British Antarctic Survey Aircraft

British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

The British Antarctic Survey (BAS) carries out an ambitious and challenging programme of science. This is supported by a fleet of five aircraft, specially adapted to operate in the extreme Antarctic climate.

The BAS aircraft fleet consists of four de Havilland Canada Twin Otters and one de Havilland Canada Dash-7. Between them they undertake a wide variety of transport and science missions. The Dash-7 and three of the Twin Otters have been modified to allow them to carry out airborne science surveys.

At the beginning of each season the aircrew – eight pilots and four engineers – ferry the aircraft south from their base in the northern hemisphere. Flights in the Antarctic take place during the Antarctic summer, between October and March, as winter darkness and very cold temperatures prevent flying at other times.

Rothera Research Station, the centre for BAS air operations, has a 900m gravel runway. The Dash-7 undertakes regular shuttle-flights from Rothera to and from the Falkland Islands and Punta Arenas, Chile. BAS aircraft also operate out of Halley Research Station and from Fossil Bluff and Sky-Blu Field Stations.

The first Antarctic flight

The first Antarctic flight took place more than 100 years ago. On 4th February 1902, British explorer Robert Falcon Scott ascended above McMurdo Sound in a somewhat precarious gas-filled balloon. The balloon was attached to tethers held by men on the ground and rose several metres above the mast of his ship, Discovery. Scott made observations of the surrounding landscape before being hauled back down to Earth. The next flight was made by his Third Lieutenant Ernest Shackleton, who took the first aerial photographs of Antarctica. Unfortunately, the balloon tore and developed a faulty valve. It was packed away never to be flown again.

Image: *The Dash-7 aircraft touches down at Sky-Blu Field Station.*

Flying in the Antarctic

Antarctica is the coldest, harshest and most isolated environment on the planet. Even in summer, only a few thousand people inhabit the continent and there are vast distances between research stations. Geographically, Antarctica is also isolated from the rest of the world – the nearest civilisation is some five hours away by air. Flying in the Antarctic is a challenging undertaking.

Safety is at the heart of all Antarctic air operations. BAS pilots receive specialist training and always fly with a co-pilot. The aircraft carry fuel reserves and emergency supplies because Antarctic flying is extremely weather dependent. Poor conditions can often ground aircraft for several days.

The Rothera air facility has a control tower and radar beacons. From here, planes fly either directly to the field or via fuel depots to their final destination. One of the Twin Otters is based at Halley Research Station to support projects in the eastern sector of BAS operations, covering an area up to 800km from the station.

The Twin Otter aircraft are equipped with skis for landing on snow and ice in remote areas. In addition to its role ferrying people and supplies between Rothera and the Falkland Islands or Punta Arenas, the Dash-7 also lands on the blue-ice runway at Sky-Blu Field Station – a staging post for deeper forays into the continent.

