

The **GEO** Quarterly

Group for Earth Observation



www.geo-web.org.uk

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

*Number 9
March 2006*



Inside this issue . . .

Blue Marble—amazing high-resolution planetary images from NASA, and how you can use them as backgrounds for your MSG images.

The PADAT137 RQH antenna—Ruud Jansen takes us through the design and development stages as a prelude to describing how to build this rugged, weatherproof antenna in the next issue

QUIKScat—how NASA's 'Seawinds' scatterometer is revealing the role of ocean winds in dictating our planet's weather

GeoSatSignal 5—With the termination of WEFAX and PDUS just weeks away now, Douglas Deans details the basic features of the new software GEO readers must master if they wish to migrate to Meteosat-8 via EUMETCast.

The Indian Space Program part 5—Peter Wakelin concludes his overview of this oft-neglected contribution to planetary meteorology

Symposium 2006

Join GEO at Leicester for what promises to be yet another enthralling day in the National Space Centre

Great News For WXSAT Enthusiasts!

Recently launched hobby radio listeners' magazine, Radio and Communications Monitoring Monthly provides a regular four page WXSAT column 'Satellites' View' presented by Lawrence Harris. Monitoring Monthly will also include an annual special feature covering WXSATs also written by Lawrence.

"We are pleased to serve all the specialist areas of the hobby", commented Editor Kevin Nice, "I am pleased to say that all of our regular columns provided more information than any current or former alternative."

It is the aim of Monitoring Monthly to become the magazine of choice for all serious radio enthusiasts. Our initial customer feedback indicated that we are well on the way.

Radio and Communications Monitoring Monthly ISSN 1749-7809 is available from most good newsagents and direct from the publishers. Subscriptions are available world-wide. For more information contact Nice One Publishing Ltd, Tel: +44 (0)1202 862690 or visit the website

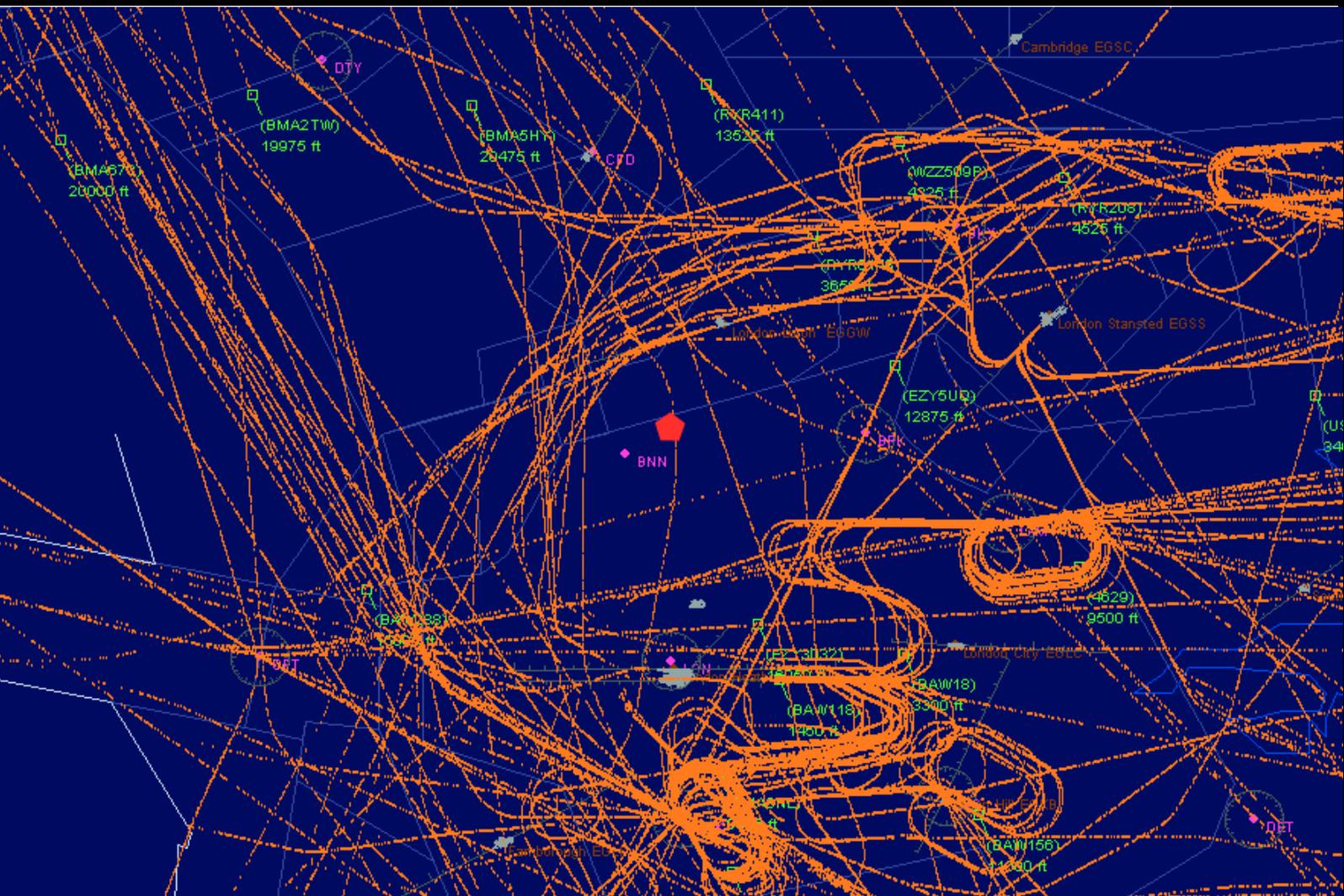
www.monitoringmonthly.co.uk



The current issue of RCMM on sale until March 23, 2006



Part of the March 2004 image from NASA's new **Blue Marble** series, created from MODIS images accumulated by NASA's *Terra* and *Aqua* EOS satellites. See article on page 13.



Effects of the Buncfield fire on local air traffic as visualised using virtual radar. Sam Elsdon explains on page 12.



Pride of place in this issue of GEO Quarterly is the first instalment of a two-part article from Ruud Jansen, chairman of *Werkgroep Kunstmanen*, GEO's sister organisation in the Netherlands. In this issue Ruud takes you through the design stages in developing the new RQH antenna for APT and pays particular attention to impedance matching. In the following issue Ruud will describe how to construct his new PADAT-137 design from rugged aluminium rod and strip.

At the upper right of the facing page is what at first sight looks like a map of Europe and Africa. But in reality, this is a composite of many images from the MODIS instruments aboard NASA Earth Observation satellites. These images are readily available with ground resolutions of 2- and 8-km/pixel and can already be incorporated into two software packages as backgrounds for your weather satellite images—see articles on pages 13 and 43.

The 3rd GEO Symposium is booked at the National Space Centre, Leicester for Saturday, April 29 when meteorology will provide the focus. Among the speakers will be Sally Wannop (EUMETSAT) and Doug Mansfield (a senior forecaster with the Met Office). Many of the GEO Management Team will be staying overnight in the Campanile Hotel, Leicester. If you are planning an overnight stay, take advantage of GEO's preferential booking rates: details on page 19.

Finally, we welcome the appearance of a new magazine to the news-stands, Radio Communication and Monitoring Monthly. As you can read opposite, this new venture includes regular monthly articles on the weather satellite scene from Lawrence Harris, and should be of interest to GEO readers.

Contents

GEO Report	Francis Bell	2
GEO Symposium - 2006		4
Buncefield Explosion Smoke Plume Images		5
Developing the PADAT 137 RQH Antenna	Ruud Jansen	6
Effects of the Buncefield Fire on Local Air Traffic	Sam Elsdon	12
Blue Marble	Les Hamilton	13
Fiddler's Ferry	Robert Moore	16
Earth Imaging News	Peter Wakelin	18
GEO Symposium - Hotel Accommodation		19
Imaging for Margarine	Kimberley Loh Ying-Ying	21
Exclusive GEO Shop APT Receiver Deals	Clive Finnis	22

<i>GEO Shop Page</i>		i
<i>NOAA Satellite Predictions for the UK and western Europe</i>		ii
<i>Helplines and Internet Discussion Groups</i>		iii
<i>Copy Deadline for GEO Quarterly No 10 (June 2006)</i>		iii
<i>GEO Membership Renewal Form</i>		iv

News in Brief		23
Werkgroep Kunstmanen	Fred van den Bosch	24
Birds of a Feather - Members' Photographs		24
QuikSCAT - NASA's Eyes on Ocean Winds	Les Hamilton	26
Arctic Front	Robert Moore	29
Indian Space Program, part 5	Peter Wakelin	32
GeoSatSignal 5 - the basic functions	Douglas Deans	34
Meteosat-8 Radiometer Decontamination	David Taylor	39
Tracking Hurricanes in Digital Atmosphere	Fred van den Bosch	41
Book Review: 'MSG in Orbit - In Use'	Francis Bell	42
More about 3D images	Fred van den Bosch	42
Software Showcase	Douglas Deans	43
'Far East' Competition		44

CONTACT INFORMATION

Public Relations

Francis Bell,
Coturnix House,
Rake Lane,
Milford,
Godalming,
Surrey GU8 5AB
England.
Tel: (01483) 416 897
e-mail: francis@geo-web.org.uk

General Information

John Tellick
e-mail: info@geo-web.org.uk

Editor

Les Hamilton,
8 Deeside Place
Aberdeen AB15 7PW
Scotland, UK.
e-mail: editor@geo-web.org.uk

Membership and Subscriptions

Nigel Evans,
L'Eventail, 7 Gloster Ropewalk, Aycliffe,
Dover CT17 9ES
England, UK.
e-mail: members@geo-web.org.uk

Meteorological Consultant

Peter Wakelin
e-mail: meteo@geo-web.org.uk

Webmaster and Website Matters

Ray Godden
e-mail: webmaster@geo-web.org.uk

Education Coordinator

David Painter
e-mail: education@geo-web.org.uk

GEO Shop Manager

Clive Finnis
e-mail: shop@geo-web.org.uk

International Liaison

Peter Green
'Hollowtree'
Eggesford
Devon EX18 7QX
Tel: (01769) 580 700
e-mail: international@geo-web.org.uk

Publisher

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 4975597.

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

Printing

Advent Colour Ltd., Unit 1, Crown Way,
Walworth Industrial Estate
Andover, Hampshire SP10 5LU.

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.

Copyright GEO © 2006

The contents of this Quarterly remain the intellectual property of the Group for Earth Observation Ltd. and its contributors. Copying of text or images, either from the printed Quarterly or from any electronically stored source, is forbidden without permission from the editor.

The GEO Report



Francis Bell

GEO is now just into its third year of existence. If you have just joined for the first time and this is your first GEO Quarterly, welcome to a talented and resourceful group. I am pleased with the way we have evolved during our short life and although it would be rather indulgent to attempt to list all our achievements, there is one which I would like to identify.

It has been GEO's policy to develop and maintain good relations with the weather satellite operators EUMETSAT, NOAA and other agencies. I think we have achieved this, resulting in mutual benefits. The satellite operators know that GEO represent a substantial user community embracing many countries and GEO members benefit by being kept in touch with satellite developments. Just one example here is not out of place.

NOAA-18 Frequency Change

When NOAA-18 was launched, it started transmitting its APT on 137.9125 MHz. This frequency is adjacent to high-power terrestrial pager transmissions in the UK, and interference from them made NOAA-18 reception almost impossible in many places. Because of GEO's feedback to NOAA, by reporting members experiences, personal contacts in the USA and other forms of communication, NOAA recognised the problem we were experiencing and on an experimental basis have switched the APT downlink to 137.1 MHz. Without the background of our collective representations perhaps this change would not have been made. Our formal thanks to NOAA for responding to our problems in the UK. But why was this necessary?

Frequency Allocations

The frequency allocation conflict came about as a result of licensing high powered pager transmission within a frequency band which, by world agreement, was allocated to weather satellite transmissions. This is my interpretation.

As a matter of UK Treasury policy, enacted via the Radiocommunication Agency (RA) —now Ofcom—as much revenue as possible is to be extracted from licensing the use of the radio spectrum: in this case regardless of the existing international allocation.

Now the unforgivable element. The UK Prime Minister goes to Kyoto and signs up for a 'World Environmental Accord' yet, while he's away, his Treasury, via the RA, is selling off a frequency allocation which encroaches on weather satellite reception; those very frequencies which are used to monitor our planet. Does anybody know a better definition of international hypocrisy! Or can somebody explain it to me differently!

Unfortunately, there may be more to follow as

other frequencies, including amateur radio allocations seem under threat. I have read the detailed submissions made by RSGB and AMSAT-UK in response to the Ofcom consultative document and more recently RSGB's joint response to the European plans to allocate Ultra Wide Band (UWB) transmissions encompassing computer technology into the microwave band. These are warning bells to which we should all be alert. Of course, the RF spectrum is a valuable natural resource and there will be a never-ending change in its use, but along with the administration of this resource goes responsibility.

Meteosat Changes

Members should not forget that Meteosat-7 is scheduled to stop WEFAX and PDUS transmission next June. If you wish to start receiving live transmissions from Meteosat-8, you will have to migrate to EUMETCast reception. Do not wait until June 2006 and say: 'Oh dear, what's happened to my satellite signal?'

There is an exciting year ahead. MSG-2 was launched in December 2005 and is currently being commissioned and a the new polar orbiting MetOp satellite launches in June. Short of being a national meteorological office, the best framework enabling individual user stations to keep abreast of these changes is within the GEO membership, where information, advice and support are available.

GEO at Rallies

About 60% of the GEO membership have amateur radio callsigns and I expect many of these members will have been to radio rallies, which nowadays, quite understandably, are combined with computer interests. Until recently GEO has not been represented at any of these rallies but in November 2005 the decision was taken to have a stand at the West London Radio and Computer Show at Kempton Park.



David Simmons and John Tellick on the GEO stand ready for the day's influx of visitors

The GEO stand was in the main exhibition hall with access to a window through which we ran co-ax to an outdoor dish to run live Meteosat-8 reception. We judged that setting up on the morning of the rally for live reception was a bit speculative, so John Tellick and I went the day

before the rally to establish the dish position and orientation also to set the cable runs. On the day everything went well as we ran live signals into two systems which generated an eye-catching display. John manned the stand all day with David Simmons looking after our software requirements. We also had on display some back issues of GEO Quarterly and examples of the hardware available from the GEO Shop. EUMETSAT very supportively provided us with technical leaflets and posters of Earth images; some of the technical literature remained at the end of the day but all the image prints were taken by visitors. I know some of these will be displayed in radio shacks, studies and on children's bedroom walls. The very best use for such stunning images of our planet.

I was naturally pleased to receive compliments from visitors to our stand, who stated that it was attractive and informative. We did sign up some new members and also prompted some renewals. 'Oh! I forgot to renew my membership - I'll do it now'. I didn't try to count the number of visitors we had but David Simmons, who was on the stand with us all day, quite unprompted, said to me: 'We must have had about 200 visitors to the stand'. We were busy from 9.30 pm to 4.00 pm.



John Tellick in animated discussion with a group of enthusiastic visitors to the GEO stand

Provisional Rally Program

As a result of our experience at Kempton, GEO have arranged a possible programme of events for 2006, as follows:

- West London Radio and Electronics Show, Kempton Park (Sunday, May 7).
- GEO's own symposium at the National Space Centre (Saturday, April 29)
- Hamtronic Friedrichshafen, located on the shores of Lake Constance, Germany (June 23-25)
- GEO hopes to be invited again to the AMSAT colloquium in Guildford (July 26-28)
- Leicester Amateur Radio Rally, Donington (October 2006, dates to be confirmed)
- West London Radio and Electronics Show, Kempton Park (Sunday, November 19)

GEO very much looks forward to meeting its

member at these events. If you can attend, your support will be very much appreciated.

Meetings in The Netherlands

In addition to these events, members may wish to note the meeting dates of our Dutch friends Werkgroep Kunstmanen. Their meetings are held in Utrecht and the dates for 2006 (all Saturdays) are:

- March 11
- May 13
- September 9
- November 11

I'm sure support for our Dutch friends would be appreciated. Utrecht is an attractive historical town and is worth visiting anyway with the added bonus of attending a meeting with our talented Dutch friends.

Symposium 2006

As you can read on page 4, GEO is holding its Symposium at the NSC, Leicester, on April 29. As well as providing the opportunity to listen to key speakers it's a chance to meet friends, and as always, the key aspect of the day's proceedings will be member participation. If you have not been to Leicester before, at least consider joining us in 2006.

To help us plan the Symposium, it would be useful to know in advance of any topics members would like to discuss. If you cannot come yourself but have a topic for discussion, please let me know by e-mail or post and I will ensure it appears on the agenda. Advance notice will enable time for GEO to research any background details or issues involved. However, any member may raise any topic for discussion on the day itself.

Workshops

Any GEO reader who would like to make a presentation or run a workshop or demonstration at Symposium 2006 is welcome to get in touch with me. Please do so as soon as possible so that you may be incorporated into the programme.

Finally, my usual sincere thanks to the support we all derive from friendships and shared experiences within our interest area and of course to those who contribute to our Quarterly publication.



The Quarterly question this time is related to a publication I received recently and relates to a statement in it about which I was not previously aware. Many members may be able to give an answer from their own background knowledge of our Earth's weather systems but for me the information came as a surprise. The answer to the question can be found on page 75 of 'Global Earth Observation System of Systems'. Here is some background to this publication.

At about the same time as GEO was formed another organisation, called Group on Earth Observations, was also constituted. In spite of the similarity of the names, which are descriptive of the mutual interest area, the similarity stops there. We are an amateur educational and non-commercial group whereas 'Group on Earth Observation' is a United Nations sponsored group comprising of

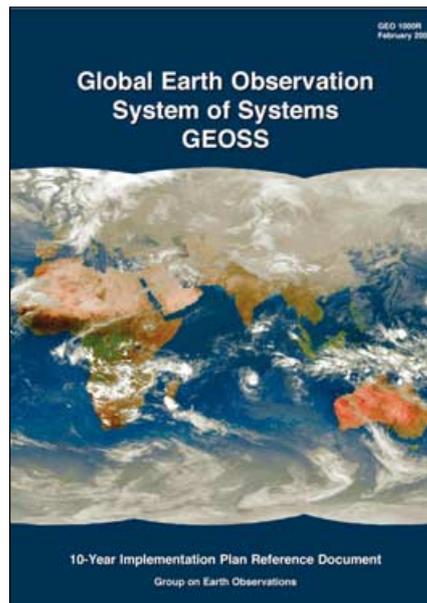
60 nations with their government support looking at a 10 year time frame for an international coordinated plan for monitoring the Earth. Last year the group produced a 210 page book (650 g) outlining a 10-year plan of observation and data use. I obtained a copy of this book which I found informative, outlining the background issues and presenting an ambitious 10-year plan within their established framework.

The book has a wide perspective covering environmental issues and their observation. In some parts this publication is not light reading but I found the first half of the book very interesting, colourful and well illustrated. After that it was rather heavy going because it addresses issues of international policy, implementation and performance indicators. All of which are important of course.

To obtain a copy of this book, which is free of charge, write to:

ESA Publications Division
ESTEC
PO Box 299
2200 AG Noordwijk
The Netherlands

There may be an e-mail address you can use but my advice is to write a letter saying you would like a copy of this book. You will probably be rewarded for your effort. That's what I did and I recommend other GEO members to do the same.



The Question

Page 75 of the above book contains a photograph of a typical Cumulonimbus cloud and the caption to the photograph reads:-

'The hottest air mass in the world from May to August is generated over 'this area' and affects the seasonal and inter-annual variation of the Asian monsoon. The very active water cycle 'over this' area sometimes associated with cumulonimbus clouds, plays an important role in the atmospheric heating process and then the Asian monsoon variability.'

The question is: Where is 'this area'?

Answers to me either by post or e-mail. As usual the winner, or their nominee, will receive a free admission to our annual symposium at Leicester. I will pick a winner six weeks after our GEO Quarterly 9 is dispatched to members.

The December Quarterly Question

You may remember my question in the last Quarterly which asked: 'What is the surface level of the water in the Caspian Sea with respect to Mean Sea Level?'

From a personal perspective, I was surprised when I noted this level from an old map I was studying while on a cruise in the Black Sea. The map gave the water level as -25.5 m and also showed extensive areas of surrounding land below sea level. I know small areas of North Africa and North America are below sea level but the elevation, or lack of it, for the Caspian Sea had escaped me.

I'm unsure whether the water level of the Caspian sea is changing. I know it's adjacent to the much smaller Aral Sea (Lake Aral) which is falling. Water abstraction from the rivers feeding the Aral Sea have resulted in too little water entering the sea to match evaporation from its surface. The shrinkage of the Aral Sea shows up well from satellites images. Would somebody please send to GEO's editor an example image of the Aral Sea.

There were several entries to the competition. I did exactly as promised and picked a winner on December 25. The winning entry was from Fred van den Bosch from The Netherlands who submitted an answer of -27 metres. This equated quite closely to the old 1953 Philips atlas I had used and which gave a level of -25.5 m. However, if both figures are exact it means the Caspian Sea as well as the Aral Sea is evaporating more water than its feeder rivers provide to maintain an equilibrium water level.

Fred or his nominee receives the free entry to GEO's annual symposium in Leicester this year. And a thank you to all the other readers who sent in entries.

MSG - In Orbit, In Use

EUMETSAT have produced a superb 120 page colour A4 brochure which explains the entire MSG system and its instruments as well as possible applications of the delivered data. You can read a review of this publication on page 42. GEO readers so wishing may obtain a copy as follows:

- If you live in the UK, send Francis Bell a written request, clearly stating your return address and enclosing seven first class stamps to cover the cost of postage
- If you live in the EU, send Francis Bell a written request, clearly stating your return address and enclosing a five euro banknote to cover the cost of postage
- If you live elsewhere in the world, I suggest you contact EUMETSAT directly—their postal address is:- EUMETSAT User Services, Am Kavalleriesand 31, D-64295 Darmstadt, Germany. You could also make an email request via ops@eumetsat.int.

I will take some copies of the brochure to the Kempton Radio and Computer rally in March and also to our GEO Symposium in Leicester.

The brochure is also available as a 4.9 MB PDF download from the EUMETSAT website:

<http://www.eumetsat.int/>

Follow the link to 'Brochures' then scroll down the page to reference 'MSG.02'.

GEO Symposium

in the National Space Centre, Leicester, England



April 29 2006

Francis Bell e-mail: francis@geo-web.org.uk

The GEO Symposium will be held on Saturday April 29, 2006 at the National Space Centre (NSC), Leicester. The venue is conveniently located in central England with easy access by road, rail and the nearby East Midlands Airport. There is ample free car parking at the NSC. To find out more about the venue visit the NSC website at:

www.spacecentre.co.uk

Although there are developments in progress at the NSC, we will be using the same rooms and lecture area as we have in the past. These suit us well, providing display areas, space for workshops, a room for lectures and presentations as well as access to the sky for live satellite reception.



The GEO Shop display at Symposium 2005

Reaching the NSC is quite easy. It is located one mile north of Leicester city centre and there are numerous helpful brown 'spaceship' direction signs at road junctions around the city, regardless of the direction from which you approach. More details, with an explanatory map, can be found on the GEO website at:

www.geo-web.org.uk/sym06.html

Accommodation and transport must be left to each individual delegate to organise. Food may be purchased inside the NSC. Alternatively, there are restaurants and pubs within walking distance of the centre. My usual approach is to take a few sandwiches and a drink with me, thus avoiding a protracted lunch during the midday break when other matters are more pressing.

Last year we had a very full but enjoyable programme; the main complaint was that there just was not time to do everything justice. So this year's programme has been reduced a little to allow more time for workshops, interaction with other members and more opportunity to visit the NSC's own exhibition halls. The quality of the draft programme, shown in the panel opposite, is outstanding, and should not be missed.

Registration

The cost of attending is £12.00, which just covers the cost of hiring the facilities within the NSC. Please pay your £12.00 at GEO's registration desk on April 29. Please be prepared to pay by cash or cheque please—we will not have credit card facilities available at the NSC.

Pre-registering

If you are planning to attend, please pre-register by post or e-mail to myself because this makes administration a little easier on the day (details on page 1). All I require is your name so that I can establish an expected delegate list.

Of course, you are welcome to come on the day without pre-registration, but there is a slight risk we might be fully subscribed by then. Health and Safety at the NSC places an upper limit on the number of people using their facilities.

We have never had to refuse anyone yet, but prior registration does guarantee your place and also provides you with complementary access to the NSC's exhibition halls.



Dish pointing workshop at Symposium 2005

Provisional Programme

- 09.00 Doors open. Anybody with display or demonstration materials may set up
- Registration**
- 10.00 Opening remarks by a member of GEO's management team
- 10.10 Douglas Mansfield from the UK Met office. A presentation about the practical application of satellite data for weather forecasting
- 11.00 Sally Wannop, User Support Manager at EUMETSAT User Services. Sally will give an introduction to EUMETSAT's activities, an overview of operational services and a live demonstration of their new website
- 12.30 Lunch break and time for the workshops. David Simmons will be demonstrating the almost unbelievable data rates coming from Hot Bird-6. You may remember David from last year; with a new computer, card and software, he had a Meteosat-8 station running inside 30 minutes. Others will run workshops.
- 14.30 Darrell Robertson, our guest from NOAA, will deliver the afternoon presentation: 'NOAA's Plans for the Coming Years'.
- 15.30 Tutorial / Workshop run by David Taylor, GEO's software consultant. The time of this and other workshops is flexible and to some extent will be judged on demand.
- 16.00 GEO AGM
- 17.00 End of programme
- 18.00 We must have the rooms cleared and be away by 6.00pm.

Symposium 2006 will be a day well spent. I encourage all members to come to Leicester; if you have friends who are not members of GEO they will also be welcome so long as there is room. The most important aspect of the Symposium is that it is a meeting of like minded friends.

Contact

To pre-register, or for further details about Symposium 2006, contact:

Francis Bell,
Coturnix House, Rake Lane,
Milford, Godalming,
Surrey GU8 5AB England.
e-mail: francis@geo-web.org.uk



Spectacular Smoke Plume Imaged from Orbit

The two images on this page illustrate the giant plume of thick black smoke that followed the explosion and fire at the Buncefield Petrol Depot in Hemel Hempstead, England.

The 300 metre resolution image at the top of the page was acquired by the Medium Resolution Imaging Spectrometer (MERIS) aboard **Envisat**, Europe's largest environmental monitoring satellite, at 10:45 UT on December 11, 2005. The smoke cloud was 140 kilometres wide at this point.

The fire followed a massive explosion that occurred at about 6 o'clock in the morning local time on Sunday, December 11, 2005 and which continued to burn for the best part of the following three days. The explosion, which was detected as far away as the Netherlands, rattled windows, blew doors off of homes and caused several thousand residents to be evacuated from the area because of health concerns. A high pressure regime which prevented the smoke from dispersing was responsible for the lateral spread of the smoke plume across much of the London and surrounding areas.

Image: ESA

GEO reader **Chris Waddington** caught the 13:45 UT NOAA-18 APT image reproduced at left using his RX2 and a turnstile antenna then processed the image using *SatSignal*. Even with its maximum ground resolution of only 4 kilometres per pixel, this image shows the smoke cloud very clearly.

Developing the PADAT 137

A new, rugged, aluminium strip RQH Antenna Part I - The Design

by Ruud Jansen PA0ROJ - translation by Chris van Lint

This article is a follow-up to my earlier one relating to the PITA137 [1] weather satellite antenna. The 137 MHz signal transmitted by a weather satellite is directed towards the Earth's surface with circular polarisation and our antenna must therefore be able to receive this signal without noise bands regardless of the position of the satellite above the horizon. The PITA137, which was constructed using lengths of steel from a measuring tape, was intended to be taken along on holidays or to hang up in an attic indoors. This antenna is not particularly storm resistant and during my visit to Brazil in December 2004 [2], when I took along my complete receiving equipment, gusts of wind made my nice antenna look more like a tangle of messed up measuring tapes than a cylindrical RQHA (Resonant Quadrafililar Helical Antenna). Since I was (and still am) very satisfied with this type of antenna—which in comparison to the Turnstile, Lindenblad and other designs, frankly stands out as the best—I wanted to build a rugged outdoor version of the RQHA. I call this the PADAT137.

Copper Tube Design

My very first solid-state antenna was constructed from 12 mm copper tubing. In contrast to antennas based on large and small loops [3], I wanted to construct my antenna with two *equally* sized loops. The required 90° phase shift would be achieved by making one loop effectively 'longer' by connecting an inductor (coil) in series with it while making the other loop effectively 'shorter' by means of a series capacitor (similar to the PITA137 design). Since I wanted maximum sensitivity at the horizon, I opted for a long, thin design with a diameter/length relationship of about 0.25 [4], and duly constructed the antenna from copper tubing.

Unfortunately, it turned out that the impedance of this rather thin antenna was around 15 Ω and it was very sensitive to its design specifications. Minor mechanical alterations (making the antenna flatter or rounder) changed

the impedance; additionally, the phase shift between the loops was no longer 90°. Soldering was also quite challenging due to the critical shape requirements and I had to construct a complete mechanical jig to hold all the pieces of copper tubing in place during the soldering process. Following a couple of weeks of effort I decided to design a less critical antenna.

To construct a good antenna for my own use was no problem and after a considerable amount of effort I did obtain a useful result. However, the purpose of my design was to allow others to copy my antenna successfully, even those without access to the electronic measuring equipment I had at my disposal. My account of how the PADAT137 aluminium strip RQHA was developed now follows.

Aluminium Strip Design No 1

The PADAT137 was to be a storm-resistant aluminium version of the PITA137, using 12 mm aluminium rod for the horizontal sections of each loop and 15 × 3 mm aluminium strip for the vertical parts. My first design consisted of two equal loops, each making a ¼-turn, and using a capacitor and an inductor to obtain the 90° phase shift between them. An advantage of this design is that the dimensions of all the horizontal elements are identical, as are those of the vertical ones. A disadvantage was the requirement for two different components (capacitor and inductor) to achieve the 90° phase shift.

Aluminium Strip Design No 2

My second design utilised two equal *extra-long* loops, in which one loop was effectively 'shortened' by means of a small series capacitor. By making the dimensions of both loops *extra-long* (giving a resonant frequency lower than 137.5 MHz) and then rendering just one of them shorter in this way, I was able to dispense with the inductor.

