

South Africa has access to magnificent marine treasures, writes **Claire Keeton**. About 600km south of Cape Town lies the Southern Ocean, our deep neighbour who holds the key to Earth's survival. And just off the Cape coast wondrous kelp forests are home to one of the planet's most biodiverse ecosystems



The waters of life



The icy Southern Ocean helps to control the climate by absorbing both carbon dioxide and heat. Picture: SOCCO-SA-RobOTIC

The kelp forests off the Cape coast teem with life of many kinds, from exotic fish to lively sea otters. Pictures: Craig Foster

Waves were crashing against the hull of SA Agulhas II Antarctic research ship as it headed into the stormy Southern Ocean five years ago to pick up a set of hi-tech "wave gliders" that have become a key tool in measuring the health of the ocean and the climate.

But, says Prof Pedro Monteiro, an oceanographer at the School for Climate Studies at Stellenbosch University: "It was too dangerous for the ship to go close to the wave gliders, which resemble very large surfboards packed with instruments, so we piloted them back about 2,800km to Table Bay," he says. "They were in a holding pattern until we could pick them up in a rubber duck."

Monteiro is one of the local scientists who are making the most of South Africa's grandstand seat on the edge of the Southern Ocean to carry out cutting-edge research into the vast ocean's planetary-scale importance for climate change.

"The importance of the Southern Ocean in climate is not just that it is taking up CO₂ [carbon dioxide] but also that it is playing a very big role in taking up heat," he says. "All the surplus human-emitted CO₂, which is not taken up by the land and the ocean, is generating a heat imbalance in the atmosphere and the Southern Ocean takes up about 75% of that heat."

Monteiro says the SA team were the pioneers in deploying the gliders, devices about 3m long that use wave energy to follow courses controlled via satellite by pilots on land. First launched in 2011, they "give us a window in the Southern Ocean" as they collect ocean and climate data.

Without the Southern Ocean, Earth would be uninhabitable and scientists such as Monteiro are leading the research that uncovers the mysteries of the planet's life support system.

Cape Agulhas, where the Atlantic and Indian oceans meet, is one of the closest points to the Southern Ocean, which Monteiro says begins about 600km south of Cape Town. Also known as the Antarctic or Austral Ocean, this deep ocean plays a critical role in protecting the planet against climate shocks by absorbing roughly 12% of the man-made carbon emissions heating up the atmosphere. The Southern Ocean's cold currents help to cool the planet as they circulate, and its abundant biodiversity helps to sustain countless species.

Monteiro, who has been studying the ocean's CO₂, oxygen, salinity and other elements for 20 years, says it is slowing down the warming rate of the planet. "Without it, we would be way past the 2°C limit by now. [It is] a critical hub for global ocean systems."

In 2015, nearly 200 countries adopted the Paris Agreement at the UN Framework Convention on Climate Change, a treaty to try to limit the rise in global warming to under 1.5°C. But the global average temperature for the past 12 months was at 1.56°C above pre-industrial levels, the World Meteorological Organisation reported last week. It said last month was the hottest February on record – an estimated 1.77°C warmer than pre-industrial levels – and the world's average sea surface temperature also hit a record high.

Monteiro says: "The cost of the heat and CO₂ uptake by the Southern Ocean is that it is warming and acidifying, both of which limit its capacity to



continue this service at present rates of emission."

Craig Foster, co-founder of the Sea Change Project who gained international recognition for his Oscar-winning documentary *My Octopus Teacher*, says: "The oceans keep us alive. They are more precious than all the wealth on the planet. Why then do we carry on undermining our own support systems?"

Overfishing, pollution and coastal development threaten the ocean and marine ecosystems, the World Wildlife Fund of South Africa reports. Coastal mining and deep-sea mining pose further risks to oceans. WWF-SA says that 10% of the world's population depends on fishing activities and oceans provide food for more than 1-billion people globally, while tourism and marine transport also contribute to livelihoods.

