The GEO Quarterly

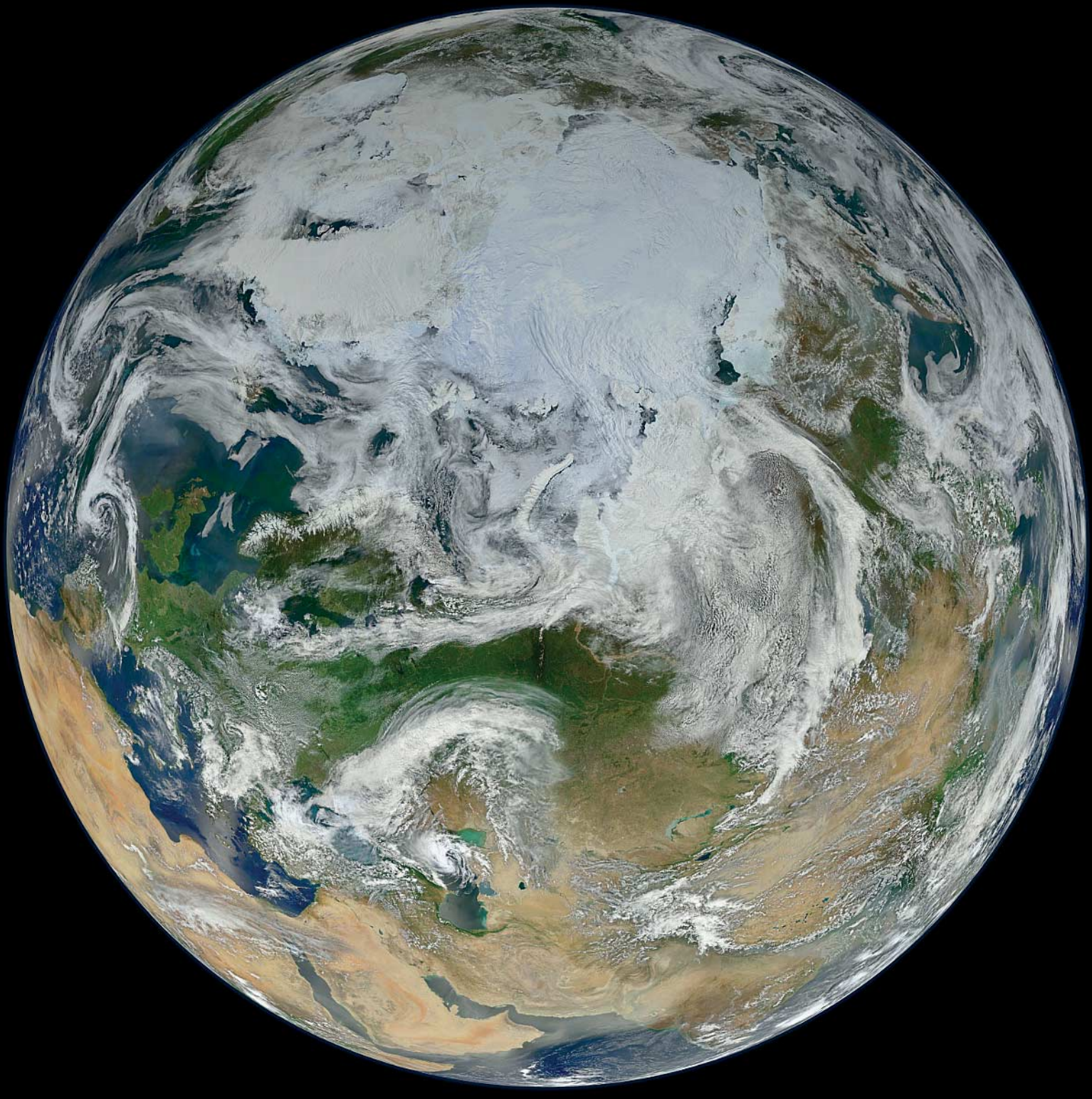
Group for Earth Observation

Group for Earth Observation

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

35

September 2012



NOAA recently released this new *Blue Marble* image of Earth, created by combining multiple VIIRS images from the *Suomi-NPP* satellite.
Image: NASA/NOAA

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

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

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

Editorial

Les Hamilton
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Many readers will be familiar with the *Blue Marble* visualisations of Earth created by NASA using MODIS imagery acquired from their *Terra* satellite. Recently, a new *Blue Marble* image was created from fifteen passes of the new Suomi-NPP satellite on May 26, 2012. But there is a difference: this image looks down on Earth from above the North Pole. It's so spectacular that it appears on this quarter's cover. You can read more about this visualisation in 'View from the Top' on page 34. There have now been several follow-up *Suomi* Blue Marble images which van be viewed at

http://npp.gsfc.nasa.gov/science/feature2012-bluemarble.html

This issue sees us returning to the grass roots of satellite imaging with the second part of Ron Hahn's series on *APT Weather Satellite Reception*. This time, Ron focuses on the popular *WXtoImg* software package, and provides a detailed guide to its features, aimed most particularly towards newcomers to the hobby.

My immediate thoughts are that David Taylor has developed several new software packages in recent years: looking at his website I note CHLO Viewer, CMA Viewer, Metop LSA Viewer and MODIS L1 Viewer.

I presume that there are GEO members who use these software packages, yet **nothing** has ever been mentioned of them in the pages of GEO Quarterly.

It would be very much appreciated if readers familiar with these packages, and who are making use of them regularly, would be kind enough to write articles for GEO describing how to utilise them: a basic 'how-to' guide outlining the main features that they provide, and descriptions of the results that can be obtained. Little really new has happened in amateur Earth Imaging recently. This could be just the trigger needed to awaken enthusiasm and, perhaps, encourage seasoned GEO members to remain in the fold.

Masthead photograph: Morven in Aberdeenshire, seen from Tomnaverie recumbent stone circle.

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The GEO Report

Francis Bell

MSG-3

My first comment must be to offer congratulations to EUMETSAT and ESA for the successful launch of MSG-3. I watched the launch live on TV and it was impressive, with such a massive rocket and the short time scale for the satellite to reach orbit. I know other manoeuvres are necessary to secure the final orbit but the first 30 minutes were thrilling. I believe that the testing and commissioning of MSG-3 are progressing according to plan. Again: congratulations to all concerned.

Envi-Ham

On a less happy note, I understand that the Earth observation satellite '*Envisat*' is effectively lost, which is a great disappointment to me. I just loved receiving those outstanding Earth images disseminated via the Envi-Ham programme. I don't know what the future now holds, but I have written to the 'Principal Investigator', Stefano Badessi in Frascati, asking if there are alternative images/ data sources in mind for the Envi-Ham project. As soon as I receive a response I will try to inform GEO members.

Membership Renewals

Elsewhere in this Quarterly you can read about our members' AGM which took place in Guildford on June 8. In addition to the meeting there were further informal discussions which took place over the weekend and some of these resulted in a number of action points one of which related to membership renewal procedures.

The GEO party enjoying a meal together following the AGM held at SSTL

It is clear that GEO loses many members each year by the default of just not renewing their membership. I know from the responses I receive from the membership renewal reminders that I send out that only a small number say they actively decided not to renew because of changed interests or other equally valid reasons. Many others, I suspect just fail to renew by default.

In order to minimise this drainage of members, UK readers will, in future, be invited to complete a bank 'Standing Order Mandate'. This has a double advantage. Firstly members will only have to complete one mandate and their annual renewal will be done automatically via the bank. However, this mandate or instruction can be cancelled by the member at any time. In return, GEO will try to keep the annual subscription constant for as long as possible hence minimising the need to alter bank mandates. Members will receive the necessary form when their next renewal becomes due. A second advantage is the saving GEO will make by not having to pay commission to *PayPal* or others when receiving members' subscriptions. For overseas members, and, indeed, UK members, the option remains of using *PayPal. A*nd when dealing with different currencies and making a sterling payment, this may remain the preferred option.

The Format of GEO Quarterly

It has been suggested on a number of occasions that *GEO Quarterly* be made available in electronic format as an alternative to the printed copy we currently enjoy. There are a number of ways this could be achieved and we will be guided by members' opinions. Our membership secretary is currently canvassing opinion on this subject, and no decision will be taken until this is complete. My view is that I value the printed copy of *GEO Quarterly* and would **not** wish to see it substituted by an electronic version. I confirmed this to myself when I saw the electronic copy of EUMETSAT's 25 year history in PDF format on their website. I viewed the web material diligently, but promptly requested a copy of the printed book which I find much more user friendly!

There are also issues to be addressed relating to printing costs, the number of copies we print, distribution and the security of material published electronically. Until we are all happy, the short term plan is continue with our printed Quarterly.

EUMETCast Receivers

We now hold fresh stocks of the *DVBWorld EUMETCast* receiver. Some months ago there was doubt over whether we could buy more stocks of this receiver but this is now resolved. We currently hold stocks that should satisfy demand for a few years to come. During this period of uncertainty, I bought two *TechniSat* '*SkyStar*' receivers from Germany to test them for *EUMETCast* reception. Both the basic S1 and the S2 HDTV receivers worked well with EUMETCast reception and were compatible with the David Taylor software which I run at home. Should the day ever come when our *DVBWorld* receiver is not available, it's reassuring to know that there are modestly priced alternatives available.

The popular *DVBWorld* receiver is shown here alongside the *TechniSat USB 2* receiver (centre), now in service with GEO's mobile *EUMETCast* receiving station. Note that the remote control unit is not needed for *EUMETCast* reception but is usful if watching the many TV stations available on the same satellite's transponder.

Interestingly, EUMETSAT are testing one of 'our' *DVBWorld* receivers for compatibility with their potential new data formats, which I believe are 64-bit. There will never be an end to the evolution of data speeds and formats, so it's reassuring to know that collaboration is taking place between some of our knowledgeable GEO members and EUMETSAT. I wish to record my thanks to both sides involved with these technical issues for keeping the GEO membership up-to-date with live *EUMETCast* reception.

Poster advertising the 2nd *eteorological Technology World Expo*

Meteorological Technology World Expo 2012

Following last year's inaugural event, *Meteorological Technology World Expo 2012* will take place in Brussels, Belgium on October 16-18 this year. Information indicates that there will be about 160 exhibition stands and a full programme of lectures and presentations. Interestingly, there is free admission to this event for the general public. At the time of writing I'm not sure whether GEO will have a stand in the exhibition area but the opportunity to attend such an event free of charge seems too good to miss. For more details about this event, and for registration, visit

www.MeteorologicalTechnologyWorldExpo.com

Software Defined Radio

I have to admit I'm on a learning curve with software defined radio. I attended an evening presentation on the subject by David Simmons, and Arne van Belle briefly spoke about it during the recent GEO afternoon visit to SSTL in Guildford. However, I still consider myself a beginner on this subject. I would like to know where I can buy a receiver covering APT frequencies? Also, where can I obtain the necessary software to run such a system?

I would love to hear from any reader experience in this area and willing to help me: and better still, I would very much appreciate it if someone could write an article on software defined radio for *GEO Quarterly*.

Space Link

I am currently progressing collaboration with this educational group which evolved out of my Millennium Satellite programme in the late 1990s. Space Link, who are supporting space topics in schools, visit different schools a number of times each term, and I am currently assembling a mobile *EUMETCast* station for them to demonstrate weather satellite reception in a school context. I would like to see as many schools as possible running daily live satellite reception, and GEO will certainly try to help where we can. To learn a little more about this educational project visit their web site at

www.spacelink.org

Space:UK

Quite by chance, I have just received the latest copy of the Space:UK magazine, a special edition celebrating 50 years of the UK in space. It is well worth reading. I did review this publication in GEO Quarterly 34, page 40, but this is just a reminder that Space:UK is available free of charge. To be placed on the regular mailing list write to:

Newsletter and Space:UK Subscription,
UK Space Agency,
Polaris House,
North Star Avenue,
Swindon SN2 1SZ

Continued on page 9

QUARTERLY QUESTION

This Quarterly Question is very straight forward:

'What was the mass of the recently orbited MSG-3 satellite, in kilograms, at the time of its launch?'

For my reference, I have a definative answer from EUMETSAT which I will use to judge answers. Please send your answers to Francis Bell at

francis@geo-web.uk

by October 31, 2012.

A winner, picked from the correct answers submitted to me,, will receive a new copy of the book ***EUMETSAT 25 Years***, reviewed on page 40 of this issue. Help can be found on the web, either at ESA or EUMETSAT.

Envisat Bows Out

following ten succesful years in orbit

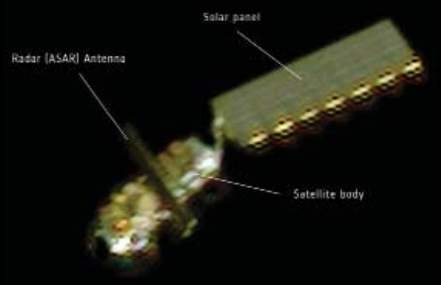
Les Hamilton

When the European Space Agency's *Envisat* lifted off from the Kourou Space Centre in Guyana on March 1, 2002, the 8.2 tonne craft became the largest civilian Earth observation satellite ever to enter orbit. By comparison, NASA's *Terra* satellite weighs in at a mere 5.2 tonnes. And with a minimum design lifetime of five years, *Envisat* had continued to transmit flawlessly beyond its tenth anniversary until all contact mysteriously ceased on April 8 this year. *Envisat's* final two images were received shortly after 11:00 UT on that date, a MERIS image of the Iberian peninsula (figure 1) and an Advanced Synthetic Aperture Radar (ASAR) image showing the Azores (figure 2).

Envisat's abrupt failure came as a real surprise: there had been no hint of any problem—such as image degradation—prior to loss of contact. Readers will no doubt recall how several of the NOAA weather satellites (NOAAs -12, -14 and -17 in particular) exhibited fluctuating imagery problems during the years and months prior to their ultimate failures.

The reason for *Envisat's* sudden demise remains unknown, but could result from a number of causes. Initially, ESA expressed the hope that a fault with the satellite's electronics might have placed Envisat into 'safe mode', from which recovery should have been routine. However, despite tireless efforts throughout April, when continuous commands were sent to *Envisat* via a widespread network of ground stations, the craft obstinately refused to respond.

Another possibility was that a piece of space junk might have damaged *Envisat's* 70 m^2 solar array, thus depriving the satellite of power or destabilised its orbit. But images from, the French Space Agency's new *Pleiades* satellite [3]—which normally provides very high-resolution images of Earth but which was reoriented towards Envisat on April 15—indicated that it was still intact, and optical, radar and laser observations from the ground confirmed that *Envisat* remained in a stable orbit. Another possible scenario was that a power regulator might have failed, blocking telemetry and telecommands to and from *Envisat*.



This image of *Envisat* was acquired by the *Pleiades* Earth Observation Satellite, and shows Envisat at a range of about 100 kilometres. *Envisat's* main body, solar panel and radar antenna are all clearly visible.
Image: CNES

In early May, after a month-long recovery effort proved fruitless and the cause of the failure remained unsolved, ESA formally declared the end of the *Envisat* mission. But ESA have not completely lost hope and will continue making attempts to re-establish contact with their flagship satellite for some months yet.

References

1 Advanced Synthetic Aperture Radar from Envisat - GEOQ 1, page 22
2 Multitemporal ASAR Imagery from Envisat - GEOQ 21, page 36
3 Pleiades - http://smsc.cnes.fr/PLEIADES/

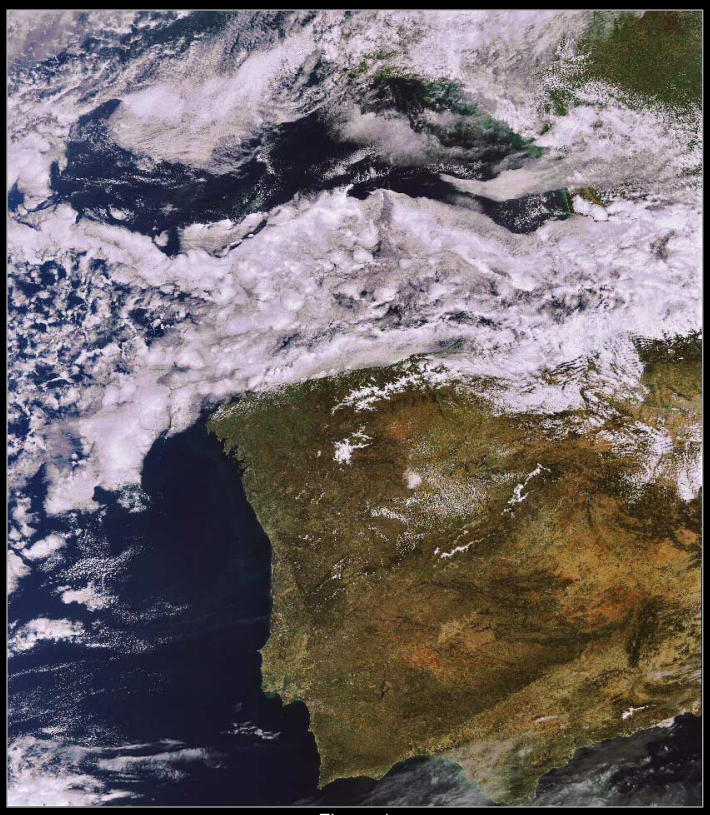


Figure 1
Envisat's Medium Resolution Imaging Spectrometer (MERIS) captured this image at 11:05 UT on 8 April 2012. The image shows Portugal and Spain and was the last data transmitted via Ka-band before communication was lost.
Image: ESA

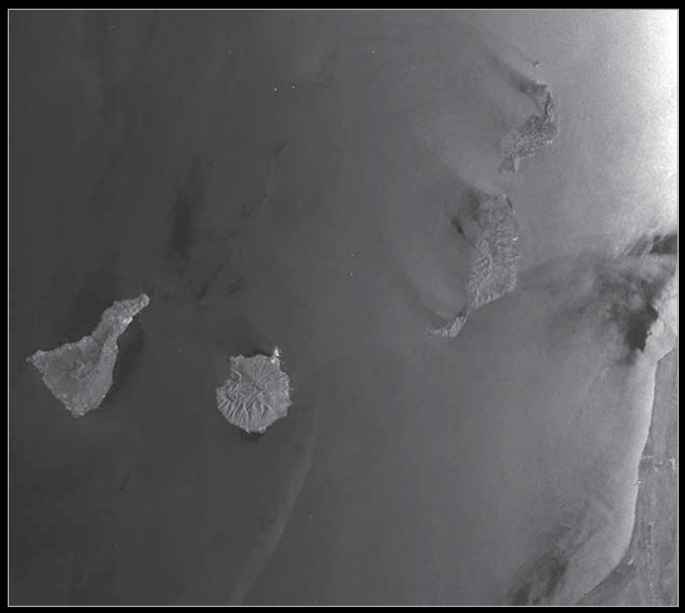


Figure 2
This ASAR image, transmitted at 11:09 UT on 8 April 2012, shows Spain's Canary Islands, and is the final Envisat data transmitted via X-band.
Image: ESA

Installing a New EUMETCast System

at the Amberley Museum Amateur Radio Club

Francis Bell

I have previously reported my contacts with the Amberley Museum and Heritage Centre and can now report on the successful completion of a small project which will, I hope, provide the general public and many school groups with access to live *EUMETCast* images.

The Amberley Museum site is set in the heart of the South Downs National Park and located in a disused chalk quarry. In the past, the chalk was excavated for burning into lime which was then used for agricultural applications over the Weald of Kent. Lime production ceased many years ago and the quarry site became more or less abandoned. More recently, the 36 acre site has become home to a unique collection of listed buildings and scheduled ancient monuments, many from the Sussex area of the UK. The museum and exhibition buildings, about 40 of them, cover not only the history of the site, but incorporate country crafts, railways, electricity generation and distribution, the history of telephone communications and a dedicated building covering the history of radio communications. The radio building also houses an amateur radio station run by Amberley Museum Amateur Radio Club GB2CPM (Chalk Pit Museum).

I have visited this heritage site several times but was prompted by Paul Le Feurve G0DBS, a member of my own Three Counties Amateur Radio Club, who had also spoken to the people running the amateur radio station at the Amberley museum site. He told me that they had expressed an interest in establishing a weather satellite receiving station and to have this running whenever they were manning their amateur radio station. With this background in mind I visited the museum again, and discussed with the radio club members there the hardware and software necessary to run a live *EUMETCast* station in the Radio and Communications building.

David Taylor (GEO) and Sandra Grindlay G0KAG (Amberley Radio Club) pictured with amateur radio equipment and the live EUMETCast display.

One issue that immediately came to mind was the site's view of the sky. Being in a disused quarry with adjacent cliffs, I questioned if direct satellite reception would be possible. To resolve this issue, I returned a few days later with my mobile station which I set up just outside the Radio and Communications building. Good news: there was an excellent signal from *EUMETSAT's* relay satellite at 10°E, which carries the *EUMETCast* data stream: hence a decision was made to progress this project. From my perspective, the inducement was to have a *EUMETCast* station available to the visiting public and particularly to school groups. However, there was little money available, so GEO called on the goodwill of some of its own members to provide the necessary hardware and software. Eventually, after a number of tests, and moving equipment from one location to another, a working station was established. The contributors to the station were:

- Amberley Radio Club, who provided the dish which was securely located on a mast and gave a strong signal.
- David Simmons G1MAL, who provided the computer.
- GEO, who sponsored the purchase, at a reduced rate, of software from David Taylor GM8ARV.
- The EKU, was provided by David Stickland, an ex GEO member.
- *EUMETSAT*, who made the necessary configuration changes to enable the EKU to access data streams.

David Taylor and I recently revisited the site and checked that everything continued to work. We were greeted by a working system, but with a display which was in need of some adjustments. David made changes to the software to improve the display and make the system easier to use. Because the station is manned by different members of the Amberley's Radio Club, the weather satellite station was made as easy to operate as possible. For the future, I would like to see their *EUMETCast* display monitor in a more prominent position: this was discussed by the Amberley Radio Club for possible action in the near future.

I am very pleased with the outcome of this small project, the prime motivation having been to make *EUMETCast* images available for viewing by the general public, particularly school groups. My thanks to all who have contributed to this project.

If you have the time, and are in the area of the Amberly Museum and Heritage site, it's well worth a visit. You could easily spend a whole day there. For more details, and information about other events held there, visit their web site at

www.amberleymuseum.org.uk

Francis Bell G7CND successfully established a *EUMETCast* station on the steps of the Amberley Museum's Radio and Communication Building.

ESA's Sentinel Satellites

Les Hamilton

The unexpected failure of *Envisat* earlier this year (see page 4) has left ESA with a major problem. Unlike other satellite programs such the *NOAA* and *Metop* series, there is no Envisat-2: none was ever planned. Perhaps the very longevity of *Envisat*, where the satellite's mission was successfully extended beyond twice its design lifetime, may have induced a degree of complacency regarding its eventual replacement. Work had, of course, been progressing on *Envisat's* eventual replacement, the *Sentinel* missions, for a number of years, but the earliest launch is not scheduled before mid 2013.

ESA is in fact developing five new missions under the *Sentinel* umbrella; some of these are satellites in their own right but others simply packages that will share platforms with future *Meteosat Third Generation* and *Metop* satellites. The ESA *Sentinels* will become the first operational satellites to meet the Earth observation needs of the European Union-ESA GMES (Global Monitoring for Environment and Security) programme.

http://www.gmes.info/

The instrumentation that flew aboard *Envisat* will no longer be carried by a single satellite, and the operations will be shared between the *Sentinel* missions as follows:

Sentinel-1	SAR imaging
Sentinel-2	High resolution optical imaging
Sentinel-3	Low resolution optical imaging + Altimetry
Sentinel-4	Atmospheric Monitoring from geostationary orbit
Sentinel-5	Atmospheric Monitoring from low Earth orbit

Sentinel-1

The *Sentinel-1* mission, the *European Radar Observatory*, will consist of a constellation of two polar orbiting satellites devoted to Synthetic Aperture Radar (SAR) applications. These satellites will follow sun-synchronous orbits at an altitude of 693 kilometres with a 12-day repeat cycle. *Sentinel-1* is a C-band radar imaging mission aimed at providing continuity for ERS and *Envisat* data products to be used for operational services. The mission will benefit numerous services, particularly those relating to

- the monitoring of Arctic sea ice extent, including routine sea ice mapping,
- surveillance of the marine environment, including oil-spill monitoring and ship detection for maritime security,
- monitoring land-surface for motion risks,
- mapping for forest, water and soil management,
- mapping to support humanitarian aid and crisis situations.

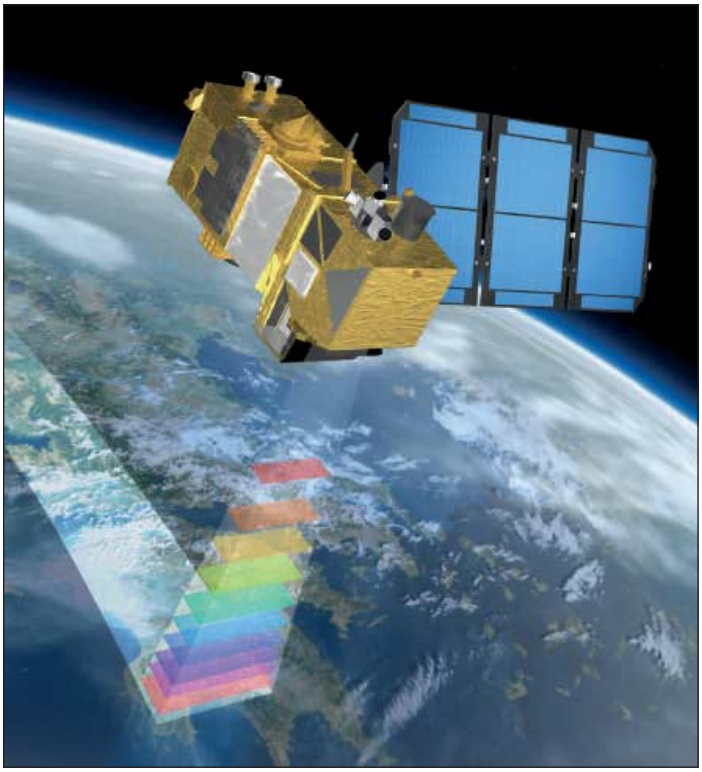
Sentinel-1
Image: P Carril - ESA

The C-band radar is unhindered by cloud and will make continuous all-weather imagery possible by day and night, while the twin satellites will fulfil revist and coverage requirements to provide robust data sets for GMES Services. The first *Sentinel-1* satellite is expected to be launched during 2013, to be followed by its twin in early 2015. *Sentinel-1* will ensure the continuity of C-band SAR data, building on heritage SAR systems established by ESA and Canada with *ERS-1*, *ERS-2*, *Envisat* and *Radarsat*.

The *Sentinel-1* pair is expected to provide coverage over Europe, Canada and major shipping routes over a 1–3 day period, regardless of weather conditions. Radar data will be delivered to end users within an hour of acquisition, a big improvement over current SAR systems. *Sentinel-1* is being realised by an industrial consortium led by *Thales Alenia Space (*Italy) as prime contractor and *Astrium* (Germany) who are responsible for the C-SAR payload, which will incorporates a central radar electronics subsystem developed by *Astrium UK*. *Sentinel-1* will be launched on a *Soyuz* rocket from Europe's Spaceport in French Guiana.

Sentinel-2

Sentinel-2, the optical mission segment of the GMES programme, is also a twin satellite system. From 2013 onwards, the first satellite will circle the Earth in a sun-synchronous polar orbit, fully covering the planet's landmasses every ten days. When the second satellite of the constellation follows it into orbit in 2015, this interval will be reduced to just five days.



Sentinel-2
Image: Astrium GmbH

Sentinel-2 will carry the multispectral instrument (MSI), which will generate wide-swath, high-resolution optical images in 13 spectral channels in both the visible and short-wave infrared ranges, with a swath width of 290 km. *Sentinel-2* is intended to image Earth's landmasses from its 800 km sun-synchronous polar orbit for at least 7 years, thus securing continuity of optical Earth observation as a successor to the *Spot* and *Landsat* satellites currently in operation. This will provide a lasting supply of comprehensive data that will serve as a basis for operational services in:

- land monitoring, providing imagery of vegetation, soil and water cover, inland waterways and coastal areas,
- land cover, usage and change-detection-maps
- creating geophysical variable maps (such as: leaf chlorophyll content, leaf water content, leaf area index)
- forestry,
- fast imaging for disaster control and humanitarian relief programmes.

