

Inside this issue . .

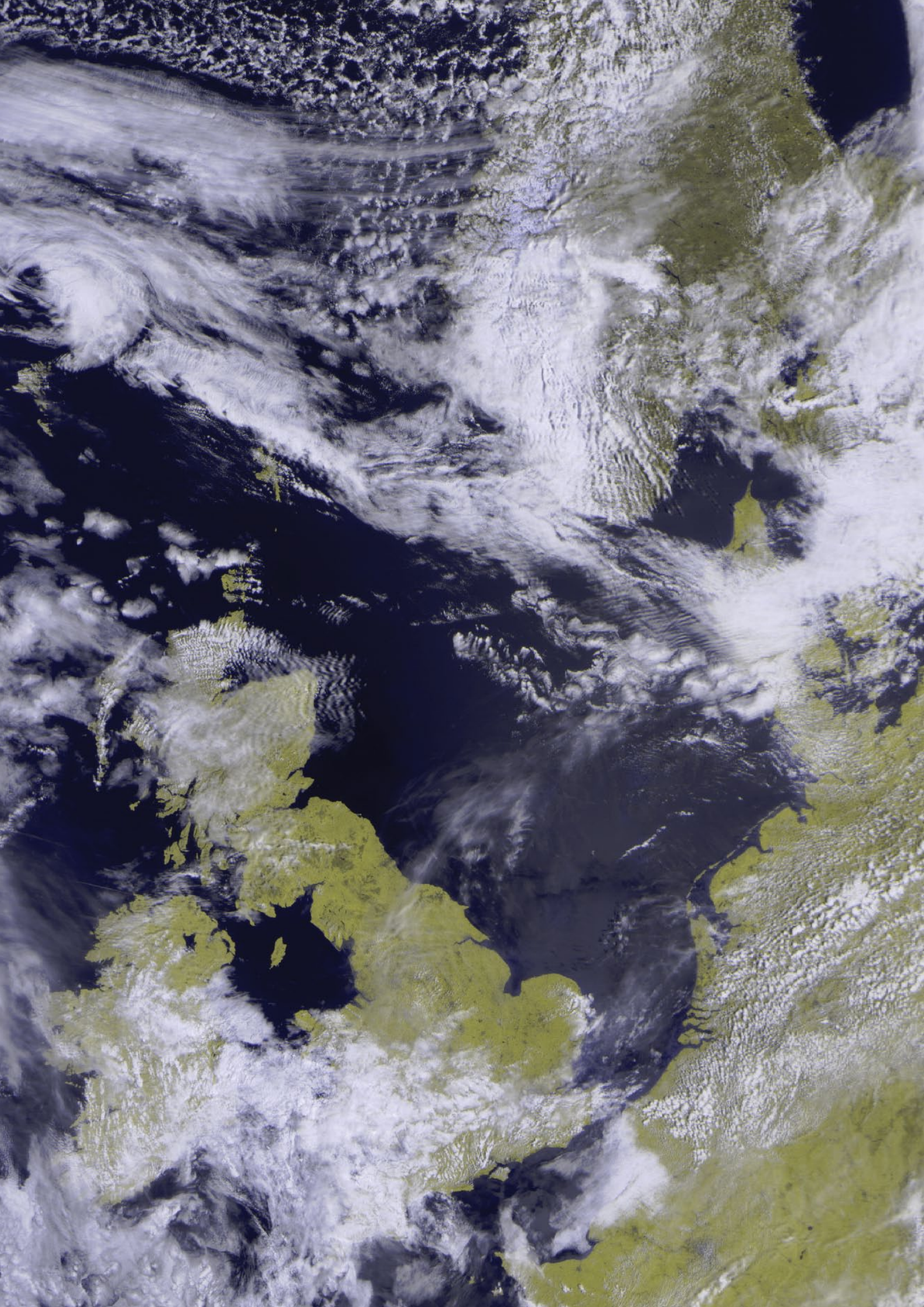
GEO recently attended the London Amateur Radio and Computer Rally held at Kempton Park, and you can read Francis Bell's illustrated report on page 13.

Meteosat-7, one of the longest serving meteorological satellites, ended a 19-year operational life-span when it was decommissioned last March. David Taylor reminisces over this old friend.

Data from the Copernicus Sentinel-3A satellite is now available for download from the internet, a boon for members who do not use the EUMETCast service. Les Hamilton details how to obtain this data, and also explains how to use Hugo Van Ruyskensvelde's EUMETCastView software in 'passive' mode to create stunning images of our planet.

We also feature a fascinating article from NASA illustrating the 'Night Light' maps of Earth that are now being created using data from the Suomi-NPP satellite.

And of course there is the usual eclectic mix of short features from NASA's Earth Observatory.



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Editorial

Les Hamilton

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I have been editing and compiling GEO Quarterly since the start of 2004, making this year my 14th at the helm, and it is time to ask a serious question: “Is there any point in continuing with this magazine”.

In earlier years it was a joy to work with members who were keen to share their experiences and ideas concerning satellite imaging, making up their submissions and collaborating to create attractive articles. But this is long gone. EUMETCast has made everything too easy. There is no longer any innovation, and almost no-one can be bothered researching ideas to share with the membership.

All too often I find myself working for weeks on end on a project in which I have no personal interest, just to keep the magazine ‘afloat’ and provide content (such as the piece on the EUMETCastView software, which occupied much of my spare time for at least five weeks). Many GEO members use this software, but none was prepared to help create an article on using it, despite prompting from myself.

A glance at the Contents list shows that this Quarterly, like many before it, exists only through reprinting web-based content from NASA and ESA—material that anyone can consult freely on the internet.

The outcome is that I plan to retire from post following the December 2017 issue of GEO Quarterly. Also, I plan to be far too busy with my own interests over summer to create original content for the September issue. If members do not rally round and help, then there may not be a September Quarterly.

I will of course make up any material received for Quarterly 55, but if past experience is anything to go by, I will wait in vain.

Copy deadline for the June issue of GEO Quarterly is Sunday, August 27, 2017.

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The GEO Report

Francis Bell



I have found the last three months unusually quiet in relation to my usual GEO activities, possibly for two reasons.

Travel has taken me away from home for some of the time which nowadays means no direct weather satellite reception for me. This has not always been the case because, on many occasions in the past, I have taken an APT receiving station with me on holiday and I have received images as far afield as India, Falkland Islands, Ecuador and California. However, for security reasons I am now a little more circumspect about taking satellite receiving equipment abroad.

A second reason for my relative inactivity relates to the lack of arrangements for a GEO annual meeting this year. Although rewarding with a successful event, organising such a meeting can take up a lot of my time, but this year, disappointingly, there seems to have been a lack of demand for such a meeting. I was disappointed with the response to the request in our previous Quarterly for ideas and support for an annual meeting: only three members contacted me and I judged this was far too small a response to justify setting up a meeting. It's not too late for a meeting this year but we need ideas and prompt action if this is to happen.

Perhaps a compromise idea for an annual meeting may be attractive, that is, to share such an event with another organisation. I note this year that AMSAT-UK is hoping to share its annual meeting with the RSGB's annual meeting. Something similar could be a way forward for GEO. Please let me have your comments.

I continue to promote GEO as best I can at local events such as radio rallies, club meetings and other events if requested, and have several such events lined up for the coming months. If any GEO member needs support in presenting GEO's activities to their local radio clubs or similar events, please get in touch with me. Help and support can be arranged.

Visit GEO on Facebook

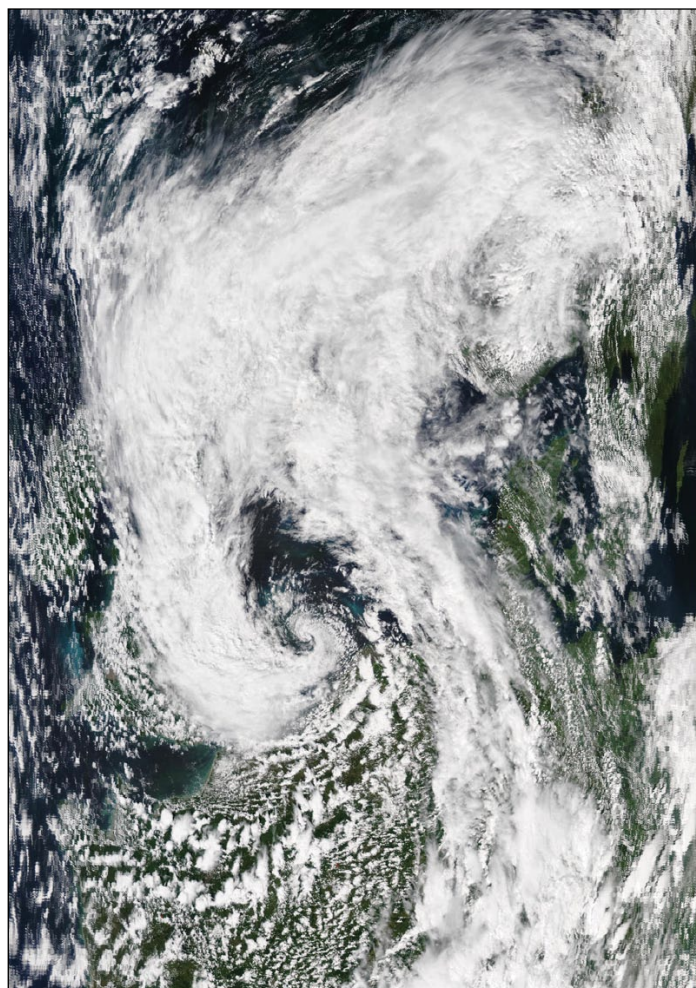
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Group for Earth Observation



and follow the dozens of links to NOAA, NASA, ESA, EUMETSAT and much more ...



This image, from NASA's Aqua satellite, shows the dreadful storm that hit the UK on June 6, 2017. Worst hit was northeast Scotland, where over a month's rain fell over the ensuing three day period.

Image: LANCE Rapid Responses / NASA / GSFC

Cover Image Details

Front Cover

This splendid image in which the entire British Isles basks in sunshine was captured from the **Sentinel 3A** satellite on March 25, 2017 by Mike Stevens.

Image © EUMETSAT 2017

Inside Front Cover

On the brink of summer, this was the scene captured by **Meteor-M2** at 10.03 UT on the final day of May this year.

LRPT image captured by Les Hamilton

Inside Back Cover

Under a cloudless sky on May 25, 2017, the **Sentinel 3A** satellite captured this image of the AWPR (Aberdeen Western Peripheral Route), a new highway being built to divert through traffic past the heavily congested NE Scotland city of Aberdeen. Stretching nearly 50 kilometres from Stonehaven in the south, the new dual carriageway is estimated to cost £745 million, and will be completed early in 2018.

Image: Modified Copernicus data © ESA / Sentinel (2017)

Back Cover

Alaska was imaged by the MODIS instrument aboard NASA's **Terra** satellite on June 1, 2017—the first day of meteorological summer—emerging from its winter mantle of snow and ice. This image is remarkable in being almost cloud-free: it's rare to see so much of Alaska in this detail.

Image: LANCE Rapid Responses/NASA/GSFC

Quarterly ? Question

Francis Bell

Quarterly Question 53

My thanks to those members who contacted me with regard to the last Quarterly Question, which related to two HDTV images recorded from the ISS. One of these images was of Lake Michigan, USA which I thought was rather difficult to quickly identify because some of the northern coastal outline was masked by snow and ice as the image was taken in late winter. However, given the scale of this enormous lake, with most of the coastal outline clearly visible, it should have made identification straightforward.

The other image in question was of the Gulf of California, which separates Baja California from the rest of mainland Mexico. This gulf is about 700 miles long and almost certainly created by the activities of the San Andreas geological fault line.

It is often the case that I take an interest in Earth images because I have visited the areas in question; in this case I had visited several of the ports along the Pacific coastline of Baja California. This personal connection applies to this issue's Quarterly Question, asking for the names of three capital cities.

Quarterly Question 54

Quarterly Question 52 asked for the names of two capital cities, which turned out to be Lisbon the capital of Portugal and St Petersburg the ancient capital of Russia, although Helsinki, capital of Finland and Tallinn the capital of Estonia were also clearly visible. The question for this issue again relates to capital cities which can be seen on two satellite images. And yes! I once more have a personal interest because, during my travels, I have visited all three of these cities. The question is straightforward: name the three capital cities seen in these two images.

When considering the images, note the differences in scale. Figure 1, showing a little of mainland Europe and some islands, has a width of about 50 miles (80 km) while figure 2 showing part of mainland South America has a width of about 320 miles (510 km). A little consideration should enable the three capital cities to be named. A glance around the European coastline should give just one candidate, while inspection of the coastline of South America should reveal the names of the additional two cities.

Answers, please, by email to:

francis@geo-web.org.uk

by Sunday, August 27, 2017.



Figure 1 - This recent Sentinel 1A radar image shows part of mainland Europe together with islands which belong to the country shown. The capital city is close to the centre of this image.

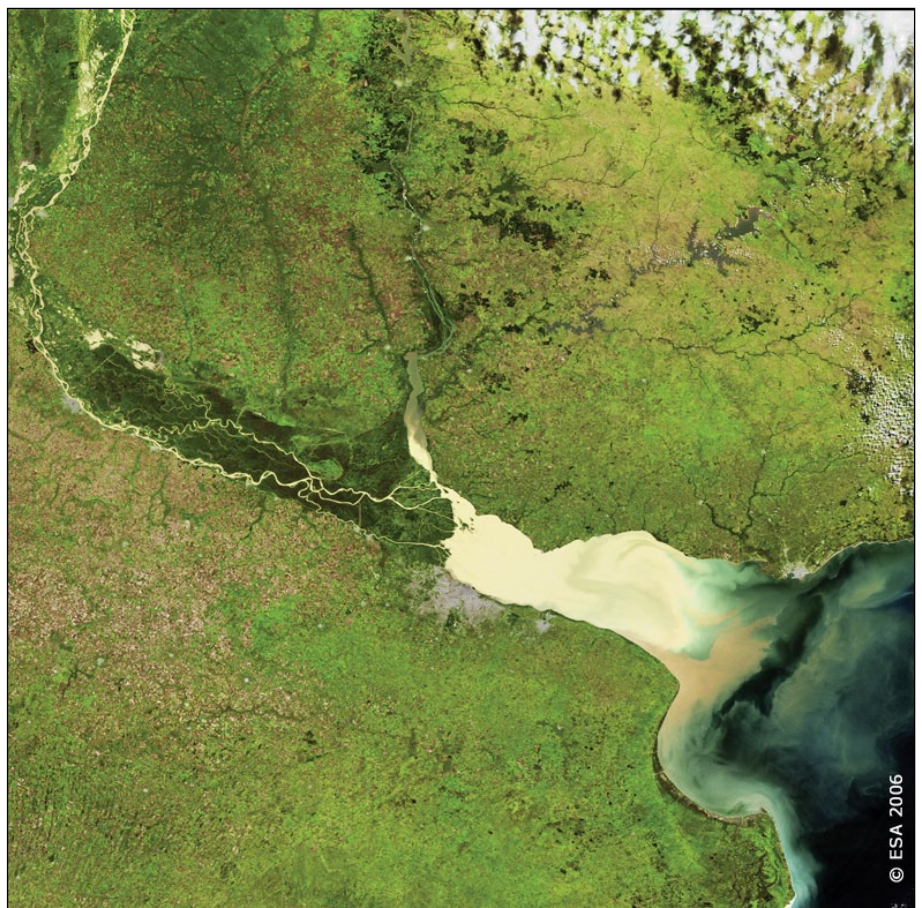


Figure 2 - This *EnviSat* visible image from April 2004 shows part of the coast of South America with a large river estuary. One capital city is located on the north of the estuary close to the open sea; the other is located closer to the start of the estuary on its southern side.

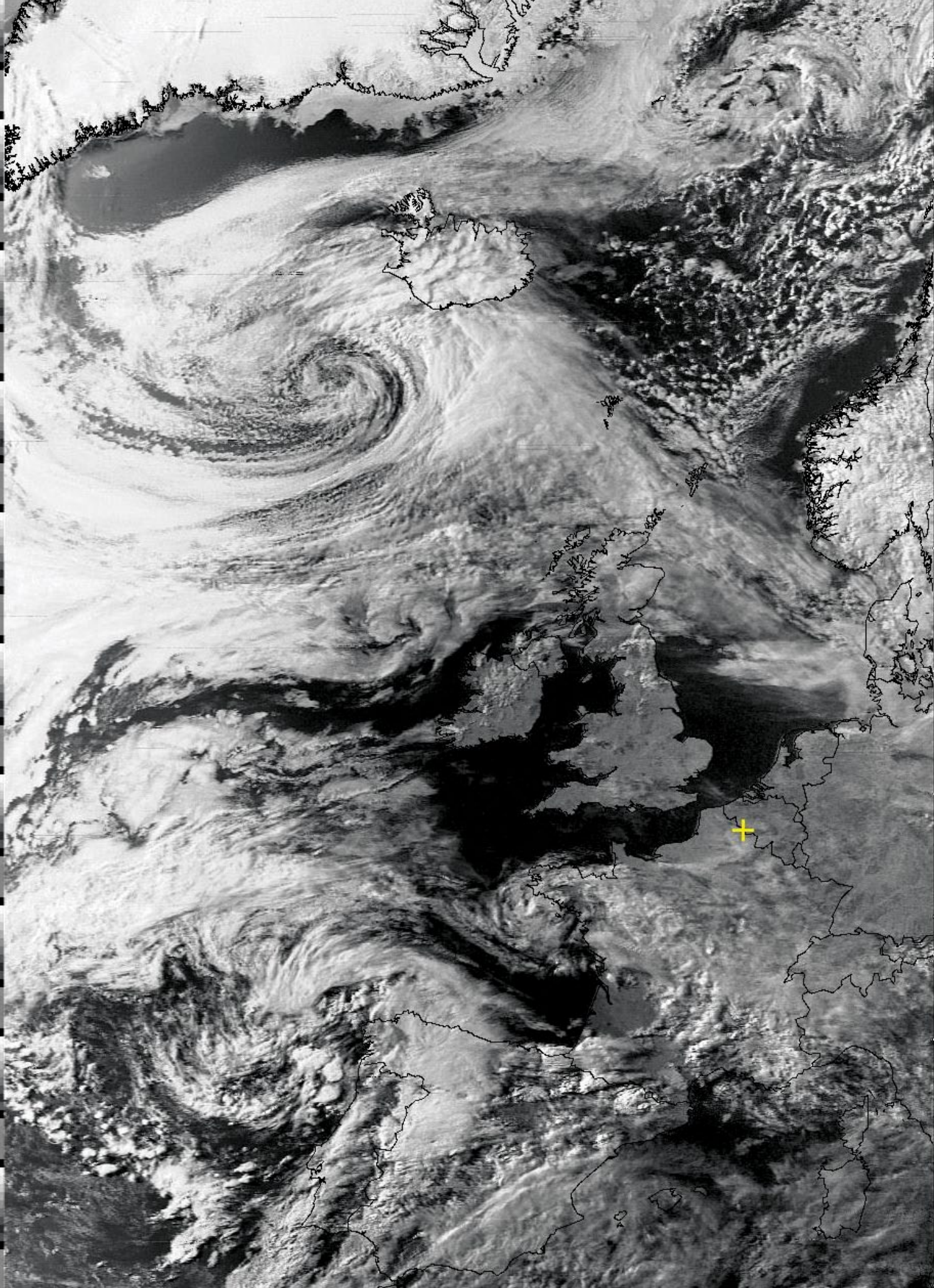
Phytoplankton Blooms in the Black Sea

MODIS Web



Oh May 29, 2017, the Moderate Resolution Imaging Spectroradiometer (MODIS) aboard the **Terra** satellite acquired a stunning true-color image of phytoplankton blooms in the Black Sea. The blue, green, and turquoise swirls represent huge colonies of single-celled, microscopic organisms called phytoplankton. These plant-like organisms live in the waters year-round in small numbers but when they have the right combination of nutrients, water temperature and sunlight, they can reproduce explosively, creating blooms that can easily be seen from space.

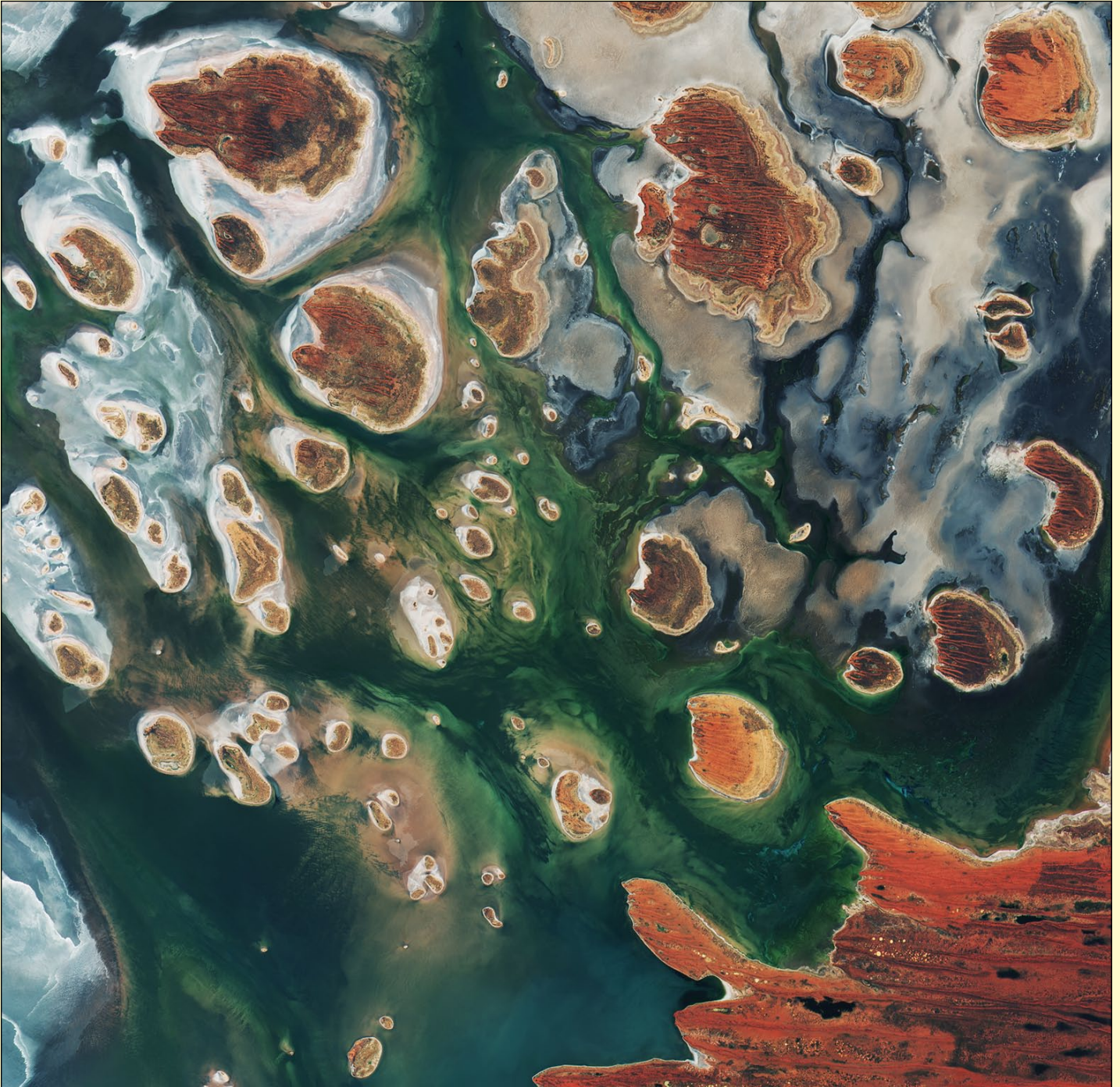
Image Credit: Jeff Schmaltz, MODIS Land Rapid Response Team, NASA GSFC



André T'Kindt from Ronse in Belgium sent in this evening APT image from NOAA 15, acquired from the 17:54 UT pass on May 10, 2017.

