Following several increasingly turbulent years in the North Atlantic Ocean, the 2005 Hurricane Season proved the most active ever recorded, breaking almost every record in the book. Almost inevitably, pundits around the world seek to pin the cause on what they variously term '*Global Warming*' or '*Climate Change*'. But a recent report in *NOAA Magazine* explains that there is now general agreement amongst a number of their hurricane researchers and forecasters that the recent increase in activity is primarily the result of natural fluctuations in the tropical climate system. You can read about their findings in our page 26 article, which also summarises the final weeks of Hurricane Season and lists the many records achieved.

Continuing with this stormy theme, Ferdinand Valk has prepared an in-depth article on the subject of tropical cyclones. If you have any queries about how and why tropical storms and hurricanes form you are sure to find your answer here.

Last January, NOAA acceded to requests from many UK-based GEO members by switching the NOAA-18 APT frequency to 137.10 MHz to allow them pager-free reception. Alas, with this frequency now required by *EUMETSAT* for their MetOp satellites, NOAA-18 resumed transmissions on 137.91 MHz on June 20, a move that is sure to disappoint many *GEO Quarterly* readers. We are grateful to NOAA for having afforded the amateur community this window of opportunity to enjoy NOAA-18 APT at its best throughout the past six months.

Contents

The GEO Report

Francis Bell

A New Member of the GEO Team

David Simmons has formally agreed to join GEO's management team and we are confident that he will be a great asset to our group. Many members will already have met David because he has attended all our Leicester events where he has been conspicuous giving demonstrations, on one occasion, fitting hardware into a new computer and loading the software to set up a running EUMETCast system inside 30 minutes. Last April, he demonstrated the extraordinary data rates coming from Hot Bird-6. David has appeared in photographs in several *GEO Quarterlies*.

David Simmons talking to visitors to the GEO stand at Kempton last March

David G1MAL has been involved in amateur radio for about 20 years. He is membership secretary for the TCARC and plays an active role in the local 70 cm repeater group GB3GF. He supports GEO at the Kempton rallies and the AMSAT colloquium in Guildford.

We extend a warm, formal welcome to David. He has said that he would try to fulfil a technical role, mainly on the hardware side. David who lives in Surrey may be contacted by email at:

g1mal@btinternet.com or *tech@geo-web.org.uk*

Kempton Rally

The South London Amateur Radio and Computer Rally is held at Kempton where, on May 7, 2006, GEO attended for a second time. We had a double stand and also resourcefully made use of existing shelving and extra floor space under a window. From a dish positioned just outside this window we ran live *EUMETCast* signals to the stand all day, plus recorded images. *EUMETSAT* as usual had provided us with literature: both technical and posters and we displayed some of our *GEO*

Shop hardware. Most importantly, we talked to the visitors and, as last year, we estimated the number coming to our stand to be about 200.

A busy GEO stand at Kempton, showing the wide age range of visitors attending

We did take in some GEO membership renewals but the most important factor was the interaction with our visitors. Secretaries of two different clubs asked if they could have extra literature for their clubs and of course their requests were fulfilled. Almost all the posters, bearing images of the Earth, were taken. I remember two children, not related I think, who both said: 'These pictures would look super on my bedroom wall'. Surely no better use for them!

GEO plans to be at Kempton again in November. Do come and visit us if you can.

AMSAT Colloquium

I have just returned from the AMSAT colloquium in Guildford. GEO was invited to give a presentation during the three-day meeting at Surrey University and I made a brief presentation relating to the background of GEO. David Taylor was also present and brought us all up to date with the latest weather satellite news. I hope that a fuller report with photographs will appear in our next Quarterly.

In preparation for the AMSAT meeting I had a discussion with some members of GEO's management team asking what I could report in relation to GEO's achievements in the brief two and a half years of our existence. The answers impressed me:

1 The production of a quality quarterly publication—recognising the skills of the editor and contributors

2 An established good relationship with our national Meteorological Office who allow a *EUMETCast* receiving licence in the UK without a fee. This precedent was successfully taken up by our Dutch friends. This license policy has now cascaded across Europe, and countries who used to charge for a receiving licence now in many cases allow the license free of charge

3 A friendly and informed relationship with *EUMETSAT* and NOAA. These organisations know about GEO and our international membership. An example here would be NOAA's knowledge of problems in the UK with reception of NOAA 18. They changed the APT downlink frequency to reduce interference problems. It has now been restored to the original planned frequency but as a gesture of goodwill it's difficult to think of anything more responsive than changing a satellite frequency

4 A busy web site, a busy shop and a user group forum providing advice on technical issues and software from our membership.

Not bad in two and a half years. The above is more or less what I said at the AMSAT meeting.

Renewals

Please try to renew your membership on time otherwise it makes work for an already busy team. If you do not wish to renew that's fine, but by default don't just forget your renewal.

Two members have recently been in touch with me, interestingly, making almost the same point. They remarked that our hobby has changed from the pioneering stage in which weather satellite enthusiasts engaged in the 1970s, 1980s and 1990s, to a more commercial dimension today. Perhaps an aspect of this argument is true but this has to be set against a long and distinguished tradition within the amateur radio and satellite community to push back the frontiers of what is technically possible. Long may this continue. However, numerically, we do need a healthy membership to maintain our shared skills and talent within our group.

If you remember from our last issue, I asked the question: "How many European or North African country outlines can you see from weather satellites?"

My answer is two. Iceland and Malta. I ruled out Cyprus because it is politically divided. Within contiguous mainland Europe I cannot see any complete country outlines. Of course major rivers and mountains are visible from weather satellites but nowhere do these enclose a complete country. The point of the question relates to the ephemeral nature of a country: we all share the same planet but countries seem to be more dynamic.

If anybody wishes to contribute to this topic please send me an e-mail or letter.

Future GEO Events

GEO is planning to be at the Kempton Park amateur radio and computer rally in SW London, on Sunday 19th November 2006. This will be the third time that GEO has run a stand at this event.

Our own events for 2007 are in the planning stage. It has been suggested that we move our symposium from Leicester, where we have been for the last three years, to a location in the SE of England - perhaps Guildford. The date will be planned to avoid any public holiday weekend.

GEO has been invited to visit EUMETSAT's headquarters in Darmstadt. This is an opportunity which we will not miss. Arrangements still have to be made but a date sometime during June or July 2007 looks promising, again avoiding public holidays.

Details of our events will be published on our web site and in the Quarterly as soon as they are firmly established.

My thanks to GEO's friendly and talented membership for contributing to our hobby.

Don't forget: if you have any experiences which you can share with us, any text or photographs they are always welcome.

Swallow This!

Now I don't suppose anybody will be interested, but that will not stop me. The family of swallows which I photographed on my VHF aerial and which were featured in GEO Q8 did

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GEO requires a New Membership Secretary

commencing early 2007

After 3 years in post, Nigel Evans plans to stand down as GEO Membership Secretary at the end of this year.

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return this year. They built a new nest within a few centimetres of the previous one and reared four of five fledglings.

Two of these were very lucky! They fell out of the nest! I was privileged to find them and gentlly pick them up and return them to their nest—and they survived.

How these birds manage to navigate around the world is a mystery to me. Celestial, terrestrial and magnetic I guess. They certainly

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GEO requires a New GEO Quarterly Editor

commencing early 2007

Les Hamilton has combined the roles of Principal Feature Writer with both Editor and Make-up Editor since GEO first appeared. He now looks to take a well-earned break.

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do more Earth observation than I do. Me: I don't even know what GPS stand for!

New Editor and Membership Secretary

Disappointingly, I have had **no** offers from our membership regarding the posts of Editor and Membership Secretary. These two members of the GEO Management Team have given substantial warning that they wish to step down from what can be demanding posts to concentrate their own interests.
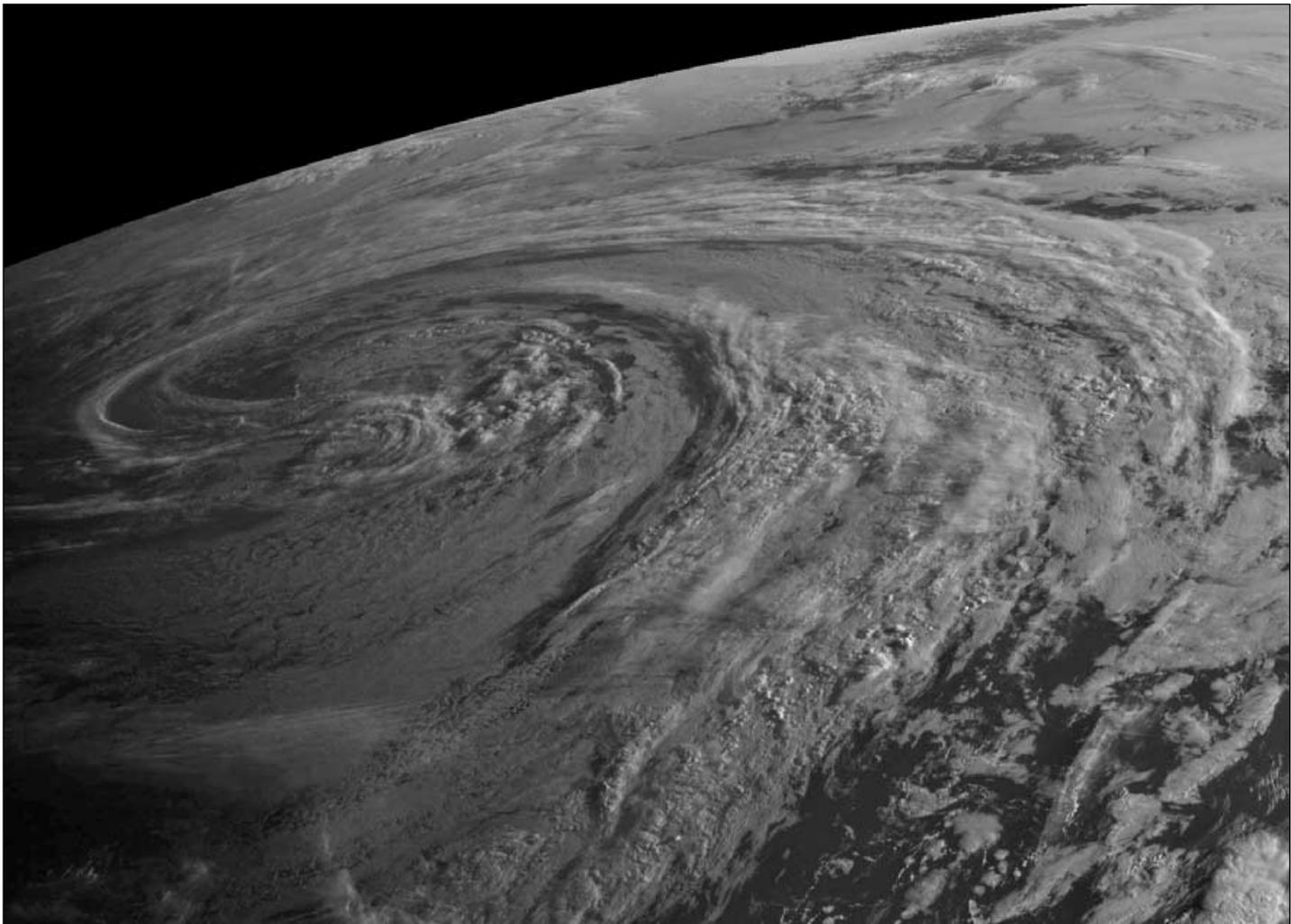
David Taylor submitted this segment from the 06:15 UT Meteosat-8 HRV image on July 27 where the low sun angle gives an alsost 3D appearance to the large Atlantic depression.

Image © EUMETSAT 2006

Experiments with Receivers and Antennas

Unexpected paging interference reduction

John Tellick

Living in SW London, I have been plagued with pager interference to polar orbiting satellite APT ever since paging services around 138 MHz became operational in the early 1990's. Pager transmitter sites are normally spaced 18 km apart, but more densely in urban areas where buildings reduce the effective reception area.

I have three nearby pager transmitter sites, one just three quarters of a mile away, emitting 100 W on 137.975 MHz and other sites just a couple miles away.

I long ago gave up polar orbiting reception owing to the interference, as my main interest was the Sahara and the Arctic. I used to receive noise-free imaging from AOS to LOS using a beam antenna on a rotator and a turnstile mounted on the roof. But with the advent of wide-area paging channels around 138 MHz in the UK, obtaining even the overhead sections of passes on some frequencies without interference was a bonus.

The distant imaging of Meteor 3-05, which had a higher orbit than NOAA satellites, therefore gave me extended coverage N and S well into the Arctic and southern Sahara while its higher APT resolution (around 2 km) gave superb images of these distant locations.

But living in a bad paging interference area *is* useful for investigating APT receiver susceptibility to interference.

New Frequencies

NOAA-N and NOAA-N prime, the two final NOAA APT/HRPT satellites, use one or other of two new frequencies, 137.9125 MHz and 137.10 MHz. The new European MetOp series of satellites will all use 137.10 MHz for their digital LRPT. Since I had suffered from pager interference to the Meteor 3-5 on137.85 MHz, I initially assumed that trying to receive NOAA-18, would be a waste of time.

Nevertheless, when NOAA-18 started transmitting on the upper new frequency, widespread pager interference was reported from across the UK in a survey undertaken by two GEO members [1]. I set out to determine what the possible interference situation would be like using an assortment of APT receivers—a Proscan, a RIG/Dartcom module receiver with EPROM tuning, an RX2, a Gola, an R2FX and a Vierling.

Receiver Experiments

Since the squirrels that live in the trees at the bottom of my garden had long ago chewed through the cables from my roof mounted antenna and beam, I set up a turnstile antenna in the garden atop a 16-foot pole.

Not having any test gear, my experiments were quite 'non-technical': the receivers either demonstrated pager breakthrough at 137.91 MHz (the nearest most could tune to .the NOAA-18 frequency) or they didn't. This was initially done by listening for pager break-through under this under zero APT signal conditions (i.e. no satellite within range).

Of the six receivers tested, three were 'flattened' by my local 137.975 MHz pager and proved to be incapable of producing satellite images; two of these receivers also suffered from pager interference problems at lower frequencies.

Two other receivers, the RX2 and Vierling, experienced only slight pager interference, which appeared as light 'banding' on images when the satellite was at a lower elevation. But one receiver, the Dartcom module, showed no interference at all.

Antenna Experiments

It was at this time, using a turnstile antenna, that I accidentally noticed a reduction in pager breakthrough could be achieved on some receivers by rotating the turnstile slightly, so that the relationship of the antenna rods to the direction of the paging transmitter changed.

Following a suggestion by a GEO member, I'd previously done some tests using ferrite rings and cores around the phasing harness and downlead of the turnstile antenna but these appeared to make little if any difference to my high interference levels. I was also told that a good earth rod should help reduce interference. My receivers were duly earthed to a metal rotary clothes line spike embedded in damp soil on my lawn but again this didn't reduce the interference.

The pole-mounted turnstile

Using my Dartcom module receiver, I tuned to 137.94 MHz where the pager signal started to break through strongly, reaching close to maximum on my signal level meter. Turning the antenna slowly through 360° produced two deep, sharp nulls and two broad high peaks in pager pick-up, which clearly depended on the horizontal orientation of the antenna elements to the direction of the paging transmitter site. Pager transmissions are, of course, vertically polarised.

Next I tested a QFH which has some vertical components in its construction, and which I found to be more prone to pager pick-up. This also demonstrated some reduction of pager pick-up by rotating it – albeit very much less so than the turnstile.

There was of course the possibility that the effects I was experiencing might be due to reflection of pager signals from something in my neighbourhood, so I should moved the antenna to a new location to see if the same phenomenon occurred. In the event there was no difference: a 360° rotation still produced identical pager nulls and peaks of the same intensity. I repeated the experiment with a turnstile antenna from a different manufacturer, and once more the results were identical.

But how much reduction in pager pick-up was I obtaining by rotating the antenna?

I consulted *Dartcom Electronics* who kindly loaned me a precision switchable attenuator. By matching meter readings, with the attenuator in-line on maximum pager pick-up antenna orientation, and not in-line on pager null orientation, gave a figure of 35 dB+ difference between peak and null signal levels at the same frequency just by rotating the antenna by a quarter-turn.

Although rather crude and non-technical, this experiment demonstrated a staggering reduction in pager signal pick-up by merely rotating the antenna. As to what is actually happening here, I don't know, and would welcome any suggestions.

In practical terms this means that certain receivers (the RX2 and the Vierling, which had previously shown slight banding) were no longer affected by pager interference.

Postscript

With all MetOp satellites using 137.10 MHz, NOAA may eventually have to utilise 137.9125 MHz again for APT transmission. In that case, pager interference could again pose a problem for some users.

Reference

1 NOAA-18 Reception and Pagers, GEO Quarterly No 7, page 11, September 2005

TROPICAL CYCLONES

Ferdinand Valk

By the time this article reaches you, the Atlantic Hurricane Season should be well under way and those of us receiving *EUMETCast* will already have sifted through many Meteosat and GOES images—and even through AVHRR material—to see with our own eyes the impressive behaviour of these monster storms. Not everybody, however, is fully aware of what a hurricane actually is, how it forms and from where it draws its enormous power.

The purpose of this article is to provide some insight into these energetic weather phenomena, commonly referred to as Tropical Cyclones.

What exactly is a Tropical Cyclone?

Let's start out with a definition:

A tropical cyclone is a storm system with a closed circulation around a low pressure centre that is driven by heat energy.

With this rather simple definition in hand we immediately recognise three important aspects:

· they form in the tropics,
· are cyclonic in nature,
· and are heat engines.

Three types of tropical cyclone can be distinguished depending on the windspeeds reached:

1 A Tropical Depression, which is an organised system of clouds and thunderstorms that, as a whole, already possesses a distinct surface circulation. The maximum sustained wind speed is less than 17 m/s. The depression has no organised overall spiral shape and no eye. Again, as the name implies, it is a depression in a tropical region. They are plentiful, can be inconvenient, but seldom cause disruption of daily life.

2 A Tropical Storm, which is an organised system of strong thunderstorms with a pronounced surface circulation and maximum sustained winds between 17 and 32 m/s. Although a distinctive cyclonic shape starts to form, an eye is usually not present. It is common practice in most regions in the world to identify the Tropical Storm with a name or number at this stage of its formation, .

3 Hurricane, Typhoon or Cyclone. Once a tropical storm system has reached an intensity such that it produces sustained wind speeds greater than 33 m/s (118 km/h), we no longer call it a tropical storm but a hurricane, a typhoon or just a cyclone, depending on the region in which it occurs. At this stage, a strong spiral shape has formed and we can normally clearly recognise an eye.
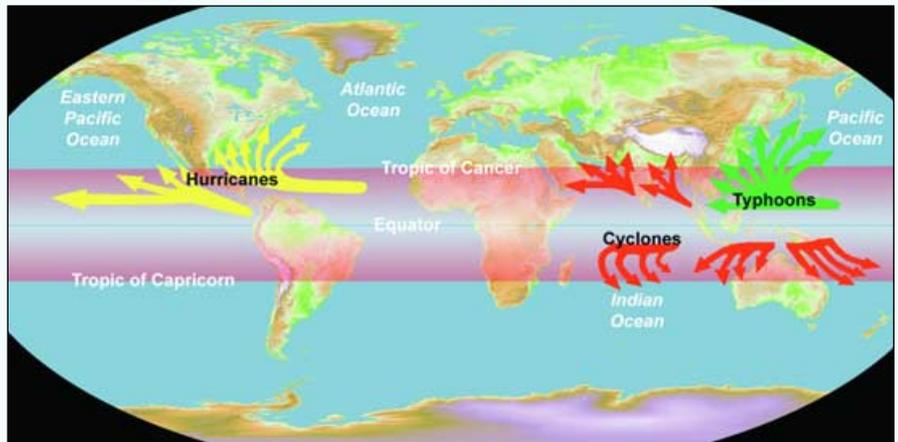
Figure 1 - Basins of Tropical Cyclone Formation
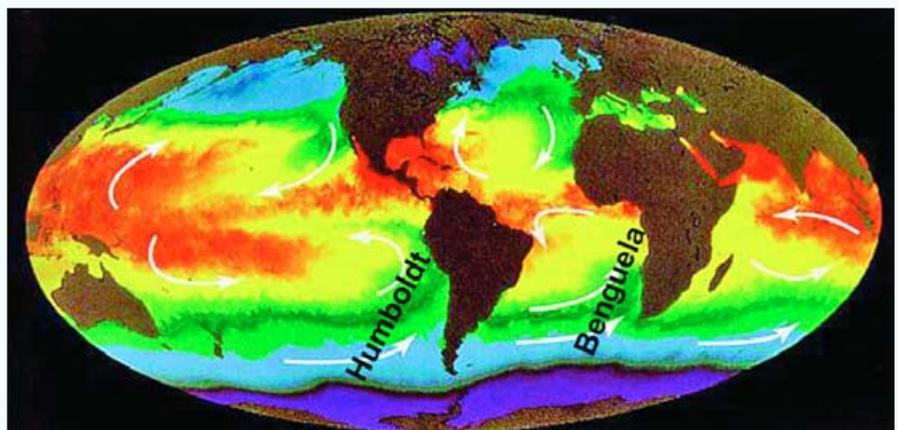
Figure 2 - Global Ocean Surface Currents
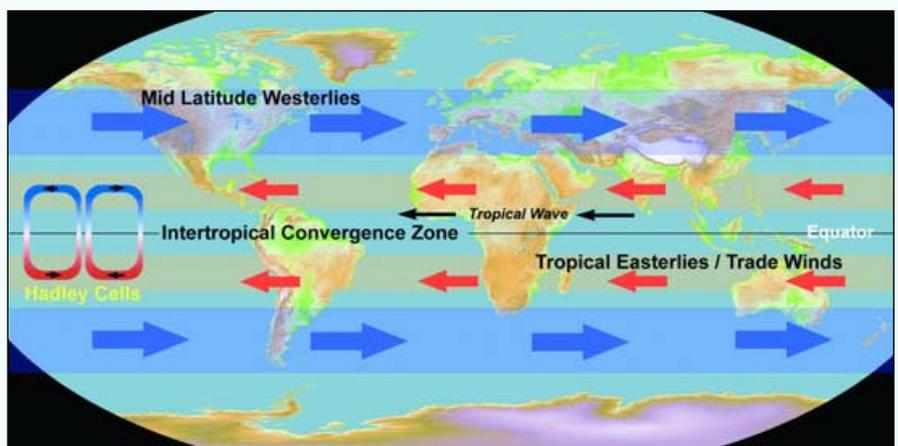
Figure 3 - Atmospheric Belts

There are seven regions along the equator where Tropical Cyclones of the third type form (figure 1). Those that form within the Tropic of Cancer, east and west of Central America, are called Hurricanes while all those that form in the Pacific, north of the equator and west of Hawaii, are labelled Typhoons. All other Tropical Cyclones of the third type are simply referred to as 'Cyclones'. These include tropical cyclones occurring east and west of India, all those that form south of the equator in the Indian Ocean and those to both the northwest and northeast of Australia.

The same figure also shows that there are regions in the Tropics where, apparently, no cyclone formation takes place. Large parts of the Pacific Ocean south of the Equator, and the entire Atlantic Ocean south of the Equator, seem to lack the conditions for cyclone formation. The reason for this is reflected in figure 2 where the temperatures of the major ocean currents have been plotted (red is warm and purple is cold) as well as the flow direction of the surface currents.

Along the western South American coast we find the Humboldt stream, a cold upwelling current that causes the waters near the equator to be far too cold to trigger tropical cyclone formation. Also, the waters flowing along the West African coasts of Namibia and Angola in the Benguela current are very frigid, due to their Antarctic origin. The low surface temperatures are not conducive to the formation of a tropical cyclone.

Not surprisingly, the basins associated with Cyclone formation coincide largely with the areas shown in red in the image. It is important to note, however, that the figure is drawn for northern hemisphere summertime. During winter, the region of warm ocean surface waters moves south, explaining the seasonal nature of cyclone formation.

Preconditions for the Formation of Tropical Cyclones

Tropical Cyclones can only form when a number of environmental conditions are met. First of all, as can be understood from figure 2, *the ocean water temperature should be high*. A minimum temperature of 26.5°C is required and that value should extend down to a depth of at least 50 meters. The reasons for this are twofold: waters of this temperature cause enough instability in the overlying atmosphere to sustain convection and thunderstorm systems, and on the other hand the warm waters form the reservoir of energy on which the cyclone feeds.

A second precondition is that the *air temperature should be decreasing quite rapidly with increasing altitude*. The quicker the air cools down the greater the rate at which latent heat (energy stored in water vapour) is released from the atmosphere. The principle behind this is that, when air saturated with water vapour gets cooled down, the water vapour transitions to a liquid (condenses). The amount of energy released during the transition from vapour to liquid is a physical property of the substance in question. For water this is about 2240 kJ/kg of water produced—about five times the energy needed to heat water from 0 to 100°C. If we calculate the total number of kilograms of water produced in an active hurricane it becomes apparent that the quantity of latent energy available in the water vapour must be enormous. Scientists at the National Centre for Atmospheric Research (Boulder, Colorado) have estimated that the rate at which a hurricane releases heat energy is of the order of 100 to 200 terawatt. And all of this is *green* energy. By comparison, the total energy production capacity of the whole world is estimated at one terawatt.

Note: *one terawatt = one million megawatts.*

High humidity, especially in the lower-to-middle troposphere, is another requirement. When there is a significant amount of moisture in the atmosphere conditions are more favourable for the development of disturbances. And, as all things big start out small, the atmospheric disturbance is at the root of any major tropical cyclone. For clarity of definition I mention here that the troposphere is the lowermost portion of the atmosphere; it extends from the surface up to the tropopause, where the stratosphere begins. The extent of the troposphere varies around the globe but is greatest in the tropics, reaching up to about 16 kilometres, and smallest at the poles where the tropopause starts at around 8 km above the surface.

Low Wind Shear. In the definition of a Tropical Cyclone provided at the beginning of the article, mention was made of a closed circulation pattern around a low pressure centre. When there are high winds passing the region of closed circulation with a different tangent (not necessarily at the same atmospheric level), wind shear will disrupt the required convection in a cyclonic system which then loses its coherence. Conditions that are conducive to hurricane formation include a troposphere in which wind shear is virtually absent.

Source of Bad Weather. Again, for a weather system to grow to impressive proportions it has to have originated from something small. It is therefore not surprising that a system of disturbed weather must already be in place, and that *that* system should have some sort of circulation as well as a low pressure centre that can serve as the catalyst for cyclone formation and for rotation.

The Coriolis Effect

The last in the list of requirements has to do with *a minimum distance from the Equator*. In this context, two aspects are relevant: the Inter-tropical Convergence Zone, a low pressure belt around the Equator caused by the constant updraft of warm air, and the Coriolis force. As the world turns around its axis, the rotational movement influences the motion of both the atmosphere and large bodies of water via the so-called Coriolis force. The strength of this force is greatest in the polar regions, because there, the surface of the Earth is at right angles to the axis of rotation; it is weakest near the equator because there the surface of the Earth is parallel with the axis of rotation. If the Earth were not rotating, air would flow directly into the low pressure belt (towards the equator), but as the Earth is spinning, the Coriolis force causes that air to be deviated and to travel around the low pressure centre. We have seen that rotation is a prime ingredient in cyclone formation. The fact that the Coriolis force can impart considerable rotational momentum to a forming cyclone makes it understandable that hurricanes do not form at or very near to the equator, where that force is weakest. It needs to be sufficiently distant from the equator to be strong enough to deflect winds blowing into the low pressure centre. In practice this is at a distance of 500 km or more from the equator. It is the Coriolis force that is responsible for the direction of rotation of both air and water masses on earth: cyclonic or anti-clockwise in the northern hemisphere, anti-cyclonic or clockwise in the southern hemisphere.

Setting the Stage

All of the aforementioned variables need to be in place simultaneously for a tropical storm to attain hurricane proportions. However, we still need to set the stage upon which the performance is going to take place.

This stage is well depicted in figure 3. Starting out from the equator we first encounter the Inter-Tropical Convergence Zone, a belt of low pressure that girdles the Earth. The Tropics of Cancer and Capricorn are both home to a belt of subtropical high pressure, bordering winds with a fixed westward orientation, the Trade Winds or Tropical Easterlies. At higher latitudes, outside the Tropics, we find in both hemispheres a rather wide band of principally eastward flowing air, the Mid-Latitude Westerlies, which is bordered on one side by the subtropical high (30°) and on the other by a belt of sub polar low (60°).

All these belts are organised parallel with the equator. One more essential actor in the show is the *Hadley Cell*. This is essentially a global air transportation system that moves warm air away from the Tropics to higher latitudes and colder air away from the higher latitudes back towards the Tropics. Finally, the *Tropical Wave* illustrated in figure 3 is the source of the bad weather I mentioned earlier under 'Preconditions for Hurricane Formation'.

Now that the stage is set, the actors identified and all props are available, we can try to attend the show itself. In the example

below I have considered events in the Atlantic Basin.

The Life and Times of a Hurricane

The proverbial butterfly has been busy flapping its wings in sunny western India, setting off a tiny rhythmic local oscillation in a pocket of air; this acts as an amplifier and vehicle for the propagation of a signal destined for greater things. Left in the hands of Mother Nature, chaos theory takes over, transforming the flapping into an area of low pressure, also called a Tropical Wave; this travels westward with the prevailing air currents over the warm waters of the Indian Ocean. The funnel formed by the Gulf of Aden directs the wind flow straight into the Ethiopian highlands where the interplay between warm moist air brought in from the Indian Ocean and the cold air from the highlands causes the formation of strong gusty winds and thunderstorms with heavy rain.

By this time the Tropical Wave has transformed into a Tropical Disturbance, which in turn crosses the full width of the continent of Africa, increasing in intensity but remaining structurally unchanged. When a Tropical Disturbance persists for more than 24 hours and increases in intensity, as is the case in our example, it is upgraded to the level of a Tropical Depression. During its crossing of the continent the Tropical disturbance also obtains a more pronounced Coriolis driven rotational motion. Once it has reached the west coast, the system is blown off Africa into the Atlantic Ocean, well within the region of persistent low we call the Inter Tropical Convergence Zone (figures 5-8).

