



# **A Guide to producing HRPT Images**

using data from the

## **CLASS**

(Comprehensive Large-Array Data Stewardship System )

## **Electronic Library of NOAA Environmental Data**

(formerly the Satellite Active Archive - SAA)

*by Les Hamilton*

### Introduction

Whilst the dedicated enthusiast can, with the aid of a dedicated HRPT receiver and steerable antenna, download HRPT data directly from the NOAA satellites, relatively few choose to do so. There are two reasons for this. First, the not inconsiderable cost of hardware, particularly for the steerable antenna assembly, and second actual siting of the antenna.

But there is an easier way. The same raw HRPT data files transmitted from the NOAA satellites are available on the Internet and can be downloaded free from a number of sources, most notably from NOAA's own *Comprehensive Large-Array Stewardship System* (CLASS), an environmental data library—formerly known as the Satellite Active Archive (SAA). If you cannot afford to purchase a commercial HRPT system and lack the expertise to build your own from a kit this provides an alternative means of accessing the fascinating world of high-resolution satellite imagery.

### Registering with CLASS

Although you must first register with CLASS before they will permit you to download their products, this is just a formality—and there is no charge. Just direct your Internet browser to:

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

and click the 'Register' link at the top right-hand corner of the screen. The only information you have to supply are your first name, last name, e-mail address and password. The password is of your own choosing, and is required when you log-in to the site.

### Logging-in

Once registered, you can log-in to the CLASS site and select files for download. Do this by clicking on the 'Login' link at the upper right-hand corner of the opening screen.

Type your first name into the 'Username' field and your chosen password into the 'Password' field. (figure 1) then click OK. Wait a few seconds until the screen refreshes (the 'Login' link will now have disappeared) and open the 'Please select a product to search' window, part of which is shown in figure 2. Click on the first item in the list, 'Advanced Very High Resolution Radiometer', then on the link labelled 'Go'. You are now taken to the page where you can select the type of image you wish to search for, a specific satellite, and the start and end dates for your search. The relevant part of this page is shown in figure 3.

### Available Data Types

There are three types of data that you can select. The uppermost item, **GAC**, provides global coverage from satellites at a similar resolution to the familiar 137 MHz APT. These files produce images with a maximum ground resolution of just four kilometres per pixel. You are almost certain to be able to locate an image from anywhere on the planet in this file format. **HRPT** provides the full-resolution 1-km/pixel raw data stream received live from the satellites at ground stations in the USA, ideal if you require images of North America and the Caribbean. **LAC** also provides the HRPT data stream, but these files are recorded aboard the satellites whilst flying over regions out of direct range of US ground stations; the data are relayed to Earth during a subsequent orbit.

If you require HRPT data files for Europe, Asia or Australasia, then you should check the box beside LAC. Because of the recovery method for these data, you may often have to wait till

