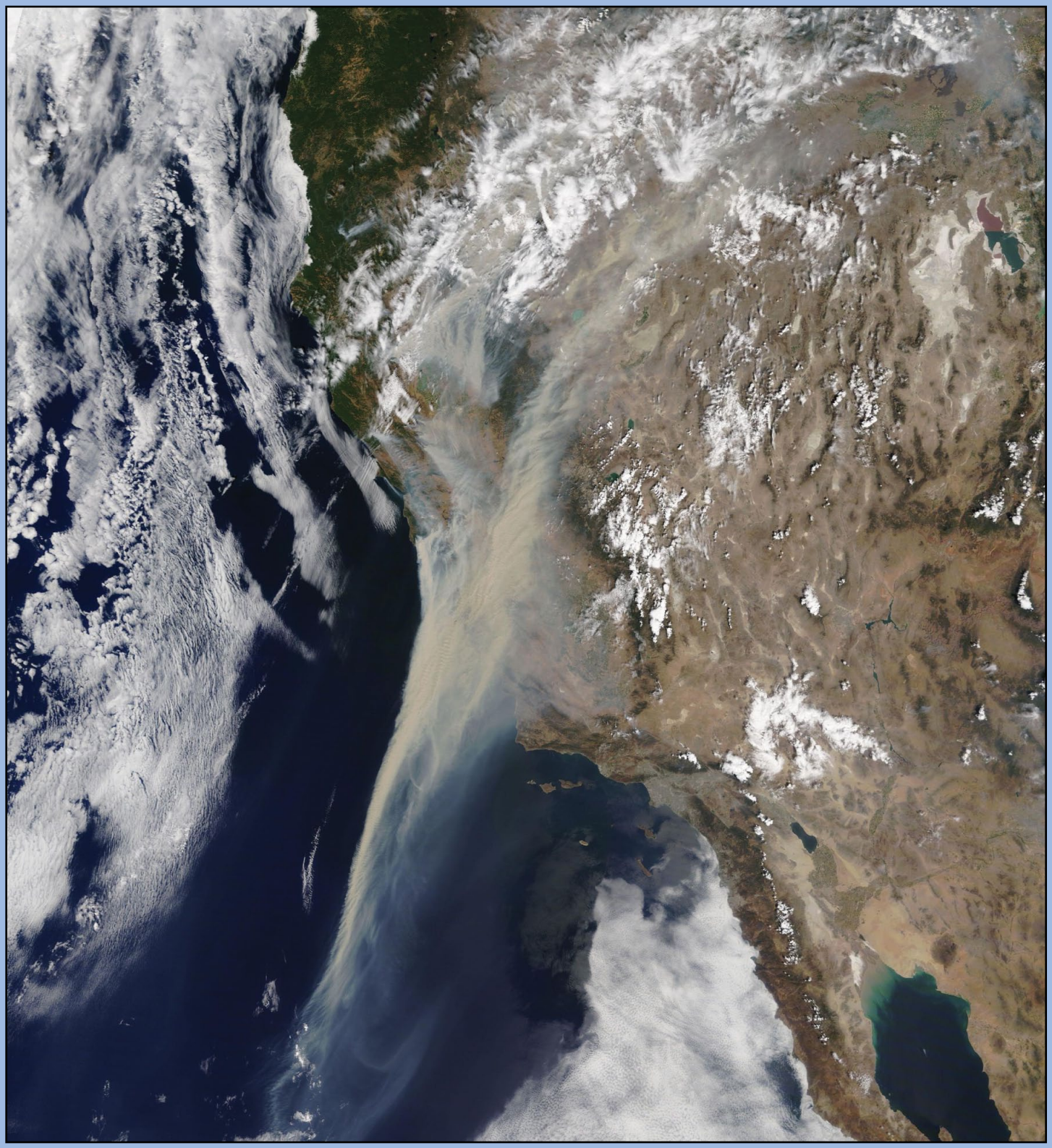
GEO Newsletter

Group for Earth Observation

Group for Earth Observation

No 67 - September 2020



As wildfires rage across northern California, enormous smoke plumes are smothering cities and towns in the San Joaquin Valley and San Francisco Bay area. On August 19, 2020, the Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Terra satellite captured this natural-color image just before noon.

Image © NASA Worldview Snapshots

Useful User Groups

Weather Satellite Reports

This group provided weekly reports, updates and news on the operational aspects of weather satellites.

https://groups.io/g/weather-satellite-reports

SatSignal

This end-user self help group is for users of David Taylor's Satellite Software Tools, including the orbit predictor WXtrack, the file decoders GeoSatSignal and SatSignal, the HRPT Reader program, the remapper GroundMap, and the manager programs - MSG Data Manager, GOES-ABI Manager, AVHRR Manager etc.

https://groups.io/g/SatSignal

MSG-1

This forum provides a dedicated area for sharing information about hardware and software for receiving and processing EUMETCast data.

https://groups.io/g/MSG-1

GEO-Subscribers

This is the official group is for subscribers of the Group for Earth Observation (GEO), aimed at enthusiasts wishing to exchange information relating to either GEO or Earth Observation satellites.

https://groups.io/g/GEO-Subscribers/

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http://www.facebook.com/groupforearthobservation

From the Editor

Les Hamilton

As if the world did not have enough troubles with the Covid-19 pandemic, record forest fires in California and Siberia, a highly active Atlantic hurricane season with a record 13 tropical storms developing before the start of September, drought in Brazil and record melting in the Arctic have all hit the headlines this past quarter. Several of the articles in this issue relate to these events

Ed Murashie highlights California's *Lightning Siege* fire, and explains how satellite data can be used to track the incidence of wildfires. Ed has also promised a follow-up article for the December issue in which he will describe his receiving station.

We also have a follow-up article from Neil Lonie describing progress in setting up the new Dundee Satellite Station at Errol Airfield. The project has already raised over £17,000 on their *GoFundMe* page at

https://www.gofundme.com/f/dundee-satellite-receiving-station

Many GEO Newsletter readers have already contributed to this venture, but more funds are still required to guarantee the project comes to fulfillment.

You can keep in touch with progress on the DSS Team's Twitter feed at

@DundeeSat

Contents

The GEO Report

Francis Bell

Because of the ongoing pandemic of Covid-19 virus, there have, quite understandably, been no meetings involving GEO. I am particularly disappointed that, for a second time, our planned visit to Darmstadt had to be cancelled. Who know what next year will have to offer?

However, an important event since the previous publication of our Quarterly Newsletter has been the retirement of Alan Banks as our webmaster. It was many years ago that Alan took over the management of our website and without a doubt transformed it to its present day slick informative easy to use format. Our website is important as a high profile point of contact, not just for GEO members, but for anyone scanning the Internet. Alan has retired to give himself more time for his increasing personal and family commitments. I wish to record our sincere thanks to Alan and I hope he remains in contact with GEO during the years to come.

A New Webmaster

This is a specific request to anyone with the necessary technical skills and commitment to GEO to consider taking over the roll of webmaster for us. Please consider this invitation and, if you are in any way willing to contribute to this webmaster rôle, then get in touch with me or some other member of the GEO Management Team as soon as is reasonably possible. Over to you.

Accounts

There has been little change in our accounts since the last Newsletter. We have approximately £8,390 in the bank, with any stock or old equipment we may own have been written off in value. Currently one outgoing we have is the £16 monthly charge for the Website which, incidentally, I think needs analysis because it seems too much to pay. The other regular cost we face is £13 a year for Company House renewal.

The Dundee Satellite Project

Regular readers may remember the brief reports we have published relating to the long established satellite project based at Dundee University. Unfortunately this project had its government funding withdrawn about a year ago but the team at Dundee decided to independently run the project at Errol, just a few miles from the university site. GEO, being supportive of earth observation contributed some funds to the new project, hence our interest in following its progress.

I understand that, over the past few months, and in spite of one of the team contracting the Covid-19 virus, progress has been made in establishing working equipment at the new Errol site and in due course we hope to see some of the images they receive. GEO certainly wishes success to the new receiving station and congratulates the team involved in this project.

Quarterly ? Question

Quarterly Question 66

My thanks to those members who submitted their answers to the last Quarterly Question. The question related to that point on the Earth's surface which is furthest distant from any land. This point is known as Point Nemo (perhaps with other names) and is of particular interest to the space industry because it represents an area of the planet's surface where space debris can be dumped in the sea with a reduced chance of hitting land causing local damage if the re-entry is not perfectly positioned.

The approximate position of Point Nemo is 48°S, 123°W, or in more general terms it is located in the south Pacific approximately midway between Easter Island and New Zealand. For more information about Point Nemo you could try looking it up on Wikipedia, which is what I did. The name Nemo comes from the Latin and translates as 'No One'.

Quarterly Question 67

I was drawn to this question by a very recently published image by ESA which shows an island which is cloud free (figure 1, next page). I have seen images of this island before but never completely cloud free. The Quarterly Question is very straightforward: "Name the island shown in the satellite image".

Because I think the question might be easy I am not giving any clues relating to the scale of the image or its approximate location. However, below is some brief text, which I have edited, which was attached to the published image. This gives a few reference names if your need them.

Here is the text which accompanied the image shown in figure 1.

"The white, circular patch in the centre of the country is Hofsjökull, the country's third largest glacier and its largest active volcano. The elongated white area west of Hofsjökull is Langjökull, the island's second largest ice cap.

"The capital and largest city of the island, is located on the Seltjarnarnes Peninsula, in southwest of the island. In the top-left of the image, several sea ice swirls can be seen off the coast of a local land mass."

Part Two

This part of the Quarterly question is not connected in any way with space or satellite imaging but relates more to political strategy and national defence.

The country of Costa Rica is located in Central America with coastlines on the Caribbean and the Pacific Ocean: I have had the good fortune to visit Costa Rica, which is perhaps why I know about this rather obscure aspect of their current national policy. I have not checked in fine detail but I think Costa Rica and the island shown in figure 1 have approximately the same surface area.

The second part to this Quarterly Question is: "What rather unusual national defence strategy do these two countries have in common?"

Just for interest, a *BlueMarble* satellite image of Costa Rica is shown in Figure 2.

Please send you two answers to Francis Bell at the email address

francis@francisbell.com

by November 28, 2020.

