



New Earth Observation Frontiers (NEOFrontiers)
Research, Development & Innovation for New Products & Services
Framework Document

February 2021

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1. INTRODUCTION

New Earth Observation Frontiers (NEOFrontiers) is an innovation funding mechanism established by South African Space Agency (SANSA) in collaboration with the National Research Foundation (NRF). It seeks to stimulate collaboration, cooperation, and innovation in the South African Earth Observation community, both public and private. The NEOFrontiers funding opportunity is envisaged as a collaborative yet competitive funding mechanism for developing capabilities around new sensors, products and services, and value-added components.

NEOFrontiers seeks to achieve its objectives by publishing a call for proposals related to:

- **Support Actions:** short term 1-2 year actions that typically seek to either inform further R&D investment through review/desktop study type actions or seek to develop specific short term capabilities that enable transition of research outputs into downstream operational services.
- **Domain Development Actions:** longer term 2-3 year research and development projects that typically seek to establish new national EO capabilities across the value chain, aiming at long term exploitation and bringing SA closer to the leading edge internationally. Both directed (closely constrained thematically) and Open calls are envisaged.

2. STRATEGIC CONTEXT

Through a statutory mandate embedded in the SANSA Act, 36 of 2008, the South African National Space Agency (SANSA) coordinates and integrates space science and technology programmes, conducts long-term research and implementation of space-related innovations in South Africa. The agency ensures the supply of cost-effective space-based Earth Observation (EO) data and products to support South Africa's policy, decision-making, economic growth and sustainable development. NEOFrontiers which is an initiative of SANSA is an instrument that enables capacity building and development of innovative products and services through research and collaboration within the EO community. SANSA and national strategies and policy briefs can be found here: <https://www.sansa.org.za/annual-reports-documents/>.

The NRF's object is to contribute to the National Development by:

- a) Supporting, promoting and advancing research and human capacity development, through funding and the provision of the necessary research infrastructure, in order to facilitate the creation of knowledge, innovation and development in all fields of science and technology, including humanities, social sciences and indigenous knowledge;
- (b) Developing, supporting and maintaining national research facilities;
- (c) Supporting and promoting public awareness of, and engagement with science; and
- (d) Promoting the development and maintenance of the national science system and support of Government priorities.

The NRF recently launched its vision 2030 as well as strategy 2025.

NRF Vision 2030

The overall objectives for vision 2030 are to shape, influence and impact the national research system; to establish the NRF as a thought leader and source of knowledge within the science sector; to create a clear

causal relationship between research and national development; to have a transformative effect on the national research enterprise and the relationship between science and society; and to enable, initiate, facilitate and perform excellent research with direct and indirect impact, whether immediate or long-term, that extends the frontiers of knowledge and addresses national challenges.

Strategy 2025

NRF Strategy 2025 is an implementation framework for the ten-year vision. This strategy is centered on the NRF's desire to contribute to national development through research with impact. The strategic outcomes include:

- i. A transformed (internationally competitive and sustainable) research workforce.
- ii. Enhanced impact of the research enterprise.
- iii. Enhanced impact of science engagement.
- iv. A transformed organisation that lives its culture and values.

2.1 Environmental scan

In recent years there has been a growing support and uptake of the EO research by the South African government. The Department of Science and Innovation (DSI) has been instrumental in ensuring that EO research goes forward through its participation in initiatives such as Group on Earth Observation (GEO), which led to the establishment of the South African Group on Earth Observation (SAGEO). Government has made the funding for the NEOFrontiers programme available to support research and innovation in EO - this will be complemented with additional funding from the Space Infrastructure Hub project. There are global initiatives such as Committee on Earth Observation Satellites (CEOS), Global Monitoring for Environment and Security (GMES) & Africa (GMES & Africa) and United Nations on Global Geospatial Information Management (UN-GGIM) that foster research through collaborations within countries and regions.

Earth observation research is multidisciplinary, focusing on various thematic areas such as food security and agriculture, water resource management, integrated spatial planning (including infrastructure monitoring) and land reform, and oceans and coastal zone management. The research is aligned with government priorities, existing multilateral agreements, and existing initiatives developing earth observation expertise nationally and regionally.

The major role players in EO research include academia, science councils, public and private sectors. The academia and science councils' roles include the development of innovative solutions and knowledge generation. Earth observation is by nature highly collaborative, with international space agencies and other national and international partners around specific project-based collaborations as appropriate.

2.2 Objectives

The objectives of NEOFrontiers are to:

- i. Advance the implementation of South African Earth Observation Strategy for addressing South Africa's socio-economic and environmental priorities;
- ii. Generate knowledge through research and collaborations within the EO sector;
- iii. Develop a transformed, sustainable national science and industrial skills base ;
- iv. Stimulate coordination, collaboration, cooperation and competitiveness in the South African Earth observation sector;

- v. Stimulate the development of innovative Earth observation upstream capabilities and information services in industry;
- vi. Develop national capability to further service an African and global market; and
- vii. Effect tangible contributions to AfriGEO, GEO and CEOS and other international partnerships.

NEOFrontiers seeks to establish two mechanisms to achieve its objectives, as described above.

2.3 Specific Call Details: NEOFrontiers - February 2021

The section below provides more detail as to the nature of the work thematic areas to be supported in this specific call.

NB: The Support Action SA/2020/1 and Domain Action DDA/ 2020/1 will be awarded funding from April 2021.

The Support Action SA/2021/1 and 2021/2 and the Domain Development Action 2021/1 will be awarded funding from January 2022.