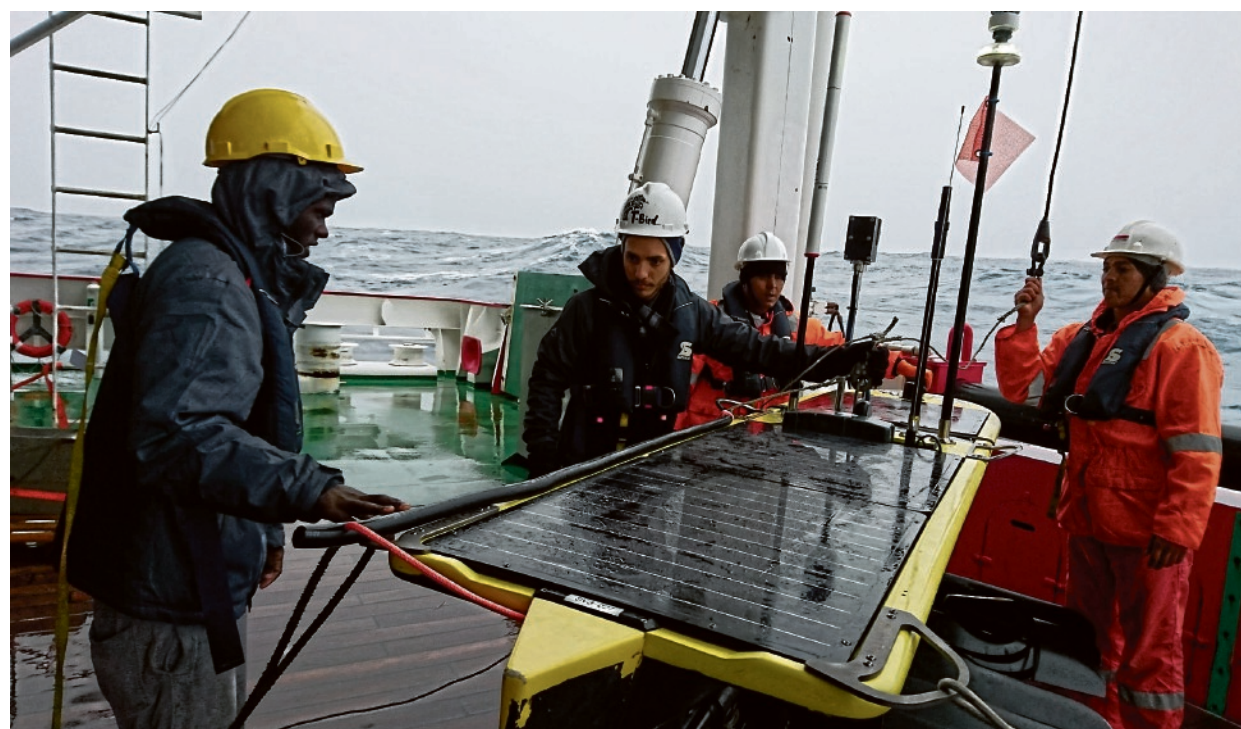
The acting head of the School for Climate Studies, ecology professor Guy Midgley, stressed the importance of the Southern Ocean and South African research this month at a climate change indaba organised by the Western Cape government. South Africa invests way more proportionally than other countries in climate science, he says.

"The Western Cape has an intimate relationship with ocean systems, with warm and cold oceans and access to the Southern Ocean. The Southern Ocean is one of the biggest carbon sinks on the planet: it sucks CO₂ out of the atmosphere and stores it down in the deep ocean. Every time we drive a car, about 12% of its emissions from the tailpipe get absorbed."

Midgley told the Sunday Times that the ocean has both physics-driven and biological pumps – driven by phytoplankton – that contribute to carbon storage.

"The Southern Ocean is a bit like the Serengeti, with the mammal populations [such as whales] that move in on areas of plankton growth. They munch them and defecate, and the carbon falls [to the ocean bed]," he said.

