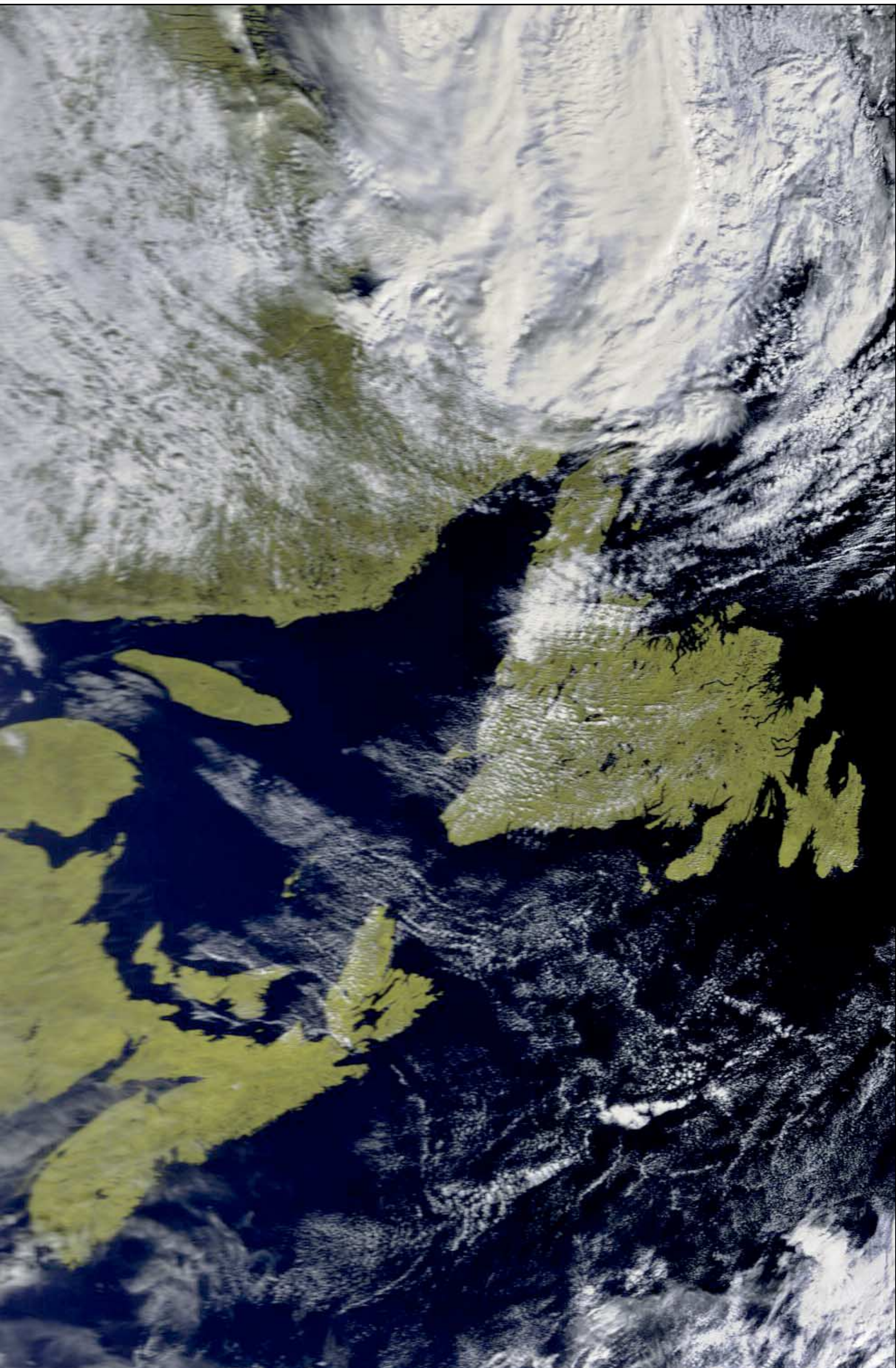
The GEO Quarterly

Group for Earth Observation

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

36

December 2012



Inside this issue . . .

Esko Petäjä has produced an informative article on Fire Detection and Monitoring, where he investigates the important role played by satellites.

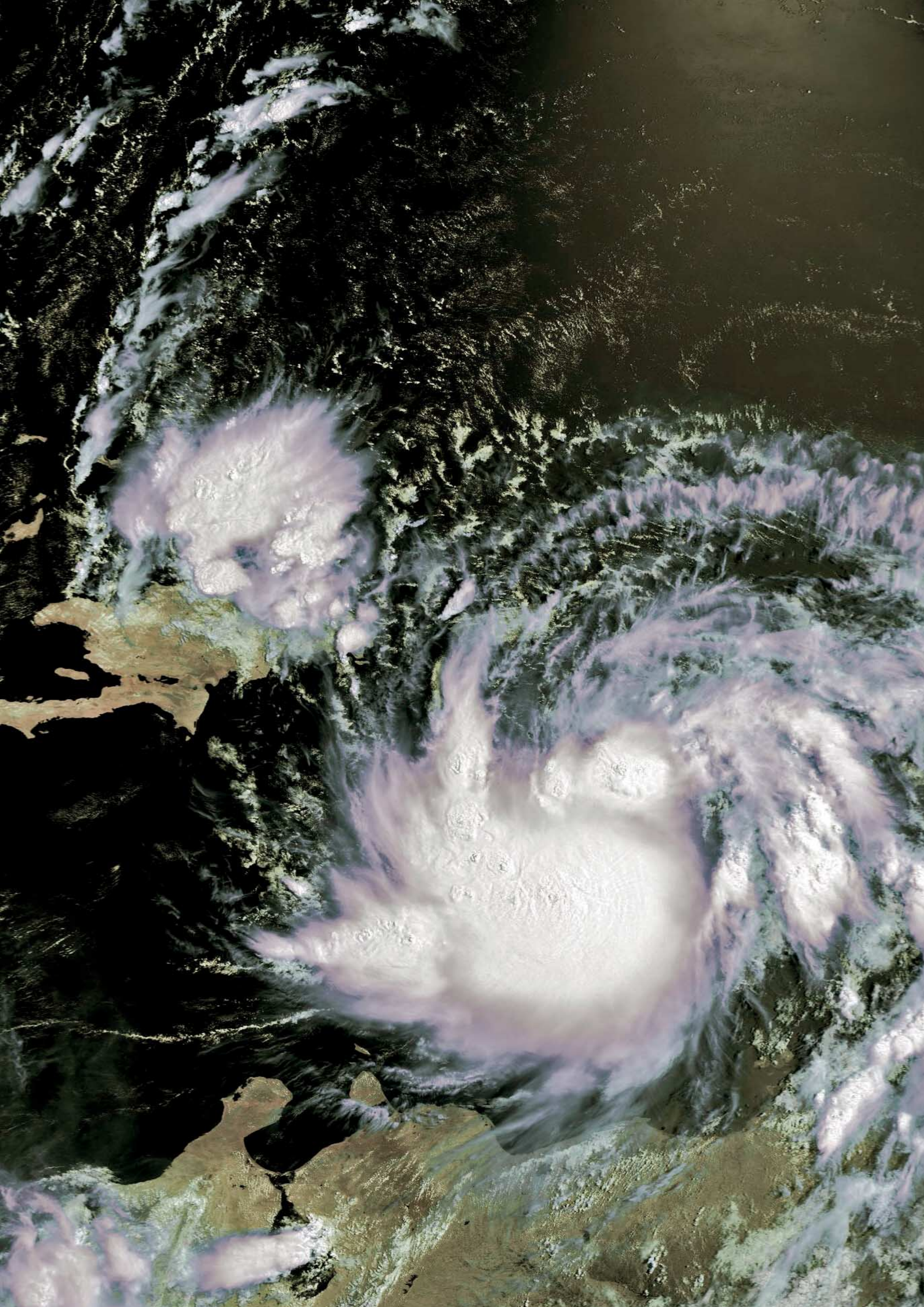
It's now 25 years since the Montreal Protocol was set up to tackle the problem of ozone depletion in the atmosphere. Les Hamilton investigates whether or not it has proved a success.

With MODIS L1 data now beaming down into readers' EUMETCast systems, Mike Stevens takes a look at a popular item of dedicated viewing software.

For readers who like a challenge, Rob Denton is offering some unusual prizes for the 'farthest west' APT image you send him.

Though Envisat is no longer active, Francis Breame provides an informative overview of his experiences while taking part in the Envi-Ham programme.

... plus further articles on Hurricane Sandy, Wildfires in Greece, Auroras observed by the Suomi-NPP satellite.



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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,
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Editorial

Les Hamilton
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The front cover of this issue is graced by some splendid imagery from *GEO Quarterly* reader Robert Moore. Robert sent in a wonderfully clear satellite image of the Falkland Islands that so impressed me that it was a shoe-in for the front cover. Robert also submitted a beautiful panoramic photograph of clouds to illustrate his article on page 33: it also finds a place as our masthead background.

This Quarterly completes GEO's ninth year, and also heralds an important change. Clive and Carol Finnis have now retired after eight years managing the *GEO Shop*, although they remain valuable colleagues on the Management Team. Nigel Evans is the new Shop manager, and is responsible for the acquisition and maintenance of stock. As before, David Simmons mans the 'front office', and processes all your orders. The *GEO Shop* is probably the single most important aspect of GEO. Although your subscriptions pay for the high quality printing of the *GEO Quarterly* magazine, they go little farther than that; it's the profits from the *GEO Shop* that pay for all the 'extras', such as the hefty postal charges for distributing the Quarterly, staging Symposiums, and attending rallies.

You will notice changes to the *GEO Shop* advert inside our back cover. The R2FX receiver has sold out and no more are being manufactured, while, at the time of writing, there were only two each of the R2ZX and the Dartcom QFH remaining in stock (also the last of the line). If you plan to order either of these, email Nigel (see panel at left) to check on availability first. On a brighter note, Holger Eckert is currently designing a follow-up APT receiver to the R2FX/Z, though it is not yet in production. Hopefully, we will be able to bring you news of this in the not too distant future.

May I wish you the very best for the Christmas and New Year seasons ahead, and look forward to your contributions of images and informative articles for the next issue.
Copy Deadline for Quarterly No 37, is Sunday, February 3, 2013.

Contents

The GEO Report

Francis Bell

Recent Launches

My first comment must be to offer congratulations on behalf of all the GEO membership to EUMETSAT and ESA for the successful launch of MSG-3. I watched the launch live on TV and it was impressive. I would also like to congratulate EUMETSAT for the successful launch and the current commissioning phase of their latest satellite Metop-B. Unfortunately I was abroad on holiday for the launch date, so I did not see it live on TV as I had for the launch of MSG-3, but my understanding is that the launch was perfect and the satellite is now safely in its planned sun-synchronous polar orbit. Congratulation to all concerned. I will not dwell on this topic because Metop-B is covered on page 40: nevertheless I still offer congratulation for the successful launch of this satellite from which I hope to receive images for many years to come.

The launch of MSG-3
Image:EUMETSAT

GEO Activities

As usual, GEO has been very active over the past three months. We visited the National HamFest in Newark (see page 15) as well as other local events, and one of our management team visited the *International Meteorological Conference* in Brussels . We continue to have a close relationship with our *Werkgroep Kunstmanen* friends in the Netherlands and two of our members attended their September meeting in Utrecht. Unfortunately, personal prior commitments prevented me from attending.

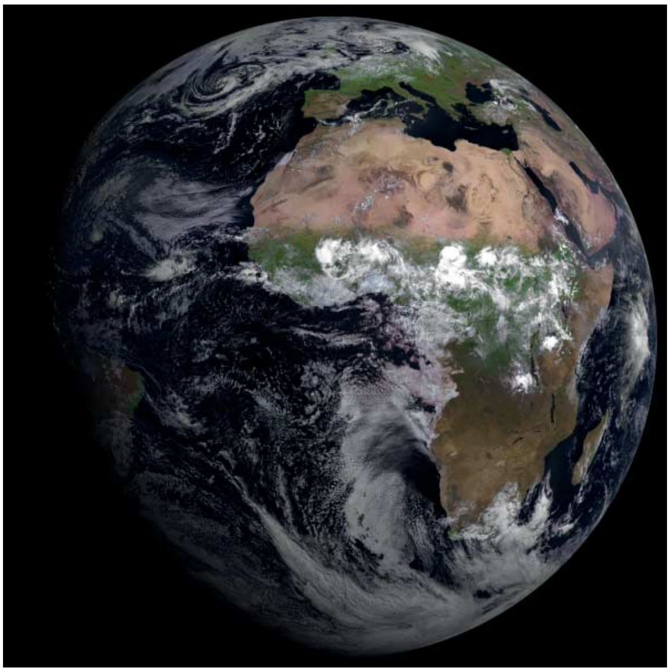
Our programme of visits and meetings for 2013 is still in the planning phase but there are a number of ideas being progressed. Following our successful visit to Surrey Satellite Technology Ltd., we are hoping to visit the UK's largest satellite manufacturer, *Astrium* in Portsmouth, as well as the *National Oceanographic Centre*, coincidently also located in Portsmouth. Approaches to these organisations have already been made and we await their replies with interest. A symposium in 2013 based at Bletchly Park is also being progressed. Our pattern of attending selected radio rallies and similar events has been confirmed as our policy for 2013, and I hope events at Kempton, Newbury and the National HamFest in Newark will have a GEO presence, and perhaps others as appropriate.

Please follow our web site, where the latest news of dates for these and other events will be posted.

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

On the subject of the website, our thanks and congratulations to Alan Banks, who has done an outstanding job in overhauling it and giving it a professional appearance.

In almost every report I write, I express disappointment about the number of members who do not renew their membership with us. We have almost no feedback about why this should be. Over nine years, only a handful of members have given quite understandable and valid reasons for not renewing; in the vast majority of cases, members just disappear without saying why. I judge this is just by default, not taking the active step to renew when the time comes. In order to address this issue, we are investigating alternative subscription payment methods, including offering an automatic renewal if chosen by the member. I hope these changes can be implemented sooner rather than later.



This is the first SEVIRI image transmitted by
MSG-3, at 09:45 UT on August 7, 2012

Educational Support

The UK Space Agency (UKSA) was established last year and currently has offices in Swindon. They produce a quarterly publication *Space:UK* which I have reviewed from time to time in previous GEO Quarterlies. The UKSA has established an educational department, and GEO is in contact with this new venture to assess any ways in which we can cooperate or progress educational ideas. GEO has the experience of establishing and operating low cost weather satellite receiving stations, and with this background we may be able to support UKSA in schools.

Still on an educational topic, GEO has helped an educational group called *Space-Link* to establish a portable EUMETCast receiving station which they can use for demonstrations during their school visits. GEO donated a *DVBWorld* receiver for their new receiving station and helped with its commissioning. I will report further on this project after the system has been used in a number of schools, by when its educational value and the robustness of the system can be evaluated.

APT Turnstile Antenna

Until about a year ago, the *GEO Shop* was able to supply a turnstile antenna for 135 MHz circular polarised APT signals. Unfortunately our supplier exhausted his stocks of specialist parts so, for about a year, we have been unable to supply this antenna. We do recognise a continuing demand for such an antenna, but one problem faced by manufacturers is that no-one knows how long APT will remain available. Recent renewed contact with our supplier has had positive results, as he has discovered a small stock of these old turnstile antennas, which we can now make available to you via the *GEO Shop.* This supplier is currently making a prototype for a new antenna, using different components, and if this proves successful this will also be offered to our members.

Here is a bit of personal heresy, certain to be controversial. I don't think a QFH antenna can out-perform a turnstile antenna for signal reception. A turnstile antenna will receive a signal from horizon to horizon without any dip in strength from the overhead direction. What a QFH antenna may have is physical robustness, making it suitable for marine and other extreme conditions; but for the average domestic or amateur application give me a turnstile antenna any time. My mobile turnstile antenna, which I have taken all over the world, is constructed from coat hanger wire and plastic plumbing tube. It folds up and travels in a suitcase. I couldn't do that with a QFH antenna.

Subscriptions

The cost of GEO membership has not changed for about five years. During this time there have been several increases in postage rates. Until now we have been able to offset some of these additional charges by changing our printer and limiting print runs more closely to our membership numbers. However, the recent substantial increase in postage rates means we are losing money, particularly for overseas readers.

Reluctantly, we have increased membership charges as indicated in the panel at the foot of this column. These increases will take effect from December 1, 2012.

It is worth noting that about 80% of our membership subscription income is spent on printing and postage. To keep costs down we are looking at alternative membership structures; for example, a membership where only an electronic copy of *GEO Quarterly* is available. We are also reviewing other options.

New Subscription Fees

GEO 's subscription fees have remained unchanged for six years, since March 2007, surely unique for any subscription magazine of its quality. But rising costs of materials, and more particularly distribution, mean that GEO is losing over £1000 a year in maintaining this service.

Regrettably, the only way to ensure continuity without eventually bankrupting our organisation, is to increase the fees to a realistic level, as of now.

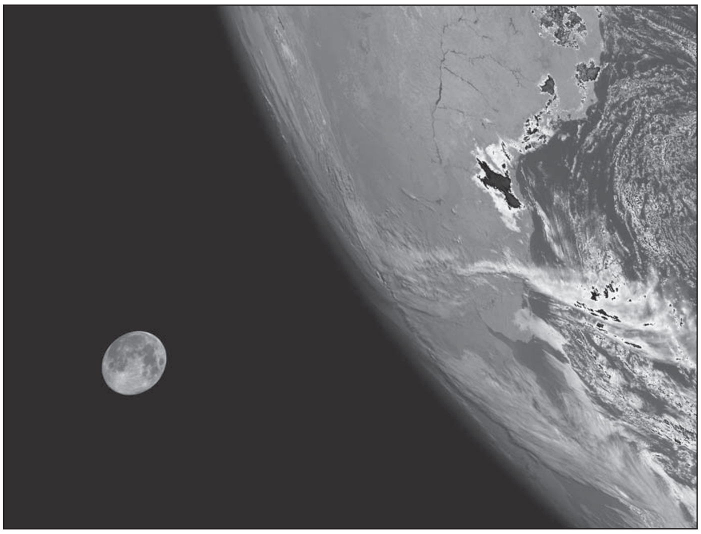
You will find the new costs for membership on the Membership Form on page 47 and the *GEO Shop* page that follows it.on

Blue Moon Imaged by MSG-3

Francis Bell

Readers might be interested in this image, one of the first images received from MSG-3 during its commissioning process. It is shown just as received by the ground station without correction, and is unusual because it shows the moon in the background.

Of course there are many occasions when the moon can appear in imagery from MSG and other geostationary satellites. However, these images are normally rectified to correct the view of Earth as seen from the satellite to a consistent perspective, then cropped prior to retransmission to user communities. This is necessary because gravitational influences from the Moon and sun result in slight deviations of the satellite from its nominal position. The rectification process tends to remove any image of the moon which may be in the background.



The moon appears in this test transmission from MSG-3
Image © EUMETSAT 2012

Once every year there are two occurrences of a Full Moon in the same calendar month. This year, it was August, when the moon was full on both the 2nd and 31st. The second full moon of the month is known as a 'blue' moon, and the August 31 event was captured by the recently launched MSG-3 satellite just before it disappeared from sight behind Earth's southern hemisphere. The infrared image was captured by the Spinning Enhanced Visible and Infrared Imager (SEVIRI) instrument at 11:20 UT on August 31, 2012. The image also shows Brazil's eastern coast along the South Atlantic Ocean, with clouds forming over the water.

Aral Sea Video

Readers who have been following recent articles on the Aral Sea and its catchment area may well be interested in an English language *YouTube* video '*Aral Sea Reborn*' available from this URL

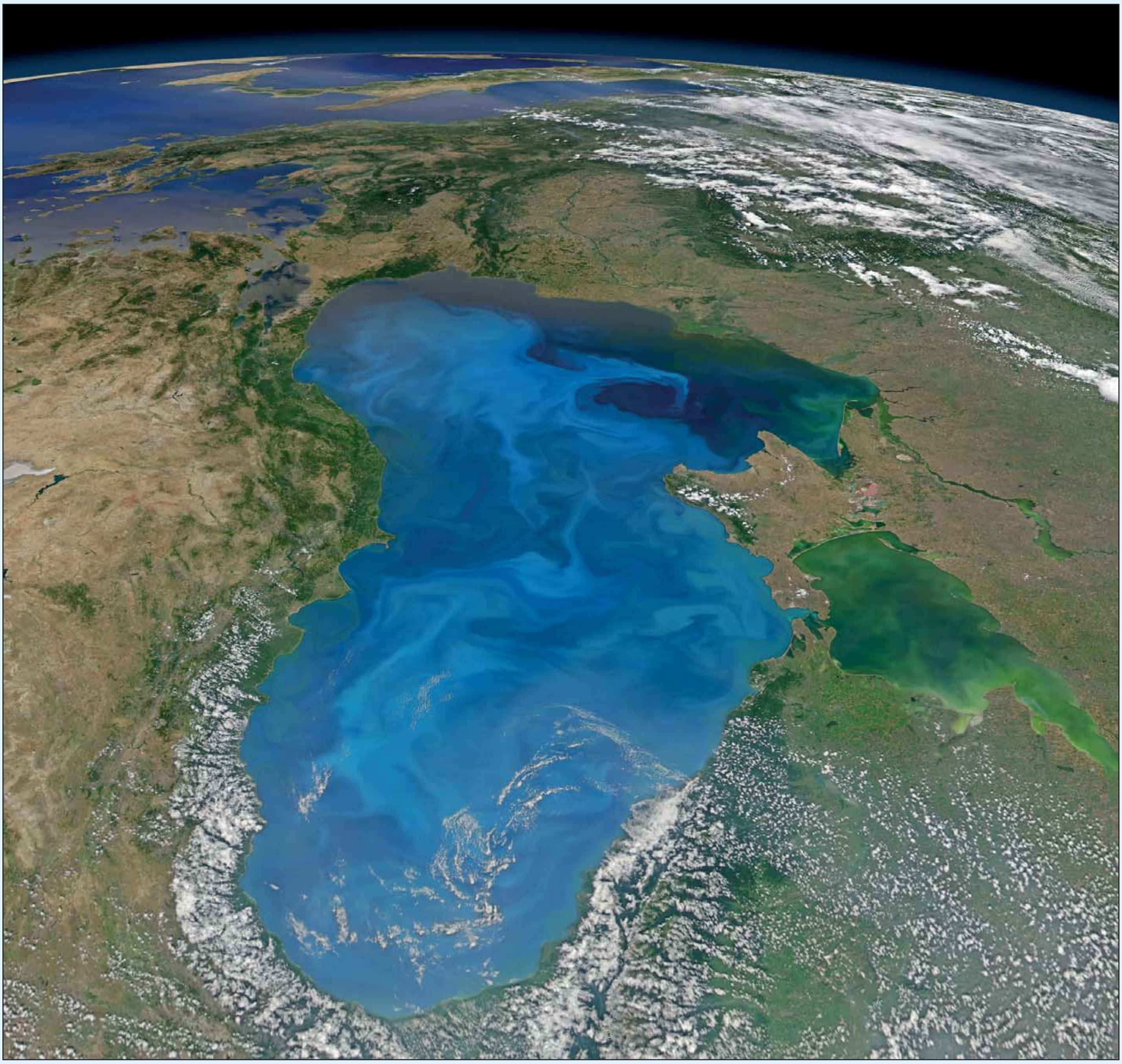
http://www.youtube.com/watch?v=LJnNYDK48kA

This 12 minute film, shot as recently as July 2012, includes archive footage dating from the era before the sea started drying out and is accompanied by eye-witness commentary. Starting in Aral'sk, you are taken on a tour of the Aral basin, past abandoned ships and scrubland to the waters of the North Aral itself.

There is also an explanation of the reasons behind the sea's demise and of the measures in hand to restore the Northern Aral Sea and its fishing industry. Thoroughly recommended.

Carbon Eaters on the Black Sea

A NASA Earth Observatory Report



The swirling cyan patterning across the surface of the Black Sea in this MODIS image, captured by NASA's *Aqua* satellite on July 15 this year, is a bloom of microscopic phytoplankton. The multitude of single-celled algae in this bloom are most likely coccolithophores, one of Earth's champions of carbon pumping. Coccolithophores constantly remove carbon dioxide from the atmosphere and slowly send it down to the sea floor, an action that helps to stabilise the planet's climate. Ocean scientist Norman Kuring of NASA's Goddard Space Flight Center suggested that the bloom was likely to be *Emiliania huxleyi*, though it is impossible to know the species for sure without direct sampling of the water.

Coccolithophores use carbon, calcium, and oxygen to produce tiny plates of calcium carbonate (coccoliths). Often termed 'stones' by researchers, coccoliths resemble tiny hubcaps. During their lifespan, coccolithophores remove carbon from the air, and chemically 'fix' it into what is effectively a form of limestone. When they die, they take it with them as they sink to the sea floor.

These coccoliths are thought to speed up the ocean's biological pump because, without their dense calcium carbonate shells to help them sink, less carbon dioxide would be drawn down into the depths of the oceans.

NASA image courtesy Norman Kuring, Ocean Color Web

QUARTERLY QUESTION

Francis Bell

My thanks to those members who took an interest in **Quarterly Question 35**. The question asked for the mass of MSG-3 at the time of launch. The answer of 2031 kg was given on EUMETSAT's web site and was personally confirmed to me by EUMETSAT Operations. Just four resourceful GEO members provided a correct answer and, although some of the finest detail did vary, they were generally correct.

Correct answers were received from Elmar Bogels (The Netherlands), Frank Skillington (UK), Andreas Lubnow (Germany) and Adrian Chamberlain (UK). Elmar Bogels clearly researched the question thoroughly and submitted the following answer:

> "The dry mass of MSG-3 was calculated at 1064.6 kg, but additionally there was a propellant load of 601.5 kg of MON (mixed oxides of nitrogen) plus 365.5 kg of MMH (monomethyl hydrazine), thus generating the quoted mass of 2031.7 kg The tiny discrepancy when adding these together is probably accounted for by labels removed from the satellite before launch."

Elmar visited the following site for details relating to MSG-3's launch details

http://blogs.esa.int/eolaunches/2012/06/22/msg-3-gearing-up-for-launch/

It is interesting to note that about half the launch mass of the MSG-3 satellite consisted of propellant, and I presume this will be true for many other satellites. Of course, this propellant is necessary to establish the desired orbit after parting from the launch rocket, but also to fine-tune its orbit during the satellite's operational lifetime. Propellant reserves can often determine the operational life of a satellite; all the electronics and sensors may continue to work but, if the satellite cannot be kept in the correct orbit or attitude, it may have no operational value. Often the last remaining dregs of propellant are used to push the satellite into a graveyard orbit more distant from the Earth for decommissioning.

Notes on satellite propellants

Monomethylhydrazine (MMH) is a volatile hydrazine chemical with the chemical formula $CH_3(NH)NH_2$. It is used as a rocket propellant in bipropellant rocket engines because it is hypergolic [1] with various oxidisers such as nitrogen tetroxide (N_2O_4) and nitric acid (HNO_3).

MMH is a hydrazine derivative used in a satellite's orbital manoeuvring system (OMS) and reaction control system (RCS), such as the engines of NASA's Space Shuttle and other large satellites which use MMH and MON-3 (a mixture of nitrogen tetroxide with approximately 3% nitric oxide). This chemical is toxic and carcinogenic in small amounts, but it is easily stored in space where it provides moderate performance for very low fuel tank system weight. Recently the European Space Agency (ESA) has attempted to seek new options in terms of bipropellant rocket combinations to avoid poisonous chemicals such as this and its relatives.

1 Chemicals are termed as hypergolic if they spontaneously ignite on contact with each other.

Quarterly Question 36

This Quarterly Question relates to the orbit of Metop-B and is quite straightforward: '**What is the orbital altitude of Metop-B?**' I will accept answers to within plus or minus one kilometre. Answers to me via email, to

francis@geo-web.org.uk

by Sunday, February 3, 2013. Again there will be a prize of the book *EUMETSAT 25 Years* for one correct winning entry.

Cover and Full Page Images

Front Cover

This splendid **Metop-A** image, showing Newfoundland on September 28 this year, was sent in by Robert Moore, who remarked: "It's not often you get a good view of Newfoundland, Nova Scotia and Prince Edward Island, especially at this time of the year".

Image © EUMETSAT 2012

Inside Front Cover

Mike Stevens spotted this **Metop-A** image on his *EUMETCast* stream on August 23, 2012. Prominent as it tracks westwards north of the coast of Venezuela is Hurricane Isaac.

