

**Horizon Europe Programme**

**Specific Application Form (HE CSA)**

**HORIZON-WIDERA-2023-ACCESS-02**

**Project proposal – Technical description (Part B)**

Instructions, please remove

**Version 1.0**

**14 February 2023**

**Structure of the Proposal**

The proposal contains two parts:

• **Part A** of the proposal **is generated by the IT system. It is based on the information entered by the participants through the submission system in the Funding & Tenders Portal.** The participants can update the information in the submission system at any time before final submission.

• **Part B** of the proposal is the narrative part that includes three sections that each correspond to an evaluation criterion. Part B needs to be uploaded as a PDF document following the templates downloaded by the applicants in the submission system for the specific call or topic. The templates for a specific call may slightly differ from the example provided in this document.

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- Step 3: Create a draft proposal: Title, acronym, summary, main organisation and contact details

- Step 4: Manage your parties and contact details: add your partner organisations and contact details.

- Step 5: Edit and complete web forms for proposal part A and upload proposal part B

- Step 6: Submit the proposal

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| **HISTORY OF CHANGES** | | |
| **Version** | **Publication date** | **Changes** |
| 1.0 | 14.02.2023 | * Initial version |

**Proposal template Part B: technical description**

**Greek Space Geodesy Excellence Centre (ACRONYM)**

[This document is tagged. Do not delete the tags; they are needed for processing.] #@APP-FORM-HECSA@#

**List of participants**

|  |  |  |
| --- | --- | --- |
| **Participant No. \*** | **Participant organisation name** | **Country** |
| 1 (Coordinator) | National Technical University of Athens (NTUA) | Greece |
| 2 | Chalmers Tekniska Hogskola AB (OSO) | Sweden |
| 3 | Collecte Localisation Satellites (CLS) | France |
| 4 | Institut de physique du globe de Paris (IPGP) | France |
| 5 | DeutschesGeoForschungs Zentrum (GFZ) | Germany |

**1. Excellence** #@REL-EVA-RE@#

**1.1 Objectives** #@PRJ-OBJ-PO@#

**1.1.1 Space Geodesy and Earth Observation**

Since the introduction of Earth orbiting satellites, Space Geodesy has played a crucial role in our understanding of the complex Earth system. An ever increasing number of space-based applications are heavily dependent on results and products derived by methods of Space Geodesy, and hence correlated with advances and progress within this scientific field. Observing the Earth system through space, is in essence an exercise of Space Geodesy.

Space Geodesy is a rapidly evolving multidisciplinary scientific field, playing a crucial role in a series of applications and research areas including Earth monitoring, navigation and positioning, climate studies, earthquake and volcano monitoring, spacecraft navigation, Earth’s interior and geodynamic research, astronomy and fundamental physics. It lays the fundamental groundwork for the exploitation of data collected from Earth orbiting satellites via its unique ability to provide precise modeling of satellite trajectories (i.e. Precise Orbit Determination (POD)), accurate observations and models for the Earth’s rotation and orientation as well as spatial reference frames of the utmost quality. In essence, Space Geodesy provides the fundamental data and measurements that underpin various scientific, environmental, and practical applications essential for our understanding of Earth and space.

The ever-increasing number of earth orbiting satellite missions accompanied with an ever increasing need for improved accuracy demanded by a series of applications (e.g. climate change studies) have in recent years upgraded Space Geodesy’s role, placing it at the core of Geoscienses. In 2020, the geoscience community has fixed an objective of 1mm accuracy and 0.1mm/yr stability for the terrestrial reference frame (TRF) realization, a goal still to be reached. Exciting new missions, such as the ESA GENESIS mission (accepted in November 2022) utilizing multiple space geodetic techniques (“space-ties”), EUMETSAT Sentinel series (Sentinel-3, 4, 5 and 6) and the Surface Water and Ocean Topography (SWOT) mission among others, are evidence of the exciting future and renovated importance and expectations of the field.

ESA’s most ambitious Earth observation program to date, COPERNICUS, headed by the European Commission (EC) in partnership with the European Space Agency (ESA), heavily depends on and contributes to Space Geodesy. The GEO international partnership (<https://www.earthobservations.org/index.php>) and its Global Earth Observation System of Systems (GEOSS) initiative (<https://www.earthobservations.org/geoss.php>) as well as the Global Geodetic Observing System (GGOS) (<https://ggos.org/>), both established in the last two decades, underpin the global interest in a**dvancing our understanding of the dynamic Earth system by quantifying our planet’s changes in space and time.**

**The aforementioned global initiatives and prospects, as well as the growing importance, impact and attention drawn in Space Geodesy, affirm a flourishing research field with a key role in technological and scientific advance.**

**1.1.2 NTUA and Space Geodesy in Greece**

Space Geodesy can also provide crucial insight on a regional scale. Greece lays on a region of exceptional interest for a series of Geoscience fields, constituting in essence a “physical laboratory”; tectonic crustal deformation is inhomogeneous and among the largest in rate within Europe, seismic events are often and large in magnitude and a series of active volcanoes are spread throughout the country, posing both a public threat as well as unique research opportunities (e.g. inflation of Santorini island due to volcanic activity during 2011-2012). Space Geodesy is the key in understanding such processes, via its unmatched crustal monitoring capabilities and is thus used by a number of Greek institutes involved with such studies, including Universities and public institutions. However, they are merely “consumers” of Space Geodetic products and results (e.g. spatial reference frames, satellite orbits, data analysis software and products, etc), a fact that severely undermines their research initiatives, independence, results and impact. The presence of a dedicated center of excellence for Space Geodesy, disseminating knowledge and expertise, could significantly enhance the capacity of this national ecosystem.

The Project Coordinator (NTUA), via its School of Rural, Surveying and Geoinformatics Engineering, is the oldest and most prestigious institution in Greece providing a curriculum in the field of Geodesy. It has a twofold role in Greece; on the one hand educating and training the next generation of geodesy experts and on the other hand, being involved in relevant research, both to support its academic expertise and also to push scientific frontiers.

In the dawn of the Space Geodesy era, NTUA via its Dionysos Satellite Observatory (DSO) laboratory, had played a significant role in expanding knowledge, involved in a series of novel and invaluable observational techniques, including astrometric data and laser ranging measurements. However, in recent decades, NTUA’s contribution and involvement in the field has lagged behind, while on the same time Space Geodesy has moved forward on a rapid pace. This string of events, have caused NTUA’s research capacity to fall behind currently leading institutes in the field, and its research profile to shrink. In turn, this capacity gap between NTUA and prestigious European institutes in the field, severely undermines its ability to successfully apply for research proposals and secure funding for its research activities and recruitment needs (e.g. PhD students). Unfortunately, NTUA’s international standing has been impaired, and currently does not constitute an appealing destination for young, talented scientists and engineers that want to thrive in the field of Space Geodesy.

This technological and research gap (in the field of Space Geodesy) is evident in all Greek institutions involved in the field. Relevant studies are usually constrained to regional scale, producing scientific results of limited importance and impact. Networking and synergies both between these institutions and their international peers are intermittent, infrequent and often incidental, missing long-term planning and well defined objectives and aims. Research capacity is limited and severely constrained by lack of expertise, well trained and skilled workforce to state-of-the-art methodologies and a low international standing (e.g. involvement in international and European consortia and services).

The lack of a dedicated excellence center in the field of Space Geodesy, is also reflected in the limited involvement of Greece in one of the currently fastest blooming technology markets internationally, that of Space sciences. Lack of expertise and a modern knowledge hub in the field are definitely factors that should be swiftly addressed to reverse the current situation.

**1.1.3 ACRONYM Objectives**

ACRONYM aims at creating a Center of Excellence for Space Geodesy in Greece, hosted by the Project Coordinator (NTUA), with the crucial contribution of leading experts in the field. Within this framework, NTUA will enhance its research and scientific footprint, increase its technology and research capacity and promote innovation and the involvement of Greece (both of the public and private sector) in Space.

Consortium partners (other than the host), are hand-picked prestigious internationally leading experts in a series of Space Geodetic techniques, collectively constituting the fundamental observational techniques of Space Geodesy. Through the synergy with these institutes, NTUA will be able to:

* Significantly enhance its research capacity, gain knowledge and expertise from world-leading scientists in the field and build its own state-of-the-art software tools that will allow it to establish a key role for the future of Space Geodesy on an international level.
* Mitigate the technological/scientific gap between the host institute and its partners, transforming it to an attractive center of excellence for new scientists, a center of excellence and innovation in the field of space-based geosciences.
* Significantly increase its international standing and visibility in the research community. Create a network of international collaborators, get involved in high-caliber international consortia and establish synergies with distinguished research institutions, severely enhancing its international prestige. Such strategic networking will assist NTUA in maintaining a long-term role as a center of excellence in Space Geodesy, and a long-term involvement in the research frontiers of the field.
* Create a dedicated task force trained in research project claiming, submission and management and boost host’s success rate in research funding bids. Enhance the host's capacity and efficiency in partnership-building, preparation and carrying out of research proposals funded by a series of alternate grant pools. Increase financial support capabilities for its research activities and its ability and capacity to attract and recruit talented young scientists.
* Establish a national (Greek) ecosystem of space related stakeholders, including universities, research institutes and (private) companies; promote innovation, networking and dissemination of scientific expertise and advancements. Boost Greece’s involvement and role in the space and earth observation fields.

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| **Objective** | **Involved WP** | **Key Performance Indicator** |
| **Improving excellence capacity** | | |
| Creation of highly skilled workforce (in Coordinator) | WP2 and WP3 | * Number of host institute staff trained * Number of host institute staff involved in software development * Number of training events attended (not organized by ACRONYM) |
| Recruit and train new/young scientists | WP2 and WP3 | * Number of PhD and PostDoc students trained |
| Research capacity enhancement via in-house software &  reaching scientific excellence | WP3 | Release of software tools to accommodate:   * analysis of DORIS observations * analysis of SLR observations * state-of-the-art handling of EOPs   Software validation by expert partners and released online (free and open-source).   * number of satellite missions successfully incorporated in validation tests |
| **Raised reputation, research profile and attractiveness of the Coordinator and the research profile of its staff** | | |
| Involvement of NTUA in the future of Space Geodesy on an international level | WP2,WP3, WP5 and WP6 | Number of international geodetic services and consortia in which NTUA will get involved in (various roles). Such are IDS, ILRS, IVS, IAG and GGOS. |
| Attractive center of excellence for young scientists | WP4, WP5 and WP6 | * Number of applicants for PhD, PostDoc and (possible) tenure open positions. Expected to take place gradually after the start of ACRONYM. * Number of funding bids submitted including PhD and PostDoc studies (carried out in host institute) * Number of PhD and PostDoc scholarships successfully applied for (from national and/or European funding pools) |
| Increase host’s international standing and visibility | WP3, WP5, WP6 | * Number of conferences/workshops attended * Number of scientific publications in high-impact journals * Impact factor of scientific journals publishing results of ACRONYM * Level of involvement in International Association of Geodesy (IAG) and GGOS * Number of users of software released (measurable via online means, acknowledgments and DOI references) |
| **Increased mobility (inwards and outwards) of qualified scientists** | | |
|  |  | * Number of Coordinator staff visiting ACRONYM partnership * Number of partner staff visiting NTUA * Mobility activities included in successfully bid for research proposals |
| **Strengthen research management, administrative and funding capacity of the Coordinator** | | |
|  | WP4 | * Number of host institute staff trained (included in research administration unit) * Number of research proposals submitted (within the time span of ACRONYM) * Diversity of funding pools targeted * Success rate of funding bids submitted |
| **Establish a national (Greek) ecosystem of space-based geosciences related stakeholders and promote R&I** | | |
|  | WP5 | * Number of stakeholders present in info-days and seminars. * Number of stakeholders included in research proposals submitted * Number of stakeholders interested in and/or subscribed to the ACRONYM newsletter * Number of stakeholders requesting/accessing online lectures and training videos (via ACRONYM’s website) |

#§PRJ-OBJ-PO§#

**1.2 Coordination and/or support measures and methodology** #@CON-MET-CM@# #@COM-PLE-CP@#

**1.2.1 General Concept and Overview**

Building a Center of Excellence for Space Geodesy in Greece is based on three fundamental pillars, which determine the methodology to be followed to achieve the proposal’s objectives. The first pillar is the significant enhancement of the Coordinator’s research capacity via staff training to create a highly skilled work force and in parallel build and/or refine a state-of-the-art software toolset. The latter, accompanied with skilled personnel, constitutes an invaluable asset towards achieving scientific excellence.