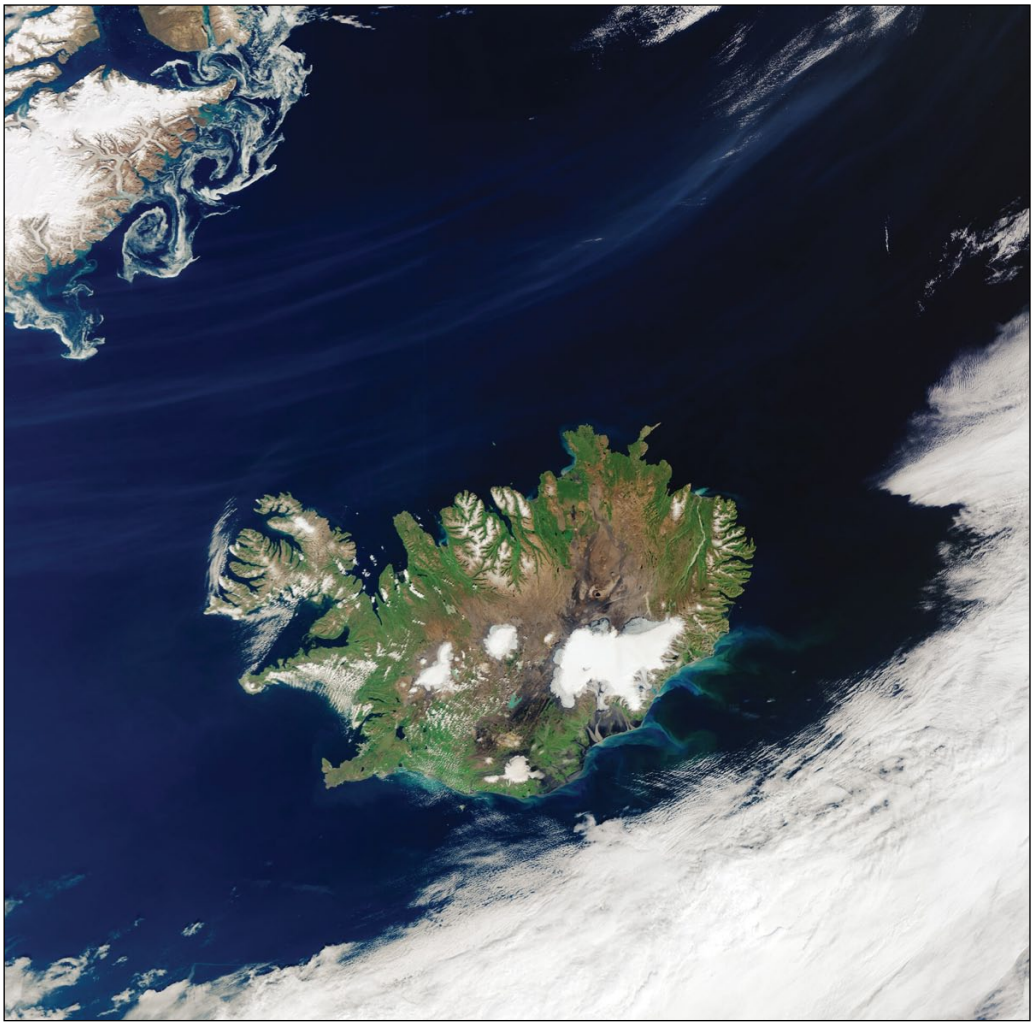
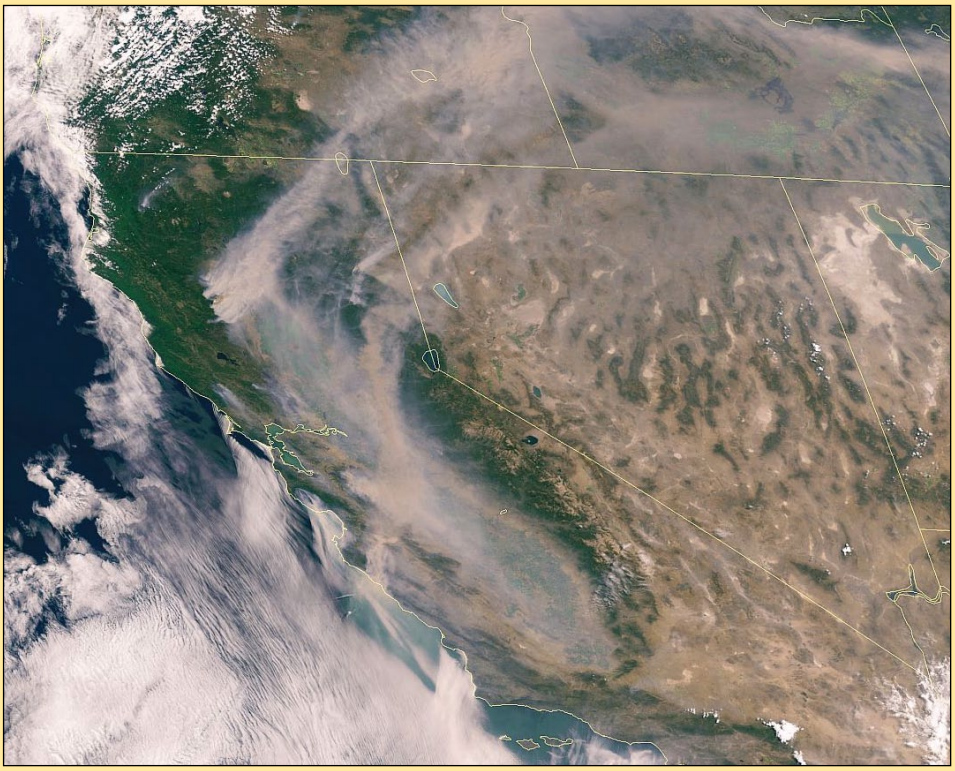


Figure 1
Can you identify this cloud-free island?
Image © ESA

Figure 2
Costa Rica
Public domain satellite imagery taken by screenshot from NASA World Wind software / Wikimedia

California on Fire

Ed Murashie



August Lightning Siege of 2020 [1] is the ominous name that *CAL Fire* has given this August's unprecedented number of fires in California. *CAL Fire* is the nickname given to The Department of Forestry and Fire Protection that protects over 32 million acres of California's privately-owned wildlands and also provides services in 36 of the State's counties.

Much of it started on August 17, when over 10,000 lightning strikes were recorded in a 72 hour period over Northern California, igniting hundreds of fires burning over a million acres. But that is just part of the story because there have been other fires up and down the state that were started by human actions ranging from car accidents to being intentionally set. The worst high pressure dome in ten years over Arizona started a long heatwave lasting weeks with many temperature records being set. In Southern California we had rolling blackouts that we had not seen in nineteen years. The high pressure was in the perfect location to pump up moisture from Mexico and Hurricane Elida which traveled up the coast of Baja. This combination of heat and moisture was the perfect recipe for thunderstorms and lightning in Southern California.

One of the best sources to track the fires besides the news channels are the Geostationary GOES-17 (GOES-EAST) and polar satellites; each have their own advantages. The geostationary satellite's advantage is being able to animate its imagery and the GOES Re-Broadcast (GRB) transmission provides the best geostationary resolution to do so. Sixteen wavelengths [2] in full disk, CONUS (Continental United States) and mesoscale formats are available. Mesoscale images, like the one reproduced above, are small sections of a CONUS image that scientists/forecasters use to study local phenomena because they are transmitted every minute as opposed to CONUS every five minutes and full-disk every ten minutes.

Lately NOAA has been using one of two mesoscale channels, channel-2, to image the State of California and the wildfires. Combining imager channels 1-3 makes for a false color image during the day and channel-7 thermal infrared provides the best nighttime imagery with black dots representing each fire.

A 1080 line MP4 animation created on Aug 21 between 8:30 am and 10:30 pm can be viewed online [3]. The images were received from GOES-17, on the author's GRB station using a 2 meter dish, and the animation was created using *IrfanView*, *Microsoft Photos* and *Shotcut video editor*. IrfanView batch processing was used to scale the 2000 pixel by 2000 line false color images and the 500 pixel by 500 line infrared images to create 1920 pixel by 1080 line images. These were sharpened and the contrast and brightness were optimized. Next the images were loaded into *Photos*, the transition delay of each image was set to 0.05 seconds and the MP4 created. Finally the video was loaded into *Shotcut* to add the transition from day to night and the video was speeded up 1.5 times to shorten play time.

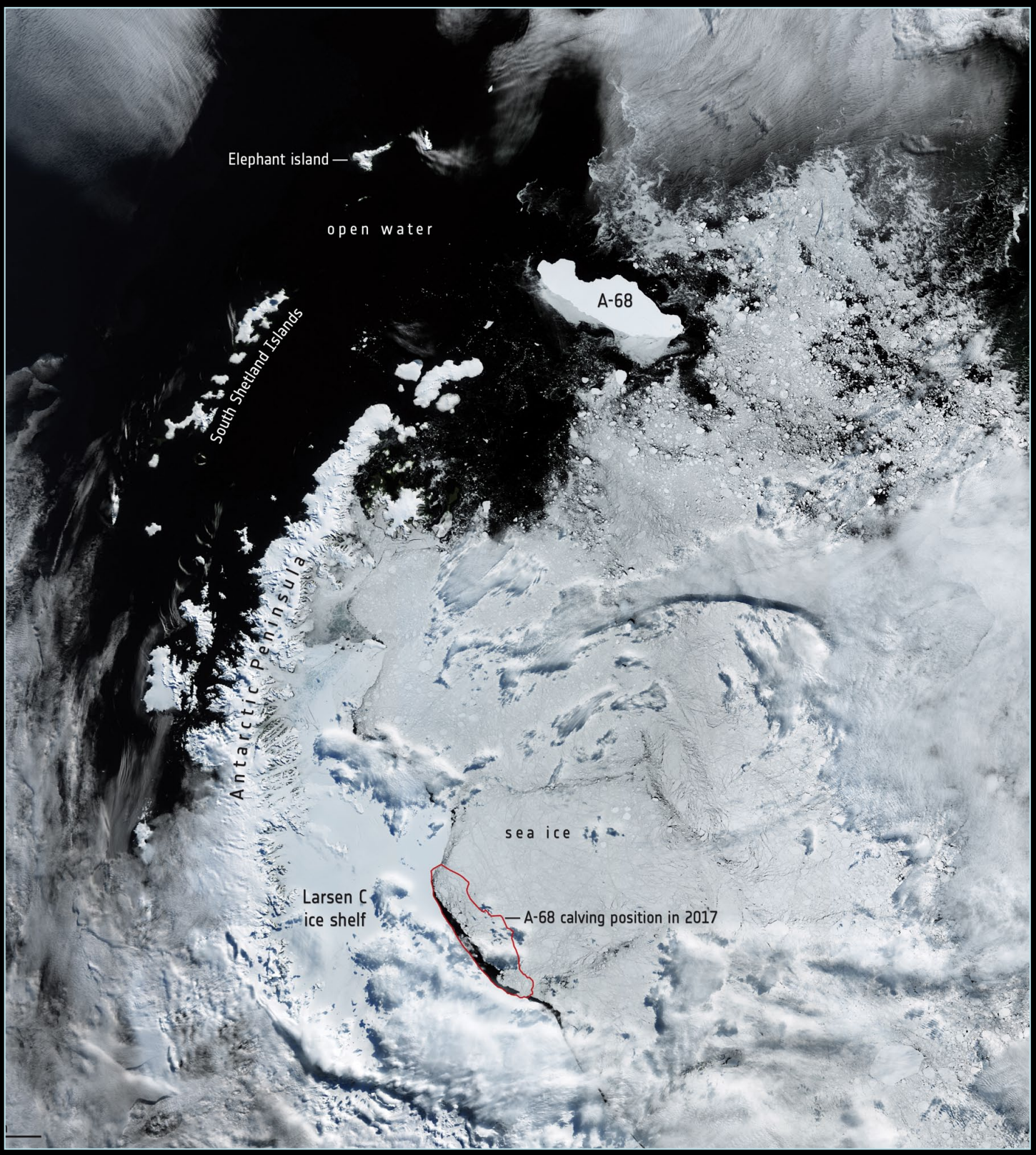
Because of the reduced channel-7 GRB resolution of 4 km, polar satellite HRPT transmissions can offer better thermal infrared image resolution up to 1.1 km. Channel-3 from the Metop and NOAA satellites provide the best wavelengths for fire detection. A Metop-C pass was received on August 21 and the channel-3 image can be found at the same website as the animation. It was received on the author's station using a 39" modified WiFi dish, *AirSpy Mini Software Defined Radio* (SDR) and UHF-Satcom's *xHRPT* program. More on the station in a future article.

