



# A short review on the development of research infrastructures – Lessons learnt for the development of a greenhouse gas observation research infrastructure in Africa



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# List of Acronyms

AU	African Union
EFTEON	Expanded Freshwater and Terrestrial Environmental Observation Network
ERIC	European Research Infrastructure Consortium
EU	European Union
GBIF	Global Biodiversity Information Facility
GEOMAR	Helmholtz Centre for Ocean Research Kiel
GHG	Greenhouse Gas
HLPD	EU-Africa High-Level Policy Dialogue
ICOS	Integrated Carbon Observation System
NRF	National Research Foundation
OSCM	Ocean Science Centre Mindelo
RI	Research Infrastructure
SAEON	South African Environmental Observation Network
SARIR	South African Research Infrastructure Roadmap
SASSCAL	Southern African Science Service Centre for Climate Change and Adaptive Land Management
SEACRIFOG	Supporting EU-African Cooperation on Research Infrastructures for Food Security and Greenhouse Gas Observations
STI	Science, Technology and Innovation
SMCRI	Shallow Marine and Coastal Research Infrastructure



### **1** Introduction

This report is telling how the Research Infrastructures (RI) have evolved or are developing in particular SEACRIFOG partner (OSCM, organisations ICOS, SAEON. SASSCAL). For the SEACRIFOG project it is interesting to see what this development means to the development of RIs in Africa and which findings can be derived for the future of design greenhouse gas observations.

Information was collected during interviews and reading reports of the respective institutions. Questions concerning the development of the RIs were investigated taking into consideration critical aspects of developing RIs as well as valuable learnings on what could have been done differently. Also, the meaning of RI evolvement to Africa, which factors could contribute to the future development and Europe's role in this process were investigated. The interviews – four in total - were conducted via Skype during April and May 2019.

Persons interviewed are all working in the facilitation of a RI. RIs are in general, and especially for Africa, a chance since they contribute to collect and store the data we can get today and will need in future to predict changes or find solutions from past recorded developments. RI can be based in one place or distributed, such as ICOS stations are distributed all over Europe. Some RIs are basically data infrastructure, such as GBIF, where scientists enter their data as long as they meet the requirements of the specific RI or data are collected from paper or other databases. These can be then processed e.g. in maps or models. A RI has also a legal framework and it keeps and mostly collects data; coherent and longlasting. It also should have financial and political long term back-up.

# 2 The Research Infrastructures ICOS, OSCM, SAEON, SASSCAL

Here we present four different institutions (OSCM, ICOS, SAEON, SASSCAL), with their already existing RIs. We will focus on the establishment process of the respective RI, giving an overview about different kinds of RIs and their development. A special emphasis is given on opportunities, challenges and solutions. in the development process of RIs. Learning from the experiences of already established RIs is helpful to avoid problems and to deal with repeating challenges. All information is based on interviews with scientists facilitating the respective RI for the institutes and corresponding reports.

Helmholtz Centre for Ocean Research Kiel (GEOMAR) has long cooperation with local research institutes in Cape Verde. There are few projects running about long term monitoring and GHGs in the ocean project, but also other projects which could convince to create a centre which supports local research and community. This Ocean Science Centre (OSCM) was opened in Mindelo, Cape Verde in 2017. The idea of this centre is to create RIs to the region for carrying out marine observation and monitoring program. But also the purpose is to establish a knowledge exchange hub and organise international conferences and annual meetings where local researchers and other scientists can liaise. Soon they are also establishing two years funded master programme with the local university, and



the aim of the programme is to train ten students from Western African countries to be future specialists or even policy makers.



Picture 1 SEACRIFOG partners visiting the labs of OSCM © Arne Körtzinger

The work which was done in Mindelo was in close cooperation with local partners and one of the learnings from this was that one should interact with the local partners as much as possible to understand their needs and experience. Good cooperation and relationships both in professional and personal level is seen important so it is good to take time to interact with the people. If this is not considered, it might causes troubles during the project. To develop further the ideas in the project, it is also important to have a good common ground.

