGHT THERMAL PROTECTION SYSTEMS

Future Reusable Space Systems (RSS) will require greatly improved Thermal Protection Systems (TPS) to achieve the ambitious goal of reducing the cost of delivering a payload to orbit by an order of magnitude. An improved TPS must not only perform its primary function of maintaining the underlying vehicle structure within acceptable temperature limits, but must also be durable, operable, cost-effective and light.

LIGHT-TPS will develop a new super-light TPS for various space applications, capable of operating within the entire range of working temperatures. The project aims at radical properties' improvements over TPSs used in existing and underdevelopment RSS.

The basic underlining idea of the project is to combine principle advantages of new metallic and Ultra-High Temperature Ceramic (UHTC) materials in a single thermal protection system.

The project's efforts will be centred on the 2 major research challenges, namely: lighter alloys with improved high temperature resistance and manufacturing technologies for the construction of a metallic honeycomb frame with specific weight of no more than 10 kg/m²; new coatings of UHTC composites suitable for applications at temperatures up to 2000°C and technologies for the deposition of erosion-resistant UHTC coatings on metallic and non-metallic materials.

Modelling of critical processes occurring in the different material synthesis/shaping steps and the material response under advanced characterisation test environments will assist the whole experimental work.

TPS prototypes will be manufactured and validated by ground tests under realistic entry conditions to assess the project results and define an optimal model for future TPS in-flight tests.

QUESTIONS & ANSWERS

What is the project designed to achieve?

LIGHT-TPS aims to develop innovative materials and manufacturing technologies for a new generation of TPSs. The main approach is to combine new metallic and Ultra-High Temperature Ceramic materials in a single TPS, in a particular way that allows a significant weight reduction of the global system, while keeping the fundamental features of spacecraft components for atmosphere re-entry and hypersonic flights.

Why is this project important for Europe and how does it benefit European citizens?

Europe is committing significant resources in order to progress towards a new generation of TPSs. The project will build on the previous achievements and investments of leading European and Ukrainian research teams, in order to enable the further transfer of the developed technologies to future projects developing RSS.

How does the project exceed the current state of knowledge?

Better constructional and exploitation properties will be achieved for a TPS, by combining high thermal resistance/radiation ability, significant resistance to thermal, mechanical, acoustic and vibration impacts, very low specific weight per surface unit (no more than 10 kg/m²), improved isolation properties (cold surface < 200°C in the entire range of working temperatures) and opportunities for effective service and maintenance.

LIST OF PARTNERS

- Fundación Tecnia Research & Innovation, Spain
- Frantsevich Institute for Problems of Materials Science of National Academy of Science of Ukraine, Ukraine
- YUZHNOYE Design Office Named After Mikhail Yangel, Ukraine
- Space Research Institute of National Academy of Science of Ukraine (SSAU), Ukraine
- E.O. Paton Electric Welding Institute, Ukraine
- Consiglio Nazionale delle Ricerche, Italy
- ECM Space Technologies GmbH, Germany
- Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Germany

COORDINATOR

Fundación Tecnia Research & Innovation,
Spain

CONTACT

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PROJECT INFORMATION

Super Light-weight Thermal Protection System for Space Application (LIGHT-TPS)

Contract N°: 607182
Starting Date: 01/05/2014
Duration: 36 months
EU Contribution: € 1.997.363,00
Estimated total cost: € 2.741.033,40

LONGESST

Low Cost Germanium Substrates for Next Generation 4-Junction Space Solar Cells utilising Dilute Nitride Technology



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Typical satellite utilisation of solar cells tailored for space applications.

ABSTRACT

Future satellite power requirements will increase due to the adoption of electrical propulsion, sensing and telecommunication. Next generation space solar cells will require increased conversion efficiencies to enable higher energy generation with minimal increase in overall system weight and cost. This proposal will develop multi-junction space solar cells on high-quality, low-cost, large-area (150 mm diameter) thin Germanium substrates, with high conversion efficiencies, using novel dilute-nitride epitaxial technology and 4-Junction architectures.

III-V SOLAR CELLS ON LOW-COST GERMANIUM SUBSTRATES AS A CRITICAL TECHNOLOGY FOR POWER GENERATION IN SPACE

Multi-junction III-V solar cell technology on Germanium substrates is well established as the primary photovoltaic technology used in satellite power generation. With future adoption of technologies, such as electrical propulsion, sensing and telecommunications, next generation space solar cells will be required to significantly increase their conversion efficiency to enable higher energy generation with minimal increase in overall system weight and cost. This project will develop multi-junction space solar cells on high-quality, low-cost, 150mm diameter Germanium substrates, with conversion efficiencies, which are >33% (AMO) and utilising novel 4-Junction architectures. The process will adopt MBE dilute-nitride epitaxial technology using a powerful consortium covering the entire skill set of substrate manufacture, advanced epitaxy, device design, device fabrication, test and qualification.

The specific advantage of this approach is one of simplicity and lower cost, achieved in a single epitaxial growth, lattice matched to Germanium.

The low, overall epitaxial thickness will result in a cheaper and more manufacturable approach. By using thinner substrates, reducing the cost/wafer (by >20%), (the substrate being the main component of this weight), lower cost and overall cell weight are both achieved. Together with ground-breaking dilute nitride materials, in conjunction with existing MOVPE multi-junction technology, a complete European supply chain will be established for future volume manufacture of these advanced space solar cells. The supply chain will be completed by device design, device manufacturing optimization, volume device fabrication, test and reliability. Conventional 3J structures with dilute-nitride technology as the basis for 4J cells will result in the desired Technology Readiness Level 5.



Iwan DAVIES
Project Coordinator

QUESTIONS & ANSWERS

What is the project designed to achieve?

The project will achieve a lower-cost, higher-efficiency space solar cell technology together with a lower weight per cell unit area. These characteristics will be required for future satellite developments in the areas of electrical propulsion, sensing and telecommunications and, hence, it is imperative that this increased functionality is achieved with minimal increase in weight.

Why is this project important for Europe and how does it benefit European citizens?

The project amalgamates complementary skills across the full value-chain from raw materials to end-product. III-V cell technology on low-cost Germanium substrates has been recognised as a Space Critical Technology by the EU and the project achieves a state of European non-dependence, by ensuring a supply chain, together with a Production Roadmap, established wholly within the European Union.

How does the project exceed the current state of knowledge?

The project seeks to employ novel dilute-nitride technology, in conjunction with conventional 3-Junction cells, currently established for space utilisation. By combining these with larger area and thinner Germanium substrates, the project aims to achieve several goals beyond state-of-the-art by increasing cell efficiencies, whilst reducing cell weight/unit area resulting in reduced overall costs.

LONGESST

Low Cost Germanium Substrates for Next Generation 4-Junction Space Solar Cells utilising Dilute Nitride Technology

LIST OF PARTNERS

- International Quantum Epitaxy plc, United Kingdom
- Universidad Politecnica de Madrid, Spain
- Umicore, Belgium
- Compound Semiconductor Technologies Global, United Kingdom

COORDINATOR

International Quantum Epitaxy plc,
United Kingdom

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PROJECT INFORMATION

Low Cost Germanium Substrates for Next Generation 4-Junction Space Solar Cells utilising Dilute Nitride Technology (LONGESST)

Contract N°: 607153
Starting Date: 01/08/2014
Duration: 30 months
EU Contribution: €2.498.368,00
Estimated total cost: €4.044.316,00

MACSPACE

High-Performance ManyCore Rad-Hard DSP for Computation-Intensive Space Applications



Master Image Programmes ©THALES ALENIA SPACE

Artist view of an IRIDIUM NEXT satellite which is a good candidate for MacSpace chips.

ABSTRACT

The MacSpace project aims to research, innovate, design, develop and validate a non-dependent, high-performance ManyCore processor and DSP computer for computation-intensive space applications. The consortium will bring the necessary elements together, including the DSP core and software tools, a custom ManyCore DSP rad-hard-processor-by-design, FPGA DSP computer prototype and a prototype chip. A commercial evaluation of the technology will take place.

REVOLUTIONISING THE CAPABILITY FOR ONBOARD COMPUTATIONAL POWER IN SPACE

The massive amount of data being generated on modern space missions has led to a demand for higher performance computing in space. The ability to analyse data, make real-time decisions and obtain better situational awareness will greatly enhance mission capabilities. This high performance must be achieved with low power consumption and while remaining small in size and weight. Additionally, solutions need to be reliable and robust enough to withstand the harsh environment of space where radiation can damage electrical components, temperatures range from -55°C to 125°C and lifetime missions can exceed fifteen years.

The MacSpace consortium has brought together a plan to solve this challenge. The project will research and develop many-core digital signal processor chip and computer. The chip will be designed to provide radiation-tolerant, space grade, parallel processor, optimised for a wide range of application workloads and connectivity that fit levels of performance that far exceeds today's abilities and expectations.

The foundation blocks to be developed by the project partners include the DSP core and software tools, a MacSpace custom 75 GMACS / 150 GOPS / 20 GFLOPS ManyCore DSP processor, FPGA DSP computer prototype and a rad-hard-by-design MacSpace prototype chip. An evaluation of the technology will also take place within the scope of the project.

MacSpace will enable future difficult-to-achieve space applications that require demanding computational performance in the areas of remote sensing, planetary exploration, scientific missions, navigation and telecommunications. The results will be shared and available for study and user testing towards the end of the project.



Ran GINOSAR
Project Coordinator

QUESTIONS & ANSWERS

What is the project designed to achieve?

The MacSpace project aims to research, innovate, design, develop and validate a non-dependent high-performance ManyCore processor and DSP computer for computation-intensive space applications.

The consortium will bring the necessary elements together in such a way that the MacSpace processor will reach computational performance over ten times higher than the emerging alternatives, which set 1GFLOPS as the minimum for space DSPs.

Why is this project important for Europe and how does it benefit European citizens?

MacSpace will enhance European independence in the realm of computational power in space. The technologies developed will be ITAR-free and will enable the European space industry to get unrestricted access to onboard high performance processing. This will greatly enhance the worldwide competitiveness of European space operators, such as satellite vendors and thus positively impact employment and economic growth across Europe.

How does the project exceed the current state of knowledge?

The current space-borne computation power is a fraction of what will be needed for the processing and interpretation tasks envisioned for the lifetime of future satellites and space crafts. The MacSpace consortium is targeting a value proposition that far exceeds current abilities in the areas of floating point performance, fixed point performance, performance/power ratios, ease of programming and space availability.

MACSPACE

High-Performance ManyCore Rad-Hard DSP for Computation-Intensive Space Applications

LIST OF PARTNERS

- Ramon Chips Ltd, Israel
- Digitale Signalverarbeitungssysteme & Informationstechnik GMBH, Germany
- Ceva Limited, United Kingdom and Israel
- Technische Universitaet Braunschweig, Germany
- Thales Alenia Space Italia, Italy
- Preston Engineering Europe SA, France
- Arttic, France and Israel

COORDINATOR

Ramon Chips Ltd, Israel

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PROJECT INFORMATION

High-Performance ManyCore Rad-Hard DSP for Computation-Intensive Space Applications (MACSPACE)

Contract N°: 607212
Starting Date: 01/12/2013
Duration: 33 months
EU Contribution: € 2.495.048,00
Estimated total cost: € 3.310.928,00

MERLIN

Multi-gigabit, Energy-efficient, Ruggedized Lightwave eNginés for advanced on-board digital processors



VCSEL wafers.

© PHILIPS Technologie GmbH U-L-M Photonics



Leontios STAMPOULIDIS
Project Coordinator

ABSTRACT

MERLIN develops new space photonics hardware for enabling Terabit optical connectivity within next generations of high-capacity telecom satellites. The successful development of MERLIN lightwave engines and transceivers is expected to favour the advent of highly flexible, advanced telecom satellite payloads, based on optically interconnected Tera-scale digital on-board processors, by achieving disruptive capacity scalability, power efficiency and cost-effectiveness.

DEVELOPMENT OF HARSH ENVIRONMENT OPTICAL TRANSCEIVERS FOR HIGH-SPEED INTRA-SATELLITE DIGITAL PROCESSOR LINKS

Modern broadband communication networks rely on satellites to complement the terrestrial telecommunication infrastructure. Satellites accommodate global reach and enable worldwide direct broadcasting by facilitating wide access to the backbone network from remote sites or areas where the installation of ground segment infrastructure is not economically viable. At the same time the new broadband applications increase the bandwidth demands in every part of the network - and satellites are no exception.

Modern telecom satellites incorporate large boxes of electronic equipment called on-board digital processors that are responsible to process hundreds of signals. As the amount of information exchanged increases, so does the physical size and power consumption of these systems that are required to transfer massive amounts of data quickly, efficiently and at low cost through bulk electric wires.

MERLIN is a technology-intensive project that aims to provide the missing enabling technology for the development of multi-gigabit on-board connectivity that will hit the right size, power consumption and cost targets of next generation telecom satellite payloads.

MERLIN invests in the unique combination of low power, high bandwidth Vertical Cavity Surface Emitting Lasers (VCSEL) and photo-detectors, radiation hard, multi-core fibres and driver integrated circuits and their integration on a space-compatible photonic integration platform to disrupt the capacity upgrade within payloads. The MERLIN harsh environment lightwave engines will be capable of delivering a record-high 150 Gb/s throughput at a record low <10 mW / Gb/s energy consumption through small size photonic chipsets and lightweight fibre optic cables.

QUESTIONS & ANSWERS

What is the project designed to achieve?

MERLIN's objective is to develop power efficient and compact lightwave engines that will be capable of transferring hundreds of gigabits per second generated by on-board digital processors through lightweight optical fibre cables. The aim is to provide capacity scaling while at the same time reducing the size and power consumption - a combination that is difficult with mainstream electrical solutions.

Why is this project important for Europe and how does it benefit European citizens?

The global broadband satellite market will enter the "multi-billion" era by 2020 resulting in an increase in employment in the European space industry. Market sustainment and re-enforcement requires innovative connectivity solutions for future satellite systems. MERLIN provides this solution by investing in photonics with all critical technologies developed in Europe, strengthening the European industry and allowing non-restricted access to the entire technology chain.

How does the project exceed the current state of knowledge?

Multi-beam high capacity satellites require a disruptive approach to address digital on-board processors, since state-of-the-art electronics are space, power and cost hungry and are reaching their capacity saturation. MERLIN's solution combines scalability, technical feasibility, power-efficiency and cost-effectiveness relying on the unique combination of low-power vertically emitting lasers/detectors, low power rad-hard digital driving electronics and rad-hard multi-core optical fibres.

MERLIN

Multi-gigabit, Energy-efficient, Ruggedized Lightwave eEngines for advanced on-board digital processors

LIST OF PARTNERS

- Constelex Technology Enablers, Greece
- Thales Alenia Space France, France
- PHILIPS Technologie GmbH U-L-M Photonics, Germany
- OFS Fitel Denmark APS, Denmark
- IHP GmbH Innovations for High Performance Microelectronics, Germany
- Technical Research Centre of Finland (VTT), Finland
- Chalmers University of Technology, Sweden

COORDINATOR

Constelex Technology Enablers, Greece

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PROJECT INFORMATION

Multi-gigabit, Energy-efficient, Ruggedized Lightwave Engines for advanced on-board digital processors (MERLIN)

Contract N°: 607274
Starting Date: 01/10/2013
Duration: 36 months
EU Contribution: € 2.498.998,00
Estimated total cost: € 3.614.294,80

MOONWALK

Technologies and Human-Robot Collaboration for Surface EVA Exploration Activities and Training in European Analogue Environments



Astronaut-robot team on a lunar sampling mission (artist's impression).



