

The **GEO** Quarterly

Group for Earth Observation



www.geo-web.org.uk

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

LAUNCH ISSUE



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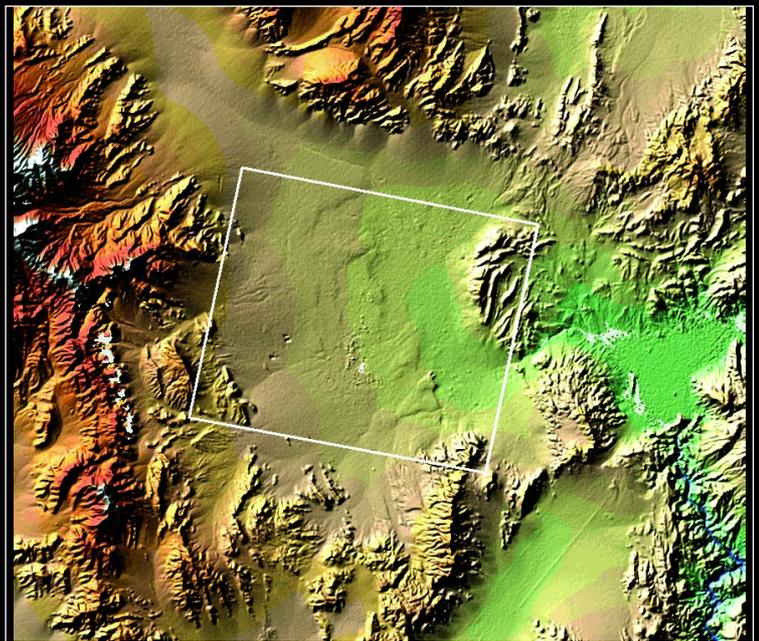
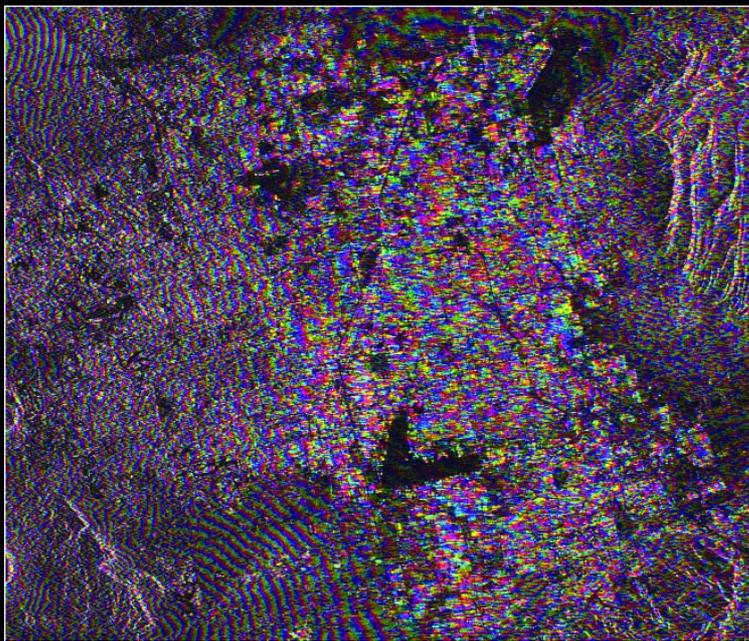
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Glacier Bay National Park and Preserve, Alaska with Gulf of Alaska in the left foreground and the Brady Glacier behind. The visualisation was created by draping elevation data from the USGS National Elevation Dataset - predominately 30-meter resolution elevation data collected by NASA's Shuttle Radar Topography Mission (SRTM) - over an Enhanced Thematic Mapper Plus (ETM+) image acquired by the Landsat-7 satellite in August 1999. This true-color image was created by combining the red, green, and blue wavelengths (ETM+ bands 3, 2, and 1).



Radar interferogram of the Las Vegas area (left) with a digital elevation model for comparison (see article on page 22)



Welcome to your first issue of the *GEO* Quarterly, the official magazine of *GEO*, the Group for Earth Observation. *GEO* is a new organisation aimed towards everyone with a keen interest in weather satellites and Earth imaging.

GEO has been conceived as a wholly amateur group, which will remain totally independent of any commercial interests in the weather satellite and Earth imaging fields. *GEO* is totally dedicated to serving both educational users and the amateur community.

Inside this launch issue you will find numerous articles aimed at newcomers to the hobby. Arthur Andrews reminisces about how he started out in Australia. Cedric Roberts explains what fired his interest in the weather. John Tellick traces the MSG-1 story from its launch in 2002 up till the present. Francis Bell suggests an Earth-imaging project to test your skills.

Now turn to page 2 and read Francis Bell's 'Mission Statement' on The Group for Earth Observation. Learn of our hopes and aspirations, and the bright future we all see ahead for the Remote Imaging Community.

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Group for Earth Observation Ltd.

The Group for Earth Observation Limited is a company in England and Wales limited by guarantee and not having share capital. Company number 4975595.

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

Printing

Toptown Printers, Vicarage Lawn,
Barnstaple, Devon EX32 7BN.

Responsibility for Constructional Projects and Software

Every effort is made to ensure that the technical and constructional articles published in this Quarterly are correct. However, the ultimate responsibility is with the reader to ensure the safety of constructions and for any interfacing with other equipment. *GEO* cannot accept liability for shortcomings in any published design or any constructions carried out by members or other third parties.

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Introducing GEO

The Group for Earth Observation



Francis Bell

Welcome to this first publication of 'GEO Quarterly'. In this introduction I will be as brief as possible because the content of the following pages will be much more interesting and will relate to the practical aspects of our interests in live weather satellite reception.

The background to this new group stems from a wish to establish an amateur organisation interested in the reception of live weather satellite images directly from space. The history of amateur weather satellite reception goes back over 20 years, to the time when Muirhead printers and dedicated framestores were used for recording a section of an image. Today however, with readily available fast computers and sophisticated software, together with a second generation of weather satellites beyond APT and WEFAX data formats, a second look at our interest group / hobby seemed timely. Hence, the new group: 'Group for Earth Observation', associated with the appropriate acronym 'GEO' and its quarterly publication.

In the very long tradition of amateur interests—the best example must be amateur radio—our intention is to experiment, free from any commercial association, and to help other members interested in direct reception of weather satellite signals. You may have seen publicity material submitted to *Short Wave Magazine*, the RSGB's *RadCom* and the National Space Centre's *BNSC Directory*. These published texts are exactly in line with the above statements of our plans and rationale.

Without wishing to excessively flatter those people who have agreed to lead this new group, there is a wealth of intellectual background within the group, embracing disciplines such as RF, astronomy, computing, meteorology, oceanography, publishing and a wide experience of weather satellite reception.

We have decided to make this first GEO Quarterly publication freely available, but of course, to maintain our group and cover the costs of the quarterly publications (quarterly implies four times a year) we do need a subscription membership. If you have not yet joined then read this publication and then judge whether £12 a year is money well spent. Visit our web site at www.geo-web.org.uk which is readily accessible and will be under constant review as this GEO Group develops.

Alternatively, write to:

FJB (GEO),
Coturnix House,
Rake Lane, Milford,
Godalming GU8 5AB
England,
Great Britain.

for information about joining the GEO group.

Forgive me if I repeat this but GEO has a passion for being an amateur based group. And here comes the big benefit:

EUMETSAT have just written to me stating that amateur and educational users of their satellite services **do not have to pay any license fee** for the reception of their encrypted satellite data streams. Here I must express particular thanks to John Tellick who deserves most of the credit for making this possible. For over a decade now, John has campaigned tirelessly with EUMETSAT, the Met Office and other Agencies on behalf of weather satellite enthusiasts.

I cannot understate the benefit of this which I and others have worked for with EUMETSAT. Herewith my public thanks to the EUMETSAT Council and to our UK Meteorological Office for their

support of the amateur and educational communities who explore the science and technology of what is possible for the reception and display of the new generation of weather satellite images.

A cautionary word here. I believe that GEO is in a privileged position in the amateur community and I ask that this status is not compromised. I ask that nobody distributes or publishes material, text or images, where the copyright resides elsewhere. Most of our material is directly available in the public domain so there is no problem, but it is courteous and perhaps a legal requirement in some cases to have the permission of the author or copyright holder before submitting material for printed publication or display on the Internet.

GEO will not support any exploitation of the intellectual property owned outside the public domain or without that owner's permission.

Judge our first publication by reading it and then decide whether you wish to join us. To join, visit our web site or write to FJB as shown above.

If you think our new GEO group with its quarterly publication plus its support for amateur and educational users is worthwhile, then please recommend GEO to your friends and colleagues. We do need an extensive membership to make GEO viable and worthwhile.

I cannot finish without expressing my admiration for the commitment and skills of those people (friends), responsible for the formation of GEO. The same goes to contributors to this publication who have made it so worthwhile. I look forward to the success of the group and the exciting times ahead.

Enjoy reading and exploring the rest of your first GEO Quarterly.

GEO Symposium

GEO has secured an outstanding location for its inaugural one-day symposium—the **National Space Centre** in Leicester. This Centre is a stunning venue, and well worth a visit even without the bonus of a GEO meeting. Please put this date, May 1, 2004, in your diary. If GEO is to continue with these events we do need your support.

From about 9.30 am, in the exhibition area, we will have on display live satellite reception: interesting for beginners and the experienced alike. The hardware and software will be there, together with advice on the purchase of the equipment for weather satellite reception.



The 'Rocket Tower' at the National Space Centre in Leicester

Invitations have been issued to potential speakers for the day, mainly relating to the latest developments in weather satellite reception. Nothing is guaranteed here because it depends on other people but the track record thus far is encouraging.

The cost for the day is a very modest £10 which will include access to the Centre's exhibition area. This fee does not include food, travel or accommodation. These personal details must be the responsibility of each delegate.

The National Space Centre is about two miles north of Leicester city centre. Leicester, almost in the centre of England, is readily

accessible by road or rail. There is a bus service to and from the city centre to the National Space Centre. There is a large free car park at the Space Centre if you come by car.

As this is *GEO's* first symposium, we do need your support for the event. It is expected that distinguished speakers will be there and every effort will be put into live satellite reception. Please come if you can to support *GEO*.

Registration

If you wish to register, please send your name and address by post to:

'FJB' (GEO),
Coturnix House,
Rake Lane, Milford,
Godalming, Surrey GU8 5AB

or email your details to:

100523.1037@compuserve.com

marked 'Leicester Symposium'.

You will be put on the database and later, in March, sent details of Leicester's local accommodation, travel details, the day's programme and invoiced for £10.

If you are coming from outside the UK you may pay the £10 on the day or the equivalent in Euros or US\$.

However, because of restricted numbers it would be much better to avoid disappointment and register your details in advance.

Details of *GEO*, and in due course the day's programme, may be found on our website at:

www.geo-web.org.uk

Details of the National Space Centre may be found at:

www.spacecentre.co.uk

You are advised to consult both websites if you can.

Leicester
Saturday, May 1, 2004



An American 'Gemini' space capsule, one of the exhibits on display inside the National Space Centre.

Finding Your Way to the National Space Centre

By Car

The National Space Centre is located just off the A6, two miles north of Leicester City Centre, and midway between the inner and outer ring roads. Brown signs direct you from junctions 21, 21a and 22 on the M1 and all other arterial routes around Leicester. There is free parking for 400 vehicles at the Space Centre.

By Train

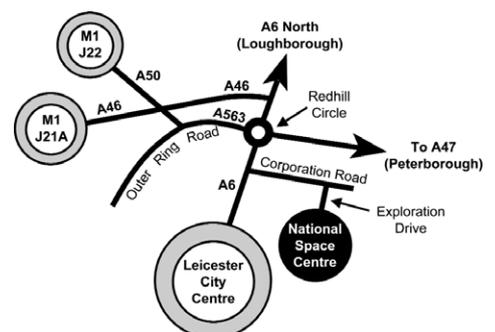
Midland Mainline and Central trains serve Leicester station.

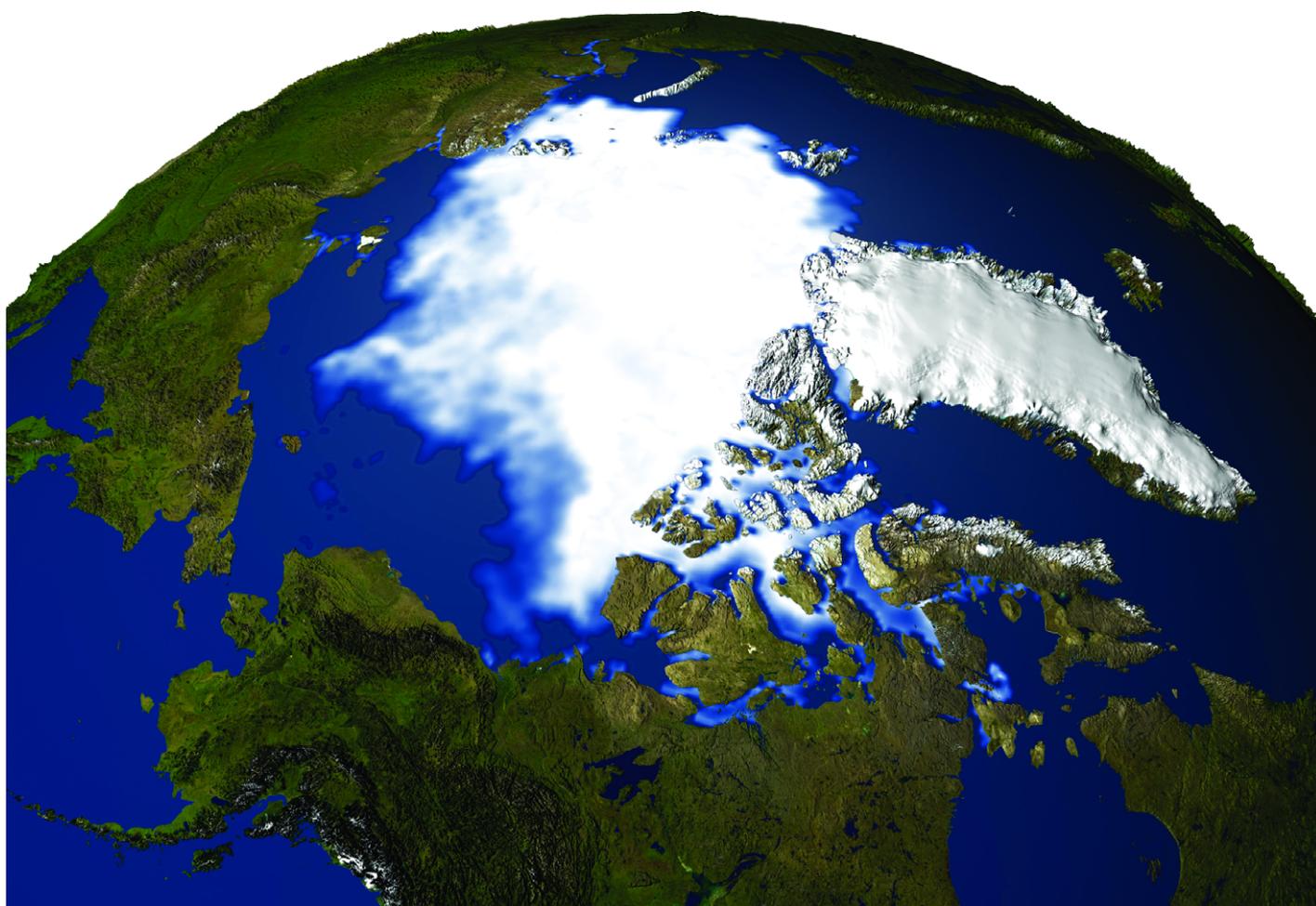
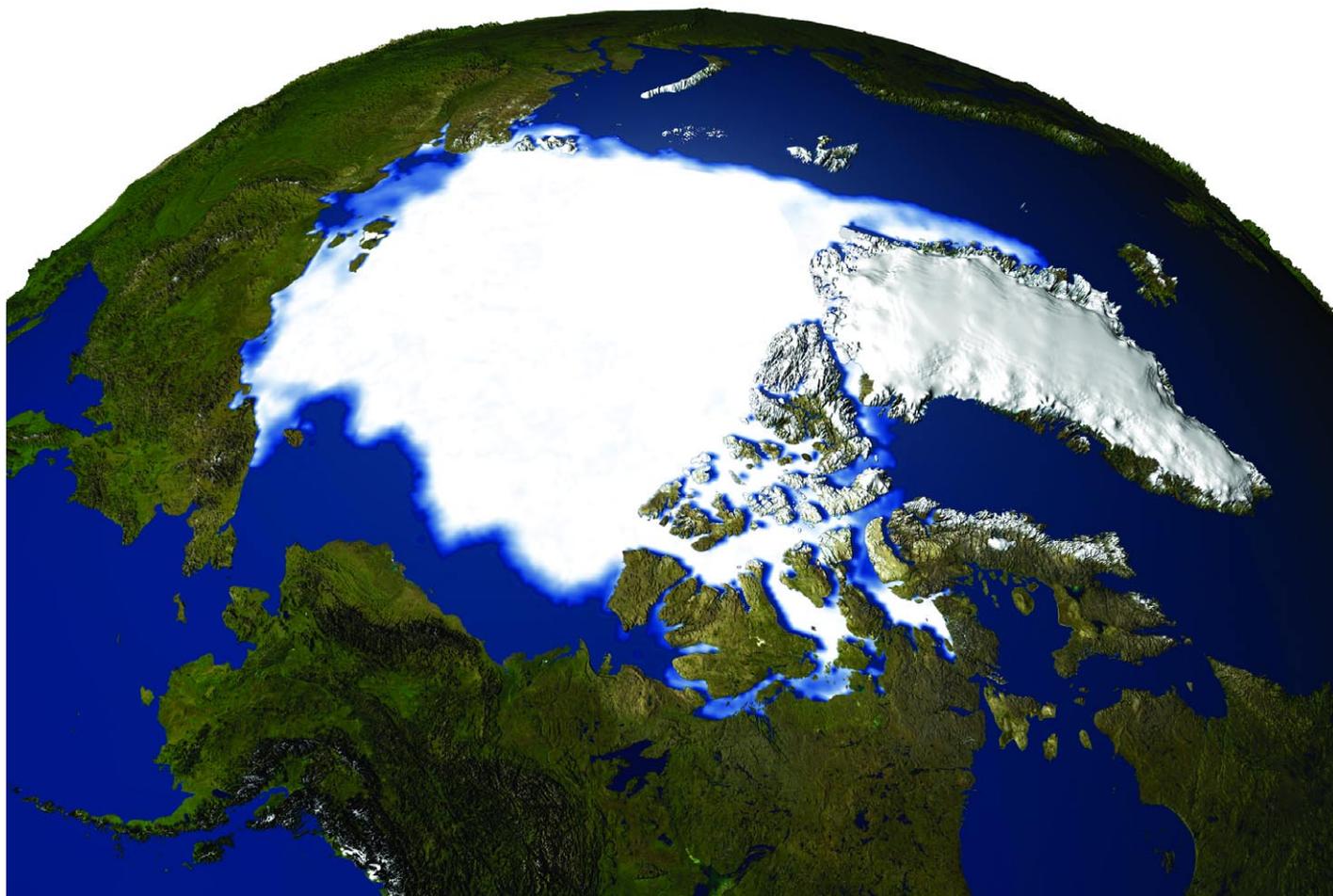
By Bus

Bus route 54 serves Leicester Station, City Centre, St Margaret's Bus Station and Abbey Lane, the latter just 5 minutes walk from the Space Centre.

For information on shuttle buses serving the Space Centre, telephone Leicester Tourist Information Centre on (0116) 299 8888.

The map below indicates the location of the National Space Centre (not to scale).





The Disappearing Perennial Arctic Sea Ice

NASA/Goddard Spaceflight Center

A NASA study finds that perennial sea ice in the Arctic is melting faster than previously thought—at a rate of 9% per decade. If these melting rates continue for a few more decades, the perennial sea ice will likely disappear entirely within the 21st century as a consequence of rising temperatures and interactions between ice, ocean and the atmosphere that accelerate the melting process.

Perennial sea ice floats in the polar oceans and remains at the conclusion of the summer, when the ice cover is at its minimum and seasonal sea ice has melted. This year-round ice averages about 3 meters in depth, but can be as thick as 7 meters.

The study also finds that temperatures in the Arctic are increasing at the rate of 1.2°C per decade. Melting sea ice would not affect sea levels, but it could profoundly impact summer shipping lanes, plankton blooms, ocean circulation systems, and global climate. 'If the perennial ice cover, which consists mainly of thick multi-year ice floes disappears, the entire Arctic Ocean climate and ecology would become very different,' said Josefino Comiso, a researcher at NASA's Goddard Space Flight Center, Greenbelt, Maryland, who authored the study.

Comiso has used satellite data to track trends in minimum Arctic sea ice cover and temperature over the Arctic since 1978. Since sea ice does not change uniformly in terms of time or space, Comiso sectioned off portions of the Arctic data and carefully analysed these to determine when ice had reached the minimum for that area each year. The results were compiled to obtain overall annual values of perennial sea ice.

The rate of decline is expected to accelerate due to positive feedback systems between the ice, oceans and atmosphere. As temperatures in the Arctic rise, the summer ice cover retreats, more solar heat is absorbed by the ocean, and more ice is melted by a warmer upper water layer. Warmer water may delay freezing in the fall, leading to a thinner ice cover in the winter and spring, which makes the sea ice more vulnerable to melting during the subsequent summer.

Also, the rise in summer ice temperatures by about 1.2°C each decade could lengthen the summers, allowing earlier spring thaws and later freeze dates in the fall, causing further thinning and retreat of perennial ice.

Comparing the differences between Arctic sea ice data from 1979 to 1989 and data from 1990 to 2000, Comiso

found the biggest melting occurred in the western area (Beaufort and Chukchi Seas) while considerable losses were also apparent in the eastern region (Siberian, Laptev and Kara Seas). Also, perennial ice actually advanced in relatively small areas near Greenland.

In the short term, reduced ice cover would open shipping lanes through the Arctic. Also, massive melts could increase biological productivity, since melt water floats and provides a stable layer conducive to plankton blooms. Also, both regional and global climate would be impacted since summer sea ice currently reflects sunlight out to space, cooling the planet's surface, and warming the atmosphere.

Comiso recently analysed the ice cover data up to the present and discovered that this year's perennial ice cover is the least extensive observed during the satellite era. The study appears in the late October issue of Geophysical Research Letters, and was funded by NASA's Cryospheric Sciences Program and the NASA Earth Science Enterprise/Earth Observing System Project.

The two composite images presented opposite provide a comparison between the minimum sea ice concentration in the Arctic between the years 1979 and 2003 as imaged by the DMSP Special Sensor Microwave Imager (SSM/I). The upper image shows the minimum sea ice concentration for the year 1979, and the lower one shows the minimum sea ice concentration in 2003.

Thanks to the National Aeronautics and Space Administration (NASA) for making this material available. The original article can be consulted on the NASA/Goddard Spaceflight Centre website at:

<http://www.gsfc.nasa.gov/topstory/2002/1122seaice.html>

Images courtesy Scientific Visualizations Studio, NASA GSFC.

Official GEO Internet Discussion Group

GEO has its own, private and moderated on-line discussion forum, called 'GEO-Subscribers'.

The aim of the Group is to provide a forum where **GEO** members can share information, ask questions and receive speedy responses.

To sign up, send an email to:

GEO-Subscribers-subscribe@yahoogroups.com

asking to be placed on the list.

THE SNOWS OF KILIMANJARO

Francis Bell

- or How Band-Aid Got it Wrong . . .

Although it has taken me several months to intermittently commission my new MSG-1 home receiving station, it is fully working and I am now receiving strong signals 24 hours per day. The results are astonishing! All those lovely spectral bands, so regular and so fast. Take a breath and that's several megabytes you have missed. I still consider myself a beginner. Animations, overlays, political boundaries, colours, combining or subtracting images; these are all for the future but what I am receiving at the moment is awesome.

As a total beginner of course, I looked at the new images in the light of experience with previous Meteosats and polar orbiters. I was so pleased because one feature I saw in the MSG-1 visible high-resolution band I recognised: I had seen something almost equivalent in an image from a NOAA APT pass I recorded a year ago. I strongly believed what I was looking at, using the new satellite, was snow in Africa. I had previously checked with Peter Wakelin that what I thought to be snow was correct. Peter confirmed that it was almost certainly snow which was showing up on my image. He knew the area which I had imaged and years before had cycled through some of the mountains there. From my atlas, spot heights of 4165 m and 3797 m are shown. I wish I could cycle in this sort of terrain! I went back to the image and admired it! I reopened my atlas and looked up the latitude, longitude and altitude relating to the image's area. It seemed to fit but I was still surprised. Africa is supposed to be hot desert or tropical forest. I discovered that perhaps not everywhere on the continent is like that.

I thought it would be a challenge to our new readership to invite submissions for satellite images showing snow in Africa. I think any amateur or educational receiving station should qualify for an entry. The use of any satellite and RF modulation format will be acceptable. No professional SPOT or LANDSAT images please: that's not quite in the spirit of what I'm suggesting. Submissions to the editor please within one year from this publication. The 23° tilt of the Earth's axis from the ecliptic determines the seasons. So a year gives everybody time and all the seasons to secure an image for a potential entry to this publication.

One of the targets is quite easy. Even from my house in the S.E. of England I have received images of snow in Africa from two different satellites. Other images of snow in Africa are not quite so easy but I know they are possible using home equipment.

Please accept this challenge. The advent of MSG-1 opens up major new opportunities for us. There is no

specific prize: just the satisfaction of having your image(s) published in our new-style magazine.

Having posted this challenge, I began to think about Africa. What area of land constitutes continental Africa? There are some peripheral island anomalies and the Sinai peninsula. Eventually I decided Africa was the contiguous land mass that we would commonly recognise as Africa, bounded by its coastal outline and limited to the north east by the Suez Canal. Within this definition please submit as many images as you can of different areas in Africa showing snow.

From the title of this article I may have given away one of the permanent areas of snow in Africa which I have personally seen.

