The New ImageDB Server – Direct Access to Selected ERS SAR Data Products

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To support the prevention, management, analysis or mitigation of natural hazards, users need rapid access to the latest remote-sensing data for the area concerned. ESA's internal Earth Watching project has also shown the strategic value of access to historical data for 'change detection' in such critical situations. A novel system has therefore been set-up at ESRIN, for both internal and external use, to support activities requiring the fast availability of archived remotely sensed data. The new ImageDB server provides instantaneous on-line access both to specific collections of quick-looks and full images.

The project was started at the end of 1998, in cooperation with the company Web Bridges (I) for the server design and development. The implementation proceeded in steps, with releases of intermediate functions as soon as available. The first release was opened on-line in May 1999, providing access, through DESCW*-supported inventory searches and quick-look downloads, to 100 geocoded (GEC) products over the major European rivers, generated from data acquired by ERS-2 during the period July–September 1998.
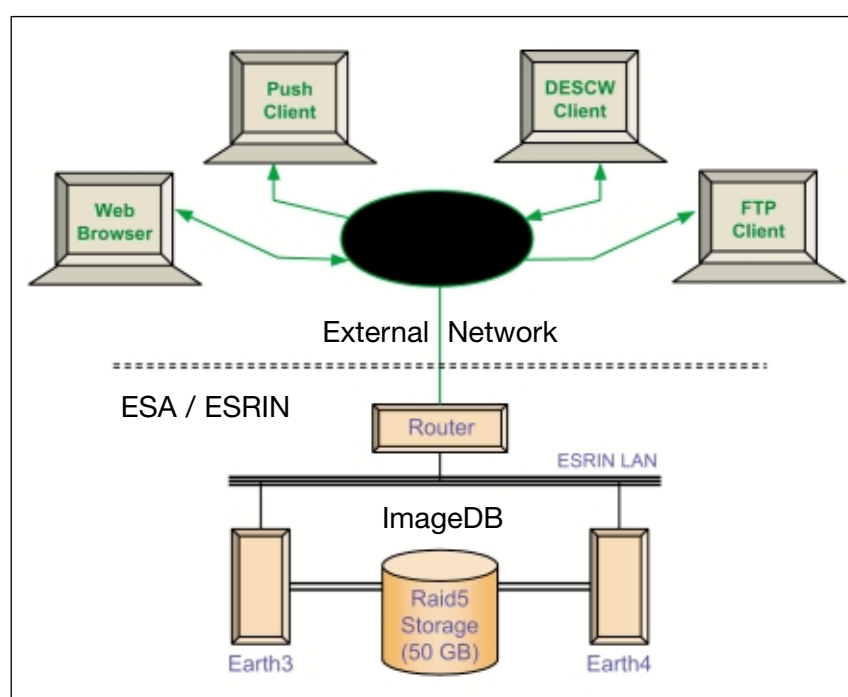
What is the ImageDB?

The ImageDB acronym identifies a server at ESRIN, which provides direct access to remote-sensing products, and in particular to those generated from the data acquired by ESA's ERS-1 and ERS-2 satellites. It has been implemented (Fig. 1) in the Windows NT environment (Release 4.0 Enterprise Edition) and resides on two clustered, dual Pentium-II 450 MHz machines (one for operational use and the other for maintenance). The two machines, known as Earth-3 and Earth-4, are connected to a storage subsystem providing 50 Gbyte of mass storage with built in redundancy, where the products (ERS GECs), quick-looks (for ERS and Landsat) and thumbnails (ERS only) reside.

The ImageDB application is replicated on both machines, although one of the installations is used primarily for internal/development purposes. The software configuration also includes the Internet Information Server 3.0, provided by Microsoft with Windows NT 4.0, in order to allow HTTP and FTP access to the ImageDB data. As indicated in Figure 1, the external access methods also include DESCW* and push clients.

