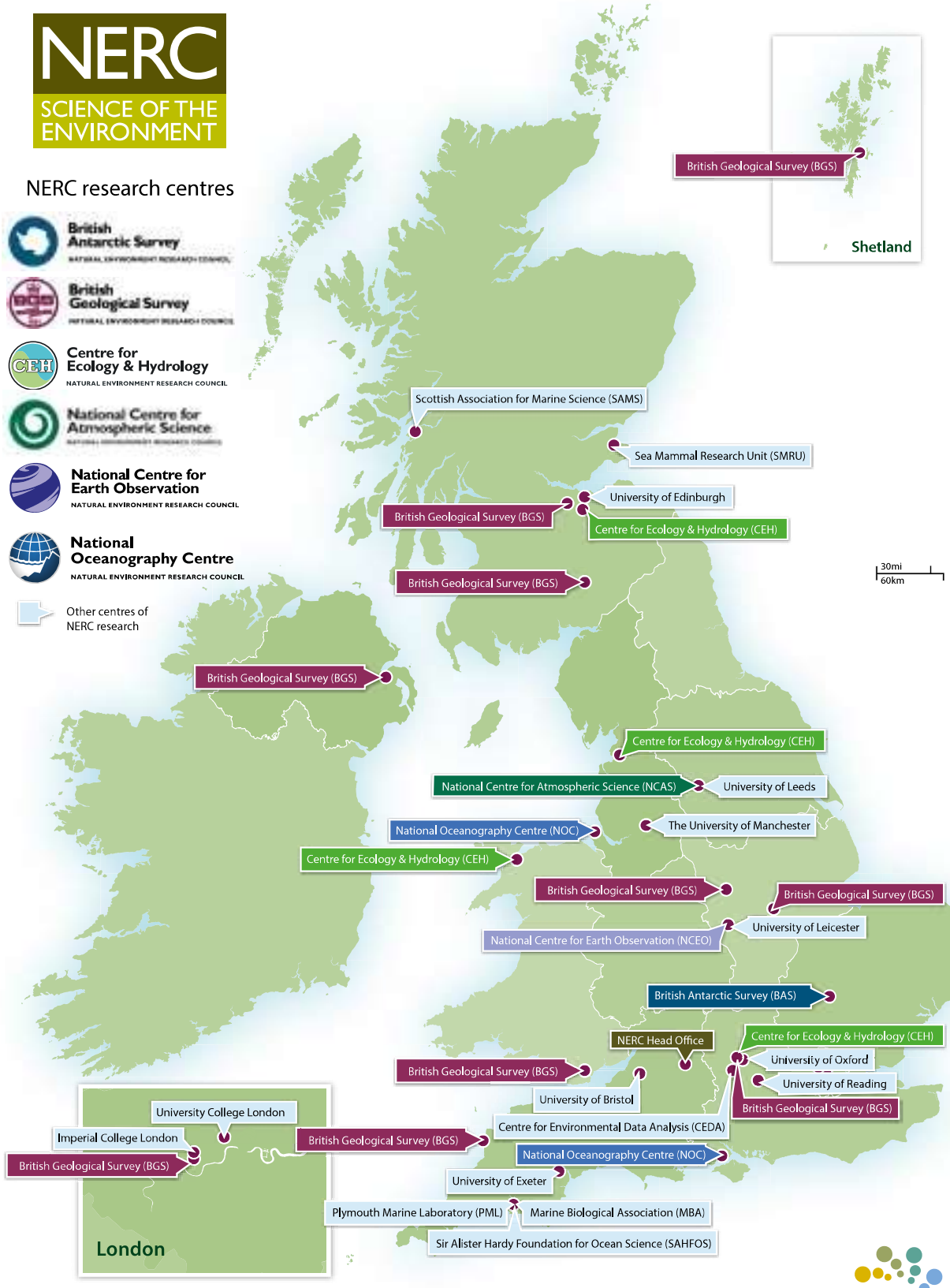
NERC across the UK

NERC SCIENCE OF THE ENVIRONMENT

NERC research centres

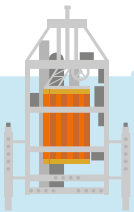
- British Antarctic Survey
- British Geological Survey
- Centre for Ecology & Hydrology
- National Centre for Atmospheric Science
- National Centre for Earth Observation
- National Oceanography Centre