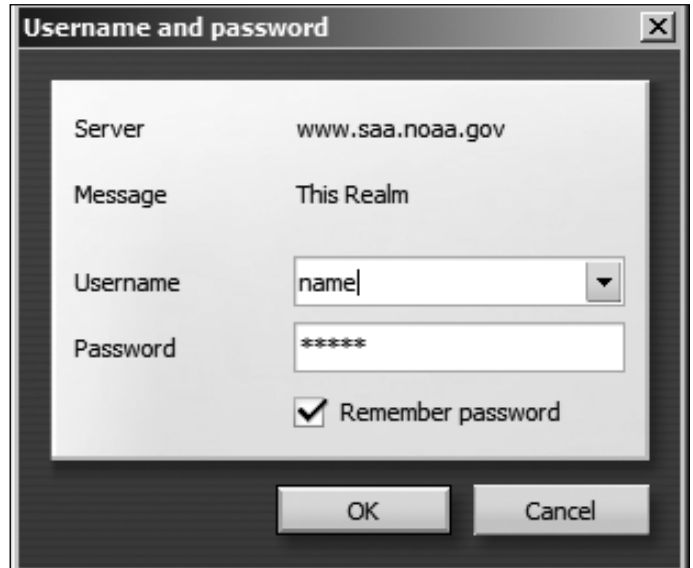


Figure 1 - The Login window

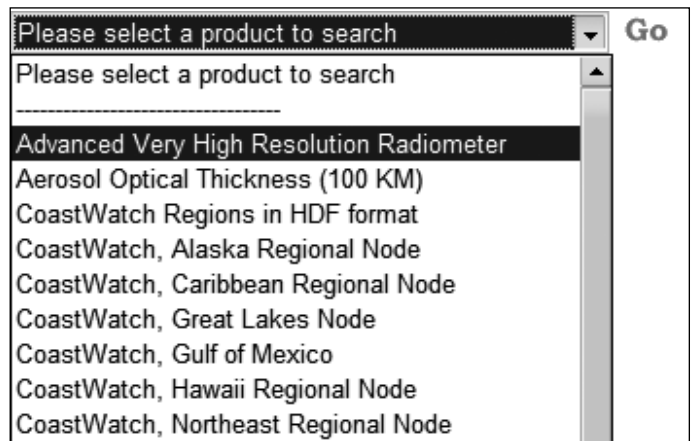


Figure 2 - Selecting NOAA data

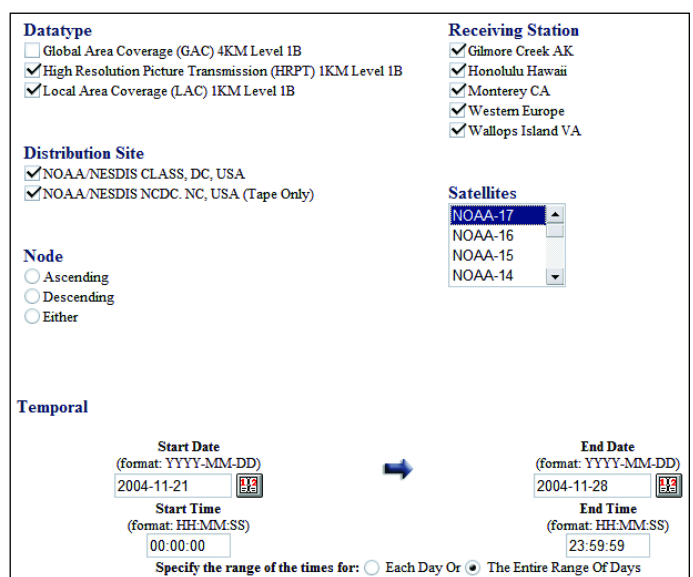


Figure 3 - Selecting a Dataset

the following day before LAC files become available for downloading.

**Selecting a Dataset**

The options for **Receiving Station** and **Distribution Site** can safely be left untouched at their default settings. The **Node** options afford the opportunity of restricting your search to ascending or descending satellite passes: leaving all options unchecked has the same effect as checking the 'either' option. Should you wish to restrict your search to just one specific **Satellite**, click on its name to highlight it—otherwise passes for all satellites will be searched for and displayed.

The **Temporal** setting allows you to refine the search interval (one week prior to the current date by default). Either or both of two interactive calendars above the map at the foot of the page may be modified to increase the breadth of search, or to restrict it to a single day (figure 4). You can also restrict the hours searched by entering **Start Time** and **End Time** in the fields provided. Finally, you must define **Spatial** details for the area over which you wish to search for satellite data by dragging a rectangle over the map (see Appendix: 'Java') to outline the target region. You can zoom in for increased accuracy (figure 5).

**User Preferences**

The menu in the left-hand margin of each page contains the option 'User Preferences'. It is here that you can choose which of the five HRPT channels you require for the various file formats. Do this prior to ordering your first datafile from CLASS. Be certain that you select 10 bits/pixel for each (figure 6). These preferences remain in force for future downloads until such time as you decide to change them.

**Ordering Datasets**

Once all the above has been completed, click on the **Search** button beneath the map and await a listing of all the appropriate satellite passes (figure 7). If you are searching over an extended time interval this may take a little time and present you with a large number of datasets in a paged list. Generally, it is helpful to restrict the search to a specified 24-hour period. You can view thumbnails of any image by clicking the button in the **View Details** column at the left of each line in the table (figure 8).

If you are happy with the image, return to the **Search results** screen, check the box in the **Shopping cart** column then click the **Go to cart** button at the top of the page. This takes you to the Shopping cart screen (figure 9) where all that remains to be done is to click the **Place order** button at upper left. Note: the 'Include Archive Header' box is always checked by default - **do not** alter this.

