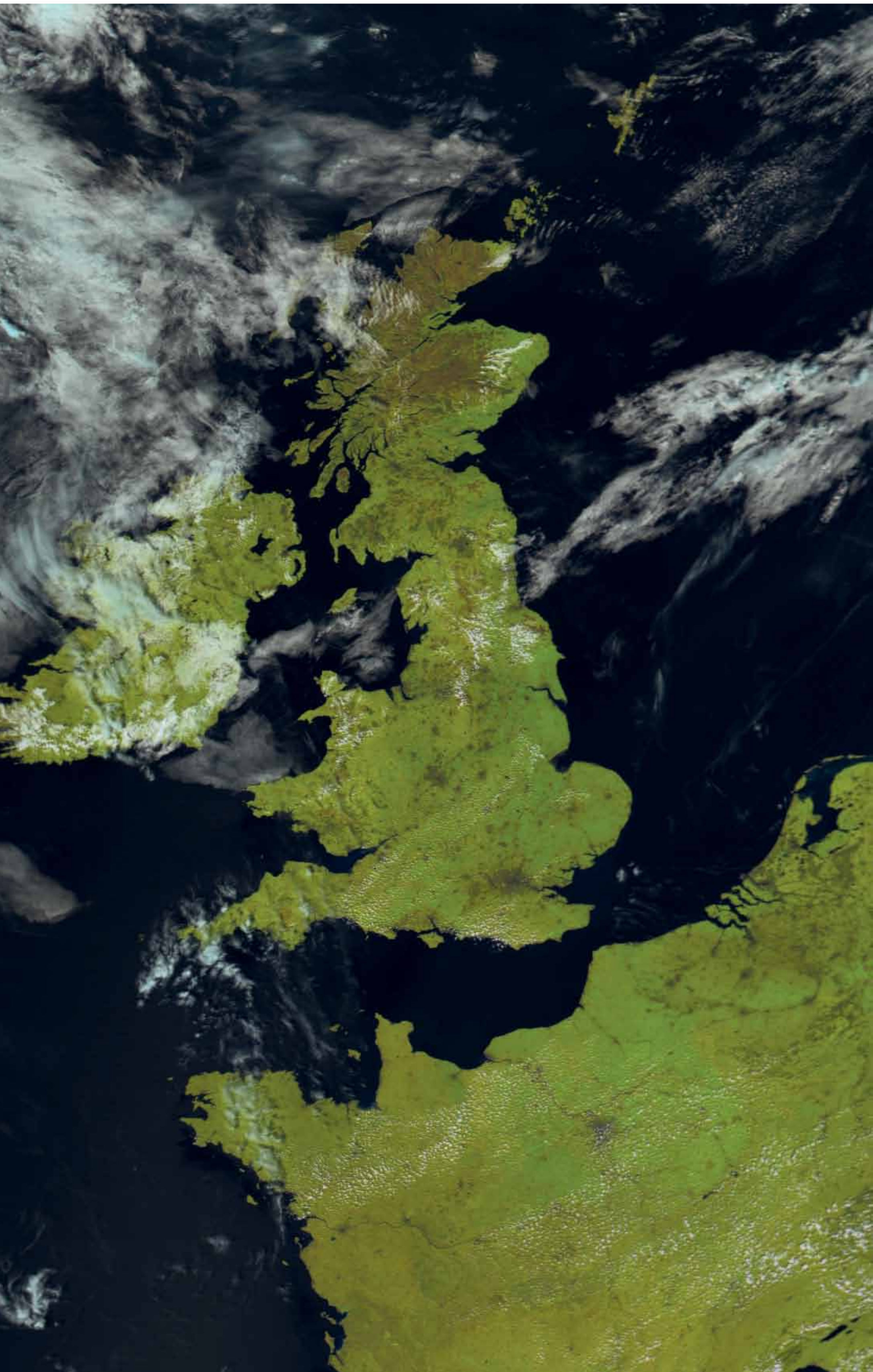
# The GEO Quarterly

Group for Earth Observation

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

39

September 2013



***Inside this issue . . .***

*This issue of GEO Quarterly features a fascinating look back to the earliest days of weather satellite imaging. James Brown, a notable pioneer in this field explains how all the hardware and electronics had in those days to be invented, then constructed by the user.*

*Inspired by February's Chelyabinsk Meteor event, Peter J Bradley details how a group of amateurs are hard at work detecting meteors entering Earth's atmosphere.*

*As promised, Mike Stevens follows up last quarter's EUMETCast article by updating the details for a Windows-7 PC ...*

*... and in a separate article, Mike explains how to enjoy the world-wide Metop imagery now made available as part of the EUMETCast service.*

*For the APT enthusiast, Alistair Dunlop describes his mobile reception station, including details of how to construct a compact wire antenna.*

*This issue contains an extra eight pages, many of them devoted to some of the spectacularly clear satellite images readers acquired during this year's July heatwave.*

*Plus many informative notes and images from NASA's Earth Observatory.*

**GEO MANAGEMENT TEAM**

**Director and Public Relations**
Francis Bell,
Coturnix House, Rake Lane,
Milford, Godalming, Surrey GU8 5AB,
England.
Tel: 01483 416 897
email: francis@geo-web.org.uk

**General Information**
John Tellick,
email: info@geo-web.org.uk

**GEO Quarterly Editor**
Les Hamilton,
8 Deeside Place,
Aberdeen AB15 7PW, Scotland UK.
email: geoeditor@geo-web.org.uk

**GEO Quarterly Despatch**
Peter Green

**Membership and Subscriptions**
David Anderson,
35 Sycamore Road,
East Leake, Loughborough LE12 6PP,
England, UK.
email: members@geo-web.org.uk
Tel: 01509 820 067
Fax: 01509 559 015

**Technical Consultant (Hardware)**
David Simmons
email: tech@geo-web.org.uk

**Webmaster and Website Matters**

**Alan Banks,**
e-mail: webmaster@geo-web.org.uk

**Education Coordinator**
David Painter
email: education@geo-web.org.uk

**GEO Shop Manager**
Nigel Evans (Assistant: David Simmons),
email: shop@geo-web.org.uk

**International Liaison**
Rob Denton,
email: international@geo-web.org.uk

**Clive and Carol Finnis**

**Publisher**
Published by *The Group for Earth Observation Limited*, a company in England and Wales, limited by guarantee and not having share capital.
The Company Number is 4975597.

The registered office is Coturnix House, Rake Lane, Milford, Godalming, Surrey GU8 5AB, England.

**Printing**
Hedgerow Print,
16 Marsh Lane,
Crediton, Devon EX17 1ES.
Tel: 01363 777 595



# Editorial

***Les Hamilton***
***geoeditor@geo-web.org.uk***

After experiencing several dismal summers in a row, Great Britain has at last enjoyed a memorable July, with day after day of clear sunny skies and temperatures regularly—in England at any rate—climbing into the 30s. This has resulted in a wealth of quite breath-taking satellite images, which is reflected in this *Imaging Special*, 56-page edition of *GEO Quarterly*. Thanks are due to all the readers who contributed towards this 'picfest'. We are also grateful to others who rallied round to provide articles for this issue.

James Brown has been a pioneer in the field of amateur weather satellite imaging since the inception of the hobby, and in our headline article this quarter, reminisces over his experiences during those early years. Today, all the hardware and software required for satellite reception are available 'off-the-shelf': James describes in detail a time when he and his fellow enthusiasts had to construct and design their own receivers and antennas, as well as devise ingenious ways in which to display the APT satellite signals as viewable images. The second part of James Brown's article, which details the impact of the personal computer on the hobby, is already prepared, and will appear in our next issue.

The December publication of *GEO Quarterly No 40* will mark the most significant event yet in GEO's history, effectively the Group's 10$^{th}$ anniversary. The meeting at which GEO was launched was convened during December 2003, and it would be most appropriate if, exactly a decade later, we could produce another 'special' issue to celebrate the occasion. Of course, we will need your help to do this, and hope that readers from far and wide will rally round to put pen to paper (or, more likely, fingers to keyboard), in a concerted effort to do justice to the occasion.

We don't plan to organise a readers' survey, but this would be the ideal time to publish an extended *Feedback* page based on correspondence from you. What is your opinion on the balance of *GEO Quarterly's* content over the decade? What types of articles would you wish to see more of, or fewer of? Are there any topics you would have liked to see covered, but which have yet to appear in print? Do get in touch with either myself or Francis Bell with your thoughts on those ten years.

## Contents

# The GEO Report

***Francis Bell***

The first part of this report sadly relates to the death of Ray Godden. Ray died a few months ago while staying, together with his wife Chieko, in their second home in central France. Ray was admitted to hospital there but unfortunately died of a brain haemorrhage while in the hospital. Chieko telephoned me with the news a few weeks ago and I told her that I would pass on the sad news to all the GEO membership.

Ray was a founder member of GEO and it was at a meeting held at his home, in 2003, that our group was established. One of Ray's first actions in support of the new group was, at his own expense, to establish the GEO website and act as our webmaster for about eight years.

I first met Ray in 1990 when I was seconded onto the committee of RIG. At that time Ray was RIG's membership secretary, not only looking after membership issues, but also making important technical contributions to direct weather satellite reception. He designed two low-cost APT receivers which were welcomed by those unable to afford more expensive commercial units. I still have my Ray Godden designed *RX1,* and its successor the *RX2* which I still use daily, even taking it abroad with me for weather satellite reception in far flung places. Ray was very supportive of all GEO's activities and came several of our annual meetings at the National Space Centre in Leicester. His friendship, wisdom and technical skills will be missed by our group.

**EUMETCast: New Service**

Readers should be aware of the pending changes to the *EUMETCast* transmissions, as the current standard will finish in December 2014. If users are not prepared with new hardware for the new service they will **not** be able to receive *EUMETCast* beyond this date. The new transmission standard starts in August 2014 and, for just for a few months, there will be a parallel service: but after December 2014 you must have a new receiver if you are to be able to access *EUMETCast* reception.

It is my highest priority to ensure that we have a receiver capable of receiving this new service available for our GEO membership. In anticipation of this, I recently bought a new **SkyStar S2** receiver which is able to receive the new S2 standard to be used by *EUMETCast.* Unfortunately, I have since discovered that this particular receiver is listed by EUMETSAT as unsuitable for the new service, as it cannot cope with the VCM mode which *EUMETCast* will be using.

We will continue to co-operate with EUMETSAT on this issue and keep our membership advised about the new receiver necessary to meet the new S2 VCM standard. For up-to-date information about the changes to EUMETCast data services please visit the EUMETSAT website at

***http://www.eumetsat.int/website/home/DataNewsletter/EUMETCast/DAT_2043191.html***

Failure to do so will leave you uninformed.

**SDR Receivers**

On the subject of receivers, I'm on a sharp learning curve in relation to a new receiver I bought just a few days ago: the **FUNcube Pro + Dongle**. This software defined radio receiver is about the size of my thumb and plugs into a USB port on my computer. The frequency range is an amazing 150 kHz to 1.9 GHz with modulation capabilities for FM, AM, SSB and CW, with variable bandwidth. I purchased the receiver from Martin Lynch for about £150. If you want to know more about this radio, visit Martin Lynch's web site at

***www.hamradion.com***

This receiver has opened up a whole new world for me and I have already used it for the reception of excellent APT images from NOAAs 15,18 and 19, but I know that there is potential for much more, perhaps including reception of LRIT and AVHRR images. I will write a fuller report with example images which is planned for publication in the December Quarterly.

I understand that there are very much cheaper SDR USB receivers available, for as little as £20, and it is my intention to investigate these. If any reader has experience with such devices it would be great if you could write a report for our editor.

**GEO Symposium 2014**

The date for our 2014 symposium has been set as April 26, 2014, and will be held at the National Space Centre in Leicester. If you would like to make a contribution to the symposium, please get in touch with me directly at

***francis@geo-web.org .uk***

Demonstrations and presentation on relevant topics will be most welcome. Our priority for this meeting must be the preparation for the new *EUMETCast* service which will only be a few months away. Please put this date in your diary for next year and remember the success of such an event is proportional to the contributions made by members.

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**QUARTERLY QUESTION**

The last Quarterly Question asked about the *EUMETCast* Europe assigned data-rate on *Eutelsat's* 9A transponder. Thank for those who submitted correct answers. I received this model answer from Andreas Lubnow:

> Dear Francis,
> Here is my answer to the GEO38 Quarterly Question.
> Currently EUMETCast Europe is assigned 20.5 Mbps net rate on the transponder on *Eutelsat 9A*. The maximum usable data rate on the current transponder is 29 Mbps using DVB-S.
> Best regards,
> Andreas Lubnow Braunschweig Germany.

It is worth noting from EUMETSAT's notice on the subject that the maximum data-rate for the new service will be 60 Mbps. You can read about this on EUMETSAT's data notice referenced above.

**Quarterly Question 39**

This question is quite deliberately directed at a detail relating to *EUMETCast's* new DVB S2 standard for their new service beginning August 2014. If you have read my text above you will have noticed that twice I have used the initials 'VCM' in relation to this new service but without saying what exactly VCM stands for. The Quarterly Question is quite straightforward:

'In the context of a radio broadcasting standard, what does the abbreviation VCM stand for?'

Answers to myself at

***francis@geo-web.org.uk***

by Saturday, October 26.

## *Major Meteor Showers*

Peter J Bradley's article describing the SPAM group's activities in the field of meteor detection on page 9 may well provide readers with an appetite to look out visually for meteors in the night sky.

Here's a list of the dates for the most prominent meteor showers.

| | |
|---|---|
| Quadrantids | January 2-4 |
| Lyrids | April 21-23 |
| Eta Aquarids | May 4-6 |
| Delta Aquarids | July 27-29 |
| Capricornids | July 29-30 |
| Perseids | August 11-14 |
| Draconids | October 8-9 |
| Orionids | October 20-22 |
| Taurids | November 5-12 |
| Leonids | November 16-18 |
| Geminids | December 12-14 |

## *Sich-2 Failure*

Communication with Ukraine's Sich 2 spacecraft ceased on December 12 last year, due to a loss of power. This high-resolution satellite was barely half-way through its planned three-year operational life.

Sich-2 acquired this image of Dubai's artificial island of Palm Jumeirah on October 7, 2011.
*Image: Dniprokosmos*

# Summer's End?

Following the longest spell of hot July weather since 2006, the broke with a vengeance on July 27. This MODIS channel-5 image acquired by NASA's *Terra* satellite at 10.55 UT that morning shows cloud embedded with thunderstorms advancing on England from both the south and east. Over the ensuing 24 hours, much of the country experienced thunder, lightning and torrential rainfall, some places receiving their full mean July total of as much as 75 mm of precipitation.

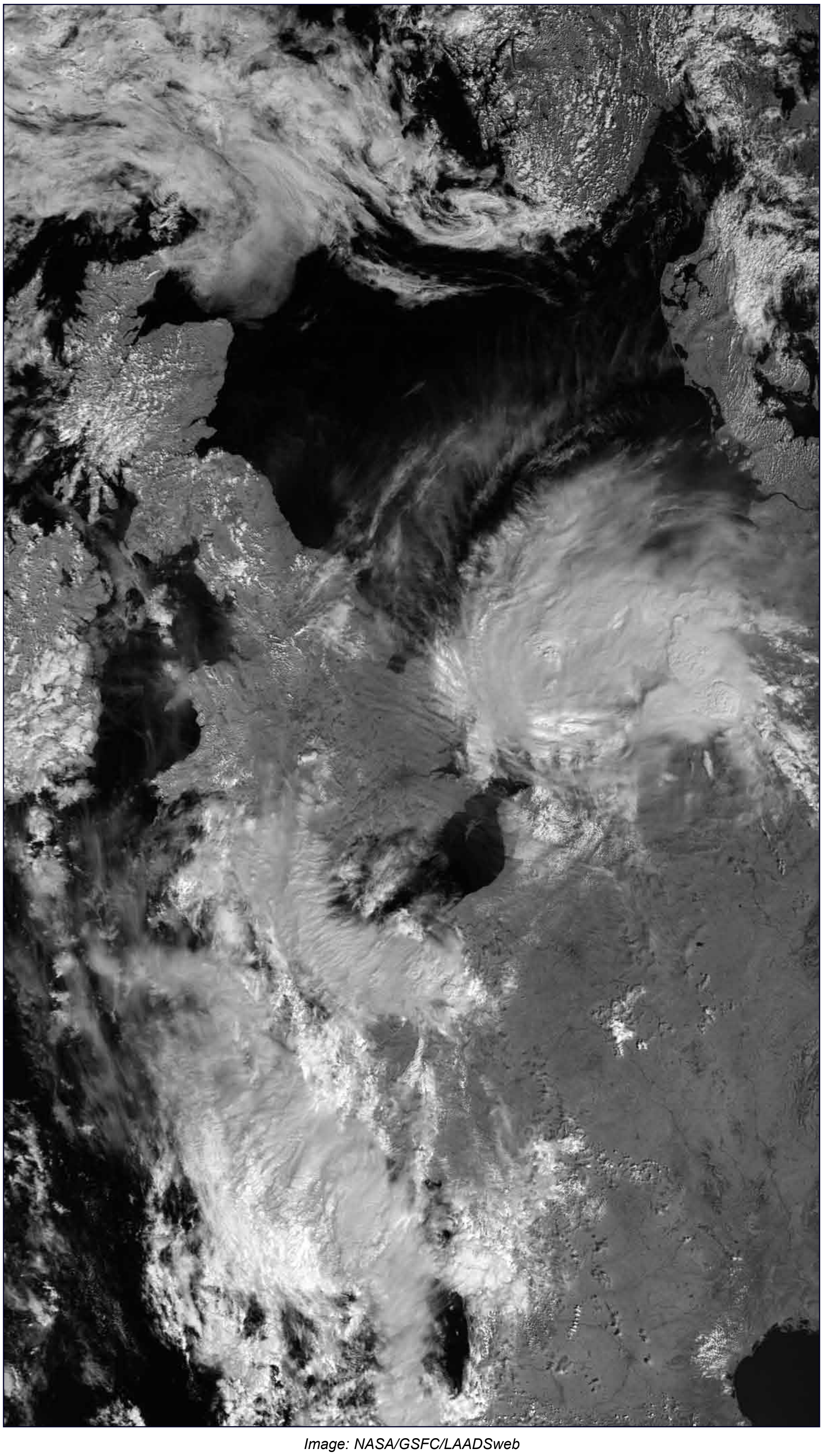
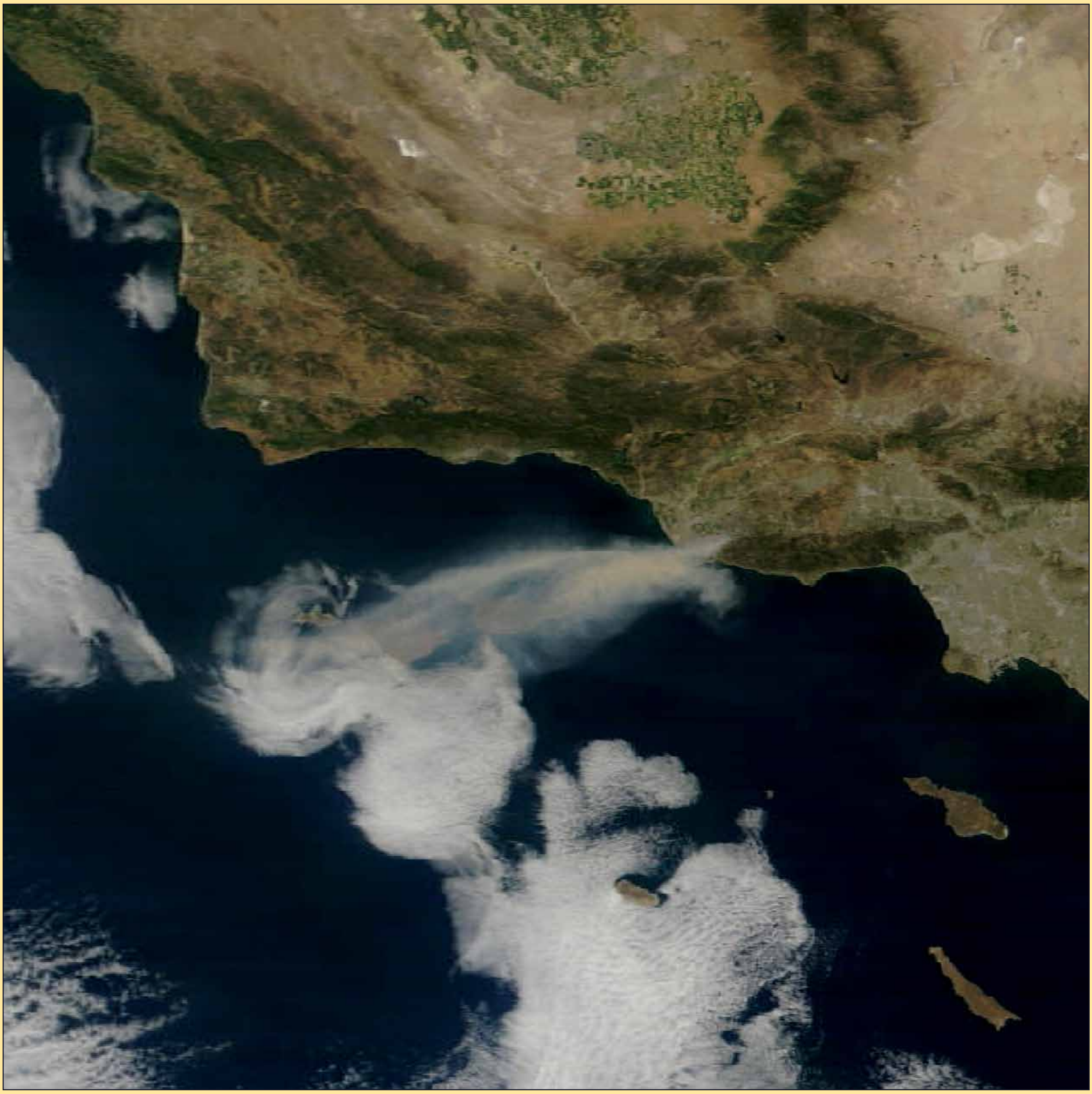


*Image: NASA/GSFC/LAADSweb*

# Spectacular California Smoke Plume

***A NASA Earth Observatory Report***



Fueled by hot, dry *Santa Ana* winds, several wildfires broke out in southern California in early May 2013. The *National Interagency Fire Center* had predicted an earlier than normal fire season in California following scarce winter and spring precipitation.

On May 2, a fire started near *Camarillo Springs* and gusty winds blew it toward the coast, wafting smoke out over the Pacific Ocean. The Moderate Resolution Imaging Spectroradiometer (MODIS) aboard NASA's Terra satellite captured this image of the fire as it burned about 50 miles northwest of Los Angeles, California. According to fire fighting agencies in California, the *Camarillo Springs* fire had spread over 10,000 acres by early morning the following day. More than thirty homes and other buildings had been damaged by fire, and another 4,300 were under threat. The fire was being fought by 14 water-dropping helicopters and planes as well as more than 900 firefighters on the ground.

Temperatures in Southern California were above 30°C in many places, with humidity as low as 5% as winds gusted between from 70 and 120 kilometres per hour.

*Image: NASA / LANCE-MODIS Rapid Response*
*Processed with SmoothMODIS software*

# TWO NILES MEET

***A NASA Earth Observatory Report***

Though it moves just a tiny fraction of the water carried by the Amazon, Congo, or Niger rivers, the Nile is the world's longest. Its main tributaries—the White Nile and the Blue Nile—meet in Khartoum, Sudan, a rain-poor city of nearly two million inhabitants that relies on the Nile for irrigation. Well-watered crops line the river banks and patchworks of croplands, including circular, centre-pivot irrigated fields, dot the city's outskirts.

The Advanced Land Imager (ALI) on NASA's Earth Observing-1 (EO-1) satellite acquired this natural-colour image on April 26, 2013, near the end of the region's dry season. Compared with the White Nile, the Blue Nile is narrow, its highly variable flow being near its lowest point at this time of year. In exceptionally harsh dry seasons and droughts, the Blue Nile can dry out completely.

The White and Blue Niles derive their colours from the sediments that they carry. Originating in the Equatorial Lakes region, the White Nile is rich in light gray sediments. As this long river meanders over flat terrain, it loses over half of its water to evaporation.

Shorter than the White Nile, the Blue Nile rises in the highlands of Ethiopia and Eritrea, picking up black sediment en route to Khartoum. The Blue Nile is fed by monsoon rains and, when these are abundant, the river can actually flow backward near its confluence with the White Nile.

Upstream from both rivers, residents rely largely on precipitation for farming. Most water extraction along the Nile occurs in Sudan and Egypt, where rainfall is too sparse to support crops. More than 120 million people rely upon Nile waters for irrigation and other uses.

*NASA Earth Observatory image by Jesse Allen and Robert Simmon, using EO-1 ALI data from the NASA EO-1 team. Caption by Michon Scott.*

# Fire Tornados

## Illuminate Australia's Red Centre

**Les Hamilton**


The 30 metre tall fire tornado that suddenly sprang to life just after 5 pm local time on September 11, 2012.
*Photo © Chris Tangey (2012)*

Earlier this year, I received an interesting email from one of GEO's Australian readers, Ken Morgan, which included some amazing photographs of a rare **Fire Tornado** that had been observed near Mount Conner, in the vicinity of the Curtin Springs cattle station, about 80 kilometres from Uluru in the southwest corner of Northern Territory. I was sufficiently impressed that I suggested to Ken that, if permission to publish could be obtained, it would be great to share these with readers of *GEO Quarterly*. Ken contacted Chris Tangey, a film-maker with *Alice Springs Film and TV*, who, completely by chance, was working in the area when the phenomenon appeared, and shot a movie of the event. Chris graciously gave his consent for GEO to publish some stills from his HD video, and provided additional background details.

What, then, are fire tornados. How, why and where do they occur? Why are they so rarely seen? Fire tornados are more closely related to dust devils than to fully fledged tornados, though both have in common a rapidly rotating, rising column of air. Tornados are associated with thunderstorms and drop downwards from the clouds towards the ground. Dust devils form when hot air close to the ground forms a vortex as it rises quickly through cooler, lower pressure air above it.

In the case of a fire tornado, it is usually the heat from a sizeable wildfire or brush fire that sets the air in motion, the updraught then drawing flames and combustible material aloft. The majority of fire tornados are no more than a metre or so in width and some 10 metres tall, though examples up to 50 metres wide and reaching 100 metres into the air are not unheard of. Fire tornados are normally short-lived, and tend to peter out after just a few minutes.

Why then, are fire tornados are so rarely seen? This is due more to where they form rather than to their rarity. They occur in locations where it is very hot and dry, and the majority are believed to form in forest fires where they are often completely hidden by trees, flames and smoke. It is only on rare occasions in grass fires, that they become more open to being captured on film for posterity. Not surprisingly, those who observe fire tornados most frequently are the firefighters who work to prevent the spread of wildfires.

On the day in question, Chris Tangey had finished his day's work scouting for film locations near Curtin Springs and, noticing a small bushfire burning not far away decided to take some shots of it. Suddenly, much to his surprise, he observed the sudden appearance of a 30-metre tower of flame which 'sounded like a fighter jet'. It was 5.15 pm local time, about an hour before sunset on a very mild day with a temperature of just 25°C. There was absolutely no wind. The fire tornado remained almost stationary, spawning pillars of fire and smoke for a full forty minutes.

Much of the local vegetation consists of spinifex grass, which contains a highly flammable resin which burns extremely fiercely. This, coupled with the fact that the region had been protected from fires for over half a century, and had just experienced the driest spell ever recorded in Central Australia, could explain the incredible intensity of the fire tornados.

*continued on page 7*


The fire tornado produced columns of smoke and flames for some 40 minutes against the backdrop of Mount Conner.
*Photo © Chris Tangey (2012)*

A close-up image of the Fire Tornado
*Photo © Chris Tangey (2012)*

At its height, the Fire Tornado blots out the sky.
*Photo © Chris Tangey (2012)*

The station workers kept watching in amazement, too enthralled by the scene to be scared. And all the while, Tangey continued photographing the event—as up to three simultaneous fire tornados burned no more than 300 metres away—in HD video, which can be viewed on *Vimeo* at

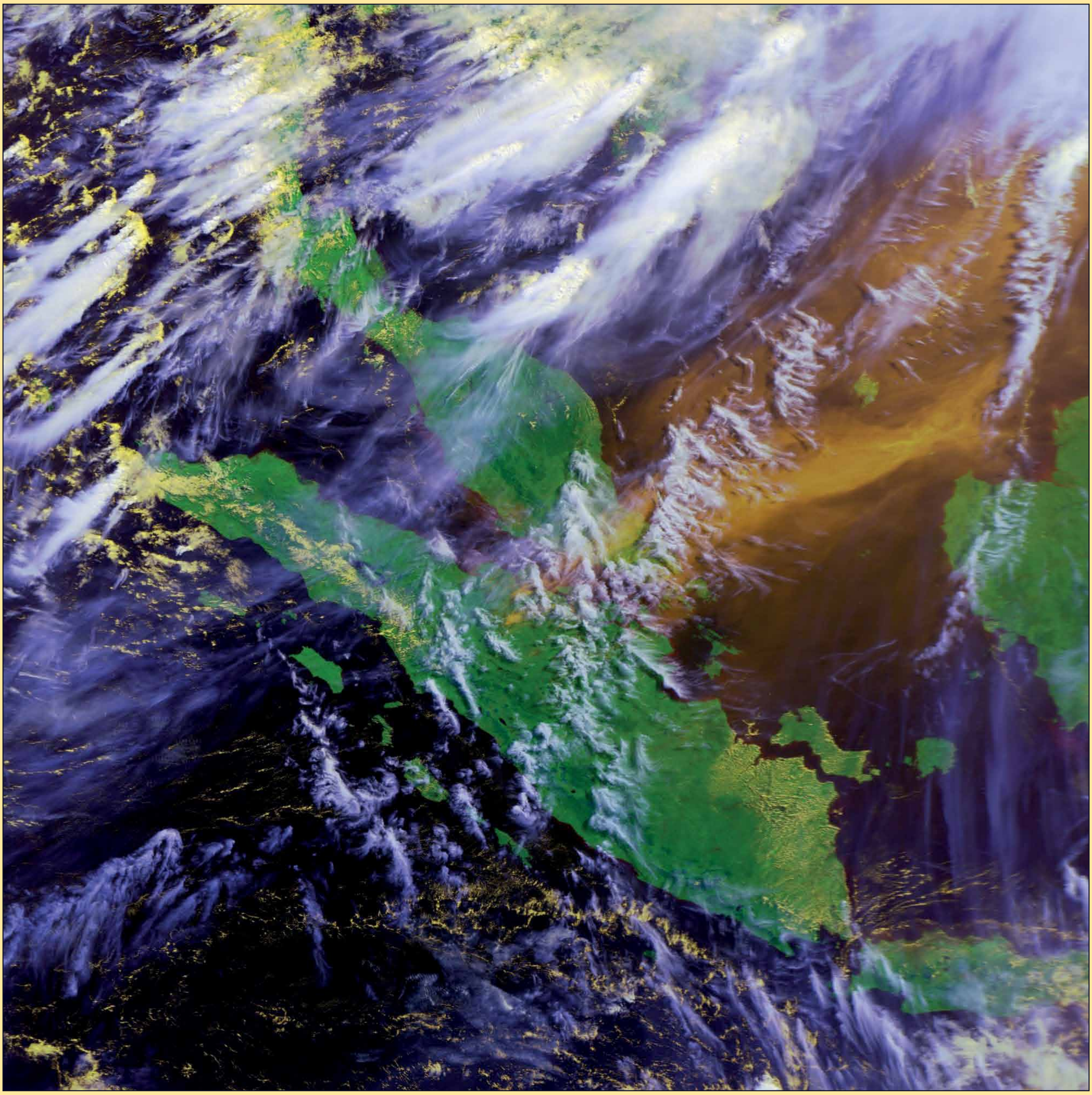
***http://vimeo.com/alicespringsfilmtv/firetornado***

Following the event, Chris Tangey commented:

*'I've been shooting in the outback for 23 years and have never seen anything like it. We've heard about them, but they're never seen. If I had known what was about to happen, I would have happily paid $1,000 to watch it. The whole experience was staggering and the length and variety were astonishing. In my case there was almost a miraculous positioning of the camera, not only next to the only rocky feature in any direction, Mt Conner, but in **front** of the prevailing smoke.'*

# Singapore suffers Indonesian 'SLASH-AND-BURN' SMOG

**John Tellick**



Television news bulletins in the UK devoted considerable air-time to the dense smog that blanketed Singapore on June 21, 2013. This large smoke cloud resulted from farmers and companies on the adjacent Indonesian island of Sumatra —many illegally—clearing large areas of forest by 'slash and burn' for the cultivation of palm oil.