Image © EUMETSAT 2012

Inside Back Cover

Another image of Hurricane Isaac from Mike Stevens, this time from **Metop-A**, showing the storm making landfall in the USA at 15:40 UT on August 18, 2012.

Image © EUMETSAT 2012

Back Cover

This MODIS L1 image from NASA's **Terra** satellite was acquired by Mike Stevens via *EUMETCast* on August 5, 2012, and shows much of south and central Europe basking in sunshine while western Europe suffered one of its wettest summers ever.

Image © EUMETSAT 2012

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This **NOAA-18** channel-4 infrared image was acquired at 04:03 UT in the early hours of October 27, 2012, when Winter's first icy blast descended from the Arctic over Great Britain. Eastern Scotland in particular awoke to a winter wonderland, which rapidly melted as temperatures rose following late-morning sunshine.

Image: Space Monitoring Information Support (SMIS)
http://smisdata.iki.rssi.ru/data/noaa/html/cat_tlm.shtml?lang=english

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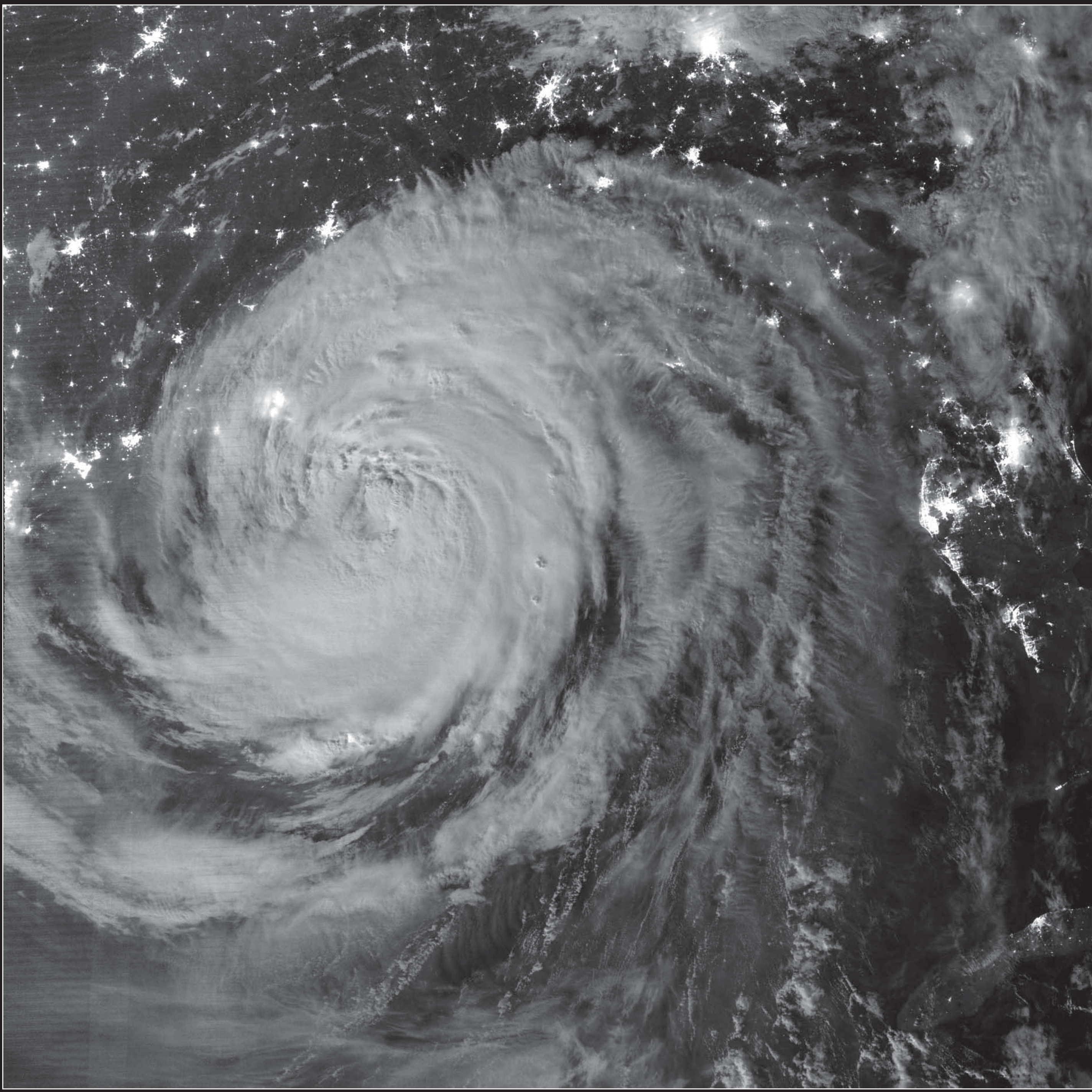
The Drake Passage between the Atlantic and Pacific oceans is one of the stormiest places on Earth. At this latitude, there is absolutely no land mass to dull the intensity of the circumpolar winds and currents that girdle Antarctica. This **Metop-A** image acquired at 13:05 UT on October 27, 2012 illustrates a typical stormy day in the Passage. Part of Argentina, and Tierra del Fuego, are prominent at the top of the image and the Antarctic Peninsula curves like an icy scimitar at lower right. The prominent open water west of the base of the peninsula is a bay in the Bellinghausen Sea off Ellsworth Land, the latter named after the American explorer Lincoln Ellsworth who flew over the region in late 1935.

Image: NOAA Class Archive

Night View of Hurricane Isaac

A NASA Earth Observatory Report



Early on August 29, 2012, the Visible Infrared Imaging Radiometer Suite (VIIRS) flying aboard the *Suomi-NPP* satellite captured this night-time view of **Hurricane Isaac** and the lights of cities near the Gulf Coast of the United States. The image was acquired at 6:57 UT by the VIIRS 'day-night band', which detects light in a range of wavelengths including near-infrared and uses light intensification to detect dim signals. In this case, the clouds of Isaac were lit by moonlight.

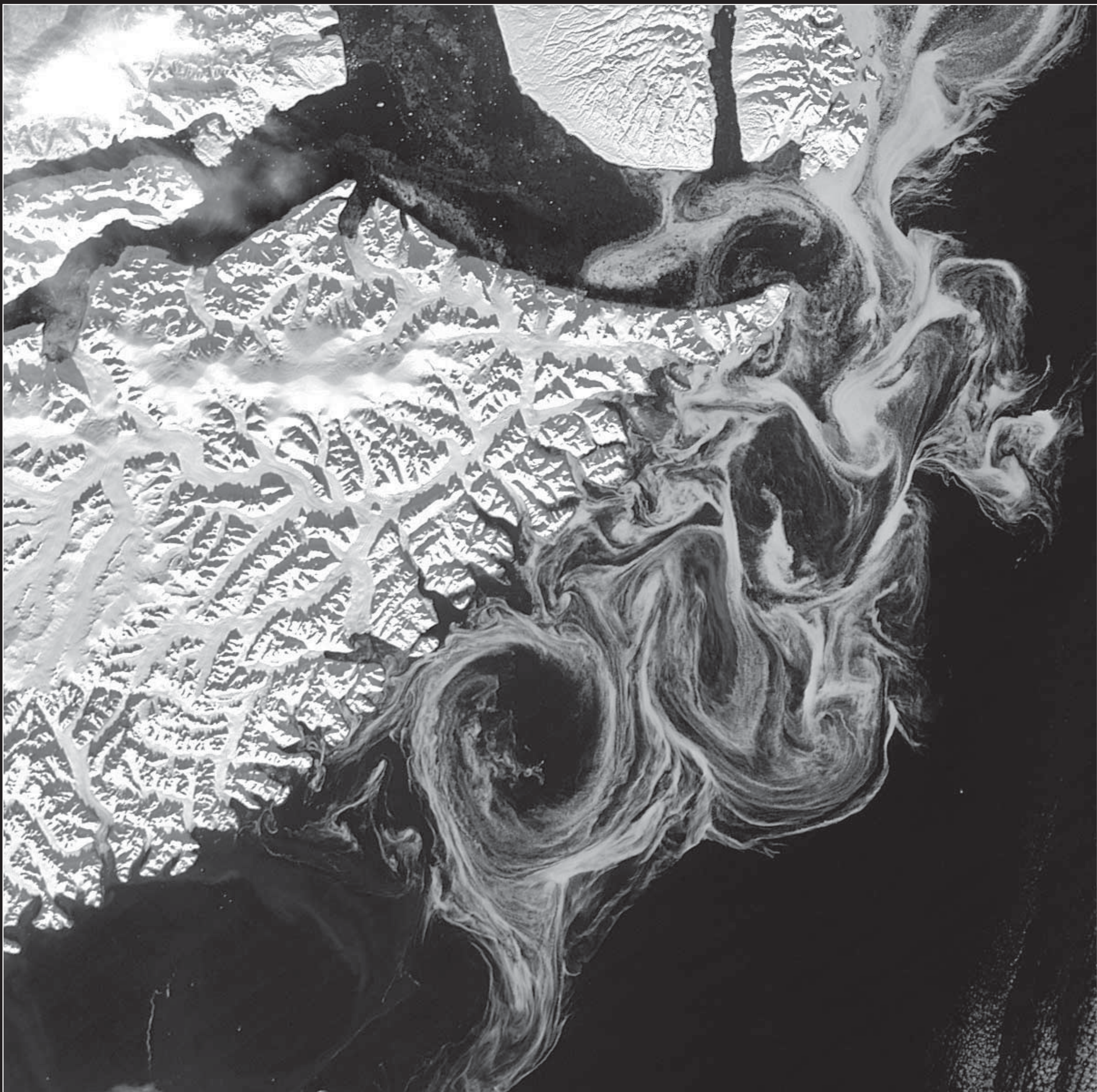
Isaac, a slow-moving storm, had made landfall as a category-1 hurricane, with maximum sustained winds of 130 kph, near the mouth of the Mississippi River in southwestern Louisiana around 23:45 UT the previous evening, then moved westward, back out over water, until making a second landfall near Port Fourchon at about 9:00 UT on the 29th.

As *Isaac* weakened, it churned slowly northwest throughout the day at 9 kph, with a minimum central pressure of 970 millibars. The heavy rainfall, nearly 50 mm per hour at the centre of the storm, deposited up to 36 centimetres of rain across much of Louisiana, southern Mississippi, and southwestern Alabama. Although thick cloud obscures New Orleans itself, the lights of State Capital Baton Rouge shine through the storm at approximately 10 o'clock.

NASA Earth Observatory image by Jesse Allen and Robert Simmon, using VIIRS Day Night Band data.

Swirls along an Ice Highway

A NASA Earth Observatory Report



Sea water off the east coast of Greenland looked a bit like marbled paper on October 17, 2012. The shifting swirls of white in this MODIS image from NOAA's Aqua satellite were sea ice. This ice moved discernibly between October 16 and October 17 because thin, free-drifting ice moves very easily under the actions of winds and currents.

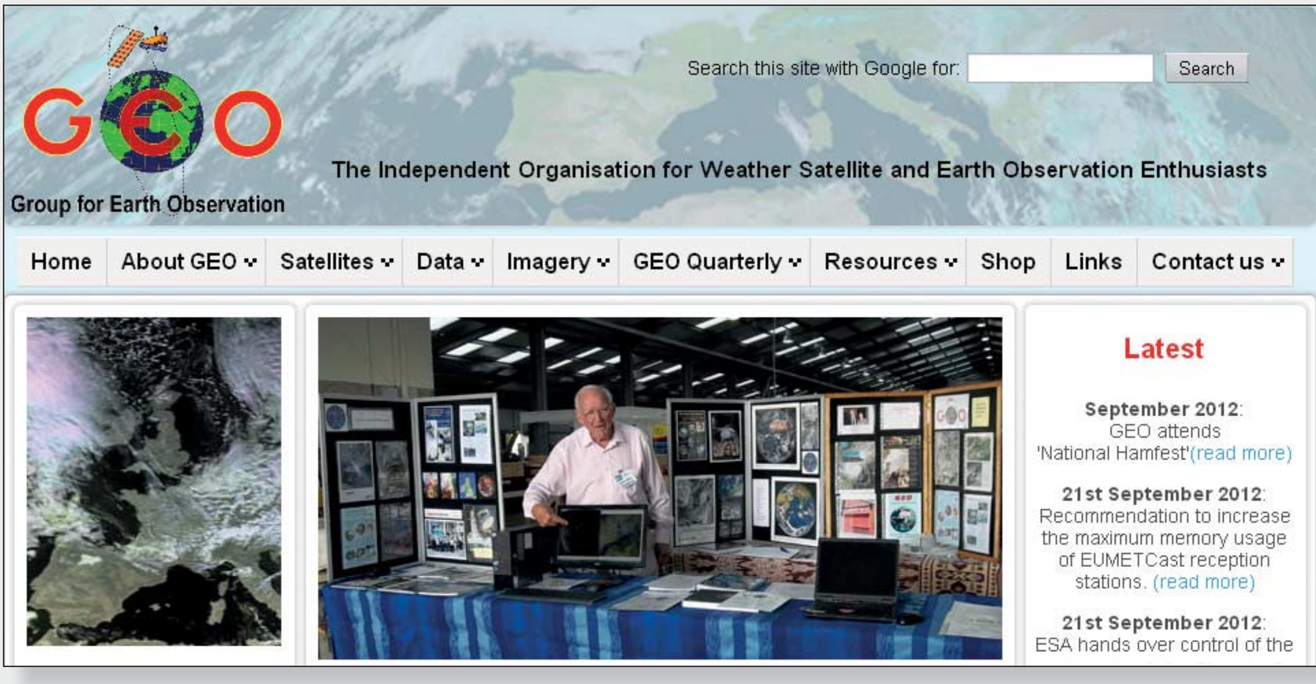
Each year, Arctic sea ice grows throughout winter, reaching its maximum extent around March. It then melts during summer, falling to a minimum in September. By October, Arctic waters start freezing again. However, the ice in the image above is more likely to be remnant old ice that has migrated down to the coast of Greenland, since seawater is unlikely to start freezing so far south as early as October.

The Fram Strait between Greenland and Svalbard serves as an expressway for sea ice exiting the Arctic Ocean. Movement of ice through the strait used to be offset by the growth of ice in the Beaufort Gyre and, until the late 1990s, ice could persist in the gyre for years, growing thicker and more resistant to melt. Since the start of the 21st century, however, ice has been less likely to survive its journey through the southern part of the Beaufort Gyre. As a result, less Arctic sea ice has been able to pile up and form multi-year ice.

NASA image courtesy Jeff Schmaltz
LANCE MODIS Rapid Response Team at NASA GSFC.

Updating the GEO Website

Alan Banks



Towards the end of 2011 there was considerable debate on the GEO-Subscribers *Yahoo* Group about the inadequacies of our website. There were many suggestions for its improvement but few offers of actual 'doing it'.

As I already had experience of managing three other websites, I offered to do so and, perhaps more importantly, try to maintain it as current once redrawn. I didn't anticipate that it would take so long, nor how much I would learn over the following year. Back in 2007, with no knowledge of HTML or CSS, I wrote my first website using the *NVU* authoring package and referring to the Haynes publication *Build your own website* by Kyle MacRae. I progressed over the years to alternative web authoring software such as *Kompozer* and *Web Dwarf* and, for this project, moved to my current editor *Amaya*. All the above are freeware.

Amaya is open source software and still in development, the latest release being January 2012. I use *Amaya* as an HTML and CSS style sheet editor. I like it because one can easily move between HTML editing and a WYSIWYG screen. *Amaya* can be buggy and sometimes crashes, so one has to remember to save the work frequently.

Before settling on *Amaya* I spent some time exploring the open source Content Management System *Joomla,* but ended up not using this as, when a template or 'module' failed, you were stuck, and often the author had moved on. If I had been starting the site from scratch this might have been useful, but the migration of one 'drawing' of the site to another was made easier by using an HTML and CSS editor.

All this was going on whilst we moved house and spent several months doing lots of new house jobs. Eventually, by spring, I got some of the major pages done. With much of the rest of the year being taken up with family and the Olympics, it was only at the beginning of October that I could say that the job was done. Now it needs the be maintained and kept up to date.

I had what I thought was a great dropdown menu that depended on CSS but didn't work on *iPads* and mobile devices. However, the web is a great place to discover things, and after several days of searching I found some *JavaScript* that would do the job. This led me, in a roundabout way, to buying an *iPad* for my wife; now she has gone from zero computer use to avid user of *iPad* and *Facebook* in only a month or so. At least I can use it to check that the website works on more than just my own PC.

The old site structure had more or less disappeared under a mass of unconnected pages, with out-of-date information and old files. Many useful pages had become lost from view. I had to decide what was relevant, where it might go and how it should be arranged so that the navigation menu had a reasonably logical construction. I wanted all this done before writing content in order that I could have one template for all pages. One of the main advantages of *Amaya* is that it immediately tells you whether there is an HTML error, though it can be difficult to pinpoint the actual problem (usually a missing '/' several lines earlier).

There is a new design and layout throughout the site and elements can now be changed without major editing. Every page has the same banner and menu, which I hope gives the site a consistent 'branding'.

Most pages carry a left sidebar with a display of random images, mostly of low resolution, which give a taster as to what our hobby is all about. On the home page is a right-hand sidebar which I intend to develop as a news module to which approved authors can contribute. The home page also features 3-hourly updated imagery from both Meteosat-7 and Meteosat-9 and the 'Imagery' menu leads to some updated satellite imagery, some of it at high resolution with large pictures.

I hope to keep the website reasonably up-to-date with news items. GEO is now present on **Facebook** [1] and **Twitter** [2] and I will try to maintain the links between these and our site. I will experiment with further interactive content and hopefully enable more authors to contribute.

I would like to thank Rob Denton for allowing me to edit his piece on HRPT reception and Les Hamilton for his considerable input on failed links, the quarterly update pages and most recently an excellent page on Metop imagery.

References

1 GEO on Twitter
http://twitter.com/geowebuk

2 GEO on Facebook
http://www.facebook.com/groupforearthobservation

Fire Detection and Monitoring

Esko Petäjä

I participated in a EUMETSAT **Land Surface Analysis** training week during late 2011, part of which dealt with forest fire detection. This experience increased my interest to study more on this topic, as I already do fire patrolling during summer months as part of my activity in the local flying club. This article describes forest fires in general and fire detection using MSG and polar orbiting satellites. Satellite fire detection is mostly used in Africa and Mediterranean areas where fires are an annual problem. Additionally, I have described fire detection and observation from the point of view of my native Finland.

Forest Fires in General

A wildfire is an uncontrolled fire in combustible vegetation, that occurs in the countryside or a wilderness area. A wildfire differs from other fires because of the high speed with which it spreads out from its original source, the fact that it can change direction unexpectedly, and its ability to jump gaps such as roads, rivers and fire-breaks. There are several causes: lightning, a volcanic eruption, sparks from rockfalls and spontaneous combustion. Additionally, fires are often the result of human activity—like arson, discarded cigarettes and sparks from equipment.

The biggest forest fires in Europe were those in Greece in 2007, when a series of massive forest fires broke out in several areas. The effect was the destruction of 2,700 km^2 of forest, as well as 1,000 houses and 1,100 other buildings; many more were damaged. Additionally, 84 people lost their lives. To be able to prevent and monitor fires, several satellite applications have been developed as described below. Figure 1 shows smoke from the Greek fires, the source of each outbreak highlighted in red.

Forest Fire Detection using MSG Satellite Data

The development of forest fire detection is done by the *Land Surface Analysis Satellite Applications Facility* (LSA SAF) located in Portugal. The LSA SAF currently disseminates the following products on an operational basis:

- the Fire Risk Mapping (FRM) product, that provides daily maps of meteorological fire risk over Mediterranean Europe;
- the Fire Detection and Monitoring (FD&M) product, that provides a continuous monitoring of fire activity over Africa and Europe;
- the Fire Radiative Power (FRP) product that allows the estimation of carbon emissions from the vegetation fires.

These data are used in agricultural and forestry applications, together with the growing demands for environmental monitoring and risk management.

Fire Risk Mapping (FRM) product

The FRM product provides daily maps of meteorological fire risk, specially over Mediterranean Europe, where fires are common because of the alternating rainy and drought periods. Vegetation that grows during rainy periods provides good fuel to feed fires during dry seasons. Fire risk is calculated from vegetation type according to the *Global Landcover 2000 Database* (GLC200), which provides information from available fuel and flammability, information on location and duration of fires, and the *Fire Weather Index* using meteorological data to estimate the available fuel and fire spread rate. Figure 2 shows a typical calculated fire risk map.

Fire data is distributed by SAF-Europe, but you need to activate this with *EUMETCast* before you can receive it. The files come in HDF5 format, with filenames such as:

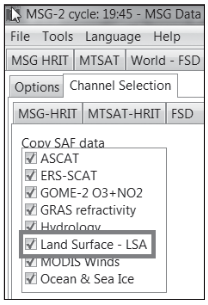
S-LSA_-HDF5_MSG_LSASAF_FRM-F024_Euro_201201251200.hdf5

S-LSA_-HDF5_MSG_LSASAF_FRM-F048_Euro_201201261200.hdf5

To be able to receive fire data through *EUMETCast*,

- add the following to your *channels.in*i file:
  [SAF-Europe]
  target_directory=D:\EUMETCast\received

- in *MSG Data Manager*, open the **Setup** tab, click the **Channel Selection** option, then the **SAF** tab and finally make sure that the **Land Surface - LSA** option is checked.



There are multiple software package's available to visualise Fire Risk. I have been testing David Taylor's *HDF viewer*.

http://www.satsignal.eu/software/hdf-viewer.htm

Data visualisation is also available from the LSA website.

http://landsaf.meteo.pt/algorithms.jsp?seltab=18&starttab=18

Fire Detection and Monitoring (FD&M)

The FRP product estimates the Fire Radiative Power generated during fire events. There are two different presentation methods: Fire pixel and Fire Grid. The *Fire Pixel* method presents data from SEVIRI pixels every 15 minutes, with resolution at the sub-satellite point a nominal 3 × 3 km. The *Fire Grid* method provides data observed by SEVIRI at every 5° of spatial resolution, averaging the total FRP measured over 1 hour.

The FRP is measured in megawatts (MW), representing the amount of radiant heat energy emitted from fire within each pixel. The amount of fuel or biomass burned can be calculated

Fuel biomass burned (kg) = 0.368 (± 0.015) × Fire Radiative Energy (MJ)

Data Visualisation and Delivery

Data is delivered through *EUMETCast* in the form of HDF5 files. There are many HDF Viewers available but they need some scripting to visualise the data. At this time I have not studied them all in detail and plan to write a dedicated article on how to use them at a future date. I find it a great advantage to enjoy software written by David Taylor. It's really easy learn.

Another easy way for visualisation is to use *Google Earth* (figure 3). KLM files can be downloaded from

http://landsaf.meteo.pt/googleEarth.jsp?hh=00&mm=00

Active Fire Monitoring (CAP)

Active fire monitoring makes use of a fire detection product that indicates the presence of fire within a pixel. It uses the fact that the MSG SEVIRI channel IR3.9 is very sensitive to hot spots caused by fires. Additionally to the IR3.9 channel, other channels are used to make detection more accurate according the following criteria:

- Brightness temperature of channel IR3.9
- Brightness temperature difference of channels IR3.9 and IR10.8
- Difference of the standard deviations of channel IR3.9 and IR10.8
- Standard deviation of channel IR3.9
- Standard deviation of channel IR10.8

The product data is delivered using CAP (the Common Alerting Protocol), which is an XML-based data format for exchanging public warnings and emergency information between alerting technologies. CAP allows a warning message to be consistently

Figure 1 - Forest fires in Greece during 2007.
Image:LANCE/EOSDIS MODIS Rapid Response/NASA/GSFC

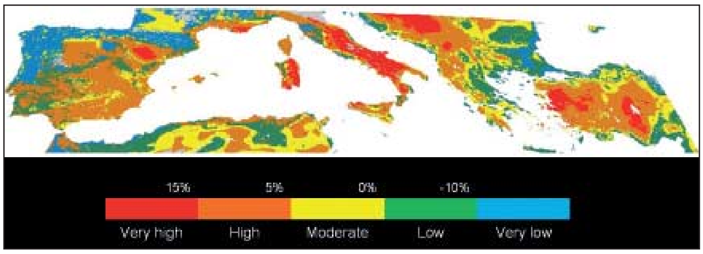


Figure 2 - Fire risk over Mediterranean Europe - © Eumetcast.

Figure 3 - Fire Radiative Power displayed in *Google Earth*.

Figure 4 - A foresr fire detection tower.
Photo © Rajavartiolaitos

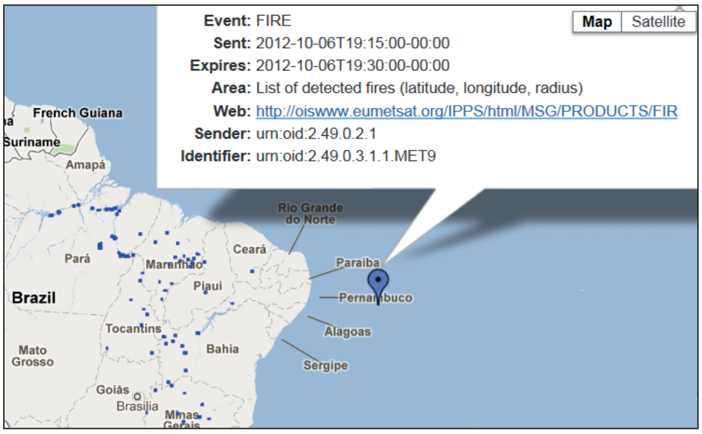


Figure 5 - An example of CAP XML shown in *CAP Validator.*

Figure 6 - Fire data in the MODIS L1 Viewer.

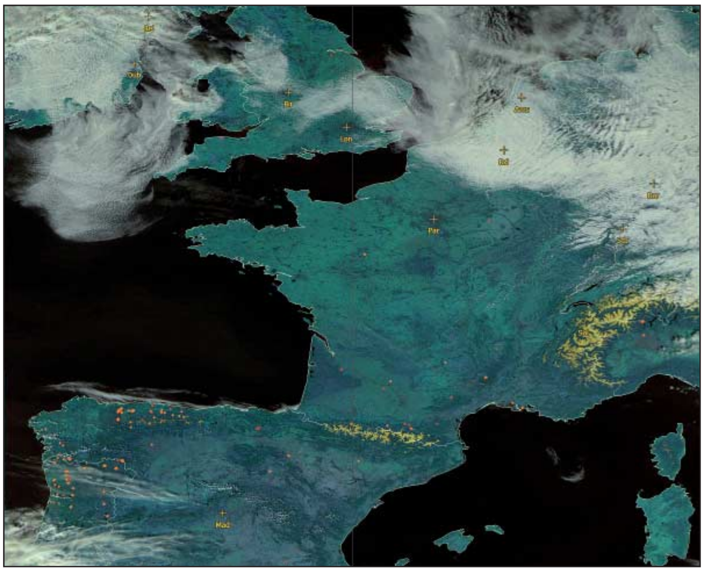


Figure 7 - Fire data in the MODIS L1 Viewer, including a background.

Figure 8 - The effects of the Tuntsa forest fire 40 years on.
Photo © Toinenlinja

disseminated simultaneously over many warning systems, and to many applications. CAP increases warning effectiveness and simplifies the task of activating a warning for responsible officials. Here is an example of a simple CAP XML file showing fire pixel position and radius.


```
<?xml version = "1.0" encoding= "UTF-8"?>
<alert xmlns = "urn:oasis:names:tc:emergency:cap:1.1">
<identifier>urn:oid:2.49.0.3.1.1.MET9</identifier>
<sender>urn:oid:2.49.0.2.1</sender>
<sent>2012-10-06T19:15:00-00:00</sent>
<status>Actual</status>
<msgType>Alert</msgType>
<scope>Public</scope>
<info>
  <category>Geo</category>
  <event>FIRE</event>
  <responseType>Assess</responseType>
  <responseType>Monitor</responseType>
  <urgency>Immediate</urgency>
  <severity>Moderate</severity>
  <certainty>Likely</certainty>
  <effective>2012-10-06T19:00:00-00:00</effective>
  <expires>2012-10-06T19:30:00-00:00</expires>
  <senderName>EUMETSAT</senderName>
  <headline>Fire detection report</headline>
  <description> This is a computer generated report and has not been
reviewed by a human.</description>
  <web>http://oiswww.eumetsat.org/IPPS/html/MSG/PRODUCTS/FIR</
web>
  <area>
  <areaDesc>List of detected fires (latitude, longitude, radius)</
areaDesc>
  <circle>-23.642,21.299 1.757</circle>
  <circle>-21.906,-60.848 3.319</circle>
  <circle>-21.866,-60.721 3.305</circle>
  <circle>-21.876,-60.905 3.324</circle>
  <circle>-21.831,-60.686 3.300</circle>
  <circle>-21.836,-60.777 3.310</circle>
  <circle>-21.841,-60.870 3.320</circle>
```


Figure 5 shows an example of a CAP XML file displayed by *Google's* on-line *CAP Validator service*

http://cap-validator.appspot.com/

The CAP protocol seems to be in early development and at present files have to be manually exported into the application. I believe that this process will become automated in future versions. The philosophy behind this protocol is good as it permits multiple warnings to be displayed on the same map.

