Integration of the CBERS catalogue in the eoPortal

Vanessa Cristina Oliveira de Souza
Division of Image Processing – DPI
National Institute for Spatial Research, INPE
São José dos Campos, Brazil
vanessa@dpi.inpe.br

Gilberto Câmara
Division of Image Processing – DPI
National Institute for Spatial Research, INPE
São José dos Campos, Brazil
gilberto.camara@inpe.br

Abstract— **The cooperation between the Brazilian and Chinese governments established in 1988 led to the development of imaging satellites, which help monitor the natural resources of both countries. In Brazil, the CBERS program includes a policy of free distribution of the images, first inside the national territory and, more recently, to other countries. This distribution is done through a catalogue available on the Internet. The current catalogue is built on a structure based on PHP scripts and mysql relational database. The catalogue's search interface does not have an editing map, a geo-coding system and file upload. Although the catalogue provides data from many sensor systems, the searches are not multi-sensor. The eoPortal is a geoportal and the main entrance of an architecture, issued by ESA, called Service Support Environment (SSE), in which the users and the service providers can interact automatically and dynamically. The objective of this work was to integrate the CBERS catalogue in the eoPortal through the implementation of a web service. With the integration, the CBERS catalogue received a robust computational platform, a more flexible interface and greater visibility.**

Keywords- CBERS catalogue; integration; eoPortal; geoportal;

I. INTRODUCTION

A geoportal is the human interface for a collection of online geo-spatial information, including a set of data and services. Technically, geoportals are sites connected to web servers that issue metadata on their geographic data or services [1,2]. For Tait [3], geoportals provide functions capable of searching for, mapping, publishing and managing geographic information.

Many geoportals provide, as a set of data, satellite images and, as services, catalogues in which the information can be accessed. These catalogues do not have any interface patterns and are not connected to each other. It becomes difficult for the user to interact with different interfaces and to find the catalogues on the web, as the current search engines were not designed to find geographic information. Therefore, the user must find the catalogues, learn how to use them and, later, combine the data manually.

In this context, a geoportal from which different image centers scattered around the world could be accessed, and in which the particularities of each are made clear to the user, is desirable.

The Instituto Nacional de Pesquisas Espaciais – INPE (National Institute for Spatial Research) is today one of the biggest distributors of online remote sensing images in the world [4]. The CBERS program, developed in collaboration between the Brazilian and Chinese governments to produce imaging satellites, has already distributed thousands of scenes since July of 2004, when the policy of distribution through its Brazilian catalogue was implemented [5].

The objective of this work was to integrate the CBERS catalogue in the eoPortal. The aim of this integration was to give greater visibility to the catalogue and to build a computational platform so that the other CBERS receptor stations can issue their scenes in the same environment and in the same interface.

Another important aspect of the integration will be to incorporate the eoPortal's metadata[1] search and presentation interfaces, as the current CBERS catalogue uses a search interface that does not have an editing map or a geocodification system and does not allow for file uploads. Although the catalogue provides data from diverse sensor systems, the user searches allowed are not multi-sensor. The interface for publishing the metadata does not have a reference map and the metadata presented are minimal.

In session 2 will be presented the state of the art. In session 3 will be presented integration framework (SSE). At session 4, will be presented the current architecture of the CBERS catalogue. In session 5, the integration of the CBERS catalogue in the eoPortal will be presented. At

---

[1] Interface that presents the scenes information returned by the search in the catalogue.

section 6, results and discussions will be presented. Finally, at section 7, will be presented the conclusion.

II. STATE OF THE ART

Data integration is the problem of combining data from different sources, offering the user a unified vision (global scheme), and of defining a set of searches that determines how to obtain each element of the global scheme in function of the data stored in the local sources [6,7].

Web Services are, currently, the most promising way of integrating applications on the Internet [8]. According to W3C [9], web services (WS) are "applications identified by a URI whose interfaces can be identified, described and discovered by XML documents. A WS can support direct interactions with other softwares using XML messages, which are exchanged via Internet based protocols". XML is a programming language designed to codify data and information on data (metadata).