Other centres of NERC research



www.operationearth.co.uk
www.sciencecentres.org.uk

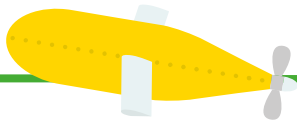
UK Association for Science and Discovery Centres



Natural Environment Research Council

NERC
SCIENCE OF THE ENVIRONMENT

The Natural Environment Research Council (NERC) was created in 1965 when a number of environmental research organisations and surveys were brought together.



What is NERC?

NERC is the UK's largest funder of independent environmental science delivered through universities and research centres in the UK. They advance the frontiers of knowledge by funding new research, infrastructure, innovation and training that delivers valuable scientific breakthroughs. Their science explores the physical, chemical and biological processes on which our planet, life and economy depends – from safe food and water to energy and minerals, from air quality and flooding to long-term changes in our environment and climate.

They invest public money in world-leading science, designed to help people sustain and benefit from natural resources, predict and respond to natural hazards and understand environmental change. They work closely with policymakers, industry and society to make sure their knowledge can support sustainable economic growth and wellbeing in the UK and around the world and deliver solutions to UK and global challenges.

NERC is supported mainly by the Department for Business, Energy & Industrial Strategy (BEIS), but their activities and funding decisions are independent of government.

NERC invests in environmental science across the UK, supporting:

- 3,000 scientists and 1,000 PhD students.
- 1,000 research projects and 60 UK or international programmes.
- 55 universities and 20 research institutes.
- UK research capability including four ships, seven aircraft, six polar stations, six data centres and 32 research community facilities.

What NERC does?

NERC's vision

To place environmental science at the heart of responsible management of our planet.

Understanding our changing planet is fundamental to our future wellbeing and economic prosperity. People no longer live in a natural world - there is virtually no part

of the environment that people have left unchanged. Our growing population and the way we live has changed our relationship with the environment and humans are now the dominant source of change. People around the world aspire to escape poverty and improve living standards. Achieving this whilst living within the Earth's limits is a great challenge of the 21st century.

NERC science has a critical role to play in meeting this challenge - to help the UK deliver innovation and growth with responsible environmental management.

NERC Research Centres:

NERC has six research organisations in multiple locations throughout the UK. They access all parts of the environment (from deep Earth and oceans to upper atmosphere and space, and from pole to pole) and support world-leading environmental science and innovation in universities.

These research centres are:

British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

British Antarctic Survey – Cambridge.

BAS's 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. Numerous national and international collaborations, combined with excellent BAS facilitates, help sustain a world-leading position for the UK in Antarctic affairs.

BAS employs over 400 staff. Facilities to support scientific and operational activities include laboratories and offices in Cambridge; two year-round Antarctic research stations - Rothera, Halley - and the summer-only Signy; two sub-Antarctic stations on South Georgia; and the NERC Arctic research facility at Ny Alesund. Two research ships - RRS James Clark Ross and RRS Ernest Shackleton - and a fleet of five aircraft enable logistic support and access to the polar regions as well as supporting research missions elsewhere.

www.bas.ac.uk
Contact BAS: Press@bas.ac.uk

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

British Geological Survey – Belfast, Cardiff, Devon, Edinburgh, Langholm, London, Nottingham, Oxfordshire, and Shetlands.

The British Geological Survey (BGS), founded in 1835, is the world's longest-established national geological survey and the UK's premier centre for earth science information and expertise.

In addition to geological work in the UK, BGS has an extensive programme of overseas research, surveying and monitoring, including major programmes in the developing world. BGS's headquarters are based at Keyworth, just outside Nottingham. They have regional offices in Edinburgh, Oxfordshire, London and Cardiff as well as other smaller research offices across the UK.

www.bgs.ac.uk
Contact BGS: enquiries@bgs.ac.uk

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

Centre for Ecology & Hydrology – Bangor, Edinburgh, Lancaster, and Oxfordshire.