Fire Detection using MODIS Satellite Data

MODIS fire data, received on *EUMETCast* data channel-4, can be visualized using the *MODIS L1 & Fire Viewer* from *SatSignal Software*. The viewer has two operating modes, manual and automatic. Manual mode works in a simple way: you just drag and drop the fire data files for the selected date from File Manager into *MODIS L1 Viewer*. The resulting display is shown in figure 6.

Automated Command Line Operations

The processing of fire files can be automated by using command line operations. The command line has parameters for file path, picture size, location, projection and file save location. There's an example of the command line operation I use in the grey panel at the foot of this page.

A further development by David Taylor enables the *MODIS L1 Viewer* to generate and manage background files, which makes

continued on page 34

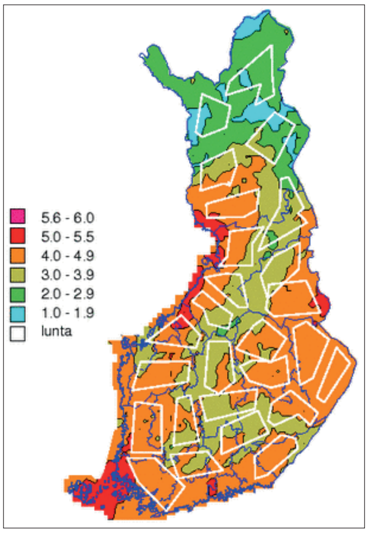


Figure 9 - A forest fire warning index and flight patrolling map (white).
Image © FMI

Figure 10 - Preparing for a fire protection patrol.

Figure 11 - A forest fire near a lake is detected by one of the aerial patrols.

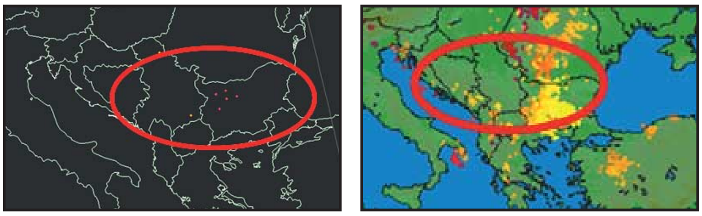


Figure 12 - Correlating lightning with forest fires in the same area.

Command line options for processing fire files

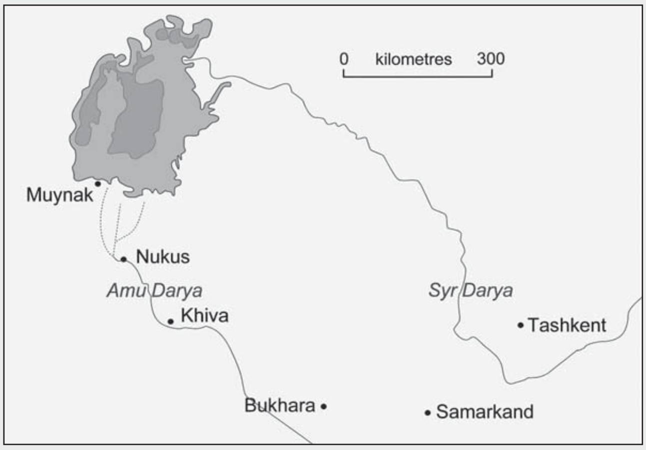
```
MODISL1Viewer -fire:e:\EUMETCast\MSG-2\Fire\2012\06\18 -Width:1200 -Height:1200 -Dlat:50 -Dlon:50 -Par:45 -Mer:0 -Proj:Plate -Save:fire.bmp
```

The Southern Aral Sea

A GEO Reader's Journey through Uzbekistan

Anders Höök and Lars-Olof Hilmertz

From October 1–13 this year, my wife and I, and another couple from Vallentuna in Sweden, joined a charter tour to Uzbekistan. Our journey stretched from Nukus in the western part of the country over Khiva, Bukhara and Samarkand to Tashkent in the east. Our stay in Nukus included an excursion to Muynak, the former big fishing port on the South Aral Sea. An excellent local guide, history graduate Dr Oktyabr Dospanov, who was born near Muynak, accompanied us.



Quite a lot about the Aral Sea has been written in earlier issues of *GEO Quarterly*, notably in GEO Q16 and GEO Q34. It may, however, be appropriate to recall that it is the river Amu Darya that should be feeding the Aral Sea with water from the south, while Syr Darya is feeding the Northern Aral Sea.

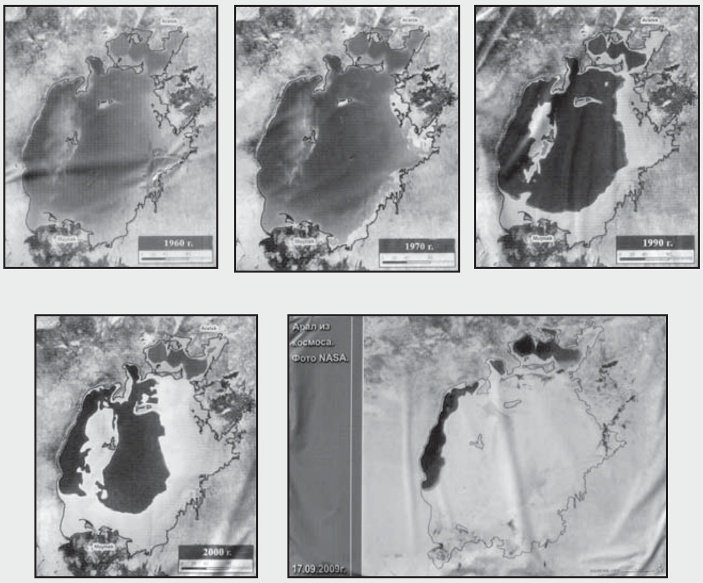
As we travelled by bus from Nukus to Muynak, a distance of some 200 kilometres, we could see remnants of the Amu Darya (figure 1) before finally arriving in Muynak with its entrance monument (figure 2). When the Aral Sea flourished, this town was inhabited by more than 100 000 people. Now, there are fewer than 10 000 people living there, the majority of them partially living on money sent from relatives elsewhere, or from grants from the state.

We went directly to the big monument commemorating the disappeared sea (figures 3,4). Our guide told us how, when he was young, he would accompany his father and others on a fishing boat from Muynak, and how they sailed far out on the sea. What we now saw from beneath the monument was an endless plain stretching to the horizon, littered with a number of stranded ships (figure 5). A close up of one of the ships, with the monument behind can be seen in figure 6. The shipwrecks shown in the photos are more or less a museum these days. Most of the ships that were stranded by the receding Aral Sea have now been sold off for scrap, broken up and taken away. Just those pictured, and a few others, are preserved. A view back towards Muynak from where the ships now lie is shown in figure 7. Walking a little bit further into Muynak, we came upon another ship preserved as a monument. You can see it in figure 8, with part of the town in the background.

Our guide also told us that he remembered about one day in 1965 that the water level of the Aral Sea suddenly fell by several metres. Everyone was frightened, but the authorities assured them that this was nothing to be scared of. Such things could happen now and then. They claimed that the sea level would soon return to normal—but it never did.

It is said that there is a 600-kilometre underground connection between the Aral Sea and the Caspian Sea. The Caspian Sea has a level some 28 metres <u>below</u> mean sea level, while the South Aral Sea lies 29 metres <u>above</u> it. So water transfer is theoretically possible from the Aral to the Caspian. It has also been said that the level of the Caspian Sea increased considerably at the same time. There are suspicions that some sort of experiment, military or otherwise, was carried out in or near the connection at that time, but this has never been confirmed. If it was so, it could have been a tremendous temporary outflow from the Aral Sea to the Caspian Sea.

The well known disappearance of the sea is described in a series of posters beside the monument, as shown below. You can see two of the posters behind the monument in figure 3.



Maps at Muynak illustrating the disappearance of the South Aral Sea

As pinpointed in the article on the Aral Sea in GEO Q34, there are no plans to restore the Southern Aral Sea; interests are rather directed towards extraction of oil and gas. We saw some such installations on our way.

Our guide told us how, some 15 years ago, efforts were made to stabilise the dusty bed of the sea by planting tamarisk bushes, which bind the sand; some of these bushes can be seen in figures 5 and 7.

The eastern part of the Southern Aral Sea is nearly nonexistent, while the western part still holds a lot of water. Its length is roughly 150 km and it is about 30 km wide. Our very pleasant and knowledgeable guide told how, every year, he goes to a camp on the shore of the western part of the Southern Aral Sea for bathing.


Figure 1 - The Amu Darya between Nukus and Muynak

Figure 2 - The impressive monument at the entrance of Munyak

Figure 3 - The monument to the Aral Sea in Muynak (front view)

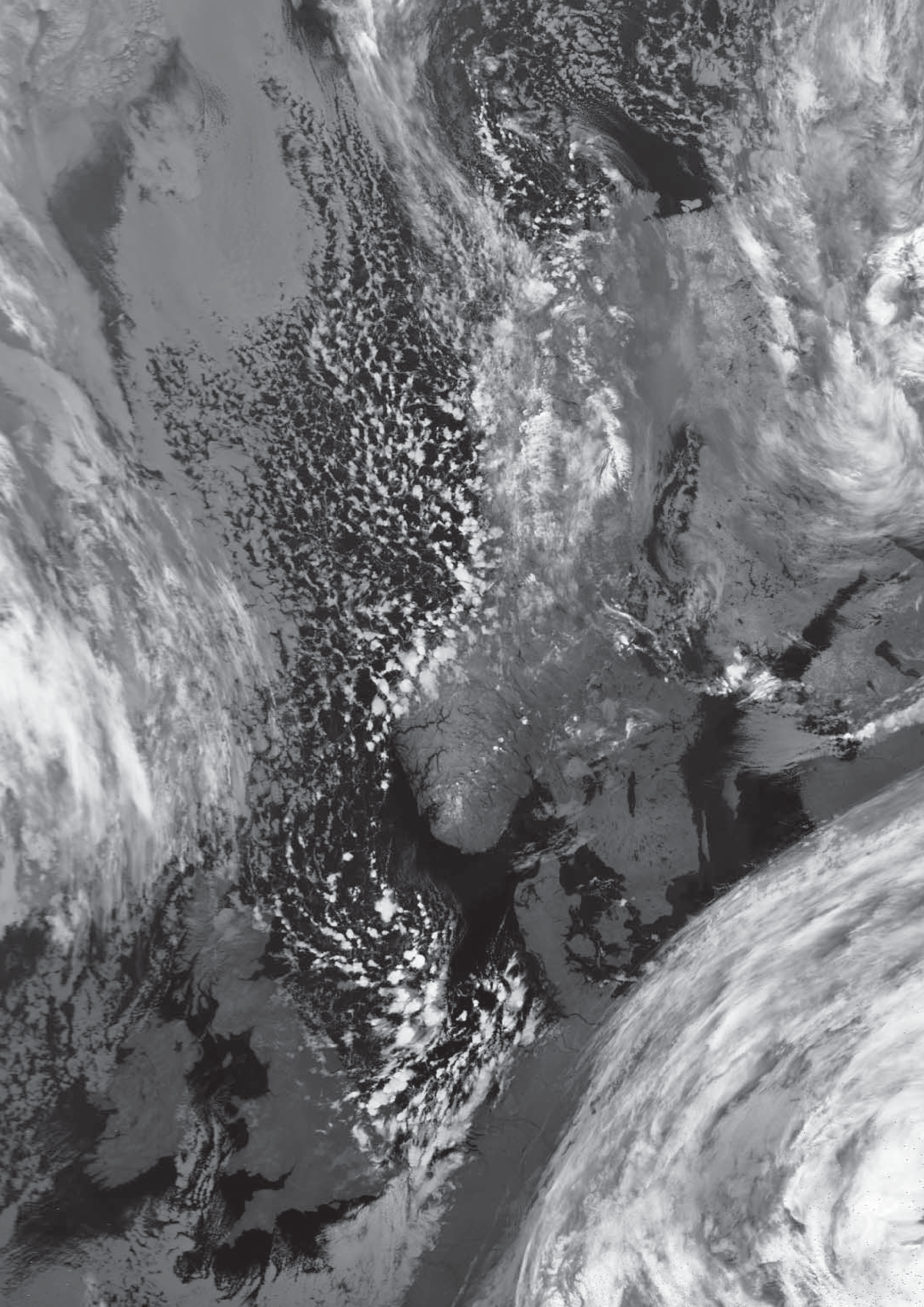
Figure 4 - The monument to the Aral Sea in Muynak (back view)


Figure 5 - Ships stranded in the former South Aral Sea near Muynak


Figure 6 - A close-up view of one of the stranded ships


Figure 7 - The view from the stranded ships back to the shore at Muynak


Figure 8 - A ship-memorial in the town of Muynak



A Satellite Dish for a Mobile EUMETCast System

Francis Bell

GEO has recently been supporting the educational group *Spacelink Learning Foundation* to establish a mobile *EUMETCast* receiving station which will enable them to demonstrate live reception of *EUMETCast* images in schools.

For my own mobile *EUMETCast* station, which I transport to rallies and exhibitions, I take either a 60 cm or 80 cm dish mounted on a low flat stand. This is easy to deploy but, with its fixed fittings, is rather bulky to move around. For the *Spacelink* station, we discovered the availability of a 60 cm dish complete with a tripod stand designed to fold up and pack into a bag not much bigger than the diameter of its dish. This was judged to be a potentially useful piece of equipment for a mobile station.

This dish is supplied by *CPC Farnell*, as their Portable Satellite Kit (Order code: AP02012, Manufacturer Part No: 120.791), at a cost of £98.27, including VAT and delivery. To contact the company go to

www.cpc.farnell.com/dishes

The *Farnell* tripod mounted 60 cm dish is shown on the right of this photograph with the author's fixed-mount 60 cm dish is on the left.

Kit Specification

This portable satellite dish kit is ideal for digital satellite reception when camping or touring. The 60 cm elliptical dish has a folding LNB arm for ease of transportation and includes a universal LNB, lightweight aluminium tripod and a tough black weatherproof carry bag. Also included are a satellite finder, compass, 3 x 230 mm hooked securing pins and 15 m of white coax cable with four F-plugs and rubber sleeve.

Technical Data

LNB gain	65 dB
LNB input frequency	10.7 - 12.75 GHz
LNB noise figure	0.3 dB
LNB output frequency	950-2150 MHz
Overall weight	7 kg
Tripod height	1 metre

The first use of the dish was very encouraging and straightforward. The tripod provided the fixed base, and the outward folding arm—which carried the LNB—locked into position without further adjustment. With the tripod placed in a position for the approximate direction of the satellite, signal fine adjustments for azimuth and elevation were provided by swivel points and wing nuts which proved easy to use. A meter was used to align the dish for maximum signal reception and, with a strong signal from *Eurobird 9* at 9°E carrying EUMETCast transmissions this, was easily achieved.

I think this tripod mounted dish may be a useful asset for any GEO member operating a mobile receiving station, or even for someone at their own home where planning requirements may restrict the deployment of too many permanent dishes.

Note

Although EUMETSAT recommend a dish slightly larger than 60 cm for EUMETCast reception, my 60 cm dish has proved satisfactory from many locations in England.

National Hamfest - 2012

Francis Bell

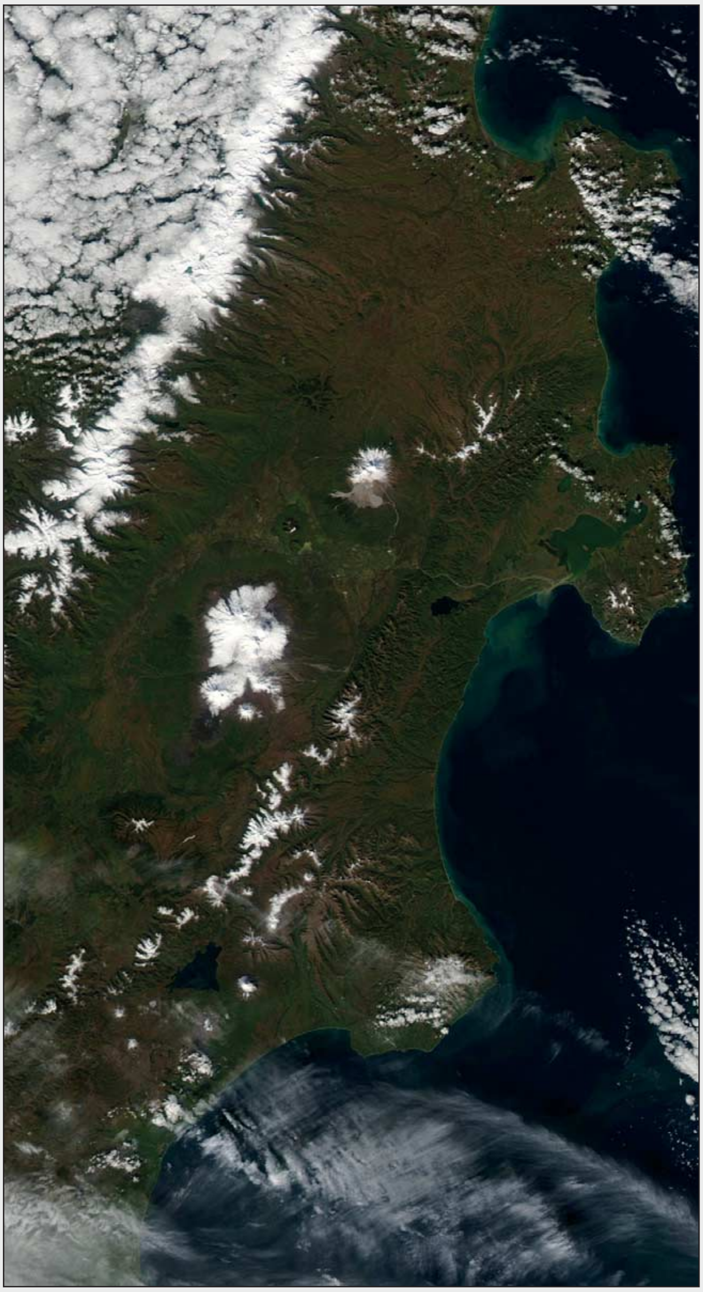
This was the fourth time that GEO has run a stand at the National HamFest, held on the Newark showground. The event proved as popular and successful as ever, with many hundreds of visitors attending on both the Friday and Saturday. The GEO stand proved to be very popular with its displays of EUMETCast and APT images plus our literature. Many visitors expressed interest for their personal reception of weather satellites and took away our leaflets, which outline how this could be readily achieved. Some visitors were interested enough to join GEO on the spot, and a number of others renewed their memberships. Several visitors, whose own past careers were in the space industry, were impressed with what could be achieved so easily at home.

Francis Bell and GEO's company secretary Nadine Bell, pictured after setting up the GEO stand at the National HamFest on the Thursday, prior to the two event days of Friday and Saturday.

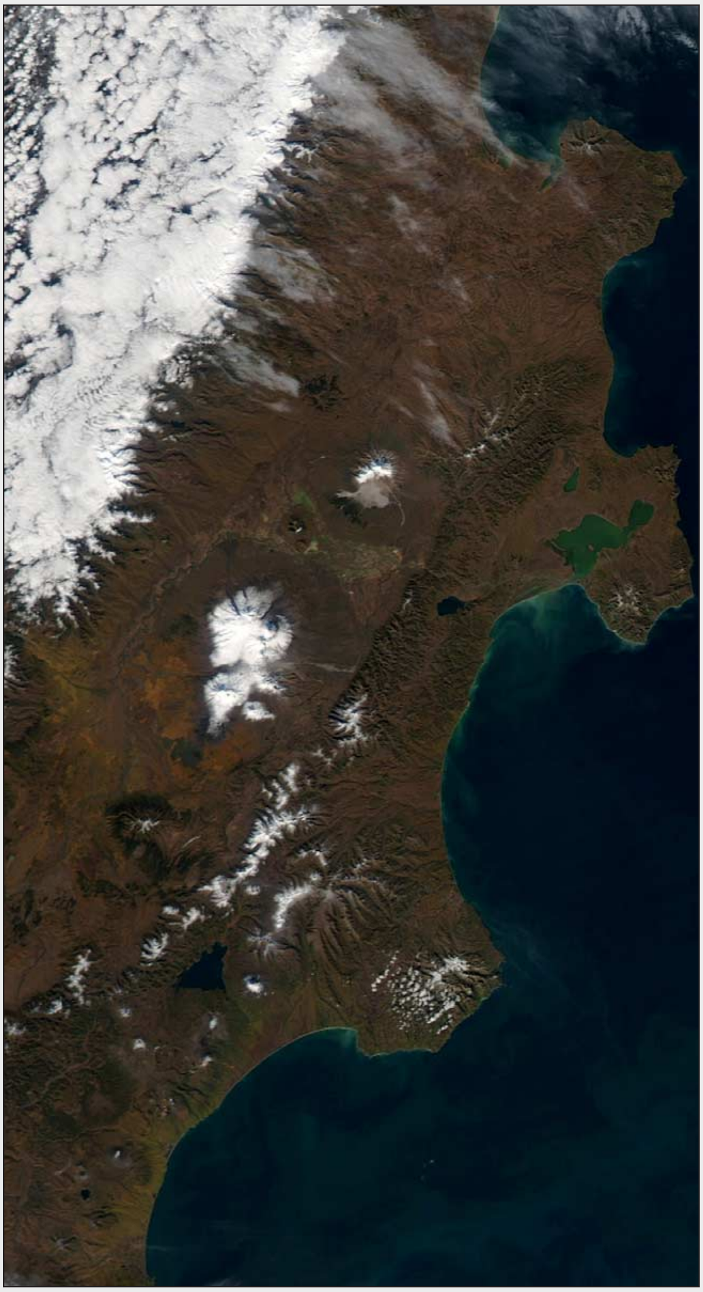
Two members visiting the GEO stand at Newark. Conversation revealed that they were very talented with the use of computers and their multi-tasking capabilities including weather satellite reception.

Autumn Colours sweep across Kamchatka

A NASA Earth Observatory Report



September 20, 2010



October 1, 2010

With temperatures dropping in the northern hemisphere, autumn colours swept across the taiga forests of the Kamchatka Peninsula in October 2010. Within a span of 11 days, the forests of far eastern Siberia changed from green to deep brown. The Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's *Aqua* satellite captured the transformation beautifully in the two images on these two images.

The top image dates from October 1 and the other from September 20. The forests shown surround the snow-covered active volcanos of Bezymianny, Klyuchevskaya, and Shiveluch.

In autumn, leaves change colour as they lose the green chlorophyll which absorbs red and blue components from the sunlight striking their surfaces. As the concentration of chlorophyll drops, the green colour in leaves fades, allowing other pigments such as carotenoids and anthocyanins to display their colours. Carotenoids absorb blue-green and blue light, and in the absence of chlorophyll they cause leaves to appear yellow. Anthocyanins absorb blue, blue-green, and green light, and light reflecting off them appears red.

The range and intensity of autumn colours is strongly affected by the weather. Low temperatures and bright sunshine destroy chlorophyll, but temperatures above freezing make it easier for anthocyanins to form. Dry weather, which increases the sugar concentration in sap, also increases the amount of anthocyanin. So the brightest autumn colours occur when dry, sunny days are followed by cool, dry nights.

NASA Earth Observatory images by Robert Simmon, courtesy of the LANCE/EOSDIS MODIS Rapid Response Team, GSFC.

Wildfire Rages

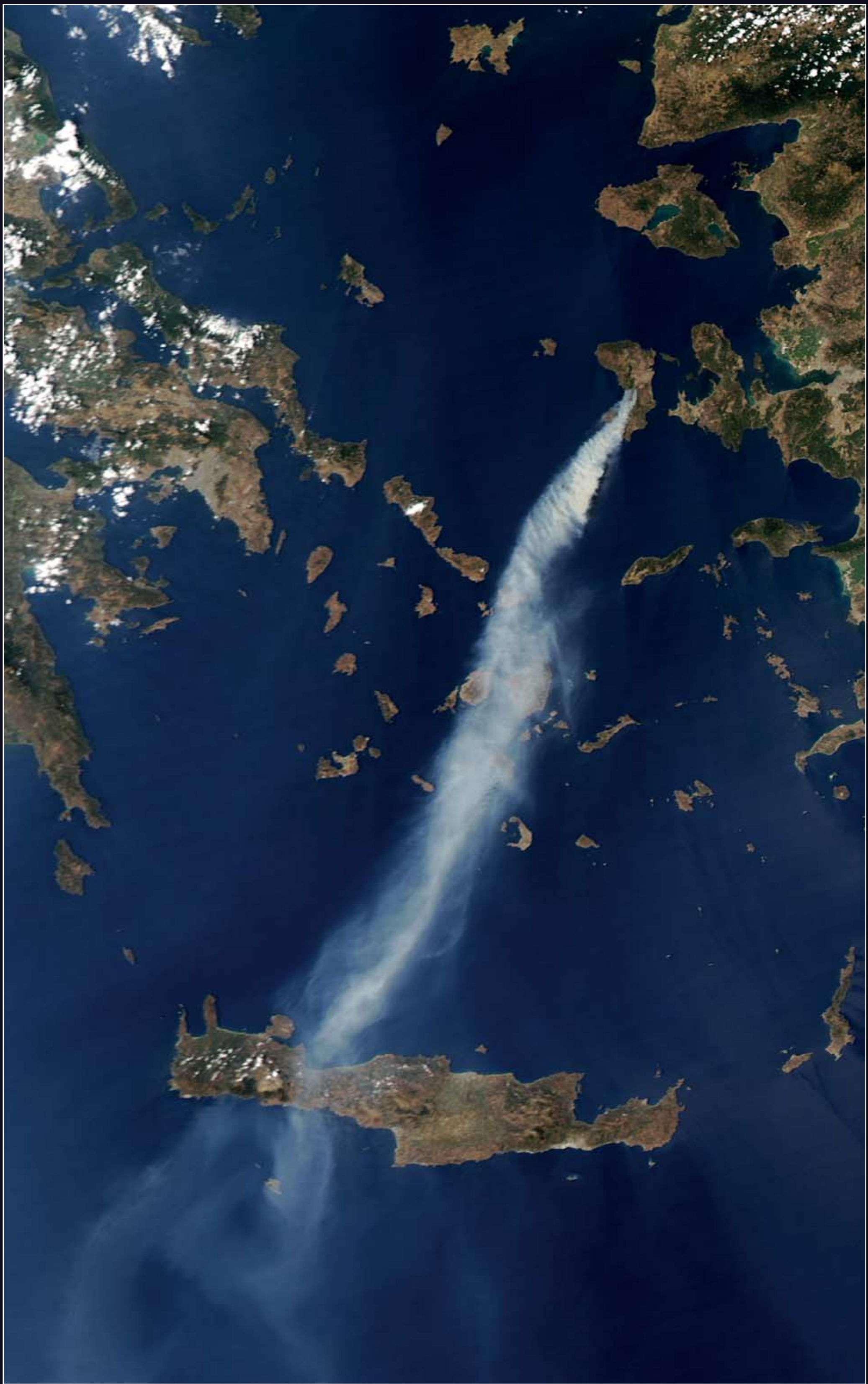
on the Greek Island of Chios

NASA Earth Observatory

The Greek holiday island of Chios, fifth largest in the Aegean Sea, was hit by a devastating wildfire which broke out in the early morning of August 18. With strong winds fanning the flames, numerous villages had to be evacuated, the residents left watching from the beaches as fire ravaged their islands forests and arable land. Local media reported that smoke from the fire could be seen from Crete, almost 100 kilometres to the south. Several hundred firefighters, soldiers and volunteers battled with the blaze over four days, by which time almost 13,000 hectares, comprising almost half of the island's forest and farmland, had been destroyed. But gale-force winds hampered their efforts, preventing water-bombing aircraft from flying over the conflagration.