Sentinel-2 will also be able to observe natural disasters such as floods, volcanic eruptions, subsidence and landslips.

Sentinel-3

The main objectives of the *Sentinel-3* spacecraft are the measurement of sea-surface topography, sea- and land-surface temperature and colour with high-end accuracy and reliability in support of ocean forecasting systems, and for environmental and climate monitoring. The mission will also provide measurements of elements of atmospheric chemistry at high temporal and spatial resolution. The *Sentinel-3* instrumentation includes:

- A Sea and Land Surface Temperature Radiometer (SLSTR) based on *Envisat's* Advanced Along Track Scanning Radiometer (AATSR). This will determine global sea-surface temperatures to an accuracy of better than 0.3°C. The SLSTR improves the along-track-scanning dual-view technique of AATSR and provides advanced atmospheric correction. SLSTR measures in nine spectral channels and two additional bands which are optimised for fire monitoring. The SLSTR has a spatial resolution in the visible and shortwave infrared channels of 500 m, and 1 km in the thermal infrared channels.
- An Ocean and Land Colour Instrument (OLCI) based on heritage from *Envisat's* Medium Resolution Imaging Spectrometer (MERIS). With 21 bands, compared with the 15 of MERIS, the design has been optimised to minimise sun-glint and provide a resolution of 300 metres over all surfaces. OLCI marks a new generation of measurements over the ocean and land.
- A dual-frequency (Ku and C band) advanced Synthetic Aperture Radar Altimeter (SRAL) based on *CryoSat* heritage, which will provide along-track measurements at a resolution of approximately 300 metres in SAR mode. SRAL is supported by a microwave radiometer for atmospheric correction and a DORIS receiver for orbit positioning.

Sentinel-3
Image: J Huart - ESA

The combined topography package will provide exact measurements of sea-surface height, essential for ocean forecasting systems and climate monitoring. SRAL will also provide accurate topography measurements over sea ice, ice sheets, rivers and lakes.

The first *Sentinel-3* satellite is expected to launch into its 815 km sun-synchronous orbit in 2013, eventually to be followed by its twin. The *Sentinel-3* duo will enable a short revisit time of less than two days for OLCI and less than one day for SLSTR at the equator. The satellite orbit provides a 27-day repeat for the topography package.

Near-realtime data will be provided for ocean forecasting, sea-ice charting, and maritime safety services—who require accurate and timely measurements of the state of the ocean surface, including surface temperature, ocean ecosystems, water quality and pollution monitoring.

Land services—to monitor land-use change, forest cover, photosynthetic activity, soil quality and fire detection—will also benefit significantly from *Sentinel-3*.

Sentinel-4 is a payload that will be flown on a *Meteosat Third Generation-Sounder* (MTG-S) satellite in geostationary orbit, provisionally scheduled for launch in 2019. *Sentinel-4* is dedicated to atmospheric monitoring and covers the needs for continuous measurement of the atmosphere's chemistry at high temporal and spatial resolution from geostationary orbit. The main data products will relate to O_3, NO_2, SO_2, formaldehyde (HCHO) and aerosol optical depth. These will be generated hourly to support air quality monitoring and forecast over Europe.

Sentinel-4's UVN instrument is a high resolution spectrometer covering the ultraviolet (305-400 nm), visible (400-500 nm) and near-infrared (750-775 nm) bands. The spatial sampling is 8 km at a spectral resolution ranging between 0.12 nm and 0.5 nm (depending on the band).

Sentinel-5 is a payload that will be flown aboard a *Metop Second Generation* satellite, likely to be launched in 2020. Dedicated to atmospheric monitoring, *Sentinel-5* will increase the frequency of cloud-free observations required for the study of tropospheric variability.

Five years prior to this, a *Sentinel-5 Precursor* mission is expected to launch on an *Astrobus* L 250M space platform from *Astrium* to provide measurements of ozone, NO_2, SO_2, CO and aerosols. This mission is designed to bridge the inevitable gap between NASA's current EOS *Aura* Mission and *Sentinel-5*. The precursor payload is a UV-VIS-NIR-SWIR spectrometer derived through tailoring the *Sentinel-5* specifications to give priority to spectral resolution, coverage, spatial sampling distance, signal-to-noise ratio and only high priority bands.

Acknowledgements and Further Reading

Thanks to ESA, *Astrium* and USGS for making the following illustrated documents available. These proved invaluable in compiling this article, and contain a wealth of further information.

Overview of the Sentinel Programme

http://landsat.usgs.gov/documents/10_Martimort_Sentinel2.pdf

Astrium Sentinel Datasheets

http://www.astrium.eads.net/media/document/sentinel_data_sheet_1.pdf
http://www.astrium.eads.net/media/document/sentinel_2_data_sheet.pdf

ESA Sentinel Datasheets

http://esamultimedia.esa.int/docs/S1-Data_Sheet.pdf
http://esamultimedia.esa.int/docs/S2-Data_Sheet.pdf
http://esamultimedia.esa.int/docs/S3-Data_Sheet.pdf
http://esamultimedia.esa.int/docs/S4-Data_Sheet.pdf
http://esamultimedia.esa.int/docs/S5-prec_Data_Sheet.pdf

MSG-3 Launch

The latest weather satellite in Europe's highly successful Meteosat second-generation series was successfully orbited by an *Ariane 5* rocket on July 5. The launch took place from Europe's Guiana Space Centre in Kourou in French Guiana.

MSG-3 is the third in a series of four satellites which carry the SEVIRI imager, which focuses on Europe and Africa to deliver weather coverage, scanning Earth's surface and atmosphere every 15 minutes in 12 different wavelengths.

It is planned to launch MSG-4 in 2015

GEO VISITS SSTL

Francis Bell

The afternoon of July 8, 2012 was certainly a date to be remembered, both from the perspective of meeting GEO friends and for visiting the UK's latest satellite assembly facility, owned and run by Surrey Satellite Technology Limited (SSTL), a leading UK company in the satellite and Earth observation arena.

SSTL's roots hark back to the days of the amateur radio satellites built and operated by Surrey University. In those early '*Operational Satellite Carrying Amateur Radio*' (OSCAR) days, both the technology of operating in space and the format of the radio signals were in an experimentally stage. In the late 1970s, the orbiting OSCAR 8 satellite ran into unexpected problems and it was the expertise of Surrey University's amateur radio group which led to this satellite being rescued. Shortly afterwards, at short notice, NASA recognised Surrey's achievement and offered to launch one of their satellites as a secondary payload on the launch of the *Solar Mesosphere Explorer* satellite in October, 1981.

The University responded by designing and building a small amateur radio satellite, 74 × 42 × 42 cm, within the six months deadline they were given. *University of Surrey Satellite 1* (UoSAT 1), also designated *OSCAR 9,* proved a great success and operated in space for exactly eight years before its re-entry. UoSAT 1 was followed by UoSAT 2 (OSCAR 11) in 1982. Although well beyond its operational design life, signals from this satellite can still be detected today. It was in fact my personal involvement with the UoSATs and their *Packet Radio* facilities which 'launched' my lifetime interests in Earth observation satellites.

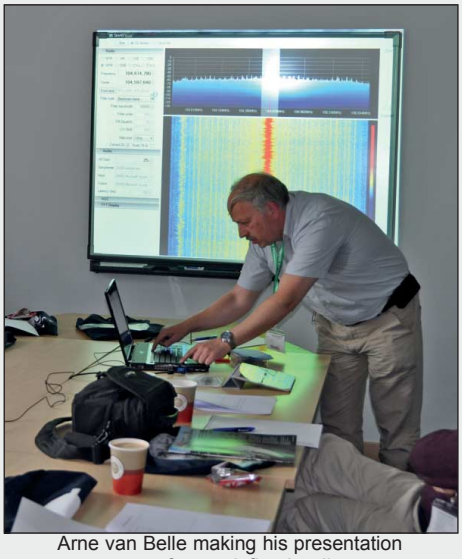
These successes built upon the skills and experiences learned at Surrey University led to the department becoming a commercial business, constructing and operating satellites for others. No longer a mere department within the university, a commercial company, *Surrey Satellite Technology Limited* (SSTL) was born. The facilities necessary to support this rapidly expanding venture demanded a new building next to the university's existing electrical engineering department, and this came to fruition in the 1990s.

Within a mile of Surrey University's campus is a research park where a number of high technology businesses are located. The logical expansion of SSTL has resulted in new facilities, consisting of a satellite

The SSTL satellite assembly building
Photo: David Taylor

The GEO visitors pictured outside the SSTL satellite assembly building
Photo: Baz Omidi

A chance meeting of old friends, Francis Bell (left) and Professor Craig Underwood of Surrey University
Poto: Arne van Belle



Arne van Belle making his presentation on software defined radio
Photo: David Taylor

assembly building with a separate office and administration building, being built in this research park rather than expanding over the university campus. This new assembly building was officially opened last year, and must be the most advanced satellite assembly building in the UK: it was this facility which we had come to see.

The Visit

SSTL were very flexible and hospitable with our visit, which was split between their large meeting room and a tour of the adjacent satellite assembly building. There were twelve GEO members present which, for a weekday afternoon visit, was close to what had been expected.

Our afternoon commenced at 1.30 pm, in the meeting room, when we enjoyed a presentation relating to radio receivers and software defined radio from Arne van Belle of the Dutch *Werkgroep Kunstmanen*. Personally, I was on a sharp learning curve with this subject area as I have never used software define radio, but I have subsequently attended a lecture on the subject. Familiarising myself with this subject is a personal project for the coming year. I did not fully understand all Arne presented to us but his message seemed to be that the future of radio reception will become ever more reliant on sophisticated software rather than hardware.

Next came a 30-minute illustrated talk from Ian Stotesbury of SSTL, detailing the company's history and business rationale. He also presented examples of SSTL's current and past satellite programmes, and we were all impressed by the quality of imagery produced by SSTL's satellites. I asked if it were possible to receive such images directly at home but was gently reminded that these are commercial images and, unless published by SSTL, they are not generally accessible to user groups such as GEO.

GEO members who are interested in SSTL are strongly advised to visit their website, which comprehensively covers all aspect of their business and also reflects the close ties which still exist between SSTL and Surrey University.

www.sstl.co.uk

An illustrated summary of Ian Stotesbury's talk appears on page 26.

The Assembly Building Tour

Although I had no particular expectation of the Satellite Assembly building, this did not prevent me from being surprised by the scale of the main assembly room. The two-story frontage of the building consisted of distinct rooms where we saw component modules for satellites being assembled by hand. We could not enter these 'clean' rooms because of the potential contamination we might have introduced. However, large windows allowed us to view the activities within each room. Throughout the tour, guides Ian Stotesbury and Jordi Barrera-Aars explained which satellite modules were being constructed and tested.

From the viewing area on the second level, the main assembly hall could be seen stretching from one end of the building to the other, three stories tall and filled with satellites under construction. A photograph of the hall can be seen on page 26. On enquiring why such a high and spacious hall was needed, our guides explained that this was needed not only for construction but also for manoeuvring fully built satellites. For example, a three metre tall satellite would need to be lifted vertically to place it into a container, which could require headroom of up to six metres. Additional space for manoeuvring and room for lifting equipment in the roof results in a very tall assembly hall. At the time of our visit some six or eight satellites were under construction, some of them *Galileo* satellites for the European Uniln's satellite navigation programme. Security meant that we could not take photographs inside the assembly building but there are some photographs on SSTL's web site at

www.sstl.co.uk/media-gallery/images

showing the inside of the assembly building and some example satellite images. SSTL have made an archive of some fifty of their images and photographs available for download at

https://dl.dropbox.com/u/84436143/SSTL%20Gallery.zip

Back in the meeting room I thanked Ian and Jordi for their time, their skilful presentation and for the fascinating tour of their assembly building.

GEO Group Photo

Those pictured in the group photograph opposite are, left to right:

Arne van Belle, Donald Martin, David Taylor, John Green, Baz Omidi, Francis Bream, Vaughan Cherry, John Tellick, Francis Bell, David Bland, Paul le Feurve, David Anderson.

Continued from page 3

Future Events

September 28-29, 2012

The RSGB and Lincoln Short Wave Club are hosting the *National HamFest* on the Newark showground. This is a large two-day event and GEO will be present on both days with a stand demonstrating live weather satellite reception. For more details go to

www.nationalhamfest.org.uk

October 16-18, 2012

The second *Meteorological Technology World Expo* in Brussels, Belgium. Entry is free if you preregister. For more details see

www.MeterologicalTechnologyWorldExpo.com

November 11, 2012

The busy *West London Radio and Electronic Show* takes place at Kempton. GEO will have a stand demonstrating live weather satellite reception. GEO will also be giving a public presentation on the subject of amateur reception of Earth observation and weather satellites. For more details go to

www.radiofairs.co.uk

Tornadoes hit Poland

On July 15, a wave of unusually powerful tornadoes ripped through northern Poland, wrecking houses, uprooting trees and downing power lines. Ten people were injured and thee was a single fatality, a 60-year-old man who was crushed to death when his summer cottage collapsed.

Some 1,200 rescuers worked to remove fallen trees, unblock roads and restore utilities in the hardest hit Baltic region of Pomerania.

There was a miraculous survival by a family of three when their caravan was sent flying through the air with them still inside it. Although the caravan smashed into pieces upon landing, none of its occupants suffered serious injury.

Missing Quarterly?

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

Contact Details

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35 Sycamore Road,
East Leake, Loughborough LE12 6PP
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Telephone - 01509 820 067
Fax - 01509 559 015
email: members@geo-web.org.uk

Algal Blooms

Francis Bell

Like all other members of the Envi-Ham project I was desperately disappointed with the loss of *Envisat's* downlink signals in early April 2012. Reports about the loss of the satellite will have appeared elsewhere so I will not dwell on the details here. However, there was a tiny mitigation in the disappointment because, instead of the fresh daily satellite images, the Envi-Ham project did continue—by sending previously unreleased archived *Envisat* images until May 1, when the project closed. During these three weeks it was not known whether *Envisat* could be recovered but it gave a buffer at least to keep part of the programme running.

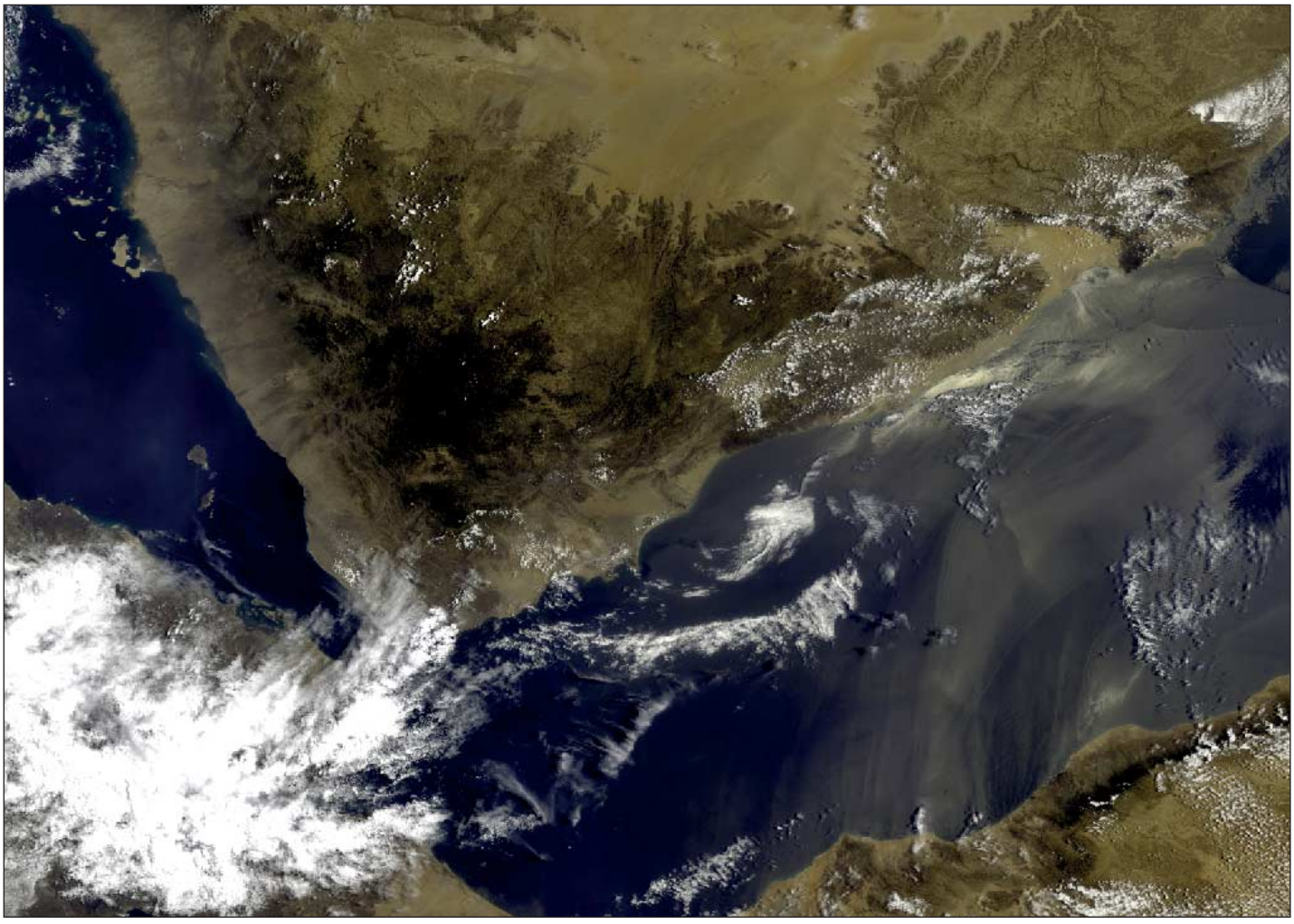
During this period, I received two images which attracted my attention. One showed the Gulf of Oman and a dust storm being blown over the sea; the other was of southern Spain, showing the coastal areas adjacent to the Atlantic Ocean and the Mediterranean Sea which, I thought, showed the presence of marine algal blooms.

I speculated that the two processes—dust being blown over the sea and marine algal blooms—might be related. In order for algal growth to take place via photosynthesis, not only must there be light, water and carbon dioxide present but also other minerals, albeit in trace amounts. If these minerals are not present, there will be no algal growth no matter how favourable other factors may be. I felt that dust blown over the sea and then washed out by rain might be like adding a marine fertiliser, hence stimulating algal growth. The terrestrial analogy here would be a farmer adding fertiliser to a crop to stimulate its growth.

As a slight digression here I may mention that the UK sometimes experiences Saharan dust. This can be readily recognised by bright red dust deposited on light coloured cars and other light surfaces. This dust is transported by the same air stream which occasionally brings locusts to the UK: although not necessarily at the same time as the dust.

As an undergraduate at university, I spent one of my years studying oceanography. In those days, a branch of the UK *National Oceanographic Centre* was located just few miles from home. I took advantage of this and not only progressed my academic studies but, on a number of occasions, was able to visit the land-based research facilities of our National Centre with its practical studies.

Unfortunately, the Centre has been relocated from my area of Surrey to Southampton where it is co-located with Southampton University. However, to progress my interest in the two *Envisat* images I had received, I contacted the Centre and asked about



This false colour *Envisat* image, originally acquired at 07:10 UT on August 29, 2010, shows dust being blown over the Gulf of Oman.
Image: ESA

This Envisat image dating from 10:33 UT on November 2, 2010 shows southern Spain and Gibraltar with what appears to be an algal bloom off Spain's Atlantic coastline.
Image: ESA

A sad sight, Francis Bell's Envi-Ham dish put out to grass.

any connections between dust storms over the sea and algal blooms. As a result of my enquiries I was contacted by Jason Hopkins, a PhD research student at the Centre who is researching the dynamics of marine phytoplankton production. As a result of our discussions, Jason agreed to write the article that appears on page 31 of this issue. Jason wrote:

'I would be happy to write something about my PhD thesis which is looking at the dynamics of phytoplankton called coccolithophores. These form highly reflective patches across large areas of the ocean that can only be viewed by satellite and create some quite beautiful true colour images.

'Your images certainly look interesting. There is a variety of literature that appears to show a connection between iron input to the surface ocean (perhaps from aeolian dust) and phytoplankton blooms in certain areas of the global ocean. It's difficult to confirm whether the variation in ocean colour in the image at the top of this page is indeed an algal bloom without some type of sea truthing, or looking at the chlorophyll product from the same time-frame—as we often see a variation in ocean colour around the coasts from coloured dissolved organic matter which can be mistaken for a bloom in 'true' colour images.'

For readers who have issue No 2 of GEO Quarterly, you can find an article (pages 25 - 28) that I wrote which touches on marine phytoplankton production and its role in the carbon cycle. The article is illustrated by some electron micrographs of coccolithophores and foraminifera which are small marine algal cells.

Footnote

If, like the author, you are now the proud owner of a defunct Envi-Ham dish, there is a happier note. With just half a degree of rotation, these dishs can deliver a massive *EUMETCast* signal: so they have a future.

Venus Solar Transit observed in Vietnam

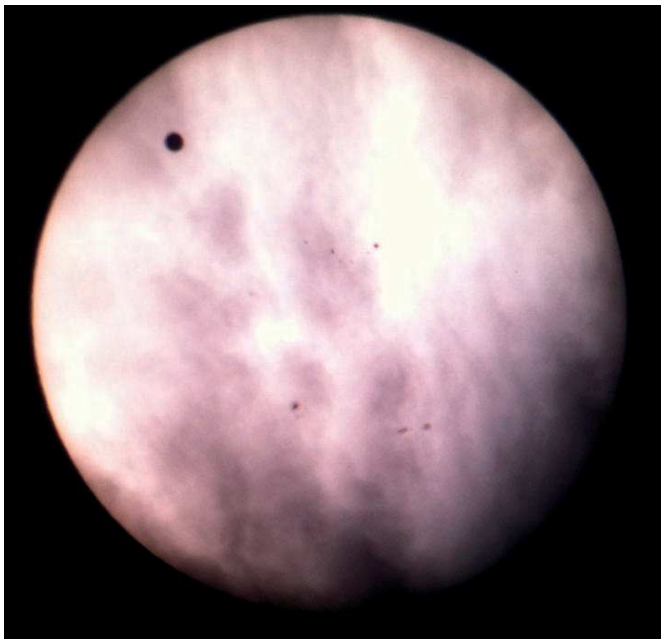
Fred van den Bosch

While the June 6 transit of Venus across the face of the sun was obscured by cloud across almost the entire UK, Fred van den Bosch, now living in Vietnam, was more fortunate.

Fred used a 25-inch Newtonian telescope with a *Hyperion* zoom lens. A layer of *Baader* sunfoil placed over the end of the tube made it safe to view the sun directly. Fred takes up the story:

"Here sunrise was 5:17, but it was cloudy. Around 6:30 the sun appeared behind the clouds and I was able to make the first photo. The second was made around 9:15 and shortly after that it completely clouded over. "I made the photos with my *iPhone* by holding it close to the eyepiece. A lot of trial and error was involved because even slight movement of the iPhone—as when pressing the shutter—tended to throw the image off-screen; so I took lots of photos, and just a few turned out more or less OK.

"Back in Holland, the weather was very bad. Just a few people in the very north of Groningen saw a bit of the transit. Eight die-hards drove more than 500 kilometres overnight to Travemunde on Germany's Baltic coast, where they were rewarded with great views."



Return to Usingen

Francis Bell

Most GEO members will know that the Head Quarters of *EUMETSAT* are located in Darmstadt, Germany. The HQ building accommodates administration and satellite operations together with data services and storage. However, the main radio dishes—which are in direct communication with EUMETSAT's geostationary satellites—are located at Usingen, about 50 km away.

EUMETSAT HQ

In the early days of European weather satellite operations, the administration was based within the European Space Operations Centre (ESOC) in Darmstadt. Back in the 1980s, with the success and growth of their weather satellite undertakings, it was determined that *EUMETSAT* needed their own purpose-designed building: accordingly, their new headquarters were built just 2 kilometres from ESOC in Darmstadt, and *EUMETSAT* staff occupied their new premises in 1994. Since the opening of their new HQ, *EUMETSAT* has continued to expand, and a large new technical operations centre built adjacent to their HQ, was opened in May 2012. It will be fully commissioned in due course. Even with their new building, the HQ is still located on a crowded Darmstadt site with restricted space for massive satellite dishes. Consequently, the ground station for linking directly with their satellites remains in Usingen.

Usingen

Usingen, located about 30 km north of Frankfurt, is an ancient town with a history going back at least 1500 years. Some of the town's medieval buildings are to be found in its picturesque centre but the satellite communications facility, with its associated collection of very large dishes, is located about 2 km farther west. This satellite site occupies an old WW2 airfield with no urban or industrial buildings nearby, at an altitude of about 400 metres, thus giving a good all-round view of the sky. The area has stable geology and provides plenty of room for deploying several hundred satellite dishes.

The site is run by *Media Broadcast GmbH* which, I believe, is a subsidiary of *T-Systems* who are based in Frankfurt.

I have visited the Usingen site twice, in 2007 and 2011, on each occasion

This radio tower provides microwave links between the ground station and MCC in Darmstadt

with a visiting GEO party. During our 2011 visit, we were given VIP treatment by our hosts, *Media Broadcast*. I did gently ask them if all visitors were given such treatment and was flattered to be told that, because we were *EUMETSAT* guests, we were special, hence the red carpet treatment. My thanks at this point to Harriet Locke of *EUMETSAT* who organised the visit for us, and to *Media Broadcast* for allowing us access to their high-technology and security-sensitive site.

Our visit in 2011 lasted a full morning, during which we were given a presentation by three *Media Broadcast* staff followed by a comprehensive tour of the site. I'm not sure how many satellites, with their multitude of transponders, were being controlled from this site, but I suspect that many satellites and hundreds, perhaps thousands, of TV and data channels were being processed. During our tour we visited the two giant *EUMETSAT* dishes and their control room, located in a small building at the bottom of one of the dishes. From their size it's tempting to think these dishes remain in a fixed position but, as I was standing next to one dish, it moved several times on its circular rails. I hadn't quite realised how accurately these so called geostationary satellites are continuously tracked.

The *EUMETSAT* dishes and their control equipment had a small number of staff on duty while we were visiting, but I understand that the operations can be controlled remotely from Darmstadt and perhaps elsewhere. The site tour was so interesting, with much to see, we could have spent more time there. But we had to depart for a pressing engagement in Darmstadt for a scheduled visit to the European Space Operations Centre (ESOC), so we had to thank our hosts and leave with just time enough to make it to ESOC. In the back of my mind I was so pleased to have seen for myself the ground station which handles all the *EUMETCast* data I receive at home on a daily basis.

Later I asked EUMETSAT to briefly comment on their communication links with Usingen. This is the response I received from one of their technical staff.

"The Primary Ground Station supporting the Meteosat Second Generation(MSG) satellites is in Usingen, Germany, about 30 km north of Frankfurt. This ground station is the main channel of communications between the Mission Control Centre (MCC) and the Meteosat Second Generation (MSG) satellites.

"The ground station at Usingen is usually unmanned and can be remotely monitored and controlled from the MCC in Darmstadt.

"The prime transmission channel between the MCC and the Primary Ground Station (PGS) is a 34 Mbit microwave link with a terrestrial-based back-up link. These links support all traffic to and from the PGS, including image data; Telemetry, Tracking and Command (TT&C), and disseminated data. To reliably accomplish these vital tasks a considerable amount of redundancy is incorporated in the station design, hence its ability to function completely automatically most of the time."

EUMETSAT's near circular HQ building In Darmstadt can be seen near the centre of this aerial photograph.
Image: GoogleEarth

This aerial photograph shows the Usingen satellite dishes, with the white, square-shaped operations building in the centre of the view.
Image: GoogleEarth

The old mediaeval centre of Usingen, viewed from a coach window.

The visiting GEO party inside Media Broadcast's visitor centre.

Outside the Visitor Centre.

One of the EUMETSAT dishes with its control room at the base.

A collection of small dishes on the roof of the operations building.

A group photo of the visiting GEO party.

GEO at Kempton

April 2012

GEO paid it's twelfth visit to the *West London Radio and Electronics Show* at Kempton last April which, with the exception of the annual *National Radio HamFest* at the Newark showground, must be one of the best attended rallies which overlaps with the interest areas of GEO members. Our stand was well place in the exhibition area, in a location more or less dictated by our needs to access mains electricity and feed coax to our stand to support live satellite reception.

