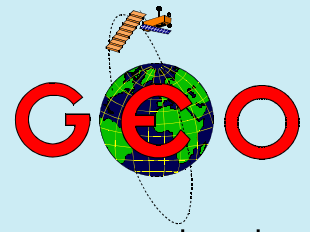


# The **GEO** Quarterly

Group for Earth Observation

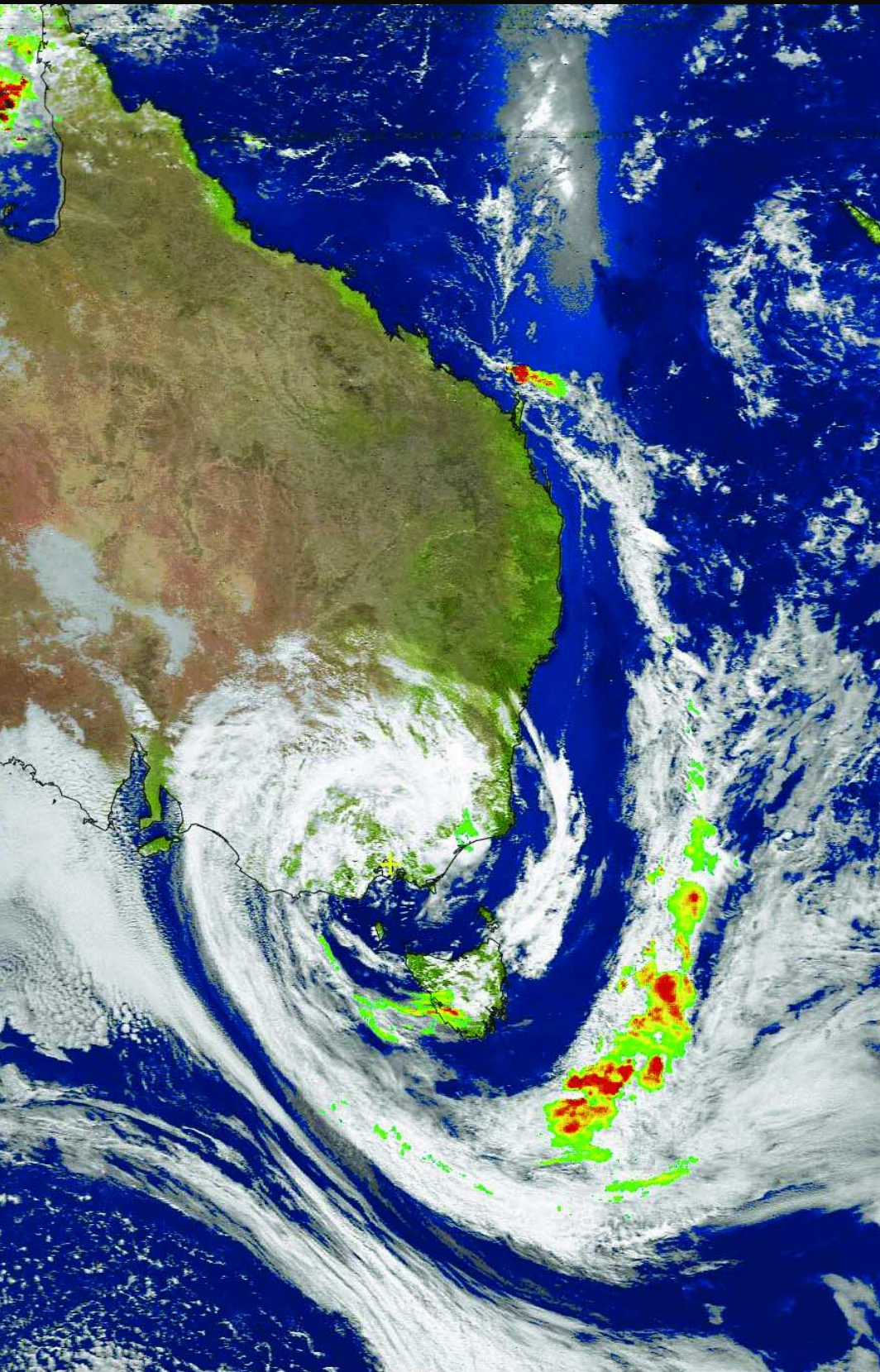


[www.geo-web.org.uk](http://www.geo-web.org.uk)

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

Number 6

June 2005



## *Inside this issue . . .*

*Ruud Jansen describes his visit to the Funceme meteorological station in Brazil*

*Peter Wakelin continues his discussion about the Indian Space Programme*

*Ship Trails: Les Hamilton writes about these weird tracks that can appear on weather satellite images*

*Highway in the Sky - France's tallest motorway bridge viewed from orbit*

*Arne van Belle explains how to use a RAMdisc to optimise EUMETCast reception*

*Kimberley and C S Loh describe how the Boxing Day Tsunami affected coastlines around the Strait of Malacca*

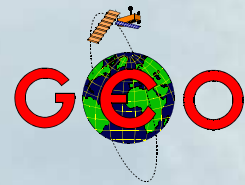
*Beginners' Guide to installing and using Digital Atmosphere Workstation*

*Learn to splice together NOAA HRPT images using Paintshop Pro*

*Mike Stevens returns with more reports on the success of his MSG station*

*Plus all the regular features ...*





The era of Meteosat WEFAX imaging is nearing its end—transmissions are due to be switched off for good some time during December 2005. The *GEO Shop* can help you to prepare for the future by migrating to Meteosat-8. Meteosat-8 data is disseminated via a domestic DVB link from the *Hot Bird-6* geostationary satellite. You will find all the hardware you require on this page.

You have to register with EUMETSAT and obtain an amateur user licence from the Met Office and, in addition, purchase the *Tellique* software and *e-Token* key unit. If you are unsure how to obtain these, please consult '*Meteosat 8—the Challenge*' by Mike Stevens in *GEO Quarterly* No 4. You can find a detailed guide to completing your *EUMETCast* Registration Form on the GEO website at <http://www.geo-web.org.uk/eumreg.html>



### 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 (if you do not feel confident about installing cards inside your computer use the USB version below)

UK - £49.50  
Continental Europe - £51.00



### TechniSat SkyStar 2 USB Box

The external version of the above which plugs into the computer's USB socket and does not require installing inside the computer. It comes complete with power supply, USB cable & CD-ROM of driver software.

UK - £109.50  
Continental Europe - £121.50



### Telestar 80 cm dish (or similar model) and Universal 0.6 dB LNB

A quality German made aluminium dish and LNB with an AZ/EL mount to fit onto a vertical pole. (Wall or patio mounts are available from local satellite TV dealers)

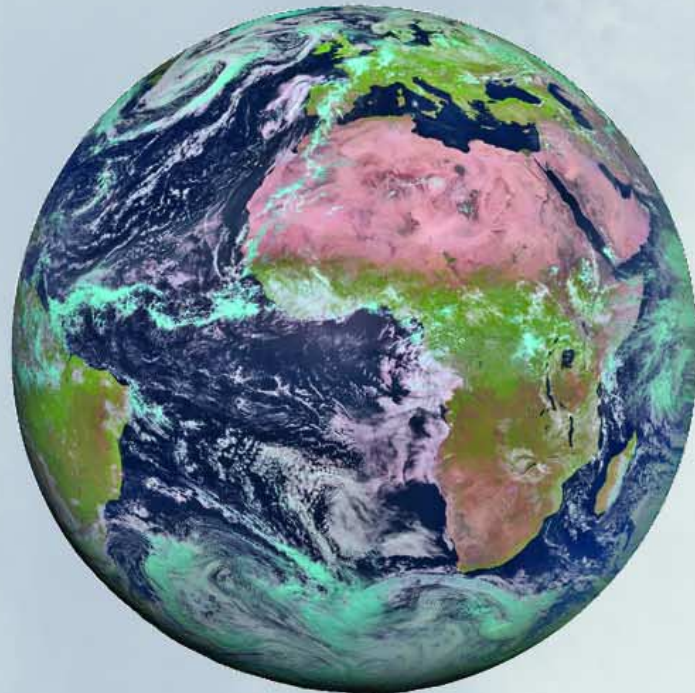
UK - £49.00  
Continental Europe - enquire



### Telestar Universal Ku-band 0.6 dB Universal LNB (or similar model)

Digital satellite TV Universal LNB for use with the SkyStar receivers above or any DVB satellite TV receiver.

UK - £11.00  
Continental Europe - £12.50



Meteosat-8 image - © EUMETSAT 2004



### 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.

UK - £21.50  
Continental Europe - £24.50



### GEO PIC 1.0 for the RX2

Programmed with the new channel frequencies required for NOAA-18.

UK - £7.00  
Continental Europe - £7.40  
Rest of World - £8.40

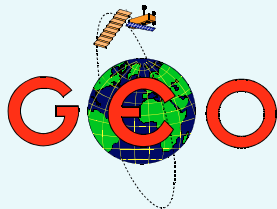
### Ordering and Shipping

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

### Orders should be sent to:

GEO Shop,  
PO Box 1375,  
Christchurch BH23 9AS,  
England.

Check the *complete GEO Shop catalogue* in our centre pages



As you can scarcely fail to notice from our advertisement on the opposite page, the **GEO Shop** is now fully operational, stocking just about everything you need to set up your own MSG-1 station for receiving *EUMETCast's* Meteosat-8 dissemination service. Readers still relying on WEFAX and PDUS transmissions from Meteosat-7 have little more than six months to migrate to the new technology before these services are terminated (some time during December this year). A full **GEO Shop** listing can be found in our centre pages, along with contact information and details of how to place orders.

GEO was highly honoured to receive a request from none other than Gordon Bridge, *EUMETSAT's* Training Consultant, for permission to use articles authored by two of our members in their training programme. The articles in question came from GEO Q4: 'Meteosat-8 - the Challenge' by Mike Stevens and 'Receiving MSG by C-Band' from Kobus Botha. This request reflects highly on the calibre of these individuals and of course enhances the international profile of GEO itself.

The GEO Symposium at Leicester last April proved even better than last year and a full report will appear next issue. Meanwhile, a few photographs sprinkled throughout this issue provide a taste of the event.

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## 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

### Articles and Images for Publication

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

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### Responsibility for Constructional Projects and Software

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# The GEO Report



Francis Bell

## Symposium

As I write I have only just come back from the recent GEO Symposium in Leicester. I hope a full and illustrated report of the symposium will be included in our next Quarterly publication. However, in anticipation of that, just a few sentences now seem appropriate.

Judging from the feedback I have received, the event was a great success. The venue was the National Space Centre in Leicester which is ideal, with its exhibition area, technical support and lecture room. The programme we ran was as published on our web site with the inclusion of one additional speaker. The speakers were all outstanding and the lunch-time workshops were well attended. The day concluded with most delegates staying for GEO's AGM. Thanks must go to all involved: GEO management, speakers, delegates and the NSC for their co-operation and technical support.



Antenna alignment workshop  
at the GEO Symposium  
Photo: David Taylor

One point which did arise in Leicester was the legal and administrative structure of GEO. The management team had discussed this and, as a matter of policy, have decided for the time being not to superimpose any additional rules or bylaws beyond GEO's existing legal structure, which was professionally written and registered with Companies House. The membership's interests are in safe hands within this structure.

## Membership

Turning to membership. It has been encouraging to note the percentage of

our membership renewing for a further year. I take that as a vote of confidence in the group as a whole. However, a reminder to all is that, with some small exceptions, it is the membership subscriptions which are our main source of income. This has to support the printing and distribution of our Quarterly publication. Multiply the number of members by the annual subscription and we are just short of a financial break-even point. Please encourage any friends, acquaintances, local radio club members to join GEO. Currently GEO membership is mainly in the UK but we also have members in the Netherlands, the rest of Europe and other parts of the world.

With reference to the Netherlands, their own *Werkgroep Kunstmanen* is very supportive of GEO and six of their members came to Leicester this year. I went to Utrecht last year for one of their meetings and will try to do so again this year. I know other GEO members have been to their meetings. The dates of their meetings in Utrecht later this year are September 10 and November 19.

## Guildford

AMSAT-UK hold their annual colloquium in Guildford again this year, at the University of Surrey. An announcement appears on page 31. As I write this, GEO has just received an invitation to participate, and will give a presentation and run live satellite reception. If you missed GEO at Leicester this year, perhaps a day visit to Guildford may be an alternative for you. A chance to meet some of GEO's management team and experience appropriate demonstrations and talks. Check our web site for details which still have to be confirmed but I expect GEO to be most active this event on Saturday, July 30.

## Quarterly Question

My thanks to John Bunting for being the first to provide an answer to the last Quarterly Question which related to the ratio of the Earth's oceans to the atmosphere if it was all measured at sea level pressure. His answer was ocean to atmosphere 1 to 0.7. The point of the

question was to indicate how little atmosphere we actually have. The figure surprised me when I worked it out for myself. Our planet only has a thin skin of atmosphere and ocean; they are equally fragile so we must care for both environments.

Now I'm in trouble again. Increased carbon dioxide in the atmosphere as the cause of global warming? I don't believe it! Try looking in the sky on a sunny day to find the cause. There isn't much atmosphere to shield us from our local star.

On a light hearted note, a physicist commented on the modal answer provided to the last quarterly question. I thought the additional comments were just going off at a tangent.



The RSGB GB4 FUN vehicle  
at the GEO Symposium  
Photo: Cecilia Taylor

## GEO Shop

The GEO shop is progressing with a range of items for our membership. This can be seen on our website and in our advertisements inside the front cover and on the centrefold.

The initiative for the 'shop' came from within the management team. Thanks to Clive and John for starting this; their initiative adds an extra dimension to the benefits enjoyed by GEO members. At Leicester a delegate said to me: 'Does GEO make any profit from running the shop?' Although I don't know the fine detail (which is left with Clive and John), I do know that time and effort

goes into the shop. I replied: 'Yes we make a small margin'. Response: 'I'll use the GEO shop then'. I thought that was very supportive. I smiled and said: 'Okay! That' nice.

#### APT

Another point arising from Leicester is a new APT receiver. Personally I have seven APT receivers all of which work well but each with a different degree of pager interference resistance. Please be assured that GEO's management team are aware of the issues relating to APT reception. APT transmissions will last for perhaps ten years. A new receiver, pager resistant and a year's work on design, all interrogative: but we are looking at the issues.

In the next few days I am going to visit my son and his family in Raleigh, North Carolina USA. Sometimes, in the past, I have taken my APT receiving station around the world. With the *EUMETcast* relay of GOES E I can follow the weather in NC but I would love to see an HRPT image of Raleigh. Does GEO have a member in the USA who can send us a high resolution satellite image of this area? If you have something that fits the specification please send it to myself or our editor.

A respectful note here. A few hours ago I received news about the death of Ron Broadbent MBE. Ron was a good friend, an occasional guest at my house and my mentor in my early days of amateur satellite reception. He was AMSAT-UK's secretary for many years. I sent him a copy of GEO Launch edition. He telephoned me a few days later to say he would join: and he did.

My final comment as usual is a 'thank you' to our contributors. Please keep sending your copy, images, comments or analysis to our editor. We try to cover a full spectrum of interests from the absolute beginner to the frontiers of what's possible. Wouldn't you like to have something published in a GEO Quarterly?

## Coming in the September Issue

Our in-depth look at Digital Atmosphere Workstation continues when Fred van den Bosch demystifies the program's scripting features, and shows how easy it is to overlay all kinds of synoptic data over your charts and weather satellite images

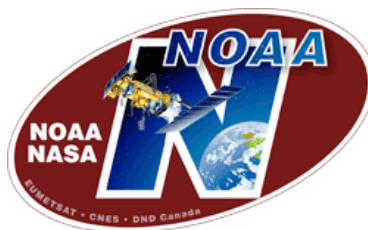
Decoding and displaying NOAA HRPT telemetry files has been exclusively the preserve of the PC user—until now that is! Sergei Ludanov describes the MacHRPT software he has written to decode HRPT files from NOAA's *CLASS* (formerly SAA) site on the Apple Mac.

There will be a feature evaluating the R2FX weather satellite receiver that caught so many member's attention during GEO's Leicester Symposium, more on splicing satellite images using Paintshop Pro, and an overview of the first results from NASA's Aura satellite.

## QUARTERLY QUESTION

Our poser this time comes from David Taylor, who asks: 'To which satellite does MSG-1 (i.e. Meteosat-8) cause interference? This will test whether you read *ESA's Bulletin*, or simply look at the pictures!'

Answers, as usual, to Francis Bell by post or e-mail (details on page 1)



## The NOAA-N Launch

**Douglas Deans**

By the time you read this, NOAA-N should have been successfully launched and renamed NOAA-18. I have prepared a few notes for those not familiar with NOAA launches. Hopefully this will answer some of your questions and outline what can be expected for the first hours, days and indeed weeks following a successful launch. Information is a little scarce so some details are best guess from previous launches.

- The launch was scheduled to take place from Vandenberg Air Force Base between 10.22.01 and 10.32.01 UTC on Wednesday 11th May 2005.
- If all goes to plan, hand over to orbit mode should happen about 84

minutes after launch.

- NOAA-N will be launched into an 870 kilometre circular, near polar orbit with an inclination of 98.73°, giving an orbital period of approximately 102.14 minutes.
- The spacecraft will cross the equator at about 2 pm northbound and 2 am southbound, local solar time.
- At the time of writing there is still some doubt regarding the APT frequency but it is likely to be 137.9125 MHz. (NB: this is a new NOAA frequency).
- If this launch follows the course of previous ones, we can expect the HRPT and APT transmitters to be activated perhaps within hours of successful injection into orbit (visible imagers only).
- For several weeks the APT will carry 2 visible images (channels 1 and 2). The infrared system requires out-gassing before being switched on and is the reason for the delay (usually about 2/3 weeks) in its operation. My understanding is that the out-gassing prevents precipitation (and contamination) when the coolers are switched on. Thereafter the APT format should follow the norm of Channel 2 (visible) and channel 4 (IR) during daylight passes, switching automatically to channels 3 (3A) and 4 during darkness. All being well, the IR channels should be activated on 28th May 2005.
- Let's wish NOAA-18 a long and successful life (especially its APT!).

Any updates or changes will be posted to the Weather-Satellite-Reports group at:

<http://groups.yahoo.com/group/weather-satellite-reports>

## Cover Images

### Front

This striking NOAA-17 APT image of Australia dates from February 4, 2005 and shows what is known locally as a 'southern cyclone' bringing chaos to the region around Melbourne.

Image: Lindsay Vincent Processing: WXtolmg

### Back cover

This NOAA-17 HRPT image in azimuthal equidistant projection dates from 10:25 UT on March 18, 2005 and depicts a wintry scene over Scandinavia. Ice is apparent in the Gulf of Bothnia while streamers of cold air can be seen picking up moisture as they stream south past the Gulf of Finland.

Telemetry: NOAA

Processing HRPT Reader and GroundMap



# Mega Sastrugi in East Antarctica

NASA Earth Observatory

At first glance the casual observer might well mistake the wavy features in this image as being a cloud feature, perhaps akin to a 'herringbone' sky. But the underlying landmass is East Antarctica, and imaging throughout the period 2002-2004 has indicated that the feature is stationary.

As it passed over Antarctica on December 16, 2004, the Multi-angle Imaging SpectroRadiometer (MISR) on NASA's Terra satellite captured this image showing a wavy pattern in a field of white. At most other latitudes, such wavy patterns would likely indicate clouds but MISR saw something different. By using information from several of its multiple cameras (each of which looks at the Earth's surface from a different angle), MISR was able to show that the feature was actually a wavy pattern on the ice surface.

The view shown here, which came from MISR's most oblique backward-viewing camera actually shows sastrugi, long, wavelike ridges of snow formed by the wind and found on the polar plains. Usually sastrugi are only several centimetres high and several meters apart. However, large portions of East Antarctica are covered by mega-sastrugi ice fields, where the ripples have assumed dune-like proportions and can be as high as four meters, separated by two to five kilometers. These mega-sastrugi result from unusual snow accumulation and redistribution processes that are influenced by the prevailing winds and climate conditions. The features provide information that is useful for ice-core interpretation.

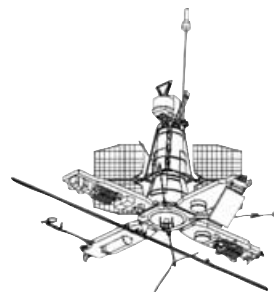
This image area covers about 277 kilometers by 421 kilometers in the interior of the East Antarctic ice sheet.

## Acknowledgements

Image courtesy  
NASA/GSFC/LaRC/JPL, MISR Team.  
Text based on original material posted  
on NASA's 'Earth Observatory' website.

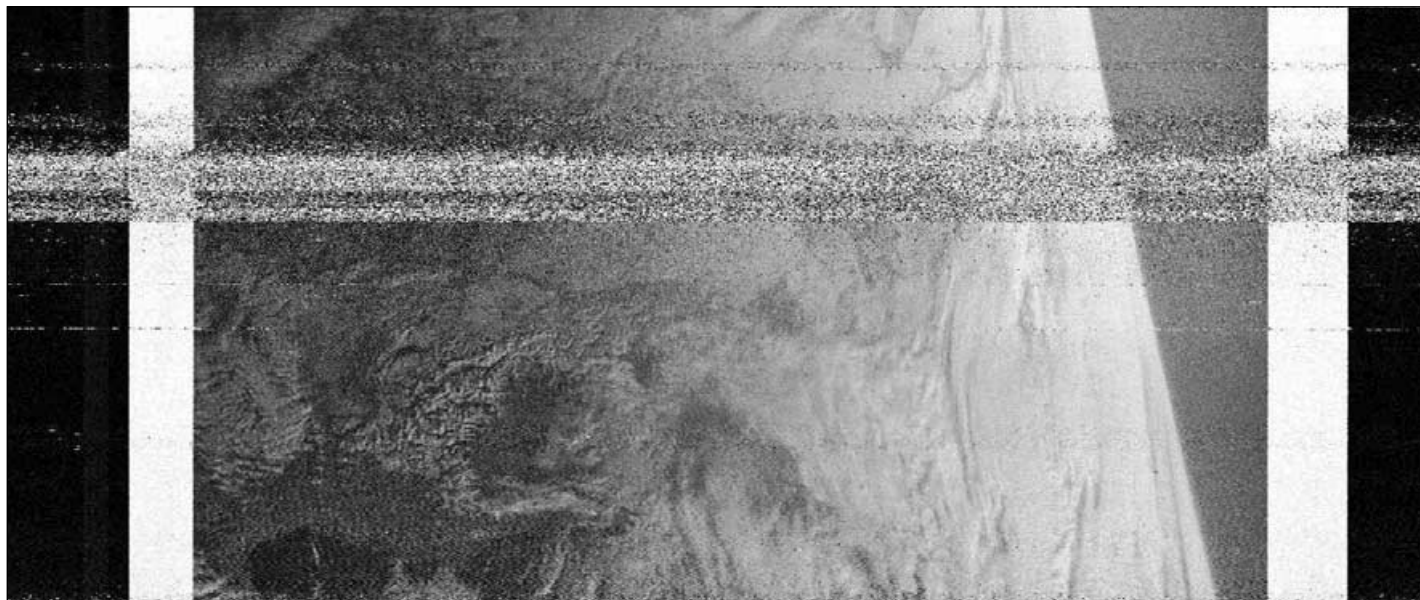


# Snapshots from from SICH-1M



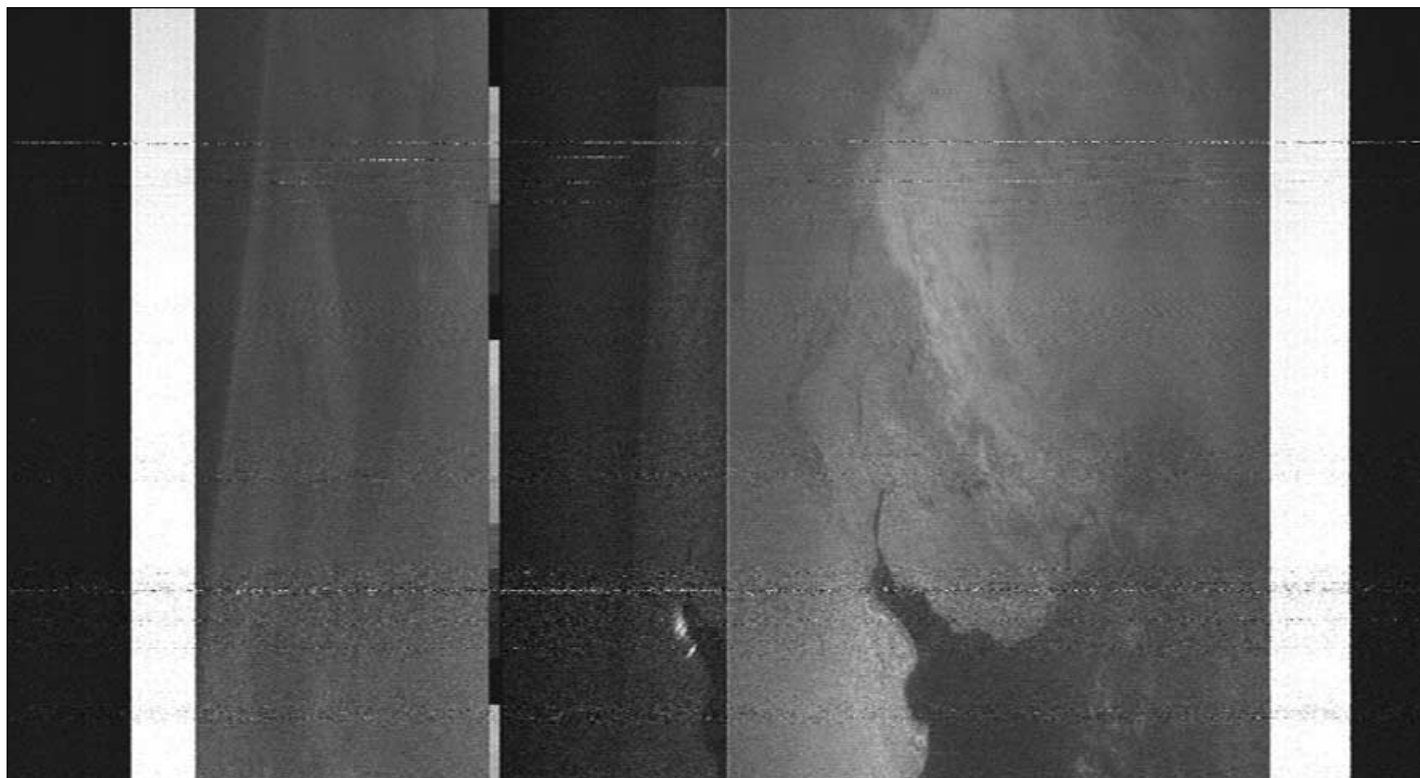
As you will read in Peter Wakelin's article overleaf, Ukraine's SICH-1M satellite has proved a massive disappointment, with very little imagery being received. Two of the most revealing images

are presented below. They clearly fall far short of the quality we normally publish in GEO Quarterly, but they are included as a historical record of this satellite's brief active lifetime.



This is the first SICH-1M image detected from the UK and was obtained from **David Taylor** in Edinburgh, Scotland at 08:12 UT on January 29, 2005. The only readily recognisable feature is the snow-covered Alps at lower left. The sharp division between light and dark at the right-hand side

of the image is believed to be the limb of the Earth itself, due to the satellite's attitude irregularity. (Paul Hayes QFH antenna, RX2 receiver, WXSAT wave capture software, processing software SatSignal.)



GEO member **Nigel Heasman** relocated to Cyprus last year, and is better placed than most to receive SICH-1M transmissions, which only occur well to the east when the satellite is flying over its command station in Ukraine. The image above is one of the best he received and was clearly recorded while SICH-1M flew over Uruguay on March 23. The image was later

transmitted when the satellite was passing over Ukraine. Clearly visible is the estuary of the River Plate between Uruguay and Argentina. In the central radar image the bright smudges are the signatures of the cities Buenos Aires and its conurbation. Again, there is evidence suggestive of Earth's limb on the extreme left of the image.

# Earth Imaging News

Peter Wakelin

## Sich-1M Abandoned

Following a shortfall in velocity of about 100 m/s after the circularisation burn of the third-stage rocket, Sich-1M was left, not in the planned 650 km circular orbit, but in an eccentric one with apogee about 637 km and perigee of 280 km where atmospheric drag is significant. The MK-1TS sub-satellite, which was attached to Sich, was ejected from it at about 2100 UTC on December 25, some 34 hours after launch and is in a similar orbit.

The first known transmissions on 137.40 MHz were picked up in the UK on January 29 (see David Taylor's image on page 5) and they continued sporadically until late March. Imagery was of a similar format to that of the earlier Sich and Okean spacecraft but it was obvious from the earliest images that there was a serious orientation or stability problem.

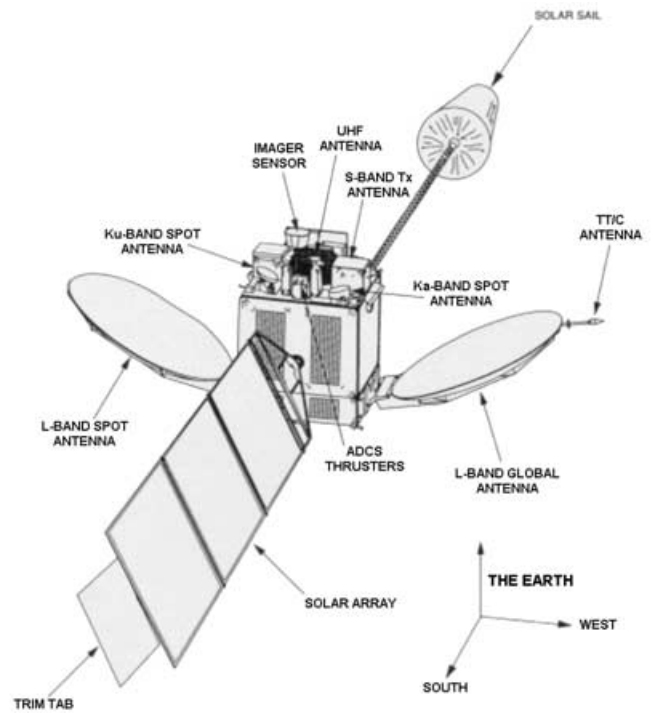
This type of spacecraft relies, in part, on a gravity gradient stabilisation system to maintain pointing accuracy. In such a system, the main body of the spacecraft is separated from another mass by a long boom and the tiny difference in gravitational acceleration between the two masses ensures that the boom remains perpendicular to the Earth's surface. At 650 km this stabilisation method would work satisfactorily as atmospheric drag is extremely low but with a perigee of only 280 km it seems probable that the increased drag, which is much greater on the main spacecraft than on the boom's end-mass, generated a torque too great for the stabilisation system to cope with.