During the establishment of OSCM it was noticed that sometimes communication can be an issue. The European partner in the establishment process of OSCM realised that it is important to either send scientists from Europe to the partner county for few years to establish projects there participatory, or then let the local partners to be more independent and creative. The European partner should not be too dominant. In the latter option, good regular communication is then needed to make sure that everyone is on the same page. To create a good communication is a long-lasting process of mutual learning.

In Integrated Carbon Observation System (ICOS) it was a few years project to establish RIs with help of many European projects which were funded and supported by the European Union (EU). These projects cooperated and applied funding for further projects together. Several of those projects established а structured research community, with network stations across the European continent. There were already many countries and networks in Europe, with GHG emissions measurement stations. With the help of the structured projects ICOS evolved as an overarching network. In some point researchers wanted to have even a more prominent structure a loose network. Using a window of opportunity they gathered the networks and created a RI under the name ICOS. The legal framework called European Research Infrastructure Consortium (ERIC) was established, in the end of this process. Actually, there have been ICOS stations already decades, which have been running before under another heading. The process lasted 15 years before



Picture 2 ICOS terrestrial GHG measurement site in Italy © Thünen Institute AK, Jean-Pierre Delorme



ICOS was established. ICOS ERIC has been running now 3 years.

The experience that was gathered for ICOS could be also used in Africa. ICOS does not want to create African ICOS because the situation there still differs far from the one in Europe, but moving towards the same idea of long term commitment and sustainability. Most of the stations in Africa have some funding problems. They might be running 2-5 years, but then stopping because of money issues. Gathering a research community in Africa can be challenging too. In Europe this is easier because there is already a huge and structured research community existing which is a result of a lot of money the EU has invested to framework programs since 1980's. In Africa there are very few countries where this happens at the moment. South Africa is far ahead of other African countries, but in Northern Africa, especially in Morocco, RIs are quite well developed, too. In many countries there might be only one university taking care of RIs and then they might be quite isolated. In SEACRIFOG, ICOS is leading a work package, which tries to raise awareness among decision makers that there should be some kind of long term commitment to RIs in the African continent. This serves as seed money to go towards RIs. There should be commitment of relevant stakeholders (African Union or countries) and funding to help developing towards a RI type of work.

TheSouthAfricanEnvironmentalObservation Network (SAEON) is part of theNationalResearchFoundation (NRF) inSouthAfrica.SAEON operates throughdifferent environmental observation nodes.Each node is located in different ecosystems.

The role of SAEON is to investigate, observe and model ecosystems in offshore-marine areas, coastal areas and on land. In addition it recently has been appointed to host research infrastructures that form part of the Department of Science and Innovation South African Research Infrastructure Roadmap (SARIR), these being Expanded Freshwater and Terrestrial Environmental Observation Network (EFTEON) and Shallow Marine and Coastal Research Infrastructure (SMCRI). SAEON provides an infrastructure for long term environmental research, including the observation platforms a core team of researchers and data infrastructure.

In SAEON there was little funding at the beginning, and 1.5 funded positions form 2005-2012. However, after 2012 they were



Picture 3 Construction of GHG measurement tower in Vuwani, South Africa © Thünen Institute AK



successful in getting indirect funding to build environmental and earth observations research infrastructure. One critical part during the establishment process was that a lot of time and money was used to develop soft and hard infrastructure that has already been built somewhere else before. The case is that well-funded OECD projects do not have enough resources to disseminate their outputs to the developing countries. Local initiatives can have some good experts and ideas, but OECD researchers often dismiss these. There are also overlaps between RIs in South Africa, because sometimes the partners are so busy with all the workload that they do not have time to communicate enough with each other.

In the experience of SAEON the EU and US funded projects could have more impact if extra capacity would be put to outputs in developing countries. Often the problem is that other projects do not want to collaborate and therefore, the outputs are not exchanged. The same applies also when building metadata.

#### Southern African Science Service Centre for Climate Change and Adaptive Land

Management (SASSCAL) started as a huge program by the German Ministry of Education and Research and Southern African partners. Out of the program structures and RI's evolved in Africa. even so SASSCAL is still depending to large parts on the German funding. Distributed RIs running SASSAL under are Weathernet and ObservationNet. Weathernet has 160 automated weather stations in SASSCAL partner countries which are Angola, Botswana, Namibia, South Africa and Zambia. ObservatioNet is also working mainly in the same partner countries, except



Picture 4 Meteorological station in Zambia © Thünen Institute AK

Botswana. It has 65 biodiversity in observatories which offer long term observations in biodiversity. In the meantime, SASSCAL runs laboratories in countries and partner university experiments. There is for example soil lab in Angola and Zambia.