I measured out the vertical components to be a couple of centimetres longer than those of the older PITA137 then shortened the vertical strips until, at

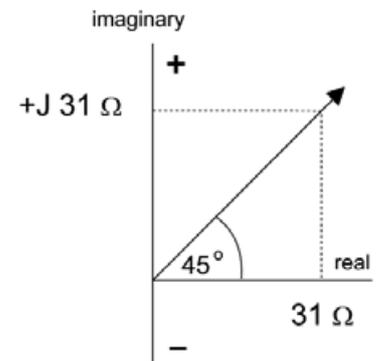


Figure 1 - Phase shift

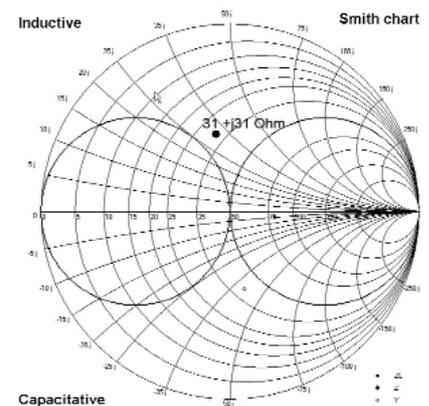


Figure 2 - Smith chart

137.5 MHz, the phase shift between the real resistance and the imaginary resistance was +45° (figure 1). This is only true when the real resistance value of this loop is equal to its positive imaginary value. Refer to the measurements in the Smith chart (figure 2).

The impedance value I determined in this case consisted of a real value of 31 Ω and an imaginary value of +j 31 Ω. The formula is $Z = 31 + j 31 \Omega$. The loop is inductive and hence too long (as we knew already). I then measured the resonant frequency (pure impedance) and resistance of the loop at resonance. Although the Smith chart initially looks very complicated, this method of presentation exceeded expectations [5].

I next mounted a second loop, with the same dimensions as the *extra-long* loop, parallel to the first one. In order to

obtain a 90° phase shift between these two loops we have to make this loop 'shorter' (i.e. capacitive) by inserting a 19 pF capacitor in series with it. Connecting the two loops in parallel ensures that, at a frequency of 137.5 MHz, the antenna represents a pure impedance and the phase shift between the currents in both loops is 90°.

A major disadvantage arises from the critically low 19 pF series capacitance. Any mechanical deviation, however small, or any variation in the connecting cables and/or capacitor value, will result in a considerable difference in the phase shift and impedance between the two loops. In practice this was really an unusable design.

Aluminium Strip Design No 3

Another attempt to obtain the required phase shift was to *really* make the second loop smaller. When I constructed a test antenna in which the heights of both loops were identical, but where the diameter of the second loop was smaller, it caused problems: the real impedance of the smaller loop was less than that of the 'fatter' one, so that the impedances of the two loops were not equal at the resonant frequency. Additionally, the diameter/length relationships for the two loops were no longer equal, resulting in a non-symmetrical radiation pattern. Since the radiation pattern is determined by the diameter/height ratio, among other factors, the radiation patterns of the loops were not the same.

Aluminium Strip Design No 4

In my final test antenna I modified both the height and diameter of the small loop so that the diameter/height relationship of both loops became identical—giving rise to identical radiation patterns. The two loops also shared the same centre point. This solved the problem of the differing radiation patterns. The difference between the real impedance of the 'thin' loop and the 'fat' loop were now less than for Designs 2 and 3 at less than 2 Ω. The disadvantage of this design was that the horizontal components of the two loops were now at different heights and had unequal (plus and minus) impedances at resonant frequency, although the difference was smaller than in Design No 3.

The Action Plan

I decided to build all four designs and carry out measurements on them. One problem is that I can make general

antenna measurements in my attic; however because of the adjacent walls and electrical wiring, etc. such measurements are not reliable. For a frequency of 137 MHz I should ideally have a free space of several dozen meters around the antenna: but unfortunately I don't. I had therefore to wait for a few dry days in order to set up my measuring equipment in the garden (figure 5).

In order to build these four designs and perform measurements on them I constructed an antenna where the height of both loops and their diameters, as well as the relationship between the loops, could be adjusted by means of interchangeable horizontal and vertical components (figure 6). To reduce or extend the vertical strips, I started off with strips which were all *extra-long*, but which, by means of pre-drilled slots or holes, could be mounted 'shorter' (figure 7).

To adjust the loop diameter, I prepared a number of short lengths of aluminium rod which could be used to extend each existing 240 mm horizontal component (figure 8). By using a larger or smaller piece of rod every time, I was able to reduce or enlarge the diameter in 2 mm steps.

Measurements

Years ago, I measured my first RQHA's in the HF-laboratory of the school where I worked (The Haarlem College of Advanced technology). The complete measuring set-up consisted of *General Radio* gear, most importantly their *1602 UHF Admittance Bridge*.

The measuring process is very involved and results have to be corrected to adjust for the electrical cable length, a process which has to be repeated following every change to the antenna. In order to be independent from the school equipment, I have managed to collect similar equipment of my own from flea markets and second-hand shops. Although reasonably happy with my measuring equipment, the measuring methodology was too complicated. After searching for a couple of years, I managed to track down an *HP 8410-C/8411-C Network Analyser* with *8414A Polar Display unit*, which produces a graphic representation of the resonant frequency and the impedance (figure 9), and an *HP 8620* sweep generator.

Once the dry weather arrived, I moved my measuring equipment from the attic to the garden and set the gear up. I

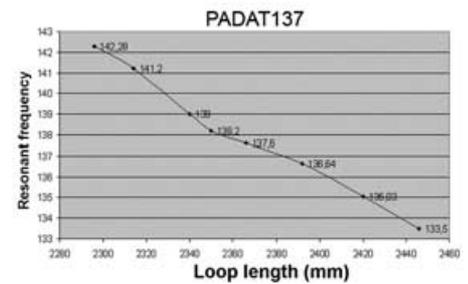


Figure 3 - First results (graph)

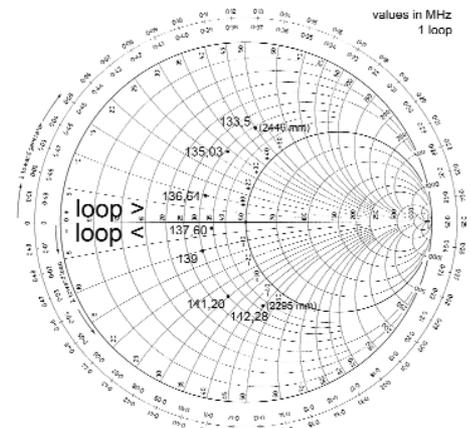


Figure 4 - First results (Smith chart)

made sure that all co-axial cable was as short as possible, as cable attenuation influences the measurement results.

For my first measurement I chose an antenna with a diameter/height ratio (D/h) of 0.33. On the one hand I wanted to have as large a D/h ratio as possible (with real resistance between 30 Ω and 38 Ω), whilst on the other hand there was a need for a small D/h ratio to allow for greater sensitivity at the horizon [6,7,8].

I started with a diameter of 360 mm and measured the resonance frequency and impedance at 137.5 MHz. Next, whilst maintaining the D/h relationship, the loop was shortened step by step and more measurements made. The results appear as a graph in figure 3 and as a Smith chart in figure 4. After a few days of assembling and measuring, I had collected dozens of tables with measurement results, which I could use to construct the four types of antenna, viz.

- 1 An antenna with two equal loops (resonant frequency 137.5 MHz), one loop with a series capacitor and the other with a series inductor (± 45° phase shift).
- 2 An antenna with two large loops, one loop only with a series capacitor (-90° phase shift)
- 3 An antenna with two loops of equal height, but one with a wide diameter and the other a narrower diameter.
- 4 An antenna with both a large and a small loop (± 45° phase shift).

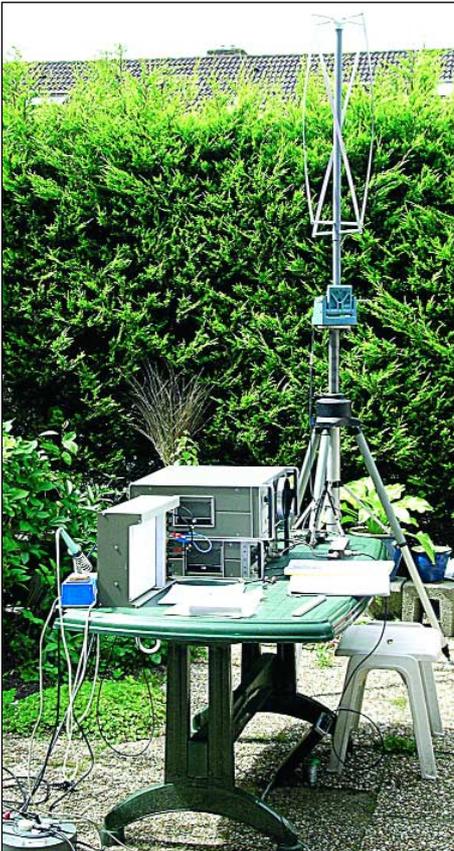


Figure 5 - In the garden



Figure 6 - The adjustable antenna

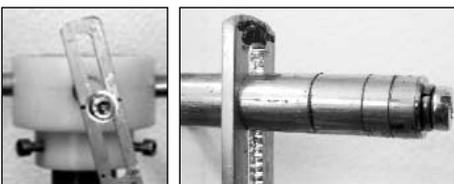


Figure 7 (above, left)
Pre-drilled slots in the ends of the vertical antenna elements allow them to be shortened.

Figure 8 (above, right)
Short lengths of drilled aluminium rod bolted on to the ends of the horizontal elements to make the antenna loops wider.



Figure 9 - The Polar Display



Figure 10 - The Outdoor Testbench

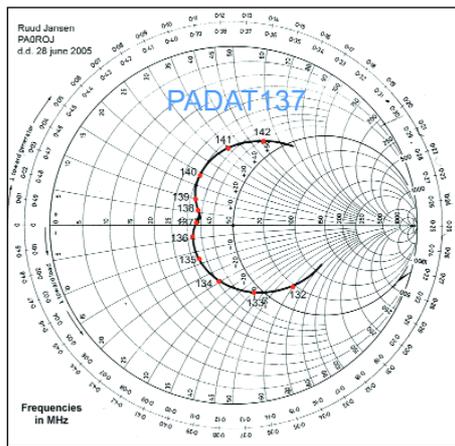


Figure 11 - Impedance on the X-Y Plotter

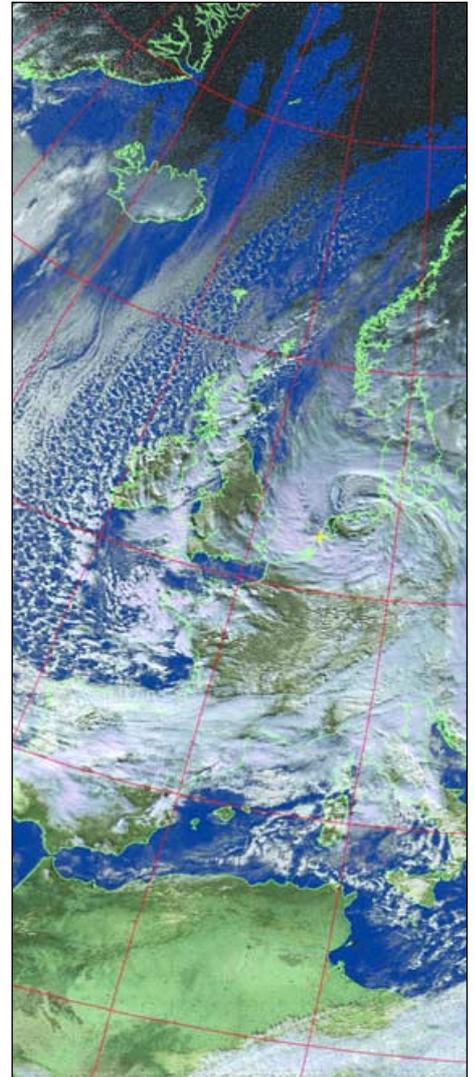


Figure 13 - A section from the 13:06 UT November 11, 2005 NOAA-18 pass. Despite the PADAT137 antenna being located indoors below Ruud's tiled attic roof, and surrounded by all his electronic equipment, it produced an excellent horizon-to-horizon image.

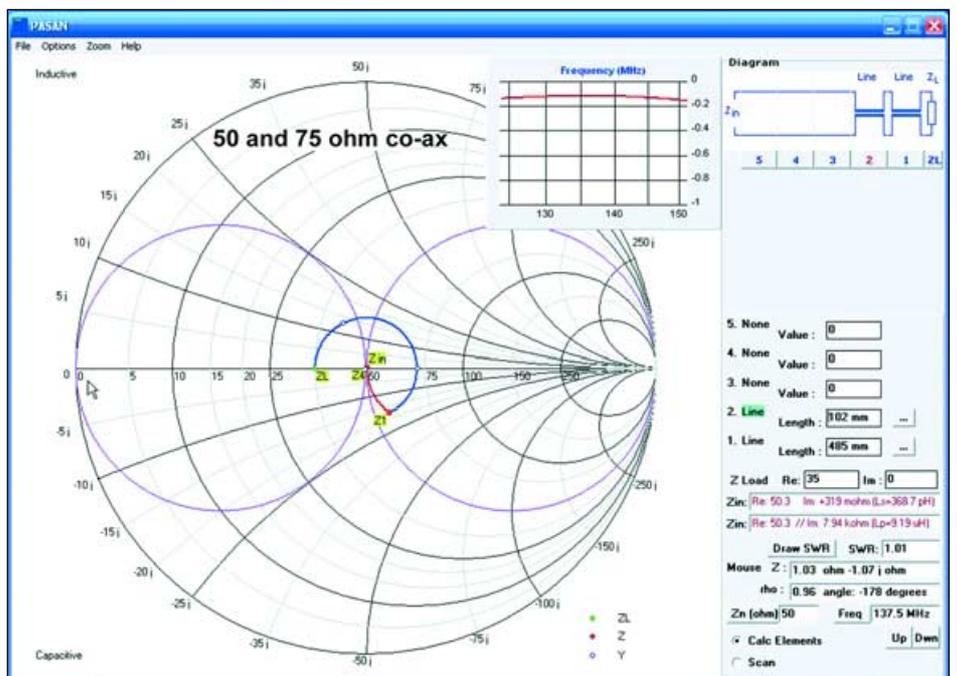


Figure 12 - PASAN screenshot showing antenna/receiver impedance matching

The Final Design

After a further couple of weeks sawing, drilling, turning on the lathe and heaving measuring equipment back and forth between attic and garden, only one design finally remained, No 4.

For this, I left the top horizontal components at equal heights with a distance of 40 mm between the two lower horizontal components; the distance between the mid-points of the two loops was thus 20 mm. This resulted in a very small difference in radiation pattern between the two loops, which in practice could be ignored. The impedance of this ultimate antenna was measured using the set-up shown in figure 10.

By sweeping the signal generator output between 132 and 142 MHz, both the impedance and resonance could be read directly on the display of the Network Analyser; and by connecting an X-Y plotter to its output, the impedance curve was plotted on paper (figure 14). Figure 11 shows the scanned plotting paper with the frequencies written in, indicating clearly that the antenna has a purely resistive value at about 137 MHz (and is consequently resonant) and that the impedance is 35 Ω. The antenna had now reached its final form, and in practice was producing excellent weather images (figure 13). It now remained to match the antenna to the asymmetric co-axial cable and the 50 Ω input impedance of my receiver.

Matching the Antenna

There are two factors that can have a negative influence on the properties of an antenna.

- 1 The absence of a matching system to achieve a good match between a symmetrical RQHA and an asymmetrical co-axial cable by means of a linking 'balun' (balanced-unbalanced).
- 2 The mismatch between the antenna receiver impedances.

1. Matching to the Co-ax

Why is matching a symmetrical antenna to an asymmetrical co-axial cable so important? If the match is absent or incorrect, a 'skin' current will flow along the outside of the co-axial cable ('i3' in figure 16). The outside braid of the cable will thus become part of the antenna, as a result of which the antenna will exhibit an asymmetrical radiation pattern. The resultant effect is shown in figure 15. When a signal is

transmitted without correct matching it is not distributed in a symmetrical fashion. The antenna would then exhibit rather 'cross-eyed' behaviour and in the case of a RQHA it would be directional [9].

Secondly, part of the transmitted signal will be transmitted through the outside of the co-axial cable shield. Since in most cases the antenna co-ax runs from the top to the bottom, part of this signal will be transmitted through the cable in a vertically polarised fashion. When a horizontally polarised signal is received, the receiver input will not only contain the dipole signal, but additionally, the signal received from the vertically acting component in the co-axial cable.

In practice this means that a good (but incorrectly connected) antenna will be subject to considerable interference (usually from vertically polarised signals such as pagers) which will interfere with the desired signal and result in unwanted noise bands. In the case of our PADAT137 antenna this would make it directional and thus lacking all-round circular sensitivity.

The length of the co-axial cable also influences both of these sensitivities. As a result, a well constructed RQHA could turn out to be a disappointment (insensitive and/or directional and noise bands).

Options

There are a number of options to provide a proper match.

The trifilar wound 1:1 transformer

This device is used in short-wave applications and a number of types I built for 137 MHz produced good results. The capacitance between the three windings has a considerable influence on the correct functioning of this balun; the best results were obtained with a small ferrite toroid with three 0.1 mm diameter windings (figure 17).

Note: Whilst perusing some *Amidon* documentation, I came across a sentence in the text, which recommended that the three wires should be twisted in order to avoid mutual capacitive influences. This is something I will need to follow up!

The Bazooka

The bazooka (figure 18) consists of a copper or tin cylinder, ¼-wavelength long, where the bottom side is connected to the outer shield of the co-

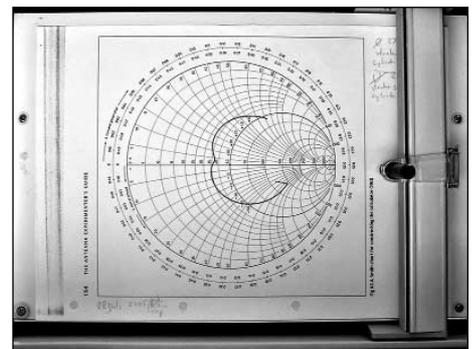


Figure 14 - Impedance on the X-Y Plotter

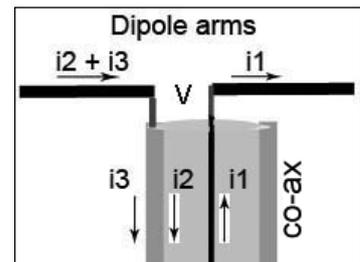


Figure 15 - The Skin Current (i3)

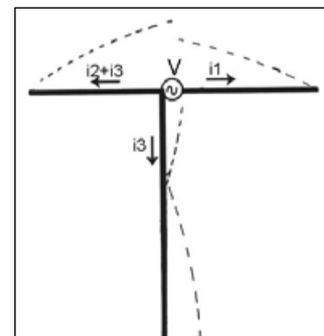


Figure 16 - An asymmetrical radiation pattern

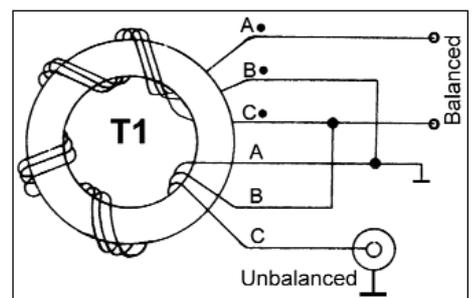


Figure 17 - Trifilar balun

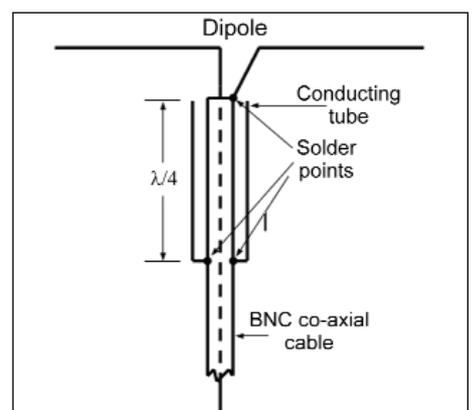


Figure 18 - The bazooka balun

axial cable. When such a cylinder is tightly mounted around the plastic insulation of the co-ax, a so-called velocity factor has to be applied. Depending on the plastic shield (polythene or Teflon) this $\frac{1}{4}$ -wavelength needs to be multiplied by 0.66 or 0.7. If a larger diameter of cylinder is used, so that the space between the cylinder and the co-ax consists of air, there is no need to apply a correction factor. However you must remove the insulation from that part of the co-axial cable which is inside the cylinder.

The 2-Element Bazooka

The 2-element bazooka is another possibility (figure 19). Instead of using a cylinder around the co-axial cable, a second length of co-axial cable (with the same outside diameter as that used for the antenna) is mounted parallel to the co-ax. Since the efficiency of this balun (similar to previous designs) depends on mechanical construction, I have not pursued construction of this type.

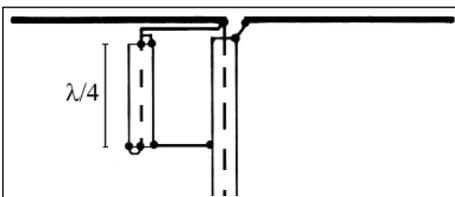


Figure 19 - The 2-element bazooka balun

The Inductively Wound Cable Choke

This type, a balun (RF choke), has quite often been used in earlier published construction notes for an RQHA but is not very effective at 137 MHz. It was often used in short-wave applications but it is less useful at higher frequencies, since the mutual capacitance between the windings has a negative effect on performance. Such windings must not be placed adjacent to one other. After some experimentation I also discarded this approach (figure 20).



Figure 20 A wound cable choke

The Ferrite Toroid Balun

This design does not really constitute a real balun. In reality it is a 'ferrite loaded co-axial RF-choke', but it does effectively result in a 1:1 current balun. The use of ferrite toroids or tubular cores is not cheap but does offer many advantages with respect to other baluns. This balun is simple to construct, is not frequency dependent and its usable frequency ranges several

dozen MHz. According to details provided by *Amidon* [10] the appropriate material is designated as 'Type 43'. This provides the greatest degree of attenuation between 100 and 300 MHz. The total length of ferrite tubes or rings threaded on to the cable will determine the impedance and hence the balun choke function.

Measurements indicate that extending the total ferrite length in excess of $\frac{1}{4}$ -wavelength does not provide any benefit. When RG58 cable is used, many different types of cores are suitable. Since an impedance of 800 to 1000 Ω is sufficient to suppress any skin effect currents, the number of cores to be used depends on the length of the cores themselves. When using *Amidon* cores, 25 of type FB-43-2401 and 12 of type FB-43-6301 are required. The total length of these cores is around 12 cm. You can also use the cheaper *Richcom* cores. The inner diameter of these cores is around 5 mm. If it proves to be impossible to thread them over the co-ax cable, the insulation over the outer shield of the co-axial cable will have to be removed.

I finally decided on using the ferrite ring balun. I have used both ferrite toroids and tubes in my experiments; the use of tubes is cheaper than toroids since fewer units are required. The baluns were constructed from 25 *Amidon* toroids (or 15 *Richcom* tubular cores). At 137.5 MHz, these cores have a per unit impedance of around 35 Ω (*Amidon*) or 65 Ω (*Richcom*). When these are connected in series the impedances of individual cores must be added together. Such cores are often offered cheaply at amateur radio field days. Just make sure that the material is *Type 43*.

2 - Matching with the Receiver

The measurement results showed the impedance to be somewhere between 33 Ω and 35 Ω at 137.5 MHz. Most receivers have an input impedance of 50 Ω so, to obtain the maximum transfer of the energy received at the antenna to the receiver, the antenna impedance needs to be transformed to 50 Ω . If the input impedance of the receiver is around 70 Ω (as it is in our HRX137 and many home-brew receivers), an effective match can be obtained by simply adjusting the co-axial feed cable to a multiple of $\frac{1}{4}$ -wavelength (electrical). No actual impedance adaptation should be necessary as the impedance at the end of the cable should be around 71 Ω .

A further possibility is to use an antenna amplifier, though not generally needed except when a very long length of co-ax is in use. By adjusting the impedance of the RF input to 70 Ω , a good match can be obtained.

Further possibilities involve the use of stubs, lengths of co-ax sticking out from the main downlead. The length and correct placement of these stubs can be calculated [11]; their efficacy depends on their precise dimensions and positioning, which is very difficult to achieve without appropriate measuring equipment.

Another solution would be the use of an impedance transformer. Such a device consists of a $\frac{1}{4}$ electrical wavelength co-axial circuit. The impedance of this circuit may be calculated from the formula

$$Z_t = Z_a \times Z_l$$

where Z_t represents the impedance of the transformer, Z_a that of the antenna and Z_l the combined impedance of the co-axial cable and receiver input (figure 21).

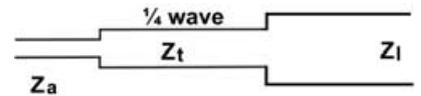


Figure 21 - Impedance transformer

Example

- Z** antenna is 36 Ω
- Z** line is 50 Ω
- Z** transformer is $\sqrt{(36 \times 50)} = 42 \Omega$

The dimensions of the impedance transformer can be calculated with the formula

$$Z_t = 138 \log b/a$$

where 'b' is the inner diameter of the outside conductor and 'a' is the outer diameter of the inner conductor (figure 22).

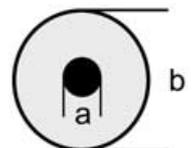


Figure 22

Using Pasan Software

The first impedance matching system I used consisted of pieces of 50 Ω RG58 U co-axial cable. I used the 'Pasan' software to explore a number of possible matching approaches using combinations of 50, 75, and 93 Ω . *Pasan*, developed by Marien van Westen, is a great aid when calculating and constructing such a matching device.

A basic guide to using Pasan for impedance matching can be found in the sidebar on page 11.

I recommend first aiming to use a 0.101 wavelength piece of 50 Ω co-ax for 'Component 1' and a 0.038 wavelength piece of 25 Ω cable for 'Component 2'. If we assume a co-ax velocity factor (Vf) equal to 0.67 we will need a 147 mm length of 50 Ω cable and a 54.6 mm length of parallel-soldered 50 Ω co-ax.

Note

Although it is very difficult to obtain co-axial cable of 25 Ω impedance, you can join two 50 Ω pieces in parallel to obtain 25 Ω .

If desired, you can use a longer piece of 50 Ω cable at the top of the antenna so that more room is available to facilitate installation of a bazooka or ferrite ring core balun. A possible alternative solution to the matching problem would then be to use a 505 mm length of 50 Ω cable (0.349 λ) together with 62.4 mm of 93 Ω network co-axial cable.

It is also possible to make an impedance-matching circuit with a combination of just 50 Ω co-ax and a capacitor or coil (inductor). In my latest experiments I decided on a combination of 487 mm of 50 Ω and 101 mm of 75 Ω cables.

Note

In all the above examples, I am assuming a velocity factor (Vf) of 0.67 (for RG58 and RG59). If a 75 Ω satellite cable is to be used (which gives less attenuation), be aware that Vf would be increased to around 0.70.

If you have any questions related to the *Pasan* program (operation, adjustment etc.), please contact me at

ruud@farbridges.net

For those of you who are keen to learn a bit more about baluns, Smith charts and RQHA's, Walter Maxwell W2DU has written a book [12] on this subject. He is also the designer of the Quadrafilair antennas on board the TIROS, ESSA and NOAA weather satellites.

Part 2 of this article, in the June GEO Quarterly, will describe the construction of the PADAT-137

References

- 1 Ruud Jansen - De Pita137, De Kunstmaan, April 2000
www.jendela.nl en www.kunstmanen.nl
- 2 Ruud Jansen - De Kunstmaan, February 2005, p 16; GEOQ 6, p 24.
- 3 Rob Hollander - RQHA, Technote 1999-1 (www.kunstmanen.nl)
- 4 Rob Hollander - Article on radiation patterns, GEO Q3, page 26.
- 5 <http://www.microwaves101.com/encyclopedia/smithchart.cfm#smith>
The ARRL Antenna Book, chapter 28. ISBN: 0-87259-904-3
The Antenna Experimenter's Guide, G3LDO. ISBN 1-872309-36-4
- 6 H.S.C. Wang - IEEE transactions on antennas and propagation, vol. 39, No 8, August 1991
- 7 C.C.Kilgus - The Microwave Journal, December 1970
- 8 Rob Hollander - Technical Note 2004-1
ftp://ftp.kunstmanen.nl/pub/technotes/RQHA/RQHA_2004-1.pdf
- 9 http://www.poynting.co.za/tech_training/tut_balun.shtml
- 10 Amidon (<http://www.amidon.de/ferritrinkerne.htm>) and ELECTRON, September 1991 page 468-469 (VERON).
- 11 <http://www.circuitsage.com/matching.html> and <http://www.ee.surrey.ac.uk/Personal/D.Jefferies/jefferies-stub.html>.
- 12 'Reflections II' By M. Walter Maxwell, ISBN 0-9705206-0-3

A Simple Guide to Impedance Matching with PASAN

You can download *Pasan* from Marien van Westen's website:

<http://members.home.nl/mvanwesten/>

Click the link to *Electronics* in the menu panel, then *Pasan*. Be sure to download the new version of the program, *PasanSE*.

Define your circuit in the *Diagram* panel at the top right of the *Pasan* screen; it will consist of two components—the two lengths of co-ax you need to match. Click the **right** mouse button once on the empty square above '1' then once in the box above '2' to define components 1 and 2 as lengths of co-axial cable (figure 23 on page 12).

Select **<Options → Preferences>** from the menu-bar and fill in the fields from Table 1, as illustrated in figure 24.

Check the *Save current settings* box then click 'OK' to store these values as your default *Pasan* settings.

You are now ready to start the calculations to match the two impedances. In the data panel at lower right of the main *Pasan* screen (figure 25), under 'Z load', enter '0.35' for 'Re:' (followed by the *Enter* key) and '0' for 'Im:' (this is the antenna impedance). You will now see that a green dot has appeared on the horizontal mid-line of the Smith chart, with the value '35' (figure 12).

Click on the button with the ellipsis (...) beside the entry labelled '1 Line' in the data panel (figure 25). This opens the *Transmissionline data* window (figure 26), where you must enter the *Characteristic impedance* as '50' and the *Velocity factor* as '0.67' (this value applies to RG58 cable). This window shows a length for the co-ax and the equivalent electrical length in λ . (these will be adjusted correctly later: you don't need to change any of the other fields at this stage). If you click **<Options → Bode plot>** you can view the

circuit attenuation in a pop-up window.

Click on the ellipsis (...) button labelled '2 Line' and this time enter the *Characteristic impedance* as '25' and the *Velocity factor* as '0.67'.

The Smith chart display now shows the curves for the 50 Ω line and 25 Ω line (figure 12). The selected component is shown in red, any other ones blue.