References

1. https://www.fire.ca.gov/incidents/
2. https://www.goes-r.gov/mission/ABI-bands-quick-info.html
3. https://www.dropbox.com/sh/1mn41avpdiskljf/AAAK1h5Z565c6V6P0M5KZyala?dl=0

Iceberg A68A

European Space Agency



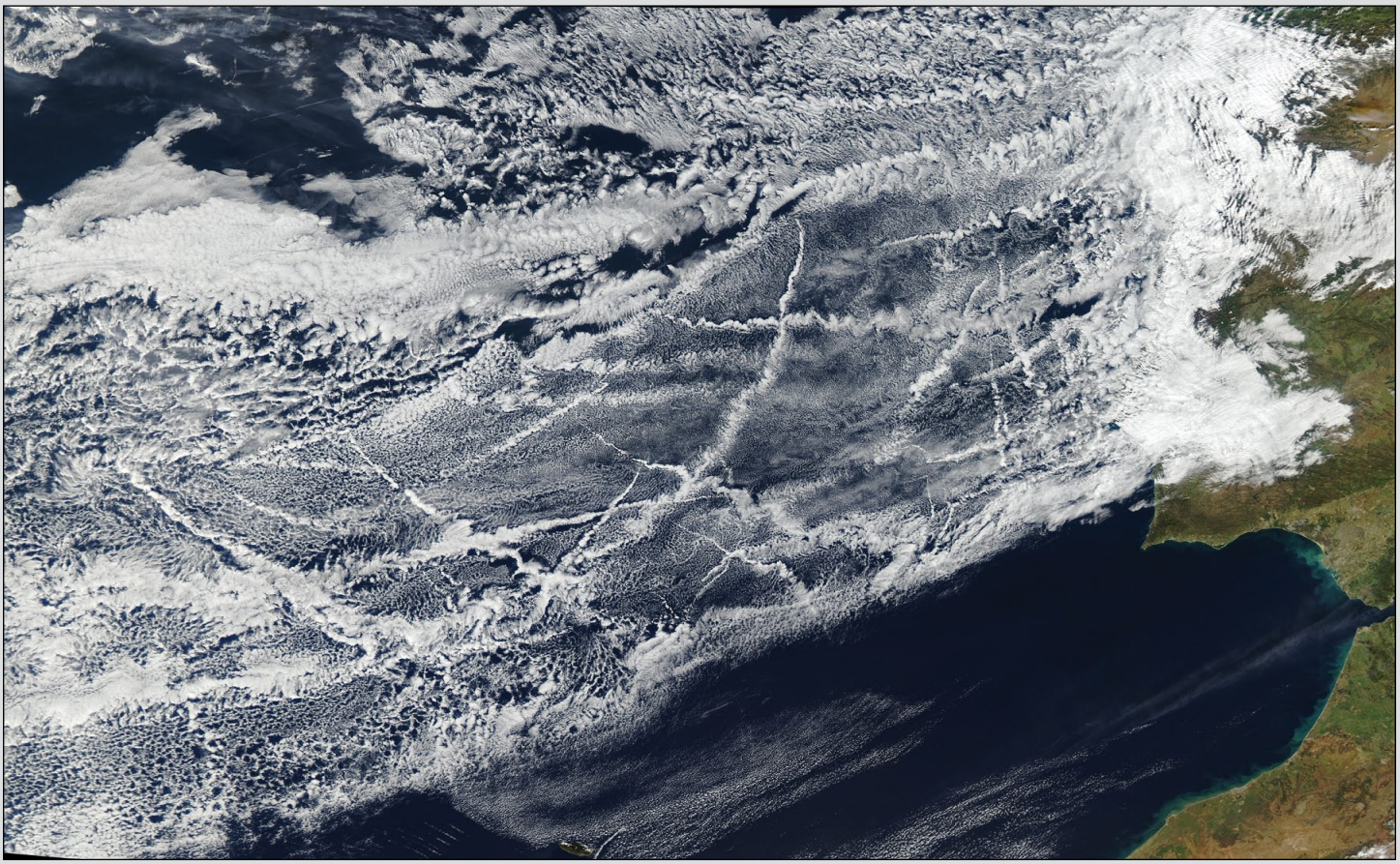
A huge iceberg called A68 calved from the Antarctic Peninsula's Larsen C ice shelf on 12 July 2017.
This image, which was captured by the Copernicus Sentinel-3 mission, shows its position on 9 February 2020.

The berg is now known as A-68A after losing two chunks of ice: A-68B and A-68C. Antarctic icebergs are named from the Antarctic quadrant in which they were originally sighted, then a sequential number, then, if the iceberg breaks, a sequential letter.

Image contains modified Copernicus Sentinel data (2020), processed by ESA, CC BY-SA 3.0 IGO

Cloud Changes in Busy Ship Corridors

NASA Earth Observatory
Story by Kasha Patel



Ship tracks over the south Atlantic Ocean on January 18, 2018, observed by NASA's Aqua satellite
MODIS image by Jeff Schmaltz, LANCE/EOSDIS Rapid Response.

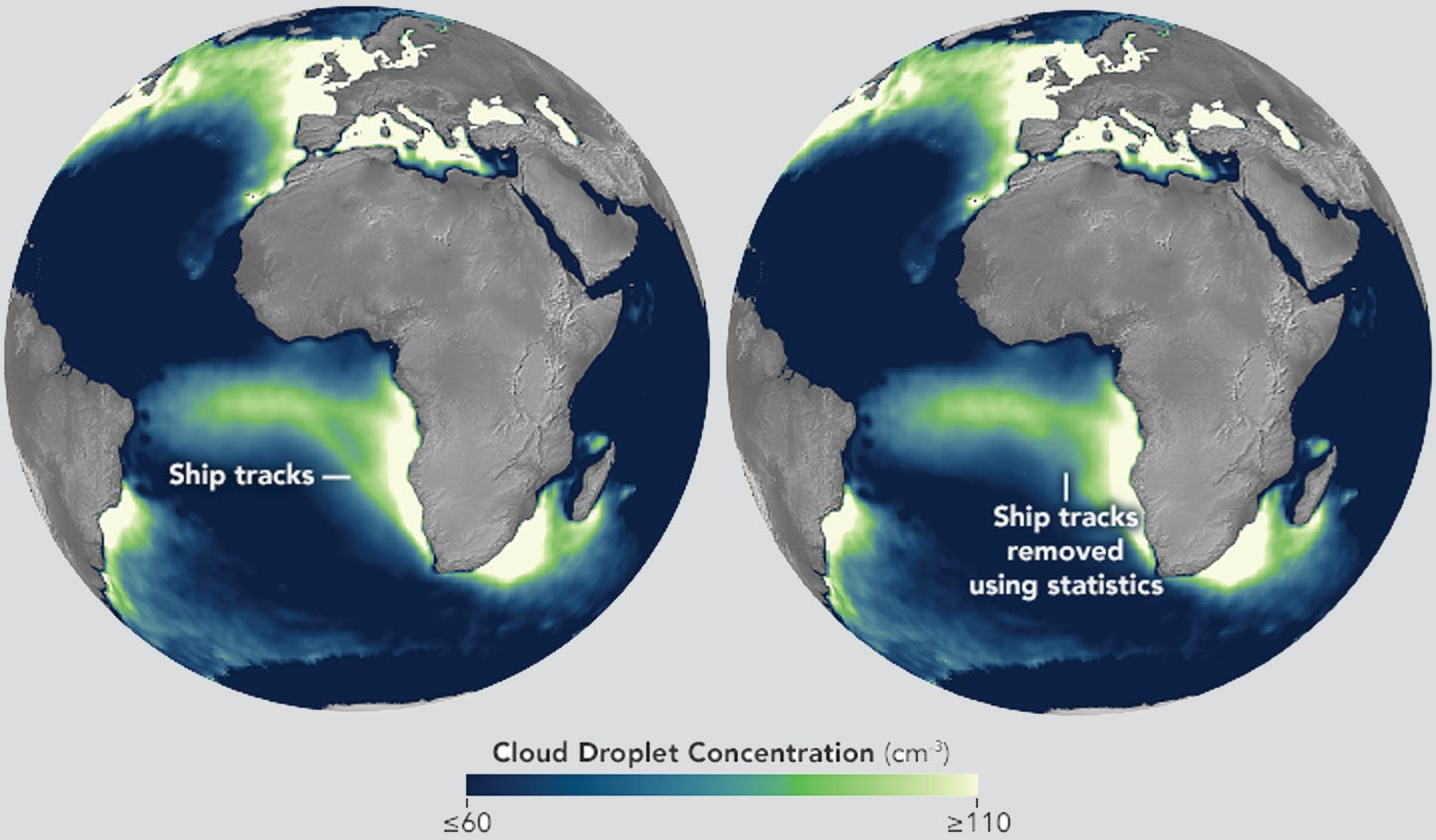
As ships cruise across the ocean, they emit a large number of small airborne particles—aerosols—into the lower atmosphere. Under the right conditions, these exhaust particles cause long, thin cloud patterns referred to as 'ship tracks'. For decades, scientists have theorised that these cloud changes might alter climate by affecting the quantity of sunlight reaching Earth's surface.

Now, for the first time, researchers have measured exactly how ship emissions affect clouds at a regional scale. University of Washington scientist Michael Diamond and colleagues examined more than a decade of cloud patterns over a busy shipping lane in the southeast Atlantic that connects Europe to southern Africa and Asia.

The team measured the cloud properties inside the shipping corridor using satellite data and compared them to what they estimated the values would be without shipping activity. The scientists found that the shipping activity increased the number of cloud droplets over the shipping lane. They further showed that those clouds prevented about 2 watts of solar energy from reaching each square metre of ocean surface along the shipping lane. The team's results agreed with previous computer modelling studies that predicted a sizeable cooling effect due to shipping.

> "*If you look at a satellite image of a high-traffic shipping area, when the weather conditions are right, you can clearly see bright lines of clouds right along where those ships are travelling and emitting aerosols*," stated Diamond, an atmospheric scientist. "*Ship tracks are a prime example of how tiny particles of pollution in the atmosphere can influence cloud properties. The clearly visible ship tracks are only the tip of the iceberg, however, so our study looked at how shipping could affect cloud properties on average over a long time period.*"

The natural-colour image above shows an example of ship tracks over the southeast Atlantic Ocean as observed on January 18, 2018, by the Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's *Aqua* satellite. The maps overleaf show the average cloud droplet concentrations from 2003 to 2015 during the cloudiest months for the region (September, October, and November).



NASA Earth Observatory image by Lauren Dauphin, using data from Diamond, Michael, et al. (2020).

The map on the left shows the cloud droplet concentrations observed by MODIS on NASA's Aqua and Terra satellites. The map on the right shows the expected cloud droplet concentrations without shipping activity. The expected values were calculated based on statistical patterns from nearby, unpolluted areas. The team then calculated the difference in the amount of sunlight reflected back into space between the two scenarios. The team used data from NASA's Clouds and the Earth's Radiant Energy System (CERES) instruments, which monitor the solar energy reflected by Earth and the heat energy emitted by the planet.

Diamond explained that the aerosols from the ships create 'seeds' in the atmosphere that water vapour can latch on to and condense into small cloud droplets. These smaller droplets make clouds brighter so that they reflect more sunlight, which creates a local cooling effect at the planet's surface.

That change is small on a regional scale, but it could be enough to affect global temperatures if the same phenomenon occurs worldwide, according to study co-author Hannah Director of the University of Washington. When the team scaled their findings across the planet, they found that changes in low-lying clouds from all industrial pollution sources could block about one watt of energy per square meter globally. For context, greenhouse gases from industrial activities have trapped roughly 3 watts per square meter so far.

"*Cloud changes caused by industrial pollution have produced a global cooling effect that is about one-third as strong as the warming from increased greenhouse gases*," said Diamond.

Diamond explains that even though these ship emissions have a short-term cooling effect, they create other issues. Pollutants from ship exhaust have detrimental effects on human health, while also adding carbon dioxide to the atmosphere.

The algorithms developed for this study could be applied to study other anthropogenic sources of pollution around the world. "*We can use a similar methodology to determine the effects of other human sources of aerosols like power plants*," said Diamond. "*We could model the world with and without various human activities and better understand our impact on Earth's climate*."

Progress update for the

Dundee Satellite Station (DSS) Ltd Groundstation

Neil Lonie

Figure 1 - The current situation at the Errol groundstation

As reported in the March 2020 issue of *GEO Newsletter*, following closure of the University of Dundee Satellite Receiving Station in 2019 some of its former staff rescued the antennas and equipment which would otherwise have been disposed of. They formed *Dundee Satellite Station Ltd* with the intention to relocate the ground station to a new site where it could operate on a commercial basis.

At the time of our March report, planning permission had just been granted by Perth & Kinross Council to establish the facility at the former RAF Errol Airfield, approximately 8 miles west of Dundee, and the DSS team was looking forward to starting construction of the new station. Alas, COVID 19 and the resulting lockdown intervened, forcing a delay of around three months. However, the lockdown period was not wasted as we were able to work on detailed site designs plans, identify contractors to assist with construction and continue discussions with potential customers, research partners and funders etc. An anti-vandal modular building was also built to order and installed at the airfield in late May to provide the on-site operations/maintenance room that will host all antenna-related and other operational equipment.

On-site activities finally began in early June and so far have included complete electrical wiring of the operations room with distribution board, surge protection and circuits for equipment/UPS, air conditioning, internal/external 13 amp outlets, lighting and security lighting etc. as well as IT network cabling.

An underground power cable has been installed, requiring excavation of a 100 metre long trench, to deliver a 100 amp 3-phase supply from the nearby substation/industrial units. Cable routes (trunking and trays) have been constructed for all internal equipment and network cables, and for external routes to our first two antennas. The electrical installation also includes provision for adding a generator later to allow automatic fail-over in the event of mains supply interruptions. Temporary site security fencing has been erected but will be replaced by a permanent fence in due course, while a mains water feed has also been installed.