Lake MacKay, Australia

ESA: Space in Images



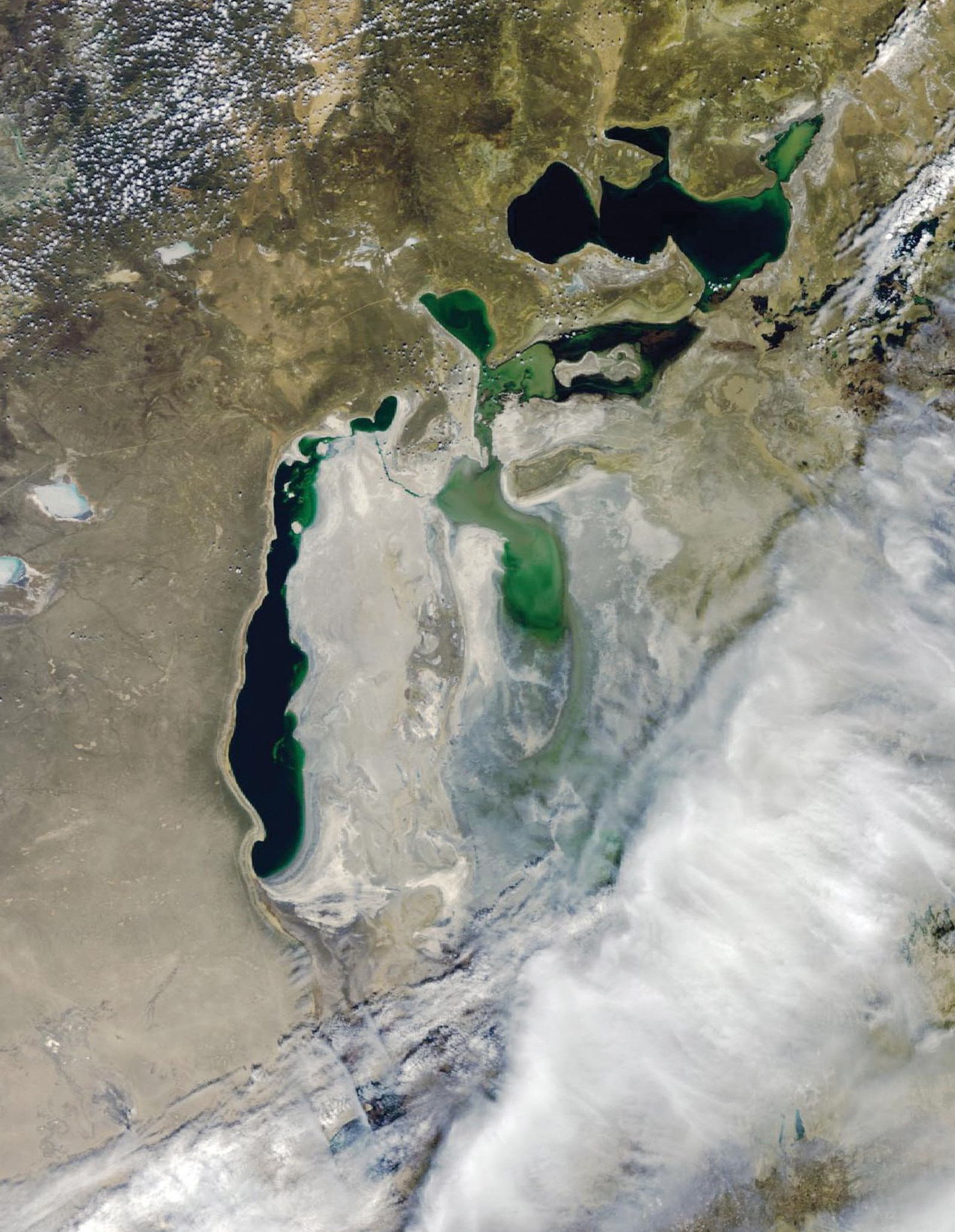
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Brown hills speckle the eastern part of Australia's Lake MacKay in this satellite image. Located on the border between the states of Western Australia and Northern Territory, this salt lake only contains water following seasonal rainfall—if at all. It is classified as an ephemeral lake, meaning that it exists only after precipitation. This is not the same as a seasonal lake, which sees water for longer periods. About half of Australia's rivers drain inland and often end in ephemeral salt lakes.

The greens and blues in this image show desert vegetation or algae, soil moisture and minerals—mainly salt. On

some of the brown 'islands', and on the shore at lower right, you can see the east-west sand ridges forming lines in the landscape.

The lake lies at the edge of the Great Sandy Desert, which covers nearly 285 000 square kilometres. Roads are scarce in the area, and often frequented by four-wheel drive adventurers. Roads include the Canning Stock Route about 300 kilometres to the west of the image, and Tanami Track, which connects Australia's Stuart Highway to the Great Northern Highway around 300 kilometres to the east.



Mike Stevens captured this fascinating Sentinel 3A image of the Aral Sea region on April 16, 2017. It looks as though large quantities of water have been released from the North Aral Sea as the channels to its south, completely dry in recent times, are now filled with water.

Image © EUMETSAT 2017

Farewell Old Friend

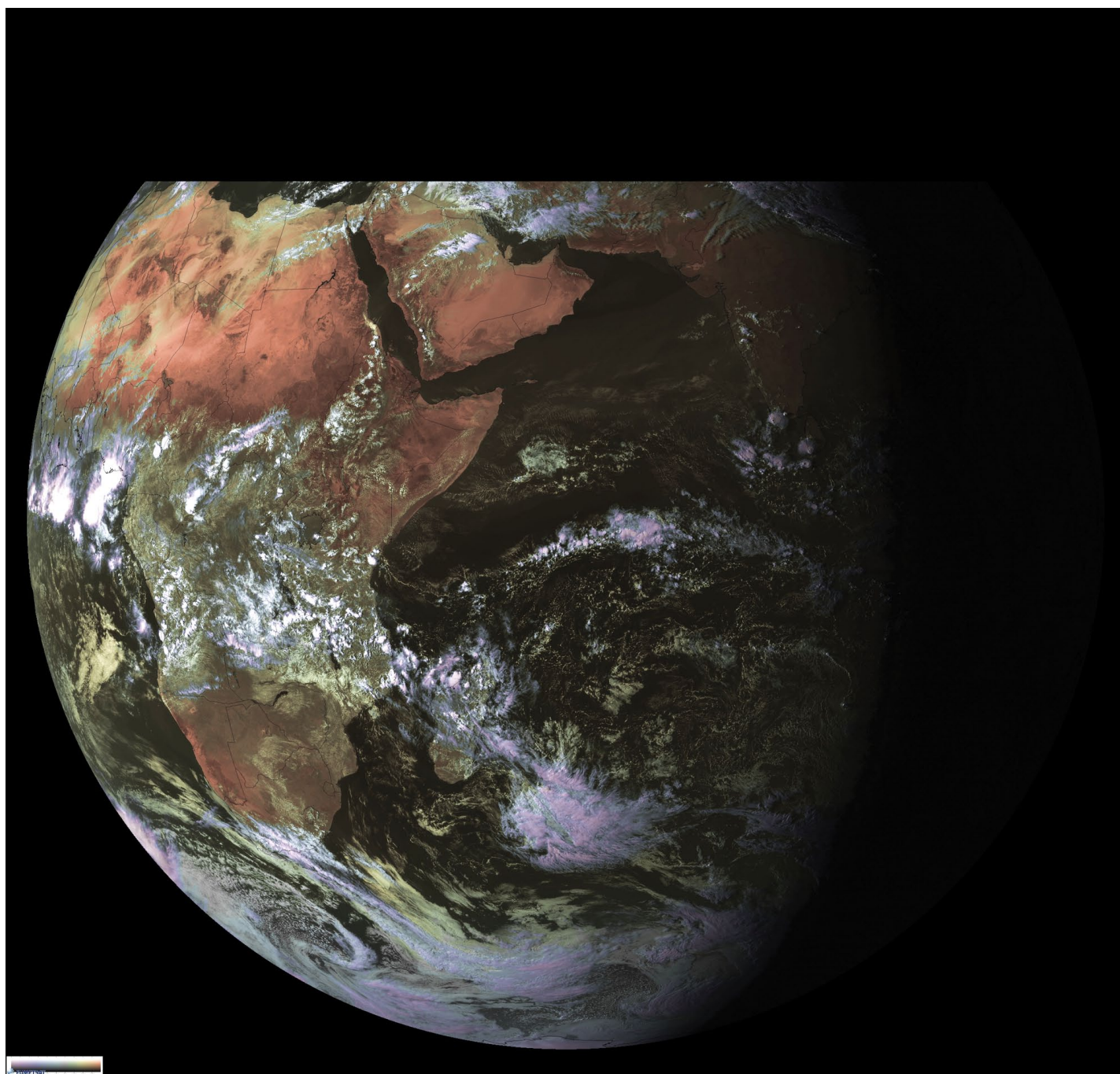
Meteosat-7 is Deactivated after 19 Years of Service

David Taylor

Although scheduled to stop at 09:00 UT on Friday, March 31 2017, images carried on being disseminated from Meteosat-7 until 12:30 UT when this final transmission was made. The image looks as though someone pulled the plug just before it was complete.

Meteosat-7, the last of its line, was a '*Meteosat First Generation*' bird, and started its life covering Europe and Africa following a September 1997 launch. It replaced Meteosat-5.

As the newer MSG (*Meteosat Second Generation*) satellites were launched, providing greater spatial resolution, more bands and a greater repeat frequency, Meteosat-7 was relocated from zero degrees to 57 degrees East in 2007 where it provided coverage of the Indian Ocean (IODC) until 2017. The IODC service is now provided by the first of the MSG satellites—Meteosat-8. Zero degree coverage is currently provided by Meteosat-10 (full-scan) and Meteosat-9 (rapid-scan), with MSG-4 (Meteosat-11) currently being stored in orbit.



The last ever IODC image transmitted from Meteosat-7, prior to the satellite's decommissioning at 12.30 UT on March 31, 2017.

Cloud Streets in the Greenland, Norwegian, and Barents Seas

MODIS Web

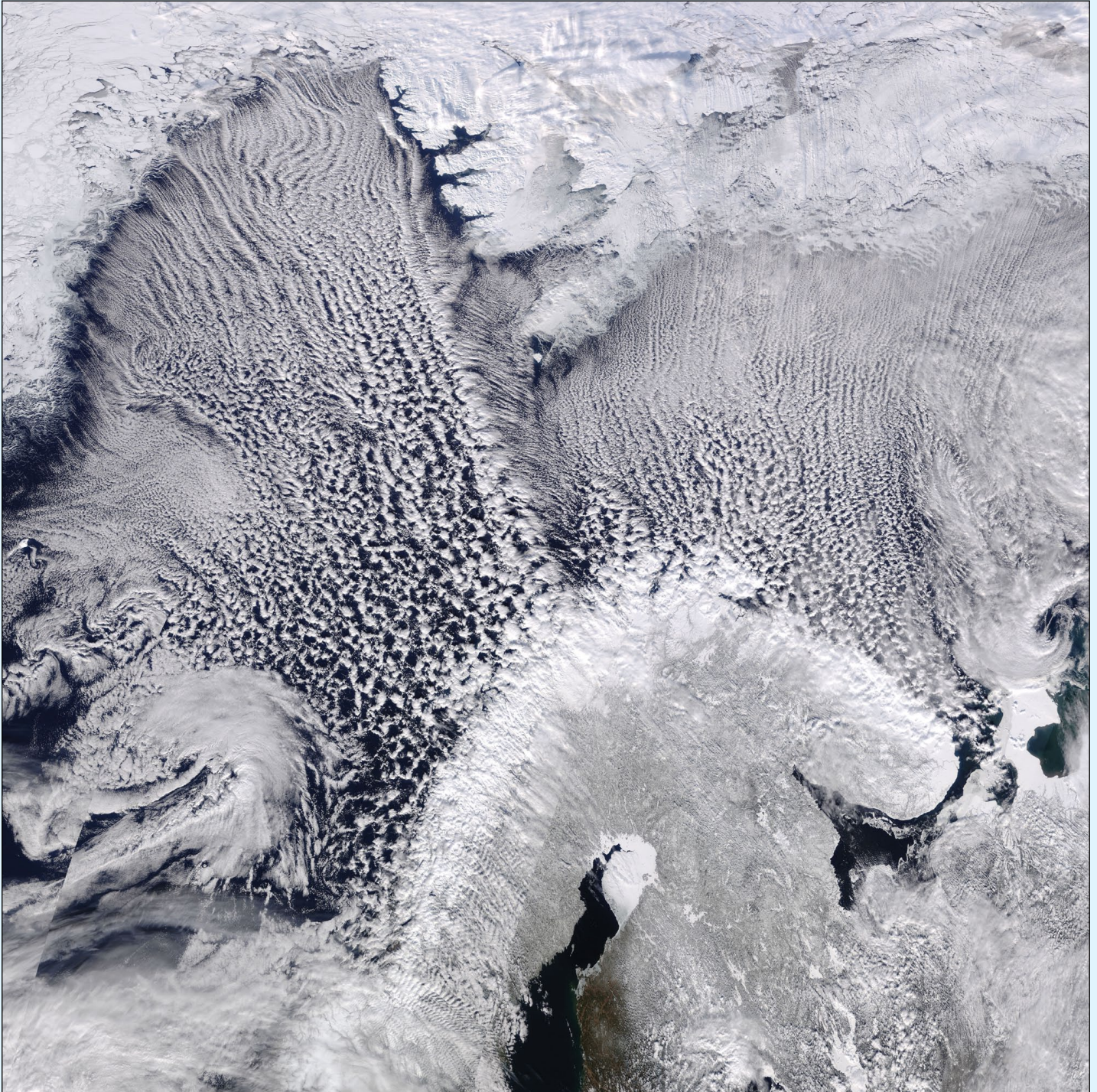


Image Credit: Jeff Schmaltz, MODIS Land Rapid Response Team, NASA GSFC

On March 28, 2017, the Moderate Resolution Imaging Spectroradiometer (MODIS) aboard NASA's *Terra* satellite captured a stunning true-color image of cloud streets over the Greenland, Norwegian, and Barents Seas.

Greenland sits in the northwestern section of the image and Norway, Sweden, and Finland sit in the south. The Greenland Sea lies off the coast of Greenland and blends with the

Norwegian Sea, which lies north and west of Norway. The Barents Sea lies to the northeast of Norway and north of Russia. Cloud streets, which are long, parallel bands of cumulus clouds, stretch from roughly north to south over each of these bodies of water.

Cloud streets are formed when cold air blows over relatively warmer waters. To transport the heat away from the sea surface, columns of warmed air

called thermals naturally rise through the atmosphere. These air masses rise until they encounter a warmer air layer (temperature inversion), which acts like a lid. The rising thermals roll over when they hit this 'lid', and loop back on themselves, creating parallel cylinders of rotating air. On the upper edge of these cylinders of rising air, clouds form while along the downward regions (descending air), skies are clear.

Long Island

An island carved by water

NASA Earth Observatory

The story of Long Island began with ice. As glaciers advanced and retreated over this patch of land at the end of the most recent Ice Age, the sediment they deposited piled up as hills. When the ice melted and seas rose, those piles of glacial debris became surrounded by the sea. Stretching out into the Atlantic like a giant fish, Long Island continues to change: thousands of years later, water still resculpts the island's shoreline.

On October 17, 2016, the Operational Land Imager (OLI) on the **Landsat 8** satellite captured this image of Long Island's East End. While the North Shore is characterized by craggy inlets and peninsulas, the South Shore is lined with smooth, protective sand bars—the result of constantly pounding waves.

Between the branching tails of the East End lies Gardiners Island, which spans more than five square miles and is closed to the public—a source of curiosity given its proximity to population-dense Long Island. In the 1600s, Gardiners was believed to possess a cache of pirate gold, but modern scientists appreciate it for another form of booty: its rich coastal geology.

On the northern end of Gardiners Island (figure 2), a fang-like feature juts into the water. This cusped foreland at Bostwick Point owes its shape to the waves. As they hit the shore, waves agitate sediment along the coast. When they break at an angle to the coast, this creates a current parallel to the coastline called a 'longshore current'. Combined, these processes can rake sand and sediment into this triangular feature.



Figure 1 - Long Island, highlighting its northern and southern regions (white rectangles)

The opposite end of the island (figure 3) includes a long, finger-shaped sand bank called a spit. These sand features frequently form at the mouths of inlets and in places where water must move around coastal barriers and other features. The spit projecting from the island's southern end has grown by 1.6 kilometres over the past few decades. In the process, the ocean has breached its length at several points, creating smaller islets like Cartwright Island.

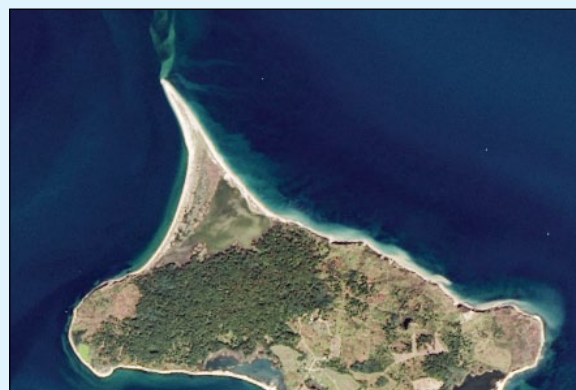


Figure 2 - Bostwick Point foreland on Gardiners Island

Coastline breaches most often form during hurricanes, nor'easters, and other potent storms. However, over time, the constant pounding of waves tends to smooth out spits, refilling the gaps between them. Strong currents tend to develop around such features, and in this image, the faint, light-coloured streams of sediment in the water trace this movement. The spit acts like a funnel, forcing water to move through a narrower channel and resulting in more powerful currents.

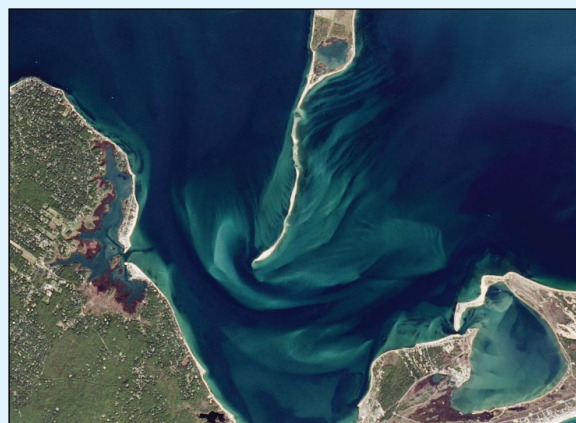
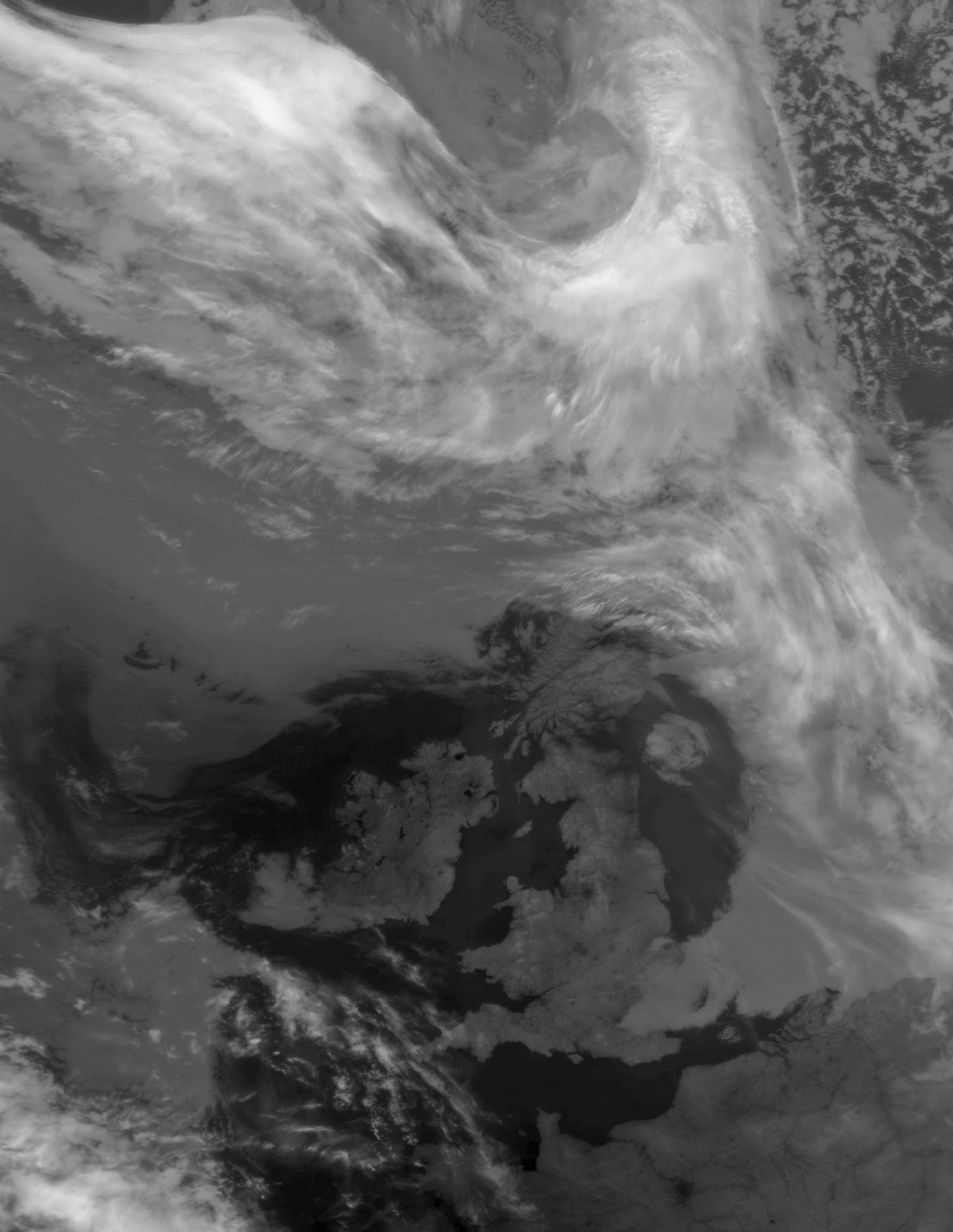


Figure 3 - Spit at the south of Gardiners Island

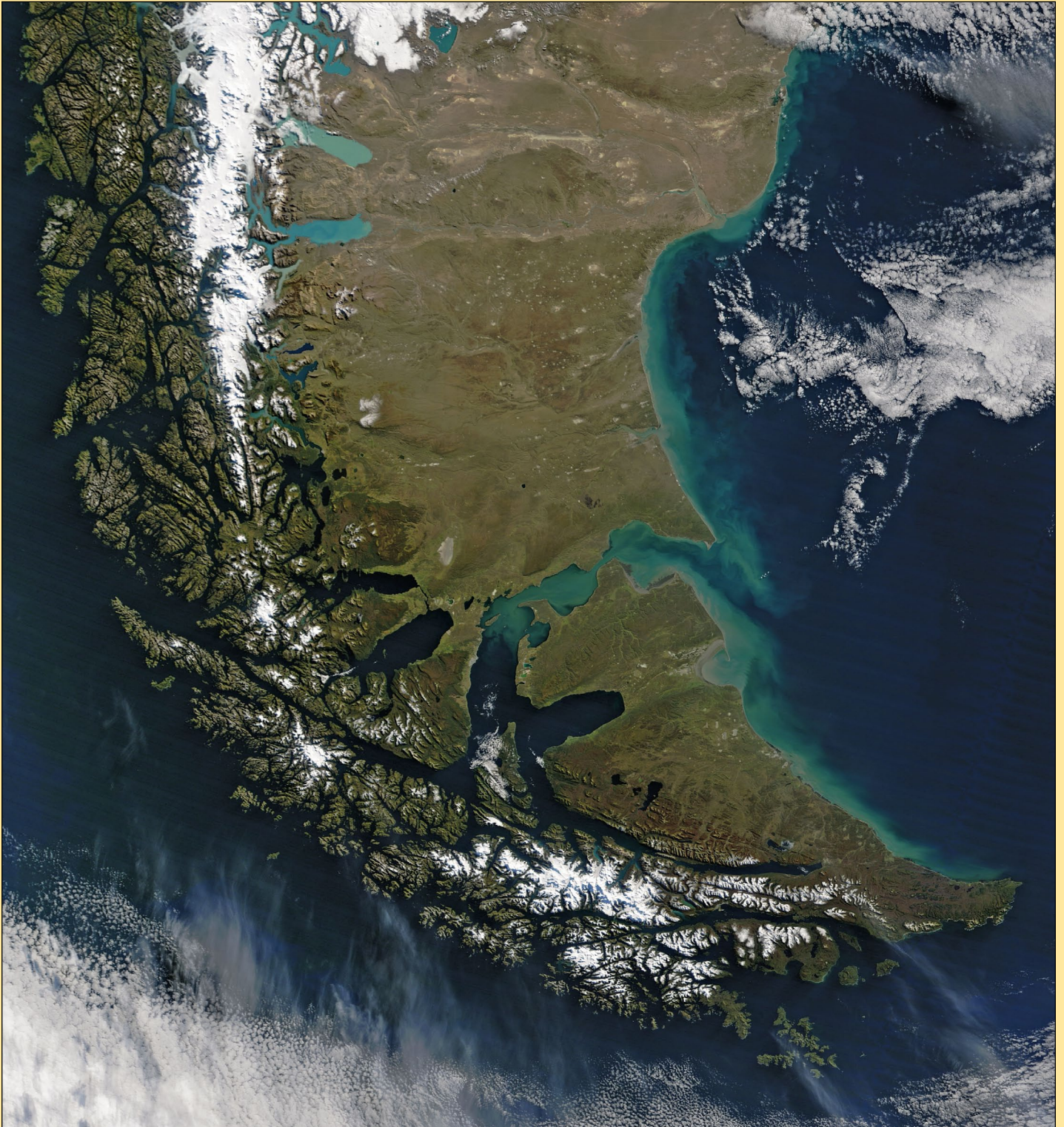
NASA Earth Observatory image by Jesse Allen
 using Landsat data from the US Geological Survey
 Story by Pola Lem



During the early days of May this year Great Britain enjoyed an extended period of high pressure. Long hours of sunshine warmed the land by day, but clear skies during the evening resulted in temperatures rapidly falling to near freezing. This Meteor M2 infrared image acquired by Les Hamilton at 20:29 UT, paints a vivid picture of the anticyclone on the evening of May 9, 2017.

