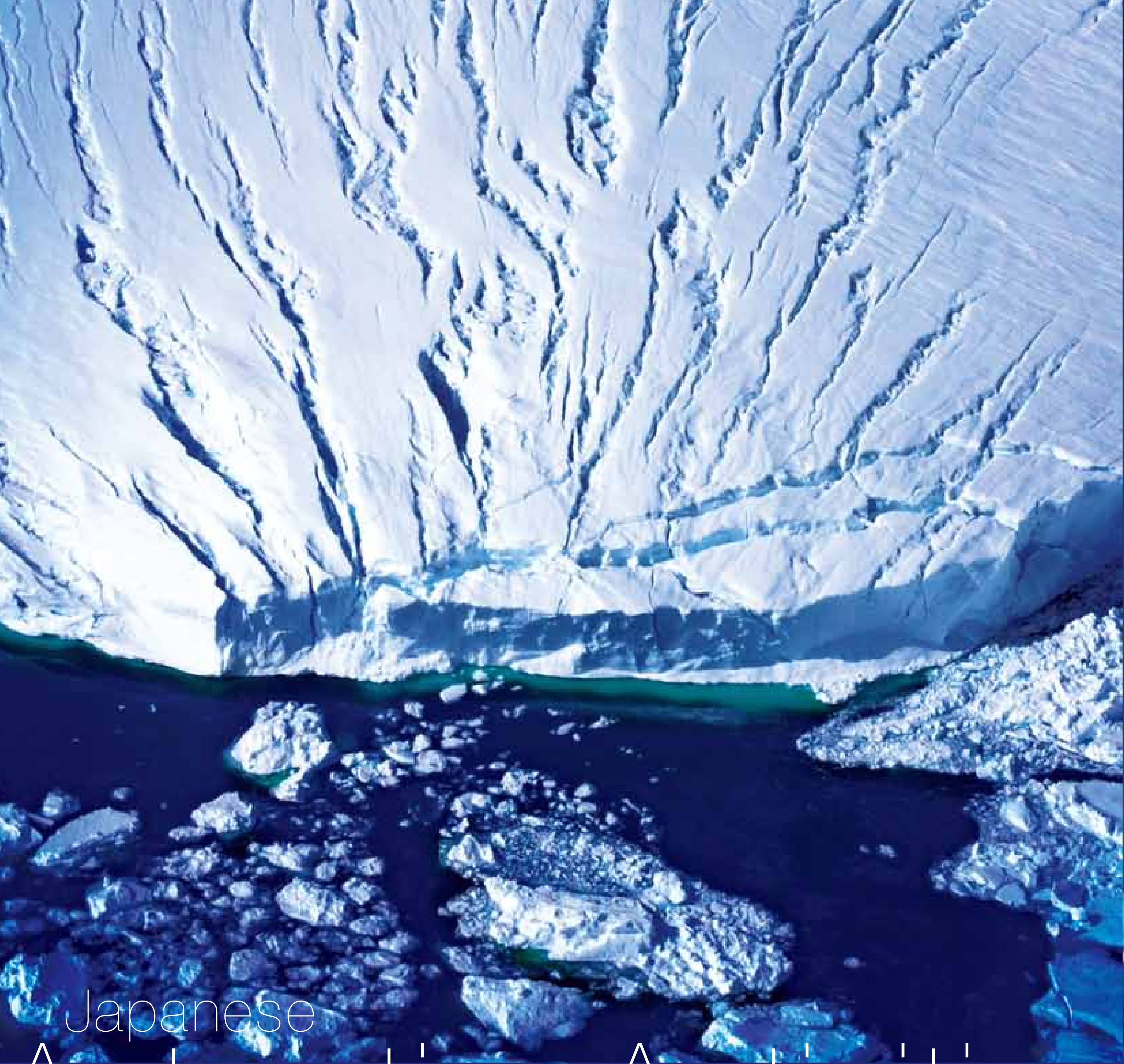

Japanese Antarctic Activities

Japanese Antarctic Activities

National Institute of Polar Research Japan
Research Organization of Information and Systems

National Institute of Polar Research Japan
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Midori-cho 10-3, Tachikawa-shi, Tokyo 190-8518, JAPAN
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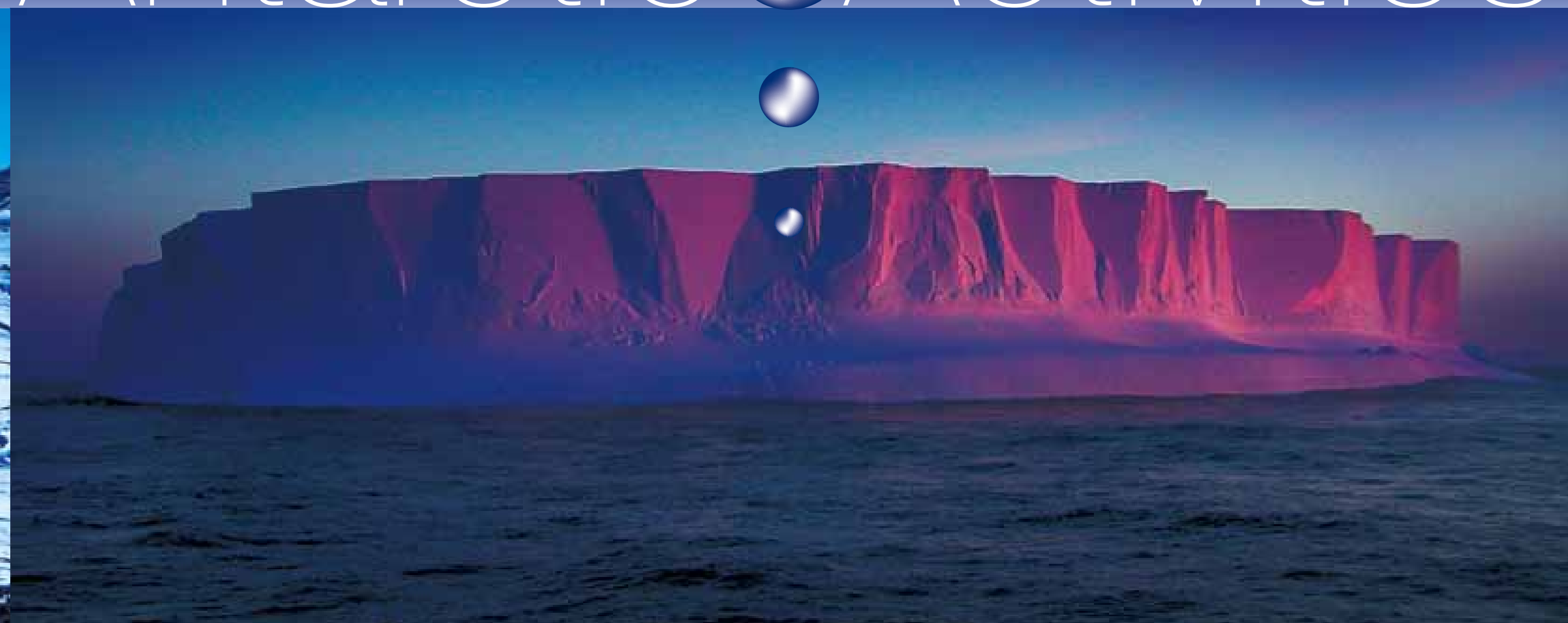
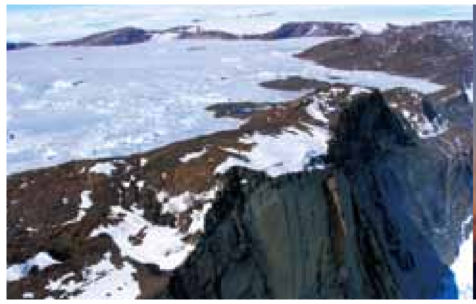