The framework of web services is divided into three areas: communication protocol, description and discovery of the services [8]. Each of these areas generates a pattern. The communication protocol pattern is SOAP (Simple Object Access Protocol). The service description is standardized by WSDL (Web Services Description Language) and the service discovery by UDDI (Universal Description, Discovery and Integration). In sum, XML is used to codify the data, SOAP to transport them, WSDL is used to describe the services available and UDDI to list which services are available [10].

III. INTEGRATION FRAMEWORK - SSE

The eoPortal is the main entrance of an architecture issued by ESA called Service Support Environment (SSE) (Figure 1), where the service providers and users can interact automatically and dynamically. In the portal, the providers register their services and data, and the users access them [11].

The SSE is a system open to remote services integration whose domains are focused on observing the Earth and on the geographic information systems. The system allows for web services integration without it being necessary to re-compile or re-design it [12]. Its architecture is constituted of a set of functionalities, components and gateways, resulting in a distributed environment oriented towards services. This architecture for data distribution and discovery is open, scalable, and robust. The Interface Control Document (ICD) defines the SSE's external interfaces, particularly the interfaces between the SSE Portal and the remote services provided by the servers. These interfaces constitute the global scheme or unified vision of the data integration system. For this work, the

most relevant interfaces are ESRIN EOLI [13] and MASS [12]. EOLI defines the messages that are exchanged between the SSE and the image catalogue services, which implement the search and present operations. MASS defines various operations, among them the order operation.
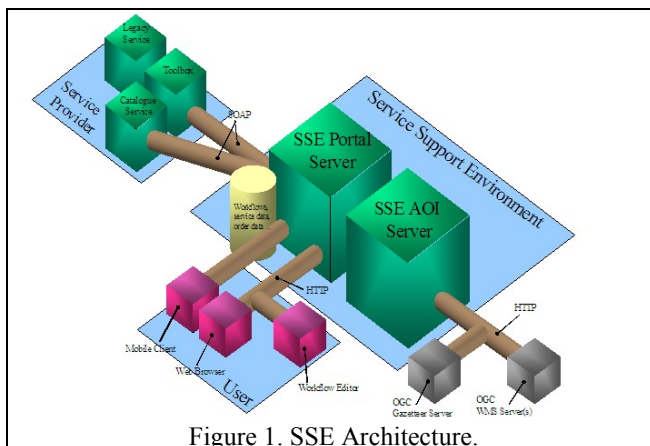

Figure 1. SSE Architecture.

The search operation is used to execute a search in the catalogue. It returns a set of scenes to the search parameters. The present operation details a specific scene, already returned by the search operation. The order operation carries out a scene order.

For the services to be integrated using the SSE's infrastructure they must reveal their SOAP interface, according to the ICD. The Toolbox [14] is an environment developed to help servers create their services, which is done by converting these services into SOAP based ones. The servers are required to write a set of scripts in the Toolbox, which is responsible for executing these scripts and returning the results. Toolbox runs on the Apache Tomcat server.

IV. CURRENT ARCHITECTURE OF THE CBERS CATALOGUE

The current CBERS catalogue is built on a structure based on PHP scripts and MySQL database, and functions according to Figure 2.

V. INTEGRATION OF THE CBERS CATALOGUE IN THE EOPORTAL

To carry out the integration, a web service was created to communicate with the SSE. This web service was generated using the Toolbox. After generating the services, it is necessary to generate the operations. The search and present operations were generated in compliance with the ESRIN EOLI interface, forming the basis of the images

catalogue and allowing the user to search for them. In compliance with the MASS interface, the order operation was created to allow the user to order a scene in the catalogue through the eoPortal.