- **Support Action SA/2020/1:**

- **Focus:** Innovative Earth Observation Approaches to Sustainable Urban and Rural Development;
- **Addressing:** SDG 11 Sustainable Cities and Communities: Make cities and human settlements inclusive, safe, resilient and sustainable
- **Primary Activities and Outputs:** South Africa is rapidly urbanizing with more than 63% of its population living in urban areas and this number will rise to 70% by 2030. This will put a lot of pressure on the natural environment, services and infrastructure, calling for adequate and effective urban planning. The growth of cities also results in degradation of natural habitats, changes in species composition, cities micro-climate, energy flows and subsequently creating urban heat islands. The realization of the Human Settlements Vision 2030, on the road to 2050 requires effective and sustainable urban planning and development management, supported by adequate and up-to-date geospatial information base.
- Earth observation technologies provide opportunity to map, monitor and inform human settlement-related dynamics, providing valuable geo-spatial information on the interaction between human activities, the built environment, natural habitats and climate. Proposals are requested to develop innovative earth observation-based approaches to improve decision-making for sustainable urban and rural development in South Africa. Proposals should seek to maximise the value of available earth observation data through new analytics, data fusion, quantitative knowledge addition or other innovative approaches. Proposals must use a multi-product approach, utilising data from at least two satellite-derived product types. There must be a strong focus on high level metrics or indicators - whilst proposers have significant flexibility in choice of these metrics, there must be strong justification, demonstrated innovation and high potential impact value

Indicators should address sub themes including, but not limited to:

- Human settlements growth patterns
- Services and infrastructure
- Informal settlements
- Low cost housing
- Rural development

- Servitude monitoring
- Urban land use
- Small businesses and stimulating commerce
- Urban metabolism
- Urban development indicators/SDG indicators

Proposals should focus on:

- I. Identification and development of key high-level indicators i.e. highly synthesized metrics based on multi-year data. Choice of indicators must be supported with strong justification, demonstrated innovation and high potential impact value.
- II. Identification of key user and stakeholder archetypes, clear elucidation of the typical use cases, proposed co-design and take-up mechanisms, and clear projected socioeconomic impact.
- III. The development of new analytics and/or artificial intelligence to deliver such indicators from the automated processing of available satellite-derived and other relevant data. Proposals must use a multi-product approach, utilising data from at least two satellite-derived product types.
- IV. Demonstrating effective application through several case study type examples, in addition to providing a clear implementation plan or prototype system to scale the capability for national coverage.
- V. The development of a prototype operational capability as output, showing clear evidence of user co-design in the development

Proposals should also demonstrate an ability to interact with municipal government through mechanisms such as the District Delivery Model.

- **Keywords:** urban and rural development, human dynamics, human settlements, built environment
- **Budget Considerations:** Anticipated maximum requested budget of R3 million over 2 years. A budget for one MSc student may be included in the proposal. Allocation of funding to the MSc student should be in line with the NRF Postgraduate students funding policy presented in section 4.2 below, the bursary amount is estimated at ~R200,000 per annum.

- **Domain Development Action DDA/2020/1:**

- **Focus:** Development of new High Resolution Water Quality Observation Capabilities for Coastal and Estuarine Systems
- **Primary Activities:** Coastal ecosystem services are of national importance as they impact on food security and agriculture, human livelihoods, and trade and industry. Water quality is critical to these coastal ecosystem services, impacting upon the ability to sustainably exploit and conserve ecosystem functionality. Marine biodiversity, fisheries, tourism, infrastructure and the built environment within coastal areas have all been identified as sectors requiring specific interventions to ensure that the oceans and coastal environment continues to deliver goods and services to society. Such services include extractive resource use, abstraction and discharge, fisheries, aquaculture, and tourism. Water quality can be compromised by any combination of anthropogenic activities such as domestic and industrial wastewater, solid waste, contaminated storm water run-off, climate change – and natural phenomena such as harmful algal blooms.

In the last few years, the availability of free data from relatively high-resolution sensors (<1km), such as Sentinel 2 and Sentinel 3, provided the potential to provide high-frequency water quality information on a routine basis at appropriate scales. Whilst this operational potential has been realized to some degree for South African freshwater systems, through programmes such as the Earth Observation for National Eutrophication Monitoring (EONEMP), there is currently no routine high-resolution capability for South African coastal and estuarine waters. Proposals are requested to further develop such a coastal water quality capability, as an integrated component of the Oceans and Coastal Information Management (OCIMS) project.

Proposals are requested to undertake the development of new high resolution (<1km) near coastal and estuarine/embayment water quality products, based primarily on the Sentinel 2 and Sentinel 3 Full Resolution (FR) sensors. These products are expected to be integrated into the existing Oceans and Coastal Information Management System (OCIMS) Water Quality Decision Support Tool, with appropriate development of the relevant OCIMS front end. Proposals should also recognize analogue systems under development for inland water quality monitoring and seek to establish some first order synergy between the initiatives for estuarine applications. Proposals are expected to address the following issues:

- i. Identification or development of ecosystem and water-type appropriate products from Sentinel 2 and Sentinel 3 FR, most important of which are chlorophyll-a and suspended particulate matter. Such products should show some form of new or historical geophysical validation for the core products and sensors.
- ii. Development of redundant processing chains for these products, ideally using both cloud- and locally-based processing. The Digital Earth Africa platform should be utilized if appropriate, or some other cloud-based system such as the Sentinel Hub, in addition to existing OCIMS processing systems.
- iii. Development of new front-end systems for the dissemination of these products through the OCIMS Water Quality DeST, ideally using a full pan- and zoom-based system allowing multi-sensor and -resolution products.
- iv. The demonstrated use of the products and systems for high impact case studies e.g. industrial abstraction and discharge around pipelines, estuarine conservation, fisheries and aquaculture and any high conflict multi-use coastal ecosystems. Of particular importance is the ability of the system to provide a "plumes and fans" capability - enabling the coastal research community to assess inter-annual riverine discharge for South African major river systems, and any water quality impacts from coastal mining.

- **Keywords:** coastal and estuarine water quality, Sentinel 2, Sentinel 3, OCIMS
- **Budget Considerations:** Anticipated maximum requested budget of R6 million over 2 years. A budget for one MSc student should be included in the proposal. Allocation of funding to the MSc student should be in-line with the NRF Postgraduate students funding policy presented in section 4.2 below, the bursary amount is estimated at ~R200,000 per annum. Proposals that include supplementary non-NRF co-funding sources will be viewed favourably.