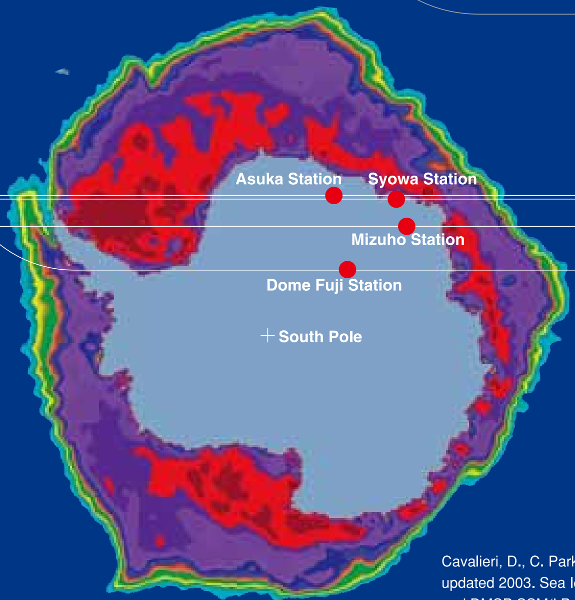
Contents

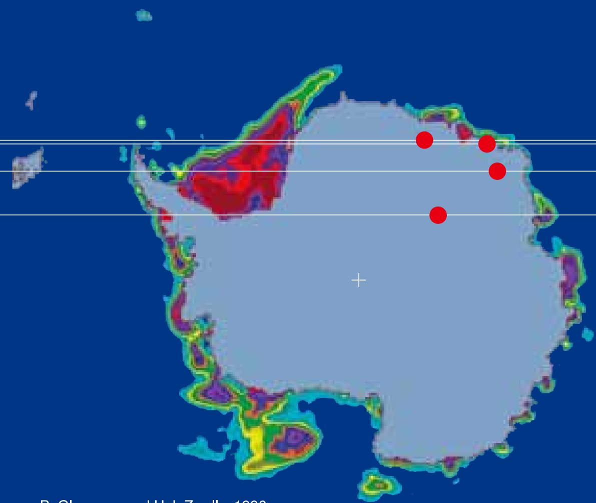


Ice Distribution and Seasonal Change

Left diagram shows maximum distribution (August)
Right diagram shows minimum distribution (February)

100 90 80 70 60 50 40 30 20 10 0
Proximity to Sea-ice (%)





Cavalieri, D., C. Parkinson, P. Gloerson, and H.J. Zwally. 1996, updated 2003. Sea Ice Concentrations from Nimbus-7 SMMR and DMSP SSM/I Passive Microwave Data. Boulder, CO, USA: National Snow and Ice Data Center. CD-ROM.

Japanese Research Stations

Syowa Station

Location : 69° 00' south latitude ;
39° 35' east longitude
Elevation : 29m
Established : 1957
Straight-line Distance from Tokyo : approximately 14,000km
Building Floor Area : approximately 6,800m²
Average Temperature : −10.5℃
Maximum Temperature : 10.0℃
Minimum Temperature : −45.3℃

Dome Fuji Station

Location : 77° 19' south latitude;
39° 42' east longitude
Elevation : 3,810m
Established : 1995
Building Floor Area : approximately 420m²
Average Temperature : −54.3℃
Maximum Temperature : −18.6℃
Minimum Temperature : −79.7℃

Asuka Station

Location : 71° 32' south latitude ;
24° 08' east longitude
Elevation : 930m
Established : 1985
Building Floor Area : approximately 440m²
Average Temperature : −18.3℃
Maximum Temperature : 0.5℃
Minimum Temperature : −48.7℃

Mizuho Station

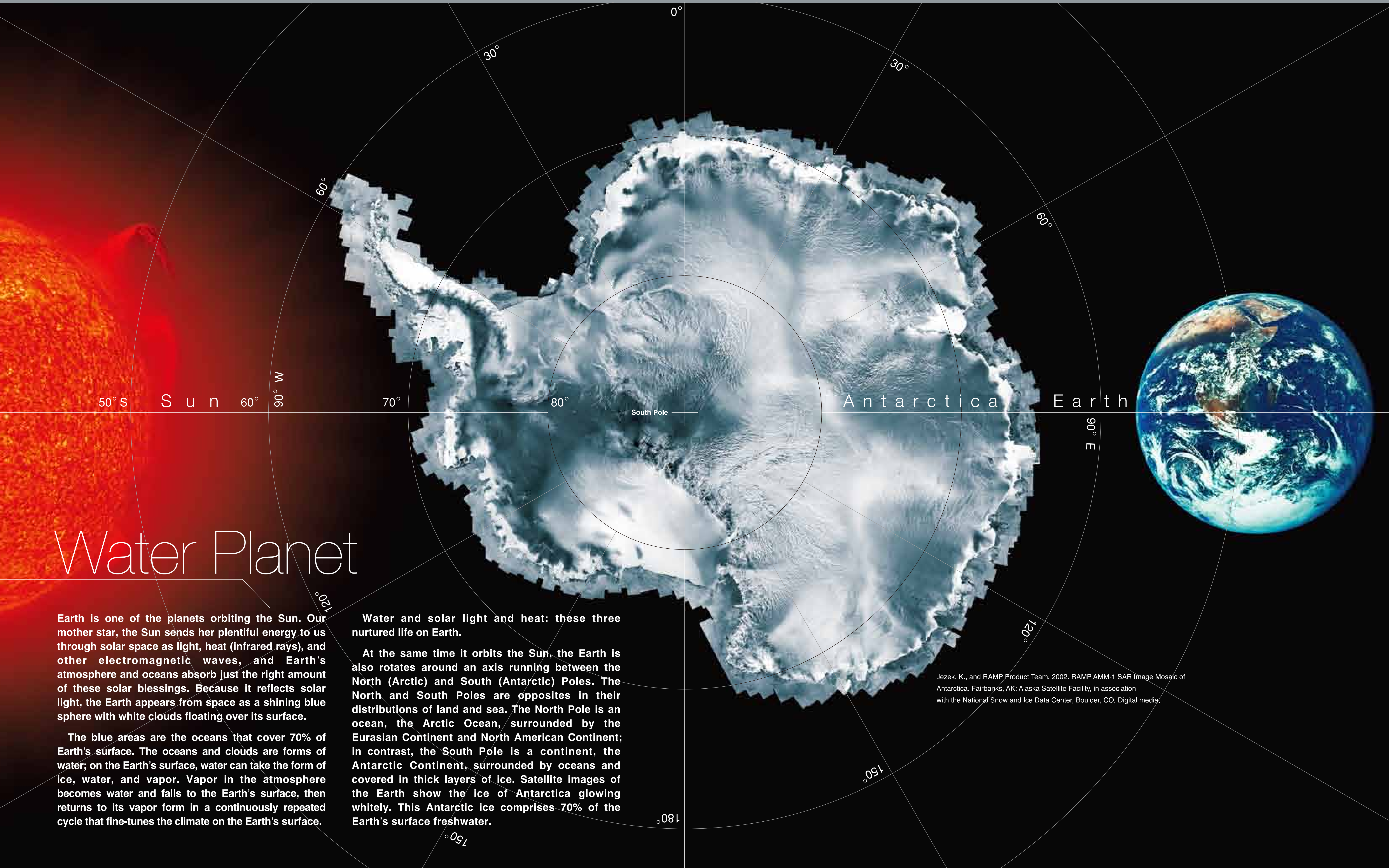
Location : 70° 42' south latitude ;
44° 20' east longitude
Elevation : 2,230m
Established : 1970
Building Floor Area : approximately 100m²
Average Temperature : −32.3℃
Maximum Temperature : −2.7℃
Minimum Temperature : −61.9℃

Size of Antarctic Continent

Continent Area	12,267,000km²
Average Overall Ice Thickness	1,856m
Greatest Ice Thickness	4,776m
Highest Elevation	4,892m
Sea Level Rise if All Ice Melted	57m

Design : Takada Jimusho
Photography:
Table 1: National Institute of Polar Research (NIPR)
Table 4: Asahi Shimbun Co./Tsuyoshi Takeda; National Institute of Polar Research (NIPR)
2−3 National Snow and Ice Data Center
2−3 National Institute of Polar Research (NIPR)
4−5 Jezek, K., and RAMP Product Team. 2002. RAMP AMM-1 SAR Image Mosaic of Antarctica. Fairbanks, AK: Alaska Satellite Facility, in association with the National Snow and Ice Data Center, Boulder, CO. Digital media.
4 SOHO (ESA & NASA)
6~15 National Institute of Polar Research (NIPR)
16~17 Asahi Shimbun Co./Tsuyoshi Takeda
17 (center/right panel) National Institute of Polar Research (NIPR)
17 (bottom) Nimbus 7; Earth Probe, TOMS
18~33 National Institute of Polar Research (NIPR)
28 (bottom panel, left/center) Asahi Shimbun Co./Tsuyoshi Takeda
34 (left) Asahi Shimbun Co./Tsuyoshi Takeda
35 National Institute of Polar Research (NIPR)/Earth Probe, TOMS/ Shirase Antarctic Expedition Memorial Museum

【Production Assistance】
Sci-Tech Communications Inc.



