FROM GRASSLINKS TO WEB PROCESSING SERVICES WITH GRASS GIS

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ABSTRACT

With increasing availability of geospatial data over the Web, there is a need to offer enhanced Web Services to users for data searching and sharing which have been largely standardized by adoption of WMS, WFS and WCS services and metadata standard. In this paper, we examine the ways and means to effectively implement WPS services in Web clients.

At first, we examine possibilities of integrating CGI script written in Perl and/or UNIX shell scripts in existing Web GIS clients. A Web GIS interface could improve better understanding for area information for both before and after data processing and analysis. Furthermore, we discuss the limitation of such integration and describe methods to provide more standardized services using Python programming environment and data exchange in GML format. The study will focus on implementing Web Processing Service (WPS) 0.4 compliance with draft of Open Geospatial Consortium. The advantage of Web GIS interface could allow the data processing to be limited to a specific area. The integrated Web client developed in this research handles both raster and vector processing and can be applied to offer availability of Web GIS solutions with analytical capabilities.

1. INTRODUCTION

Web mapping technology has been utilized for many applications. The various developments also improve an efficient use of applications. However, most of the developments focus on an accessibility of data. Thus, various applications show only statistic map from existing spatial data. Some application has analysis feature to make dynamic Web-mapping application by using a capable GEOS (Geometry Engine – Open Source) library with Postgresql/Postgis database server to query a spatial analysis such as intersection, overlap, within etc. Advanced spatial analysis is also possible by cooperation of Mapscript API with Postgresql/Postgis database server such as analysis of gas station within specific radius according to user input value. However, it is available only for each implemented server, thus, the sharing and accessing to spatial information and releasing from different system is impractical. Recently, Open Geospatial Consortium (OGC) launches a draft specification of Web Processing Service (WPS) to enable a standard method for processing data as a request from client to server.

This study describes how Web Processing Service benefits to dynamic Web-mapping application and in brief the interface. The utilization of Web Processing Service will be demonstrated with GRASS GIS.

2. GRASSLINKS SYSTEM

GRASSLinks is early implementation of interactive Web GIS with processing capabilities developed by The Regents of the University of California (REGIS). GRASSLinks is based on GRASS GIS functionality, which allows for sophisticated GIS functionality to be made available as CGI application. GRASSLinks allow user to select datasets and GRASS GIS functionality with any necessary parameters for processing then the result of process will be displayed as one of the dataset in that Web-mapping application. A utilization of DHTML and JavaScript technology also enhanced more interaction for GRASSLinks application as developed by Raghavan *et al* (2001). The application of GRASSLinks (http://gisws.media.osaka-cu.ac.jp/grasslinks/) is an online GRASS GIS command application that allow user to select functionality to process data and also brief description for necessary input parameter, which serves as a very attractive educational base for GRASS GIS users to self-learning about GRASS GIS function and investigate result.

Not only one processing functionality is available, but also the model of specific purpose that composed series of GRASS GIS function is available. Masumoto *et al* (2004) developed an online Spatial Information System for Geologic Modelling (SISGeM) that is capable of generating 3-D geologic models using data that is recorded in a field outcrop or derived by digitizing hardcopy geologic maps and visualizing horizontal sections at user-defined depths. Series of command such as *r.mapclac* and *r.reclass* are used during data manipulation and d.rast and *p.vrml* are used for generating an output file.

