

The **GEO** Quarterly

Group for Earth Observation



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

40

December 2013



Inside this issue . . .

The lead article this issue relates to the developing practice of using a DVB-T dongle to receive APT satellite imagery. Author Raydel Abreu Espinet boldly states that 'The Future is Software Defined Radio', and his APT images show that he has mastered this new technique superbly.

It's now well known that the Jet Stream is a major player in determining our weather. Mike Stevens provides a basic introduction to this fascinating topic.

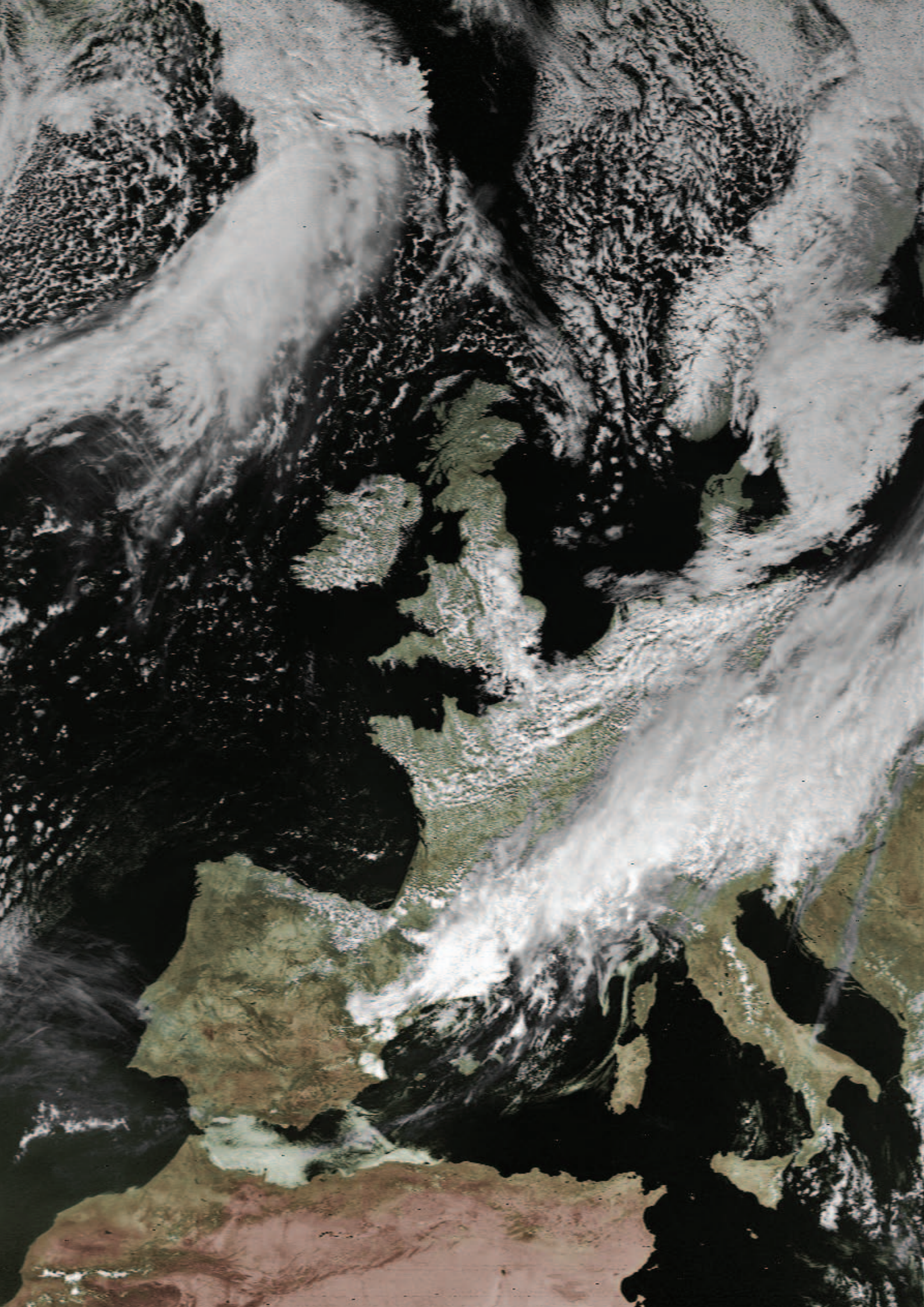
Marc Peigneux describes a visit to Mont Aigoual, the last active mountain weather observatory in France.

For the computer hobbyist, David Taylor introduces the Raspberry Pi and describes how he programmed a digital wall-clock.

We also have the second part of James Brown's article, this time explaining the impact of the personal computer on our hobby.

This issue of GEO Quarterly also carries features on Arctic Melting, Cyclone Phailin, an eruption of Kluychetskaya and the recovery of the Chelyabinsk meteorite ...

10th Anniversary
Edition



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Editorial

Les Hamilton

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Our headline article this issue is an expert treatise on the reception of APT satellite imagery in which Raydel Abreu Espinet, who lives in Cuba, describes his progress over the years using a variety of receivers. But as Raydel boldly relates: "The Future is Software Defined Radio", and the second section of his essay details his experiences using the inexpensive *RTL-SDR Ezcrap EZTV645 DVB-T Digital TV USB 2.0 dongle* (which covers 48 - 864 MHz) with SDR software. If Raydel's NOAA-15 image which appears on page 17 is anything to go by, he is most certainly producing results to rival conventional APT receivers. GEO Quarterly readers looking for an inexpensive, interesting project to occupy themselves during the dark winter days could do worse than follow a similar course, and we look forward to learning about your experiences next year. Raydel's article starts on page 14.

GEO will hold a Symposium at the National Space Centre, Leicester on Saturday, April 26, 2014. Certain to be at the top of the agenda is the impending upgrade of the *EUMETCast* Europe service from the DVB-S to the DVB-S2 standard. You can read full details, insofar as they are currently known, on page 25.

This month brings the conclusion of James Brown's two-part series chronicling his experiences during a lifetime interest in weather satellite imaging. In this final part, James details how the appearance of the now ubiquitous personal computer marked a turning point for the hobby.

As Francis Bell laments in his *GEO Report*, issue No 38 of EUMETSAT's popular *Image Newsletter* has turned out to be the final paper-based copy. Rebranded *Insight*, the stories that would have appeared in *Image*, as well as archived PDF copies of *Image* newsletters, are now only available on-line at

<http://www.eumetsat.int/website/home/Insight/>

One of the great success stories of the past two years has been the popularity of the credit-card sized Raspberry Pi mini computer. David Taylor has been experimenting with this remarkable little device and presents a project he has been working on to create a digital wall clock display on an LCD television screen.

Finally, as GEO celebrates its 10th anniversary, we wish all our readers the very best of health and happiness for the Festive Season ahead, and for the New Year that awaits us. With imminent changes in EUMETCast, and the emergence of SDR for decoding APT satellite images, there are sure to be exciting times ahead.

**Copy Deadline for the next issue of GEO Quarterly is
Friday, January 31, 2014.**

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The **GEO Report**



Francis Bell

This issue of **GEO Quarterly** celebrates the 10th anniversary of the formation of GEO. Although a previous meeting had taken place a few weeks before, my guiding date for our formation is the November 23, 2003, the date on which the Group was registered with Companies House as a limited company. The decision to register as a company was a form of protection for all our members, and the management team, so that ultimate responsibility for legal, financial and other areas would rest with the company, and not with any individual member. Fortunately, we have never had to seek this protection and, now established, the cost of running the company is only £15 a year provided we comply with the legal administrative requirements.

I offer my congratulation to those members who have been with us for the full 10 years and for sharing their technical knowledge and experiences in our specialised hobby. Particular thanks must go to those involved in the production of *GEO Quarterly*: our contributors, the editor, the printers, and those involved with its distribution. *GEO Quarterly* is recognised by all who read it as high quality publication. Thanks also to those who have helped to run the *GEO Shop*, which was established in March 2005. The Shop makes available high quality satellite receiving equipment at reasonable prices: these items would be difficult to buy elsewhere and their availability is a recognition of the time and trouble that has been invested into sourcing these items from around the world. Our website is another area from which we all benefit, thanks to the expertise and commitment on the part of our webmaster.

I fully expect the next 10 years will be as dynamic as those just passed because there are planned changes to both the *EUMETCast* and *NOAA* satellite services: hence a requirement for GEO to keep in touch with these organisations, and to exchange skills and experiences within our own group.

EUMETCast

In the near future there are to be profound changes in the direct reception of the *EUMETCast* service. The encoding of the data streams will change from the current DVB-S to the DVB-S2 standard, and this will also necessitate transmission being disseminated from a different satellite. These changes are necessary to enable higher rates of transmission to be achieved.

Currently, the maximum data rate is about 20 Mbps but the new system will be capable of 60 Mbps and have a flexible more efficient method of encoding the data. *EUMETCast* is planning to retransmit more high resolution images, hence the requirement for this new service.

EUMETSAT publish their plans for the upgraded service in their weekly bulletins.

The guide to finding the latest bulletin issued by EUMETSAT which relate to the proposed changes from the DVB-S standard to the new DVB-S2 VCM standard can be found by the following route.

Log on to EUMETSAT's web site

www.eumetsat.int/

At the right of the page, below the main image, you will see this panel bearing the caption:

EUMETCAST EUROPE MIGRATING FROM DVB-S to DVB-S2



Click anywhere on this panel to move directly to the updated Technical Bulletin relating to the proposed new service.

This route should continue to work, even if the page reference is changed by EUMETSAT as the bulletins are updated. If we publish a single page reference it is likely to become out of date, hence the above route is recommended.

If necessary, I will try to have an extract of this/these notices placed on our own website, which may make them more accessible to our members. GEO management is following these notices closely and are in touch with EUMETSAT for technical advice and the availability of necessary new receiving equipment for the upgraded service. We are planning our own tests with new receivers so that we may give best advice to our membership when the new *EUMETCast* service begins. With this in mind, we hope to have further information available, perhaps with demonstrations, at our symposium in April 2014. See the Symposium notice on page 25

NOAA

Looking further into the future, it is worth noting the potential change to NOAA's policy relating to direct reception of their weather satellites. My assessment is there will be no changes to the current service from existing NOAA polar orbiting satellites, and APT will continue for the life of NOAA's -15, -18 and -19, but the future of direct reception from weather satellites is being questioned, as there are other methods of disseminating these data, such as by Internet or landline.

Together with others, I have received a notice for NOAA which raises the above issue but also identifies potential down-link specifications for new satellites. The notice also includes a questionnaire but by the time members have a chance to read this text, the time frame for responding to the questionnaire will have passed. You can read a summary of the main points covered in this questionnaire on page 37 of this magazine.

Should you wish to read the full notice, I can forward it to any member on receipt of an email request to myself at

francis@geo-web.org.uk

You will not be able to make a formal response to the notice but at least it will keep you informed of NOAA's thoughts

regarding the future of direct weather satellite reception.

GEO Symposium - April 26, 2014

On page 25 you can read a notice relating to our 2014 Symposium. I hope this event will be well attended because, as well as bringing delegates up-to-date with *EUMETCast* services and other technical issues with presentations and demonstrations, towards the end of the day we will hold our members' AGM. During this meeting there will be reports about membership numbers, accounts and those other matters usually covered at an AGM. However, in addition it is the opportunity for members to offer their own feedback to the Group, with possible suggestions for GEO's future. This is why I hope the meeting will be well attended.

Image

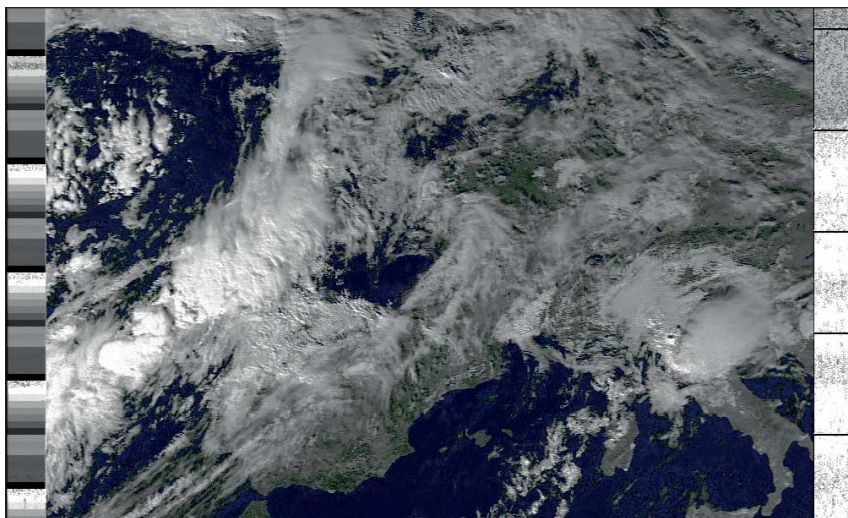
Several time a year, I receive a printed copy of EUMETSAT's publication 'Image', and usually read it cover to cover. But in the September 2013 issue there is a notice saying that this is to be the last printed version of the publication, which in future will only be

available electronically via their website. I am disappointed because I like the paper copy but recognise the economy of having an electronic only publication.

Software Defined Radio (SDR)

Prompted by Rob Alblas' report in GEOQ 37, plus articles in *RadCom* and *AMSAT-UK's* quarterly journal, I became intrigued with the use of SDR for the reception of weather satellites. I had to have a go myself. Accordingly, I bought a plug-in USB dongle which claimed to receive a wide range of radio frequencies and modulations with the 137 MHz narrow-band FM used by the current NOAA satellites falling well within it's specification. It has taken me several months of experimentation, but now I can receive horizon to horizon APT images using SDR. I will write a report of my experiences for the next issue. One of my recent images is shown below.

My experience with my first SDR dongle has provoked me to buy another very modestly priced, widely available one. My experiments will begin as soon as I have the correct software for this device.



QUARTERLY QUESTION

The Quarterly Question posed in *GEO Quarterly* 39 related to the abbreviation 'VCM' in the context of data transmissions from communication satellites. The question was prompted by the fact that EUMETSAT is moving to a new data transmission standard for their new service, beginning with validation in July 2014 and a full service starting 1st August 2014. They will be using DVB-S2 VCM and those wishing to receive the service must have equipment capable of receiving this new standard. The answer to the question what does the abbreviation VCM stand for is **Variable Coding and Modulation**.

My thanks to those who took an interest in this question and knew the answer. I received correct answers from:

Mike Stevens (G4CFZ) UK
Elmar Bogels Brunssum The Netherlands
Andreas Lubnow Braunschweig Germany
Dermot Cronin Killiney Co Dublin

Quarterly Question 40

This Quarterly Question is less technical, but relevant to every one of our members who receive live signals via the *EUMETCast* service. According to EUMETSAT's published plans, what is the very last date on which it will be possible to receive the current DVB-S transmission service from the current communications satellite? After this date you will have to be on the new system or receive nothing. Answers to

francis@geo-web.org.uk

by January 31, 2014.

Cover and Full Page Image Details

Front Cover

Reader Keith Fraser spotted this **Terra** MODIS image on September 3, 2013, which shows an unusual pattern of cloud whorls surrounding the Balearic islands.

Image: LANCE-MODIS/NASA/GSFC

Inside Front Cover

Laurence Holderness acquired this APT image from the 13:55 UT **NOAA-19** pass on April 19, 2013. Laurence kindly provided the WAV file, captured using *WxSat*, which we have processed using *SatSignal* and *Photoshop*.

Inside Back Cover

This splendid image of the entire east coast of Australia is a composite of three MODIS frames acquired by NASA's **Aqua** observatory on September 29, 2013.

Image: LANCE-MODIS/NASA/GSFC

Back Cover

Mike Stevens sent in this attractive **Terra** MODIS image captured on April 21, which displays a veil of semi-transparent high-altitude cloud swirling from the Bay of Biscay and across England.

Image: NASA/GSFC/LAADS Web

Page 8

NASA's **Aqua** satellite obtained this graphic MODIS image of New South Wales on October 19, 2013, showing smoke from wildfires billowing over the state while a thick pall of smoke stretches offshore.

Image: NASA/GSFC/LAADS Web

Page 9

Anthony Lowe acquired this attractive **NOAA-19** channel-2 visible image of the UK from the satellite's 13:10 UT pass on September 23, 2013. Great Britain sits in the centre of a region of high pressure and fog lingers over central England.

Page 31

This channel-4 IR image from NOAA-18 dating from 03:58 UT on October 29 shows calm conditions either side of the English Channel in the wake of the previous day's Great Storm.

Image: SMIS

Page 32

This segment from a **Metop-B** pass acquired by Mike Stevens via *EUMETCast* on September 10, 2013 shows a region from the Caspian and Aral seas, through Iran to the Persian Gulf and Gulf of Oman.

Image © EUMETSAT 2013

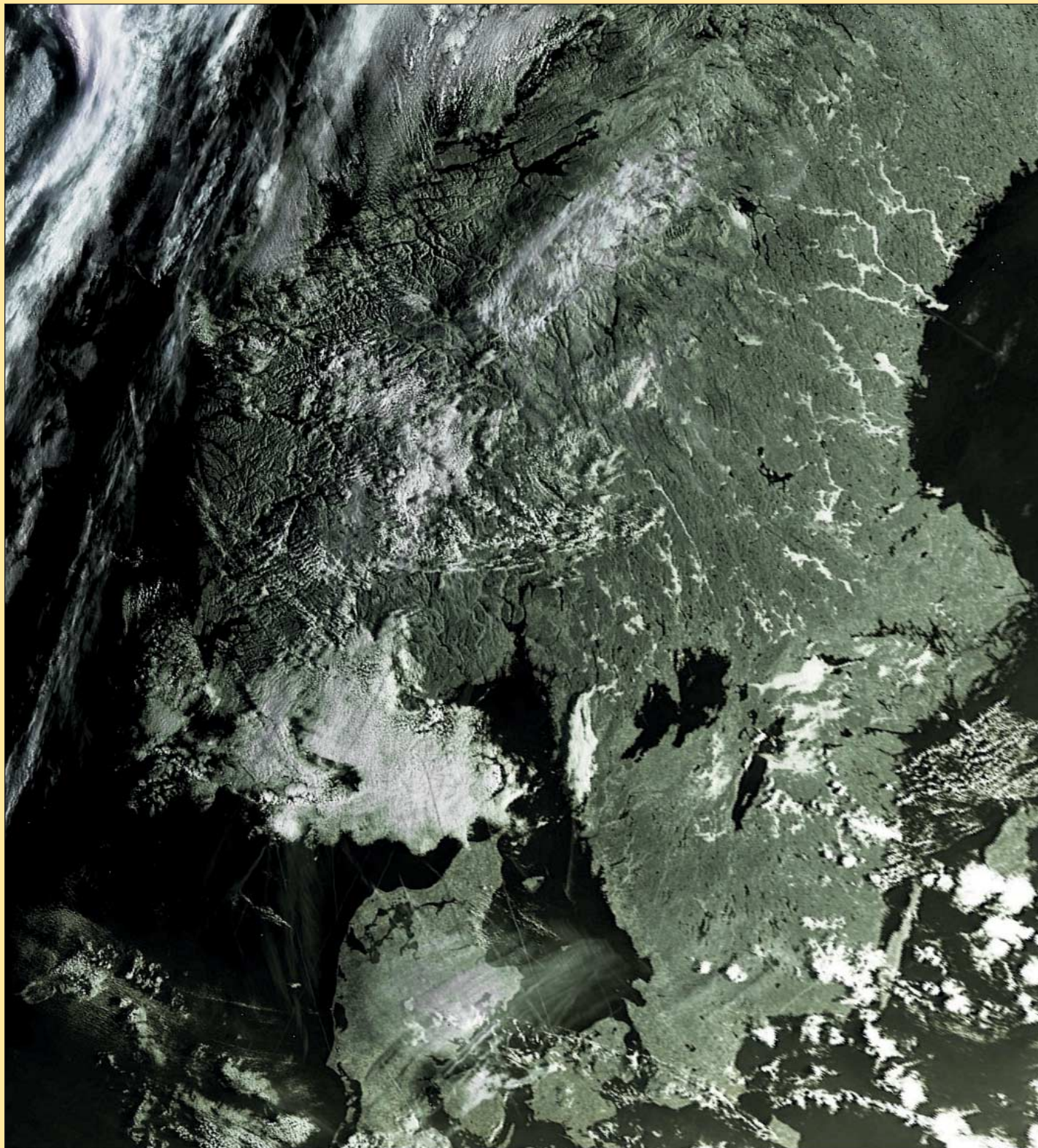
Page 40

Just days before the South Korean Grand Prix was due to take place, *Typhoon Fitow* threatened to spoil the show. In this image from China's newest geostationary satellite, **Feng Yun 2E**, *Fitow* is seen heading north across the East China Sea at 01:30 UT on October 3, 2013.

*Image: FengYun Satellite Data Center
(http://satellite.cma.gov.cn/)*

Swedish River Detail Revealed by NOAA-15

David Taylor



On August 25 this year, taking advantage of the long polar summer, I captured an APT image from NOAA-15 that I found particularly interesting. It's from the early 05:47 UT pass over Sweden, and it was the rivers entering the east coast that caught my attention.

I was fortunate to be able to obtain an HRPT version of the pass, courtesy of the University of Berne, and

the image on this page is the result of converting the processed image into a natural scaling centred on 60°N, 15°E.

I would love to have confirmation from one of our Swedish readers as to what may be causing the effect, and whether it was fog or mist, or maybe even sunglint. I've not seen a phenomenon quite like this before.

A Raspberry Pi Digital Wall Clock

David Taylor

The **Raspberry Pi Card Computer** was designed to get youngsters programming, with a view to them having more experience when they started their university courses. But the computer has actually become very popular with hobbyists as well, due its low cost, ease of programming, and the fact that it has a variety of input and output pins which can be connected to hardware and used in programs to sense and control a multiplicity of peripherals.

<http://www.raspberrypi.org/>

The *Raspberry Pi* can have a camera attached and has been used in high-altitude ballooning. Although the range of applications to which the 1.5 million cards sold so far have been put is very diverse, my own simple project was to just replace a radio clock working from the 60 kHz MSF transmissions with a clock based on the Network Time Protocol (NTP)—time derived from the Internet or from a local GPS receiver. NTP has been mentioned in *GEO Quarterly* on a number of occasions, as accurate time is required for good satellite tracking, lightning detection, and for coordinated reporting of events from stations scattered throughout the world. It just so happened that an older 10.2-inch LCD TV became free and I wanted to have a go at programming the *Raspberry Pi* to learn just a little (but not too much) more about *Linux*. A free, close variant of my favourite programming language (Embarcadero's *Delphi/Pascal*, not free) is available for *Linux*, *Windows* and the *Mac*, so it was a chance to try that as well.

The project involved setting up the *Raspberry Pi* to display correctly on the analogue TV, using the *Free Pascal* and *Lazarus* IDE to write a suitable wall-clock program, learning how to auto-login on the *Raspberry Pi*, and how to start a program automatically on the desktop (*i.e.* using the GUI). Figure 1 shows the clock program feeding the wall-mounted TV. The source and binary files are available for download ^[1], so you can either run the program as *is*, or modify it to suit your own preferences. It's very simple right now, but the results are just what I want.

Your *Raspberry Pi* should be up and running, network connected, and running NTP correctly. It should be almost correctly configured using the NOOBS (New Out Of Box) software you can download or buy on an SD card. Select the *Raspbian Linux* from the choices



Figure 1 - The Digital Clock Display on the TV Screen

offered by NOOBS. My own *Raspberry Pi* runs over Wi-Fi allowing it to be placed anywhere within Wi-Fi range. Although it's not required in this application, if you want to be very precise with your *Raspberry Pi*'s timing, you can configure it as a stratum-1 server and use that for the rest of your network ^[9]. As the average CPU taken by the clock program is just 3% it shouldn't make the *Raspberry Pi* get too hot. Although I've shown the display as



Figure 2 - The Raspberry Pi Computer with a GPS Module attached

wall-mounted above, you may be able to use a VESA adapter to mount the *Raspberry Pi* card on a monitor, and perhaps, should a USB port be available on the monitor, use that port to power the computer and Wi-Fi dongle.

What does a Raspberry Pi look like?

Figure 2 shows the *Raspberry Pi* while an experimental GPS receiver module—which plugs directly into it—was being evaluated. Working clockwise from the left, you can see the lead to the mouse (just for testing) plugged into the upper USB port, while in the lower USB port is a compact *Edimax* Wi-Fi adapter: it's only just visible as it's really tiny. Support for that Wi-Fi adapter (and many others) is built into the *Raspbian Linux* supplied. Next, at 12 o'clock, is the SMA connector for the GPS receiver's active antenna (I used a magnetic 'puck' antenna which provided adequate signal when placed near an outside, but north-facing, wall on the top storey of my house). At two o'clock you can see the 5 V power lead fed into a micro-USB socket and, just below that, a standard SD card used for the *Linux* operating system and other files. At the six o'clock location you can see the TV video lead plugged into the yellow RCA jack socket.

The GPS board is a prototype, but all being well you will be able to buy a similar assembled GPS card and antenna by the time this article appears. See: <http://ava.upuaut.net/store/>

Setting the Display Size

As the display unit was an analogue TV and not a digital computer monitor, the scanning parameters required tweaking to get the display to just fill the screen. It was easy to convert an existing *Delphi* program for *Windows* to run on *Linux*, thereby providing a testcard to check the screen coverage. The program and its source code are in the Zip download. Setting the overscan parameters is a rather fiddly business as a reboot is required after each change, so progress is not very fast. I ended up with the following changes to the `/boot/config.txt` file.

```
sdtv_mode=2 # PAL system
sdtv_aspect=3 # set 16:9 aspect ratio
overscan_left=-5 # scan margin adjustments
overscan_right=-30
overscan_top=-20
overscan_bottom=-20
```

Your values will be different. For more options please refer to the following web page

http://elinux.org/RPi_config.txt

With the above settings, the indicated display area was 928 x 552 pixels, an aspect ratio of 1.68:1, compared to the theoretical 1.78:1, and this with a *NextBase* 10.2-inch 800 x 480 pixel analogue PAL TV.

Running a Program Automatically

Originally, I had intended to write a screen-saver, so that the digital clock would be shown when the display was otherwise not in use. However, I could not find a digital clock screensaver which suited me—the examples in C which I could find were too complex to modify quickly, and I could find no examples in my preferred *Object Pascal* language. Following helpful discussions with Stefan Enziger, Jasen Betts and others on the *comp.sys.raspberry-pi* Usenet newsgroup (also available on *Google Groups*), I decided that making a program start automatically from the graphical desktop would be a better approach (rather like adding a program to the 'Startup' group in *Windows*). No-one else would normally be logged on to the desktop.

Auto Login at boot time

The next step was to make the *Raspberry Pi* automatically log me in as a user (at the main desktop) when the *Pi* was booted. There are instructions here ^[2]. In condensed form, they read as follows:

```
Auto Login: Edit /etc/inittab
Scroll down to: 1:2345:respawn:/sbin/getty 115200 tty1
Change to: #1:2345:respawn:/sbin/getty 115200 tty1
Under that line add:
```

```
1:2345:respawn:/bin/login -f pi tty1 </dev/tty1 >/dev/tty1 2>&1
Save the file and exit
[Optional] Install xscreensaver and set one.
[Required] Set to boot to GUI mode with: sudo raspi-config
```

To check that this has worked, simply reboot the *Raspberry Pi* and watch for the desktop to appear on the TV. If you like, you can go a little further and install a package of screensavers, set one with, say, a 1-minute timeout, and check that the screen-saver activates at one minute past desktop start time. Remember to set the screen-saver back to 'None' for the wall-clock program, though. To add screen-savers to your *Raspberry Pi*, enter the command

```
apt-get install xscreensaver
```

and you should now find a new item on the Desktop Preferences menu => Screensaver.