ImageDB is built to host products, as well as related quick-looks, thumbnails and inventory information. All data can be freely accessed, but products can only be downloaded by entering an ESRIN-provided user name and

Figure 1. ImageDB system configuration

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* DESCW is a PC software tool that allows one to perform multi-mission inventory searches on the major ESA-supported remote-sensing missions – ERS-1, ERS-2, JERS, Landsat and Envisat – by displaying the satellites' coverage over the Earth map (see ESA Bulletin No. 97, March 1999 issue, for a description, or contact the Help Desk).
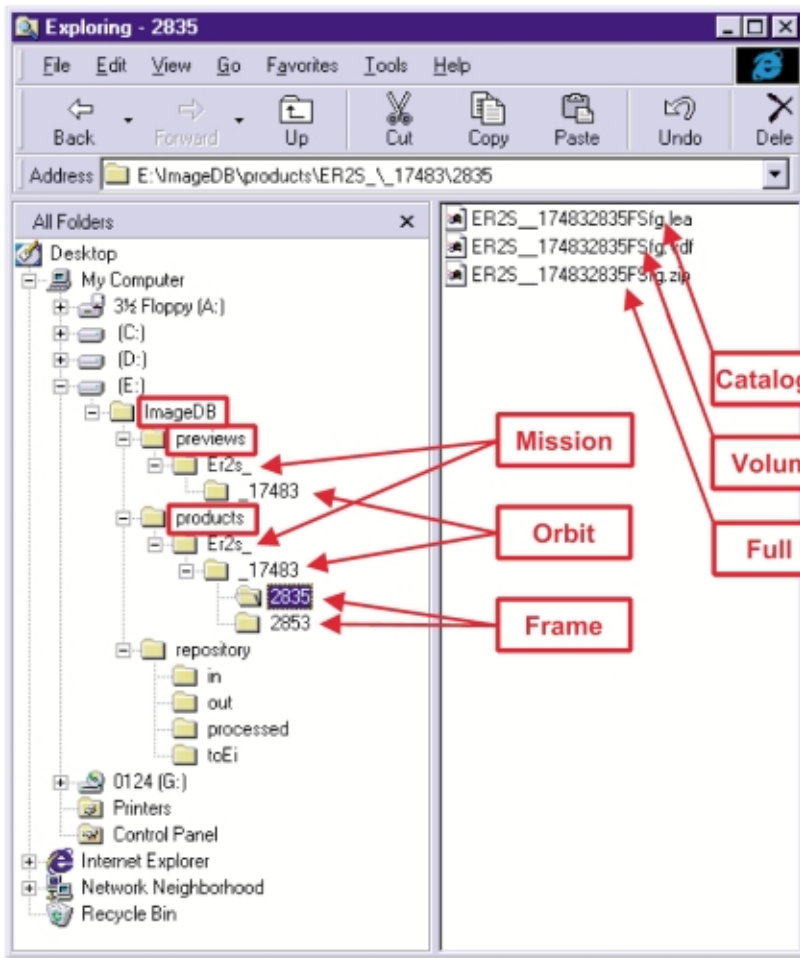
Figure 2. ImageDB directory structure

thumbnails can be accessed starting from the 'Previews' directory.

In order to provide the most user-friendly access, DESCW has been upgraded in order to:
– permit the search and filtering of specific inventory collections
– access the quick-looks on-line
– start the product's downloading.

Potential users should apply to the ESRIN HelpDesk (see address below) or to one of the commercial distributors in order to obtain the access conditions and a password. Data downloads are registered and invoiced, as appropriate. Dedicated processing and functions have been included to make this service available also via a network. In particular, special attention has been paid to reducing and compressing the images, as well as to permitting the on-line selection and transmission of user-defined image sub-sets.

The inherent flexibility of the system also allows it to be used for additional applications, such as the creation of specific collections of images to support training, promotion, and public-relations activities.

What does it contain?
Products, quick-looks, thumbnails and inventory data can all be stored in the ImageDB. Thanks to its flexible naming convention (Table 1) and the use of a central indexing table, it permits one to store and handle different types of images, and even to create 'collections' of images.

In addition to some collections intended for internal use, the ImageDB currently hosts two major collections: the Landsat-5 Quick-Looks and the ERS GEC Products.

password, since there might be a cost associated with them.