Once the depression has entered the Convergence Zone, it arrives in an area where there is a constant influx of moist air. The *Hadley Cell* mechanism that is always at work causes an updraft of the warm moist air towards the colder upper air. When the cooling is rapid enough the warm water-vapour condenses on a large scale, thus releasing huge quantities of latent heat energy (see the explanation earlier under 'Preconditions').

The energy that is freed in the condensation process is used in two different ways. Part of the heat energy is converted into kinetic energy which causes the wind speed to increase. It should be remembered that the rotation—in our example anti-clockwise—is already present in the system. Those higher wind speeds and the consequential lower pressure result in the capacity to suck in much more warm saturated air, driving storm intensity up in the process. Another

substantial part of the energy freed up by condensation goes towards increasing the height of the storm clouds. The fact that the heights of the clouds increase means that the system reaches into a colder environment. It also means that the total surface exposed to the cold condensing environment will increase and thus the capacity for condensation is greatly enhanced.

Eventually, the amount of energy within the cyclonic system may increase to a point where enough energy is released for it to become self-sustaining. This positive feedback loop ensures that the system remains self-supporting until one or more of the input requirements starts failing.
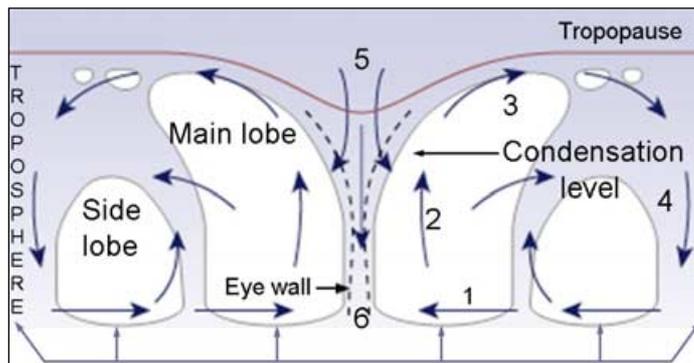
Figure 4 - Rain Bands

Left undisturbed in the positive feedback loop, the Tropical Cyclone progresses naturally through the stages from Tropical Depression and Tropical Storm to a real hurricane. Wind speeds within the system keep increasing, as do height, diameter and the rate of rotation. The pressure at the centre of rotation drops dramatically and the fast rotation of the system causes an eye to form. Although wind speeds within a hurricane system can reach values from 120 to over 250 kph, the total hurricane complex in fact flows with the prevailing wind currents at a speed that is often comparable with that of a cyclist.

At this stage, when we have a full-fledged hurricane in place, a cross section of the system would look something like figure 4.

We recognise the eye chimney in the middle, the main lobes and a number of side lobes on each side. Arrow 1 represents the influx of air which, by passing over the warm ocean surface, has absorbed great quantities of moisture. As this hot air is loaded with water vapour it rises up the centre (arrow 2) to the level where condensation takes place. The faster the updraft of this air the more explosive the release of latent heat. The energy released by condensation speeds up the wind movement and increases the height and volume of the cloud column. At point 3 the ceiling of the troposphere has been reached and the air stops climbing further. This typically

occurs at an altitude of some 16 km. By this stage the clouds have cooled down considerably, and as indicated by arrow 4, drop back to sea level.

It should be understood that, because of the very low air pressure at the core of the hurricane, the ceiling of the troposphere is sucked in as it were, resulting in an influx of cold air from the tropopause into the chimney. This is depicted at point 5. This cold air passes downward through the chimney along the eyewall to point 6, helping to cool the ocean surface.

The Eye and Eyewall

There is something more to say about the eye and eyewall. Due to the rotation of the whole complex, the updraft of warm air forms an upward spiral, right up to the top of the hurricane. This spiral forms the eyewall of the hurricane and it is the region with the strongest winds, the tallest clouds and the heaviest precipitation. In really strong tropical cyclones the eyewall wraps completely around the upper portion of the eye of the storm. The greater the storm intensity the tighter the eyewall winds and consequently the more the storm speeds up. It is the same process by which a pirouetting ice skater speeds up when pulling the arms in.

Because thunderstorm activity also takes place *outside* the eyewall region this process of speeding up has a natural maximum limit. At a point when the eyewall and area of strongest winds has contracted to a diameter of between 8 and 25 km, thunderstorm activity in the periphery may become disassociated from the eyewall region and outer rain bands may organise into an outer ring of thunderstorms (an outer eyewall) that slowly moves inward and robs the inner eyewall of its necessary moisture and momentum. Such an outer eyewall typically forms some 80 km from the centre of the storm.

During this phase, the hurricane weakens, which means that the maximum winds die off a bit and the central pressure rises. Eventually, the outer eyewall may replace the inner one completely and the storm can then regain its previous intensity or, in some cases, become even stronger. This is called the *Eyewall Replacement Cycle*, and is a phenomenon that may repeat itself several times during the life of a hurricane, effectively placing an upper limit to possible wind speeds. The schematic overview in figure 4 also shows the regions of heaviest precipitation or rain bands. The wider the hurricane system, the more side lobes and hence rain bands will be present.

Figure 5 - The Ethiopian highlands
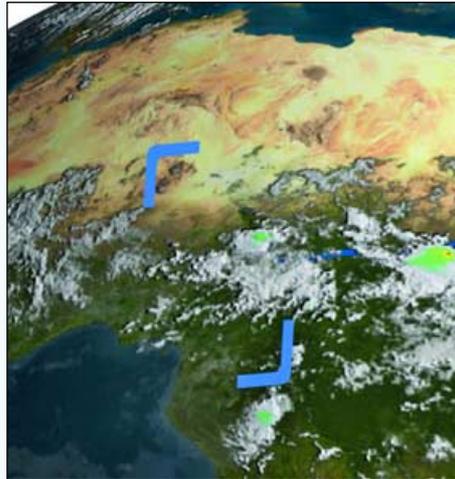
Figure 6 - The complex crosses Africa
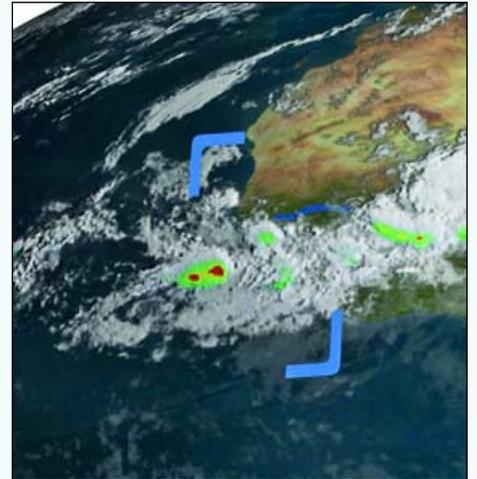
Figure 7 - Arrival at the west Coast
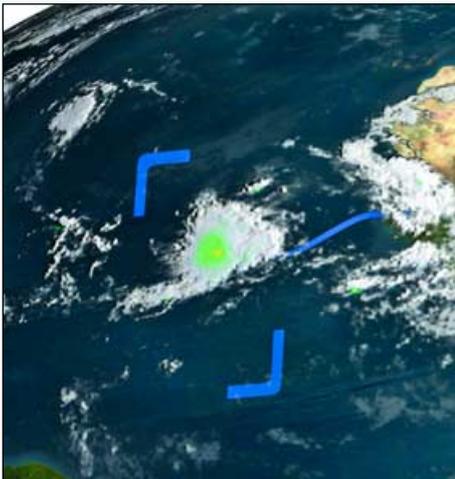
Figure 8 (left)
Over the Atlantic ocean

Figure 9 (right)

A 3D rain intensity graph by
the TRMM satellite
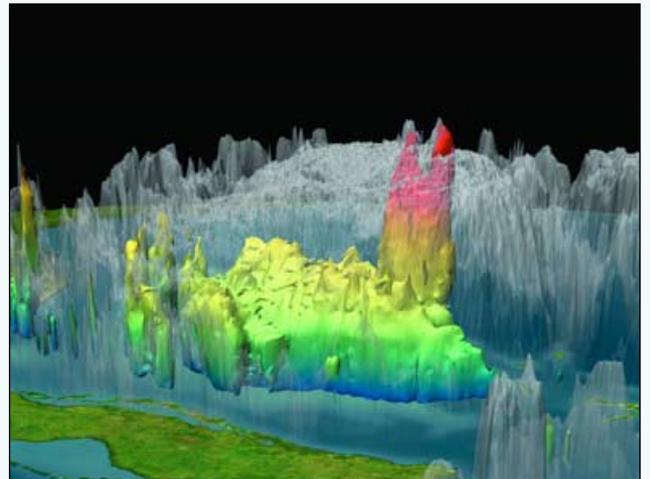
Figure 10 (below)
Hot towers in hurricane Ivan

Figures 5-8: Credit NASA
Figure 9: NASA/JAXA
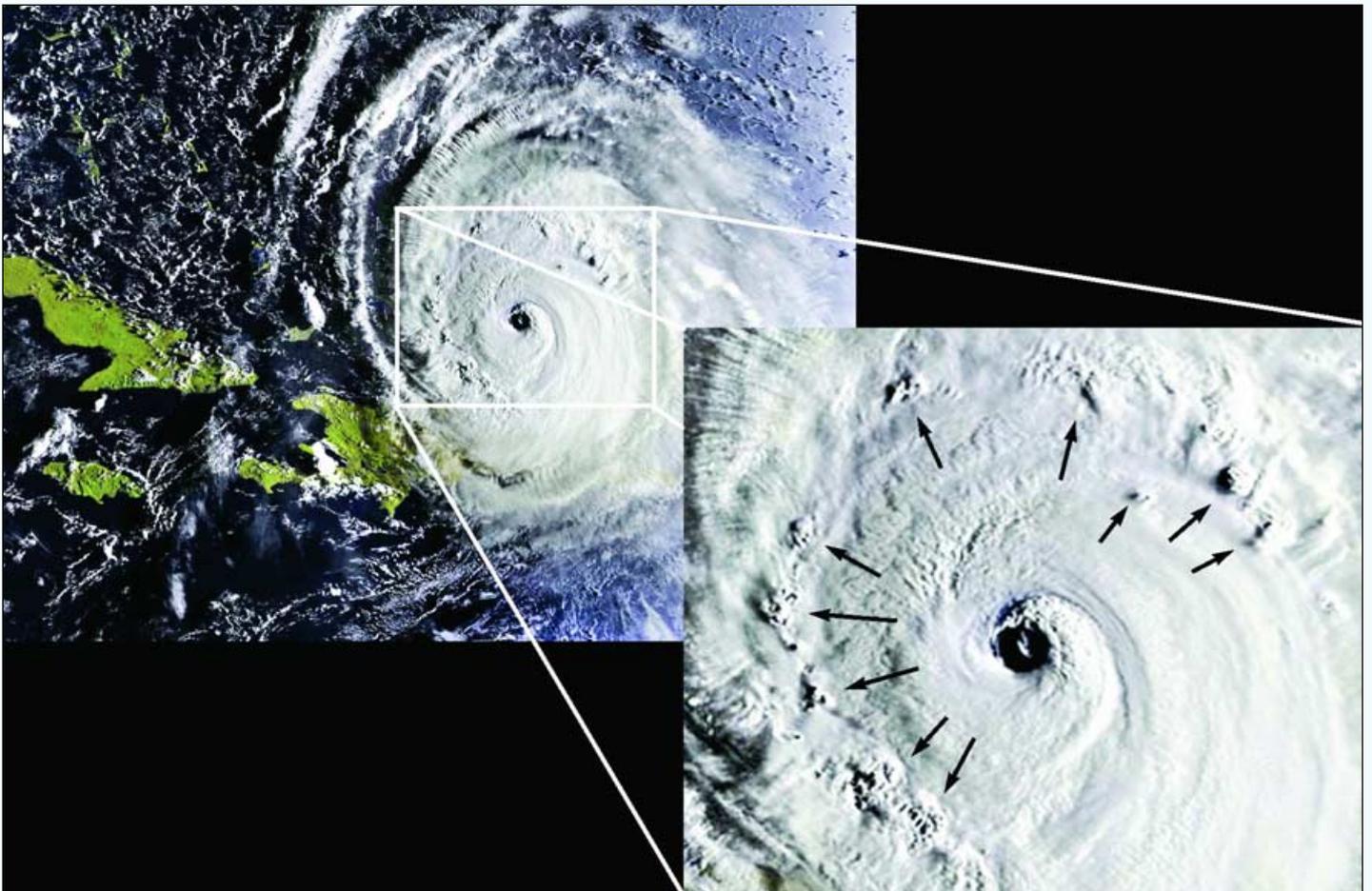
There is another quite remarkable aspect of very active hurricanes which has to do with the rain intensity and concentration throughout the storm complex. Since the launch of NASA's Tropical Rainfall Measuring Mission (TRMM), it has become possible to study this in a detailed and structured way. Figure 9 is a 3D product from TRMM (rather in the style of a CAT scan) in which we see the distribution of rain within the cloud complex of hurricane Rita. The colour is a measure of the storm's rain intensity with red being most intense and blue least, while the height of the each peak refers to the actual elevation of the cloud column. In this true-to-reality graph, two spikes appear in the rain structure. These spikes are termed *Hot Towers* and are in fact tall cumulonimbus clouds that, in the case of hurricane Rita, reached an altitude of almost 20 km. The phenomenon has a rather limited diameter when compared with the hurricane itself and it is of quite short duration. Still, it is one of the mechanisms by which the intensity of a tropical cyclone is maintained or enhanced. This is, in itself, quite understandable, because when, in a very short time, a huge column of hot wet air soars to the very cold stratosphere, the resulting condensation and release of energy must be truly explosive. This energy can do but one thing: drive the hurricane to greater intensity.

Figure 10 shows an AVHRR image from hurricane Ivan taken at daybreak on September 1, 2004. The very low angle of incoming sunlight clearly demonstrates the presence of a significant number of hot towers outside of the eye region. They are already starting to form an independent ring (outer eyewall) that, at a later stage, will replace the inner eyewall. The occurrence of hot towers is now being used as an accurate parameter in forecasting the intensification of hurricanes.

Assessing Hurricane Intensity

It has always been very difficult to provide an objective measure of the force associated with a particular Tropical Cyclone. Even today, classification is not commonly done outside the northeast Pacific and western Atlantic. However, for these two regions, *Herbert Saffir* developed a scale to classify them in accordance with objective and measurable criteria (largely based on wind speeds and the typical damage associated with certain wind speed categories). *Bob Simpson*, working on behalf of insurance companies, realised that certain damage not directly attributable to high winds remained unaddressed. This was the damage inflicted by the surge of water that usually accompanies a heavy storm. He incorporated this information into the scale, mainly to have a measure for assessing inflicted damage more accurately. The resulting *Saffir-Simpson scale* has since been widely adopted within the Western World to classify all hurricane-force tropical cyclones.

Saffir-Simpson Category	Maximum sustained wind speed (Herbert Saffir)		Minimum surface pressure	Storm surge (Bob Simpson)
	m/s	kph	millibar (mB)	metres
1	33-42	118-152	>980	1.0 - 1.7
2	43-49	153-177	979-965	1.8 - 2.6
3	50-58	178-209	964-945	2.7 - 3.8
4	59-69	210-249	944-920	3.9 - 5.6
5	70+	250+	<920	5.7+

Table 1 - The Saffir-Simpson Scale

The Demise of a Hurricane

I noted earlier that, as long as there are no changes to the conditions present once the hurricane is established, it will sustain itself 'indefinitely'. Fortunately, the strict conditions required for the formation of a hurricane are also instrumental to its stagnation and dissipation. This can be summarised as follows:

Landfall: When the storm's centre reaches land (i.e. the centre of the eye, not its edge) then no more moist air is fed from the ocean surface into the system and thus the condensation motor runs out of fuel and switches off.

Westerlies: It has been noted that the entire hurricane complex drifts with the prevailing winds and currents. Such currents may drive the hurricane out of the Tropics into the belt of westerly winds, which may destroy its structure and/or drive it into colder waters. In the first case the hurricane will hiccough and stop, whereas in the second, it loses its tropical characteristics and may convert into an extra-tropical cyclone.

High wind shear: When a hurricane drifts into a region where there is a strong higher level wind, wind shear takes the stability out of the circulation pattern and the direction out of the convection. The hurricane cannot then support itself any further.

Semi-stationary: When a hurricane remains in the same area of ocean for too long, it draws heat from the ocean surface until locally, there is no longer enough sufficiently warm water available to feed it (remember: 26.5°C and 50 m deep). Again the heat engine will stop and the hurricane cannot survive.

Weakness: Even a hurricane can fall victim to another area of low pressure and be consumed by it. Usually such a merger causes disruption, resulting in a large area of non-cyclonic thunderstorms. Of course, it may very well turn out to strengthen the non-tropical system as a whole instead, but it still spells the end for the original hurricane.

Outer eyewall: The formation of an outer eyewall reduces the intensity of the hurricane. Such weakening is generally temporary unless it meets other conditions such as I mentioned above. This can then lead to its demise even when the other conditions by themselves are of insufficient intensity to cause the dissipation.

Caveat

This article has focused exclusively on generic tropical cyclones and the mechanisms involved in their creation and demise. It by no means implies that this is the full story, as many unknowns remain and many deviations from the standard description occur in Nature.

Examples of Non-Standard Tropical Cyclones

Typhoon Vamei defied the Coriolis restriction when it appeared in the South China Sea a mere 1.5° north of the Equator. Very specific local conditions took over the function of the Coriolis force. *Cyclone Catarina* was, in March 2004, the first ever recorded hurricane-force storm south of the equator in the Atlantic ocean, in an area where the prevailing ocean surface currents are normally too cold to allow hurricane formation.

Non Tropical Cyclones

Extra-tropical cyclones draw a portion of their energy from the evaporation and condensation of ocean water, and some through horizontal temperature gradients in the atmosphere. They occur in-between tropical and mid-latitude cyclones. Many tropical cyclones turn into extra-tropical ones at the end of their life cycle. Extra-tropical storms seldom transition into tropical ones.

Subtropical cyclones, like their extra-tropical counterparts, constitute an intermediate form between tropical and mid-latitude cyclones. They are, however, mostly associated with the region south of the Azores and the Mediterranean basin

Mid-latitude cyclones are driven by baroclinic processes, which means that the temperature contrast between warm and cold air masses is the driving process behind their energy influx. They are found in the temperate regions (between the tropical and polar regions) and occur above land as well as sea.

The sub-Arctic and sub-Antarctic systems are basically the same as mid-latitude ones, but they occur at very high latitudes and involve very cold winds.

ship Waves

Les Hamilton

The image at the foot of this page, acquired by the NASA *Terra* satellite, is a prime example of a cloud pattern known as a *Ship Wave*. Although the name might suggest otherwise, this phenomenon does not owe its origin to any ship, unlike a ship trail [1]. Ship waves are so named because of their *resemblance* to the wake of a ship as it moves through still water, an effect identical with that observed downstream from a duck swimming in a pond.

Figure 1 - A mallard trailing 'ship waves'

The 250-metre resolution MODIS image reproduced in figure 2 contains a particularly well-developed ship wave to the lee of Amsterdam Island in the southern Indian Ocean. Another particularly good example of ship waves, this time emanating from the South Sandwich Islands, appears opposite.

Kelvin ship waves, as these phenomena are correctly termed in the sphere of fluid dynamics, form a distinctive feathered wave pattern within an envelope that makes a fixed angle of 19.5 degrees with the direction of travel; they are named after the physicist Lord Kelvin who established the mathematics governing their formation. Note that they are completely distinct from—and unrelated to—the churned-up wake emanating from a ship's propellors. Though originally described in liquids, these wave patterns can occur in any fluid, including Earth's atmosphere. The drawing in figure 3 illustrates a set of Kelvin waves trailing behind a moving ship. The cloud patterns in figure 2 resemble these waves very closely, although in this instance it is the fluid itself (the atmosphere) that is in motion and the waves derive from the obstructing effect of Amsterdam Island.

Cloud Patterns

Air is a fluid and, when wind encounters an obstacle, it must move around and
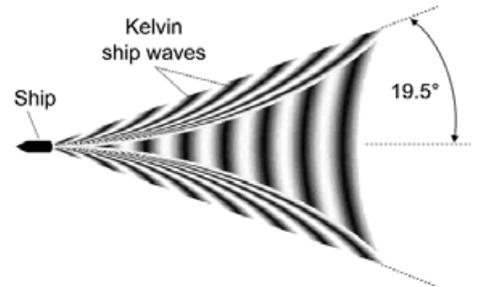
Figure 3 - Kelvin ship waves

Figure 4
This aerial photograph shows actual Kelvin ship waves trailing behind the USS John F Kennedy and her escorts in the Arabian Gulf
Image: US Navy (Christian Eskelund)
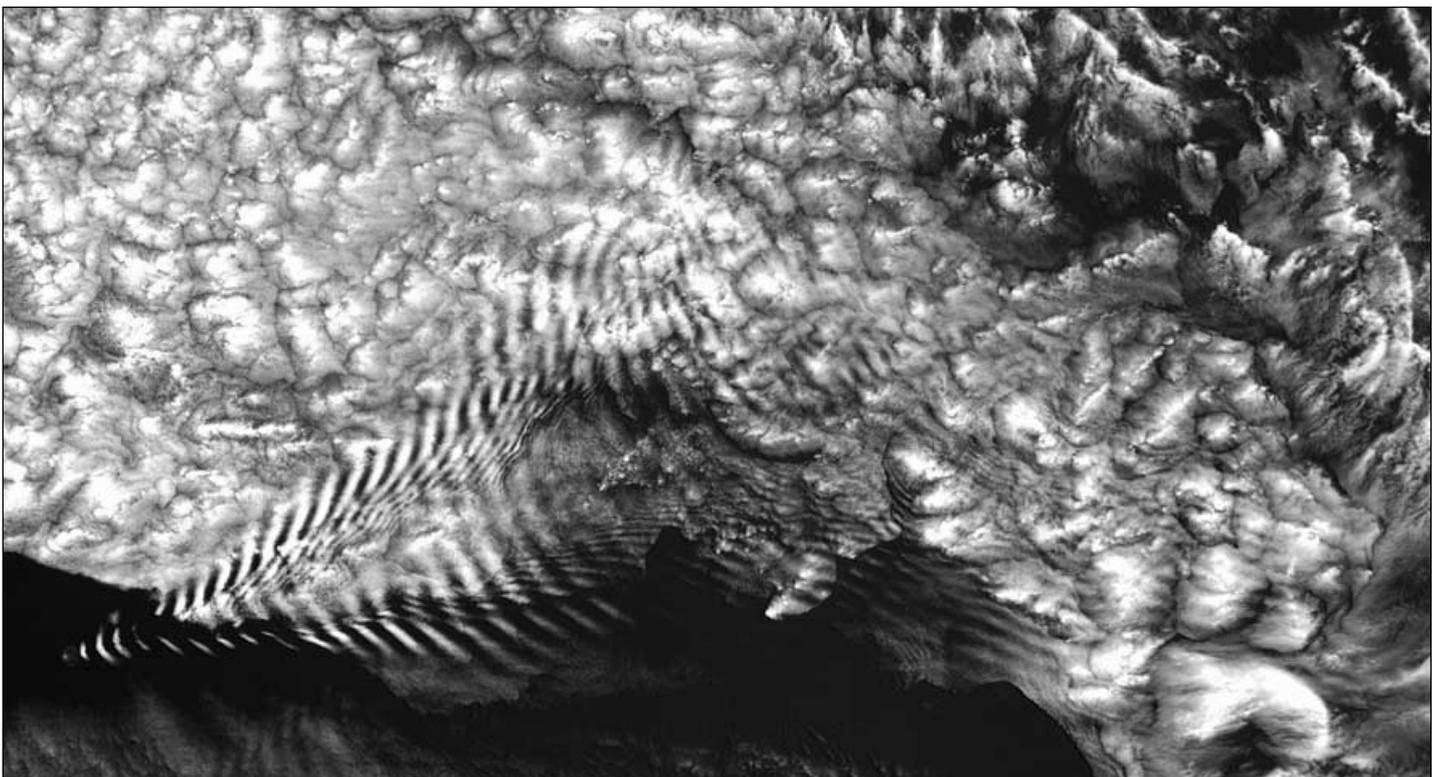
Figure 2 - A MODIS image of Ship Waves induced by Amsterdam Island in the southern Indian Ocean on December 19, 2005
Image: Jeff Schmaltz, MODIS Land Rapid Response Team, NASA GSFC
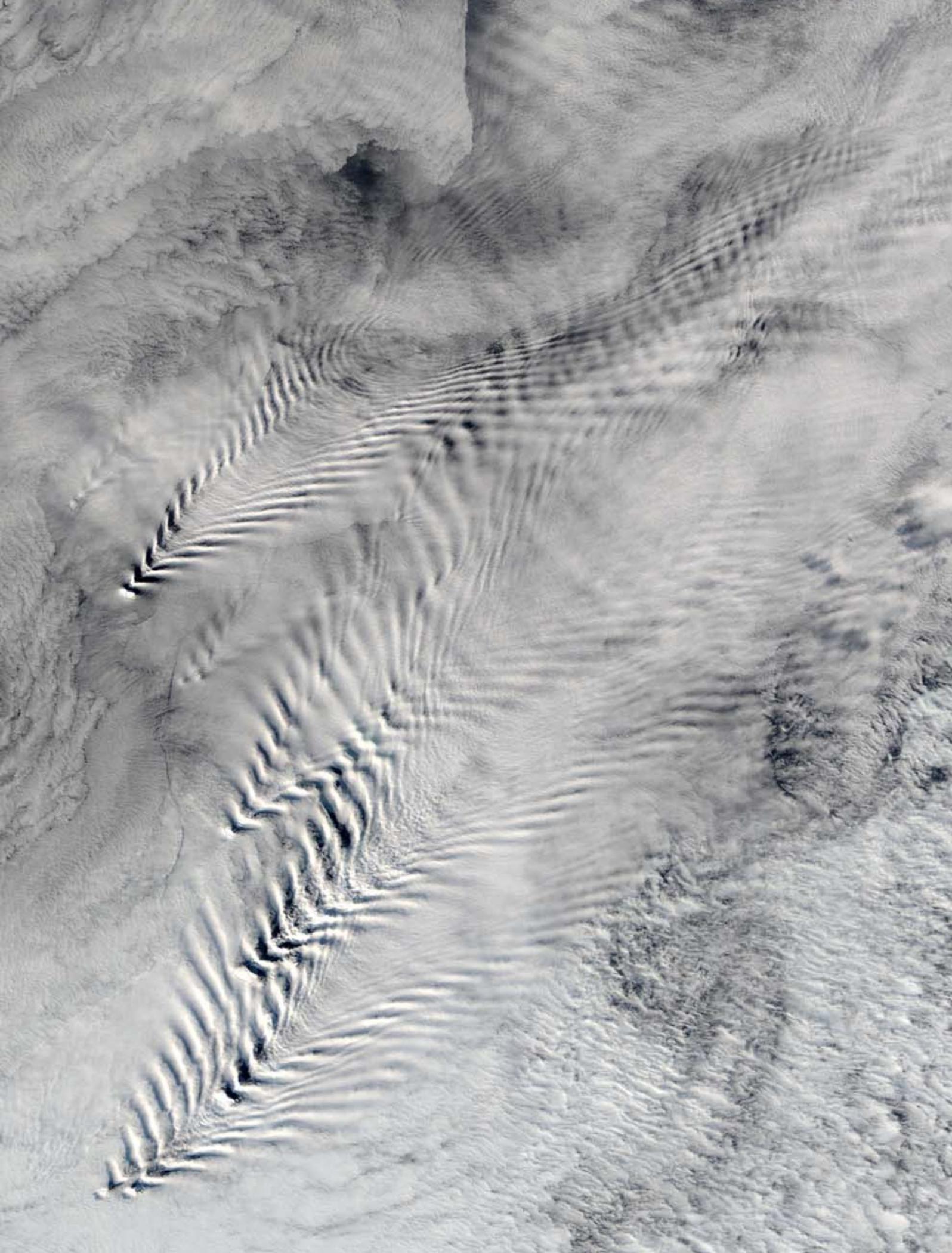
Kelvin Ship Waves induced by the South Sandwich Islands in this 250-metre resolution MODIS image from NASA's Terra satellite on September 18, 2003
Image: Jacques Descloitres, MODIS Rapid Response System

over it. This causes it to trail a wake through the atmosphere, very similar to the one shown in figure 3. Everyone is familiar with the way in which ripples crossing a pond cause floating objects to bob up and down. The air within a Kelvin ship wave oscillates up and down in exactly the same manner.

Where the air is relatively dry these waves will remain invisible but, when air oscillates in this manner as it must in a Kelvin wave, it alternately cools at each wave-crest and warms at each trough. In air that is close to being saturated with water vapour, cooling causes condensation and cloud formation while warming makes the cloud evaporate once more, rendering the Kelvin wave visible as a cloud pattern which repeats itself at each wave crest.

Jan Mayen Island

The north Atlantic Jan Mayen Island can also give rise to ship waves. The 2280 metre conical volcano Beerenberg produced the cloud pattern shown in figure 4

The Crozet Archipelago

The appearance of ship waves is favoured by the same general weather conditions that produce the more familiar Von Kármán vortices[2]: a low level subsidence temperature inversion above a warm sea. In figure 5, dating from late 2004, islands of the Crozet Archipelago in the southern Indian Ocean have disrupted air flow and formed both ship waves and Van Kármán vortices[3].