Thomas VÖGELE
Project Coordinator

ABSTRACT

The main objective of MOONWALK is to develop and validate concepts and technologies for man-machine-interaction in robot-assisted EVA for the exploration of planetary surfaces and asteroids. These concepts specifically take into account the constraints imposed on the movement of astronauts by environmental conditions and heavy EVA space suits. The technologies are tested and validated in field excursion simulations using Earth-analogue environments to simulate key environmental conditions on Moon and Mars.

NEW TECHNOLOGIES FOR HUMAN-ROBOT CO-OPERATION, VERIFIED IN EARTH-ANALOGUE SIMULATIONS OF MOON AND MARS ENVIRONMENTS

How will astronauts train in the most realistic manner missions to far-away planets? How can robots assist them? In MOONWALK, a consortium comprised of seven European partners from research institutes, SMEs and industry tries to find answers to these questions.

The project develops and tests technologies for future joint missions of astronauts and robots to Moon, Mars, or asteroids. The focus is on robot-astronaut cooperation for Extra Vehicular Activities (EVA) on planetary surfaces.

Astronauts are limited in their movements due to the bulky pressurized spacesuit, the reduced gravity and the extreme environmental conditions. Robots could support astronauts with their work on planetary surfaces, but new technologies are needed for astronaut-robot interaction that take into account the constraints imposed by the natural Space conditions and standard astronaut equipment.

Simulations under realistic conditions are necessary to prove the usability of the new technologies. In MOONWALK, the technical equipment is tested in Earth-analogue simulations that mimic relevant parts of exploration missions on Moon and Mars. Reduced gravity is simulated in the DFKI Neutral Buoyancy Facility in Bremen, Germany, and the COMEX Underwater Space Analogue Site in Marseilles, France. Mars-like environmental conditions are reproduced in the Rio-Tinto Earth-analogue site in Spain.

To support the preparation and monitoring of the trials, MOONWALK has established a close connection with the Johnson Space Center in Houston, USA. The project will thus benefit from the long experience of NASA in Earth-analogue simulations and prepare the basis for joint mission simulations in the future.

QUESTIONS & ANSWERS

What is the project designed to achieve?

The project is designed to develop technologies for the safe and comfortable interaction of an astronaut and a robotic helper during EVA on a planetary surface. The technologies are verified and tested in Earth-analogue simulations of missions to Moon and Mars. During these simulations, typical aspects of the environmental conditions on Moon and Mars, such as reduced gravity or extreme temperatures and terrain, are reproduced in terrestrial test-sites and -facilities.

Why is this project important for Europe and how does it benefit European citizens?

Many robotic technologies developed for the extreme conditions in space are also applicable in extreme environments on the Earth. An example is the exploration and exploitation of the deep sea, where robotic tools, very similar to those used in Space, are employed for the benefit of European citizens.

How does the project exceed the current state of knowledge ?

Enabling seamless co-operation in teams of humans and robots is a very interesting research topic. The control of a robot by an astronaut is particularly challenging due to the heavy space suit and the extreme environmental conditions in space and on planetary surfaces. MOONWALK develops methods and technology that supports the easy and intuitive co-operation between astronauts and robots.

MOONWALK

Technologies and Human-Robot Collaboration for Surface EVA Exploration Activities and Training in European Analogue Environments

LIST OF PARTNERS

- Deutsches Forschungszentrum für Künstliche Intelligenz GmbH. (DFKI), Germany
- Compagnie Maritime d'Expertises SA, France
- EADS UK Ltd./AIRBUS Defence & Space, United Kingdom
- Liquifer Systems Group GmbH., Austria
- Space Application Services NV, Belgium
- NTNU Samfunnsforskning AS, Norway
- Instituto Nacional de Tecnica Aeroespacial, Spain

COORDINATOR

Deutsches Forschungszentrum für Künstliche Intelligenz GmbH. (DFKI), Germany

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PROJECT INFORMATION

Technologies and Human-Robot Collaboration for Surface EVA Exploration Activities and Training in European Analogue Environments (MOONWALK)

Contract N°: 607346
Starting Date: 01/09/2013
Duration: 36 months
EU Contribution: € 2.372.660,00
Estimated total cost: € 3.151.717,00

MPBUS

Modular Power BUS for space vehicles



© JMP Design Department developed in CINEMA 4D program

Battery distribution along the launcher and used batteries are jettisoned with the stage 1 boosters.

ABSTRACT

MPBUS Project is focused on reducing the total weight of the new generation launchers by working with two concepts: using the same wire harness to provide power to the systems and to allow data transmission between all the devices with a data rate up to 3 Megabits per second, and a distributed network of intelligent batteries' nodes that will allow any discharged battery to be jettisoned in the launching stages without any power disruption in the main bus.

DEVELOPING AN INNOVATIVE MODULAR POWER BUS FOR SPACE VEHICLES

The rapid growth of the private satellite launchers sector is leading the space race. With the privatization of the sector, all involved companies are racing for a more efficient and profitable way to set satellites in orbit, bearing in mind the new industrial framework of the space sector. In space terms, weight-saving is one of the best strategies to achieve these objectives, and this is one of the main results expected from the MPBUS project.

Weight-saving, means not only to reduce the cost per kilogram of the payload on each launch, but to open a whole new range of possible missions with current or future next generation launch vehicles.

The onboard electric systems use a considerable percentage of the total operational weight of a launcher. The weight of the launcher is not only affected by the weight of the batteries but also by all the wires used for powering the electronic and electrical devices and the wires for data communications.

The MPBUS project is proposed as a technology that would revolutionize power management in current and future launchers, bearing in mind not only the needs for power management in the vehicle, but also the weight reduction of the total electric system.

The project is committed to develop a new power bus architecture, synchronizing a group of distributed and ejectable batteries with the main vehicle bus through intelligent nodes. These nodes are able to communicate between themselves and with the battery controllers, using an improved technology based on the use of the same wire harness for powering the electronic devices of the launcher and to provide data communication between all the systems along the launcher.

With this new electronic architecture, the project is expected to reduce the total weight of the launcher, improving the use of the batteries and reducing its size, and using the same wires harness for both power distribution and communications.



**Eduardo REMIREZ
MIGUEL**
Project Coordinator

QUESTIONS & ANSWERS

What is the project designed to achieve?

New BUS concept aims at saving weight in launcher space vehicles reducing installation complexity and, consequently, operational cost of the new launchers. By the end of the project duration, a built and operative prototype is expected to be tested in space conditions. This includes a full power supply system and a 3 Mega bites per second communications bus over the same physical wire harness.

Why is this project important for Europe and how does it benefit European citizens?

Cheaper access to space, will allow the new scientific generations to prepare more affordable experiments to develop new products and technologies. Universities, private companies and also public administration entities will increase the opportunities for having an access and playing a role in the space future. Other industrial sectors, such as aeronautic, naval, automotive and energy will be able to profit from the results of this project.

How does the project exceed the current state of knowledge?

Actual systems of data over direct current lines are much lower than the data rate expected for this project and never have been used in a launcher vehicle. Moreover, the global concept of the power bus of a launcher has not been modified for several years. The project is going to work on a new concept of battery management and bus distribution to be used for the new generation of launchers.

MPBUS

Modular Power BUS for space vehicles

LIST OF PARTNERS

- JMP Ingenieros S.L., Spain
- Najera Aerospace S.L., Spain
- YAMAR Electronics LTD, Israel
- Centre Spatial de Liege (Universite de Liege), Belgium

COORDINATOR

JMP Ingenieros S.L., Spain

CONTACT

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PROJECT INFORMATION

Modular Power BUS for space vehicles (MPBUS)

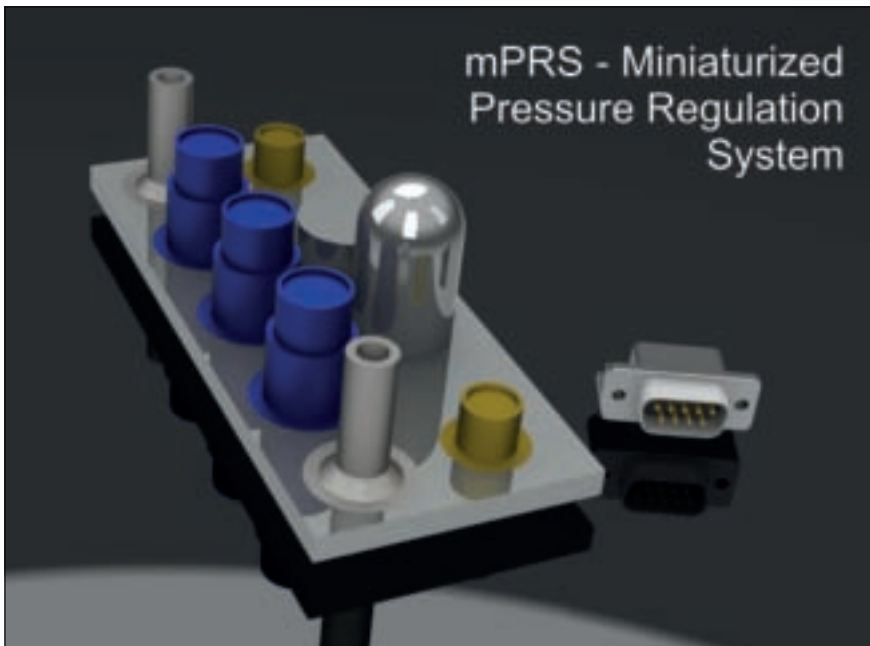
Contract N°: 60818

Starting Date: 01/05/14

Duration: 27 months

EU Contribution: € 1.613.666,95

Estimated total cost: € 2.045.108,40



Impression of a mPRS pressure reduction and regulation system.

ABSTRACT

The main objective of mPRS is to develop a miniaturized pressure regulation system together with the related components. All key components shall be "made in Europe" to reduce the dependency on other nations. The device shall be electronically controlled to allow an inflight adjustment of the pressure. Such reconfigurations can be used for failure recovery or advanced operational concepts. mPRS shall provide a technology ahead of the state-of-the-art, thereby establishing Europe's technological leadership in space gas fluidic devices.

ELECTRONIC PRESSURE REDUCTION AND REGULATION SYSTEM BASED ON COMPONENTS OF EUROPEAN SOURCE

Propulsion is one of the key technologies for space probes and satellites. Most of the propulsion systems require a constant inlet pressure that has to be provided by the pressurized gas supply system. It is essential for Europe to have independent access to such technologies.

Most European companies involved in the fields of flow control components have been acquired by U.S. competitors during the past years. Today, Europe relies on the supply of external sources, making the business vulnerable. As a consequence, the European institutions (the European Commission, the European Defence Agency) as well as the European Space Agency (ESA) have compiled a list of critical technologies that have to be available within Europe. Flow control and distribution components have been part of this list right from the beginning.

Aim of the mPRS project is to provide components and units that are developed and manufactured independent of non-European sources.

The main components covered by mPRS are high pressure solenoid valves, the flow path board, the pressure sensors and the PRS unit itself. The development of each of the components will reduce Europe's dependence in the related niche.

The mPRS has the capability to reduce system size and complexity of a spacecraft's propulsion system. It is expected that the mPRS allows the use of the pressure regulation system throughout the full spacecraft lifetime of up to 15 years.

In contrast to mechanical pressure regulation systems, the mPRS allows a change of the outlet pressure in flight, providing access to improved operational strategies of propulsion systems. All satellites and space probes may benefit from these features.



Hans-Peter HARMANN
Project Coordinator

QUESTIONS & ANSWERS

What is the project designed to achieve?

The project aims to develop high pressure flow components from European origin, with long lifetimes and superior performance. The components shall be designed, manufactured and verified by testing to reach a readiness level of TRL 5. After the end of the project the components shall be ready to be used e.g. for ESA missions.

Why is this project important for Europe and how does it benefit European citizens?

The results of the project will reduce Europe's vulnerability and dependencies in the space sector. Reduced dependency allows Europe to address markets worldwide without constraints, due to non-European export restrictions. As a consequence, Europe's space business may increase its market share, thereby improving revenues and securing employment in the high-tech sector.

How does the project exceed the current state of knowledge?

The project will transfer the new fluidic surface mounted device-technology (developed in a former FP7 project) to high-pressure space applications. Consequently used, it may drive all field of space fare. In satellites, it reduces the size and the cost of the overall system. In exploration missions, it will allow more payloads to the planets. Science missions will benefit from more direct control over accuracy and longer lifetime.

LIST OF PARTNERS

- AST Advanced Space Technologies GmbH, Germany
- Staiger GmbH & Co KG, Germany
- RHP Technology, Austria
- Idneo Technologies S.L., Spain
- Listemann AG Werkstoff und Waermebehandlungstechnik, Liechtenstein
- STS Sensor Technik Sirmach AG, Switzerland

COORDINATOR

AST Advanced Space Technologies GmbH,
Germany

CONTACT

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PROJECT INFORMATION

Miniaturized Pressure Regulation System (mPRS)

Contract N°: 607013
Starting Date: 01/01/2014
Duration: 36 months
EU Contribution: € 2.474.430,80
Estimated total cost: € 3.479.314,69

PHASER

High speed, high frequency electro-PHOTonic ADC for Space Enabled Routers



© Thales Alenia Space España, S.A.

Telecommunication Satellite with an Space Router Prototype (left) and a PHASER Unit Drawing (right).

ABSTRACT

PHASER aims to provide the European space industry with an analogue to digital converter that allows direct digitisation of RF signals up to Ka band. PHASER will develop a laser disciplined, high speed Analog-to-Digital Converter (ADC) based on the combination of fast traditional ADCs with photonic sampling. This direct digitisation of the RF band will enable the full Digitally Defined Satellites that will bring new features and services to the future internet, such as delay-less satellite communication or satellite communications for smart cars and unmanned planes.

USING PHOTONICS TO ENABLE THE NEXT GENERATION OF DIGITALLY DEFINED SATELLITES

The vision behind the PHASER project is to provide the European space industry with a new analogue to digital conversion system that allows the direct digitalization of typical radiofrequency signals used for satellite communications. PHASER will develop a space-grade, high speed digitiser capable of direct RF-sampling up to Ka band signals.

This means an improvement of the sampling frequency in more than two orders of magnitude with respect to the state of the art. This will enable a substantial reduction in hardware complexity for the next generation satellite payloads. The high speed, high frequency, electro-photonic analogue to digital conversion system, capable of down-converting and digitising a high radio frequency signal, will have a photonic core, capable of working in a very wide range of frequencies (from few kHz up to tens of GHz) and down-converting high bandwidth signals in one stage.

It will be followed by a very high speed analogue to digital conversion to bring the radio frequency into the digital domain, without electronic mixing hardware or intermediate frequency stages. After this signal down-conversion, the system will use a suitable electrical Analog-to-Digital Converter (ADC) to digitise the signal.

PHASER system will be able to be integrated in any medium or large satellite platform, in order to provide the different system designers with one of the key elements necessary to arrive at the so called "Digital Defined Satellite".

Having a Digital Defined Satellite means that all the possible evolutions in customers' needs can be covered by the suitable reprogramming of the on-board signal processing elements, thus extending the useful satellite lifetime over 25 years and gradually increasing the satellite profitability.



Angel ALVARO
Project Coordinator

QUESTIONS & ANSWERS

What is the project designed to achieve?

The project target is to design an ultra-high speed analogue to digital conversion, using laser as core technology. This integrated high speed ADC converter will be designed and prototyped and will test the validity of the concept under space environmental conditions. In order to achieve this, all the key elements of the system: Sampler, ADC and laser will be engineered by the project partners.