The most serious casualty of the fire was Chios' gum mastic industry. *Pistacia lentiscus* is a deciduous shrub, widely cultivated throughout Chios for its aromatic resin—known as mastic— which is used world-wide as a cooking spice and for other culinary purposes, as well as in pharmaceutical products. Mastic possesses antibacterial and anti-fungal properties, and is widely used in the manufacture of ointments for skin disorders.

Mastic resin has long been a major source of income for the islanders of Chios, but with more than half of its mastic orchards destroyed, the fire has been a massive financial disaster. The orchards must now be replanted, but It could be as long as eight years before the shrubs become mature enough to start producing mastic again. The importance of this crop can be gauged from the fact that, In 2011, 53% of the European Union's entire mastic production came from Chios.



This MODIS image, acquired from NASA's *Aqua* satellite, shows the Chios smoke plume drifting towards Crete on August 18, 2012.

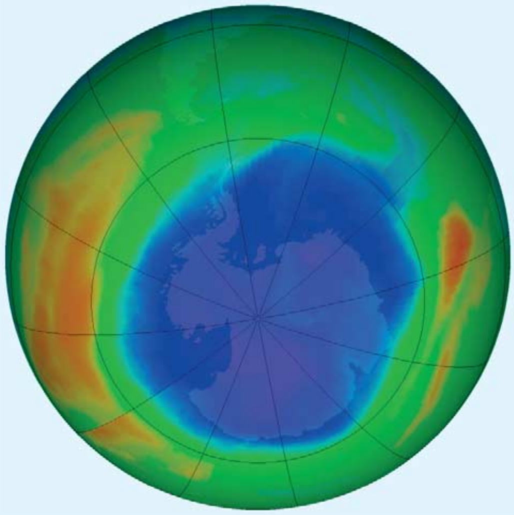
NASA image courtesy Jeff Schmaltz
LANCE MODIS Rapid Response Team
Goddard Space Flight Center

How the Montreal Protocol has affected The Ozone Hole

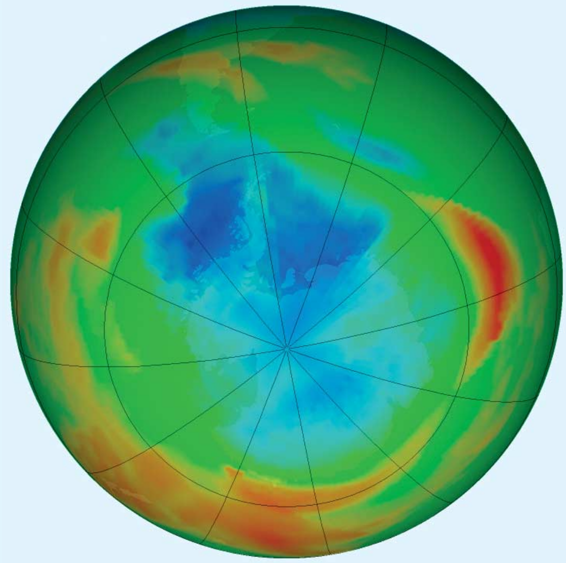
Les Hamilton

Twenty five years ago, on September 16, 1987, scientists and policymakers unveiled what the United Nations called '*the most successful treaty in UN history*'. On that day, the first 24 nations signed the **Montreal Protocol on Substances that Deplete the Ozone Layer**. In the years since, the number of signatory nations has risen to 197. This international agreement has set an example on how to develop and implement environmental policy, and has almost certainly saved our planet from an environmental crisis.

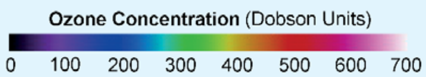
Prompted by scientific observations from the laboratory, the ground, aircraft, and satellites, the Montreal Protocol first reduced—then later banned completely—the use of halogenated hydrocarbons, most specifically CFCs (chlorofluorocarbons) that destroy atmospheric ozone. The destruction of the ozone layer allows more of the sun's ultraviolet radiation to reach the surface of the planet, increasing the risk of sunburn, skin cancer and eye damage. The most prominent and infamous sign of depletion is the annual 'ozone hole' that forms around the South Pole [1,2].

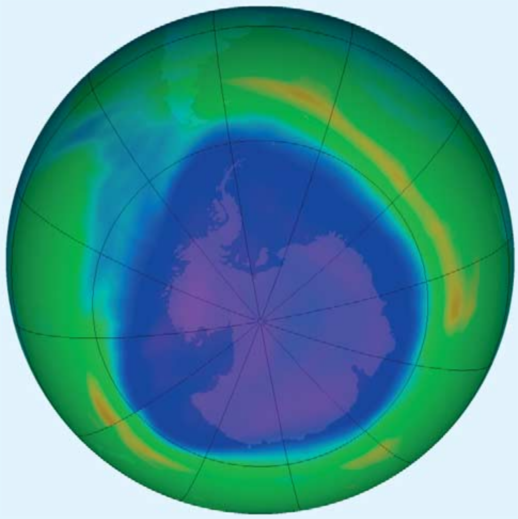


The Ozone Hole map for 1987



Map of the Ozone Hole for 1979

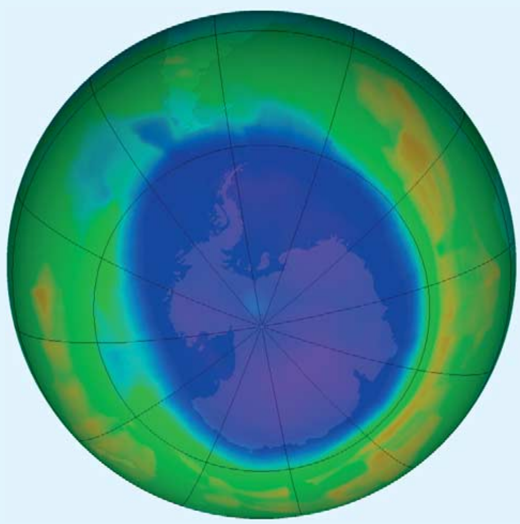




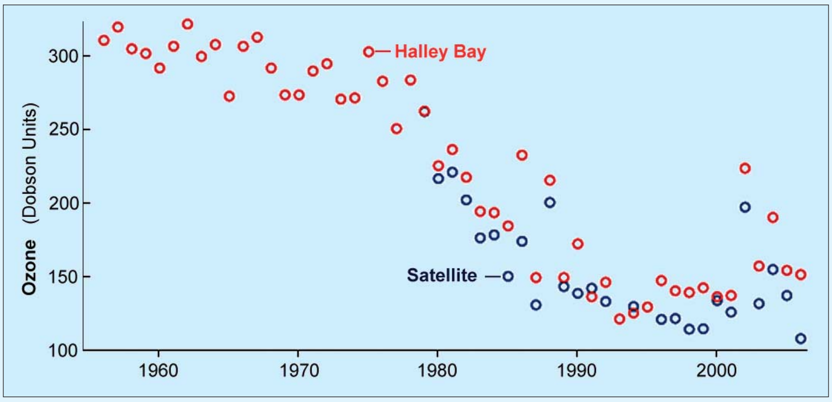
The Ozone Hole maximum of 2006

The images on this page show the Antarctic ozone hole on September 16 (*the International Day for the Preservation of the Ozone Layer*) in the years 1979, 1987, 2006, and 2011. The first two maps are based on data from the Total Ozone Mapping Spectrometer (TOMS) on the *Nimbus-7* satellite. The others were made using data from the Ozone Monitoring Instrument on NASA's *Aura* satellite. Though acquired by different instruments, the data sets have all been cross-calibrated and reanalysed by scientific models.

Stratospheric ozone is typically measured in *Dobson Units* (DU). One DU is that concentration of the gas in the atmospheric column that would create a layer of pure ozone 0.01 millimetre deep at 0°C and standard atmospheric pressure. On average, the total ozone in the atmospheric column amounts to 300 DU, equivalent to a layer 3 mm deep were it concentrated at Earth's surface.



The Ozone Hole shows a slight decrease in 2011



In the late 1970s, a springtime 'hole', an area with total ozone concentration below 220 DU, started to develop in the ozone layer above Antarctica. British researchers stationed on the ice of Halley Bay, Antarctica, made this discovery using ground-based measurements (red). In later years, data from NASA satellites corroborated the discovery (blue) and mapped the extent of the hole.

NASA graph by Robert Simmon, based on data from the British Antarctic Survey and GSFC Atmospheric Composition Team

In 1979, when scientists were just starting to understand that atmospheric ozone was suffering depletion over Antarctica, the minimum concentration had fallen to 194 DU, while the depleted area—the so-called Ozone Hole—extended over 1.1 million km^2. In 1987, as the Montreal Protocol was being signed, ozone concentration had fallen to 109 DU and the hole had expanded to 22.4 million km^2.

By 2006, the worst year for ozone depletion, the numbers were 84 DU and 29.6 million km^2. By 2011, the most recent year with a complete data set, the hole stretched 26 million km^2 and dropped to 95 DU, suggesting that matters were stabilising and that a slow recovery might be taking place.

The amount of ozone-depleting substances (ODS) in the atmosphere has stopped rising in recent years and may now actually be decreasing. But the ozone hole will continue to show its hand for many years to come, since CFCs and other ODSs can endure in the atmosphere for many decades.

What if CFCs had not been banned?

Ozone is Earth's natural sunscreen, absorbing most of the incoming ultraviolet (UV) radiation from the sun and protecting life from DNA-damaging radiation. CFCs, first used as refrigerants in the 1930s and later as propellants for chemical sprays, diffuse through the atmosphere where they destroy the ozone molecules.

In May 2009, a team of NASA-led scientists set out to predict how the ozone layer would have developed today—and in the future—if the Montreal Protocol Treaty banning ozone-depleting chemicals had not come into being. The series of images at the right of this page shows projected levels of ozone concentration over the mid-latitudes of the Western Hemisphere. These are based on calculations by the *Goddard Earth Observing System Chemistry-Climate Model*, and concluded that, by the year 2050, global ozone depletion would be at least 10 times worse than currently.

The series of images starts with 1974, before CFCs had begun to do significant damage to the ozone layer. Concentrations of ozone in the stratosphere over the United States and Canada are high. By 1994, the model predicts that ozone concentrations over the region have fallen from highs in excess of 500 DU to about 400 DU. By the simulated year 2009, the ozone layer over much of the United States has thinned to only 300 DU.

Moving forward to 2020, the model predicts that an ozone hole, defined as a region where the ozone concentration has fallen below 220 DU, forms over the Arctic as well as the Antarctic. By 2040, the ozone hole has become global, allowing the UV index in mid-latitude cities to reach 15 around noon on a clear summer day. A figure of 10 is considered extreme by today's standards. By the end of the model run in 2050, global ozone has dropped to less than 110 DU, a 67% reduction since the 1970s.

To learn more about the experiment and what it taught scientists about stratospheric circulation, read the Earth Observatory feature *The World We Avoided by Protecting the Ozone Layer* at.

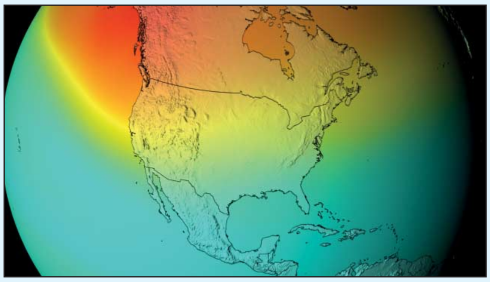
http://earthobservatory.nasa.gov/Features/WorldWithoutOzone/

References

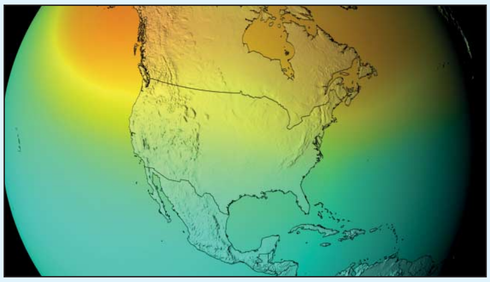
1 The Expanding Ozone Hole GEOQ 13, page 4 (2007)
2 Record Loss of Ozone over the Arctic GEOQ 30, page 37 (2011)

Acknowledgement

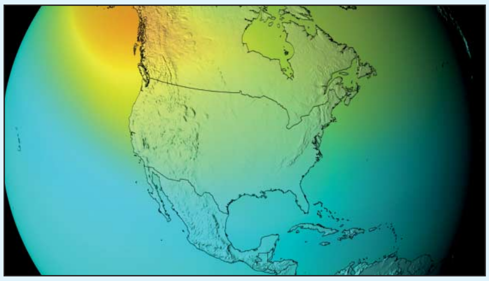
Thanks to NASA Earth Observatory for making much of the information collected for this article available on their web pages.



1974



1994

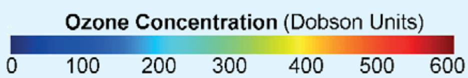


2009

2020

2040

2050

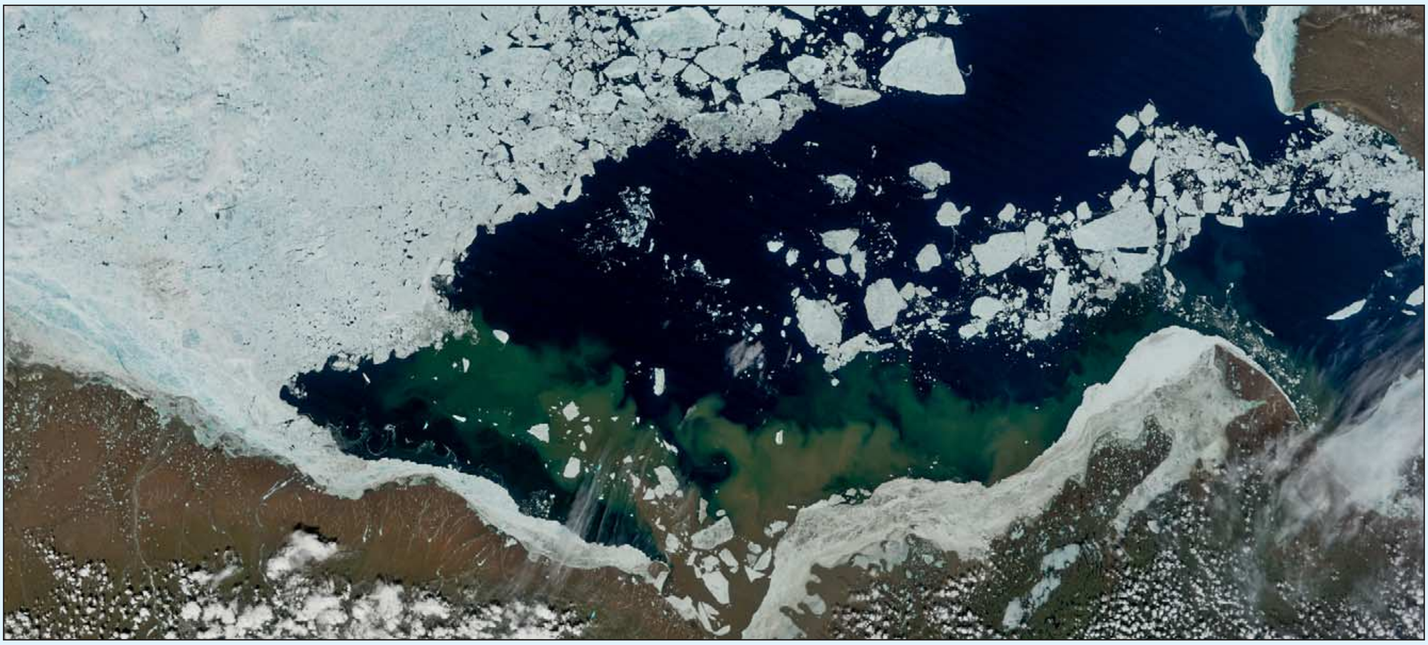


NASA images courtesy of the Goddard Space Flight Center Scientific Visualization Studio.

Sea Ice Retreat in the Beaufort Sea

A NASA Earth Observatory Report

The Beaufort Sea viewed on May 13, 2012



The Beaufort Sea viewed on June 16, 2012

These two images from the Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's *Terra* satellite illustrate the rapid ice retreat in the Beaufort Sea, north of Alaska, between May 13 and June 16 last summer. This rapid melt was part of a larger phenomenon as sea ice across the entire Arctic reached a record-low level for the time of year, slightly below the June 2010 record.

During the first half of June 2012, the Beaufort Sea was a 'hotspot' of rapid retreat, driven by a high pressure system over the region that kept skies clear at the very time of year when sunlight lasts the longest. In addition, larger-scale climate patterns were also favouring ice retreat along the coastlines of Alaska and Siberia.

As of June 18, temperatures were above freezing over much of the sea ice in the Arctic, and snow had melted earlier than normal, leading to warming on land. The following day, NSIDC [1] reported that 'Recent ice loss rates have been 100,000 to 150,000 square kilo meters **per day**, more than double the climatological rate.'

For comparison, the area of England plus Wales is 151,000 km^2.

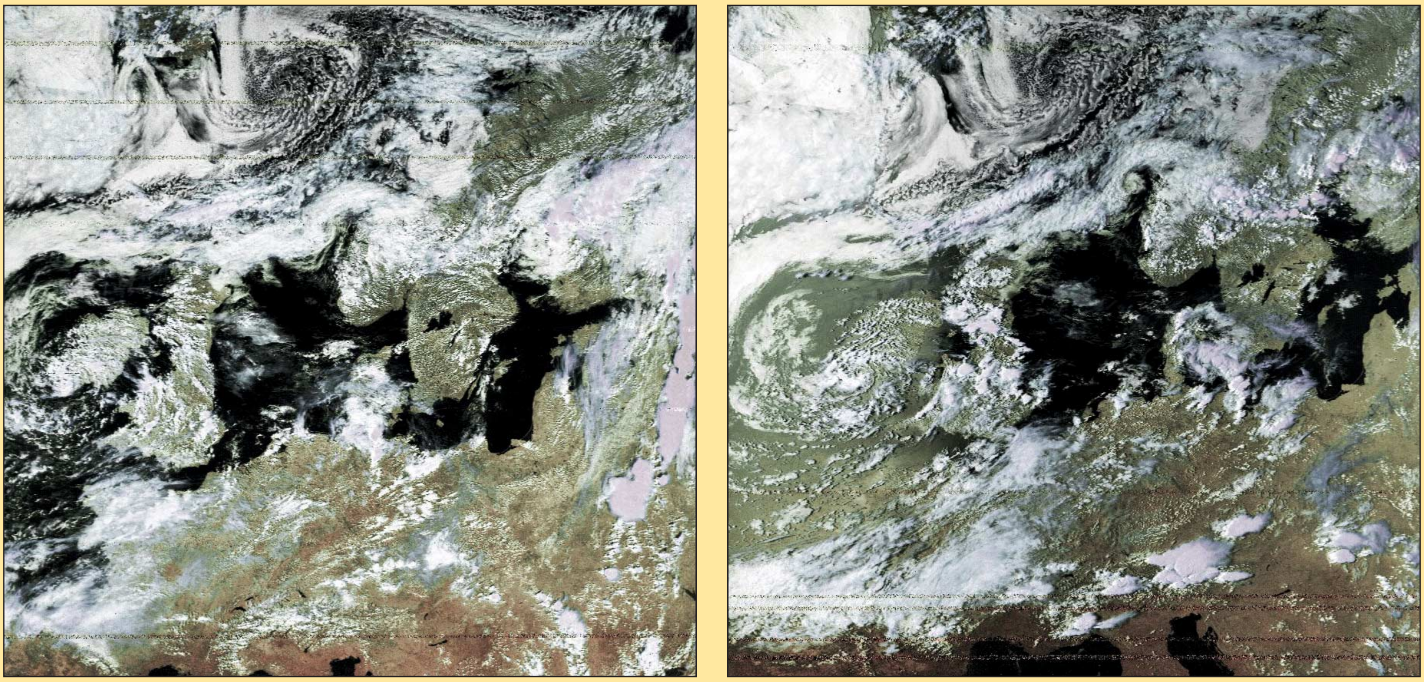
NASA Earth Observatory image by Jesse Allen, using data from the Level 1 and Atmospheres Active Distribution System (LAADS).

Reference

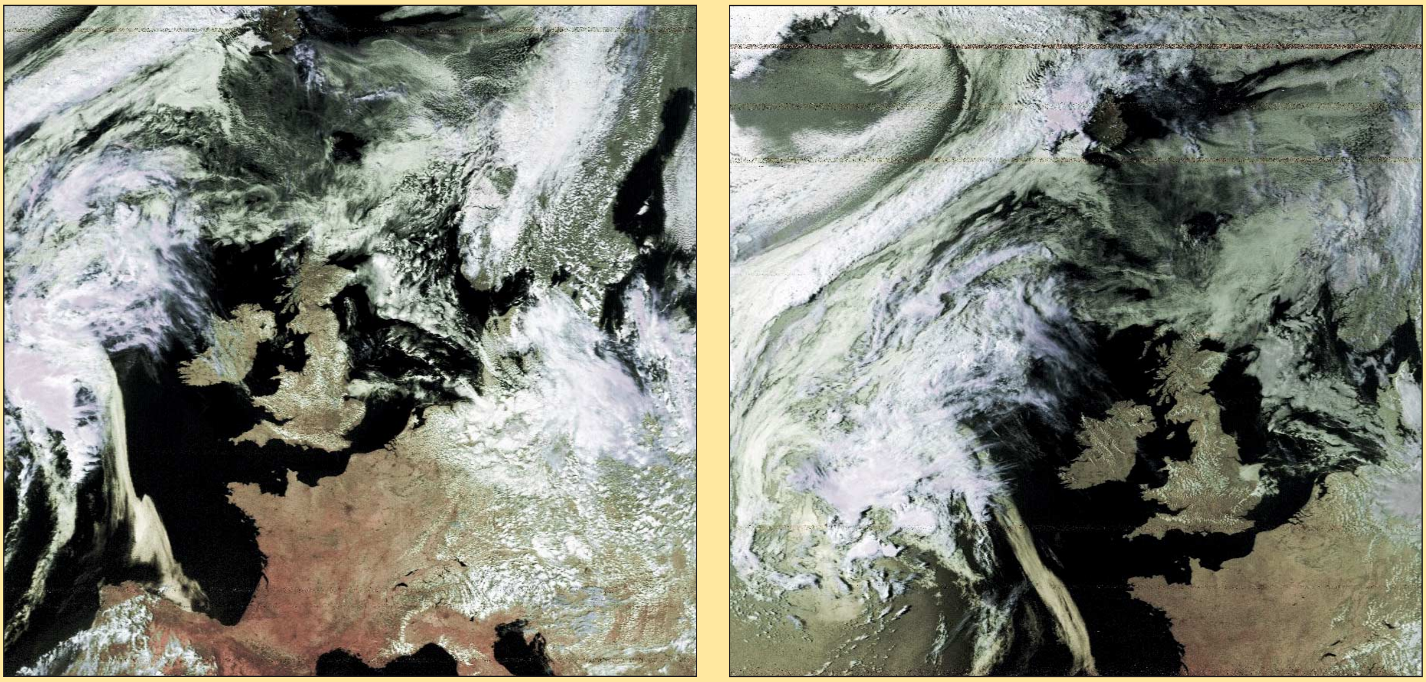
1 National Snow and Ice Data Center

Summer Images from the NOAA Satellites

David Taylor



The 12:01 UT NOAA-19 (left) and 15:36 UT NOAA-15 images on August 4, 2012



The 12:37 UT NOAA-19 (left) and 16:30 UT NOAA-15 images on August 10, 2012

Despite the wealth of high quality imagery available via EUMETCast these days, I still monitor the NOAA satellites from time to time, despite the generally poor reception available in Edinburgh.

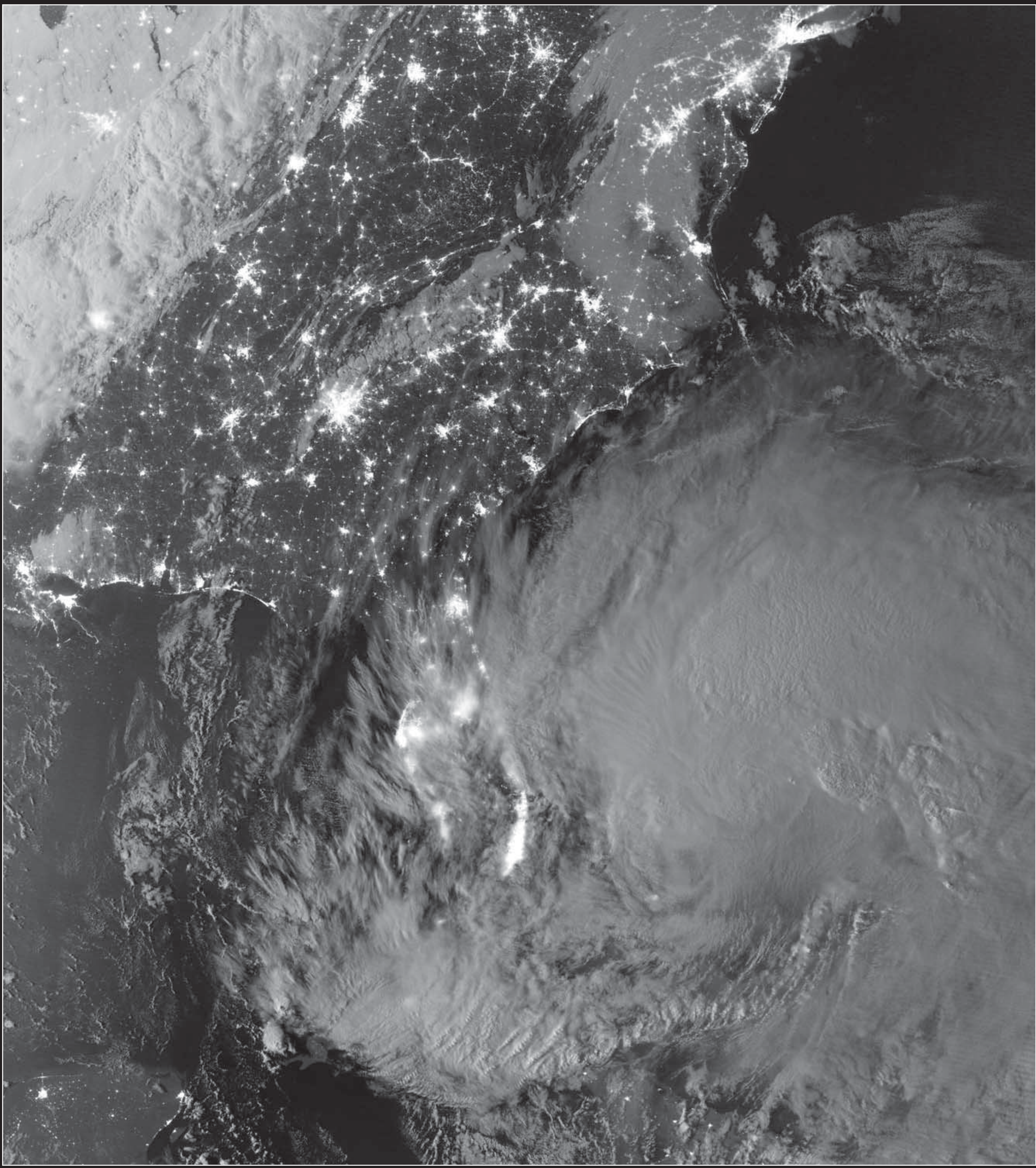
One thing that interested me recently was the comparison between the near overhead, approximately noon images from NOAA-19 and the mid-afternoon images from NOAA-15.

With the sun being less in line with the satellite during the mid-afternoon image, much more detail can be seen in the clouds because of the shadows which are now visible. The same applies to some of the land topography as well, showing more detail. These afternoon images are an artefact of the gradual change in NOAA-15's orbit plane over the years: the satellite started life as a morning satellite in 1998 but has gradually drifted over the last 14 years.