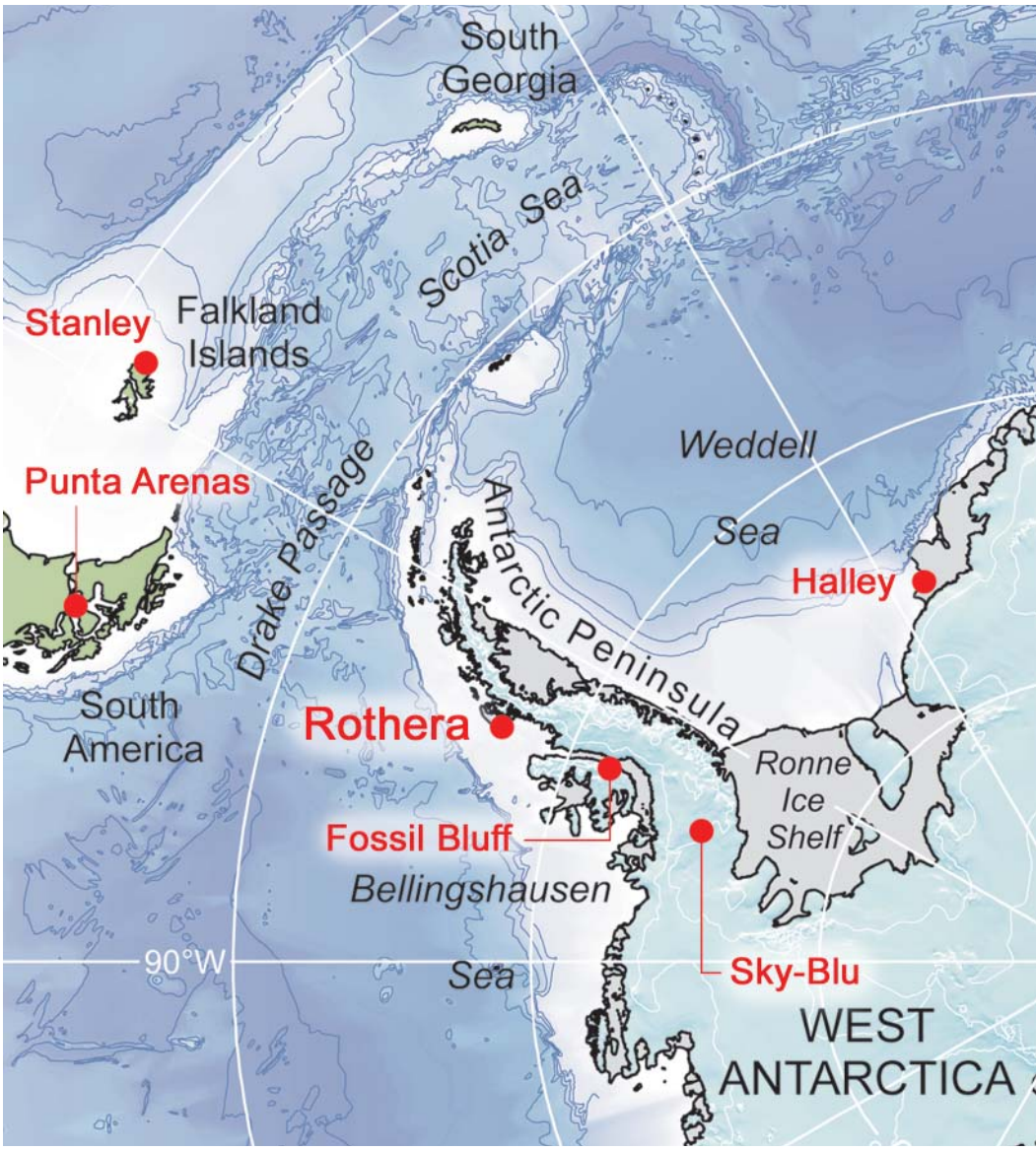


Image: *Key locations for BAS air operations in Antarctica.*

Rothera air facility

Rothera, the largest BAS research station in Antarctica, is situated on a rocky outcrop in the south-east of Adelaide Island on the Antarctic Peninsula. The station has been occupied since 1975 and operates year-round. Until 1991, aircraft landed on a skiway – a flat area of snow or ice – on the Wormald Ice Piedmont, 300m above the station.

In 1989 a comprehensive environmental impact assessment was undertaken before building a 900m crushed rock runway, apron (parking area), hangar and fuel storage tanks. This assessment was approved by the UK Foreign and Commonwealth Office.

This development enhanced significantly BAS science programmes by enabling air support to reach deep-field science parties and improving summer access to Rothera via the link from the Falkland Islands or Punta Arenas, Chile.

Image: *The 900m gravel runway at Rothera Research Station.*

The air facility operates as support for BAS science operations, for collaboration with other Antarctic operators and for emergencies. It is not open for commercial flights.