I have had the double privilege of being in the Amboseli National Park, Kenya, at 6.00 am one morning and seeing a stunning African dawn with the snow-capped mountain of Kilimanjaro in the background. Kilimanjaro is a serious mountain with an altitude of 5895 m. Don't attempt to climb it without a professional guide. Many people have died of acute mountain sickness on this mountain trying! It looks tropical and beguiling but it is a seriously high mountain.

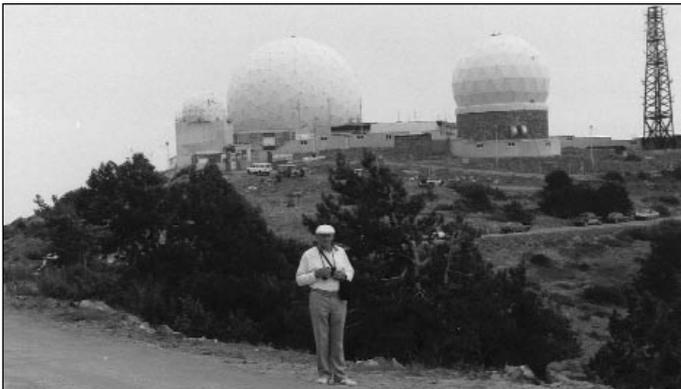
My second privilege was a chance meeting with the man / family who hosted Ernest Hemingway while he stayed in the area at the time he was writing his book: 'The Snows of Kilimanjaro'. It's still in print. My new friend lived in a village close to the base of Kilimanjaro. I spent half a morning talking to him and was impressed with his skilful use of English literature and his knowledge of the mountain. He had been to the top twice.

As a starting point for this challenge I will give the following details. Kilimanjaro's latitude is approximately 4°S, it's longitude is 47°E and the altitude of the mountain is 5895 metres. There is permanent snow here. Please submit your best image. I have tried imaging the snow on this mountain myself but at the time of writing I have only managed to image its cloud cover. But that doesn't mean it can't be done! There is another mountain at zero degrees latitude not all that far north of Kilimanjaro.

Now for the peripheral areas of non-contiguous Africa. There were two islands that troubled me - Tenerife and Cyprus. I'm going to exclude Tenerife as part of Africa, even though it is very close at only 300 km distance and Tenerife does have permanent snow. Although I have never set foot on the island I have seen it from the sea.

A deep sea fishing trip (more Ernest Hemingway I'm afraid: 'The Old Man and the Sea', an appropriate description) brought us close to the island, and a view of its snow-capped mountain was very clear. The scale of the mountain was impressive (No I didn't catch any fish: and yes, Nadine was sea sick).

Cyprus spooks me a little. In which continent is it located? Cleopatra would have it as Egypt hence part of Africa: Mark Anthony gave it to her. Rome (ancient or modern), Greece and Britain would have it as European. The Turks, (well at least the northern third of the island), would claim it for Turkey, hence Asia. I take the geological perspective. I have been to the island more than once and seen the extruded pillow-lavas forming the Troodos mountains, indicating the island's marine origin. A collision of three continents. So the ambiguities of this island rule it out of the challenge but it still remains an interesting target for imaging. I know the Troodos Mountains in Cyprus and they do have snow in winter. I have been there and seen the ski facilities. Fortunately I was there in the summer: T-shirt and riding a motor bike. It was cool as we approached the summit but no snow in mid summer. However, I did see an impressive array of large dishes - NATO's ears to the east.



NATO's ears to the east, with the author in the foreground

Images of snow in the Troodos mountains represents an interesting challenge. What about snow in Palestine? It does happen! Who can image that? I have deliberately not submitted any of my images to the editor in anticipation of better entries from our readership.

You only have twenty years to accept this challenge. Peter Wakelin has just informed me that the ice cap on the summit of Kilimanjaro is melting. In twenty years time it may have gone!

In starting this article it was not my intention but a further challenge has come to mind. Can anybody submit an image of Key West, Florida. HRPT or LRIT would be interesting. I visited Ernest Hemingway's house in Key West about a year ago. I will not make any friends by saying this—but that will not stop me—Key West is the only interesting place in Florida.

Meteosat Second Generation

John Tellick



The dawn of a new era was signalled with the successful launch of Europe's newest geostationary satellite, MSG-1 on August 28, 2002. MSG-1 is the first in a new series of all-digital European geostationary meteorological satellites which will replace the original Meteosat series which has been operational since 1977.

MSG is a cylindrical, spin-stabilised satellite, rotating at 100 rpm around a principal axis which is aligned nearly north-south. The spin is also a necessary feature for the operation of MSG's Earth scanning radiometer, the Spinning Enhanced Visible and Infrared Imager (SEVIRI).



Launch of MSG-1
© 2002 ESA/CNES -
Arianespace/Photo Services
Optique CS

This instrument scans the Earth every 15 minutes to produce full-globe images in eleven spectral channels ranging from visible light (VIS) through Infrared (IR). These images have a resolution of 3 km at the sub-satellite point (SSP) while a selected area, including Europe, is provided as a high resolution visible image (HRV) with 1 km resolution at the SSP.

MSG satellites transmit two end-user imaging channels. High Rate Information Transmission (HRIT) on 1695.15 MHz* provides all twelve SEVIRI channels at full resolution every 15 minutes. Low Rate Information Transmission (LRIT) at 1691 MHz* contains a subset of five of the SEVIRI spectral channels at reduced resolution every 30 minutes plus, in addition, relays of foreign satellite data (GOES-E and -W, Meteosat-5 IODC and GMS/MTSAT imagery) every 3 hours.

MSG-1 also carries a Geostationary Earth Radiation Budget (GERB) instrument, the first time this has been flown on a geostationary satellite. Its data, both alone and combined with that from SEVIRI, will provide vital new information on diurnal variations into the radiative balance of the planet. It will also have important applications regarding climate studies and monitoring.

Failure of the MSG-1 Power Amplifier

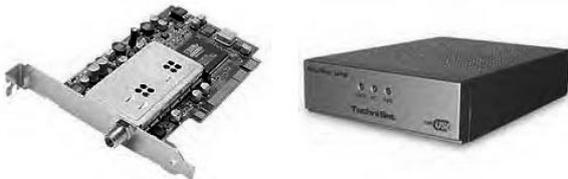
Following its successful launch and placement into geostationary orbit, MSG-1 commissioning tests began in late September 2002. But in mid-October, the downlink under test ceased when the Solid State Power Amplifier (SSPA) being used unexpectedly switched off and could not be reactivated. Subsequent imaging tests proved the SEVIRI instrument and the raw data downlink chain to be operating correctly, but it was eventually decided not to disseminate user services directly owing to doubt over the remaining SSPAs.

The EUMETSAT EUMETCast Service

EUMETSAT had already been testing a new data retransmission service for the Advanced TIROS Operational Vertical Sounder (ATOVS) data from sensors aboard NOAA polar orbiting satellites. Following the SSPA failure, EUMETSAT were obliged to pursue an alternative means of disseminating the MSG-1 data and trials via EUMETSAT's Multicast Distribution System (EUMETCast) began at the end of April 2003. These were transmitted by EUMETSAT's Hot Bird-6 satellite stationed at 13°E using the digital video broadcast (DVB) format used by digital satellite TV. This service was due to become fully operational as the primary 0° longitude service in late January 2004 with MSG-1 renamed Meteosat-8 and located at 3°W.

System Hardware Requirements

The main component of the hardware system is the TechniSat SkyStar-2 PCI DVB receiver card. This is a free-to-air digital satellite-TV receiver that is installed inside your computer (there is also a USB version). The SkyStar unit can also receive data transmissions, including satellite Internet services. The receiving



The SkyStar-2 card (left) and USB unit (right)

antenna recommended by EUMETSAT for most of Europe is an 85 cm offset satellite-TV dish, provided a good quality standard Universal digital satellite TV LNB is employed. Good quality satellite TV co-ax cable such as CT100 is required between the dish and the receiver. Care should be taken when stapling and routing this cable as digital signals can suffer losses due to sharp bends or cable constriction.



A typical 85 cm offset satellite-TV dish

Aligning the dish to Hot Bird-6 is not too difficult if you have a sensitive satellite-TV level meter at the dish. One of the SkyStar installation set-up screens includes

a signal-strength meter which allows you to 'fine tune' your dish set-up.

Software Requirements

To receive the EUMETCast service from Hot Bird-6 you also require software called *tq*®-TELLICAST to handle the DVB data stream. This software is available either from T-Systems in Germany for €60 plus handling charges, or from EUMETSAT, who send you purchasing details once you have applied for the service. To be able to purchase this software you must first successfully register with EUMETSAT for MSG dissemination using the form EUM/OPS-MSG/REG/01 which is available on the EUMETSAT website at:

<http://www.eumetsat.de/en/dps/helpdesk/registration.html>

Once you have been successfully registered, you will be issued with the username and password required for installation of the *tq*®-TELLICAST software and notified that you may now apply for the software.

To assemble, save and display the files generated by the T-Systems software you will also require David Taylor's MSG Data Manager software. This can be obtained from David Taylor for £44 at:

<http://www.satsignal.net>

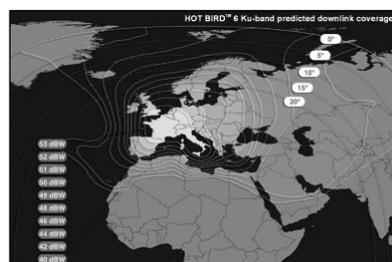
It is also strongly recommended that you download and read EUMETSAT's technical document EUM TD 15, Issue No 3. A link is available from our website at:

http://www.geo-web.org.uk/eumet_docs.html

as it contains much useful information concerning the EUMETCast service.

The Fully Operational Service

This began in January 2004 and contains the complete 12-channel SEVIRI HRIT data every 15 minutes plus full LRIT data every 30 minutes, as well as foreign satellite relays. With the exception of the WMO requirement of 'free' 6-hourly HRIT and LRIT data sets, this data will be encrypted from March 2004. To receive the full encrypted data sets an Aladdin eToken PRO decryption unit (a USB dongle) will be required, together with associated software to control access to the data in accordance with the EUMETSAT Data Access Policy and your user category as applied for at registration. The current price is around £40 for the dongle and software. All users who have applied for the EUMETCast service will be contacted regarding application for the decryption unit and software before the service is encrypted in March 2004.



The Ku-band signal power level foot-print for Hot Bird-6. Most of central Europe and S and SE England lie within the 53 dBW contour.

C-band MSG-1 EUMETCast Service

Although Europe is now catered for with the Ku-band *EUMETCast* service via *Hot Bird-6*, *EUMETSAT* also have an obligation to supply African States with MSG meteorological data under the EU-funded *PUMA* Agreement, which had equipped African States with MSG receiving stations.

For technical reasons, C-band transmission was preferable and, following tests, *EUTELSAT*'s Atlantic Bird-3 satellite stationed at 5°W was chosen. These tests proved successful, and a trial service began late in 2003. The C-band beam covers the whole of Europe and Africa, all of which, with the exception of parts of Morocco, southern Algeria, Mali and Niger, lie within the 39 dBW footprint.

The format of the C-band dissemination will be *DVB EUMETCast*, the same as for the *Hot Bird-6* Ku-Band dissemination. The data will be uplinked to *Atlantic Bird-3* via the Fucino ground station in Italy and will be a re-broadcast of the *Hot Bird EUMETCast* service.

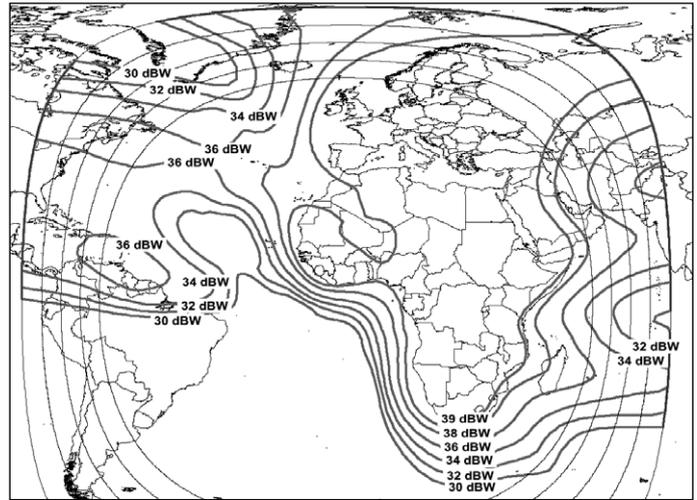
Access to the C-band *EUMETCast* trial dissemination both within and outside *EUMETSAT* Member States is subject to applications using the same MSG Image Data Service registration form described above.

The same *T-Systems tq®-TELLICAST* software will be required, as will MSG Data Manager to deal with file management and image viewing.

The *Atlantic Bird-3* C-band footprint over Europe and Africa is only 39 dBW compared with *Hot Bird-6*'s Ku-band spot beam of 53 dBW over SE England and central Europe, This means that a significantly larger antenna will be required to receive this service, and *EUMETSAT* recommend a 2.4 metre dish.

The *Atlantic Bird-3* C-band *EUMETCast* footprint also extends into the eastern part of the USA at reduced levels and *EUMETSAT* recommend that a dish size of 3.7 m will be required in most US locations.

* No longer relevant to MSG1 due to SSPA failure.



Footprint diagram for Atlantic Bird-3 C-band transmission

FREE

Amateur and Educational Access to MSG Data for GEO Quarterly Readers

The paragraph printed below is probably the most important paragraph in this publication. It is reprinted with the permission of *EUMETSAT*.

If you don't understand it at the first reading, it relates to the availability of satellite data from *EUMETSAT* to amateur users.

***EUMETSAT* will not charge a license fee for the reception of their data to a UK amateur or educational user.**

You are sincerely counselled to conform strictly to *EUMETSAT*'s licensing conditions and *GEO* will be dissociated from any individual or group who infringe *EUMETSAT*'s licensing agreement. *GEO* wish this privilege for our membership to continue.

The *EUMETSAT* notice below was released in December 2003

'The *EUMETSAT* Data Policy concerning access to HRIT and LRIT SEVIRI data has been amended. It is now possible for individual users (amateurs) who require access to data for their own personal use to

be treated like 'Educational Users' for data licensing purposes.

'Such users would be required to sign a license agreement and strict compliance of the license conditions for 'Educational Users' will apply. License fees are not charged for access to data as an 'Educational User.

'For further information on the licensing conditions please consult your licensing authority or refer to the *EUMETSAT* Data Policy brochure, *EUM BR 12*, available on the *EUMETSAT* website.'

Regards,

Sally Wannop
User Support Manager
EUMETSAT User Service

STOP PRESS - January 7, 2004

EUMETSAT / UK Met Office
License Agreement for Reception of MSG
Data

METEOSAT SECOND GENERATION

EUMETSAT

esa



Logo © *EUMETSAT* 2003

In line with *EUMETSAT*'s policy for individuals within member states of the EU to deal with their own meteorological office, I have just concluded my own licence agreement with the UK Met Office in Exeter.

I was in the MSG trial, so my details would have been forwarded from *EUMETSAT* to the UK Met Office: hence my early license. However, there is nothing to stop other UK resident *GEO* readers, or any other European users from registering their interests and concluding a licence agreement for MSG data reception.

In the UK contact:

Colin Cuthbert,
UK Licensing Agent, *EUMETSAT*,
Met Office,
Fitzroy Road,
Exeter EX1 3PB
Tel: 01392 884678
Fax: 01392 885681
email:
colin.cuthbert@metoffice.com

Francis Bell

The *Polar Low* Phenomenon

Les Hamilton

When you examine your NOAA channel-4 infrared images during the winter months, you may from time to time spot what looks like a miniature cyclone in the Barents Sea or the North Atlantic Ocean. What you are observing is almost certainly a *polar low*.

Just such a phenomenon was observed by Ferdinand Valk in December 2003, and his image is reproduced opposite. The *polar low* is the whorl of cloud which fills the Barents Sea and obscures the southern part of the island of Novaya Zemlya.

What is a Polar Low?

During long Arctic winter nights, cold air builds up to create what is known as the *polar front*, the boundary between cold air to the north and warmer air to the south. A *polar low* is a small cyclone with windspeeds near to or above gale force, which forms in the cold air far north of the *polar front* itself.

The European Polar Low Working Group [1] defines any cyclone to the north of the polar front, and which has a spread of less than 2000 km across, as a 'meso-scale cyclone' or 'mesocyclone'. The classical *polar low* is included as a subtype, restricted to very intense maritime systems stretching up to 1000 km and where the near-surface winds exceed 15 metres per second (30 knots).

A *polar low* forms only over the sea, and exclusively during the winter months: it arises when a packet of cold polar air moves across relatively warmer water (such as that provided by the North Atlantic Drift as it sweeps past Iceland and into the Barents Sea). Typically, these *polar lows* show considerable similarity to tropical hurricanes but they are generally only of the order of 400 to 800 km across: some may span

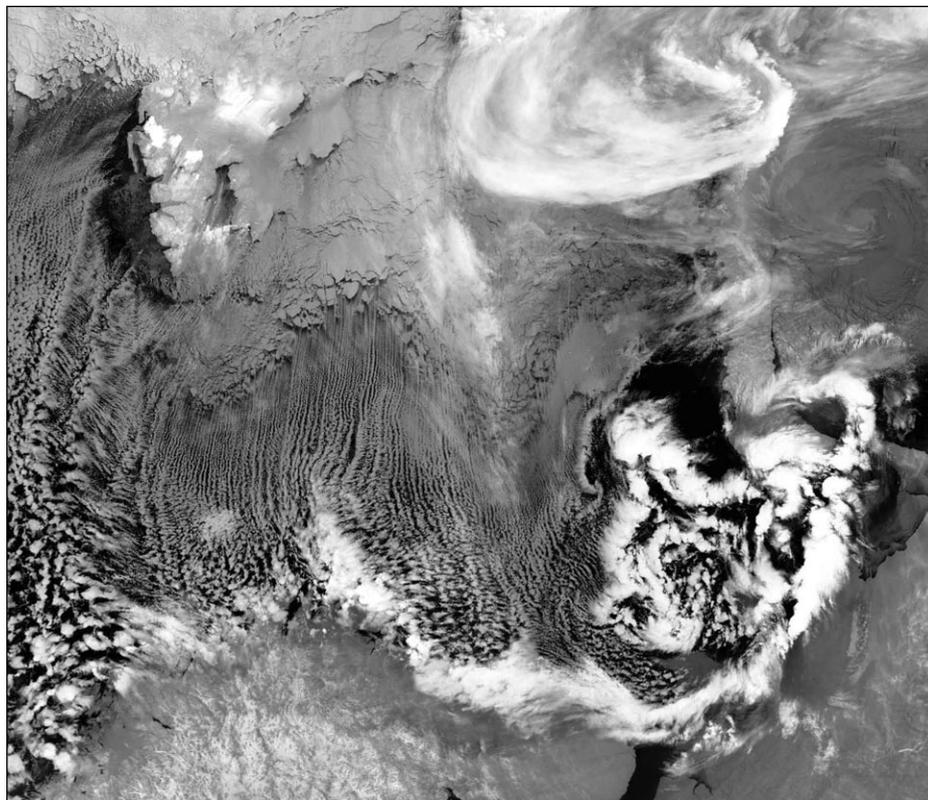


Figure 1 - NOAA 17 - 09:14 UT on December 21, 2003 (© Ferdinand Valk)

as little as 100 km. The polar low illustrated in figure 1 spanned around 900 km. Figure 2 shows the synoptic sea-level pressure chart for the region. The long, trailing comma-shaped tail seen hugging the northern coastline of Russia's Kola peninsula is a characteristic feature of the *polar low*. As the storm matures, spiral cloud bands, often with a clear eye at the the centre of the cloud vortex, look remarkably similar to a tropical cyclone and provide the *polar low* with its alternative appellation, that of Arctic hurricane.

For many centuries, seafarers in the north Atlantic and Arctic oceans have recounted tales of fierce storms that seemed to appear from nowhere, often accompanied by strong winds and snowfall [3]. It is highly probable that ships which disappeared without trace over the years may have been the victims of these unpredictable, short-lived cyclones. *Polar lows* show a very

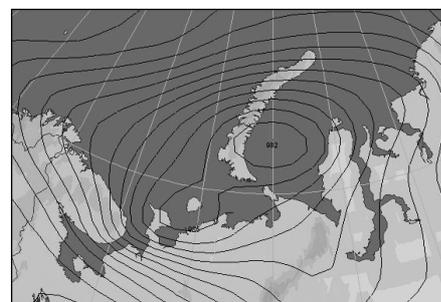


Figure 2 - Sea-level isobars at 12:00 UT on December 21, 2003

characteristic pattern and life cycle during which they produce severe weather consisting of heavy precipitation (usually falling as snow) coupled with strong surface winds.

Eventually, most *polar lows* encounter the coasts of Norway, Scotland and Denmark where their activity rapidly diminishes. In fact, Northern Scotland bore the brunt of just such a polar low in February 1969 during which a gust of wind measured during a violent snow

shower at Kirkwall airport in the Orkney Islands was recorded with a speed of 118 knots (218 km/h) .

It was not until satellite imagery arrived on the scene during the 1960's that a better understanding of these storms was realised. Because of their northern position and small scale, and the fact that they appear in the dark winter season, AVHRR-NOAA IR images provide one of the best ways of detecting *polar lows*.

Today we know that *polar lows* are a frequent feature of the relatively warm ice-free waters around the coasts of the Nordic countries, in the Labrador Sea, the Gulf of Alaska and the Sea of Japan. And of course, they are also a feature of Antarctic polar waters.

Lifespan of a Polar Low

A *polar low* can brew up and disperse completely again in a surprisingly short period of time: typically the phenomenon lasts only between 12 and 36 hours.

The illustrations on the right trace the appearance and dispersal of the December 21 *polar low*. Exactly one day before Ferdinand Valk spotted this system, a NOAA-17 channel-4 HRPT segment revealed no sign whatever of any activity of this nature (figure 3) although there was clear evidence that streamers of polar air were heading southwards over the Barents Sea. Early the following day, NOAA-12 imaged a compact polar low encircling the area (figure 4), but just six hours later (figure 1) it was already clearly beginning to show signs of decay. The final image in the sequence came from a NOAA-16 transmission in the early hours of the following day (figure 5), by which time the storm had all but exhausted itself, leaving behind only a few isolated fragments of bright cloud to indicate that it had ever existed.

Further Examples of Polar Lows

Interestingly, a particularly well formed *polar low* appeared in precisely the same region almost exactly one year ago, on December 20, 2002 (figure 6).

Although *polar lows* are generally associated with the Arctic, they can form in the waters of the north Atlantic, in the region between Greenland and Norway and sometimes, rarely, even as far south as the Faeroe Islands. Furthermore, a *polar low* embedded in a southerly moving airstream may on occasions track into the North Sea. We need look back only as far as January 2003 to remind ourselves of one of these relatively rare visitations when much of Britain and the Low Countries experienced paralysing blizzards as a *polar low* made landfall. The culprit coursed down the North Sea, and is illustrated in figure 7, a NOAA-17 channel-4 APT image acquired shortly before noon on that day.

Like their much larger tropical cousins, *polar lows* tend to decay rapidly when they reach land, due to the

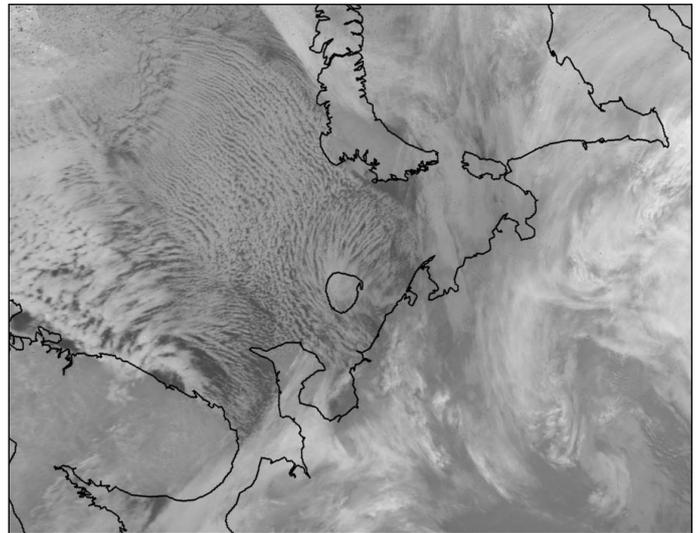


Figure 3 - NOAA 17 - 07:33 UT on December 20, 2003

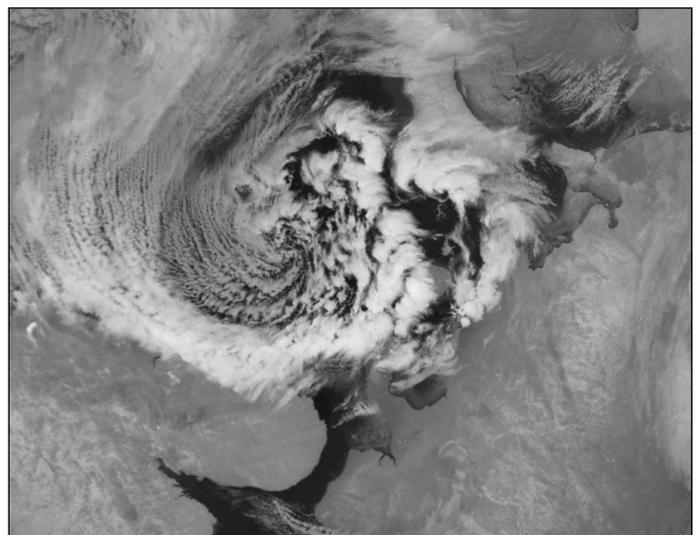


Figure 4 - NOAA 12 - 02:41 UT on December 21, 2003

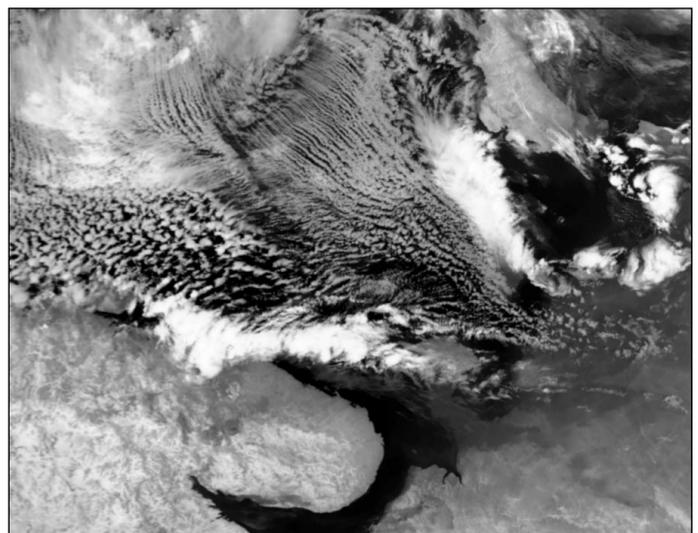


Figure 5 - NOAA 16 - 00:11 UT on December 22, 2003

loss of the energy supply provided by the relatively warm sea they are traversing. But before they do, they can produce severe weather conditions over the land and this was one such occasion. The cyclone advanced southwards over the North Sea and caused severe

blizzards over much of eastern Britain as well as over large parts of Holland and Belgium (figure 7) [2]. At some locations on the east coast of England, wind speeds reached force 10!