On March 18, ITAR-TASS, the Russian news agency, reported that the Ukrainian National Space Agency's press service had said, *inter alia*, that 'Sich 1M had taken the first pictures of designated areas of the Earth and beamed them back to the mission control centre'. There was no mention in the report of any problems with the spacecraft. It was another month before the Ukrainian authorities admitted that there was an insurmountable stability problem. At the time of writing, in late April, nothing has been heard on 137.40 MHz for about five weeks and no further transmissions are expected. The instruments of the VARIANT international experiment, which is incorporated in Sich-1M, are less dependent on a stable platform and scientists from Ukraine, Russia, France, the UK and elsewhere are retrieving some useful data.

By late April, the loss of energy at each perigee passage had caused the apogee to lower from 637 km at launch in December to 570 km and the perigee to drop 4 km to 276 km (all altitudes relative to a spherical Earth). Most of the orbit decay occurs when the perigee passes over the Earth's equatorial bulge where the satellite passes closer to the surface and in Sich-1M's case this happens every 51 days. The fourth such event occurs around May 31 but the spacecraft will probably not meet its fiery end until late this year.

## MTSAT-1R Successfully Launched

Japan's H-IIA rocket returned to flight at 0725 UTC on February 26 and the 7th flight vehicle placed MTSAT-1R in the planned geostationary transfer orbit from where it was



MTSAT-1R schematic

later raised to geostationary altitude. Its final location will be above 140°E when it becomes operational and it will replace the aged GMS 5 spacecraft which has been relaying GOES 9 imagery since its own imager developed problems.

The launch restores some confidence in the troubled Japanese Aerospace Exploration Agency (JAXA). JAXA's next major launch is the scientific *Astro-E2* satellite on the M-V rocket. The previous H-IIA launch failed soon after lift-off and deposited its payload—a pair of Information Gathering Satellites (IGS 3 and 4)—in the Pacific Ocean. An M-V flight in 2000 carrying *Astro-E1* also failed but M-V successfully launched the *Hayabusa* asteroid probe in 2003. H-IIA launch operations are carried out by Rocket Systems Corporation and the major components are built by Mitsubishi Heavy Industries Ltd. MTSAT-1R is an SSL-1300 satellite built by Space Systems/Loral in the USA. In addition to providing weather data to the Japanese Meteorological Agency, MTSAT-1R carries air traffic control support equipment for the Japanese Civil Aviation Bureau. The design lifetime for the meteorological payload is 5 years and 10 years for the ATC equipment.

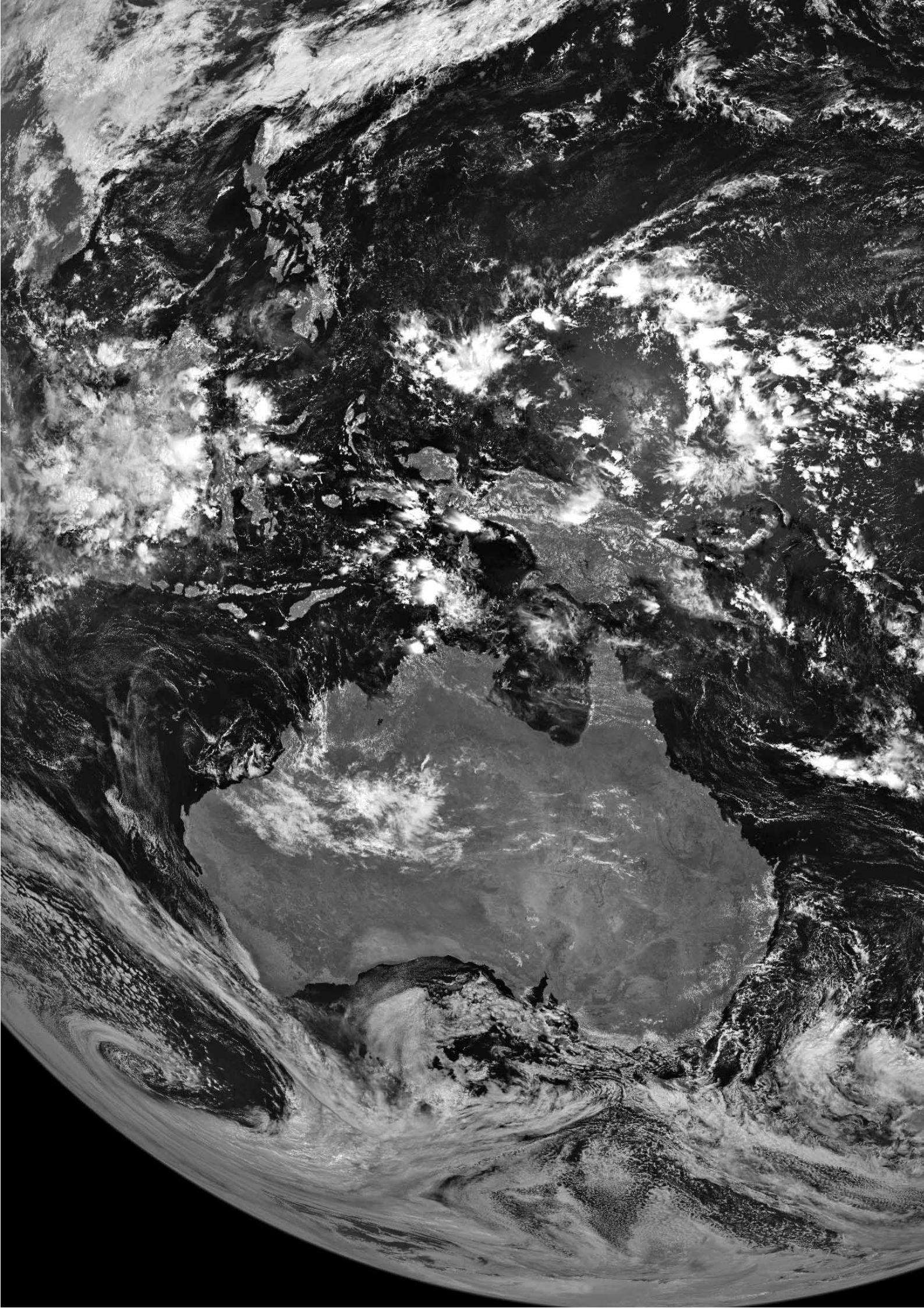
MTSAT-1R, also known as *Himawari-6* (sunflower), is a three-axis stabilised, cubic structure with a single solar array

*concluded on page 8 ...*

### First MTSAT-1R Image

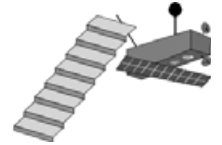
The first infrared and visible test images from MTSAT-1R were acquired on March 24, 2005. The image presented here comes from the visible channel (0.55-0.90  $\mu\text{m}$ ). The original image, which includes the entire hemisphere, measures 2750 pixels square. Only a section from it is reproduced opposite.







# News in Brief



## 2-Line Element Latest

The United States Strategic Command (USSTRATCOM) has recently taken over responsibility from NASA for distributing the two-line element sets required by satellite tracking programs. The Space-Track website ([www.space-track.org](http://www.space-track.org)) has been set up for this purpose. Before you can download element sets from this site you must first register (there is no charge) and apply for a password. However, you must be aware that use of the element sets you download is restricted; you can use them for your own purposes but are not normally permitted to transfer them, or products derived from them (e.g. satellite predictions), to any third party.

There is, however, a process whereby organisations can apply for permission to redistribute this information, and both Celestrak ([www.celestrak.com](http://www.celestrak.com)) and GEO have been successful in this respect. This means that GEO can continue to publish pass predictions for the NOAA satellites and that GEO members can continue to download their keplerian element sets from Celestrak.

GEO is grateful to the *USSTRATCOM Orbital Data Release Authority* for considering our application favourably.

## Free CD-ROMs from ESA

Did you know that there are some interesting CD-ROMs available (free) from ESA's Earth Observation Library?

Visit

[http://earth.esa.int/services/esa\\_doc/doc\\_env.html](http://earth.esa.int/services/esa_doc/doc_env.html)

Among the wealth of brochures and bulletins available are two interesting CD-ROMs.

### Envisat in Action

This CD-Rom presents a first overview of the Envisat results, in the form of a compilation of images and findings provided by the Envisat data user community. The information and images are categorised under the headings 'Land', 'Ocean', 'Ice' and 'Atmosphere'.

### Around the World in 80 Images

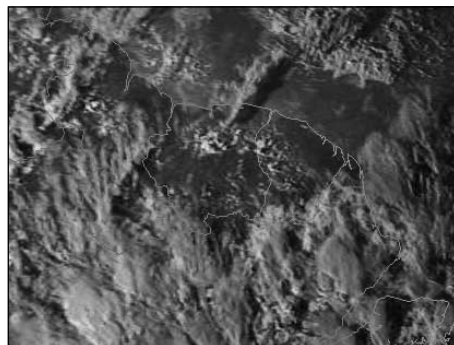
This CD aims to present an enjoyable and informative way of introducing just

some of the many satellite images provided by Envisat as it makes its journey around the world. There are options to select a particular country, follow in the footsteps of Jules Verne or devise your own route around the world. In all cases you are zoomed into an interesting terrestrial feature accompanied by a text annotation.

Both the above can be ordered directly from the web page, and provide a useful overview of Envisat and its applications.

## Meteosat Spies Ariane Launch

Nick Hewgill spotted what he believes to be the launch plume from the first proving flight of the upgraded Ariane-5 ECA launcher that lifted off from Kourou in French Guiana at 21:03 UT on February 12, 2005.



This Meteosat-8 image was obtained shortly before night fell on the launch pad at Kourou. The Ariane exhaust plume is clearly visible at upper centre, casting a conspicuous shadow to the east on the ground beneath. The Amazon estuary appears at lower right.

## Russian Anglers Drown in Frozen Lake

A popular winter pastime among Russian anglers is ice fishing; where they venture out on to the frozen ice over lakes and rivers to cast their lines through holes cut in the ice.

A group of anglers who were fishing on Europe's largest freshwater lake, Lake Ladoga, near St Petersburg perished last February after the ice gave way beneath their car.

Although one angler did manage to escape from the car, his three

companions drowned. Ice fishing is also carried out over the frozen waters of the Gulf of Finland and dozens of fishermen have to be rescued every winter after becoming trapped on ice floes which have broken away from the shore.

## Look out for NOAA 18

If all goes well, NOAA 18 will have been launched by the time you read this (on May 11). Visible light images were due to start transmission immediately, with the IR channels operating from May 28. Remember the satellite will transmit on a new frequency: either 137.10 MHz or 137.9125 MHz.

## Earth Imaging News

... continued from page 6

mounted on the south facing side. On the north side is a 15 m boom carrying a solar sail to counteract the torque generated by solar radiation pressure on the 19 square metres of solar panels. 12 small thrusters are available for attitude control and orbit station-keeping manoeuvres (see schematic above).

In the focal plane of the 31 cm diameter optical system there are sensors sensitive to five wavelengths: 0.55-0.80 micrometres (visible), 3.5-4.0 (near infrared), 6.5-7.0 (water vapour) and the two infrared channels centred on 10.8 and 12.0 micrometres. Imager data are received at the Command and Data Acquisition Center and retransmitted to users in various formats. The WEFAX and HiRID imagery familiar to GMS 5 users will continue to be broadcast, on a time-shared basis, with the new, digital LRIT and HRIT formats until the end of 2007. Only LRIT and HRIT will be available from 2008.

## Acknowledgements

The following websites provided some of the information in this report:

- Dr Kelso's CelesTrak for Two Line Elements  
<http://www.celestrak.com>
- Bureau of Meteorology, Australia  
<http://www.bom.gov.au>
- Japan Meteorological Agency  
<http://www.jma.go.jp>
- Jonathan McDowell's Space Reports  
<http://www.planet4589.org/jsr.html>



# Meteorological Charts and Satellite Images

Robert Moore

In GEO Quarterly No 4, Ton Lindemann explained how to use *Fleetcode* data to plot synoptic charts as overlays on *Meteosat-8* images. Thus we now have (at least) two means of enhancing our imagery with charts—or perhaps elaborating our charts with satellite imagery.

In figure 1, David Taylor's *Geosatsignal* has been used to overlay the Bracknell chart on to an IR image of the North Atlantic acquired at 1400 UTC on January 17, 2005. Figure 2 shows the same image overlain by *Fleetcode* data using *Digital Atmosphere Workstation*. Both figures show an Atlantic high pressure area and a low between Greenland and Iceland that was to bring stormy weather to the UK. The fronts associated with these systems are also clearly shown. The charts are slightly different interpretations of the meteorological data—meteorologists and their computer programs are unlikely always to produce identical analyses of the available data.

**Is there much to choose between the two presentations?**

Figure 1 covers more of northern Greenland; the chart is clearly drawn and uncluttered. Figure 2 is in colour although the lines and labelling are not so refined. The *Digital Atmosphere Workstation* presentation is potentially a more dynamic one in that it is possible to add additional features such as individual station plots, wind barsbs or streamlines, temperature and humidity data etc. So whilst *Geosatsignal* with the Bracknell chart overlay gives one a very pleasing picture, and enhances the interpretation of the satellite imagery, *GeoSatsignal* allied with *Digital Atmosphere* enables one to select and manipulate data.

If we are only interested in plotting the basic surface features of the North Atlantic then there is little to choose between the two presentations: aesthetic

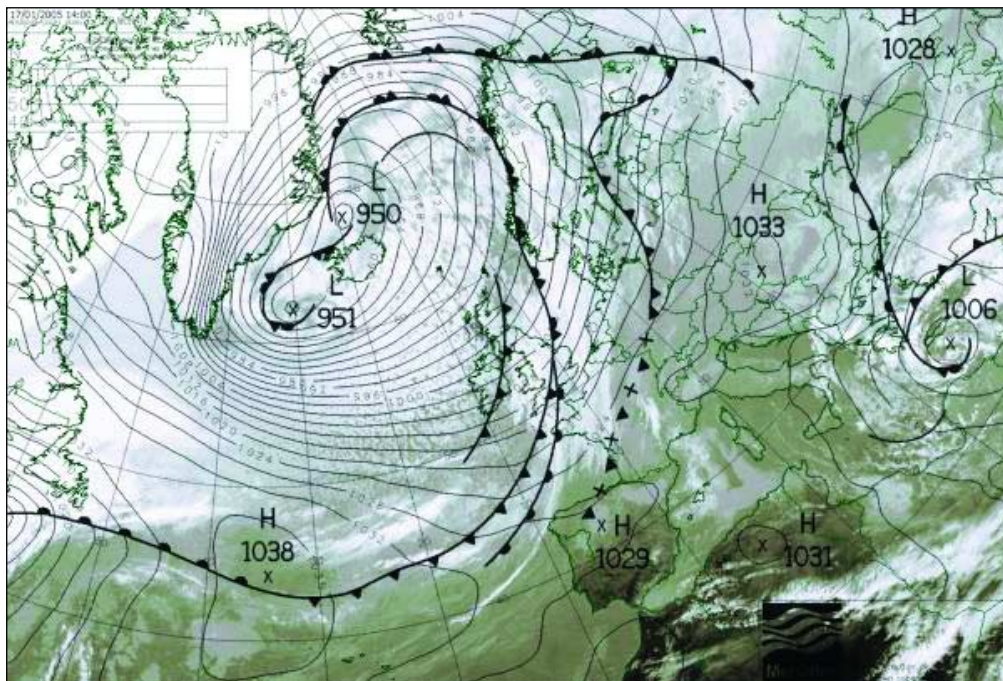


Figure 1 - Overlaying a Bracknell chart on to a *GeoSatsignal* image  
Bracknell chart reproduced with permission of the Met Office, Crown Copyright reserved

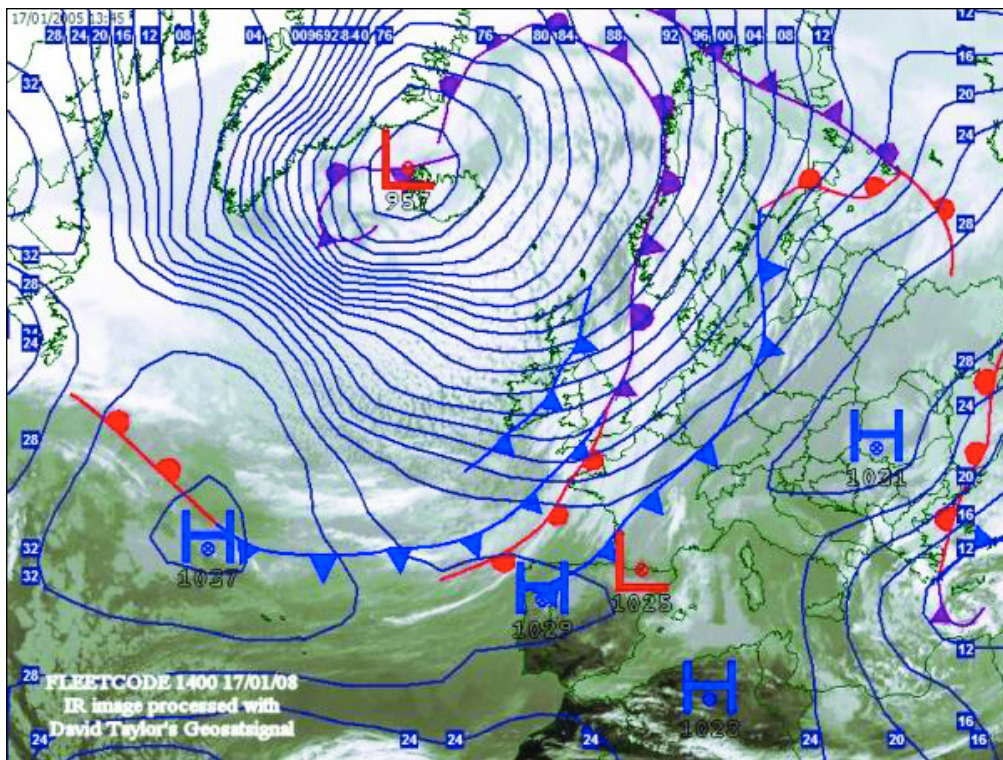


Figure 2 - Overlaying *Fleetcode* data on a DA basemap created from a *Meteosat-8* image

judgements may prevail. The non-specialist will probably not invest in *Digital Atmosphere* software anyhow so will continue to enjoy the output of *Geosatsignal* alone. More

specialist users with a particular interest in weather or climate may prefer the flexibility and versatility of *Digital Atmosphere Workstation* coupled with *Geosatsignal*.



# The Indian Space Programme

## Part 4

Peter Wakelin

Earlier parts in this series described the developmental *SLV-3* (Satellite Launch Vehicle), the *ASLV* (Advanced Satellite Launch Vehicle) and the *PSLV* (Polar Satellite Launch Vehicle)—which was the first to operate on a commercial basis—together with some of their payloads. The fourth-generation vehicle was developed to place heavy communications satellites into highly elliptical geostationary transfer orbits (GTO) from where the payload's own propulsive system would raise the orbit to geostationary altitude above the equator. Unsurprisingly, it was named *GSLV* (Geostationary Satellite Launch Vehicle).

### GSLV's Early Development Plans

Conceptual studies for the *GSLV* started more than 20 years ago when development work on the *PSLV* was still under way, but by 1989, after studying numerous possible configurations, a design was selected which would utilise modules and infrastructure already developed for the *PSLV* wherever possible. These plans were approved by the Indian Government in 1990. This design included a cryogenic third stage utilising liquid hydrogen as fuel and liquid oxygen but, as the Indians knew they could not develop such a stage in a reasonable time, it was decided to purchase the third stage and associated technical services from Glavkosmos in Russia.



GSLV pictured shortly prior to launch



The latest launch of GSLV on September 20, 2004

### The Russian Connection

The advantage of using hydrogen as a fuel lies in its much greater propulsive efficiency than solid fuels or other liquids such as the commonly used UDMH (unsymmetrical dimethyl hydrazine) but has the drawback of having to be maintained at extremely low temperatures to keep it in the liquid state. The specific impulse of a hydrogen-powered stage is about 200 seconds greater than that of other fuels and, for the *GSLV* configuration, each additional second of gain in specific impulse increases the payload capability by more than 10 kg.

Soon after the agreement with Russia was signed it took a severe setback when the Soviet Union disintegrated and President Yeltsin refused to honour it. There were additional problems in 1993 when Russia joined the Missile Technology Control Regime and, at this stage, the Indians decided to go ahead with the development of their own cryogenic stage. However, it was eventually agreed that up to seven cryogenic stages could be purchased but with limited technology transfer, which meant that India would have to develop its own flight guidance and control systems for the third stage.

### First Propulsion Stage

The first stage comprises a solid-fuelled core with four strap-on liquid-fuelled motors. The core is 2.8 m in diameter, 20.1 m in length and contains 138 tonnes of hydroxyl terminated polybutadiene (HTPB)-based propellant; it develops a thrust of about 4,700 kilonewtons (kN) and burns for about 107 seconds. The 2.1 m diameter, 19.7 m long strap-on motors each contain 40 tonnes of the hypergolic propellants UDMH and nitrogen tetroxide, develop a thrust of 765 kN and burn for up to 160 s by which time the altitude is about 73 kilometres.



## The Upper Stages

The second stage is 2.8 m in diameter, 11.6 m long and is filled with up to 40 tonnes of UDMH and nitrogen tetroxide which generates about 800 kN thrust for up to 140 s, raising the altitude to about 127 km. Unusually, this stage is ignited 1.6 s before the first-stage separation charge is detonated, thereby utilising its exhaust gases to assist in making a clean separation. During this part of the flight the payload fairing, which protects the payload during ascent through the denser lower atmosphere, is jettisoned at around 115 km altitude.

The third stage, from Russia, is also 2.8 m in diameter and incorporates two separate aluminium alloy tanks for 12.5 tonnes of fuel and oxidiser in its 8.7 m length. It develops a thrust of 73 kN for up to 12 minutes. The pyro-actuated release mechanism and retro thrusters on the second stage ensure a clean separation before the third stage is ignited. When the third stage has completed its job it is at 195 km altitude and has a speed of 10.2 km/s. A spring mechanism separates the spacecraft from the third stage which then performs a small manoeuvre to eliminate the possibility of a collision with the payload during the coast phase to geostationary altitude. Also, all residual fuel and gases in the third stage are vented into space to prevent build-up of pressure which could lead to an explosion and debris fragments hazardous to other spacecraft.

## From GTO to Geostationary Orbit

*GSLVs* are launched from Sriharikota on the east coast of India about 100 km north of Chennai (Madras) to an azimuth of 104° which results in an inclination of about 19° for the geostationary transfer orbit. The perigee is typically 180 km and the apogee close to the geostationary altitude, 36,000 km. The launch profile is such that apogee occurs close to the equator so that the circularisation burn of the payload's apogee motor can also reduce the inclination to zero in the most fuel efficient manner. The apogee motor used on all *GSLV* payloads to date is the 440 newton Indian-developed motor which has been used on *INSATs* launched on foreign rockets.

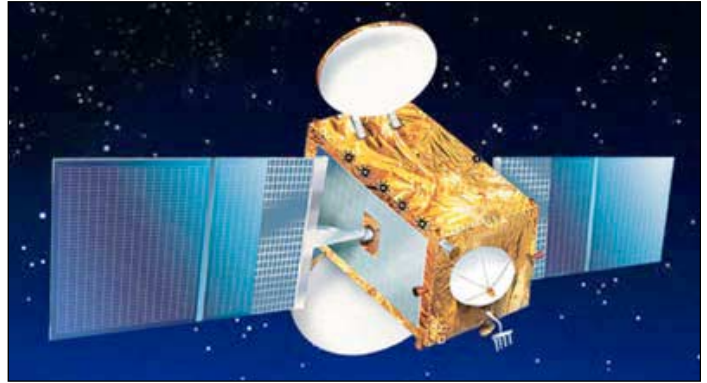
## Satellites Launched by PSLV

Although the first developmental test flight was intended to validate the vehicle design and its performance characteristics, the opportunity was taken to launch the 1540 kg experimental satellite *GSAT-1*. The launch took place on April 18, 2001 and was successful in all respects. *GSAT-1* also performed well and, in addition to carrying experiments to prove new spacecraft elements for use in future flights, it also had on board three C-band and two S-band transponders which were used to demonstrate digital audio broadcasting, Internet services and to carry out digital TV experiments.

Two years later, on May 8, 2003, the second test flight successfully placed another experimental payload, *GSAT-2*, in GTO from where its propulsion system moved it in three stages to geostationary orbit at longitude 48°E. In addition to six transponders *GSAT-2* carries four scientific payloads:

- Total Radiation Dose Monitor to measure radiation doses within the satellite using a radiation-sensitive field effect transistor.
- Surface Charge Monitor to indicate the charge state in the vicinity of the spacecraft.
- Solar X-ray Spectrometer to study solar flares.
- Coherent Radio Beacon Experiment for ionosphere studies and to investigate several aspects of equatorial electrodynamics.

*GSAT-2* weighed 1823 kg at launch including 840 kg of propellant for the apogee motor and for the 16 small (22 newton) reaction control thrusters used for attitude control. The solar panels span 9.55 metres and generate 1,380 W of power backed up by two 24 Ah Ni-Cd batteries.



The latest launch of *GSLV* on September 20, 2004, successfully placed *EDUSAT* at 74°E longitude (illustration above). Dedicated exclusively to education, this satellite provides a C-band beam and a Ku band beam covering the whole of India and 5 Ku band regional beams. Each beam can support up to 5 television channels simultaneously and 72 channels have already been established by schools and universities throughout the country.

The final part in this series will detail some of India's future space plans.

## Acknowledgement

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

<http://www.isro.org>

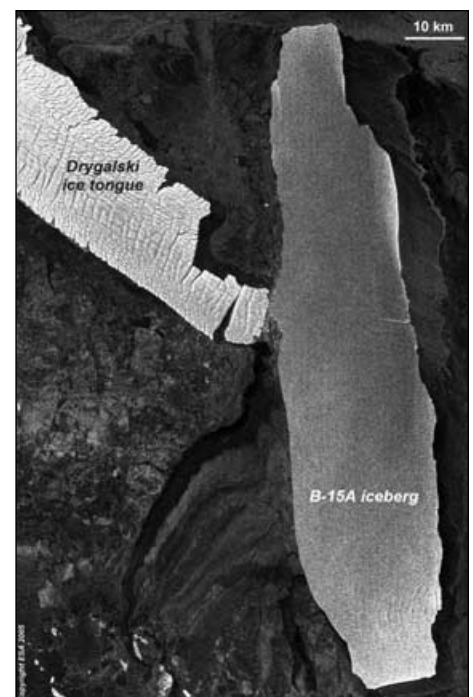
<http://www.nrsa.gov.in>

## B15A Iceberg Latest

The B15a iceberg has finally drifted away from McMurdo Sound in Antarctica since our last report in Quarterly No 5, page 27).

On April 18, the giant 'berg collided with the tip of the Drygalski ice tongue as shown in this ENVISAT ASAR wide-swath radar image.

Credit: ESA



# Highway in the Sky

John Tellick

The new € 394 million *Millau Viaduct* across the Tarn Valley to the south of France's Massif Central region opened to traffic on December 17, 2004. The 2460 metre-long bridge, which reaches a maximum height of 270 metres above the valley floor, is now the world's highest road bridge. It is expected to carry between 10 000 and 25 000 vehicles per day (toll € 4.90 for a light car).

The bridge, which was designed by English architect Sir Norman Foster, is supported by seven concrete pillars, the tallest of which, at 336 metres, is higher than the Eiffel Tower in Paris (324 m including its flagpole). Each of the six central spans measure 342 metres. The bridge was actually constructed by *Compagnie Eiffage*, the same group that built the Eiffel Tower. There is enough steel in the decking alone—36 000 tonnes—to build the equivalent of five Eiffel Towers while 205 000 tonnes of concrete were used for the pillars and supports.

The Millau bridge, which is part of the A75 motorway, can be seen from space and was photographed by the ESA *Proba* satellite's high resolution camera [HRC] which has a 5-metre spatial resolution, on December 11, 2004.



Above: the Millau Viaduct sweeps majestically above the Tarn Valley  
Photo: Daniel Lavabre



The Worlds tallest road bridge is seen from space by the European Space Agency's PROBA microsatellite on December 11, 2004.

Image: ESA

## Proba

*Proba* is a microsatellite developed by ESA's General Support Technology Programme (GSTP) and built by an industrial consortium led by the Belgian company *Verhaert*. *Proba* was launched from India on October 22, 2001 and is operated from the ESA Ground Station at Redu in Belgium. Its main Compact High Resolution Imaging Spectrometer (CHRIS) instrument was funded by the British National Space Centre (BNSC) and built by UK company *SIRA Space*.

*Proba* was intended as a one-year technology demonstration mission but has had its lifetime extended to serve as an Earth Observation mission.

A follow-on technology demonstrator called *Proba-2* is due to be deployed in late 2006 or early 2007 depending on the available launch opportunities.

Thanks to ESA for the image and information about *Proba*.