Rare Glimpse of Cloud-Free Patagonia

MODIS Web



When clouds parted over southern Patagonia during early April 2017, NASA's **Terra** satellite was flying overhead. The Moderate Resolution Imaging Spectroradiometer (MODIS) aboard that satellite captured this stunning true-colour image of the nearly cloud-free landscape on April 7.

Southern Patagonia is a remote, sparsely populated, roughly triangular region at the tip of South America. The country of Chile lies along the Pacific coast while Argentina sits along the Atlantic Ocean. The borderline between the two countries lies in the Andes Mountains throughout

most of southern Patagonia, although it does cut across the large island of Tierra del Fuego. Tierra del Fuego lies south of the continent and is separated from it by the Magellan Strait.

The ice fields in the Andes are the most spectacular feature of this image, along with the turquoise glacial lakes in the north. Glacial sediment suspended in the waters of these lakes gives them a turquoise colour when viewed from space.

Image Credit: Jeff Schmaltz, MODIS Land Rapid Response Team, NASA GSFC

GEO Outreach

Visit to the London Amateur Radio and Computer Rally

Francis Bell

Since 2004, GEO has regularly attended the twice-yearly *London Amateur Radio and Computer Rally* held at Kempton Park, London. This spring the rally was well attended, with stands covering interests in amateur radio (including the RSGB) and computing plus related high tec. activities with visitor numbers contributing to a busy day.

In the past the GEO stand had run a display of live *EUMETCast* reception but nowadays, with the requirement for a larger dish and its very accurate alignment, we have dropped live reception and instead display recorded images from the previous day. To be honest, I think a display of well prepared images is better than risking marginal reception of live signals on the day with unpredictable image reception.

I think visitors to our stand were attracted by the recorded *EUMETCast* and NOAA images being displayed, and the fact that they can be received at home with guidance and the support of our GEO Group was an added attraction. As a result, we took four new memberships on the day with other visitors saying they may join via our website. We also sold eight SDR dongles with their potential for APT and low rate digital image reception, while also recognising the potential of these dongles for other modes of radio signal reception.

Again my thanks to David Simmons G1MAL for his support on the day, manning the GEO stand with me.

I feel sure that other radio rallies around the country would welcome a stand representing GEO so, if you have a local rally (or just a club event) which you could attend and represent GEO, that would be great both for your local groups and for GEO by publicising our skills and support for satellite image reception.



David Simmons making adjustments to one of the four computers on our GEO stand just prior to opening for visitors.



A quiet moment during an otherwise busy day with just one visitor remaining at the GEO stand.

GLACIERS EBB IN SOUTH GEORGIA

NASA Earth Observatory

Frequent cloud cover in the southern Atlantic Ocean often obscures satellite images of South Georgia and the South Sandwich Islands. But occasionally the clouds give way. On September 14, 2016, the Operational Land Imager (OLI) on NASA’s Landsat 8 satellite captured natural-colour images of South Georgia Island, where several glaciers are in retreat. The rectangles overlain on figure 1 pinpoint the locations of two of these glaciers.

Figure 2, a closer crop of the Landsat scene, shows **Neumayer Glacier**. A blue line indicates the position of its terminus, or leading edge, on September 10, 2000. In the 16 years since, Neumayer has retreated more than four kilometres. Like other large glaciers on the island, Neumayer is a tidewater glacier—that is, it flows down into the ocean.

“The glacier is on the verge of separation into two main tributaries,”

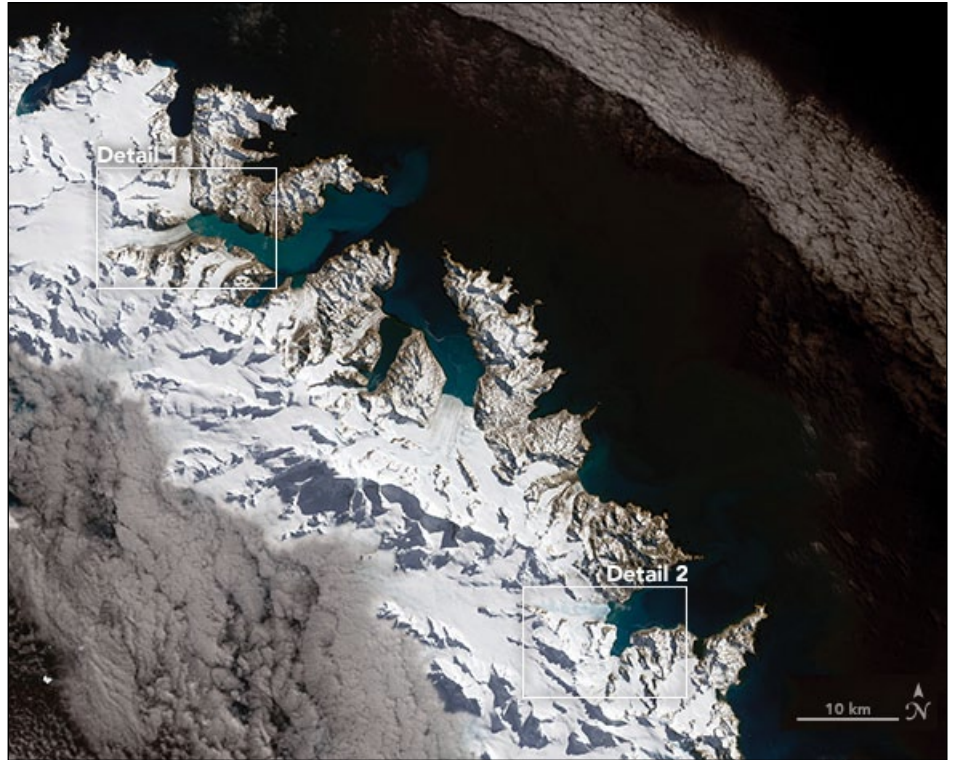


Figure 1 - Locations of the two receding glaciers on South Georgia island



Figure 2 - Neumayer glacier imaged on September 14, 2016

wrote glaciologist Mauri Pelto in his blog, *“This will enhance calving from the glacier and promote additional mass loss and retreat. This retreat will impact Konig Glacier to the north, which is connected to the Neumayer Glacier.”*

Roughly 30 kilometres to the southeast of Neumayer, on the same side of the island, **Hindle Glacier** has also retreated markedly since 2000—more than three kilometres (figure 3). Like Neumayer, Hindle used to merge with another glacier (Ross), and as recently 2002, the two were still connected, according to Pelto.

The retreating ice on South Georgia Island could have a significant impact on the island’s animals. Glaciers act like barriers, preventing the spread of certain animals such as the non-native rats that have become a threat to other species in the area. Rat populations have boomed on the north side of the island as the ice has ebbed, while colonies of seabirds like pipits and small burrowing petrels have declined in number in that area—likely due to predation of eggs and chicks. As the glaciers in the centre of the island shrink, rat populations could spread to the south and decimate bird populations.

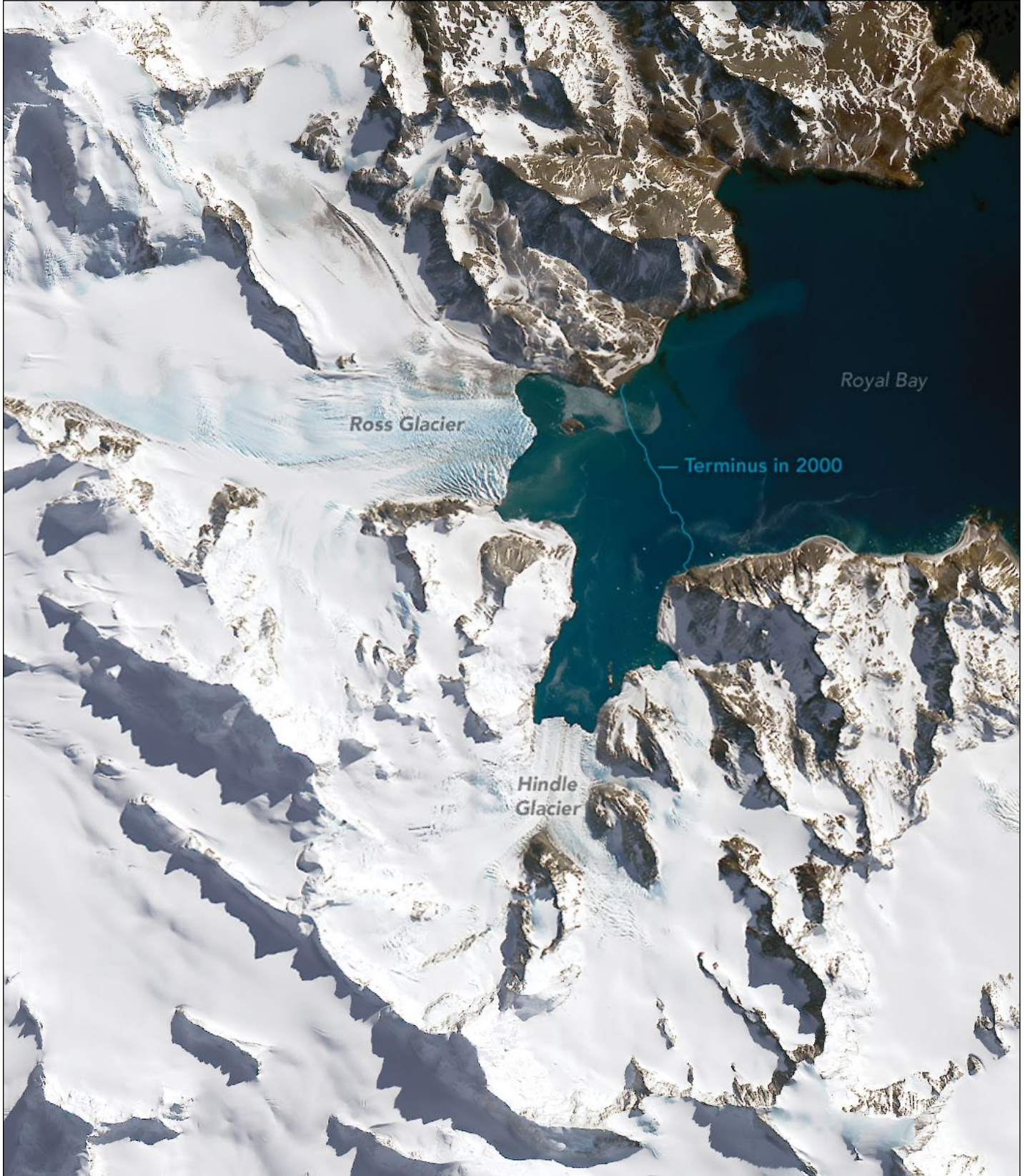
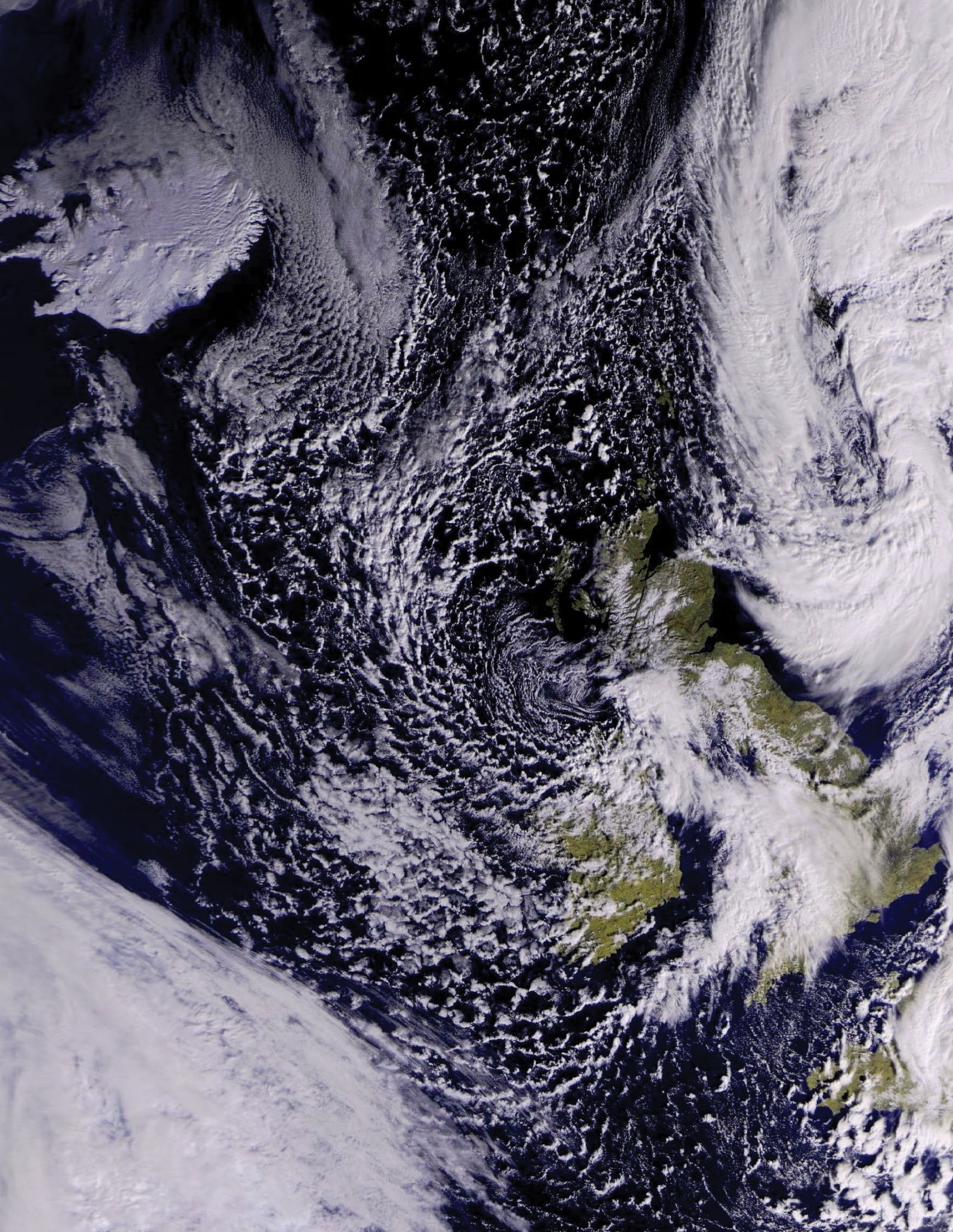


Figure 3 - Hindle glacier imaged on September 14, 2016



This beautiful image from the Meteor M2 satellite was acquired by Enrico Gobbetti on February 28, 2017. Particularly striking is Iceland, virtually cloud-free and covered by snow and ice.

Improving Meteor M2 Reception with the FUNcube Dongle

Norbert Pütz

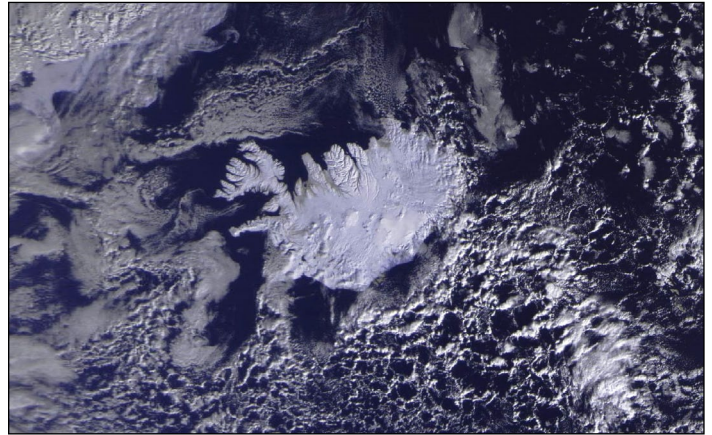
In GEO Quarterly 46, I explained that I was being plagued by interference from unknown sources which was disturbing my Meteor M2 satellite reception. As a result, I could not decode signals from south of the Alps. I am happy to report that the disturbances of my neighbourhood have since reduced and I no longer need to use the Würth 829 999 USB-filter stick.

It turned out that my problem was not related to disturbances in my immediate neighbourhood, but to a *Pluto* Over-the-Horizon radar installation. Fortunately—the station recently changed its signal modulation. This new modulation is less critical and produces fewer harmonics, which no longer cause strong disturbances in the shortwave bands and less intermodulation products in preamplifiers.

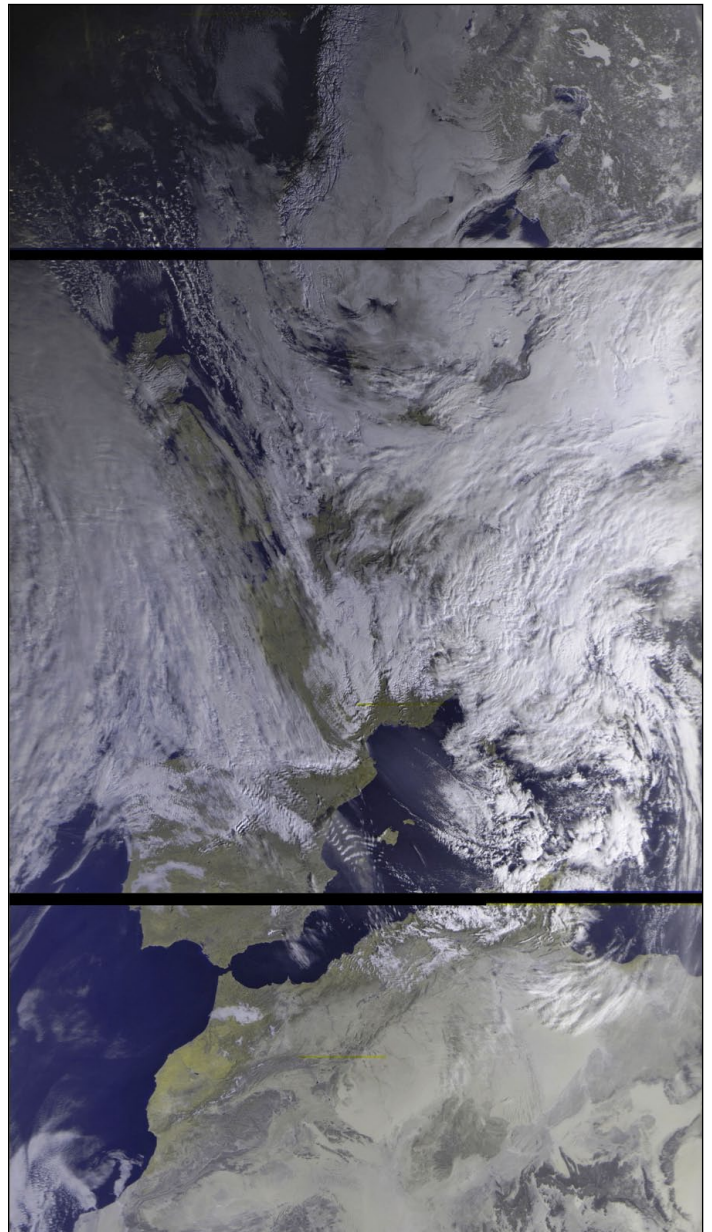
I have now bought a galvanic separation device with built in separated power source which brings two benefits: 2 kV protection of my FUNcube Pro dongle and laptop (in case of voltage surges) and perfect decoupling of my FUNcube from my laptop. The coupling capacity between both sides is approximately 2 pF (note that this galvanic separation does not work with the RTL-SDR DVB dongle).

But this nice box isn't, however, able to power my DVBT stick, because it needs more power than my FUNcube dongle. But it's not a big problem as there is still the possibility to use a split USB-cable.

Attached are some nice pictures, and as you can see, I am now often able to obtain excellent imagery from far south of the Alps and well into North Africa. Of course this is not true every time: the picture below is one of my best ones.



Meteor M2 imaged Iceland on March 4, 2017



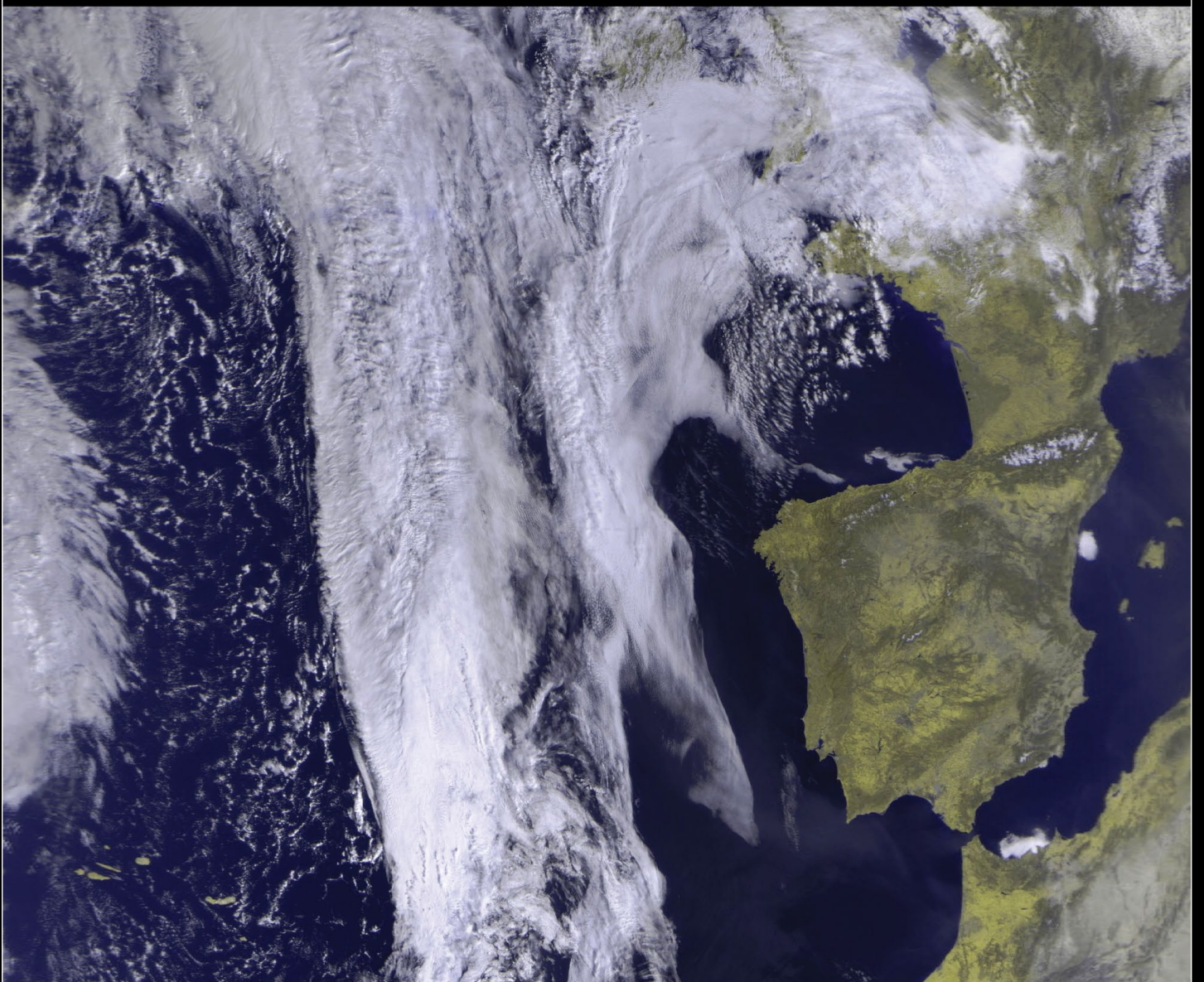
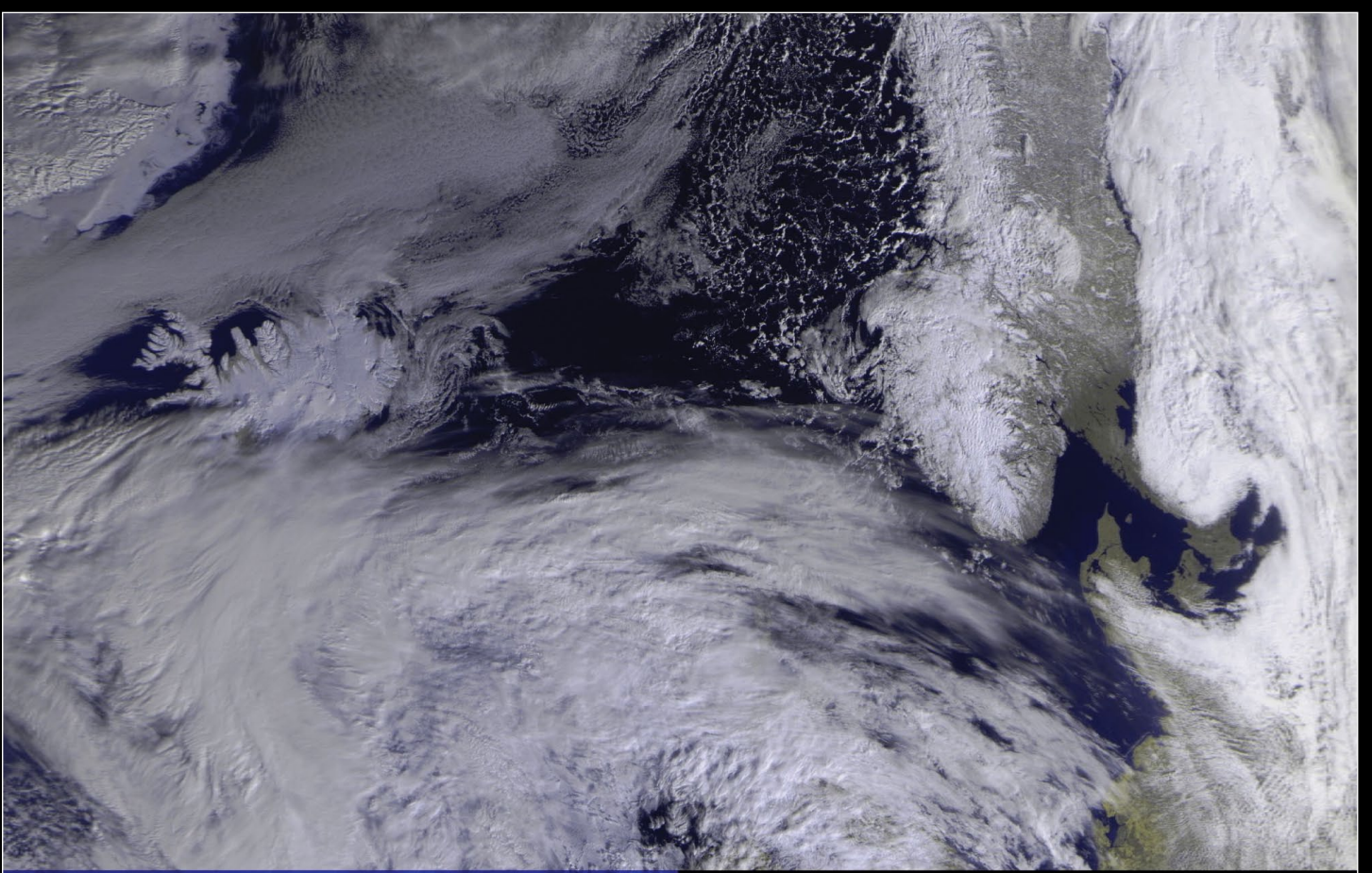
This fine Meteor M2 image was acquired on February 6, 2017



Improved reception is achieved using a USB isolator which contains an IC for galvanic separation



The reverse side of the isolator housing showing the type and manufacturer.



