The GEO Quarterly

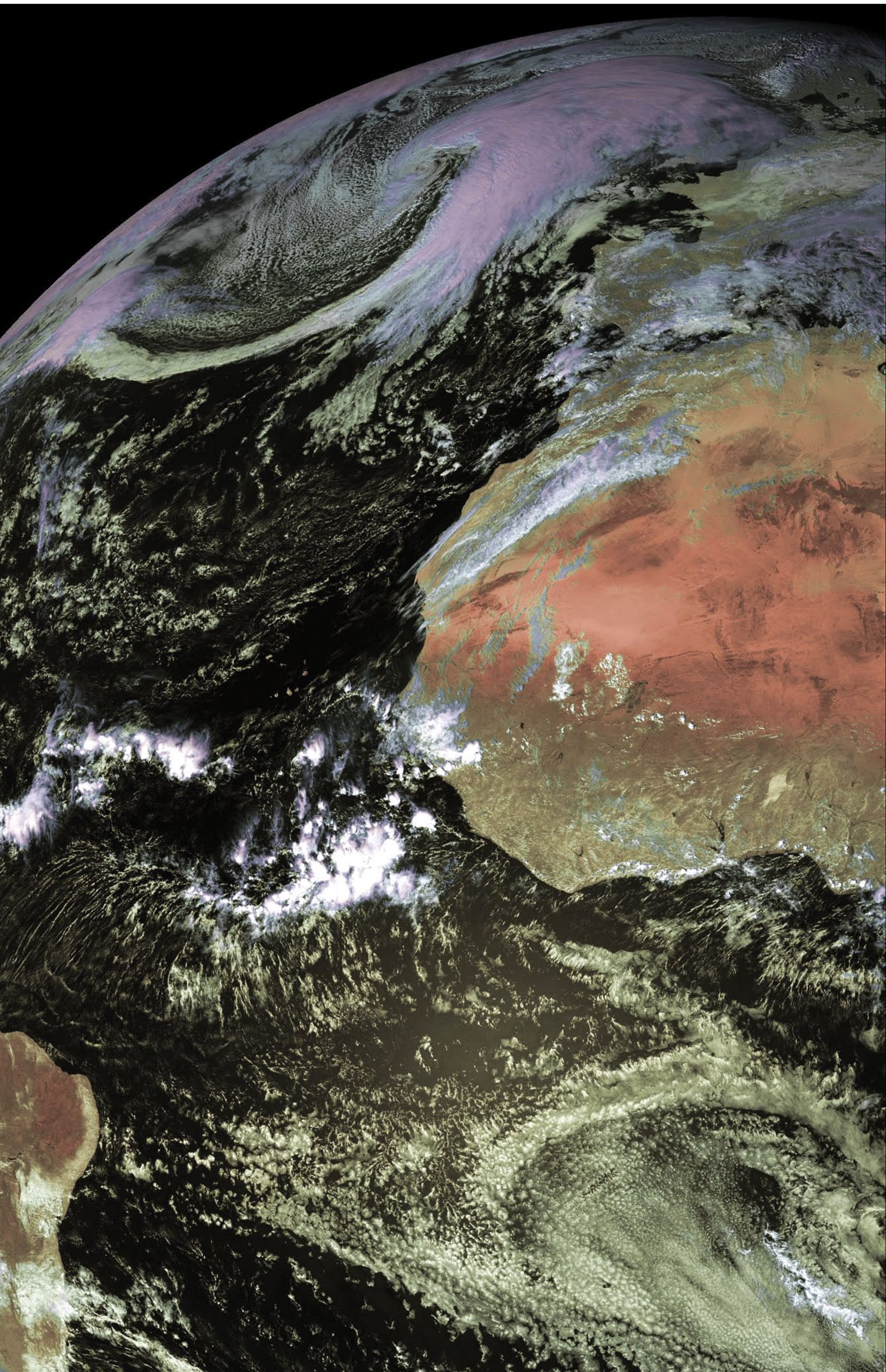
Group for Earth Observation

Group for Earth Observation

The Independent Amateur Quarterly Publication for Earth Observation and Weather Satellite Enthusiasts

48

December 2015



Inside this issue . .

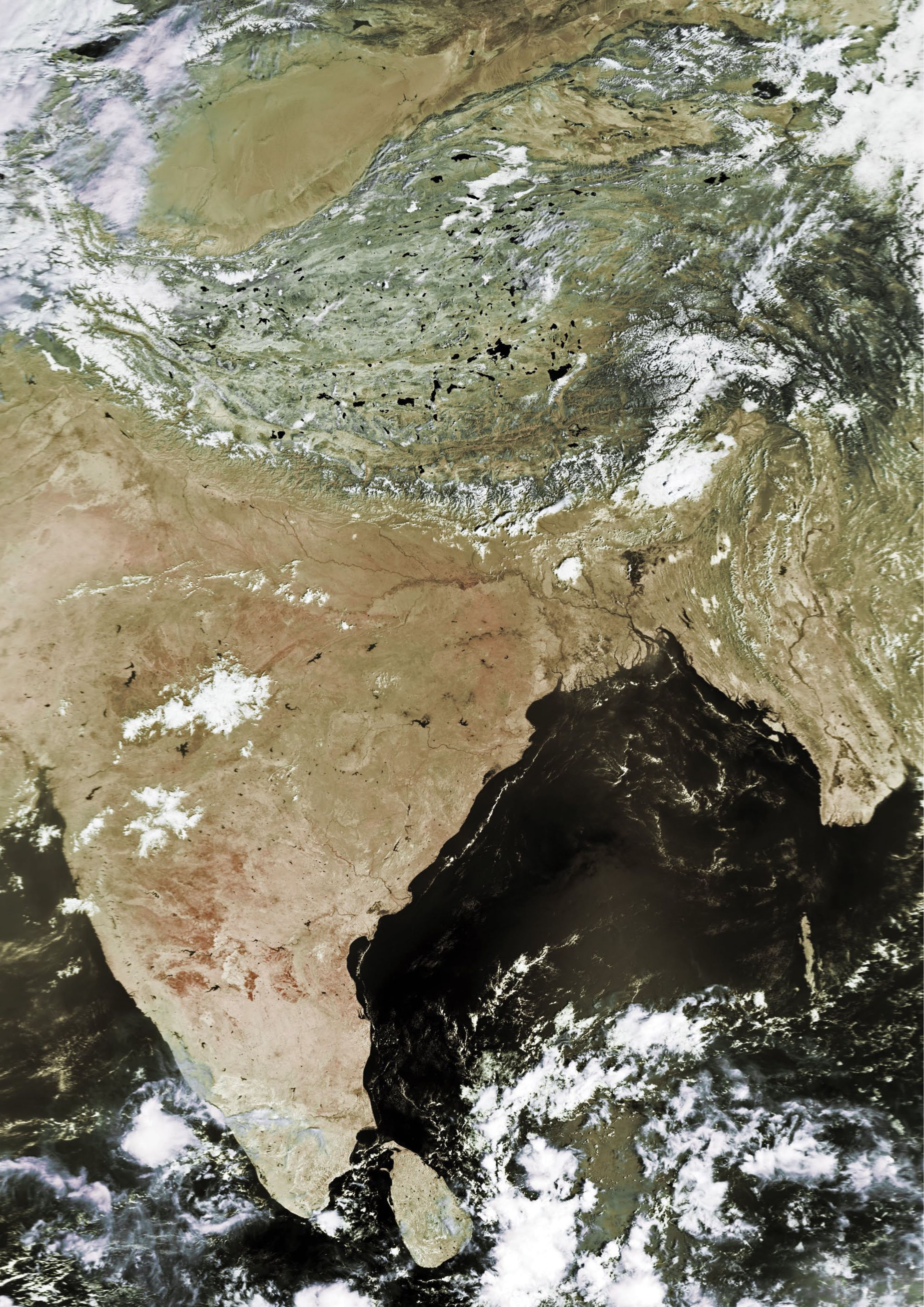
At last, we offer a comprehensive and up-to-date guide to setting up a basic Meteor M2 receiving station. There has been such rapid progress in this field, particularly in software development, that many URLs for downloading software are no longer active. This article puts this right.

Also on the theme of weather satellite reception in the 137 MHz band, we reproduce Chris van Lint's article on building a QFH antenna from PVC tubing and coax cable.

If you have ever wanted to investigate your reception horizon, Barry Smith may have the answer as he describes a website that can produce accurate contour maps around your station.

Finally, Mike Stevens reports on the TBS-6908 DVB-S2 tuner that he has been evaluating over the summer.

And of course, there are the usual selection of articles from NASA Earth Observatory.



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Editorial

Les Hamilton
geoeditor@geo-web.org.uk

As *GEO Quarterly* approaches its 50th issue next June, we can look back on one of the most productive years for direct satellite reception. The arrival of Meteor-M2 sparked a flurry of activity, with reception and processing software being developed apace; so much so that many of the sources for required software have changed. It is clear that newcomers to Meteor reception now find it very challenging indeed to set up a reception station, so I have compiled a new guide (page 27) with current URLs for everything that's required, from the *SDRSharp* software defined radio (now under the *Airspy* banner) and its essential plugins to processing software.

Associated with this there's been increased interest in constructing antennas for the 137 MHz satellite band (no doubt many of you are now regretting disposing of old APT gear). To remedy this, we are reprinting an article that appeared in the very first issue of GEO Quarterly, detailing the construction of Chris van Lint's collapsible QFH antenna: it can be constructed in just a few hours from PVC tubing and coaxial cable. I have built several of these over the past 15 years, and can confirm that they are every bit as good as my commercially manufactured turnstile.

Finally, a reminder that, in addition to your digital copy of GEO Quarterly, you will also be mailed a printed copy of the December issue, as promised last year. We very much hope you enjoy it.

Everyone on the GEO Management Committee wishes all our readers all a most pleasant Christmas, and a productive New Year.

Copy deadline for the March issue of GEO Quarterly is Sunday, February 21, 2016.

Contents

The GEO Report

Francis Bell

Since GEO's visit to Darmstadt in July this has been a rather quiet summer for me in relation to weather satellite reception, with domestic and other travel engagements tending to occupy much of my time. However, I have been trying to keep up to date with members' activities, particularly those relating to the reception and decoding of images from the Russian Meteor-M2 satellite. My congratulations and admiration to those progressing the home reception of data from this satellite: however, it would be of great benefit to our members if we saw more regular reports and articles about this latest satellite, plus the established fleet of weather satellites, in our Quarterly.

I know of the editor's frustration about the lack of materials being submitted to him for publication, so I urge members who have access to technical information—or just personal experiences—to write a report and send it to our editor. Such initial material does not have to be perfect because editing and redrafting may be possible, but if there is no starting point there is nothing to publish. I must issue the warning that lack of copy from our members puts at risk the continuation of *GEO Quarterly,* of which I feel sure we are all proud. The future of our Quarterly rests firmly with the membership, in anticipation of their contributions.

Structure of GEO

This is just a reminder that the overall structure of GEO remains the same: that is, we are a registered limited company but with no shareholders. The advantage of this format is that it provides protection for the Group should there be any disputes, with the responsibility resting with the company and not with any individual. Each year I submit information to Companies House which includes a summary of our accounts. We do not publish accounts in the Quarterly but they are always available at our members AGM which is usually held in Leicester. Broadly speaking, the membership subscriptions cover the publication and distribution of the Quarterly together with some additional expenses. The *GEO Shop* generates a profit which provides a buffer against any capital expenditures.

Symposium 2016

On the subject of Leicester please see the separate notice on page 10 relating to our 2016 Symposium which is scheduled for April 23, 2016. Please attend if you can. The day's programme is looking great, and there is the plus factor that it offers the opportunity for members to meet with each other. This makes it a must-attend event for me!

ISS

I continue to follow the HDTV images being transmitted from the ISS. In this country, the ISS will become more newsworthy because astronaut Tim Peake will soon be joining the crew onboard the station for several months. Tim will be only the second British astronaut, the first being Helen Sharman 25 years ago. With Tim onboard the ISS there are plans to involve UK schools in space science and technology. I will follow these with interest because of my own background in a Guildford school where we were concerned in the first radio contacts with Helen Sharman while she was on the Russian MIR space Station. The URL for the HDTV from the ISS is

www.ustream.tv/channel/iss-hdev-payload

The BBC have recently contacted me because they have embryo plans for a TV programme celebrating the 25th anniversary of Helen Sharman's flight on the MIR space station. It is currently planned to be part of '*The One Show*' which is scheduled for early evening on BBC 1. Perhaps I can contribute to the programme using some of the live recordings I made of my personal and school contacts with the MIR space station all those years ago.

ESA Bulletin

I noticed that the last ESA Bulletin I received, No 161, contained a notice about the future of the printed copy of their Bulletin. Routinely, in future, it will be available on-line, and only by special request will a printed copy of the Bulletin be posted. I will be regularly asking for a paper copy because I find it infinitely more convenient than reading material from a computer screen.

Final Note

If you have any material or even references to third party material which you think may be of interest to our GEO Group, please send it to our editor. Without a steady input of potential copy for the Quarterly it is likely to cease publication in its present form. Over to the membership!

The Notice from ESA

The ESA *Bulletin* is 40 years old this year, and in a bold move, ESA Communications has decided to reduce its print run. Why? To reduce ESA's carbon footprint and encourage more readers to access the ESA *Bulletin* online.

Launched in 1975, the printed *Bulletin* now has a readership of 10,000 people worldwide, with many more reading the electronic version. Each Issue is packed with articles on ESA space activities, as well as updates on the status of our major projects.

Bulletin 161, released for the 1st quarter of 2015, was the last issue on general and automated distribution. For future editions, we invite all our readers to read the free online version of the *Bulletin*, available on our *Spacebooks online* platform at

www.spacebooks-online.com

or through the *ESA Bulletin App* on the ***iTunes*** store.

If you still wish to receive printed copies of the *ESA Bulletin*, you can order them via the *Spacebooks Online Platform*. Note that the printed *ESA Bulletin* will still be free for readers located in any of ESA's 22 Member States, and Canada. Readers outside these areas will be asked to contribute to the delivery costs. You can choose to order individual copies of the *ESA Bulletin* or take out a subscription to receive all four issues published in a year.

Cover Image Details

Front Cover

When the first winter storm hit the British Isles, specially severe over Scotland's Western and Northern Isles, Mike Stevens was on hand to capture this **Meteosat** image with his TBS-6903 tuner at 13.15 UT on October 25, 2015.

Image © EUMETSAT 2015

Inside Front Cover

Mike Stevens sent in this **Metop-A** image dating from 03:52 UT on October 22, 2015. The myriad of lakes dotting the Tibetan plateau is revealed, with the cold, dry Taklimakan Desert to the northwest

Image © EUMETSAT 2015

Inside Back Cover

This image acquired by NASA's **Terra** satellite on November 2, 2015 highlights the huge bank of fog which developed over the North Sea and caused dozens of flights from UK airports to be cancelled. If you look carefully, you can see the dark shadows of aircraft contrails over the cloud.

Image: LANCE Rapid Response/NASA/GSFC

Back Cover

Unusually for this region, category-2 Cyclone Chapla bore down over the Horn of Africa on November 2, 2015. This image of the beautifully compact storm comes from a **Meteosat** image sent in by Mike Stevens.

Image © EUMETSAT 2015

Quarterly ? Question

Islands Divided into more than one Country

When I first view a satellite image of any part of the Earth, I mentally try to identify the area by looking for any coastal boundaries which may be visible in it. If I can identify a coast I immediately relate this to a country, thus giving a frame of reference to the rest of the image.

Coastal outlines often represent not only a geographical feature but may also have a political dimension. Other major geographical features can also be important in relation to political boundaries such as a mountain range, a major lake or river. Other country boundaries are often historic, dynamic and quite arbitrary, representing the territorial ambitions of cultural, religious or ethnic interests of local leaders. Even in my lifetime I have I have seen many changes establishing different or new boundaries for many countries.

Many land boundaries between countries are difficult or impossible to see in a satellite image. However, even recognising the dynamic political background to our present day countries, what has not changed are the permanent costal outlines, particularly of islands, compared with dynamic political changes on the continents.

Individual islands or island groups are usually associated with a specific country, and although I recognise that countries can argue over the sovereignty of a particular island or group of islands, there are a small number of islands which are divided into, or between, more than one country. I think that there are fewer than ten such islands. I have visited several of these islands hence this Quarterly Question.

The Question is this:

> 'Name those islands in the world which are divided into more than one political country. Also, for as many islands as you can, create a list of the islands and the names of the countries associated with them'.

It would be an interesting bonus if you could provide a satellite image of one or more of the island you identify. As encouragement, and a clue to one qualifying island, please see page four of *GEO Quarterly 44,* which shows an image of a qualifying island imaged by the ISS.

Answers by email to

francis@francisbell.com

or

francis@geo-web.org.uk

I will try to compile a comprehensive list for publication in our next Quarterly.

Red Sprites above the USA and Central America

NASA Earth Observatory

Viewing from a point over northwest Mexico, astronauts aboard the International Space Station looked northeast and shot these unusual photographs of red sprites above the white light of active thunderstorms. In the first instance (figure 1), the sprite was 2,200 kilometres away, high over Missouri or Illinois. The lights of Dallas, Texas appear in the foreground. The sprite shoots up towards the greenish airglow layer, near the rising moon.

Two minutes and 58 seconds later, as the ISS was above the coastal Mexican resort of Acapulco, the crew documented another red sprite over a brilliant white thundercloud and lightning discharge near the coast of El Salvador (figure 2). The shorter distance to the storm—about 1150 km—makes it somewhat easier to see details of the sprite. City lights are a diffuse yellow because they are shining through clouds.

These photos show the sprite's tendrils reaching as high as 100 kilometres above Earth's surface. Sprites are major electrical discharges, but they are not lightning in the usual sense. Instead, they are a cold plasma phenomenon without the extremely hot temperatures of the lightning that we see underneath thunderstorms. Red sprites are more like the discharge of a fluorescent tube. Bursts of sprite energy are thought to occur during most large thunderstorm events. They were first photographed in 1989.

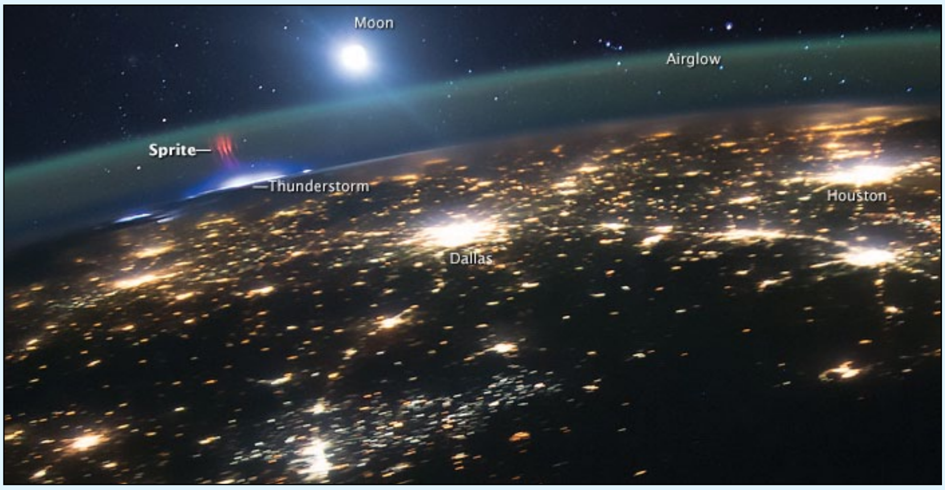


Figure 1 - A red sprite bursts upwards above a thunderstorm at the left of this image.
Credit@ NASA Astronaut Photograph ISS044-E-45553

Figure 2 - A red sprite bursts from a thunderstorm above El Salvador.
Credit @ NASA Astronaut Photograph ISS044-E-45576

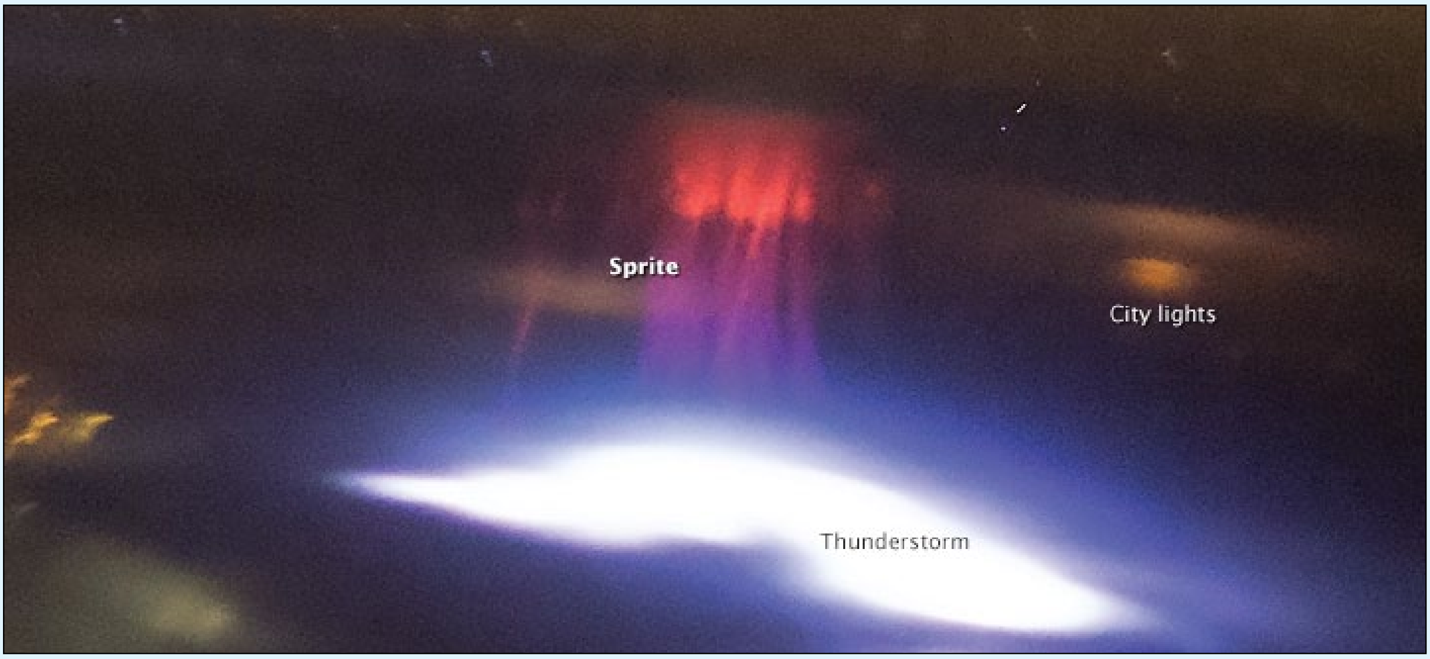
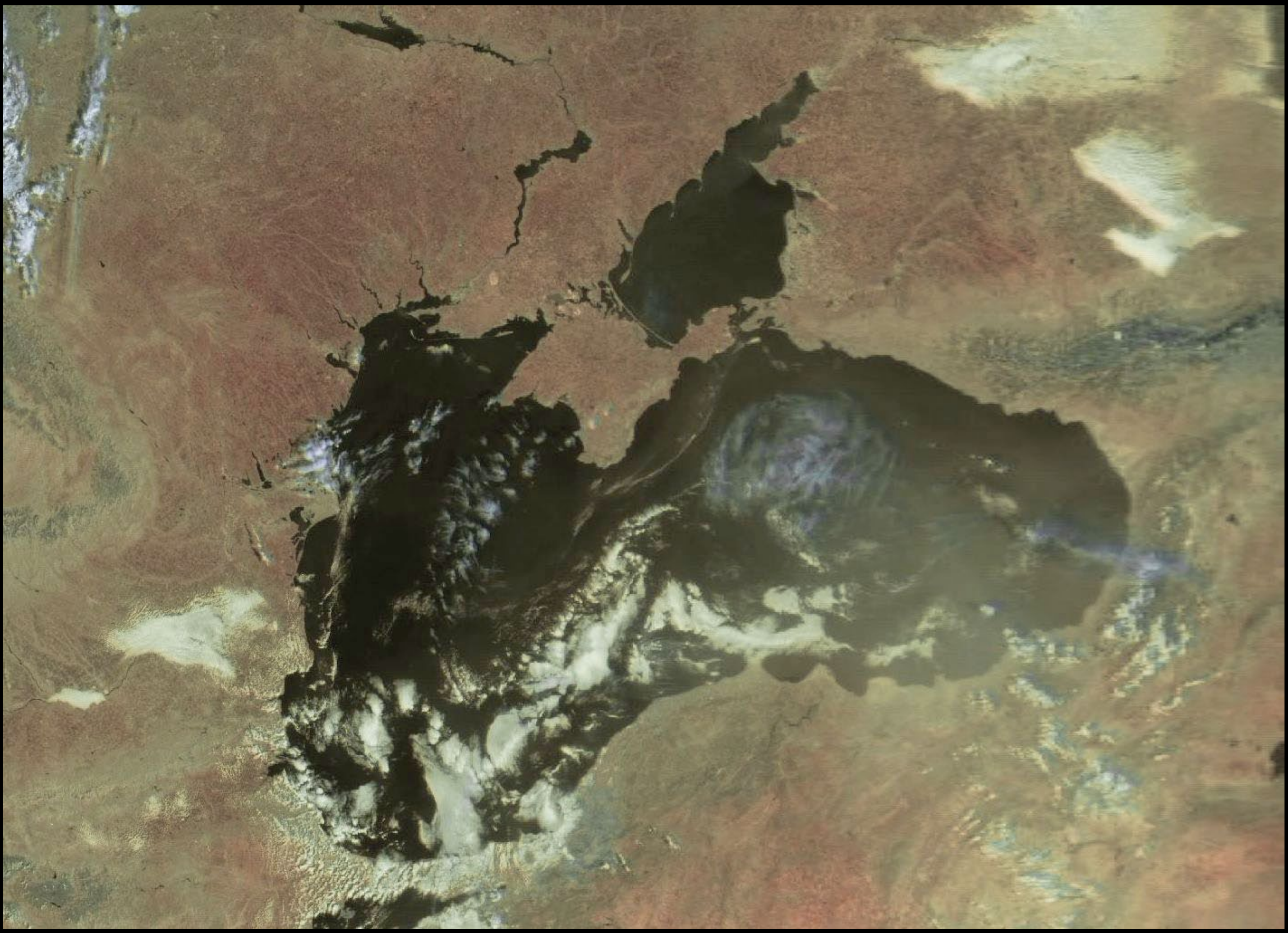
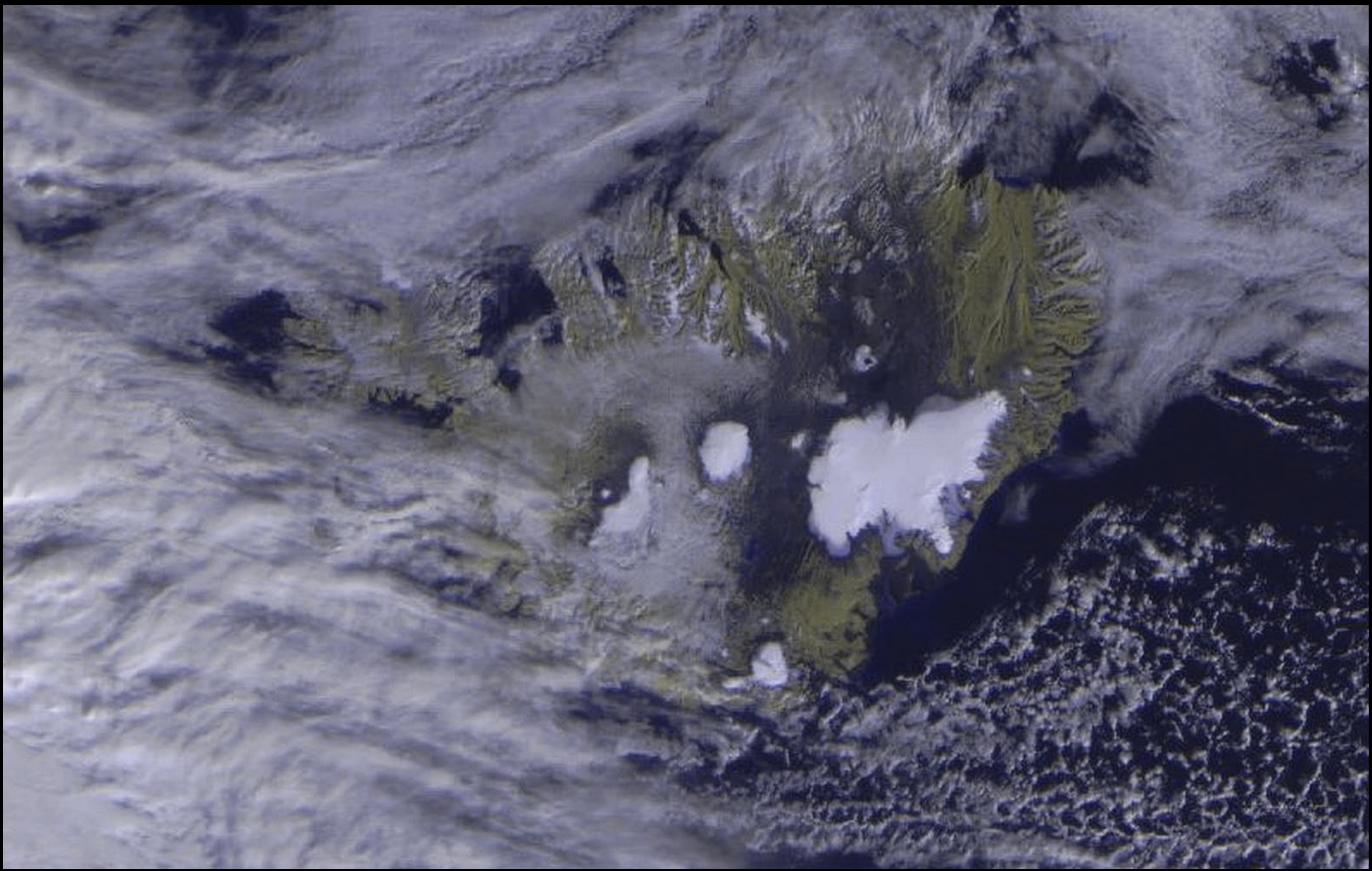


Figure 3 - This is an enlarged view of the red sprite observed over El Salvador.
Credit @ NASA Astronaut Photograph ISS044-E-45576



Peter Kooistra obtained this excellent Meteor M2 image showing the entire Black Sea from the 08:05 UT pass on September 20, 2015.