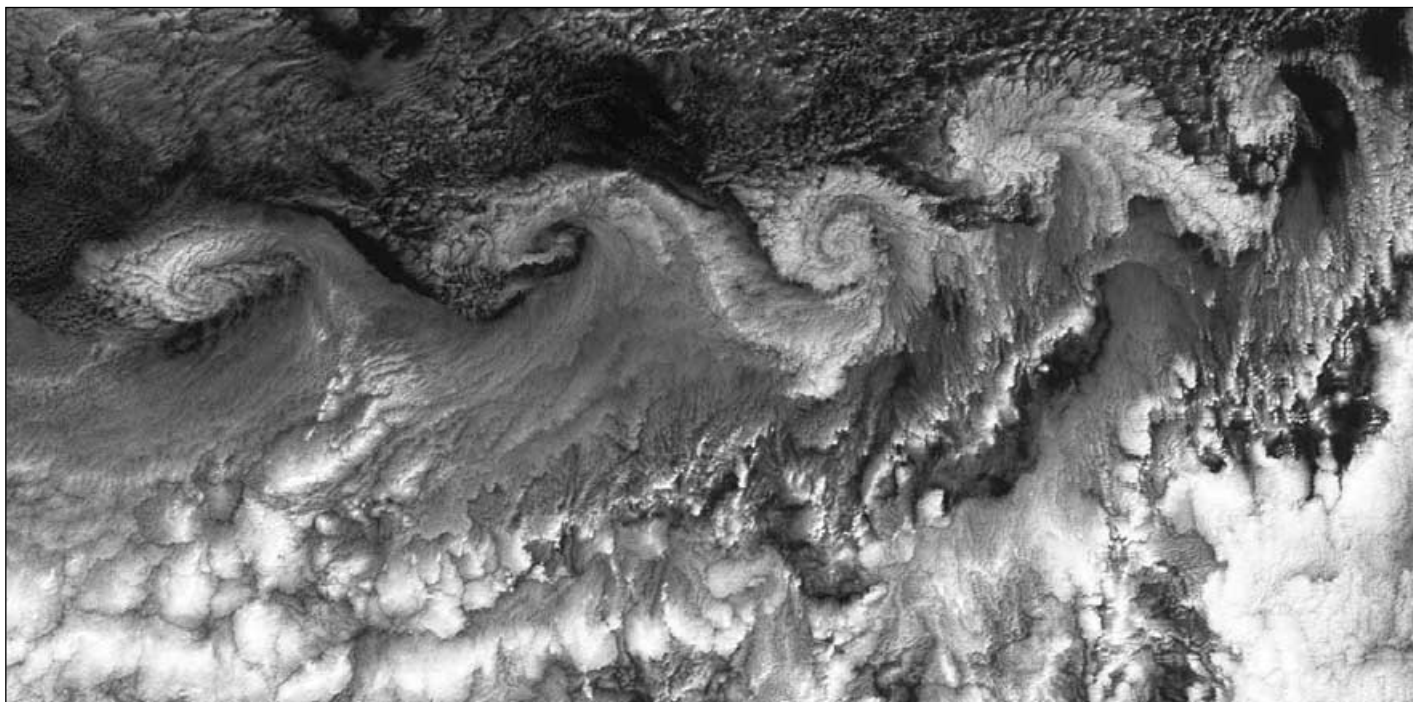


Artist's impression of PROBA in orbit.  
Image: ESA



# Spectacular Cloud Eddies in the North Atlantic

*Peter Wakelin*



The MODIS instrument aboard NASA's Terra satellite imaged this spectacular set of vortices stretching across the north Atlantic between Iceland and Norway on March 28, 2005.

These vortices were not caused by a physical obstruction as in the case of von Karman vortices but are almost certainly caused by pronounced wind shear on the curved trajectory blowing around an anticyclone to the north. The strong, cold, dry, northeasterly flow off Norway is cloudless initially but soon picks up moisture from the relatively warm North Sea and shallow convective clouds develop which enable the eddies in the turbulent flow to be seen.

This can be likened to the flow in a fast stream; the flow in the deeper, fast flowing middle is usually laminar and turbulence-free whereas, towards the edges, and especially on bends, the flow speed is reduced by friction and eddies or whirlpools can often be seen.

Quite remarkable cloud patterns associated with wind shear can frequently be seen at any level in the atmosphere where there is a significant change in wind speed over a short distance either in the horizontal or vertical. One of the best places to look is on the north side of the sub-tropical jet stream over north Africa which is usually evident as a band of high-level cirrus cloud on Meteosat images. The cirrus is usually tenuous and often inconspicuous on the visible images so the turbulence patterning, often of a 'herring-bone' nature, is best seen in the thermal IR channels. Speeds in excess of 100m/s (200 knots) are regularly recorded here with marked wind shear, especially when the airflow is curved. Although the height of the sub-tropical jet's core is generally above the flight levels of civilian aircraft, pilots are aware of the risk of extreme turbulence in this region.

## Overseas Guests

GEO held a highly successful Weather Satellite Symposium at the end of April and a full report on proceedings will appear in our September issue. Over 60 delegates and speakers attended including several from overseas. One of the highlights of the day was a talk on the US weather satellite program from Ed Murashi while several members of the Dutch *Werkgroep Kunstmanen* held workshops and spoke on a variety of topics.



Pictured above enjoying informal discussions over breakfast prior to the GEO Symposium in the National Space Centre are (l to r) Ed Murashie with Rob Alblas, Arne van Belle and Ferdinand Valk from the Netherlands.

# Optimising EUMETCast Reception using a RAM disk



Arne van Belle - Co-ordinator, Radio Observers, Werkgroep Kunstmanen

EUMETSAT recommends use of quite a powerful PC for the reception of *EUMETCast*, its DVB dissemination route for Meteosat-8 pictures and the many other data products that are transmitted using the Hot Bird 6 satellite. This is not without reason! From experiments it has become clear that a low-specification PC rapidly becomes overloaded and starts to lose image segments (horizontal segments of the picture remain blank).

After a thorough study of the complete reception process, experiments and discussions with David Taylor, I concluded that the hard disk is mainly to blame. By reserving part of the PC memory as a RAMdisk, and instructing the reception process to use this instead of the hard disk, you can receive *EUMETCast* using a much lower specification PC.



A Meteosat-8 channel-9 IR image illustrating a missing segment  
© EUMETSAT 2005

A clean installation of Windows 2000 (Service Pack 3 or higher) plus sufficient memory in your PC is a first requirement. Windows 98 and ME are not suitable. In these operating systems, the reception buffer is too small and it is this problem that causes many missing segments.

The RAMdisc approach does also work with Windows XP, but tends to load the CPU and memory a bit more compared with Windows 2000, especially on older PCs where resources may be scarce.

## Why Does a RAMdisk Help?

The *Tellique* software uses a temporary file (called '*0.fsy*') to buffer the received data stream. All received data is 'dumped' directly into a database to keep up with the continuous stream. Only later is this database analysed and the data assembled into complete files. There is a separate file for each segment of image data.

From my experiments it has become clear that you can lose segments at times when there is a lot of activity on the hard-disk. At these moments, *Tellique* is not able to access the database in the *0.fsy* file quickly enough and therefore loses some of the incoming data stream.

As a side-effect you may notice that, during bad reception conditions or when using a slow PC, the *0.fsy* file size increases rapidly. This is because the database is becoming clogged with incomplete data that could not be converted into files.

By telling *Tellique* to maintain this database on RAMdisk, you can drastically improve access times and so prevent data loss.

Tests have shown that disk usage will decrease from 30% to 7% when *Tellique* is using a RAMdisk instead of the hard disk.

Using the method described here I can now receive *EUMETCast* using a 400 MHz Pentium II. This PC can receive all the HRIT + FSD data and decode them using *MSG Data Manager* while at the same time updating and displaying an HRV animation using *MSG Animator*.

Before using the RAMdisk I had to be very cautious when moving decoded images to my *GeoSatSignal* processing PC; I even had to lower my network transfer speed to 10 Mbit/s to prevent segment loss. But now I don't suffer from lost segments when moving all one day's images at 100 Mbit/s.

But you do need sufficient memory in the PC and take care to limit tasks on it. Using 384 Mb of memory I can receive and decode all HRIT channels and FSD (GOES 9,10,12 and Met-5) as well as run *MSG Animator* (although updating only one animation). You can run with less memory by decoding only a select number of HRIT channels and not running *MSG Animator*. To prevent heavy paging to hard disk you should have at least 192 Mb RAM.

Also, disable all other tasks like virus scanner, screensaver, automatic updates etc. to free up as much memory as possible. But never use an unprotected PC to perform any downloads from the Internet.

## Adapting Your EUMETCast PC to run with RAMdisk

I assume that you already have the *Skystar2* DVB card, *Tellique* software and the EKV installed on this PC. Download the RAMdisk software (just 93 kb) from:

<http://www.arsoft-online.de/products/product.php?id=1>

It is a free program suitable for Windows NT, Windows 2000 and Windows XP. Install the RAMdisk, by double-clicking on RAMdisk setup.exe.

- Go to Start, Settings, Control Panel and double-click the 'RAM disk' icon
- Set the drive letter to 'Z:' and click on the 'Geometry' tab
- Set 'Disk size' to 25 Mb (using the slider or arrow keys left/right)

When running Windows XP, you must also set 'Emulate a local hard disk' under the 'General' tab.

## Now Reboot the PC

First make a backup of the folder

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

called

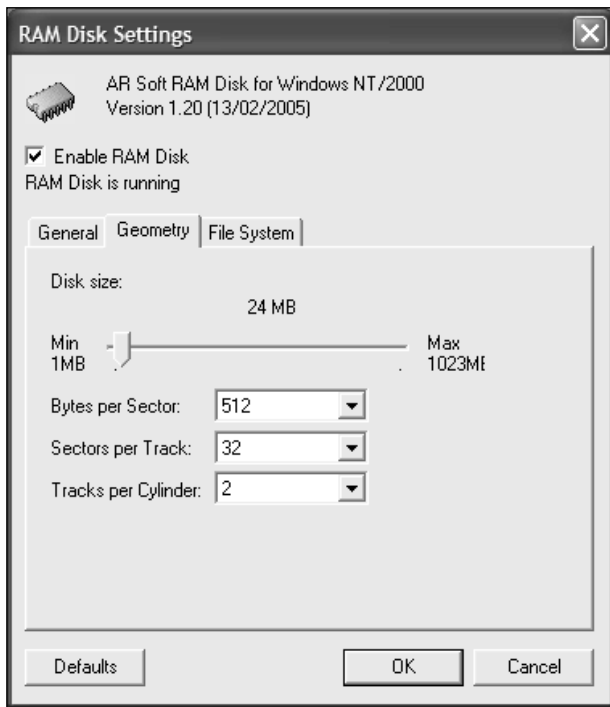
C:\Program Files\T-Systems\BusinessTV-IP-backup

If you use an older setup you will find all the files in folder C:\Tellique but the changes mentioned below are the same.

## Edit the file 'recv.ini'

- Change 'log\_file\_number = 30' to 'log\_file\_number = 2'
- Change also 'log\_level = normal' to 'log\_level = quiet'





Setting the size of the RAMdisc

These changes ensure that *Tellique* does less logging and causes less hard disk access. A side effect is that you will only see errors in the log, not the normal messages.

#### Under [locations] add the line below

```
file_database_directory=Z:\receiving
```

This entry instructs *Tellique* to place the *0.fsy* file on RAMdisk in folder 'receiving' and not on the hard disk.

#### Under [parameters] add the line below

(If this line already exists, then only change the number)

```
file_database_size = 24 576 000
```

This ensures that the *0.fsy* file cannot overflow the RAMdisk (24 x 1024 kb).

#### Now edit file 'recv-channels.ini'

Change the line

```
#temp_directory = receiving/tmp'
```

to

```
'temp_directory = Z:\receiving/tmp'
```

Pay attention to the use of '\ ' and '/'. They must be entered exactly as shown (*Tellique's* origin is UNIX !).

This change instructs *Tellique* to buffer received data on RAMdisk during build-up of a file. Only once a file is completed is it moved to the target directory on hard disk.

You need to restart *Tellique* to make these changes effective. *Tellique* will create a file called '*0.fsy*' in 'Z:\receiving\'. Within a couple of minutes data should be coming in again.

#### Points to watch during first week running with RAMdisk

The free space on Drive Z: should never be less than 1 Mb; if necessary increase RAM disk size a bit.

Check Task Manager, Performance and 'Memory usage' regularly. The average over a day should be below the total amount of physical memory. A temporary peak can be handled by paging to hard disk but excessive paging will lead to segment loss. If necessary free up memory by de-selecting channels in MSG Data Manager or installing more RAM.

Normally the hard disk LED will light up regularly in short bursts. But if the LED lights up almost continuously for several minutes the load on the disk might be too high. You should be aware that older hard disks not only have a smaller capacity but also have a lower transfer rate. Replacing by a disk with 7200 rpm and an 8 Mb buffer can improve the overall performance of an older PC considerably. But be careful with large hard disks (over 40 Gb). Check in your motherboard manual about using large hard disks as you may need to upgrade your BIOS to use them.

## News from EUMETSAT

EUMETSAT's latest Operations Bulletin, No 11, was issued in January this year, updating its predecessor, issued in December 2003.

#### New EUMETSAT Domain Name

As of February 2005, the official EUMETSAT Internet domain changed from *eumetsat.de* to *eumetsat.int*. Users wishing to access EUMETSAT Web pages should update their web browsers with the new address. Likewise, the new Helpdesk e-mail address is [ops@eumetsat.int](mailto:ops@eumetsat.int).

#### Geostationary Satellites after 2005

As was intimated in GEO Q4, page 26, all direct transmissions from *Meteosat-6* and *Meteosat-7* will cease once *Meteosat-9* (MSG-2) is successfully commissioned. The date for this switch-off is anticipated to be during December 2005 and all Wefax and PDUS users should have equipped themselves for EUMETCast reception by that time.

#### The following paragraph is of particular interest!

The forthcoming EUMETSAT Polar Services (EPS) will include:

Metop Direct Readout (local reception) – consisting of direct instrument readout data delivered to the user as the satellite passes over the field of view of the local reception station. These data are available in high and low resolution and can be received by Advanced High Resolution Picture Transfer (AHRPT) and Low Resolution Picture Transfer (LRPT) reception stations respectively. ***Under nominal operations, these data will be unencrypted and available to users without licence and without charge.***

Operations Bulletin No 11 may be downloaded from:

<http://www.eumetsat.int/en/dps/helpdesk/documentation/pdf/newsbulletin11.pdf>

# The Indian Ocean Tsunami

## Its Effects on the Strait of Malacca

C.S. Loh and Kimberley Loh Ying-Ying

Much has been written elsewhere about the tsunami event that devastated many countries bordering the Indian Ocean on December 26 last year. But peninsular Malaysia, though much closer to the earthquake epicentre than Sri Lanka and about the same distance away as Thailand, suffered comparatively fewer casualties. We believe that this probably resulted from specific local conditions.

### The Geophysical Facts

The earthquake induced thrust-faulting and slippage along approximately 1200 kilometres of the boundary between the Australia-India and the Burma-Sunda plates. It was estimated that the average displacement on the fault plane was about fifteen meters, uplifting the sea floor and displacing the overburden of water. This caused waves to radiate out from that location, those travelling towards the east and west carrying much more energy than those heading to the north and south.

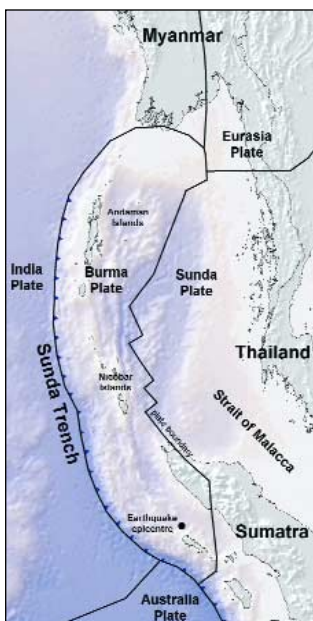


Figure 1 - The earthquake epicentre  
Topographic Map: USGS

Whereas shallow coastlines such as that of western Thailand tend to be hit by high, steep and often very destructive waves, a landmass rising abruptly from the ocean depth, like the chain of Langkawi islands, absorbs the energy of the waves and suffers less severe damage.

The explanation is that the tsunami's leading wave slows down as it enters

shallow water. This allows the following waves to pile on top of it, adding to its overall height. This is illustrated for Khao Lak on the Thailand coast in the IKONOS images reproduced on page 17 of GEO Quarterly No 5. More images and a DEM-generated flypass by Kwoh Leong Keong can be viewed at:

[http://www.crisp.nus.edu.sg/tsunami/khaolak\\_fly.wmv](http://www.crisp.nus.edu.sg/tsunami/khaolak_fly.wmv)

It is also noted that coral reefs, islets and other smaller islands (like Pulau Singa Besar, Pulau Dayang Bunting and Pulau Tuba which surround the main Langkawi island) were able to deflect the impact by disrupting some of the energetic wave forms. Chalets in Langkawi, built within coves and bays, and those facing reef islets or islands offshore, escaped major damage.

The minimal damage incurred by peninsular Malaysia compared with the Indian subcontinent and Thailand could also possibly be attributed to the low tide condition in the Strait of Malacca at that time (figure 2). Bagan Datoh, which faces the Strait at the estuary of Sungai Perak, had a receding tide at 10:58 am on December 26, 2004 and was sheltered from the monsoon winds by the Central Highlands. Had the tsunami crashed in with a monsoon behind it and at high tide, it could have destroyed a lot more of the coastal infrastructure along the Strait.

At Galle (Sri Lanka), Mergui (Myanmar) and Port Blair (Andaman Islands), it was approaching high tide when the tsunami waves arrived. It is therefore not surprising that the waves were much bigger and stronger at those locations. Examples of the damage wreaked on Katchall Island in the Nicobars is illustrated in figure 3.



Following the earthquake, it was reported that the land elevation at Port Blair in the Andaman Islands had shifted by as much as 1.2 metres and fishermen were sighted standing knee-deep on flooded roads to cast their nets: 'The sea has brought the fish closer to us', said one resident.

### The Geographical Features

Mangrove forests, known locally as *bakau*, act as a 'vegetable belt' that protects the Strait's coastal areas from the states of Perlis in the north to Johore in the south. It may well be that they helped to soften the tsunami's impact by absorbing much of the energy of the waves pounding upon the shores.

On Penang island, fishermen found that there was less damage to their houses in areas where the mangrove swamps were more abundant. The mangrove tree (*rhizophora*) is an efficient soil binder, with a dense root and branch structure, and thus contributed to a large extent to the cushioning of the impact of the oncoming waves. At the height of the waves' insurgence many fishermen clung to the mangrove trees and indeed, some even

Location	Longitude (east)	Latitude (north)	High Tide (metre)	Local Time	LOW TIDE (metre)	Local Time
Galle	80°13'	06°02'	0.57	2:23 pm	0.21	8:34 am
Madras	80°18'	13°06'	0.94	8:06 am	0.28	2:05 pm
Trincomalee	81°13'	08°33'	0.55	7:59 am	0.23	1:39 pm
Port Blair	92°46'	11°41'	1.64	8:50 am	0.49	2:3 pm
Mergui	98°36'	12°26'	4.27	10:23 am	0.77	4:27 pm
Belawan	98°43'	03°50'	1.98	1:43 pm	0.60	7:35 am
Bagan Datoh	100°45'	04°00'	2.34	4:47 pm	0.48	10:58 am
Port Dickson	101°47'	02°31'	2.53	6:40 am	0.69	1:12 pm
Malacca	102°15'	02°11'	2.17	8:09 am	0.60	3:10 pm
Singapore	103°51'	01°16'	2.84	10:42 am	0.30	5:37 pm

Figure 2 - Tide Conditions in Selective Locations on December 26, 2004



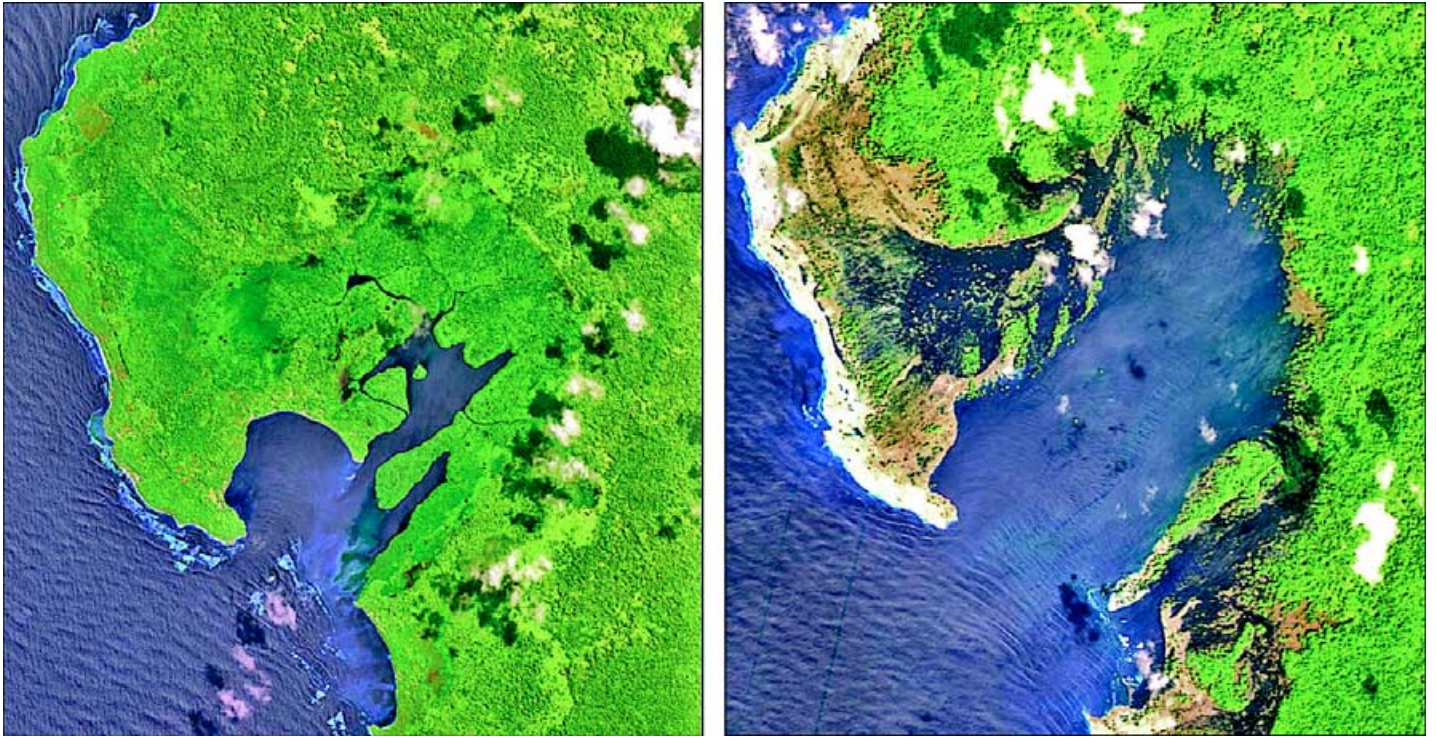


Figure 3 - SPOT-5 images showing Tsunami damage on Katchall Island - July 10, 2004 (left) and December 28, 2004 (right)  
 SPOT-5 images © CNES 2004, acquired and processed by CRISP, National University of Singapore



Figure 4 - Mangroves, with aerial roots exposed  
 Photo: C S Loh



Figure 6 - Location of Batu Ferringhi on Penang Island  
 Credit: Tiungsat-1, May 17, 2001 - © Astronautic Technology (M) Sdn Bhd



Figure 5 - Beach lookout tower  
 Photo: 'The Star' local newspaper



took refuge within the mangrove swamps where they were shielded from the full force of the tsunami.

The tiny island of Simeuleu, situated off the devastated Banda Aceh peninsula in northern Sumatra, and just 40 kilometres from the earthquake epicentre, was saved by wide belts of mangroves which acted as natural buffers between the sea and the coast. These limited the full fury and wrath of the tidal waves and the island suffered only four fatalities. Eyewitnesses reported that although the tsunami penetrated the mangrove belt, the water rose smoothly, like a rising tide.

However, mangrove forests in Southeast Asia (figure 4) are under threat, partly by man-made pollution (which limits the propagation of mangrove plants) and as a result of development. It is no coincidence that there were higher casualties in the Kuala Muda estuary of Kedah where more than 2 500 acres of mangrove forest had been cleared since the 1990s.

Off the state of Kedah in the north-west of Malaysia lies a cluster of 104 islands, the Pulau Langkawi archipelago, which is a holiday resort not unlike Phuket in Thailand. Although there were mud and debris to be cleaned up following the tsunami, the hotels remained intact and the airport remained operational, as did the ferry services between the islands and the mainland. And although Langkawi emerged from this event relatively unscathed and without any tourist casualties, there was physical damage to properties, especially luxury boats moored off hotels facing the Indian Ocean.

The extensive coral reefs and scattered offshore islets surrounding the main Pulau Langkawi islands acted as solid barriers against the sea, limiting the power of the tsunami surge and protecting beach-side hotels and villas. Also, some beaches were sheltered within bays protected by a headland facing the Indian Ocean (e.g. Penang's Batu Ferringhi, behind Mukah Head), which partly reduced the strength of the onrushing waves. Even so, some of the waves were as high as palm trees. Another reason why sunbathing tourists escaped major casualties may be that Penang island was partially sheltered from the impact of oncoming tsunami waves by the headland of Sumatra.

### The Human Factors

The Ferringhi Baywatch Tower early warning system on the Penang coast is credited with saving many lives and there were no reported casualties along the two-kilometre beachfront in Batu Ferringhi. The location is shown in figure 6, a 72-



Figure 7 - An IKONOS image showing the sea-wall sheltering Pulau Langkawi International Airport - December 29, 2004.

Image: Spaceimaging

metre false colour image from Malaysia's *Tiungsat-1* microsatellite.

Around noon on that fateful Saturday, lifeguards at a beach tower (figure 5) noticed rough and choppy waters and a red flag was raised to warn people that the beach was not safe. All beachfront hotels then warned their guests to stop all activities and move away from the beach. Several minutes later, the first of the large waves hit the beachfront. Between Kuala Teriang and the Cehang river, an 8 km long 3-metre high sea wall softened the impact of the waves on the coastal defences sheltering the Pulau Langkawi International Airport (figure 7). This structure prevented the incoming tsunami from destroying more inland areas. However, the nearby fishing village of Kuala Teriang was not sheltered by this barrier and the tsunami killed one villager and damaged or demolished 139 houses.

### The Aftermath

Following the devastation from the tsunami there were numerous amazing tales of survival: one of the more miraculous was that of Malawati Daud. Malawati was washing clothes at her house two kilometres from the sea when the killer waves swept through her home in the Aceh Jaya district of Sumatra and swept her out to sea.

Malawati was eventually rescued, five days later, by the crew of a Penang-based tuna boat 185 kilometres out in the Indian Ocean. She was discovered clinging to an uprooted one-metre length of nipah palm and had survived by eating small clusters of nipah fruit.

The Indian Ocean tsunami experience had a deep impact upon Malaysians.

Bypassed by the Indian Ocean's cyclones and Pacific Ocean's typhoons, and situated just outside the volcanic belt of Southeast Asia, the perceived security has been shattered by this seismic movement.

### Acknowledgments

The satellite images from IKONOS and SPOT 5 in this article were acquired by the Centre for Remote Imaging, Sensing and Processing (CRISP) at the National University of Singapore, with gratitude from the authors.



Figure 8 - C S Loh is a lecturer with *Informatics* in Kuala Lumpur. He is pictured above amidst mangroves, receiving wxsat signals with a home-made QFH built from SWG21 copper wire and a 1.8 metre glassfibre fishing rod—the CAST (Compact Antenna for Satellite Tracking). The antenna is connected to an RX2 receiver operated from a 9-volt battery and enclosed within a video-cassette holder: the CLEAR (Compact Light-mobile Experimental APT Receiving) system.



Kimberley (above) is a Form Four Gamma pupil of Sekolah Menengah Kebangsaan (National Secondary School) Seri Bintang Utara (Bright North Star), Kuala Lumpur where she is a school prefect and basketball player.

Kimberley has twice attended the Outward Bound School's programme in Lumut, Perak. In November 2004, Kimberley had the fortunate opportunity to greet Prince Andrew when, as its Patron, he visited the School. Kimberley enjoys reading, kayaking and travelling. Kimberley researched this article as part of her term assignment on "Typhoons, Tornadoes and Tsunamis".

Homepage of C.S. Loh:

<http://geosat.homestead.com/homepage.html>

Homepage of Kimberley Loh:

<http://kimberley.homestead.com/loh.html>



# DESERT MOONS

**Francis Bell**

I would like to report an observation I made recently which I have never seen before and which I am unable to explain. Perhaps one of GEO's readers could offer an explanation.

This observation relates to a double image of the moon as seen from the southern tip of the Sinai desert, Egypt at 7.00 pm local time on March 11, 2005. The location was latitude 28°N, longitude 34°E; the angle of the moon in the sky was adjudged to be about 40 degrees (not measured).

There had been some intermittent winds during the day but the sky was mostly clear with sunshine. The daytime temperature had been about 32°C, dropping to around 25°C that evening. The early night sky appeared to be quite clear.

Figure 1 illustrates, as best I can judge, what I saw. Unfortunately I have no photographs just naked eye observations.

This is what happened. At the location described I received a telephone call from a friend who was staying in a building about 200 m away. He said: 'I can see two moons'. In mild disbelief I went outside, looked up at the sky, and indeed there were two distinct images of the moon. There were two crescent moons slightly, but distinctly from my perspective, vertically displaced. Also, the rest of the moon's face was faintly illuminated. In total a very unusual sight.

When the angles are correct I know the moon can be illuminated by reflected light from the Earth as well as direct sunlight. I have seen this many times before. So had Shakespeare: 'The new moon with the old moon in her arms'. But an explanation for this double image defeated me.

I know that people can sometimes see double. Two eyes with a confused brain, by accident, indulgence, or other reason may see double. However, unless you are in a very unusual position this effect produces a *horizontal* displacement of an image; but what I saw was a *vertical* displacement. It was not just I who saw this—four of us agreed on the observation. I rashly promised one of my friends an explanation within six months.

Keeping my mouth shut I mentally ran through a few possible explanations. I know the atmosphere is not uniform and light can be bent by refraction as it passes through the atmosphere. Unusual effects can be observed. From a low cliff top in western Wales I have seen the silhouette of the Comeragh Mountains in County Waterford, Ireland. With light travelling in a straight line this should be impossible. Under some circumstances, usually at evening time, low angle incident sunlight is progressively refracted into a curve so that it becomes possible to see structures below the geographic horizon.

This type of explanation does not seem viable in this case because it would still generate a single image. I am trying to explain a double image of the moon.



Figure 1 - An artist's reconstruction of the double moon

I know that the mineral calcite, in its very pure form *Iceland Spar*, can refract light in two directions.

