

Research Stations and life in the cold

Need to overcome three things in Antarctica:

1. **logistics (how to build, maintain, and power them plus food and water, waste disposal)**
2. **climate control (how to keep them at a comfortable temperature including types of insulation, orientation to winds, drifts, adapt to the environment, etc.)**
3. **comfort (not just temperature, but space, working and sleeping facilities, toilets, quality of food, and leisure)**

The first research station was a stone hut built in 1902 by William Bruce on Laurie Island, South Orkneys, as part of the Scottish National Antarctic Expedition

Established as a meteorological station, base for exploring the islands



The next stations were the huts built in the Heroic Age by Borchgrevink, Scott, and Shackleton

Pre-fabricated for rapid construction, durable, but not always very comfortable

Wind, snow would seep through cracks and snow would blow and collect on the leeward side or the roof and never melt







The Cape Evans hut was separated into three areas: officer's quarters, enlisted quarters, and a work area. There also was a dark room where the photographer, Herbert Ponting, worked and slept



These huts were followed later by larger stations with multiple buildings.

Little America was the first, built in 1929 on the Ross Ice Shelf, went through five iterations by 1956 with Richard Byrd's expeditions

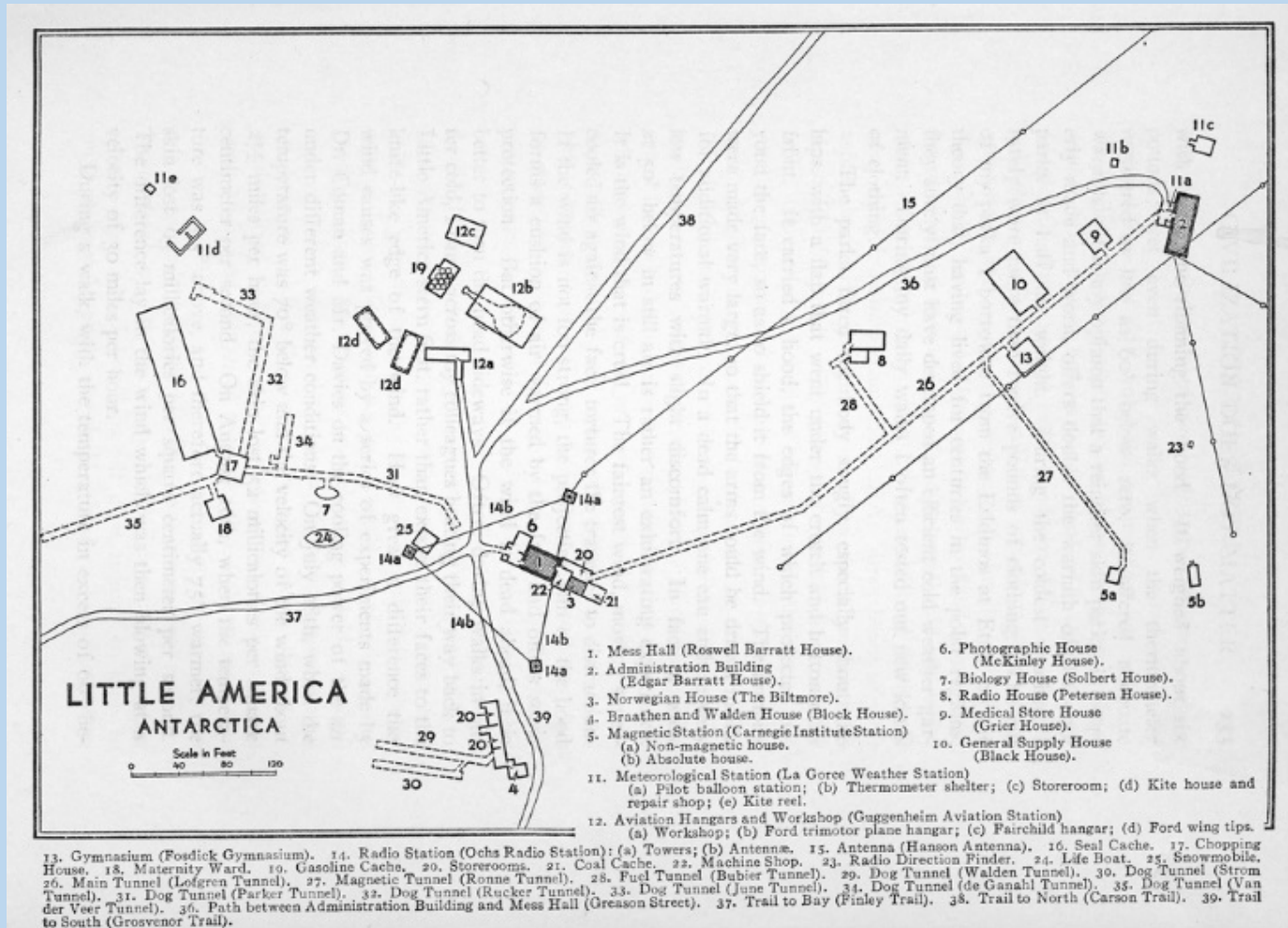
The first included three radio towers and the main hut



