

Evaluation Panel: NATURAL SCIENCES - Earth and Atmospheric Sciences and Climate Change

Panel Members

Hans Thyb (Chair)	Eurasia Institute of Earth Sciences, Istanbul Technical University, Maslak, Istanbul, Turkey
Bilal Haq	Smithsonian Institution, Washington DC, United States of America and Sorbonne University, Paris, France
Daniel Conley	Plymouth University, United Kingdom
Donald Dingwell	Ludwig-Maxmillians University of Munich, Germany
Irina Artemieva	University of Copenhagen, Denmark
Ole Hertel	Aarhus University, Denmark

R&D Units

Centro de Estudos do Ambiente e do Mar (CESAM)	Universidade de Aveiro (UA)
Centro de Geociências (CGEO)	Universidade de Coimbra (UC)
Centro de Investigação da Terra e do Espaço da Universidade de Coimbra (CITEUC)	Universidade de Coimbra (UC)
GeoBioCiências, GeoTecnologias e GeoEngenharias (GeoBioTec)	Universidade de Aveiro (UA)
Instituto de Ciências da Terra (ICT)	Universidade de Évora (UE)
Instituto de Investigação em Vulcanologia e Avaliação de Riscos (IVAR)	Universidade dos Açores (UAçores)
Instituto Dom Luiz (IDL)	Faculdade de Ciências da Universidade de Lisboa (FC/ULisboa)

Evaluation Panel: NATURAL SCIENCES - Earth and Atmospheric Sciences and Climate Change

R&D Unit: Centro de Estudos do Ambiente e do Mar (CESAM)

Coordinator: Ana Isabel Lillebø Batista

Integrated PhD Researchers: 214

Overall Quality Grade: EXCELLENT

Evaluation Criteria Ratings

- (A) Quality, merit, relevance and internationalization of the R&D activities of the Integrated Researchers in the R&D Unit Application: 5
- (B) Merit of the team of Integrated Researchers: 4
- (C) Appropriateness of objectives, strategy, plan of activities and organization: 5

Base Funding for (2020-2023): 3858 K€

Recommended Programmatic Support

PhD Fellowships: 14

Programmatic Funding: 1492 K€, including for 4 (Junior) New PhD Researchers Contracts.

Justification, Comments and Recommendations

The Center for Environmental and Marine Studies (CESAM) is a leading marine science center in Portugal whose researchers have been visibly productive as is evident from the publication list presented in the proposal. Currently, a major focus of marine and environmental sciences at CESAM is in the climate change area, especially as it affects the country, as well as its consequences for the ecological health of the coastal and marine systems, both locally and on a wider basis. CESAM scientists have developed very fruitful collaborations with the international community and are cognizant of EU 2020 strategy and its SC2 and SC5 objectives. CESAM researchers expertise is equally broad and includes modeling, biodiversity, sustainable technologies and bioinformatics, among others. It is currently organized into four major interlinked thematic groupings that seem to work well together, i.e., ecology and functional biodiversity; environmental biology and health; environmental systems; and marine ecosystems and resources.

The proposal lists several major contributions made by the Center researchers in the period 2013-2017 that is under review. These include a better understanding of water, carbon and heat fluxes and the impacts of climate change on urban coastal areas. These also include modeling of future scenarios (2016-35, 2046-65, 2081-2100) for the Portuguese mainland. A resulting Urban Atlas that includes projections for all of Portugal is considered an important tool for assessment of the impact of climate change on ecosystems and economy and for the development of adaptation plans. The Panel thought this particularly useful exercise that needs to be continued. CESAM expertise also provided useful input into the impacts of recent wildfires on degradation of soils, water and wildlife and they participate in an independent commission set up by the Parliament as well as other committees where, the Panel agreed that their expertise is of considerable importance in issues of national importance. Another area where the Center excels is in the study of wader species and their behavior. A study published in Nature reaches counter-intuitive results, which show that social synchronization among shorebirds generates diverse rhythms, which defy the assumption of entrainment to circadian rhythms. The Center has also been active in anti-pollution studies such as a treatment developed in the use of marine fungi in the removal of plastics from seawater that is relatively quick acting and effective. This may result in a patent. CESAM is also a contributor to policy issues at EU, UN and national levels and active in promoting marine science agendas and research in developing countries.

CESAM proposal lists 18 major research papers and reports in support of their proposal that present a broad documentation of productivity of their researchers. Their record also shows a broad range of international R&D activities in cooperation with the private sector in EU countries, Portuguese speaking countries and the USA. They offer advanced courses, and have hosted many national and international meetings and published several volumes containing collected research. The Center scientists are also active in outreach and public awareness activities. The Panel thought the Center to be well internationalized. The research papers listed as well as those perused through the CVs of the Center scientists are mostly published in fairly high-impact journals (though there are exceptions for those listed in the proposal). The Panel was impressed by CESAM broad interests and broad reach in marine sciences that are, nevertheless, focused on the biological aspects. That is also the reason that the Panel was not clear about the highlighting of a paper on Iberian Lupus that does not seem to be relevant to marine science focus of the Center.