We ran live *EUMETCast* signals on one computer and displayed slide shows of Envisat and APT images on two laptops. You have to be well organised to set all this up in about an hour. Securing the position and direction of the dish on the roof is critical for signal acquisition, and David Simmons aligned our 60 cm dish with the aid of his signal meter.

The day was busy with visitors to our GEO stand, all showing a genuine interest in our display. Some GEO memberships were renewed and several new members joined on the day. Interestingly, it has been reported back to me that there is a small but encouraging peak of new membership applications following these shows, so the time and effort devoted to establishing and manning a stand may be judged worthwhile from this perspective. However, it must be recognised that

The GEO stand at a quiet moment during a busy day. David Simmons can be seen talking to a visitor about our faulty USB lead.

running a show stand is a major commitment of time and effort by those involved.

On the technical side it was 'first' for taking my new *Technisat EUMETCast* receiver to a show. This is a receiver I purchased in addition to the DVBWorld box that I have been using for several years and I'm pleased to report that it performed perfectly in its new temporary surroundings. A photograph showing the two receivers appears on page 3.

However, we did suffer one technical glitch when, unaccountably, we experienced intermittent loss of the *EUMETCast* signal. A knowledgeable visitor to the stand suggested that there was a problem with our USB2 lead and kindly bought a replacement from a nearby stand. Once fitted to our equipment, the problem disappeared. I suspect that continued handling of the original lead had resulted in its damage. We thanked our unnamed visitor for his expertise and kindness in providing this new lead.

I think GEO's presence at the show was appreciated by the organiser because I have been asked to make a presentation about GEO's activities, and amateur satellite reception in particular, at the next Kempton show, to which I have agreed. Please note the date in your diary: Sunday November 11, 2012.

Finally, my thanks to David Simmons, who manned the stand with me and looked after the *EUMETCast* live reception.

Cover and Full Page Images

Front Cover

This vision of Earth is a composite image created from data acquired during fifteen passes made by the *Suomi-NPP* satellite on May 26 this year. You can read more about this in the article '*View from the Top'* on page 34.

Image by Norman Kuring, NASA/GSFC/Suomi NPP

Inside Front Cover

David Taylor sent in this amazing NOAA-19 AVHRR image showing the UK and western Europe basking in hot sunshine on May 25, 2012, as an anticyclone kept cloud fronts at bay.

Image © EUMETSAT 2012

Inside Back Cover (upper image)

Top: An Envisat MERIS image dating from August 31, 2011 sent to us by Mike Stevens, showing the Canary Islands.

Image: ESA

Inside Back Cover (lower image)

This Meteosat-9 image from Mike Stevens highlights thunderstorms moving through central France towards England at 13:00 UT on June 21.

Image © EUMETSAT 2012

Back Cover

On July 21, 2012, the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) on NASA' s *Terra* satellite captured this image of an ice island, newly calved from Greenland's Peterman glacier. You can read a report on this significant Arctic melting event on page 25 of this issue.

NASA Earth Observatory image by Jesse Allen and Robert Simmon, using data from NASA/GSFC/METI/ERSDAC/JAROS and the U.S./Japan ASTER Science Team.

Page 32

This is a composite from two *Terra* MODIS image segments acquired on May 22, 2010, showing a prominent algal bloom off southwest Ireland.

Image: NASA/GSFC, Rapid Response Team

Page 35

This Metop-A AVHRR channel-2 image acquired on June 1 this year shows the island of Greenland with a swarm of icebergs and brash ice streaming southwards along much of its eastern coastline. Also prominent are Iceland, with its icecaps sparkling in the sunshine, and, to its north, Jan Mayen Island.

Image: NOAA CLASS Archive

Antarctic Mystery

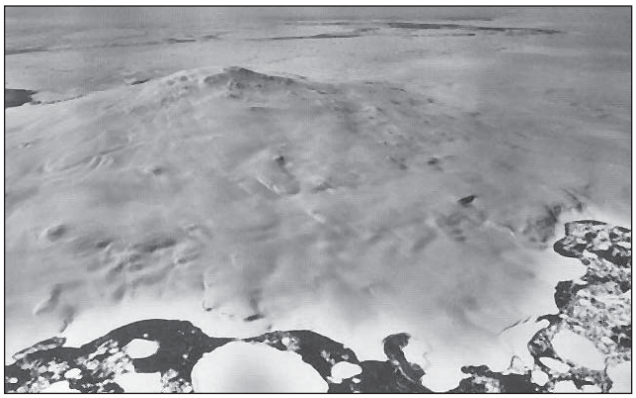
Has Mount Siple erupted recently?

Les Hamilton

Mark Drapes recently reported on the *GEO-Subscribers* forum that Metop-A images of the Antarctic on June 20 appeared to show a plume of steam venting from Mount Siple, a 3110 metre shield volcano just off the coast of Marie Byrd Land in Antarctica (73°26' S, 126°40' W). The volcano has a bulk similar to Mount Erebus, and has a summit caldera measuring 4 × 5 kilometres. The mountain is named after Paul Siple (1908–68), an American explorer and geographer who visited Antarctica six times. The plume is also noted on the *Volcano Discovery* website at

http://www.volcanodiscovery.com/siple/news.html

The Metop-A image below, dating from 12:36 UT on June 20, provides an exceptionally fine view of the Antarctic peninsula. The plume described above is clearly visible as a comet-like artefact, near the foot of the image on its left hand side. Mark interpreted the image as indicating that the volcano was about -22°C, about 6° warmer that the surrounding landscape, while the base of the plume was at about -55°C. Images showing the plume in greater detail can be seen on page 16.



Aerial view of Mount Siple taken in 1958
Photo: US Navy/Wikimedia

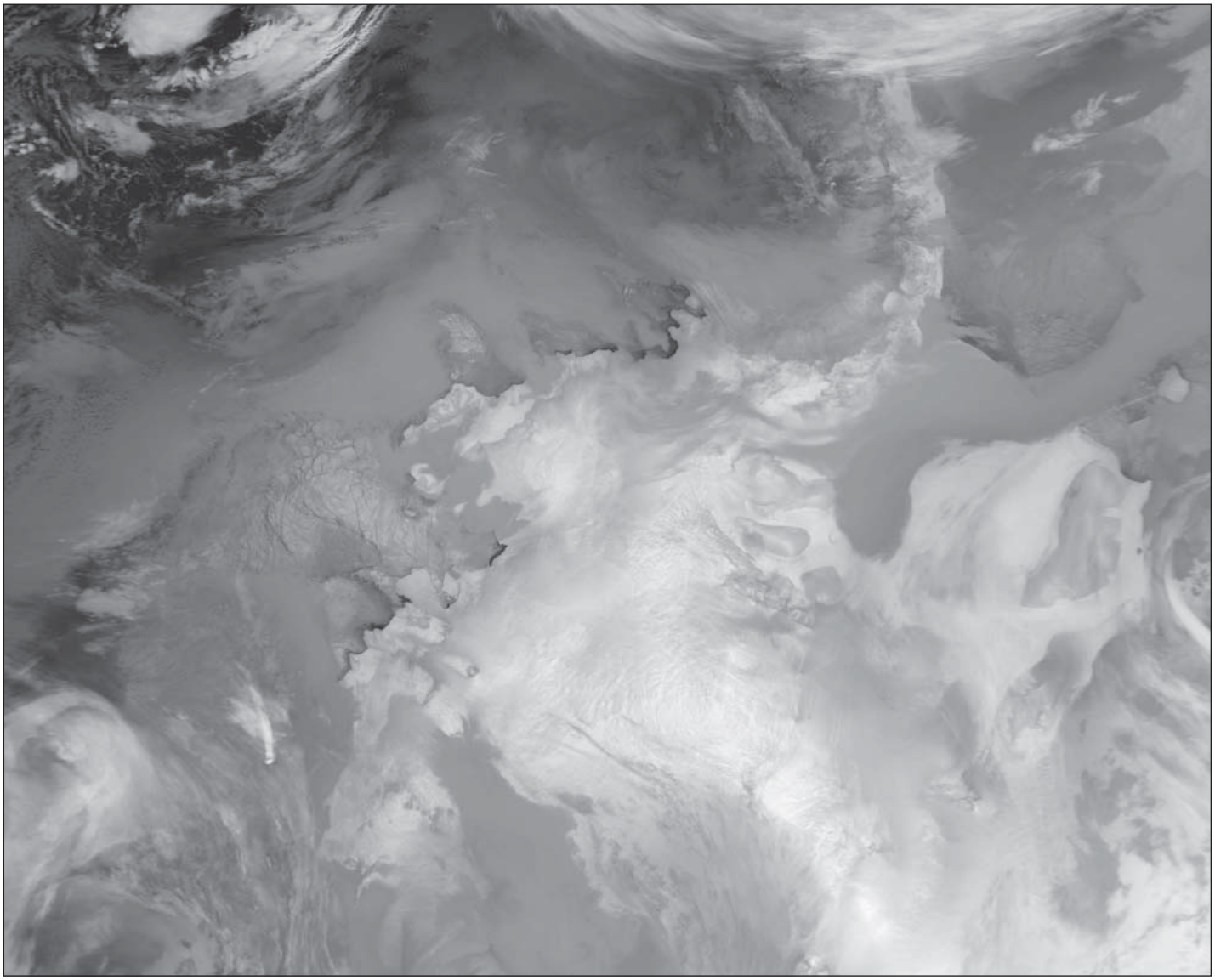


Figure 4 - This channel-5 AVHRR image was acquired during the 12:26 UT Metop-A pass over Antarctica on June 20, 2012.
Image: NOAA Class Archive

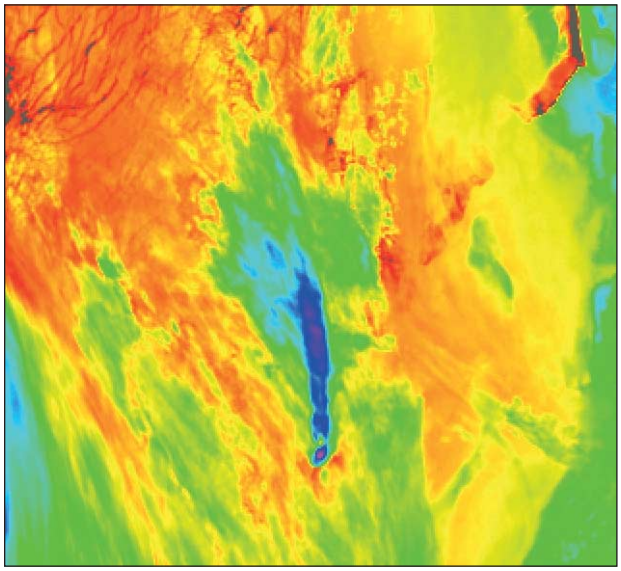


Figure 1 - Temperature profile of the Mount Siple plume

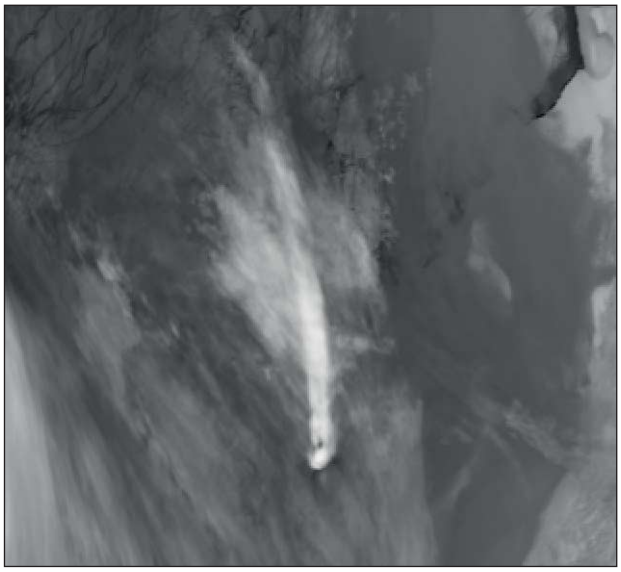


Figure 2 - Metop channel-5 image of the Mount Siple plume

Figure 1 is an enlargement of the region surrounding the plume as revealed by the 'temperature' tab of David Taylor's *HRPT Reader* software, which shows it, coloured blue, at around -50°C, significantly colder than its surroundings, which register in the range -25° to -30°. Figure 2 is the same scene, as revealed by the channel-5 sensor aboard Metop-A.

ESA Bulletin No 150 Review

Francis Bell

Although I have reviewed ESA's Bulletin before, the most recent issue, May 2012, deserves a special mention because it's the 150th issue of this publication. Celebration of this milestone resulted in a special issue of the Bulletin, with 96 pages of reports and high quality colour photographs, some of which are in 3D, taken in space: a pair of glasses to view these photographs is included. The content of the Bulletin is worth reading from cover to cover. The celebration cover of the 150th Bulletin shows how the publication has evolved over the years.

There is a foreword by Jean-Jacques Dordain which gives a perspective on the rationale behind this regular publication which started in 1975.

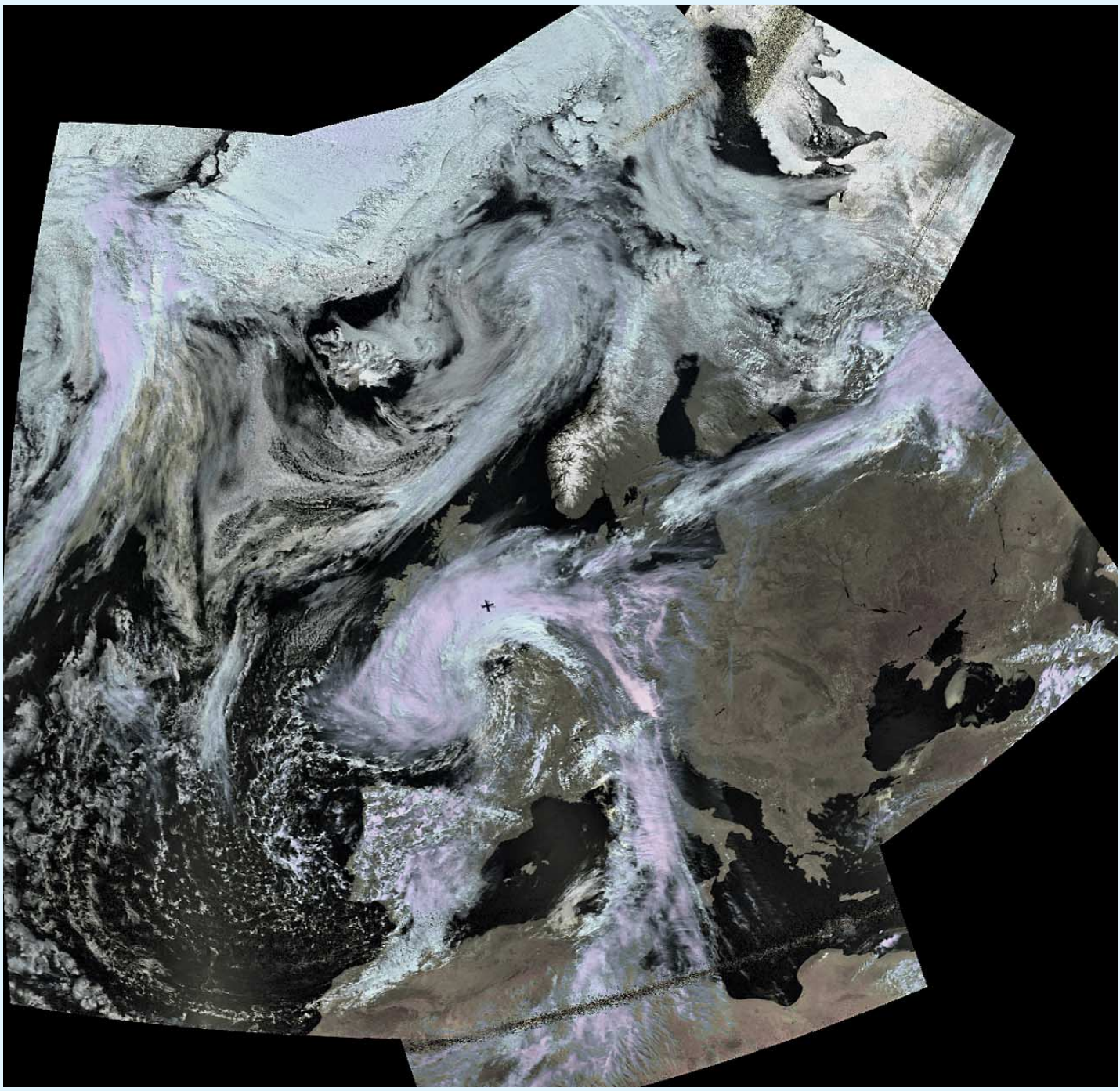
'*The Bulletin is a window on the universe: it portrays ESA's activities almost day by day and it exists because of the ESA specialists whose written contributions reach out to the international space community of decision-makers, industry, academics, students and the space-interested general public. As well as a wide range of in-depth articles on various disciplines, from space science to telecommunications, from satellite navigation to earth observation, from launchers to human space flight, from operations to technology, every issue provides an overview of ESA's ongoing programmes and is a useful tool to keep abreast of the status of major space projects within ESA*'.

I remind those who read this review that the ESA Bulletin is available free of charge if you apply to be included on the distribution mailing list. If you don't action this point then that's your loss.

To receive a regular copy, write to Distrimail, Postbus 122, 2370 AC Roelofarendsveen, The Netherlands, and ask to be put on their regular mailing list. Or email to *info@distrimail.nl* making a clear concise request to be placed on the ESA Bulletin mailing list: remember, this is a mailing company dealing with many customers, not just ESA, so be brief and specific with your request. Also give the reason for your request: perhaps a single word may cover your request: research, personal, education or other. This will enable ESA to know who is receiving their publication.

Composite Imagery with WxToImg

Rob Denton G4YRZ



Rob Denton demonstrated the versatility of the *WXtoImg* software when he created this HVC composite image on April 29, 2012.

Rob writes:

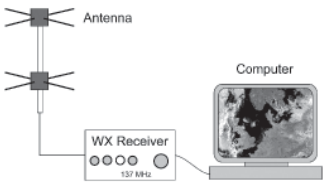
'This image made using WXtoImg capturing only four northbound, daytime passes from NOAA-19. The program does everything automatically once you have decided which palette selection(s) you require. It's amazing what can be obtained on simple equipment. I used just a Dartcom System II VHF receiver and a *Wimo* sloping crossed dipole antenna—with no added extras. Even though I'm now in a location further east than my previous home in Worksop, I have managed to image further west. The image was captured at my new home which is at the Windmill in *North Leverton with Habblesthorpe*, the longest village name in England. No wonder the locals simply call it 'Leverton'. By the way, I'm living off-grid—no mains gas or electricity here: my power is produced by a generator and batteries. It's such fun but a lot harder and more expensive having to buy diesel for the generator and bottled gas. I hope eventually to write an article describing my new life at Windmill Cottage. The windmill will be 200 years old next year, a cause for great celebrations. It's still fully functional.

'This just shows that APT can be received anywhere.

'This particular image captured the severe storms that caused flash flooding in much of the UK. Surprisingly, the rain didn't seem to attenuate the signals on 137.100 MHz, allowing a clear image of what was happening despite the torrential downpours at the time. The local River Trent (2 km away), burst its banks, resulting in flooding to low-lying areas.'

An introduction to APT Weather Satellite Reception

Part 2 - Capture and Display using WXtoImg



Ron Hahn

In my last article [1], I gave an overview of the hardware and software required to successfully receive APT images. Here I will go more in-depth into the software setup, operations and some potential problems to be looking out for.

For the last several years, I have been using *WxToImg* as my automatic solution to receiving APT weather images. This software supports the fully automatic recording, decoding, editing, and viewing of received images. It offers so many options that the newcomer may be overwhelmed by the choices. It runs on all modern versions of Windows (*XP*, *Vista*, and *Windows 7*), as well as on *Mac OSX* and *Linux*. My installation runs on *Windows XP*, so I will be concentrating on the setup for that platform.

As I mentioned in my previous article, there are a few prerequisites that are required for successful operation of a fully automatic weather station. A stable operating system, accurate time, a computer-controllable receiver, and a software suite capable of unattended operation. So, I have my *Intel Atom* PC, running *Windows XP*, *NTP* (network time protocol) provided by my local network, the excellent *R2ZX* receiver (available from the GEO shop) and *WXtoImg* software.

Although the freeware version of *WXtoImg* offers useful options, I recommend purchase of a license to unlock its full potential. There are two levels for this: *Standard Edition* at €47.95 and the Professional Edition at €69.95. Most of the basic features are the same between the latter two version but the Professional Edition includes extras like an on-image temperature scale, additional contrast and filter controls, selectable resampling algorithms and a commercial license. I have the Professional Edition and will focus on it for this article. The software is available from

http://www.wxtoimg.com/downloads

and the *Windows* package is approximately 8.5 MB in size. When you purchase the license, the author both emails and posts a paper copy of the license key. Also included in the envelope is a set of 3D glasses for viewing the stereoscopic images, a nice touch.

To get the program up and running, you need to input your license key, and your receiving station's latitude, longitude and altitude. The program only accepts decimal values for latitude and longitude so, if your GPS or other position source uses degrees, minutes, and seconds, you will have to convert these. I have found a useful on-line converter at

http://transition.fcc.gov/mb/audio/bickel/DDDMMSS-decimal.html

It is essential to have the correct position of the station or all position-based calculations, such as pass start and end times, will be incorrect. I used my *Garmin* GPS reading and converted it to decimal using the above link.

When the program is started, it first asks for the station location. In my situation, I entered my city (Rosslare Strand), country (Ireland), latitude (52.25), longitude (-6.23), and altitude (29 m) in their respective boxes, and pressed 'OK'.

When this is completed, the program opens up a calibration dialogue explaining all the steps. First step: setting the ground station location (done in the previous paragraph). Second step: update the Keplers. This is easily done by going to the main *WXtoImg* menu and selecting **File→Update Keplers.** Third step: adjusting the volume. This requires patience because you have to be actually receiving a satellite signal to set this. The audio tones from the satellite are sent from the receiver to the computer soundcard as an audio signal, and must be at the correct level to be decoded properly by the software. Too little signal and the images lack contrast, too much signal and the soundcard is overloaded and the images are terrible. So setting the correct input level for the soundcard is exceptionally important. The *WXtoImg* page explains this exactly:

> 'Set the volume control on the receiver to a low to moderate level, then select **Mixer Control** from the **File** menu. Configure the mixer to take input from the source the receiver is plugged into (normally the Line In). Set the Line level at about the mid-point. It's better for the volume and line levels to be too low than too high to start with'.

Select **Record** from the **File** menu, and click on **Auto Record**.

Wait for a satellite to arrive. *WXtoImg* will indicate when the satellite is expected (in UTC) and on what frequency the satellite is transmitting in the status bar. *WXtoImg* will record the pass, during which an image should be shown. Do not be concerned with the brightness or darkness of the image, or other problems, such as it slanting across the screen. When setting the volume, never use this image as a guide—use only the volume setting discussed below. After recording is complete, *WXtoImg* will build a map and decode the image again to produce the best possible results.

Avoid using the scrollbars to scroll the image while a recording is taking place as this can cause the resulting image to be split.

The program volume (vol) will be displayed while the signal is being recorded. If a satellite is passing overhead, and the status line indicates that the program is still waiting for a signal, this can mean that the receiver volume is too low or that the mixer input level may be set too low. Slowly increase either or both until the status line indicates that the signal is being recorded. The volume on the receiver (or the recording level on the mixer) can then be easily adjusted during the pass to set a volume between 50.0 and 75.0. If the receiver has no volume control or the volume control does not affect the speaker output, then adjust the mixer settings (recording or input line level) until the displayed volume is between about 50.0 and 75.0. The volume bar should be green when a signal is being received: red or yellow indicates the volume is too high or too low, as shown in figure 4.

At this stage it is important to check that the pass has sufficient signal. Signals from a satellite at low elevation will not fully 'quiet' the satellite receiver and produce a false volume input setting. I always listen to the pass during this process to ensure that no noise is present on the signal before I make any volume adjustment.

The image will be re-decoded after the satellite has passed, and when this is complete the overall volume will be shown on the right hand side of the status line below the image. The overall volume should be between about 40.0 and 85.0. Higher numeric values of volume (e.g. 90.2) indicate that the volume should be decreased, lower numeric values of vol (e.g. 24.7) indicate that the volume should be increased.

My current receiving station indicates a volume level of 79.5 on the most recent pass, which is well into the green category. If I set the volume too high, clipping occurs and detail is lost in the white areas

of the image. If I set the volume too low, detail is lost throughout the image, which turns out dark. Except for this calibration, I found there is no need to adjust the volume when the satellite is passing overhead. Adjusting the volume during a pass produces bands in the final image and adversely affects the temperature calibration.

Once this calibration is completed I found that only some small adjustment was required on a subsequent pass. I have not touched it since.

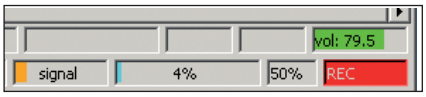


Figure 1 - Satellite Volume Level

In figure 1, the input volume is set to 79,5, the received signal is low at this point in the pass, and the pass is 4% complete.

A problem that I discovered when I was first setting this up was images slanting across the screen. My current reception computer, based on an *Asus Atom D525* (AT5NM10-I) motherboard, experienced this problem but my previous reception computer (an *IBM Thinkpad T41*) did not. So I had to perform a 'slant correction' to overcome this problem with the sound card.

Image Slant Correction

Start by selecting **Disable PLL** from the **Options menu**, which allows you to properly set the sampling rate. Next, select a recording to decode. Select **Open Audio File** from the **File menu**, and choose a recording, preferably one from a satellite making a high overhead pass for best results. Wait for the image to be decoded and displayed; it will appear bent slightly from top to bottom as a result of the Doppler shift, which is normal when the PLL is disabled.

Select **Slant Correction...** from the **Image menu**. Scroll to the top of the image and click on a vertical edge in the image. Continue holding the mouse button down and drag it down this edge, allowing the image to scroll, until you reach the bottom of the image, then release the button. A dialogue box will now pop up and display the suggested sampling rate. *WXtoImg* can estimate the sampling rates for all other satellites. Select the **Estimate** and **Set sampling frequencies for all satellites** option if it is not already selected, then click on **Set**. Deselect **Disable PLL** from the **Options menu**. The image will be decoded again and this time should be completely straight. If it is bent or jagged, ensure you have deselected **Disable PLL**. If it is still slanted, repeat the process, paying close attention to following the image margin down the screen.

While options are supposed to be saved on exit, I ensured that the sampling frequencies were saved by selecting **Save Options** from the **Options menu**. If the license key hasn't been installed, now would be a good time to do that, before regular reception is started.

Now that the calibration and slant correction is complete the software is ready to start receiving pictures. Go to **File→Record**, and make sure **Record and auto process** is ticked. Once this is done press the **Auto Record** button and wait for the next pass, which will be indicated on the lower left hand corner of the screen (figure 2).

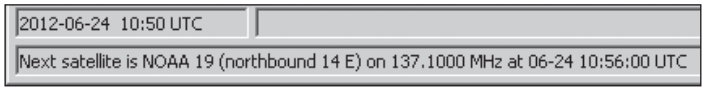


Figure 2 - Waiting for a Satellite

Remember that all times shown in *WXtoImg* are in UTC in order to avoid confusion about daylight time or time zones.

If all goes well, I will see the following change once reception of the satellite has commenced (figure 3).

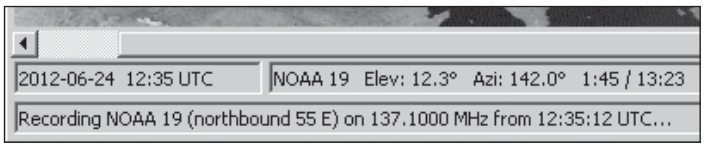


Figure 3 - Waiting for a Satellite

Figure 5 on the following page shows a full screen shot of this reception in progress. As you can see, the reception is 52% through the NOAA 19 pass at this stage. Everything about the reception is shown on the display in real time: the date, time, satellite name, elevation, azimuth, volume level and pass start time, so that the operator can see exactly what is going on.