They used wooden crates to construct tunnels between buildings



Aside from an administration building and bunk house, the complex included three radio antenna towers, a mess hall, hangers for the airplanes, storage sheds and a machine shop that contained the first generator of electricity in Antarctica. <https://library.osu.edu/>



This plan not only made it easier and safer to move between buildings during the winter, it was protection from fires too

Over time, gradual snow accumulation and melting from the darker color of the station caused it to sink into the ice shelf

This also caused ventilation problems, possibility of carbon monoxide poisoning from heating systems



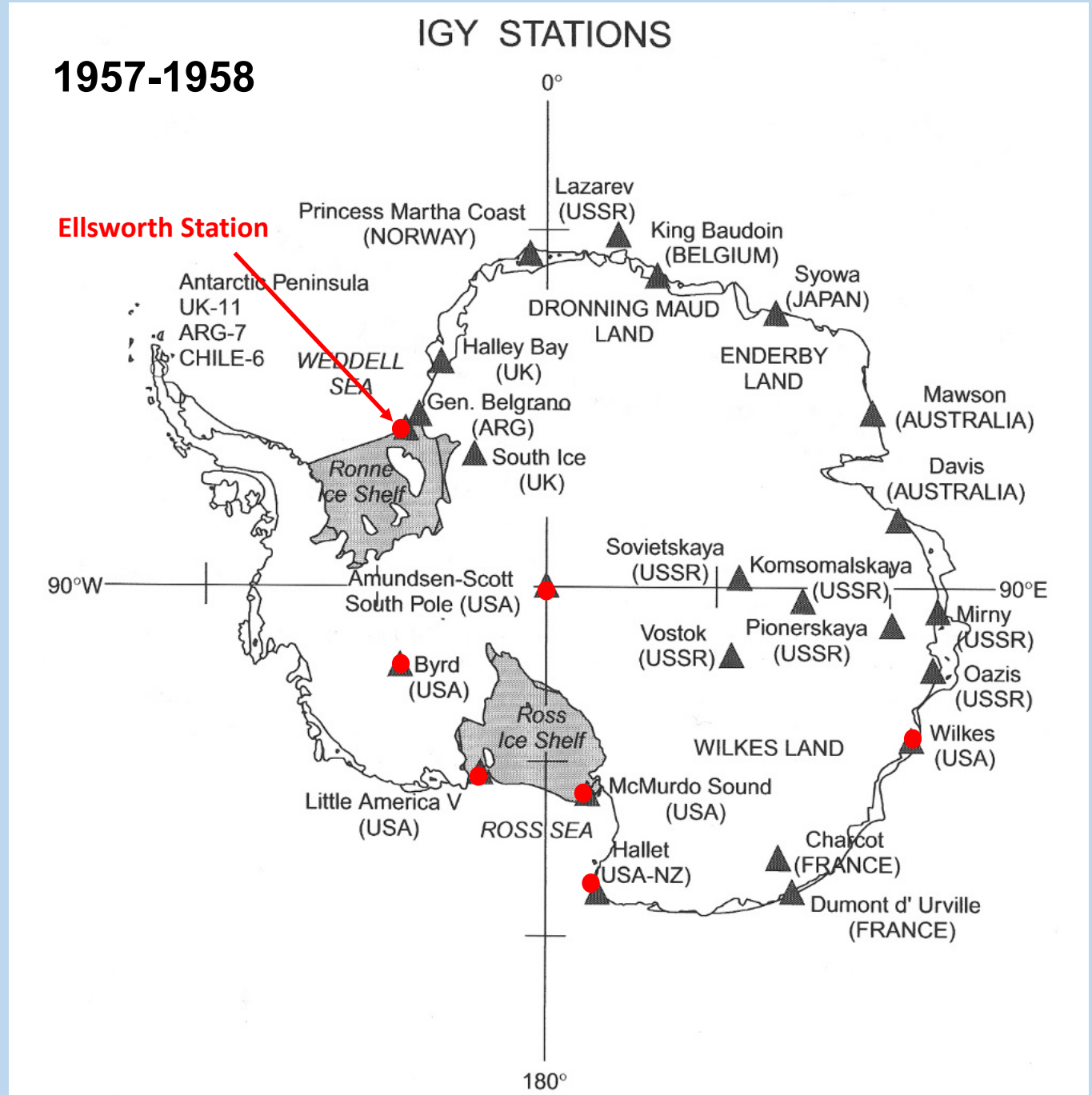
Remains of Little America III in a tabular ice berg that broke from the Ross Ice Shelf in 1963





