

## THE EON2000 PROJECT - PROMOTING EARTH OBSERVATION DATA WITHIN HABITAT MONITORING

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### ABSTRACT

Natura 2000 is the title for the network of areas designed to conserve natural habitats and species of plants and animals which are rare, endangered or vulnerable in the European Community. The term Natura 2000 comes from the 1992 European Commission (EC) Habitats and Species Directive which symbolises the conservation of precious natural resources for the year 2000 and beyond.

Earth Observation for Natura 2000 (EON2000) is a three year pilot project partly funded under the CEO component of the EC Framework 4 Environment and Climate Programme. The two main purposes of the project are (1) to integrate the use of Earth Observation (EO) data into nature conservation management and monitoring at a European level, using WWW, image processing and Geographical Information System (GIS) technology; and (2) to introduce EO data to new users through the services and structures of the Centre for Earth Observation (CEO). EON2000 concentrates on forest habitats which are important to the participating countries (Caledonian Forests for Scotland, Alpine Coniferous Forests for Austria and Boreal Forests for Finland).

After the pilot phase, the team expect to extend the project to monitoring other habitats.

### 1. INTRODUCTION

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The Directives are a major contribution by the European Community to implementing the Biodiversity Convention agreed at the 1992 Rio Earth Summit. The Habitats and Species Directive aims to contribute to the conservation of biodiversity by requiring Member States to take measures designed to maintain or restore certain natural habitats and wild species at a favourable conservation status in the community, giving effect to both site and species protection objectives.

Earth Observation for Natura 2000 (EON2000) is a three year pilot project partly funded under the CEO component of the EC Framework 4 Environment and Climate Programme. The two main purposes of the project are (1) to integrate the use of Earth Observation (EO) data into nature conservation management and monitoring at a European level, using WWW, image

processing and Geographical Information System (GIS) technology; and (2) to introduce EO data to new users through the services and structures of the Centre for Earth Observation (CEO). EON 2000 allows the customer to apply modern satellite remote sensing techniques, without the need for knowledge about the acquisition or processing of satellite data, to extract information from the data.

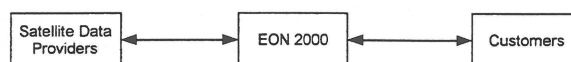


Figure 1. EON2000 System Interaction

The main interactions of the system at the highest level (Figure 1) are the:

- **interaction between the system and customers** to get information about the customer and his needs, to give (potential) customers information about the system and its capabilities, to obtain ancillary information from the customer and to deliver results to the customer.
- **interaction between the system and satellite data providers** to search for satellite data and to order data.
- **internal functions:** management of the system, the customers and the data, processing of the data and generation of reports, data types and volumes.

### 2. PARTNERS & CUSTOMERS

The partnership is comprised of four European organisations; National Remote Sensing Centre Ltd. (NRSC), UK; GeoSpace, Austria; University of Joensuu, Finland; and Scottish Natural Heritage, UK.

Customers for the project are the national conservation agencies responsible for the implementation of the Natura 2000 concept which requires monitoring of the conservation status of natural habitats. They therefore require detailed information concerning land cover changes. EO data provides coverage of a wide area at low cost. This will provide a valuable additional source of data to traditional forms of ground data collection.

Customers already identified include; Scottish Natural Heritage, UK; Federal Environment Agency, Austria; Government of Federal County of Salzburg, Austria; Department of Nature Conservation, Austria; Management of National Park Hohe Tauern, Austria; North Karelia Regional Environment Centre, Finland. EON2000 concentrates on forest habitats which are important to the participating countries (Caledonian Forests for Scotland, Alpine Coniferous Forests for Austria and Boreal Forests for Finland).

The customers have expressed the following information requirements (at workshops held in Austria, Finland and Scotland):

- strategic information on natural habitats for reporting purposes
- operational information for management of Natura 2000 sites

Strategic and operational information is needed for inventory (forest, non forest, species and age classification), surveillance (forest habitat development and expansion, non forest habitats) and protection (detection, assessment and causality of incidents, monitoring for recovery, land use management change and topographic / structural changes).