CESAM funding in the past has come from several national (including FCT) and international sources that comprise competitive project funding. In this last five years this has totaled to 54 M€. The bulk (48 M€) came from research projects (39%), PhD and research positions (53%); infrastructural and equipment grants (4%); as well as consulting (4%). The FCT contribution to total has been relatively small (about 12%). The Center indicates that the FCT funding allows a better coordination of crosscutting topics, of productivity stimulation rewards, development of strategic themes with competitive incentives, and the provision of a continuous basic funding for researchers. The administrative overhead at CESAM is relatively small (about 10%) and 30% of direct funding is vested in recruiting highly qualified researchers for areas deemed as strategically important by the Center. Direct funding was also used to hire top PhD technicians/science managers. The Panel was impressed by the multiple sources that CESAM has innovatively used to finance their research objectives.

The Panel was impressed with the CESAM research teams that are considered top notch with their expertise in modeling of atmospheric and hydrographic processes, biodiversity from subcellular to ecosystem levels, sustainable technologies and analytical methods and bioinformatics. It is currently organized into four interlinked and well working thematic groupings, i.e., ecology and functional biodiversity; environmental biology and health; environmental systems; and marine ecosystems and resources. Both PhD students and young early career scientists expressed their contentment with the Center leadership and the working environment in the Center and with the privilege of living in Aveiro the city near the ocean. Access to a variety of scientific expertise, when needed, was also considered a real plus by both these groups.

Researchers at CESAM are obviously located in positions of some prestige and power (e.g., head negotiator on Portuguese law of the sea extension), however, in spite the large research staff and facilities and high productivity in general, the Panel felt that a single Nature paper and many others in not so high impact factor journals (e.g., STOTE, ENS and Metallomics) in the last four years falls short of expectations for such a world-class R&D Center. It is not clear to the Panel how much of the original science is being generated that can attract publication in more competitive, higher-impact science journals. The Panel also noted a feeling of somewhat less than a whole-hearted collaboration with other local R&D Units. The Panel would like the Center to take this message seriously to heart. This is the main reason why the Panel slightly reduced the rating for the Center for Evaluation Criterion B.

CESAM aims for the future include that it would like to be the best national center for environmental and marine sciences, and to be near the top of European research and educational stature. These future objectives include UN, EU and Portuguese priorities all of which share innovation, sustainable development and growth of knowledge amongst their goals. Among the usual boiler-plate hyperbole that one sees in many such proposals, one can actually detect a good plan for CESAM to remain near the top of European marine science policy matters. They hope to build upon their past achievements in this area, armed with concrete plans, where one hopes that the center will not forget the trees (outstanding science) in order to stand over and control the forest (the policy issues).

CESAM hopes to increase the total funding for science in the next five years to 835 M€ (a 40% increase) mostly through competitive applications to private, national and EU sources. Some investment is also envisaged in equipment and infrastructural machines. The proposal envisages adding 10 high-level research positions that will consider a balance between natural and social sciences, and between applied and fundamental research. A highly qualified technician for analytical/environmental chemistry is also planned. To bolster CESAM recent investments in lab equipment and a research vessel, the budget contemplates the employment of the first national pilot infrastructure; the completion of a greenhouse infrastructure with automatic systems for light and humidity regulation and a drone with high resolution visible and FLIR thermal cameras; a hyper-spectral imaging camera for research in support of the development of chemo-metrics applications on food-safety; a deep-sea digital camera for understanding of the processes occurring at the seabed. Funding is also requested for the acquisition of two 4-wheel drive vehicles for effective fieldwork. The Panel considered CESAM plans to invest their efforts in the envisaged CoLabs as very innovative and such academia-government-industry collaboration is to be encouraged. This could form the core of future development and expansion of CESAM.

Evaluation Panel: NATURAL SCIENCES - Earth and Atmospheric Sciences and Climate Change

R&D Unit: Centro de Geociências (CGEO)

Coordinator: Maria Helena Paiva Henriques

Integrated PhD Researchers: 39

Overall Quality Grade: GOOD

Evaluation Criteria Ratings

- (A) Quality, merit, relevance and internationalization of the R&D activities of the Integrated Researchers in the R&D Unit Application: 4
- (B) Merit of the team of Integrated Researchers: 3
- (C) Appropriateness of objectives, strategy, plan of activities and organization: 3

Base Funding for (2020-2023): 446 K€

Recommended Programmatic Support

PhD Fellowships: 7

Programmatic Funding: 430 K€, including for 1 (Junior) New PhD Researcher Contract.

Justification, Comments and Recommendations

The Geosciences Center at Coimbra is presented as a truly novel and possibly unique combination of Stratigraphy, basin analysis and Geoconservation; Geotechnology; human actions in the Quaternary. The description and focus of this assembly has the potential to be visionary in impact in the future. It may well serve as an international example for others to follow in combining resource utilization, geotechnological exploitation and sustainability and the palaeo-record of human activities along these lines over the course of our archaeologically accessible history in the quaternary. The proposal conveys this message convincingly in its goals.