Figure 2. Architecture of the CBERS catalogue.
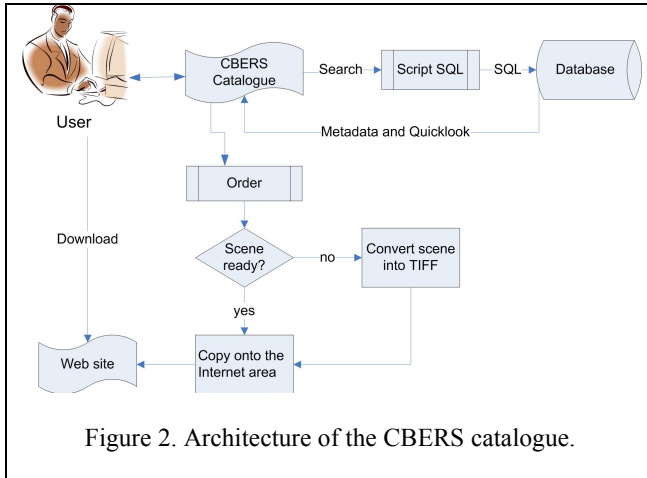
In Figure 3, the Geoportal represents the eoPortal. The user makes a search in this geoportal, which sends it to the CBERS web service via SOAP. The CBERS web service's basic function is to decode the XML message sent by the eoPortal with the search parameters executed by the user. After decoding of the parameters, a search is generated in SQL, which is sent to the catalogue's MySQL database. The database's responses are encapsulated in a new XML message, sent to the geoportal and presented to the user.

The coding and decoding of the message from the eoPortal was done using XSL (eXtensible Stylesheet Language) and XSLT (eXtensible Stylesheet Language for Transformations), both XML derived languages. The function of XSL is to transform the parameters, received from the SSE Portal interface in XML format, into SQL. The XSLT, on the other hand, is responsible for transforming XML documents into other XML documents, mapping the entrance parameters and the results of the search in the content of the SOAP messages.

To be integrated, the service must be running correctly on the Toolbox, in a local server. When a user accesses the service in the eoPortal, it sends a SOAP message to the local server. It is this server that executes the scripts and then sends the XML response, encapsulated in a new SOAP message, back to the eoPortal, which presents the results to the user.

Figure 3. Functioning of the implemented service.
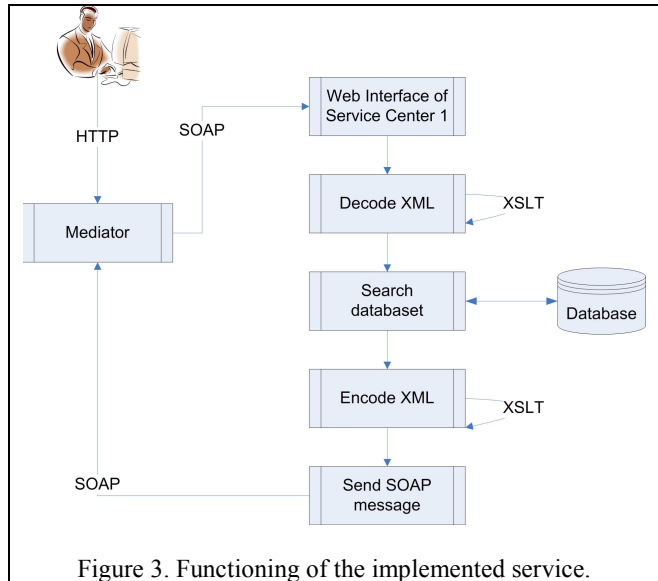
VI.   RESULTS AND DISCUSSION

The CBERS catalogue was integrated in the eoPortal using the whole SSE architecture. The images issued by the service refer to sensors MSS, TM and ETM of the Landat platforms 1, 2, 3, 4, 5, and 7, the CBERS 2 sensors CCD, IRM and WFI and also the CBERS 2b sensors CCD, HRC and WFI.

