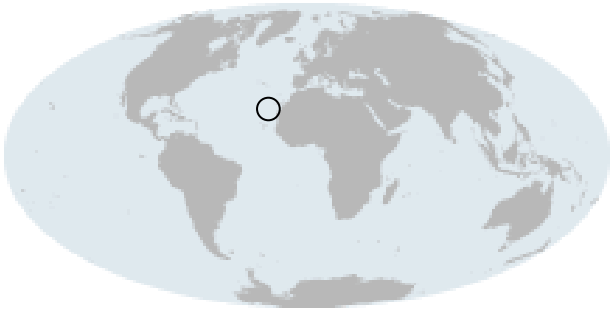
The red line drawn in the image above represents ≈ 24.8 km.

CONTEXT MAP AND IMAGE INFORMATION

Image ID#: ISS023-E-29617

Geographic Location: Cape Verde Islands



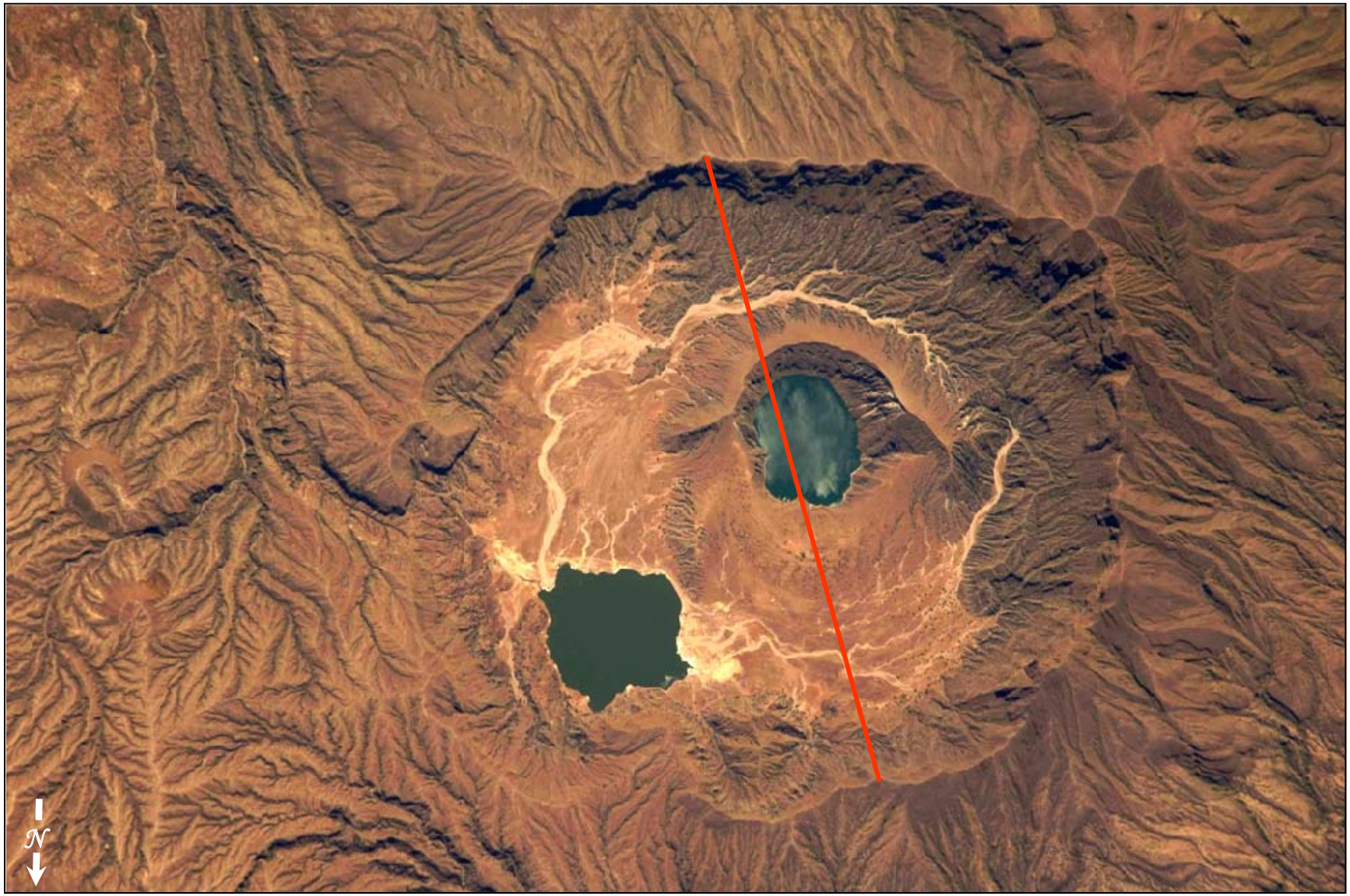
Instrument:	N4: Nikon D3X
Lens:	300 mm
Center Latitude:	14.9N
Center Longitude:	24.4W
Sun Elevation:	39 degrees
Date Acquired:	April 20, 2010

This image captures the entire island of Fogo, one of the active volcanic islands of the Cape Verde archipelago.

The Cape Verde Islands consist of 10 islands located in the Eastern Atlantic Ocean, off the coast of West Africa, near Mauritania and Senegal.

This island, called Fogo (Portuguese for Fire) is one of the active volcanic islands of Cape Verde, and rises to an elevation of about 3,000 meters (10,000 ft) above sea level. This volcano last erupted in 1995, forming the small crater called Pico Pequeno inside the larger and older caldera. The larger caldera has a broken rim on its eastern side. Lava flows from the volcano are visible within the caldera and especially along the eastern side of the structure. Water has likely carved the ravines seen along the caldera as it flowed down the slopes of the volcano.

Image provided by the ISS Crew Earth Observations experiment and the Image Science & Analysis Laboratory, NASA Johnson Space Center. Additional images available at http://eol.jsc.nasa.gov.



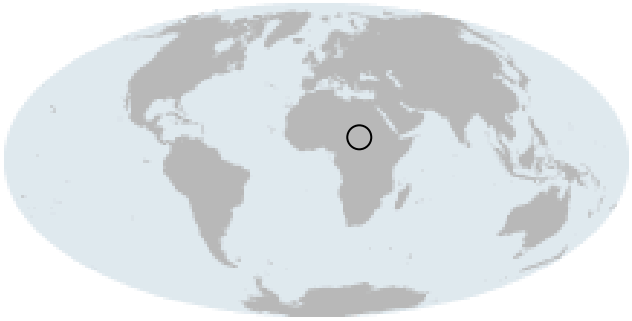
ISS018-E-6051

The red line drawn in the image above represents ≈ 5.3 km.

CONTEXT MAP AND IMAGE INFORMATION

Image ID#: ISS018-E-6051

Geographic Location: Sudan



Instrument:	ISS Digital Camera: NikonD2X
Lens:	800 mm
Latitude:	13N
Longitude:	24.3E
Sun Elevation:	63 degrees
Date Acquired:	October 29, 2008

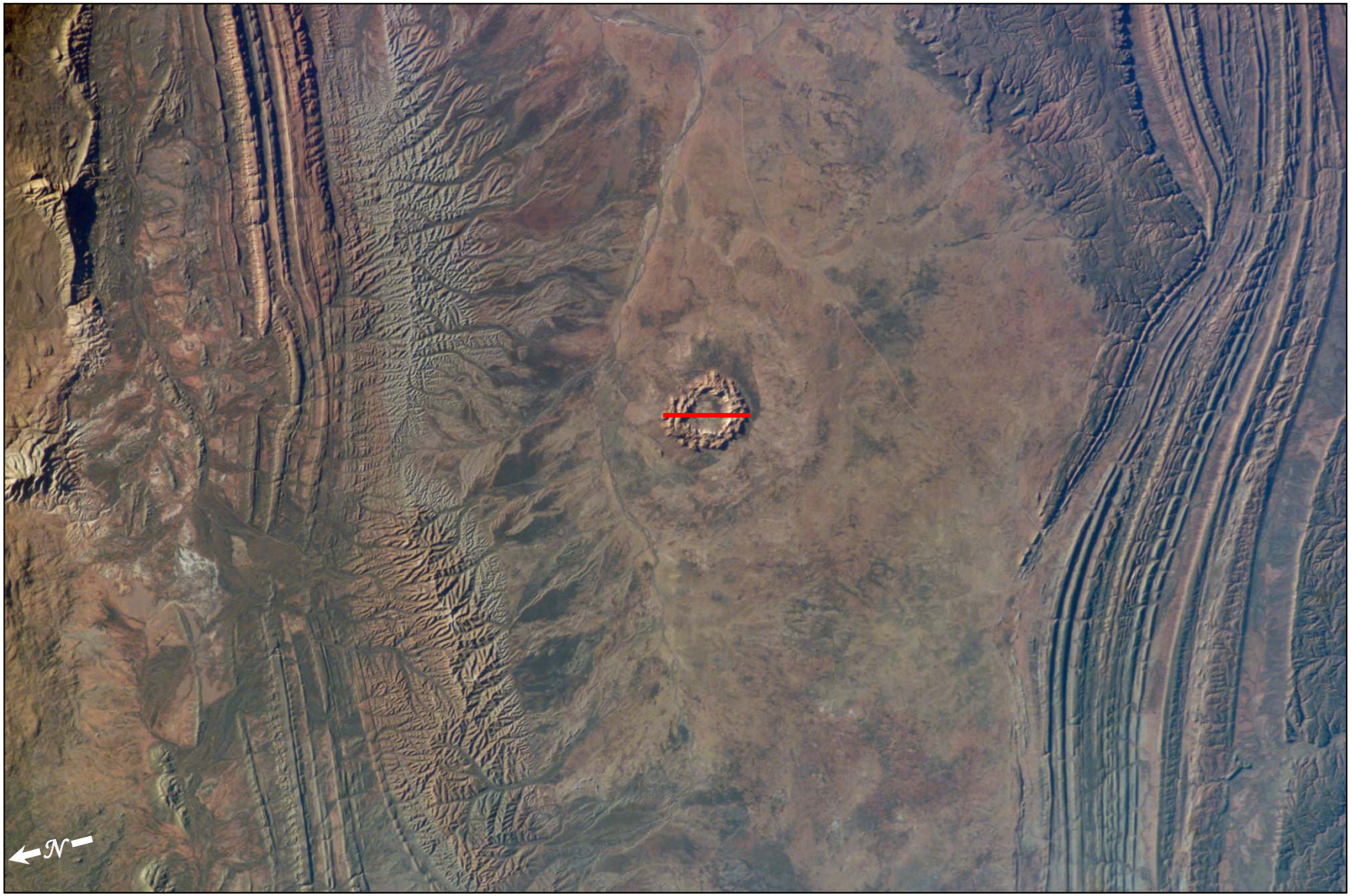
This image is centered on the Deriba Caldera, at the top of the Jebel Marra volcano in central Africa.