- **Support Action SA/2021/1:**

- **Focus:** Artificial Intelligence and Earth Observation: Roadmap to Establish Cross-Sector Value and Approaches;
- **Primary Activities and Outputs:** Artificial intelligence (AI) offers significant potential to increase the value of Earth observation, in particular the ability to more fully exploit large amounts of data from new generations of satellites. These include new means of calculating geophysical

parameters from satellites, and new means of handling data diversity, volume and complexity. This action will focus on fostering the relevant AI skills, knowledge and resources, enabling the South African and regional communities to more effectively use AI across the research, public and private sectors. The action should be followed by further calls in coming years to build upon the roadmap developed here. This call should enable the building of a community to allow a greatly improved capability to exploit AI, through the following roadmap activities:

- The identification of key national innovation areas and capabilities for AI and Earth Observation, and recommendations for future research focus areas. Criteria to identify these areas should include potential economic impact, the ability to substantially increase value of existing EO data streams and data sets, predictive capability, and the ability to add market-related value to new national upstream missions.
 - The identification of prioritized exploratory EO activities e.g. class-based technical problems such as algorithmic and inversion approaches, classification, detection, earth systems feedback loops and causality, data fusion, predictive capabilities, autonomous systems etc
 - Scoping and planning capacity building activities, including a skills and capabilities needs analysis; identifying software and training resources and needs; identifying and enabling open data sets for application; challenges and hackathons
 - Scoping, planning and preliminary community building actions, including: community workshops bringing together the EO and AI research communities; establishing regular high value forum type events; establishing international communities of collaboration; fostering dialogue and investment opportunities with the private sector; providing recommendations around startup, accelerator, incubator type activities.
 - The identification of demonstration activities, e.g. value chain examples used to demonstrate potential value. These could include agricultural applications such as smart farming; human dynamics such as settlements and urban dynamics; and marine applications such as predictive ecosystem state capabilities for fishing support.
- Key outputs should include a project website; a report with a series of recommendations as above; a position paper-type publication in peer-reviewed media; synthesis of a series of community engagements.
 - **Keywords:** Artificial Intelligence, Machine Learning, Deep learning, Data fusion, Data mining
 - **Budget Considerations:** Anticipated maximum requested budget of R1 million over 1 year. Proposed budget should have a minimum of 20% allocated to running costs and clearly elucidate budget allocations for staff, consultations and stakeholder engagements.

● **Support Action SA/2021/2:**

- **Focus:** Earth Observation and Disruptive Economics: Developing Smart Tools for Value Enhancement for Small Scale Food Production

- **Primary Activities and Outputs :**

Monitoring agricultural activity relies on the availability of accurate and consistent information from diverse sources including EO services. The EO products enable early detection of risks and frequent and consistent monitoring of the condition and health of agricultural production systems, such as field crops and other vegetation resources (e.g. grazing and browse material for livestock production). Providing small-scale farmers with mobile smart solutions through EO derived predictive information, presented in appropriate forms, would result in enhanced and

more consistent production, reduced exposure to risk, and an enhanced ability to enter larger-scale supply chains and exploit financial support.

The call focuses on eliciting, collection, optimisation and evaluation of the user requirements for the development of an EO-based mobile application. These user requirements should be quantitatively synthesised using the Reference Model for Open Distributed Processing (RM-ODP) or a similar justified analogue model. This call will focus only on the user interaction layer i.e. the enterprise (What for? Why? Who? When?) and the information (What is it about? How is it interpreted?) viewpoints. These requirements should include user archetypes, typical functional requirements, typical interfaces and other relevant information. These requirements should therefore address both content (what) and presentation (how), and include case study narratives around a variety of decision-making scenarios. These requirements will then be used in a further call for app development.

There has already been considerable development of appropriate open agricultural EO products, e.g. from GEOGLAM, Cropwatch, ARC-Umlindi, Agriculture Marketing Information System (AMIS), AgriCultural Systems with the support of Remote Sensing (AfriCultuRes) and others. User co-designed systems are required to fully optimise, deliver and realise impact at the farm level using these science products as a starting point. The focus of this call is on deriving, testing and optimising the quantitative user requirements necessary to further develop operational app-based systems, primarily targeted at small scale farmers. These requirements should address both content, context and presentation around visually optimized open EO and predictive products; market, supply chain and financial information; and other information as deemed relevant. The requirements should include, but not limited to, user needs and various capability aspects of the mobile application. A key mechanism in the proposed response should be the creation and use of a social media-based preliminary operational system for pilot user communities. These pilot communities should be explicitly chosen to reflect several crop and agricultural use types, and at least one user engagement workshop per annum and per community is required. Please note: the call does not envisage the development of an app at this stage, but seeks to gather the requirements needed for full-scale app development. The meaning/role of disruptive economics in the transformation of small-scale farmers to becoming more productive should also be considered. Key outputs should include:

- Defined small scale farmer user requirements for deriving value from open EO and other product types, relating to productivity, risk management, and potential market value. Requirements for predictive products, even if hypothetical, should also be defined. These requirements should be structured within the RM-ODP model (as above), address both content (what) and presentation (how), and include case study narratives around a variety of decision-making scenarios.
 - A preliminary operational decision support system, specifically to test and optimise product content and context, based on broadly available social media platforms. This system should be deployed for at least six months with several pilot user communities, with resultant synthesis, optimization and recommendations.
 - User engagement workshop syntheses delivered online and providing a short, visual, easily understood summary of engagements with small-scale stakeholders.
- **Keywords:** Earth Observation; Agriculture; Small-scale Farmers; Smart Farming; App development
 - **Budget Considerations:** An amount of R2 million is budgeted by NEOFrontiers for SA/2021/2 over 2 years. Proposed budget should have a minimum of 15% of the grant allocated to running costs. Unlike the majority of the NRF-managed instruments, this funding instrument will provide

funding for staff, consultancies and stakeholder engagement, as appropriate. Therefore, **clear motivation for cost of staff, consultations and stakeholder engagements is required**. A budget for one MSc student may be included in the proposal. Allocation of funding to the MSc student should be in-line with the NRF Postgraduate student funding policy presented in section 4.2 below. The bursary amount is estimated at ~R200,000 per annum. Proposals that include supplementary non-NRF co-funding sources will be viewed favourably.