Running a Program when the Desktop Appears

This is just a little more complex, and involves creating a file to run the program of your choice. First, if you haven't already compiled the program *DigitalClock*, you will want to extract it from the Zip archive and make it executable with the command:

```
chmod +x DigitalClock
```

On my *Raspberry Pi*, I had created the directory *lazarus* within the *home* directory (which therefore had the path `/home/pi/lazarus`), and placed the *DigitalClock* program and its source code there. With the File Manager accessory, you should be able to run the *DigitalClock* program and check that you see something on your display resembling the photograph shown in figure 1. Move the mouse and click anywhere to end the program. Now you see why I have a mouse plugged into the *Raspberry Pi*.

Creating the Required Autostart File

Unfortunately, it's not as simple in *Linux* as on *Windows*, where you can just create a shortcut to the program in a Startup directory. On *Raspbian Linux* you need to create a file named *DigitalClock.desktop*, in the directory `.config/autostart` under your home directory. By default, that directory does not exist on a new *Raspberry Pi* installation, so you could use the following commands ^[3] to create it and make a file to configure the *DigitalClock* startup:

```
mkdir ~/.config/autostart
touch ~/.config/autostart/DigitalClock.desktop
```

You can then edit the contents of the *DigitalClock.desktop* file - only a few lines are required:

```
[Desktop Entry]
Name=DigitalClock
Exec=/home/pi/lazarus/DigitalClock
Terminal=False
Type=Application
```

The line 'Exec=' should point to the full path of the *DigitalClock* executable file. If you want to know more about entries in the `.desktop` file, refer to reference 4.

Compiling the DigitalClock Software

If you want to compile the software, for example should you want to make some changes to suit your own needs, you will need to install the *FreePascal* compiler (fpc), and the *Lazarus* development system. It's not as speedy as *Embarcadero's Delphi* on a *Windows* PC, but developing a small program like this is perfectly feasible on the *Raspberry Pi*. As *fpc/Lazarus* is also available for *Windows*, you could develop and test on *Windows* (or the *Apple Mac*), and then transfer the source for the `.pas` and `.lfm` files to the *Raspberry Pi*. I ended up creating skeleton applications on the *Raspberry Pi*, adding event handlers to the form, and cutting and pasting the code for the event handlers from my *Windows* version to the *Raspberry Pi*. For these short programs, typing the code in by hand is straight-forward enough.

Installing Lazarus

I followed a discussion ^[5] which led to this most helpful web page ^[6], getting a more recent version of *Lazarus* than that in the

default *Raspberry Pi Raspbian OS*. Thanks to Jack (a.k.a. 'zog') for that page and package. Once installed, *Lazarus* should appear as a new entry on the desktop Programming menu. One hint: to keep the size of the executable down, disable the debug information in the Project, Options, Compiler, Linking menu. This will reduce the size of the executable file from 15 MB to around 2 MB.

For help with *Lazarus*, try this *Usenet* group:

nntp://news.gmane.org/gmane.comp.ide.lazarus.general

which is also available through a mailing list.

How to Test while Developing

My procedure has been this: I log in via an *X-Windows* server for *Windows* (ming) using *PuTTY* for authentication, and can thus access the *Lazarus* IDE, to edit, compile and run the program. Both *PuTTY* and *ming* are free *Windows* programs for your PC. This produces output on the *X-Windows* server running on the PC, completely separately from any display running on the TV.

I can also be logged in remotely from my PC via SSH to a console session, and run the graphics program to produce output on the TV screen by telling the SSH session where to display its output:

```
export DISPLAY=:0
```

Thanks to Stefan Enziger for that nugget. Of course, you can't overwrite a program which is being actively run by the *Raspberry Pi* on the TV, so for that reason you may want to have a separate copy of the program which you auto-start. I was slightly surprised to find that even though I had the *DigitalClock* running via autostart, I could still run the *TestCard* program to confirm the resolution figures I mentioned above.

Future Enhancements

At the moment the screen brightness is fixed. It would be nice to be able to adjust it live. Also, perhaps for astronomy enthusiasts, a darker red text on a very dark grey background would be useful. With low-cost temperature sensors^[7], an indoor/outdoor temperature read-out could be added to the display, or made to alternate with the clock. You have the working source code so it's over to you now.

You might ask: 'What else have you done with the *Raspberry Pi*'?

- I've received ADS-B signals on 1.09 GHz with a cheap TV dongle and fed the results to *Plane Plotter* over a Wi-Fi link. This allows me to place the receiver right up close to the antenna, avoiding an expensive (or lossy) length of cable; indeed, avoiding the need for a cable run at all^[8]. It's not much more than following someone else's instructions, but at least I can vouch for every command on that page, and perhaps you will find something useful there.
- I've built a stratum-1 NTP server with microsecond-level offsets and a power consumption of less than 4 watts. This reference^[9] provides information about interfacing a GPS receiver to the *Raspberry Pi*, choosing between various receiver options, and how to compile NTP from the source. I hope you will find the page interesting, and perhaps build a GPS-locked stratum-1 NTP server yourself.

Acknowledgements

My knowledge of *Linux* is very limited, but at least I am learning a little due to my purchase of the *Raspberry Pi*. This project would have been impossible without the patient help of folks on various mailing lists and *Usenet* newsgroups, to whom I am very grateful. Offering the following Web page and my software is my way of actively saying many thanks.

<http://www.satsignal.eu/ntp/RaspberryPiDigitalClock.html>

Thanks to Rob and Les for their encouragement to publish this article. Let's hear from **you** about your experiences with this delightful new computer card.

References

- 1 <http://www.satsignal.eu/ntp/RaspberryPiDigitalClock.zip>
- 2 http://raspisimon.no-ip.org/rpi_autologin.php
- 3 <http://www.raspberrypi.org/phpBB3/viewtopic.php?t=18968>
- 4 <http://standards.freedesktop.org/desktop-entry-spec/latest/>
- 5 <http://www.raspberrypi.org/phpBB3/viewtopic.php?f=34&t=7422&start=75>
- 6 <http://superbitysoft.co.uk/lazberrypi/page13.html>
- 7 <http://learn.adafruit.com/downloads/pdf/adafruit-raspberry-pi-lesson-11-ds18b20-temperature-sensing.pdf>
- 8 <http://www.satsignal.eu/Radio/dump1090.html>
- 9 <http://www.satsignal.eu/ntp/Raspberry-Pi-NTP.html>

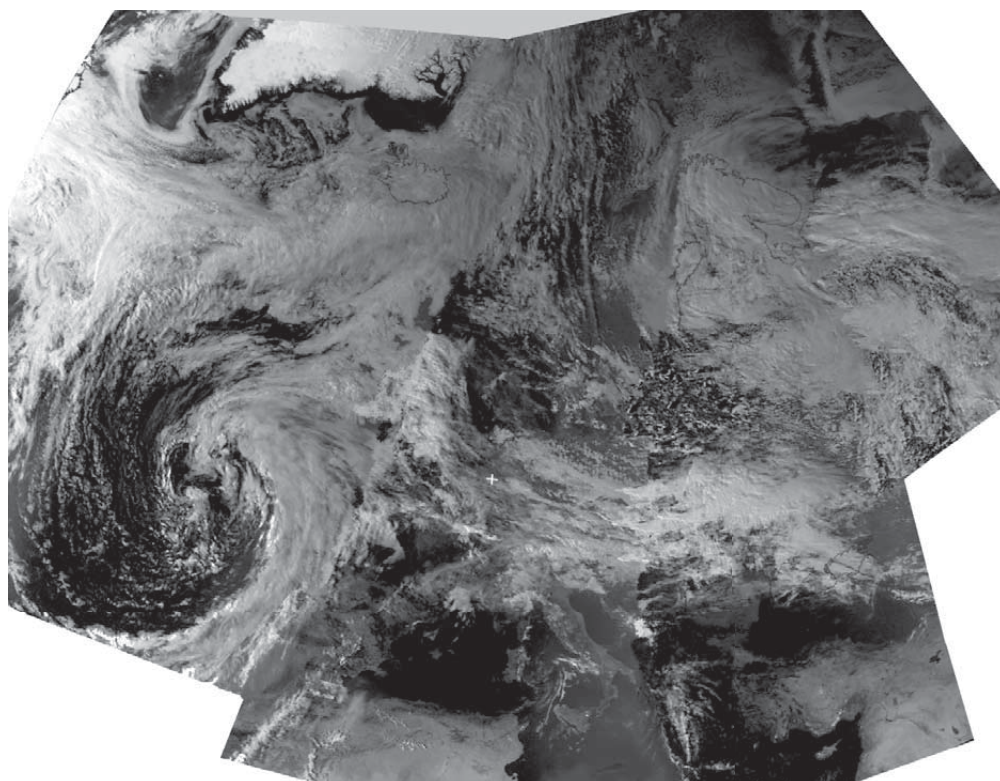
Composite APT Image

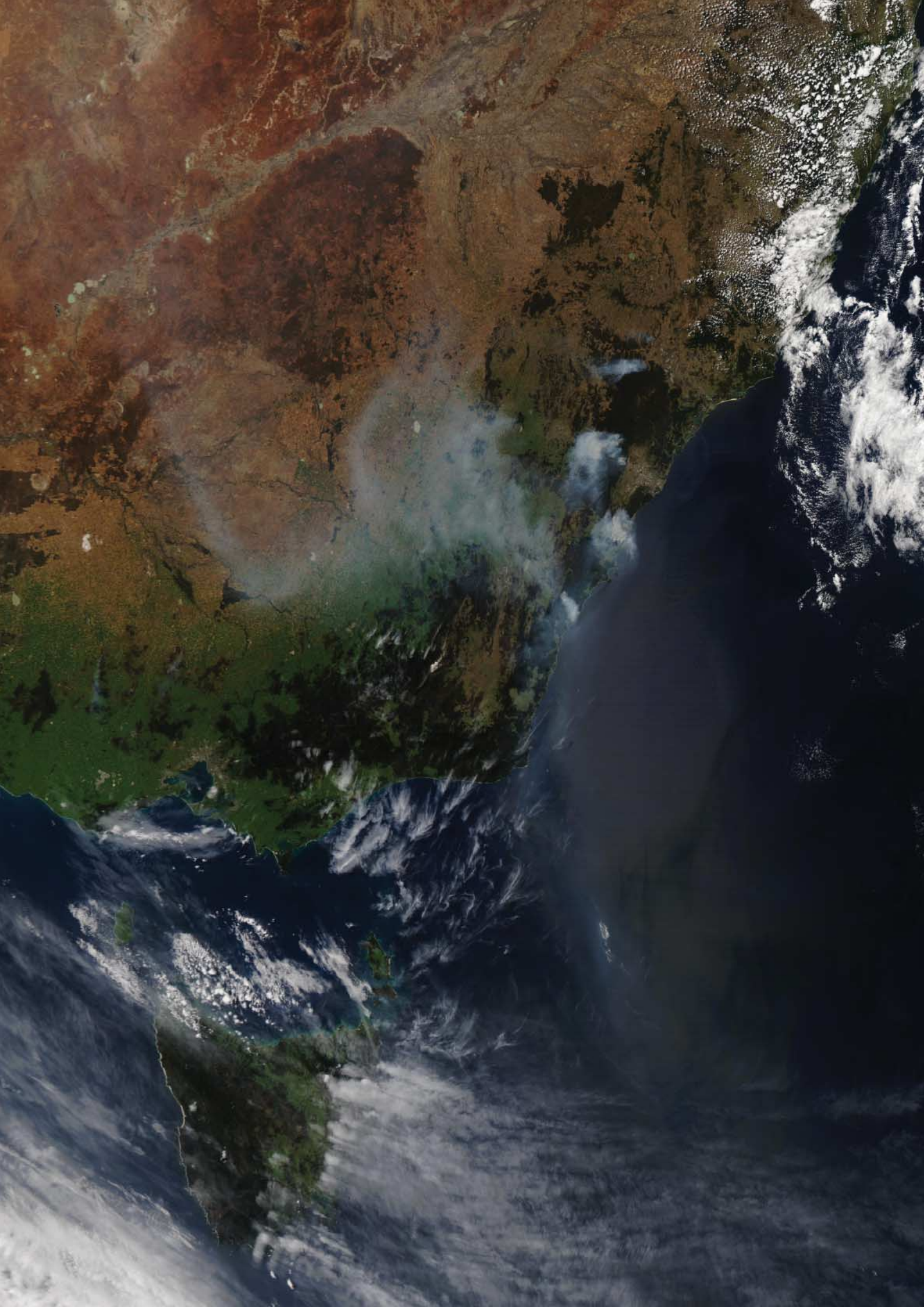
Andre T'Kint, a *GEO Quarterly* reader based in Belgium, enjoys creating mosaics of APT images.

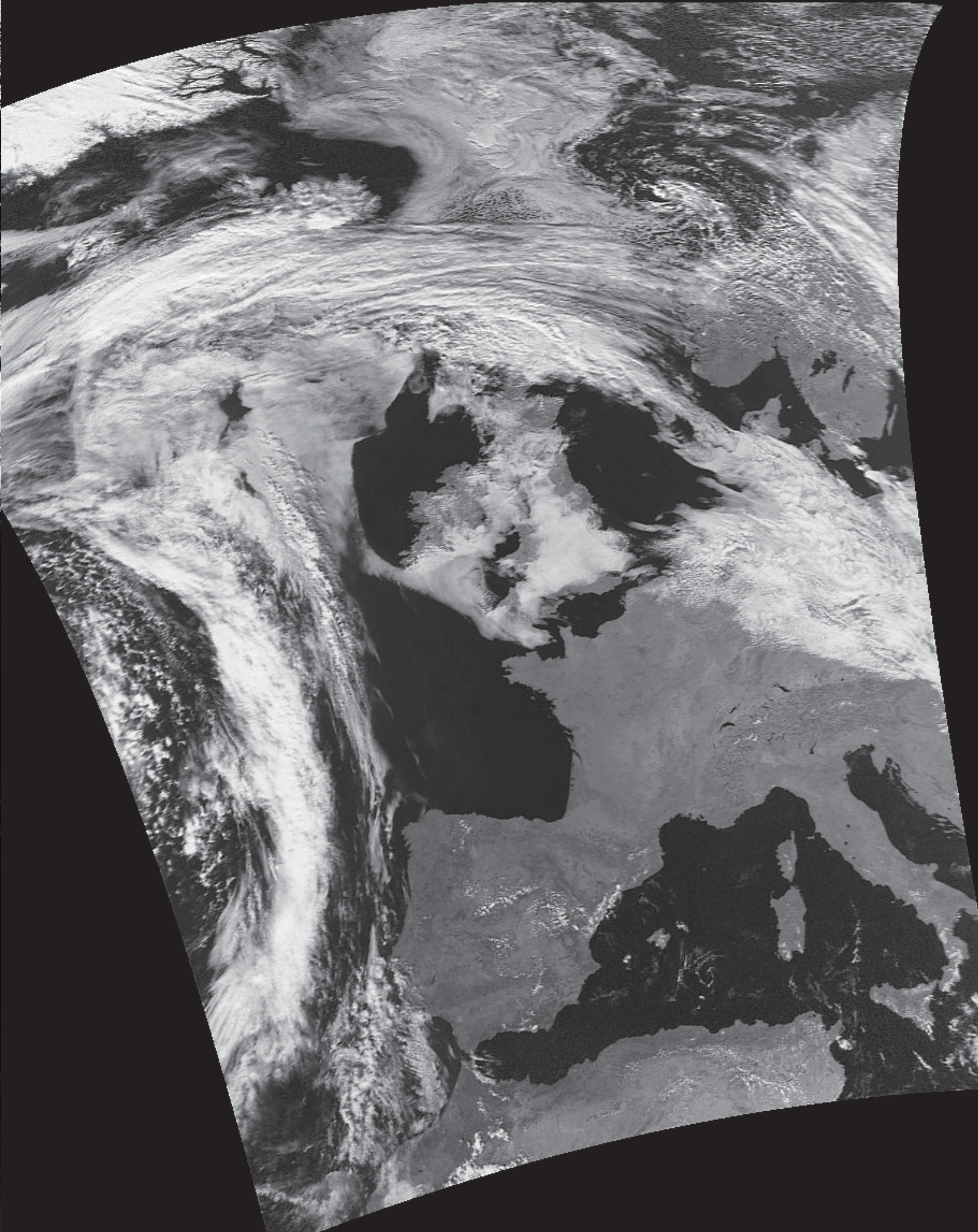
The composite image on this page comes from a sequence of NOAA-18 images acquired on September 26 this year.

The image is notable for the unusually large percentage of cloud on display, but Turkey is clearly visible at lower right and Tunisia at lower centre.

At the upper left of the scene, Greenland stands out sharply in its own cloud-free oasis.







Arctic Meltdown

Permanent Arctic Sea Ice shows significant Increase

Les Hamilton

Sea ice loss in the Arctic Ocean during 2013 rather bucked the trend of recent years, primarily as a result of a lengthy regime of relatively cool and stormy conditions. In contrast with last year, when the annual minimum extent during the month of September dropped to a record low (dotted blue line in figure 1), substantially more ice remained at summer's end this year. The Greenland ice sheet also showed less extensive surface melt while, by contrast, Antarctic sea ice spread to its greatest recorded extent since satellite records began. Figure 1 shows this summer's minimum Arctic ice extent, with the pink line representing the 1981 - 2010 median extent for the month of September. For comparison, the dotted blue line outlines 2012's record September minimum.

Arctic Ocean sea ice annual minimum was reached on September 13, 2013, and remained largely unchanged until the end of that month when strong autumn cooling started to take hold. Averaged over the whole of September, Arctic sea ice extent was 5.35 million km², 1.17 million km² below the 1981 to 2010 average but 1.72 million km² greater than the record low set in 2012. Nonetheless, despite being 47% up on the 2012 figure, this was still the sixth lowest September minimum extent on record. To further set these figures in context, 10.03 million km² of sea ice were lost over the entire summer, between the maximum winter extent last March and September.

Figure 2 graphs Arctic Ocean sea ice extent for each year since 2008 along with the long-term average. The broad grey band indicates the two standard deviation range of the mean data.

Contrasting weather conditions were a significant factor in this year's higher sea ice extent and lower Greenland Ice Sheet melt intensity, compared with last year. Compared with recent years, this summer was distinctly cool over much of the Arctic Ocean, particularly north of Greenland, with air temperatures at the 925 hPa level 1°C to 3°C lower than in 2012. Also, unusually low pressure over much of the Arctic Ocean limited heat import from the south and created extensive cloud cover that kept temperatures down. In addition, the winds associated with the low pressure caused the ice cover to spread out and cover a larger area.

A major factor leading to the loss of multiyear sea ice in recent years has been its transport into the Beaufort and Chukchi seas,

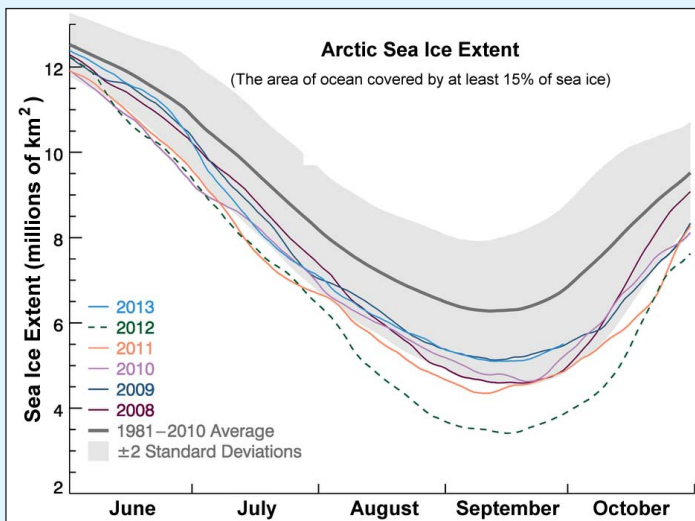


Figure 2 - Average Arctic sea ice extent from 2008 - 2013
Credit: National Snow and Ice Data Center

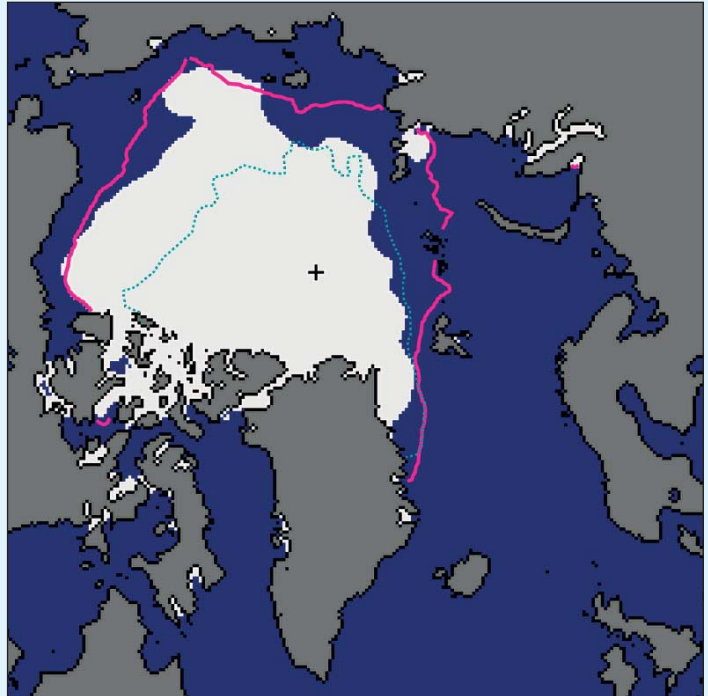


Figure 1 - Average Arctic sea ice extent during September 2013. The added dotted blue line indicates the 2012 record minimum.
Credit: National Snow and Ice Data Center

where it has been broken up and exposed to warmer waters and higher air temperatures. But 2013 was different, the wind pattern largely holding this older ice into a compact area along the Canadian Archipelago and preventing it from reaching the Beaufort and Chukchi seas. The cooler conditions this year also helped to preserve more of the first-year ice throughout the summer. The first-year ice that survived the past summer will now thicken during autumn and winter to become 2014's second-year ice.

However, it will require several more cool summers in a row to restore the sea ice cover to the levels characteristic of the 1980s, when there was a much larger proportion of thicker, multiyear ice that proved more resistant to melting during the summers. And even though the Arctic sea ice will thicken through this autumn and winter, its accumulation is still at the mercy of the winds, which could yet transport some of it out of the Arctic Ocean and into the North Atlantic.

Meanwhile, in the Antarctic ...

At the same time that Arctic sea ice was showing signs of recovery, that in the Antarctic was stretching seawards to a record extent since satellite records began in 1981: in all, 19.47 million km² on September 22. This maximum extent exceeded the long-term mean by 3.6%, which represents an ice edge 35 kilometers farther north on average. Overall, Antarctic September sea ice extent is currently increasing at 1.1% per decade. It is suggested that changes in winds are resulting in greater compaction within the ice pack and more ridging, resulting in a thickening of the ice which makes it more resistant to summer melt.

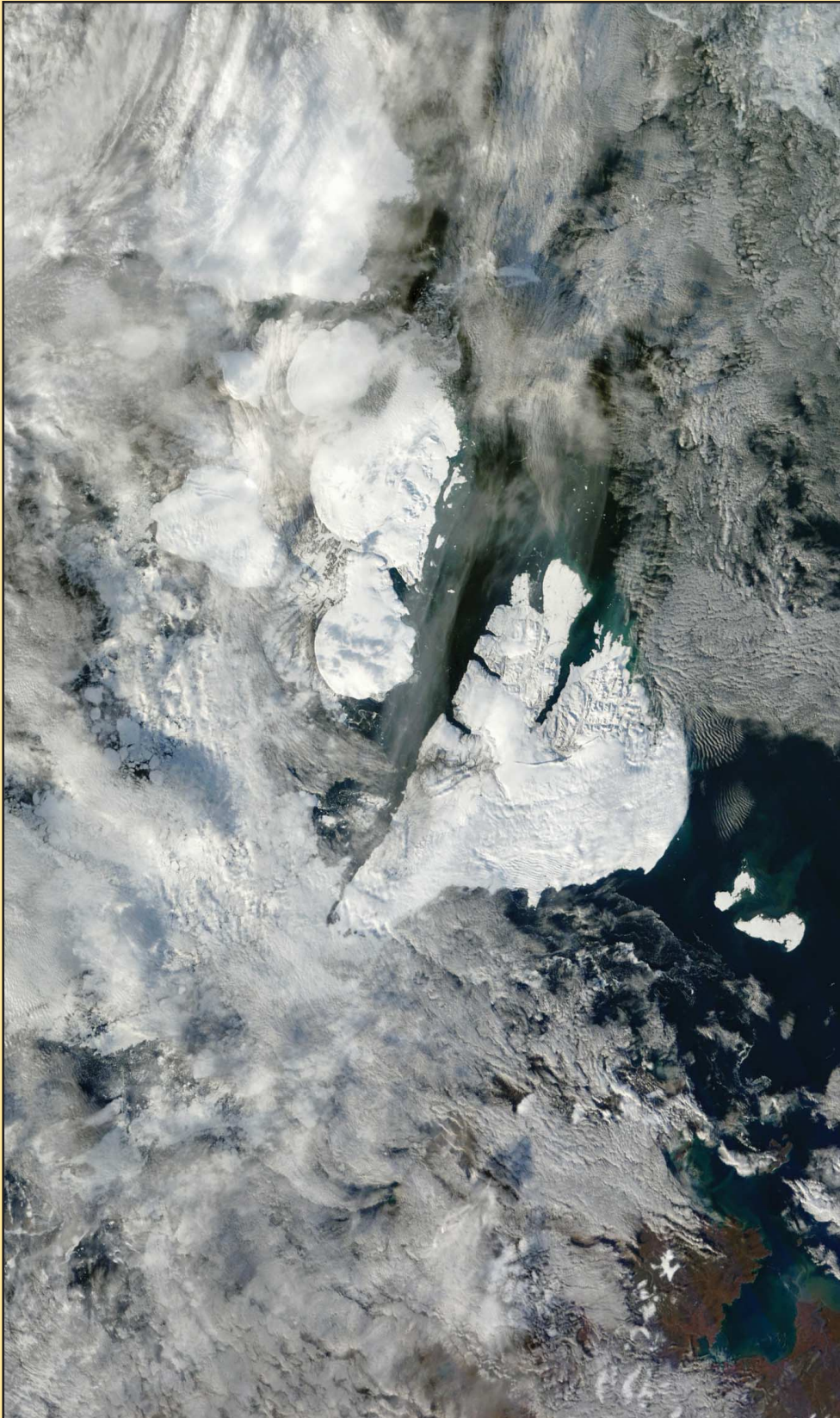
Source

Information in the above has been sourced from the website of the National Snow and Ice Data Center at

<http://nsidc.org/arcticseaicenews/>

Bolshevik Island

Les Hamilton



Map courtesy Wikimedia Commons/Kennonv

Rarely seen because of persistent cloud and fog, Bolshevik Island (78.6°N, 102.48°E), which lies some 50 kilometres north of Russia's Taymyr peninsula, across the Vilkitsky Strait is the southernmost and, with an area of 11,270 km², second largest island of the Arctic archipelago of Severnaya Zemlya. Rising to only 935 metres, the island is largely mountainous and includes three glacier systems which account for almost one third of its area. The northwestern coastline is indented by a number of fjords but, with an annual average temperature of -16°C, life is confined to sparse coastal vegetation consisting of moss and lichen. Apart from an Arctic base there is no human population.

Severnaya Zemlya was first noted in 1913 and first charted in 1930–32, making it the last archipelago on Earth to be discovered. This island group has long been the major obstacle to opening the *Northeast Passage* between the Pacific and Atlantic oceans for trade, remaining firmly in the grip of ice even at the height of the late summer melt season. But, with the continued decadal shrinkage of the permanent Arctic ice cap, open water is now often found to the north of the archipelago.