Deriba Caldera is a geologically young volcanic structure located at the top of the Marra Mountains of western Sudan. The Marra Mountains are part of a large geologic feature known as the Darfur Dome. The dome appears to be the result of a mantle plume, which is a fixed "hotspot" in the Earth's mantle (the layer of Earth below the crust). The mantle plume heated the crust from below, leading to uplift of the crust and providing a magma source for the extensive volcanism observed in the region. The 5-kilometer-wide Deriba Caldera was formed by explosive eruption of the Jebel Marra Volcano approximately 3,500 years ago. The volcano is considered dormant, rather than extinct, as hot springs and fumaroles (gas and steam vents) are still present.

The caldera has the classic shape: it formed as overlying rock and soil collapsed into the magma chamber after it was emptied by powerful eruptions. Shadows in this astronaut photograph throw the steep southern wall of the outer crater into sharp relief. Following the formation of the main outer crater, a second inner crater (image center) formed, most likely due to later uplift and eruption of fresh magma moving towards the surface. This inner crater is filled with water.

Because the walls of the inner crater are higher than the adjacent caldera floor, precipitation flowing inwards from the outer crater walls do not enter the inner crater lake. White stream bed sediments (image center) show the water pathway around the inner crater to a second lake located along the northeast wall of the outer crater. While Jebel Marra is high enough (3,042 meters) to have a temperate climate and high precipitation, these lakes may be fed by hot springs as well as rainwater. The inner crater lake has a mottled appearance caused by sunglint-light reflected off a roughened water surface back towards the astronaut onboard the International Space Station.

Image provided by the ISS Crew Earth Observations experiments and the Image Science & Analysis Laboratory, NASA Johnson Space Center. Additional images available at http://eol.jsc.nasa.gov.



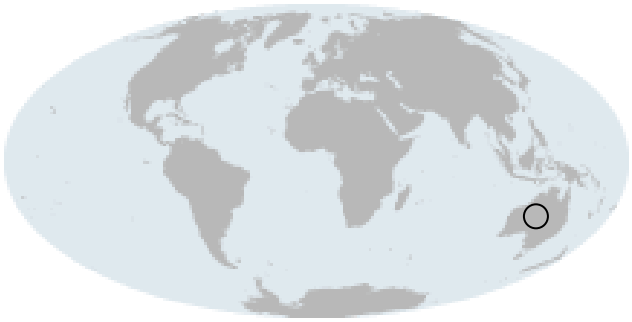
ISS007-E-5697

The red line drawn in the image above represents ≈ 4.5 km.

CONTEXT MAP AND IMAGE INFORMATION

Image ID#: ISS007-E-5697

Geographic Location: Australia



Instrument:	E4: Kodak DCS760C
Lens:	180 mm
Latitude:	24.0S
Longitude:	132.5E
Sun Elevation:	17 degrees
Date Acquired:	May 20, 2003

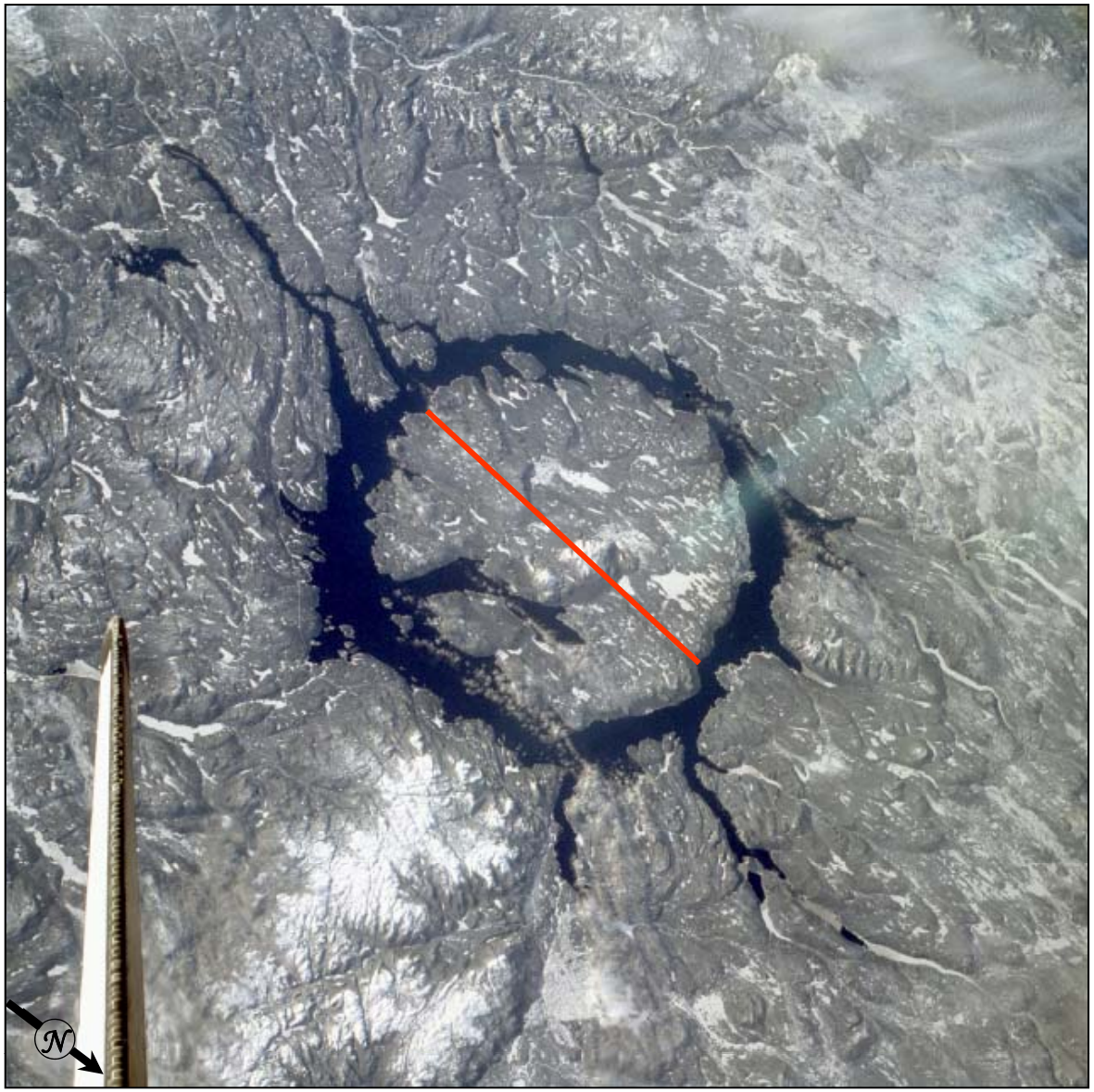
This image is centered on the Gosses Bluff impact crater in Australia.

Impact craters, like those we observe on the moon, also occur on Earth. They result from the collisions of extraterrestrial bodies (like meteors, asteroids or comets) with the Earth. Planetary scientists study Earth's impact craters to gain insight about the early history of the Earth and the Solar System. Recent studies indicate that large impacts on Earth may have played an important role in the succession of life on Earth.

Australia is a very good place to observe and study impact craters. Much of the Australian surface is very old, so Australia has collected more impacts than many other parts of the world. Because of the dry climate, the craters haven't weathered away, nor are they hidden by dense vegetation.