- **Domain Development Action DDA/2021/1:**

- **Focus:** Development of New Hyperspectral Capabilities across Terrestrial, Aquatic and Atmospheric Domains
- **Primary Activities:** SANSa seeks to establish improved national capabilities to exploit future space-based hyperspectral sensors and missions. The initial focus will be on terrestrial vegetation (including agriculture), coastal and inland water quality, and atmospheric applications, with a strong emphasis on optical and radiative transfer modelling. There is potential for collaboration with the NASA Surface Biology and Geology and NASA Bioscape projects, including participation in 2022 NASA multi-sensor overflights in South Africa. Proposals should seek to broadly address the following: better quantitative understanding of hyperspectral signal variability; comparative analyses of hyper- over multi-spectral in extracting value; assessing optimal hyperspectral sensor configurations; addressing critical challenges in atmospheric correction and inversion; developing technology demonstrators for enhancing the scientific readiness levels (SRL) of future hyperspectral missions. Proposals should focus on the following key areas:
 - i. The construction of published and publicly available domain-specific very large synthetic data sets, for the purposes of signal and sensor needs analyses, and development/training of atmospheric correction and geophysical algorithms;
 - ii. The use and development of available or emergent ground-/water-based observation systems to provide hyperspectral and geophysical **validation** data across the three domains;
 - iii. Comparative analyses of hyper-vs multi-spectral signal value, including the assessment of spectrally dense methods only available through hyperspectral data, e.g. derivative analyses requiring spectrally contiguous data at < 10nm spectral resolution. Analyses of signal value across range of key target and sensor characteristics such as spectral resolution and Signal to Noise Ratio (SNR). Addressing the critical issues of atmospheric correction and hyperspectral inversion, ideally through comparative techniques that include the use of machine learning/artificial intelligence.
 - iv. Supporting the NASA Bioscape 2022/2023 planned Western Cape overflight programmes through dedicated field campaigns and scientific exploitation of results

Note that any proposed validation systems should be based largely around the existing infrastructure.

Key outputs should include:

-publications and reports.

-at least two technology demonstrators: publicly available, published and documented large synthetic data sets; and candidate atmospheric correction and appropriate geophysical algorithms for top-of-atmosphere application across the three domains.

-Science engagement outputs, such as workshop/event/conference

- **Keywords:** Hyperspectral signal analysis, radiative transfer modelling, synthetic data sets, validation
- **Budget Considerations:** Anticipated maximum requested budget of R9 million over 3 years. Maximum of 35% of the grant may be allocated to salaries/research assistant/consultant. Proposals should include a budget for two PhD students. Proposals that include supplementary non-NRF co-funding sources will be viewed favourably.

2.4 Management of the funding instrument

A steering committee consisting of SANSA and NRF management will provide oversight to the NEOFrontiers funding instrument. As stipulated in the Memorandum of Agreement (MoA) between SANSA and the NRF, SANSA will provide strategic direction and avail funding for NEOFrontiers projects. The NRF will manage NEOFrontiers in accordance with existing policies and processes of the NRF and in-line with its organisational structural and matrix system.

The NRF will manage the NEOFrontiers funding instrument through its various directorates. The strategic direction and outcomes of the funding instrument are managed by the Knowledge Advancement and Support (KAS) Directorate. The Reviews and Evaluation (RE) Directorate is responsible for the review processes up to the recommendations of grant awards. The Grants Management and Systems Administration (GMSA) Directorate's responsibilities include posting of the research call, communicating funding decisions, disbursement of grant funds, and ensuring adherence to the conditions of the grant.

2.5 Financing support

NEOFrontiers is funded through SANSA, and funding will be distributed as follows:

- For the SA/2020/1 and DDA/2020/1 the total funding will be limited to R9 million. It is envisaged that one Support Action project with a maximum amount of R1.5 million per annum over two years and a Domain Development Action project with a maximum of R3 million per annum over two years will be funded.
- For the SA 2021/1 and SA 2021/2 and DDA/2021 the total funding will be limited to R12 million. It is envisaged that two Support Action projects with a maximum amount of R2 million per annum and a Domain Development Action project with a maximum of R3 million per annum over three years will be funded from 2021/22.

2.6 Key stakeholders

The intended beneficiaries for this call are Tertiary Education Institutions, Science Councils, South African Private Sector companies and small medium and micro enterprises (SMMEs), and Non-Profit Organisations working in the relevant domain areas, and these must have legal presence in South Africa. Intended non-funded participating beneficiaries also include Government Departments and their Agencies. It should be noted that only public research institution can submit applications to the NRF.

Partnership between these entities is encouraged through collaborative consortia. The partnerships are expected to proceed in a manner that is culturally sensitive, relevant, respectful, responsive, equitable and reciprocal, with regard to the understandings and benefits shared between the research partners. It must be noted that subcontractors that provide service at a cost to the project are not viewed as partners as they are expected to benefit financially from the project.

Criteria defining the partners:

- Must be making a clearly defined contribution or end beneficiary of the project.

- Firms/companies or Non-profit Organisations, do not have to register on the NRF grant recipient database in order to participate.
- Must be South African or at least having a legal presence in South Africa.

3 MODUS OPERANDI

3.1 Call for proposals

Proposals will be submitted by researchers and experts based and or affiliated with public research institutions that are registered in the NRF grant recipient database. All proposals are expected to include, as consortia members, some combination of at least three of the following: government departments (non-funded), Tertiary Education Institutions, Science Councils, and Private Sector companies and SMMEs or Non-profit Organisations working in the relevant domains. Proposals that include representation from the private sector will be viewed advantageously.

All application materials must be submitted electronically via the NRF Online Submission System at <https://nrfs submission.nrf.ac.za>

All applications **must** be endorsed by the research office/designated authority of the applicant’s institution before submission to the NRF. It is the responsibility of each applicant to familiarise him/herself with the **internal closing dates**, set by his/her institution in order to meet the NRF closing date included in the “General Application Guide 2022”.