Another interesting Meteor M2 image from Peter Kooistra, of Iceland at 13:20 UT on September 25

TBS-6908

The Professional DVB-S2 Quad Tuner PCIe Card

Mike Stevens

This is the latest DVB Tuner Card from our friends in the Far East, and what a card it is!, I have been running one since July/August 2014 without any problems at all, so let me give you some technical details about this unit.

Technical Details

The **TBS-6908** is built to the highest possible professional standards and shows rock-steady reliability, which is capable of supporting ACM/VCM Multi-input stream, 16APSK and 32APSK Generic Stream Mode. Application of a unique DVB-S2 Demodulator Chipset makes it possible to receive all these modes at a rate of up to 190 Mbit/s channel bit-rate capture. It also has a wide range of symbol rate support from 1 Msps to 45 Msps, and is capable of High Speed Data download via a satellite link. The receiving Frequency ranges from 950 to 2150 MHz.

Power consumption is 0.66 - 33.13 watt, and it will support Data Burst and Tone Burst, DiSEqC2 and Motor. The card will operate on Windows XP/Vista/7/8/10 and Linux operating systems.

Installation

By now, most readers will be aware of PCIe Cards and how to fit them into a computer. The TBS-6908 is no different, fitting neatly into to a PCIe Slot on the motherboard, with one exception: this particular card will only fit into a full size, 19 cm wide PC. As it is a Quad Tuner, it has <u>four</u> LNB inputs, making it impossible to fit into the narrower and smaller 9 cm wide small form factor desktop PCs (figure 1).

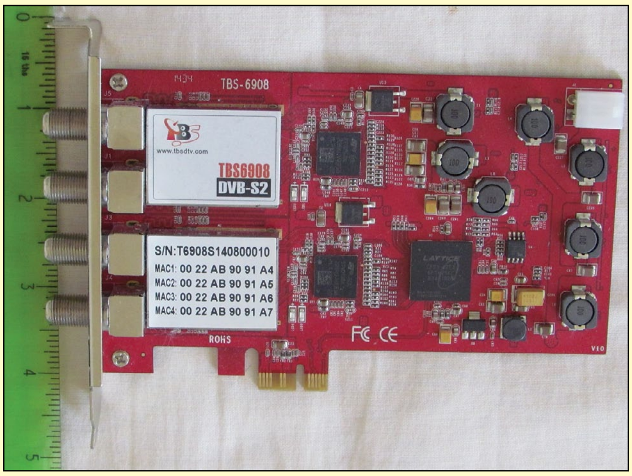


Figure 1 - The TBS-6908 PCIe Card

That is the only drawback, however, and all other connections are the same as for the TBS-6925/6983, with an additional connector for supplying power to a satellite dish rotor, should you plan to use one.

Once you have removed the cover and inserted the card into the PCIe slot its a case of downloading the required software from the TBS website at

www.tbsdtv.com/downloads

and installing same. The specific software required is as follows:

- TBS 6908_windows_driver_v1.0.0.6
- TBS_IP_Tool_v3.0.4.6
- TBS_tsrecorder_v3.0.1.1 (this is required for test purposes)

Just as a precaution, I downloaded these to a flash drive, then installed from there once I had checked for any problems.

I advise to start by installing the **6908 Windows Driver.** And do not forget the **dpinst** file ('dpinst64' or 'dpinst86', depending on whether you run a 64-bit or 32-bit system); without that file the system will not open correctly as many members have discovered.

Once this software is installed, you then continue by installing the **TBS-IP Tool** software. Follow the on-screen details and all should be well. Then finally, of course, the last item is the **TS-Recorder** software. Immediately all three packages have been installed, I recommend a system restart to bed everything in.

System Set-up

After the PC has come back on-line you should have new icons on your Desktop for *TS-Recorder* and *TBS-IP Data*. Click on *IP-Data* to open the screen shown in figure 2 at the **Tuner Setting tab**. This is where you must enter all the relevant data for *Satellite*, *Frequency*, *Symbol Rate* and *MODCODES*.

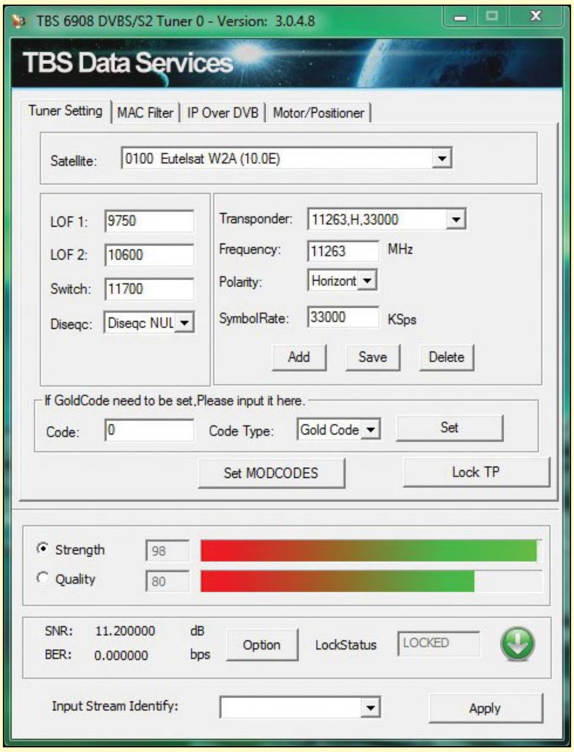


Figure 2 - The Tuner Setting Tab

Then press the '*Set MODCODES*' button to reveal the screen where you must tick the correct boxes for the services you wish to receive (figure 3):

- '8PSK_3/5' for the Basic Service
- '16APSK_2/3' for the High Volume Service.

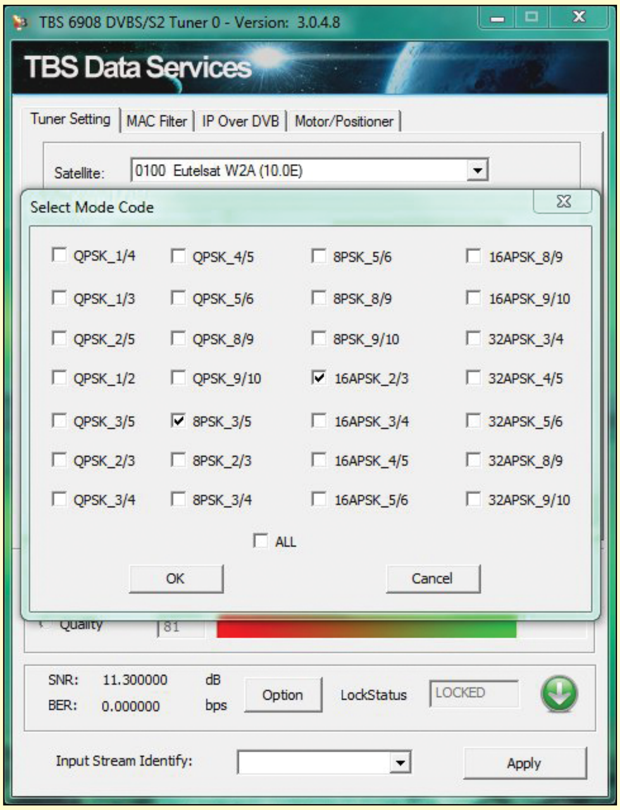


Figure 3 - Selecting the appropriate MODCODES.

You then open the **IP Over DVB tab** (figure 4) where you must enter all the *EUMETCast PIDs*. Once that operation is done, **switch off** the *TBS Data Services* box and reboot. You should now see the red-to-green bars in your *Strength* and *Quality* section, indicating that the system is receiving data from *EUMETCast*.

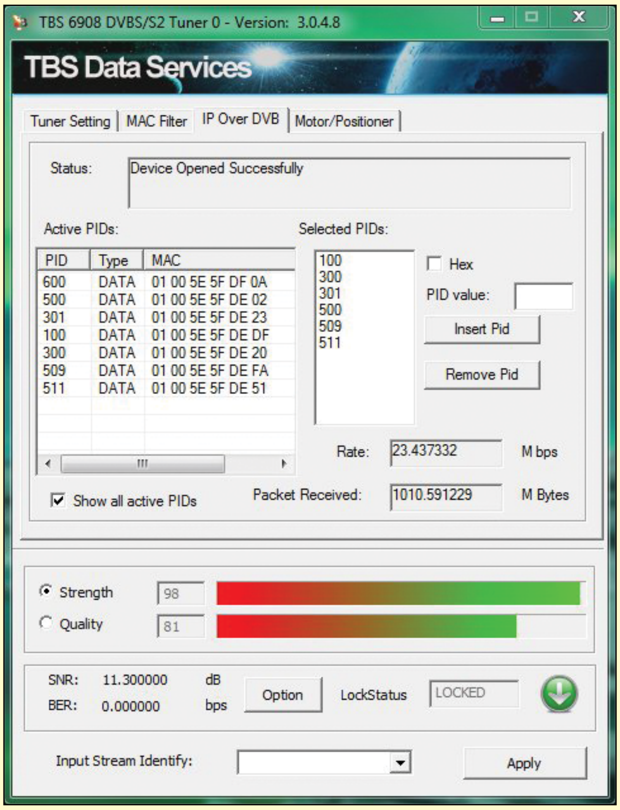


Figure 4 - The IP over DVB Tab

Next comes the task of making sure that *TBS-6908* card talks to *Tellicast* (which I assume is already installed). Open the **Network and Sharing Centre** and change the adaptor settings, locate **Virtual MPE Decoder Adaptor**, right-click, and go to *Properties* to enter in our old friend 192.168.238.238, which should coincide with the Interface Address in your *Tellicast* '*recv.ini*' file.

Next I advise going into **Windows Firewall** and allow the new programs to operate. You may need to use the **Command Prompt** to run the programme, to enter the line 'Run as Administrator' (see my article on the TBS-6925 in *GEO Quarterly* 44).

Once all that is completed, I would again advise a system re-start to bed everything in. When you next reopen *TBS-IP Data*, your tuner should open correctly and EUMETCast files should be coming into the system.

You are now ready to run David Taylor's software (MSG DataManager etc.) and start receiving some excellent satellite images.

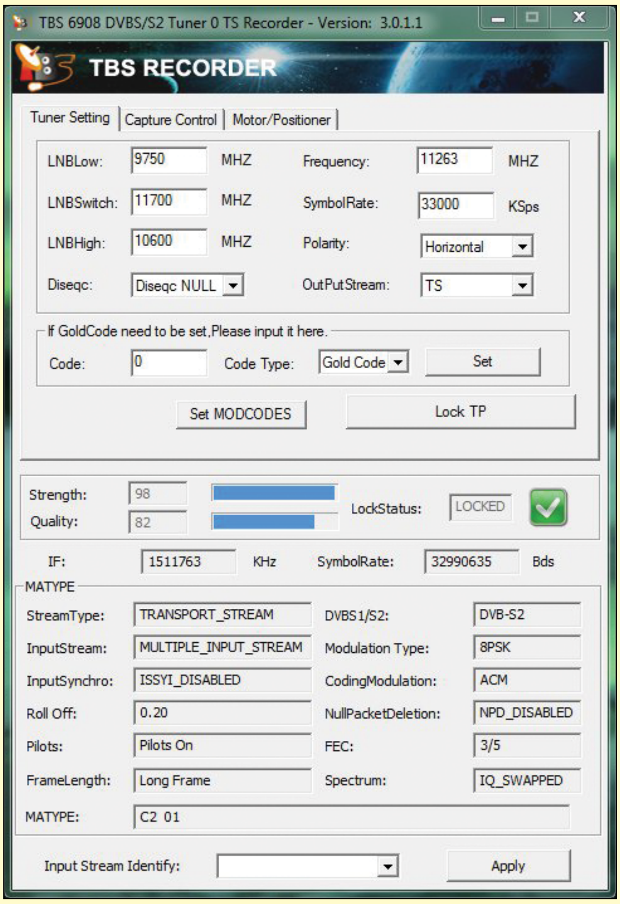


Figure 5 - The TBS-TSRecorder Capture Control Tab

TBS-TSRecorder

TBS-TSRecorder (figure 5) is a handy piece of software which allows the user to see the type of transmissions being received at the tuner. On the bottom half of the screen you have all the relevant details and information to show you what your Tuner is physically capable of.

Don't forget to add in all satellite details, and if you go to the **Capture Control tab**, you will find that you can set and record a *Q-capture file* for more analysis later. This has been used by me to send a file to *TBS Support*, for them to look into back at HQ.

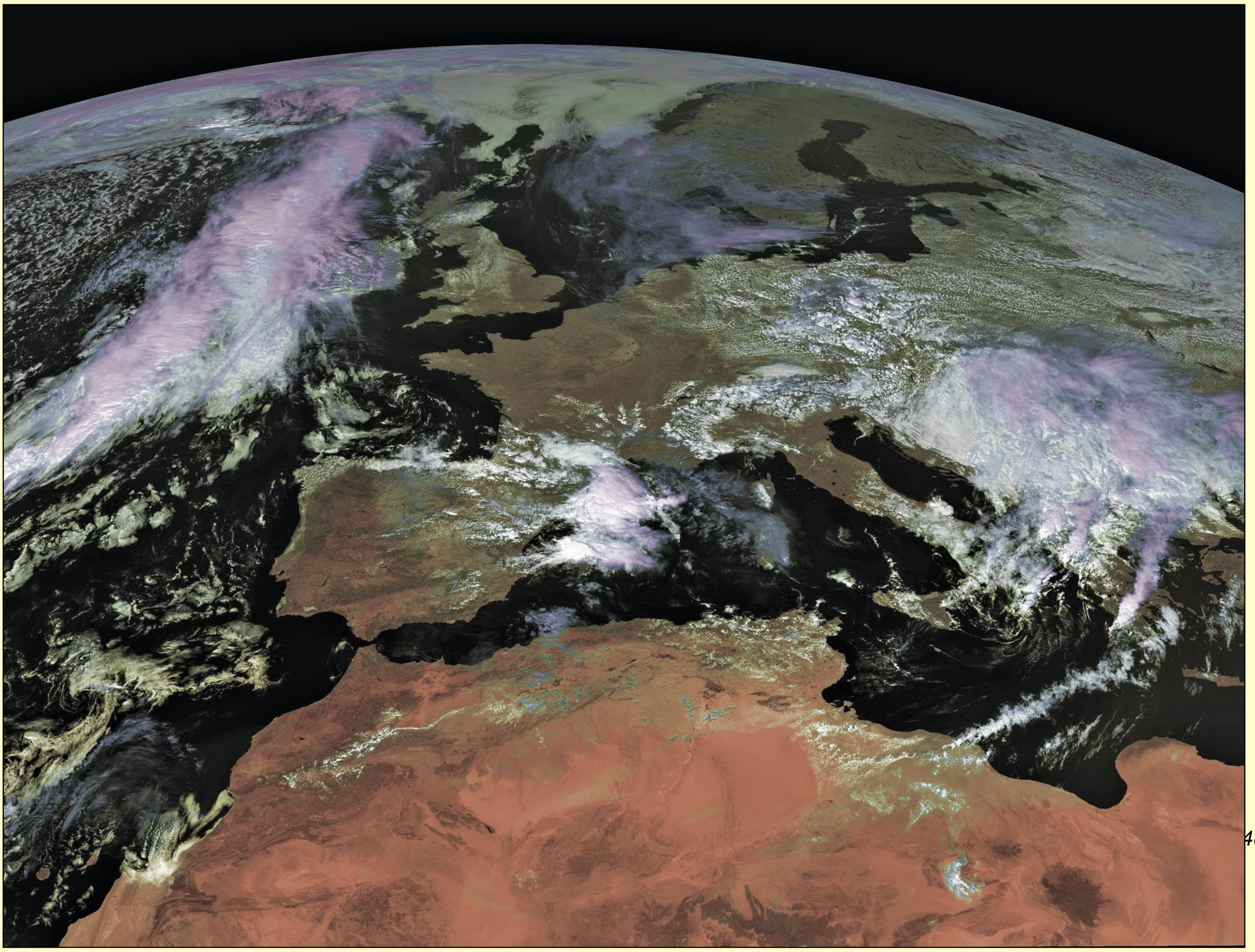


Figure 6 - A Meteosat-10 image acquired at 12:15 UT on September 10,2015
Image © EUMETSAT 2015

Finally, you must run *TBS-TSRecorder* using 'Run as Administrator', and you cannot run the TBS-6908 at the same time. To reactivate the Tuner, you must switch off the Recorder, and sometimes may even require a PC re-boot to unlock the receiver.

Multiple LNB Inputs

If you plan to use the TBS-6908 receiver card, you will have three additional LNB inputs to play with. The tuner will handle them all, which gives you a lot of scope to carry out experiments with other satellites and different broadcast channels simultaneously with reception of *EUMETCast*. I have done this myself with no adverse effects at all using *DVB-Dream v 26*, so happy weather watch and satellite hunting from Portland.

The TBS-IP Data software, used in these trials at the time of writing this article, was not officially released but should now be available. Also, there is now a new PCIe Card available, the TBS-6903, which I will look at in detail and report back on for users later.

My thanks to *TBS Support,* whose help has been invaluable in testing these new tuners. I am sure there will be more to follow, getting ever more user friendly and affordable.

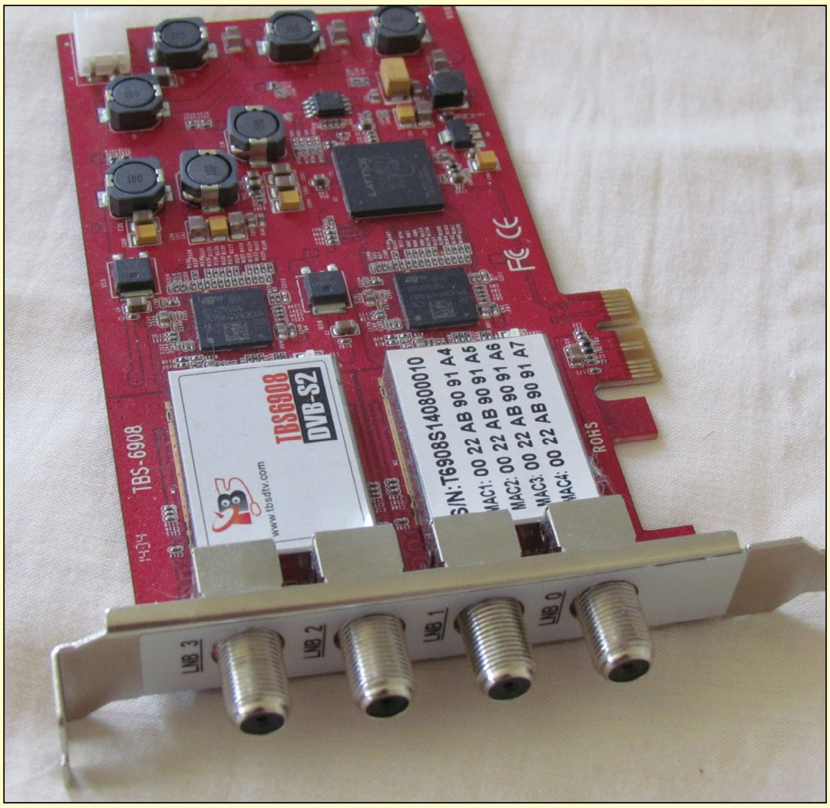


Figure 7
Another view of the the TBS-6908 PCIe Card, clearly showing the four LNB inputs.

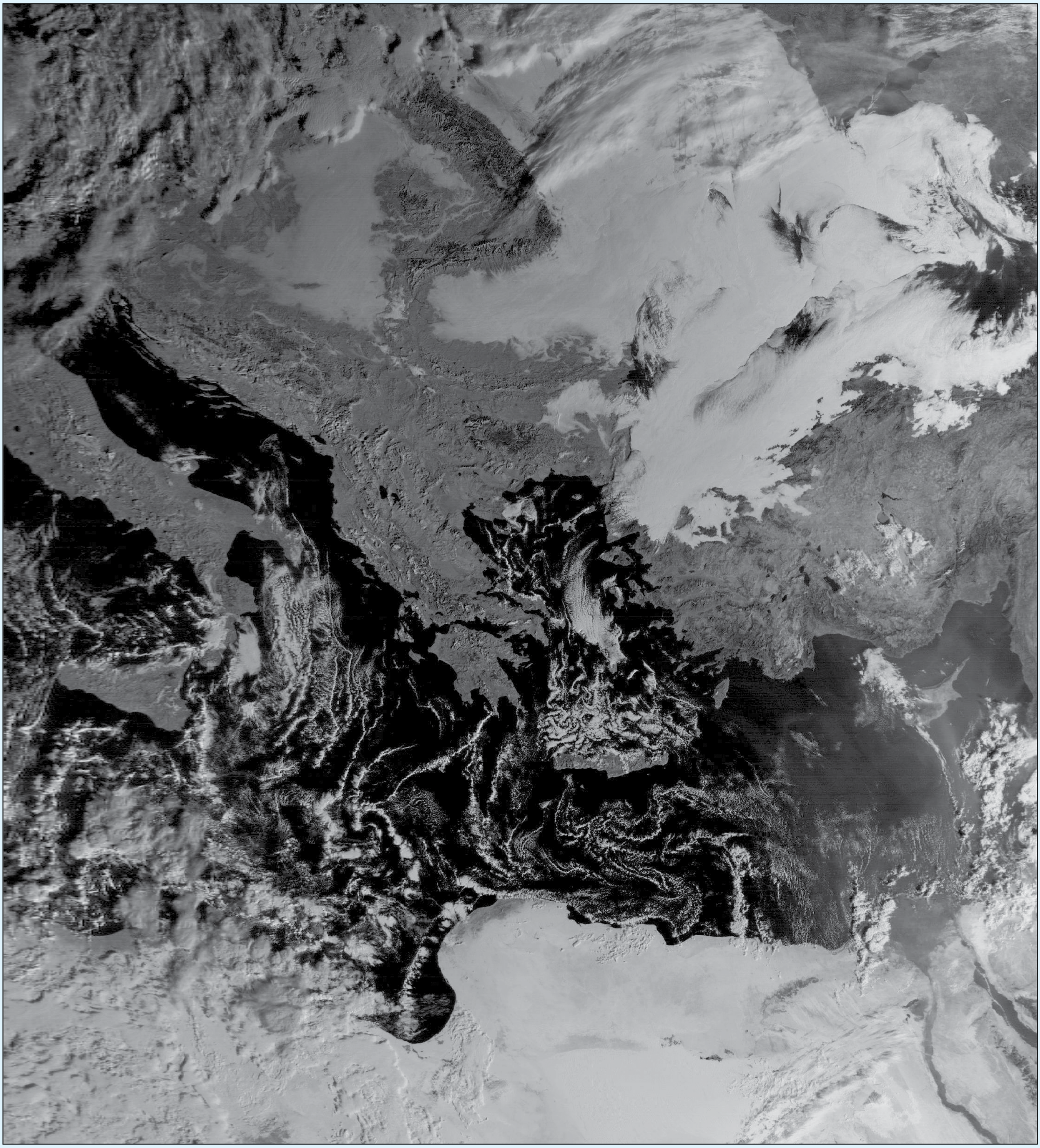
Meteor M1 Transmits Again!

Image from Enrico Gobbetti

After having been withdrawn from operational use on October 1, 2014, Russia's Meteor M1 satellite was reactivated on November 6, 2015. This satellite is similar in most respects to Meteor M2, except that it transmits at the 80k symbol rate and displays a telemetry band at one side of each image. At the time of writing, Meteor M1 is flying close to the Earth's terminator and channel 1 and 2 images are very faint. But channel-3 is producing excellent images, as the 06:36 UT pass reproduced below illustrates.

Enrico's reception system consists of two motors for Az and El tracking, a 9 + 9 element right circularly polarised beam antenna, a cavity filter for 137/138 MHz, an amplifier providing 10-15 dB, 27 metres of 75 ohm coaxial (satellite TV) downlead, and as a USB DVB-T + DAB + FM dongle costing €8.

The software used is SDRSharp with the QPSK v 1.5 demodulator, LRPT Analyser, SmoothMeteor and Microsoft Office Picture Manager to correct the brightness and contrast.



GEO Symposium

At the National Space Centre, Leicester

Saturday, April 23, 2016

Francis Bell

Similarly with previous years, GEO has booked the National Space Centre, Leicester for our 2016 Symposium, which will be held in their '*Shuttle Suite*'. This accommodation is ideal as it provides space for any individual or group to set up a small display or demonstration stand, while leaving us a seating area for more formal business. For more details about the National Space Centre, its location and activities, visit their web site at

www.spacecentre.co.uk

Please note the date, which is Saturday, April 23, 2016.

The impressive entrance and rocket tower at the NSC

Timings

The programme for the day is not yet fixed but is likely to run between 9.00 am and 5.00 pm, which will include time for our members or other groups to make presentations, followed by an AGM at the end of the day. There will be breaks during the day for lunch and for visiting the NSC's exhibitions areas.

Presentations and Displays

The following groups have been invited to contribute to our day's activities:

- Leicester University Space Department – with particular reference to the GERB instruments being carried on weather satellites
- EUMETSAT
- Surrey Satellite Technology Ltd. (SSTL)
- NOAA
- Space Band - with reference to their SR1 receivers
- European Space Agency (ESA) - hopefully a presentation similar to the one given when GEO visited ESOC last July.

Note that the above is a list of invitations of attendance: it has yet to be confirmed and is not guaranteed. Additionally, if you—or any individual or group you know—would wish to make a worthwhile contribution to our symposium, please contact Francis Bell by email at

francis@francisbell.com

or by telephone on 01483 416897

Location

The National Space Centre (NSC), Exploration Drive, Leicester LE4 5NS is located about 1.5 miles north of Leicester city centre. There is a railway station in the centre of Leicester and a bus service from there to the NSC. If coming by car to the NSC, there is a large car park adjacent to the centre.

Accommodation

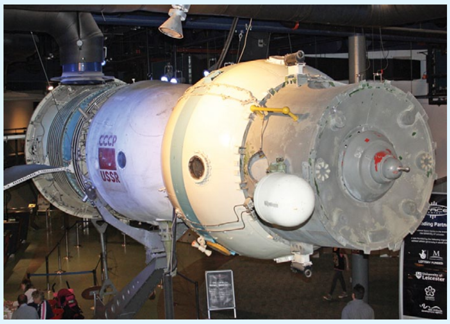
If you are staying in Leicester overnight there are several reasonably priced hotels nearby. As in previous years, I expect a number of our delegates will be staying at the

Ibis Hotel, St. George's Way, Constitution Hill,
Leicester LE1 1PL
Tel: (+44) (0) 1162 487 200

which is only an eight minute car drive from the NSC. For more information about this hotel visit the Ibis website at

***http://www.ibis.com/gb/
hotel-3061-ibis-leicester-city/index.shtml***

Their current price for a twin room about £40 per night.



The Soviet Soyuz capsule on display at the NSC

Symposium Cost

The cost for attending the symposium is not yet fixed and will depend to some extent on numbers but the current estimate is between £10 and £15. The bonus here is the fact that this price also includes entry into the NSC's exhibition area which is very interesting plus free car parking. Good value for money!

Registration

It would be useful if you registered your intention to attend this symposium by contacting Rob Denton at his email address

liaison@geo-web.org.uk

Alternatively you can just turn up on the day. Non GEO members are also welcome to attend, hopefully the experience should provide useful information for anybody thinking of starting their own live weather satellite reception or researching the topic.

Latest Information

For the latest information relating to the symposium and the programme for the day please regularly visit our website

www.geo-web.org.uk

GEO Outreach

Visits to Newbury and AMSAT

Francis Bell

The Newbury Rally

As in previous years, GEO attended the **Newbury Amateur Radio Rally** located on the Newbury show ground. This rally is well attended by the public and offers an opportunity to promote GEO to technically minded visitors.

The venue is a rural showground without a central building, which means we have to be resourceful in demonstrating live satellite signals on our stand. This was achieved again this year and our efforts generated some degree of admiration from those attending. A small number of new GEO members enrolled on the spot but just as satisfying was the promotion of our group to a receptive public.

Although confined to his wheelchair the knowledgeable gentleman, shown in the centre of this photograph signed up as a new GEO member

The GEO stand at the AMSAT-UK 2015 colloquium where we displayed recorded satellite images and demonstrated the use of SDR dongles.

The AMSAT-UK Colloquium July 2015

I have been a member of **AMSAT-UK** for about 20 years and, as best I can judge, it is still a flourishing organisation—albeit with a specialist interest area. Their main activity relates to communication with amateur radio satellites, but like myself, there is often a wider interest in satellite communications. GEO has attended AMSAT-UK annual colloquiums for many years, sometime giving a presentation relating to weather satellites.

This year the event was held in Guildford using the *Holiday Inn* as a venue, with SSTL close by for visits to their satellite production facilities. GEO made no formal presentation during the two and a half day event this year, but we did run a stand illustrating recorded weather satellite images. There was general interest in our stand and a small number of people joined GEO as new members. Also on the stand we demonstrated the use of SDR dongles, which attracted the attention of many visitors, and within a very short space of time all the stock that we had taken to the event was sold. Other AMSAT-UK members ran live satellite reception from several amateur radio satellites including the recent cubesats.