Copernicus Online Data Access

Download Sentinel 3 data direct from the Internet

Les Hamilton

I'm sure that like me, many readers of our March issue would have been impressed by the Copernicus Sentinel-3A images displayed throughout its pages. Of course, a fair number of you will have been receiving these on your home systems via EUMETCast: but again like myself, not all *GEO Quarterly* readers have access to this distribution channel.

So it was with great interest that I learned a few months ago that EUMETSAT now offers precisely the same Sentinel-3A data in the form of internet downloads from their new web portal at

<https://coda.eumetsat.int/>



Figure 1 illustrates the startup screen that is displayed when you first visit this site.

Signing Up

Use of this EUMETSAT service is free, but you do have to sign up for it before being afforded access to the data. Click the **'SIGN UP'** button at top right on the screen then, at lower left on the following screen, select **'NEW USER - CREATE NEW ACCOUNT'**. This reveals the *EUMETSAT EO Portal Account Creation* screen where you input your details: Username, Password, Email Address, Organisation etc.

This does not, however, bring immediate access, and the password you enter seems quite irrelevant. About 24 hours later you will receive an email confirming your registration, but providing you with a new password (of EUMETSAT's choosing). From this point, you will be able to access Sentinel-3 data by hitting the **'LOGIN'** button and entering your chosen Username and the EUMETSAT-supplied password. Be aware though that this password is case sensitive: enter it exactly as supplied.

Using the Portal

Open the **Insert search criteria** panel at top left on the screen (figure 2) by clicking the  icon. Here you select the **date/time** of the image(s) you are seeking, the **Product Type** and **Instrument**. Next, select the area of interest on the map, then finally click the  icon to search for the available data. Provided data are available, all relevant image tiles will be

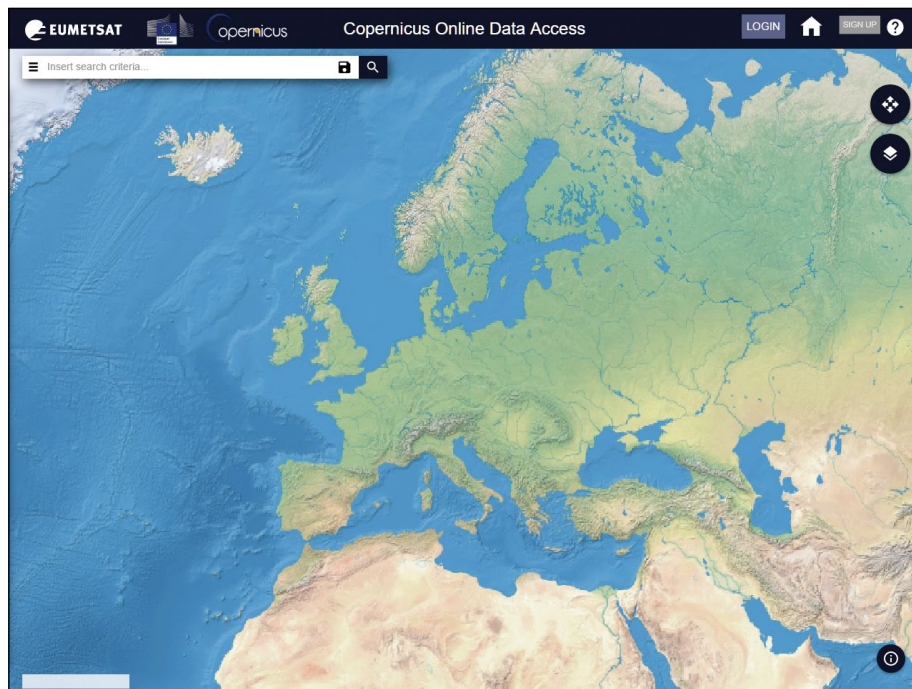


Figure 1 - The Coda start screen

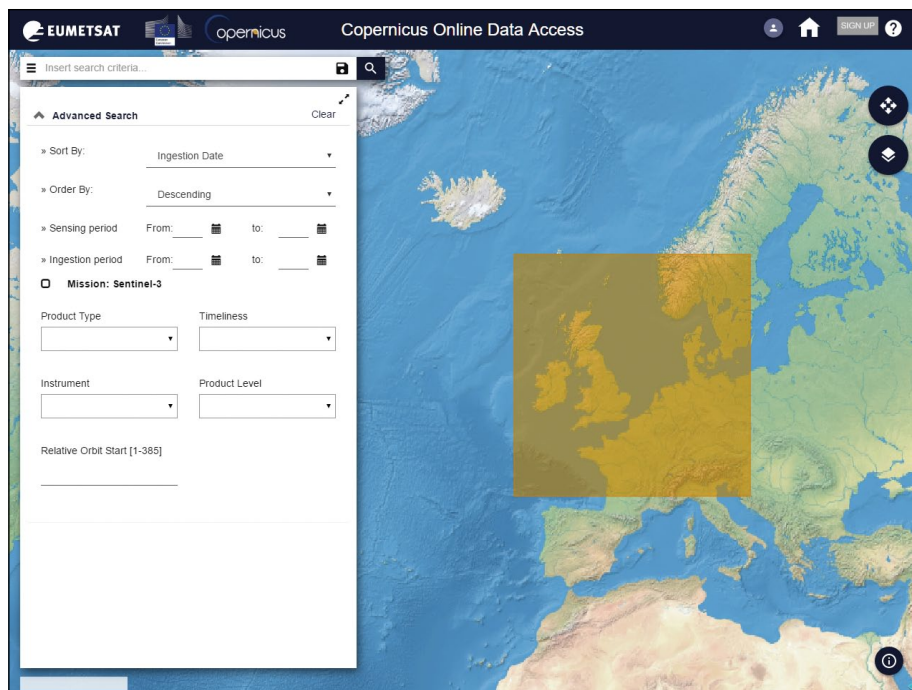



Figure 2 - Selecting and data sets for the UK on March 3, 2017


highlighted, both by boxes overlain on the map and in a menu at the left of the screen, as illustrated in figure 3. Select your tile and press its 'Download' button in the menu list.

That's the gist of it. Now let's take it more slowly, one step at a time.

Navigating the Map

The map can be dragged to reveal any part of the Earth's surface you wish.

By default, dragging the cursor over the map selects an area of interest. But if you click on the  icon at upper right, you toggle the cursor into

‘Drag Mode’, whereby the map can be dragged around to reveal the region you require. Once you have positioned the map, click the  icon again to return it to ‘Select Mode’.

Searching for Sentinel-3 Images

Figure 2 shows the *Search Panel*, with the map moved somewhat to the east so that, in this instance, the British Isles is clearly seen. This panel includes options to set a specific window of time—spanning either a few hours on a particular date or a period of many days duration—within which to search for images. There are two options: *Sensing Period* (the actual time when the satellite acquired its images) or *Ingestion Period* (the time when images were placed in the archive). I tend to select both to cover all bases, as it were.

Sentinel-3 Instruments

There are two optical instruments aboard Sentinel-3 that produce 300 metre/pixel images. These are:

- **OLCI**, the Ocean and Land Colour Instrument, described as a medium-resolution imaging spectrometer which uses five cameras to provide a wide field of view.
- **SLSTR**, the Sea and Land Surface Temperature Radiometer, which measured in eleven spectral channels to determine global sea-surface temperatures to an accuracy of better than 0.3 K.

Instrument and Product Type

It is also advisable to select appropriate **Product Type** and **Instrument** options from the *Search Panel*, otherwise you will obtain a list of all available Sentinel-3 products, most of which are of no meaning to the casual enthusiast. The two meaningful selections are

- Product Type: OL_1_EFR___
Instrument: OLCI
- Product Type: SL_1_RBT___
Instrument: SLSTR

Of the two, the former usually provides the most realistic colour composite images.

Selecting an Area

This can be done either before or after setting the search parameters. Make sure that the search area is clearly accessible on the screen and drag a rectangle over the map to suit your requirements (figure 3), in this example, over the British Isles. Because every available tile that overlaps even the tiniest corner of this rectangle will be listed and displayed on the map, it’s a good idea to make the search area quite small.

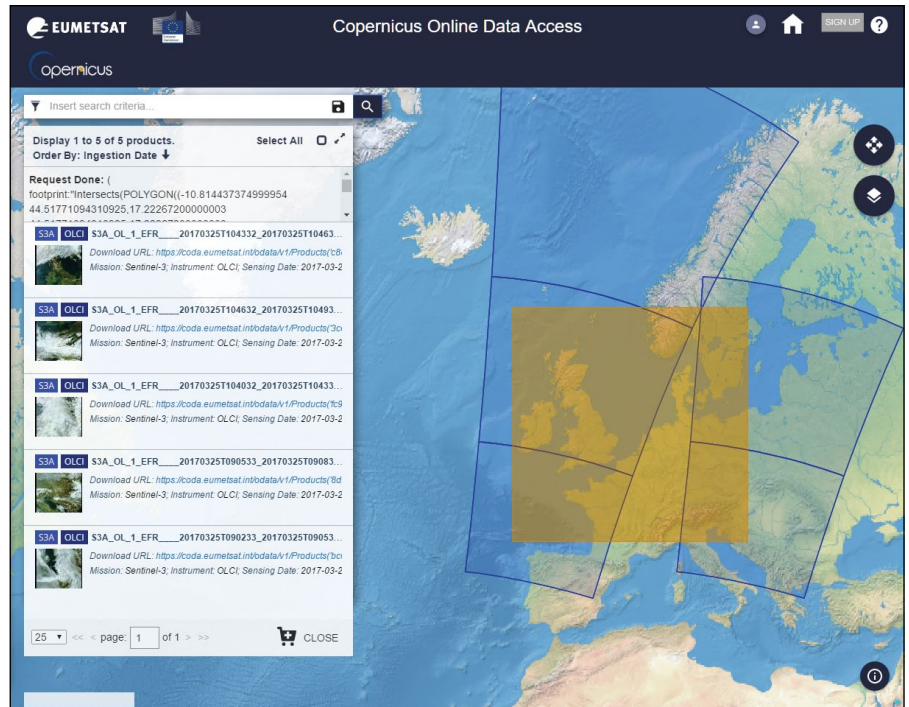


Figure 3 - Available segments revealed by the search (March 26, 2017)

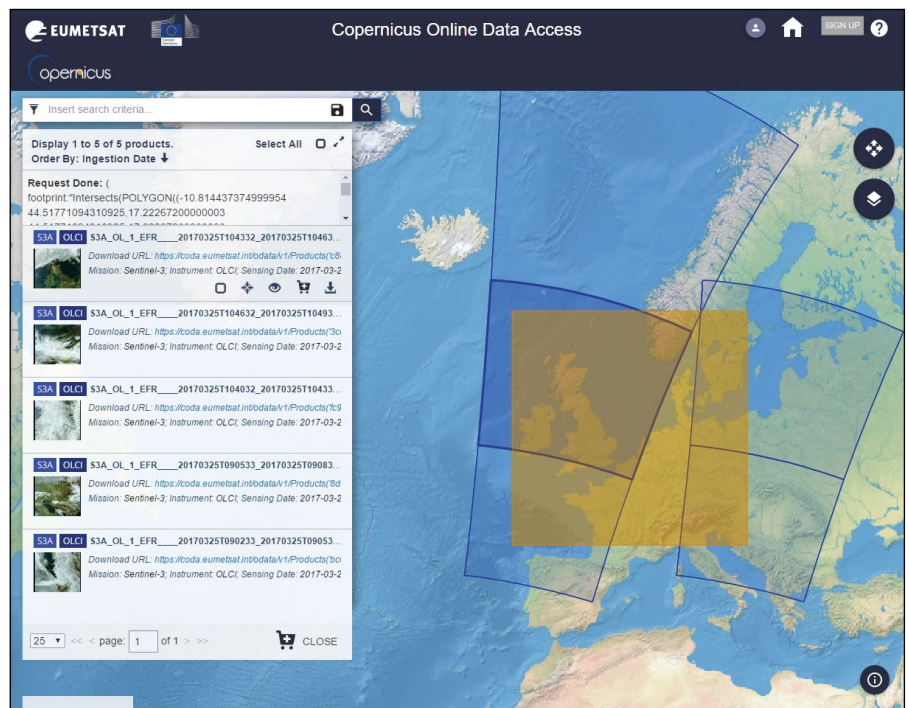


Figure 4 - A file is selected for download

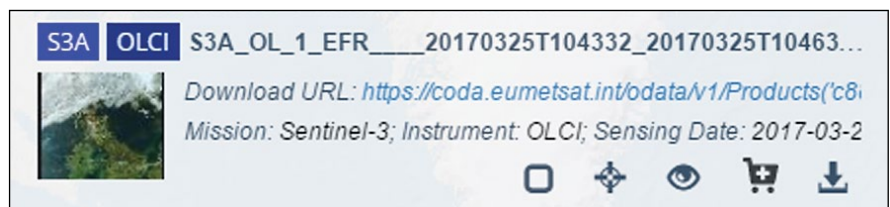



Figure 5 - An image is selected from the panel

Of course, you can select as large an area as you like, but this often produces a confusing clutter of many overlapping tiles.

You are now all set to go, so click the *Search Icon*  and await the appearance of the list of tiles. In figure 3, you will observe that

additional tiles to the east of Britain are displayed because the search rectangle partly overlapped them.

Selecting a Tile

Every tile outlined on the map will have an accompanying entry in the **Display Panel** at the left hand side of the screen. As you hover the cursor

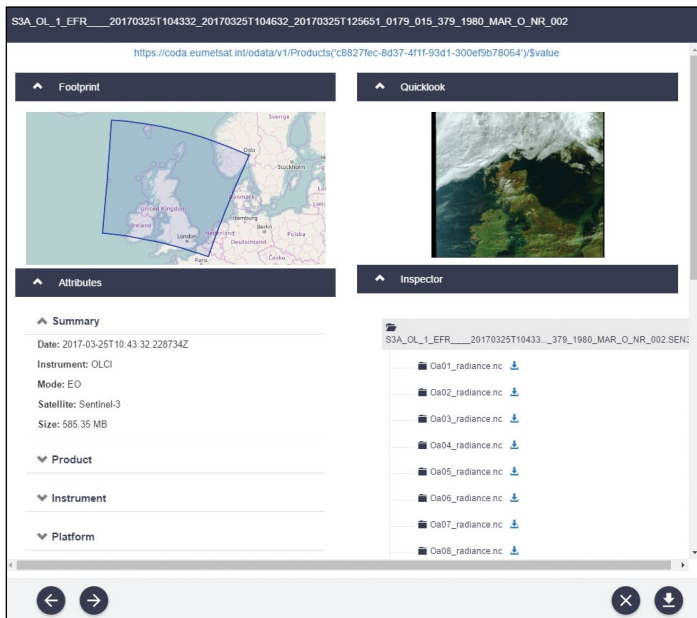


Figure 6 - A Tile Information Screen

over the entries on this panel, each tile shown on the map becomes highlighted in turn (figure 4). Figure 5 is an enlarged image of the list entry for the tile that is shown covering Scotland and much of England. At left is a (very) small thumbnail image covered by the selected tile, and on the right are five small clickable icons. From left to right, these are:

- Select Product
- Zoom to product (on map)
- View Product Details
- Add Product to Cart
- Download Product

Probably the most useful of the five icons is the middle one, which displays an information window (figure 6). Here you can quickly verify that you have selected the intended tile (left hand image), and can check a coloured ‘quicklook’ image of the included scene.

When the tile you wish to download is highlighted, hover over its menu entry and click its download icon, .

The Downloads

The files that are downloaded are large, generally between 600-650 MB, and in my experience can take up to ten minutes to download—but this will very much depend on the speed of your internet connection.

The downloaded files are not themselves images. The OLCI downloads are zipped archives containing data for 21 bands in the 400 - 1020 nanometre range, tuned to specific ocean colour, vegetation and atmospheric correction measurement requirements. The spatial resolution is 300 m/pixel in all cases, similar to the highest resolution of NASA MODIS imagery.

The SLSTR downloads are also zipped archives, in this instance comprising 11 channels, three in the visible spectrum and the remainder in the infrared.

Resolving Sentinel-3A zip Archives into Images

Probably the most straightforward way to create images from this data is to use Hugo Van Ruyskensvelde’s *EUMETCastView* software.

David Taylor introduced this versatile software in the previous Quarterly for processing images downloaded from EUMETSAT. Using it to process the files downloaded from the internet is explained in the following article.

Processing Sentinel-3A Files from the Internet with *EUMETCastView*

Les Hamilton

Many GEO readers will already be familiar with Hugo Van Ruyskensvelde’s *EUMETCastView* software as a means of processing the satellite files they acquire via *EUMETCast*. Fortunately, the same software package can be used to process Sentinel-3A files downloaded from the CODA internet site.

There is one minor difference however. Sentinel-3A files obtained from *EUMETCast* are bundled together as *.tar* archives whereas those from the internet are bundled in *.zip* archives. To create imagery from the zip archives, you need to have installed v 1.2.3 (or later) of *EUMETCastView*. Earlier versions only accept the *.tar* archives. *EUMETCastView* v 1.2.3 can be downloaded from

<https://github.com/hvanruys/EUMETCastView/releases>

Also, if you wish to investigate the SLSTR imagery, again, you will have to install this version.

Installation of EUMETCastView

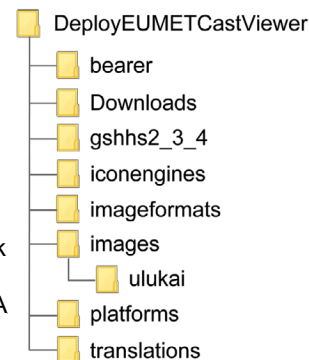
EUMETCastView is a ‘portable’ program, so can be installed anywhere on your computer. The program comes as a zipped archive, which, when extracted, places all its files in a folder named ‘DeployEUMETCastViewer’. A word of advice here: do not install into the *Program Files*—or *Program Files(x86)*—

folder, because the software needs to write files to its own folder, something that modern versions of Windows do not allow.

David Taylor recommends unzipping *EUMETCastView* into a working folder called *C:\Tools*. I prefer to unzip the program directly to a different disc partition, *D:\DeployEUMETCastViewer*. If your hard drive is not partitioned, the program runs perfectly if extracted to the main drive as *C:\DeployEUMETCastViewer*.

The next step will almost certainly differ from that used with *EUMETCast*.

Despite my exhortations, no-one has seen fit to support GEO by providing a comprehensive article on the use of *EUMETCastViewer*: so I have had to invent my own work scheme. In order to accommodate the files downloaded from the CODA website, I created a new folder named ‘Downloads’ inside the main *DeployEUMETCastViewer* folder, as illustrated here.



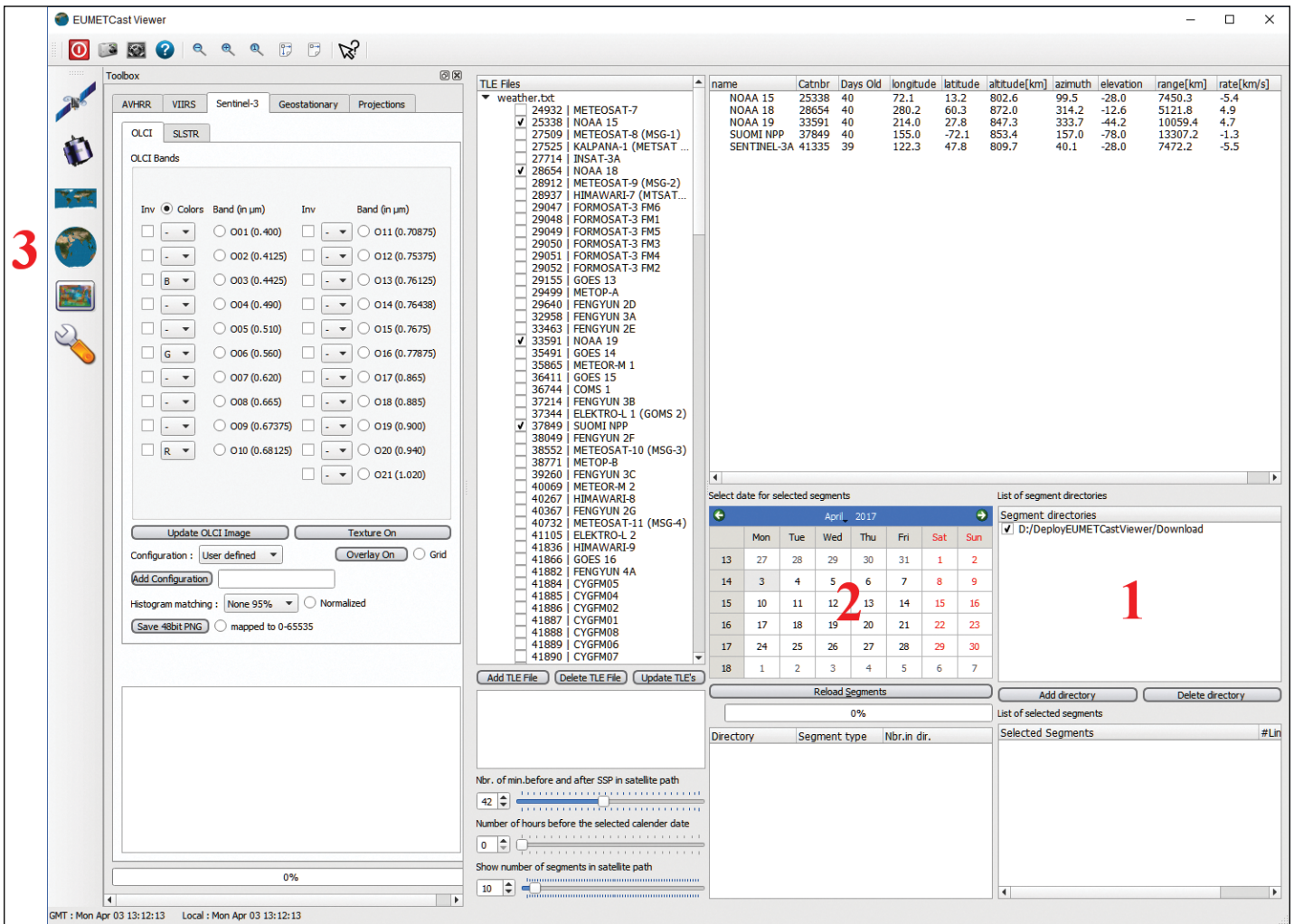


Figure 1 - Three key areas on the Satellite Setup screen

The program file, found in the *DeployEUMETCastView* folder, is 'EUMETCastView.exe'. It is a good idea to right-click this file, drag on to the Desktop, and create a shortcut for future ease of use.