Why is this project important for Europe and how does it benefit European citizens?

This project will enable satellite manufacturers to design full digital satellites, positioning Europe as leader in the telecommunication satellite market. These new digital defined satellites will be key elements in the future structure of Internet, providing European and worldwide mobile users with ultra wideband services. These services will be key for innovations such as smart cars or sensorised infrastructures, opening a new market that will be over 100ME per year starting in 2020.

How does the project exceed the current state of knowledge?

The project will develop a converter with sampling frequencies one or two orders of magnitude higher than solutions available today on the space market. This improvement is based on an innovative approach that integrates photonic and electronics disciplined by an ultra stable laser source. When finished, PHASER will allow the replacement of some heavy and high power consumption radio frequency equipment with light optical devices, making satellites lighter and more powerful.

PHASER

High speed, high frequency electro-PHOTonic ADC for Space Enabled Routers

LIST OF PARTNERS

- Thales Alenia Space España, Spain
- DAS Photonics, Spain
- OneFive GMBH, Switzerland
- Centre Suisse d'Electronique et de Microtechnique SA (CSEM), Switzerland
- Thales Alenia Space France, France

COORDINATOR

Thales Alenia Space España, Spain

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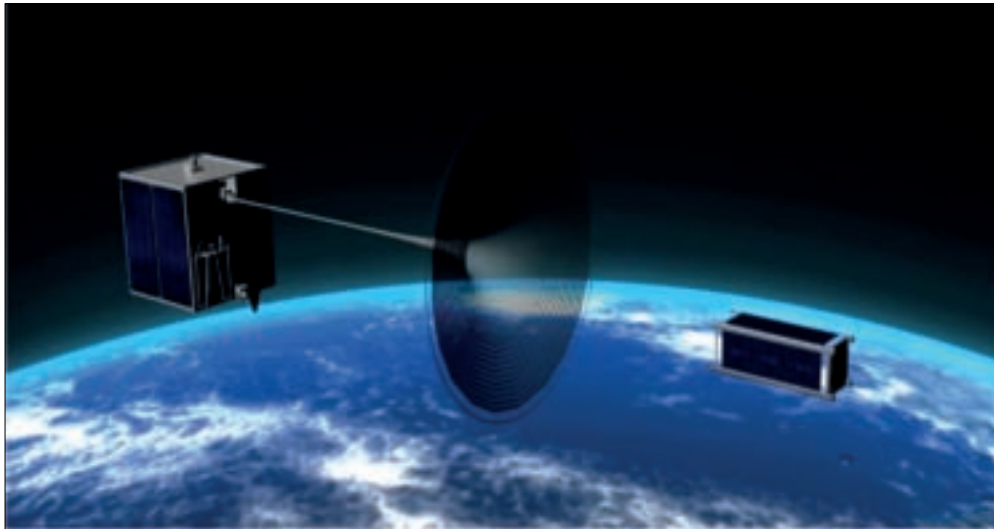
PROJECT INFORMATION

High speed, high frequency electro-PHOTonic Adc for Space Enabled Routers (PHASER)

Contract N°: 607087
Starting Date: 01/11/2013
Duration: 36 months
EU Contribution: € 2.483.500,00
Estimated total cost: € 3.411.162,00

RemoveDEBRIS

A Low Cost Active Debris Removal Demonstration Mission



RemoveDEBRIS Mission Concept.

© University of Surrey



Vaios LAPPAS
Project Coordinator

ABSTRACT

The RemoveDEBRIS mission is an unprecedented venture to mature several key active debris removal technologies. Drawing upon the experience of the Surrey Space Centre/University of Surrey, Airbus, SSTL and ISIS, RemoveDEBRIS, launching in 2016, will demonstrate: net capture, harpoon capture, drag sail deployment and vision-based navigation. Such technologies are key to the future of debris removal missions.

THE FIRST DEMONSTRATION OF KEY ACTIVE DEBRIS REMOVAL TECHNOLOGY ON GROUND AND IN ORBIT

Active debris removal (ADR) is becoming an important research area. Debris in low Earth orbit, such as defunct satellites, rocket casings and debris caused by in-space collisions is a major concern today, where debris is becoming more of a threat to space assets. The removal of large items of inactive debris from space is considered as one of the key solutions to the growing problem. This can be done by 'capturing' the debris, then deorbiting it so that it burns up in the Earth's atmosphere.

The RemoveDEBRIS mission, due for launch in 2016, aims to demonstrate and improve the Technology Readiness Level (TRL) of some of the key debris removal technologies needed in the future, including net capture, harpoon capture, drag sail deployment and vision-based navigation.

The mission consists of a main 'RemoveSat' spacecraft, which will eject three smaller cubesats (simulating debris). The first cubesat will deploy an inflatable structure and then will be captured by a self-constricting net fired from the RemoveSat. The second cubesat will be captured by a harpoon fired from the RemoveSat without creating any debris. The third cubesat will be used to mature LIDAR-assisted vision-based navigation technologies. Once the three experiments have been performed, a large drag sail will be deployed as an end-of-life deorbiting device.

Specific focus is on the safety of the in orbit operations of the space mission and on pushing the TRL of much needed debris removal technology for future missions, in line with European space debris roadmaps.

QUESTIONS & ANSWERS

What is the project designed to achieve?

The RemoveDEBRIS project aims to develop several technologies including, net and harpoon capture, drag sail usage and vision-based navigation. Both net and harpoon capture are currently considered one of the best ways to 'capture' uncooperative debris. Vision-based navigation is also considered mandatory for future debris removal missions, where local sensors are the only ones available for navigation.

Why is this project important for Europe and how does it benefit European citizens?

Protecting our space environment from becoming cluttered, just like protecting the Earth from global warming, is a responsibility for all of us. One day, if the generation of space debris is not curbed, there will be limited space for future satellites, which are necessary for the services people use every day: mobile phone, Internet, TV, GPS, weather forecasting and natural disasters' monitoring.

How does the project exceed the current state of knowledge?

RemoveDEBRIS is one of the first ever debris removal missions. Neither net nor harpoon have ever been tested in space before. This will provide a key opportunity to develop and test these technologies that are considered one of the best ways of capturing debris. The mission will also advance technology in miniaturised drag sail deployment and Lidar-assisted vision-based navigation.

RemoveDEBRIS

A Low Cost Active Debris Removal Demonstration Mission

LIST OF PARTNERS

- Surrey Space Centre (University of Surrey), United Kingdom
- SSTL (Surrey Satellite Technology Limited), United Kingdom
- AIRBUS Defence & Space GmbH – Bremen, Germany
- AIRBUS Defence & Space SAS – Toulouse, France
- AIRBUS Defence & Space Ltd – Stevenage, United Kingdom
- Innovative Solutions In Space BV (ISIS), the Netherlands
- Centre Suisse d'Electronique et de Microtechnique SA (CSEM), Switzerland
- Institut National de Recherche en Informatique et en Automatique (INRIA), France
- Stellenbosch University, South Africa

COORDINATOR

Surrey Space Centre (University of Surrey),
United Kingdom

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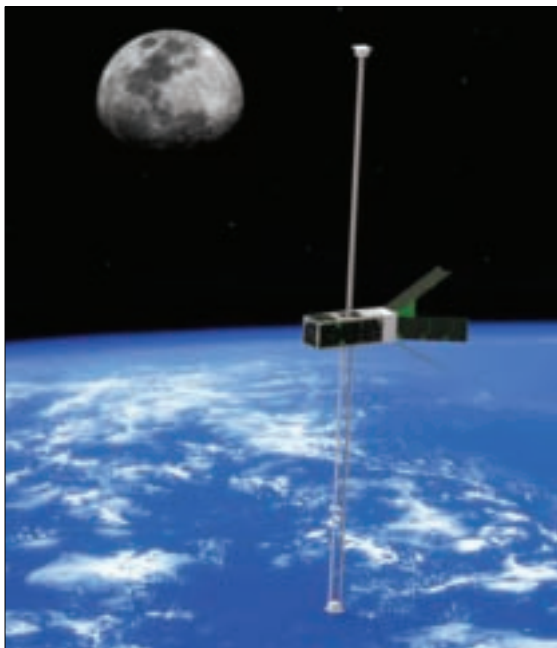
PROJECT INFORMATION

A Low Cost Active Debris Removal Demonstration Mission (RemoveDEBRIS)

Contract N°: 607099
Starting Date: 01/10/13
Duration: 36 months
EU Contribution: € 6.999.867,00
Estimated total cost: € 11.730.796,00

SEAM

Small Explorer for Advanced Missions



© N/A

An artists impression of the SEAM satellite.

ABSTRACT

The objective of SEAM is to build and launch an electromagnetically clean nanosatellite with precision attitude determination, flexible autonomous data acquisition system, high-bandwidth telemetry and an integrated solution for ground control and data handling. The scientific objective is high-resolution observation of the DC and AC magnetic field of the Earth for characterisation of auroral current systems, and monitoring of natural and anthropogenic VLF and ELF waves.

NANOSATELLITE FOR SCIENTIFIC MEASUREMENTS OF MAGNETIC FIELD FEATURING MULTIPLE INNOVATIVE SOLUTIONS

Micro- and nanosatellites are a present reality of space research. Their low launch enables ground-breaking missions employing satellite constellations. A class of nanosatellites is defined by the CubeSat form factor, which standardizes satellite preparation and launch. Nominally, these satellites are a cube with a side length of 10 cm, but multiples of this 1U form factor have arisen, with the most common being a 3U CubeSat: 30x10x10. A number of educational CubeSats have been launched. For scientific missions to fully realise the potential of low-cost nanosatellites, there are challenges related to limitations of the existing CubeSat platforms and to the availability of small, yet sufficiently sensitive sensors.

The consortium of SEAM unites the expertise of a university, a state-owned company and several SMEs with various establishment levels in the space sector, specializing in development and commercialization of advanced instrumentation, data processing and telemetry systems.

Together, the consortium will develop and demonstrate an electromagnetically clean nanosatellite with precision attitude determination, flexible autonomous data acquisition system, high-bandwidth telemetry and an integrated solution for ground control and data handling. The satellite will carry novel magnetic sensors, mounted on booms to provide science-grade measurements.

Ultimately, SEAM will provide a unique high-end commercial product range, constituted either by the platform and related services as a whole, or by selected subsets. The combination and further development of the technologies by the consortium will make it possible to provide a comprehensive platform for unprecedented missions and to propose it to the European and worldwide markets.



Nickolay IVCHENKO
Project Coordinator

QUESTIONS & ANSWERS

What is the project designed to achieve?

The project will bring together the expertise of the partners to develop a nanosatellite platform for advanced scientific missions. This will be demonstrated by flying science-grade magnetic instruments to study electric currents and wave phenomena in the geospace. The success of the project will open up possibilities for future missions with constellations of nanosatellites.

Why is this project important for Europe and how does it benefit European citizens?

The project brings together six small and medium enterprises, a technical university and a large state-owned space company. By working together on developing the technology, the European companies will be able to strengthen their position on the fast-growing nanosatellite market, targeting high-end customers and offering attractive solutions to advance science – in Europe and beyond.

How does the project exceed the current state of knowledge?

Currently, most nanosatellites are built for educational purposes by universities around the world. To use CubeSats for viable scientific research, the platform and subsystems must meet strict requirements. In SEAM, we identify these requirements and work to achieve them. For example, SEAM requires electromagnetic cleanliness, novel attitude control, data handling, and high-bandwidth communication.

LIST OF PARTNERS

- Kungliga Tekniska Högskolan (KTH), Sweden
- AAC Microtec AB, Sweden
- Engineering Consulting and Management Office, Germany
- Laboratory of Electro-Magnetic Innovations LLC, Ukraine
- BL-Electronics Szamitastechnikai Korlatolt Felelozsegu Tarsasag, Hungary
- GomSpace Aps, Denmark
- Swedish Space Corporation, Sweden
- Kayser Italia SRL, Italy

COORDINATOR

Kungliga Tekniska Högskolan (KTH), Germany

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PROJECT INFORMATION

Small Explorer for Advanced Missions (SEAM)

Contract N°: 607197
Starting Date: 01/10/2013
Duration: 36 months
EU Contribution: € 1.998.970,00
Estimated total cost: € 2.631.631,00

SLOGAN

Space qualification of High-Power SSPA based on GaN technology



Satellite with high-efficient SSPA based on GaN-technology.

ABSTRACT

The aim of SLOGAN project is to design, implement and test a solid-state power amplifiers (SSPA) EQM based on European GaN technology for the next-generation of Galileo satellites. The development of the project will allow not only to show the feasibility of GaN technology in high output power SSPA's for space, but also to open the door to a wide variety of applications where GaN technology promises clear advantages over current solutions.

SSPA BASED ON GAN TECHNOLOGY FOR THE NEXT GENERATION OF GALILEO SATELLITES

With the increased usage of satellite communications which require an increase in the available power of navigation signals to the receiver on the ground, high efficiency and high output power amplifiers are in demand and will also be requested in the future. Traditionally, travelling wave tube amplifiers have been widely used for such applications, due to their high output power and added efficiency. However, these amplifiers require an extremely high voltage and moreover, their reliability can be questionable, due to the hot electrons in the vacuum tube. Due to these reasons solid-state power amplifiers (SSPA) are becoming a competitive solution.

In the particular case of Galileo system, current satellites make use of travelling wave tube amplifiers. However, the next generation of Galileo satellites will require higher output powers, in addition to increased efficiency and very demanding linearity. All these exigent requirements, together with the harsh environmental conditions associated with space applications, present great challenges in the design and implementation of power amplifiers.

Nevertheless, gallium nitride (GaN) technology can overcome the challenge. This technology has made a remarkable breakthrough in the world of microwave electronics, allowing to manufacture radiofrequency devices with significant output power performance. GaN devices offer high output power with small physical volume and high efficiency. Due to all these reasons, this technology is the best candidate for high power amplifiers.

SLOGAN project will develop and test a space qualified SSPA based on European GaN technology for the next generation of Galileo satellites.



Laura GONZALEZ
Project Coordinator

QUESTIONS & ANSWERS

What is the project designed to achieve?

SLOGAN project will design, develop, implement and test a GaN SSPA engineering qualification model for the next generation of Galileo satellites. The project will evaluate and apply the potentiality of GaN technology, applied to high efficiency SSPAs in space applications. It will also allow new applications to be explored, in which GaN can offer clear benefits over current technologies.

Why is this project important for Europe and how does it benefit European citizens?

The non-dependence of space GaN-based technologies applied to SSPAs is strategic for Europe. It will allow the Galileo satellites to offer more transmitted power. European citizens can benefit from a received navigation signal which will be immune to other navigation systems, providing a better quality of service. The solution can be applied in terrestrial wireless and commercial aviation markets.

How does the project exceed the current state of knowledge?

SLOGAN will provide substantial improvement over current power amplifiers technologies, such as travelling wave tube amplifiers. In particular, SLOGAN will create a new generation of GaN SSPAs with higher output power, efficiency, reliability and mass reduction, based on a European technology. These GaN SSPA's expect to substitute current solutions in next Galileo satellites.

SLOGAN

Space qualification of High-Power SSPA based on GaN technology

LIST OF PARTNERS

- TTI Norte S.L., Spain
- United Monolithic Semiconductors SAS, France
- Universita Degli Studi di Roma Tor Vergata, Italy
- Alter Technology Tuv Nord SA, Spain
- OHB System AG, Germany
- Active Space Technologies Vof, the Netherlands

COORDINATOR

TTI Norte S.L., Spain

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PROJECT INFORMATION

Space Qualification of High-Power SSPA based on GaN technology (SLOGAN)

Contract N°: 606724
Starting Date: 01/10/2013
Duration: 30 months
EU Contribution: € 2.391.248,00
Estimated total cost: € 3.419.548,71

SpaceNav

Space-based Maritime Navigation



© N/A

Earth observation system.