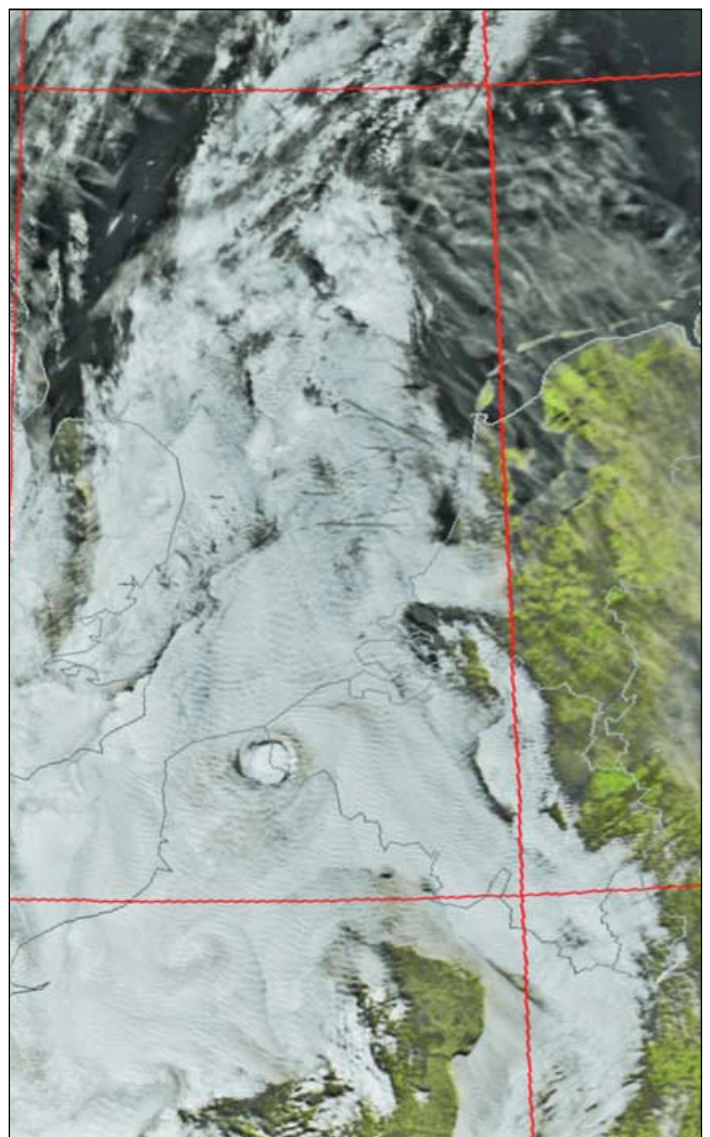
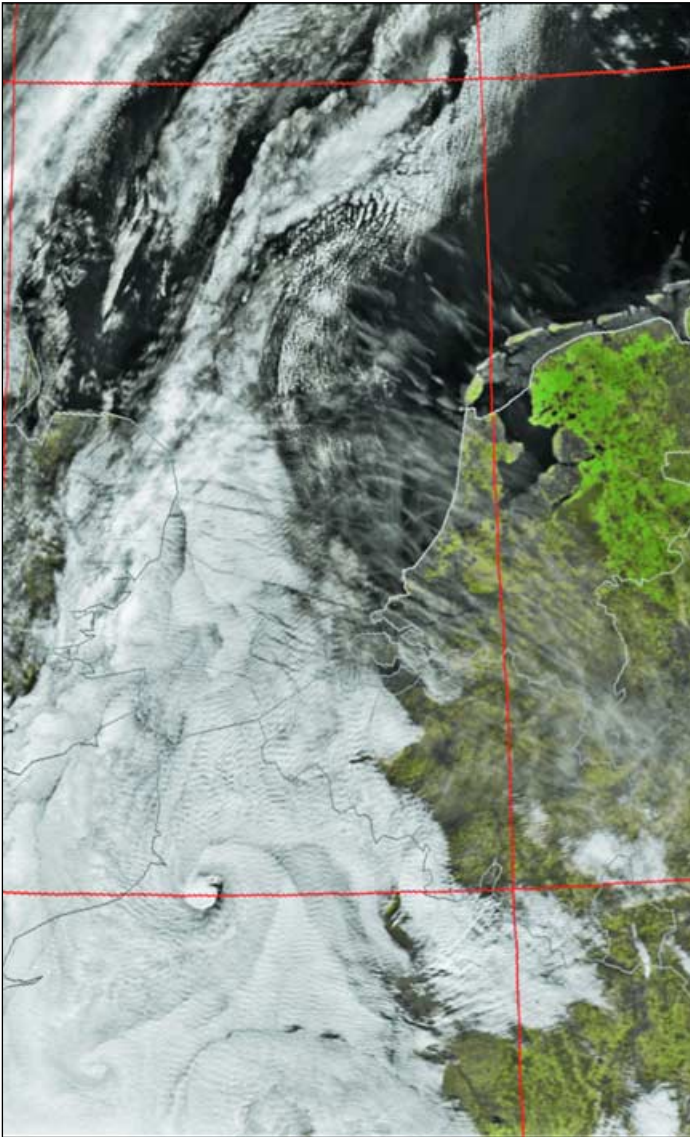
with light striking the crystals at a particular angle the light can be refracted in two directions, that is, *Iceland Spar* exhibits two refractive indices. But I was not looking through *Iceland Spar* I was looking through the atmosphere. I understand diffraction but I think that, if this was the explanation, I might have seen a series of images. I only observed two very sharp images.

Our atmosphere contains a mixture of gases and is variously layered, some of the layers being ionised. I also know that it contains particulate matter; dust and a wide range of microscopic crystals from sea water. Can this particulate matter under some circumstances, behave like *Iceland Spar* by generating a double refractive index in the atmosphere?

There are two questions.

- Why did I see two images of the moon on the evening in question?
- Are the sensors on weather satellites subject to this effect for reflected light and other emitted radiation coming back from the Earth to a weather satellite's sensors? The radiation must pass through the same effect in the atmosphere if this effect exists.

If anybody can explain my/our observation and its impact on weather satellite imaging it would be great to know the answer.



'Vegetation' images showing the unusual whorl of cloud over France on February 5 (l to r: NOAA 17 at 11:05 UT and NOAA 16 at 14:06 UT)  
 Image: NOAA CLASS Library - Processing HRPT Reader



Brownies Lorraine (left) and Stephanie at the Meteosat-8 station, supervised by Francis Bell



The entire Brownie troupe



The Meteosat-8 ground station



# UNUSUAL CLOUD WHORL OVER FRANCE

In early February this year there was some discussion on the MSG-1 Internet group concerning an interesting cloud phenomenon spotted over northern France. One report likened it to a 'mini hurricane' and David Taylor provided a NOAA 16 image for comment. His image, and a similar one from NOAA 17 taken three hours earlier, are reproduced here together with part of a surface pressure chart for about the same time.

We asked our meteorological expert, Peter Wakelin, for his thoughts.

## Peter wrote:

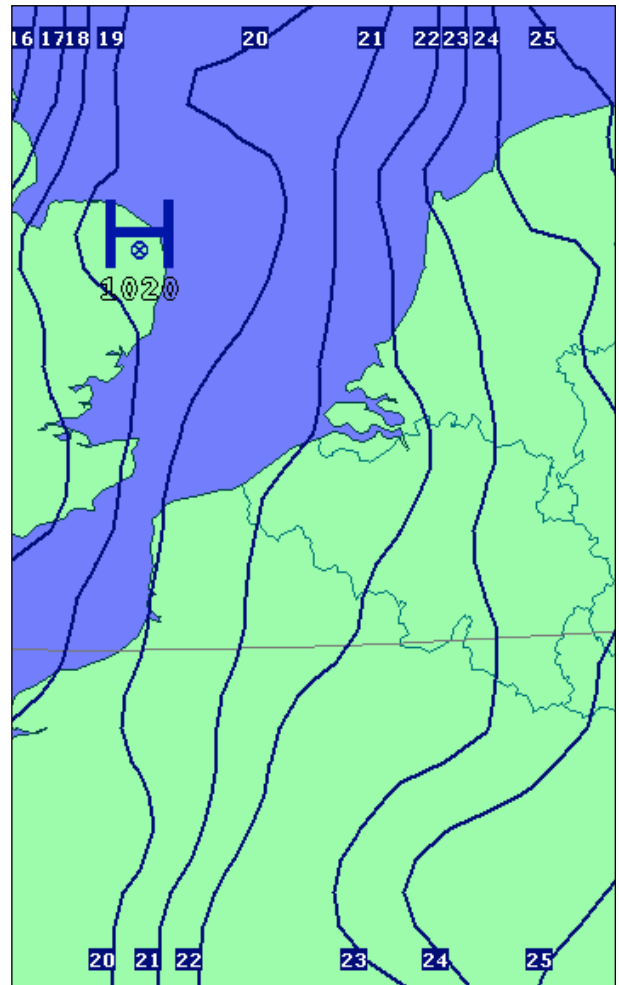
Clearly there is a stable southerly airflow over the area with a marked wave motion evident in the shallow stratocumulus cloud which is nicely enhanced by the low elevation of the winter sun. The NOAA 17 image shows a second vortex near the bottom left corner and, three hours later in the NOAA 16 image, there's a hint of a third one developing.

I believe a glance at a topographical map of the area reveals what is happening here. A

hilly area in the vicinity of l'Aigle is near the bottom left corner of the images with flat, low-lying ground to the east towards Paris. Now stable air prefers to go around hills rather than over them and the pressure chart confirms that this is happening with the tightening of the pressure gradient (closer isobars) in this region. This results in eddies forming to the lee of the high ground which, eventually, break away and travel downwind.

I was puzzled by the apparent continuation of the wave motion through these eddies; it is difficult to visualise the physical process which permits rotation and wave motion in the same cloud so I suspect that the wave cloud is at a higher level than the eddies.

The fact that the wave motion is evident over a wide area suggests it originated over hills further south, possibly in central France, so it may well be at a higher level. Temperature data from the thermal infrared channel is inconclusive on this point as the cloud is too thin and fragmented to derive accurate temperatures.



Synoptic chart (12:00 UT)

## BROWNIES

Francis Bell

In February each year there is an international event for Brownies. Even now I'm not quite sure what it is called, *Thinking Day on the Air* or something similar. The idea is that, on a particular weekend, Brownies from all over the world contact each other either through amateur radio or, nowadays, also via the Internet.

My local *Three Counties Amateur Radio Club* has been supportive of the local Brownies, Guides and Scouts for many years but this was only the second time I had contributed to this event—for a Brownie group in Hampshire. TCARC club members, David, Paul, Damian and Bob supervised the amateur radio and Internet communications while I took my Meteosat-8 ground station (plus a

standby laptop) along to the weekend meeting. I set up the station quite quickly and ran live images and animations.

I was taken a little by surprise because I thought I would set up on the Friday afternoon, run the station all day Saturday and then go home. But no! Somebody slipped an extra day into the experience and it lasted until the Sunday afternoon. The Brownies had brought their own beds and bedding, and 'slept over' rather than going home. I must say they were delightful company. My creature comforts dictated: home to bed—but I returned each morning.

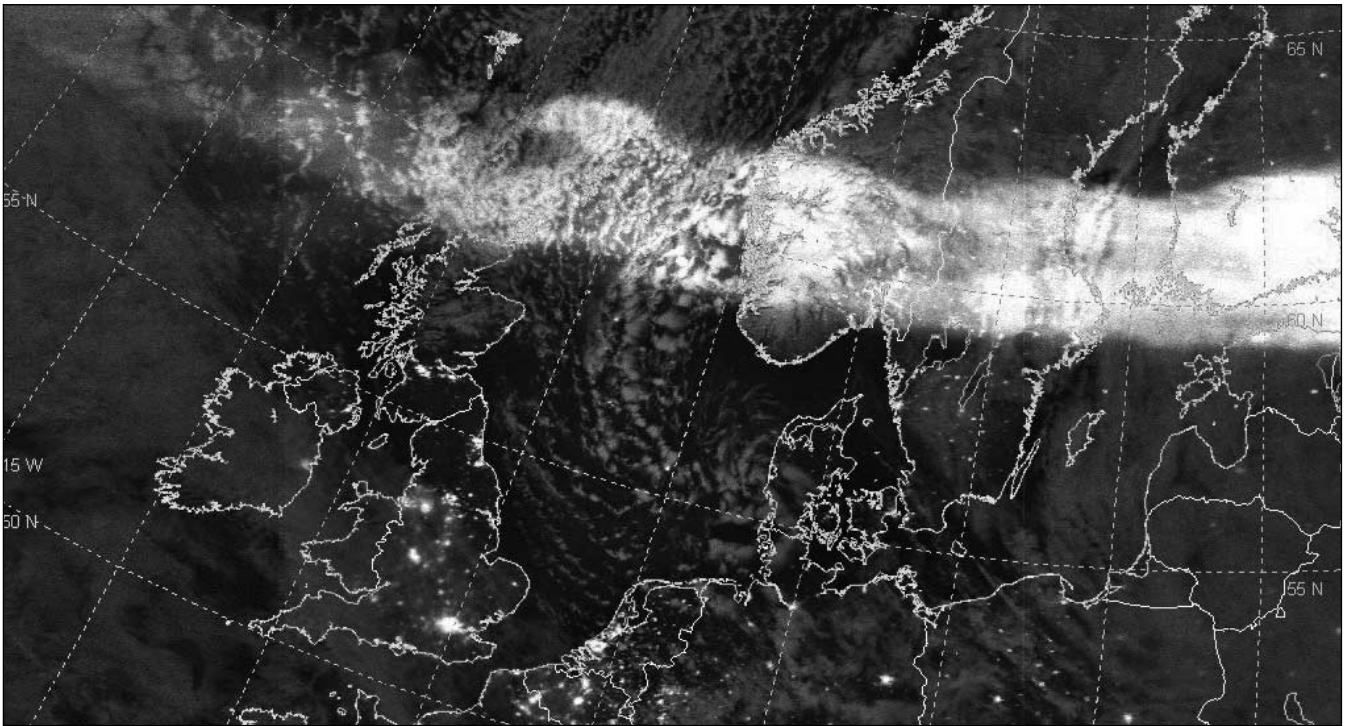
The Brownies did take a fleeting interest in the weather satellite station but the

repeated question I was asked was: 'Is it going to snow?' The UK Met. Office's forecast for Hampshire had been marginal. I looked at the incoming images and said: 'Snow: I don't think so'. But I was wrong! Two days later we had about 2 millimetres of snow which managed to survive for half a day.

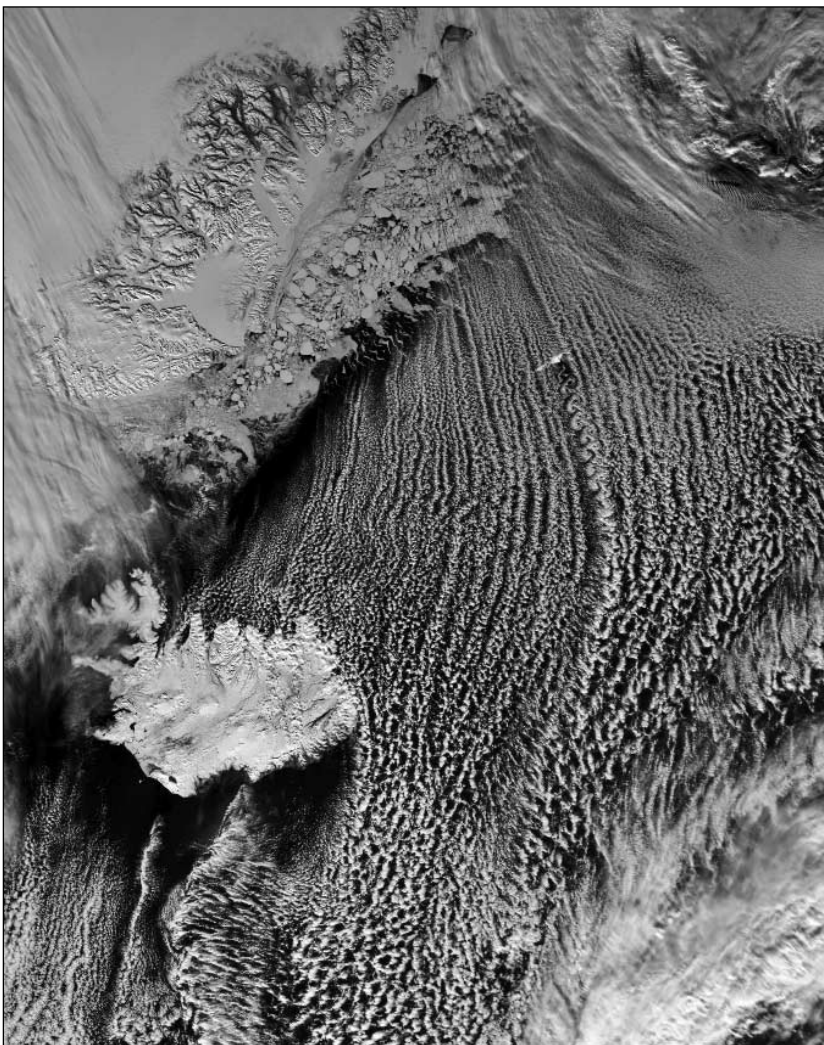
My laptop. Well, that was commandeered for Internet use but I was happy to see it productively used by the Brownies for Internet messages.

I was very pleased I attended. It's great to promote communications by and between young people. My thanks to the Brownies for their company, friendship and for feeding me at every opportunity. (See photographs on page 20)



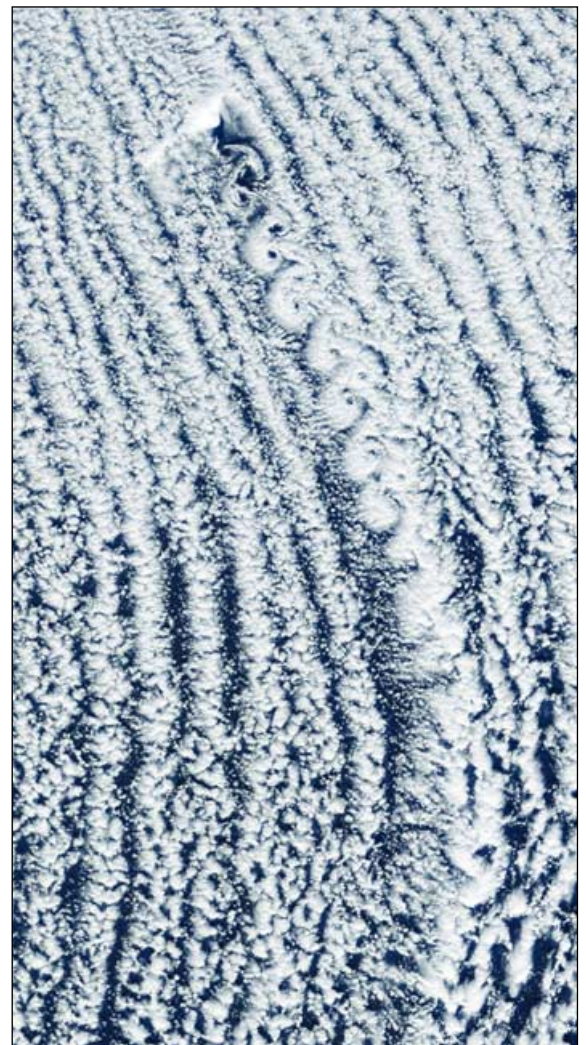


This spectacular display of the Aurora Borealis over Europe was obtained by the USAF DMSP-15 satellite at 18:50 UT on January 21, 2005  
Image: US Air Force Weather Agency



This NOAA 17 HRPT image from April 7, 2005 illustrates the flow of Arctic air that brought snow to much of Great Britain. Where the flow is intercepted by Jan Mayen island, a clearly defined street of Von Kármán vortices is being generated.

Image: NOAA CL:ASS Library



This image of the vortex street was taken on the same date, at a resolution of 250 metres per pixel, by the MODIS imager aboard NASA's Terra satellite.

Image: MODIS Rapid Response Team



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

NOAA 12			NOAA 15			NOAA 17			NOAA 12			NOAA 15			NOAA 17										
Jun 01	04:42	06:21	14:29	16:07	06:52	08:33	16:39	18:19	10:14	11:54	20:02	21:40	Aug 01	04:36	06:16	16:02	17:44	06:07	07:47	15:54	17:33	10:19	11:59	20:08	21:46
Jun 02	04:17	05:57	15:43	17:24	06:29	08:09	16:16	17:55	09:51	11:31	21:18	22:59	Aug 02	04:12	05:52	15:38	17:18	05:43	07:23	17:09	18:51	09:57	11:37	21:23	23:05
Jun 03	05:32	07:12	15:19	16:58	06:05	07:45	15:53	17:31	11:08	12:48	20:55	22:35	Aug 03	05:27	07:07	15:14	16:53	05:20	06:59	16:46	18:26	11:14	12:54	21:01	22:41
Jun 04	05:07	06:47	14:55	16:34	05:41	07:21	17:08	18:49	10:45	12:25	20:33	22:12	Aug 04	05:02	06:42	14:50	16:28	06:36	08:16	16:23	18:02	10:51	12:31	20:38	22:18
Jun 05	04:43	06:23	14:31	16:09	05:18	06:57	16:44	18:25	10:22	12:02	20:11	21:49	Aug 05	04:38	06:17	16:04	17:45	06:12	07:52	15:59	17:38	10:28	12:08	20:16	21:55
Jun 06	04:18	05:58	15:44	17:25	06:34	08:14	16:21	18:01	09:59	11:39	21:26	23:07	Aug 06	04:13	05:53	15:39	17:20	05:48	07:28	15:37	17:15	10:05	11:45	21:32	23:13
Jun 07	05:33	07:14	15:20	17:00	06:10	07:50	15:58	17:37	09:37	11:16	21:04	22:44	Aug 07	05:28	07:08	15:15	16:54	05:25	07:04	16:51	18:32	09:43	11:22	21:09	22:50
Jun 08	05:09	06:49	14:56	16:35	05:47	07:26	17:13	18:54	10:54	12:34	20:41	22:21	Aug 08	05:03	06:44	14:51	16:29	06:41	08:21	16:28	18:08	10:59	12:40	20:47	22:27
Jun 09	04:44	06:24	14:32	16:10	05:23	07:03	16:49	18:30	10:31	12:11	20:19	21:58	Aug 09	04:39	06:19	16:05	17:46	06:17	07:57	16:05	17:44	10:37	12:17	20:24	22:03
Jun 10	04:20	05:59	15:46	17:26	06:39	08:19	16:26	18:06	10:08	11:48	21:35	23:16	Aug 10	04:14	05:54	15:40	17:21	05:53	07:33	15:42	17:20	10:14	11:54	20:02	21:41
Jun 11	05:35	07:15	15:21	17:01	06:15	07:55	16:03	17:42	09:45	11:25	21:12	22:53	Aug 11	05:29	07:10	15:16	16:56	05:30	07:10	16:56	18:37	09:51	11:31	21:18	22:59
Jun 12	05:10	06:50	14:57	16:36	05:52	07:32	15:40	17:18	11:02	12:42	20:50	22:29	Aug 12	05:05	06:45	14:52	16:31	06:46	08:26	16:33	18:13	11:08	12:48	20:55	22:35
Jun 13	04:46	06:25	14:33	16:11	05:28	07:08	16:55	18:35	10:39	12:20	20:27	22:06	Aug 13	04:40	06:20	14:28	16:06	06:22	08:02	16:10	17:49	10:45	12:25	20:33	22:12
Jun 14	04:21	06:01	15:47	17:28	06:44	08:24	16:31	18:11	10:17	11:57	20:05	21:43	Aug 14	04:16	05:55	15:42	17:22	05:59	07:39	15:47	17:25	10:22	12:02	20:11	21:49
Jun 15	05:36	07:16	15:23	17:03	06:20	08:01	16:08	17:47	09:54	11:34	21:21	23:02	Aug 15	05:31	07:11	15:17	16:57	05:35	07:15	17:01	18:42	10:00	11:39	21:26	23:08
Jun 16	05:11	06:51	14:58	16:38	05:57	07:37	15:45	17:23	11:11	12:51	20:58	22:38	Aug 16	05:06	06:46	14:53	16:32	06:51	08:32	16:38	18:18	11:17	12:57	21:04	22:44
Jun 17	04:47	06:27	14:35	16:13	05:33	07:13	17:00	18:41	10:48	12:28	20:36	22:15	Aug 17	04:41	06:21	14:29	16:07	06:27	08:08	16:15	17:54	10:54	12:34	20:41	22:21
Jun 18	04:22	06:02	15:48	17:29	06:49	08:30	16:36	18:16	10:25	12:05	20:13	21:52	Aug 18	04:17	05:57	15:43	17:23	06:04	07:44	15:52	17:30	10:31	12:11	20:19	21:58
Jun 19	05:37	07:18	15:24	17:04	06:26	08:06	16:13	17:52	10:02	11:42	21:29	23:10	Aug 19	05:32	07:12	15:18	16:58	05:40	07:20	17:06	18:48	10:08	11:48	21:35	23:16
Jun 20	05:13	06:53	15:00	16:39	06:02	07:42	15:50	17:29	09:40	11:19	21:06	22:47	Aug 20	05:07	06:47	14:54	16:33	05:17	06:56	16:43	18:23	09:45	11:25	21:12	22:53
Jun 21	04:48	06:28	14:36	16:14	05:38	07:18	17:05	18:46	10:56	12:37	20:44	22:24	Aug 21	04:43	06:23	14:30	16:09	06:33	08:13	16:20	17:59	11:02	12:43	20:50	22:29
Jun 22	04:24	06:03	15:50	17:31	06:55	08:35	16:41	18:22	10:34	12:14	20:22	22:01	Aug 22	04:18	05:58	15:44	17:25	06:09	07:49	15:57	17:35	10:39	12:20	20:27	22:06
Jun 23	05:39	07:19	15:25	17:05	06:31	08:11	16:18	17:58	10:11	11:51	20:00	21:38	Aug 23	05:33	07:13	15:20	16:59	05:45	07:25	17:12	18:53	10:17	11:57	20:05	21:43
Jun 24	05:14	06:54	15:01	16:40	06:07	07:47	15:55	17:34	09:48	11:28	21:15	22:56	Aug 24	05:08	06:49	14:56	16:34	05:22	07:01	16:48	18:29	09:54	11:34	21:21	23:02
Jun 25	04:49	06:29	14:37	16:15	05:44	07:24	17:10	18:51	11:05	12:45	20:52	22:32	Aug 25	04:44	06:24	14:32	16:10	06:38	08:18	16:25	18:05	11:11	12:51	20:58	22:38
Jun 26	04:25	06:05	15:51	17:32	05:20	07:00	16:47	18:27	10:42	12:22	20:30	22:09	Aug 26	04:19	05:59	15:45	17:26	06:14	07:54	16:02	17:41	10:48	12:28	20:36	22:15
Jun 27	05:40	07:20	15:26	17:07	06:36	08:16	16:23	18:03	10:19	11:59	20:08	21:46	Aug 27	05:34	07:15	15:21	17:01	05:50	07:30	15:39	17:17	10:25	12:05	20:13	21:52
Jun 28	05:15	06:55	15:02	16:42	06:12	07:53	16:00	17:39	09:57	11:36	21:23	23:05	Aug 28	05:10	06:50	14:57	16:36	05:27	07:07	16:53	18:34	10:02	11:42	21:29	23:11
Jun 29	04:51	06:31	14:38	16:17	05:49	07:29	15:37	17:15	11:14	12:54	21:01	22:41	Aug 29	04:45	06:25	14:33	16:11	06:43	08:23	16:30	18:10	09:40	11:19	21:06	22:47
Jun 30	04:26	06:06	15:52	17:33	05:25	07:05	16:52	18:32	10:51	12:31	20:38	22:18	Aug 30	04:21	06:00	15:46	17:27	06:19	07:59	16:07	17:46	10:57	12:37	20:44	22:24
Jul 01	05:41	07:22	15:28	17:08	06:41	08:22	16:28	18:08	10:28	12:08	20:16	21:55	Aug 31	05:36	07:16	15:22	17:02	05:56	07:36	15:44	17:22	10:34	12:14	20:22	22:01
Jul 02	05:17	06:57	15:04	16:43	06:18	07:58	16:05	17:44	10:05	11:45	21:32	23:13	Sep 01	05:11	06:51	14:58	16:37	05:32	07:12	16:58	18:39	10:11	11:51	20:00	21:38
Jul 03	04:52	06:32	14:40	16:18	05:54	07:34	15:42	17:20	09:43	11:22	21:09	22:50	Sep 02	04:46	06:26	14:34	16:12	06:48	08:29	16:35	18:15	09:48	11:28	21:15	22:56
Jul 04	04:27	06:07	15:53	17:35	05:30	07:10	16:57	18:38	10:59	12:40	20:47	22:27	Sep 03	04:22	06:02	15:48	17:28	06:24	08:05	16:12	17:51	11:05	12:46	20:52	22:32
Jul 05	05:43	07:23	15:29	17:09	06:46	08:27	16:33	18:13	10:36	12:17	20:24	22:03	Sep 04	05:37	07:17	15:23	17:03	06:01	07:41	15:49	17:27	10:42	12:23	20:30	22:09
Jul 06	05:18	06:58	15:05	16:44	06:23	08:03	16:10	17:49	10:14	11:54	20:02	21:41	Sep 05	05:12	06:52	14:59	16:38	05:37	07:17	17:04	18:45	10:20	12:00	20:08	21:46
Jul 07	04:53	06:33	14:41	16:19	05:59	07:39	15:47	17:26	09:51	11:31	21:18	22:59	Sep 06	04:48	06:27	14:35	16:13	05:14	06:53	16:40	18:20	09:57	11:37	21:23	23:05
Jul 08	04:29	06:09	15:55	17:36	05:36	07:15	17:02	18:43	11:08	12:48	20:55	22:35	Sep 07	04:23	06:03	15:49	17:30	06:30	08:10	16:17	17:56	11:14	12:54	21:01	22:41
Jul 09	05:44	07:24	15:30	17:10	06:52	08:32	16:39	18:19	10:45	12:25	20:33	22:12	Sep 08	05:38	07:18	15:25	17:04	06:06	07:46	15:54	17:32	10:51	12:31	20:38	22:18
Jul 10	05:19	06:59	15:06	16:45	06:28	08:08	16:15	17:55	10:22	12:02	20:11	21:49	Sep 09	05:13	06:53	15:00	16:39	05:42	07:22	17:09	18:50	10:28	12:08	20:16	21:55
Jul 11	04:55	06:35	14:42	16:21	06:04	07:44	15:52	17:31	10:00	11:39	21:26	23:08	Sep 10	04:49	06:29	14:36	16:15	05:19	06:58	16:45	18:26	10:05	11:45	21:32	23:13
Jul 12	04:30	06:10	15:56	17:37	05:41	07:21	17:07	18:48	11:16	12:57	21:04	22:44	Sep 11	04:24	06:04	15:50	17:31	06:35	08:15	16:22	18:02	09:43	11:22	21:09	22:50
Jul 13	05:45	07:25	15:32	17:12	05:17	06:57	16:44	18:24	10:54	12:34	20:41	22:21	Sep 12	05:39	07:20	15:26	17:06	06:11	07:51	15:59	17:38	10:59	12:40	20:47	22:27
Jul 14	05:20	07:01	15:07	16:47	06:33	08:13	16:20	18:00	10:31	12:11	20:19	21:58	Sep 13	05:15	06:55	15:02	16:41	05:47	07:27	15:36	17:14	10:37	12:17	20:25	22:03
Jul 15	04:56	06:36	14:43	16:22	06:10	07:50	15:57	17:36	10:08	11:48	21:35	23:16	Sep 14	04:50	06:30	14:38	16:16	05:24	07:04	16:50	18:31	10:14	11:54	20:02	21:41
Jul 16	04:31	06:11	15:57	17:38	05:46	07:26	17:12	18:54	09:45	11:25	21:12	22:53	Sep 15	04:26	06:05	15:51	17:32	06:40	08:20	16:27	18:07	09:51	11:31	21:18	22:59
Jul 17	04:07	05:46	15:33	17:13	05:22	07:02	16:49	18:29	11:02	12:43	20:50														



## 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.freeserve.co.uk

### John Tellick, Surbiton, Surrey, ENGLAND

Information about the hardware required to receive Meteosat-8 and advice about registering for the various MSG services. John will also 'field' any queries of a more general nature 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 aerial, coax,connectors, mounting hardware etc. Also done a lot of work with the orbiting satellites. Geoff is know his way with most of David Taylor's software. He has recently started with MSG, so should be able to share his experiences with other 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@hwc.net

**E-mail contact can of course be made at any time, but we would ask you to restrict telephone contact to the period 7.00-9.00 pm in the evenings.**

## 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**

### WXtolmg

Users of the WXtolmg 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 6 Sunday, July 31, 2005

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

- Technical articles concerning relevant hardware
- Construction projects
- Weather satellite images
- Reports on weather phenomena
- Description of readers' satellite imaging stations
- Activities from overseas
- 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, CD or e-mail attachment). But 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**

Large attachments (1 Mb or greater) can be sent to:

**lesw.hamilton@gmail.com**



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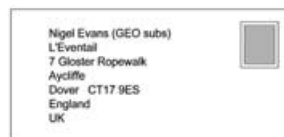
I have no objection to GEO holding my membership details on its computer database. I understand that such information will be used exclusively for internal GEO administration purposes. Please sign and date below to confirm

**Signature**

**Date**

**Please send your completed form to**

Nigel Evans (GEO subs),  
 'L'Eventail', 7 Gloster Ropewalk, Aycliffe,  
 Dover CT17 9ES, England, UK.



