A New Geostationary Weather Satellite Station

by Douglas Deans

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Background

Those of you who read my recent two-part article on Geostationary Weather Satellite reception (RIG Journals 69 and 70) will well remember my final paragraph anticipating the digital future with a mixture of enthusiasm but some trepidation. Well, how quickly the future has arrived but in such an unexpected and unpredictable way.

MSG-1 was launched as planned on August 28, 2002 and commissioning began on September 25 the same year. However, just before the switch-on of the imagery mission (SEVIRI), an event took place that would prove to have far reaching consequences for all, but particularly the amateur fraternity. One of the solid state power amplifiers (SSPA-C) failed. Those amplifiers should have played a key role in the dissemination process for HRIT and LRIT data and although there was in-built redundancy that was now gone.

An enquiry board was set up to investigate and advise and the eventual outcome many months later was to consider an alternative dissemination scheme not involving the satellite. Whilst this may seem to have been a daunting prospect, it so happened that *Eumetsat* had quite recently set up their *EumetCast* service to provide ATOVS and Rapid Scan data. This is a multicast system with a file distribution mechanism based on Digital Video Broadcasting (DVB) and can utilise existing commercial satellites. For the *EumetCast* service *Hot Bird-6* at 13°E is used. It seemed logical to extend the use of this service to the dissemination of MSG-1 data, albeit the size and number of those files would be challenging.

I do not propose to discuss the setting up of such a receiving station as this has already been well dealt with by David Taylor and Hugh Marnoch in articles published in Journal 73. However, a few general points about this service need to be said. It is not an exaggeration to say that, until recently, the direct reception of digital HRIT data from MSG by amateurs was just not on the agenda, both for technical and financial reasons. For a start, the dish size to deal with this quantity of data at the frequency and bandwidth used by MSG would have been prohibitive to the majority of amateurs; and in addition, the hardware would likely have cost thousands of pounds. Indeed, LRIT reception was also considered to be a technical and financial challenge.

With that background in mind it is almost inconceivable that I am now receiving continuous HRIT and LRIT data for a cost (excluding computers) of well under £200 including all the processing software. The imagery is simply outstanding but I leave you to form your own opinion from the examples provided with this article. Of course a 19-inch CRT monitor would do the images a bit more justice!

Image Products

Having dealt briefly with the background leading to this unexpected situation, let us turn our attention to the real purpose of this article: a look at some of this new satellite's imaging products. You could be forgiven for thinking that figure 1 was an HRPT polar image. But no, it is an orthographically corrected colour composite from MSG-1's High-Resolution Visible (HRV) channel-12 showing a close-up of a very beautiful day in the UK. Consider this image and keep in mind that the location lies approximately between 50°N and 60°N and that the imaging satellite is in geostationary orbit. You will then appreciate how good the 1-km sampling interval is at the sub-satellite point. This is further demonstrated in figure 2 with the stunning detail of a band of mature thunderstorms over central Africa. Farther north over northern France the satellite is able to depict all the majesty and strength of this huge storm illustrated in figure 3.

MSG-1 provides imagery in 12 spectral bands. All twelve are disseminated by HRIT but only five of the channels are transmitted in the LRIT format. I have listed the 12 channels in Table 1 below, followed by a few brief suggestions as to the meteorological strengths and uses of the various wavelengths. The channel data is provided by courtesy of *Eumetsat*.

Clearly there are many advantages presented by such a wide range of channels. Channels-1 and -2 can be used for cloud detection and cloud tracking along with the monitoring of land surfaces. A combination of those channels can be used to generate vegetation indices. Channel-3 helps to discriminate between snow and cloud, and between clouds composed of ice

Channel	Details
Channel 1 (also LRIT)	Visible band centred on 0.6 µm
Channel 2	Visible band centred on 0.8 µm
Channel 3 (also LRIT)	Near infrared band centred on 1.6 µm
Channel 4 (also LRIT)	Infrared band centred on 3.9 µm
Channel 5 (also LRIT)	Water vapour band centred on 6.2 µm
Channel 6	Water vapour band centred on 7.3 µm
Channel 7	Infrared band centred on 8.7 µm
Channel 8	Ozone band centred on 9.7 µm
Channel 9 (also LRIT)	Infrared band centred on 10.8 µm
Channel 10	Infrared band centred on 12.0 µm
Channel 11	Carbon dioxide band centred on 13.4 µm
Channel 12	Broadband high resolution visible channel

Table 1 - The twelve MSG-1 HRIT channels

crystals and water droplets. Channel-4 is ideal for detecting low cloud and fog at night and can also be used for the measurement of land and sea temperatures at night. Channels-5 and -6 measure the mid-atmosphere water vapour while channel-7 also helps to discriminate between ice and water clouds.