This summer, history was made when the 19 000 tonne Chinese freighter *Yong Shen* became the first ship to successfully navigate the 5400 kilometre passage when she docked in Rotterdam on September 10 following a 35-day journey from China's northernmost warm-water port, Dalian (formerly Darien). The traditional sea route through the Suez Canal and the Mediterranean Sea takes 48 days.

This Terra MODIS image acquired on September 15, 2013 provides a rare glimpse through the cloudy Arctic of the triangular, glacier covered Bolshevik Island belonging to the Svernaya Zemlya archipelago.

The Jet Stream

How it affects Britain's weather

Mike Stevens (G4CFZ)

What is the Jet Stream? It is a strongly flowing ribbon of air that flows around our planet, high up in the atmosphere, situated between the tropopause and the stratosphere. It's exact height above the Earth varies from approximately 11 kilometres at the Poles to 17 kilometres at the equator. Jet Stream winds typically flow at between 100 and 160 kph.

We often hear weather presenters on TV mentioning the Jet Stream and how it is responsible for influencing our weather in the UK, so it is no wonder that we need to know more about what causes it and why it has such an influence on the weather we experience at ground level.

Jet Streams form, and are normally seen, in two zones:

- the boundary between the polar and mid-latitude air, termed the **Polar Jet**.
- the boundary between the mid-latitude air and tropical air, known as the **Subtropical Jet**.

Although both these Jets are separate entities, they do join up from time to time across various parts of the Earth.

Jet Streams form near the boundaries of adjacent air masses with significant differences in temperature, such as the polar regions and the warmer temperate zones. The Polar Jet is the stronger as the temperature gradients across polar and mid-latitude regions is greater than those between mid-latitudes and the equator. And of course, the temperature gradient over northern and southern latitudes increases significantly during the winter months.

Both the Polar Jet and the Subtropical Jet travel from west to east, and would do so uniformly were it not for other influencing factors, such as the Coriolis effect, the landmasses they encounter and the temperature gradients. Landmasses affect the flow of the Jet Stream through friction and temperature differences, while the spinning of the Earth produces the Coriolis effect, which accentuates these changes by causing the Jet Stream to meander above the Earth just like a river.

Good and Bad

So, understanding this, how and why does the Jet Stream affect our weather? A simple way to explain this in a manner that we can understand is to describe the Jet Stream as having two sides: a 'good' side and a 'bad' side. You are on the *bad* side of the Jet Stream when you are situated north of it: this has the effect of pulling in the Atlantic low pressure areas. Recall the so-called summer of 2012 when it rained from April till October as one low pressure system followed another. At that time the Jet Stream lay over northern Spain, meaning that Britain was on its *bad* side. Additionally, a very high pressure system had formed over Scandinavia and this remained stationary for many weeks, maintaining the Jet Stream in more or less the same position, at approximately 40°N over Spain.

The *good* side of the Jet Stream (in the northern hemisphere) is its southern side. This is where all the good weather and the high pressure zones are found. The July heat wave of 2013, which produced some amazing temperatures within the British Isles, was so because the Jet Stream was located at approximately 60° north latitude, between northern

Scotland and Iceland. And it remained there for almost three weeks, until an Atlantic low pressure area moved in, steered by the Jet Stream, which then diverted south. This created a trough in the Jet Stream which allowed a southerly airflow to draw heavy thunderstorms from France over Great Britain, marking an end to the extreme temperatures. This situation continued for several days until the Jet Stream's track changed again, bringing more Atlantic lows on to our shores.

Now you begin to see the influence that the Jet Stream has over weather in the British Isles. The direction and angle of the Jet Stream will determine what air flows we experience, be it warm air, moist or maritime air, or cold air, all of which greatly influence our weather.

As experienced Earth observers, we are able, with the help of *EUMETCast* and its amazing images, to see these fast moving Jet Streams above us on a daily basis. Once you have *MSG-Data Manager* up and running, with images arriving on your screen at regular intervals, you are capable of detecting these flowing ribbons of air. They produce a markedly different cloud formation due to the wind speeds produced at high altitude and are soon easily recognisable both at ground level and from satellite images.

The images shown in figures 1 and 2 display exactly how the Atlantic or Polar Jet Stream can change over several days. On these images, the faster the Jet, the more intense the red colouring. On July 31 (figure 1), the Jet Stream was flowing northward over the British Isles, carrying warmer air from the mid Atlantic across the country. This can bring in moisture on a southwest air flow, which could mean the arrival of a low pressure system, and the chance of rain. But by August 7 (figure 2), a trough in the Jet Stream lay to the south of Britain, which allowed cooler air to penetrate to lower latitudes.

In short, cooler air lies to the North of the Jet Stream and warmer air to its South. As the Jet Stream constantly changes its strength and direction, it can affect our weather quite dramatically.

The Jet Stream in Satellite Images

We can now tie all this information to a *Meteosat-10* satellite image. Figure 3 is a channel-9 10.8 µm infrared image taken from my system at 19.15 UT on the same date as figure 1. If you look carefully, you can see how the cloud pattern in the satellite image lines up closely with the Jet Stream. This alignment provides absolute confirmation as to how the Jet Stream has such an influence on our weather here at ground level. Nothing could be clearer than that. Or could it?

One type of travel that benefits from the Jet Stream is aviation. Long haul flights from the USA to Europe can, once they have located the Jet, save time in travel and costs in fuel which, in this day and age, means money saved. To big companies with huge fuel bills that can be very beneficial. The down side comes if you are travelling in the reverse direction: the Jet could in this case make your flight longer and burn more fuel: so the Atlantic weather forecast can be most helpful to the aviation industry in avoiding the Jet on westward journeys.

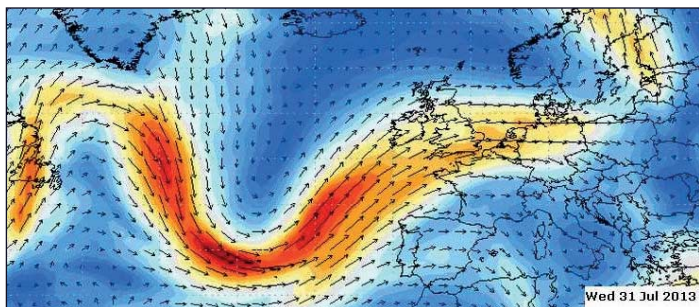


Figure 1 - The Jet Stream on July 31, 2013
Image: Metcheck

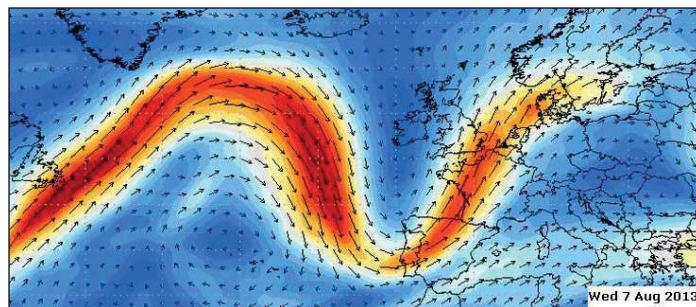


Figure 2 - The Jet Stream on August 7, 2013
Image: Metcheck



Figure 3 - A Meteosat-10 channel-9 10.8 IR image on July 31, 2013
Image © EUMETSAT 2013



Figure 4 - A Meteosat-10 channel-9 10.8 IR image on August 7, 2013
Image © EUMETSAT 2013

Jet Streams produce strong atmospheric turbulence, often resulting in long bands of cloud, and with the winds flowing at some 160 kph, can produce distinctive narrow trails of cirrus cloud, as shown in figure 4. This photograph was taken during the STS039 shuttle mission in 1991, and shows the Jet Stream crossing above Cape Breton Island in the Maritime Provinces of Eastern Canada.

We, as observers, can see these, and its fun to try and discover this weather wonder that is constantly moving around above us. Many meteorologists around the world are trying to ascertain what makes the Jet Stream move the way it does. They now understand about landmass and temperature gradients, but feel that there are also other forces in play, making its movement more erratic and creating such adverse weather conditions as severe storms and heat waves. It's even been suggested that the Arctic ice melt, which has been continuing at an alarming rate may have something to do with it. Another possible influence could be *El-Nino*.

But of course, meteorologists do make use of the Jet Stream to assist with weather forecasting. As I have explained, it holds most if not all the information as to what the weather is going to produce, so getting to understand this flowing ribbon of air much better could lead to even more accurate forecasting in the future.

Next time a weather presenter tells you: *'it's all to do with the Jet Stream'*, I hope this article will have given you a better understanding as to how it really does affect our daily lives at ground level.

My thanks to *Metcheck* for the Jet Stream images, and to EUMETSAT for the Meteosat image.

Happy weather watch from Portland.

Reference Sources

- 1 Metcheck
<http://www.metcheck.com/UK/>
- 2 Wikipedia
<http://en.wikipedia.org/wiki/>
- 3 Encyclopedia of Weather & Climate, 2011 Edition.



Figure 4 - The Northern Hemisphere Jet Stream above Cape Breton Island
Image: STS039-601-049 - NASA/JSC

An overview of APT Reception with Low-Budget Stations

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In the following article we are going to explore some low budget solutions attempted by the author in order to receive APT imagery. The text is focused on the hardware chain and the reference to the software utilities is made as complement for some of the elements featured on it. A basic knowledge of the reader regarding the APT format, active frequencies and signal characteristics is assumed.

Antenna

When designing any ground station, one of the key elements to take into account is the antenna. Choosing one that meets your requirements is often a time-consuming problem. Several considerations about size, ease of construction, materials availability, etc. must be dealt with. About four years ago, when I first started my APT reception attempts, the antenna was, initially, the only one I had available, a 145 MHz homebrew *Moxon Rectangle* [1].

After some months of receiving very limited results due to the extremely narrow bandwidth of the commercial FM transceiver used, I had no thoughts of complaining about the antenna. But when the receiver was upgraded, it became clear to me that it was time to upgrade the antenna as well. In the world of APT reception there are two main antenna types: the phased twin dipole with reflector (turnstile) and the quadrifilar helix (QFH). The QFH is considered by most users as the better antenna for APT, which is understandable as it is the very same antenna that the satellites use to broadcast their imagery to Earth. However, as the 145 MHz *Moxon* did produce good results, which was considered a point at its favour, it was also included in this consideration.

When the three candidates were compared, I soon discarded the turnstile because the *Moxon* has similar characteristics and better gain. However, the QFH is quite difficult to build for a newbie, and it ended not being considered either. So, as the *Moxon* came out my winner, some studies were carried out. Using the simple but excellent free software *MoxGen* [2], which is easy to find on the Internet, a 137 MHz version of the *Moxon* antenna was calculated. *Moxons* can be phased to provide circular polarization, and an article published on the August 2001 QST Magazine (Vol. 85; No. 8; pp. 38-41) written by L B Cebik (W4RNL) provides a good guide to it.

Initially only one *Moxon* was built as a test-bed. As the antenna is linearly polarised due to the phase mismatch, a 3 dB loss in signal gain is expected when compared with a pair of phased *Moxons*, because we are losing half of the signal transmitted by the satellite. If we analyse the behaviour of the single *Moxon* scenario with an antenna modelling and analyser tool like *MMANA-GAL Basic* [3], which is also free and easy to use, we can decide the best conditions to locate the *Moxon*.

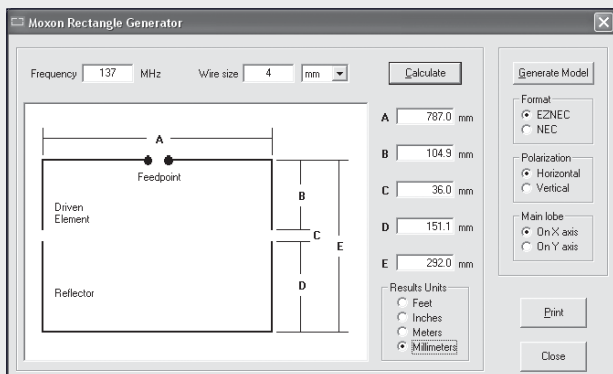


Figure 1 - The Moxon Antenna modelled with MoxGen

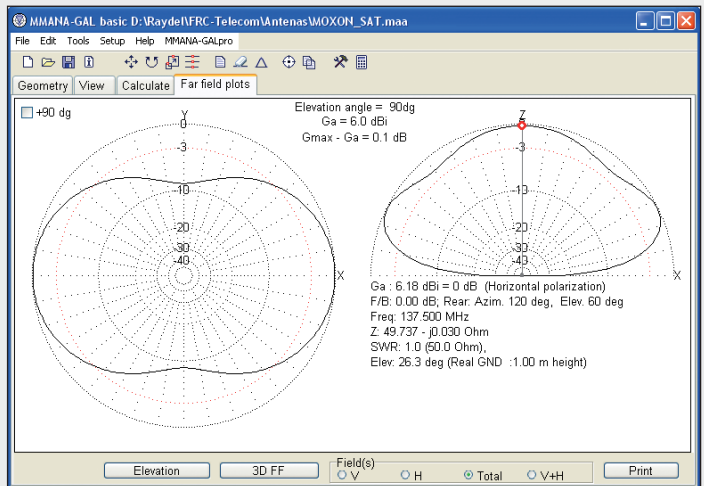


Figure 2

Screen capture of the Moxon gain pattern calculated with MMANA-GAL Basic

When correctly built, the *Moxon* is a 50 ohm match and provides around 5.9 dBi on free space. However, if we take a look at figure 2, we can see that the *Moxon* provides a great pattern with a nice gain when it is located one meter above the ground or the roof. Placing the antenna at higher elevations may increase the gain and improve its line of sight, but it also deforms the gain pattern due to the appearance of fringes and deep nulls which can degrade the received picture quality badly. A single antenna produces an oval-like pattern, another reason why two *Moxons* phased together are better—because the resulting gain pattern has a dome-like form very similar in shape to the pattern provided by QFH antenna. The *Moxon* has a low gain at the horizon and is horizontally polarised, so it is less sensitive to ground station interference. Of course this means we lose the lower part of the pass, but for those living in highly populated areas with buildings obstructing the horizon, and in-band emitters, it may not be a bad deal at all.

If we want to test APT reception right away in a fast and easy fashion, a single *Moxon* is a solid candidate for a beginner's antenna. If we correctly align the oval-shape pattern in order to obtain the maximum in a north-south trajectory (which polar orbiting satellites follow), we can achieve a good noise-free signal on every pass with an elevation greater than 30° whenever the satellite is 10° above the horizon. Just point the antenna's arms into an east-west alignment. Greater coverage was achieved with a preamp attached to the antenna, and this will be discussed later. So, three years later, the so called 'test' antenna is still in use, even after suffering all the climatic challenges that the Caribbean weather has to offer (figure 5).

Preamp

A reception preamplifier was obtained a few months ago and it helped to extend my coverage. It is a Soviet-era preamplifier, built in East Germany at the mid 1980s, but

still in good working condition, even after many years of use and a few more in storage. Only some minor adjustments were required. When using long runs of coaxial cable, a preamplifier is recommended; however, in the several cases where I have tested it, it provided only a small improvement with traditional receivers and 15 metres of low loss *RG-11/U* (Belden 8213) coaxial cable. The convenience or not of using the preamp will be better discussed later. Whether it is required may well depend on local conditions, and the level of quality we are looking for in our images. However, in special conditions it may be a must. The circuit board of my preamp is shown in figure 6.

Receiver

Now is time to discuss the receiver. In the past four years I have received APT imagery with three different receivers. My first receiver was a *Kenwood TK-760* FM communications transceiver which had a very narrow bandwidth (15 kHz), but which nevertheless received some nice pictures (figure 3). Later a new receiver was obtained, an *AOR AR-3000A*, which, however, has too much bandwidth, 200 kHz. The *Plus (+)* version of this receiver features a modified Wide-FM filter of only 50 kHz, good enough for APT imagery, but I own the normal version with the wider filter. Yet, even with the 200 kHz bandwidth, only few issues were detected in more than two and a half years. The 136-138 MHz band in Cuba is free from ground transmissions so the only interference that can be picked up by the wider bandwidth comes mainly from the *Orbcomm* satellites—especially on the 137.560 MHz downlink, when the satellites are in range of ground stations in Florida. This downlink badly affected both NOAA-17 (now decommissioned) and NOAA-15, but NOAAs-18 and -19 were received without major problems: just some minor noise from time to time which could be easily be filtered by the ‘Despeckle’ utility most APT reception software has.

However, the greater a receiver’s bandwidth is in comparison with the transmitted signal bandwidth, the more energy is required so, when using the *Moxon* antenna without a preamplifier, the coverage was limited to passes greater than 35° when the satellite was above 15° in order to receive a noise free picture. Using the preamplifier, the coverage was extended to passes of greater than 30° when the satellite was 10° above the horizon (figure 4). An even more modern receiver with great features, based on even cheaper technology, will be discussed later.

Computer and Software

For traditional methods, almost every computer is capable of decoding APT imagery as long as it has a soundcard and compatible APT decoding software. So far, three programs have been used for different purposes. An elderly and excellent software named *WXSat* [4] is the best choice for very slow, old computers: it provides all the minimum required options and runs at acceptable speed even in an *Intel 80486* computer. One more bonus, it is free.

WXtoImg [5] is another great tool that many users prefer. It can be used in three ways: as a *free* version providing basic features, a *registered* version with some improvements and a *professional* version which unlocks all its features. A normal computer is required, not extremely fast, but slower computers may produce lost of sync when recording. Still, *WXtoImg* has a resync option that may help in such cases. This software is capable of producing acceptable results even with very limited antenna and receiver conditions. So far only the free version was tested but it provides good results.

Another favourite is David Taylor’s *SatSignal* [6], which can also be used also in a *free demo version* with basic tools or a registered version with a lot more improvements. This program may not have all the fancy options *WXtoImg* has, but in my personal opinion the best pictures I have ever seen were obtained with *SatSignal*, especially when activating the ‘Larger Image’ and the ‘Wide Input Filter’. Of course, as it squeezes every single detail from the analogue APT transmission, a stronger and noise clean signal is essential, otherwise a degraded picture is obtained.

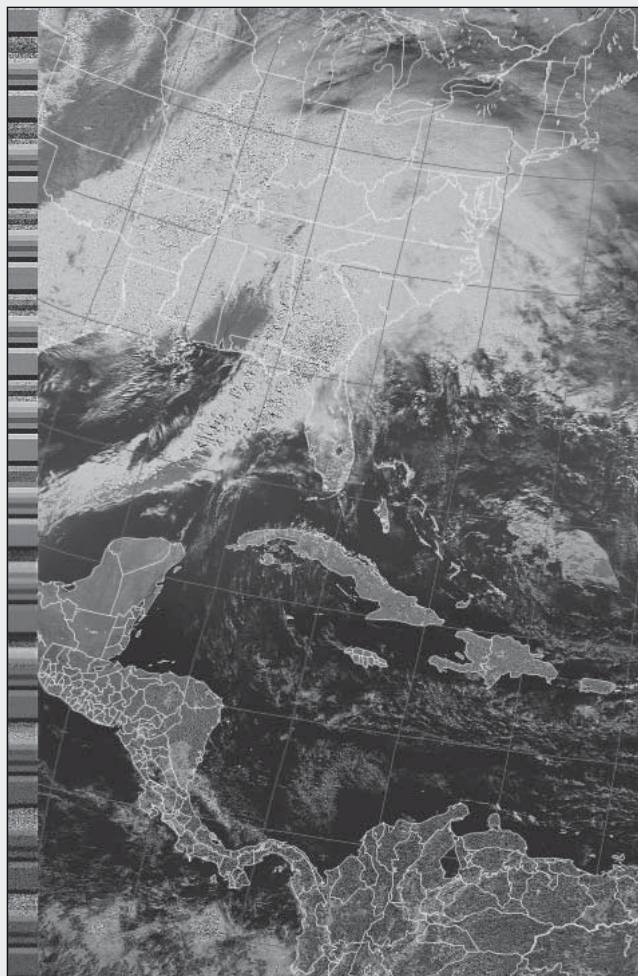


Figure 3 - A NOAA-19 afternoon pass received with a narrow-band Kenwood TK-760 Communications Transceiver

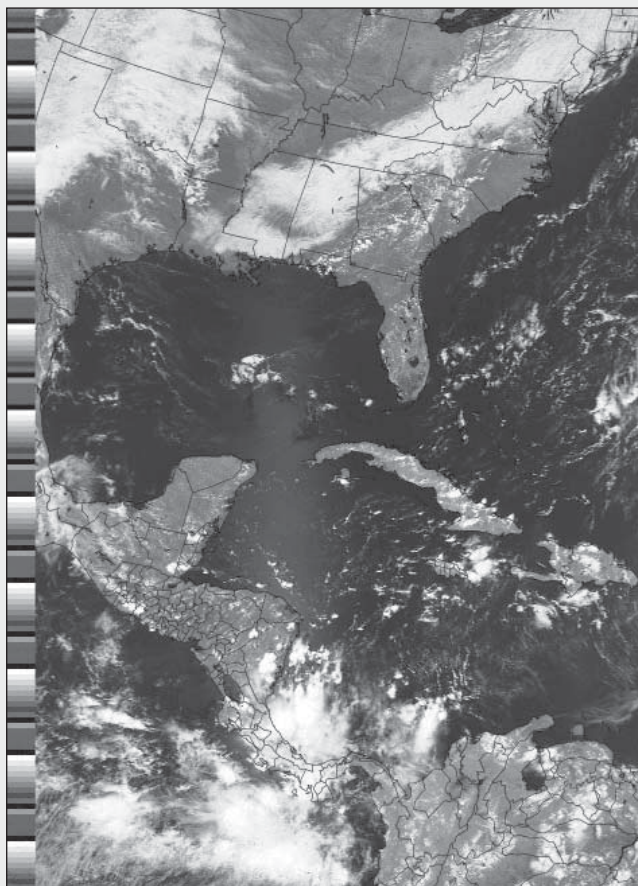


Figure 4 - A NOAA-19 afternoon pass received with the AOR AR-3000A General Communications Receiver



Figure 5 - The 'test' single Moxon is still in use three years after being built



Figure 7
The RTL-SDR EzTV645 dongle and FC0013 tuner attached to the rear USB ports of the author's computer.

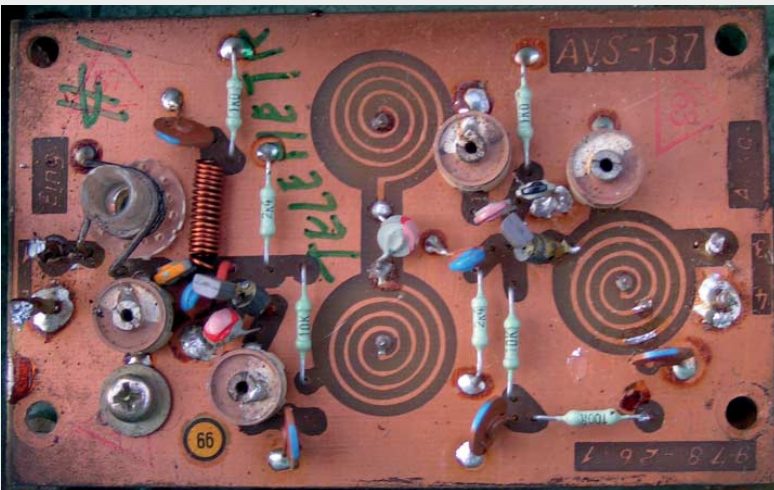


Figure 6 - The Circuit Board of the Author's preamplifier.

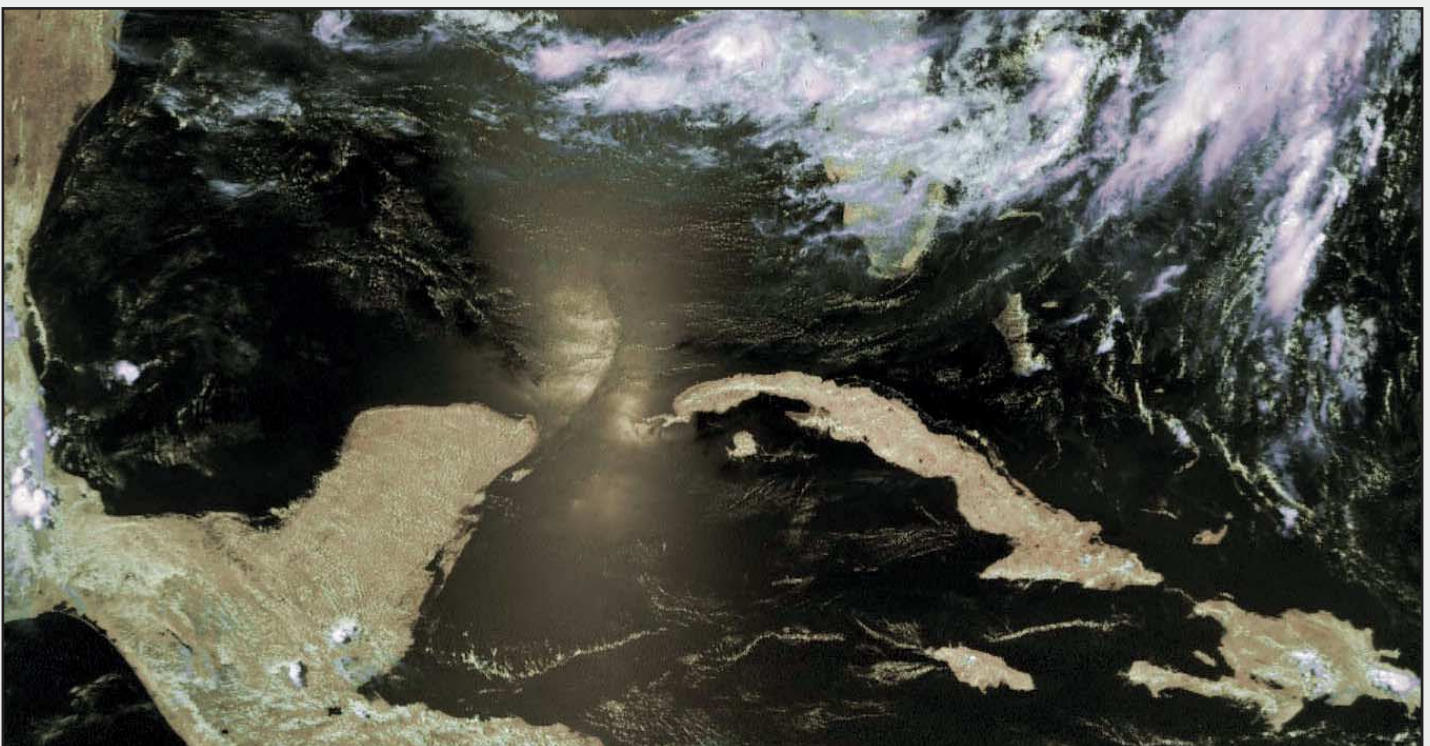


Figure 8 - A section from the 18:53 UT NOAA 19 pass on July 25, 2013, decoded with RTL-SDR, which clearly shows the author's homeland, Cuba.