This image shows Gosses Bluff, an impact crater sandwiched between the Macdonnell Range to the north and the James Range to the south in Australia's Northern Territory—it is about 160 km west of Alice Springs. It is one of the most studied of the Australian impact craters. The impactor, an asteroid or comet, was probably about 1 km in diameter and crashed into the earth about 142 million years ago. The isolated circular feature within the crater consists of a central ring of hills about 4.5 km in diameter. The faint circular feature surrounding this inner ring of hills (rocks) probably marks the original boundary of the outer rim of the crater.

Image provided by the ISS Crew Earth Observations experiments and the Image Science & Analysis Laboratory, NASA Johnson Space Center. Additional images available at http://eol.jsc.nasa.gov.



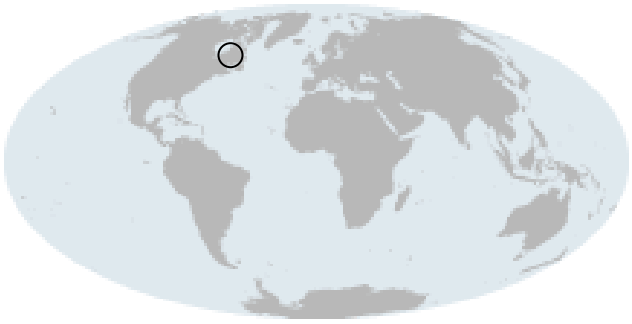
STS009-48-3139

The red line drawn in the image above represents ≈ 51 km.

CONTEXT MAP AND IMAGE INFORMATION

Image ID#: STS009-48-3139

Geographic Location: Canada



Instrument:	Hasselblad
Lens:	100 mm
Latitude:	51.5N
Longitude:	68.5W
Sun Elevation:	Data not available
Date Acquired:	1983

This image is centered on the Manicouagan impact crater in Canada.

Located in a rugged, remote area of the Canadian Shield in Quebec Province, the Manicouagan Reservoir is impressive in this low-oblique, west-looking photograph. The reservoir, a large circular lake, marks the site of the Manicouagan impact crater that formed when a large meteor hit Earth almost 212 million years ago. The original diameter of this crater was thought to be approximately 60 miles (100 kilometers). Over time, the impact crater has been worn down by many advances and retreats of glaciers and other processes of erosion. The reservoir is drained at its south end by the Manicouagan River, which flows from the reservoir and empties into the Saint Lawrence River nearly 300 miles (483 kilometers) south.

Image provided by the ISS Crew Earth Observations experiments and the Image Science & Analysis Laboratory, NASA Johnson Space Center. Additional images available at http://eol.jsc.nasa.gov.

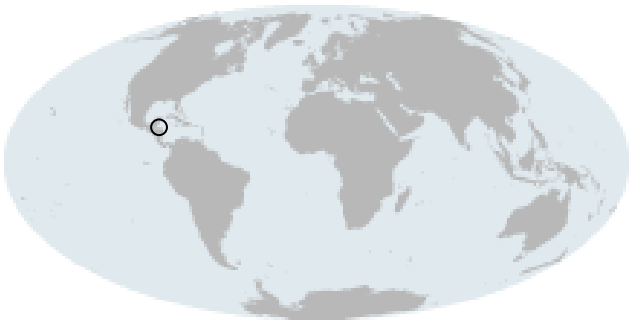
ISS004-E-11078

The red line drawn in the image above represents ≈ 54 km.

CONTEXT MAP AND IMAGE INFORMATION

Image ID#: ISS004-E-11078

Geographic Location: Belize

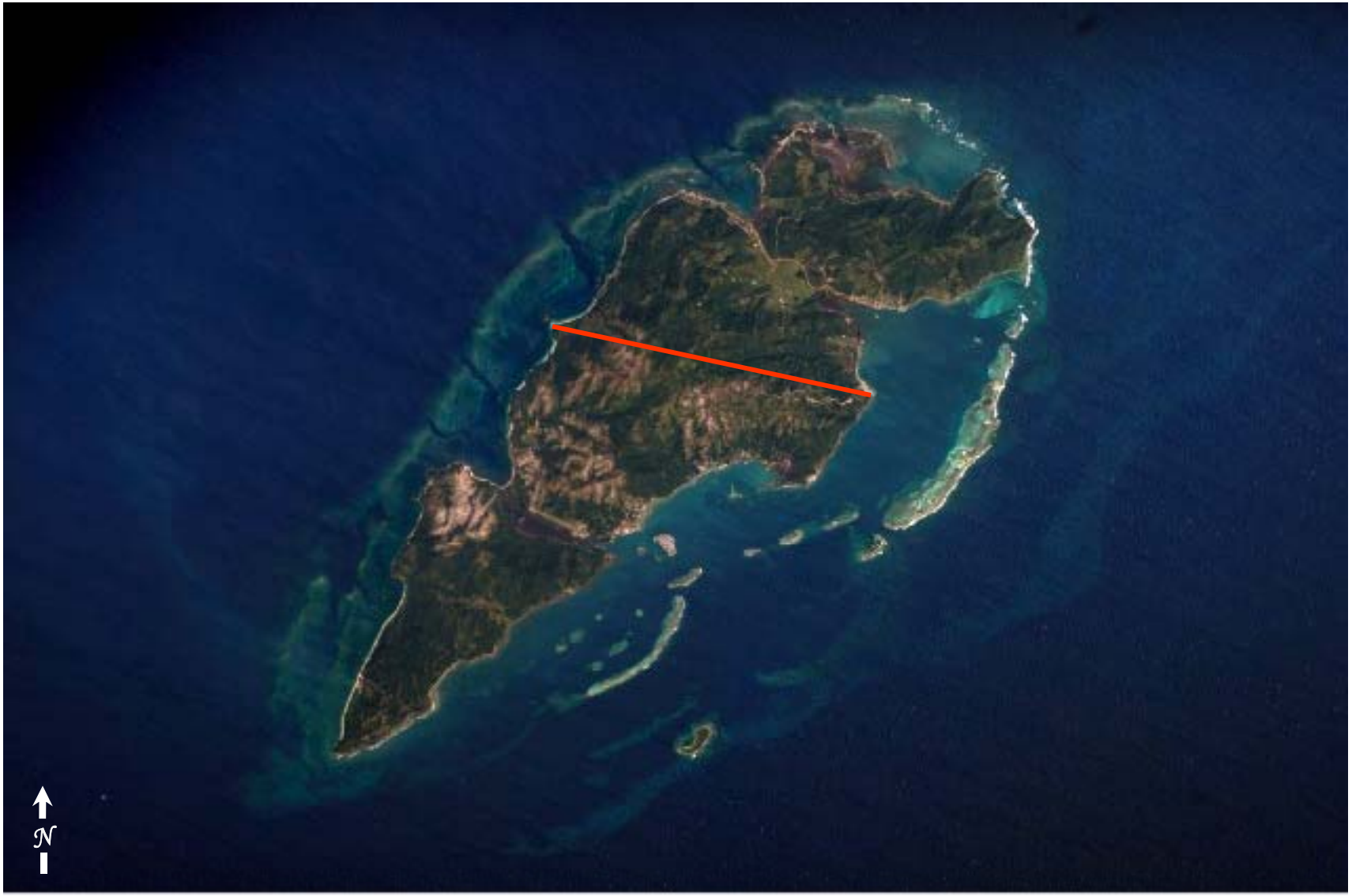


Instrument:	ISS Digital Camera: Kodak760C
Lens:	25 mm
Latitude:	17.5N
Longitude:	88.5W
Sun Elevation:	40 degrees
Date Acquired:	May 1, 2002

This image, taken along the east coast of Central America, is showing forest fires near the coast of Belize.

The bright blue water of the Gulf of Honduras contrasts sharply with the smokey areas over Guatemala and Belize in this photograph taken from the International Space Station. Fires in the Yucatan Peninsula and northern Central America began burning in early April, and intensified by the end of the month. Also visible in the image are small white clouds somewhat blurred together with the smoke, as well as islands or cays surrounded by coral reefs. This area is part of the Belize Barrier Reef, one of the largest reef systems in the world.

Image provided by the ISS Crew Earth Observations experiments and the Image Science & Analysis Laboratory, NASA Johnson Space Center. Additional images available at http://eol.jsc.nasa.gov.

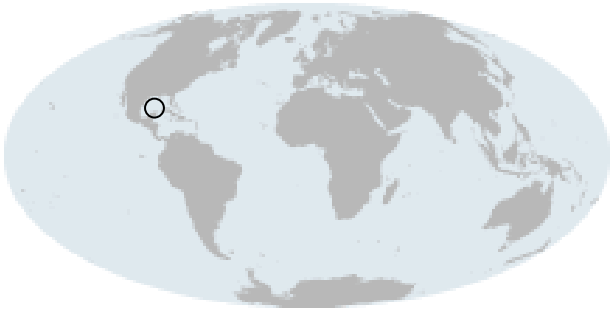


The red line drawn in the image above represents ≈ 6.3 km.