In this particular instance the elevation of the obstructing islands is all-
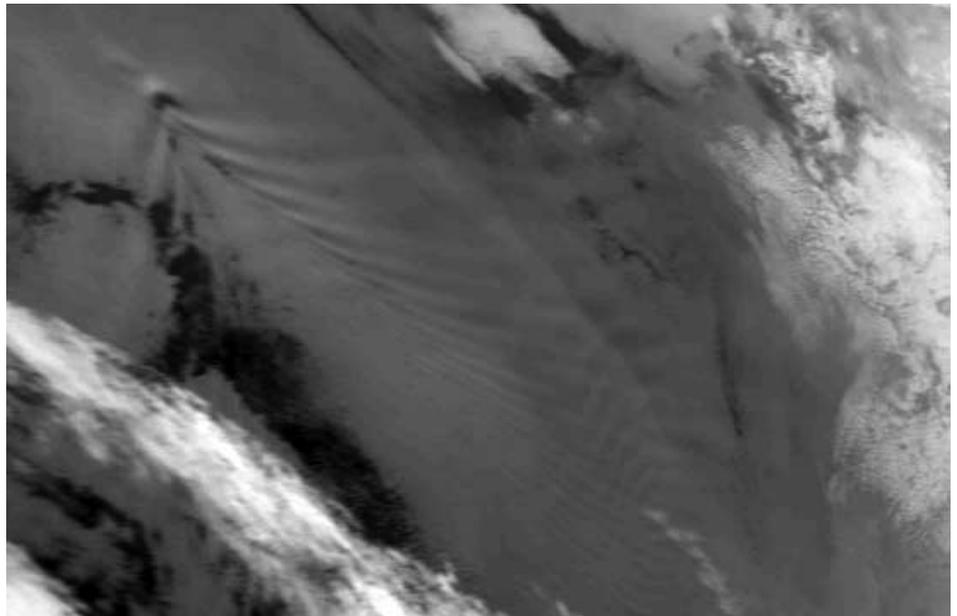
Figure 4 - Kelvin ship waves spreading from Jan Mayen island in the north Atlantic
NOAA-15 at 14:56 UT on January 25, 2000
Image: NOAA CLASS archive (www.class.noaa.gov)

important. Where the inversion occurs *below* the highest part of the obstructing island, as it does in the case of Île de l'Est (1090 m) at the eastern end of the group, the vertical oscillation of the cloud wakes is compromised because the air can no longer flow *over* the obstruction. The consequence is that a series of eddies forms as air is compelled to flow *around* the island, creating the familiar Von Kármán vortex street.

However, where the inversion lies well *above* the highest part of the obstruction, as with Île aux Cochons (826 m) to the west of the archipelago, the air can flow freely both around and over the island, resulting in the formation of ship waves.

References

1　GEO Quarterly No 6, page 28

2　GEO Quarterly No 2, page 46

3　http://www.weathersa.co.za/Pressroom/2005/2005Oct21ShipwaveCrozet.jsp
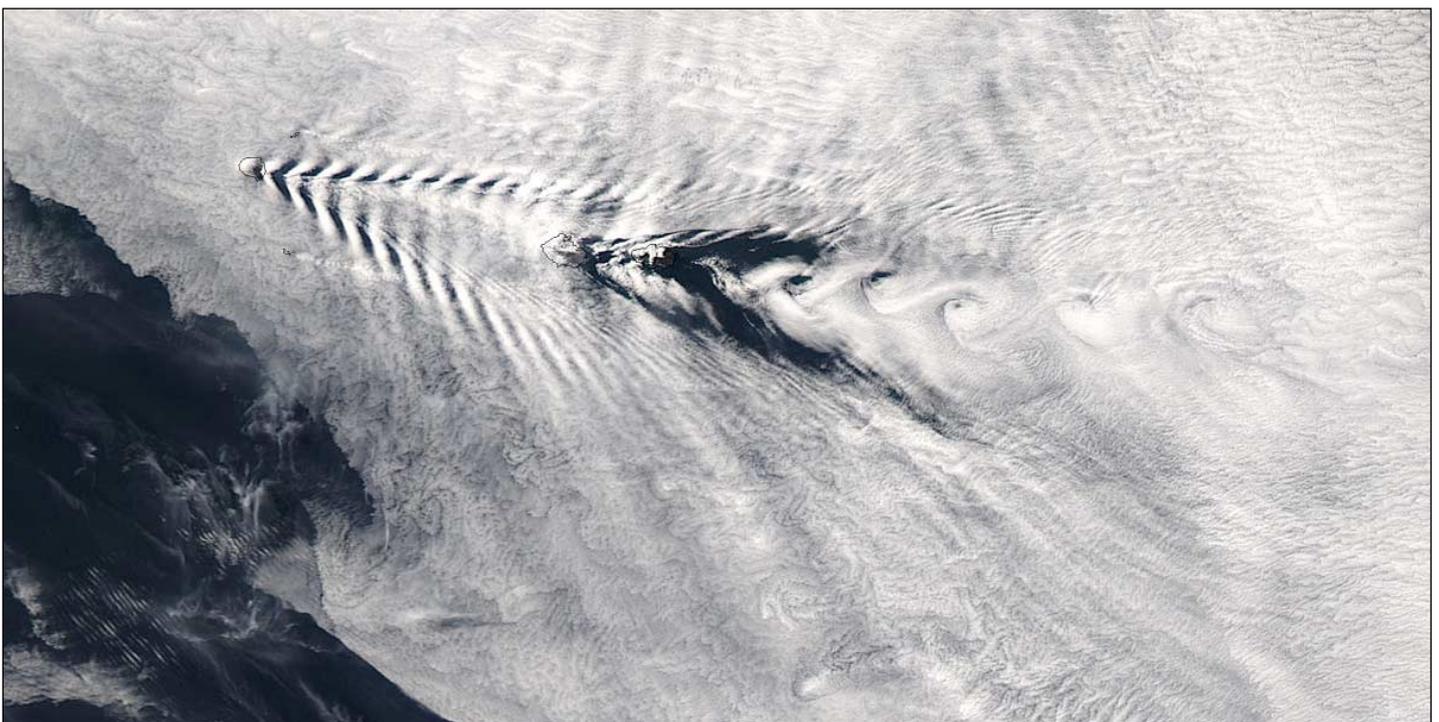
Figure 5 - A MODIS image showing both Kelvin ship waves and Van Karman vortices spreading from the
Crozet Archipelago in the Indian Ocean, viewed from NASA's Aqua satellite on November 2, 2004.
Image: *: Jacques Descloitres, MODIS Rapid Response System*
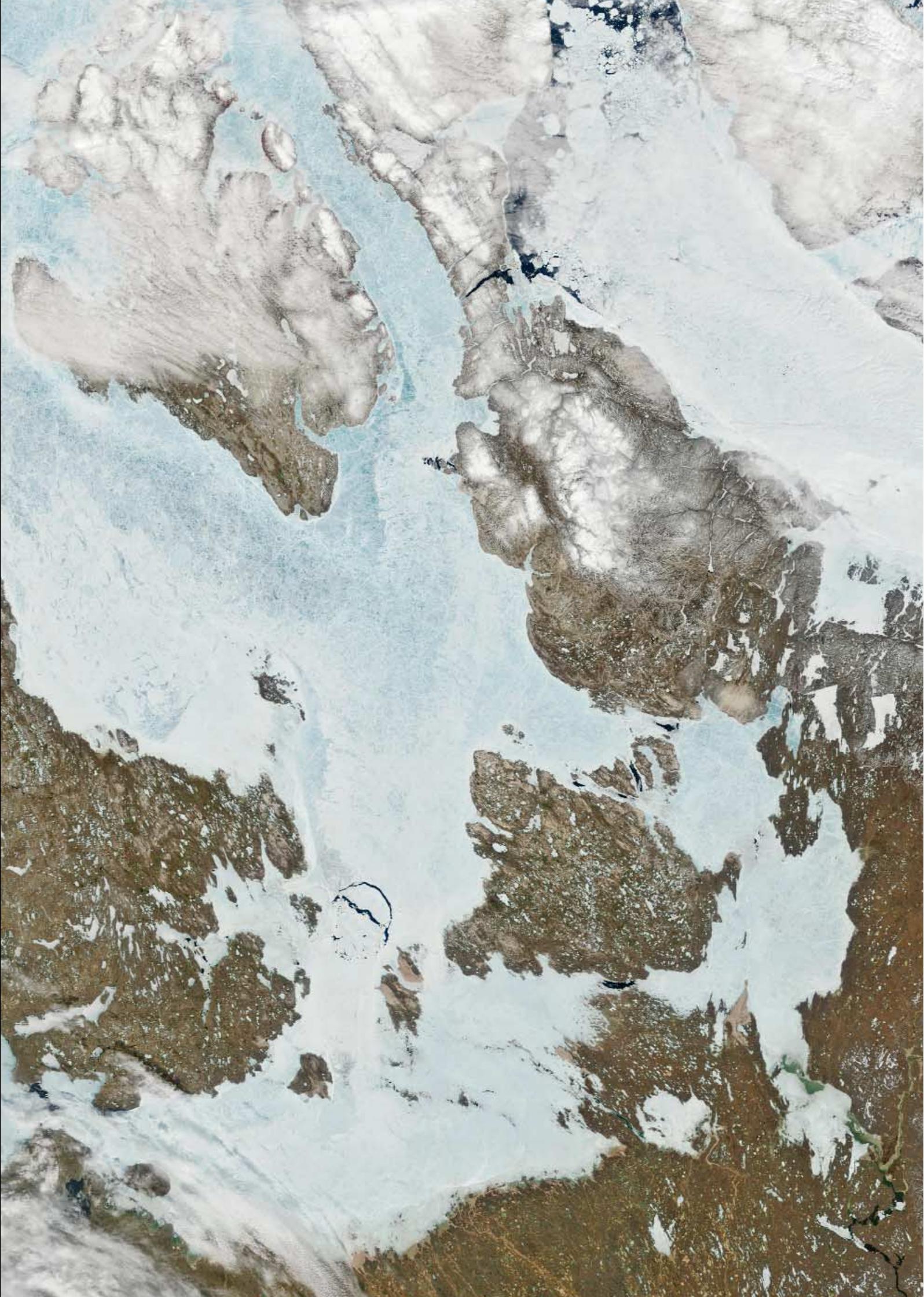
EUMETCast Reception

Using a semi 2-PC Setup

Arne van Belle

EUMETSAT's recommended system consists of a dedicated PC which receives *EUMETCast* data using the *Tellicast* client software and then sends this data to a networked second PC for conversion into images and storage on disk. This means that you need both PCs running 24 hours a day if you want up-to-date images.

However, with the advent of the fast modern PC, it is now possible to use a single PC to receive, decode and store images and data. This setup is ideal, specially if you don't want to receive and decode 24 hours a day. But you do have to limit the load on the system. Starting other demanding programs like *GeoSatSignal* or a large animation will take so much of your system resources away from the *Tellicast* client that you suffer missing segments.

There are other disadvantages with a single PC

- Any minor hiccough affecting Windows (which happens now and then) is also likely to cause missing data, specially if you have to reboot.
- Running your fast PC for 24 hours a day will cause a high energy bill as fast PCs run at between 150 and 250 watt nowadays.
- In the near future, *EUMETCast* will be extended to include high volumes of MetOp data.
- If you want to receive this data too, the performance of your single-PC setup might prove insufficient.

The Receive PC

An alternative to using a single high-performance PC is what I call the 'Semi 2-PC Setup'. This involves running an older, less powerful PC 24 hours per day to receive all data (currently I use a 1 GHz Pentium-3 computer). This **same** PC also runs MSG Data manager which decodes and stores the images. A RAM disk is used to buffer the *Tellicast* file database, which not only eases the load on the hard disk but also helps *Tellicast* to continue it's vital job at times when other programs are accessing it.

The Process PC

All your decoded images and data are transferred to a second, faster, networked processing PC (this could be your normal Internet/work computer) for all subsequent image browsing, viewing, processing and animating using programs like *MSG Animator* and *GeoSatSignal.* This PC is only switched on when you actually need it and can also be used for lots of other tasks like photo or movie editing, surfing and so on. An unexpected system halt or other mishap on this system will not result in missing segments or lost data.

Transferring the Data

To make this setup work we need to move all decoded data from the receive PC to the process PC. I have written a simple script that runs on the receive PC and which is started by *MSG Data Manager* after every 15-minute cycle. The script checks whether the process PC is ready to receive data and if so, moves all decoded images and data to it. Folders are created on the fly so that, in the end, you have exactly the same folder structure on your process PC as if MSG Data manager were running on it too.

I run *MSG Animator*, *GeoSatSignal* and the *AVHRR Manager* on the process PC. To automatically update the animation you have to set 'updates' to 15 minutes as *MSG Data Manager* runs only on the receive PC and cannot trigger an update in *MSG Animator* over the network. Within 15 minutes of starting up the process PC, data will be transferred.

If the process PC has been switched off during the night and most of the day it will take around 15 to 20 minutes to transfer all the received images and data to it (including the recent AVHRR trial data). By prioritising the channel-12 north images, I can have an up-to-date High Resolution Visual animation running only 5 minutes after booting up the process PC. If the process PC is switched off, or if a previous transfer is in progress, the script will halt.

Advantages

- Because you move decoded images, not the raw data, the quantity of data that needs to be transferred over the network is much reduced.
- The receive PC is not used for other tasks that could interfere and runs remarkably stably.

I have run this setup using Windows 2000 since early April 2003 and the receive PC has never been halted unexpectedly or needed a forced reboot.

Disadvantages

- You need network interfaces in both PC's and a network hub.
- If you do not have a network already, a simple network cross-cable can be used to interconnect the two PCs (*Cross cables are now available from the GEO Shop*).

The Script

Here are some details about the script I use to copy the images from the receive PC to the process PC.

Microsoft offers the *Robocopy* command line utility. This is part of the Microsoft Windows resource kit and can be downloaded for free. *Robocopy* stands for 'Robust File Copy Utility' and is used by Microsoft to synchronise servers. *Robocopy* will automatically resume broken transfers and can be set up to throttle down to reduce the load on disk and CPU. It comes with a 35-page manual that explains all options in detail.

The Windows resource kit has to be installed on Windows XP or Windows server 2003 first. Once installed, the *Robocopy* command can be copied and also works on Windows 2000 and NT4.

Before using my script you have to set the source and destination once. You can tailor this script to your needs. Another useful option could be to synchronise time on the receive PC.

A copy of the script and instructions are available at:

http://www.satsignal.eu/software/msg_dm_pc2.zip

This script actually converts an older PC into a 'Set And Forget' EUMETCast receive-and-decode server. Although I do have a Keyboard/Video/Mouse switch to control my receive PC, I only check signal strength now and then. It runs at 60 to 90 watt and runs fairly cool.

Requirements for the Receive PC
- 1 GHz pentium-3 or better (current status receiving all PID's including the new AVHRR data and processing all images except Meteosat-8 LRIT).
- At least 512 MB is required for *MSG Data Manager* but more memory is recommended for the future *EUMETCast* extensions.
- A 100 Mbit network interface card
- Crosslink cable to processing PC or a network switch/hub
- Windows XP or Windows 2000. I prefer Windows 2000 because it uses less memory and runs more stably.

Optimising a PC for 24 hour use

A PC that needs to run stably for 24 hours a day needs our attention:

- We want it to run stably, for a lengthy period of time, with low maintenance and cost.
- The average home PC is not designed to run continuously.
- Most hardware failures are caused by prolonged overheating, so we need to keep it running cool.
- To save power and reduce heating, disconnect the CD-ROM and diskette drive <u>after</u> installation of the system.
- If needed you can use the CD-ROM drive on your processing PC by sharing it over the network.
- A bare-bones PC does take up less space but I prefer a tower model as this can be modified more easily to run cool and with low noise.
- You need to monitor the temperatures of the CPU and hard drive. If temperatures remain high (over 50° for the disk and over 60° for the CPU), hardware failures are quite likely within 2 years.
- Most mainboards and discs are equipped with onboard temperature sensors; you only need to install software to get a readout.
- DTEMP and MBM5 are two universal programs that can be downloaded free.
- To ease the load on the disk use a RAM Disk to buffer the *Tellicast* file database.
- If you use XP you need to exclude the RAM Disk from system restore! See article on page 39.
- As the PC runs 24 hours we don't want a lot of noise either.
- A quick way to solve this would be putting you PC in the freezer and closing the door ! But this way you will run out of cooled beverages very quickly during summer.

> Don't try this at home as condensation will ruin your system in the end.

So I opted for Case Modding.

- By improving airflow inside the case and mounting the hard disk at a better location, you can lower temperatures drastically.
- Most PC cases are designed to look nice but not for cool running.
- The air intake area at the front should be at least twice as large as the exhaust area at the back!
- If needed, drill additional holes in the front.
- With an increased airflow inside you can use passive cooling for the chipset and CPU.
- You can use plastic or cardboard guides to force airflow through the passive CPU cooler.
- To keep the noise and maintenance low, use large fans.
- Large sized fans (120 or 92 mm) run with lower rpm. They not only give less whining noise, the bearings last much longer and they transport more air ! Use vibration dampening mounts to reduce fan noise.

- To handle different load situations and varying ambient temperatures efficiently I use a fan controller that automatically adjusts fan speed according to the inside temperature.
- Alternatively you can run a 12 V fan from 7 or 5 volts to lower noise level.
- Do not use fan grills that have sharp edges or block airflow. Grills made up from round wire are the best and these also provide good Radio Frequency Interference shielding.

With the rise of the Multimedia or Home Theatre PC there are good low-noise fans and accessories available nowadays. I can recommend the low noise fans from *Glacial Tech* called 'silent blade', as these use nine specially formed blades and double ball bearings to give high airflow at low rpm. Other brands like *SilenX* and *Nexus* also offer low-noise fans but are priced a bit higher.

- Don't use a high performance graphics card as these use a small fan. You do not need high graphics performance for this purpose.
- By mounting the disk <u>upright</u> behind the front air intake, it gets a continuous flow of cold air. Point the electronics board towards the incoming air and use rubber dampers or grommets to isolate vibrations from the case.
- Using this setup I have disk temperatures that are only 5 to 10 degrees above room temperature.
- To further reduce noise and vibrations you can pad the larger inside panels with carpeting tiles.
- The 'woolly' side effectively dampens high frequency noises.
- Use the type with a bitumen or rubber base and glue it to the inside of the panel. This dampens any low frequency vibrations.
- Do not use carpet tiles with a foam base as the glue will dissolve the foam!
- Self adhesive dampening mats can be bought at computer stores but come at a cost and are not as efficient at dampening.

Maintenance
- Do not forget to plan a 'dust out' maintenance at least half yearly as too much dust will reduce cooling and raise temperatures. Be <u>very careful</u> when using a vacuum cleaner to dust out; never touch electronic components with the hose as static build-up in the hose could jump over. Use a clean paintbrush to loosen the dust and keep the vacuum cleaner at a distance.
- The cheaper fans use sleeve bearings and these may run dry after a year, emitting rumbling sounds or even seizing up completely.
  There is an easy fix to prolong the life of your fans. Remove the sticky label. Most fans have a rubber cover underneath to seal the sleeve bearing. Apply 2 to 5 drops of motor oil to the spindle bearing. Use *Sellotape* to seal the bearing cover again. If done in time and, say, every two years, your fans will run smoothly for ever.
- Power cuts are unavoidable. Uninterruptible power supplies are cheap nowadays but they can only bridge short interruptions of up to 20 minutes. But you can set up your system to help it recover better from a power failure. In the BIOS, set 'power state' to 'always on'. Now your PC will reboot directly when power is restored.
- Windows2000 and XP can be set to boot automatically with a given username and password.
- *Setup4PC* and *Tellicast* should already start up automatically.
- The next step is to add the parameter '-Start' to your *MSG Data Manager* link and place a copy of this link in the 'Startup' group.
- Never choose 'reconnect at startup' when you map a network drive on the receive PC as this will halt windows at reboot !

Above is a colour composite image utilising the full 'north' segment provided by Dundee Satellite Receiving Station. At lower left is a segment from this image at full resolution while at lower right is a full resolution section from the 'south' image showing Namibia and part of South Africa.

All images © EUMETSAT 2006, NERC Satellite Receiving Station, University of Dundee - Processing in GeoSatSignal-6 by David Taylor

MSG Imagery

from Dundee Satellite Receiving Station

Les Hamilton and David Taylor
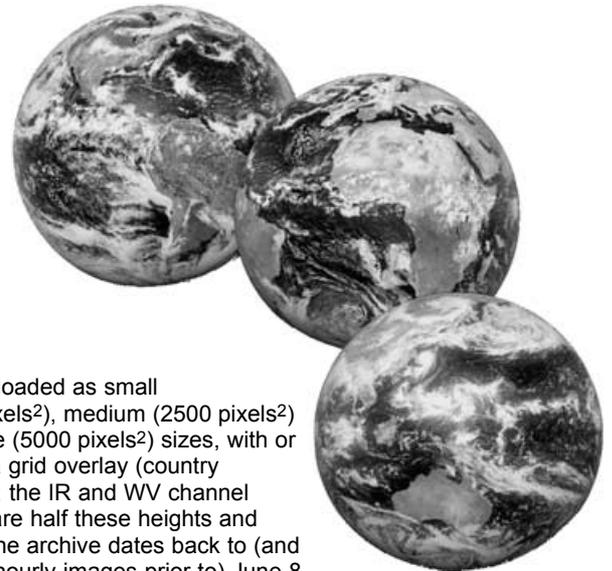
Registering

GEO readers who do not have access to *EUMETCast* may be interested to learn that all 'essential' 6-hourly MSG images are now available for download from Dundee Satellite Receiving Station. To gain free access to these, all that is required is that you visit

http://www.sat.dundee.ac.uk

and click the '*Register for free images*' button. Supply a username (your own choice) along with your e-mail address and you will be forwarded a password which you can then use to access the MSG images, which are archived at

http://www.sat.dundee.ac.uk/abin/geobrowse

Images Available

As is clear from the screen-shot of the web page above, you will also have access to relayed imagery from the first generation Meteosat-7 (6-hourly), Indian Ocean Data Coverage (IODC), currently from Meteosat-5 (6-hourly), GOES-E and GOES-W (3-hourly) and MTSAT-1R (3-hourly).

MSG

In all, 14 download options are provided. These consist of the full range of 11 normal resolution channels, 2 HRV options ('north' and 'south') plus an RGB321 colour composite. All are available as small (928 pixels^2), medium (1856 pixels^2) and large (3712 pixels^2) sizes, with or without a grid overlay (country outlines). There is an archive available stretching back to noon on August 11, 2004.

Meteosat 7 and Indian Ocean Data Coverage (Meteosat 5)

There are three download options, consisting of high resolution visible, infrared and water vapour images. The visible channel may

be downloaded as small (1250 pixels^2), medium (2500 pixels^2) and large (5000 pixels^2) sizes, with or without a grid overlay (country outlines); the IR and WV channel images are half these heights and widths. The archive dates back to (and offers 3-hourly images prior to) June 8 2006, since when only 6-hourly images are available. The Indian Ocean Data Coverage (IODC) archive contains only the previous 30 days worth of 6-hourly images.

GOES East and West

There are three download options, consisting of the high resolution visible, infrared and water vapour images. Both visible and infrared channels may be downloaded in small (704×812 pixels), medium (1408×1624 pixels) and large(2816×3248 pixels) sizes, with or without a grid overlay (country outlines); the WV channel images come at 50% width and height. The archive consists of the previous 30 days worth of 3-hourly images.

MTSAT

Three channels are available at present, channel-1 (visible), channel-4 (infrared) and channel-6 (water vapour). All may be downloaded as small (640×696 pixels), medium(1280×1392 pixels) and large(2560×2784 pixels) sizes, without gridding only. The archive includes the previous 30 days worth of 3-hourly images.

Image Quality

All the images are provided in 'a slightly degraded JPEG format' (histogram equalised), so cannot be used for accurate calibration purposes like the directly received *EUMETCast* data. Also, as the MSG data are available only every six hours, these images are not really suitable for animation purposes.

Nevertheless, the still images are of excellent quality and should appeal to anyone without direct *EUMETCast* access—whether for cost or antenna planning permission reasons. The latest versions of David Taylor's software have been updated to handle the Dundee data: the free *AutoGet* program can download them on to your PC while *GeoSatSignal-6* can process them into spectacular false-colour images.

As a sample of what can be done, David Taylor has kindly supplied the false-colour images reproduced on page 16 and on the inside back cover of this issue. All were processed using *GeoSatSignal 6* using data downloaded from Dundee, by combining a high-resolution visible image from channel-12 with a thermal image from channel-9. Note that Dundee splits the channel-12 HRV data into 'north' and 'south' regions.

The Europe image on page 16 shows the full 'north' segment (though inevitably at reduced scale: the full image measures 5568 x 2784 pixels and would stretch across three pages of GEO Quarterly). A full size clip containing Britain, France and Spain serves to illustrate the resolution that is available.

The inside back cover of this issue shows the full 'south' region at reduced scale while the lower right-hand image on page 16 is a full size clip depicting part of southern Africa.

Peter Wakelin

With the recent successful CloudSat/CALIPSO launch, the ambitious A-Train project has come a step closer to realisation.

The A-Train Constellation

When completed, the constellation will comprise six quite different spacraft, in co-planar orbits, carrying a wide range of complementary instruments to study many aspects of the atmosphere, clouds and weather. For the first time, near-simultaneous measurements from six satellites passing within a few minutes will be possible. The five satellites of the constellation now in orbit are Aqua, which is followed by *CloudSat*, then *CALIPSO, PARASOL* and *Aura. Aura* trails about eight minutes behind *Aqua*. Still to be launched is *OCO,* which will lead the train some 15 minutes ahead of *Aqua*. Launch is due in early 2008.

The Orbit

Each of the satellites has the ability to manoeuvre occasionally to maintain the required ground track and spacecraft separation. The 705 km circular orbit requires an inclination close to 98.237 degrees to maintain sun-synchronism and the atmospheric drag effects have to be compensated for to ensure the ground track repeats precisely after 233 orbits to match the WRS-2 grid whereby orbits are separated by 172 km at the equator. The *World Reference System-2 Grid* was developed many years ago to facilitate regular sampling patterns by remote sensors in the *Landsat* programme. The orbit plane is oriented so that the satellites cross the equator, in a northbound direction, at about 13.30 local time, which is several hours later than the mid-morning plane favoured for most Earth-imaging spacecraft.

Aqua

Currently the leader in the A-Train, *Aqua* was launched in May 2004 and, initially, was known as EOS PM as it was the the 'afternoon' satellite in the NASA-centred international Earth Observing System (EOS). *Aqua*, the Latin word for water, is an appropriate name as the mission is gathering large amounts of data about the Earth's water cycle, including ocean evaporation, atmospheric water vapour, precipitation, clouds, soil moisture and ice on both land and sea. Aerosols, vegetation cover on land and phytoplankton and dissolved organic matter in the oceans are also being routinely measured, as are temperatures of the air, the land and ocean surfaces.
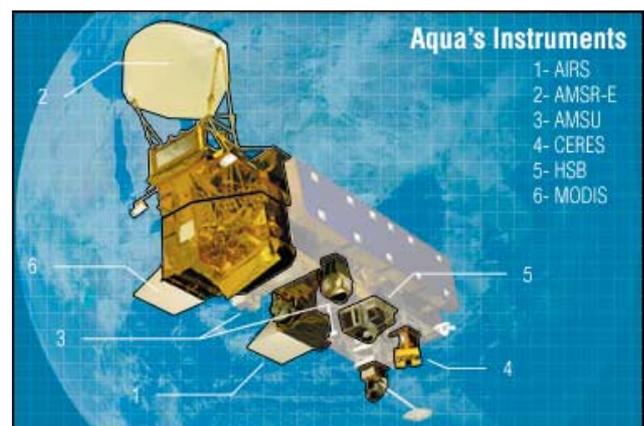
Aqua's instruments
Credit: NASA

Two of the instruments on *Aqua* will be familiar to readers; the Advanced Microwave Sounding Unit (AMSU-A) is also on board the NOAA weather satellites (since NOAA 15) and measures temperature profiles in the high atmosphere. The Moderate Resolution Imaging Spectroradiometer (MODIS) is also aboard NASA's *Terra* satellite.

Also carried are the Humidity Sounder for Brazil (HSB) developed by the Brazilian National Institute for Space Studies, Clouds and the Earth's Radiant Energy System (CERES), which evolved from NASA's Earth Radiation Budget Experiment, Japan's Advanced Microwave Scanning Radiometer for EOS (AMSR-E) and the Atmospheric Infrared Sounder (AIRS). Data from the 2,378 infrared channels on the latter, together with those from the microwave sounders, permit a highly accurate temperature profile of the atmosphere from the surface to the high stratosphere to be derived.

CloudSat

Launched on a Delta rocket on April 28, 2006, *CloudSat*, together with *CALIPSO*, was placed in a deployment orbit a few kilometres below the planned operational orbit. After a 30-day checkout period, *CloudSat* was nudged upwards to its operating position trailing *Aqua* by about one minute.

CloudSat's only instrument is the Cloud Profiling Radar (CPR) developed jointly by NASA's Jet Propulsion Laboratory and the Canadian Space Agency. Both organisations have extensive experience in designing and building satellite-borne radar systems and are confident that CPR will exceed its 22-month design life.
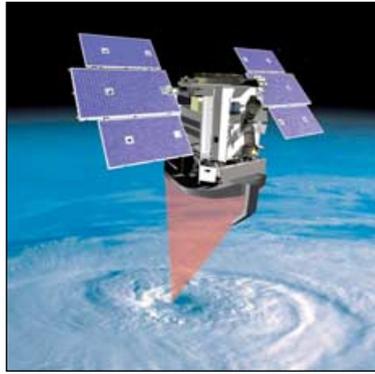
Artist's impression of CloudSat in orbit
Credit: NASA

CPR is a 94 GHz nadir-looking radar; this frequency was considered to be the best compromise between the larger antenna needed for a lower frequency and signal attenuation through cloud at higher frequencies. Most ground-based weather radars operate at 3 GHz and are ideal for locating heavy rain and hail but 94 GHz is well-suited for profiling the much smaller drop sizes making up the clouds.