The Centre for Ecology & Hydrology (CEH) is a world-class research organisation focusing on land and freshwater ecosystems and their interaction with the atmosphere.

CEH integrates UK-wide observation and curiosity driven research, from the smallest scale of genetic diversity to large-scale, whole Earth systems. Their long-term monitoring, analysis and modelling deliver UK and global environmental data, providing early warnings of change and management solutions for our land and freshwaters. These range from evaluating the causes of change in biodiversity stock and function, forecasting floods, identifying and addressing the impacts of pollution and climate change, to safeguarding UK soils and carbon stocks. Their work also includes developing decision support tools for the sustainable intensification of agriculture and the management of ecosystem services and water resources.

CEH has four research sites located in England, Scotland and Wales.

www.ceh.ac.uk
Contact CEH: cehcomms@ceh.ac.uk

National Centre for Atmospheric Science
NATURAL ENVIRONMENT RESEARCH COUNCIL

National Centre for Atmospheric Science – Leeds.

The National Centre for Atmospheric Science (NCAS) is a world leader in atmospheric science. NCAS carry out research programmes in the science of climate change, including modelling and predictions; atmospheric composition, including air quality; weather, including hazardous weather; technologies for observing and modelling the atmosphere.

NCAS provides national capability in atmospheric science research. The centre performs directed and multi-disciplinary research, using state-of-the-art technologies for observing and modelling the atmosphere.

Additionally, NCAS provide scientific facilities for scientists and researchers across the UK to enable excellent atmospheric science on a national scale. These include a world-leading research aircraft, ground-based instrumentation, access to computer models and facilities for storing and accessing data.

www.ncas.ac.uk
Contact NCAS: media@ncas.ac.uk

National Centre for Earth Observation
NATURAL ENVIRONMENT RESEARCH COUNCIL

The National Centre for Earth Observation – Leicester.

The National Centre for Earth Observation (NCEO) is an established NERC research centre that provides NERC with national capability in earth observation science.

NCEO is building on the considerable expertise of the Centres of Excellence by using data from earth observation satellites to monitor global and regional changes in the environment so that we might predict future environmental conditions.

www.nceo.ac.uk
Contact NCEO: info@nceo.ac.uk

National Oceanography Centre
NATURAL ENVIRONMENT RESEARCH COUNCIL

National Oceanography Centre - Southampton and Liverpool.

The National Oceanography Centre (NOC) is a national research organisation, delivering integrated marine science and technology from the coast to the deep ocean, working in partnership with the UK marine research community.

NOC was formed by bringing together the NERC-managed activity at Liverpool's Proudman Oceanographic Laboratory and the National Oceanography Centre, Southampton, creating the UK's leading institution for sea-level science, coastal and deep-ocean research and technology development.

The centre works in close partnership with institutions across the UK marine science community addressing key science challenges including sea-level change, the oceans' role in climate change, predicting and simulating the behaviour of the oceans through computer modelling, development, the future of the Arctic Ocean and long-term monitoring technologies.

The NOC works with many organisations and partners to help deliver national capability through major research facilities, mapping, data management and programmes of sustained observing.

www.noc.ac.uk
Contact NOC: communications@noc.ac.uk

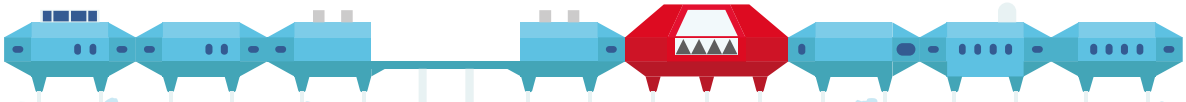
Major discoveries

NERC scientists have contributed to:

- The discovery of the ozone hole in 1985.
- Efforts to help the UK Civil Aviation Authority establish safe flying limits when Eyjafjallajokull erupted in 2010 - one of the research aircraft NERC jointly runs with the Met Office flew through the ash plume.
- A coastal flooding model that feeds directly into the Thames Barrier control centre.
- A project to decode the ash tree's genetic sequence in 2013 to help identify the genes that mean some trees are resistant to ash dieback.
- Data and risk models that are used to predict local flooding and plan major investments in infrastructure.
- The first ever countryside survey in 1978.
- The UK National Ecosystem Assessment in 2011.

