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THE LAST GREAT WILDERNESS

From Gondwana to Antarctica

195-136 mya

JURASSIC ERA – A single mass of land (a super-continent) called Gondwana begins to break up to form modern day Africa, Antarctica, New Zealand, Australia and India. Dinosaurs evolve and oceans teem with fish. Bird-like creatures evolve and the climate is warm and wet.

136-65 mya

CRETACEOUS ERA – Antarctica has a sub-tropical climate and is covered with ferns and conifers. Australia and New Zealand breaks away from Antarctica as it drifts towards the South Pole.

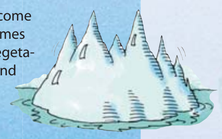
60 mya

PALAEOCENE ERA – As the continents drift further apart from each other, oceans begin to surround them. Antarctica drifts further south towards the South Pole and moves further away from New Zealand and Australia.

54-38 mya

EOCENE ERA – Large ice caps form on Antarctica as it settles in its position over the South Pole. The surface becomes jagged with ice mountains which stretch from coast to coast.

38-26 mya



OLIGOCENE ERA – Icebergs become permanent and Antarctica becomes a frozen winterland with little vegetation, the coldest temperatures and strongest winds.

26-7 mya

MIOCENE ERA – Whole surface of Antarctica becomes covered with ice and seal-like creatures, or pinnipeds, become inhabitants of Antarctica.

7-1,8 mya

PLIOCENE ERA – Fossils of plants and animals from this era indicate many ice sheet movements and melting.

1,8 mya-10 000 years ago

PLEISTOCENE ERA – The Great Ice Age begins. 30% of the Earth is covered by glaciers and some oceans freeze.

10 000 years ago – Today

HOLOCENE – The Earth warms and deserts form in some areas. Human civilisations develop. A cold ocean current isolates waters around Antarctica, and the continent is permanently frozen.

Note: mya = million years ago.

Climate

- Antarctica is the coldest, windiest and driest continent on Earth. The lowest temperature recorded was -88 degrees Celsius. In the interior of the continent, wind speeds reach as high as 320km/h. The annual rainfall is about 50mm inland, and 35mm along the coastline.
- During summer, Antarctica has 24 hour days and no nights. During winter, Antarctica has 24 hour nights when it is continually dark for about one month.
- Antarctica is so cold because it is:
  - surrounded by an ocean with cold currents;
  - the windiest place on Earth;
  - completely covered with snow – since snow is white, it reflects rather than absorbs the Sun's rays; and
  - situated at an extremely high altitude.

Indigenous plants and animals

Antarctica is a hostile environment and most of the plants and creatures in South Africa will not survive there. Lichen – a plant composed of fungus and algae – is found growing on the rocky outcrops. Invertebrates (animals without any backbones) such as ticks and mites are also found. Larger land animals include penguins and seals. Some breeds of penguin include the Emperor and Adelie penguin. Twelve seal species live on the coastline. The surrounding ocean is the home of whales, which feed on krill and sometimes seals and penguins.

The discovery of, and early expeditions to, Antarctica

350 BC
Early Greeks hypothesise that a large mass of land must exist to counter the weight of the Arctic. They call this land Antarctica – meaning 'opposite the Arctic'.

1773
Captain James Cook circumnavigates the Antarctic and is the first to cross the Antarctic Circle.

1819
Fabian von Bellingshausen becomes first person to see the Antarctic continent, after crossing the Antarctic Circle.

1820
Captain John Davis, on a sealing expedition, reports first landing on the continent of Antarctica.

1823
British whaler James Weddell sails to 74 degrees South, which is the furthest most south sailed. The Weddell Sea is named after him.

1840
British, French and American expeditions establish status of Antarctica as a continent.

1899
Carsten Borchgrevink leads British expedition that landed men at Cape Adare. This was the first expedition team to spend a winter in Antarctica.

1911
Norwegian Roald Amundsen, along with four other expedition members, discovers a new route that leads to the South Pole.

1923
The beginning of large-scale factory-ship whaling in the Ross Sea.

1928
Sir Hubert Wilkins makes the first Antarctic flight from the Antarctic Peninsular to the Ross Sea.

1935
Caroline Mikkelsen from Norway becomes the first woman to land on Antarctica.

1961
The Antarctic Treaty governing activities in Antarctica is signed. South Africa is one of the original signatories of this Treaty.