The Pollutants Standard Index (PSI) at noon local time in Singapore reached an alarming 401, the first time ever the 'hazardous' level had been attained. The PSI scale runs from 0 to 500, with the following classifications:

| | |
|---|---|
| 0 - 50 - | good |
| 51 - 100 - | moderate |
| 101 – 200 - | unhealthy |
| 201 - 300 - | very unhealthy |
| 301 - 500 - | hazardous |

The vast pollutant cloud shows up well in this Metop-B, R1G2B4 image, captured via **EUMETCast** and processed using David Taylor's **Metop Manager** and **HRPT Reader** software.

*Image © EUMETSAT 2013*

# Meteor Detection at Norman Lockyer Observatory

# The SPAM Group

**Peter J Bradley**

The *Norman Lockyer Observatory (NLO)* was built in 1912 by Sir Joseph Norman Lockyer following the closure of the South Kensington Observatory, where he had been a principal researcher of solar activity and meteorology. While observing the 1868 solar eclipse, Sir Norman detected a previously unknown yellow spectral line in the solar spectrum, and was the first to propose that it was due to a new element, which he named helium. Many of his original spectrographic slides of the sun and stars still survive. Helium itself was finally discovered as a product of the radioactive decay of uranium ore in 1895 by the Swedish chemists Per Teodor Cleve and Nils Abraham Langlet.

The observatory has five telescopes, three historic and two, more modern. It also has an excellent revitalised planetarium which was moved from Greenwich a number of years ago. But as well as its activities in the field of optical astronomy, the observatory supports several more diverse interest groups in the fields of astro-imaging, meteorology, and meteor detection and imaging. Recently there has been considerable interest in meteor detection following the February 15 asteroid visits of 2012 DA14 (figure 1) and the Chelyabinsk meteorite [1].

It is relevant, first of all, to give some indication of the relationship between asteroids and meteors. **Asteroids** are, in general, inactive lumps of rock or metal, sometimes also containing organic matter, which vary in size from few metres to many tens of kilometres across. Most of these are confined to the asteroid belt between planets Mars and Jupiter, but some approach much closer to Earth. The Chelyabinsk asteroid, credited by NASA as having a diameter of 17 metres and a mass in excess of ten thousand tonnes, was found to have been a member of the Apollo group of asteroids, characterised by the fact that they all cross Earth's orbit on their way towards perihelion. The smallest of these bodies, most probably fragments created by collisions between asteroids, ranging from the size of a typical pebble to as small as a grain of sand, are usually called **meteoroids**.

A **meteor** is observed as a flash or trail of light when a meteoroid enters Earth's atmosphere at high speed. Often referred to as a shooting star, friction with the atmosphere causes it to heat up and glow for a few seconds. Most meteors tend to burn up completely and never reach the ground. Some, however, do not completely burn up, and reach the Earth's surface, when they are termed **meteorites**.

Very occasionally, a significantly larger meteoroid impacts the atmosphere, the Chelyabinsk event being a case in point. So much heat was generated as it sped through the atmosphere that it exploded into innumerable smaller fragments, hundreds of which were subsequently found in the area below the meteor's explosion. Even more occasionally, an asteroid collides with Earth, as in the case of the body that created the Chicxulub crater in Mexico, and with it, almost certainly the great Cretaceous–Paleogene extinction event.

The intense heating that accompanies the passage of a meteoroid also causes ionisation of the atmosphere immediately around it and it is this that we use to detect meteors.

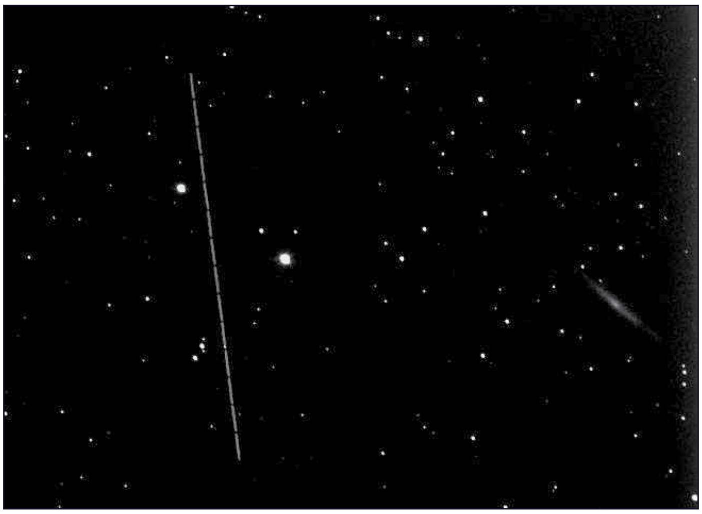


Figure 1 - This photograph shows part of the track of asteroid 2012 DA14, which bypassed Earth by a mere 27 700 kilometres on February 15, 2013.

Figure 2 - The GRAVES Space Surveillance System
*Image © ONERA 1996-2006*

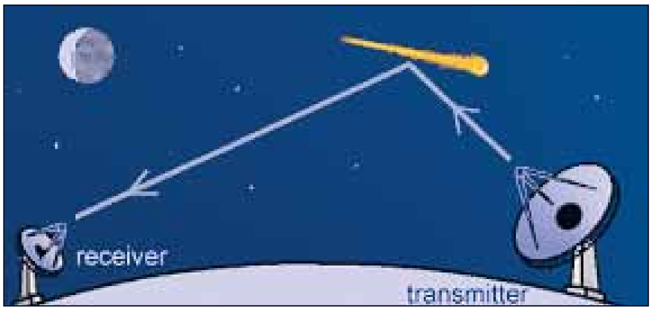



Figure 3 - Signal Path

Asteroid 2012 DA14, which hurtled close to Earth at a distance of approximately 27,000 kilometres at it's closest approach—well inside the Clarke Belt where geostationary satellites orbit—continues away from Earth as an asteroid. Figure 1 is a photograph showing a short track of *2012 DA14* taken on the night of it's visit by NLO president, David Strange.

### Solar, Planetary and Meteor Detection Group (SPAM)

For a few years now a group of enthusiasts have been detecting meteors/meteorites at the Norman Lockyer Observatory in Devon. The group was initiated by a couple of radio amateurs interested in radio astronomy and quite separately from the radio amateur group under the NLO. The participants in this project are now spread across the UK and contribute to the website which displays these time related images,

***www.merriott-astro.co.uk/spam3D.htm***

Figure 4 - An aerial view of the GRAVES transmitting array

*Image © 2010, Google Earth, Europa Technologies, IGN-France, Tele Atlas.*

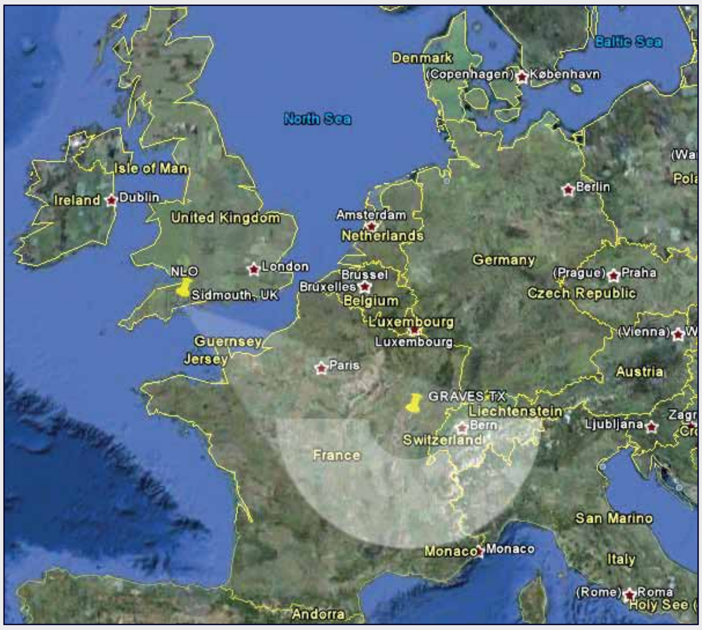
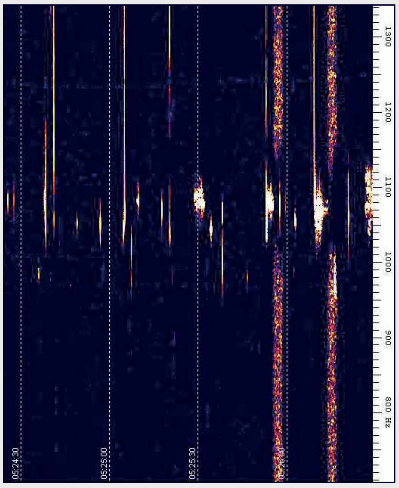



Figure 5 - The approximate GRAVES ionospheric illumination field, and the corresponding antenna direction from East Devon.

*Background image © 2010, Google, Europa Technologies, Tele Atlas.*

Figure 6
A signal from a typical meteor shower, acquired on
January 13, 2013, and displayed in two dimensions (2D),



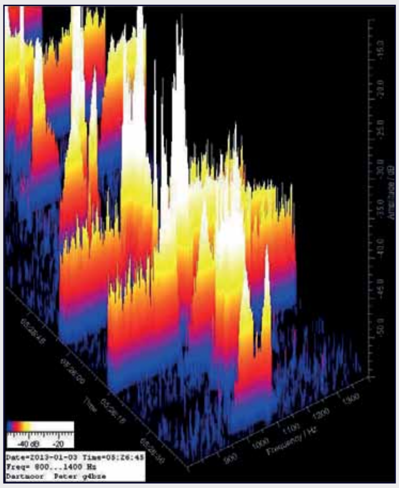


Figure 7
A signal from the same meteor shower, acquired on
January 13, 2013, and displayed in three dimensions (3D)

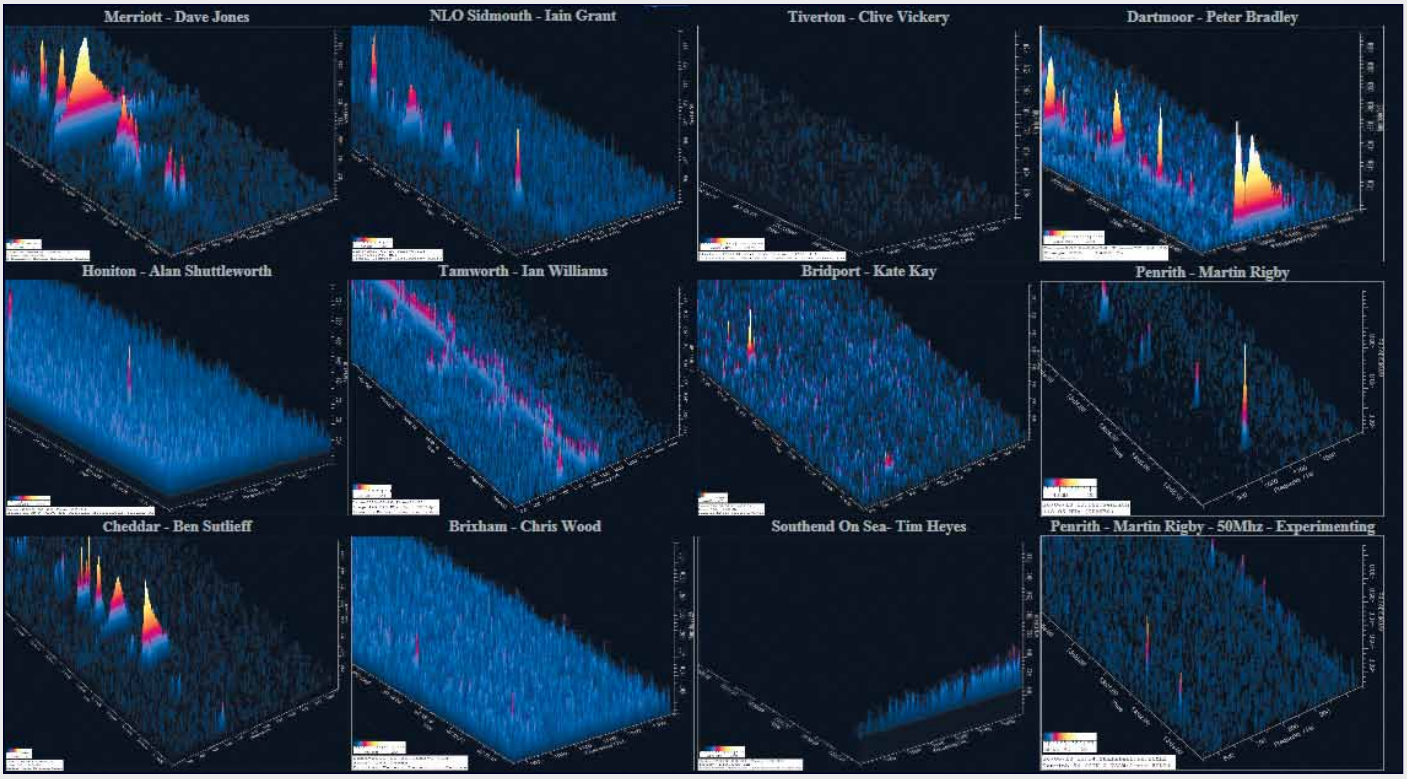



Figure 8 - Comparing meteor signals from different stations

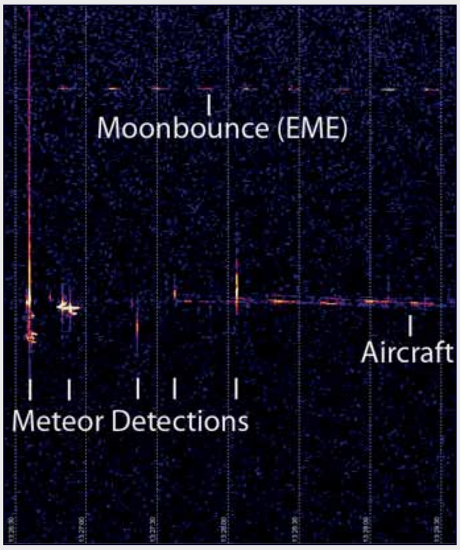


Figure 9 - Interference signal (moonbounce)

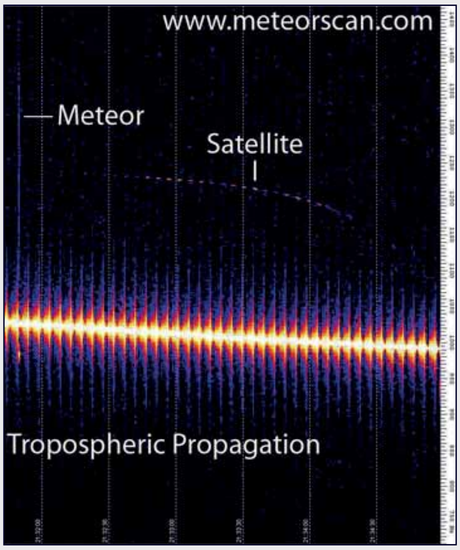
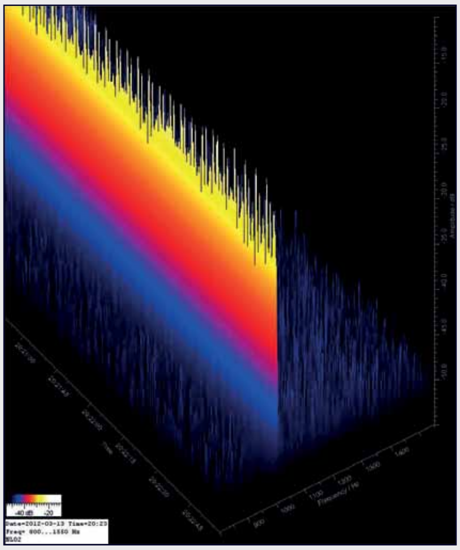


Figure 10 - Interference from tropospheric propagation (2D)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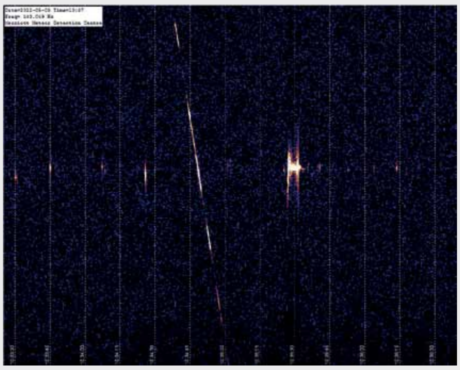
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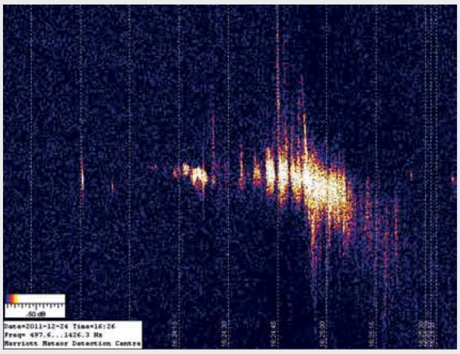
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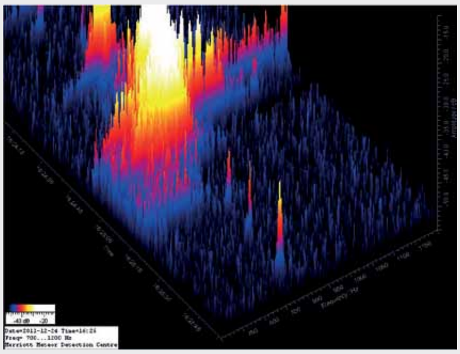


Figure 14 - A Soyuz rocket booster re-entry (3D)


Figure 15 - A Meteor imaged from Ash Vale

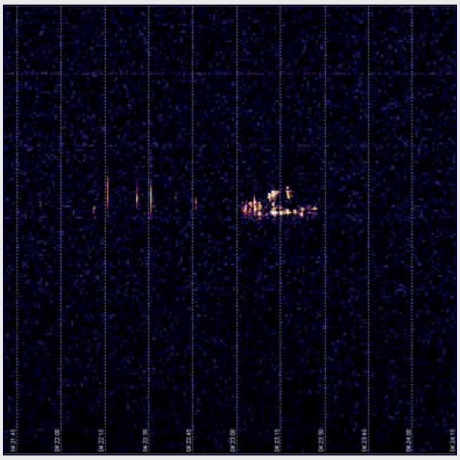


Figure 16 - The ‘Ash Vale’ meteor signal (2D)

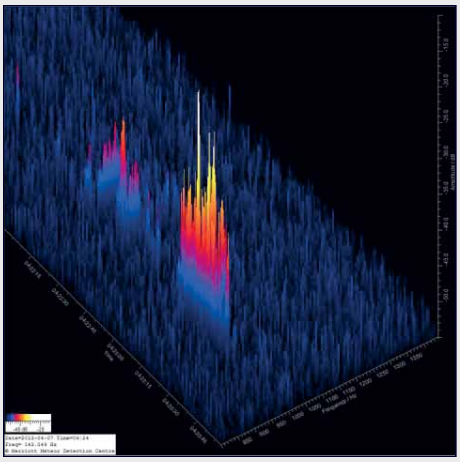


Figure 17 -The ‘Ash Vale’ meteor signal (3D)


Figure 18 - SPAM members pictures outside the Lockyer Technology Centre


Figure 19 - Inside the Lockyer Technology Centre

Most of the detection by the group members is done by using a technique called forward-scatter and is achieved by riding on the back of the French Radar signal at *GRAVES* (Grand Réseau Adapté à la Veille Spatiale) near Dijon in France. Some other RF signal sources are used for this forward-scatter, for example the lower frequency TV station signal around the 50-60 MHz across parts of Europe.

Figures 2, 4 and 5 show views of the *GRAVES* ground station, the map of the theoretical radiation pattern and the path of the signal.

The French radar transmits a series pulses at 143.05 MHz, in a semi circular arc directed southwards of Dijon and upwards towards the ionosphere.

***www.fas.org/spp/military/program/track/klinkrad.pdf***

***http://www.onera.fr/fr/node/1028***

When a meteor enters the atmosphere at very high speed, the friction is so great that the air around it is ionised. This ionised air acts as a reflector to radio waves and the reflections can be displayed after reception and demodulation. With suitable equipment it is a relatively simple procedure to display almost every ionisation event that is within the signal field from which a reflection is derived.

Most of the equipment used is that suitable for radio amateurs' 2-metre reception using the SSB mode. Although outside the normal 144-146 MHz amateur band, tuning down to 143.049 MHz USB, 1 kHz away from the transmitted signal, enables the reception of these meteor reflections. As the meteor ionisation trail is moving very rapidly, what is received as a signal changing in frequency relative to the radar signal.

This Doppler shift, as a result of the moving ionisation trail, is used to plot these reflections on 2D and 3D time related graphs. These moving meteor trails vary in length from very short to much longer traces that can also be resolved as sound bursts: it is the latter that are plotted on the audio frequency spectrum analyser using *Spectrum Lab.* a very flexible, free software program written by the German radio amateur Wolfgang Buescher (DL4YHF),

***www.qsl.net/dl4yhf/***

A couple of members, including the author have used ***FUNcube* dongles** and **Ezcap DTV dongles** to receive these signals, though some degree of preselection or bandpass filtering is required, particularly if there are pager or repeater signals in the vicinity (as there are near NLO). A variety of both free and shareware software defined radio (SDR) programs are available for resolving the signals. The normal signal path is from a suitable, vertically polarised antenna (2-metre Yagi, collinear, etc) to the receiver, then from the audio output of the receiver to the audio input of the PC sound card. The rest is software controlled.

An example of a meteor shower that was detected from my own station at 05:36 UT on January 3, 2013 is shown, both in 2D (figure 6) and in 3D (figure 7) versions.

The 3D charts are more visually impressive as every ping can be seen with amplitude and shift (on frequency scale) plus the time relationship to others. The 2D ones, on the other hand, give a more accurate time relationship, duration and shift. The amplitude is in the colour scale which is not as discernible as in the 3D.

If a cross section of these signals received from different parts of the UK is examined (figure 8) it is clear that these pings show quite different strengths depending on the station location. For example the stations in line with the focus of the reflected signal in Devon are often quite different from the stations further to the west or to the east and some stations, including my own, will receive the direct signal from *GRAVES*, particularly if there is a *lift* (*) on. This can be seen to coincide with *tropo ducting*. The following website, dragged over to Europe, gives a very good indication of any lifts.

***http://aprs.mountainlake.k12.mn.us/***

When there is a slight *lift*, I receive the GRAVES signal at almost full strength along with the meteor strikes, which tends to mar the visual impact of the meteor strikes alone.

Although the aim of the exercise is to detect meteors which are most likely to be debris from comets or bits of space junk, it is difficult to setup to distinguish meteors from man made space objects. Also, as well as receiving the meteor signals, at certain times in the month the moon bounce trace can be seen as a long low-level signal across the length of the graph, usually at an angle, either increasing or decreasing in received frequency depending on whether it is waxing or waning. We also receive reflections from the ISS when it is within the reflection zone. Generally, aircraft are too low to affect the signal. Figures 9 - 13 show a collection of reflections from various objects.

Often, when an expected meteor shower is to occur—and they are quite frequent throughout the year—the UK weather is such that it is difficult to see any meteor trails visually owing to cloudy skies. With the SPAM system, meteor pings occur almost all the time and can be seen and heard on the system.

It is hoped to start meteor imaging alongside the radio detection and, to that end, we are linked in to United Kingdom Meteor Observation Network (UKMON). An example of that image combination can be seen in figures 15-17. The photo of the meteor burst was taken at the Ash Vale camera station, part of the UKMON group.

Weather parameters are also being monitored at the centre, with a *Davis Weather Station* and our *EUMETCast* reception station running David Taylor's software. This is an important component for the astro-imagers and observers in predicting whether there is any point in attempting direct observations on a particular night.

Equipment to monitor Coronal Mass Ejections (CME) and Sudden Ionospheric Disturbances (SID) is also being used, or is under construction. A VLF reception station has been used to detect the effects of CMEs. Lightning detection stations are working at individual members' stations, and one is planned for NLO. Similarly, a couple of members have seismology stations and one of these is also planned for NLO in the near future.

Figure 18 shows the *Lockyer Technology Centre*, as it is called, which is part of the Connaught Dome. This was recently opened by Dr Brian May as part of the centenary celebration of the setting up of the NLO in 1912. Members (left to right) are Iain Grant (M1OOO, SPAM founder), Dave Jones, (software and IT coordinator ), myself (G4BZE) and Clive Vickery (G4YCV, co-founder). Figure 19 shows the same team inside the technology centre. There are now some dozen or so active members in the group in addition to the above.

The *Lockyer Technology Centre* in the Connaught building at the NLO at Sidmouth in Devon is open to the public on certain days.

***http://www.normanlockyer.com/***

*continued on page 37*

* A 'lift' is a term used to describe a propagation situation where VHF signals appear to travel further than line of sight as a result of either reflection or ducting within the atmosphere: this generally results from a change in the atmosphere's refractive index at those radio frequencies.

# My Local Weather Station

**Geoff Morris - gw3atz@btopenworld.com**

Having observed the weather from afar via *EUMETCast* for several years, I have now started to look at the data on my doorstep. This came about due to a birthday present from my son some two years ago, a small home use **Watson WS 1081** weather station. What follows is not intended to be a detailed description of how to operate it, or install the hardware: rather, just my way of making the most of it.

My *Watson Station* is a fairly simple device. There lots of variants of these, and indeed many different makes with more functions than mine. In truth, I think I ended up with this particular one because it was on special offer at a large electrical retailer. It provides me with wind direction and speed, rainfall, pressure and temperature: all standard stuff for this type of device. The more expensive stations provide more functions.

Data from remote sensors (figure 1) is sent to the indoor display via wireless and presented in an easy to read form on the display screen (figure 2). The most interesting aspect of such a device is to be able to store all the data on a long term basis and examine all the highs and lows. To this end, the station came with software to do just that, and connects with a PC via a USB connector. This was OK as far as it went, but I felt that more could be made of the data I had captured

Having been using the supplied software for a short while, I started to search the Internet for other software I could use. There are several programs around—some free, some not—that can make use of data from these types of weather stations. I also spotted that many of these other PC programs include files and information about setting up a website to display this information. I should also mention here that some of these applications are also available for *Linux*, and other systems.

On seeing this, I got the urge to go down that route, as I already had a personal website. Not that it got many hits. Originally, it was hosted for free by BT, but they later discontinued the free service. As it happens, my son-in-law works in IT, and came to my rescue with an offer of free web hosting. This was quickly sorted out, and I moved my site to the new host, and at the same time obtained my own domain name.

The program I now use is **Cumulus**, which displays all the information from the weather station as well as lots of other useful details. Also included are templates and all the other files needed to set up a website. The web page is updated at regular intervals, and you can also upload data to the various weather reporting sites, as well as sending messages to *Twitter*. After using the web site templates that came with *Cumulus* for a short while, I went searching for other types and designs of websites. The design I now use comes from a site called **Weather by You**. This site provides web templates of several designs, and only for *Cumulus*. Most of them are HTML templates, which are, in their basic form, easy for the casual user to get to grips with, but I have now moved on to php templates.

Without going into too much detail, and at its basic level, HTML web pages are sent from the web host to the end-user, without the remote host doing anything to them. With php, the web host processes the page file first, adds any data, and then sends the page to the end-user. What it means in action for my website is that, when *Cumulus* uploads the latest data, it sends only the detailed data, and not the complete web page, as it would if it used HTML.

As I mentioned earlier, I have just tried to give a small insight into making the most use of the small weather stations that are available. It has been interesting for me to see all the historical highs and lows, the longest period of no rain (19 days) . I won't go into the number of consecutive days of rain!!!. It has also helped to keep the grey matter in shape, as I get to grips with the web site side of things. I am more than happy to answer any questions etc., if you want to get in touch directly.

Figure 1 - The remote weather sensors

**Web links with more information**

My own website

***www.gw3atz.co.uk/shotton_weather/***

Web page templates

***www.weatherbyyou.com***

Cumulus software

***www.sandaysoft.com***

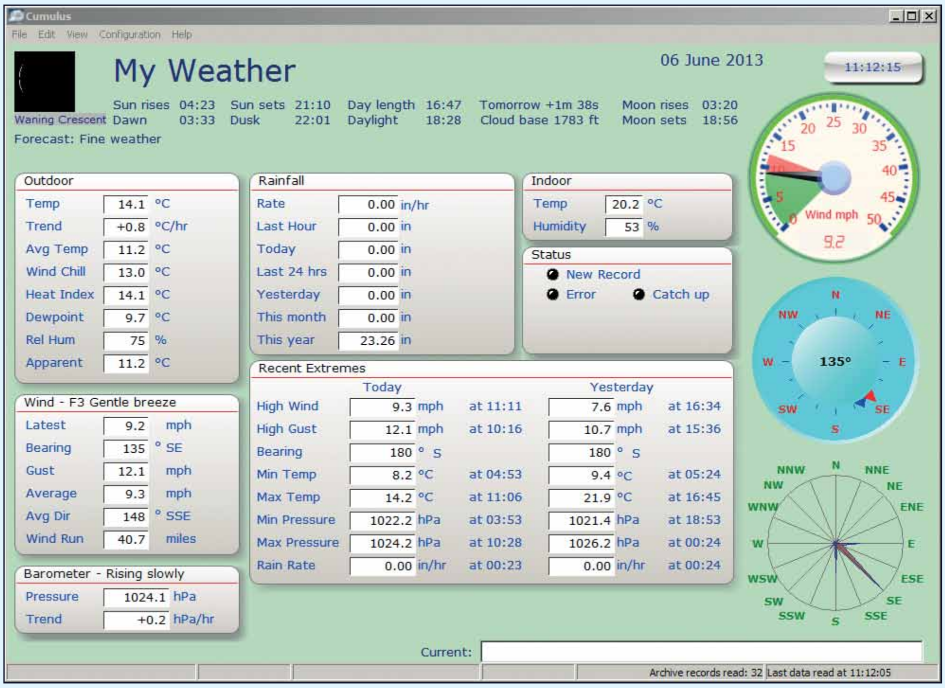



Figure 2 - Data from the *Watson Weather Station* displayed by the *Cumulus* software.