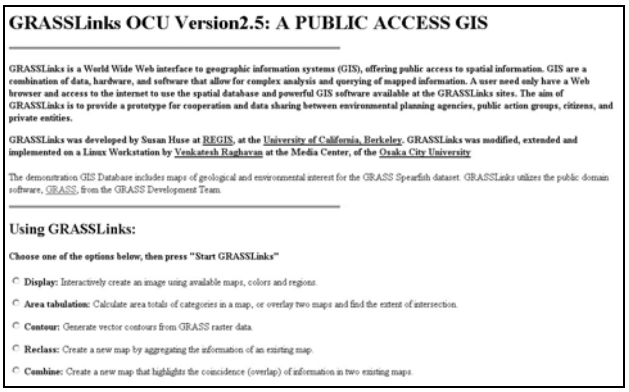

Figure 1. GRASSLinks menu showing various data processing options

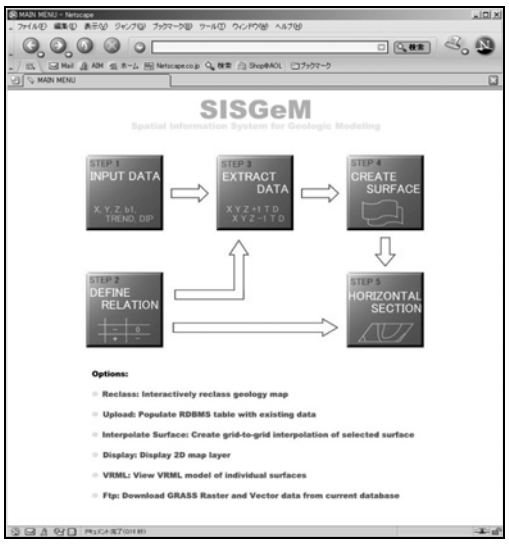

Figure 2. Web based procedure for generating 3D geology maps.

However, all of spatial analyses for dynamic Web-mapping application, including capabilities of GEOS library with Postgresql/PostGIS server and GRASSLinks procedure, are available only on each implemented server and has limited capabilities. Furthermore, the previous method is not available as open standards to help in implementing interoperable communication between different systems, which accelerate for sharing, and accessing spatial information. Thus, the new standards, which allow not only requests of system that spatial data are needed but also requests of process across any different system environment, could be applied for dynamic Web-mapping application and sharing spatial data.

3. WEB PROCESSING SERVICE

Web Processing Service or WPS, originally named Geoprocessing Service, is one of the specification from standards of OGC (Open Geospatial Consortium). Currently, WPS specification is still draft 0.40 version under OWS (OGC Web Services) specifications for standardizing GIS data communication. The specified Web Processing Service provides client access to pre-programmed calculations and/or computation models that operate on spatially referenced data. The data that are required by the processed service can be delivered across a network, or made available at the server. This data can use image data formats or data exchange standards such as Geography Markup Language (GML) or Geolinked Data Access Service (GDAS). The calculations can be simple as subtracting one set of spatially referenced numbers from another or as complicated as a global client change model.

The WPS interface specifies three operations that can be requested by a client and performed by a WPS server. Those operations are:

a) GetCapabilities – This operation allows a client to request and receive back service metadata (or Capabilities) documents that describe the abilities of specific server implementation. This operation also supports negotiation of the specification version being used for client-server interactions.

b) DescribeProcess – This operation allows a client to request and receive back detailed information about one or more process that can be executed by an Execute operation, including the necessary input parameters and formats, and the outputs.

c) Execute - This operation allows a client to run a specified process implemented by the WPS, using provided input parameter values and returning the output produced.

These operations have many similarities to other OCG Web Services, including the WMS, WFS and WCS. Many of these aspects that are common with other OWSs are thus specified in the Open GIS Web Service Common Implementation Specification [OGC 05-008].

4. BASIC CHAIN PROCESS EXECUTION

A WPS can be configured to offer any sort of GIS functionality to clients across a network. The Execute operation allows WPS clients to run a specified process implementation by a server, using input parameter values provided and returning the output produced. The outputs can be returned as a direct response to the request. On the other hand, the server can store the result as web accessible resources. In case the results are stored, the Execute response of request process will consist of a XML document that includes a URL for each stored output, which the client can use to retrieve those outputs.

The Execute response will be returned after process is completed. Alternately, the Execute response can be returned delayed according to process time that is needed for process execution. In that case, the Execute response includes information about the status of the process, which indicates whether or not the process has completed, as well as a status

URL. The status URL must return an updated Execute response. This status URL allows the client to ask the server if the process takes an amount of time to execute. The updated Execute response indicates the completion status of the process and a measure of the amount of processing remaining if the process is not complete.