ABSTRACT

The main goal of the SpaceNav project is to add Earth Observation satellite data to a sail plan service and conduct operational testing to further gain insight in the qualities of the system. The integration is a crucial component of the overall system and innovative approach to sail plans in maritime industry. The mentioned activities would serve as a background for planning and executing a commercialization plan of the project.

NEW CONCEPTS FOR CREATING EFFICIENT SAIL PLAN FOR SHIPS BASED ON EARTH OBSERVATION DATA

Maritime industry is in a great need for a much improved observation capability of the ocean surface layer. It is important to utilize all possible observations to allow for the most efficient maritime transport and, in particular, to optimize operational impacts, including fuel and emissions. Current working sail-plan solutions are mainly based on weather forecasts, seaborne and costal observations.

SpaceNav will further supplement satellite Earth Observation (EO) capabilities. The new addition will be tested, validated and demonstrated to quantify and qualify the positive impact of the space-based observations of the system. SpaceNav fuses ship-specific parameters such as yaw, pitch, roll, sailing speed, GPS position, structural stress, engine parameters, drift, loading condition, wetness, etc. with real-time weather and sea state observations: waves, winds, currents, sea ice concentration and drift. By combining observations from multiple sensors, weaknesses of one particular sensor are compensated for by the characteristics of another.

The sensor suite is chosen such that the sensors' capabilities partly overlap and complement each other. This makes SpaceNav an all-weather, 24/7 surveillance and sail plan system.

SpaceNav is focusing on creating a system which combines information obtained from various sensor systems like spaceborne, seaborne and coastal and weather forecast data into advanced numerical models to calculate the optimum sail plan for any vessel — continuously and in real-time. Optimized sail plans will be communicated to the ships for multiple benefits (depending on the chosen optimization criteria), for instance to save fuel, reduce pollution or to improve passenger and crew comfort.



Sverre DOKKEN
Project Coordinator

QUESTIONS & ANSWERS

What is the project designed to achieve?

Space-based maritime navigation addresses: (1) the add-on of the space based observations to the sail optimization service to greatly improve input data to the sail plan model to assist the captain in selecting the optimal route and speed pattern to the next port and (2) to further commercialize the system for the benefit of the project partners and end-users.

Why is this project important for Europe and how does it benefit European citizens?

The project significantly contributes to the well-being of European society by providing reliable energy supply, moderate energy prices, production and transport; optimizing transport of passengers; improving sail planning and thereby reducing environmental pollutions. SpaceNav would make European products more competitive in the global shipping market and encourage cleaner transport solutions with less fuel consumption and environmental releases.

How does the project exceed the current state of knowledge?

The SpaceNav project introduces Earth Observation sea and ice state geophysical parameter extraction in sail planning. It may be utilized in commercial shipping industries to reduce shipping impacts on the environment and climate. Moreover, the system reduces operational costs and improves resource efficiency of shipping transport, thereby reducing the overall transport costs of European goods.

LIST OF PARTNERS

- Offshore Monitoring Ltd. (OSM), Cyprus
- Advance Computer Systems, Italy
- Global Maritime Services Ltd., United Kingdom
- Chalmers University of Technology, Sweden
- Det Norske Veritas, Norway

COORDINATOR

Offshore Monitoring Ltd. (OSM), Cyprus

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PROJECT INFORMATION

Space-based maritime navigation (SpaceNav)

Contract N°: 607371

Starting Date: 01/12/2013

Duration: 36 months

EU Contribution: € 1.996.632,00

Estimated total cost: € 2.575.714,00

UPCD

Ultrasonic Planetary Core Drill



Ultrasonic drilling technology being tested by some members of the UPCD consortium in Tenerife (2011).

ABSTRACT

The objective of UPCD is to develop and test a drill that can extract and seal a sample of ice-bearing rock from a planetary surface, thus enabling future sample-return planetary exploration missions. To demonstrate the effectiveness of the design, the tests will be conducted on Devon Island, Canada. Devon Island has a cold, dry and icy environment that makes it one of the most Mars-like places on the Earth.

DEVELOPMENT OF A TOOL TO CORE AND CONTAINERISE SAMPLES OF VOLATILE-BEARING ROCK FOR SAMPLE RETURN MISSIONS

Exploration of our solar system may be facilitated by the existence of a technology that can extract samples of volatile-bearing rock and seal them in-situ, prior to returning the samples to the Earth for more detailed analysis.

The UPCD consortium will develop a tool that makes use of ultrasonic vibration to cut through rock whilst heating the sample to the lowest possible degree, minimising the extent to which volatiles are driven off. The sample will then be extracted, still within the coring bit, and ultrasonic vibrations will again be used to weld the bit shut. This will ensure that the sample material is hermetically sealed within, protecting both the sample and the Earth in any later return mission.

There are a number of technical challenges to be overcome. Maintaining an effective ultrasonic vibration requires feedback from the tool assembly that has not yet been made sufficiently autonomous for planetary operations, and rotating the drilling bit using a different mode of ultrasonic vibration has thus far only

been demonstrated in a laboratory environment. Furthermore, each impact of the drill will generate forces of several kilonewtons – and there will be around ten impacts per second – and therefore the deployment system must be able to withstand these forces while still delivering the tool to the target rock with pinpoint accuracy.

The consortium will develop a prototype tool over the period 2014 – 2016, and then field-test it in one of the Earth's most Mars-like environments to learn how it might perform in space.



Patrick HARKNESS
Project Coordinator

QUESTIONS & ANSWERS

What is the project designed to achieve?

This project will create a device that will allow future spacecraft to take samples from beneath the surfaces of other planets. It will be then possible to study the samples with the aim of learning about the planet's history. This information can help us take better care of the Earth in the future.

Why is this project important for Europe and how does it benefit European citizens?

Having access to a technology that can be used for planetary exploration will ensure that Europe can play a leading role in future missions. This will provide an inspiration for the next generation of scientists and engineers, while the scientific data we gather in space will help us view our own world in a wider context and, therefore, care for it better in the future.

How does the project exceed the current state of knowledge?

This project will develop autonomous drilling capabilities. For example, a feedback loop is going to be built so that the drill can constantly re-calculate the force it must apply to the rock to ensure that the fastest progress is maintained. This will cut out several minutes' delay every time a new command is sent from the Earth.

LIST OF PARTNERS

- University of Glasgow (UOG), United Kingdom
- Space Systems Finland OY (SSF), Finland
- LIDAX Ingenieria SL (LDX), Spain
- Magna Parva LTD (MPA), United Kingdom

COORDINATOR

University of Glasgow (UOG), United Kingdom

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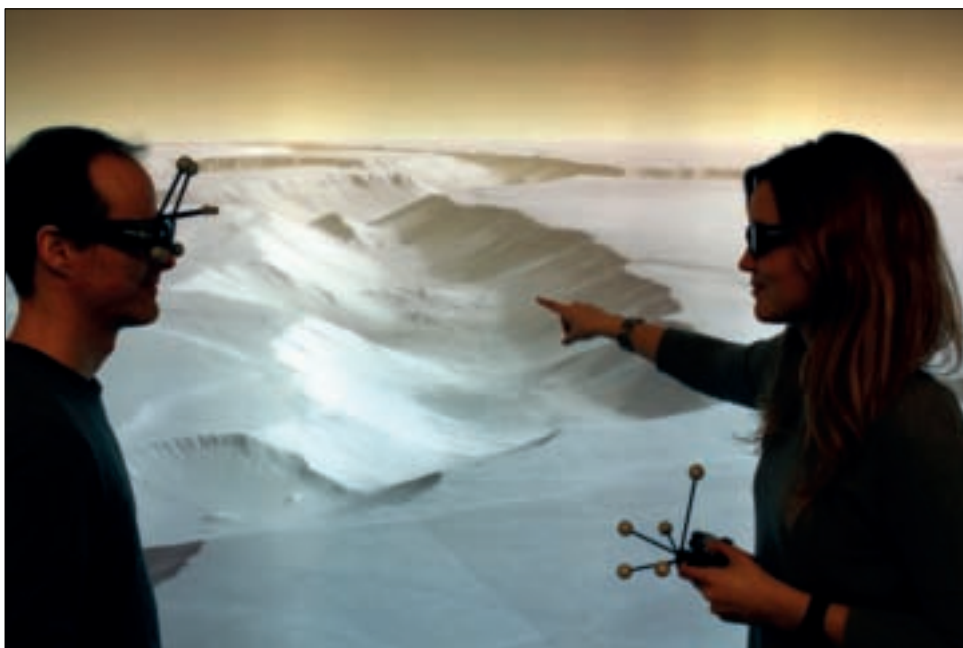
PROJECT INFORMATION

Ultrasonic Planetary Core Drill (UPCD)

Contract N°: 607015
Starting Date: 01/01/2014
Duration: 36 months
EU Contribution: € 2.360.244,00
Estimated total cost: € 3.069.190,80

CROSS DRIVE

Collaborative Rover Operations and Planetary Science Analysis System
based on Distributed Remote and Interactive Virtual Environments



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Interactive Mars Science Data Analysis in an immersive Virtual Environment.

ABSTRACT

The CROSS DRIVE project aims to develop an innovative collaborative workspace infrastructure for space missions that will allow distributed scientific and engineering teams to collectively analyse and interpret scientific data, as well as execute operations of planetary spacecraft. It aims to mobilise a team of the best European expertise in the field of Mars science data collection and analysis to propose and study synergic combinations of data sets and their benchmarking.

EXPLOITING SPACE SCIENCE DATA IN COLLABORATIVE ENVIRONMENTS

CROSS DRIVE aims at creating the foundations for collaborative distributed virtual workspaces for European space science. Space exploration missions have produced huge data sets of potentially immense value for research, as well as planning and operating future missions. However, currently expert teams, data and tools are fragmented, leaving little scope for unlocking this value through collaborative activities.

The question of how to improve data analysis and exploitation of space-based observations can be answered by providing and standardising new methods and systems for collaborative scientific visualisation and data analysis, and space mission planning and operation. This will not only allow scientists to work together, with each other's data and tools, but importantly to do so between missions.

The consortium brings together unprecedented expertise from space science, scientific visualisation, virtual reality and collaborative systems.

The proposed collaborative workspace encompasses various advanced technological solutions to coordinate central storage, processing and 3D visualization strategies in collaborative immersive virtual environments, to support space data analysis.

Three case studies will demonstrate the utility of the workspaces for European space science: Mars atmospheric data analysis, rovers landing site characterization and rover target selection during its real-time operations. The use cases will exploit state-of-the-art science data sets and they will be constructed in view of the ESA ExoMars 2016 TGO and 2018 rover missions' scenarios.

Impact on beneficiaries will be maximised both through providing an expandable backbone infrastructure and three levels of workspace for: scientists who are directly engaged, other external scientists, and the general public.



Andreas GERNDT
Project Coordinator

QUESTIONS & ANSWERS

What is the project designed to achieve?

Contributing to the exploitation of space science data by allowing research groups and scientists in various fields of science for analysis and interpretation of data and supporting data exploitation of space missions is the higher-level objective of CROSS DRIVE. It will allow space scientists to take full advantage of the potential value of the existing data for future missions.

Why is this project important for Europe and how does it benefit European citizens?

CROSS DRIVE develops scientific and technological solutions contributing to the integrated support of space science and exploration in the context of the EU's flagship initiative, Innovation Union, therefore supporting European collaboration. Development of common visions and consensus at a European level is extremely important to make sure the developed system is applicable to space missions and acceptable by the European space community.

How does the project exceed the current state of knowledge?

CROSS DRIVE will develop a novel technology platform that brings scattered data sets, analytical tools, simulation tools and computing power to accelerate the advances in Mars science studies. The outcome of CROSS DRIVE will revolutionise the way future planetary missions, such as ExoMars, will be conducted, by deploying new form of immersive and non-immersive collaboration technology platform and partnership models.

CROSS DRIVE

Collaborative Rover Operations and Planetary Science Analysis System
based on Distributed Remote and Interactive Virtual Environments

LIST OF PARTNERS

- Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Germany
- University of Salford, United Kingdom
- Advanced Logistics Technology Engineering Center SPA, Italy
- Thales Alenia Space Italia, Italy
- Istituto Nazionale di Astrofisica, Italy
- Institut d'Aéronomie Spatiale de Belgique (IASB/BIRA), Belgium
- National University Corporation Tohoku University, Japan

COORDINATOR

Deutsches Zentrum für Luft- und Raumfahrt
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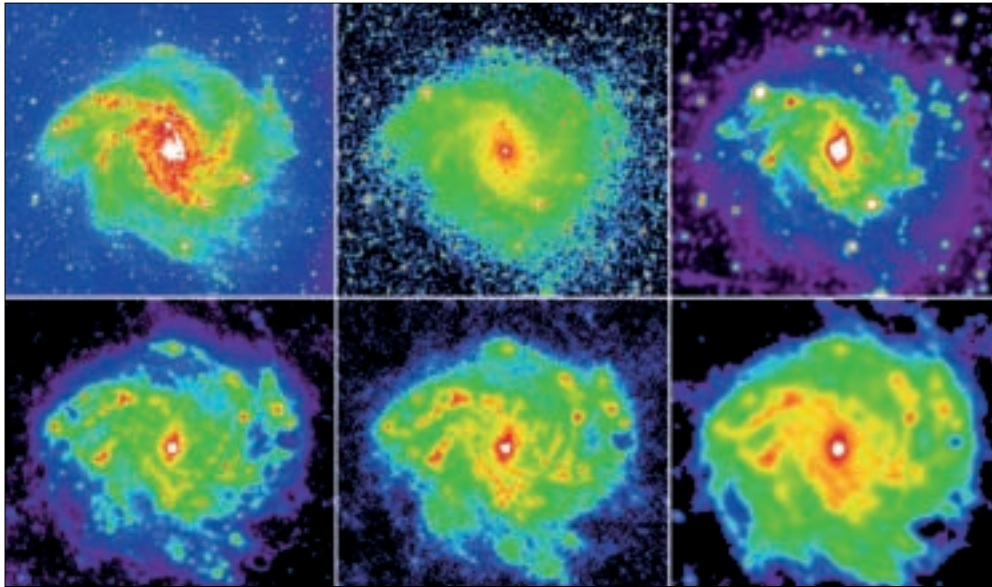
PROJECT INFORMATION

Collaborative Rover Operations and Planetary Science Analysis System based on
Distributed Remote and Interactive Virtual Environments (CROSS DRIVE)

Contract N°: 607177
Starting Date: 01/01/2014
Duration: 36 months
EU Contribution: € 2.493.427,00
Estimated total cost: € 3.586.759,00

DustPedia

A Definitive Study of Cosmic Dust in the Local Universe



Images of the nearby galaxy NGC6946 at different wavelengths – from left to right, visual (SDSS), near infrared (2MASS), 4.6 μ m (WISE), 24 μ m (Spitzer), 100 μ m (Herschel), 250 μ m (Herschel). © N/A

ABSTRACT

The primary goal of the project is to provide a clearer understanding of the role dust plays in the evolution of galaxies by using state-of-the-art models to interpret newly obtained data. The project is focused on the origin and fate of cosmic dust and the role it plays in physical processes in the interstellar medium.