Making the Match

Now comes the final trick! Click the mouse on the number '1' below the 1st graphic (figure 23), then move the mouse over the Smith chart (figure 12) and click at various positions inside the upper hemisphere of the left-hand purple circle until *Length* in the '1 Line' field is approximately 150 mm.

Next, click on the number '2' below the 2nd graphic (figure 23) and click the mouse on the very centre of the Smith chart (on the value '50'). Repeat these two steps, making small adjustments, until the values on both the 'Zin' fields (figure 25) show exactly '50'. Once you achieve this the value for SWR should be exactly '1.00'. Any final adjustment is most easily made by editing the actual value in the '1 Line' field in figure 25.

You can now read off the two co-ax cable lengths required for matching (and their associated electrical wavelengths) by clicking the ellipsis buttons and referring to the *Transmissionline data* windows (figure 26). You can also view the total attenuation in the *Bode-plot* window.

Because the antenna impedance has been converted to 50 Ω you can now use a length of 50 Ω co-ax as the download to connect your antenna to the receiver. If you use 10 metres of download, you can add a third 'line' element to *Pasan*, enter its length as 10 m, and determine the overall attenuation due to all three lengths of co-ax from the Bode-plot window.

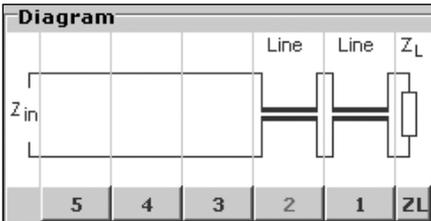


Figure 23 - Defining the circuit in PASAN



Figure 24 - PASAN default parameters

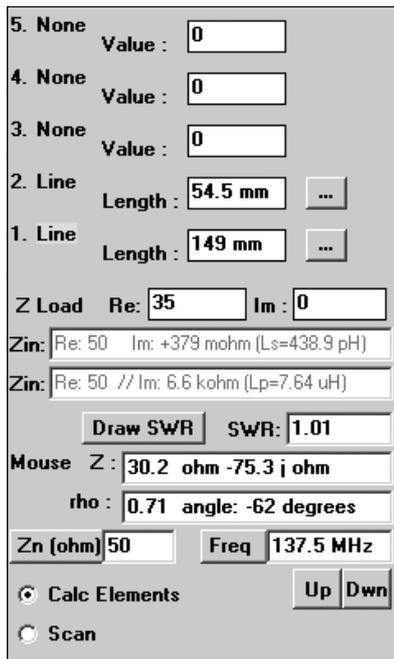


Figure 25 - Calculation panel in PASAN

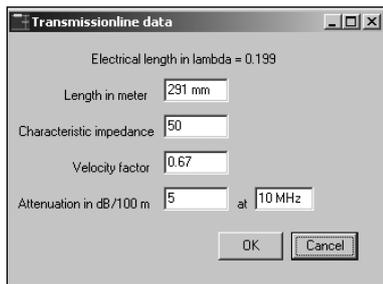


Figure 26 - Transmissionline data panel

Frequency	137.5 MHz
Up/Down steps	10 MHz
Zn	50
Q factor	0
Start Frequency	123.8 MHz
Stop Frequency	151.3 MHz
Number of steps	100
Major	1 MHz
Minor	200 kHz
Show Smith chart normalised	unchecked
Full screen	unchecked

Table 1 - Pasan default parameters

Effects of the Buncefield Fire on local Air Traffic

Sam Elsdon

Sam Elsdon, who works less than a mile away from the Buncefield oil storage depot that caught fire so spectacularly last December, not surprisingly took a particular interest in the event. The lower colour image on the inside front cover of this issue was provided by Sam and uses virtual radar to illustrate the effect that the conflagration had on air traffic in the neighbourhood.

Image Background

The image was created on a *Kinetic Avionics SBS-1* virtual radar system. The antenna is mounted approximately 30 feet above the ground giving a range of around 190 nautical miles in all directions apart from the west, where the Welsh hills and mountains slice off everything past central Wales. Naturally, aircraft altitude greatly influences the range but from my location, aircraft can be tracked into Luton and Stanstead until they are almost on the ground, and into Heathrow and City airports down to about 1300 feet.

*VOR: VHF Omni-directional Radio Range. A ground based, air navigation beacon that transmits both its identity, and signals that permit airborne receivers to determine the bearing from the aircraft, to the beacon. A very good description of the VOR system can be found at:

<http://en.wikipedia.org/wiki/VOR>

Sam takes up the story ...

Here is a different kind of remote imaging. The image shows a plot of what was happening to air traffic in the Hemel Hempstead area at the time of the Buncefield fuel depot fire on December 11, 2005. The orange trails show the paths of some passing aircraft—not all aircraft are fitted with equipment that transmits their location so these cannot be plotted. The Buncefield depot is indicated by the red pentagon near to the Bovingdon VOR* (shown by the legend 'BNN') at the centre of the image where the result of an air traffic exclusion zone can be clearly seen as a large gap in the trails. The few trails that do cross the gap would have done so at high altitude.

The View from Satellite ... in Infrared

David Taylor

Here's a slightly more unusual image of the Buncefield fire. It is a night-time pass from NOAA-17, using the user-mode RGB processing in my HRPT Reader software to allow channel-3 (the mid-IR data) to show the hot-spot from the fire itself. The two plumes, the main one blowing approximately south, and the secondary one blowing approximately SSE are clearly visible. The remaining details are due to slight differences in the land surface temperature. The fire-fighting had not started when this data was collected.



This segment from the 21:25 UT NOAA-17 pass over southern England on December 11, 2005 clearly shows the hot-spot from the Buncefield fire as a white spot north of London.

Heathrow can be easily located due south from Buncefield, just over half-way towards the bottom of the image. It is represented in grey with many orange trails (arriving aircraft) leading to it from the east. The grey shape becomes a map of the airfield if zoomed far enough. On December 11, traffic was arriving and departing Heathrow towards the west. Normally, when arrival traffic at Heathrow is heavy, aircraft from the northwest are placed into a holding pattern at Bovingdon, one of four holding points for Heathrow. The other three, at Ockham, Biggin and Lambourne can be clearly seen to the south, SE and NE of Heathrow respectively. To approach Heathrow from the east, Bovingdon traffic would normally be routed to the south east, through the exclusion zone, and merged with traffic from Lambourne so the gap would usually be covered with aircraft trails. On this occasion, Bovingdon traffic was routed to the Ockham hold, making it very busy indeed, whilst some traffic was routed around the north and east sides of the zone. With all of the changed routings, air traffic controllers had their work cut out, particularly those controlling the southern approach to Heathrow from Ockham and Biggin.

Blue Marble

Add impact to your MSG images with MapToGeo, a new program from David Taylor

Les Hamilton

What is Blue Marble?

The description 'Blue Marble' was originally coined to describe the stunning full-disc colour photographs of Earth taken by astronauts during the Apollo-17 mission to the moon (figure 1). In 2002 the concept was extended by combining four months of Terra MODIS observations, collected during the previous year, into a seamless true-colour mosaic covering the entire planet at resolution of one kilometre per pixel (figure 2).

This year NASA has gone a stage further, with the creation of a set of high-definition cloud-free Earth images in *plate carrée* projection [1] at a maximum resolution of 500-metre/pixel. These images are also available at lower resolutions of 2-km/pixel and 8-km/pixel. These new *Blue Marble* images may be downloaded from the following URL, which is **Case Sensitive**, by following the link to 'Monthly global images'.

<http://earthobservatory.nasa.gov/Newsroom/BlueMarble/>

Unless you have access to a powerful mainframe computer, do not even think about ordering a 500 metre image. Your PC will be totally unable to display it. Indeed, even a 2-kilometre image, which measures 21600 x 10800 pixels and occupies 20 megabytes as a JPEG image, is so large that most PC imaging software will struggle to display it adequately. Even these images are recommended for use on only the very highest specification modern PCs.

The lowest resolution Blue Marble images (8 km) are the ones to aim for. These measure a not inconsiderable 5400 x 2700 pixels and are provided for download as JPEG images of around 1.5 to 2 MB each; even these are highly impressive.

Images are available for each month of 2004, plus others which offer topographic and bathymetric shading. Part of the March 2004 Blue Marble image appears on the inside front cover of this issue.

MapToGeo

Apart from being intrinsically beautiful realisations of our planet, the *Blue Marble* images may now be put to practical use by means of *MapToGeo*, a new offering from David Taylor (*Satsignal Software*) devised following discussions with Ferdinand Valk.

MapToGeo allows the user to manipulate a *plate carrée* Blue Marble image and convert it into an Earth view seen from the location of any of the current geostationary weather satellites. These modified images can be used as attractive backgrounds for *GeoSatSignal*, and combined with cloud patterns from current MSG images, as an aid to weather presentation.

The great thing about this technique is that realistic images can now be generated by both day and night; there is no longer any need to wait for a daylight MSG image. This greatly extends the ability of *GeoSatSignal* to generate easily understandable data around the clock.

Program Installation

MapToGeo is available as a 30-day time-limited evaluation from

<http://www.satsignal.net>

by following the link to '*MapToGeo*' and downloading it as a ZIP archive. Create a new folder called '*MapToGeo*' and extract the ZIP file into this. It should be noted from the outset that *MapToGeo* is intended for use on a PC with the **minimum** specification of a 1 GHz processor with 1 GB of RAM running Windows XP or Windows 2000. *MapToGeo* may run on earlier Windows platforms but this is neither supported nor guaranteed.

Using MapToGeo

Run *MapToGeo* and from the 'File' menu select **<Open plate carrée image ...>**. Click **<Full world image ...>**, navigate to the folder containing your *BlueMarble* image and double-click its filename to load it into the program. All that remains is to select the **<Remap>** option to create the view that you require (figure 3). The front cover of this issue displays the March 2004 *Blue*

Marble full Earth image remapped to the view you would see from the location of China's Feng Yun-2C satellite.

GeoSatSignal Backgrounds

When creating a Job in *GeoSatSignal*, one of the available options allows the use of a background image which, when used in combination with an appropriate *Land-Sea Mask* colour lookup table (CLUT), can be made to show through those parts of the image that are not obscured by cloud.

To implement this feature, save copies of appropriate background files (created in *MapToGeo*) in your *GeoSatSignal* folder, then, in **<Options → Job setup ...>**, select '*Background*' from the '*False Colour*' dropdown selection menu. Next, select a CLUT designed for transparency from the '*Vis ch.*' selection menu. The CLUT used in figure 4 was called '*LutBlueMarbleTest*'.

GeoSatSignal will now intelligently select the correct background for the image being processed without further user intervention (provided you have located it in the *GeoSatSignal* folder). Figure 5 illustrates a full disc channel-9 Meteosat-8 (10.8 µm infrared) image on the main *GeoSatSignal* '*False colour*' tab; likewise, figure 6 displays part of a Feng Yun 2C image—note that *GeoSatSignal* has automatically loaded the new background to reflect the appropriate satellite.

The Transparent CLUT Filter

The filter CLUT is a small 24-bit true-colour BMP bitmap image just 2 pixels high and 361 pixels wide. *GeoSatSignal* interprets such files as representing temperatures ranging from -120°C at the leftmost pixel and incrementing in 0.5°C steps to +60°C at the farthest right pixel. In the case in point the left 240 pixels in each row represent half-degree increments between -120° and 0° and are coded between 100% white and a moderate grey selected to produce the most realistic visual effect on the final product. The rightmost 121 pixels in each row represent positive temperatures (0° to +60°) and are made solid red. This results in these pixels



Figure 1 - Earth from Apollo 17 on December 7, 1972.

Astronaut photograph AS17-148-22727, courtesy NASA Johnson Space Center



Figure 2 - Blue Marble 2002 image of the Western Hemisphere

Image: Reto Stöckli and Robert Simmon, NASA Goddard Space Flight Center

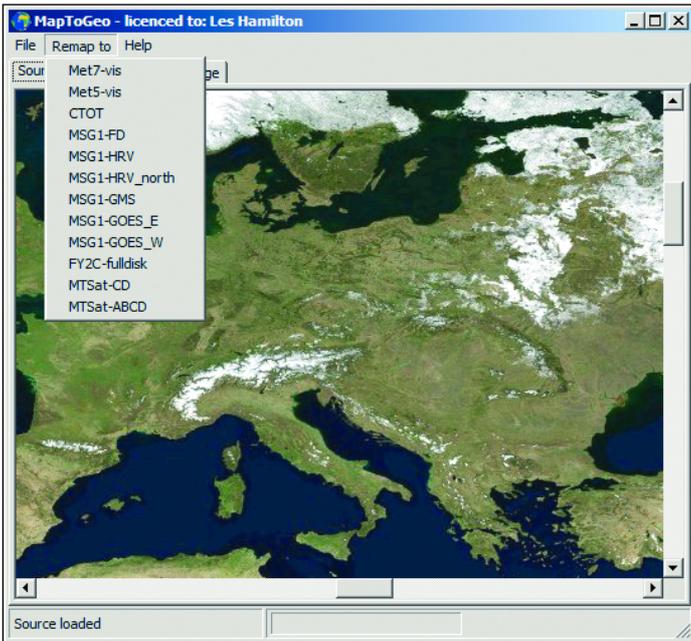


Figure 3 - Selecting 'Remap' mode in MapToGeo

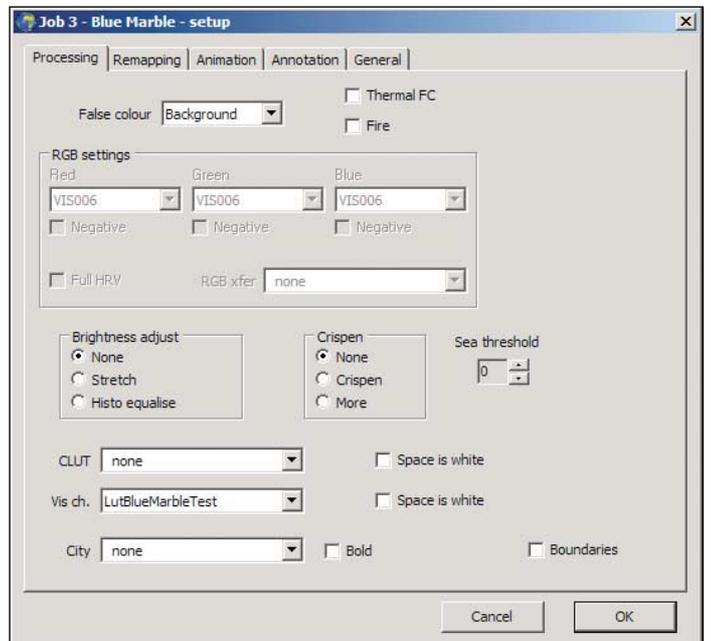


Figure 4 - Selecting the background in GeoSatsignal

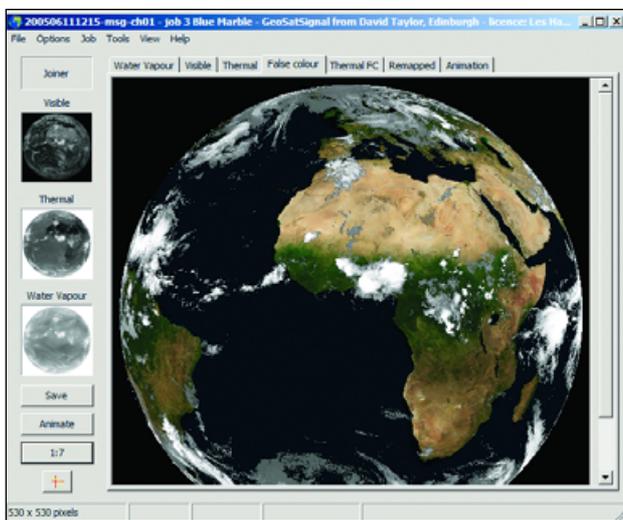


Figure 5 - Blue Marble background with Meteosat-8

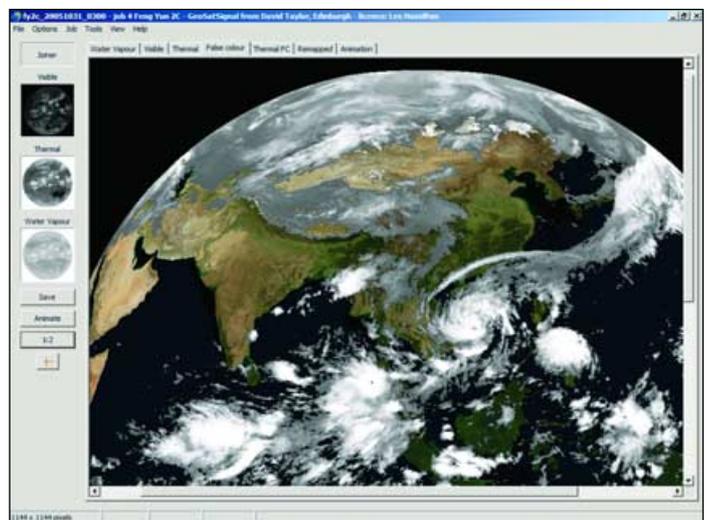


Figure 6 - Blue Marble background with Feng Yun 2C

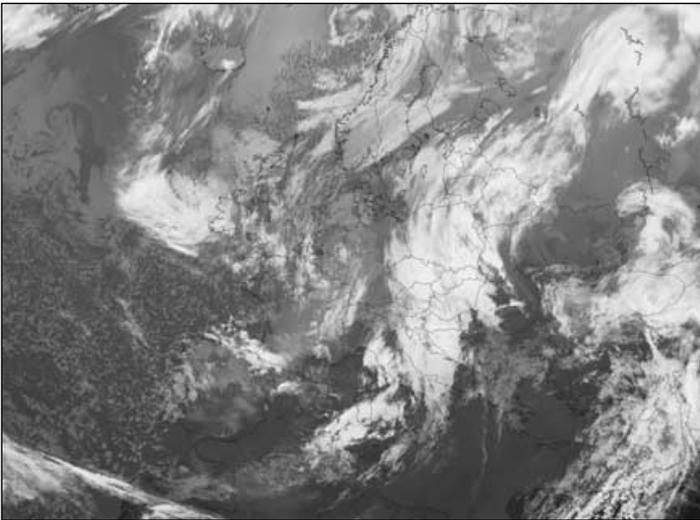


Figure 7 - A regular IR 'Europe' view from Meteosat-8
Image © EUMETSAT 2005



Figure 8 - The same Meteosat-8 with a *Blue Marble* background

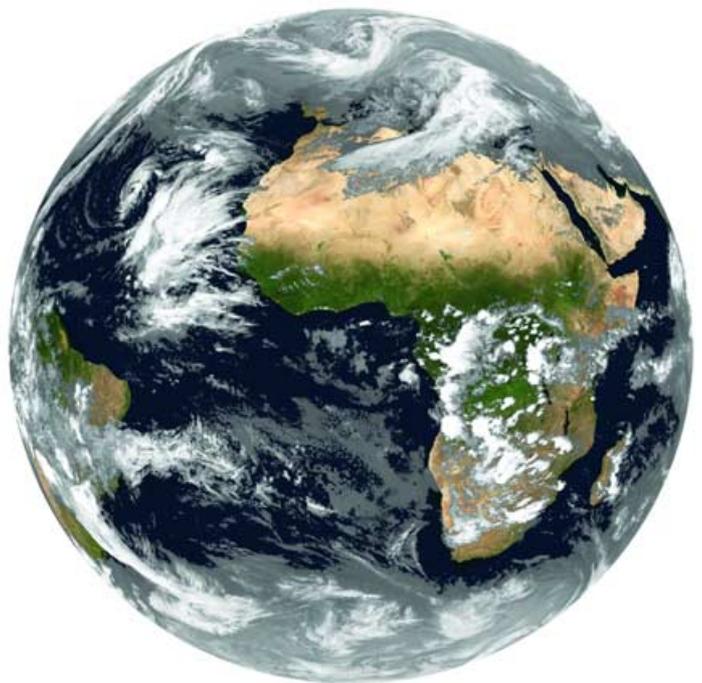
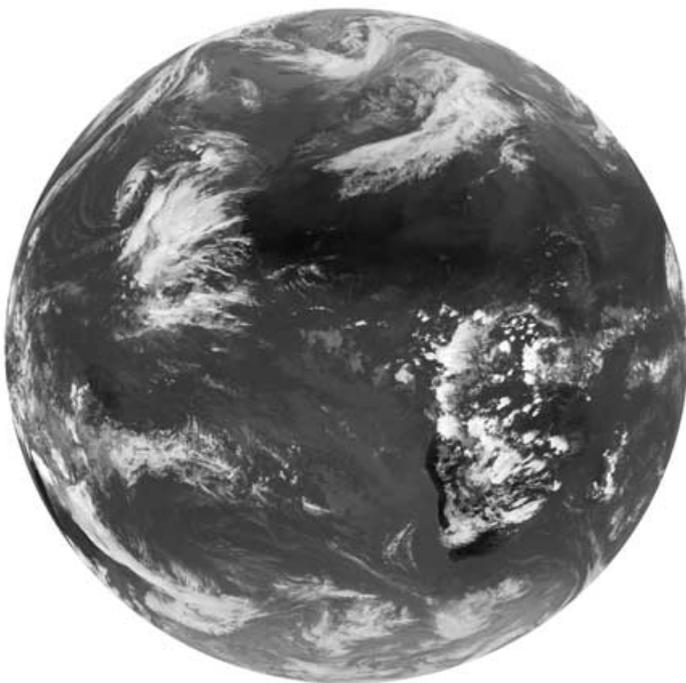


Figure 9 - A full disc IR image (left) and with added *Blue Marble* background (right)

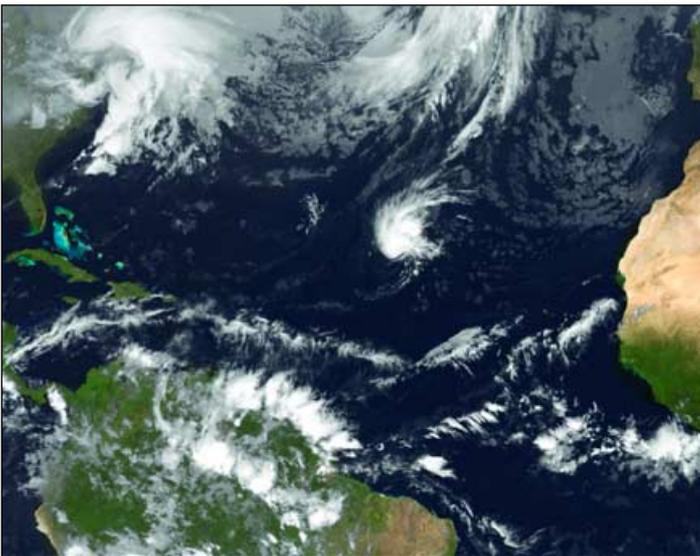


Figure 10 - Tropical Storm Zeta at 12:00 UT on January 3, 2006

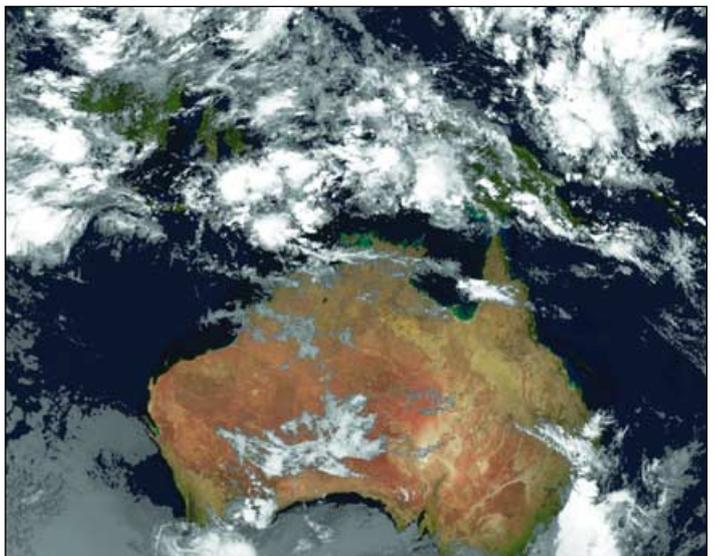


Figure 11 - A segment from an MTSat image, showing Australia



Figure 12 - The standard Land-Sea Mask CLUT used for Europe

being filtering out (made transparent) from the MSG image so that the background image shows through.

Note that temperatures below -80°C are rarely encountered in Earth's atmosphere, so that all the pixels in the -120° to -80° range are normally coloured 100% white. An image of this CLUT appears in figure 12.

This CLUT works fine for most of the year in northern latitudes. In colder conditions it may be necessary to use a CLUT where the 'red region' extends a few degrees into the 'negative temperature' part of the bitmap, while to represent hot tropical areas you may find a CLUT with a shorter 'red region' to give more realistic results.

The Results

Figure 7 on the previous page is a regular infrared view of Europe from Meteosat-8 dating from November 27. There is a considerable degree of cloud throughout the image, and without the superimposed country boundaries, it would be quite difficult to interpret. With a Blue Marble background applied (and using the standard CLUT filter) the overall scene is much clearer. The match between the two images is pretty good and certainly fit for weather presentations.

Figure 9 shows a similar comparison for a world view. Since the world view of necessity focuses almost exclusively on the warmer areas of the Earth, a 'tropical' version of the CLUT has been employed. The filter adjustment does depend a bit upon the area under scrutiny, but in practice the demarcation position between cloud and land/sea (in the CLUT bitmap) is around 15°C (this concept has its restrictions over desert areas during night time though).

Figure 10 is an interesting combination of a GOES-12 and a Meteosat-8 image over a Blue Marble background to create a viewpoint that you would never normally experience. Finally, figure 11 is an example taken from a MTSAT-1R image, showing Australia. Again a small degree of CLUT filter adjustment has been made to suit this particular region.

In Conclusion

These Blue Marble maps are great fun to view and work with and really can improve the impact of your MSG images, particularly those from overnight infrared transmissions. They cannot of course, from an analytic standpoint, be considered as a replacement for genuine MSG-1 imagery. The addition of a Blue Marble background is primarily useful as a tool for presenting practical daily meteorological information in an informative and attractive way; when used in the creation of animations there is no other mechanism that can compare with this method because it produces consistent results 24 hours per day.

Acknowledgements

Thanks to David Taylor and Ferdinand Valk for invaluable help and discussion during the compilation of this article: also to Ferdinand for making available all the MSG images on page 15.

References

1. Plate Carrée

A map projection (similar to Mercator) where lines of latitude are regularly spaced apart by the same distance as the lines of longitude.

Fiddler's Ferry

Images from Above and Below

Robert Moore

Following an extended autumn in the UK, winter at last arrived on November 17, plunging the country into freezing conditions as an anticyclonic regime prevailed. The **NOAA-18 HRPT image on the opposite page** shows most of Britain free of cloud during the satellite's 12:48 UT pass. Robert Moore took advantage of the conditions to spot evidence of human activity near where he lives. Robert takes up the story ...

Fiddler's Ferry is a coal-fired power station near Warrington in Cheshire. According to *Friends of the Earth*, 'It has no sulphur controls (technology which cuts acid rain causing sulphur dioxide) so mostly burns imported low sulphur coal.' FoE suggest that Fiddlers Ferry is a 'dinosaur ... well past its sell by date'.



Figure 1 - Steam rising from Fiddler's Ferry power station

This power station is a major landmark, its eight towers being visible from north Wales and large parts of Cheshire and southwest Lancashire. Fiddlers Ferry emits regular plumes of steam from its towers, which provide shade in the immediate locality. For observers living further afield and in clear weather the plumes provide a useful indication of weather conditions; notably the height of the tropopause and the presence of upper level wind shear. The much more modern Queensferry power station on the south of the Dee—just inside north Wales—provides an interesting comparison point with Fiddlers Ferry when the plumes are visible at both locations.

The photograph above was taken shortly after midday on November 17 when the plumes of steam could be seen rising vertically before generating a small line of cumulus cloud. This feature was not visible in Meteosat-8 imagery but is just visible in the NOAA-18 HRPT image. The photograph was taken at about the same time.