When the reception is finished, the program will store the data as an audio file on disk (as a WAV file in *Windows*) then start the automatic processing. This takes several minutes with an *Atom* CPU but a CPU with greater processing power will take less time. But the *Atom* works fine for me and has no CPU fan to fail from continuous operation. Once the processing is finished, the program waits for the next satellite pass to occur.

Further Processing

There are many, many processing and post-processing options in *WXtoImg* and I will now focus on some those that I use.

Under **Options→Active APT Satellites**, I have NOAA 19 ticked as priority No 1, NOAA 18 as priority No 2 and NOAA 15 ticked as priority No 3. I have unticked NOAA 17 because this satellite no longer produces images.

Under **Options→Recording Options**, I use the settings in figure 4.

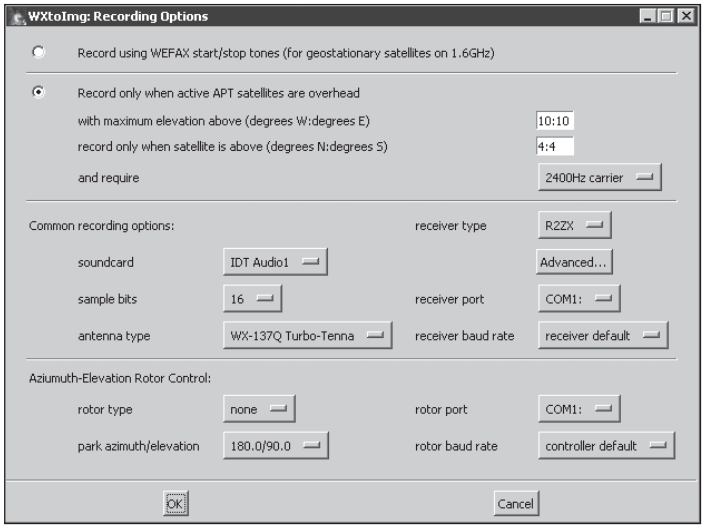


Figure 4 - WXtoIMG Recording Options

In my setup, I have made several changes from the defaults. First, as my reception station is located on a peninsula with excellent exposure on both north-south and east-west directions, I have chosen to start recording when the satellite is at least 10° elevation (N/S) and 4° (E/W). I make use of the NOAA 2400 Hz carrier frequency, so do not depend on a guess to start recording. The common recording options are specific to my equipment, and the azimuth-elevation rotor control is not used. For example, your soundcard will show up as something else if you don't have an IDT soundcard built into your receiving computer. If you are not getting any images when the satellite comes overhead then maybe you have not set the sound card properly. I have made this mistake.

Now is a good time to focus on the **Options→Auto Processing Options**. I found this section the most difficult to understand. So I go to **Options→Auto Processing Options** and tick **Create image(s)**, then select the **Image Settings** button. I have the following **Record Image Settings** selected:

- Normal
- Pristine
- Contrast enhance (NOAA ch A only)
- Contrast enhance (NOAA ch B only)
- MCIR map colour IR
- MSA multispectral analysis MSA with precipitation
- HVCT false colour
- HVCT with precipitation NO colour IR enhancement

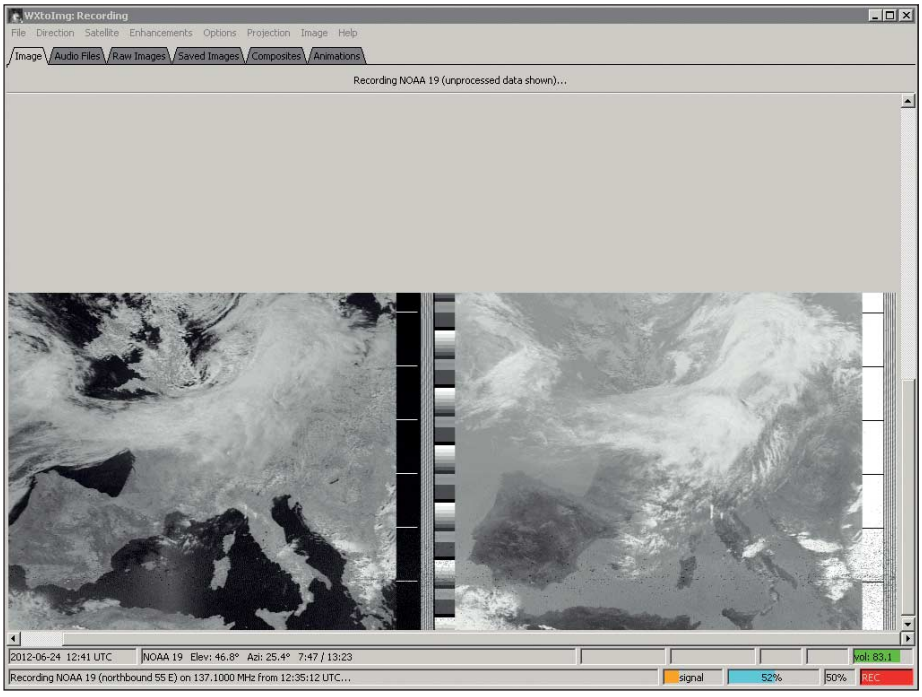


Figure 5 - Recording a NOAA-19 pass

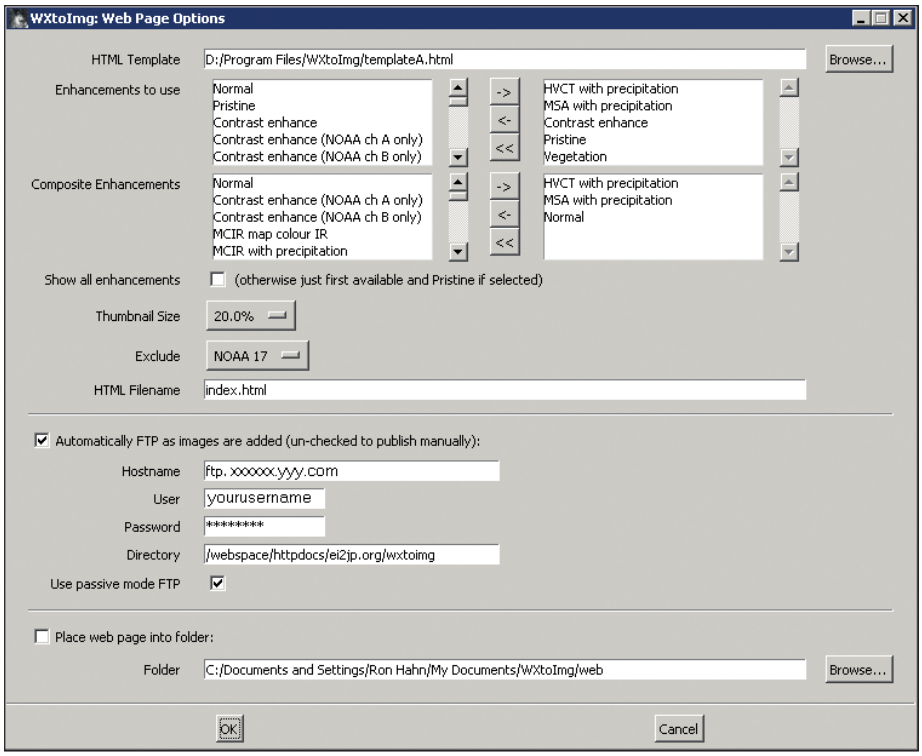


Figure 6 - The Webpage Options

Enhancement	Use
MSA	Multispectral Analysis enhancement (used for daytime passes). The visible and IR channels are combined to produce a false-colour image.
MCIR	Map Coloured IR enhancement (used for nighttime passes).
MSA-precip	MultiSpectral Analysis enhancement with coloured estimated precipitation (used with daytime passes).
HVC	False Colour, with or without precipitation.
HVCT	An enhanced false color image for daytime passes (with and without precipitation) SEA and SEA-Day - Sea temperature (day or night). With this enhancement, thin clouds will alter the imagery, giving artificial readings.
ANAGLYPH	3D presentation of clouds (like the 3D movies, you need 3D glasses to see this).
VEG	Vegetation Index.

Table 1 - Some of the WXtoImg Enhancements

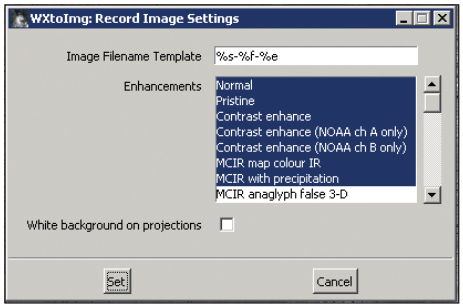


Figure 7 - Record Image Settings Pane

The reader is reminded that not all of these options are available at all times: it depends on the specific satellite sensors in use during a pass. At night time, an enhancement that depends on the visible channel will not be available, for example. Figure 7 shows the panel where you select the images you wish to be processed.

The more enhancements you select, the longer it will take to complete the post-processing after an image is received and decoded. I find that it takes about 15 minutes to do all the post-processing of the image with my *Atom* CPU. As the post-processing is done you will see the processed images displayed on the screen as the work is completed. When it is all finished you can then go to the **Saved Images tab** on the menu bar to view them.

Image Processing

WXtoImg provides so many options for image processing that it is hard to know what will be the most pleasing to the eye. The ideal images, of course, would show where the cloud is, country outlines and maybe where the precipitation bearing clouds are. *WXtoImg* achieves all this automatically if it is set up to do so.

First of all, keep remembering that accurate time is very important for all of these things to come out properly. So, make sure that the *Meinberg NTP* software

http://www.meinberg.de/english/sw/ntp.htm

is installed and working properly. If the local PC clock is inaccurate, the country outlines will be displaced and this will cause a big headache later. David Taylor has done much good work about timekeeping in his web pages at

http://satsignal.eu/ntp/index.html

The *WXtoImg* site gives good examples of all the types of enhancements that the software can provide, at

http://wxtoimg.com/pics/

The main types of enhancements are listed in Table 1 opposite.

It is hard to find detailed information on these enhancements on the Internet but I have found that

http://tiete.be/jo/Noaa/NoaaLast.htm

has some of the best explanations, and some really good imagery too. In the end, I chose the enhancements that most appealed to me.

Continued on page 30

Swirling Winds

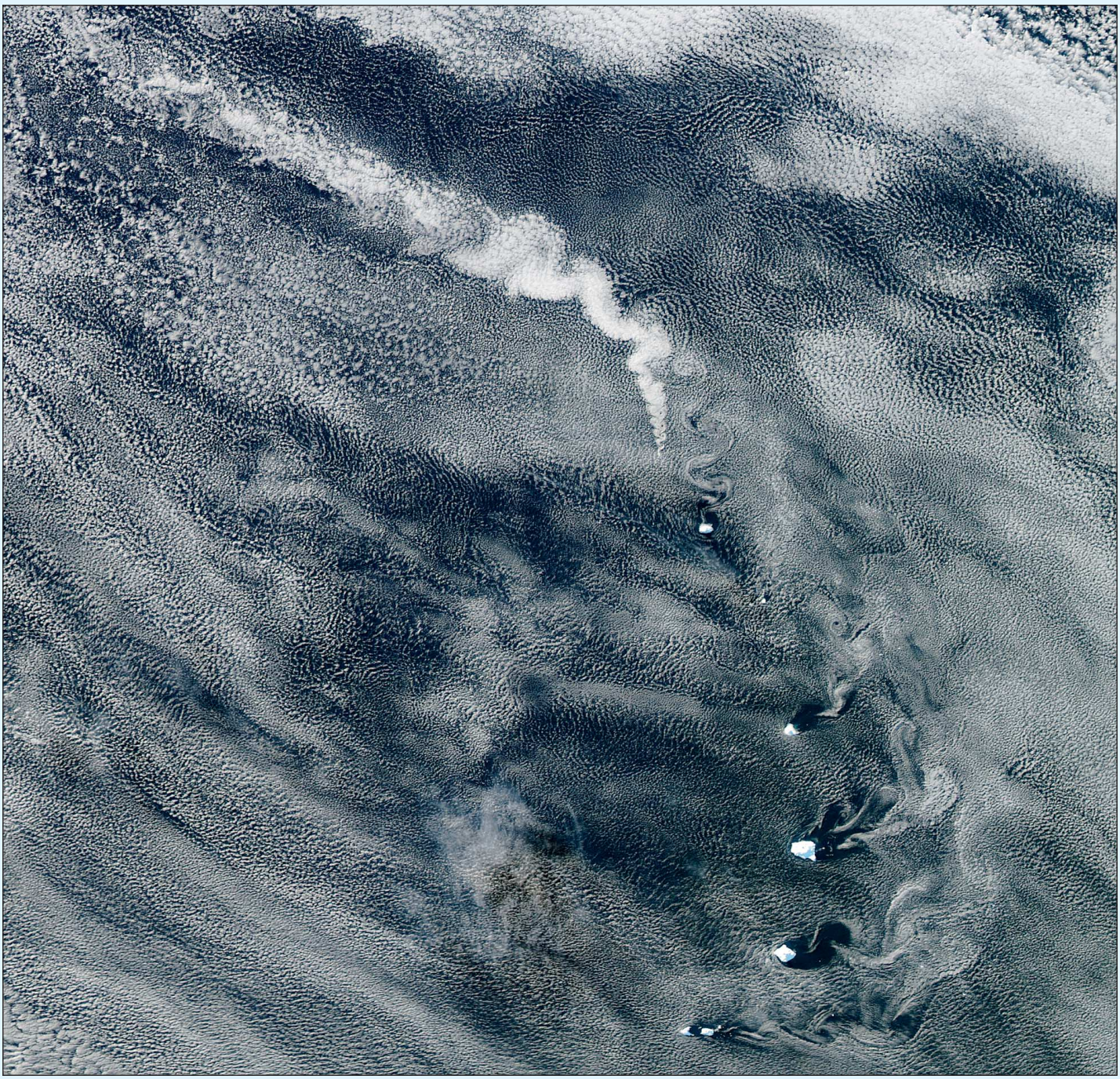
A NASA Earth Observatory Report

Zavodovski Island, just five miles wide, uninhabited and the northernmost of the volcanic South Sandwich Islands in the far South Atlantic, is one of the remotest places on the planet. Dominated by Mount Curry volcano, this tiny island can do compelling things to the sky around it, as this natural-colour MODIS image acquired from NASA's *Aqua* satellite on April 27, 2012 shows: an interplay between low-level volcanic emissions, clouds, islands and winds.

Mount Curry is known to emit steady streams of gases and aerosols—tiny solid and liquid particles. Aerosols are important in the formation of clouds, as they provide the nuclei around which water molecules accumulate to form droplets, and ultimately clouds.
In the case of Zavodovski Island, sulphate aerosols from the simmering volcano seed clouds in the air masses passing over the island. Note how the plume stretching north is brighter than the surrounding clouds, a result of the small aerosol particle size and the numerous small water droplets that form around them. The smaller droplets provide more surfaces to reflect light.

To the southeast, **Visokoi Island** is also disturbing the atmosphere. It's not clear whether gas and aerosols were being emitted from Hodson Volcano, or if the interesting cloud vortices are being created by topography. Like ships streaming through water, islands can create wakes in the cloud patterns above them. Visokoi rises to 1005 metres above sea level and, as prevailing sea winds push past, the jut of the island into those low-level marine clouds alters the flow of winds and air masses enough to affect their shape.

NASA image by Robert Simmon, based on data provided by Jeff Schmaltz, LANCE MODIS Rapid Response



Koksaray Reservoir

Les Hamilton

In the June *GEO Quarterly* I included brief mention of the Koksaray Reservoir in the article: *Syr Darya Control and Northern Aral Sea Project* [1]. By the most amazing coincidence, just as your magazines were being distributed, Ukraine's *Sich-2* satellite transmitted the superb 8 metre per pixel image of the Koksaray Reservoir, reproduced opposite.

For years, there has been friction between Kazahstan and Kyrgyzstan over the latter nation's use of water for hydro-electricity generation. Over the years, Kyrgyzstan constructed numerous dams and reservoirs in the upper reaches of the Syr Darya river and its tributaries to store the water needed to operate their hydro-electric power stations.

January and February, the coldest months of winter, create the highest demand for electricity, and this is when the volume of water released from the reservoirs is at its maximum. The outpouring of this water is discarded back into the Syr Darya, significantly increasing the river's flow. A major consequence of this was annual flooding lower down the Syr Darya in southern Kazakhstan, where the terrain flattens and the river meanders across an extensive flood plain between the Shardara reservoir and the Aral Sea.

The Shardara reservoir measures 70 × 20 kilometres, is 6.5 metres deep and has a capacity of 5.5 cubic kilometres of water. It was constructed in 1966, in part to buffer the Syr Darya's winter surges, but also to provide water for irrigation during the summer. It also includes a 100 MW hydro-electric plant to provide energy to Kazakhstan. But as Kyrgystan's demands for electricity have mounted in recent times, the Shardarya reservoir has proved unable to adequately contain

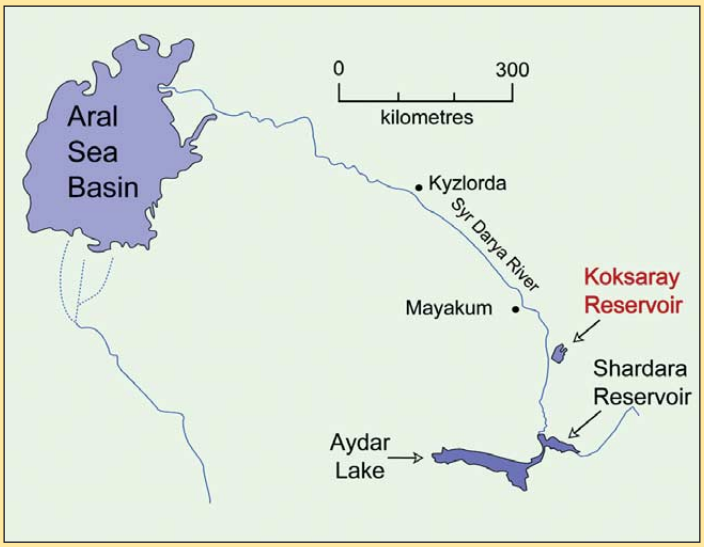


Figure 1 - A map showing the location of the Koksaray reservoir in relation to the Aral Sea, Syr Darya and Shardara reservoir.

Figure 2 - The Syr Darya on June 12, 2009, with no sign of the reservoir
Image: NASA/GSFC Rapid Response Team

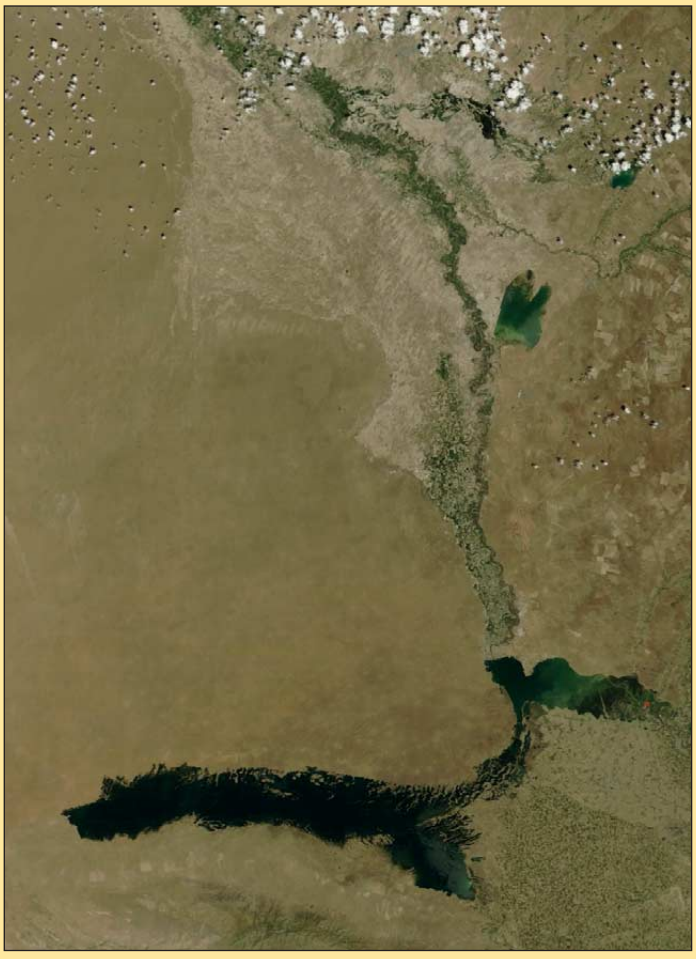


Figure 3 - The Syr Darya on June 2, 2012, the reservoir now filled with water
Image: NASA/GSFC Rapid Response Team

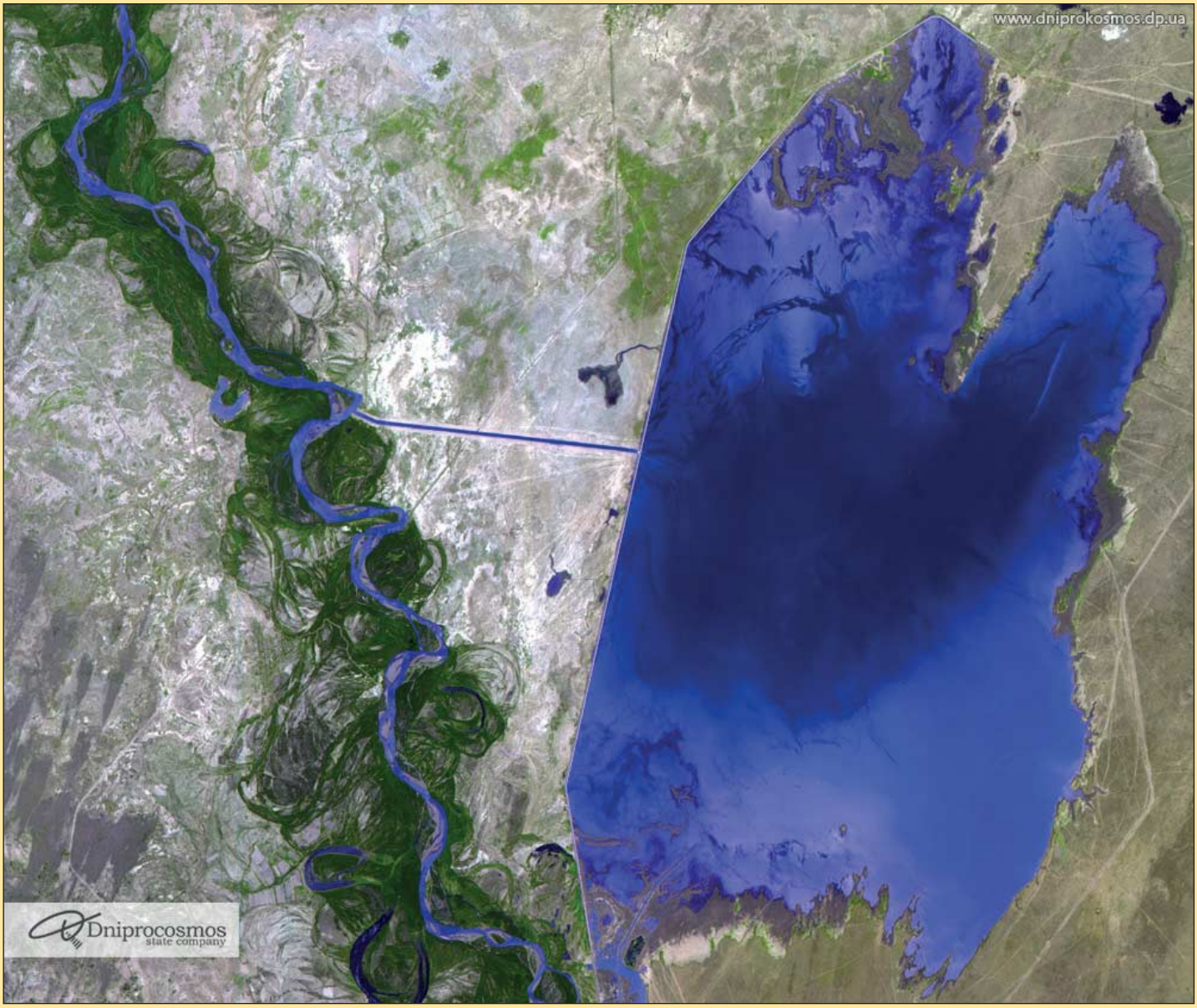


Figure 4 - The Koksaray Reservoir, still well filled with winter floodwater, on June 2, 2012.
Image: Dniprokosmos (www.dniprokosmos.dp.ua)

the floodwaters, and Kazakhstan's winter floods had become a chronic problem. Two factors conspired to create this scenario.

The main culprit was Kyrgystan's Toktogul reservoir, at 215 metres high by 292 metres long, the largest in central Asia (figure 6). It was built in the mid 1970s, backing up behind the dam as a lake 65 kilometres long and up to 120 metres deep, capable of holding 18 km^3 of water. As a result of the massive outflow of water from the Toktogul hydro-electric station there have been floods along the lower Syr Darya every winter in recent decades.

The second factor is the extremely shallow gradient of the Syr Darya below Shardara. Over the 1200 kilometre stretch of the river between the reservoir and the Aral Sea, the level drops through a mere 250 metres: from 291 metres above sea level where the Syr Darya leaves the Shardara reservoir to 46 metres a.s.l. when it reaches the North Aral Sea. That's a mean drop of only twenty or so centimetres per kilometre. Little wonder then, that the Syr Darya flows sluggishly along a highly meandering course and that widespread annual flooding has been such an ever-present problem. The *Sich-2* image (figure 4) shows the looping meanders of the Syr Darya as it flows past the Koksaray reservoir.

Matters really came to a head in the spring of 2008 when the worst flooding since 1969 destroyed more than three million homes and cost Kazakhstan the equivalent of at least $US130 million. This disaster finally led Kazakhstan to embark on a major project to counter this flooding: and thus was conceived the plan to construct a new reservoir lower down the Syr Darya, just south of the village of Koksaray. This would hold excess water from the Shardara reservoir and protect a population of some 400,000 people who live on the river's flood plain.

Koksaray Reservoir

The Koksaray reservoir was constructed in little over two years, commencing in 2008 as a high-priority project. During that time, 7500 workers built a 44.7 kilometre long retaining dam 7.7 metres high and 8 metres wide at its crest, to contain the water (figures 7, 8). The mammoth project utilised 5.5 million cubic metres of earth and 74 000 cubic metres of concrete capping. The speed at which the work was accomplished can be appreciated from the two *Terra* MODIS images opposite. Figure 2 dates from June 2009 when the project was less than a year old, and shows little sign of the reservoir, although there is evidence of construction work: specifically, what appear to be the retaining dam and the outflow channel that would eventually return water to the Syr

Darya. Figure 3, acquired on June 2 this year, clearly shows the new reservoir, now filled with water collected during the February/March floods.

Termed the *Koksaray Counter Regulator*—because it was conceived to counter excess flow from the Shardara reservoir and regulate the flow-rate of the river—the reservoir started storing water on a trial basis in February of 2010, even before work on it was complete. Over a billion cubic metres of floodwater (a cubic kilometre of water) were abstracted that spring. Construction was finally completed in December 2011, allowing the storage up to three cubic kilometres of floodwater from the Syr Darya. This water is channelled into the reservoir along a flume 16 km long, capable of a flow-rate of 500 cubic meters per second. When the time comes to return water to the river, this is done via a 10.2 km canal, seen on the left of figure 4, also capable of delivering 500 cubic metres of water per second [2].

The main aim of the Koksaray reservoir was to create a facility for storing excess winter runoff from the Syr Darya, and it first came into full operation in early 2011, proving its worth by providing complete flood protection to scores of villages in southern Kazakhstan. For the first time in ten years, residents of some 70 towns and villages along the flood plain from southern Kazakhstan to Kyzylorda experienced a spring without the fear of flooding to their homes and fields.

Figure 5 - The first uptake of water passes through the flood control dam of the Koksaray Reservoir in 2010
Photo: Tengri News

The high-resolution colour image (figure 4) shows the Koksaray Reservoir as was on June 2, 2012. The location of the reservoir is shown in the map on page 22, over a thousand kilometres up the Syr Darya from the Aral Sea and 160 km north of the Shardara reservoir.