From that afternoon chaos reigned throughout Great Britain. Stanstead Airport was closed while thousands of travellers were delayed at Heathrow Airport as flights were cancelled; the London underground came to a halt; schools were closed; many workers trying to make their way home after work found themselves in traffic gridlock for many hours; thousands suffered power cuts; snowploughs struggled to keep roads open, with many short journeys taking hours and there were numerous road accidents as up to 15 cm of snow fell in many places. Yet in the corresponding NOAA-17 image the following day, only a tenuous streamer, possibly a remnant of the cyclone's 'comma' tail, remained to tell the tale (figure 8).

References and Further Reading

1. The European Polar Low Working Group
<http://www.meteo.uni-bonn.de/mitarbeiter/GHeinemann/eplwg/eplwgop.htm>
2. 'Polar low' boven zuidelijke Noordzee
<http://www.knmi.nl/~floor/artikelen/zenit/polarlow/>
3. Weather Online
<http://www.weatheronline.co.uk/feature/wf261103.htm>
4. Cloud Structure (of the Polar Low)
<http://www.zamg.ac.at/docu/satmanu4.0/satmanu/manual/PL/pl1.htm>

Images

Figure 2

Synoptic chart created with Digital Atmosphere

Figures 3, 4, 5, 6

Reproduced by courtesy of the SMIS NOAA HRPT telemetry archive at:
http://d902.iki.rssi.ru/dataserv/engl/oper_e.shtml

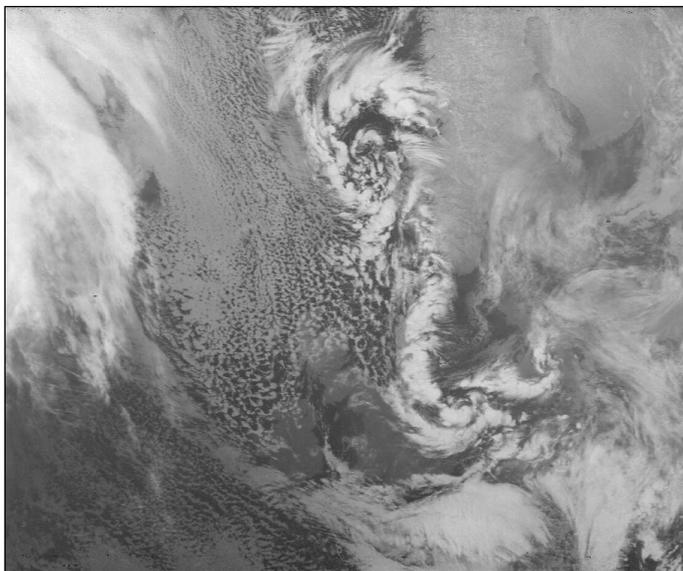


Figure 7 - A polar low brings blizzards to Britain and the Low Countries (NOAA 17 - 11:08 UT - January 30, 2003)

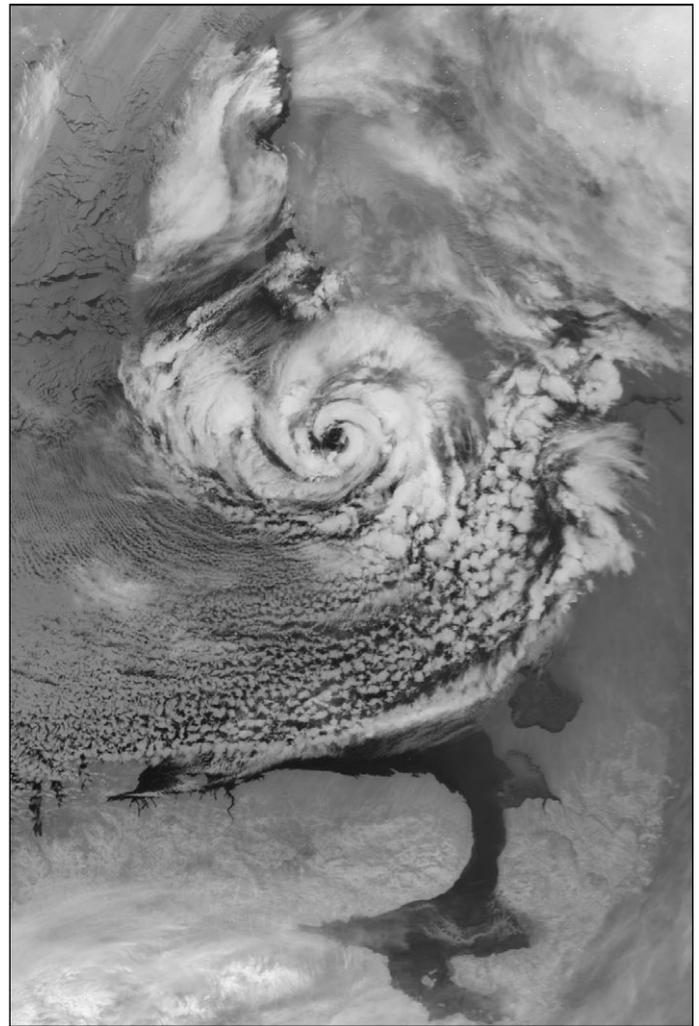


Figure 6 - NOAA 12 - 04:33 UT on December 20, 2002

The images were processed using David Taylor's HRPT Reader, then converted to orthographic projection using his Groundmap program, which also added country outlines.

Figures 7 and 8

NOAA-17 APT images received by Les Hamilton and processed using Craig Anderson's Wxtoimg software

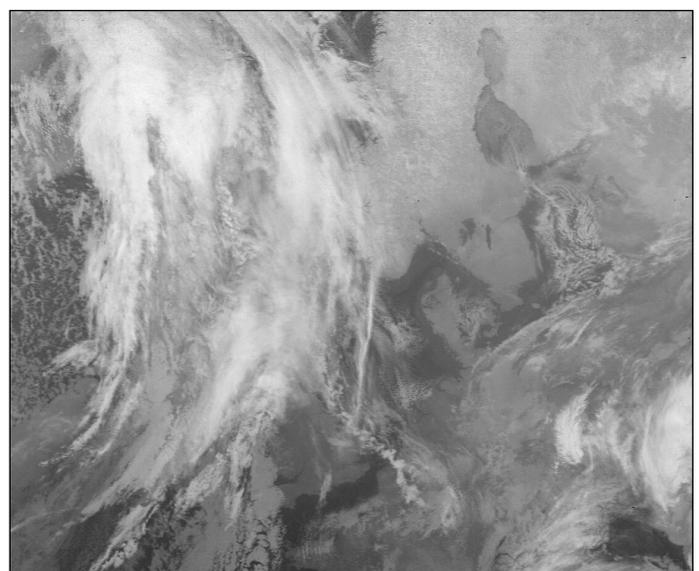


Figure 8 - Next day, the polar low has completely disappeared (NOAA 17 - 10:43 UT - January 31, 2003)

Watching the Weather

My Years with Satellite Acquisition

Cedric Roberts M.B.E.

I decided, or rather my health decided for me, to take early retirement from teaching at the end of the autumn term in 1986. I had been in full time education work since 1955 and my current position, in 1986, as Head of the Upper School at the local large mixed comprehensive had thrown such pressures upon me that my health was beginning to suffer. So, when I was offered a 'way out' I did not need further prompting!

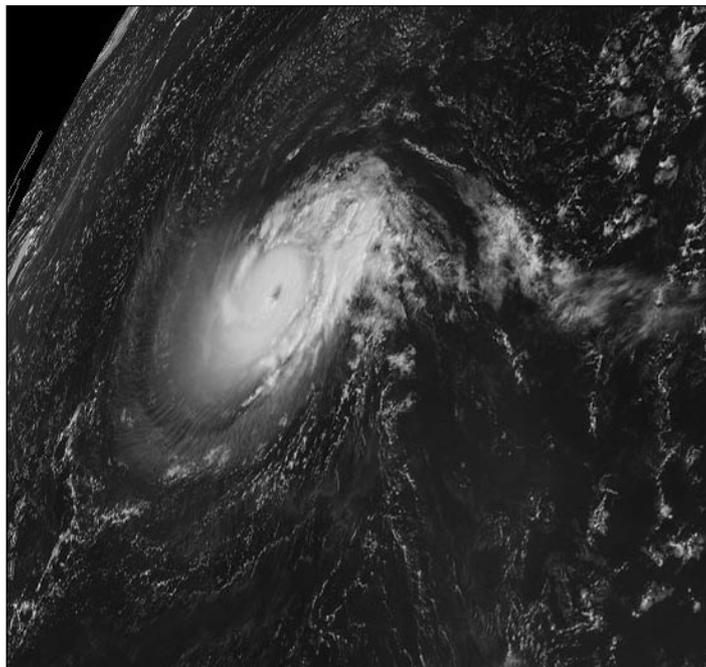
Leaving a full-time career that had taken every moment of my time left me at first feeling like a fish out of water. I had time on my hands and no prompting to get things finished as soon as possible. So I looked round for some hobby that would supplement my life-long passion for the 'weather; a hobby that had started on January 1st 1946 with daily climate readings, and which continues to this very day. But what was I to do?

Much to my pleasure, a friend sent me his copy of *Amateur Radio* magazine in which I found mention of a new area of study dealing with the acquisition and display of the weather satellites that were then in their early days. I decided that this would be an excellent aid to my work on weather, and set about acquiring, installing and making operational a simple system in use at the time. This was supplied by a firm in the south of England, and used a device under the name of 'Grace' to decipher the radio signals transmitted by the polar orbiting satellites. These satellites, then only recently placed in position, were the American NOAAs and the Russian Meteors. The initial system was produced by *Martelec* and I was thrilled after spending several days installing all of the equipment, including a rather unusual antenna termed a 'turnstile', to receive my first rather fuzzy image of the Earth as the satellite sped across the sky.

However, I soon discovered that producing a good image was not all that easy as I seemed to be getting a lot of noise, not connected with the satellite at all, on the receiver. Living as I do on the boundary of the West

Midlands conurbation, I was subject to the radio signals being generated by all manner of people, and some of these almost blotted out the entire satellite signal from the satellite. Not being in any way a 'Radio Ham' I was totally unsure about what to do in order to try and eliminate as much of this interference as was possible. I looked around for guidance and had the good fortune to make contact with a firm called *Spacetech* working from Portland Bill. They proved some of the most helpful people that one could wish to meet and guided me through a whole maze of their new software, plus the installation of a new *BBC Archimedes* computer, which enabled me to produce images many times more detailed than my earlier attempts.

Consequently I had a year or two of relatively 'stable' conditions and collected some excellent imagery from both polar orbiting and geostationary satellites using



An MSG-1 image of Hurricane *Isabel*, imaged by Cedric Roberts

the *Spacetech* system. These continued to supplement my climate work, which had itself expanded greatly and now required a more powerful computer, as well as improved software, if I were to get the most from it. I therefore moved over to a PC and installed *Windows* and *Excel* to enable me to make full use of the, by now, extensive files of climate data, and it was at this point in time that I came across a firm called *Dartcom* working from Yelverton in Devon.

After brief discussion of requirements I moved over to the full *Dartcom* system, using their own receiver and software, and began to take even more detailed images than ever.

All of this brought me from the 1980's to the 2000's, the last decade or so making use entirely of the *Dartcom* system. In 2001, I decided to install the *Dartcom* HRPT system, even though it would not be possible to place the rotator and dish on the roof. As it had to be installed at ground level I had to make a very careful choice of position if I were to obtain any worthwhile imagery at all, since I had 3-story houses to the north and a very large oak tree to the south. However, judicial planning enabled a good position to be found permitting imagery to be obtained from Iceland in the north to north Africa in the south, and as far east as the Black Sea on suitable passes.

This has continued to provide excellent imagery and when the new MSG-1 satellite was put into orbit and promptly had difficulties with one of the power units, I

opted to go ahead with *Dartcom*, who installed the *Telique* software and new dish to acquire the signals from this satellite. David Taylor proved a real godsend as he provided a massive amount of help in the use of his software for reading and displaying the signals from this satellite.

A colour composite image of the full Earth disc is shown on the inside back cover of this issue, along with a geometrically rectified segment covering Europe.

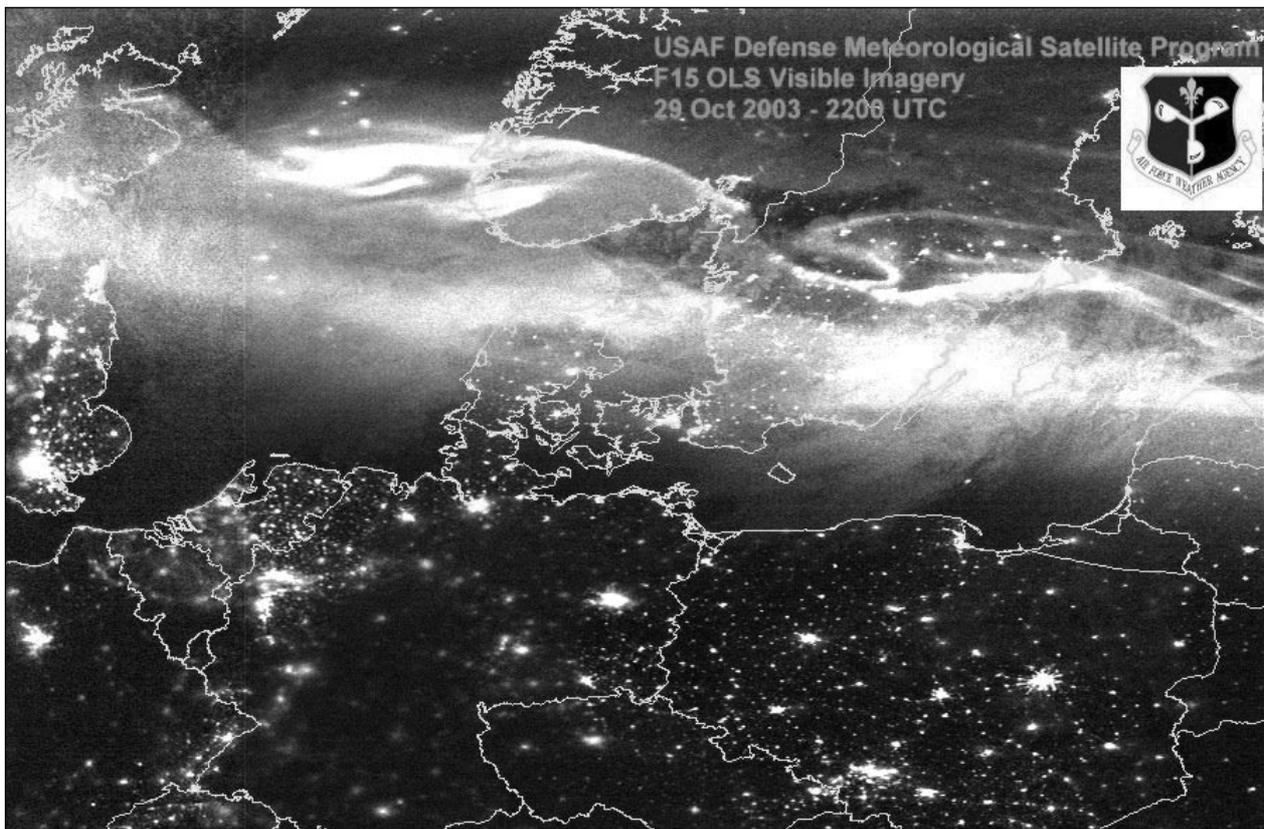
Currently I am able to take polar orbiting and geostationary images, both containing superb detail. Matters have gone a long way since I looked at my first, rather blotchy image of the UK and western Europe, which I then considered the height of excellence. Today

the images can be seen in extreme detail, in false colour and even in animation, so far has the software progressed. I have been indebted to all with whom I have dealt, and especially to David Wright at *Dartcom* and David Taylor for his guidance on the use of software.

I now look forward to even greater things as I am hopeful of taking receipt of the new *Dartcom* Software for using with MSG-1 over the Christmas period. The World of Science moves ahead at an astonishing rate, though I am now beginning to feel that the newer material is more suited to those who are not quite as old as myself. Today I do at times feel that I am in danger of being left behind as the subject races ahead.

Unusual Solar Activity

Peter Wakelin



A Powerful display of Aurora Borealis as imaged over Europe on October 29, 2003 by the F-15 DMSP satellite
Image courtesy US Air Force Weather Agency.

The last peak in the 11-year solar cycle occurred early in 2001 and the average sunspot count has been decreasing since then. But in late October 2003 three huge sunspots appeared: one, named 'sunspot 486', was the biggest for 13 years. The three spots unleashed 11 X-class flares (the most powerful class) in only 14 days, equalling the total number seen throughout the previous year. The effects on Earth were many; radio communications were disrupted, astronauts and some air travellers received radiation doses equal to a chest X-ray and auroras appeared at unusually low latitudes.

The Operational Linescan System on the US Defense Meteorological Satellite Program spacecraft incorporates a photomultiplier system enabling it to image clouds in moonlight. This high sensitivity permits night-time imaging of auroras as well as the lights of towns and cities as the accompanying image shows. The lights of North Sea oil installations are also visible. The auroral glow extends from northern Britain across to Latvia in this image and exceptionally bright displays were reported in southwest Norway.

May the **FORCE** be with You

Francis Bell

In a recently published journal I invited entries for a competition relating to the forces experienced by MSG-1. The idea was to stimulate an appreciation of the extreme environment which science, engineering and technology place upon space satellites.

The inducement for winning entries, was a CD-ROM containing aerial photography of their local county. This was sponsored by *Getmapping plc*. The competition is now closed but for those who missed the details the single question to be answered was this.

What is the G force experienced by the external surface of MSG-1? The satellite is in space, it is 3.2 metres in diameter, and spins about its central axis 100 times a minute.

I asked for the answer to be given in the unit of a G: even though it is not an SI unit it is what most of us experience every day and we are familiar with a force of 1 G.

I received 16 answers of which I judged 15 to be correct. The favoured answer was 17.88 G. Rounding to the nearest whole number generates the answer 18 G. I did allow one answer of 17 G.

A model answer was provided by Rob Hollander and his entry went as follows:

The Answer is 18 G

Since, in a stable orbit, gravitational forces and centrifugal forces (due to the orbiting) cancel, we only have to take into account the centrifugal force due to the spinning of the satellite. The acceleration is defined as the ratio of force over mass or as the change of velocity per unit time. In your case only the direction of the velocity is changing. Then is simply derived that:

$$a = \frac{dv}{dt} = \omega^2 r = \left(2\pi \frac{100 \text{ rpm}}{60 \text{ s/m}} \right)^2 \frac{3.2}{2} = 175.46 \text{ ms}^{-2}$$

On the surface of the earth we experience a gravitational force over mass ratio of 1 G, which depends slightly on the place on Earth. But in the Netherlands, 1 G = 9.81 ms⁻². So, the answer in G is 175.46 / 9.81 = 17.88, close to 18G, which is huge indeed.

I hope that this answer is correct enough to make me a candidate for the CD-ROM, and the calculation short enough not to bore you.

Yours sincerely,
Rob Hollander,
DEN HAAG, The Netherlands.

Below is a list of the people who sent in a correct entry (The first correct entry received came from Les Hamilton, the Journal Editor - but as he had over a month longer than everyone else to work out the answer, he is not eligible for a prize.)

Andrew Thornton	Accrington Lancashire
Des Watson	Ringmer E. Sussex
Ken Barker	Winsford Cheshire
Derek Beales	Bury St Edmonds
Andreas Lubnow	Braunschweig Germany
Bert Harms	Hooghalen Netherlands
John Malos	Brisbane Australia
Jonathan Gudgeon	Milton Keynes
Brian Davies	Lingfield Surrey
Paul Telco	Welwyn Garden City
Gerry Morgan	Corrandulla Ireland
Rob Hollander	Den Haag Netherlands
John Nixon	Sheffield
Chris Ashby	Whitstable Kent
Terry Baldwin	Broadstairs Kent
R. E. Hogben	Dover Kent

I think Rob Hollander's comment: 'indeed this is huge', correctly states the extreme environment in which this satellite operates. Of course the instruments embedded close to the axis of rotation experience smaller G forces but the whole structure must remain intact.

Some CD-ROMs have been sent to winning entries. Writing this report close to the date of the competition closing I have not yet arranged for the *Getmapping plc* CD-ROM to be sent but I hope this will be possible soon.

My thanks to all who took an interest in the competition.

A Postscript

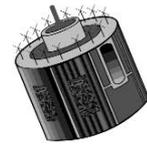
Within some of answers I was very diplomatically taken to task over some of the terms I used in the competition text. Words like 'constant', 'velocity', 'force' and 'acceleration' seem to be the province of physicists, not mere mortals like me—a humble biologist.

Okay: Here's a question for any reader who has only a physics degree as qualification.

How does water manage to travel from the soil to the top of a tree which may be 100 m tall?

Here is a hint. There is no physics formula which will directly generate an answer for you. Answers in less than 50 words to me please.

Meteosat-8 Update



Questions Answered

David Taylor Answers John Tellick's Questions

Q I want a system that acts like a Meteosat WEFAX system—to be able to view a European or global sector every ½-hour in either VIS or IR and animate it. Every ¼-hour would be preferable but one has to be realistic. Can I do that, and what system spec would I require—one or two computers?

A One dedicated computer (but I don't recommend that) or two PCs networked. Spec for processing (or single) PC: 1-2 GHz+ processor, 512 Mb-1 Gb of memory (1 Gb memory if you want to use the HRV or Meteosat-5 visible channel). Fast hard disks with 2 Mb or 8 Mb buffers. See below for second Receiver PC spec.

Q I want 24-hour full imaging and animation and want real-time display of any channel I choose. Can I do that and what system spec do I need—two computer I suspect?

A Same answer as above, with more emphasis on CPU speed and memory.

Q I just want to dip in every now and again to see 'what's going on' and use the computer for other things at other times. Can I do that and what system spec do I need?

A For me, the critical item here is 'use the computer for other things.'

For example, if you start doing complex image processing, making panoramas, complex spreadsheets etc., the CPU load

that this produces can cause missing segments. If this doesn't matter, that's fine. The 500 MHz PC below would do that, but I would suggest at least 256 Mb of memory.

Q What is the most basic computer spec I can use to download *EUMETCast*, accepting considerable downgrading of the system's possibilities?

A If you don't mind missing very occasional segments, then use a 500 MHz Pentium III with 256 Mb memory for data capture only. Use a separate processing PC.

In short, if you want to do everything on a single PC, try to make sure it's a good one (1-2 GHz or better, 512 Mb to 1 Gb according to your aims) and expect missing segments if you overload the single PC with other tasks. So make it a dedicated MSG PC if possible. Use Windows 2000 or XP. If you can find a 500 MHz PC for separate receiver use, most of the potential problems disappear and you can do what the heck you like on the processing PC. Use Windows 2000 or XP.

There's nothing to stop you using the single PC solution to start with, and later migrating to two PCs as funds allow.

Q Where should I install the *SkyStar* card?

A Locate a PCI slot with no card to either side of it, remove the

back panel blanking plates from both adjacent empty slots (to improve the air flow over the DVB card) and install the card.

Q When will encryption of the MSG data start?

A The service start date is early March, 2004.

MSG-1 Transmits its First Meteosat-5 LRIT Image

On November 25, 2003, MSG-1 added another 'foreign' satellite to its FSD (Foreign Satellite Data) relay on the LRIT data stream.