The quality of achievement in each of the research areas is very high by international standards and leading in some. The merit of the work appears to be confirmed by the representative involvement of members of the center in major global initiatives. The relevance of the work is also unquestionable relating as it does to the grand question of sustainability and the securing of responsible resource utilization and geotechnical interactions with the subsurface and infrastructure. The internationalization of the center would appear to be guaranteed by the culture of publications as well as the active influence being exerted in various international (European to Global) bodies constituted to deal with various issues of sustainability and related matters.

The Geosciences Center (CGEO) has Integrated Researchers with PhD distributed into 3 research clusters (Fossil Energy & Sustainable Development, Geotechnology and Quaternary, Human Adaptations and Landscape Management). The average annual budget is 363K€ of which FCT provides 50% (27% pluriannual, 14% research project, 0% researcher staff, 10% fellowships). CGEO is a R&D Unit managed by the University of Coimbra and with partnerships with Instituto Politécnico da Guarda (IPG), Instituto Politécnico de Leiria (IPLeiria), Instituto Politécnico de Tomar (IPT), Universidade de Trás-os-Montes e Alto Douro (UTAD), Universidade dos Açores (UAçores), Instituto Terra e Memória (ITM), and Veiga Pinto - Consulting, Lda (VPCONSULTING).

CGEO has a traditional role to identify geological resources which has been expanded to include sustainability considerations. Significant contributions in the preceding period include participation in coordination of Iberian activities in IYGU, membership in UNESCO steering committees, enhance industrial sponsored research on sedimentary basins, research on engineering use of natural materials and cataloguing of cultural heritage. The Unit is particularly active in service applications of science such as providing refresher courses to industry, geotechnology studies for infrastructure projects in Cape Verde and Mozambique. Studies related to increased sustainability include work on plastics separation from waste streams using mining technology,

The publishing record at CGEO is mixed with book chapters among the main publications of the Unit. Several publications, (largely in cultural heritage and palaeontology), are in top level journals. Significant contributions are also provided in engineering geology and natural materials applications. In general the group does not appear to be highly productive in traditional academic outputs and the H-indices of the participants listed as having a nuclear CV is not impressive.

While there is some evidence of international activities such as the UNESCO activities, hosting of AAPG European Regional meeting, participation in EU projects, the relatively low citation rate of publications suggests that the members could use more international exposure (part of strategy for coming period). This is however surprising as international funding accounts for 47% of CGEO budget.

The construction of the three major areas of scientific thrust, infrastructure and collaboration clearly predate the establishment of the perceived interlinking in this proposal. The proposal refers to the previous round of funding and their existence on something like the present form in the previous phase of funding. Clear reference is made to the apparent attractiveness of the structures resulting in a near doubling of the participants (78%). These changes were explained to us during the site visit.

CGEO is in charge of two UNESCO chairs, one in Geo-Parks, Sustainable Development and Healthy Lifestyles and the second in Integrated Landscape Management.

On average, CGEO members have fairly low publication numbers and citation rates but there are alternate lines of communication in many of the fields represented in the Center. PhD supervision is relatively high among the members exceeding 20 theses for some members. In general there is a low level of project direction among the Center members even if participation rates are reasonable. Few if any awards are included in the description although some level of recognition is seen in the CVs.

CGEO has outlined a clear strategy for the coming 4 years with goals to: expand interactions with global bodies to further collaborative projects; expand regional efforts in geoheritage and participative science, seek opportunities for transversal activities among the Center including stratigraphy, risk assessment, technologies, and heritage. In order to promote sustainability, Center members have adopted a philosophy of overcoming barriers between natural and human and social sciences. The Center intends to continue to build its global footprint through association with MSc and PhD programs in Portugal, Spain, France, Italy and Cape Verde.

The application refers to the consolidation of an alignment with the sustainability goals. This presumably involves the recasting to a certain extent of the major research thrusts, or at least their nature in some details, to achieve such alignment. The requests for funding however are essentially a series of projects whose location in one of three elements of the Center is obvious and whereby the evolution of the Center towards further alignment and/or synergistic effects could have been made more apparent. The basis style of justification is based on their growth in personnel and a continuity of the research goals that they have defined. A description of the tactics to further integrate, and to deliver on the grand goals of sustainability of the planet could also have been more explicitly linked to the requests for funding.

Center governance is bit complex for a 24 member organisation. It is based around 5 levels of management, a board, plenum, internal advisory team, stakeholders Panel, and the external advisors team.

The proposal seeks a 25% growth in PhD researchers by hiring 6 new PhD researchers. It should be an attractive recruitment package because the Center is also seeking to obtain one PhD fellowship for each new researcher (24). Equipment, membership, and travel costs asked for are a lot without a total number known.

Evaluation Panel: NATURAL SCIENCES - Earth and Atmospheric Sciences and Climate Change

R&D Unit: Centro de Investigação da Terra e do Espaço da Universidade de Coimbra (CITEUC)

Coordinator: João Manuel de Morais Barros Fernandes

Integrated PhD Researchers: 32

Overall Quality Grade: GOOD

Evaluation Criteria Ratings

- (A) Quality, merit, relevance and internationalization of the R&D activities of the Integrated Researchers in the R&D Unit Application: 4
- (B) Merit of the team of Integrated Researchers: 3
- (C) Appropriateness of objectives, strategy, plan of activities and organization: 3

Base Funding for (2020-2023): 351 K€

Recommended Programmatic Support

PhD Fellowships: 7

Programmatic Funding: 401K€, including for 1 (Junior) New PhD Researcher Contract.