3.2 Eligibility

- Applicant or the Principal Investigator (PI) must have a minimum of 5 years’ experience in research with a record of research outputs and, where relevant, supervision of students;
- Full-time or contracted employees at a South African public research institution (Science Councils, University or Museums);
- Contractual employees must demonstrate that their appointment at the South African institution is for (at least) the duration of the project applied for; and
- Other stakeholders/entities/organisations indicated in section 2.6 above may be Co-investigators and are not allowed to submit the application by themselves.

3.3 Proposal requirements

This guide is aligned to the application template on the NRF Online Submission System, and reflects in the scorecard presented in **Annexure 1**. The proposal must clearly present:

- all of the requirements of the specific call that is being responded to, in addition to the objectives of NEOFrontiers programme presented above;
- proposed rationale, approaches and methodology;
- work plans must demonstrate scientific, logistical, technical and financial feasibility;
- the impact of the research on knowledge production and relation of its outcomes on delivering government policies and strategies must be clearly articulated;
- how the research outcomes will address transformation including equity.
- the roles, deliverables and budget allocation for each consortia partner and work package.
- a commitment to transformation through the make-up of their team members.
- user and stakeholder consultation and co-design process where appropriate.
- a draft consortium agreement as guided in the partnership section.

3.4 Application assessment

The assessment of applications will be guided by a Panel Assessment Scorecard (see Annexure 1), and Proposal Grading (see Annexure 2). Proposals submitted by applicants for grant funding through NEOFrontiers funding instrument will be reviewed via a one-phase process. No postal reviews will be conducted for this call.

- **Panel-peer review**

The adjudication panel will be broadly constituted to include senior specialists in the relevant fields, selected based both on their respective knowledge fields, their research standing, and/or their experience in relevant earth observation value-chain analysis and capability development. The panel meeting will be held at a central location or by way of tele- or video-conferencing. Panel members will deliberate on submitted written reviews and will be expected to offer their own expert opinions.

NB: Applicants must ensure that their Curriculum Vitae are updated on the NRF Online Submission System at <https://nrfs submission.nrf.ac.za>.

These Curriculum Vitae are used in the assessment processes, and incomplete or outdated inputs will jeopardise the application.

3.5 Rules of participation

ONE application per Lead institution may be submitted to this call. However, the Lead institution may participate either as a co-investigator or collaborator in more than one project. Students, technical and support staff are NOT eligible to apply as leads.

a) Principal Investigator

The principal investigator (i.e. the main applicant) must be an active researcher who takes intellectual responsibility for the project, its conception, any strategic decisions required in its pursuit, and the communication of results. The PI must have the capacity to make a serious commitment to the project and cannot assume the role of a supplier of resources for work that will largely be placed in the hands of others. The PI will take responsibility for the management and administration of resources allocated to the grant award, and for the meeting of reporting requirements. In order to align with government regulations, funding preference will be made to South African citizens and permanent residents.

The research team may also include:

b) Co-investigators

A co-investigator is an active researcher or specialist who provides significant commitment, intellectual input and relevant expertise into the design and implementation of the research application. The co-investigator will be involved in all or at least some well-defined research activities within the scope of the application. Only South Africa-based co-investigators will be eligible for funding in successful grant applications. Private Sector Companies and Non-profit Organisations can also be considered as co-investigators.

It is important to note that students, technical and support staff DO NOT qualify as co-investigators

c) Collaborators

These individuals or groups make a relatively small, but meaningful contribution to the research endeavours outlined in the application, but do not participate in the research design. They are not considered a part of the core research team, and are not eligible to directly receive NEOFrontiers funds,

but may have appropriate costs covered by the lead and funding recipient. Government departments, who are not eligible to directly receive funding, will be identified as collaborators.

3.6 Consortium Agreements

The Lead institution is responsible for initiating the consortia agreement. A draft of the consortium agreement must form part of the documents submitted with the proposal and should be congruent with the roles, responsibilities and budget indicated in the proposal. The agreement has to be drafted in a spirit of equity, and must have details regarding rights (such as copyright, publications, intellectual property etc. of products or other developments in the project), knowledge utilisation, as well as affairs such as payments, progress and final reports, and confidentiality. The agreement furthermore details conditions and arrangements of governance of the consortium (to the extent that it gives sufficient guarantee for effective collaboration), finances, and if applicable, basic knowledge to be contributed, liability, disputes, and information sharing within the consortium. The lead and funding recipient will be expected to submit a finalised consortia agreement within 3 months after the award has been allocated.

3.7 Data management and use

A data management Plan (DMP) is a formal document that is required to be included as part of the application and that describes the data you expect to acquire or generate during the course of a research project, how you will manage, describe, analyse, and store those data, and what mechanisms (including digital data storage) you will use at the end of your project to share and preserve your data. Research data sharing that underlies the findings reported in a journal article/conference paper/thesis as set out in the NRF Open Access Statement.

The findings reported in a journal article or conference paper should be deposited in accordance with the NRF Open Access Statement. It is acknowledged that some data generated are more sensitive than others. Before initiating the research, it is the grantholder's responsibility to consider the following: confidentiality, ethics, security and copyright. Possible data sharing challenges should be considered in the DMP with solutions to optimise data sharing.