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10 YEARS OF FREEDOM
South Africa 1994 - 2004

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SOUTH AFRICA'S INVOLVEMENT

1663 – 1773
Discovery of the Prince Edward Islands which includes Marion Island.

1800 – 1932
Sealing industry thrives and leads to the near extermination of fur seals on Prince Edward Islands.

1939 – 1948
After World War II, Marion and Prince Edward islands are annexed in 1948 and officially proclaimed South Africa's territory.

1958/59
The first South African National Antarctic Expedition (SANAE) based at an old Norwegian station.

1962
SANAE I, the first South African base is built in Antarctica.

1963
The first postgraduate degree (MSc) is awarded for research conducted as part of South African National Antarctic Programme (SANAP).

1970/71
The first SANAE base in Antarctica replaced by a second base called SANAE II.

1978
The research vessel, the mv SA Agulhas, makes its maiden voyage.

1978/79
SANAE II is replaced by SANAE III.

1981
Two long-range Aerospatiale Puma helicopters become available on the SA Agulhas.

1991/92 – 1996/97
The SANAE IV base is erected on hard rock at Vesleskarvet in Antarctica.

2003
Research support transferred to the Department of Science and Technology and logistics remains with the Department of Environmental Affairs and Tourism.

SA Agulhas

The SA Agulhas is the Department of Environmental Affairs and Tourism's research and supply vessel, which is used by the South African National Antarctic Programme (SANAP) for the transportation of personnel and cargo to its three bases in Antarctica and on Marion and Gough islands. Other countries also charter the Agulhas to assist with their Antarctic programmes, e.g. Germany. The ship also conducts research, weather observations and buoy deployments in the waters surrounding Antarctica, and Marion and Gough islands. Many weather buoys have been released at 12-hourly intervals on these voyages, and meteorological reports are transmitted every three hours when at sea. The Agulhas uses satellite navigation to plot its way from South Africa to the three bases. The ship has a large hanger that accommodates helicopters used for air support in the offloading of personnel and cargo at all three stations. The Agulhas can accommodate 94 non-naval passengers and each cabin has its own shower and toilet facilities.

Living conditions for humans in Antarctica

Antarctica has no native human population. It is a hostile environment and living there is extremely difficult. Researchers from a number of countries occupy the continent at various bases. Ship and air support provide the transportation of personnel, equipment, cargo and supplies. This includes vehicles, food, fuel, research equipment, clothing, etc.

South African base in Antarctica

Antarctica has hostile living conditions that are not suitable for human beings, therefore the design of the South African base requires careful consideration. In addition to this, researchers are committed to preserving the fragile environment of the Antarctic and have to be extra careful not to destroy or pollute the surrounding ecosystems.

When South African researchers first started staying in the Antarctic they stayed in bases – SANAE I, II and III – which were built on the ice shelf. However, these bases had a short lifespan due to impacting snow. The decision was therefore made to build SANAE IV about 170km inland on a 'nunatak' (meaning rocky outcrop) at Vesleskarvet.

The frame of the base is made of steel and the outer layer is rigid, pre-constructed foam and fibreglass panels. The base is built on stilts, to allow for wind flow and to prevent the accumulation of snow. The roof and bottom panels are painted bright orange which makes it easier to see the base from the air. The living quarters are heated by heat exchangers that are run off a generator. Fresh water is obtained by melting snow.

Antarctic Treaty

The Antarctic continent belongs to no state or government. The Antarctic Treaty was drafted to ensure that no dispute arises over the ownership of Antarctica. The governments of Argentina, Australia, Belgium, Chile, France, Japan, New Zealand, Russia, Britain, Northern Ireland, the United States and South Africa are the 12 original signatories of the Antarctic Treaty. The treaty recognises the important contributions Antarctica makes to scientific investigations and prohibits any military or mining activity. Some of the conditions of the treaty include that:

- Antarctica may be used for peaceful purposes only;
- freedom of scientific investigation is allowed;
- information regarding plans for scientific programmes in Antarctica must be exchanged to ensure maximum economy and efficiency of operations;
- scientific personnel in Antarctica can be exchanged between expeditions and stations;
- scientific observations and results from Antarctica must be freely exchanged; and
- no nuclear explosions or disposal of radioactive materials will be allowed in the Antarctic.