When you run *EUMETCastView* for the first time it opens to display the **Satellite Setup Screen** (figure 1). Although this appears hugely complex, in fact very little of it is relevant to processing Sentinel 3A files from the CODA site. The relevant areas are marked by prominent red numerals, and are the **Segment Directories** panel (1), the **Selection Calendar** (2) and the **3D Globe** button at upper left (3).

The Segment Directories Pane

By default, this pane is filled with a long list of folders relating to *EUMETCast* reception. If, like me, you are not receiving this data, click each entry in turn to select it then click the 'Delete Directory' button. When the pane is empty, click the 'Add Directory' button, navigate to the 'Downloads' folder, click on the folder to select it then click the 'Select Folder' button.

Finally, ensure that *EUMETCastView* 'knows' where to look for your downloaded files by ticking the checkbox against its name in the Segment Directories Pane (which now contains just one entry, your new Downloads folder).

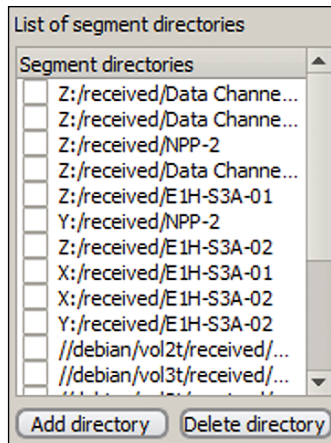


Figure 2 The Initial Segment Directory

The Calendar

Every file you download from the CODA site includes the date of acquisition in its filename. I'm using files relating to Cyclone Debbie which hit northern Queensland in Australia on March 27, 2017, which are safely stored in my 'Downloads' folder. Each download comes with a 94 character filename like the example at the foot of this page (figure 3). The key feature is the fact that this contains the date of acquisition—March 27, 2017.

To load this file into *EUMETCastView*, move to the Selection Calendar, select the correct Year, Month and Day, then press the **Reload Segments** button immediately below the calendar.

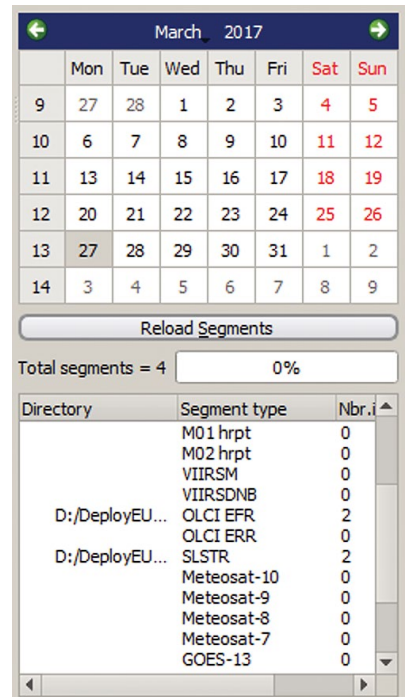
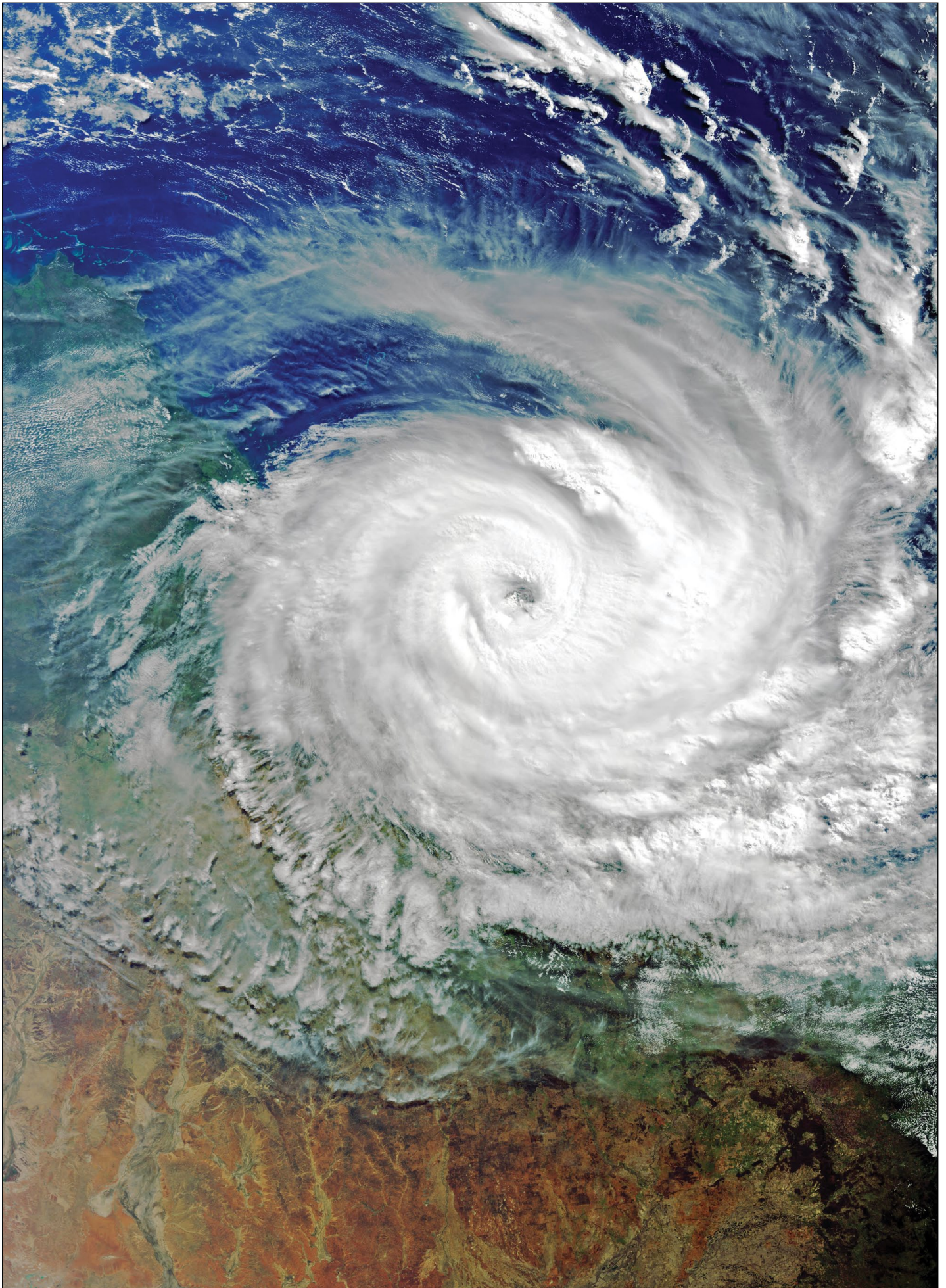


Figure 4 Loading Segments

In my case, I had collected four files relating to Cyclone Debbie: two each from OLCI and SLSTR (because the storm was split between two tiles) and these all now appear in the Directory list beneath the calendar (figure 4).

Figure 3 - A typical, 94-character Sentinel-3 tile filename

S3A_OL_1_EFR___20170327T234004_20170327T234304_20170328T013642_0180_016_030_3239_MAR_O_NR_002



Cyclone Debbie shown shortly after making landfall on Queensland, Australia on March 27, 2017 in this Sentinel 3A image, realised in **EUMETCastView** using data from CODA, with additional processing in **Photoshop**.
Image: Modified Copernicus data © ESA / Sentinel (2017)

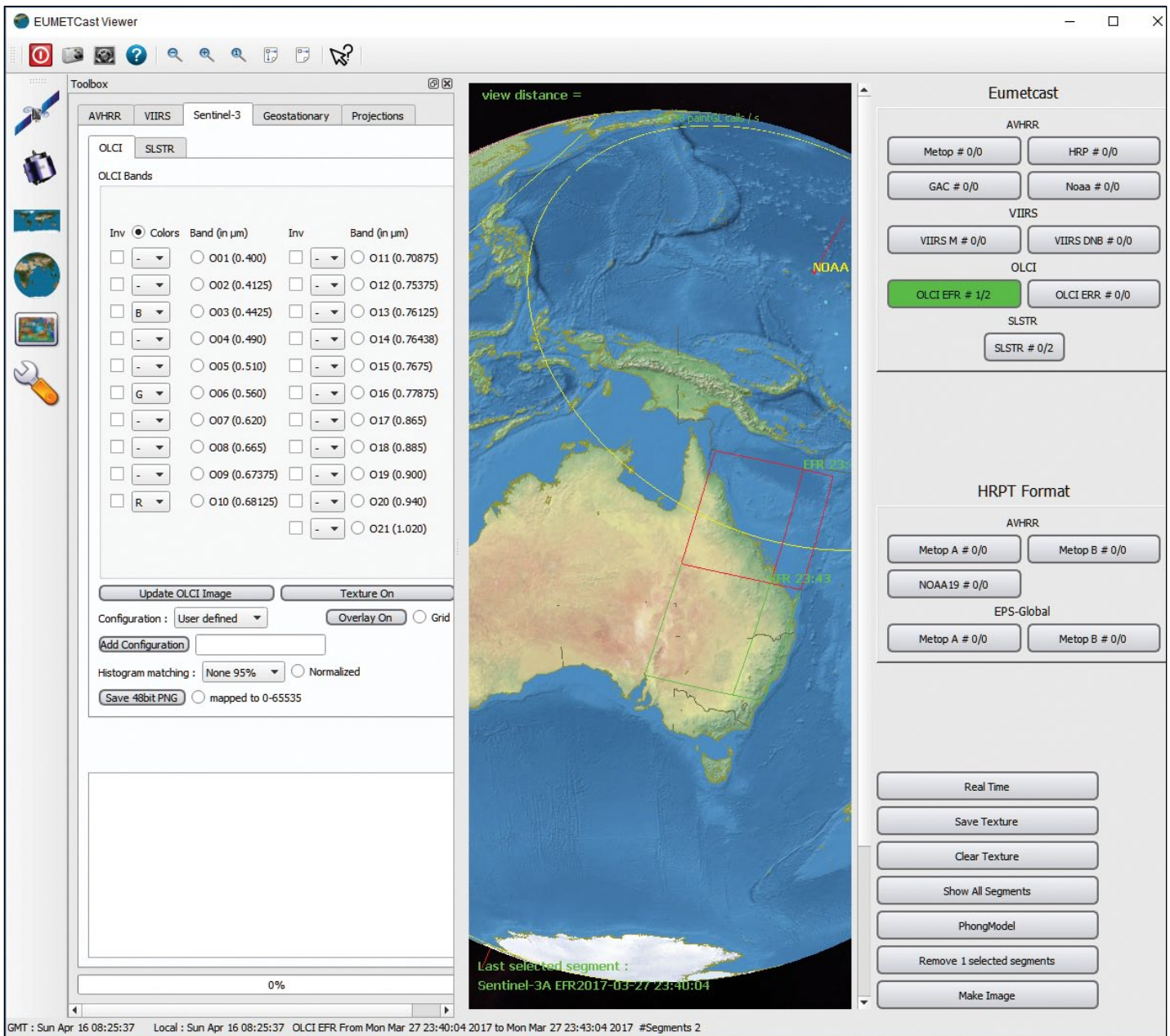


Figure 5 - The 3D-Globe Image Processing Screen, showing the positions of two tiles, one selected (red) and the other yet to be selected (green).

The 3D Globe Button

The final step is to analyse the file(s) that have been loaded. Click the **3D Globe** button to reveal the **Image Processing** screen (figure 5). The centre pane is now a map of Earth which can be dragged around by the mouse to bring any desired area into view. You can also zoom in and out using the mouse-wheel. Although there are zoom-in/zoom-out buttons at the top of the screen, I have found these to be totally ineffective.

Creating High Resolution OLCI-EFR Sentinel 3A Images

To produce images from 'EFR' high-resolution OLCI tiles, you must select the **OLCI EFR # 2/2** button from the right-hand pane, shown in green in figure 5. The areas covered by the two OLCI tiles that I had selected relating to Storm Debbie were outlined in green over Queensland. To create an image, it is necessary to right-click on each tile to select it, when its outline turns to red. If you right-click on just a single tile, only that tile will be processed. By selecting both tiles, *EUMETCastView* will not only process each tile, but seamlessly join them together to create the full scene.

To create an image, click the **Make Image** button at the foot of the right-hand pane. The image produced will be in accordance with the default settings in the left-hand panel (figure 5). A progress bar at the foot of the panel reaches 100% when the image is

complete, and a thumbnail of the result is generated within the tile outlines on the World Map, as shown in figure 7. You can zoom in to view the scene in greater detail by means of the mouse wheel. The image can now be saved as either a PNG or JPG using the second-left button at the top of the screen.

OLCI Image Processing Options

The left hand panel (figure 5) is the **Toolbox**, where you can control how the Sentinel 3A tiles are processed. The Toolbox may be toggled on/off using the 'spanner' icon. The top section of the Toolbox lists all the OLCI channels, and immediately below are a number of image processing controls.

The '**Configuration**' dropdown list, contains three options (figure 6a), which are:

- User defined
- Natural Colors
- True Colors

'Natural Colors' and 'True Colour' select default (fixed) channel combinations, either of which is capable of rendering attractive colour composite visible light images. The 'User defined' option allows you to experiment using your own choice of channel combinations.

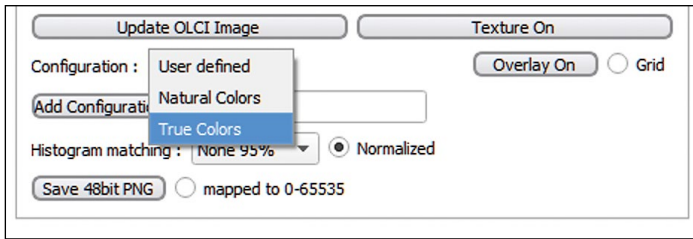


Figure 6a - Colour and normalisation options

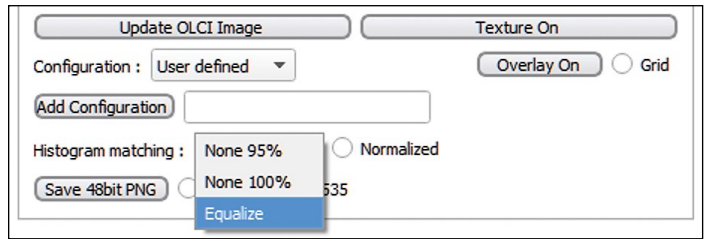


Figure 6a - Image equalisation option

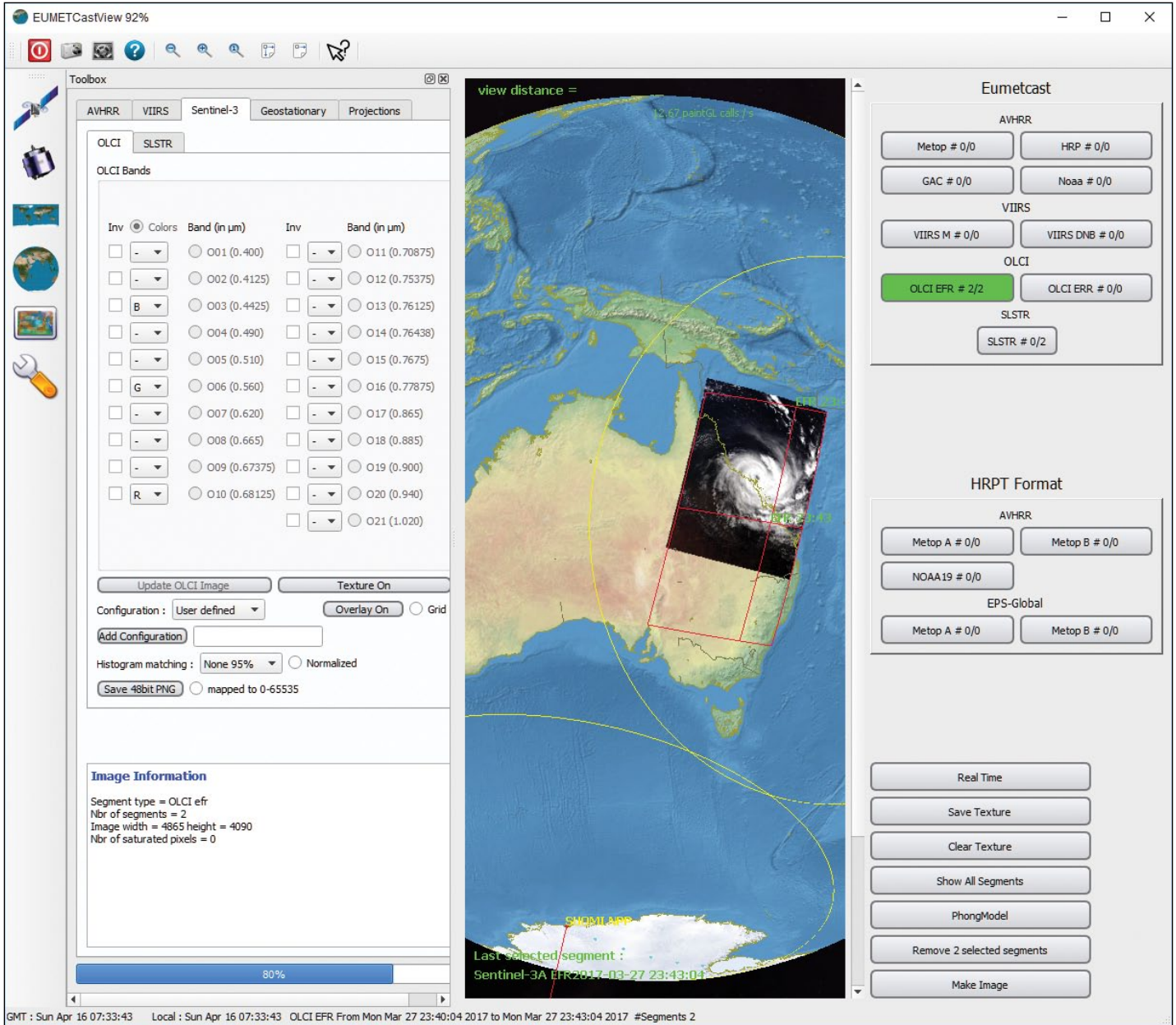


Figure 7 - Processing two Sentinel 3A tiles for Cyclone Debbie. The progress counter shows 80% at lower left (blue strip)

Below this is the 'Histogram Matching' dropdown list, shown in figure 6b, which also contains three options:

- None 95%
- None 100%
- Equalise

What precisely the 'None 95%' and 'None 100%' entries mean is beyond me: clearly these are presets that apply a degree of histogram stretching. These options do have a definitive effect on the Sentinel 3A images, which is best appreciated by referring to the comparison images of Cyclone Debbie on page 26.

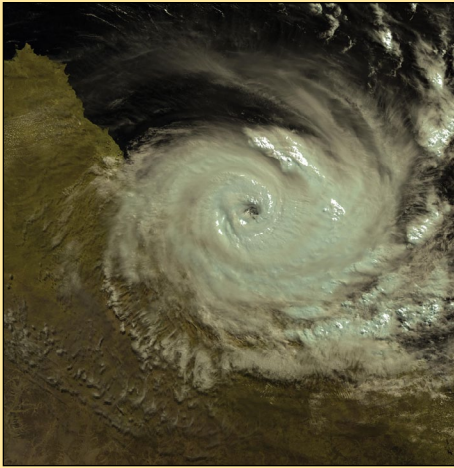
Each time new tiles are selected in *EUMETCastViewer*, you must click the **Make Image Button** to initiate the processing operation,

using your selected parameters. However, to subsequently investigate the effects of the different *Histogram* options, this can be achieved by simply making a new selection from the dropdown list. Note though, that a change to the *Configuration* dropdown list does not take place automatically: you must click the **Update OLCI Image** button in the Toolbox to effect this change.

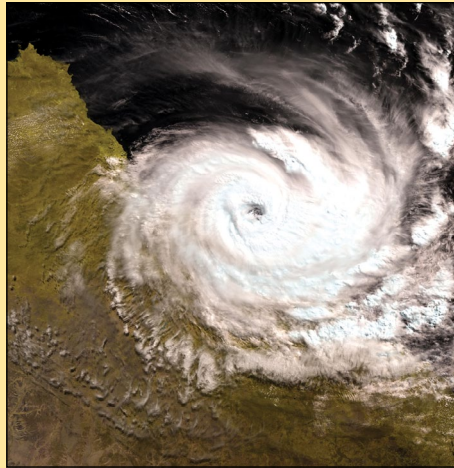
Processing SLSTR Tiles

Creating images from the Sentinel 3A SLSTR data follows a very similar course to what has already been described above. The one essential difference is that the **SLSTR #1/2** button, just beneath the **OLCI EFR #2/2** button, must be clicked, whereupon it turns green. This brings with it a change in the appearance of the Toolbox, which now displays the eleven SLSTR channels in place