Jezek, K., and RAMP Product Team. 2002. RAMP AMM-1 SAR Image Mosaic of Antarctica. Fairbanks, AK: Alaska Satellite Facility, in association with the National Snow and Ice Data Center, Boulder, CO. Digital media.

Water Planet

Earth is one of the planets orbiting the Sun. Our mother star, the Sun sends her plentiful energy to us through solar space as light, heat (infrared rays), and other electromagnetic waves, and Earth's atmosphere and oceans absorb just the right amount of these solar blessings. Because it reflects solar light, the Earth appears from space as a shining blue sphere with white clouds floating over its surface.

The blue areas are the oceans that cover 70% of Earth's surface. The oceans and clouds are forms of water; on the Earth's surface, water can take the form of ice, water, and vapor. Vapor in the atmosphere becomes water and falls to the Earth's surface, then returns to its vapor form in a continuously repeated cycle that fine-tunes the climate on the Earth's surface.

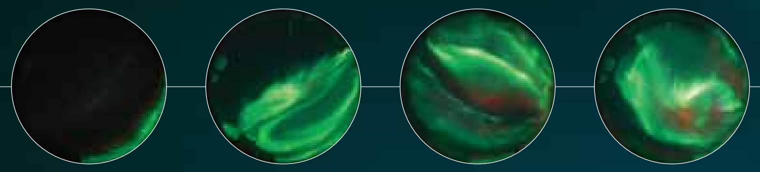
Water and solar light and heat: these three nurtured life on Earth.

At the same time it orbits the Sun, the Earth is also rotates around an axis running between the North (Arctic) and South (Antarctic) Poles. The North and South Poles are opposites in their distributions of land and sea. The North Pole is an ocean, the Arctic Ocean, surrounded by the Eurasian Continent and North American Continent; in contrast, the South Pole is a continent, the Antarctic Continent, surrounded by oceans and covered in thick layers of ice. Satellite images of the Earth show the ice of Antarctica glowing whitely. This Antarctic ice comprises 70% of the Earth's surface freshwater.

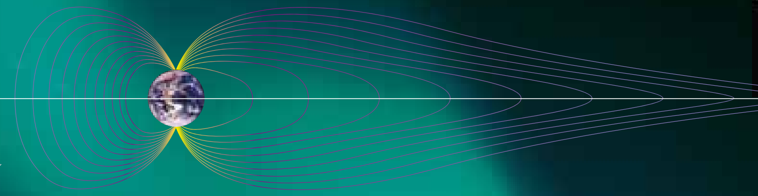
Earth within the Universe

Auroras and Solar Wind

S o l a r W i n d

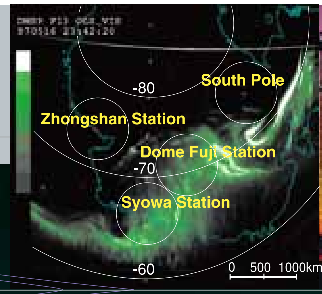


Time series of all-sky auroral images observed at Dome Fuji Station on May 29th, 2003.
Pictures were taken at 18:22, 18:32, 19:12 and 19:22 UT(from left to right).



Magnetic field lines in the magnetosphere.
They converge to the southern and the northern poles.

Auroral images over Antarctica observed by DMSP satellite.



Antenna array for HF radar at Syowa Station.

Syowa Station is an excellent site for watching auroras, because the station is located just beneath the auroral zone, an oval shaped area centered at the magnetic pole having frequent auroral activity.

The source of auroras is the kinetic and electromagnetic energy of solar wind. Solar wind, which is originated from the solar corona, reaches the earth and transfers its energy to the magnetosphere through electromagnetic and kinetic interaction with the earth's magnetic field. The transferred energies accelerate electrons and ions in the magnetosphere and these charged particles bombard the atmosphere above the polar regions at an altitude of 100-500 km called as ionosphere. Auroral light is emitted from these excited molecules and atoms, such as oxygen and nitrogen, in the course of the process as they settle down.

Auroras appear in various colors and shapes, and show rapid motion at times. Much about their generation mechanism, however, remains a mystery. Japanese researchers are continuing their efforts to find these answers through theoretical studies and field experiments utilizing various instruments such as all-sky TV cameras, auroral spectrometers, radio wave receivers and radar. HF radars at Syowa Station can measure the motion of ionospheric plasma through the Doppler shift of the backscatter. They are part of the international HF radar network in which 16 stations participate in both polar regions.

Two areas in the northern and southern polar region connected with the same field line are called as "magnetic conjugate points". It is speculated that similar auroras are seen at magnetic conjugate points because the auroral electrons responsible for auroral luminosity move along the field lines. To confirm this theory, we have been conducting simultaneous observations of auroras at Syowa Station and the magnetic conjugate point in Iceland since 1984.

Earth within the Universe

Meteorites

Meteorites are the only extraterrestrial materials that we humans have been able to lay hands on. They fall all over the Earth's surface, but meteorites that fall on Antarctica are buried in snow and remain frozen for tens of thousands of years or more.

The buried meteorites move with Antarctic ice sheets; if they hit a mountain range, however, they slow down and the surface ice sublimes, allowing the meteorites to show themselves on the surface. This meteorite accumulation mechanism was clarified by Japanese researchers in 1978 following the discovery of 663 "Yamato meteorites" in 1974 by Japanese observation personnel. Since then, huge quantities of meteorites have been collected.

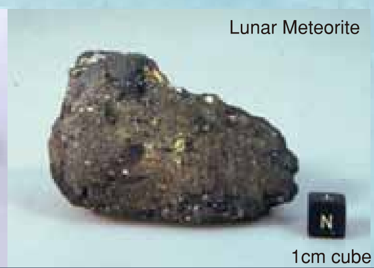
Most meteorites originate from asteroids created early in our solar system's formation. Thus these meteorites are being analyzed to find out what happened to their parent bodies (collisions with other asteroids, etc) in an attempt to piece together a model of how the solar system was formed. In order to obtain the comprehensive data for such a model, more meteorite samples are needed. This is why the recovery of meteorites from Antarctica is so important.

Meteorites recovered from Antarctica are analyzed and stored at the NIPR Antarctic Meteorite Research Center. Currently the center has 16,836 meteorites, the largest collection in the world. Amongst the wide variety of meteorites in the collection are, in addition to the more typical asteroidal meteorites, nine lunar meteorites and six martian meteorites. Samples of all of the meteorites stored at the Antarctic Meteorite Research Center are freely available to researchers throughout the world.

Iron on the bare ice

Eucrite from Vesta

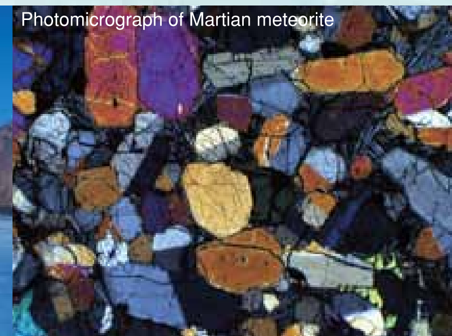
Martian Meteorite



Lunar Meteorite

1cm cube

Meteorite Search around the Yamato Mountains



Photomicrograph of Martian meteorite

Antarctica within the World

Ice Sheets

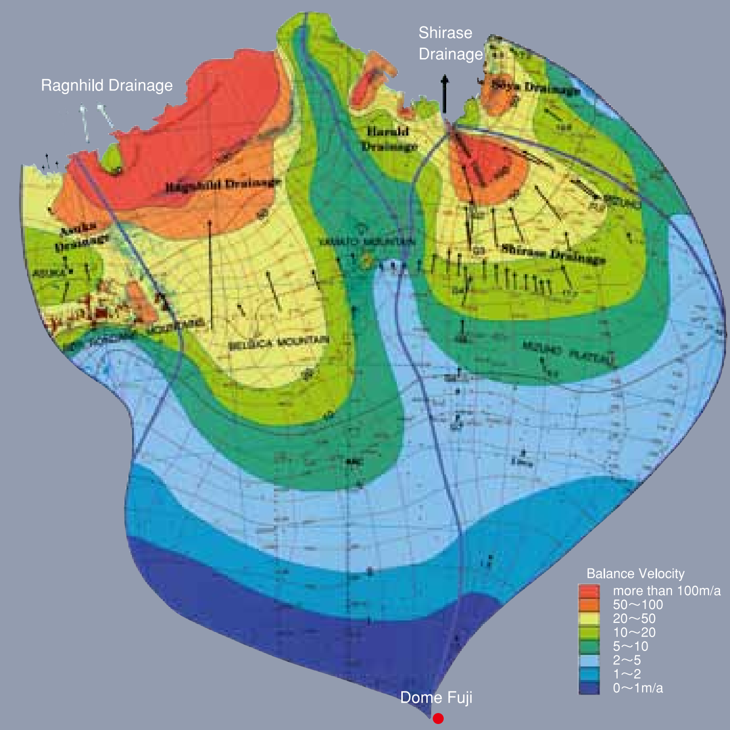
The vicinity of the Dome Fuji. There is thicker than 3000m of ice underneath of the station and the age of the deepest ice is estimated around one million.