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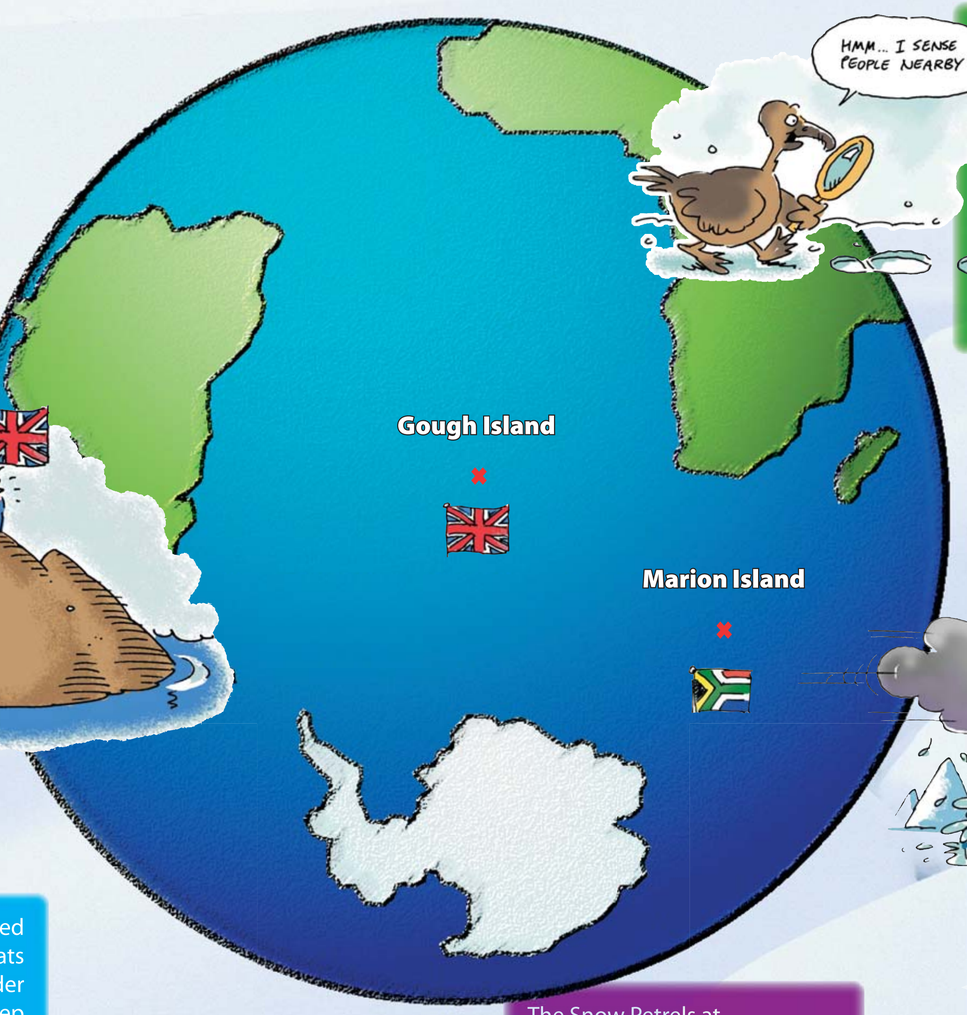
DID YOU KNOW?

The increase in temperature on Marion Island has improved conditions for the mice on the island, which were introduced by passing ships over 200 years ago. They eat insects and earthworms, which are the only creatures feeding on plants. With fewer herbivores, the energy and nutrients from plants are not being effectively passed back into the ecosystem. The natural bottleneck has become tighter because of the rodents.

During 1996, Gough Island and its surrounding waters were given World Heritage Site status.

PATRIMONIO MUNDIAL • WORLD HERITAGE • PATRIMOINE MONDIAL

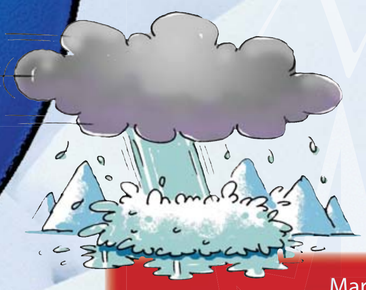
Gough Island is a British possession, and is uninhabited save for the eight to ten South Africans and British nationals undertaking research and manning the meteorological station, leased as part of an agreement between the two countries.