Irrigation

Of course, the Koksaray Counter Regulator was not designed solely to protect villages from floods. It was also devised to manage the region's annual flood-drought cycle by providing water for crop irrigation during the summers. During the irrigation season, the contents of the Shardara reservoir had rarely been sufficient to provide for the needs of the hundreds of hectares of cultivated fields in southern Kazakhstan and the region around Kyzlorda. Now, Koksaray can release additional water to help irrigate rice fields at Kyzylorda, as well as some 135 000 hectares on which to grow fruit and vegetables.

In tandem with the preexisting Shardara reservoir, a total of eight cubic kilometres of water can now be retained during winter and spring to augment the Syr Darya when its level drops during the summer. And of course, it is also an important part of the plan to refill the North Aral Sea.

Figure 6 - The Toktogul Dam in Kyrgystan
Image: Heinerbischkek / Wikimedia

Figure 7 - Construction of the Koksaray Dam in October 2010
Photo: Kazakhstan Ministry of Emergencies Press Service

Figure 8 - The Crest of the Koksaray Dam
Photo: Kazakhstan Ministry of Emergencies Press Service

In the past, Kazakhstan had to negotiate with its neighbours to release water for summer irrigation; now they have their own supply. And in the summer of 2011, the water released for irrigation from Koksaray was instrumental in ensuring a record rice harvest in the farmlands around Kyzylorda.

Continued on page 34

Huge Ice Island

Calves from Greenland's Petermann Glacier

A NASA Earth Observatory Report

The Petermann Glacier grinds and slides toward the sea along the northwestern coast of Greenland, terminating in a giant floating ice tongue. Like other glaciers that end at the ocean, the Petermannn periodically calves icebergs, and a massive ice island broke from it in August 2010.

Now, nearly two years later, another large section of its floating ice tongue has calved into the Petermann Fiord, fracturing along a rift that was first identified in 2001, and which had been visible in satellite imagery for several years.

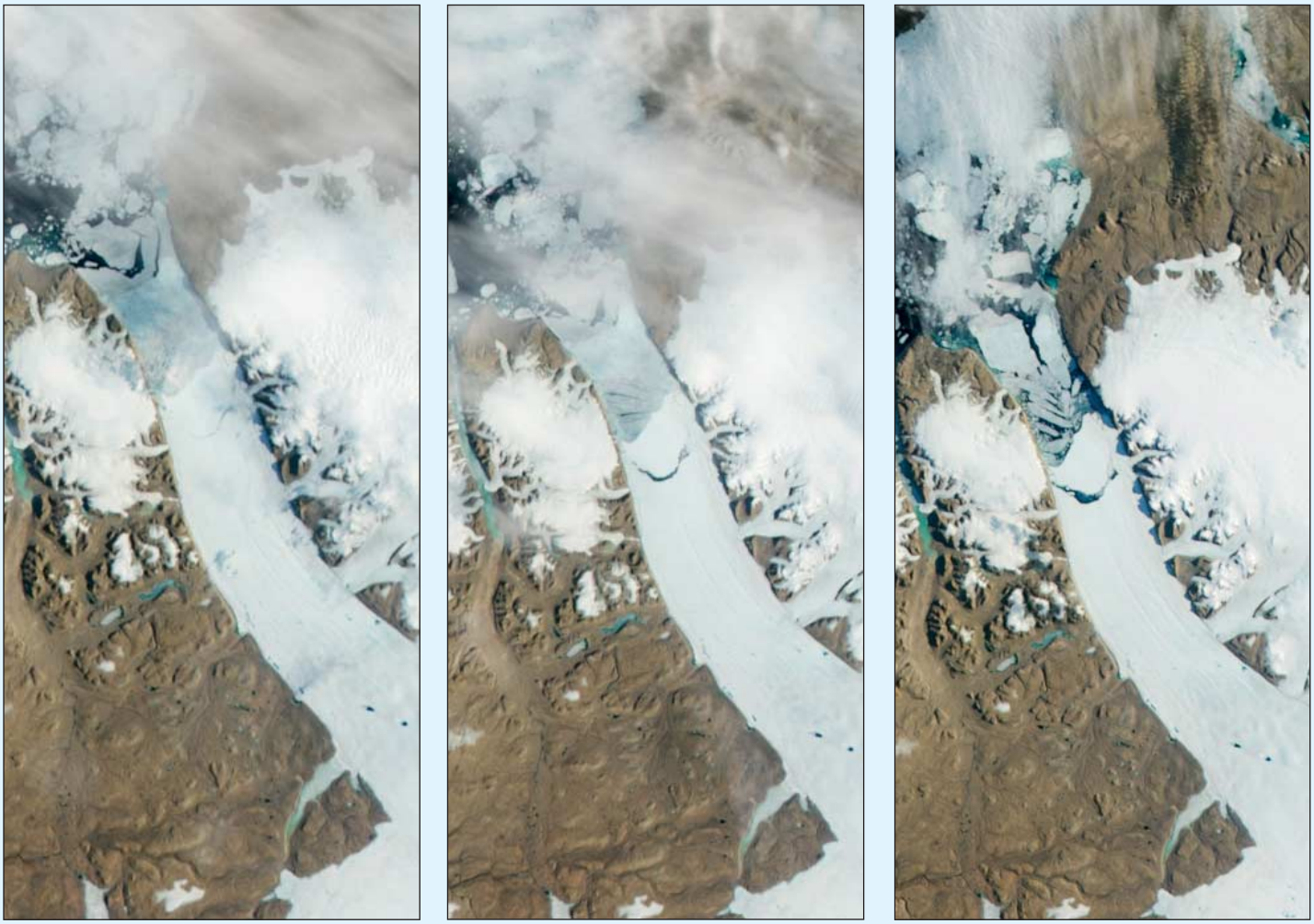
The Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's *Aqua* satellite observed the calving at 10:25 UT on July 16, 2012. At this point the iceberg was still close to the glacier, but by noon that day it had already started drifting northward down the fjord towards Nares Strait. The area of the original ice island was estimated to be approximately 130 km^2, approximately half the size of the one that calved in 2010. Ice islands from this glacier drift southwards into Baffin Bay, and occasionally reach well down the Labrador coast, sometimes reaching Newfoundland, where they pose a hazard to shipping and navigation.

One day later, at 09:30 UT, *Aqua* spied a larger opening between the glacier and the iceberg, as well as some breakup of the thinner, downstream ice. The current iceberg broke from the glacier tongue farther upstream than in the 2010 event, as a result of which the Petermann Glacier has now retreated farther back the farthest yet recorded.

In the days that followed, the ice island started rotating and disintegrating, and when imaged by the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) aboard NASA's *Terra* satellite on July 21, the iceberg had an area of 32.3 km^2. This image is reproduced on the back cover..

ASTER combines infrared, red, and green wavelengths of light to make false-colour images that help to distinguish between water and land. Water shows as blue, ice and snow vary in colour between pale blue and white, while land areas appear brown. Clouds in the scene cast dark shadows on to the iceberg surface.

NASA Earth Observatory images on this page by Jesse Allen, using data from the Land Atmosphere Near real-time Capability for EOS (LANCE). Instrument:



Aqua MODIS images showing the ice island at image centre: left at 10:25 UT on July 12, centre at 12:00 UT on July 12 and right at 09:30 UT on July 13.

SSTL - Changing the Economics of Space

Ian Stotesbury (SSTL)

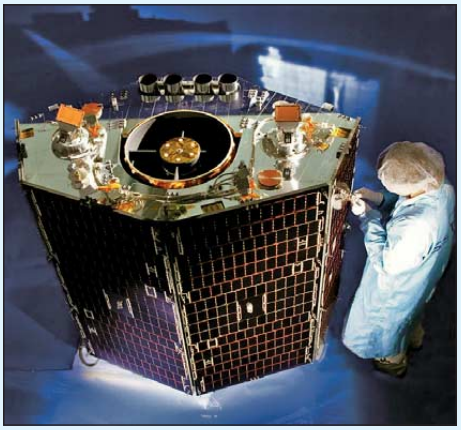
Surrey Satellite Technology Limited (SSTL) is the world's leading small satellite company, delivering operational space missions for a range of applications including Earth observation, science and communications. The company designs, manufactures and operates high performance satellites and ground systems for a fraction of the price normally associated with space missions, with over 400 staff working on turnkey satellite platforms, space-proven satellite subsystems and optical instruments.

Since 1981 SSTL has built and launched 36 satellites—as well as providing training and development programmes, consultancy services, and mission studies for ESA, NASA , international governments and commercial customers, with its innovative approach that is changing the economics of space.

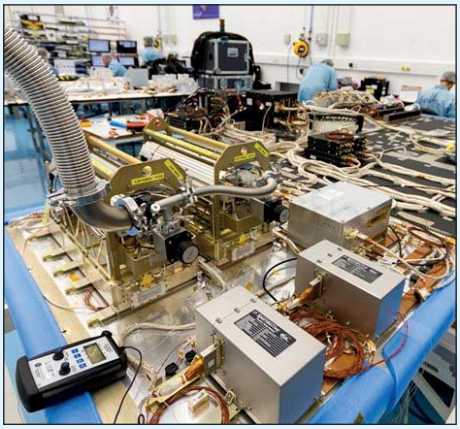
The SSTL satellite assenbly hall, pictured shortly after its opening in July 2011
Credit: SSTL

SSTL focuses on small satellites (from approximately 7 kg up to 600 kg) sold at a firm fixed price and with short production time, typically 18 to 24 months. SSTL has experience as mission prime for 30 satellite missions with a combined flight time of over 200 years. The highest performance Earth Observation satellite for SSTL currently in orbit, *NigeriaSat-2*, has a resolution of 2.5 metres and was launched in 2011 for NASRDA. By nature of a proven heritage evolution of products, the *NigeriaSat-2* design is being developed into SSTL's next generation, state of the art, satellite design—a constellation of three satellites each capable of 1-metre, high-resolution imagery.

SSTL was also selected by ESA to supply 22 navigation payloads for the deployment phase of the *Galileo* satellite navigation system. SSTL is teamed with OHB–System of Bremen, Germany, for the provision of these fully operational Galileo satellites. The two companies agreed to work together as a 'core team' on Galileo at the end of 2007, with OHB taking the role of prime contractor and builder of the spacecraft 'bus' and SSTL taking full responsibility for the navigation payloads aboard the satellite that will form the heart of the *Galileo* navigation system. Galileo is Europe's own Global Navigation Satellite System (GNSS), providing real-time positioning, navigation and timing services with unrivalled accuracy and integrity. It will be interoperable with the American GPS system and Russia's GLONASS system.



NigeriaSat-2
(SSTL-300 platform)
Credit: SSTL



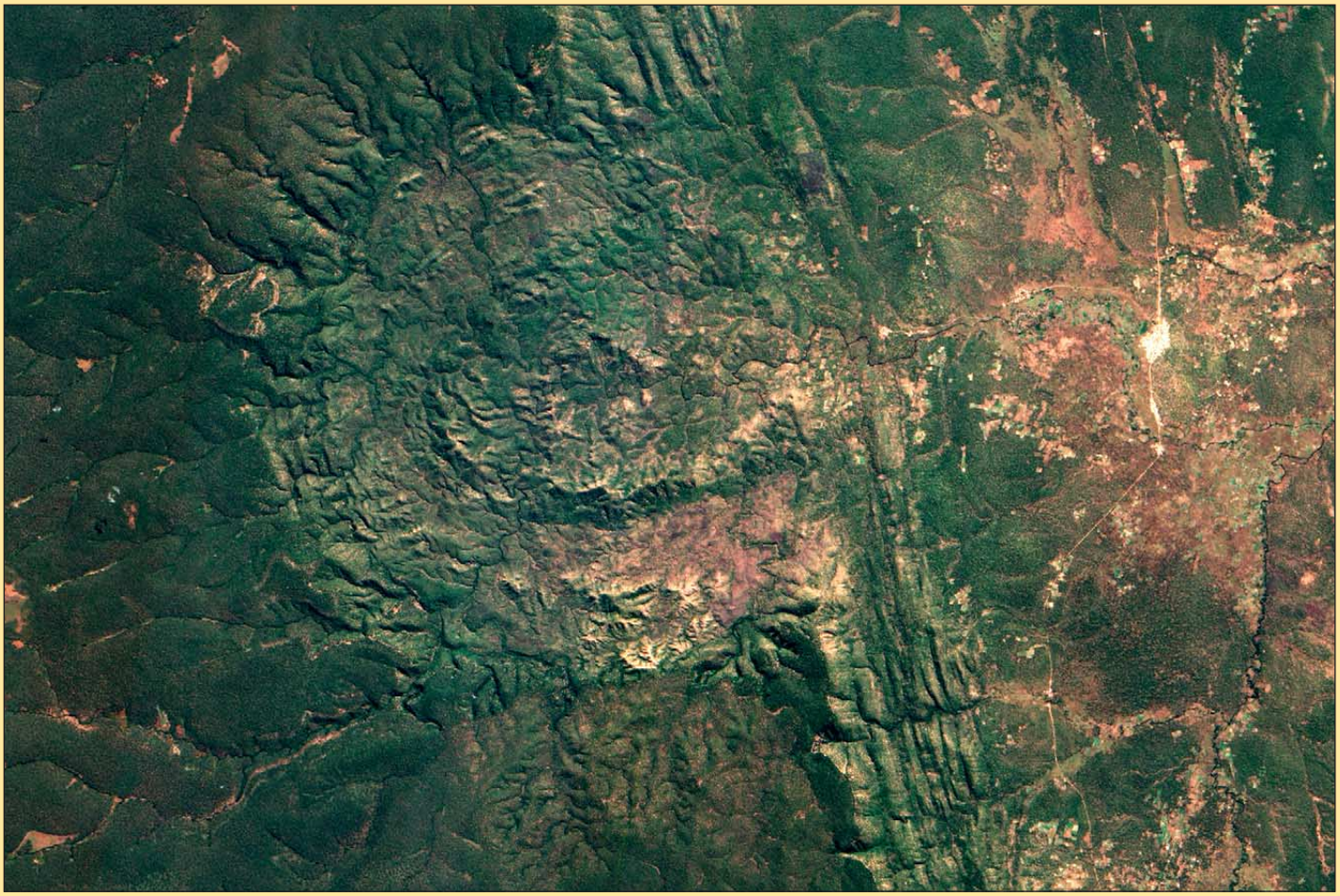
A Galileo FOC FM1 payload in the SSTL clean room for final tests
Credit: SSTL

A 2.5-metre resolution image of Dubai Airport acquired by NigeriaSat-2
Image © *National Space Research and Development Agency (NASRDA) of Nigeria - 2012*

NigeriaSat-2 captured this 2.5 metre resolution image of Salt Lake City Airport, USA in September 2011.
Image: National Space Research and Development Agency (NASRDA) of Nigeria

Luizi Crater

A NASA Earth Observatory Report

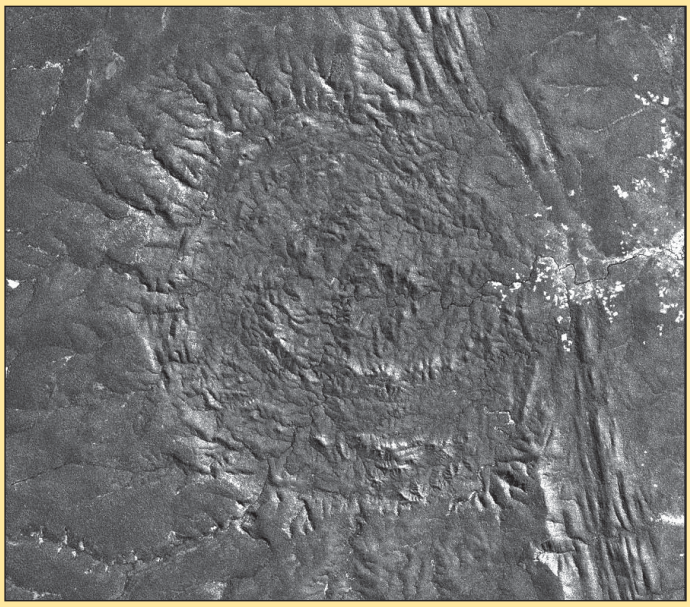


The Advanced Land Imager (ALI) on NASA's Earth Observing-1 (EO-1) satellite captured this natural-colour image of Luizi on June 2, 2012. It is not perfectly round, but instead fills a semicircular basin where vegetation carpets the complicated topography.
NASA Earth Observatory image by Jesse Allen and Robert Simmon, using Advanced Land Imager data from the NASA EO-1 team.

Impact craters can be tough to detect from the ground, especially when they are situated in remote locations and covered by vegetation. First identified in a German geological report in 1919, the *Luizi Structure*, hidden under grasses and vegetation more than a metre tall, remained unexplored for many decades. It was as recently as the 1990s that satellite imagery hinted that the structure might be a meteorite impact crater, and a week-long expedition to the Congo in June 2010 to collect rock samples for analysis finally provided the evidence to confirm this.

Microscopic analysis of the rock samples collected from the site revealed shocked quartz grains, strong evidence of meteorite impacts. The researchers studying Luizi reported the crater to measure about 17 kilometres in diameter, with an intermittent ring about 5.2 kilometers across and a smaller, central ring 2 km across. Around the perimeter of the crater rises a rim reaching 300 to 350 metres above the interior: a typical, well-preserved, moderately sized, meteorite crater.

Exactly when Luizi formed is hard to answer. The researchers estimate nearby rocks to be 575 million years old, so the crater must be younger then this. The meteorite causing the crater must have measured close to a kilometre across, and been travelling at around seventy thousand kph.



A Landsat image of the Luizi Crater
Image: NASA

El Hierro Undersea Eruption

A NASA Earth Observatory Report

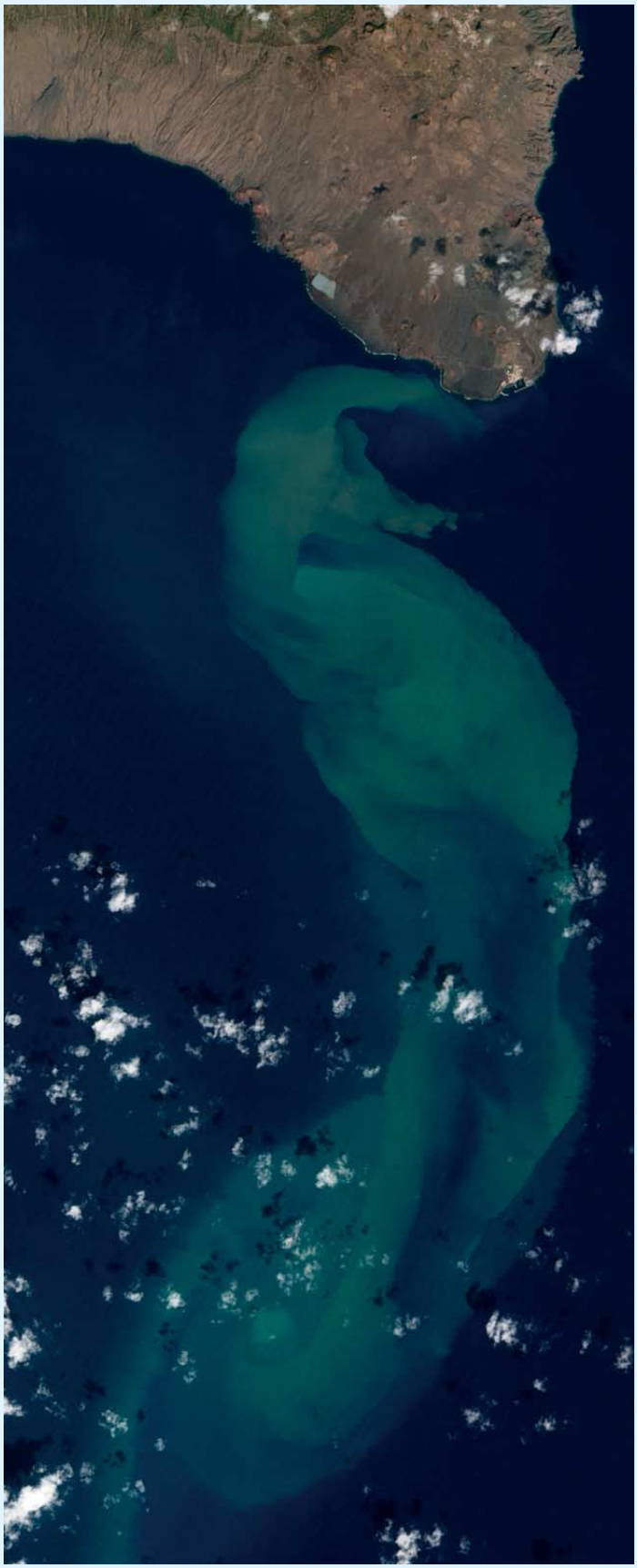


Figure 1
The El Hierro volcanic plume on November 2, 2011

Starting in July 2011, the tiny island of El Hierro in the Canaries experienced earthquake swarms that numbered in excess of 700 tremors by the end of the month. By late August, the total number of tremors had exceeded 4000. It was little surprise when, in late October, an underwater volcanic eruption was confirmed a mere kilometre south of the island's southern tip.

El Hierro, the farthest south and smallest of the Canary Islands, sits on a tectonic hot spot in the Atlantic Ocean some 450 kilometres west from North Africa and Spain. The eruption is believed to be venting from a depth of some 200 meters below the sea surface, warming the water by as much as 10°C. Two months into the eruption, a significant mass of new crust had already built up but was yet nowhere near rising above the ocean surface and extending the Canary Island chain. Figure 2 shows milky green swirls of steaming lava fragments, heated gas, and other debris being carried to the west and north by currents.

By February 2012, the underwater volcanic eruption was showing no sign of drawing to an end, and figure 3 shows the situation on February 12. Bright aquamarine water indicates high concentrations of volcanic material and immediately above the vent, a patch of turbulent brown water indicates where the eruption is strongest.

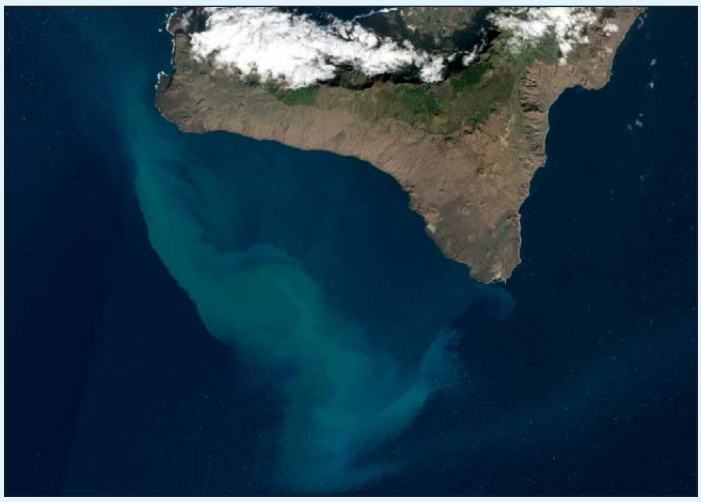


Figure 2
El Hierro and its offshore eruption on December 16, 2011.

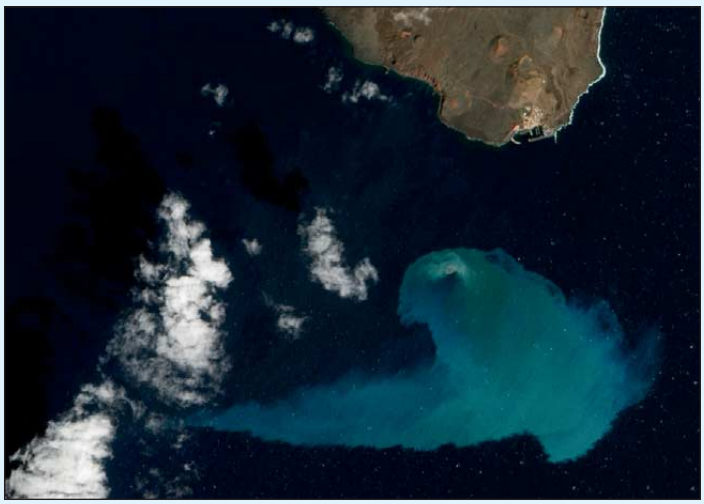


Figure 3
El Hierro and its offshore eruption on February 2, 2012.

All images acquired by the Advanced Land Imager (ALI) aboard NASA's Earth Observing-1 (EO-1) satellite
NASA images by Jesse Allen and Robert Simmon, using ALI data from the EO-1 Team

An introduction to
APT Weather Satellite Reception
Part 2 - Capture and Display using WXtoImg

Continued from page 20

Living in Ireland, where it often rains, I place a special emphasis on the *MSA-precip* and *HVCT-precip* enhancements. So I encourage you to experiment with the different enhancements and decide which you like the best.

Website

These images are nice to look at on the local machine (or via Remote Desktop Protocol) but to really appreciate these things I like to have a web page that displays all the latest images. *WXtoImg* does this really excellently. Once I have made some small settings changes, the software automatically creates a web page with each new satellite pass and updates the web server.

To set up this option you need to use the **Options→Auto Processing Options** settings, with **Add images to web page** ticked. To set up these, click on the **Web Page Settings** button, where this dialogue appears in the second panel down in figure 6).

This is a simple pane to set up. Select the enhancements you wish to display on the web page—the name of the index file (HTML Filename box) and the ftp account details—and the program will automatically update the web page after every satellite pass. I tick the **Exclude NOAA 17** option because this satellite is no longer able to transmit images, and would just waste space on the web page.

Things to Look Out For

Over the years I have seen several problems occur with my system, which affected the unattended reception of images.

Sometimes, *WXtoImg* raises an error and stops running. The usual sign of this is that the web images fail to update. Usually, this is an 'out of memory' error. Closing the dialogue box and restarting the program clears this and you can start receiving images again. Sometimes, reception continues uninterrupted for weeks, sometimes for only a few days. I have not determined the cause of these errors.

Very occasionally, the auto-ftp to my web server fails and I have to completely reboot the computer to clear this. The problem shows itself by failing to log into the ftp server. Everything looks good but it just won't log in. Again, the result is a failure of my web page to update.

I have had a problem to do with the storage of images. When I started this automatic reception, I decided that a 20 GB drive for the system and a 480 GB drive for the data would be enough. But one day I noticed that my pages were not updating, and, after

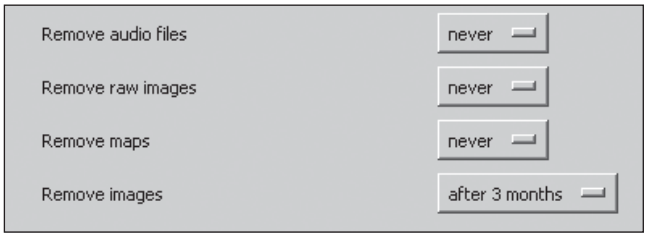


Figure 8 - Setting the epiry time for old files

logging on, discovered that my data drive was full. I had not set any of the **expiry options** for my files and *WXtoImg* had completely filled up my hard drive. The lesson is to make use of the settings to expire old files (figure 8).

With the **Remove images** setting set to **after 3 months** my storage problem came under control and I have never again had this problem.

Despite these problems, I have found *WXtoImg* to be very stable. It receives the images, post-processes them, and uploads them to my web site at

http://www.ei2jp.org/wxtoimg/index.html

mostly without issues. I have been running *WXtoImg* for the past three years and am pleased at the results that it achieves.

Wrap Up and Work To Do

I received an email from Laurent Thomin, who has been creating wide-swath composite images of the Earth using images from many *WXtoImg* users, including myself. You can see the results of Laurent's work at

http://www.thomin.com/wxtoimg/WCI.html

It was great to see that my images were being used as part of the curriculum of the *Awty International School* [2] in Houston, Texas.

Maybe you are thinking that I have nothing left to do with APT reception before the satellites turn off in some years time. But I still have a few things on my to-do list, such as getting my receiving aerial back up to full height, and experimenting with John Silver's preamplifier [3], available from the *GEO Shop*.

I am not completely happy with the quality of my images and can still see some room for improvement. I think this is what makes the hobby both interesting and a challenge.