Justification, Comments and Recommendations

The CITEUC is a R&D Unit with 40 researchers (26 holding a PhD) and currently none on contracts. CITEUC contribute to the needs of society by their research in space weather and light pollution. The results from space weather research has strong implications on areas such as air navigation, telecommunication, electric power, as well as defense and safety, and may further affect economically businesses like oil producers and insurance companies.

The CITEUC brings together very diverse research groups in the fields earth dynamics and solar system sciences to work on space weather, Geo-hazards and risks (incl. anthropogenic) and the history, education, dissemination and popularisation of science. This is a somewhat eclectic mix of topics, predisposed no doubt by the expertise of pre-existing research groups. Linking them however is the high level of physics understanding that must be brought to bear on each of the problems. A clear description of how this group distinguishes itself from others in Portugal in space weather is not necessary but rather obvious. The same case cannot be made so easily for the geo-hazards and risks and a few words on this issue in the proposal would have been useful.

The quality of the team is at an international level. The topics are all justified in their manner in terms of relevance. The internationalization of the topics is partially given (such as the colonial observations records) and the space weather. CITEUC teach in a number of MSc and PhD courses including GeoPlaNet "International Research and Training Network in Planetary Geoscience". CITEUC has furthermore organized a summer school with the title: "How to be an Astronaut".

CITEUC is successful in disseminating research activities. As an example, they have had >10,000 visitors at the AGAUC (merge of Geophysical Institute and the Astronomical Observatory) since 2015. They have a weekly FM radio program, biweekly Planetarium sessions for schools and monthly public sessions, they have school visits to seismic station; annual Asteroid Day (75% students). CITEUC has collaborative agreements with eight national institutions. Fundamental research includes collaboration with Germany, Italy, and USA (planetary sciences); France (solar physics); Spain and USA (seismo-tectonics); Argentina and Brazil (volcanology); UNESCO and Spain (hydrogeology); Spain (paleontology).

CITEUC was one of the 10 winners of a European contest (H2020 Stars4All project) for educational citizen-science program in Portuguese and Galician schools "Education in Light pollution".

Four members of CITEUC are national delegates to international professional organizations (including IAGA and EuroGeoSurvey); one member is Field Editor of the Encyclopedia of Astrobiology.

The researchers involved appear to be performing at an international merit level of competitive research with a good publication rate (about 170 peer reviewed articles in the period 2013 to 2017), although it would strengthen the research merit with more publications in journals with high impact factor. To exemplify in relation to the impact factor of selected journals for publication, the highlight of papers in the application contains valuable peer reviewed articles, but published in journals with moderate impact factor for this research area (all below 10 and most below 3). The productivity might have been higher, had the received funding not taken a substantial dive in 2014.

The funding from FCT went from 272,000 Euro in 2013 to 112,000 Euro in 2017, and the number of contracts obtained by integrated researchers was 87 in 2013, whereas it was only 12 in 2017. The team has partly been able to compensate this loss through other funding. As an example, CITEUC has increased funding from companies, industry and other private sources from zero to 50,000 Euro over the same period of time.

The team does not appear to have talent at the absolute top level. The strongest CVs are among senior researchers that have good publication record, but none of these demonstrates exceptional impact or publication rates. The research team has been admirably active in international conferences, and thereby disseminated their research extensively to the international research community. The greatest threat to these researcher careers would appear to be the potentially subcritical size of the research groups and, as mentioned above, the uniqueness of one of the three research areas in terms of the national context.

The projection of activities for this proposal is largely described in the language of a continuance of activities along three major research themes that have defined the past decade. The novelty and/or innovativeness of the development of future research themes could have been better presented. The proposal clearly described a SWOT analysis where all of the Threats are essential externally defined issues associated with the size of the research groups involved in the proposals. CITEUC has a strong focus on natural and anthropogenic hazards and risks. They have formed SPINLab anchored in space weather mechanisms and time-series analyses, and aiming on participation in H2020 "Safe Societies" with outset in aerial navigation. There seem to be a need for strengthening the research profile of key staff members to increase chances of good success rates in such international research programs.

Evaluation Panel: NATURAL SCIENCES - Earth and Atmospheric Sciences and Climate Change

R&D Unit: GeoBioCiências, GeoTecnologias e GeoEngenharias (GeoBioTec)

Coordinator: Fernando Joaquim Fernandes Tavares Rocha

Integrated PhD Researchers: 71

Overall Quality Grade: VERY GOOD

Evaluation Criteria Ratings

- (A) Quality, merit, relevance and internationalization of the R&D activities of the Integrated Researchers in the R&D Unit Application: 4
- (B) Merit of the team of Integrated Researchers: 4
- (C) Appropriateness of objectives, strategy, plan of activities and organization: 3

Base Funding for (2020-2023): 1035 K€

Recommended Programmatic Support

PhD Fellowships: 9

Programmatic Funding: 600 K€, including for 2 (Junior) New PhD Researchers Contracts.