For safety, the aircraft hangar and fuel depot at Rothera are located well away from the station accommodation and laboratories. The specially-designed fuel depot protects the local environment from spills or leaks. Tanks are replenished each year when the first BAS ship arrives to resupply them.

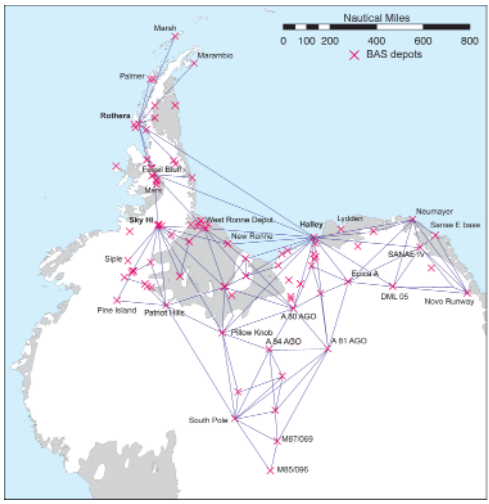
A well-equipped hangar and workshop, staffed by specialist aircraft engineers, ensure that all five aircraft are properly maintained throughout the Antarctic summer season. In winter, the aircraft return to the northern hemisphere for major servicing and overhauls.

Air operations are managed from a control tower which provides communications support to all aircraft in this part of Antarctica, as well as to BAS field parties. During flights, the Field Operations Manager at Rothera tracks an aircraft's progress until safe touchdown.

The first aircraft in Antarctica

The first powered flight in Antarctica took place in 1928 when an Australian, George Wilkins, made a 20-minute flight in the Antarctic Peninsula. Later that year he made an 11-hour flight along the Peninsula taking observations and photographs. The most famous Antarctic flight is probably that of American Rear Admiral Richard Evelyn Byrd, who in 1929 made the first flight over the South Pole. The three man crew only just made it – at one point they had to jettison empty fuel tanks and their emergency food supplies to avoid crashing into the Transantarctic Mountains. Byrd later became the first person to successfully cross Antarctica by air.

Image: *Inside the operations tower at Rothera Research Station.*



Crossing the air bridge

Many BAS staff arrive in the Antarctic by air. One of the primary roles of the Dash-7 aircraft is to provide an 'airbridge' between Rothera and either Stanley in the Falkland Islands or Punta Arenas, Chile.

The weather determines if a flight will take place and each morning before take-off, pilots check the weather forecast for the entire route. Sometimes weather at Rothera deteriorates mid-flight and the pilots have to return to wait for an improvement. This can sometimes take several days.

While the UK has flights to Antarctica from the Falkland Islands and Chile, other countries embark from New Zealand (including the United States), Chile and Argentina. BAS also uses the Falkland Islands as a port for its two ships.

Antarctic Air Operations

During any Antarctic field season BAS aircraft fly many thousands of kilometres, often deep into the continent or high onto the polar plateau. These flights would be impossible without fuel depots and supply stops. BAS operates two field stations which are permanently staffed during the summer – Fossil Bluff and Sky-Blu. Other temporary fuel depots are established as necessary, sometimes over numerous seasons.

ℹ FIDASE topographic survey

The first large-scale British aerial survey in Antarctica, the Falkland Island Dependencies Aerial Survey Expedition (FIDASE), took place along the Antarctic Peninsula from 1955-1957. Using two Canso amphibious aircraft (sea-planes) and several ship-borne Sikorsky helicopters, 13 surveyors produced 10,000 vertical photographs of approximately 90,000km^2 of previously unmapped terrain. Taken at 10,000 feet above sea level, the photographs produced an invaluable record which, when combined with ground-based observations and measurements, led to accurate mapping of the western Peninsula region. BAS's mapping department still use some FIDASE photographs for reference today.