CALIPSO

CALIPSO, Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations, is stationed no more than 15 seconds (about 100 km) behind *CloudSat* so that they can both observe the same clouds. Aerosols are small particles suspended in the atmosphere and arise both naturally, such as sea salt, desert dust, forest fires and volcanic eruptions, and also as a result of man's activities such as the burning of fossil fuels and chemical manufacturing. Not only are they a health hazard in high concentrations but they are known to affect weather and climate. Observations from spaceborne lidar, combined with passive imagery, will lead to improved understanding of the role aerosols and clouds play in regulating the Earth's climate, in particular, how the two interact. *CALIPSO's* payload comprises three co-aligned nadir-viewing instruments designed to operate autonomously and continuously.
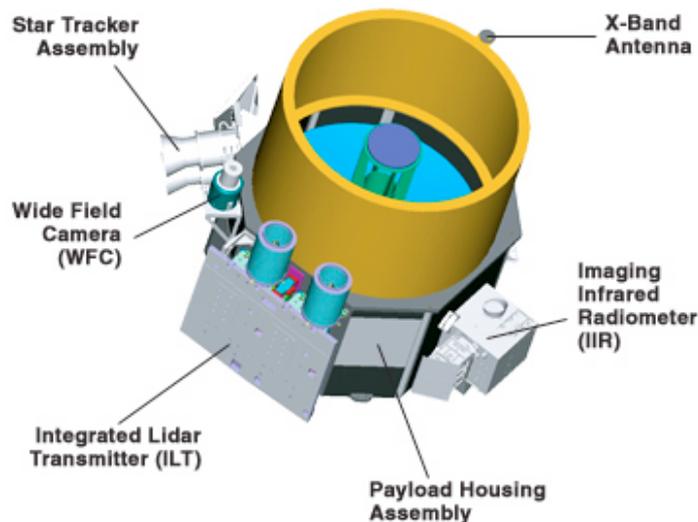
Calipso's instruments
Credit: NASA

They are:

- **CALIOP** (Cloud-Aerosol Lidar with Orthogonal Polarisation), a two-wavelength polarisation-sensitive lidar that provides high-resolution vertical profiles of aerosols and clouds. The laser beams operate at 532 and 1064 nanometres in the green and near-infrared part of the spectrum respectively and the receive telescope has an aperture of one metre. Ball Aerospace Corp developed the instrument which also incorporates a redundant laser
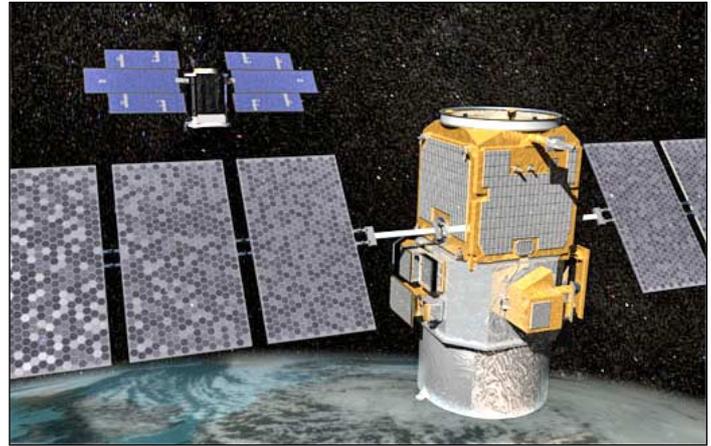
Artist's impression of CALIPSO (foreground) with CloudSat
Credit: NASA

transmitter and an active boresight system to maintain co-alignment between the transmitter and receiver
- **IIR** (Imaging Infrared Radiometer), a nadir-viewing, three-channel imager with a swath width of 64 km and a pixel size of 1 km. The CALIOP beam is aligned with the centre of the IIR image. The three channels in the thermal infrared region are centred on 8.7, 10.5 and 12.0 micrometres to optimise joint CALIOP/IIR retrievals of cirrus cloud emissivity and particle size
- **WFC** (Wide Field Camera), a modified version of a commercially available Ball Aerospace camera. It is a fixed, nadir-viewing instrument with a single 50nm-wide channel centred on 645nm which matches band 1 of the MODIS instrument on Aqua.

PARASOL

PARASOL (Polarisation & Anisotropy of Reflectances for Atmospheric Sciences coupled with Observations from a Lidar) is the smallest component of the A-Train at just 120 kg and was one of several secondary payloads launched with the French military surveillance satellite *Helios 2A* in December 2004. It was developed by CNES, France and lags *CALIPSO* by about one minute.

The only instrument on *PARASOL* is POLDER (POLarisation and Directionality of Earth's Reflectances) whose measurements will allow better characterisation of clouds and aerosols in Earth's atmosphere and, in particular, will distinguish between natural and manmade aerosols. Three of POLDER's nine spectral bands are dedicated to observing ocean colour.

Aura

This word is derived from Latin and Greek words for breath or breeze so is an appropriate name for a satellite carrying a suite of instruments designed to gather data on five of the six 'criteria pollutants' as identified by the US Environmental Protection Agency. This powerful chemistry laboratory, launched in July 2004, flies about five minutes behind *PARASOL* and its four instruments are studying the evolution of the vertical and horizontal distribution of pollutants. They are the Tropospheric Emission Spectrometer (TES), the Microwave Limb Sounder (MLS), the Ozone Monitoring Instrument (OMI) and the High Resolution Dynamics Limb Sounder (HIRDLS).

OMI is far more sensitive than the Total Ozone Mapping Spectrometer (TOMS) carried on seven earlier spacecraft and also measures many other chemicals and trace gases. In conjuction with *Aura's* other instruments, it is now possible to distinguish between the 'good' ozone at high level which protects us from dangerous ultraviolet radiation, and the 'bad' low-level ozone that creates a serious health hazard.

Within months of Aura's launch there were two major volcanic eruptions on inhabited Manam Island, Papua New Guinea, and on remote, uninhabited Anatahan in the Mariana Islands.
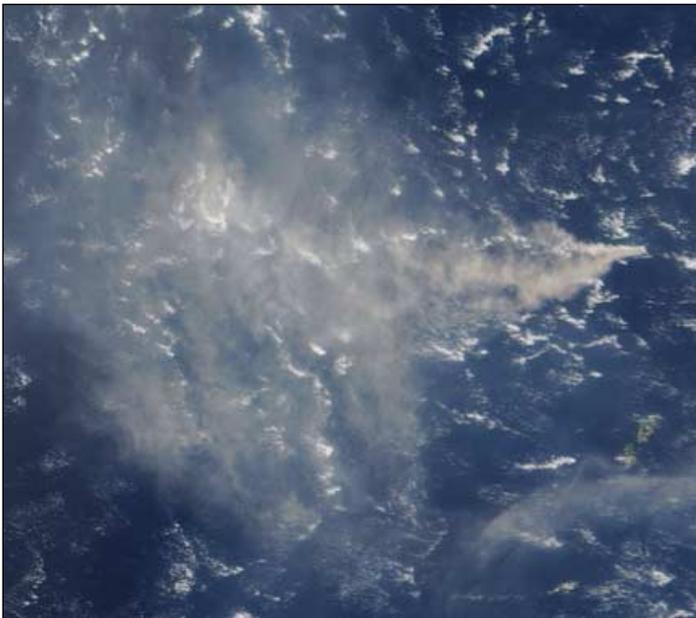
This volcanic eruption on Anatahan Island was
subjected to detailed study by Aura's instruments.

Credit: MODIS Rapid Response Teamat NASA/GSFC

Aura's instruments are ideally suited to monitor such events
within hours of their occurrence. Sulphur dioxide emissions are
of particular concern; in the troposphere it is readily washed out
as acid rain but above the tropopause it is converted to
particulate sulphates which can persist for years and affect the
Earth's radiation balance.

OCO

NASA's Jet Propulsion Laboratory, in conjunction with Orbital
Sciences Corporation and Hamilton Sundstrand Sensor
Systems, are developing the Orbiting Carbon Observatory. To
be launched in 2008, *OCO* will be placed at the front of the
train, some 15 minutes ahead of *Aqua. OCO's* instruments will
measure carbon dioxide concentrations globally to an
unprecedented precision and resolution leading to a better
understanding of the sources, both natural and man-made, of
the gas and where human-generated carbon dioxide is absorbed
from the atmosphere by natural processes.

Further Information

This has necessarily been only a brief account of a complex
project. Much more information can be found by entering 'A-
Train' or the individual satellite names into one of the Internet
search engines.

Acknowledgement

The A-Train constellation image used in the heading for this article.
credit: NASA

Mount Etna trails an eruption plume in this Meteosat-8
HRV segment from 06:15 UT on July 27, 2006

Image © EUMETSAT 2006

POVIM

Presentation Manager
The Software

Fred van den Bosch

The activities concerning weather satellites consist of many
different, and often separate and independent programs. This
often results in a messy system where it's difficult to find files
and automate processes. POVIM has been developed to provide a
structured and integrated environment. POVIM stands for
Product Oriented Video, Images and Maps (see page 23).

POVIM PM software integrates all the separate programs, and
consists of two parts:

- the Product Manager and
- the Presentation Manager

and offers the following possibilities:

Product Manager

Product Manager allows you to:

- Create your own products and determine where they are to
  be stored
- Structure products to a maximum of 3 levels
- Permits each level to be user-defined
- Lets you combine similar products into specified groups, e.g.
  Oceans, Hurricanes, Europe etc.
- You can create files with basic information
- All the programs you use for weather satellites and weather
  watching can be defined

Presentation Manager

The Product Manager allows you to:

- Select up to 20 products from a list of products
- Display all products as thumbnails
- Synchronise scrolling in steps of 5, 15 and 60 minutes
- Call your favourite photo viewer to examine the images on full
  screen
- Use all the options of your photo viewer like zoom, scroll and
  print
- Choose a different date and time
- Display saved images or generate an image 'on the fly'
- Display image details stored in the database
- Display the latest received image
- Display images (jpg, bmp) video (avi, mpeg) and maps(jpg,
  bmp) from other programs (e.g. Digital Atmosphere)
- Start up a satellite or weather related program or visit a
  specific Internet site.
- Directly start the photo viewer to see the content of all the
  folders as thumbnails (depending on the options your viewer
  provides)

For whom is this program intended?

POVIM PM is useful for everybody using programs for generating
images from weather satellites or weather programs and wants
to maintain and view them in an easy and structured way.

A prototype was first showed on the GEO symposium 2006. You
can find my program on my website:

http://www.vandenbosch.speedlinq.nl/downloads.html

I will of course be interested in your comments, particularly any
bugs that you encounter.

I can be contacted by e-mail at:

fred@vandenbosch.speedlinq.nl

Current Developments in the EUMETCast AVHRR–EARS Service

David Lee

David Lee is an employee of Moltek Consultants Limited, working at EUMETSAT on the EARS project. David is in regular communication with David Taylor, who is currently developing the software readers require to create images from the EAR-AVHRR data (and shortly from MetOp). The article below is based on a communication from David Lee outlining recent progress with the services.

I am glad to see that you are enjoying the joined Svalbard / Lannion AVHRR data! The step of getting Lannion and Svalbard to send out AVHRR data is a very significant one for the EARS project and team. We have been pushing to get the EARS stations upgraded for MetOp, which has now mostly been done at Lannion (France), Longyearbyen (Svalbard) and Maspalomas (Canary Islands). This meant a lot of work with our station partners and our own new hardware installations, and of course software upgrades, reconfigurations and development.

The Lannion and Svalbard stations, along with the central *EUMETSAT* computer, are now working as an integrated system. The stations are sending three-minute segments acquired from the satellites to our remote computers at these sites. These computers then create one-minute segments ready for dissemination and report (send a message) availability, completeness and quality to the central computer 'decision maker'. The decision maker will wait a short time to receive messages about available segments at the remote computers and identify if there are any duplicate segments for the same time slot (duplicates arise due to station coverage overlaps). Finally, a decision is made as to which station has the best segment and this decision is sent to the particular remote computer instructing it to send the segment to the *EUMETCast* uplink server and on to users. This means that overlaps between stations are removed and end users should get a continuous set of 'best quality' segments.

As I say, this is a significant step as there is a lot more involved in getting the multi-station system communicating and working well than was the case in the simple single-station case we originally operated at Maspalomas. This also means that we will be able to add new stations in more easily and provide users with long passes of continuous high quality data. So Maspalomas should fit into the system fairly easily, though it is just going to take a bit of work to do the upgrades.

The other target stations, Athens (Greece) and Kangerlussuaq (Greenland) could take a bit longer though—Greenland because of the special communications to this site and Athens because of ongoing discussions with our station partner and other technical issues.

I think the three stations (Lannion, Svalbard and Maspalomas) should offer a good service for a while, though. We have been working hard to get the data element up and running. Then I can work on improving the monitoring and reporting of the system. We have some limited monitoring on our side, but this needs to be finalised and then put onto the 'public' side for reporting to users. For the moment we need to keep taking all NOAA birds at Svalbard for test purposes, but you should still get some nice long passes. Eventually we will send the Svalbard and Lannion data out for the ATOVS service also. I'm also glad to see that users understand that these systems are all new and that we will be working to improve the service in the near future.

Right: A joined NOAA-17 channel-2 image comprising data captured from both the Svalbard and Lannion acquisition stations.
Assembled by David Taylor using the AVHRR Manager, then processed with HRPT Reader.
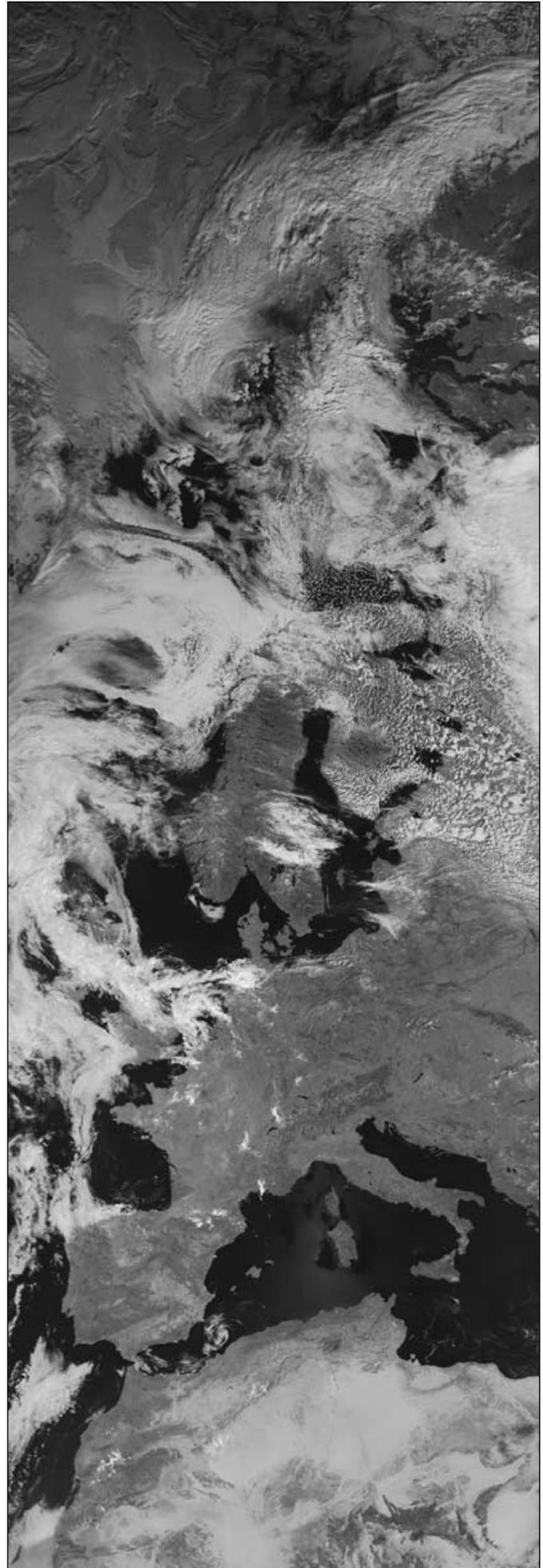
News in Brief
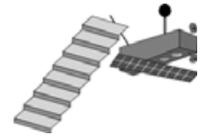
MSG2 Commissioning

MSG-2 was due to become operational on August 1, following completion of commissioning operations, when it would be renamed Meteosat-9. However, due to unexpected anomalies with two of its WV 6.2 μm channel detectors (discovered during the commissioning process and still being investigated) it will be remain a back-up to Meteosat-8, replacing Meteosat-7 which is being moved over the Indian Ocean to take over the IODC service from Meteosat-5. A trial of the direct Meteosat-9 LRIT service commenced on August 2 and will continue, possibly till the end of September. Meanwhile, Meteosat-8 will continue as the primary operational satellite until further notice.

Dissemination of MSG-2 image data and meteorological products will continue on a trial basis via *EUMETCast's* Ku-band until the end of September 2006, with meteorological products also being made available on the Global Telecommunication System.

Meteosat-7 Termination

On June 14, just before 09:00 UT, Meteosat-7 sent its final WEFAX frame (a CTH) and so ended a service of WEFAX and PDUS imaging from 0° which began in 1977 with Meteosat-1 (see GEO Quarterly 5 page 33). There was no 'on-air' celebration with a 'goodbye' ADMIN frame—the transponder simply went dead.

Meteosat-7 heads for the Indian Ocean

On July 11, the operations team at EUMETSAT's Mission Control Centre initiated Meteosat-7's three-month drift from 0° longitude to its new location at 57.5° over the Indian Ocean where it will replace the long-serving Meteosat-5. Both satellites will operate in parallel during December, disseminating data via *EUMETCast's* Ku-band service. The Indian Ocean Data Coverage (IODC) service provides critical data in a region subject to severe, life-threatening natural events such as tropical cyclones and tsunami, and Meteosat-7 will ensure continuation of this service until the end of 2008.

Meteosat-7 will also take over the Meteosat-5 Data Collection Platform (DCP) acquisition service from buoys located in the Indian Ocean. This service makes data available to the international community for a tsunami warning system for the region.

Once Meteosat-7 reaches its destination, Meteosat-6 will be drifted from 9.5°E to 63°E in early 2007. Meteosat-5 will then be jettisoned into a graveyard orbit during March 2007 prior to Meteosat-6's arrival in April/May.

How Meteosat-7 is Relocated

Geostationary satellites orbit the Earth from west to east, keeping pace with the planet's rotation and completing a full orbit once every sidereal day. In order to relocate such a satellite, its path has to be changed by moving it away from a geostationary orbit, when it will start drifting either east or west depending on whether the orbit is lowered or raised respectively. In order to move Meteosat-7 eastward its orbit has to be lowered below geostationary level. Since the physical length of the orbit is thus reduced, the satellite starts drifting to the east, a manoeuvre effected by firing small thruster motors mounted on its side: these are angled appropriately to apply thrust in the desired direction. Once the required longitude over the Indian Ocean has been attained the thrusters will be used to raise the satellite back into geostationary orbit.

In planning the drift itself, care has to be taken so that the east-drifting orbit keeps Meteosat-7 at a safe distance from other objects in a geostationary orbit. The current catalogue of near-synchronous objects was analysed in order to determine a safe altitude range during the drift phase and a minimum distance of 39 kilometres below geostationary altitude was determined to be appropriate. This corresponded to a minimum daily drift rate of 0.5 degree.

While Meteosat-7 is being drifted to its new position, it will continue sending back images of the Earth, rectified every 10° to a different sub-satellite point. Images captured during the drift should make for an interesting animation as the satellite passing over regions previously not covered by Meteosat-7, such as India, Siberia, China and parts of South-East Asia. From its final position over the Indian Ocean, Meteosat-7 will have an excellent view of large parts of Europe, Africa, the Middle East and Asia, as well as coverage of the Indian Ocean.

NOAA-18 Frequency Change

The launch of MetOp inevitably resulted in the NOAA-18 frequency (changed to 137.10 MHz on January 4 this year) being switched back to 137.91 MHz on July 20. *EUMETSAT* requires the 137.10MHz frequency for its MetOp LRPT service.

GEO Shop

Carol and Clive wish to thank all their customers for supporting the GEO Shop. Already, they have exceeded last year's entire turnover in *just the first eight months* of 2006. GEO Shop profits play an important role in stabilising membership contributions and financing the group.

The Post Office launches its new 'price in proportion' scheme August 21 this year but, after looking at our prices, we have decided **not** to pass on any additional costs incurred. Once again thank you all for your continued support. We hope that you value our service.

R2FX News

John Tellick has been testing an improved version of the German R2FX APT receiver. John writes:

'I had been disappointed with the performance (at my location in SW London) of the R2FX receiver, which was being badly affected by pager interference. However, Holger Eckardt has provided an upgraded R2FX which I have recently tested with the same set-up described in my article on page 4. I am very pleased to report that 137.91 MHz (and all the other frequencies) are now free from pager breakthrough.

'I haven't been able to test 137.91 MHz with an actual APT signal of course, but all my previous tests have shown that, if there is no pager breakthrough on a frequency under zero-signal conditions, there has been no problem with an APT signal present.'

The down side of all this is that the upgraded model would have to be specially manufactured solely for the UK market, which would inevitably make it more expensive. In the light of the NOAA-18 frequency change, any reader thinking of purchasing an upgraded R2FX is advised to contact *GEO Shop* as soon as possible to express an interest. If there is sufficient interest (a minimum batch of 25 units would have to be produced), GEO will pursue the matter further.

Svalbard Station Comes On-line

On July 18, 2006, the first data from the Svalbard (Norway) station joined the stream of polar orbiting data now being broadcast over *EUMETSAT's EUMETCast* service (see our front cover illustration). This particular data was received from the 14:20 UT pass of NOAA-17 and the image includes the North Pole (upper left), Greenland (lower centre), and Svalbard (upper centre), where the reception station was located. Data from the polar orbiting NOAA satellites complement those from the existing geostationary satellites operated by *EUMETSAT* by providing high-resolution polar coverage.

The data was sent from Svalbard to Darmstadt in Germany, where it was processed and uplinked to the *Hot Bird-6* satellite as part of the *EUMETCast* pilot EARS AVHRR service. Well over a hundred users were ready with David Taylor's updated AVHRR Manager software, which assembles the segments into a composite pass which can then be viewed using *HRPT Reader*.

For more information about software for processing EARS AVHRR data, visit the 'Satellite Tools' section on David Taylor's website (note the new address) at:

Http://www.satsignal.eu

GEO-NETCast

NOAA have begun a year long trial of Ku-band *GEO-NETCast* in the USA. This is based on the Ku-band *EUMETCast* service we have in Europe (from Hot Bird-6), and the C-band service for Africa (via Atlantic Bird-3) and the Americas (via NSS-806). The trial is being disseminated via the AMC-3 satellite from a Ku-band transponder. An overview of the system can be found at

http://www.osd.noaa.gov/geo-netcast/

GEO Shop

R2FX APT Weather Satellite Receiver

This diminutive German-built APT receiver is packed with features and is the ideal receiver for the newcomer to the hobby. May be affected by pagers on the upper NOAA frequency of 137.91 MHz.

UK member's price   -   £135.00
UK non-member's price   -   £149.00

R2FX Accessory Pack

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

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

We do not normally ship outside the UK as this receiver should be available elsewhere more cheaply from the manufacturer. But contact the GEO Shop if you wish a quote.

UK member's price - £59.00   UK non-member's price - £69.00
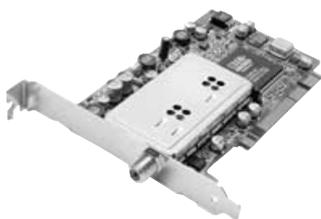
TechniSat SkyStar 2 PCI Card

This 'free-to-air' DVB satellite TV and data receiver card recommended by EUMETSAT must be installed <u>inside</u> your computer. It comes with comprehensive installation instructions and a CD-ROM of driver software (if you do not feel confident about installing cards inside your computer, we recommend the USB version above)

UK members price   -   £53.50
UK non-members price   -   £59.50

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   -   £21.50
UK non-member's price   -   £24.50

TechniSat SkyStar 2 USB Box

This external 'free-to-air' DVB satellite TV and data receiver plugs into a USB port on your computer and comes complete with power supply, USB cable and a CD-ROM of driver software.

UK   -   £94.50
Continental Europe   -   £119.50

Telestar Universal Ku-band 0.6 dB Universal LNB

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

UK members price   -   £11.00
Continental Europe   -   £17.50

Telestar 80 cm dish and Universal 0.6 dB LNB

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

UK members price   -   £49.00
UK non-members price   -   £56.00

GEO PIC 1.0 for the RX2

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

UK   -   £7.00
Continental Europe   -   £7.80
Rest of World   -   £8.40

GEO/Dartcom EPROM v 1.3

This new EPROM for the Dartcom APT receiver is available exclusively from GEO.

UK   -   £10.00
Continental Europe   -   £10.75
Rest of World   -   £11.25

Martelec MSR40 EPROM

UK   -   £10.00
Continental Europe   -   £10.75
Rest of World   -   £11.25

Ordering and Shipping

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

Orders should be sent to:

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

If you are paying by credit card, you can FAX us your order to:

+44 (0) 1202 893 323

If you are not 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. However, the latter cannot benefit from the discounted prices available to members.

Why not join GEO and take advantage of the discounted prices we can offer members.

Subscription Rates (12 months/4 issues of *GEO Quarterly*) are just £18 (UK), £21 (EU) and £24 (rest of world).

GEO Members' PRICE LIST

	Members Prices			Non Members		
	UK	EU	RoW	UK	EU	RoW
APT Equipment						
R2FX APT Receiver (no PSU)	135.00	-	147.00	149.00	-	161.00
R2FX Accessory Pack	59.00	-	-	69.00	-	-
Vierling Weatherman Complete Kit	349.00	-	-	369.00	-	-
Dartcom high quality QFH antenna	259.00	279.00	-	279.00	299.00	-
Turnstile APT antenna	37.50	-	-	42.50	-	-
GEO- PIC 1.0	7.00	7.80	8.40	7.00	7.80	8.40
GEO/Dartcom EPROM v 1.3	10.00	10.75	11.25	10.00	10.75	11.25
Martelec MSR40 EPROM	10.00	10.75	11.25	10.00	10.75	11.25
EUMETCast Equipment						
TechniSat SkyStar 2 PCI Card	53.50	55.00	-	59.50	61.00	-
Technisat Skystar USB box	94.50	113.50	-	119.50	123.50	-
Telestar 80 cm dish with LNB	49.00	-	-	56.00	-	-
Telestar Ku band universal LNB	11.00	12.50	-	17.50	19.00	-
Technisat Satfinder alignment meter	21.50	24.50	-	24.50	27.50	-
Miscellaneous						
GEO Quarterly Back Issues (subject to availability)	3.50	4.20	5.10	n/a	n/a	n/a
GEO 2004 CD (PDF back issues)	8.00	8.80	9.30	n/a	n/a	n/a
GEO 2005 CD (PDF back issues)	8.00	8.80	9.30	n/a	n/a	n/a
GEO Membership (4 x *GEO Quarterly*)	18.00	21.00	24.00	18.00	21.00	24.00

All prices are in £ sterling and include postage and packaging

NOAA Satellite Predictions

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

	NOAA 12 137.50 MHz	NOAA 15 137.50 MHz	NOAA 17 137.62 MHz	NOAA 18 137.91 MHz
Sep 01	05:07 06:46 14:54 16:32	05:59 07:39 15:46 17:26	10:33 12:13 20:20 21:59	02:29 04:10 12:22 14:03
Sep 02	04:42 06:22 16:08 17:49	05:35 07:16 15:23 17:02	10:10 11:50 19:58 21:36	02:19 04:00 12:12 13:52
Sep 03	05:57 07:37 15:43 17:24	05:12 06:52 16:38 18:19	09:47 11:27 21:13 22:54	02:09 03:50 12:01 13:42
Sep 04	05:32 07:12 15:19 16:58	04:48 06:28 16:15 17:55	11:04 12:44 20:51 22:31	01:58 03:39 11:51 13:32
Sep 05	05:08 06:48 14:55 16:34	06:04 07:44 15:51 17:31	10:41 12:21 20:28 22:08	01:48 03:29 11:41 13:21
Sep 06	04:43 06:23 16:09 17:50	05:40 07:20 15:28 17:07	10:18 11:58 20:06 21:44	01:38 03:19 11:31 13:11
Sep 07	05:58 07:39 15:45 17:25	05:17 06:57 16:43 18:24	09:55 11:35 21:21 23:03	01:28 03:08 11:21 13:01
Sep 08	05:34 07:14 15:20 17:00	04:53 06:33 16:19 18:00	09:32 11:12 20:59 22:39	01:17 02:58 12:50 14:33
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You can download a PDF version of these predictions from: *http://www.geo-web.org.uk/predictions.pdf*

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

Useful Internet Discussion Groups

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

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

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

Satsignal
An end-user self help group for users of David Taylor's Satellite Software Tools including the orbit predictor WXtrack; the file decoders GeoSatSignal and SatSignal; the HRPT Reader and image creator program; the image remapper GroundMap; and software for the EUMETCast service—the MSG Data Manager, the AVHRR Manager and the ATOVS Reader.

e-mail: SatSignal-subscribe@yahoogroups.com

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

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

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

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

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

e-mail: wxtoimg-subscribe@yahoogroups.com

Copy Deadline
for GEO Quarterly No 11
Saturday, October 28

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

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

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

Please note, however, that **major articles** which contain large numbers of satellite images, photographs or other illustrations should be submitted **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, e.g. JPG, BMP, GIF, TIFF etc. Images in both monochrome and colour are welcomed for inclusion. Line drawings and diagrams are preferred in Windows metafile and postscript formats. We can also scan original photographs, negatives and slides.

Gridding, Overlays and Captions
Please note that readers' satellite images should be provided *without* added gridlines, country outlines or captions *unless* these are considered essential to illustrate an article.

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

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

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

editor@geo-web.org.uk

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

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

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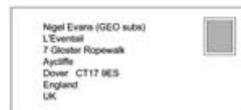
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POVIM-2

Automating all Processes

Fred van den Bosch

The sheer volume of data now available via *EUMETCast,* where the original MSG 15-minute data has been augmented by SAF products, EARS-ATOVS and most recently EARS-AVHRR data, means that it is essential to automate your station. You cannot sit in front of your PC 24 hours per day monitoring its output, creating products from the data and filing everything away in a meaningful way. This article is a continuation from POVIM [1] and describes how a system can be arranged so that as many processes as possible are automated in the simplest possible way. This is where true automation begins.

There are several ways to realise this ideal but, however it is achieved, I must emphasise that a consistent and unambiguous plan of campaign is necessary to keep the process manageable. Automation can take place in several ways and on several levels:

1. During the system start-up
2. By batch operation with .BAT files
3. Through batch programs via a Task Manager
4. Other possibilities

Below, I describe a number of different solutions for each of the above. I do assume a certain basic knowledge of both computer and software management on the part of the user: for example, I may state that a shortcut must be made—but I won't explain how you do this. Without this basic knowledge it is nearly impossible to achieve everything. Moreover, bearing in mind the KISS Principle [2], no exotic scripts are used.

System Start-up

This is the first level of attack. It is very easy to make a number of programs start automatically as part of your PC's boot-up sequence. All that is needed is the creation of a shortcut for each such program in the start-up folder. Every time the system is started up, these programs will automatically start up too. This is particularly important for anyone who uses *TechniSat* reception software with *MSG Data Manager* (Meteosat) and the *AVHRR Manager* (NOAA and MetOp HRPT). If the system resets itself during the night (I believe this has happened at me a couple times as a result of an automatic *Windows* update) then you will lose very little data.