In the IGY, 12 countries established 40 stations in Antarctica with an additional 20 on islands

Seven established by the U.S., but Byrd and Little America were eventually abandoned, Wilkes was turned over to Australia in 1959, and Ellsworth to Argentina in 1959



Other stations built on ice faced similar problems in sinking and snow accumulation rate of ~1.2 to 1.5 m per year

Halley Station (U.K.) built in 1956 for the IGY in 1957-1958 on the Brunt Ice Shelf in the Weddell Sea

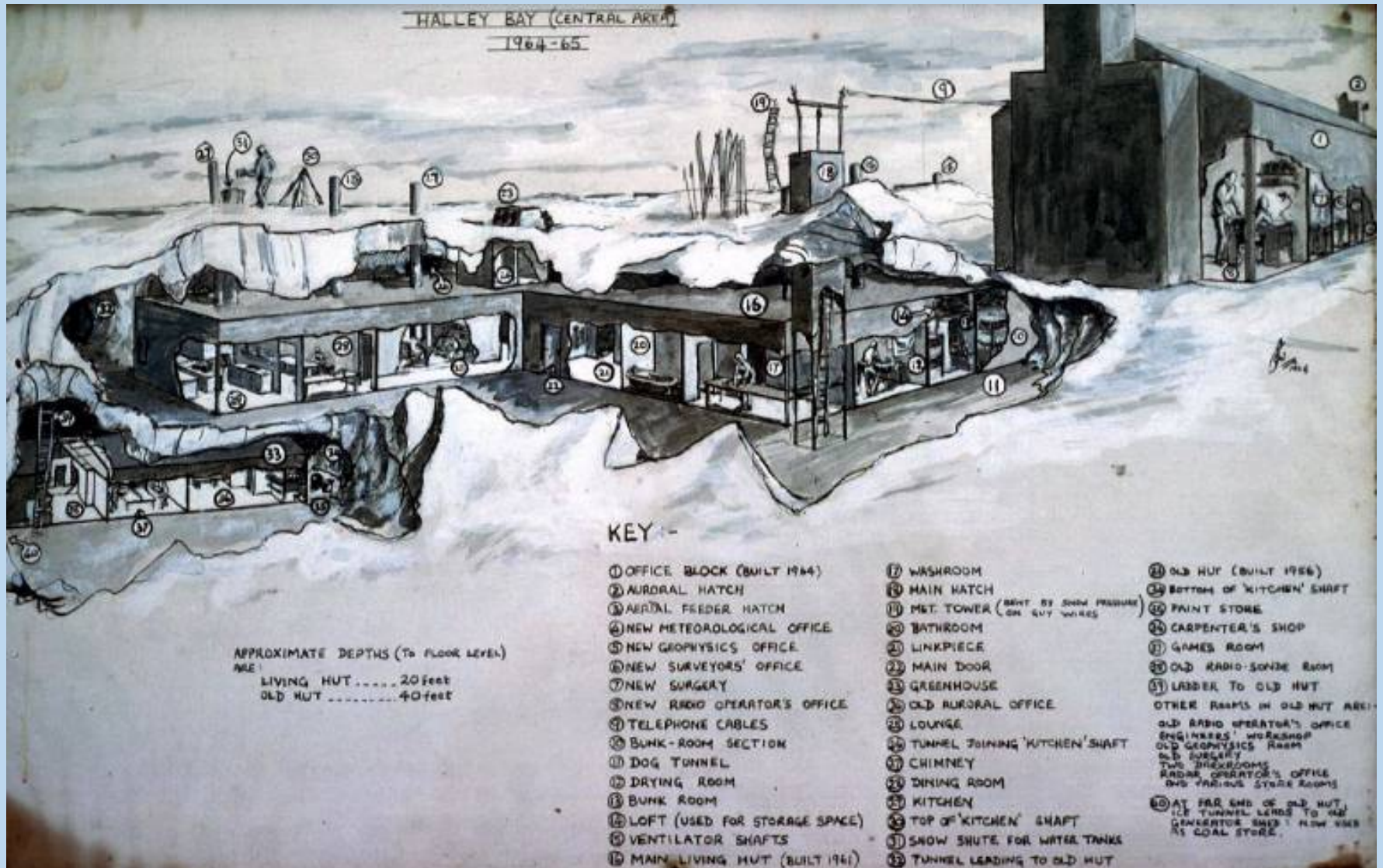
Originally a wood structure, it was engulfed by snow accumulation and abandoned by 1963