You should receive confirmation of your order almost immediately, and an e-mail (to the address you provided when you registered) confirming this is also sent out shortly thereafter.

The datasets that you order are placed in a folder on the CLASS FTP server for you to download. There will be a delay while this is set up for you, but you should receive a second e-mail confirming the address; this often arrives within minutes though it can take several hours during busy periods. Note, however, that if you request data that is more than a week old, it may sometimes be several days before it is made available for you. HRPT datasets can be large (some are of the order of 100 Mb). In general, a 10° spread in latitude equates to 16 Mb of data. As image processing can take a considerable time, particularly on low specification computers, it doesn't pay to order a file larger

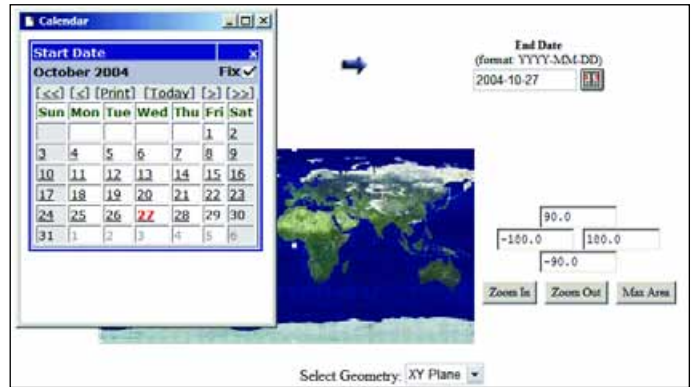


Figure 4 - Selecting a date from the calendar

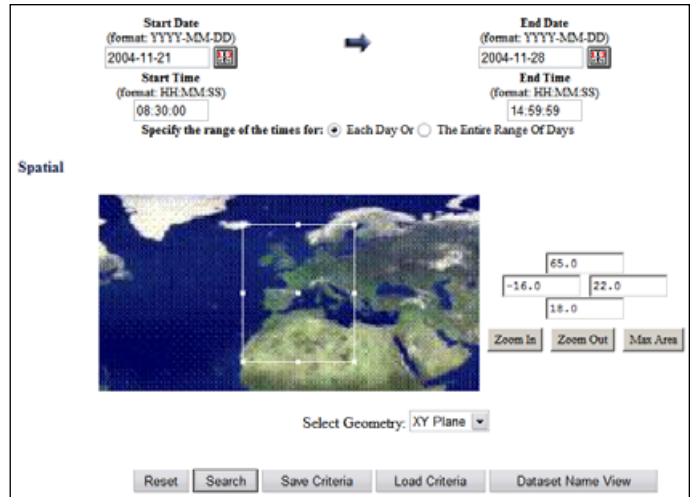


Figure 5 - Selecting the area (zoomed)

AVHRR Data Extraction Preferences									
Data Type	Scan Line	Bits/Pixel			Channel Number				
		8	10	16	1	2	3	4	5
AVHRR_HRPT	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
AVHRR_GAC	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
AVHRR_LAC	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
AVHRR_FRAC	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Figure 6 - User preferences