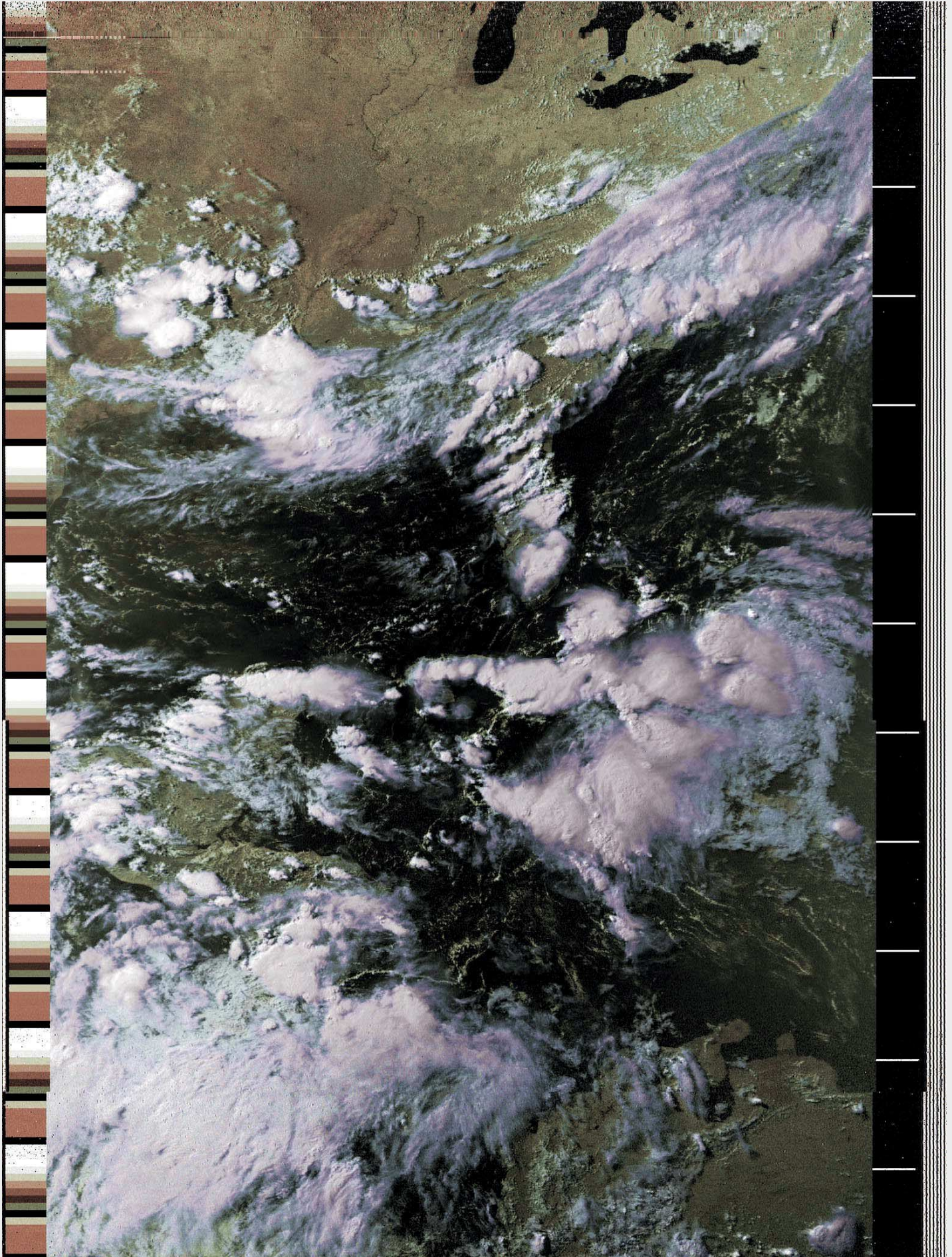


Figure 9

A NOAA-15 afternoon pass decoded with *RTL-SDR*. The resulting WAV file was decoded with *SatSignal 5.2.2*, and although sync was lost four times, a good picture was nevertheless obtained. Cuba, however, is completely overcast.

SatSignal doesn't feature a self-recording option but this is not a problem at all as we will see later. Again, only the free version has been used so far with no complaints.

There are several other decoding programs for APT and all may work as well, each one with its good features and drawbacks. However, in your personal scenario you may choose the one that accomplishes your expectations best.

The Future is Software Defined Radio

Not too long ago, a brand new device appeared which captured the imagination and the heart of many radio monitoring enthusiasts: it was the **RTL-SDR dongle**. For many years before that, *Software Defined Radio* was used; however, its prices were prohibitive for most APT beginner users. It was not until the discovery of the possibility of using some USB Digital TV receivers—based on the RTL2832U chipset—as radio receivers that SDR technology became affordable to most people.

Several attempts and experiments on receiving analogue APT imagery—and even digital data such as LRIT and HRPT—were carried out by a few users with mixed results. Using a device designed for receiving television from a powerful transmitter in a scenario of weak signals coming from space in a heavy RF interference environment is not an easy task.

Many RTL-SDR users report a lot of drawbacks, like ESD (Electro-Static Discharge) sensitive components, de-sensing, overloading, low sensitivity at VHF, need for high computing resources, etc. However, if we consider that we have integrated into a small space an RF Spectrum Analyser and versatile all-mode, free-to-customize receiver, which can be bought by around 20 dollars, it may not look too bad. Many of its problems can be solved with patience and perseverance. Adding a couple of diodes will protect it from ESD, a bandpass filter may help with out-of-band interference, a preamp will improve sensitivity, and so on.

The Ezcrap EzTV645 Dongle

The RTL-SDR dongle we are going to explore in the rest of this article is an **Ezcrap EzTV645** with an **FC0013 tuner** covering from 48 MHz to 864 MHz. In order to start using this dongle we need the proper software and drivers. One of the most used is the **SDR#** (pronounced SDR Sharp). During the tests described here, version 1.0.0.1135 was used. Figure 7 shows the *RTL-SDR* and tuner connected to my PC. The original antenna connector was replaced by a BNC one taken from an old Ethernet card. A pigtail cable has been used to attach the dongle to the computer's rear USB ports.

Integrating *SDR#* with the *RTL-SDR* DLL libraries may be hard work, so it is recommended to use an integrated distribution provided by 'EA1KR' which can be downloaded from

<http://www.divxexa.tk>

This package comes in both Spanish and English language versions and features the most used tools and plugins an *RTL-SDR* enthusiast will require. It is a ready-to-use solution.

After completing the package's self-extractor program, we open the folder where we installed it and execute the application named **SDRSHARP TOOLS UPDATE.exe**, which is the Start Menu for the main programs contained in the package. In order to use our *RTL-SDR* dongle we must install an SDR compatible driver, but not the one provided on the original CD supplied with the dongle. The driver has an install application named *Zadig*, which can be accessed via the Menu Application.

To install the driver it is very important to first connect the dongle to a free USB port. When *Windows* asks for the driver, close and abort the installation, then run the *Zadig* program. It is very important to be sure the correct device is chosen to

avoid overwriting any other USB device's driver. The *RTL-SDR* dongle should be identified as **Bulk-In, Interface (Interface 0)**. Once the device has been correctly chosen, proceed with the installation by pressing the 'Install Driver' button. With some computers it may be required to re-start *Windows*: *even if this is not requested*, it is a good practice to do it. If the driver is correctly installed the device will appear at the *USB Safe Extract* icon (Another driver installation window may appear. This one is for the included Infrared Remote Controller but can be ignored as it is not required). Figure 10 illustrates the *Zadig* driver installation screen, showing that the correct device has been identified.

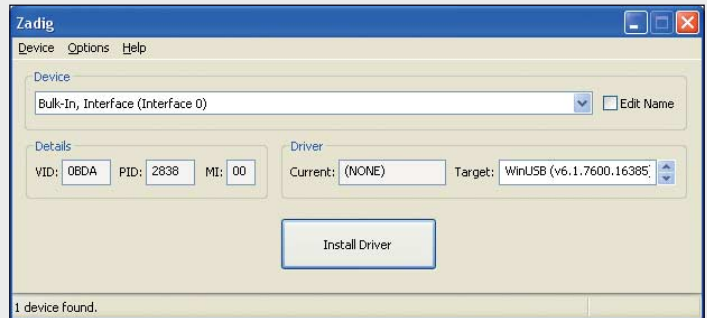


Figure 10 - Zadig Driver Installation Screen

Once we have completed the *Zadig* driver configuration and the plugin's installation or de-installation, then we run *SDR#*. On the SDR front-end selection menu, to the right of the 'Play' button, choose 'RTL-SDR/USB'. If everything is properly configured there should be no problem; otherwise it will produce a message box indicating the device was not detected. If no error message is shown, click on the 'Play' button and proceed to adjust the range, speed and contrast of the **waterfall** to your own preferences. This so-called 'waterfall' is the dynamic on-screen spectrum (see figure 12) displaying the evolution of the radio spectrum with time, with frequency strength colour-coded.

Many dongles may be quite inaccurate in frequency, around 5 kHz as an average. This problem is due to the poor quality of the 28.8 MHz quartz crystal used internally. However, the stability seems to be acceptable, so we only need to perform a frequency correction using an option which *SDR#* provides. The best way to do so is using a frequency generator, but if you don't have one available, a less precise but nevertheless efficient way is to use a known frequency transmission for adjustment. However, not every commercial service transmitter may be as accurate as we expect, so we can check for several stations, then calculate the average offset and elect the best one. Once the selection is made, with the station tuned, open the front-end configuration window by clicking the button at the left of the VFO (variable frequency oscillator) indicator. At the bottom of the window there is the 'Frequency Correction' selection tool which can be increased or decreased until the VFO frequency displayed matches the real transmitter frequency. That value may be different when using other computers and dongles.

In order to overcome some of the problems *RTL-SDR* dongles present with de-sensing and overloading, we may need to adjust the RF gain level. On the test performed here, it was discovered that both RTL AGC and Tuner AGC on the *RTL-SDR* configuration window produced very unsatisfactory results, so a manual RF Gain is my recommended choice. Of course, in your environment it may be different, so electing the option that fits your station best will be required. It was discovered also that, when choosing positive gain values, the *RTL-SDR* produces mixing products and image signals (a copy signal similar to a harmonic) from strong nearby FM and TV broadcast stations. The cleanest and most interference free band was obtained with negative RF Gain, but such an option attenuates the received signals badly.

So, during the test performed here, the best result was obtained with a preamplifier at the antenna, which may be considered essential in some situations. Of course, in an environment that suffers high in-band ground interference, a preamp may actually make matters worse. But again, as the 136-138 MHz band is free from ground interference in Cuba, I found no problems when using the preamplifier. In fact, as the preamplifier attenuates out-of-band signals, it served both as an amplifier and a band-pass filter. After choosing a -9.9 dB RF Gain Level with the preamplifier working, no indication of *RTL-SDR* produced image signals was seen and still the satellite's signals were amplified.

The only interference detected was a medium strength TV carrier right at 138.0 MHz. However, when using the old Soviet era preamplifier with analogue receivers like the AOR, this carrier continued to be detected, so we can conclude it is the preamplifier which is producing the signal, not the SDR dongle. As that carrier is far enough from the NOAA-18 downlink at 137.9125 MHz, when using 50 kHz or less *Wide-FM bandwidth* it has no incidence—so it was ignored, and no correction measures were required. Recently, another interference signal showed up on the spectrum, at 137.500 MHz, produced by an image signal from a strong nearby broadcast transmitter at 101.500 MHz. But NOAA-17 is now decommissioned and there is no current satellite on this frequency that may be affected.

Figure 12 shows the *SDR#* screen with the software running at 2.0 Msps bandwidth, selected to show the entire 136-138 MHz band. Several satellite downlinks and instances of local interference can be seen. From left to right:

- (1) 136.060 Computer generated Carrier
 - (2) 136.200 Computer generated Carrier
 - (3) 136.380 GOES-3 VHF Beacon and its SideBands at ± 33 kHz
 - (4) 136.800 Airplane ACARS
 - (5) 136.885 Steady Carrier (Computer?)
 - (6) 136.975 Airplane ACARS
 - (7) 137.020 Weak Steady Carrier (Computer?)
 - (8) 137.100 NOAA-19 APT
 - (9) 137.500 Image Signal of FM Broadcasting at 101.500 MHz
 - (10) 137.770 NOAA-19 TIP Beacon
 - (11) 137.999 Mix product of a TV NTSC Carrier
- (The three wide horizontal lines are distant lightning)

When using *EAIKR's SDR package*, many plugins are already included. However, for APT reception we only need the following two: 'Satellite Tracker' and 'WAV Recording'. In slow computer environments, disabling other plugins is recommended but not essential. The Satellite Tracker is not commonly included, but a version for *Orbitron* (a free satellite tracker program) can be downloaded from the *SDR#* website at

<http://www.sdrsharp.com>

This website also includes an easy step-by-step configuration tutorial. David Taylor also provides a Satellite Tracker plugin compatible with *WXTrack* on his website at

<http://www.satsignal.eu/software/wxtrack.htm>

The tracker plugin is not essential, but greater success was achieved with it.

If all previous requirements were completed correctly, *SDR#* should now be ready for APT reception. A few minor configurations are pending and may or may not be needed for several computer scenarios.

The First APT Trial

When attempting the first APT trial with *RTL-SDR*, a 1.024 Msps bandwidth was chosen with a 32768-point FFT

waterfall. Wide-FM mode with 50 kHz was selected and the decoded audio was fed directly into *WXtoImg* using the 'Stereo Mix' setting on the soundcard recording tab to adjust the audio level to the computer's requirements. However, an extremely choppy picture was obtained due to computer slowness. The higher bandwidth, added to the excessive resolution of the waterfall and the *WXtoImg* requirements, forced the microprocessor to run at high rates; so many samples were being lost and not processed. The audio sounded perfect, but some short 10 to 50 milliseconds gaps were present, causing *WXtoImg* to lose sync quite a lot. The resulting picture is shown below in Figure 11.

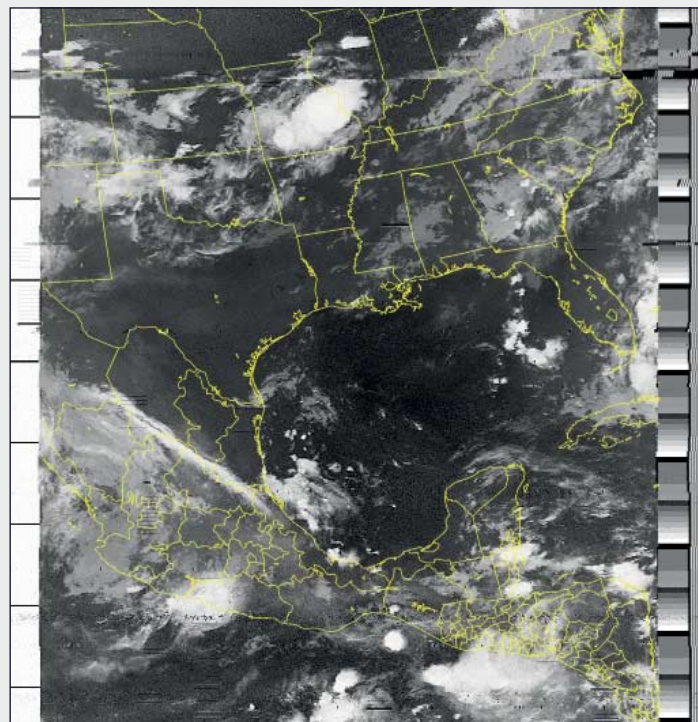


Figure 11
An early morning NOAA-15 pass received using *RTL-SDR*. The author's first attempt at reception using *SDR#*, this image features many loss of sync issues.

A way to reduce computing resources to a minimum was needed. Of course, with the fastest modern computers that may not be necessary at all, and the setup described above may work perfectly.

Modifications for Older Slow Computers

In order to achieve good results with slow computers during a NOAA satellite pass, the *RTL* bandwidth should be decreased to 0.25 Msps and the FFT resolution to 512 points: such settings affect only the waterfall and cause no degradation of the decoded audio. To reduce even more the computing resources, the WAV recording plugin of *SDR#* could be used. On its tab just select 'Audio', with a 'Sample Format' of '16-bit PCM Mono', and a 'Sample Rate' of between 8 and 15 kHz. Press the 'Record' button during the satellite pass and stop when the signal is too noisy. These steps reduce the amount of computing resources, which is very useful when using slow computers. However, the generated WAV file sample rate is incompatible with most APT decoding software so some sort of re-sampling must be done.

The free audio handling tool, **Audacity**, which can be downloaded from this URL

<http://audacity.sourceforge.net>

may be used for this purpose. In order to adjust the sample rate, open the recorded WAV file in *Audacity*. The file's current sample rate will be shown in the bottom left section of the program's main window. Just edit the number by changing it to '11025'. Optionally, an audio boost may be

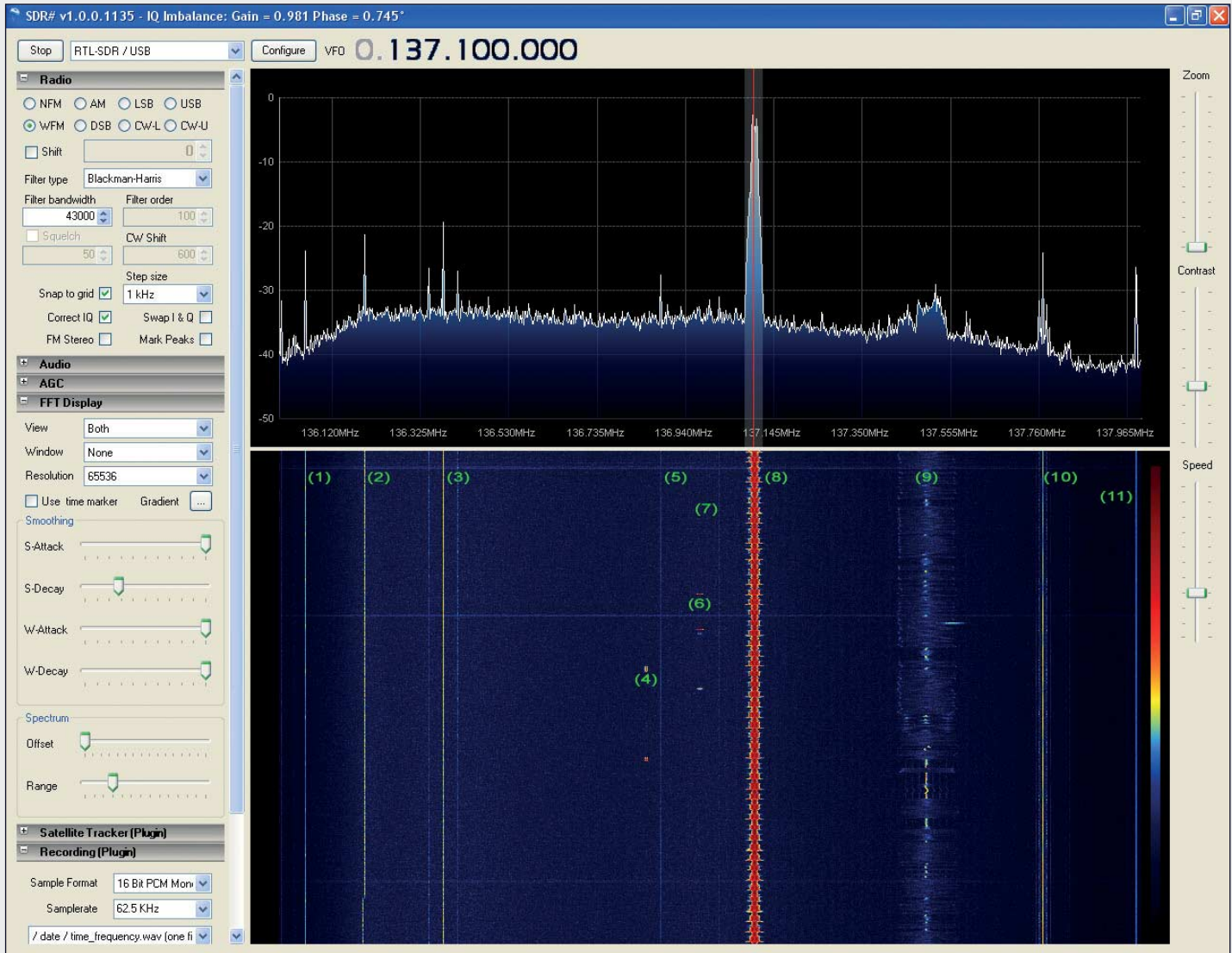


Figure 12 - A Screen Capture showing SDR# in operation

performed with the tool 'Amplify...', which you find under the 'Effect' menu. I used a 15 dB boost with great results but a different value—or even no boost at all—may be best with your setup. Once all the audio post-processing requirements are completed, save the audio file using the 'Export' option under the 'File' menu. Here, be sure to select 'WAV (Microsoft) signed 16-bit PCM' for the file format, complete the saving and we are ready to go. Now, we can open the saved wave file with our favourite APT decoding program and process the picture. In very slow computers there may still be a few samples lost, but the number should be low enough to decode images satisfactorily, as shown in figures 8 and 9.

As previously described, a 50 kHz Wide-FM mode was being used for receiving so far, but if we want to reduce the amount of noise to a minimum and extract the greatest detail from the signal as possible, a narrower filter may be required. During a test, I tried slowly reducing the filter bandwidth to obtain a better satellite downlink spectrum, and found a 43 kHz filter to be the best. This smaller value may produce noisy pictures when Doppler compensation is poor due to factors such as old Keplerian elements or a time mismatch, and frequency compensation was found then to be essential. This was achieved by using the **Satellite Tracker Plugin** in conjunction with *Orbitron*, otherwise the downlink signal could fall out of the filter, making the whiter pixels look noisy. When using this plugin, it is also essential to perform the dongle frequency correction (described above) to avoid differences between the frequency tuned by SDR# and the

satellite downlink signal frequency due to the poor quality of the 28.8 MHz quartz crystal.

Conclusion

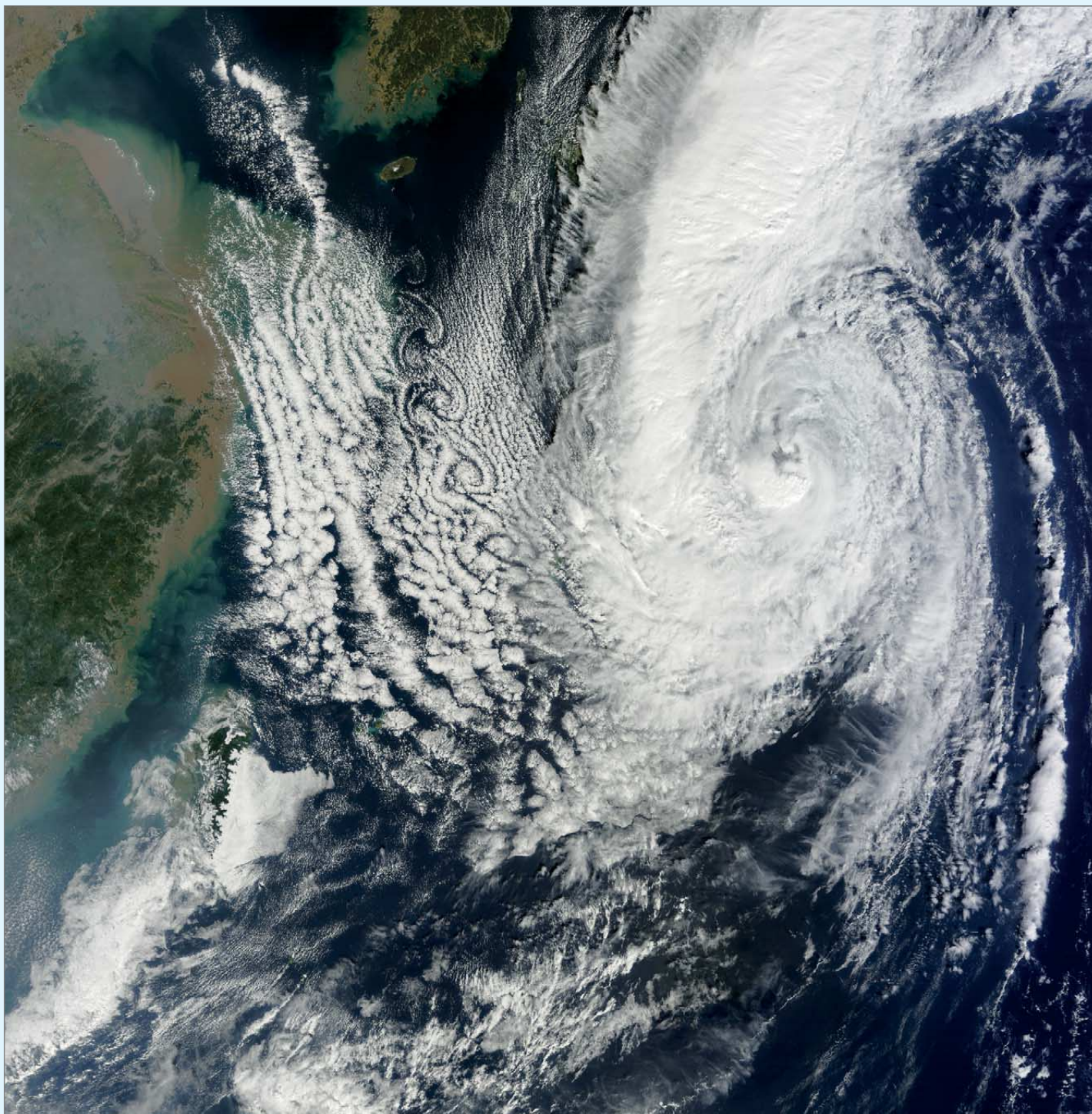
In this discussion, we have discussed several low budget solutions performed by an APT user in Havana, Cuba. Traditional analogue receivers and new but yet economical solutions were explored. Unfortunately there may not be many more years remaining for APT users, as the evolution of technology imposes new digital downlink systems. However, for beginners and low budget stations APT is still an option. The cheap RTL-SDR dongles may be used for new downlink formats like LRPT, LRIT, HRIT and HRPT but the decoding tools are yet to be written or adapted, and new experiments must be done. Let's hope more software developers take a look into this fascinating and economical solution.

References

- 1 Moxon antenna
http://www2.mmae.ucf.edu/wiki/Moxon_antenna
- 2 MoxGen
<http://www.ac6la.com/moxgen1.html>
- 3 MMANA-GAL Basic
<http://hamsoft.ca/pages/mmana-gal/>
- 4 WXSat
http://www.hffax.de/html/hauptteil_wxsat.htm
- 5 WxToImg
<http://www.wxtoimg.com/>
- 6 SatSignal
<http://www.satsignal.eu/software/satsignal.htm>

Weather Systems in Collision

Les Hamilton



A tropical depression that formed over the ocean, northeast of the Pacific island of Guam in early October 2012 rapidly deepened to become category-3 **Typhoon Papiroon** by October 14, with peak wind intensity of 165 kph. By the time NASA's *Terra* satellite acquired this MODIS image on October 18, Papiroon was winding down: sustained winds were reduced to 65 kph and the typhoon had lost the distinct eye and spiral arms it had sported days earlier.