Links to further information

www.NERC.ac.uk
Contact NERC:
publicengagement@nerc.ac.uk

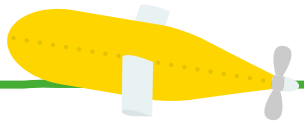


Autosub long range

(Boaty McBoatface)

Associated NERC centre:
National Oceanographic Centre (NOC).

Launch date:
Weddell Sea – in the Southern Ocean - on Tuesday 4th April 2017. Boaty was deployed from on board the RRS James Clark Ross.



What is it?

Boaty McBoatface is an Autosub Long Range, an automated , sub-sea research vessel designed to explore and collect data from Earth's deepest oceans in the Arctic and Antarctica. This yellow submarine is capable of travelling under ice, reaching depths of up to 6,000 meters and sends data back to researchers via radio link-ups. Boaty will eventually be deployed from the RRS Sir David Attenborough on completion of the research ship in 2019.

What does the Autosub do?

Autonomous Underwater Vehicles (AUVs) help researchers gather data about what's going on in the Earth's ocean environments. Boaty is one of the most advanced sub-sea research vessels available, collecting valuable data which provides new insights into the underwater worlds of planet Earth. On its first mission, Boaty gathered data on temperature, speed of water flow and underwater turbulence rates of the Orkney Passage in the Southern Ocean. This data can help us understand how ocean mixing affects global climate change. In time, Boaty will be kitted out with additional sensors (chemical and acoustic) that will help scientists explore the release of gases beneath the seabed, and could even be used to complete the first ever crossing of the Arctic Ocean under ice.

Key fact:

- The ability to travel under Ice and to depths of up to 6,000m will mean Autosubs like Boaty will be able to explore around 95% of the ocean.

Additional information

The National Oceanographic Centre operates three types of AUVs which include:

- Autosub3
- Autosub6000
- Autosub Long Range

Links to further information

www.noc.ac.uk/facilities/marine-autonomous-robotic-systems/autosubs
www.noc.ac.uk/education/educational-resources/boaty-mcboatface
www.bas.ac.uk/media-post/first-dive-boaty-mcboatface/

RRS Sir David Attenborough

Associated NERC centre:
British Antarctic Survey (BAS).

Launch date:
RRS Sir David Attenborough is still under construction and due to launch in 2019.

What is it?

The RRS Sir David Attenborough is a research vessel set to launch in 2019. The ship is 128 metres long and will be able to support up to 60 scientists and support staff. The ship is named after the famous broadcaster and naturalist, Sir David Attenborough,and replaces a pair of existing vessels, RRS James Clark Ross and RRS Ernest Shackleton. The ship's construction helps keep Britain at the forefront of world-leading research in Antarctica and the Arctic.

What will it do?

The RRS Sir David Attenborough is specially constructed to travel through extreme polar regions and will provide a state of the art platform for polar science, with laboratories and advanced technology.

With improved efficiency and an ice-strengthened hull, designed to break through ice up to one metre thick, this ship will be able to spend up to 60 days at sea unsupported, and travel further than NERC's current polar vessels. This will enable it to provide extensive support to BAS researchers working inshore. The ship will be able to operate year-round, spending the summer supporting Arctic research cruises and the winter in Antarctica carrying out research programmes and transporting people and supplies to BAS research stations. With a range of over 35,000km, which is more than twice around the continent of Antarctica, it will push the boundaries of polar science and exploration.

The ship will be a multidisciplinary research platform studying the oceans, seafloor, ice and the atmosphere. In order to achieve this, the ship is equipped with some of the latest research technology. This includes a range of remotely operated devices that can be deployed from the ship including Autonomous Underwater Vehicles such as the Autosub Long Range. These vehicles will be packed full of scientific instruments and collect data from previously inaccessible places, including far under the ice. They will make measurements on such things as Antarctic krill distribution and the abundance and thickness of sea-ice.