Image: *Comparison of BAS operational area with Europe.*

Fossil Bluff

Fossil Bluff is a former research station, situated at the base of a scree-covered ridge overlooking George VI Sound on the Antarctic Peninsula. Today, it is a refuelling stop and meteorological observing station. A 1,200m unprepared snow runway allows the facility to be used as a transit station for refuelling the Twin Otters. The station at Fossil Bluff normally houses up to four people – although if aircraft are grounded due to bad weather, it can accommodate several more.

An important role for Fossil Bluff and Sky-Blu Field Stations is to supply weather reports to Rothera so that decisions can be made about flying. Trained personnel take recordings and observations which are sent to Rothera during daily radio schedules. BAS also operates several automatic weather stations to support air operations and record scientific observations.

Sky-Blu

High winds at Sky-Blu scour the surface of the ice, making it an ideal runway for wheeled aircraft. The Dash-7 is used here to deliver supplies, fuel and people for field operations. At 74°51'S, Sky-Blu is the farthest south the Dash-7 routinely flies.

The blue-ice runway was established in 1997 and is up to 1,200m long and 50m wide. It is 'groomed' by field support staff and permanently marked by flags. During each season, snow drifts must be cleared away by tractor before the Dash-7 can land.

Sky-Blu is situated close to Sky-Hi Nunataks in Eastern Ellsworth Land and for those stationed there it can seem very isolated. Facilities consist of a large semi-permanent hut as well as weatherhaven and pyramid tents and weather-monitoring equipment. There is an ice cavern garage for storage of equipment and vehicles.

Image: *The Dash-7 aircraft landing on the blue-ice runway at Sky-Blu Field Station.*

Twin Otter

De Havilland Canada Twin Otters (DHC-C) are a vital part of BAS Antarctic operations. They transport science teams out to their field camps, they resupply them or move them during the season and then return them to Rothera or Halley.

The Twin Otter is a high wing, twin engine, turboprop aircraft. They are used all over the world and are known for their rugged construction, reliability and 'short take off and landing' (STOL) performance. In other parts of the world, Twin Otters are often termed a 'bush' aircraft as they are designed for remote environments.

The version operated by BAS is the wheel/ski-equipped aircraft which lands on snow, ice or any other type of hard runway. During a typical season they will transport people, fuel, skidoos, sledges, food and scientific equipment to remote camps, landing on skis on unprepared snow. The planes will also lay depots and stockpile fuel for field science parties.

Twin Otter factfile

Wing span	19.8m
Length	15.7m
Take off weight	5,670kg
Engines	Twin Engine Turboprop
Range	1,435km
Cruising speed	130 knots

A first flight in a Twin Otter

"Taking off on gravel in a Twin Otter is smooth but noisy. If you are lucky (and have been trained), you get to sit in the co-pilot seat which allows a fantastic view of the surrounding scenery. Flying close to the ground over the crumpled ice of glaciers, alongside jagged mountains or close over the water is an exhilarating experience. The plane will 'bob' on the smallest air current and in the unpressurised aircraft your ears 'pop' at altitude. The landing on skis is not unlike racing over bumpy ground in a very fast sledge – you're glad when it stops!"

Image: *BAS Twin Otter lands at a remote field camp.*

Surveying from the air

The Twin Otters are extremely versatile and can be modified to allow airborne surveying and other scientific equipment to be fitted. Remote sensors fitted to the aircraft provide scientists with data on land, ice and sea. Radar can decipher features under the ice or layers within the ice itself. Longer-term monitoring from the air can be used to record the break-up of ice sheets or atmospheric changes.

Two of the four BAS Twin Otters are equipped with a full remote sensing capability. This includes a dual magnetometer – instruments used to measure the strength and direction of a magnetic field, which help detect different rock types.

Other instruments include a radio echo sounder which is used to bounce radio waves through ice to determine its thickness. There are also several different types of cameras employed for mapping or for counting the populations of birds, penguins or seals.