AMSAT-UK members arranging antennas for live reception

My thanks to David Simmons for his support at both the Newbury and AMSAT-UK events.

Special Note

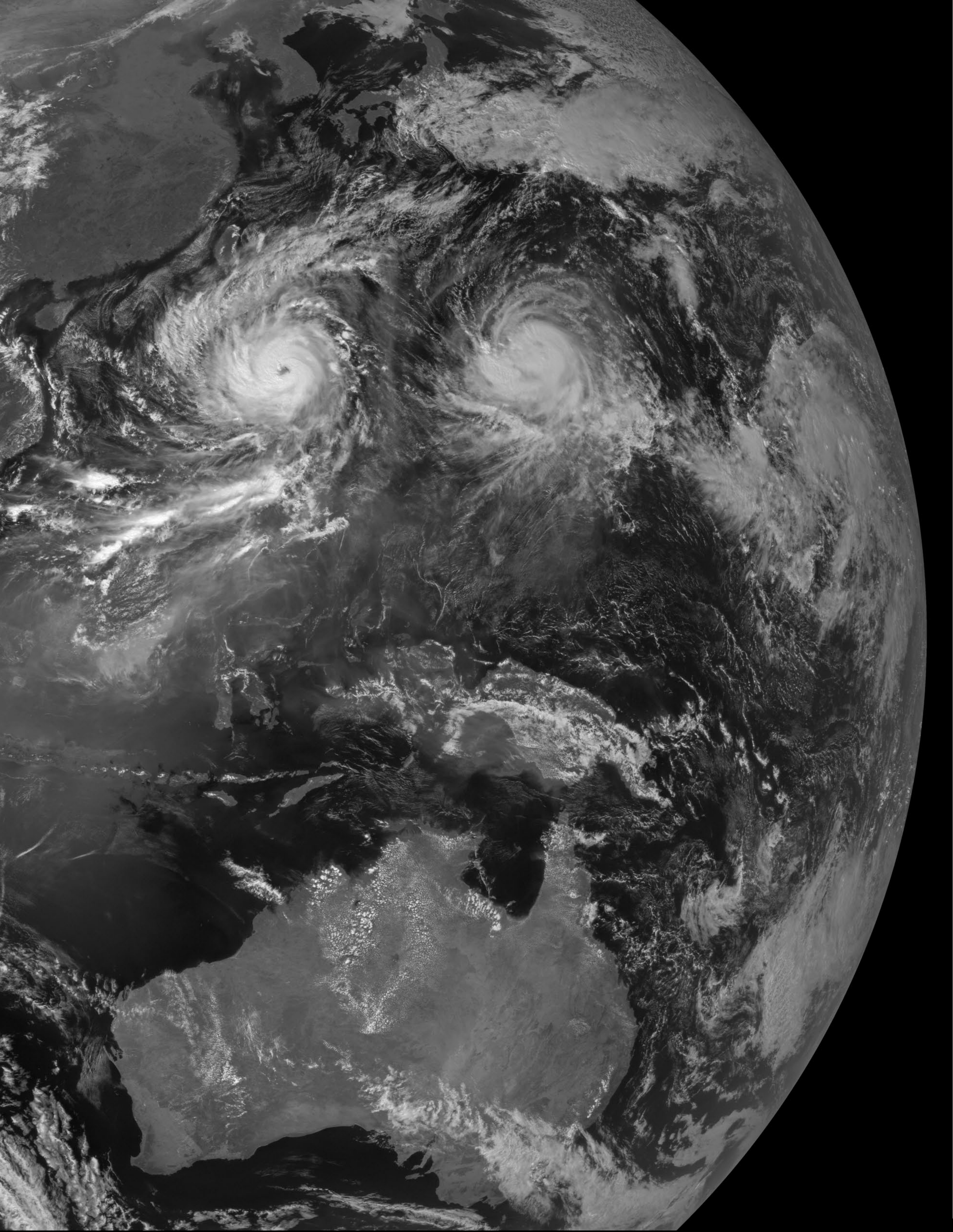
If any reader knows of a Club or Event where there is potential interest in weather satellite reception or other earth observation please, try to be supportive and contribute if you are able. The GEO Group may be able to help by providing information or back-up for such an event if we know in time.

Please contact Francis Bell by email at

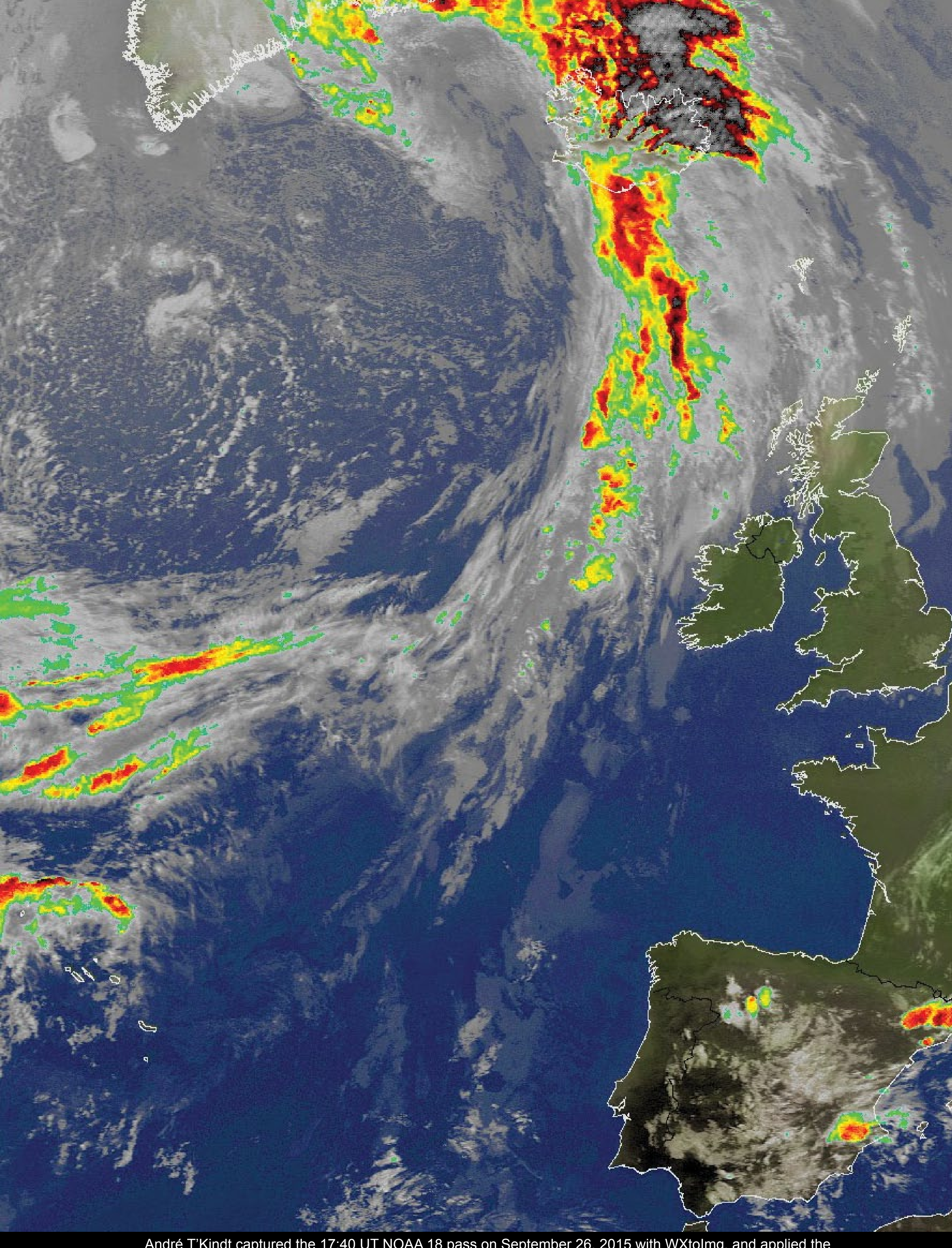
francis@francisbell.com

if you need help or advice.

AMSAT delegates awaiting the next presentation



This section from the 04:30 UT image captured by China's Feng Yun 2F satellite on October 17, 2015 shows Typhoon Koppu poised to make landfall over the Philippines. The fifteenth typhoon of the season, Koppu's 200 kph winds whipped up coastal surges 4 m high and drenched the islands for over three days causing major flooding and displacing thousands from their homes.



André T'Kindt captured the 17:40 UT NOAA 18 pass on September 26, 2015 with WXtoImg, and applied the *MCIR with Precipitation* overlay to highlight heavy rainfall in the depression to the northwest of Scotland.

Magnetic Storm Disables Meteor M2

Les Hamilton

Readers will recall that we reported on an unusual Meteor M2 image in our previous issue, resulting from a loss of spatial orientation. Another similar event occurred on September 23, when the 08:42 pass produced an unusual 'twisted' image and the subsequent pass no image at all. A report from *Moscow's TASS News Agency* attributed the problem to a magnetic storm, which caused the failure of a microcontroller on one of the craft's orientation system subsystems. Thanks are due to Enrico Gobbetti, who sent in part of the Meteor image (figure 1) along with a NOAA 19 APT image (figure 2) from a few hours later for comparison. Enrico also forwarded a link to a report on the situation on *lifenews.ru* at

http://lifenews.ru/news/162238

which cast additional light on the problem.

Apparently, the fault—which was attributed to a solar flare—was discovered thanks to images provided by radio amateurs. These images clearly showed that the sensors aboard Meteor M2, which should have been pointing vertically downwards towards the Earth's surface, had become aligned more towards the limb of the planet. This led to the conclusion that the satellite had started to spin out of control. Restoring the operation of the microprocessor took specialists about an hour and a half, after which the satellite returned to normal.

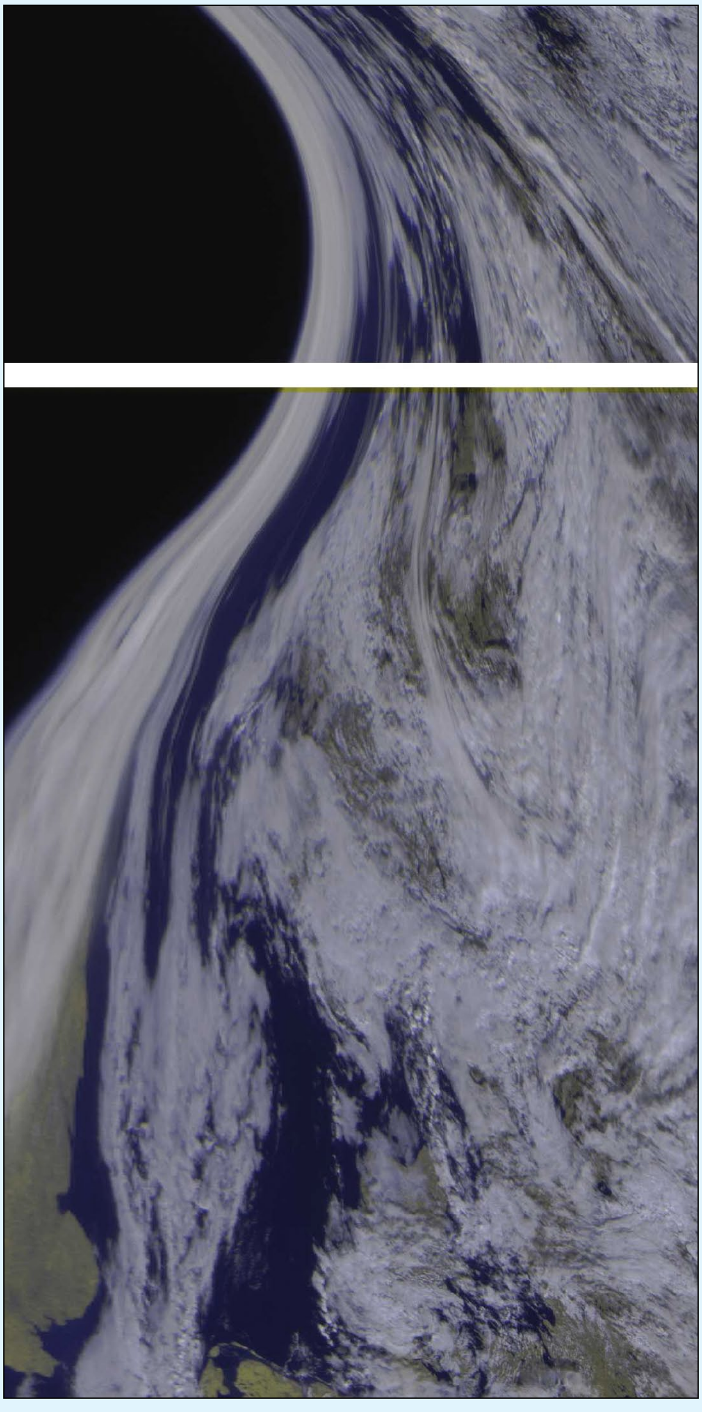


Figure 1 - The aberrant Meteor M2 Image at 08:42 UT

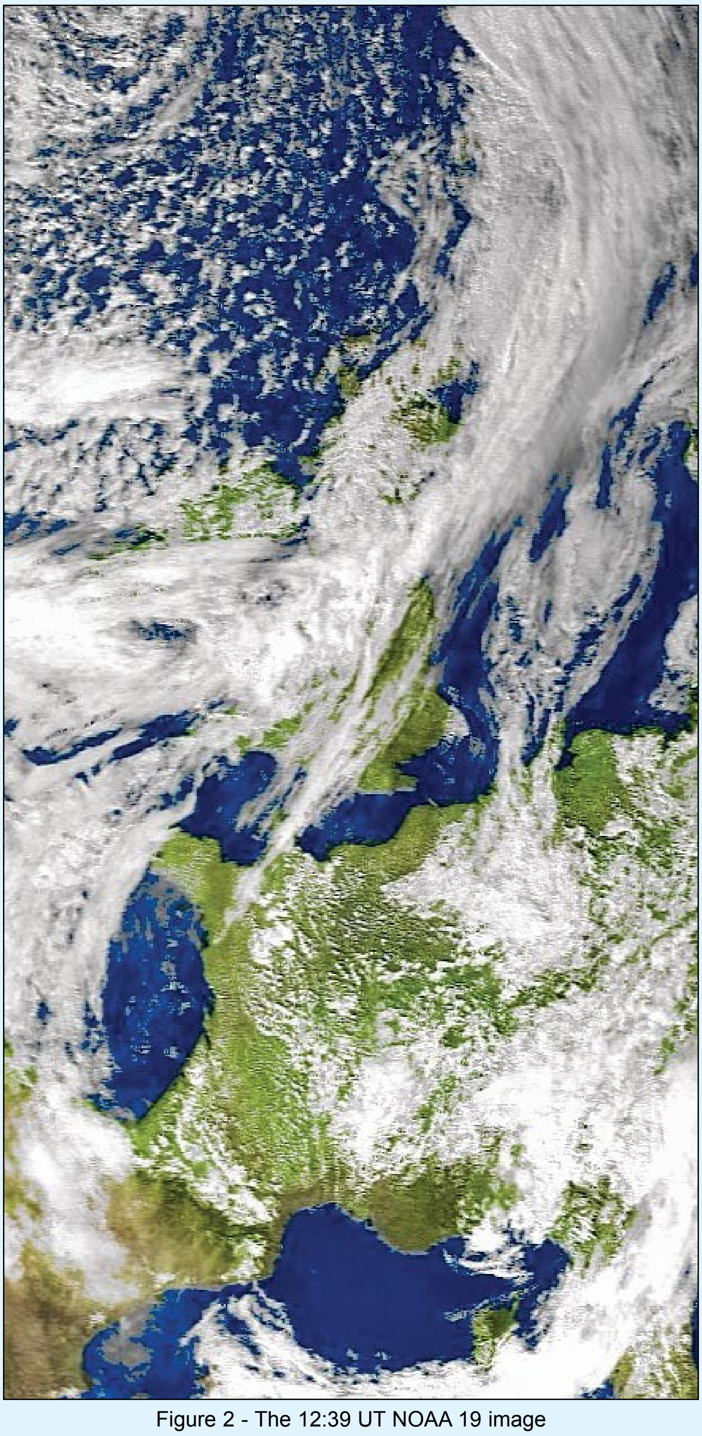
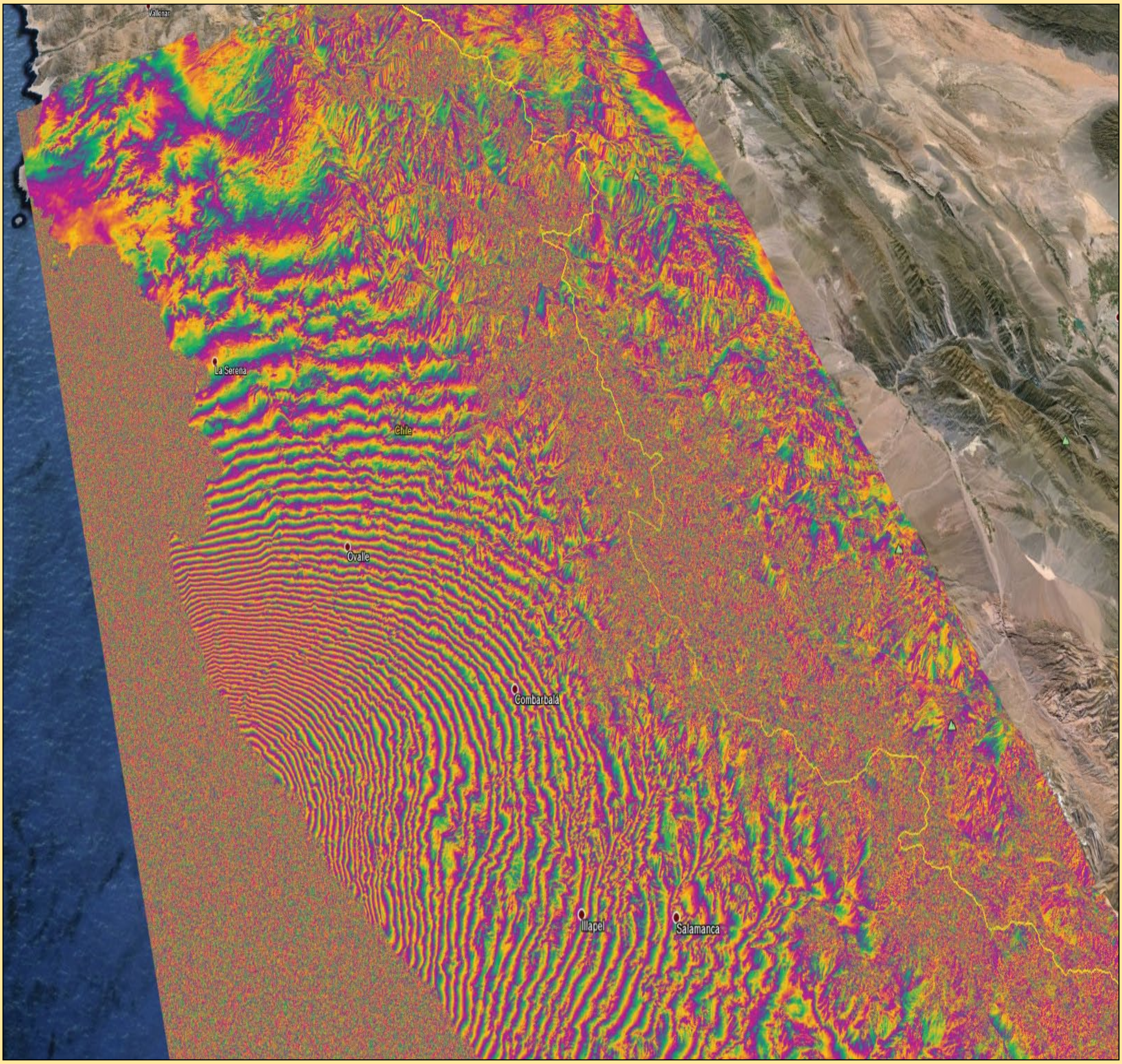


Figure 2 - The 12:39 UT NOAA 19 image

Chile Earthquake on the Radar

ESA: Space in Images



This image contains modified Copernicus Sentinel data (2015)

On September 16, 2015, an 8.3 magnitude earthquake struck the coast of central Chile, triggering tsunami warnings and coastal evacuations. Lasting three minutes, this powerful earthquake occurred along the boundary of the Nazca and South American tectonic plates.

By combining Sentinel-1A radar scans from August 24 and September 17, the rainbow-coloured patterns in the image show how the surface has shifted as a result of the quake. Interferograms such as this allow scientists to quantify ground movement. By counting the fringes, it is estimated that the earthquake caused a displacement of 1.4 metres along the viewing direction of the radar observation. In addition, a 0.5 metre horizontal movement was estimated along the flight direction of the satellite.

Sentinel-1A's all-weather, day-and-night radar imagery is particularly suited to support impact assessment for many types of geohazards. Read more about ESA's *InSARap Project* at ***insarap.org***.

Sentinel-1A, developed and operated by ESA, was the first satellite launched for Europe's environmental monitoring *Copernicus* programme, is led by the European Commission.

GEO Visit to EUMETSAT

Francis Bell

This year's trip to Darmstadt was GEO's third visit to EUMETSAT's HQ and ESA's ESOC centre. We seem to be following a four yearly cycle with these visits.

Our visiting group consisted of 22 GEO members from five different countries. I think most if not all of us stayed in a central Darmstadt hotel, just a twenty minute walk from EUMETSAT's HQ and a similar distance from the ESOC facilities. A bonus for us was the proximity of a number of delightful eating places for evening meals which, together with some staff from EUMETSAT and ESOC, made for very enjoyable evenings after the day's technical business.

Without doubt the most striking feature of our day at EUMETSAT was the personal support and welcome we received from the staff who work there, some of whom we have known for many years. Other features which I noticed were the complex and thorough preparations behind the technical details which lay behind our tour of their buildings and the more formal presentations which we experienced during the day. If you have the opportunity to view the computer-based materials which formed part of the presentations, you will see that they were personalised for our visit. [See the separate notice about obtaining the CD containing these presentations.]

Prior to our visit, the day's programme was agreed and some variations made at our request, giving us time to visit more of their control facilities and large new data storage facility which lies adjacent to the Headquarters building.

The programme for our visit, shown below, also lists some of the many EUMETSAT individuals who were involved with us. Some of the names may be familiar because they have made presentation at our own GEO Symposiums in Leicester. We followed the agenda quite closely, with only the lunch break being shortened a little because of our

Figure 1 - A full scale modle of a Meteosat outside EUMETSAT HQ with the new data storage building in the background

Figure 2 - The EUMETSAT HQ building with the new data storage building shown just beyond the flags

GEO Visit to EUMETSAT - Darmstadt 2015

09.00 - 09.15	Registration	
09.15 - 09.30	Welcome address and Overview of Current Satellite Operations	Livio Mastroddi Director of Operations & Services to Users
09.30 - 10.30	EUMETCast DVB-S2 Operations and Future High Volume Service	Klaus-Peter Renner Dissemination System Manager
10.30 - 10.45	Coffee Break	
10.45 - 11.15	Future Satellite Services - Sentinel-3	François Montagner Competency Area Manager – Marine Applications
11.15 - 11.45	Future Satellite Services – MTG	Stephan Kox Lightning Imager Support Consultant
11.45 - 12.20	Tour of the Technical Infrastructure Building	Peter Muellner Technical Infrastructure Manager
12.30 - 14.00	Lunch	
14.00 - 14.45	Presentation of a Case Study	Jochen Kerkmann Training Officer
14.45 - 15.15	Tour of the Control Rooms	Phil Harvey Ground Segment Analyst
15.15 - 15.30	Coffee Break	
15.30 - 16.00	Update on User Service Activities (UNS, WMS, Data Centre Ordering Client)	Sally Wannop - User Relations Manager Kim-Hui Gaune – User Support Officer Harald Rothfuss – Data Centre Operations Manager
16.00	Wrap-up and Group Photograph	Sally Wannop – User Relations Manager

The Agenda for the EUMETSAT Visit

Figure 3 - A group photo outside the EUMETSAT HQ

morning extended visit to the Technical Infrastructure Building.

Our main meeting area was in the Council Room which was suitably equipped with a PA system and a computer projector. There were six sessions in this room, as listed on the agenda. It is not possible to relate all the content of these sessions but in summary they were as follows:

1. The welcome address was given by EUMETSAT's Director of Operations, who also outlined EUMETSAT's current satellite operations (figure 6, next page). The presentation covered each of the main headings shown on the slide.

2. This presentation indicated that future data rates via the EUMETCast service will rise in the coming years. This did not surprise me, as technology and innovation will never end, but I recognise that I may struggle to collect all the available data. Figure 7 illustrates potential future data rates via the EUMETCast service.

3. I must say I was on a sharp learning curve in relation to the ESA *Copernicus* programme and its *Sentinel* satellites, which were outlined during this presentation. The programme involves a series of satellites and EUMETSAT have a role in the dissemination of some of the data generated. EUMETSAT is already dealing with *Sentinel 2* data, and I note since our visit that *Sentinel 3* has been successfully launched and images are being disseminated.

4. This presentation related to MTG satellites which are expected to come into service in a few years time. Unlike EUMETSAT's previous spinning satellites, MTG will be based on three axis stabilised satellites carrying many instruments as illustrated in figures 8 and 8a. These diagrams give a broad perspective of the planning and imaging capabilities of the MTG satellites.

5. This presentation used a series of case studies of atmospheric observations. These are available to readers, as are all the presentations, from the GEO website. The URL appear at the foot of this page.

6. This presentation related to stored data, not only from EUMETSAT's own satellites, but also from their international partners. Guidelines for access to the immense database, which is steadily being archived, was illustrated (figure 9).

7. This was the final formal presentation of the day, which related to 'User Services' activities. I did not fully understand all the framework of this service but it was well described in the presentation slides: Figure 10 gives more detail.

The Evening

The day's events did not end with our departure from the HQ building because the staff there had booked a local restaurant for an evening meal with us. This extra curricular event was attended by most of the GEO delegates, together with a significant number of EUMETSAT 'ops' staff, plus several of the speakers who had kept us informed during the day.

I would like to place on record how much GEO appreciated what I judge to be our VIP treatment during the day at their HQ but, perhaps as importantly, the delightful social evening we spent together.

ESOC

The second day of our expedition to Darmstadt involved a visit to ESOC. This centre is, unsurprisingly, quite close to the EUMETSAT HQ, because it was only in the 1980s that ESOC's weather satellite activities were devolved into the newly formed EUMETSAT.