The system is organised around a simple directory structure (Fig. 2), which gives the user easy access to the data being sought. Basically, it is necessary to know the mission, orbit, frame and acquisition station in order to reach the *.zip file* of the product, stored with this standard compression under the 'Products' directory. Similarly, quick-looks and

Table 1. ImageDB naming convention for data and products

Field	Size	Type	Value
Mission identifier	3	character	ER1, ER2, LN5
Sensor identifier	1	character	S for SAR, T for Thematic Mapper
Mode identifier	1	character	"_"
Orbit	6	digit	
Frame	4	digit	
Station identifier	2	character	FS for Fucino, MS for Maspalomas, KS for Kiruna
Image type	1	character	Quick-looks: q = Quick-look, l = ILU, b = IBP
			Products: f = Full
Representation mode	1	character	n= Normal, g = Geocoded
Separator	1	character	"."
Extension	3	character	zip (full images), jpg (quick-looks), gif (thumb-nails),
			lea (leader file), vdf (volume data), cat (catalogue data)

Landsat-5 Quick-Looks

Full Landsat-5 quick-look strips, covering the entire acquisitions of one station, are received at the ImageDB server, where they are split into frames, according to the standard Landsat World Reference System. These output frames, covering an area of about 180 km x 170 km, contain about 500 x 480 pixels. During the splitting, the data are processed and compressed in such a way as to provide the best compromise between image quality and file size. Bands 7, 5 and 2 are used for best cloud detection and provide an artificially coloured image. A histogram stretching is then applied, acting on contrast and luminosity, improving the readability of the images at northern latitudes. The result is compressed in jpg format, with minor losses (Fig. 3).

The Landsat quick-looks are available for the recent past and can be directly downloaded using DESCW, by searching the relevant items in the dedicated inventory collection and clicking with the mouse on the status column of the item in the Scene List.

ERS GEC Products

For ERS-2, a special collection of GEC products, each covering an area of 100 km x 100 km, is made available. The GEC products are originally generated positioning each pixel on its location on the Earth, using the transverse Mercator projection, without additional correction related to target height. In order to reduce storage needs and transmission times, the GEC products are stored in the ImageDB with a 2 x 2 block averaging, bringing the geometric resolution to 25 m. The product is also compressed using the standard Zip compression tool (Fig. 4). This processing allows the original image of about 160 Mbyte to stored in less than 25 Mbyte.

The related quick-looks are stored as 600 x 600 pixel images in jpg format, whilst the thumbnails, which have a resolution of about 1 km, are stored in gif format with a transparent background.

With the current coverage (Fig. 5), the images are progressively covering the whole of Europe, with most of the data acquired during the period July – September 1998 (for as homogeneous as possible coverage during the dry season). The quick-looks and the products can be searched and downloaded through DESCW.