A second pillar is the strengthening of research management capacity and administrative skills of the staff working in the Coordinator institute. Furthermore, this task aims at significantly broadening possible funding pools (available or targeted by the host institute) and capabilities and increase mobility (inwards and outwards) of qualified scientists.

Finally, a third pillar focuses on networking activities and involvement of the Coordinator in international, high prestige consortia, raising NTUA’s reputation and visibility. Additionally, a Greek space-based geosciences ecosystem will be established, aiming at promoting relevant technology, innovation and collaboration of stakeholders on a national level.

Dedicated dissemination and communication activities are also included, aiming at promoting activities and results of ACRONYM, maximizing its impact and exploiting its outcomes.

**1.2.2 Enhancing Research Capacity and Achieving Scientific Excellence**

Modern Space Geodesy input is based on four fundamental observational techniques, namely Global Navigation Satellite Systems (GNSS), Doppler Orbitography and Radiopositioning Integrated by Satellite (DORIS), Satellite Laser Ranging (SLR) and Very Long Baseline Interferometry (VLBI). These four techniques constitute the pillars of modern Space Geodesy and providing the crucial dataset to study the Earth system and its variations.

The ever growing accuracy demands in the fields of Space Sciences and Geosciences, entail an urge for analysis results of the utmost accuracy. During the last few decades, a long list of modeling improvements have taken place, that allow for sophisticated and robust processing methodologies to yield precision analysis products. Implementing such state-of-the-art methodologies though, requires a deep, comprehensive understanding of both the observational techniques as well as the underlying scientific background. Thus, such software packages are a privilege of a limited number of high-caliber scientific institutions, with significant international standing and highly skilled workforce. An example of such institutions are the internationally-leading partners involved in ACRONYM.

International Services have been established for all the above techniques, namely International DORIS Service (IDS), International Laser Ranging Service (ILRS) and International VLBI Service for Geodesy and Astrometry (IVS), comprised by world leading experts in the respective fields. These consortia play a key role in the shaping, growth and progress of the techniques themselves and are hence of fundamental importance for Space Geodesy, setting quality standards and enabling dissemination of its products in the scientific community. Such products (e.g. precise satellite orbits) constitute nowadays essential, mandatory input for Earth observation and space studies. The twinning partners of ACRONYM, are all members of such top-class International Services.

While NTUA has a well established expertise in the field of GNSS, verifiable by its contribution in international consortia (e.g. EUREF) and its long list of relevant publications in scientific journals, its lacks knowledge, involvement and expertise in the other three techniques that lay at the core of Space Geodesy. This severely weakens its research capabilities at the field, as well as its ability to drive innovation for the country in a fast growing market related to Space.

Within the framework of ACRONYM, synergies are proposed with leading experts in the techniques of DORIS, SLR and VLBI with the aim of closing the knowledge and technological gap. A strategic aim of ACRONYM is that by the end of the project’s lifespan, the host institute will have an in-house collection of software tools and a highly-skilled workforce to support high-end research in the field of Space Geodesy and Earth observation. The bulk of the effort for this goal will be undertaken in WP2 and WP3.

**Expert Nodes**

Each member of the consortium will act as a knowledge transfer node for one of the techniques involved. A dedicated task force will be established in NTUA for each of the three techniques, made up of University personnel (i.e. professors and technical staff), at least one PhD student and one Post-Doc student per technique. This allocation is expected to significantly enhance knowledge assimilation, create highly skilled experts in the involved fields of study, simplify management and logistics and solidify networking between partners. Given that at the time of writing NTUA has no active PhD or Post-Doc students at the aforementioned fields, ACRONYM is expected to significantly increase its manpower and research capacity, alluring young talented scientists to work on the field. In summary, it is expected that at least six new young scientists will be recruited by NTUA (three PhD students and three PostDoc students) to be involved in the project’s activities.

IPGP and CLS will act as the DORIS expertise nodes. Both institutes are leading experts in the field, heavily involved in the technique since its introduction. Their role and contribution is underpinned by their status as Analysis Centers, and involvement in the IDS. The two institutes will take up the task of transferring relevant knowledge to NTUA via interaction with the dedicated task force.

NTUA has, in recent years, started an effort to take up the technique and build a software package to process DORIS data. The assistance of IPGP and CLS will prove to be invaluable for the stepping up of this effort, and the consolidation of NTUA's contribution in the technique. Additionally, the two institutes are long contributors of the IDS and can introduce NTUA in the service, a fact that can lead to a solid, long lasting technical involvement and further networking capacity with high esteem institutions.

Despite SLR's prominent role in Space Geodesy, NTUA's involvement in the technique has been minimum in the last few decades. Besides core geodetic results (e.g. Earth Orientation Parameters (EOP)) SLR provides the most accurate observations for precise orbit determination, a problem inherently coupled with all space geodetic applications. Laser Ranging Reflectors (LRR) are part of the payload of a large number of satellites, especially missions where precise knowledge of the trajectory is required.

GFZ will act as the SLR expertise node, since it has a longstanding contribution in the technique, evident by its involvement in the ILRS as an Analysis Center and a long list of relevant scientific publications.

OSO/Chalmers will act as the VLBI knowledge node. OSO hosts one of the few VLBI sites in Europe and is a prominent member of the IVS. OSO will undertake the task of transferring technique-specific knowledge and expertise to the host institute.

By means of a specialized, technique-based contribution of each member of the consortium to the host (NTUA), knowledge transfer can be better achieved, managed, digested and verified. The host institution will be the sole recipient of this flow of expertise, attributing dedicated personnel to each of the techniques described, thus creating a pool of experts.

**Achieving Scientific Excellence Phase I**

Achieving scientific excellence within ACRONYM is split into two distinct phases, to allow for a more efficient and robust scheme. During the first phase (WP2), highly skilled scientists from the expert nodes will transfer knowledge and expertise to a dedicated (per technique) task force made up by personnel and young scientists in the Widening institute. The roadmap of the procedure and the scientific syllabus and curriculum will be determined by respective the expert nodes. Focus here will be placed on (a) the internals and details of the techniques themselves, (b) data curation, (c) technique specific error-budget, its treatment and mitigation, (d) application range, instrumentation and technique specific results, and (e) recent trends and research frontiers. Expert nodes will also present their own, home-grown data analysis pipelines to NTUA, identifying best practices, strengths, weaknesses and limitations.

Knowledge transfer will be performed by means of:

* remote (on-line) webinars, virtual training and video conferences hosted by the expert nodes and attended by the dedicated task force set-up at the Coordinator institution. Both training/lectures and Q&A sessions will take place during these meets, which will be held approximately twice per month, with a duration of two to four hours.
* remote (on-line) venture labs, where the expert nodes will present and introduce their own analysis pipelines and in-house, state-of-the-art software tools to the dedicated task force set-up at the Coordinator institution. Approximately a series of four venture lab meets will be held (per technique).
* one short-term visit of the dedicated Coordinator task force at the premises of the respective expert node (i.e. visits at IPGP, GFZ and OSO). The visit will have a duration of one to two weeks, and will focus on an integrated presentation and schooling at data collection/acquisition and instrumentation, data curation and analysis procedures followed by the expert nodes. A guided tour at instrumentation sites will also be performed at GFZ and OSO, since these institutes host instrumentation not available in Greece (only few such sites are installed worldwide). These visits will also place focus on solidifying networking activities and allow for further one-on-one communication and intercourse.

This first phase will start at the beginning ACRONYM (first month) and will have a duration of one year. At the end of this phase, the dedicated task forces (setup at the Coordinator institute) will have gained a deep understanding of the methodologies involved within each of the Space Geodetic techniques. With the newly found skills and the assistance of the respective partners, this phase will culminate with the compilation of technical documents that describe specifications, models and standards to be used to design a state-of-the-art software toolbox to perform data analysis of DORIS and SLR observations, accompanied with respective validation procedures. These documents will act as roadmap for the next step of research capacity building and achieving scientific excellence.

**Achieving Scientific Excellence Phase II**

The next, second phase (WP3) will build on the knowledge gained from the previous phase and will adhere to a more “hands on”, technical approach. This phase will start by the end of the previous and will last until ACRONYM’s end of life. The target here will be the severe strengthening of NTUA’s research capacity via the designing and building of a space geodetic software tool-box, to perform robust analysis of satellite data, incorporating state-of-the-art methodologies. Under the (per-technique) guidance of the expert partners and the work-plan established (in WP2), NTUA will undertake the task of gaining knowledge and expertise and in parallel applying lessons learned in its own, in-house software package. This collection of tools will allow the analysis of space geodetic data (both DORIS and SLR) to perform precise orbit determination, positioning, and estimation of a series of geodetic parameters of interest. Note that during the last couple of years, NTUA has already ignited an effort to develop such software tools, a fact that is expected to significantly assist the effort and outcome of ACRONYM.

Software development will adopt the work plan established in the first phase, enabling step-by-step validation. Such a process will enable the efficient administration of the capacity building process, monitoring progress through well established, timely milestones, goals and validation tests.

Focus will be placed on (a) problem solving skills, (b) robust algorithmic approaches and best practices, (c) numerical methodologies, (d) program design and implementation strategies and (e) adoption of state-of-the-art models. Knowledge transfer will be performed by means of:

* remote (on-line) webinars hosted by the expert nodes and attended by the dedicated task force set-up at the Coordinator institution, focusing on implementation and validation of specific specific technical issues, i.e. modeling approaches (according to the roadmap laid out in the technical documents of the previous step). These meets will be performed once every two months.
* remote (on-line) one-to-one and one-to-many video conferences hosted by the expert nodes and attended by the dedicated task force set-up at the Coordinator institution. The conferences will be focused on Q&A sessions, problem solving and advisory meetings, targeting specific needs and problems that (may) come up during the implementation phase; they will be requested “on demand” by the task force.
* two short-term visits per technique; the dedicated Coordinator task force will visit the respective expert node (i.e. visits at CLS, GFZ and OSO) and staff of the expert nodes will also make a short term visit to the Coordinator. The visits will have a duration of one to two weeks, and will focus on inspection, evaluation and validation of the software under construction and exchange of best practices. They are also expected to further strengthen twinning synergies and provide a framework for teamwork, enhancing collective problem solving.

The expected impact of this phase is twofold; on the one hand, it will result in a state-of-the-art software toolbox, which will constitute an invaluable asset for NTUA’s research capacity, a fundamental building block for further scientific development and growth. As already noted, such software packages are only few worldwide, owned and developed by prominent research institutes. On the other hand, the process of designing and implementing such a package will result in a highly skilled scientific workforce, with a deep understanding of the most elaborate and complex concepts of Space Geodesy and the means to tackle even the most demanding research questions. Hence, this approach is expected to stimulate scientific excellence and innovation capacity.

DORIS day etc, where should I put these?

Coordinator’s staff, and especially young scientists involved, will seek to attend any virtual and/or on-site training events organized by IGS, IDS, ILRS, IVS and IAG (e.g. DORIS-days organized by IDS).

**1.2.3 Strengthening research management capacity and administrative skills**

In order to further enhance NTUA’s research capacity, funding capabilities and resources, knowledge and expertise transfer will expand beyond technical matters, to include coaching on research proposal preparation/writing, submission, management and administration. A dedicated Work Package is included in the Proposal to accommodate for related tasks (WP4), which is expected to result in a highly skilled and effective research administration unit to significantly enhance future NTUA’s successful proposal submission rate, secure financial aid for the host’s research activities in the long-run and boost long-term synergy between the consortium partners.