**If paying by credit card, you may FAX a copy of this form to (01304) 207 731**

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# Upside-down    Mɹɹɹɹɹɹɹɹ    Down-under

*Lindsay Vincent*

On the front cover of this Quarterly is a NOAA-17 APT pic I received on February 4, 2005, showing what was called in some parts of the media (and we all know how excited some parts of the media can get!) a 'southern cyclone'. It was reported that 'Meteorologists described it as a southern Australian cyclone—similar to a tropical cyclone, but in a cold climate'. It did rotate clockwise for several days.!

Most of Australia has been in drought for the best part of eight years and here in Melbourne, we've had below average rainfall for the last seven years. Our major dam (the Thomson) has fallen to below 40% capacity. We've had stage 2 water restrictions for some time, although, as I type this, the restrictions have eased, as summer is now over.

Anyway, having set the scene....

This low pressure system caused a fair bit of chaos. It sat over Melbourne for two whole days, dumping record rainfall on a dry and parched state. Here in southeast Melbourne, I received a total of 128 mm in 48 hours, with 120 mm of that falling in one 24-hour period. Some places in outer Melbourne experienced as much as 168 mm! Our average rainfall for February is only 40 mm, so we tripled that in one day!

The pic shows moist air from the tropical north coming down the East Coast, and being fed into the low, along with cold and wet air from the south which was being drawn into it as well.

## Some Interesting Facts about this Low

- It was the coldest day on record in Melbourne: 36°C on one day followed by just 11°C the next!

- Wind speeds to 104 km/h, with gusts to 120 km/h in the Snowy Mountains
- 12 cm of snow fell on the Victorian Alps. Snow and sleet were reported in Canberra, and on the New South Wales Southern Highlands
- Waves of up to 20 meters were reported in Bass Strait (between mainland Australia and Tasmania) causing minor damage to some cabins of the passenger and car ferry (some portholes blew in!)

Early estimates of damage were put at AU \$100 million just for Melbourne. Trees and power lines were down everywhere, train tracks blocked, major roads flooded. The wind woke me up at 3 am, so I lay there listening to the roof tiles rattling. The power went off three times in 20 minutes and a transformer on a power pole on the other side of the road put on a wonderful display!

Sydney, New South Wales, also took a beating, with severe thunderstorms and golf ball-sized hailstones.

Down here in southern Australia, our weather patterns always come from the west and head east. Not this time! The Bureau of Meteorology issued a severe weather warning which included: 'A deep low pressure system, currently east of Melbourne, is expected to move slowly westwards and will remain near Melbourne this morning.' Westwards? What the..?

It was one I wont forget in a hurry!.

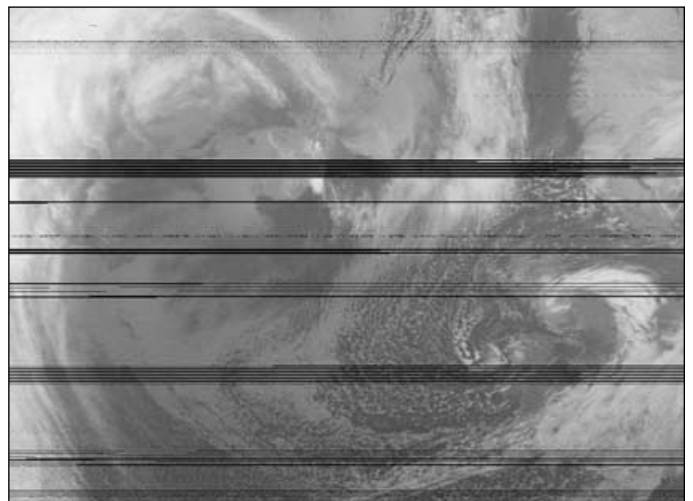
I use an RX2 receiver, a 142 MHz pre-amp (mounted at the antenna) tuned down to 137 MHz, a tall narrow QFH (Steve Blackmore's design) and the *WXtoImg* imaging software.

## Severe Interference on NOAA-15 Images as NOAA-6 Comes to Life Again

During February 15 the Internet newsgroups were abuzz with reports of a sudden deterioration in the quality of APT signals from NOAA-15. The signal was experiencing frequent nulls and it was widely speculated that another satellite, transmitting on or around NOAA-15's frequency of 137.50 MHz, was the culprit. Two days later, the problem was gone and all seemed well until the interference returned with a vengeance on March 1.



It was eventually discovered that NOAA-6, a weather satellite officially deactivated as long ago as 1987 had come back to life and was emitting a carrier frequency that was interfering with that of NOAA-15. The map above indicates the degree of overlap of the footprints of the two satellites on March 1.



This NOAA-15 channel-4 APT image acquired at 08:11 UT on March 1 this year is streaked with black lines. The effect, which manifests itself every 15-days or so, is believed to result from co-channel interference by a 'rogue' carrier frequency from the long-decommissioned NOAA-6

# My Trip to Brazil

**Ruud Jansen**

Translated by Chris van Lint



Around November last year, my wife was once again looking for one of the so-called 'last minute' travel 'specials'. Our preference has always been to visit the Far East but unfortunately there were no cheap fares available on the Net at the time. Next we thought we might visit Goa (India) again: however the hotel we wanted to reserve was fully booked and this left us no alternative but to look for somewhere else—as long as there was plenty of sunshine and a minimum temperature of around 25°C.

After some searching, my wife located a very appealing and reasonably priced offer in a rather large country to the southwest—Brazil. We made a quick booking, paid, and only then started to think about the place we were about to visit. The location was in the northeast of Brazil (Ceará Province), toward the southern border of the city of Fortaleza. Our next step was to buy a Portuguese dictionary and of course to surf the Internet for as much information as possible (such things as whether our mobile phone would work, availability of ATM machines, city maps, transport etc.).

Naturally I had to gather my portable weather satellite receiving equipment, test it and carefully pack it away for transport in my backpack as hand-luggage. I deliberately do not pack this kit in my suitcase as, following the security scan, the rather strange collection of electronic items, wires and plastic components sometimes cause the airport security people to open my luggage for a more detailed check. In any case, I often have to open my scanned backpack as well, following the security scan, but by offering a plausible explanation with the aid of copies of our *De Kunstmaan* magazine and satellite images I have produced myself, any misunderstanding is quickly resolved.

While I was packing, I suddenly remembered that I had read an article in GEO Quarterly No 3 written by Les Hamilton and Raul Fritz Teixeira. Raul does in fact live and work in the same province where I was to spend my holidays, so I obtained his e-mail address from Les and contacted Raul.

In his reply Raul and his wife extended a cordial invitation to us to visit the building where he works as a meteorologist. Not only that, he and his wife insisted on showing us around the Fortaleza area and introducing us to the local culinary delights.

## Funceme

My first visit was to Raul's workplace, the *Fundação Cearense de Meteorologia e Recursos Hídricos* (abbreviated to Funceme). His department is called *DEMET*, and at present they are very busy predicting climatic developments for the period of February to May. This period encompasses the season throughout which most of the rain falls. Climatic prediction is more important than a weather report since a major problem in this province is the severe droughts. Large reservoirs in the hills, pipelines and artificial water channels excavated by machines must ensure that sufficient water is delivered for agriculture and the population alike. Many farmers in the hinterland moved to the big cities after the last severe drought and are now living in the city's poor slum quarters. The weather is critical for agriculture, fishery, road construction, water processing and water supply. *DEMET* also produces daily 12-hourly weather forecasts (reduced 24-hourly at week-ends).

I was picked up by an official vehicle and taken to a two-storied white building which in the past belonged to the adjoining church, and was ushered to the reception desk, from where I was taken to Raul's department (figure 1).

There Raul provided me with detailed explanations about all the equipment and software being used and I was able to experience 'live' reception of a NOAA-17 satellite pass. I was suitably impressed with this organisation; they have considerable computer capacity, a sizeable number of network servers and large plotters. The reception antennas are located elsewhere and we did not have time visit them. But there are a number of photographs showing the antenna arrangement on the Funceme website where you can also learn more about Funceme itself as well as view

some recent weather images of Fortaleza (Ceará province). Visit:

<http://www.funceme.br>

At our first meeting I had given Raul a few copies of 'De Kunstmaan' containing some of the weather images I had obtained in Thailand using my home-made kit (the *Pita 137* aerial, *Kecil 137* receiver, minidisk and *Sony* miniature notebook). He and his colleagues were absolutely amazed at the results. I gave Raul a short demonstration of the *WXtrack*, *SatSignal* and *WXtoImg* software.

## The Weather station

A demonstration weather shack has been constructed in the courtyard of the building, surrounded by a number of meteorological instruments (figure 2). The first of these to catch my eye was the RVS rain gauge which records precipitation (figure 3). An actinograph to measure the intensity of the sun's radiation (figure 4), a rain intensity meter (figure 5), a sunshine autograph to record the hours of sunshine during the day (figure 6) and the weather shack itself, complete with wet and dry bulb thermometers (figure 7), provide the visitor with a good idea of how weather conditions can be observed and recorded.

## My own images

Of course I did not take my gear along just to show it to others. I was determined to make my own images. After starting up my notebook and *WXtrack*, I determined which satellite would be most suitable to produce a nice image from my location. Since Fortaleza is located on the very northeast coast, only water would be visible to the north and east. Hence only satellite passes directly overhead or to the west of Fortaleza could be considered. The late afternoon passes of NOAA-17 were not really useable since the sun would be close to the westerly horizon and there would be insufficient illumination of the landmass to produce a so-called 'false-colour' image. That left only the morning pass. The next day I headed for the beach and dangled my *Pita 137* from a palm tree. There was always a brisk breeze on the beach, which at times





Figure 1 - Raul Fritx Teixeira pictured at his desk at DEMET.



Figure 2 - The weather station in the courtyard



Figure 3 - The rain gauge

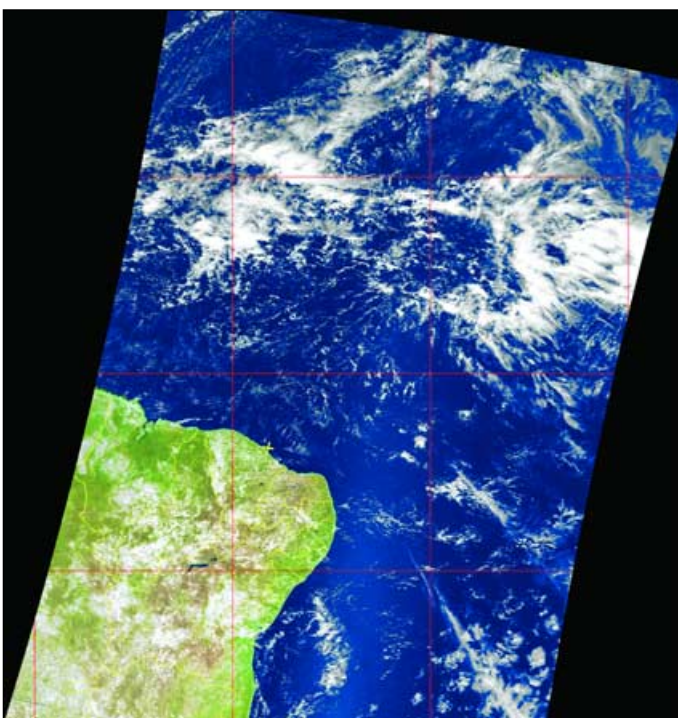


Figure 8 - NOAA 17 at 12:33 UT on November 28, 2004, processed in WXtoImg in MSA mode and Mercator projection.



Figure 4 - The actinograph



Figure 5 - The rain intensity meter



Figure 6 - The sunshine autograph



Figure 7 - The wet and dry thermometers

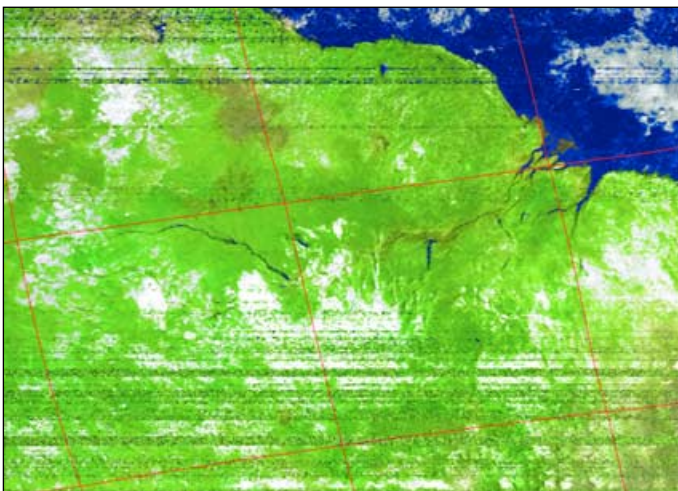


Figure 9- NOAA 17 at 14:10 UT on December 7, 2004, looking south towards the River Amazon, showing interference

caused my light-weight antenna to fly horizontally like a kite tethered to a string. This strong wind also caused the vertical measuring-tape elements to distort and become folded in half or twisted. Alas, my once-symmetrical antenna with its all-round radiation pattern had changed into something resembling a broken, wind-blown umbrella. This ensured that noise bands spoiled a considerable number of images.

Images taken from the balcony were not much better; half way through the pass I had to run with my gear from the balcony at the northeast, through my hotel room, to the gallery in the southwest. Additionally, there were occasions when the strong wind and heavy rain outside sent the antenna toppling to the ground, so that the recordings failed. According to Raul a strong cold front was active during this period. Nevertheless I did

manage to produce three images on the beach, unfortunately with noise bands, because I had to lower the aerial a few times to straighten it out following distortion by the wind. One of these images, from NOAA-17 at 12:33 UT on November 28, is shown in figure 8.

I also made an attempt to produce an image of the Amazon region on December 7 (figure 9). The maximum elevation from my location in the hotel was about 9° above the western horizon. However some rather high dunes are located in close proximity to the hotel, which meant that the satellite would only be 'visible' from about 4° elevation.

A problem results from the relatively narrow bandwidth of my *Kecil* receiver. For black and white images this bandwidth is more than adequate (which was my original design criterion). However, these days we are looking for nice coloured images in which the infrared channel is used together with the visual channel to produce a so-called 'false-colour' image. For satisfactory reception of the IR channel, a bandwidth of 28 kHz is required. If this is not the case, the IR information will be 'clogged up' in the band filter and will not produce a nice coloured combination image. Craig Anderson's *WXtoImg* program (which I used for these images) provides an option to make some corrections and adaptations to obtain acceptable results when using narrow bandwidth receivers such as the

*Kecil 137*, scanners or FM-narrow bandwidth amateur receivers. However, I do not as yet have any experience with this option but will most certainly explore this feature at the first available opportunity.

During the final week of our holidays, making images on the beach was no longer possible due to safety concerns. During our stay at least four robberies targeted at guests staying at our hotel took place on the beach (two with guns and two with knives). The last attack occurred almost at the entrance of the hotel. There was a low-flying police helicopter containing a sharp shooting 'gunman', police cars everywhere with flashing lights and a TV crew in our hotel, so there was plenty of 'action'. In any case it gave me the chance to make some rather unusual holiday photos of the resulting commotion and we were even able to recognise ourselves in the coverage from a local TV station.

Brazil is a beautiful country with a friendly population. However there is an enormous gap between the incomes of different population groups. The population of Fortaleza is about four million, divided into a small group consisting of the rich, a middle class and a large group of poor people who live in slums distributed throughout the city. Raul and his wife showed us the surroundings and the natural beauty of this city during the four days that we were there. We had the opportunity to

enjoy many delicacies at a number of local eateries. My wife and I would like to take this opportunity to once again thank Raul and his wife Poliana for the hospitality we were afforded by them. I would also like to thank *Funceme* for their cordial reception.

Also, my thanks also to Chris van Lint for translating this article into English.

### Equipment Details

#### Aerial

PITA137 (Home-made Resonant Quadrifilar Helical Antenna)

#### Receiver

Kecil 137 (Home made)

#### Recorder

Sharp Minidisk MD-MT88

#### Decoding Software

WXtoImg (Craig Anderson)

#### Satellite Track Prediction software

WXtrack (David Taylor)

### Reference

- 1 People are always asking me for plans to build the PITA-137 antenna, so I have prepared a PDF file with instructions, diagrams and photographs. It is available in both Dutch and English versions. You can download the file (900 kb) from my website at:

<http://www.jendela.nl>

Click on the image 'Weersatellieten' and then on the link 'Antennes 137 MHz'. This takes you to the 'Antennes' page with links to both versions of the document.

# HRPT for Mac Users

Do you or anyone you know run a Macintosh computer? GEO reader Sergei Ludanov does just that, and was very much taken by the article on using HRPT datafiles obtained via the Internet.

But Sergei had one problem. He doesn't have a PC, but does all his computing on a Mac.

After unsuccessfully searching for a program that would view these HRPT images, Sergei decided to write his own, and the result is MacHRPT.

The first version of MacHRPT is now available for download from:

<http://homepage.mac.com/kd6cji>

At the time of going to press, this was version 1.1 although regular updates are planned.

This initial release can decode the current NOAA HRP, LAC and GAC telemetry files from CLASS (SAA). Any of the individual channels may be displayed, and there are options for creating colour composite images. At present there are only a few basic image processing tools, such as histogram equalisation and geometric correction.

*A feature article describing MacHRPT will appear in the September issue of GEO Quarterly.*

Meanwhile, if you own a Mac, do try out MacHRPT, and get in touch with Sergei to let him know what you think of it. Future enhancements will depend very much on user requirements.

Sergei can be e-mailed at:

[kd6cji@mac.com](mailto:kd6cji@mac.com)



# Silting of the Irrawaddy

C S Loh

Fanning into the Andaman Sea, not unlike a lotus leaf floating in a pond, images of the Irrawaddy delta captured on my RX2, have often fascinated me by the changing cloud patterns over that region. Images received during the seasonal monsoons also display varied distribution of sediment silting, towards the east of the Irrawaddy, in the Gulf of Martaban. In recent years, having the privilege to view HRPT images captured at the Microsatellite Station in Kuala Lumpur has further heightened my interest in observing changes in the delta during the monsoon seasons (see figure 1). SPOT images (figure 2) from CRISP (the Centre for Remote Imaging, Sensing and Processing) at the National University of Singapore present even more intricate details of the region.

It is estimated that more than 350 million tonnes of sediment are discharged annually by the Irrawaddy. This sediment is composed mainly of silt and clay with less than 1% sand (unlike the Mekong and other major Asian rivers). More than 80% of the annual river and sediment discharge occurs during the southwest monsoon period between May and September. During this period, discharged sediment from the Irrawaddy, Sittang and the Salween rivers is transported clockwise along the coast, towards the Gulf of Martaban.

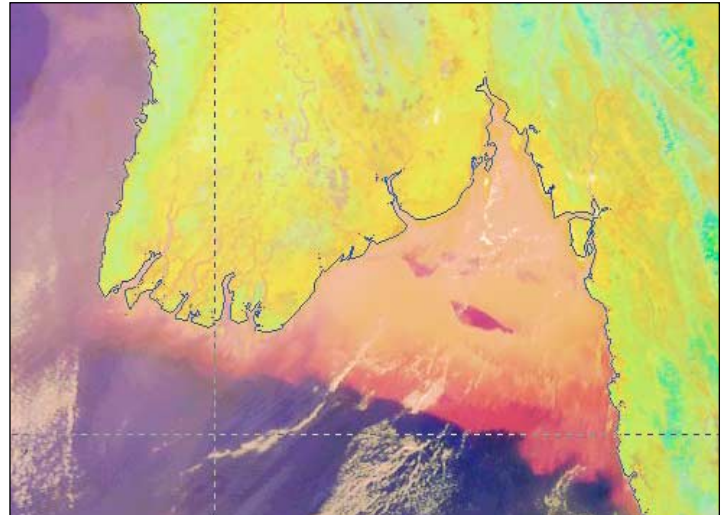


Figure 1 - NOAA 17 image at 03:51 UT on January 29, 2005  
Credit: Meteorological Services Division, National Environment Agency, Singapore



Figure 2 - A SPOT-5 image of the Irrawaddy delta on January 5, 2005  
Image and processing: National University of Singapore's CRISP

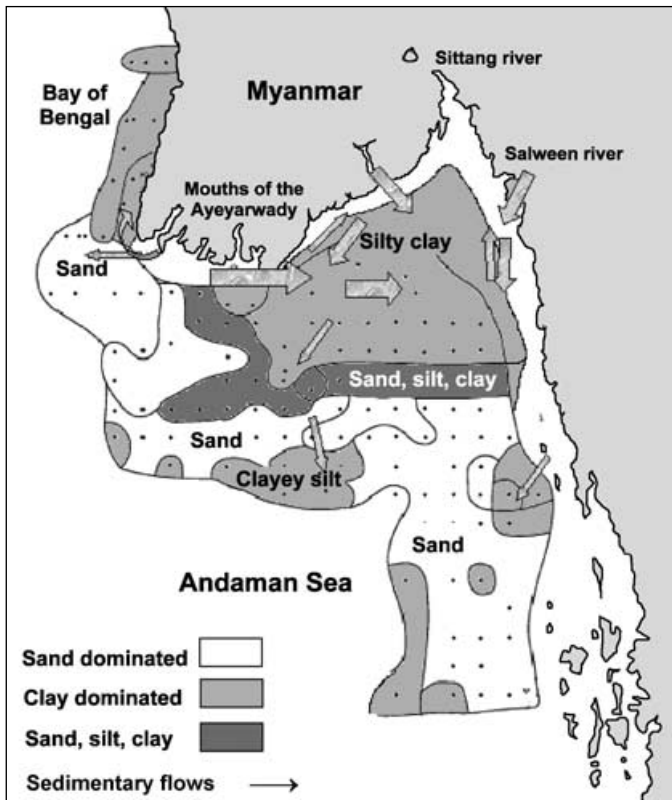


Figure 3 - Map showing sediment distribution in the Gulf of Martaban

During the northeast monsoon period between November and April, sediment plumes have been noted to move westwards towards the Bay of Bengal, composing mainly of

low carbonate sands and thick silty clays (illite, kaolinite, chlorite and smectites) with high amounts of mollusks.

At the mouth of the Irrawaddy, broad estuaries meander over shoals and mangrove flats. Grasses and mangroves often clump on to offshore sandbars, even during high-water levels. The dendrite channels of the Irrawaddy delta are broad, about 20 km wide nearer to the Andaman Sea, but shallow at no more than 20 m deep (figure 2).

concluded on page 39 ...



# Understanding Ship Trails



## Les Hamilton

Every once in a while, when conditions are favourable, weird snaking cloud patterns can show up on weather satellite images. A good example can be seen south-west of the UK in Ruud Jansen's superb NOAA-17 image reproduced here.

These unusual cloud formations are ship trails, a phenomenon that owes its origin to the exhaust emissions from shipping plying the oceans of the world.

### The Formation of Cloud

To understand how ship trails arise, it is necessary first to detail how 'normal' cloud forms in Earth's atmosphere. Ship trails are, after all, just one particular form of cloud, albeit man-induced.

Earth's atmosphere contains water vapour but this does not automatically condense into liquid droplets to form clouds, even when the temperature is well below freezing. Cloud formation depends on the presence of aerosols—suspensions of tiny, microscopic solid and liquid particles dispersed throughout the atmosphere.

Cloud-forming aerosols originate, in the main, from natural sources like sea salt, volcanic ash, desert dust and biomass burning but also, increasingly, through the burning of fossil fuels by man.

Aerosol particles often contain substances that dissolve easily in water (such as sea salt, sulphur dioxide etc.) and it is these that provide the cloud condensation nuclei (CCN) around which water molecules condense. If the air were devoid of aerosol particles, cloud, mist and fog would never form at all and the sky would be forever clear and cloudless!

### When do Ship Trails Form?

Ship trails generally form in the still, moist air commonly associated with anticyclonic conditions, when the sea is overlain with a stable layer of air at a similar temperature to that of the water itself. This layer may on occasions already contain thin cloud or mist but it is in effect supersaturated and lacks sufficient CCNs to generate full-scale cloud.

When ships pass through this region, fine aerosol particles from their exhausts float up through the moist layer of air where they become additional CCNs. This means that water vapour in the air now



**Figure 1** - Ship trails west of Biscay - NOAA 17 APT - 11:48 UT on February 10, 2005

Image: Ruud Jansen Processing: WXtollmg software

contains many more nuclei upon which to condense and these produce new cloud droplets where few may have existed before. The outcome is that the cloud becomes more reflective to sunlight.

As a ship crosses the ocean its exhaust issues a continual stream of CCNs in its wake. Consequently, its path shows up as a trail of shallow stratus clouds—a 'ship trail'. This cloud streamer often stretches for hundreds of kilometres and can extend tens of kilometres in width.

Generally speaking, the faster a ship travels, the narrower, longer, and less diffuse its ship trail will be. Slower ships

leave shorter, wider, and more diffuse trails. It is worth noting that ship trails often reflect the direction and speed of local winds as much as the direction and speed of the ship itself.

Ship trails normally persist for many hours and sometimes remain visible for days on end provided that the air mass surrounding them remains relatively undisturbed.

Ship trails show up well in satellite images, even those from low-resolution APT transmissions. The trails show up most strongly in reflected radiation (NOAA channels 1, 2 and 3) where they appear as



bright lines that can be distinguished clearly from any surrounding clouds. The same trails are usually all but invisible in the radiated infrared from NOAA channels 4 and 5.

### What Conditions Favour Ship trails?

Persistent ship trails often form beneath a low-level temperature inversion where humidity is high and low-level stratus or stratocumulus cloud may already exist. Such conditions are most likely to occur during conditions of high pressure when the lower atmosphere can become especially calm due to a layer of warmer air lying approximately 500 meters above the sea surface. This effectively places a 'cap' over the cooler moist air below, trapping pollutants and water vapour alike.

In general, ships vent their exhausts into still, relatively clean marine air that suffers minimal convective turbulence and which is near-saturated and generally depleted in CCNs. Under these conditions exhaust fumes are able to rise only as far as the top of the cool air-mass where particulates greatly increase the number of CCNs present (figure 2). The result is the formation of many tiny water droplets, too small to produce precipitation, but which form relatively low-elevation clouds that resemble larger versions of aeroplane contrails. Unlike contrails, ship trails last for many hours. The inside back cover of this issue features two more splendid true-color MODIS images featuring ship trails.

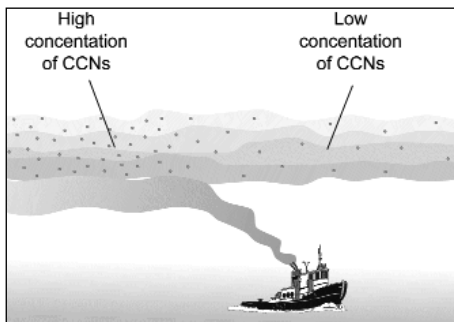


Figure 2

A layer of moist air, relatively depleted in condensation nuclei, is trapped beneath a high-pressure inversion. The ship's exhaust fumes can rise to the upper reaches of the trapped air-mass but no farther, greatly increasing the number of condensation nuclei present. The increased numbers of tiny water droplets produced in the air-mass makes it more reflective, giving rise to the phenomenon of 'ship trails' in satellite images.

### Aircraft Contrails

Enthusiasts spotting these cloud trails on their satellite images for the first time often mistake them for aeroplane contrails. Contrails (condensation trails) produced by jet aircraft normally form at altitudes of eight kilometres and more, where the

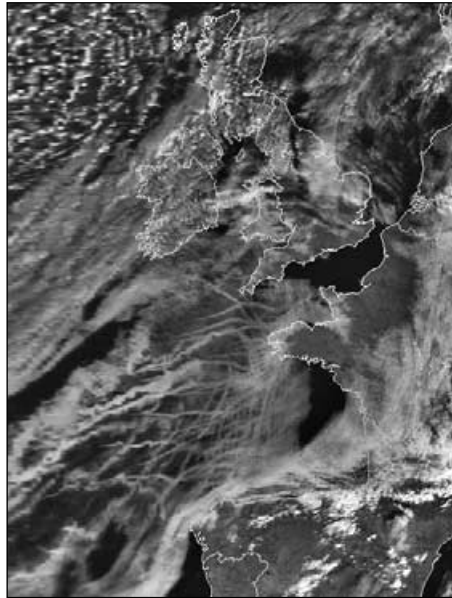


Figure 3

An exceptional case of ship trails was observed off the Bay of Biscay during a high-pressure situation on January 26-27, 2003. The NOAA-17 channel-2 image above shows many persistent ship trails along the regular shipping lanes entering and leaving the English Channel. There is also clear evidence of how the trails are modified by the effects of the wind.