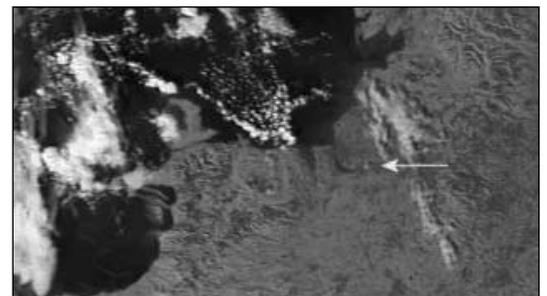
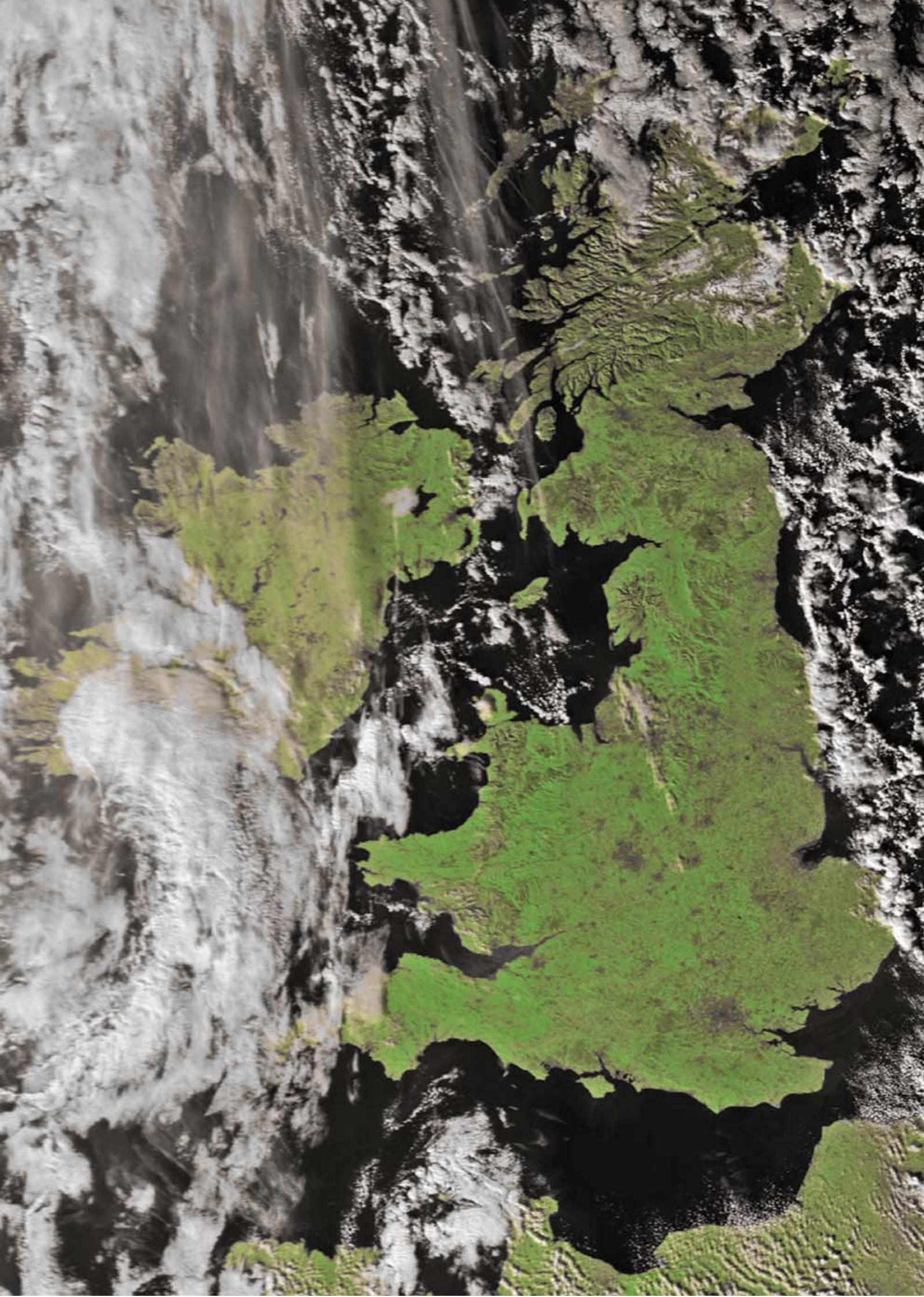


Figure 2 - Location of the steam plumes (arrowed)

Image: NOAA CLASS Archive
Processing: HRPT Reader

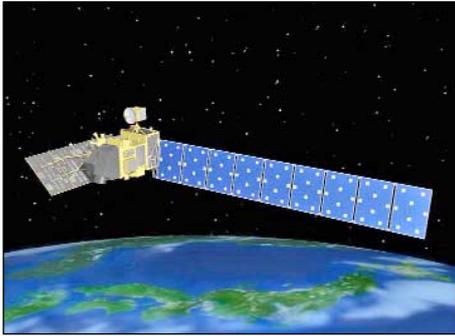


Earth Imaging News

Peter Wakelin

Japan Launches Advanced Land Observing Satellite

The eighth H-IIA launch vehicle lifted off from Tanegashima at 01:33 UT on January 24 carrying Japan's Advanced Land Observing Satellite (ALOS). First stage thrust was supplemented by two SRB-A strap-on motors and two smaller Castor IVL strap-on motors. The second stage made a single 524 s burn to place the payload, which is known as 'Daichi' in Japanese, into the planned 700 km circular sun-synchronous orbit.



Artist's impression of ALOS in orbit

JAXA (Japan Aerospace Exploration Agency) was the prime contractor for the spacecraft but other contractors involved include Mitsubishi, NEC and Toshiba. ALOS will continue the work done by its predecessors *JERS-1* and *ADEOS* but with more advanced sensors. The three advanced sensors are PRISM, AVNIR-2 and PALSAR.

The Panchromatic Remote-sensing Instrument for Stereo Mapping (PRISM) is a panchromatic radiometer with 2.5 m resolution at the nadir and will provide a digital surface model of high accuracy. There are three independent optical systems looking forward and backward, as well as at the nadir, to produce stereoscopic images along the 35 km-wide swath.



ALOS within its huge fairing atop the rocket



ALOS on its way

The Advanced Visible and Near Infrared Radiometer type 2 (AVNIR-2) is to be used for land-coverage maps and land-use classification maps for monitoring regional environments. Its 10 m resolution is an improvement on the 16 m attainable at the nadir by the original AVNIR flown on *ADEOS*.

The Phased Array type L-band Synthetic Aperture Radar (PALSAR) is an active microwave sensor using L-band to achieve day and night land observations even through cloud. As well as

operating in the conventional mode, PALSAR can use 'ScanSAR' which permits a much wider swath but at the expense of spatial resolution.

NPOESS First Launch Delayed until 2012

The first spacecraft in the USA's next-generation polar-orbiting weather satellites, *NPOESS* (National Polar Orbiting Operational Environmental Satellite System) will not be launched for at least six years.

The *NPOESS* project was born out of the US Presidential Decision of May 5, 1994 which directed the Departments of Commerce and Defense to converge their separate polar-orbiting environmental satellite programmes into a single programme to serve both military and civilian needs. By 1996 the programme was taking shape and the first *NPOESS* launch was then expected in 2007. Such predictions are invariably optimistic and it is worth pointing out that, also in 1996, *EUMETSAT* expected the first *MetOp* launch to be in 2002.

The one remaining launch in the NOAA polar-orbiting series, *NOAA N'*, will be *NOAA-18's* replacement in the afternoon orbit. In addition, *DMSPs* 17, 18, 19 and 20 remain to be launched over the next few years; all are destined for morning orbits. These four are the last of the Defense Meteorological Satellite Program's polar-orbiters and, although direct read-out is not available to civilian users, the spacecraft are now operated by NOAA and the data from them are widely distributed. So, notwithstanding any serious malfunctions, these and existing spacecraft, together with the upcoming *MetOp* and *NPP* (*NPOESS* Preparatory Project), should ensure that there is no data gap before *NPOESS* becomes operational.

The GOES-N Saga Continues

GOES-N was originally scheduled for launch in 2001 but construction and launch were extended to 2003 as the on-orbit satellites were in good health. In 2003 the launch was set for December 2004—and then January 2005. In February 2005 it was rescheduled to May to avoid the spring eclipse season. In April there was concern about the Delta IV rocket and launch slipped to late June whilst some tanks were replaced. Further rocket concerns, and checks for possible lightning damage, delayed the launch till August. On August 16 the launch was aborted during the final countdown and rescheduled for early November. Since then, strike action by some Boeing employees has prevented launch. May 2006, after the spring eclipse season, is the next likely launch target.

This strike action has delayed other Delta launches too, including the imaging satellites *Cloudsat/Calypso* and *DMSP-17*.

MSG-2 Successfully Launched

Arianespace continues its string of successes with the launch of vehicle number 525, a standard 5GS model, which put *MSG-2* and *INSAT-4A* into a transatmospheric orbit. After first-stage separation, a single burn of the upper stage pushed the payloads towards a 620 × 35853 km geostationary transfer orbit inclined at 3.9° to the equator where the payloads and their *Sylda* adapter were separated. Meanwhile, the first stage reentered the

atmosphere over the Pacific Ocean. ESA took control after spacecraft separation and began the Launch and Early Operations Phase (LEOP), manoeuvring the spacecraft to its commissioning location above 6.5° west longitude on the equator, aligning its spin axis with the Earth's and stabilising the spin rate at 100 revolutions per minute.

EUMETSAT took over control of *MSG-2* on January 2 and immediately started commissioning activities by activating the onboard instruments and beginning the check out of all systems. The commissioning phase is expected to last until June but the routine dissemination of data is likely to begin before that for evaluation purposes.

On completion of the commissioning activities in June, *Meteosat-9* (as *MSG-2* will then be known) will be moved to zero degrees longitude and become fully operational. The service currently provided by *Meteosat-7* will then be terminated and this satellite will be moved to the Indian

Ocean to replace *Meteosat-5*.

Some users of the WEFAX service from *Meteosat-7* may be experiencing interference to their images caused by *MSG-2* commissioning activities. Turning the receiving antenna slightly to the east may help but, as this service is ending soon, the solution is to move to the *EUMETCast* or Internet service.

MSG-3 is built and is currently in storage and the fourth and final one is under construction. This second-generation series is planned to operate for at least another 12 years.

Fiery End for Sich 1M nears

Sich 1M was launched into a useless orbit following an under-performance of an upper-stage rocket in late 2004. Significant atmospheric drag at its low perigee has steadily reduced the apogee from the initial 600 km and by late January, 2006 the orbit was just 248 x 382 km. Final orbit decay will be rapid and the spacecraft will soon burn up in the atmosphere.

Symposium 2006

Accommodation

If you are planning to attend the GEO Symposium on April 29 and intend to stay overnight in Leicester on the Friday, you may be interested to learn that GEO has made arrangements with the Campanile Hotel, Leicester.

Many of the GEO Management Team will be staying at the Campanile overnight. Why not come along and join them?

The special room rate is £46.95 for a double room including breakfast for two people, a saving of £12.50 on the normal rate. Ample parking is available.

To take advantage of this rate, book quoting the reference 'GEO'. Contact details are:

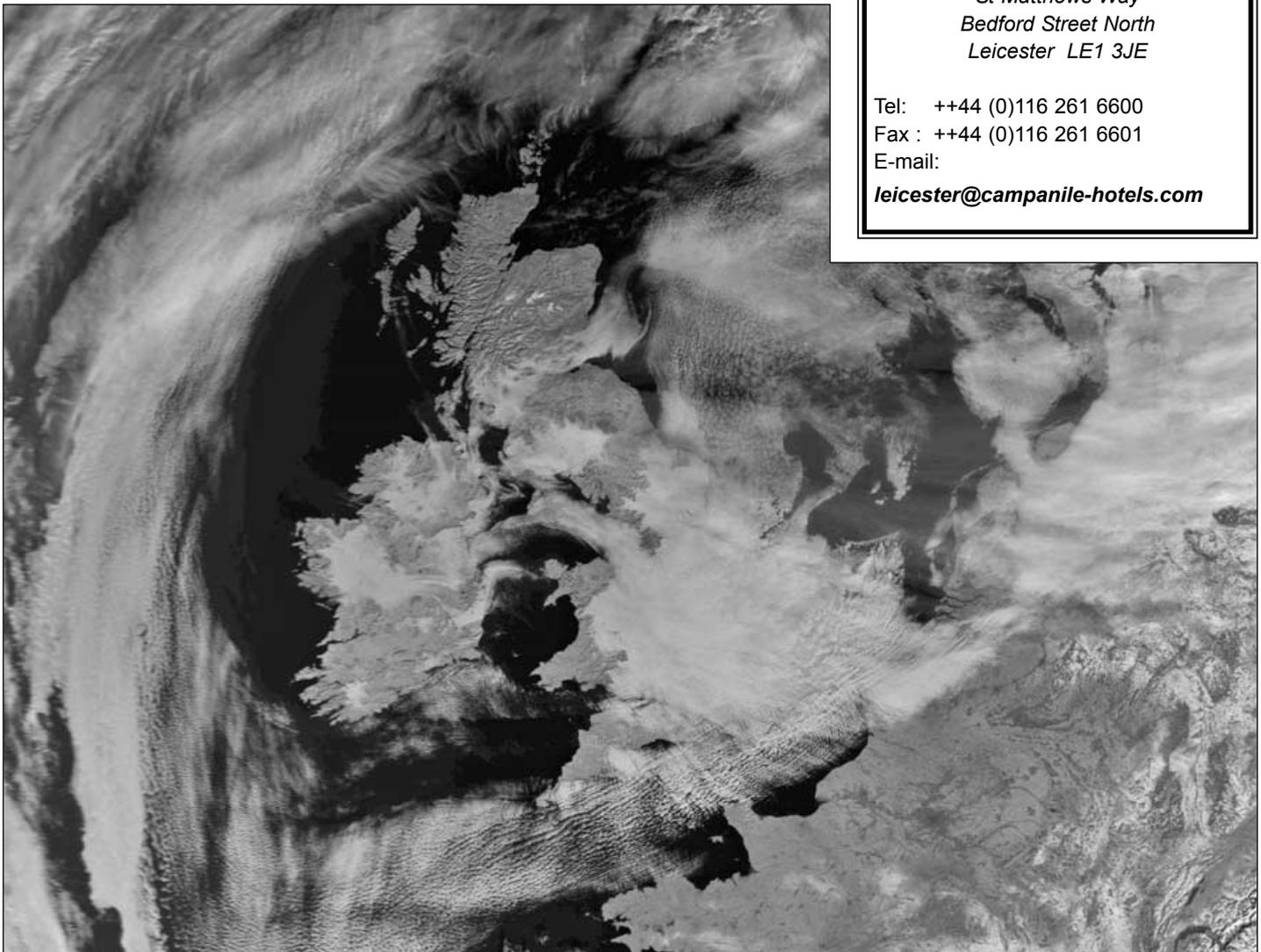
Mark Smith & Sue Wilson
Campanile Hotel
St Matthews Way
Bedford Street North
Leicester LE1 3JE

Tel: ++44 (0)116 261 6600

Fax : ++44 (0)116 261 6601

E-mail:

leicester@campanile-hotels.com



This January 30, 2006 NOAA-17 channel-2 HRPT image shows high pressure bringing sub-zero temperatures to most of the UK

Image: CLASS archive (<http://www.class.noaa.gov>)



Figure 1 - Landsat Thematic Mapper image (bands 13, 45 and 57) showing oil palm estates in Sumatra, Indonesia
Image: NASA



Figure 3 - The writer photographed amongst young oil palms on the Guthrie estate amidst the rolling hills of Negeri Sembilan.



Figure 4 - Kim indicating fruit in the crown of a palm tree



Figure 2 - This 250-metre MODIS Terra image of the Sumatra coastline facing the Strait of Malacca shows plumes of fire-haze
Image: © CRISP

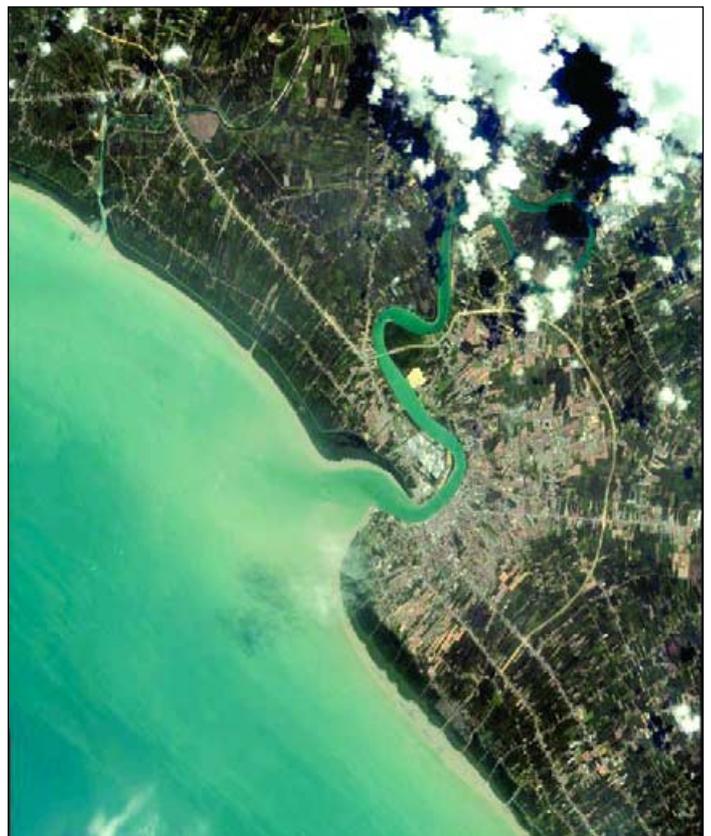


Figure 5 - The Sungai Muar river which meanders across the town of Muar on its journey towards the Strait of Malacca. This river is prone to flooding, affecting surrounding fruit orchards, rubber estates and oil palm plantations.

Image © SpacelMaging



Imaging for Margarine

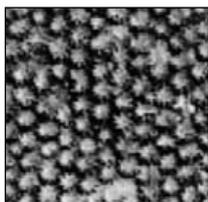
The role of remote satellite sensing in plantation management

Kimberley Loh Ying-Ying

Oil palm plantations occupy more than 3.3 million hectares, about 40% of all cultivated land in Malaysia. Nowadays, synthetic aperture radar sensing and remote satellite imaging are playing an important role in helping plantation managers to maintain a competitive edge over their competitors. Plantations need to know fruit and frond sizes, bunch numbers, photosynthetic efficiency, land drainage in oil palm plantations besides other production factors (figure 1).

Counting the Trees

Oil palm owners count tree stocks on their plantations in order to know the value and production of their assets. Manual stock keeping is tedious and unreliable; a common method is to walk through dozens of oil palm estates conducting bunch counts in batches of 10 trees and thus estimating the total number present. A more modern approach is to count the palm trees from space, as their crowns are clearly visible in 1-metre resolution IKONOS imagery.



IKONOS image of tree crowns used for recording trees in oil palm plantations
IKONOS imagery
© Space Imaging

Classifying the Trees

High-resolution IKONOS imagery also helps to distinguish between young and mature oil palm trees. Mature trees generally appear darker in tone with well-formed canopies, while the young ones are lighter in colour with well-separated individual tree crowns. Synthetic aperture radar microwave energy can penetrate planted vegetation and detect the crowns and trunks of oil palms. In the C-band, backscattered energy is correlated mainly with the crown constituents such as the leaves, twigs and small branches. Further, using a texture-based image-processing algorithm, IKONOS can accurately classify oil palm age at estate level from its satellite images.

Locating Unhealthy Trees

Plantations management must also ensure healthy plants to produce fine end-products like margarine. The location and surrounding area of a plantation's vacant land may signify poor planting, unsuitable soil or disease. For instance, if the tree

density in a surrounding grove is about 100 trees per hectare, then the manager can infer that more trees could have grown healthily were it not for unfertile soil or tree fungi.

Identifying Sites for Trees

Oil palm trees demand land with well-drained soil. Land covered by water can affect yields. IKONOS imagery has helped to identify areas subject to flooding during bad weather conditions. For example, a stream flowing through an oil palm plantation may cause the tree trunks to be covered, and possibly rot, during a rainy season (figure 5)

Planning Tracks among the Trees

Plantations also have to plan routes to transport harvested fruits to the mills. Typically, newly planted palms are planted parallel to contour lines and tracks through the plantations appear bright against the green tree background. However, in mature plantations the palm canopies often close up obscuring the road network layout and route lines can then be computed from IKONOS images through a pixel-based classification algorithm which can clearly show up large-scale land and logistics development (figure 6).

Destruction of the Trees

When oil palms have matured the traditional procedure is to fell the trees. On undulating land in the forests, commercial plantations burn their trees as a cheap way towards replanting. This has caused air pollution with drifting smog affecting neighbouring countries (figure 2).

Oil palm crop yields are reduced by haze if less than one third of the sunlight reaches the leaves—this is the critical level for photosynthesis—because the palm fruits' ripening process is significantly affected. The low oil extraction rate experienced during the first 5 months of 1998 was directly related to haze produced between September and October 1997 as shown in the table below.

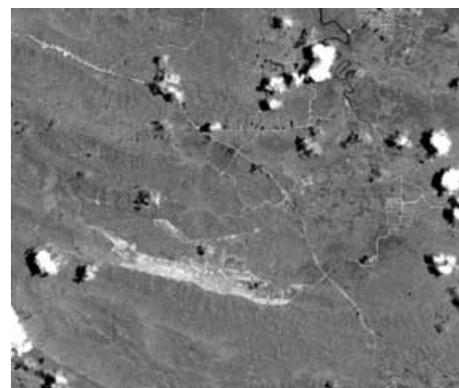
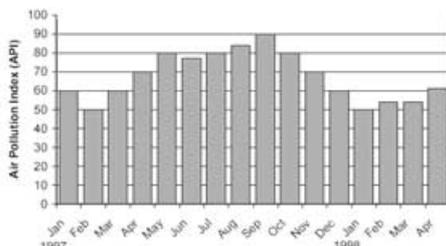


Figure 6 - This IKONOS image clearly shows tracks through the palm-tree canopy in the Sandakan district of Sabah, Borneo. Image © SpaceImaging

Harvesting the Trees

The harvesting of the oil palm, *Elaeis guineensis*, for palm olefin conversion into food and cosmetic products, and using by-products as biofuel or nutrients for animal feeds and mushroom cultivation, are well documented.

There are about 340 palm-oil mills throughout Malaysia, processing palm olefin for the food and health care industries. Malaysia is the world largest producer of oil palm products and by-products.

The Dutch planted the first oil palms in Buitenzorg (now Bogor) Botanical Garden in Java, Indonesia in 1848. The first batch of oil palms from Africa was received in the then Malaya through the Royal Botanic Gardens in Kew, England in the 1870s. The commercialisation of oil palms in Malaysia was largely due to Frenchman Henri Fauconnier, who used seedlings obtained from palms in Sumatra in 1911 and 1912.

You can read more at:

<http://www.mpopc.org.my/abtegf2.htm>

What is less well known is the role of the 'soft' ingredient of remote imagery in oil palm cultivation.

In conclusion, one must say that it is more than a 'light' product whenever margarine is spread.

Acknowledgement

A thank-you to Puan Suhaila, biology teacher at the Seri Bintang Utara school, Kuala Lumpur and my private tutor, Cik Noraini, for guidance on the draft of this article.

This paper is part of a research assignment on the Fourth Form subject: 'English for Science and Technology.'

Exclusive GEO Shop Deals

to supply German Weather Satellite APT Receivers

Clive Finnis

We are delighted to report that the GEO Shop has secured exclusive deals to be the **sole UK distributor** of two German-built APT weather satellite receivers, the *Vierling* 'Weatherman' and the *R2FX*, both of which have been reviewed in recent GEO Quarterlies [1,2].

GEO is the exclusive UK agent for both receivers. You cannot purchase either anywhere else in the UK.

R2FX Receiver

Diminutive in size, but packed with features, the new *R2FX* APT receiver is ideal for the newcomer to the hobby or for the experienced user who wants a convenient portable receiver for mobile use. Full computer control is built in (compatible with *WXtoImg*) and a novel feature is the twin antenna sockets. The receiver will automatically select the antenna with the strongest signal to provide long fade-free passes. Fully cased and ready to go, a full APT system (including antenna and all cables) is available for under £200 by purchasing the *R2FX* with the optional accessories pack described below.



R2FX Accessory Pack

This contains everything required to implement a complete APT receiving system when used with the *R2FX* receiver. It comprises:

- 137 MHz Turnstile Antenna
- UK plug-in power supply
- PC audio lead + PC Serial 'computer control' lead
- Aerial lead (20 metres long with fitted connector)
- CD of PC shareware starter software
- Instructions

Just brilliant value for money!

Note: in some areas of the country this receiver has experienced pager intrusion on 137.91MHz, but generally performs well on 137.1, 137.5 and 137.62.

The Vierling 'Weatherman' Professional APT Receiving System

A very impressive professional receiver, the German designed and built *Vierling*, will satisfy the requirements of the most dedicated enthusiast. It features an LCD display and has proved to have excellent resistance to pager interference. Extensive testing by John Tellick from his pager 'hot-spot' in southwest London showed it to be barely affected at all.

Also available separately is the *Vierling QFH antenna* with excellent performance at a very competitive price.



Complete 'Weatherman' System

This comprises the APT Receiver, QFH Antenna and *Windows* based computer control software. The complete system is available as a special introductory offer for a limited period, offering considerable savings on purchasing the receiver and QFH separately.

- GEO Members - £349.00 (saving £69.00)
- Non Members - £369.00 (saving £79.00)

Martelec MSR40 EPROM

Following the invaluable help and assistance of Chris Pretty, the original designer of the *Martelec* range of receivers, GEO can now offer an EPROM for the *Martelec MSR40* receiver to cover the two NOAA18 frequencies of 137.1MHz and 137.9125 MHz.

Initial tests have shown the *MSR40* to be a very sensitive receiver whilst having excellent resistance to pager interference at 137.9125 MHz. Fitting instructions are included

Prices

Prices for the above are listed below. They all include carriage and packing to UK addresses. Readers in EU countries are advised to purchase direct from the German manufacturers; they will certainly save on carriage charges [3,4]. Readers residing in the rest of the world are advised to contact the GEO shop for a quote if they are interested in making a purchase.

	GEO Members	Non Members
R2FX receiver only	£135.00	£149.00
R2FX Accessories Pack	£59.00	£69.00
Vierling 'Weatherman' receiver	£239.00	£259.00
Vierling 137 MHz QFH Antenna	£179	£189
Vierling - Complete system	£349	£369

All prices include post and packing to UK addresses

	UK	EU	Rest of World
Martelec MSR40 EPROM	£10.00	£10.75	£11.25

Queries

If you wish to make a queries about any of the above items, please e-mail them to:

shop@geo-web.org.uk

References

- 1 R2FX APT Receiver - GEO Q7, page 19
- 2 Weatherman - GEO Q8, page 19
- 3 <http://www.df2fq.de>
- 4 www.vierling-group.com/weatherman

GEO Shop

Manager: Clive Finnis
 e-mail: shop@geo-web.org.uk
 FAX: +44 (0) 1202 893 323



PRICE LIST

	UK	EU	RoW
R2FX APT Receiver	-	see page 22	-
Vierling Weatherman APT Receiver	-	see page 22	-
Vierling QFH Antenna	-	see page 22	-
TechniSat SkyStar 2 PCI Card	49.50	51.00	-
Technisat Skystar USB box	109.50	121.50	-
Telestar 80 cm dish with LNB	49.00	-	-
Telestar Ku band universal LNB	11.00	12.50	-
Technisat <i>Satfinder</i> alignment meter	21.50	24.50	-
Dartcom high quality QFH antenna	259.00	279.00	-
Turnstile APT antenna	36.00	-	-
GEO-PIC 1.0	7.00	7.40	8.30
GEO/Dartcom EPROM v 1.3	10.00	10.75	11.25
GEO 2004 CD (back issues)	8.00	8.40	9.30
GEO 2005 CD (back issues)	8.00	8.40	9.30

Printed Back Issues

GEO Quarterly Back Issue (only Nos 2 to 8 available)	3.50	4.20	5.10
--	------	------	------

All prices are in £ sterling and include postage and packaging

HOW TO PLACE YOUR ORDER

Orders should clearly state your **name** and **address**, including **postcode**, and contact **telephone** number and **e-mail** address in case we need to contact you about your order. Items ordered should be **clearly described** and quantified.

It is preferred that you submit your order on a copy of the official **Shop Order Form**, which you can download from the GEO website at:

<http://www.geo-web.org.uk/Orderform.pdf>

(Of course, we will also accept handwritten or typed orders)

Please mail your orders to:

GEO Shop
 44 Disraeli Road
 Christchurch BH23 3NB
 Dorset, England

If you are paying by credit card, you can FAX us your order to:
+44 (0) 1202 893 323

TERMS AND CONDITIONS

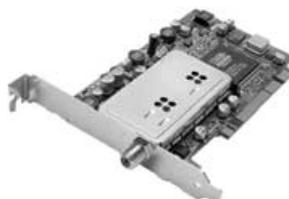
Payment Methods

Payments from **UK Members** can be accepted by *Personal Cheque, Postal Order, Credit Card* and *Debit Card*. Payments from **EU** and **Rest of World** members can be accepted by *Credit Card* or *Debit Card*.

Cheques and Postal Orders must be made payable to 'Group for Earth Observation'

VISA, Mastercard, Switch and Switch Solo are all accepted, but please note that you **must state**

- the cardholder's signature
- the type of card, card number and expiry date
- the issue number (for Switch and Switch Solo only)



TechniSat SkyStar 2 PCI Card

A 'free to air' DVB satellite TV and data receiver card as recommended by EUMETSAT. This card requires installing inside the computer and comes with comprehensive installation instructions and CD-ROM of driver software.



TechniSat SkyStar USB Box

If you do not feel confident about installing cards inside your computer you can use the external USB version.



Telestar 80 cm dish (or similar model) and Ku-band LNB



GEO PIC 1.0 for RX2

This PIC comes programmed with the two new frequencies to be utilised by the forthcoming NOAA-18 and NOAA-19 satellites.

Note: Check your RX2 synthesiser chip before ordering (see GEO Quarterly No 5, page 16)



GEO/Dartcom EPROM v 1.3

Recent tests have shown the **Dartcom APT receiver** to be one of the best regards pager immunity in the UK. This NEW EPROM for the Dartcom APT receiver adds the two new NOAA frequencies to the scan list in memory page 0.



TechniSat SatFinder Alignment Meter

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



Turnstile APT antenna



Dartcom QFH antenna



GEO 2004 CD
 Back issues in PDF format - so that new members can catch up on last year.

All credit cards are authorised before goods are despatched.

Please include your e-mail address or telephone number in case we need to contact you about your order. In the event of problems with items purchased from GEO-Shop, please contact Clive Finnis (contact details at top of page).

Ordering and Shipping

We will ship by post, so please allow 28 days for delivery although we hope UK and EU orders will take just a few days; orders to the Rest of the World may take a few weeks.

Items from the GEO shop are available only to paid up GEO members

GEO Helplines

Douglas Deans, Dunblane, Perthshire, SCOTLAND

All aspects of weather satellites from APT, HRPT to Meteosat-8 DVB/EUMETCast systems.

- telephone: (01786) 82 28 28
- e-mail: douglas@dsdeans.freemove.co.uk

John Tellick, Surbiton, Surrey, ENGLAND

Meteosat-8 advice - registering for the various MSG services, hardware and software installation and troubleshooting. John will also field general queries about any aspect of receiving weather satellite transmissions.

- telephone: (0208) 390 3315
- e-mail: info@geo-web.org.uk

Keith Holland, London, ENGLAND

Specifically, help for APT users (137 MHz band) and Meteosat-7 wefax.

- e-mail: geo@koholland.plus.com

David Strickland, Truro, Cornwall, ENGLAND

David has set up his own wireless network system of three computers. He has interests in electronic design and prototyping, general computing, microchip processors with various facilities and of course MSG satellite imaging. He will be happy to discuss any of the above topics, and to help anyone local, including viewing his setup.

- e-mail: David@Strickland.uk.com

Geoff Morris GW3ATZ, Shotton, Flintshire, NE WALES

Geoff has lots of experience with aerial, co-ax, connectors, mounting hardware etc. and has also done a lot of work with the orbiting satellites. Geoff has been a EUMETCast Meteosat-8 user for some time and is familiar with David Taylor's MSG software; he should be able to share his experiences with newcomers to this branch of the hobby.

- Tel: (01244) 818252
- e-mail: gw3atz@btopenworld.com

Guy Martin G8NFU, Biggin Hill NW Kent, ENGLAND

Guy is prepared to advise anyone who wishes to receive MSG under Windows 2000. He also runs Meteosat-7 SDUS.