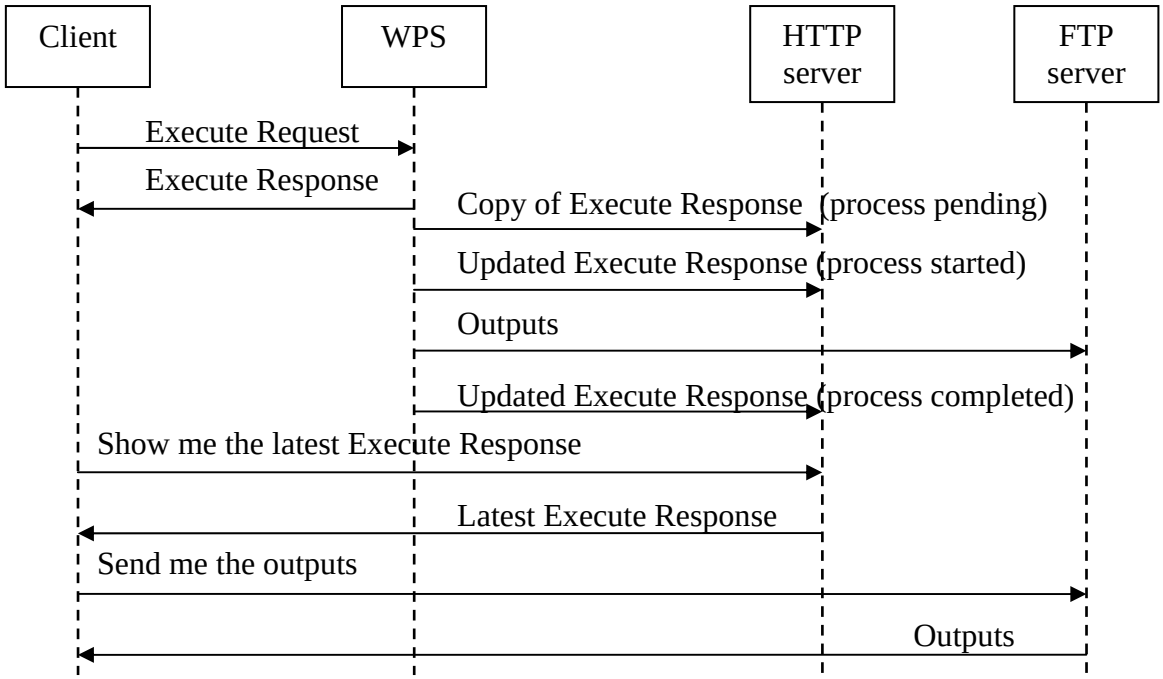

Figure 4. Activity diagram when client requests storage of results.

The basic chain of process can be configured by preparing a set of process commands. Some GIS analysis methods have to follow a series of method to achieve a final objective. This benefit could contribute to any spatial data model calculation, which needs series of command to generate a result of model similar to the SISGeM. However, only basic chain process can be done due to the limitation of pre-computation process that only input parameter from request URL and series of spatial data set result are available for further process. Thus, any dynamic parameter of processed result cannot be used as input parameter for subsequently process only actual spatial data set results are available.

5. WPS INTEGRATION WITH WEB-MAPPING CLIENT

Web Processing Service is still a very new international standard for sharing pre-computation service. The actual implementation could accelerate more sharing of spatial data and development of content and interaction for dynamic Web-mapping application. However, The benefit of WPS server can not be utilized without WPS supported client. Presently, the WPS client as a plug-in for JUMP (Java Unified Mapping Platform), desktop GIS application is available as shown on Figure 5. After execution of selected desired Execute Process with necessary input parameters, the result of the execution will be display as a new layer in JUMP application

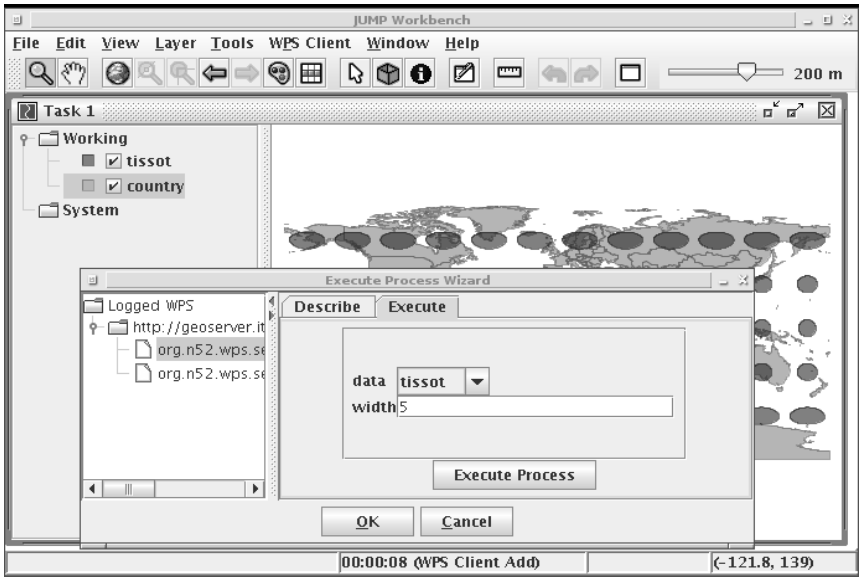

Figure 5. WPS client for JUMP application.

