science & innovation

Department:
Science and Innovation
REPUBLIC OF SOUTH AFRICA

South African Research Infrastructure Roadmap

Research Infrastructure (RI) proposal

South African Polar Research Infrastructure (SAPRI)

February 2021

Type of RI

Physical	X
Virtual	

Location of RI

Single sited	
Distributed	X

EXECUTIVE SUMMARY

The Southern Hemisphere polar region is a system of interconnected physical and ecological components comprising the Antarctic continent, sub-Antarctic islands, the Southern Ocean and the deep ocean basins surrounding South Africa, along with the overlying atmosphere and the opportunities to observe the universe from this largely uninhabited location. The human dimension gives structure to the research investigation, because Antarctica and the surrounding region outside the countries' exclusive economic zones are regulated by treaties engraved in the principle of science for society. The Antarctic region is hence climatically, ecologically and socio-economically linked to South Africa, and the vast range of disciplines require a holistic approach. The proposed establishment of the South African Polar Research Infrastructure (SAPRI) will ensure coordination of South African marine and Antarctic research as a national *Big Science* programme, providing seamless access to existing and new research infrastructure required to develop and enhance long-term observations of South Africa's polar region.

The SAPRI is designed as a consortium hosted at the South African Environmental Observation Network (SAEON), which has proven experience in managing infrastructures and will fast-track its set up and operations. The ultimate objective of SAPRI is to enable balanced research growth across the polar disciplines, and to maintain and further expand the world-class long-term observational datasets already established. In addition, SAPRI will transform the access to, and perception of, the South African polar regions for technicians, engineers, scientists of all disciplines, learners and students, government, private business and civil society. The establishment of SAPRI will elevate South Africa into a central role within the Antarctic space, with the produced science and international standing directly benefiting the governmental strategies for Antarctica and the sub-Antarctic islands. As the only African player in the polar regions, South Africa will further accelerate the implementation of the pan-African Science, Technology and Innovation agenda, thus achieving the main imperatives of the National System of Innovation.

Impact

The SAPRI founding principle is to ensure that the investment in research infrastructures translates into the generation of science for the benefit of society, retention of capacity and international recognition of expertise. South Africa has a comparative geographical and historical advantage to study the Antarctic region and the polar sciences. As one of the first signatories of the Antarctic Treaty, and through the existence of the South African National Antarctic Programme (SANAP) overseen by the governmental departments DSI and DEFF, which manages one of the world's leading ice breaker research vessels, the country has established itself as a major international player. To build on this and ensure sustainability, the SAPRI represents a strategic step change in the coordination of national infrastructure for the polar sciences, which is based on a redesign of the SANAP structure within DSI according to the principles of economy of scale along with transparent institutional agreements between the SAPRI and its consortium partners. The proposed RI is conceived to improve coherence and budget coordination across the SANAP stakeholders and beyond, as well as international programmes, which is expected to ultimately enable a more favourable environment for innovation, research and development of human capacity in an area that is not traditionally represented by Africa.

Through SAPRI, government and the research community will join forces to: (1) contribute to the national obligations in terms of treaties, international agreements and scientific bodies, by means of sustained long-term observations and a single entry-point for expert consultations; (2) grow the scientific understanding of the incredibly large region of ocean and territories surrounding Southern Africa, through a substantial increase of research outputs and training capacity, and the establishment of physical and digital infrastructures to simulate the polar environment in Africa and increase the diversity of contributions; (3) improve the relationship between polar science and society, by showing the relevance of scientific and operational activities in this region through the Antarctic Legacy and the use of advanced digital technology; (4) unleash the innovation and commercial potential linked to developing instruments and services for operating in extreme and remote environments, such as the design of new sensors, polar vessels and the development of services from digital twin models.