Researchers should note that publicly-funded research data should be in the public domain, with free and open access, by default. Collaborators and co-investigators in the research project should be informed by the applicant that due to public funding and funder mandate, one is expected to share research data as openly as possible. The Data Management Plan should indicate which data will be shared. If (some) research data is to be restricted, an appropriate statement in the DMP and subsequent publication should explain why access to data is restricted. The National Research Foundation has adopted and is given permission to use the DCC Checklist for Data Management Plan, and this can be used as a guide for developing the DMP. (http://www.dcc.ac.uk/sites/default/files/documents/resource/DMP/DMP_Checklist_2013.pdf)

3.8 Science Engagement

SANSA supports science engagement through its coordination and implementation of the Department of Science and Innovation's Engagement strategy. The strategy embraces a broad understanding of science, encompassing systematic knowledge spanning natural and physical sciences, engineering sciences, medical sciences, agricultural sciences, mathematics, social sciences and humanities, technology, all aspects of the innovation chain and indigenous knowledge. Within this context, science engagement refers to activities, events, or interactions characterised by mutual learning and dialogue among people of varied backgrounds, scientific expertise and life experiences, who articulate and discuss their perspectives, ideas, knowledge and values. Science engagement is an overarching term for all aspects of public engagement with science, science awareness, science education, science communication and science

outreach, which aim to develop and benefit individuals and society. Researchers funded through the NEOFrontiers programme are required to contribute to science engagement and report the related outputs in their project's Progress Report. It is therefore critical for the applicant to include information in their proposal on how they will address the area of science engagement.

3.9 Ethical Clearance

It is the responsibility of the grantholder, in conjunction with the institution, to ensure that all research activities carried out in or outside South Africa comply with the laws and regulations of South Africa and/or the foreign country in which the research activities are conducted. These include all human and animal subjects, copyright and intellectual property protection, and other regulations or laws, as appropriate. A research ethics committee must review and approve the ethical and academic rigor of all research prior to the commencement of the research and acceptance of the grant.

The awarded amount will not be released for payment if a copy of the required ethical clearance certificate, as indicated in the application, is not attached to the Conditions of Grant.

Please also refer to the "Statement on Ethical Research and Scholarly Publishing Practices" on the NRF website at <https://www.nrf.ac.za/media-room/news/statement-ethical-research-and-scholarly-publishing-practices>.

4 FINANCIALS

The grants of this funding instrument are to be primarily used for **research and development** and for the development of associated human resources under the auspices of the NRF standard grant and finance policies. However, unlike the majority of the NRF managed instruments, this funding instrument will provide funding for staff, consultancies and stakeholder engagement, as appropriate. Therefore, **clear motivation for cost of staff, consultations and stakeholder engagements is required**. Funds will be released upon acceptance and signing of the conditions of grant, both by the applicant and his/her employing institution. These grants will fall under the NRF audit requirements of beneficiary institutions.

Additional funding support to cater for disability will be allocated to people with disabilities as specified in the Code of Good Practice on Employment of People with Disabilities as in the Employment Equity Act No 55 of 1998.

4.1 Funding ranges

Successful applications will receive funding that accommodates the following budget items:

a) Research-related operating costs

These costs include materials and supplies, travel (including conferences) and subsistence, equipment and research/technical/*ad hoc* assistance/salaries. These costs should be justified and commensurate with the planned outputs, as they will be assessed on this basis. The amount awarded within this framework can be used at the discretion of the applicant.

Materials and Supplies

Generally, the NRF does not provide financial support for:

Basic office equipment including computers and consumables unless the computer is required for the research itself.

- Basic office stationery, photocopying costs, printing costs unless these items form part of the research tools.
- Journal publication costs, journal subscription costs and book costs.
- Telephone, fax and internet costs.

Travel and subsistence

- International conference attendance: This should be motivated clearly and consideration of other travel budget requirements presented below must be made, and must not exceed the limit presented in Table 1 below.
- International visits: These will be considered on a case by case basis. Such visits must be integral to the research plan and strong motivations should accompany these requests. Realistic funding allocations will be based on the requested activities. Only outgoing visits will be considered depending on the availability of funding.
- Local conference attendance: The applicant should clearly motivate for the benefit to attend more than one local conference per annum, and for the number of people attending each local conference.
- Local travel: The NRF does not stipulate any rate for mileage as this will depend on the rate which varies per institution/organisation. Applicants are requested to provide details of this rate as well as the estimated distance to be travelled within the given year. This travel should be well motivated and exclude travel to conferences mentioned above.
- Local accommodation costs should not exceed a 3* establishment. This relates to local travel for research purposes and an estimation of accommodation costs for each trip should be clearly presented in the motivation.

Research Equipment

Funding for small equipment will be limited to the percentage presented in Table 1 below. Requisitions for large equipment items should be submitted through the NRF's Research Equipment Programme.

Salaries

Remuneration may be paid to team members including Co-investigators and should be in-line with the policy of the institution where the grant is held.

The limits for expenditure per category are presented in **Table 1** below.

Table 1: NEOFrontiers funding ranges per budget category

Budget categories	Minimum number/percentage of the total grant	Maximum/percentage of the total grant
Research cost	No restriction	No restriction
Mobility/travel	0%	20%
Equipment	0%	20%

Budget categories	Minimum number/percentage of the total grant	Maximum/percentage of the total grant
Science engagement	3%	5%
Salaries*	No Restriction	As per call text in 2.3
Student bursaries	As per call text in 2.3	As per call text in 2.3

4.2 Postgraduate student support

Full-/part-time students at Master and Doctoral level will be funded through this instrument. The National Research Foundation (NRF) has developed a new Postgraduate Student Funding Policy that uses postgraduate student funding as a lever to address the challenges of inequity of access, success and throughput. The policy is underpinned by the pursuit of research excellence in all of its dimensions and has transformation of the postgraduate cohort as the core objective. Its purpose is to retain high academic achievers in the system to pursue postgraduate studies up to the doctoral level, as part of a national drive to grow the next generation of academics to sustain South Africa's knowledge enterprise. The NRF is prioritising postgraduate students with research inclination, with the aim to grow the pool of early career researchers. Another motivation for this policy is to fast-track the development of postgraduate students in high-impact, priority and vulnerable disciplines critical for national socio-economic development.