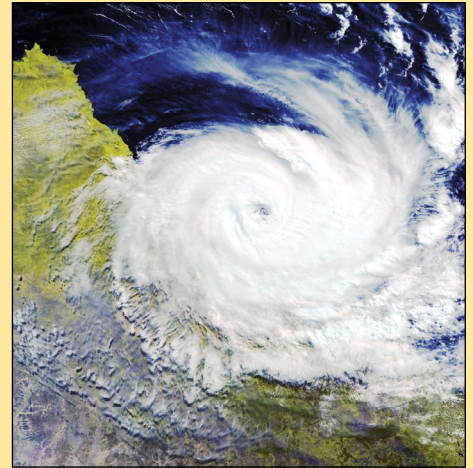
continued on page 28



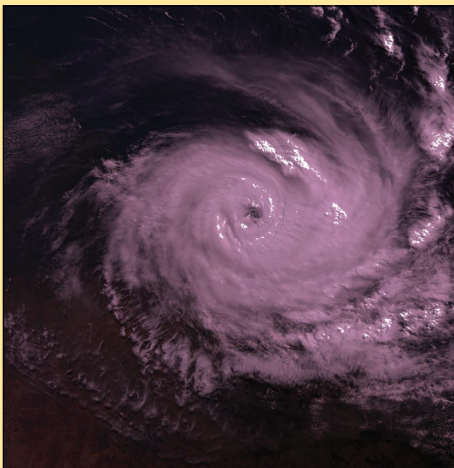
OLCI / Natural Colour / None 100%



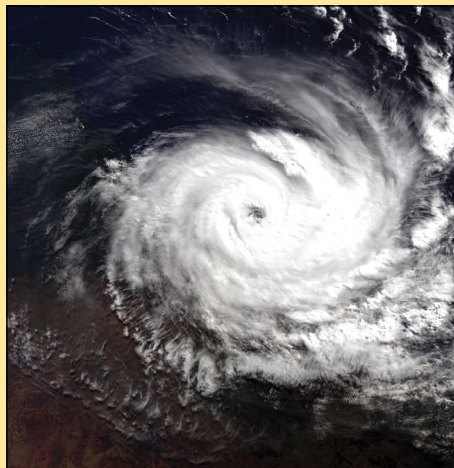
OLCI / Natural Colour / None 95%



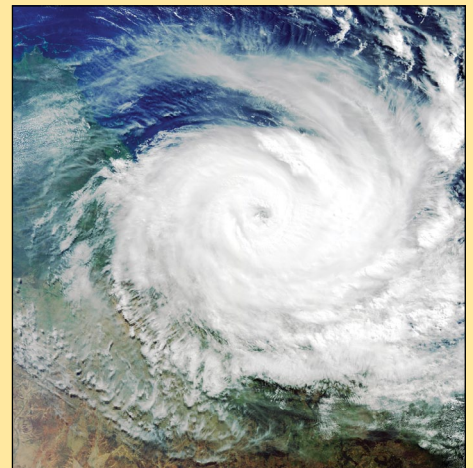
OLCI / Natural Colour/ Equalised



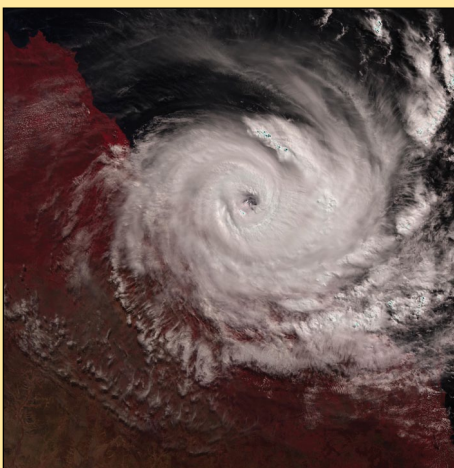
OLCI / True Colour / None 100%



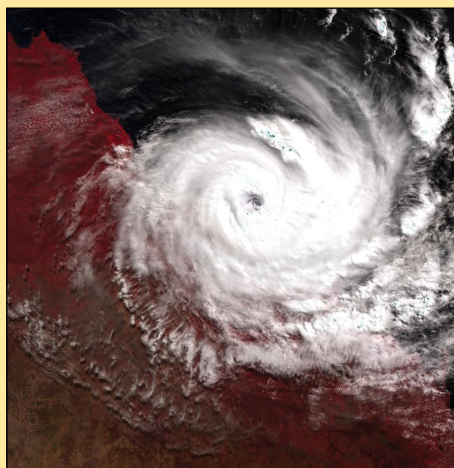
OLCI / True Colour / None 95%



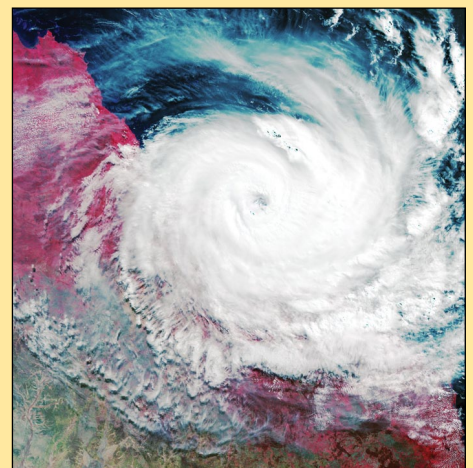
OLCI / True Colour / Equalised



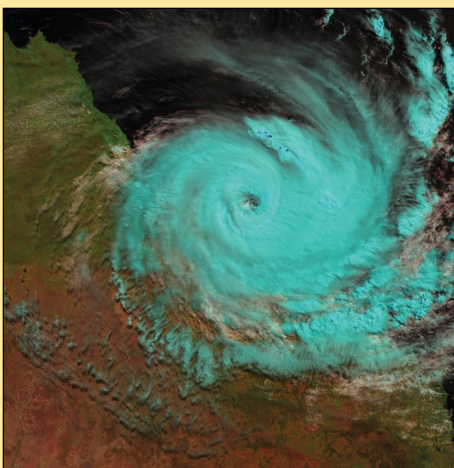
SLSTR / Natural Colour / None 100%



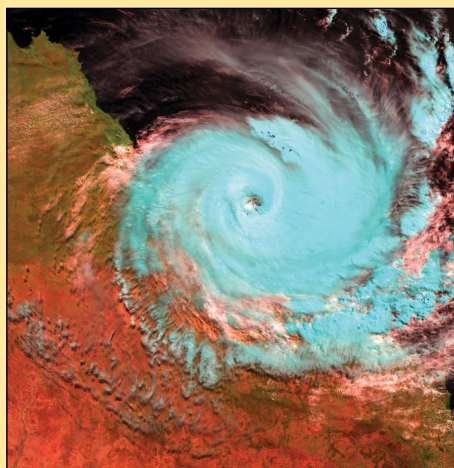
SLSTR Natural Colour / None 95%



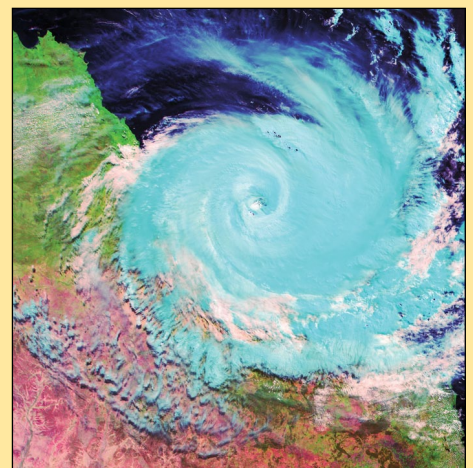
SLSTR / Natural Colour / Equalised



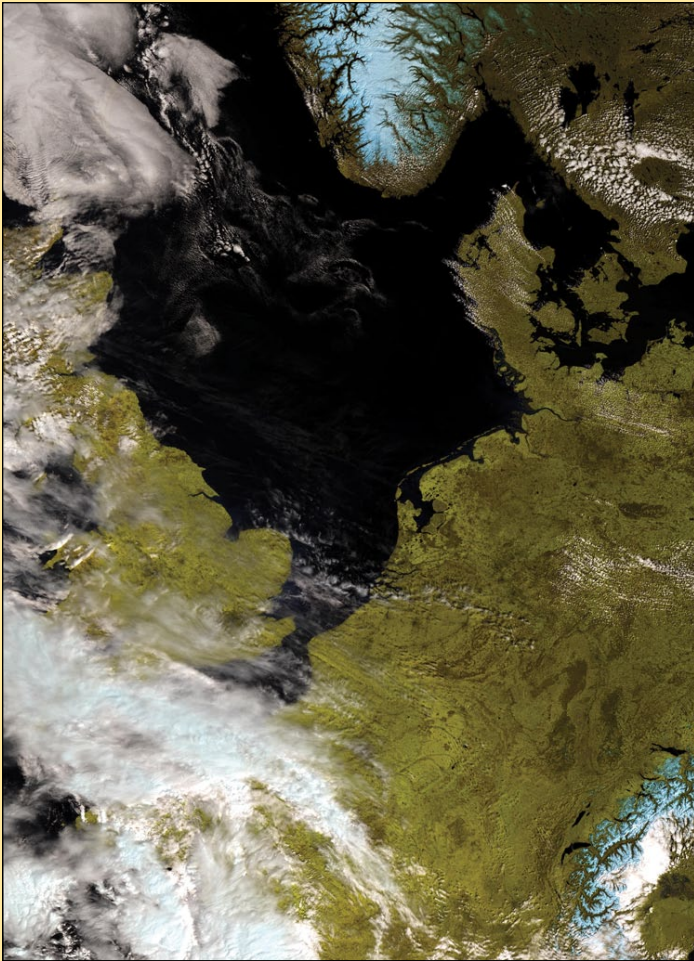
SLSTR / False Colour / None 100%



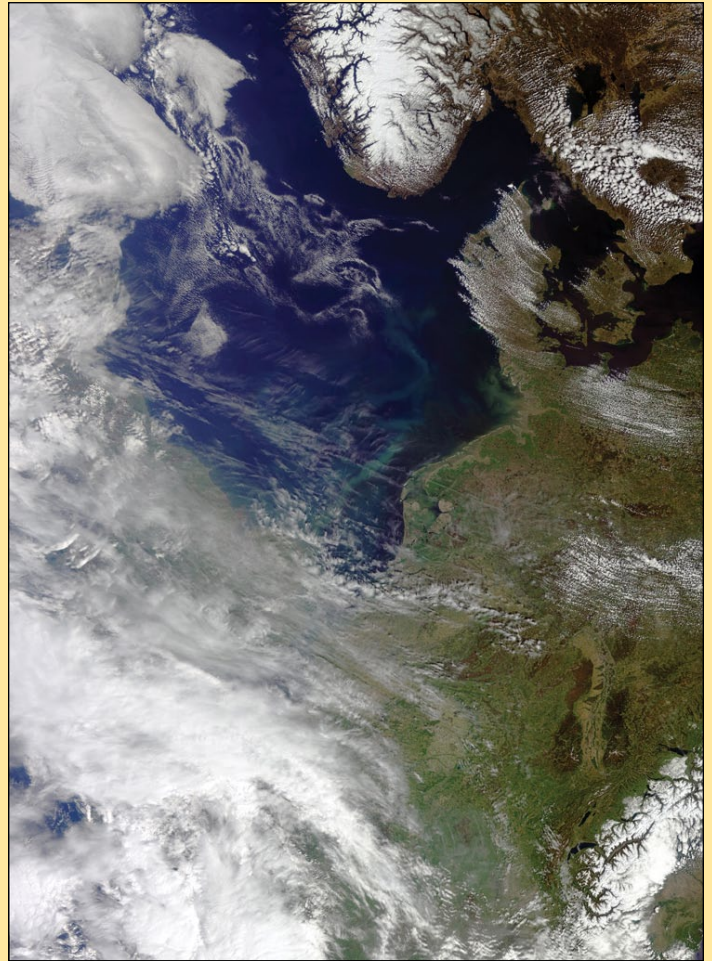
SLSTR / False Colour / None 95%



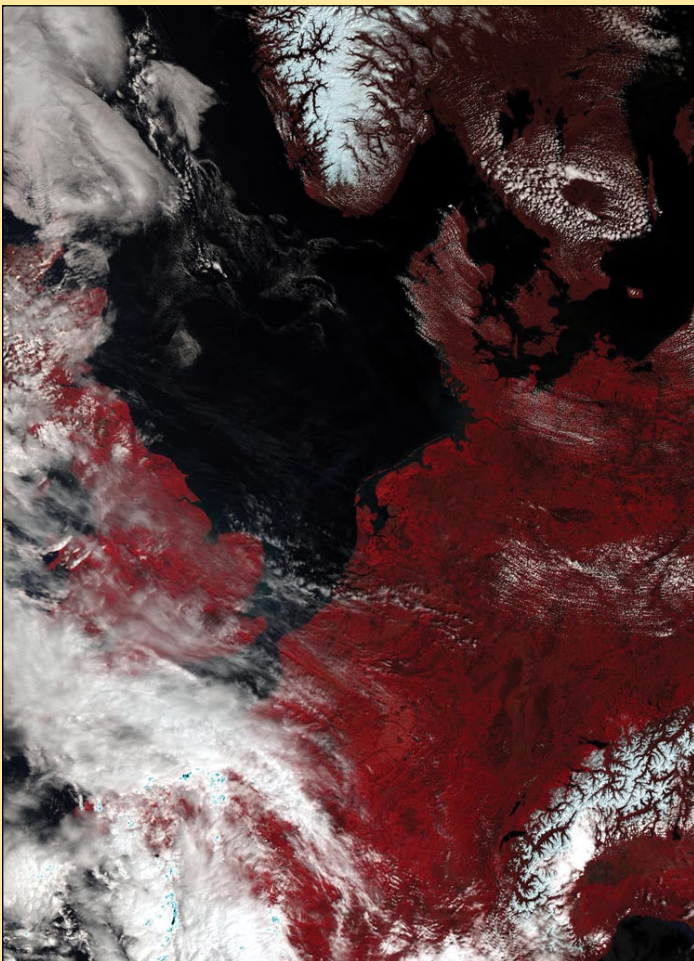
SLSTR / False Colour / Equalised



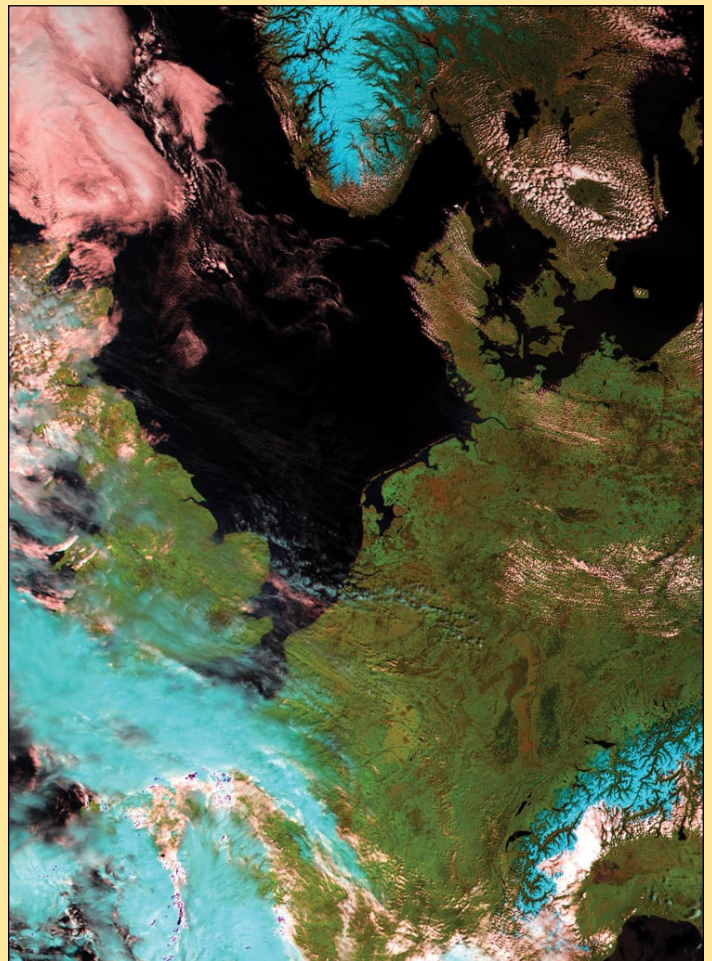
OLCI / Natural Colour / None 95%



OLCI / True Colour / Equalised



SLSTR / Natural Colour / None 95%



SLSTR / False Colour / None 95%

of the 21 OLCI channels. Again there are two 'Configuration' presets: 'Natural Colors' and 'False Colors', and the same three 'Histogram matching' possibilities. Comparison SLSTR images of Cyclone Debbie are shown on the lower half of page 26.

Of course, the colours rendered in the SLSTR images are frequently quite weird, but can be useful for highlighting certain features. The four images featuring western Europe on page 27 show Sentinel 3A products from April 30, 2017. In general, for well illuminated scenes like this, I find that setting **Histogram Matching** to 'None 95%' results in the most pleasing results in the vast majority of cases. The one exception seems to be when using a **Configuration** of 'True Color', which typically produces very dark land features: in this particular case, the most pleasing results come by setting **Histogram Matching** to 'Equalise'.

48-bit OLCI PNG Files

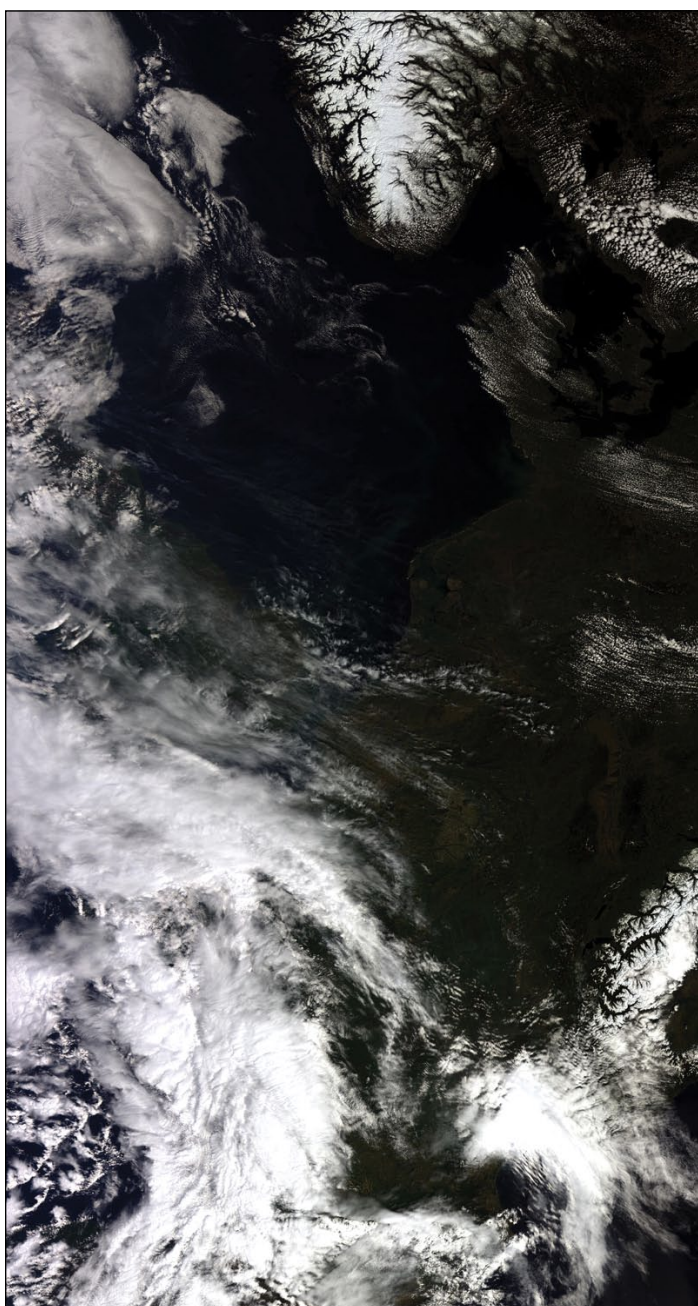
Readers familiar with David Taylor's **Sentinel 2 to JPEG** software, reviewed in *GEO Quarterly 53*, may be interested to learn that it can also process 48-bit OLCI PNG files of Sentinel 3A data., providing more sophisticated adjustment of both gamma and histogram equalisation.

EUMETCastView includes the **Save 48-bit PNG** button on its OLCI version of the Toolbox. For both the 'Natural' and 'True' colour options, following image processing, this button will save the raw data for the three selected channels to a 48-bit PNG file (no histogram matching included). The resulting PNG file can be rapidly processed many times over within **Sentinel 2 to JPEG** to investigate the effects of altering both gamma and histogram stretching.

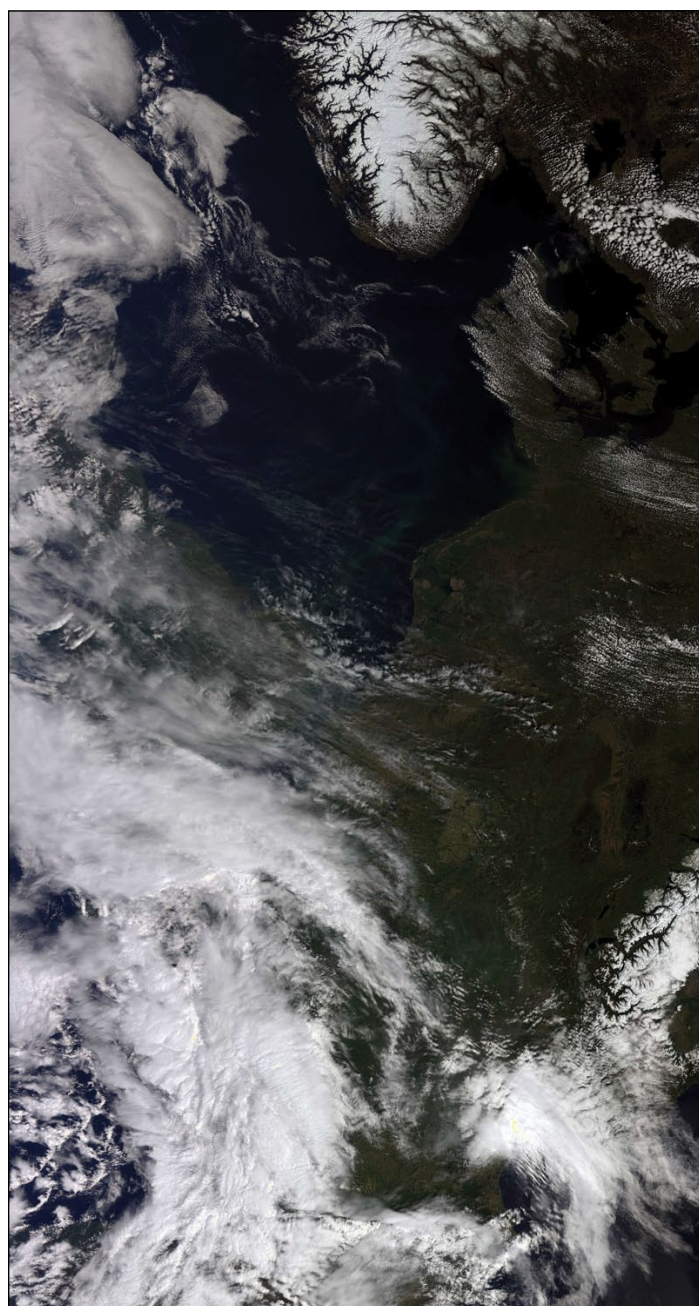
The two images from April 30 presented below illustrate the True Colour version from **EUMETCastView**, with Histogram Matching set at 'None 95%' (left) and the 48-bit PNG file after processing with '**Sentinel 2 to JPEG**' where the minimum histogram level has been raised to 48 (right) to improve land rendition.

Feedback

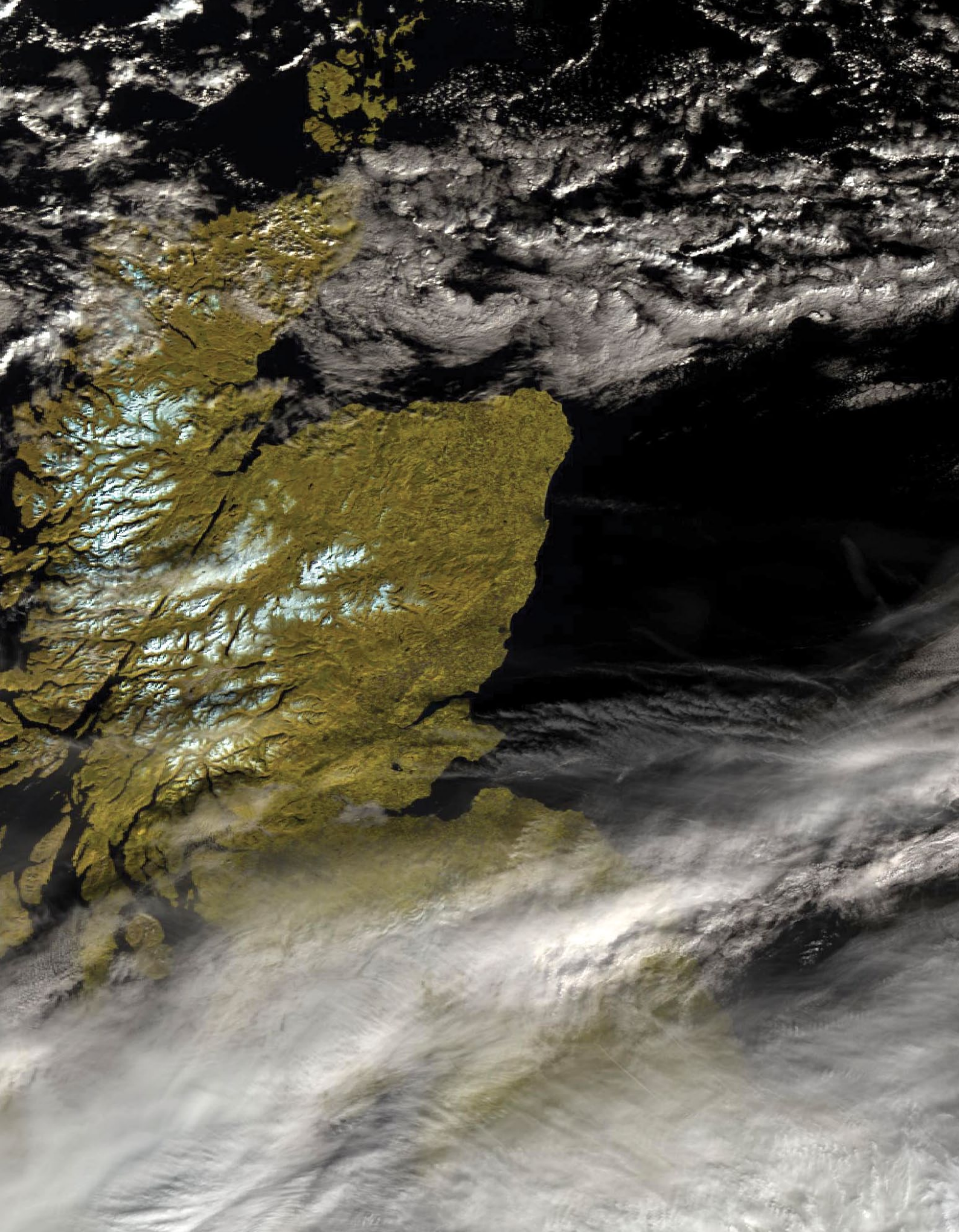
I have only considered the default features of **EUMETCastView**, and there is clearly a great deal of scope for further experimentation, particularly with the 'User' option for selection of OLCI and SLSTR channels. Any feedback that can advance our collective enjoyment of Sentinel 3A data from the CODA site will be most welcome.



Sentinel 3A image acquired on April 30, 2017
and processed in EUMETCastView
Image: Modified Copernicus Data © ESA / Sentinel (2017)



Sentinel 3A image acquired on April 30, 2017
and processed in Sentinel 2 to JPEG
Image: Modified Copernicus Data © ESA / Sentinel (2017)



This is a small segment taken from the March 3, 2017 Sentinel-3A image, when the only area of the British Isles not under heavy cloud was Scotland. Snow lying on the tops of the Scottish mountains shows up clearly.