Polar research is built on infrastructures of various sizes, which result from several investment cycles and are custodied by different players. SAPRI will maximize the return on investment by subscribing to the main principle of Antarctic expeditions, thus ensuring that several valuable platforms are exploited at the same time for operational and scientific needs, from large facilities such as ships and field bases, to medium facilities such as land-based laboratories, ship-based container laboratories and supply vehicles, down to individual field gear. The establishment of SAPRI will hence create one of the main pillars for the transition towards a polar institute that would eventually combine the logistics with the strategic scientific agenda.

Scientific excellence

The scientific plan of the SAPRI follows on from extensive engagement with the Marine and Antarctic community, from established teams and newly engaged research teams wanting to develop into this space. The SAPRI will establish scientific excellence in multiple disciplines - from terrestrial science on the sub-Antarctic Islands of Gough and Marion and Antarctica itself, to ocean physics and biogeochemistry, through the full suite of ocean trophic levels to the top predators who make the terrestrial space their breeding grounds, to the deep-seafloor dynamics and ecosystems that exist here, to the cryosphere, sea-ice dynamics, atmosphere and space physics. Throughout the SAPRI this scientific excellence will constantly be viewed and communicated in terms of value to society.

The uniqueness of SAPRI is better represented by the concept of unitedness: the creation of a unified but distributed infrastructure that will coordinate, combine and strengthen the existing fragmented components. SAPRI is novel because it creates a model in which the scientifically established lines of research that rely on the observations of essential variables will be transformed into long-term monitoring structures. This will create new opportunities for research and substantially increase our understanding of the impacts of global climate change on the regions which impact South Africa, but also which South Africa are custodian to.

The SAPRI, as systemic innovation, will enable polar research through its integrated facilities (IFs), which are components combining various kinds of research infrastructures that share common objectives and/or logistical needs. Four IFs will be coordinated and connected through a hub, responsible for polar science logistics, data management and administration. One is dedicated to digital data transformation, product dissemination, training, outreach and societal benefits. Two of the three research-related SAPRI IFs will ensure sustainability of long-term observations (LTO) on land,

ocean, seafloor, atmosphere and space, by means of a balanced combination of autonomous devices and dedicated equipment for fieldwork on the Antarctic continent and on the islands. The third is an innovation that will bring new opportunities for ice-related research in Africa by establishing the first sub-zero, temperature-controlled laboratory for the simulation of the Antarctic and sub-Antarctic environment. Thanks to the Polar Lab, more students, scientists and technicians will be exposed to polar science and technology without the need to leave the continent and participate in research cruises to Antarctica. These technologies represent a novel and innovative approach in thinking, which the SAPRI will develop to support new science on the continent of Africa and gain a deeper understanding of our regional interest and to increase our scientific reputation internationally.

Management plan

The SAPRI Lifecycle has been designed as follows:

- Currently: SAPRI proposal development and initial stakeholder engagement, which encompasses the Conceptual and Technical co-design.
- Year 1-3: Setup phase and initial infrastructure procurements. This will begin in April 2021 and infrastructure required for installation during the SA Agulhas II dry-dock will be prioritized for procurement in 2021. This phase also includes continued technical design and establishment of SLA's and MoU's
- Year 4-13: Running phase. Within this phase is the functional running of the SAPRI: all procurements and replacements of infrastructure, data management, engagements, research and takeover cruise work, student development and publications. This phase will also start the consultation towards the establishment of a South African Polar Research Institute
- Year 14-15: Closure or continuation or transition depending on recommendations from reviewers and consortium investors (DSI, DEFF).

The Management Team for SAPRI, and those advisory structures governing them, are detailed in Chapters 3 and 4 extensively. The key to effective governance is of course communication and this will be established and encouraged throughout the SAPRI lifecycle to ensure the effective working relationships. Key to the success of SAPRI will be the alignment of the endorsed scientific projects with the infrastructure availability from different partners before finalizing the evaluation process of SANAP proposals. Access to platforms will hence be maximised through multiple projects' coordination and co-design of the expensive Antarctic expeditions. Given the seasonal nature of polar research, this joint management of resources will also make valuable equipment available to other communities outside the polar space. The management of observational networks and research platforms done by the SAPRI will allow the researchers to focus on the new science that will be enabled by the infrastructure.