Images like the one above only become available during the summer, since, as winter approaches and daylight fades, the satellite switches to sending mid-IR data instead of the 0.8 micrometre visible wavelength channel. So, if you are missing summer already, here's something to look forward to next year.

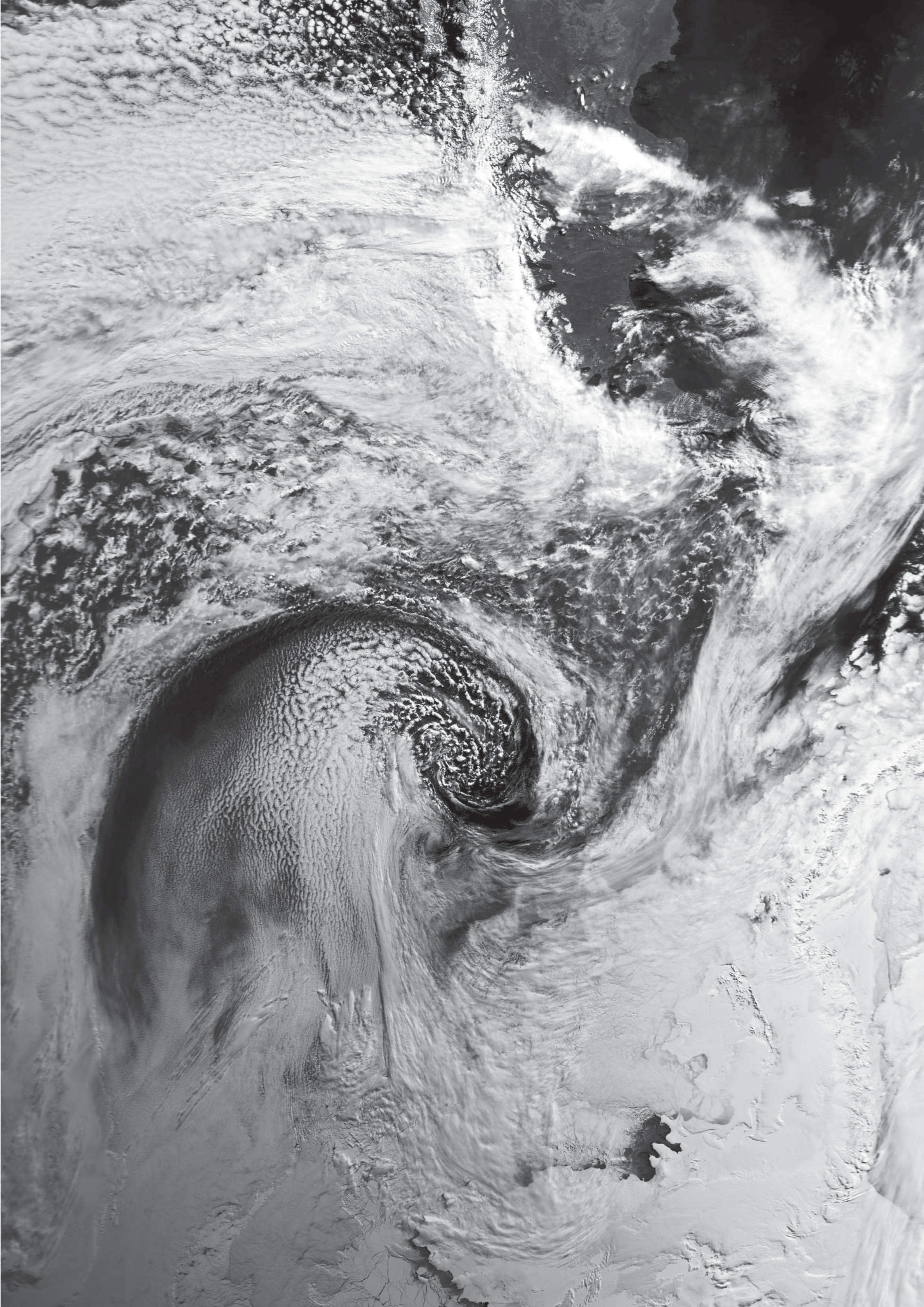
Hurricane Sandy at Night

A NASA Earth Observatory Report



This satellite image shows the cloud tops of Hurricane Sandy illuminated by a nearly full moon. The lights of Florida's urban areas and the USA's eastern seaboard shine through the relatively thin clouds on the periphery of the hurricane. At the time the image was acquired by the Visible Infrared Imaging Radiometer Suite (VIIRS) aboard the Suomi-NPP satellite on October 26, 2012, the hurricane was centred near the Bahamas, with maximum winds of 140 kilometres per hour.

NASA image by Jesse Allen and Robert Simmon, using VIIRS Day-Night Band data from the Suomi National Polar-orbiting Partnership (Suomi NPP) and the University of Wisconsin's Community Satellite Processing Package.



APT from Canada

Steve Craggs - VE3KSC

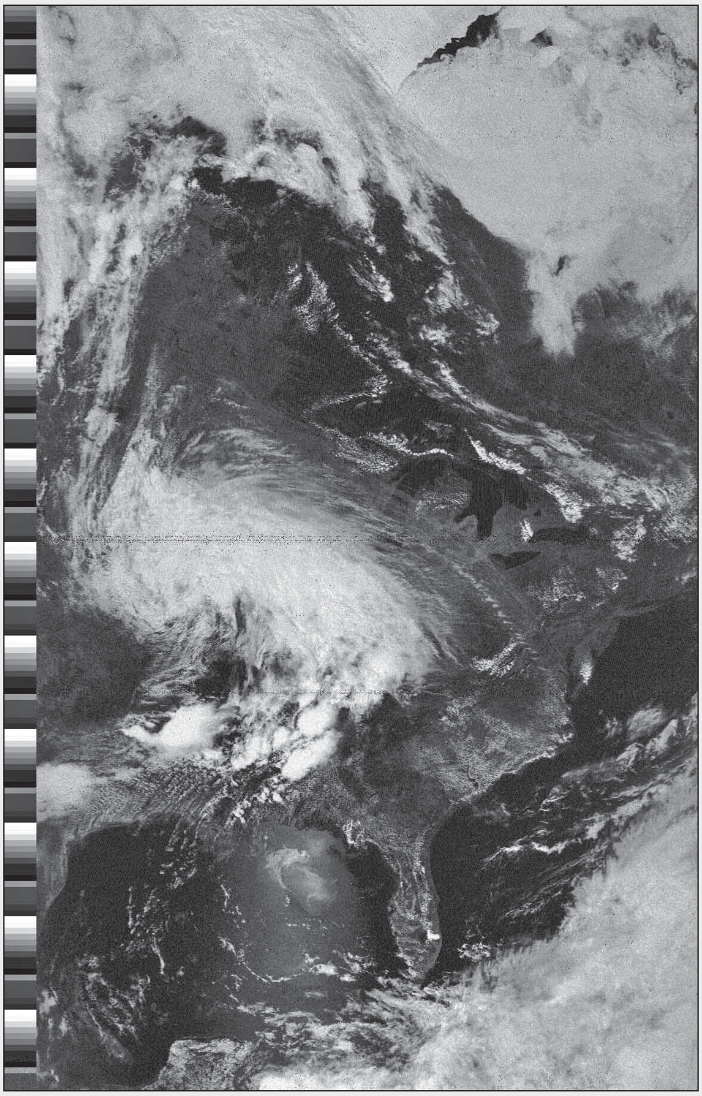
I live in Petrolia ,Ontario, Canada, which is 200 kilometres west of Toronto. My weather equipment consists of a home-built DCDP antenna feeding an *R2FX* receiver. One of the photographs shows me installing this antenna.

I feed the *R2FX* audio out to a *SignaLink* USB external soundcard which gives me manual control of the audio strength to the computer. The laptop runs *Windows XP* and I use *APTDecoder* software.

I have had great success with this setup, giving me nice images of North America and the Caribbean. The best time of the year is Hurricane Season, between June and November.

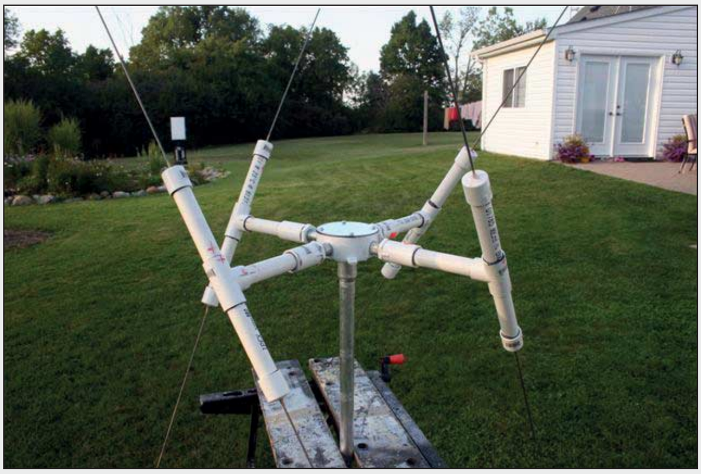
Using my 5-year old laptop is OK for APT work, but I would like to get into HRPT. So I have built a powerful desktop PC consisting of an *ASUS Sabertooth Mobo* motherboard fitted with an *AMD 1090T* 3.2 GHz 6-core processor with 8 GB of RAM. For storage I have a 60 GB SSD and a terabyte hard drive.

I hope to buy a DVB receiver and antenna this summer and start receiving beautiful images like those I see in *GEO Quarterly*.



A NOAA visible image featuring an oil spill in the Gulf of Mexico

Steve's communications desk with his R2FX at upper left



Steve's home-built double-cross antenna

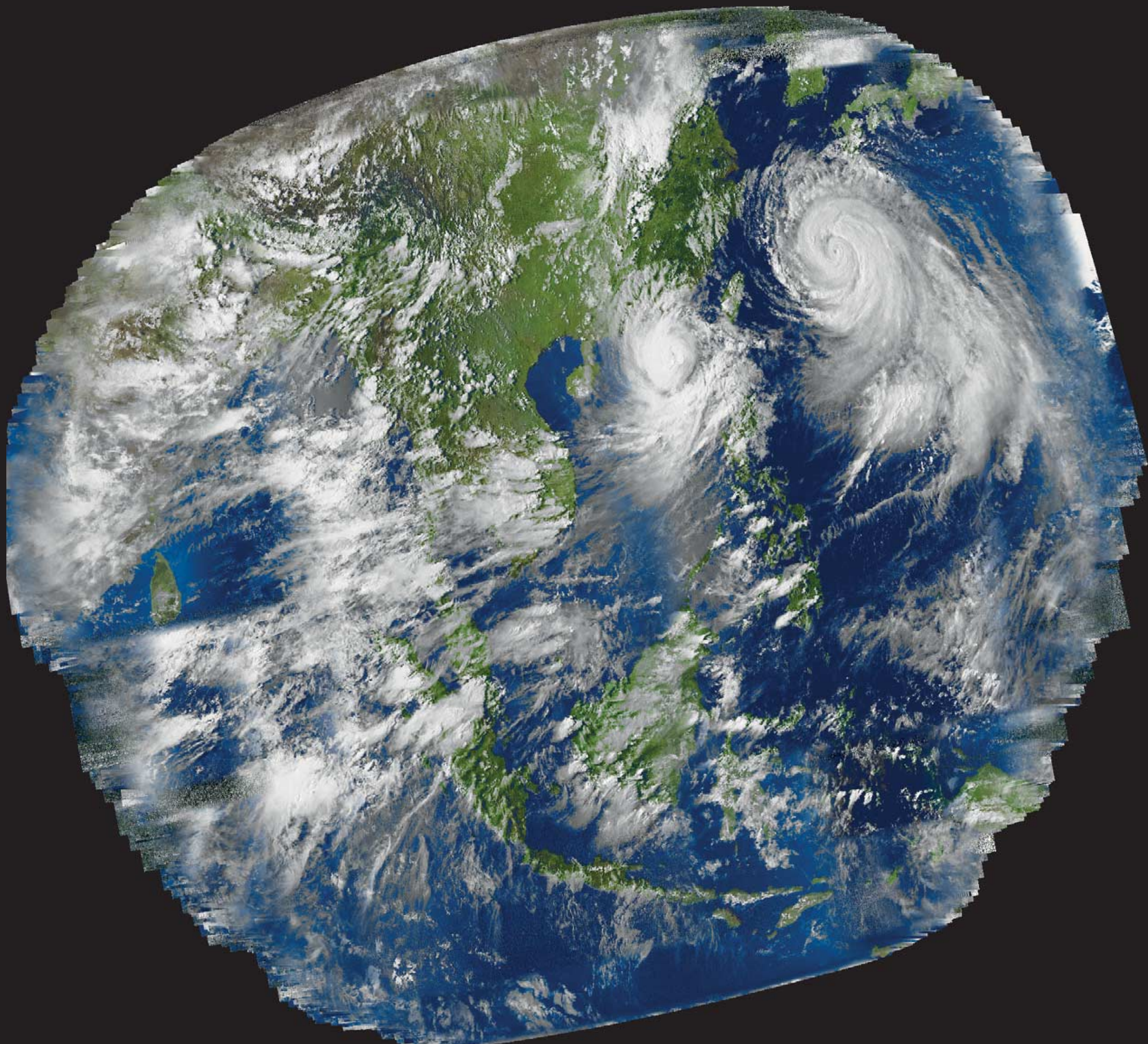
Steve up the mast installing the APT antenna

I hope you enjoyed the quick tour of my shack. And I would like to give a thanks to all the people who put together such a high quality magazine as GEO.

Creating a Continuous Composite Image with WXtoImg

Fred van den Bosch

Fred van den Bosch has devised an ingenious way of creating composite APT images that completely fill his radio horizon. The image on this page shows the result of his efforts.



After reading Rob Denton's article in GEO Quarterly 35 about creating composite APT images using *WXtoImg*, I thought readers would be interested to learn about a technique that I have been using to create a 'continuous' image.

Since end of last year, I have been making a 'year-long' composite image by using **%y-%e** in the capture definition. This means that every new APT image is superimposed on the previous one(s) and added to the composite. The result is that, over time, the image you see more or less matches your radio horizon.

There is the disadvantage, of course, that a bad image can ruin your whole composite. Therefore I use *Autohotkey* to automatically make copies of my image after each run. This process is triggered by WXtoImg's **WxpEnd** option. Unfortunately, this starts immediately after the reception of the satellite signal has finished, not when creation of the image is complete. The result is that my backup image is always one image behind.

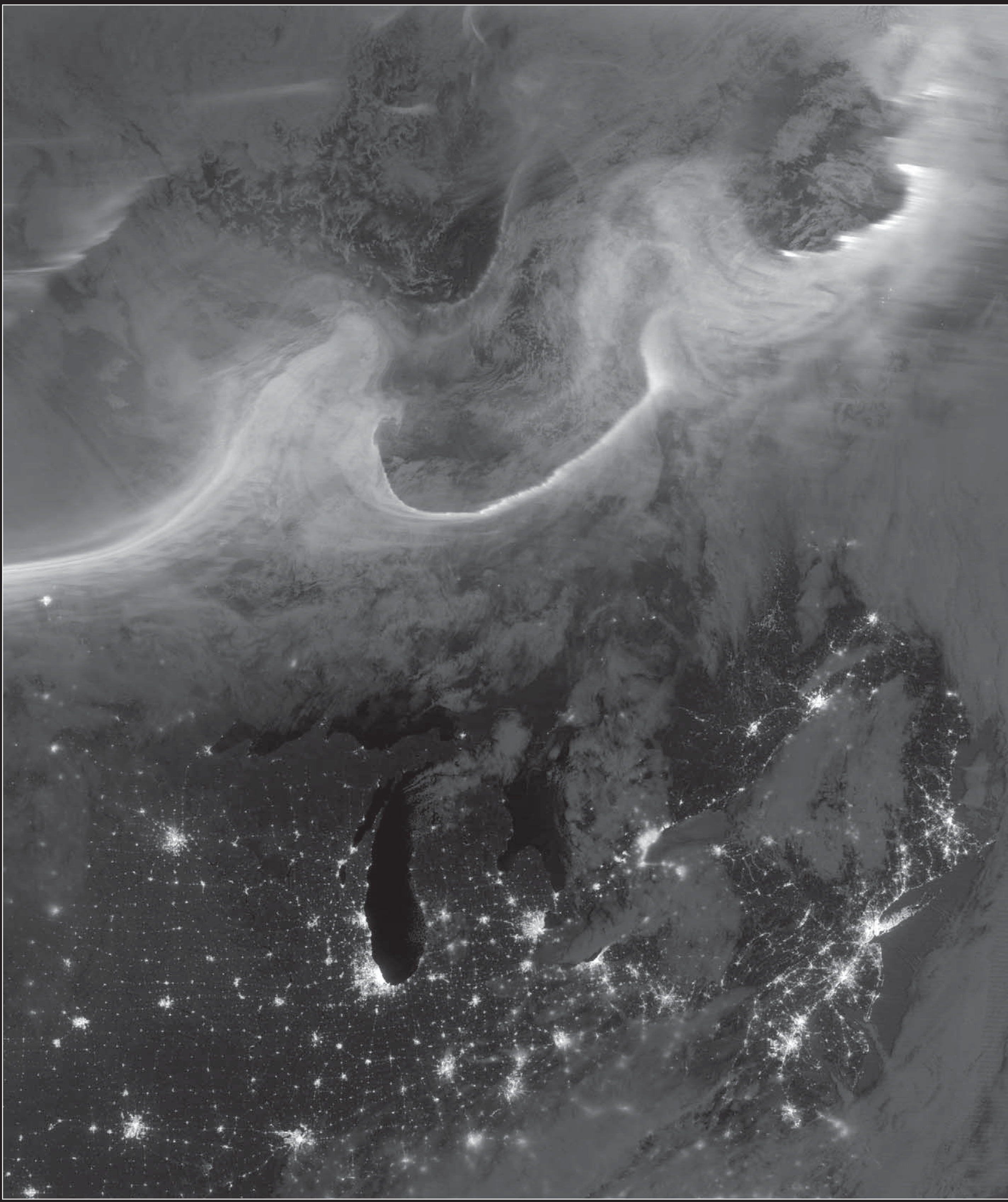
Early this year, Craig Anderson promised a better solution, but up till now there is no update. Every evening I check to see if I must replace the image on the website by a backup-image.

You can see my daily results on

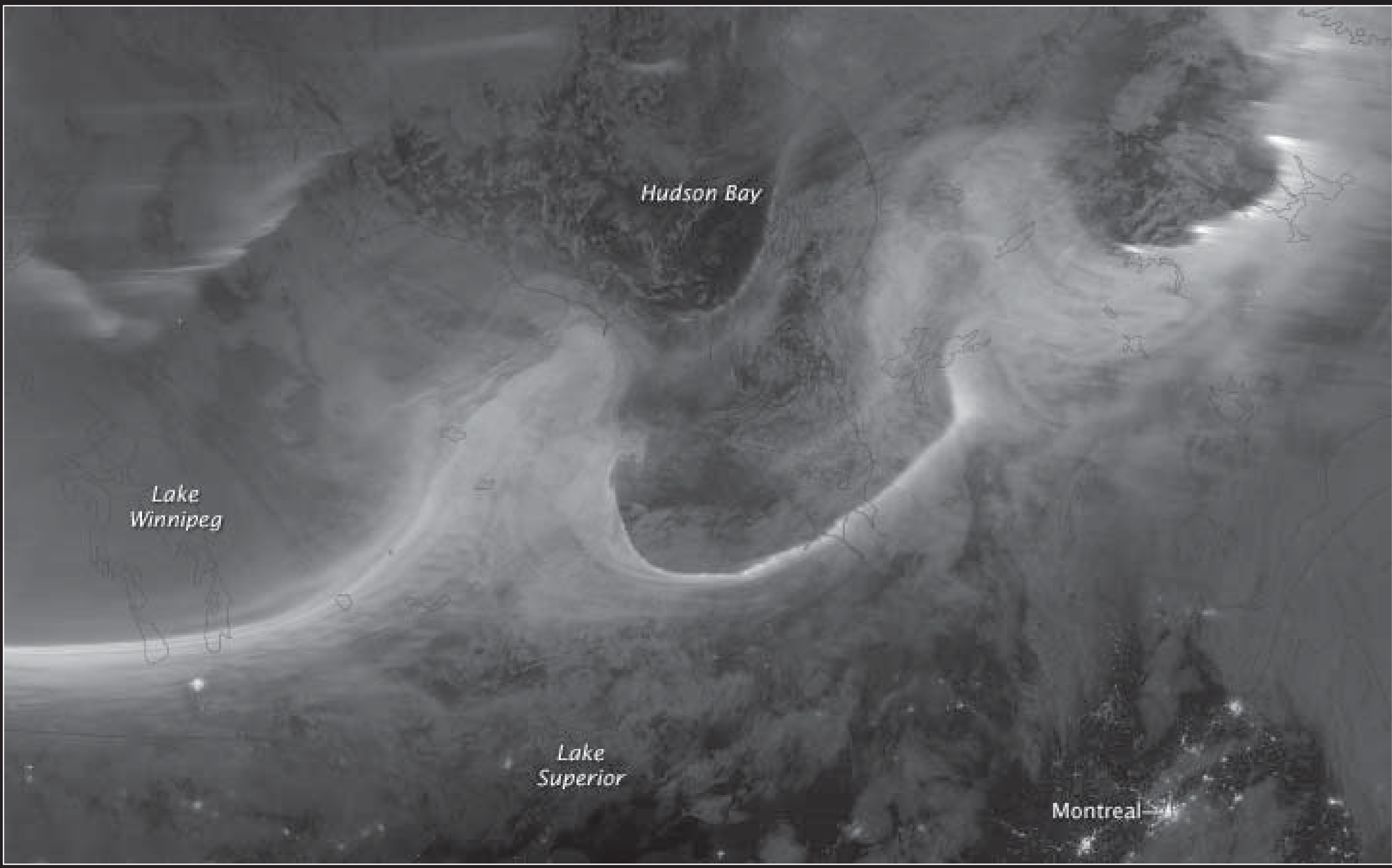
http://www.fredvandenbosch.nl/wxtoimg.html

Auroras over North America

A NASA Earth Observatory Report



Suomi-NPP VIIRS Day-Night Band image by Jesse Allen and Robert Simmon



Northern Lights over North America as images by the Suomi-NPP satellite

Overnight on October 4-5, 2012, a mass of energetic particles from the atmosphere of the Sun were flung out into space, a phenomenon known as a coronal mass ejection. Three days later, the storm from the Sun stirred up the magnetic field around Earth and produced gorgeous displays of the Northern Lights. NASA satellites track such storms from their origin to their crossing of interplanetary space to their arrival in the atmosphere of Earth.

Using the 'day-night band' (DNB) of the Visible Infrared Imaging Radiometer Suite (VIIRS), the Suomi National Polar-orbiting Partnership (Suomi NPP) satellite acquired this view of the Aurora Borealis early on the morning of October 8, 2012. The northern lights stretch across Canada's Quebec and Ontario provinces and are part of the auroral oval that expanded to mid latitudes.

The DNB sensor detects dim light signals such as auroras, airglow, gas flares, city lights, and reflected moonlight. In the case of the image opposite, the sensor detected the visible light emissions as energetic particles rained down from Earth's magnetosphere and into the gases of the upper atmosphere. The images are similar to those that have been collected by the *Operational Linescan System* flown on US Defense Meteorological Satellite Program (DMSP) satellites for the past three decades.

'When I first saw images like this as a graduate student, I was immediately struck by the fluid dynamic characteristics of the aurora', said Tom Moore, a space physicist at NASA's Goddard Space Flight Center. 'Viewing the aurora in this way makes it immediately clear that space weather is an interaction of fluids from the Sun with those of the Earth's upper atmosphere. The electrodynamics make for important differences between plasmas and ordinary fluids, but familiar phenomena such as waves and vortices are still very apparent. It makes me wonder at the ability of apparently empty space to behave like a fluid.'

Auroras typically occur when solar flares and coronal mass ejections—or even a particularly active solar wind stream—disturb and distort the magnetosphere, the cocoon of space protected by Earth's magnetic field. The collision of solar particles and pressure into our planet's magnetosphere accelerates particles trapped in the space around Earth (such as in the radiation belts). These particles are sent crashing down into Earth's upper atmosphere—at altitudes of 100 to 400 kilometers—where they excite oxygen and nitrogen molecules which release photons of light. The results are rays, sheets, and curtains of light, dancing in the night sky.

Auroras are a beautiful expression of the connection between Sun and Earth, but not all of the connections are benign. Auroras are associated with geomagnetic storms, which can distort radio communications (particularly at high frequencies), disrupt electric power systems on the ground and give slight but detectable doses of radiation to flight crews aboard spacecraft and passengers on high-latitude aeroplane flights.

The advantage of images like those from VIIRS and DMSP is their resolution, according to space physicist Patrick Newell of the Johns Hopkins University Applied Physics Laboratory: 'You can see very fine detail in the aurora because of the low altitude and the high resolution of the camera'. Most aurora scientists prefer to use images from missions dedicated to aurora studies (such as Polar, IMAGE, and ground-based imagers), which can offer many more images of a storm (rather than just one per orbit) and allow researchers to calculate the energy moving through the atmosphere. There are no science satellites currently in orbit that provide such a view, though astronauts regularly photograph and film auroras from the International Space Station.

Acknowledgements

NASA Earth Observatory image by Jesse Allen and Robert Simmon and the University of Wisconsin's Community Satellite Processing Package. Suomi NPP is the result of a partnership between NASA, the National Oceanic and Atmospheric Administration, and the Department of Defense. Caption by Mike Carlowicz.

Explore the World of *Aqua* and *Terra* Imagery with the MODIS L1 Viewer

Mike Stevens

The *MODIS L1 Viewer* is another fine software development from our friend, David Taylor, designed to make use of the visual and fire data from the MODIS instruments aboard NASA's *Aqua* and *Terra* satellites. These data, which are available free of charge, are disseminated over the *EUMETCast* broadcast system: all you need to do to receive them is to register for them with EUMETSAT.

Once you have obtained verification from EUMETSAT that you are configured to receive the data you will have to carry out some modifications to your system, as follows:

- You will have to enable data channel-4. If you are already receiving the hourly FSD data no change is needed; if not, then you must add the following line to your *recv-channels.ini* file:

    [EUMETSAT Data Channel 4]
    target_directory=received

- The next operation is to open your *MSG DataManager* program and select the **Setup** tab, then open the **Channel Selection** tab followed by the **Other** tab (figure 1). Here you will find, in the 3rd column, a box marked **MODIS L1/L2 data**.
  You must tick the boxes labelled **Manage MODIS L1/L2** and **Copy M02 sensor files**. You then need to adjust the **Data retention** box to the desired number of days. This determines how long MODIS data is retained on your computer before it is automatically deleted. In my setup, I have set it at two days.

- For the MODIS Fire data you will need to enable data channel-12. If you already have this in the system, then no need to bother. If not, then add this line in the *recv.channels.ini* file:

    [EUMETSAT Data Channel 12]
    target_directory=received

- To receive the Fire Data you will need to return to the same section as before in *MSG DataManager* and tick the boxes for **CH-12 Data**, **Manage fire data** and **Unzip Fire HDF**. Again, adjust the **Data retention** box to your own preference.

Some other operators of this system may have tagged them differently. However, it's up you how you tag them. This is the way I have them tagged and it works fine. Tagging them separately will reduce the load on the 'received' directory.

Once you have all these new parameters in place and your EKU Key has been reset by EUMETSAT, you should switch to the directory where all the MSG-1 images are stored. Open the 'Images' directory, which should display a list of all the separate received files. If you scroll down you should see a directory marked 'MODIS-L1'. Open this directory and you should see your MODIS data files—indexed by year, day and time of the pass—for each day of reception (according to the number of days you elected to store when adjusting the **Data retention** box).