In the case of *MSG Data Manager* it is a good idea, after making the shortcut, to append the parameter '-START' to the 'Target' path under 'Properties'. This means that after *Data Manager* restarts it immediately starts running again, so that you do not have to 'catch up with data' several hours later as you would following a manual restart.
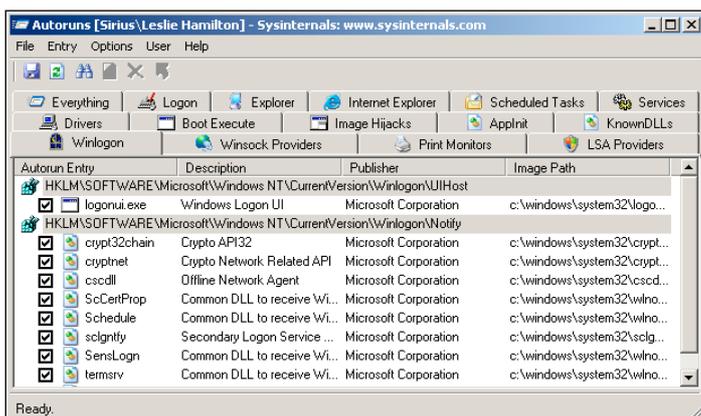
Figure 1 - Autoruns in action

If you need to check whether all the desired programs are actually running on your computer following bootup or logon, I recommend using the handy utility called *Autoruns* [3]. The *Windows* logon screen of *Autoruns* is shown in figure 1.

Operations Using Batch (.BAT) Files

Batch files contain a number of commands which are all executed one after the other when the file is run in either *MS-DOS* or *Windows*. An example could be a batch file which allowed a number of different images to be made with *GeoSatSignal*. In general, no special programming ability is required for making batch files. A batch file is a text file, with filename extension '.bat', which can be created using *Notepad*. It's a good idea to make a short-cut to each batch file.

A Typical Batch File Example

Here's a simple example of what is possible with a batch file. I myself use, among others, the programs *WXSIM* and *WXSIMATE* [4]. They are respectively, a program that makes a local weather forecast and a utility which downloads data from the Internet. At the same time, during the download, one's own data can be added.

To save time I have placed all this in a shortcut on the Desktop, which calls the following batch file.

```
copy \\Satellieten\weatherdisplay\logfiles\*.* d:\logfiles\
wxsimateREADY.lnk
c:\windows\notepad.exe D:\Program Files\wxsim\Data\a.dat
wxsimate.lnk
wxsim.lnk
```

After clicking the shortcut for this batch file, the following happens:

1. Logfiles are copied from my satellite weather station PC to my large system
2. The shortcut 'wxsimateREADY' with content ("C:\Program Files\Internet Explorer\iexplore.exe" "http://www.arl.noaa.gov/ready/cmet.html") is started. This opens *Internet Explorer* and visits a site where some data must be gathered manually.
3. *Notepad* opens up and the file 'a.dat' is opened and the data collected in the previous step are added to it.
4. As soon as *Notepad* is closed, a shortcut is called to start up *WXSIMATE*. This program downloads data from the Internet and adds the contents of the file a.dat (from step 3) to it.
5. A final shortcut is called to run *WXSIM* which starts the predicting stage.

This is just an example—one of my own batch files—to illustrate the technique. Everyone can create their own batch files to suit their needs. It's simply a question of 'try it and see what happens'.

Batch Programming by Means of a Task Manager

In particular, David Taylor's programs offer the possibility of batch operations. This means that the data are taken up once only, in the form of a program line and a parameter line, both of which can be incorporated in a task manager. Here's an example to show how to do it.

The Program Line

D:\Program files\David Taylor\GeoSatSignal\GeoSatSignal.exe

This opens the *GeoSatSignal* program.

The Parameter Line

D:\products\data\HRIT*ch12nw.jpg -j19 -remap:D:\products\MSG\J19_HRV_Europa\%YY%MM%DD%HH%NN.jpg -min

This does three things:

- The most recent ch12nw image is opened.
- This image is remapped according to the data in GSS-job 19.
- The result is written away to the folder 'J19_HRV_Europa'.

The variables named %YY etc. ensure that the filename under which the final image is saved has the form 'year-month-day-hour-minute'.

Task Managers

A task manager is a program which remains active in the background and which ensures that all your batch files are started up automatically at the desired times. Such a task manager will contain details of those programs or batch files you want to run, the times when they must be activated, and whether this takes place daily, weekly or whatever (based on the system clock). I'll briefly discuss some of the different task managers that you can use.

The Standard Windows Task Manager

This is accessed from the Windows **Control Panel** by double-clicking 'Scheduled tasks'. All tasks planned will already be found in the list. You can add a new task to the list by clicking **<New Scheduled task>**.

Other Task Managers

If you use *Google* to search the Internet you can find an enormous number of task managers. Frequently these offer extra options or greater ease of use than *Windows* Task Manager and most of them are freeware. Because choice of this type program is frequently based on individual preference, I'm not going to state a personal favourite. Everyone can decide on his own preferred version. I want nevertheless to name two you might wish to try.

VisualCron [5] offers vast possibilities. Some of the most useful include

- adding scheduled jobs using a visual/graphical mode
- edit jobs easily with a right mouse-click
- view active jobs in a list with name, description and current status
- customised popup, e-mail, play sound, popup message, execute sql
- run missed events

and perhaps the most important:

- one job can have many tasks that can be run in order.

Macro Maker [6]. The particular strength of this program is that it allows you to record a sequence of mouse-clicks and play them back later. I have, however, found it very difficult to build more complex macros. Among other things you must ensure that pauses are regularly built in because otherwise the processing of the macro commands proceeds faster than the screen refreshes.

If you would like to learn what a professional (commercial) task manager can achieve, take a look at **Automate** [7]. On their website you will find a training video and data sheets which give an impression of how this kind of program works. This information may help you to decide which task manager is best for you.

Other Possibilities

There are obviously more ways to deal with automatic tasks. Here are a couple more options.

GetCharts [8] is a *Perl* script which allows you to automatically download files from the Internet by either FTP or HTTP at planned times according to a configuration file. As the program has a huge help file, I will only discuss the main ideas.

The details are provided by means of a script, which consists of two parts:

Fixed data which apply to the complete script

Here is a selection:

- the number of times that a download should be attempted
- its own e-mail address
- whether a file that has already been transferred should be overwritten.

To learn more about the fixed data, I refer you to the help-file, where the individual parameters are treated in depth.

One or more blocks with, for every block

- The address of the site and folder where the file must be saved
- The name of the location on the site and the name under which it must be stored.

Here is an example of the second block-data part

```
SITE=http://oiswww.eumetsat.int/~idds/data/grib#DIR=D:\PRODUCTS\DATA\MPEF
    \%y\%m\%d
```

```
MPE_%y%m%d_0030_M5_63.grb#FILE=%y%m%d0030-mpe-5.grb,t=0030
```

```
MPE_%y%m%d_0100_M5_63.grb#FILE=%y%m%d0100-mpe-5.grb,t=0100
```

```
MPE_%y%m%d_0130_M5_63.grb#FILE=%y%m%d0130-mpe-5.grb,t=0130
```

etc.

The Address

On the first line, 'SITE' is followed by the address where the files can be found. Following the # is the folder where the files must be stored. Here also variables such as %y, %m. etc. may be used. These are converted during the process to the real value. Although it is not obligatory that the 'DIR' command be on the same line as 'SITE', this is very strongly recommended by the author of the program (Francis Breame).

Files

The exact name of the program, as listed on the site, must appear first on the line. If the file is to be written under a different name, this can be done by means of the subsequent 'FILE' command. If this is omitted, the original name is used. Next follows the time (t=xxxx) at which the download must start. This overwrites the default time from the first block.

Download Manager

A download manager can also be useful for large files. Such a program allows you to download a large file faster by using several simultaneous Internet connections. *GetCharts* has been tested with the download manager program *GetRight* [9]. In *GetRight* you can decide yourself when to download files, including variables for year, month etc, and for some files this works well. If you require to download large quantities of data frequently (every half hour, for instance), then *GetCharts* is a much better choice.

Optimisation

From the beginning it is necessary to optimise the processing. Do not wait until everything has been completed because by that stage it becomes very difficult to alter and improve things.

Planning

It is important to plan your batch files carefully. You do not want to overload your system by running them all at the same time. I have created a spreadsheet for this purpose where the minutes increment line by line and the hours are listed across the columns. The name of each batch file is listed on the line representing the minute at which it must be started. Where the minute lines intersect the hour columns, a cross indicates those hours during which the batch file should be activated. If a batch file runs every 15 minutes, its name would therefore appear on four different lines. Figure 2 (next page) shows the first few lines of the spreadsheet.

FreeRAM XP pro

The most important aim of this freeware program [10] is freeing memory, which can be done automatically as well as manually. The more free memory you have, the faster your system is. Moreover, this program can give an overview as to how much memory space each program requires.

This can be very handy at optimising the system. In this way I have found that *Digital Atmosphere* uses up approximately

20 MB when it starts up but after running for a full day this increases to around 400 MB! It is clear that this can lead to problems.

A solution is to make a script with the single command 'TIMERON' and store this under a name like *start.dsf*. Next, a shortcut is made to *Digital Atmosphere* with *start.dsf* as its parameter. At a particular time we program the task manager to close *DAWS* and then start it up again with *start.dsf*.

TrimTree

Trim Tree is an unsupported program from David Taylor which can be downloaded from the 'Disc Utilities' section of his website at:

www.satsignal.eu

It can remove files that are older than a given number of days. It is very handy for deleting all the files you automatically make each day by incorporating one or more commands in a batch file. Here is an example to remove SAF-files older than 3 days.

```
TrimTree 3 C:\MSG - 1 \ images \ SAF \ * - LMLDLI_ *.* * - LMLSSI_ *.*
    * - LMLSST_ *.* * - MAPDLI_ *. * * - MAPSSI_ *. * * - NARSST *. *
```

All this is on one line. These batch files can be incorporated into the task manager so that old files are automatically and regularly deleted. If files must be deleted immediately after reception, this is possible by entering '-1' for the number of days. This can be useful for files which are not used again after automatic reception (such as some SAF files).

Screensaver

Are you tired of your dull *Windows* screen saver? Click the right mouse button on the *Desktop*, click 'Properties' and then the 'Screensaver' tab. Select 'My Pictures Slideshow' then, under

Batch		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
	0																								
Grib CLAI	1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Grib CRM	2														x										
DAWS sluiten en starten	3	x																							
GetCharts	4	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
MSG 17-20 IR DAWS 1024	5	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
MSG 17-20 HRV DAWS 1024	6	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
MSG DAWS 768 Overig	7	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	8																								
	9																								
MSG 14-16 RGB	10	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	11																								
Delete Data files	12	x						x						x					x						
	13																								
	14																								
	15																								
Grib CLAI	16	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	17																								
	18																								
	19																								
MSG 17-20 IR DAWS 1024	20	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Figure 2 - Spreadsheet

'Settings', use the 'Browse' button to navigate to a folder where your most recent images have been stored.

Acknowledgements

Everything I have discussed in this article has been obtained, over the course of years, from books, guides, forums, illustrated magazines, colleagues etc. and it is therefore impossible to list all the sources here. My apologies for this.

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8. GetCharts   http://www.vf0123.btinternet.co.uk/
9. GetRight   http://www.getright.com
10. Free RAM XP Pro   http://www.yourwaresolutions.com/

Store your APT Recording Level

Fred van den Bosch

You are about to record a NOAA satellite pass and, at the beginning of the recording, you notice that the soundcard settings have been modified by another program. Before you have time to set everything back to normal, part of the transmission has been lost!

Recognisable? I have discovered a tip to safeguard the recording level you use for saving NOAA APT transmissions as WAV files.

The solution is to download the program *Mixer* from:

**http://www.qsl.net/pa1are/software.html**

Mixer has several possibilities. After starting you see a number of sliders (illustration) where you can adjust the sound level for both recording and playback. You can store these settings under a suitable name (e.g. 'satellite').

If you recall this setting before recording a satellite you can ensure that the same sound level is always used for recording or playback. The easiest way is to do this with a batch-file.

Here is the batch file I use for *WXtoImg*. You can make it using *Notepad* and save it in your *WXtoImg* folder under the name '*wxtoimg.bat*'.

The content is:

C:\Program Files\Mixer\Mixer.exe satellite\xwxtoimg.exe
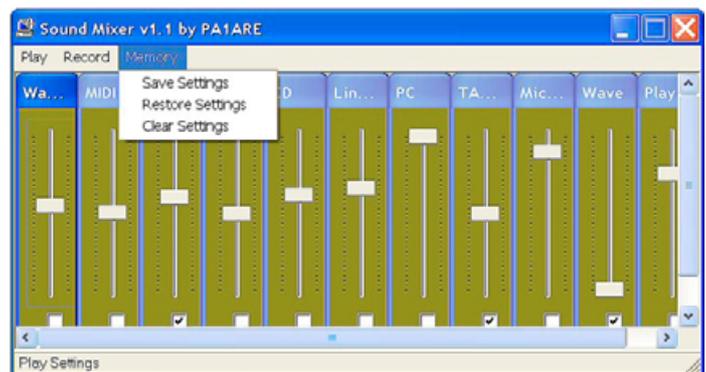
The 'Mixer' window

The first line points to the location of the program *Mixer*, while the second line is the program that must be started. By placing 'aptdecoder.exe' on this line you can use the same method for that program. For an easy start-up you can create a Desktop short-cut icon with a right mouse click.

You can initially define the correct sound level, during a 'live' satellite pass, using the program *SatLevel* from David Taylor (you can find it under the Audio Tools section at *www.satsignal.eu*). Unfortunately this program cannot be added to the batch file: *WXtoImg* and *SatLevel* cannot be started together via a batch file. So you must always start this program separately.

HURRICANE SEASON UPDATE

2005 season smashes all records . . .
. . . but Climate Change in not an Issue – NOAA

Les Hamilton

At the time of our last report in GEO Quarterly No 8, the 2005 Hurricane Season was still in full flow and five additional named storms, two of these hurricanes, developed before Nature finally threw in her cards when Tropical Storm Zeta finally gave up the ghost on January 6 this year.

Beta formed in the southwestern Caribbean and scored a direct hit on the eastern coastline of Nicaragua as a Category 3 hurricane, whose sustained winds of 120 kph wrecked buildings, toppled trees and forced thousands to flee the coastline. And in neighbouring Honduras, some 8000 people were evacuated from 50 communities north of the Nicaraguan border after rivers overflowed following torrential rain.

Honduras was once again the target when **Gamma** developed off its coast two weeks later. Again, thousands had to be evacuated from their homes while an estimated 50,000 more were cut off after bridges were damaged or destroyed, leaving several cities and towns isolated. Gamma's heavy rains left more than half of El Progreso, a city of 200,000 situated on a river near the coast, under water.

Tropical Storm **Delta** spent its life over the central Atlantic where it posed a threat only to shipping. During its death throes, however, Delta ripped through Tenerife and La Palma in the Canary Islands, cutting power supplies to over 200,000 people and forcing ports and airports to close. Delta finally fizzled out over north Africa where it brought much needed rains to Morocco.

Tropical Storm **Epsilon** (later to become only the 5th December hurricane recorded in the past 120 years) formed in the mid-Atlantic some 1500 km west of the Azores and spent its entire lifetime well clear of land. Against all predictions, Epsilon twice strengthened to a Category 1 hurricane as it lingered for ten days.

Finally, a full month after the official conclusion of Hurricane Season (November 30), Tropical Storm **Zeta** brewed up 1600 km west of the Azores. Though it never posed a threat, Zeta is noteworthy as the all-time record

27th named storm ever, and also equalled the 1954 record for the latest storm. Our inside front cover displays a MODIS image of Zeta obtained from NASA's *Terra* satellite on January 3, 2006.

Notable Records

The 2005 *Atlantic Hurricane Season* was remarkable for the number of records it produced. An incredible 28 storms (table 1) exceeded the 64 kph threshold above which they are normally assigned names. NOAA publicity declared that there were in fact 28 named storms (figure 1) but the October 4/5 storm in fact missed out as it was only identified retrospectively during a post-season review. This storm system brought gale-force winds to the eastern Azores where Santa Maria Island reported a ten minute average of 78 kph on October 4 with a peak gust of 93 kph.

Figure 1 - 2005: A Season of Firsts

This eclipsed the previous 1933 record when 21 storms achieved Tropical Storm status or greater.

As figure 2 illustrates, the final storm tally outstripped pre-season estimates by one third and exceeded the long-term average by a whopping 250%.

Figure 2 - 2005 Hurricane Season

Recent Trends

The unprecedented severity of the 2005 Hurricane Season has given rise to much discussion as to its underlying cause. As usual, alarmists are quick to shout 'Global Warming' or 'Climate Change', pointing out that this heightened

	Name	Dates	Max Speed (kph)	Min Pressure (mbar)	Hurricane (category)
1	Arlene	Jun 8-13	110	989	
2	Bret	Jun 28-29	65	1002	
3	**Cindy**	**July 3-7**	**120**	**991**	**1**
4	**Dennis**	**July 4-13**	**240**	**930**	**4**
5	**Emily**	**July 10-21**	**260**	**929**	**5**
6	Franklin	July 21-29	110	997	
7	Gert	July 23-25	70	1005	
8	Harvey	Aug 2-8	100	994	
9	**Irene**	**Aug 4-18**	**170**	**970**	**2**
10	Jose	Aug 22-23	90	998	
11	**Katrina**	**Aug 23-31**	**280**	**902**	**5**
12	Lee	Aug28-Sep2	65	1006	
13	**Maria**	**Sep 1-10**	**185**	**962**	**3**
14	**Nate**	**Sep 5-10**	**145**	**979**	**1**
15	**Ophelia**	**Sep 6-23**	**135**	**976**	**1**
16	**Philippe**	**Sep 17-23**	**130**	**985**	**1**
17	**Rita**	**Sep 17-26**	**290**	**895**	**5**
18	**Stan**	**Oct 1-5**	**130**	**977**	**1**
(28)	Not named	Oct 4-5	82	999	
19	Tammy	Oct 5-6	80	1001	
20	**Vince**	**Oct 8-11**	**120**	**988**	**1**
21	**Wilma**	**Oct 15-25**	**295**	**882**	**5**
22	Alpha	Oct 22-24	85	998	
23	**Beta**	**Oct 26-31**	**185**	**962**	**3**
24	Gamma	Nov 13-20	85	1002	
25	Delta	Nov 22-29	110	980	
26	**Epsilon**	**Nov 29-Dec 8**	**135**	**981**	**1**
27	Zeta	Dec29-Jan6	100	994	

Table 1 - Tropical Storms and Hurricanes, 2005 Hurricane Season.

Statistical Records for the 2005 Atlantic Hurricane Season

Previous records are shown in brackets

- 15 Hurricanes (12 in 1969)
- 4 major Hurricanes hitting the U.S. (4 in 2004)
- 4 Category-5 Hurricanes (2 in both 1960 and 1961)
- 7 Tropical Storms before August 1 (5 in 1997)
- Costliest ever Hurricane: Katrina, at least $80 billion ($26.5 billion for Hurricane Andrew in 1992)
- Deadliest U.S. Hurricane since 1928: Katrina with at least 1,300 fatalities
- Strongest Hurricane in the Atlantic Basin: Wilma 882 millibars (Hurricane Gilbert, 888 mb in 1988)
- Three of the six strongest Hurricanes on record: Wilma 882 mb (1st), Rita 897 mb (4th), and Katrina 902 mb (6th)
- Strongest July Hurricane: Emily, with 255 kph top sustained winds (Hurricane Dennis, 240 kph in 2005.
- 2-Year consecutive total of Tropical Storms: 42 (32, most recently in 1995-96)
- 2-Year consecutive total of Hurricanes: 25 (21 in 1886-87)
- 2-Year consecutive total of Major Hurricanes: 13 (ties with the 1950-51 record)
- 2-Year consecutive major Hurricane landfalls: 7 (5 in 1954-55)
- 2 -Year consecutive Florida major Hurricane landfalls: 5 (3 in 1949-50)
- 3-Year consecutive total of Tropical Storms: 58 (43 most recently in 2002-04)
- 3-Year consecutive total of Hurricanes: 30 (27 in 1886-88)
- 3-Year consecutive total of major Hurricanes: 16 (ties with 1949-51 and 1950-52)
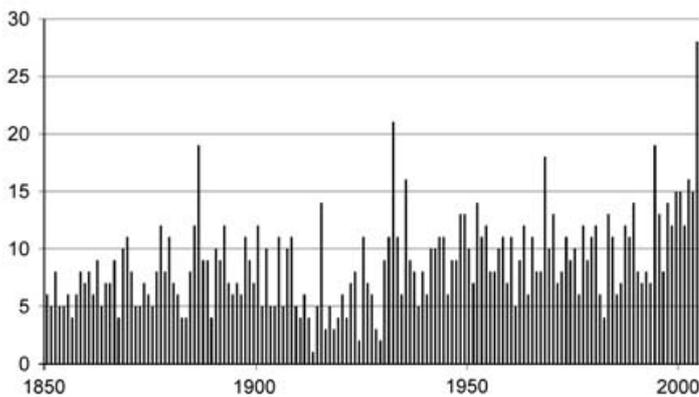
Figure 3a - Number of Tropical Storms per Season
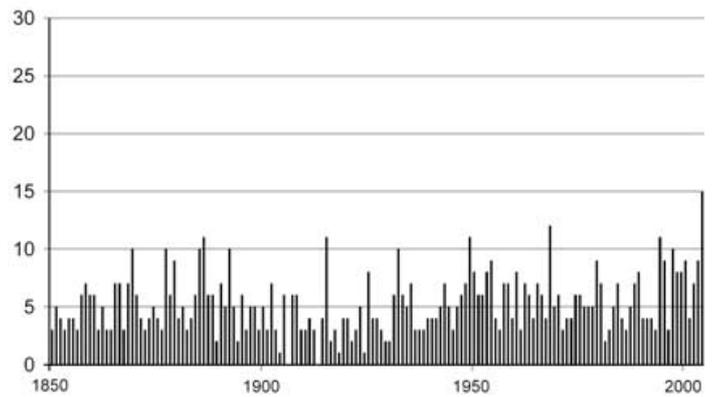
Figure 3b - Number of Hurricanes per Season

hurricane activity in the Atlantic Basin coincided with some of the warmest years ever recorded world-wide.

But the National Oceanic and Atmospheric Administration (NOAA) totally refute this argument and state that this enhanced activity is simply part of a naturally occurring cycle of tropical climate patterns near the equator. These cycles are termed the Tropical Multi-Decadal Signal (TMDS) and normally span several decades: typically 20 to 30 years although they can last longer. This means that the North Atlantic tends to experience alternating 20 to 30 year periods when hurricane activity may be either above or below the norm. Figures 3a and 3b plot the numbers of Tropical Storms and Hurricanes since records began in 1851 [4]. And another key point that must not be overlooked is this: prior to the launch of the TIROS-I weather satellite in 1960, many tropical storms and hurricanes that spent their entire lives over the ocean could have gone unnoticed, skewing the long-term record. These days, no tropical storm can escape surveillance and detection.

> In fact, the global tally of hurricanes and tropical storms in any calendar year remains remarkably constant, at approximately 90 ± 10 [5]: increased activity in the Atlantic almost certainly coincides with reduced activity elsewhere.

NOAA research shows that it is the TMDS that is causing the recent spell of increased Atlantic hurricane activity and that it is not related to greenhouse warming. The tropical climate patterns producing this increased activity are very similar to those recorded during the 1920s and late 1960s when hurricane activity was also greater than normal. The TMDS manifests itself in weather events around the world, including Atlantic hurricane variability, and was also responsible for the below-normal hurricane era between 1970 and 1994.

The strength of the Atlantic hurricane season is largely determined by the number of tropical storms that form between Africa and the Caribbean Sea in an area known as the Main Development Region (MDR), particularly during the peak months of August through October.

Key Conditions

The occurrence of an above-normal hurricane season is not a random event: it results from interplay between several key atmospheric and oceanic conditions which favour hurricane formation in the MDR. These key conditions have persisted since

1995 and were operative throughout the 2005 season. They include:

Warm Ocean Waters

Hurricanes need warm ocean waters to strengthen and sustain them, and do not form unless the water temperature is at least 26.5°C. Such a temperature is essential in order to create sufficient atmospheric convection to elevate moisture 15 km and more into the atmosphere.

Ocean waters generally were 1° to 1.5°C warmer than the norm during the 2005 season, favouring stronger hurricanes.

Low Wind Shear

Hurricanes can form only in areas of low wind shear, regardless of the ocean temperature, and during 2005 wind shear was particularly low between the central tropical Atlantic and the Gulf of Mexico (figure 4).

Favourable Mid-Level Easterly Winds

The pattern of easterly winds blowing off the west coast of Africa plays a critical role in determining the strength of a Hurricane Season. During 2005 these winds strengthened the tropical low-pressure systems moving westward across the Atlantic and also steered them toward the low-shear, warm-water environment of the MDR where they transformed into tropical storms and hurricanes.

Since 1995 the TMDS has produced lower wind shear (changing windspeed with altitude) and warmer waters across the tropical Atlantic; along with conducive winds coming off the west coast of Africa, this was a key combination of conditions for the production of an active Hurricane Season (figure 5).

An active hurricane regime does, of course, mean that many more tropical storms and hurricanes achieve landfall in the United States, where, since 2002, there has been an average of seven such storms annually. During below-normal seasons, such as the period from 1970-1994, relatively few tropical storms and hurricanes form in this area.

How the TMDS Affects Hurricanes

The TMDS affects atmospheric and oceanic conditions in and around the MDR for decades at a time, key aspects being the warmer than average waters across the tropical Atlantic, a stronger monsoon in the region of West Africa and a weaker monsoon in the Amazon Basin (figure 6). Monsoons are large-scale seasonal wind and air pressure patterns associated with heavy
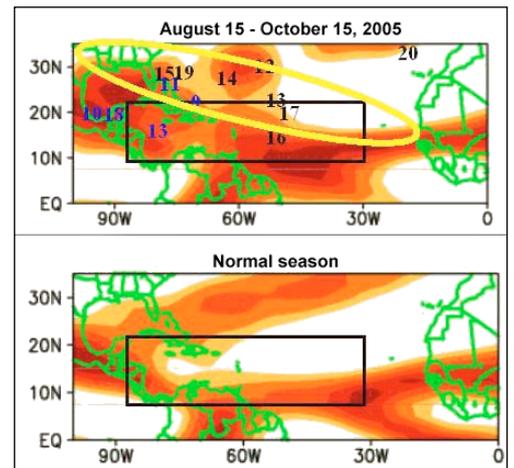
Figure 4 - Low wind shear during 2005
Very low wind shear (heaviest shading shows the lowest wind shear) in the MDR (boxed) led to the active 2005 Hurricane Season. Numbers indicate where named storms formed.

Image: NOAA
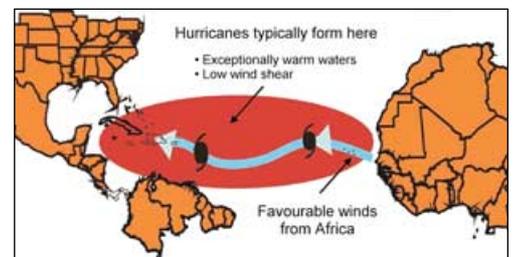
Figure 5 - Conditions during 1995-2005
Image: NOAA

Figure 6 - The TMDS and Hurricane Activity
Anomalous upper-level easterlies and lower-level westerlies produce low wind shear

Image: NOAA

convective rainfall. When convection is strong, warm, moist unstable air in the lower atmosphere rises to great altitudes and as it cools on ascent it forms clouds and rain.

The combination of an enhanced West African monsoon with a relatively weak Amazon Basin

monsoon results in stronger upper level winds but weaker lower-level trade winds over the tropical Atlantic (figure 6). Such a wind pattern favours more Atlantic hurricanes by producing lower wind shear in the MDR. The enhanced West African monsoon is also associated with favourable westerly winds in the middle atmosphere, yet another important ingredient for an active hurricane season.

Research by NOAA scientists Gerry Bell and Muthuvel Chelliah, currently in press with the *Journal of Climate,* describes the TMDS and shows that it accounts for the *entire* inter-related set of conditions that controls decadal hurricane activity. Their study also shows that the TMDS *is* causing the observed multi-decadal fluctuations in Atlantic hurricane activity since 1950.

These results expanded upon a 2001 study in the journal *Science* [1], which suggested that 'decades-long cycles in sea-surface temperatures and wind shear in the tropical Atlantic closely matched the cycles of major hurricane formation in that region.' That study also showed the recent increase in hurricane activity to be nothing new—'Atlantic Ocean temperature data shows that this is just the latest manifestation of a long-running hurricane cycle that dates back to at least 1870'.

The *El Niño* Southern Oscillation

It was discovered in 1984 that *El Niño* and *La Niña* episodes strongly influence Atlantic hurricane activity. *El Niño* and *La Niña* episodes occur roughly every three to five years and generally last between nine and 15 months. An *El Niño* event results in a warming of the waters of the central equatorial Pacific Ocean while *La Niña* produces a cooling effect. These events control the patterns of tropical convection across the central equatorial Pacific, *El Niño* increasing convection in these regions while *La Niña* suppresses it.

Variations in tropical convection affect the wind and air pressure patterns in the upper atmosphere across the eastern Pacific and also the winds in the MDR. *El Niño* inhibits Atlantic hurricanes by producing upper-level westerly winds and increased wind shear in the MDR while La Niña promotes Atlantic hurricanes by producing upper-level easterly winds which decrease wind shear in the MDR.

The combination of *El Niño* with an inactive hurricane era produces conditions conducive to a below-normal season. This was the case between 1970-1994 when every *El Niño* was associated with well below normal hurricane activity. By contrast, since 1995, only two seasons have failed to show above-normal hurricane activity—and these coincided with the two *El Niño* years of 1997 and 2002. Indeed, the record 1997 *El Niño* produced a below-normal season.