GAC Telemetry: NOAA CLASS Library  
(<http://www.class.noaa.gov>)

Image: HRPT Reader/GeoSatsignal

temperature is around  $-40^{\circ}\text{C}$ . Under these conditions, water vapour in the exhaust can change directly into ice crystals (without forming liquid water at all), a process that does not require nuclei such as dust particles.

Contrails can be observed in satellite images, but show up most strongly in NOAA channels 4 and 5—the very ones where ship trails are least likely to be visible. Contrails are much colder than the terrain beneath them and this temperature differential shows up sharply in the radiant infrared channels. Of course, contrails (and their shadows) also show up by reflected radiation, but are so narrow (a few hundred metres only) that they rarely appear in APT images. They can, however, be readily identified in many HRPT images.

### Further Reading

- Studying ship tracks  
[http://earthobservatory.nasa.gov/Study/Pollution/pollution\\_2.html](http://earthobservatory.nasa.gov/Study/Pollution/pollution_2.html)
- Every cloud has a filthy lining  
<http://earthobservatory.nasa.gov/Study/ShipTracks/>
- Scheepswolken studieobject  
<http://www.keesfloor.nl/artikelen/zenit/shiptrail/>

## Temperature Inversions

Under normal conditions, air temperature decreases with altitude. That's why high mountains retain snow even during summer. A temperature inversion is a situation where this temperature decrease is interrupted by the presence of a layer of warmer air at higher altitude.

An inversion is an extremely stable layer of the atmosphere which acts rather like a lid. Rising currents of air within the lower cool air mass lose their buoyancy when they reach the warmer, less dense inversion layer; they cannot rise any higher and are forced to spread laterally. Any pollutant particles released into the lower layer become trapped there because normal convective mixing of the atmosphere is prevented.

Phenomena associated with temperature inversions are valley fog (where surrounding mountain peaks may be bathed in sunshine) and red sunsets (caused by the build-up of pollution particles).

### What causes an Inversion?

Temperature inversions are produced in a variety of ways. A familiar but usually short-lived example occurs in secluded mountain valleys where overnight radiative cooling of the ground produces low-level air that is colder than the air above. If the cooling is sufficient, valley fog may form although the mountain peaks, surrounded in the warmer inversion layer, remain clear. This inversion ends when the morning sun warms the lower levels once more.

The type of inversion that results in ship tracks is of longer duration, and is found within a region of high pressure. High pressure is caused by descending air and as the air descends it becomes compressed and experiences adiabatic warming. This increases its buoyancy, eventually arresting its descent and isolating a cooler, denser layer of air below it. This is known as a 'subsidence inversion'. As high-pressure systems often combine temperature inversion conditions with low wind speeds, they can persist for a long time, and provide ideal conditions for the formation of ship trails.

# SOFTWARE SHOWCASE



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

As many of you will already know, there have been some fundamental changes in the way NORAD two-line element sets (TLEs) can be downloaded and distributed. The recent history of this is complicated and too lengthy to explain in detail in this limited column space. For a full appraisal of the events leading up to the present situation I strongly recommend reading the notes provided by Dr T Kelso on his excellent web site at:

<http://celestrak.com/NORAD/elements/>

The *Important Notice* page has full explanatory notes dating back to August 3, 2004, outlining the problems, difficulties and general headaches as events have developed and progressed.

In simplistic terms the fundamental change has come about as the Air Force Space Command (AFSC) plans to provide space surveillance data, including NORAD two-line element sets, with the NASA OIG web site closing down. This is further complicated because public law prohibits the redistribution of data from the new service without express approval of the Secretary of Defence. However as I said

earlier do go to Dr Kelso's web site for all the background and up-to-date news.

The situation is still changing and as I prepare this column I have just heard that Dr Kelso has received the necessary approval from Air Force Space Command to redistribute TLEs and Space Situation Reports obtained from the Space-Track web site. This means that for the moment the Celestrak web site is once again providing up to date element sets. This is indeed excellent news. Nevertheless, the approval is only valid for one year and so Dr Kelso is still encouraging all users to apply for a Space-Track account and he has advised me that he intends to continue offering his new software.

In order to help those who rely on element sets, two items of free software have been made available to the community at large. The first of those has been written by David Taylor, already well known to weather satellite enthusiasts for his wide range of excellent software; the other is from Dr Kelso. Remember, both sets of software require that you are a registered user of the Space-Track web site at:

<http://www.space-track.org/perl/login.pl>  
Registration, however, is free.

## Kepler Manager v1.1.4

David Taylor's program allows you to interface with the new Space-Track web site and greatly simplifies the downloading of elements. The basic program is free but for those who have a registered copy of his *WXtrack* program there are a number of



**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 3.4.8
SatSignal	Creates images from wave files	v 4.1.0
HRPT Reader	Converts raw HRPT data files into images	v 2.5.6
GroundMap	Rescales satellite images	v 1.3.8
RX2 PassControl	Computer control program for the RX2 receiver	v 3.0.2

**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
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
Irfan 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)	
Paintshop Pro	Image processing program (30-day evaluation)	
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	
WXtolmg	WAV file recording and decoding program with many options.	v 2.5.11

**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

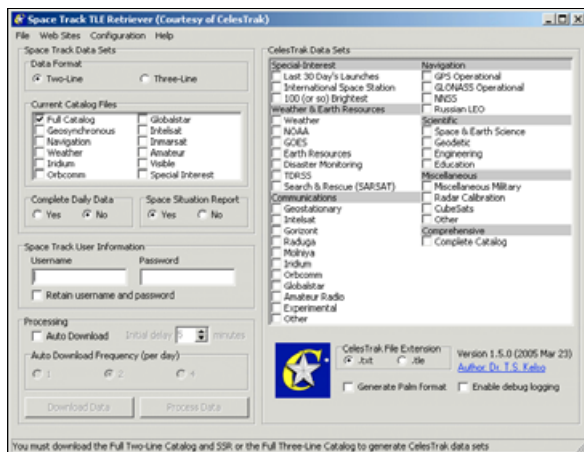


very useful additional features. Those include the ability to automate the program using Windows scheduler, calling the program directly from *WXtrack* and adding your own favourite satellites to download. The use of Windows scheduler ensures complete freedom to schedule as you wish. A further bonus is the ability to build up your own historic kepler data, useful for programs which process non real-time data. The basic program is available on GEO software **CD GS1** (Program Extras > *WXtrack*) or, for more information and to download the program go to :-

<http://www.satsignal.co.uk>

### Space Track TLE Retriever v1.5.0

This second software offering has been provided by Dr Kelso in conjunction with his Celestrak web site. The main purpose of this program is to allow users who have an active Space-Track



account to download Space-Track data sets and use them to generate data sets in the old Celestrak groupings. The groups available for download from the Space-Track site have different names and content which is inconvenient for those who have been downloading from Celestrak for a very long time. The program addresses this issue. It can be run as and when required but can also be set to download automatically, although this is restricted to starting any time up until 90 minutes from setting, and updates can be set for once, twice or four times per day. The downloaded data is automatically archived in a file system.

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

<http://celestrak.com/SpaceTrack/TLERetrieverHelp.asp>

#### 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.

## AMSAT-UK Space Colloquium 2005



AMSAT-UK will be holding a Space Colloquium at the University of Surrey in Guildford, England from July 29-31, 2005.

This 3-day event always attracts Radio Amateurs from across Europe as well as North America, Africa, Asia and the Pacific. Over a third of those attending come from outside the UK. It provides an opportunity to rub shoulders with the designers of the Amateur Satellites and find out the latest news.

As in previous years there will be special beginners' sessions to teach newcomers how to get started in the fascinating world of Amateur Radio Space communications. You can get started using little more than a standard dual-band FM hand-held radio.

An antenna-testing range will be available to enable you to check out the gain of your latest antenna—not all commercial



Some of the attendees at AMSAT's 2004 Colloquium

antennas perform as well as you might think! Microwave experts will be on hand with test equipment covering up to 24 GHz, so you can have your equipment tested and receive professional advice.

There will be guided tours of the Surrey Space Centre with the satellite mission control centre and the satellite assembly facility. These tours are always popular and they provide a unique opportunity to see satellites in various stages of construction.

The RSGB GB4FUN van, which contains a fully equipped satellite station, will be available during the event for visitors to work the Satellites.

There is an extensive lecture programme ranging from highly professional technical presentations to basic down-to-earth 'how to do it' type talks.

Guildford is 40 miles from central London and is easily reached from both London-Heathrow and London-Gatwick airports.

Day passes and 2- or 3-day packages covering meals and accommodation in the University campus are available. For details contact the secretary, Jim Heck G3WGM

Tel: 01258 453959

E-mail: [g3wgm@amsat.org](mailto:g3wgm@amsat.org)

Website: <http://www.uk.amsat.org/>

# Meteosat 8 - The Results



Mike Stevens - mikeg4cfz@tiscali.co.uk

Since writing my previous article in *GEO Quarterly No 4*, I am now able to pass on my experiences as to how it has all worked out for me—or not—as the case might be.

Winter has come and gone and we in the Weather Satellite fraternity have been watching the pictures in awe; and we've been forecasting the coming day's weather well before the TV weather-man or -woman has had time to take breath. And yes: *we* were right! It *was* going to rain, it *did* snow, *and* the sun shone.

But what did it cost us in time and labour to achieve all that? Those of us who have taken the plunge and are receiving the fantastic pictures from Meteosat-8 will know the answer. Since my last article I have had quite a few e-mails requesting help or assistance to get systems up and running, and most of the problems seem to centre around the *Tellicast* software and setting up the satellite dish.

## Software

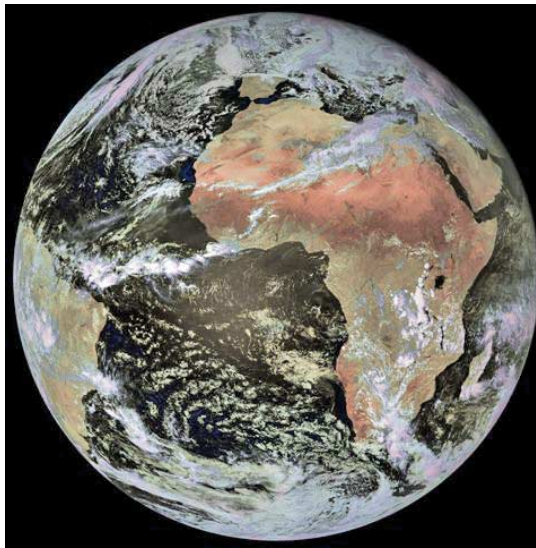
As far as the software is concerned it really is a case of reading '*Broadcast System for Environmental Data*', EUMETSAT document *EUM TD 15*. I stressed last time that you must read this paper through: to inwardly digest it before you attempt to load the software, and to pay particular attention to entering your username and password by the copy/paste method. Incidentally, I have found the staff at *EUMETSAT* extremely polite and helpful—a delight in this day and age. Well done to them!

## Satellite Dish

The satellite dish is something quite different. My own experiences have been fraught with problems caused by the high winds in this area of Dorset. When I first installed my own one I knew that it would be difficult to stabilise a 60 cm satellite dish in such a location, and I was right. I first noticed a problem one weekend while the system was up and running; I was experiencing missing segments. At the time the wind was gusting to gale-force 8 from the west and it was dark and wet. To go outside and see what was happening wasn't quite what I wanted to do: but I had to!

So out I went, with torch in hand and sou'wester on. When I saw the satellite dish I was amazed at its antics. It was swaying from side to side and vibrating despite all the brackets I had used to secure it to the mast and the fact that the unit had been braced against the slope of the garage roof. All this just wasn't enough. As soon as the wind dropped, the dish became more stable and the reception improved but that wasn't the end of it. The next gale came from the north-west and was even worse: at one time I thought I was going to lose the dish completely as the wind was catching the back of it full on and the vibration was very severe indeed.

When I returned to the house the signal meter was indicating red and I discovered that I had lost the signal completely. It was a disaster! Just when I wanted the satellite to see what was happening it was 'dead'. It was a good thing that I still had my Polar Orbiter NOAA APT system operational. I could at least see the storm that was doing all the damage.



Meteosat 8 - 13:00 UT on February 19, 2005  
Image: © EUMETSAT 2005

After the gale had gone and more settled conditions returned I started to repair the damage. Upon examination, I noticed that the wind had pushed the dish downward and I had lost my elevation angle to the *Hot Bird-6* satellite—hence the lack of signal. As soon as I readjusted the elevation of the dish the signal returned at 70% and, using the signal strength meter in *Setup4PC*, final adjustments to the dish gave me a maximum signal strength of 73%. I then tightened all the bolts and brackets to ensure this would not happen again.

Since carrying out the repairs we have had several gales in the area and I have suffered only very slight loss of segments but as soon as the better weather returns I am going to try and locate the dish at a lower

level in a more sheltered part of the garden. I have also acquired a second satellite dish which I am going to experiment with. That should be quite exciting, and I'll let you know the results.

## Magnetic Variation

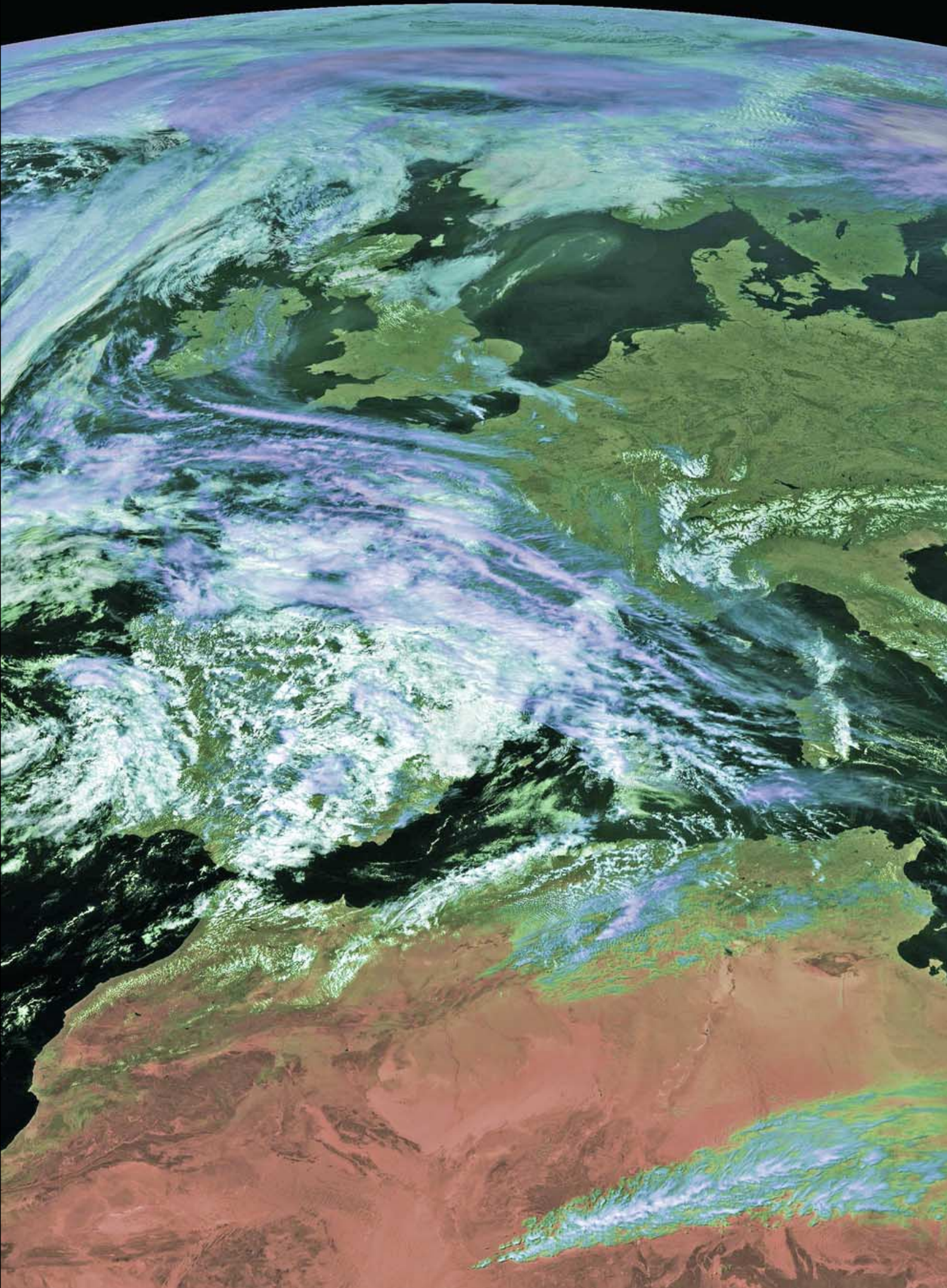
One other question I have been asked was: 'What is magnetic variation?'

Magnetic variation is the difference between *true north* and *magnetic north*, and always has to be considered when using a magnetic compass. The compass contains a magnetic needle that points to *magnetic north*, which, in Britain, currently deviates from true north by 3°. When hiking or walking over long distances it is important to take magnetic variation into account.

When using a compass to calculate the position of a geostationary satellite, it is important to *add* 3° to your compass reading in order to obtain its true direction. This may not seem important until you consider that *Hot Bird-6* and *Astra* are only 6° apart.

I have included several pictures from my system to show the results of my labour. All were prepared using David Taylor's excellent software. I will report again from Dorset in the future to let you know how the experimenting is going. Until then remember that it is well worth all the effort—and the results are stunning.

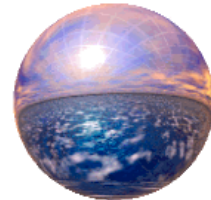






# An Introduction to DIGITAL ATMOSPHERE WORKSTATION

Les Hamilton



As we become increasingly aware of the impact of Climate Change on our planet, more and more satellite enthusiasts are taking an interest in the production and analysis of synoptic weather charts. During the past year, there have been articles by both Fred van den Bosch [1,2] and Ton Lindemann [3] describing how they use the program *Digital Atmosphere* to superimpose synoptic information over their weather satellite images.

Digital Atmosphere has been around for a long time now and the most recent incarnation of the software, *Digital Atmosphere Workstation* (often referred to as *DAWS*), launched during 2004, extends its capabilities considerably.

## Installation - Evaluation - Registration

*DAWS* can be downloaded from the Weather Graphics download centre at:

<http://www.weathergraphics.com/dl/>

At the time of writing, the current version is version 1.1i (this is a 12.6 Mb download). Registration for new users costs \$89 for the standard version. If you have already registered an earlier version, the fee is \$68 to upgrade.

Once the download is complete, double-clicking the mouse on the installation file, *daws11i-std.exe* starts the installation process. You now have the opportunity to evaluate the fully featured program for 30 days after which many of the program's most useful features such as scripting and the loading/saving of maps are disabled.

Once you have evaluated the program, the chances are you will wish to purchase a copy. To do so, go to:

<http://www.weathergraphics.com/catalog.htm>

As soon as you make payment you will become a registered user, and be entitled to apply for your **software key** to fully enable *DAWS*. To obtain your software key you must first open your copy of *DAWS* and click **<Help → Register>** on the menu-bar to open the *Register* window (figure 1). *DAWS* will already have calculated your *Serial Number* (which is based on the architecture of your PC) but the *Key Number* field is empty.

Send an e-mail to:

[weather@weathergraphics.com](mailto:weather@weathergraphics.com)

informing them of your *Serial Number* and requesting your *Key*. You will shortly receive a return e-mail containing the *Key*. All you have to do now is type the key into the blank field and click **OK**.

If you do not wish to purchase *DAWS* over the Internet, you can find full details of other ways to purchase and register the software in the Help file (*manual.pdf*) inside the application folder on your PC.

## Note

Should you for any reason have to reinstall Windows your *Software Key* will no longer function. No major problem! As you are a registered user, just e-mail your new *Serial Number* to *Weather Graphics* as before, and a new *Key* will be sent to you. You will also need a new *Key* if you install *DAWS* on a new PC.

## Creating a Base Map

Although *DAWS* comes with a default base map of the USA it is almost certain that the first thing you will wish to do is create one for your own part of the world. Open **<Map → Generate base map>** (figure 2) and insert all the appropriate parameters (such as latitude, longitude, scale, height and width) and press **OK**. The orthographic base map created from this screen is shown in figure 3. This map automatically becomes the default and will display each time *DAWS* is loaded (until you generate a different one). The positional data entered to create the base map is also stored by *DAWS* and used to position synoptic data over it.

## Preferences

Maps initially appear only in outline and use the program's default values for the colours and rendering of features such as coastlines, national boundaries, rivers, lakes and so forth. These may all be edited to suit your individual taste by clicking on **<File → Preferences → Styles>** (figure 4). Here you can select fill colours for the background (sea), land, lakes etc. as well as colours for many linear features such as land boundaries, rivers, and weather fronts. One feature that is 'missing' in this version of Digital Atmosphere, though, is the facility to set

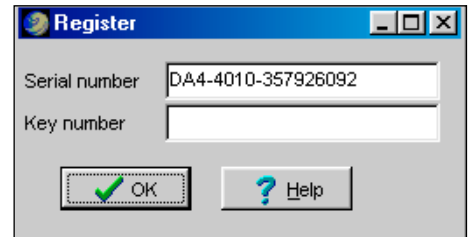


Figure 1 - DAWS Serial number

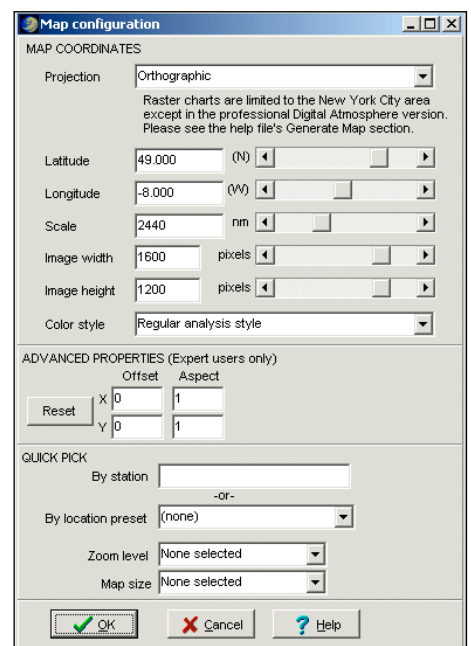


Figure 2 - DAWS Map configuration window



Figure 3 - A typical DAWS Base Map

the styles for the multitude of analytical contours (isotherms, isobars etc.) from the *Preferences* menu. These, and indeed the entire *Analysis* drop-down menu, are now dealt with through the *DAWS scripting language*. The default *Analysis* menu is actually created by the editable file *digitmos.mnu*. This resides inside your *DAWS* folder, and can be edited using Notepad both to modify existing options and to add new ones.



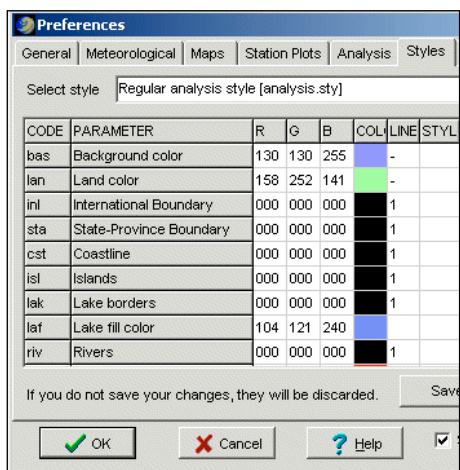


Figure 4 - The Preferences/Styles tab

```

Temperature
Temperature (deg C) %2          |CONT CINT=2 COLOR=200:0:0 DASH TEMP
Temperature (deg F) %3          |CONT CINT=5 COLOR=200:0:0 DOTS DEG F TEMP
Pressure
Sea level pressure (mb) %1      |HILO CONT CINT=4 LINE=2 SLPR
    
```

Default temperature and pressure scripts as they appear in the *digatmos.mnu* file

```

Temperature
2 degree C intervals %2        |CONT CINT=2 COLOR=200:0:0 SOLID TEMP
1 degree C intervals %3        |CONT CINT=1 COLOR=0:0:0 SOLID LINE=2 TEMP
Pressure
Sea level pressure (4 mb isobars) %1|HILO CONT CINT=4 LINE=2 SLPR
Sea level pressure (2 mb isobars) %1|HILO CONT CINT=2 LINE=1 SLPR
Sea level pressure (1 mb isobars) %1|HILO CONT CINT=1 LINE=1 SLPR
    
```

**Modified temperature and pressure scripts.**

Both temperature options now draw unbroken lines (SOLID). The Fahrenheit entry has been edited to yield Celsius temperatures at 1-degree intervals (CINT=1), while the line display has been coloured black (COLOR=0:0:0), the line thickness has been changed to 2 (LINE=2). Two additional script lines have been added to display the pressure at 2-mB and 1-mB intervals while the line thickness has been decreased (LINE=1) to make the display of closely grouped contours clearer [4].

**Obtaining Synoptic Data**

Synoptic data files are available from a number of sources, one of the most useful being the University of Albany site.

[www.atmos.albany.edu/  
weather/data1/surface/](http://www.atmos.albany.edu/weather/data1/surface/)

Whole-world datasets (which are around 3 Mb each) are available for each synoptic hour (00, 06, 12, 18) and have filenames in the format *yymmddhh\_syn.wmo*. You can download these directly from within DAWS using <Internet → Retrieve data> and making sure that the option 'Synop from Albany' is checked.

If you choose to download synoptic data manually you will have to load them into DAWS using <File → Import file>. Data loaded directly is automatically activated.

**Displaying Data**

Once you have created your base map and loaded synoptic data you are ready to create displays using the 'Analysis' menu. Here are some examples using synoptic data for 12:00 UT on March 28, 2005.

Select <Analysis → Temperature → (°C)> to use the default settings for temperature measured in °C. Figure 5 (page 36) illustrates the situation around Great Britain. Isotherms are drawn in red, as dashed lines, at 2-degree intervals.

Clear the temperature overlay by pressing <Ctrl+E> on your keyboard then select <Analysis → Sea level pressure> to use the default settings for sea-level pressure measured in millibars (figure 7). Isobars are displayed as thick solid dark blue lines, at 4 mB intervals.

Clear the map and select <Analysis → Wind → Wind speed (kt)> to display windspeed isopleths (figure 9). Without clearing the display, use <Data → Data plots> or <Ctrl+D> to superimpose Station Plots. In fact, you can superimpose as many information displays as you wish in this way.

**Editing the Analysis Display**

The default settings in the Analysis menu are great for starting out but it is certain that you will soon wish to alter the colours, line styles and line thicknesses to improve clarity, specially if you are overlaying them on actual weather satellite images rather than outline maps [1, 3].

Compare the charts in figures 5 and 6 on page 36. These show the same base chart plotted with the same synoptic data—but showing clear differences. In the former, isotherms are thin, coloured red and dashed; in the latter they are thick, black and continuous. Compare also figure 8 with figure 7, where the isobars have been made thinner, and the display changed from 4 mb to 1 mb intervals.

**Just how were these transformations achieved?**

To accomplish these alterations you **have** to modify the Analysis menu script file, *digatmos.mnu*, which resides inside your DAWS folder. The grey panels at the top of this page show the relevant extracts from this file both before and after editing.

**Editing the Analysis Script**

It is not the intention in this article, to delve deeply into DAWS scripting. An in-depth article on this topic by Fred van den Bosch will appear in our September issue (GEO Q7). Here I will detail just a few simple ideas to help dispel the trepidation that so many users feel when faced with a new idea like scripting (the interested reader can learn more by consulting the *DAWS manual.pdf* file, pages 108-121).