Shallow ice coring

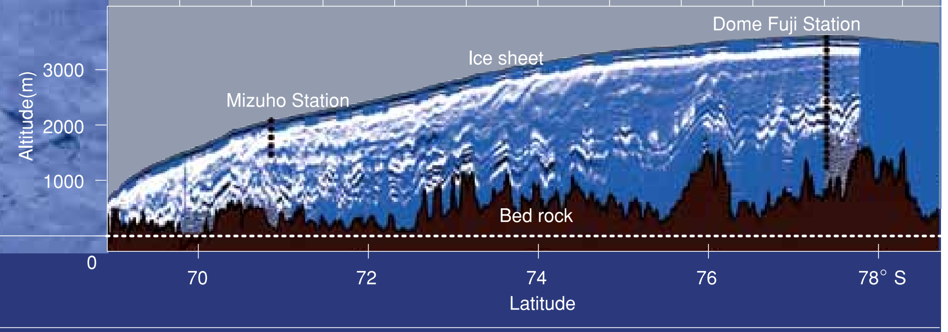
Ice radar observation

Geodesic observation by GPS

Surface ice flow map in East Dronning Maud Land.
Arrows shows ice flow velocities.



Bed rock and internal layering detected by ice radar soundings.



Antarctica is covered in a gigantic mass of ice, called an “ice sheet.” Measuring approximately 33 times the area of Japan, this ice sheet averages a depth of 1856m over the entire Antarctic continent. It has been created over a time scale of 100 thousand to one million years as fallen snow and frost accumulated and gradually turned into ice. Because the ice sheet is propelled by its own weight to move unrelentingly towards low areas, year on year massive amounts of ice break off the edge of the continent and float out to sea, even as snowfall continues to accumulate.

“Mass balance” – the balance between the amount of ice added through snowfall and the amount that breaks off into the sea – is closely linked to global climatic changes such as global warming. Thus in order to clarify the overall scale of the ice sheet (mass) and the changes taking place (balance), the topography, thickness, and movement (flow) of the ice sheet and the distribution of snowfall are being observed.

Japanese Antarctic Research Expedition (JARE) organizes a team to undertake an “observation journey” of some several thousand kilometres in the Antarctic interior. During this time, they will measure the movement of a reference point using GPS and examine year-on-year snow accumulation. The team will also study the thickness, internal structure,and movement of the ice sheet using electromagnetic waves emitted from an ice radar fitted to a vehicle on the ice sheet’s surface, analysing the waves bounced off the surface and bed over snow rock lying underneath.

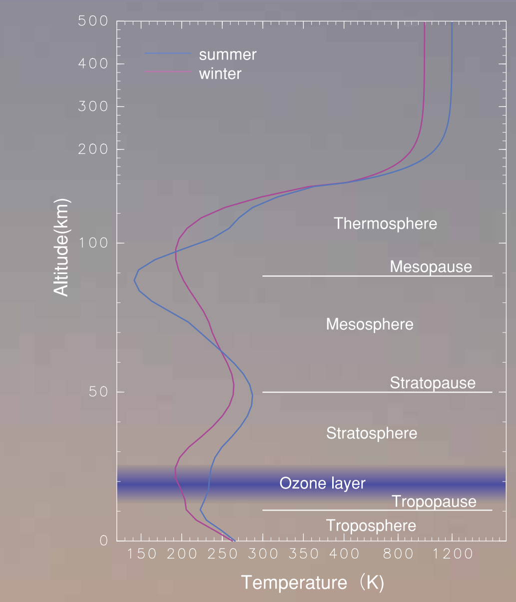
Atmosphere

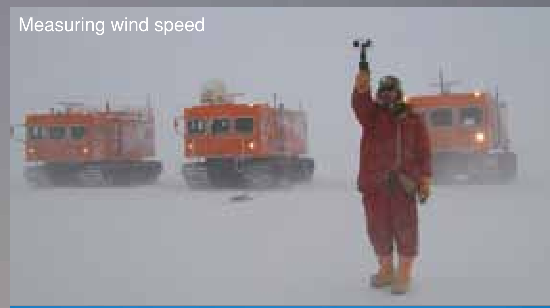
Overall, there is balance between the solar radiation absorbed by the Earth and the terrestrial radiation that escapes into space. Terrestrial radiation is intense in the polar regions, while solar radiation is intense in the tropical regions. Solar radiation absorbed in the polar regions is weak not only because the Sun's rays strike at an angle but also because most of the radiation reflects off the white ice sheets covering the land and sea in these regions. In actual fact, a general circulation system operates in the atmosphere and oceans to reduce these temperature differences; the global climate is determined by the polar regions, acting as "cold origins", and the tropical regions, acting as "heat origins."

Radiation is not the only force driving this general circulation. Ocean circulation is also driven by the production of high-saline seawater created by the sea ice-forming process being pushed deep below the ocean surface. The sea ice prevents heat loss from the ocean surface. Katabatic winds – strong winds created by air becoming cold and heavy over Antarctica that blow down mountains and other slopes – are an important driving force in the Southern Hemisphere tropospheric circulation. In atmospheric layers above the stratosphere, various atmospheric waves, such as atmospheric gravity waves, drive circulation. The ozone, carbon dioxide and trace constituents, such as aerosol, carried via circulation, affect the global climate by transforming irradiation processes such as the greenhouse effect.

In this way, the global climate is balanced and determined by various interracting processes. Observing these processes in the inhospitable polar regions is, however, fraught with difficulty, and so much about many of these processes remain a mystery. For this reason, Japan's Antarctic observation team employs in the course of their research ground-based observation, balloons, radars, lidars, air-based observation of the upper atmosphere, and ship-based observation. Some of the data thus collected is used to analyse global weather. Furthermore, the world's first large-scale atmospheric radar in Antarctica, covering a broad high-altitude area, has been planned at Syowa, and plans are moving ahead to comprehensively study the role of the polar regions within the global climate.

Atmospheric Temperature profile at Syowa Station




Measuring wind speed


Radio sonde launching


HF radar in Syowa Station


The shadow of the Earth

Antarctica within the World

The ocean surrounding the Antarctic is home to numerous and diverse organisms, from penguins, seals, and the whales that visit during summer, to squid, octopus, fish, and the sponges and sea squirts that live on the ocean floor. These biologically rich marine ecosystems are supported by the phytoplankton such as diatoms that produce vast quantities of organic matter during the summer, when the hours of sunlight are long, and by the zooplankton such as Antarctic krill that reproduce relying on the phytoplankton.

Japan's research team examines not only Antarctic krill distributions but also DMS (dimethylsulfide) production mechanisms. These studies will enhance our understanding of biological production of the Antarctic marine ecosystems as a whole, as well as their link with global climate change. Furthermore, the team examines at-sea behaviour of penguins and seals using small recording devices attached to the animals. These devices can measure not only diving depth but also swimming speed, migratory routes, and physiology of the animals; the surrounding environment of the animals can be observed by attaching digital camera loggers as well.

Unlike the flourishing ocean, land-dwelling creatures are able to inhabit only a limited number of areas along the edge of thick ice-covered Antarctic continent: only approximately 3% of the continent is exposed. This is an inhospitable environment of extremely low temperatures, dryness, strong winds, and little food; yet on close inspection we discover plants such as mosses and lichens growing and arthropods such as mites and springtails living there. The ecosystem structure of the exposed rock area around Syowa Station is the best understood of all Antarctic terrestrial ecosystems.