The Coordinator will set up an agile research administration unit within its institution, made up of both scientific and administrative personnel. The sole purpose of this unit will be to seek, claim and manage research proposals. The unit will be trained by the internationally leading partners, utilizing their experience and sharing best practices. A two phase approach will also be followed here. The first phase will place focus on the training of the unit from the twining partners. All partners will be involved in this task, sharing knowledge, experience and know-how. Training will involve the following:

* Introduction and familiarization with diverse funding pools and schema. Training here will focus on the introduction of various funding pools and capabilities which the unit can utilize to support research either individually (i.e. NTUA being the sole recipient of funding) or through partnerships. Such pools can be European (e.g. EU, ESA, etc), **collaborative funding schema (contributions from various stakeholders, such as government agencies, private foundations and industry partners), funding via research consortia and networks (e.g. funding claiming via contribution in international services such as the IDS, ILRS and IVS), and public-private partnerships, where partnerships with industry will be seeked for, to support research and development in Space and Earth Observation industry and technology. Special care will placed in funding pools and networking capabilities specifically targeting young scientists, e.g. MSCA Doctoral Networks and support for inwards/outwards mobility of skilled scientists.**
* **Project preparation, proposal writing and organisational issues. The leading partners will share their experience and skills gained throughout the years in successfully preparing and organizing a research proposal submission. This will include project team composition, networking and partnership building, budget considerations and allocation, research focus presentation, dissemination activities and organization, common pitfalls and best practices in proposal preparation (writing and/or submission), seeking greater impact and pathways to achieving it.**
* **Project management and administration. Focus here will be placed in the successful administration and management of research projects, involving effective monitoring activities both scientific-wise and financially, risk management, robust and agile financial administration and management activities and schemes correlated to budget scale.**

**Training will be performed via online webinars, hosted by the partners and attended by the research administration unit. Each of the partners will host a total of three webinars, split into three training units, as described above.**

**Once this training phase is over and throughout the rest of ACRONYM’s lifespan, the research administration unit with the help and guidance of the twinning partners, will prepare and submit at least four research funding proposals. These will build upon the research capacity build via ACRONYM, and will specifically target:**

* **two EU large scale research and innovation calls (e.g. HORIZON, COST),**
* **two research proposals targeting young scientists and mobility (e.g. EU MSCA calls)**
* one funding bid targeting private/public collaboration, including at least one the ecosystem commercial (business) partner

**Apart from NTUA, at least two of the ACRONYM partners will be involved in each of the proposals to be submitted, the aim being however for the consortium to be included as a whole.**

**1.2.4 Raising Research profile and Strategic Networking**

Through the consortium synergy and in the framework of ACRONYM, at least three papers will be published in high impact, peer-reviewed scientific journals (impact factor > 2.4).

Scientific publications are considered in ACRONYM as a significant pathway in achieving the project’s objectives and maximizing its impact. For the lifetime of ACRONYM, a target of nine scientific publications in peer-reviewed journals is set; three of these will be published in high-impact journals (impact factor > 2.5). These publications will target specific issues of the three respective Space Geodetic techniques tackled in ACRONYM. This goal is expected to strengthen the commitment and engagement of the twinning partners, additionally raising the host institute’s research profile and international prestige.

Further strengthening of networking activities and scientific prominence will be seeked through the consortium’s presence in at least ten international conferences, where outcomes of ACRONYM will be presented. Presence in technique-specific workshops organized by the respective international services (i.e. IDS, ILRS and IVS) will be prioritized. Partners will also attend at least two IAG related events, which are known to attract top class scientists in the field.

To further enhance strategic networking, synergy and mobility of skilled scientists, the Coordinator and the twinning partners will decide on the co-supervision of three PhD and three PostDoc thesis. Given the regulations that currently stand in NTUA regarding postgraduate studies, CLS will be exempted from this task. One PhD and one PostDoc student will be allocated to each technique-specific task force (described in Section 1.2.2 and WP2, WP3) and the co-supervision will be performed by one representative of the respective expert node (i.e. GFZ, IPGP and OSO), acting as a member of the three-party advisory committee. PhD and PostDoc students will be included in the short term visits to the partners, with the possibility to extend their stay if such a need arises. The research subject of the thesis will be relevant to the respective technique, submitted in NTUA and written in English.

Getting involved IDS ILRS IAG

**1.2.5 Establishing a Greek ecosystem of Space-based geosciences and ties between market and academia**

The coordinator will take the initiative of bringing together all parties in Greece involved in space-based geosciences and related applications, thus establishing a Greek ecosystem of related partners, in an effort to disperse and disseminate the impact of ACRONYM on a national scale. Through this newly established ecosystem, it will seek further strategic networking, both with research institutions and collaboration agreements with businesses active in the field.

The ecosystem call is expected to attract more than ten participants, including possible industry partners active in:

* Space industry, space sciences, space awareness and security, geosciences, Earth observation, tracking and navigation and related fields (e.g. Libre Space Foundation (<https://libre.space/>), Geosystems Hellas (<https://www.geosystems-hellas.gr/>), Planetek Hellas (<https://www.planetek.gr/>)),
* Governmental agencies and research institutions (e.g. National Observatory of Athens, Beyond Centre (<http://beyond-eocenter.eu/>), Hellenic Group on Earth Observations (<https://www.greekgeo.noa.gr/>))
* Universities (e.g. Aristotle University of Thessaloniki, National and Kapodistrian University of Athens and the University of West Attica).

Two dedicated (on-site) meetings will be organized by NTUA to take place in Greece, aiming at networking activities and potential collaborations between ecosystem parties. The first conference will span a two-day interval and will focus on presenting ACRONYM’s aims, objectives and anticipated impact, as well as Space-based earth observation research activities currently active at NTUA performed in various laboratories (e.g. remote sensing, positioning and navigation, atmospheric studies, etc). All ACRONYM partners will attend the meeting, introducing space geodetic techniques (according to their expertise) as well as recent trends, applications and use cases. Ecosystem parties will be asked to present their current activities, research and industry portfolios, aspirations, products and solutions, as well as specific needs and interest related to ACRONYM and Space Geodesy.

The second meeting will have the format of an info-day, co-organized by NTUA and CLS in an effort to present current products and trends related to Space-based solutions and promote innovation. CLS will address issues of providing high value-added products and services, being a worldwide pioneer provider of monitoring and surveillance solutions for Earth, focusing on Environmental and Climate monitoring, Maritime Surveillance and Infrastructure monitoring. Target audience will include the Greek ecosystem with special focus on businesses and stakeholders active in the field.

In order to further raise interest in both ACRONYM itself, its impact and participation in the ecosystem, the partners will issue a Newsletter to be published every six months (throughout the lifetime of the project). All partners will take the effort to submit short articles related to ACRONYM activities and outcomes as well as Space Geodesy related research and products.

To explore, access and evaluate both academia and commercial needs and interest on a national scale, the ACRONYM partners will compile and hand out a series of (on-line) questionnaires; one subset of these will target academia partners of the ecosystem and a second set will target commercial users/businesses. Information to be collected will target (a) methods and techniques of Space Geodesy they use, (b) application range, (c) datasets and analysis pipelines (d) specific needs in data processing and products (e) research interest, aspirations and future plans.

**1.3 Open Science**

ACRONYM will adhere to an open-science policy, a fact reflected through a series of its outcomes. All publications described above, both the ones to be published in peer-reviewed journals and the ones to be presented in international conferences/workshops, will be open-access.

Additionally, the software to be designed and implemented (described above) will be developed using a free and open-source policy, using a license agreement that will adhere to this property (e.g. MIT License). The development phase, will be performed in the public domain, using one or more public repositories (e.g. via the gitlab platform). Hence, the scientific community and any interested parties will be able to browse, download/clone and use the software or specific components of it and even modify, expand and repurpose it to fit their needs. Due to the public domain development scheme adopted, the software will be available to users throughout the development phase, and not only at discrete “release” phases.

**1.4 Gender Equality**

#§CON-MET-CM§# #§COM-PLE-CP§# #§REL-EVA-RE§#

**2. Impact**

**2.1 Project’s pathways towards impact**

**2.1.1 ACRONYM Outcomes**

**Improved excellence capacity and resources in Widening countries enabling to close the still apparent research and innovation gap within the European Union.**

ACRONYM specifically targets the significant enhancement of the Coordinator’s research capacity and resources. Two Working Packages are allocated solely for this purpose (WP2 and WP3). To successfully reach this goal, expert assistance from top-class scientific partners is not only crucial but imperative. This Twinning action thus provides the perfect framework for such a cooperation. ACRONYM partners are world leading research institutes in their respective fields of expertise and ACRONYM is organized in a way that fully exploits their commitment in sharing knowledge and expertise.

In a first phase (WP2), the partners will share knowledge and best practices with their peers in the Coordinator institute, using a well structured series of online seminars, venture labs and a short term visit. In a second phase (WP3), focus will be placed in a joint effort to build a crucial research and scientific asset, that is a state-of-the-art package of software tools to enable analysis of Space Geodesy data. On-line meetings and a further set of short term visits will be performed here.

This list of activities will result in a highly skilled, extensively trained scientific workforce at NTUA, counting no less than 10 individuals (including research and academic staff and young scientists). Additionally, the resulting software tools will provide an unprecedented, invaluable asset for NTUA providing (in combination with the newly found expertise) the required capacity to reach scientific excellence in the field. It is important to note here that such software tools are only available by a small set of prestigious institutes around the world, the current leading experts of Space Geodesy. With these assets in place, NTUA will be able to significantly expand, intensify, refine and diversify its contribution to Space geodesy and a series of applications that depend on earth observation from space, e.g. climate studies, atmospheric studies, orbit determination, geodynamics and geophysics.

For the first time in decades NTUA, and in general a Greek institution, will be equipped with the knowledge and tools/resources to tackle research frontiers and innovation in the field. Through the establishment of a Greek ecosystem of Space-based geosciences (Section 1.2.5) the Coordinator will gradually disperse knowledge and help raise expertise and involvement in Earth Observation on a national scale (actions described in Tasks 5.3 to 5.5). This is expected to significantly assist in closing the -still apparent- research and innovation gap with leading European institutions and countries.

**A new set of free and open-source software tools to process space geodesy data.**

One results of ACRONYM that is of special importance, is the creation of a new software toolbox to tackle state-of-the-art analysis of Space geodetic data, especially targeting the fundamental DORIS and SLR techniques. The work-flow followed to reach this goal is described in WP3. As noted in Section XX, such software tools are not only few in number, but also either not-free or not open-source or even both. They are usually developed by in-house scientific teams in prestigious, top-class institutes worldwide. Via ACRONYM, the Coordinator with the crucial input of the expert partners will build a set of tools using standards and models of the highest standards and follow a policy of imminent, direct sharing with any interested partners (via development on the public domain using a free and open-source policy).

To place this result into perspective, it is worth noting that for the most recent realization of ITRF, the ILRS contributed data from 7 Analysis Centers (Pavlis et al. 2023) including GFZ, while at the same time the IDS’s contribution was derived from only 4 Analysis Centers (Moreaux et al. 2022) including CLS. The European Space Agency (ESA) was involved in both contributions, and so was NASA’s Goddard Space Flight Center. This shortage of dedicated analysis centers, is indicative of the limited availability of dedicated software solutions designed to handle such data in a precise manner and the challenges such a task poses. Hence, the aforementioned institutions hold a high level of expertise, international prestige and research capacity.

**Scientific Results.**

Within the lifetime of ACRONYM a series of scientific publications will be issued, tackling open issues (i.e. modeling approaches) used in the fundamental Space Geodetic observation techniques. These include at publications in high-impact, peer-reviewed scientific journals and publications in international conferences (Section 1.2.4). It is expected that these publications will either create new knowledge (e.g. adopt/introduce new modeling and/or numerical techniques) or reinforce current approaches through robust validation, experimentation and assessment of their characteristics.

**Enhanced strategic networking activities between the research institutions of the Widening countries and at least two internationally-leading counterparts at European Union level.**

As already described and thoroughly presented in Section 3.2, all 4 ACRONYM partners (excluding the Coordinator) are world leading experts in Space Geodesy. ACRONYM activities are targeted towards creating solid, seamless networking between the Coordinator and the partners, past the lifetime of this project. On-line meetings and a series of visits (at least two visits from and to the partners) are expected to solidify networking. Additionally, a number of tasks focuses on networking, including (a) co-supervision of PhD and PostDoc students, (b) submission of further (at least five) research proposals including all or a subset of ACRONYM’s consortium, (c) co-authorship of research papers and (d) attendance of international conferences.

Strategic networking IDS, etc

**Raised reputation, research profile and attractiveness of the coordinating institution from the Widening country and the research profile of its staff.**

ACRONYM recognizes the need to raise the Coordinator’s institute attractiveness and reputation. To revert this fact and significantly boost NTUA’s appealingness, specific actions are proposed, targeting:

* a raised research profile of the Coordinator and its staff; (a) scientific publications in peer-reviewed, high impact scientific journals, (b) attendance of international, high prestige conferences, and (c) introduction of the Coordinator and involvement of its staff in prominent international geodetic services and consortia (such as IDS, ILRS, IAG, GGOS, see Tasks 5.XX) are all measures to maximize the reputation and research profile of the institution and its staff.
* significantly enhanced funding capabilities and successful funding bid rate; a series of measures are proposed, such as (a) the establishment of a research administration and management unit in the Coordinator, (b) its training in project seeking, claiming, and proposal submission (see Task 4.2), (c) diversification of funding pools and schema (see Task 4.3) and finally (d) the submission of at least five further research proposals. These measures are expected greatly enhance the Coordinator’s competence in claiming research funding bis and thus secure significant financial aid for its research activities.