The functioning of the search and present operations is shown in Figure 4. In the case of the search operation, the user executes a search in the eoPortal, choosing parameters such as area of interest, sensor, date and cloud cover. These parameters are encapsulated in a SOAP message by the SSE and sent to the CBERS web service, physically located at the INPE. The scene's metadata recovered from the database are translated into XML, in compliance with EOLI. The XML generated is encapsulated in a SOAP message by Tomcat and sent back to the SSE, which applies a style to the message, codifies the coordinates of the scene in GML[2] and presents both the textual data and the graphs in the eoPortal.

The present operation follows the same scheme as the search. However, in this operation, the search parameter will always identify one single scene, and the response to the requisition made to the database contains a greater number of metadata.

The greatest difficulty in implementing these operations was mapping the metadata in the catalogue's

---

[2] *Geography Markup Language* is a language expressed in XML, designed to convey geographic characteristics.

database into the metadata required by EOLI. Some of the data had to be pre-processed into the format required by the interface.

With the integration, the CBERS catalogue gained a helpful and flexible interface for searching and presenting metadata. Through the eoPortal, the user can locate an area of interest using various methods, such as drawing points, polygons and circles over a reference map, uploading the file in shape format, typing in the area's coordinates or choosing the location through a gazetter. Through the eoPortal, it is also possible to carry out a multi-sensor search. In this way, it is possible, in the same search, to obtain TM/Landsat 5 and CBERS 2B CCD results.

Another advantage of the integration was the quality of the metadata presented by the eoPortal, in comparison to the current catalogue. After a search, the eoPortal presents in a clear way a reasonable number of metadata to the user. A large part of this information is also available in the current CBERS catalogue; however, to read it, the user must de adapted to the scene identifier's format.

Figure 5 presents the result of a search made in the eoPortal. The area of interest comprehends São Paulo state, sensors CCD/CBERS 2 and CCD/CBERS 2b, between January and September of 2008, and images with up to 20% of clouds. This search reflects the WS search operation, and its results can also be seen in Google Earth®.

Each scene returned by the search has its limits drawn over the reference map. The field 'percentage of overlap' tells the user the percentage of the scene area included in the area of interest. Sometimes, the search scenes outside the interest area are drawn. This is because the database used in the catalogue does not have spatial extension, which forces the SSE to draw an encompassing rectangle over the non-rectangular search areas.

Clicking on a scene's quicklook or on its identifier, the user is guided to the present operation's results page, which shows detailed metadata of the chosen scene. The more information on the scenes the catalogue's interface presents to the user, the more he/she will be sure of his/her choice, decreasing the risk of ordering scenes only to discover that they are not the ones desired (Figure 6).

The order operation follows the MASS interface's data model. In the way it was implemented, it receives, as entrance parameter, the identifiers of the desired scenes and the user's name and e-mail, and returns the scenes themselves through a link to the file stored on disk.

As the CBERS catalogue has a complex ordering operation which depends on accessing different engines and transforming the scene into TIFF, whenever necessary, the

order operation was implemented as shown in Figure 7. After the search operation, the user selects the scenes he/she wants to download and begins the order operation, placing the scenes in his/her cart. When the order is closed, both actions are executed by the script:

- Communication with the user in the eoPortal is finalized. The user is informed that the images ordered will be sent to the e-mail address given.
- The order, with the user's name and e-mail and the list of scenes requested, is sent to the existing CBERS catalogue. In this way, the entrance into the system is done in a non-canonic way, registering the user in the database and initiating the order as if it came from the current catalogue. From this point on, all communication with the user is done via e-mail by the current system. At the end of the process, the link with the web address in which the scenes were copied, is sent to the user's e-mail.

Figure 8 presents the result of a order operation made in the eoPortal. The order operation was implemented in this way for academic effects only. The eventual operating of orders via the eoPortal will require adaptations, such as restricting the users' access to the catalogue only if they are logged on the eoPortal. In this way, it is possible to obtain precise information on the user who is effectively using the catalogue. This information is necessary for the catalogue's managers to know their users' profile.