### 3. SYSTEM ARCHITECTURE

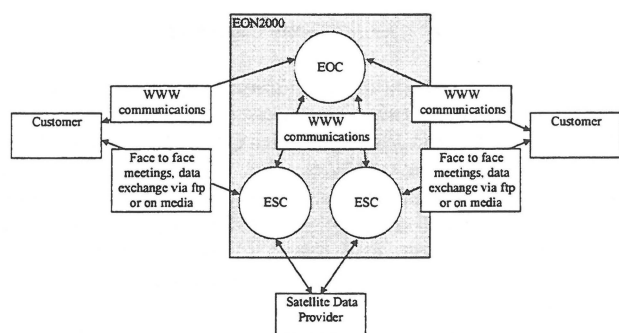


Figure 2. System Architecture

EON2000 (figure 2) is constructed at two levels:

- EON2000 Centre (EOC)
- EON2000 Service Centres (ESC)

#### 3.1 EOC

The EOC is a central facility responsible for the distribution of general information about the system and a store for all customer specific information. The centralised EOC holds the web server and the system database. The EOC provides a central gateway to the EON 2000 web site and a platform for the information exchange, such as processing guidelines and quality assessment guidelines, between the operational parts of the system. The Sybase central database stores all customer information and site and image details. Data can be entered into the database through the web pages by the customers or the ESC's.

#### 3.2 ESC

Several ESC's across Europe will be linked to the central EOC. The ESC has three areas of functionality; (1) customer activities to determine their site requirements, data processing activities, and reporting; (2) off-line contact with satellite data providers to search for data that will meet the customer requirements; (3) On-line communications with the EOC to access procedures and guidelines and gain access to the database through the web pages.

### 3.3 Information Channels

An important aspect of the system structure described above is that the customer interacts both with the EON Centre and with the EON 2000 Service Centres. The EON Centre is responsible for the on-line interactions (i.e. access to the system via web pages to obtain general information on the system and on-line versions of reports), the EON Service Centre for the off-line interaction (assistance during the specification of sites and requirements, general advice on the use of the system, etc.). The ESC's across Europe communicate with the central EOC via the WWW.

The interaction with the customers and the distribution of information to the customers shall be done preferably online (WWW). However, the system has to take into account that a significant proportion of the (potential) customers do not have the capability of online access, be it for technical reasons or as a consequence of company policy (e.g. for security reasons). So in all cases off-line distribution channels have to be provided (i.e. fax, phone, CD-ROM). The availability of on-line distribution channels depends on whether it is technically feasible (e.g. transport of large data volumes) and whether it is reasonable (it is important e.g. to have direct contact with customers to assist them defining sites and requirements). For the future development of EON 2000 it is planned to further increase the part of on-line data exchange.

### 4. EON 2000 USERS

The EOC system design defines a number of types of user:

- **browser user** (*public access pages*)
- **public customer** (*registered user - restricted public access pages*)
- **private customer** (*registered customers - private clients access pages*)
- **consortium member** (*private consortia access pages*)

#### 4.1 Browsing User

These users are interested in satellite products or environmental monitoring. The Public Access Page details information about the project and provides access to the consortium members home pages and public domain images. A user is also able to register on a mailing list which will give them access to partially restricted web pages and images. A user may also register his interest in becoming a client, i.e. a purchaser of EON 2000 products. A Public Area General Mail Back form is available to allow a user to send messages to the consortium.

#### 4.2 Public Customer

Registered users will be able to access restricted imagery through password controlled web pages.

#### 4.3 Private Customer

Registered customers will have their own private web pages, an image/product database within the EON 2000 web site, and a Clients Reply Form which allows members to post general messages to the consortium. These pages are password controlled and can be accessed by the consortium members and the individual client only.

#### 4.4 Consortium Member

Private web pages accessible only by consortium members allowing access to and updating of a consortium bulletin board. Consortium members also have access to all web pages, plus the consortium pages (system operation information) which provide procedural guidelines and methods to communicate between EOC & ESC's.

In general, the access rights are restricted to the owners of the data, i.e. customers registered on the system and allowed to define sites and requirements (*Private Customers*). Private Customers can make parts of their data public, these data and standard products are accessibly by a second category of registered customers (*Public Customers*). *Unregistered customers* have access only to general information about the system and to a system demo.

Registered Private and Public Customers are members of the EON 2000 mailing list which via emails actively informs them on news concerning the system in a wider sense (such as information about new remote sensing techniques). These emails are stored in an archive accessible via a web page. The web page structure for the various users is illustrated below in Figure 3.