Figure 4 - GEO delegates visiting EUMETSAT's main control room

The ESOC establishment is so popular with visitors that the task of organising visits is contracted out to a local tour agency, leaving the ESOC staff to progress their jobs with the minimum of interruptions. For a number of reasons, it took me many months of negotiation with the tour agency to arrange our GEO visit, but eventually

Figure 5 - The busy Sentinel Mission Control Centre

Powerpoint presentations made during the EUMETSAT visit can be downloaded from
http://www.geo-web.org.uk/darmstadt-2015.php

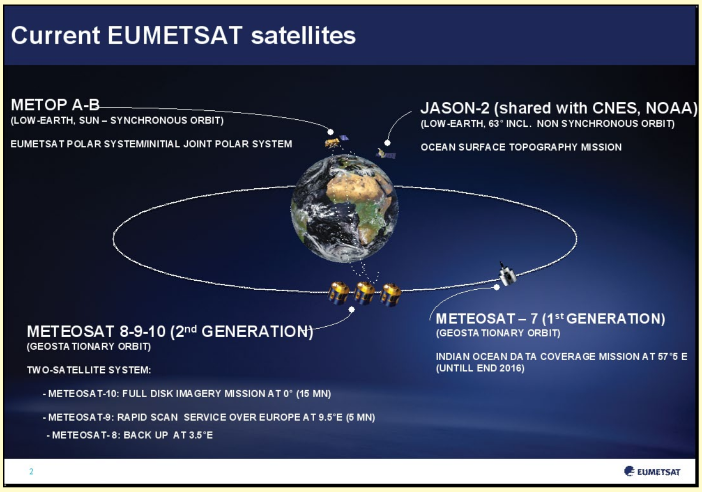


Figure 6 - An overview of current satellite operations

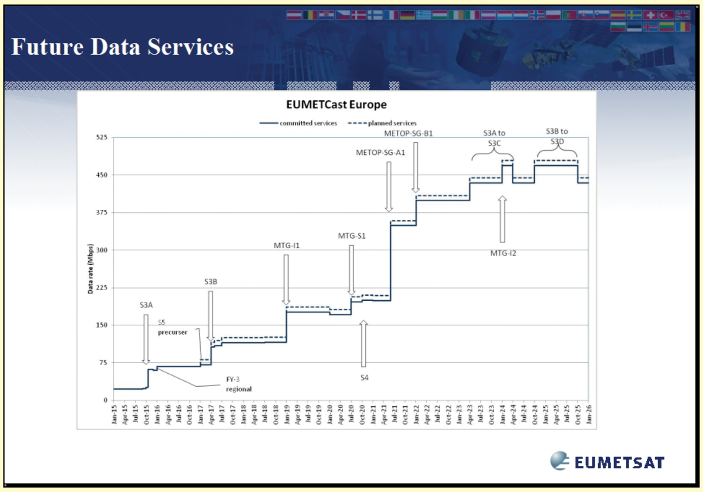
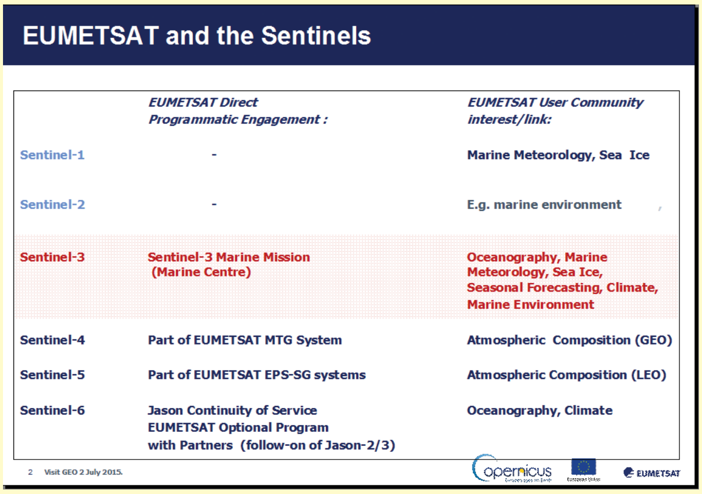


Figure 7 - EUMETCast DVB-S2 Operations and High Volume Service



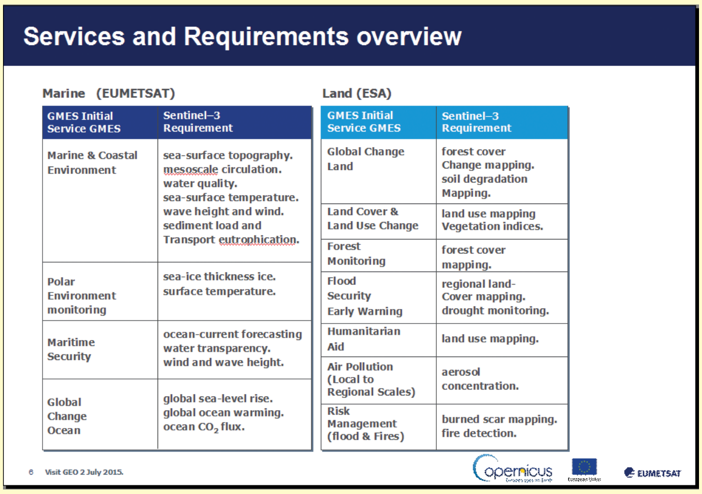


Figure 8/8a - Future Satellite Services and Sentinel 3A Mission

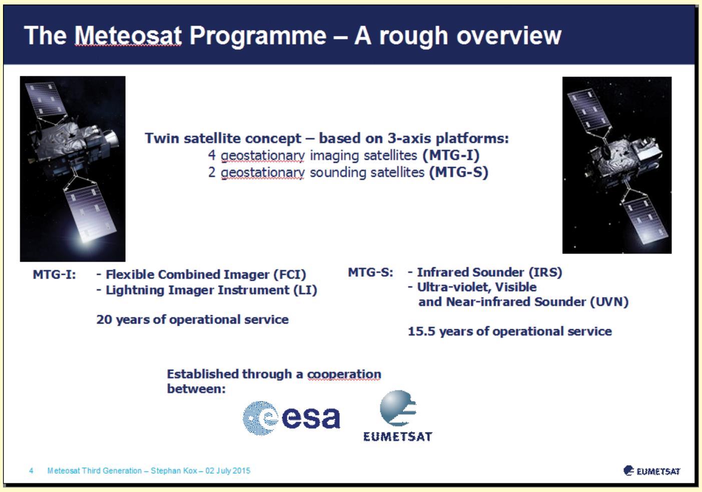


Figure 9 - Future Satellite Services – MTG

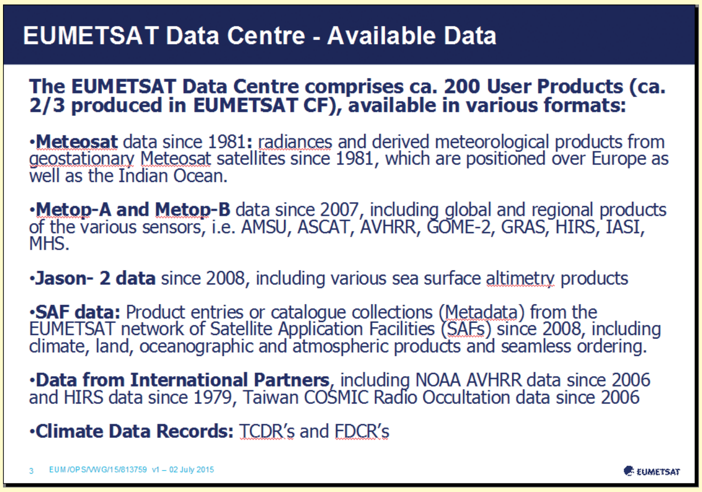


Figure 10 - Data stored by EUMETSAT

I persuaded them of GEO special interests. They must have contacted ESOC about this, because eventually they not only agreed to our visit but also to provide a technical speaker for a one hour presentation at the end of our tour.

Our tour of ESOC took us past the control rooms for many ESA space projects including the Rosetta Mission, the Sentinel satellites and others. In addition to our official tour guide, we also enjoyed the company of Mark Drapes, a GEO member who works at ESOC. He had negotiated time off from his normal duties in order to be able to spend a few hours with us. His additional knowledge supplemented that of our tour guide, and indeed provided us access to some areas not normally accessible during standard tours.

A further bonus to our privileged tour was seeing ESOC's amateur radio station, which is located in a small building separate from the main facility but still within the grounds. I had to smile when we saw, through the window of the radio room, a computer screen displaying live EUMETCast and running David Taylor's software. I think the call sign of the station was DE1ESA.

The final hour of our visit was outstanding. Arrangements had been made for us to receive a presentation relating to ESA's Earth observation projects, and particularly the *Copernicus* programme with its *Sentinel* satellites. I have to say I was on a very sharp learning curve with this brilliant presentation. I will try to keep in touch with this speaker.

Unfortunately, we were not allowed to take photographs inside the ESOC buildings, but outside photographs were allowed and we have one showing our group just outside ESOC buildings.

The evening of this second day was again a very sociable time and it was great that Mark Drapes was able to join nearly all of our GEO visitors for that final evening meal.

I place on record, on behalf of all GEO members, our thanks to the staff at EUMETSAT and ESOC for the technical tours of their facilities, the informative presentations we experienced and the social dimension of friendship plus the evening meals. We very much hope to see you all again in four years' time.

The Darmstadt Presentations

The technical presentations which were given to us during GEO's visit to Darmstadt in July 2015 were mainly illustrated by means of computer generated images using *PowerPoint* software. EUMETSAT recognised that the subjects covered during the day would be valuable to a wider audience beyond those present on the day, and they have kindly made these available for distribution to the membership at large.

Although there is no audio with this visual material, the slides do provide a broad perspective relating to the content of each presentation. They are all now available for download. You will find the links at the foot of the 'Darmstadt 2015' page on the GEO website at

http://www.geo-web.org.uk/darmstadt-2015.php

If any reader is unable to download these through lack of a reliable Internet connection—or for any other reason—I can supply them on a CD. Just contact me by post, or email at

francis@francisbell.com

giving your name and full postal address. I will send a disc to any country providing the costs are covered. There will be a small element for the disc but the postage may be the main cost, perhaps a few pounds. Rather than requesting payment in advance, the most economical option is simply to add the cost to your next membership subscription. I will include note with the disc giving the total charge.

Elements from the disc's content may be published, provided EUMETSAT's copyright is recognised.

GEO Shop Report

Nigel Evans

The *GEO Shop* transferred to Burnham-on-Sea four years ago. Whilst membership has reduced over recent years, the Shop played a major role in supplying the *Ayecka SR1* to GEO members, as well as to commercial and governmental organisations in Europe. In total we have supplied over 170 receivers to date. We also purchased the remaining stock of APT aerials from *Sandpiper* of Aberdare Wales, and have just a couple of these turnstiles remaining in stock. We also decided to stock SDR dongles as they provide the most effective means of capturing images from LRPT data from Russia's Meteor M2 satellite.

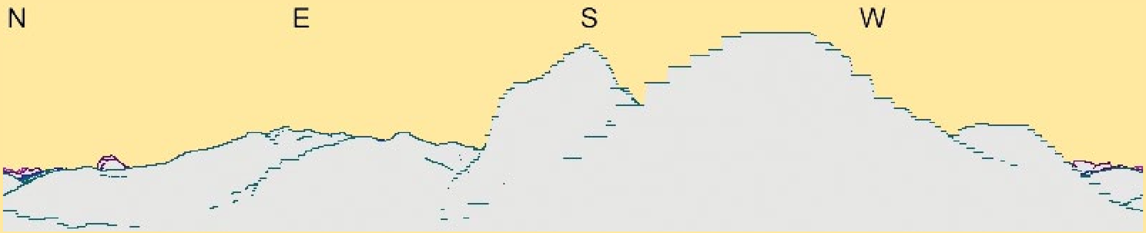
Sales of the SR1 have slowed down recently. GEO has now met the demand from existing members and currently sells SR1s at a rate of two or three a month: the Shop was selling three a day just before the DVB-S2 switchover deadline. Since the start of 2015 GEO has sold 40 SR1s and 40 SDR dongles at the time of writing, and hold stock of approximately 60 SR1 units and 10 SDR dongles.

Items such as LNBs and satellite dishes are no longer stocked. Such items rarely sell and are easily purchased at great prices online from the likes of *Amazon* and *eBay*.

In addition to providing the SR1, the GEO team have provided free support on installing the unit and getting the system up and running: this included helping a couple of individuals who were close to giving up, to get their systems working.

GEO has only had to replace two units under warranty and one power supply. Special thanks go to David Taylor and Arne van Belle for their work supporting members and the Shop. The *GEO Shop* would also like to thank Aharon from *SpaceBand* and Baruch from *Ayecka* for their support and for responding to our feedback on some of the challenges we faced.

The hobby has changed from one where enthusiasts would construct their own receivers and aerials to one which requires complex technical equipment and commercially produced large dishes. Combine this with declining membership, and it's clear that the Shop cannot provide the same scale of financial contribution to the Group as it used to in past years; however, every item sold helps towards funding events such as the Symposium.



What's *Your* Horizon?

Barry Smith

Some enthusiasts of *Low Earth Orbit* weather satellite reception, myself included, like to see if they can receive a satisfactory signal at low elevations. No matter how good the equipment, reception will always be limited by the local terrain and the height of the antenna.

You will have some idea of your local horizon in different directions just using your eyes. In the days before the Internet, measuring the angle of the horizon with a reasonable degree of accuracy could involve using maps, measuring the distance between contours and performing some mathematics. Now, with *Google Maps*, detailed measurements should be much easier. I searched for some time trying to find either a program or a web page that could automate the process. Eventually I stumbled upon

www.heywhatsthat.com

This website has various tools that make use of *Google Maps* with either the map or satellite view, on which elevation contours can be displayed (the data sourced from the United States Geological Survey). I have checked several locations: UK, Germany, Italy, Mexico, USA and even places like Jan Mayen Island, and it appears that it works worldwide... except for Antarctica.

The first facility I used was

www.heywhatsthat.com/profiler.html

which draws a profile of the terrain between two points and displays the latitude, longitude and height (above sea level) of both points, the azimuth of the second point from the first, the distance between the two points and the change in elevation (figure 2).

From my own location I can see a landmark called Jubilee Tower, built on a hilltop 1,200 feet above sea level, overlooking the town of Darwen (which is why, locally, it is known as Darwen Tower).

Generating a Profile

After opening the *HeyWhatsThat Path Profiler* page, start by zooming the map in to the region of interest, or type a placename in the '*Find*' field. If you require to add contours, click the '*Contours*' button at the top right corner of the map. Next, simply click over the map to select two points: the '*origin*' and '*distant*' points.

To locate the '*origin*' accurately you can drag the map (or satellite view) and zoom in on the location then click. To locate the '*distant*' point, zoom out and drag the map, then (if required) zoom in again before clicking. It does not matter if the '*origin*' is not visible on the map when clicking on the '*distant*' point. To see the profile in a different direction click '*Backspace*' once and click on a new '*distant*' point. The '*origin*' selected is maintained until

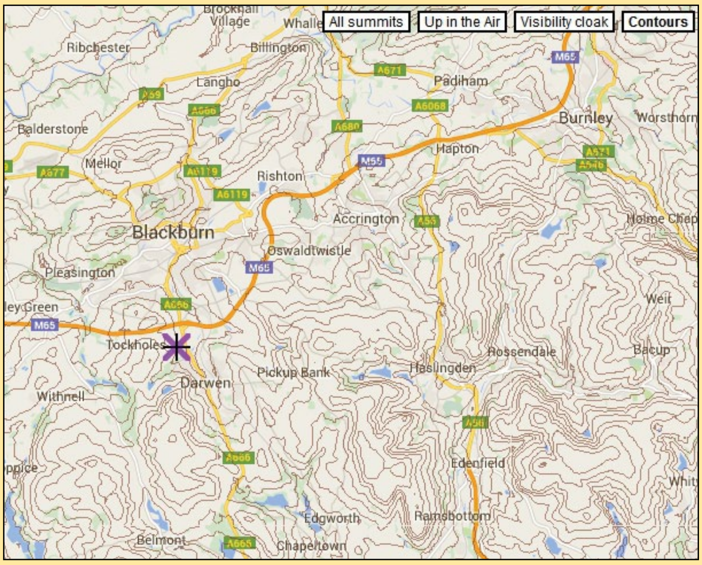


Figure 1 - A modified Google Map with added elevation contours around the author's location (purple 'X')
Mao Data © 2015 Google / USGS

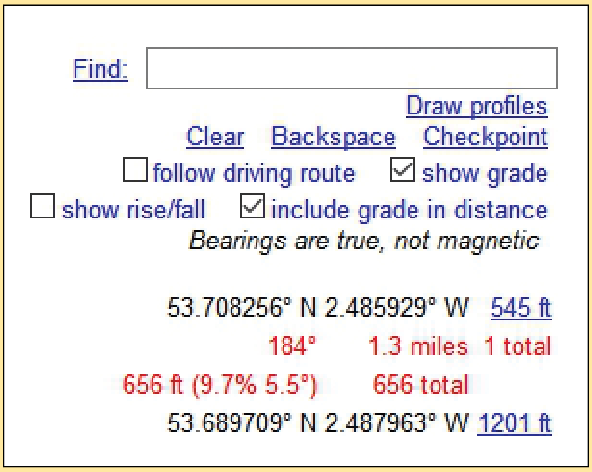


Figure 2 - Profiler Data Display

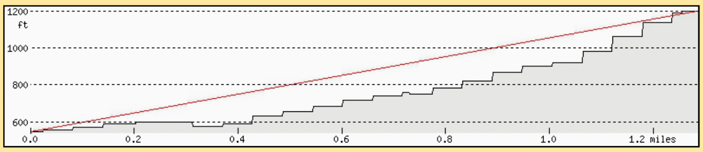


Figure 3 - Jubilee Tower Profile.

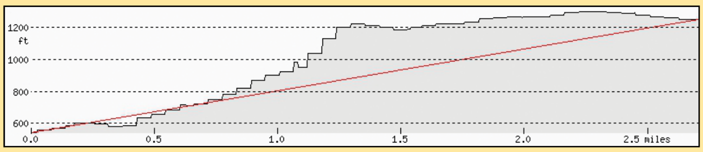


Figure 4 - Profile in the same direction (184 deg.) as figure 3, but with the 'distant' point further away.

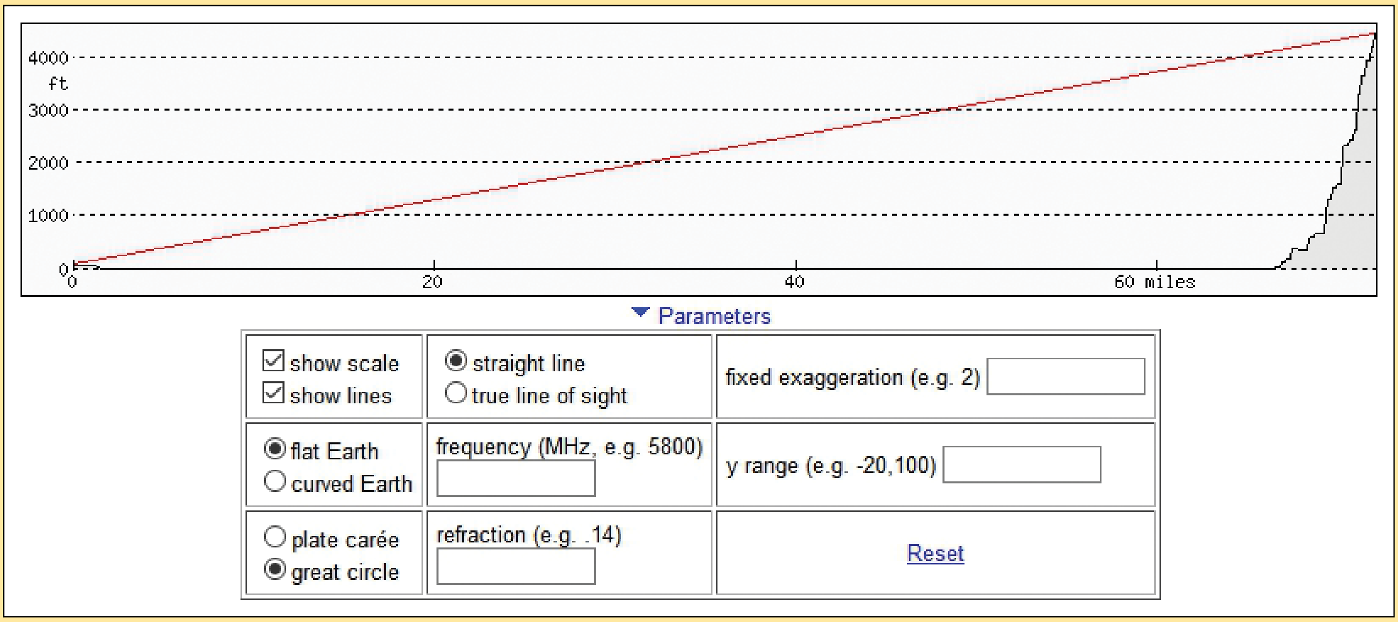


Figure 5 - Reykjavik and Snæfellsjökull profile for an ideal 'flat' Earth

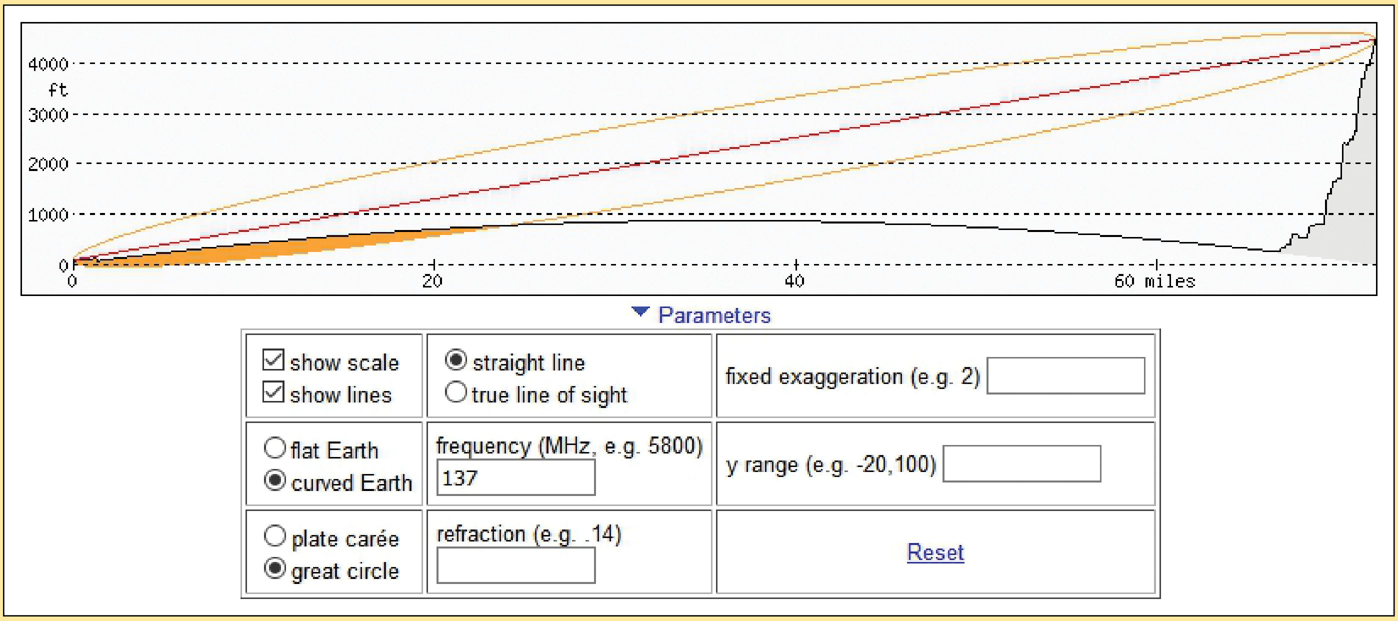


Figure 6 - Reykjavik and Snæfellsjökull profile for 137 MHz with a 'curved' Earth

you click '*Clear*' (or click '*Backspace*' twice).

A profile is quickly generated, along with a table showing all the relevant parameters (figure 2). In my case, the data showed the tower to be 1.3 miles away from me at azimuth 184° and, from ground level at my location, stands at an elevation of 5.5° (figure 3). The profile shows a straight red line between the two points selected. The terrain may be such that the red line 'cuts through' the profile, indicating that the distant point can not be seen from the origin due to closer land at higher elevations. Figure 4 shows the profile in the same direction, but with the distant point further away, and obscured.

The profile can be tailored, by clicking on '*Parameters*' and selecting '*flat Earth*' or '*curved Earth*'. If a frequency is entered, calculations are performed to show deviation from the straight (red) line for high-frequency radio signals. The higher the frequency, the smaller the deviation from the line-of-sight path.

The effect of these different parameters can be seen in the profiles of the path between the Hallgrímskirkja church in Reykjavik and Snæfellsjökull in Iceland (figures 5 and 6). Even though they are 115 km apart, I could see the volcano from the church bell-tower when I was there on holiday. The orange shaded portion in the lower image shows the area that would be 'obscured' at 137 MHz (figure 6). It should be noted that the profiles are based on the natural landscape. The effects of obstructions such as tall buildings (or indeed trees) can not be catered for.

In order to calculate the whole horizon from the origin, these profiles would have to be created at intervals around the full 360 degree azimuth, and this, as I discovered, could be very time consuming.

Fortunately, there is another facility on the same website to create a panorama. From the main site at

www.heywhatsthat.com

click on *New Panorama*. By clicking on the map, or entering the latitude and longitude of the origin, the profile of the full 360 degree horizon is created at intervals of one degree. Currently the site is only able to create panoramas for locations between 60° north and 54° south (plus most of Alaska).

A useful additional feature is that the elevation of the viewpoint above the

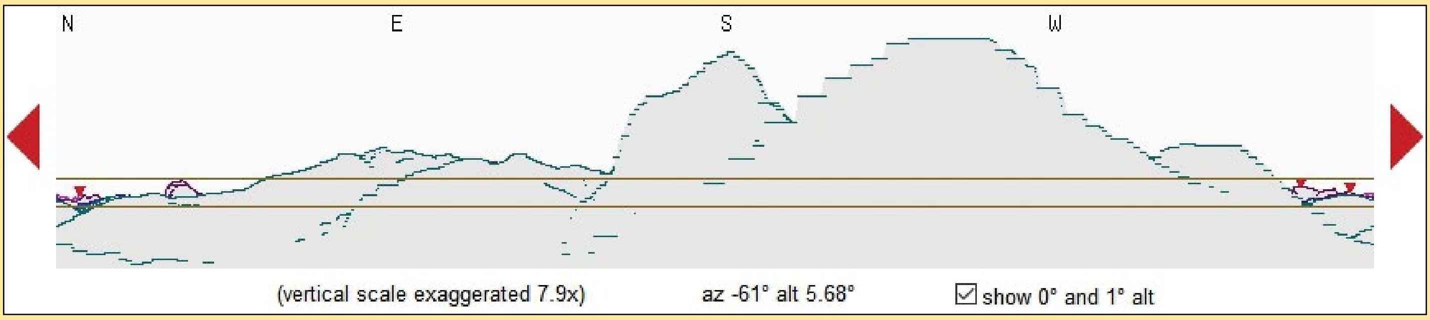


Figure 7 - A typical 360° Panorama

ground can be included. In my case, the *Google Map* shows my elevation above sea level as 545 feet. My antenna is mounted on a mast and is 30 feet above ground. The panorama created is therefore based on the 'view' from 575 feet. It appears (from reading the technical FAQ) that the resulting image and data take into account not only the curvature of the Earth but also refraction. Tall, distant peaks appear at a lower elevation than local, less tall, features.

Figure 7 shows the panorama from my own location. Clicking on the large red triangles shifts the azimuth by 45 degrees per click. The small red triangles—of which three are shown from my location—identify notable peaks. The data for these—azimuth, elevation angle, name, distance and height asl—is shown to the right of the map, lower down the web page.

The panorama is displayed with an exaggerated vertical scale and is comprised of 8 images in PNG format, each 100 pixels wide. The base of the displayed panorama is not necessarily zero degrees elevation, but clicking on '*show 0° and 1° alt*' draws horizontal lines at those elevations, giving a sense of the vertical scale of the image.

As you move the mouse pointer within the drawn panorama, the data displayed directly under the image updates to give the azimuth and elevation (in degrees) at the tip of the mouse pointer.

Clicking within the panorama creates a profile (with the selected parameters) for the selected azimuth and also redraws the displayed *Google Map* (or satellite image). The zoom setting of the map is not affected, but can easily be changed with the + and - icons, and the map itself can be click/dragged to centre the area of interest.

Visibility Cloak

By selecting '*Visibility cloak*', pixels of an image that would be visible from the origin are coloured, each pixel being 3 arcseconds square and representing roughly 0.8 hectare (2 acres). Figure 7 below, with '*Contours*' turned off because there were so many that they tended to obscure the coloured pixels, shows the effect well from a viewpoint on Pen-y-ghent, a 2,277 foot hill in the Yorkshire dales in northern England. Of course, the reverse also applies. If you are located in a coloured pixel area of this map, you should be able to see Pen-y-ghent... if it's not cloudy or raining!