All data collected using infrastructure procured through the SAPRI will be made freely available for use. Certain datasets may be embargoed pending student dissertation write-ups or sensitivities, but never indefinitely nor for commercial gain. All international data standards and best practices will be adhered to.

Governance and stakeholder engagement

SAEON, the host institution of the SAPRI, already manages two Research Infrastructures (SMCRI and EFTEON) and thus has extensive management experience in this regard. SAEON follows all of the NRF policies in terms of procurement and financial management, human resources and employment of staff, and legal framework. These policies will be used in the effective governance and management of the SAPRI.

A number of advisory panels will be established to govern the activities within the SAPRI: the DSI-DEFF Steering Committee, the SAPRI Advisory Panel, the SAPRI Scientific Panel, Thematic User Fora and a structure that has been largely requested by the science community, a SANAP Coordination Committee that will be responsible for the alignment between science projects and the infrastructure. This combination of advisory structures will ensure transparent institutional arrangements and continuous scientific inputs for the expansion of the SAPRI.

Through the drafting of this proposal, the SAPRI has already engaged with over 25 South African stakeholders (including government departments, Historically Black and White HEIs, science councils, research institutions and non-government organisations) primarily related to the scientific endeavours of the RI and thus the infrastructure required. The DEFF provided specific comments on the fundamental requirements pertaining to logistical arrangements. Once established, SAPRI will further engage with all stakeholders including national government departments with interests in the marine and Antarctic space to ensure the national priorities are addressed within the RI. In addition, international collaborators and potential funders, private enterprise and philanthropic groups will be engaged to market the RI but also gain traction and support internationally.

Capacity development

The SAPRI will employ 39 staff members annually to manage, procure, maintain, train, operate and process data streams stemming from the infrastructure made available through the RI. These include seven Management Team staff who will manage the relationships, the funders, the Integrated Facility teams, the outreach, the data management and above all, the expectations associated with the SAPRI. Additionally, SAPRI will have a minimum of 11 technicians, four interns, four overwinter team members for top predator research at Marion Island, two administrators and 10 data centre team members. SAEON will provide specialised services such as IT network administration, data curation, HR, financials and supply chain management. These positions will be shared with SMCRI and EFTEON.

No direct funding through the SAPRI will be available for student bursaries or post-doctoral positions owing to the proposal being primarily an enabler of infrastructure and such infrastructure needs to be maintained for optimal use. However, SAPRI will capitalise on the experience of the Antarctic Legacy of South Africa to promote humanities and social sciences research and the STEM disciplines involved in polar sciences. Dedicated training initiatives will enhance the capacity to do science in the polar environment, either by allowing more students to experience Antarctic conditions in the Polar Lab and by consolidating the SANAP project SEAmester, the first South African class afloat. SAPRI will work with the Principal Investigators of the endorsed projects to find and support funding avenues (e.g. NRF/DSI and PDP bursary schemes) to support training from the BTech / Honours level, right through to Post-doctoral fellows. Focus will be driven towards Historically Black HEIs and the progression of Women in STEM fields of study.

SAPRI's goal within capacity development is to encourage the next generation through outreach and engagement to follow STEM pathways of study, make available the required infrastructure and / or data to research projects for students to undertake their field work and support the career pathways as best as possible to retain skills to South Africa.

Monitoring, evaluation and risk management

The SAPRI monitoring is based on a detailed plan of stage-gating, reporting structures and analysis of risks. Overseeing the SAPRI and to ensure it always aligns with National Government Priorities, is a DSI-DEFF Steering Committee which will receive annual reports on SAPRI progress and will be instrumental in the five-yearly reviews of the RI. The SAPRI will report quarterly to the SAEON Managing Director, the NRF Corporate and DSI funders on progress, to raise any fundamental issues and comment on scientific excellence achieved. Annually, the progress of SAPRI will be reported to all stakeholders, any additional funding entities and conservation agencies in terms of permitting restrictions.