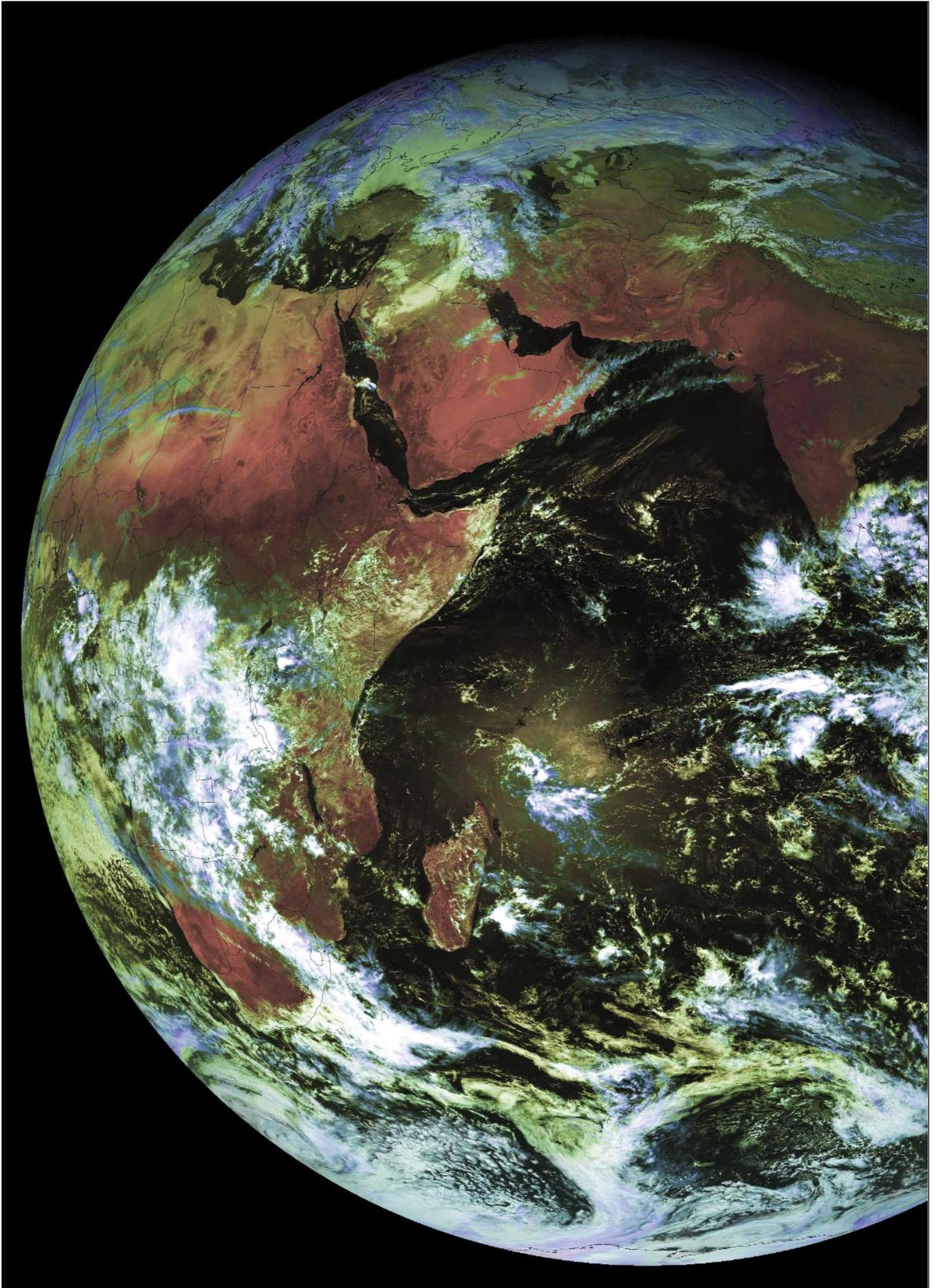
This time the satellite wasn't really foreign, but an older *EUMETSAT* satellite, Meteosat-5, now relocated over the Indian Ocean. The images are transmitted every three hours and comprise thermal and water vapour data at 2500 x 2500 pixels and a visible channel at a stunning 5000 x 5000 pixels.

Data at this resolution was previously only available to users with access to the PDUS data stream. This data may also be made available over the Internet as part of the LRIT data service.

The image opposite was processed through GeoSatSignal-4, using the visible channel to provide brightness information and the thermal channel to provide the colour component.

Image processing: David Taylor

Image © EUMETSAT 2003



The Indian Space Programme

Part 1

Peter Wakelin

'There are some who question the relevance of space activities in a developing nation. To us, there is no ambiguity of purpose. We do not have the fantasy of competing with the economically advanced nations in the exploration of the moon or the planets or manned space-flight. But we are convinced that if we are to play a meaningful roll nationally, and in the community of nations, we must be second to none in the application of advanced technologies to the real problems of man and society.'

The Man

These were the words of Dr Vikram Sarabhai, spoken more than thirty years ago. His early interests and research activities were in the areas of interplanetary physics and the Earth's high atmosphere. It was he who established India's programme for the International Geophysical Year, 1957/58, during which the USSR launched Sputnik 1.

Shortly after that he became Chairman of the newly-created Indian National Committee for Space Research and in 1962 set up India's first rocket launching facility at Thumba, in southern Kerala. The first sounding rocket was launched on November 21, 1963: the Indian space programme was under way and, quite rightly, Dr Vikram Sarabhai is regarded as its architect.



Dr Sarabhai
Photo: 'The Hindu'

The Plan

With a land area in excess of three million square kilometres and a population heading inexorably towards one billion, it was realised very early on in the space age that communications satellites, and imaging spacecraft to monitor weather and land usage, would be of great benefit to the Indian nation. The long-term aim was to build and launch their own satellites but, initially, much experience could be gained by utilising other nations' spacecraft.

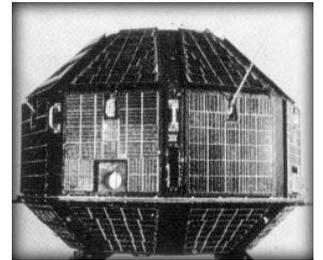
By establishing an Earth station at Ahmedabad in 1967, experiments in satellite communications became possible and in 1975, in cooperation with NASA, the Satellite Instructional Television Experiment was set up using an American Advanced Technology Satellite, ATS-6. A ground station was established near Hyderabad in 1979 to receive imagery from the NOAA

weather satellites and also the US and European Earth-resources satellites such as Landsat, ERS and SPOT.

Meanwhile, experimental and development work on their own satellites and launch vehicles was proceeding steadily.

The Outcome

The first Indian-built satellite, Aryabhata, went into orbit in 1975 aboard an Intercosmos rocket launched by the USSR. A further five years passed before India became the seventh nation to launch its own spacecraft.



Aryabhata
India's first satellite

There were delays, setbacks and some spectacular launch failures but eventually these problems were overcome. More powerful rockets were developed and reliability improved to such an extent that other nations' spacecraft are now being orbited on board Indian rockets.

India's launch vehicles are not yet capable of launching their very heavy communications and meteorological satellites to geostationary altitude so they still rely on the USA and Europe to launch them but their most powerful vehicle did successfully place Kalpana-1 into geostationary transfer orbit in 2002.

2003 was a very successful year with four satellites successfully launched. Two were heavy spacecraft in the INSAT-3 series, launched by Ariane-5 rockets from Kourou, French Guiana, but the other two were launched from India. Sadly, Dr Sarabhai did not live to see his country's space programme evolve into the remarkable success story that it is today.

This brief overview of the Indian space programme ends with a chronological listing of significant events over the last 42 years. Part two will detail the early achievements in both satellite and launch vehicle development.

1962 Indian National Committee for Space Research was formed by the Department of Atomic Energy and work on establishing the Thumba Equatorial Rocket Launching Station commenced.

- 1963 The first sounding rocket was launched from Thumba on November 21.
- 1965 The Space Science and Technology Centre was established at Thumba.
- 1967 A satellite telecommunications Earth station was built at Ahmedabad.
- 1969 The Indian Space Research Organisation (ISRO) was formed under the Department of Atomic Energy on August 15.
- 1972 The government of India set up the Space Commission and the Department of Space on June 1; the latter taking over ISRO from the Department of Atomic Energy. The first airborne remote sensing experiments also took place in this year.
- 1975 The first Indian-built satellite, Aryabhata, was launched on April 19 by an Intercosmos rocket of the USSR. Experiments in satellite telecommunications, especially educational television, were started using the USA's Applications Technology Satellite ATS-6.
- 1979 Bhaskara-1, an experimental satellite for Earth observation was launched on June 7 by the USSR. On August 10 the first experimental launch of the Indian-built Satellite Launch Vehicle (SLV-3) rocket failed to orbit its Rohini technology payload.
- 1980 The second SLV-3 launch from the Sriharikota launch site successfully placed a Rohini satellite into orbit on July 18 making India the seventh country to launch its own spacecraft.
- 1981 Another Rohini satellite was launched by an SLV-3 rocket on May 31 to conduct remote sensing technology studies. On June 19 APPLE (Ariane Passenger Payload Experiment) was launched with Meteosat-2. It was a communications test satellite. Bhaskara-2 was India's second experimental remote sensing satellite and was launched from the USSR on November 20.
- 1982 The first of four operational INSAT-1 satellites procured from the USA was launched on April 10. This multipurpose communications and meteorological satellite, INSAT-1A, was launched by the USA on a Delta launch vehicle but failed after a few months' service. INSATs 1B, 1C and 1D followed in 1983, 1988, and 1990.
- 1987 An updated rocket, the ASLV (Augmented Satellite Launch Vehicle), failed to orbit its payload, an advanced Rohini satellite, on March 24. A similar failure occurred 16 months later.
- 1988 The first operational Indian Remote Sensing Satellite, IRS-1A was launched by the USSR on a Vostok rocket on March 17.
- 1992 The first successful launch of the Augmented Satellite Launch Vehicle (ASLV) orbited an advanced Rohini experimental satellite on May 20. The first of the Indian-built second-generation INSATs was launched into a geostationary orbit on an Ariane-4 rocket from French Guiana on July 10. INSAT-2A carried communications and meteorological payloads. INSATs 2B, 2C, 2D and 2E followed in 1993, 1995, 1997 and 1999.
- 1993 The first launch of the Polar Satellite Launch Vehicle (PSLV) was unsuccessful and failed to orbit its payload, IRS-1E.
- 1994 IRS-P2 was successfully placed into sun-synchronous orbit by a PSLV on October 15. P3 and P4 followed in 1996 and 1999.
- 2000 INSAT-3B, the first in the third generation INSAT series, was launched aboard an Ariane-4 rocket from French Guiana on March 22.
- 2001 On April 18, the first developmental launch of the Geostationary Satellite Launch Vehicle (GSLV) took place. It successfully placed its payload GSAT-1, an experimental communications satellite, into a geostationary transfer orbit.
- 2002 An improved PSLV placed METSAT-1 into a geostationary transfer orbit on September 12. The spacecraft, India's first exclusively meteorological satellite, was later renamed Kalpana-1 in memory of Kalpana Chawla who died in the Columbia accident.
- 2003 This was a busy and very successful year with INSAT-3A launched on an Ariane-5 from French Guiana on April 10, GSAT-2 launched on a GSLV on May 8, INSAT-3E orbited by an Ariane-5 on September 28 and finally, on October 17, ResourceSat-1 was boosted into orbit by a PSLV.



Acknowledgement

I am indebted to the Indian Space Research Organisation for making so much information available on their website:

<http://www.isro.org>

EUROPEAN PUBLICATIONS

... free to GEO readers !

Francis Bell

I thought readers would like to know about a number of other publications which are available in our interest area of weather satellite reception.

Below are described three publications which I receive at home. Each one is available free of charge once you have applied to have your name and address added to the publisher's mailing list. I think this is a right and proper course of action for any of this readership because these publications are ultimately paid for from public taxes. You will find that the publishers are pleased to extend their readership to those who are genuinely interested in their materials. But it's up to you to submit you name and address: GEO will not do it for you.

Here are the details of the three publication I receive. If any reader knows of other publications of potential interest in our field, please let me know.

ESA Bulletin - Space for Europe

This magazine appears four times per year and ESA describe it as their house magazine. It covers the high-profile activities of the European Space Agency. The Bulletin contains some 100 glossy A4 pages containing articles about ESA's activities, projects, space vehicles and background science. There are always a few pages devoted to current space missions which include weather satellites. I have been known to read the Bulletin from cover to cover but more usually I read the abstracts and only read fully those pages of special interest to me.

Earth Observation Quarterly

(Guess the frequency of this publication)

This Remote-sensing Newsletter is also produced by ESA and usually contains about 20 A4 pages. The latest edition covers meteorology, earthnet, remote sensing, solid Earth and future programmes. It also contains a picture of MSG-1's launch but you can't see much detail and also includes some stunning Earth images.

To be placed on the mailing list for either of the above publications, write to:

ESA Publications Division,
c/o ESTEC,
PO Box 299,
2200 AG Noordwijk
The Netherlands

Image

This is published by EUMETSAT twice a year.

This periodical, which comes directly from EUMETSAT, appears in a 12-page A4 format and specifically covers the latest weather satellite news. The latest edition includes special pages relating to MSG-1 plus other interesting topics and a global satellite update. I think most GEO readers would be interested in *Image*. I usually read it from cover to cover. If you are quick you may still be able to receive the latest edition which I recommend: but I cannot promise this, it depends on EUMETSAT's policy.

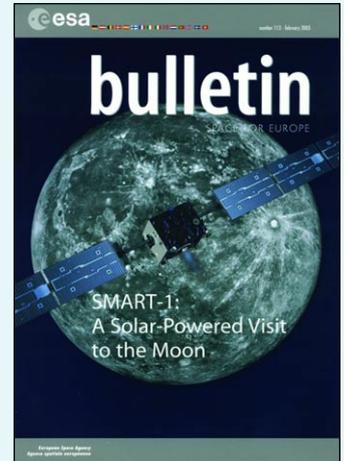
To be placed on EUMETSAT's mailing list for *Image*, write to:-

EUMETSAT User Service
Am Kavalleriesand 31,
D-64295 Darmstadt
Germany

If you decide to request your name and address to be added to either of the above mailing lists, I think it would be quite constructive to give your name and then in brackets (GEO).

This will have the mutual benefit of letting ESA and EUMETSAT know the extent of their current readership and give GEO an influence within these organisations should it ever become necessary in the future.

Postage to Europe is 38 pence but the use of two second class stamps worth 40 pence may be easier.



The front covers of these three publications are shown here together with our grateful acknowledgment to their publishers.

Please Support the New GEO Quarterly

Copy Deadline for Issue No 2 is March 31, 2004

Articles

The Editor is always on the lookout for articles and images relating to all aspects of Remote Imaging for inclusion in the GEO Quarterly. Particularly welcome are topics, such as:

- Technical articles on antennas, receivers and other hardware
- Construction projects
- Weather satellite images
- Reports on weather phenomena
- Description of how you set up your own Remote Imaging station
- Activities of overseas members
- Reviews of relevant software and hardware
- Letters to the Editor
- Problems and Queries for our experts to answer

Please don't be deterred if you have never written for a magazine before. Please don't hesitate because you don't feel you have sufficient expertise to piece an article together. Don't be put off because you feel your spelling and grammar might not meet our requirements.

We will always be happy to help and advise you, to add the final polish to your contribution, and convert your drawings into quality graphics. You will be sent a proof copy of your article in PDF format so that you can make

final suggestions, additions and alterations prior to publication.

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

Images and Diagrams

Images can be accepted in any of the major bitmap formats, e.g. JPG, BMP, GIF, TIFF etc. Images in both monochrome and colour are welcomed for inclusion. Line drawings and diagrams are also welcome in Windows metafile and postscript formats.

Please note that images and drawings **must not be embedded** within the text of your article, but should be submitted as individual files.

Submission of Copy

All materials for publication should be sent to the Editor, Les Hamilton, 8 Deeside Place, Aberdeen, AB15 7PW, Scotland.

Materials may also be sent as attachments to the following e-mail address:

editor@geo-web.org.uk

Weather Satellites and their Frequencies

Polar Orbiting Satellites	Frequencies	
	APT (MHz)	HRPT (MHz)
NOAA 12	137.50	1698.0
NOAA 14	137.62	1707.0
NOAA 15	137.50	1702.5
NOAA 16	-	1698.0
NOAA 17	137.62	1707.0
Feng Yun 1C, 1D	-	1700.4

Geostationary Satellites		Location	Frequencies WEFAX (MHz)
GOES-E	USA	75°W	1691.0
GOES-W	USA	135°W	1691.0
Meteosat-5	India	63°E	1691.0
Meteosat-6	Europe	10°E	1691.0
Meteosat-7	Europe	0°	1691.0, 1694.5

Where to Download NASA 2-line Elements

Satellite tracking programs require regular updates of the NASA 2-line element sets that they use to calculate the positions of Earth-orbiting satellites. One of the best Internet sources for these files is Celestrak at:

<http://www.celestrak.com>

Elements for many groups of satellites are updated daily. Particularly useful are:

<http://celestrak.com/NORAD/elements/weather.txt> (most weather sats)

<http://celestrak.com/NORAD/elements/resource.txt> (Okean and Sich)

<http://www.celestrak.com/NORAD/elements/stations.txt> (ISS)

Advanced Synthetic Aperture Radar from 'Envisat'

Historical Background

On March 1, 2002, the European Space Agency (ESA) launched its most ambitious Earth observation satellite, *Envisat*, into an 800 km orbit from the European spaceport at Kourou in French Guiana. This gigantic satellite, the size of an articulated lorry and weighing some eight tonnes, was by far and away Europe's most ambitious project to date for the continued monitoring and investigation of climate and environmental change. Full details of the mission can be found at:

<http://envisat.esa.int>

Developed from the European 'Polar Platform' project initiated in 1988 and subsequently renamed *Envisat* (ENVironmental SATellite) in the early 1990's, this satellite was developed at a cost of 2.3 billion euros. Powered by a 70 square-metre solar array generating over 6 kW of electricity, *Envisat* is the most powerful tool yet devised for monitoring the state of our planet and the impact of human activities upon it. *Envisat* views the Earth with unprecedented detail, and produces enough digital data every 24 hours to fill the hard drives of 500 desktop PCs.

Introduction

The largest instrument carried aboard *Envisat* is the Advanced Synthetic Aperture Radar (ASAR), a high-resolution, wide-swath imaging radar. ASAR is capable of producing high quality images, by both day and night, of the oceans, coastal zones, polar ice and land regions of Earth, irrespective of weather conditions or cloud cover.

ASAR collects information on:

- ocean wave characteristics
- snow and ice extent
- sea ice extent and motion
- land and surface properties
- surface topography
- deforestation and extent of desert areas
- surface soil moisture and wetland extent
- disaster monitoring, e.g floods, earthquakes, landslides

The images presented on the page 24 illustrate the capabilities of *Envisat's* ASAR imager.

Radar Imaging

The microwaves used for radar imaging occupy a niche in the electromagnetic spectrum between light waves and radio waves. Since both light and radio waves are used for imaging, most notably in astronomy, it will come as no surprise to learn that radar can also be harnessed for this purpose.

In its simplest form, a radar antenna sends out a

narrow beam of microwaves directly towards an object which reflects some of the signal straight back to the antenna. The travel time and signal strength of the returned microwaves can be used to determine the distance of the object. This is the type of radar used in air-flight control operations, and by shipping. However, this mode of radar lacks the resolution to produce actual images. For imaging purposes, radar must project its beam parallel to the antenna, and to one side of it—what is termed side-looking radar (SLR). When a beam of microwaves from *Envisat's* SLR meets a smooth surface at an angle (figure 1), most of the beam is reflected away from the satellite at an identical angle to that at which it arrived at the surface. This means that few if any of the reflected microwaves return to the satellite.

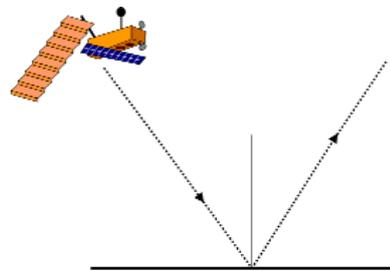


Figure 1

Reflection from a smooth surface

On the other hand, where the microwaves meet a rough surface, the beam undergoes backscattering, with radiation reflecting in a multitude of directions (figure 2). Some of these backscattered microwaves do return to *Envisat's* radar antenna, and modern signal processing techniques can use these to build up an image of the terrain below. The intensity of backscattered radiation is related to the texture, most particularly roughness, of a surface and is directly related to the 'brightness' of the eventual image: the rougher the terrain, the brighter it shows on a radar image.

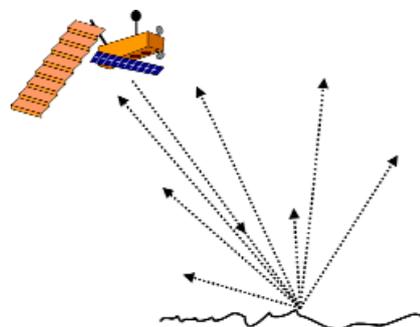


Figure 2

Backscatter from a rough surface

Synthetic Aperture Radar

The larger an antenna, the more unique information can be obtained about a particular viewed object, permitting the creation of a more detailed image. This

principle is used in modern radio astronomy, where two dish antennas situated hundreds of kilometres apart can operate in tandem to provide an effective resolution equivalent to a single dish with an aperture equal to the separation between the two smaller ones. Modern optical telescopes likewise use ever larger mirrors to improve resolution of distant deep-sky objects.

The length of an SLR antenna determines the image resolution along the direction of travel: the longer the antenna, the smaller the detail that can be resolved. To achieve its maximum ground resolution of 30 metres, *Envisat* would require an antenna several kilometres in length. But it would be prohibitively expensive to launch such a large radar antenna into space, so another option has to be found. By employing a relatively small antenna and making use of the spacecraft's forward motion, a much larger antenna can be simulated. The technique is known as Synthetic Aperture Radar (SAR).

SAR makes use of the forward motion of a spacecraft to create a synthetic 'aperture' of (potentially) unlimited length, thereby narrowing beamwidth and increasing resolution. The radar antenna aboard *Envisat*, which is aligned with the craft's flight direction, measures just 1.3 metre wide by 10 metres in length yet has the effective size of a stationary antenna several kilometres in length. This arises because *Envisat*, at its orbiting altitude of 800 km, travels some 7.5 km per second between positions 'X' and 'Z' (figure 3).

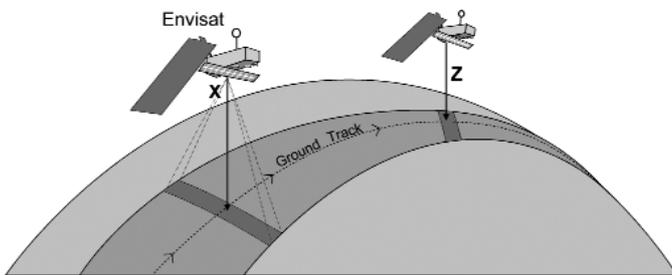


Figure 3 - The synthetic aperture

As *Envisat* flies over this section of its ground-track it emits some 1700 short radar pulses (each just a few microseconds in duration) towards its viewing swath each second, and any object over which the satellite passes returns approximately 1000 back-scattered responses to the antenna. All this microwave information returned while *Envisat* moves from position 'X' to position 'Z' is stored, and later converted into images by computers using modern signal processing techniques.

After intensive signal processing, all the backscattered responses are integrated to produce an image that looks as though it had been obtained from a large, stationary antenna. Such *Envisat* images can have a resolution as high as 30 metres. The synthetic aperture in this case is the distance travelled by the spacecraft during the integration time (i.e. while it moves from 'X' to 'Z' in figure 3).

SAR provides its own illumination (microwave pulses)

and can thus image independently of sunlight; images can be obtained with equal effectiveness during both day and night. *Envisat*'s ASAR operates in the C-band (frequencies in the 4 GHz - 8 GHz range) which means an operating wavelength of 3.5 - 7.5 cm. Unlike visible radiation which is scattered and diffused by the water droplets in atmospheric clouds, the radar's longer wavelengths are relatively undistorted by clouds.

Applications

Envisat is able to respond quickly in the wake of a natural disaster such as the 'Prestige' oil spill highlighted in figure 4 overleaf. ASAR imagery can be a vital tool for risk and disaster management teams alike, monitoring the extent of flooding, or spotting landslides in remote and inaccessible terrain.

The Advanced Synthetic Aperture Radar aboard *Envisat* can map Earth's surface to an accuracy of a few tens of metres in a single pass. And when images from two orbits are combined using a technique called interferometry, *Envisat* can detect subsidence in a city street, the bulging of a volcano's slope, or the sagging of a glacier above a buried hot-spot, even when the movement is only a few centimetres. Experiments in London, Rome and Paris have proved that ground movement of as little as one millimetre per year can be clearly detected from *Envisat*'s radar data.

The bottom left image on the inside front cover of this *Quarterly* is an interferogram created at the German Aerospace Centre (DLR) by combining a 1999 SAR image from the ERS-2 satellite with a recent image from *Envisat*'s ASAR instrument. It shows an area of approximately 30 x 35 km around the US city of Las Vegas which can be seen in the centre of the image as an area of bright colours with its major thoroughfares appearing as straight dark lines. Each colour cycle in the image, from blue to red to yellow, represents an elevation change of 8.4 metres, the effect producing bands of colours showing the topography of the city and surrounding area. The right hand image is a digital elevation model showing the area under observation (Image credits: ESA/DLR).

Acknowledgments

All SAR images reproduced courtesy the European Space Agency (ESA). Much of the explanatory text accompanying the images is summarised from the *Envisat* web pages at:

<http://www.envisat.esa.int>

Further Reading on the Internet

- <http://envisat.esa.int/instruments/tour-index/>
- <http://www.envisat.esa.int/instruments/alar/index.html>
- http://www.esa.int/export/esaSA/ESAGSWTHN6D_earth_0.html
- <http://southport.jpl.nasa.gov/desc/imagingradarv3.html>
- <http://www.soest.hawaii.edu/GG/HCV/NEWSV2N1/mackay1.html>

The Prestige Oil Spill

Figure 4 is an *Envisat* ASAR image that was acquired five days after the tanker *Prestige* was badly damaged in a storm off the northwest coast of Spain on November 17, 2002. The dark plume emanating from the stricken ship and stretching to the Spanish coast is an oil-slick over 150 kilometres long. The tanker itself is discernible as a bright white point located about 100 km off the coast. Support vessels are also identifiable as smaller white points surrounding the ship. The ASAR was operating in its wide-swath mode covering an area approximately 400 kilometres square, and the illustration is approximately 200 kilometres wide.

