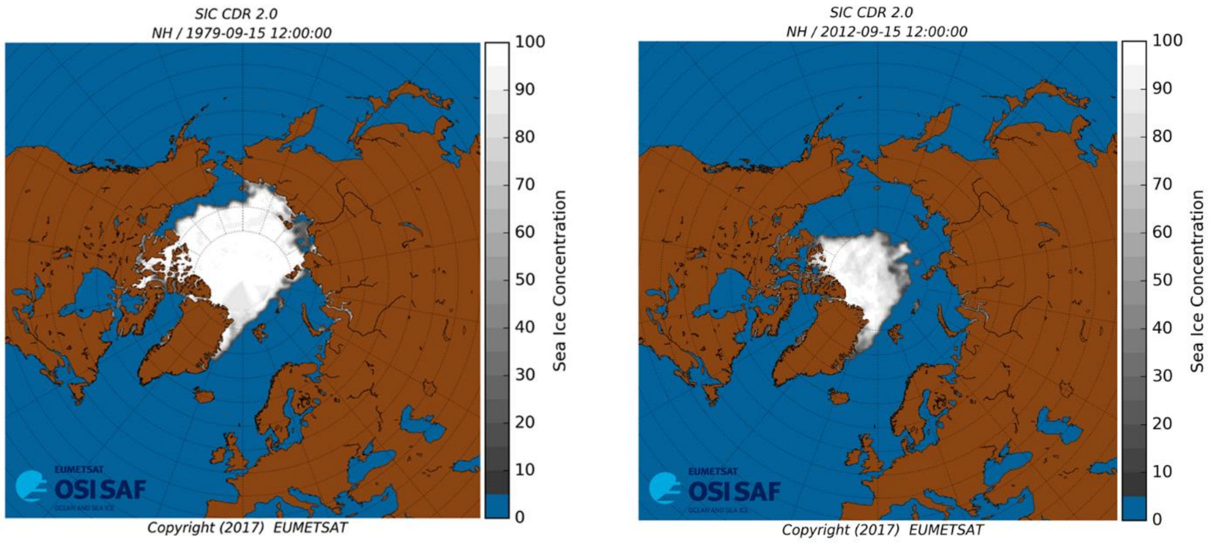
Satellites Help To Monitor and Manage the Arctic

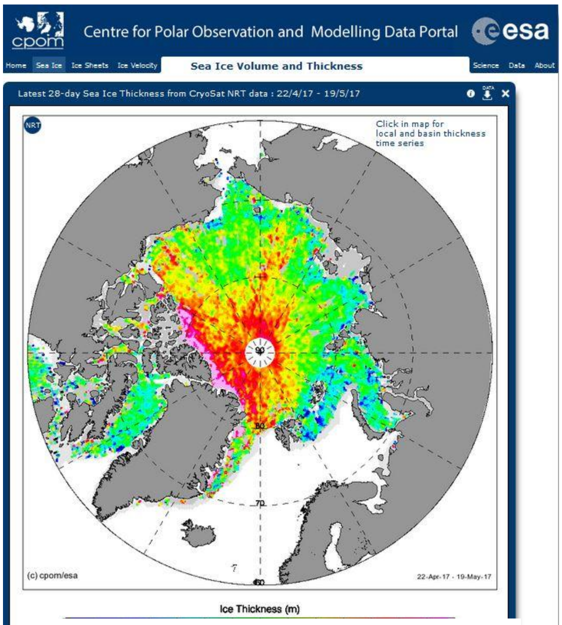


(September Arctic Sea Ice Coverage – 1979 and 2012. Copyright (2017) EUMETSAT)

The Arctic plays an important role in regulating and driving the global climate and it is experiencing significant change. Over the 33 year period from 1979 to 2012, the annual minimum extent of sea ice in the Arctic ocean shrank by over half from 8 million km² to just 3.41 million sq. km in 2012, and in 2017 Arctic minimum sea ice extents are likely to reach 4.64 million sq. km, well below the long term average for this period.

Whether this is seen as positive or negative depends on ones' interests. The change in sea ice extent reflects regional climate change and is causing major impacts on regional wildlife, food-webs, ecosystems, and indigenous populations. For example, the reduction in sea-ice is likely to have devastating consequences for polar bears, ice-dependant seals and the local peoples for whom these animals are a major food source. With wider global consequences as well, there is widespread concern among the public about impact on the delicate and pristine Arctic environment.

On the other hand, reduced sea ice increases marine access to the region's resources, expanding a wide range of commercial opportunities. There are rapid increases in oil and gas exploration, fishing, and new shipping routes underway. This raises major challenges in monitoring and protecting this pristine area, to enable sustainable exploitation to take place without degrading the environment irreparably. In addition to monitoring sea ice, it will also be essential to monitor shipping (to observe both fishing and traffic), detect natural and man-made oil slicks, identify icebergs, and support navigation in the sea ice. Developing tools to model, understand and monitor these changes is vitally important in order to better predict and mitigate the resulting global economic and environmental consequences.