Justification, Comments and Recommendations

The GeoBioTec Center is an interdisciplinary institution that brings together specialists in a broad range of academic and applied geoscience disciplines. The breadth and quality of activities and the scale of infrastructure within the GeoBioTec consortium is truly remarkable. The five research groups are highly complementary with their research focus on geochronology, geochemistry, paleontology, tectonics, climate and soil research, medical geology, ecology, environmental geosciences, geotechnical sciences and geomaterials. With these the GeoBioTec Center has the capability to be an international competitor in broad areas of investigation of the physical, chemical and biological implications of resource management and sustainability.

A number of research subjects covered by the GeoBioTec Center are unique in Portugal and are of a high national importance. Among academic projects, some important ones include radiogenic isotope geology (centered around a nationally unique radiogenic isotope laboratory), geodynamics of the Portuguese, Brazil and Iran crustal provinces, marine geology, and paleontology. The major focus of the applied research is on sustainable use of mineral resources, geo-environmental problems (including urban geochemistry, environmental problems related to abandoned mines, agro-chemicals, dust pollution, and waste disposal), environmental geophysics and geochemistry, marine geobiology, medical geology, geomaterials, soil sciences, and geophysical support to cultural heritage. The societal relevance of the work with respect to the national mining sector and ecology is clearly defined and is of unquestionable national importance. Extending the research focus to agro-geosciences and soil sciences promotes the national importance of the Center and sustainability of its development.

Coming with this great breadth is the tremendous challenge of setting priorities, measuring merit, establishing transversal synergies between the components of the consortium, and extending collaboration within and outside the consortium beyond the experimental infrastructure. The internationalization of the efforts should continue to be in focus and its role should be emphasized.

The GeoBioTec Center has achieved the critical mass of integrated researchers, who have the capability to perform at an internationally competitive level of achievement. To a great extent this is already the case as documented by their level of research and publication activity in a broad range of geoscience subdisciplines. Highly variable proportions of academic and applied research by the members of the consortium lead to a broad spectrum of individual contributions to the GeoBioTec Center activities and to fund raising. The measures of merit of the consortium participants are a clear indication of specific measures to be implemented and very welcome. Professional publications and business contracts of the Center cover a broad spectrum of topics, including participation of the Center in the national and international activities in the mining sector and in several collaborative and international research projects in academic, public and private sectors. Fund raising activity from various sources is overall high, and fund raising from academic grants should be boosted. The GeoBioTec Center has a good gender balance of the team at all levels, and the change of generations should be considered in the near future.

The GeoBioTec Center sees itself focusing on multidisciplinary approach to scientific and technological aspects of the life cycle of mineral and forestry resources focused on primary raw materials for environmental and economic sustainability, with particular emphasis on industrial minerals, raw materials, soil and water resources for agroforestry, geotourism and geoheritage. The Center isotopic lab, is widening its scope that includes Rb-Sr and Sm-Nd studies, unique in the country, in addition to traditional analyses. Strategic focus of the GeoBioTec Center will continue to be on a combination of applied and fundamental research. The measures by which this will be accomplished, beyond the specific research areas, include research themes and coordination policies. Synergy between the geographical poles and the research teams within the GeoBioTec Center is not yet fully achieved, and requires further development. Plan to booster publication activity and internal collaboration within the consortium is very welcome and several types of activities are planned to involve different groups into research proposals, supervision of PhD students, and industry contracts. Planned external professional activities include continued collaboration with the most important national mining projects with plans to strengthen the cooperation with industry and involve international partners to training of PhD students.

Evaluation Panel: NATURAL SCIENCES - Earth and Atmospheric Sciences and Climate Change

R&D Unit: Instituto de Ciências da Terra (ICT)

Coordinator: António Domingos Heitor da Silva Reis

Integrated PhD Researchers: 76

Overall Quality Grade: VERY GOOD

Evaluation Criteria Ratings

- (A) Quality, merit, relevance and internationalization of the R&D activities of the Integrated Researchers in the R&D Unit Application: 4
- (B) Merit of the team of Integrated Researchers: 4
- (C) Appropriateness of objectives, strategy, plan of activities and organization: 4

Base Funding for (2020-2023): 1065 K€

Recommended Programmatic Support

PhD Fellowships: 9

Programmatic Funding: 742 K€, including for 2 (Junior) New PhD Researchers Contracts.

Justification, Comments and Recommendations

The Institute of Earth Science (ICT) has 63 Integrated Researchers with an average annual budget of 2.4M€ of which FCT provided 33% (9% pluriannual, 7% research project, 6% researcher staff, 11% fellowships). ICT is an Earth Sciences institute dedicated to multi-disciplinary approaches to studying the earth as an integrated system. The members of ICT come from three sponsoring organisations, the Universities of Évora, Minho, and Porto and are distributed in 6 research groups, (A) Atmospheric Sciences, (B) Energy, (C) Georesources and materials, (D) Geoconservation and Geoscience Education, (E) Env. Monitoring and Remediation, and (F) Lithosphere dynamics.