Shopping Cart									
View Details	Shopping Cart	Inventory ID	Dataset Name	Orbit	Start Time	End Time	Sat ID	Dataset Name	
<input type="checkbox"/>	<input type="checkbox"/>	428083	AVHRR_HRPT	1202	2004 11 30 02:46:10.989	2004 11 30 02:54:07.900	317	N88.HRPT.NL.D04335.80240.E0254.B1165242.WT	
<input type="checkbox"/>	<input type="checkbox"/>	428121	AVHRR_HRPT	1203	2004 11 30 04:22:52.323	2004 11 30 04:33:24.400	317	N88.HRPT.NL.D04335.80422.E0433.B1165353.WT	
<input type="checkbox"/>	<input type="checkbox"/>	428159	AVHRR_HRPT	2100	2004 11 30 07:35:11.882	2004 11 30 07:49:09.900	316	N88.HRPT.NL.D04335.81070.E0749.B1165000.WT	
<input type="checkbox"/>	<input checked="" type="checkbox"/>	428204	AVHRR_HRPT	2100	2004 11 30 08:45:45.302	2004 11 30 08:59:44.900	316	N88.HRPT.NL.D04335.81084.E0859.B1165000.WT	
<input type="checkbox"/>	<input type="checkbox"/>	428244	AVHRR_HRPT	2101	2004 11 30 10:09:34.908	2004 11 30 10:31:55.302	316	N88.HRPT.NL.D04335.81010.E1031.B1168000.GC	
<input type="checkbox"/>	<input type="checkbox"/>	428411	AVHRR_HRPT	1200	2004 11 30 14:38:33.823	2004 11 30 15:12:25.323	317	N88.HRPT.NL.D04335.81458.E1512.B1168959.WT	
<input type="checkbox"/>	<input type="checkbox"/>	428451	AVHRR_HRPT	1200	2004 11 30 16:38:18.323	2004 11 30 16:52:11.323	317	N88.HRPT.NL.D04335.81638.E1632.B1168960.WT	
<input type="checkbox"/>	<input type="checkbox"/>	428460	AVHRR_HRPT	1201	2004 11 30 18:12:22.323	2004 11 30 18:23:12.900	317	N88.HRPT.NL.D04335.81812.E1823.B1168661.GC	
<input type="checkbox"/>	<input type="checkbox"/>	428480	AVHRR_HRPT	2100	2004 11 30 18:29:44.135	2004 11 30 18:43:40.900	316	N88.HRPT.NL.D04335.81829.E1843.B1169000.WT	
<input type="checkbox"/>	<input type="checkbox"/>	428461	AVHRR_HRPT	2107	2004 11 30 20:11:54.802	2004 11 30 20:24:35.302	316	N88.HRPT.NL.D04335.82011.E2024.B1169707.WT	

Figure 7 - Search results

than you require! The whole point of HRPT, surely, is to investigate small regions in high detail.

Additionally, if you are using a dial-up Internet connection, it again pays to order the smallest datafile that suits your needs, as even a 16 Mb file as noted above will take the best part of an hour to download. You can reduce file size by ordering only channels 2+4 if all your interest is in producing false-colour images.

If you plan to download HRPT telemetry files on a regular basis, you should seriously consider switching to a broadband Internet account.

Once you receive notification that your file is available for download you have just 72 hours to retrieve it before it is cleared. You can retrieve your file with an ftp program of your choice or via your web browser. Note that when downloading via ftp you must select a 'binary' (or 'image') mode of transfer, not 'text' or 'ascii'.

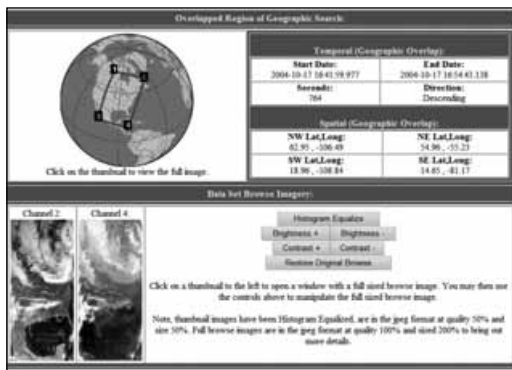


Figure 8 - Dataset details



Figure 9 - Shopping cart

**HRPT Imaging Software**

Once you have downloaded an HRPT or LAC datafile you have to process it into images. The software preferred by the majority of enthusiasts is the **HRPT Reader Program** [1] written by David Taylor. This program can be obtained in both free and registered versions. The free version is perfectly adequate for getting started but a number of more sophisticated image processing options are available upon registration. If you have not run any of David's software before, you will also require to install the **Runtime Library Bundle**.

HRPT Reader comes as a ZIP file. As it does not have an installer you must create a folder on your hard drive called 'HRPT Reader' and unzip all the contents into this. It is also advisable to create two sub-folders within it, *RAW* and *IMAGES*, the former to store your downloaded datafiles, the latter to hold

the images you prepare from them.

**Creating HRPT Images**

The files from CLASS have meaningless automatically generated filenames: for example 'A4416181.L5629091'. This can be read by **HRPT Reader**, but it is best to edit the extension to 'GAC', 'HRP' or 'LAC' to give a filename like 'A4416181.HRP'. The stem of the filename can also be changed to a more meaningful name if you wish. Using these extensions ensures that the decoding software 'understands' the architecture of each specific datafile, and interprets it correctly.