A raised reputation and research profile of the Coordinator institution and its staff, accompanied with significantly enhanced research funding capacity, is expected to cast NTUA into an attractive scientific destination, both for skilled researchers and young talented scientists.

**Strengthened research management capacities and administrative skills of the staff working in institutions from the Widening country.**

ACRONYM makes special provision for strengthening the Coordinator’s research management and administrative capacity. On top of that, it seeks to significantly enhance its competence in claiming research funding bids and the diversification of the targeted funding pools and schema. A dedicated Working Package (WP4) is allocated to meet these aims.

A dedicated research management and administration unit will be established in NTUA, consisting of both scientific and administrative staff. This unit is going to be trained by all of the partners included in ACRONYM, utilizing their own extensive experience and exchange of best practices via a series of on-line seminars. Each partner will provide a series of webinars (at least three), harshly covering topics of (a) diverse funding pools and schema (b) p**roject preparation, proposal writing and organisational issues and (c) project management and administration (see Section 1.2.3). The unit is going to be further trained following a “hands-on” approach, as by the end of ACRONYM it is expected that it will have prepared and submitted at least five research funding proposals, under the guidance of the expert partners.**

**Given the fact that such a unit currently does not exists in NTUA, it is expected to greatly enhance the institution's capacity in managing research projects and substantially help in securing funding for preserving and extending the scope and reach of the institution’s research activities.**

**A Greek ecosystem of Space-based geosciences stakeholders.**

The Coordinator with the support of ACRONYM partners, will take up the effort of establishing, for the first time, a national ecosystem of stakeholders involved in Space studies, Earth observation, Geosciences and related applications and fields. Despite the fact that Greece, as a region, constitutes a “natural laboratory” of global interest for a series of Earth observation studies, relevant research in Greek institutes is sporadic, unorganized (strategically) and dependent on expertise, products and tools only available via internationally leading experts. Additionally, scientific and commercial partnerships are hardly ever conducted and there are no ties between the industry and commercial users to the research community. This fact significantly inhibits innovation and the national growth in a growing market.

A major part of WP5 and its Tasks are dedicating to reaching this goal. The Coordinator will make extensive calls to all possible interested parties, for establishing the ecosystem described above. It is expected, that at a first phase at least 10 to 15 individual partners will participate in relevant activities. Two meeting will take place in Greece, to further strengthen ties and enable networking between ecosystem members. ACRONYM will issue a six-month Newsletter, to further attract interest in the ecosystem and at the same time promote and advertise ACRONYM activities and results. Through a series of questionnaires, answered by all members of the ecosystem, an insightful, clear view of all activities relevant to the fields of interest (on a national scale) will be gained.

**2.1.2 ACRONYM Impact**

**Scientific Impact**

With its newly found expertise and research capacity, the highly skilled scientific staff of the Coordinator will be able to significantly contribute to on-going research in the the field of Space Geodesy and Earth Observation. Utilizing its training and its deep understanding of the underlying methods and models, its staff will be able to perform high-impact research in a series of fields such as precise orbit determination, reference spatial and time frames, gravity and geopotential, modeling of non-conservative forces (e.g. atmospheric drag and solar radiation pressure), etc, creating new knowledge, introducing novel approaches and improving efficiency and robustness of algorithms. As already noted, only a few, selected international research teams are able to take up such challenging research areas, hence the Coordinator’s expected scientific input could prove to be crucial.

High-end scientific contribution will also result from the 3 PhD and 3 PostDoc theses to be implemented (partly) within the framework of ACRONYM. With the co-supervision of the expert partners, this series of theses is expected to target open issues in analysis and modeling approaches of space based geodetic data, specifically targeting DORIS and SLR.

Apart from ACRONYM’s consortium direct scientific contribution, the creation of a state-of-the-art, free and open collection of software tools, is expected to allure newcomers in the field of Space Geodesy and Earth Observation. This new set of tools, will equip such teams with the necessary toolset to perform high-end scientific studies and apply results and products to a wide range of multi-disciplinary applications such as climate change and atmospheric studies, space studies, geodynamics and geophysics, etc. Additionally, the set of tools can provide crucial and needed input in a series of international services providing solutions of utmost importance; IDS and ILRS can further strengthen and validate/access their disseminated product quality, while the IERS will benefit from a more diverse and robust solution-base, helping in reaching the global declared objective of 1mm accuracy and 0.1mm/yr stability for the TRF realization. ACRONYM’s impact is thus expected to significantly support an enhance space geodesy analysis quality and products in the long run, hence indirectly boosting scientific research in a wide range of fields that use its products.

The scope and reach of ACRONYM’s scientific contribution will be further enhanced by the ability to strategically coordinate and drive a (national) ecosystem of related stakeholders and the dispersion of new knowledge within its established networks. Instead of acting individually and being dependent on (external) expert contribution, which is currently the case, synergies between ecosystem members will be able to lead to high value research. Since these institutes already have, through the years, gained experience in the exceptional tectonic, volcanic and seismic characteristics of the region, coupled with extensive instrumentation networks installed throughout the country, synergies can lead to world class scientific output.

**Target Groups:** Greek and national scientific community and researchers involved in Space Geodesy, Earth Observation, Geosciences and big list of related disciplines such as climate and atmospheric studies, geophysics, geodynamics, space studies.International geodetic services and consortia. Young scientists and researchers. The Coordinator and its research and scientific personnel.

**Economic/Technological**

One of the main objectives and outcomes of ACRONYM is the creation of a research management and administration unit which will also be extensively trained in seeking and claiming funding bids from diverse pools and schema. Coupled with the established strategic networking and synergies with top-class institutions, as well as an extensive network of Greek stakeholders active in relevant scientific fields (both for research and commercial usage), it is expected that both the Coordinator itself and other national stakeholders (or partnerships) will significantly enhance their R&I funding income and scope.

According to the EU’s R&I Country profiles[[1]](#footnote-2), Greece’s success rate in both HORIZON Europe and HORIZON 2020 is below average, and the same goes for NTUA’s individual submissions. Additionally, NTUA has not been involved in any ERC program as PI. To revert this situation, the Coordinator will now have at its disposal the skills to target a significantly wider range of funding bids and apply for bids with a severely boosted success rate and an elevated role (e.g. PI). Networking actions are also expected to stimulate preparation of joint research projects. Given the fact that limited research funding is a major drawback for all Greek institutions, the expected impact is of paramount importance.

Enhanced research funding is expected to also boost the Coordinator’s attractiveness and enhance recruitment capacity and opportunities. Thus NTUA will be able to recruit skilled researches and talented young scientists and significantly increase inward/outward mobility. All the latter are currently severely inhibited by the limited research budget available at NTUA.

ACRONYM is also expected to strengthen ties and synergies between research and commercial users and/or industry, especially on a national scale. Possible commercial users and industry partners could be any agency or firm active in the fields of space industry, space awareness and security, monitoring and surveillance solutions (including remote sensing, positioning and surveying), navigation, environmental monitoring, maritime surveillance, mobility and energies and infrastructures monitoring. This list is indicative but by no means exhaustive, since Space Geodesy products are used by an ever-growing range of applications.

According to a comparative analysis of innovation performance in EU countries[[2]](#footnote-3), Greece is only ranked as a “Moderate innovator”; ACRONYM’s impact in the long run, can significantly help in raising innovation performance, via providing highly skilled and trained human resources, diffusing knowledge and know how in the Greek ecosystem and promoting synergies between its members.

In the long run, stronger linkages between academia and business and improved career permeability are expected. Transition from an academic oriented career to a relevant business industry related one and vice versa will be more easily pursued, thus, providing alternative choices to the Greek researchers for their career paths.

Todate, space-based earth observation studies in Greece are of limited scientific importance and scale (usually confined to small scale, regional studies) owing to the fact of missing relative expertise. Highly skilled personnel is scarce and expertise is sought for through partnerships with leading European institutions. Accordingly, Greece’s share of the relevant market is limited and only recently struggling to make infant steps. Hence, ACRONYM’s impact is expected to be highly significant on a national scale; the Coordinator will be able to disseminate knowledge, provide (via its academic curriculum) the country with new, highly skilled scientists and engineers, support Greece’s autonomy and self-sufficiency in related research and boost its commercial involvement.

The release of state-of-the-art software tools adopting an open-source and free policy, can also have a positive effect for commercial users on an international scale. Agencies active in space data analysis can freely use the tools or parts of it, avoiding purchase cost (relevant software are usually notably expensive), decreasing cost and increasing profit. Via its open-source character, the toolset can be easily repurposed, tailored to meet diverse needs, a fact that could lead to increased efficiency and/or new products/solutions.

**Target Groups:** Coordinator institute and its personnel, Greek ecosystem of space and earth observation actors, Greek space industry and , young scientists and engineers, worldwide commercial users of space geodetic data.

**Societal**

A direct impact of ACRONYM will be the significant enhancement of NTUA’s academic capacity. With the new-found expertise and a highly skilled scientific personnel, the Coordinator will be able to upgrade and refine its curriculum, incorporating cutting edge scientific trends, technology and applications. Since NTUA is the most prestigious technical university in Greece, with hundreds of new students each year, the effect will be directly translated to a more skilled scientific and engineering manpower primarily for Greece and the EU.

Additionally, ACRONYM is expected to have an effect in the quenching of the crowding-out effect experienced in the European research area and especially Greece. During the last years and especially after the economic crisis that struck Greece, the country has experienced a sever crowding-out effect especially of young skilled scientists. This fact continues to have severe consequences in the country’s ability to pursue economic growth especially in technology and R&I. ACRONYM can create viable conditions, through raised reputation, enhanced research funding capacity and recruitment ability of the Coordinator, and boosting of the Space Sciences and Earth Observation national market, for partly alleviating the crowding-out effect and accommodating skilled human capital redux.

ACRONYM will create the potential for boosting scientific advancement in Space Geodesy, which as noted earlier, plays a major role in widely used applications on a worldwide scale. Prominent examples are (a) positioning and navigation, which is heavily dependent on quality orbit determination, (b) climate change which is coupled with earth observation from space (e.g. from altimetry missions which are equipped with either LLRs or DORIS antennae) and (c) spatial, global reference frames used throughout all fields of geosciences and realized via Space Geodesy observations. Hence, in the long-run, ACRONYM can lead to scientific advancements that will improve positioning and navigation accuracy (for scientific and application usage), enhanced Earth monitoring capabilities and climate change impact monitoring.

Finally, dissemination activities targeting high-schools and the STEM community of Greece (see Section 2.2) will take place during the lifetime of ACRONYM. The effect of these activities is expected to have a long term societal impact; students will be introduced in fundamental concepts of Space Geodesy, information that is currently unavailable (at least at this level) yet of growing importance, in an era where technologies such as navigation and Earth monitoring are taken for granted. Exposure to such information can lead to a better understanding of everyday space-powered tasks (e.g. satellite communication) and an expanding world which now includes near space. Among other advantages, better educated citizens are better equipped to fend off trending phenomena such as conspiracy theories (often associated with space). Additionally, these educational visits are expected to boost interest in Space Geodesy and Earth monitoring, broaden student’s scientific and carrier horizon and help in raising the country’s future role in space sciences and technology.

**Target Groups:**

**2.2 Measures to maximise impact - Dissemination, exploitation and communication** #@COM-DIS-VIS-CDV@#

ACRONYM foresees to promote the project itself, the obtained results as well as interest and involvement in Space Geodesy and related applications by carrying out different types of activities, tailored to multiple and diverse audiences. An overview of dissemination activities to be carried out throughout the lifetime of ACRONYM is presented in Table XX.

As a first step, ACRONYM will develop its logo, establishing its visual identity and promoting recognizability; ACRONYM’s logo will be used in all project-related documents and presentations.

A dedicated, user-friendly ACRONYM website will be created, to act as as a main channel for promoting and providing up-to-date information about the project, partners, activities, results, events and progress. Mandatory sections to be included in the website, relate to general project information (aim, objectives, consortium members), the list of activities and achieved results, news and events, links to software pages and contact information. The website will be continuously updated during the whole life of ACRONYM project. The Quality Measurement Board will periodically collect visitor statistics and if needed provide means to further popularize the website (e.g. change design, introduce media, etc). Except from ACRONYM’s website, each of the software tools to be built in the project (Section 1.2.2) will have a dedicated webpage, including the source code, example usage, help, manual, information and wiki pages. It is expected that this setup can greatly boost the user base, helping in incorporating engineers, scientists, researchers and commercial users.