Major contributions in the past cycle include identifying water attenuation and turbidity as key factors in determining water temperature in lakes which is important for proper limnological modelling and may help explain unexpectedly large uptake of CO₂ by Mediterranean lakes as observed by ICT. This work fostered a European Meteorological Association (EMS) award for the author and has led to the development of associated sensors. Multi-faceted investigations have been performed to improve geo-prospecting activities for metals and hydrocarbons. Quantitative GIS based methods have been developed for assessing geodiversity and geo-heritage. Applied research within ICT includes the use of UAVs for coastal monitoring which contributed to National Coastal Management plans; collaboration within UNESCO to develop the first seismotectonic map of Africa; development of strategies to minimize mercury poisoning impact from informal mining activities in Colombia.

A longstanding ICT run atmospheric sciences observatory serves as a critical station of reference. Baseline knowledge related to solar power using thermal energy storage and creation of integrated photovoltaic systems is being developed. ICT is becoming a global reference center in the field of geoconservation with researchers invited to visit institutions in over 7 nations distributed globally. International postdocs and postgraduate students from Brazil, Italy, Romania, and Mexico have visited and worked in ICT on geoconservation.

International nature of the research is evident through activities performed in North Africa, Brazil, Colombia, and Mexico with strong evidence of extensive involvement in Brazil both in terms of research as well as training. International sources provide 26% of the institute budget.

49 PhD completions were supervised at the supporting institutions in 2013-2017 and ICT is involved in negotiation regarding the development of an EU PhD in Earth Sciences involving Portuguese and European institutions. Fresh progress on this avenue was not discussed during the site visit.

The researchers in ICT appear to be fairly productive with many senior members having publication numbers approaching or exceeding 100 but their impact is less certain with h-factors on the order of 20 or less suggesting limited international impact. The publication record at ICT seems to vary depending on the RG with RG (E) reporting 80 Scopus papers of which half are Q1 in quality while other RGs most prestigious publications are very much good journeyman quality publications of no exceptional notariety. Of the highlighted publications, 3 are books and the other 7 are in journals with impact factors ranging from 1.7 to 4.9 with a median between 2 & 3.

Many conferences and workshops are organised by FCT and some of them are international in scope (eg. LAKE2015, Euro Conf. On Permafrost). Members have also been leading sessions at other conferences (e.g., 7 years of EGU general assembly). Strong involvement in international organisations is evidenced (e.g. CCP-International Committee for Coal and Organic Petrology including management of 3 accreditation programs; Management Committee of the Cost Action OC-2016-Tools for Forensic Science; Chairmanship of Int. Ass. of Hydrogeologists; Vice-Chairmanship of IUGS Task Group on Geohazards; Evaluation Team of UNESCO for Global Geoparks; Geoheritage Specialist Group of IUCN/WCPA; Advisory Committee of the EU Geoparks Network; Presidency of the Portuguese Geological Soc.; Presidency of the Portuguese I. Solar Energy).

Young researchers have received international and national awards (including, M. Potes Young Scientist Award of the European Meteorological Society - 2015, P.S. Kulkarni- EMS Young Scientist Travel Award - 2013). While it appears there is a sizeable body of talented young researchers at FCT, they were not very visible in the site visit and there is indication that FCT is not taking proper advantage of their enthusiasm and fresh vision.

The Center has had a disappointing rate of success in FCT project proposal submission and improving this is clearly of high urgency, both for survival but also staff satisfaction.

Part of the future plans appears to continue to collect the high quality measurements which ICT so clearly does and to apply much of this to helping address regional issues. There are some notable ambitions for the coming period. These include: transforming existing association with ACTRIS to full partnership by including ACTRIS in the Portuguese roadmap; adaptation of consideration of geodiversity in the determination of ecosystem services; development of a geoethics curriculum; expand funding circle (RG (E)) to World Bank and foreign governments. However, large-scale vision and strategy for future plans and the research development was not fully clear during the site visit.

The proposal requested 33 defined PhD studentships to be distributed among the poles (16 in Évora, 8 in Minho and 9 in Porto). New hires are requested for the purpose of expertise expansion. It was not clear if universities will cover the costs of these contracts after 3 years. ICT also sought support for new technicians, the need for which was convincingly supported during the site visit. Support was also requested for participation in international partnerships, equipment maintenance, and smaller instrument purchase.

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R&D Unit: Instituto de Investigação em Vulcanologia e Avaliação de Riscos (IVAR)

Coordinator: José Manuel Rodrigues Pacheco

Integrated PhD Researchers: 20

Overall Quality Grade: EXCELLENT

Evaluation Criteria Ratings

- (A) Quality, merit, relevance and internationalization of the R&D activities of the Integrated Researchers in the R&D Unit Application: 5
- (B) Merit of the team of Integrated Researchers: 5
- (C) Appropriateness of objectives, strategy, plan of activities and organization: 5

Base Funding for (2020-2023): 311 K€

Recommended Programmatic Support

PhD Fellowships: 8

Programmatic Funding: 595 K€, including for 2 (Junior) New PhD Researchers Contracts.

Justification, Comments and Recommendations

IVAR is a reconstituted research and teaching facility whose emphasis is on the volcanology AND multiple risk analysis (marine, landslides, gas exhalations, earthquakes, etc.) of the fragile environment of a volcanic archipelago. The proposal is very convincingly written and well-researched and prepared. The author(s) are clearly very experienced.