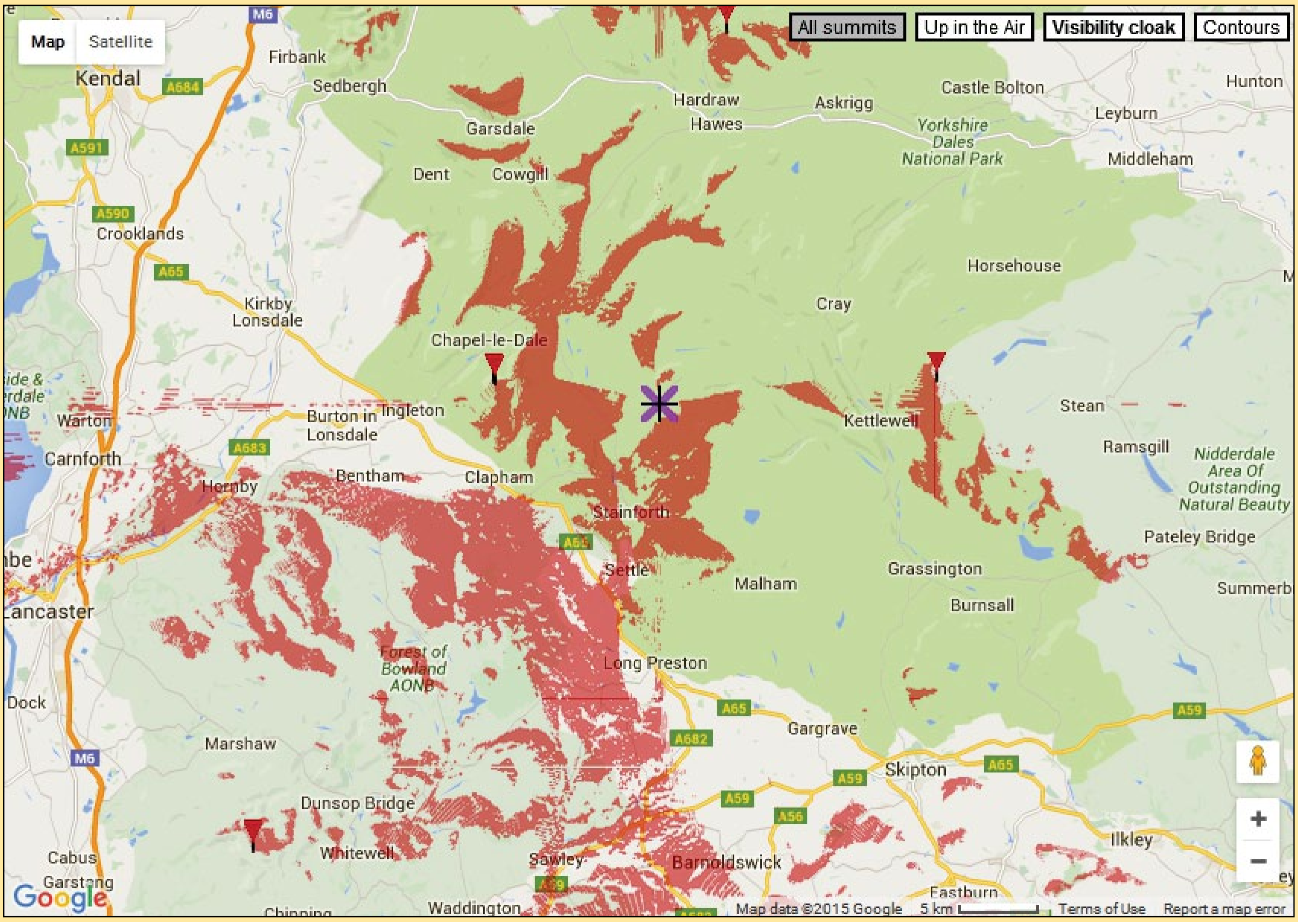
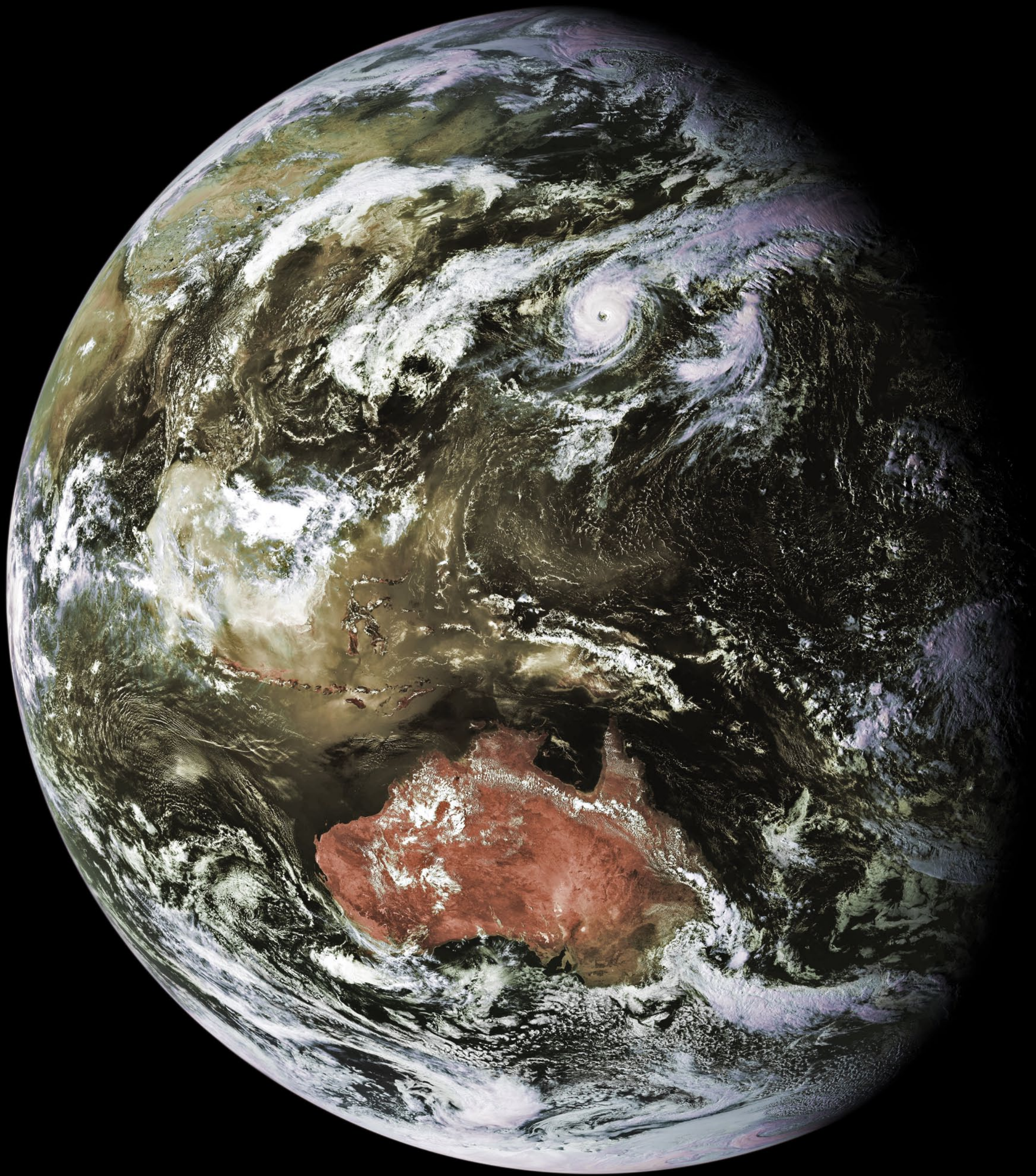


Figure 7 - Pen-y-ghent

Himawari-8

Les Hamilton



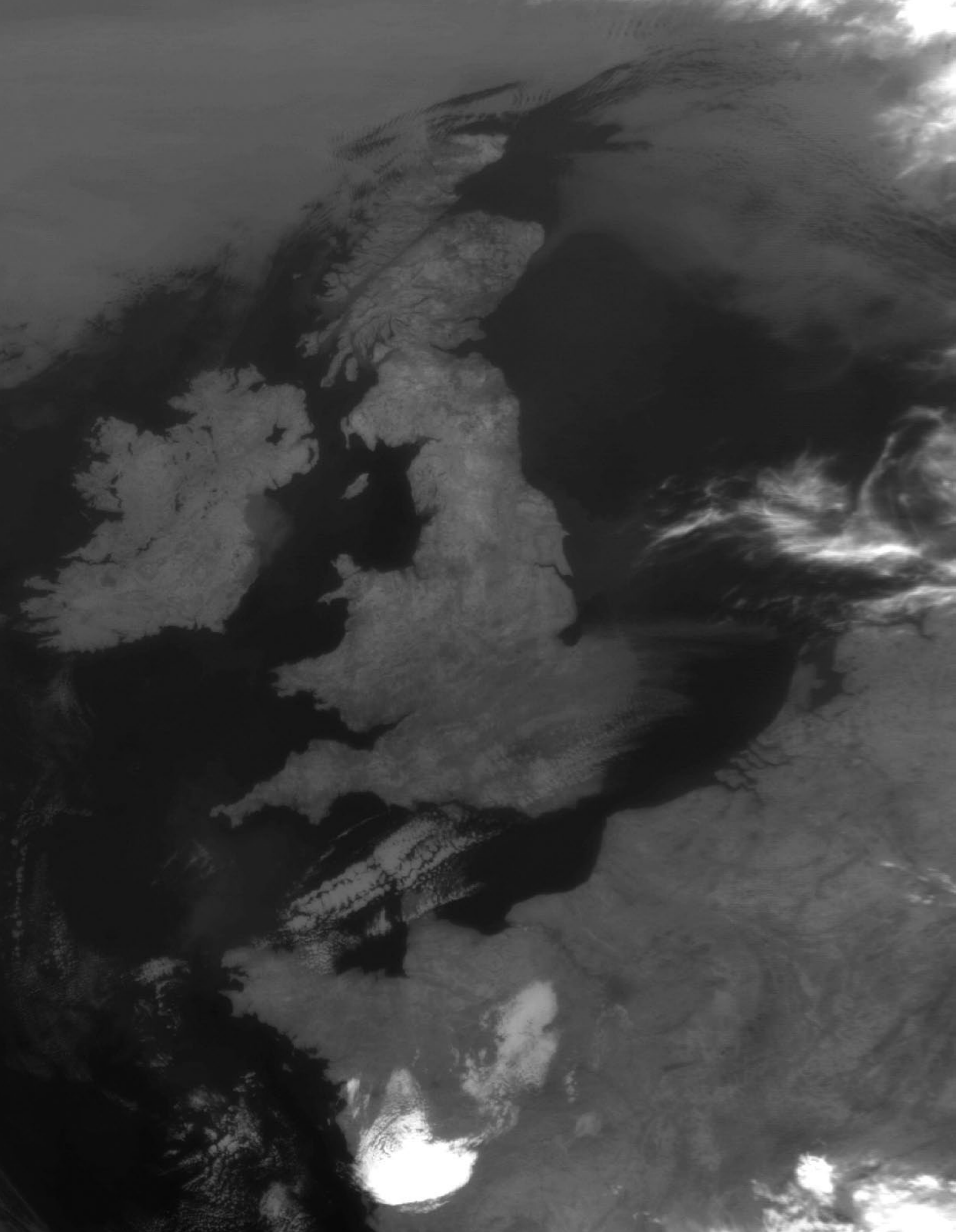
Mike Stevens submitted this image from Himawari-8, captured on October 17, 2015
Image © EUMETSAT 2015

Japan's latest geostationary Earth observing satellite, **Himawari-8** (Sunflower) was launched on October 7, 2014 and became operational on July 7, 2015. It is operated by the Japan Meteorological Agency (JMA), to support weather forecasting, tropical cyclone tracking, and meteorology research. Most meteorological agencies in East Asia, Southeast Asia, Australia and New Zealand use the satellites for their own weather monitoring and forecasting operations.

Since the launch of GMS-1 (Himawari-1) in 1977, there have been three further generations, the latest comprising Himawari-8 and -9. The Himawari satellites do not carry equipment for direct dissemination: instead, all imagery derived from the satellites is distributed to the various National Meteorological and Hydrological Services via an Internet cloud service. Additionally, there exists the **HimawariCast** service which disseminates primary sets of imagery via a communication satellite using DVB-S2 technology. This service provides full-disk HRIT/LRIT image files compatible with MTSAT HRIT/LRIT data every ten minutes.

For more information, refer to the URLs below.

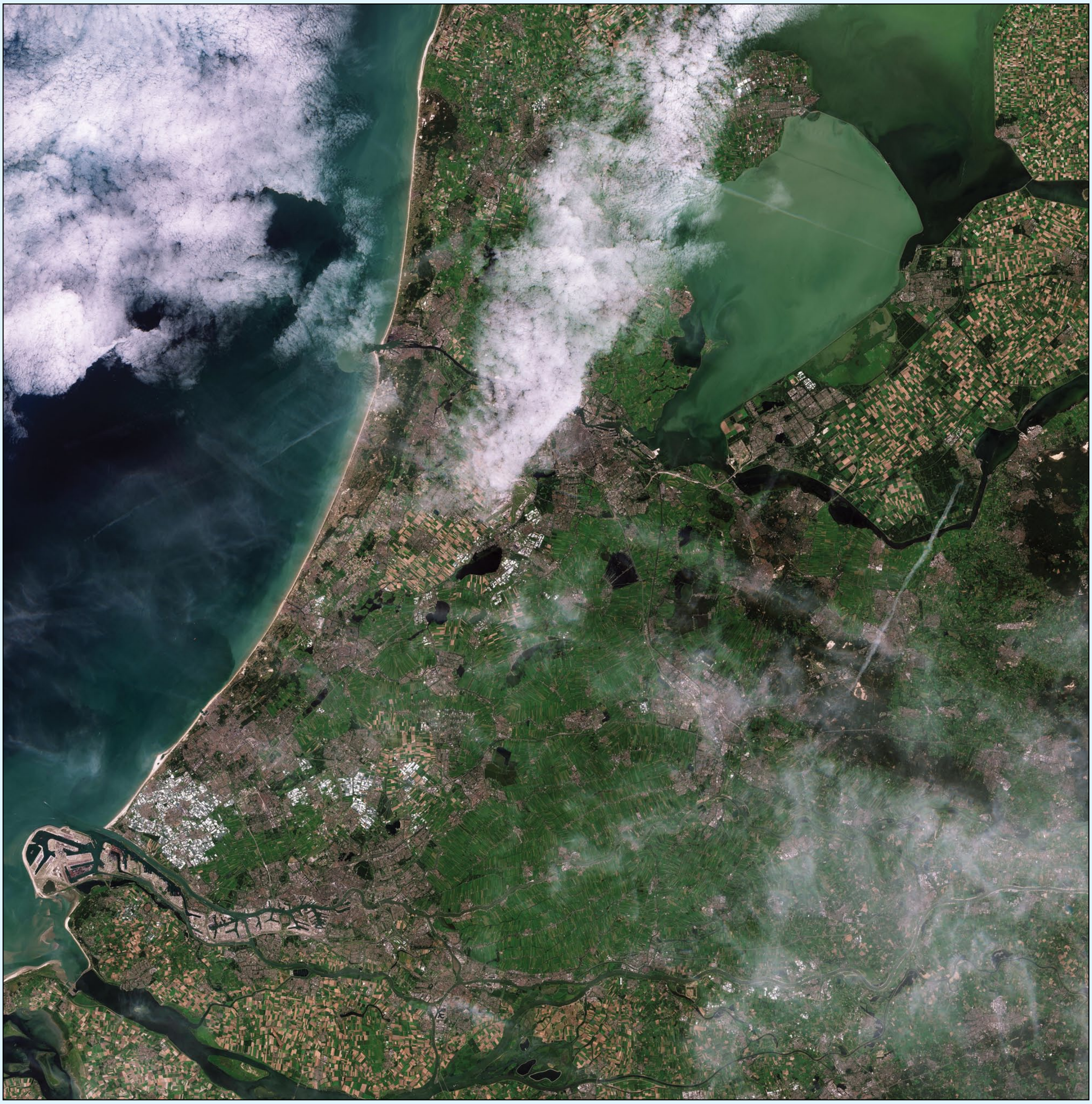
http://www.jma-net.go.jp/msc/en/general/system/system89/index.html
http://www.data.jma.go.jp/mscweb/en/himawari89/himawari_cast/himawari_cast.html



Great Britain enjoyed an *Indian Summer* during the final week of September/October 2015, when a large area of High Pressure became established over the North Sea. This infrared LRPT image from Russia's Meteor M2 satellite, acquired at 20;51 UT on the evening of October 2, shows splendid detail of Britain, France and The Netherlands as the overnight temperature plummeted.
Image: Les Hamilton / RTL dongle / SDR#

Summer in the Netherlands

European Space Agency

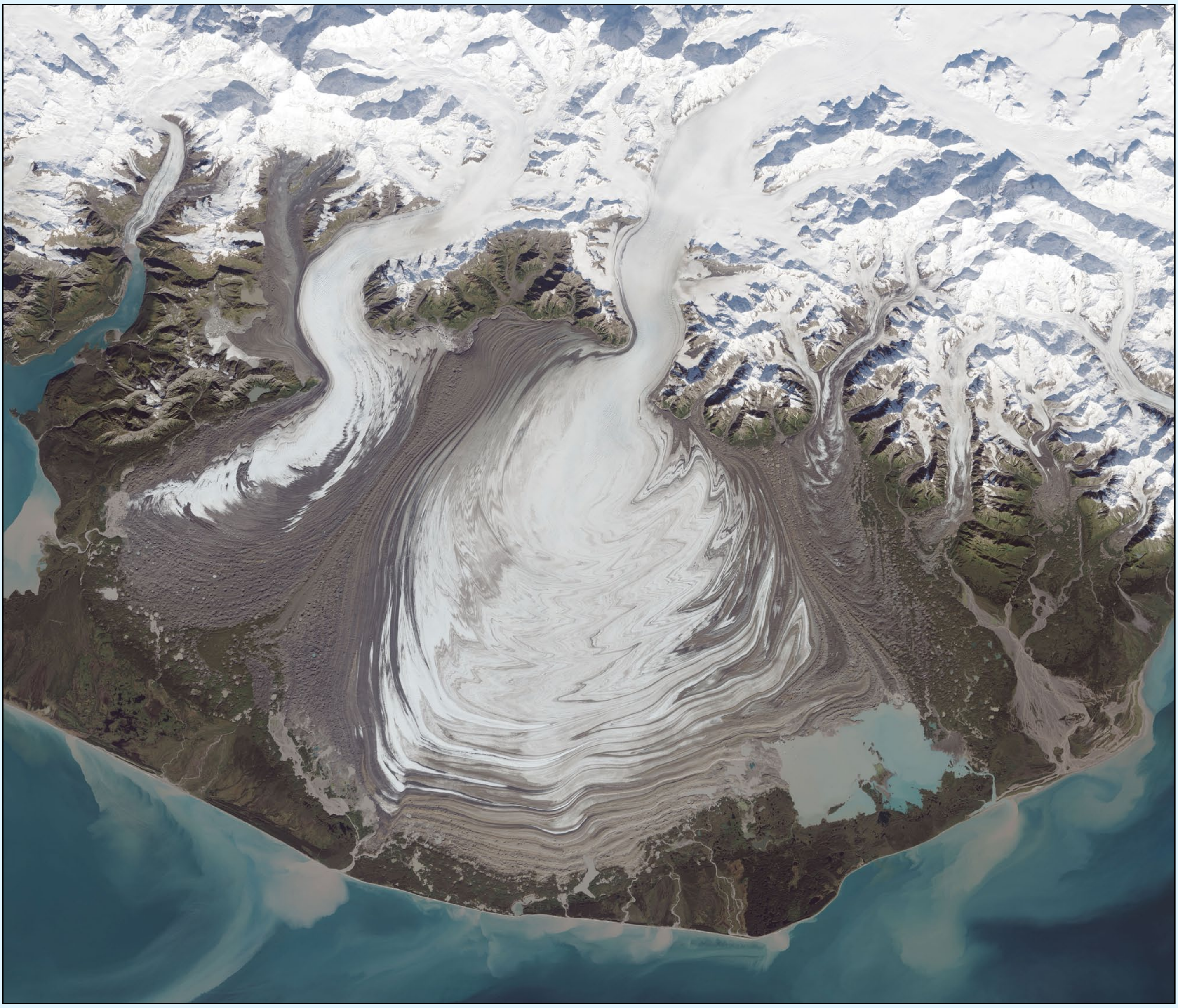


This image was captured by **Sentinel-2A** on August 5, 2015 from over 780 km above Earth. It clearly picks out features such as Rotterdam harbour, patchworks of fields throughout the country, Amsterdam and Schiphol airport. The image also shows how the Enkhuizen–Lelystad dike separates the different concentrations of sediment and algae in the Markermeer and the IJsselmeer.

As part of Europe's *Copernicus* environmental monitoring programme, Sentinel-2A carries an innovative wide swath high-resolution multispectral imager with 13 spectral bands for a new perspective of our land and vegetation. The combination of high resolution, novel spectral capabilities, a swath width of 290 km and frequent revisit times will provide unprecedented views of Earth. Its images will be used for numerous applications, including monitoring plant growth, mapping changes in land cover, monitoring forests and for detecting pollution in lakes and coastal waters.

Malaspina

NASA Earth Observatory



The ice of a piedmont glacier spills from a steep valley on to a relatively flat plain, where it spreads out unconstrained like pancake batter. Elephant Foot Glacier [1] in northeastern Greenland is an excellent example; it is particularly noted for its symmetry. But the largest piedmont glacier in North America, and possibly the world, is Malaspina in southeastern Alaska.

On September 24, 2014, the Operational Land Imager (OLI) aboard NASA's *Landsat 8* satellite acquired this image of Malaspina Glacier. The main source of ice comes from Seward Glacier, located at the top-center of this image. The Agassiz and Libbey glaciers are visible to its west and the Hayden and Marvine glaciers on its east.

The brown lines on the ice are moraines—areas where soil, rock, and other debris have been scraped up by the glacier and deposited at its sides. Where two glaciers flow together, their lateral moraines merge to form a medial moraine. Glaciers that flow at a steady speed tend to have moraines that are relatively straight.

But what causes the dizzying pattern of curves, zigzags, and loops of Malaspina's moraines? Glaciers in this area of Alaska periodically 'surge', meaning that they lurch forward quickly for one to several years. As a result of this irregular flow, the moraines at the edges and between glaciers can become folded, compressed, and sheared to form the characteristic loops seen on Malaspina. For instance, a surge in 1986 displaced moraines on the east side of Malaspina by as much as five kilometres.

Reference

Elephant Foot Glacier - GEOQ 46 (2015), page 31

Receiving Images from the Meteor Satellites

Preparing for the future following a year of progress

Les Hamilton

It's exactly a year since *GEO Quarterly* published its first article on the reception of images from Russia's Meteor-M2 satellite [1] and there have been several more articles since [2,3,4,5]. But during the year, thanks to new versions of the **SDRSharp** Software Defined Radio application from *Airspy.com*, customised plugins for *SDRSharp* written by Vasili Beliakov (http://rtl-sdr.ru) and updated decoding software from Oleg Bekrenev (Robonuka), everything has advanced at an unprecedented rate.

Although much of what has previously been written remains true, recent developments have created problems which now make it more difficult for newcomers to set up a working Meteor LRPT receiving station. Many of the URLs for downloading software have changed; as *SDRSharp* and its plugins develop apace, incompatibilities arise that can cause a system to fail; and support for *Windows XP* has ended. Current versions of *SDRSharp* and its plugins require *Windows Vista, -7, -8 or -10* to function. They cannot be run in Windows XP.

The most recent change occurred in September 2015 when *Microsoft's* **dot NET 3.5 Framework** was abandoned in favour of the newer **dot Net 4.6**. Current versions of *SDRSharp* and the plugins required for Meteor reception have all been recompiled to run under **dot NET 4.6**, and will not run on the older Framework. In many cases the converse is also true, and older plugins may not work under the new Framework.

Another change that will be become important when the next satellite in the Meteor series is launched is a new transmission mode. QPSK is to be replaced by OQPSK, and from version 1.5, the *Meteor Demodulator* plugin already possesses this capability.

This article is basically an updated User Guide to receiving Meteor M2 using an RTL-SDR dongle, its key thrust to take onboard new developments and clarify all the essential issues.

Preparing a Computer for Meteor Reception

Many readers will have benefitted from Alex's tutorial: "*Receiving Meteor M-N2 Images in Realtime with the QPSK Plugin on RTL-SDR Dongles*", which is still a valuable document [6], and can be downloaded from the GEO website at

http://www.geo-web.org.uk/lrpt_Files/ MeteorM-N2_Realtime.pdf

Unfortunately, many of the URLs listed for downloading the necessary software, specifically *SDRSharp* and its plugins, are no longer valid. There have also been name changes: for instance, what used to be termed the '*QPSK Demodulator* 'is now called '*Meteor Demodulator'*.

SDRSharp from Airspy.com

SDRSharp is now distributed under the 'Airspy' banner, and can be downloaded from their website at

http://airspy.com/download/

where it is the top option on the page. A new development is that this download is a zipped archive already containing most of the files you require to run *SDRSharp*.

Start by creating an empty folder named *SDRSharp* on your computer (preferably **not** in the *Programs* folder) and extract all the files into it. My own preference is to create the *SDRSharp* folder directly on the C\: drive.

Interfacing SDRSharp with the RTL-SDR Dongle

In order that *SDRSharp* can detect your RTL dongle, the appropriate driver must be installed. In earlier versions of *SDRSharp*, the driver installation software **zadig.exe** was provided as part of the package. With the current versions this is no longer the case. Instead, you will find a file called **install-rtlsdr.bat** in the *SDRSharp* folder. Run this as administrator (you must be online, of course) and it will deposit a copy of **zadig** inside the *SDRSharp* folder.

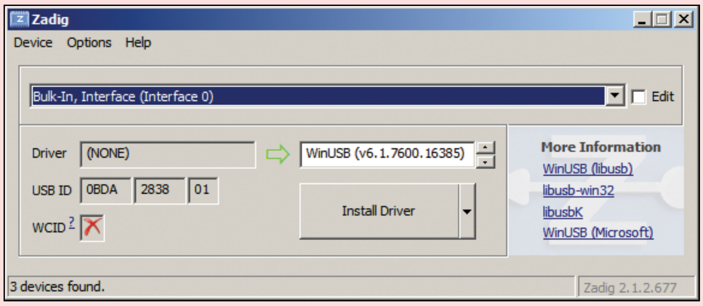


Figure 1 - The 'Zadig' driver installer.

Before carrying out the next step, you **must** plug an RTL-SDR dongle into one of your computer's USB ports so that the *Bulk Interface* options become accessible. Now run **zadig** as Administrator, to download and install the required driver. Make sure that the drop-down selector shows: '*Bulk-In Interface (Interface 0)*'. If you can't see this option, click '*Options*' and tick '*List all devices*' first (figure 1).

Front End RTL-SDR Drivers

By default, the *SDRSharp* 'Source' menu defaults to the *Airspy* Front End Driver. To engage your RTL-SDR dongle, this must be changed to the 'RTL-SDR (USB) option. This provides a relatively simple RTL Driver, with just a single RF Gain slider. If

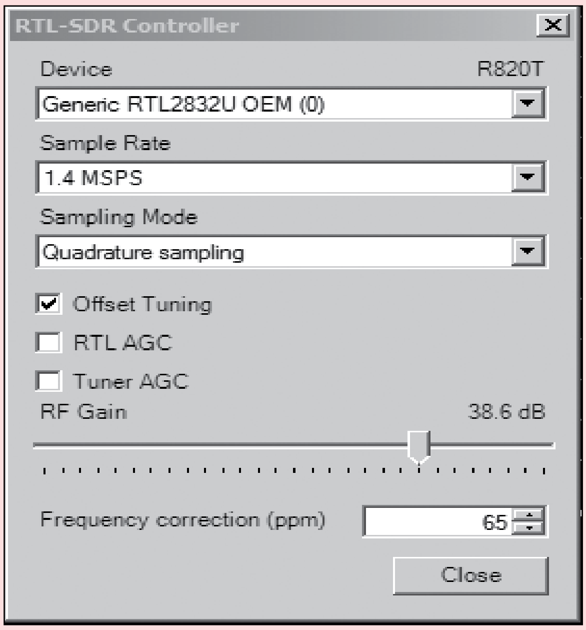


Figure 2 - The simple, default RTL-SDR Driver

you use this driver, you must tick 'Offset Tuning' (figure 2). By default, when newly installed, the RF Gain defaults to zero. Drag this, initially, to at least mid-scale to enable reception of a Meteor signal.

There is, however, a more versatile alternative, Vasili's optional **modified R820T driver**, which offers three levels of gain control (figure 3). This can be downloaded as the file 'modrtlsdr.zip' from

http://rtl-sdr.ru/uploads/download/modrtlsdr.zip

Extract the contents of this file and copy the four DLL files into the *SDRSharp* folder.

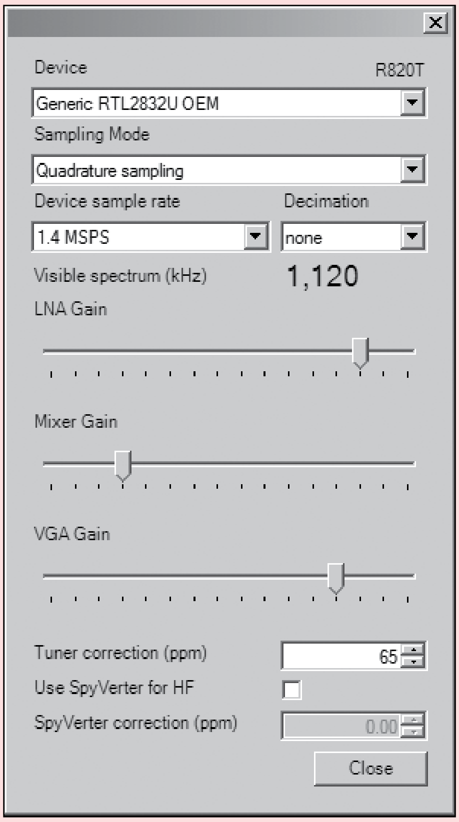


Figure 3 - The modified RTL-SDR Driver

To enable it, you must copy and paste the **front-end key** from the 'ReadMe' file into the **FrontEnds.xml** file in the *SDRSharp* folder (you can easily do this using *Wordpad*), then save it. Next time you run *SDRSharp*, you will find the new option 'RTL-SDR (R820T)' in the 'Source' menu. Note that this driver deals with the offset tuning feature automatically.

You can access the RTL Driver Menu by clicking the 'wheel' icon at the top of the *SDRSharp* screen. Figure 3 shows the settings I use for receiving Meteor.

A degree of experimentation may be necessary depending on local conditions and your PC. If you experience difficulties obtaining good images because of ambient rf, it is often possible to reduce this by experimenting with different **Gain levels** and the **Device sample rate**.

Preparing for Reception

There are two options for receiving imagery from the Meteor satellites. The simplest procedure is to store the satellite transmission as an **S-file**, then decode it into images using Oleg's **LRPTOffLineDecoder** software. An alternative is to make use of the *TCP socket* feature of the *Meteor Demodulator*, coupled with a modified version of *LRPTOfflineDecoder,* which allows real-time visualisation of the satellite images building up, and which also automatically saves these images. I prefer the former system, which is what will be described below.

Setting up the SDRSharp Radio Section

Here, it is essential to select **WFM** (wide FM) mode, and a **Bandwidth** of 120,000 Hz. It is also helpful to tick **Snap to grid** and set the **Step size** to 100 kHz. You must also check **Correct IQ**.

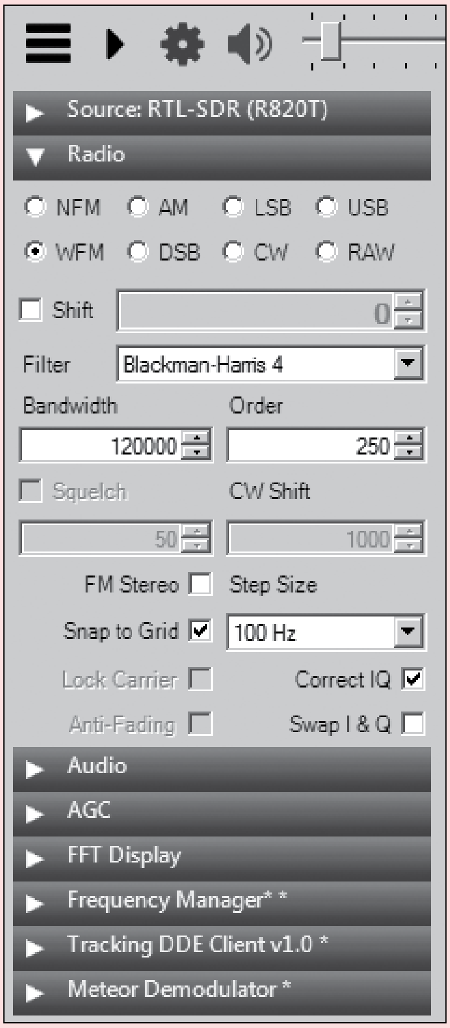


Figure 4 - Setting the Radio Parameters

The Frequency Manager Section

The best way to centre the precise 137.100 MHz Meteor frequency on the screen is to edit the appropriate details into the *Frequency Manager* (figure 5) then select it from its menu. (figure 6).

If future Meteor satellites transmit on different frequencies, this will provide an rapid means of switching satellite.