The greatest risks are financial in terms of cuts to government funding for the SAPRI and drastically unfavourable exchange rates. Additional high risks associated with the impact of SAPRI include changes in national political priorities, high-level incongruence between government department funders, failure of funders to contribute and changes in international agreements. These are effectively out of the hands of SAPRI Management Team and host institution, but will be closely monitored and mitigation plans developed to support the continuation of SAPRI. The potential failures to recruit excellent leadership and of the host institution to operationalize systems are risks which need to be addressed from the outset of SAPRI to ensure the RI is effective from the start.

Financial plan and budget

The SAPRI budget over its 15-year life-cycle falls just short of R 1.1 billion, while using a staggered incremental approach of inflation given the difficulties in forecasting economic growth, and thus inflation, over the next 15 years. The projected running cost of the SAPRI is less than R 60 million per year, which is exclusive to the current R 130 million annual budget made available for the SA Agulhas II and maintenance of the bases at Marion and Gough Islands and Antarctica. The proposed outlay for capital expenditure, linked to physical infrastructure, amounts to R 386 million. These infrastructures cover the wide range of scientific disciplines engaged within this document, and further augment the large and medium infrastructure already in existence and maintained by the stakeholders of the SAPRI. The balance of the budget relates directly to the human capital, maintenance and support of the infrastructure purchased and the incredible data management capacity required for such a diverse entity. Every single one of the over 25 stakeholders engaged in the drafting of the SAPRI stated that the support required to optimally make use of, maintain, obtain data from and make accessible and useable to the greater community was instrumental to such an enterprise and should be effectively budgeted for at similar levels afforded to other *Big Science* programmes.

From the offset, additional funding avenues for the SAPRI have been identified and in some instances, already engaged. The first of these is to realign the DSI SANAP-Science funding, which is currently made available in three-year competitive call cycles, to support long-term projects in terms of running costs, while making available funding for new and innovative scientific endeavours. SAPRI, through the proposed integration of the SANAP budget, will take a balanced approach of financing the required

infrastructure and reallocating funding to science proposals for greater support to research and innovation in the polar space. Secondly, funding to build the proposed Polar Lab, on premises owned by the UCT, has been requested from the DHET under the Infrastructure Funding Category Focus Area "National Academic Priorities" of ~R 50 million. Finally, funding initiatives from national (e.g. student bursaries and internships, science funding, etc), international (multinational partnerships, polar science initiatives, etc), private entities and philanthropic donor grants need to be investigated more robustly once the SAPRI is established to ensure continuity and longevity, while easing the burden on central government support.

In conclusion, the SAPRI was co-designed by the Marine and Antarctic community, including established and newly engaged stakeholders ranging from multi-disciplinary scientists to policy makers and funders, to develop holistically and in support of one another, a comprehensive *Big Science* Research Infrastructure that benefits everyone. If consolidation of the current fragmented components of polar science in South Africa is not undertaken, then postgraduate students, once trained, will leave to work within established research facilities who value their skill sets (often overseas), scientific publications will suffer, multi-disciplinary research and technical innovation will be stifled, the transformation of polar science will be drawn out and the important link to society will remain under prioritised. In order to create the *Big Science* this proposal hopes to achieve, it will require authentic leadership, dynamic management, innovative thinking, out-of-the-box problem solving to deal with, not only the multiple stakeholders involved with SAPRI, but the extreme conditions in which these infrastructural resources will be deployed and used. The outcome of this will be a co-designed, sustainable and responsive Research Infrastructure which services the needs of all whilst enhancing what has already been established.

Contents

LIST OF FIGURES

LIST OF TABLES