VII. CONCLUSION

The integration of the CBERS catalogue in the eoPortal makes it easier for the user to search for and recover images. For INPE, this integration decreases the effort of implementing and maintaining geographic web interfaces and allows data sources to be gathered in a single interface, since other image reception bases, such as the one in China and in Africa, can use the implemented service.

The greatest difficulty found in this work was the requirement of a complete knowledge of the tools and languages necessary for the integration. In total, an understanding of XML, XSL, WSDL, SQL and the tags defined by the Toolbox, is demanded. On the other hand, XML, and all the technology associated to it, is indispensible for this architecture to function with complete integration between the parts.

Currently, the catalogue is in the testing and adapting phase, prior to being open to all users. For now, it can only be accessed through passwords. Initially, it will be available only for search. Later, after evaluations that include the catalogue access number, the feasibility of placing orders via the eoPortal will be studied.
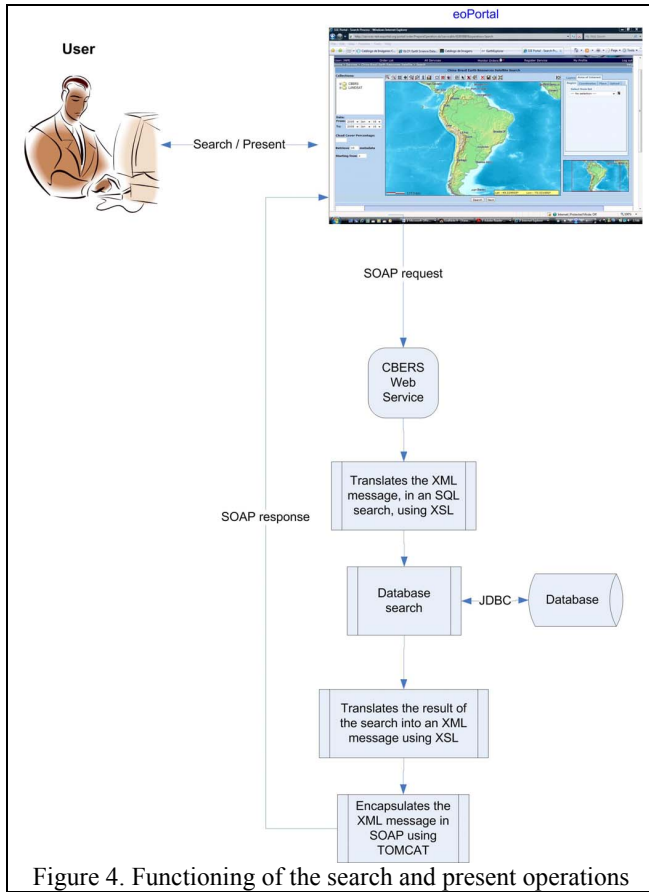
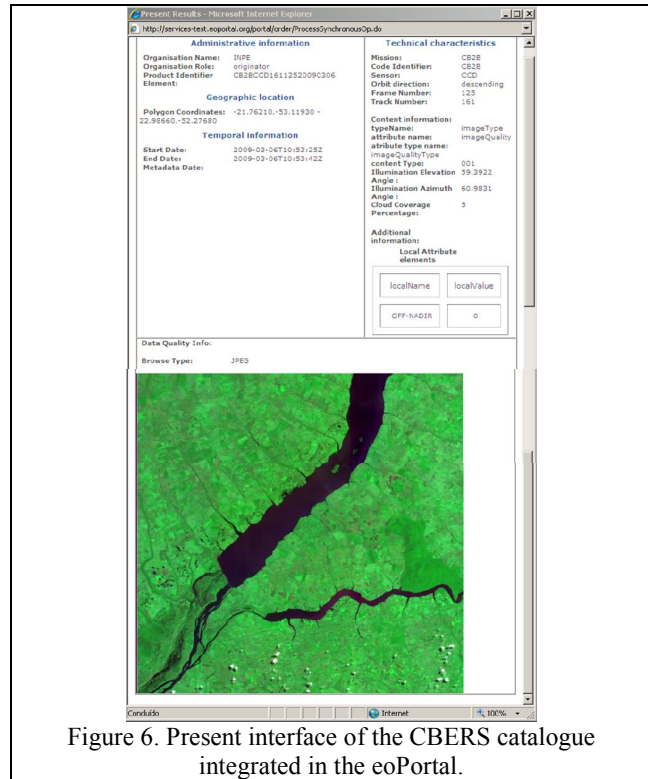Figure 4. Functioning of the search and present operations