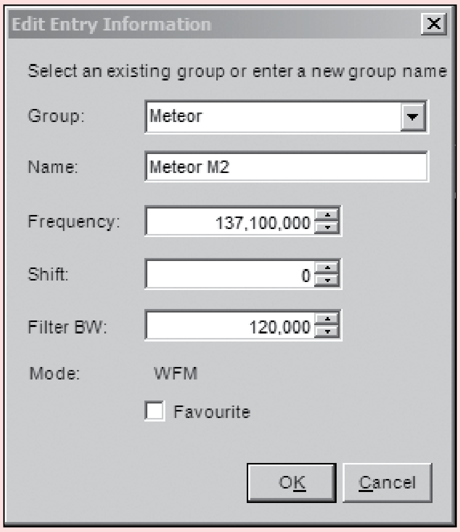


Figure 5 - Entering the Meteor frequency

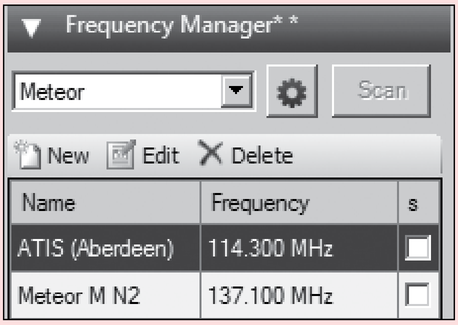


Figure 6 - The Frequency Manager Menu

The top item in figure 6 relates to the ATIS (*Automatic Terminal Information Service*) signal for my local airport in Aberdeen. An ATIS [7,8] frequency is useful for precisely calibrating an RTL-SDR Dongle using the **Tuner Correction** feature of the RTL Controller (figure 3).

The ATIS signal shows in *SDRSharp* as a sharp peak with a precise frequency. Zoom in to this and adjust it to exactly centre screen using the RTL Driver's **Tuner correction** option.

The Meteor and DDE Tracker Plugins

By default, the *SDRSharp* package does not contain the plugins required for Meteor tracking and reception. You must download and install these yourself.

Download the **Meteor plugin** from

http://rtl-sdr.ru/uploads/download/meteor.zip

Copy the two DLL files into your *SDRSharp* folder, then copy and paste the '*magic line*' into the **Plugins.xml** file.

Download the **DDE Tracker plugin** from

http://rtl-sdr.ru/uploads/download/ddetracker.zip

This time there are three DLL files to copy into the *SDRSharp* folder, and additionally the **SDRSharpDriverDDE.exe** file. Copy and paste its '*magic line*' into **Plugins.xml**.

To download the very latest SDRSharp plugins, visit Vasili Beliakov's website at

http://rtl-sdr.ru

Receiving Images Manually

You are now in a position to receive images from Meteor satellites **manually,** without at this point making use of the *DDE Tracking Client*.

With 137.1 MHz precisely centred on the *SDRSharp* screen, click the triangle icon at the top of the display to initialise *SDRSharp* reception.

In the **Meteor Demodulator** screen (figure 7):

- Click 'Demodulator'
- Click 'File' in the Output section
- Click the 'Start' button
- Check 'Out' above the Diagram
- Check 'Constellation' below it

The software is now active, although you will not see any evidence of this until a Meteor signal is being received (figure 8). The Meteor signal is the pronounced 'hump' at the centre of the *SDRSharp* display (the two peaks to its right are caused by rf interference).

The shaded section encompassing the 'hump' relates to the 120,000 Hz bandwidth set in the 'Radio' plugin.

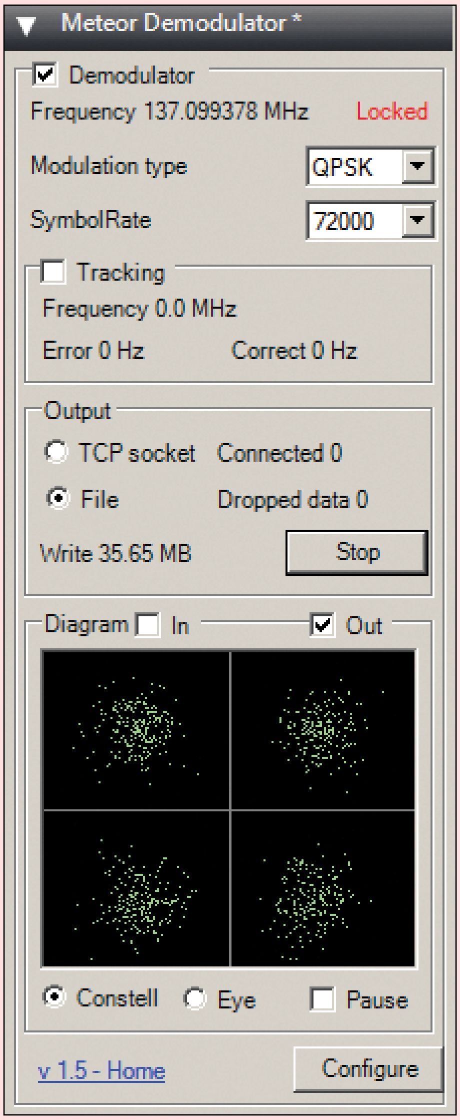


Figure 7 - The Meteor Demodulator Screen

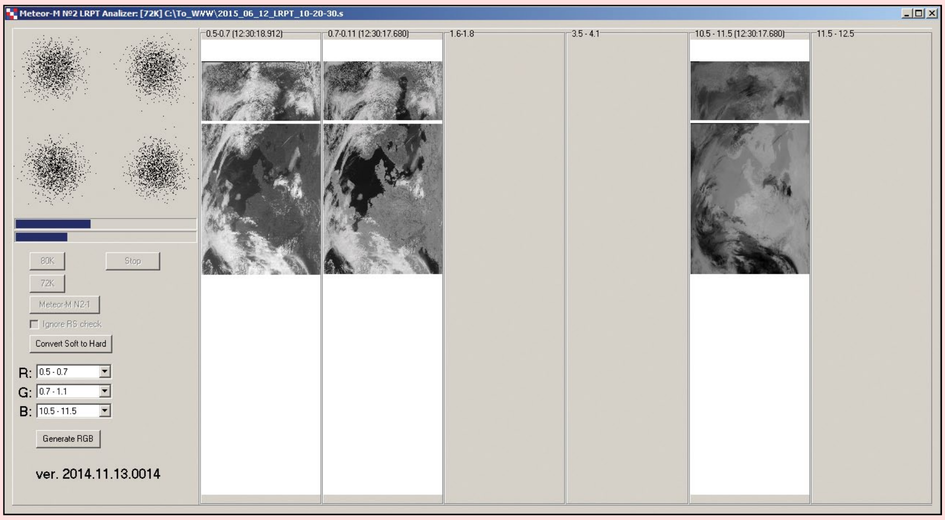


Figure 9 - Decoding an S-file with LRPTOfflineDecoder

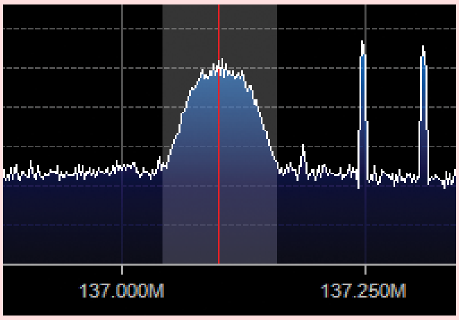


Figure 8 - A section from the SDR# screen showing a received Meteor signal

During reception of a QPSK signal, the constellation diagram will display the typical four-dot pattern illustrated in figure 7. Eventually, as the satellite rises higher above the horizon and its signal strengthens, the word **Locked** will appear, indicating that the QPSK-encoded Meteor signal is being demodulated and saved. At the same time, in the '*Output*' panel, you will see the '*Write*' value increasing as the **S-file** containing the demodulated Meteor data is written to the hard drive. When the signal level falls too low for decoding, the process comes to an end. You can now press the '*Stop*' button and process the data (described later), or simply leave the system running to continue unattended reception of subsequent Meteor passes.

By default, **S-files** containing the demodulated Meteor signal, are stored inside the *SDRSharp* folder. I find it more convenient to create a new folder on the hard drive—called QPSK—and use the 'Configure' button in the *Meteor Demodulator* to define this as the default save location. For the record, the saved files have the structure

2015_10_19_LRPT_09-28-51.s

and include the date and time of reception.

Note that all the default parameters within *Meteor Demodulator* have been fine-tuned for the Meteor M2 satellite, and need not normally be altered. Do not change the 'Symbol Rate'. Apart from a few early test transmissions, Meteor M2 always transmits at the 72000 symbol rate.

When future Meteor satellites arrive, at least one change will be essential. Meteor M2 uses QPSK-encoding for its transmissions, but all forthcoming Meteors will abandon this format in favour of OQPSK-encoding. This is already built into the software, and will have to be selected manually using the '*Modulation type*' option. Whether any other changes will be needed, only time will tell.

Producing Meteor Images

I'll cover the use of the *DDE Tracker* plugin to control Meteor reception below, but to complete the initial 'beginners guide' it's time to describe how to decode the saved **s-file** data into images.

The **s-files** saved by the *Meteor Demodulator* plugin can be resolved into images using Oleg Bekrenev's **LRPTOfflineDecoder** (figure 9)

This software can be downloaded from

http://meteor.robonuka.ru/ for-experts/new-lrpt-analizer/

There are two versions, the advantage of the more recent one being greater control via an **ini file**. A sample **ini file** for each version is also provided.

The **ini file** can be used to suppress unwanted log files, and also to determine which colour composite image is produced by default. My version is as follows:

```
[IN]
mode=72K

[OUT]
rgb=125.bmp
logs=no
```

This acknowledges that Meteor M2 operates at a Symbol Rate of 72000/

sec, creates BMP colour composite images by combining channels 1+2+5, and suppresses unwanted log files. Type this into *Notepad* and save it with the same stem filename as *LRPTOfflineDecoder*, but with the extension '.ini'.

To commence processing, click the '72K' button and navigate to the location where you have saved your **s-files**. Processing should start immediately, soon signified by the appearance of a 4-dot constellation in the upper left panel, similar to that seen during demodulation (figures 7,9). Processing is complete when the upper blue progress bar reaches 100% and the lower bar falls to zero.

Next, click the Generate RGB button to create the colour composite image. If no image appears, make sure that the frequencies showing in the three RGB selector boxes correspond with the channels that produced images in **LRPTOfflineDecoder**. In figure 9, channels 1, 2 and 5 are displaying images, so it is the frequencies shown at the top of these that should be chosen for the R, G and B selectors (figure 10a). The resulting RGB image is shown in figure 11a.

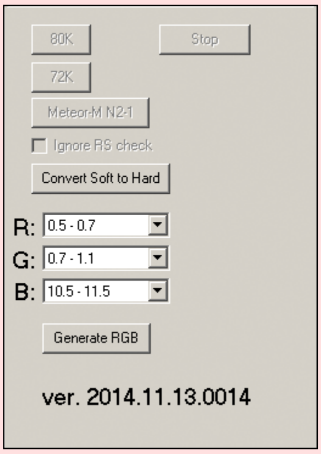


Figure 10a
Selecting an RGB125 image

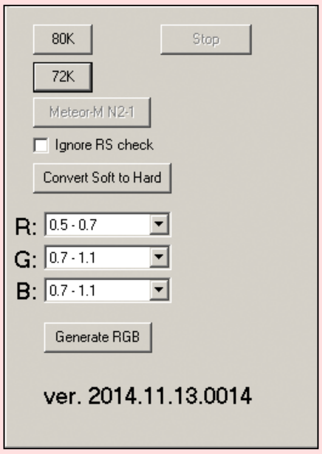


Figure 10b
Selecting an RGB122 image

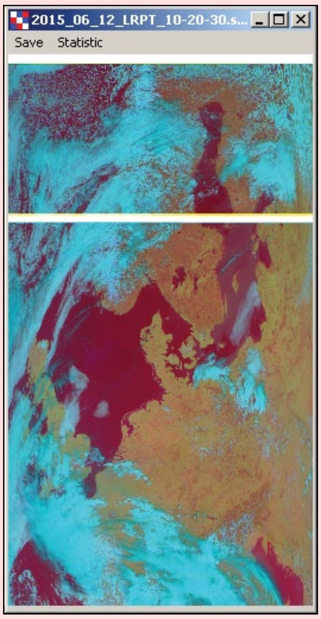


Figure 11a
The resulting RGB125 image

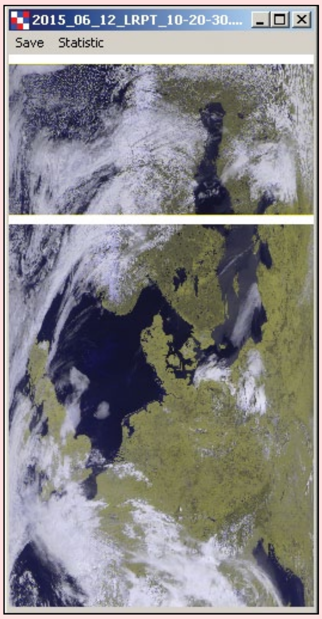


Figure 11b
The resulting RGB122 image

This has a distinctly unusual appearance but don't discount it. But if you prefer a more appealing instant result, select the channel 2 image for **both** the G and B components (figure 10b) to produce the more realistic rendition shown in figure 11b. To save the displayed image as either a BMP or JPG, click the 'Save' option above it.

As explained in David Taylor's article in our previous issue [5], so-called RGB125 images (formed by combining channels 1+2+5) are your gateway to a wealth of processing options. You can download his free program, **LRPT Processor**, from this URL

http://satsignal.eu/software/LRPT-processor.html

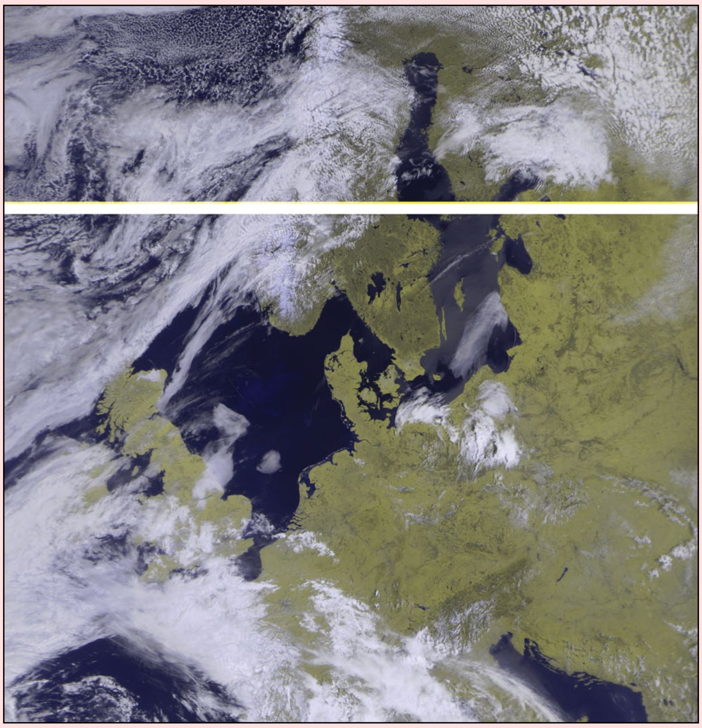


Figure 12 - A geometrically corrected version of the image

Geometrically Rectifying Images

The images received by Meteor satellites show geometrical distortion to east and west as a result of Earth's curvature. This can be corrected to produce more satisfying results using the program **SmoothMeteor**, which can be downloaded from this page

http://leshamilton.co.uk/meteor3m.htm

David Taylor's **LRPT Processor** also provides an option to provide this geometrical correction. The corrected version of figure 11b is illustrated above in figure 12. Note that the broad white gap in the image is due to a hardware fault aboard the satellite. This results in a break roughly every 6½ minutes during almost every transmission.

Fully Automated Meteor Reception

Recording Meteor transmissions manually, as described above, can produce very satisfying results: but improvements are possible. As the satellite approaches and recedes from your station, the Doppler effect modifies the received frequency, increasing it as the satellite approaches and decreases it as it departs. If a means can be found to continuously adjust this Doppler effect during a satellite pass, the software will lock on to the signal earlier, provide longer images, and be less susceptible to the effects of local rf interference.

The solution is to use a satellite tracking program such as Sebastian Stoff's **Orbitron** (figure 13) to control *SDRSharp* and feed it an updated Doppler-corrected frequency throughout the satellite pass. *Orbitron* can be downloaded from

http://www.stoff.pl/

Double-click on the file 'orbitron.exe' and install it directly to the C:\ drive (**not** to the 'Programs' folder). When first run, *Orbitron* has an annoying habit of taking over the entire screen. Press Alt+Enter on the keyboard to reduce it in size.

Interfacing Orbitron with SDRSharp and DDE Tracker

The most important task in configuring *Orbitron* to engage with both *SDRSharp* and the *DDE Tracker* module is to open the 'Orbitron/Config' folder and edit its '*setup.cfg*' file to add an entry for the SDRSharp driver. Load *setup.cfg* into a text editor such as *Wordpad* and add the following two lines at the end of the file, immediately following the [Satellites] section, then resave it.

[Drivers]
SDRSharp=C:\SDRSharp\SDRSharp.exe

This, of course, presupposes that you have *SDRSharp* installed directly on your PC's C:\ drive. If not, replace 'C:\' with the path to the *SDRSharp* folder.

Setting up Orbitron

There is an excellent, illustrated guide to setting up all the required parameters for *Orbitron* in Alex's tutorial document referenced above [6]. Every step of the procedure is illustrated by a screenshot, making the entire process very straightforward. A brief summary follows here.

<u>Updating Satellite Orbital Elements</u>

It is important to keep *Orbitron* updated with the latest Two-Line Elements (TLEs) for the Meteor satellite in order that the software can track the satellite accurately. These are available from the *Celestrak* site as a text file called 'weather.txt'. *Orbitron* can download these automatically.

Click the **Setup** icon, which is located just above the tabs along the foot of the *Orbitron* display (circled in **red** on figure 13). Select the '**TLE updater' tab** and make sure that the '**www.celestrak.com - All**' group is selected (this should already contain 'weather.txt'), and check the box against '**Mark this group to autoupdate**'.

<u>Load the Satellite 2-lineData</u>

Click the **Load TLE** button below the panel at top right in the *Orbitron* display. Navigate to 'weather.txt' in the browser that opens and double-click to select it. The names of the various weather satellites will appear in the pane (figure 13). Select Meteor M2 as the active satellite by ticking the checkbox to the left of its name in this listing.

<u>AOS Notification</u>

Open the **'Miscellaneous' tab**. If the **Play sound** box is ticked, an alert will sound as soon as the satellite rises above your horizon. There is also an option to delay the alert till the satellite elevation is several degrees above the horizon.

<u>Make Meteor the Active Satellite</u>

Open the **'Extra' tab.** Tick the final option '**AOS notification: make satellite active**'.

<u>Select the Displayed World Map</u>

Open the **'World map' tab**, where you can select from a variety of maps. The popular '**coloured**' option is shown in figure 13.

<u>Set your Time Zone</u>

First, make sure that your computer clock is correct for your time zone. Absolute accuracy is not crucial, but should be within a few seconds of the true time. It's a good idea to check regularly, or use software to maintain accuracy.

If your PC clock is not set to local time, open the **'General' tab** and add a correction for **Local time**.

<u>Set your Location</u>

On the main *Orbitron* screen, open the **'Location' tab** at the foot of the display and select your location. If this is not listed in the menu, you must insert it and enter your latitude and longitude coordinates manually.

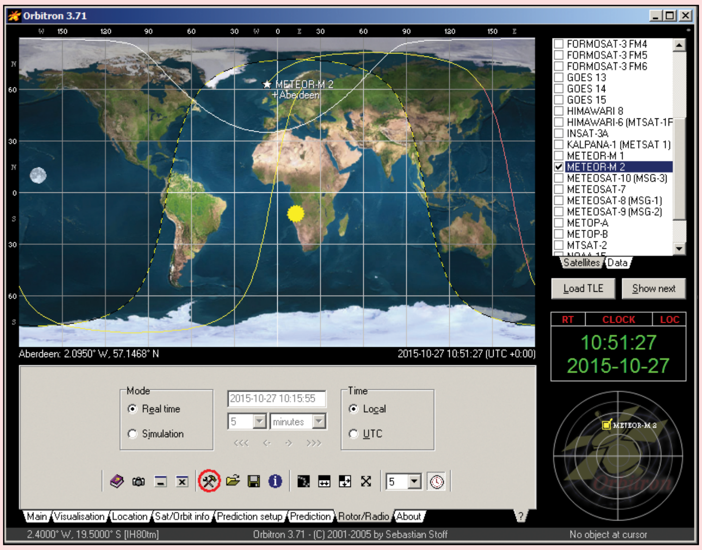


Figure 13 - Orbitron - Main Screen

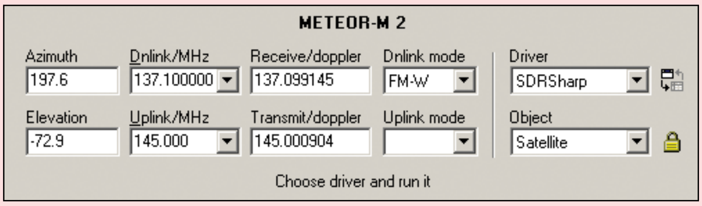


Figure 14 - Orbitron - Rotor/Radio Tab

<u>Interfacing with SDRSharp</u>

Finally, open the **'Rotor/Radio' tab** (second from right at the foot of the display - figure 14) and enter 137.100 in the **DNlink/MHz** field. In the **Dnlink mode** field, select 'FM-W'.

Finally, select your driver from the dropdown list. You should find an entry for *SDRSharp* there (you appended this to *Orbitron's setup.cfg* file earlier).

Note: If you find that the *SDRSharp* driver has not been added to the dropdown list, the most usual cause of the problem is installing *Orbitron* in the **Program Files (x86)** folder. It may be sufficient to move the entire *Orbitron* folder directly to the C:\ drive. If this doesn't help, delete the *Orbitron* folder and make a fresh install **directly to the C:\ drive**.

Running SDRSharp via Orbitron

There are three things you must do to initiate automated Meteor reception after starting *Orbitron*:

- Open *Orbitron's* '**Rotor/Radio' tab**, and click <u>once</u> on the icon immediately to the right of the 'Driver' slot (which should now show 'SDRSharp'). There are often a few seconds delay before the *SDRSharp* screen appears.
- Click the triangle icon at the top of the SDRSharp screen to start radio reception.
- Make sure that the '**Scheduler**' option in the *DDE Tracker* plugin is ticked (in fact, if you open *SDRSharp* on its own, set this option, and close down, it will automatically be ticked every time you run the program via *Orbitron*).

At the end of a session, close *Orbitron*, which will automatically close *SDRSharp* too.

Configuring the DDE Tracker Plugin

The *DDE Tracker* must be programmed to perform appropriate tasks, when a Meteor M2 signal is first detected (AOS: Acquisition of Signal) and at the end of the pass (LOS: Loss

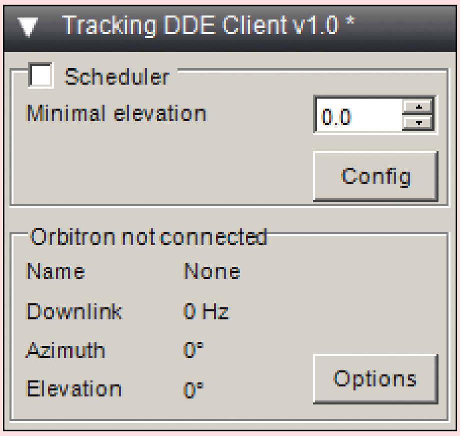


Figure 15 - The inactive DDE Client Panel

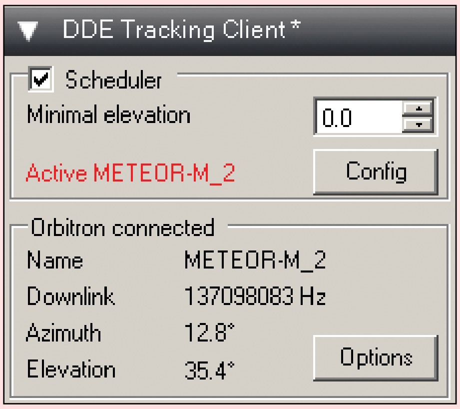


Figure 16 - The DDE has detected QPSK

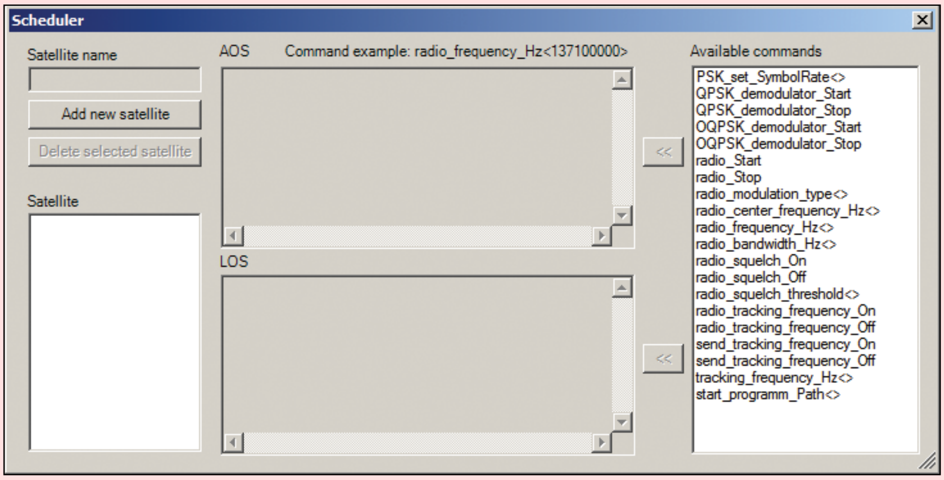


Figure 17 - The blank DDE Tracker 'Scheduler' screen.

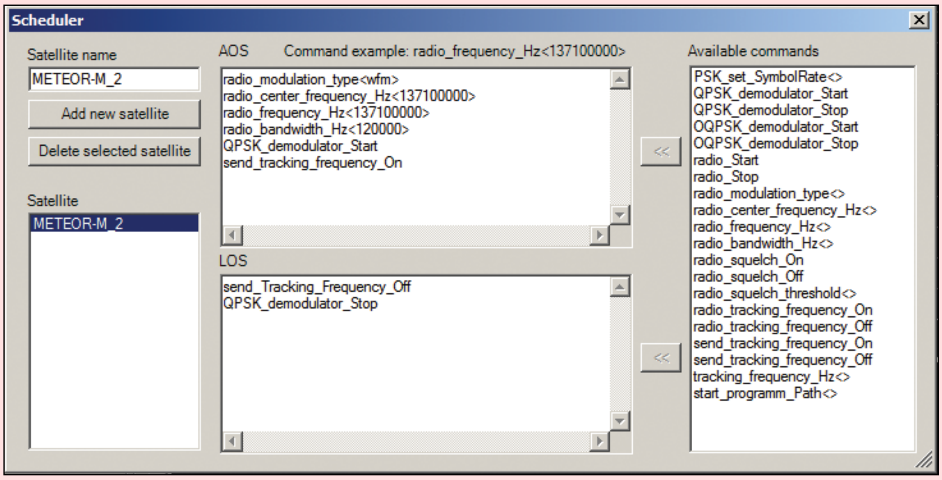


Figure 18 - The DDE Scheduler, configured to receive Meteor M2.

of Signal). At AOS these consist of the transmission frequency, modulation type and bandwidth, plus commands to send the corrected frequency (calculated by Orbitron) to the Meteor Demodulator, then finally to activate the 'Demodulator' checkbox in the Meteor plugin panel as soon as QPSK has been detected in the transmission.

At LOS, the final two items are switched off again (figure 18) .

1. Entering the Satellite Name

The name you type into the '*Satellite name*' field must be identical with the way it appears in the TLE (2-line Keplerian Element) file used by *Orbitron*: with one important exception. Any 'space' character <u>must</u> be replaced by the 'underscore' character. So '**METEOR-M 2**' in the TLE file translates to '**METEOR-M_2**' in *DDE Tracker*. Even changing the lettering from upper case to lower case means that tracking will not work.

2. Preparing for Satellite AOS

Any of the options listed in the right hand panel of figure 17 can be selected with the mouse and copied into either of the centre panes using the arrow buttons. The top panel, labelled '*AOS*' relates to Acquisition of the satellite signal.

<u>Add Radio Modulation Type</u>

Click **radio_modulation_type<>** and copy it to the top centre panel. Edit it by typing 'wfm' between the angle brackets.

<u>Add the Centre Frequency</u>

Click **radio_center_frequency_Hz<>** and copy it across too. Type 137100000 between the angle brackets.

<u>Add the Radio Frequency</u>

Click **radio_frequency_Hz<>** and copy it across. Type 137100000 between the angle brackets.

<u>Add the Radio Bandwidth</u>

Click **radio_bandwidth_Hz<>** and copy it across. Type 120000 between the angle brackets.

<u>Finally</u>

Click **send_tracking_frequency_On** and copy it across.

Click **QPSK_demodulator_Start** and copy it across (this switches on the Meteor Demodulator).

3. Preparing for Satellite LOS

Only two items need be added to the lower centre panel, **QPSK_demodulator_Stop** and **send_tracking_frequency_Off**.

Note that there is no 'Save' button. All entries and alterations are automatically saved to a file called **DDESchedule.xml**, which is found in the *SDRSharp* folder.

Running SDRSharp/Orbitron

Everything is now in place to record **s-files** from Meteor M2 transmissions fully automatically, and under Doppler correction. Just run *Orbitron*, select the *Rotor/Radio tab*, click the icon beside the *SDRSharp Driver*, and wait a few seconds till *SDRSharp* activates. Click the 'triangle' icon to start the radio, and wait.