Seasonal Landfall Predictions

Below-normal seasons average one landfalling hurricane in the United States, while above-normal seasons average two to three. This increase is related to the fact that many more hurricanes form in the MDR during above-normal seasons and that these are then steered generally westward toward the Caribbean Islands and the United States. As a result, both regions are at a greatly increased risk of hurricane landfalls during seasons of above-normal activity.

Whether or not a tropical storm or hurricane strikes the United States depends critically on the weather patterns present at the time it is approaching land. For example, when air pressure in the upper atmosphere is higher than normal over the broad region encompassing the southeastern United States, the Gulf of Mexico and the western tropical Atlantic, the wind shear tends to be low and the steering currents bring stronger hurricanes closer to shore.

This high-pressure region is strongly influenced by the prevailing weather patterns over the continental United States. As this cannot be predicted more than a few days in advance, seasonal hurricane landfall forecasts remain an ongoing challenge and it is not yet possible to predict whether any given locality is more likely to be struck by a hurricane than another during a particular season.

During the 4-year period 2002-2005 a total of 13 hurricanes struck the United States, an average of three landfalling hurricanes per season, while eight hit the Gulf Coast and five the East Coast—averages of two and one per season, respectively.

NOAA's Seasonal Hurricane Outlooks

NOAA's research has shown that two prominent climate factors, TMDS and the *El Niño* Southern Oscillation (the *El Niño-La Niña* cycle), strongly control the key inter-related set of conditions governing the formation of tropical storms in the MDR between August and October. The new understanding of these climate factors means that NOAA can often predict with confidence how conditions will develop across the

tropical Atlantic as the season progresses. In May 2005 NOAA predicted a 70 percent chance of an above-normal season and updated this to a 95% or greater chance in early August (with the possibility of a near-record season). In the event, the 2005 season gave rise to record early-season activity with the rare experience of two major hurricanes, Dennis and Emily forming as early as July, and ultimately smashed almost all existing records.
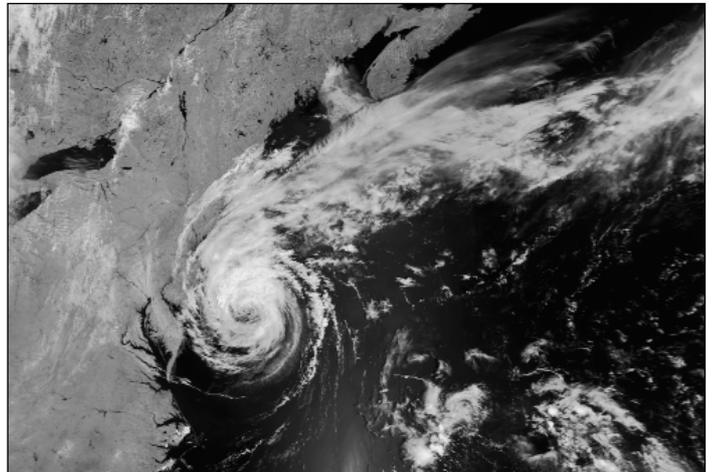

Figure 7 -   Tropical Storm Beryl pictured off Long Island
NOAA-17 HRPT at 15:35 UT on July 20, 2006.

Image: NOAA CLASS Archive (www.class.noaa.gov)

Consensus

There is consensus among a number of NOAA hurricane researchers and forecasters that recent increases in hurricane activity are primarily the result of natural fluctuations in the tropical climate system known as the *Tropical Multi-Decadal Signal*. The tropical climate patterns currently favouring very active hurricane seasons are similar to those experienced in the late 1920s and the late 1960s when there was also enhanced hurricane activity. The USA is currently eleven years into an active era that began in 1995 and which could easily last another 20-30 years, bringing a high probability that the ongoing high levels of hurricane activity and landfalls are set to continue.

What lies in store for 2006?

In May this year NOAA predicted an 80% chance of a very active North Atlantic Hurricane Season for 2006, forecasting between 13 and 16 named storms with eight or 10 of these escalating into hurricanes and the chance of four to six 'major' hurricanes (those reaching Category 3 or above). The chance of a near normal Hurricane Season was rated as only 15%.

Although not anticipating a repeat of last year's record-breaking events, the potential for hurricanes striking the USA remains high. As *El Niño-Southern Oscillation* conditions across the equatorial Pacific are expected to remain neutral during the next three to six months, neither *El Niño* nor *La Niña* is likely to be a factor in determining this year's hurricane season.

By the end of July 2006 though, only two minor tropical storms, Alberto and Beryl, had developed (compared with seven last year, three of them hurricanes) and neither of these posed a significant threat. Perhaps we can indeed look forward to a less stressful Hurricane Season for 2006. Only time will tell!

References

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    Stanley B. Goldenberg, Christopher W. Landsea, Alberto M. Mestas-Nuñez, William M. Gray.

2   Multi-Decadal Climate Variability
    http://www.magazine.noaa.gov/stories/mag184.htm

3   Active 2006 Hurricane Season Predicted
    http://www.noaanews.noaa.gov/stories2006/s2634.htm

4. Data for these graphs from:
    http://www.aoml.noaa.gov/hrd/tcfaq/E11.html

5. Anthropogenic Effects on Tropical Cyclone Activity
    Kerry Emanuel, Program in Atmospheres, Oceans, and Climate, Massachusetts Institute of Technology
    http://wind.mit.edu/~emanuel/anthro2.htm

Monitoring Lightning Strikes in Real Time

'If you hear it, fear it – If you see it, flee it'

John Heath G7HIA

With only a few large electrical storms each year in Great Britain, it is easy to underestimate the significance of this force of nature, one which has a massive impact on a global scale. Of the many thousands of lightning events which take place each day, about 80% are discharges between clouds. The 20% or so that do reach ground can be immensely destructive. A bolt of lightning reaches temperatures of around three times that of the Sun's surface.

My own experience of a nearby lightning strike was in 1997 when most of my radio gear was knocked out. There were no external signs but just about everything containing solid state devices failed to work when switched on. The clue to this lightning strike was a PL259 plug on the end of a disconnected antenna lead, which was firmly welded to a metal radiator.

Surprisingly, human beings can survive a strike due to something very much like the Faraday Cage effect. Instead of taking a direct route through the body and causing the explosive destruction often seen with trees, the lightning tracks over the moist skin surface. Recent research using MRI scanning techniques shows that survivors sometimes have aspects of their brain functions altered by the event. It would be very unwise to underestimate the danger from lightning if in an open space during a storm. Good advice is contained in this little rhyme:

If you hear it, fear it; If you see it, flee it

A lightning discharge produces electromagnetic fields that can be detected over long distances: a phenomenon that can be used to detect lightning, characterise the type of discharge and estimate its range and bearing. The commercial system I am covering in this article is the *Boltek* Lightning Detection System, which seems to be widely used in the USA and is readily available. The Boltek website at

www.boltek.com

is well worth a visit, as are the links it provides, which include research data and a link to Douglas 'Lightning Boy' Keisling's web site, where you can see some amazing photos of lightning and read valuable hints and tips for successful lightning photography.

The Boltek LD-250 antenna and detection package costs around $800 from the USA so unless you have a serious interest this

is probably not something you will rush out to buy. There is a least one Boltek system running in the UK, at

www.peterboroughwvs.info/stormvue.html

where you can obtain up-to-date information for up to 375 miles around Peterborough. I don't know who the owner is, but if he or she is a GEO member, and reads this, thanks for making your data available on the Net. The screenshot below was a live capture from the Peterborough site on July 7 and shows intense lightning activity off the

there is a running text commentary giving the number of storms being tracked, their intensities, distances and bearings. I have found that this text feature does not load every time I log on—it may be a fault with my computer.

I look in at the Peterborough site most days and when there is storm activity I like to compare the lightning strike map with current NOAA APT images which I capture with my RX2 receiver. I hope you find that lightning data adds extra interest to your weather imaging.
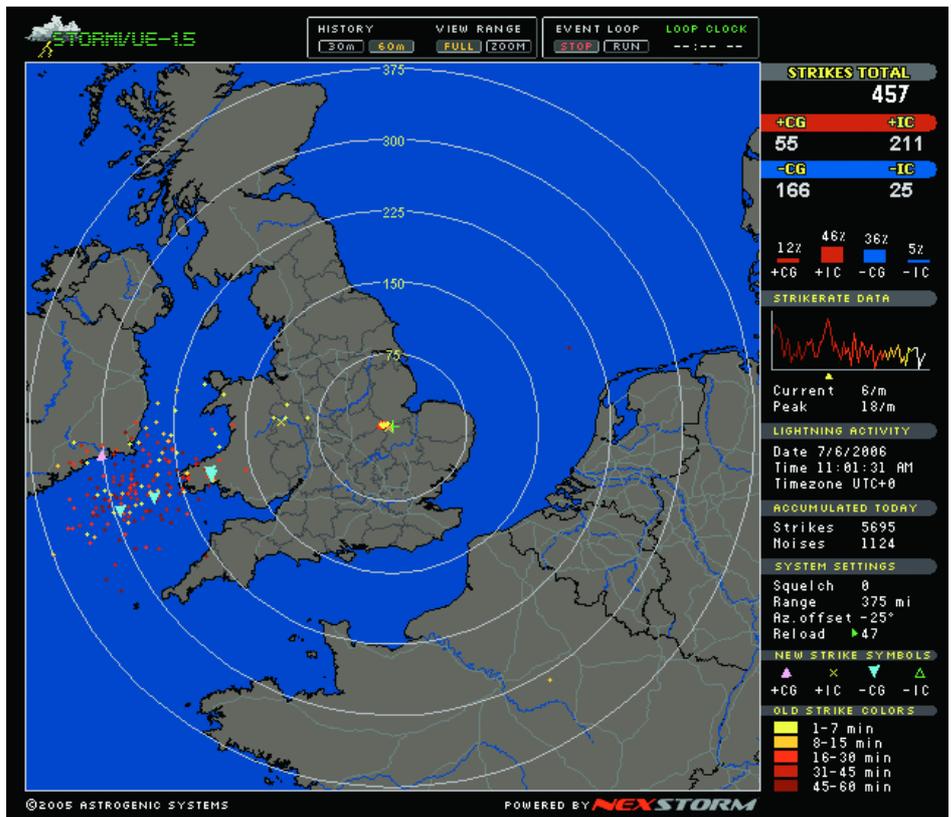
Pembrokeshire coast. The use of colours indicates the age of each discharge: yellow means 1-7 minutes ago, pale orange (8-15 minutes ago) and red (16-30 minutes ago). This enables a clear picture of the intensity and direction trend of the strikes to build up. In addition to the map display
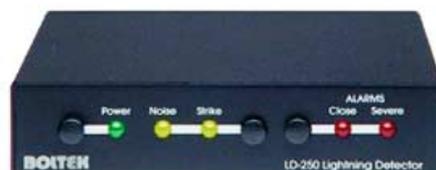
The Boltek LD-250 Lightning Detector

The small active direction-finding antenna used with LD-250, which is able to tell from which direction the signal is coming.

EUMETCast Data Throughput

Just how much data does your EUMETCast PC have to handle?

David Taylor

The addition of trial NOAA AVHRR high-resolution data to the *EUMETCast* data stream was discussed in the previous issue of *GEO Quarterly* and since then, trial dissemination of simulated *EUMETSAT* Polar Satellite (EPS) data (MetOp) has been added. Clearly, both the reception and processing burdens being placed on *EUMETCast* reception systems is increasing all the time, and this will continue to mushroom as additional *EUMETSAT* Reception Stations are brought on-line and the trial services become upgraded to full operational status. I recently felt it prudent to make some tests with my own equipment in an effort to ascertain what the likely data rates involved might be, and whether the additional load of receiving EPS data would interfere with existing Meteosat-8 reception by causing missing segments. For this I purchased an 'inexpensive' PC which was on offer from *PC World* and beefed up both the memory and hard disk capacity.

The graphs opposite show data throughput from a *EUMETCast* test system installed on this PC during May and June 2006.

- During most of weeks 21 and 22 (late May into early June) the system was operating <u>without</u> an eToken and receiving <u>only</u> the data for which no licence is required (figure 1).

  The average data throughput was some 40 kilo<u>bytes</u> per second **(40 kB/s)**, although it is difficult from the scale of the monthly graph to judge this with any accuracy.

- During Monday and most of Tuesday on week 25 (figure 2) there was no *EUMETSAT* Polar Satellite (EPS) test data, and the throughput was typical of many systems receiving the normal *EUMETCast* stream. Data flow averaged just over **150 kB/s**, peaking at approximately **225 kB/s** over each 30-minute period.

- During the day prior to the screen-shot (figure 3), EPS test data was being transmitted and, over a 5-minute period, the maximum throughput was **645 kB/s**.

Whilst I am not prepared to put hard figures on this, a rule of thumb might be that EPS throughput will be at least twice the present *EUMETCast* level, meaning that if you take both EPS and your present data, expect a three-fold increase in data throughput.

The relevant details of the test PC are:

- AMID 64 3200+ processor
- 2 GB memory
- 300MB RAMdisk for the FY file
- Windows XI Home
- 2 physical hard drives: one for the programs and one for the data
- *SkyStar* V2.6D PCI DVB card
- *SkyStar driveps* V 4.3.0a
- *TelliCast* software V2.4.4 B
- Also running full *MSG Data Manager* and *AVHRR Manager* software for data decoding.
- EPS data just kept as files, and automatically deleted after one day
- Each EPS data stream in its own folder
- No extra Meteosat-8 segment loss due to EPS data

For Meteosat-8 users, the key outcome is that the addition of EPS test data to what was being received before caused <u>no extra segment loss</u> to the standard Meteosat-8 data.
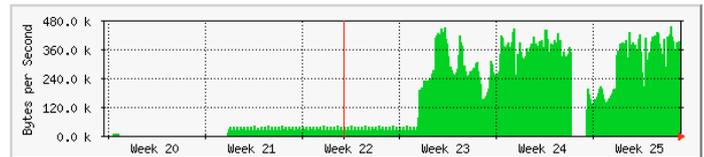
Figure 1 - Essential data only during weeks 21 and 22.
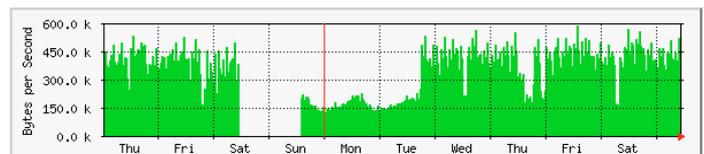
Figure 2 - No EPS data from Sunday to Tuesday
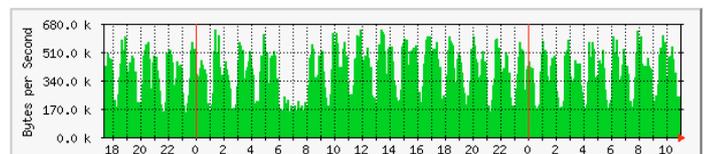
Figure 3 - Daily graph showing 5-minute averaged EPS test data
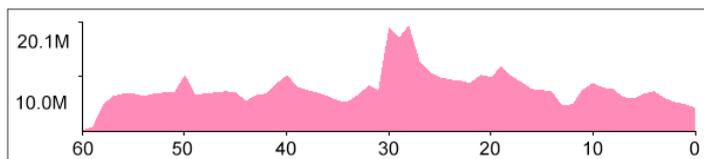
Figure 4 - Tellicast throughput screenshot (in mega<u>bits</u> per second)

More recent tests and analysis of the data have shown a maximum throughput exceeding 20 mega<u>bits</u> per second (**20 Mb/s**), measured using the *TelliCast* HTML Shell (figure 4). *Do note that this program uses <u>bits</u> rather than <u>bytes</u> to quantify throughput.*

However, the full IASI (Infrared Atmospheric Sounding Interferometer) data was not being sent during these tests, so the maximum data rate could be even higher. The tests have also shown that, for many people who only require the AVHRR high-resolution image data from MetOp, the peak rate can be limited to around **6 Mb/s** by using the channel selection, possible by editing the *recv-channels.ini* file.

Tests with a USB 1.1 *TechniSat* box showed very little segment loss (only *one* segment in 24 hours) when used with the main services of interest to amateurs—the present *EUMETCast* data (Meteosat-8 and regional AVHRR) and the MetOp AVHRR.

However, when the full EPS data were taken, the data rate exceeded the capabilities of the USB 1.1 interface.

Of course, this is with simulated test data, and not live MetOp data, so it is a provisional conclusion. Having the ability to select channels by editing the *recv-channels.ini* file is a life-saver in this situation.

At the time of writing we are still waiting for MetOp to be launched so these results are a work-in-progress. I would like to acknowledge the help of Arne van Belle, Douglas Deans, and *EUMETSAT* during these trial-data tests.

HRPT Images in 3D

Gérard Kruger F6BEK

If you have an interest in NOAA HRPT imagery, whether by direct reception or downloaded from the Internet, you can render them in 3D by making use of a program called *3DEM* in conjunction with David Taylor's *GroundMap* and *HRPT Reader* software. Without claiming this to be more than an initial aid, I'll to try to explain as simply as possible the operation of *3DEM* with HRPT images of the NOAA satellites.

The Software

The three items of software you require are all readily available, both from the Internet and from Software Showcase (page 42). *3DEM* [1] is completely free—there is nothing to pay and you do not have to register your copy. *HRPT Reader* [2] and *GroundMap* [2] are also available as free shareware versions, but you <u>must</u> use a fully functional <u>registered</u> version of each if you wish to prepare 3D images as explained below. The key component is *3DEM*, software specifically designed to drape satellite images over a digital elevation model (DEM) of the Earth's surface to give the illusion of a 3D image.

You will have to create a suitable folder each for *GroundMap* and for *HRPT Reader*, and then extract their respective zip archives into these. *3DEM* comes with its own self-install routine. It is also a good idea to have an easily remembered location for your working images—personally I chose to create a folder named 'satellite images' inside the *3DEM* folder.

HRPT Datafiles

If you do not run your own HRPT station you can download high-resolution telemetry files from the CLASS electronic library of NOAA environmental data at:

http://www.class.noaa.gov

Although you must register before you can download data from this site, there is no charge. An article describing in detail how to select and order your HRPT data was published on page 18 of GEO Quarterly No 5. This process is also described, in French, on my own website at:

http://perso.wanadoo.fr/ f6bek/nouveau_fichier10.html

The Digital Elevation Model

In order to produce a 3D image we must first obtain a DEM covering the region of interest. This is a file containing accurate data relating to the elevation of the Earth's surface. Such data is available from a number of sources but we will use the GLOBE data from the NOAA National

Figure 1 - Ordering a GLOBE DEM from NGDC

Geophysical Data Center (NGDC). This is a one-kilometre Digital Elevation Model of the entire Earth but you can easily download a subset covering just the region you are interested in. The DEMs can be ordered and downloaded from:

http://www.ngdc.noaa.gov/ mgg/topo/globeget.html

To obtain your DEM, which is provided gratis, visit this page and click the link '*Select your own area*' at upper the right to reveal the download page (figure 1). Here, enter the coordinates for the region you desire, in my case a 16° by 16° area centred on France and shown in figure 5. Just edit the values in the four fields for *north*, *south*, *east* and *west* with the correct values. All that remains is to type a suitable filename (in the *File name* field) and click the *Get Data* button at the foot of the page. About a minute later, a set of three links appears (figure 2). Download all three files into a suitable folder (e.g. a folder called 'GLOBE' inside your *3DEM* folder).

If you prefer, you can type your e-mail address into the field provided and these links will be sent to you in an e-mail message. Note that you have just 48 hours to effect the download. If you delay longer than this you will find that the files have been erased.

If any of these files acquires an additional filename extension during the download process (e.g. changing to 'mydata.hdr.txt'),

Figure 2 - The DEM ready for downloading

remove it. The three files must be saved under the filenames shown in figure 2.

Note: Although you might prefer to download a much larger DEM, you are restricted to a maximum of about 40 MB. The 'France' DEM above is a 7 MB file.

Processing the Files

HRPT Reader

The first step is to select an HRPT image containing a region of high relief that is free of cloud—and is of course covered by the downloaded DEM. For the purpose of this article, I have selected the European Alps. The image used in these examples came from the 13:24 UT NOAA-16 pass on April 24, 2004. The data file is loaded into HRPT Reader and, after making sure that the overlay feature is switched off, saved using the 'Save displayed image' option from the **<File>** menu. Images must be saved this way in order to save an additional location file (type '.lcn') which holds all the essential spatial details
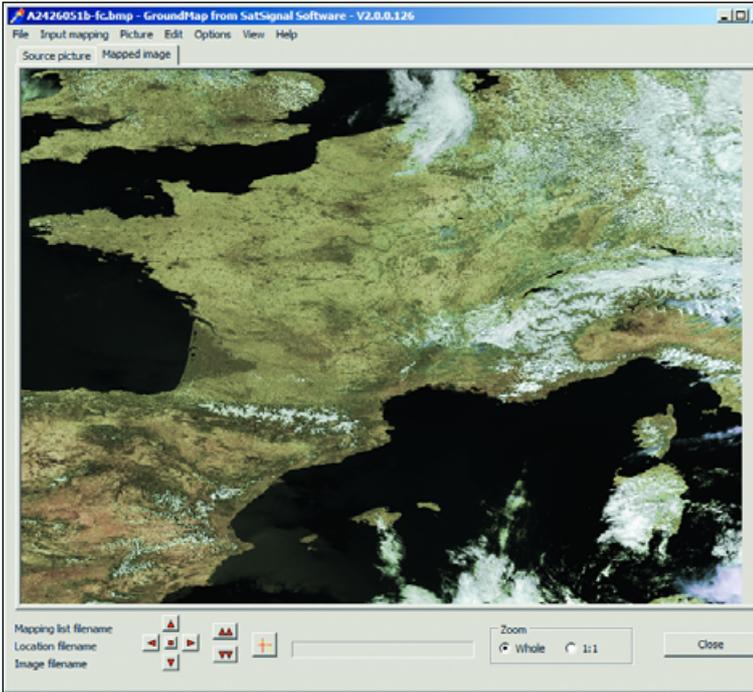
Figure 3 - The HRPT segment remapped in *Groundmap*
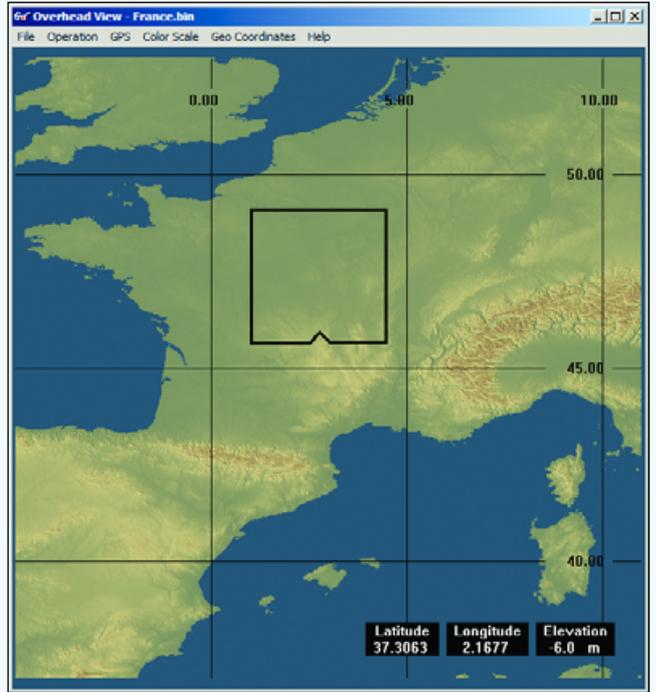

Figure 4 - The 'France' terrain model in *3DEM*
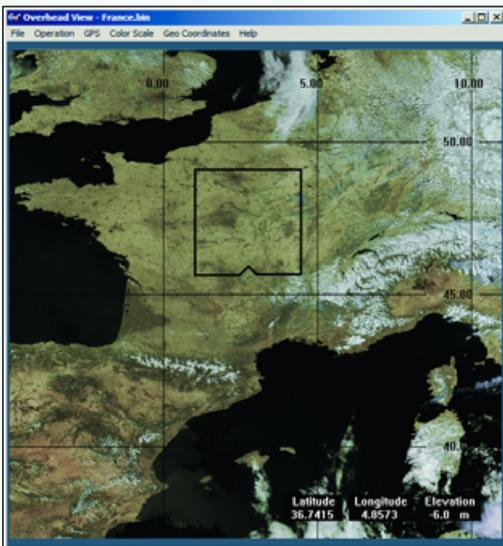
Figure 5 - Image overlain over the terrain model

Figure 6 - Positioning the cropping tool

Figure 7 - The final 3D view looking south over the Alps

relating to the image. These are required by *GroundMap* in the next stage of processing.

At this stage there is no reason why you cannot—within the limits of good taste—modify the colour balance, gamma, brightness or contrast of the image using your favourite image processing software. Just make sure that you do not rescale it.

GroundMap

The key to this entire process is the extraction from this HRPT image of a section having <u>exactly</u> the same coordinates and geographical projection as the DEM. This is where *GroundMap* enters the picture. It should be noted that the operations which follow call upon advanced functions requiring the <u>registered</u> version of this program.

Open *GroundMap* and make the following changes in the **<Options/Setup>** menus:

Output size   = Giant - 3600 x 2700
Location   = User
Map projection   = Cylindrical equidistant
  (zoomed)

Next, in the **<Setup/General>** tab, enter the coordinates shown below: these

match exactly those used when downloading the *France* DEM. Check the '*Use my map settings*' box (figure 8).

Open the **<Files>** menu, select **<Open location data …>** and search in the folder where you saved the image from *HRPT Reader*. The file you must load will have the same stem filename as that image but the extension '.lcn'. Select this file and you will see *GroundMap* work and produce an image with characteristics that you have selected (figure 3). You must now save it using the function **<File/save image…>**. Save this image in your '*Satellite images*' folder. By default, this will be called *remapped.bmp*, but it is a good idea to save it with a more meaningful filename.

3DEM

Now the program *3DEM* comes into play. This software makes it possible, inter alia, to superimpose your satellite image over a terrain model. This implies that, for the two files to make a perfect superposition, they must possess absolutely identical geographical coordinates. The choice of parameters used in downloading the DEM and in setting up *GroundMap* have ensured that this is the case.

Open *3DEM*, open the **<File>** menu, click '*Load terrain model*' then choose '*Terrain matrix*' (figure 9), click 'OK' and load the *France.bin* DEM that you stored in your *GLOBE* folder. An image centred on France then appears, as shown in figure 4. This is your terrain model, which will have exactly the same geographic coordinates as the image produced in *GroundMap*. You are now ready to overlap the satellite image over this terrain model.

For the first step select **<Operations/F4>** and select '*No*' in the following popup message box (you don't want to convert to UTM projection).

In the '*Apply map overlay*' window that follows (figure 10), click on '*Load*', navigate to the *GroundMap* image from your '*Satellite images*' folder and open it. Click 'OK' to close the warning box that appears. Your satellite image now appears: validate it by clicking the 'Accept' button.

The satellite image now becomes available on the working screen, covering the terrain model (figure 5). You can see on this screen a black square with a notch in the middle of one edge (the cropping tool). This square is mobile and resizeable; it is used to define the exact region you wish to display in 3D.

Start by clicking over the image (with the left mouse button) at the position from which you wish to observe the 3D view—the square will move so that the notch now stands where you clicked the mouse. The rectangle itself can be resized/rotated by holding down the mouse on any corner and dragging.

Next, rotate the box till the centre of the edge opposite the notch points in the direction you wish to observe then increase the size of the visualisation zone as required. In this example, I have selected a large selection of the Alps looking south towards Corsica (figure 6).

Finally select **<Operation/F2 3D Scene>** to bring up the *Terrain Projection Parameters* window (figure 11). The principal functions are:

1. Legend: the title, which will appear at the top of the 3D image
2. Projection size: the dimensions chosen for the 3D image
3. Observer's altitude: only available if 'Background' is selected in point 6 below
4. Terrain illumination: select azimuth and elevation for the sun, depending on the hour of acquisition of the original satellite image.
5. Terrain vertical magnitude: this allows you to exaggerate the vertical scale to obtain a 'better' 3D effect
6. Terrain position: a foreground image slopes into the distance producing a perspective view; a background view fills the screen
7. Terrain resolution: min or max (honestly, I haven't seen any difference)
8. Terrain type: selects a colour scheme suited to particular types of terrain

This last item is particularly useful for aligning the image precisely with the terrain model. I recommend that you start by preparing a 3D image for a region comprising part of a coastline with the **<Island/Ocean>** option selected. The resulting image should reveal clearly if there is any offset between the terrain model and the satellite image. If there is, the image can easily be nudged into place using the option **<Operation/F5 - Adjust map overlay>**. It is advisable to do this in very small steps till the 3D image shows a perfect match.

You can now change the terrain type back to **<Mountain/Plain>** and click 'OK' to create a perfect 3D image from any region in the satellite image. Of course, there is a strong chance that you will not be immediately satisfied with it; but *3DEM* possesses all the tools to allow you to proceed with any modifications which you wish.