USING NEW DUST MODELS, SPECTRAL ENERGY DISTRIBUTION FITTING AND RADIATION TRANSPORT CODES TO PROVIDE NEW INSIGHTS INTO COSMIC DUST

The European Space Agency (ESA) has invested heavily in two cornerstone missions: Herschel and Planck. These space observatories provide us with an unprecedented opportunity to study, at far infrared wavelengths, the cold Universe beyond our galaxy. When these missions came to an end (2013) they left behind a huge legacy data set that the project intends to exploit. The data provides us with an opportunity to study cosmic dust in galaxies to answer fundamental questions about: the origin of the chemical elements; physical processes in the interstellar medium (ISM); its effect on stellar radiation; its relation to star formation and its relation to the cosmic far infrared background radiation.

In the course of the project's duration, tools and computer models will be developed that will help us relate observed cosmic dust emission to the physical properties of the dust (chemical composition, size distribution, temperature), to the origins of dust (evolved stars, super novae, growth in the ISM) and the processes that destroy

it (high energy collisions and shock heated gas).

The data will be interpreted using world leading Monte Carlo photon tracing radiative transfer models of galaxies. To carry out this research the Herschel/Planck data will be combined with that from many other new and state-of-the-art databases that contain observations at other wavelengths, thus creating the DustPedia database. To maximise the spatial resolution and sensitivity to cosmic dust, the intention is to use 3045 local galaxies ($d < 42$ Mpc) selected via their near infrared luminosity (stellar mass).



Jonathan DAVIES
Project Coordinator

QUESTIONS & ANSWERS

What is the project designed to achieve?

The project aims at a clearer understanding of the important part cosmic dust plays in physical processes in the interstellar medium. It will address, in particular, the role of the formation of stars and the fraction of stellar radiation that is absorbed by cosmic dust and then re-radiated at far infrared wavelengths.

Why is this project important for Europe and how does it benefit European citizens?

The project primarily uses data from two high profile European Space Agency (ESA) space missions – Herschel and Planck. This new data will be used to investigate issues central to our understanding of why we exist in the Universe like this and particularly the origin of the elements like carbon, oxygen and nitrogen that are central to life here on the Earth.

How does the project exceed the current state of knowledge?

The project is using state-of-the-art space data, combining it with newly developed models of the physical properties of cosmic dust (what it is made of and how it interacts with radiation) and then exploring the implications through a unique and powerful photon tracing radiative transfer code that will make simulated images of the galaxies for comparison with what was observed.

LIST OF PARTNERS

- Cardiff University, United Kingdom
- Ghent University, Belgium
- Osservatorio Astrofisico di Arcetri (INAF), Italy
- Université Paris Sud, France
- Service d'Astrophysique (CEA), France
- National Observatory of Athens, Greece

COORDINATOR

Cardiff University, United Kingdom

CONTACT

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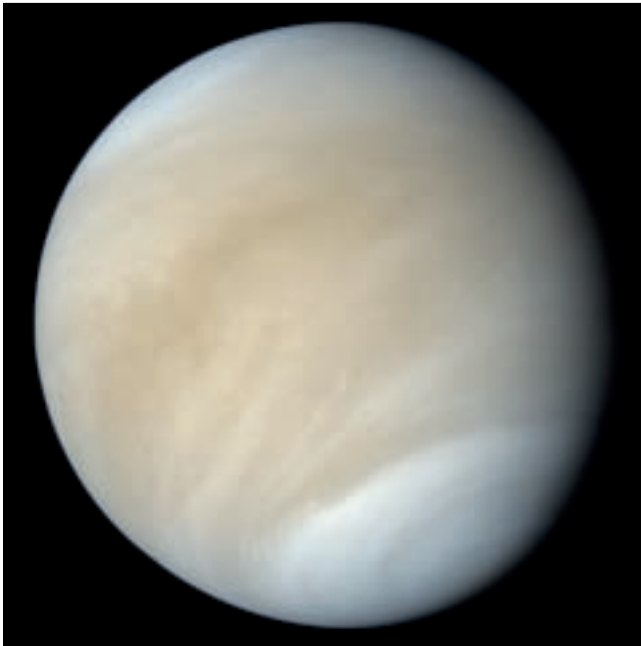
PROJECT INFORMATION

A Definitive Study of Cosmic Dust in the Local Universe (DustPedia)

Contract N°: 606847
Starting Date: 01/11/2014
Duration: 42 months
EU Contribution: € 2.093.068
Estimated total cost: € 2.778.315

EuroVenus

European Unified Research on Observations of Venus using co-ordinated Space- and Earth-based facilities



EuroVenus will enhance knowledge about Venus as environmental and climate change studies are relying more and more on comparative evolution of planetary atmospheres.

ABSTRACT

Venus is increasingly important to study, whether we are considering the future of our Earth's climate or the long-term habitability of terrestrial planets in other solar systems. European Space Agency's (ESA) Venus Express, the first European mission to Venus, has provided global long-term remote-sensing observations of the atmospheric temperature and winds. European planetary science laboratories combine their efforts with ground-based observations to provide a long-term climatology of Venus.

NEW RESEARCH INTO OUR SISTER PLANET: A PAN-EUROPEAN VENUS RESEARCH INITIATIVE

Venus Express, the first European mission to Venus, has provided global long-term remote sensing observations of the atmosphere. When launched in 2005, it was the first mission to Venus since 1992.

Dedicated to studying the thick and inhospitable atmosphere by remote sensing, European Space Agency's (ESA) Venus Express (VEx) mission uses the so-called infrared windows that can peek through the thick layers of clouds on Venus' nightside and characterise the rapid changes in dynamics and trace gases chemistry at several heights in the lower atmosphere. Thanks to the exceptional success of Venus Express operations, Europe has now gained a world leadership in the study of our twin planet, the nearest example of an Earth-analog in its habitable zone.

Like climate studies on the Earth, we rely on long series of inter-calibrated measurements. The project funds continued exploitation of Venus Express large datasets, in particular SOIR (Solar Occultation), VeRa (Radio Occultation), Wind tracking data from in-orbit imagers (VMC, VIRTIS). At the same time, the project supports comparison and cross-validation between Venus Express and terrestrial telescopes, such as the Atacama Large Millimeter Array (ALMA), the Canada-France-Hawaii telescope (CFHT) and the Infrared Telescope Facility (IRTF).

The main purpose of EuroVenus is to help to put together efforts from the ground-based community and the Venus Express instrument teams to interpret the massive, direct, as well as indirect, information on the Venus' atmosphere obtained by Venus Express in the course of its extended mission, and prepare for future exploration of our sister planet.



Thomas WIDEMANN
Project Coordinator

QUESTIONS & ANSWERS

What is the project designed to achieve?

The project will focus on gathering large datasets of winds, chemistry, clouds/hazes and temperature to provide the first long-term climatology of Venus. Our goal is to combine data from Venus Express instruments (VIRTIS, VMC) and large terrestrial telescopes such as the Atacama Large Millimeter Array (ALMA) in Chile, the Canada-France-Hawaii telescope (CFHT) and the Infrared Telescope Facility (IRTF) in Hawaii.

Why is this project important for Europe and how does it benefit European citizens?

Environmental and climate change studies are relying more and more on comparative evolution of planetary atmospheres. Modelling tools for climate change are increasing in complexity and Venus is the largest Earth-like planet in the solar system that can be studied in terms of global circulation, interaction of the atmosphere with solar radiation, cloud composition and radiative properties, in comparison with the Earth.

How does the project exceed the current state of knowledge?

In a context where the European Space Agency (ESA) has gained a historical leadership in the study of Venus, the project strengthens and expands the position of European researchers in the field of comparative planetology. Like climate studies on the Earth, new findings rely on long series of inter-comparison of measurements at various time scales, latitudinal and altitude ranges, to validate climate modelling tools.

LIST OF PARTNERS

- Observatoire de Paris, France
- Institut d'Aéronomie Spatiale de Belgique (IASB/BIRA), Belgium
- Fundacao da Faculdade de Ciencias da Universidade de Lisboa, Portugal
- Rheinisches Institut für Umwelt-Forschung an der Universität zu Köln e.V., Germany
- University of Oxford, United Kingdom
- Centre National de la Recherche Scientifique (CNRS), France

COORDINATOR

Observatoire de Paris, France

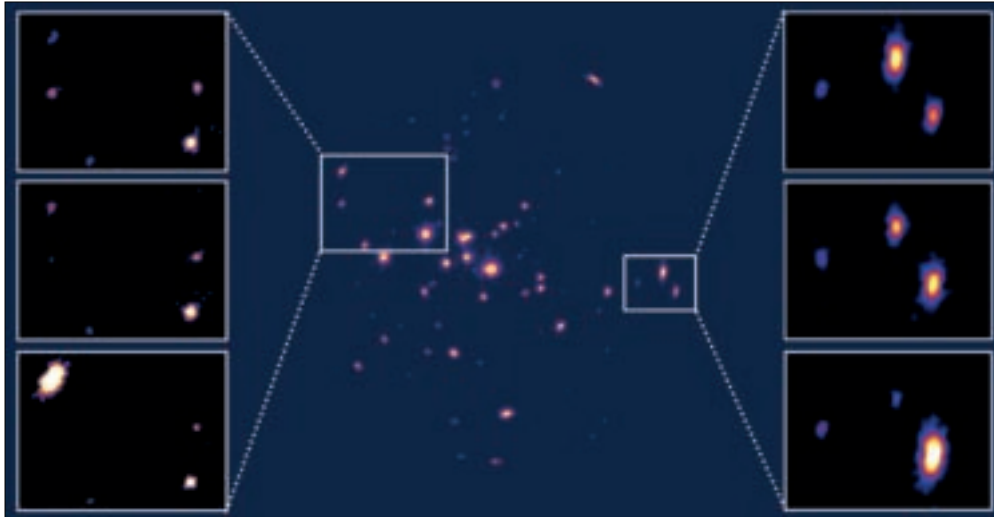
CONTACT

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PROJECT INFORMATION

European Unified Research on Observations of Venus using co-ordinated Space- and Earth-based facilities (EuroVenus)

Contract N°: 606798
Starting Date: 01/10/2013
Duration: 36 months
EU Contribution: € 2.184.687,00
Estimated total cost: € 2.831.692,54



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Highly variable cosmic sources, on timescale from hours (left) to weeks (right) in XMM/EPIC data.



Andrea DE LUCA
Project Coordinator

ABSTRACT

EXTraS will harvest the hitherto unexplored time domain information buried in the serendipitous data collected by the EPIC instrument onboard the European Space Agency (ESA) XMM-Newton mission during 13 years of observations, characterise it and release it to the community in an easy-to-use form. A catalog of variable objects will be compiled to become the reference dataset for time domain astrophysics in the X-ray band, until a future, dedicated mission is deployed.

A COMPREHENSIVE STUDY OF VARIABILITY ON THE LARGEST EVER SAMPLE OF SOFT X-RAY SOURCES

Variability pervades the cosmos. Almost all astrophysical objects, from nearby stars to supermassive black holes in the cores of very distant galaxies, display distinctive variability on a range of time-scales, which yields crucial clues to understand their physics.

This is especially true in the high energy range of the electromagnetic spectrum (X- and gamma-rays), where every day, high energy telescopes collect huge amounts of valuable information, which remains mostly unused, stored in data archives.

EXTraS will systematically explore and characterise the temporal content in the entire database collected by the EPIC cameras onboard the XMM-Newton mission. These observations, made with the most powerful instrument currently studying the X-ray sky, already span 13 years. We will search for objects only fleetingly detected for a short time (transient objects), often the signature of the most energetic events in the cosmos.

More generally, we will search for and characterise variability, both periodic and aperiodic, in hundreds of thousands of objects on a broad range of time scales. The X-ray results will be complemented by multiwavelength characterisation of new discoveries. Phenomenological classification of variable objects will also be performed. All the results will be made publicly available, together with new analysis tools.

EXTraS will aim at unveiling new and unexpected classes of objects.. The results will become a reference dataset for the forthcoming era of large surveys. By providing the most sensitive search for variability ever performed, EXTraS is expected to raise new questions in high-energy astrophysics and serve as a pathfinder for future missions.

QUESTIONS & ANSWERS

What is the project designed to achieve?

EXTraS will characterise the temporal behaviour of the largest ever sample of objects in the soft X-ray range with a complex, systematic and consistent analysis of the whole XMM-Newton/EPIC database. Our output catalogue and products, together with visualisation tools, will serve a very broad community, helping to address a wide range of unsolved problems in almost all fields of astrophysics.

Why is this project important for Europe and how does it benefit European citizens?

EXTraS will devise statistical techniques relevant to temporal data mining in all contexts, from prompt recognition of epidemic outbursts to social and economic trends monitoring. With a strong programme of outreach and education (including direct involvement of high schools in the project activities), EXTraS will also inspire young scientists, contribute to the popularization of science and to the promotion of scientific culture.

How does the project exceed the current state of knowledge?

A quantitative characterization of all types of variability in a large sample of diverse X-ray objects is very challenging – indeed, such a task has never been attempted so far. EXTraS will fill this gap by performing a sophisticated statistical analysis aimed at systematically identifying and extracting the most useful information on the temporal behaviour of hundreds of thousands of objects.

LIST OF PARTNERS

- Istituto Nazionale di Astrofisica (INAF), Italy
- Istituto Universitario di Studi Superiori di Pavia (IUSS), Italy
- Consiglio Nazionale delle Ricerche (CNR), Italy
- University of Leicester, United Kingdom
- Max Planck Gesellschaft zur Förderung der Wissenschaften E.V., Germany
- Friedrich-Alexander-Universität Erlangen Nürnberg, Germany

COORDINATOR

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PROJECT INFORMATION

Exploring the X-ray Transient and variable Sky (EXTraS)

Contract N°: 607452
Starting Date: 01/01/2014
Duration: 36 months
EU Contribution: € 2.479.114,80
Estimated total cost: € 3.214.364,00



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Gaia artist's impression.



Xavier LURI
Project Coordinator

ABSTRACT

The main objective of GENIUS is to contribute to the Gaia Mission Archive development by: ensuring an archive design driven by the needs of the user community; the provision of exploitation tools to maximise the scientific return; ensuring the quality and interoperability with existing and future astronomical archives; the cooperation with the Japanese astrometric missions and facilitating outreach and academic activities to foster public interest in science and astronomy.

EUROPEAN NETWORK FOR IMPROVED DATA USER SERVICES FOR THE GAIA ASTRONOMICAL SPACE MISSION AND ITS SCIENTIFIC EXPLOITATION

The GENIUS project is designed to boost the impact of the next European breakthrough in astrophysics, the Gaia mission. Gaia is an European Space Agency (ESA) cornerstone mission that was launched on 19 December 2013 from Kourou in French Guiana. The mission aims at producing the most accurate and complete 3D map of the Milky Way to date. A pan-European consortium named DPAC is working on the implementation of the Gaia data processing, of which the final result will be a catalogue and data archive containing more than one billion objects.

The archive system containing the data products will be located at the European Space Astronomy Centre (ESAC) and will serve as the basis for the scientific exploitation of the Gaia data. The design, implementation, and operation of this archive are a task that ESA has opened up to participation from the European scientific community.

GENIUS aims at significantly contributing to this development based on the following principles: an archive design driven by the needs of the user community; provision of exploitation tools to maximise the scientific return; ensuring the quality of the archive contents and the interoperability with existing and future astronomical archives; and cooperation with the only two other astrometric missions in the world, the Japanese nanoJASMINE and JASMINE.