References

1 Receiving Meteor M2 with an RTL-SDR Dongle
Raydel Abreu Espinet - GEOQ 44, page 6.
2 Trials and Tribulations Receiving Meteor M2 LRPT
Les Hamilton - GEOQ 45, page 41.
3 EMC Advice for using an SDR Dongle
Norbert Pütz - GEOQ 46, page 21.
4 Reducing Noise on an SDR Dongle
Marc Peigneux, GEOQ 46, page 32.
5 Enhance Meteor imagery with LRPT Image Processor
David Taylor - GEOQ 47, page 6.
6. Receiving Meteor M-N2 Images in Realtime by 'Happysat'
http://www.geo-web.org.uk/lrpt_Files/MeteorM-N2_Realtime.pdf
7 ATIS fequency list
http://www.javiation.co.uk/vu.html
8 UK ATC Frequencies
http://www.lightning.org.uk/frequencies.html

Using Satellites to Study Svalbard's Growing Season

NASA Earth Observatory

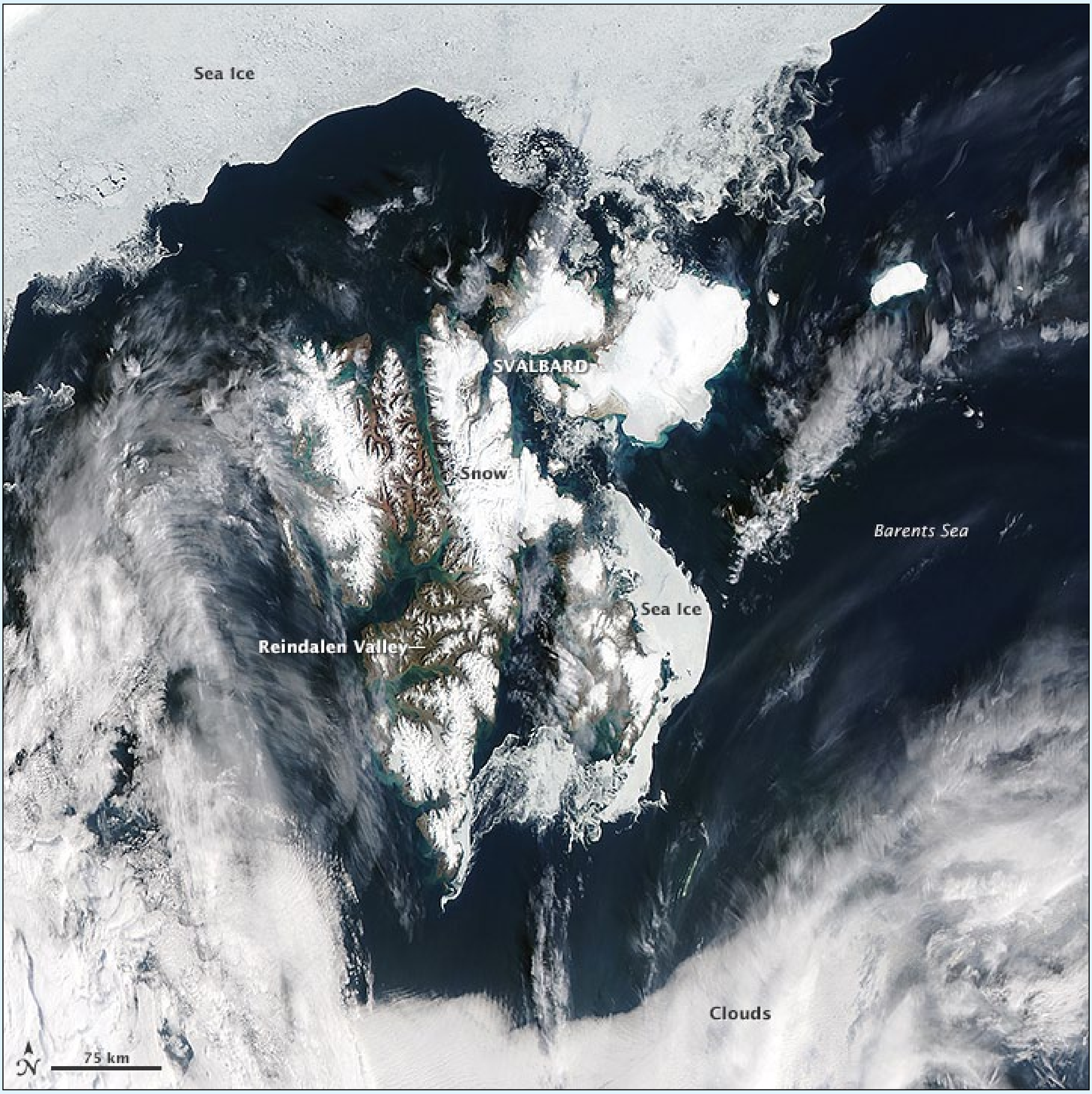


Figure 1 - The Svalbard archipelago, imaged by the MODIS instrument aboard NASA's Aqua satellite, on August 9, 2015.
Image: NASA/GSFC, Rapid Response

Based on its location above the Arctic Circle, just 1,300 kilometres from the North Pole, you might anticipate that the remote Norwegian archipelago of Svalbard would be a barren land of snow, ice, and rock. However, the *West Spitzbergen Current* brings a relatively warm stream of water from the south into the fjords and inlets of western Svalbard. This warm water moderates the climate sufficiently that coastal areas and certain valleys witness an explosion of green in the summer. In contrast, a cool south-flowing ocean current keeps the eastern coasts of Svalbard's islands cold and snowy even during the summer.

The image opposite, acquired by the Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's **Aqua** satellite, shows the archipelago as it appeared on August 9, 2015. Note how sea ice hugs Svalbard's eastern coastlines. In western Svalbard, however, dense mats of moss, grass, and flowers emerge in the light-filled days of summer.

The pair of images on the following page were acquired by the Operational Land Imager (OLI) aboard NASA's **Landsat 8** satellite, and illustrate the dramatic summer greening. Figure 2 shows the Reindalen Valley on April 29, 2015, when the entire landscape was in the embrace of snow and ice.

Contrast this with an image of the same area on July 9, shown in figure 3, where the dark green areas near the lakes in the lower parts of the scene are wetlands dominated by Fisher's Tundragrass (Dupontia fisheri) and White Cottongrass (Eriophorum scheuchzeri). Patches of peat moss, rare in other parts of Svalbard, are also present in the wetlands. The lighter green areas are mostly tundra heath, made up largely of Northern Woodrush (Luzula confusa) and Polar Willow (Salix polaris). The gray areas below the snow line are rocky areas with minimal vegetation, although Svalbard poppy (Papver dahlianum) and some other species are present in small numbers. In total, Svalbard is home to 178 vascular plant species, 390 moss species, 708 lichen species, and more than 750 fungi species.

Stein Rune Karlsen, a Norwegian ecologist at *Norut Northern Research Institute*, has developed a method of monitoring the timing and duration of the summer growing season using satellite observations. In a 2014 study, Karlsen reported that the average onset of the growing season in the Reindalen Valley occurred in June, though there is considerable variability from one year to the next. Figure 4 depicts the timing of the onset of the growing season for a broader area that includes Reindalen Valley and several other valleys in western Svalbard.

Karlsen also found that MODIS detected a slight trend toward a later growing season—a tenth of one day per year, or 1.3 days for the study period. This came as a surprise, because temperatures increased 1.46 degrees Celsius during/. June and 0.44 °C in July over the study period. However, the amount of snowfall also increased over the 14-year period.

"*The effects on the growth season due to the higher spring temperatures were probably counteracted by the effects of the increased amount of winter snow, which delays the timing of winter snowmelt,*" explained Karlsen.

NASA Earth Observatory images by Joshua Stevens, using Landsat data from the US Geological Survey.

Figure 2 - The Reindalen Valley on April 29, 2015

Figure 3 - The Reindalen Valley on July 9, 2015

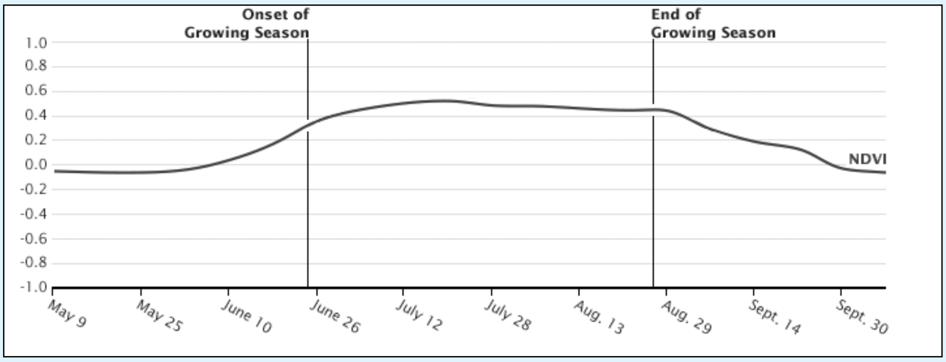


Figure 4 - Onset of the growing season in Svalbard

Lake Tuz

Les Hamilton

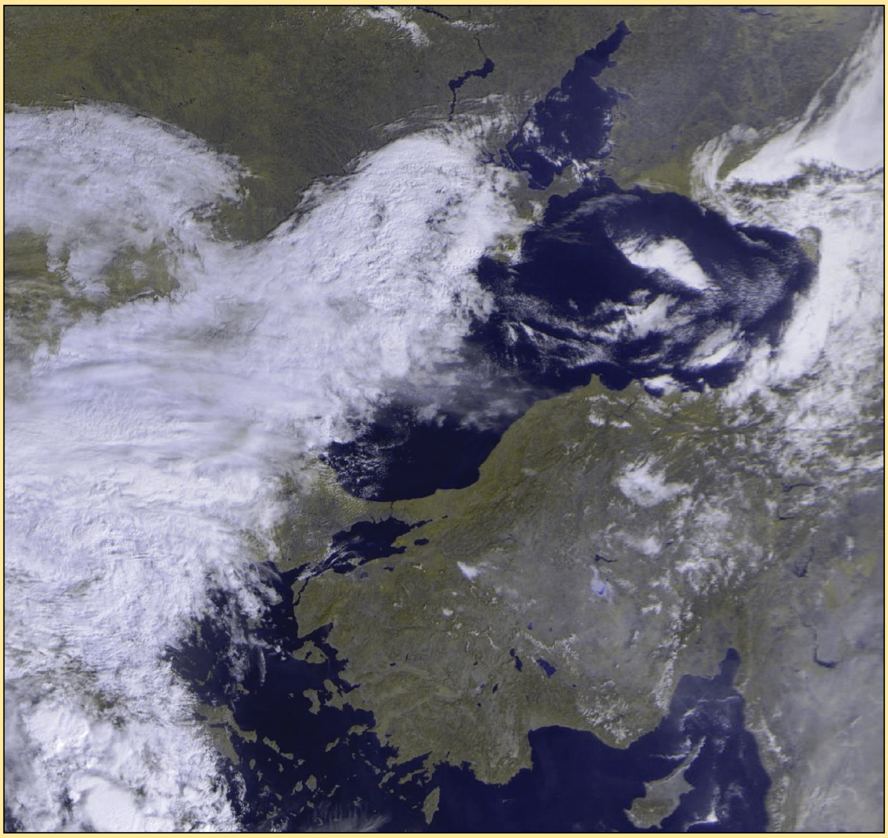
On October 10 this year, Peter Kooistra sent me a Meteor M2 image he had just received, which showed an unexpected cyan coloured object in central Turkey. This came on a day when Meteor's infrared channel had been deactivated for decontamination purposes, and replaced by channel-3. The majority of Meteor enthusiasts tend to concentrate on producing RGB colour composites using just channels 1 and 2 (so-called RGB122), and this format just did not show this object. But Peter included all three channels in his image (RGB123), and contacted me to query what the cyan colour meant. Cyan in RGB123 images generally indicates cold: high altitude cloud in the atmosphere and snow/ice on land. After searching on *Google Maps*, I identified the location as Lake Tuz.

Located in an endorheic basin in central Turkey, Lake Tuz is one of the world's largest hypersaline lakes with a surface area of approximately one thousand square kilometres. In the NASA image on page 37, Lake Tuz is coloured white, bright cyan, blue and green: vegetation shows as green and bare ground tan.

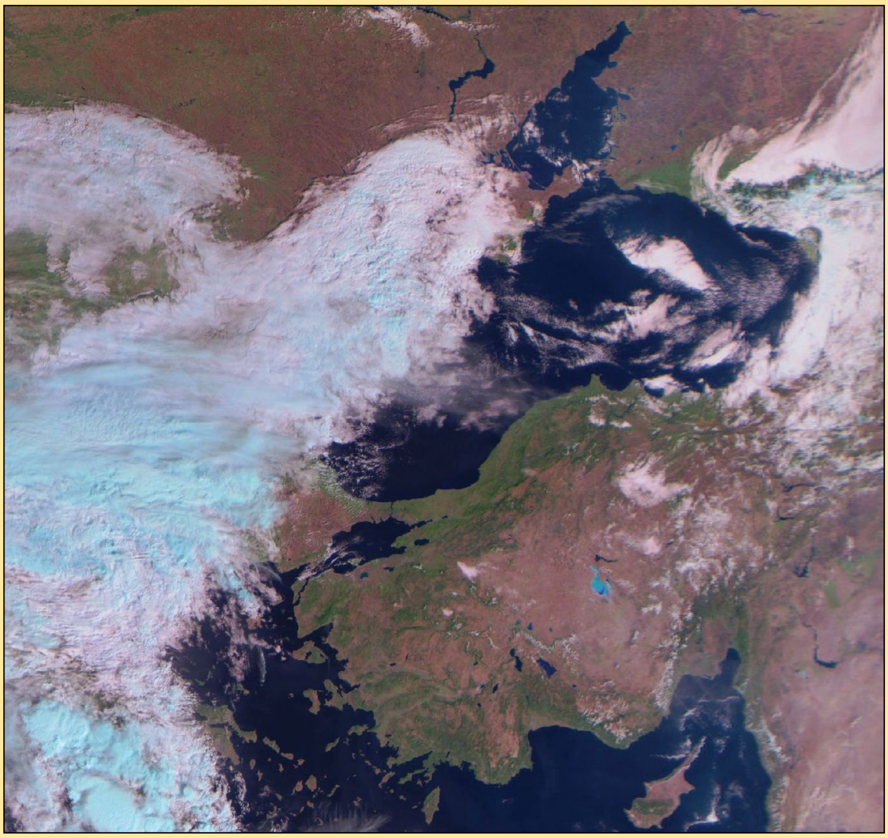
Tuz Golu in Turkish, the lake is the second largest in Turkey, lying at an elevation of 905 metres but, in spite of it's huge area, is very shallow for most of the year with a depth of under one metre. During dry summer months, the water evaporates in huge quantities to leave crust of salt up to thirty centimetres thick over its surface.

This salt is extracted, worked, refined and sold in local markets, thus making this the biggest industry for the economy of communities in the area. It's not only the biggest salt lake of Turkey but one of the biggest in the world as well. Lake Tuz has no outlet, and only a few surface streams feed it, but these tend to dry up during the hot summer months. Rainfall in the surrounding area is only of the order of 250 millimetres per year.

At the time of Peter's image, the Lake Tuz basin would almost certainly have been dry and salt encrusted. By the time the image was received, in early morning, overnight cooling might have created a pool of cold air in this mountain basin, or perhaps even a ground frost, hence the cyan colour in the RGB123 Meteor image. Both versions of the image are reproduced opposite.



The RGB122 version of the Meteor M image, barely showing Lake Tuz



The RGB123 version of the Meteor M image, clearly showing Lake Tuz

Lake Tuz, imaged by NASA's Landsat 5 satellite in June 2009.
Image: NASA GSFC Landsat/LDCM EPO Team

Following two miserable wet days beneath a slow moving depression, the skies cleared during the evening of October 8, 2015, resulting in a rapid drop in temperature. The result was this superb Meteor M2 infrared image of Britain and northern France, acquired from the 20:12 UT pass
Image: Les Hamilton / RTL dongle / SDR#

A Portable, Collapsible QFH Antenna

for the 137 MHz Band

Chris van Lint

Editor's Note

In the very first issue of *GEO Quarterly*, when APT in the 137 MHz band was still the entry-level experience for the majority of amateurs receiving weather satellite imagery, we published Chris van Lint's simple but effective design for a QFH antenna that could be built in a few hours. Noting that there has been some discussion in the Internet Forums on antennas for receiving the new Russian Meteor satellites, it seems an appropriate time, over a decade later, to repeat the article for newcomers to the hobby.

Chris has since relocated to Australia, and regular readers may remember that he contributed a fine Meteor M2 image of Australia in GEO Quarterly 45.

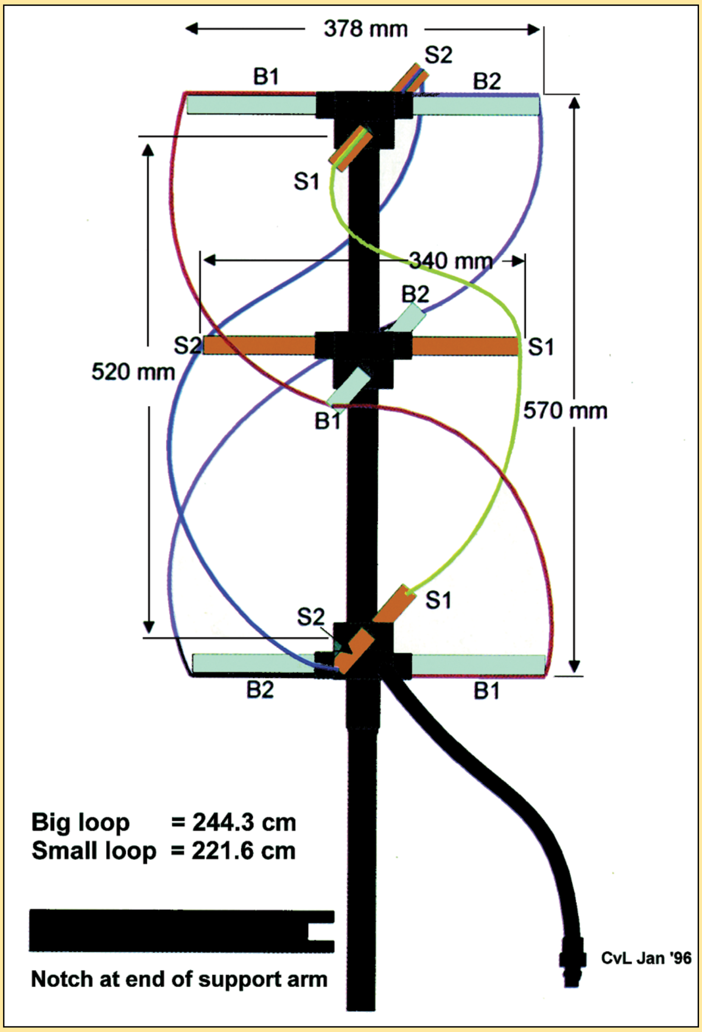


Figure 1 - Measurements for constructing the QFH

Background

In the past, many articles have appeared in a number of publications singing the praises of Quadrifilar Helix (QFH) antennas. Those of us who have had an opportunity to try such an antenna will agree that this device appears to be optimum for APT, since it is truly circularly polarised, with more gain as compared to the classical Turnstile or Lindenblad types. Often these articles are accompanied by construction details to allow the home constructor to build a suitable device themselves. The majority of these articles, however, employ an infinite balun matching-scheme, which is not exactly constructor-friendly to the average home experimenter.

These antennas rely on using copper tubing filars together with a hard-line coax filar to form the balun. In some locations, hard-line coax is difficult to obtain and expensive. QFH antennas using this construction method require that the filars be insulated from the support and often PVC piping is used for this purpose. Since the filars have to be shaped into the desired helical form, they have to be self-supporting, and some means of anchoring them to the support mast has to be devised. This is not an easy feat, in addition to which the shaping of 8-mm tubing is not as simple as it seems. The interconnection of the filars has to be done carefully or the antenna will not work. Construction details which I have seen so far are rather confusing and they have put me off building a QFH of the infinite matching balun type.

Ever since arriving in Hong Kong I have been plagued by pager interference. Hong Kong uses the 137-138 MHz frequency bands for paging applications as well as various others. In fact there is a pager transmission on 137.95 MHz. This has made reception of certain APT frequencies a misery and I cannot get acceptable results on the 137.50 MHz and 137.85 MHz transmissions. After having tried numerous ideas to overcome the problem, including narrow band-pass filtering, I have decided that the only practical solution is to change location. This is of course easier said than done. It is not practical to relocate from my present abode for a number a reasons, not least of which is the fact that another residential area will not necessarily offer relief from the interference. The only areas where one could expect to get interference-free reception would be the more remote and less populated areas on the south eastern part of Hong Kong Island and this would require some form of mobile set-up. Having convinced myself that the best possible APT antenna must be the QFH, I set my sights on constructing a portable version.

Description

I claim no originality for the antenna I am about to describe. As mentioned before, there are numerous descriptions in circulation at the moment. A fundamental deviation from classical QFH antennas is the fact that in this design the filars are not supported directly by the mast but by PVC arms. This relatively simple but nevertheless brilliant idea came from Eugene Buck W3KH, who also provided the dimensions. My contribution lies in the idea of using removable arms and conventional flexible coaxial cable for the filars and matching line alike, which allows the filars to be folded against the support mast when not in use. This antenna is a ½-turn, half wavelength device using a self-phasing big/small loop configuration. Impedance matching is achieved by an infinite balun arrangement in which one of the four

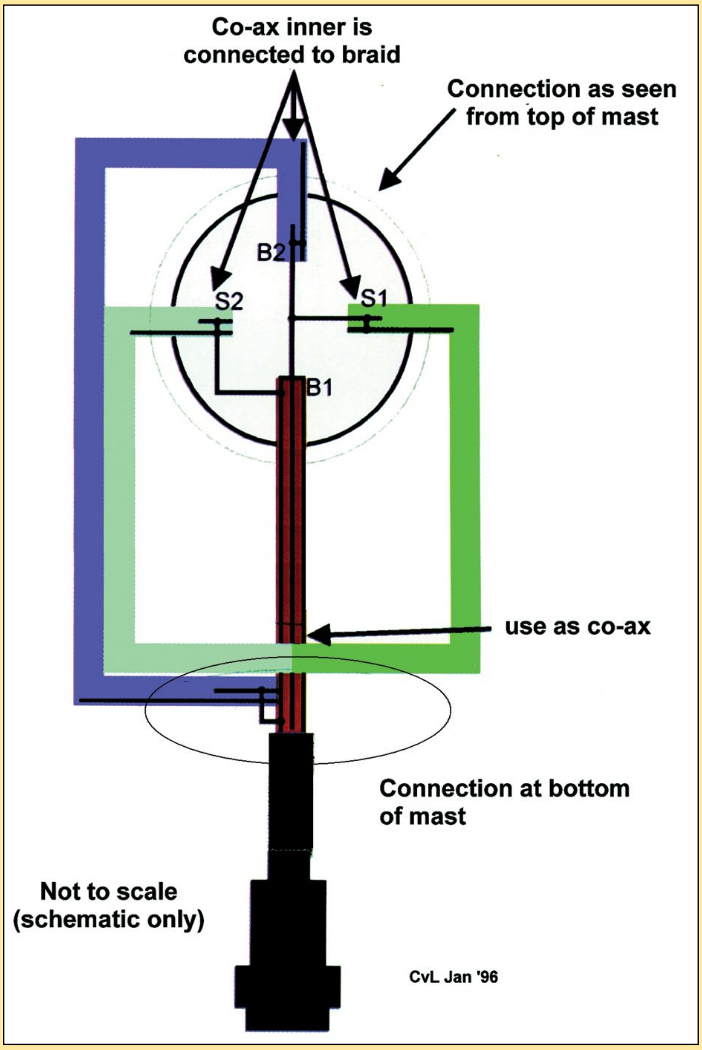


Figure 2 - Connection diagram for constructing the QFH

elements is a length of coax to produce a characteristic impedance of approximately 40 Ω. The antenna is constructed from standard 20 mm PVC electrical conduit tubing for the support arms and a length of 32 mm PVC tube for the support mast. To accommodate the support arms I used six PVC 2-way junction boxes. The relevant dimensions can be noted from figure 1. The dimensions for individual arms are always half the total width when measured from the centre of the support mast. QFH antennas of this type use a **big loop** and a **small loop** and this is the reason why, instead of 4-way, two 2-way junction boxes were used, mounted at 90° one above the other. This procedure creates a (B)ig and (S)mall loop.

Each loop splits into two filars, which are supported by removable PVC arms B1, B2, S1 and S2. Figure 2 shows the connection of the filars in relation to each other. Note that the smaller loop is not connected at the bottom and for this reason filars S1 and S2 may be left joined so that a single length of coaxial cable 221.6 mm in length is used. The diagram shows connection details as viewed from the top of the mast, connections at the bottom and the joining of the feed cable.

Only one filar (one half of the big loop) is used as a coaxial conductor and those filars which do not require use as a coaxial cable have the centre conductors soldered to the braid at both ends. I used RG-6U coaxial cable, not because of its low loss, which is not particularly relevant at these frequencies, but because it has a continuous aluminium shield in addition to the braid: this gives the cable extra rigidity which is useful for shaping the filars once the arms are fitted. Since the APT satellites in which we are interested transmit their signals using right-hand circular polarisation (RHCP), the filars must be wound in an anti-clockwise direction when viewing the antenna from the top down its vertical axis.

Construction

Start by cutting a suitable length of support mast. In my case I cut the mast just long enough to allow a socket to be fitted inside the lowest 2-way junction box. This allows the mast to be extended by inserting another length of 32 mm pipe. Cut holes in the undersides of the junction boxes. The two junction boxes are cemented together at a 90° offset angle to form a cross and a total of three sets of such assemblies are required.

Slide the centre assembly on to the mast, followed by the top and bottom ones. For the centre assembly, a suitable hole may be cut in one of the junction box lids which is than slid over the mast to cover the centre assembly. Note that no dimensions are given for positioning the centre assembly, as this is not critical and should simply be near the centre. Cement the assemblies into place, initially with solvent-based PVC cement. I find that this adhesive, once a little dry, allows some level of adjustment before it sets completely. Once you are satisfied that the assemblies are correctly aligned and the adhesive is dry, apply generous amounts of an epoxy-based adhesive to complete the mast assembly.

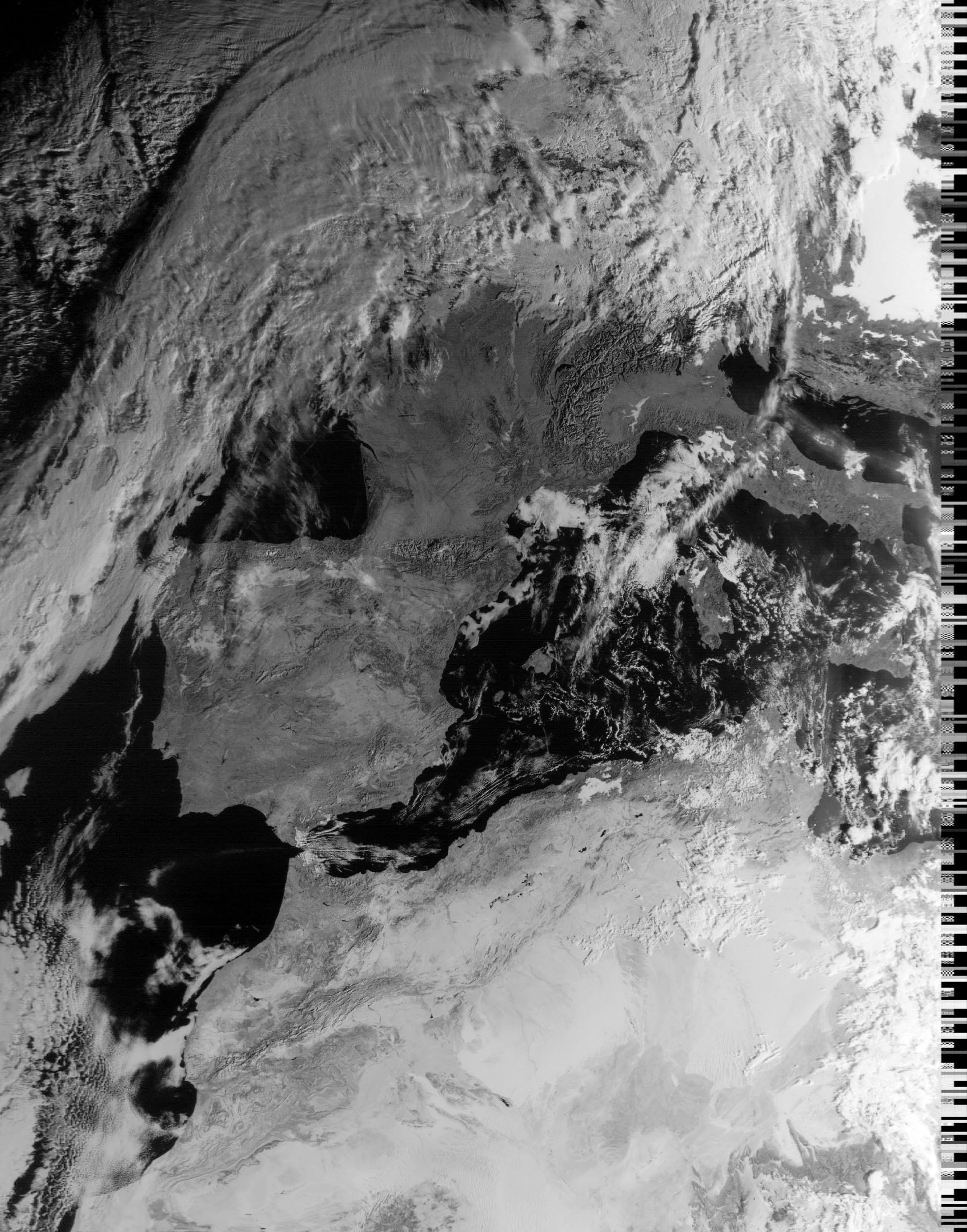
Now cut the support arms. The actual length will depend on the physical dimensions of the junction boxes used. Make sure that you adjust the final length on the basis of the arms having been tightly fitted into the junction box sockets. Remember that the loop dimensions shown in figure 1 constitute the total width of each of the two loops, and the width of the corresponding arms should therefore be half this, and measured from the centre of the mast. Allow a little extra length to accommodate two slots in the support arms into which the coaxial cable filars can be snugly pressed.