I am happy to answer questions about APT reception. You can email me at

ron.hahn@dhco.org

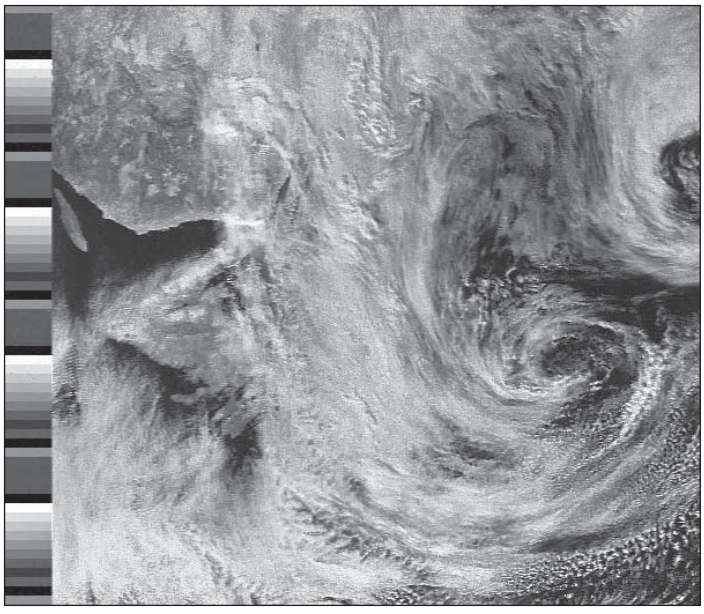
and maybe I can help you to get receiving too.

References

1 APT Weather Satellite Reception, GEOQ 32, page 34 (2011)
2 Awty International School - http://www.awty.org/
3 High Linearity LNA for APT - GEOQ 12, page 17 (2006)

View from the Windmill

When Rob Denton returned to England from Bulgaria, he set up home in a windmill at *North Leverton with Habblesthorpe,* the village with the longest name in England. Judging by some of Rob's satellite images, the location also boasts some of the best horizons for APT reception, as his NOAA-19 image showing Newfoundland proves.



The 15:30 UT NOAA-19 image from March 24, 2012 featuring Newfoundland

From Microscope to Satellite

Using Ocean Colour to Study Algal Blooms

Jason Hopkins

Satellites have revolutionised the way we are able to visualise the Earth and in particular its oceans. Prior to the advent of satellite-derived data, oceanographic data could only be collected during research cruises. These datasets were usually confined to a relatively small area of ocean and represented a snapshot of the conditions at a discrete sampling site. Whilst *in situ* measurements remain an important part of marine science, satellites provide today's oceanographers with the sort of temporal and spatial resolution that can reveal previously unseen ocean phenomena, such as the dynamics of algal blooms.

My work concerns the study of a particular type of alga (commonly referred to as phytoplankton) called a coccolithophore, specifically a species known as *Emiliania huxleyi* (figure 1). These are single celled algae, which are covered with an outer layer of intricately designed calcium carbonate (calcite) plates called coccoliths (figure 2). This particular species is approximately 5 – 10 μm in size (approximately one tenth the width of a human hair), so a scanning electron microscope is normally needed to observe individual cells in detail.

Figure 1
A single coccolithophore
Image courtesy of Chris Daniels, NOC

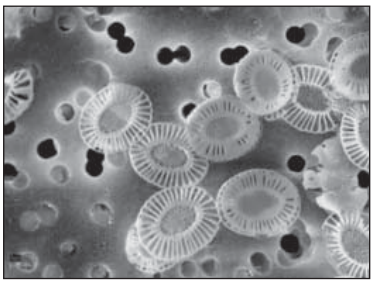


Figure 2
Shed liths from a coccolithophore
Image courtesy of Chris Daniels, NOC

Phytoplankton are tiny plant cells that are poorly understood, but are vitally important to life on Earth as they produce half of all the oxygen in the atmosphere (land-based plants produce the rest). Phytoplankton extract carbon dioxide from the seawater, which is in equilibrium with the atmosphere, and convert it to organic carbon and oxygen in a process known as photosynthesis. The coccolithophore also extracts carbon—in the form of carbonate—from the water column to form its calcite coccoliths. The shed coccoliths have the potential to sink out of the surface ocean into the deep ocean and, over geological time periods, these can become compressed into sedimentary layers, sequestering the carbon. A prime example of this process is the White Cliffs of Dover. But how do satellites play a part in our understanding of this microscopic organism?

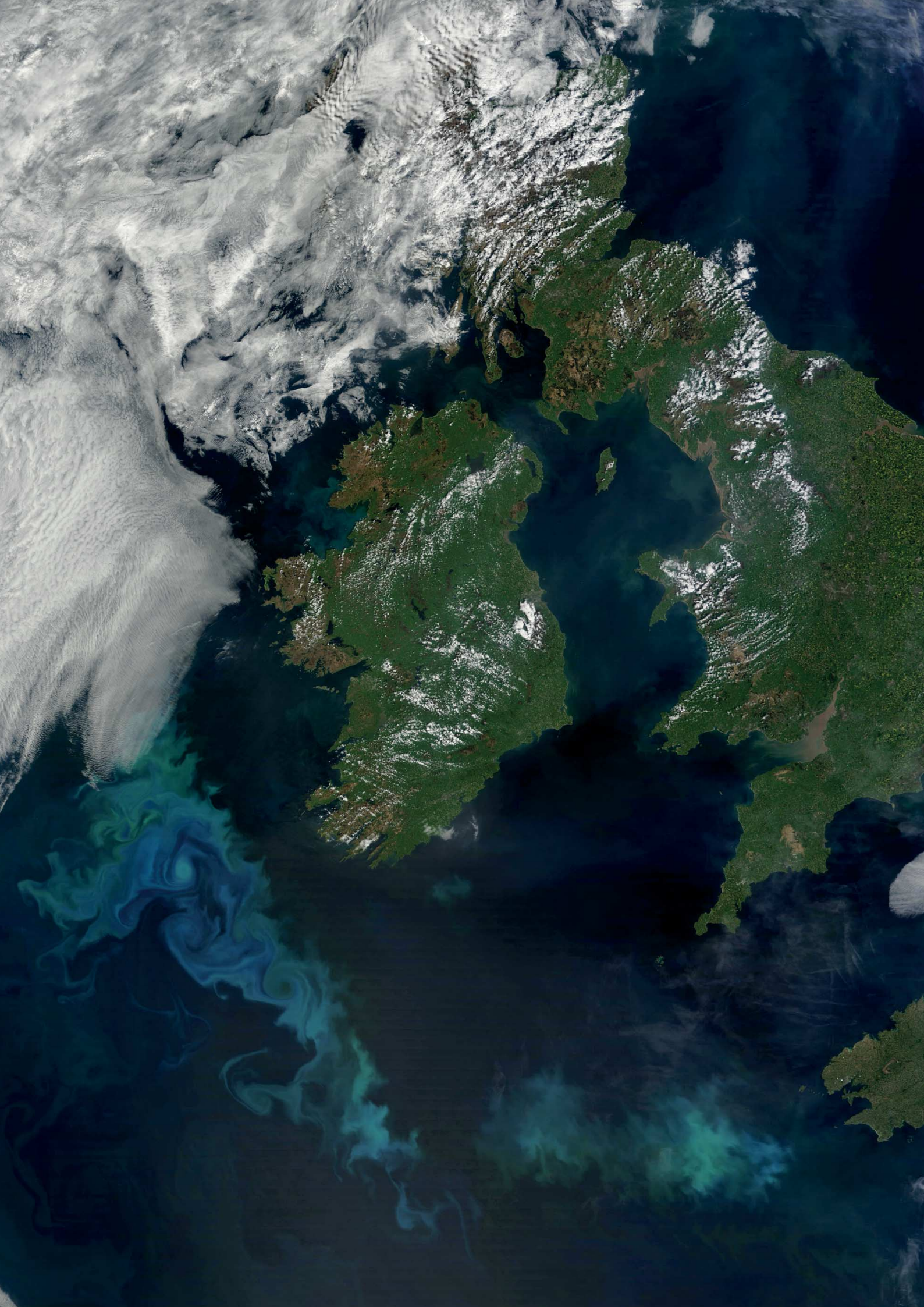
Like any photosynthetic organism, coccolithophores require sunlight and so need to occupy the upper few tens of metres of the water column. When conditions are optimal, their growth rate increases and they form blooms, similar to the greening of terrestrial vegetation in spring.

Several mechanisms have been proposed as possible catalysts for blooms. It is likely that bloom initiation is the result of a complex interplay of many different environmental factors, for example, light and nutrient availability, which may in turn be driven by other environmental variables. The process is further complicated by evidence that in certain parts of the world's oceans, such as the Southern Ocean, even when there are sufficient nutrients available that would normally promote growth, phytoplankton biomass remains relatively low. These are known as High Nutrient, Low Chlorophyll (HNLC) areas, and it is suspected that a lack of iron may responsible for the unexpectedly low growth rates. This hypothesis is supported by evidence that indicates that wind-blown dust from islands within these HNLC regions introduces iron to the surface ocean, which in turn encourages phytoplankton to bloom in these normally barren areas.

Towards the end of the bloom stage, *E. huxleyi* starts to produce multiple layers of coccoliths, which are subsequently shed into the water column. These tiny coccoliths (~ 2 μm across) act like mirrors, reflecting a large proportion of the incident light back out of the ocean, turning the ocean a milky turquoise colour and resulting in patches of high reflectance that can be observed by ocean colour sensors such as the MODerate resolution Imaging Spectrometer (MODIS) sensor onboard NASA's *Terra* and *Aqua* satellites.

Although these 'white waters' had previously been observed during research cruises, the extent of their coverage could not be fully determined without satellites. The earliest indications of these high reflectance patches in satellite imagery came from coastal *Landsat* imagery. It was theorised that these were probably phytoplankton, as they appeared to follow the course of an oceanic front. However, it wasn't until 1983, when Professor Patrick Holligan (then at the Marine Biological Association, Plymouth) set out to investigate these patches that it was confirmed that they were indeed caused by coccolithophores. He found that these 'blooms' could extend over an area of up to 250,000 km^2 (approximately the same area as the UK), making the coccolithophore a major influence on the biogeochemical carbon cycle. Figure 3, opposite, is a true-colour *Terra* MODIS image dating from May 22, 2010, showing a coccolithophore bloom off the southwest coast of Ireland (*Image: NASA/GSFC, Rapid Response Team*).

Traditionally, variations in satellite derived ocean colour that have been converted to estimates of chlorophyll concentration (the green photosynthetic pigment found in plants) have been used to monitor long-term, global variations in phytoplankton populations. However, these data alone do not enable us to clearly distinguish coccolithophores from other phytoplankton that contribute to the chlorophyll signal. The bloom seen in figure 3 is not obvious in the 8-day chlorophyll composite for the area from the same time period (figure 4), probably due to the relatively low chlorophyll content of coccolithophores. Fortunately, because the calcite containing coccoliths affect backscattered reflectance, oceanographers can utilise this property to investigate coccolithophore distributions, via the application of a mathematical algorithm that converts the change in backscattered reflectance caused by the coccoliths into an estimate of Particulate Inorganic Carbon (PIC). Thereafter



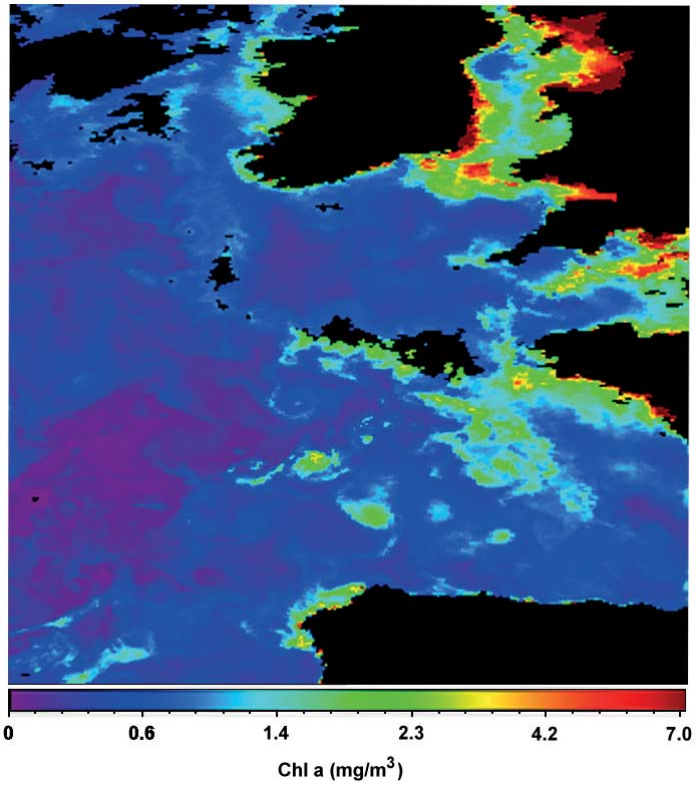


Figure 4
MODIS 8-day composite chlorophyll data from May 17-24, 2010. Note that the feature shown in figure 3 is not clearly defined in the chlorophyll product alone.
(Data processed using WinBilko v3.3)

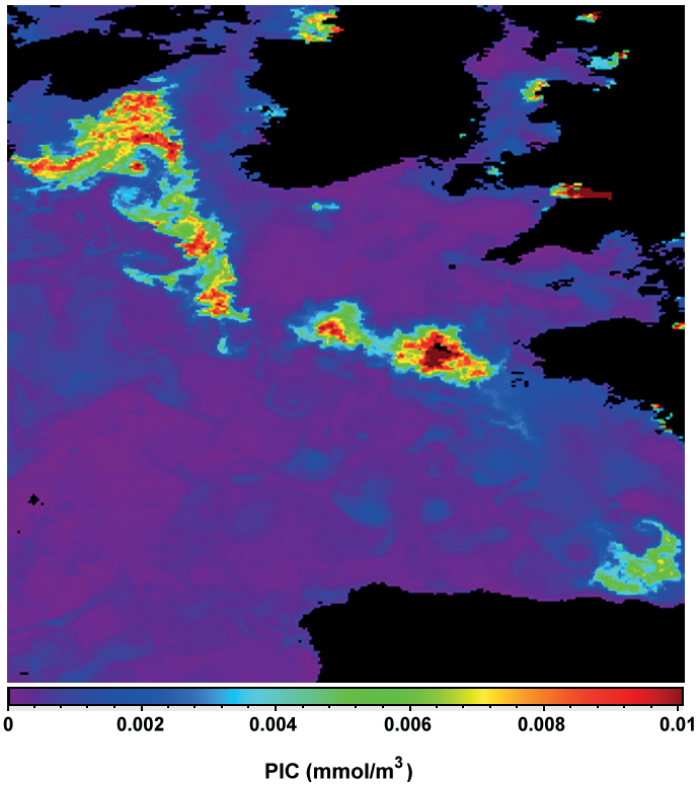
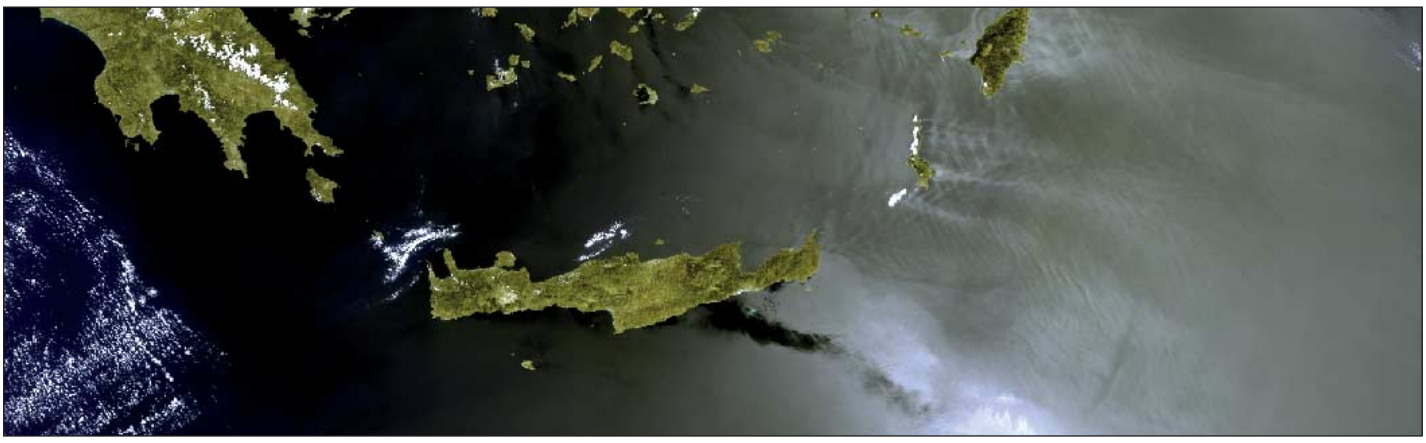


Figure 5
MODIS 8-day composite Particulate Inorganic Carbon data from May 17-24, 2010 showing coccolithophore bloom.
(Data processed using WinBilko v3.3)

it can be assumed that any variation in the location and magnitude of the PIC signal corresponds to similar changes in the underlying coccolithophore population. Figure 5 shows the PIC composite product for the same time period as the chlorophyll signature in figure 4. In this case the structure of the bloom is more evident. The NASA Ocean Colour website (http://oceancolor.gsfc.nasa.gov/) provides a wealth of freely available data products of parameters, derived from various algorithms, that affect ocean colour. These data are available at different levels of processing. The Level 3 products used in my study are geolocated, spatially and temporally composited data obtained from several overpasses that can be easily processed in analytical packages such as *Matlab* or *WinBilko* to provide insights into the dynamics of this biogeochemically important phytoplankton.

Whilst *E. huxleyi* is typically found in all areas of the global oceans, it seems to produce its largest blooms in discrete oceanographic regions. These blooms have a high degree of both temporal and spatial variability associated with them, the causes of which remain undetermined. But why is this important? The use of satellites to identify areas where coccolithophores bloom on a regular basis allows scientists to not only understand the underlying drivers that may favour growth, but also to monitor any long term variation in this species: for example, in response to climate change. This is crucial, as changes in coccolithophore populations may result in the loss of a carbon sink and disruption to the complex oceanic food webs. In addition, the application of our present day knowledge to the distribution of the fossilised remains of coccolithophores found in sediment cores can help provide a window on the oceans' responses to past changes in climate. It is only with the use of satellite data that we are able to monitor the long-term, global trends of this important phytoplankton, which will hopefully provide scientists with more pieces to fit into the climate change puzzle.

Jason Hopkins is a PhD student at the
National Oceanography Centre, Southampton



This fascinating Envisat segment shows the island of Crete, enhanced by sunglint and sea surface rippling on January 30, 2012
Image submitted by Mike Stevens - © ESA

Koksaray Reservoir

Continued from page 24

Other benefits are anticipated, such as introducing fish into the reservoir with a view to establishing a seasonal, commercial fish catch, and making use of the reservoir basin for growing forage crops for harvesting and grazing once the waters have dispersed.

Aydar Lake

A glance at the map (figure 1) immediately reveals that there is another body of water in the region, Adyar Lake (Aidarkul), which is considerably larger than the Shardara and Koksaray reservoirs combined. Therein lies an interesting tale.

At first sight this would appear to be yet another reservoir but that is not the case. When the Shardara Dam was built in the early sixties to create its eponymous reservoir, Aydar Lake did not exist. All that was present was a dried out salt basin located in the Arnasay lowland, a natural depression in the Kyzylkum desert. In the spring, a small lake sometimes appeared there for a short period, but dried up completely by the summer.

In 1969 there occurred one of the most serious floods ever on the Syr Darya, so much so that the Shardara reservoir was in danger of overflowing. Between February 1969 and February 1970, the gateways controlling the water level behind the dam had to be opened to protect the structure, and some 21 km^3 of runoff from the Syr Darya drained into the Arnasay lowland, unintentionally creating the Aydar Lake. In the years since, this lake has regularly been fed by excess floodwater from the Syr Darya when it exceeded the capacity of the Shardara Reservoir. Over the years, the natural cavity of the Arnasay lowland has filled up to create the second largest lake in the region (after the remnant Aral Sea). Unfortunately, as it lies at a lower elevation than the Syr Darya, there is no easy way of returning the waters of Aydar Lake to the river during periods of drought.

Today, Aydar Lake is 250 km long by 15 km wide, has a surface area of 3000 km^2 and contains 44.3 cubic km of water. Though slightly brackish, Aydar is basically a freshwater lake, averaging only two grams per litre of salts. Many species of fish such as pike, perch, bream and catfish have been introduced into the lake, which nowadays supports a fishing industry providing catches up to 2000 tonnes annually. In addition, many species of water birds, migrating from the Aral Sea, make their homes around the lake.

2012 ... and the Floods Return

Against all expectations, flooding returned to the lower Syr Darya valley in 2012 following a particularly high river flow during the first three months of the year. Because of a particularly severe winter, the Syr Darya had frozen completely along the length of its flood plain between Shardara and Kyzlorda. The 'normal' excess flow from upstream power stations was augmented when rain and mild conditions in the mountains produced unexpected mass melting of snow. With the Syr Darya frozen, this water could not be channelled away, and flooding returned to southern Kazakhstan.

Hundreds of homes were damaged, roads were washed out and fields and pastures flooded. More than two thousand people were evacuated to schools, hospitals and mosques. Both the Shardara and Koksaray reservoirs were filled to capacity and able to accommodate only around half the excess flow of the Syr Darya. Although this was recognised to have been a unique event, unlikely to be repeated, it does now raise the question as to whether a further reservoir may have to be constructed lower down the river, in the Oguzsayskoy depression near Mayakum.

References

1 Syr Darya Control and Northern Aral Sea Project GEOQ 34, page 10 (June 2012).
2 gazeta.kz - http://engnews.gazeta.kz/art.asp?aid=356072

View from the Top

A NASA Earth Observatory Report

There have been many images of the full disc of Earth from space—a view often referred to as the *Blue Marble*—but few have looked quite like the version on the front cover of this issue. Using natural-colour images from the Visible/Infrared Imaging Radiometer Suite (VIIRS) on the recently launched *Suomi-NPP* satellite, a NASA scientist has compiled a new view showing the Arctic and high latitudes.

Ocean scientist Norman Kuring of NASA's Goddard Space Flight Center pieced together this composite image of Europe, Asia, North Africa and the entire Arctic. It was compiled from fifteen satellite passes made by *Suomi-NPP* on May 26 this year. The spacecraft circles the Earth from pole to pole at an altitude of 824 kilometres and multiple passes are needed to gather sufficient swaths of data to display the entire hemisphere without gaps in the view.

Kuring stitched the image swaths together then set up this view, looking down from 70°N, 60°E. This is, of course, an artificial view, as the satellite cannot image the full Earth disc at one time. Kuring was able to show the Arctic in this image because northern hemisphere spring spreads enough sunlight over the North Pole to allow a 360° natural-light view.

VIIRS is a scanning radiometer that acquires data in 22 spectral bands which cover visible, near-infrared, and thermal infrared regions of the electromagnetic spectrum. It was designed to extend and improve upon the measurements of land masses, oceans, ice and the atmosphere made over the past two decades by the Advanced Very High Resolution Radiometer (AVHRR) and the Moderate Resolution Imaging Spectroradiometer (MODIS).

Image by Norman Kuring, NASA/GSFC/Suomi NPP

Launch Date for Metop-B Agreed

Following a lengthy wrangle, Russia and Kazakhstan have at last come to an agreement over the Metop-B launch from Baikonur, originally May 23, and which is now slated to take place on September 19, 2012.

City Lights on Google Maps

Fred van den Bosch contacted us with details of a new *Google Maps* service. Many readers will be familiar with the 'City Lights' imagery acquired by NOAA's DMSP satellites.

There is now a new Google Maps overlay, which, in addition to the normal 'Map' and 'Satellite' views, also offers a 'Night' option. You can now zoom into any location on Earth and view the planet by the lights of its cities at

http://www.blue-marble.de/nightlights/2010

Erratum

In the circuit diagram for Guy Martin's digital thermometer project, the inputs and outputs on the voltage regulators are transposed. For **In** read **Out**, and vice versa.

A Simple JeeNode Barometer

David Taylor, GM8ARV

I had been looking for a way to record a few weather parameters on a casual basis for some time and had already found indoor and outdoor temperature probes available on the Internet; I later discovered an indoor temperature and humidity probe. However, pressure seemed to elude the Chinese makers of these probes so, late last year, I bought a wireless weather station—which would have been ideal were the software up to the same standard as the hardware. Unfortunately though, while the indoor display panel worked most of the time, it was so unreliable when interrogated by software that I sent the unit back for a refund. During my Internet explorations I discovered a low-cost pressure sensor, which was an add-on hardware to an *Arduino* compatible computer. The discovery was the *JeeNode* from JeeLabs.

http://jeelabs.com/products/jeenode

Seeing Guy Martin's recent article made me realise that this alternative approach might be of interest to GEO readers, as only a very few non-surface-mount components are required, and the programming model is the widely supported *Arduino*.

http://www.arduino.cc/

The JeeNode

JeeLabs offer a variety of formats of hardware, all designed for 'physical computing' (i.e. real-world measurements) and the hardware is designed to be very easy to connect together. The main computing part is designed around *Arduino* compatibility, so there's plenty of software available, and there is an extensive library of software to support the hardware boards you can add to a *JeeNode*. I wanted to drive this from a PC, so I chose a *JeeNode* with a USB port, but there is quite an interest in battery-powered *JeeNode*s which can be interrogated remotely with an 868 MHz RF signal.

The *JeeNode* can be programmed with the standard *Arduino* development environment, which is well described and well supported. There is forum here where you can get help.

http://arduino.cc/en/Guide/Environment

The development environment communicates with the *JeeNode* via a USB lead with a serial COM port emulation. Once your program (in *Arduino* nomenclature, your sketch) is running on the *JeeNode*, the same COM port is available for the PC to communicate with the *JeeNode*.

Hardware

For this project, I chose a *JeeNode* with a USB interface and a *Pressure Plug*, a small board for their atmospheric pressure sensor, which is based on a BMP085 chip.

http://jeelabs.net/projects/hardware/wiki/JeeNode_USB

http://jeelabs.net/projects/hardware/wiki/Pressure_Plug

You can get various multi-pin connectors to solder to the board to adapt the configuration to best suit your own needs—I used just a single 6-pin header so that I could

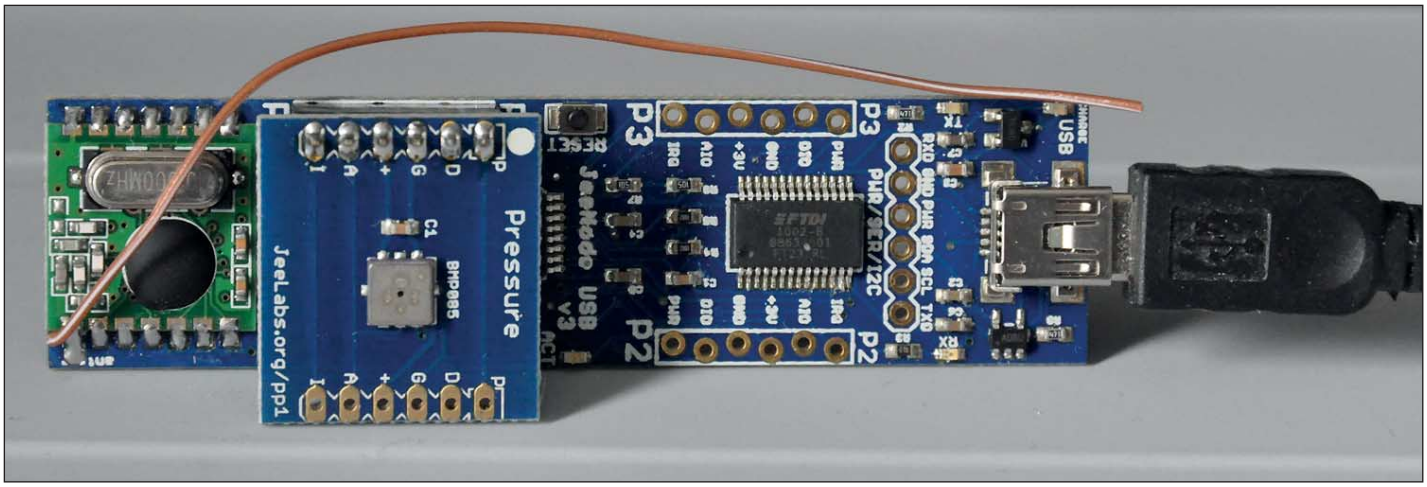


Figure 1 - General view of the JeeNode Barometer.