Last but not least, the archive will facilitate outreach and academic activities to foster the public interest in science, in general, and astronomy in particular. GENIUS is defined to fit seamlessly into existing Gaia activities, exploiting the synergies with ongoing developments.

QUESTIONS & ANSWERS

What is the project designed to achieve?

GENIUS is designed to boost the impact of Gaia mission, ensuring that its final result goes beyond being another specialised stellar catalogue. GENIUS represents the essential part of the Gaia project, namely the dissemination of the results of the biggest astronomical survey up-to-date to the scientific community and the general public.

Why is this project important for Europe and how does it benefit European citizens?

Gaia is the world leader in space astrometry, so this project is a contribution to the consolidation and continuation of this leadership. Furthermore, its impact on society goes beyond the resulting science and outreach activities, since the use of Information Technology for scientific results in the training of highly qualified developers pushes forward development of new technologies.

How does the project exceed the current state of knowledge?

The full potential of Gaia's 6D (positions and velocities phase space) information for astrophysics can be realised only from the advanced tools which GENIUS will develop. Furthermore, in the surveillance activities, the developed software will confirm and automate the alerts and combine ground with space-based data for solar system objects, including the potentially hazardous Near-Earth Objects.

LIST OF PARTNERS

- Universitat de Barcelona , Spain
- Centre National de la Recherche Scientifique (CNRS), France
- University of Edinburgh, United Kingdom
- Universiteit Leiden, the Netherlands
- Consorci de Serveis Universitaris de Catalunya, Spain
- Istituto Nazionale di Astrofisica (INAF), Italy
- Agencia Estatal Consejo Superior de Investigaciones Científicas, Spain
- Université de Genève, Switzerland
- Université Libre de Bruxelles (ULB), Belgium
- Fundaçao da Faculdade de Ciências da Universidade de Lisboa, Portugal
- University of Bristol, United Kingdom
- The Chancellor, Masters and Scholars of the University of Cambridge, United Kingdom
- National University Corporation, Kyoto University, Japan

COORDINATOR

Universitat de Barcelona, Spain

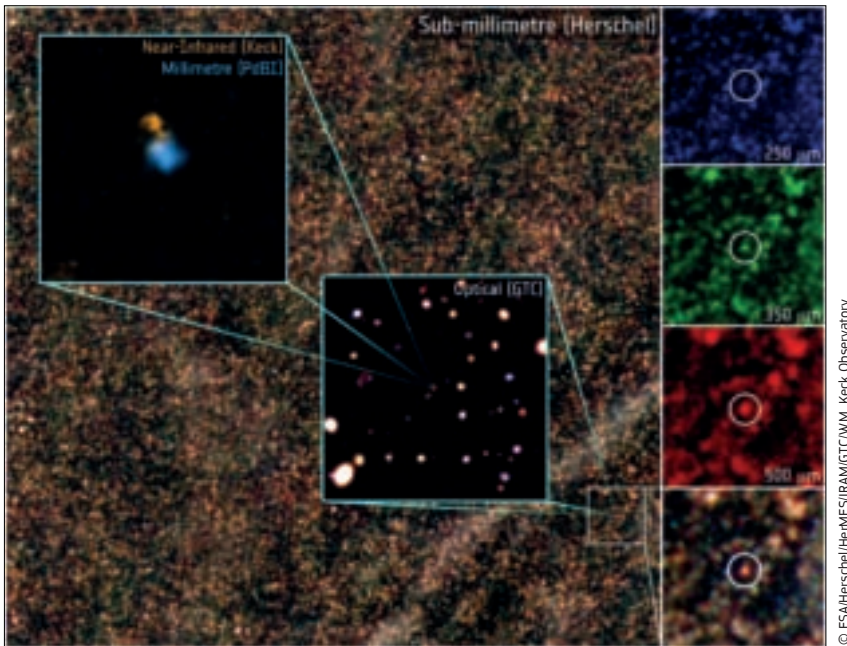
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PROJECT INFORMATION

Gaia European Network for Improved data User Services (GENIUS)

Contract N°: 606740
Starting Date: 01/10/2013
Duration: 42 months
EU Contribution: € 2.493.463,00
Estimated total cost: € 3.217.237,95



HELP will combine data from many different telescopes, enabling discoveries like this galaxy, HFLS3 found by Herschel 13 billion light years away.

ABSTRACT

The main objective of HELP is to provide a rich new data set characterising the physical properties of hundreds of thousands of distant galaxies. This will bring together a vast range of data from many different astronomical observatories. The focus is on the images produced by the European Space Agency's (ESA) Herschel mission. These chart the star formation enshrouded in dust and the HELP project will unlock the full potential of those images.

PROVIDING NEW TECHNIQUES, TOOLS AND DATA TO ENABLE STUDIES OF THE DISTANT UNIVERSE EXPLOITING ESA'S MISSION HERSCHEL

Understanding the evolution of galaxies across cosmic time is one of the great challenges of astrophysics. Galaxies found with many companions today are very different from those that are isolated. To understand how this came to be, we need to map a wide range of environments in the early universe using telescopes that probe different physical processes.

Astronomical observatories have thus been undertaking ambitious programmes to chart large areas of the distant universe. Most of these will be completed in the next four years.

Our project brings together key members of the teams conducting these projects to combine these data homogeneously. This will allow us to derive new information about the physical properties of the galaxies.

The European Space Agency's (ESA) Herschel mission in particular has a unique role, probing the star formation that has been obscured to conventional telescopes by dust. Exploration of the star formation history of the universe, using extragalactic surveys, was a major goal of the Herschel mission. However, the Herschel images have a relatively low resolution. By combining the data from many observatories, utilising advanced statistical techniques and developing new tools we will overcome the limited resolution and enable astronomers in Europe to realise Herschel's full potential.

We will thus provide a population census of distant galaxies and their three-dimensional spatial distribution. This will be a vast resource for studying the universe at early times, similar to that which the Sloan Digital Sky Survey provided for the present-day universe and a lasting legacy of these major ground-based and space-based surveys.



Sebastian OLIVER
Project Coordinator

QUESTIONS & ANSWERS

What is the project designed to achieve?

HELP will assemble the largest coherent database of galaxies in the distant universe. It will bring together new data from the best observatories and provide new tools to analyse these data. This will help European astronomers to understand the formation and evolution of galaxies over the history of the universe.

Why is this project important for Europe and how does it benefit European citizens?

Europe has world-leading expertise in the astrophysics of the formation and evolution of galaxies. This research has stimulated the development of ambitious instruments and telescopes that push the boundaries of technology. HELP ensures that these projects can be fully exploited to achieve the full return of that investment and will keep Europe at the forefront of this scientifically and technologically innovative field.

How does the project exceed the current state of knowledge?

The astronomical data are amongst the most sensitive ever achieved by any telescope and yet cover a vast area of the sky. This combination of area and sensitivity allows us to see the light from galaxies over most of history of the universe and in all conceivable environments. This provides a fundamental database against which to test any theories of the formation and evolution of galaxies.

LIST OF PARTNERS

- University of Sussex, United Kingdom
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- Centre National de la Recherche Scientifique (CNRS), France
- Commissariat à l'Energie Atomique et aux Energies Alternatives (CEA), France
- Universiteit Leiden, the Netherlands
- AS Cyprus College Limited, Cyprus
- The Chancellor, Masters and Scholars of the University of Cambridge, United Kingdom
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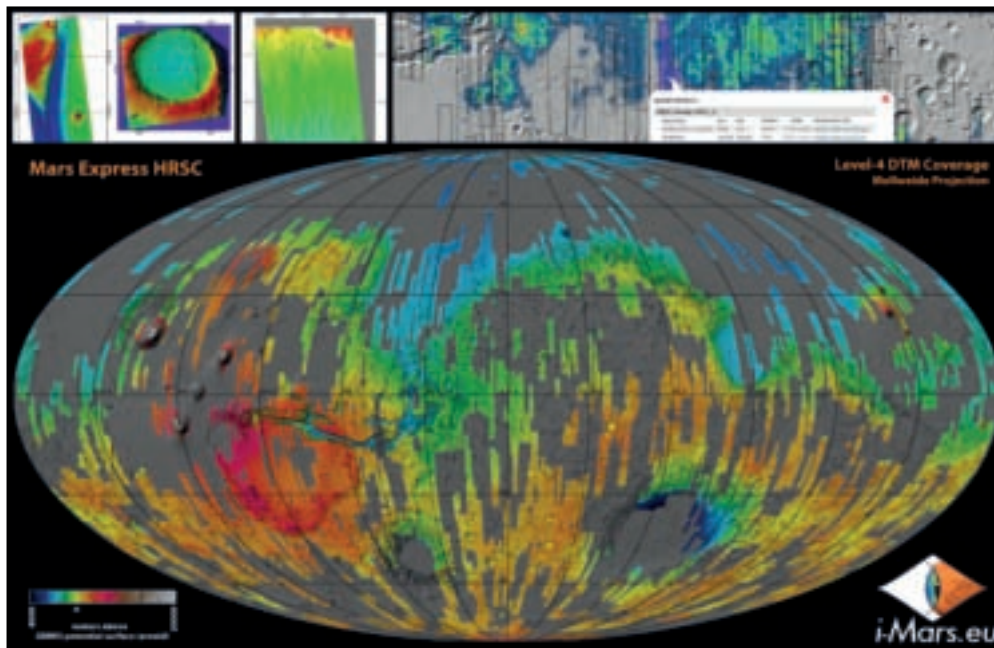
PROJECT INFORMATION

The Herschel Extragalactic Legacy Project (HELP)

Contract N°: 607254
Starting Date: 01/01/2014
Duration: 48 months
EU Contribution: € 2.475.824,70
Estimated total cost: € 3.288.553.00

iMars

Analysis of Mars multi-resolution images using auto-coregistration, data mining and crowd source techniques



Examples of 3D models of Mars generated by iMars partners from $\geq 50\text{m}$ (HRSC), 3m & 75cm (HiRISE), 20m (CTX) and example webGIS display.

ABSTRACT

The project will develop software for automated co-registration of orbital images of the Martian surface to a base image map from the HRSC onboard European Space Agency's (ESA) Mars Express. These co-registered images and a multi-resolution Digital Terrain Model (DTM) generated by project partners will be used to improve their geocoding. This time series will be analysed using both automated data mining and crowd sourcing, the results of which will be visualised through a webGIS.

CHANGE DETECTION OF MARS FROM 50 YEARS OF CO-REGISTERED ORBITAL IMAGES USING DATA MINING AND CROWD SOURCING TECHNIQUES

The National Aeronautics and Space Administration (NASA) and the European Space Agency (ESA) spacecrafts have imaged Mars from orbiting spacecrafts since 1977. Far from being the dead planet that Mars appeared to be in 1977, the Martian surface shows many signs of surface changes, including seasonal changes in polar ice-caps and global dust storms, new impact craters, geyser like features, gullies, dust devils and sand dune motion. These have been mainly observed over the last 10 years as resolution has increased above 100m . No systematic analysis has yet been made of the entire record of orbital images due to the difficulty in comparing features in different mission images, not the least of which is the poor co-registration of the images and the need for a global terrain model to correct for distortions arising from the steep topography.

The iMars project will address the need to create a co-registered time series of orbital images with resolutions $\geq 100\text{m}$ using automated feature matching and will exploit this further to produce

the best available Mars Digital Terrain Model (DTM) from the ESA Mars Express multi-angle stereo imager, HRSC ($\leq 25\text{m}$) and the two latest NASA imagers which have repeat-pass stereo pointing, CTX ($\approx 6\text{m}$) and HiRISE ($\approx 25\text{cm}$). This multi-resolution DTM will then be employed to correct for terrain distortions. The co-registration processor will enable time series to be generated for any part of the Martian surface back to 1977.

In order to detect changes, which will be revealed by this co-registered time series, a twin strategy will be adopted, as well as intelligent data mining techniques and citizen science crowd sourcing.



Jan-Peter MULLER
Project Coordinator

QUESTIONS & ANSWERS

What is the project designed to achieve?

Production of a seamless time series of 50 years of image maps of the Martian surface with resolution $\leq 100\text{m}$. Changes can then be visualised and detected and be made measurable for both the science community and for all the world's citizen scientists. For any part of the Martian surface, everyone will be able to view the finest detail available.

Why is this project important for Europe and how does it benefit European citizens?

European scientists developed the first mapping camera, High Resolution Stereo Camera (HRSC), for imaging the Martian surface down to 12.5m . The resultant 3D models and height corrected images, is a reference dataset which can be exploited to co-register every preceding, current and future orbital image. This unlocks the international archives of Martian images to European citizens and the crowd sourcing software invites their participation.

How does the project exceed the current state of knowledge?

We only have limited views of how the Martian surface has changed since the first spacecraft orbited Mars in 1977. Although the technology has improved we have never been able to view any area in any epoch and study surface changes on a planetary scale. iMars provides that opportunity and its results can be exploited for any other planet.

LIST OF PARTNERS

- Mullard Space Science Laboratory, University College London, United Kingdom
- Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Germany
- Freie Universität Berlin, Germany
- École Polytechnique Federale de Lausanne, Switzerland
- University of Nottingham, United Kingdom
- University of Seoul, South Korea

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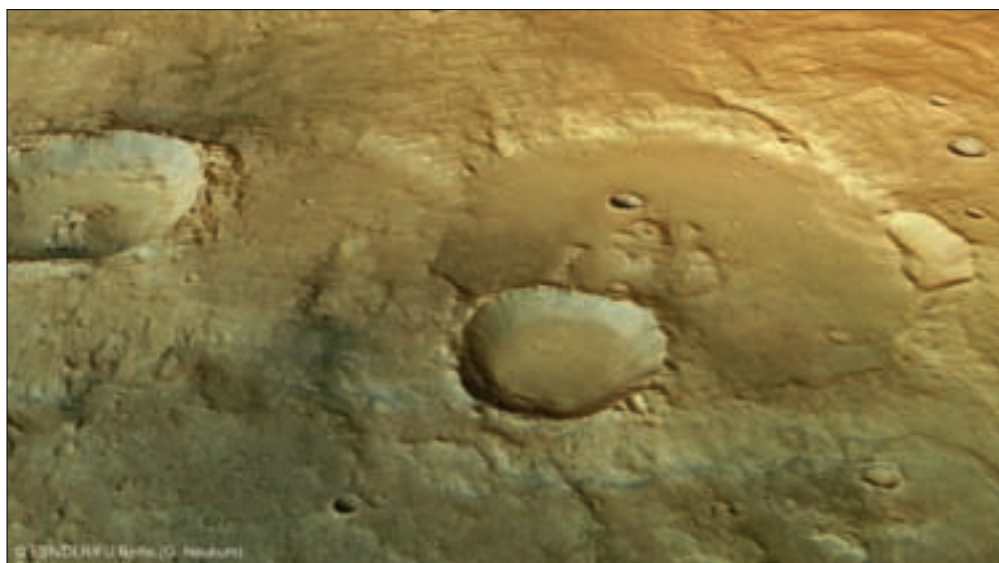
PROJECT INFORMATION

Analysis of Mars Multi-Resolution Images using Auto-Coregistration, Data Mining and Crowd Source Techniques (iMars)

Contract N°: 607379
Starting Date: 01/01/2014
Duration: 36 months
EU Contribution: € 2.014.171
Estimated total cost: € 2.553.279

MASE

Mars Analogues for Space Exploration



This close-up perspective view focuses on the craters in the centre of the main colour image. Here, a smaller crater clearly overlies the older, larger crater. To the right in this orientation lies a heavily deformed crater. Nearby, a channel appears to flow from the crater – perhaps this once transported water and sediments from a crater lake.