Data loading

The Landsat-5 quick-look loading activity is almost entirely offline and automatic: periodically, each incoming Landsat jpeg quick-
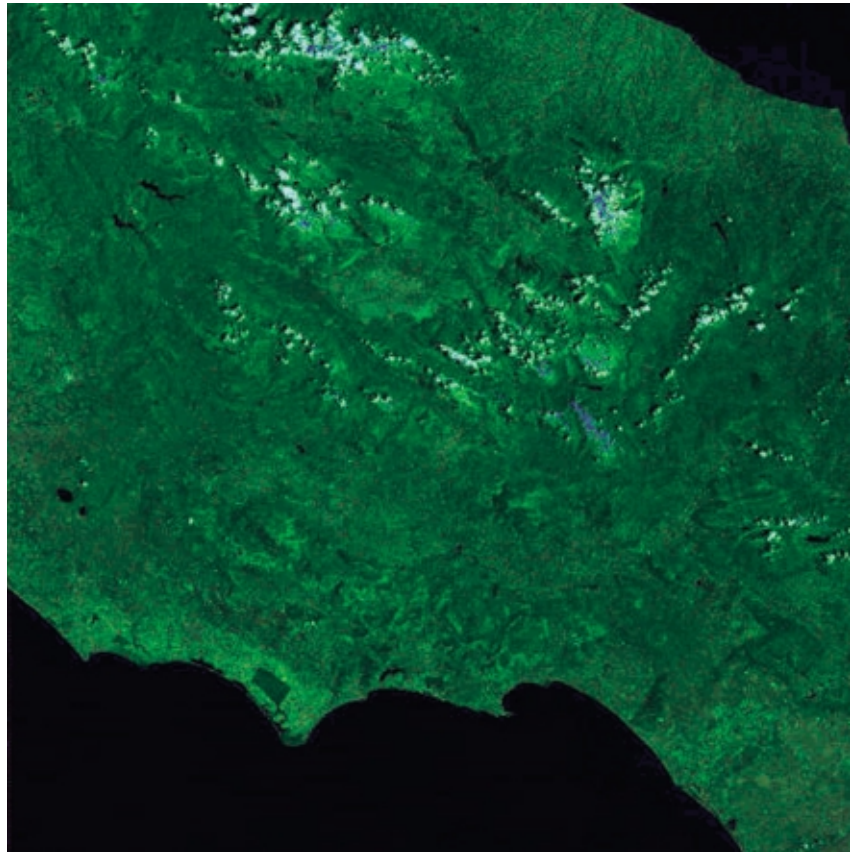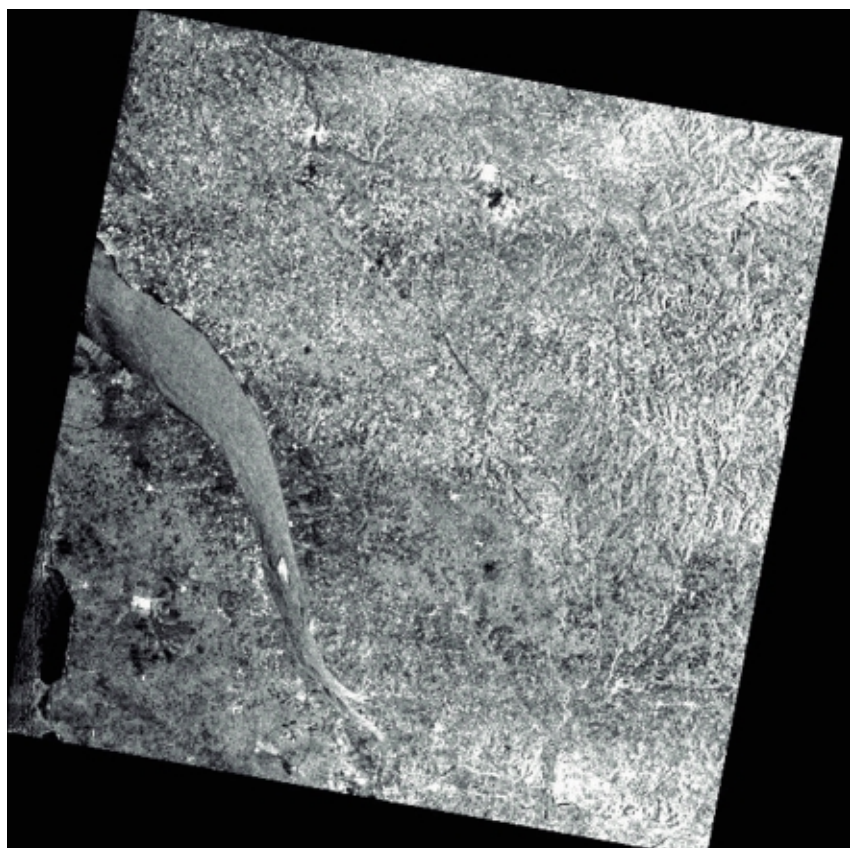