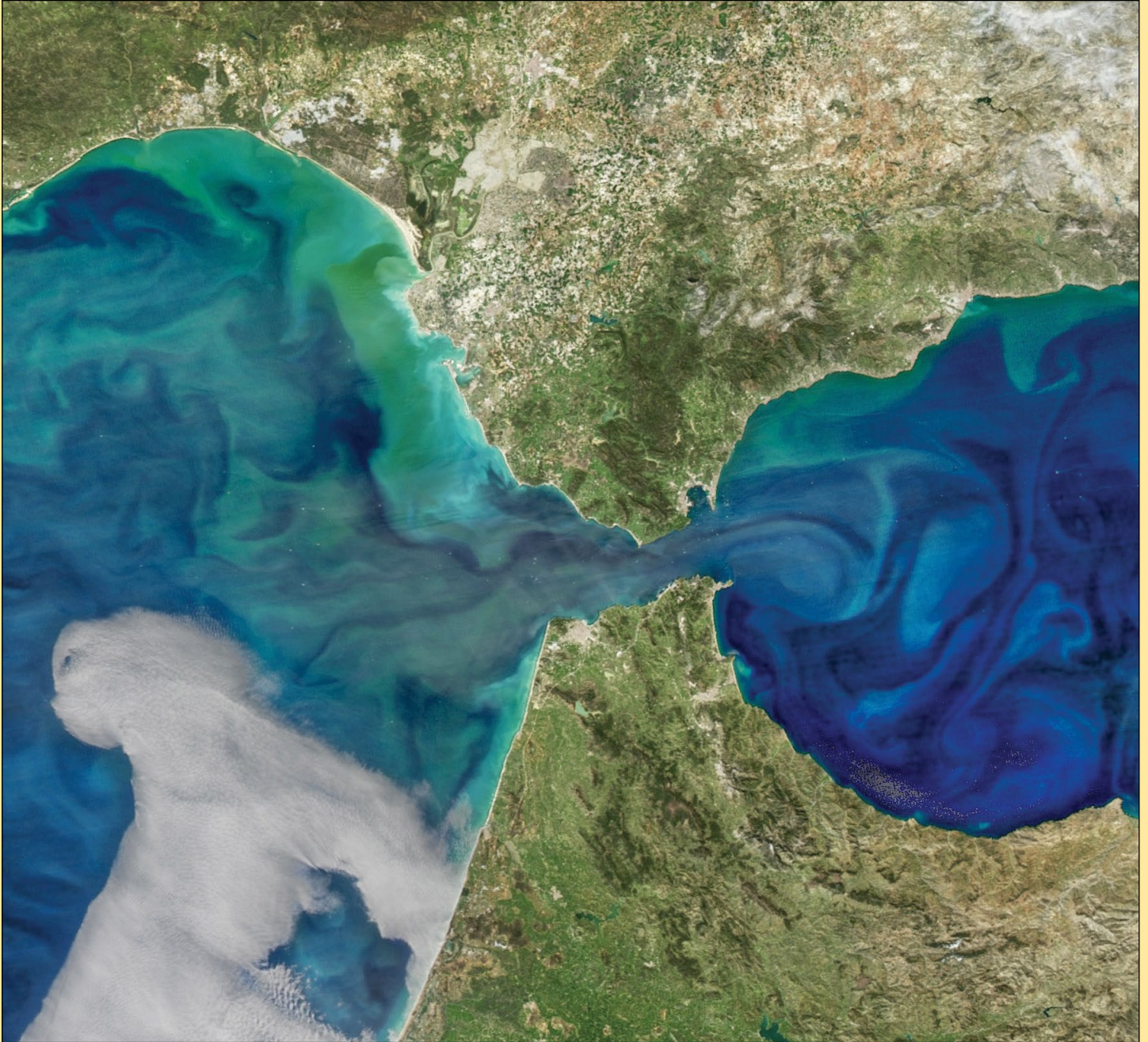
Image: Modified Copernicus data © ESA / Sentinel (2017)



Mike Stevens submitted this April 17 Sentinel-3A image showing his home location of Portland (the small peninsula at the east of Lyme Bay on the Dorset coast). The image shows remarkable cloud detail over the Atlantic Ocean, including a large cluster of aeroplane contrails west of Land's End.
Image © EUMETSAT 2017

Blooming Gibraltar

NASA Earth Observatory



NASA image by Norman Kuring, NASA's Ocean Color web. Story by Kathryn Hansen.

From space, the Strait of Gibraltar appears tiny compared with the continents it separates. At the strait's narrowest point, Africa stands just 14 kilometres from Europe. But the narrow waterway is a complex environment that gives rise to striking phytoplankton blooms when conditions are right.

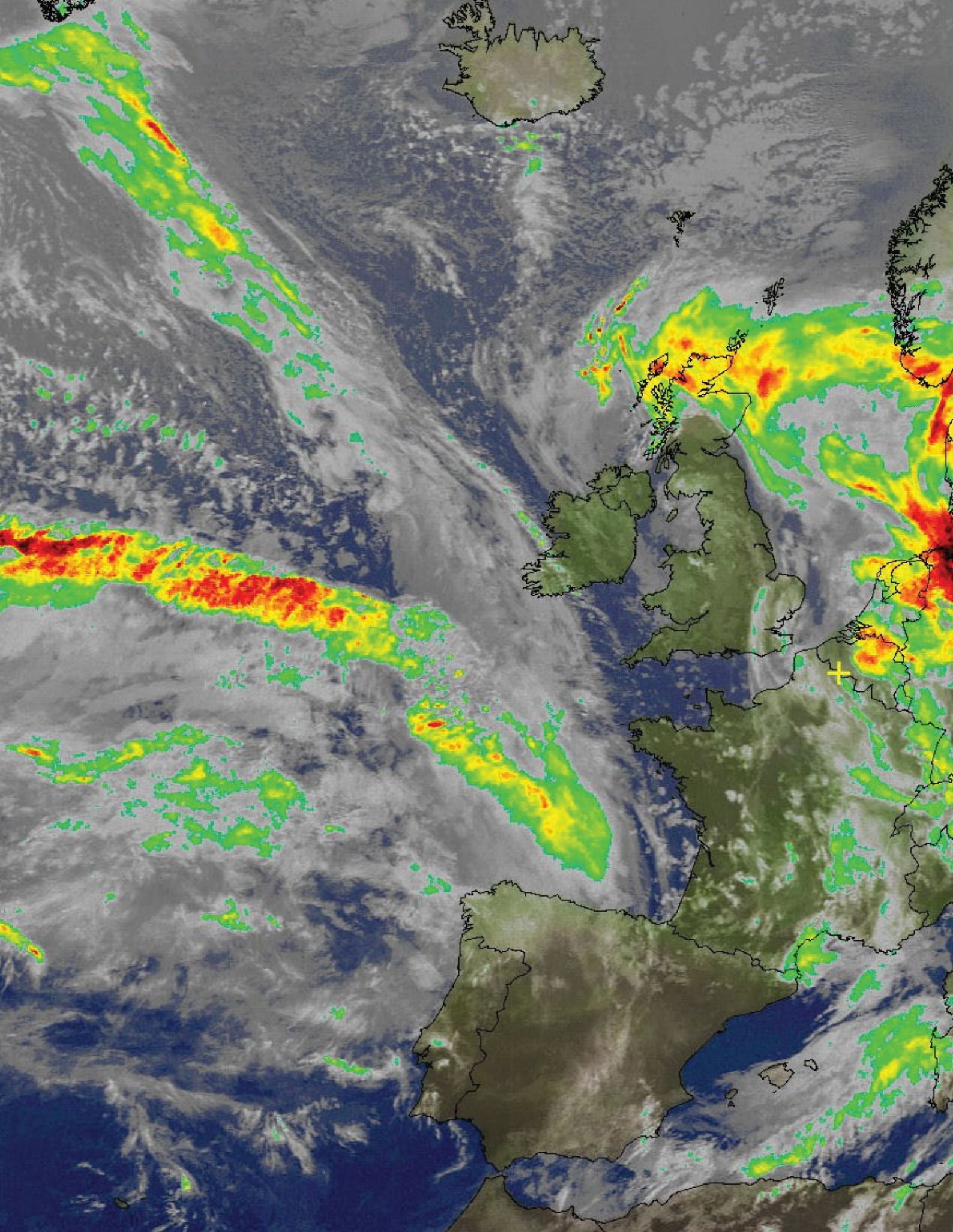
Water conditions and circulation near the strait produced the bloom with colourful tendrils visible in this image, acquired on March 8, 2017. The image is composed from data acquired with the *Visible Infrared Imaging Radiometer*

Suite (VIIRS) on **Suomi NPP**, and the *Moderate Resolution Imaging Spectroradiometer* (MODIS) on NASA's **Aqua** satellite. A series of processing steps were applied to highlight colour differences and bring out the bloom's subtler features.

The intricate swirls of phytoplankton trace the patterns of water flow, which in this region can become quite turbulent. For example, water moving east from the North Atlantic into the Mediterranean Sea has created turbulence in the form of internal waves. These waves—sometimes

with heights up to 100 metres—occur primarily deep within the ocean, with just a mere crest poking through the surface. At the same time, water flowing west helps stir up water in the North Atlantic, including the Golfo de Cádiz.

While most of the swirls of colour are phytoplankton, some of the colour near coastal areas could be due to sediment suspended in the water, particularly near the mouths of rivers. Some of the yellow-green plume near the Guadalquivir River, for example, could be due to coloured dissolved organic matter.



It was a particularly wet day over much of Britain on Saturday March 4. Aberdeen in northeast Scotland suffered over 20 hours of continuous rain and local flooding. Andre T'Kindt captured the 18.41 UT NOAA 18 pass and applied an MCIR+Precipitation overlay to illustrate the rainfall.

Arctic Meltdown

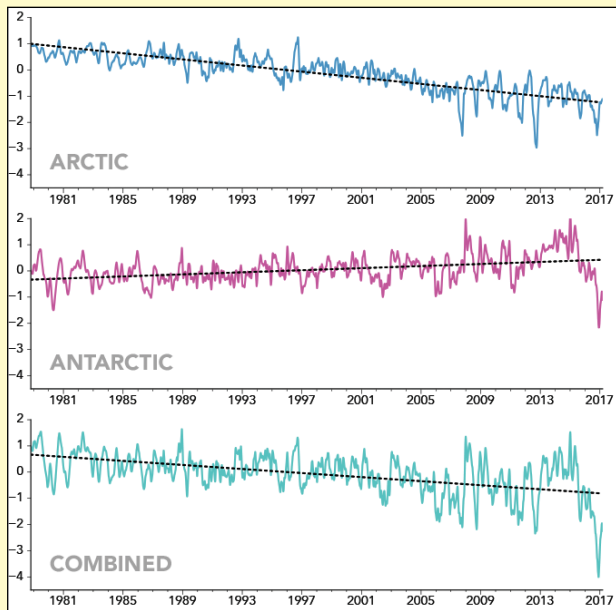
Winter Sea Ice Maximum hits Record Low

NASA Earth Observatory / NSIDC

In March 2017, Arctic sea ice reached a record-low maximum extent, according to scientists at NASA and the National Snow and Ice Data Center (NSIDC). In the same month, sea ice on the opposite side of the planet, around Antarctica, hit its lowest extent ever recorded at the end of an austral summer—a surprising turn of events after years of moderate sea ice expansion.

On February 13, 2017, the combined Arctic and Antarctic sea ice numbers were at their lowest point since satellites began to continuously measure sea ice in 1979. Total polar sea ice covered 16.21 million square kilometers (Mkm²), which is 2 Mkm² less than the average global minimum extent for 1981–2010. That’s the equivalent to losing a chunk of sea ice larger than Mexico.

The line graphs below plot the monthly deviations and overall trends in polar sea ice from 1979 to 2017 as measured by satellites. The top line shows the Arctic; the middle shows Antarctica; and the third shows the global, combined total. The graphs depict how much the sea ice concentration changed above or below the long-term average (**not** total sea ice concentration.)



Changes in sea ice concentration / Mkm²

Arctic and global sea ice totals have decreased consistently over 38 years. Antarctic trends are more muddled, but they do not offset the great losses in the Arctic. The maps opposite provide a closer look at the record lows that occurred at each pole this year.

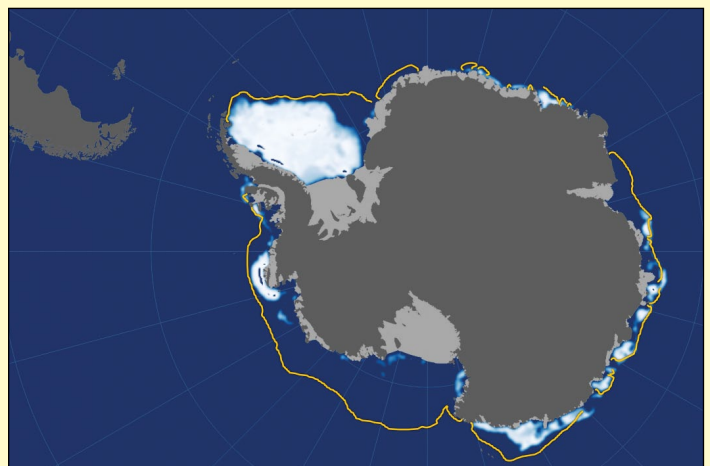
The ice floating on the Arctic Ocean and its surrounding seas decreases from mid-March until mid-September. As the Arctic temperatures drop in the autumn and winter, the ice cover increases again until it reaches its yearly maximum extent, typically in March. This winter, a combination of warmer-than-average temperatures, unfavorable winds, and a series of storms stunted sea ice growth in the Arctic.



Figure 1 - A NASA visualisation of Arctic Ice cover on March 7, 2017. Credits: NASA's Goddard Space Flight Center



Figure 2 - Arctic Sea Ice Extent on March 7, 2017



Antarctic Sea Ice Extent on March 3, 2017

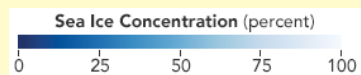


Figure 2 shows the concentration of Arctic sea ice on March 7, 2017, when it reached its maximum extent for the year. Opaque white areas indicate the greatest concentration, and dark blue areas are open water. All icy areas pictured here have an ice concentration of at least 15 percent (the minimum at which

space-based measurements give a reliable measurement), and cover a total area that scientists refer to as the “ice extent.”

The maximum extent on March 7 was a record low, measuring 14.42 Mkm². That's 97 000 m² below the previous record low that occurred in 2015.

'We started from a low September minimum extent,' said Walt Meier, a sea ice scientist at NASA's Goddard Space Flight Center. 'There was a lot of open ocean water, and we saw periods of very slow ice growth in late October and into November because the water had a lot of accumulated heat that had to be dissipated before ice could grow. The ice formation got a late start and everything lagged behind—it was hard for the sea ice cover to catch up.'

'This year's record-low maximum will not necessarily lead to a new record-low minimum extent in summertime, since weather has a great impact on the melt season's outcome,' stated Meier, 'but it's guaranteed to be below normal.'

Sea ice around Antarctica behaves in a similar manner, but with the calendar flipped—it usually reaches its maximum in September and its minimum in February. This year, Antarctic sea ice reached a record-low minimum on March 3. Figure 3 shows the concentration of sea ice on that day.

The extent on March 3 measured 2.11 Mkm², 184 000 km² below the previous record low in the satellite record, which occurred in 1997. This year's low happened just two years after

several monthly record-high extents in Antarctica and decades of moderate sea ice growth.

'There's a lot of year-to-year variability in both Arctic and Antarctic sea ice, but overall, until last year, the trends in the Antarctic for every single month were toward more sea ice,' said Claire Parkinson, a senior sea ice researcher at NASA Goddard. 'Last year was stunningly different, with prominent sea ice decreases in the Antarctic. To think that now the Antarctic sea ice extent is actually reaching a record minimum, that's definitely of interest.'

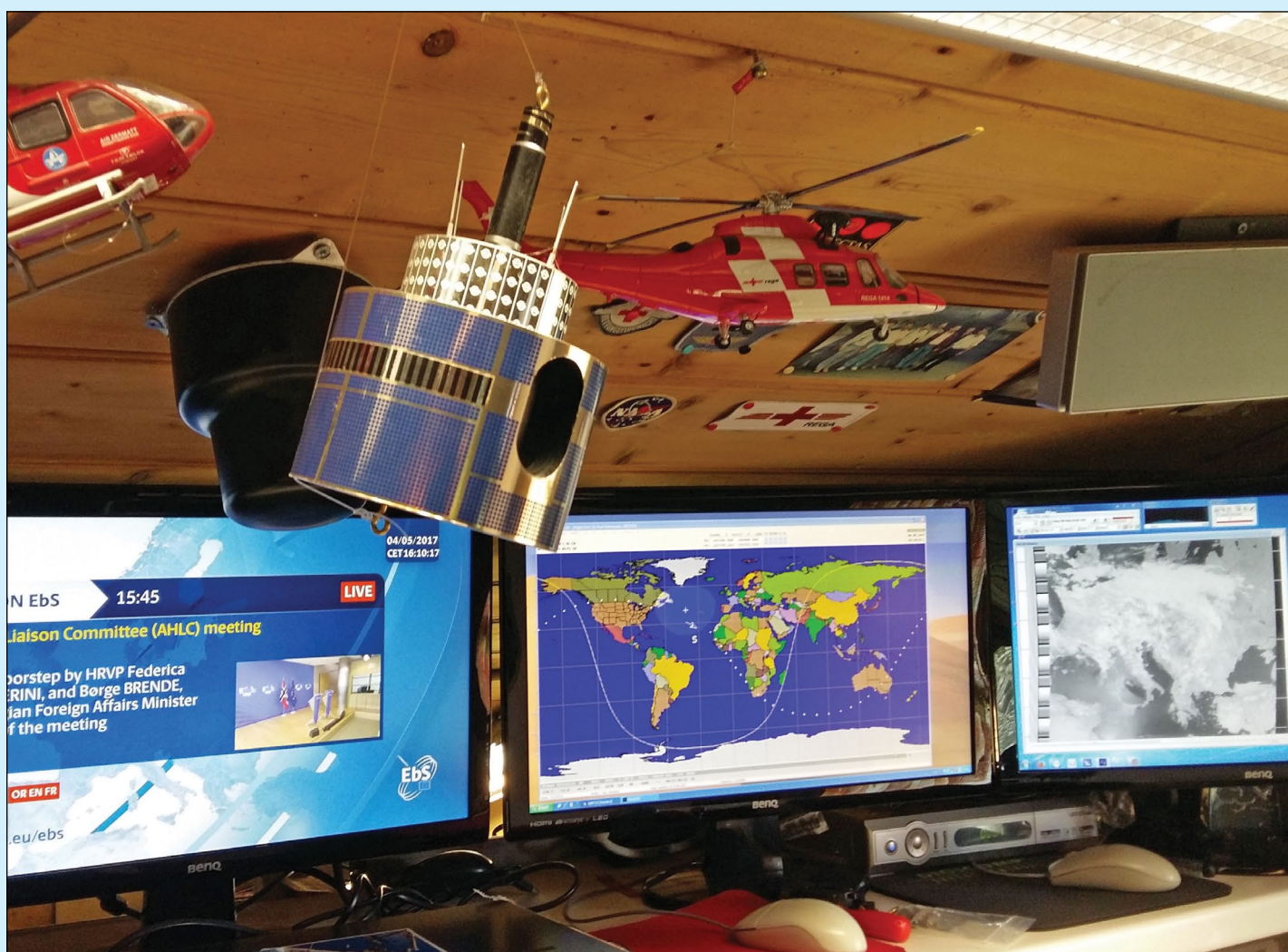
Meier said it is too early to tell if this year marks a shift in the behavior of Antarctic sea ice.

'It is tempting to say that the record low we are seeing this year is global warming finally catching up with Antarctica,' Meier said. 'However, this might just be an extreme case of pushing the envelope of year-to-year variability. We'll need to have several more years of data to be able to say there has been a significant change in the trend.'

You can view movie animations showing the changes in sea ice cover at both Earth's poles at

<https://svs.gsfc.nasa.gov/12537>

Credit: NASA Earth Observatory images by Joshua Stevens, using data from the Advanced Microwave Scanning Radiometer 2 (AMSR2) sensor on the Global Change Observation Mission 1st-Water (GCOM-W1) satellite and the Scanning Multichannel Microwave Radiometer (SMMR) on the Nimbus-7 satellite. Caption by Maria-José Viñas, adapted for Earth Observatory by Kathryn Hansen.



This photograph, taken inside Paul Geissmann's satellite receiving station in Säntis in northern Switzerland, shows off his recently acquired model of the Meteosat-7 geostationary satellite.

Russia's Bay of Whales

NASA Earth Observatory



NASA Earth Observatory image by Joshua Stevens, using U.S. Geological Survey. Story by Pola Lem.

If you were in the market for a moulting whale epidermis, Russia's Ulbanskiy Bay might be a good place to search for one. The area is mostly uninhabited by humans, but it does support sizable numbers of whales, whose cast-off skins have been spotted in these Siberian waters by scientists.

In summertime, this bay becomes a feeding ground for bowhead whales, as well as belugas and orcas.

Beluga whales come to Ulbanskiy for the seafood buffet. They hunt by driving fish like herring and smelt toward the coast and into freshwater inlets. Some whales begin to enter Ulbanskiy Bay as early as May, when the winter fast ice begins to break up. Their numbers swell in late July, and aerial surveys have observed upwards of 1,200 of them here in August, when food is plentiful. Occasionally,

when predatory orcas approach, belugas swim close to the shore for protection. With the arrival of autumn, new ice forms in the bay, and the whales head out to open waters.

Despite this abundant underwater activity, the bay's waters appear serene from space. The image above was acquired on September 30, 2014, by the *Operational Land Imager* (OLI) on the **Landsat 8** satellite.

Freshwater streams meander into marshlands and gently sloped mud flats. Ground photography shows that further inland, the incline becomes steeper, with darker green, pine-covered slopes. A lighter green band on the left side of the image indicates deciduous trees that have begun to turn color. The marshes around the bay are dotted with small bodies of water—likely thermokarst lakes.

Suomi NPP Night Light Maps

Open Up New Applications

NASA Earth Observatory



A Suomi-NPP Night-Time image of Europe for 2016

NASA scientists have released new global maps of Earth at night, providing the clearest-yet views of the patterns of human settlements across our planet. Satellite images of Earth at night—often referred to as ‘*night lights*’—have been a curiosity for the public and a tool of fundamental research for at least 25 years. They have provided a broad, beautiful picture, showing how humans have shaped the planet and lit up the darkness. Produced every decade or so, such maps have spawned hundreds of pop-culture uses and dozens of economic, social science, and environmental research projects.

But what would happen if scientists removed the moonlight, fires, and other natural sources of light and updated such night-time images yearly, monthly, or even daily? A research team led by NASA Earth scientist Miguel Román plans to find out this year.

Since the 2011 launch of the **NASA-NOAA Suomi National Polar-orbiting Partnership** (Suomi-NPP) satellite, and the 2012 release of Earth-at-night maps, Román and colleagues at NASA’s *Goddard Space Flight Center* have been analysing night lights data and developing new software and algorithms to make them clearer, more accurate and more readily available. A research team in the *Earth Observing Satellite Data and Information System* (EOSDIS) has also been working to integrate night-time data into NASA’s *Global Imagery Browse Services* (GIBS) and *Worldview* mapping tools. Freely available to the science community and public via the Web, GIBS and Worldview allow users to see natural- and false-colour images of Earth within hours of satellite acquisition.