- agm@tonbridge-school.org

Hector Cintron, San Juan, Puerto Rico, USA

Hector is prepared to field enquiries on HRPT, APT, WEFAX, EMWIN and NOAAPORT

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

E-mail contact can of course be made at any time, but we would ask you to restrict telephone contact to the

Useful Internet Discussion Groups

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

GEO-Subscribers

This is a group where GEO members can exchange information relating to either GEO itself or Earth observation satellites and related matters.

e-mail: GEO-Subscribers-subscribe@yahoogroups.com

Satsignal

An end-user self help group for users of David Taylor's Satellite Software Tools including the orbit predictor WXtrack, the file decoders GeoSatSignal and SatSignal, the ATOVS and HRPT Reader programs, the remapper GroundMap, and the MSG Data Manager

e-mail: SatSignal-subscribe@yahoogroups.com

MSG-1

A forum dedicated to Meteosat-8 (formerly MSG-1), where members can share information about the reception hardware and software.

e-mail: MSG-1-subscribe@yahoogroups.com

Weather Satellite Reports

A group providing reports, updates and news on operational aspects of weather satellites.

e-mail: weather-satellite-reports-subscribe@yahoogroups.com

WXtoimg

Users of the WXtoimg software package for capturing and imaging NOAA APT can air their problems, discuss its features and ask questions about it.

e-mail: wxtoimg-subscribe@yahoogroups.com

Copy Deadline for GEO Quarterly No 10 Tuesday, April 22, 2006

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

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

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

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

Images and Diagrams

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

We can also scan original photographs, negatives and slides.

If your article submission contains embedded images and diagrams, please note that we do also require, in addition, individual copies of each image or drawing which is not embedded within the article, for make-up purposes.

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

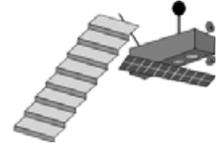
Larger attachments (1 Mb to 10 Mb) are best sent to:

editor.geo@googlemail.com

And finally . . . if you do have material ready for the next GEO Quarterly, please submit it as soon as it is ready—do not wait till the deadline before sending it in. This simply creates an editorial log-jam.



News in Brief



New NOAA-18 Frequency

Following extensive lobbying from many UK-based weather satellite enthusiasts, NOAA have implemented a trial NOAA-18 APT frequency change. Darrell Robertson, from the NOAA Satellite Data Services Satellite and Information Service stated:

'A NOAA-18 APT frequency change was collectively requested by several APT users in the United Kingdom. This action is being implemented to help mitigate high power pager transmissions in the UK on the 138 MHz frequency, that are impacting direct readout ground stations operating on the current NOAA-18 APT frequency of 137.9125 MHz.

NOAA will re evaluate the NOAA-18 APT frequency change following the MetOp-A launch scheduled for June 30, 2006 as part of the U.S.A. and EUMETSAT cooperative Initial Joint Polar System (IJPS) agreement.'

Effective from January 4, 2006, NOAA-18 switched from 137.9125 MHz (VTX-2) to 137.10 MHz (VTX-1). Early reports indicate that APT enthusiasts the length and breadth of the UK—many for the first time—are now receiving perfect NOAA-18 images on the new frequency

Updated EUMETCast Registration Form

Once MSG-2 is fully commissioned, the existing WEFAX and PDUS services from Meteosat-7 will cease forever, leaving many weather satellite enthusiasts without real-time access to geostationary data. GEO members keen to continue their activities in this sphere are strongly advised to register for MSG data access. The EUMETCast Registration form, updated last December, is available from the GEO Website at:

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

along with a convenient guide to filling in all the important sections.

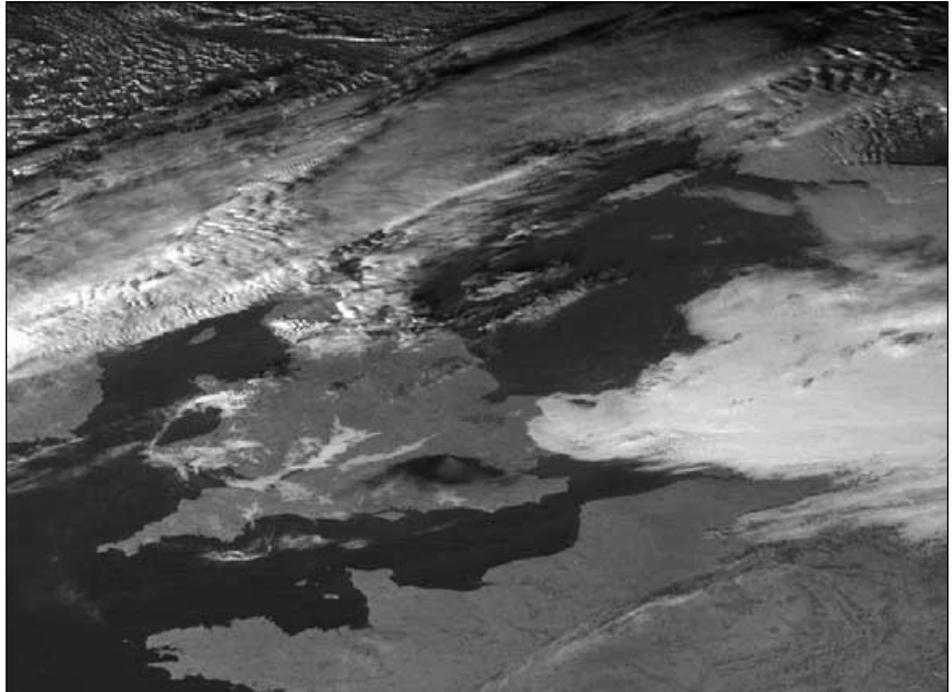
You can also hunt it down on the EUMETSAT website at:

<http://www.eumetsat.int>

although it is a major logistical exercise to locate it. Here's how it works ...

1. Click the link 'ACCESS TO DATA' at the top of the page
2. Click the link 'Delivery Mechanisms' in the side menu
3. Click 'EUMETCast Dissemination Scheme'
4. At the very foot of this page, click the link 'EUMETCast Registration form'
5. At the foot of this page is a table headed 'Registration Forms'
6. Click on the first link in the table, 'REG 01' and download the PDF document
7. Once you have got your breath back, print out this form and complete it.

(Now you know why we placed the direct link on our website!)



Eric Dean sent in this fine Meteosat-8 HRV image showing the smoke plume over southeast England following the Hemel Hempstead oil depot fire on December 11. You can view the event from the perspective of polar orbiting satellites on page 5.

MSG-2 Safely in Orbit

The second of EUMETSAT's new generation of geostationary weather satellites (MSG-2) enjoyed a successful launch from Kourou, French Guiana, on an Ariane-5 GS launch vehicle on December 21 last. Commissioning commenced on January 2 and continues until summer. First images from the new satellite were expected late January.

Fame!

It transpires that some of the craft competing in the 2005-2006 Round the World Volvo Ocean Yacht Race use David Taylor's GeoSatSignal software to process their weather data during the race. Competitors set out last November and can expect to be at sea for nine months and cover some 60 000 kilometres before the race ends. Awareness of current and future weather conditions is an important aspect of day-to-day planning and preparation for the teams involved and it is fascinating to learn that the software used by amateurs plays such an important role on this stage.

Record Hurricane Season

The 2005 Atlantic Hurricane Season broke all previous records with the final 'encore', Tropical Storm Zeta, still clinging to life into the first few days of 2006!

Zeta was the record 27th named storm of the season, smashing the previous record of 21 dating back to 1933. There were also 13 hurricanes, three of these reaching Category-5. Of these, Hurricane Katrina was the costliest

ever Atlantic Hurricane, causing damage and destruction estimated at \$80 billion, three times greater than that from the previous record-holder, Hurricane Andrew (1992).

Cover Colour Images

Front cover

A Blue Marble visualisation of the Earth from the perspective of China's Feng Yun 2C satellite. This global view was created using David Taylor's new MapToGeo software (read our article about Blue Marble and MapToGeo on page 13).

Inside Front Cover

Upper: An unmodified Blue Marble image of the Earth in plate carrée format.

Lower: A virtual radar image showing the (lack of) air traffic around the Bouncefield area during last December's great fire.

Inside Back Cover

Upper: NOAA-12 images from David Taylor illustrating how his SatSignal 5 software can add a Blue Marble background to an APT image. There is more information in Software Showcase on page 43.

Lower: An image of the Caspian Sea from Rob Denton: more on page 43.

Back Cover

Wolfgang Baschant took his Vierling weather satellite kit with him on his holiday on Madeira and captured this unusual NOAA-17 APT image dating from 13:42 UT on October 24, 2005.

Werkgroep Kunstmanen

Members' Meeting - November 2005

Fred van den Bosch



Five times a year, in every odd month except July, the Dutch 'Werkgroep Kunstmanen' [1] organises a meeting in Utrecht. The November 2005 meeting was a special one, our first joint meeting with 'Vereniging voor Weerkunde en Klimatologie' (Organisation for Meteorology and Climate) [2]. The meeting's programme included topics of common interest to members of both organisations. The day began with introductions from both chairmen about themselves and their organisations and following some general announcements (satellite status etc.) the presentations started

Kees Floor

The first speaker was Kees Floor, who has worked for more than 20 years at KNMI (The Royal Dutch Meteorological Institute). For some years now he has been working as a science journalist and is the author of several meteorological books. Kees started by showing some animations to explain the difference between polar and geostationary satellites. We were then treated to a display of many individual images, mainly from the MODIS satellites, and enjoyed Kees' interpretation of them. Kees also included some animations to illustrate the theory behind terms like high and low pressure, warm and cold fronts etc. Many of the images are in his latest book 'Het Weer op Satellietbeelden' (The Weather from Satellite Images [3]), which contains many more beautiful examples accompanied by detailed explanations. Unfortunately, at the moment, the book is only available in Dutch. Kees has a fascinating website [4], although mainly in Dutch, which is well worth a visit.

Arne van Belle

Arne's presentation was about how to receive MSG. He explained in detail, step by step, how to set up the different parts of a receiving station and mentioned the difficulties you may face. He showed some impressive animations—like

sandstorms in Africa and fires in Portugal. He ended with a calculation of the costs and the time that is needed for obtaining the licence and the EKU (Eumetsat Key Unit).

Jacob Kuiper

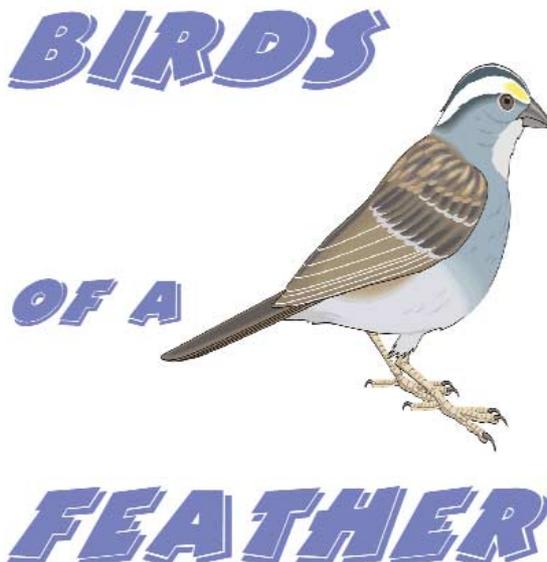
Jacob came to the meeting following only a few hours sleep following his night shift at KNMI and presented us with the weather forecast for the next couple of days, making direct use of an MSG animation that Arne had made earlier during the meeting. Jacob pointed out a number of phenomena and explained what he expected would happen. Of course his talk raised some discussion in the audience. His presentation was so clear and easily understood that, when it ended, there was only one question boiling in my mind: 'Why don't I see all these things when I look at *my* images?'

Finally

Though the programme was rather full, I think we all learned a lot about each other's interests. I have always been interested in receiving images from satellites but less so in interpreting their meaning for weather forecasting. The stories from the above speakers have already had good effects: I now feel curious and stimulated to know more about what the images can tell about our weather. After such a meeting you feel encouraged and your hobby is broadened... Who knows, it may happen to you too if you join us for the next meeting of *Werkgroep Kunstmanen*.

References

1. Werkgroep Kunstmanen - <http://www.kunstmanen.nl/>
2. KNMI - <http://www.vwkweb.nl/>
3. Het Weer op Satellietbeelden - ISBN 903891625 6, September 2005
4. Kees Floor - <http://www.keesfloor.nl/>



Last issue, Francis Bell launched a light-hearted competition for GEO members to present photographs of the greatest number of birds photographed on an antenna. The leading entries are reproduced opposite.

Mike Jupp was the first to submit a photograph (left) for this light-hearted competition. Mike caught these starlings perched on his 144 MHz 13-element *Cushcraft* antenna. Mike wrote: 'Sometimes I count over 60 starlings. I have seen more but this is the most caught on camera'.

Roy Quantic was next with his submission (far right) showing no fewer than 133 common starlings (*Sturnus vulgaris*) perched on the various elements of his antenna. Roy tells us that the starlings favour the 6-metre beam and the linear loading tubes on the HF aerial. Again, Roy claims to have seen more. Can anyone beat his total?



In discussion: left to right, Rob Hollander, Frans Schmal, Ben Schellekens, Jaap Rusticus and another member.



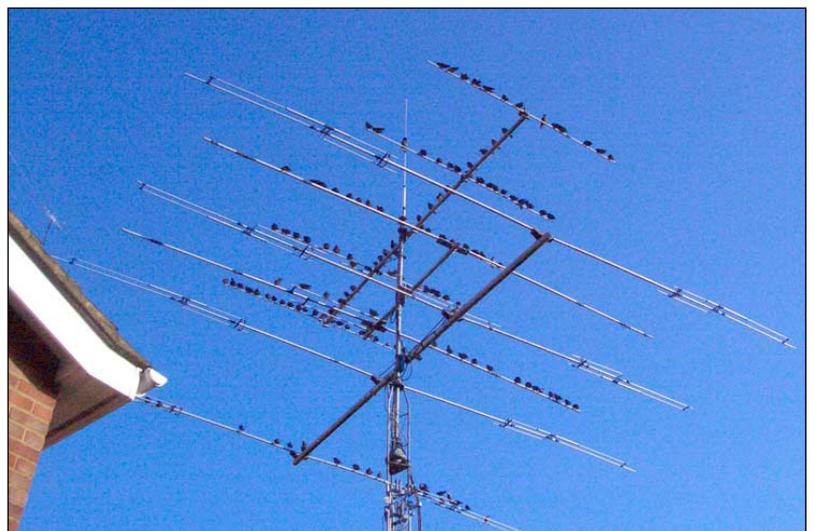
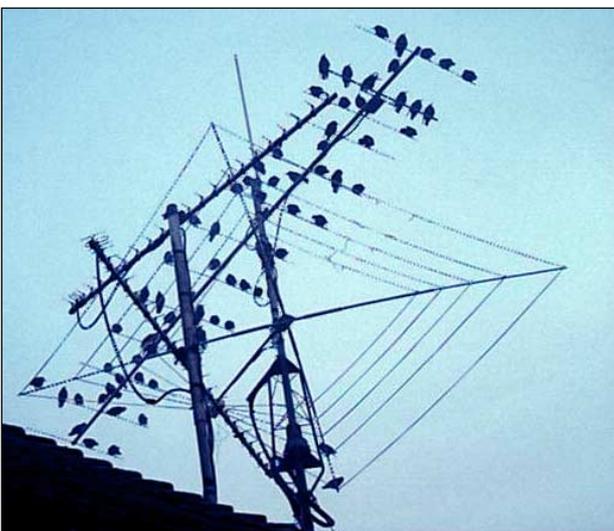
The attentive audience during the meeting



Arne van Belle explains how to set up an MSG station



Kees Floor making his presentation



Birds on antennas: photographs submitted by GEO Quarterly readers

QuikSCAT

NASA's Eye on the Oceans' Winds



Les Hamilton

Winds, particularly those which blow over Earth's oceans, play a major role in every aspect of our planet's weather; they directly affect the turbulent exchanges of heat, moisture and greenhouse gases between atmosphere and ocean. *SeaWinds*, a state-of-the-art radar scatterometer carried aboard NASA's *QuikSCAT* [1] satellite, measures the roughness of the oceans, thus providing climatologists, meteorologists and oceanographers alike with detailed daily snapshots of the winds that constantly swirl above their waters.

Wind and Waves

Although a general idea of wind circulation around the planet is apparent from the movement of clouds in the atmosphere, as perceived from weather satellites, wind is itself invisible. The only realistic method of making *accurate* determinations of wind-speed must therefore derive from the effects of the wind on an other entity, specifically, the surface waters of our oceans. Winds create surface roughness on the oceans and this can be measured by microwave scatterometry and accurately correlated with the speed of the wind.

Wind, of course, produces waves, which range from the merest ripples on the surface of a rock pool to the 30-metre monsters that characterise the fiercest ocean storms. There are two distinct types of wind-induced waves—gravity waves and capillary waves [2].

The 'normal' waves observed on the sea surface—those which eventually break on to the shore—are **gravity waves**, so-called because the principal force trying to level them results from gravity. Such waves typically have wavelengths measured in hundreds of metres. For example, waves arriving on a beach with a frequency of one every 10 seconds travel at over 50 kph and have a wavelength of 156 metres.

As wind blows over the ocean it also deforms the surface into much smaller rounded waves known as **capillary waves**, where the principal restoring force tending to smooth them out is surface tension; such waves, by contrast, must have a wavelength of less than 1.73 centimetres. Capillary waves characteristically have rounded crests but sharp V-shaped troughs which cause small-scale roughness over the sea surface and allow the wind and water to interact more efficiently. The entire ocean surface, including gravity waves, is in fact covered with capillary waves, but we fail to notice them because they are so small. It is the small-scale roughness due to capillary waves (not the large undulations of gravity waves) that is harnessed by the *SeaWinds* scatterometer.

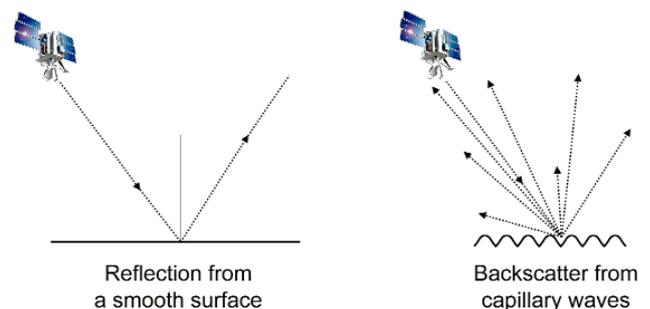
QuikSCAT and SeaWinds

NASA's Quick Scatterometer satellite (*QuikSCAT*) was launched on June 19, 1999. It is a 970 kg, 3-axis stabilised craft which flies in an 803 km sun-synchronous orbit. Built in a record time in just 12 months, *QuikSCAT* was a replacement for the Japanese *ADEOS* satellite which failed in June 1997 (and which carried NASA's earlier NSCAT sea-surface

scatterometer). Dubbed NASA's next 'El Niño watcher', *QuikSCAT* is leading to a better understanding of global weather abnormalities and is an aid to improved weather forecasting. The mission, which was originally designed for a 3-year operational lifetime, remains fully functional after more than six years in orbit.

QuikSCAT carries the *SeaWinds* instrument [3,4], a specialised radar that transmits high-frequency microwave pulses towards the ocean surface and measures the back-scattered (echoed) pulses that return to the satellite. By sensing capillary wave ripples caused by winds near the oceans' surfaces, scientists can compute windspeed and direction. *SeaWinds* acquires hundreds of times more surface wind velocity observations every day than older traditional methods using ships and buoys, and because radar normally passes through clouds relatively unhindered, it is the only remote-sensing system with the ability to provide continuous, accurate and high-resolution measurements of near-surface wind speed and direction regardless of cloud conditions.

SeaWinds uses a 1-metre rotating dish antenna which emits two pencil beams of 13.4 GHz (Ku-band) microwaves that sweep in circular patterns at slightly different incidence angles (40° and 46°). The dual-pulse microwave antenna radiates across broad regions of Earth's surface employing a similar wavelength to that of the capillary waves on the ocean. Data is collected in a continuous 1800 kilometre-wide swath with a horizontal resolution of 25 km, making approximately 400,000 measurements and covering 90% of Earth's surface every day.



The Reflection of Microwaves

In common with light, microwaves also reflect from smooth surfaces. The left-hand drawing above illustrates how a microwave beam angled down on to a perfectly smooth ocean surface would reflect away from *QuikSCAT* with none of the reflected rays returning to the *SeaWinds* sensor. But when the sea surface is covered by small ripples (i.e. capillary waves, right-hand drawing), the microwaves intercept their surfaces at many different angles and reflections take place in a multiplicity of directions (scattering). Consequently, some of the scattered radiation *will* now reach the sensors aboard

QuikSCAT. The rougher the sea surface, the stronger the signal that returns to the satellite sensor.

The Mission

QuikSCAT is tracked from polar ground stations in Svalbard (Norway), Poker Flats (Alaska), Wallops Island (Virginia) and McMurdo (Antarctica). High-quality research data products are produced at NASA's Jet Propulsion Laboratory (JPL) and distributed to the science community within two weeks of receipt; operational data products aimed at the international meteorological community are produced at National Oceanic & Atmospheric Administration (NOAA) within 3 hours of data collection.

QuikSCAT's primary mission objectives include

- Acquisition of all-weather, high-resolution measurements of near-surface winds over global oceans
- Determination of atmospheric forcing, ocean response, and air-sea interaction mechanisms on various spatial and temporal scales
- Combination of wind data with measurements from scientific instruments in other disciplines to help gain a better understanding of the mechanisms of global climate change and weather patterns
- The study of both annual and semi-annual rain forest vegetation changes
- Studying daily, seasonal sea ice edge movement and Arctic/Antarctic ice pack changes
- Improving weather forecasts near coastlines by using wind data in numerical weather and wave prediction models
- The improvement of storm warning and monitoring.

Storm Prediction

Information on global sea-surface windspeed and direction obtained by scatterometry has proved invaluable in predicting both global and regional weather patterns, as well as helping in the determination of the location, direction, structure and strength of hurricanes and typhoons [5]. Our ability to detect and track severe storms has been dramatically enhanced by the advent of weather satellites, and data from scatterometers like *SeaWinds* now augments satellite images by adding direct measurements of surface winds to compare with the observed cloud patterns. Advance warning of strong winds now allows shipping to be re-routed to avoid heavy seas and strong headwinds.

El Niño

El Niño [6] is a phenomenon affecting the trade wind patterns over the Pacific Ocean, and which is now understood to have world-wide effects on climate. Under normal conditions, trade winds blow westward, driving warm water towards Indonesia; this is accompanied by an upwelling of cooler, nutrient rich water off the coast of Ecuador. The temperature difference is of the order of 8°C. During an *El Niño* episode, these trade winds weaken, reducing the upwelling with drastic effects on marine ecosystems and commercial fisheries off the South American Pacific coast. Rainfall patterns also reverse: Indonesia and Australia suffer drought while the Pacific coast of South America can experience unseasonable heavy rains and flooding.

One of the design objectives for *SeaWinds* was to be part of a global monitoring system to observe the tropical oceans and help to predict *El Niño* and other irregular climatic variations. Ocean scatterometry improves man's ability to anticipate how climate and weather may change, both seasonally and from year to year, leading to better management of global

agriculture and water reserves. The ability to accurately predict *El Niño* would be of great benefit to countries, not just those surrounding the Pacific basin, but around the world.

Ice Detection and Monitoring

In addition to its primary role of wind analysis, the *SeaWinds* radar also finds use in mapping ice sheets and icebergs in the polar regions. Again, its ability to cut through cloud, and to image during the southern winter are its most valuable attributes. Figure 1 is a composite image of Antarctica constructed from a full day of scatterometer data. The bright central area of the image is the Antarctic icecap while the darker rim represents the seasonal ice surrounding the continent. Figure 2 is an enlarged section showing the icebergs B15 and B16.



Figure 1 - A composite *SeaWinds* radar image of Antarctica dating from October 2, 2000

Image: NASA/JPL.

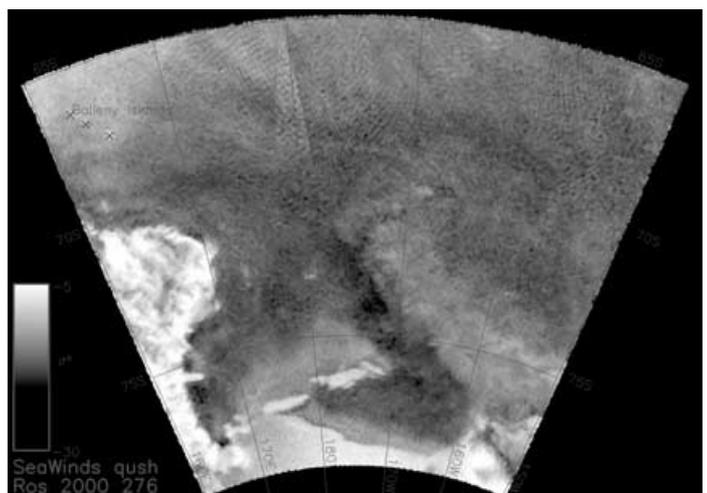


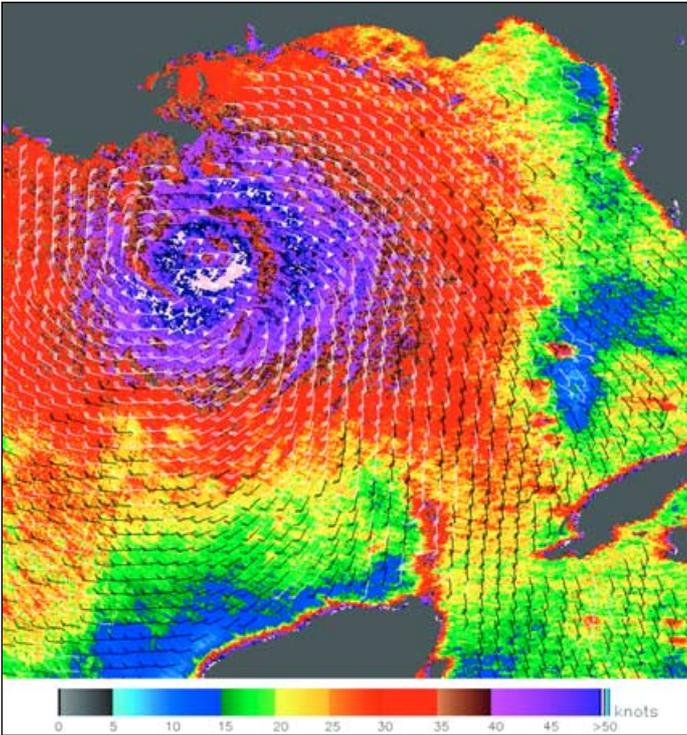
Figure 2 - Image of Icebergs B15 and B16 off the Ross Ice Shelf

Image: NASA/JPL.

Accuracy and Errors

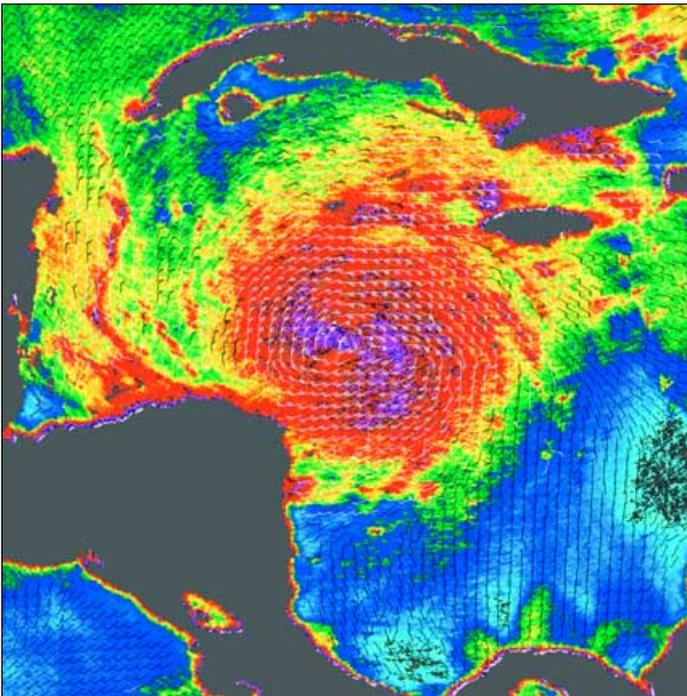
SeaWinds measures windspeeds of between 3 m/s and 20 m/s with an accuracy of 2 m/s, its direction with an accuracy of 20°

continued on page 44 ...



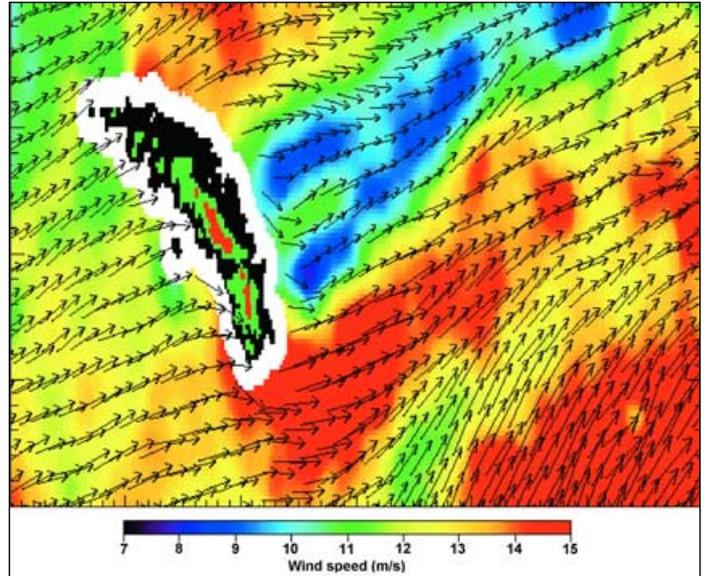
At the time that *QuikSCAT* acquired this image of **Hurricane Katrina** on August 28, 2005, the National Hurricane Center was reporting winds of over 250 kph. This image depicts relative wind speeds swirling around the calm centre of the storm. The highest wind speeds, shown in shades of purple, circle a well-defined eye with gradually weakening winds radiating outward. The bars reveal wind direction, and the white bars show heavy rainfall.