IVAR has with success focused on participation in EU projects. Most important, they have participated in EU-FP7 "MED-SUV", "Mediterranean Supersite Volcanoes" (2013-2016) on research of perception of risks related to volcanic and seismic activity. Another international project was funded the American institution Alfred Sloan Foundation on estimation of CO₂ emissions. Furthermore, the IVAR is involved in H2020 project ARISE2 "Atmospheric Dynamics Research Infrastructure in Europe 2" (2015-2018) aiming a remotely monitoring volcanoes by use of ultrasound techniques. Finally, IVAR has since 2017 been involved with the ITERREG-MAC project VOLCRISKMAC on strengthening knowledge exchange between Madeira, Cape Verde, Canary and Azores Islands.

The quality of the application is excellent from the point of view of the detail of the description of the status quo and the explanation of the basis on which new the next strategic steps should be taken. The work proposed has a high level of merit with each type activity being undertaken finding its justification in the consequences for the population of the Azores and thereby Portuguese national considerations. The relevance of the work is unquestioned and measurable in the enhanced quality of multiparametric monitoring of the territory and fundamental research into the entire earth history archive of the archipelago with respect to volcanic events and their consequences. The relevance of the work reaches as well into the planning basis for the development of the islands.

The internationalization of the institute is extraordinary. This appears to result from an early recognition, so 20 years ago, that a Europeanisation and Internationalisation of the scientific collaborators and projects would lead to a great strengthening of the scientific basis for the future of the Azores with respect to volcanology as well as hazards and risk assessment, preparedness and mitigation science. There are numerous examples of this internationalization import and export of expertise making IVAR a role model for Portuguese science in this regard. Today, major volcanological efforts in Europe without the Azores contribution are unthinkable.

As a result, IVAR has a strong international cooperation: member of World Organization of Volcano Observatories (WVO) and of the international networks: CTBTO (Comprehensive Nuclear-Test-Ban Treaty Organization), DORIS (Doppler Orbitography and Radiopositioning Integrated by Satellite), EMSO (European Multidisciplinary Seafloor and Water Column Observatory), EPOS (European Plate Observing System), EUROVOLC (European Network of Observatories and Research Infrastructures for Volcanology), NEREUS (Network of European Regions Using Space Technologies), RAEGE (Atlantic Network of Geodynamical and Space). Furthermore, a bilateral agreement with the Chinese Academy of Science is under preparation.

Outreach is ambitiously described and includes several novelties which are clearly deeply rooted in an organic understanding of what is feasible and effective given the geography of the archipelago.

The team assembled at IVAR is carefully organized into areas of expertise and activity which taken together make for a remarkable level of coverage of the themes judged necessary to cope with the geohazards and risks implications of living on these islands. It is clear that long and careful multiyear thought has gone into this configuration. Nevertheless, there are still gaps which are addressed below.

The scientific level of activity and quality of the results of these researchers are at an internationally competitive level. This is the reason that they are continuously able to attract the world's top experts in a great many elements of the modern field of volcanology as well as hazards and risk analysis to collaborate with them routinely. In short, they have developed a strategy for alimending their core Azores-based team which has been highly successful. They have also clearly demonstrated their ability to find the synergies inherent at IVAR by for example recently generating the holistic publication of the GSL text on the Azores.

It is very important to point out that IVAR activities involve a great deal of monitoring tasks for which they are responsible. For such an institute, charged with monitoring, the creativity and ambition of their members with regard to fundamental sciences is repeatedly impressive.

The IVAR institute has a very strong research staff with good productivity in terms of papers in peer reviewed journals, conferences presentations, reports and popular papers. Many peer reviewed journal articles are published in journals with high impact factor. The institute has top researchers (Principal Gaspar, Vice Principals Fialho and Queros, Director Cruz, Director Wallenstein, Professor Fereira and Dr Pacheco) with strong research profiles and substantial experience in supervision of post docs, PhDs, and MSc's, to the dissemination of research to the international research community but also to society through popular papers. In addition, the IVAR institute has a series of young promising researchers that are ready to take over from the more experience researchers but this process of rejuvenation requires some FCT support to be realised.

From the point of view of internationally cherished research colleagues in volcanology as well as hazards and risk analysis the steadily growing excellence of their monitoring activities (and their ambitions for the future, see below) is equally impressive.

The strategy of IVAR for 2018-2022 is presented as a clear, well-justified, and carefully-prepared set of targets. In addition to state-of-.the-art advances in monitoring and fundamental geological history studies, it involves, with great wisdom, exploiting the synergistic possibilities available on the Azores in the directions of marine and atmospheric sciences. The case reads as though a careful selection of the balance between the desired and the possible has been worked out for the preparation of this report and proposal. With a range of broad to specific objectives and with the establishment of three methodological/organisational pillars to achieve them, - projection, collaboration and impact, the thinking in this proposal appears to be very mature. The resources requested are clearly defined.