The Temperature Menu

Personally, I have no use at all for the archaic Fahrenheit temperature scale (so beloved by the Americans), so my first inclination was to delete the second line from this menu altogether. However, it soon became apparent that there were many occasions when the temperature gradient across a chart was very shallow and it would be useful to be able to plot isotherms at 1°C intervals. To do so, I edited out the 'convert to Fahrenheit' code, DEGF, changed the display code to SOLID and set the 'contour interval', CINT, to '1'. I also changed the description. This now allows me to alternate between the two temperature modes simply by clicking on the menu. COLOUR=0:0:0 gives black.

```

Temperature (deg C)
Temperature (deg F)
Potential temperature (deg K)
Wind chill (deg F)
Wind chill (deg C)
    
```

The default temperature menu

```

2 degree C intervals
1 degree C intervals
Potential temperature (deg K)
Wind chill (deg F)
Wind chill (deg C)
    
```

The modified temperature menu

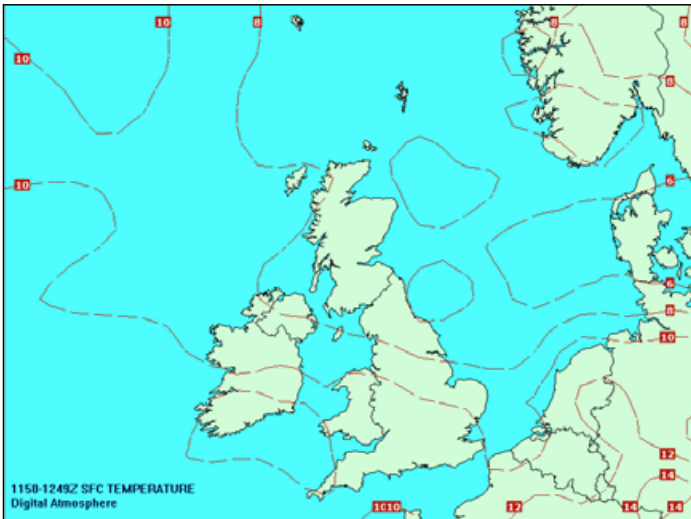


Figure 5 - Temperature isotherms at 12:00 UT on March 28, 2005  
(Thin red dashed lines at 2°C intervals)

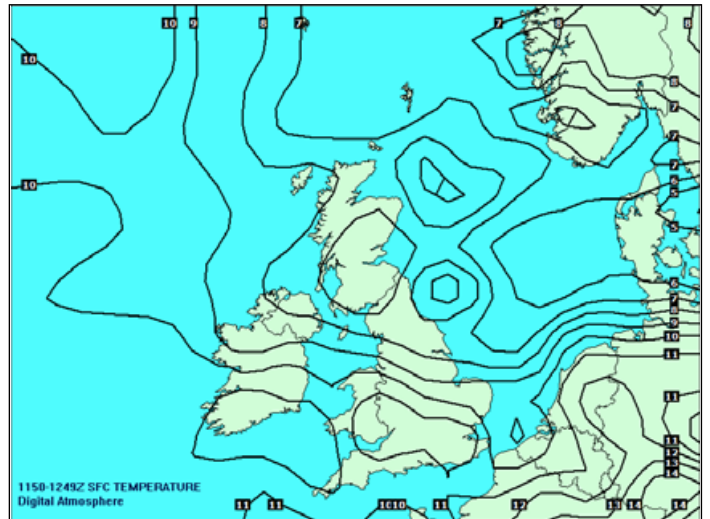


Figure 6 - Temperature isotherms at 12:00 UT on March 28, 2005  
(Thick black solid lines at 1°C intervals)

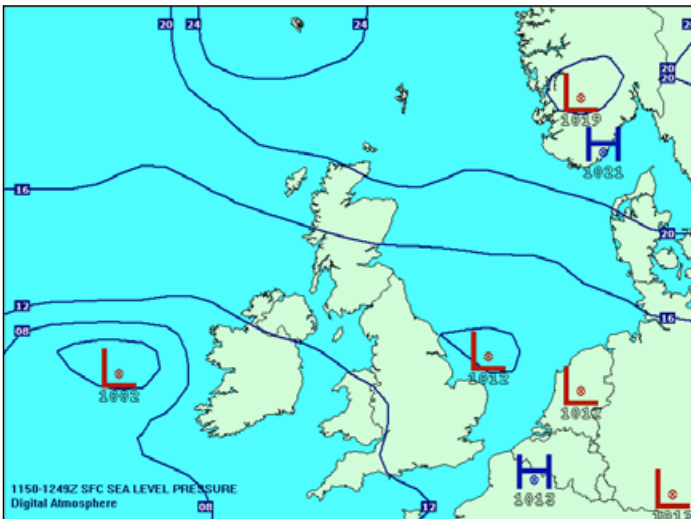


Figure 7 - Sea level pressure isobars at 12:00 UT on March 28, 2005  
(Thick solid lines at 4 mb intervals)

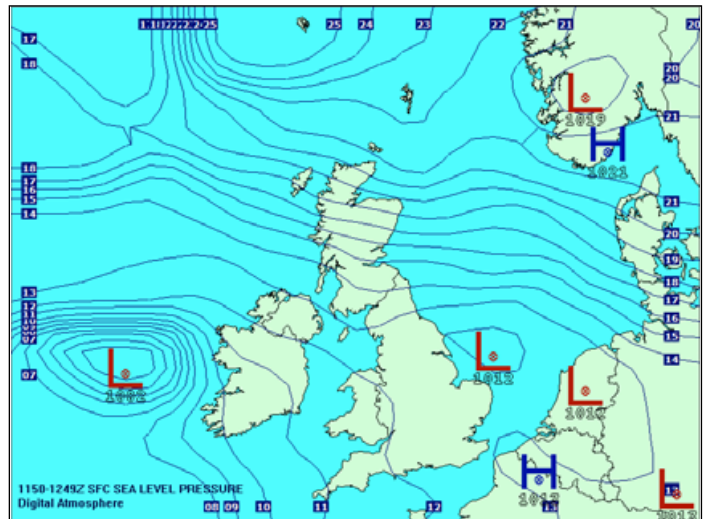


Figure 8 - Sea level pressure isobars at 12:00 UT on March 28, 2005  
(Thin solid lines at 1 mb intervals)

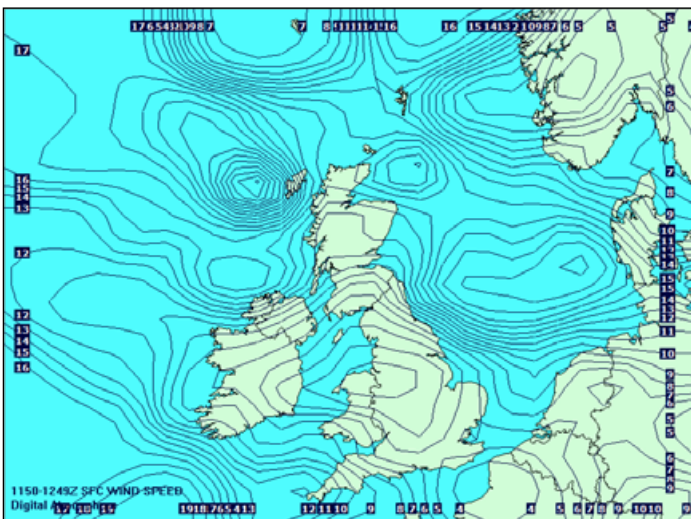


Figure 9 - Windspeed isopleths at 12:00 UT on March 28, 2005  
(Thin black solid lines at 1 knot intervals)

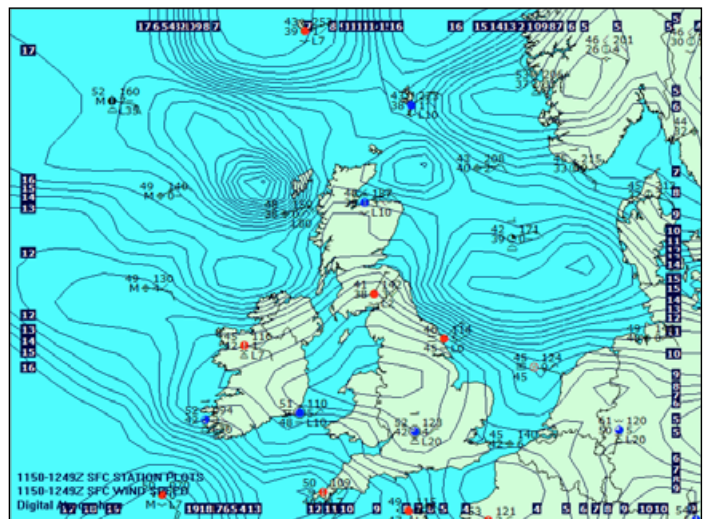
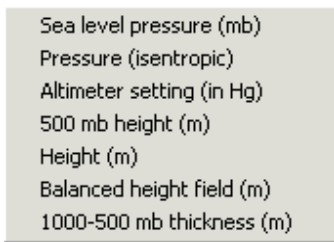


Figure 10 - Station plots added to figure 9

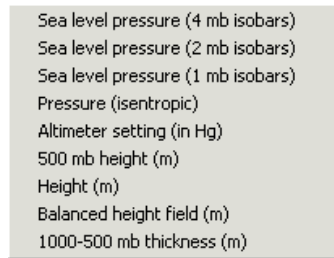


**The Pressure Menu**

When it came to this menu, rather than modifying what was already offered, I added two entirely new lines to allow me to plot isobars more closely together. The chart in figure 7 gives little indication of the pressure situation as the gradient across the region is very shallow. By increasing the sampling from 4 mb to 1 mb, the situation becomes much clearer (figure 8).



The default pressure menu



The modified pressure menu containing the two new options

The original 4 mb line was copied twice below the original entry and all three lines given suitable captions. Because the new entries would display the isobars closer together, the line thickness was reduced to '1' (LINE=1) and the respective contour intervals reduced (CINT=2 and CINT=1).

Now, depending on prevailing conditions, I can select whichever setting provides the best chart at the click of a mouse button.

**Further Possibilities**

The *Analysis* menu also offers opportunities to plot various parameters related to atmospheric moisture content, winds and precipitation. Figure 9 illustrates the windspeed chart that accompanies the temperature and pressure charts already described above. Another useful feature that can enhance any of these charts is a *Station Plot* overlay. An example is shown in figure 10. Just enter <Ctrl+D> to overlay these plots on top of any displayed chart.

**Troubleshooting**

I have occasionally found downloaded synoptic data files to contain corrupt (or inaccurate) data that causes *DAWS* to 'freeze'. Often the program recovers next time it is loaded, but sometimes

the dreaded 'No available workchart' message is displayed.

Not only does the base map fail to appear, but attempts to load one from disc are thwarted by appearance of a similar message.

The solution is to create a new base map (*any map* will do since your original base map is actually still intact within the *DAWS* folder—no need to worry about parameters). Save this base map, giving it a name like 'sparemap'. You will now be able to use <Map → Load base map> to return to your preferred base map—problem over.

**Future Developments**

*DAWS* is such a complex piece of software that its applications are limited solely by the ingenuity of the user. *GEO* readers who make regular use of *DAWS*, and who have developed their own techniques to enhance the way that the program displays synoptic data are encouraged to write to us about their methods and experiences for the benefit of all (whether full articles or just short notes).

At the conclusion of his article in *GEO* Q5 [2], Fred van den Bosch gave us a hint of what is possible by showing us a short **Scheduler Script** to fully automate the addition of *Fleetcode* overlays to *Meteosat-8* images. In the next issue, Fred gets to grips with the whole concept of scripting, including *Analysis Scripting* which can greatly enhance your *DAWS* synoptic charts in many ways.

Meanwhile, if you wish to learn more about scripting, why not visit the **Weathergraphics on-line forum** at:

<http://www.weathergraphics.com/forum/>

and follow the link 'Digital Atmosphere scripting'.

**References**

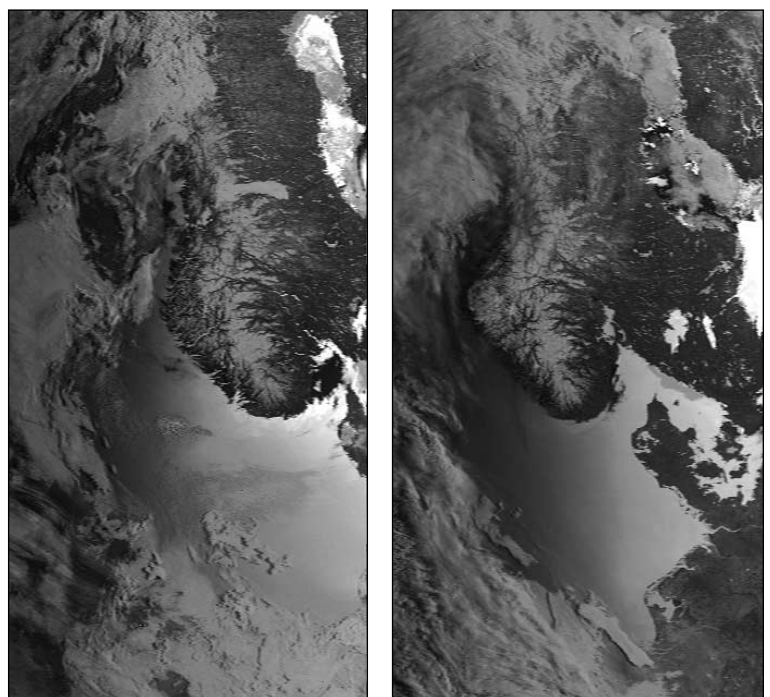
- 1 Using *WXtoImg* Images in Digital Atmosphere *GEO* Q2, page 8
- 2 My Experiences Setting up an MSG System, *GEO* Q5, page 44
- 3 Adding *Fleetwood* Data to *Meteosat-8*, *GEO* Q4, page 25
- 4 The symbols '%1', '%2' and '%3' in the example scripts enables these commands to be called by clicking the 'SLP', '°C' and '°F' short-cut buttons on the *DAWS* toolbar.

**Spectacular  
Sunglint  
from NOAA 15**

If you were monitoring the early morning passes from NOAA-15 around Easter time this year, you would have observed several wonderfully evocative examples of sunglint around the Scandinavian coastlines.

On the immediate left is the 07:59 UT NOAA-15 pass from March 31 where the still waters of the Skagerrak and Baltic Sea both reflect strongly. In the 07:36 UT April 1 image at far right, Denmark is beautifully framed within a pool of light showing the most subtle variations in intensity.

APT images - Les Hamilton Processing - Satsignal



# Unusual Cloud Plume over Scotland

*Les Hamilton / Peter Wakelin*

March 6 this year was a splendid day in Scotland. Recent snowfalls had salvaged what was looking to be a dismal winter sports season and the extensive snow cover over the Grampian Mountains is clearly visible in the NOAA-17 channel-2 image at upper right. Overall, conditions were calm and clear with high pressure prevailing but what intrigued me was the prominent, detached cloud plume that stretched north-south across the country. Relatively tenuous and unremarkable in the visible channel, it was the most prominent feature of the channel-4 infrared image. To investigate this in more detail I downloaded the HRPT telemetry from the NOAA CLASS Library (formerly the SAA - see GEO Q5 page 18) and ran it through HRPT Reader; this indicated cloud-top temperatures varying between -22°C and -34°C while surrounding clouds were registering temperatures in the 0°C to -5°C range. I wondered if this cloud might hint at some significant meteorological activity and passed the matter to Peter Wakelin for his comments.

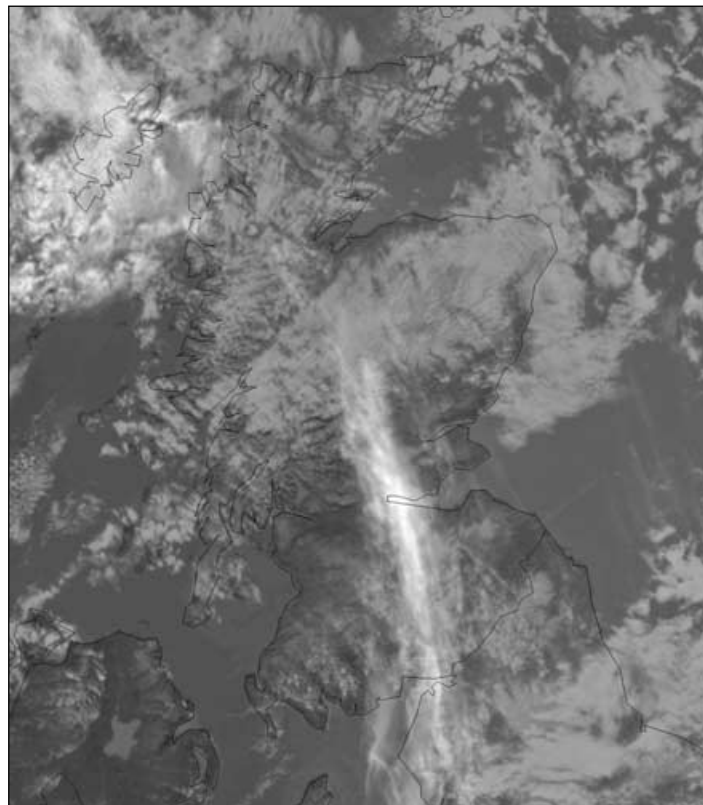
## Peter wrote:

I don't think there's anything very exciting going on here. I haven't looked at any upper air charts around this date but I suspect there is a strong NW flow up at cirrus levels. With more extensive cirrus further west over the Hebrides, the air's water vapour content is clearly close to saturation and the plume further east is almost certainly the result of wind shear creating turbulence which, in turn, has generated sufficient uplift for the water vapour to become saturated and cloud to form. Note that the plume is slightly curved which would enhance any turbulence if, as is likely, the cloud is indicative of wind direction.

You say the plume temperature 'varies between -22°C and -34°C' but you don't say how you derived these figures. If, as I suspect, you took pixel values from the thermal infrared image and somehow converted them to temperatures, then your results are almost certainly far too warm. Cloud-top temperatures derived in this way can be reliable *only* if

- the pixel concerned is completely filled with cloud at the same level and
- the cloud is sufficiently dense that no radiation from warmer clouds or the Earth's surface can penetrate it and reach the satellite's sensor.

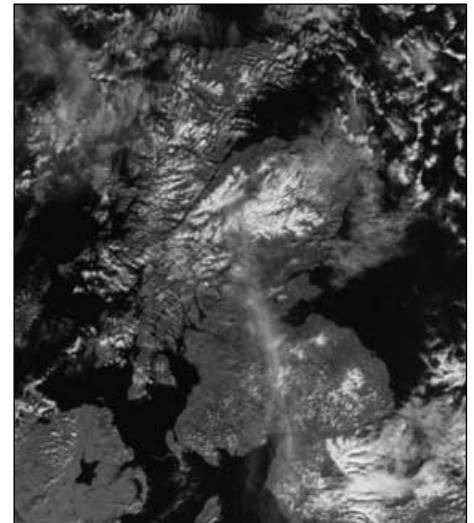
I doubt if either of these criteria has been met in this case; indeed, you remarked that the plume is much less prominent in the channel-2 visible image. It is so tenuous that low level cumulus clouds and the ground can clearly be seen through it. At the low pressures and temperatures encountered at cirrus levels, air can hold very little water in any of its three states so can rarely, if ever, be dense enough to 'hide' a warmer radiating source below it. A good covering of low-level water droplet cloud on a calm winter's night prevents the Earth's surface temperature from falling much but even the thickest of high level ice crystal cloud has very little effect and the temperature plummets after dusk. If that energy is going out *through* the clouds



NOAA-17 channel-4 IR, 11:45 UT, March 6, 2005 - Credit: NOAA CLASS

then it must impinge on any infrared sensors orbiting above.

Infrared pixel values can be reliably converted to temperatures in some circumstances but caution is always



NOAA-17 channel-2

needed. Sea surface temperatures can be measured this way but it is essential to ensure that no colder clouds are present. The sea may be covered with small fair-weather cumulus clouds which, individually, are too small to show on the images but, collectively, will lower the apparent sea temperature derived in this way. The temperature of the top of thick stratocumulus layers, typically at around two kilometres altitude, can also be measured in this way provided it is known that there are no holes in the layer. In the tropics most rain falls from convective clouds and their vertical height, derived from cloud-top temperatures, can be helpful in estimating likely rainfall; but deriving accurate temperatures is not easy.

These clouds are small in area so imaging resolution has to be high and, more importantly, only at the sub-satellite point will the sensors be seeing *only* the cloud tops.

The NOAA polar-orbiting satellites have a swath width of 2700 km and operate from 850 km orbits which means that, near the edges of the

image, an observer would see the satellite at below 30° elevation.

Under these conditions, the sensors are more likely to be imaging the warmer sides rather than the tops of convective clouds.



# IN TRAY

**The Column for Readers' Letters and Queries**  
e-mail: editor@geo-web.org.uk

Hello Les,

I've got as far as page 9 in GEO Q5, Mike Rowe's article, and am puzzled. I've never heard of 'HLS images' and the article offers no explanation, but the images appear to be from the visible channel.

Obviously cloud top temperatures can only be determined from the thermal IR channel so has Mike derived temperatures from the IR channel and superimposed them on the visible images? Or, heaven forbid, has he tried to derive temperatures from the brightness of the visible images, in which case the results would be nonsense?

Actually, in general, the correlation between cloud top temperature and rainfall is poor. It's not too bad in the tropics where downpours occur from convective clouds which don't glaciate (develop fuzzy cirrus tops) but up here where glaciation is common, the cold tops can persist for many hours after convection has died. For frontal cloud the correlation is virtually zero.

If the BBC weather rainfall maps use cloud top temps at all, then it would be just one of a number of parameters incorporated.

Peter Wakelin

## Reply from David Taylor

*SatSignal (and the HRPT Reader) can map the data from NOAA satellites in a way which both produces attractive false-colour images and retains the scientific value of the data. They do this by using a two-dimensional colour lookup table (CLUT) in which the temperature is used as an index to the X-axis and the brightness is used as an index to the Y-axis. Depending on how many temperature steps you want, or feel are valid in the input data, the X-axis (the CLUT bitmap width) may have either 100 intervals from -60°C to +39°C in 1°C steps or 361 intervals from -120°C to +60°C in 0.5°C steps, derived from the channel-4 data. The Y-axis indicates the brightness as derived from the channel-2 data, which has 256 values. Thus, with proper design of the CLUT, the colour hue of the image can be used to indicate temperature while retaining the more photographic style of the visible image.*

*HLS and HSV simply refer to two different methods of specifying the colours.*

*SatSignal offers the choice of both HSV and HLS-based colour lookup tables. The choice is a personal preference. HLS\_CT is a special variant of the HLS lookup table which works in the following way:*

- *the normal colour lookup table has a continuous range of brightnesses and colours, so that the clouds which appear colder but brighter than the land may be made to look "cold", e.g. by using a purple colouring for the coldest cloud tops. Figure 1 in Mike Rowe's article shows an image processed in this way.*
- *in the cloud-top CLUT, data down to a certain temperature level is processed as in a normal CLUT. However, once the temperature of the pixel data drops below a certain level (say -30°C) any variations in brightness are ignored and the resulting lookup is a constant colour.*

*Because these regions of cloud may carry more precipitation, it is useful to mark the regions with bright colours, going with a given colour sequence such as cyan, green, red, yellow, purple, white etc. to indicate progressively colder cloud-tops, and therefore progressively more likelihood of precipitation content. Figure 2 shows an example of this CLUT in use, where a particularly cold cell just off Ireland is visible as a purple patch.*

*Thus while the normal CLUTs are designed to give an attractive picture, the cloud-top CLUTs are designed to retain that style of image in most regions, but to allow easy detection of regions with a high precipitation likelihood.*

Hello Les

I have installed the new PIC in the RX2 but I regret that the channels to be used by NOAA18 are used, around here at any rate, by beepers and pagers. These are not small signals but blast through. I thought you may like to know and let others know about it. I have been aware of these for a very long time, since my FT847 covers these frequencies.

In theory I can use this setup for the reception of NOAA satellites but these very strong signals just swamp out any chance. I am wondering if there is any patch or such. This is the Cambridge area, for reference. I wonder why the powers

that be select frequencies which are in the neighbourhood of the world-wide known satellites. Is there is any likelihood of a change?

Les. Beeson g3ivb@tiscali.co.uk

Dear Clive

I was delighted to read in GEO Q5 that you now have in stock the new PIC for the RX2. Would you please accept a cheque for £7.00 and send me the new PIC. Thank you all for what you are doing for the new group and I think GEO Quarterly is a really good read with lots of information for all levels of experience.

I am looking forward to the new satellites and, like all of us, hoping that all goes well with the launch. It is so disappointing when, like the Amateur AO-40 satellite, it all goes wrong.

Ah well! Here's hoping.

Regards and thank you

David K. Brierley, Bideford, N. Devon

## Silting of the Irrawaddy

... continued from page 27

Within the Gulf of Martaban lies the bathymetric Martaban Canyon that divides the gulf from the Andaman Sea. The Martaban Canyon has a graben-like structure featuring faults, slump scars and eroded wastes from the sea floor. Having a high SSC (suspended sediment concentration), it is not surprising that turbidity is visible in weather satellite images. The turbidity front in the Gulf of Martaban oscillates by about 150 kilometres in phase with the spring-neap tidal cycles, increasing from less than 15 000 km<sup>2</sup> (square kilometres) to more than 45 000 km<sup>2</sup> during spring tides. Sediments are then transported from the Gulf of Martaban across the Martaban Canyon to the Andaman Sea during this period by the tidal currents.

## Acknowledgement

Figure 3 (map showing silting in the Gulf of Martaban) adapted from an original published in:

'Sediment distribution and dispersal on the Ayeyarwady continental shelf and Gulf of Martaban, northern Andaman Sea.' by V.Ramaswamy, P.S. Rao and Swe Thwin.

# Merge HRPT Images

## using Paint Shop Pro Part 1 - The Basic Principles

Les Hamilton

Our article in GEO Q5 describing how to produce HRPT images from telemetry files downloaded from NASA's Satellite Active Archive (SAA) generated a great deal of interest. In this issue we continue to explore the HRPT theme by explaining how multiple images can be merged to cover an extended geographical area. Figure 4 was made up from three successive NOAA 16 passes over Europe combined into a single, larger, image.

### Requirements

To prepare the HRPT images you require registered copies of two of David Taylor's software packages, *HRPT Reader* and *GroundMap*, plus of course, at least two successive HRPT telemetry files.

NOAA has set up a new facility for downloading these HRPT files, called the *Comprehensive Large Array-data Stewardship System (CLASS)*. Requests from SAA have in fact been actioned from CLASS for some time now and it does seem probable that the new site will eventually take over from SAA. The address for NOAA's CLASS site, which is an exact clone of the SAA site described last time, is

<http://www.class.noaa.gov>

Once the images have been prepared you will require *Paintshop Pro*, probably the most popular image processing package in use these days, to assemble them. Everything described below was achieved using version 6 of PSP—so you don't need to rush out and purchase the latest version.

### HRPT Reader

Most of the details concerning the use of this package were covered last time. Three further points are critical, though.

- 1 You **must** use a **registered** version of *HRPT Reader* so that you can create 'location' files in addition to the actual images. Location files are required by *GroundMap* in the next stage of the process.
- 2 Your images must be stored using the **<File → Save displayed image>** option. This saves uncorrected images; the necessary geometric correction will be carried out later using *GroundMap*.
- 3 Make sure that the 'Eq hist' box at the upper left of the HRPT Reader window is **unchecked**.

You will now discover that, every time you store an uncorrected HRPT image, two files will be saved to your hard drive. One will be a BMP image file, e.g. 'image.bmp', the other its location file, 'image.lcn'.

### GroundMap

Images of the Earth obtained from orbit always exhibit distortion due to the planet's curvature. Whilst features directly below the satellite are rendered correctly, those near the margins of the field of view become foreshortened as a Earth's surface curves away from the satellite. *HRPT Reader*, like most visualisation programs, can introduce a degree of correction to improve the overall appearance of the image but this correction alone is not sufficient to enable seamless merging of adjacent satellite passes.

This is where *GroundMap* comes in. This software can process uncorrected HRPT images and map them precisely to a number of standard projections. Figures 1, 2 and 3 show how the three NOAA-16 images to be merged in figure 4 were dealt with. Each image frame outlines exactly the same area on the Earth's surface, in this particular instance using the polar stereographic projection option, centred on latitude 53°N, longitude 15°E.

Each of the HRPT images has been positioned on to the appropriate part of this frame. As a result, when the three images are stacked on top of one another, coastlines, rivers and other land features should be in perfect registration where they overlap. This, of course, will not necessarily be true of weather features due to the fact that clouds actually move during the intervals between successive satellite passes.

### Setting up GroundMap

You really do need a registered copy of this program to make the best use of your HRPT files. The freeware version restricts the user to a relatively small 800 x 600 pixel working canvas and allows access to only three predefined geographical areas, 'Europe', 'USA' and 'Australasia'.

Registration enables the creation of the 'Giant' 3600 x 2700 pixel images used to produce the illustrations in this article and, most importantly, makes available the

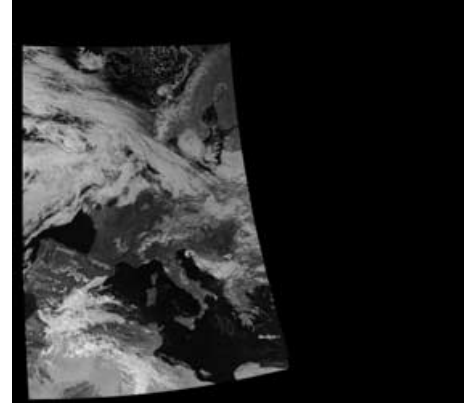


Figure 1 - 'Atlantic.bmp'

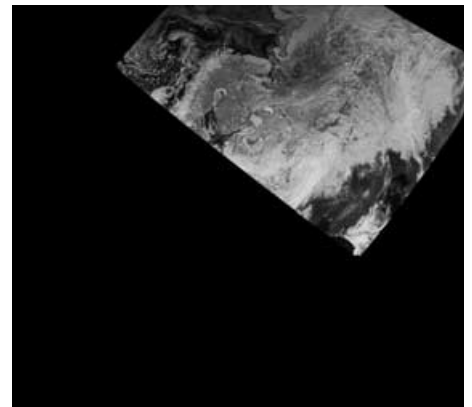


Figure 2 - 'Arctic.bmp'

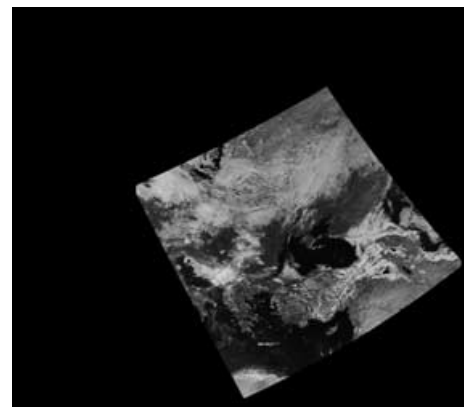


Figure 3 - 'Blacksea.bmp'

#### Options Menu

Output size	Giant - 3600 x 2700
Location	User
Map projection	Polar stereographic

#### User Setup (General tab)

Meridian	15°
Parallel	53°
Lat span	48°
Picture margin	0

Table 1 - Suggested mapping parameters



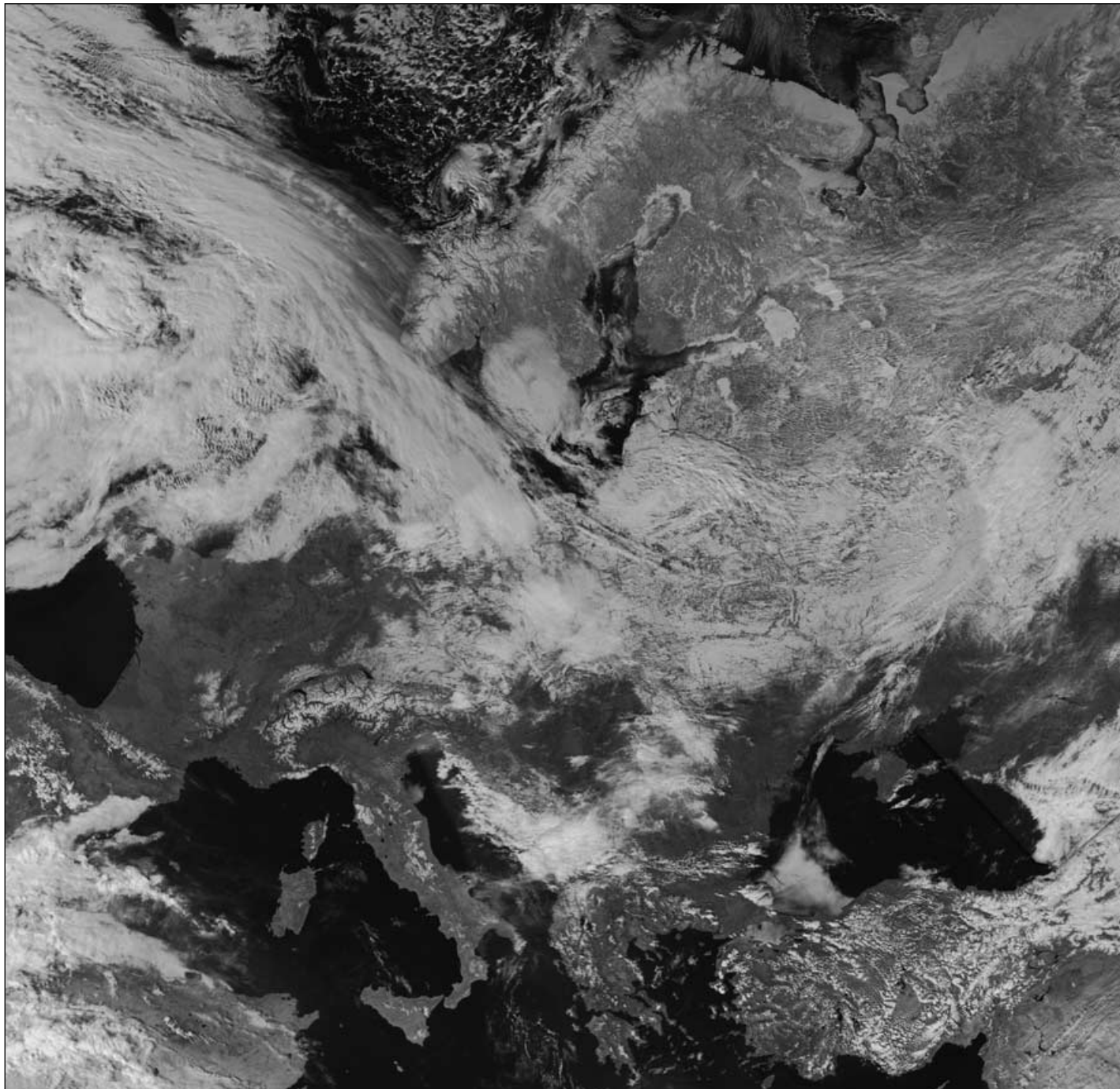


Figure 4 - This is a composite image created from three successive NOAA-16 channel-2 images acquired on March 15, 2005.