Subsequent structures ranged from surface buildings with steel roof supports (Halley II), to subsurface steel tubing (Halley III), but these also had to be abandoned



Halley II drawing about 10 years after construction





Halley III became too deep to safely access, ventilate, so was abandoned after seven years



Halley IV built in 1983 with curved roof, but still had snow drift piling up and blocking windows, vents. Abandoned after nine years



Then it was built on jackable steel stilts, so it could be raised above the drift, but it was fixed to a moving ice shelf and eventually had to be abandoned as it approached the edge

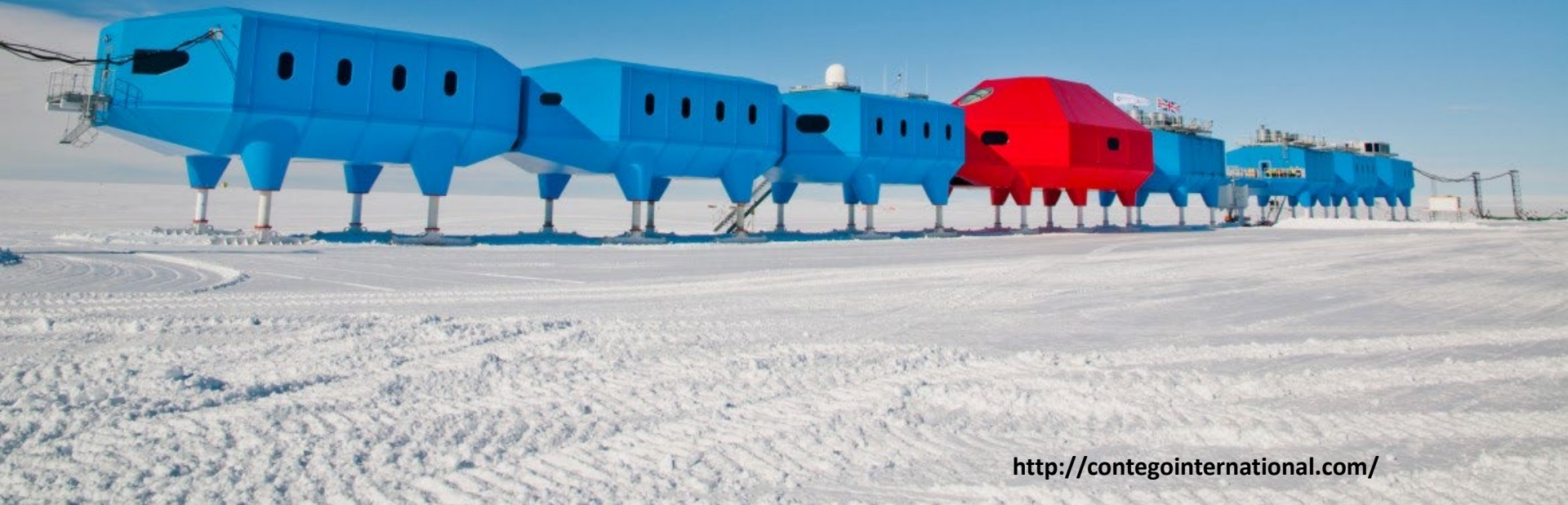
Halley V





It is currently on its sixth iteration—2013 built on stilt skis, so it can be moved in sections when needed