CONTEXT MAP AND IMAGE INFORMATION

Image ID#: ISS014-E-15767

Geographic Location: Honduras



Instrument:	E4: Kodak DSC760C
Lens:	400 mm
Center Latitude:	17.4N
Center Longitude:	85.0E
Sun Elevation:	53 degrees
Date Acquired:	March 1, 2007

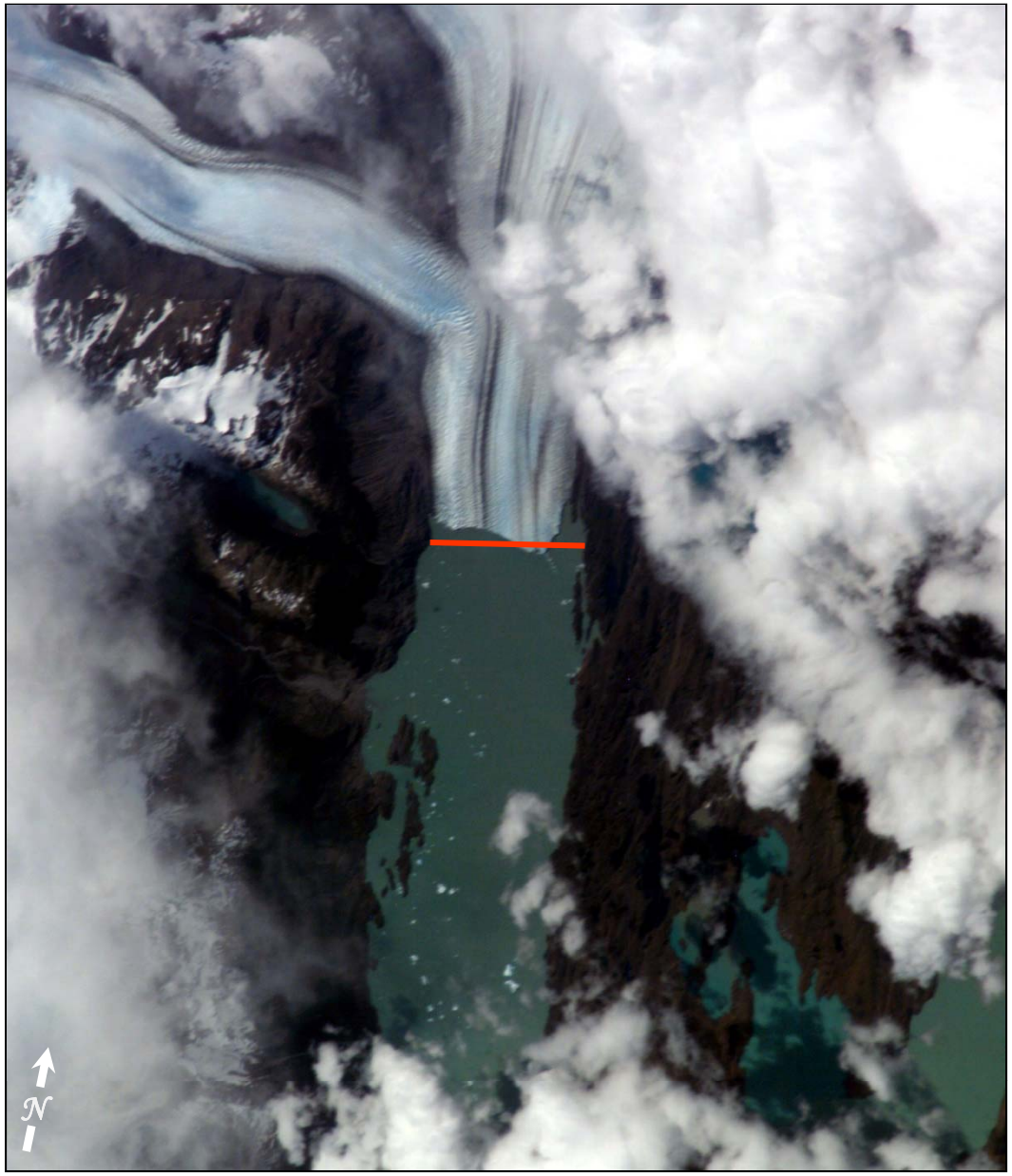
This image captures a view of the Honduran Island of Guanaja and its surrounding coral reefs.

Guanaja Island is located in the western Caribbean, approximately 60 kilometers (about 37 miles) north of mainland Honduras. The island is near the western edge of the Cayman Ridge, a topographic feature made of rock types associated with ancient volcanic islands, sedimentary layers, and ocean crust. The Cayman Ridge resulted from tectonic interactions between the North American, South American, and Caribbean Plates. Guanaja and the nearby islands of Roatan and Utila (not shown) are the only portions of the western Cayman Ridge currently exposed above water.

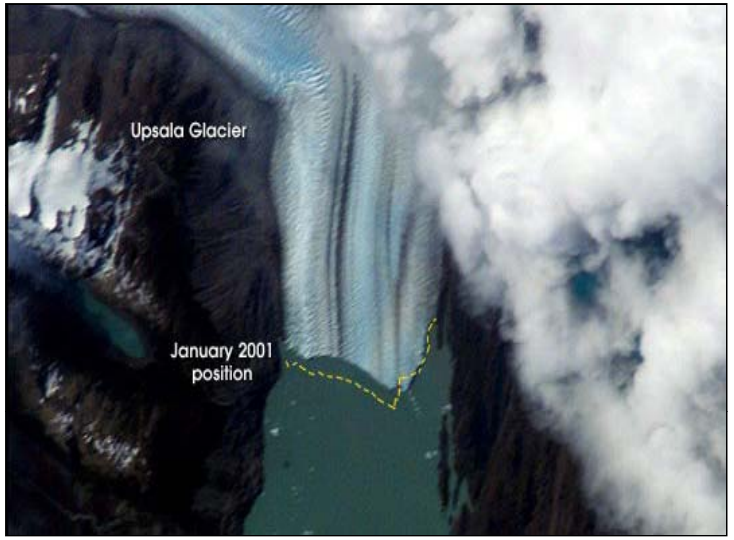
This island is largely undeveloped with the exception being highly concentrated development on Bonacca Cay, a small island (roughly 0.5 by 0.3 kilometers) located along the southeastern coastline of the main island. The main island has little in the way of roads or other infrastructure—a canal is the major means of traversing the island—making it an attractive destination for hikers and eco-tourists. The clear waters and reefs that almost completely encircle Guanaja also attract divers.

In 1998, Hurricane Mitch destroyed almost all of the island's mangrove forests, devastating coastal habitats and causing soil erosion. Regeneration of mangroves is slow, and scientists have suggested active reseeding efforts as the only way to restore the forests.

Image provided by the ISS Crew Earth Observations experiment and the Image Science & Analysis Laboratory, NASA Johnson Space Center. Additional images available at http://eol.jsc.nasa.gov.



ISS008-E-11807



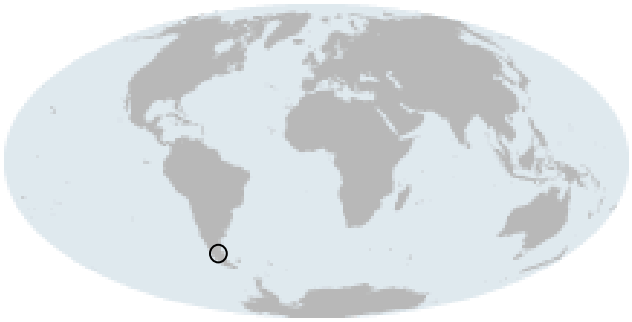
ISS008-E-11807 (cropped) - yellow dashed line is showing the extent of the glacier from an image taken in December 2000/January 2001.

The red line drawn in the image to the left represents ≈ 2.9 km.

CONTEXT MAP AND IMAGE INFORMATION

Image ID#: ISS008-E-11807

Geographic Location: Argentina



Instrument:	ISS Digital Camera: Kodak760C
Lens:	400 mm
Latitude:	50S
Longitude:	73W
Sun Elevation:	51 degrees
Date Acquired:	January 3, 2004

This image is showing the Upsula Glacier in South America. Numerous clouds are also visible on either side of the glacier and mountains.

For the crew onboard the International Space Station, South America's Patagonian Ice Fields and glaciers in the far southern Andes mountains offer beautiful, dynamic features that astronauts are able to image whenever weather conditions permit. On the afternoon of January 3, 2004, the crew took this view of the Upsala Glacier in Argentina through a 400mm lens. This is the third largest glacier of the Southern Patagonian Ice Field with an estimated area of over 800 square kilometers. This long, north-south oriented river of ice terminates in the northern arm of Lake Argentino.

The small cropped image on the right shows a yellow dashed line indicating the extent of the Upsala Glacier in late December 2000/early January 2001 (based off of comparisons with image ISS001-E-5318) and comparing it to the glacier's extent in January 2004.

A worldwide retreat of glaciers was observed during the twentieth century and most of Patagonia's glaciers, including Upsala, were no exception. From the late 1960's to the mid 1990's the retreat of some glaciers exceeded 4 kilometers. The crew continues to monitor most of the principal glaciers of Patagonia as science targets for Crew Earth Observations.

Image provided by the ISS Crew Earth Observations experiments and the Image Science & Analysis Laboratory, NASA Johnson Space Center. Additional images available at http://eol.jsc.nasa.gov.