NASA image courtesy the *QuikSCAT* Science Team at JPL



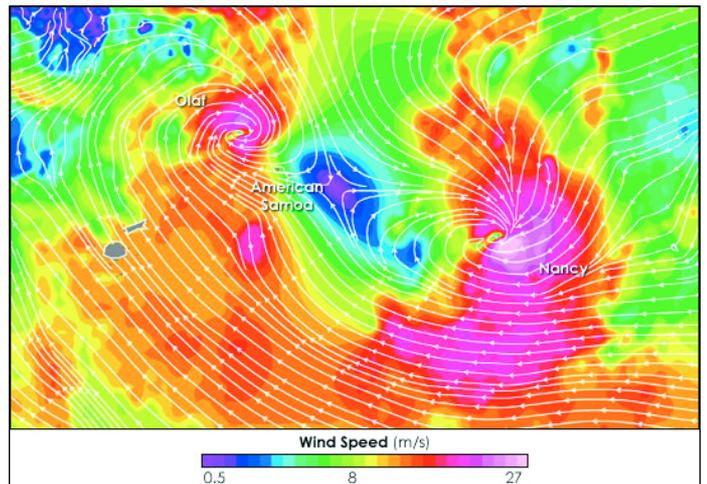
When *QuikSCAT* imaged **Hurricane Wilma** at 23:31 UT on October 18 sustained windspeed was 130 kph. During the following twelve hours Wilma's power increased dramatically as she developed into a Category-5 hurricane with sustained winds of 280 kph! At that point, Wilma had become the most powerful Atlantic storm ever recorded, in terms of both wind speeds and air pressure. Ground measurements of the wind strength of Hurricane Wilma showed sustained windspeeds somewhat higher than those shown by *QuikSCAT* observations. This is because the sheer power of the storm made accurate radar measurements difficult.

NASA image courtesy of David Long, Brigham Young University, on the *QuikSCAT* Science Team, and the Jet Propulsion Laboratory



Mountainous islands and steep coastal topography can modify the surface wind field for many hundreds of kilometers. This is well illustrated from *SeaWinds* data acquired from a *QuikSCAT* pass by **South Georgia** on September 13, 1999. Ocean winds blocked by the island's mountainous spine have produced a long 'shadow' of low winds to the lee of the obstruction; it stretched some 500 kilometers in this image produced using data from *SeaWinds*

Image: NASA / Jet Propulsion Laboratory (JPL)



This colourful image superimposes measurements of wind direction over wind speed. *QuikSCAT* collected this image over the **south Pacific** on February 15, 2005, showing two large cyclones moving steadily closer to each other in a potentially dangerous dance.

It is very unusual for south Pacific cyclones to occur so close together and it is hard to predict how the storms will interact. One possibility is that the weaker storm will be tugged off course by the large-scale atmospheric circulation of the other. Eventually, the weaker storm will seem to 'orbit' the stronger one. A second possibility is that the outflow from one storm will impede that of the other, weakening it. Regardless of the interaction, the storms posed a potential threat to **American Samoa** and the **Cook Islands**, which are indicated as small grey dots.

At the time this image was acquired, 'Ola' was a strengthening Category-4 cyclone with steady winds of 250 kph and gusts up to 305 kph. 'Nancy' was beginning to weaken with winds of 160 kph and gusts of 210 kph. The strongest winds, shown in pink, circle the centres of the storms. Even without any sort of interaction, the two large storms could pack a dangerous one-two punch to the island nations of the South Pacific.

NASA image courtesy Timothy Liu, Wendy Tang, and Xiaosu Xie, of the *QuikSCAT* Science Team at the Jet Propulsion Laboratory

The Arctic Front

of November 24, 2005

Robert Moore

The passage of a vigorous arctic front on November 24 provided weather observers with an opportunity to record the event simultaneously with a range of instruments, including the 'Mark I Eyeball'. I receive the *Northwood* (Admiralty) chart by radio fax, in black and white, of course. When I asked for permission to use the charts FWOC kindly sent me coloured copies. The chart for 0600Z (chart 1) shows a northerly air-stream with two cold fronts ahead of troughs. The first of the fronts passed my weather station in north Wales at about 0800 as is shown by the thermograph trace (chart 2), although it is barely visible in the barograph trace (chart 3).

At about noon the sky turned very dark and lights had to be switched on indoors. Low dark clouds could be seen approaching rapidly from the north (figure 1, page 30). Shortly after this photograph was taken, rain started rattling against the windows (chart 4). That this really was a very vigorous front may be seen from the dramatic drop in the air temperature at midday. There was also a very brief rise in barometric pressure, immediately followed by a continuation of the rapid fall that had started about 24 hours earlier. The wind shifted from west to north-west.

Having looked at the satellite imagery (figure 3), I confidently told a visitor that the wind and rain would soon be replaced by bright skies. Unsurprisingly, this proved to be so. The second photograph was taken at 13:45. At this time we passed into cold and clear Arctic air, which gave almost unlimited visibility—the peaks of the Lake District could easily be seen from north Wales.

I have an especially good vantage point to observe weather coming from the north, but we can all use our eyes and ears to observe the weather (see for example my report of a similar event in GEOQ 3, page 42). Watching the barometer or the smoke from neighbours' chimneys—low-tech activities—can add to our understanding of our high-tech satellite imagery. Some additional instruments, like an outside thermometer and a barograph, enable us to tie our observations together even more cogently. On a day-to-day basis we relate our satellite imagery to general conditions outside, as shown in the weather charts. In the UK this mainly means the passage of Atlantic lows or the presence of blocking highs which are typical features of our annual pattern of weather change; we are less likely to be able to follow very short term or local changes. The events of November 24 were not typical or routine incremental changes however, but sudden and sufficiently dramatic to hit the headlines in the press and television. Using our satellite imagery and relatively simple instruments, plus our normal human senses, gives us insight into such weather events, as they happen, and enables us to do local short-term forecasting of our own. This may even enable us to beat the television forecasters to the punch!

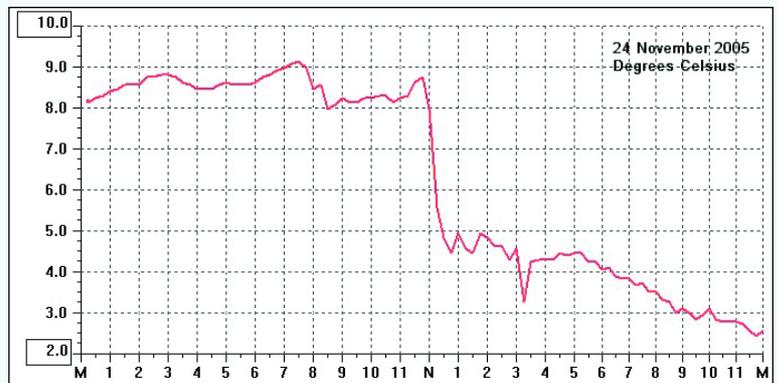


Chart 2 - Air temperature

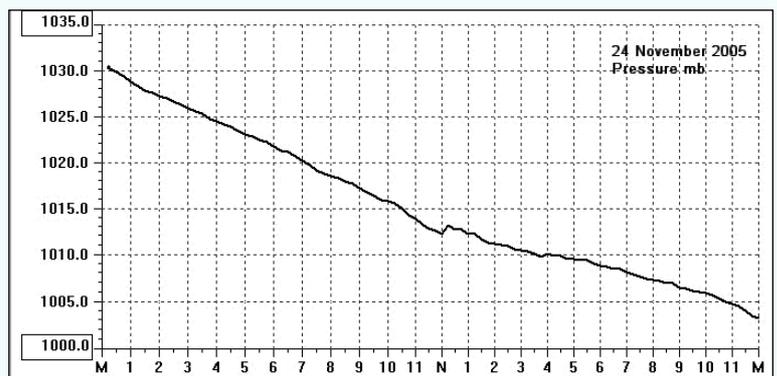


Chart 3 - Barometric pressure

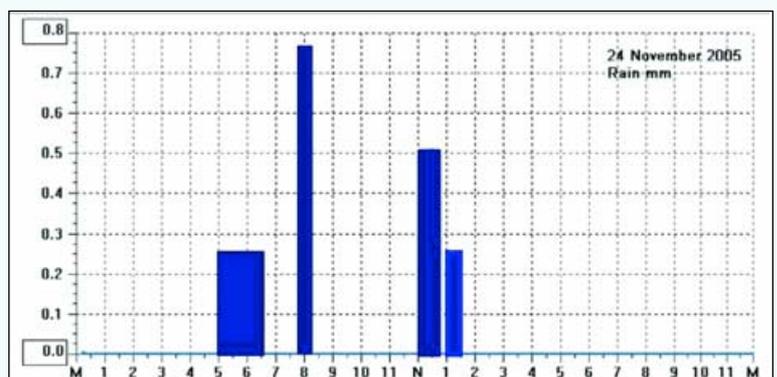


Chart 4 - Rainfall

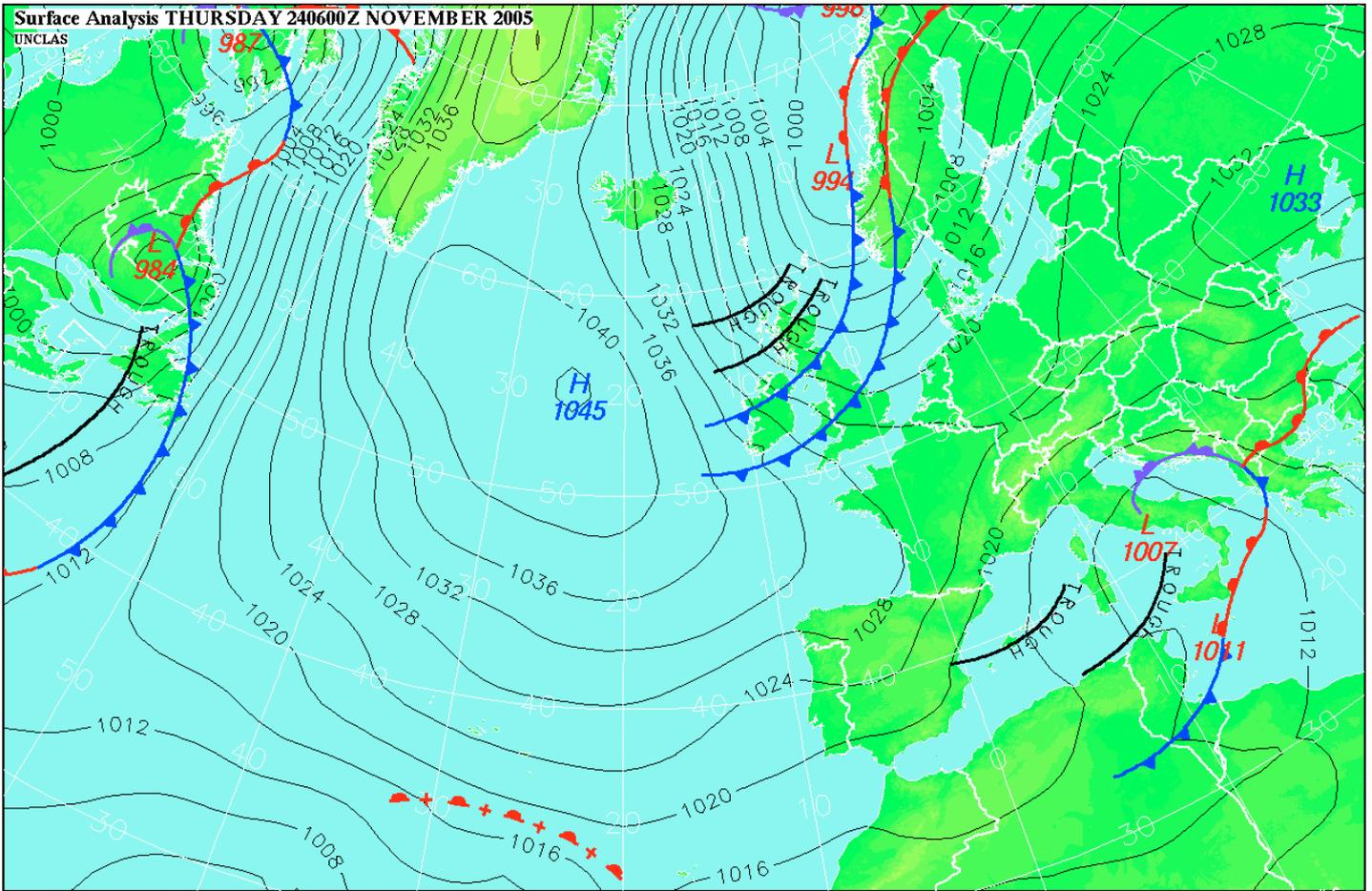


Chart 1 - The MSLP 0600/24 (Image: Commander-in Chief Fleet's Weather and Oceanographic Centre, Northwood.)



Figure 1 - View North at 12:00



Figure 2 - View North at 13:45

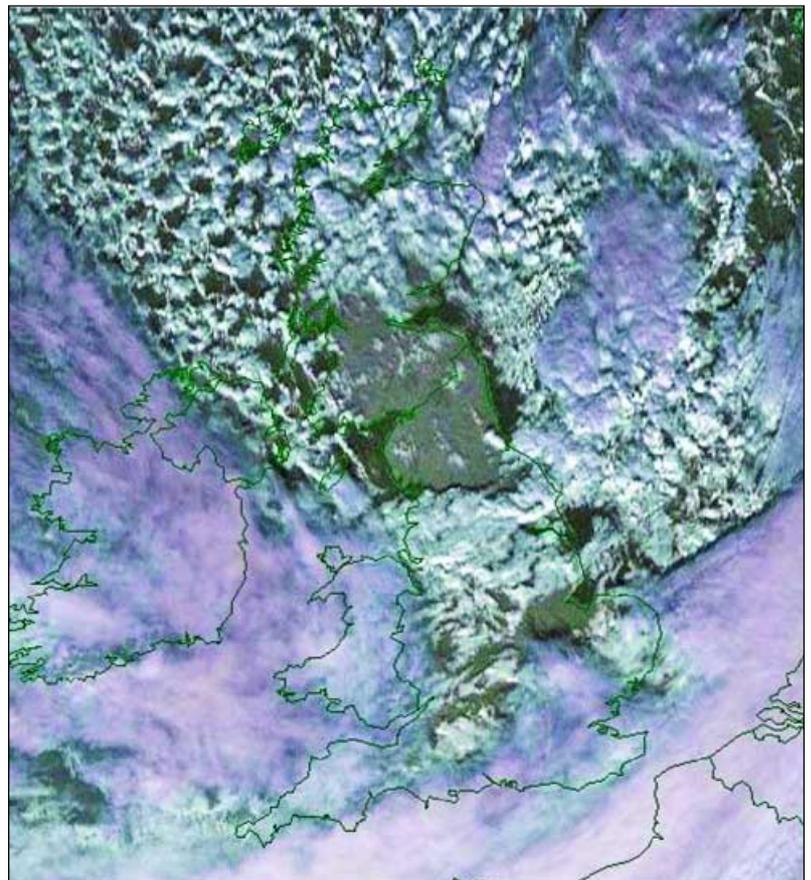
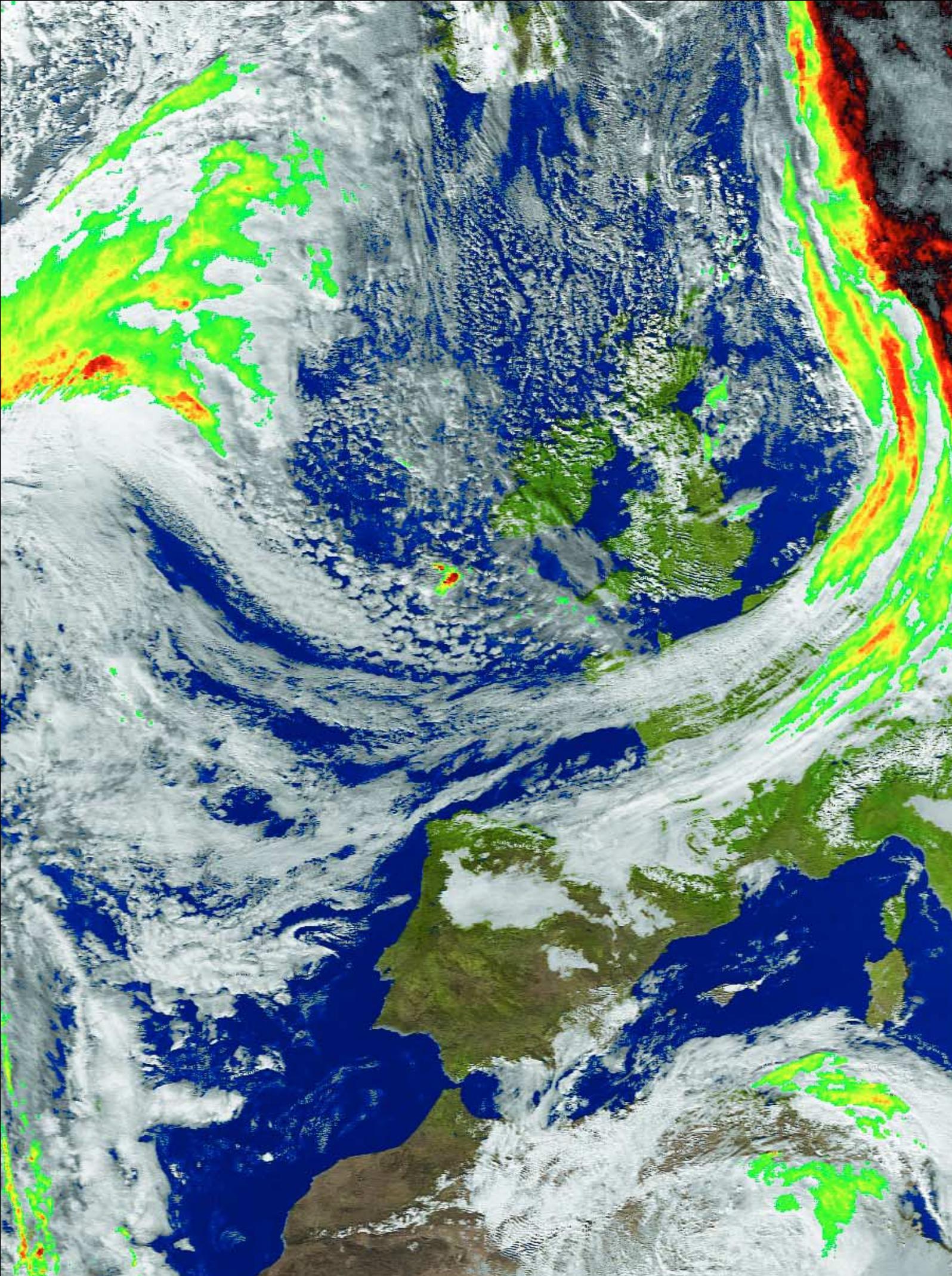


Figure 3 - Meteosat-8 HRV at 12:00

Image: © EUMETSAT (2005) Processing: GeoSatSignal



Gerry Berg sent us this NOAA-18 APT image decoded from the 13:40 UT pass on January 20. While Russia was enduring temperatures as low as -30°C, high pressure over the North Sea kept the big freeze at bay from the British Isles. Image processing was with WXtools using the MSA mode (channels 2+4) with added precipitation colouring. The darker the colour (orange, red, black) the greater the precipitation intensity.

The Indian Space Programme

Part 5

Peter Wakelin

This final part in the series details some recent events in the Indian Space Programme and looks at some of the exciting plans for the future.

CARTOSAT-1 Launched from New Facility

A newly completed second launch pad at the Sriharikota range was used to launch the 6th commercial flight of the Polar Satellite Launch Vehicle (PSLV) on May 5, 2005. The 1,600 kg payload comprised *CARTOSAT-1* and *HAMSAT*, both of which were placed in 632 × 621 km sun-synchronous orbits. Lift-off occurred shortly after ignition of the core first stage and four of the six strap-on boosters; 25 seconds later, the two remaining boosters ignited and, subsequently, booster separation, first stage separation, second stage ignition, payload fairing separation, second stage separation, third stage ignition, third stage separation, fourth stage ignition and cut-off all went exactly as planned. *CARTOSAT-1* was successfully released from the fourth stage 1078 seconds after launch and, 40 s later, *HAMSAT* left the equipment bay.

CARTOSAT-1 is the eleventh satellite in the Indian remote-sensing series. It carries two panchromatic cameras that take stereoscopic images in the visible part of the electromagnetic spectrum with a ground resolution of 2.5 metres in a swathe 30 km wide. A 120 gigabit solid-state recorder is also on board, enabling imagery to be returned from well beyond the range of ground stations within India and at Bearslake (Russia), Mauritius and Biak in Indonesia.

Radio Amateurs Develop Transponders for HAMSAT

The 42 kg *HAMSAT*, launched with *CARTOSAT-1*, is India's contribution to the international amateur radio community. One of the transponders was developed by Indian amateurs with some help from the Indian Space Research Organisation (ISRO).



HAMSAT

A second transponder was developed by a Dutch amateur radio operator who is a graduate engineering student at the Higher Technical Institute, Venlo, Netherlands. It is ISRO's hope that this spacecraft will help to popularise space technology throughout the region.

INSAT-4A, ISRO's Heaviest Satellite Launched

The 169th flight of the Ariane launch vehicle (an Ariane-5G version) lifted off from Kourou, French Guiana, on December 22 carrying ISRO's *INSAT-4A* and its co-passenger



INSAT-4A

MSG-2. The first stage vehicle was sub-orbital and re-entered the atmosphere over the Pacific Ocean. A single burn of the second stage took it, with its massive payloads, to a 620 × 35853 km geostationary transfer orbit (GTO), inclined to the equator at 3.9°, where the satellites and the *Sylda* adapter were released. Three orbit-raising burns of *INSAT*'s propulsive system took the 3080 kg spacecraft into geostationary orbit where the solar arrays were successfully deployed. When commissioning is complete, *INSAT-4A* will operate alongside *INSAT*s 2E and 3B at 83° east longitude.

Built at ISRO's Satellite Centre (ISAC) in Bangalore, *INSAT-4A* is the first of a new series of Indian communications satellites. It carries 12 Ku-band transponders with a footprint covering mainland India and 12 C-band transponders with expanded radiation patterns extending eastwards to the western Pacific region and westwards to support the large Indian population in the Persian Gulf area. The 15 m-span solar cell array provides 5.5 kW of electricity and there are three 70 Ah nickel-hydrogen batteries to continue operations during solar eclipses. Other satellites in the *INSAT* series which are currently operating, some of which incorporate meteorological sensors, are listed in the panel at right.

Satellite	Location
GSAT-2	48°E
INSAT-3E	55°E
EDUSAT	74°E
KALPANA	74°E
INSAT-3C	74°E
INSAT-2E	83°E
INSAT-3B	83°E
INSAT-3A	93.5°E

New Propulsion Systems under Development

ISRO successfully ground-tested an improved version of the solid-propellant strap-on motor for the PSLV on December 29. At present, each of PSLV's six strap-on motors carry 9 tonnes

of propellant but the new motor, designated PSOM-XL, with a length of 13.5 m, has a 12-tonne capacity which will permit a significantly increased payload mass.

Work is at an advanced stage in developing a cryogenic upper stage for ISRO's Geosynchronous Satellite Launch Vehicle (GSLV) which uses extremely cold liquefied hydrogen and oxygen. These cryogenic engines are far more efficient than conventionally-powered ones but huge technological problems hinder their development. A brief 'potted history' of the background to this development follows:

In the late 1980s, various problems delayed development of the International Space Station. The US wanted to fly their Space Shuttles to the up-and-running Russian *Mir* Space Station. At about this time ISRO wanted to acquire foreign cryogenic engines as it knew it did not have the capability to develop its own, so it placed a contract with Russia to provide the engines and technical assistance. The US Clinton Administration did not want India to have cryogenic technology and forced Russia to cancel the contract for engines on the grounds of 'weapons proliferation issues'. The Russians retaliated by raising the cost of Shuttle/Mir flights to recoup the (greatly exaggerated) losses allegedly incurred by cancelling the engine contract. Eventually, some Russian engines were permitted to go to India but now ISRO has developed the technology and it poses no military threat.

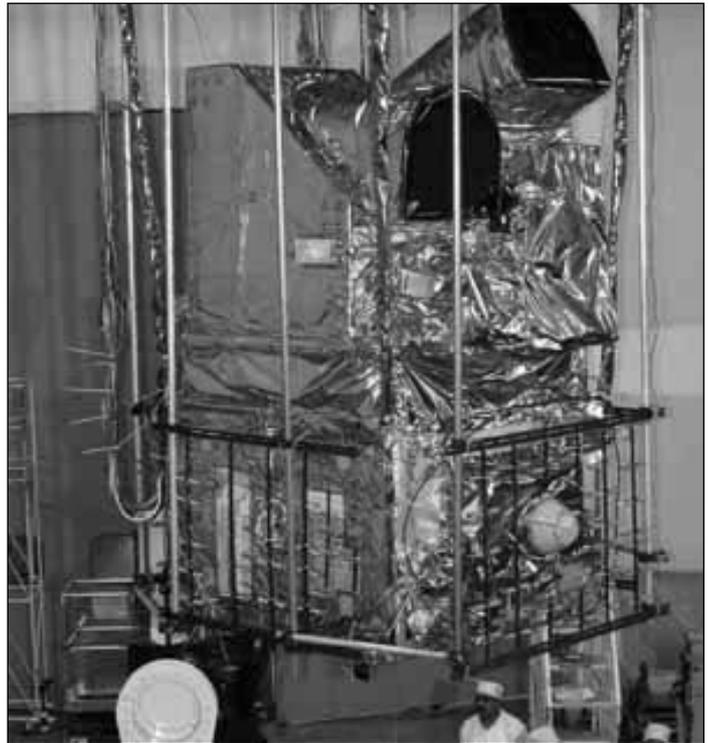
Ground tests have been successfully completed and a test flight of the new cryogenic stage is to be conducted on a developmental flight of the GSLV this year. The updated vehicle will be known as the *GSLV-Mk III* and will be capable of putting more than 4,000 kg into GTO. It will obviate the need to purchase foreign launch services to orbit heavy payloads such as the recent *INSAT-4A* launch conducted from Kourou as well as create many highly-skilled jobs for Indians.

ISRO's Vikram Sarabhai Space Centre at Thiruvananthapuram, has successfully carried out the design, development and realisation of the Supersonic Combustion Ramjet (SCRAMJET). Through a series of ground tests, a stable, supersonic combustion has been demonstrated for nearly 7 seconds with a Mach 6 inlet airspeed. To date, only the US has conducted an in-flight SCRAMJET demonstration but the potential benefits the technology offers are enormous. If a highly efficient SCRAMJET could be developed for a launch vehicle's first stage, the need to carry oxidiser for the fuel would be eliminated and the payload could be significantly increased. The development of reusable hardware would dramatically reduce launch costs too. A flight test using ISRO's two-stage RH-560 sounding rocket, modified to take an experimental SCRAMJET is planned, but will not take place soon.

Some Forthcoming Launches

The year 2006 is likely to be a busy one for ISRO with several spacecraft being prepared for launch as well as the test launch of the new cryogenic engine.

CARTOSAT-2 is scheduled for a July lift-off although one source suggests a delay until August or September. It is an updated version of *CARTOSAT-1*, already in orbit, with an improved resolution of only one metre. The payload of this PSLV launch will also include *SRE-1* and *ANUSat*. The former is a small Space capsule Recovery Experiment (SRE), developed by ISRO to carry out zero-gravity experiments in the fields of metal melting, composites and microbes for biological tests. A capsule will return the experiments to



CARTOSAT-1

Earth after a few weeks. *ANUSat* is a co-operative microsat mission of Anna University of Chennai and ISRO. Anna University is the first in India to take up space technology, with emphasis on microsat development, in its engineering curriculum.

INSAT-4B is another 3,000 kg communications satellite scheduled for a July lift-off from Kourou on an Ariane-5 vehicle.

INSAT-4C is somewhat lighter than 4B, making a launch on a GSLV from Sriharikota in August possible.

ISRO has launched several small foreign satellites as 'piggyback' payloads on its rockets but, for the first time and possibly as soon as May, the Italian satellite *AGILE* will be the lone passenger on a PSLV launch. The financial details of the multi-million dollar contract have not been disclosed. *AGILE* (Astro-rivelatore Gamma a Immagini LEggero) will provide a powerful and cost-effective observatory for gamma-ray astrophysics. Its sensors will be the first to be sensitive to photons above 30 MeV.

GSAT-4 is an ISRO-built, experimental, communications satellite destined for a ride to geostationary orbit on a GSLV later this year. Bolted to its side will be a rotatable platform carrying the Tel Aviv University Ultra Violet Experiment, *TAUVEX*. The *TAUVEX* is a telescope operating in the ultra-violet region and will help to answer astrophysical questions in areas such as star formation, history of galaxies, physics of giant black holes etc. Indian scientists will also use the data in preparing themselves to receive and analyse the data from their own UV imager on the forthcoming *ASTROSAT* (see below).

INSAT-3D is a dedicated meteorological satellite to be launched by a GSLV in October.

concluded on page 39 ...

GeoSatSignal 5



Part 1 - the basic functions

Douglas S Deans.

The development of this program by David Taylor began in 2001 and I consider myself privileged to have witnessed at close hand its progress from a simple joining program through to the sophisticated package of today. Let me make it quite clear from the offset that my involvement was merely one of providing a very eager test computer and, with my many years of geostationary reception experience, the odd useful suggestion. The program was born from a need to provide post reception processing for geostationary weather satellite imagery. Much of the software provided with geostationary hardware packages, while excellent for many things, was less good for subsequent image processing. Anyone familiar with the 9 sectored format of Meteosat WEFAX would realise that it was screaming out for an automated way of joining adjacent sectors.....incredibly nothing was available until David Taylor embarked upon GeoSatSignal (GSS).

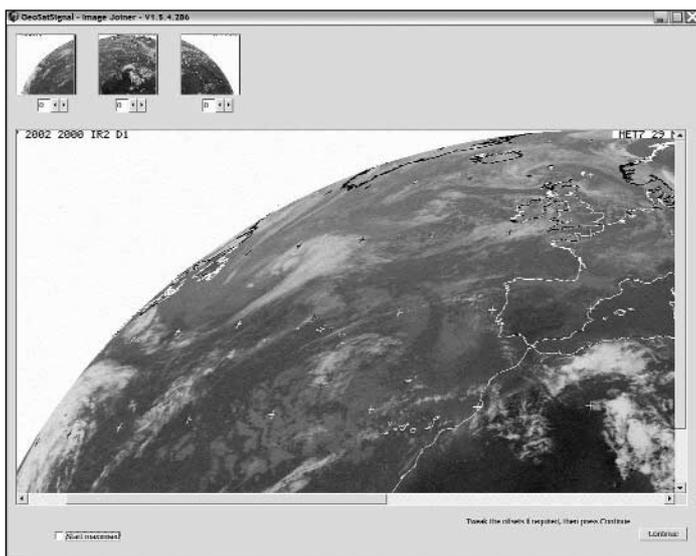


Figure 1 - Combining WEFAX segments

Figure 1 shows a composite WEFAX D1/D2/D3 joined using an early version of GSS. As received WEFAX images could be a pixel or two out of registration the program provided a nudge facility to perfect the join. This was particularly useful where images were being utilised for animation purposes.