Biosphere

Mother-pup pair of Weddell seals

Plankton Sampling

Colored sea ice with algae

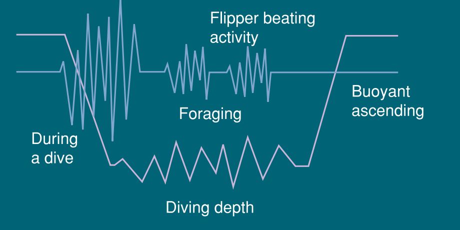
Grown ice algae in sea water

Antarctic krill

Field study on Weddell seals

King penguin with data logger

Flipper beat of penguin during dives



Viewing the World from Antarctica

Climatic Changes

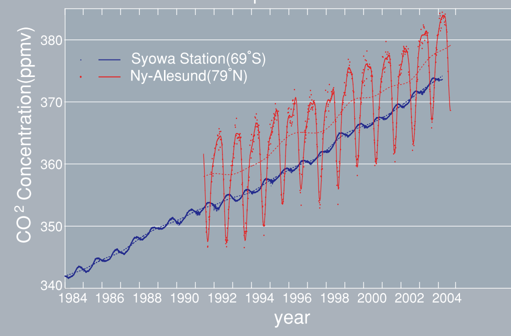
Stratospheric air sampling observation by large plastic balloon

Balloon-borne observation of Ozone

Polar stratospheric clouds

Total Ozone observation

Secular trend of Atmospheric Carbon Dioxide



Encircling the globe at an altitude of around 25km is an ozone layer in the atmosphere that protects life on Earth from the sun's harmful ultra-violet radiation. Since about 20 years ago, however, an "ozone hole" – a thinning of the ozone layer over Antarctica similar to a hole opening up – has appeared. The ozone hole has gradually expanded and has recently grown to a size approximately twice the area of Antarctica.

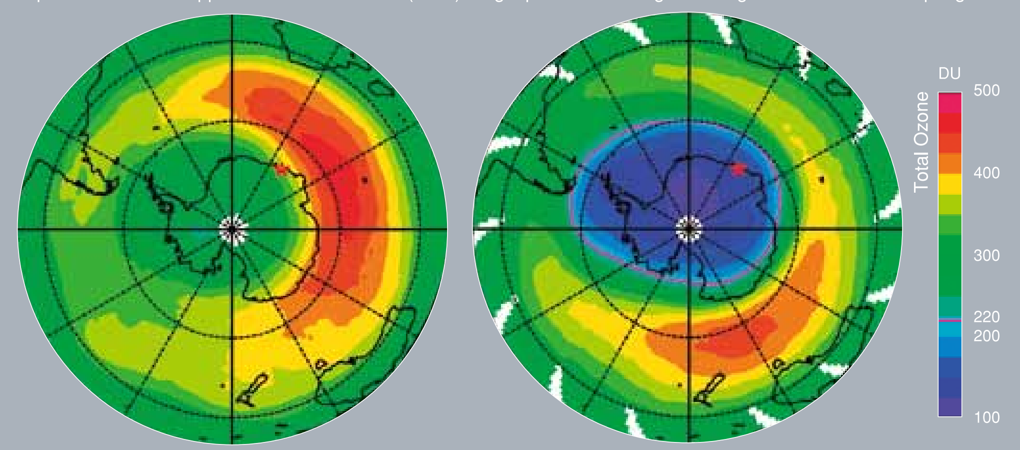
Chlorofluoro-carbons, the substances causing the ozone hole, are anthropogenic. Atmospheric circulation carries them up into the stratosphere, where ultra-violet radiation transforms them into ozone-depleting substances. Unusual clouds called polar stratospheric clouds form during the Antarctic winter, and because these accelerate the ozone destruction, an ozone hole has appeared above Antarctica and nowhere else.

Thus, because environmental conditions in Antarctica are so extreme to begin with, the region is more easily and greatly affected by environmental destruction resulting from human activities. At the same time, because Antarctica is located so remotely from human activities, there are no noise sources such as urbanization or industrial activities, and this enables highly accurate observation of changes in the Earth's atmosphere.

Research of meteorological elements, such as temperature and wind speed, and of carbon dioxide and other representative greenhouse gases has been carried out at the Syowa Station for several decades, contributing to study of global warming and other phenomena affecting the Earth's climate. Ozone observation also continues, one major achievement being the discovery of the ozone hole in 1982.

Total Ozone Map of the Southern Hemisphere

Left panel : before the appearance of Ozone hole(1979) Right panel : The image of a large Ozone hole in the spring 2003



＊＊ Data : Nimbus 7・Earth Probe, TOMS ★Syowa Station

Viewing the World from Antarctica

Geosphere

Interaction between the plates covering the Earth's surface is thought to be the trigger for various crustal movements, such as earthquakes and volcanic eruptions. There are several plates, each of which moves independently to the others; mountain ranges are formed where they collide, and faults are formed where they pass each other.

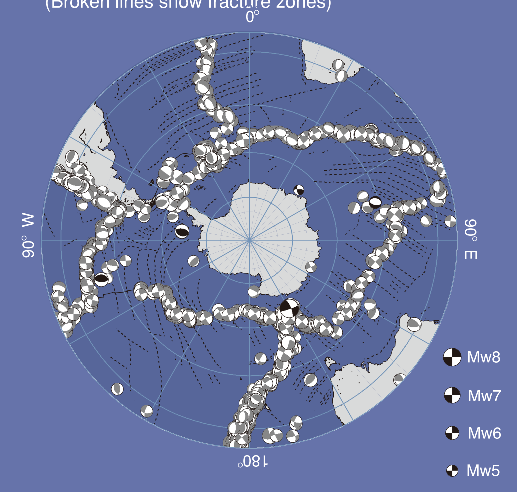
Another form of change that occurs is "post-glacial rebound," crustal upheaval caused by the melting of ice sheets. In order to understand crustal processes over various time scales, as well as the Earth's internal structure, field research and continuous observation over extended time periods is indispensable.

The Antarctic Continent and surrounding ocean regions sit on one plate, the "Antarctic Plate." Syowa Station is continuously monitoring not only terrestrial magnetism, but also earthquakes, oceanic tides, and gravity, as well as land surface topography using SAR (Synthetic Aperture Radar). The station is also participating in a global observation network employing GPS (Global Positioning System) satellite data and VLBI (Very-Long-Baseline Interferometry).

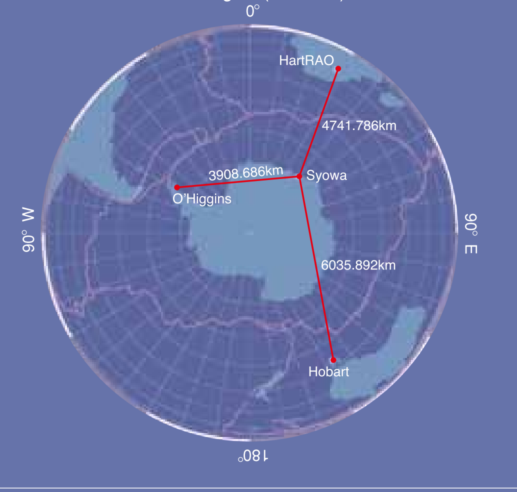
These observation activities are conducted by not only the National Institute of Polar Research (NIPR), but also in cooperation with the Japan Meteorological Agency, National Institute of Information and Communications Technology, Geospatial Information Authority of Japan, and Japan Coast Guard. Collected data is reported to relevant international organizations to be archived and used widely.

The accuracy of crustal movement detection is currently being improved to a scale of 1cm per season or year. Syowa Station is the only Antarctic facility conducting geodesic surveys continuously over many years, and functions as one of the most productive observation bases in Antarctica.

Distribution of earthquakes and their focal mechanisms around Antarctica (Broken lines show fracture zones)



VLBI experiment stations (Syowa, HartRAO, Hobart and O'Higgins) and their baseline lengths (red lines)



Glacial landforms and isostatic rebound lakes after ice retreat

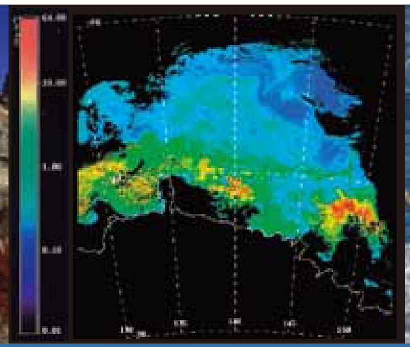
Absolute gravity measurements at gravity observation hut, Syowa Station

Viewing the World from Antarctica

Environment


Ecological study on moss vegetation


Reddish lichens glowing on rock cliff


Phytoplankton distribution

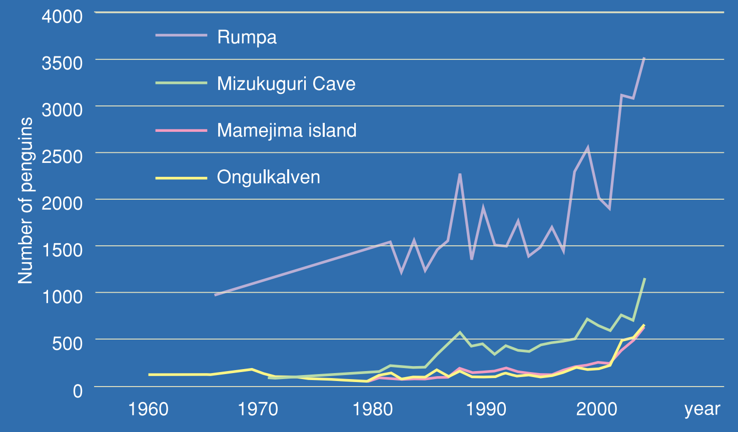

Seawater sampling

In connection with global warming, increases and decreases in seawater levels in the Antarctic Ocean have gained mounting interest. Seawater levels are known to influence population numbers for such Antarctic inhabitants as Adélie and Emperor Penguins, and so detailed studies are being conducted to see whether or not population numbers are indicators of global warming.