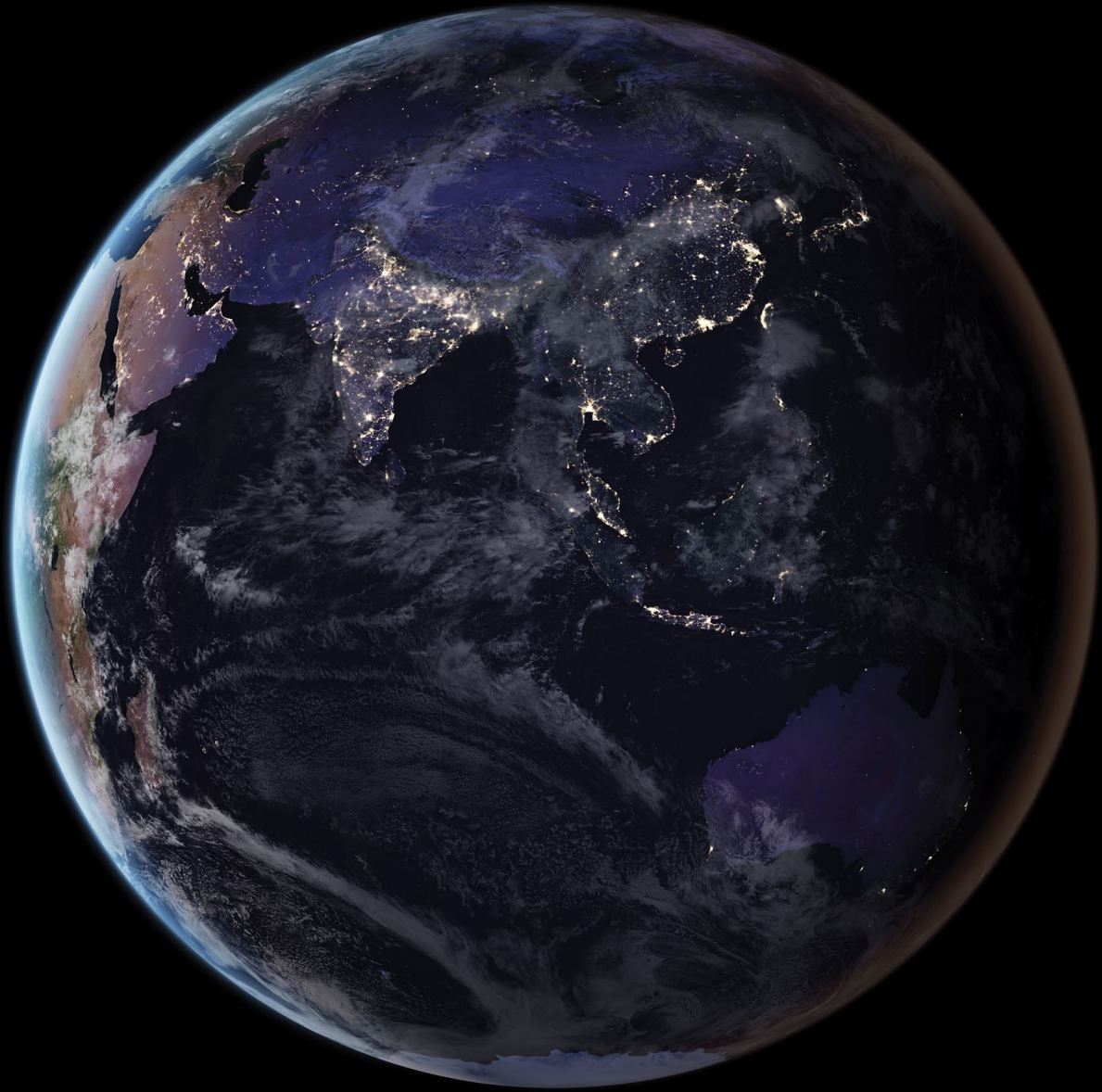
The images below show Earth’s night lights as observed in 2016: they are drawn from a new global composite map (below) that was recently added to *Worldview* and *GIBS*. The compositing

technique selected the best cloud-free nights in each month over each land mass. (Note that clouds and sunlight have been added to some of the images for aesthetic effect: those data are drawn from our *Blue Marble* products.) The team has also reprocessed 2012 data with the new techniques so that researchers can compare and contrast light sources over the years. By late 2017, Román and colleagues hope to provide daily high-definition views of Earth at night.

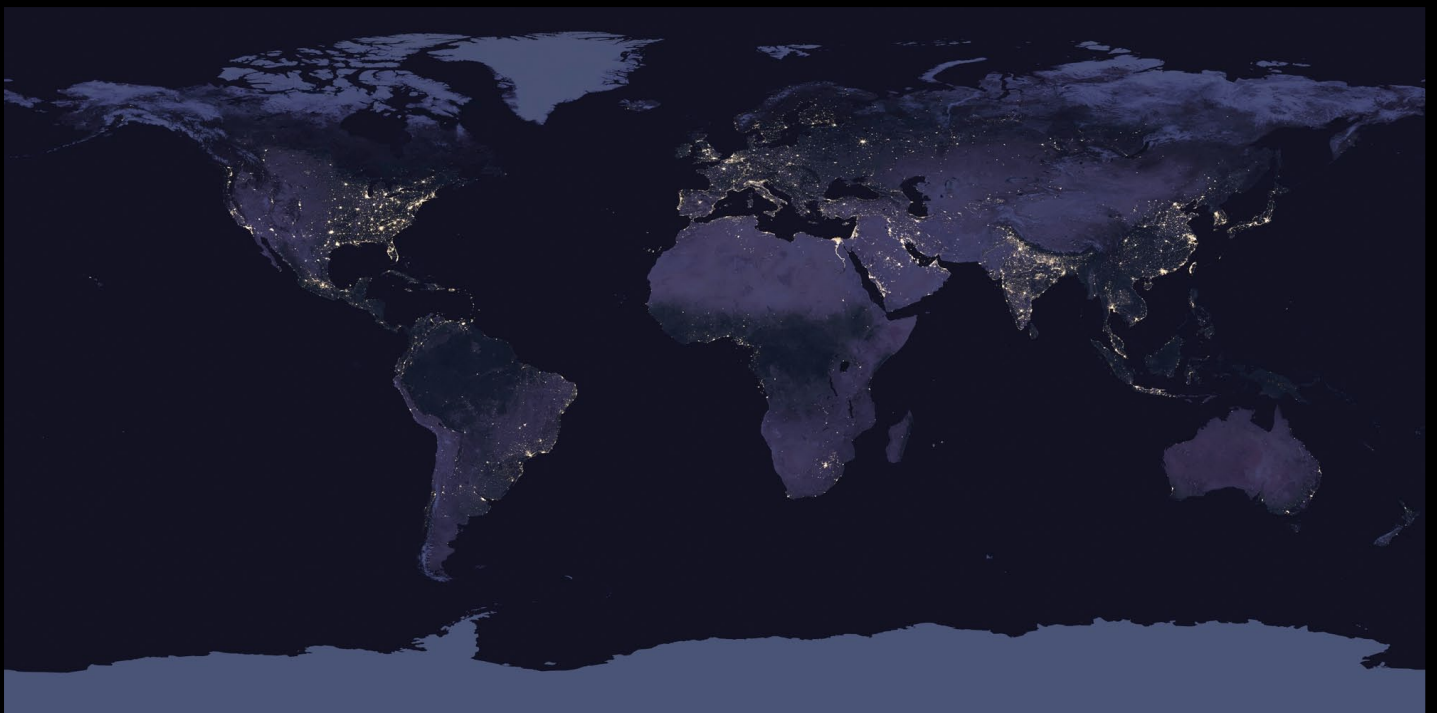
To make the new maps, Román and colleagues examined the different ways in which light is radiated, scattered, and reflected by land, atmospheric, and ocean surfaces. The principal challenge in night-time satellite imaging is accounting for the phases of the Moon, which constantly vary the intensity of light shining on Earth, though in predictable ways. Likewise, seasonal vegetation, clouds, aerosols, snow and ice cover, and even faint atmospheric emissions (such as airglow and auroras) change the way that light appears in different parts of the world.

Román and colleagues have been building remote sensing techniques to filter out these sources of extraneous light, gathering a better and more consistent signal of how human-driven patterns and processes are changing. The improved processing moves *Suomi NPP* closer to its full potential of observing dim light down to the scale of an isolated highway lamp or a fishing boat.

Suomi NPP observes nearly every location on Earth at roughly 1.30 UT and 13.30 UT (local time) each day, as it images the planet in vertical 3000-kilometre strips from pole to pole. The satellite’s workhorse instrument is the *Visible Infrared Imaging Radiometer Suite* (VIIRS), which detects photons of light reflected from Earth’s surface and atmosphere in 22 different



A Suomi-NPP Night-Time image of Asia for 2016



A Suomi-NPP Night-Time image of Earth for 2016



A Suomi-NPP Night-Time image showing Italy in high resolution

wavelengths. Because *Suomi NPP* is a civilian science satellite, those data are freely available to scientists within minutes to hours of acquisition.

VIIRS includes a special '**day/night band**,' a low-light sensor that can distinguish night lights with six times better spatial resolution and 250 times better resolution of lighting levels (dynamic range) than the older *Operational Line Scan (OLS)* imaging systems on *Defense Meteorological Satellite Program (DMSP)* spacecraft. VIIRS makes quantitative measurements of light emissions and reflections, which allows researchers to distinguish the intensity, types, and the sources of night lights, and observe how they change over several years.

Armed with more accurate night-time environmental products, the NASA team is now automating the processing so that users will be able to view night-time imagery within hours of acquisition. This has the potential to aid disaster response. For instance, VIIRS detected power outages in the wake of Hurricane Matthew, a major storm that struck the northeastern Caribbean and the southeastern United States in September 2016. NASA's Disasters Response team provided those data to colleagues at the *Federal Emergency Management Agency*; in the future, NASA, FEMA, and the Department of Energy hope to regularly produce power outage maps and integrate the information into recovery efforts by first responders.

The NASA team envisions many other potential uses by research, meteorological, and civic groups. For instance, daily night-time imagery could be used to help monitor unregulated or unreported fishing. It could also contribute to efforts to track

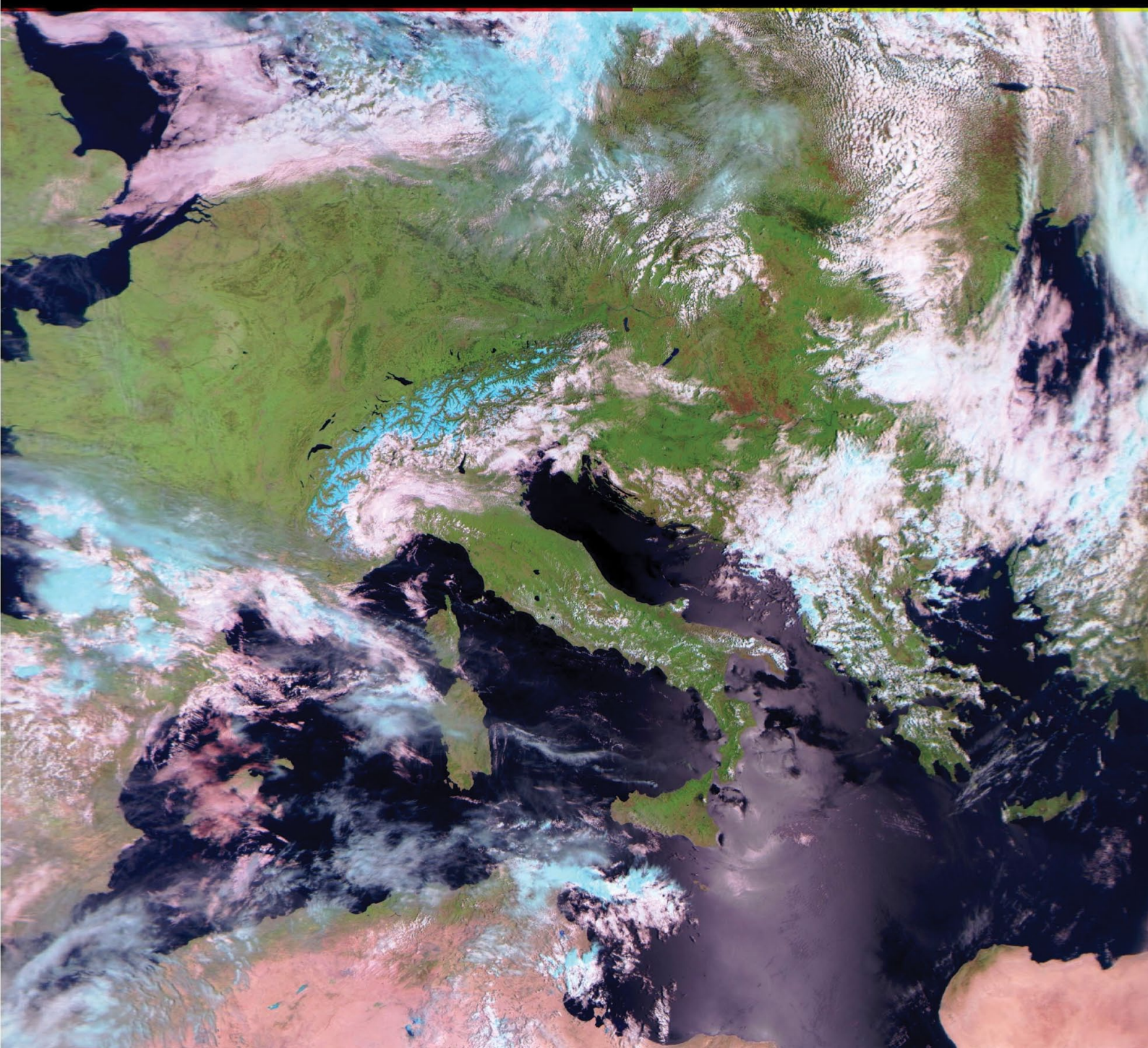
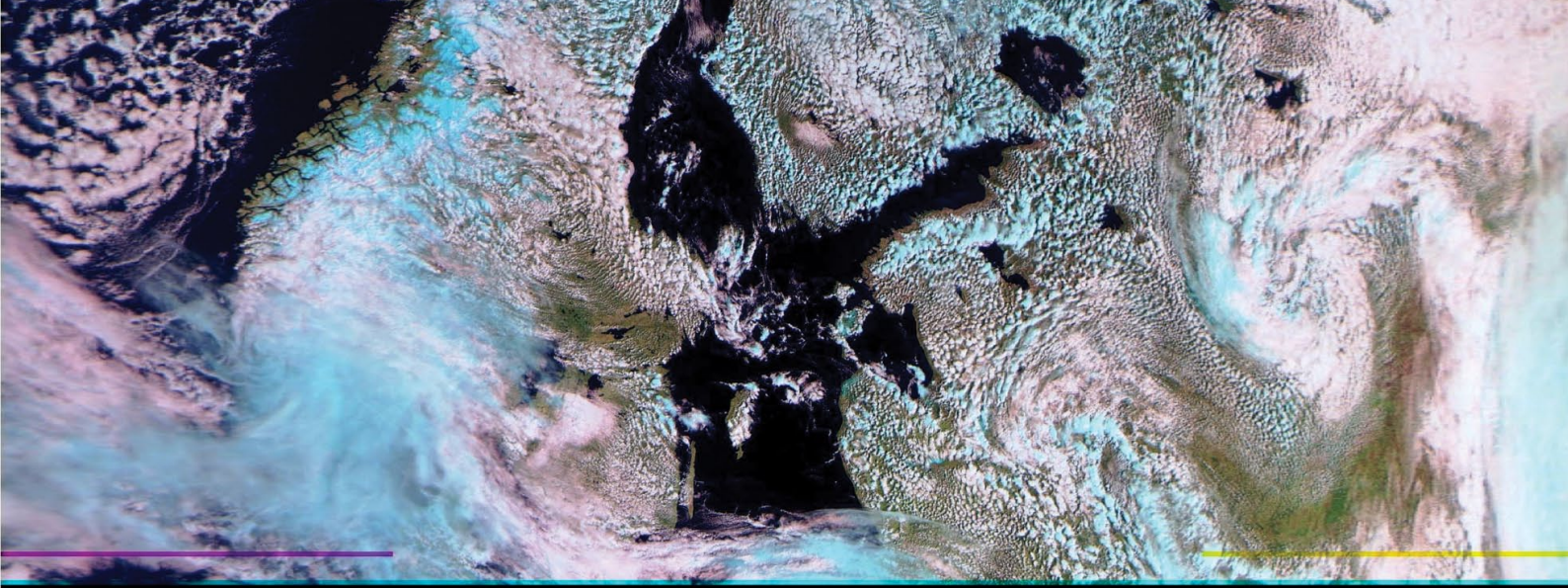
sea ice movements and concentrations. Researchers in Puerto Rico are working with night-time data to reduce light pollution and help protect tropical forests and coastal areas with fragile ecosystems. And a team at the United Nations has already used preliminary versions of Román's night lights data to monitor the effects of war on electric power, and the movement of displaced populations in war-torn Syria.

In a separate, long-term project, Román is working with colleagues from around the world to improve global and regional estimates of carbon dioxide emissions. The team at NASA's *Global Modelling and Assimilation Office* is combining night lights, urban land use data, and statistical and model projections of anthropogenic emissions, in ways that should make estimates of sources much more precise.

'Thanks to VIIRS, we can now monitor short-term changes caused by disturbances in power delivery, such as conflict, storms, earthquakes, and brownouts,' said Román. *'We can monitor cyclical changes driven by reoccurring human activities such as holiday lighting and seasonal migrations. We can also monitor gradual changes driven by urbanization, out-migration, economic changes, and electrification. The fact that we can track all these different aspects at the heart of what defines a city is simply mind-boggling.'*

To view and download the new images, and to read stories of night light science, visit our *Earth at Night* page at

<https://earthobservatory.nasa.gov/Features/NightLights/>



On May 10, 2017, Russia's Meteor M2 satellite underwent one of its infrequent decontamination periods when the infrared sensors are inactive. In place of the channel-5 infrared, the LRPT stream includes Channel-3 briefly allowing the user to create RGB123 images as shown here.
Image captured by Enrico Gobbetti at 08.42 UT

Currently Active Satellites and Frequencies

Polar APT/LRPT Satellites			
Satellite	Frequency	Status	Image Quality
NOAA 15	137.6200 MHz	On	Good
NOAA 18	137.9125 MHz	On	Good
NOAA 19	137.1000 MHz	On	Good ^[1]
Meteor M N1	137.0968 MHz	Off	Dead? ^[7]
Meteor M N2	137.1000 MHz	On	Good

Polar HRPT/AHRPT Satellites				
Satellite	Frequency	Mode	Format	Image Quality
NOAA 15	1702.5 MHz	Omni	HRPT	Weak
NOAA 18	1707.0 MHz	RHCP	HRPT	Good
NOAA 19	1698.0 MHz	RHCP	HRPT	Good
Feng Yun 1D	1700.4 MHz	RHCP	CHRPT	None: Device failure
Feng Yun 3A	1704.5 MHz	---	AHRPT	[2]
Feng Yun 3B	1704.5 MHz	---	AHRPT	[2]
Feng Yun 3C	1704.5 MHz	---	AHRPT	[2]
Metop A	1701.3 MHz	RHCP	AHRPT	Good
Metop B	1701.3 MHz	RHCP	AHRPT	Good
Meteor M N1	1700.00 MHz	RHCP	AHRPT	Dead? ^[7]
Meteor M N2	1700.0 MHz	RHCP	AHRPT	Good

Geostationary Satellites				
Satellite	Transmission Mode(s)		Position	Status
Meteosat 7	HRIT 1691 MHz / WEFAX 1691 MHz		57.5°E	On
Meteosat 8	HRIT (digital)	---	3.5°E	Standby ^[3]
Meteosat 9	HRIT (digital)	LRIT (digital)	9.5°E	On ^[4]
Meteosat 10	HRIT (digital)	LRIT (digital)	0°W	On
GOES-13 (E)	GVAR 1685.7 MHz	LRIT 1691.0 MHz	75°W	On ^[5]
GOES-14	GVAR 1685.7 MHz	LRIT 1691.0 MHz	105°W	Standby
GOES-15 (W)	GVAR 1685.7 MHz	LRIT 1691.0 MHz	135°W	On ^[5]
MTSAT-1R	HRIT 1687.1 MHz	LRIT 1691.0 MHz	140°E	Standby
MTSAT-2	HRIT 1687.1 MHz	LRIT 1691.0 MHz	145°E	On
Feng Yun 2D	SVISSR	LRIT	86.5°E	Off ^[6]
Feng Yun 2E	SVISSR	LRIT	104.0°E	On
Feng Yun 2F	SVISSR	LRIT	112.0°E	On
Feng Yun 2G	SVISSR	LRIT	86.5°E	On

Notes

- 1 LRPT Signals from Meteor M N2 may cause interference to NOAA 19 transmissions when the two footprints overlap.
- 2 These satellites employ a non-standard AHRPT format and cannot be received with conventional receiving equipment.
- 3 Meteosat operational backup satellite
- 4 Meteosat Rapid Scanning Service (RSS)
- 5 GOES 13 and GOES 15 also transmit EMWIN on 1692.70 MHz
- 6 There has been no imagery from Feng Yun 2D since June 30, 2015. Since Feng Yun 2G is operating from the same position (86.5°E), it is likely that FY-2D is now in standby as a backup satellite.
- 7 On March 20, 2016, Meteor M1 suffered a catastrophic attitude loss, frequently pointing its sensors towards the sun. The following day all signals ceased and it seems highly probable that this satellite is now incapable of imaging the Earth.

Internet Discussion Groups

There are a numerous Internet-based discussion groups of interest to weather satellite enthusiasts. The home page for each group provides an email address through which you can request membership. Even a blank email containing the word 'subscribe' in its Subject line is all that is required.

GEO-Subscribers

This is GEO's own group, where members can exchange information and post queries relating to any aspect related to weather satellite reception (hardware, software, antennas etc), Earth observation satellites and any GEO-related matter.

<https://groups.yahoo.com/neo/groups/GEO-Subscribers/info>

Satsignal

An end-user self-help group for users of David Taylor's Satellite Software Tools (SatSignal, WXtrack, GeoSatSignal, HRPT Reader, GroundMap, MSG Data Manager, AVHRR Manager and the ATOVS Reader).

<https://groups.yahoo.com/neo/groups/SatSignal/info>

MSG-1

A forum dedicated to Meteosat Second Generation (MSG), where members share information about the EUMETCast reception hardware and software.

<https://groups.yahoo.com/neo/groups/MSG-1/info>

Weather Satellite Reports

If there is a single Internet Forum that is relevant to all weather satellite enthusiasts, it must surely be Douglas Deans' Weather Satellite reports.

Here you will find every conceivable type of information about weather satellites, whether polar or geostationary, APT, HRPT, LRIT, or EUMETCast, updated every Monday.

You can read the bulletins from this URL

<https://groups.yahoo.com/neo/groups/weather-satellite-reports/info>

or, even better, elect to have the reports sent to you by email every Monday.

EUMETCast On-Line Registration Guide

If you require to register as a first-time user for any of the free EUMETCast data streams such as MSG, NOAA AVHRR, Metop etc., or need to renew an existing subscription, this must be done on-line.

GEO has produced a step-by-step guide to the entire process at

<http://www.geo-web.org.uk/eumreg.php>

This guide also contains a direct link to the official EUMETCast on-line registration form, which can otherwise prove somewhat tricky to locate.

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Original contributions relating to any aspect of Earth Imaging should be submitted in electronic format (although handwritten and typed copy will be accepted).

Please note that **major articles** which contain a large number of illustrations should be submitted **as early as possible before copy deadline**, to give time for preparation prior to publication.

Please note that it is preferred that satellite images are provided **without added grid lines, country outlines or captions** unless these are considered essential for illustrative purposes in an accompanying article.

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The most efficient way to do this is by **email attachments** to the following address

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GEO Helplines

Douglas Deans, Dunblane, Scotland.

All aspects of weather satellites from APT, HRPT to Meteosat-9 DVB/EUMETCast systems.

- telephone:(01786) 82 28 28
- e-mail: dsdeans@btinternet.com

John Tellick, Surrey, England.

Meteosat advice: registering for the various MSG services, hardware and software installation and troubleshooting. John will also field general queries about any aspect of receiving weather satellite transmissions.

- telephone: (0208) 390 3315
- e-mail: info@geo-web.org.uk

Geoff Morris, Flintshire, NE Wales.

Geoff has lots of experience with aerial, coax connectors, mounting hardware etc. and has also done a lot of work with the orbiting satellites. Geoff has been a EUMETCast Meteosat user for some time and is familiar with David Taylor's MSG software. He should be able to share his experiences with newcomers to this branch of the hobby.

- Tel: (01244) 818252
- e-mail: gw3atz@btopenworld.com

Guy Martin, Kent, England.

Guy is prepared to advise anyone who wishing to receive MSG/Metop using Windows 2000 or XP. Can also help with networking and ADSL router setup.

- gmartin@electroweb.co.uk

Hector Cintron, Puerto Rico, USA.

Hector is prepared to field enquiries on HRPT, APT, EMWIN and NOAAPORT

- Phone: 787-774-8657
- e-mail: n1tkk@hwic.net

Email contact can of course be made at any time, but we would ask you to respect privacy by restricting telephone contact to the period 7.00 - 9.00 pm in the evenings.

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- Frequency range: (*100) 700 kHz - 1864 MHz
- MCX Socket
- Active Crystal Oscillator
- Reinforced Socket

This stick does not come with SDR software or instructions.



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UK non-member's price - £29.50

UK members price - £20.00
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Edimax USB 2.0 Fast Ethernet Adapter	15.00	17.00	18.00	-----	-----	-----
DVB-S USB 2102 Receiver	60.60	67.00	-----	70.60	77.00	-----
SDR Dongle kit for APT/LRPT	20.00	25.00	26.00	-----	-----	-----
Technisat Satfinder Alignment Meter	26.50	29.50	-----	29.50	32.50	-----
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Inverto-Black-Ultra High-Performance LNBS



GEO currently recommends these LNBS for EUMETCast reception. We are currently **not stocking** this item but it is available at **Amazon**.

<http://www.amazon.co.uk/gp/product/B0010NAEKI/>

Twin LNB 40mm 0,2dB £15.50
Single satellite LNB £ 9.95

Edimax USB 2.0 Fast Ethernet Adapter



This adapter enables you to add a *second* network connection for your PC/Laptop, to connect to the Ayecka SR1 Traffic port, thereby relieving loading on the home network. Typically, you would assign this adapter with an IP address on the same network as the SR1 i.e 192.168.10.103. Data from the SR1 passes directly to the PC whilst its internet connection remains on your usual home network 192.168.1.xxx (Management Port).

UK members price - £15.00
UK non-members price - £17.00