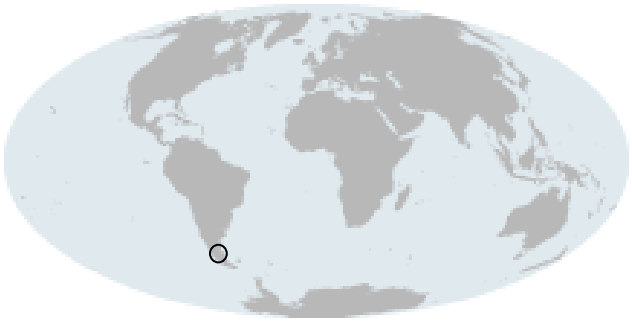
ISS013-E-6947

The red line drawn in the image above represents ≈ 4.1 km.

CONTEXT MAP AND IMAGE INFORMATION

Image ID#: ISS013-E-6947

Geographic Location: Argentina



Instrument:	ISS Digital Camera: Kodak760C
Lens:	800 mm
Latitude:	49.5S
Longitude:	73W
Sun Elevation:	20 degrees
Date Acquired:	April 12, 2006

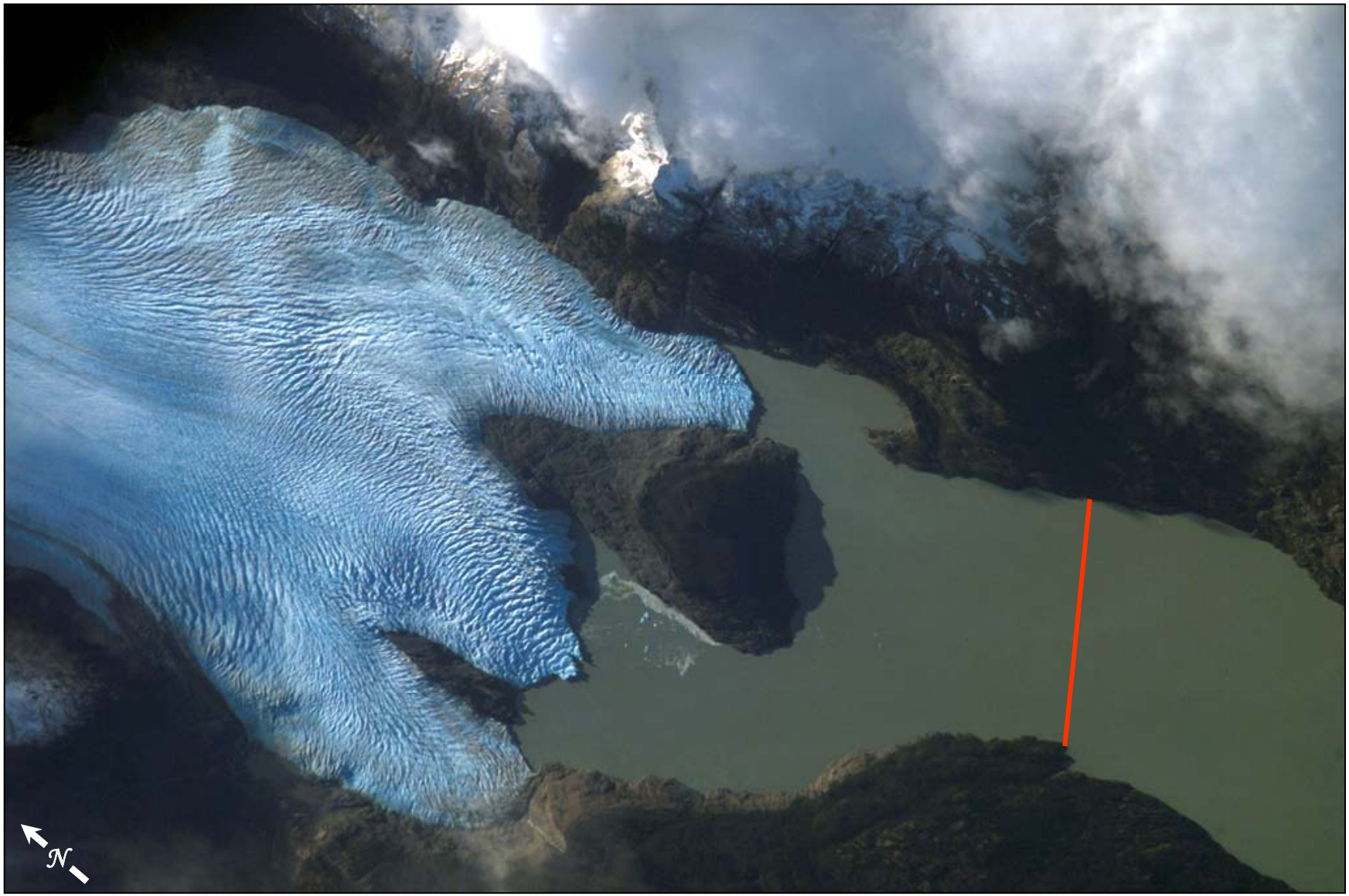
This image captures a view of the Viedma Glacier in South America.

The icefields of Patagonia, located at the southern end of South America, are the largest masses of ice in the temperate Southern Hemisphere (approximately 55,000 square kilometers). The icefields contain numerous valley glaciers that terminate in meltwater-fed lakes. These are known as “calving” glaciers, as they lose mass when large ice chunks collapse from the terminus—or end—of the glacier. These newly separated chunks of ice are then free to float away, much like ice cubes in a punch bowl.

The terminus of the Viedma Glacier, approximately 2 kilometers across where it enters Lake Viedma, is shown in this astronaut photograph. Moraines are accumulations of soil and rock debris that form along the sides and front of a glacier as it flows across the landscape (much like a bulldozer). Independent valley glaciers can merge together as they flow down slope, and the moraines become entrained in the center of the new ice mass. These medial moraines are visible as dark parallel lines within the white central mass of the glacier (image center and left). Crevasses—oriented at right angles to the medial moraines—are also visible in the grey-brown ice along the sides of the glacier. These canyon-like crevasses form as a result of stress between the slower moving ice along the valley sides (where there is greater friction) and the more rapidly moving ice in the center of the glacier. Calving of ice from the southwestern fork of the glacier terminus is visible in the lower left portion of the image.

As they respond to regional climate change, the Patagonian glaciers are closely monitored using remotely sensed data. Scientists compare series of images collected over time to monitor the change in ice extent and position. Scientists have also estimated changes in volume using topographic data from NASA’s Shuttle Radar Topography Mission.

Image provided by the ISS Crew Earth Observations experiments and the Image Science & Analysis Laboratory, NASA Johnson Space Center. Additional images available at http://eol.jsc.nasa.gov.



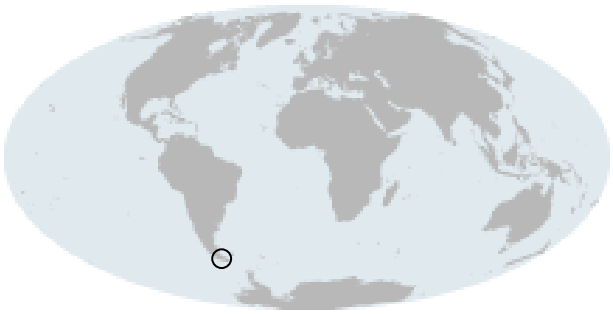
ISS015-E-10704

The red line drawn in the image above represents ≈ 2.4 km.

CONTEXT MAP AND IMAGE INFORMATION

Image ID#: ISS015-E-10704

Geographic Location: Chile



Instrument: ISS Digital Camera: Kodak 760C
Lens: 800 mm
Latitude: 51.1S
Longitude: 70.9W
Sun Elevation: 15 degrees
Date Acquired: June 4, 2007

This image captures a view of Grey Glacier terminating into Grey Lake in Chile.