Phytoplankton is important for primary producer of marine ecosystems. Since primary production (photosynthesis) consumes carbon dioxide, its intense may affect the global climate changes. Phytoplankton abundance has been investigated in the surface water along the cruise track of Icebreaker *Fuji* or *Shirase* in the Antarctic Ocean for the long period more than 40 years. Recently, primary production is estimated based on satellite image and light properties. These observations are conducted along the almost same season and location every year and the results become important for a monitoring data of the global environment.

In addition, mosses and lichens growing near the Syowa Station have been photographed since 1985 in order to observe and document any changes. Because of its simplicity and the lack of interference from human activities, Antarctic ecosystem is highly suitable for observing organisms that are indicators of environmental changes.

Population changes of Adélie penguins at colonies near Syowa Station




Adélie penguins on ice floe

Witness to Global History

The Old Continent

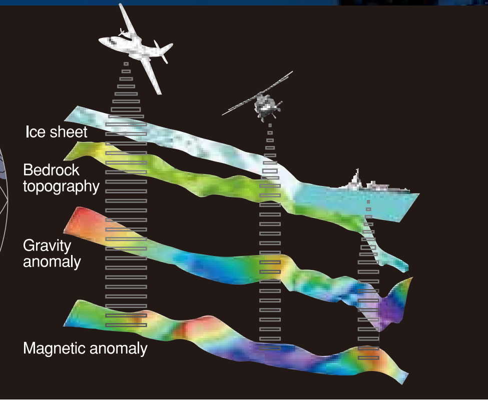
The Earth came into existence 4.6 billion years ago. Beginning as a molten mass, an inner structure – the core, mantle, and outer crust – formed as the planet gradually cooled. The oceans were created next, followed by the continents. The earliest continental crust has been discovered as 3.8 billion-year-old fragment within the Napier Complex, 600km to the east of Syowa Station.

Lying scattered between Syowa Station and the Napier Complex are rocks formed between 500 million and 1 billion years ago. Recent investigations have shown that a supercontinent called Gondwana formed approximately 500 million years ago as a result of tectonic activity. The continents sitting atop the crustal plates repeatedly converged and fragmented as the plates moved, eventually taking the form of the continents we see today.

Paleomagnetism recorded when the aforementioned rocks were produced indicates that 100 million years ago the eastern half of the Antarctic Continent (East Antarctica) was located in a mid-latitude, close to the Equator; moving southward, it seems to have arrived at its current location 80 million years ago. Meanwhile, the fragments that would become West Antarctica were also coming together. The ice sheet covering the continent is thought to have developed around 30 million years ago. Antarctica holds clues to unlocking the mystery of how the Gondwana supercontinent was formed. In an attempt to uncover these clues, the National Institute of Polar Research (NIPR) is developing a plan jointly with Germany to observe the full 500km of rocks stretching from Syowa Station to the Napier Complex, monitoring terrestrial magnetism, gravity, and ice thickness from the air.

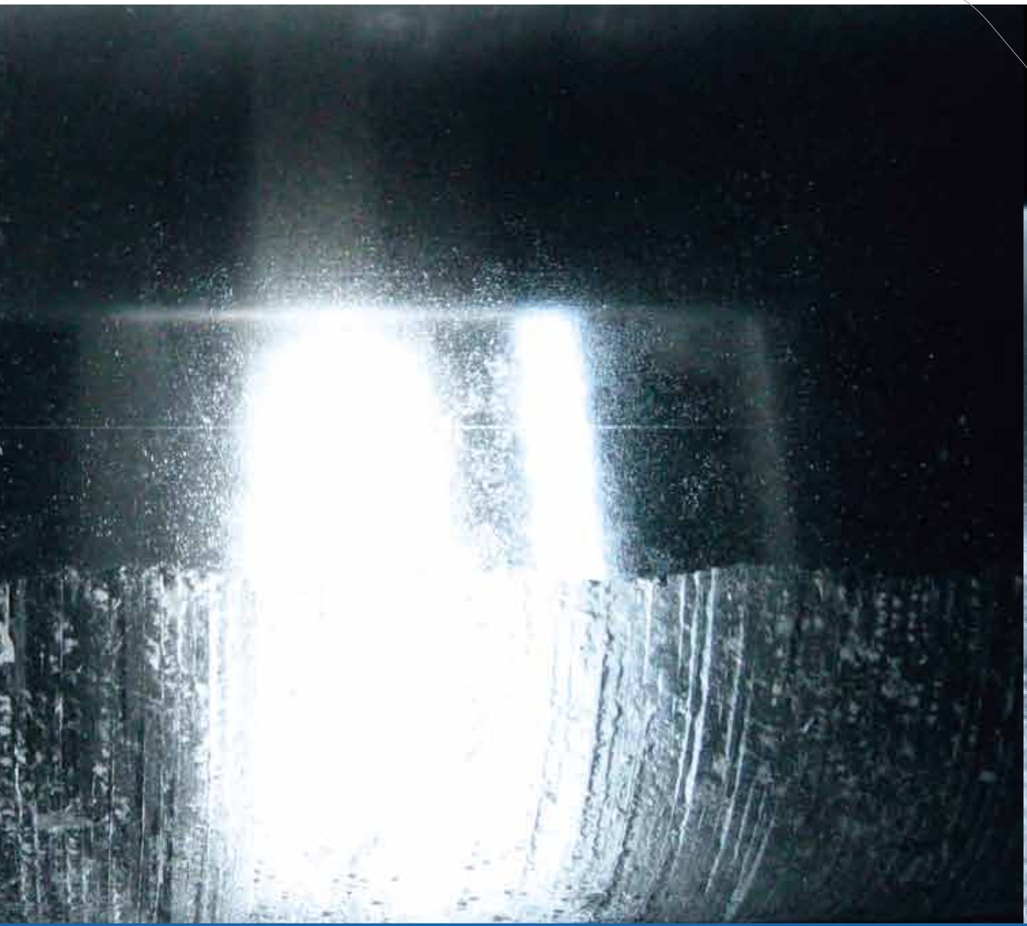
The Napier Complex compound of 3.8 billion-year-old rocks

Reconstruction of Gondwana



Remote observation by aircraft and vessels to search geological structure under sea or ice

Witness to Global History



An ice core drilling at Dome Fuji

Deep ice coring at Dome Fuji

Ice Core

Various substances in the Earth's atmosphere, such as cosmic dust and substances generated in the stratosphere, are captured together with air in snow and deposited over hundreds of thousands of years as the snow transforms into Antarctic ice. In other words, Antarctic ice sheet is a time capsule preserving chronological information about the Earth's environment in the past.

Deep ice coring carried out at the Dome Fuji between 1994 and 1997 obtained a 2503m-long ice sample, called an "ice core," containing layers dating from 340 thousand years ago up to the present. Data obtained through analysis of this ice core has proved that the Earth's temperatures are rising. For example, the ice core shows environmental changes between the glacial and interglacial ages, and the composition of air trapped within the ice shows that levels of greenhouse gases such as carbon dioxide have increased over the past several hundred years. Later, the 2nd Fuji Deep Ice Drilling project (2003-2007) was successful in drilling an ice-sheet core spanning the past 720 thousand years.

Ice core research is focusing on several new targets, the largest task being the elucidation of changes in the global environment over a 700 thousand year time span. At the same time, research is also focussing on "extraterrestrial environmental changes," such as the history of solar activity and cosmic climates, as well as the study of microorganisms living in or under the ice, in efforts to explore the Earth, universe, and life from this extreme environment.