From the 2021 academic year onwards, the NRF will be phasing out the block grant nomination process as well as the grantholder-linked modalities of funding postgraduate students. All the postgraduate students will be expected to apply on the NRF Online Submission System by accessing the link: <https://nrfs submission.nrf.ac.za/>. This single entry point will allow the NRF to coordinate the applications that have not yet had the financial means test conducted. This financial means test will be conducted by Ikusasa Students Financial Aid Programme (ISFAP). Postgraduate students will be funded either at Full Cost of Study (FCS) or Partial Cost of Study (PCS) under the new policy. To ensure equity of access to postgraduate studies, financially needy students (i.e., those whose combined household income is R350 000 per annum or less) and students with a disability will be funded at FCS. Academic high fliers achieving a distinction or first-class pass will also be eligible for funding at FCS. International students as well as any other South African student who is not eligible to be funded at FCS will be eligible for PCS funding.

The students are expected to meet the NRF minimum entry requirement in order to be eligible for FCS or PCS as illustrated in **Table 2** below.

Table 2: Eligibility criteria for NRF postgraduate funding for FCS and PCS.

Study Level	Full Cost of Study <i>(South African Citizens and Permanent Residents only)</i>		Partial Cost of Study <i>(South African Citizens; South African Permanent Residents and 5% Non-South African Citizens)</i>
	Exceptional Achievers	Financially Needy & Students with Disability	Other
Honours	<ul style="list-style-type: none"> • ≥ 75% Mark in Final Year of study 	<ul style="list-style-type: none"> • ≥ 65% Mark in Final Year of study 	<ul style="list-style-type: none"> • ≥ 65% Mark in Final Year of study
	<p>Honours students must be 28 years of age or younger in the year of application. Non South African Citizens are not eligible for Honours Scholarships.</p>		
Masters	<ul style="list-style-type: none"> • ≥ 75% Mark for Honours • Completed Honours in one year 	<ul style="list-style-type: none"> • ≥ 65% Mark for Honours • Completed Honours in one year 	<ul style="list-style-type: none"> • ≥ 65% Mark for Honours • Completed Honours in one year
	<p>Masters students must be 30 years of age or younger in the year of application.</p>		
Doctoral	<ul style="list-style-type: none"> • ≥ 75% Mark for Masters • Completed Masters in two years 	<ul style="list-style-type: none"> • ≥ 65% Mark for Masters • Completed Masters in two years 	<ul style="list-style-type: none"> • ≥ 65% Mark for Masters • Completed Masters in two years
	<p>Doctoral students must be 32 years of age or younger in the year of application.</p>		

In cases where a grade is not indicated, the application will not be considered for funding by the NRF.

The NRF will allocate all postgraduate bursaries under its management control as follows:

95% South African citizens and permanent residents;

5% students from SADC countries and from the rest of the world; and

55% women.

The NRF disaggregates these targets for South African citizens and permanent residents as follows:

90% Black (African, Coloured, and Indian);

10% White; and

1% students living with a disability.

For further details on the NRF Postgraduate Funding policy, kindly refer to the framework document which is available on www.nrf.ac.za."

4.3 Financial control and reporting

Upon receipt of the signed Conditions of Grant (CoG), the NRF will release the awarded amount for the year. Grantholders will then be required to comply with the standard NRF financial management procedures, including the submission of an annual Progress Report (PR). These reports are to be submitted by 15 February of the following year, and are a prerequisite for the release of the subsequent year's funding. Failure to submit a Progress Report will result in the cancellation of the grant.

5. CONTACT DETAILS

Funding rules related queries	Application process related queries
<p>Dr Zolani Dyosi Director: Knowledge Advancement and Support Email: zolani@nrf.ac.za</p> <p>Ms Zodwa Masinga Professional Officer: Knowledge Advancement and Support Tel: 012 481 4310 Email: Zodwa.masinga@nrf.ac.za</p>	<p>Ms Jane Mabena Professional Officer: GMSA Tel: 012 481 4067 E-mail: jane.mabena@nrf.ac.za</p> <p>Ms Lerato Thokoane Liaison Officer: GMSA Tel: 012 481 4327 E-mail: lerato.thokoane@nrf.ac.za</p>
Research Areas (Support Action and Domain Action) Related Enquiries	
<p>Dr Stewart Bernard Chief Scientist SANSA Earth Observation sbernard@sansa.org.za</p>	<p>Mr Imraan Saloojee Chief Sector and Business Developer SANSA Earth observation isaloojee@sansa.org.za</p>

6. LIST OF ACRONYMS

AfriCultuResAfrican	AgriCultural Systems with the support of Remote Sensing
AfriGEO	African Group on Earth Observation
AI	Artificial Intelligence
AMIS	Agricultural Market Information System
ARC-Umlundi	Agricultural Research Council Newsletter
CEOS	Committee on Earth Observation Satellites
DCC	Digital Curation Centre checklist
DMP	Data Management Plan
DSI	Department of Science and Innovation
EO	Earth Observation
FCS	Full Cost of Study
GEO	Group on Earth Observation
GOGLAM	Group on Earth Observations Global Agricultural Monitoring Initiative
GMESE & Africa	Global Monitoring for Environment and Security (GMES) & Africa
GMSA	Grant Management and Systems Administration
KAS	Knowledge Advancement and Support
NASA	National Aeronautics and Space Agency
NEOFrontiers	New Earth Observation Frontiers
NRF	National Research Foundation
PCS	Partial Cost of Study
PI	Principal Investigator
RE	Reviews and Evaluation
RISA	Research and Innovation Support and Advancement
RM-ODP	Reference Model for Open Distributed Processing
SAGEO	South African Group on Earth Observation
SANSA	South African National Space Agency
SNR	Signal to Noise Ratio
UN-GGIM	United Nations on Global Geospatial Information Management

ANNEXURE 1A: Panel Assessment Scorecard - Call SA/2020/1 Innovative Earth Observation Approaches to Sustainable Urban and Rural Development and Domain Action 2020/2 Development of new High Resolution Water Quality Observation Capabilities for Coastal and Estuarine Systems