Figure 5. Search interface of the CBERS catalogue integrated in the eoPortal.

Figure 6. Present interface of the CBERS catalogue integrated in the eoPortal.

ACKNOWLEDGEMENTS

REFERENCES

[1] OGC, Open Geospatial Consortium. Geospatial Portal Reference Architecture. 2004. Available in: < http://portal.opengeospatial.org/files/?artifact_id=6669 >. Accessed: Janeiro/2007.

[2] Maguire, D. J.; Longley, P. A. The emergence of geoportals and their role in spatial data infrastructures. Computers, Environment and Urban Systems, v.29, n.1, p.3-14, 2005.

[3] Tait, M. G. Implementing geoportals: applications of distributed GIS. Computers, Environment and Urban Systems, v.29, n.1, p.33-47, 2005.

[4] Souza, V. C. O. Geoportal Global para Centros de Imagens de Sensoriamento Remoto.2008. 99 p. (Mestrado em Sensoriamento Remoto) - INPE, São José dos Campos/SP.2008.

[5] INPE, National Institute for Spatial Research - CBERS's Catalogue http://www.cbers.inpe.br/.

[6] Lenzerini, M. Data integration: a theoretical perspective. Proceedings of the twenty-first ACM SIGMOD-SIGACT-SIGART symposium on Principles of database systems, Madison, Wisconsin, 2002.

[7] Lóscio, B. F.; Salgado, A. C.; Vidal, V. M. P. Using Agents for Generation and Maintenance of Mediators in a Data Integration System on the Web. In: XVI Simpósio Brasileiro de Banco de Dados, 2001, Rio de Janeiro - Brazil. p. 172 - 186.
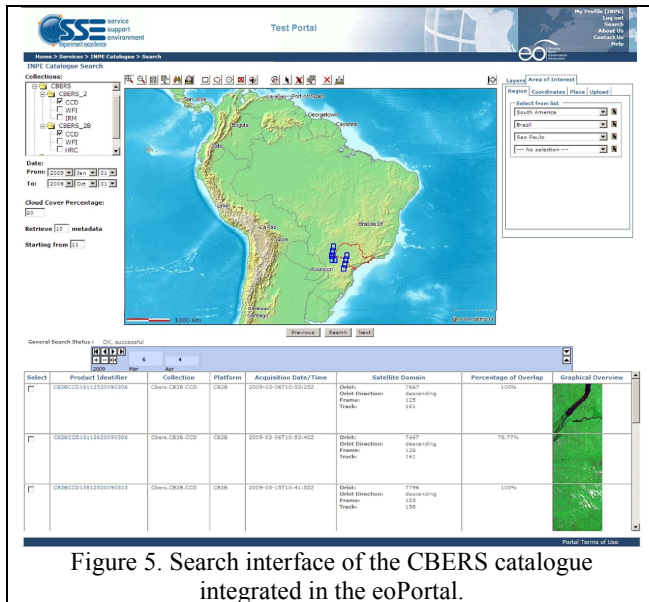
[8] Curbera , F.; Duftler, M.; R., K.; Nagy , W.; Mukhi, N.; Weerawarana, S. Unraveling the Web Services Web - An Introduction to SOAP, WSDL, and UDDI. IEEE Internet Computing, p. 8, Janeiro/2007 2002. ISSN 1089-7801.