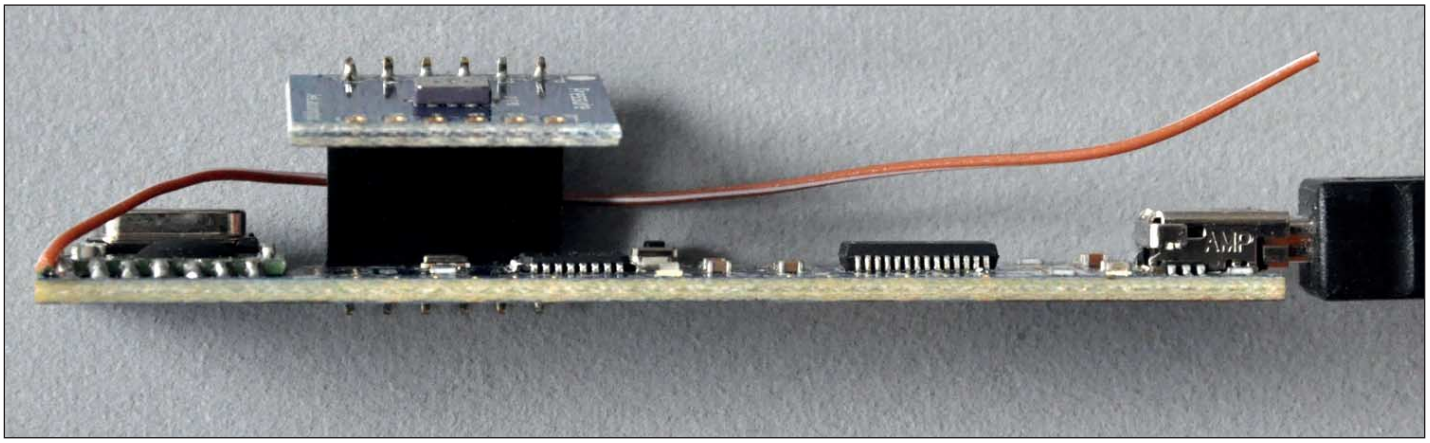


Figure 2 - An elevation view, showing how the Pressure Plus is mounted above the main JeeNode USB board.

unplug the pressure sensor if required. You can buy these boards ready-made (as I did), and there are some kit options if you have surface-mount facilities (which I do not).

Software

Getting data from the JeeNode

There is sample code provided to drive the BMP085 in a *JeeNode* configuration, and all I had to do was to provide serial access to that data. Most of the listing, in Appendix 1, is simply copied from the sample provided. As this is both my first *Arduino* and first *JeeNode* program, I could probably have done things in a much better way. The function I wanted was to be able to send a serial character to the board and get back the pressure data. Line 32 in the execution loop waits until a character is received on the serial line. Any character will do to elicit a response. Lines 36-45 get the current pressure (and temperature) reading, and calibrate it into the expected values. Lines 48-56 send the values back to the serial port, including a prefix of the characters 'BMP' and a carriage return suffix so that you could read the data a line at a time.

Using the Data

As regular readers may recall, I am a fan of MRTG for simple graphing of data over both short and long intervals, so I wrote a small program which interrogates the *JeeNode* and returns data in a suitable form for MRTG. Please contact me if you wish a copy of this program.

You could easily write a program in *Visual Basic*, or your favourite language, to interrogate the data by sending one character to the COM port, and reading the response.

An alternative, should you wish a stand-alone unit such as Guy Martin described in GEO Quarterly 34, would be to add a compatible graphics board from the JeeLabs shop and program it appropriately.

http://jeelabs.com/products/graphics-board

The Photos

Figure 1 shows a general view of the *JeeNode* Barometer, looking directly down on the board. The USB connector is on the right and the (unused) RF interface on the left. The pink wire is the antenna for the RF interface. The Pressure Plug is the square board left of centre, and you can just see a few of the pins from the surface-mount processor to the right of it. The chip right of centre is the FTDI serial-to-USB chip. There are red and green LEDs which flash when serial data is sent or received.

Figure 2 is an elevation view of the board, and illustrates how the *Pressure Plug* is mounted above the main *JeeNode* USB board. The black item is a multi-way socket allowing the *Pressure Plug* to be removed and different hardware substituted.

Appendix 1 - Code Listing

```
(0 ) // Ports demo, reads out a BMP085 sensor connected via I2C
(1 ) // 2009-02-17 <jc@wippler.nl> http://opensource.org/licenses/mit-license.php
(2 )
(3 ) // 2010-05-22: added support for all resolution modes
(4 ) // 2010-05-25: extended to also broadcast all readings over wireless
(5 ) // 2010-06-17: add power saving logic, should reduce consumption by over 90%
(6 ) // 2010-06-24: improved power savings, several “hot spots” optimized
(7 )
(8 ) // see http://news.jeelabs.org/2010/06/20/battery-savings-for-the-pressure-plug/
(9 ) // see http://news.jeelabs.org/2010/06/30/going-for-gold-with-the-bmp085/
(10)
(11) #include <JeeLib.h>
(12) #include <PortsBMP085.h>
(13)
(14) PortI2C two (4);
(15) BMP085 psensor (two, 3); // ultra high resolution
(16)
(17) // This power-saving code was shamelessly stolen from the rooms.pde sketch,
(18) // see http://code.jeelabs.org/viewvc/svn/jeelabs/trunk/jeemon/sketches/rooms/
(19)
(20) void setup() {
(21)  Serial.begin(57600);
(22)  Serial.print(“\n[bmp085demo]”);
(23)
(24)  psensor.getCalibData();
(25) }
(26)
(27) void loop() {
(28)  // sensor readout takes some time, so go into power down while waiting
(29)  // int32_t traw = psensor.measure(BMP085::TEMP);
(30)  // int32_t praw = psensor.measure(BMP085::PRES);
(31)
(32) if (Serial.available())
(33)
(34) {
(35)  char ch = Serial.read();
(36)  psensor.startMeas(BMP085::TEMP);
(37)  delay(16);
(38)  int32_t traw = psensor.getResult(BMP085::TEMP);
(39)
(40)  psensor.startMeas(BMP085::PRES);
(41)  delay(32);
(42)  int32_t praw = psensor.getResult(BMP085::PRES);
(43)
(44)  struct { int16_t temp; int32_t pres; } payload;
(45)  psensor.calculate(payload.temp, payload.pres);
(46)
(47)  // this code is not needed for use as remote node, keep it for debugging
(48)  Serial.print(“BMP “);
(49)  Serial.print(traw);
(50)  Serial.print(‘ ‘);
(51)  Serial.print(praw);
(52)  Serial.print(‘ ‘);
(53)  Serial.print(payload.temp);
(54)  Serial.print(‘ ‘);
(55)  Serial.print(payload.pres);
(56)  Serial.print(“\n”);
(57)
(58) }
(59) delay (300);
(60) }
```

WEATHER, NATURAL DISASTERS AND EMERGENCY COMMUNICATION

Esko Petäjä

We have been reading from newspapers and seeing in TV how weather disasters have been hitting different areas. Indeed, the very cold conditions in Europe, when many people froze to death, were featured in the previous two issues of this magazine. In Finland and the other Nordic countries we are use to the cold and snow, and it is very seldom that such conditions cause deaths. The main problems resulting from severe cold are damage to infrastructure and transportation. Below I describe how storm '*Dagmar*' hit the Nordic countries and Finland and how amateurs have helped in the field of emergency communications

In Finland, the most typical effect of bad weather (storm, wind, snow or lightning) is that we lose electrical power. In cities, the electrical network is based on underground cables but in countryside we use overhead wires which are often carried on pylons through narrow breaks in forests. In winter, heavy snowfall often topples trees on to the power lines, and then we lose electrical power. During last Christmas, after several storms, there were wide areas where people were without electricity for two to three weeks. When storms hit a wide area, electricity supply companies are not able to fix errors in short time. When there is a lot snow, repairs will be harder and time consuming.

Figure 1
A Helicopter trims trees near a power line
Image © Fortum

Today, when regular land line telephones are not used so much, we are highly depended on wireless communications. Last Christmas, storm *Dagmar* caused such widespread loss of electricity (and for such a long time) that many GSM cellphone base stations were put out of commission. There was a widespread loss of communications and even governmental offices such as the police and fire services were unable to operate fully. The photograph below shows how trees are cut back to prevent them falling on to power lines.

Storm Dagmar (December 24-25, 2011)

Starting on Christmas Day, *Dagmar* moved from northern Scotland to western Norway, unleashing winds as intense as many hurricanes. Winds at Sella Ness, Shetland, in the north of Scotland, produced gusts of up to 162 kph. Still more powerful winds were clocked on oil rigs west of Norway, where they were about as strong as those of a Category 3 hurricane (over 178 kph). Figure 2 shows the storm reaching the west coast of Norway.

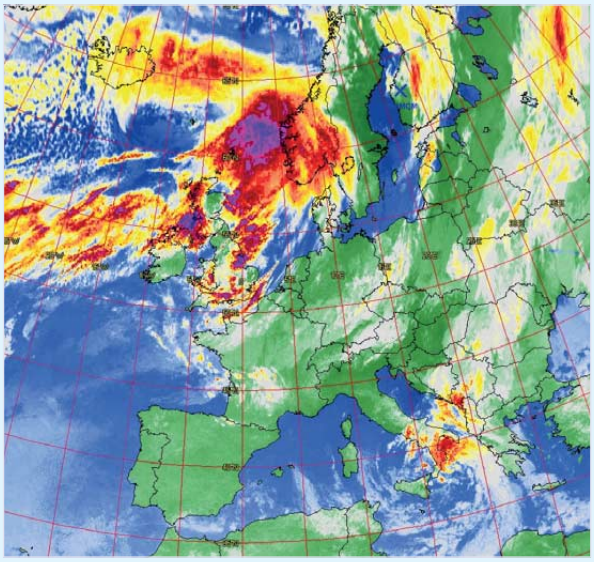


Figure 2 - Storm Dagmar approaching Norway
Image © EUMETSAT 2011

When *Dagmar* reached Scandinavia, many roads where closed and over 100 000 people in Norway and 200 000 in northern Sweden lost power; in some places broadcast radio went off the air although most still had phone and cellphone coverage. The Home Guard (reserve military) were called out to assist with damage assessment and power line inspection.

Figure 3 - *Dagmar* hits small village on the west coast of Norway

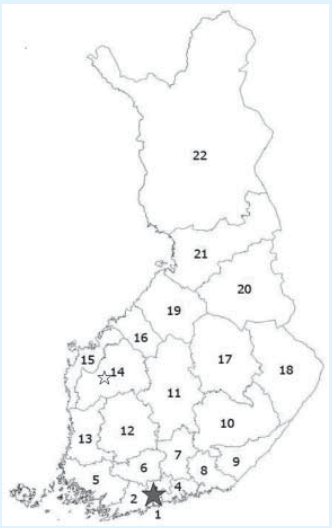
The worst communications emergency happened in the municipality of Vågsøy, where they were completely lost. Emergency services were organised in the city hall, where inhabitants were asked to report if they needed help. The only communication method was by the satellite phone of a line fishing boat, MS Frøyanes, which provided a lifeline to the outside world. Some '*Simplex*' handsets were used to communicate with care homes. The governor of Sogn og Fjordane county asked the military to establish HF radio links. Amateur radio emergency communications were also activated.

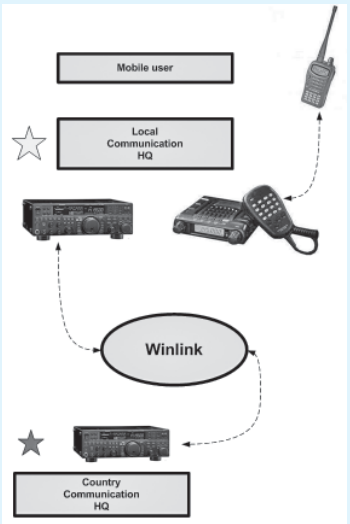
Figure 4 - A local radio amateur helping with emergency communications
Image © NRRL

The storm reached Finland on Christmas Day morning and winds were strongest throughout the morning and early afternoon. On the southwest and the west coasts, the wind blew at more than 80 kph, felling trees, which caused the power outages. In the Baltic Sea winds were storm force, and severe storm force in the Gulf of Bothnia.

Sea level probably increased to dangerously high levels in lowland coastal areas. The rain came mostly as rain or sleet, but snow in the north of the land. Wind gusts increased throughout the country during the evening causing loss of electrical power across large areas.

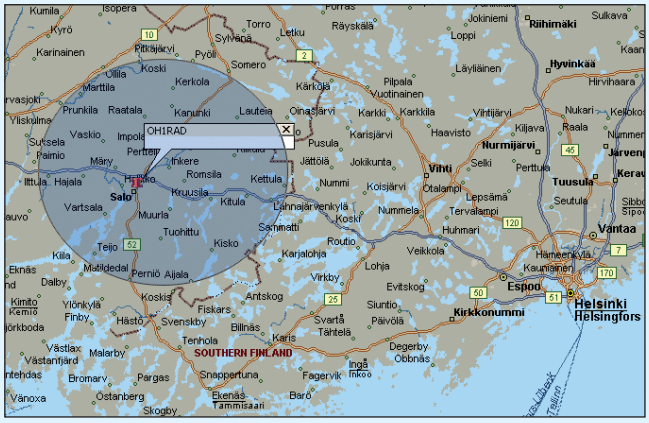
Electrical lines downed by *Dagmar*





The principle of communication during the national power outage exercise

Most of the longest power outages occurred near the city Salo (where *Nokia* was established). The Salo region suffered power outages for ten days and the GSM networks were down for three days. This raised concerns in the city's social service authorities about elderly people living alone. Without means of communication, they could not be contacted and, also, they had no way to call for help in the event of an emergency. For this reason, the authorities asked radio amateurs to patrol elderly peoples' homes to check that everything was OK, which they did throughout the three days. A local high-power 2-metre repeater with a range of 50 kilometres (OH1RAD) was used for communications and high power (50 watt) mobile stations were used in cars.



Location and coverage of the 2-m repeater OH1RAD used during the emergency

Preparation for Total Disaster

Because wide scale power outages are not uncommon in Finland, there is held, every second year, an exercise for emergency communication organised by amateurs. This year's exercise topic simulated a major breakdown in the main National Power Grid. This topic was very well adapted to the effects of storm *Dagmar* and the communications exercise was organised by dividing Finland into security areas, in each of which communication was effected by VHF radios to the area HQ. From this area HQ, further communications with the national HQ was done using by *HFLINK* [1] communication.

Emergency Communication through Amateurs

Even the professional communications equipment used by the Authorities can sometimes fail during a total disaster. Amateur systems, by contrast, are not as dependent on terrestrial facilities that can fail; also, they are dispersed throughout communities, and they do not have 'choke points' that can become overloaded, like cellphone base stations.

In the USA. Radio amateurs undertake a lot of emergency communications work: specifically, during the North America blackout (2003), Hurricane Katrina (2005). The same was true in China in the wake of the 2008 Sichuan earthquake. The goal of Radio amateurs is to create a voluntary secondary communication system which can be used when other methods are failing, thus helping authorities to do their duties. These activities are coordinated by GAREC (Global Amateur Radio Emergency Communications) [2].

Hurricane Katrina (September 2005)

Hurricane Katrina was the deadliest and most destructive hurricane of the 2005 Atlantic Hurricane Season. It was the costliest natural disaster, as well as one of the five deadliest hurricanes, in the history of the United States. Katrina caused at least 1,836 deaths, some in the actual hurricane, others as a result of the subsequent floods. In total, property damage was estimated at $81 billion. During this hurricane, 1000 amateur radio volunteers served in the stricken area to provide communications for agencies such as the American Red Cross and The Salvation Army, and to facilitate interoperability between agencies.

Some of the Montgomery, Alabama Radio Amateur Team in their communications centre while helping in the aftermath of Hurricane Katrina
Image © ARRL

EUMETSAT 25 years ans d'EUMETSAT

A Book Review by Francis Bell

This substantial new publication from *EUMETSAT* covers the past 25 years of their history. A substantial hard-back book with 320 high quality A4 sized pages, this is a comprehensive record of *EUMETSAT's* history and its achievements. It weighs 1.7 kg. The text is divided equally between English and French: generally, even numbered pages are in English and odd numbered ones in French, and the photographs, tables and diagrams carrying notes in both languages.

A Preface to the book states:

> The success story of satellite meteorology in Europe is closely linked to two organisations. One is EUMETSAT itself which, in just two decades, has become one of the world's pre-eminent meteorological and environmental satellite organisations, serving the interests of Europe's National Meteorological Services, the citizens of Europe and way beyond. The other is the European Space Agency (ESA).
>
> ESA research expertise was required for the conception and development of the first Meteosat back in the 1970s, and ESA was also the driving force behind the original formation of *EUMETSAT*. Over the past 25 years the relationship between the two organisations has evolved, and ESA has now become an established and important cooperation partner and procurement agency for EUMETSAT.

A sample page from the book, illustrating its format

Although the book is well illustrated and contains some satellite images together with tables, charts and diagrams, it is not a book devoted to '*wow*' factor satellite images, but follows the history and important events leading up to EUMETSAT's 25 year anniversary in 2011.

The first two chapters recount the early activities of Europe in the field of meteorological satellites and the setting up of *EUMETSAT*. Chapter three deals with the expansion of national memberships and cooperative agreements intended to lead on to full membership. Chapters four and five record the story of geostationary and polar-orbiting satellites, chapter six tells the story of *EUMETSAT's* foray into the world of ocean altimetry with the *Jason* programme, while chapter seven deals with *EUMETSAT's* ground segment composition. Chapters eight and nine record international cooperation and involvement with assistance given to developing countries. Chapter ten examines the role of research and training and helping users exploit EUMETSAT's products. Finally, chapter eleven sums up the history and provides additional information about the internal workings of the organisation. There are five annexes. I found Annex 2, which covers important milestones in the evolution of *EUMETSAT,* particularly interesting because of its concise nature.

I would judge this book to be a '*must have*' for anyone seriously interested in weather satellites and particularly EUMETCast reception. I received my book as a complimentary copy from *EUMETSAT* and I offer my thanks to them for this beautiful and informative publication.

Book details

ISBN 978-92-9110-091-0: Printed in 2011: Published by EUMETSAT, Eumetsat-Allee 1, 64295 Darmstadt, Germany.

I have just ten copies of this book for distribution to GEO members. The book itself is free of charge but packing and postage will cost £8.00 or €10.00. If you would like a copy sent to you, please email, telephone or write to me and I will let you know if I still have stock.

You can download this book in PDF format (21 MB) from

http://www.eumetsat.int/groups/cps/documents/document/pdf_br_history-book.pdf

Weather, Disasters and Emergency Communication

Continued from page 39

Kobe Earthquake (Japan 1995)

On January 17, 1995, at 05:46 local time, a magnitude 7.3 earthquake hit the densely populated surrounding the city of Kobe. The centre of Kobe was heavily damaged, with 6434 fatalities and 43,782 injured. Over half a million homes were damaged, and a hundred thousand destroyed. Over 300 000 citizens had to be evacuated.

In response to an administrative request, JARL (the Japanese Amateur Radio League) started its Emergency Communication effort later the same day. They were specially authorised to handle amateur communications relating to road and traffic conditions, safety and location of residents, names of shops able to provide water and food, and the availability of Public Services.

Emergency Communications used by Authorities

Authorities such as energy companies and fire brigades use TETRA (Terrestrial Trunked Radio) radio in their communications and there are many nationwide TETRA radio network. TETRA supports both speech and data transmission, the latter in both packet and circuit switched modes. In Europe, TETRA uses the 380-400 MHz and 410-430 MHz bands.

A TETRA network call can be established very quickly (0.3 seconds) and provides two-way calls between units. TETRA can also support calls involving multiple users.

TETRA radios, as used by Authorities
Image: © Fortum

Conclusion

Although we have very high-tech infrastructure with all our sophisticated communication devices like 3G/4G, these rapidly become useless following a major power outage. Area infrastructure is very vulnerable. From case studies, it is clear that VHF communication provided by amateurs has been very helpful in conditions of severe weather and natural disaster.

References

1 HFLINK - http://hflink.com/
2 GAREC - http://www.iaru.org/garecnet/

Spectacular High Pressure South of Australia

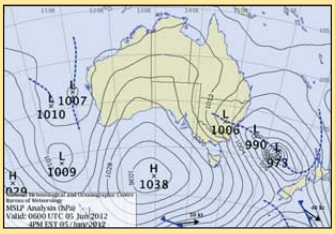
A NASA Earth Observatory Report

High-pressure weather systems often bring fair weather and relatively clear skies. In early June 2012, an anticyclone off the coast of Tasmania did just this in spectacular fashion.

This MODIS image at right, from NASA's *Aqua* satellite, displays a spectacular weather system over the Great Australian Bight at 05:00 UT on June 5, 2012. The high pressure region appears as a 1000 kilometre wide oval hole in the blanket of marine stratocumulus clouds.

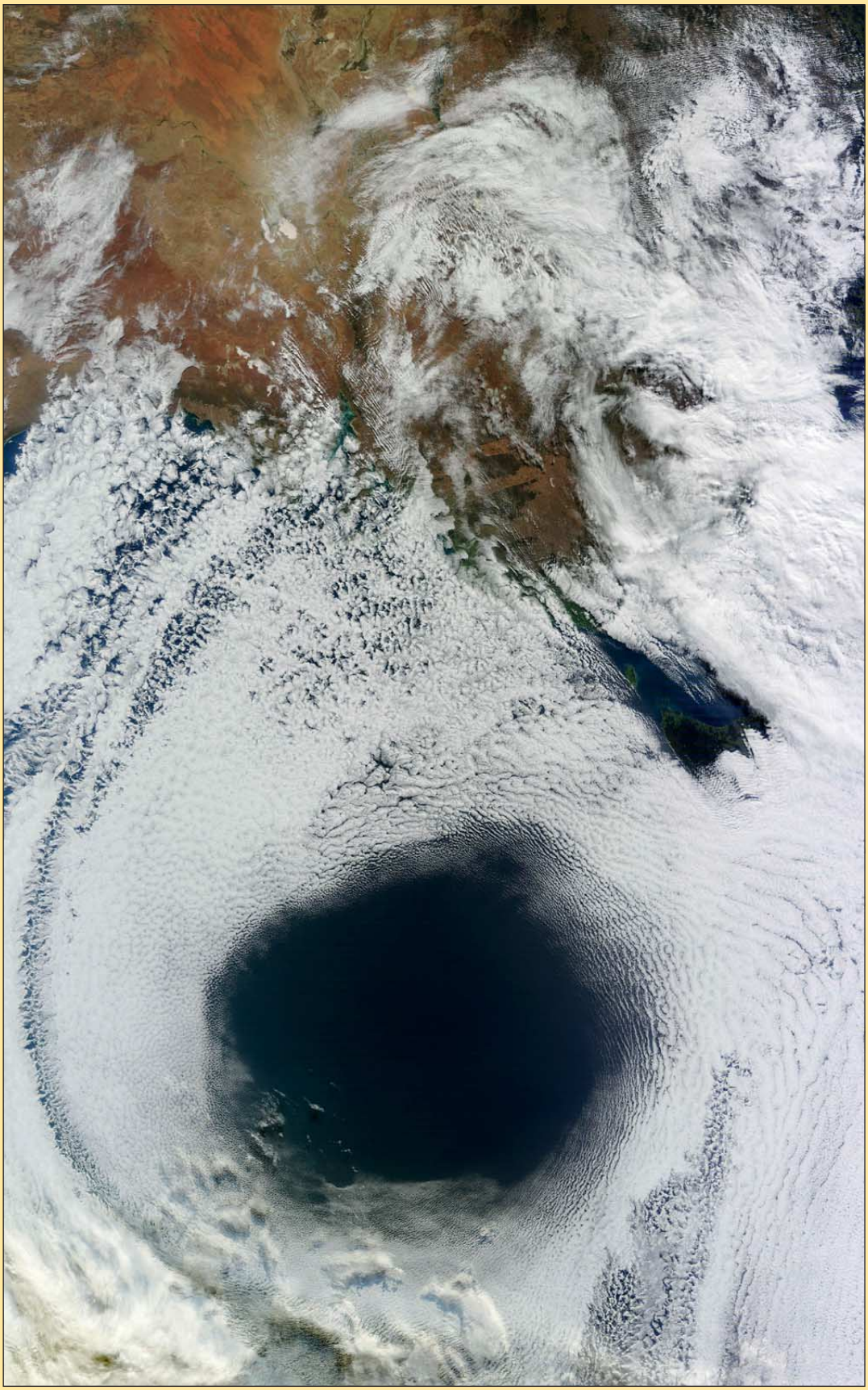
The cloud hole results from sinking air associated with the anticyclone. Compared with the average sea-level pressure of around 1013 millibars, the pressure at the centre of this high exceeded 1040 millibars.

The 06:00 UT sea-level pressure map published by the Australian Bureau of Meteorology on the same day shows the shape of the cloud hole to match the shape of the high-pressure area. However, the respective centres of high pressure and the cloud hole didn't match precisely. The centre of the anticyclone was located near the western edge of the cloud free zone, some 100 kilometres from the cloud edge.



The 06:00 UT sea-level pressure map showing the Anticyclone
Credit: the Australian Bureau of Meteorology

In general, winds blow outward and away from areas of high pressure, as a result of which areas of high pressure pull air downwards. As the air sinks, it also warms, increasing the rate of evaporation of cloud droplets, thus making it difficult for the air to sustain clouds. Areas of low pressure, by contrast, pull air upwards, generating clouds and stormy weather.



This MODIS image acquired by NASA's *Aqua* satellite at 05:00 UT on June 5, 2012 shows a high pressure system south of Australia.
Image: NASA/GSFC Rapid Response Team

http://earthdata.nasa.gov/data/near-real-time-data/rapid-response

FEEDBACK

The page where readers can express opinions about GEO Quarterly Matters

Email: geoeditor@geo-web.org.uk

Dear Les,

I quite felt for you when you questioned in the current editorial the efficacy of committing 100 plus hours to produce the GEO Quarterly to a shrinking audience. Couple this to a lack of articles to fill the pages and I feel I would be asking similar questions.

The life of our particular hobby can be likened to a generation game: the first generation that used mechanical devices coupled to electronics to get an image; the second generation who built frame stores and the third generation using a purely PC based system.

I have worked my way through each sector of the generation game and, even though I still marvel at the quality and reasonably reliable method of obtaining images, nothing will ever match the excitement of developing a sheet of bromide fresh off the facsimile machine on a Sunday evening. The ergonomics of owning such a beast as a *Muirhead K300*, coupled to shift working, meant I was fortunate to get one image a week.

Keeping up with developments in the weather satellite field as it grew meant there was no shortage of articles in the magazines of the day. Constant fine-tuning of all components and reacting to the latest published 'tweek' or circuit kept one very busy. With the reliability of today's products, once you are up and running the world is your visual oyster and little else needs to be touched (OK, I know that's a silly thing to say as all my systems will now stop).

I feel that the unsaid role of the *Quarterly* is to keep members abreast of developments with the service providers. Our hobby is totally different from the 'pay for' services offered to industry, military and others. We do not provide them with funds other than our taxation allotment via our current government. Down all the years, with very few exceptions, all the providers have treated the amateur weather satellite enthusiasts with equanimity.

The *Quarterly's* role is very important and I hope it will continue. It could become three times a year rather than disappear. I would not wish you to feel downhearted at what is achieved in the Quarterly as it is superbly published with some of the finest images I have ever set eyes on. Other professional publications in the field suffer a dearth of constructive articles and pad their pages with far less worthy items than our publication does.

The magic of being able to provide an up to the minute image has never left me, and no young person I have shown an image to has failed to be enthralled by it. As amateurs that's something we do well.

Please continue, as you and the GEO Quarterly I am sure, are most appreciated by all in the field, and who knows what impact it may have on the scientists of the future.

Peter Stien

Hello Les,

GEO Q34 arrived a while ago, and I was as always happy to receive it. I really liked the article about the Aral Sea. It is interesting to note the different ambitions between Kazakhstan and Uzbekistan when it comes to restoring the sea.

I became a bit sad when I read the editorial with your question 'Is there any demand for GEO to produce an expensive glossy magazine.' For me, here in Sweden, where I feel somewhat alone with my hobby, it is incredibly valuable to receive the magazine. It gives me a touch of what happens. And even if I am only receiving APT, I learn about the possibilities that EUMETCast and other things give. And also articles on meteorological and environmental matters are very pleasing.