Use the <File → Open> menu to navigate to your RAW folder and double-click on an HRPT datafile. If you have a relatively high-specification computer, HRPT Reader should display the image after just a few seconds. Figure 11 compares processing times for a variety of PCs, using raw datafiles of two different

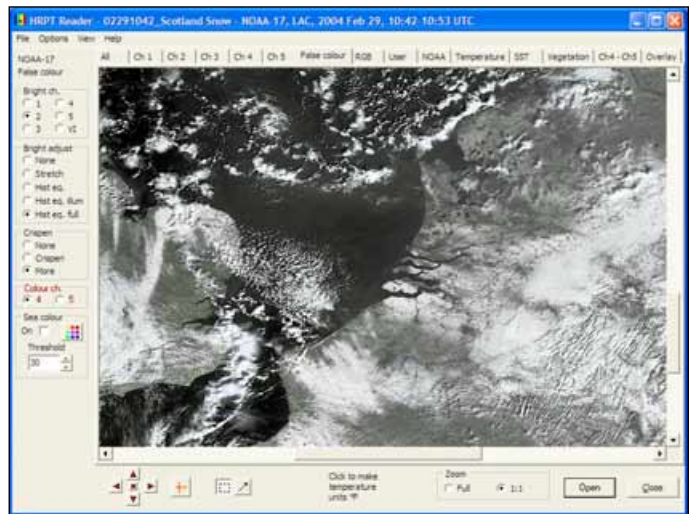


Figure 10 HRPT Reader screen displaying overnight snowfall in the Low Countries - NOAA 17, February 29, 2004

sizes. Although a faster processor bring benefits, the key to speed is having lots of RAM.

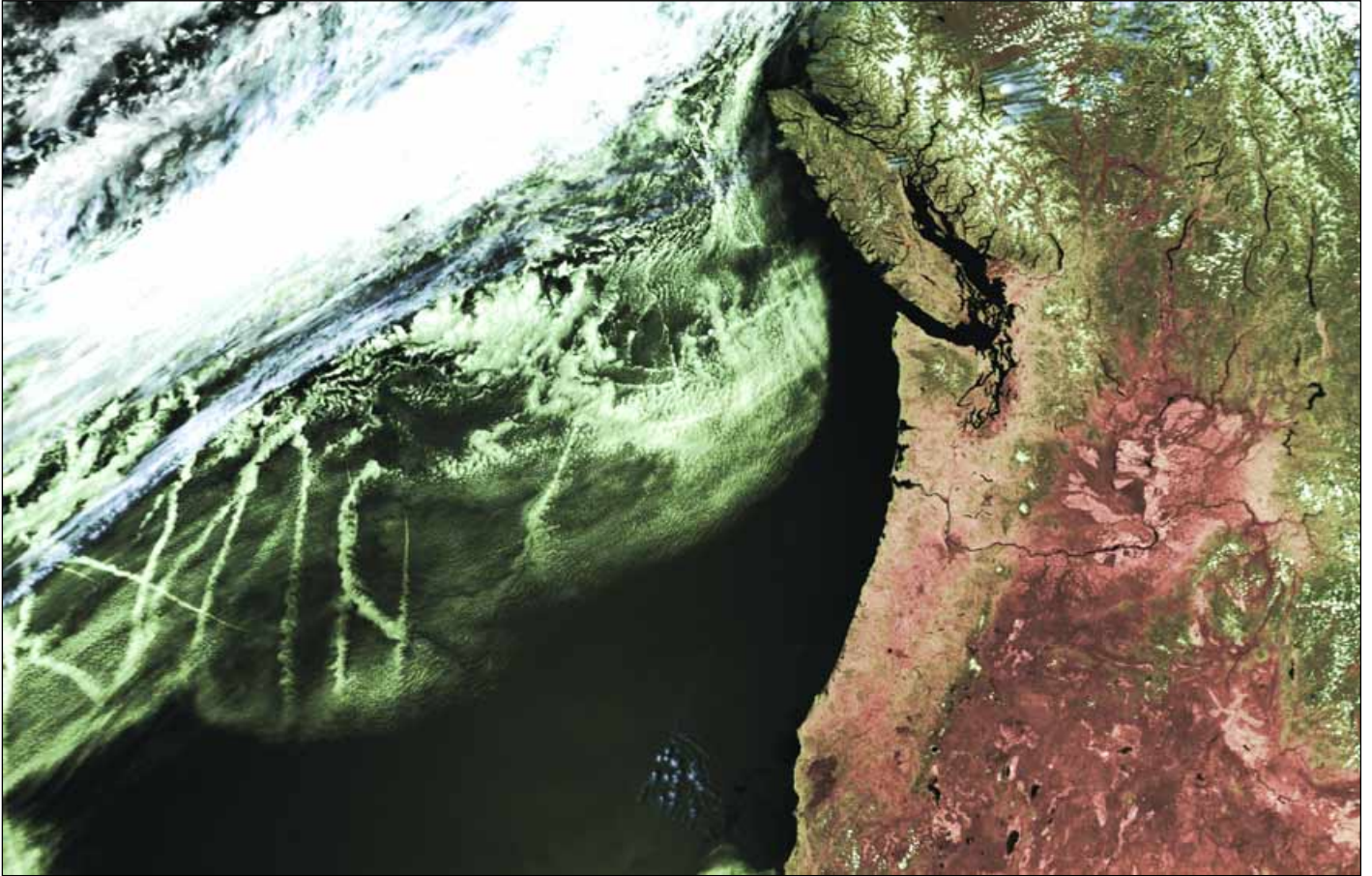
The images from all five of the HRPT channels are available for inspection simply by clicking the appropriate channel tab at the top of the screen (figure 10). A number of specialised images produced by combining these channels in various ways can also be viewed on the other tabs (False colour, RGB, Sea surface temperature etc), but a detailed description of these is beyond the scope of this article.