The MODIS filenames take the form:

thin_MOD021KM.A2012271.1440.005.20122711621221.NRT.hdf

Displaying the Data

Typical MODIS L1 files received via *EUMETCast* all have the format shown above but, of course, they vary due to different

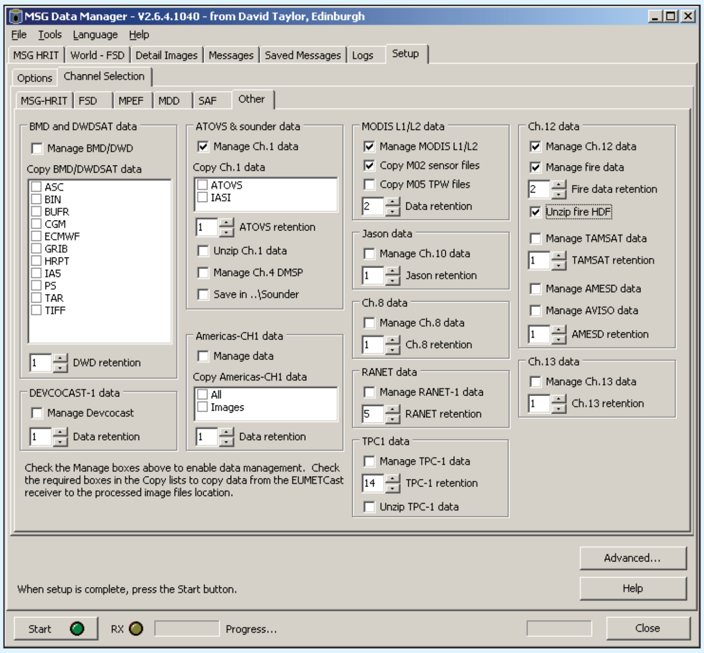


Figure 1 - Configuring MSG DataManager to receive MODIS data

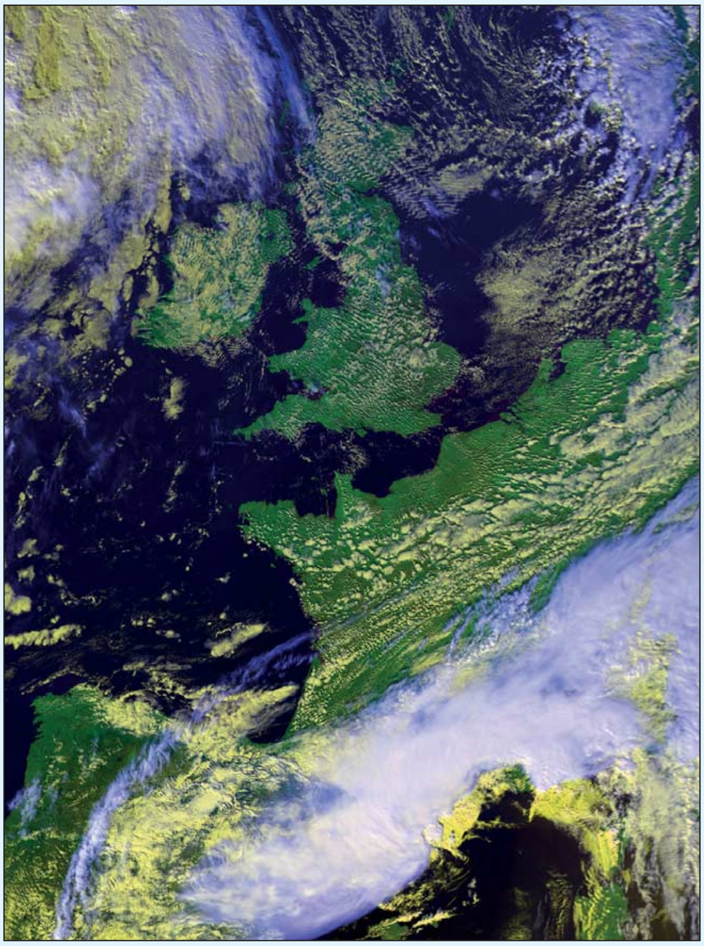


Figure 2 - This Aqua image shows the weather system that brought severe flooding to Andalusia in southern Spain on September 29, 2012.
Image © EUMETSAT 2012

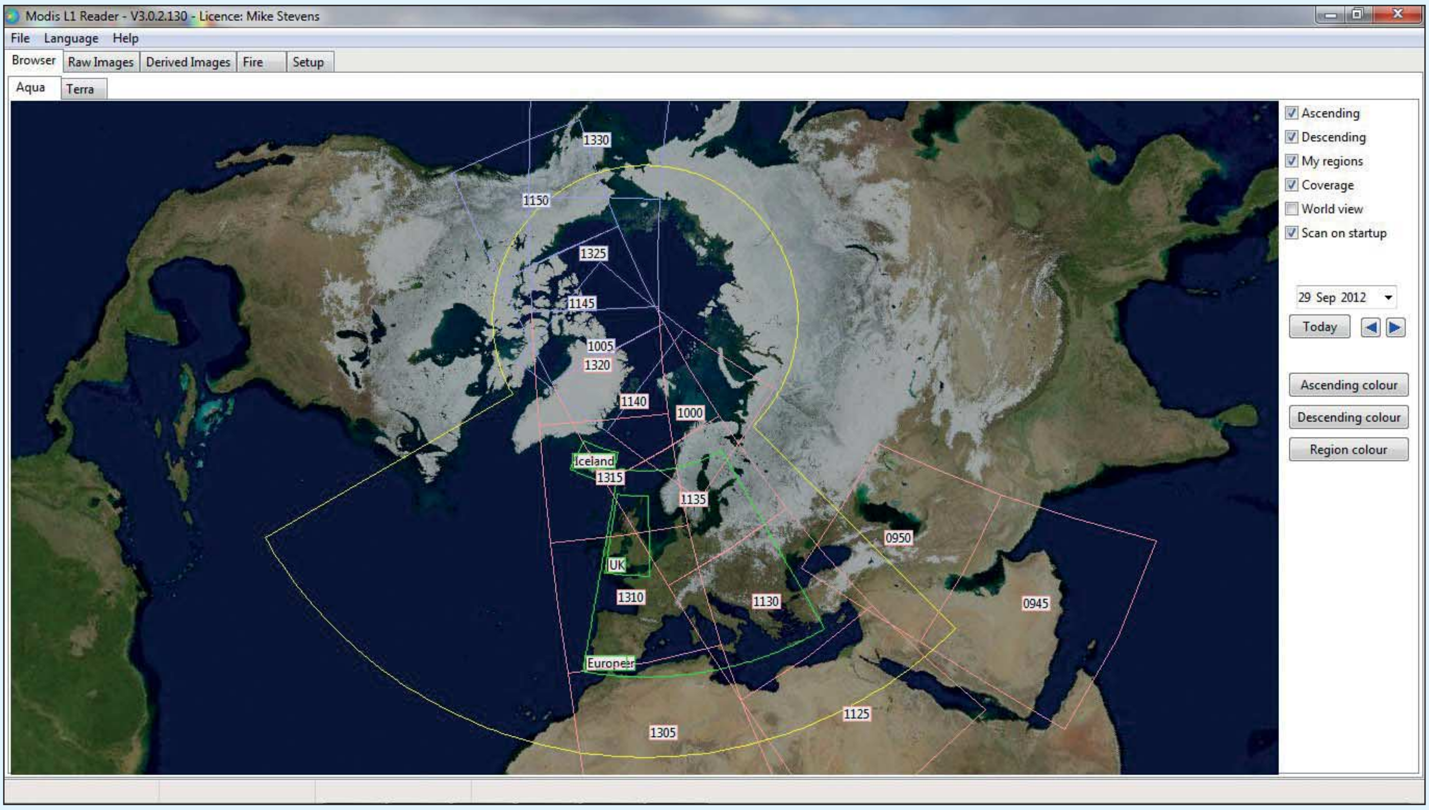


Figure 3 - The MODIS L1 Viewer browser tab, illustrating the squares that represent the downloaded image segments

dates and times of reception. But, as soon files are being received on your system, you should be able to open the *MODIS-L1 Viewer* software to make some final adjustments.

You need to locate the MODIS L1 File source directory which, with the setup described above, you should find in **C:\MSG-1\Images\MODIS-L1** by using the **Browse** option in the **File** menu. The same also applies for the MODIS Fire files source directory, which you should find in **C:\MSG-1\Images\Fire**.

Whilst you are in the *MODIS L1 Viewer* **Setup** tab, you will find various operations that you can use. The software installs with default settings already in place for you, but you may wish to enhance or change them to meet your own specifications. Features that you do need to set up are the **Boundary and City Locations** options (figure 4). These are contained in the same *countries.dat* file used by *WXtrack*, and which normally resides in the *WXtrack* directory. If you do not already have this file installed, you can download *countries.dat* from

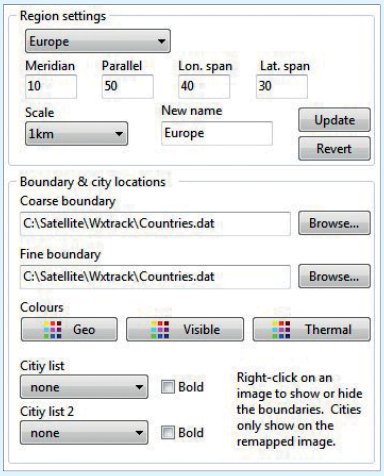


Figure 4
Adjusting the Boundary Data

http://www.satsignal.eu/software/countries.zip

and extract it into your *MODIS L1 Viewer* directory instead.

Now, upon opening the *Modis L1 Viewer* software, the program will automatically look into the MODIS directory and display all the received segments on the World Map display in the **Browser** tab as squares of data (figure 3). Also if you have updated to version 3.0.4.138 of the program or higher, you will find two active tabs above the image marked *Aqua* and *Terra*. These allow you to make on-screen selections from files from either satellite.

To open a MODIS file, just place the mouse icon into one of the data squares and left-click to highlight it: then right-click in the box to bring up another box marked '*open one or open multiple*'— that's your choice. Just highlight the one you want and double-click. Immediately, the **Raw Images** tab will be displayed containing the default image.

Along the top of this image appear numbered buttons which allow you to display, at your leisure, any one of the eighteen MODIS channels distributed by *EUMETCast* (figure 5). A descriptive list of them can be found on David Taylor's excellent website at

http://www.satsignal.eu/software/modis-L1-viewer.html

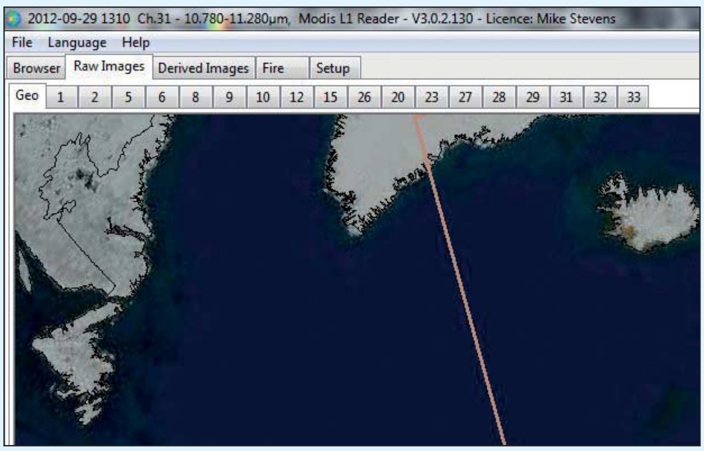


Figure 5 - Part of the Raw Images tab showing the channel buttons

By default, the display shows the Channel-31 image, which relates to land surface and cloud temperatures. A click on the **GEO** button at the left will show you the track of the image displayed.

continued on page 44

New Polar Records Established

Arctic Sea Ice falls to all-time Record Low - Antarctic Ice spreads to all-time Maximum

Les Hamilton

The Arctic Ocean

On September 16, 2012, the cover of sea ice in the Arctic Ocean fell to a historic summer minimum of just 3.41 million km^2, by a considerable margin the lowest seasonal minimum recorded since the satellite record began in 1979. The previous record, recorded in 2007, was broken by a whopping 760,000 km^2, a reduction of 18% (an area twice that of Germany), and a figure that reinforces the long-term downward trend. A comparison with the 1979-2000 mean sea ice minimum is quite an eye-opener: a reduction of 3.29 million km^2, a drop of 49%, and an area equivalent to that of the Indian subcontinent. The orange line in figure 1 shows the 1979 to 2000 median extent for this day, the black cross indicating the location of the geographic North Pole.

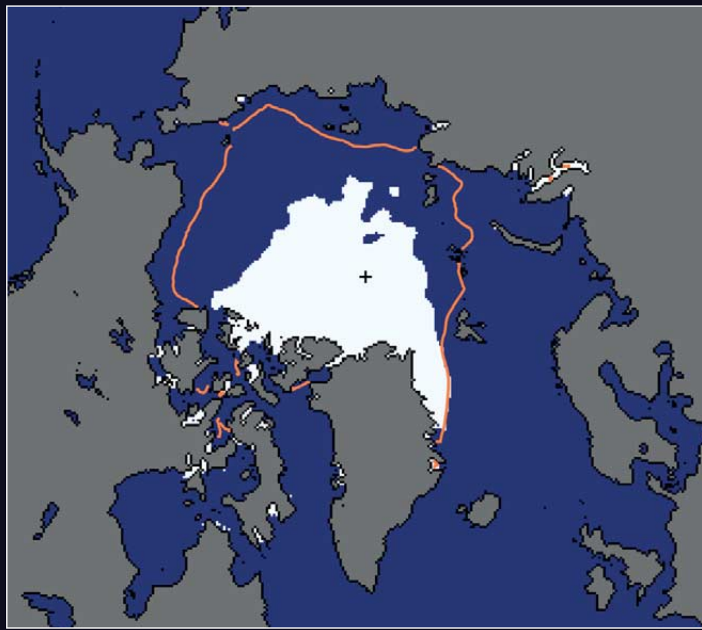


Figure 1 - The record-breaking sea ice minimum of September 16, 2012
Credit: National Snow and Ice Data Center, Boulder, Colorado.

Since the spring 2012 maximum extent on March 20, 11.83 million square kilometres of ice had been lost, the largest summer reduction in the satellite record by rather more than one million square kilometers. Figure 2 graphs the daily Arctic sea ice extent for 2012 (defined as the area of ocean carrying at least 15% of ice cover), along with comparative figures for 2005 and 2007 (the previous years with record lows) and the 1979-2000 average. The grey area around the latter shows the two standard deviation range of the data. The seasonal ice minima between 2007 and 2012 are collectively the six lowest figures within the satellite record.

It is acknowledged that the 2007 minimum resulted from winds and elevated air temperatures that favoured summer melting. But this year weather conditions were generally near average. Summer temperatures across the Arctic, though slightly warmer than average, were certainly cooler than in 2007.

One possible factor was the unusually powerful cyclonic storm that formed north of Alaska on August 5 and which tracked into the central Arctic Ocean (figure 3). On August 6, its central pressure had dropped to 964 hPa, an extremely low value for this region. Persisting for several days, the storm initially brought warm and very windy conditions to the Chukchi and East Siberian seas. Such polar cyclones are more usual in winter, and only a handful of this strength have ever been recorded over the Arctic during August since satellite records began 34 years ago.

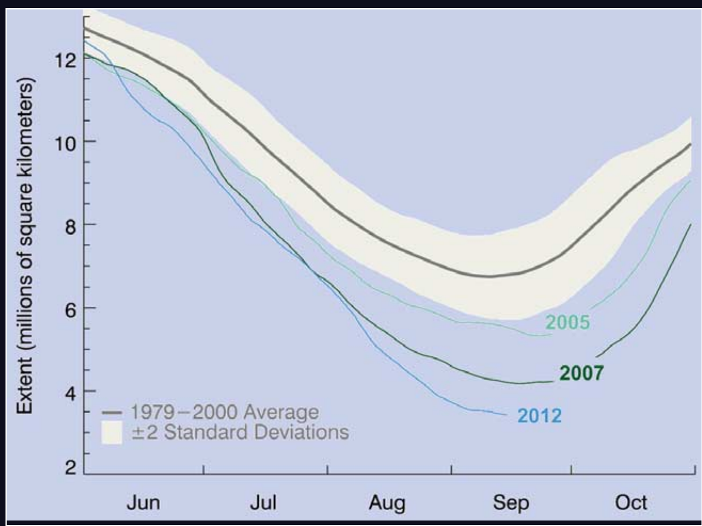


Figure 2 - Daily Arctic sea ice extent as at September 17, 2012
Credit: National Snow and Ice Data Center

Since the Arctic ice cover is becoming ever more dominated by seasonal ice [1], it seems probable that this thinner ice was broken up and melted by the storm. This storm apart, the pressure pattern during the 2012 summer did not appear to have been as favourable for promoting ice loss as was the case in 2007—and yet a new record low occurred. Arctic storms can have a large impact on sea ice by

- tearing large swaths of ice from the main pack and pushing them to warmer waters
- churning the ice into fragments and making it slushier
- pulling warmer waters up from the depths of the Arctic Ocean

Entering the melt season, the thinner ice cover made the Arctic sea ice more vulnerable to weather, and the storm quickly broke it up, after which melting accelerated through the action of wind and waves. Figure 4 shows the distribution of ice at the time of the 2012 minimum compared with that of 2007. Dark grey shows where ice was present only in 2007, white where ice was present only in 2012: light grey represents locations where sea ice was present in both years.

The spatial pattern of ice extent at this year's minimum differs from that in 2007, with more ice in some parts of the central Arctic Ocean but less in the Beaufort Sea, the western Laptev Sea, the East Greenland Sea and parts of the Canadian Archipelago. The Northern Sea Route across Russia opened around mid August this year, whereas in 2007 a tongue of ice stretching to the coastline blocked the route throughout the summer.

The Antarctic Paradox

It is well known that temperatures in the Antarctic have been gradually rising for many decades now [2]. Records from ground-stations, most of them based in the Antarctic peninsula and around

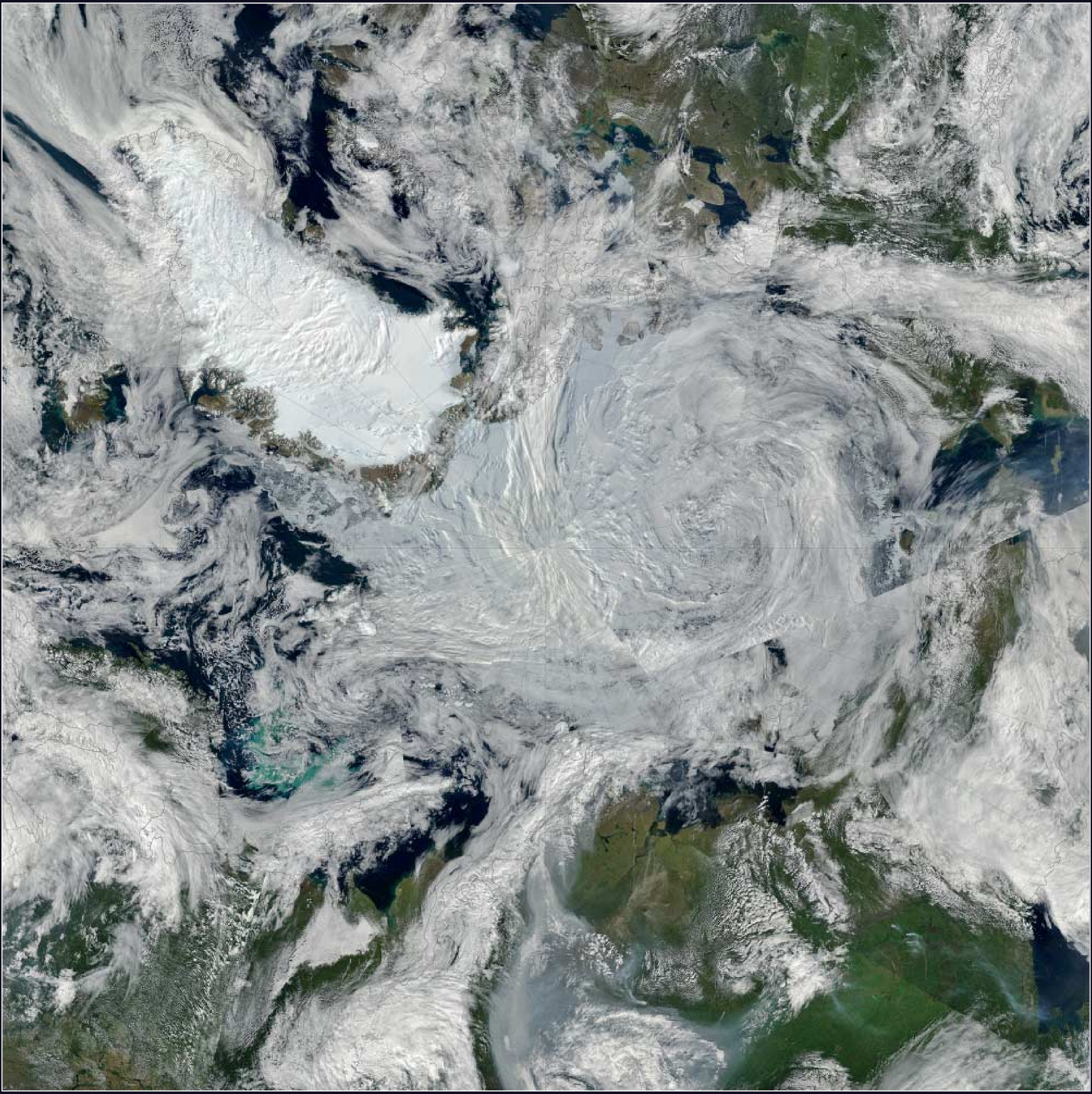


Figure 3 - This powerful cyclonic storm was imaged over the Arctic Ocean by the MODIS instrument aboard NASA's *Aqua* satellite on August 7, 2012.
NASA image by Jeff Schmaltz, LANCE/EOSDIS Rapid Response

the edges of the continent, have been recording temperature data since 1957. These indicate that much of East Antarctica has experienced cooling since 1978.

But now the record has been extended by gathering measurements from a series of Advanced Very High Resolution Radiometer (AVHRR) instruments deployed on satellites since 1981. By applying statistical methods to this data, scientists have been able to estimate temperatures missing from ground-based observations and correlate them with the ground measurements from 1957 to 1981 to calculate what the satellites would have observed.

The new analysis shows that Antarctic surface temperatures increased by an average of 0.12°C per decade between 1957 and 2006, representing a rise of more than 0.5°C over the past half century. West Antarctica warmed at an even higher rate, rising 0.17°C per decade, results which serve to confirm the earlier findings based on limited weather station and ice core data. Even

Figure 4 - Comparative sea ice distribution for 2007 and 2012
Credit: National Snow and Ice Data Center

though certain areas of East Antarctica have been cooling in recent decades, the longer 50-year trend tells us that, on average, temperatures are rising across the entire continent.

West Antarctica is particularly vulnerable to climate changes because its ice sheet is grounded below sea level and surrounded by floating ice shelves. Should it melt completely, global sea level would rise by between five and six metres.

However, notwithstanding this temperature increase, satellite observations also show clearly that the maximum extent of winter sea ice surrounding the Southern Continent is increasing—not decreasing due to the warming as you might at first expect. Indeed, just ten days following the 2012 Arctic summer sea ice minimum, the winter sea ice extent in the Southern Ocean around Antarctica expanded to an all-time high of 19.44 million km^2. Figure 5 illustrates this: the seasonal winter ice envelope is displayed in white with a superimposed orange line showing the 1979 to 2000 median extent for that day of the year. The black cross indicates the geographic South Pole. The September 2012 monthly average also showed a record high, at 19.39 million km^2, slightly above the previous record of 2006.

The graph in figure 6 shows the Antarctic sea ice extent on September 30, 2012 as a blue line, with the 1979 to 2000 average in dark grey. Once again, the light grey band straddling this line represents the two standard deviation range of the data.

The increase in the extent of Antarctic sea ice is an interesting response to changes in circulation patterns in the Southern Hemisphere. While the Arctic was experiencing a record minimum sea ice extent, the Antarctic attained its highest ever sea ice level during the satellite record. The 1979 to 2012 trend for sea ice maximum is just above the statistical significance level—0.9% per decade, plus or minus 0.6%—and this new September value is slightly greater than typical year-to-year variations: roughly equivalent a 40 kilometre northward shift of the ice edge relative to the 1979 to 2000 average. The trend for ice extent growth during Antarctic winters is about 16,000 square kilometres per year, just over a third the area of The Netherlands, and only one fifth the magnitude of Arctic ice loss (figures 7,8).

The warming climate experienced by much of the Antarctic is related to two factors: warming of the Pacific Ocean and strengthening circumpolar winds. This warming, allied with ozone loss [3], act to strengthen the circumpolar winds in the south of the continent, which generally act to blow the sea ice northward, slightly increasing its extent. The only significant exception to this is around the Antarctic peninsula where, due to the geography of the region, increasing winds from the north push the ice southward. Thus, sea ice extent near the northwestern Antarctic Peninsula continues to decline rapidly, while areas in the Ross Sea and the southern Indian Ocean show significant increases.

A direct comparison between winter and summer sea ice trends for the two poles is problematic because the processes at work in each hemisphere differ. During summer, surface melt and ice-albedo feedbacks are in effect; winter processes include snowfall on the sea ice, and wind. Small changes in winter extent may be a more mixed signal than the loss of summer sea ice extent. An expansion of winter Antarctic ice could be due to cooling, winds, or snowfall, whereas Arctic summer sea ice decline is more closely linked to decadal climate warming.

References

1 Oldest sea ice is disappearing - GEOQ 34, page 16
2 Satellites Confirm Half-Century of West Antarctic Warming
http://www.nasa.gov/topics/earth/features/warming_antarctica.html
3 The Ozone Hole - This issue, page 18

Acknowledgement

This report would not have been possible without extensive reference to news reports from the *National Snow and Ice Data Center* in Boulder Colorado at

http://nsidc.org/arcticseaicenews/

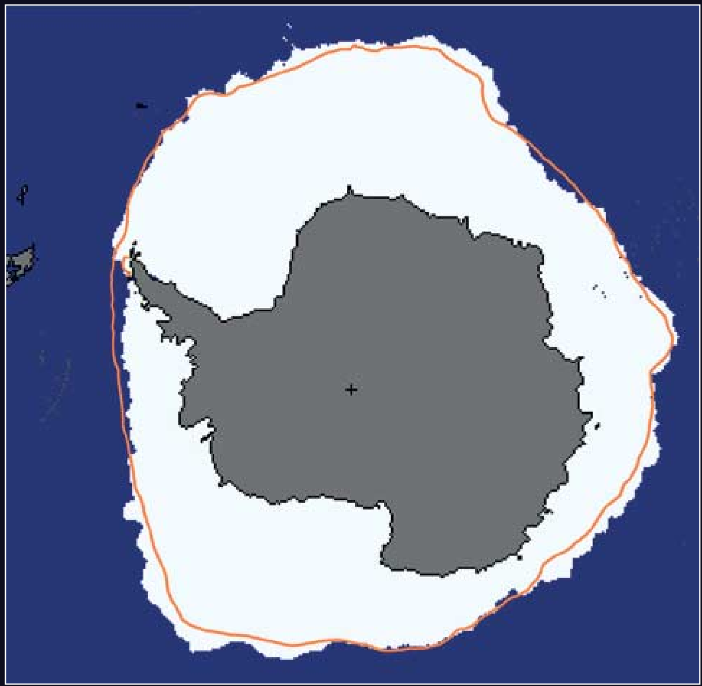


Figure 5 - The record-breaking sea ice maximum of September 26, 2012
Credit: National Snow and Ice Data Center, Boulder, Colorado.

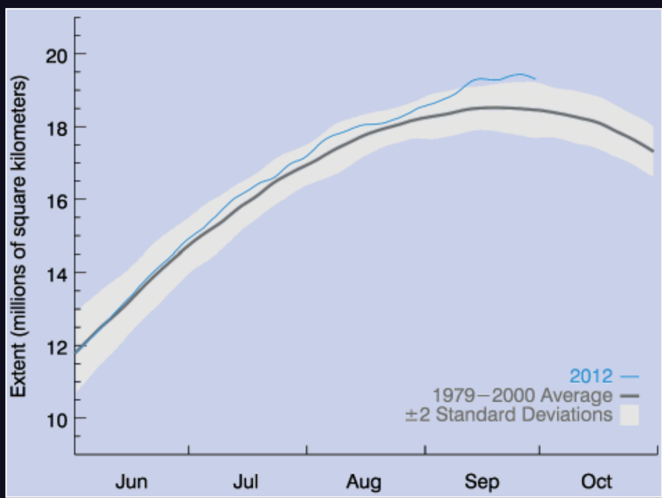


Figure 6 - Daily Antarctic sea ice extent as at September 30, 2012
Credit: National Snow and Ice Data Center, Boulder, Colorado.