Figure 3. Example of a Landsat-5 quick-look
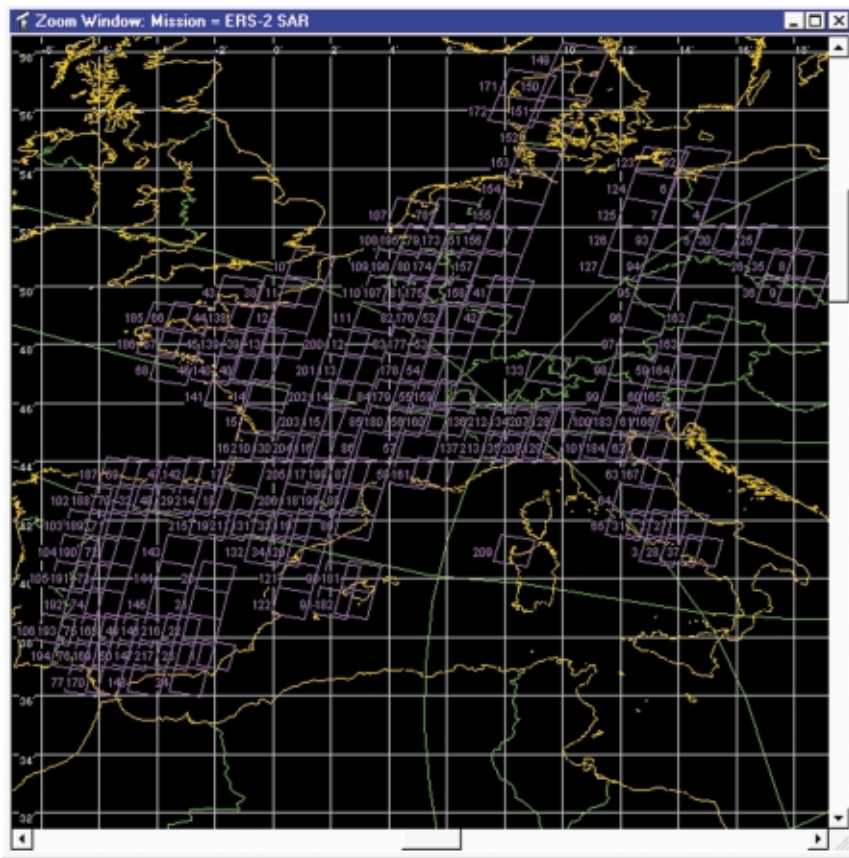
Figure 4. Example of a GEC product

Figure 5. Coverage of GEC products

look strip (the full pass of data acquired by one station) is cut into a set of frame-sized jpeg's and gif's and a *catalogue* file generated for each frame. The files (three for each frame) are then moved into the RAID storage and the ImageDB index table is updated. The only interactive activity is the log-watching to be performed by the operator to detect any ingestion errors.

The loading process for GECs is more sophisticated and is divided into two phases: pre-loading and processing. During the *pre-loading* phase, three or four GEC products are copied from the CD-ROM into an internal temporary storage. During the *ingestion phase,* all of the pre-loaded images are processed concurrently, resulting in a set of six files for each product:

– a sub-sampled GEC image, with unchanged radiometric resolution (still 16 bits per pixel), stored as a .zip file of about 22 Mbyte (subsampling is performed by applying a 2 x 2 block averaging to the original image)
– a header file (with .lea extension), containing geographic and radiometric information about the product, updated in terms of the parameters that have been changed by image subsampling

Table 2. Index table layout

Field	Description
Mission ID	Identifies the mission (satellite) associated with the image
Sensor ID	Identifies the sensor from whose data the image was generated
Mode ID	Identifies the special mode (if any) in which the sensor was at data acquisition time
Mission Orbit Number	The absolute orbit number at data acquisition time
Frame Number	The frame number at data acquisition time, according to the World Reference System (WRS) defined for this mission and sensor
Station ID	Identifies the station that acquired the data
Image Class	Separates the entries in this Index Table into major classes like no product entry (no product associated), quick-look entry, full product entry, etc.
Image Type	Represents the type of the image (e.g. interferometric image, full product, quick-look, etc.)
Representation Mode	Describes the representation mode of the image (e.g. normal, geocoded, etc.)
Track Number	Cyclic track number (as defined by the WRS) during data take
Archive Location	Indicates the location where the data is archived
Pass Type	Can be ascending or descending
Acquisition Start	The date and time when the data acquisition started
Acquisition Stop	The date and time when the data acquisition ended
Centre Co-ordinates	Latitude and longitude of the scene centre
Four Corners Co-ordinates	Latitude and longitude of the four image corners (NW, NE, SE, SW)
Missing Data Percent	The percentage of missing data during image acquisition
Cloud Coverage	The cloud coverage relative to the four image quadrants (NW, NE, SE, SW)
Keywords	A set of keywords associated with the image that can be used during a search session by the user
Related Documents	Documents or hyperlinks to documents (Texts or Articles) related to the image

– a volume descriptor file, which is an unchanged copy of the one on the source CD-ROM
– a 600 x 600 pixel jpeg-compressed quick-look
– a gif thumbnail with a spatial resolution of about 1 km per pixel
– a catalogue file (with .cat extension) filled in with the available inventory data, including image co-ordinates.