**Saving Images**

Before saving an image for the first time it is necessary to 'tell' HRPT Reader the location of your 'IMAGES' folder. Select <Options → Results location> from the menu-bar to navigate to this folder then click on it. Now any file saved using the options under the <File> menu will be placed in that folder. The particular image saved is always the one actually displaying at the time of the save; if you save while the false-colour image is displayed on the screen, it is that false-colour image that will be saved, and so on.

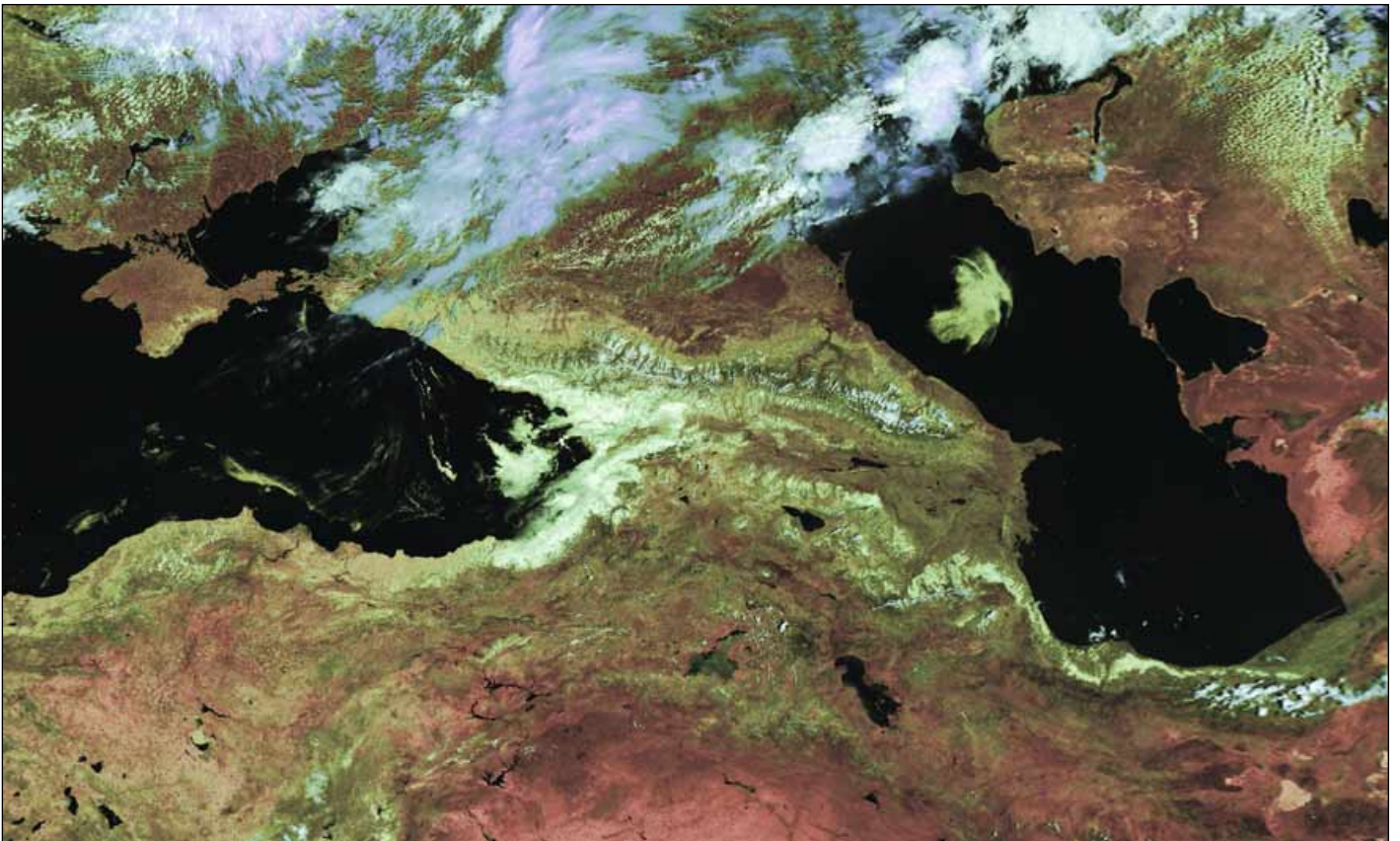
Processor	Speed (MHz)	RAM (Mb)	Processing (32 Mb file)	Processing (64 Mb file)
Pentium II	366	192	18 sec	70 sec
Pentium III	500	256	12 sec	47 sec
Pentium IV	2800	1000	3 sec	7 sec