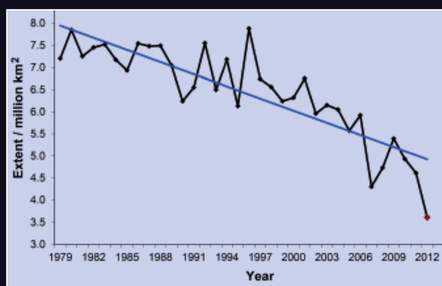


Figure 7 - Yearly September average sea ice extent over the Arctic
Credit: National Snow and Ice Data Center, Boulder, Colorado.

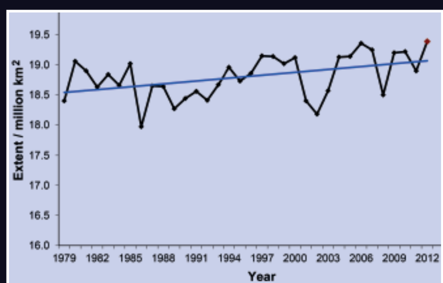
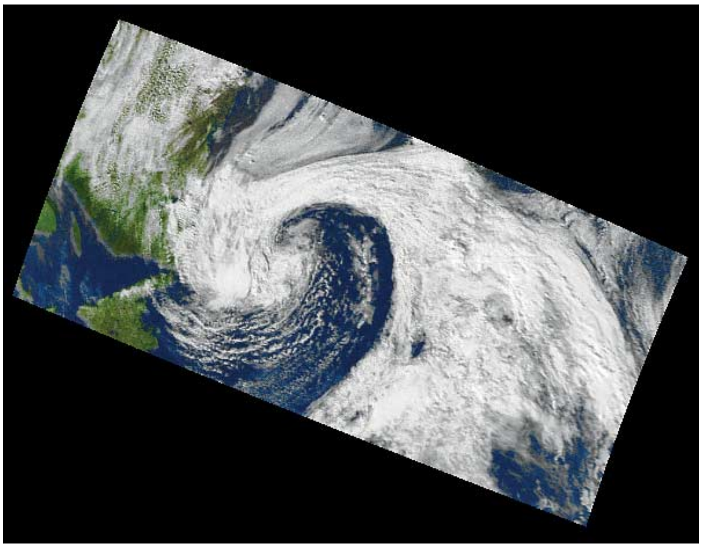


Figure 8 - Yearly September average sea ice extent over the Antarctic
Credit: National Snow and Ice Data Center, Boulder, Colorado.

Challenge

Can GEO Readers in the UK better Rob Denton's "farthest west" APT Image?



Newfoundland, on September 28, 2012.

Some time back, I challenged readers to submit their images showing how far east they could 'see' with their APT systems.

Now I'm laying down the gauntlet again, only this time it's: "How Far West can you see?". I captured the image above from a NOAA-19 northbound pass on September 28, using a *Dartcom System II* receiver and a *WiMo* sloping crossed dipole antenna. The location was North Leverton, just 5 miles east of Retford in Nottinghamshire, GPS coordinates 53.319°N -0.838°W.

Dare you be brave enough to beat me? I'm sure those living west of me can; perhaps even those situated to my east if they are using a beam antenna. The prize, which will be awarded to the reader capturing the 'farthest west' image, will be a bag of home-ground flour, either wholemeal or strong white, freshly ground at the windmill in North Leverton with Habblesthorpe. There will also be another surprise gift if the image also beats my one.

I'm waiting for those entries to flood in, no matter how scratchy. If they beat me you win the prize. Entries are open only to mainland UK to make the challenge fair.

Submit your entries to

international@geo-web.org.uk

For all other GEO members throughout the world, I have also a small prize lined up for the best APT image you can send me. To have the chance of winning a prize, send them to the address above.

It doesn't matter where in the world you live or what area you capture. Good luck!

Closing date is April 30, 2012 and the winners will be revealed in the June 2013 *GEO Quarterly*. You should have plenty time to search for images of Newfoundland and beyond, which will be accepted in both visible light and infrared formats.

Rob Denton G4YRZ

Look down - Look up - Look out

Robert Moore

The morning of October 4 brought some welcome blue sky to north Wales. At 08:00 UT there was, however, considerable evidence of convective cloud over southwest Lancashire, which included a spectacular anvil cloud (figure 1).

By 09:30, a long line of cumulus cloud was to be seen stretching from east to west to the north of Liverpool (figure 2). An extended version of this panoramic photograph has been used as the masthead image on the front cover of this issue.

Some of these clouds later developed vigorous convective activity, creating more 'anvils'. This cloud structure can be seen very clearly in the 09:48 UT NOAA-16 pass (figure 3). The viewpoint for the pictures and for the reception of the HRPT image is indicated by the square on the satellite image.

Figure 1 - A spectacular anvil cloud.

Figure 2 - Panoramic photograph showing cloud stretching along the horizon.

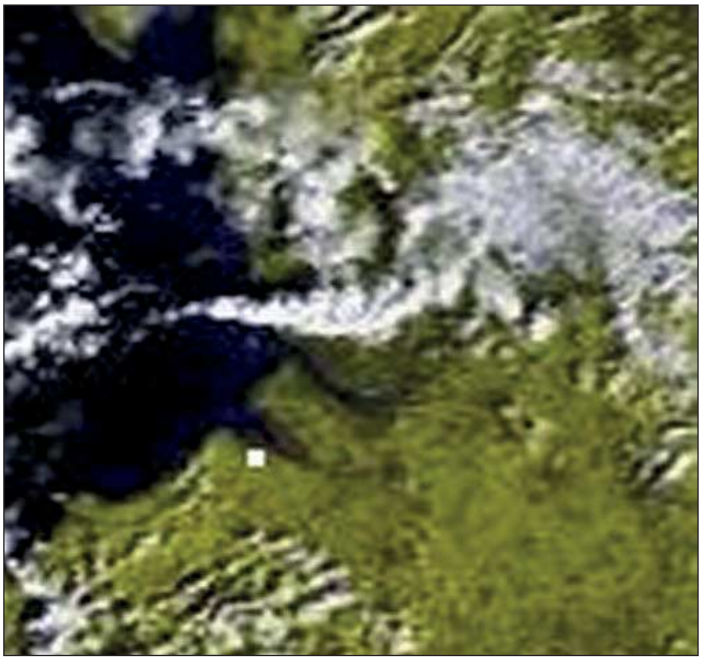


Figure 3 - North Wales, imaged by NOAA-16 at 09:48 UT on October 4, 2012.

Fire Detection and Monitoring

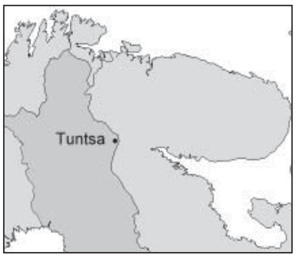
continued from page 11

it possible to view fires against different backgrounds, such as weather images. It is also possible to generate background pictures from a selected area by processing files from a complete day, but including only images which show something from the area in scope. Figure 7 shows fires against a MODIS satellite image background.

Forest Fires in Finland

Forest fires in Finland are different from those in Mediterranean areas. Typically fires are very small and localised. There have been only a few big fires in recent times:

- 1959 Isojoen-Honkajoki fire, about 1 700 ha
- 1960 Tuntsa fire - about 120 000 ha (20 000 ha in Finland)
- 1970 Kalajoki fire - about 1 600 ha
- 1970 Liminka - about 500 ha
- 1992 Lieksa - about 150 ha
- 1997 Laihian - about 150 ha
- 1997 Tammela - about 250 ha



The biggest of these was the Tuntsa forest fire in the northern part of Finland, and its effect on Nature can still be seen today. This map shows the location of the Tuntsa fire and figure 8 illustrates how the ravaged forest now looks, 40 years after the event.

In the past, fire detection was done using towers with a cameraman on duty (figure 4). Additionally, aircraft were used to monitor smoke from fires. Nowadays, the temperature anomalies detected by Earth observation satellites have made possible the detection of forest fires in large unpopulated areas. Today, FMI (the Finnish Meteorological Institute) is providing forest fire warnings. Their fire warning system aims to raise public awareness about the terrain during drought conditions, and the resulting fire hazard. FMI issues a **Forest Fire Index** calculated according to the dryness of the terrain, weather observations and assessment of their drought-calculation model.

The FMI Drought Calculation Model

A calculation model is used to estimate the humus moisture content of regions where partial clear-cutting has taken place to leave a patchwork of woodland and open terrain. Such areas are the most flammable, as the open areas contain vegetation that dries quickly adjacent to trees (which provide the main combustible material). The model calculates the moisture content of the surface humus for 3 cm and 6 cm thick layers. The surface moisture is calculated on daily basis across the territory of Finland and the information communicated daily to the FMI weather stations.

A substantial improvement in local accuracy is achieved by the application of the so-called *grid method*, whereby the measurement is estimated on the basis of the value of weather variables such as relative humidity, wind speed, air temperature, solar radiation and precipitation levels in grid areas measuring 10 × 10 km.

Nationwide, some 20 automatic stations measure solar radiation, and it can also be calculated at 50 Synop stations which have a cloud measurement instrument. Another 150 stations record temperature and humidity, while almost the whole of Finland is now covered by weather radar. Areas that the rain radar does not cover are served by stations provided with automatic rain gauges.

The output of the calculation model is the forest fire warning map, an example of which appears in figure 9.

As explained earlier, most fires are small local ones and they cannot be detected by satellites as in Mediterranean areas. The MSG satellite has a low viewing angle towards Finland, for which reason it too cannot detect the fires. MODIS fire images (pixels) could be used, but the best method is observation by aircraft, which patrol areas where the fire probability index is high, once or twice daily. The patrolling routes are outlined in white on figure 9.

I am a member of a flying club which is involved in these patrols, each of which is manned by a pilot, a fireman and a volunteer observer (figure 10). It is important that there are several sets of eyes to look out for possible fires which may be very small and hard to detect. The pilot needs to concentrate to flying and navigation. When a possible fire has been detected, the fireman contacts the local fire brigade using a *Tetra* phone. Sometimes the plane continues patrolling the affected area to help direct firemen on the ground to the correct area. Figure 11 shows an example of a forest fire detected by one of these flying patrols.

Forest Fires and Lightning

I wrote an article for *GEO Quarterly No 32* about lightning detection. One of the causes of forest fires is lightning, and after writing the article I did some research work to study whether there was any correlation between heavy lightning and forest fires. I can track lightning using the *Blitzortung* detection system and *MyBlitzortung* software.

http://www.blitzortung.org/Webpages/index.php

Readers interested in learning more of these topics should read the detailed article in GEOQ 32, page 37.

My correlation studies involved using *MyBlitzortung* to track moving lightning during the day and checking this information against fire pixels from MODIS images to see if there was any correlation. Figure 12 does seem to show some correlation in Bulgaria and Serbia.

Acknowledgements

I would like to thank the following for providing help and background information for this article.

- David J Taylor, for extending the MODIS L1 Viewer for Fire detection and automated operations.
- The LSA team for excellent presentations during LSA week.

References

1 http://landsaf.meteo.pt/
2 http://cap-validator.appspot.com/validate#r

My Envi-Ham Experiences

Francis Breame - vf0123@btinternet.com

The *Envi-Ham Project* [1] has now finished, at least in its original form. This article is taken from the report which I wrote for the Project. It is intended that collated reports from participating Envi-Ham stations will be issued in due course.

Reception Setup

Since the Envi-Ham link budget is marginal at best with amateur equipment, and my garden layout forces a fairly long cable run, I decided to use a relatively large dish (1.2 m) and WF125 cable from the outset. This size of dish looks a lot larger than one might imagine by comparison with the 80 cm version commonly used for *EUMETCast* reception, and impressed the delivery driver when told that it was for TV satellite reception (figure 1).

Obviously, the alignment of a relatively large antenna, combined with a fairly low-level downlink signal, requires extreme care. I used a laptop with the production DVB-S receiver next to the antenna to monitor the DDS (Data Dissemination System) channel signal quality. The DDS is the setup for rapid dissemination of the *Envisat* satellite's data using DVB-S over commercial satellites, very similar to *EUMETCast*.

Note that cheap 'Satfinder' analogue meters, which monitor the entire passband, are virtually useless for this application. Unfortunately, I didn't get a spectrum analyser until after I had aligned the dish. It would have been ideal for the alignment.

I had to construct a simple adjuster which held the dish accurately in elevation, as shown in figure 2. This allows fine adjustment via the threaded screws and holds the dish while the clamping bolts are tightened. It could then have been removed, but I left it in place for additional support. It would also be useful for *EUMETCast* dish adjustment, although this is not nearly as critical.

I also found it necessary to use a 20 dB head-end line amplifier to compensate for the long cable run. This is claimed to have a flat frequency response. Curiously, a different preamp, designed for this application in that it had a low-frequency roll-off to compensate for the lower cable losses at those frequencies and avoid overloading, performed less well in terms of error rates when it actually came to data reception.

The waterproof housing for the preamplifiers is visible in figure 3, which also shows the feeder terminations. The one with four cables leads to a motorised TV reception dish. I've found readily-available blue 25 mm MDPE water pipe to be a cheap and effective means of running feeders underground in the garden. It provides both protection (having managed to put a spade through them on more than one occasion) and allows them to be easily altered. Although rather snake-like, it can be fairly easily buried by cutting a slot with a spade—no need to dig trenches (figure 4).

Other than this, the station hardware and software was set up with no problems, following the invaluable advice given by David Taylor et al. in the GEO Quarterly [1,2,3]. I used the common 2-PC configuration (one for reception, one for processing). Both computers were used simultaneously for *EUMETCast* reception.

The *Tutioune* software [5] described by Esko Petäjä [6] was ideal for monitoring. Unfortunately, my setting up of it coincided with the demise of *Envisat* (I don't think the two are linked), so it had little use.

Data Usability

Having set up the receiving equipment, my main concern was to improve the usability of the *Envisat* data received by Envi-Ham. This was prompted by two observations:

- Whilst the supplied visualisation program *VISAT* does an excellent job of processing the data, it is very slow to start and to load images. This is partly due to the need to decompress very large files—those approaching 1 GB—before processing can commence.
- There is no way of telling from the filename the geographic coverage of the data. Thus it is difficult to select images of interest. Finding this out by opening in *VISAT* is not practical on a routine basis, since it first decompresses the entire file. In fact, only the file header needs to be read to determine the coverage.

Thus, I wrote two companion programs to improve the situation, and made them available at no cost under the GNU General Public License, together with comprehensive User Guides, via my website at

http://www.elnath.org.uk

These were publicised in *GEO Quarterly* No 30 [6], and via relevant *Yahoo* groups [7,8], which resulted in a number of Envi-Ham stations using them for routine processing. I am very grateful to the stations who provided me with suggestions for facilities which I was able to incorporate into the software to improve its usefulness. In particular, Esko Petäjä incorporated it into his satellite downlink monitoring configuration (which uses the Tutioune software), so that current thumbnails could be displayed for the latest image.

The two programs are intended to work together. The first program, *Envi-HamManager*, is intended to be operational all the time that DDS reception is running. Its main functions are to:

- Detect new files as they are received by DDS, as well as certain file reception errors.
- Move files from the reception PC to the processing PC where a 2-PC setup is in use.
- Delete received files which are not wanted.
- Automatically generate DIMAT and JPG files (both full-size and thumbnails) from received files.
  DIMAT is the native file format used by VISAT and will therefore be loaded more quickly by VISAT. JPG is the familiar image file format, which is used Envi-HamBrowse for previewing.
- Show thumbnails of the latest received files.
- Monitor the DDS file reception log. Provide graphs of counts of files received successfully and failed for various periods.
- Delete old or unwanted files to keep disk space under control.
- Report the status of its functions.

The second program, *Envi-HamBrowse*, is a browser which displays, on a world map, the areas covered by the *Envisat* files. Images of interest can then be selected and *VISAT* started automatically to display them. *Envi-HamBrowse* can do this very quickly since it reads just enough of the file to

Figure 1 - The author's 1.2 m dish used for Envi-Ham reception

Figure 2 - The dish adjuster

Figure 3 - The waterproof housing

Figure 4 - Making use of MDPE piping for underground feeders

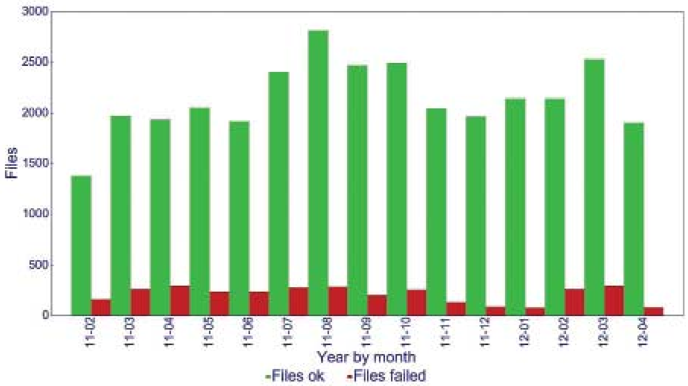


Figure 5a - Reception Results

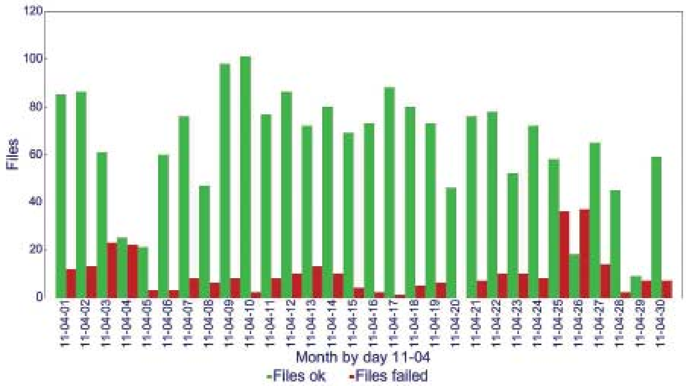


Figure 6 - A sample showing data failures

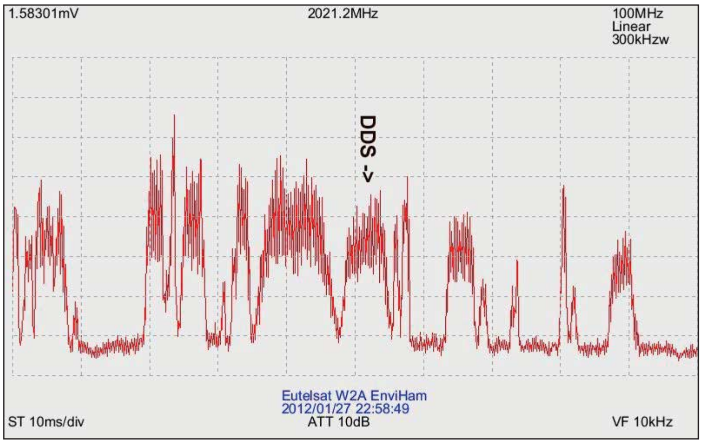


Figure 7 - Normal transponder spectrum

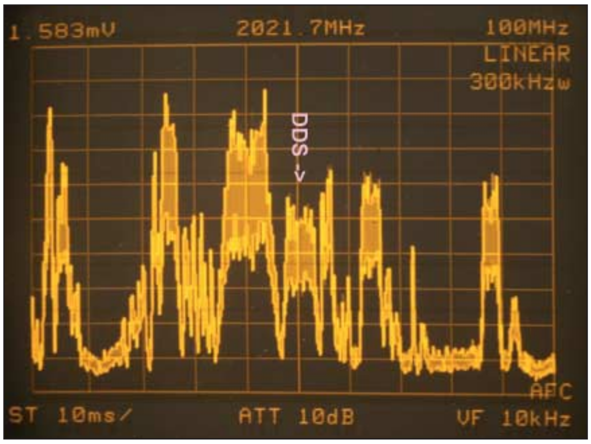


Figure 8 - Transponder spectrum showing possible failure cause

determine its coverage area. It also includes a number of features to help with viewing and maintaining Envi-Ham files.

Its main functions are to:

- Display the coverage area of files in the reception directory, filtered according to date, file type, or image type. Information about each image, including a thumbnail, is also displayed as a popup.
- Display the coverage area of manually-selected files.
- Display the coverage area of the last file received.
- Launch the *VISAT* viewer for selected images.
- Display the associated JPG files for selected images, which is quicker that launching VISAT.
- Generate DIMAT and JPG files for selected images, where these were not generated automatically by Envi-HamManager.
- Delete all files associated with selected images.
- Move chosen file types associated with selected images to an archive directory, and delete the rest.

Envi-HamManager and *Envi-HamBrowse* are written in *Perl* and P*erl/Tk* (which provides the GUI facilities). For those used to using *Perl* as a 'glue' scripting language, this may seem a surprising choice. However, I've found *Perl* to be extremely efficient, and most suitable for many applications, for the following principal reasons:

- It comfortably handles the most complex applications.
- It is freely available for open-source projects.
- It has access to vast library resources.
- Its built-in pattern-matching facilities and content-addressable storage (hashes) are most useful.
- It is possible to distribute an application as a self-contained .exe file which includes all the necessary *Perl* runtime files. It is not therefore necessary to have *Perl* installed, or to bother about runtime or library versions.
- It is readily available for most platforms. *Envi-HamBrowse*, and especially *Envi-HamManager*, have a lot of interactions with the operating system which restrict them to running under Windows. However, the OS interfaces are clearly defined and it would not therefore be difficult to port to *Linux* (indeed, the OS interactions would be considerably easier than the Windows version).

Now that the Envi-Ham project is regrettably at an end, *Envi-HamManager* is obviously no longer relevant. However, *Envi-HamBrowse* is still most useful in looking at archived data. For full details of the programs please refer to the user guides, which are available from my website.

Reception Results

Figures 5a summarises the raw file reception results in terms of success and failure, as obtained by analysis of the DDS log file over the period of 15 months between February 2011 and April 2012. This is of interest, as Envi-Ham did not use the retransmission request feature of DDS.

Month 11-02	1377 files ok	165 failed	10.7%
Month 11-03	1974 files ok	263 failed	11.8%
Month 11-04	1936 files ok	297 failed	13.3%
Month 11-05	2053 files ok	238 failed	10.4%
Month 11-06	1916 files ok	236 failed	11.0%
Month 11-07	2409 files ok	276 failed	10.3%
Month 11-08	2815 files ok	286 failed	9.2%
Month 11-09	2472 files ok	202 failed	7.6%
Month 11-10	2493 files ok	255 failed	9.3%
Month 11-11	2047 files ok	134 failed	6.1%
Month 11-12	1964 files ok	91 failed	4.4%
Month 12-01	2142 files ok	78 failed	3.5%
Month 12-02	2141 files ok	264 failed	11.0%
Month 12-03	2533 files ok	295 failed	10.4%
Month 12-04	1903 files ok	83 failed	4.2%
Total	32175 files ok	3163 failed	9.0%

Figure 5b - Numerical breakdown of the figure 5a data

A further breakdown for each month by day is also available. Figure 6 is a typical sample and shows data for April 2011. This shows that the failure rate is typically clustered. Failure spikes can often be attributed to reception equipment problems, especially early on in the period. However, this did not account for clusters such as we see in figure 6. I have speculated that, since the *Eutelsat* transponder was shared with a number of relatively narrowband services, the uplink power levels of others were not always controlled as well as they might have been, resulting in a downlink deficit on the DDS signal (which was marginal on amateur equipment anyway). The transponder spectra in figures 7 and 8 illustrate this effect.

Figure 7 shows the transponder spectrum for the normal case, illustrating the large number of services sharing the transponder. Figure 8, on the other hand, shows the spectrum on April 26, 2012, which corresponded with the higher failure rate recorded for two days near the right of figure 6. The service to the immediate left of DDS has a very noticeably increased level.

The Future

Given the apparent enthusiasm for Envi-Ham within the amateur community, I hope that it may be possible one day to build on the experience gained and establish a similar project using other data from present or future satellites. It would also capitalise on the equipment acquired for Envi-Ham.

Acknowledgements

Many thanks to Stefano Badessi for creating the Envi-Ham project in the first place, and to Francis Bell and David Taylor who publicised its availability and provided much invaluable advice on setting up a station [1,2,3]. In addition, thanks to all the stations who used and provided suggestions for my software.

System Details

Location	Central southern England 51.09° N, 0 80° W.
Period covered	February 2011 - April 2012
Antenna	Dedicated 1.2m dish at ground level Invacom LNB40 0.3 dB LNB Head-end line amplifier 20 dB ~35 m WF125 cable
Receiver	DVB World DVB-S
Reception PC	2-core AMD Athlon 64 X2 Toledo 2.2 GHz CPU, 2GB memory Windows XP
Processing PC	6-core AMD Phenom II X6 1090T 3.2 GHz CPU, 8GB memory Windows 7 Pro 64-bit

Links and References

1 Envi-Ham Project: Francis Bell, GEOQ 25, March 2010, page 12.

2 The Envisat Data Dissemination System: David Taylor, GEOQ 26, June 2010, page 18.

3 David Taylor's notes on setting up Envi-Ham reception at http://www.satsignal.eu/wxsat/EnvisatDDS/

4 Tutioune software: http://www.vivadatv.org/page.php?p=tutioune-en

5 Tutioune: New Software to Analyse Your EUMETCast and Envi-Ham Systems, Esko Petäjä, GEO Quarterly No 33, March 2012 page 15.

6 Envi-HamBrowse: A Front-End for Displaying Envi-Ham Images, Francis Breame, GEOQ 30, June 2011, page 24.

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

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

ASH PLUME FROM SHIVELUCH

A NASA Earth Observatory Report

When NASA's *Terra* satellite passed over Russia's Kamchatka Peninsula at local noon on October 6, 2012, **Shilveluch** Volcano was quiet. But by the time NASA's *Aqua* satellite flew over the area two hours later, the volcano had erupted and sent a plume of ash over the Kamchatskiy Zaliv. The plume travelled 90 kilometres south-southeast where a change in wind direction caused it to dog-leg towards the east. The Kamchatka Volcanic Emergency Response Team (KVERT) reported that the plume rose 3000 metres above sea level and travelled 220 kilometres from the volcano's summit.

With a height of 3,283 metres, Shiveluch ranks among the biggest and most active volcanoes in Kamchatka. The mountain is a stratovolcano, composed of alternating layers of hardened lava, compacted ash and rocks ejected by previous eruptions. The beige coloured expanse of rock on Shiveluch's southern slopes is due to avalanche debris resulting from an explosive eruption in 1964 when part of its southern flank collapsed. High-resolution imagery shows very little vegetation within that avalanche zone.

Reference

Shiveluch Erupts - GEOQ 34, page 36

NASA image courtesy Jeff Schmaltz
LANCE MODIS Rapid Response Team at NASA GSFC

Envisat – the Lost Satellite

Mike Stevens (G4CFZ)

I think the expression is: *'it was good while it lasted'.* It was very good indeed, so different from the data we receive daily from *EUMETCast*, very interesting, and above all, with more detail. I am, of course referring to *Envisat* and the *Envi-Ham Project*.

I have very specific regions of interest, mainly within the Mediterranean Sea with all its islands shown in great detail, a truly interesting area, and one that *Envisat* covered extremely well (figure 1). One of my favourites is the area around the Suez Canal region, truly breathtaking and with lots of detail (figure 2). Another area of particular interest was, of course, our old friend the Aral Sea, which was described so well in a recent issue of *GEO Quarterly* [1].

So it was with great sadness that the satellite was 'lost' just as we, the amateur fraternity, were getting used to the incoming data and the pictures that we developed. I have to say that learning how to use the *Visat* software took a bit of getting used to, but it was mastered in the end and created some stunning imagery.

So where do we go from here? Those of us who received the *Envisat* data stream now have spare capacity on our systems: two DVB receivers and a one-metre dish which we can now use to our advantage. I have also kept in circuit the twin outlet LNB that I installed with the new dish I set up for use with *EUMETCast* to increase the capability of the system.

My own experiences have been documented in the past but for now I have dedicated everything to *EUMETCast*. A slight movement of the satellite dish has increased my signal strength from *Eurobird 9* at 9°E, which I am able to receive at 100% signal strength with 65% signal quality. I now suffer no loss of signal during heavy rain such as we have had recently and, should we be invited to receive any future data from ESA via *Eutelsat*, then it's just a case of realigning the dish: not so difficult now that I have had the experience.

I have split up my system so that one of the DVB receivers is bringing in the MSG-Rapid Scanning Service, which runs continuously on one PC. The other DVB receiver is dedicated to the MSG-2 standard cycle of data, feeding into a second PC which is shared with *Metop Manager*, *AVHRR Manager* and *Modis L1 Viewer*. But, once *Metop-B* data becomes available, I will be reorganising the system again to even out the load on the PCs.