ACRONYM will adopt a free and open-source policy for all of its software products (MIT license), making them available to any interested party. The release of the software however, will be accompanied with a relevant DOI (via zenodo), so that usage of the software tools is trackable and citeable. With the growth of the user community, this fact is expected to significantly boost the partnership’s and especially the Coordinator’s research profile and standing, since usage of the tools for research, scientific and commercial reasons will be properly acknowledged with a reference.

As already noted, a series of scientific publications will also help disseminate ACRONYM results. These will include scientific publications in peer-reviewed journals, attendance of international conferences, submission of three PhD theses and three PostDoc theses. All of the above, will be published adopting a strict open-access policy.

A dissemination activity of major importance will be the organization of a five-day Summer School that will take place in Greece, in the premises of DSO, for the endorsement of ACRONYM, dissemination of its scientific output and results and promotion of expertise and innovation in the fields of Space Geodesy, Orbit Determination, Space Studies and Geosciences in general. IPGP, GFZ, OSO and CLS will all be involved (via physical attendance), presenting the space geodetic techniques, current and future trends, applications and challenges. Additionally, CLS utilizing its decades old involvement in the field of providing space-based solutions, will address issues of providing high value-added products and services related to monitoring and surveillance solutions for Earth. The school will target the scientific and research community, commercial users/businesses, industry and the Greek ecosystem (Section 1.2.5). An attendance of approximately thirty individuals is expected. At the last day of the School, a guided tour of the geodetic observation sites hosted at DSO will be performed (stationed in Dionysos, Attica).

All partners will be proactive in social media engagement; this will involve routinely posting new and updated information, results, progress, milestones achieved, attended and organized events, scientific and technical publications. To reach out to a diverse scientific and commercial audience, all relevant digital platforms will be utilized, i.e. LinkedIn, ResearchGate and Academia. Media engagement will also include Twitter (now X), targeting young talented scientists (e.g. postgraduates) not yet fully networked into scientific media platforms.

Since all partners with the exception of CLS are either academic institutions or have direct involvement to academic curriculum, they will undertake the task to publicize and promote ACRONYM, especially to young scientists, e.g. graduates, postgraduates and PhD students. This will be performed by incorporating ACRONYM’s results and activities in lectures and using the software tools to be developed in relevant data analysis exercises and training sessions. The latter fact can help in the creation of a vivid user community which can in the future play a key role in greatly expanding the scope, reach, application and product range of the software tools built in ACRONYM.

Communication and dissemination activities specifically targeting the national (Greek) ecosystem of institutions, industry and business that are active in the Space industry and space solutions, earth observation and related applications will also be a focal point. This multidisciplinary ecosystem (described in Section 1.2.5) will be established during the course of ACRONYM (see WP5) by issuing calls to any interested party. However, membership in the ecosystem will be continuously open and endorsed, expanded beyond the lifetime of ACRONYM, in an effort to establish an enduring, long-standing partnership to efficiently promote space-based geosciences in Greece.

One dedicated conference and one info-day will be organized and take place in Greece, to enhance networking, and promote both ACRONYM results and most importantly the impact of the project (described in Section 1.2.5 and WP5). A Newsletter will be issued and distributed (every six months) to the stakeholders to further raise interest and inform ecosystem members of relevant tasks, events, new challenges, issues and trending new in Space Geodesy and related applications.

The partner will also issue a series of questionnaires, targeting both research institutions and business members of the ecosystem (Section 1.2.5). The data collected will be thoroughly examined and evaluated so that all ACRONYM partners and especially the Coordinator gain a clear view on research and business demands and needs in the field. Conclusions will play an important role in further expanding research activities and products; the Coordinator will exploit this knowledge to meet user demands and needs (both via expertise and software solutions) and elevate to a key role for space-based geosciences in the long run.

The impact of the ecosystem is expected to be significant both for the Greek research community and for commercial users/businesses active in the field. Promoting synergies and collaboration, and for the first time bringing together researchers and commercial users, it is expected to create new partnerships, better exploit funding opportunities, improve career permeability (between academia and business), expand technological access of businesses to new research results and emerging products/solutions, boost Greek involvement in relevant scientific fields and R&I, and claim a bigger share of an emerging market for Greek institutions/businesses, thus also creating new job opportunities. Via ACRONYM, NTUA will be able to educate highly skilled new scientists to take up these tasks.

Last but not least, the Coordinator will introduce fundamental concepts of Space Geodesy and Earth Observation and their crucial input for Climate Change monitoring and Space Science in high school students around Greece. NTUA will organize and host a series of high-school visits in the observational facility of DSO, where students will be presented with the fundamentals of relevant scientific fields, their application range, interactive venture labs and educational activities and perform guided tours at the instrumentation sites (GNSS antennae, DORIS beacon, astrometric camera, gravitimeters, etc). Such calls will also be issued to the STEM community of Greece, and any interested STEM member can be a beneficiary. It is expected that during the lifetime of ACRONYM ten such visits will be performed.

| Dissemination Activity | Details | Target Group |
| --- | --- | --- |
| Scientific Publications | Set target of nine scientific papers (at least three of which in high-impact (>2.5) journals) and presentation in ten international conferences/workshops. | International scientific community of Geodesy, Space Geodesy, Earth Observation, Geophysics & Geodynamics and related fields. |
| Newsletter | Issued every six months. |
| Ecosystem Meetings | One info-day and one two-day (hybrid) seminar. | Greek ecosystem members, including industry, commercial users, businesses and institutions involved in Navigation, Positioning, Climate Science & Environmental Monitoring, Satellite Technology, Natural Resources Management, **Construction and Infrastructure, Remote Sensing, Space Security and Awareness, etc.** |
| Lecture notes & Videos | Accessible at ACRONYM’s website. | International scientific community, ecosystem members, industry, commercial users, businesses and research institutions active in Space Geodesy and related applications. |
| Summer School | Five-day Summer Schools to take place in the premises of DSO; all ACRONYM partners will be actively involved. Attendance of approximately 30 individuals. |
| ACRONYM Website | The project’s public-access website, including all relevant, up-to-date project information |
| Software Release & Software Pages | Dedicated webpages for each software tools created in ACRONYM (including examples, wiki-pages, user community forum, etc) | All of the above, but also targeting Space Geodesy data analysis engineers, and user community. |
| Academic Curriculum | Promote ACRONYM activities and results via lectures and venture labs to be carried out in University associated with ACRONYM partners. | Young scientists and engineers, graduate and post-graduate students in NTUA, IPGP and OSO. |
| Secondary Education Visits/Schools | NTUA staff visiting high-schools in Greece and/or high-school students visiting the observation site of DSO. | High-school students in Greece and STEM community of Greece. |

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**2.3 Summary**

**KEY ELEMENT OF THE IMPACT SECTION**

|  |
| --- |
| **SPECIFIC NEEDS** |
| *What are the specific needs that triggered this project?*  Enhance Coordinator’s research capacity in the field of Space Geodesy and Earth Observation. Build state-of-the-art technological assets (software) and highly skilled and qualified research staff to enable scientific excellence.  Enhance strategic networking and synergy with top class European institutes in the field and promote involvement in prestigious international consortia. Significantly increase NTUA’s standing, visibility and introduce the institution as a key player in the present and future of Space Geodesy.  Raise reputation, research profile and attractiveness of the Coordinator. Elevate NTUA to an appealing scientific destination for talented and skilled scientists.  Raise Coordinator’s share in funding pools and improve financial support for research activities. Strengthened research management and administrative skills, as well as research funding capabilities. Support and enlarge the Coordinator’s research activities via diversification of targeted funding pools and schema; highly improve success rate in research funding bids.  Raise awareness and interest in Space Geodesy and Earth observation in Greece. Mitigate the technological gap and (the consequent) funding handicap between Greek institutions and European leading peers.  Establish a Greek ecosystem of stakeholders active in space-based geosciences; enable communication, collaboration and promote research and innovation. Raise national involvement in relevant research and market share.  Create a state-of-the-art software toolbox, following a free and open-source development/release policy (i.e. freely available to the scientific community), to process space geodetic data. |
| **D & E & C MEASURES** |
| What dissemination, exploitation and communication measures will you apply to the results?  **Communication**   * Issue a Newsletter and use social media to promote ACRONYM and inform the public about its objectives, activities, results and events. * Issue calls to any interested party (universities, research institutions, government agencies, businesses, etc) to get involved in a national ecosystem of space-based geosciences. * Promote ACRONYM to graduate level students in Greece, using NTUA’s academic capacity (e.g. lectures, national meetings and consortia, etc). * Greek high-school and STEM community educational visits at DSO   **Dissemination:**   * Release of DORIS analysis software, attributing a citeable and trackable DOI (e.g. via zenodo). Software release using a public domain software repository/development platform using MIT license. * Release of SLR analysis software, attributing a citeable and trackable DOI (e.g. via zenodo). Software release using a public domain software repository/development platform using MIT license. * Scientific publications in peer-reviewed journals. * Attendance and presentations in international conference. * Summer School on Space Geodesy, Earth Observation and applications * One info-day and one conference in Greece, targeting the Greek ecosystem   **Exploitation:**   * Use the research management and administration unit to claim research bids. Use the network of top-class partners/collaborators and Coordinator’s involvement in prestigious consortia to get involved in large scale research projects and claim funding. * Use the increased research profile and international standing of the Coordinator, as well as increased funding capabilities, to allure young scientists and promote inward/outward mobility of highly skilled scientists. * Use the software tools built in ACRONYM to produce high-quality, state-of-the-art solutions and products. Target scientific excellence, high-impact publications and increased interest from the private sector. * Use synergies within the national ecosystem to |

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| **EXPECTED RESULTS** |
| What do you expect to generate by the end of the project?  Brand new software tools to perform analysis of Space Geodetic data, using state-of-the-art modeling.  Three scientific papers in peer-reviewed, high-impact journals. Five publications in international conferences.  Three PhD and three Post-Doc students trained. Trained and highly skilled work force in the coordinator, with increased scientific reputation.  Grant agreements and secure financial support for relevant research activities (extending beyond the lifetime of ACRONYM).  A prestigious network of collaborators, Involvement in international, high-prestige consortia such as IDS, IRLS and GGOS, which shape the future of Space Geodesy.  A highly skilled, trained research management and administration unit to support bid claiming and project management in the long run.  A national ecosystem of |

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| **TARGET GROUPS** |
| *Who will use or further up-take the results of the project? Who will benefit from the results of the project?*  **Research and Scientific community** (Greek and international) in the fields of Space Geodesy and Earth Observation.  **Greek ecosystem** **of stakeholders active in space-based geosciences.** This includes relative research institutes, commercial users, businesses and industry  **End users/industry** related to Space applications (e.g. Space Security and Awareness, etc) and monitoring and surveillance solutions for Earth (e.g. Environmental and Climate monitoring, Maritime Surveillance, Infrastructure monitoring, etc).  **Graduate, PhD students**.  **Young Scientists and Engineers** in the wider field of Geoscienses. |
| **OUTCOMES** |
| *What change do you expect to see after successful dissemination and exploitation of project results to the target group(s)?*  Usage of software tools by the scientific community (measured by their attributed DOIs).  Involvement of Coordinator in high prestige international consortia and services, in multiple roles and levels.  High use of the scientific papers published (measured with the relative rate of citation index of publications).  Increased visibility and international standing of NTUA in the field of Space Geodesy and Geosciences.  Establishment of a highly skilled task force in the host institute, with extended networking capabilities and international reach (in a European and international level).  Raise attractiveness of NTUA to young talented scientists along with its ability to provide relevant funding (via successfully claiming research funds). |
| **IMPACTS** |
| *What are the expected wider scientific, economic and societal effects of the project contributing to the expected impacts outlined in the respective destination in the work programme?*  Quench the crowding-out effect of young, skilled scientists experienced in Greece, targeting the field of Space Geodesy and Geosciences.  Increase Greece’s share in research funding pools.  Increase Greece’s awareness, interest and involvement in a rapidly growing international market, that of Space technology and Earth Observation.  Significantly up-scale academic curriculum and research scope in Greece. Create a pool of experts in Space and studies and Geosciences, boosting innovation and research capacity on a national scale (improve innovation ranking).  Stimulate NTUA’s collaboration with the private sector, involvement in R&I and products/solutions targeting Space technology and Earth observation.  Mitigate the currently apparent technological gap between Greece and leading European countries in Space and Earth Observation.  Equip the scientific community with state-of-the-art software tools to analyse space geodetic data; boost interest and growth in the field, attract new scientists, and stimulate the generation of new products and/or products of increased quality.  Disperse and disseminate space geodetic products in yet a wider audience of scientists and applications. |

#§IMP-ACT-IA§#

**3. Quality and efficiency of the implementation** #@QUA-LIT-QL@# #@WRK-PLA-WP@#

**3.1 Work plan and resources**

The work plan for ACRONYM is heavily focused on an seamless, one-way transfer of excellence between the top-class consortium partners and NTUA. Project administration activities are placed in an individual Working Package (WP1) to allow for its efficient management, coordination and progress checking. Capacity building is split into two Working Packages, each with its own focus and goals; WP2 targets the establishment of networking channels, task forces and technique-specific synergies, introductory level coaching on the respective techniques, and the establishment of a detailed work-plan and goal setting for the transfer of excellence and capacity building to follow. WP3 aims at a more hands-on approach, where the top-class partners will assist NTUA in enhancing its research capacity and prestige via the refinement of its scientific arsenal, specifically aimed at implementing state-of-the-art software tools. An additional Working Package (WP4) is aimed at dissemination activities through e.g. the sharing of outcomes and results via open-access scientific publications and promoting innovation, especially in Greece. The work plan is described in detail in the following.