RRS Sir David Attenborough will also have a moon pool at her centre, which is a vertical shaft running from her top, straight through into the sea. This means that scientific equipment can be deployed and recovered through the centre of the ship. This is much safer than doing so over the side of the ship, especially in rough seas.

The ship also has space for special laboratories in containers. This means that it can continually be supplied and adapted with the most up to date scientific tools.

Applications:

- **Earth observation** - mapping the geology, monitoring sea-ice conditions, changes in surface temperature and concentrations of greenhouse gases.
- **Ecology & biodiversity** - state-of-the-art genetic methods to study the DNA of microscopic life.

Key facts:

- RRS Sir David Attenborough will have a range of over 35,000km, which is more than twice the distance around the continent of Antarctica.

Links to further information

www.bas.ac.uk/polar-operations/sites-and-facilities/facility/rrs-sir-david-attenborough/

Facility for Airborne Atmospheric Measurements (FAAM)

Associated NERC centre:
The National Centre for Atmospheric Science (NCAS).

Launch date:
FAAM's first research flight took place in 2004.

What is it?

FAAM is the UK's most advanced research aircraft and a key tool for environmental scientists in understanding how our planet works and how it's changing. Owned by NERC, and operated in partnership with the Met Office, FAMM is a modified BAe 146-301 Atmospheric Research Aircraft, equipped with state of the art technology to measure clouds, aerosols and radiation.

What will it do?

Taking to the skies can help us understand atmospheric processes and how these impact upon the different systems and environments on Earth. FAAM has been used to measure the onset of monsoons in Asia, how clouds affect climate in the Polar Regions, to explain dust outbreaks in the Sahara Desert and how Saharan dust is deposited all over the world. FAAM can also be used to help environmental scientists understand how oceans influence cloud and rain formation, as well as explore how global warming and ocean acidification are affecting the chemical composition of the sea, and the plants and animals that live there.

FAAM is equipped with scientific equipment designed to help us understand the state of different environments. Attached to the wings of the plane are probes which help us understand the make-up of clouds, radiometers which help obtain the temperature of the atmosphere, and a variety of other probes that measure air currents. FAAM has technology that maps ground terrain and a series of antennae to send and receive data. The plane is capable of dropping equipment, called 'dropsondes' from the aircraft to ground level, which are capable of measuring pressure, humidity, temperature and wind speed.

Applications:

- Radiative transfer studies in clear and cloudy air.
- Tropospheric chemistry measurements.
- Cloud physics and dynamic studies.
- Dynamics of mesoscale weather systems.
- Boundary layer and turbulence studies.
- Remote sensing - verification of ground based instruments.
- Satellite ground truth - radiometric measurements and winds.
- Satellite instrument test-bed.

Key facts:

- FAAM has flown around 1.3 million miles over the past 13 years, embarking on research missions from 30 different countries spending around 5,000 hours in flight.

Links to further information

www.faam.ac.uk

Halley VI Research Station

Associated NERC centre:
British Antarctic Survey.

Launch date:
Halley station first opened in 1967.

What is it?

The Halley Research Station is an innovative research facility based in Antarctica on the Brunt Ice Shelf on the Caird Coast. Halley provides polar researchers with facilities for studying the atmosphere, space weather and glaciology. Halley VI is the world's first re-locatable research facility with each of its eight 'pods' able to be towed to new locations using specialist vehicles.

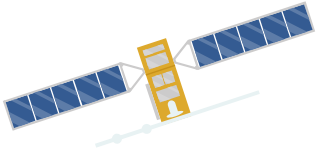
What will it do?

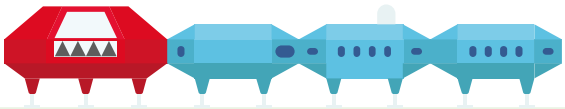
The Halley station collects information from instruments designed to measure temperature, humidity, sunshine, pressure, wind speed and direction data. The station is part of a global network which provides reliable data on the chemistry of Earth's atmosphere and how it's changing. Around 70 staff are based at the Halley during the Antarctic Summer (late December to early March) and 16 staff in the Antarctic Winter. The staff team is made up of people from different disciplines including doctors, chefs, scientists and specialist technicians and engineers.