The 3D image that you create is presented in a new window which contains two buttons:

• File
• Operation

The first is used for saving your work while the second gives you access to some of the options from the **<Operation>** drop-down menu:

• F1 - allows you to reposition the observation square
• F2 - to modify the parameters used to generate the 3D image


Figure 8 - Entering coordinates in GroundMap
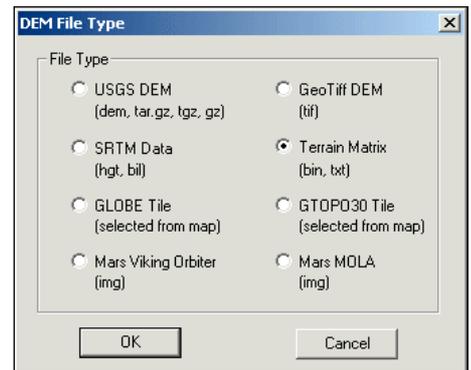

Figure 9 - Selecting the terrain model
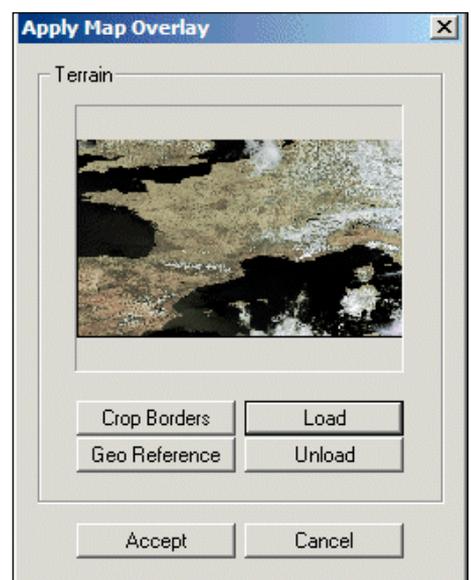
Figure 10 - The map overlay window
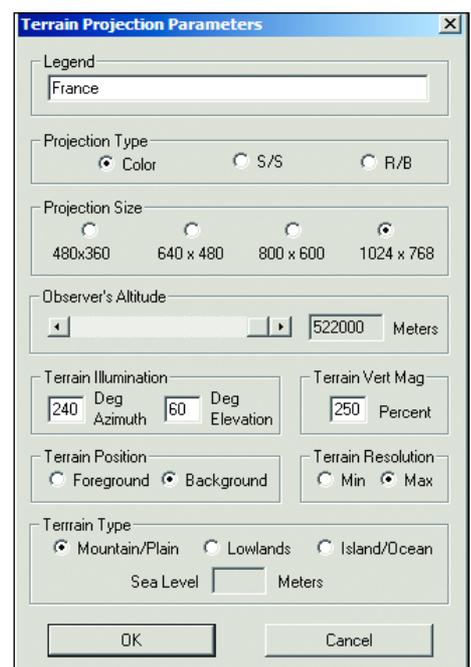

Figure 11 - Terrain Projection Parameters

HRPT Images in 3D

- F3 - to modify the colours of the terrain model and text
- F4 - to load a different image
- F5 - to nudge the terrain model in line with the image
- F6 - to rotate the scene

After this, it is recommended that you carry out numerous tests in order to become completely familiar with the program.

References

1 3DEM can be downloaded from:

   http://www.visualizationsoftware.com/3dem.html

2 HRPT Reader and GroundMap

   http://www.satsignal.eu

   Under 'Satellite Tools', click the appropriate link.

Additional Help

If you require more information about 3DEM there are numerous websites that provide you with tutorials and images.

http://www.suissegeo.ch/didacticiels_dossiers.php?page=3DEM

http://ailexhere.free.fr/volvirt11.php

http://perso.wanadoo.fr/darthmagus/3dem.html

Although the above three sites are in French, there are plenty more available, in English. Just search for '3DEM' in your search engine—you will be surprised.

News in Brief

In 2005 the Intergovernmental *Group on Earth Observations* (not ourselves), an international partnership of countries, the European Commission and international organisations, embarked on establishing a Global Earth Observation System of Systems (GEOSS) within the next 10 years.

So it looks like the prediction, made some years ago, that there would be a world-wide system for dissemination of Meteorological data via commercial satellites is to become a reality for all users.

Colour Images

Front Cover

The first NOAA-17 HRPT image from over the North Pole was transmitted from EUMETSAT's new Svalbard at 14:20 UT on July 18. This image was processed by David Taylor using AVHRR Manager and HRPT Reader software. Read more on page 22.

Inside Front Cover

NASA's Terra satellite captured this dramatic image of Tropical Storm Zeta on January 3, 2006 through its MODIS instrument. Despite the date, this was the final storm of the 2005 hurricane season. You can read more on page 26.

Image: Jeff Schmalz, MODIS Rapid Response Team

Page 13

This true-color 250-metre resolution MODIS image was acquired by the NASA Terra satellite at 18:25 UT on June 28, 2006. It shows part of Canada's northern archipelago, and features early ice melt in Simpson Strait between King William Island and Adelaide Peninsula (see page 40).

Source: MODIS Rapid Response Team

Inside Back Cover

This colour composite Meteosat-9 image of Africa was processed by David Taylor using his GeoSatSignal-6 software. It was created using the noon 'essential data' imagery downloaded from Dundee Satellite Receiving Station (see page 16)

© EUMETSAT, NERC Satellite Receiving Station, University of Dundee.

Back Cover

Robert Moore sent us this spectacular false-colour NOAA-12 HRPT image obtained from the 15:33 UT pass on May 5, 2006. It displays sun glint extending from the Normandy coast, completely around Britain and north to Iceland. Many of the Scottish lochs are highlighted, Loch Ness very clear

Putting Names to Faces

Four Scottish members photographed attending their annual 'GEO lunch' in Edinburgh : from left - Ian Deans, David Taylor, Douglas Deans and Les Hamilton.

Photo: Cecilia Taylopr

WARNING

Anthriscus sylvestris can severely downgrade your EUMETCast reception

John Tellick

Being a keen gardener and satellite zapper can be a bit of a compromise—and I'm not talking about time.

I have several dishes tucked away at ground level on one side of my patio, which allows easy access for adjustments and they are out of the way.

Early last year I noticed a rather interesting plant pushing up from a crack in the patio. It had dark green feathery leaves like a carrot and looked quite exotic so I left it to see what developed. Well, it grew and it grew, getting taller and wider by the week.

Having left it growing that long without identification I wanted to see if it would

Cow Parsley (Anthriscus sylvestris)

flower but the trouble was it was growing close to the front of my Hotbird/Astra-1 multi-dish; the taller and wider it grew the less signal I was receiving.

However, it was now summer and more time was spent outdoors than messing around with satellites. Finally it looked like some flower buds were developing though they took a time to open as they were quite large. At last they opened and were flat and quite broad umbels of creamy white flowers. It became blindingly obvious what I had been nurturing (and suffering poor signals for) all this time.

Nothing but the common cow parsley, which grows abundantly along road sides and in fields in the UK.

It was however a very fine specimen and the flower heads were swarming with a great variety of insects. But 'normal services had to be resumed' and, with several swift snips from my secateurs, it was!

A Novice's Experiences Setting up an MSG Receiving Station

David Tyler

For many years I have been interested in radio communications and have owned a variety of short wave, VHF and UHF receivers. I had frequently observed advertisements for weather satellite receivers in monthly magazines and it became a logical step forward to research the availability and viability of entering into the field of weather satellite reception. After a search on *eBay*, I bid for and won a *Proscan* receiver with software, which was where my involvement with weather satellites began.

The seller, now a good friend named Oglivie Jackson from Selkirk, gave me immense help in setting up for APT reception. Having seen nothing like it before I had no intention of going further, but then a suggestion was made that, with WEFAX coming to an end, I should move forward to MSG data. Ogilvie said he had progressed in setting this up, but had aged 20 years and gone grey in doing so.

Now I am in mature in years, with very limited knowledge of computers and so forth, but with a wife who has some experience, I went for it and bought my *Skystar* PCI card DVB receiver, dish and LNB from the **GEO Shop**. I had already been in touch with *EUMETSAT*, registered for the data I required and obtained my licence from the Met Office. The staff at *EUMETSAT* took phone calls from me and sent prompt email returns on every occasion: just as I had been told, they couldn't have been more helpful. One lady in particular, named Debbie, gave me very personal service (if that is the right phrase) and as this was at the time of the World Cup, I mailed her about Germany losing: she replied that it did not bother her as she hailed from Brighton!

Once the dish arrived I positioned the wall brackets myself, having some idea where the satellite was located, but paid a tradesman £70 to align it for me. He was certain it was directed at the correct satellite (*Hot Bird*), but it fact it wasn't. It was actually pointing towards *Eutelsat*. Eventually, after airing my problem on the **GEO-Subscribers Yahoo Group**, Terence, another MSG user, came to my help and sorted this problem out—with his help we got the system all but up and running.

> *For details about the GEO-Subscribers Yahoo Group, see page iii of our centrefold—Ed.*

I say 'all but' because trying to run this on an existing computer in addition to its day-to-day workload was causing conflict between programs. I sought more help on *GEO-Subscribers*, and both David Taylor

and Douglas Deans became involved and advised me that the answer was to run my system over <u>two</u> computers.

I read all the documentation and Help Files plus suggestions on what to do by the experts. There is a wealth of information of David Taylor's website

> **http://www.satsignal/eu/**

particularly *Meteosat & ATOVS* in the *Weather Satellites* section and *MSG Data Manager* in the *Satellite Tools* section.

A times you can encounter conflicting opinions, particularly in relation to setting up the capture software. Some users recommend installing the software for TV viewing first (in order to get a fix on the satellite for dish alignment); others recommend that you wait for *EUMETSAT* to confirm your acceptance and licence. My own recommendation would be to throw away the *Technisat* CD that comes with the *Skystar* unit and wait to install the necessary software from the *EUMETCast* CD. This will ensure that you are using the most up-to-date software and drivers.

I read Arne van Belle's comments on choosing a suitable PC, which can be found by following the link to *MSG Data Manager* on the 'Satellite Tools' section of David Taylor's website. Under the heading 'What PC configurations are supported?' there is a link called 'discussion about PC requirements here'. You can also find it at this direct link:7

> **http://www.satsignal.eu/ software/msg_dm_pc.htm**

then scroll down to the section headed '*Comments from Arne van Belle*'.

In the end I obtained a second (new) computer, exclusively to handle reception and all the required processing software. This contained a 2.8 GHz *Celeron* processor, 40 GB hard drive and, initially, 256 MB of memory. I increased the memory to 750 MB at the time of purchase, then again, later, to 1.5 GB when my virtual memory went low on two occasions. I have no thought of running 24/7 or, at this moment in time, creating animations

Of course I had now to consider how to switch between the two computers with just a single screen so I visited *PC World* and purchased a *Belkin* 2-port KVM switching device. When I first attempted to install this unit problems arose, which seemed to be because I was using a wireless mouse and keyboard. This was replaced in case it was faulty and, finally, I got the system working, with fingers crossed, during a phone call to *PC World*.

Another unusual problem I encountered related to the soundcard in the new computer (an *E-System 102*). The soundcard simply would not work until I had uninstalled then reinstalled it (the soundcard being required in order to announce events).

My wife and I set up *MSG Data Manager* and *GeoSatSignal* with help from our friend Terence. I also needed two telephone sessions with Douglas Deans with whom I spent at least two hours in discussion to resolve setting-up problems. Configuring an MSG system can be very frustrating and stressful; you feel brain-dead at times and it takes over your life—but in the end I can assure you how well worthwhile all the effort is.

With MSG safely under our belts we became ambitious and are looking towards the next challenge: of AVHRR and additional package programs. A 30-day trial of David Taylor's *AVHRR Manager* convinced me that this was the next and essential step forward. Just look at the colour pictures that are appearing in *GEO Quarterly* magazine (it is worth every penny) and you will be tempted to go forward with AVHRR and achieve these quite outstanding results for yourself. After only a few days usage of the trial package we were already registering for the new services and the necessary software.

This might be straightforward for some but not for us. We had trouble getting the code/key accepted, despite using copy-and-paste, until David Taylor told me I was trying to load it into the wrong program. I don't know how he puts up with me—almost all day on a Sunday, sending e-mails to and fro to resolve the set-up and registration details.

I believe it has taken us at least 4/5 weeks since first approaching *EUMETSAT* to get this far <u>but we have finally made it</u>. Did I lose a few hairs? I haven't got much anyway. Did I age 20 years? I can't afford to as I am 72 now. But was it all worth it? Yes, It has been in every sense!

For those of you with past experience and computer knowledge it might still give a mild headache. For everybody else, go for it because there are people out there who will give you timeless advice and help—all the way along.

As David Taylor keeps on reminding us, <u>read the help pages</u>, <u>join a support group</u> and make friends along the way. The biggest problem I have had all the way along is that all the web pages and help files are written assuming you understand the terminology, both in regards to the computer and the satellite imaging. This is not for the faint-hearted. Many like myself find it hard to comprehend what Arne, David and Douglas are telling us to do. What is needed is an *Idiots' Guide* guide to satellite imaging!

Do you know, I feel I have become an expert, but I am only kidding myself—it is all in my mind. Having said that, we *have* achieved our goal, the sky *is* the limit as they say: make it yours!

News from Sweden

Anders Höök

Anders Höök, who joined GEO earlier this year, lives in Vallentuna, 25 km north of Stockholm in Sweden. He was kind enough to share the following details of his APT receiving station with us.

I have just recently turned 70 years of age. Six years ago, I retired from my job with a power generation company, where my final post was as a 'senior analyst' working with analysing movements of the electricity price in the Nordic electricity market, quite a fascinating occupation. Now that I am retired I have got time take up the hobbies from my youth, which were both constructing and listening to radio. I also once had an R 1155. I have even started to learn some Spanish in order to try to understand something from Latin America.

The upper left hand photograph on the opposite page shows the equipment I have in my shack. The small upper radio is the R2FX from Holger Eckardt—I bought it directly from him in the beginning of January this year. It works very well and I am very satisfied with it. The possibility to

control it from the computer is specially good, making it possible to leave the shack and let the images be automatically recorded, something that I do quite often.

The other radios are from top to bottom: Lowe HF 150, Kenwood R-1000, Fairhaven RD500VX and AOR 7030 Plus. Those I use for shortwave listening. In fact I started to record satellite images with the Fairhaven. This radio is the one I like the most, even if the AOR is somewhat better in 'difficult situations.'

The image at the far right shows my QFH antenna. The wire you can see below the antenna is part of an L-antenna for short wave listening.

The QFH-antenna itself was constructed after Paul Hayes' description. A friend of mine and myself worked a whole day with bending and soldering copper tubes.

Except for a certain amount of noise, I am very satisfied with it. This problem is probably unsolvable because there is a

power line about 100 metres away stretching east and south of my QTH. This gives strong noise for satellites in that direction.

The NOAA-17 image opposite shows a quite cloudy Sweden on April 14. Parts of the image with the lowest elevation have been cropped because there was quite a lot of noise. This pass had a maximum elevation of 12 degrees. The more recent NOAA-18 image is a low elevation pass from June 28 ranging from 7.5° to a maximum of 13°. Near the easternmost part of this image, a little below the middle, is the Yenisey river and some lakes just to its east. Even farther to the east and quite in the middle of the image is the Piasina river which flows out near the town Makarova.

Processing was done with WXtoImg, using MSA enhancement. (Most often I prefer the HVC enhancement because it gives better view of the clouds, but in this case MSA gives a little bit better view of the ground).

APT on the Move

Norbert Puetz - email: n100.21113@arcor.de

Norbert Puetz, one of GEO's German members, has designed a handy case to keep his APT satellite gear safe while travelling. He is now hoping to collaborate with an equipment manufacturer with the view of marketing a complete APT kit in a single package.

Norbert writes ...

I thought that GEO readers might be interested in the neat 'suitcase' I have made to house my APT equipment when I am on my travels (photographs on opposite page).

Case contents
- TV dipole rod antenna with 50 ohm adaptor and holder tube
- R2FX receiver with battery pack
- *Sharp MD MT 180 H* mini-disc recorder plus spare battery
- compass
- required cabling

Positive features
- suitcase size 38 x 36 x 10 cm
- weight: only 1.8 kg
- safe and scratch free storage for all the expensive components
- less weight because no sensitive laptop is required
- absolute worldwide mobility
- lossless data storage with MD recorder (no data compression

The 'suitcase'

because of the narrow audio bandwhidth)
- maximum antenna gain (1 dipole) with minimum cable loss
- no antenna mast required

Negative features
- system not pager resistant
- aircraft radio sometimes causes interference
- the antenna has to be moved by hand during reception
- the recordings have no timestamp for later processing

The MD-Player has to be a 'quiet' one with minimal electromagnetic interference. Older models sometimes cause problems by disturbing the R2FX.

The reception has to be performed in a reflection free environment with no houses and obstructions around.
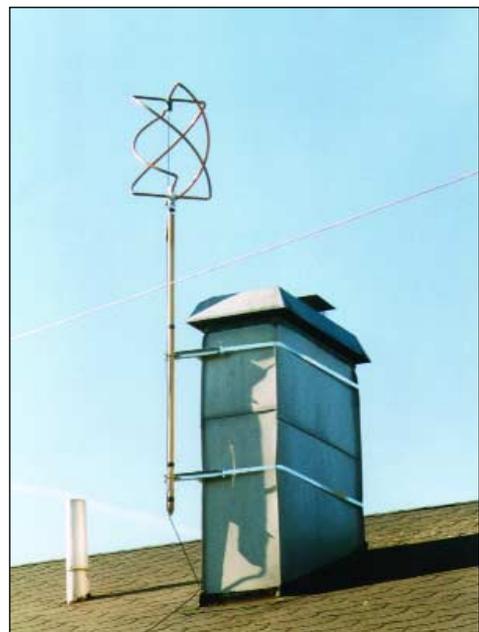
Anders Höök's shack (left) and roof mounted QFH antenna (right)
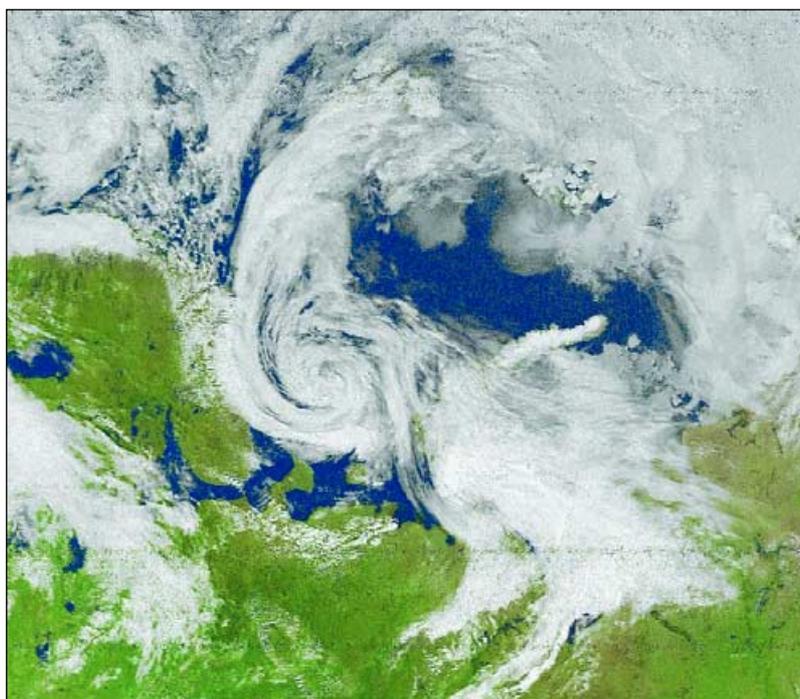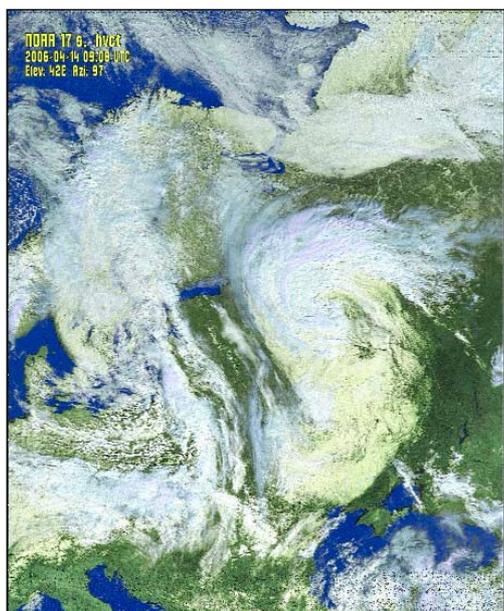
Above: NOAA 17 at 09:08 UT on April 14 (12°)
Right: NOAA 18 at 08:26 UT on June 28 (13°)

Norbert Puetz pictured with his neat portable APT weather satellite travelling case (left) and the packed case itself (right)

Symposium 2006

Peter Green

We arrived at the NSC Leicester on the Friday evening after an interesting drive from Devon to find our friends from Holland already setting up, along with the GEO Shop and Membership stand. One of the great aspects of the Symposium is the social side: time to catch up with old friends and to make new ones, to exchange ideas, learn from their experiences and tap into to their knowledge. So with this in mind a group about twenty strong set out to discover the delights of Leicester's restaurant district. You can't go to Leicester without having a curry and we found, with the help of Arne's hand held GPS, a restaurant recommended to Robert Moore. Although we had not booked a table there was no problem, and we had a great meal in good company.

We awoke to a very bright, warm and sunny Saturday and set off to the NSC to finish the preparations. I am always amazed at the dedication of delegates to the symposium, some arriving from hundreds of miles away as early as 8.30 am.

The day opened with a brief welcome and introduction from Francis Bell, followed by the presentation of a *EUMETCast* licence to the NSC to enable them to receive MSG data.
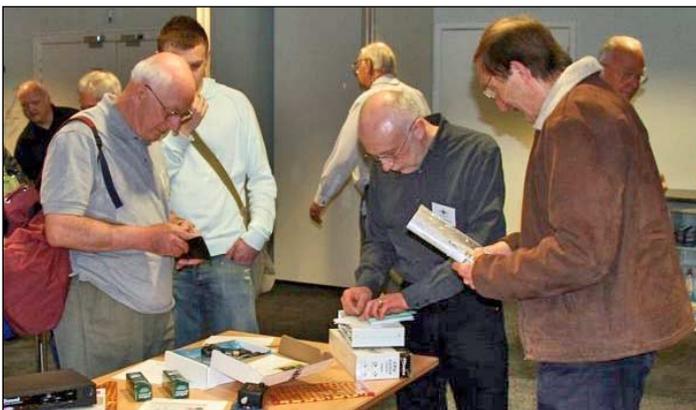
Pete Green (centre) selling raffle tickets
Photo: Peter J Bradley

Douglas Mansfield

Our first guest was Douglas Mansfield, a senior weather forecaster from the UK Met Office. After obtaining his PhD in Physics at Imperial London, he did research into boundary layers, polar lows and thunderstorms off the west coast of Africa then joined the Met Office in 1979 as a member of their long range forecasting team. In 1989 he joined their main office and has now become a chief forecaster.

Douglas Mansfield
Photo: Cecilia Taylor

Douglas gave us an illustrated and detailed overview of the Numerical Weather Prediction (NWP) that is used by the UK Met Office and explained how the forecasters use satellite images. It is obvious that forecasters are never perfect, but bench forecasters use their experience of the manner in which the forecast behaves imperfectly, to modify and improve it, often for distance and time scales or specific sites which are beyond the scope of the NWP model. This is largely done by mathematical models and the job of the Chief Forecaster is to interpret the outputs of these models. The Chief Forecaster offers guidance to other forecasters within the Met Office and to TV & radio forecasters, as they may interpret the data differently.

Douglas also showed us several examples of the forecaster's use of satellite imagery allied to Conceptual Models to interpret jet streams, and surface lows. He explained that the Model can be at variance with their experience and data has to be input by the forecasters to correct this. By way of illustration he showed us IR images with isobars depicting strong winds on the rear of surface lows. These he called *sting jets*. You would normally expect the strongest winds to be found at the leading edge of a depression but you can get very destructive winds on the rear—thus called sting jets.

Sally Wannop

Sally, User Services Support Manager at *EUMETSAT*, stated how very pleased she was to meet the users with whom she usually communicates only by e-mail or telephone. She opened with an overview of *EUMETSAT* and its mission: '*To deliver cost efficient operational satellite data and products that satisfy the meteorological and climate data requirements of its Member States, taking into account the recommendations of the World Meteorological Organisation*'.This covered their industry partners, their Space and Ground Segments and infrastructure, and an overview of their ground stations. Their objectives are constantly changing to make more environmental products available, mainly to Met Offices—but the 850 registered amateur users are also important.

EUMETSAT plays a vital role in providing Geostationary data to the World Meteorological Organisation and polar orbiting data will be added following the launch of MetOp. The Special Application Facility (SAF) products are designed to encourage member states to gain the maximum benefit from the satellites.Some countries specialise in derived products that are disseminated either via *EUMETCast* or from the *EUMETSAT* website.

EUMETSAT is actively exploring the *GEONETCast* project, which seeks to provide a whole-world audience with a global network of disseminated products, involving partners like NOAA, which would provide daily data throughout the year in a format based on *EUMETCast*. Key updates forthcoming to the *EUMETCast* service will include 1-hourly GOES dissemination (which should be in available Oct/Nov 2006), an increased range of SAF meteorological products and the inclusion of high-resolution data from NOAA and MetOp satellites. There are currently 280 users registered for the EARS AVHRR service and this should expand rapidly as the service comes completely on stream.

On the conclusion of her talk, Sally was thanked by the audience who asked her to pass on their gratitude to the members of the Help Desk for their efficient, helpful and friendly service. I wish all companies paid such attention to its customers as *EUMETSAT*.

Informal discussions with our Dutch friends during the lunch break
Photo: Ferdinand Valk

David Taylor

David's presentation was a software workshop, which was based on questions raised by users. He explained some of the new data types coming from *EUMETSAT* and which can be viewed in *Geosatsignal-6*. Labelled F-type products, these are delivered as sectored data which must be combined into complete images. David also discussed the latest versions of some of his other software: *MapToGeo*, *MSG Data Manager* 2.5 (which now has support for MSG2 data), *AVHRR Manager*, the *HRPT Viewer*, *WXtrack* and the *Kepler Manager*.

One useful piece of advice was to turn on *Clear Type* within Windows XP, which greatly improves the rendition of screen fonts (Open 'Display' in Control Panel and on the 'Appearance' tab, click 'Effects'; select the 'Use the following method to smooth edges of screen fonts' check box then check 'ClearType' in the list).

Lunch Break

This year more time was given over to the lunch break, to look over the demonstrations and to visit the Space Centre. Rob Albas was giving his normal excellent demonstration of MSG reception using a Linux Box with his XRIT software, and displayed some stunning images.

IN TRAY

Dear Francis,

Many thanks for GEO Q10. Regret that I haven't got time to help you out with any of the vacant roles but you have motivated me to put finger to keyboard over your *Ku Band Reception behind Glass/in Loft* article.

Firstly, I am delighted that you have recognised the problem that many of us have. For practical or cosmetic reasons it is often impossible to locate receiving hardware on the roof; instead one either opts for a permanent loft location or 'temporary for the afternoon' garden location, in favourable weather, when suitable satellite passes are due.

All of my permanent weather satellite receiving set-ups have been loft-based under pot/masonry type roof tiles. In my experience of several different homes, a turnstile or QFH mounted high up in the apex of the loft, well away from metallic items (e.g. TV aerials, electrical wiring), works 'OK' for APT reception, although others with roof mounted antennas always seem able to receive longer passes with less noise. 137 MHz has similar radio characteristics to stereo FM radio, which is why loft mounting still works but is less superior to rooftop mounting, especially at low satellite elevations.

For several years, I mounted my RIG loop Yagi antenna in the loft to receive 1.6 GHz WEFAX signals. This produced noisy audio (and thus pictures) which gave up entirely when it was raining—either due to atmospheric moisture attenuation or, more likely, a film of water on roof tiles increasing signal absorption. 2G mobile phones operate at 0.9 and 1.8 GHz and these can operate effectively indoors in strong signal strength areas. Geostationary satellites do not pump out the same power as a local mobile phone base station, so results are more marginal.

At 11 GHz (Ku-band) signal attenuation is a much bigger issue. I'm not an expert on the physics but my experience is that a major downpour of rain can interrupt reception, either due to atmospheric moisture attenuation and/or a torrent of water running down the dish distorting radio wave reflection focus to LNB.

I dare say that the materials-science industry will have designed some ultra-low absorption materials through which Ku-band reception with a small dish is possible, but household glass and roof tiles are almost certainly too lossy without installing a Jodrell Bank size dish in the house!

An externally mounted 'squarial' (1980s BSB UK Ku band antenna = linear phase array?) would also do the job, but these are only marginally better than dishes due to their superior visual appearance and lower wind loading. With the advent of the Internet and always-on broadband connections with ever increasing speeds, one starts to wonder for how much longer broadcast (as opposed to point to point) via satellite will continue. If I can plug into a live stream from Darmstadt through my existing broadband infrastructure, why bother installing a Ku-band dish with all the associated hardware and software to receive exactly the same data feed?

An idea: *Voice-over-IP* is now in widespread use around the world to provide low cost audio communication between suitably equipped parties. The amateur radio community has seized this opportunity to link repeaters around the world (*www.irlp.net*). I wonder whether we in the weather satellite community could use this as an opportunity to collect real time APT audio from around the world and make it available to others. In the European context this could mean a reception station in southern Spain receiving a NOAA as it heads north over Africa and streaming the audio to users on-line, who can receive and decode it using traditional APT audio decoding software. As the satellite drops below the radio horizon of the Spanish station, a Scottish station could take over providing the audio feed, and then onward to Norway, Russia, Japan, Philippines, Australia, etc (or wherever the satellite travels). I don't know about the legal status, but that would be an awesome experience. I guess that with a network of amateur receiving stations every 4000 km, all linked to an APT VOIP network, we could get the planet covered. What do you reckon?

Actually, perhaps the first thing to do would be to get appropriately located amateurs to collect pictures from the same satellite as it moves round the planet and then for someone to join these together.

Cheers,
Ben Ramsden (33.4°S 151.1°E)

[*Anyone with further ideas for pursuing this line of thought is welcome to send their submission to the Editor.*]

Using the ARSoft RAMdisk with Windows XP

Arne van Belle

Windows XP has a System Restore feature which can be used to return your computer to an earlier state if you have a system failure or other major problem with it.

System Restore automatically tracks changes to your computer and creates *Restore Points* before major changes are to occur. For this it takes a full snapshot of the registry and some dynamic system files and stores this info in a 'System Volume Information' folder on every local disk.

> **XP does not recognise the ARsoft RAMdisk correctly and treats this drive as a hard disk drive by default.**

If the RAMdisk is too small, System Restore crashes when it tries to save information on the RAMdisk. This will cause all restore points to disappear. You can prevent this by excluding the RAMdisk drive letter from System Restore. Unfortunately, the only way to do this is by editing the registry, so I recommend you to create a full backup first (see footnote), then add the following line and reboot.

Only then you can safely install and activate the RAMdisk without losing System Restore points!

1. Open Regedit and navigate to HKEY_Local_Machine\System\CurrentControlSet\Control\BackupRestore\FilesNotTobackup
2. Choose Edit, new, multi-string value
3. Give the descriptive name 'RAMdisk'
4. Double-click this, enter "Z:* /s" in the 'Value data' field, then click OK (don't input the quotes)

Here, Z: is the RAMdisk's drive letter and there is a space between '*' and '/s'.