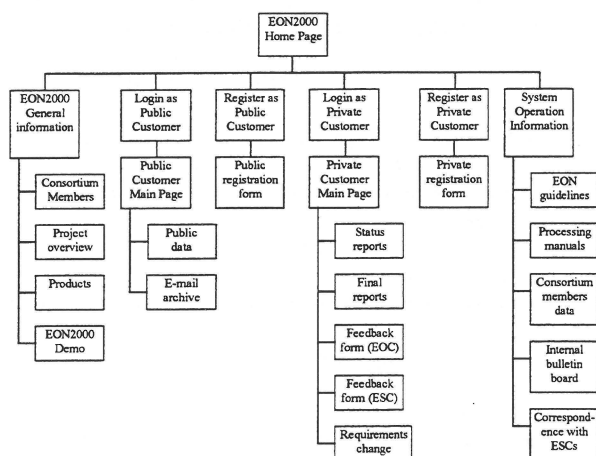


Figure 3. Web Page Structure

A general user has four options when accessing the EON 2000 home page:

- register as public customer
- login as public customer
- register as private customer
- login as private customer

#### 4.5 Register As A Public Customer

The user completes a WWW EON 2000 registration form containing their company and contact details. The EOC will then automatically email the customer with their new user name and password.

#### 4.6 Login As Public Customer

Once a user has received a user name and password they can log on to the Public Customer WWW pages. These include the

restricted imagery and the email archive which contains the latest information on the EO developments.

#### 4.7 Registering As A Private Customer

In addition to emailing the customer their user name and password the EOC will determine which is the most suitable ESC to meet the customer requirements. In general, the ESC will be selected on a geographical basis (an ESC from the same country as the customer, or the nearest ESC to the customer), but if necessary any ESC can be selected (e.g. if the customer prefers a special ESC or if the capacity of the scheduled ESC is insufficient). The ESC will arrange a meeting with the customer to determine their requirements, to give advice on the specifications of the sites and information on how to make the best use of the system.

#### 4.8 Login As A Private Customer

After determining all the customer requirements the ESC will enter the details into the database (held at the EOC) via the web pages. The EOC then generates a HTML page accessible only by the Private Customer. This page contains the customer details extracted from the database and links to the customer bulletin board, email archive and their site information. The site information will hold details of their requirements, imagery ordered, processing status and final reports.

### 5. DATA ACQUISITION & PROCESSING

Once the customers have selected a site, vector data will be digitised from topographic maps. Polygons defining the areas of interest will be digitised followed by any polygon, line or point features of secondary interest such as rivers, fences etc.

An image archive search, including CEO services, will be completed to acquire available image data. Where possible associated habitat records will also be obtained. For each of the chosen test sites three new EO images will be acquired each year. The times of year will be selected by each country but should a potential catastrophic event such as a storm occur then imagery can be ordered immediately. This will provide a catalogue of data, over the project duration, for change detection analysis against baseline data on each image. Historical imagery, where available, may also provide useful input to the analysis.

The data processing can begin once the imagery, aerial photography and vector data (topographic information, administrative information, biotop maps, etc.) have arrived at the appropriate ESC. The ESC will use the digital procedures held on the web pages at the central EOC to guide then through the correct processing stages. The data assimilation is a combination of image processing and GIS analysis. The image processing will be carried out using ERDAS Imagine software. The GIS functionality will use the ESRI ARC/INFO software. All processing will be carried out on SUN workstations. The status of the processing will also be entered into the central database, via the web. This allows the user to log onto their private web pages and obtain an automatic status report, detailing the state of the processing to date.

Two methods of image processing are shown in Figure 4. The left hand route treats images individually carrying out

illumination correction, image classification and filtering, fragmentation and post classification comparison. The second route carries out relative calibration on the selected images, generating a difference image and a multi-temporal classification. The images are then filtered. Presentation statistics are generated for both sets of resulting images.