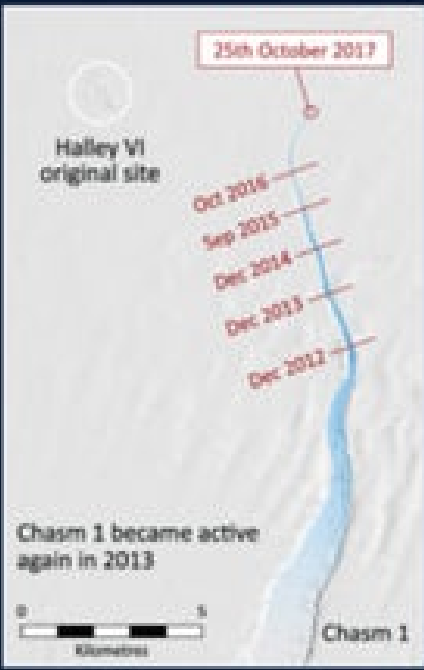
Halley VI





HALLEY VI RESEARCH STATION - Brunt Ice Shelf, Antarctica

satellite image acquired 25th October 2017



After completion, ice chasm became more active, threatening station

Halley VI had to be moved in the 2016-2017 season due to large crack in ice shelf extending towards it





The Amundsen-Scott Base (USA) at the South Pole also was built for the IGY

Anticipating snow accumulation, the base was built from wood in two stories, so the upper story would be at ground level in the future



NSF photos

Original South Pole Station in 1957, built by the U.S. Navy

It eventually was buried by snow accumulation and drift and was abandoned in 1975



NSF photos



Next, a large dome was built with aluminum panels and used as a protective bubble for buildings inside



NSF photos



Still had problems with snow and condensation and ice inside the dome

It was removed during construction of the new base in 2009-2010

The new station also is built on jackable steel supports, snow blows under it and it can be raised several stories as it sinks



The carbon 'footprint' for building stations in the Antarctic is greater than that for buildings anywhere else in the world

Must move materials to the sites from great distances around the world

Must burn lots of fuel to keep them heated and waste disposal also can be a problem

Early stations dumped wastes into the sea, holes in sea ice, or just in large garbage dumps on land

Trash being burned at McMurdo Station in the 1970s



<http://www.transantarcticmountains.com/>

Skuas increased in numbers during this period, feeding off the trash, and the Adélie penguin colony nearby declined from increased predation



Greenpeace got involved in Antarctic environmental issues in the 1980s and built a temporary station at Cape Evans to keep up pressure for change from 1986 to 1991



By 1989-1990, McMurdo began a recycling program and stopped burning waste in 1991. Now all burnables are retrograded by ship back to the U.S.



Wind and solar power are now more common at most stations and the Environmental Protocol of the Antarctic Treaty came into effect by 1998



State-of-the-art Princess Elisabeth Station (Belgium) completed in 2009

Aerodynamic shape faces wind, stilts prevent snow accumulation and allows melt water drainage



A zero-emission station, first of its kind: nine wind turbines, two types of solar panels, batteries to store excess power, and two generators as back up for emergencies



Built with steel anchoring on bedrock, wooden structure, wall modules with nine layers of wood, aluminum, felt, paper, insulation for minimal heat loss and also to be water and air tight