[9] W3C, World Wide Web Consortium. Web Services Architecture Requirements. Web Services Architecture Working Group, 2002. Available in: < http://www.w3.org/2002/ws/arch/2/wd-wsawg-reqs-03262002.xml >. Accessed:12 de Mar. 2007.

[10] Alonso, G.; Casati, F.; Kuno, H.; Machiraju, V. Web Services - Concepts, Architectures and Applications. Verlag: Springer v.XX. 2004. 354 p. (Data-Centric Systems and Applications)

[11] SSE Team. SSE Infocenter. 2007. Available in: < https://services.eoportal.org/infocenter/index.jsp >. Accessed:: 12 de Jan. 2007

[12] SSE Team. SSE Interface Control Document. p. 156, 2006. Available in: < http://services.eoportal.org/massRef/documentation/icd.pdf > Accessed:: 12 de Dez. de 2006.

[13] Nencioni, P. Earthnet Online XML Front-End. 2006. Available in: < http://earth.esa.int/rtd/Documents/EOLI-XML-ICD.pdf. > Accessed: 17 de Jan. 2007.

[14] SSE Team. Toolbox. 2006. Available in: < http://mass.pisa.intecs.it/download/main.jsp > Accessed:: 12 de Dez. de 2006.
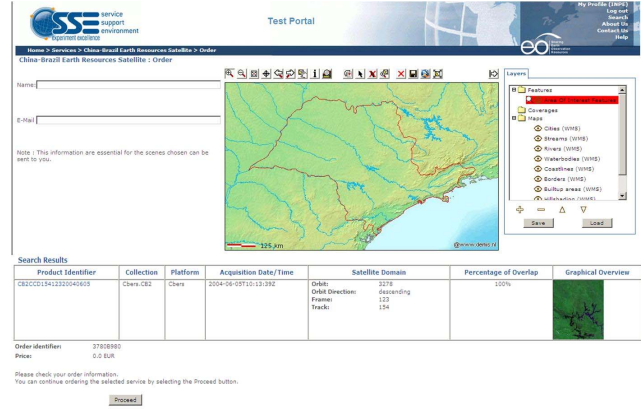
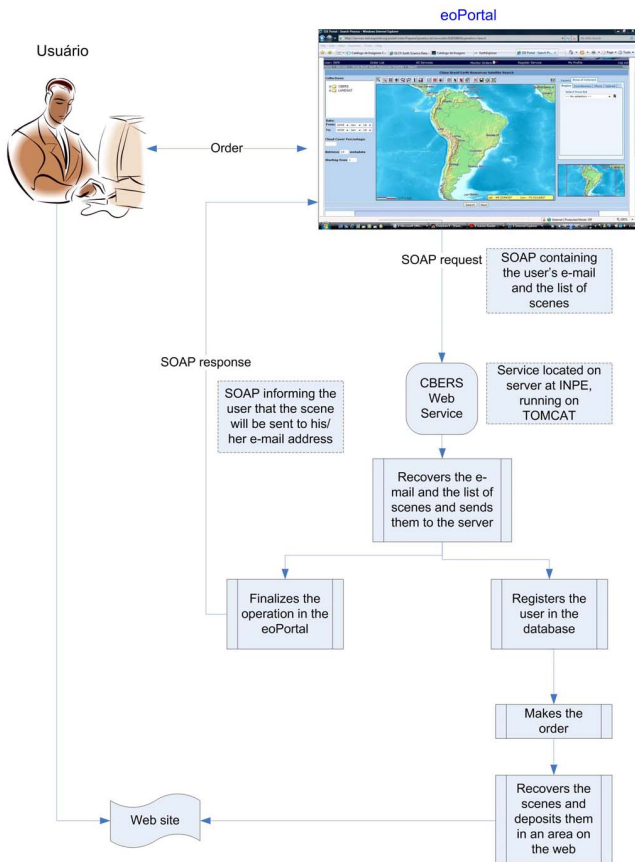Figure 8. Order interface of the CBERS catalogue integrated in the eoPortal.

Figure 7. Diagram of the functioning of the order operation.