Skuas are scavenging, gull-like birds with unerring instincts when it comes to finding human activity. These birds arrive at campsites far inland within hours of them being established. American scientists have gone so far as to suggest that the birds detect the vapour trails of helicopters and follow them inland.

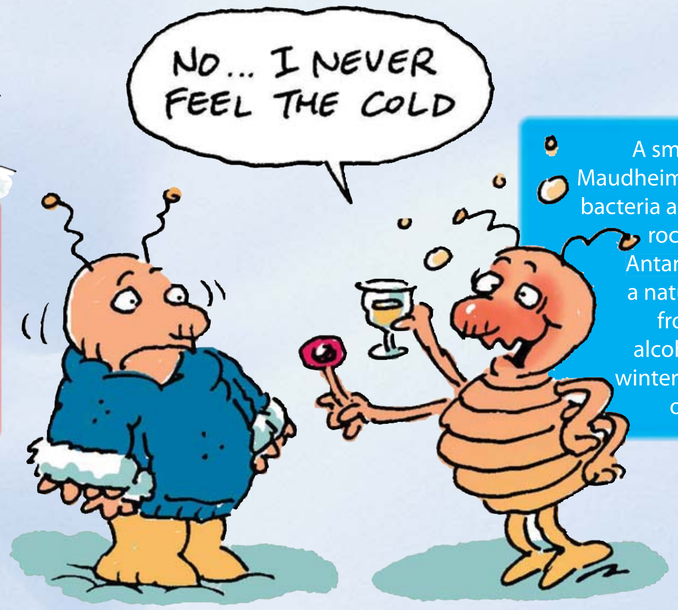
Some lichen species in Antarctica can survive temperatures of -96 degrees Celsius, even though many of the same species are also found in mild and tropical climates.

In the past 40 years, Marion Island's average temperature has increased by approximately 2 degrees Celsius. Sub-Antarctic temperatures are rising faster than anywhere else in the world.



Marion Island has about 2 400mm of rain every year (Gough Island has in the region of 3 120mm), and the average wind speed is about 60% higher than that of Cape Town.

This area still retains its hard-to-pronounce Norwegian names, like Borgmassivet, Ahlmannryggen and Sverdrupfjella-Kirwanveggen.



A small mite called Maudheimia, which eats bacteria and lives under rocks in the deep Antarctic, produces a natural antifreeze from sugars and alcohols to survive winter temperatures of -30° Celsius.

South Africa established its first station in Antarctica when it took over the Norwegian base in Queen Mary Land in 1960, after Norway vacated it.

The Snow Petrels at Robertskollen, near the SANAE IV base, nest so deep inland that adults have to make a daily round trip to the sea and back of more than 300km every time they feed their chicks.

South Africa first occupied Marion Island in the late 1940s, for use as a whaling base.

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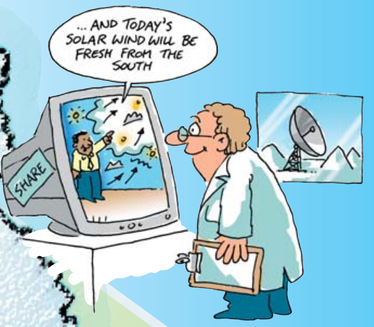
ANTARCTIC RESEARCH: PHYSICAL SCIENCE

What is physical science?

- Physical science is the study of non-living things. This science includes physics and chemistry.
- Physical science research is conducted all year round on the Antarctic, as the research is not constrained by temperature fluctuations and weather conditions.
- Physical science research has been conducted on Antarctica since 1957.
- Universities carrying out physical science research on the Antarctic include the University of KwaZulu-Natal and North West University.