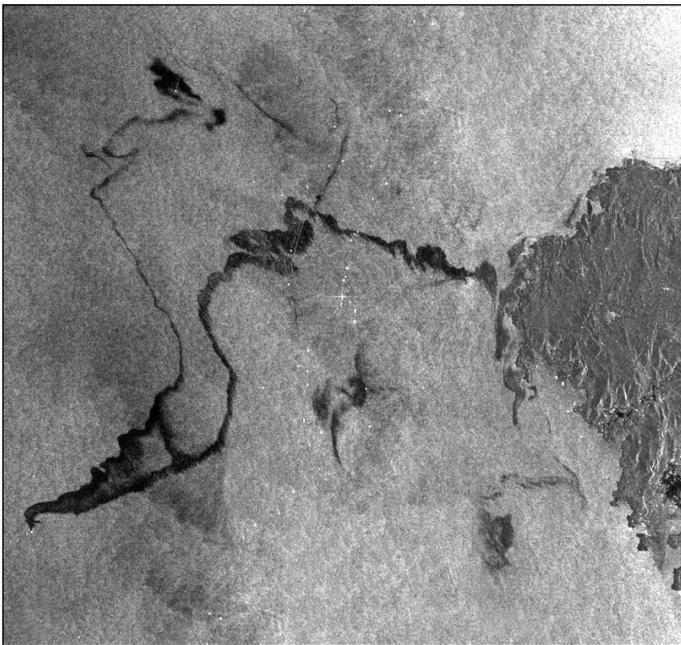


Figure 4 - The Prestige oil spill - November 17, 2002
Photo © ESA, 2002

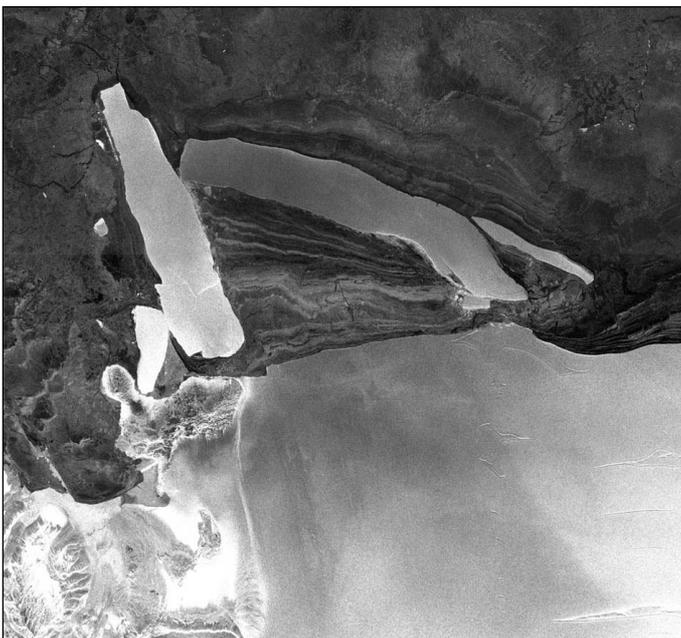


Figure 5 - The newly calved C-19 iceberg - July 18, 2002
Photo © ESA, 2002

Monitoring Ice Movement

Figure 5 is a wide-swath image (150 m resolution) showing the birth of antarctic iceberg C-19, which measured 200 x 32 km, and was some 200 metres in thickness, shortly after it calved from the Ross Ice Shelf in the Antarctic. The white swirls surrounding the 'berg indicate sea ice. This radar image also shows clearly difference between Antarctic ice that is resting on land or water: the Ross Ice Shelf at lower right, for instance, is seen as a smooth surface while at lower left the image shows the rougher terrain of Antarctic ice resting on land.

The Arabian Peninsula

In the centre of this wide-swath, 150-metre resolution radar image (400 km wide) is the Arabian Peninsula, consisting of the countries of the United Arab Emirates (left side) with its main cities of Ajman, Ash Shariqah and Dubai, visible as bright areas along the coast, and Oman (right side and tip of the peninsula).

The group of small white dots off the east coast of Oman is a fleet of ships. To the north is Iran with its Qeshm Island and on the mainland the city of Bandar-el Abbas and the Zagros Mountains (left).



Figure 6 - Arabian peninsula - June 22, 2003
Photo © ESA, 2003

Setting the Correct Time on Your Computer

David Taylor

Introduction

An important part of any amateur weather satellite station is time-keeping. Accurate times (and up-to-date Keplers) are required to predict when a satellite will be visible and perhaps to steer an antenna to track it accurately. For most of us that will mean getting the station computer accurately synchronised to UTC (Coordinated Universal Time). How you do this will depend on the accuracy you require and whether or not you are connected to the Internet.

The typical PC clock might have an accuracy of the order of 100 parts per million, which means that it could drift several seconds every day. Of course, some PCs will be more accurate than this and some will be worse! For some purposes, simply setting the PC's clock once a day might be adequate, but this would result in a step change of the time at the instant of correction. This approach is called 'stepping the clock'. Some software might not work properly in the presence of a large time step; in particular the widely used *WXSat* uses the 16-bit C run-time library, which appears to completely ignore such step corrections. A better approach, and one which eliminates these clock steps, is to measure the clock frequency error over a period of time, and then adjust the clock frequency so as to compensate for any error. This is possible because, although the hardware clock frequency is fixed, the system timer interrupt frequency is driven via a software programmable divider from the hardware clock, and it is the rate at which these timer interrupts occur that determines the internal time held by the operating system. Software that adjusts the clock rate or clock frequency, rather than simply stepping the clock, is therefore to be preferred.

By the way, *Windows* works in UTC in its internal operations. What you see presented as a clock time, or file date and time in Explorer, is derived from the internal UTC value by the addition or subtraction of the bias that is appropriate to your Time Zone. This can have some unexpected effects. For example, file dates and times on both CDs and the NTFS (NT File System used by more recent versions of Windows) are held in UTC, so that between summer time (daylight saving time) and standard time there will be a one hour difference in the apparent file time stamp as displayed by Explorer. But the FAT file system keeps its time in 'clock time', so that the file time stamp displayed for an FAT file will stay the same between summer and winter!

Another issue is the BIOS – there is a CMOS Real-Time Clock (RTC) chip included in the BIOS section of your PC to store the time and other settings while the PC is powered off. By convention, the BIOS displays

local clock time, and any operating system must allow for the difference between clock time and UTC when it boots. Windows will offer to set the BIOS clock forward or back for you when it discovers a difference in the time settings from one boot to the next. However, it has no way of knowing whether the BIOS itself has been set, so if you boot multiple versions of Windows across clock time changes, you will be asked multiple times whether or not to reset the (BIOS) clock. You should only agree to do this once, of course. Whether or not booting multiple versions of Linux does the same I do not know.

If You Have an Internet Connection

There is plenty Windows software available to allow you to keep time accurately, and which one you choose will depend on whether you have a permanent Internet connection and which version of Windows you are running. If you are running Windows NT 4, 2000 or XP then the obvious choice is the public standard Network Time Protocol (NTP) server software from the following URL:

<http://www.ntp.org/links.html>

Basically, NTP works by having a hierarchy of servers. Servers at the root of the hierarchy are synchronised to very accurate external sources such as GPS, precision radio clocks, or atomic standard clocks. Such externally synchronised servers are marked as 'stratum-1' servers. Systems further down the hierarchy are typically synchronised to upstream servers and then provide synchronisation for clients downstream. The NTP software provides both client and server in a single package. Thus your Internet-facing PC which may be synchronised with a public stratum-2 server, will itself be operating at stratum-3, and may also provide time synchronisation services for other PCs on your network which would then operate at stratum-4. See illustrations on page 26.

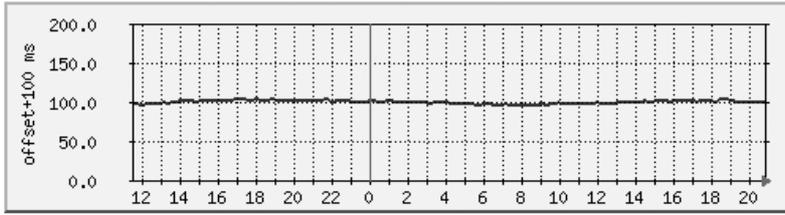
If you have more than one Internet-connected PC, you should designate just one of these as a master time server for your station. It is good practice to limit the number of PCs that you connect to an external NTP time server because this limits the load on these servers. Your Internet Service Provider (ISP) may provide an NTP service, or you can choose a stratum-2 server from the list at:

<http://www.eecis.udel.edu/~mills/ntp/servers.html>

If you are interested in the engineering theory behind NTP and, in particular the use of both frequency-locked and phase-locked loops, then I recommend that you read the papers by David Mills at:

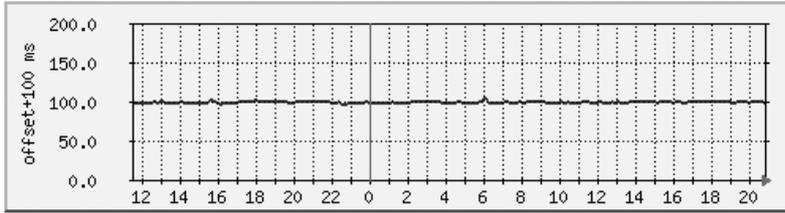
<http://www.ntp.org/documentation.html>

Accuracies Achieved with NTP



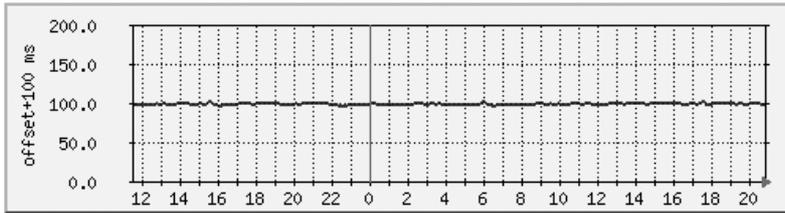
PC Bacchus

233 MHz AMD, 64 Mb
 NT4 SP6 - no interactive
 Synched from the Internet



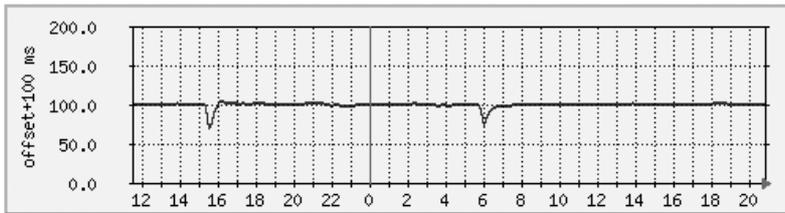
PC Hermes

1 GHz Pentium III, 512 Mb
 Win2000 Pro SP4 - no interactive
 Synched from Bacchus
 Peered with Odin and Stamsund



PC Odin

1.9 GHz Pentium 4, 1 Gb
 Win XP Pro SP1 - heavy interactive
 Synched from Bacchus
 Peered with Hermes and Stamsund

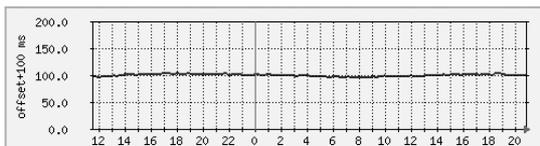


PC Stamsund

2.8 GHz Pentium 4, 1 Gb
 Win2000 Pro SP4 - heavy interactive
 Synched from Bacchus
 Peered with Hermes and Odin

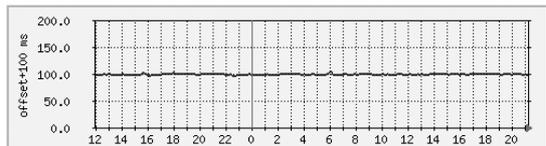
These graphs relate to my four network PCs. The reported offset from UTC is plotted, plus a fixed 100 ms offset required because the graphing tool I used is only intended to plot positive values. PC *Bacchus* is synched from servers on the Internet. In general, all PCs are within 10 ms of UTC, with glitches most noticeable on *Stamsund*, caused by heavy interactive or batch CPU use. It is as if some timer interrupts are being lost. The PC takes about an hour to recover after such a glitch. As the bottom three PCs are synched as peers to each other, when *Stamsund* gets a negative glitch there is a small positive glitch visible on the other two PCs.

'Daily' Graph (5 Minute Average)



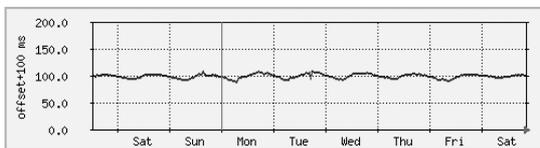
Max offset: 105 ms Average offset: 100 ms Current offset: 100 ms

'Daily' Graph (5 Minute Average)



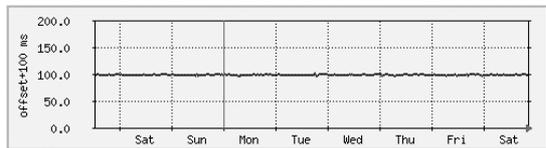
Max offset: 104 ms Average offset: 99 ms Current offset: 100 ms

'Weekly' Graph (30 Minute Average)



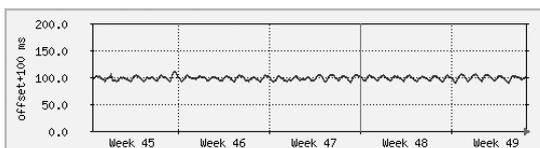
Max offset: 109 ms Average offset: 99 ms Current offset: 100 ms

'Weekly' Graph (30 Minute Average)



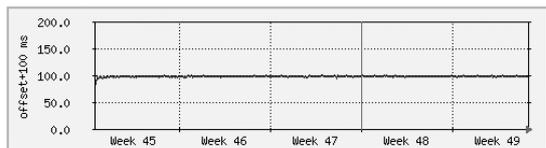
Max offset: 103 ms Average offset: 99 ms Current offset: 100 ms

'Monthly' Graph (2 Hour Average)



Max offset: 111 ms Average offset: 98 ms Current offset: 102 ms

'Monthly' Graph (2 Hour Average)



Max offset: 100 ms Average offset: 98 ms Current offset: 99 ms

These graphs show *Bacchus*, which is synched off the Internet, during three different time periods which demonstrate short, medium and long-term errors. The daily drift due to temperature variations is clearly visible, together with the occasional glitch.

These graphs show *Hermes* over three time periods. There is much less daily variation than with the Internet synched PC, because the clock is synched every 64 s instead of every 1024 s (using 64s polling against an Internet server is considered bad practice).

Unfortunately if you have Windows 98 or ME, then you cannot run the public standard NTP software, as it requires to be run as a service, which is not allowed by those versions of Windows. An NTP client normally talks to its upstream servers about once every 20 minutes, so if you have a dial-up connection you may also have problems with the software. For both of these situations, I recommend the Tardis software, which was written in the UK. Of course, there are many other alternatives. You can download Tardis from:

<http://www.kaska.demon.co.uk/tardis.htm>

Tardis does have the ability to provide a frequency adjustment, rather than a simple clock step, under certain conditions. Please see its documentation for details. Tardis is shareware, although it is the full version that you download. If you continue using Tardis, do remember to register it!

If You Have no Internet Connection

If you have no Internet connection but are connected to a network that has an NTP server included, then you can use the NTP software described above. Otherwise, you will need an external reference source of time. Suitable sources include a GPS receiver or a time code receiver working from the LF signals from MSF at Rugby, England on 60 kHz or DCF77 from Frankfurt, Germany on 77.5 kHz. Equivalent US (WWVB) and Japanese services also exist.

There are two ways by which a GPS receiver can provide time. The first method is a serial interface where the time code is sent in ASCII once a second: the other method is a pulse-per-second (PPS) interface where there is no time code but simply a regular pulse occurring once every second. Whilst the PPS interface can provide an accurate time reference when each new second starts, it does not provide an absolute time value, and therefore must be used in conjunction with a separate time of day reference. The NTP software mentioned above will accept input from both types of GPS receiver. A simple Radio Clock receiver has been described by Jonathan Buzzard at:

<http://www.buzzard.org.uk/jonathan/radioclock.html>

but unfortunately the software described is for Linux and not Windows. Various GPS modules appear on the surplus market from time-to-time.

Accuracies

What sort of accuracy can you expect to achieve? Well, it all depends on your connection. With a modem connection, I would expect you to achieve sub-second accuracy, but if you are using clock-stepping software then the accuracy will immediately degrade after the time is set.

If you are using frequency adjustment software, then you should do rather better in the medium term. Be aware that the BIOS RTC only holds time to the nearest second, so switching your PC off and on will introduce a time step even if the clock rate is perfect.

If you have a permanent Internet connection, then you should get accuracy between 10 and 100 milliseconds depending on the connection quality. If you are using a cable modem, or other connection with an asymmetrical send and receive propagation delay time between you and your reference server, then you may end up with a low jitter, but a fixed offset relative to UTC. The NTP software allows you to trim out such offsets if you can measure them. With the radio clock, you may expect accuracies of the order of one millisecond (although you will need to trim out propagation delay time and receiver rise time), and with the GPS PPS connection even better than that! If you are curious, you can see how well (or otherwise) my PCs are doing at:

<http://www.satsignal.net> =>

Network Statistics, NTP Summary

Conclusions

The requirement for accurate time-keeping at your station can be satisfied whether you have a permanent internet connection or not. If you want your own time-standard then a home-built receiver could be the solution and a project for the Winter! Software to help you is readily available.

Appendix I

During the preparation of this article, a number of further questions on time scales came to mind. These were presented to Peter Wakelin for his comments, and I am indebted to him for the answers which appear below.

Which Time Scale is Used in Kepler Data?

UTC without exception. So if a leap-second occurs between epoch of elements and predicted time, a one-second correction will be required.

How accurate does my data need to be and how accurately does my computer need to be set to track the satellites I receive today and will receive tomorrow?

If concerned about accurately pointing an antenna at a satellite using a computer-based system then there are several considerations:

1. Acceptable pointing error - beamwidth of dish and frequency. The fact that NOAA satellites near the zenith move about 0.5 degree in a second gives an idea of the overall accuracy needed for acceptable pointing accuracy.
2. Prediction software accuracy - some (including Instantrack and Timestep's Track2) use a crude spherical Earth model so if you use geographic coordinates for your site instead of geocentric ones you are starting off with a location error of around 20 km (in the UK). which equates to more than a degree on an overhead NOAA satellite.
3. Computer clock - from (1) it is clear that 1 or 2 second accuracy is needed.

4. The accuracy of the Two-Line element sets themselves. Errors are rare but not all perturbations are catered for in the Two-Line data or in prediction software: but for 850 km satellites like the NOAAs, updating every couple of days should be adequate for 1 or 2 seconds accuracy.

Bearing in mind all the above, I decided long ago to continue with manual tracking for HRPT reception, watching the signal strength meter constantly.

How Does GPS Handle Leap Seconds?

There was much discussion on this topic on one of the satellite forums a year or two back but I didn't take a lot of notice. I'm sure an internet search would reveal much but as I recall GPS uses a modified form of International Atomic Time but offset by an integer number of seconds so that it equated to UTC when GPS started back in the 80's. I also recall that GPS operators want rid of UTC and everyone to adopt TAI but astronomers won't have this so meanwhile GPS is reluctantly 'corrected' at some stage to UTC.

Appendix II

Professor David Mills of the University of Delaware teaches courses in computer architecture, computer networks and computer security. He added the following clarifications to the leap-second debate:

"If we ever had to give back a leap-second, it would be a disaster. The WWV/WWVB time code has only a single bit to signal leap insertion and no way to signal deletion. The GPS time code has the UTC-GPS offset in seconds, but the GPS receivers I have indicate only

leap insertion. From the ERTS data the rate of increase has flattened out over the past three years, which certainly gives me the willies; but my professional friends tell me not to worry about it."

Appendix III

Ton Van Baak provided me with these additional comments:

"Yes, there is only a single bit in the WWV/WWVB time code to indicate a pending leap second but the sign and magnitude of the UT1 correction bits tell you if the leap second is positive or negative. For WWVB these are bits 36/37/38 for the sign and bits 40/41/42/43 for the magnitude.

"For example, for the 6/30/1997 leap second the UT1 correction was -0.5 before the leap second and +0.5 after the leap second. Similarly for the 12/31/1998 leap second the UT1 correction was -0.3 before and +0.7 after the leap second.

"When the net change in UT1 correction is +1.0 the leap second will be positive and if the net change is -1.0 it will be a negative leap second. So a separate bit for positive/negative leap second is not needed in the specification.

"I'm not saying there won't be hardware or software trouble elsewhere if a negative leap second were ever to occur, but the WWV/WWVB time code specification itself is not a limitation."

For further details on these leap second examples see:

<http://www.leapsecond.com/notes/lS-wwvb-97.htm>

<http://www.leapsecond.com/notes/lS-wwvb-98.htm>

<http://www.leapsecond.com>

Cover Images

Front Cover

This SeaWiFS image shows smoke billowing from California wildfires on October 26, 2003. Flames fanned by *Santa Ana* winds generated large quantities of smoke which covered over 150,000 square miles of the Pacific Ocean to the southwest.

Image courtesy the SeaWiFS Project, NASA/Goddard Space Flight Center, and ORBIMAGE.

Inside front Cover

Glacier Bay National Park and Preserve, Alaska, imaged by the Landsat-7 satellite's Enhanced Thematic Mapper Plus (ETM+) instrument in August 1999 with elevation data from the USGS National Elevation Dataset (NED). This true-color image was created by combining the red, green, and blue wavelengths (ETM+ bands 3, 2, and 1). The resulting image was then draped over a visualisation of the NED data with no vertical exaggeration. The USGS NED

is a merged data product created from several sources, predominately 30-meter resolution elevation data collected by NASA's Shuttle Radar Topography Mission (SRTM).

Image courtesy Landsat Project Science Office, NASA's Goddard Space Flight Center

Inside Back Cover

Top: Colour composite MSG-1 images from Cedric Roberts

Foot: Patrick Prokop captured this enchanting NOAA 12 HRPT image of Hurricane Isabel on September 17, 2003. Note the strong sunglint on the waters of the Gulf of Mexico.

Back Cover

B-15A, B-15J, and C-16 icebergs in the Ross Sea, Antarctica, imaged at 250 metre resolution by the NASA Aqua satellite at 03:55 UT on November 12, 2003.

Image credit: MODIS Rapid Response Team, NASA Goddard Space Flight Center.

Opposite Page

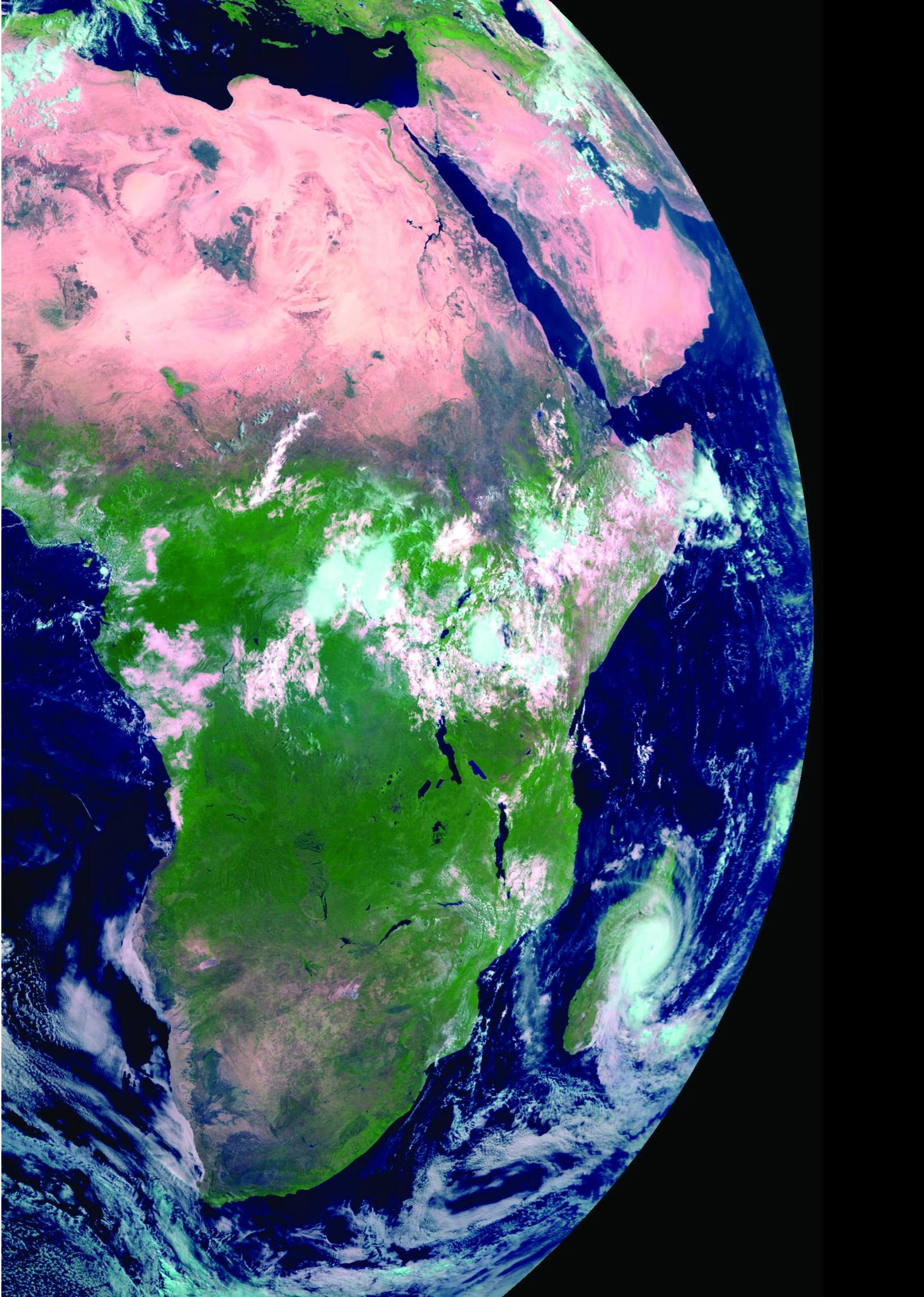
Arne van Belle from s'Gravendeel in the Netherlands received this MSG-1 image via the *Eumetcast* service at 08:44 UT on May 8, 2003.

The image was decoded using David Taylor's *MSG Data Manager*. After remapping, channels VIS006 (blue), VIS008 (green) and IR016 (red) were combined into this colour composite image using *GeoSatsignal*.

This selection of channels gives, generally, the most realistic colour scheme: it can be used to differentiate ice and snow from water. The high cold clouds are tinged cyan, as is snow in the Alps.

A striking feature of the image is Cyclone 'Manou' centred over Madagascar.

MSG-1 Trial Data, © EUMETSAT, 2003



Training Modules

Cooperative Program for Operational Meteorology Education & Training

Peter Bartlett

For readers interested in gaining a further understanding about weather forecasting via remote imaging from weather satellites, I recommend studying some of the training modules available on the Internet from the Meteorology Education and Training (METED) web-site at:

<http://www.comet.ucar.edu/>

A list of all the modules available can be seen at:

<http://www.comet.ucar.edu/modules/index.htm>

A few of the topics on offer are discussed below.

The Remote Sensing Module

This unit was developed for students enrolled in an introductory Earth or atmospheric science course. It is designed to supplement lecture and textbooks and aims. Its goal is to make you a better consumer of weather information by providing dynamic graphics, animations, and science content about remote sensing, satellite imagery, and hurricanes. When you have completed this module, you should be able to view satellite imagery in a typical weather forecast on TV or the Web and recognise the importance of some features.