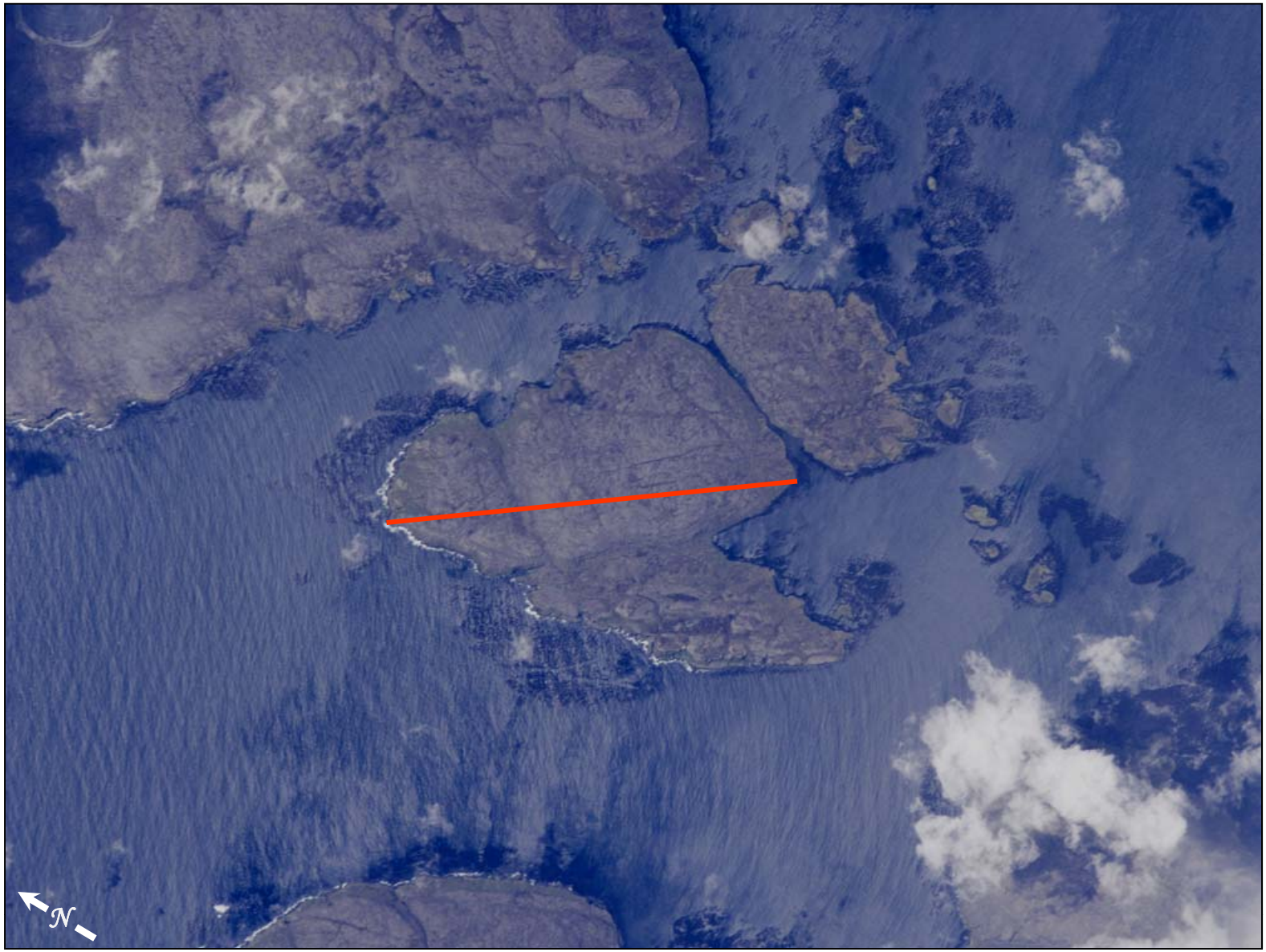
The Southern Patagonian Icefield of Chile and Argentina hosts several spectacular glaciers—including Grey Glacier located in the Torres del Paine National Park in Chile. This glacier, which in 1996 had a measured total area of 270 square kilometers and a length of 28 kilometers (104 square miles in area, 17 miles long), begins in the Patagonian Andes Mountains to the west and terminates in three distinct lobes into Grey Lake shown in this image. This image was taken by an astronaut aboard the International Space Station, and it captures a striking bluish coloration of the glacier. The coloring is due to the ice's absorption of red wavelengths of light and scattering of blue wavelengths of light as it is transmitted through the ice.

Certain portions of the glacier visible in the image are indeed gray. Linear gray-brown *moraines* are accumulations of soil and rock debris that form along the edges of a glacier as it flows downhill across the landscape (much like a bulldozer blade). Glaciers flowing downslope through adjacent feeder valleys ultimately meet, and debris carried along their sides becomes concentrated in the central portion of the resulting single, large glacier—much as smaller streams of water join to form a single large river.

Gray-brown patches of debris from adjacent mountainsides color the surface of the easternmost lobe of the glacier (image top). Several *crevasse fields* are visible in the image. The crevasses, each a small canyon in the ice, form as a result of stress between slower- and faster-moving ice within the glacier. The crevasse patterns of Grey Glacier are complex, perhaps due to the three-lobed nature of its *terminus,* or end, into Grey Lake. The rugged surface of the glacier is also demonstrated by the jagged shadows it casts onto the surface of the lake.

From comparing images of Grey Glacier taken in 1986, it was found that all three lobes have retreated over the 22-year period, with the greatest loss of ice occurring along the westernmost lobe terminus. Grey Glacier, like others in southern Patagonia, loses ice from its terminus as it enters the water, a process known as *calving.* Calving produces large free-floating chunks of ice; some floating ice is visible near the central glacier lobe in the image. The observed retreat means that ice loss has been greater than ice replenishment. It is most likely due to a combination of increased regional temperatures and changes in precipitation.

Image provided by the ISS Crew Earth Observations experiments and the Image Science & Analysis Laboratory, NASA Johnson Space Center. Additional images available at http://eol.jsc.nasa.gov.



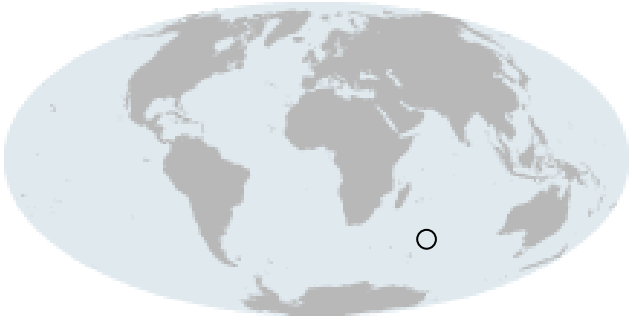
ISS018-E-18110

The red line drawn in the image above represents ≈ 3.2 km.

CONTEXT MAP AND IMAGE INFORMATION

Image ID#: ISS018-E-18110

Geographic Location: Southern Indian Ocean



Instrument:	ISS Digital Camera: NikonD2X
Lens:	800 mm
Latitude:	48.9S
Longitude:	69.4E
Sun Elevation:	61 degrees
Date Acquired:	January 6, 2009

This image includes the majority of two islands (Mac Murdo Island and Howe Island). Also visible are ocean waves as well as kelp forests visible as darker areas in the ocean.

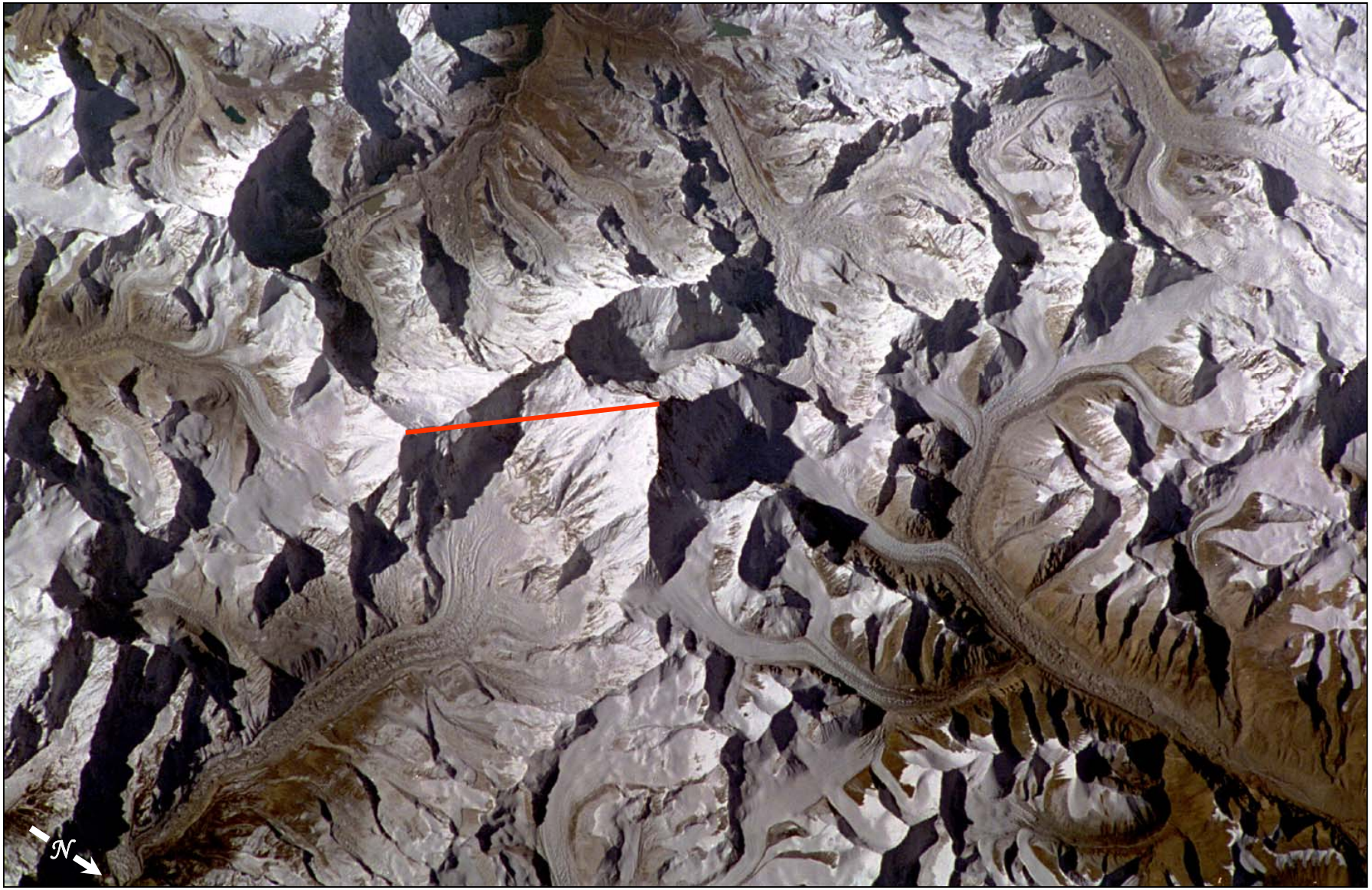
Mac Murdo and Howe Islands are 2 of the 300 islands of the remote Kerguelen Archipelago, located in the southern Indian Ocean. The islands are part of a larger island group called the French Southern and Antarctic Lands. The Kerguelen Archipelago is also called the "Desolation Islands." The coastal regions of the islands support low-growing vegetation (mainly the genus *Acaena),* while elevations above 50 meters are bare rock. There are no permanent (human) residents on the islands, but a permanent settlement (Port aux Francais – located further to the south east and not visible in this image) hosts visiting biologists, oceanographers, and other Earth scientists. In addition, the settlement maintains a weather station and a satellite/rocket tracking station.