The central red module is the main socialising area for the research team, with the seven blue modules consisting of accommodation for the researchers, generators, labs and observation platforms.

Halley is important in the study of rising sea levels, polar atmospheric chemistry and climate change. Halley has provided a continuous record of meteorological and atmospheric data since opening in 1967.

The station is ideally positioned for gaining an in-depth understanding into space weather, with its data being used to produce space weather forecasts which protect satellites that drive our telecommunications infrastructure on Earth. The station is equipped with facilities both on-board the vessel, as well as in surrounding sites.





Facilities available:

- **Clean Air Sector Laboratory (CASLab)** – specialised observatory with a suite of instruments to measure the air and snow chemistry around Halley.
- **Dobson Photospectrometer** – the instrument that led to the discovery of the hole in the Ozone layer over Antarctica.
- **Halley computing facilities** – computer and printing facilities for the scientists.
- **Halley garage and mechanical workshop** – the vehicles at Halley are essential for the successful operation of the station and are required to work around the clock.
- **Halley radars** – studying winds, waves and tides in the upper atmosphere across the polar regions.
- **Halley VLF receiver** – the Halley VLF receiver listens to very-low frequency radio waves as part of a network of receivers located all over the polar regions.
- **Halley weather balloons** – at Halley, balloon launches take place every day at 11am. A device called a radiosonde hangs beneath the helium-filled balloon and measures temperature, pressure and humidity.
- **Magnetometers** – monitoring magnetic wave activity using a search coil magnetometer can tell us about interactions between the solar wind and Earth's magnetosphere and waves associated with bright aurora displays.
- **Met instruments** – Met Tower Meteorological scientists at Halley have been measuring the weather in great detail since the station first opened in 1967.
- **Microwave radiometer** – the microwave radiometer enables us to gain a better understanding of the chemistry and physics of the polar middle atmosphere 35–90km above the ground and how it affects the climate.
- **Optical caboose** – The Bomem has been operating at Halley periodically since 2002. It is a Spectrometer, an instrument that splits light into its component colours.
- **Riometer** – the riometer at Halley measures radiowave noise at 30MHz coming from the Galaxy.
- **SAOZ – AOZ** measures sunlight scattered from the overhead sky. This allows us to calculate how much of the atmospheric gases ozone and nitrogen dioxide the light has passed through on its journey.

Key facts:

- Each of Halley's eight modules sits upon hydraulic legs fitted with skis. The height of each leg can be raised or lowered depending on snow cover and each module can be moved individually to a new location.
- The hole in the Earth's Ozone layer was first discovered at Halley in 1985 as a result of the long-term data record Halley provided. This led to the signing of the Montreal Protocol, an international agreement banning the use of Ozone depleting gases.

Links to further information

www.bas.ac.uk/polar-operations/sites-and-facilities/facility/halley/
https://youtu.be/uSp1XL-5agM

Earth Observation Satellites

Associated NERC centre:
The National Centre for Earth Observation (NCEO).

Launch date:
On-going launches.

What are they?

Earth Observation Satellites are objects that have been intentionally placed into orbit to observe the earth from up high. They are tools used by scientists that can view the entire globe. The satellites carry a range of instruments that collect different types of environmental data. This data along with information collected from aircrafts and instruments on the ground allow scientists to map and monitor local and global changes in our environment.

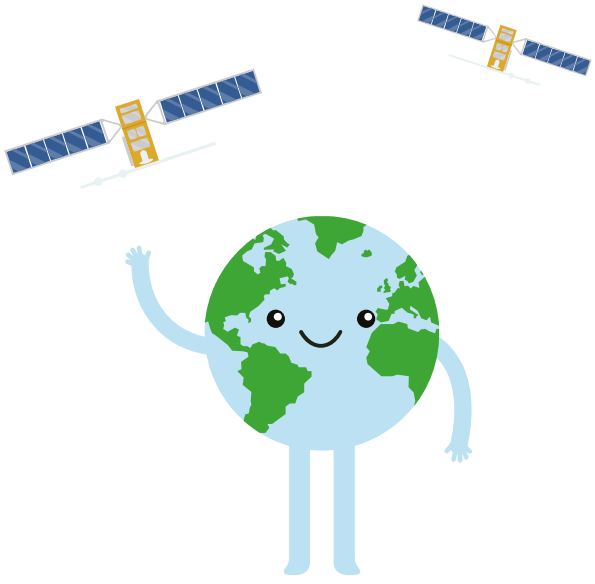
What do they do?