Channel-8 is responsive to ozone concentration in the lower stratosphere, channels-9 and -10, used together, help to reduce atmospheric effects when measuring surface and cloud top temperatures whilst channel-11 is the carbon dioxide absorption channel. The high-resolution visible channel-12 has a sampling interval of 1kilometre.

For amateur purposes there seems little point in saving all 12 channels. A selection of a visible, water vapour and IR along with the HRV seems a good mix, and also provides excellent colour composites as demonstrated in figure 5 (see centre pages). However, if for example there were a need to view fog details etc. then the relevant channel(s) can be selected to help. This is so easy to do with quarter hour scans.

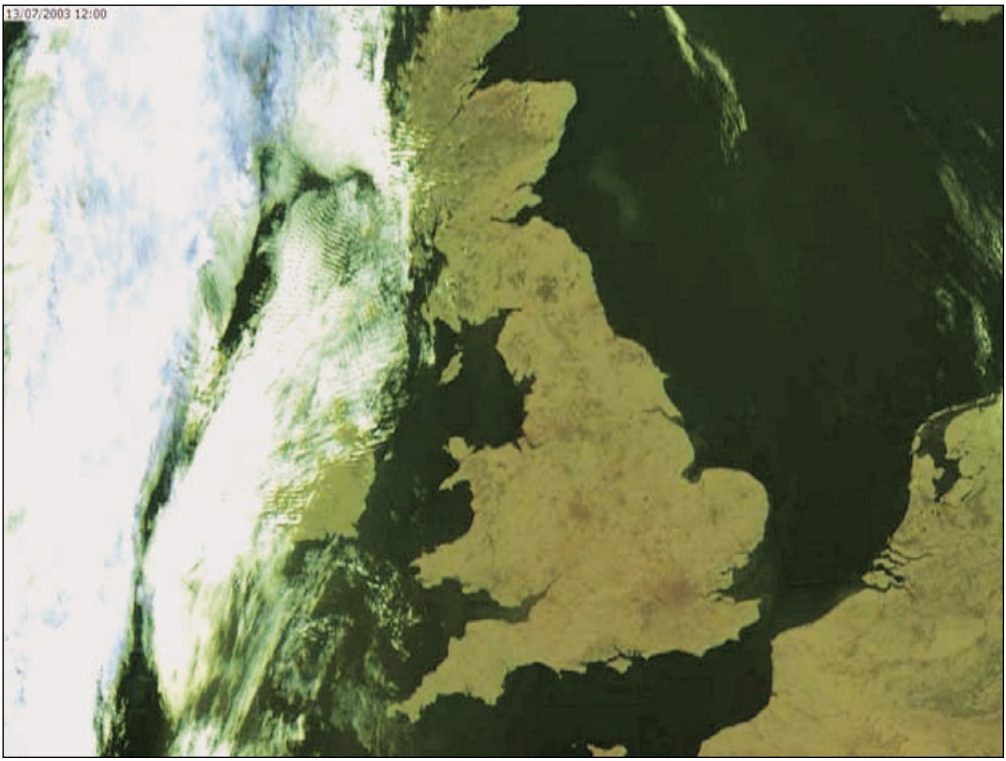
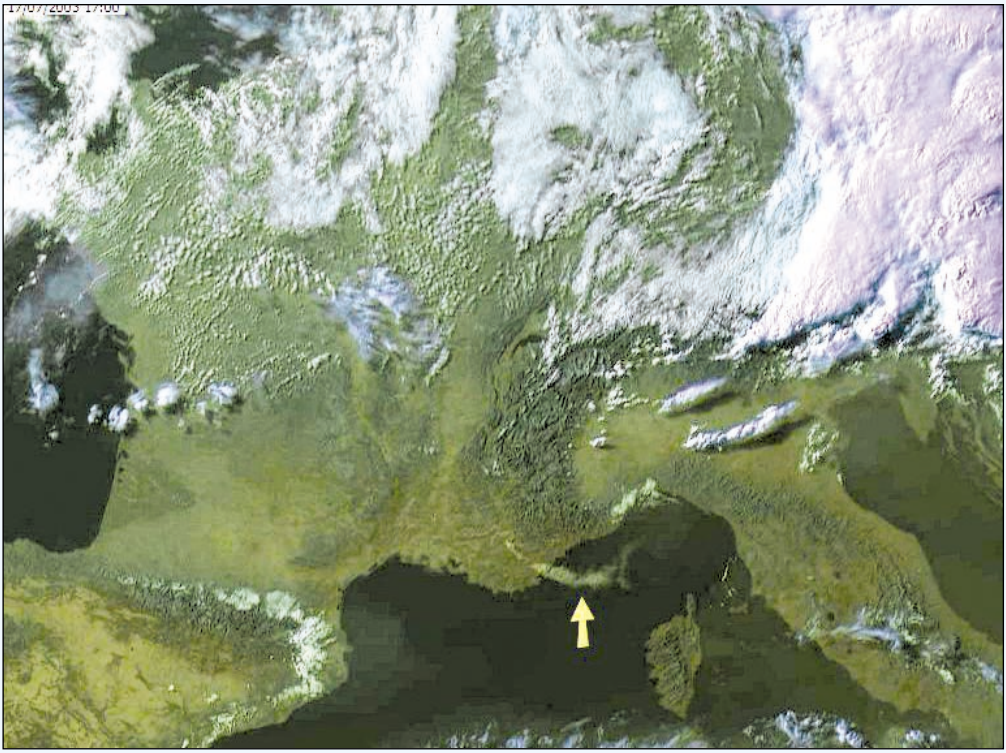