Telemetry files: NOAA CLASS Library - Processing HRPT Reader, GroundMap and Paintshop Pro v 6

'User' item in the <Options → Location> menu. This option allows you to define accurately the geographical area in which you wish to work. The various parameters used to create figure 4 are listed in Table 1 but everyone is free to create their own. The user parameters also include options for the addition of gridlines and country boundaries to the corrected images, if desired.

#### Using GroundMap

Select <File → Open location data> from the main menu-bar and navigate to the folder containing your uncorrected HRPT images. Open the first of these: *GroundMap* will issue a message

informing you of the name of the mapping list—just click OK to continue. After a short delay (depending on the speed of your PC and the available RAM) the rectified image will appear on your screen; save it using a meaningful, easily recognised filename. Repeat for each of the other images you plan to merge together.

#### The Images

LAC files from three successive NOAA-16 passes were requested from CLASS and duly downloaded. Each was processed in HRPT Reader with the Channel-2 tab selected and histogram equalisation switched off, then saved using the 'Save displayed image' option.

#### Setting up Paint Shop Pro

I find it helpful if all images auto size to fit the computer screen. From the menu-bar, open the <File → Preferences → General Program Preferences → Viewing> window, and make sure only the 'New images - Auto size' box is checked.

#### Merging the Images

First, click <File → New> to create a blank image the same size as the *GroundMap* images (3600 x 2700 pixels in my case) then set the 'Background color' to 'Transparent' and 'Image type' to '24-bit'. It is a good idea to save this blank image immediately with a filename such as '*composite.psp*'.

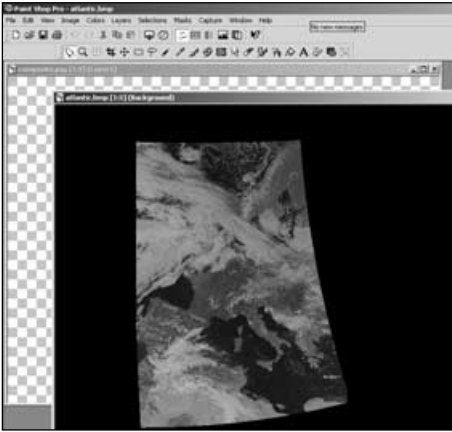


Figure 5 - Adding the first layer

The images created by *GroundMap* must now be stacked as separate layers within 'composite.psp'. Their black backgrounds must also be removed as we progress.

Select the *Magic Wand* tool and, in the Tool Options Window, set both 'Tolerance' and 'Feather' to zero.

The complete sequence of events is set out in the following bulleted list.

- The first image, 'Atlantic.bmp', was opened and copied to the clipboard using <Edit → Copy> (or Ctrl-C). (figure 5)
- The 'Atlantic.bmp' window was closed.
- The image was pasted as a separate layer in 'composite.psp' using the menu <Edit → Paste → As new layer> (or Ctrl-L).
- The Magic Wand tool was clicked on the image's black background. After a few seconds, the entire image area became highlighted (figure 6).
- <Edit → Clear> was clicked on the menu-bar (or use the Delete key). This cleared the black background, allowing the checkerboard display of the transparent canvas to show through (figure 7).
- The mouse was right-clicked (anywhere) over the image area to disengage the Magic Wand tool (*important step!*)
- The second image, 'Arctic.bmp', was opened and the entire sequence of events repeated.
- The third image, 'Blacksea.bmp', was opened and the entire sequence of events repeated yet again. The result was figure 8.

At this stage it is advisable to save *composite.psp* as a master copy of your image. There is still work to be done and, should you mess up subsequent steps, you can always return to this saved copy and start over again.

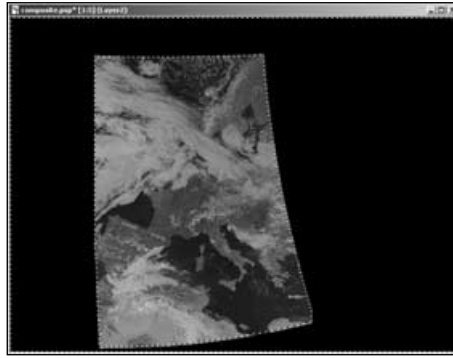


Figure 6 - Using the 'Magic Wand' tool

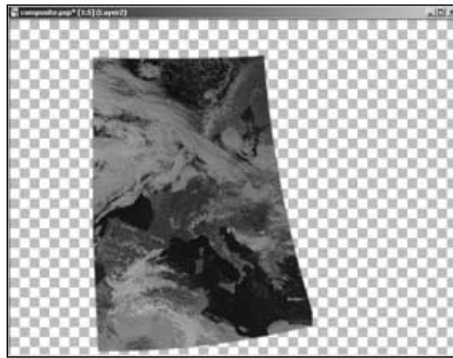


Figure 7 - Clearing the background

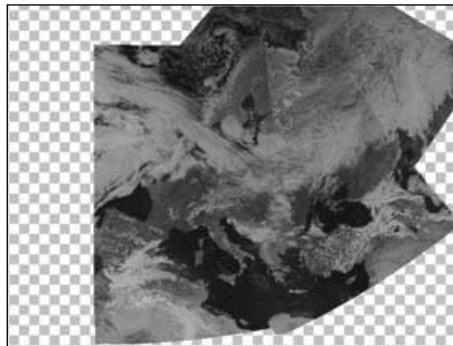


Figure 8 - The merged image

**Note:** to preserve the layers in the merged image, this copy must be stored in PSP's native '.psp' format.

**Final Touching-Up**

Although the separate passes are now successfully combined, the merged image is marred by several rather intrusive straight edges where individual passes overlap (this can be caused by uneven solar illumination across the frames). The following section explains how to soften such artifacts using PSP's *Freehand* tool. Removing the prominent vertical division through Scandinavia will be used as a definitive example.

**Selecting the Working Layer**

Figure 8 consists of four layers—the transparent canvas plus the three NOAA-16 images. We first of all need to identify the layer containing the darker, left-hand portion of Scandinavia—so press key <L> on your keyboard to reveal the *Layer Palette* (figure 9).

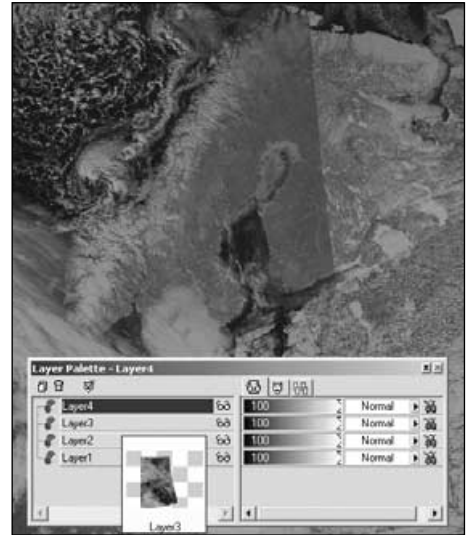


Figure 9 - The layer palette

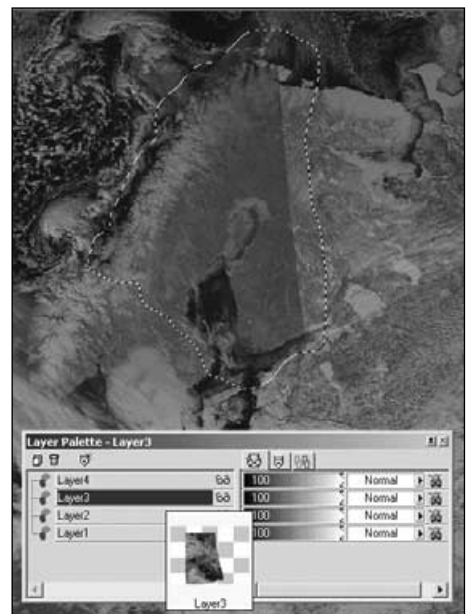


Figure 10

Using the Freehand tool to outline a region in Layer 3 for removal

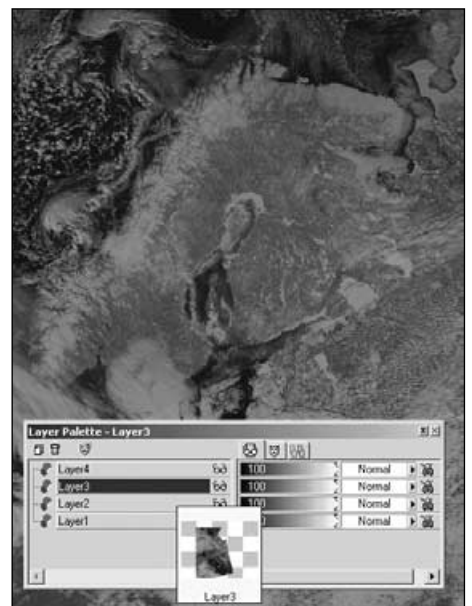


Figure 11 - Softening a boundary



Figure 9 shows a zoomed portion of the image, along with the *Layer Palette*. There are two ways to identify a particular layer:

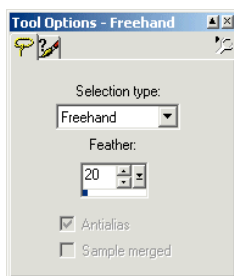
- Simply place the mouse cursor over a layer in the list and a small thumbnail of its image pops up
- Successively click each layer's visibility toggle ('spectacles' icon) to make the layers flip in and out of view

When you have identified the layer you wish to work on, click its name in the Layer Palette to highlight it. This means that any modifications you make to a selected area of the image will affect only this layer.

### Cropping and Feathering

Before employing the *Freehand* tool we need to be certain that it does not itself introduce unwanted boundaries on to our image. We can achieve this by *feathering* the edges of any selections we make.

Feathering the edges of a selection means that, instead of terminating with a straight edge, it 'fades out' to transparency across a selected range of pixels.



Select **<View → Toolbars>** then place a tick against **<Tool options window>**. Click the 'Freehand' icon (lasso) on the toolbar (or press key **<A>**) and set the 'Feather' value to 20 in the *Tool Options* window (above).

### Removing the Edges

Zoom in to the image and use the *Layer Palette* to activate the layer you intend to modify (the left-hand part of Scandinavia in this example). Select the *Freehand* tool and click the mouse at your starting point on the image. Keeping the mouse button depressed, drag it around the area you wish to remove, ending as close as you can to the starting point. When the mouse is released, PSP automatically connects the two ends of the line (figure 10). Click **<Edit → Clear>** or press **<Delete>** and the job is done (figure 11).

Move around the merged image, dealing with all intrusive margins in the same way until your masterpiece is complete. Again, save as *composite.psp* in case you feel further processing is necessary later. To complete the job click **<Layers → Merge → Merge all (Flatten)>** then save in your preferred format (TIFF, BMP, JPG etc.). Figure 4 was rotated slightly then cropped before using the **<Colours → Adjust>** menu to modify the image brightness, contrast and gamma to suit my personal taste.

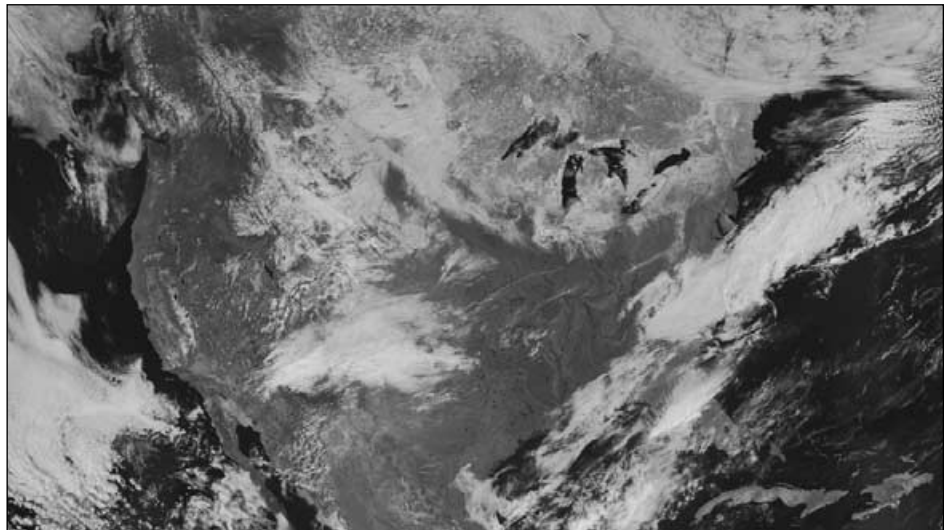


Figure 12 - A composite image stretching the full width of the USA

### Troubleshooting

- Sometimes you may crop beyond the region where two layers overlap and part of the checkered background canvas shows through. Don't worry—just click on **<Edit → Undo clear>** and start over.
- The degree of feathering is open to experimentation. But excessive feathering does lead to blurring in the image and loss of detail.
- If, when using the *Magic Wand* to remove the black background from each *GroundMap* image, black regions within the image area are also deleted (revealing the checkerboard background), this is almost certainly the result of applying histogram equalisation in *HRPT Reader*—don't do it!
- As was mentioned earlier in this article, HRPT images must be prepared without equalisation. This is because Groundmap applies a completely black background (RGB=0:0:0) to all its output images. On the other hand, the AVHRR radiometer aboard the NOAA satellites transmits even the darkest colours at a 6% modulation level, reproducing on (non-equalised) images as (RGB=16:16:16). It is this difference that enables PSP's *Magic Wand* to eliminate the backgrounds from the images.
- To make image boundaries as 'invisible' as possible, it is a good plan to drag the *Freehand* tool in a convoluted path that follows closely any natural, high-contrast features such as cloud outlines and coastlines.

Above all, do be mindful that considerable artistic judgement and patience may be required to achieve the best results. Part 2 of this article will look at ideas that will improve your composite images even

more. Meanwhile, do try out this technique and submit your results to the editor for publication.

If we receive a good response from GEO readers we will publish a gallery of your best work.

### Acknowledgments

Thanks are due to Ferdinand Valk, who pioneered the merging of HRPT images, and whose efforts inspired this article. You can view some of Ferdinand's work at:

<http://www.fvalk.com>

### Software

If you would like to try out the techniques described above, you can obtain evaluation versions of all the necessary software from Software Showcase (page 39).

Paintshop Pro can be downloaded as a 30-day evaluation version from:

<http://www.corel.com>

You can download HRPT Reader and GroundMap from David Taylor's website at:

<http://www.satsignal.net>

You will find the links under the 'Satellite Tools' section. If you haven't used David's software before you also require his *Runtime Library Bundle* (link on the HRPT Reader page under the section headed 'System Requirements').

If you would like to sample **full versions** of *HRPT Reader* and *GroundMap*, David can usually provide time-limited licences which allow you to experience the programs' full features for two weeks or so.

You can e-mail David at:

[davidtaylor@write.me.com](mailto:davidtaylor@write.me.com)

# NEWS from Down Under

**Doug Thwaites**

I have enjoyed a long and wonderfully adventurous life which could fill a book, so I will just mention my activities in the field of electronics. I was born in London in 1916 and at the age of 13 built a three-valve SW Radio and became a SWL. My wall became covered with QSL cards, my most prized coming from the then pope, complete with papal seal. Following technical school, I went into radio servicing, testing components at the *Ultra* factory.

During the war I spent some time in Scotland as a member of *Technical Training Command*, flying six hours a day, six days a week training operators in aircraft interception (AI), radar and aircraft to surface vessel (ASV) radar. Later I was transferred to London where I was chief instructor of No 7 Radio School where we trained radar technicians before moving to Great Malvern where I helped develop H2S radar.

I came to Australia in 1956 where I trained radio technicians to cope with the advent of the first television service. After working for some years in the TV industry, during which time I set up three companies, I sold out and built and ran a country motel. I retired at 60 and began to write, something I have continued ever since.

A friend of mine built weather satellite receivers and I am fortunate to have one of them. It scans six channels and stops when the 2400 Hz tone is found. I use a 'J' antenna after trying and building all the other types.

## Satellite Images

Once summer comes we get the monsoon clouds building up around the equator. In the east of Australia, we depend on rain from south-east winds off the sea—and also experience the odd cyclone. We seem to have been in constant drought conditions during the last few years as there have been no cyclones this side of Australia. I live in a valley running north-south with a hill to the south. Not a good site, but I can obtain pictures from New Guinea to Tasmania and if conditions are right and I get a pass from over the Pacific I can see New Zealand.

Figure 1 shows a scan over a large area of eastern Australia. You can see the monsoon clouds stretching across the top, over the Gulf country.

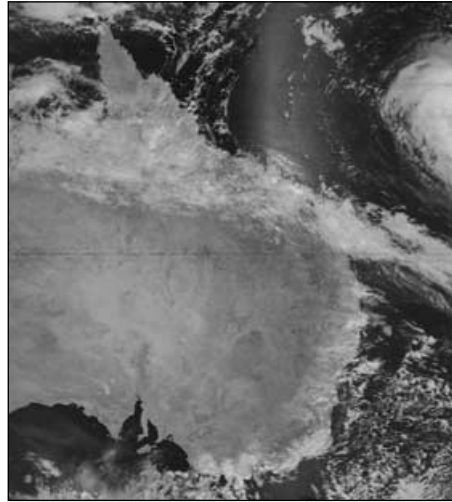


Figure 1 - January 1, 2005

On the lower east coast, around Sydney, you can see cloud on the coast from strong south-east winds. At the far south is a weird peninsula shaped like a leg and foot—the Southern Yorke Peninsula with Spencer Gulf to its west. At the top of this gulf, as you look northwards, you can see the dark mass of Lake Eyre, a huge salt lake system then, north of that, massive areas of desert. It is hard to believe but, when a cyclone hits Queensland and causes extensive flooding, it can be months later before the water flows down through what is called the *Channel Country* and floods Lake Eyre.

Figure 2 was taken on December 28, the second day of the Sydney to Hobart yacht race, and shows the storm that caused so much chaos sitting over its path. Figure 3 shows the birth of cyclone 'Kerry', the first for about ten years, a category-3 storm at this point. Figure 4 shows 'Kerry' slowly moving down the coast and weakening to Category-1. So our drought goes on. All images are from NOAA 17 on north-south passes.

About the interference: during the hot summer months when there are thick clouds and intense lows around, I get one or more black bands where the signal cuts out. I have discussed this with other satellite viewers, and we feel it is due to disturbances in the atmosphere caused by the conditions. Europeans could not imagine the summers we get. The monsoon cloud has descended down the coast, covering it all the way to Brisbane at the moment; it is hot and so humid that everything feels wet. There have been rainfalls of twelve inches in a day. Rivers



Figure 2 - December 28, 2004

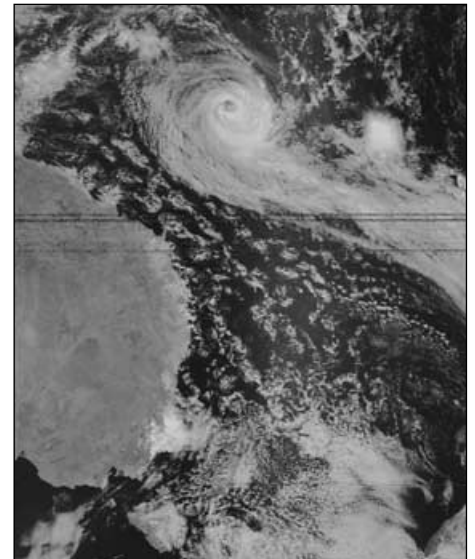


Figure 3 - January 8, 2005

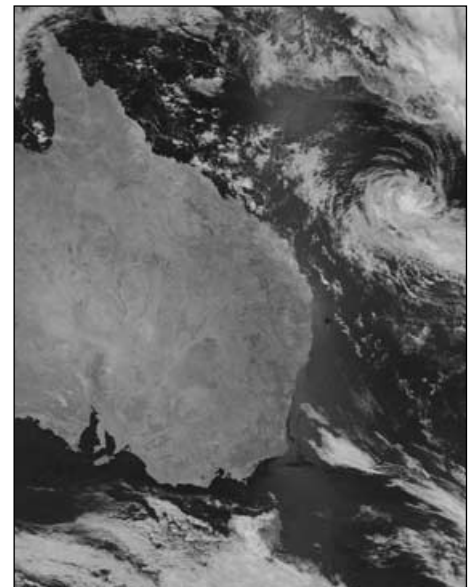
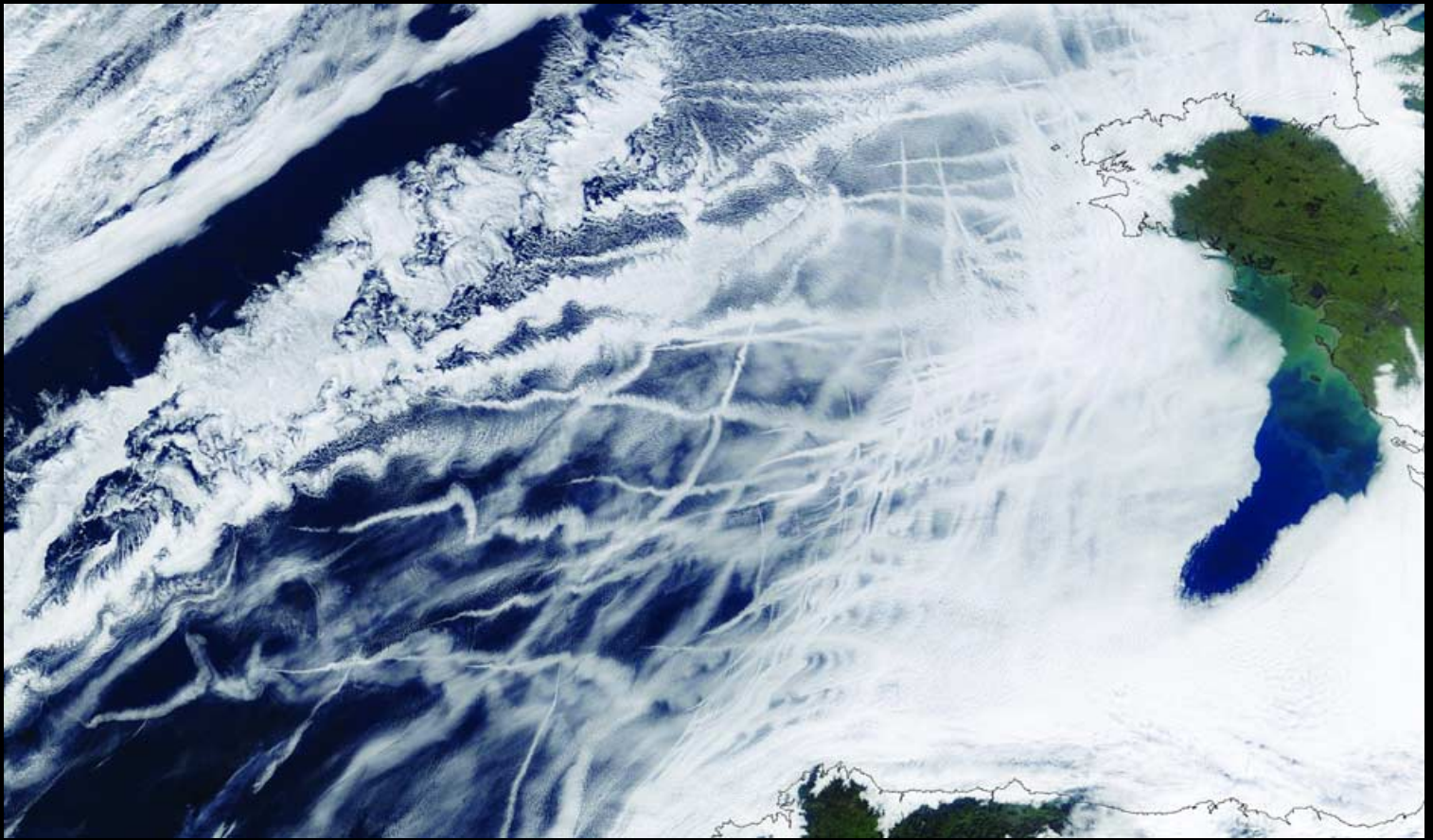


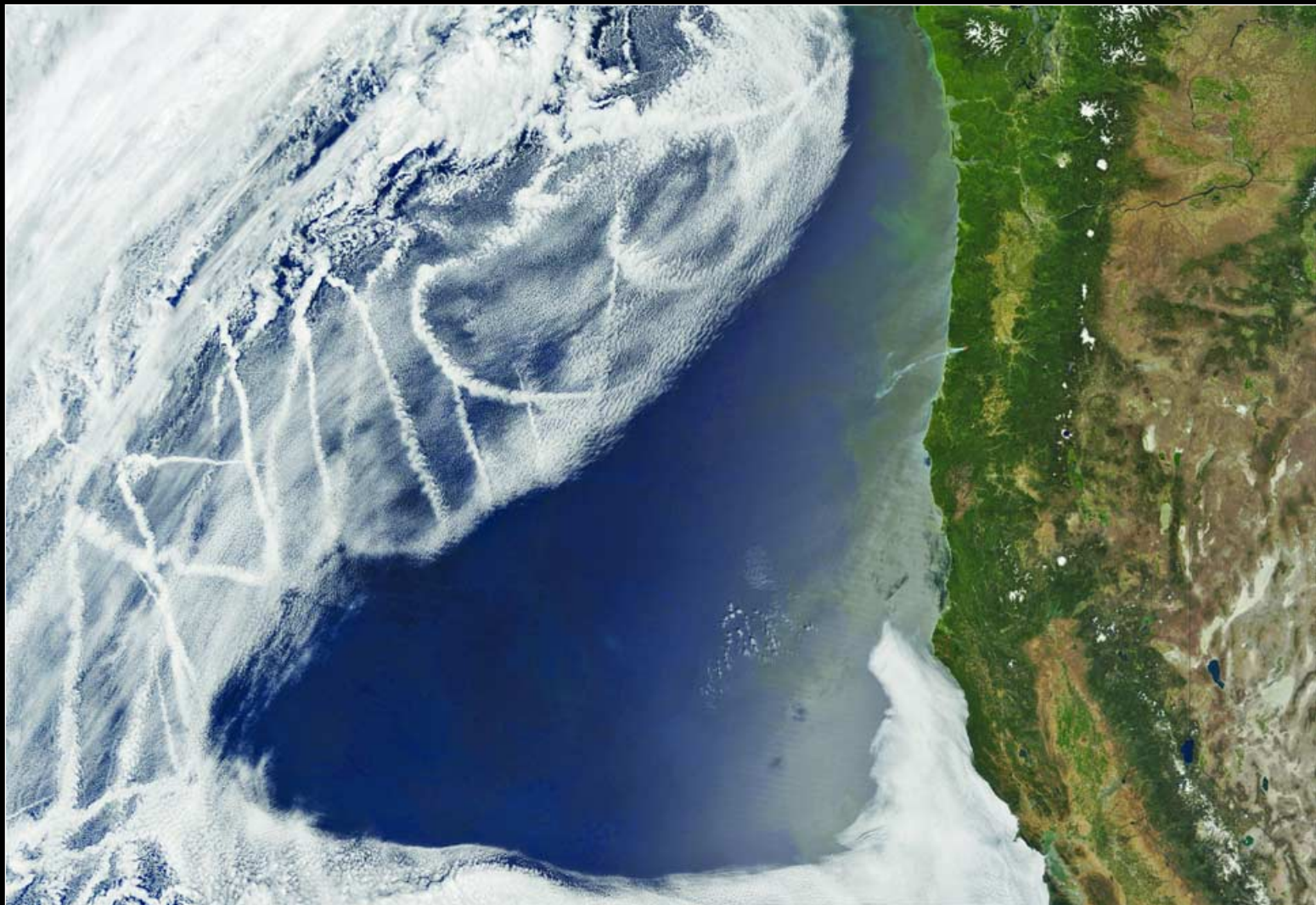
Figure 4 - January 10, 2005

are rising and breaking their banks. But this is the only way Queensland gets its rain. The farmers are jumping for joy as they stand in their flooded fields. But our winters are paradise where you stand in the constant sunshine and get tanned.





A true-colour MODIS image from NASA's *Terra* satellite taken on January 27, 2003  
This ship trail formation, also pictured on page 29, persisted for some 36 hours  
*Image: MODIS Land Rapid Response Team*



A spectacular *Terra* MODIS image showing ship trails off the Oregon coast of North America on June 28, 2003  
*Image: MODIS Land Rapid Response Team*