Earth Observation Satellites collect data that cannot easily be collected from the ground. From orbit the satellites are able to view and gather information about large areas of the planet's surface within a short amount of time. Compared to other satellites, Earth Observation Satellites usually have a lower orbit. This is required for the various instruments to get close enough to collect the data they need. They orbit the planet several times a day, normally in a polar orbit (passes above, or nearly above both poles) while the earth spins below them. This allows the satellites to have a global coverage of planet Earth.

There are many different Earth Observation Satellites used by different organisations throughout the world. The NCEO uses data from 20 separate satellite instruments collecting photo and radar imagery data as well as measurements of different wavelengths such as infrared, microwave and visible light.

Different materials such as water, soil, vegetation and buildings interact in different ways with different wavelengths. This means, if you know the type of object you are trying to observe, you can choose a particular wavelength to identify it.

The different measurements collected by satellites allow scientists to interpret, analyse and compare results to other data collected. This allows them to create maps of our planet with information on many important topics.



Applications:

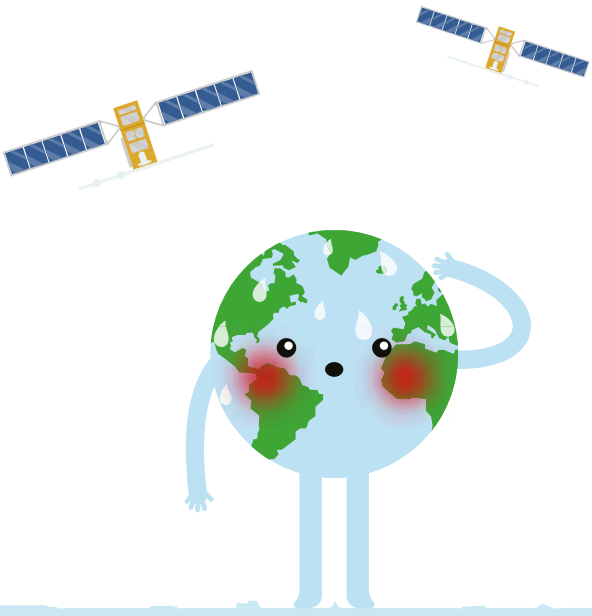
- Managing natural resources such as energy, freshwater and agriculture.
- Monitoring the weather.
- Measuring ice thickness and ice cover.
- Monitoring air quality.
- Monitoring atmospheric composition and trace gas content (e.g. ozone).
- Measuring carbon content in forests.
- Monitoring ocean salinity.
- Monitoring changes in vegetation.
- Responding to natural disasters including fires, floods, earthquakes, landslides, land subsidence and tsunamis.

Key Facts

- Satellites can be referred to as either active or passive.
- **Passive satellites** detect radiation reflected off the Earth's surface such as visible light and infrared. In general, passive satellites are not able to work through clouds.
- **Active satellites** however, transmit energy towards the Earth. In general, active satellites can see through cloud.

Links to further information

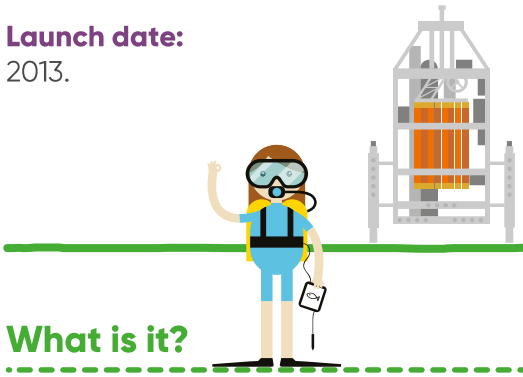
www.nceo.ac.uk



RD2 55m Rockdrill

Associated NERC centre:
British Geological Survey (BGS).