Figure 1 - MSG-1 channel-12 High Resolution image of Great Britain



An MSG-1 colour composite image based on the HRV channel showing the July 17 fires in southern France (smoke plume arrowed)

Image credit: David Taylor

David Taylor Writes:

This image shows multi-channel false-colour processing of MSG-1 data, on which the smoke trail from these fires is clearly visible.

Visible channel data from the High Resolution Visible channel has been combined with colouring from the 10.8 μm thermal channel data and in addition to the smoke trail, the image shows temperature differences within land and cloud areas. The low angle of the afternoon sun produces some attractive cloud shadows.

The data was received at 17:00 UT on July 17, 2003 using an 88 cm satellite TV dish and a standard PC fitted with a DVB card at my location in Edinburgh, Scotland.

Processing was carried out using my own *MSG Data Manager* program and *GeoSatSignal4* software.

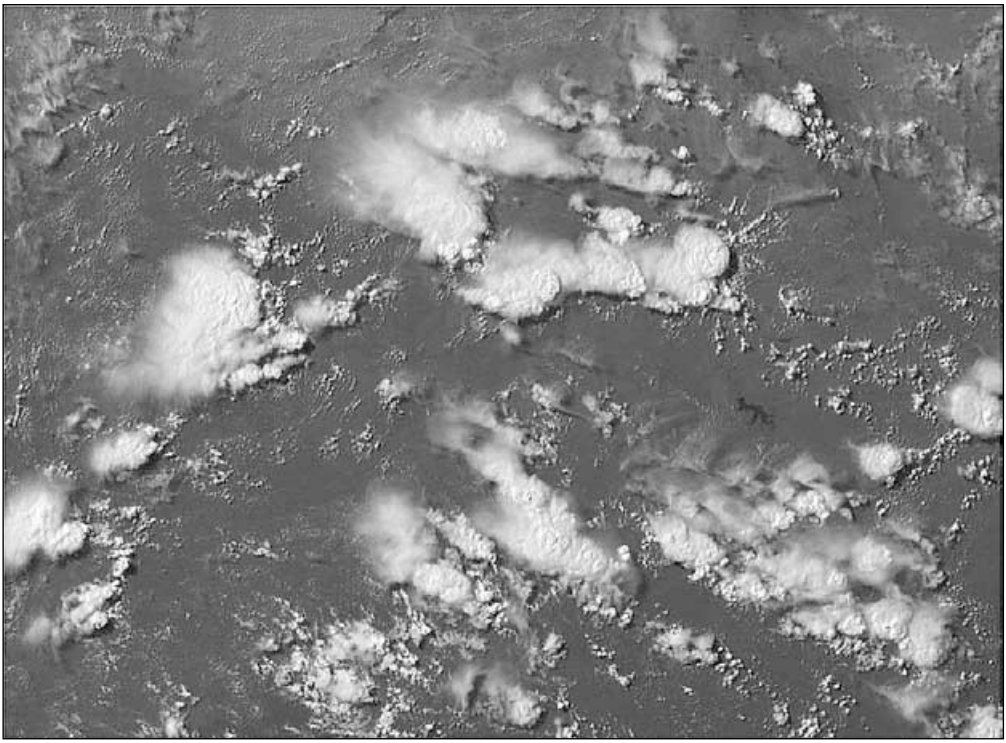


Figure 2 - A channel-12 HRV segment showing thunderstorms over central Africa

For those of us more used to analogue signals, the digital quality is stunning. Consider the portion of channel-9 IR image shown in figure 4. Look at the clarity (and the excellent temperature) of the Canary Islands, keeping in mind that all the images in this article have several levels of zoom still available. In addition the twelve channels are provided every 15 minutes and all the images in this article (and any others) can be animated with incredible smoothness.

Receiving Software

A few words about the software required for both reception and processing. To my knowledge, at the time of writing, the only programs available for processing the received files and subsequently processing images have come from the keyboard of David Taylor, already well known for his many weather satellite associated programs.

Despite the lack of any trial data via the DVB system prior to commencement, both David's programs were available and working from day one, a tremendous achievement. The programs to which I refer are *MSG Data Manager* and *GeoSatSignal 4*, both still in development as experience is