Contact details

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South Hemisphere Auroral Radar Experiment (SHARE)

- The polar regions provide excellent locations for observing geospace from Earth.
- Geospace is the area of space that surrounds Earth. In this region, the stream of particles from the Sun, known as solar wind, interact with the Earth's magnetic field.
- These particles travel along geomagnetic field lines, which provide information on the activities in deep space.
- The geomagnetic field lines intersect at the polar regions and extend into space.
- SHARE is a high frequency coherent phased array radar experiment, which gathers information about electric field lines, velocities and irregularities in the upper atmosphere over some of Antarctica.
- This is a cooperative international programme involving institutions in South Africa, Australia, Canada, France, Japan, the United Kingdom and the United States of America.
- The radar came into operation in 1997 and is part of the SuperDARN programme.
- Antarctica is a window into geospace. Satellites, which orbit in geospace, provide communication, navigation and remote sensing on Earth. Understanding the solar wind and geospace will enable scientists to better design and protect satellites from particle radiation and magnetic storms, which may damage or destroy the satellites.

Super Dual Auroral Radar Network (SuperDARN)

- SuperDARN is a network of high-frequency radars used to study the Earth's ionosphere.
- The radar operates 24 hours a day and provides global observations.
- SuperDARN has won a NASA award for its high quality data collection and has become a primary radar resource for satellite researchers.
- SuperDARN coordinates observations and integrates the data products, so that they are available to all participants.

Antarctic Research On Cosmic Rays (ANOKS)

- Cosmic rays are extremely energetic particles originating both in the Sun and in the galaxy.
- Understanding cosmic rays is essential for studying space weather, which influences satellite communication systems.
- A neutron monitor has been operational at SANAE IV since the earliest expedition.
- It offers a nearly continuous data set extending over approximately four solar cycles, which offers an understanding of the modulation of cosmic rays by solar activity.

Antarctic Magnetosphere, Ionosphere Ground-based Observations (AMIGO)

- The magnetosphere protects the Earth by deflecting solar wind and by blocking some of the radiation, which is potentially dangerous to life on Earth.
- Since scientists on Earth cannot recreate any of the reactions that take place in space, AMIGO is an important contributor to the study of geospace.
- AMIGO contributes to the international cooperative programme: Solar Terrestrial Energy Programme (STEP).
- AMIGO measures energy transfer processes in the magnetosphere and ionosphere, including phenomena such as magnetic pulsations and the aurora.

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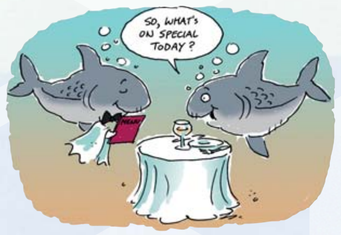
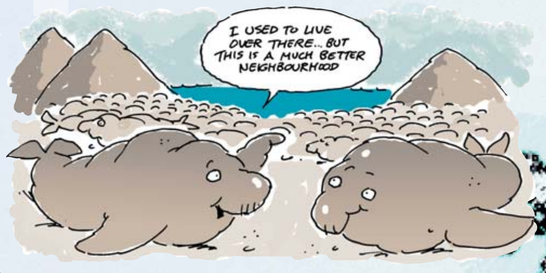
ANTARCTIC RESEARCH: OCEANOGRAPHIC SCIENCE



Some ongoing research projects conducted around Antarctica include:

- the composition and feeding ecology of demersal fish communities;
- the trophic position of pinnipeds at Marion Island; and
- the ecology of the swimming prawn, *Nauticaris marionis*, at the Prince Edward Islands.

Investigating the vast oceans south of Africa, contributes to a concise understanding of the weather and climate of southern Africa.



Studying the oceanic environment of the Prince Edward Islands has revealed the unexpected presence of a range of cyclonic and anti-cyclonic eddies (small swirls) near the islands.

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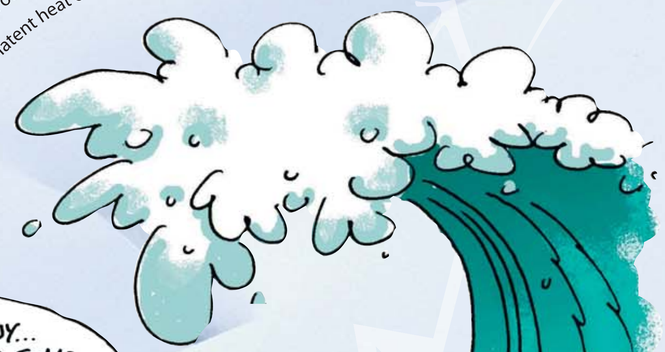
University of Fort Hare
Dept. of Zoology
www.ufh.ac.za

University of Cape Town
Dept. of Oceanography
www.uct.ac.za

Some of South Africa's research activities include measuring surface atmospheric variables and ocean surface fluxes, such as turbulent fluxes of momentum, sensible heat and latent heat over the southern ocean.