Launch date:
2013.



What is it?

RD2 is the latest and most advanced seabed sampling system – developed by the BGS to provide a multi tool package that can work in a range of environments, and extend the sampling capabilities of the BGS into deeper waters and further into the seabed. The RD2 is a remotely operated sampling system which can collect core samples from up to 55m below the surface of the sea floor in water depths of up to 4,000m. The RD2 has its own launch and recovery system (LARS), which allows for the safe operation of the system by one person.

What will it do?

The RD2 system can continuously core in 1.7m sections and can operate continuously for long periods of time. RD2 combines a wireline rotary coring system, water sampling systems and other logging tool capabilities into a single package. The instruments that make up RD2 allow it to act as a multi-data capturing system collecting core samples, drill feed data, video data, taking water samples and in-situ water chemistry samples, to name just a few of its capabilities.

Collecting cores from the ocean can help us understand some of the biggest environmental challenges our planet faces, with cores providing a record of environmental change over time. Sediment cores provide evidence on issues associated with changes in sea temperature, changes in global temperature, the effects of pollution on sea life and changes in ocean circulation.

Since its first deployment, RD2 has been used to sample sediments from the Sea of Japan, as well as numerous sites around Scotland including Loch Linnhe, the Firth of Forth and glacigenic sediments around the Western Isles of Scotland.

Key facts:

- RD2 is a remotely operated sampling system which can collect core samples from up to 55m below the surface of the sea floor in water depths of up to 4,000 metres.
- A core is a vertical cylinder, or block of sediment samples retrieved by forcing a drill bit or tubing into sediment, and then retracting it out to obtain a sample.

Links to further information

www.bgs.ac.uk/scienceFacilities/marine_operations/sampling_equipment.html

Drones

Associated NERC centre:
Used by all NERC research centres.

What are they?

Drones are remotely operated vehicle that can be flown over inaccessible areas to gain a birds-eye view of the land below and surrounding environment. They offer high resolution imagery and videos of specific targeted areas helping researchers collect data that otherwise cannot be collected from the ground. Drones can also have additional centres attached to them to enable them to collect a wide variety of data.

What do they do?

Drones help researchers save time, with the ability to gather data much faster than collecting data first-hand on foot. Drones also offer researchers the ability to attach different instruments onto them to collect different measurements. For example; video cameras, infrared cameras and LiDAR instruments can all be added onto drones depending on the individual research needs of different scientists.

Researchers working in a range of different environments – from the tropics to the Poles – use drones to gain valuable data on issues such as the changing distributions of animals and plants, mapping changing landscapes, or monitoring atmospheric CO_2 levels.

There are many advantages to using drones for environmental science research. The technology allows researchers to gather data that may be too dangerous (e.g. collecting samples from volcanic plumes) or difficult to complete themselves (e.g. population tracking through use of a helicopter).

It is also a lot cheaper to use a drone to take to the skies rather than more traditional forms of flight, such as a helicopter/aeroplane. The images that can be captured from drones can provide more detail than satellite imagery, and provide a valuable new data source for how landscapes or environments are changing. Unlike aircraft, drones can be piloted at short notice, and provide research teams with a new tool to explore environmental change on a regular basis with ease.

However, drones are not without their challenges. It can take a long time to learn how to operate them professionally, and anyone wanting to use them for commercial or research purposes must obtain a piloting license to do so. Many researchers learn how to fly drones using simulation software. Even with the licence in hand, drone pilots have a lot of challenges to face such as how to retrieve crashed drones and establishing the limitations of the drones when working in harsh environments.

Key facts:

- The British Antarctic Survey use drones to help their ships steer clear of ice as they provide a much wider view of what lies ahead of the ships.
- Drones are a great tool for monitoring a species' population and determining its range, and can stop poachers before they strike by pinpointing their locations.
- Drones equipped with thermal imaging cameras have been used to monitor warm and cool water flows around coral reefs.

"Drones help researchers save time, with the ability to gather data much faster than collecting data first-hand on foot"

Links to further information

www.nerc.ac.uk/planetearth/stories/1829/