**3.2 Capacity of participants and consortium as a whole** #@CON-SOR-CS@# #@PRJ-MGT-PM@#

**3.2.1 Capacity of GFZ in the field of SLR and other space geodetic techniques**

GFZ´s Section 1.2 “Global Geomonitoring and Gravity Field” within GFZ´s Department 1 “Geodesy” has a long-standing expertise using data from all four space geodetic techniques (SLR, GNSS, Doris, VLBI) to improve the International Terrestrial Reference Frame (ITRF) and to provide numerous Earth system parameters such as Earth orientation or station coordinates and velocities to the international community. The Section actively runs an Analysis Center (AC) for the International Laser Ranging Service (ILRS) and will shortly also become an AC for the International Doris Service (IDS). The Section has developed in house a software package “EPOS” (Earth Parameter and Orbit System) with its nucleus EPOS-OC (Orbit Computation) for data pre-processing, precise orbit determination (POD) of LEO (Low Earth Orbiting), MEO (Medium EO) and HEO (High EO) satellites, orbit integration, orbit prediction, simulation of observations, and normal equation handling and solution. Its periphery comprises data pre-processing, orbit predictions for SLR tracking and mission operations, normal equation handling and solution. EPOS is capable to analyze all kinds of space geodetic tracking data, inter-satellite tracking data as well as 3D accelerometer data to handle non-gravitational forces and star camera attitude data, e.g. for time-variable gravity field determination from GRACE and GRACE-FO mission data. The software always follows most recent standards such as the IERS2010 Conventions or new terrestrial reference frames as the ITRF2020. EPOS-OC is regularly compared to other internationally accepted software package such as GINS (GRGS, Toulouse) or UTOPIA (CSR, Austin).Various simulation studies have recently been performed to improve the ITRF towards the Global Geodetic Observing System (GGOS) requirements (1 mm accuracy and 1 mm per decade long-term stability) either by optimizing the global ground station network for SLR or VLBI or to use so called “space tie satellites” such as the upcoming ESA GENESIS mission by co-locating all four techniques on the same satellite, with the instruments duly calibrated and synchronized.

The Section also runs a SLR station on the Telegrafenberg in Potsdam which will celebrate its 50th anniversary in March 2024. The station is always under the best 10 stations in the world and fulfils the ILRS requirements what concerns, e.g., number of passes, accuracy and latency. The station shall be renewed within the next 2-3 years and will then become the first “MHz-station” in the world.

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**Tables for section 3.1**

**Table 3.1a: List of work packages**

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| **Work package No** | **Work Package Title** | **Lead Participant No** | **Lead Participant Short Name** | **Person-Months** | **Start Month** | **End month** |
| WP1 | Project Management and Coordination | 1 | NTUA |  | 1 | 36 |
| WP2 | Transfer of Knowledge | 1 | OSO |  | 1 | 36 |
| WP3 | Building Excellence Capacity | 1 | IPGP |  | 12 | 36 |
| WP4 | Strengthening research management, administration and funding capacity | 1 | CLS |  | 1 | 36 |
| WP5 | Networking and Ecosystem Activities |  | NTUA |  |  |  |
| WP6 | Dissemination, Exploitation and Communication Activities |  | GFZ |  | 1 | 36 |

**Table 3.1b: Work package description**

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| **Work package number** | WP1 |
| **Work package title** | Project Management & Coordination |

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| **Objectives**  The objective of this WP is to ensure successful implementation of project activities and timely delivery of high-quality results, so that by the end of implementation life the project achieves its overall goal and fulfills all foreseen objectives as given in the Proposal. In more detail, specific aims targeted at this WP are:   * Establish a strong project management scheme * Establish appropriate communication and reporting channels to the European Commission * Ensure successful achievement of the project objectives on time and within budget * Establish an efficient electronic service for communications, and document exchanging * Conduct continuous quality assurance activities for the operation of the project and the production of its results within its lifespan * Ensure continuous monitoring of the project’s progress and timely initiation of corrective actions (if needed) * Coordinate the organization and execution of the various project meetings, and/or participation of the project in various external or self-organized events * Perform risk analysis and ethical and legal framework analysis to ensure successful and continuous compliance with ethical and legal standards concerning the project objectives. |

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| **Description of work**  **Task 1.1: Project implementation plan and Project Management Board (M1-M36): Lead NTUA**  A Project Management Board will be decided on and formed at the kick-off meeting (Task 1.x). This board will act as the highest project body in charge for executive decisions and responsible for project activities and results, risks, quality assurance, resources, impact monitoring, meetings preparation, as well as for in-house reports and the reporting towards the European Commission. ACRONYM Management Board will consist of representatives of all partners (one representative per partner).  The Project Management Board will explain project work methodology, confirm objectives, list tasks and the time of their execution, present resources, roles, and responsibilities of ACRONYM partners, give milestones and the paths to the achievement of project results, and elaborate all other aspects important to successful project implementation in accordance with the workplan of this Proposal. The task forces of all active work packages will periodically deliver in-house progress reports to the Project Management Board.  The board will perform on-line meetings every three months, or whenever one of the Quality Management Board, Risk Management Board or Financial Management Board identifies a specific need/subject to be addressed. It will also periodically submit progress reports (every six months).  **Task 1.2: Quality management and monitoring (M1-M36): Lead CLS**  The project will establish the Quality Management Board, whose role will be to develop a quality management plan, define and monitor the achievement of high quality project deliverables, conduct quality checks, and organize quality-related project meetings and teleconferences. The board members will be decided on and formed at the kick-off meeting (Task 1.x), made up of personnel from all partners.  At the beginning of project implementation period, the board will prepare, and the Project Management Board will adopt the Quality Plan, a document that prescribes quality assurance mechanisms and metrics, internal and external quality control measures, particular quality-related requirements for scientific project results including gender dimension, and define roles and responsibilities of all participants included in quality procedures. Every 6 months starting from the project beginning, the Quality Management Board will deliver integrated reports to the Project Management Board.  **Task 1.3: Risk management (M1-M36): Lead GFZ**  The Project Management Board will adopt at the beginning of the project the Risk Management Plan referring to the monitoring of the risks identified at the time of Proposal preparation, and to those risks occurred in the period between Proposal submission and Grant awarding. The Plan will be continuously revised, and it will be the responsibility of all project participants to report promptly about any newly emerged risk that could impact project implementation and cause deviation from the original work plan. For every identified risk, the level of likelihood to occur and the level of severity must be elaborated, and timely prevention and mitigation actions and mechanisms precisely defined. Risk Management will be discussed as a separate session at every gathering of the Project Management Board.  **Task 1.4: Financial management (M1-M36); Lead NTUA**  One specific support team to the Project Management Board will be the Financial Committee, that will develop the Guidelines for the Use of the Grant, monitor project expenditures, deliver in-house reports to the Management Board every 6 months, and prepare financial reports for the European Commission.  **Task 1.5: Coordination, communication and administration (M1-M36); Lead NTUA**  The Coordinator shall form a collective, and each partner shall form its own administrative base of the project. The Coordinator shall issue labelling instructions and store hardcopies of all project documentation. In a separate part of the project web platform (Task 4.1), an electronic project register will be formed. The Coordinator leads day-to-day communication through agreed electronic channels at the level of the Project Management Board, with Leaders of Work Packages, coordinates project activities, distributes documents, news, and achievements, and reports on communication with the European Commission. Mutually, all members of the Project Management Board shall inform each other about the project progress in locale and the potential obstacles and changed conditions for its implementation, so that the difficulties could be dealt with successfully and timely, or the back-up plans prepared.  **Task 1.X Kick-Off Meeting (M1-3); Lead: OSO**  A two-day meeting will be held with the presence of all involved partners, organized by OSO. The focus of the meeting will be the establishment of sound networking and communication between partners, the acquaitance of the different task forces and groups, decisions on on-line communication means (e.g. video conference platforms) and first imminent steps to be performed.  **Task 1.X Wrap-Up, Evaluation and Conclusions Meeting (M32-36); Lead IPGP**  Near the end of ACRONYM, a two-day meeting will be held organized by GFZ with the presence of all partners. The aim of the meeting will be the evaluation of the overall work done during the lifespan of ACRONYM, assessment of initial goals established and the extend they were reached, current status of the Center of Excellence for Space Geodesy research capacity, possible shortcomings and imminent next steps for their overcoming.  Conclusions will be drawn on the success rate of the project, acting as guidelines for the next steps of the consortium and especially the awaited synergies proposed for at Task 2.4. Evaluation and concussions will be drawn both for the research capacity building part of ACRONYM, as well as the administrative and managerial performance. |

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| **Work package number** | WP2 |
| **Work package title** | Transfer of Knowledge |

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| **Objectives**  The objectives of this WP are to:   * transfer knowledge from expert nodes to the Coordinator, building foundations for scientific excellence * establish technical standards, requirements and specifications for further research capacity (building software, WP3) * involve talented young scientists in training and increase inwards/outwards mobility (via co-supervision and visits) * seek and utilize training channels/options other than ACRONYM * establish solid, agile research task forces allocated per Space Geodetic technique, making skill building and knowledge dispersion more effective and efficient |

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| **Description of work**  **Task 2.1 Transfer of knowledge for DORIS (M1-M12); Lead IPGP**  The Coordinator along with IPGP and CLS will establish a task force (with members of all three involved institutes) and the means through which this force will maintain a long-term, sound communication and collaboration.  The expert partners will introduce the DORIS technique to their peers via online webinars, virtual training, videos conferences, venture labs and one short term encounter (duration between one and two weeks) of all three involved partners. At this stage, virtual meetings will be held twice per month.  Exploiting the expertise of the top-class institutes (IPGP and CLS), the partners will document specifications, standards and models as well as hierarchically ordered tasks, acting as a road-map for designing and implementing a DORIS analysis software, eventually leading to state-of-the-art quality. The plan will include timely milestones, goals and validation tests.  **Task 2.2 Transfer of knowledge for SLR (M1-M12); Lead GFZ**  GFZ and NTUA will establish a task force (with members of both involved institutes) and the means through which this force will maintain a long-term, solid communication channel.  The expert partner will introduce the SLR technique to their peers via online webinars, virtual training, videos conferences, venture labs and one short term encounter (duration between one and two weeks) of all three involved partners. At this stage, virtual meetings will be held twice per month. During the visit, NTUA personnel will make a guided in-situ visit to the SLR station in Potsdam (operated by GFZ), where they will be introduced to the instrumentation and operational aspects of the site.  Exploiting the expertise of GFZ, the partners will document specifications, standards and models as well as hierarchically ordered tasks, acting as a road-map for designing and implementing an SLR analysis software, eventually leading to state-of-the-art quality. The plan will include timely milestones, goals and validation tests.  **Task 2.3 Transfer of knowledge for VLBI (M1-M12); Lead OSO**  OSO and NTUA will establish a task force (with members of both involved institutes) and the means through which this force will maintain a long-term, sound communication channel.  The expert partner will introduce the VLBI technique to their peers via online webinars, virtual training, videos conferences, venture labs and one short term encounter (duration between one and two weeks) of all three involved partners. At this stage, virtual meetings will be held twice per month. During the visit, NTUA personnel will make a guided in-situ visit to the VLBI site in Onsala (operated by OSO), where they will be introduced to the instrumentation and operational aspects of the site.  Exploiting the expertise of OSO, the partners will document specifications, standards and models as well as hierarchically ordered tasks, acting as a road-map for designing and implementing through designing and implementing a geodetic toolbox, specifically aiming at an efficient and accurate handling of Earth orientation parameters, celestial and terrestrial reference frame transformations and modeling of tidal phenomena, eventually leading to state-of-the-art quality. The plan will include timely milestones, goals and validation tests.  **Task 2.4 Assessment of currently available software tools (M6-12); Lead GFZ**  All partners will be involved, according to their respective fields of expertise, in an effort to inspect, assess, test and validate software tools that the Coordinator has in the past designed and built. Expert nodes will evaluate design and implementation issues, possible shortcomings and mitigation/refinement actions. This is expected to significantly assist the software building process described in WP3.  **Task 2.5 Attending training events (M6-M36); Lead NTUA**  The Coordinator will closely follow any training activities/events offered by International Geodetic Services and Consortia (e.g. IGS, IDS, ILRS, IVS, IAG, GGOS, ESA, etc), and will pursue attendance by the relevant task forces (established in Tasks 2.1 through 2.3) either physically or remotely. Priority will be given to young scientists of the Coordinator institute. |