A pair of concrete and structural steel beam bases have been constructed with subsequent mounting of the first two tracking antenna pedestals on them. Currently we are working through servicing and refurbishing these antennas and anticipate that they will be ready for testing towards the end of September with the aim of being available to support the first customer before the year end.

Figure 2 - The repainted and refurbished 3.7 metre antenna

The initial focus of the venture is providing support for small-satellite operations as this is essential for the station to be financially viable. However, we also plan to test EO data reception capability and publish sample images during the next 2-3 months.

The intention is that EO data services and research project support will be part of regular operations after the second phase of antenna installations is complete, and data distribution facilities such as a website have been established. At present, these antennas are expected to be installed early in 2021.

The ***Gofundme*** campaign to assist with set up of the Errol station is still active and has raised over £17,000 so far, while the very generous donation of GEO is also available towards the cost of establishing EO data capabilities, for which we remain extremely grateful.

Figure 1 (previous page) shows the current situation with construction of the ground station. Two antenna pedestals are in place, a 2.4 m antenna with reflector is already mounted (foreground) and a 3.7 m antenna pedestal just prior to its reflector being mounted is in the background

The Parched Paraná River

NASA Earth Observatory
Story by Adam Voiland

A prolonged period of unusually warm weather and drought in southern Brazil, Paraguay, and northern Argentina has dropped the Paraná River to its lowest water levels in decades. The parched river basin has hampered shipping and contributed to an increase in fire activity in the delta and floodplain.

On July 3, 2020, the Operational Land Imager (OLI) on Landsat 8 captured figure 1, a false-colour image (bands 7-6-4) of the river near Rosario, a key port city in Argentina. The combination of shortwave infrared and visible light makes it easier to distinguish between land and water. Water appears dark blue or black. Figure 2 shows the same area on July 1, 2019, on a day when water levels were high across many of the delta's marshes, lagoons, islands, and meandering streams.

Data from the Argentine coastguard shows that, on July 3, 2020, river gauges near Rosario stood at one metre higher than in May 2020, when it dipped as low as 0.08 metre. "*While this low water level was the worst in the past 49 years, much lower levels were frequent before the 1970s,*" explained Andrés Antico, a climatologist with Argentina's *National Scientific and Technical Research Council* who is working on a project to recover and preserve historical records for the Paraná River. Thanks to dams constructed in the 1970s in the upper Paraná in southern Brazil, water managers can usually prevent low water levels by releasing water from reservoirs during dry periods.

The drought has affected the region since early 2020. The low water levels have grounded several ships and many vessels have had to reduce their cargo in order to navigate the river. With Rosario serving as the distribution hub for much of Argentina's soy and other farm exports, low water levels have caused hundreds of millions of dollars in losses for the grain sector, according to news reports.

Figure 1 - Landsat 8 image captured on July 3, 2020
Image: NASA

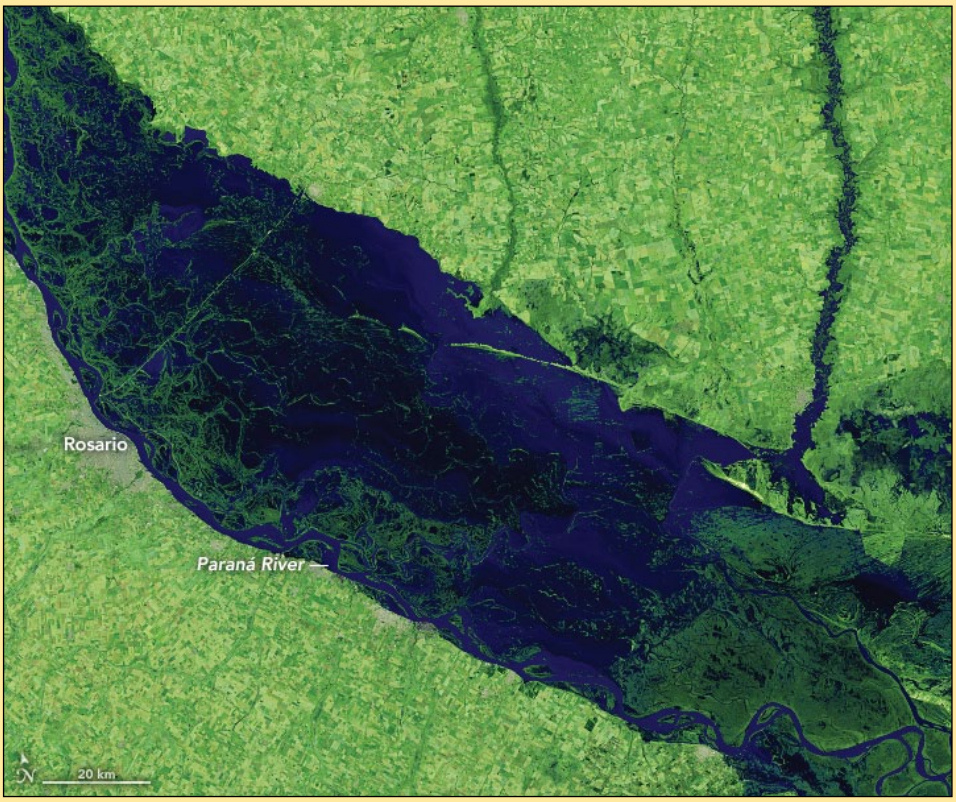


Figure 2 - Landsat 8 image captured on July 1, 2019
Image: NASA

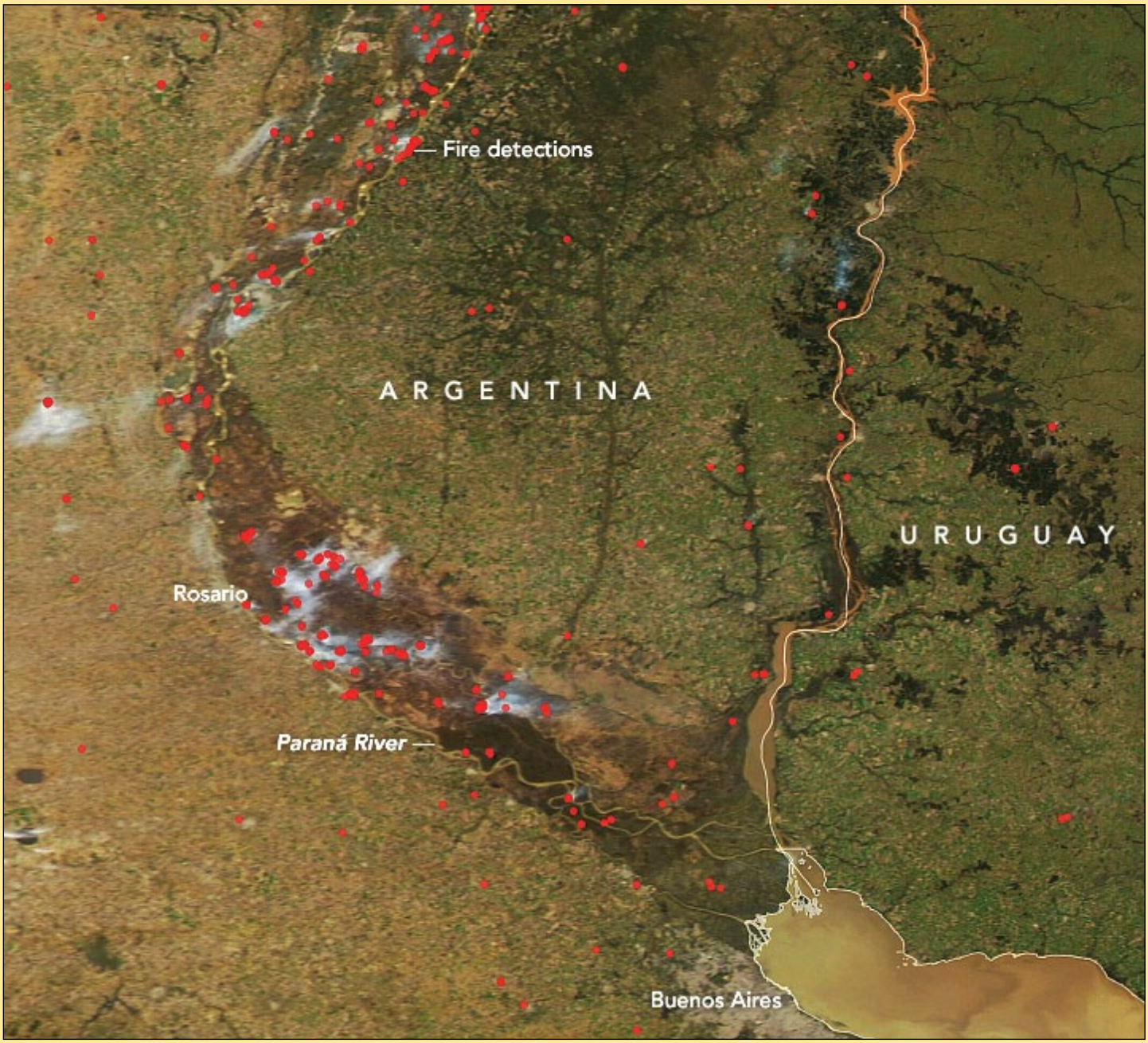


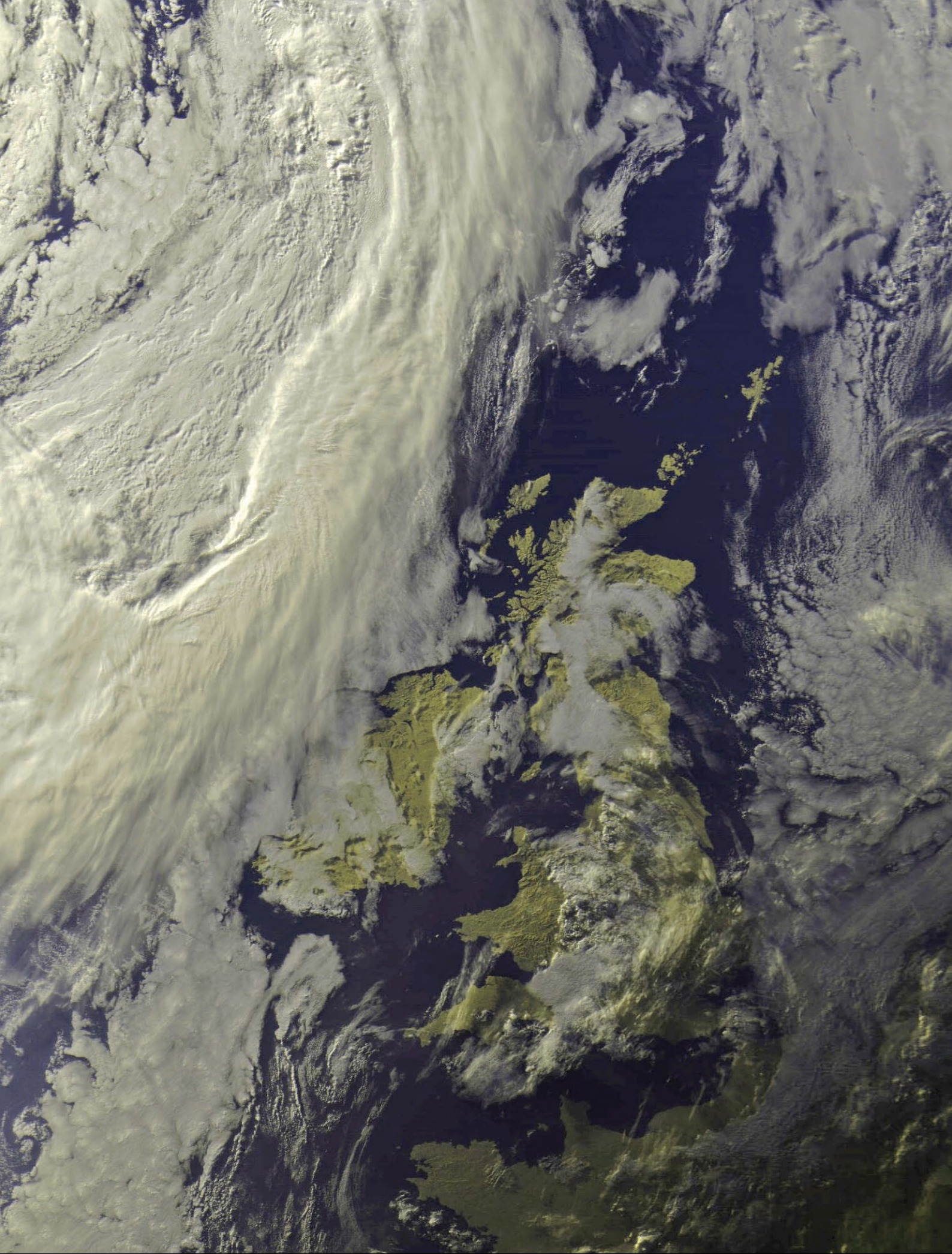
Figure 2
This natural-colour MODIS image, dating from July 14, 2020, is overlain with hotspots detected by NPP VIIRS.
Image: NASA

The low water levels on the Paraná River have coincided with increased fire activity within the delta. Remote sensing scientists at the *Universidad Nacional de San Martín* have been tracking how many active fire detections the Visible Infrared Imaging Radiometer Suite (VIIRS) and Moderate Resolution Imaging Spectroradiometer (MODIS) satellite sensors have made in recent months, finding that MODIS had in 2020 detected more than 1,450 hotspots in the Paraná River delta through July 22, more than any other year since 2008. The natural-colour image in figure 3, acquired by MODIS, shows where the VIIRS sensor detected unusually warm temperatures associated with fires on July 14, 2020.