Figure 11 - Processing times on various PCs



This splendid NOAA-16, false-colour image was prepared from a CLASS 'HRP' datafile dating from 21:40 UT on June 28, 2003. The image displays a cluster of fascinating 'ship tracks' over the Pacific Ocean. Vancouver Island and the

snow-capped Coast Range are prominent, as are the Columbia and Snake Rivers. The volcanic peaks of the Cascade Range stand out like a regiment of white beacons.  
*Telemetry data: NOAA CLASS Processing: HRPT Reader*



This scene was observed by NOAA-17 at 03:11 UT on June 12, 2003. The raw datafile was acquired from Russia's SMIS server. The centre of the image is

dominated by the Caucasus Mountains stretching between the southern Caspian Sea and the Black Sea.  
*Telemetry data: SMIS Processing: HRPT Reader*

Images can be stored in a variety of formats. <File → Save displayed image> saves the geometrically uncorrected HRPT image (exactly as it appears on screen) in lossless BMP format at 1.1 km/pixel resolution. The <File → Save with correction> option applies geometric correction to counteract perspective effects caused by Earth's curvature, which occur at the edges of the images. <File → Save as APT> produces a corrected but subsampled version of the latter, with a resolution of 4-km/pixel. There are also options to save in the compressed JPEG format.

### Java

In order to visualise and make use of the interactive map feature on the CLASS web page (figure 5) you require to have J2SE, the **Sun Java™ 2 Platform v 1.4.2**, Standard Edition installed on your PC. This is not provided with Windows XP, and some users have queried why they are not able to make use of the map. You can download the installation file for Java from:

<http://java.sun.com/j2se/1.4.2/>

Once this is installed, all the features of the CLASS website should be accessible in your web browser. Of course, even without the map, you can still enter relevant latitude and longitude values to define your region of choice, manually, into the fields immediately above the 'zoom' buttons.

### Other Sources for HRPT Files

HRPT data from the NOAA satellites is downloaded daily by the Space Monitoring Information Support Laboratory (SMIS) in Moscow, Russia [2]. There is a wealth of material available on the 'Satellite Data Page' [3]. The link 'Telemetry Active Archive' allows you to download datafiles collected during the previous 28 days and files for the previous 24 hours are available from the 'Last telemetry files' link. HRPT files are also available from the ZS RCPOD, Novosibirsk server [4]. This has the advantage of access to NOAA passes farther east than Moscow.