Airborne survey of West Antarctica

Twin Otters were used in a joint BAS/University of Texas survey of the West Antarctic Ice Sheet. This is an area likely to show rapid melting in the future, leading to a rise in global sea level. Operating from two camps 400km apart, the team flew 100,000km in more than 100 separate sorties. The results provided data on ice thickness and structure as well as details of the underlying rock formations. The scientists also discovered several new lake-like structures under the ice and mapped the deepest bedrock in the whole of Antarctica. The West Antarctic Ice Sheet has rarely been visited by scientists and without this kind of basic information, accurate predictions of future change are almost impossible.

Image: *BAS Twin Otters are loaded with scientific instrumentation.*

Dash-7

The de Havilland Canada Dash-7 (DHC-7) is a four-engined aircraft with a worldwide reputation for reliability, economy and performance. It made its first flight to Antarctica in 1994.

The cabin of the Dash-7 is pressurised – some airlines use the plane to transport up to 50 passengers on short-haul routes. The version operated by BAS has had a variety of technical modifications. These include the fitting of long-range fuel tanks with a fuel jettison system, large cargo door and strengthened cargo floor. It has also been fitted with enhanced avionics and navigation systems. It usually seats 12-16 people.

BAS chose the Dash-7 for its rugged design, fuel efficiency and, crucially, short take off and landing capability. As a result of its large slow-turning propellers, the aircraft is also quiet in operation.

Dash-7 factfile

Wing span	28.4m
Length	24.5m
Take off weight	21,320kg
Engines	4 x Turboprop
Range	4,000km (1,500km fully loaded)
Cruising speed	230 knots

History of BAS aircraft

BAS and its predecessors have been using aircraft in the Antarctic for more than 50 years. In the 1940s, sea-planes were used to carry out aerial surveys from ships. Other planes used in the past have been the single-engined de Havilland Otter and Beaver aircraft. BAS originally used the same air base as Antarctic aviation pioneer, George Wilkins, on Deception Island, until a volcanic eruption forced its closure in 1969. The main facility was then transferred to Adelaide Island – the current site of Rothera Research Station.

Image: *The Dash-7 landing on the runway at Rothera Research Station.*

During the Antarctic summer, the Dash-7 makes regular flights to and from the Falklands and Punta Arenas, Chile. The 1,900km journey can be completed in five hours with up to 16 passengers or 2,000kg of cargo on board. The introduction of the aircraft as an intercontinental link allows some BAS scientists to make relatively short trips for summer fieldwork, rather than spending the entire season south if they were to travel by ship. It has also provided a regular link for spares, urgent supplies and fresh food as well as freeing up the two BAS ships, enabling them to spend more time at sea on scientific cruises.

Because the Dash-7 can land on ice runways, it is a regular visitor to the field station at Sky-Blu. Thanks to its greater capacity over the Twin Otters, the Dash-7 has significantly reduced the number of flights required to ferry fuel and supplies.

The aircraft has modifications to allow surveying equipment to be fitted. This includes magnetometer pods on the wing-tips enabling the aircraft to be used for aerial studies, remote sensing work or aerial surveying.

The long flight north

At the end of the summer season all BAS aircraft leave Antarctica for servicing and maintenance in the northern hemisphere. The flight north is always a strenuous one and each year it takes at least nine days to make the journey, with short hops across South and North America. In October the aircraft return south before making the crossing to Rothera for another season's work.

Image: *The Dash-7 flying in the spectacular scenery of the Antarctic Peninsula.*

British Antarctic Survey (BAS), a component of the Natural Environment Research Council, delivers and enables world-leading interdisciplinary research in the Polar Regions. Its skilled science and support staff based in Cambridge, Antarctica and the Arctic, work together to deliver research that uses the Polar Regions to advance our understanding of Earth as a sustainable planet. Through its extensive logistic capability and know-how BAS facilitates access for the British and international science community to the UK polar research operation. Numerous national and international collaborations, combined with an excellent infrastructure help sustain a world-leading position for the UK in Antarctic affairs.

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