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| **Work package number** | WP3 |
| **Work package title** | Building Excellence Capacity |

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| **Objectives**  The objectives of this WP are to:   * effectively enhance host’s research capacity through expertise, skill building and software implementation * transfer of knowledge and best practices using a “hands-on” approach * build a software toolbox to perform state-of-the-art data analysis for observations collected by both DORIS and SLR techniques. Additionally, efficiently incorporate recent advances and high-quality products from VLBI analysis. * enhance NTUA research profile via adherence to a free and open-source policy (software) * create highly skilled scientific personnel at the host institute * establish a long term plan for further enhancing the host institute’s research capacity, international standing and involvement |

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| **Description of work**  **Task 3.1 Building research capacity via DORIS (M12-M36); Lead CLS**  CLS and IPGP will provide assistance to NTUA aiming at the upgrade and refinement of its own DORIS analysis software, to perform precise orbit determination and estimation of geodetic parameters. A working group of at least four members of NTUA, including one PhD and one PostDoc student, will be involved in this task on the Coordinator’s part.  Both expert nodes will assist NTUA’s personnel via online webinars, one-on-one and one-to-many training, problem solving and advisory meetings, exploiting the capacity already established in Task 2.2. Additionally, NTUA’s staff will visit CLS and both CLS and IPGP personnel will make one short visit to NTUA’s facilities, in an effort to further consolidate efficient flow of expertise. Knowledge transfer at this stage will include robust algorithmic and design approaches, best modeling practices, state-of-the-art methodologies and implementation strategies. Regular virtual meetings will be held once per month to monitor progress, while additional meetings will take place on demand, targeting specific issues and/or problems that may come up (problem solving and training sessions).  Software development will adopt the work plan established in Task 2.2, enabling step-by-step validation. Such a process will enable the efficient administration of the capacity building process, monitoring progress through well established, timely milestones, goals and validation tests.  **Task 3.2 Building research capacity via SLR (M12-M36); Lead GFZ**  GFZ will provide assistance to NTUA aiming at the development of its own SLR analysis software, to perform precise orbit determination and estimation of geodetic parameters. A working group of at least four members of NTUA, including one PhD and one PostDoc student, will be involved in this task on the host institute’s part.  The expert node will assist NTUA’s personnel via online webinars, one-on-one and one-to-many training, problem solving and advisory meetings, exploiting the capacity already established in Task 2.3. Additionally, NTUA’s staff will visit GFZ and GFZ personnel will make a short visit to NTUA’s facilities, in an effort to further consolidate an efficient flow of expertise. Knowledge transfer at this stage will include robust algorithmic and design approaches, best modeling practices, state-of-the-art methodologies and implementation strategies. Regular virtual meetings will be held once per month to monitor progress, while additional meetings will take place on demand, targeting specific issues and/or problems that may come up (problem solving and training sessions).  Software development will adopt the work plan established in Task 2.3, enabling step-by-step validation. Such a process will enable the efficient administration of the capacity building process, monitoring progress through well established, timely milestones, goals and validation tests.  **Task 3.3 Building research capacity via VLBI (M12-M36); Lead OSO**  VLBI is known for its importance in the observation of the Earth's orientation parameters and fluctuations in the length of day. Such observations are of immense importance in Space Geodesy, since they enable e.g. the permanent tie between Celestial and Terrestrial Reference Frames.  OSO will assist NTUA in incorporating a state-of-the-art handling of Earth Orientation Parameters and consequently reference frame transformation schema in its own software toolset. The expert node will assist NTUA’s personnel via online webinars, one-on-one and one-to-many schooling, problem solving and advisory meetings, exploiting the capacity already established in Task 2.4. A working group of at least four members of NTUA, including one PhD and one PostDoc student, will be involved in this task on the host institute’s part. Regular virtual meetings will be held once per month to monitor progress, while additional meetings will take place on demand, targeting specific issues and/or problems that may come up (problem solving and training sessions). Additionally, NTUA’s staff will visit OSO and OSO personnel will make a short visit to NTUA’s facilities, in an effort to further consolidate networking and efficient expertise transfer.  Knowledge transfer at this stage will include robust algorithmic and design approaches, best modeling practices, state-of-the-art methodologies and implementation strategies. Software development will adopt the work plan established in Task 2.4, enabling step-by-step validation. Such a process will enable the efficient administration of the capacity building process, monitoring progress through well established, timely milestones, goals and validation tests.  **Task 3.4 Long term plan for scientific excellence (M30-36); Lead NTUA**  The consortium will thoroughly evaluate the progress performed within the framework of ACRONYM in terms of research capacity and scientific excellence achieved. It will then accordingly establish a work plan for all remaining steps required for NTUA to reach either an Analysis Center status or an Associate Analysis Center status, for the DORIS and SLR techniques, depending on each international service’s needs (i.e. IDS and ILRS) and prerequisites.  Additionally, the consortium will identify weak points in the capacity built and propose means to mitigate them. Finally, it will identify and propose a number of study areas that currently lay in research frontiers and attract international research interest. These focus areas will act as pathways for future evolution and growth of the Centre of Excellence. |

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| **Work package number** | WP4 |
| **Work package title** | Strengthening research management, administration and funding capacity |

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| **Objectives**  The objectives of this WP are to:   * strengthen research management capacity and administrative skills of the Coordinator * create a dedicated, skilled workforce at NTUA responsible for project claiming * boost Coordinator’s success rate in research funding bids * expand and diversify funding pools and capabilities targeted by NTUA * build expertise at efficient and successful research proposal writing * claim research funds to enhance NTUA’s appealingness to scientists and recruitment opportunities, increase mobility and support and expand research activities (financially-wise) * secure financial aid for the host’s research activities in the long-run and boost long-term synergy between the consortium partners |

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| **Description of work**  **Task 4.1 Establish a research management/administration unit in the Coordinator institute (M1-M3); Lead NTUA**  The host institute will establish a task force made up of four to six NTUA employees including administrative staff, which will be trained in project funding seeking, proposal writing and efficient research project management and administration, via remote mentoring and coaching. The sole purpose of this unit will be to seek, claim and manage research proposals and its  scope will expand well beyond ACRONYM, effectively securing financial aid and supporting and administration for research activities in the long run.  The unit will report on its activities every six months to the Project Management Board.  **Task 4.2 Strengthening research management capacity and administrative skills (M3-M12); Lead OSO**  The consortium partners (CLS, IPGP, GFZ and OSO) will transfer technical knowledge, know-how and best practices to the Coordinator’s research administration unit. Training will be performed via online webinars, hosted by the partners and attended by the research administration unit. At least two training sessions will be hosted per partner, emphasizing on (a) Project preparation, proposal writing and organisational issues and (b) Project management and administration (Section 1.2.3). Partners will use large scale research projects they have managed in the past, to provide detailed examples of successful management and administration schema.  **Task 4.3 Exploring funding pools and opportunities (M12-M16); Lead GFZ**  The consortium partners (CLS, IPGP, GFZ and OSO) will introduce and acquaint the Coordinator’s research administration unit to various, diverse research funding pools, grants, capabilities and opportunities, which the unit can utilize to support research either individually (i.e. NTUA being the sole recipient of funding) or through partnerships (Section 1.2.3). Partners will use their own experience to transfer relevant knowledge to the Coordinator. At least one training session will be hosted per partner and attended by the unit.  **Task 4.4 Enhancing research funding capacity (M12-M36); Lead CLS**  Once the training phase of the research administration unit is (nearly) over and throughout the rest of ACRONYM’s lifespan, the unit with the help and guidance of the twinning partners, will prepare and submit at least four research funding proposals, targeting various funding opportunities. These will build upon the research capacity build and scientific excellence gained via ACRONYM.  At a minimum, the following funding bids will be submitted:   * two EU large scale research and innovation calls (e.g. HORIZON), and * two research proposals targeting young scientists and/or mobility (e.g. EU MSCA calls) * one funding bid targeting private/public collaboration, including at least one the ecosystem commercial partner   Apart from NTUA, at least two of the ACRONYM partners will be involved in each of the proposals to be submitted, the aim being  however for the consortium to be included as a whole. |

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| **Work package number** | WP5 |
| **Work package title** | Networking and Ecosystem Activities |

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| **Objectives**  The objectives of this WP are to:   * establish efficient and seamless communication and knowledge transfer channels * establish efficient and solid networking and collaboration between twinning partners * introduction of NTUA to international consortia and/or services (i.e. IDS, ILRS and IVS) * establishment of a Greek ecosystem of partners involved in space-based geosciences and applications * accommodate NTUA’s involvement in prestigious international consortia |

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| **Description of work**  **Task 5.1 Agreement on PhD and PostDoc co-supervision (M1-M6); Lead NTUA**  The Coordinator will reach an agreement with each of IPGP, GFZ and OSO, regarding the co-supervision of three PhD and three PostDoc thesis (each partner involved in one PhD and one PostDoc). The agreement will be formally submitted to NTUA, and one representative of each partner will be included in the three-part advisory committee (for PhD Thesis).  The subjects of the thesis will be co-decided between the partners, depending on their respective expertise; the students will be allocated in the task forces described in WP2 and WP3.  **Task 5.2 Introduction to Space Geodetic International Services and International Geodetic Consortia**  Expert nodes will introduce the Coordinator to the IDS consortium, facilitating its involvement within the service and further networking with prestigious international top-class institutes.  **Task 5.3 Establishing a Greek Ecosystem of partners in space-based geosciences (M6-24); Lead NTUA**  NTUA will take the initiative of bringing together all parties in Greece involved in Space-based geosciences, related applications and industries (e.g. Space industry, space awareness and security, tracking and navigation, etc). This will include possible industry partners, businesses, commercial users, governmental agencies and institutions, as well as universities.  NTUA will organize (see also Section 1.2.5):   * one hybrid two-day conference to take place in Greece, with the (virtual or physical) attendance of all ecosystem partners as well as ACRONYM partners. ACRONYM’s aims, objectives and anticipated impact will be presented, relevant research activities carried out in different NTUA laboratories. Ecosystem parties will be asked to present their current activities, research and industry portfolios, aspirations, products and solutions, as well as specific needs and interest related to ACRONYM and Space Geodesy. * One info-day to take place in Greece, with the attendance of all ecosystem partners co-organized by CLS. This meeting will focus on presenting current products and trends related to Space-based solutions in an application range of interest to the ecosystem partners.   **Task 5.4 Exploring Greek academia needs and interest in Space Geodesy (M18-24); Lead NTUA**  The Coordinator along with the expert partners will compile a series of two on-line questionnaires to be sent to the academia members of the ecosystem established in Task 5.3. The questionnaires will contain a number of questions and inquires to comprehensively access and evaluate Greek academia/scientific and research needs and interest in Space Geodesy and Earth Observation (Section 1.2.5).  **Task 5.5 Exploring stakeholders and commercial needs and interest in Space Geodesy (M18-24); Lead CLS**  The Coordinator along with the expert partners will compile a series of two on-line questionnaires to be sent to the commercial/business members of the ecosystem established in Task 5.3. The questionnaires will contain a number of questions and inquires to comprehensively access and evaluate market needs and interest related to Space Geodesy and Earth Observation (Section 1.2.5). |

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| **Work package number** | WP6 |
| **Work package title** | Dissemination, Exploitation and Communication Activities |

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| **Objectives**  The objectives of this WP are to:   * significantly enhance the host institute’s international standing and prestige via dissemination and communication activities * endorse and promote the achievements of ACRONYM and the newly established center of excellence * enhance NTUA’s research profile through scientific papers in top-tier peer reviewed journals, co-authored with the top-class consortium partners (at least three) * enhance NTUA’s visibility, prominence and networking capabilities via consortium presence in at least five international conferences/workshops * strengthen the potential for future collaborations nationally and beyond borders * enhance NTUA’s appeal to young talented scientists * enhance and support the national (Greek) ecosystem of stakeholders related to Space studies and geosciences; boost innovation and disperse knowledge |