But what makes this image particularly interesting is the formation of Von Karman vortices to the west of Papiroon. Though we think of ocean water and air as completely different materials, they are both fluids. And when a fluid encounters an obstacle, it can form spiral

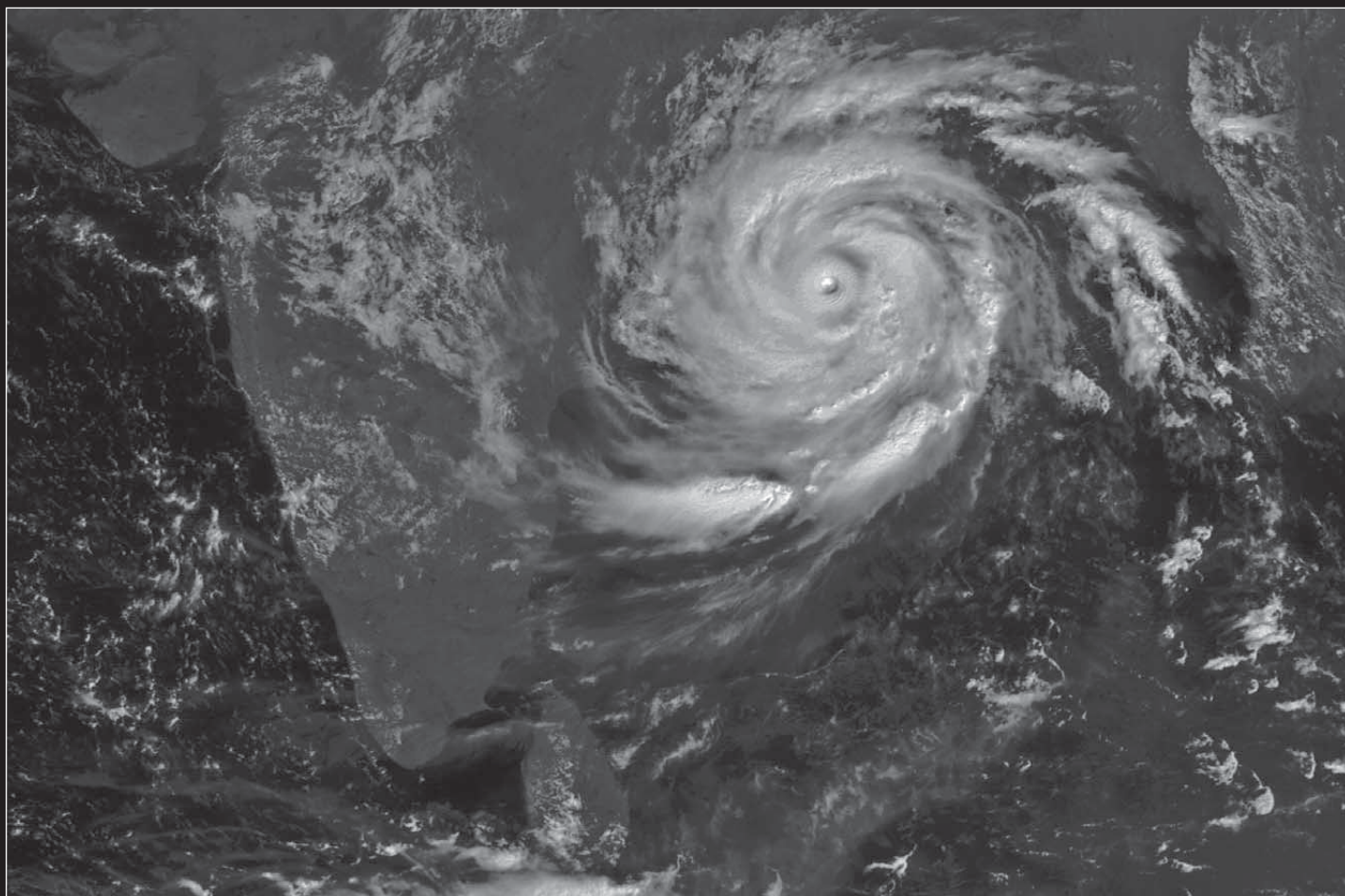
eddies. The air-flow obstacle responsible for these vortices was almost certainly the mountain of *Hallasan*, which comprises the bulk of South Korea's Jeju Island. Hallasan is a Pliocene shield volcano which, rising to 1950 metres, is South Korea's highest point. The volcano is probably extinct, the last recorded eruption from its flanks being in the year 1007.

In the image above, the spiral eddies extend for over 700 kilometers to the south of the island.

*Image: MODIS Rapid Response Team at NASA GSFC
Image processing: SmoothMODIS
Text sources: Wikipedia and NASA Earth Observatory*

CYCLONE PHAILIN

Les Hamilton



You would hardly imagine that an innocuous tropical depression that formed in the Gulf of Thailand on October 4, 2013 would eventually turn into the strongest cyclone ever recorded in the Indian Ocean. But that's exactly what did happen. It drifted across the Malay peninsula into the Andaman Sea, gaining strength as it continued to track northwest over the Bay of Bengal. Five days later it was classed as a *Very Severe Cyclonic Storm*, equivalent to a Category-1 hurricane. Named *Phailin* (sapphire), the storm continued to intensify and, on October 11, became the equivalent of a Category-5 hurricane, and by the early hours of the following morning *Cyclone Phailin* was officially stated to be the strongest storm ever measured in the Indian Ocean, and the most severe to hit the subcontinent since *Cyclone Odisha* in 1999, when over ten thousand lost their lives. According to the US Navy's weather service, wind speeds at sea were gusting at up to 310 kph and it was feared that the scale of damage caused by *Phailin* could exceed that of Hurricane *Katrina* which hit New Orleans in 2005. To place this storm in context, it was twice the size of *Superstorm*

Sandy which devastated the east coast of America in 2012 ^[1].

Although *Phailin* weakened slightly as it approached the Indian coastline, it still packed sustained winds of 250 kph when it made landfall on the shores of Odisha and Andhra Pradesh on October 12. *Phailin* tore down power and communication lines and knocked out road and rail links in addition to flattening thousands of coastal homes, uprooting trees and overturning cars and trucks; hundreds of thousands were forced to flee their homes and spend the night in makeshift refuges. But the evacuation effort—said to be the biggest in India's history for such an event—kept the death toll low.

A major difference from fourteen years ago was that present-day communications are much better with the proliferation of cellphones and television, and the arrival of *Phailin* was predicted well in advance. This enabled the authorities to be much better prepared, particularly by setting in motion the biggest storm evacuation in India's history. Officials in Orissa claimed

that 873,000 people were moved from the coast to schools, temples and government-run shelters before *Phailin* made landfall, while over 100,000 more were evacuated in Andhra Pradesh. As a result the death toll was just 27, far fewer than had been feared. It was also fortunate that *Phailin* hit at low tide, reducing the effect of its four metre storm surge.

Phailin left made more than half a million people homeless, damaged or destroyed at least a quarter of a million buildings, and caused an estimated loss of \$320 million through the destruction of five thousand square kilometres of paddy crops. But there were tales of good fortune: 28 sailors whose ship sank in the cyclone were rescued from the Bay of Bengal. And in another remarkable story of survival, 18 fishermen trapped offshore in rough seas abandoned their trawler as the cyclone approached and successfully swam to shore.

Reference

- 1 Superstorm Sandy Savages States - GEOQ 36, p.42

Another Tale from Yesteryear

Francis Bell

For the second time in the space of just a few months, I was telephoned by the widow of one of our long standing GEO members. This time the call was from Joanna Swan, to pass on the sad news relating to the death of her husband Alan.

Alan had been a member of GEO since our group was established in 2004 and was very supportive of our activities, together with his own live home live reception of weather satellites. During my conversations with Joanna, I learned of Alan's early work with the reception of *UoSATs* 1 and 2 (*Oscars* 9 and 11) as well as the early NOAA satellites and *Meteosat*. Joanna remembered visits to Surrey University's campus and its ground station in the early 1980s, at the time when the university was becoming innovative in the production of low-cost satellites. We agreed that those early days, with the skills which they developed, lead to the establishment of today's very successful company, *Surrey Satellite Technology* (SSTL).

Over the telephone, Joanna explained that Alan had left large quantities of satellite equipment and she wanted, if possible, that these items should go to a good home. After some delay I personally visited her home and tried to assess the best way to dispose of the many items Alan had left. I brought some of these away, together with 13 years worth of *RIG Journals*. Where possible, I have found most of these items good homes; however, one item I still have left is a *Mitsubishi Video Printer model P55B*. I cannot quite date this printer, but it must date to some time during the early 1980s. I know these printers were used in the early days of weather satellite reception, before the advent of home computers and the electronic storage of images.

Figure 1 shows a photograph of this video printer and figures 2 and 3 show two scans of typical images which it produced. I would be disappointed to see this item scrapped but have no use for it myself. If any GEO member would like to have this video printer—or indeed knows of any other club member who would—either for



Figure 1
The Mitsubishi printer and monitor, which Alan Swan used during the 1980s.

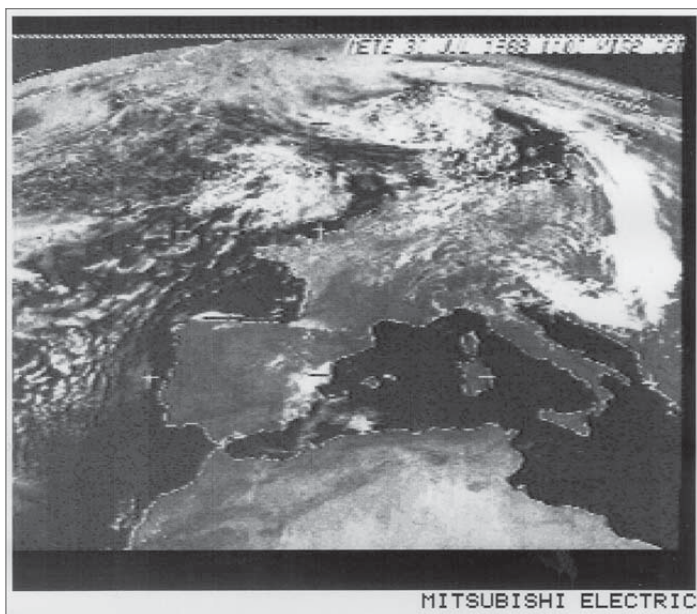


Figure 2

This is an image transmitted by *Meteosat-2* on July 30, 1988 and printed on Alan Swan's Mitsubishi printer. In those early days, a visible image of the Earth was taken every 30 minutes, but processing by the ground station would divide the original image into many sections including nine standard resolution visible sections ready for general dissemination. Section number two in this group is shown above. These images were sent via a transponder on the imaging satellite, unlike today where images are disseminated via a different commercial satellite using a different transmission standard (DVB).

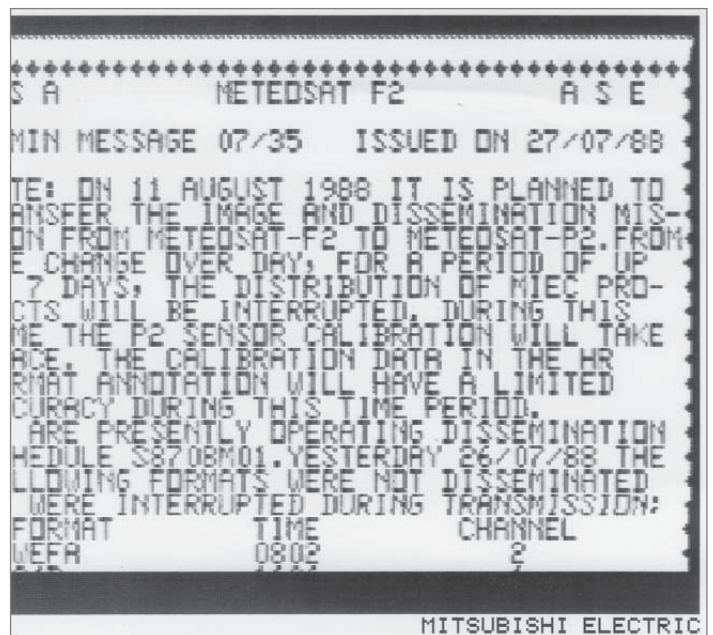


Figure 3

This is an image printed on the Mitsubishi printer, and illustrates the way in which EUMETSAT communicated with its user community in those days. The date on the print (1988) reveals that this was before the widespread use of the Internet, which EUMETSAT use today for such messages. Note that although the very left of the image is missing from this print, the message still makes sense.

personal use or for a museum-type collection, please get in touch with me at

francis@geo-web.org.uk

There would be no cost except for the carriage.

GEO will miss Alan Swan. In addition to his early amateur work on weather satellite reception, and his keeping up to date in the following years, Alan had a distinguished professional career with BOC as an overseas engineering manager. I hope that some of his electrical and astronomical instruments find suitable homes, and where appropriate continue to be used.

Get Space!

Interactive Space and Science Experience at Broadwater School

Francis Bell

I was delighted to be invited—on behalf of GEO—to a *Spacelink Learning Foundation* meeting at Broadwater School last July, where I made a presentation to the attending school students and provided a stand running live weather satellite images. Last December GEO provided *Spacelink* with a one-page flyer for its member schools, relating to direct weather satellite reception. The flyer was illustrated by current NOAA and EUMETCast images, together with a brief summary of the equipment needed for live satellite reception. Feedback indicated that this information was well received, but the numbers actually installing a receiving station in their school is unknown—but at least they have the information.

My relations with *Spacelink* go back to the mid 1990s when I started the *Millennium Satellite Project*. This had the aim of launching a UK-built satellite dedicated to school interests, to provide easy access to Earth images, international communications and scientific data. The project was intended to be 50% funded by the *Millennium Commission*, in the belief that NASA would provide a free launch as a secondary payload with a commercial satellite. But after about two years the *Millennium Commission* short-sightedly turned down the project leaving it rather stranded. As a consequence, my educational efforts were redirected towards schools using existing satellite missions to sustain or generate educational interests in space science. However, other members of my group continued with the project and subsequently founded the *Spacelink Learning Foundation*, which still runs today.

I was told to expect an attendance of some 12 schools, each bringing about ten students aged 10-16, and I planned equipment and displays which I thought would be appealing and appropriate for this age group. These included live EUMETCast reception and sequences of diverse recorded satellite images, along with a stand displaying GEO literature and posters kindly provided by EUMETSAT.



Students assemble for the formal presentations.

The day went according to plan, and featured a number of presentations given by leading space scientists.

The main programme included:

- 'Living in Space' by Dr Helen Sharman, the first UK woman in space
- 'The Sun Seen from Space' by Dr Lucie Green of the Mullard Space Laboratory, who is often seen contributing to space and science related programmes on TV. She is a trustee of *Spacelink*
- 'Saturn and its Moons' by Shelia Kanani, a member of the *Spacelink* management team.



GEO's stand ready to receive visitors.

I was particularly interested to hear Helen Sharman's presentation and renew my friendship with her after a gap of almost 20 years. Helen was the first British cosmonaut when she spent eight days on the Russian *MIR* space station in May 1991. During her time on *MIR* there were planned amateur radio links with UK schools. My own school, the Royal Grammar School, Guildford, was allocated a slot in the *MIR* schedules and issued with the callsign GB7JUNO. At that time I followed events closely and had the privilege of, opportunistically, being the first amateur station to talk to Helen (using the callsign GB7JUNO) while the space station was crossing over the UK.

After her return to Earth, I was so pleased when Helen accepted my invitation to visit the Royal Grammar School. After several visits Helen became supportive of my Millennium Satellite programme, and subsequently the follow-on *Spacelink Foundation*, of which she is now patron.



Cosmonaut Helen Sharman pictured with Francis Bell.



Dr Lucie Green of MSSL pictured with GEO Membership Secretary David Anderson.

Helen came over to see the GEO stand, and I think she was impressed to see what we were doing towards enabling schools the opportunity to run their own satellite station. Later in the day, and equally satisfyingly, Lucie Green also visited the GEO stand. In both cases I gave them recent copies of *GEO Quarterly* plus other informative literature.

Between the presentations, students visited the various stands located in the hall. I was impressed with the genuine interest that they showed when visiting the GEO stand, and in return I gave brief presentations about weather satellites, their history and how to receive images at home or at school. The students all departed with literature and the EUMETSAT posters showing whole Earth images.

Others stands in the hall were provided by:

- ESERO and their UK 'Space Education Office'
- SSTL (Surrey Satellite Technology Limited)
- MSSL (Mullard Space Science Laboratory)
- STEMNET (Science, Technology, Engineering and Mathematics Network)
- Kingston University Aerospace Engineering Department

I have seen feedback from the visiting schools, and all said what a rewarding and interesting day they had experienced. I hope that GEO contributed in some way to their satisfaction.

My specific thanks to David Anderson who helped with all the GEO activities, spending two days of his time to be at the event.

For further information on the *Spacelink Learning Foundation*, visit their website at

<http://www.spacelink.org>



Francis Bell, with students from a Cranleigh school who visited the GEO stand.

GEO Symposium

To be held on Saturday, April 26, 2014 at the
National Space Centre, Leicester

In the past the NSC, with its high profile space exhibition area, has proved to be a popular venue for some of GEO's annual meetings. We hope the 2014 symposium there will be well supported by our members, friends and other interested visitors.



The coming Symposium is particularly important because of the technical issues relating the **EUMETCast transmission changes** many of us will face in the next 18 months. An important objective for this meeting is to keep members informed about, and offer practical information and demonstrations relating to, the upgrading of the **EUMETCast Europe Service** from DVB-S to the DVB-S2 standard.

The Saturday programme will be along the following lines:

- 9.00 - Arrival and registration
- 9.30 - 12.30: Presentations
- 12.30 - 2.00: Lunch and viewing the NSC exhibition areas
- 2.00 - 4.00: Presentations
- 4.00 - 4.30: Afternoon break
- 4.30 - 5.00: GEO Membership AGM

Those involved in setting up the exhibition and demonstration area for the Symposium will be able to do so on the Friday afternoon.

The programme is not finalised at this time, but we already have a commitment from **EUMETSAT** to provide us with a technical speaker relating to the new **EUMETCast** dissemination standard.

Other topics to be covered could include results from the GERB instrument being carried on the MSG satellites and the use of software defined radio (SDR) for polar orbiting satellite reception.



Any member wishing to make a contribution, be it a presentation, a suggestion for a topic to be covered or a workshop for the exhibition and demonstration area, is invited to get in touch with Francis Bell at

francis@geo-web.org.uk

The cost for this one day symposium will depend on numbers attending but should be in the range £15 - £20. Note this fee includes free car parking and a free pass into the NSC exhibition: good value for money.

Fuller details of the programme, which will include information on pre-registration, will appear in the March 2014 *GEO Quarterly*, and on the Group's website at

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

But in the meantime, do write the date, April 26, 2014, into your diary.

Weather Watching away from Home

Part 2: Weatherfax Charts

Alistair Dunlop

A previous article ^[1] has covered the reception of weather satellite images when away from home. Sooner or later, most weather observers will want to predict the weather; if only to satisfy the family cry: 'I know what it's done, what is it going to do?'. Whilst this is easily explored using the Internet, forecasting presents more problems away from home. Assuming that you are not prepared to spend large sums on mobile Internet, this article describes one source of wireless data that is free, and which can help to indicate future weather trends even for the nonexpert.

Many articles have appeared in *GEO Quarterly* by Peter Wakelin and others on the interpretation of weather images, and this article does not pretend to cover this in detail. It is intended to be a rough outline of the process only. Forecasting generally needs additional data over and above a received image. This usually takes two forms: first, the synoptic pressure chart with contour lines of constant pressure known as 'isobars', frequently with weather fronts added; and secondly, winds at altitude—usually at a pressure of 800 millibars or thereabouts. The pressure charts are reasonably familiar from TV and other weather forecasts; the pressure drives the winds and frontal systems are usually indicated, so this type of chart is perhaps more useful for the nonexpert and easier to interpret than the wind charts, although the winds at altitude are perhaps more useful for detailed forecasting.

Before the satellite era, raw weather data were gathered by weather ships out at sea and from meteorological aircraft as well as a number of land-based meteorological stations. These data were then used to produce the various charts which were broadcast to distant stations using a form of facsimile transmitted in the short-wave radio bands. These transmissions still continue today, even though much of the meteorological information is gathered by satellites, and completed charts are disseminated in the same manner. The major advantage of weather facsimile broadcasts (usually abbreviated as weatherfax or wefax) is that they can be received on a simple short-wave receiver and decoded using readily available computer software.

There is a flourishing market for this system for yachts, fishing boats and other small craft sailing away from coastal waters. The basic requirements are simple—a short-wave receiver with aerial and a computer to decode the information. Figure 1 is a typical surface chart as received in a suburban area; as can be seen, it has significant noise. You should be able to do better when well away from houses ^[2] but even so, the main weather fronts and areas of high and low pressure can be related to the main land masses.

Short-Wave Reception

The short-wave band, also known as the High Frequency (HF) band, lies between 3 MHz and 30 MHz. To receive wefax signals, the radio must be capable of **Single Side-Band** (SSB) reception. As not all short-wave radios can do this, look for the specific claim of SSB reception; if the specification only states 'short waves', this usually means that it will only receive amplitude-modulated (AM) programmes used by major broadcasters such as the BBC World Service. Additionally, the radio should be capable of fine-tuning across the frequencies of interest. Most radios have a main tuning system, usually synthesised, which tunes in fixed steps, with a second fine-tuning control for intermediate frequencies. For wefax reception, you require the ability to tune in main steps of 1 kHz or less. Some receivers only tune in 5 kHz steps in the short-wave bands; whilst this is adequate for the AM broadcasters, it makes fine-tuning for SSB reception difficult since the fine-tune control must cover ± 5 kHz or more and you need to tune to an accuracy of at least 100 Hz.



Figure 1 - A typical weather facsimile chart.

Every receiver needs a good aerial system. For reception of reasonably powerful wefax, a wire aerial of around 3 meters or so is usually adequate. Ideally, this should be as high as possible and as far away as possible from sources of interference such as mains leads and computers. In built-up areas, the set-mounted telescopic aerial is usually too prone to interference to be useful although it may be adequate well away from civilisation. Too long an aerial may give the problem of too much interfering signal level, leading to overload; try different aerial lengths if you have reception problems.

Connection to the computer is easy, using a suitable stereo or mono miniature audio jack-plug cable from the receiver output (headphones, tape outlet etc.) to the computer line-in or microphone input. Check and adjust the audio levels, particularly if you are using the microphone input on a laptop. The software you use will have some way of indicating overload but it is possible to totally overload some microphone inputs to such an extent that it appears that no signal is being received. This has caused me confusion in the past. Note that SDRs are already using the computer, so these systems require either a second soundcard or a utility such as 'Virtual Audio Cable' ^[3] to transfer data streams between programs.

Frequencies

There are several guides to the frequencies used for wefax transmissions. One of the most comprehensive is the **US Coastguard** ^[4], which covers the world but may not be up to date. It was dated February 2012 when I last looked. However, these frequencies rarely change, although the transmission schedule of when charts are transmitted may alter with the seasons.

In Europe, the two main broadcasters are the **German Weather Service** based in Hamburg and the **British Royal Navy** based at *Northwood* (note that the transmitters may be some distance from these actual locations). Both of these stations transmit a whole range of weather charts—Hamburg even covers ice conditions in the Baltic Sea, should you be sailing there in winter. The main frequencies used are shown in Table 1.

Hamburg also broadcasts the transmission schedule at 11:11 UT which is a useful guide to all of the charts transmitted.

Hamburg Weather	Northwood
3855 kHz	2618.5 kHz (20:00 to 06:00 UT)
7880 kHz	4610 kHz
13 882.5 kHz	8040 kHz
	11 086.5 kHz (06:00 to 20:00 UT)

Table 1 - The main European weatherfax frequencies.

All three frequencies are continually used for Hamburg but generally I have found only the lower two (3855 and 7880) to be readily receivable in the UK. I have found that generally only the middle two of the *Northwood* frequencies are readily receivable in the UK. In all cases, the receiver should be set on USB and tuned approximately 1.5 to 2 kHz below the frequency shown—this will be indicated as 2 kHz low (*i.e.* 3853 for Hamburg) if the set tunes in 1-kHz steps. Fine tuning can be carried out once a signal is received.

Decoding

There are several programs capable of decoding wefax transmissions. Old favourites such as *Wxsat* and *JVComm32* will decode both weather satellite APT signals and HF wefax. A more modern program is *Fldigi* [5], which will decode almost any Amateur Radio transmission and wefax, but not APT at present. This is a modern program with a number of add-ons designed to reduce noise and so on. Having said that, it is fairly intuitive to use provided you configure the soundcard properly. In all cases, the usual setting is HF-Fax or Wefax, IOC 576 and 120 lines per minute. This will usually come up automatically but may need checking if the resulting weather chart looks odd. You will almost certainly need to adjust the slant setting in order to produce vertical edges on the chart—**always read the manual for whatever software you are using.**

The wefax signal itself sounds like a chirrupy tone (not unlike APT) when a chart is being sent, and a single tone or no signal when not. It consists of two tones, one for black and one for white, and these alternate so that the spectrum displays two peaks. All the programs I am aware of show the spectrum of the received signal with two tuning markers on the screen; with earlier programs (*e.g.* *JVcomm32*) you have to fine-tune the radio to line up the received signal peaks with these markers. Lining up the signal peaks accurately with the markers is important for good results, hence the need for a smooth, slow fine tuning control. With *Fldigi*, you can move the signal markers with the computer mouse, so fine-tuning of the receiver is less important. *Fldigi* also has a reasonably good Automatic Frequency Control (AFC) which will lock on to the relevant tones if they are somewhere in the receiver audio passband, but this process can become confused with particular types of interference. The wefax signal has specific start and stop tones which have a characteristic buzz; the programs detect this to stop and start chart recording so you can leave the system on automatic mode waiting for the next chart. *JVComm32* lets you set up specified recording times so you don't have to record everything to get the chart you want, nor sit up all night in waiting by the on-off switch. But all programs will record all received charts in a specified memory folder and it's simple to delete the unwanted ones. It is also possible to record to a tape-recorder and decode later by playback into the computer; this method avoids keeping the computer powered up all the time but does depend on the recorder and tape quality.

Weather Charts

The wefax transmissions include a wide variety of charts, only some of which are useful for our purposes. In between these charts are many other more specialised ones. Note that chart content and timing may vary, so do check with the transmission schedule. In my experience, *Northwood* frequently changes the timing and content of transmissions while *Hamburg Weather* keeps to its published schedule. The most useful charts are the **Surface Analysis** and the **Surface Prognosis** ones. The former contains the surface pressure isobars and contributing weather station observations at a particular time, usually 06:00 or thereabouts. The chart itself is somewhat cluttered as it contains a large number of individual numbers as well as the derived isobars. The latter show the predicted surface isobars for 1, 2 or 3 days ahead, which help to forecast future weather. *Hamburg Weather* transmits many charts but some of the

Surface Analysis	Surface Prognosis	
	T+24	T+48
07:43	07:17	07:30
11:45	12:05	12:20
18:00	18:34	18:47

Table 2
Useful Analysis and Prognosis
Transmissions (all in UT)

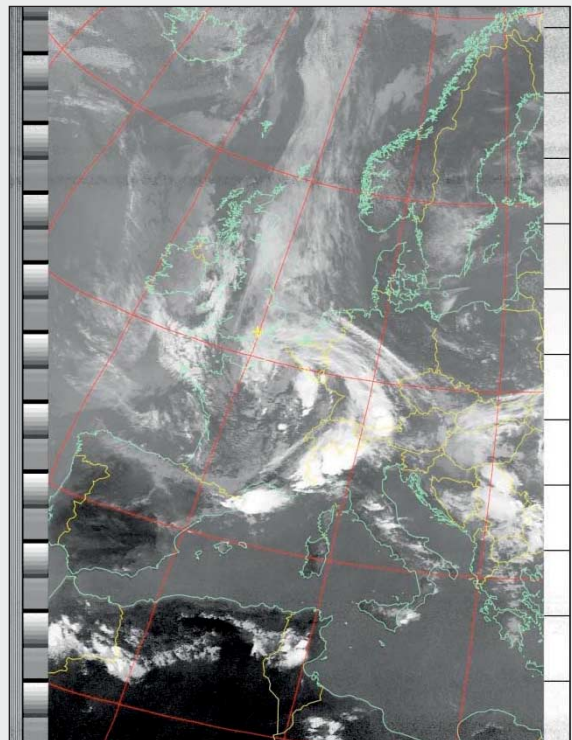
most useful sequences are shown in Table 2 (all times in UT). It also broadcasts the transmission schedule at 11:11 UT which is a useful guide to all of the charts transmitted.