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Charles COCKELL
Project Coordinator

ABSTRACT

Through its innovative and ambitious workplan, MASE will look at isolation, growth, stress and preservation of anaerobic microorganisms from Mars analogue sites on Earth to better assess and understand Mars habitability. It also aims at identifying new organisms from these sites. Besides extant life, MASE will also consider fossilisation and biomarker preservation. The project will also look at improved protocols and methodologies for sample management and life detection.

FROM EARTH TO MARS, TOWARDS UNDERSTANDING BETTER THE RED PLANET HABITABILITY

Assessing the habitability of Mars and detecting life, if it was ever there, depends on knowledge of whether the environmental stress experienced on Mars is compatible with life and whether a record of that life could ever be detected. However, our current ability to make these assessments is hampered by a lack of knowledge of how the combined effect of different environmental stresses influences the survival and growth of organisms. In particular, many combinations of stress, such as high radiation conditions, combined with high salt and low temperature, relevant for early Mars, have not been investigated.

Even if life can be shown to be potentially supported on Mars, there exist no systematic studies of how organisms would be preserved. MASE will address these limitations in knowledge by: isolating and characterising microorganisms from selected sites that closely match environmental conditions that might have been habitable on early Mars; studying their responses to realistic combined environmental stresses that might have been experienced in

habitable environments on Mars; investigating their potential for fossilisation on Mars and their detectability by carrying out a systematic study of the detectability of artificially fossilised organisms exposed to known stresses.

MASE will also consider thoroughly: optimised methodologies for sample management and experimental process, and optimised methodologies for life detection. Eventually, it will allow to gain knowledge on Mars habitability and on adaptation of life to extremes; it will also present opportunities to optimise mission operations and life detection.

QUESTIONS & ANSWERS

What is the project designed to achieve?

MASE aims at isolating and characterising novel anaerobic organisms from Mars analogue sites to study effects of analogue conditions. It will study the responses of these (and other selected) organisms to realistic combined environmental stresses that might have been experienced in habitable environments on Mars and will carry out the artificial fossilisation of stressed cells to study their preservation.

Why is this project important for Europe and how does it benefit European citizens?

MASE implements an innovative approach cutting across the life cycle of anaerobic microorganisms, up to fossilisation as well as the detection of extant and extinct life. This project strengthens Europe's position in understanding life in extreme conditions by developing optimised methodologies for life detection. This knowledge is also relevant for industrial sectors such as biotechnology, food or health industry.

How does the project exceed the current state of knowledge?

Through its investigations, MASE will allow advancement of knowledge of the limits of anaerobic life applied to Mars, as well as reaching a better understanding of adaptations of anaerobic life to extra-terrestrial conditions. The project will also improve the knowledge of biosignatures of life and how to detect them, including the technological aspect of life detection.

LIST OF PARTNERS

- University of Edinburgh, UK Centre for Astrobiology, United Kingdom
- Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Germany
- Universidad Autónoma de Madrid, Spain
- MATÍS ohf., Iceland
- Leiden University - Leiden Institute of Chemistry, the Netherlands
- Instituto Nacional de Técnica Aeroespacial - Centro de Astrobiología - INTA-CAB, Spain
- Regensburg University, Germany
- Centre National de la Recherche Scientifique (CNRS), France
- NERC - British Antarctic Survey, United Kingdom
- European Science Foundation (ESF), France

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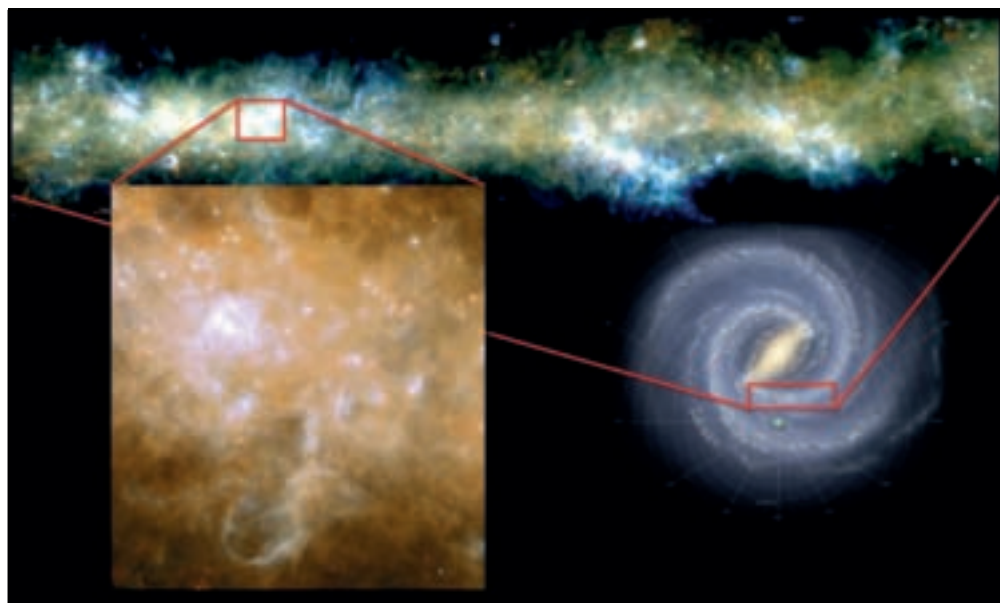
PROJECT INFORMATION

Mars Analogues for Space Exploration (MASE)

Contract N°: 607297
Starting Date: 01/01/2014
Duration: 48 months
EU Contribution: € 2.499.903
Estimated total cost: € 3.253.804

VIALACTEA

The Milky Way as a star formation engine



© ESA and the Hi-GAL Consortium

Cold dust and star formation in the Milky Way, captured with unprecedented detail by the European HERSCHEL satellite.

ABSTRACT

The objective of the VIALACTEA project is to exploit the combination of the new-generation infrared-to-radio surveys of the Milky Way Galactic Plane from space missions and ground-based facilities, using 3D visual analytics and data mining tools, to deliver a quantitative 3D model of our Galaxy as a star formation engine, that will be used as a template for external galaxies and study star formation across the cosmic time.

A NEW 3-D SCENARIO OF GLOBAL STAR FORMATION IN THE MILKY WAY GALAXY

VIALACTEA will bring to a common forum the new-generation surveys of the Galactic Plane of the Milky Way from the infrared to the radio wavelengths, to engage one of the fundamental challenges in Galactic astronomy: to quantify Galaxy-wide the relationship between the physical agents responsible for the onset and the regulation of star formation in a spiral galaxy and the resulting rate and efficiency of star formation, and to obtain a “star formation recipe” that will be a cornerstone to trace the star formation history of galaxies back to their formation.

The new state-of-the-art Milky Way paradigm is offering today, for the first time, the possibility to deploy a coherent science analysis methodology that can be uniformly applied from the Galactic Center to the outskirts of the Galaxy. The characterisation of the cold filamentary structures that fragment into dense clumps, together with the homogeneous and inter-calibrated evolutionary classification of these clumps hosting young forming clusters, will allow the delivery of a new 3D model of the Galaxy,

mapping the essential critical parameters like column density thresholds, rate and efficiency of star formation.

To make such an analysis possible in a timely and effective manner, we will develop a suite of next-generation 3D-visualization tools that will integrate visual analytics, on-the-fly handling of multi-SED radiative transfer modeling and data mining/machine-learning technologies, to incorporate the astronomer’s know-how into a set of supervised scientific analysis workflows with decision making capabilities.



Sergio MOLINARI
Project Coordinator

QUESTIONS & ANSWERS

What is the project designed to achieve?

VIALACTEA will build and visualize a new 3D representation of the star-forming component of the Milky Way Galaxy, mapping the quantitative relationships between the physical mechanisms responsible for the onset of star formation, and the Star Formation Rate and Efficiency. The result will be a prescription that will relate the physical agents at work in a spiral Galaxy to basic observable quantities.

Why is this project important for Europe and how does it benefit European citizens?

VIALACTEA will produce panoramic and 3D views of the Milky Way on a variety of supports (like 3D movies, stunning colour pictures on 100-meter long walk-on carpets) which will be of strong and inspirational impact to the public, helping to place us and the Sun in the spatial and temporal context of an evolving Galaxy in an evolving Universe.

How does the project exceed the current state of knowledge ?

The effective scientific analysis of Galaxy-scale multi-wavelengths datasets is beyond the capabilities of current methodologies. VIALACTEA is an initial step in building a system that integrates 3D visualization, mousetips/fingertips interaction with data and models and provides access to data-mining/machine-learning tools to incorporate the astronomer’s know-how into automated and decision-making science analysis workflows.

LIST OF PARTNERS

- Istituto Nazionale di Astrofisica (INAF), Italy
- University of Leeds, United Kingdom
- Max Planck Institut für Astronomie (MPIA), Germany
- Magyar Tudományos Akadémia Számítástechnikai és Automatizálási Kutató Intézet (SZTAKI), Hungary
- Cardiff University, United Kingdom
- Université d'Aix Marseille, France
- Centre National de la Recherche Scientifique (CNRS), France
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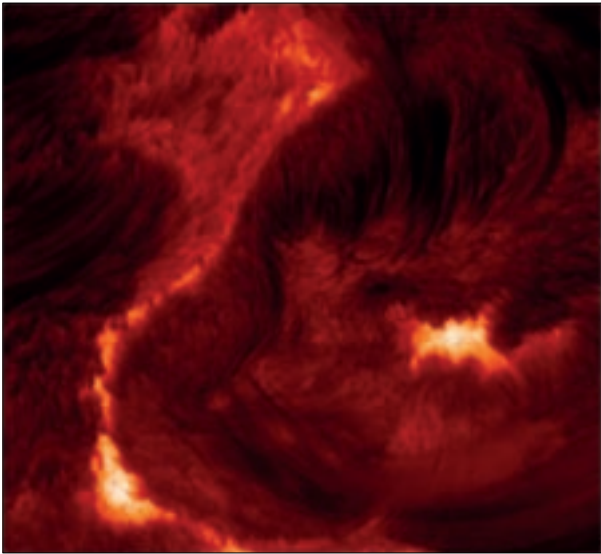
PROJECT INFORMATION

The Milky Way as a star formation engine (VIALACTEA)

Contract N°: 607380
Starting Date: 01/10/2013
Duration: 36 months
EU Contribution: € 2.488.590,85
Estimated total cost: € 3.100.358,37

F-CHROMA

Flare Chromospheres – Observations, Models and Archives



© Queen's University Belfast / ROSA

A solar flare taken with the ROSA instrument at the Dunn Solar Telescope.



Lyndsay FLETCHER
Project Coordinator

ABSTRACT

The main objective of F-CHROMA is to acquire, analyse and interpret co-ordinated ground and space-based datasets of solar flares, and to set these observations in the context of advanced modelling, to understand the transport and dissipation of energy in the flaring solar atmosphere. A catalogue and archive of flare observations and models will also be created.

ACQUIRING, ANALYSING AND INTERPRETING SOLAR FLARE DATA, TESTING IT AGAINST MODEL PREDICTIONS AND CREATING A PUBLIC ARCHIVE OF SOLAR FLARE DATA AND MODELS

Solar flares are dramatic and short-lived bursts of radiation from the Sun. They are the most intense energy release events in the solar system, and – via their associated coronal mass ejections – are a driving force of space weather.

The project focuses on the physical processes occurring in the lower, dense part of the solar atmosphere – chromosphere – which is the main location of flare energy dissipation and radiation, and hence a primary target for searching out and studying the observational signatures of basic physical processes.

The project will combine space-based and ground-based observations from European and international telescopes, plus theoretical and modelling expertise to understand how energy is transported and dissipated in the Sun's flaring atmosphere, resulting in strong heating and the observed radiation.

Chromospheric flare radiation spans the whole electromagnetic spectrum, which drives our requirement for the combination of space- and ground-based data. The project will provide a catalogue and archive facility for the solar physics community to identify and access combined space-based and ground-based datasets for well-observed flare events.

In particular, a strong emphasis is put on bringing ground-based solar flare observations into the scientific mainstream, where it will also significantly enhance the use and usefulness of the much more commonly used space-based data. Observational data will be supported by a library of flare solar atmospheric models to aid in data interpretation. This will also be vital for the interpretation of stellar flares, including the superflares which frequently occur in active solar-type stars.

QUESTIONS & ANSWERS

What is the project designed to achieve?

The project is addressing fundamental astrophysical processes occurring on the Sun (and other stars). It aims at answering the following questions: how is energy released from a magnetised stellar atmosphere; how does it travel through that atmosphere; and how is it ultimately dissipated and converted into forms that we can observe and hence use to probe the basic physics at work?

Why is this project important for Europe and how does it benefit European citizens?

The project will lead to increased exploitation and science return from European solar telescopes and European-built instruments operating here, overseas, and in space. In understanding the physics of solar flares we are also able to contribute basic knowledge to a Europe-wide effort to learn how to predict flares and the 'space weather' effects that they cause.

How does the project exceed the current state of knowledge?

The part of the solar atmosphere that we investigate – the chromosphere – is complicated and poorly observed in flares, but it is key to understanding how they work. Our project emphasises high-quality, systematically obtained and analysed datasets, coupled with targeted modelling efforts and carefully constructed model-data comparisons in a concerted study of this single critical region of the Sun and its physics.

F-CHROMA

Flare Chromospheres – Observations, Models and Archives

LIST OF PARTNERS

- University of Glasgow (UOG), United Kingdom
- Queen's University of Belfast, United Kingdom
- Uniwersytet Wrocławski, Poland
- Astronomický Ústav AVČR VVI, Czech Republic
- Universitetet i Oslo, Norway
- Istituto Nazionale di Astrofisica (INAF), Italy
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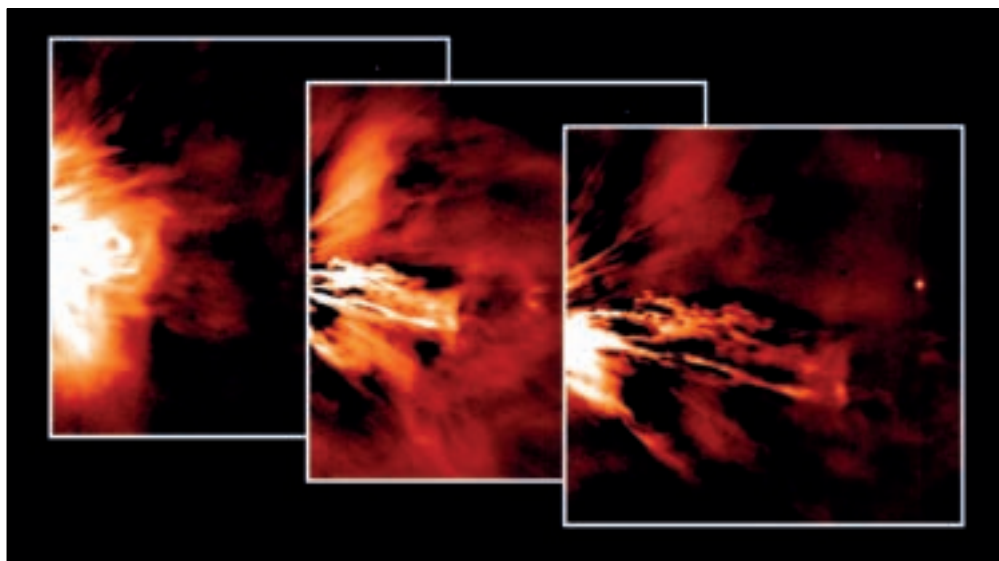
PROJECT INFORMATION

Flare Chromospheres: Observations, Models and Archives (F-CHROMA)

Contract N°: 606862
Starting Date: 01/01/2014
Duration: 36 months
EU Contribution: € 2.204.174,50
Estimated total cost: € 2.811.687,60

HELCATS

HELiospheric Cataloguing, Analysis and Techniques Service



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Sequence of images taken by the Heliospheric Imager on the STEREO-A spacecraft, illustrating the propagation of a coronal mass ejection through the field of view.