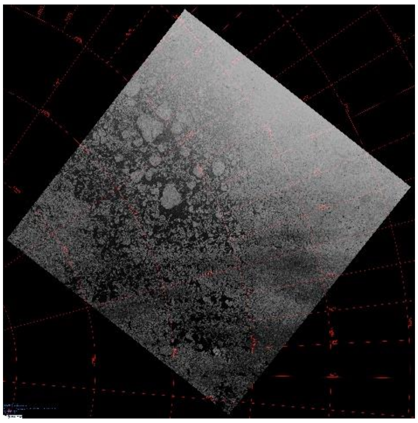


(CryoSat Sea Ice Thickness. Source: ESA)

Our knowledge of what is happening in the Arctic ocean comes from a string of satellite missions that have been monitoring the area over this period, most recently from the Sentinel satellites, part of the EU Copernicus programme. Radar mounted on satellites is used to provide all weather, day/night images and can be used to measure the distribution and thickness of the ice. And satellite instruments also make use of a handy feature of nature – the earth's surface, water and ice all emit small amounts of microwave radiation (similar to Radar). Microwave radiation travels through clouds, meaning that the Arctic can be imaged and monitored day and night, whatever the weather, and the highly sensitive sensors on the satellites can measure it. Because the frequencies of the radiation emitted by earth, water and ice are slightly different, the sensors can separate them, creating images of each. Satellite monitoring is the only source of consistent, repeatable, regional scale, calibrated, year-round data, and is both logistically and financially impossible to obtain in any other way.

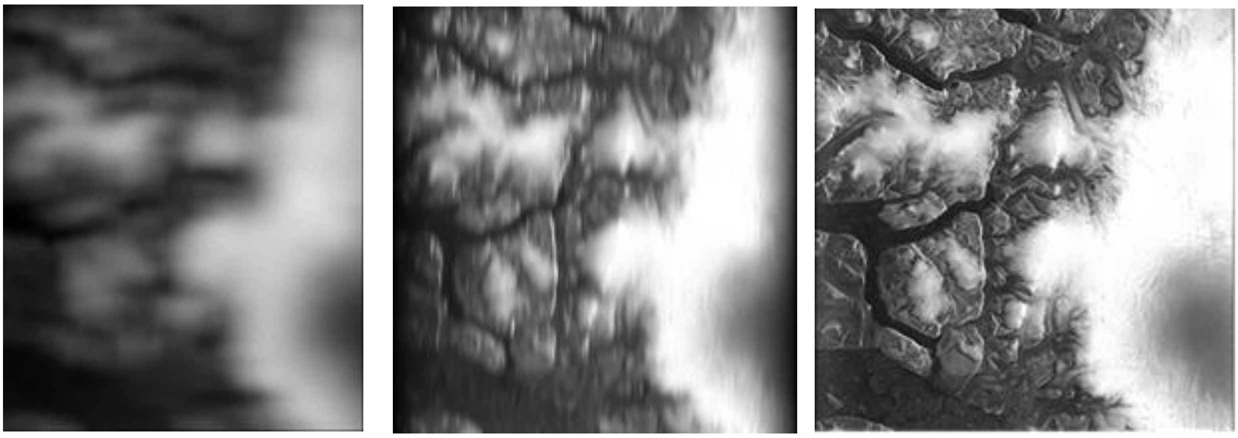
These images can show a wide variety of features, including oil slicks and icebergs, which will be essential to effective monitoring and management of this delicate area.

Oil Slick Imaged by SAR
(Copyright 2010 Airbus / Infoterra GmbH)



Ice Flows Imaged by SAR
(Copernicus Sentinel 1 Source: Polar View)

However, the microwave sensors on these satellites produce very large amounts of data which needs lots of processing to convert it into the pictures we see. Computers with enough capability to do this processing have until recently not been radiation tolerant and so could not be used in space, so the data is sent down to the ground to be processed.



Example output at different stages in data processing of an area of Greenland.
Left to right: raw data, compressed data, and the final processed image.

Help is now at hand with the shrinking size of computers. It is now possible to install far more powerful radiation-tolerant computers on these satellites, which in turn has allowed scientists to develop new ways of processing the data onboard to produce the pictures far faster and broadcast them directly to users. Future generations of satellites will be able to provide almost real-time imaging and monitoring of the Arctic Ocean, supporting shorter maritime shipping routes that reduce CO_2 emissions, opening safer fishing grounds to feed earth's growing human population, and monitoring of oil and gas extraction to ensure that it doesn't pollute the environment.

The Centre for Earth Observation Instrumentation (CEOI) is funding a wide range of innovative new instruments that measure our weather, our atmosphere, the polar regions, and many other aspects of the natural environment. Many of the technologies are also finding fascinating new applications in everyday life.

Further information about this technology and others funded by the CEOI can be found at www.ceoi.ac.uk. You can also contact the CEOI Director, Professor Mick Johnson: Tel: +44 (0)1438 774421 or email: mick.johnson@astrium.eads.net.