Depending on the aerial system used, the local level of interference and the time of day, there will be more or less noise on the received chart. Usually, the lower frequencies are better at dawn and dusk and the higher ones better during the day, but a quick check will show you what is best for your location. At certain times and locations the chart may display a pale 'ghost' copy, shifted a little to one side: this is caused by the radio signal arriving first by the ground wave then, a little later, via reflection from the ionosphere.

Interpretation

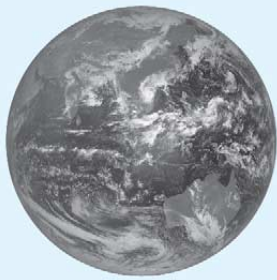
A few basic notes on interpreting the charts. High pressure areas ('H' on all charts) generally indicate settled weather, usually sunny and warm with clear skies in summer. Low pressure areas ('L' on *Northwood*, 'T' on German charts) usually denote unsettled weather. Close pressure lines (isobars) mean strong winds which blow from High to Low pressure. In the northern hemisphere, the *Coriolis* effect causes these winds to spiral out clockwise from High pressure areas and spiral in counter-clockwise to Low pressure areas. Weather generally travels in the direction of upper level winds, so identification of Highs and Lows tells you roughly in which direction the weather is travelling: the closeness of the isobars tells you how fast, and the fronts usually denote cloud and probably rain.

Note that accurate weather forecasting is significantly more complicated than described above. There are many excellent books and articles on the subject if you wish to go into it in more depth.



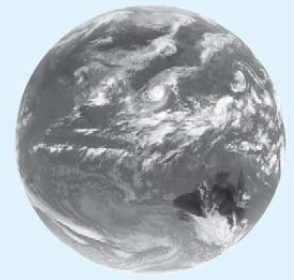
This infrared APT image 15:50 UT on August 24, 2013 while the surface prognosis chart in figure 1 relates to 06:00 UT the following morning. Weather charts are based on various conical projections so won't overlay on APT images without some extra geometric processing, but it is usually possible to cross-reference specific features such as fronts, Highs and Lows by eye. In this case, the 'hook' of clouds seen southeast of the UK in the APT image roughly corresponds with a Low pressure area. The surface prognosis in the wefax chart shows this remaining more or less stationary while the associated front over France is reducing in strength under the influence of High pressure to the southwest. This would imply cloud giving way to sunshine in the west of the UK although, as the front was predicted to remain over the southeast, it would remain cloudy there. The High pressure area has widely-spaced isobars, so winds are likely to be light and will spiral outwards clockwise, then anti-

concluded on page 42



Download Geostationary Satellite Imagery

Direct from China's Fengyun Satellite Data Center



Les Hamilton

Did you know that near real-time imagery from China's **Feng Yun 2D** and **Feng Yun 2E** geostationary satellites is available for free download from the *Fengyun Satellite Data Center* (FSDC). The URL for this page is

<http://satellite.cma.gov.cn/>

Registration

As with most sites of this kind you have first to register, though there is no charge for doing so. On first visiting the site, you will notice the **Sign In/Sign Up panel** at top right (figure 1). Click on 'Sign Up' to open a new page featuring the panel shown in figure 3. Complete the fields, including both a username and password of your own choice, then tick the 'I accept box' and click the **Sign Up Button** at the foot of the page (not shown in figure 3). You should now be able to log into the website by entering the **Username** and **Password** you selected. Be sure also to enter the four character verification code into the field provided. If you tick the 'Stay Signed In' box, you will not need to enter these details again to access the site (figure 2). This now entitles you to the basic service of downloading 500 MB of data per day.

Available Imagery

When you sign in to the *Fengyun Satellite Data Center* website, the middle panel at the top of the page provides access to the data from numerous satellites, by default from the Chinese low-Earth orbiting craft (FY-LEO). To access data from the geostationary Feng Yun 2 craft, select the FY-GEO panel (figure 4). The available satellites are FY-2D, FY-2E and FY-2F. FY-2C is also offered but only for historical data prior to satellite's decommissioning in early 2009. At present the most recent satellite, FY-2F, is mainly concerned with RSS operations, so what follows relates to FY-2D at 86.5°W and FY-2E at 104°W, the satellites that produce regular **Normalized Geostationary Projection VISSR** data. This supplied as 205 MB HDF files, each containing five channels of full-Earth imagery: four in the infrared and one in the visible. The five images measure 2750 pixels square and have a resolution of 5 km/pixel. Additionally, each file also includes a high-definition version of the visible image that measures 11000 pixels square and has a ground resolution of 1.25 km/pixel.

Ordering FY-2 Files from FSDC

First, from the tick-boxes that appear at the top of figure 4, check the satellite you are interested in. Next, click the mouse in the **Data Name** field (initially blank), and when the 'Select' panel opens, click on the **Visible and Infrared Spin-Scan Radiometer** option.

Next, select a **Start Date** and **End Date**, which should be the same if you have a specific day in mind (usually, I would imagine, the current date). Clicking on either data field reveals a pop-up calendar where you can choose the date with a mouse-click (figure 5). As for time, the sun is overhead in China at around 05:00 UT, so a selection of a few hours centred on this time provides the best illuminated images. Finally, click the **Search Button** to reveal a new page listing

the available passes within your selected time span (figure 6). If you click on the small square icon in the third column, you can check a quickview of the selected image before downloading it.

All you need do now is to check the tick-box against the file you require and click the **Add to Cart Button**. The next screen allows you to edit the contents of your cart



Figure 1 - The Sign In Panel



Figure 2 - Signing in to FSDC

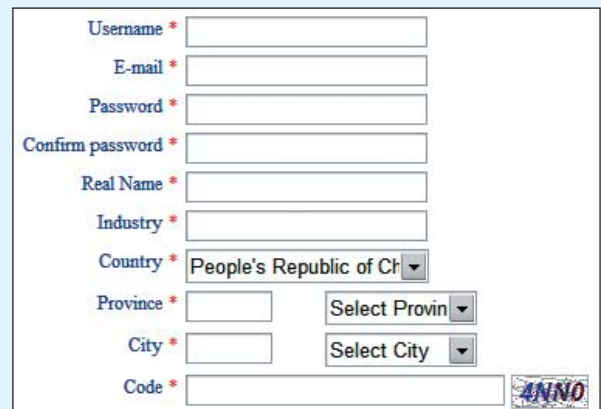


Figure 3 - The required Sign Up information panel



Figure 4 - The default Selection Panel for FY-2 satellites

if need be, but if you know what you are doing you will more likely just click the 'Next' button at this point, which submits your order.

Recovering Ordered Files

A few minutes after ordering a file, you will receive an email containing a link that will allow you to download your file(s) by FTP from

fy3-ftp.cma.gov.cn

My FTP software refuses to recognise this, though this may well be due to my own shortcomings in understanding how to effect this.

What I have found to be the best and simplest way to recover files is via the **MyOrders** option on the menu bar at the top of each page of the FSDC website. Click this to open a list of your ordered files (figure 7). Note particularly the final **Download** column; when the link appears here, click it to move on to the final page containing the direct download link for the file. After the wait of five minutes or so before your download becomes active, refresh your browser to display it—or reload the browser.

Displaying FY-2 Geostationary Images

Many *EUMETCast* users already possess software that can open the Feng Yun-2 HDF files and display its imagery: it is David Taylor's *GeoSatSignal* (registered version only). From the **File** menu, select **Open one**, navigate to the HDF file, and double-click on it. *GeoSatSignal* has tabs for displaying the

- channel-1 thermal infrared image
- channel-3 water vapour image
- channel-5 visible light image
- channels 1+5 false colour image

There is also a tab for remapping a selected area of the image into a variety of projections (orthographic, Mercator, etc).

The latest version of *GeoSatSignal* can be downloaded from

<http://www.satsignal.eu/software/geosatsignal.htm>

If you are not a registered user of *GeoSatSignal*, there is a freeware alternative that I have compiled for my own use, *FY2-HDFReader*. This program loads FY-2 HDF files and displays all five channels (channel-2 is almost identical with channel-1 while channel-4 contains imagery on an alternative

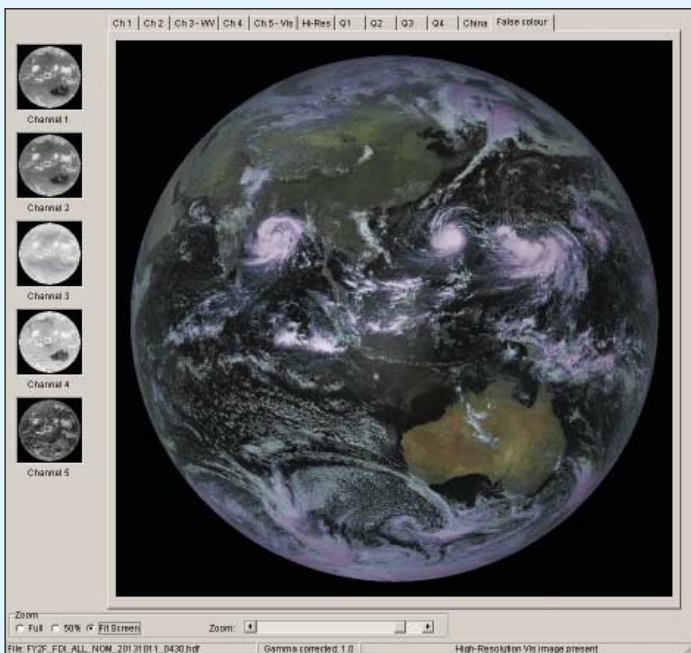


Figure 8 - The default channel-5 tab of FY2-HDF Reader, showing the 04:30 UT visible image captured by Feng Yun-2F on October 11, 2013. Image: Feng Yun Data Centre at CMA (<http://satellite.cma.gov.cn>)

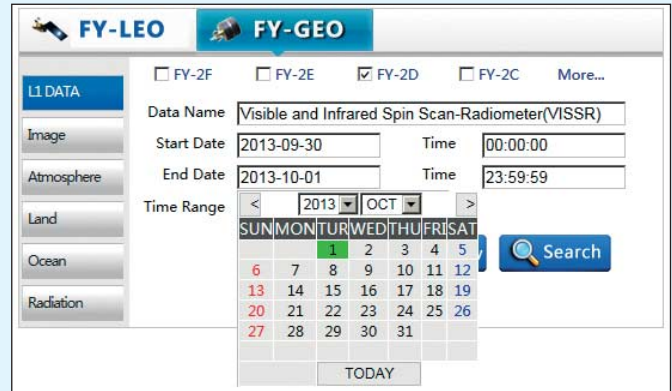


Figure 5 - Selecting download parameters

Select	Filename	Quick View	Catalog	Product	Resolution	Channel	Start time	Size
<input type="checkbox"/>	FY2D_FDI_ALL_NOM_20130930_0530.hdf		LI	Normalized Geostationary Projection VISSR data	Full Resolution	MLT	30/09/2013 05:30:01	209.83MB
<input type="checkbox"/>	FY2D_CSV_MLT_NUL_20130930_0330.DAT		LI	Compressed full disk VISSR data	Full Resolution	MLT	30/09/2013 05:30:00	98.41MB
<input type="checkbox"/>	FY2D_FDI_ALL_NOM_20130930_0430.hdf		LI	Normalized Geostationary Projection VISSR data	Full Resolution	MLT	30/09/2013 04:30:00	209.83MB
<input type="checkbox"/>	FY2D_CSV_MLT_NUL_20130930_0430.DAT		LI	Compressed full disk VISSR data	Full Resolution	MLT	30/09/2013 04:30:00	98.41MB

Figure 6 - List of available FY-2 passes

Order NO.	Date	Deadline	Status	Files	Volume	Download
A201310110011174197	11/10/2013 11:12:41	14/10/2013 11:17:30	Retrieve Finish	1	209.83MB	Download

Figure 7 - The browser link for downloading the HDF files

infrared frequency). On the processing side, there are far fewer options than with *GeoSatSignal*, but there are limited functions which provide control over *gamma* and *gain*, as well as a few very basic *colour palette* options. You can download the installation package for *FY2-HDFReader* from

<http://myweb.tiscali.co.uk/wxsatellite/soft/fy2-hdfreader-setup.exe>

An example of the imaging capabilities of the Feng Yun-2 satellites can be seen on page 22, which shows just a small

Concluded on page 42

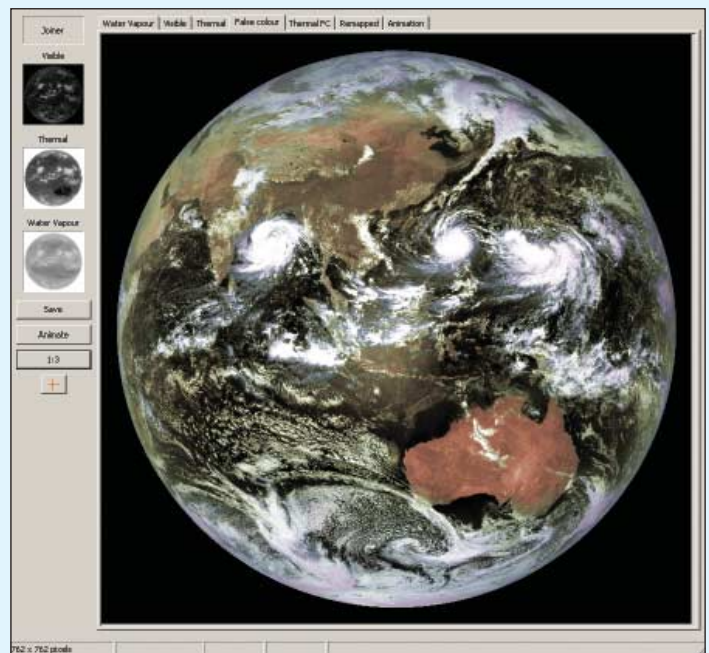


Figure 9 - The same Feng Yun-2F image displayed in the False Colour tab of GeoSatSignal Image: Feng Yun Data Centre at CMA (<http://satellite.cma.gov.cn>)

Short Wave Receivers for WEFAX

Alastair Dunlop

The short-wave bands from 1.6 MHz (megahertz) to 30 MHz contain several transmissions of interest to weather watchers. Chief amongst these are weather facsimile ^[1] (weatherfax or wefax) transmissions of various meteorological charts which are covered separately in the article on page 28. Other transmissions of interest are the NAVTEX ^[2] broadcasts in the medium-wave, primarily at 518 kHz (kilohertz) but also locally around 490 kHz. Whatever your interest, you will need some form of short-wave receiver. This article is intended as a simple introduction to suitable receivers.

You can pay anywhere from £50 to £500 or more for a short-wave radio. Wefax and Navtex are transmitted at a reasonable power level, so are relatively easy to receive, hence receivers at the cheaper end of this scale are usually fully adequate. The more expensive receivers are only necessary if you want to receive low-power transmissions in the presence of high-level interference. The extra cost comes in the form of high dynamic range front-ends and steep-sided filters—very similar to the way pager interference is rejected in APT receivers. Short-wave receivers fall roughly into four main types: portable multi-band radios which can receive the main broadcast bands, wide-band scanning radios, dedicated short-wave receivers, and Software-Defined Radios (SDRs) often in the form of computer 'dongles'.

Multi-Band Receivers

These receivers are usually about the size of a paperback book or a bit larger. They usually receive the Long and Medium Wavebands and the VHF broadcast band. The ones we are interested in also receive the shortwave bands—make sure that the specification mentions Single Side-Band (SSB) reception. There are several Far Eastern radios at reasonable prices—I have heard good things about the *Eton G5* series but have not used them personally. *Sony* no longer makes this sort of radio but models such as the *SW 7600G* and *SW 7600GR* (figure 1) are sometimes available second-hand and from my personal experience are excellent for this purpose. Don't use the earlier *7600D* model since this tunes in 5 kHz steps and in my experience is extremely tricky to fine tune to the required accuracy on SSB.



Figure 1 - The Sony SW 7600GR Multiband Receiver

Scanning Radios

These receivers are designed to rapidly scan a range of frequencies, usually in the VHF bands. A typical example is shown in figure 2. Very few of them can receive SSB signals in the short-wave band and those that do usually have inadequate selectivity and stability for long-term recording of data signals. Not recommended unless you have the technical know-how to interpret the specifications properly.



Figure 2 - A scanning radio

Dedicated Short-Wave Receiver

These radios are typically about the size of a car radio or a bit larger, usually with controls and displays on the front and

connections for aerials etc. on the back. Many are designed for 12 volt power, which is helpful when using from a campervan or boat. They are generally purpose-designed for the task but have higher performance than needed for wefax reception—this is usually reflected in a higher price. The *Target HF3* series are specifically designed for wefax reception in small boats. They are simple but adequate and cost around £200 new: perhaps half of this second-hand depending on age and condition. You may also come across the *Radio Shack/Realistic DX 394* receiver, which is also adequate, but in my opinion not as nice or easy to use as the *Target HF3*. Second-hand models from manufacturers such as *Lowe* and *Icom* can be good value but are often considered as 'collectables' with ridiculously high prices on auction sites such as *eBay*. Figure 3 shows an *Icom IC-706* transceiver but is generally representative of this class of radio.



Figure 3 - The Icom IC-706 Transceiver

Software Defined Radios

These radios use digital sampling at an early stage in the receiver followed by computer processing of the sampled radio frequency to decode the signal of interest. They can provide good performance at relatively low cost and are usually extremely versatile, since practically any signal can be demodulated. The downside is the need for a fast computer to handle all the processing involved. Since the computer is intimately involved with the radio, you usually need either a second sound card or a utility such as *Virtual Audio Cable* to transfer the digital numbers from the radio control program to the input of your wefax decoding software. The *Fun-Cube Dongle Pro Plus*, at around £150 (figure 4) appears very promising and, on paper at least, looks able to receive both weather satellite APT signals and shortwave wefax signals, although not at the same time. This area is a work in progress—see other articles in *GEO Quarterly*. The short cable seen below the dongle converts the SMA connector on the dongle to a BNC aerial lead, as mentioned in Rod Alblas's article in *GEO Quarterly 37*. The flexible cable reduces any strain on the dongle aerial connection. Note that the Radio/TV dongle described by Rob is not generally capable of short-wave reception.



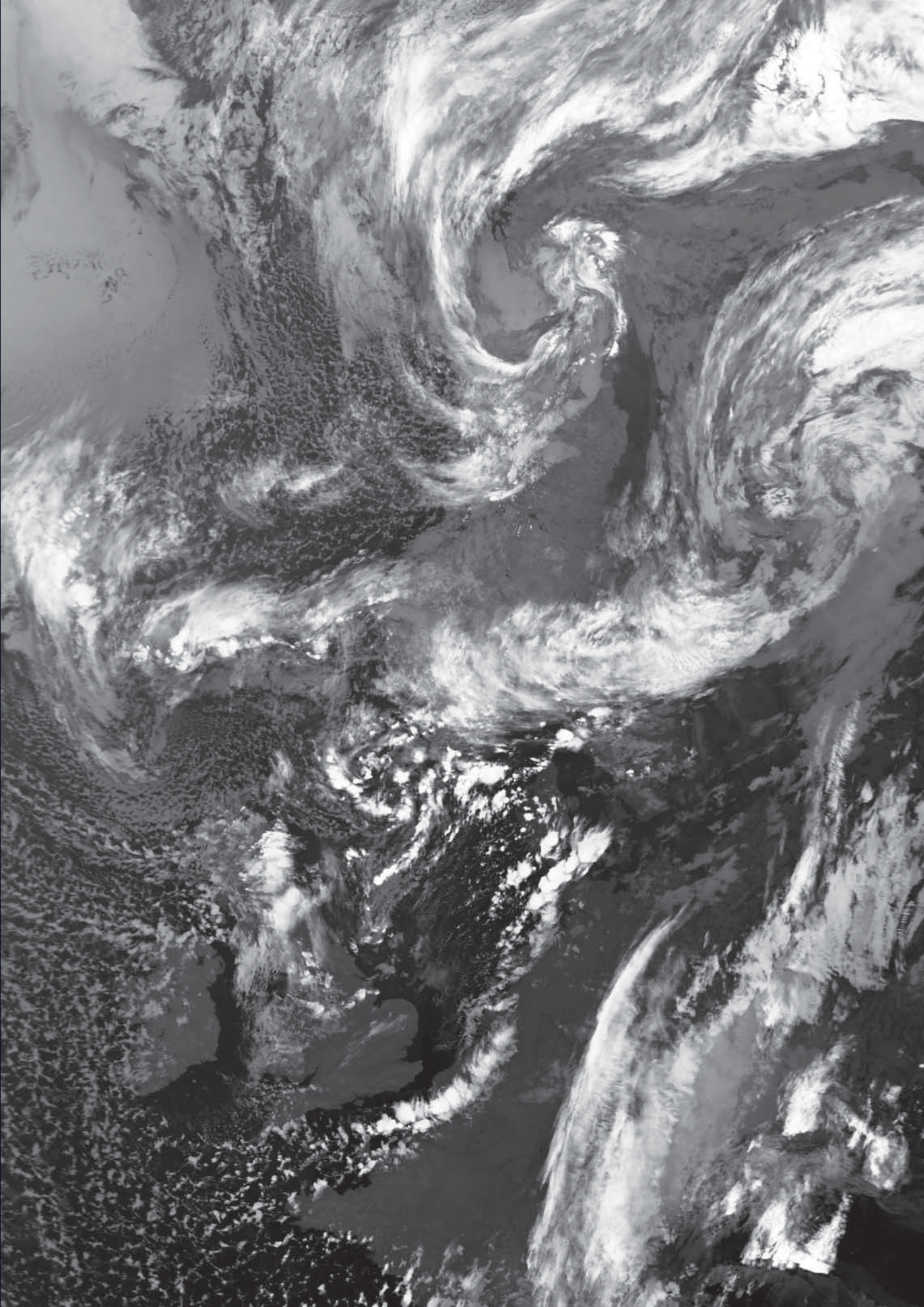
Figure 4 - The Fun-Cube Dongle

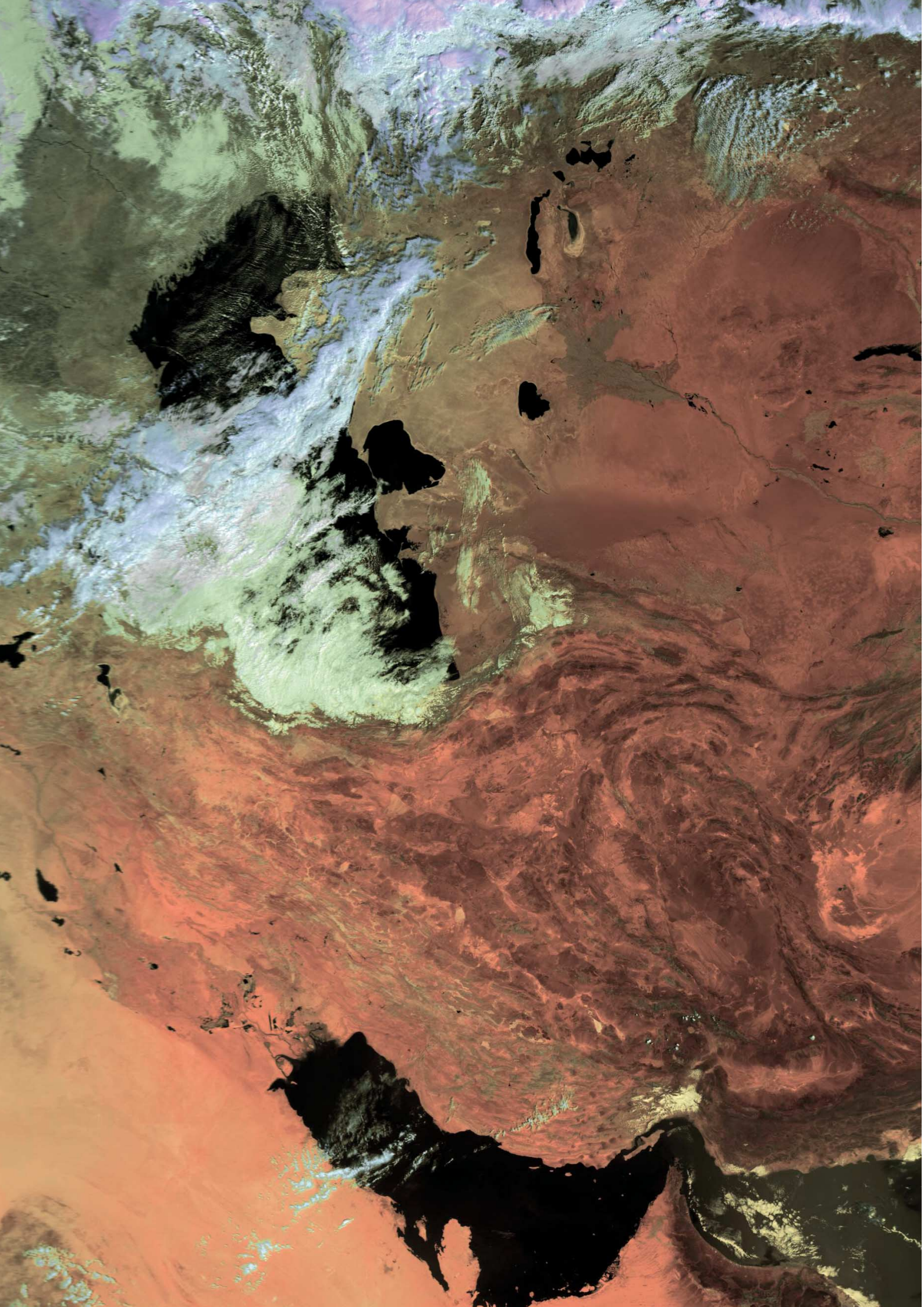
Conclusion

As with many things, try before buying if at all possible. Get to know your friendly neighbourhood Amateur Radio enthusiast if there is one. However, remember that many enthusiasts love technology, specifications and high-end kit, whether its cars or radios. Buy something simple and cheap at first and, when you have the experience, you will know whether you wish to go further or give it up. Finally, take the extra effort to drape 3 metres or so of aerial wire out of the window or even around the room—it will usually transform the received signal compared with an in-built aerial. Good listening and I hope you enjoy the experience.

References

- 1 <http://en.wikipedia.org/wiki/Radiofax>
- 2 <http://en.wikipedia.org/wiki/Navtex>





The Way We Were

Part 2: How the Personal Computer changed everything

James Brown

I was keen to explore what other folk were doing and had an invitation from Dr Andrew Eccleston of the Met Office research lab at the *Royal Signals and Radar Establishment* in Malvern. They operated a Primary Data User (PDUS) station designed and supplied by the folk at Dundee and using *PDP 11/34* minicomputers for display. They were also overlaying radar images—obtained from their own radar station—on the PDUS images. Figure 1 is a sample that they kindly let me take away with me. Very different from the images we are used to today, but bear in mind that this was 1982.

I also offered a short article to *Weather*, which is a journal of the Royal Meteorological Society. This was taken up and published in December 1982, and subsequently gained the James Patton Memorial Prize.

Others were also realising that a number of us had been working along similar lines. Folk like Bob Sansoni of York had use of a University of Bradford PDUS station, and after a couple of visits we became firm friends. I was even permitted a short loan of the equipment to see what my own dish was capable of.

Slowly the computer era was opening up. A *Sinclair ZX Spectrum* provided my first foray into computing, but then the ubiquitous *BBC B microcomputer* came along. It was a relatively expensive item, but a friend of mine worked in the factory where the boards for this and the later BBC ADSL 'Master' version were being manufactured. Every day a number of boards failed the production test, and were discarded for either recycling or, if possible, repair. My friend was legitimately allowed to take a small selection of useless boards home as scrap, and both he and I had fun over a year discovering the faults and eventually having enough parts to construct two working models. I then built an interface to connect to the A/D convertor, and with the aid of some machine-code programming borrowed largely from another article I found in a magazine, was able to display the first colour pictures. The system was somewhat primitive as there were effectively only eight colours, but nonetheless, progress was being made.