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| **Description of work**  **Task 6.1 Project website and social media engagement (M6-M36); Lead NTUA**  The host institute will design and implement a dedicated web site for the project, assisting networking capabilities, promotion and communication of activities taking place in the framework of the project and, dissemination of ACRONYM outcomes and results and in general outreach material.  Mandatory sections to be included into the website include general project information (aim, objectives, consortium members), the list of activities and achieved results, news and events, contact information, and login area for ACRONYM beneficiaries. The website will be continuously updated during the whole lifespan of the project.  Promotion, communication and endorsement activities will also be performed via social media (e.g. LinkedIn) on a timely manner, throughout the duration of ACRONYM.  **Task 6.2 Sharing of technical knowledge and know-how (M12-M24); Lead IPGP**  Lectures and presentations prepared by the consortium experts (see WP2) will be made available (on-line, free access) to any interested parties, on demand. Users will be able to browse content and watch video-lectures, shared on the project’s web site. Such actions are expected to increase visibility of the project and promote awareness in the field, especially targeting Greek institutions (both public and private).  **Task 6.3 Joint Summer School (M12-M36); Lead NTUA**  The host institute will organize a three-day Summer School that will take place in Greece, for the endorsement of ACRONYM, dissemination of its scientific output and results and promotion of innovation in the field of Space Geodesy, Orbit Determination, Space Studies and geosciences in general. IPGP, GFZ and OSO will all be involved, presenting the space geodetic techniques, current and future trends, applications and challenges. The school will especially target the Greek ecosystem of stakeholders that are involved in Space studies and geosciences. This will include public research institutions, universities and private sector organizations/companies.  CLS utilizing its decades old involvement in the field of providing space-based solutions, will address issues of providing high value-added products and services related to monitoring and surveillance solutions for Earth. Focus will be placed on Environmental and Climate monitoring, Maritime Surveillance and Infrastructure monitoring. Target audience will be the Greek ecosystem relevant to the Space studies and geosciences (public research institutions, universities, private sector and any interested party) in an effort to promote and endorse innovative and trending ideas, products and solutions in the field.  **Task 6.4 Open-Access publications (M12-M36); Lead NTUA**  Expert partners will collaborate with the host institution in the co-authorship of nine scientific papers (in their respective fields of expertise) to be published in peer-reviewed journals. Three of these will be high-impact publications, i.e. journals with impact factor > 2.4. Scientific publications will adhering to an open-access policy.  Additionally, members of the consortium will attend and present relevant publications in ten international conferences. The target here includes technique-related workshops (e.g. Analysis Centre Workshops organized by IDS and/or ILRS) and conferences of significant importance and prominence (e.g. IUGG, EGU and AGU international conferences).  **Task 6.5 Dissemination activities and support for the Greek ecosystem (M12-M36); Lead CLS**  To support the establishment and longevity of the Greek space-based geoscienences ecosystem (Task 2.5), NTUA and partners will prepare and disseminate a newletter, containing information on: (a) the aims and objectives of ACRONYMS, (b) milestones reached, (c) activities performed within ACRONYM including software design and release, conference attendance and relevant publications, (d) new prospects, missions and trends in pace Geodesy, (e) outreach material from all partners of ACRONYM and (f) outreach material from ecosystem members.  The first issue of the newsletter will be prepared and published by the 12th month and from then on, a new issue will be released every six months.  **Task 6.6 Approaching high-schools students and the Greek STEM community (M12-M36); Lead NTUA**  Issue calls to the STEM community of Greece and high-schools around the country. Each beneficiary will be hosted at the observational facilities of DSO, where they will be introduced to fundamental concepts of Space Geodesy, Earth Observation, their crucial input for Climate Change monitoring and Space Science and their application range. Visits will also include interactive and venture labs, educational activities and guided tours at the instrumentation sites. |

**Table 3.1c: List of Deliverables**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Deliverable (number)** | **Deliverable name** | **Work package number** | **Short name of lead participant** | **Type** | **Dissemination level** | **Delivery date**  **(in months)** |
| D1.1 | Kick-Off Meeting | WP1 | NTUA | R | PU | 3 |
| D1.2 | Project Management Board Meetings | WP1 | NTUA | R | PU | 6,12,18,24,30 |
| D1.4 | Final ACRONYM meeting | WP1 | NTUA |  |  | 36 |
| D5.X | Formal agreement on PhD & PostDoc co-supervision | WP5 |  |  |  | 4 |
| D2.X | Assessement of NTUA’s in-house software tools | WP2 | GFZ | R | PU | 12 |
| D2.X | Standards and specification for DORIS analysis | WP2 | IPGP | R | PU | 12 |
| D2.X | Standards and specification for SLR analysis | WP2 | GFZ | R | PU | 12 |
| D2.X | Standards and specification for EOP and tidal analysis | WP2 | OSO | R | PU | 12 |
| D2.X | Attendance report of training events (omitting ACRONYM) | WP2 |  |  |  | 36 |
| D6.X | ACRONYM Newsletter | WP4 | CLS |  |  | 12,18,24,30,36 |
| D4.X | Report on research proposal submission | WP4 | NTUA | R | PU | 24, 36 |
| D4.X | Research management and administration unit | WP4 |  |  |  | 3 |
| D4.X | Research management and administration unit training | WP4 |  |  |  | 12, 16 |
| D2.5 | Greek ecosystem meeting I | WP2 | NTUA |  |  | 12 |
| D2.6 | Greek ecosystem meeting II | WP2 | NTUA |  |  | 24 |
| D3.1 | Software toolbox for analysis of DORIS observations | WP3 | IPGP | R+O | PU | 36 |
| D3.2 | Software toolbox for analysis of SLR observations | WP3 | SLR | R+O | PU | 36 |
| D3.3 | Validation tests for EOP precise handling | WP3 | OSO | R+O | PU | 36 |
| D3.4 | Long term plan for scientific excellence | WP3 | NTUA | R | PU | 36 |
| D6.1 | Project Website | WP4 | NTUA | DEC | PU | 12 |
| D6.2 | Lecture notes and Training material | WP4 | NTUA | DEC | PU | 30 |
| D6.3 | Joint Summer School | WP4 | NTUA | DEC | PU | 32 |
| D6.4 | Space Geodesy Solutions Info-day | WP4 | CLS | DEC | PU | 32 |
| D6.5 | Open-Access Publications | WP4 | NTUA | DEC | PU | 36 |
| D1.X | Evaluation and Conclusions | WP1 | GFZ |  |  | 36 |

**Table 3.1d: List of milestones**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Milestone number** | **Milestone name** | **Related work package(s)** | **Due date (in month)** | **Means of verification** |
| MS | Kick-Off Meeting Organized | WP1 | 3 | Organization of an all-partner meeting |
| MS | Agreement on PhD/Post-Doc co-supervision | WP2 | 8 | Official certification by NTUA and the respective partner involved |
| MS | ACRONYM website | WP4 | 8 | ACRONYM website publicly accessible |
| MS | Standards and specifications for software development | WP2 | 12 | Document reports (three individual reports as described in Tasks 2.1, 2.2 and 2.3) |
| MS | Issue of the first volume of the ACRONYM newletter | WP4 | 12 | Delivery by e-mail to all parties involved in the Greek ecosystem |
| MS | Establishment of a Greek ecosystem for space-based Earth observation | WP2 | 12 | Two open meetings of the Greek ecosystem performed. Expected attendance of over 12 different individual institutions |
| MS | Orbit determination via SLR and DORIS | WP3 | 20 | Software tests validated by expert nodes; publicly available via software repository (version 1.0) |
| MS | Precise orbit determination via SLR and DORIS for one satellite | WP3 | 28 | Software tests validated by expert nodes; publicly available via software repository (version 2.0) |
| MS | Estimation of parameters of geodetic interest | WP3 | 34 | Software tests validated by expert nodes; publicly available via software repository (version 3.0) |
| MS | Wrap Up Meeting | WP1 | 36 | All-partner meeting and technical report |

**Table 3.1e: Critical risks for implementation** #@RSK-MGT-RM@#

|  |  |  |
| --- | --- | --- |
| **Description of risk (indicate level of (i) likelihood, and (ii) severity: Low/Medium/High)** | **Work package(s) involved** | **Proposed risk-mitigation measures** |
| Inability to travel e.g. due to pandemic security measures (l:medium,s:low) | WP2 and WP3 | If such a situation shall arise, then the partners will perform the required tasks via online platforms, utilizing experience gained throughout the last few years of security measures. |
| Failure to fully implement the Space Geodesy software (l:low,s:high) | WP3 | Due to the partner's expertise in such tasks, and the availability of a relevant package that can act as a fundamental building block, such a risk is considered extremely small. If however such a situation arises at some minimal extent, then the consortium will limit the number of involved satellites (e.g. from three to two or one).  If the software build does not reach state-of-the-art standards (upon project completion), the host institute will have already gained the knowledge and know-how to further refine it and will have already submitted proposals to extend its funding and support via relevant research projects. The network of collaborators that will have been established, will guarantee its on-going support in technical matters. The Long term plan for centre of excellence (established in Task 3.4) will act as a roadmap for eventually reaching state-of-the-art quality. |
| **One partner resigns from consortium** |  | **Other partners can still support the research component of the project** |
|  |  |  |

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**Table 3.1f: Summary of staff effort**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **WPn** | **WPn+1** | **WPn+2** | **Total Person-**  **Months per Participant** |
| **Participant Number/Short Name** |  |  |  |  |
| **Participant Number/**  **Short Name** |  |  |  |  |
| **Participant Number/**  **Short Name** |  |  |  |  |
| **Total Person Months** |  |  |  |  |

**Table 3.1g: ‘Subcontracting costs’ items**

|  |  |  |
| --- | --- | --- |
| **Participant Number/Short Name** | | |
|  | **Cost (€)** | **Description of tasks and justification** |
| **Subcontracting** |  |  |

**Table 3.1h: ‘Purchase costs’ items (travel and subsistence, equipment and other goods, works and services)**

|  |  |  |
| --- | --- | --- |
| **Participant Number/Short Name** | | |
|  | **Cost (€)** | **Justification** |
| **Travel and subsistence** |  |  |
| **Equipment** |  |  |
| **Other goods, works and services** |  |  |
| **Remaining purchase costs (<15% of pers. Costs)** |  |  |
| **Total** |  |  |

**Table 3.1i: ‘Other costs categories’ items (e.g. internally invoiced goods and services)**

|  |  |  |
| --- | --- | --- |
| **Participant Number/Short Name** | | |
|  | **Cost (€)** | **Justification** |
| **Internally invoiced goods and services** |  |  |
| **…** |  |  |

**Table 3.1j: ‘In-kind contributions’ provided by third parties**

|  |  |  |  |
| --- | --- | --- | --- |
| **Participant Number/Short Name** | | | |
| **Third party name** | **Category** | **Cost (€)** | **Justification** |
|  | **Select between**  Seconded personnel  Travel and subsistence  Equipment  Other goods, works and services  Internally invoiced goods and services |  |  |
|  |  |  |  |

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**Table 3.1k: Research Component**

|  |  |
| --- | --- |
| Have you included a research component in your project? | Yes/No |
| If YES |  |
| Please indicate the WP and/or tasks which will be dedicated to research |  |
| Please confirm that the research component does not exceed 30% of the total Horizon Europe grant amount | Yes/No |
| Please confirm that at least 50% of the research component is allocated to the coordinator | Yes/No |
| Please indicate the total amount of budget allocated to the research activities | EUR |
| Please indicate the amount of the research budget which will go to the coordinator | EUR |
| For each Beneficiary, please indicate the amount of budget allocated to research: |  |
| Beneficiary 1 | EUR |
| Beneficiary 2 | EUR |
| Beneficiary 3 | EUR |
| Beneficiary 4 | EUR |
| Beneficiary 5 | EUR |
| Beneficiary 6 | EUR |
| Beneficiary 7 | EUR |
| … | EUR |

1. R&I Country Profile for Greece, https://dashboard.tech.ec.europa.eu/qs\_digit\_dashboard\_mt/public/sense/app/1213b8cd-3ebe-4730-b0f5-fa4e326df2e2/sheet/0c8af38b-b73c-4da2-ba41-73ea34ab7ac4/state/analysis/select/Programme/H2020/select/Country%20Code/EL [↑](#footnote-ref-2)
2. European innovation scoreboard 2023, https://research-and-innovation.ec.europa.eu/statistics/performance-indicators/european-innovation-scoreboard\_en [↑](#footnote-ref-3)