After ingestion is completed, the temporary storage area is cleaned up and the result files are moved into the storage subsystem according to a specific directory structure organised by mission, sensor, mode, orbit and frame number of the processed images. The average duration of the ingestion process for three GEC products loaded concurrently is about 10 min per product, consisting of a fixed pre-loading time of about 1.5 min for each product, plus 25 min for the parallel processing of the three GEC images.

Ingestion is then completed by inserting the inventory information on the loaded images into the internal index table, the layout and field descriptions of which are shown in Table 2. The various fields of this table are filled in according to the mission (e.g. cloud-cover information is available for optical sensors only).

The loading process is guided via a Graphical User Interface. This GUI offers not only a set of tools for easily performing the loading into the ImageDB archive of the ERS GECs, but also a way of checking out the logs produced during the ingestion phases of both ERS GECs and Landsat quick-looks. Another feature of the operator interface is the possibility to start the generation of the DESCW collection inventory files. It allows the operator to specify the parameters necessary to generate and send via FTP these files, which contain the inventory data related to a subset of the ImageDB archived entries.

The user interface

DESCW
The simplest way to retrieve and download the ERS-2 quick-looks and the GEC images available in the ImageDB is through DESCW. A prerequisite is the provision to DESCW of personal user information, through the dialogue window opened by selecting the 'User Info' option of the 'Define' menu.

The weekly updates to the DESCW inventory files include one ERS-2-specific collection designated GEC_Prod.cll, which lists all of the ERS-2 GEC products stored on the ImageDB server. From the DESCW Mission window, for ERS-2, it is possible to select this collection and perform a normal search on it (most of the products are currently from the period July - September 1998). From the result of the search, listed in the Scene List window, by clicking with the mouse on the status column of the relevant frame and selecting when requested the source station and the quick-look location (the 'ImageDB' remote server), the quick-look is automatically transferred and displayed on the screen.

The compressed GEC products can also be obtained by following the above procedure, but then selecting 'Full Image Download' in the dialogue window used to define the image location ('ImageDB'). The system then asks for the User Name and Password, which must have been requested beforehand from the ESRIN ERS Help Desk or one of the ESA distributors. If the user is recognised, the FTP transfer of the GEC product (about 22 Mbyte) starts as a separate process, the progress of which is indicated in real time.

Direct FTP download
When the full identifier of the required image is known, it is also possible to directly log onto the ImageDB server (earth3.esrin.esa.it), look
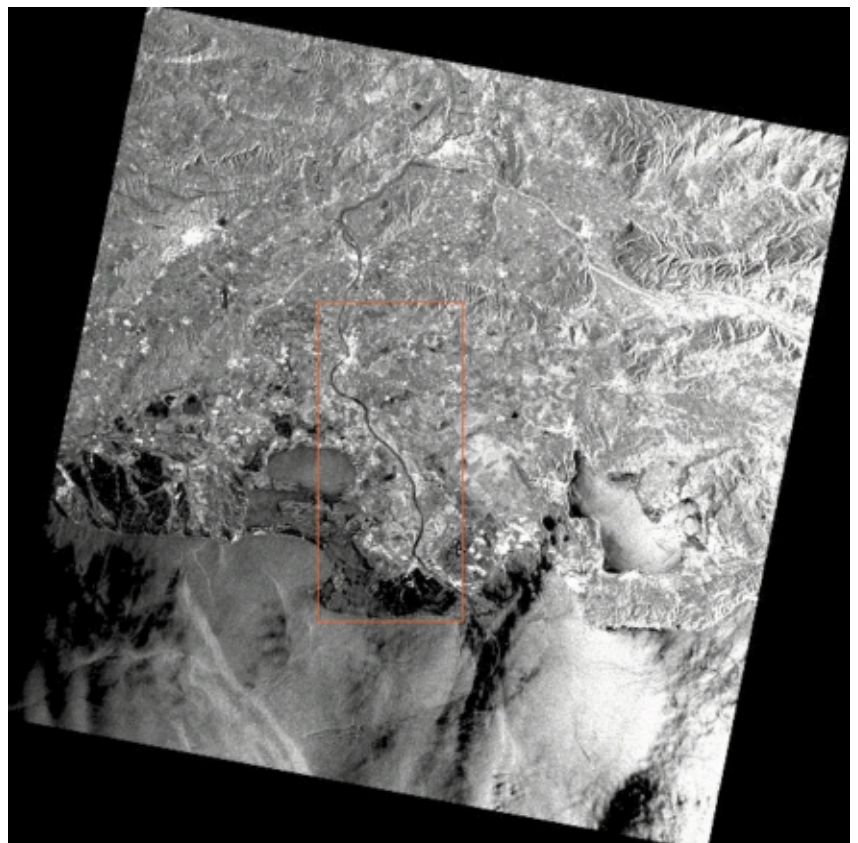