# The Way We Were

## Part 1: Remote Imaging in the Early Days

**James Brown**

Perhaps a warning would be in order before you start reading this article. It is **not** meant to be a definitive guide to all the years of weather satellite reception. I neither know enough, nor have space enough to do that. Neither is it likely to be an entirely accurate account due to my own declining memory and the scarcity of some of my records. Some of the images that are included are not of the greatest quality, largely because they are taken from photographs, as the original equipment has long gone: apologies also for that. What, hopefully, it will do is lift a bit of a curtain on life before so many of us opted for a slot-in card for our computers and largely laid aside our soldering irons. It has been, for me, a hugely enjoyable passion for over thirty years, full of big challenges, exciting moments, and making along the way, I trust, some good friendships which have endured despite all the ups and downs of life.

Like others who have written for GEO, my interest in remote imaging by means of meteorological satellites goes back a considerable time. Imagine if you will a world without the Internet, and where all purchases were made using hand-written or typed requests, needing cheques, which then often took weeks for goods to appear. A world without the now familiar and ubiquitous Personal Computers, (though small 8 k RAM varieties were appearing); a world in which the Met Office was still using wet-paper facsimile machines to receive charts and images from the **TIROS** series of USA weather satellites, (and still did until the mid 1990's); a time when the first European geosynchronous satellite, **Meteosat 1**, was yet to be launched. But the door was being opened up by some remarkable developments, including a major decision to transmit some low resolution data (APT) from these early satellites, firstly in the VHF band (137 MHz). At the same time the availability of ever cheaper ICs opened the door to all kinds of amateur projects.

I was by no means a first pioneer in this realm, as my own passion was first triggered by a series of articles in *Wireless World* in 1974 and 1975—alongside a number of others by various authors such as J M Osborne and Alan Trusler—when Dr Gerry Kennedy, who is still an active radio amateur, described a system for receiving and displaying data from polar orbiting satellites, entitled '*Weather Satellite Ground Station'*. This was followed by a series of four articles in 1977 describing '*A Weather Satellite Picture Facsimile Machine*'.

The very first of the USA's Television Infra-Red Observation Satellites, **TIROS 1**, which weighed just 122 kg, was launched on April 1, 1960. Five hours later, President Eisenhower was looking at a cloud picture from space. The satellite remained in operation for an impressive 78 days. In 1975, Dundee University became famous for being the first academic institution to build an AVHHR receiving setup, and I had the privilege on one occasion of visiting them and seeing at first hand their amazing system. I was particular interested to see how they had modified some old *Muirhead-Jarvis* newspaper photo-telegraphic machines, probably the D-356 type, one generation on from the D-355 shown in figure 1. This made use of a mirror galvanometer which deflected light from a projector tungsten lamp to run at two lines per second and read out stored high-resolution data on to photographic paper. Jarvis used to make lathes, so these machines looked a bit lathe-like from the outside. They had a phonic motor-drive for constancy of speed and angular position, and the quality of all the mechanical parts was of a very high order, giving superb results. Later, Peter Baylis and his colleague R J H Brush described an excellent contrast expansion circuit for enhancing the display of infra-red imagery in *Wireless World*. Years on, this was overtaken by discrete log-amps. I still have one of their print-outs, and it is almost impossible to see the individual lines except under very high magnification: the image is very crisp and detailed.

Figure 1
A Muirhead-Jarvis D-356 photo-telegraphic machine
*Image: courtesy, Museum of London*

A lower data-rate transmission was begun in 1963, being first tested on **TIROS-8**. It was called Automatic Picture Transmission (APT), and is still in use today on the remaining **NOAA** satellites. Sadly, APT is destined to cease on spacecraft after **NOAA 19**. These transmissions were in the 137-138 MHz VHF band, and it was this that caught my eye.

I managed to contact Gerry Kennedy at the Chilbolton Observatory, and when my wife and I paid a visit to him there we were allowed to stand in the middle of the 25-metre dish and examine the tiny laser disks used for aligning each of its reflecting plates, an awesome experience. The dish can be seen in figure 3, on page 20. Gerry also put me in touch with the late Les Currington of Welwyn Garden City who had also been working on a similar project. Les and I became life-long friends and spent many happy hours designing and working through numerous issues involved in those pioneering days. I still have one of Les Currington's early printouts, which reads 'TIROS-XI 17th February 1979'.

The first priority was to receive a signal, and to that end a (now ubiquitous) simple crossed dipole vertical aerial was built using U-shaped bits of aluminium. The appropriate varieties of coax were soldered into place to get the phasing harness correct. A design by J M Osborne of Westminster School in London, with a reflector positioned 0.3 wavelength below the dipoles, was found to give superior results. My receiver consisted of a couple of modules from *AMBIT International* (Cirkit) - an *EF803* VHF tunerhead, and an IF and audio decoder panel with a 50 kHz ceramic filter. It sported two enormous salvaged meters for signal strength and IF tuning. A picture of this first magnificent beast and it's similar size PSU can be seen at the left side of the wooden table in figure 13 (page 21).

All the rest of the circuitry was built from old circuit boards obtained from electronic scrap dealers. All the coils were changed for ones spanning the 137 MHz band. I also bought a cheap *DFM1* frequency meter from *AMBIT* to allow me to see accurately where the receiver was tuning. Later, phase loop lock (PLL) technology gave us a better signal to noise ratio, but the *PlesseySL6600* series of 'one chip radio' units were yet to be discovered. Not to mention that super SP705B oscillator on a chip: just add a crystal (apologies for the jargon for those not into construction).

It was with some degree of scepticism that I first switched it on with the aerial connected and tuned it up and down the 137 MHz band to listen for an elusive signal. Amazingly, at some point, the receiver burst into life and the familiar 2.4 kHz 'croak' was heard for the first time. That was enough to get me hooked. I found that I could hear the signal for over 13 minutes, without noise, on overhead passes. Now I had to figure out how to create images from these signals.

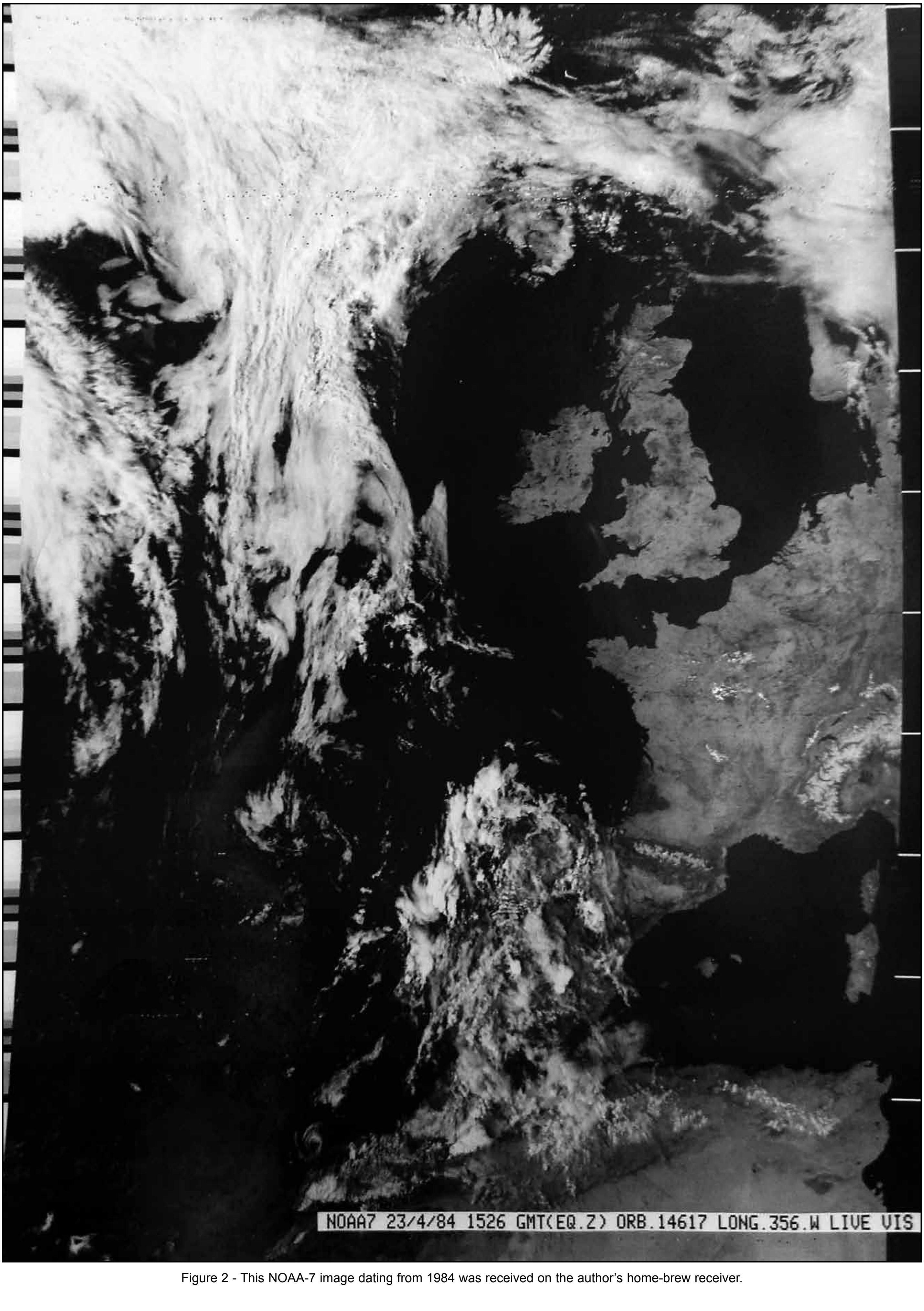



Figure 2 - This NOAA-7 image dating from 1984 was received on the author's home-brew receiver.

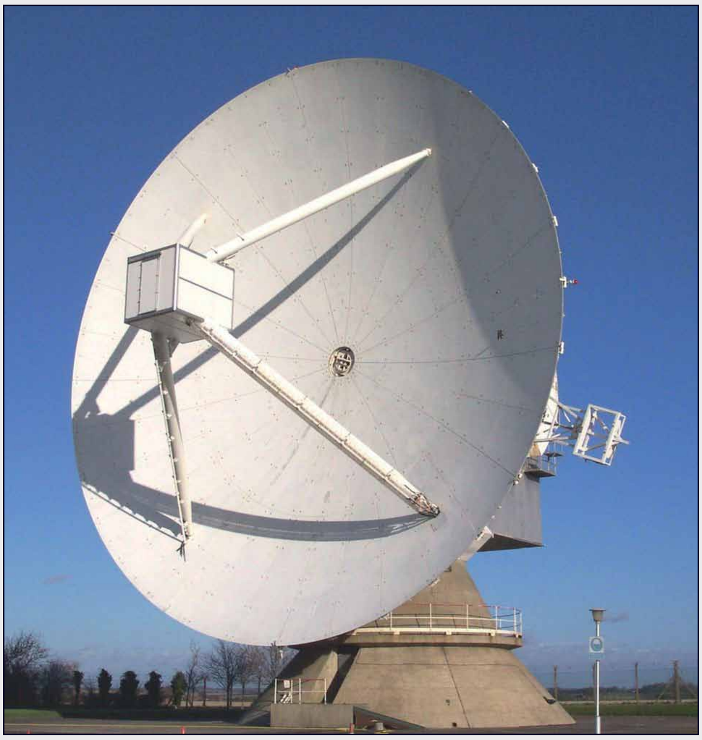


Figure 3 - The 25 metre dish at Chilbolton Observatory


Figure 6 - The old-style cold-cathode crater tube used in the process for printing out APT images

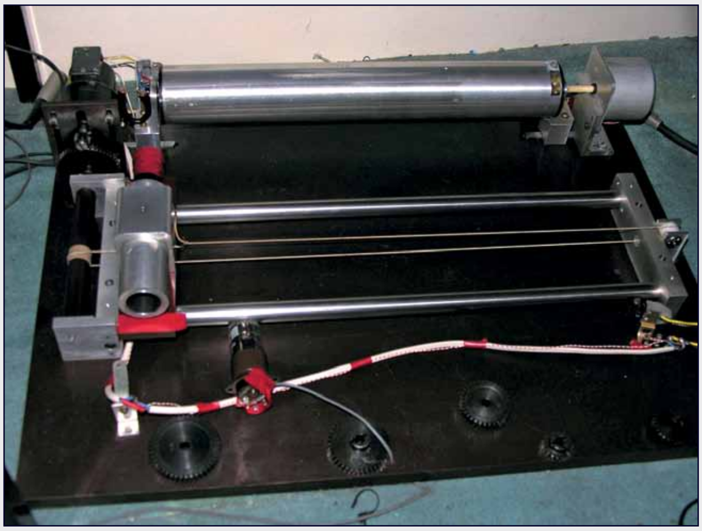


Figure 4 - The moving light trolley used in early APT imaging


Figure 7 - The completed control box used for early APT Imaging

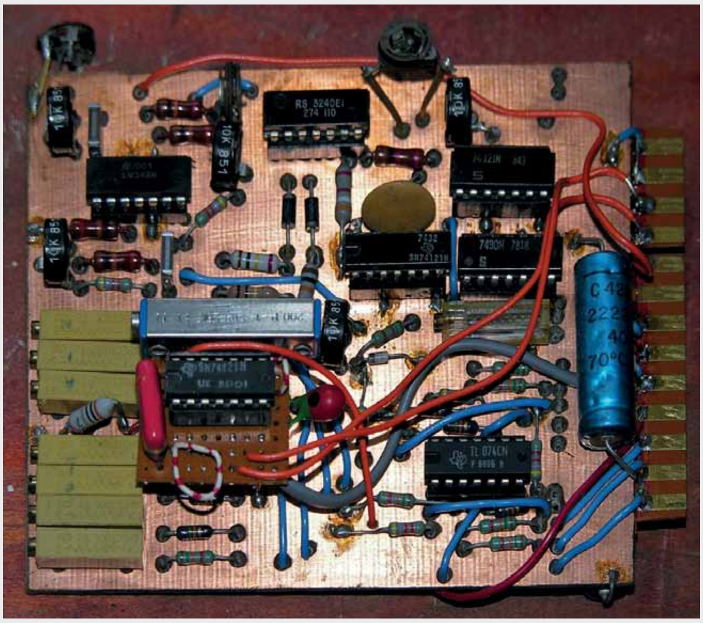


Figure 5 - One of the author's early circuits for decoding satellite APT


Figure 8 - The modified 'Mk II' *Muirhead 901* facsimile machine

**Converting APT Signals into Images**

There were various solutions around at the time. One idea was to place photosensitive paper in front of a large flat-screen cathode ray tube which was driven by circuits which could lower the X axis of the trace down the tube face with each successive line of image data. Another was to use aluminium coated paper and have a stylus burn off the shiny surface to reveal dark paper behind. But neither of these methods could produce the very best of results, though the former could come close using the right equipment.

Gerry's solution, on the other hand, was to wrap photographic paper around a rotatable drum and modulate a light source with the 2.4 kHz signal. The light was mounted on a trolley which was slowly drawn past the side of the rotating drum, hence effectively illuminating a tight helix on the photosensitive paper. But it did require high tolerance engineering, a bit above my pay grade. Fortunately a friend who worked on the engineering side at *ICI Fibres*, when told of my dilemma, explained that he would love to have his apprentices do the engineering work as a training project. The design they came up with is shown in figure 4.

**Building the Control Box**

I then had to consider how to do all the circuitry and obtain the motors to drive the units, as well as learn the basic skills of darkroom technology. A very steep learning curve ensued, with late hours after work spent poring over '*The TTL and CMOS Cookbook*' manuals, and scouring adverts for suitable motors and circuitry. Les Currington came to my aid with some gold-plated sockets he had located, and I in turn had found a source of old printed circuit boards with gold plated edges that fitted the sockets. With very little cash to spare, everything had to be salvaged from whatever old TV or radio boards could be found. Hours were spent with a solder sucker, rescuing high tolerance resistors, capacitors and IC holders, etc. New double-sided PCB boards were etched (another new experience) and then drilled; then the PCBs were glued to the gold-plated edge connectors. Invariably, as time went on, the need for modifications arose and the PCB shown in figure 5 is a prime example. My intention was always to be neat and tidy, but then the mods came along.

There were also various 'nightmares' along the way with this method. A classic one was not having adequately scraped away the old copper tracks from an edge connector, thus creating phantom connections from one region of the new board to another. Boy, did that involve some head scratching.

To get the very maximum s/n ratio we had to design fifth-order CMOS op-amp filters to give a very sharp cut-off after the 4 kHz bandwidth, but without introducing 'ringing' or other artefacts.

The most expensive item was the light source. Known as a cold cathode 'crater tube', it emitted a narrow beam of purple light from the glass end (figure 6). When focussed through a lens, this gave a pin-point of intense light on the photographic paper. An IB59 was the first model, and it needed careful driving: not only did it require a trigger source of around 220 volts DC, but anything much over 50 mA of current left you with just a glass tube on your hands, something I discovered to my cost some time later after a short in a wire. Thankfully, Dundee came to my rescue, and Peter Baylis kindly sent me a couple of similar spare tubes. Later on, experiments with blue LEDs opened up another possibility for those experimenting in this field.

Incidentally, an initial attempt to do everything via *Veroboard* and fit it into a miniscule case was a disaster as there was virtually no room for manoeuvre. So after a couple of futile attempts to rejig, I decided that in this case, big was going to be best!

An electronics salvage firm in Liverpool supplied the *Beckman* 10-turn dials, and various other switches were salvaged from ex-GPO and BBC units. The neat grey triangular faced multi-way gold plated switches I found particularly fascinating, and an example of brilliant but simple engineering.

One of the problems with the evolution of the main control box was labelling. Holes had initially been drilled in anticipation of what was needed, but as enhancements came along new places had to be found for switches, dials and test points. I can tell you, it isn't easy pressing *Letraset* letters on to confined spaces amidst various switches etc.

Slowly, over the next couple of years, the control box became filled with units for separating satellite sync pulses to drive the motors, and automate certain features, while other boards cleaned up the audio signal and added facilities such as signal conditioning, contrast and brightness controls. Gerry had described an ingenious method of motor control using a reverse engineered audio amp design. The divided output of the 2.4 kHz clock signal was turned from square-wave to sine-wave then fed into the amplifier. This in turn then fed to a toroidal transformer working in reverse which output a clean sine wave with near 240 volts output from the amp's 30 V output. Clever, and it meant that the synchronous motors could actually be driven at different speeds depending on the clock frequency supplied. Both 120 rpm and 240 rpm were required by the system for producing imagery from the various satellite formats. Lots of cheap, high-power PA amplifier units came on to the market using the *2N3055* power transistors with a particular design published by *Maplin,* which I followed. The drum drive motor I got from *McLennan Servo Supplies* of Camberley. The completed control box is shown in figure 7.

**The Trolley Drive and Rotating Drum**

The trolley drive motor was a redundant yarn motor from ICI. It was geared to run at very low speeds and designed to move yarn slowly but evenly over a spinning cone. It had a variety of gear cogs which could alter the ratio of the finished image.

The motors were excellent but became suspect when, in first tests, there were intermittent gaps on the print-out caused by uneven trolley movement. At first the gears were doubted but, after lengthy investigations, it turned out that the apprentices had left the ball races for the trolley and pulleys open on the bench when working on the aluminium blocks and the sintered steel rods. As a result, tiny shards of metal had entered the races and were intermittently jamming the ball bearings. A good clean-out of the races eventually cured that problem.

But how could the photographic paper be attached to the drum. Double sided *Sellotape* was the answer, which needed to be smeared a good few times so that it was just tacky enough without ripping the paper. A strip would last about fifteen uses before losing its tackiness.

Then there was the question of how to align the edge of each image line with the edge of the paper. Again, it was Gerry who found the solution. A small piece of magnetic strip was attached to the appropriate place on the drum and an old tape-recorder head was judiciously placed within a millimetre of it. The weak signal in the head was then amplified so that it produced a pulse of several volts, which was cleaned up by more op-amps and gates.

But the signal still needed to be observed, together with the drum pulse. A visit to *SGS Electronics* of Abergavenney revealed a number of elderly *Tektronix* dual-beam oscilloscopes for sale at knock-down prices. The owner was recently retired from the military, and regarded customers as a necessary but inconvenient part of his life. The 'beast' I bought in the end was a 555 plug-in module version measuring about two feet by eighteen inches. It weighed a ton and came with a separate power supply unit, not too dissimilar in size. This masterpiece of engineering, with its dual timebases, hummed and whirred with its various fans, and the seventy odd valves in total rendered heating unnecessary in the small room which doubled as my receiving station. It was always a thrill to push the big switch on the power supply, wait the three or so minutes until it deemed that circuits were warm enough, when a tube relay would click and the main unit would spring into life. The bright blue medium-persistence crisp display was a wonder to behold, and there were enough dials to satisfy the most ardent twiddler. Now I could see the unprocessed audio signal on one beam and locate the drum pulses on another. By electronically 'slipping the clutch' so to speak I could now align the start of each line with the drum edge.

**The Satellite Images Take Shape**

I can well remember my first printout. Surrounded by baths of developer, fixer and cleaning fluids, and under an eerie red safelight, my first print emerged. The contrast was way too strong, the image had a few edge movements caused by loss of sync during noise bands—I hadn't yet learned to lock the sync to an external crystal oscillator—but the thrill of seeing an Atlantic depression just minutes after the satellite had passed overhead was amazing. After all those hours of battling with soldering irons and smelling like an embalmer, I was wonderfully rewarded with my first picture. This was just the start though: much more was to follow.

There were different photographic papers. Some of the cheaper ones gave a slight yellow bias, and others needed glazing, which meant drying the wet paper on a very hot chrome-plated surface. Later on, others like ones from *Kodak*, gave semi-glossy results without the need of that extra step.

**Data Archiving**

One of the issues was to look at methods of archiving data. Although I could now create hard copy images from the transmitted satellite signal, how could I produce further printouts, or extract just the visual channel from the side-by-side NOAA transmissions? As the recovered signal is basically audio, tape recorders seemed the obvious solution. I had two possibilities, a *TEAC* cassette tape recorder and a *Revox A77* reel-to-reel tape machine that took 10½-inch reels. I soon discovered that, even recording at the higher speed of 7½ ips, dropout of the metal oxide on the tape could cause data loss that could never be recovered.

Then I came across another *Wireless World* article, by J B Tuke in July 1976, describing how an audio signal could be converted to an FM signal and recorded on domestic recorders with excellent playback results. Provided the recorder could cope with a carrier frequency of, for example, 11 kHz and sidebands up to 16 kHz, you were pretty much assured of near perfect playback, regardless of tape condition, provided of course that the recorder had very little wow or flutter.

I built up a unit and, after some modifications and tweaking, found that the cassette tape-deck produced excellent though slightly fuzzy images, whereas the *Revox* gave flawless results. I still have the *Revox* by the way, and a few of the original recordings, though sadly none of the equipment remains to decode it.

The ability to archive data also initiated the friendly exchange of tapes from across the world, and soon we were decoding APT from the USA and New Zealand on our own machines.

Despite screening and hefty smoothing capacitors on the main power supplies, I was noticing a moiré pattern on some of the prints. You wouldn't believe how many tests were conducted, capacitors changed, etc. to try and sort that one out. In the end I traced it down to the vibration from the oscilloscope fans which were causing miniscule errant movements of the trolley. Some foam pads solved that problem.

Some while later, a friend who worked for *British Steel* became aware of my hobby and told me his department was getting rid of some old *Muirhead 901* facsimile machines: would I be interested? I certainly was, and ended up getting two sets of site-to-site machines, one of which went to Les Currington. Unfortunately, the motor and gearing was the wrong speed for satellite reception, but the transmitter had a superb high-quality lead screw drive and larger drum size. After considerable cannibalisation, the Mk II machine was born. I retained one original motor for a fast return at the end of a pass, and had to *Araldite* the drum to different bearings, but the results were pictures with lines so precise that you were hardly aware of them. Micro switches controlled and automated a few other functions (figure 8).

By now I had also acquired a *Jaybeam* eight-element steerable aerial which, with a cheap pair of rotators, meant I could track satellites from horizon to horizon, giving me up to fourteen minutes of good quality pass time. Attaching this to the chimney stack at a time when the crows were nesting almost brought my life to an untimely end. They can be quite vicious when defending their young, and I can testify that slates, when wet, are potentially lethal.

**Geostationary Satellite Developments**

The next development came when Les Currington mentioned that EUMETSAT had launched a geostationary satellite which also transmitted APT (WEFAX), albeit in the 'L' band between 1691 MHz and 1694.5 MHz. The first available transmissions in the UK were in 1977, from **Meteosat-1**. But to receive these lower powered transmissions I now needed a dish and a downconvertor. The initial dish and downconvertor were obtained from a firm advertising in the German Magazine *VHF Communications*. The dish consisted of twelve, shaped petals, which when married together created the dish shape. It came with a brass feed-horn.

Calculations were made to insert a probe towards one end of the horn, holes were then drilled and the results confirmed that our sums had been pretty accurate. With the dish propped up in a corner of the garden, I eventually began to receive transmissions from the two WEFAX data channels then active. This was truly exciting, seeing 800 x 800 pixel pictures continuously from 36,000 kilometres out in space. As the occasional transmission displayed the full Earth disc, this meant I could now see parts of the world I had never seen from space before, first hand. The images were slightly noisy and grainy, which quickly prompted me to make my first attempt at constructing an LNA. This greatly increased the gain and slightly improved the s/n ratio. Then I read yet another article—always my downfall.

This article was about making your own dish. It suggested creating a parabolic former out of plywood, dumping a load of sand on to a base, running a former over the top to create the outline, then applying thin narrow sheets of glass fibre and resin to produce a shallow dish. My ICI friend had suitable garden space, so we set about the construction. We built a rough base of bricks and stones, then adding a little cement to the sand to give a firmer outline as we then made a small cone of material. The former was carefully constructed according to the standard parabolic principles, with a flat outside lip for attaching supports or feed horn struts. It was for a 1.5-metre design. After applying copious amounts of glass fibre and resin, we felt it was safe enough to lift up the dried layers and, lo and behold, there was the dish. Not perfect, but with something like an overall 0.5 cm tolerance, it would be good enough.

It was a heavy old thing by now and we secured it to the top of Dave's *Transit* van to move it down one side of the mountain where he lived and up the other to where my house was. Once the wind got under the dish as we travelled we were almost convinced that the van had become airborne. Folk on the street who saw us passing, later reported that a flying saucer had been captured by some locals and a hunt was on for the aliens.

*BacoFoil* was then my friend to produce the reflective surface, and arms made out of copper pipes provided the supports for the feed-horn. A larger feed-horn was required, so a paint tin was brought into service. The proof of all this work was a superb signal. Later on, **Meteosat-2** was launched and the resulting images were amazing. Very occasionally the mask which EUMETSAT normally applied around the edges of the disk was omitted and intrusions of the moon could be seen on some images.

The best resolution imagery was regularly sent as a series of nine segments of the whole disk. By careful alignment one could mate adjacent segments and create ones own large-scale full disk. The later example pictured in figure 10, which is about two feet square, still hangs on my wall today, and was derived from a series of **Meteosat-2** transmissions received on March 12, 1985.

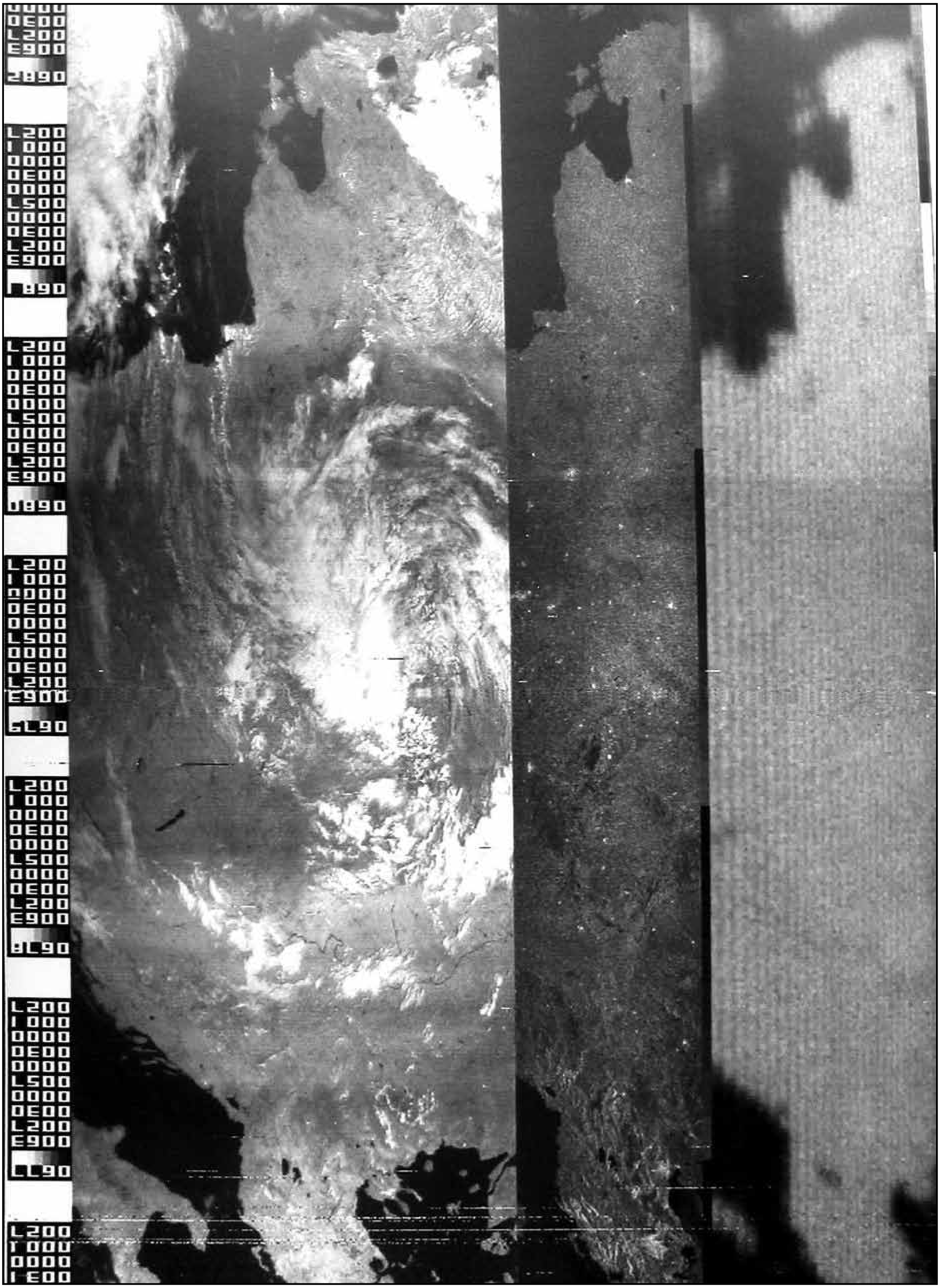



Figure 9
This image from Kosmos-1766, on April 25, 1987, shows a combination of visible and microwave imagery, plus the characteristic telemetry side panel. Note the river Danube snaking across the left-hand panel (the visible image).