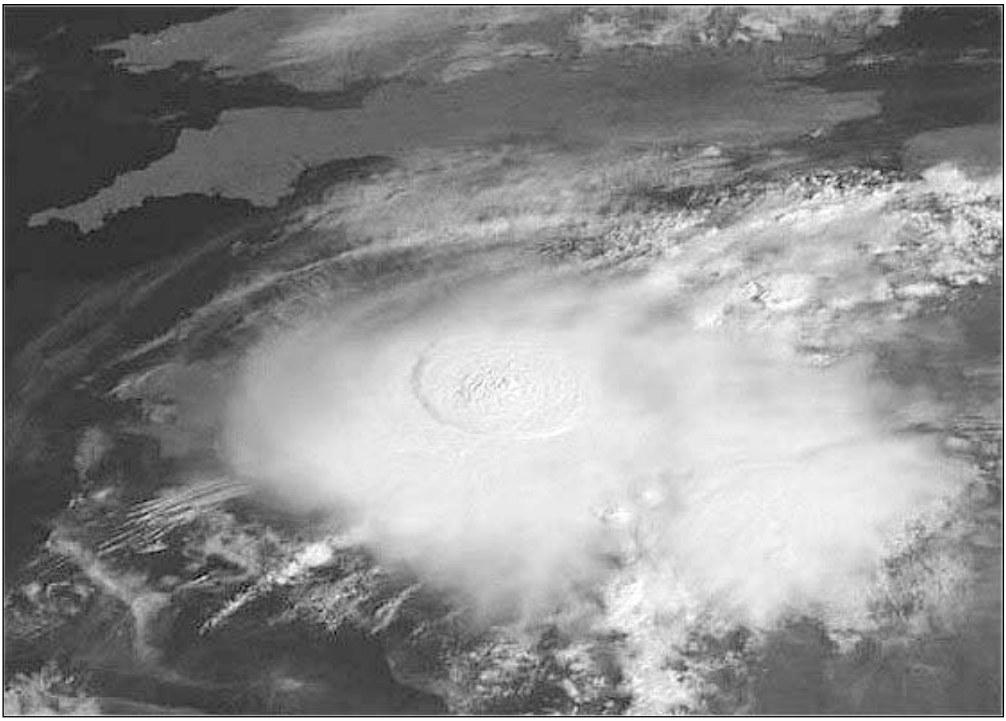


Figure 3 - A channel-12 HRV segment showing a vast thunderstorm over France

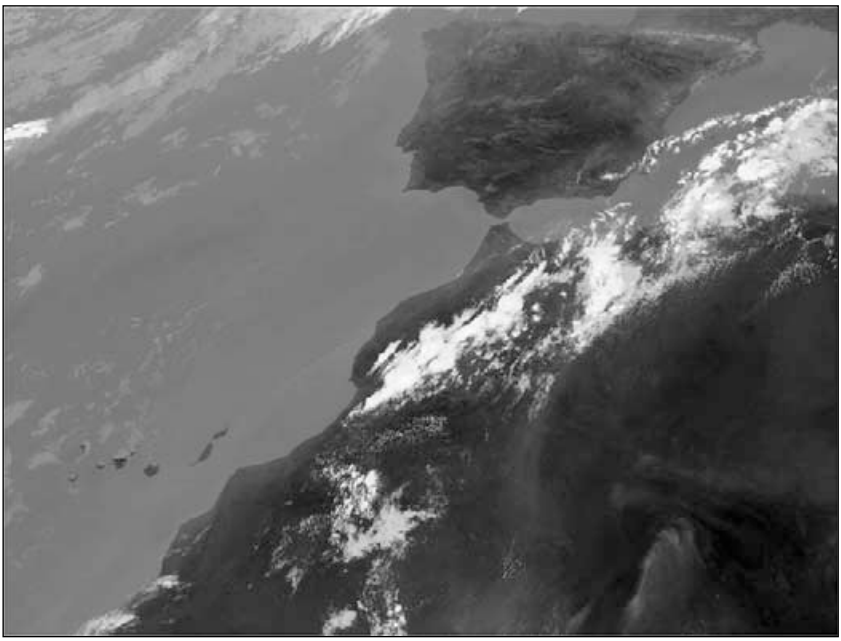


Fig.4

A channel-9 infrared image showing the Canary Islands