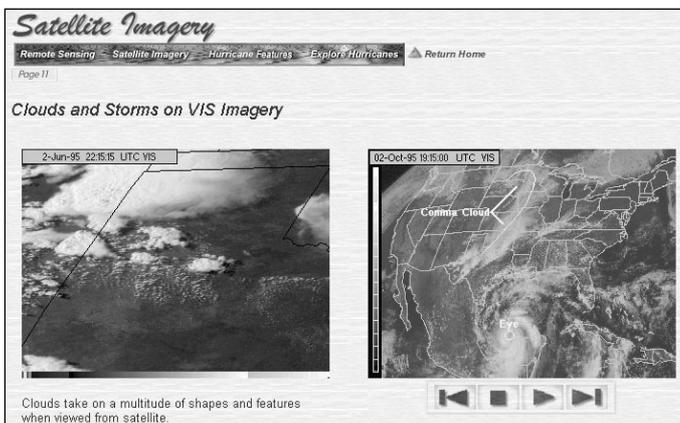


Figure 1 - Clouds and storms on VIS Imagery (Hurricane Opal)

The unit contains four sub-topics relating to Remote Sensing, Satellite Imagery, Hurricane Features and Exploring Hurricanes. Here you will learn the basic principles of remote sensing, what satellite-based sensors observe, the imagery they create, and how to interpret these. You will learn the basics about classic hurricane characteristics and explore three recent hurricanes through a time sequence. There are opportunities to inquire about phenomena, develop and test hypotheses, and make calculations. In all, this module includes over 30 graphical images, including movies and flash animation sequences depicting cloud

movement and other weather features: some sections include audio descriptions. Figure 1 is a screenshot on the theme 'Clouds and storms on Visible Imagery' and includes an animation of Hurricane Opal.

Remote Sensing of Land, Ocean & Atmosphere with Modis Module

This presentation focuses on the capabilities of the MODIS instrument on the *Terra* satellite platform. It is divided into short sections and includes an overview of the MODIS instrument with multiple examples of imagery products, highlighting applications in the Earth, oceanic, and atmospheric sciences. Topics covered include the Modis Launch, Cloud Mask, Land, Ocean and Atmospheric applications. Figure 2 comes from the section that explains how MODIS uses its many imaging channels to detect whether the land is masked by cloud cover.

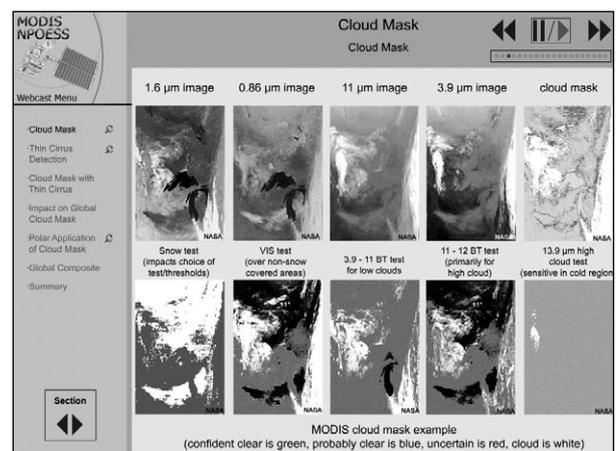


Figure 2 - Cloud mask

The topic areas described above are some of the 60 plus modules that are available for viewing on-line. Certain modules are also available for downloading but some of these are 60-80 Mb so can take a while, especially if you are not using broadband. All modules include large numbers of detailed graphics, both static and animated, some with additional voice-overs.

The source of the above material is the Cooperative Program for Operational Meteorology, Education, and Training (COMET®), whose web site is hosted by the University Corporation for Atmospheric Research (UCAR), funded by the National Weather Service at:

<http://www.comet.ucar.edu/>

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View from the Other Side

Arthur Andrews VK2 AAE

I felt very honoured when I was asked if I would like to write a regular article for the magazine of the newly formed Group for Earth Observation. This I will be pleased to do subject to the restraints of the farm and other commitments.

As this is the first of what I hope will be many articles, I thought I would bore you with some personal details about how I managed to end up on a small farm on the other side of the world. I was born and raised in Fareham, Hampshire and educated at St. John's College, Southsea. In 1961 I met and later married my wife Hazel who comes from the little village of East Dean near Chichester, West Sussex.

In June 1967, taking advantage of the heavily subsidised migrant scheme, we boarded a plane to Australia with our two children, Nigel aged 3, and Helen aged 2. Thus we became some of the many 'Ten Pound Poms' to come to this land. Sadly this scheme was discontinued a few years after our arrival. For the most part of my working life we lived in one of the outer suburbs of Sydney and my job took me to all States and Territories of Australia which was a great experience. In 1985 when I turned 50 I decided to take early retirement and we purchased a small farm deep in the Central Tablelands of N.S.W. and realised a lifelong dream.

Ever since I built my first crystal set when I was about 10 years old I have been interested in radio and electronics and in 1977 I obtained my amateur operator's certificate. About eleven years ago I became interested in weather satellites, an interest which has not diminished with time. Like most beginners I started off with APT and had a lot of fun experimenting with different types of antennas for APT and dish feeds for wefax reception. Later I progressed to an HRPT system which opened up a new field in image interpretation and manipulation. A few years ago I was lucky enough to acquire a five-bedroom demountable which had been used for workers on a remote building site. It was fully wired for power and even had two air conditioners. I removed four of the five internal partitions making one large and one small room and the building was then known by the grand title of the 'Communications Centre'.

In it are housed the HRPT system and dedicated computer: a secondary computer is used for wefax images from GMS-5, the weather station readouts and the lightning detector data. My main computer and amateur radio gear are in my study in the house. Figure 1 shows the 'Communications Centre' in all its glory. The 1.8 metre dish on the left is for GMS-5 reception, whilst the 90 cm offset dish on the roof was

for HRPT reception but has since become redundant. The trees behind the building are a bone of contention between my beloved and me. I'm for chopping all of them down to give me a better all-round view but this is strongly opposed in certain quarters. It was suggested I move my building instead and I suppose there is certain logic in that proposal.

Due to some experimental work I am engaged in I found I needed a larger centre-focus dish sited so that I had a good view to the east. This turned out to be an agricultural project. Ideally I wanted a 1.2 metre centre-focus dish, but try as I might I could not find a supplier in Australia who stocked them. There were plenty of offset dishes of that size but they were not suitable for my requirements. Eventually I decided to use a spare 1.5 meter ex-satellite TV dish I had lying around. I had decided to site the dish in an adjoining paddock, (fields are called paddocks in Australia), about 50 metres from the Communications Centre. This necessitated the purchasing of a new run of low loss co-axial cable for the feed and two runs of six-strand cable for the az/el rotator. The next problem was how to fix the dish to the rotator.

A talk to Terry down at the village garage solved the problem. Terry is a true 'bush' mechanic and can turn his hand to almost anything and next day he designed and welded together a cradle to fix on to the dish, complete with brackets for fixing to the elevation arms of the rotator. As the dish was of pressed steel it was pretty heavy and as Hazel and I are not as young as we were we found we could not lift it up to attach it to the rotator. However, placing the dish on the hydraulic front end loader of the farm tractor and raising it to the required height, from where it was then easily fixed into place, soon solved that. One final problem remained: how to counter-balance the weight of the dish so that undue strain would not occur to the rotator. Farmers world-wide have always followed the adage, 'necessity is the mother of invention', and this farmer is no different. After a bit of thought, I got Terry to weld a bracket on to a steel bar, and then a piece of railway track to the bar. This I attached to the rear of the rotator but found that it was still out of balance. I had some lengths of galvanised pipe lying around so I experimented with different lengths until a balance was achieved, the pipe lying snugly in the groove on the side of the railway track. To stop the pipe sliding out when the dish was raised I used a clamp to keep it in place and the job was complete. Figure 2 shows a picture of this magnificent invention. It certainly isn't pretty, but it works.

During summer I have often had trouble with the LNA fitted to the feed at the focal point of the dish. I put the

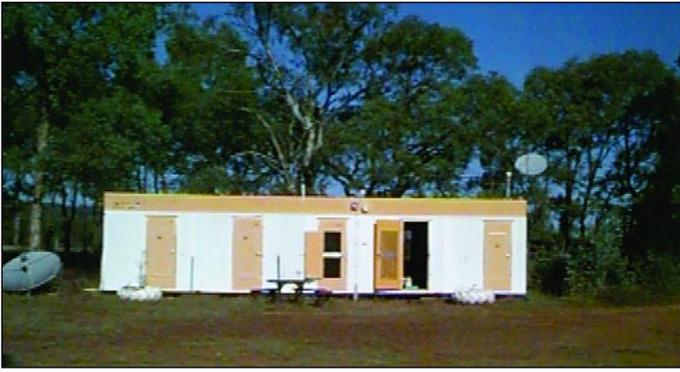


Figure 1 - The 'Control Centre'



Figure 2 - My innovative dish support

erratic behaviour of the LNA down to excessive heat radiating from the centre of the dish. Shade temperatures at my location regularly reach 100°F during the summer months so I was interested to find out just how hot the LNA got on these days. Most normal thermometers seem only to go up to about 130°F so were not really suitable. My brilliant wife suggested using an oven thermometer and bought me one on her next trip into town. This fits neatly next to the LNA so now I will be able to see the difference between shade and dish temperatures. These should vary considerably depending whether the dish is

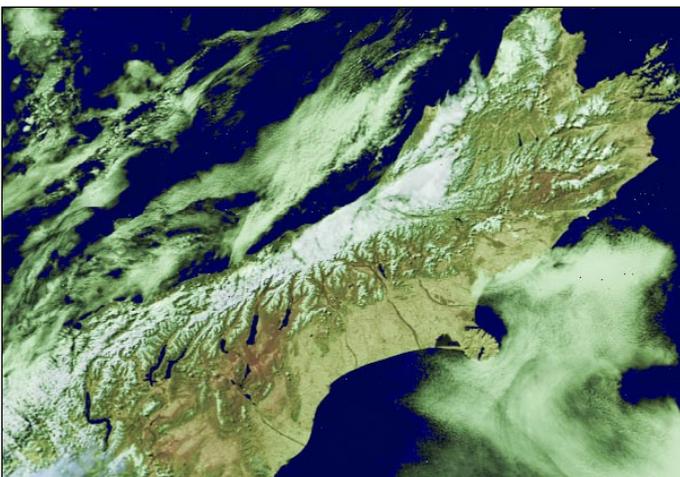


Figure 3 - South Island, New Zealand

pointing towards or away from the sun. I will let you know the results of the tests in the next issue.

The new dish and its location now give me a good view to the east and I can now acquire the satellites at 3° of elevation. This now allows me to capture good images of New Zealand, which I have been unable to do before. Figure 3 is an image of part of the South Island of New Zealand captured from NOAA-16 in October and processed in false colour by David Taylor's excellent HRPT Reader software. The snow lying on the mountain ranges can clearly be seen, as can some of the many lakes that abound in the South Island.

I am always on the lookout for unusual weather systems when I examine the HRPT data that I have captured and Figure 4 is a case in point. This image, again processed by HRPT Reader and received from NOAA-16, shows a large thunderstorm in Bass Strait neatly sandwiched between the Victorian coast and Flinders Island.

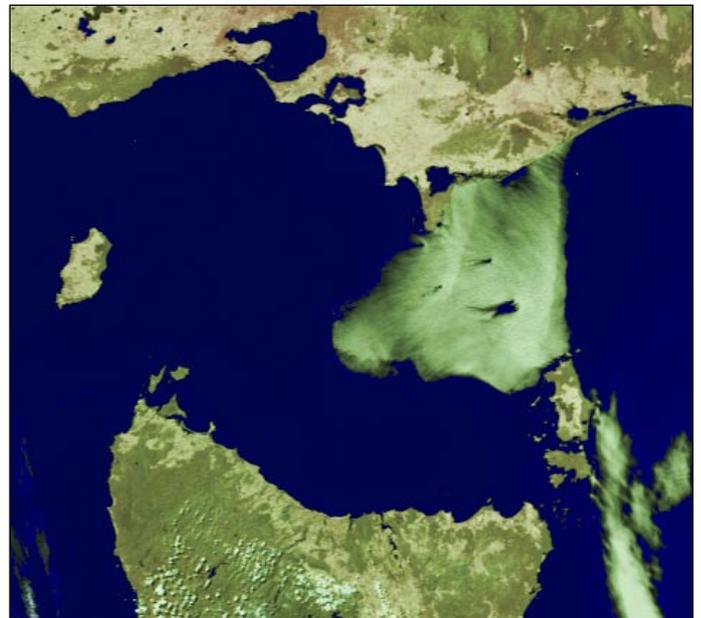


Figure 4 - Thunderstorm in Bass Strait

Port Phillip Bay can be seen centre left whilst the north coast of Tasmania can be seen at the bottom. The storm was travelling from west to east and it is interesting to note the almost straight leading edge and the large thunderheads poking above the cloud mass like so many pimples. There was no other significant cloud within hundreds of miles of this storm.

October ushered in the Summer Madness Period again where Australia's time zones border on the ridiculous when the various States and Territories adopt or reject daylight saving. This stupidity is best understood by looking at the map (Fig 5). The normal time zone offsets are shown in bracketed figures, South Australia being half an hour behind the east coast and West Australia two hours behind which is sensible enough.

Continued on page 35 . . .

Improved W/V Data from MSG-1

David Taylor



The original LRIT W/V channel relayed at 13:15 UT on October 28, 2003

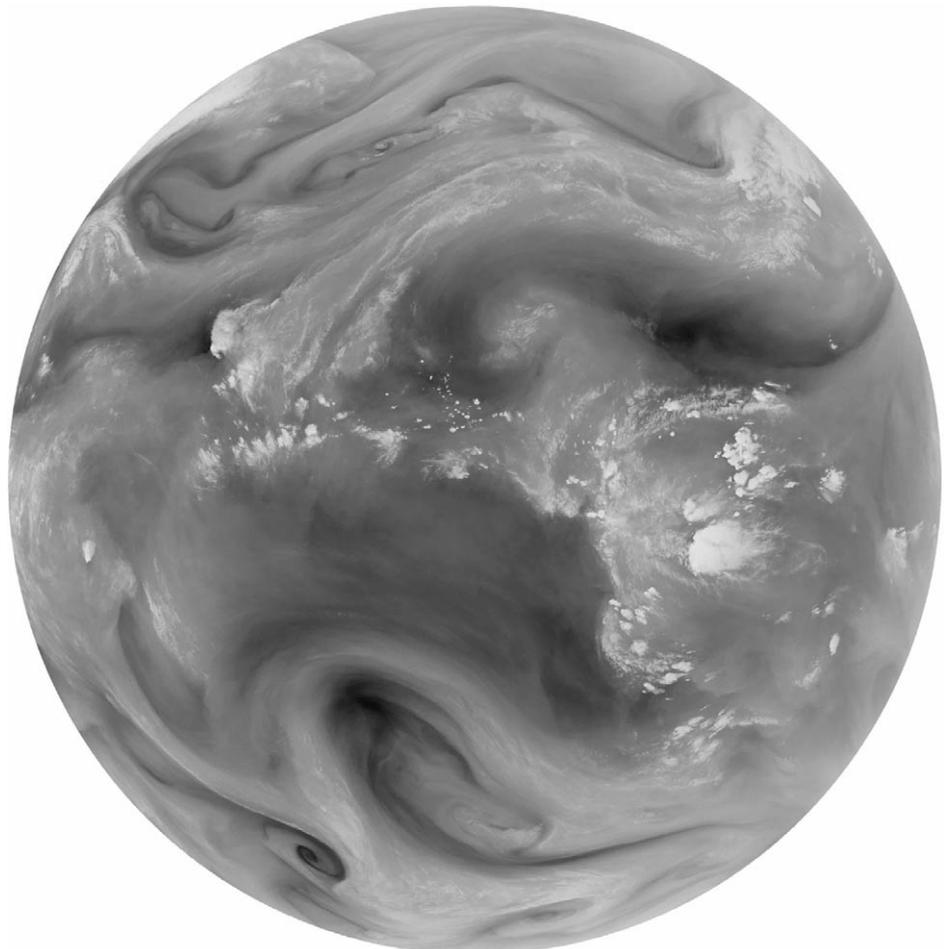
One of the most dramatic effects of the recent transition to the production IMPF ground processing software for MSG-1 has been that *Eumetsat* took the opportunity to review the gain settings for the channels, to optimise the dynamic range and prevent clipping. This resulted in the gain for the water-vapour channels being increased substantially, so that the pale image received from the 12:15 UT LRIT data (left) was replaced with a much more contrasty image from the 13:15 UT scan (main image, below). This change was made on October 28, 2003.

As the LRIT data is transmitted with lossy JPEG compression, much of the low-contrast detail in the earlier image was masked by JPEG artefacts. No such problems arise with the new gain settings though! Users of the HRIT data also saw the same change.

The next day saw the start of a test where the lossy JPEG

compression for the HRIT channel-12 image (High Resolution Visible - 5568 x 11136 pixels) was replaced with the same lossless wavelet compression used on the other eleven channels. This resulted in a somewhat greater data flow, as the files are larger, but no users have reported problems as a result. The actual images are now significantly better, with the JPEG artefacts being replaced by smooth transitions, which is particularly visible in the darker regions. Whether *Eumetsat* will continue with this format is unknown at the time of writing.

Eumetsat made the following comment on October 29, 2003: 'Following the successful introduction of HRV lossless wavelet compression on October 29, we have not observed any loss in quality or timeliness to the services delivered on *EUMETCast*. In addition, we have received positive feedback on the improved HRV image quality from Dissemination Trial Users. As a result, we plan to continue with HRV lossless wavelet compression for the foreseeable future.'



The 'improved' LRIT W/V channel relayed at 13:15 UT on October 28, 2003

MASSIVE B-15 ICEBERG SPLITS IN TWO

NASA

A massive iceberg that had been blocking traditional shipping routes to McMurdo Station, the National Science Foundation's research station in Antarctica, snapped into two recently. The iceberg, which is designated B-15A, appeared intact when imaged by the Moderate Resolution Imaging Spectroradiometer (MODIS) aboard NASA's *Terra* satellite on October 7, 2003, but an image captured just two days later (figure 1) showed the 'berg to have split into two. The larger northern section is about 75 miles long; the shorter one is 20 to 25 miles long. A more recent colour image acquired by NASA's *Aqua* MODIS instrument appears on the back cover, and shows the split even more clearly.

The B-15A iceberg calved from the Ross Ice Shelf at the end of March 2000, at the end of the Antarctic summer melt season, and has since drifted to its present location. At that time, it measured 170 miles long by 25 miles wide with an area of 4 250 square-miles, almost exactly the area of the island of Jamaica.

B-15A was formed from glacial ice moving off the Antarctic continent and calved along pre-existing cracks in the Ross Ice Shelf near Roosevelt Island. The calving of the iceberg resulted in the northern boundary of the ice shelf receding some 25 miles to the south, a loss that it will probably take the ice shelf up to 100 years to replace. Cracks in the Antarctic ice shelf have been closely observed since the advent of remote sensing by satellite and are of particular interest to scientists studying the potential effects of global warming. The break-off of this iceberg is believed to be part of a normal process in which the ice sheet maintains a balance between constant growth and periodic loss.

Figure 2 shows the scene as captured by Terra's MODIS instrument on September 17, 2000. The enormous bergs became locked up in winter sea ice before they could drift very far that first season, but at the onset of the following

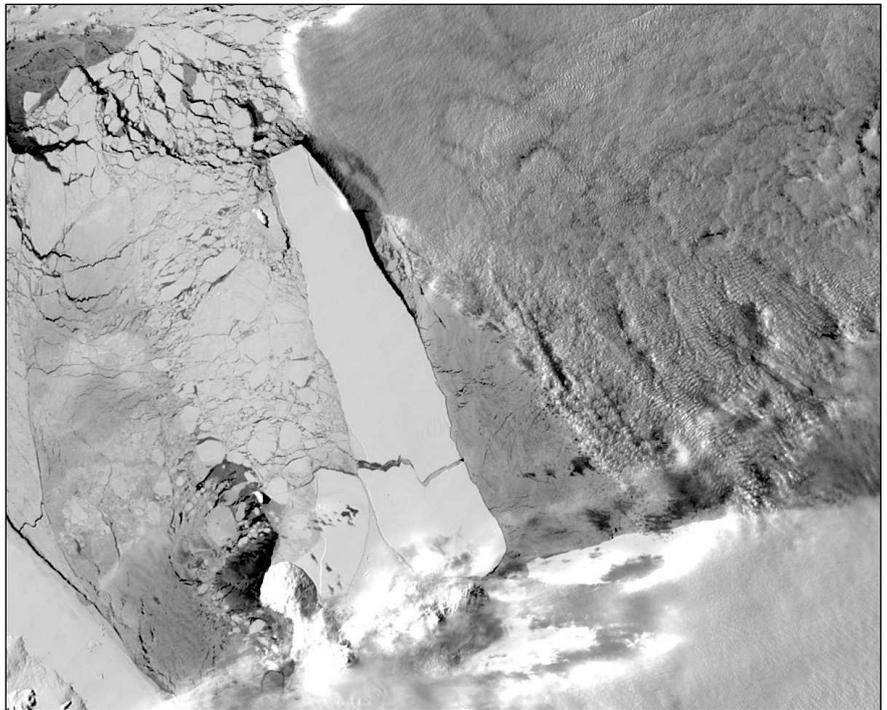


Figure 1 - Terra MODIS image showing Iceberg B15a on October 9, 2003
Image courtesy Jeff Schmaltz, MODIS Land Rapid Response Team at NASA GSFC.



Figure 2 - Terra MODIS image showing Iceberg B15a on September 17, 2000
Image courtesy Jacques Desclotres, MODIS Rapid Response Team at NASA GSFC.

spring thaw, soon after this image was acquired, they began to drift. The large, southernmost berg is B-15A, and it eventually drifted toward Ross Island, seen at the bottom left of the image. The amazing shadow being cast on the ground south of Ross Island is from *Mount Erebus*. An unusual situation arose during the Antarctic summer, December 2002, when seasonal sea ice in the Ross Sea failed to

disperse, and blocked the route used by supply ships bound for McMurdo Station (the National Science Foundation's research station on Antarctica). Normally, the ice dramatically retreats from Antarctic coastal waters, but this year unusually high levels of ice persisted in the Ross Sea despite the advancing summer, impeding the passage to Ross Island.

Figure 3 shows the scene on December 17, 2002. Ross Island, seen at the lower left hand corner of the image, is engulfed by the outer reaches of the Ross Ice Shelf (bottom). The build-up of pack ice may have been due to the presence of two large icebergs (B-15A, lower left and C-19, top centre) which had run aground, interfering with the ocean circulation patterns that melt or carry off the seasonal ice.

The Ross Ice Shelf is a massive field of snow and ice that begins on land but hangs out over the sea. Ross Island reaches a maximum elevation of 3 794 meters on *Mount Erebus*, an active volcano. The fact that parts of the island appear just barely to rise above the ice shelf provides dramatic evidence as to just how thick the ice sheet is—1 000 metres in some places. The shelf undergoes perpetual demolition and reconstruction as its outer portions break off,

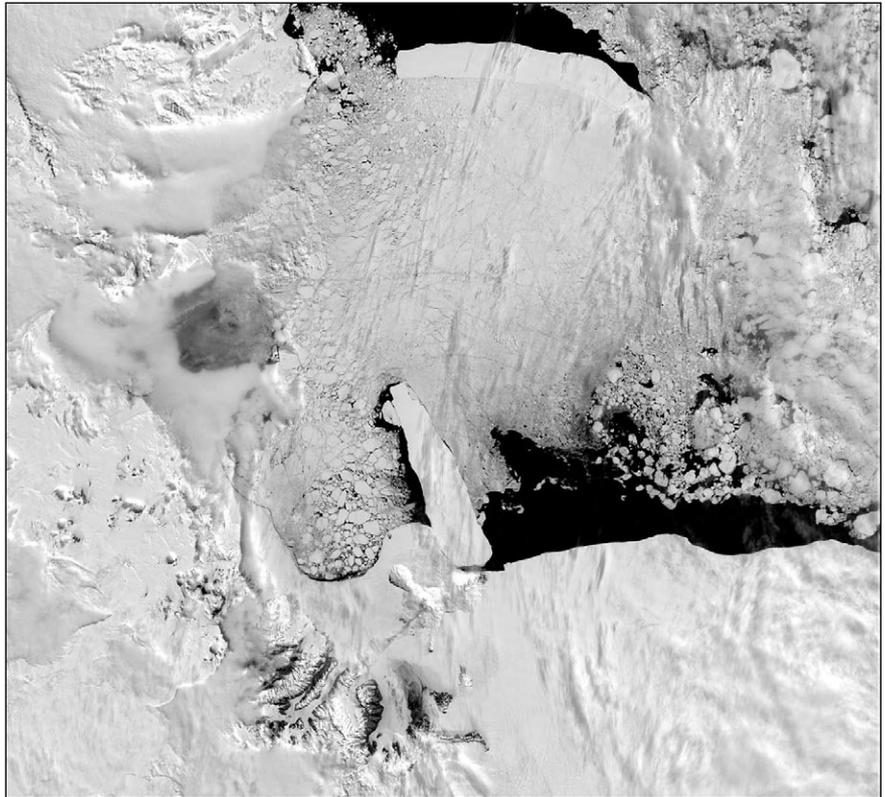


Figure 3 - Icebergs B-15A and C-19 trapping seasonal ice in the Ross Sea
Terra MODIS - December 17, 2002
Image courtesy Jacques Descloitres, MODIS Rapid Response Team at NASA GSFC.

occasionally giving rise to enormous icebergs like B-15A, while the interior regions are fed by glaciers which flow down on to the shelf from the mainland of Antarctica.