As many of you know WEFAX will be coming to an end very soon. Indeed it is already dead in America. It seems likely that there will be many enthusiasts migrating to the new digital formats which have been available, from a range of sources, for several years. This is where the current GeoSatSignal 5 program comes into its own and is part of the reason for my undertaking the article at this time. Of course I hope it will also act as a refresher for others, including myself ! I do not want to spend any more time discussing the original versions of GSS but I did want to reminisce for a moment and remind everyone of the simple beginnings of this program. Does make you appreciate the development even more ! Of course all the facilities first provided in those early versions of GSS are still there along with the more recent developments.

What I would like to do in this, the first part of my article, is to give an insight into the more basic aspects of the program including setting up and to look at some of the more common day to day chores. It is essential that you become familiar with the basic functions before tackling some of the more advanced features which I will be looking at in Part 2 next quarter. I was fortunate in that I have used the program over a long period of time with many features being added progressively. Many of you will come to the full program from day one and that is perhaps a little more daunting.

There is a basic version of GeoSatSignal which is provided as a free program, but for support and to enjoy many of the more advanced features, registration is required. Quite frankly given the not unreasonable cost of the program and the additions available, registration is a must. By all means use the free software to assess if it is what you want but if so please register. Do remember that software authors have to earn a living and we all want our programs updated from time to time. Many of you will already know of the incredible support that David provides for his full range of registered software. With this in mind my review is based on the fully registered version. Of course it is not possible in an article of this size to cover all aspects of such comprehensive software but I do hope it will be helpful in setting new users on their way and for others perhaps offering a light refresher course. The program can be downloaded from David Taylor's web site at :-

<http://www.satsignal.net>

under 'Satellite Tools' and following the link to GeoSatSignal. It is also available on the GEO Software CD, GS1 along with many of David's other programs.

The File System.

GeoSatSignal is designed to work with a vast range of file types and as such can be used by those employing direct reception methods including EUMETCast, or utilising Internet data and other methods of file reception. There are too many formats to mention here but the table below shows the most important ones.

Formats supported	Filetype extensions
General Images	.JPG, .BMP, .PNG, .TIF
Timestep images	.DAT
Dartcom images	.ASD
FY2C data as small IR images	.JPG
FY2C data as 133 MB HDF files	.HDF
GMS-5 data in the Taiwan FDK and LCC formats	.FDK, .LCC
GSFC Meteosat 7 data	.ARA
MSG-1 data as image files	.JPG, .PNG
Orbit/SSB files	.HRM
PDUS files in the Dundee Level-1 format	.PDU
PDUS files in Timestep format	.MPD
PDUS files in DTP MET format	.MET
PDUS files in Rob Alblas format	.RAH

The simplest way to use GSS is to utilise the <File → Open> menu and load the required file. If you have the colour option selected in the Job set up and you choose a visible channel then the program will automatically look for and load a corresponding IR and WV

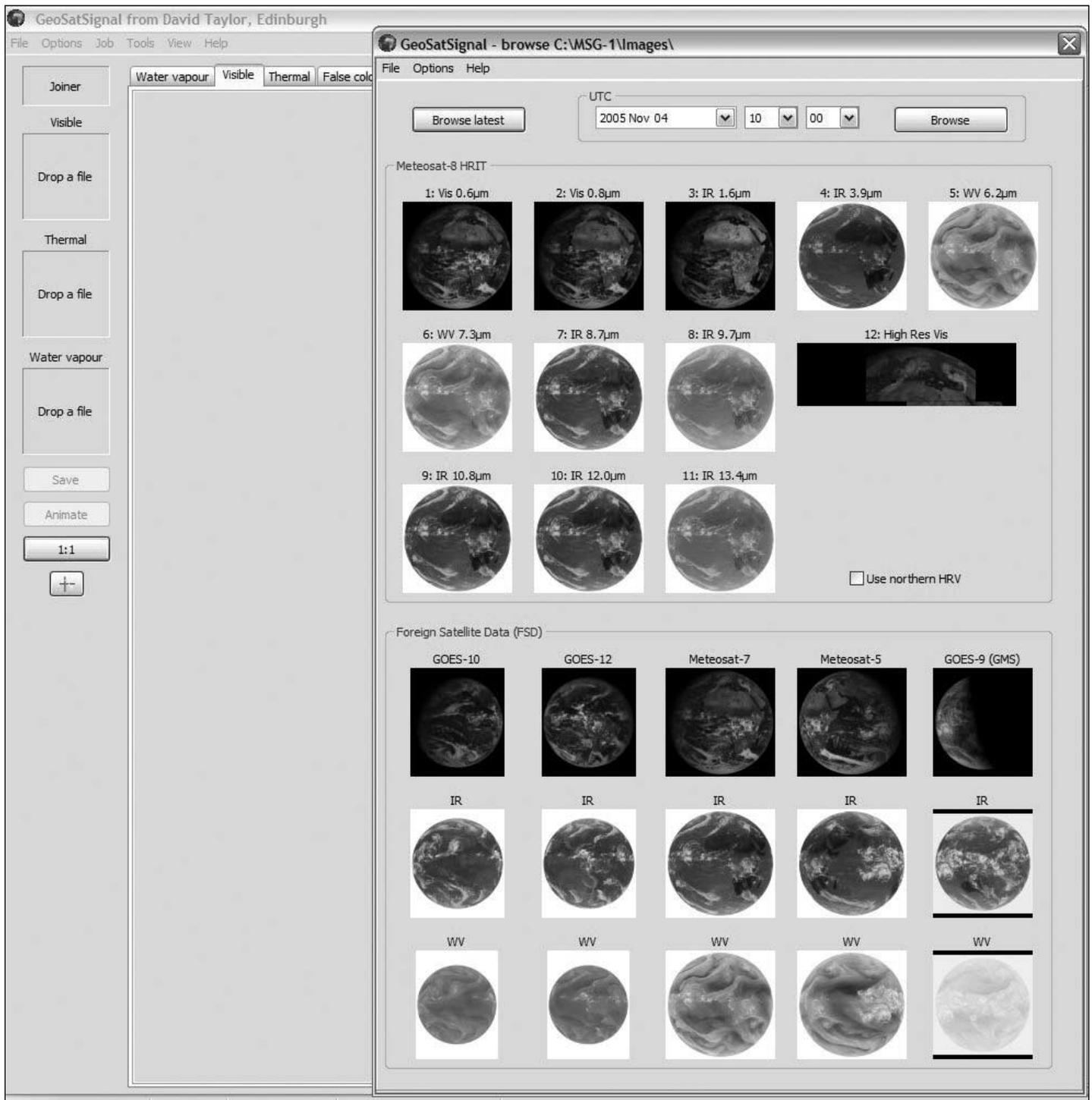


Figure 2 - The GeoSatSignal MSG browse window

channel if it is available. If an IR image is loaded the program does not look for any other files. Another useful option is the ability to drag-and-drop files on to the panels provided. Those panels can be seen on the left of Figure 2 where it says 'drop a file'. This can be useful where, for example, filenames of multi-wavelength images are not matching and so would not be picked up automatically by the program for the colour setting. It also allows some experimentation by providing user control of wavelength mix. However, that is probably for more experienced users.

Under the <File> menu there are a couple of handy browse options where large thumbnails can be viewed for either the EUMETCast system or for WEFAX. For obvious reasons I will look at the EUMETCast system. This option gives you a visual on

the whole range of EUMETCast image data including 12 channels of HRIT, 5 channels of LRIT and the Foreign Satellite Data (FSD) channels. Figure 2 shows an example of the EUMETCast browse window where HRIT and FSD have been selected. Under <Options> you can choose which (or all) of those categories you want and there is a further option to re-sample. Usefully there is a 'Browse latest' button which will do just that for the categories you have already set up but there is also an option to choose a specific date and time if that is required. Double-clicking on the image filename will load it into the currently selected Job (see later) and process it in accordance with that Job's settings. Choosing a Job other than the current one is achieved by simply right clicking on the image of your choice, selecting the desired Job (from a menu) and hence processing suite: could not be easier. The 'Browse' button provides a useful visual alternative to

loading in a file and is particularly handy when there is a large selection of channel options, or where a quick first look might influence the image choice.

'Job' Hunting

One of the most fundamental and important concepts to be grasped, because it makes life so easy, is **<Jobs>**, which can be found on the upper taskbar between **<Options>** and **<Tools>**. Forty-nine Jobs are provided—more than enough for even the most active enthusiast to set up. GSS is able to offer a huge range of processing options including false colour, overlays, zooms, animations and remapping to mention just a few. Jobs will involve some or all of those processes and so can be quite complicated, and hence time consuming, to set up. Not something that you want to do on a regular basis.

However with the Job arrangement you only need to do this once for each process package you wish to set up—and the work is done. Thereafter when you wish to use that package, simply load the image or images into the appropriate Job and the operation is completed automatically. Simplicity itself. As an example Figure 3 is a coloured, orthographically remapped close-up of the UK with geographic outlines and grid lines employing the use of several images. With the Job option, it was produced by simply loading a single channel-12 HRV, HRIT image from Meteosat-8 into the appropriate Job name. You can even animate these complex images ... but I am getting ahead of myself here!

Job Setup.

Let us now look at setting up Jobs. For the moment, I will concentrate on the basic functions then deal with the more advanced options in Part 2 of this article. There are many settings that are clearly self-explanatory, and as space is limited, I will leave you to look at those yourself. Setting up a Job is very straightforward: firstly select a new Job number then go to **<options → Job setup>**. Notice at this point that there is also **<options → Common setup>** for basic items which are relevant to all Jobs. I will come back to that later in this article.

A typical setup window is shown in figure 4 with the *General* tab highlighted. The most important options from the *General* and *Processing* taps are listed in the tables 1 and 2 on this page.

CLUT (Coloured Look Up Table)

This option from the *Processing* tab merits special mention. The concept is a little more difficult to grasp and I strongly recommend reading the program *help* file provided as there is an excellent write up on this. It is possible to make up your own CLUTs but I would suggest that the majority would use those already provided. Other experts such as Ton Lindemann have produced additional CLUTs for specific tasks and those can be freely downloaded from David Taylor's GSS page (address on page 33).

A CLUT is a small bitmap where pixels along the vertical axis control the greyscale of the visible image, whilst colours on the horizontal axis can represent either brightness values or temperatures for the IR image, dependent on the width of the bitmap. The point is that you have full control of combining visible and IR channels into your chosen colours at each level of combination. This can be most useful in highlighting specific conditions and can, for example, be used to differentiate subtle temperature variations in high cloud that may not otherwise be easily visible.

CLUTs must reside in the *GeoSatSignal* folder and when this is done they will be available for use in the CLUTs and 'Vis ch.' windows. This is an area that requires some reading and

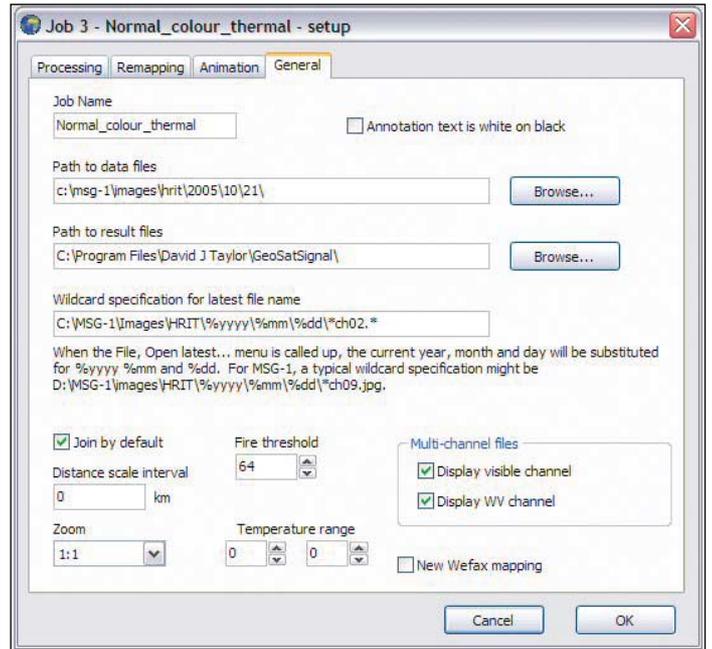


Figure 4 - The Job setup window

Job Name	Very straight forward but choose an easily recognisable description for the package you are setting up. Once you have another 48 of them you will appreciate clarity ! For the example given above and shown in figure 3, a suitable name might well be UK HRV Colour.
Annotation text	Simply decides whether you want black or white text.
Path to Data Files	The program needs to know the location of your Job files
Path to Results Files	The program needs to know where you want the final processed images to be saved.
Wildcard Specification for Latest File Name	Open latest is dealt with elsewhere in the article but this option tells the program which image is required for the process and this will ensure the most recent will be used. A particularly useful function.
Fire Threshold	Only relevant if a channel of appropriate wavelength is used. I recommend leaving the default value but more information on this option is discussed later in the paragraph under the Processing tab heading
Multi-channel Files	This refers only to multi-channel digital data such as PDUS and simply dictates whether the visible and WV channels should be displayed.

Table 1 - Job Setup: General tab options

False Colour	Select 'Normal' if you want a colour image made up from visible and IR images: 'None' for no colour. Other options will be discussed under advanced usage in Part 2.
Thermal FC (Thermal false colour)	Choose this option if you want the IR image overlain on a colour land/sea mask. The resulting image appears on the Thermal FC tab and an example showing a Meteosat-8 full disc can be seen in figure 5.
Fire	This option can only be used for channel-4 (3.9 µm) MSG data, which is particularly good at detecting forest fires and hot spots. If 'Fire' is ticked for a colour option, channel-4 will be substituted for the WV channel and processed in accordance with the fire threshold setting referred to above. Any hotspots will show up on the colour image as a red dot. The threshold setting, discussed earlier, can be adjusted although the value provided by default is probably best left until further experience is gained. Simply put, increasing the threshold is more likely to produce more hot spots and more false positives. An example of such fires using this option is shown in figure 6, where plumes of smoke are also clearly visible.
Boundaries	If you want geographical outlines displayed in the final image then this box should be ticked. Other settings such as the colour of the outlines are dealt with in Common Setup.

Table 2 - Job Setup: Processing tab options

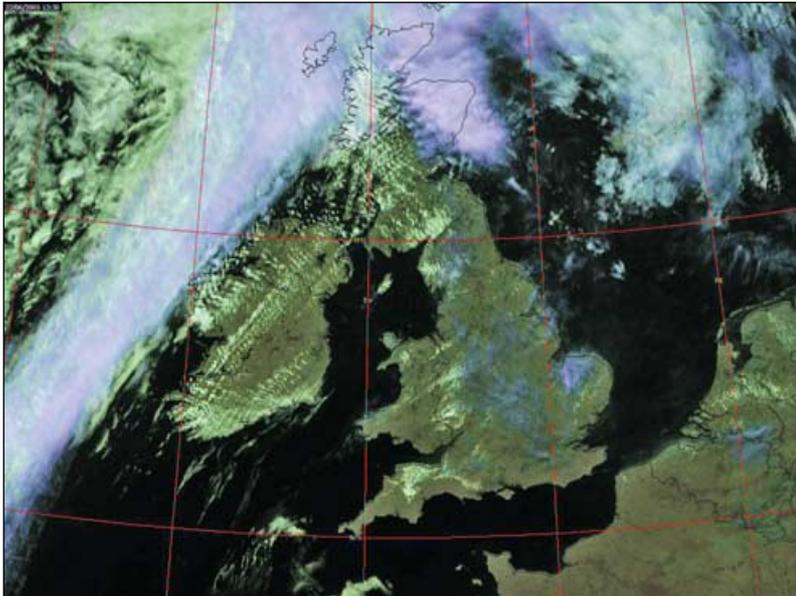


Figure 3 - A coloured, orthographically remapped close-up of the UK

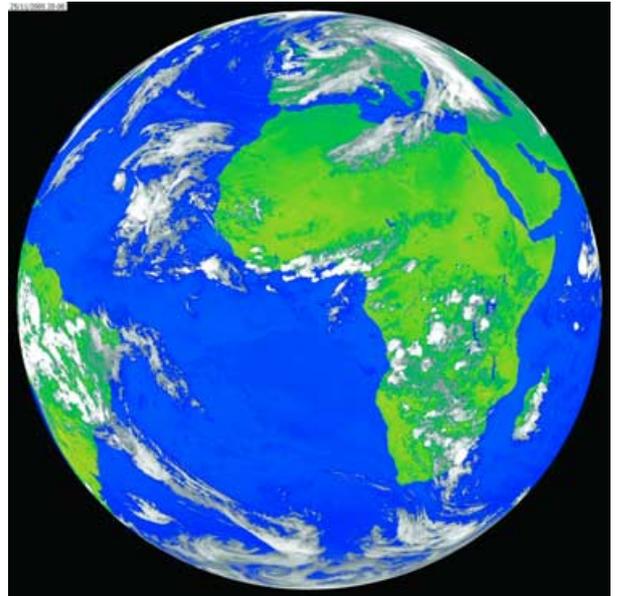


Figure 5 - A full disc IR image from Meteosat-5

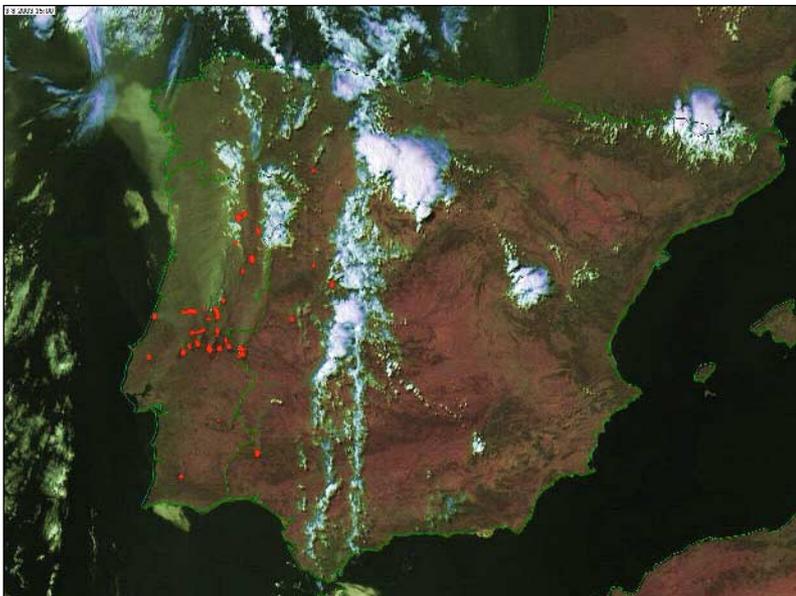


Figure 6 - Fires in Portugal
Image processed by Arne van Belle

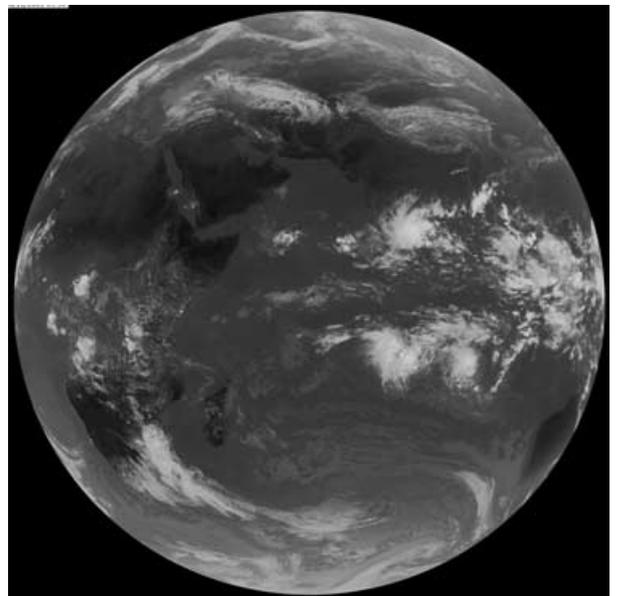


Figure 7 - Calibrated IR image from Meteosat-5

experimentation. There are some unexpected results. As an example, I find that full disc IR images can be visually more pleasing when they have the black surround associated with the visible images: perhaps not for the purist but a pleasing result nevertheless. More importantly, the calibrated data within the disc is not compromised so accurate temperature readings can still be read with the mouse. Figure 7 shows a full disc IR image from Meteosat-5 over the Indian Ocean, processed in this way. CLUTs can be used for both IR and visible imagery and a separate selection point is provided for each.

Common Setup.

As I mentioned before there is also a 'Common setup' for settings that will be valid for *all* Jobs, in other words not Job dependant. Again I do not intend to waste reader's time by going through each and every option, as many of those are also self explanatory. However let me pick out a few that perhaps merit special mention and where a hint or two may be of help to first time users.

Options under the 'General' tab

Admin notice folder: This is the location for your admin messages which are put out by Eumetsat on a daily basis, giving details of satellite

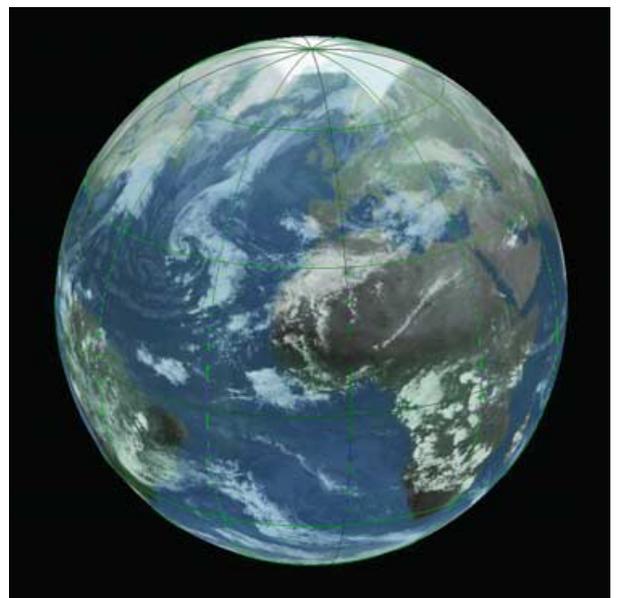


Figure 8 - A world view processed in GSS

problems or warnings for future outages and planned maintenance. There is a range of sources for those messages including wefax, Internet, and Eumetcast. Simply add in the source for your admin files and the latest message will be displayed automatically during the first run of the day of GSS. If you do not wish to see it again for that day simply tick the 'Don't remind me again' box and there will be no further display until the following day.

Auto reprocess: This was one of my pet hates or was until David kindly offered the option of not having it. Auto reprocessing means that if you change jobs it will automatically re-process using the new job but with the file selected for the previous job. If you were moving from a coloured composite job (where Meteosat 8 channel 2 was required) to an IR job (where Meteosat 8 channel 9 was required) then it was a real nuisance. There are undoubtedly times when this could be a labour saving feature but my experience is that more often than not it is the very opposite, so unless you find a particular use for it I recommend leaving it unselected.

Drop priority: This allows you to run CPU-intensive processes at a lower priority to avoid interfering with sensitive tasks such as DVB reception. This would almost certainly be recommended if you were using just the one computer for both reception and processing.

Options under the 'Cartography' tab

Although you can decide whether to have country outlines on a per-Job basis, this common setup provides the source and the colour requirements when outlines are selected.

Country boundary data file: Most readers who are already using David's WXtrack program should provide the location for the *countries.dat* file. There are other high resolution options which users can download and those are referred to in David's web site. If those are to be used ensure the correct file location is provided. Select the colours of your choice for each of the options of Boundary colour, Grid colour and City marker colour.

The Presets tab

Let me say something quickly about the 'Presets' tab as its use can be a very handy time saver. Sixteen preset options are provided for a range of satellites, covering both visible and thermal data.

Once set up, access to loading the files is via **<View → Latest IR>** or **<View → Latest Visible>** and provides very rapid access to this predefined data. As can be seen in the set-up there is also an option to associate each preset with a specific Job number which ensures that not only can you quickly load the latest data, but it can also be automatically processed in accordance with your chosen Job package. The presets provide are :-

AI/AV	- full disk, Meteosat 7
BI/BV	- European sector, Meteosat 7
EI/EV	- full disk, GOES-E
J1/JV	- full disk, GMS-5 (MTSAT-1R)
WI/WV	- full disk, GOES-W
XI/XV	- Indian Ocean, Meteosat 5
M8 FD I	- Meteosat 8, full disk, infra-red
M8 FD V	- Meteosat 8, full disk, visible

Full Example

For those new to the program and anxious to see its qualities, here is a simple example of Job settings to give a full disc Meteosat-8 coloured image with geographical outlines, and showing possible fires. A thermal FC image is also wanted. This uses many of the basic settings discussed in the article. The data

required to be residing in your computer to achieve this are three Meteosat-8 channel images from the same fifteen minute scan; channel-2, channel-4 and channel-9. If 'fire' was not ticked then the WV channel-5 would be required in lieu of channel-4.

How do we set up this Job?

First pick a new Job number and under **<options → Job setup>** go to the 'General' tab and name it. Perhaps 'MSG full disc colour' would be a suitable description for this package. The following settings will be required and those not listed should be left as default.

Processing tab

False colour	Normal
Thermal FC	Ticked
Fire	Ticked
Brightness adjust	Choose to suit time of day and preference
Crispen	0
Sea threshold	0
CLUT	None
Visible channel	None
Boundary	Ticked

General tab

Job name	MSG full disc colour.
Path to data files	Ensure correct location (my one is c:\msg-1\images\hrit2005\11\25\)
Path to results files	ensure correct location. (my one C:\Program Files\David J Taylor\GeoSatSignal)
Fire threshold	64
Zoom	1:4 (This will ensure that the entire disc can be seen in the image window. Of course at any time, you can zoom in and out to look at detail)

Now open the appropriate Job, load in the channel-2 file and voila!

Useful Tips.

There are certain functions in programs which, after months and years of use, you find almost indispensable. At the time those are often simple, innocuous additions but ones that prove to have huge benefit and labour saving. Let me pass on a few that I have grown to appreciate over the years.

Help Files

It may seem obvious but the help files provided within the program are superb and should be the first port of call if you have a problem or need some specific help to understand a more difficult concept such as CLUTs.

Open Latest

I touched on this earlier in the article but suffice to say that in my opinion this has been the most labour saving addition to the program. Prior to this being provided, the normal File>Open option had to be used for all situations. Consider late in the day going to the end of a browse window filled with files for 12 channels at 15 minute intervals. Quite a task when almost always the wanted file is at the end of the list, in other words the latest. A very simple addition but with huge benefit.

Auto reprocess

I mention this one as it can be both useful and frustrating to have this selected. Simply put, if this is ticked then when you change Jobs the file used before will be loaded into the new Job automatically, whether you want it or not. Personally I rarely want this to happen so I leave it unticked.

concluded on page 44 ...

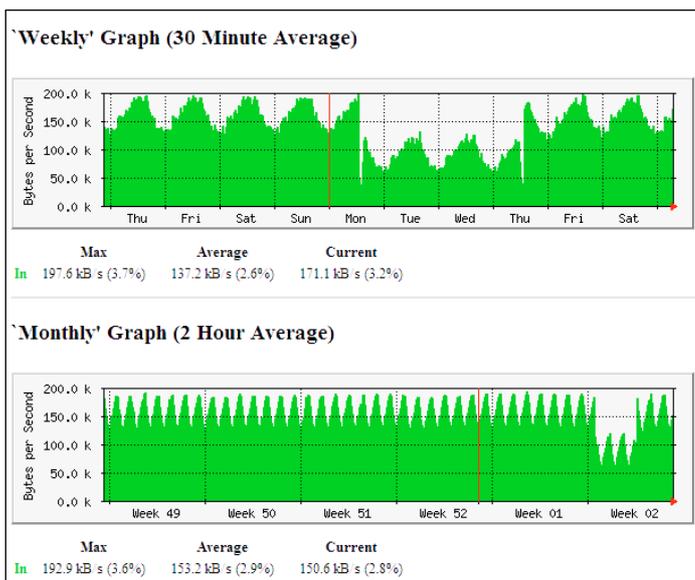
Meteosat-8 Radiometer Decontamination



David Taylor

If you regularly download Meteosat-8 imagery via *EUMETCast* you would have noticed that the flow of data ceased completely for a spell on January 9; when it resumed after a short break, only the visible channels were enabled. This was a consequence of the satellite radiometers being decontaminated.

The IR sensors aboard earth observation satellites have to be cooled to operate effectively and consequently, even in their highly rarefied surroundings, they do eventually start to suffer from a build-up of ice and other condensates. Once or twice a year it becomes necessary to power down the coolant and actually heat up the radiometer assembly for several days to vaporise these deposits. During this exercise, the infrared and water vapour detectors cannot be used. As a result, only the visible light channel data is retransmitted (during daylight hours) during these periods.



EUMETCast data throughput (January 5-14, 2006)

You can clearly see the break in transmission on Monday, January 9, plus the subsequent reduced data from just the visible channels, in the above graph of *EUMETCast* data throughput.

The daily variation of data flow is caused by the differing image content in the compressed visible data between day and night. The decontamination process proceeded until Thursday, January 12, when the imaging was again stopped while the cooling for the IR detectors was restored. Once the detectors had cooled down, imaging was restored.

To restore fully calibrated operation takes a further 24 hours, so the derived meteorological products were not available until the Friday afternoon.

You can read more about the functionality of the twelve MSG radiometer channels in *GEO Quarterly* No 7, page 14.

The Indian Space Programme

... continued from page 33

The last scheduled ISRO launch this year is a PSLV due up in November carrying Singapore's first remote sensing spacecraft, *X-Sat*. Designed at the Satellite Engineering Centre of Nanyang Technical University, Singapore the spacecraft is unique in that it carries a very large processing capacity to process raw data on board thus reducing the bandwidth needed to get the imagery down to Earth.

2007 and Beyond

Unless ISRO can achieve what no other launch authority has achieved, not all the launches planned for this year will actually take place; delays are inevitable for various reasons and some will slip to 2007 or beyond. Several launches are already scheduled for 2007 but just two space science satellites will be mentioned here:

ASTROSAT is an astronomical research spacecraft with sensors designed to detect X-rays over a wide range of energy levels. It will be placed in a low-inclination orbit, probably around 20° at an altitude of 600 km. Also on board will be a 40 cm aperture ultraviolet telescope with a high resolution array of photon counters at its focal plane. Other countries have been invited to fill some spare capacity on the spacecraft and experiments from Bulgaria and NASA have been accepted.

CHANDRAYAN-1 is an ambitious project to place a significant science payload in orbit around the moon. Improvements in the PSLV's performance in recent years means that it has the required power and accuracy for the task. ISRO has made it clear that the lunar mission will not be an exercise in re-inventing the wheel but will utilise new technologies to probe the moon's mysteries. Dr Nair, ISRO's Chairman, points out that a lunar mission can provide impetus to science in India, a challenge to technology and, possibly, a new dimension in international co-operation.