**New Processing Developments**

In time, further developments took place. There were better ways to process the audio signal using logarithmic expanders, and *VHF Communications* published a whole new set of circuits in its 1979/80 editions for us to try out, developed by German radio amateur Rudy Tellert.

I had also been minded to find some way of actually superimposing archiving data permanently on to my images themselves, rather than simply writing it on afterwards. I discovered a book entitled '*TV Typewriter Cookbook*' by Don Lancaster, and was drawn to create a device which could use memory chips to retain information, input via a keyboard, then read it out, line by line, in sync with the satellite signal. With no ability to program PICs or the like, this became an interesting challenge. Figure 11 shows the horrendously complex wiring that was needed to perform this relatively simple task. *Wireless World* asked me to write this up for an article, which I half did, but got too bogged down in the complexity of the description to complete it.

I was quite pleased that I had managed to get all the circuitry into the case of an RCA surplus touch-sensitive keyboard and work out the ASCII coding (figure 12). I would pre-program the memory with the archive data using the keyboard, and then, at the flick of a switch, it would wait for a line start pulse and then interrupt the video information to feed out eight lines of data to make up the ASCII characters. Lines could be doubled or trebled if need be for zoomed sections. It was a fun challenge though, and worked very well, as you can see in a 1984 NOAA-7 image reproduced in figure 2 (on page 15), which shows my data printout over northern Africa.

Meteosat was also acting as a relay for NOAA's **GOES** series of geostationary satellites so, a few times a day, the French receiving station at Lannion—which was far enough west to receive direct imagery from **GOES**—would inject a few frames. Unfortunately, their computer clock suffered from a slow drift and, over a month or so, EUMETSAT would have to cut off the end of their transmission as they had failed to start on time. C'est la vie!

The 137 MHz band slowly became populated with more and more satellite transmissions. The Russians had their *Meteor* series, preferring usually to use the 0.7-1.0 µm band which didn't show up much land detail but was great for cloud and snow/ice discrimination. You might like to compare the photograph of one of my **Meteor 3-2** printouts (figure 15) with the AVHRR images that have appeared in recent *GEO Quarterlies*. I regard it as showing quite amazing detail for an APT transmission. Later on in the **Meteor-2** series, the satellites started to produce night-time IR transmissions, which were displayed in inverted video—another challenge.

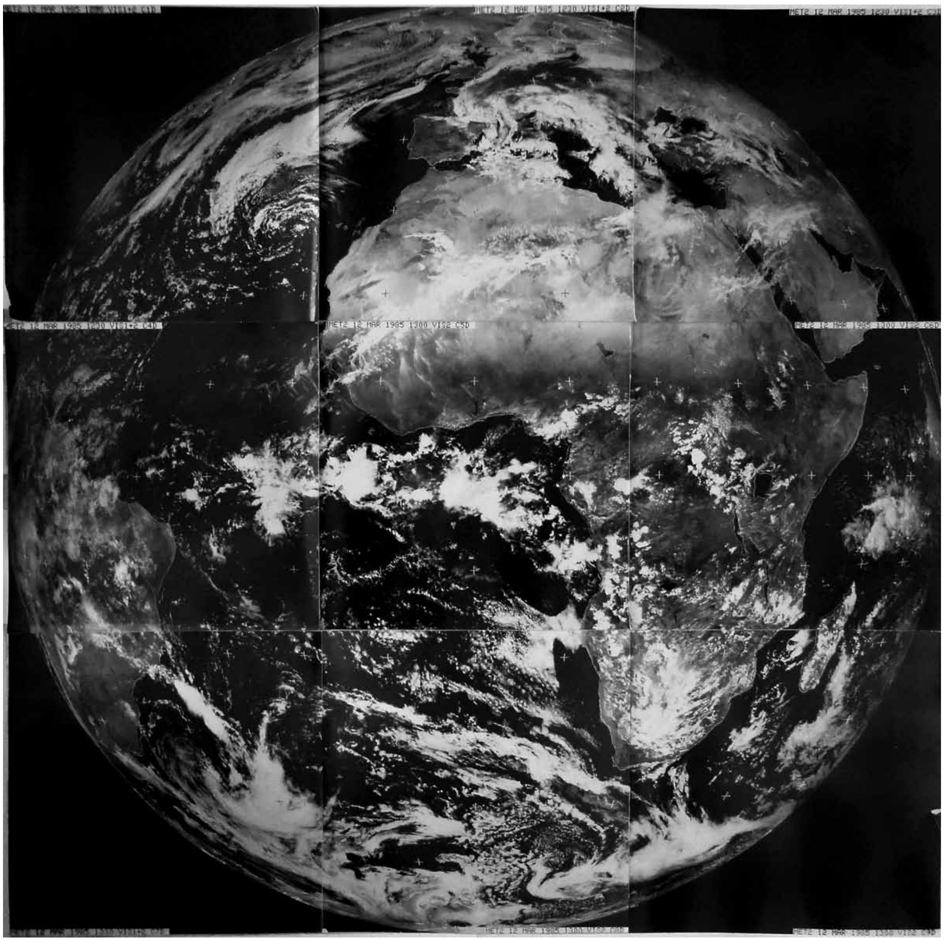


Figure 10 - A mosaic of Meteosat 2 images creates a full Earth disc

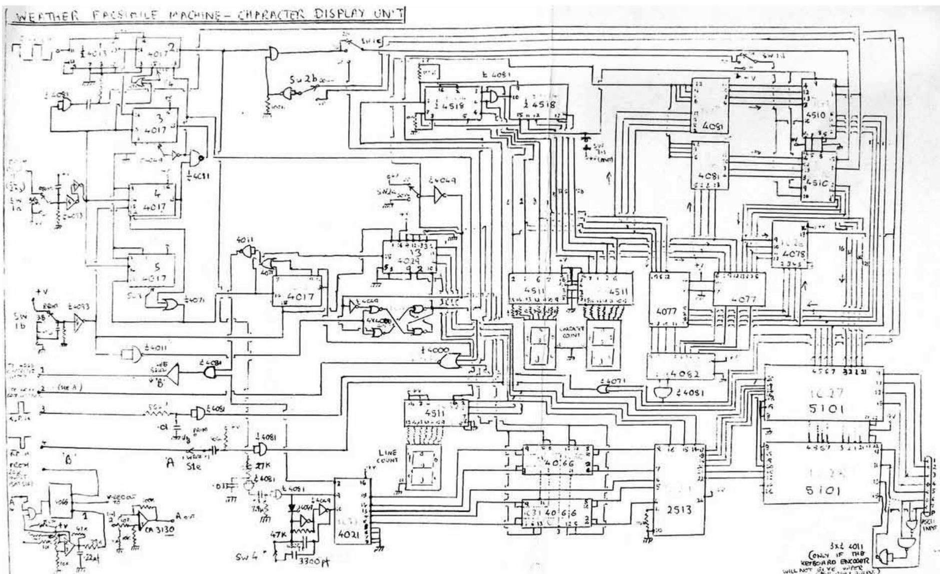



Figure 11
The complex circuit developed to superimpose text on satellite images


Figure 12
The keyboard containing the circuit for superimposing data on images

Figure 13 - This photograph, of which more next time, shows James Brown's large collection of hardware for acquiring and processing APT satellite imagery at its greatest extent, in the pre-EUMETCast era.

Russia also deployed their *Kosmos* satellites in the 1980s, followed by the *Okean* and *Sich* series up till 1999, all these producing images characterised by a side panel showing minute markers and a numerical display detailing the status of on-board instrument conditions. In particular, **Kosmos-1766** and **Kosmos-1869** gave some excellent imagery. These somewhat elusive birds only transmitted intermittently but were capable of not only visual imagery but also sideways looking radar—deploying what I believe was an early microwave radiometer. Again amazing detail could be seen, like the river Danube snaking along the border between Romania and Bulgaria in the triple sounder **Kosmos-1766** image in figure 9 (page 19).

The radar was particularly fascinating as it showed up industrial areas and was used at one point, I believe, to monitor the reservoirs in the Dnieper river system with its dams and hydroelectric facilities (figure 14). The satellites also had 'store and dump' facilities: images would be recorded on tape and stored on board, and later be transmitted when the bird was over the western USSR. So, very occasionally, we would get an image from another part of the world.

These images were transmitted at the higher speed of 240 lines/minute, and one of these satellites, **Meteor 1-30**, would, on alternate days, transmit 0.5-0.7 µm and 0.7-1.0 µm pictures. From the lower orbit this satellite occupied, this gave some amazingly detailed images though, once the orbit had carried the craft over western Europe, transmissions were curtailed. This detail can be appreciated by the resolution shown in the Alps in figure 16.

Here in the UK, a Surrey University group built the **UOSAT1** satellite which transmitted some visual imagery at two kilometres per pixel resolution by standard unencoded FSK ASCII.

In the next part of this article, I'll describe how the advent of the personal computer—and more recently *EUMETCast*—changed the way in which we approached our hobby of weather satellite imaging.

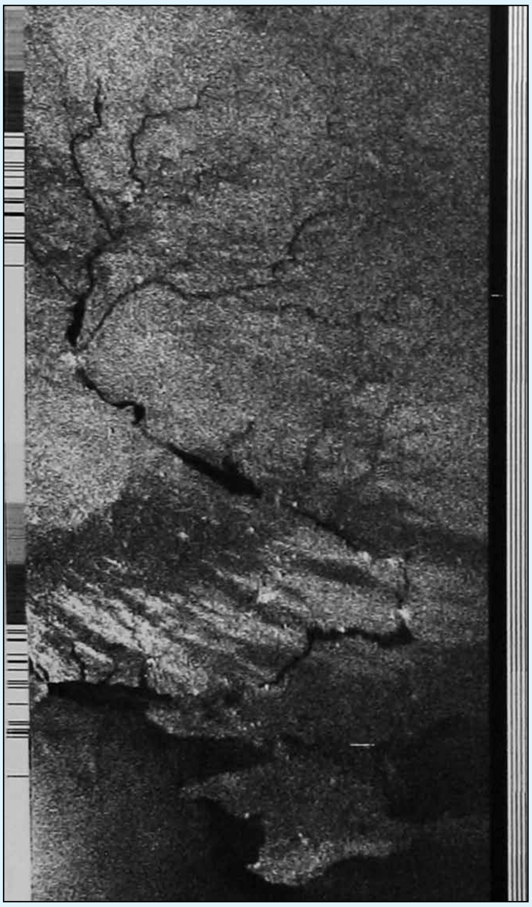


Figure 14
Kosmos radar imagery showed cities and industrial areas as white spots.

Figure 15 - A printout of an image from the Russian Meteor 3-02 satellite

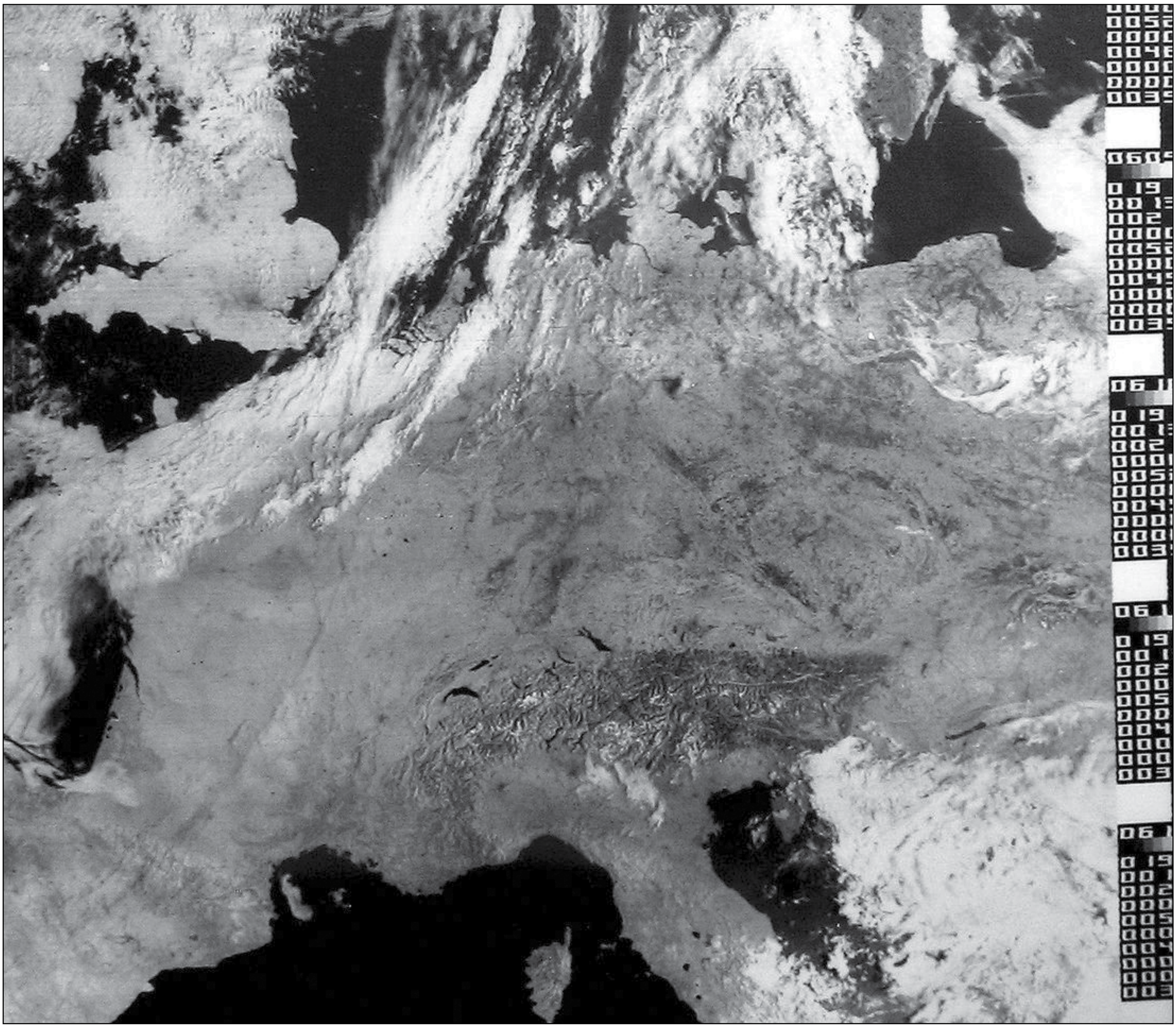


Figure 16
This splendid image showing detail of the Alps was acquired by Russia's Meteor 1-30 satellite.

# EUMETCast Update

***Mike Stevens*** (G4CFZ)

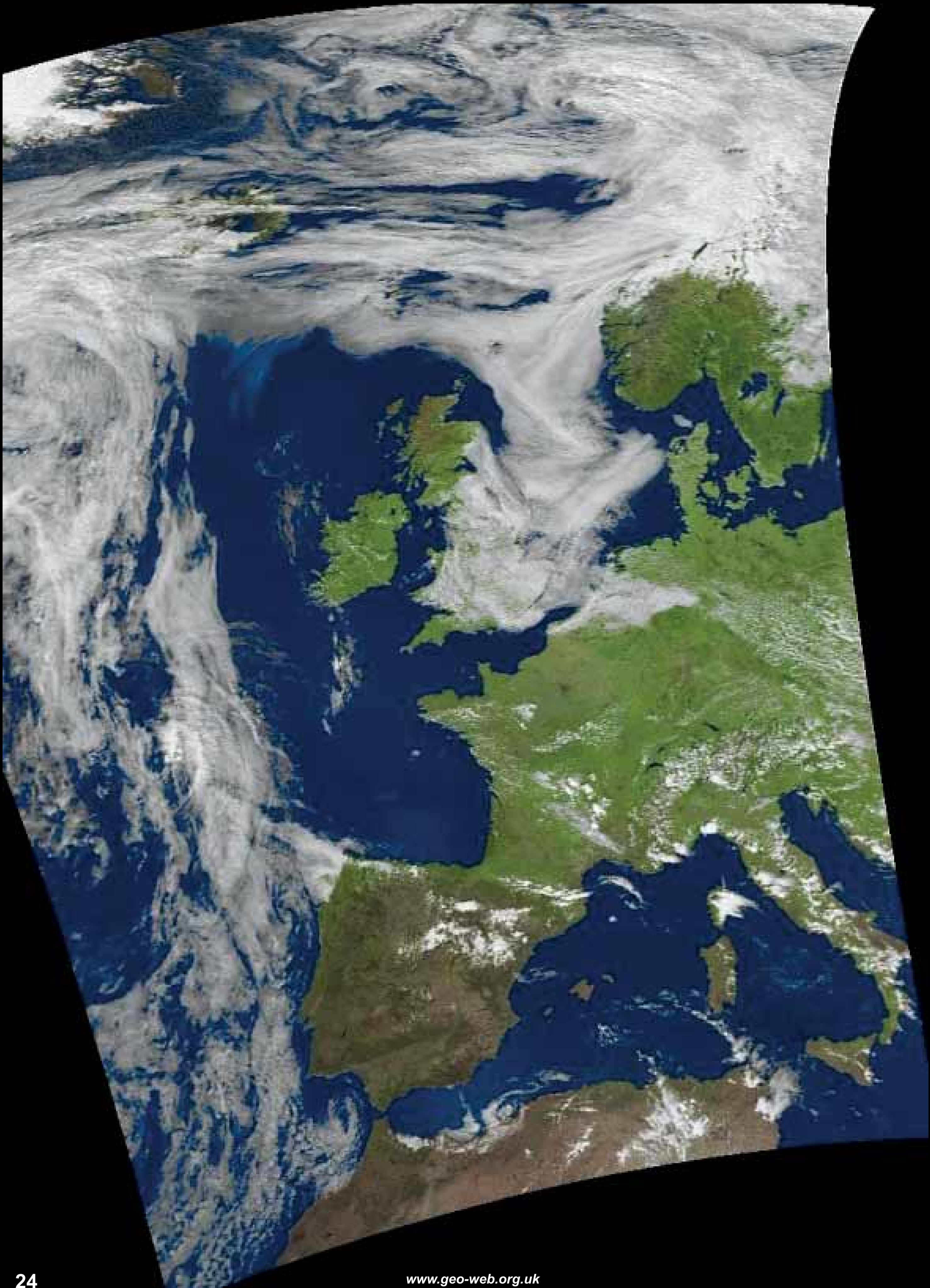
I have recently been looking over my articles on *getting started with EUMETCast reception*, and realise that there have been some changes to the service since I wrote them. This short note is to advise readers who have been referring to these articles of these changes.

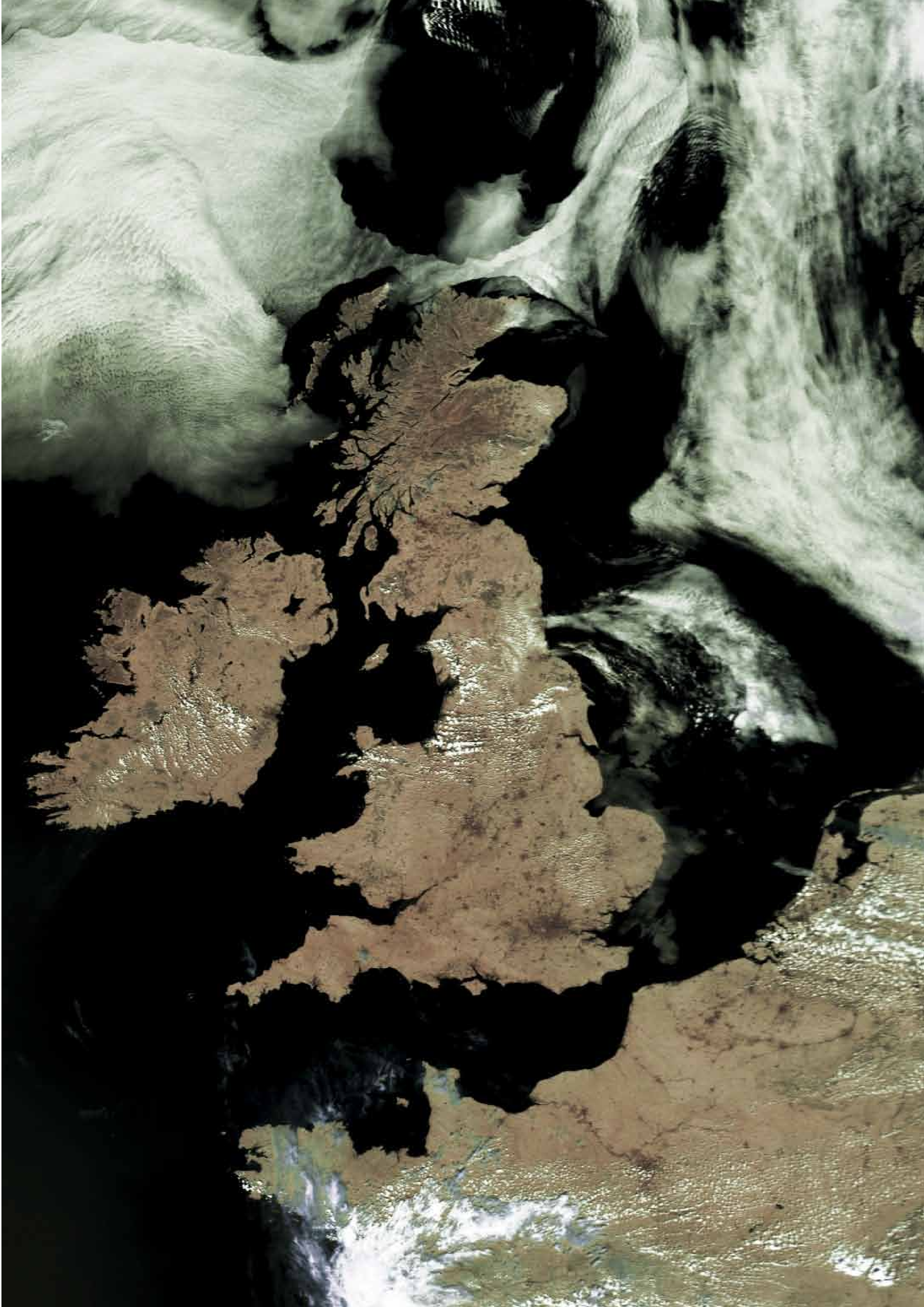
Firstly and foremost, EUMETSAT have, since Tuesday July 16, 2013, released a **new version** of their Earth Observation Portal within their Website, and therefore some of my information on Registering for Dissemination Services will be incorrect. My apologies for this but it was unforeseeable at the time the article went to print.

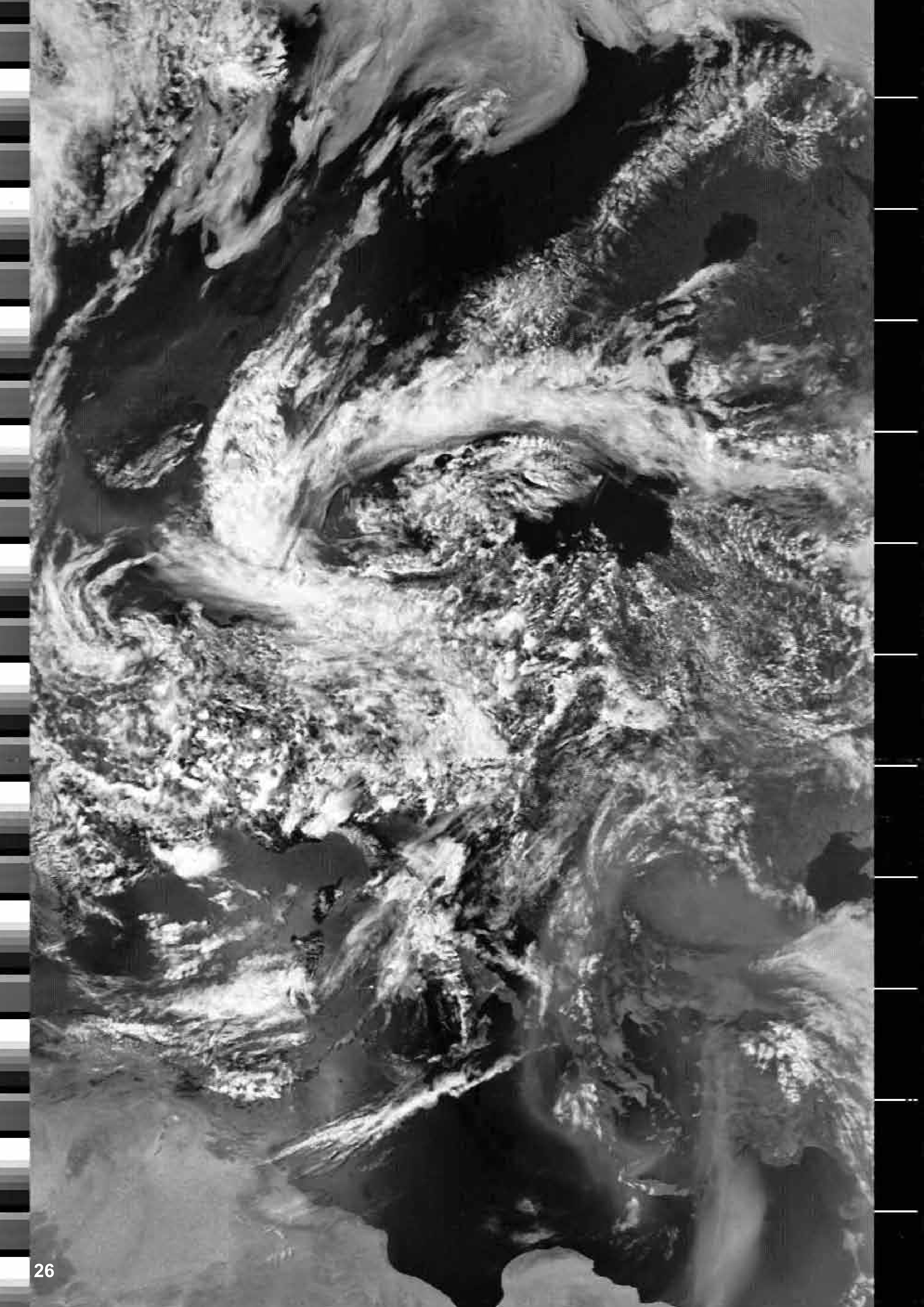
Secondly in my Article on *EUMETCast and Windows-7*, I explained that several problems could occur within that operating system. However, I have been extensively experimenting to try and sort these out: both the 'Drop out of the satellite' and the 'Co-ordinator lost' problems have now been corrected. My problem was that I was not using a **USB 2.0** socket on the *Acer* PC, and this only came to light when I was in the middle of a change round in testing for problems. My PC advised me that I was not using the correct socket for high-speed data transmissions with *DVB World*. I promptly started using the USB socket that I was advised to, and since then none of these problems has occurred.

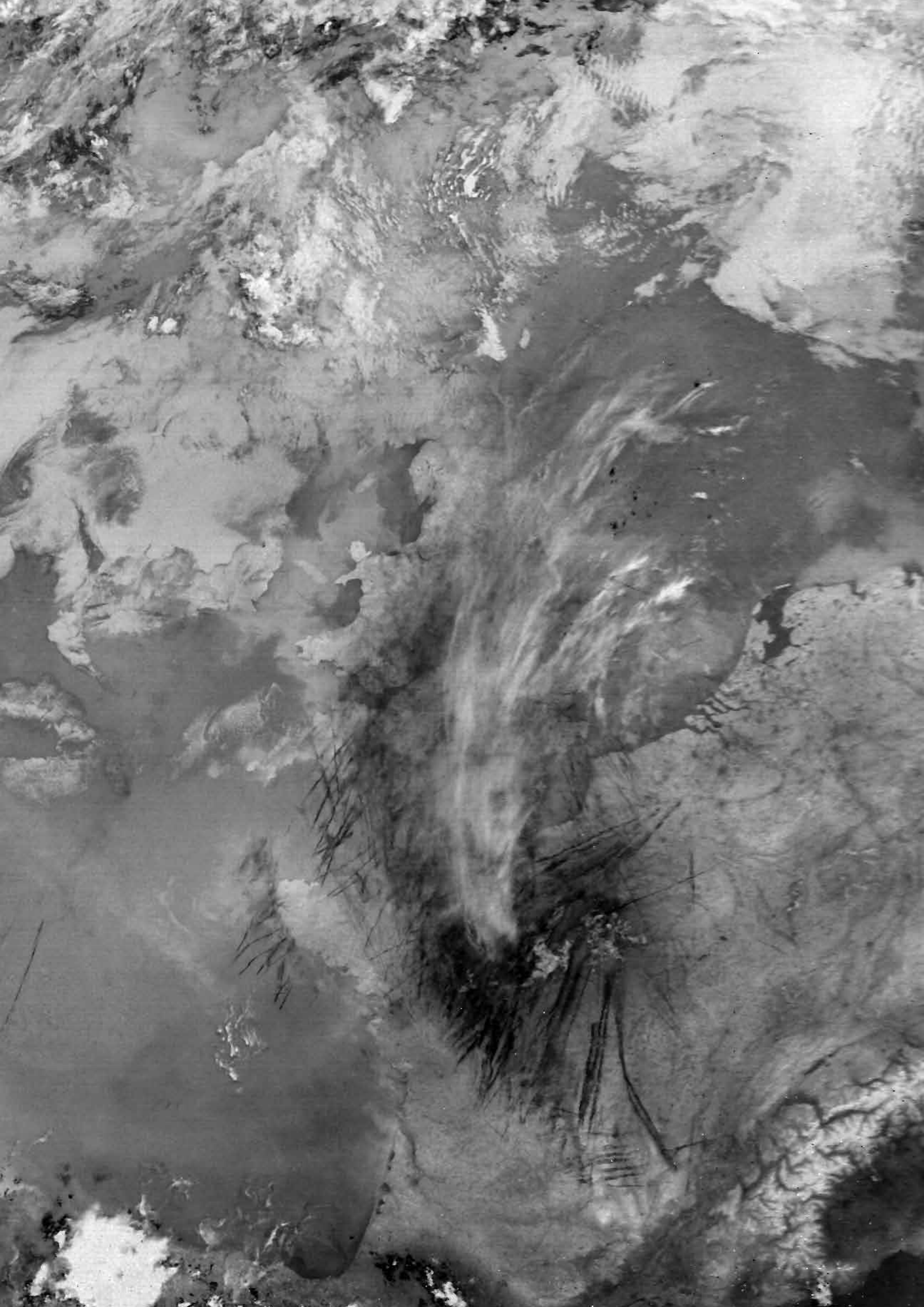
I also wrote that I felt my favourite operating system was Windows XP; perhaps, after that experience, I should change it to Windows-7. I have always said you never stop learning with this type of hobby.