Note: Windows 2000 does not use system restore and does not need this additional setting.

Backing up your Registry

Backing up the registry is easy and a good guide can be found at:

http://ts.mcafeehelp.com/faq3.asp?docid=68037

Please note that the resulting file (.reg) can be large (50 to 100 MB).

Also read the note on this link carefully:

"If you need to restore the Registry you can double click on the Registry Backup file you created. Once you have finished using the registry editor and are certain everything is working properly, it is important to delete the backup file to avoid reverting back to the old registry settings. To delete the file, right-click on it and select Delete."
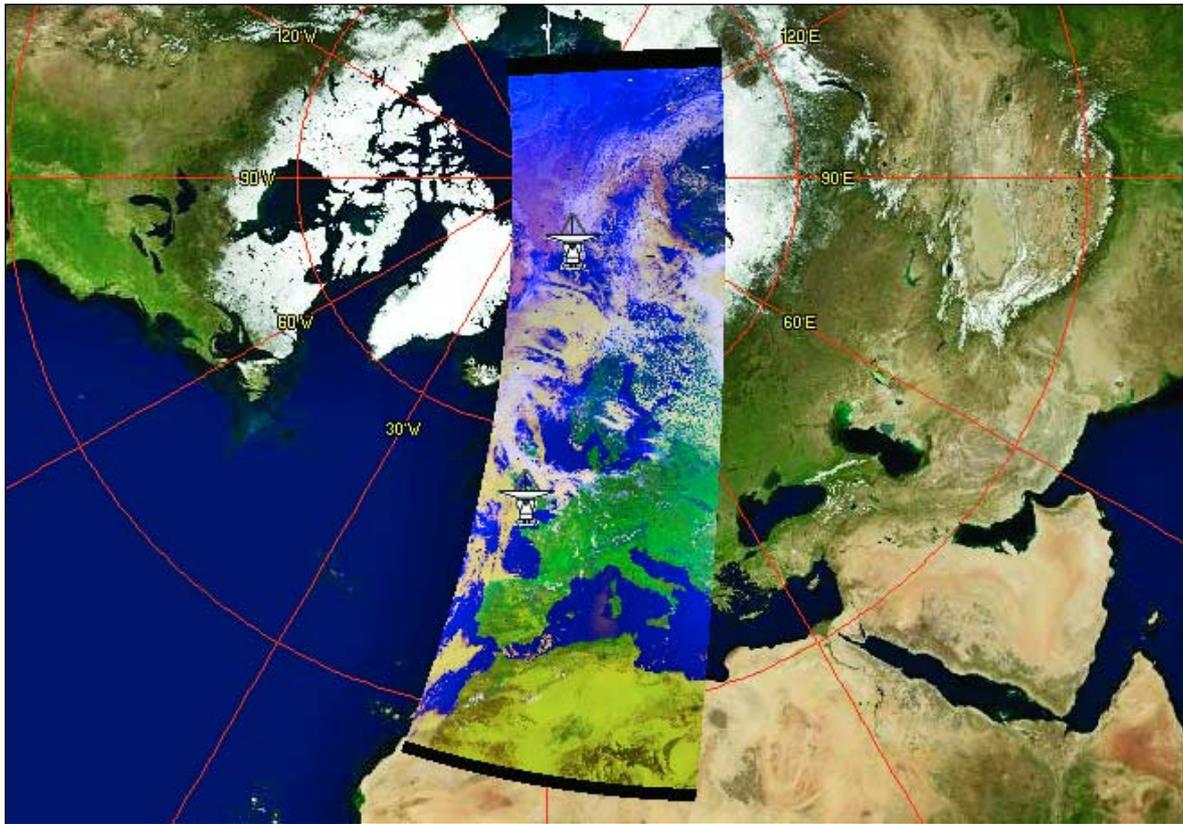
This composite NOAA-17 pass was acquired on July 20, via *EUMETCast*, by David Taylor. The image is a composite produced from data from both the Svalbard and Lannion stations (locations indicated on image) and has a total duration of 22 minutes, stretching from 10:13 to 10:35 UT.

The image at left has been taken from a screenshot of the AVHRR Manager, and vividly illustrates the uninterrupted data that is now available from the EUMETCast EARS-AVHRR service.

Early Icemelt in the Canadian Arctic
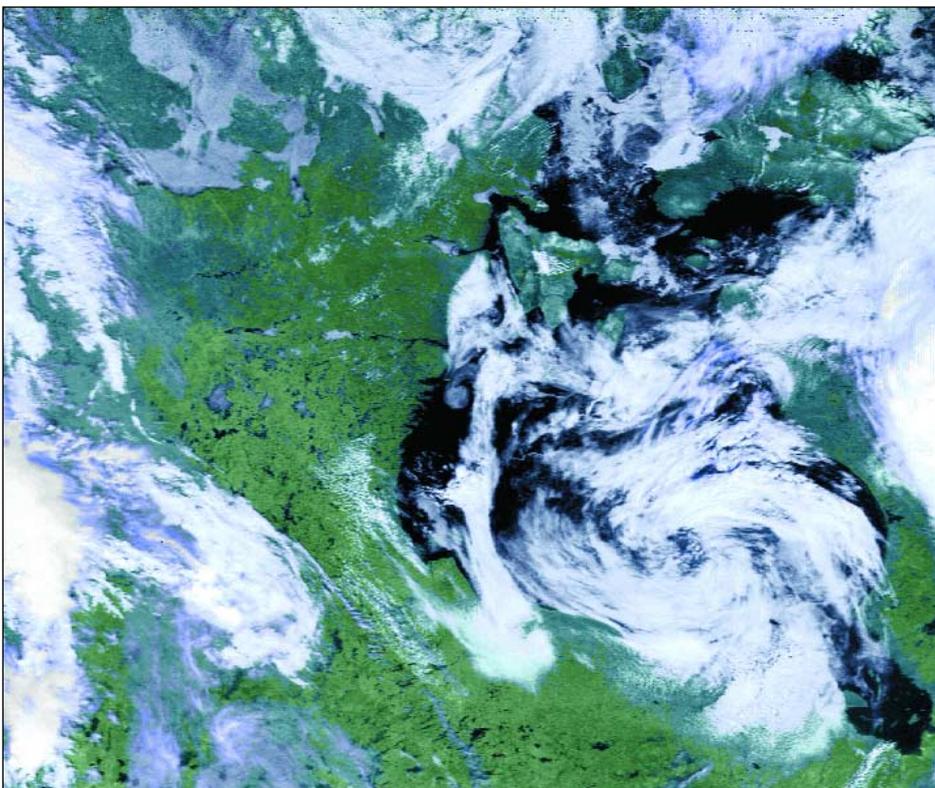
Keith Fraser KC2JC (ex GW3ZVA), a GEO reader from Canada, spotted an interesting feature in a recent NOAA 17 APT image, acquired over Canada's far north at 17:15 UT on June 26 this year.

Keith writes: 'The object of interest is very small but still significant. Near the top left-hand corner of the main image, the passage to the south of King William Island shows as open water (black). I have been observing the Arctic ice for many years and this is the earliest (June) that I have ever seen the passage into Queen Maud Gulf open. Could this be a possible indicator of global warming? The passage is hard to pinpoint so I have circled it on the enlarged segment above right.'

(A 250 m MODIS image acquired just an hour later, and including this region, appears on page 13—Ed)

SOFTWARE SHOWCASE

Douglas Deans - *douglas@tiscali.co.uk*

As is often the case at this time of year there are few updates to be reported. It is in fact quite noticeable that many of our better known programs have not been updated for some time. The exception to this is programs written by David Taylor. Not only are they continually updated and upgraded but there are exciting new developments on the horizon associated with the up and coming launch of the first European Polar Orbiting satellite MetOp; it may be flying by the time you read this. Hopefully there will be more details about the new software in the next issue.

Following last quarter's announcement of the addition of three of David Taylor's well-known programs to the showcase library, I am pleased to say that a further one of his programs, *GRIB Viewer* has now also been included in CD-GS1. A brief review of the software is given below along with some update news on the very popular JVComm32.

GRIB Viewer v 2.0.8

Many of the files now being sent via *EUMETCast*, and which are also available from other sources such as the Internet, are in a format known as GRIB (GRIdded Binary). This is not an appropriate forum to explain the purpose behind this file format but suffice to say it was developed and approved by the World Meteorological Organisation as an efficient vehicle for transmitting large volumes of gridded data. Most of us,

including myself, are probably not particularly interested in this detail but it is a fact that more and more data is being sent in this format. What is important however is that David Taylor has produced a program which can read these files and convert them into images. Most of these files are associated with meteorological products and products derived from satellite data.

Some examples of this data include sea-ice products from the Norway and

Denmark OSI-SAF team. This includes sea-ice edge, type and concentration maps. This is available via the *EUMETCast* system but in addition there are North Pole and South Pole products that can be downloaded from the Internet. An example of the North Pole ice concentration map (obviously for the current summer month) produced using GRIB Viewer is shown in the figure 1. Also available via the *EUMETCast* system are OSI-SAF products from Meteo France which include longwave

Figure 1
North polar ice concentration
(The original image is of course in colour)

GS1	All David Taylor's weather satellite programs and libraries, including the current releases of WXtrack, Satsignal, HRPT Reader, GeoSatsignal, GroundMap, RX2 PassControl and many other program extras. This disc also contains a large quantity of sample files, many of high-resolution data, for use with these programs.	
AVHRR Manager	Processes and manages the files for HRPT via EUMETCast	v 1.2.4
GeoSatSignal	Manipulates Geostationary weather satellite images	v 6.0.0
GRIB Viewer	Viewer for GRIB format files	v 2.0.8
GroundMap	Rescales satellite images	v 2.0.2
HRPT Reader	Converts raw HRPT data files into images	v 2.6.4
MSG Animator	Automatic animation of MSG images following reception	v 2.5.0
MSG Data Manager	Processes and manages the files received from MSG satellites	v 2.5.2
RX2 PassControl	Computer control program for the RX2 receiver	v 3.0.8
SatSignal	Creates images from wave files	v 5.0.2
WXtrack	Satellite Tracking Program	v 3.5.6

GS2	A wide range of software for all aspects of weather satellite reception, including tracking, receiving, monitoring and image manipulation. Content is detailed below but many other extras are provided. Titles correspond with folder names. * implies a DOS program.	
Collection D02	Recall (wave file recorder), Palette (modifies Wxsat colour palettes).	
Collection D03	Scanner recorder v 1.8 (wave file recorder), *NOAA95/*FENG99 (software for the NOAA 95 HRPT project)	
Collection D04	Wxsat (wave file recorder/decoder), Satmon (wave file recorder).	v 2.59
AGSatTrack	Satellite tracking program	v 1.33
APTDecoder	Program for capturing APT audio and processing images	v 1.0.2.70
Cirkit	Documents for the Cirkit Wxsat receiver and the UOSat receiver (PDF format)	
Element Manager	2-line element manager	v 1.59
Footprint	Satellite tracking program	v 2.10
Irfan View	Image/slideshow viewer	v 3.80
JVcomm32	Evaluation version (APT/FAX/SSTV decoder)	v 1.40 pre
Macintosh kepler editor	Edits verbose AMSAT format elements. Mac OS X and OS9 only.	
NeoPaint	Image processing program (30 day evaluation)	
Orbitron	Satellite Tracking Program	v 3.70
Paintshop Pro	Image processing program (30-day evaluation)	
PhotoFiltre	Image retouching program with many extras	v 6.1.5
Satscape	Satellite tracker and wave file recorder	v 2.02
Space-Track TLE Retriever	Generates TLE files in 'Celestrak' style from data sets recovered from Space Track	
Splitter	Utility program for splitting and reuniting large files	
WXtoImg	WAV file recording and decoding program with many options.	v 2.7.3

GS3	**3DEM Package for 3D Terrain Visualisation** This CD includes the full set of GLOBE Tiles to allow you to produce excellent images and flybys from HRPT inages. Also included is a selection of Mars MOLA files, sample images and helpful guides by Ed Murashie.

GS4	**Image CD** A wide selection of high-resolution remote images from a range of satellites, including stunning imagery from the Space Shuttle missions. A full description and source if provided for each image.

GS5	**Mars Rover Panoramics** A chronological account, in panoramic images, of the NASA Mars Rovers' progress across the Martian Terrain

irradiance, solar surface irradiance and a range of sea-surface temperature products.

There are other products also available but may I suggest the following web page for a full and detailed list and explanation:

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

GRIB Viewer is available on GEO software CD, GS1.

JVComm32 v 1.40 pre

This very versatile and popular program, written by Eberhard Backeshoff, is one of the best known programs for the reception of RTTY, FAX, SYNOP, NAVTEX and of course SSTV. At the moment this is a pre-release simply because all the help files and program additions have not been fully documented. Onc documentation is complete it will become v 1.40.

It has to be remembered that what you download, though free, is only a demo version: all the images it produces are liberally overprinted with the word 'demo'. To enable full functionality it is necessary to register JVcomm32 (£44). This program has been written by Eberhard in his own free time over a very long period. I do not as yet have a full list of all the additions and new features but can confirm that they do include a 'repair function' for pictures with stair-step type problems.

It has a new NAVTEX, SYNOP and RTTY messages viewer and runs on Windows XP without any problems The program is available on GEO software CD, GS2. For for further information and to download the program go to:

http://www.jvcomm.de/

How to Purchase CDs

Write to the address below requesting GS1, GS2, GS3, GS4 or GS5. Prices are £5 for any single CD, 2 for £8, 3 for £11, 4 for £14 or all 5 for £17. Please enclose cash or cheque (made payable to Douglas Deans - not GEO please) for the appropriate amount. Nothing else is required.

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

Orders are normally dispatched on the day of receipt.

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

Symposium 2006   *... continued from page38*

Fred van den Bosch was expanding on his 2005 presentation. His use of *Digital Atmosphere* scripts and automation of image reception with David Taylor's software have lead to the development of *POVIM* Presentation Manager (see Fred's article on page 33).

The GEO Shop was doing great business. Carol and Clive were kept very busy with items that had been pre-ordered and, of course, by those members who just couldn't refuse the excellent special prizes that were available for the day.

Werkgroep Kunstmanen

Ferdinand Valk and Arne van Belle both entertained us with significant presentations that appear elsewhere in this Quarterly (Tropical Cyclones, page 5; A semi 2-PC setup, page 20).

Ruud Jansen (left) in conversation with Patrik Tast, who visited us from Finland

Photo: Cecilia Taylor

Lawrence Harris

Well know columnist Lawrence Harris from Monitoring Monthly told us why and how he got into receiving weather satellites from a young age. His main hobby has always been astronomy. But he was becoming very frustrated to find that the stars were obscured by cloud. So he took up weather satellites reception and hasn't looked back. Lawrence showed us pictures taken from his school days

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with visiting astronomer Patrick Moore and explained how, at the schools he attended, he introduced astronomy. He rounded off with some excellent photographs taken of his current observatory.

Concluding Business

To end a very busy and packed day GEO held a short AGM where Francis Bell gave a statement of the Company's finances and his view of the year ahead. He also informed the delegates of forthcoming vacancies for Membership Secretary and the very important post of Magazine Editor. Various other members of the Management Team reported on their areas.

Ferdinand Valk talking about Cyclones
*Photo: Cecilia Taylor*

The finale event of the day was the raffle and I really must thank all of those who gave so generously. There were 36 prizes in total, including an assembled RX2 specially built for the symposium by Ray Godden and a number of KVM switches, ideal for those running a 2-PC system for MSG reception .

The 2006 GEO Symposium was a great success. Again this year we did not have enough time to fit in everything that we would have liked nor all the sessions that were requested.

Thank you all for coming. We hope you enjoyed it? It is always a great honour to greet our friends, especially those from the Netherlands, who support us so well. And of course GEO would like to thank all the speakers for giving up their holiday weekend to be with us.

What about Next year?

Watch this space and the website.
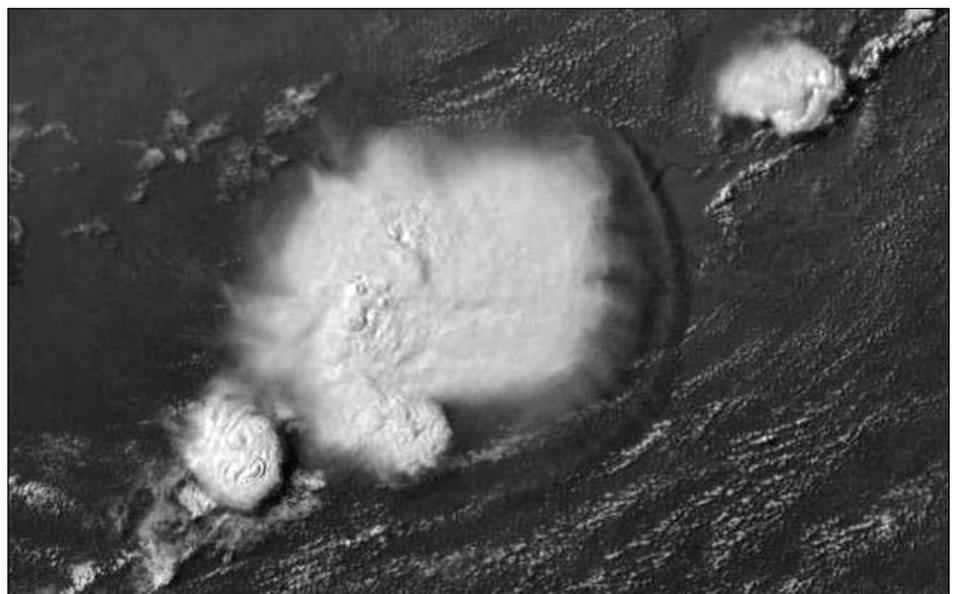
Rob Denton captured this storm front over the River Niger in Mali in the 15:15 UT Meteosat-8 channel-12 image on July 18, 2006. Rob considers this one of the best storm images he has seen from MSG imagery and was particularly impressed by the front to the right of the storm cloud.

Earth Imaging News

Peter Wakelin

Daichi Watches Merapi

The Directorate of Volcanology and Geological Hazard Mitigation in Indonesia reported renewed activity at the 2,968 metre high volcano Merapi on Java in early April 2006. Within two weeks a major eruption was taking place and Merapi was living up to its name which is derived from the words 'merah' (red) and 'api' (fire).

Japan's Advanced Land Observing Satellite (ALOS), also known as 'Daichi' in Japanese, which was launched on January 24 and was still in its commissioning phase at the time of the eruption, was able to monitor Merapi every twelve hours. ALOS's Advanced Visible and Near Infrared Radiometer type 2 (AVNIR-2) and Phased Array type L-band Synthetic Aperture Radar (PALSAR) were able to make simultaneous observations of the eruption as it progressed.

These images (right), from JAXA (Japan Aerospace Exploration Agency), were taken at 02:43 UTC on April 29 and cover an area about 9 km square.
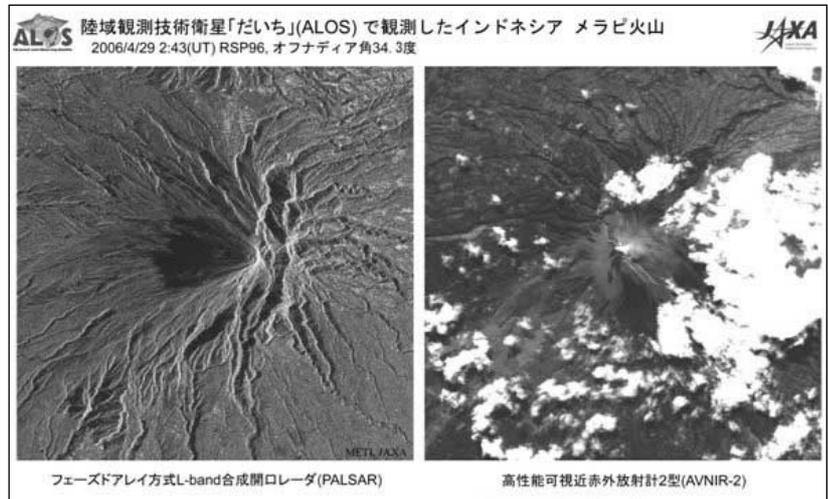
Merapi

Meteosat 7 Moves East

Following the successful launch of the second second-generation Meteosat, Meteosat 7 is no longer required at the 0 degree longitude position and is currently drifting eastwards on a four-month journey to replace Meteosat 5 over the Indian Ocean at 57.5 degrees E longitude. A quicker transfer would be possible but that would require a greater expenditure of precious fuel needed for station-keeping manoeuvres at its new location. It is expected to operate over the Indian Ocean at least until the end of 2008.

Luni-solar perturbations have significantly increased Meteosat 5's inclination since its north-south station-keeping ability ended due to lack of fuel. The spacecraft will be switched off and the residual fuel used to boost it up to a 'graveyard' orbit to avoid a possible collision with an operational spacecraft. Meteosat 5 has been operating for more than 15 years.

First Satellite for Belarus Fails to Reach Orbit.

BelKA, the first satellite to be owned by Belarus, was one of numerous spacecraft destroyed when a Kosmotras-launched Dnepr rocket from the Baikonur Cosmodrome failed after just 73 seconds of flight on July 26. Built in Russia, *BelKA* carried a 10-metre resolution multispectral camera and a 2.5-metre panchromatic camera for Earth observation.

At 750 kg, *BelKA* was the main payload but 17 other smaller satellites, some just 10 cm cubes with masses of only one kilogram, were on board. Several of the small spacecraft incorporated Earth-imaging cameras, including one from the Moscow State Technical University, one from the University of Rome and another from the Politecnico di Torino, Italy. Many of the payloads came from American universities but Norway, Japan and South Korea each provided one.

Another Resurs Spacecraft Launched

A new Russian imaging satellite, *Resurs-DK* was launched on June 18 into a 70° inclination, eccentric orbit ranging in height between about 350 and 600 km. The low perigee permits higher resolution whilst the raised apogee ensures a longer orbital lifetime. This spacecraft is for civilian purposes but is based on the Yantar-class military satellites which operate with much lower perigees.

Launch of MetOp-2 Postponed

MetOp-2 and the Soyuz/ST launch vehicle were returned to the launcher integration facility at the Baikonur Cosmodrome in Kazakhstan after a third unsuccessful launch attempt on July 19. At the time of writing, in late July, a new launch date has not been determined but an August attempt seems improbable.

Set-back for Indian Space Programme

An Indian GSLV rocket, carrying the *Insat-4C* communications satellite, fell into the Bay of Bengal on July 10 shortly after its launch from the Satish Dhawan Space Centre, north of Chennai. One of the strap-on motors failed to develop thrust and a destruct command was sent when the vehicle strayed out of the planned corridor.

South Korea's Kompsat-2 Successfully Launched

Kompsat-2 (Korean Multi-purpose Satellite 2), also known as Arirang-2, was launched by a Krunichev Rokot vehicle from Russia's northern cosmodrome at Plesetsk on July 28 into a sun-synchronous 700 km orbit. Developed and built by the Korea Aerospace Research Institute (KARI), *Kompsat-2*

*Artist's impression of Kompsat-2 in orbit
Credit: KARI*

will provide high-resolution multispectral images of the Korean peninsula for the production of maps and digital elevation models.

CALIPSO's Laser Beam Observed from Earth

Several hobbyist visual satellite observers have attempted to see the green laser light from *CALIPSO's* CALIOP instrument (see page 19) and at least two have been successful. It would seem that hazy skies enhance the possibility of spotting the thin green beam and the observer needs to be within about a kilometre of the ground track. One observer, just 250 m from the predicted path, reported seeing a green spot brighter than the planet Venus. It lasted for just a tiny fraction of a second as *CALIPSO* sped across the sky at 7 km/s.

St George's Channel Sunglint Mystery

Robert Moore

On the second of June I posted a query to the *GEO-Subscribers* list about a very unusual pattern that could be seen in a NOAA-12 HRPT image of the Irish Sea.

Not only is there extensive sunglint over the seas to the west of Great Britain, a common feature during the summer months, but there is a distinct arc of dark water embracing Ireland with a 'tributary' extending through St George's Channel then northeast into the Irish Sea. Les Hamilton replied with the following observations:

'I have looked at all the HRPT channels and note the following:

• The strong pattern of dark splodges is apparent only in channels 1 to 3 (those reflecting visible light).
• The pattern does not show up on either of the radiated IR channels (ch 4 and ch 5).
• The pattern clearly owes its existence to the pronounced sunglint, which arises from the fact that the solar radiation hits the region at a significant angle (the sun is low in the western sky).
• The NOAA 18 image earlier in the day, showed the Irish Sea without any tonal modulation whatever in all channels (i.e. totally black in the visible channels)

'Now strong sunglint requires a smooth sea surface; so the implication is that the dark splodges, most significantly the broad 'river' between Wales and southern Ireland, result from disturbed water that has lost its ability to produce a strong
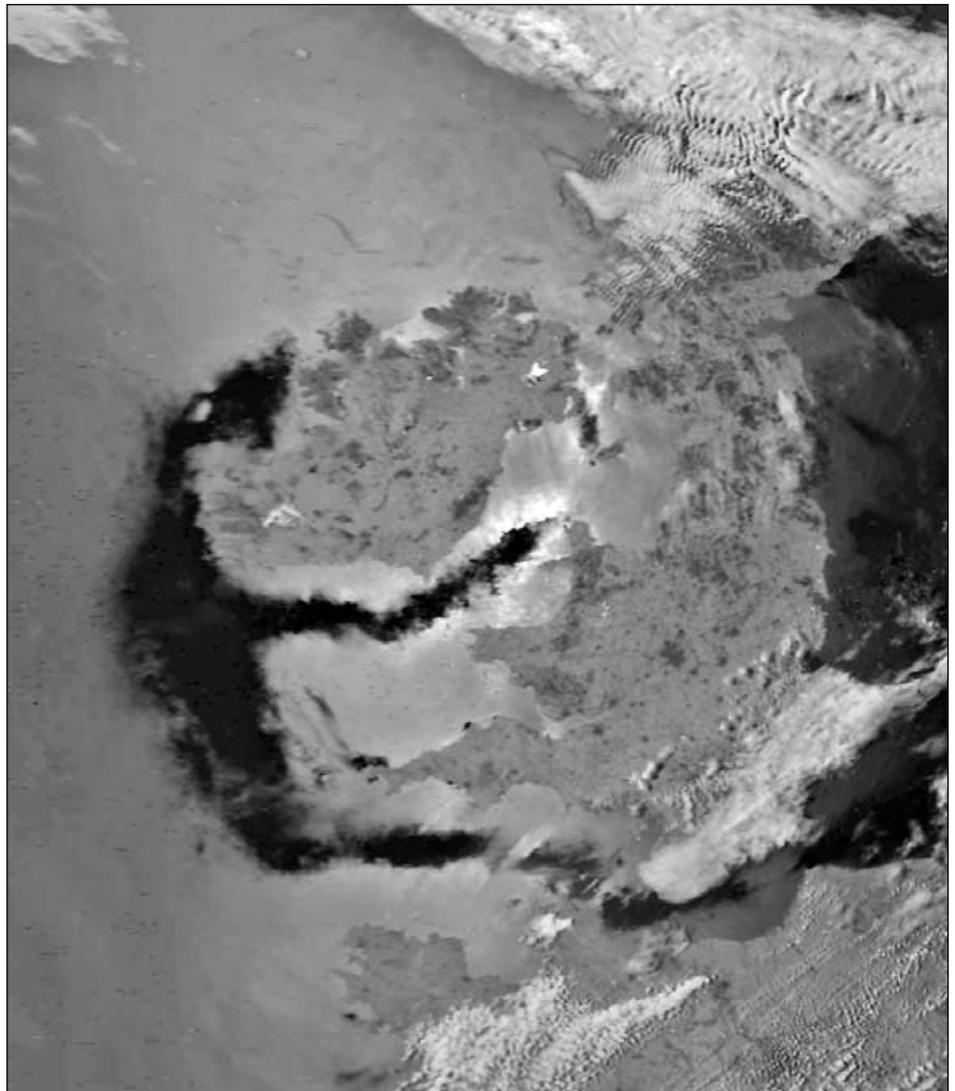
NOAA 12 channel-2 HRPT image - 15:40 UT - June 2, 2006
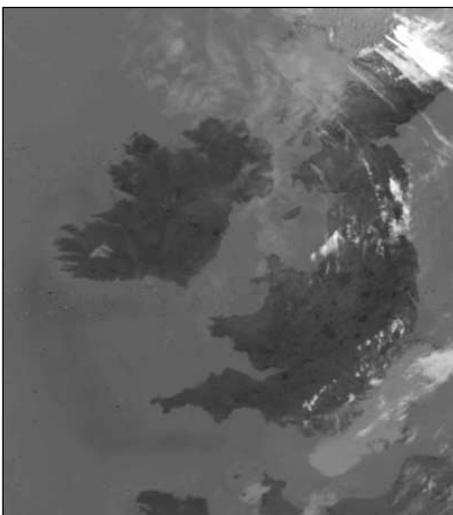
The NOAA-12 channel-4 IR image

specular reflection. Could this be due to local, low level winds, blowing through the channel?'

One other explanation occurred to me: I remember from my days at sea (I used to have a small ship in the Irish Sea) that the tide turns very rapidly and that there can be turbulence in the surface water, especially in the gap between Ynys Mon (Anglesey) and the Irish coast. Tide tables confirmed that the tide was indeed on the turn when this image was received and perusal of the Admiralty chart confirmed that there was likely to be a sudden change in the direction of the tidal stream—and possible eddies—at about the point where the dark water began in the HRPT image.

What seemed less plausible was that the disturbances in the water at this point would continue so far to the southwest and turn around the extremities of England and Ireland then up the Channel and west coast of Ireland. But it was worth a quick look if only to eliminate this possibility. An examination of the *Admiralty Tidal Stream Atlas* for the Irish Sea and Bristol Channel led me firmly to reject the hypothesis that the effect was caused by the tide. Les's suggestion that this could be wind disturbance seems more plausible—though again the shape of the disturbance does not really support this idea very strongly. I wonder if any readers of *GEO Quarterly* have any ideas about this odd event?

Reference

1 Admiralty Chart Irish Sea with St George's Channel and North Channel, Taunton, 1988

2 Admiralty Tidal Stream Atlas; Irish Sea and Bristol Channel (NP-256), Taunton, 1992.