Each junction box assembly will have one pair of short and one pair of long support arms. Drill holes big enough to accommodate the coaxial cable on top of, and as close as possible to, the topmost arms. For the bottom set of arms do the same, but below the arms.

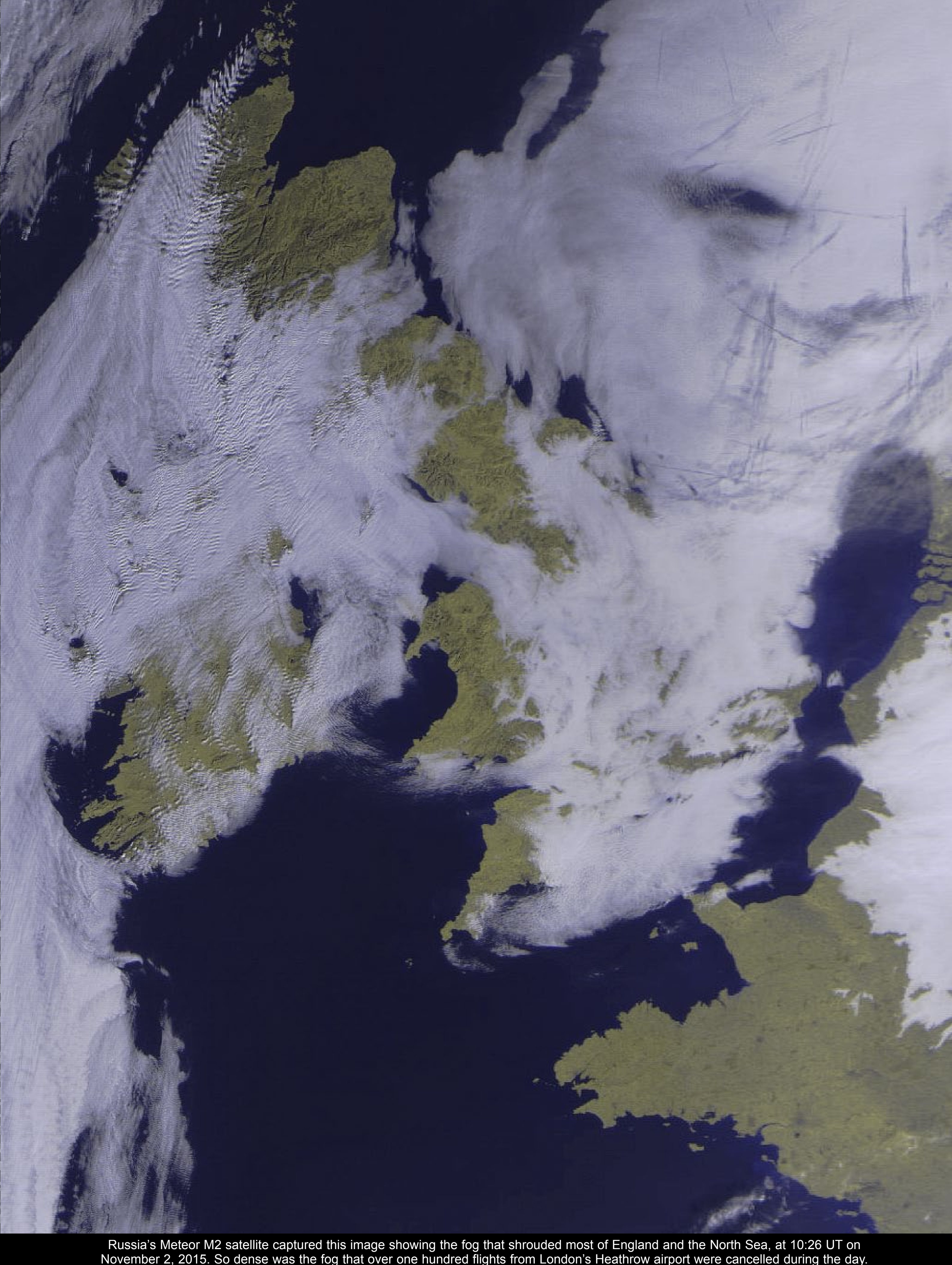
Once completed, insert and twist the arms so that the slot slopes from top left down 45° to bottom right. The arms may now be removed and put aside. It may be helpful to put marks on the sockets and arms to indicate in which position the 45° angle is achieved. If the marks on both the sockets and arms are in exactly the same position there should be no need to put identifying marks on individual arms and sockets; i.e., the position marks should be sufficient.

Insert the coaxial cable which forms the smaller loop into the hole below one of the short arms all the way so that the cable exits on the opposite side. Ensure that the length of cable at both sides is the same. Join the centre conductors to the braid. Cut two equal lengths of coax which will form the big loop. On one piece only, join the inner conductor to the braid and insert one end in the hole above one of the longer arms. Do the same with the second half-length of coaxial cable, but in the opposite hole. Solder the four cables in the top junction box according

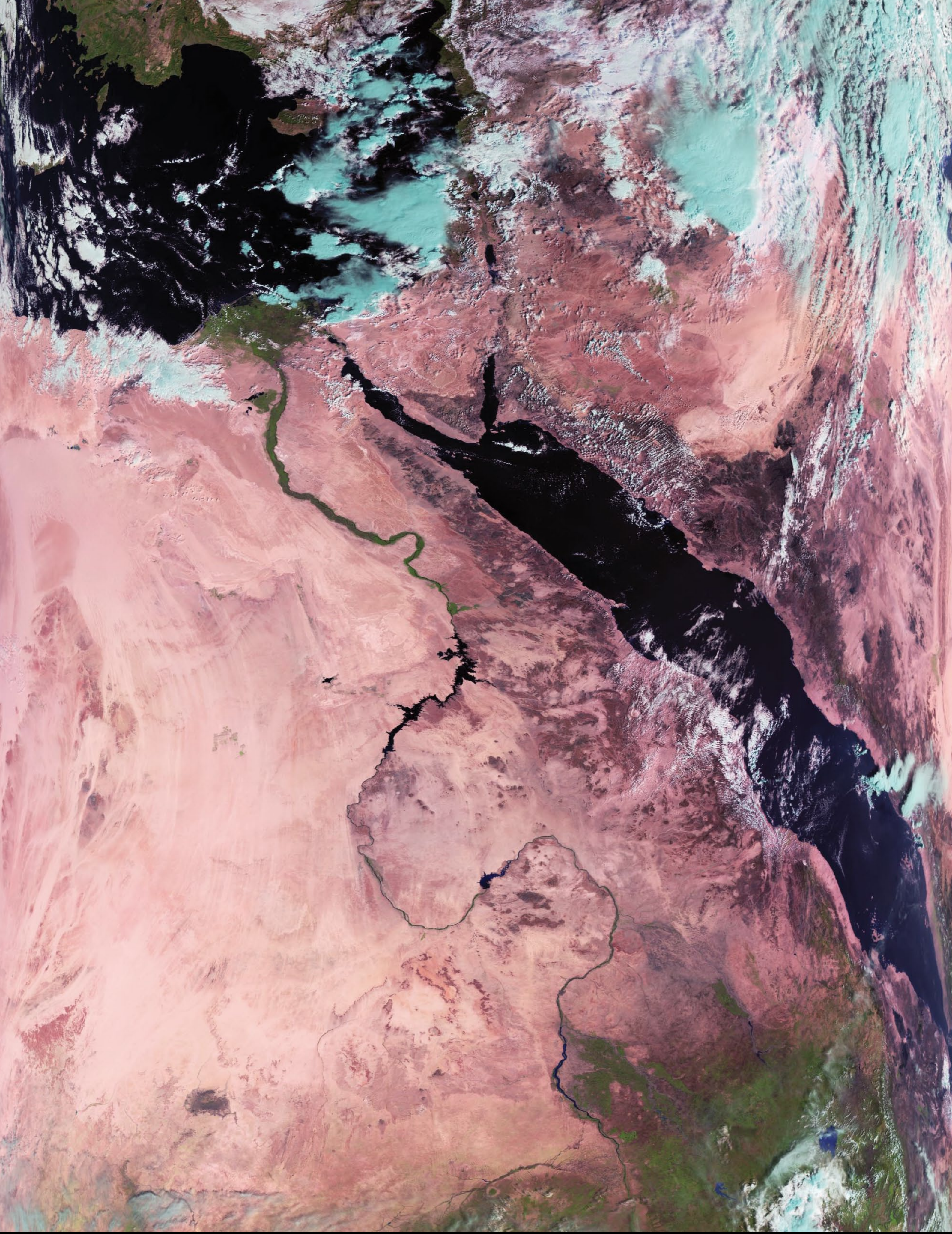
continued on page 45



This is a Meteor M1 channel-3 image from Enrico Gobbetti, acquired from the 08:20 UT pass on November 7, 2015.
You can see another of Enrico's image on page 10, along with a description of his reception system.



Russia's Meteor M2 satellite captured this image showing the fog that shrouded most of England and the North Sea, at 10:26 UT on November 2, 2015. So dense was the fog that over one hundred flights from London's Heathrow airport were cancelled during the day.
Image captured by Les Hamilton using Vasili Beliakov's SDR# Meteor Demodulator and processes with David Taylor's LRPT Processor software.



Mike Stevens sent in this amazingly detailed image showing the River Nile, acquired by the VIIRS instrument aboard NOAA’s Suomi NPP satellite and received over EUMETCast using the TBS-6903 tuner. Final processing was completed using software by Hugo Van Ruyskensvelde.

GEO Outreach

Kempton Rally - November 2015

Francis Bell

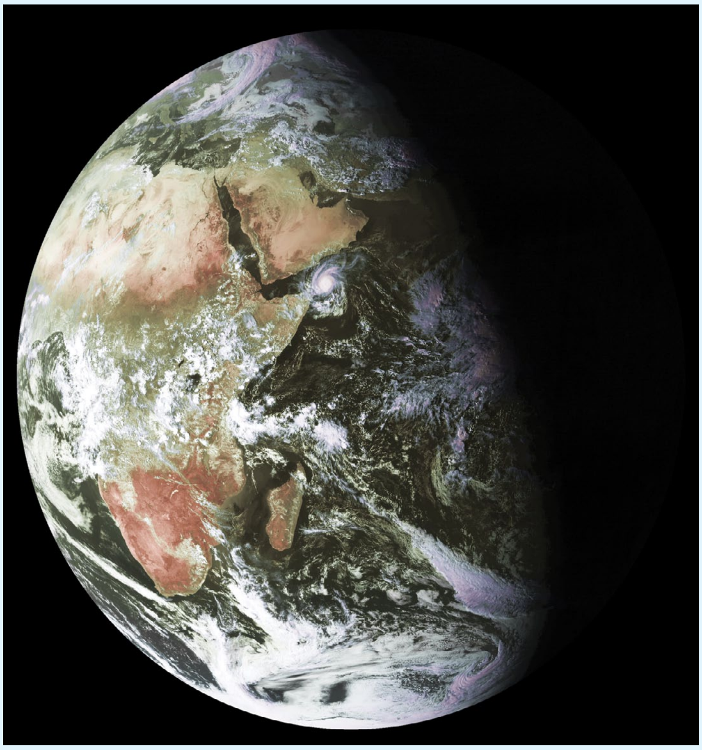
GEO attended the autumn 2015 London Radio Rally held at Kempton Park and, as usual, we had a busy and rewarding day with many visitors to our colourful and informative stand. New memberships were taken and information about weather satellite reception was available to all visitors.

Much interest was shown in the use of SDR dongles for the reception polar orbiting weather satellites, enough for us to sell the entire stock of dongles we had taken to the rally.

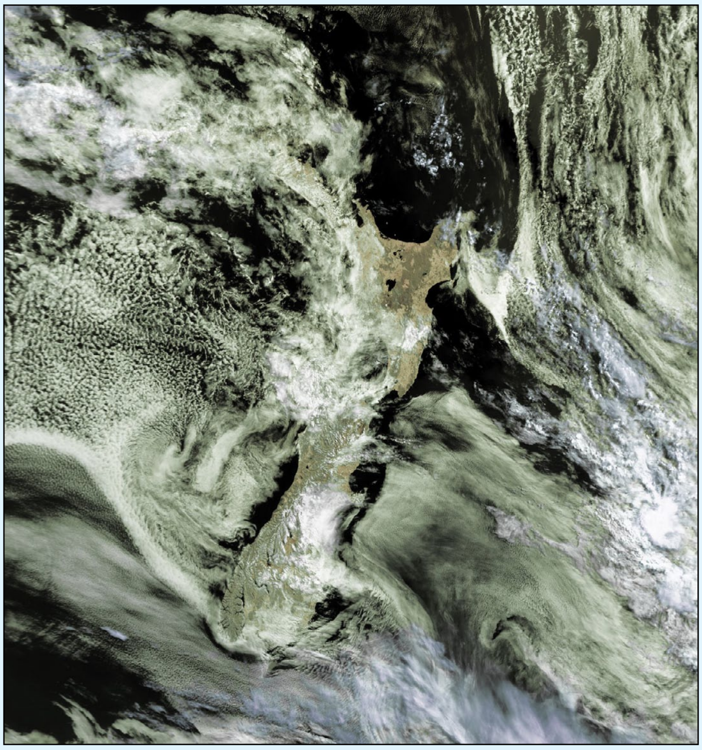
Encouragingly we attracted the attention of some young people to our Kempton stand. The 10 year old girl pictured below, wearing a striped cardigan, showed remarkable interest in all GEO's activities. She is a qualified radio amateur with her own call sign, and has featured in *RadCom* on two occasions. It was great talking to her.

The busy GEO stand at the Kempton Rally.

Two of the junior enthusiasts at the GEO stand.



This Meteosat-7 image from November 8, 2015 shows a cyclone poised to the east of the Horn of Africa.
Image © EUMETSAT 2005



This rather cloudy image of New Zealand was acquired over EUMETCast by Mike Stevens, using the TBS-6903 Tuner.
Image © EUMETSAT 2005

Ship Tracks off Kamchatka

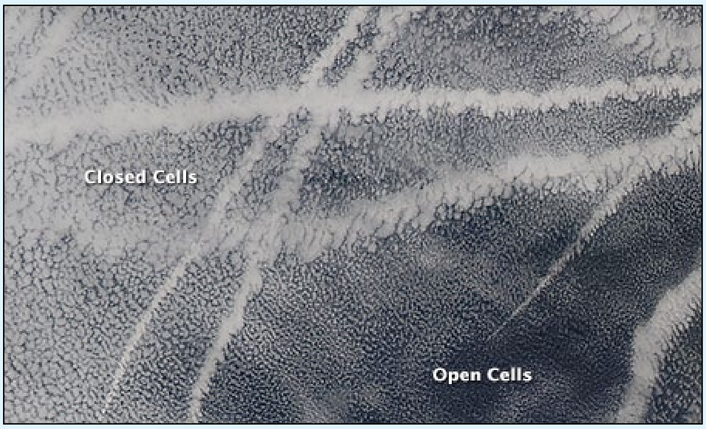
NASA Earth Observatory

Satellite images of Russia's Kamchatka Peninsula often focus on the area's many volcanoes, which frequently spew ash, steam, and aerosol plumes into the atmosphere. In this image, however, the plumes were produced by ships.

Large tankers, container ships, and other vessels emit some pollution particles as exhaust: other aerosol pollutants form indirectly as exhaust gases mix and cool in the atmosphere. Water vapour can then condense around these tiny particles to form long, narrow clouds known as ship tracks.

The Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's **Aqua** satellite acquired this image of ship tracks off the Kamchatka Peninsula on July 27, 2015. In general, the narrower ends of the clouds are younger than the broader ends.

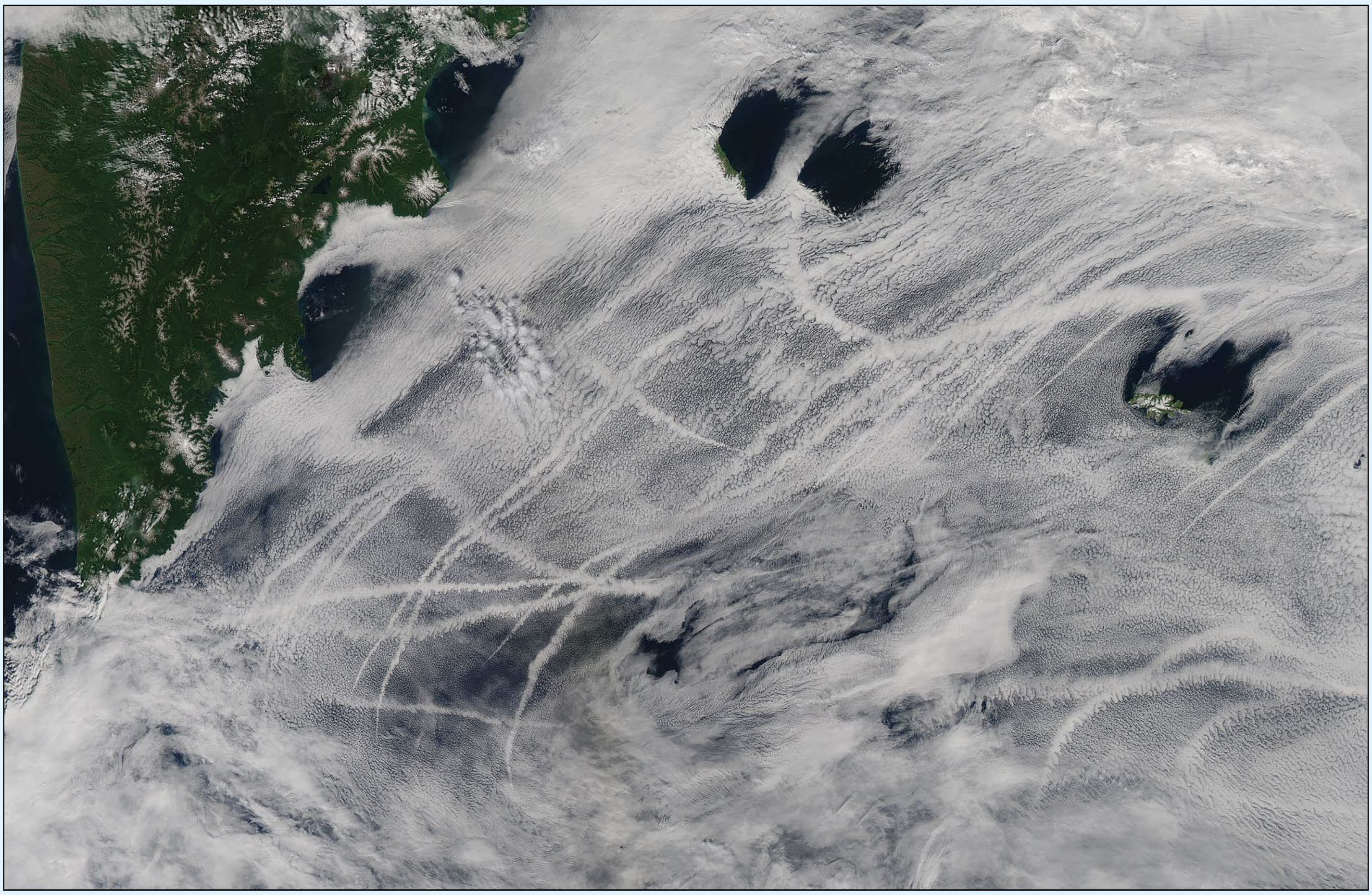
But age is not the only factor affecting the appearance of these narrow clouds. Yi-Chun (Jean) Chen, a scientist at NASA's Jet Propulsion Laboratory, and colleagues have identified specific atmospheric conditions that affect the brightness, or albedo, of ship tracks. (Albedo is the fraction of sunlight reflected back toward space.) One condition is the structure of clouds already in the area: Are they open-cell or closed-cell clouds? The image shows a close-up of an area over the Pacific Ocean that contains both. Open-cell clouds look like empty compartments, whereas closed-cell clouds look like compartments stuffed with clouds.



Open- and Closed-Cell Clouds

Chen's team used data from MODIS and from the Multi-angle Imaging SpectroRadiometer (MISR) on NASA's **Terra** satellite to investigate the interplay between ship-emitted aerosols and cloud properties. They found that aerosol plumes increased the cloud amount and albedo significantly in areas with open-cell formations. In contrast, areas with closed-cell conditions were less susceptible to aerosol plumes. The research was published in April 2015 in *Journal of Geophysical Research*.

Meteorological conditions mattered too, according to Chen. Ship tracks are generally brighter compared with surrounding clouds. But ship tracks that formed in areas where the air above the clouds was drier, and where the cloud tops reached higher altitudes, tended to have a lower albedo.


Ship Trails off the Kamchatka Peninsula
NASA image courtesy of LANCE/EOSDIS Rapid Response

A Portable, Collapsible QFH Antenna

for the 137 MHz Band

(continued from page 39)

to the instructions in figure 2. Insert the opposite ends of the coaxial cables in the holes situated -turn anti-clockwise on the bottom assembly.

Drill a suitable hole somewhere in the lowest junction box to accommodate one end of the coaxial feed line, which should be fitted with a connector of your choice at the other end. Push this feed-line through and join all cables as shown in figure 2.

Cement the top junction box cover and the cover for the bottom junction box assembly into place. Now insert the arms in their correct positions and adjust the slot angles. Simply press the coaxial filars into the appropriate slots, moving anti-clockwise from the top, completing a half turn by the time you get to the bottom.

After a little manual shaping of the filars to form the helical shapes, the antenna is finished. If the antenna is to be used as a permanent fixture rather than a mobile device, you can drill a small hole through the arms, behind the slots at 90° to accommodate a nylon tie to secure the filars into the slots.

Performance

I have compared the performance of my prototype against my other QFH antennas, including a commercial version under dynamic conditions, using a coaxial relay to switch from one antenna to the other.

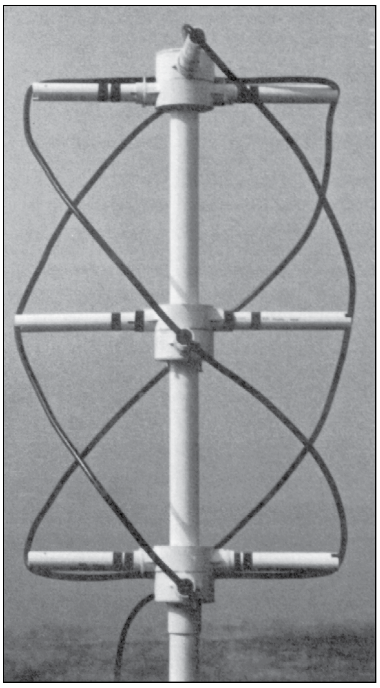


Figure 3 - The completed QFH

I am convinced that the performance of the portable QFH is a good as my other QFH antennas. There are no noticeable nulls and I get usable signals from AOS to LOS (on 137.62 MHz, the only frequency I can receive without interference!).

If you are plagued by interference from a single source, you may find the QFH more suitable than other types of antenna. The QFH produces a higher magnitude of gain on circularly polarised signals as compared to linearly polarised signals. This in effect attenuates linearly radiated signals in relation to the circular ones and reduces interference.

During field testing I noticed that the QFH appears to have distinct directivity in relation to linearly polarised signals. In my case there is a pager transmitter, which makes reception of signals on 137.5 MHz almost impossible. This interference is not intermodulation and it is there when no signal is being received from the satellite.

I found that by turning the antenna when not receiving a satellite signal, it was possible to find a very distinct reduction or sometimes a null in the strength of the interfering signal. This has enabled me, for the first time, to decode NOAA 12 signals on 137.50 MHz. A similar improvement could be obtained when dealing with other forms of linearly polarised interference.

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 N2	137.1000 MHz	On	Good [1]

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 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.

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.

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, EUMETCast or whatever.

Absolutely everything is covered, and the information is updated every week. Special additional bulletins may be issued if an important change takes place mid week.

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.

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.

APT Decoder

This is a group where users of Patrik Tast's APTDecoder can share information and problems.

https://groups.yahoo.com/neo/groups/APTDecoder/info

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

WXtoImg-l

A forum for users of the *WXtoImg* software application for receiving and processing imagery from the NOAA satellite APT signals.

https://groups.yahoo.com/neo/groups/wxtoimg-l/info

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

Mike Stevens, Dorset, England.

Assistance with reception of EUMETCast to include Metop-A and Metop-B; also MSG Data reception and set-up within the PC, assistance with dish alignment and set-up, and installation and set-up of TBS DVB-S2 units.

- email: mikeg4cfz@gmail.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.

Copy for GEO Quarterly

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.

Submission of Copy

Materials for publication should be sent to the editor,

Les Hamilton
8 Deeside Place
Aberdeen AB15 7PW
Scotland

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

geoeditor@geo-web.org.uk

Particularly large attachments (8 MB and above) can be transmitted via *Hightail*

https://wwwhightail.com/

Group for Earth Observation

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Current Subscription Rate for <u>All Members</u> is £15

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- UK residents may pay by means of a **personal cheque** or **Postal Order** made payable to '*Group for Earth Observation*'
- Payment by **direct bank transfer** can be arranged. Please email ***members@geo-web.org.uk*** for BIC and IBAN details.

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Declaration

I wish to join GEO, the Group for Earth Observation, for a period of one year.

I sign below to confirm that I have no objection to my membership details being held on a computer database and understand that these details will be used *exclusively* for internal GEO administration purposes.

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Date

Your subscription is valid for one year from your date of application and entitles you to all the privileges of membership of the Group for Earth Observation, including four issues of GEO Quarterly. Please note that your subscription will commence with the issue of GEO Quarterly that is current at the time of your application. Back issues, where available, may be ordered from the GEO Shop.

Please send your completed form to:
David Anderson (GEO subs),
35 Sycamore Road,
East Leake
Loughborough LE12 6PP, UK

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If you prefer not to remove this page from your Quarterly, a photocopy or scan of this Membership Form is perfectly acceptable

The Group for Earth Observation Limited is a company in England and Wales, limited by guarantee and having no shares. The company number is 4975597. The registered office is Coturnix House, Rake Lane, Milford, Godalming GU8 5AB.

GEO Shop

Manager: Nigel Evans
email: geoonlinestore@gmail.com

For our full range, visit GEO Shop at
http://www.geo-web.org.uk/shop.php

Ayecka-SR1 DVB-S2 VCM USB Receiver

This advanced DVB-S2 VCM Receiver has been extensively tested by both EUMETSAT and GEO, and has proved to be exceptionally suitable for trouble-free reception of the EUMETCast DVB-S2 transmissions that became standard from the start of 2015.

The price includes a USB cable, wall power supply, shipping and *Paypal* fees.

UK members price - £375.00
EU members price - £385.00

NEWSKY RTL2832U/R820T2 SDR DAB USB MCX Socket Special Dongle

for reception of NOAA APT and Meteor M2 LRPT

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

This stick does not come with SDR software or instructions.

UK members price - £20.00
EU members price - £25.00

TechniSat SatFinder Antenna Alignment Meter

This sensitive meter is a great help in setting up and aligning the dish for maximum signal. The meter comes with full instructions.

UK members price - £26.50
UK non-member's price - £29.50

Current Price List

	Members' Prices			Prices for non-Members		
	UK	EU	RoW	UK	EU	RoW
Ayecka SR1 DVB-S2 Receiver	375.00	385.00	390.00	---------	---------	---------
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	---------
GEO Quarterly Back Issues (subject to availability)	3.80	4.60	5.60	n/a	n/a	n/a
GEO Quarterly (PDF on CD) 2004-2014 (Annual compilations - state year)	8.00	8.80	9.30	n/a	n/a	n/a
GEO Membership (4 PDF magazines and one printed magazine per year)	15.00	15.00	15.00	15.00	15.00	10.00

All prices are in £ sterling and include postage and packaging

Ordering and Shipping

We will ship by post, so please allow a few days for items to arrive in Europe and perhaps a few weeks for the Rest of the World.

Orders should be sent by email to

geoonlinestore@gmail.com

or made through the GEO Website at

http://www.geo-web.org.uk/shop.php

Goods are normally shipped within 28 days, subject to availability.

Not yet a GEO Member?

GEO can provide most of the items advertised (with the exception of GEO Quarterly back-issues and CDs) to both members and non members: but non-members cannot benefit from the discounted members prices.

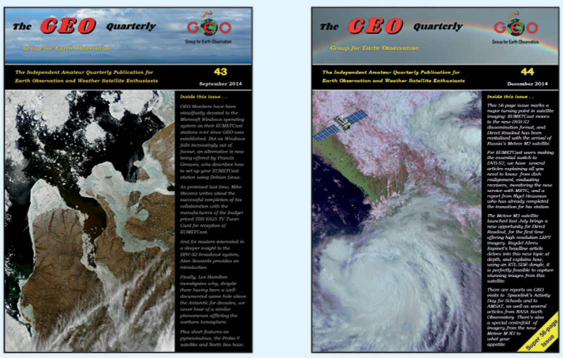
Why not join GEO and take advantage of the discounted prices we can offer you as a member?

Annual Subscription Rate for all regions in now £15 (UK)

For this you will receive 4 electronic (PDF) copies of GEO Quarterly Magazine. In addition, you will be mailed **a printed version** of the December magazine.

GEO Quarterly - Back Issues

(Only available to GEO Members)



Paper copies of back issues of GEO Quarterly may be available, but it is advisable to check before ordering.

UK members price - £3.80

Annual compilations of GEO Quarterly back issues in PDF format are available on CD. Be sure to state the year of each annual compilation that you wish to order.

UK members price - £8.00

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/B001ONAEKI/

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