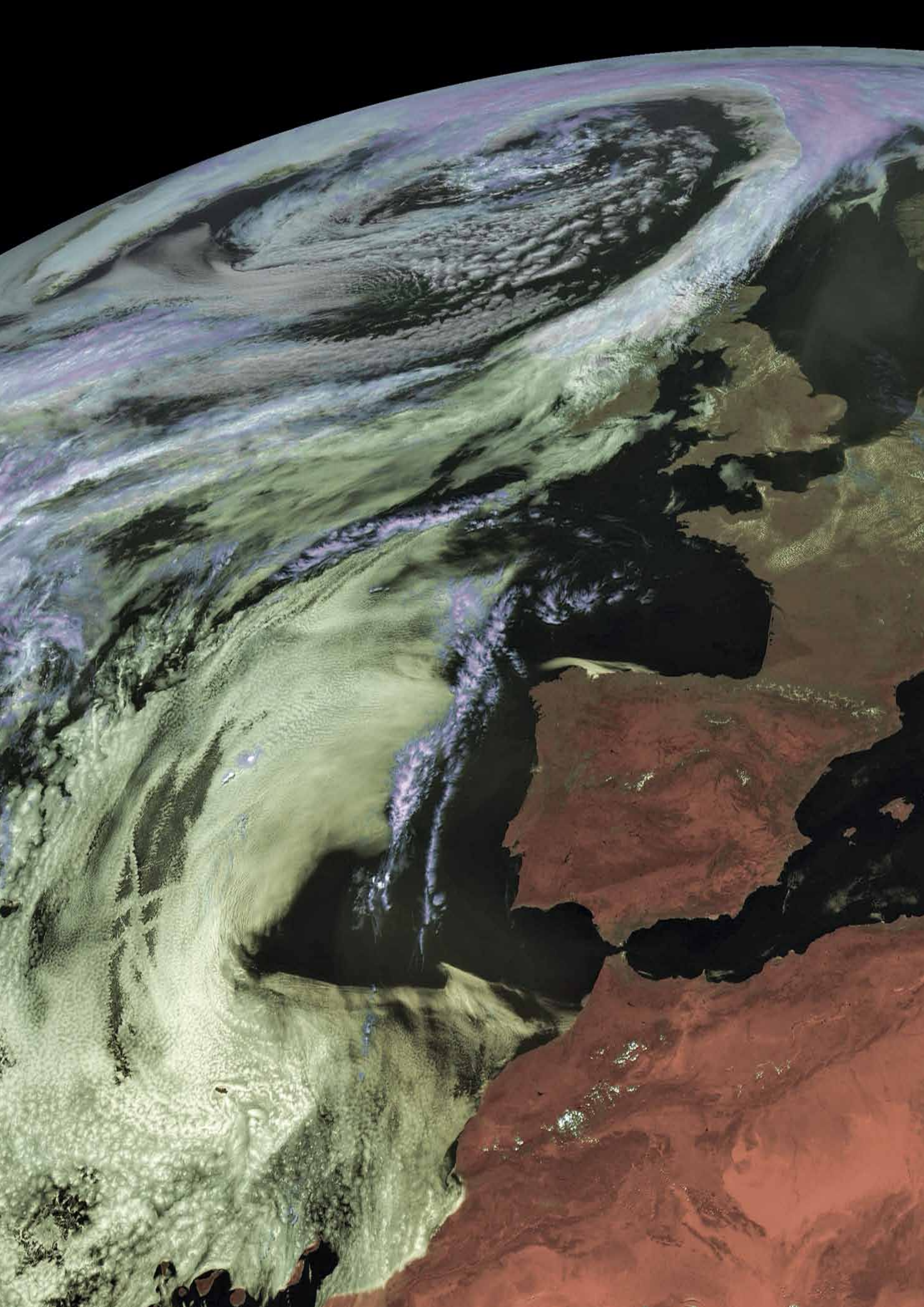
I hope this new information will assist members to get the best out of their stations and will help them to enjoy this amazing hobby.

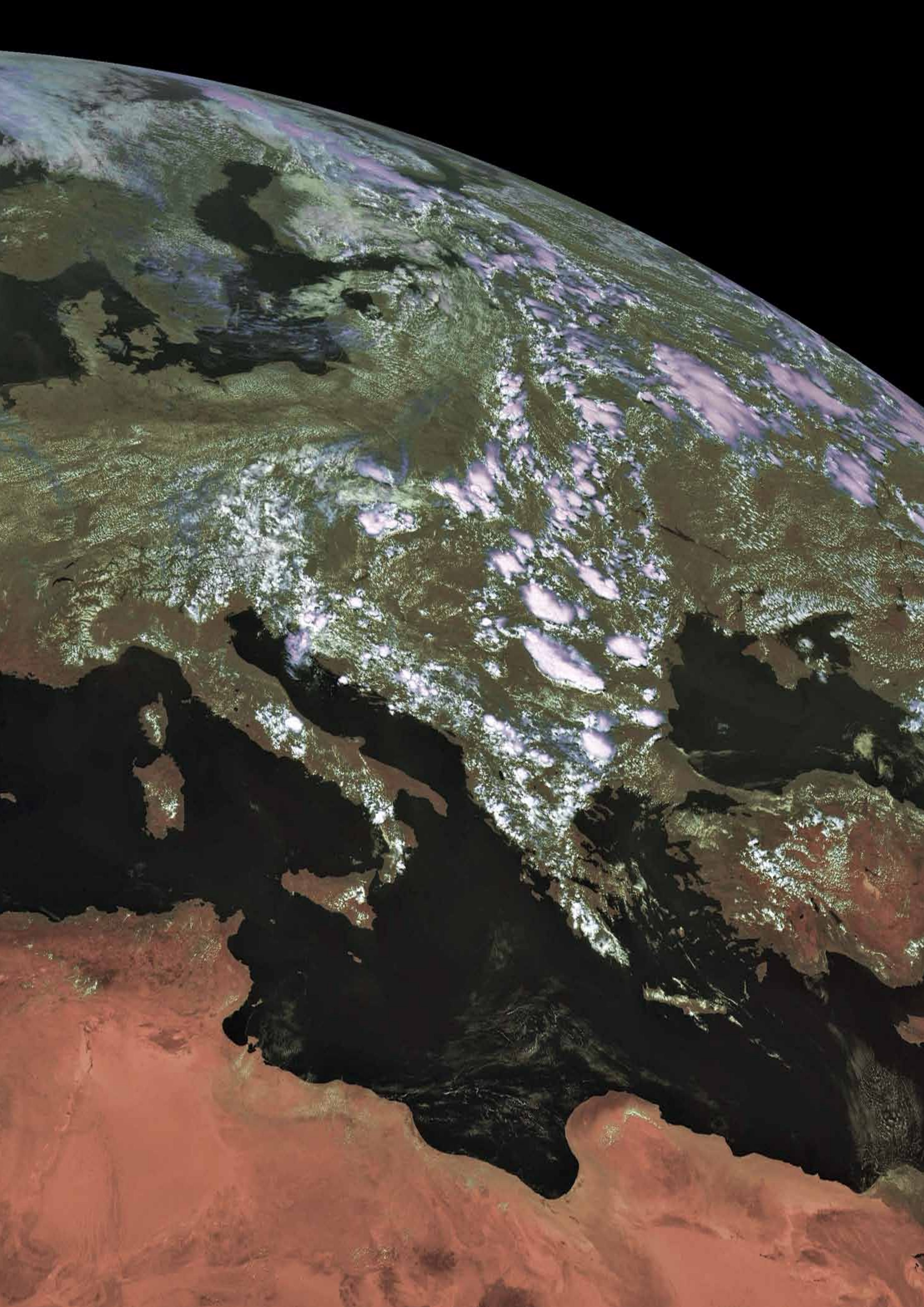












# Cover and Full Page Image Details

**Front Cover**

After the long winter, summer arrived with a vengeance in July. Mike Stevens sent us this beautiful MODIS image from NASA's **Aqua** satellite, acquired at 13:10 UT on July 7, the day Andy Murray won the Mens' Singles Crown at Wimbledon.

*Image: LANCE-MODIS/NASA/GSFC*

**Inside Front Cover**

The Aral Sea has featured several times in these pages, but seldom so spectacularly as in this **Envisat** image from Francis Breame. Acquired at 06:45 UT on August 4, 2010 following a particularly rainy spring and summer, the level of the eastern lobe of the southern Aral Sea underwent a brief recovery, which, unfortunately, has been reversed in the years since.

*Image © EUMETSAT 2010*

**Inside Back Cover**

Mike Stevens captured this **Terra** MODIS image of the British Isles and western Europe on his *EUMETCast* system at 11.15 UT on May 25, 2013. A feature of this false-colour image is the rich colour scheme, which Mike achieved by experimenting with the 'UserRGB' function of the *MODIS-L1 Viewer* software.

*Image © EUMETSAT 2013*

**Back Cover**

This **Terra** MODIS image from June 21, 2013 stretches through eastern Kazakhstan, Kyrgyzstan and Tajikistan. Lake Balhkash, the $13^{th}$ largest in the world, shows well in the upper half of the image, colouration differentiating the deeper, saline eastern part from the freshwater western region. To the south, snow still lingers on the high peaks of the Pamirs.

*Image: LANCE-MODIS/NASA/GSFC*

**Page 24**

Anthony Lowe sent us this splendid **NOAA 19** APT image, realised in the *Eckert* projection using *WxToImg*, from the 13:09 UT pass on July 20 this year.

**Page 25**

It's not often that Great Britain can be viewed entirely free from cloud, but that's exactly what David Taylor found in this magnificent **NOAA 19** image from the 13:13 UT satellite pass on July 19.

*Image: © EUMETCAST 2013*

**Page 26**

This **NOAA 19** channel-2 visible APT image from André T'Kindt of Ronse in Belgium shows disturbed weather over central Europe on May 29.

**Page 27**

This rather unusual **NOAA 16** image was sent in by Robert Moore, who received the satellite HRPT stream directly on July 15, 2013. It's a rare look at the infrared channel-4. Of particular note are the many aeroplane contrails over France and southeast England.

**Pages 28-29**

Mike Stevens sent in this exceptional **Meteosat-10** image dating from July 6, 2013, which shows all western Europe and north Africa enjoying a spell of exceptionally warm weather. A number of ship trails can be seen in the cloud to the west of Portugal.

*Image © EUMETSAT 2013*

**Page 32**

This arresting **NOAA 18** image submitted by Robert Moore, was also acquired on July 6, 2013, shortly after the onset of England's three-week summer heat wave. As so often is the case, northwest Scotland continues to lurk beneath one of the cloud fronts.

*Image: © EUMETSAT 2013*

**Page 38-39**

A study in monochrome. On July 12, one of the hottest days of the year at that point, **NOAA 19** captured this image, here rendered in channel-2 visible light (left) and channel-4 infrared (right). In the visible image, urban heat islands caused by major cities in both England and France are apparent.

*Image: NOAA CLASS Archive*

**Page 40**

NASA's **Aqua** satellite acquired this image of *Typhoon Soulik* on July 12, 2013 as the storm was moving west across the Pacific Ocean on course to strike Taiwan and China. At the time the image was taken, the storm had winds of 170 kilometres per hour.

*Image: LANCE-MODIS/NASA/GSFC*

**Page 41**

Scandinavia as imaged by NASA's **Aqua** satellite at 11:45 UT on July 12, 2013. Processing with MODIS L1 Viewer's *vegetation* tab.

*Image: NASA/GSFC/LAADS Web*

**Page 42-43**

This splendid channel-2 MODIS image, captured by NASA's **Terra** satellite on April 14 this year, features a striking cloud wake off the California coast. Within a bank of stratocumulus cloud hugging the California and Baja California, an arc of mostly clear sky curved southwest over the Pacific Ocean for over 1000 kilometres.

It is possible that the wake was set up when the airflow was disturbed by San Clemente Island, the southernmost of California's Channel Islands. The page 43 image zooms into the cloud detail.

*Image: NASA/GSFC/LAADSweb*

**Page 46**

This is a **NOAA 19** image acquired by Mike Stevens using the *Windows-7* operating system. Dating from March 26, 2012, it shows cloud-free Great Britain, Netherlands, France and Spain enjoying much milder springtime weather than the atrociously cold and miserable one we endured this year.

*Image: © EUMETSAT 2012*

**Page 50**

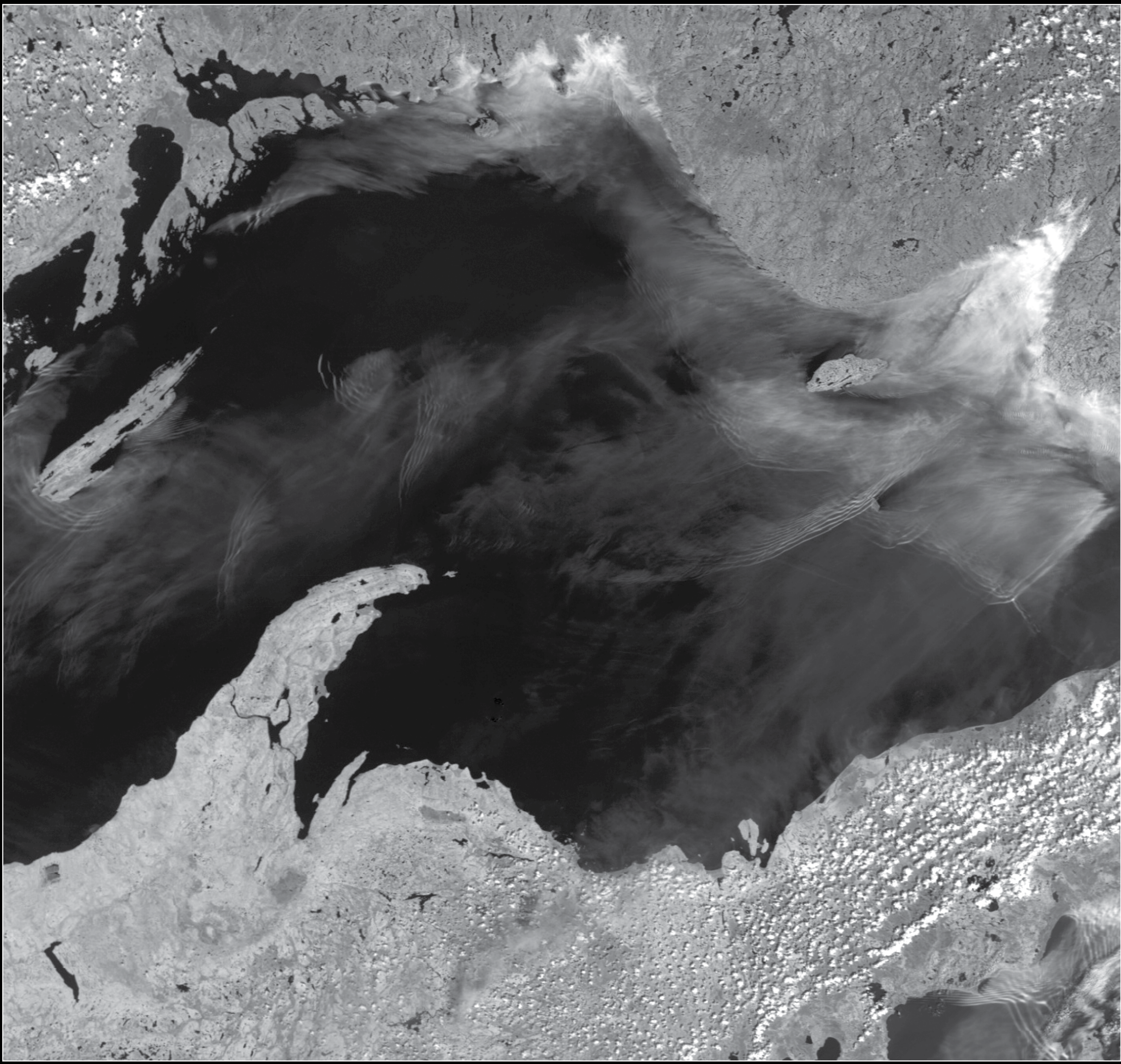
A band of severe storms swept across the USA during late May this year, spawning a large number of deadly tornados. The most dramatic of these was a large EF5 tornado which devastated the town of Moore in Oklahoma, causing 24 fatalities. Mike Stevens sent in this **Metop-B** image acquired at 16:25 UT on May 21, which graphically details the thunderstorms raging over the region.

*Image © EUMETSAT 2013*

# Atmospheric Gravity Waves

## over Lake Superior

***Les Hamilton***



This scene is taken from a 250-metre/pixel image segment captured by the MODIS instrument aboard NASA's Terra satellite on June 24, 2013, and shows several examples of atmospheric gravity waves over northern Lake Superior.

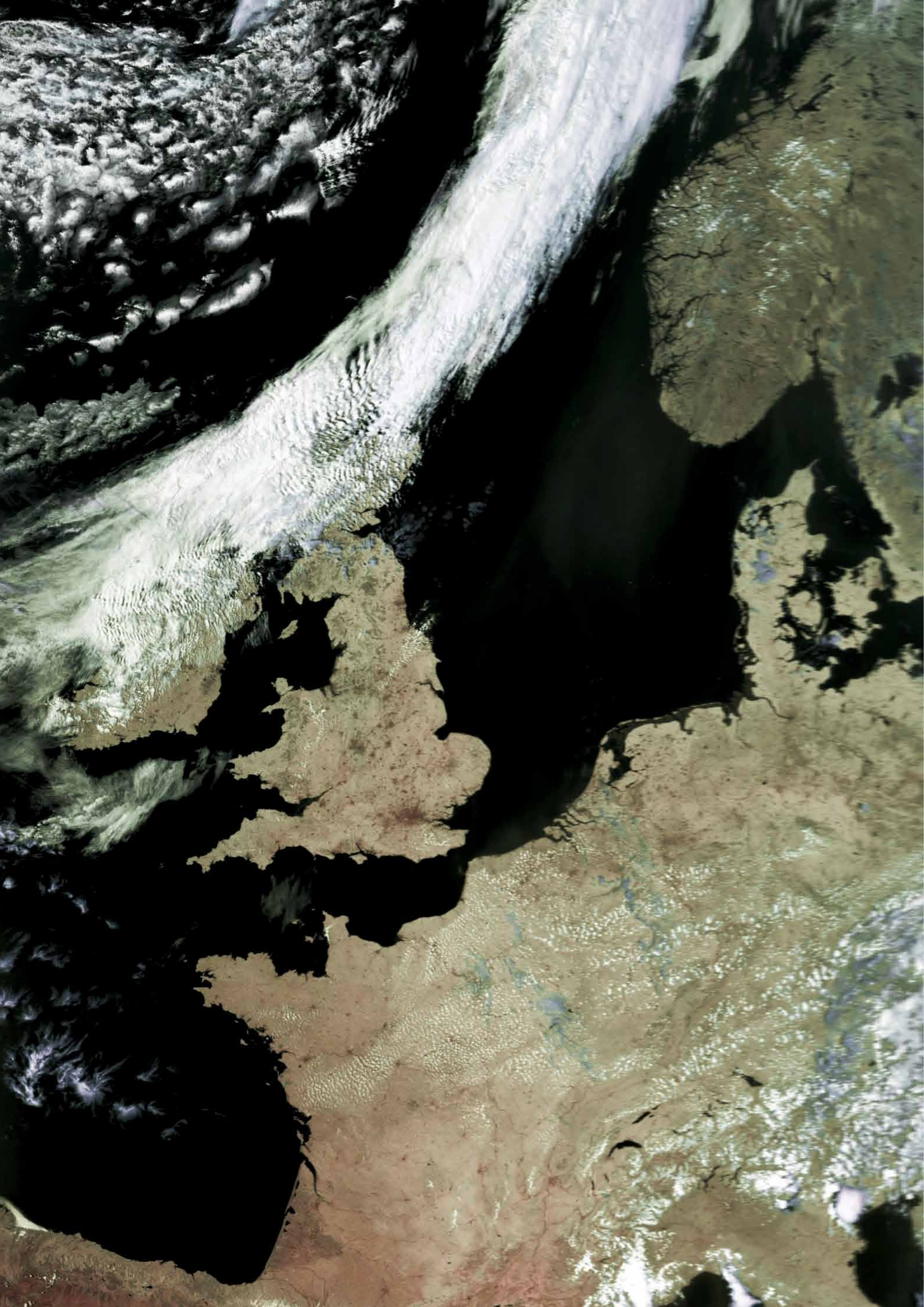
Beyond the northern coastline of the lake, in Canada, the terrain of southern Ontario is covered by an extensive forest canopy, typical of early summer. Offshore, several distinct sets of parallel cloud bands are visible: these are gravity waves, produced when moisture-laden air encounters an imbalance in air density, as can occur when cool air flows over warmer air.

Under these circumstances, the flowing air may start oscillating up and down as it advects, causing clouds to condense as the air rises and cools, but to evaporate and disappear again when the air sinks and warms. This produces alternate parallel bands of cloud and open sky, oriented perpendicular to the wind direction.

In this particular instance, the orientation of the cloud bands, parallel to the coastlines, suggests that air flowing southwards from the land surfaces to the north of Lake Superior is interacting with moist, stable air over the lake surface, to create the gravity waves.

*Image: NASA/GSFC/LAADSweb*

Text sourced in part from NASA Earth Onservatory
***http://earthobservatory.nasa.gov/IOTD/view.php?id=81650***



# Metop Reception via EUMETCast

***Mike Stevens***

After reading my last three articles you will have realised that, through the *EUMETCast* transmissions, we are able to view some wonderful images from this lovely planet that we live on. The *Metop* orbiters provide some of the very best of these, furnishing us with some outstanding images from all corners of the Earth: north to south and east to west. Let's examine in detail how we can receive them.

Firstly, what does 'Metop' stand for? *Metop* is an abbreviation of 'Meteorological Operational', and is the name given to a series of three polar orbiting satellites dedicated to providing meteorological data until at least the year 2020. They form part of the *EUMETSAT Polar System*: Metop-A was the first to be launched (2006), followed by Metop-B (2012). It was planned to launch the satellites at approximately five year intervals, and Metop-C will follow in late 2016. These satellites will ensure a continuous delivery of high quality global meteorological data to assist in weather forecasting and the study of Climate Change.

*Metop* carries an impressive suite of instruments, some of which are the same as those carried on the NOAA polar orbiting satellites: they offer remote sensing capabilities which provide high resolution images, temperature and humidity profiles plus land and ocean surface temperature measurements on a global basis. Through the kind permission of EUMETSAT, we—as weather and Earth observers—are able to acquire their data using David Taylor's excellent set of receiving software.

**How to start?**

How do we start to set all this up? If you have been following my earlier articles, you will have noted that I mention that once you have the experience to set up the *Receive Systems* on your computer, you can move on to decode more of the incoming data streams from *EUMETCast,* and I consider the *Metop* data to be the best one.

First, you need to register with EUMETSAT so they can update your EKU Key to be able to receive the incoming Metop data. This you can do by logging into the EUMETSAT **Earth Observation Portal** using your login User ID and password

***https://eoportal.eumetsat.int/userMgmt/***

noting that this URL is case sensitive.

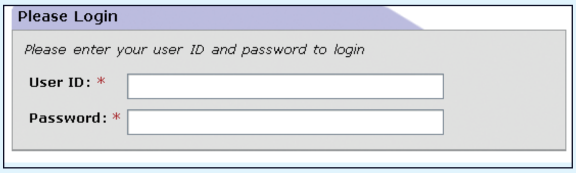



Figure 2 - The EUMETSAT login screen

Once logged in, go the box marked **Edit/View Service Subscriptions**, where you will find a link to **Add a New Dissemination Service**. Open this link and it will show you all the available services: scroll down and find the **Global Data Service Metop AVHRR** in the *Polar Data Service* section, and check the boxes of the items you wish to receive. Then confirm and come out of the site. You will receive an e-mail from the EUMETSAT Help Desk, when they will confirm that your EKU is active to receive *Metop* data.

Once you have received the confirmation from EUMETSAT that your EKU Key is active, you then need to look into your *recvd-channels* files within *Tellicast* to amend the files list to

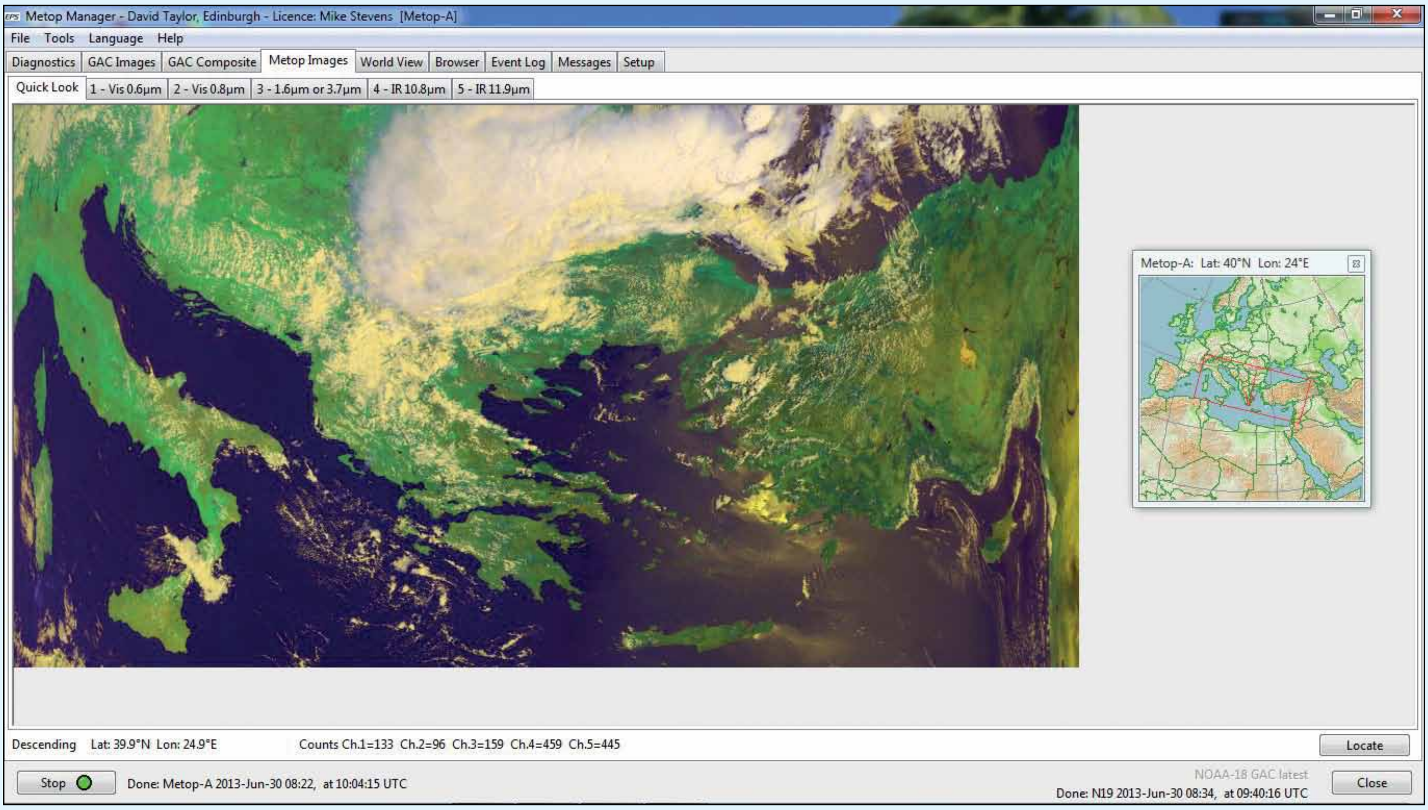



Figure 1 - A typical Metop segment displayed in Metop Manager

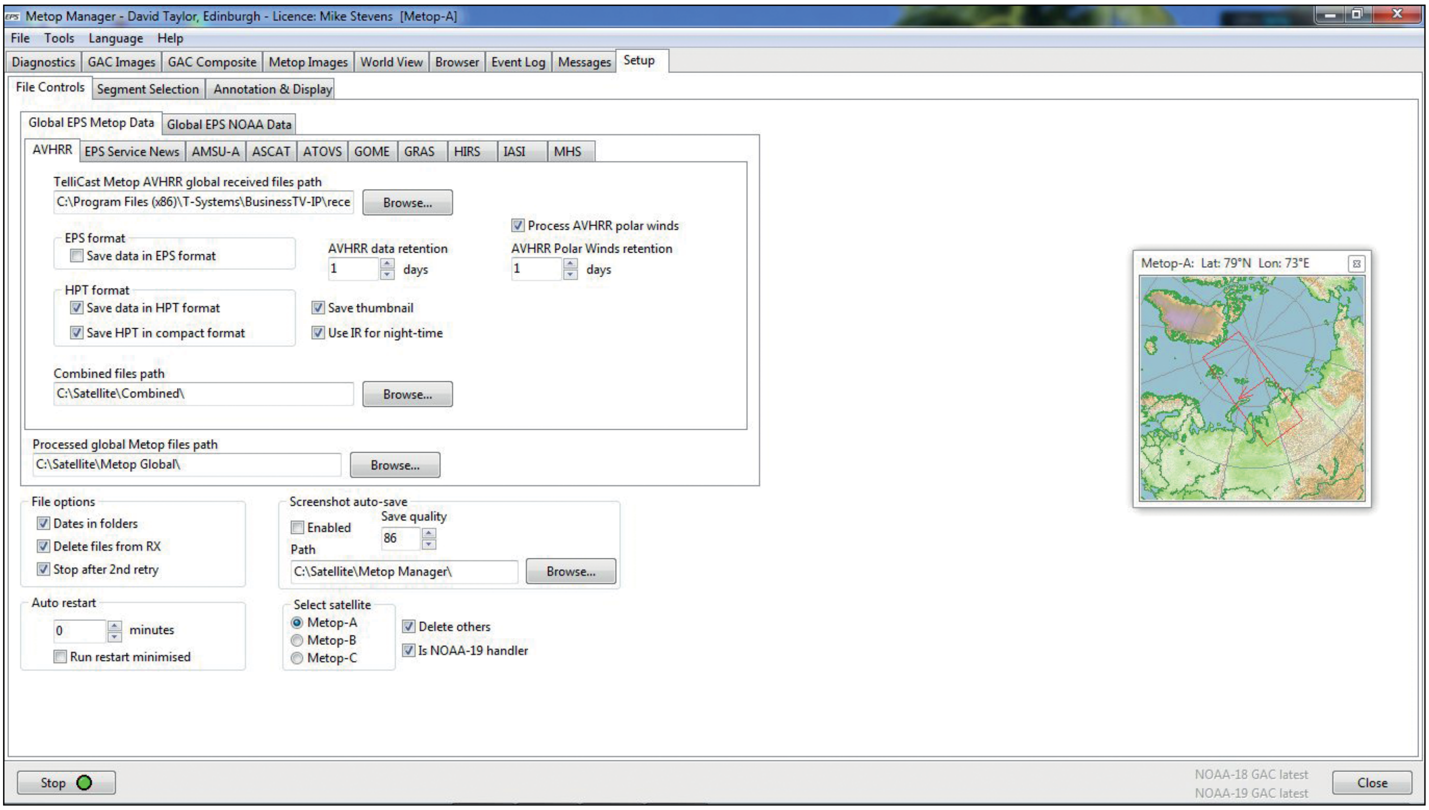



Figure 3 - The MetopManager Setup Tab: Global EPS Metop Data

enable reception of the new data streams. Here is how I've tagged these new data streams within the channels file:

```
[EPS-10]
target_directory=received-AVHRR

[EPS-15]
target_directory=received-NOAA-GAC
```

These channels will allow you reception of the *Metop* AVHRR high resolution images, and also the GAC files downloaded from the NOAA satellites, all of which are retransmitted over *EUMETCast*. The software is contained within David Taylor's *Metop Manager* program.