All water recycled, 75% reused including waste water that is purified

Water recycled five times, then disposed



Station is summer only, but could be used in winter soon

Life expectancy of station is 25 years



ANTARCTICA

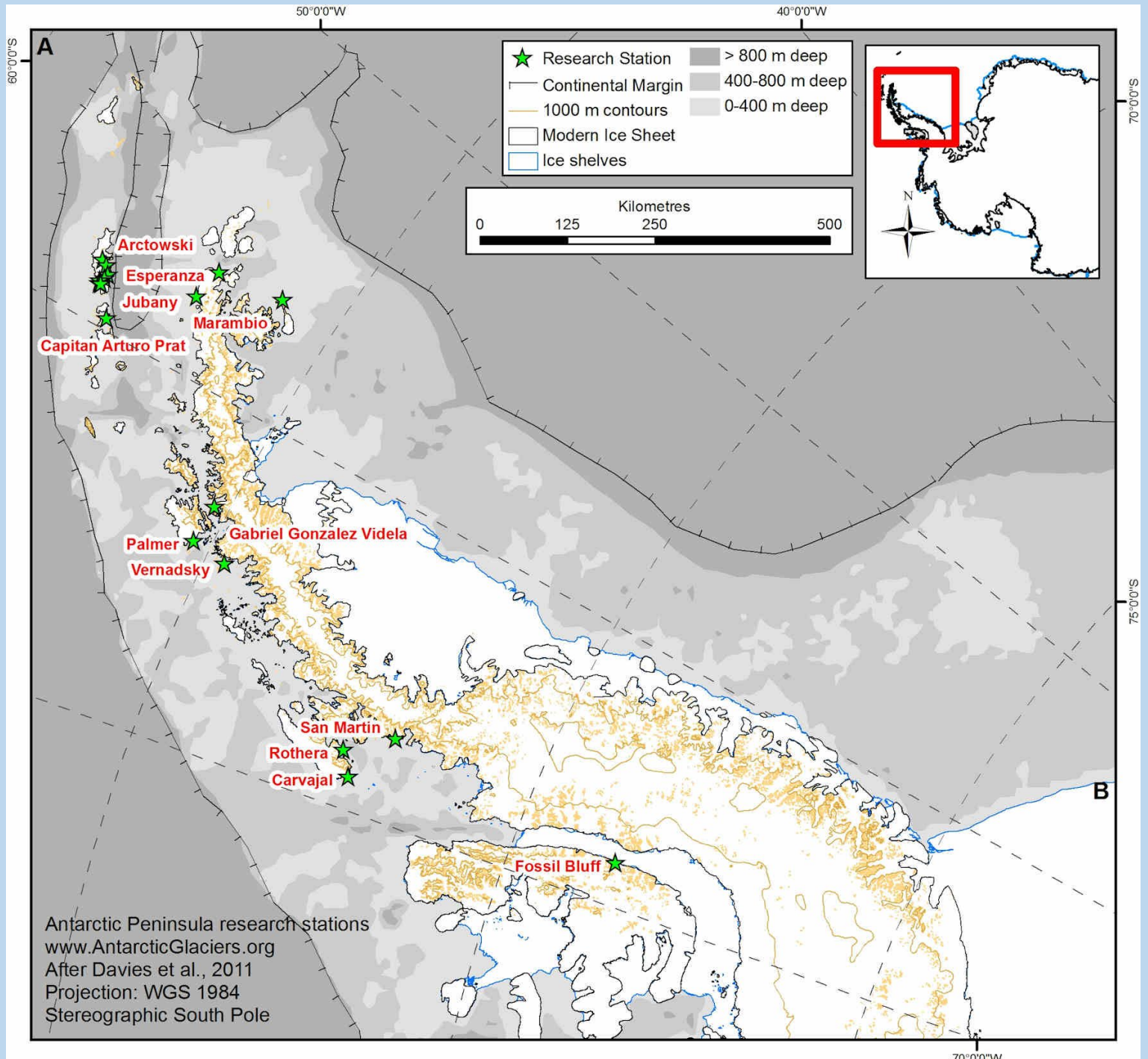


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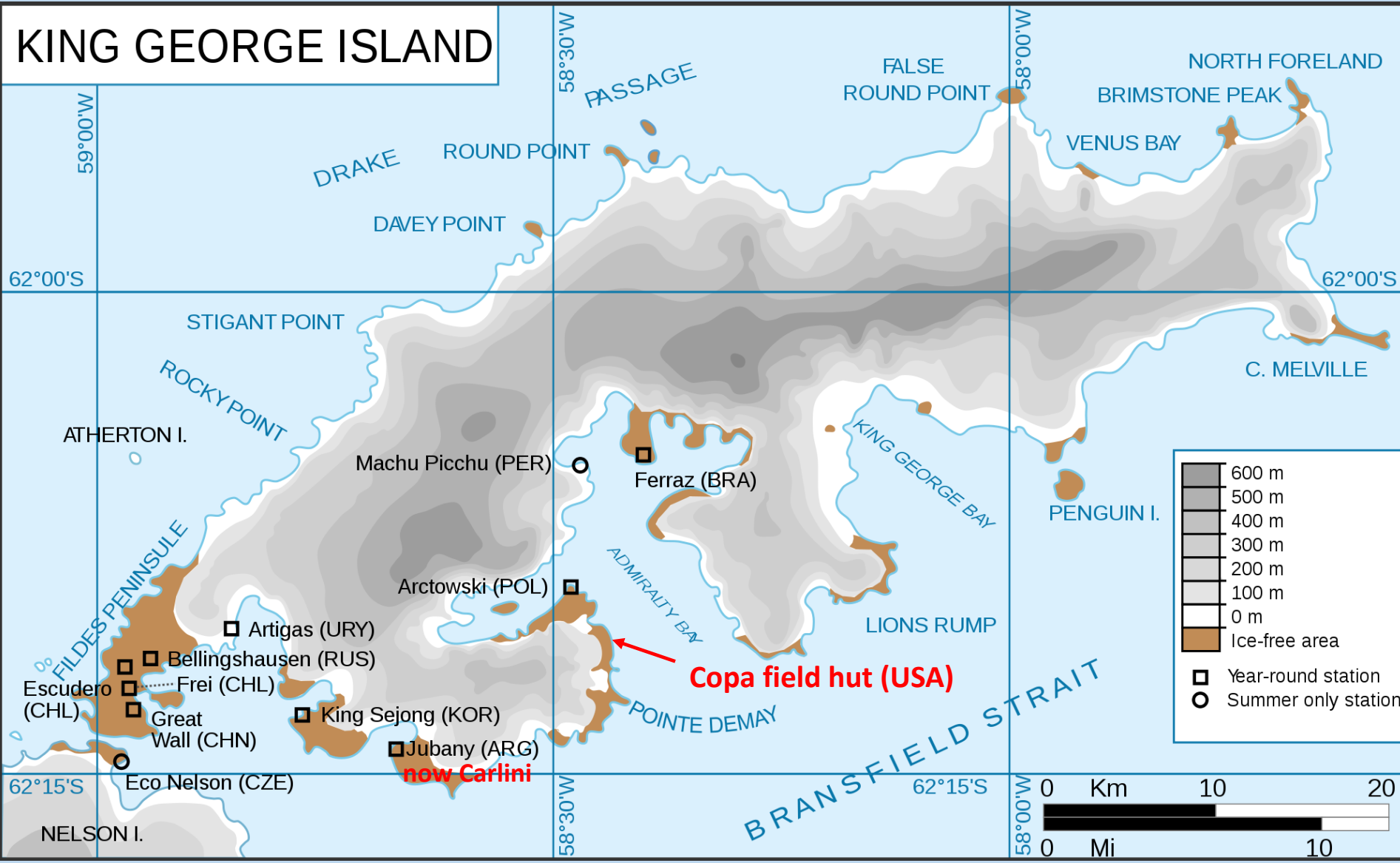
- ▲ Mountain Peak
- Research Station



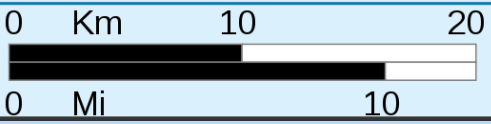
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KING GEORGE ISLAND



	600 m
	500 m
	400 m
	300 m
	200 m
	100 m
	0 m
	Ice-free area
	Year-round station
	Summer only station



Copacabana (Copa), USA, summer only hut



ANTARCTICA



LEGEND

- ▲ Mountain Peak
- Research Station



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135° 150° 165° 180° 165° 150° 135°
West of Greenwich 180° East of Greenwich

Carlini Station (Argentina)



Casey Station (AUS), East Antarctica



McMurdo Station (USA)





Crary science lab





Field Camps

<http://www.usap.gov/usapgov/travelAndDeployment/index.cfm?m=4>



Clothing issue, Christchurch, New Zealand



Snow school



Also receive training for hypothermia—how to recognize and treat it, and avoiding snow blindness



Problems that arise with personnel:

isolation and darkness

safety and accidents

social and mental fatigue

paranoia

risk assessment: is experience good or bad?

Quiz

1. What three things need to be addressed when designing a research station in Antarctica?
2. What were some of the early problems in station design and how were these resolved?
3. What is a carbon 'footprint' and how can it be reduced at a research station?
4. What is a zero-emission station and how do they operate?
5. Why is risk assessment now an important tool for station safety and why are experienced personnel more likely to have accidents or make poor decisions?