Criteria	Sub-Criteria	Details	Weight (Total = 100%)
Proposals	Scientific merit and feasibility	Reflect on the proposed rationale, approach and methodology. Reflect on the scientific, ethical ¹ logistics and technical feasibility as proposed	45%
Track record of the applicant	Past research	Reflect on past contributions to knowledge production (e.g. journal articles, book chapters, designs, performances, etc.)	5%
Equity	Of applicant	Race / Gender	15%
	Of students supervised	M and D degrees	5%
Collaboration	International, national and institutional collaborations	Are the appropriate research institution-university-private sector collaborations proposed in the application? Are the roles of the proposed collaborators clearly indicated?	10%
Impacts	Impact on knowledge production	Will the proposed work significantly advance discovery and understanding in the field?	10%
	Wider impact	Has the possibility for economic, societal or environmental impact been appropriately embedded in the proposal?	5%
Data management and use	Plans for digital data storage, usage and/or dissemination	A data management plan (DMP) is a formal document that describes the data you expect to acquire or generate during the course of a research project, how you will manage, describe, analyze, use and store data, and what mechanisms (including digital data storage) will be used at the end of your project to share and preserve your data	5%

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ANNEXURE 1B: Panel Assessment Scorecard – Call SA/2021/1 Artificial Intelligence and Earth Observation

Criteria	Sub-Criteria	Details	Weight (Total = 100%)
Proposals	Scientific merit and feasibility	Reflect on the proposed rationale, approach and methodology. Reflect on the scientific, ethical ² logistics and technical feasibility as proposed	50%
Track record of the applicant	Past research	Reflect on past contributions to knowledge production (e.g. journal articles, book chapters, designs, performances, etc.)	5%
Equity	Of applicant	Race / Gender	15%
	Of students supervised	M and D degrees	0%
Collaboration	International, national and institutional collaborations	Are the appropriate research institution-university-private sector collaborations proposed in the application? Are the roles of the proposed collaborators clearly indicated?	10%
Impacts	Impact on knowledge production	Will the proposed work significantly advance discovery and understanding in the field?	10%
	Wider impact	Has the possibility for economic, societal or environmental impact been appropriately embedded in the proposal?	7%
Data management and use	Plans for digital data storage, usage and/or dissemination	A data management plan (DMP) is a formal document that describes the data you expect to acquire or generate during the course of a research project, how you will manage, describe, analyze, use and store data, and what mechanisms (including digital data storage) will be used at the end of your project to share and preserve your data	3%

ANNEXURE 1C: Panel Assessment Scorecard – Call SA/2021/2 Earth Observation and Disruptive Economics: Developing Smart Tools for Value Enhancement for Small Scale Food Production

Criteria	Sub-Criteria	Details	Weight (Total = 100%)
Proposals	Scientific merit and feasibility	Reflect on the proposed rationale, approach and methodology. Reflect on the scientific, ethical ³ logistics and technical feasibility as proposed	45%
Track record of the applicant	Past research	Reflect on past contributions to knowledge production (e.g. journal articles, book chapters, designs, performances, etc.)	5%
Equity	Of applicant	Race / Gender	15%
	Of students supervised	M and D degrees.	5%
Collaboration	International, national and institutional collaborations	Are the appropriate research institution-university-private sector collaborations proposed in the application? Are the roles of the proposed collaborators clearly indicated?	10%
Impacts	Impact on knowledge production	Will the proposed work significantly advance discovery and understanding in the field?	5%
	Wider impact	Has the possibility for economic, societal or environmental impact been appropriately embedded in the proposal?	10%
Data management and use	Plans for digital data storage, usage and/or dissemination	A data management plan (DMP) is a formal document that describes the data you expect to acquire or generate during the course of a research project, how you will manage, describe, analyze, use and store data, and what mechanisms (including digital data storage) will be used at the end of your project to share and preserve your data	5%
Totals			100%

ANNEXURE 1D: Panel Assessment Scorecard – Call DDA/2021/2 Development of New Hyperspectral Capabilities across Terrestrial, Aquatic and Atmospheric Domains

Criteria	Sub-Criteria	Details	Weight (Total = 100%)
Proposals	Scientific merit and feasibility	Reflect on the proposed rationale, approach and methodology. Reflect on the scientific, ethical ⁴ logistics and technical feasibility as proposed	40%
Track record of the applicant	Past research	Reflect on past contributions to knowledge production (e.g. journal articles, book chapters, designs, performances, etc.)	5%
Equity	Of applicant	Race / Gender	15%
	Of students supervised	M and D degrees.	5%
Collaboration	International, national and institutional collaborations	Are the appropriate research institution-university-private sector collaborations proposed in the application? Are the roles of the proposed collaborators clearly indicated?	5%
Impacts	Impact on knowledge production	Will the proposed work significantly advance discovery and understanding in the field?	15%
	Wider impact	Has the possibility for economic, societal or environmental impact been appropriately embedded in the proposal? Is it clear how such impact will be measured?	5%
Data management and use	Plans for digital data storage, usage and/or dissemination	A data management plan (DMP) is a formal document that describes the data you expect to acquire or generate during the course of a research project, how you will manage, describe, analyze, use and store data, and what mechanisms (including digital data storage) will be used at the end of your project to share and preserve your data	10%

ANNEXURE 2: Proposal Grading

Score	Meaning of score	Notes
4	Excellent	Application demonstrates evidence of outstanding performance across all the stated criteria, as determined by the panel and relative to the knowledge field under consideration
3	Above average	Application demonstrates evidence of above average performance across all the stated criteria, as determined by the panel and relative to the knowledge field under consideration
2	Average	Application demonstrates evidence of average performance across all the stated criteria, as determined by the panel and relative to the knowledge field under consideration
1	Below average	Application demonstrates evidence of below average performance across all the stated criteria, as determined by panel and relative to knowledge field under consideration
0	Poor	There are major shortcomings or flaws as relates to the scientific / scholarly merit and feasibility of the proposed work, as determined by the panel.

Context:

Proposal grading is done with sensitivity to the context within which each application is submitted. The score of each criterion for each application will be contextualised to accommodate variability in such things as knowledge fields, institutional capacity, etc. Should a criterion not be applicable to a specific application (e.g. plans for digital data storage; collaborations; etc.), the weighting of that specific criteria will be made to equal zero, and the overall score normalised.