About the 'glossiness' of the magazine, I could well do with lower ambitions. But I am one of those people who still like to have a physical paper in hand.

The other question, about how to boost membership is really difficult. I recognise the problem from several DX clubs in Sweden, but I can't say that any of them have arrived at a good solution. Radio amateur clubs seem to be somewhat luckier in their recruitment. I believe that you already have got many proposals to work via Internet, and this may be a way, but there I believe others can come with better ideas than I.

Best regards, Anders Höök, Sweden

Les,

Let me first thank you for the excellent copies of GEO Quarterly that have arrived at my door, and for assisting me in laying out my articles and pictures. I'm very pleased with the end results.

What concerns me is the news that a lot of people who where members of GEO have decided not to rejoin the group. This is sad news indeed, and something that needs to be addressed urgently.

Every Group consists of its members: without them there is no Group, and it is sad indeed that more members are not contributing to the Quarterly to help keep the interest and the Group alive. I realise we do not have any new satellites going into orbit yet, and we lost *Envisat* just when it was getting interesting, but that is life—you get ups and downs but you still carry on regardless.

The Group Management needs to address the loss of members as an urgent issue. GEO needs to advertise more openly in different Electronic and Radio Magazines. Going to shows is fine but that needs to change by attending more in different regions—not the same shows as last year. If there is not the budget for this then that should be looked at also. And if there are problems with obtaining material for the Quarterly, then perhaps reduce the print to three issues per year and use the money saved to advertise the Group.

To survive in this extreme financial climate we have to take bold steps. Perhaps it is time the membership was asked for its thoughts on the future of GEO. Let's give up on complacency and lack of initiative and look to the progressive future of GEO, before we have too few members to sustain us.

Keep up the good work Les. We need people like you.

Kind Regards, Mike Stevens (G4CFZ)

Dear Editor,

A big Thank You from my side to all who contributed to the GEO Quarterly 34. I received my copy today (July 12), thanks to the special efforts of David Anderson and Francis Bell. Because of my mild disorganisation and carelessness I had unwillingly postponed my annual fee payment too long, but that's now solved and sorted out. The 'Thank You' extends also specially to the authors and everyone else who contributed time and work towards the Quarterly: also, I assume to several very understanding and patient spouses, if I can extrapolate from my own environment. *Cheers, Ulrich Kliegis, Germany.*

GEO AGM – 2012

Held during the visit to SSTL

Summarised from minutes compiled by John Tellick

GEO held its Annual Meeting at SSTL following the tour of the facility (see page 6), when all present were provided with a pack containing the agenda, balance sheets and reports from the membership secretary and editor.

Director's Report

Francis Bell opened by briefly recounting the rationale for GEO's company status and liability, then voiced his worries about GEO's declining membership. He wondered whether we were missing out on means of attracting new blood to the group, as new members were not coming forward as he would like. He also touched upon *GEO Quarterly*, and whether the balance of articles directed towards beginners and experts was right. Interestingly, Arne van Belle, representing the Dutch organisation *De Kunstmaan*, reported that they faced similar problems to GEO, with an ageing membership and few new young newcomers joining.

This problem was discussed and, in particular, how GEO might attract new members. There was a suggestion from the floor that GEO needed to raise its profile through increased publicity both in the UK and abroad.

Membership Report

David Anderson informed that overseas membership had fallen by 38, although USA members had been increasing for several years. It was suggested that the latter might be as a result of Ed Murashie's articles in the Quarterly and posts on the GEO-Subscribers Internet forum.

A considerable number of new members stay with GEO for only a single year, probably to obtain advantageous prices on equipment. And of course, they can, thereafter obtain the support they require from the GEO Subscribers Internet forum.

There was a suggestion from the floor that an automatic renewal system for membership subscriptions might help the situation, avoiding the loss of members by default. It was agreed that the Director and Membership Secretary would look into this.

GEO Accounts

Based on last year's figures, GEO is only just breaking even. Costs continue to rise, and an increase in subscriptions may be needed. There was some discussion about the merit of a two-tier membership: full membership, with the printed Quarterly and a reduced price membership to receive a downloadable version. But there were problems with this, most notable of ensuring security: preventing copying and sharing by non-members. Also discussed were the possibility of engaging a cheaper printing firm and consulting the membership on their preferences.

GEO Shop

Francis Bell proposed a vote of thanks to Carol and Clive Finnis for running the GEO Shop, along with David Simmons. It continues to be a success and adds considerably to GEO's funds. Carol and Clive have given notice that they wish to retire from running the Shop at the end of this year so, with David Simmons continuing in his support role, GEO now needs someone to take care of the stock holding, ordering, despatch and financial operations.

Editor's Report

Les Hamilton reported that, after some initial doubts over resuming as editor, things had gone really well in compiling the December Quarterly. Article submissions from members had arrived regularly making the task relatively straightforward. Alas, this momentum had not been maintained into the New Year, and he was faced with sourcing/producing a large proportion of the content in both the March and June issues himself. It's a worrying and disappointing trend that so few readers seem willing to support the Quarterly by making contributions these days.

Other Matters

Over the years, GEO has been pleased to welcome several members of *Werkgroep Kunstmanen* to our Symposiums, when they have set up interesting displays. It would be a nice touch if GEO could reciprocate in kind. The Dutch Group are holding a meeting in Utrecht on Saturday, September 8 this year, and David Taylor and Les Hamilton have already made plans to attend. Perhaps some other GEO members would like to join them in the Netherlands.

Everyone voiced thanks to Alan Banks for his efforts in creating the new-look GEO website, and for his continuing efforts in updating it.

Time restrictions at SSTL truncated the meeting, but discussions continued over an evening meal when a number of action points were agreed: to request a quote from our printers regarding a shorter print run for the Quarterly; contacting a sample of members to establish their views about the Quarterly in electronic format; progressing the devolvement of shop responsibilities from Clive and Caron Finnis to a willing member; promoting the advertising of GEO Shop on the web site; to maintain four annual issues of the Quarterly even if shortage of copy meant fewer pages.

Currently Active Satellites and Frequencies

Polar APT Satellites

Satellite	Frequency	Status	Quality
NOAA 15	137.6200 MHz	On	Good
NOAA 17	137.5000 MHz	On	None: scan motor failure
NOAA 18	137.9125 MHz	On	Good
NOAA 19	137.1000 MHz	On	Good / Note 1
Meteor M N1	137.1000 MHz	Sporadic	Note 1

Polar HRPT/AHRPT Satellites

Satellite	Frequency	Mode	Format	Quality
NOAA 15	1702.5 MHz	Omni	HRPT	Weak
NOAA 16	1698.0 MHz	RHCP	HRPT	Good
NOAA 17	1698.0 MHz	RHCP	HRPT	None: scan motor failure
NOAA 18	1707.0 MHz	RHCP	HRPT	Good
NOAA 19	1698.0 MHz	RHCP	HRPT	Good
Feng Yun 1D	1700.4 MHz	RHCP	CHRPT	None: Device failure
Feng Yun 3A	1704.5 MHz	---	AHRPT	Note 2
Feng Yun 3B	17.405 MHz	---	AHRPT	Note 2
Metop A	1701.3 MHz	RHCP	AHRPT	Good
Meteor M N1	1700.0 MHz	---	AHRPT	Note 2

Geostationary Satellites

Satellite	Transmission Mode(s)		Position	Status
Meteosat 7	HRIT 1691 MHz		57.5°E	On
Meteosat 8	HRIT	LRIT	9.5°E	On
Meteosat 9	HRIT 1695.15 MHz	LRIT 1691.0 MHz	0°	On
GOES-12	---	GVAR 1685.7 MHz	60°W	On
GOES-13 (E)	LRIT 1691.0 MHz	GVAR 1685.7 MHz	75°W	On [3]
GOES-14	---	---	105°W	In storage
GOES-15 (W)	LRIT 1691.0 MHz	GVAR 1685.7 MHz	135°W	On [3]
MTSAT-1R	LRIT 1691 MHz	HRIT 1687.1 MHz	140°E	On
MTSAT-2	LRIT 1691.0 MHz	HRIT 1687.1 MHz	145°E	On
Feng Yun 2D	LRIT	SVISSR	86.5°E	On
Feng Yun 2E	LRIT	SVISSR	104.0°E	On

Notes

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

Pacific Glory

A NASA Earth Observatory Report

A layer of stratocumulus cloud over the Pacific Ocean served as the backdrop for this rainbow-like optical phenomenon known as a glory. Glories, which form when water droplets within clouds scatter sunlight back toward the source of illumination, often appear as concentric rings of colour in mist or fog. Although glories may resemble rainbows, they are formed differently. Whereas rainbows are formed by refraction and reflection, glories are formed by backward diffraction. The most vivid glories form when an observer looks down on thin clouds containing droplets between 10 and 30 microns in diameter. The brightest and most colourful glories also form when droplets are roughly the same size.

This this MODIS image captured by NASA's Aqua satellite on June 20, 2012 shows a glory over the Pacific Ocean. In this case the, glory does not appear circular because MODIS scans the Earth's surface in narrow swaths perpendicular to the path of the satellite: the swaths show horizontal cross sections through the rings of the glory, which thus takes the form of two elongated bands of colour.

Another notable feature in this image is the stream of swirling von Karman vortices to the right of the glory. The alternating double row of vortices form in the wake of an obstacle, in this instance the eastern Pacific island of Guadalupe.

NASA image courtesy Jeff Schmaltz, LANCE MODIS Rapid Response

Ice Melting on Lake Baikal

A NASA Earth Observatory Report

For several months each year, Russia's Lake Baikal is covered by a thick layer of ice. Formation begins in late December, and by mid-January the entire lake is usually blanketed. Come spring, the lake begins its long, slow melt. Patches of open water usually appear in the southern part in early May and move progressively northward, but it's usually late June before the last remnants of ice disappear from Baikal's northern reaches.

This Moderate Resolution Imaging Spectroradiometer (MODIS) image from NASA's *Aqua* satellite shows ice breaking up in the central part of the lake in early May. Ice cover remains solid in the north but drifting ice and large patches of open water are visible throughout the southern part. The image also shows 'fast ice' along the coasts—this is ice that is anchored to the shore and does not move with winds or currents. It usually persists longer than ice that forms over deeper water.

A monitoring station at Listvyanka, about 70 kilometres southeast of Irkutsk on the southeastern coast of Lake Baikal has kept uninterrupted records of ice formation and melting dating back to 1869. These reveal some interesting trends related to the timing of ice break-up, most notably that it is occurring earlier nowadays than in the past. In the 1870s, thawing began around May 10; now it often begins in late April. In general terms, the onset of the thaw has advanced by half a day per decade between 1869 and 1999.

Events at Listvyanka don't necessarily apply to Lake Baikal as a whole, however. Satellite data acquired between 1992 and 2004 by NASA's *Jason-1* and Europe's *Envisat* showed that, over the central and northern parts of the lake, ice had been forming later, but also breaking up later and lasting longer overall. For the southern part of Lake Baikal, the satellite data showed that although ice was again forming later in the winter, the timing of the spring breakup remained fairly constant.

The reasons for the changes are still being debated. Air temperatures play a leading role in how long ice persists, and recent decades have seen Siberian winters become colder in response to the Arctic Oscillation. Other factors that can affect how long Baikal's ice lasts, include wind patterns, lake currents, clouds, snowfall, and the volume of river water discharged into the lake.

This image was acquired on May 4, 2012, by the MODIS instrument aboard NASA's Aqua satellite
NASA image by Jeff Schmaltz, LANCE/EOSDIS MODIS Rapid Response

EUMETCast On-Line Registration Guide

If you require to register as a first-time user for any of the free EUMETCast data streams such as MSG, NOAA AVHRR, Metop etc., or need to renew an existing subscription, this must be done on-line.

GEO has produced a step-by-step guide to the entire process at

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

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

GEO Helplines

Douglas Deans
Dunblane, Perthshire, SCOTLAND.
All aspects of weather satellites from APT, HRPT to Meteosat-9 DVB/EUMETCast systems.

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

John Tellick
Surbiton, Surrey, ENGLAND.
Meteosat-9 advice: registering for the various MSG services, hardware and software installation and troubleshooting. John will also field general queries about any aspect of receiving weather satellite transmissions.

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

Geoff Morris GW3ATZ
Shotton, Flintshire, NE WALES.
Geoff has lots of experience with aerial, coax,connectors, mounting hardware etc. and has also done a lot of work with the orbiting satellites. Geoff has been a EUMETCast Meteosat-9 user for some time and is familiar with David Taylor's MSG software. He should be able to share his experiences with newcomers to this branch of the hobby.

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

Mike Stevens
Portland, Dorset, England.
Advice and assistance offered on **EUMETCast** (MSG and Metop) and **Envi-Ham** (including ESA's *Visat* software for decoding the images).

- email: mike1g4cfz@msn.com

Guy Martin G8NFU
Biggin Hill NW Kent, ENGLAND
Guy is prepared to advise anyone who wishing to receive **MSG/Metop** using Windows 2000 or XP. Can also help with networking and ADSL router setup.

- gmartin@electroweb.co.uk

Hector Cintron
San Juan, Puerto Rico, USA
Hector is prepared to field enquiries on HRPT, APT, EMWIN and NOAAPORT

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

Email contact can of course be made at any time, but we would ask you to respect privacy by restricting telephone contact to the period 7.00-9.00 pm in the evenings.

Weather Satellite Reports

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

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

Absolutely everything is covered, and the information is updated every week. Special additional bulletins may be issued if an important change takes place mid week.

You can read the bulletins from this URL

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

or, even better, elect to have the reports sent to you by email every Monday.

Internet Discussion Groups

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

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

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

GEO-Subscribers
This is GEO's own group, where members can exchange information and post queries relating to any aspect related to weather satellite reception (hardware, software, antennas etc), Earth observation satellites and any GEO-related matter.

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

Satsignal
An end-user self help group for users of David Taylor's Satellite Software Tools (SatSignal, WXtrack, GeoSatSignal, HRPT Reader, GroundMap, MSG Data Manager, AVHRR?Manager and the ATOVS?Reader).

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

MSG-1
A forum dedicated to Meteosat Second Generation (MSG), where members share information about the EUMETCast reception hardware and software.

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

Copy Deadline for GEO Quarterly No 36 is Sunday, November 4

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

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

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

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

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

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

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

Submission of Copy
Materials for publication should be sent to the editor,

Les Hamilton
8 Deeside Place
Aberdeen AB15 7PW
Scotland

The most efficient way to do this is by **email attachments** to the following address

geoeditor@geo-web.org.uk

Particularly large attachments (8 MB and above) can be transmitted via *YouSendIt*

www.yousendit.com

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

Group for Earth Observation

Membership Application Form

Current Subscription Rates

United Kingdom ... £20 Europe ... £24 Rest of World ... £28

You can make your annual GEO Membership payment by any of the following methods:

- **PayPal** - Visit the GEO Shop website at ***http://www.geo-web.org.uk/shop.html*** and add your subscription to your basket
- UK residents may pay by means of a **personal cheque** or **Postal Order** made payable to '*Group for Earth Observation*'
- Payment by **direct bank transfer** can be arranged. Please email francis@geo-web.org.uk for BIC and IBAN details.

Name (please PRINT clearly)

Address

Town/City

Postcode/ZIP

Callsign

Country

Telephone Number

FAX

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

Declaration

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

I sign below to confirm that I have no objection to my membership details being held on a computer database and understand that these details will be used *exclusively* for internal GEO administration purposes.

Signature

Date

Your subscription is valid for one year from your date of application and entitles you to all the privileges of membership of the Group for Earth Observation, including four issues of GEO Quarterly. Please note that your subscription will commence with the issue of GEO Quarterly that is current at the time of your application. Back issues, where available, may be ordered from the GEO Shop.

Please send your completed form to:
David Anderson (GEO subs),
35 Sycamore Road,
East Leake
Loughborough LE12 6PP, UK

GEO Subscriptions
35 Sycamore Road,
East Leake,
Loughborough LE12 6PP
England, UK.

If you prefer not to remove this page from your Quarterly, a photocopy or scan of this Membership Form is perfectly acceptable

The Group for Earth Observation Limited is a company in England and Wales, limited by guarantee and having no shares. The company number is 4975597. The registered office is Coturnix House, Rake Lane, Milford, Godalming GU8 5AB.

GEO Shop

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

PayPal®

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

The 'Pager-Hardened' R2ZX
APT Weather Satellite Receiver

This upgraded version of the German-built R2FX receiver has been developed specially for the UK market and is available solely from the GEO Shop. If you are in an area suffering from pager interference on the NOAA-18 frequency of 137.91 MHz, this receiver should be the answer to your problems—see the R2ZX review in GEO Quarterly No 14.

UK members price - £210 **UK non-members price - £224.00**

We still stock the original R2FX receiver which has proved itself to be a top-quality receiver throughout Europe and the world at large. Members in the UK find that the R2FX gives perfect reception of NOAAs 15 and 19, and in favourable locations (pager-free) of NOAA-18 also.

UK members price - £180 **UK non-members price - £194.00**

Current Price List

	Members' Prices			Prices for non-Members		
	UK	EU	RoW	UK	EU	RoW
R2ZX APT Receiver (no PSU)	210.00	214.00	222.00	224.00	228.00	236.00
R2FX APT Receiver (no PSU)	180.00	184.00	192.00	194.00	198.00	206.00
BNC Lead (0.25 metre)	5.50	6.25	6.75	7.50	8.25	8.75
UK Power Supply Unit (12 volt)	10.50	---	---	13.00	---	---
Dartcom High Quality QFH antenna	280.00	360.00	---	300.00	380.00	---
John Silver Preamplifier (built)	36.00	37.00	38.50	41.00	42.00	43.50
John Silver Lightning Radar Board	55.00	58.00	61.00	65.00	68.00	71.00
Bias Tee	25.00	25.50	26.00	29.00	29.50	30.00
GEO-PIC 1.0	7.00	7.80	8.40	7.00	7.80	8.40
Martelec MSR40 EPROM	10.00	10.75	11.25	10.00	10.75	11.25
DVB-S2 USB Receiver (DVBW 2102)	60.00	65.00	---	70.00	75.00	---
DVB-S2 USB-S Receiver (DVBW 2104)	75.00	80.00	---	85.00	90.00	---
Telestar 80 cm dish with LNB	72.00	---	---	79.00	---	---
Telestar Ku band universal LNB	13.70	15.20	---	20.20	21.70	---
Technisat Satfinder Alignment Meter	26.50	29.50	---	29.50	32.50	---
GEO Quarterly Back Issues (subject to availability)	3.50	4.20	5.10	n/a	n/a	n/a
GEO Quarterly (PDF on CD) 2004-2011 (Annual compilations - state year)	8.00	8.80	9.30	n/a	n/a	n/a
GEO Membership (4 magazines p.a.)	20.00	24.00	28.00	20.00	24.00	28.00

All prices are in £ sterling and include postage and packaging

DVBW DVB-S USB2102 Receiver

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

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

DVBW DVB-S2 USB2104 Receiver

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

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

Universal Ku-band Satellite TV LNB 0.20 dB (or equivalent)

This is a quality, high specification Universal LNB for use with the *SkyStar 2* PCI card, Dexatek and DVBWorld USB receivers and digital satellite TV receivers.

UK members price - £13.70
UK non-members price - £20.20

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

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

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

APT Preamplifier

John Silver's APT preamplifier was featured as a constructors' kit in GEO Quarterly No 12 (December 2006). We are able to offer this high-linearity LNA to GEO members, ready built.

UK members price - £36.00
UK non-members price - £41.00

John Silver's Lightning Radar Board

This is a DIY kit for constructing the circuit boards needed to develop your own system to detect and track thunderstorms in your vicinity, using a computer and readily available free software. Full instructions (which appeared in an article in GEO Quarterly 17) are included.

UK members price - £55.00
UK non-members price - £65.00

Ordering and Shipping

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

Orders should be sent to:

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

Orders can be made through the GEO Website using

PayPal®

Not yet a GEO Member?

GEO can provide most of the items advertised (with the exception of GEO Quarterly back-issues and CDs) to both members and non members: but non-members cannot benefit from the discounted members prices.

Why not join GEO and take advantage of the discounted prices we can offer you as a member?

Subscription Rates
(12 months, 4 issues)
for GEO Quarterly are

£20 (UK)
£24 (EU)
£28 (rest of world)

TechniSat SatFinder Antenna Alignment Meter

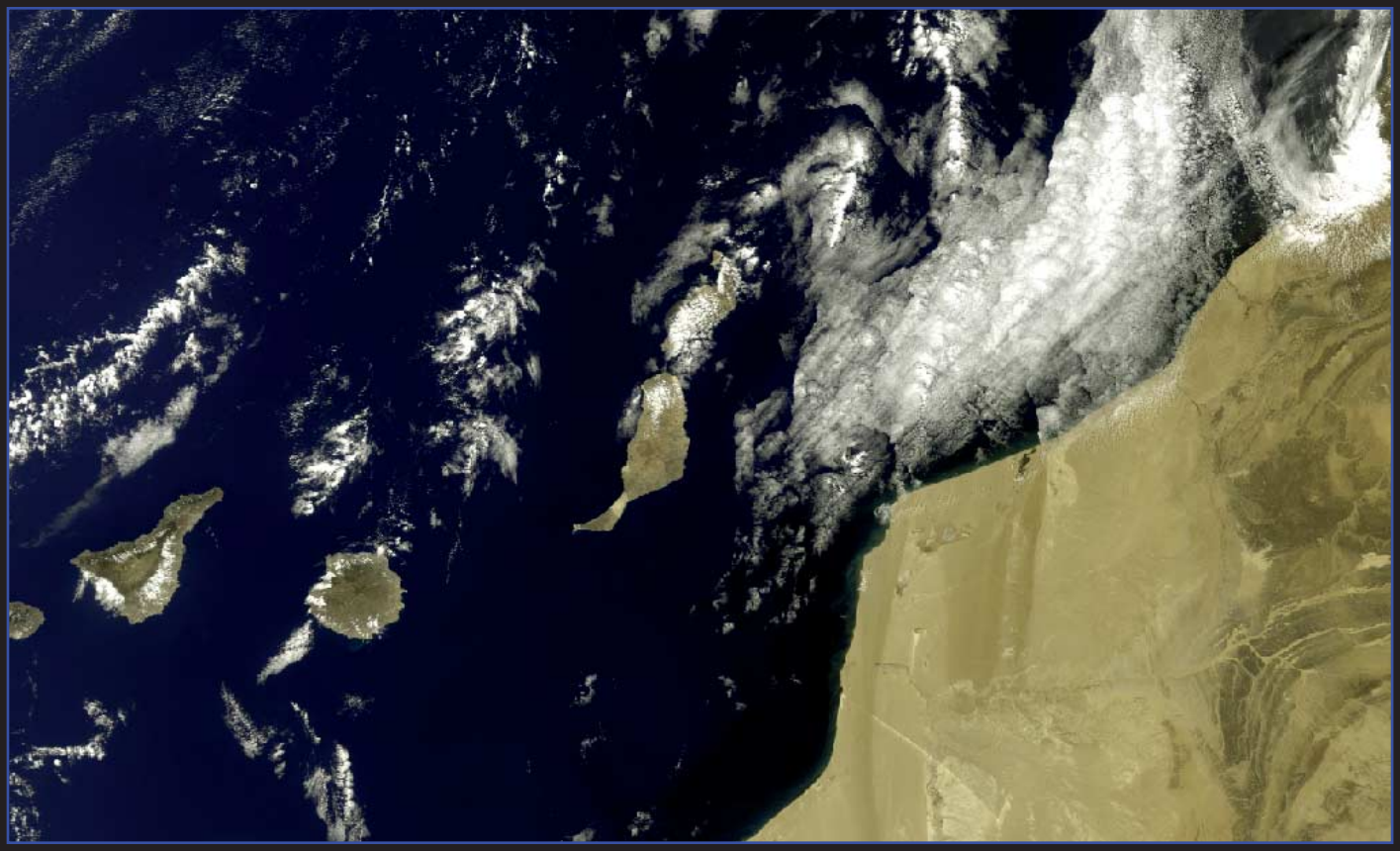
This sensitive meter is a great help in setting up and aligning the dish for maximum signal. The meter comes with full instructions.

UK members price - £26.50
UK non-member's price - £29.50

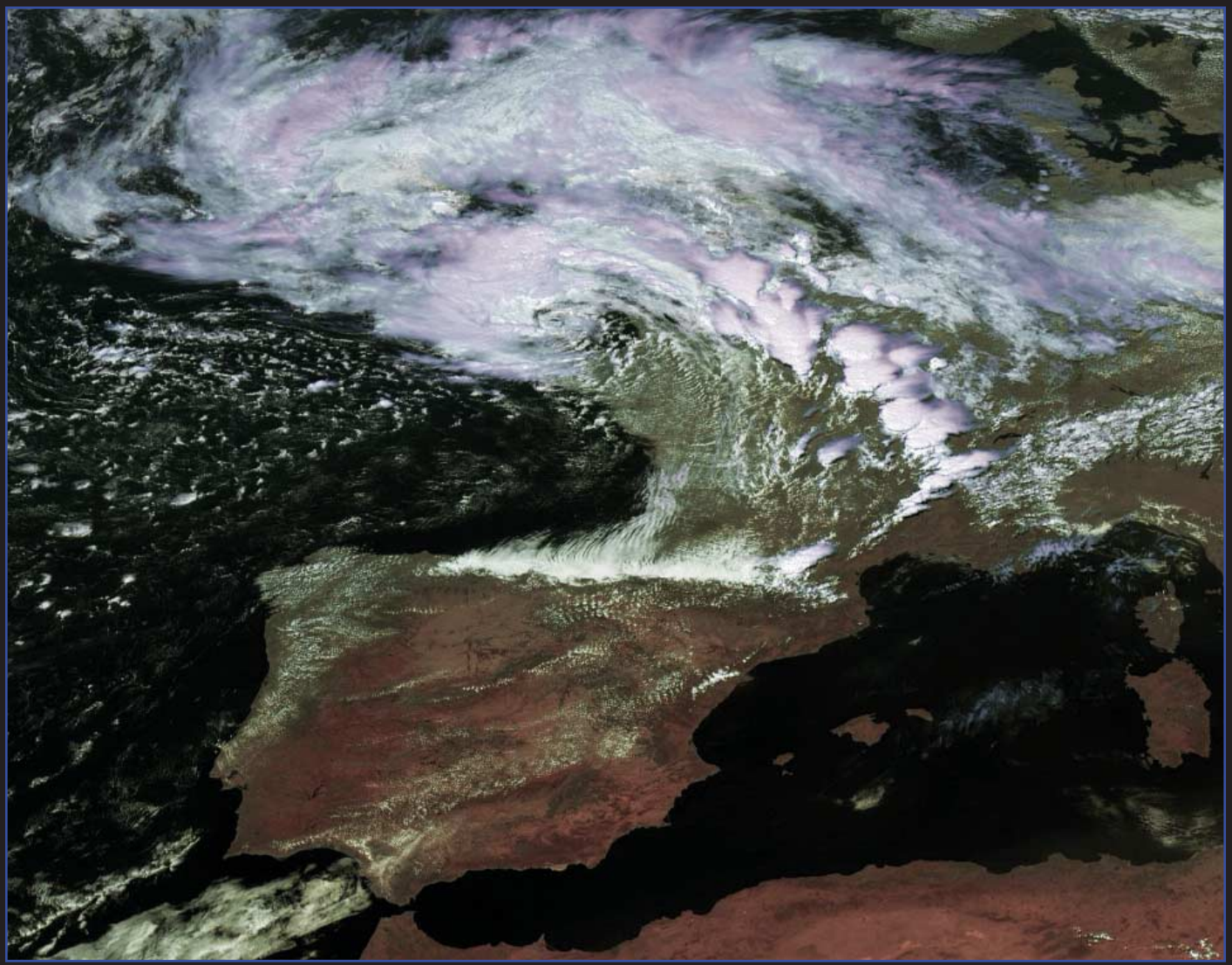
GEO Bias Tee

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

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



Mike Stevens sent us this terrific Envisat MERIS image dating from August 31, 2011, featuring the Canary Islands and part of western Africa.
Image: ESA



Mike Stevens captured a cluster of highly active thunderstorms tracking through central France towards England in this high-resolution Meteosat-9 image, received via *EUMETCast* at 13:00 UT on June 21, 2012.