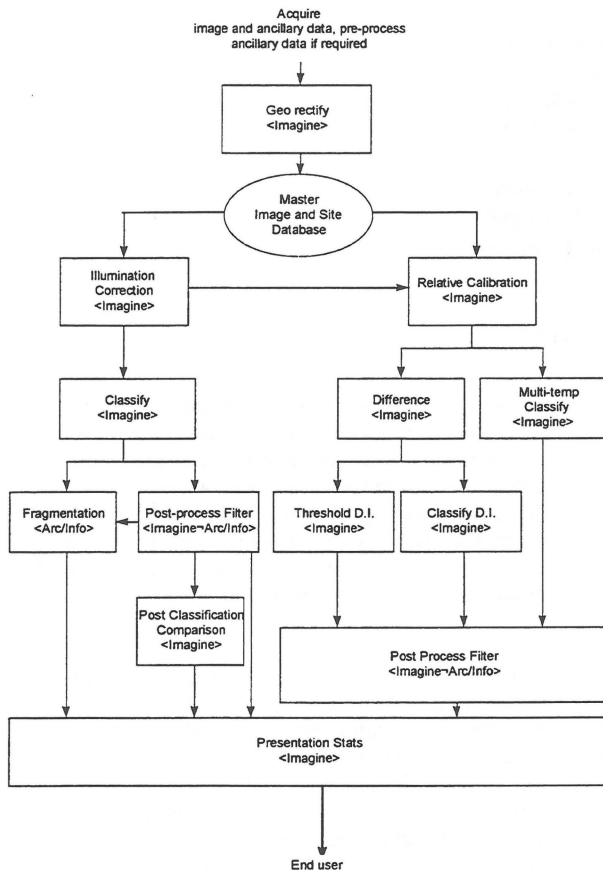


Figure 4. Image Processing Methods

### 5.1 Data Types And Volumes

The project will use satellite data collected over the customer sites. The preferred data will be SPOT or TM but ERS-SAR, Radarsat, JERS-1 will be considered if necessary, in particular with respect to cloud cover over test sites. The aim is for a total of 9 images per site plus ancillary data, supplemented by ground survey data. Additionally, digitised map and ground survey data will be used for each site. The exact nature will vary with the precise site location to be determined during the customer requirements analysis phase.

### 5.2 Reporting Mechanism

Once all the data has been processed the ESC will generate a final report which will contain all the responses to the customer requirements. Both the reports and the imagery will be held on the FTP server at the ESC. The EOC web pages for the customer (see figure 5) will be updated with the imagery and report details and a link for the information generated to the FTP server. A GIF version of the imagery will be displayed on the web. The user will also be able to download the final report

directly from the web and request the imagery be sent on suitable media.

Preferably, interaction with customers and distribution of information will be done on-line via the WWW. However a significant number of potential customers will not have online access. In all cases, the system will provide the possibility of off-line distribution channels (e.g. fax, phone, CD-ROM). In the future, it is envisaged that the EON2000 system will increase emphasis on on-line data exchange.

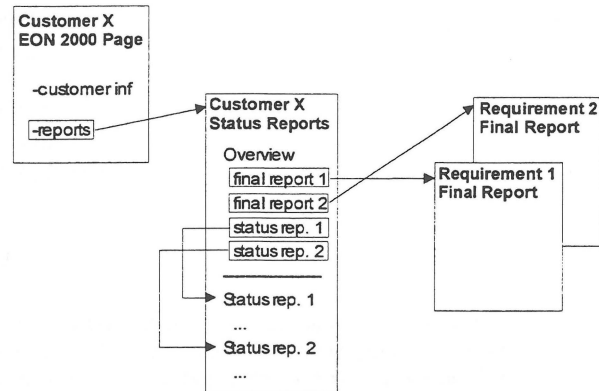


Figure 5. Web Page Report Structure

## 6. EON 2000 CURRENT STATUS

EON2000 is a three year pilot project with two years left to run. The public web page functionality is operational. The public and private customer web pages are currently being developed and will be ready for the initial customers use in the autumn. The EON2000 web site which illustrates the project and details the partners and customers can be found at <http://geospace.co.at/EON2000.html>.

The main innovation for this project will be in the introduction of Earth Observation data to monitoring habitats, without which effective monitoring would be prohibitively expensive. Earth observation derived data and information will also be introduced into the customer's decision chain. The customers being those organisations responsible for Natura 2000 sites. The current methods of habitat monitoring rely on ground survey and/or aerial photography. These methods are expensive and hence tend to have a low temporal frequency. The proposed system will be an advance on current practice by targeting ground survey resources, permitting frequent monitoring, improving accuracy and cost effectiveness, and using the WWW to effectively promote applications of spaceborne Earth observation.