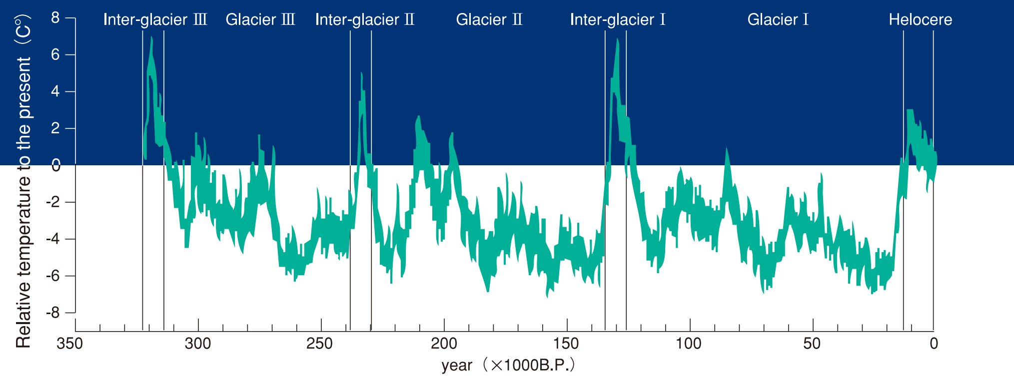
An air hydrate

Polarized light microscopic of ice core

Measurement of electric conductivity of the ice core

Ice core storage room

Revealed temperature chang of past 320 kyr.

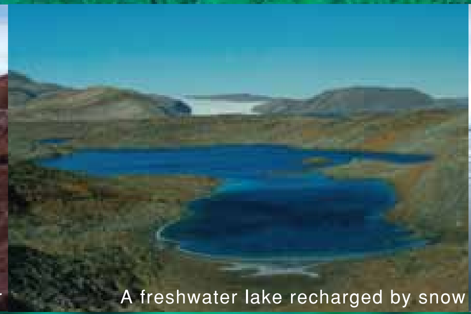


Witness to Global History

Top of the moss pillar

Physiological study on lake bottom vegetation by SCUBA diving

A freshwater lake beside the glacier



A freshwater lake recharged by snow

A saline lake beside the sea

Sediment core sample

Mysteries of the Lakes

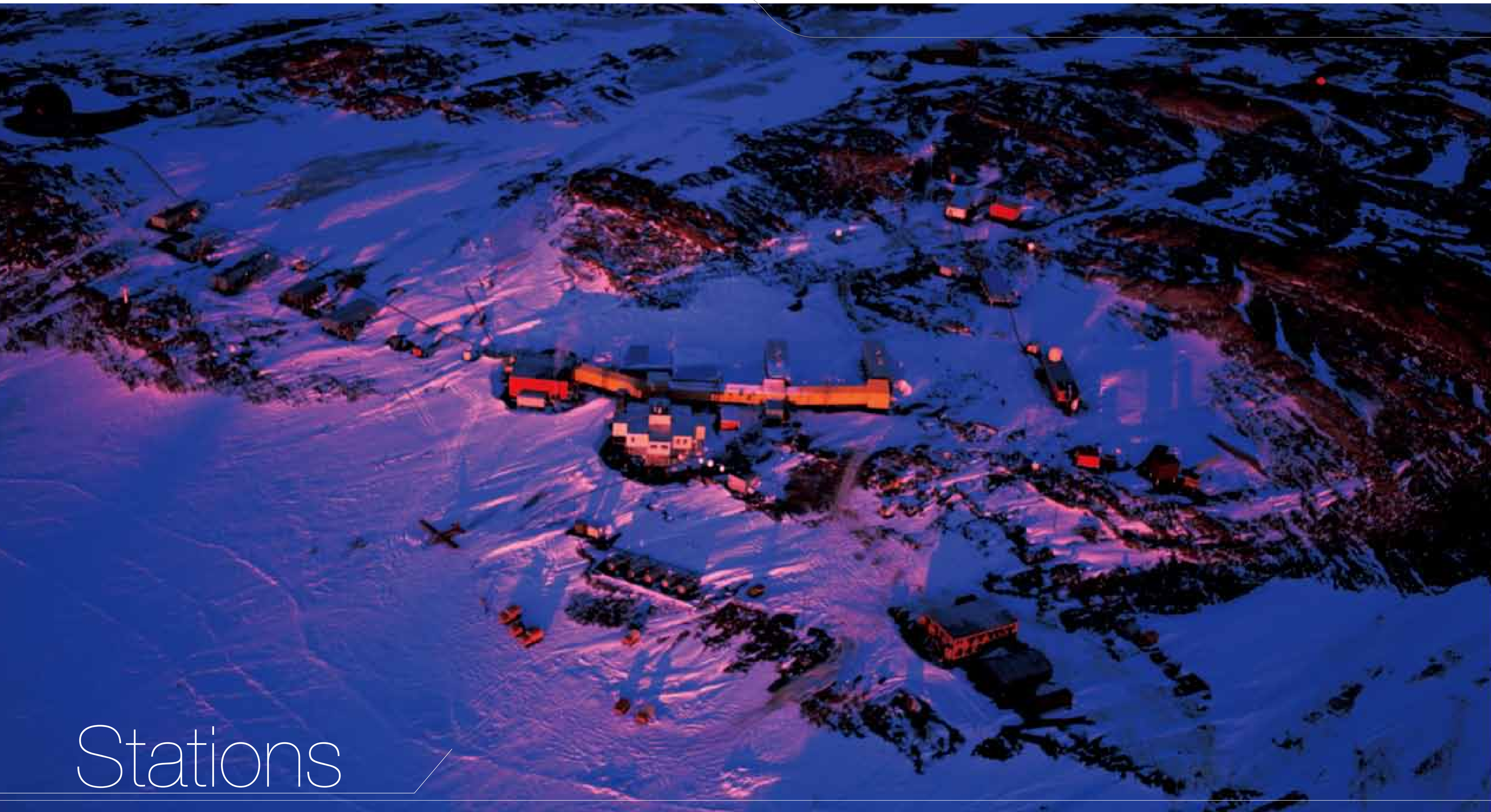
The Antarctic lakes are filled with transparent water. At the bottom of these lakes, curious colonies of plant up to 80cm high were discovered in 1995. They were actually a cluster of aquatic plants including mosses, algae, and bacteria that came to be referred to as "moss pillar (*kokebouzu*)." They were found to take more than 10 years to grow one centimeter, and the larger ones had been growing for close to 1000 years to reach their current size.

Only a few areas of land on the Antarctic continent are ice free, but the exposed rocky areas that do exist as scattered with lakes. Although the lake surfaces freeze over in winter, the water at the lake bottom never freezes and provides a far milder environment than that of the frigid land surface. The extreme oligotrophy of the lakes makes the water highly transparent, allowing the Sun's rays to reach the *kokebouzu* growing on the lake floors. The question of how these mosses came to be in Antarctic lakes, as well as how they came to form such large clusters, has researchers intrigued.

By analyzing the sediments accumulated on the lake floors, we can uncover not only the changes in organisms that lived during the past several thousand years, but also history of the Antarctic lake ecosystemystem.

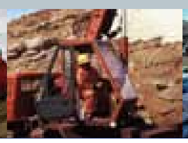
Curious algal vegetation at the bottom of a lake

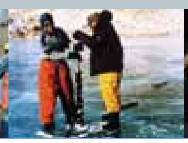
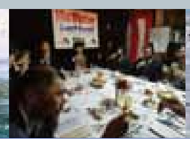
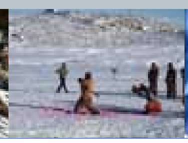
People Supporting Antarctic Observation Activities