Richard HARRISON
Project Coordinator

ABSTRACT

The field of heliospheric imaging has revolutionised the study of the Sun's expanding atmosphere (the solar wind), and the large-scale structures that propagate therein. The principal objective of the HELCATS project is to ensure the effective exploitation, by the scientific community in Europe and beyond, of world-leading European assets and expertise in this novel and innovative field, through the generation and provision of access to advanced catalogues of solar wind structures.

SCIENTIFIC EMPOWERMENT THROUGH THE FOCUSING OF UNIQUE EUROPEAN ASSETS AND EXPERTISE IN HELIOSPHERIC IMAGING

The advent of wide-angle, white-light imaging of the inner heliosphere has revolutionised the study of the Sun's expanding atmosphere (the solar wind) and the large-scale structures that propagate therein. With heliospheric imaging came the unprecedented ability to routinely track the evolution of these structures as they propagate through the entire inner solar system, out to Earth-like distances and beyond. Such features, if Earth-directed, can severely affect the near-Earth environment. Their multifarious – and potentially damaging – effects on human technologies are known collectively as space weather.

HELCATS brings together scientists from eight institutes across seven European countries and collaborators from further afield. The project acts to focus extensive European assets and expertise in heliospheric imaging established over the last decade – centred on the UK Science and Technology Facility Council's leading role for the Heliospheric Imager instruments on NASA's

twin-spacecraft STEREO mission – whilst also exploiting the vast wealth of European expertise in such areas as solar and coronal imaging, and in-situ and radio measurements of the solar wind.

HELCATS aims to empower the wider scientific community, in Europe and beyond, by generating and providing access to advanced catalogues of solar wind structures based on European expertise and instrumentation. These catalogues will be validated through the application of well-established modelling techniques and the prototyping of other, more speculative, approaches. This unique consolidation of European efforts will enable the scientific community to greatly enhance their understanding of solar wind science that also has potential to address critical issues in the prediction of space weather and, hence, the mitigation of its effects.

QUESTIONS & ANSWERS

What is the project designed to achieve?

The aim of the HELCATS project is to empower the scientific community, both in Europe and beyond, by enabling access to advanced catalogues of solar wind structures that are generated through the project's provision of a focus for the effective exploitation of Europe's world-leading assets and expertise in the field of heliospheric imaging.

Why is this project important for Europe and how does it benefit European citizens?

Earth-directed solar wind structures can cause so-called "geomagnetic storms", a key space weather effect that impacts technologies, such as the power grid and satellite-based positioning systems. The potentially damaging effects of space weather are recognised to the extent that it is now on the risk register of many European member states. HELCATS enables addressing of vital issues in space weather prediction.

How does the project exceed the current state of knowledge?

HELCATS not only provides an unprecedented focus for Europe's previously disparate efforts in the analysis and interpretation of heliospheric imaging observations, it also enables the alignment of these efforts to enable the wider scientific community to advance their understanding of the solar wind, which has significant practical applicability in terms of space weather prediction.

LIST OF PARTNERS

- Universität Graz, Austria
- Université Paul Sabatier Toulouse III, France
- Georg-August-Universität Göttingen, Germany
- Royal Observatory of Belgium, Belgium
- Imperial College London, United Kingdom
- Helsingin Yliopisto, Finland
- Trinity College Dublin, Ireland
- Centre National de la Recherche Scientifique (CNRS), France
- George Mason University, USA
- Science and Technology Facilities Council (STFC), United Kingdom

COORDINATOR

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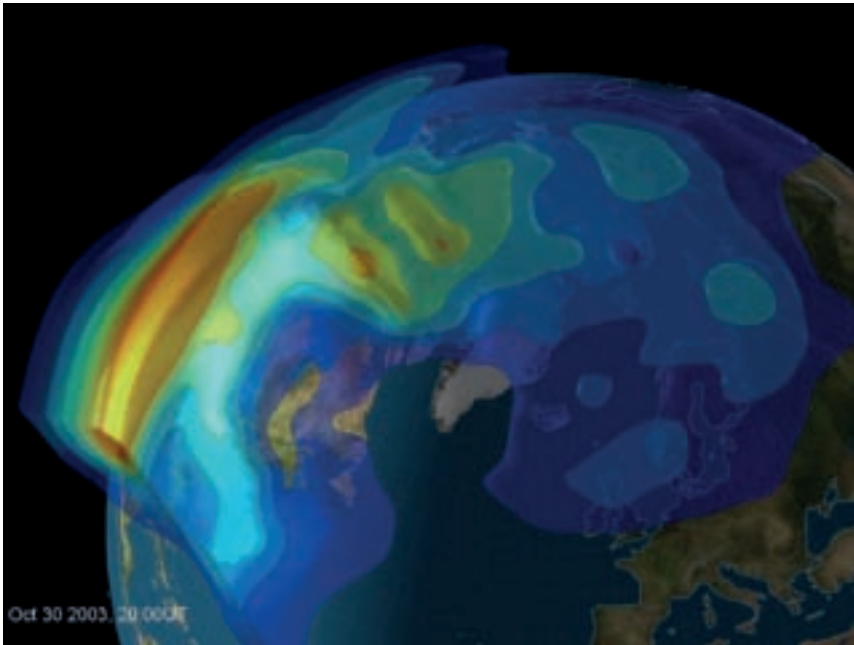
PROJECT INFORMATION

HELiospheric Cataloguing, Analysis and Techniques Service (HELCATS)

Contract N°: 606692
Starting Date: 01/05/2014
Duration: 36 months
EU Contribution: € 2.499.833,15
Estimated total cost: € 3.168.901,60

MISW

Mitigation of space weather threats to GNSS services



An image of electron density structures (calculated with MIDAS) during a severe space weather storm.

ABSTRACT

MISW aims at developing algorithms to be implemented in EGNOS and its ground monitoring stations, in order to protect satellite navigation services from space weather disruptions and pave the way for the expansion to Eastern Europe and in the African sector. Algorithms will follow from the quantification and characterisation of ionisation gradients typically present in the Earth's atmosphere, which are responsible for the disruption of satellite navigation signals.

SOLUTIONS AGAINST SPACE WEATHER THREATS FOR THE EVOLUTION OF GNSS SERVICES IN THE EURO-AFRICAN REGION

Space weather can affect many modern technologies that we take for granted. One of the most common technologies found across many systems today is navigation and timing provided by the Global Navigation Satellite System (GNSS). The main users of GNSS positioning are reliant on the inherent accuracy that the system can provide, but this is not adequate for all applications. Aviation has its own augmentation solution called a Satellite Based Augmentation System (SBAS) and the European version is called EGNOS (European Geostationary Navigation Overlay Service). These systems gather additional information that allows some mitigation of space weather events. However, they are not yet able to work in the most challenging regions and, as a consequence, space weather disturbances to the ionised upper atmosphere (ionosphere) will cause navigation errors that remain uncompensated.

MISW will research, develop and apply new solutions to compensate for ionospheric effects on GNSS.

Measurements of actual extreme events will allow realistic estimates of the ionospheric delays and errors caused by scintillation. MISW will include the development of new mapping techniques to compensate for ionospheric delay and both system-level and receiver-level solutions to scintillation events. The MISW consortium of leading industry, academia and research organisations will deliver the foundations for the next generation SBAS systems that can be extended across Europe and into Africa, ensuring reliable GNSS services over many decades ahead.

MISW will move Europe into a world-leading position in the development of SBAS systems, favouring the expansion of EGNOS into new geographical regions and markets.



Biagio FORTE
Project Coordinator

QUESTIONS & ANSWERS

What is the project designed to achieve?

MISW aims at developing algorithms to be implemented in EGNOS and its ground monitoring stations, to protect satellite navigation services from space weather disruptions and pave the way for the expansion to Eastern Europe and in the African sector. These regions experience strong space weather disruptions, which represent a clear technological barrier to the expansion of EGNOS geographically.

Why is this project important for Europe and how does it benefit European citizens?

MISW will move Europe into a world-leading position in the development of Satellite Based Augmentation Systems (SBAS). MISW will benefit all those services and applications based on EGNOS and Galileo (e.g. civil aviation, precision agriculture, timing, surveying). Most importantly, MISW will enable EGNOS to be expanded and certifiable as a service over Eastern Europe as well as over Africa.

How does the project exceed the current state of knowledge?

Part of the functions of the EGNOS system is to map the ionised regions of the ionosphere to enable specialist aviation GNSS receivers to make corrections for the ionospheric delay and hence to achieve a more accurate position. MISW will introduce novel concepts for the quantification and characterisation of ionisation gradients allowing EGNOS to operate over Eastern Europe and Africa.

LIST OF PARTNERS

- University of Bath, United Kingdom
- Thales Alenia Space Italia, Italy
- Thales Alenia Space France, France
- University of Nottingham, United Kingdom
- Politecnico di Torino, Italy
- Istituto Nazionale di Geofisica e Vulcanologia, Italy
- EISCAT Scientific Association, Sweden
- Joint Research Centre (JRC), European Commission, Belgium
- Danmarks Meteorologiske Institut, Denmark
- Centrum Badan Kosmicznych Polskiej Akademii Nauk - Space Research Centre, Poland
- Sveuciliste U Zagrebu Fakultet Elektrotehnike I Racunarstva - University of Zagreb, Croatia
- Met Office, United Kingdom

COORDINATOR

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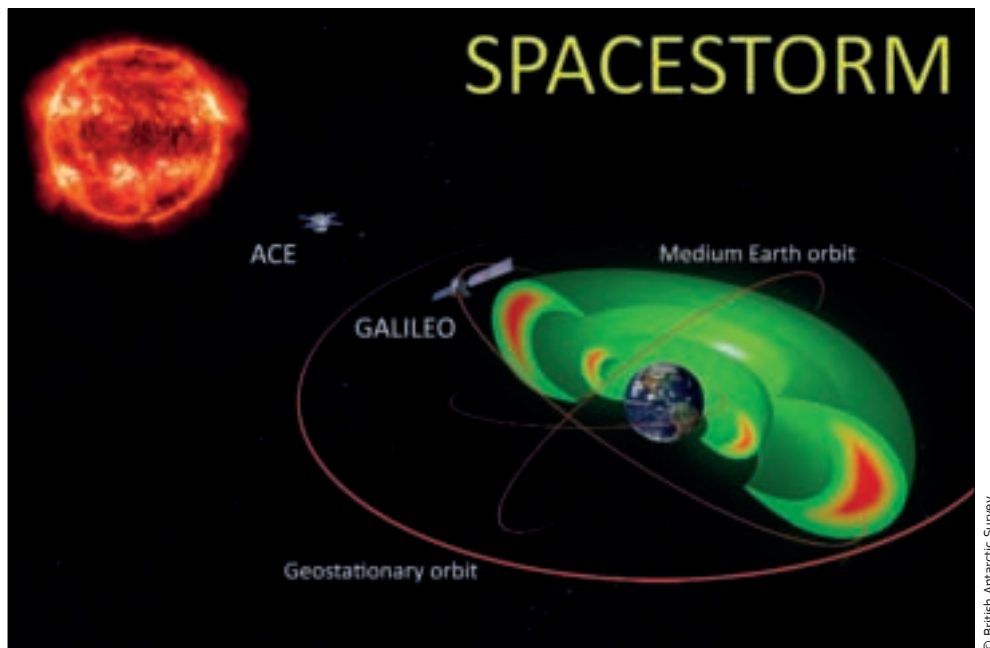
PROJECT INFORMATION

Mitigation of space weather threats to GNSS services (MISW)

Contract N°: 607081
Starting Date: 01/02/2014
Duration: 30 months
EU Contribution: € 1.968.231,00
Estimated total cost: € 2.882.063,80

SPACESTORM

Modelling severe space weather events and mitigating their effects on satellites



The Sun-Earth system showing the Earth's radiation belts and selected satellite orbits at risk to space weather.

ABSTRACT

The goal of the SPACESTORM project is to mitigate the effects of space weather on satellites by analysing past data on the radiation environment, simulating severe space weather events using state-of-the-art computer models, and by conducting laboratory experiments to determine the impact on satellites and reduce satellite charging. The results will be used to develop better mitigation guidelines, enhance design, and to improve the forecasting of space weather.

MITIGATING THE EFFECTS OF SEVERE SPACE WEATHER ON SATELLITES

With more than 1000 satellites in orbit we depend more than ever before on satellites for services such as navigation, positioning, timing, mobile phones, TV and the Internet. Severe space weather can damage satellite systems causing disruption to operations and sometimes complete satellite loss. As Europe is investing heavily in a competitive space industry and deploying the Galileo radio-navigation system of satellites, it is very important that we assess and mitigate the impact of space weather, particularly extreme events, to ensure safe operation of these assets.

The SPACESTORM project brings together scientists, engineers and commercial stakeholders from across Europe to assess the impact of severe space weather and to develop better mitigation strategies. Using state-of-the-art computer models SPACESTORM will simulate past space weather events to improve our physical understanding.

The project will reconstruct 30 years of the space radiation environment for medium Earth orbit where there are very few observations. Data analysis and computer models will be used to define the radiation environment for extreme space weather events and will be used with laboratory experiments to determine the impact on satellite systems and to develop new mitigation guidelines. SPACESTORM will also perform experiments on new materials and techniques to reduce surface charging on solar arrays and will develop better physical models to forecast the radiation belts.

The SPACESTORM project will develop a network of stakeholders and will deliver new research that will continue long after the project and which will help to improve the design and operation of future satellites.



Richard HORNE
Project Coordinator

QUESTIONS & ANSWERS

What is the project designed to achieve?

SPACESTORM is designed to achieve a better determination of the space radiation environment for an extreme space weather event. It will assess the radiation impact on satellites, especially satellite charging, and will test new methods to reduce satellite charging. The project will provide better mitigation guidelines and better computer models to forecast space weather in order to protect space assets.

Why is this project important for Europe and how does it benefit European citizens?

Europe has major space industries in the finance, design, construction, launch and operation of satellites. Space weather can damage satellites and cause disruption to satellite services such as navigation and positioning, mobile communications, TV and the Internet. SPACESTORM will help identify the impacts of severe space weather on satellites, minimise disruption and help to build more resilience.

How does the project exceed the current state of knowledge?

SPACESTORM will develop state-of-the-art computer models and use them to simulate the Earth's radiation belts for severe space weather events. New experiments will be conducted to determine radiation effects on satellite components and to test new mitigation strategies. The results will be synthesised to produce new mitigation guidelines for feedback into design and operations and to improve space weather forecasting.

SPACESTORM

Modelling severe space weather events and mitigating their effects on satellites

LIST OF PARTNERS

- British Antarctic Survey, United Kingdom
- Ilmatieteen Laitos, Finland
- DH Consultancy BVBA, Belgium
- University of Surrey, United Kingdom
- Office National d'Etudes et de Recherches Aerospatiales, France

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PROJECT INFORMATION

Modelling space weather events and mitigating their effects on satellites (SPACESTORM)

Contract N°: 606716
Starting Date: 1/4/2014
Duration: 36 months
EU Contribution: € 1.981.301,98
Estimated total cost: € 2.544.144,51

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