Once the EKU has been activated and you have updated your *recvd-channels* files you should start to receive data from the Metop-A and Metop-B satellites.

## Processing Metop Data

Its now that you need David Taylor's *Metop Manager* software, so visit

***www.satsignal.eu***

and download it as a zipped archive. David gives you 30 days to trial the program after which you will have to register and pay for the software. You should be able to evaluate it in that time.

Create a folder called 'Metop Manager' and unzip the archived files into it. Run the software by double-clicking the file *Metop Manager.exe*, which works perfectly with both *Windows XP* and *Windows 7*. After running *Metop Manager,* go immediately to the **Setup** tab. Your first task is to locate the incoming Data from the *EUMETCast* System.

Go to your *Tellicast Files* folder and browse through the subfolders to find the one marked **received-AVHRR**. Because you tagged it that way (see box above) it's easy to find, and it contains all the files for both Metop-A and Metop-B. Just confirm that the data is present within that folder and, if that is the case, go back to the **Setup** tab and locate **Global EPS Metop Data** tab (figure 3). Click on that, make sure you're on its **AVHRR** tab and click the **Browse** button to locate the file **received-AVHRR** within the *Tellicast* folder: highlight this file and click '*OK*' to confirm. It should look something like this:

C:\Program Files\T-Systems\BusinessTV-IP\received-AVHRR

That should now allow *Metop Manager* to take all the data from that folder and decode it. But wait a minute! There are two Metop satellites sending down data, so you have to decide which one you want to deal with. Go to the lower part of the **Setup** tab and you will see a small box marked 'Select Satellite', where you will find Metops A, B and C listed.

For the moment you can select either Metop-A or Metop-B: it's your choice. Don't select Metop-C as it isn't going to be launched for at least three years yet.

This is where matters can become somewhat complicated, and particularly if you are not full-on with PC knowledge, you may have problems. The *Metop Manager* licence conditions allow you to run two instances of the program—one for Metop-A and the other for Metop-B—on the same PC, which means you are able to see images from both satellites on a split screen. If that is what you want to do, my advice is to visit David Taylor's excellent website where he describes exactly how to do that in the section 'Parallel running for Metop-B' at this URL:

***http://www.satsignal.eu/software/metop_manager.htm***

If on the other hand you prefer to keep images from the two satellites separate, as I do, then you can request David's permission to run a second *Metop Manager* installation on another PC within a network system. As I write, I am receiving Metop-A on my *Acer PC* and Metop-B on my *E-Machine*. I find that this arrangement puts a lot less load on to one PC as the *Metop* data files are very large. Just look

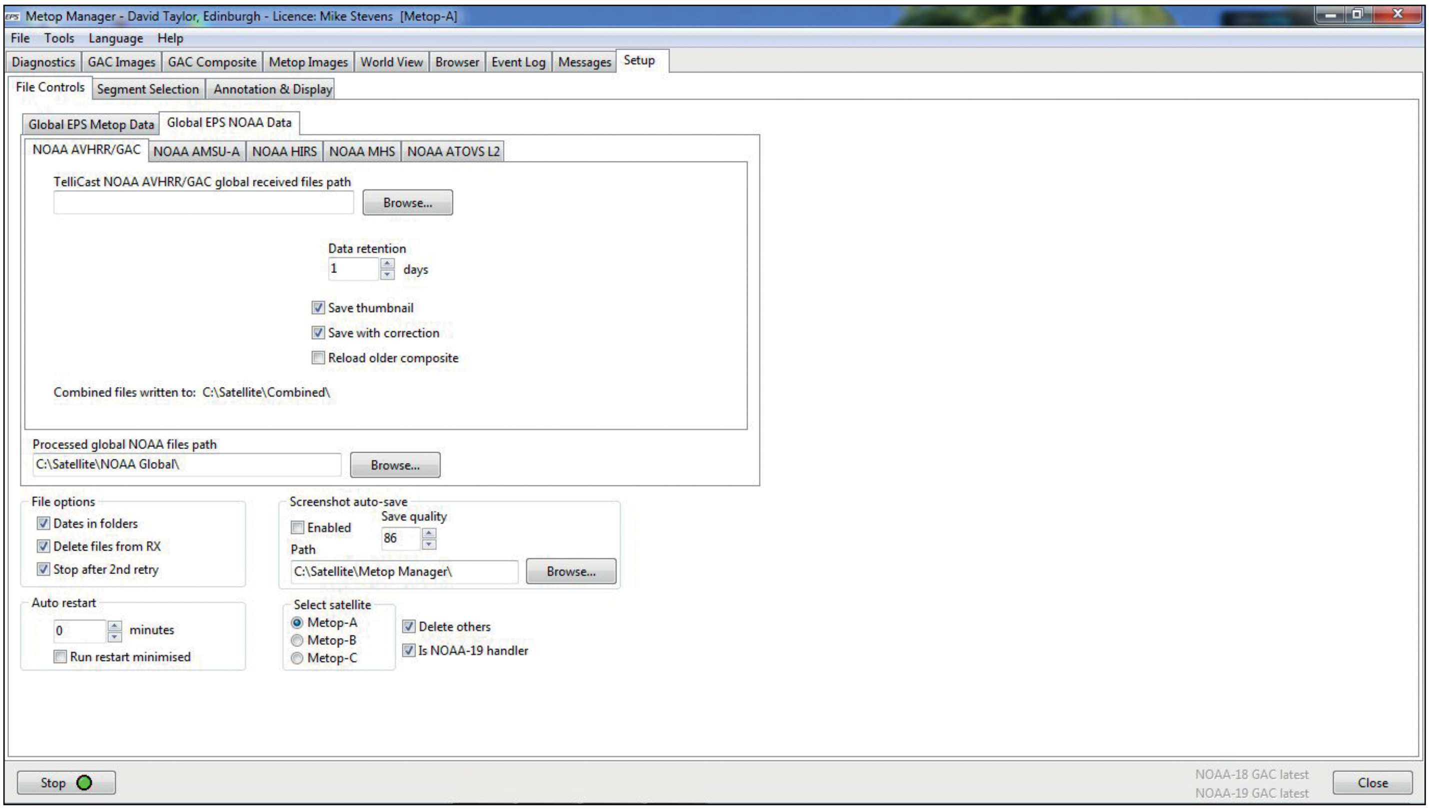


Figure 4 - The MetopManager Setup Tab: Global EPS NOAA Data

into the *HTML Shell* within your *Tellicast* folder and you will see files of the order of 117 megabytes arriving on to your hard drive. This is one reason why EUMETSAT recently advised users to add the following line within the *Tellicast* **recvd-ini file** under '*Watchdog'* to allow for the large amount of incoming data.

max_memory_usage=500000000

You should now have images building within *Metop Manager*, so open the **Metop Images** tab and see what has been decoded. It could be a night time image, which will automatically appear in **tab 4 IR 10.8**, or a normal daytime image which will show in the **Quick Look** tab (figure 1). It depends on the location of the satellite picture at the time your program starts: the approximate duration of each data segment is 3 minutes. Now you can watch the World go by with Metop.

### Processing NOAA GAC Data

The next set up is for the NOAA *Global Area Coverage* (GAC) incoming data files which also form part of the *EUMETSAT Polar System* (EPS). Hopefully, you applied for GAC at the same time as *Metop*, in which case all those files will be in the *Tellicast* system under **received-NOAA-GAC**. Look into that folder and confirm that the GAC data is there, then return to the **Setup** tab in *Metop Manager* and open the **Global EPS NOAA Data** tab (figure 4). In its **NOAA AVHRR/GAC** tab, click the 'Browse' button beside the panel labelled **Tellicast NOAA AVHRR/GAC global received files path** and, just as you did for the *Metop* data, locate within the *Tellicast* system the folder **received-GAC**, highlight it and click 'OK' to confirm. It should look like this:

C/Program Files/T-Systems/BusinessTV-IP/received-GAC

This done, you should go to either the **GAC Images** or **GAC Composite** tab (figure 5) within *Metop Manager* in order to view the NOAA images on screen. As the GAC data continues to run into your PC, the program will automatically scroll.

You may now want to look around the program to discover its other features. Start with the 'World View', which will show you the data blocks that have been received in the most recent satellite pass, then move to the 'Browser Tab' which will show you the complete set of data blocks for the whole day's reception. There are several small tabs that need to be ticked on that screen: from top to bottom, they are

- Ascending
- Descending
- Must Exist
- Open in Reader
- Use Memory.

The top one, 'Ascending' is your choice.

The **Open in Reader** option is important if you want to select a sequence of data blocks. For this, you will also need the latest *HRPT Reader* software from David Taylor's website to get fantastic images like the ones that you see in GEO Quarterly.

### Recap Summary

- Apply to EUMETSAT for an EKU update to receive Metop data
- Update the *recvd-channels* for EPS/GAC reception
- Download Metop Manager from David Taylor's website.
- Locate and confirm the incoming data stream in your *Tellicast* folder
- Set up Metop Manager to user defaults
- Download and set up *HRPT Reader* software from David' Taylor's website.
- Open *Metop Images* tab to check the incoming pictures.

All being well, you should now be able to view the incoming pictures from *Metop* arriving at your PC (figure 6) and be amazed at the quality and clarity they exhibit. If, after a period of time, you look into the **World** tab, you should have a complete segment-run from north to south across whichever part of the globe the transmission started. If you then go to the **Browser** tab and click on the 'Today' button, all the received data segments will be shown. When you drag the cursor—with the mouse—down over the segments you wish to view, those segments will be highlighted. You then have

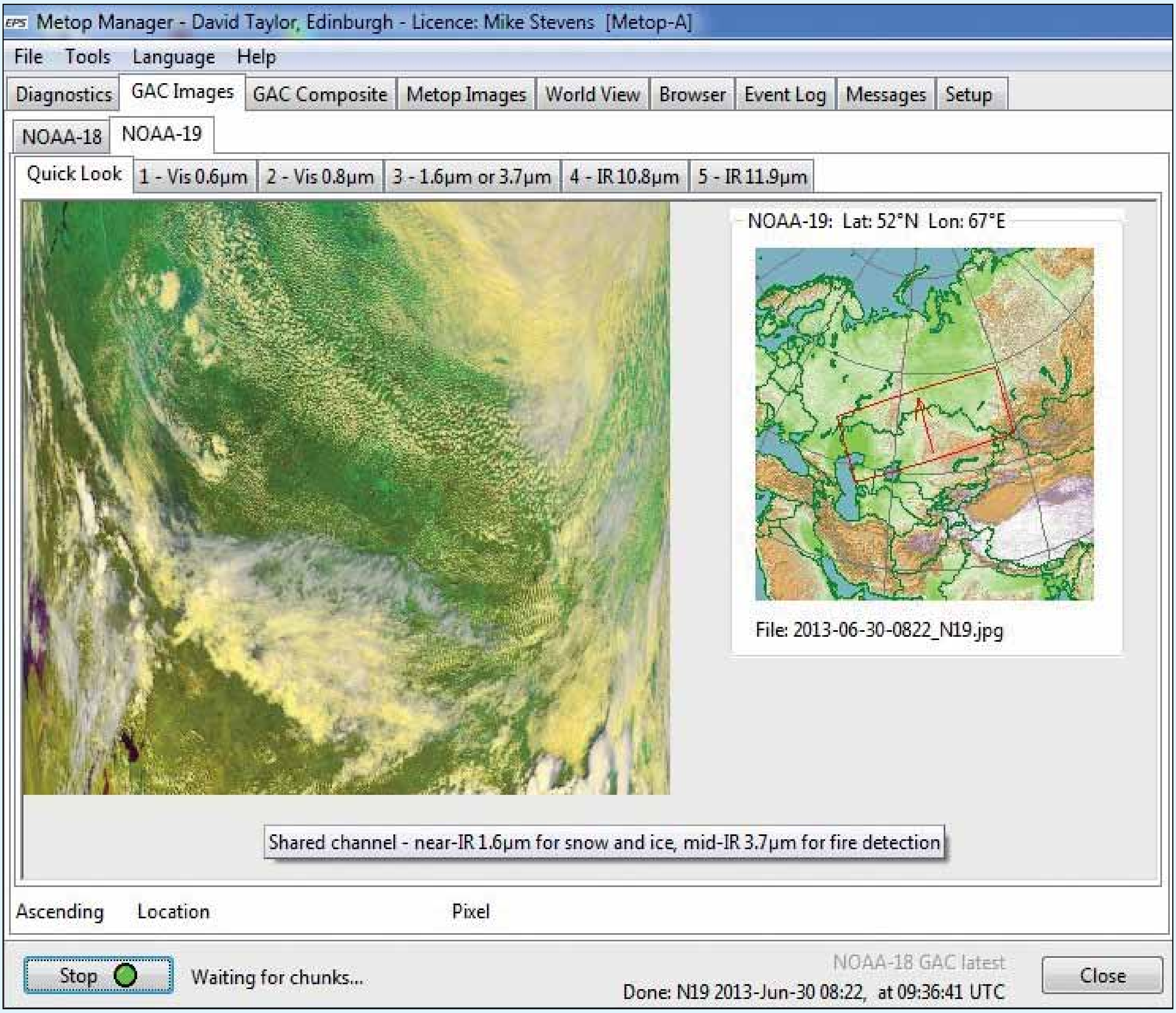



Figure 5 - A typical NOAA GAC image displayed in Metop Manager

an option to **Preview or Combine** using the buttons lower down the screen. My advice is to preview first to see if its what you want, then click on the 'Combine' button.

*Metop Manager* will automatically go into a sequence of events for HRPT: just follow the on-screen instruction and it will build the picture for you, which you can then look at in full HRPT quality. I'm sure you will be amazed at the results. Each time I carry out this operation, I never cease to be amazed at the picture quality.

So there we have it: another part of the *EUMETCast* system is now working on your PC. Make sure you keep on top of your PC housekeeping as you are now receiving a lot of data which can soon fill your hard drive. You may sometimes find you have some segments missing on a run: this could be caused by data loss from EUMETSAT, or through your PC being unable to decode the information fast enough. In the latter case, it could mean upgrading by adding more memory to your PC: the more the better—you can never have too much. You could try using a RAMDisk if an upgrade is not possible, or do as I have and purchase a top grade PC (I use an *Acer Aspire* which accomplishes everything without a RAMDisk). But its your choice which way to go.

Whatever you decide, I hope you enjoy the challenge of setting up your system, and the images you receive.

Happy Weather Watch from Portland.

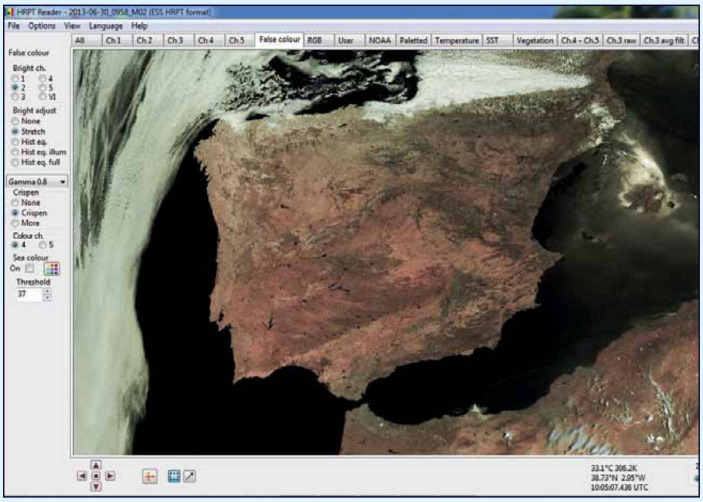


Figure 6 - A Metop image of the Iberian peninsula displayed in HRPT Reader

## Operation IceBridge

continued from page 52

completed over a five-week period from mid October to early November, when ice-penetrating radar was used to measure ice thickness and map sub-glacial bedrock, and a gravimeter was deployed to measure the depth and shape of water beneath ice shelves. Further flights to Pine Island Glacier showed that the crack discovered a year previously had grown significantly.

At the time of writing, *IceBridge* has completed its 2013 Arctic campaign of science flights north of Greenland, across the Arctic Basin and over the Beaufort and Chukchi seas north of Alaska. Of particular interest were rapidly changing outlet glaciers, such as the Jakobshavn Glacier in western Greenland. These flights built on existing datasets going back to the start of *IceBridge* and continued work in gathering ice measurements alongside partners from the European Space Agency.

**Photographs from the IceBridge Team**

After spending weeks cruising low over the ice, *IceBridge* scientists usually come back with stacks of jaw-dropping photographs of rarely seen parts of the world. A few examples appear in this article.

### References

1 Operation Ice Bridge
http://en.wikipedia.org/wiki/Operation_IceBridge
2 Previous Campaigns
http://www.nasa.gov/mission_pages/icebridge/news/past.html
3 IceBridge 2013
http://www.nasa.gov/mission_pages/icebridge/news/spr13/index.html

## Currently Active Satellites and Frequencies

| Polar APT Satellites | | | |
|---|---|---|---|
| Satellite | Frequency | Status | Image Quality |
| NOAA 15 | 137.6200 MHz | On | Good |
| NOAA 18 | 137.9125 MHz | On | Good |
| NOAA 19 | 137.1000 MHz | On | Good / [1] |
| Meteor M N1 | 137.1000 MHz | Sporadic | [1] |

| Polar HRPT/AHRPT Satellites | | | | |
|---|---|---|---|---|
| Satellite | Frequency | Mode | Format | Image Quality |
| NOAA 15 | 1702.5 MHz | Omni | HRPT | Weak |
| NOAA 16 | 1698.0 MHz | RHCP | HRPT | Good |
| 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] |
| Metop A | 1701.3 MHz | RHCP | AHRPT | Good |
| Metop B | 1701.3 MHz | RHCP | AHRPT | Good |
| Meteor M N1 | 1700.0 MHz | --- | AHRPT | [2] |

| Geostationary Satellites | | | | |
|---|---|---|---|---|
| Satellite | Transmission Mode(s) | | Position | Status |
| Meteosat 7 | HRIT 1691 MHz / WEFAX 1691 MHz | | 57.5°E | On |
| Meteosat 8 | HRIT (digital) | LRIT (digital) | 3.5°E | On [4] |
| Meteosat 9 | HRIT (digital) | LRIT (digital) | 9.5°E | On [5] |
| Meteosat 10 | HRIT (digital) | LRIT (digital) | 0°W | On |
| GOES-12 | --- | GVAR 1685.7 MHz | 60°W | On |
| GOES-13 (E) | LRIT 1691.0 MHz | GVAR 1685.7 MHz | 75°W | On [3] |
| GOES-14 | --- | --- | 105°W | Standby |
| GOES-15 (W) | LRIT 1691.0 MHz | GVAR 1685.7 MHz | 135°W | On [3] |
| MTSAT-1R | LRIT 1691.0 MHz | HRIT 1687.1 MHz | 140°E | On |
| MTSAT-2 | LRIT 1691.0 MHz | HRIT 1687.1 MHz | 145°E | On |
| Feng Yun 2D | LRIT | SVISSR | 86.5°E | On |
| Feng Yun 2E | LRIT | SVISSR | 104.0°E | On |

**Notes**

1 LRPT Signals have been reported from Meteor M N1 but are sporadic with periods off. This satellite's carrier frequency can cause interference to NOAA 19 when the two footprints overlap.
2 These satellites employ a non-standard AHRPT format and cannot be received with conventional receiving equipment.
3 GOES 13 and GOES 15 also transmit EMWIN on 1692.70 MHz
4 Meteosat operational backup satellite
5 Meteosat Rapid Scanning Service (RSS)

## FEEDBACK

**The column for Readers' Letters, Queries and Discussion**

Email: geoeditor@geo-web.org.uk

Hi Les,

Your comments in the June 2013 editorial regarding reduced participation struck a chord with me. I have been receiving weather satellite images for the last 20 years or so and have pondered the difference between when I started and now. I think that there are perhaps two main types of enthusiast—those who are primarily interested in the 'what' i.e. weather and the images, and those who are at least as much interested in the 'how' i.e. satellites, receivers, decoding etc.

In retrospect, having weather images readily available over the Internet has removed the pool of radio enthusiasts interested in the 'how' without replacing them with an equivalent sized pool of Internet/computer enthusiasts. Luckily we have several of these such as David Taylor, but the general Internet/computer technology nowadays is pretty abstract; this can tend to turn off those such as myself who like making things such as aerials and receivers. I came into weather satellites from an amateur radio background and still feel a thrill when I pick up a satellite and decode the image miles away from any Internet connection. Sadly, the days of APT are numbered. I would be very interested in being able to receive LRIT in the field but no-one seems to have progressed the necessary software. Surely this would be possible with modern computers? I am not interested in paying exorbitant prices (at least for an OAP) to receive mobile data and Internet, and mobile satellite reception of direct data does not fit with my small campervan.

In conclusion, the Magazine and GEO itself are excellently managed and produced; any reduction of interest on my part is solely due to the move away from my specific interests. This is not the fault of a very professional management team but a reflection on where satellite imagery is going.

Many thanks for a superbly produced magazine and the dedication of those involved

*Alistair Dunlop*

continued from page 12

**Acknowledgements**

Images shown in the article have been sourced either from the NLO and the website references shown in the text.

### References

1 The Chelyabinsk Fireball - GEOQ 38, page 10

### Useful Web References

Andy Smith's interesting website, with links to NLO. Andy gave valuable advice to NLO members when setting up some of the detection systems.

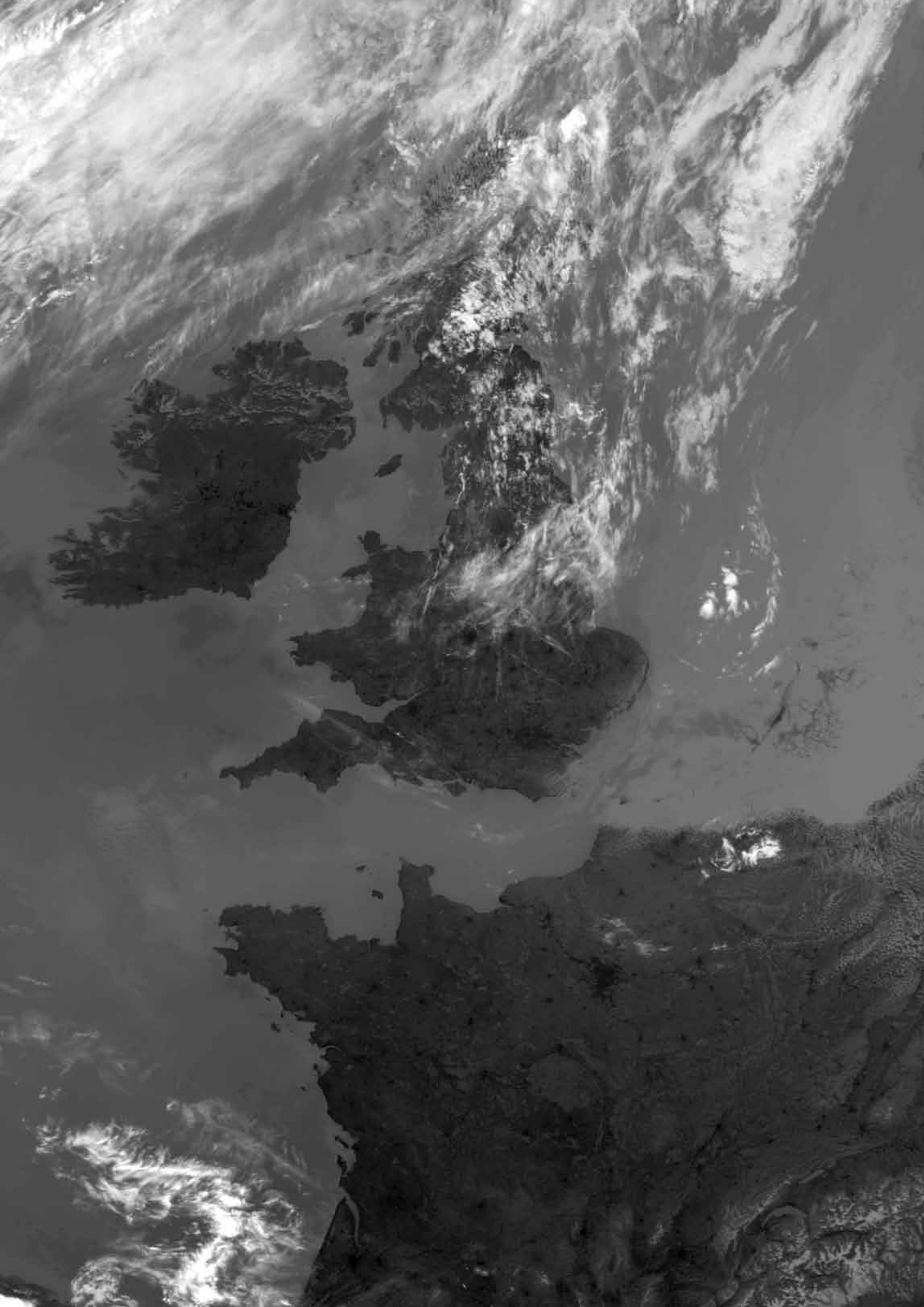
***http://www.tvcomm.co.uk/radio/index.html***

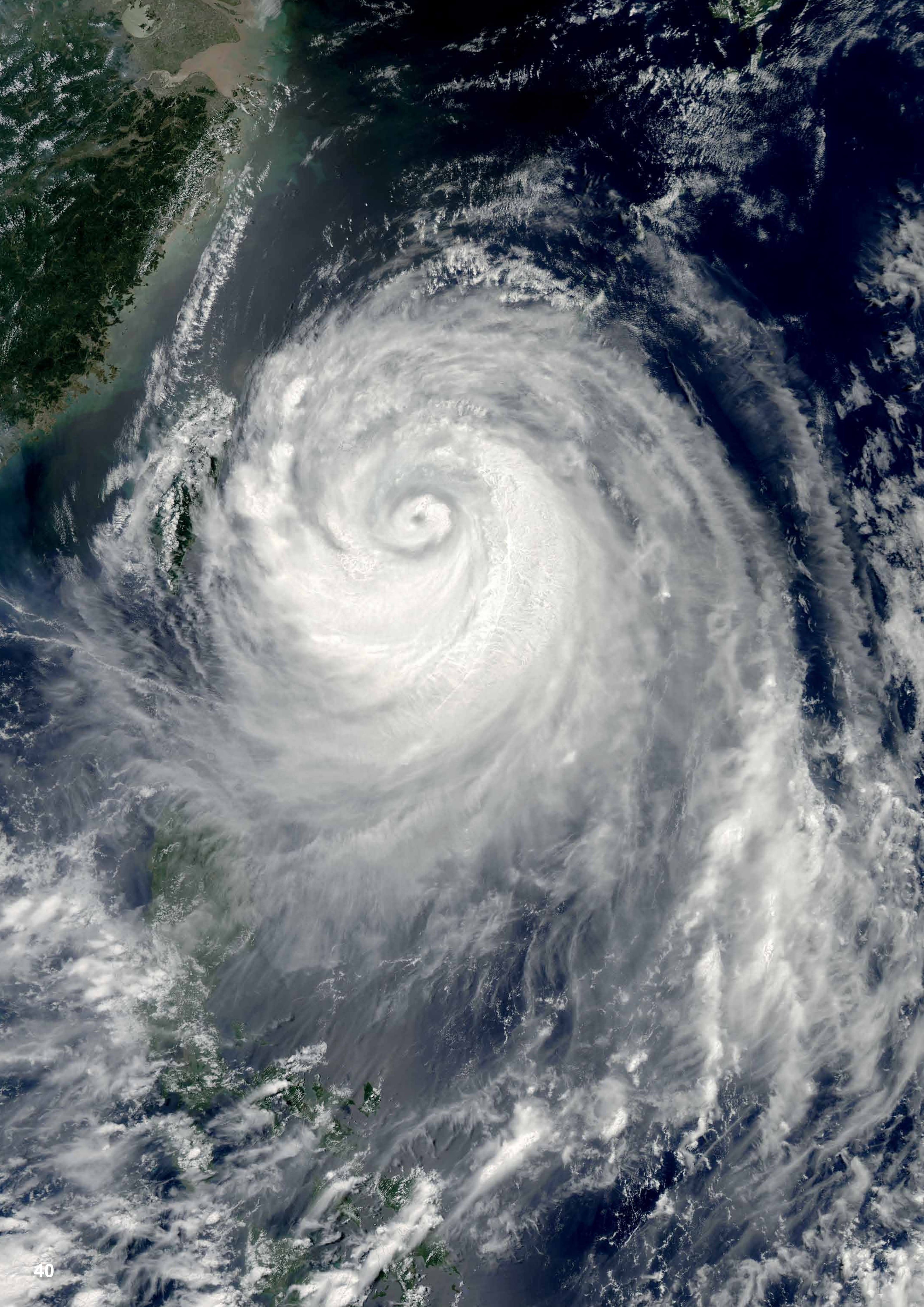
Dave Jones' website, which hosts the SPAM data and other interesting information and is also strongly linked with NLO.