Figure 6. Example of image-subset selection

freely at the quick-looks, and download the full image after having provided the correct user name and password.

Image subset
It will be possible soon to identify from DESCW the relevant subset of the image just by drawing a rectangle on the screen over the related quick-look, in order to receive only this image subset. This will allow the number of bytes to be transmitted over the network, and therefore the transmission time, to be considerably reduced.

It will be possible at the same time to specify other parameters for the image subset, such as radiometric resolution (8 or 16 bits), spatial resolution (as a multiple of 25 m), desired format and delivery method. For the latter in particular, the user can select among FTP.get, FTP.put and possibly BackWeb. When FTP is selected, the system provides the image sub-set into a user-reserved directory for a maximum specified period of time. It FTP.get was selected, the system also starts the transmission towards the user equipment. In the case of BackWeb, transmission occurs through this nonintrusive push technology, with the advantages of using at best the available bandwidth (without impacting on other ongoing user transactions), of ensuring correct data transfer even after hardware switch-off/on, and of permitting unattended transfer over a long time period (e.g. during the night) over a limited-capacity network like the Internet.

Future expansions
The following enhancements are planned:

– extend the set of GEC products stored in the ImageDB also to sites outside Europe
– repeat periodically (e.g. annually) the European coverage of the GEC products
– store in the database and handle through DESCW the keywords, documents or links associated with the images
– create specific subsets of images, text, documents and hyperlinks for loading onto CD-ROMs
– handle multi-temporal and mosaicked images
– implement a web-browser interface.

Access through DESCW
The DESCW software and related inventory files (updated weekly) are available off-line (see 'Support' below) or on-line at the ESA/ESRIN server, from where they can be downloaded for free installation and updating. Downloading can occur through:

– **FTP access**

Address	earthnet.esrin.esa.it
Username	anonymous
Password	(please enter your e-mail address)
Directory	/FTP/software/descw

– **World Wide Web access**

  http://earthnet.esrin.esa.it

  Please follow 'Software Gallery' and then 'Software to Obtain Satellite Earth Coverage'

– **BackWeb**

  BackWeb is a client-server application that permits one to send data via the Internet from a server to all clients who have subscribed to a specific 'channel'. It applies data-push technology using idle on-line time and check-point/restart (after a break, the transmission resumes from the point of interruption, even if the break is due to switching-off of the computer). The BackWeb software is free of charge and can be downloaded for a specific platform from the address:

  http://www.backweb.com

  Once the BackWeb client is installed, it is necessary only to subscribe to the DESCW channel from the location:

  http://earth1.esrin.esa.it/backweb

Support
Requests for support with ImageDB-related activities can be submitted to:

ERS Help Desk
ESA/ESRIN
Via Galileo Galilei
I-00044 Frascati
Italy

Tel: +39-06-94180777
Fax: +39-06-94180272
E-mail: eohelp@mail.esrin.esa.it   **esa**