**Big thinking. Big science. Can Africa grow intellectual and research capacity to fix its developmental challenges? Ocean Science and marine Food Security at Nelson Mandela University as a test case**

The Western Indian Ocean (WIO) has the most serious food security problem on planet. Here some 60 million people in Mozambique, Madagascar, Comoros, Tanzania, Kenya, and Somalia — and to a lesser degree Seychelles and Mauritius — live on the coast and islands, and are directly dependent on the ocean for their food and livelihood, mostly through harvesting marine resources. An increasing poor population, over-exploitation, habitat destruction, and a changing ocean threaten ecosystem health and therefore food security and livelihoods. Measurements already show that the WIO is warming faster than any other part of the world ocean. Trends indicate a decline in ocean productivity (phytoplankton) in the central IO which underpins the marine pelagic food webs that harvesting are reliant on. Allied to these changes is the fact that poor coastal communities have low adaptive capacity as fishing is the only existence they know. The combination of these factors acting at a regional scale with relativity slow rates of change, and limited information, are leading to a humanitarian disaster of significant proportions — scarcely acknowledged by governments and international commissions.

But it is important to understand that these partially observed changes in the central WIO are part of a bigger, more complex and interconnected system — the Indian Ocean (IO) — which similarly is part of the earth system comprising ocean, atmosphere and land together. While the reversible monsoon wind is the main driver of the oceanography in the northern IO, the land mass of Madagascar is the feature responsible for the unique ocean dynamics of the south. Here the South Equatorial Current that flows across the IO from east to west (as it does in the Atlantic and Pacific Oceans), strikes the world-wide unique configuration of the Mascarene Plateau and the island subcontinent of Madagascar. This interaction induces large scale turbulence in the ocean circulation in the form of mesoscale eddies in the Mozambique Channel and the Agulhas Current which propagate poleward along the south-eastern flank of Africa. In the Mozambique Channel this mesoscale turbulence is responsible for significant beneficial ocean production, but further south on the edge of the Agulhas Bank, it causes substantial loss of shelf waters — blamed for the 18-month crash of the South African squid fishery in 2013-14 as a result of larvae being swept offshore and recruitment failure. This crash saw substantial economic and social suffering in the impoverished province of the Eastern Cape with some 30 000 dependants having no livelihoods. Being the largest event in the history of the fishery, climate change is blamed for the crash. The fishery has since recovered but is on tenterhooks as will not be able to sustain another in the near future. Certainly, further investment is on hold and fishers are worried about their prospects.

It is clear that governments, organs of the state, fisheries and societies, all require an understanding of what is going on with climate and ocean, and how the future holds? Observational measurements alone, however, cannot predict the future particularly with changing drivers such as CO2 levels in the atmosphere. To understand and predict the future of the complex, feedback, earth system — big thinking and big science is required. This means the development and use of top-end coupled ocean-atmospheric computer models that are forced (‘trained’) with historical observational (satellite) data to simulate more accurately. Both the models and satellite missions need to run on the largest computers developed by humankind costing around R 500M to build and R 120M to operate annually. Such big science and the advanced skill sets required to process and interpret the output data, are fabrications of rich nations — which, with the exception of Australia, are all found in the northern hemisphere. This implies South America and in particular Africa have little means to realistically understand their oceans and ecosystems, and how these will change in the future. In other words, as things stand, Big Science is beyond their reach.

Yet, there might be a way around this predicament through the use of what Prof Roberts has termed the *Innovation Bridge – Regional Hub* (IB-RH) approach, which is the focus of his chair. Essentially this entails establishing formalised partnerships between institutions in the southern hemisphere and top-end, well-resourced, research institutions in the northern hemisphere. Through this alliance, scientific capability can be tapped into to build southern hemisphere research capacity and critical mass to tackle developmental challenges. In the case of the food security problem in the WIO, this IB-RH approach is presently being implemented as part of a 5-year plan between Nelson Mandela University and two of the largest oceanography institutions in the UK — the National Oceanography Centre and the University of Southampton. The regional hub (RH) component comprises Nelson Mandela University with links to the Kenya Marine Fisheries Research Institute, the University of Dar es Salaam, and the Western Indian Ocean Marine Science Association (WIOMSA). The new Ocean Science Campus at Nelson Mandela University which will specialise in ocean physics and productivity (ecosystem functioning), forms the principal southern footprint of the IB-RH in partnership with Rhodes University which will provide expertise in fisheries science and ocean governance to the alliance. To date, the research plan and IB-RH have been completed, R 160 M has been obtained from the UK to fund salaries and research costs, ships and robotics (technologies) are secured for field campaigns, access to the large NEMO/MEDUSA-2 biogeochemical ocean model and satellite data acquired, and the first of two ‘official’ student intakes ensues in February 2018.

The IB-RH is in place with record speed (1.5 years). While only time will tell whether this ambitious initiative can overcome the hurdles of accessing Big Science to address the impending WIO food security crisis — massive effort will be put into producing and retaining the next generation of PhDs and talent in Africa to fix the future!