However, few Web application support WPS standard as most of them are not available as Open Source Software. Many of the open Web-mapping clients that are comprehensive and ready-to-use for Web-mapping application as well as, which serve as a convenient framework for building advanced and customized applications are available such as CartoWeb, Mapbuilder, Appformap, Kamap etc. Several OWS standards such as WMS and WFS standards are also supported by these open Web-mapping clients. The open Web-mapping clients are Free/libre and Open Source Software that can help in improving existing Web-mapping clients by integrating various new web technologies to provide a richer GIS experience as Sarawut *et al* (2006) improved Appformap Web-mapping client to support 3D Web-mapping client that provide realistic visualization of spatial information using X3D technology. The integration of WPS standard support in open Web-mapping client could benefit to Web-mapping application developers and also accelerate the utilization of WPS server. However, various challenging aspects to develop the open Web-mapping clients are available. For example, the independent type and numbers of necessary input parameter for each executed process could be automatically interpreted from DescribeProcess result.

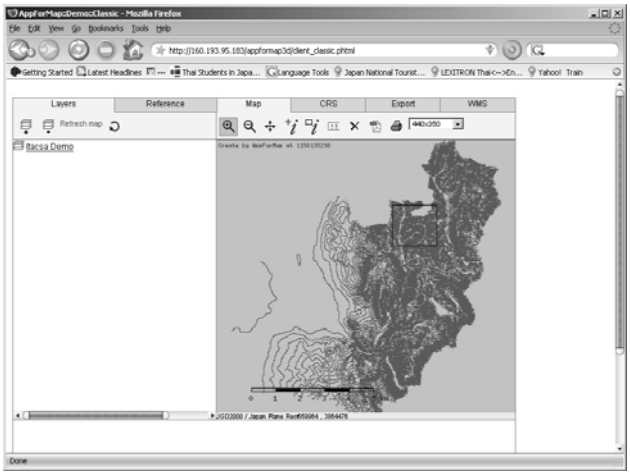

Figure 6. Appformap interface for support 3D visualized request.

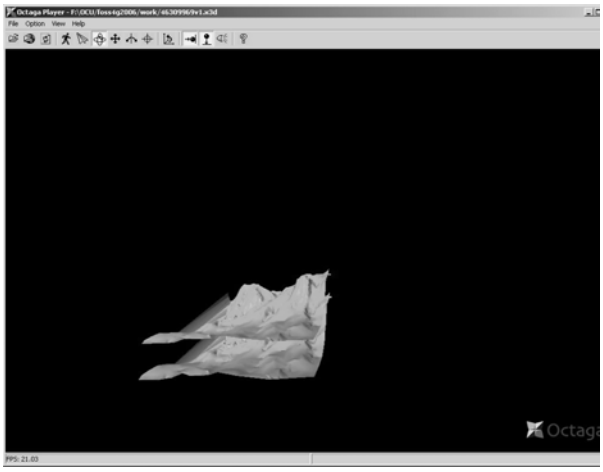

Figure 7. X3D visualizion of spatial information.

6. CONCLUSION

The implementation of Web Processing Service instead of GRASSLinks application introduces a new international standard to identify the spatially-referenced data required by the calculation, initiate the calculation, and manage the output from the calculation so that it can be accessed by the client. The available of technology could introduce more usage of geospatial data for modeling and analysis.

WPS standard is very new international standard. The actual implementation of WPS is less common due to the less of available resources such as Web-mapping client that support WPS. Thus, the comprehensive Web-mapping clients that support all OWS standards (such as WMS, WFS, WCS and WPS) and ready-to-use need to be developed to promote the development of dynamic Web-mapping applications and accelerate the utilization of Web Processing Service.

7. REFERENCES

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