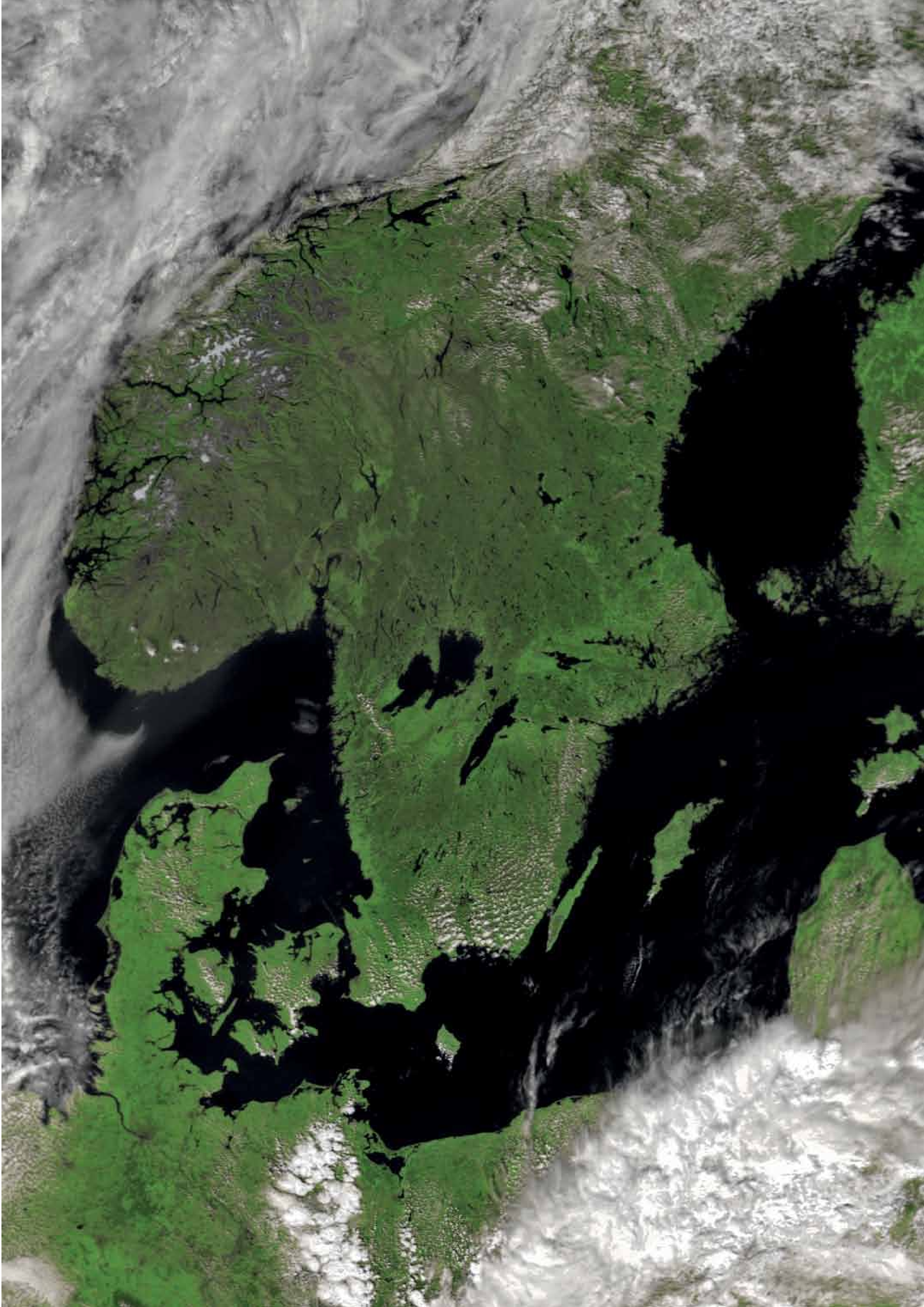
***http://www.merriott-astro.co.uk/***

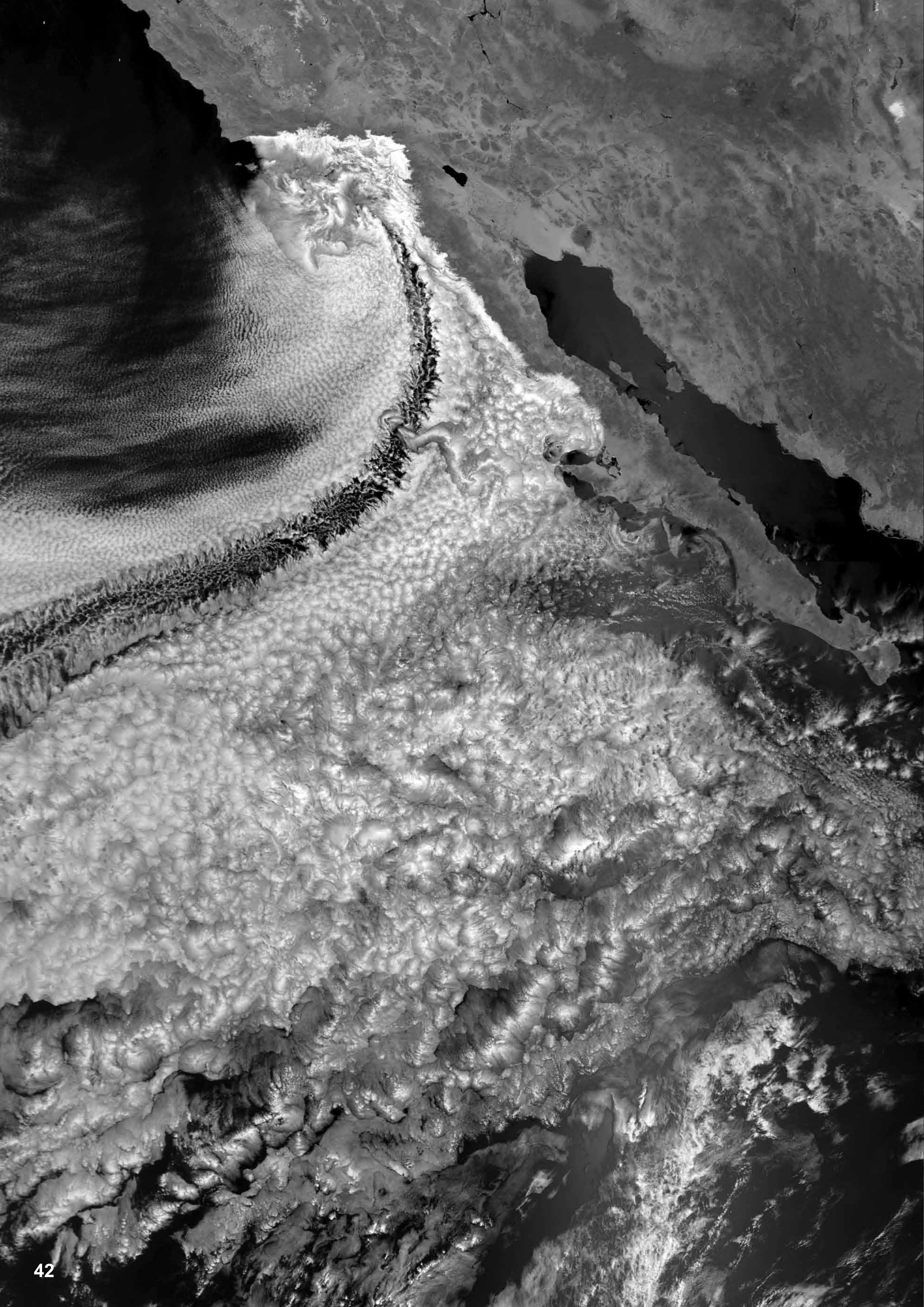
The UK visual meteor monitoring website, with which NLO is linked.

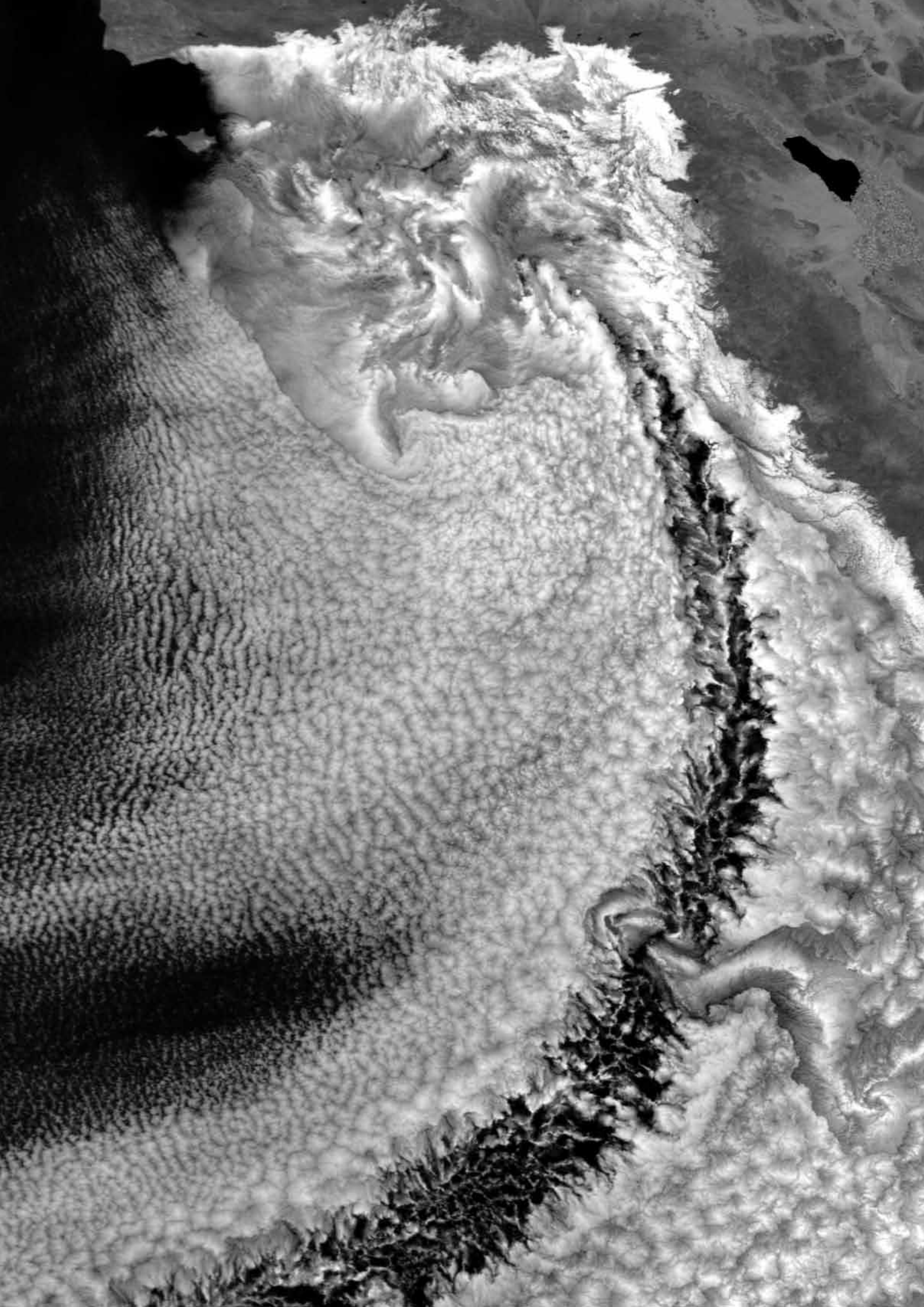
***http://ukmeteornetwork.co.uk/***











# Eumetcast and Windows-7

**Mike Stevens G4CFZ**

Having two separate operating systems means you get to know the workings of both fairly well. The ones I have are *Windows XP* and *Windows 7*, both of which are running more or less full time receiving satellite weather data from the *EUMETCast Broadcast System* via the *Eurobird 9* satellite.

I explained the *Windows XP* system in the June Quarterly, and hope that was of some help to new users and beginners. It’s always very difficult to know just how far one should go when compiling these articles as most readers are well advanced in the hobby, whereas some are somewhat afraid to take the plunge. So here we go again, this time explaining how to get the best out of *EUMETCast* under *Windows 7*. Some users find *Windows-7* to be an excellent operating system, others say it’s very complicated. I know which system I prefer but will reveal that at the end of this article.

When you decide to install all your satellite programs into *Windows-7*, you have to consider in detail what the system will allow you to ‘get away with’. Moreover, you cannot use the old versions of the *EUMETSAT* software: you must have the latest offering which, at the time of writing, is version 5.6.

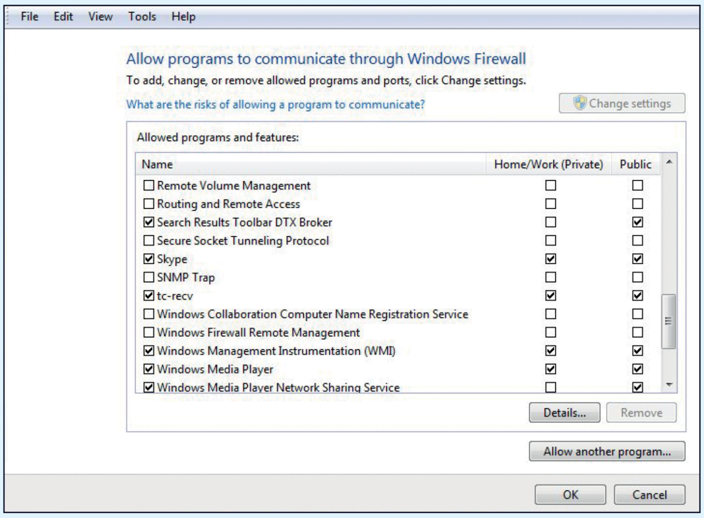



Figure 1 - Configuring software to bypass the Windows-7 firewall

But all of David Taylor’s programs will load without any problems: he has designed them all to be compatible with this system.

The first important consideration is choosing the location where you intend to install the *DVB World* Software. I suggest that you use the folder **C:\Tools** because, if you install them anywhere else, you will get problems because the other folders on your PC are protected. Connect your *DVB World* receiver into a USB-2 socket, power it on, and install the software into this folder.

Once this is completed, and you have the *DVB World* receiver icon on your Desktop, you can load in all the relevant parameters much the same as I described in the *Windows XP* article. Make sure again that you use the correct CD for the installation: that’s the GEO one. If you use the small CD supplied by *DVB World*, it will not work correctly.

The next operation is to install the *Tellicast* software. This time, I would advise that you install this into the existing

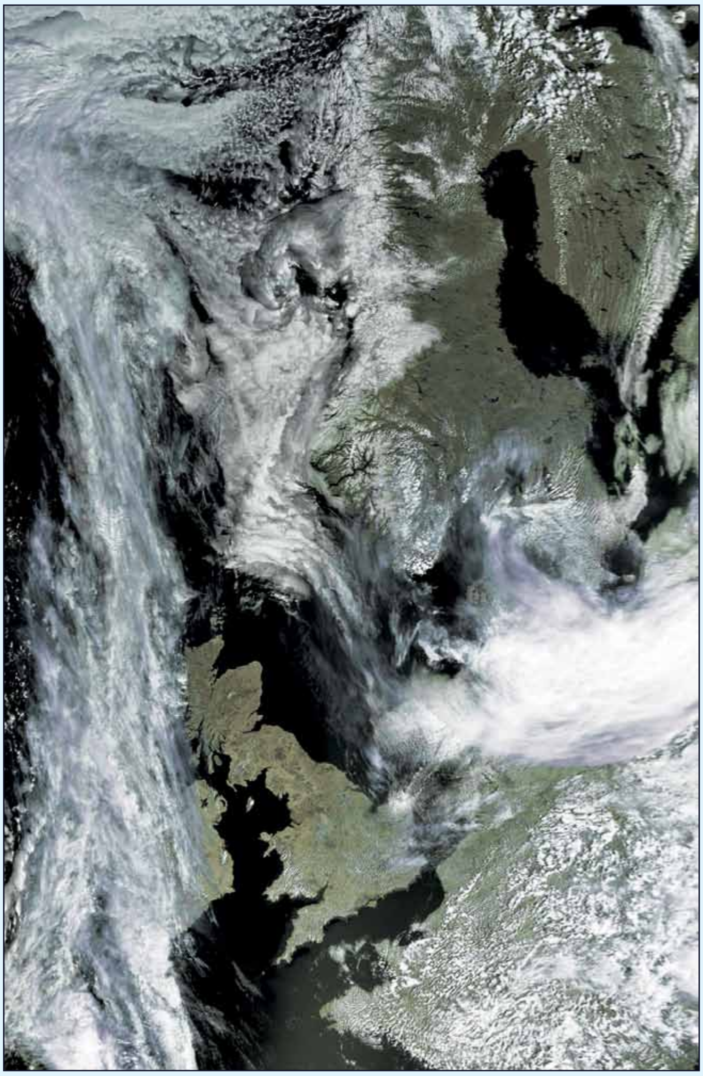


Figure 2 - This Metop-A image dates from May 25, 2013
*Image © EUMETCAST 2013*

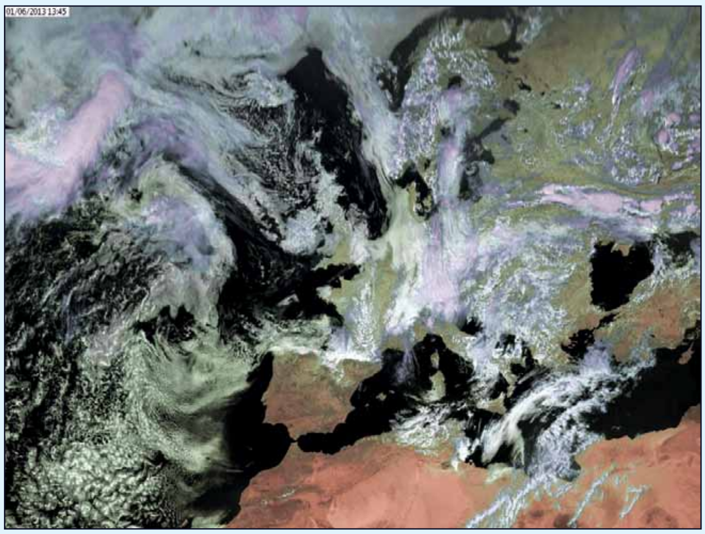



Figure 3 - A typical Meteosat-10 false colour image
*Image © EUMETSAT 2013*

sub-folder '*T-Systems*'. You can then open the appropriate files to carry out the required modifications to enable you to receive the *EUMETCast* data files. I am assuming that you already have the satellite dish operational and that you are just upgrading to *Windows-7*, as you might do if setting up on a new PC or such like.

Your next operation is to install the EKU Key into a spare USB-2 socket and load the appropriate software which, in the case of *Windows-7*, is one of two options dependent on your operating system: it will be either *PKIClient x32 4.5 version* or *PKIClient x64 4.5 version,* depending on whether you are running the 32-bit or 64-bit version of *Windows-7*. Select the appropriate version for your system and install as per normal. If you are not sure which system yours is, look into your systems guide and it will tell you.

It is at this point that the procedure gets a bit complicated. Open up your **Network and Sharing Centre**, and in the left-hand column you will see **Change Adaptor Settings**. When you select this option you will see a screen showing the devices that are connected to your *Windows-7* PC. Select **DVB Net ETAdaptor** and right-click to open **Properties**. Here you will find a box marked **Local Area Connection Properties**.

Move down to **Internet Protocol Version 6 (TCP/Ipv6)** and remove the tick mark. That particular operation may need to be reversed at a later date. Some *Tellicast* systems will work within *Windows-7* systems with that item ticked, but some will not. This is still one of those strange anomalies within *Windows-7* that I have come across while using the software.

Next, go down to **Internet Protocol Version 4 (TCP/Ipv4)**, highlight it, and go to **Properties**. Here you now have the same box as in *Windows XP,* so go to the **Use the following IP Address** and type in the one we all know, which is: 192.168.238.238; then move down to **subnet Mask** and it will insert for you: 255.255.255.0. Press 'OK' and exit, then press 'Close' and you are done.

Go to your **Search Programs and Files** box in the *Start* button and type in 'Firewall' to display a selection of firewall options. Select **Allow a Program through Windows Firewall** and click on it. Now you get a large box titled **Allow Programs to Communicate through Windows Firewall** (figure 1). Scan down the list of programs that this displays until you find either 'tq-recv' or 'tc-recv' listed.

> If they are not there, you will have to locate them by going to the box at lower right marked **Add Another Program**. This brings up a further box displaying all the programs installed on your PC. Find **Business TV-IP** and add it. Just to play safe you can also add **DVB World**.

Once these have been added you can return to the screen shown in figure 1 to locate your other programs. For each one, tick the box headed **Name** in the left-hand column, then move across to the columns headed **Home/Work (Private)** and **Public**, and tick the boxes in these columns too. If you do not do this operation correctly, your system will **not** work, as the *Windows-7* firewall is very good at stopping unlisted programs from running. That particular operation caused me a headache for hours trying to find out why nothing would work. Thanks to David Taylor for helping me to sort this problem out.

If you have followed all of this, you should now see your *Tellicast* icon in the lower tool bar, either red with a black 'T' or yellow with a black 'T'. If you start up the *DVB World* receiver by clicking on the **IP** button on the top of the DVB screen, your *Tellicast* 'T' icon should change to white with a pink 'T', which means that all is well. *EUMETCast* data files should now be coming into the system.

**Some Important Guidelines**

**Do not** attempt to make any changes within your *recv.ini* or *recv-channels.ini* files while the system is running, as the *Tellicast* program will just stop and you will have to reboot the PC. If you make such changes under *Windows XP*, the software continues to work, with *Windows-7* it doesn't.

There are variations in operation with *Windows-7* and these are just guidelines to help you get the system operational. The setting up of your *recv.ini* and *recv-channels.ini* files are much the same as described in the *Windows XP* setup; but you still have to decide on the specific data you want to receive and edit these files accordingly.

A problem that I have encountered with running *Tellicast* is that the program sometimes just stops for no apparent reason: the satellite drops out and the *DVB World* icon turns **red**. The only solution I have found is to stop the whole system and re-start again, which seems to work OK. I have no explanation for this—it just happens now and again.

Another problem, which again seems to be centred around *Windows-7*, is that *Tellicast* reception starts OK but then, after a while, stops. When you look into the *HTML Shell* (which is accessible via the *Tellicast* icon) the Log File states 'Co-ordinator Lost'. Again, I have found that stopping and restarting the whole system seems to work OK.

However there is some good news. If by any chance you unplug your *DVB World* receiver and then cannot remember which USB-2 socket it came from, fear not: *Windows-7* will re-install the drivers for you without you having to return to the *EUMETSAT* CD to reload the complete program again. I have experienced this several times after disconnecting everything to have a clean and tidy-up. Afterwards, I'm not sure into which socket everything was connected. Other *Windows-7* users may get slightly different results but I have found this to be a common occurrence, so don't worry about it. It seems quite normal from the information I have received.

I have to say I have not had these problems when running *Tellicast* on *Windows XP*, and the software seems to be a lot more stable on that system. It remains to be seen how we get on with the new *Windows-8*.

**In Conclusion**

Please do not be put off by all this information. You may experience none of the problems I described or you may even get different ones. But whatever happens, there are GEO members around to assist, and in most cases they will get you operational: so don't panic.

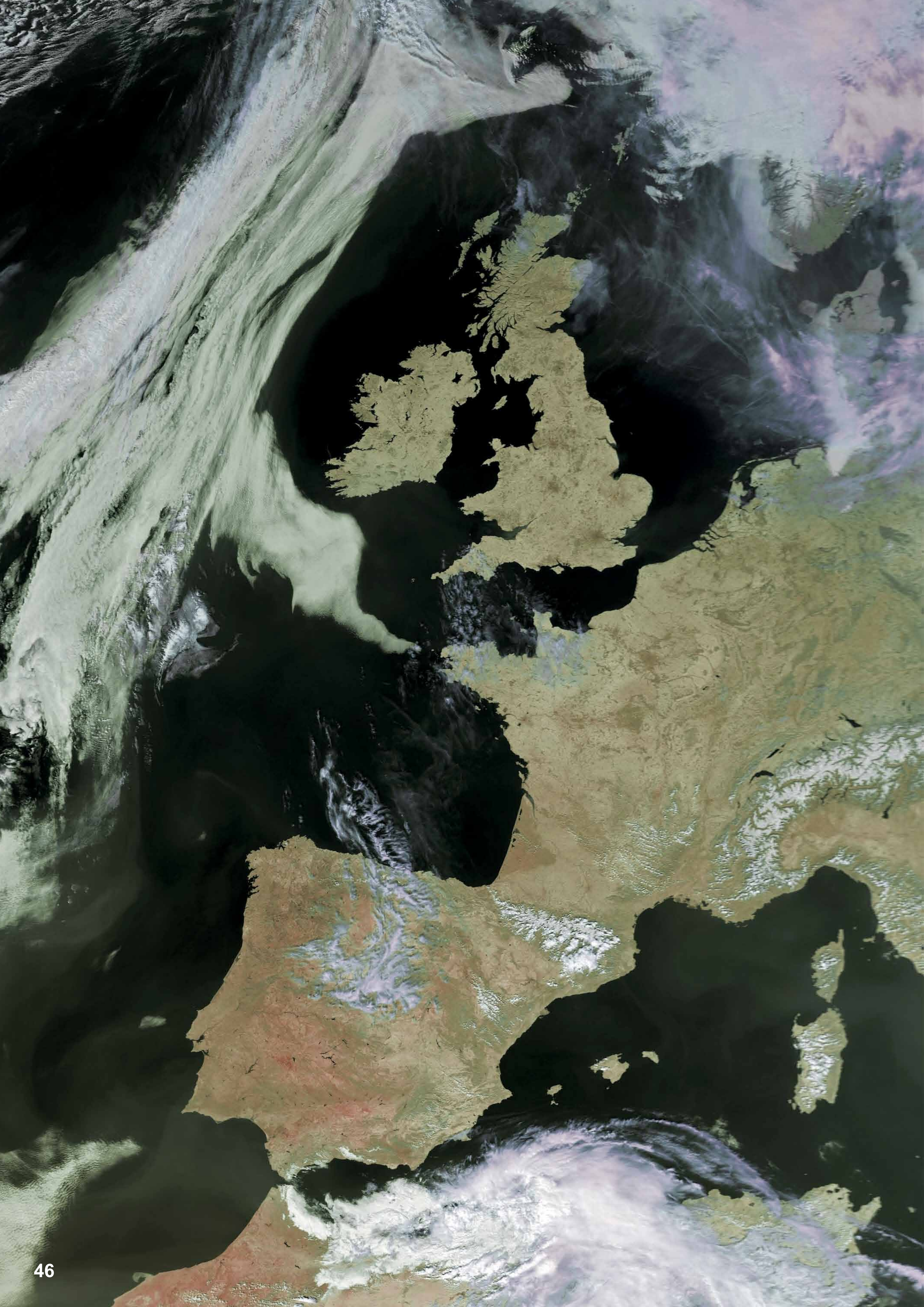
As to my choice: well, its *Windows XP.* But that is only my personal preference. In no way would I argue with anyone who prefers *Windows-7*: it is a personal choice.

It is likely that you will encounter problems, and *Windows-7* does seem to produce quite a few. I would advise a visit to

***www.satsignal.eu***

where David Taylor has some very helpful tips and information on *EUMETCast* reception. He also has a superb troubleshooting site for both *Windows XP* and *Windows-7*, so give it a go. Remember, we all had to learn at some stage.

However in the coming months we will be experimenting once more with a new reception system because *EUMETCast* will shortly be adopting a new transmission format, due to start in August 2014. This will require new receiving equipment and maybe even a new satellite dish and cables. But for sure we will all be rewriting the rule book when that starts. But do not be deterred from setting up at the moment. It will be good experience and will also prepare you to set up the new reception system when it arrives. Happy weather watch from Portland.



# Weather Watching away from Home

**Alistair Dunlop**

Many people like to go to remote or foreign places for their holidays. Normally, this will mean that you are unable to receive your fill of weather images—unless, that is, you pay a fortune in mobile Internet fees, or take a full satellite receiving system complete with a high-performance computer to decode direct-broadcast satellite weather images.

However, it is still possible to receive real-time satellite images with a minimum of readily portable equipment, albeit with only two spectral bands and lower resolution. I refer to the APT transmissions from the NOAA series of polar orbiting satellites. Reception is simple and does not require much hardware. I find the pictures useful to indicate the likely local weather, and more than once have changed my intended route in order to follow the cloudless patches around the country. The only drawback is the need to wait for one of the several times in the day when the low earth orbit satellites are visible from your location. You do need to follow the satellite visibility timetables, but there is no problem in fitting in a tea-break at the same time. This article covers three main areas: aerials, receivers and image processing.

Figure 1 - The author's APT station pictured on location near Applecross in northwest Scotland in 2009. The antenna lead goes to an RX2 receiver, just visible in the door pocket. The laptop is inside on the seat but not visible in the photo.

### Aerials

APT is transmitted at frequencies between 137-138 MHz, which corresponds to a wavelength of about 2.18 metres, in the middle of the VHF band. We want all-sky coverage without needing to track a satellite, so typical antenna sizes are around one half wavelength. This gives plenty of signal from horizon to horizon wherever a clear view is available. Don't expect it to work too well underneath a canopy of wet trees, though.

Aerials can be shop-bought, and turnstile antennas are probably the easiest to assemble and disassemble for portability. But make sure that you carry several spare bolts and wing-nuts for assembling the pieces—you are bound some day to lose some in the grass. *Screwfix* [1] have an extensive range of relevant hardware. I use a simple mast made of interlocking sections each of around 1.2 metres in length: *Moonraker* [2] and *Nevada* [3] sell a variety of 'swaged mast sets', and I have found the 30 mm diameter lightweight series fully adequate. The mast is fitted over a peg inserted in the ground to fix the base and held against the wing mirror of my car using a bungee elastic cord (with suitable cloth padding at contact points to prevent scratching the paintwork). The peg is positioned so as to make the antenna mast vertical when secured to the wing mirror mount. If your vehicle has unsuitable mirror mounts, you can obtain a drive-on plate containing a welded mast base from suppliers such as *Moonraker*. The vehicle is driven on to the flat plate part to hold the base secure, and the mast fits on to the vertical stub. They are generally robust, but with a tall mast you might want to consider guy-ropes in strong winds, since most weather satellite aerials have significantly more wind resistance than a typical amateur radio vertical. Generally, three mast sections (about 4 metres in total) are enough to raise the aerial above the campervan, even with the roof elevated, and have remained secure in even strong winds. Figure 1 shows my portable APT station in use in northwest Scotland, where a roadside sign provided a useful impromptu antenna support.