### References

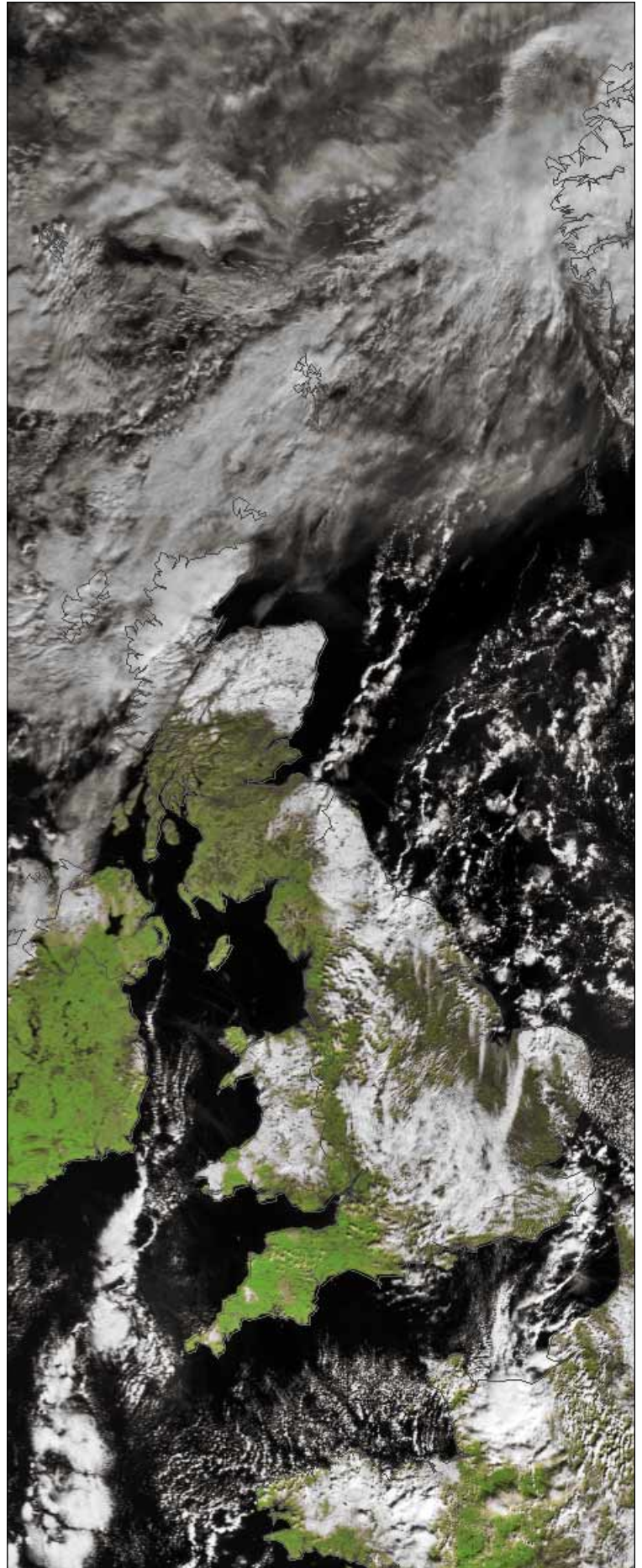
1. [HRPT Reader](#) is available from Software Showcase. You can also download it yourself from <http://www.satsignal.net> on David Taylor's website. You will find the link to HRPT Reader under the 'Satellite Tools' section. The link to the [runtime library bundle](#) is on the HRPT Reader page under the section headed 'System Requirements'.
2. SMIS  
<http://smis.iki.rssi.ru> (or <http://d902.iki.rssi.ru>)
3. SMIS Satellite Data Page  
[http://smis.iki.rssi.ru/dataserv/engl/data\\_s\\_e.htm](http://smis.iki.rssi.ru/dataserv/engl/data_s_e.htm)
4. ZS RCPOD, Novosibirsk  
[http://212.17.0.65/tlm\\_cat/tlm\\_cat\\_e.sht](http://212.17.0.65/tlm_cat/tlm_cat_e.sht)

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You can find out more about GEO by visiting their website at:

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



A NOAA-17 HRPT segment from February 29, 2004, when much of Scotland and northern England were blanketed in snow. Processed in 'vegetation' mode.