With so much data available to be downloaded on to our systems, we have the capability to receive everything that is thrown at us without too many problems. So don't despair at the loss of *Envisat*. We still have many exciting times ahead to look forward to, with data from Metop-B and perhaps also from NOAA's Suomi-NPP satellite to come in the future. Who knows? Just hang in there. The best may be yet to come.

Reference

1 Syr Darya Control and the Northern Aral Sea Project
Les Hamilton - GEOQ 34, page 10

Figures 1-3 courtesy ESA
Figure 4 © EUMETSAT 2012

Figure 1 - Envisat imaged Sicily and Malta on July 26, 2011

Figure 2 - Envisat imaged the Suez region on July 26, 2011

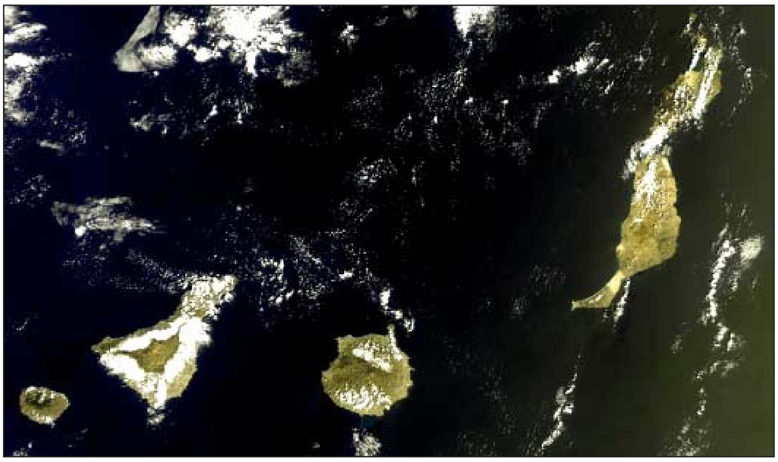
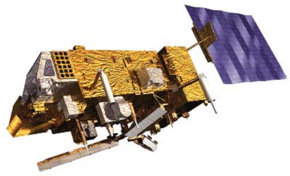


Figure 3 - Envisat imaged the Canary Islands on September 16, 2011

Figure 4 - A EUMETCast/MODIS segment of the Falkland Islands on October 5, 2012

METOP-B TAKES TO THE SKIES



Les Hamilton

Metop-B was launched from Baikonur in Kazakhstan, aboard a *Soyuz* rocket, at 16:28 UT on September 17, 2012. Carrying a suite of sophisticated instruments, Metop-B will ensure the continuity of the weather and atmospheric monitoring service provided by its predecessor Metop-A, which has now been circling Earth, 14 times a day, since 2006.

The Metop satellites are Europe's first operational polar orbiting meteorological satellites; they make up the space segment of the EUMETSAT Polar System, delivering data for modern weather forecasting, as well as climate and environmental monitoring. Metop-B carries a suite of eight instruments which monitor Earth's environment, plus four additional data dissemination packages. A brief overview of the main features of each of these is summarised below. The first three are heritage instruments provided by NOAA to fly on Metop-B, and have been in operation aboard all their satellites since NOAA 15.

Advanced Very High Resolution Radiometer (AVHRR/3)

The AVHRR/3 provides six channels of global visible and infrared imagery twice a day at 1-km nadir resolution. These monitor both reflected and radiated energy from land, sea, clouds and the atmosphere for global monitoring of cloud cover, sea surface temperature, ice, snow and vegetation cover characteristics.

High Resolution Infrared Radiation Sounder (HIRS/4)

HIRS/4 is a 20-channel radiometric sounder that measures radiance, mainly in the infrared spectrum. Data from HIRS/4 are used in conjunction with data from the AMSU instruments to calculate the atmosphere's vertical temperature profile and pressure, from the Earth's surface to an altitude of about 40 kilometres. HIRS/4 data is also used to determine ocean-surface temperatures, total atmospheric ozone levels, precipitable water, cloud height and coverage, and surface radiance.

Advanced Microwave Sounding Unit A1 and A2 (AMSU-A).

The AMSU instruments, which already fly aboard the American NOAA satellites, measure scene radiance in 15 channels of the microwave spectrum (23 to 90 GHz). These data are used in conjunction with the High-resolution Infrared Sounder (HIRS) to calculate the global atmospheric temperature and humidity profiles between the Earth's surface and the upper stratosphere. The data are used to provide precipitation and surface measurements including snow cover, sea-ice concentration, and soil moisture.

Microwave Humidity Sounder (MHS)

MHS was developed by EUMETSAT, and is a 5-channel, total power, cross-track scanning radiometer operating in the 89 to 190 GHz range. MHS scans through the atmosphere to measure the microwave radiation from the Earth in specific frequency bands. Since humidity in the atmosphere attenuates microwave radiation, MHS observations can be used to derive a detailed picture of atmospheric humidity, with the different channels relating to different altitudes in the atmosphere.

Infrared Atmospheric Sounding Interferometer (IASI)

IASI, developed by the French Space Agency CNES, is probably the most advanced instrument carried on Metop-B and provides meteorologists with data of unprecedented accuracy and resolution on atmospheric temperature and humidity, with which to improve weather prediction. IASI will also further understanding of the interactions between atmospheric chemistry, climate and pollution.

Advanced Scatterometer (ASCAT)

Developed by ESA, ASCAT is used to monitor winds over the oceans for weather forecasting and climate research. Winds create

Soyuz lifts off carrying Metop-B into orbit.
Image: ESA

The Metop-B Payload Module is lifted out of ESTEC's Large Space Simulator, after more than a month of testing.
Image: ESA

Soyuz and Metop-B rolled out to the launch pad.
Photo: EUMETSAT

The Metop-B satellite disappears from view as it is eased into the rocket fairing in readiness for the launch on September 17, 2012.
Image: ESA

Metop-B being readied for testing after arriving at the Baikonur launch facility.
Image: ESA

surface ripples over the sea (on a centimetre scale, as opposed to waves) which modify its radar backscattering characteristics. ASCAT uses radar to measure backscattered radiation from the oceans, and this information can be used to deduce actual wind speed and direction for weather forecasting.

Global Ozone Monitoring Experiment (GOME-2)

GOME-2 is another instrument developed by ESA, a nadir viewing UV and visible spectrometer which measures the radiation back-scattered from the atmosphere and reflected from Earth's surface in the UV and visible range between 240-790 nm. The recorded spectra are used to derive a detailed picture of the total atmospheric content of ozone and the vertical ozone profile in the atmosphere. GOME-2 data will provide vertical profiles of atmospheric ozone, nitrogen dioxide and sulphur dioxide, as well as other trace gases and levels of harmful ultraviolet light penetrating the atmosphere.

GNSS Receiver for Atmospheric Sounding (GRAS)

In full, the Global Navigation Satellite System (GNSS) Receiver for Atmospheric Sounding (GRAS) is a new European receiver that operates as an atmospheric sounder. GRAS uses radio occultation to measure vertical profiles of atmospheric temperature and humidity by tracking signals received from a constellation of GPS navigation satellites while they are rising or setting behind the Earth's atmosphere. By processing the navigation signals received by GRAS, highly accurate profiles of atmospheric temperature, humidity and pressure can be derived every day.

Advanced Data Collection System (A-DCS)

A-DCS, provided by CNES, will provide worldwide in-situ environmental data collection and Doppler-derived location service, with the objective of studying and protecting Earth's environment. A-DCS, also known as *Argos*, is an advanced version of the system presently operated jointly by NOAA and CNES. Installation of this package aboard Metop makes EUMETSAT the third agency to make use of this system.

Space Environment Monitor (SEM-2)

SEM-2, provided by NOAA, is a charged-particle spectrometer that makes measurements that determine the intensity of the Earth's radiation belts and of the flux of charged particles at the satellite's orbital altitude. It also provides information that can warn us of solar wind occurrences that might impact upon long-range communication or damage satellite circuitry.

Search And Rescue Processor (SARP-3)

SARP-3, provided by CNES, receives and processes emergency signals from aircraft and ships in distress and determines the name, frequency and time of the signal. These data are then fed into the SARR instrument for immediate transmission to *Cospas-Sarsat* (Search and Rescue Satellite) distress terminals on the ground.

Search And Rescue Repeater (SARR)

SARR, provided by the Canadian Department of Defence (through NOAA), receives and down-links emergency signals from aircraft and ships in distress and provides a down-link for data received by the Search and Rescue Processor (SARP-3). SARR receives distress beacon signals on three separate frequencies, then translates and retransmits them to Local User Terminals on the ground. These terminals process the signals, determine the location of the beacons, and forward the information to a rescue mission control centre.

Brochure

Readers keen on learning more about Metop and its instrumentation can download ESA's attractive full-colour 16-page brochure about the Metop satellite series from

http://esamultimedia.esa.int/docs/BR-261_MetOp.pdf

Acknowledgement

Thanks are due to ESA and EUMETSAT for making much of the above information available through their respective websites.

Superstorm Sandy Savages States

Les Hamilton

Sandy, the 18th named storm of 2012, proved to be the largest Atlantic hurricane ever recorded, its diameter of 1540 km exceeding that of Hurricane Igor (1480 km in 2010). The eight GOES images reproduced here show Sandy's progress from the Caribbean to the Great Lakes. By October 28, Sandy had passed east of Florida, after which point most storms continue northeast to die out over open waters. But not in this case. A combination of high pressure over Greenland with a powerful winter storm advancing from the west hauled Sandy back towards land and prevented its escape over the ocean. It was widely forecast that Sandy would be the worst storm ever to impinge on the east coast, and so it proved to be, some 60 million people suffering in its wake.

The Caribbean

Sandy developed in the western Caribbean Sea on October 22, and within two days had intensified to a Category-1 hurricane. As the storm tracked northwards it caused devastation across a number of island nations and claimed the lives of at least 52 people in Haiti, 11 in Cuba, two each in the Bahamas and the Dominican Republic, one in Jamaica and one in Puerto Rico.

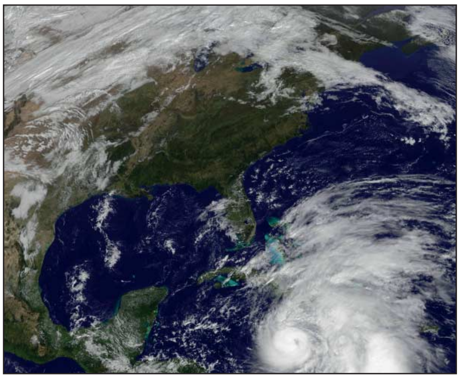
Jamaica was first to feel the force of Sandy's 125 kph winds, which left dozens of families homeless, ravaged the coffee and banana crops, and caused an estimated $20 million in damage. The island of Haiti, though not directly in Sandy's path, was hardest hit. Although the hurricane passed to the west of the island, it still dumped more than 50 centimetres of rain in under 24 hours. This downpour caused rivers to overflow and generated mudslides that engulfed homes, crops and roads: 70% of the crops in the south of the island were destroyed. Haiti has still to rehouse some 400,000 who became homeless following the 2010 earthquake: now Sandy has added a further 200,000 names to this list.

By the time Sandy crossed Cuba, it was only marginally below Category-3 in strength and devastated the island's second-largest city, Santiago de Cuba, where more than 30,000 homes lost their roofs. In addition, 1000 km^2 of essential crops like banana, bean and sugar were ravaged. Most seriously, almost one third of Cuba's coffee crop was destroyed just at the peak of the harvest season.

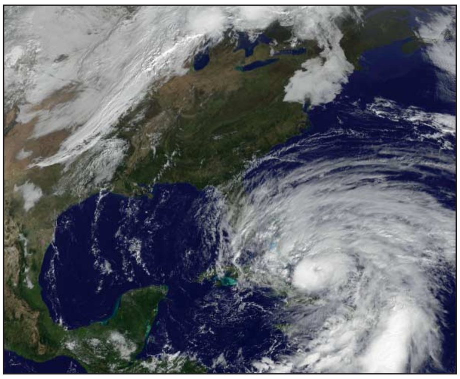
Six French tourists who had attended a music festival on Dominica disappeared after their boat was caught in Sandy's path as they travelled back to the nearby island of Martinique, a journey which usually takes no more than two hours. It seems inevitable that all perished in the storm.

New Jersey and the East Coast

Sandy weakened somewhat after battering the Bahamas and was rated Category-1 when it made landfall in the USA, just eight kilometres southwest of Atlantic City, late on October 29. The storm unleashed chaos all along the east coast, where it downed trees and power lines throughout the state. Most of Atlantic City's 40,000 residents had already evacuated their homes by the time Sandy's massive storm surge—which coincided with high tide—produced eight



15:45 UT on October 24, 2012

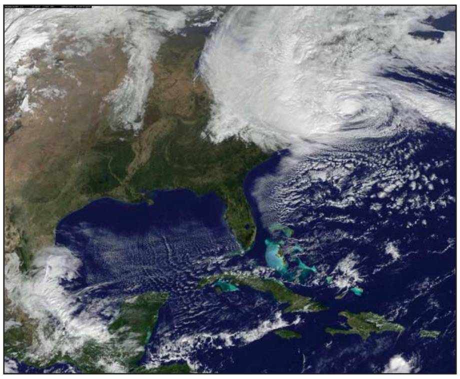


15:15 UT on October 25, 2012

15:45 UT on October 26, 2012

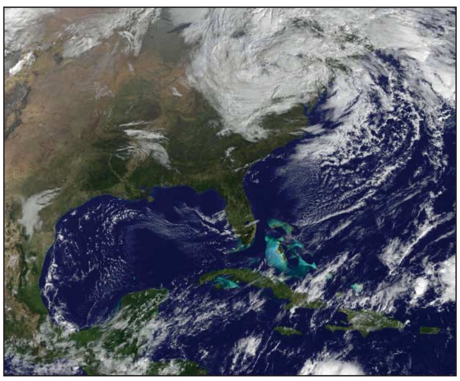
15:45 UT on October 27, 2012

15:45 UT on October 28, 2012



15:45 UT on October 29, 2012

15:55 UT on October 30, 2012



15:25 UT on October 31, 2012

All the above GOES-13 (E) images courtesy NOAA

Figure 1 - Flooding from Hurricane Sandy in Marblehead, Massachusetts.
Photo: Wikimedia / Brian Birke

metre swells that inundated most of its streets. Amusement rides that once stood on a pier in the coastal resort of Seaside Heights were simply plucked from the ground and dumped into the ocean. Torrential rain and high waves battered the Carolinas. In Fairfield, Connecticut, some residents returned to their flooded homes in kayaks and canoes to inspect the damage. Ultimately, at least 24 states—from Florida to New England—suffered at the hands of Hurricane Sandy's storm force winds which stretched far inland. A week after the storm had passed, over a million people along the east coast were still waiting for power to be restored to their homes.

New York

Fearing the worst, authorities ordered mandatory evacuation of 375 000 citizens living in low-lying areas of New York city, and more than 76 evacuation shelters were set up to accommodate them. All transport within New York was shut down the evening

Figure 2 - An NYPD truck ploughs through floodwater on FDR Drive, NY.
Photo: Wikimedia / David Shankbone

before Sandy's arrival, and all schools were closed. Foreseeing that airports would not be able to operate, extra flights from New York and Washington were added the day before Sandy struck in preparation for inevitable cancellations the following day. When the hurricane's storm surge arrived, it flooded scores of streets, tunnels and subway lines in Lower Manhattan and devastated Staten Island and Coney Island. The city's lights went out and two million consumers were without electricity for days on end. As the storm lashed the city, waves topped the sea wall in the financial district of Manhattan, and cars floated down streets which turned into rivers.

The day following Sandy, the streets were littered with debris, bridges were closed and seven subway tunnels under the East River were flooded. With no transport in or out of the city, schools, shops and businesses—including the New York stock exchange—remained closed for a further two days, while more than thirteen thousand airline flights were cancelled.

Hardest by far was Staten Island, which was devastated beyond recognition, and where 19 lives were lost. Most of these occurred in beachfront neighbourhoods exposed to the Atlantic Ocean, where homes, built decades ago and not designed to withstand a major storm, simply collapsed under the battering from the wind and the weight of water that heaped up as high as their rooftops. So complete was the devastation that only the foundations of the buildings remained the following morning. Despite a mandatory evacuation having been ordered before the storm hit, many residents had remained in their homes believing that they could handle whatever Sandy had in store for them. In the event, this was not to be, and firefighters had to wade through rushing floodwaters to the rescue of dozens of trapped residents living on the tip of the peninsula.

In the flooded Rockaway Peninsula of Queens, a fire caused by electrical faults was quickly spread from building to building by the powerful winds, ultimately leading to the total destruction of between 80 and 100 homes.

Flooding in Manhatten's East Village overnight on October 30.
Photo: Wikimedia / David Shankbone

In all, as many as 40 000 homes in New York were either destroyed or rendered uninhabitable by Hurricane Sandy. With winter starting to bite, and thousands forced to live in wrecked homes without electricity, the authorities were faced with a race against time to devise housing solutions for them, on an unprecedented scale.

The Great Lakes

So widespread was Sandy's influence that weather buoys operated by NOAA recorded wave heights exceeding seven metres on southern Lake Michigan and five metres over western Lake Erie. Cargo shipping on the Great Lakes, which transports bulk commodities such as iron ore, coal, limestone and grain, was brought to a standstill as Sandy churned up waves up to two stories in height, forcing crews to take refuge in bays and harbours.

Sandy swept this boat on to the tracks of Metro-North's Ossining Station
Photo: Metropolitan Transportation Authority of the State of New York

FEEDBACK

The column for Readers' Letters, Queries and Discussion

Email: geoeditor@geo-web.org.uk

Hello Les,

I was reading from the last GEO Quarterly about Management Group worries about the decrease of GEO's membership. The reason for me is very clear. For any company or association there is always the need to have something new going on. Companies have to keep developing new products. If a new development is not present, it will die in couple if years.

In GEO, I can see that there is a great history with APT, EUMETCast and Envisat. But APT will be soon history, EUMETCast is now widely known and Envisat is dead.

My proposal is the following

Establishing activity groups with a responsible leader for each group. The group responsibility is to develop activities in its area and also to report about them in GEO Quarterly in a regular way (just like computer corner was, in the past). This will also attract new articles. Additionally everybody sees that something is going on.

Groups could be, for example,

- Computers , EUMETCast receiving units, etc.
- Direct receiving activities.
- New from ESA activities
- New From EUMETCast activities
- Software
- Issues from amateur satellite observation sensors

and so on,

PS: My daily work is in R&D, to develop new products and also encourage organisations and capable individuals to be more innovative. One specific task is how to raise interest and to expand the number of people in the interest group.

This hobby is so interesting that it should not be any problem to increase membership if the right methods are used..

Esko Petäjä, Finland.

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
Metop B	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

MODIS L1 Viewer

continued from page 29

Next to the **Raw Images** tab is another tab marked **Derived Images**. click on that box and an amazing full-colour image will appear on screen. If you now right-click on this image, a list of options appears: you can use these to enhance the image.

Options include:

Boundaries
Grid
North Pole
Remap Region (with other options included)
RGB Setting
Thermal LUT
Vis Channel brightness (with more options included)
Zoom in and out

At the very bottom if the list is **Save with correction**, the option you would normally use to save any image you may want to keep for viewing at a later date. This option geometrically corrects the image. The **Derived Images** tab also provides a row of buttons marked **RGB-521**, **User RGB**, **Vegetation**, **Air Mass** and **Ash and Dust**, all basically self explanatory (but you may need to upgrade to get all the user information).

So there you have it: an excellent piece of software from David Taylor. If you need to investigate more, consult David's website where he has a lot of excellent information concerning all his software, with lots of extras.

A full size MODIS image from *Terra,* acquired via EUMETCast on August 5, 2012 is reproduced on the back cover of this issue. Most of south and central Europe basks in sunshine, though thunderstorms can be seen brewing over the Black Sea and the northern Caucuses.

My thanks to David Taylor for some helpful information in writing this article.

Happy weather watch from Portland.

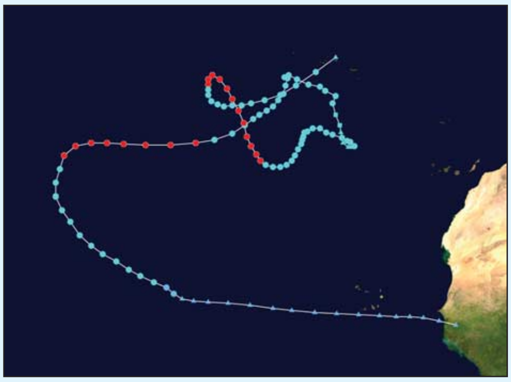
Hurricane Nadine

Francis Bell and Les Hamilton

Readers may be interested in this recent MODIS image of *Hurricane Nadine*. The overlap with GEO is the name 'Nadine', because the company secretary of *GEO Ltd*. is Nadine Bell, who has looked after the business and legal side of our company since its inception nine years ago. A fitting tribute for such commitment to have hurricane named after one!

On a more serious note, though, the effects of this hurricane caused serious damage and flooding in the north of the UK on September 23-24, 2012. Some of our UK readers will doubtless have experienced this directly.

Nadine formed as a tropical depression south of the Azores on September 11, and within 24 hours had strengthened into a tropical storm, one of the most persistent ever recorded in the Atlantic Ocean. During the 23 days *Nadine* spent weaving her erratic dance south of the Azores she intermittently attained Category-1 hurricane status, with peak winds of 140 kph. *Nadine* also became the fifth longest-lived tropical cyclone in the Atlantic Ocean, a record held by the *San Ciriaco Hurricane* as long ago as 1899, and which endured for 28 days. By comparison, the average life of a tropical cyclone is only six days. *Nadine* finally petered out on October 4.

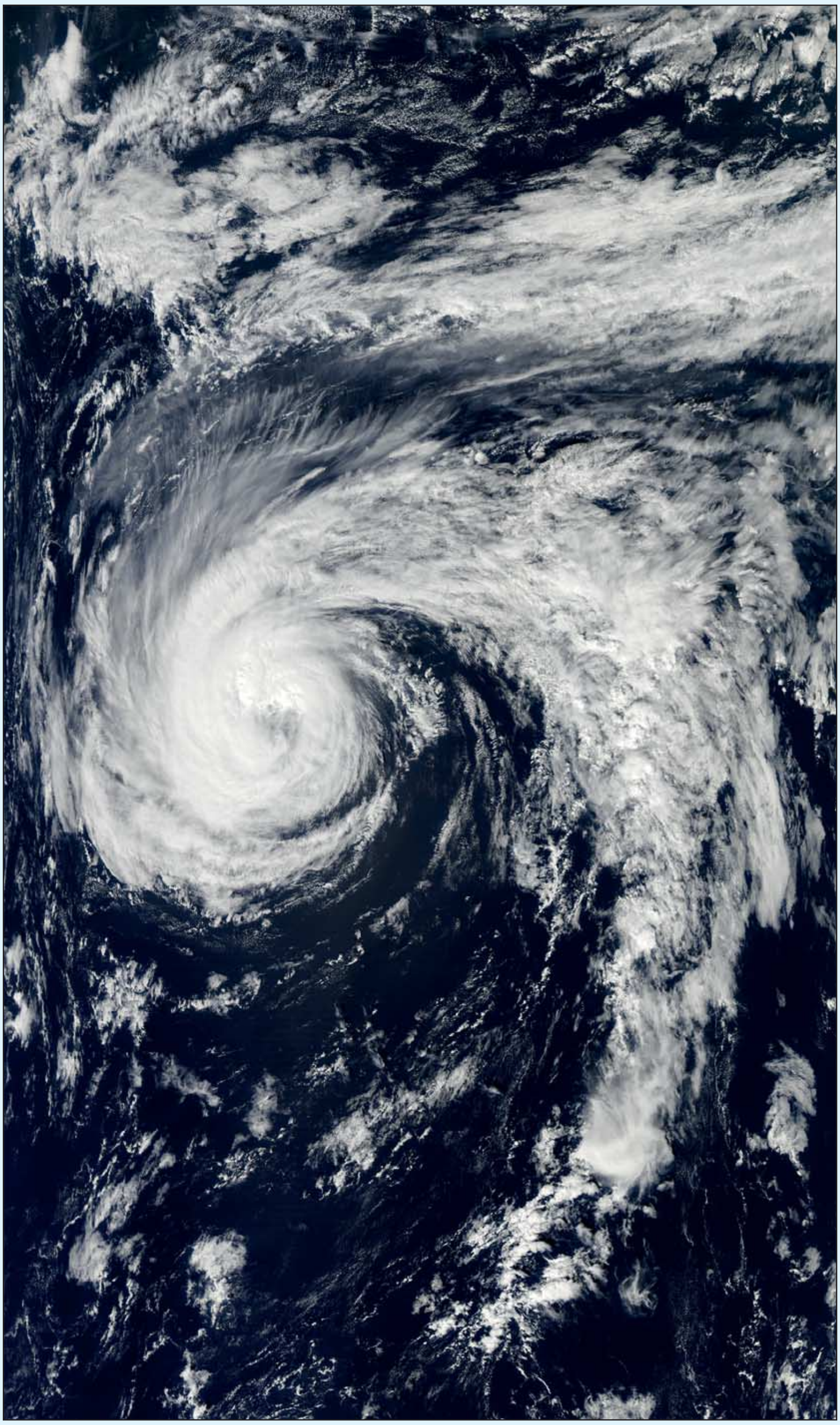


Nadine's track across the Atlantic. Red dots show when Nadine gained hurricane status

Credit: Supportstorm using Wikipedia:WikiProject Tropical cyclones/Tracks

During its lifetime, *Nadine* spawned a deep secondary depression, dubbed *Child of Nadine,* which tracked across the UK during September 23-26, subjecting the north and east of England in particular to gale force winds and torrential rain. Ravensworth in North Yorkshire experienced 131 mm of rain in less than 72 hours, almost three times what would be expected for the entire month of September. The Met Office issued more than 50 flood warnings, and many homes were deluged by floodwater, while road and rail services were severely disrupted. *Child of Nadine* was the deepest depression to hit north-east England since 1981.

As for the Azores, although the threat was always there, *Nadine* never quite made landfall. On September 17, *Nadine* started to drift northeast towards the islands but veered to the southeast before reaching them, though large ocean swells and storm force gusts of up to 74 kph were recorded on Flores.



Hurricane Nadine as imaged by NASA's Aqua satellite on September 30, 2012

NASA image courtesy LANCE MODIS Rapid Response Team at NASA GSFC

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 37 is Sunday, February 3

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

PayPal

MasterCard Maestro VISA AMEX VISA Electron

Current Subscription Rates

United Kingdom ... £25 Europe ... £35 Rest of World ... £40

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.

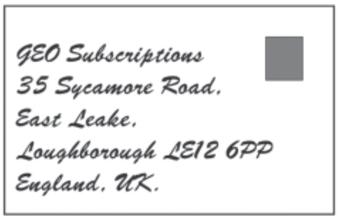
I sign below to confirm that I have no objection to my membership details being held on a computer database and understand that these details will be used *exclusively* for internal GEO administration purposes.

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



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

GEO Shop

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

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

DVBW DVB-S USB2102 Receiver

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

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

DVBW DVB-S2 USB2104 Receiver

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

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

Current Price List

	Members' Prices			Prices for non-Members		
	UK	EU	RoW	UK	EU	RoW
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	---------
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)	3.80	4.60	5.60	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.)	25.00	35.00	40.00	25.00	35.00	40.00

All prices are in £ sterling and include postage and packaging

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

Ordering and Shipping

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

Orders should be sent by email to

tech@geo-web.org.uk

or made through theGEO Website at

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

Goods are normally shipped within 28 days, subject to availability.

Not yet a GEO Member?

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

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

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

£25 (UK)
£35 (EU)
£40 (rest of world)

GEO Quarterly - Back Issues
(Only available to GEO Members)

Paper copies of back issues of GEO Quarterly may be available, but it is advisable to check before ordering.

UK members price - £3.80

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

UK members price - £8.00

TechniSat SatFinder Antenna Alignment Meter

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

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

GEO PIC 1.0 for the RX2

Programmed with the new channel frequencies required for NOAAs 18/19.

UK members price - £7.00
UK non-members price - £7.50

GEO Bias Tee

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

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