Images could now be stored on floppy disks, so time was slowly running out for the tape recorder as an archive medium. Then I upgraded the *ZX Spectrum* for a *Commodore Amiga* which could not only do sixteen grey levels, but boasted a full palette of 4096 colours. I found a company on the south coast doing a software program for the *Amiga*, which could be modified to look at input from an A/D convertor. The result was very encouraging. And something else could now be done—images could be animated using yet another freeware program. We were also now into the realm of double density 3.5" floppies (figure 2).

Some of the chips used by the *BBC B* computer were of course memory chips, and I was now a regular subscriber to *VHF Communications*. In a series of issues there appeared the description of a framestore, the famous YU3 UMV design, which happened to use the same memory chips as the BBC computer. I think you know by now what is coming (figure 3).

So my next project became the construction of a framestore. In fact, I ended up building two in the same case. The first used boards obtained from the magazine; later I was able to modify and duplicate the memory board layout to add a further section. The framestore was based around enough memory and display to scroll up a single transmitted sector. But by adding the extra memory boards it allowed me the flexibility of switching between viewing the succession of single frames from *Meteosat* (SDUS)—or from a

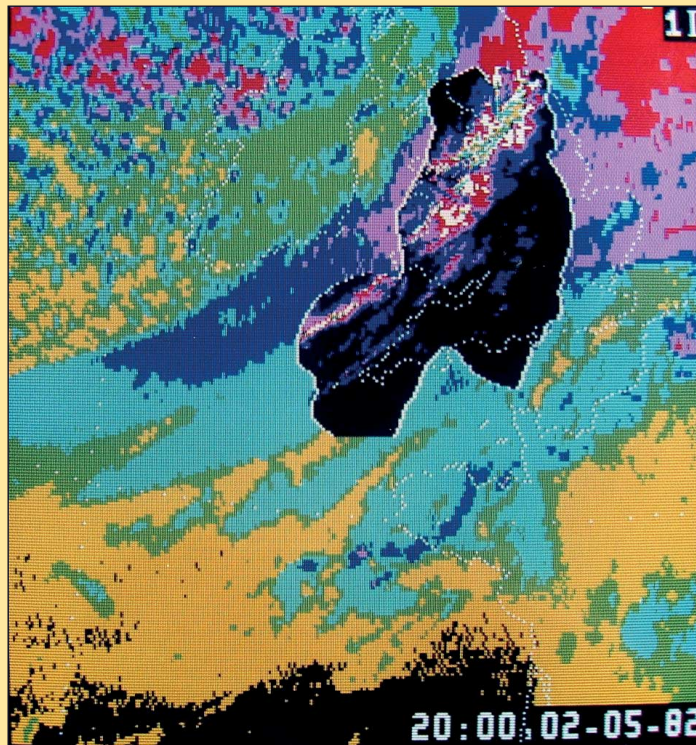


Figure 1 - A 1982 PDUS image with Radar Overlay

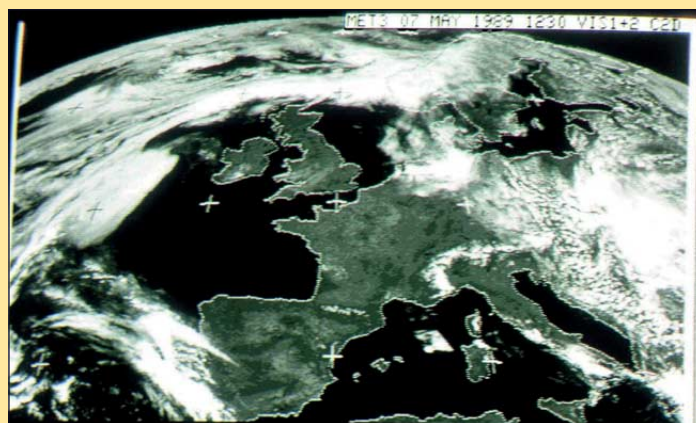


Figure 2 - A frame from one of the author's 1989 Meteosat animations created on a *Commodore Amiga* microcomputer.



Figure 3 - The YU3 UMV Framestore built by the Author

polar orbiter—whilst allowing the secondary memory boards to be used for holding multiple frames for animation of just one sector, such as the 'D2' European half-hour frames. This all required some fairly complex switching, and in particular the invention of a timing board that would be locked to the mains for accuracy. But it also had to be programmable for whatever sequence I might want to animate. No off-the-shelf solution here!

Figure 4 is the non-PIC version. Purists will no doubt be screaming at me, but you know what—it worked. And it used more chips from the BBC box, so it came free.

Looking at it now, I do just wonder if a little madness had not entered into my life.

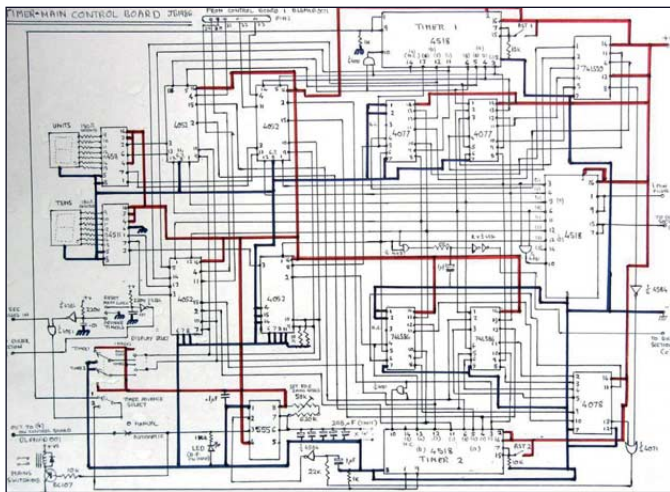


Figure 4 - The non-PIC Framestore Circuit

Like-minded amateurs were now banding together, and conferences and magazines sprouted on a number of continents. Germany, Italy and the USA in particular were getting increasingly active. I still have magazines like 'I quaderni Della Radio', which featured a very extensive introduction by Marciano Righini to the various satellites and their reception and display possibilities. This was in 1983. Also 'Weatherwise' from the USA, and the *Remote Imaging Group Journal* in the UK. And firms were now manufacturing their own modules and turn-key systems.

The PC was becoming ever more popular. My first one came with a 'massive' hard drive holding 20 MB of data. The rise of the Internet and the general advances in component quality and sophistication opened other doors. Software for the various computers became more widespread. Simple DOS based Internet was becoming a possibility.

At the same time, I was keen to explore other antenna designs that were being shown to work with both the VHF and L-band transmissions. For example, Les Currington built a magnificent pyramidal horn for HRPT and PDUS work. This was steered by means of two motors and gave a slightly better signal-to-noise ratio than his loop Yagi (figure 9).

My own experiments were with loop Yagi's for the L-band. My first used quite thick copper wire obtained from a nearby scrap yard. The thickness gave a good bandwidth but was difficult to work with. A blow torch and careful soldering were needed to join the rings to the tops of long screws which passed through insulators in the support arm. Nonetheless, it worked quite well, and I was encouraged to try a Mk II version with more, but thinner, rings. This was even more successful. By now NOAA was positioning a geosynchronous satellite at about 30°W. They also had loan of the 'spare' Meteosat-3 from EUMETSAT for a while when there were problems with the GOES fleet (Meteosat-3, incidentally, was apparently built largely from spare parts from Meteosats 1 and 2). The main purpose of the loan seemed to be for storm monitoring. These satellites were just on the edge of my horizon, but we had a

flat roof at the back of the house and I discovered that, by careful positioning, I could get a usable signal at about 3.5° elevation, though quite a skew of the antenna was needed. This gave me access to a whole new range of APT (WEFAX) transmissions, as this satellite often produced composite Mercator pictures covering the north pole as well as the standard USA ones. Now, of course, WEFAX from the GOES fleet has been replaced by LRIT. I built a second receiver to dedicate to the GOES signal (figure 5). Folk were reporting great success building their own preamps

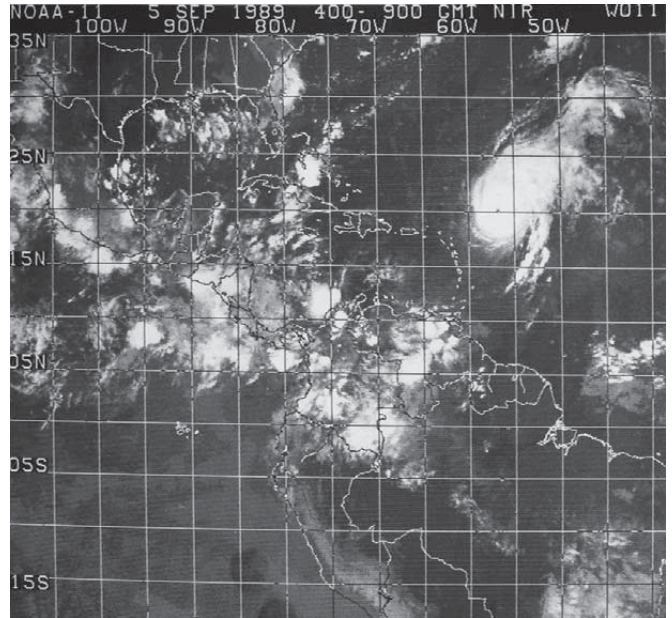


Figure 5 - A NOAA 11 image of Central America transmitted by GOES

using GASFETs and very low noise devices, and I too enjoyed the challenge of these tiny devices, though soon discovered their susceptibility to atmospheric conditions when there was lightning around.

My own links with the USA were growing. I discovered that you could actually contact the GOES programmers directly, so when I noticed registration errors for example, a call to Charlie Vance at NOAA soon got the picture fixed. I also discovered that the GOES series of satellites (GOES I-K) in the early 1990s had an additional data stream dedicated to EMWIN.

This was the *Emergency Managers Weather Information Network*. I mentioned an interest on a message board and was contacted by Colin Schulz who was the Pacific Rim operations manager. He was wanting to gain as much feedback on marginal reception systems as possible, so kindly provided me with a *Tigertronics EPS-96* device (figure 6).



Figure 6 - The Tigertronics EPS-96

The GOES downlink frequency used for the 9600 baud EMWIN data stream was 1690.725 MHz, 275 kHz lower than the standard WEFAX 1691.0 MHz signal. The received signal was passed through a downconverter to convert it to 137.225 MHz and then demodulated to 9600 baud. So if you tapped into the receiver chain just prior to the main IF, you could, by means of an extremely tight filter and FSK decoder, derive a 9600 baud signal which in turn could give all kinds of text and imagery relevant to weather warnings. An excellent software program at the time, called *Weathermode*, reconstructed the data blocks into meaningful text and images. This *Windows* product created a directory structure on the hard drive, and completed files were assembled and then assigned to an appropriate directory. Very neat. Colin is still very

much involved and a recent exchange via e-mail has provided the following notes on EMWIN from Colin himself.

EMWIN in the US and Pacific Islands

"EMWIN has been a mainstay for delivery of warnings and other related information in the US and Pacific Islands region for more than 15 years now. Its first application was during the mid 1980s, to deliver warnings of rapidly developing tornadoes and other severe storm to US Disaster Offices. In those days, private leased lines to carry data were very expensive and a US *National Weather Service* (NWS) engineer, James Doherty, decided to look for a secure but lower cost way to deliver this information to locations within the USA. He realised that spare bandwidth was available on the GOES satellites and that this could be used effectively to broadcast warnings to multiple locations at very low cost. Jim received a gold medal from NWS for his efforts to develop this system.

"After some initial experiments, a trial EMWIN broadcast was commenced on the GOES satellites. This was well received in the US by all who were concerned with emergency management as a low cost way of receiving warnings. About this time there was a heightened awareness in the Pacific that existing systems there could not deliver warnings of cyclones and other severe weather events reliably, and it was realized that EMWIN could be the answer to this problem. During the early 1990s the Pacific was hit by a number of severe cyclones and, as most countries had no reliable warning systems, it was realised that each one needed reliable satellite image receiving systems to be able to follow cyclone development and tracks. Through efforts of the *World Meteorological Organization* (WMO) and the *Pacific Regional Environment Program*, countries were supplied with APT and WEFAX receiving systems and, together with EMWIN, now had access to reasonable quality data to assist with cyclone awareness (when WEFAX transmissions were discontinued from both GOES and MTSAT, WMO, with assistance from US NWS, provided new LRIT receiving systems for 15 Pacific countries so that they could continue to have access to good quality satellite images. These systems were manufactured by *Dartcom* in the UK and have proved very reliable).

"Some preliminary EMWIN tests were conducted in 1996 and it was clear that EMWIN could be the answer to a major problem. In mid 1997, discussions were commenced with US NWS about the possibility of adding Pacific data and warnings to the EMWIN broadcast for use by Pacific nations. After some work, it was realised that the existing low-speed broadcast would not be able to accommodate the Pacific as well as US mainland data, and so a decision was made to re-design the EMWIN broadcast to operate at 9600 bps, and add the Pacific data. Receivers specific to EMWIN were produced by a couple of manufacturers, and the system commenced the new broadcasts which covered both the US and the Pacific Islands (figure 10).

"Receiving systems were rapidly deployed throughout the Pacific as well as on the US mainland and the service went from a trial to a fully supported operational system.

"In the meantime, a second transmission method was added using 'push' technology via the Internet. Anyone with a good Internet connection could connect to a set of servers and receive the EMWIN data stream. This was often used as a backup to the satellite transmissions especially, during satellite eclipses.

"A number of the Western Pacific countries could not 'see' GOES West, situated at 135°W, so it was decided that a re-broadcast of the EMWIN data could be added to GOES-7 which was being used by the Western Pacific region for data and distance education broadcasts. An uplink to GOES-7, which could be received by a number of countries in the Western Pacific, was established from the University of Hawaii. As GOES-7 was not in a stable orbit due to fuel restrictions, tracking antennas were needed.

"As the older satellites were phased out and new ones took over the GOES East and West locations, regulatory issues required



Figure 7 - A superior image of Great Britain produced by an ink-jet printer

a change of transmission format, so a new EMWIN format was developed which enabled added features, such as forward error correction and double speed to be implemented. Again, new receivers and new software were required, and manufacturers rose to the occasion by producing the necessary hardware and software to enable the transition to take place.

"Funding for these upgrades from WEFAX and EMWIN-I to LRIT and EMWIN-N were provided largely by the US NWS, USAID, EU, the *Pacific Regional Environment Program* and the *Pacific Applied Geoscience Commission*. Without these valuable contributions these systems would not be available for Pacific nations.

"With the demise of GOES-7 due to the depletion of its positioning fuel, the Western Pacific was again in EMWIN 'darkness' and now a small version of *EUMETCast* is being developed to provide a *EUMETCast*-type service to the region.

"Looking to the future, the Japan Meteorological Agency (JMA) has announced that it will cease direct image broadcast from MTSAT, and in future all users will be expected to use the Internet for access to MTSAT imagery. That suggest that a bandwidth of 35 MB will be required, which is clearly out of reach of any but the most developed countries.

"Strong representations were made to JMA that, in most Pacific countries, where the Internet service is far from satisfactory with low speeds and high cost, this is not an option for most island nations at this time. A trial broadcast of MTSAT data via GOES-W LRIT has commenced, and this will fill some gaps.



Figure 8 - The huge variety of equipment needed by the author to receive weather satellite images in 'the Good Old Days' of the hobby



Figure 9 - The pyramidal horn antenna built by Les Currington



Figure 10 - A typical EMWIN station

"Just recently, JMA has announced that it may provide MTSAT data via a commercial satellite for use by Pacific countries, so perhaps this will assist to fill in gaps after the direct broadcasts cease. It will mean another set of receiving equipment, but seeing that DVB-S2 format is proposed in 'C' band, the equipment required will be similar to that used for EUMETCast's Africa service".

Bespoke Systems

The next logical evolution as computing power grew and came down in price was for bespoke systems to appear. In the early

1990s, about five companies were regularly targeting the amateur as well as the professional market, concentrating mainly at the ubiquitous WEFAX or APT end of the market. But some had also found ways to receive HRPT and PDUS transmissions with circuit boards at prices just about affordable for the amateur pocket, as well as those from satellites like the all too short-lived 'SeaWiFS'. For a long period, both bespoke and home-brew systems ran in parallel, depending on user ability. Many schools and colleges were also buying systems using dishes and simple dipole aerials. I had the privilege on a number of occasions of visiting the nearby

comprehensive school to give illustrated talks, and also to sort out their systems when the weather itself seemed to get the upper hand. Amateur radio groups were also intrigued, as some of them were running slow scan picture transmissions (SSTV), and I remember a visit to a Bristol group of the *Radio Society of Great Britain* to put on an exhibition and do a presentation in the university.

By now I had also seen the benefits of some of those off-the-shelf systems and, with a very busy period in life coming up, I saved up the pounds to buy a couple of the systems which had interfaces to the PC. Apart from occasional glitches, they gave superb results. Colour was now prominent and, with PC graphic boards capable of using a palette of many thousands of colours, it meant that temperature profiles as well as channel combinations suited to land and sea display gave greatly enhanced imagery.

Pagers began to transmit in the VHF bands causing spill over from badly set up systems (often their transmitters rather than our receivers), requiring higher specification systems at our end to eliminate the interference.

The photograph reproduced in figure 8 shows the greatest extent of my receiving station in its pre-EUMETCast heyday. The oscilloscope had become a smaller solid-state *Cossor* one, but alongside the older machines were now the framestore, with its black and white monitor, and on the right the *Amiga* and the bare-bones *BBC Master* with its sixteen colour monitor. You may also pick out the dot matrix printer, which struggled to produce meaningful image printouts. Later, inexpensive ink jet printers began to appear, which with good printer drivers were capable of

giving some really good printouts. Figure 7 is an example showing excellent detail in a visible image with the UK.

EUMETCast

Most recently, EUMETCAST arrived on the scene, transmitting both LRIT and HRIT data via commercial satellites transmitting in the 'C' band, spelling the end for WEFAX in the L-band. Thankfully, with the agreement of the British Met office, following canvassing from amateurs, access was granted to nonprofessionals. The rest, as they say, is history. A smaller dish, a card in a PC and appropriate software: that was all that was needed.

As much as I enjoy now using the bespoke equipment and software, I would maintain that I was hugely privileged to enjoy the thrill of the chase during those earlier years. I am profoundly grateful for the plethora of help received as well as the satisfaction of a little given back. Perhaps having passed retirement age now it is just as well that I am not climbing too many ladders to adjust aerials blown around in the 70 kph gales we sometimes experience here right on the coast. Battling to align an 80 cm dish when you haven't realised that your laptop LAN link cable has pulled out, when you were using it to see the signal strength on the remote computer is not fun, but it is the best substitute.

Undoubtedly the best is yet to come in terms of data, resolution etc. But for this gentleman, the best fun was in yesteryear. I just hope that readers have found this blast from the past an informative and also enjoyable read.

All the best for the future guys!

NOAA Debates the Need for L-Band Transmission of Data from its future JPSS Meteorological Satellites

Last summer, NOAA circulated its user base with a questionnaire relating to the 'need for L-Band service on JPSS-2 and beyond'. The JPSS (Joint Polar Satellite System) is to be NOAA's next generation of weather satellites. *Suomi-NPP* is the precursor satellite of the series and is currently testing the instrument technologies to be used by future JPSS craft. Although responses to the questionnaire are long closed, the document does provide useful insights into the way in which dissemination of data could be handled in the future.

As ever, costing is at the heart of the matter, and NOAA is in the process of re-evaluating the need for direct readout services on its future polar-orbiting satellite system, most specifically to determine if there is a user requirement. Several NOAA managers believe that data delivery could be met using land lines, commercial rebroadcasting and the Internet, rather than by direct readout.

JPSS Delivery Modes

It is planned that the JPSS will carry **High Rate Data** (HRD) broadcasting on its spacecraft, comprising the complete, full resolution dataset from the entire instrument suite. The HRD broadcast will be transmitted on carrier frequencies of 7812 MHz and 7830 MHz in the X-band at a rate of 20 Mbps. Reception will require a bandwidth of 30.8 MHz with a tracking receive antenna aperture no greater than two metres in diameter.

There will also be a **Low Rate Data** (LRD) broadcast transmitting a subset of the full sensor dataset, intended for, amongst others, land and ship-based terminals, worldwide weather services, and other international users. The LRD is an L-band broadcast that will provide data at a rate of about 3.88 Mbps on 1706 MHz, using a bandwidth of 8 MHz. It will require a tracking receive antenna with an aperture not exceeding one metre in diameter.

Starting with JPSS-2, NOAA will simultaneously broadcast both HRD and LRD real-time data streams to suitably equipped field terminals worldwide.

Dissemination by X-Band or L-Band?

The NOAA JPSS Program Office believes that the data included in LRD broadcasts can be provided to users through other means. Frequencies between 7750 MHz and 7900 MHz in the X-Band have been allocated to data transmissions from polar-orbiting meteorological satellites, and several satellite operators are now considering using the X-Band (around 8 GHz) for direct readout from future generations of polar-orbiting systems.

The main reason for this is that advances in remote-sensing technology have led to high-resolution instruments that generate quantities of data an order of magnitude greater than those of a

decade ago: such high data rates cannot be accommodated in lower frequency transmissions. Furthermore, progress in radio-communication techniques renders X-Band receiving equipment more 'affordable' than it used to be.

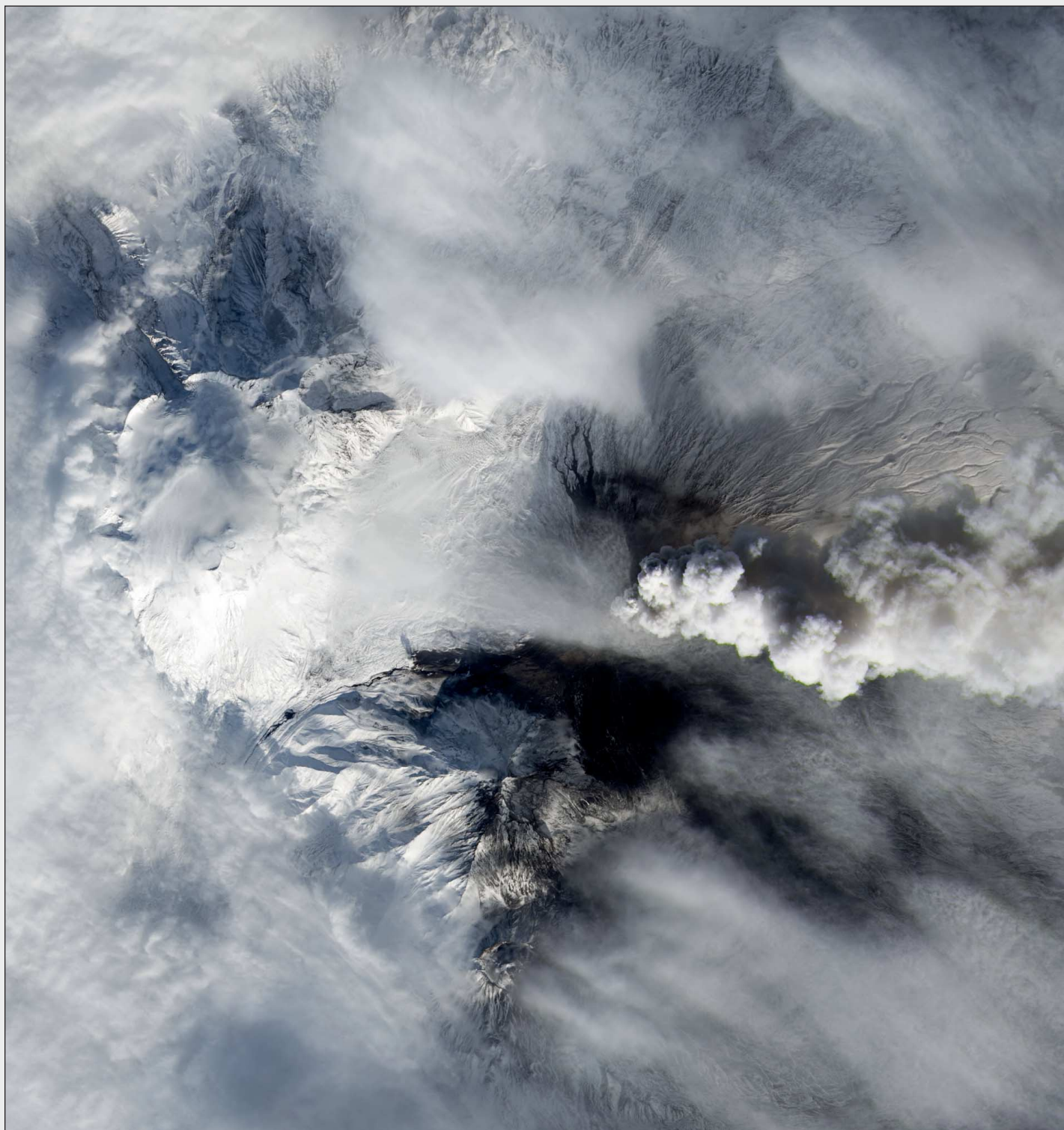
The consequences of direct readout services being available in X-Band, rather than L-Band include:

- access to higher data rate services (20 Mb/s instead of 3.8 Mb/s), which is necessary to access all data at full resolution
- the need to use a higher-class antenna and receiving chain (system cost: X-band \$350k-400k, L-band \$150-200k)
- higher sensitivity to rain, requiring appropriate margins in the link budget, especially for inter-tropical latitudes
- higher risk of interfering sources: X-Band is used by many other telecommunication applications, and the feasibility to operate an X-Band receiving site without interference has to be checked on a case by case basis for each site.

The combination of these two services is expected to satisfy the user needs for efficiency, robustness and affordability, but maintaining two different services in parallel is a design constraint for future satellite systems.

Klyuchevskaya Erupts

A NASA Earth Observatory Report



Located on Russia's Kamchatka peninsula, **Klyuchevskaya** is one of the world's most active volcanoes, with twelve confirmed eruptions since 2000. Erupting intermittently since mid August, activity intensified on October 11 when a thick plume of ash and steam streamed from the summit, and subsequent days were marked by explosive eruptions, lava fountains, and volcanic tremors. At times the ash plumes from the stratovolcano's 4750 metre summit—the highest in Kamchatka—were reaching an altitude of 10 kilometres.

This image was acquired by the *Operational Land Imager* aboard NASA's **Landsat 8** satellite on October 20, and shows multiple lava flows streaming down the mountain's northern and western flanks. Snow and clouds are white, the ash plume is light gray, and forests (where the trees are tall enough to stand above the snow cover) show as dark brown.

NASA Earth Observatory image by Robert Simmon using Landsat data from the USGS Earth Explorer

Chelyabinsk Meteorite Recovered



Les Hamilton

In the May issue of *GEO Quarterly*, we reported on the February Chelyabinsk Fireball that resulted when the largest meteoroid to enter Earth's atmosphere this century streaked across Russia's Ural mountains [1]. It was believed that a large fragment from the meteoroid had punched a mysterious hole that appeared in the ice on Lake Chebarkul.

Attempts to recover the meteorite, which was buried under the lake bed beneath twenty metres of water, began in early September, but were hampered by the thick layer of mud covering it. The divers had to work in conditions of zero visibility due to the extremely muddied waters of the lake, and storms caused additional delays. Finally, after pumping mud away from the rock for ten days, the recovery of the largest fragment, which weighed 570 kilogrammes, was able to go ahead on October 16. It is probably one of the ten largest meteorites ever discovered on Earth.