View from the Other Side

... Continued from page 32

Come daylight saving, Queensland, West Australia and the Northern Territory stubbornly refuse to adopt it whilst the remaining States do. This then leads to the farcical situation of Queensland at longitude 150°E being half an hour behind South Australia at 135°E. Equally stupid is South Australia and the Northern

Territory which share nearly the same areas of longitude, yet the N.T is an hour behind S.A. The mind boggles. If we have got to have daylight saving and personally I don't see why, I think it ought to be under Federal control and every State adopts it. This won't happen of course, as the States are very jealous of their autonomy and won't relinquish any of their powers. It was once suggested that all Australia had only one time zone based on the 135°E line of longitude but I don't think it was ever seriously considered.

Goodbye for now from the Other Side.

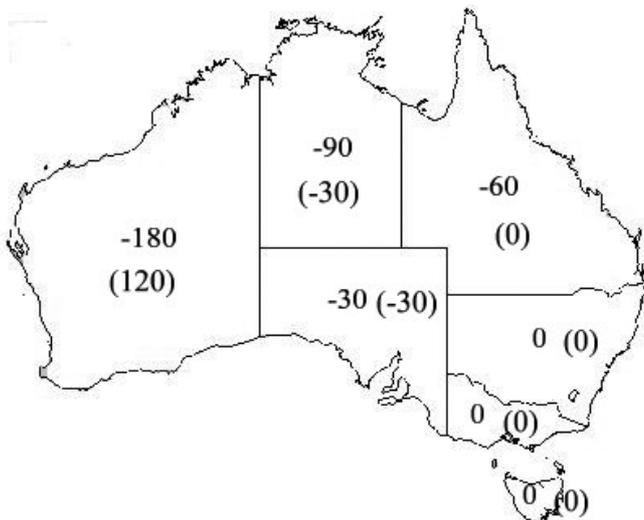


Figure 5
The Australian time zones

Earth Imaging News

Peter Wakelin

Meteor 3M Redesigned

Meteor 3M N1 was launched more than two years ago but its successor, N2, to be launched in 2006, will be a very different spacecraft; it will conform more closely to the standards agreed by the Coordination Group for Meteorological Satellites (CGMS). Like its western counterparts, it will carry imagers in the visible, infrared and microwave channels as well as infrared and microwave atmospheric sounders. It will broadcast directly to user stations in the digital LRPT (137.10 or 137.89MHz) and AHRPT (1700MHz) modes.

Meteor 3M N2 and the follow-on N3 will be based on the proven Resurs platform and are intended to demonstrate key systems and be the precursors of the next-generation purpose-built meteorological spacecraft. The basic imaging instruments include the MSU-MR scanning radiometer with six channels between 0.5 and 12.5 micrometres and having a resolution of 1.0 km and the KMSS high resolution scanner operating in four channels in the visible/near-infrared band with a resolution of 100 m but with a reduced swath-width of 100 km.

In addition to the above-mentioned imagers and sounders these spacecraft will also carry active radar imagers named 'Severjanin'. This instrument is currently under development and the first one to fly should be on the joint Russian/Ukrainian spacecraft **Sich-1M**, which may be launched later this year. Intended for ice monitoring, resolution will be better than 1 km.

India Launches ResourceSat

India's fourth satellite to be orbited in 2003 lifted off from the Satish Dhawan Space Centre onboard an Indian-built Polar Satellite Launch Vehicle (PSLV) at 0452 UT on October 17. The PSLV placed the 1360 kg ResourceSat-1 into an 802 x 875 km, 98.7° sun-synchronous orbit.

ResourceSat-1 replaces two older Earth resources satellites, IRS 1C and 1D, which have been successfully imaging for more than 6 years. In addition, ResourceSat-1 greatly enhances data quality; it carries three cameras:

- A high resolution Linear Imaging Self Scanner (LISS-4) operating in three spectral bands in the visible and near-infrared with 6m resolution
- A medium resolution LISS-3 with 23.5 m resolution
- An Advanced Wide Field Sensor (AWiFS) with 56 m resolution.

ResourceSat-1 also carries a solid-state recorder with a capacity of 120 gigabits. This recorder was used to store the accompanying LISS-4 image of part of Washington, DC, USA on November 8, which was later read out to a receiving station in India.



ResourceSat-1 image showing part of Washington DC. The White House is at lower left and the Capitol at lower right. (Image courtesy Indian National Remote Sensing Agency.)

Japanese Launch Failure May Further Delay MTSAT 1R

Two Japanese spy satellites were lost during launch on November 29 when the H-IIA rocket had to be destroyed 11 minutes after launch. Early reports indicated that one of the 10-tonne solid boosters failed to separate from the first stage less than two minutes after launch as planned, possibly because leaking hot gas burned through the command wires. Although the H-IIA is reported to have reached its planned altitude of 422 km, its velocity at that height would have been far too low, because of the extra mass carried, and its payload could not reach orbital velocity.

As the H-IIA will be used to launch MTSAT 1R, a further delay to at least mid-2004 seems likely until the problem is resolved and corrected. MTSAT 1R is a replacement for the original MTSAT 1 which was destroyed in a launch failure. It will be placed at 140°E to replace the ailing GMS-5 spacecraft.

NPP to test Next-Generation Instruments

The NPOESS Preparatory Project (NPP) is scheduled for launch in October 2006 to test four of the critical sensors to be carried on the next-generation US NPOESS (National Polar-orbiting Operational Environmental Satellite System) spacecraft.

IN TRAY

The column for readers' letters and queries

They are:

- Visible/Infrared Imager Radiometer Suite (VIIRS) which is a 22-channel radiometer having a resolution of 650 m at visible wavelengths.
- Cross-track Infrared Sounder (CrIS) which is a Fourier Transform Spectrometer to determine the vertical atmospheric distribution of temperature, moisture and pressure from the surface to the top of the atmosphere.
- Ozone Mapping and Profiler Suite (OMPS) which consists of a nadir-scanning ozone mapper similar to NASA's Total Ozone Mapping Spectrometer (TOMS) and a limb-scanning radiometer capable of much greater vertical resolution than the Solar Backscatter Ultraviolet radiometer on the current NOAA spacecraft.
- Advanced Technology Microwave Sounder (ATMS) which is a new cross-track microwave sounder for deriving temperature and humidity profiles. It will be far smaller, lighter and less power-hungry than the present generation of similar sounders.

There will be no 1.7 GHz data transmissions from NPP although direct readout will be available on 7812 MHz at 15 Mbps to suitably equipped ground stations.

NOAA-N to be Launched in September 2004

NOAA-N, to be renamed NOAA-18 when operational, is expected to be launched in mid September and will go into the afternoon orbit replacing NOAA-16. It will carry two updated instruments: the High Resolution Infrared Sounder HIRS/4 will have a much improved resolution over the HIRS/3 currently in use and EUMETSAT's Microwave Humidity Sounder will replace the Advanced Microwave Sounder Unit (AMSU-B) on current spacecraft. Imagery will be transmitted in the familiar APT and HRPT modes.

Feng Yun-2C Launch Expected in 2004

China's third geostationary weather satellite is scheduled to be launched later this year. The problems experienced by FY-2A and -2B have been addressed; in particular, the power supply has been increased to better manage thermal control during the eclipse seasons. Like its predecessors it will be stationed above 105°E. WEFAX will be replaced by LRIT. Some changes have also been made to the infrared imaging channels to enhance usefulness. The 10.5 - 12.5 micrometre window has been split into two to more accurately determine atmospheric water-vapour content and a 3.7 micrometre channel has been added to improve surface temperature measurements. In addition, all IR data will be 10-bit rather than the 8-bit of earlier spacecraft.

We would like readers to participate with us by sending us letters and queries about weather satellite imaging to GEO. We will of course also respond to these for the benefit of the readership at large, and we hope that you will too.

As this is our Launch Issue, Francis Bell has started the ball rolling with the following submissions to start you thinking.

Dear Editor

I wonder if any of your readers could help me over a puzzle have experienced over the last 10 years. Over this period of time I have been receiving weather satellite images, mainly direct from Meteosat, plus the NOAA and Russian polar orbiters. In addition to this I have also received the relayed images via Meteosat of other geostationary satellites: thus covering most of the world.

My puzzle relates to hurricanes. Hurricanes are of course storms not experienced in this country (September 1987 in the SE of England was not a hurricane) but they are almost common in the North Atlantic summer and autumn when sea temperatures are at their highest. What I don't understand is why there are no hurricanes in the South Atlantic. Maybe I have got this completely wrong and that is why I am asking.

In the Pacific there are typhoons and tropical cyclones which I understand are the same type of weather system as hurricanes but just known by another name. I know these do occur in the southern hemisphere. I can recall news reports of one in Darwin and others Polynesia with considerable local damage. But why not in the South Atlantic? When was the last hurricane to hit Rio de Janeiro or Salvador?

Okay, I know a bit about the oceans - Antarctic Bottom Water, Benguela current and the intensification of western boundary currents. Have you ever tried swimming in one? They are horrible and cold, at best you need a wet suit. Give me Hawaii or the Maldives any time!

So why no hurricanes in the South Atlantic? Or have I got this quite wrong. If I have please could you send a South Atlantic hurricane image to the editor together with some statistics.

Dear Editor,

Would you please allow me to reinforce the advice offered by David Taylor in setting up his software for the reception of MSG-1 via the Hot Bird-6 satellite.

I did align my dish with its LNB, and having installed the Tellique card and

software in my new and fast computer, curiosity got the better of me when I configured it to receive Hot Bird's TV signals. This is one of the biggest: 'Don't bothers I have experienced in my life. I didn't count, but found some 300 channels, 50 of which were TV. The only channel of any interest was 'BBC World Service' which you can receive on Terrestrial Digital and Satellite-TV anyway!

It's okay if you want Arabic, Italian, German or other foreign-language TV: it's a good service for those users. But how many radio channels can you listen to at once?

Here is a very serious conclusion which may benefit your readers. Do not bother with the TV transmissions from Hot Bird if there is the slightest chance of them compromising MSG-1 reception. It isn't worth it!

Dear Editor,

I am astonished with the detail revealed by my new MSG-1 system. As well as the raw images it is also possible to put detailed political boundary overlays on these satellite images. I often do this on the screen for an exact identification of an area which interests me.

While browsing through some of my images I noticed coastal outlines for some Atlantic islands. An atlas revealed these were the Cape Verde islands.. Lat.15°N Long. 25°W. They caught my eye because of the nearby cloud patterns which the islands must have been affecting when the image was taken. I have seen this before on other satellite images but for other island groups.

It so happens I have been to the Atlantic islands of Madeira and the Canary islands. I have also been to The Gambia which is about the same latitude as the Cape Verde islands. However, I know almost nothing about the Cape Verde islands.

Please can any of your readers say whether they have been to the Cape Verde islands and what are the island's best attributes. The biology, geology, climate, and political antecedents would I feel sure be of interest to your readers. And can I get a package holiday there?

Dear Editor,

Could somebody please advise me about forward error correction? How can you correct an error that has not happened yet? I know MSG-1 uses this system for its data stream, so it must be very clever. The word 'forward' still mystifies me.

Satellite Predictions

(Based on Latitude 52°N, Longitude 2°W, times in UT / GMT)

	NOAA 12	NOAA 15	NOAA 17	NOAA 12	NOAA 15	NOAA 17
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Feb 24	04:32 06:12 14:20 15:58	06:00 07:40 17:27 19:08	10:59 12:39 20:47 22:26	Apr 25 04:36 06:16 14:23 16:02	06:59 08:39 16:46 18:26	11:14 12:55 21:01 22:42
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Join GEO

The Group for Earth Observation



Welcome to this first issue of The *GEO Quarterly*, the new magazine aimed at everyone with an interest in Earth Imaging, Weather Satellites and Weather Interpretation. Thanks to funding that the Group has acquired, the first 2000 people to apply will receive this Launch Issue absolutely free of charge. We do hope that you enjoy reading it.

Journey of Discovery

There has probably never been such an exciting array of satellites orbiting and imaging our planet. The geostationary Meteosat-8 (formerly MSG-1) is just entering full service, providing high quality images of Earth every fifteen minutes, while NASA's *Terra* and *Aqua* satellites have already been providing amazing high-resolution true-color images of our planet for some considerable time.

Many enthusiasts throughout Europe are already enjoying near real-time reception of Meteosat-8 images on their own home-computer systems and although *Terra* and *Aqua* are as yet out of reach of the hobbyist, discussions have already taken place on Internet newsgroups concerning the feasibility of amateur access to their data streams.

And for the less ambitious, a new APT satellite, NOAA-N, is due for launch in the second half of 2004 to join the currently active NOAA's -12, -15 and -17, providing the complete beginner with the easiest entry route of all into this absorbing hobby.

It is certain that a fascinating journey of discovery lies ahead as advancing technology brings these and other yet-to-be launched satellites within the reach of amateur enthusiasts and educational users. We hope you will come and share this journey with us!

The GEO Quarterly Magazine

We plan to publish this Group magazine four times per year. This issue comes as the familiar glossy A4 colour magazine. Time will tell whether we will have the

resources to continue distributing all subsequent issues in this form: as a fledgling organisation, funding will inevitably dictate what we can achieve. We fully intend to provide another printed magazine for the November/December issue (No 4). But a printed medium is the most expensive distribution option, and the May-June and August-September issues may well have to be distributed electronically, on CD-ROM, as Acrobat PDF documents to reduce overheads.

It is very much up to you, our readers, to help us by subscribing to The Group for Earth Observation. Your contributions will provide the financial backbone to allow us to continue serving you.

Magazine Content

We hope that this first issue of The GEO Quarterly provides a well-balanced and varied range of interesting articles for you. We plan to publish spectacular satellite images, some in full colour; to outline image processing techniques; to provide construction projects related to satellite imaging; to review and detail the use of developing software packages to acquire satellite transmissions and describe how to create create images from them . . . and much, much more.

We value readers' opinions in indicating the paths we should tread. For example, a veritable armada of imaging spacecraft has just reached Mars, and the *Cassini* mission is due to arrive at Saturn in July. Would you like to see us devoting some of our coverage to these missions—or should we stick rigidly to images of our own planet?

What did you think of this issue? Please feel free to suggest ways in which we could improve our service to readers by completing the response section in the right-hand panel of the membership application form.

Symposium

Many of you may recall the successful one-day Symposium organised by Francis Bell at the National Space

Centre, Leicester last May and we are delighted to announce that he has agreed to organise GEO's first members' meeting at the same venue on Saturday, May 1, 2004. As last year, the cost will be a modest £10 for the day, a real bargain, as this includes a ticket to visit the Space Centre's Exhibition Halls in addition to admitting you to our workshops and lectures. Speakers are already being contacted, and we hope to have a working MSG-1 reception station in operation.

Subscribing to GEO

This Launch Issue of the GEO Quarterly comes to you absolutely free: it is yours to keep regardless of whether you choose to join us or not. If you enjoyed this copy of The GEO Quarterly, and wish to join the Group, please complete the coloured Membership Application Form accompanying this issue. You will then receive a further four issues of The GEO Quarterly during the ensuing 12 months.

Submitting Your Application Form

Please complete your application form and the readers' response section then return it, with the appropriate remittance, to Nigel Evans, at the address indicated at the foot of the form.

HOW TO PAY

The most convenient way to pay your GEO subscription is by **credit card** (Mastercard, VISA, Switch or Switch Solo). Additionally, overseas readers may pay by means of a banker's draft cheque, drawn on a London (England) bank, with the London Bank's address clearly printed on the cheque. UK Readers may make payment by personal cheque or postal order.



All cheques and postal orders must be made payable to 'Group for Earth Observation'.



Group for Earth Observation



Membership Application Form

Subscription Rates

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'L'Eventail', 7 Gloster Ropewalk, Aycliffe, Dover CT17 9ES, England, UK.

In which area(s) of Earth imaging are you currently active?

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Would you like to become involved with helping GEO in any way?

Are you willing to have your e-mail address passed on to other GEO members in your area, who may be seeking assistance or advice?

Yes

No

Quarterly magazine preferences

Exclusively devoted to Earth imaging

Should also cover planetary mission imagery ...

Are there any comments you would like to make about this issue of the GEO Quarterly?

Please make all cheques and Postal Orders payable to the '*Group for Earth Observation*'.

EUMETSAT Operations News Bulletins

Francis Bell

The latest bulletin, 'Issue 10', was published in December 2003. I noticed that my copy of 'Issue 9' was dated exactly a year before. Whether this is an annual publication or it was just coincidence I don't know. What I do know is that it is a very valuable document. The latest bulletin is 21 A4 pages long and is full of technical news, administrative and policy statements. For those members regularly receiving Meteosat signals it is almost a must to read. The latest issue is available on *EUMETSAT's* web site at:-

<http://www.eumetsat.de/en/dps/helpdesk/documentation/pdf/newsbulletin10.pdf>

If you do not have a copy and you are interested in Meteosat then I recommend that you download this document from *EUMETSAT's* web site. On my slow modem it took about 3 minutes. Then I printed it out. Most of the contents refer to Meteosat-8, as MSG-1 has been renamed since becoming fully operational in January of this year.

For those not able to download the document I will draw to your attention some very important paragraphs of news that it contains.

Para. 3.2.1.

This states that, from January 2004, the trial period will close and routine operations will start. From this date direct users will need to conclude a licensing agreement: or for the 6-hourly data, complete a Registration Form.

Para 3.2.2

From March 1, 2004, reception will be controlled by the *EUMETCast* Key Unit (EKU). This EKU is the USB decryption hardware used in conjunction with a 'user-name' and 'user-key' to restrict data access to an individual user reception station. The EKUs are only available from *EUMETSAT*. A fee of €40 is charged per EKU. In Europe the licensing authority will be your National Meteorological Service.

Para 5.4.1

Following the successful introduction of the second generation Meteosat services on *EUMETCast*, it has been decided to continue with this system as the baseline operational dissemination mechanism for Meteosat-8 and the subsequent MSG satellites. This decision will not only allow for continuity in the data reception mechanism for Meteosat-8 data users, but it also increases the full lifetime limit of individual satellites.

Para 5.4.2

A full complement of Indian Ocean coverage will be introduced by the end of the first quarter of 2004.

Para 5.5

EUMETSAT will be introducing a payment by credit card system in early 2004 which will allow users to pay for hardware and software.

Para 6

Amendment to *EUMETSAT* data policy. This has already been covered in this GEO Quarterly on page 9.

Wow! If you have ever read good news this is it. Amateur users do not have to pay a license fee. Payments by credit card. Indian Ocean coverage.

And the best news if you didn't recognise it - reread Para 5.4.1. The investment GEO members are making in time, trouble and experimentation in hardware and software for Meteosat reception will be a valuable investment for at least the next ten years!

Thank you *EUMETSAT*!

World Weather Eye



Last December brought unprecedented precipitation to southern **France**, vast areas being inundated by over 100 mm of rain during the 48 hours from 7.00 a.m. on December 1. And on higher ground in the Ardèche region the figures were even more severe; 393 mm at La Souche, 380 mm at Loubaresse and 367 mm in Barna—representing more than four times the entire monthly rainfall in little over two days. In the town of Montpellier, 129 mm fell on December 3 alone.

Rain, coupled with high winds, forced over 9000 people to flee their homes as the nation's second largest city, Marseilles, was declared a disaster area: a barge was used to evacuate 1000 people from one of the city's northern suburbs.

On December 17 an eleven year old Canadian boy had a lucky escape after a number of fellow school-children rolled a 5 tonne snowball on top of him. The boy lost consciousness and stopped breathing for a time during the incident at **Niagara Falls**, Ontario.

Parts of **Australia** really sizzled on Christmas day. The temperature reached a scorching 39°C, some 14 degrees above the mean December daytime high of 25.6°. By contrast, Kuri Bay in the north of Western Australia had more than its fair share of rain as 179 mm fell on Christmas eve, compared with a monthly mean of 150 mm.

Tropical cyclone 03B hit southeast **India** north of Madras with 70 mph winds on December 16, leaving thousands homeless and producing at least 45 fatalities. The storm caused considerable damage to the paddy, sugarcane, tobacco and cotton crops, as well as cutting power supplies and telephone lines.

The town of Agata just north of the Arctic Circle in Krasnoyarsk, **Siberia** expects severe winter temperatures, but saw in this New Year with a *maximum* day temperature of only -46.5°C almost 20° below its mean January average of -27.2 °C.

SOFTWARE SHOWCASE



Douglas Deans - douglas@dsdeans.freemove.co.uk

Amateur Earth Imaging relies almost exclusively these days on the use of a personal computer to acquire and process the data beamed down to us from orbiting satellites. In this first issue of the *GEO Quarterly*, I am presenting a wide range of software, a mixture of freeware and shareware, that should prove useful to everyone who enjoys our hobby, from beginners to advanced users.

All the items listed are available on the Internet, but some are sizeable downloads. To provide these in a user-friendly way, I have collected them on a series of CDs, which can be ordered from me by return.

CDs GS1,GS2 and GS3 relate to software for decoding and displaying satellite images, while GS4 is packed with over 700 Mb of data from a range of satellites, much of it large, high-resolution images that would be considered by many to be too large for download.

How to Purchase CDs

Simply write to the address below requesting **GS1, GS2, GS3** or **GS4**. Prices are £5 for any single CD, 2 for £8, 3 for £11 or all 4 for £14. Please enclose cash or cheque (made payable to Douglas Deans not *GEO*) for the appropriate amount. Nothing else is required.

The cost includes the CD, packaging and posting, a small donation towards the cost of overheads, the cost of overseas orders and the search for new or updated software. No fee is asked from overseas members although an exchange of software or interesting satellite images is always welcome.

Orders are normally dispatched on the day of receipt.

Please apply to the address at the end of this article.

GS1	All David Taylor's weather satellite programs and libraries, including the current releases of WXtrack, SatSignal, HRPT Reader, GeoSatSignal, GroundMap, RX2 PassControl and many other program extras. This disc also contains a large quantity of sample files, many of high-resolution data, for use with the programs.	
	Wxtrack	v 3.4.0 Satellite Tracking Program
	SatSignal	v 4.0.8 Creates images from wave files
	HRPT Reader	v 2.5.2 Converts raw HRPT data files into images
	GeoSatsignal	v 4.0.2 Manipulates geostationary weather satellite images
	GroundMap	v 1.3.6 Rescales satellite images
	RX2 PassControl	v 2.2.8 Computer control program for the RX2 weather satellite receiver

GS2	A wide range of software for all aspects of weather satellite reception including tracking, receiving, monitoring and image manipulation. Content as detailed below but many other extras are provided. Titles correspond to folder names. * implies a DOS program.	
Folder D-02	Recall (wave file decoder). Palette (modifies wxsat colour palettes).	
Folder D-03	Scanner recorder v 1.8 (wave file recorder). *NOAA95 / *FENG99 (Software for the NOAA 95 HRPT project)	
Folder D-04	Wxsat v 2.59 (Wave file recorder/decoder). Satellite Monitor (Wave file recorder).	
AGSatTrack	v 1.33	Satellite tracking program
Circuit	Documents for Circuit Wxsat receiver and UOSat receiver. - PDF format.	
e-weatherman	Provides current weather conditions from the Internet to your computer.	
Element Manager	v 1.58	Program to manipulate NASA 2-line element data
Footprint	v 2.10	Simple satellite tracking program
IrfanView	v 3.80	Probably the best freeware image viewing software available
JVComm32	v 1.23	APT/FAX/SSTV decoder - evaluation version only
Mac Kepler Editor	For editing verbose AMSAT format elements. Mac. OS X and OS9 only.	
Neopaint	v 4.0	Image processing program (30-day evaluation)
Paintshop Pro	v 7.04	Image processing program (30-day trial version)
Satscape	v 2.00	Satellite tracking Program
Splitter	v 4.0	Utility program for splitting and reuniting large files
Wxtoimg	v.2.5.5	WAV file decoding program - Windows 9.X/ME/2000/XP. Linux and Mac options included.

GS3	3 DEM package for 3D terrain visualisation - Includes all the necessary files to produce excellent images and flybys. All the Earth GLOBE files are provided along with a large selection of Mars MOLA files. Many other extras including sample images and helpful guides.
-----	--

GS4	Image CD (New) - A wide selection of high-resolution remote images from a range of satellites, including stunning photography from the Shuttle missions. A full description and source is provided for each image.
-----	--

Order your CDs from:
 Douglas Deans, 17 Montrose Way,
 Dunblane, Perthshire FK15 9JL, Scotland.

First Steps in Setting up an APT Ground Station

Les Hamilton

Perhaps you have visited one of the rallies this summer and seen weather satellite images on display. Maybe a friend with a PC has let you into the secret that you too can receive such images, in real time, from the skies. Or you may have discovered the hobby when browsing the Web. Either way, armed with a personal computer, suitable antenna and dedicated receiver for the 137 MHz band, you could be running your own ground station in next to no time and for relatively little cost.

The Satellites

There are currently three American satellites dedicated to the return of so-called Automatic Picture Transmission (APT) weather images of our planet. Operated by the National Oceanic and Atmospheric Administration (NOAA), the NOAA-12, NOAA-15 and NOAA-17 satellites occupy low Earth orbits 840 kilometres in altitude and pass completely round the planet once every 104 minutes. As the satellite orbits are fixed in space with respect to the Sun, the rotation of the Earth carries every part of the globe within the view of any of these satellites at least twice per day.

Receivers

In order to gain access to the signals from these satellites, you require a receiver tuned to the 137 MHz band. There are several options for European enthusiasts; the dedicated Proscan II receiver, the RX2 (which is only available in kit form) or the Czech RX137-141 or a scanner. Details can be found at:

<http://www.geo-web.org.uk/hard.html>



Fig.1 - A cased RX2



Fig.2 - The Proscan II

The fact that these satellites approach the observer, pass high overhead then recede towards the opposite horizon superimposes a significant and constantly varying Doppler effect on to their transmitted frequencies (the same as you hear when a police-car

siren approaches then recedes from you). Receivers must be able to accommodate this and a bandwidth of 40 kHz is required. Both Proscan and RX2 receivers were specifically designed to combat this but the majority of scanners were not.

Consequently, many scanners are totally unsuitable for weather satellite imagery, and even those that are (e.g. the Icom PCR 1000) produce inferior results compared with the Proscan and RX2.

The Antenna

Signals from the NOAA weather satellites are transmitted with right-hand circular polarisation, and you therefore require an antenna specifically constructed to receive this type of signal. Use of a makeshift antenna will certainly allow you to hear the audio signal through your receiver, but it will not be possible to decode it into a satisfactory image.