The robotic gliders, or "autonomous underwater vehicles", are operated by the Southern Ocean Carbon and Climate Observatory (SOCCO). Monteiro says: "SOCCO made a huge advance. The gliders could go out into the Southern Ocean at any time of year when the ships could not."



Self-powered robotic gliders, pioneered by SA scientists, sail the frigid seas of the Southern Ocean collecting climate data. Oceanography professor Pedro Monteiro says the department of science and innovation helped kick-start the Southern Ocean Carbon and Climate Observatory. Picture: SOCCO-SA-RobOTIC

Apart from these guided devices – whose sensors are powered by photovoltaic panels – there are hundreds of autonomous floats in the Southern Ocean, which drift wherever the currents take them. Some of the robot gliders can descend to 1,000m, providing a valuable insight into what's going on in the ocean depths.

"Before the advent of ocean robotics all we used were ships and, up to that point, we had an understanding of 'averages'," Monteiro says. "Now we can pilot them and tell them where to go. We are using them for experiments and can explore specific

questions over a month or a year."

He says human-generated carbon emissions are "increasing exponentially faster than the ocean can take them up. We are seeing changes already happening in the Southern Ocean ... If over time if we continue to emit at the rate we are now, we will start to diminish the help we get from it. The Southern Ocean is the flywheel of the global climate system and it plays an important mitigation role."

Another concern to scientists is that oxygen levels in the ocean are dropping as oxygen dissolves less easily in warmer waters. "We are seeing less oxygen



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in the deep waters of the Southern Ocean, especially those off the South African coastline, which has major implications for [linked] ecosystems," says Monteiro.

Closer to home, the kelp forests off the Cape Coast are a vital marine ecosystem that sustains life. Multiaward-winning filmmaker Pippa Ehrlich, a nature journalist for the Sea Change Project, says: "Biodiversity is the life support of the planet and the South African coastline has one of the most biodiverse ecosystems. I have visited kelp forests in America and they were really beautiful. But I had to go to an island 300km [off the mainland] to have the sense of awe that I get when I walk into the water here and swim 100m off Miller's Point."

To share awareness of the astonishing biodiversity of the kelp forest, Sea Change this month launched a free downloadable artwork, *The Great African Seaforest Habitat*, identifying 93 species.

Ehrlich says: "South Africa has a massive coastline but millions of South Africans will never visit the ocean. How then can we expect them to prioritise the ocean or care about it? I used to see that brown stuff on the beach when I was a child visiting Simon's Town in the holidays ... But only at about 26 years old did I start to understand what an underwater forest meant."

"There are creatures that live in the canopies, the same as a rainforest. There are creatures that live on the floor, the same as in a terrestrial forest."

Ehrlich, who co-wrote and co-directed *My Octopus Teacher*, is releasing a podcast series in May called *Back to the Water* that will explore the cultural and ancestral significance of the ocean to South Africans and their relationship to it. Singer, actor and playwright Zolani Mahola is making a film to tell this story.

As for Foster, his passion for the ocean has prompted him to write a new book, *Amphibious Soul: Finding the Wild in a Tame World*, to be released in May. World-famous primatologist Jane Goodall says: "It is an important book that will transform how we think about being human."

After diving nearly every day for 12 years, Foster says: "It is as familiar to me being in the ocean as being on land, and I have got to know many, many species in an intimate way. Occasionally you have individuals from species or an animal that takes a lot of interest in you, or is curious."

"You start to sense that animals are our kin. One sees an enormous number of predations at first, and it appears [to be] a harsh world, but you see that the kelp forest itself promotes life."

"You see amazing relationships between animals ... In the kelp forest every inch of available space is taken up, you do not find a bare patch of sand," Foster says. "Creatures are living in and on top of one another. Unfortunately the larger animals like lobster, fish and abalone are being fished out. Abalone used to be stacked like a triple-decker bus on top of each other."

"My life, your life and everybody else on the planet depends on oceans, especially on the small creatures and plants," he says. "This vast and complex biodiversity is keeping us going and we need to be protecting the mother of life."