Evaluation Panel: NATURAL SCIENCES - Earth and Atmospheric Sciences and Climate Change

R&D Unit: Instituto Dom Luiz (IDL)

Coordinator: Pedro Manuel Alberto Miranda

Integrated PhD Researchers: 112

Overall Quality Grade: EXCELLENT

Evaluation Criteria Ratings

- (A) Quality, merit, relevance and internationalization of the R&D activities of the Integrated Researchers in the R&D Unit Application: 5
- (B) Merit of the team of Integrated Researchers: 5
- (C) Appropriateness of objectives, strategy, plan of activities and organization: 5

Base Funding for (2020-2023): 1711 K€

Recommended Programmatic Support

PhD Fellowships: 12

Programmatic Funding: 1240 K€, including for 4 (Junior) New PhD Researchers Contracts.

Justification, Comments and Recommendations

The Instituto Dom Luiz (IDL) has 113 Integrated Researchers distributed into 10 research groups. The average annual budget is 4.2M€ of which FCT provides 74% (11% pluriannual, 14% research project, 15% researcher staff, 33% fellowships). IDL is a central research institution in Portugal, and consists of five interconnection research groups (RGx): RG1 Climate Change; RG2 Earth Surface Processes; RG3 Solid Earth Dynamics; RG4 Continental Margins and Deep Ocean Frontier; RG5 Energy Transition.

There is a wide range of areas in which IDL has made significant contributions in the past five years. IDL scientists identified the outsized role of atmospheric rivers and coastal jets in the weather of subtropics to mid latitudes; IDL researchers contributed facilitating the location of the LSA-SAF facility at IPMA in Lisbon. This contributed to the development by IDL of a support system for forest fire management used in Portugal, Africa, and Brazil. Pioneering work has been performed on identifying the sedimentological properties of Tsunami sediments and using those to characterise historic marine flooding events. Novel developments in high resolution imaging of diffuse plate boundaries have been performed and IDL research has been used to provide scientific evidence supporting Portugal efforts to extend ocean floor jurisdiction. They also improved identification of paleo global warming and ocean acidification events. Strong research in Energy Transition focuses on energy efficiency along with air quality in the built environment, biofuel production from waste streams, and material conservation in solar cell production.

IDL has a very strong history of international collaboration. There is active hosting of multiple international meetings in its full range of disciplines. Strong EU participation is evident with 13% of the budget (majority EU) coming through international funds. International engagement involves membership and coordination in structures such as EPOS, EMSO, Windscanner, ECMWF, and CORDEX. IDL provides an exemplary case of embracing the open access culture with the development of or contribution to multiple open source systems which are in use around the world.

IDL leads the Doctoral Program on Earth System Science (EARTHSYSTEMS), and partners in the nationwide FCT Doctoral Program on Sustainable Energy Systems (MIT-Portugal). IDL has a major role in the training of young earth science researchers in Portugal with approximately 60 completions in the past 4 years. There is a wide range of popular science outreach activities occurring at IDL with Lousal being an impressive example. Located at a deactivated mining centre, this Ciencia Viva outreach centre receives thousands of visitors per year.

The IDL proposal lists a series of excellent publications in peer-reviewed journals. Many of these are in journals with impressive impact factor above eight (impact factor up to 12.5).

Many IDL staff members have very strong research CVs, such as senior researchers like Professor Miranda with a substantial publication record, participation in many research projects and supervision of a large number of PhD and post doc students. Other strong researchers include Ana Azeredo and Antónia Mateus. There is also an extremely strong collection of younger researchers such as Alexandra Ramos, J. Casal Duarte, and M.A. de Carvalho who typically have strong publication records in high impact journals, strong post graduate supervisory experience and important

contributions on international structures. The Panel could not help but notice how much confidence the institution had in its young researchers and the youthful nature of its management structure was reflected in the dynamicism apparent at IDL.

Multiple members of the the IDL research community have received awards recognising their stature in the international science community. These include one EGU award for Outstanding Early Career Scientist, 3 UL/Caixa Geral Scientific prizes and 2 Intl. Meteorological Prize of the Catalan Meteorological Association.

IDL researchers are active supporters of the EU earth science community, propose and chair sessions at international meetings such as EGU, contribute to teaching in various summer schools and have significant roles in a large number of COST actions. IDL researchers hold many leadership positions on intl. Organisations such as EGU, EPOS, Orfeus, and EMSC.

Future vision includes, designing next generation environmental prediction systems which cover the atmosphere-ocean-earth interactions. In addition to continued study of climate change, these systems will be applied for understanding and prediction of drought, heat-wave, and wildfire risks as well as coastal hazard management. A bold initiative includes the expansion into solid earth plate dynamics modelling which incorporates the heterogeneous nature of the mantle.

The institution seeks to reinforce the already notable level of international experience in its staff by encouraging international mobility within its network as part of career development. IDL plans to access innovative funding sources in the international arena.

The submitted proposal seeks a step change in current computational and observational facilities which is of clear importance considering activities in numerical modelling and earth observation. The submitted proposal identifies clear priorities in expanding computational facilities, upgrading ocean bottom seismometers, and strategic purchases. IDL requested a similar number of PhD fellowships to those it obtained in the past and seeks support to bridge as well as initiate a range of integrated PhD positions within the structure.