Of course, if you are not driving your own vehicle, then carrying a number of mast sections and a dismantled tubular aerial may not be very convenient. It's quite possible to make a portable wire turnstile antenna that folds into a small package and uses on-site sticks or similar for support. My portable wire antenna is described in the grey side-panel on page 48.

### Receivers

In principle, you can use any receiver that will receive VHF over the range 137 to 138 megahertz and which will demodulate Frequency Modulation with a receiver bandwidth of around 45 to 50 kilohertz. In practice, it is best to use a dedicated weather satellite receiver such as those sold by the *GEO Shop* [4]. This will come with set up and operating instructions. Make sure that you will have suitable power available. If travelling in a car or campervan, 12 volts should be readily available. Otherwise, make sure you have a suitable mains power source with a plug-top adaptor to suit the mains voltage in whichever countries you intend to visit. Spare power supply fuses are always useful.

Currently, there is much interest in Software-Defined Receivers (SDR), usually in the form of a 'dongle' fixed to a USB port on your computer. These offer the ultimate in small size but early models appear to be less sensitive than conventional analogue weather satellite receivers. Watch this space though, as this is a fast-moving area.

**Processing**

Nowadays, this means a computer and suitable software. For portable use, a laptop is probably necessary. The problem with laptops is that they usually only have a single-channel microphone input socket. Whilst your weather satellite receiver will only need a single audio channel, it will probably output this at a much higher level than that produced by a microphone, potentially leading to overload of the audio input.

**Adjusting Audio Level**

These are general guidelines using *Windows-7*. But the process is similar for *Windows Vista* and *Windows-8,* but with some name changes.

Left-click on the 'Start' button and open **Control Panel**. Navigate through **Hardware and Sound/ Sound/Manage Audio Devices** and open the **Recording** tab.

Double-click on the input socket to which the audio output from your APT receiver is connected, which will usually be 'Microphone'. Click on the **Levels** tab. It is essential at this point that a connecting lead is plugged into the input socket: if not, *Windows-7* hides the 'Levels' tab from view.

Set 'Microphone boost' to zero and adjust the microphone level to around 10%: but be prepared to alter the latter when receiving a satellite for the first time. This adjustment matches the computer's input level to the receiver's output. To be able to hear to the signals from the satellites you will probably need to plug in your audio cable and tick **listen to this device** in the **Listen** tab to make them audible over the laptop speakers. This depends on the laptop manufacturer but is necessary to prevent audio feedback if your laptop has a built-in microphone.

There are several good weather satellite APT decoding programs available: previous articles in *GEO Quarterly* have covered these in detail [5]. Whichever one you use, make sure that you practise the whole setup before you go on holiday. Make sure that you can connect up the hardware and run the software without having to think about it. You don't want things to go wrong the first time you try to receive a satellite image while on holiday.

**Conclusion**

I've had a lot of interest from receiving APT images from our campervan, and it's not just interesting—we've been able to dodge bad weather many times. Don't get into a frenzy if the satellite pass time is approaching and the system is unaccountably refusing to do what you want. You're on holiday. Leave it this time and the solution will come to you over the Gin and Tonics. Have fun and enjoy.

**References**

1 Screwfix - www.screwfix.com
2 Moonraker - www.moonraker.eu
3 Nevadaradio - www.nevadaradio.co.uk
4 GEO Shop - http://www.geo-web.org.uk/shop
5 Colouring APT Images in WxSat
GEO QUarterly No 28, page 4.

## Constructing a Portable Wire Antenna

No originality is claimed for the description described here. Similar versions have appeared in previous copies of *GEO Quarterly* and have been described by Francis Bell in accounts of his foreign trips. My design is based around a so-called 'chocolate-block' electrical connector, into which four wire antenna elements, a phasing harness and the downlead to the receiver are all secured (figures 2-5).

The four antenna elements are made from thin flexible stranded equipment wire (US: 'hook-up' wire). To distinguish them, I use four differently coloured wires—red, yellow, green and blue—although you can use any colours you like as long as they are easily distinguished from each other. Alternatively, you could mark the wires with numbers or bands of tape if you are colour-blind. The wires are fixed into the top of a 4-hole 'chocolate block' connector in the order shown in figure 2. I use wires from *Maplin,* codes: FA33L (red), FA36P (yellow), FA29G (green) and FA27E (blue).

To construct the antenna elements, cut a 490 mm length of each wire and strip off 10 mm from the insulating coating at one end. Measure 468 mm from the start of the plastic insulation at the stripped end and fold the 'extra' 12 mm back on itself. Twist or tie it in place so that it cannot slip. This doubled over part allows you some slack if the wire breaks, and makes a convenient end fixing. Although I have given measurements to 1 mm, your antenna will still work reasonably well even if you are as much as 50 mm out, so don't spend too much time trying to make it exact.

Finally, insert the bare ends into the 'chocbloc' connector up to the beginning of the insulation and tighten the securing screw. Be sure to insert the four wires into the connector in the order shown in figure 2: Red – Yellow – Green – Blue.

### The Phasing Lead

The main problem when constructing a turnstile antenna is phasing the elements. The signal transmitted from the satellite is right-hand circularly polarised. This means that the signal 'screws' its way down to Earth, following a right-hand screw. If you get the order of the connections to the elements wrong, it's like trying to put a right-hand screw into a left-hand threaded nut: it doesn't work. This is the reason for the differently coloured wires; the colours are a guide to connecting everything correctly.

The phasing lead is a 410 mm length of coaxial cable, ideally RG 58U (Maplin code XS51F). Remove 25 mm of the outer plastic covering from each end and use a small-bladed screwdriver to separate the outer metal braid or shielding from the inner plastic-covered metal core and twist it into a pigtail. Strip the inner plastic cover from the inner metal core for about 20 mm at each end. This will result in a piece of coaxial cable about 360 mm long with inner and outer leads formed at each end.

### The Antenna Downlead

For the downlead to the receiver, take a second piece of the same coaxial cable of a convenient length. For a mobile set-up, this is likely to be around 3 metres. Prepare one end as described above, removing the outer plastic cover and forming pigtails from the outer metallic braid and the inner conductor. Twist the outer braid of this downlead together with the outer braid at one end of the phasing lead: twist the inner conductor of the downlead together with the inner conductor at the same end of the phasing lead. Now connect these twisted inner conductors to the bottom end of the connector which is connected at the top to the **blue** wire; connect the twisted outer braids to the lower end of the **yellow** wire connector. Connect the outer braid of the free end of the phasing lead to the lower end of the **red** wire connector, and its inner conductor to the lower end of the **green** wire (figures 2, 3).

### Erecting the Antenna

To erect your aerial, take two bamboo canes or similar around 500 mm long. Fix them together at their centres and use bracing string between their tips to ensure that they are at right-angles (figure 4). Scouts and Guides can do this with string, but thin sticky tape is easier to use although it may not look as professional. The 'chocbloc' connector is fixed below the centre with more tape or string and the wires are stretched out and taped to the spreaders. **The order is important**; when looking down on the antenna from above, the order **must** be Red-Yellow-Green-Blue in a **clockwise** direction.

Finally, fix the antenna on top of a suitable support in a horizontal plane. Figure 5 shows my prototype. It appears to give fairly similar performance to a full-scale turnstile antenna in the same location, but would probably be slightly worse at low elevations. For travel abroad, take away the spreaders and roll the antenna up. For use, simply find appropriate sticks on arrival and attach the antenna.

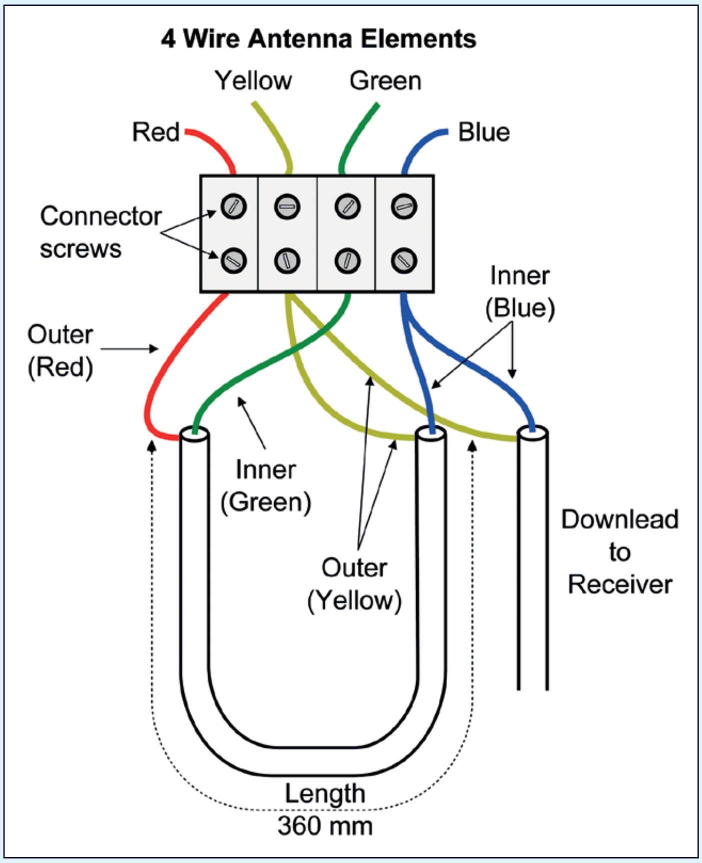



Figure 2 - The connection diagram

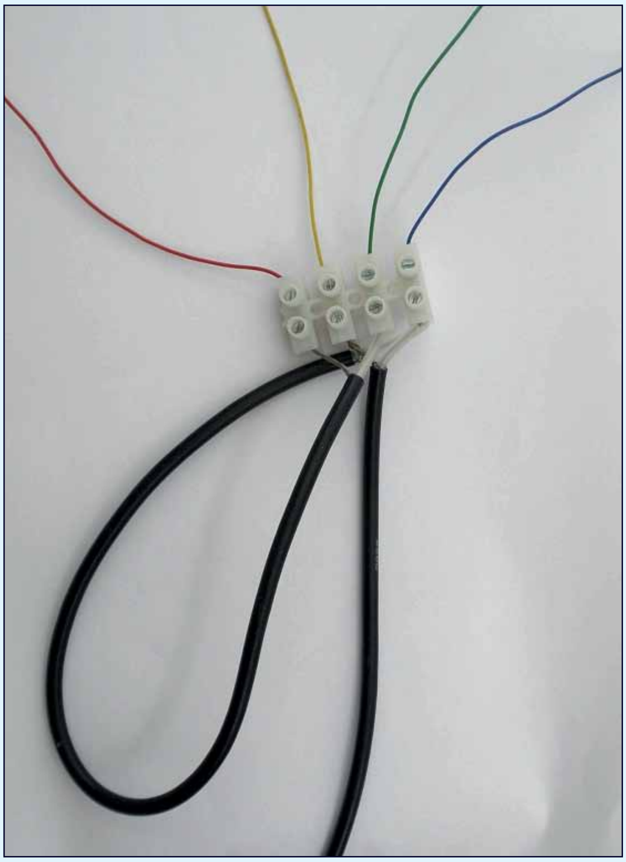


Figure 3 - The completed antenna masthead unit with phasing and receiver leads connected

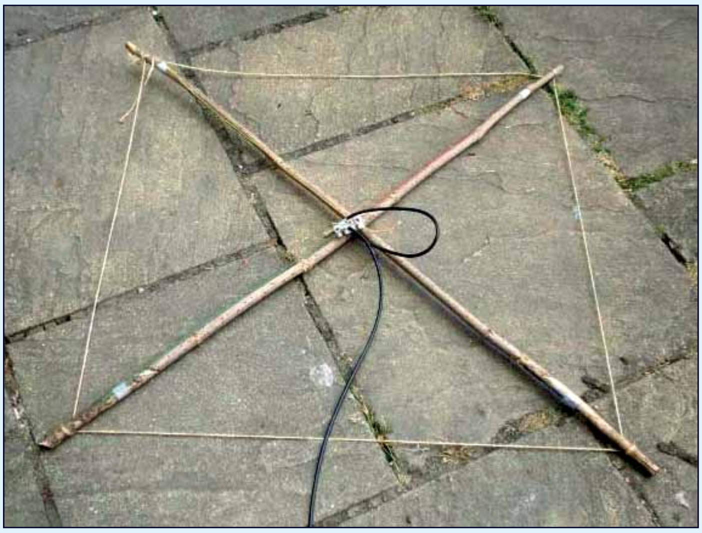


Figure 4 - The bamboo cane antenna support showing the bracing strings

Figure 5 - The completed prototype wire antenna



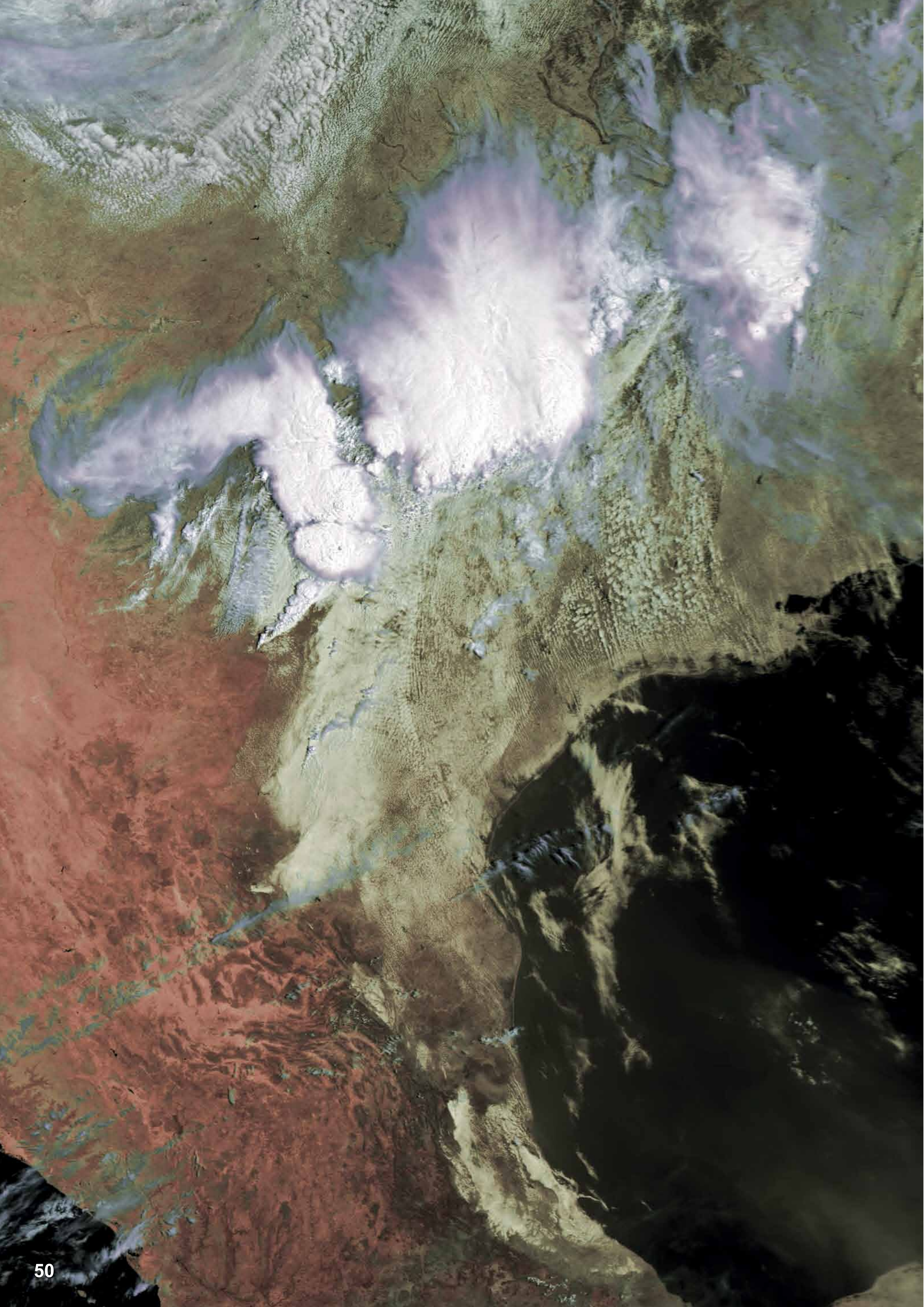
## Missing Quarterly?

If your copy of GEO Quarterly has failed to arrive by mail within four weeks of the advertised publication time, please contact our Membership Secretary, who can arrange for a replacement copy.

**Contact Details**

David Anderson,
35 Sycamore Road,
East Leake, Loughborough LE12 6PP
England, UK.

Telephone - 01509 820 067
Fax - 01509 559 015
***email: members@geo-web.org.uk***



# Operation IceBridge

**Les Hamilton**

NASA is well known as a major player in Space activities through its involvement with the International Space Station, its missions to the planets, and its fleet of Earth observing satellites such as *Terra*, *Aqua* and *Aura*. What is perhaps less well known is that NASA also makes use of aircraft to study our planet. One such mission is *Operation IceBridge*, which started in 2009 and is planned to run for six years until the launch of the *ICESat-2* satellite in 2016.

*ICESat*, the **Ice, Cloud, and land Elevation Satellite**, was launched in 2003. A member of NASA's *Earth Observing System*, this satellite carried but a single instrument, the *Geoscience Laser Altimeter System* (GLAS), a space-based LIDAR with the primary goal of acquiring altimetric range measurements of polar ice sheet topography. A secondary objective was taking atmospheric backscatter measurements, particularly of stratospheric clouds over polar areas. To meet these requirements, each of the three GLAS lasers aboard the craft carried out ranging with 1064 nm visible-light laser pulses and backscattering measurements with both this and 532 nm infrared laser pulses.

Although only one laser was active at any given time, all of them proved disappointingly short-lived, and the final one failed in October 2009. After attempts to reactivate the laser proved fruitless, *ICESat* was retired the following February and de-orbited during August 2010, ultimately re-entering the atmosphere on August 30. Although *ICESat-2* is currently under development, it is not expected to launch earlier than 2016 and, as a short-term measure, NASA started to utilise aircraft to observe targeted areas in both the Arctic and Antarctic.

The IceBridge P-38 on the Runway at Wallops Flight Facility
*Credit: NASA / Kyle Krabill*

This image, taken during a P-38 flight on April 12, 2013, shows an ice-covered fjord on Baffin Island with Davis Strait in the background.
*Image Credit: NASA/Michael Studinger*

Penny Ice Cap outlet glacier on Baffin Island, Nunavut, Canada.
*Photo: NASA / Michael Studinger*

### Operation IceBridge

To fill the breach left following the demise of *ICESat*, NASA wasted no time in equipping a *McDonnell Douglas DC-8* aeroplane with a suite of specialised instruments, including the *Airborne Topographic Mapper*, a laser to measure the surface elevation of polar ice. The use of aircraft as opposed to satellites brings both advantages and drawbacks. A satellite can, of course, collect observations over the entire Earth's surface, and can do so round the clock if required. *IceBridge* aircraft, on the other hand, only fly during short annual missions lasting a few weeks, but have the advantage of being able to carry much heavier payloads of instruments, can focus their attention on specific scientifically interesting targets, and are not constrained to a fixed flight path. Additionally, certain instruments such as ice-penetrating radar can only operate satisfactorily from the lower altitudes afforded by aircraft.

The aircraft, which have since been augmented by a *Lockheed P-3 Orion* and *P-38*, *King Air B-200*, *Gulfstream G-V* and *Guardian Falcon*, also carry gravimeters which can measure the shapes of cavities in the ice, the *Land, Vegetation and Ice Sensor*, the *Multichannel Coherent Radar Depth Sounder*, a Snow Radar, a Ku-Band Radar Altimeter, a magnetometer and a Digital Mapping System.

The principal regions targeted by Operation *IceBridge* have been the major ice sheets in Greenland and Antarctica, sea ice in both the Arctic and Southern oceans, and glaciers and icecaps in Alaska and Canada that are potentially significant contributors to sea level rise.

### IceBridge Year by Year

The first *IceBridge* flights took place in October and November, 2009 and studied changes in Antarctica's sea ice, glaciers and ice sheets. Based in Punta Arenas, Chile, the team used NASA's *DC-8* flying laboratory to study western Antarctica's Amundsen Coast, Pine Island Glacier, and the Antarctic Peninsula, where data were collected from the Larsen Ice Shelf and nearby glaciers. In subsequent years, *Operation IceBridge* mounted two missions annually, one in the Arctic during the period March to May, and the

The calving front of Petermann Glacier in northern Greenland as photographed from NASA's P-3B in March 2013. *GEO Quarterly No 35* reported how a large iceberg, twice the size of Manhattan, had broken from this glacier. Following this event, the line where the iceberg calved became the glacier's new front edge, or calving front, effectively moving it several kilometers upstream. Several valley glaciers are now flowing into the fjord, which is covered by sea ice.
*Credit: NASA / Michael Studinger*

other in the Antarctic during October and November. In 2010, the Arctic field campaign used NASA's *DC-8* and *P-3B* aircraft based at Thule and Kangerlussuaq in Greenland to monitor the Greenland ice cap and Arctic sea ice. Particular focus was given to areas where glaciers and ice sheets had been undergoing rapid changes, particularly in the *Northwest Passage*. In the southern hemisphere, over one hundred hours of flight time were undertaken over Antarctica and its environs. These included ice thickness and surface elevation measurements at Thwaites Glacier and Pine Island Bay, and also of numerous tributaries feeding the main Pine Island Glacier.

In 2011, the Arctic mission concentrated mainly on re-surveying areas of rapid change and extending activities to the Canadian ice caps. At the opposite pole, NASA's *DC-8* flying laboratory and a *Gulfstream V* owned by the *National Science Foundation* flew science flights during a six-week campaign, the highlight of which was the discovery of a large crack across the Pine Island Glacier ice shelf. The continued rapid acceleration and mass loss of Pine Island Glacier was charted, and there were flights to rarely studied regions of East Antarctica (the Slessor and Recovery glaciers) where ice-penetrating radar measured the topography of the bedrock beneath the ice sheet.

In 2012, a record 44 science flights took place in the Arctic, including a survey of the Canadian ice caps and a mission which examined bedrock topography in northeast Greenland. In *IceBridge's* fourth year of activity in the Antarctic, 16 high-priority survey flights were

concluded on page 37

The Ellsworth Mountains in Antarctica photographed in 2012 from NASA's DC-8.
*Credit: NASA/Michael Studinger*

This terminal moraine from a small glacier on Baffin Island is an accumulation of soil and rock that shows the farthest point of a glacier's advance.
*Credit: NASA / Michael Studinger*

This photograph shows Saunders Island and Wolstenholme Fjord during an Operation IceBridge survey flight over northwest Greenland in April, 2013
*Image Credit: NASA / Michael Studinger*

This photograph taken over southwest Greenland during the 2011 IceBridge campaign.
Mountains and an open-water fjord surround one of the mission's targets, a small ice cap called Sukkertoppen Isflade.
*Photo: NASA/Michael Studinger*

## 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.html***

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

## GEO Helplines

**Douglas Deans**
***Dunblane, Perthshire, 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**
***Surbiton, Surrey, ENGLAND.***
Meteosat-9 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 GW3ATZ**
***Shotton, 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-9 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**
***Portland, Dorset, England.***
Assistance with reception of *EUMETCast* to include *Metop-A* and *Metop-B*; also MSG Data reception and set-up within the PC, and assistance with dish alignment and set-up.

- email: mikeg4cfz@gmail.com

**Guy Martin G8NFU**
***Biggin Hill NW 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**
***San Juan, Puerto Rico, USA***
Hector is prepared to field enquiries on HRPT, APT, EMWIN and NOAAPORT

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

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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.

## Weather Satellite Reports

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

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

***http://tech.groups.yahoo.com/group/weather-satellite-reports/***

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 available to weather satellite enthusiasts. You can join any of these by sending an e-mail to the appropriate address, with a request to subscribe. Indeed, a blank e-mail containing the word 'subscribe' in its Subject line is all that is required. Some of the more useful groups and their contact addresses are listed below.

**APT Decoder**

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

***http://tech.groups.yahoo.com/group/APTDecoder/***

**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.

***http://tech.groups.yahoo.com/group/GEO-Subscribers/***

**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).

***http://tech.groups.yahoo.com/group/SatSignal/***

**MSG-1**

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

***http://tech.groups.yahoo.com/group/MSG-1/***

## Copy Deadline for GEO Quarterly No 40 is Sunday, October 27

The Editor is always delighted to receive articles and images for inclusion in GEO Quarterly. These can relate to any aspect of Earth Imaging, especially

- Technical articles concerning relevant hardware and software
- Construction projects
- Weather satellite images
- Reports on weather phenomena
- Descriptions of readers' satellite imaging stations
- Activities from overseas readers
- Letters to the Editor
- Problems and Queries for our experts to answer

Contributions should of course be original and, where possible, should be submitted to the editor in electronic format (e-mail attachment, CD, DVD). But of course, we would also accept handwritten or typed copy.

Please note, however, that **major articles** which contain large numbers of satellite images, photographs or other illustrations should be submitted **as early as possible**, so that they can be prepared and made up into pages in time for publication.

**Images and Diagrams**

Images can be accepted in any of the major bitmap formats: **JPG, BMP, GIF, TIFF** etc. Images in both monochrome and colour are welcomed. Line drawings and diagrams are preferred in WMF, EPS or postscript formats. We can also scan original photographs, negatives and slides.

**Gridding, Overlays and Captions**

Please note that readers' satellite images should be provided **without** added grid lines, country outlines or captions unless these are considered essential for illustrative purposes within an article.

If your article submission contains embedded images and diagrams, please note that you must **also submit copies of the original images** in one of the formats described above: these are essential for page make-up purposes.

**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 *YouSendIt*

***www.yousendit.com***

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**And finally . . .**

if you do have material ready for the next issue of GEO Quarterly, please submit it **as soon as it is ready**—do not wait till the deadline above: this will simply create an editorial log-jam and delay publication.

# Group for Earth Observation

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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 francis@geo-web.org.uk for BIC and IBAN details.

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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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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.

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East Leake
Loughborough LE12 6PP, UK

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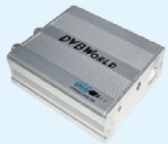
## R2FU Weather Satellite Receiver for NOAA APT

New


This state-of-the-art, USB powered APT receiver for the NOAA satellites is also controlled via a USB port, so no longer requires a serial interface like its predecessors. It also features hardened filtering to overcome UK pagers.

**UK members price - £210.60**
**UK non-members price - £230.60**

## DVBW DVB-S USB2102 Receiver



This DVBWorld **DVB-S USB-2** receiver is recommended for trouble-free *EUMETCast* reception. It is supplied with a GEO set-up CD containing software and instructions.

**UK members price - £60.00**
**UK non-members price - £70.00**

## DVBW DVB-S2 USB2104 Receiver

This DVBWorld **DVB-S2 USB-2** receiver is also available for those who wish to receive FTA satellite HDTV on their computer (but not recommended for *EUMETCast* reception).

**UK members price - £75.00**
**UK non-members price - £85.00**

## Current Price List

| | Members' Prices | | | Prices for non-Members | | |
|---|---|---|---|---|---|---|
| | UK | EU | RoW | UK | EU | RoW |
| R2FU APT Receiver | 210.60 | 216.00 | 224.00 | 230.60 | 236.00 | 244.00 |
| BNC Lead (0.25 metre) | 5.50 | 6.25 | 6.75 | 7.50 | 8.25 | 8.75 |
| UK Power Supply Unit (12 volt) | 10.50 | --------- | --------- | 13.00 | --------- | --------- |
| Sandpiper Turnstile Antenna | 65.00 | --------- | --------- | 77.50 | --------- | --------- |
| Dartcom High Quality QFH antenna | 280.00 | 360.00 | --------- | 300.00 | 380.00 | --------- |
| Bias Tee | 25.00 | 25.50 | 26.00 | 29.00 | 29.50 | 30.00 |
| GEO-PIC 1.0 | 7.00 | 7.80 | 8.40 | 7.00 | 7.80 | 8.40 |
| Martelec MSR40 EPROM | 10.00 | 10.75 | 11.25 | 10.00 | 10.75 | 11.25 |
| DVB-S2 USB Receiver (DVBW 2102) | 60.00 | 65.00 | --------- | 70.00 | 75.00 | --------- |
| DVB-S2 USB-S Receiver (DVBW 2104) | 75.00 | 80.00 | --------- | 85.00 | 90.00 | --------- |
| Telestar 80 cm dish with LNB | 72.00 | --------- | --------- | 79.00 | --------- | --------- |
| Telestar Ku band universal LNB | 13.70 | 15.20 | --------- | 20.20 | 21.70 | --------- |
| 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) 2004-2012 (Annual compilations - state year) | 8.00 | 8.80 | 9.30 | n/a | n/a | n/a |
| GEO Membership (4 magazines p.a.) | 25.00 | 35.00 | 40.00 | 25.00 | 35.00 | 40.00 |

**All prices are in £ sterling and include postage and packaging**

## Sandpiper Turnstile Antenna

This high-quality turnstile antenna has been specially manufactured for GEO, for use in APT reception from the NOAA polar orbiting weather satellites.

**UK members price - £65.00**
**UK non-members price - £77.50**

## Telestar 80 cm dish and Universal 0.2 dB LNB (or equivalent)

This quality solid steel offset dish, designed for digital and analogue reception, is coated with electrostatic polymer. The bracket has been heat dipped and zinc treated for maximum corrosion protection. Complete with LNB.

**UK members price - £72.00**
**UK non-members price - £79.00**

## 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

***tech@geo-web.org.uk***

or made through theGEO Website at

***http://www.geo-web.org.uk/shop.html***

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

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## 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.

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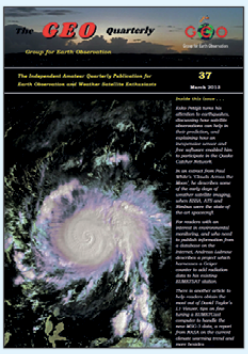
**Subscription Rates (12 months, 4 issues, including P&P) for GEO Quarterly are**

**£25** (UK)
**£35** (EU)
**£40** (rest of world)

## GEO Quarterly - Back Issues

(Only available to GEO Members)


Paper copies of back issues of GEO Quarterly <u>may</u> 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**

## 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**

## GEO PIC 1.0 for the RX2


Programmed with the new channel frequencies required for NOAAs 18/19.

**UK members price - £7.00**
**UK non-members price - £7.50**

## GEO Bias Tee


The Bias-Tee allows a mast-head preamplifier to be used with the 'Antenna 2' input of an R2FX or R2ZX. Only the 'Antenna 1' input normally feeds power to a preamp. The Bias-Tee now allows you to power twin preamps and maintain the receiver's Antenna Diversity feature.

**UK members price - £25.00**
**UK non-members price - £29.00**