Divers bring the meteorite ashore from Lake Chebarkul
 Photo © RIA Novosti / Aleksandr Kondratuk

According to Sergei Zamozdra, assistant professor at Chelyabinsk State University, initial examination showed all the characteristics of a stony meteorite: a thick fusion crust, clearly visible rust and a large number of indentations.



Revealed for the first time: the 570 kg fragment of the Chelyabinsk meteoroid
 Photo © RIA Novosti / Aleksandr Kondratuk

Just a day after recovery, and following preliminary cleaning, the meteorite was put on display in the Chelyabinsk Regional Museum, where it caused great interest. It was placed in a special display case with a fortified base so that everyone can now admire it. The showcase has become very popular. Its circular shape allows the



Museum staff preparing the Chelyabinsk meteorite for exhibition
 Photo © RIA Novosti



The cleaned meteorite exhibited in its strengthened display case
 Photo © RIA Novosti

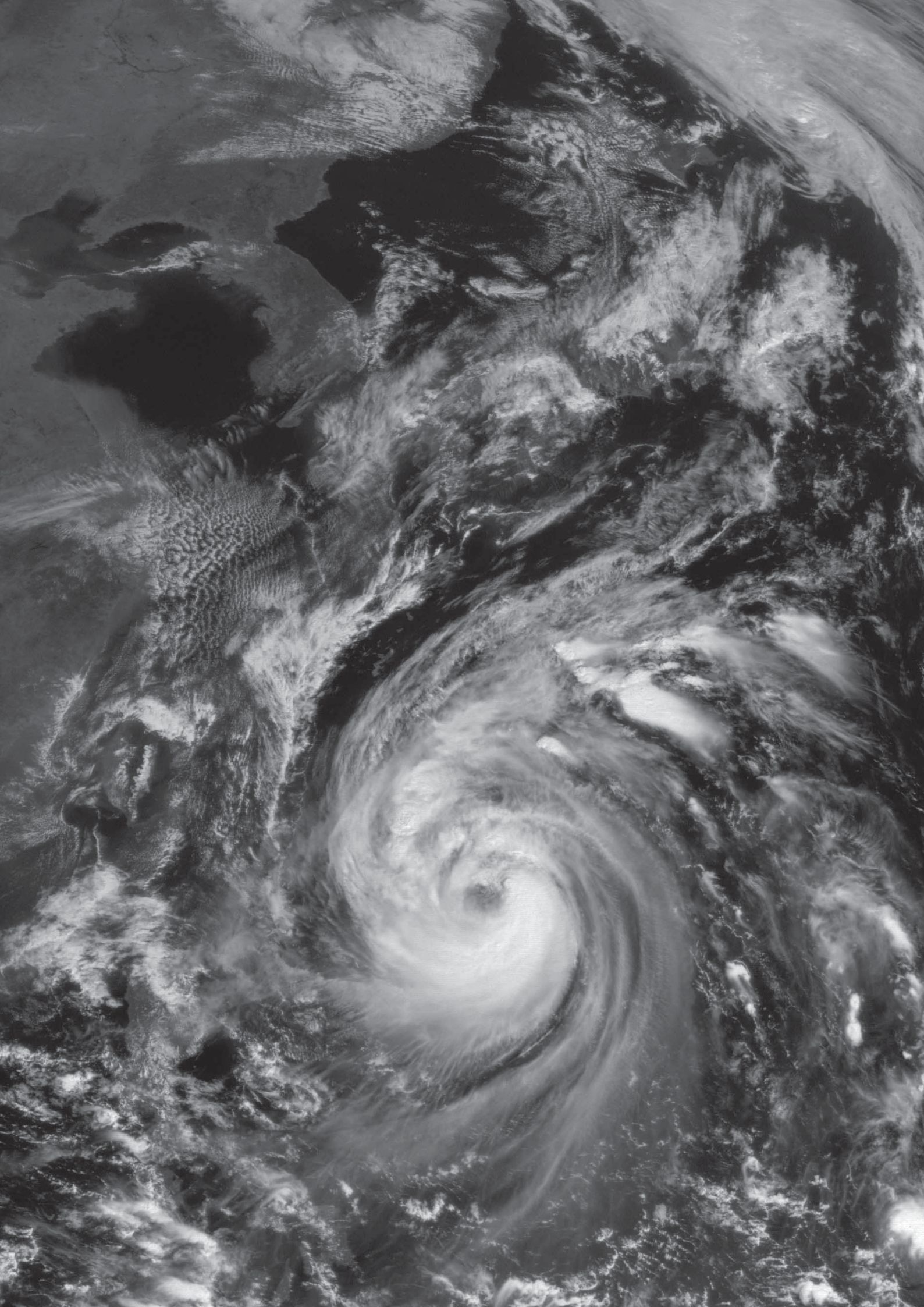


A group of local schoolchildren admire the 570 kg Chelyabinsk meteorite in its permanent display area in the Chelyabinsk Regional Museum
 Photo © RIA Novosti

exhibit to be viewed from all sides, and the dome can be raised when necessary to carry out further work on the meteorite.

Reference

- 1 Chelyabinsk Fireball, GEOQ 38, page 6 (June 2013).



Temperature Profiles of Cyclones and Typhoons

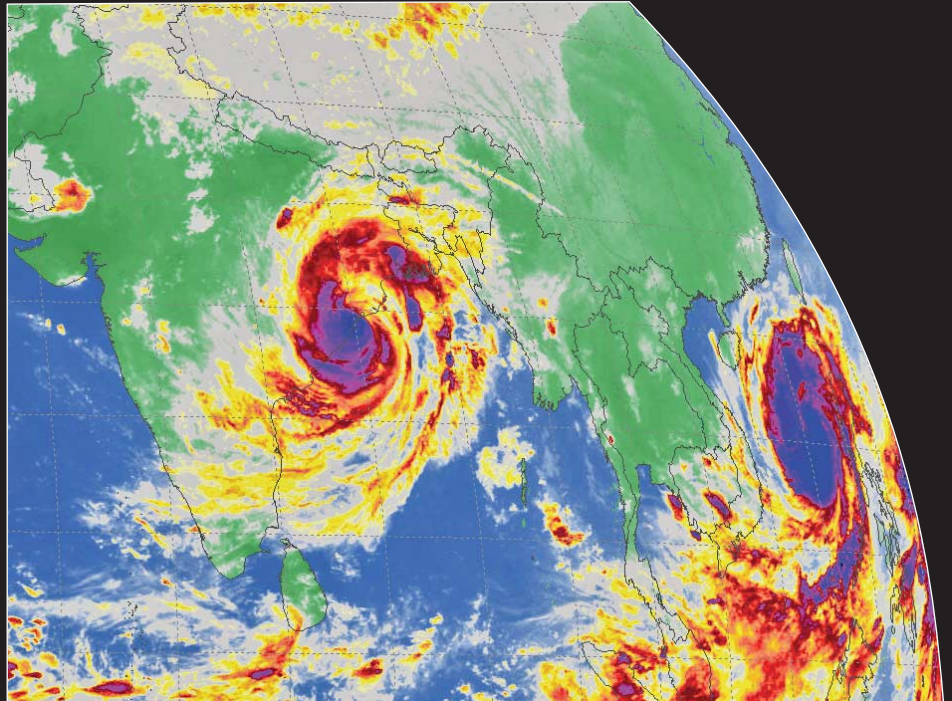
Francis Bell and Les Hamilton

The first weekend of October this year was remarkable for the number of severe cyclones that were active over the Indian and Pacific oceans.

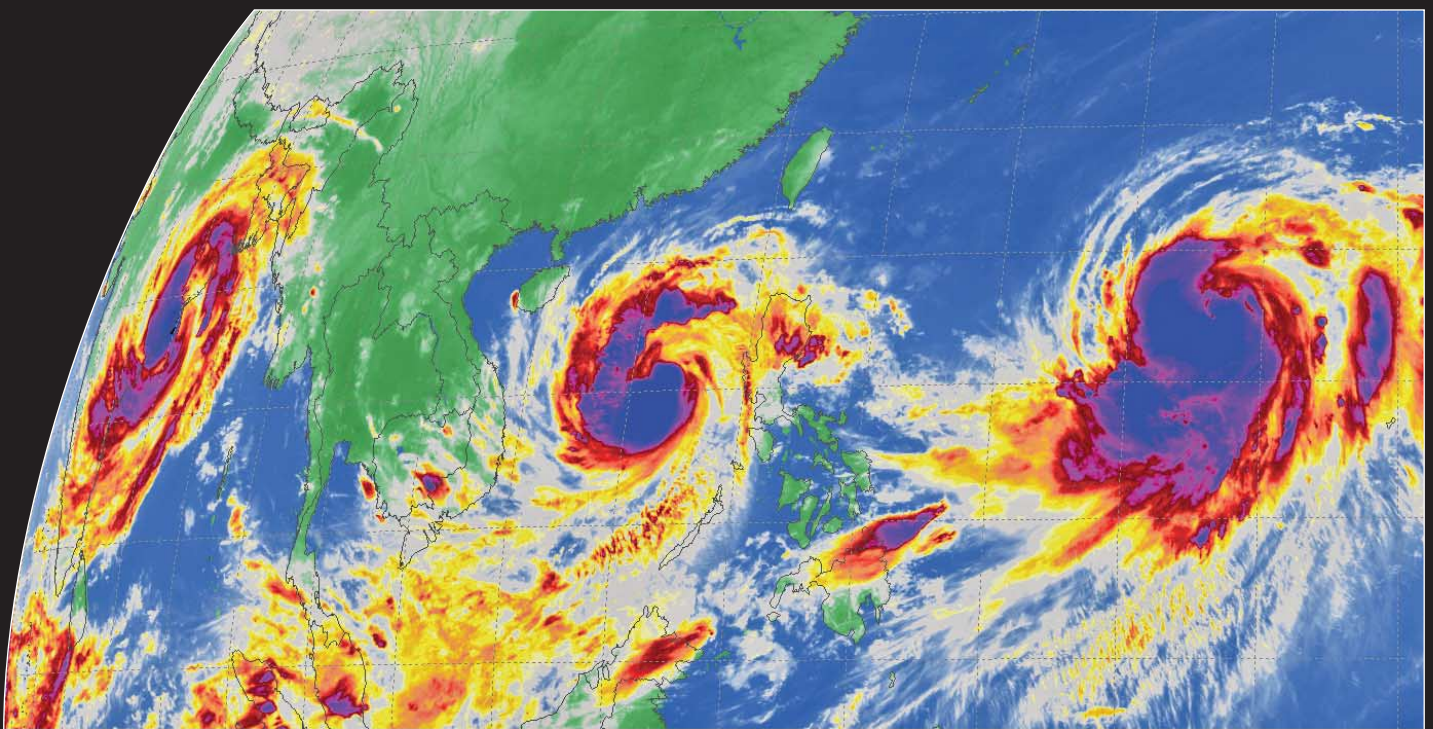
Francis Bell used the *EUMETCast* service, which relays images from geostationary satellites located over the Pacific and Indian oceans, to run an animated sequence of **MTSAT** and **Meteosat-7** images using David Taylor's *MSG DataManager* software, and applying the *LandandSea-red* colour lookup table to differentiate cloud-top temperatures.

Near centre on the image at right is Cyclone Phailin, the most powerful storm ever recorded in the Indian Ocean, about which you can read more in the article on page 22.

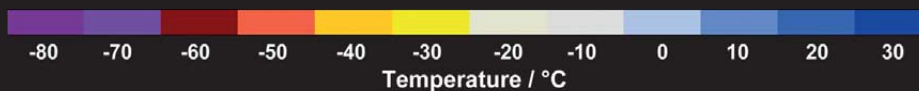
The key at the foot of this page shows the colours purple through grey for cloud temperatures between -80°C and 0°C , and shades of blue for sea surface temperatures between zero to 30°C .



Cyclone Phailin sweeps across India as Typhoon Fitow heads towards China imaged by Meteosat-7 on the evening of Sunday, October 13, 2013
Image © EUMETSAT 2013 - Processing: Francis Bell



Cyclone Phailin sweeps across India as Typhoon Fitow, hotly pursued by Typhoon Danas makes for the Chinese mainland imaged by Japan's MTSAT on the evening of Sunday, October 13, 2013
Image © EUMETSAT 2013 - Processing: Francis Bell



section from a 1-km resolution visible image displaying *Typhoon Fitow* bearing down upon China.

Ordering Larger Downloads

Should you find the FSDC service useful, and you require to download more than two Feng Yun-2 HDF files per day, you can apply to increase your allocation. On the main FSDC web page, immediately above the 'FY-GEO' button described above (figure 4), is a menu bar where you will find the option 'Documents'. Click this and select the item 'Application Form', which allows you to download a *Word* document entitled 'User Upgrade Application'.

Complete this form, in particular the field labelled 'Which level do you want?' There are two options:

- B (3 GB/order, 10 GB /day)
- C (1 GB/order, 5 GB/day)

Finally, scan the completed application form and email it to

dataserver@nsmc.cma.gov.cn

Further Image Option

In addition to HDF files of Feng Yun-2 imagery, FSDC also makes available similar files for Japan's **MTSAT2**. To access these data files, click where it states 'More ..' to the right of the FY-2C checkbox in figure 4. This moves on to a new page with a menu bar that includes 'MTSAT'. Clicking this opens two tabs, one for MTSAT2 and the other for the now defunct MTSAT-1R.

At the foot of the page tick the check-box for 'NOM Data', select the dates and times as for Feng Yun, then press the 'Search' button. Note that historic MTSAT-1R data is only available from July 2005 till July 2010.

MTSAT HDF files can be read using *FY2-HDFReader* (but not with *GeoSatSignal*).

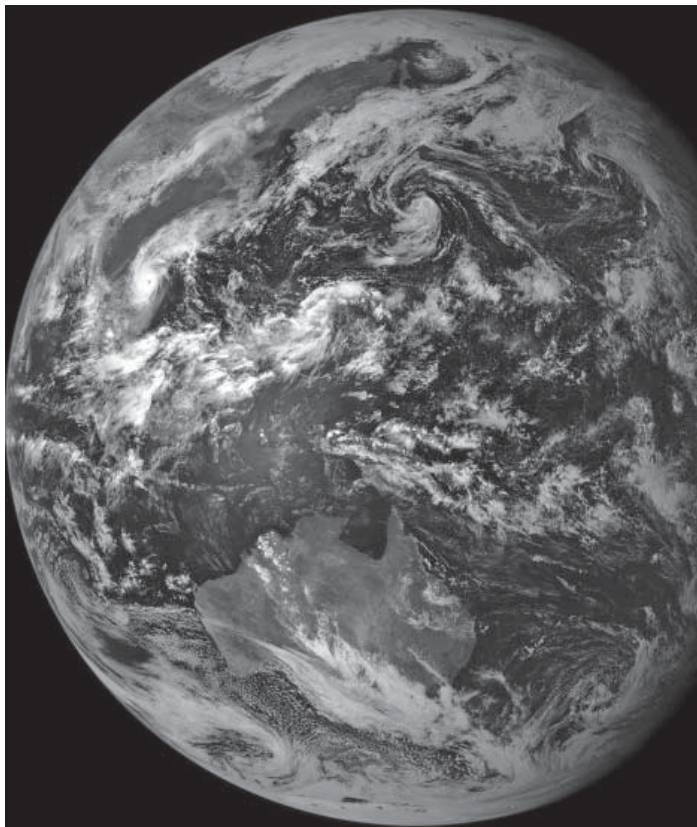


Figure 10

Part of the 04:32 UT MTSAT2 visible image from September 30, 2013
 Image: Feng Yun Data Centre at CMA (<http://satellite.cma.gov.cn>)

Weather Watching away from Home

continued from page 27

clockwise into the small areas of Low pressure over Holland and France. Wind directions across the UK will be predominantly from the west but varying from southwest to northwest depending on location.

References

- 1 Weather watching away from Home, GEOQ 39 September 2013
- 2 A major source of noise is mains-borne networking; the EU mandates spectrum notches for the Amateur Radio bands but not for Utility frequencies such as those used for wefax.
- 3 <http://software.muzychenko.net/eng/vac.htm>
- 4 <http://www.nws.noaa.gov/om/marine/rfax.pdf>
- 5 <http://www.w1hkj.com/>

Request from NOAA

NOAA is trying to put together a list of LRIT, EMWIN and future HRIT users. They would like to be able to distribute information on the upcoming GOES-R HRIT/EMWIN that users will need. Some 500 satellite users have already been contacted, but there are surely many more out there. If you can help in any way, please contact Jim Wydick at

james.wydick@noaa.gov

so that all satellite data users will benefit.

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

Dear Les

With reference to the lack of interest/material from the members referred to in the last issue of *GEO Quarterly*, I would like to put forward a few thoughts as to why this may be. I would assume that a high percentage of members are from the UK, and as such, maybe there is an attitude of 'surely you do not want more pictures of the UK and Europe—Boring'. For myself I find them interesting, with a wide range of cloud formations as seen from above, but possibly not so for readers in the USA or Down-Under.

As for those living elsewhere, some do send in pictures of their areas, and I find them interesting, but I feel that in all cases there may be the feeling of: 'I am only an amateur in the hobby, and my knowledge is very limited'. Therefore, if I try to write an article and I make mistakes, then I may have it rejected. Taking into account the time involved to produce even a short article, this may well turn a lot of members off from even attempting such an item. And time is also a factor: family affairs, jobs, care for sick *etc.*, are all reasons why we tend to put off writing to *GEO Quarterly* or any other magazine.

Many I am sure, like myself, are not really into the computing side of the hobby (*i.e.* receiving MSG via *EUMETCast*) but are happy with just the APT aspect of the it. I do wonder what will happen to those members when APT ceases in a few years time. I am unsure whether I will go over to MSG or not. The cost of a new computer and all the accessories and license fees are off-putting, around £1000.

There is a small percentage of our membership, which appears to have knowledge and experience in both the satellite/weather professions and computing, and uses these skills, as can be seen from their excellent articles; but not every one has these skills, nor are they able to obtain them. I thank them for their input, but with any magazine, we cannot reply on the membership to provide all the articles.

A thought I have for an article that readers may be interested in, is one concerned with **all** the satellites that **may** be received using the MSG set-up, and a break-down of what they do and the software required to create images from them. I know that there are many that you show pictures from, but showing my amateur status, I have no idea as to how to download them.

Laurence Holderness, Narbeth, Wales.

Interface Wanted

We have received a request from Trevor Smith VK3TI, one of our members in Australia. Trevor is on the lookout for a **TimeStep Prosat for Windows External Interface** to use with his *Timestep* APT system.

If any reader still has one of these interfaces, and no longer has a use for it, Trevor would be pleased if you could get in touch with him at

vk3ti@bigpond.net.au

More Thoughts on the WS 1081 Weather Station

Storm Dunlop

I was interested to read Geoff Morris' account of his weather station in *GEO Quarterly* 39 (page13), because I recently installed an identical, 'entry-level', WS 1081 system from *Maplin*. A few points from my own experience may help anyone else thinking about installing similar equipment. Although there are warnings in the instruction booklet about possible interference, I have had no problems with radio reception between the transmitter on the mast and the touch-screen display, despite all the different pieces of equipment either connected to my computer, or in close proximity to the display (the distance between transmitter and receiver is about 25 metres).

Ideally, of course, the wind vane and anemometer should be installed as high as possible: the standard height recommended by the World Meteorological Organisation is 10 metres. This is impractical for most domestic installations, but whatever the height, there is a problem in ensuring that the wind vane is set to the correct compass direction. This is difficult, because the directions are shown by small letters embossed on the plastic housing and, at any height above eye level, these are essentially invisible from the ground. Luckily, the arm connecting the wind vane and the anemometer needs to be orientated east-west, and this is easier to set correctly. But the task remains difficult unless you have easy access at the full height of the mast (perhaps with a tower).

This was impossible in my case, and the best I could do was to define a baseline from the mast extending to the east, and then, sighting visually from the end of the baseline, turn the whole upper mast until the arm appeared to be correctly aligned. The software does allow one to adjust the calibration for direction, and one method might be to temporarily restrict the vane to point east (along the arm) and enter the appropriate correction, shown by the difference between the reading and 90°. I intend to try this method next time I need to gain access to the anemometer and wind vane.

A common criticism of this particular equipment is the length of the connecting cables. With my equipment, the cable between anemometer and wind vane was only just long enough. Yet the cables from the wind vane and the rain gauge to the transmitter are exceptionally long. I have converted this last point into an advantage by deliberately mounting the unit containing the transmitter and the temperature, humidity, and pressure sensors much lower down the mast—which should not compromise accuracy—at such a height that the battery compartment is easily accessible when the batteries need to be changed.

Another point was raised by a friend with an identical unit, who experienced problems because his rain gauge became infested with spiders to such an extent that the readings were affected. This was cured by using an insecticidal spray such as those used around the house to kill cat or dog fleas. Spiders may not be insects, but they have certainly stayed away from the rain gauge.

I, too, use the *Cumulus* software, which is certainly superior to the *EasyWeather* program supplied with the unit. One strange problem seems to affect the software, however. Both my friend and I have found that the pressure reading shown by *Cumulus* does not agree with the reading shown on the touch-screen. Although it is easy enough to include a calibration adjustment, -6.5 hPa in my case, it seems a strange discrepancy when all the other readings are identical between touch-screen and computer display.

Mont Aigoual

France's last active Mountain Weather Observatory

Marc Peigneux

Mont Aigoual is the last mountain weather observatory still active in France (figure 1). Situated in the south of the Cévennes massif, a few kilometres from the Mediterranean sea, its summit rises to 1567 metres.

I was lucky enough to take beautiful summer hikes in this massif, but I would not for anything have missed the visit to the site actually exploited by the Météo-France engineers on this mountain. But, first of all, let us try to understand the reasons for the establishment of this ground-observation centre.

Some Reminders from History

On November 14, 1854, during the Crimean War, a terrible storm, which arose without the slightest warning, crossed Europe from west to east, causing the loss of 41 ships in the Black Sea and sparked initial investigations into meteorology and weather forecasting in Europe. Following this event (in 1855) the famed astronomer *Urbain Le Verrier*, who was at the time manager of the astronomical observatory of Paris, decided to create a network of weather-observation stations. The network consisted of 24 stations, initially all located in France, but later expanded throughout Europe.

Connected by the telegraph, these stations transmitted their information reports, three times each day, to the Imperial Observatory in Paris, which used them to prepare a Europe-wide analysis. By 1861, the network had been extended to include Saint-Petersburg, Harapanda (Norway), Valentia (Ireland), Cadiz, Naples and Constantinople, and the first isobaric maps were being transmitted to foreign weather stations (figure 2).

During the 1930s, and more specifically following the end of the Second World War, the French *National Meteorological Offices* were developed. These surface observation stations operate 24 hours per day, and their reports are made simultaneously, at fixed times every day. Besides these meteorological stations, there are also numerous climatological stations manned by volunteers, as well as automatic systems.

The recorded data are very useful in refining the forecasts and pinpointing exactly the location of exceptional meteorological phenomena. High altitude measurements were developed during the nineteenth century, with the creation of the following four 'mountain observatories':

- Puy de Dôme station, in Auvergne (1465 m)
- Mont Ventoux station in Vaucluse (1909 m)
- Mont Aigoual station, in the Cévennes (1567 m)
- Pic du Midi station, in the Pyrénées (2876 m)

The Pic Du Midi, Mont Ventoux and Puy De Dome observatories, although very busy with scientific and technical activities, are still very nice places to visit, but their present 'vocation' nowadays is somewhat different from that originally assigned. Puy De Dôme, inaugurated in 1876, is now a very important part of the Earth Physical Observatory. Mont Ventoux, created in 1882, ceased its weather observation activities in 1968 while Pic Du Midi, inaugurated in 1882, was gradually transformed into an astronomical observatory following the Second World War.



Figure 1 - The Observatory at Mont Aigoual

Mont Aigoual

In an awe-inspiring area in the centre of the Cévennes National Park, Météo-France and the 'Communauté De Communes de l'Aigoual' advocated making the public more aware of both the weather and the Aigoual massif.

Météo-France technicians introduced the public to the science of meteorology and to the techniques of weather observation. They also taught how to decode satellite and radar pictures. The centre has 600 m² of exhibitions, hundreds of photos, videos and slide shows.

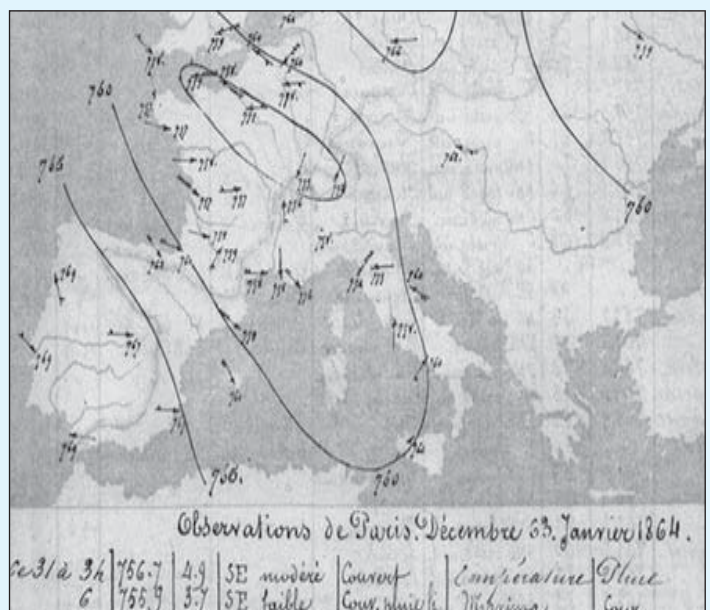


Figure 2 - One of the early Isobaric Maps

Conferences

Météo-France Mont Aigoual also hosts some conferences and, due to a lucky coincidence during my visit, I had the opportunity to attend two of them. The main subject of the first conference was **Teledetection and Satellite Meteorology**, delivered by M. Sylvain Le Moal of Météo-France, Centre de Météorologie Satellitaire de Lanion. The second conference, entitled **The Future Weather on my Planet**, was given by M. Joël Colado, a weather forecaster for Météo-France on two of Radio-France's national networks.

It is also important to point out that the Météo-France specialists also organise weather forecast workshops, where they teach about how they control the tools used for producing weather reports, as well as holding educational days for schoolchildren and students.



The locations of the original four Mountain Weather Observatories



The author pictured in the museum during his visit to Mont Aigoual Observatory



Part of the museum at Mont Aigoual Observatory



A video projection of a Meteosat IR image at Mont Aigoual Observatory



Panoramic view over the Cévennes Massif

Credits: Météo-France, Mt St Aigoual, Eric DIOT, (Météo-France)

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@btoopenworld.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

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 41 is Friday, January 31, 2014

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

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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 box Electronic Membership (downloadable PDF Quarterly) ... £15

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

Name (please PRINT clearly)

Email Address (please print **very** clearly)

Address

Declaration

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

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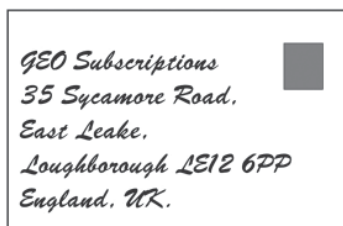
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Your subscription is valid for one year from your date of application and entitles you to all the privileges of membership of the Group for Earth Observation, including four issues of GEO Quarterly. Please note that your subscription will commence 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.

Please send your completed form to:

David Anderson (GEO subs),
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 Loughborough LE12 6PP, UK



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

R2FU Weather Satellite Receiver for NOAA APT



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	-----
Telesat 80 cm dish with LNB	72.00	-----	-----	79.00	-----	-----
Telesat 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

Telesat 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.



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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£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 may be available, but it is advisable to check before ordering.

UK members price - £3.80

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

UK members price - £8.00

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