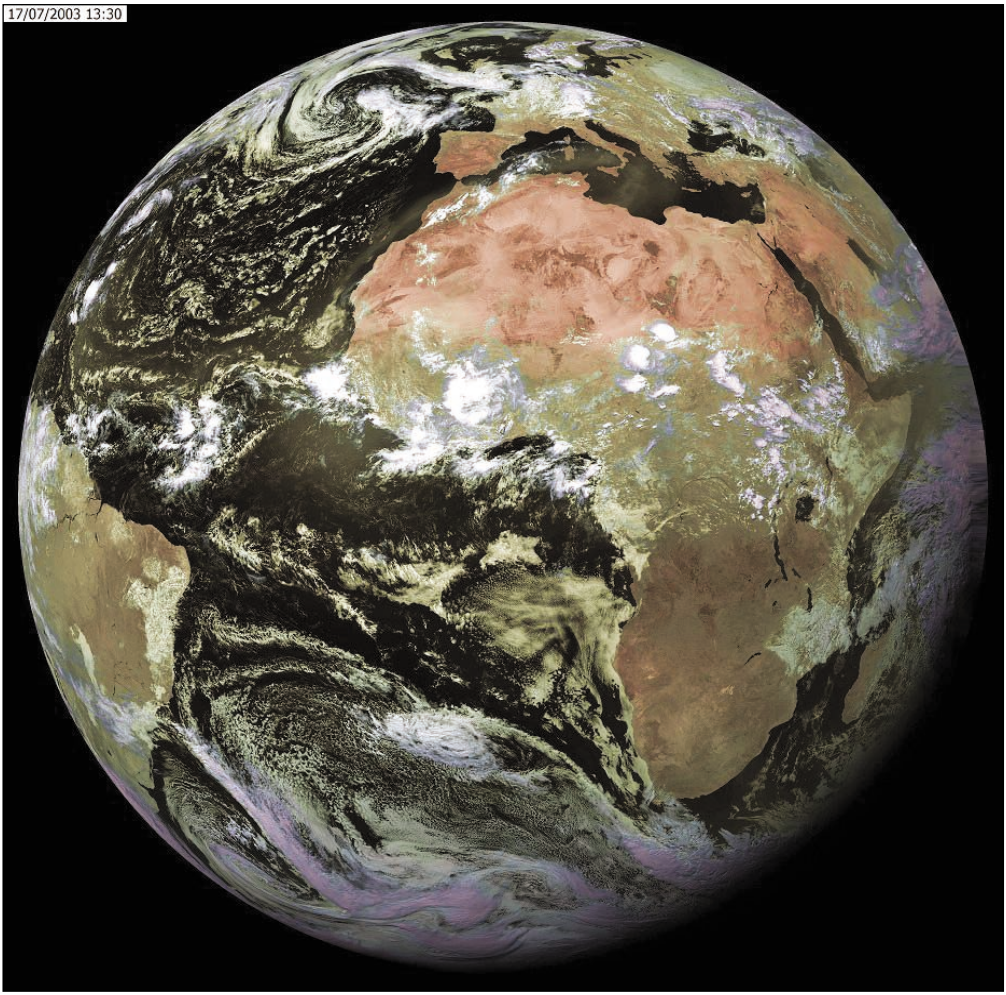


Fig.5 - Full globe colour composite MSG-1 image

built up. *Eumetsat* have nearly six months of commissioning still to complete so there is still much to be finalised.