Conclusion

More than three decades ago, Dr Vikram Sarabhai, the architect of the Indian space programme, outlined what he considered should be India's objectives in space:

'We don't have the fantasy of competing with the economically advanced nations in the exploration of the moon or manned flights. But we are convinced that to play a meaningful rôle 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 which we find in our country'

However, in the context of the recent rapid strides by India in many disciplines, such as computing technology, nuclear energy, medical research, etc, the lunar probe is but a reflection of the nation's will.

Acknowledgements

I am indebted to ISRO and the Nation Remote Sensing Agency for making so much information available on their websites:

<http://www.isro.org>
<http://www.nrsa.gov.in>



Figure 1

The annotated track of Hurricane Wilma (red) is added to the DA base-map by means of the 'wnt' warning file from NOAA.

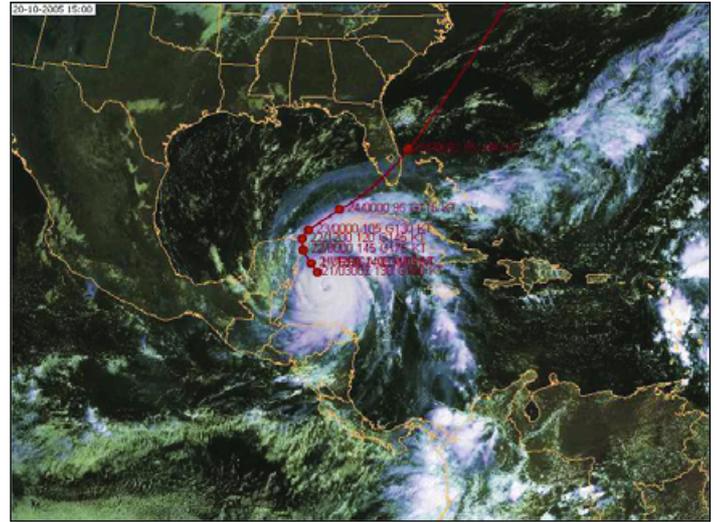


Figure 3

Similar to Figure 1, but this time an actual satellite image has been used as the background.

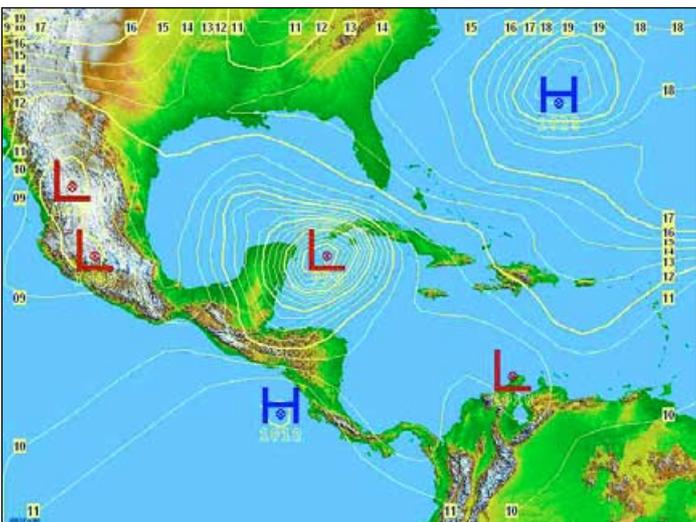


Figure 2

The same image again, with isobars added

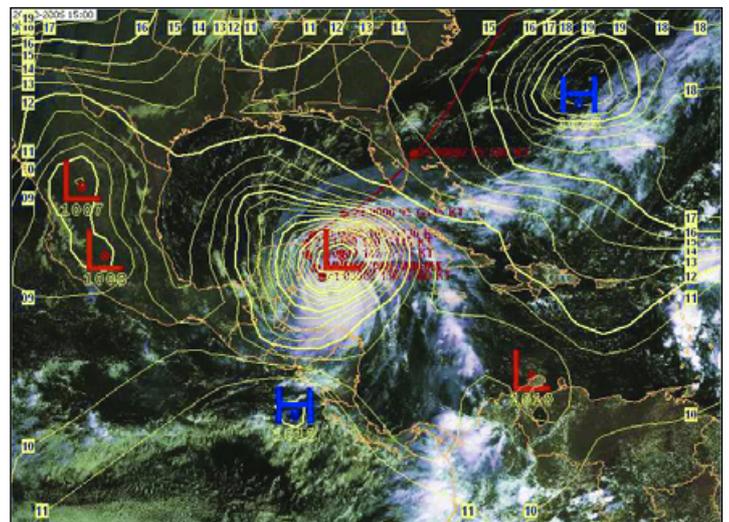


Figure 4

Similar to Figure 2, with an actual satellite image used as the background.

PODÍVEJTE SE NA ZEMI Z VESMÍRU
LOOKING AT THE EARTH FROM SPACE
<http://www.emgola.cz/>

PF 2006

READY FOR NOAA-18

GEO recently received this attractive postcard from Miroslav Gola, who manufactures the RX137141 APT weather satellite receiver.

The receiver is available both as a kit, and a built product.

The receiver has been tested by Francis Bell, and though it suffered pager interference on the 'old' 137.91 MHz frequency, it gives excellent results on the new 137.10 MHz frequency.

Tracking Hurricanes using Digital Atmosphere

Fred van den Bosch

The 2005 Hurricane Season ended on a very stormy note with the arrival of Hurricane *Wilma* [1]. With a new hurricane season starting at the beginning of June, I present here some ideas for tracking hurricanes with *DAWS*. Peter Green explained in his article *Hurricane Forecast Feeds* [2] how you can set up a system to keep yourself informed about when a hurricane is coming. As soon as there is a forecast you first go to:

<http://weather.noaa.gov/pub/data/raw/wt/>

This is the site where the hurricane forecasts used by *DAWS* are to be found. Look for the five hurricane warning files named *wtn21.knh.tcm.at1.txt* through *wtn25.knh.tcm.at5.txt*. Be sure to note which file has the most recent date as the files are continually recycled—the ‘wtn25’ file is not necessarily the current hurricane.

You can open the file with notepad to check if it's the hurricane you want to display. If so, close the file and open *DAWS*; click on the *Retrieve Data* icon (5th from the left end of the toolbar) then scroll down till you see the 5 lines ‘Hurricane track #1 from NHC (Atlantic)’ to #5. Tick the line where the number corresponds with that of the most recent hurricane warning file; e.g. if ‘wtn24’ is most recent one then tick track#4. Now retrieve the data.

Generating Maps

Load (or generate) a base-map of the area where the hurricane is active and select **<Data → Hurricane tracks → Official forecast>** to display the estimated track of the hurricane over the map. Unfortunately it is not always possible to plot only one specific hurricane if several are active at the same time.

If you tick all five ‘hurricane’ lines then all five tracks will be displayed, some of them out of date and not relevant to the current situation.

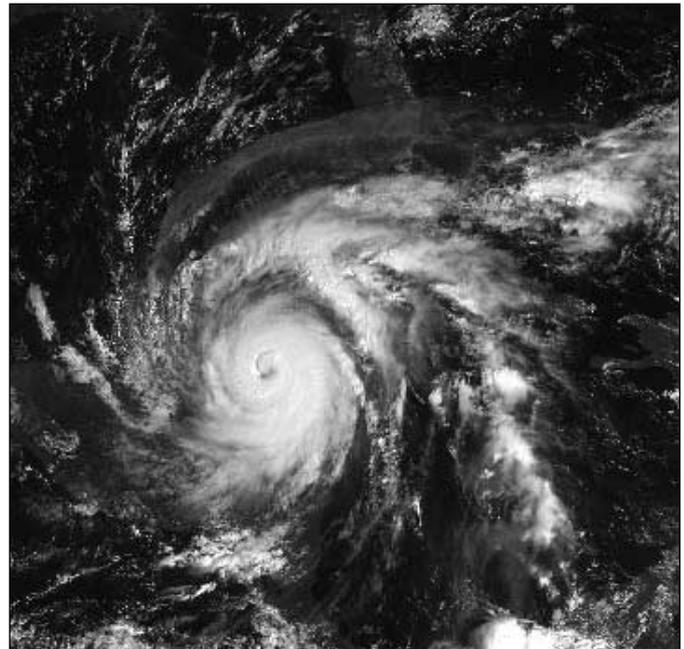
Examples

I present some examples of *Hurricane Wilma*. The parameters of the map I used are listed in the table below.

Digital Atmosphere		GeoSatSignal	
Latitude	20°	Parallel	20°
Longitude	-83°	Meridian	-83°
Scale	3170	Span	35
Size	768 x 576	Size	768 x 576

In both cases, the map projection is orthographic.

```
erase
load,d:\Program Files\DigitalAtmosphereWS\maps\MSG Amerika-Midden.dmf
import,d:\Products\MSG\DAWS\DAWS-Amerika-midden.jpg
basemap
hurricane
stamp
```



Hurricane Wilma off Florida on October 20, 2005
Image © EUMETSAT 2005

Figure 1 shows just the track of Wilma over the *DAWS* base-map and in figure 2, isobars have been added.

Figure 3 is similar to figure 1, but a Meteosat-8 image including Hurricane Wilma has been used as the background: isobars have been added for figure 4. I used a satellite image for the day before the warning file in order to show the eye of the hurricane. If you use an image from the same day, you will see that the first red dot on the hurricane track exactly covers the eye.

Provided you have ingested both the ‘wtn’ warning file and a contemporary synoptic file into *DAWS*, a script that draws the hurricane track is shown in the gray panel below. For details of making such a script refer to GEO Q7 [3]. Of course, you would choose your own names for the base-map and satellite image.

References

1. Unique finale to the 2005 hurricane season, GEO Q8, page 7 (2005).
2. Hurricane forecast feeds, Peter Green, GEO Q8, page 11 (2005).
3. Using scripts with Digital Atmosphere Workstation, Fred van den Bosch, GEO Q7, page 30 (2005).

A simple *DAWS* script for adding a hurricane track to a satellite image called ‘*DAWS Amerika-midden.jpg*’. ‘*MSG Amerika-Midden.dmf*’ is the corresponding *DAWS* base-map.

Book Review

Francis Bell

EUMETSAT have recently published a quality, 120 page paperback book in A4 format entitled *MSG Meteosat Second Generation In Orbit - In Use*. I don't very often read technical literature from cover to cover but this one I did.

If any user wants to learn about the scope and application of MSG data (currently Meteosat-8), this is the book to read. It is informative, technical and attractively produced with illustrations and examples on almost every page. I think the best way to indicate its scope and content is to read the contents page, reproduced at the foot of this page with EUMETSAT's permission. There is



information about MSG's instruments, the data they produce and the subsequent applications of these data.

My strongest recommendation for any existing user of MSG, potential user or

anybody interested in our Earth's atmosphere is that they obtain a copy of this book. It may become a reference document for many years to come.

GEO members' weather satellite interests cover a broad spectrum: the technical challenge of being able to receive and display the satellite data and translate these data into images; the pleasure of just looking at the images; colouring images, contrasting and highlighting them; pushing what is possible to receive on a home PC with minimum cost; and of course looking at the weather systems across the planet. My interests fall into all these categories and this book helped explain to me what I am receiving.

My recommendation is that every existing user of MSG, any potential user, or anybody with an interest in the Earth's atmosphere, should obtain and read this book.

The conclusions of the book read as follows:-

'The information in this publication has been based on data generated over a period substantially less than one full year of operation. Nevertheless, the huge potential is obvious and it is clear that many other specific uses will emerge in the coming years as greater understanding is obtained of the complex data streams. With a total, now, of four satellites of this type approve, it is likely that their data will be used for possibly the coming two decades, with new applications continuing to emerge and older ones improved. This publication is not the last word on the use of MSG, rather it is just the beginning.'

I have secured a bulk supply of the book for distribution to GEO's membership. I will take some copies of the book to the Kempton radio and computer rally in May and also to our GEO Symposium in Leicester on April 29. If you are patient

you can collect a copy directly from me then free of charge.

If you would like a copy before this, I can mail you a copy for the cost of postage (the brochure weighs 500 grams). In this case, refer to the options at the foot of page 3.

I recommend everyone to obtain a copy. You will be rewarded with an excellent reference book for MSG satellites.

More about 3D Images

Fred van den Bosch

In my previous article (Geo Q8, page 24), I described how to make 3D images using *Bas Relief*. By chance I found out that this can be done much more quickly.

The step <smooth> can be skipped. After loading an MSG image into both the *Image* and *Depth map* windows, you can continue generating a 3D-image by simply clicking on <Anaglyph image>. You cannot see differences between images with and without a generated depth map. It looks like smoothing also happens automatically during the generation of the image, as you can see under 'progress'.

You can also experiment with using IR images for the depth map. In fact the brighter the cloud the higher it is. Information from KNMI (Royal Dutch Meteorological Institute) indicated that channels 9 (10.8 µm) and 10 (12.0 µm) are the best for this purpose. This because here the brightness of the clouds, which relates to their height, is the best. So combinations of channel-1 with either channel-09 or channel-10 for the depth map give the most natural effect.

<p>1. Images from MSG</p> <ul style="list-style-type: none"> Imagery Basics Images of Clouds and surface Images of the Atmosphere High Resolution Imagery Presentation Methods Impact of HRV Imagery Impact of Multi-Channel Sensing Impact of 15-Minute Imagery <p>2. The MSG System</p> <ul style="list-style-type: none"> System Overview The SEVIRI Radiometer The GERB Instrument Search & Rescue Services Satellite Application Facilities 	<ul style="list-style-type: none"> Meteorological Product Extraction Facility Data Dissemination via the EUMETCast System <p>3. Forecasting the Weather</p> <ul style="list-style-type: none"> Forecasting Uses of Images and Products Nowcasting and Very Short Range Forecasting Forecasting for Aviation, Marine and Land Transport Prediction and Monitoring of Hazardous Weather Monitoring Convection Synoptic Scale Systems Hurricanes and Tropical Cyclones 	<ul style="list-style-type: none"> Data for Numerical Weather Prediction Diagnostics for Numerical Weather Prediction Support Products <p>4. Climate Applications</p> <ul style="list-style-type: none"> Earth Radiation Budget Surface Radiation Budget Archive and Long-Term Data Sets Global Data Sets Validation of Climate Models <p>5. The Atmosphere</p> <ul style="list-style-type: none"> Clouds Cloud Properties Cloud Top Heights 	<ul style="list-style-type: none"> Fog Wind Vectors Water in the Atmosphere Precipitation Condensation Trails Dust and Aerosols Volcanic Ash Plumes Stratospheric Ozone <p>6. The Surface Environment</p> <ul style="list-style-type: none"> Oceans Sea Surface Temperatures Land Surface Products Snow Cover Environmental Data Vegetation Mapping Wildfires
---	--	---	---

SOFTWARE SHOWCASE



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

This quarter sees a major update to one of David Taylor's most popular programs, SatSignal. Whilst this column was in preparation, David forewarned me of the imminent release of SatSignal 5, allowing a brief review to be given below.

Before undertaking the reviews, some information regarding the NASA World Wind program which readers will be aware was added to the GS2 CD last year. I have decided for a range of reasons to remove this program from the Software Collection. I am conscious that one of the fundamental reasons for Software Showcase, apart from reviewing shareware relevant to our hobby, is to offer those with no Internet facilities or just dial-up options the chance to enjoy programs or image data

of a much larger size. At over 180 MB, World Wind admirably fits that category. However NASA have now altered the program function to reduce the download size but this now means that there are many other items that must be downloaded after the program is up and running, including for some the Microsoft .NET environment. In addition, the program's operation now requires you to be on-line with quite considerable downloads occurring as the software is used. In short, broadband really is a necessity to run this program properly and its provision on GS2 may cause confusion and disappointment to those expecting it to work smoothly from the CD.

SatSignal 5

SatSignal has been about for a very

long time; indeed it first surfaced in early 1999 and is still recognised as the foremost program for demodulating the signals from polar orbiting weather satellites and providing considerable options for post image processing. The program has just had a major upgrade with the addition of *Background Mode* to the *EasyOverlay* facility and is now known as *SatSignal 5*. The first thing you will notice when you install the program is that you have 30 days to try the software. If you do not register it before the 30 days are up then the program automatically reverts to the free shareware version. Quite frankly, given the cost of the software and the quality and usefulness of the additional features provided with registration, you would be mad not to register. For those who have a previously registered

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 these programs.		
	WXtrack	Satellite Tracking Program	v 3.5.2
	SatSignal	Creates images from wave files	v 5.0.0
	HRPT Reader	Converts raw HRPT data files into images	v 2.6.2
	GroundMap	Rescales satellite images	v 2.0.0
	RX2 PassControl	Computer control program for the RX2 receiver	v 3.0.6
GS2	A wide range of software for all aspects of weather satellite reception, including tracking, receiving, monitoring and image manipulation. Content is detailed below but many other extras are provided. Titles correspond with folder names. * implies a DOS program.		
	Collection D02	Recall (wave file recorder), Palette (modifies Wxsat colour palettes).	
	Collection D03	Scanner recorder v 1.8 (wave file recorder), *NOAA95/*FENG99 (software for the NOAA 95 HRPT project)	
	Collection D04	Wxsat (wave file recorder/decoder), Satmon (wave file recorder).	v 2.59
	AGSatTrack	Satellite tracking program	v 1.33
	APTDecoder	Program for capturing APT audio and processing images	v 1.0.2.70
	Cirkit	Documents for the Cirkit Wxsat receiver and the UOSat receiver (PDF format)	
	Element Manager	2-line element manager	v 1.59
	Footprint	Satellite tracking program	v 2.10
	Ifan View	Image/slideshow viewer	v 3.80
	JVcomm32	Evaluation version (APT/FAX/SSTV decoder)	
	Macintosh Kepler editor	Edits verbose AMSAT format elements. Mac OS X and OS9 only.	
	NeoPaint	Image processing program (30 day evaluation)	
	Orbitron	Satellite Tracking Program	v 3.70
	Paintshop Pro	Image processing program (30-day evaluation)	
	PhotoFiltre	Image retouching program with many extras	v 6.1.5
	Satscape	Satellite tracker and wave file recorder	v 2.02
	Space-Track TLE Retriever	Generates TLE files in 'Celestrak' style from data sets recovered from Space Track	
	Splitter	Utility program for splitting and reuniting large files	
	WXtoimg	WAV file recording and decoding program with many options.	v 2.7.3
GS3	3DEM Package for 3D Terrain Visualisation This CD includes the full set of GLOBE Tiles to allow you to produce excellent images and flybys from HRPT images. Also included is a selection of Mars MOLA files, sample images and helpful guides by Ed Murashie.		
GS4	Image CD A wide selection of high-resolution remote images from a range of satellites, including stunning imagery from the Space Shuttle missions. A full description and source is provided for each image.		
GS5	Mars Rover Panoramics A chronological account, in panoramic images, of the NASA Mars Rovers' progress across the Martian Terrain		

version there is a specific upgrade offer.

There are quite a number of updates to the program and hopefully, at a future date, these may be part of a full software review. With limited space here let me concentrate on the main change which is the incorporation of the *Background Mode* to the *Easy Overlay* facility. You can choose your own backgrounds provided they fall within the criteria specified. However one of the more attractive options is the use of the recently released *Blue Marble Next Generation* with its stunning Earth images. This allows night-time weather satellite images to look as if they were daytime ones by careful blending of temperature data from the IR channel. Cloud details and temperature readings are now available over a background of blue sea and natural land colours. The outcome is quite stunning and a double image showing the original IR and the resulting composite coloured background can be seen on the inside back cover of this issue (image courtesy David Taylor).

SatSignal 5 is available on GEO software **CD GS1** or for more information and to download the program yourself go to:-

<http://www.satsignal.net>

and follow the link to Satsignal under the 'Satellite Tools' section.

For further information on Blue Marble Next Generation go to :-

<http://earthobservatory.nasa.gov/Newsroom/BlueMarble/>

APTDecoder v 1.0.2.70

This program by Patrik Tast from Finland was reviewed in depth by Les Hamilton in GEOQ 8. The upgrade includes a critical bug fix to NOAA 18 data and new to the software is updated Kepler elements being archived in two line format.

The program is available on GEO software CD GS2 or for more information and to download go to :-

<http://www.ptast.com/apt/decoder/>

How to Purchase CDs

Write to the address below requesting **GS1, GS2, GS3, GS4 or GS5**. Prices are £5 for any single CD, 2 for £8, 3 for £11, 4 for £14 or all 5 for £17. 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, posting and a small donation towards the cost of overheads. 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.

Order your CDs from:

Douglas Deans, 17 Montrose Way,
Dunblane, Perthshire FK15 9JL, Scotland.

QuikSCAT (... continued from page 27)

and wind vector resolution of 25 km. Falling rain can influence the accuracy of results on two counts. Firstly, rainfall can itself contribute to sea-surface roughness, while secondly, very heavy rain can cause scattering and attenuation within the radar beam itself, effectively reducing accuracy by degrading the data during transmission.

References

1. QuikSCAT Mission
<http://winds.jpl.nasa.gov/quikscat>
2. Ocean Waves
<http://hyperphysics.phy-str.gsu.edu/hbase/waves/watwav2.html>
3. QuikSCAT Overview (Earth Observatory)
<http://earthobservatory.nasa.gov/Library/QuikSCAT/printall.php>
4. NASA Winds Website
<http://winds.jpl.nasa.gov>
5. Applications of Scatterometry
<http://winds.jpl.nasa.gov/aboutScat/applications.cfm>
6. El Niño
<http://www.pmel.noaa.gov/tao/el-nino/el-nino-story.html>

GeoSatSignal 5 (... continued from page 38)

Mouse Controls

The mouse wheel can be used with images to zoom in and out and if it is pressed down and dragged will move the image within the scroll. Another very useful time-saving option.

And finally

In Part 2 I will be looking at some of the more advanced features of GeoSatSignal 5, including remapping, animations (both manual and automatic), the use of RGB mode and the rather impressive World View.

As a small taster of things to come have a look at figure 8, where a world view processed in GSS has been used in WXtrack GL, another of David Taylor's programs, to give cloud cover viewable for any part of the world.

Acknowledgement

All Images © EUMETSAT 2005

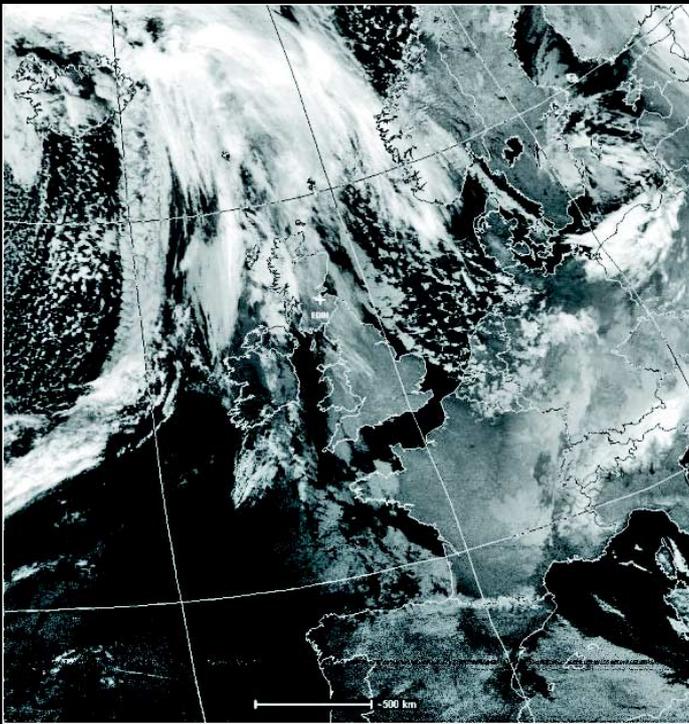
'Far East' Competition

Rob Denton has a fascination for pushing his weather satellite equipment to the limits—by striving to acquire sharp APT images farther and farther to the east from his location in Workop, England.

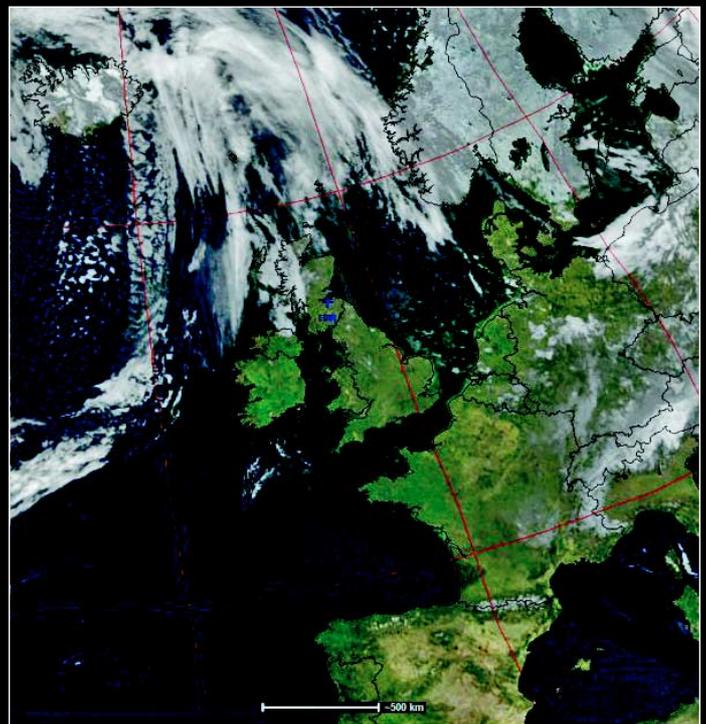
Rob is convinced that other GEO readers in England, particularly those who live nearer the east coast, could do even better, so he is offering a small prize to the best image that

'sees' farther east than his NOAA-17 image opposite. The prize will be a copy of *Pocket Guide to Weather and Forecasting* by Storm Dunlop and Francis Wilson, a 160-page hardback containing lots of illustrations.

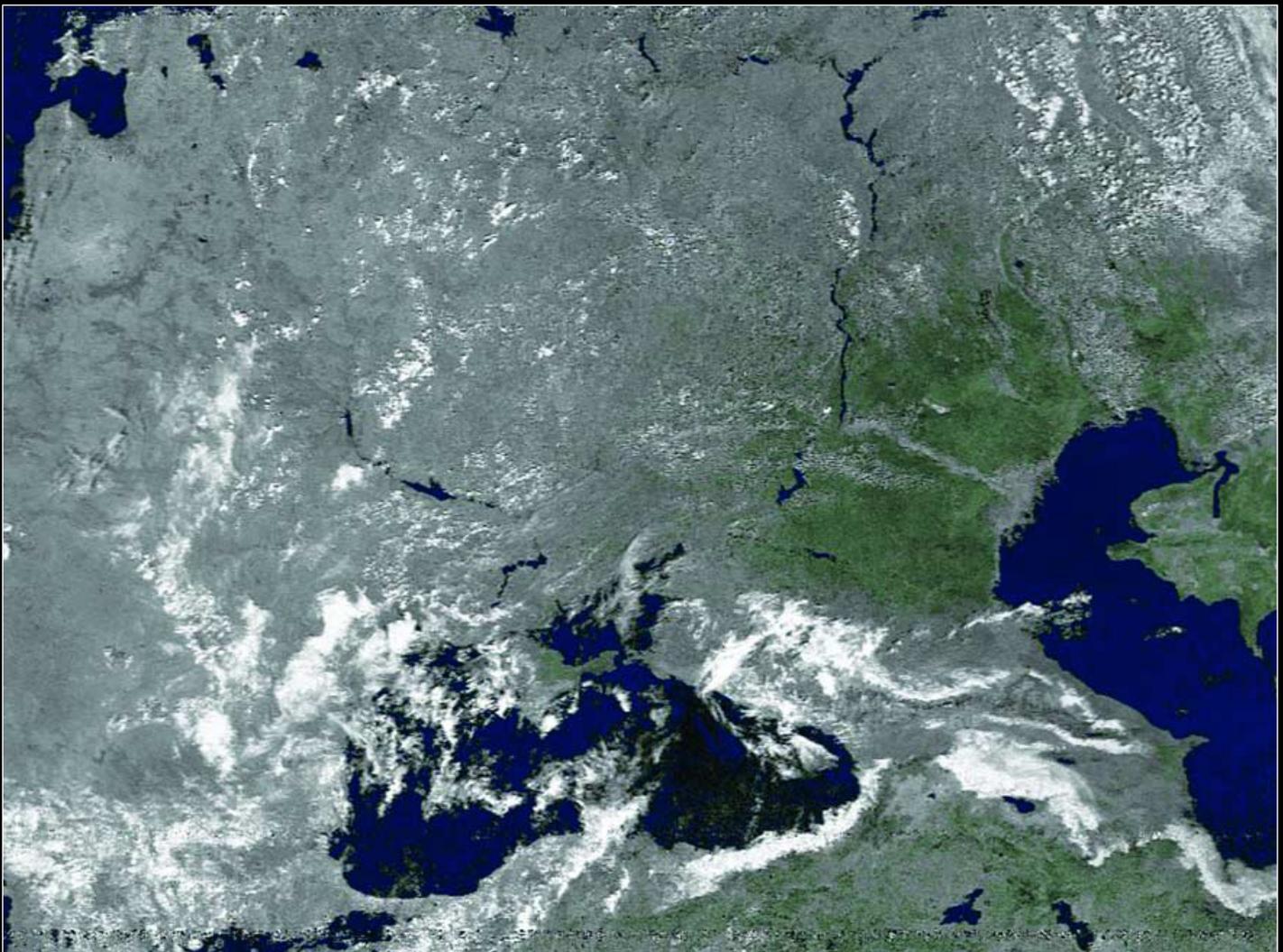
Images should be submitted to the Editor in the first instance, and will be passed on to Rob, who will decide the eventual prizewinner. Let's see GEO readers rising to the challenge!



NOAA-15 at 05:55 UT on December 18, 2005, processed using Satsignal to produce its conventional channel B thermal image



The same NOAA-15 pass produced in SatSignal-5 using its false background mode, with a Blue Marble background image (see page 43)



Another amazing 'far east' NOAA-17 image (July 15, 2005 at 08:30 UT) from Rob Denton which includes much of the Caspian Sea. Rob writes: "I'm still waiting for someone to take up my challenge of how far east they can image with basic equipment. Again captured in WXsat with my *Dartcom* System II receiver and *Wimo* crossed dipole antenna (no preamp used). Located in Worksop, Notts. 53.3°N, 1.1°W. I'm sure that someone who is further east from me in the UK can get a better image, as I'm central, so come on, lets see what can be done!"