Low water levels mean there is more area—mostly grassland and shrubs—available to burn this year. According to Patricia Kandus of the *Universidad Nacional de San Martín*, many fires appeared to have been set intentionally, though dry conditions have also made it easier for fires to escape and burn uncontrolled. "*Fires have been historically used in this region to provide pasture*," she said. "T*hey are also widely used in the islands to hunt wild animals, as well as to clear vegetation cover to carry out land reclamation and diking constructions for agriculture and tree planting projects.*"

While the Paraná River Basin received some rain in June and July, river watchers do not expect the river to make a full recovery until sustained wet season rains arrive in October.

NASA Earth Observatory images by Lauren Dauphin, using Landsat data from the U.S. Geological Survey, VIIRS data from NASA EOSDIS/LANCE and GIBS/Worldview and the Suomi National Polar-orbiting Partnership, and MODIS data from NASA EOSDIS/LANCE and GIBS/Worldview.



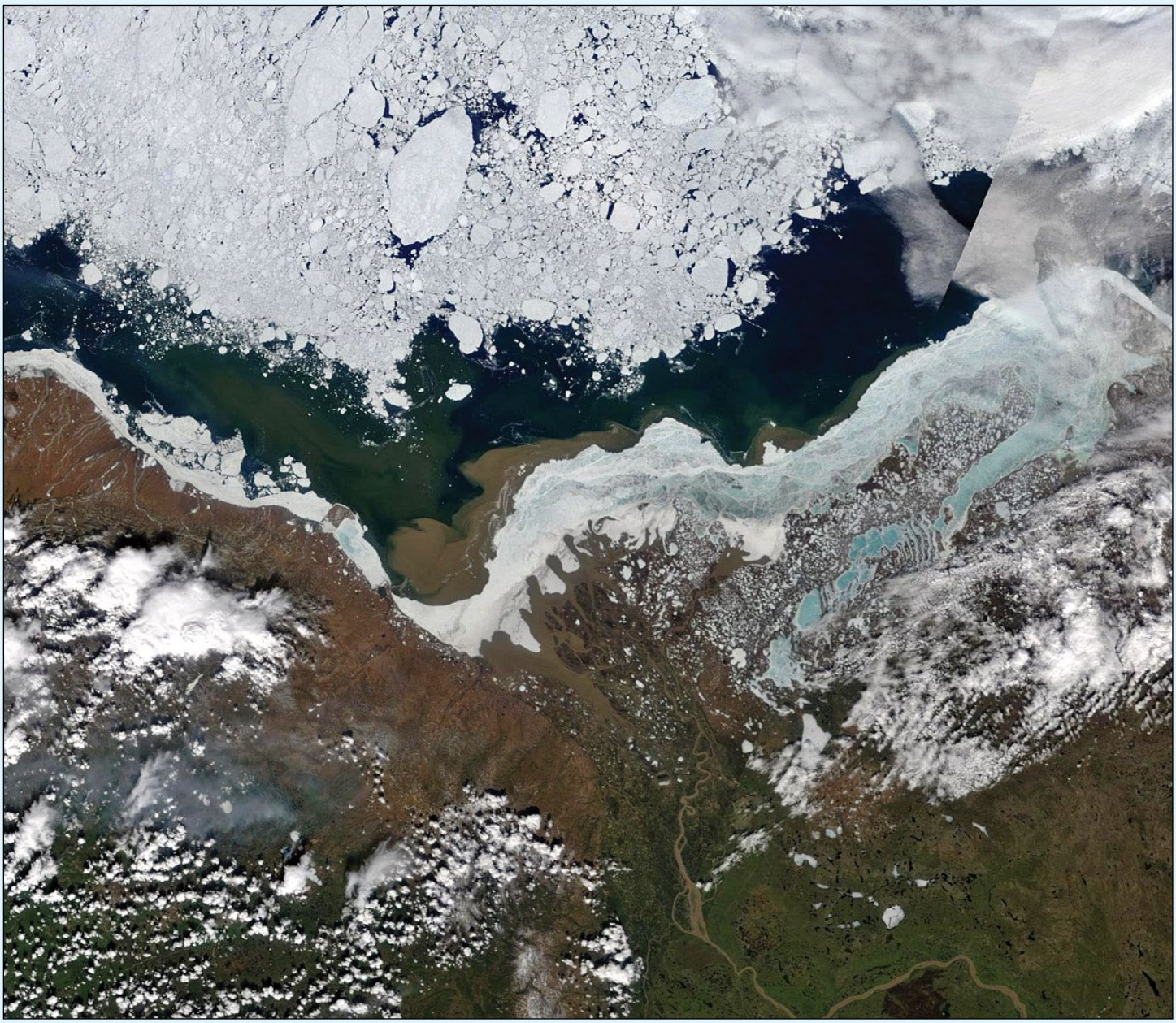
Barry Smith captured this evocative Meteor M2 RGB22 image showing the British Isles from Darwen, Lancashire on June 8, 2002.

In the early morning of August 5, 2020, with the landscape well lit by moonlight, the Visible Infrared Imaging Radiometer Suite (VIIRS) on the NOAA-NASA Suomi NPP satellite obtained a clear view of Western Europe and its lights through the use of the VIIRS day-night band. This band detects light in a range of wavelengths from green to near-infrared and uses filtering techniques to observe signals such as city lights, wildfires, airglow, and reflected moonlight.

NASA Earth Observatory image by Joshua Stevens, using VIIRS day-night band data from the Suomi NPP

Mackenzie Bay

MODIS-Web Image of the Day



Mackenzie Bay, imaged by NASA's Terra satellite on June 11, 2020.

Mackenzie Bay sits in the Canadian Arctic, close to the border of Yukon Territory, Canada. Each winter, a thick coating of ice solidifies over the Bay while deep snow coats the landscape. As temperatures rise in spring, the Mackenzie River, which flows from the warmer south into Mackenzie Bay, swells with meltwater. As it flows towards the Bay, the rushing of warmer meltwater aids in breaking up the ice clinging to the river and aids in spurring sea ice retraction from the shoreline. Spring melt also fills the river with sediment, which is carried to, and dumped into, the chilly waters of Mackenzie Bay. Eventually, increasing temperatures of spring and the flow of warmer fresh water prevail over the layer of sea ice, and by summer the river flows freely into Mackenzie Bay and from there into the Beaufort Sea.

On June 11, 2020, the Moderate Resolution Imaging Spectroradiometer (MODIS) on board NASA's *Terra* satellite acquired this true-colour image of Mackenzie Bay.

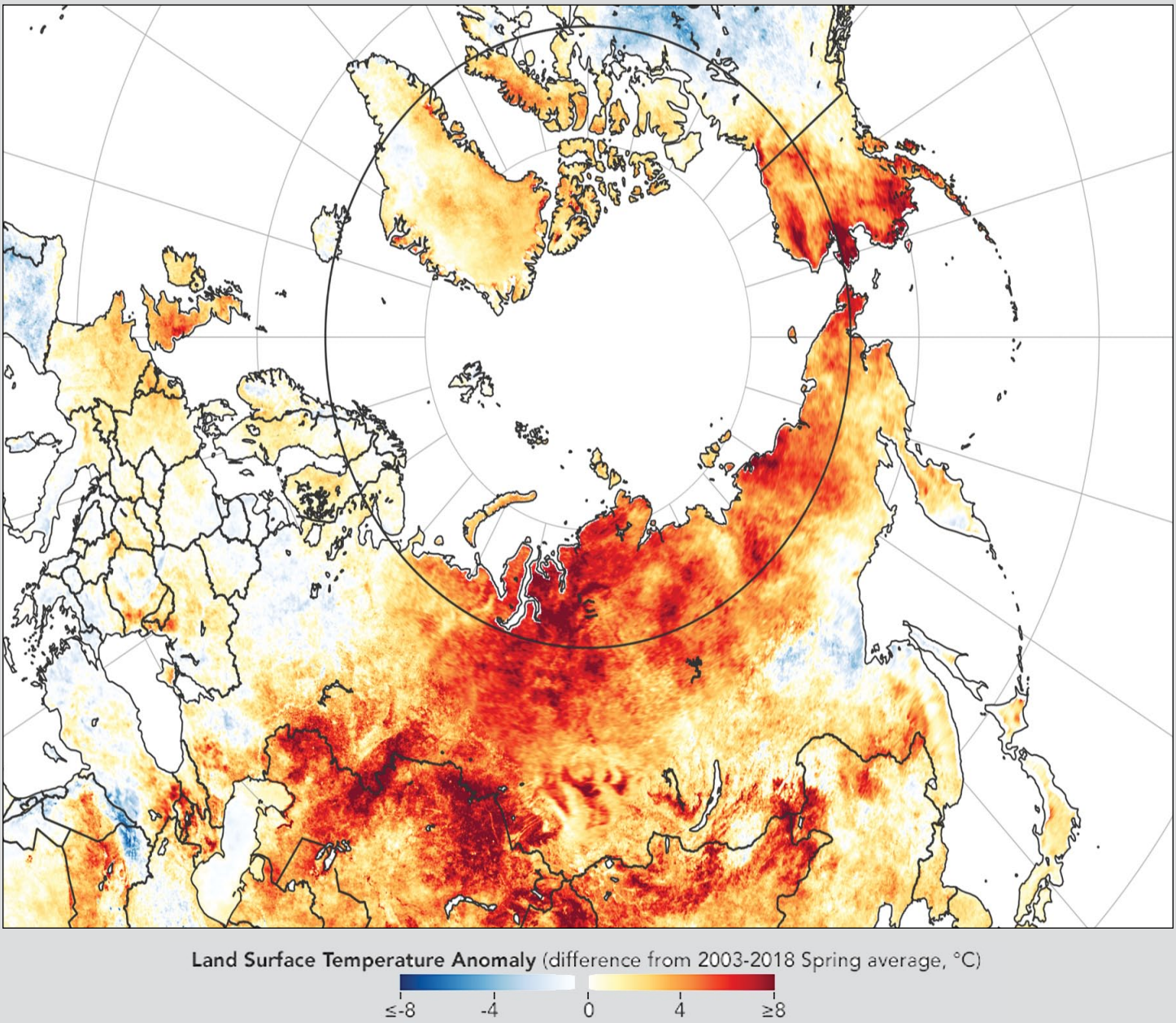
A layer of sea ice, broken and retreating, covers the waters of the Bay away from shore and a layer of fast ice clings to the Canadian coastline. The Mackenzie River, swollen with spring meltwater and sediment, curls through the scene from the bottom (south) and flows northward. On the river's delta, fingers of sediment can be seen encroaching on the ice, while copious muddy-brown sediment spills into the Bay underneath the ice.

Image Credit: MODIS Land Rapid Response Team, NASA GSFC

Heat and Fire Scorch Siberia

NASA Earth Observatory

Story by Adam Voiland.