Weather conditions on the Kerguelen Islands are typical for the latitude; at 49 degrees South, the islands sit at the crossroads of the latitude zones referred to as the "roaring forties" and the "furious fifties." This astronaut photograph was captured on January 6, 2009-early summer in the Southern Hemisphere. That day, the mean daily temperature was 4.5 degrees Celsius (40.1 degrees Fahrenheit), with mean westerly winds of 9 meters per second (about 20 miles per hour).

The coastlines of many sub-Antarctic islands, like the Kerguelen Islands, are occupied by highly productive giant kelp beds (*Macrocystis pyrifera).* One of the largest marine macroalgaes (seaweeds), the species can grow to lengths of 50 meters (164 feet), forming undersea forests in hard-bottom, subtidal areas (nearshore areas that remain underwater at low tide). Fronds can spread out to form a canopy that totally covers the water surface. The black patches surrounding coastal areas in this astronaut photograph are interpreted as offshore kelp beds. These kelp forests are habitat for marine animals, and due to their large biomass and relatively long survival, they are an efficient sink (storage location) for atmospheric carbon dioxide.

The surface wave pattern that travels southeastward along the gray-blue ocean surface and through the kelp beds is visible due to *sunglint,* the mirror-like reflection of sunlight off the water. The sunglint also improves the identification of the kelp beds by creating a different water texture (and therefore a contrast) between the dark vegetation and the reflective ocean surface.

Image provided by the ISS Crew Earth Observations experiments and the Image Science & Analysis Laboratory, NASA Johnson Space Center. Additional images available at http://eol.jsc.nasa.gov.



STS066-208-025

The red line drawn in the image above represents ≈ 7.1 km.

CONTEXT MAP AND IMAGE INFORMATION

Image ID#: STS066-208-025

Geographic Location: Tibet and Nepal

Instrument:	Nikon 35mm film camera
Lens:	Data not available
Latitude:	28N
Longitude:	87E
Sun Elevation:	Data not available
Date Acquired:	November 1994

The image is centered on Mount Everest, the highest mountain above sea level on Earth.

Located on the border between Tibet and Nepal in the central Himalaya Mountains, Everest soars 29,028 feet (8854 meters) above sea level. Mount Everest began to form millions of years ago, as did the whole Himalayan Range, when the India subcontinent collided with Asia. Deep layers of rock were folded and refolded, creating Everest and the other great, rugged peaks of the Himalayas. Further erosion by wind, rain, snow, and ice—especially in the form of glaciers—eroded Everest to its present shape. The mountain as viewed in this photograph resembles a U-shape with the opening at its northwest end and the summit at the north end. Several large, impressive glaciers radiating from the mountaintop still occupy the rugged valleys. The summit of Mount Everest was finally reached by Sir Edmund Hillary of New Zealand and his Sherpa, Tenzing Norkay of Nepal, on May 28, 1953.

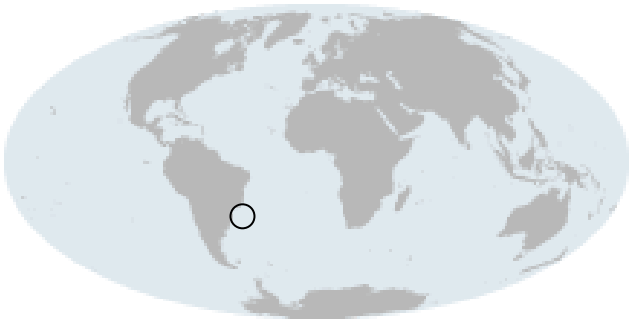
Image provided by the ISS Crew Earth Observations experiments and the Image Science & Analysis Laboratory, NASA Johnson Space Center. Additional images available at http://eol.jsc.nasa.gov.

ISS008-E-19646

CONTEXT MAP AND IMAGE INFORMATION

Image ID#: ISS008-E-19646

Geographic Location: South Atlantic Basin



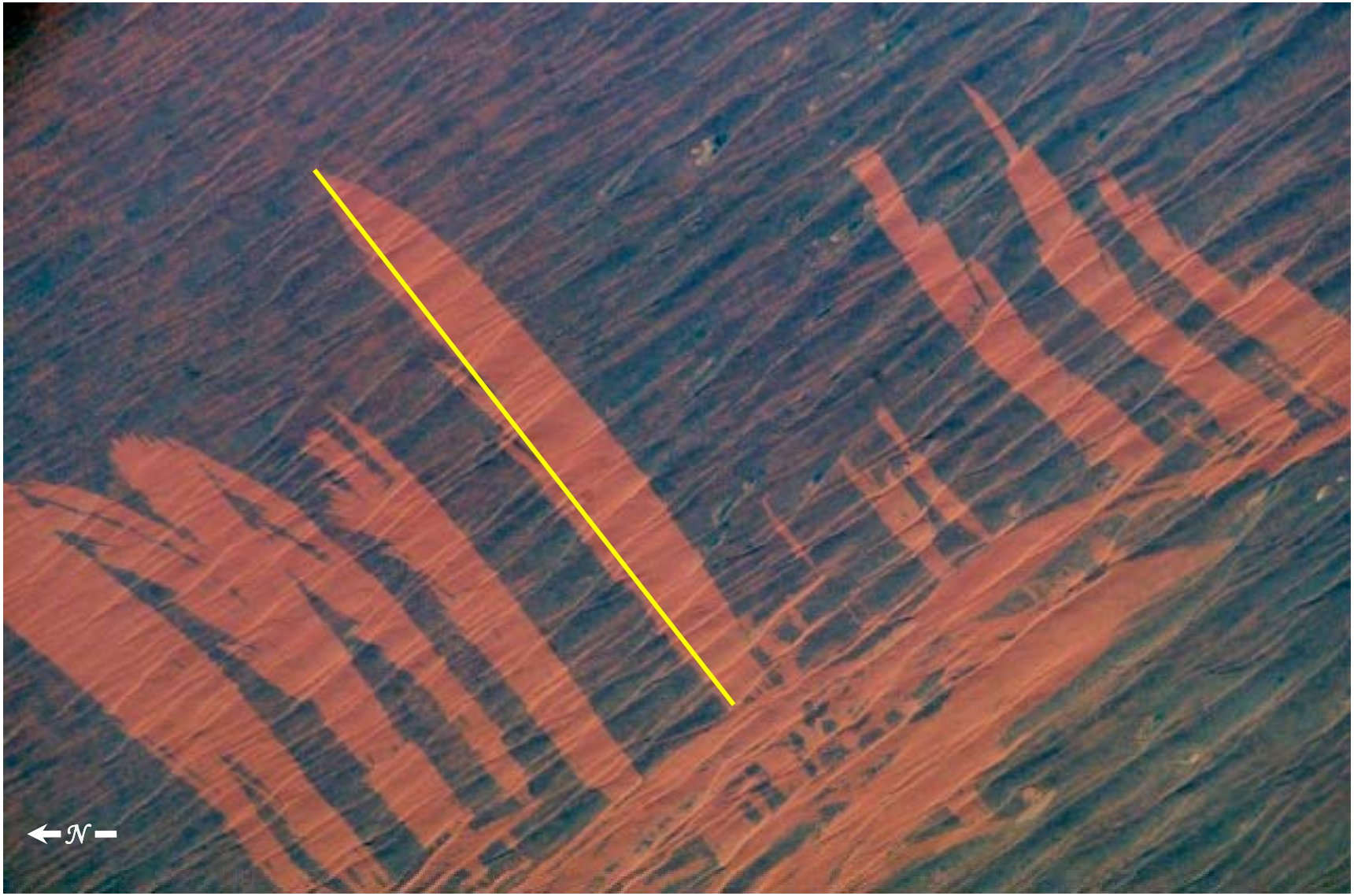
Instrument:	ISS Digital Camera: Kodak760C
Lens:	50 mm
Latitude:	35.1S
Longitude:	47.1W
Sun Elevation:	48 degrees
Date Acquired:	March 7, 2004

This image is showing a tropical cyclone off the coast of Southern Brazil.