In the experience of SASSCAL, one critical part when developing RIs in Africa is maintenance of the RIs and sustainable use of them. Often technical skills and human resources are lacking in the countries. So critical part is not only the funds but what comes to creating capacity.

SASSCAL has learnt from the past and is now trying to put more emphasis on the capacity building. Local capacity should be built to make sure to transfer the knowledge to local people and that the ownership by Africa of the RIs is strengthened.



# **3 Development of Research** Infrastructures in Africa

Developing RIs can have some critical steps and challenges in the establishment process as it was discussed above. Here we list lessons learnt from the experiences of the development of the previous described RIs.

There should be more long term commitment RIs in Africa. It would be also good to have a commitment of stakeholders, either in African Union or among different countries, and also funding which would help to go towards RI type of work. When having more long term commitments and willingness to go towards the same direction, the situation could be improved since this is the critical part at the moment. Long term commitments would hopefully lead to sustainable partnerships which are seen as an important part. Thus, it is important to build capacities in sustainable way and not just setting up RIs.

It is also important that results are not disappearing after the project has finished, and that there will not just come a new project which would start everything from the beginning. The EU has understood this and tries to cooperate better in the future with the African Union. Long term perspectives need to follow, investigating how emissions are evolving. Therefore, there should be better access to RI software and hardware and the research outputs should be openly available. Communication and mobility of African partners are also seen as big topics. Thus, there should be more communication between scientific networks in Africa to exchange the existing knowledge.

In order to avoid that the RI stations would disappear after some years, projects should be better coordinated than at the moment. Networks and projects have often money to establish stations, but sometimes they run out of money, and it might happen that also the stations disappear afterwards. Training of students and technicians is also seen as a critical part which should be taken better into account. It is important to invest already now for the future by training future specialists and policy makers.



Picture 5 GHG measurement tower in Kenya ©Lutz Merboldt



# 4 Europe's Role in the Development of Research Infrastructures on Greenhouse Gas Observation in Africa

Europe plays a very strong role globally, in the climate change debate and leadership. One reason for Europe's big role is the financial capital invested in projects related to these topics, also on the African continent partnering in many cases with the African Union (AU). The main important example in the field of science is the EU-Africa High-Level Policy Dialogue on Science, Technology and Innovation (HLPD on STI), which is a platform where research and innovation policy related knowledge is regularly exchanged. There is actually already guite a lot funding and opportunities, but in European projects the work which has already been done in Africa is unfortunately often ignored.

To get reliable results from greenhouse gas measurements, a long term timeline is indispensable. Therefore, projects should be longer than the typical three to five years, as long as there is not a long-term RI established. In the current situation short projects are often overlapping or there is a between projects. This causes gap difficulties to achieve the goals of the project, if they need to already think the next project proposal during the first project.

Overall the coherence of European lead projects in and with Africa is insufficient at the current stage. Long term funding and knowhow transfer are efficient ways how Europe could offer support to Africa in the establishment of RIs. At the one hand Africa could learn partly how to set up RIs from European examples, but the support to operate them in a sustainable way by Europe is also important. In this regard there is still a lot to do.



Picture 6 SEACRIFOG training workshop on oceanic GHG measurements ©Ingun Skjelvan

Capacity building, for example offering scholarships for students and early career researchers, is a way how Europe could easily give support. This is an essential part of having any kind of long-term monitoring of GHGs, since trained people are needed to take care of the RIs. Additionally, high qualified and internationally recognised jobs, as far as the RIs are in place, are also needed that the educated people would stay working in Africa. Therefore, it can be said that both trained people and good jobs in research infrastructure field are essential. Within the project SEACRIFOG small steps are done to train more people. Three workshops on oceanic, terrestrial and atmospheric GHG-measurements were conducted, with African participants.