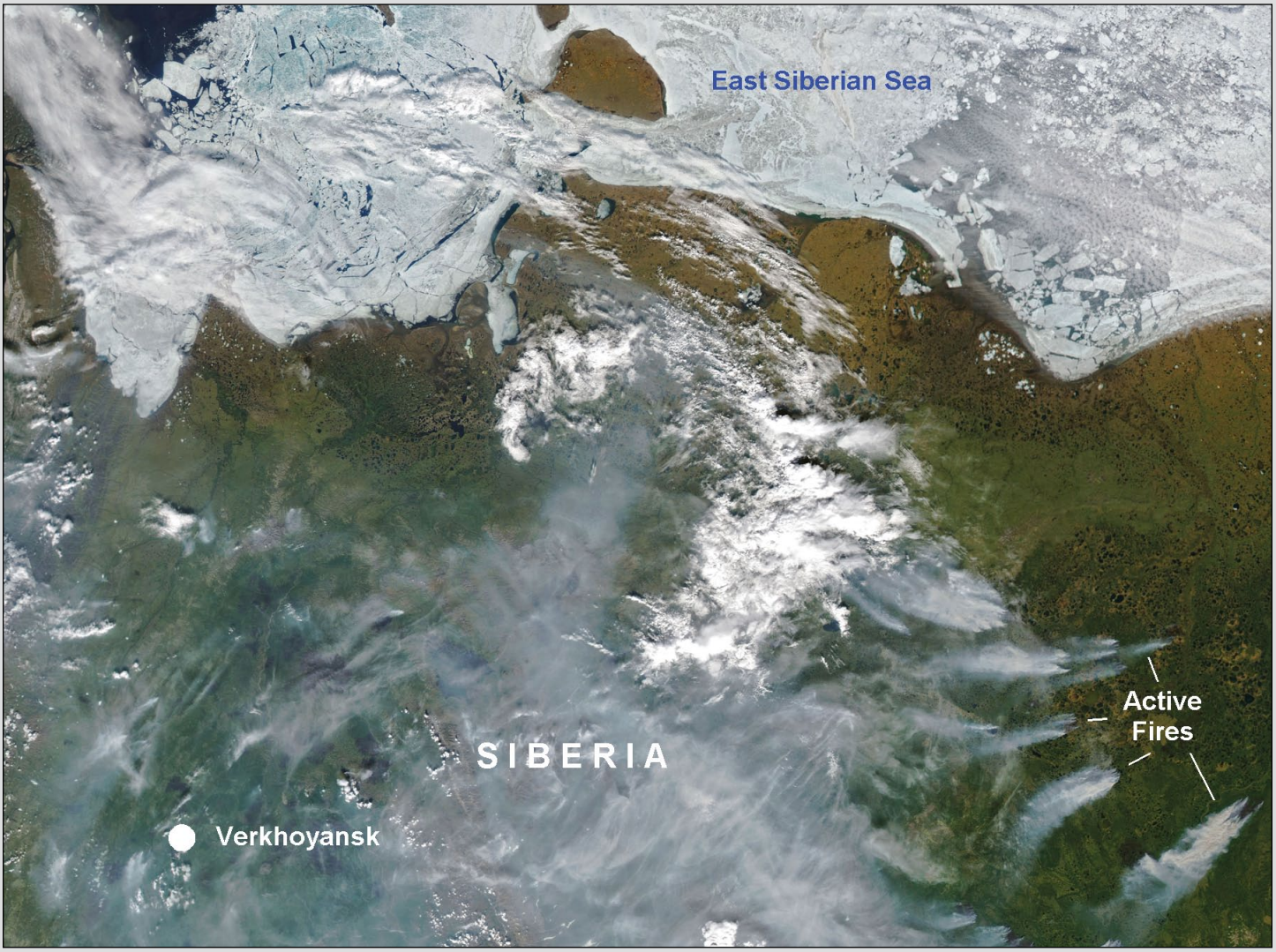
Eastern Siberia is famous for some of the coldest wintertime temperatures in the Northern Hemisphere. But in 2020, it has been the region's wildly high temperatures and wildfires that have wowed meteorologists.

After several months of warm weather, the Russian town of Verkhoyansk reported a daytime temperature of 38°C on June 20, probably a record high for the town, beating the previous high of 37.3°C, recorded on July 25, 1988. If verified, this will be the highest temperature on record in the Arctic.

> "*This event seems very anomalous in the last hundred years or so*," said NASA Goddard Institute for Space Studies Director Gavin Schmidt. "*The background trends in temperature in this region are about 3 degrees Celsius since the 19th century, so the probabilities of breaking records there are increasing fast.*"

The map above shows land surface temperature anomalies from March 19 to June 20, 2020. Red colours depict areas that were hotter than average for the same period from 2003-2018; blues were colder than average. The map is based on data from the Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's *Aqua* satellite.

Note that the map depicts land surface temperatures (LSTs), not air temperatures. LSTs reflect how hot the surface of the Earth would feel to the touch, and can sometimes be significantly hotter or cooler than air temperatures.



In a report about the remarkably warm temperatures in Siberia, European scientists examined historical temperature data in their global ERA5 reanalysis, finding that temperatures have been unusually warm in the region since January 2020. Since the ERA5 data begins in 1979, the European team also looked to GISTEMP, a NASA temperature record with data through 1880. They could not find any other examples in either dataset of such an intense heatwave in this part of Siberia persisting for such an extended period.

The persistent high-pressure atmospheric pattern that brought the extreme heat has exacerbated wildfires, prompting dozens to burn in the region's forest and shrub ecosystems. Some of those ecosystems grow on top of carbon-rich layers of peat and permafrost. The natural-colour image above shows smoke streaming from several active wildfires in Russia's Sakha region.

Most of Earth's terrestrial carbon is stored in the upper latitudes of the northern hemisphere, where many forests in the region are dominated by a coniferous tree—the Dahurian larch—that drops its needles each winter. But because the winters are so cold, there are few decomposers around to break the needles down. Over time, you end up with lots of buried fuel that has built up over centuries, even millennia, and stores huge quantities of carbon in peat and soils.

Intense heatwaves can thaw the permafrost layer and make long-frozen deposits susceptible to fires, which move carbon from the ground to the atmosphere and contribute to global concentrations of greenhouse gases. In this part of Siberia, the signs of climate change are already here. The heat and fires this year are just adding more evidence to the climate change signal that we have seen in these forests for years.

Though it is still early in the fire season, satellite observations of active fires by NASA and NOAA's MODIS and VIIRS sensors show the number of fire detections to be among the highest observed in any year since 2003.

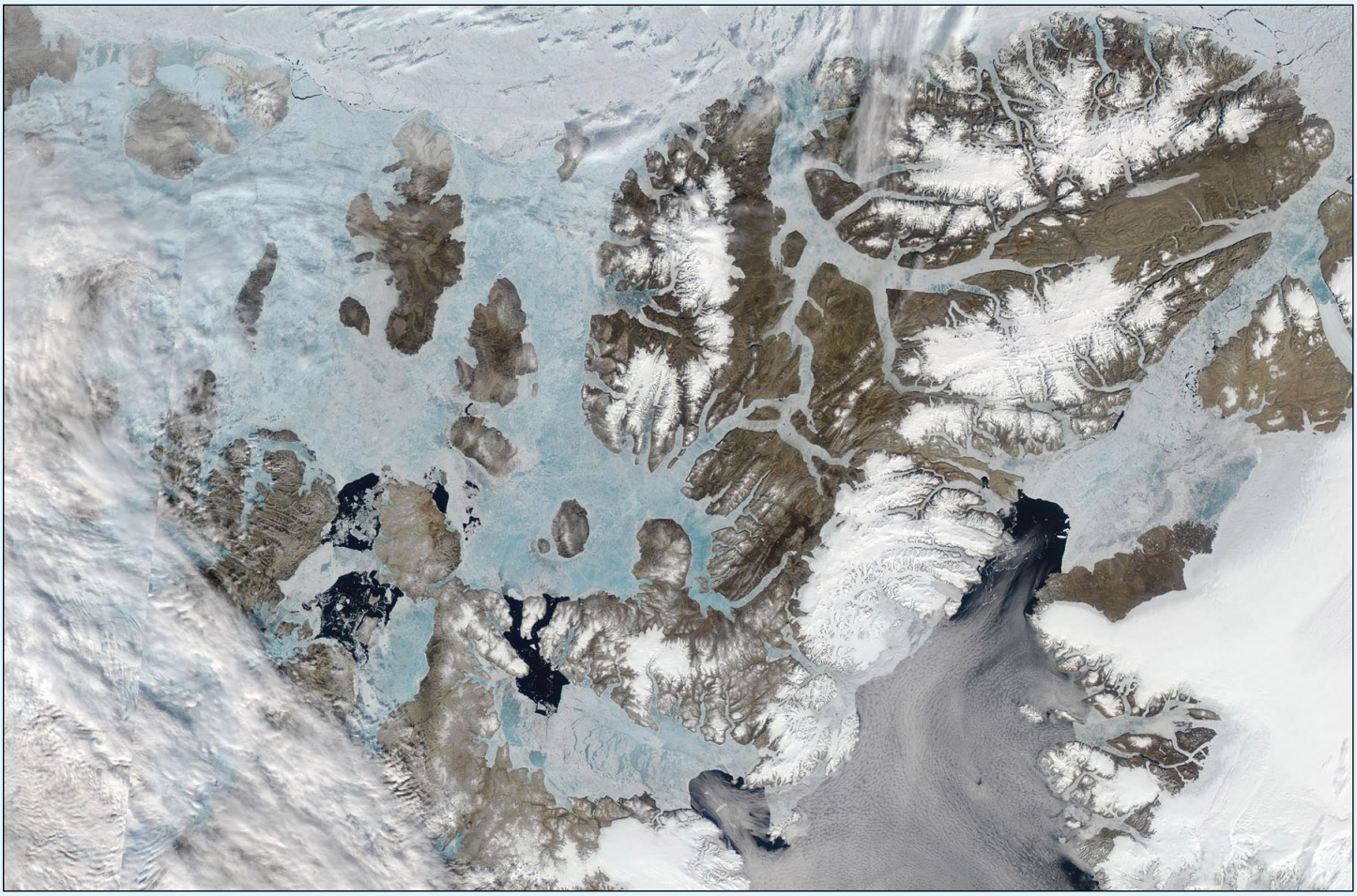
> "*Over the Russian Far East, there has been about the same amount of fire as last year, another very active year*," said NASA and Columbia University scientist Robert Field. "*Both 2020 and 2019 were about twice the 2003–2020 average, and about half as much as 2011, the most active year*."

Image Credits

NASA Earth Observatory images by Joshua Stevens, using data from the Level 1 and Atmospheres Active Distribution System (LAADS) and Land Atmosphere Near real-time Capability for EOS (LANCE), and data from NASA EOSDIS/LANCE and GIBS/Worldview and the Suomi National Polar-orbiting Partnership.

Ice Arch in the Nares Strait

NASA Earth Observatory



The Moderate Resolution Imaging Spectroradiometer (MODIS) on board NASA's Terra satellite acquired a true-color image of Ellesmere Island, Canada, Greenland, and the ice arch spanning the Nares Strait on June 25, 2020.
Image Credit: MODIS Land Rapid Response Team, NASA GSFC

Arctic Sea ice persisted in far northern Canada during late June 2020, including the important 'ice arch' that grows each winter in the Nares Strait between Ellesmere Island, Canada and western Greenland. The upside-down 'U' shape of the southwestern edge of the arch can be seen close to the right edge of the image, spanning the strait between Ellesmere Island (west) and Greenland (east). The bluish-white leading edge of the arch stands out in vivid contrast to the inky-colored open waters of the Nares Strait.