Most APT enthusiasts utilise one of two basic designs of dedicated antenna, the crossed dipole (turnstile) or quadrifilar helix (QFH). Turnstile antennas can be bought for around £30. Commercial QFH antennas are notoriously expensive, but many enthusiasts build their own from PVC conduit tubing, junction boxes and

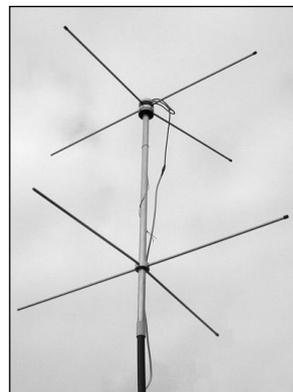


Fig.3 - A turnstile antenna

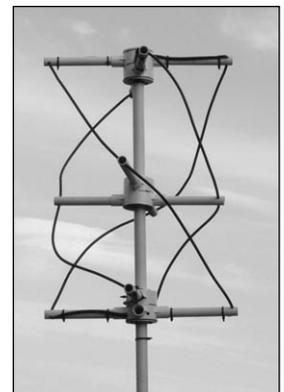


Fig.4 - A QFH antenna

co-axial cable. Chris van Lint's popular QFH project, originally published some years ago is reproduced on page 46, and takes just an afternoon to construct.

The antenna should be mounted with clear horizons all around. The best situation is at the top of your TV mast (above the TV antenna), but loft-mounted antennas can give excellent results as can an antenna mounted on a stake in the garden, just a metre or so off the ground. So long as there are no obstructions between the antenna and the satellite, nor large nearby metallic objects to cause signal reflections, good results can usually be obtained.

The Display Unit

These days, weather satellite images are almost always displayed on the screen of a personal computer. But before you can view the weather pictures, you must first convert the received radio signals into images, and for this an interface is required. There are two options: either a purpose-built decoder in the form of a PC card or external unit, or the PC's existing soundcard. The simpler option (and also the cheaper) is the latter, and this is the route described in this article.

Your receiver will possess an audio output and signals from this must be fed into the PC soundcard, generally via the line-in socket, though the microphone input is another possibility—which one you use depends on the signal level output by the receiver itself. Check which works best for your set-up.

Connecting It All Together

Once your antenna is safely mounted where you intend to deploy it, use good quality screened co-axial download (RG 59 is ideal) to connect it with your

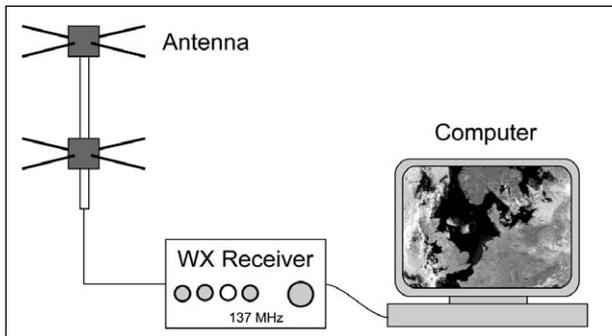


Fig.5 - How the units connect

receiver. The receiver in turn must be connected to your PC soundcard by a length of screened audio lead. Suitable short audio leads with a jack-plug at each end are readily available at rallies and computer fairs.

Preparing the PC Soundcard for Recording

First-timers frequently stumble at the very first hurdle. Although everything appears to have been set up correctly, no audio signal is heard from the PC speakers and frustratingly, no images are produced. This outcome is almost always the result of an incorrectly configured soundcard.

By default, computer sound-cards are configured for playing back audio through the PC speakers. Often the card's recording mode will not have been initialised. Do this by means of the program *Sndvol32.exe* which you can find in your Windows folder. If in doubt as to where to find this, click on your PC's *START* button and select 'Find'. Type *sndvol32* in the 'Named:' field, 'Look in:' should be drive C:, then click the 'Find Now' button. When the filename *Sndvol32.exe* appears in the browser window, double-click on it to open it. *Sndvol32* first appears with the words 'Volume Control' in its title-bar. Click the <Options> menu, followed by <Properties> to reveal the properties screen. Click the

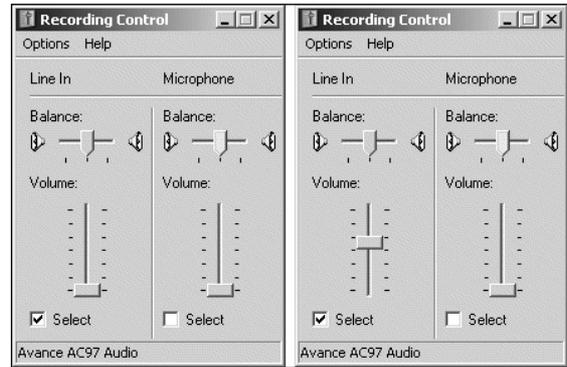


Fig.6 - The soundcard recording control with the line-in input muted (left) and active (right).

'Recording' radio-button, make sure that the 'line-in' option is ticked in the 'Show the following volume controls:' browser, then click OK to reveal the Recording Control panel (figure 6).

The usual input channel for recording from a wxsat receiver is line-in, so this must be activated by firstly checking the 'Select' box in the 'Line balance:' panel, and then elevating the volume control slider to mid-scale (this will require more careful adjustment later). However, depending on the input levels of your soundcard, you may prefer to make use of the microphone input channel instead.

Software

The simplest package, but the most popular among beginners, is *Wxsat* authored by Christian Bock 'way back in 1995. The program's appeal lies in its ability to decode the satellite transmissions into images in real time, while simultaneously recording them on to your hard-drive in the form of WAV files. Although the generation of images requires a degree of experimentation and effort by the user, recording WAV files is relatively straightforward.

Open *Wxsat's* <Recording> menu and select the third item from the foot, labelled 'Test'. This reveals a window flanked by a grey line at both top and bottom. These two lines represent the maximum permitted amplitude for an incoming satellite signal. Exceed these levels and the signal will be 'clipped', masking out much of the bright cloud detail as full white. This level must be adjusted during reception of a live

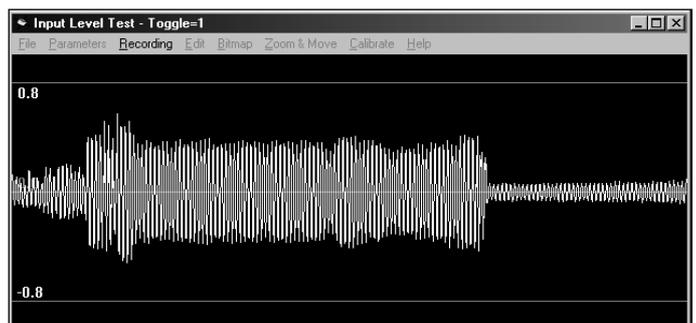


Fig.7 - Wxsat's recording-level test screen

satellite signal, something which may be accomplished by adjusting the *Sndvol32.exe* volume slider position, or by placing a variable potentiometer (volume control) into the audio line feeding the soundcard. The maximum amplitudes in the signal from the receiver must not be allowed to break either grey line.

Figure 7 shows part of a NOAA wave sample with a peak-to-peak value of ± 0.7 , which is more than adequate for the production of good images. Figure 8 was produced from the same NOAA-17 signal as the test screen above. Notice how the image displays a full range of tones from brightest white through full black and that both land and cloud show excellent tonal variation. Figure 9 shows the same transmission, but most of the cloud structure in the visible (left) frame has been lost because of 'clipping'. For the same reason, the infrared image (right) is almost devoid of detail. Although this is an extreme example, for the purpose of illustration, readers do frequently submit images with very washed-out clouds like those in figure 9.

The main reason for this would seem to be an attempt to enhance land detail, which is often quite dark, by increasing the input level. This practice is not recommended, as it destroys most the cloud detail. Instead, the balance between light and dark tones should be adjusted after the image has been created, using the 'gamma' feature of an image editing program such as Paintshop Pro.

The Usefulness of WAV Files

To actually record a WAV file while a screen image builds up you must select the appropriate decoding mode. Click the <Parameters> menu to reveal the default list of decoding options. Start by selecting the topmost item from the list; this will produce twin NOAA images as shown in figure 8, with a visible light image on the left and an infrared image to its right. Other options on the list permit decoding of individual visible or infrared images, as well as allowing the user to combine them as a false-colour image.

To initiate a recording session, select <Start at Subcarrier> from the <Recording> menu, followed by <Save Bitmap and Wave> to prime Wxsat to record a WAV file as it displays the image each time it detects a NOAA weather satellite APT signal.

The great advantage of saving WAV files as well as the actual bitmap images is that the WAV file may be repeatedly decoded through Wxsat (or another program such as *Satsignal* or *Wxtoimg*). This allows parameters to be adjusted until you judge that the final image is the best that can be achieved.

Help With Wxsat

The Wxsat program comes complete with an extensive 'Help' file extending to more than 350 kb in size. This contains dozens of pages of information, many with supporting diagrams and screenshots to help you

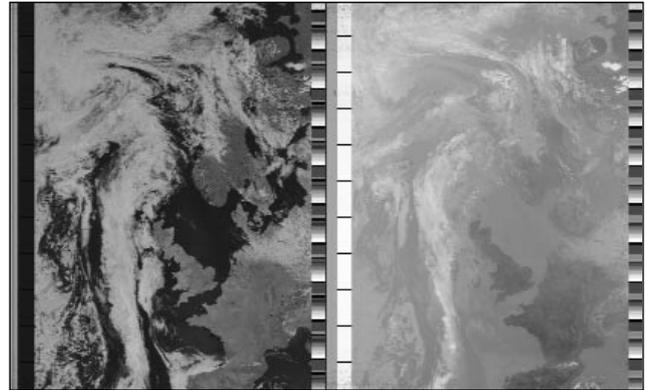


Fig.8 - NOAA 17 - 11:12 UT on July 13, 2003

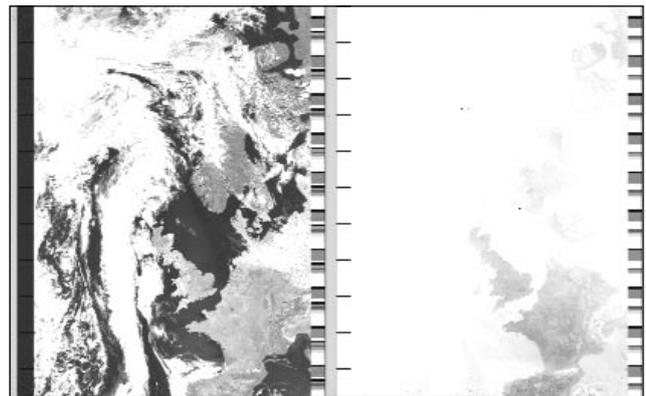


Fig.9 - NOAA 17 - 11:12 UT on July 13, 2003

This is the same image as shown above. This time the input level was far too high and clipping has occurred, destroying tonal detail in the clouds, and washing out the IR frame.

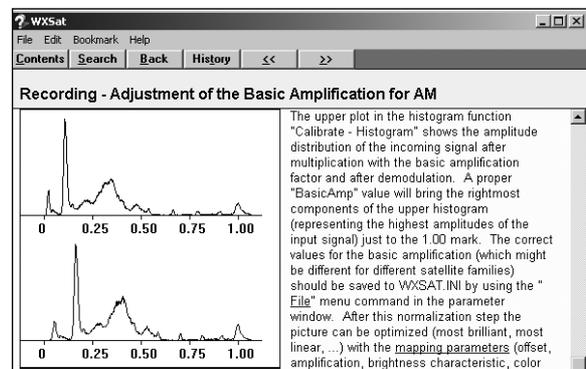
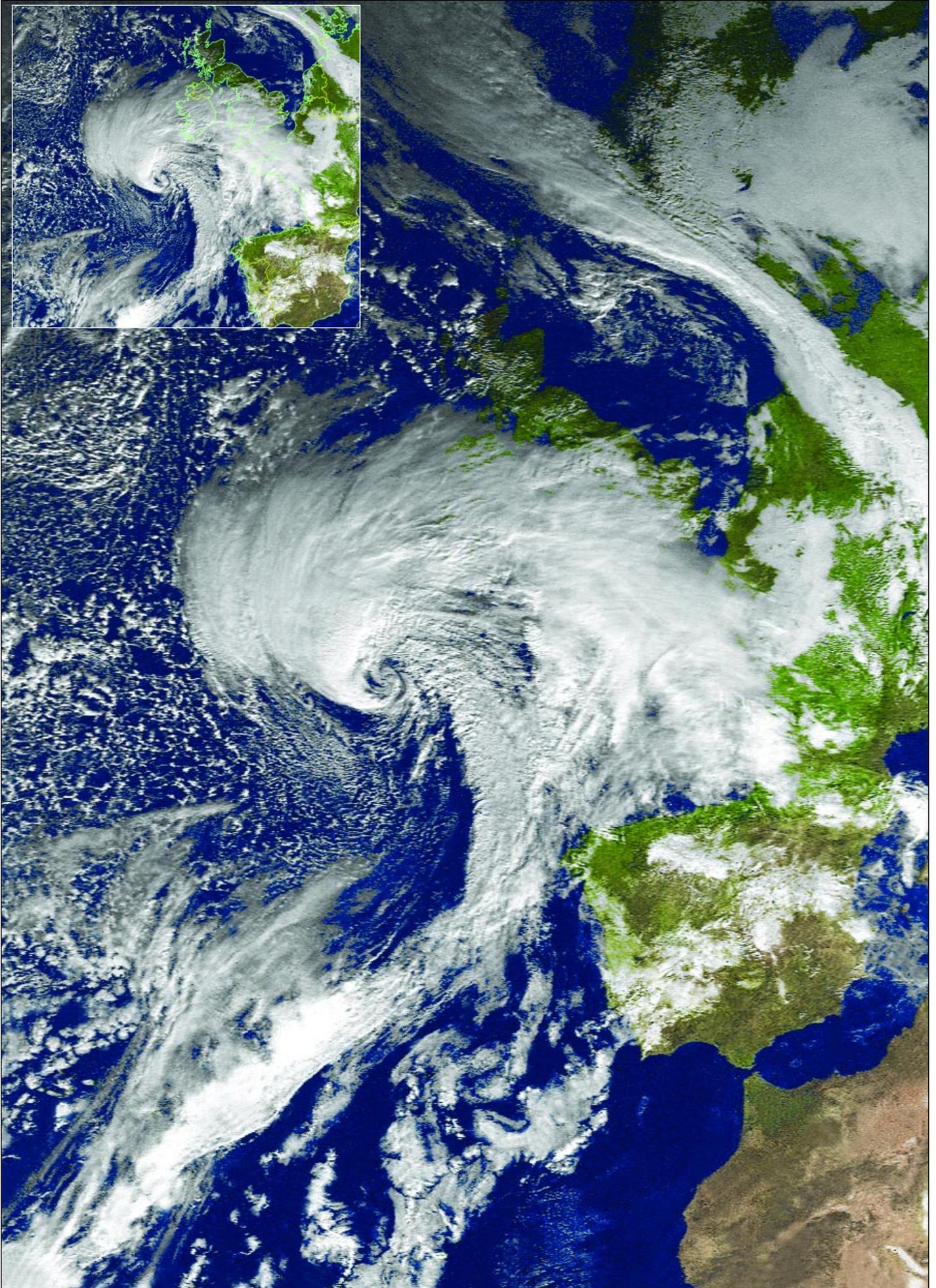


Fig 10 - A WXSAT help screen dealing with histograms

customise the program to meet your requirements. Wxsat may be downloaded from the HF-FAX site at:

http://www.hffax.de/WX_Satellite/WXSat/inst259e.exe

The splendid NOAA-17 APT image on the facing page was acquired by **Hartmut Schaksmeier** of Remscheid, Germany at 11:33 UT on November 13, 2003 and depicts the first serious winter storm to hit Great Britain. Northern Ireland and western Scotland faced the brunt of its power with winds of 120 kph. The image was processed with the software package *WXtoimg*, which will be described in a future issue.



A Portable, Collapsible QFH Antenna for the 137 MHz Band

Chris van Lint

Background

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

These antennas rely on using copper tubing filars together with a hard-line co-ax filar to form the balun. In some locations hard-line co-ax is difficult to obtain and expensive. QFH antennas using this construction method require that the filars be insulated from the support and often PVC piping is used for this purpose. Since the filars have to be shaped into the desired helical form, they have to be self-supporting and some means of anchoring them to the support mast has to be devised. This is not an easy feat, in addition to which the shaping of ¼-inch tubing is not as simple as it seems. The interconnection of the filars has to be done carefully or the antenna will not work. Construction details which I have seen so far are rather confusing and they have put me off building a QFH of the infinite matching balun type.

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

Description

I claim no originality for the antenna I am about to describe. As mentioned before, there are numerous descriptions in circulation at the moment. A fundamental deviation from classical QFH antennas is the fact that in this design the filars are not supported directly by the mast but by PVC arms. This relatively simple but nevertheless brilliant idea came from Eugene Buck W3KH, who also provided the dimensions. My contribution lies in the idea of using removable arms and conventional flexible co-axial cable for the filars and matching line alike, which allows the filars to be folded against the support mast when not in use.

This antenna is a ½-turn, half wavelength device using a self-phasing big/small loop configuration. Impedance matching is achieved by an infinite balun arrangement in which one of the four elements is a length of co-ax to produce a characteristic impedance of approximately 40 Ω. The antenna is constructed from standard 20 mm PVC electrical conduit tubing for the support arms and a length of 32 mm PVC tube for the support mast. To accommodate the support arms I used six PVC 2-way junction boxes. The relevant dimensions can be noted from figure 1. The dimensions for individual arms are always half the total width when measured from the centre of the support mast. QFH antennas of this type use a big and a small loop and this is the reason why, instead of 4-way, two 2-way junction boxes were used, mounted at 90° one above the other. This procedure creates a (B)ig and (S)mall loop.

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

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

(RHCP), the filars must be wound in an anti-clockwise direction when viewing the antenna from the top down its vertical axis.

Construction

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

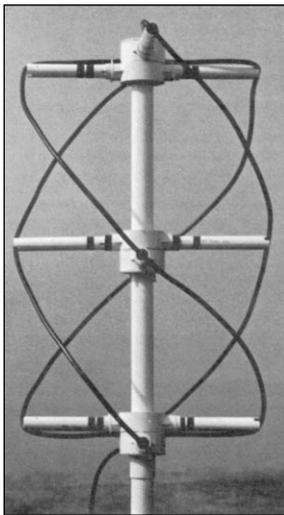


Figure 3
The completed QFH antenna.

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

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

Each junction box assembly will have one pair of short and one pair of long support arms. Drill holes big enough to accommodate the co-axial cable on top of, and as close as possible to, the topmost arms. For the bottom set of arms do the same, but below the arms. Once completed, insert and twist the arms so that the slot slopes from top left down 45° to bottom right. The arms may now be removed and put aside. It may be helpful to put marks on the sockets and arms to indicate in which position the 45° angle is achieved. If the marks on both the sockets and arms are in exactly the same position there should be no need to put identifying marks on individual arms and sockets; i.e. the position marks should be sufficient.

Insert the co-axial cable which forms the smaller loop into the hole below one of the short arms all the way so that the cable exits on the opposite side. Ensure that the length of cable at both sides is the same. Join the centre conductors to the braid. Cut two equal lengths of co-ax which will form the big loop. On one piece only, join the inner conductor to the braid and insert one end in the hole above one of the longer arms. Do the same with the second half-length of co-axial cable, but in the opposite hole. Solder the four cables in the top junction box according to the instructions in figure 2. Insert the opposite ends of the co-axial cables in the holes situated ½-turn anti-clockwise on the bottom assembly.

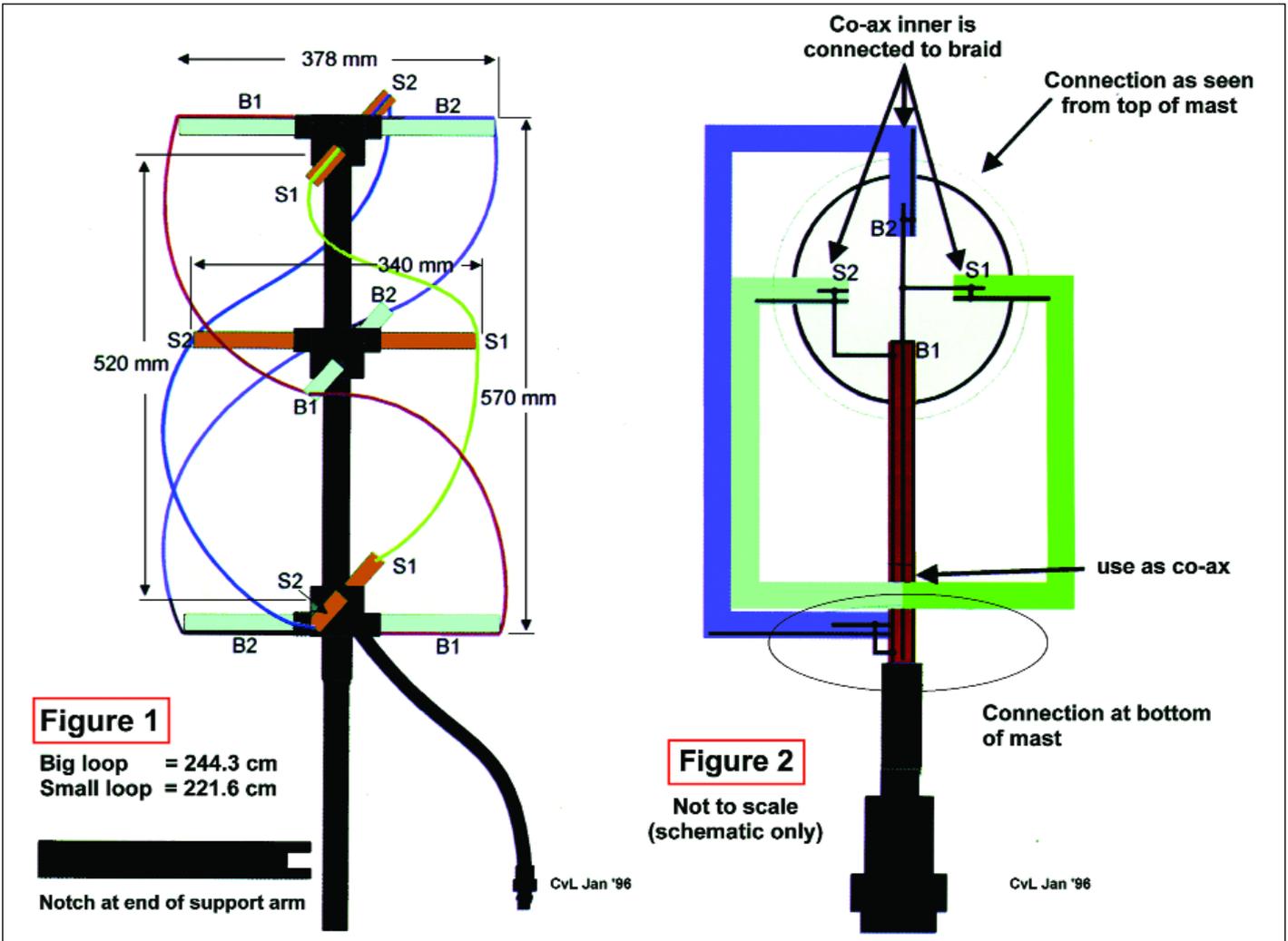
Drill a suitable hole somewhere in the lowest junction box to accommodate one end of the co-axial feed line, which should be fitted with a connector of your choice at the other end. Push this feed-line through and join all cables as shown in Figure 2.

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

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

Performance

I have compared the performance of my prototype against my other QFH antennas, including a commercial version under dynamic conditions, using a co-axial relay to switch from one antenna to the other. I am convinced that the performance of the portable QFH is as good as my other QFH antennas. There are no noticeable nulls and I get usable signals from AOS to LOS (on 137.62 MHz, the only frequency I can receive without interference!).



Figures 1 and 2 - Plan of the QFH antenna, showing dimensions.

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

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

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

*And Finally . . .
Francis Bell*



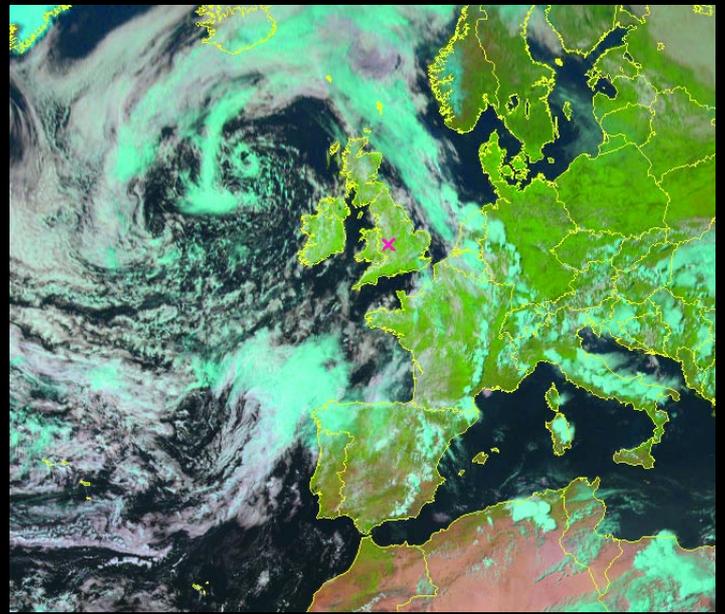
Well, if you lived in Hawaii and were interested in satellite reception, what would you put in your back garden?

I'll bet all Pacific Rim communications come through this station

Photo: Francis Bell



Cedric Roberts produced this colour composite image of the Earth from MSG-1 on June 2, 2003
Image © Eumetsat 2003



This is a zoomed section of the full Earth image at the left, rectified and with country outlines added after processing with David Taylor's MSG Data Manager and GeoSatsignal programs.
Image © Eumetsat 2003



Patrick Prokop produced this spectacular channel-1, -2, -4 colour composite NOAA 12 image of Hurricane Isabel at 5:17 pm EDT on September 17, 2003. There are over 20 more colour images of Isabel from various NOAA satellites on Patrick's website at:
<http://www.wtctv.com/Global/link.asp?L=98798&nav=0qq7Hjv>