Oceanography is the scientific study of oceans, including their chemistry, biology and geology. South Africa has participated in the International Southern Ocean Studies (ISOS) programme since 1970.

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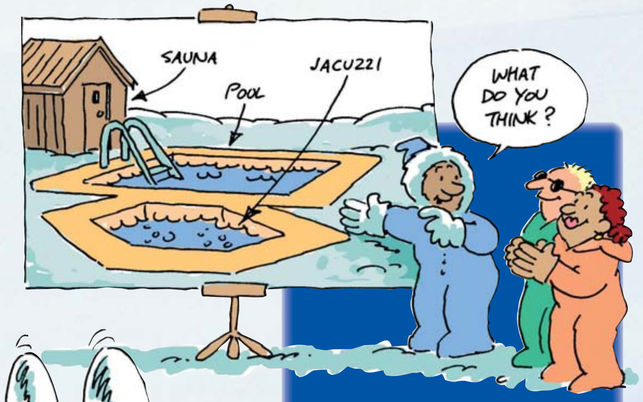
ANTARCTIC RESEARCH: ENGINEERING SCIENCES

Engineering research at the Antarctic started in 1999 and emphasises the natural and environmental dimension of science, as opposed to industrial-orientated engineering research. Students often conduct and complete their research at Antarctica.

EXPLORING WIND ENERGY

A technical and economic evaluation of how wind energy can be used at the South African Antarctic base was completed in 2003 as a Masters thesis in Mechanical Engineering.

IMPROVING LIVING CONDITIONS



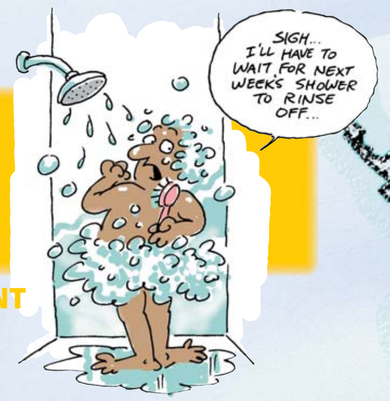
Mechanical, electronic, aeronautical and marine engineering are being used to provide for the technical needs and improve living conditions at the bases on the Antarctic.

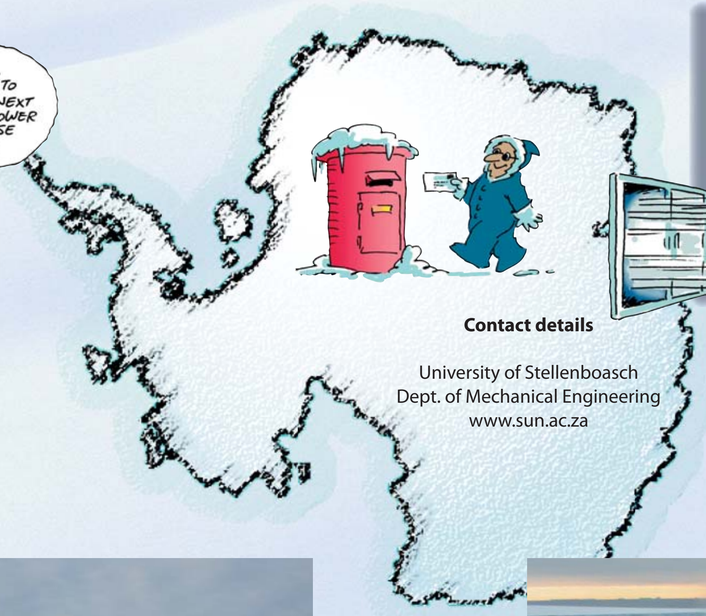
REDUCING AIR POLLUTION

An investigation was conducted into reducing the impact of diesel engines on the Antarctic environment with the associated maintenance benefits.

Other theses that have been completed at the Antarctic are:
- Energy Management in 2002; and
- Waste Management in 2003.

ENERGY & WASTE MANAGEMENT





Contact details

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Some projects include the heating and ventilation of the South African bases on Antarctica. Addressing these issues was done as a B.Sc (Eng) thesis.

HEATING & VENTILATION

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