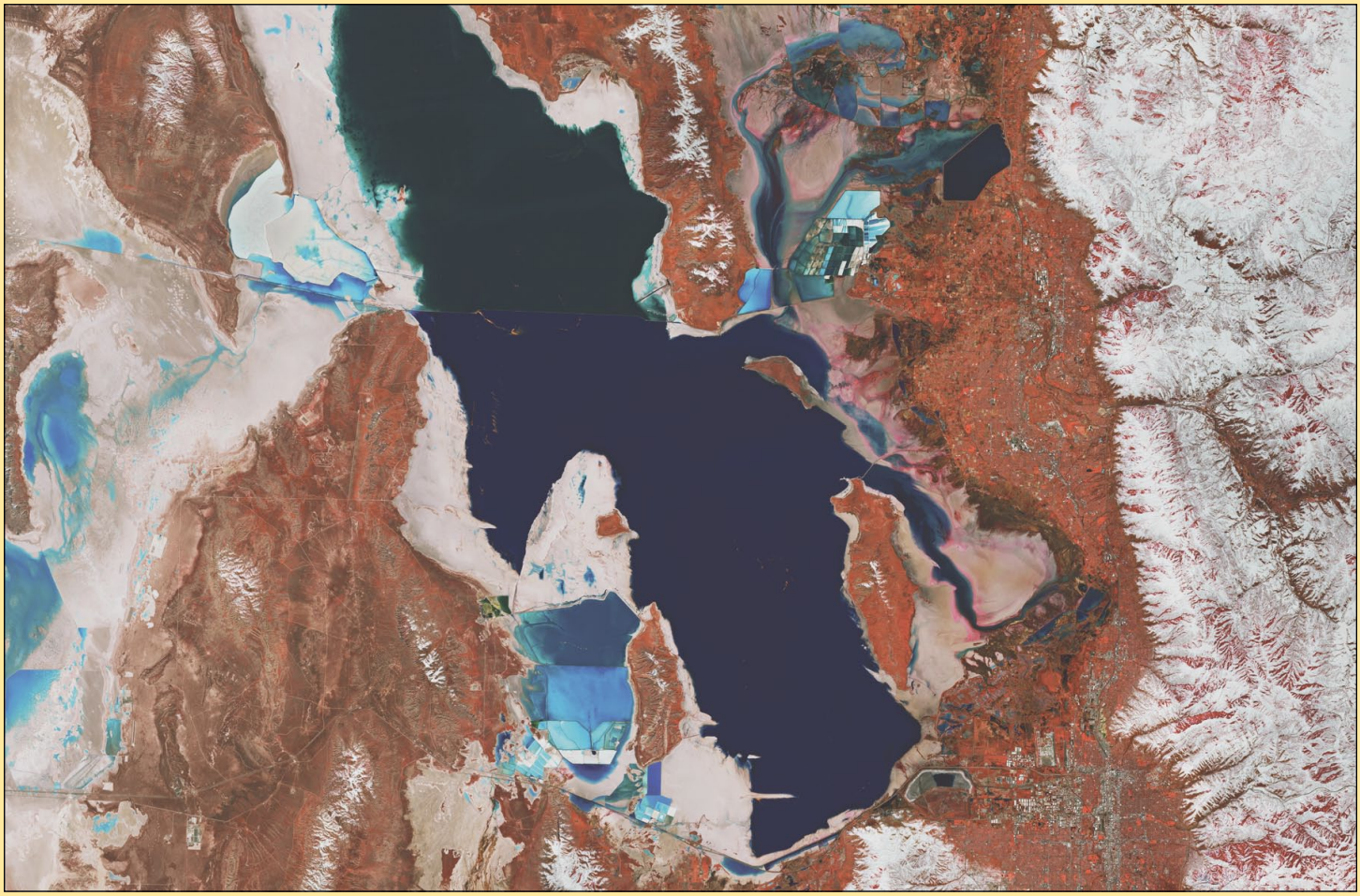
This ice arch is natural gatekeeper, preventing sea ice from exiting the Arctic Ocean and drifting southward into Baffin Bay. The Arctic Ocean is considered a semi-enclosed ocean, as it is surrounded almost entirely by land. The northern coastlines of these land masses—Eurasia, North America, Greenland and a number of scattered islands— keep most of the sea ice penned up, making it less mobile than the sea ice that forms around Antarctica. There are a few passageways that allow ice to escape in the spring and summer.

Although the Nares Strait is relatively narrow, a strong southward-flowing current through the strait ensures plenty of Arctic sea ice is lost there each year. As the ice arch forms, this flow of surface sea ice is halted and more ice remains within the Arctic Ocean. The ice arch typically melts between June and July. although in 2019 it collapsed early, beginning to crumble in April. Early breakups were reported in 2017, 2010, and 2008. In 2007, the arch failed to form at all.

Despite warm temperatures over most of the Arctic this winter, and despite the extent of Arctic sea ice hitting the fourth-lowest on record in May of this year, the ice arch remained intact in late June. The light blue tint of the ice arch suggests that the ice has thinned and is becoming wet as it melts. It doesn't appear to be quite as wet and thin as the fingers of ice on the shores and between the Canadian islands, but regions of dark open water at the coast of Ellesmere Island and very dark ice off Greenland suggest that collapse should be iminent.

Great Salt Lake, Utah

European Space Agency



This Sentinel-2 image contains modified Copernicus Sentinel data (2019), processed by ESA, CC BY-SA 3.0 IGO

The Great Salt Lake is the largest saltwater lake in the western hemisphere and one of the most saline inland bodies of water in the world. The Great Salt Lake is the largest remnants of prehistoric freshwater Lake Bonneville, that once covered much of western Utah.

The lake is fed by the Bear, Weber and Jordan rivers which, together, deposit around one million tonnes of minerals in the lake each year. As the lake is endorheic (meaning without an outlet), the water evaporates leading to a very high salt concentration. It greatly fluctuates in size, depending on the rates of evaporation and the flow of the rivers that feed it.

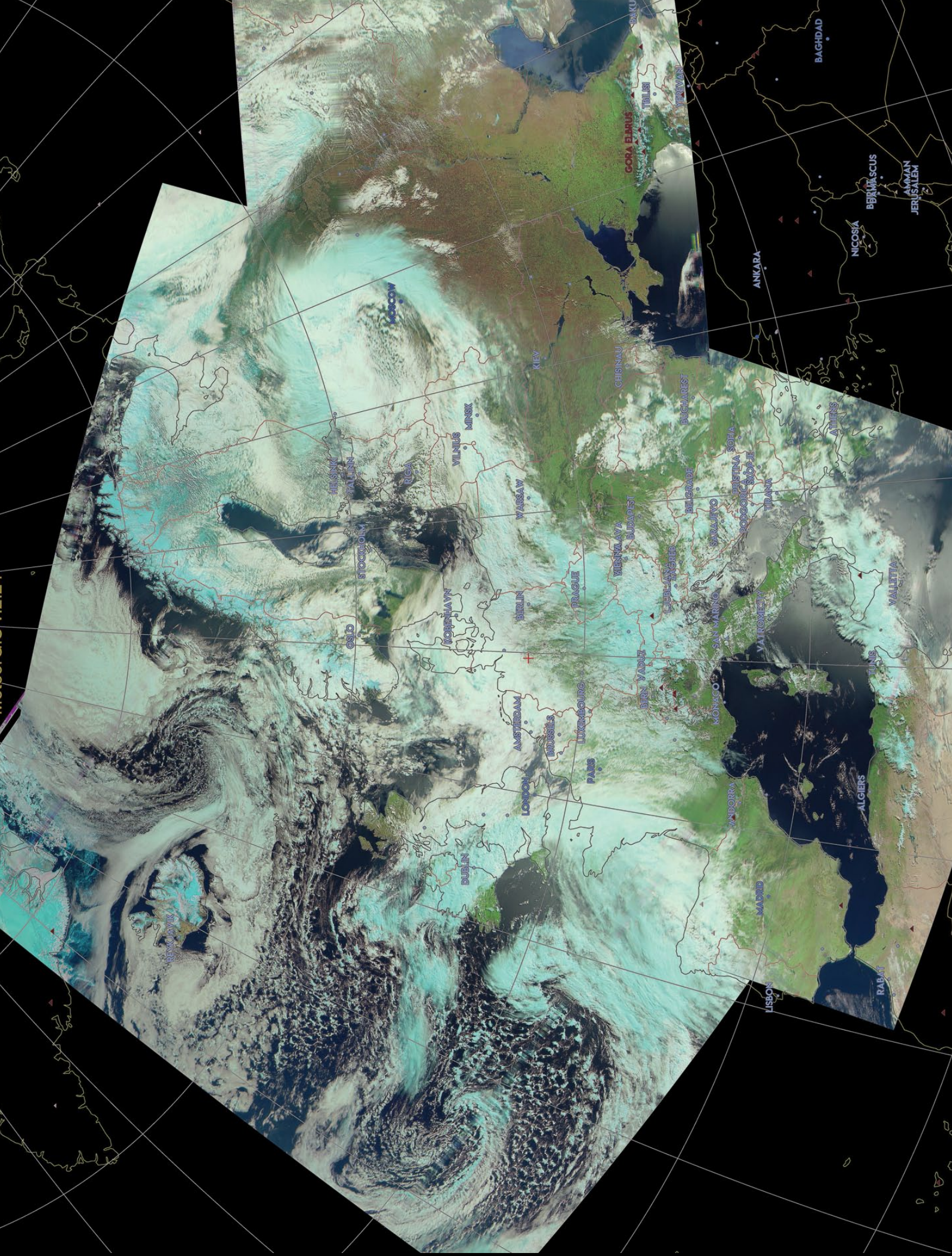
The distinct colour differences in the lake are caused by the Lucin Cutoff, an east-west causeway built to create a shorter route for the railroad, visible as a sharp line cutting across the top part of the lake. This acts as a dam, preventing the waters from mixing, leading to the north basin having a much higher salinity than the southern, freshwater part of the lake.

As the lake's main tributaries enter from the south, the water level of the southern section is slightly higher than that of the northern part. Several small islands, the largest of which are Antelope and Fremont, lie in the southern part of the lake.

The lake's varying shoreline consists of beaches, marshes and mudflats. The bright, turquoise colours visible on both sides of the lake are evaporation ponds, from which various salts are collected in commercial operations. Although it is commonly referred to as America's Dead Sea, the lake is nevertheless an important habitat for millions of native and migratory birds. It is also home to several types of algae, brine shrimp and brine flies.

The lake's basin is defined by the foothills of the snow-capped Wasatch Range to the east and by the Great Salt Lake Desert (a remnant of the bed of Lake Bonneville) to the west. This part of the desert is known as the Bonneville Salt Flats and is used as an automobile raceway, as the flat and smooth salt beds make the area ideally suited for speed trials. Utah's capital, Salt Lake City, is visible in the bottom right of the image.

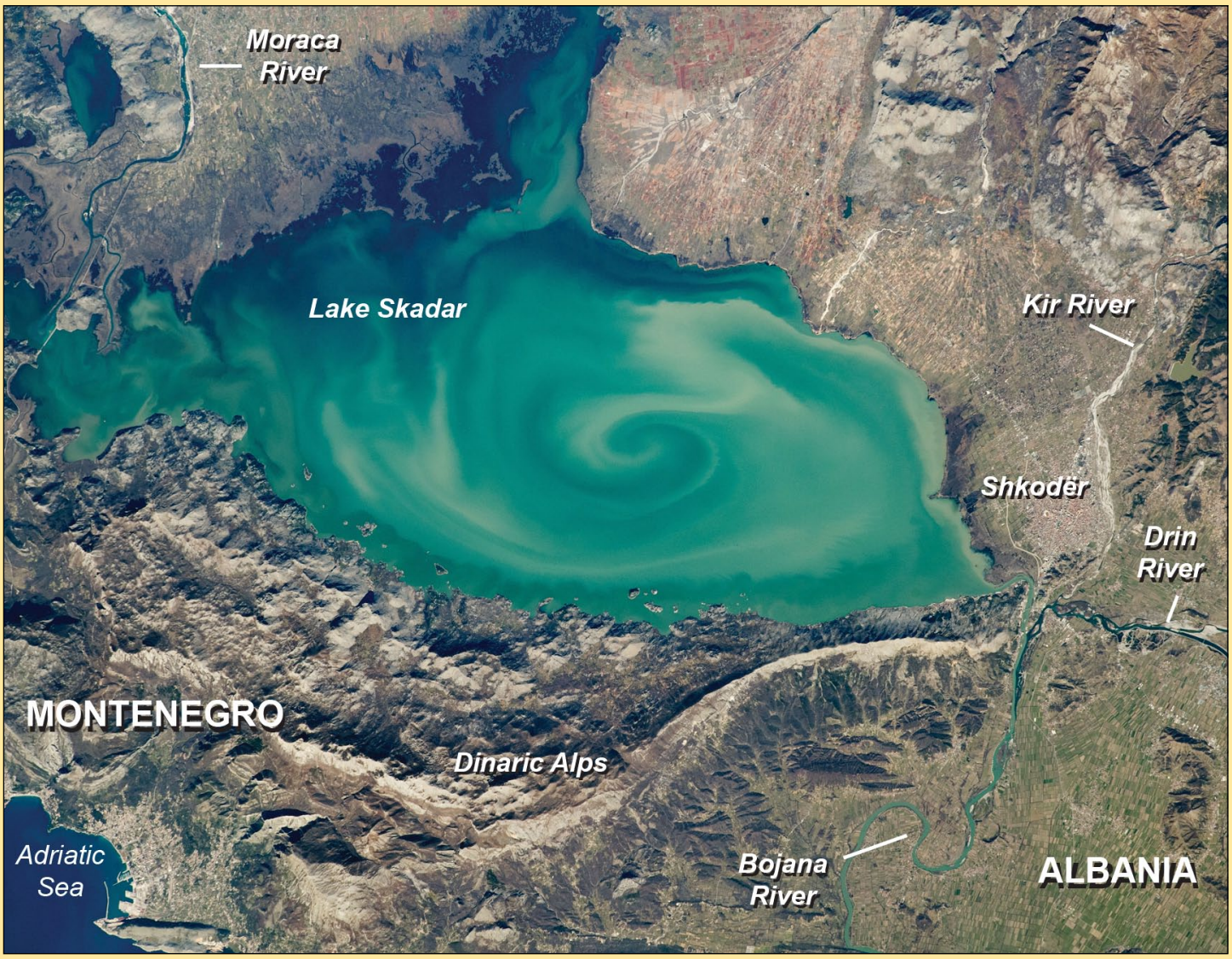
This image was processed in a way that included the near-infrared channel, which makes vegetation appear red while rocks and bare soil appear brown.