MSG Data Manger is used to process the files received from MSG-1 and in addition offers the user a high degree of file management, essential with the quantity and size of the file downloads. These are likely to number around 700 files per hour, containing a total of some 0.5 Gb of data. One could say that the management facilities in the program are almost as important as the processing content!

A typical screenshot of the HRIT window is shown in figure 6. Thumbnails of all twelve channels are shown, but if only specific channels are required then only those would be selected. The program has many facilities to offer.

You can decide which channels to process, whether the data should be deleted from the receiver and there is an option to save raw data for future use. All these settings are on a 'per channel' basis and can be selected for both HRIT and LRIT. There is an option to view a detailed image, allowing the user a look at a selected channel in full resolution.

This option is not for image processing purposes but provides the opportunity to check some aspect of an image as it is still coming in…such immediacy can be very useful. There are many other essential facilities too numerous to mention but they include control on how images are saved, adjustment of image transfer characteristics, ability to read latest administrative notices and logs to mention but a few.

This is an excellent program, cleverly designed to work when separate computers are used to receive and process the images on a network (as recommended by Eumetsat), but equally at home with one computer.

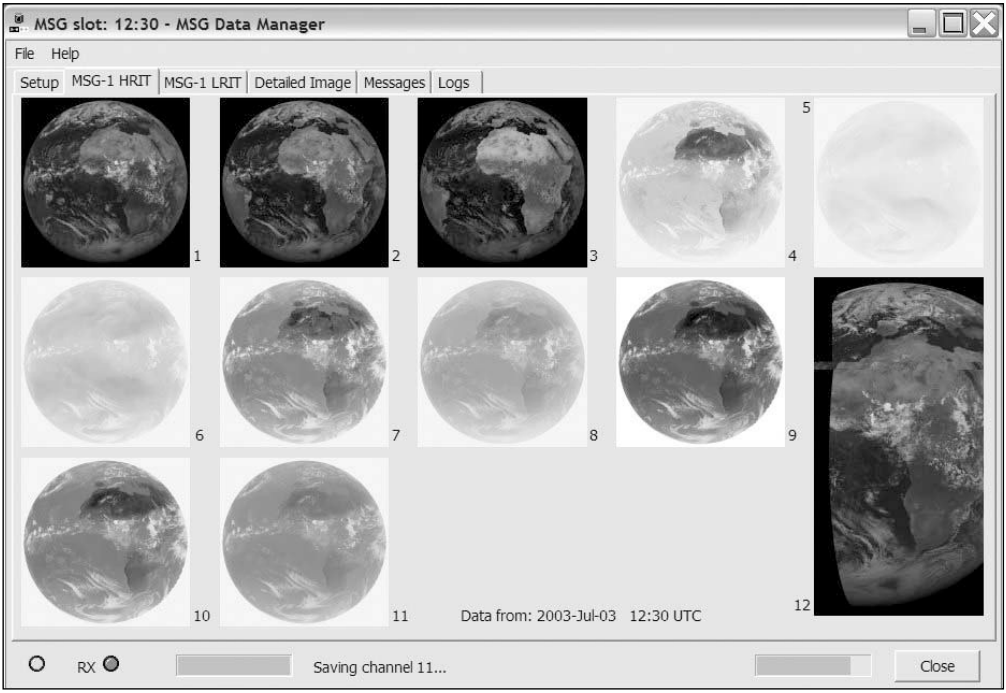


Fig.6 - The HRIT reception screen from David Taylor's MSG Data Manager program

For subsequent processing of images David has further developed his GeoSatSignal program, already well known to many, to process the MSG images. GeoSatSignal 4 now does for MSG what GeoSatSignal did for the other geostationary satellites. The results are beautiful close up images such as the one shown in fig.1, amazing colour composites, and incredible buttery smooth 15 minute animations of anything you choose.

Conclusion

With nearly six months of the trial remaining there is still much to be done by Eumetsat and a great deal to be learned by all of us. It is an exciting time and a great privilege, as an amateur, to be taking part and experiencing first hand the trials and tribulations of commissioning not just a new satellite but a completely new and unexpected dissemination system.

HRIT data is simply the best there is anywhere in the world at the moment, and I still have to pinch myself when I see it flowing freely into my computer.