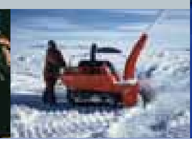


Stations

Syowa Station

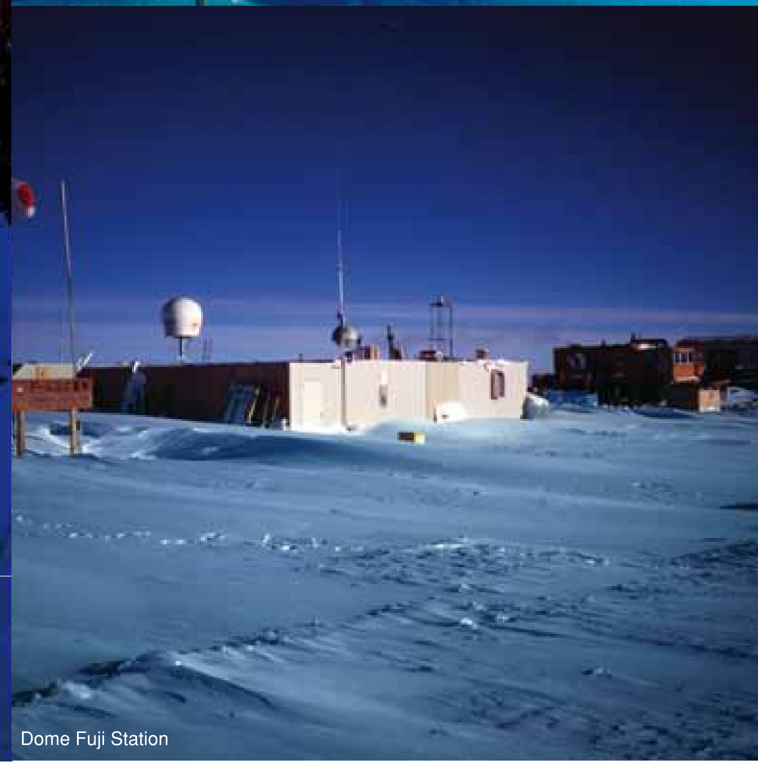



Asuka Station

Mizuho Station



Dome Fuji Station

Japan's Antarctic observation team comprises approximately 30 wintering and 30 summer personnel. Wintering personnel spend the entire year in Antarctica; summer personnel spend two months over the summer. The following is an outline of the year observation team personnel spend in Antarctica.

Late November : Personnel fly from Japan to Western Australia, where they board the *Shirase* for their sea journey to Syowa Station.

Mid-December : On arrival at Syowa Station, personnel spend an extremely busy two months completing their summertime work of building and equipment maintenance.

February 1 : Wintering life begins anew with the Change-of-party.

June : At Syowa Station, the sun does not rise for approximately one and a half months from around June 1. Over the three-day winter solstice, personnel hold a "Midwinter Festival"– the largest event on the wintering calendar – to celebrate the halfway point in the wintering year.

Mid-October : As air temperature begins to rise, field observation activities increase. Seals and penguins also make an appearance.

Mid-December : The end of the long wintering life draws near with the arrival of replacement personnel.

Late March : Personnel arrive in Sydney, Australia, on the *Shirase* then fly home to Japan.

Installation of fuel tank

Putting snow blocks into a snow melting tank

People Supporting Antarctic Observation Activities

Transportation

Everything – except water – necessary for life at Antarctic research stations must be brought in. All supplies are transported by the *Shirase*, with 60% of her 1100t cargo consisting of fuel. The *Shirase* also carries approximately 1ton of food for each member of the wintering party.

Observation personnel board the *Shirase* in Australia. Immediately on arrival at Syowa Station, 600kl of fuel are offloaded through a hose. Large-sized goods are carried over the ice, and all other items are transported in two helicopters.

Goods are transported to the inland-stations by an 11ton-snow vehicle pulling seven sleds at speeds of 5-6km/hr.

People Supporting Antarctic Observation Activities

Technology

Photovoltaic panels for station's power

Installation work of a parabolic antenna for satellite communication

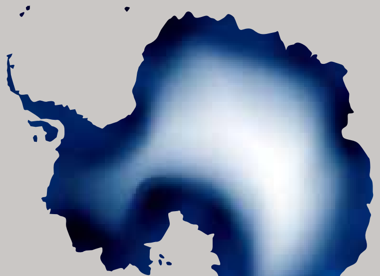
300kVA diesel generator

10kW Wind turbine

In Antarctica, outside work can only be performed over the two summer months. Prefabricated structures were actually designed for use in Antarctica. Constructed using special connectors, the panels must provide good insulation and prevent snow from getting inside.

Antarctica's unique environment calls for unusual technologies. For example, the snowmobiles used at the Dome Fuji Station, where temperatures drop to a low of −79.7°C, are equipped with rubber crawlers that remain elastic and fueled with "Antarctic diesel" that remains fluid, even at −60°C temperatures.

To ensure that fuel is used efficiently, a low-generation system that utilizes thermal energy generated by engine cooling and exhaust emissions to heat buildings and produce water has been in use for more than 20 years. Stations are furthermore equipped with 55kW solar energy generators and 10kW wind power generators so as to make the most of natural energy.



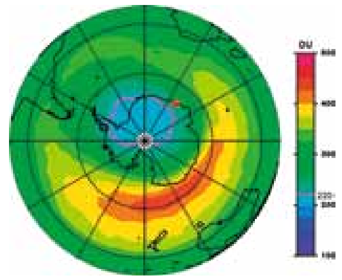
History of Antarctic Observation

Syowa Station

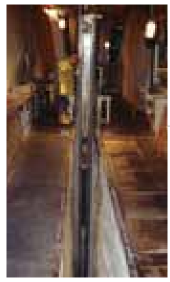
1957

2002

Yamato meteorites



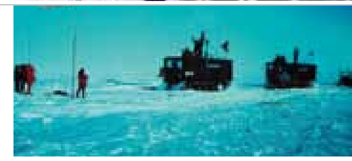
Ozone hole



Ice coring at Dome Fuji

Nobu Shirase

First JARE



Arrival at South pole

Land in the Antarctic Circle is said to have been first discovered, and landfall made around 1820. Since then, many explorers have set out to conquer the unknown continent; in 1910-12, expeditions led by Roald Amundsen of Norway, Robert Scott of Britain, and Nobu Shirase of Japan set out to reach the South Pole, with the Amundsen expedition gaining the honor of being the first to arrive. Following this achievement, scientific investigation began, with topographical surveys conducted by airplane, ice thickness measurements using artificial earthquakes, and meteorological observations. In 1957-8, large-scale observation was begun as part of the International Geophysical Year. Japan as a nation also participated as part of the cooperative framework at this time with the extensive refitting of the decommissioned *Soya* as a survey ship. Thus on 29 January, 1957, Syowa Station was established on the East Ongul Island.

The first Japanese Antarctic Research Expedition (JARE) of 1957, comprising 11 wintering personnel, conducted geophysical, meteorological, geological, and other surveys. The number of research fields gradually expanded following the first expedition. High-altitude observation using rockets and balloons began in 1968; areas under investigation also expanded from around the research station further into the continental interior; and in 1968-9, a return journey to the South Pole was accomplished.

In 1969, nine meteorites were discovered in the Yamato Mountains, leading to the later recovery of enormous quantities of meteorites. The excavation of an ice core at American Byrd Station, which elucidated climatic changes over the past several hundred thousand years, provided an opportunity for Japanese researchers to also excavate the ice sheet at an inland research station in 1971.

From the 1980s through the 1990s, observation activities in Antarctica further expanded to include observation of continental drift using satellite; observation of auroras and extremely high atmospheric layers using large antennae; observation of the Earth's crust using superconducting gravimeters; and ice core excavation at Dome Fuji Station.

Thus Antarctic observation does not merely "observe" the polar region, but has been strengthening as an integrated science investigating the structure, movement, and history of the Earth as a whole, and even the Solar System.

History

- **1957** Syowa Station was established. 11 personnel had started wintering.
- **1961** The Antarctic Treaty has entered into force.
- **1968** Round trip to the South Pole succeeded as 9th arrival in the Antarctic history. / Upper atmospheric observation was conducted by balloons.
- **1969** 9 meteorites were discovered at Yamato mountain range, which prologued to the Antarctic meteorite research.
- **1970** Aurora observation was conducted by science rockets./ Mizuho Station was established.
- **1973** National Institute of Polar Research (NIPR) was established.
- **1976** International Magnetospheric Study (IMS).
- **1982** Biological Investigations of Marine Autrctic Systems and Stocks (BIOMASS) was started. / Ozone hole was discovered at Syowa Station.
- **1985** Asuka Station was established.
- **1988** Middle Atmosohere Programme (MAP) was started.
- **1989** Multipurpose anntenna (11m in diameter) was constructed at Syowa Station.
- **1990** Observation by superconductivity gravity meter was started.
- **1995** Dome Fuji Station was established.
- **1996** Ice core drlling at Dome Fuji Station was conducted 2503m in depth.
- **1998** Protocol on Environmental Protection to the Antarctic Treaty has entered into force./ 4180 meteorites were discovered at Yamato and Belgica Mountain range.
- **2000** Rock mass research by artificial earthquake at Lützow Holm Bay was conducted.
- **2003** The secondary stage of full-scale ice core drilling at Dome Fuji Station has started.
- **2007** The 4th International Polar Year. Ice core drilling at Dome Fuji Station was conducted 3035m in depth.