Joachim Scharrer constructed this composite image covering all Europe, from three Meteor M2 passes on April 29, 2020. Captured using MeteorGIS 2.24 software, the passes were at 07:22 UT, 09.01 UT and 10:41 UT and rendered in UTM projection.

Lake Skadar, Montenegro and Albania

NASA Earth Observatory



Astronaut photograph ISS062-E-40353 was acquired on February 21, 2020, with a Nikon D5 digital camera using a 400 millimeter lens and is provided by the ISS Crew Earth Observations Facility and the Earth Science and Remote Sensing Unit, Johnson Space Center.

Dark and light sediments swirl around in the center of Lake Skadar (also known as Lake Shkodra), the largest lake on the Balkan Peninsula. This pattern captured the attention of an astronaut onboard the International Space Station (ISS).

Lake Skadar, a karst lake that straddles the border of Montenegro and Albania, is an example of a cryptodepression, where parts of the lake bed extend below sea level. The curved, spine-like ridges running parallel with the southern shore are part of the Dinaric Alps, which are comprised mostly of easily erodible rocks such as limestone, dolomite, and other carbonates.

The swirling plume in the center of the lake is probably the mixing of sediment that has been transported downstream from higher elevations via snow-melt water and other mountain run-off. A major source of this sediment inflow comes from the Moraca River; whose wide delta occupies much of the Montenegro shoreline. Smaller river deltas along the northern edges of the lake also contribute sediment. The Drin River and the Bojana River converge just south of the ancient lake-front city of Shkodër, which lies on the small delta of the Kir River. The lake and these rivers all ultimately drain into the Adriatic Sea.

As with many large freshwater lakes near cities, many of the native plants and animals in Lake Skadar have become endangered due to human activity. Montenegro has since made the western portion of the lake a national park, and Albania declared its section as a nature reserve. Both efforts were made to protect many species of birds, microorganisms and aquatic life, including eels, snails and endemic fish species.

Text by Sara Schmidt, GeoControl Systems, JETS Contract at NASA-JSC.

A Sandy Flower in the Pacific

NASA Earth Observatory

In 2001, Dubai started construction on three large artificial islands in the Persian Gulf shaped like palm trees. A few years later, Doha began dredging for an island that resembled a string of pearls and the United Arab Emirates went to work building an archipelago of 300 small islands strategically placed to look like a map of Earth.

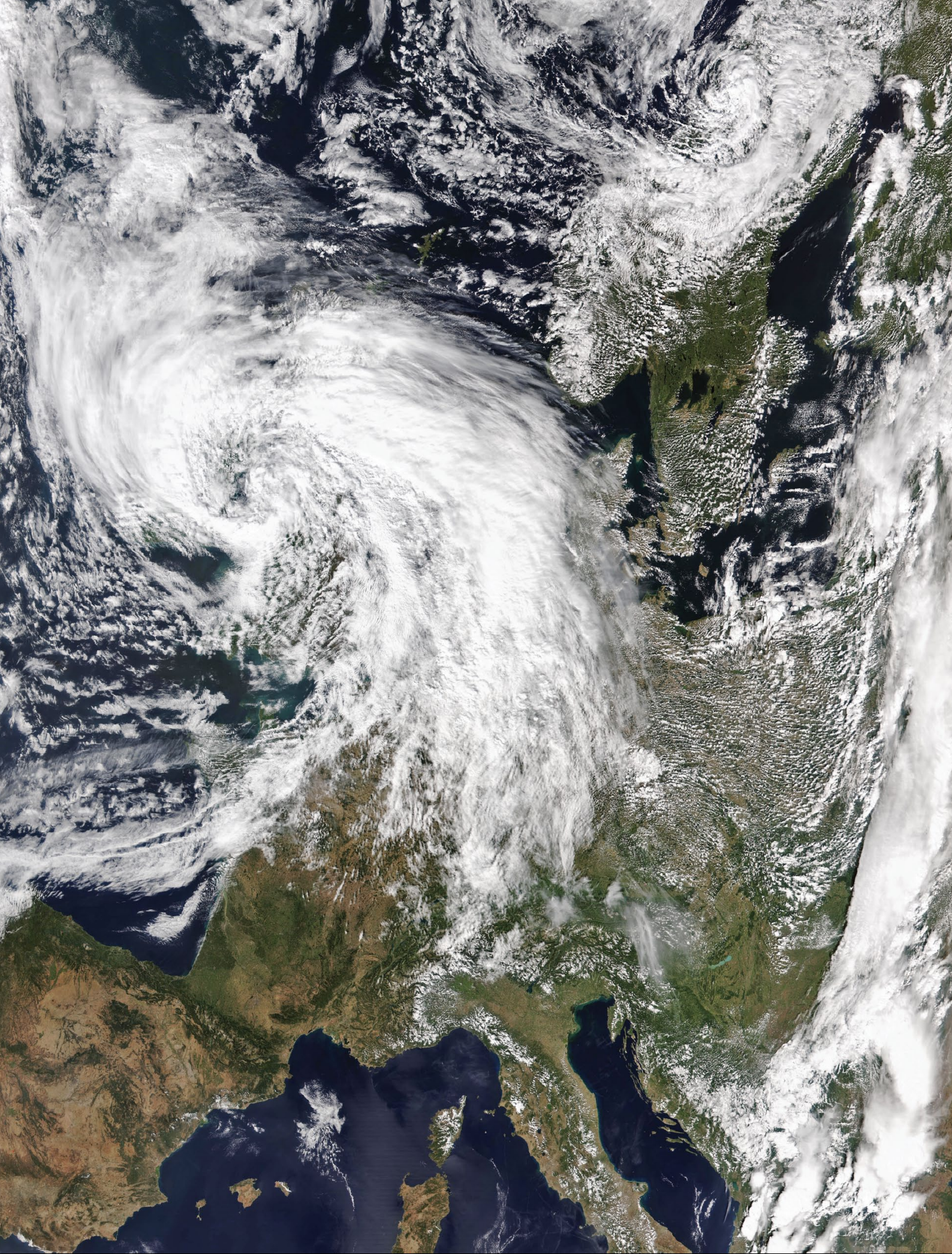
Now another island with an unusual shape has been growing in shallow coastal waters near Hainan, China's southernmost province. **Ocean Flower Island**, built in Yangpu Bay, spans roughly 8 square kilometers, putting it among the world's largest artificial islands.

The Operational Land Imager (OLI) on NASA's Landsat 8 satellite captured this natural-colour image of the new island on May 6, 2020, as construction was wrapping up and the island neared its full opening in late 2020. Early signs of construction of the main island became visible to Landsat in 2012 and by 2014, the main flower-shaped island had started to take shape. By 2020, it was flanked by two connected islands shaped like leaves. A mixture of parks, residential towers, museums, and other infrastructure had sprung up on the new land.

While planners expect the project will attract millions of tourists and boost Hainan's economy, the project's environmental impacts have attracted scrutiny. In 2018, China's central government temporarily suspended construction at Ocean Flower Island—and several others—due to concerns about damage to coral reefs, oysters, and marine ecosystems. The same year, one of China's regulatory agencies announced a temporary hold on approvals for many commercial land reclamation projects managed by local authorities.

The main flower shaped island starts to take shape in 2012
NASA Earth Observatory images by Lauren Dauphin, using Landsat data from the USGS.

Flower island, imaged by Landsat-8 in May 2020
NASA Earth Observatory images by Lauren Dauphin, using Landsat data from the USGS.



Storm Francis, imaged on August 25, 2020 by NOAA 20, overwhelmed the British Isles with unseasonably heavy rainfall and strong winds
Image: NOAA

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 [8]
Meteor M N2	137.1000 MHz	On	Good
Meteor M N2-2	137.9000 MHz	Off	Failed [12]

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	RHCP	AHRPT	Inactive [2,10]
Feng Yun 3B	1704.5 MHz	RHCP	AHRPT	Active [2]
Feng Yun 3C	1701.4 MHz	RHCP	AHRPT	Active [2]
Metop A	1701.3 MHz	RHCP	AHRPT	Good
Metop B	1701.3 MHz	RHCP	AHRPT	Good
Metop C	1701.3 MHz	RHCP	AHRPT	Commissioning
Meteor M N1	1700.00 MHz	RHCP	AHRPT	Dead [8]
Meteor M N2	1700.0 MHz	RHCP	AHRPT	Good
Meteor M N2-2	1700.0 MHz	RHCP	AHRPT	System failure [12]

Geostationary Satellites				
Satellite	Transmission Mode(s)		Position	Status
Meteosat 8	HRIT (digital)	LRIT (digital)	41.5°E	IODC
Meteosat 9	HRIT (digital)	LRIT (digital)	3.5°E	On [5]
Meteosat 10	HRIT (digital)	LRIT (digital)	9.5°E	Off [4]
Meteosat 11	HRIT (digital)	LRIT (digital)	0°W	On [3]
GOES-13	GVAR 1685.7 MHz	LRIT 1691.0 MHz	60°W	Off
GOES-14	GVAR 1685.7 MHz	LRIT 1691.0 MHz	105°W	Standby
GOES-15 (W)	GVAR 1685.7 MHz	LRIT 1691.0 MHz	128°W	On [6]
GOES-16 (E)	GRB 1686.6 MHz	HRIT 1694.1 MHz	75.2°W	On[6,9]
GOES-17	GRB 1686.6 MHz	HRIT 1694.1 MHz	137.2°W	[11]
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	123.5°E	Backup/Off [7]
Feng Yun 2E	SVISSR	LRIT	86.5°E	On
Feng Yun 2F	SVISSR	LRIT	112.5°E	Standby
Feng Yun 2G	SVISSR	LRIT	99.5°E	On
Feng Yun 2H	SVISSR	LRIT	86.5²E	
Feng Yun 4A	HRIT (digital)	LRIT (digital)	99.5°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 prime Full Earth Scan (FES) satellite
4 Meteosat backup Full Earth Scan (FES) satellite
5 Meteosat prime Rapid Scanning Service (RSS) satellite.
6 GOES 15 also transmits EMWIN on 1692.700 MHz
GOES 16 also transmits EMWIN on 1694.100 MHz
GOES 17 also transmits EMWIN
7 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.
8 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.
9 GOES Rebroadcast (GRB) provides the primary relay of full resolution, calibrated, near-real-time direct broadcast space relay of Level 1b data from each instrument and Level 2 data from the Geostationary Lightning Mapper (GLM). GRB replaces the GOES VARiable (GVAR) service.
10 Although Feng Yun 3A's status is recorded on the wmo-sat website as 'inactive (end of operation)', it continues (as of June 2018) to transmit imagery.
11 GOES 17 is expected to start operations during January 2019.
12 Following a collision with a micrometeorite, the power system aboard Meteor M2-2 has all but failed and is no longer capable of powering the AHRPT/LRPT instrument.