Tropical cyclone is the generic term for a low pressure system over tropical or sub-tropical waters. A tropical cyclone becomes a hurricane when the winds reach 74 miles per hour (33 meters/second). Until the week of March 7, 2004, only two tropical cyclones had ever been noted in the South Atlantic Basin, and no hurricanes. However, during the week of March 7, 2004, a circulation center well off the coast of southern Brazil developed tropical cyclone characteristics and continued to intensify as it moved westward. The system developed an eye and apparently reached hurricane strength on Friday, March 28, before eventually making landfall late on Saturday, March 27, 2004.

The crew of the International Space Station was notified of the cyclone and acquired excellent photographs of the storm just as it made landfall on the southern Brazilian state of Catarina (the storm has been unofficially dubbed “Hurricane Catarina”). Note the clockwise circulation of Southern Hemisphere cyclones, the well-defined banding features, and the eyewall of at least a Category 1 system. The coastline is visible under the clouds in the upper left corner of the image.

Image provided by the ISS Crew Earth Observations experiments and the Image Science & Analysis Laboratory, NASA Johnson Space Center. Additional images available at http://eol.jsc.nasa.gov.



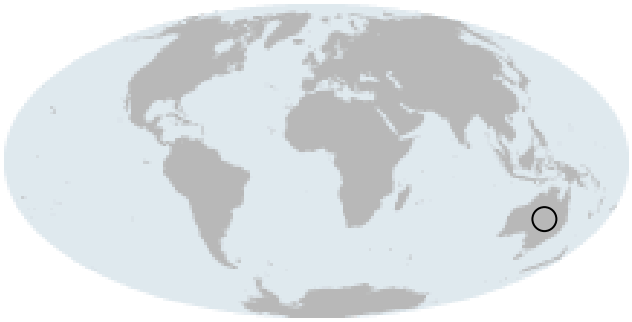
ISS005-E-21295

The yellow line drawn in the image above represents ≈ 7.1 km.

CONTEXT MAP AND IMAGE INFORMATION

Image ID#: ISS005-E-21295

Geographic Location: Australia



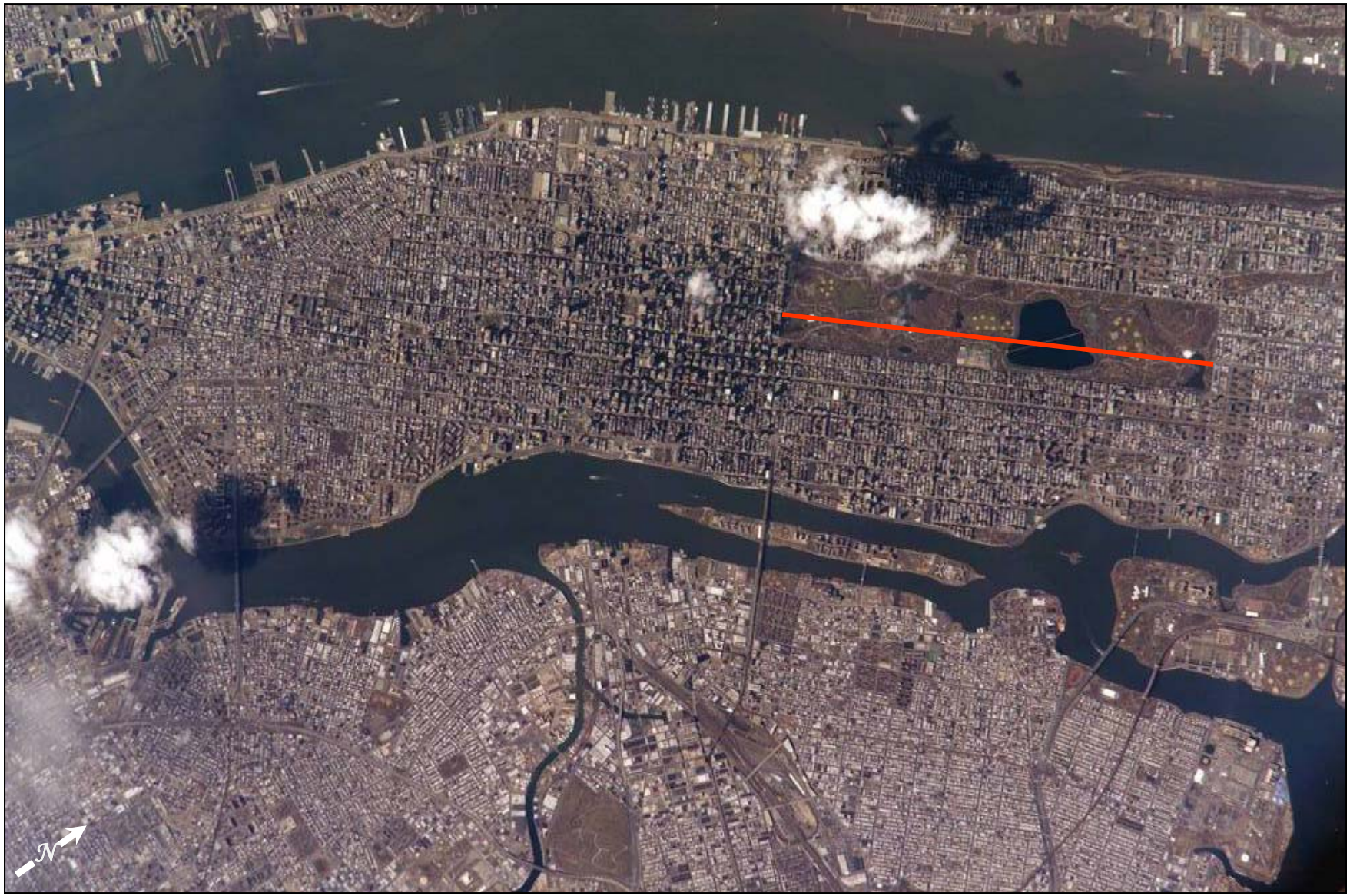
Instrument:	E4: Kodak DCS760C
Lens:	800 mm
Center Latitude:	24.6S
Center Longitude:	136.5E
Sun Elevation:	28 degrees
Date Acquired:	November 23, 2002

This image is centered on bright orange fire scars on top of sand dunes in the Simpson Desert of Australia.

Bright orange fire scars expose the underlying sand dunes and sharply contrast with the vegetated areas in the Simpson Desert, 300 kilometers east of Alice Springs. The dunes create lines of sand that angle across the image from the lower left to upper right. These “lines” of sand dunes appear somewhat greenish in color which shows vegetation. This vegetation, or desert scrub, helps to hold the sand dunes in place as it protects the sand from being easily picked up by the wind.

The fire scars were produced in a fire, probably in 2002 when this image was taken. The image suggests a time sequence of events. Fires first advanced into the view from the lower left—parallel with the major dune trend and dominant wind direction. Then the wind shifted direction by about 90 degrees so that fires advanced across the dunes in a series of long feather-like extensions. Each extension starts at some point on the earlier fire scar, and sharp tips of these extensions show where the fires burned out naturally. The sharp edges of the fire scars are due to steady but probably weak southwesterly winds. Weaker winds help stop additional fires in adjacent scrub on either side of the main fire pathways. Over time, the scars will become less distinct as vegetation grows back.

Image provided by the ISS Crew Earth Observations experiment and the Image Science & Analysis Laboratory, NASA Johnson Space Center. Additional images available at http://eol.jsc.nasa.gov.



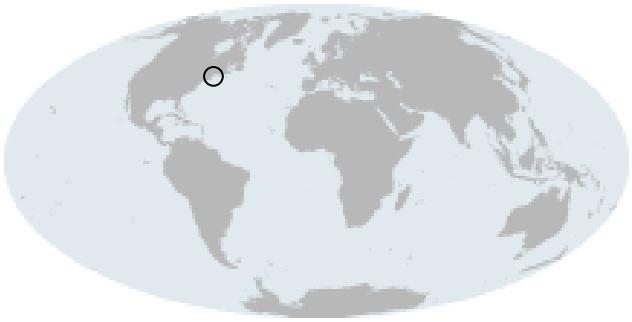
ISS010-E-21487

The red line drawn in the image above represents ≈ 4.1 km.

CONTEXT MAP AND IMAGE INFORMATION

Image ID#: ISS010-E-21487

Geographic Location: New York



Instrument:	ISS Digital Camera: Kodak760C
Lens:	800 mm
Latitude:	40.8N
Longitude:	74W
Sun Elevation:	52 degrees
Date Acquired:	March 26, 2005

This image captures a portion of New York City, with Central Park visible within Manhattan Island.

Manhattan Island and its easily recognizable Central Park are featured in this image photographed by an Expedition 10 crewmember on the International Space Station. Some of the other New York City boroughs (including parts of Brooklyn and Queens seen in the bottom half of the image) are also shown, as are two small sections of the New Jersey side of the Hudson River in the upper portion of the image.

Image provided by the ISS Crew Earth Observations experiments and the Image Science & Analysis Laboratory, NASA Johnson Space Center. Additional images available at http://eol.jsc.nasa.gov.