Spatial Cloud Project

Spatial Cloud Geoprocessing

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Project Description

We propose to develop geoprocessing services and standalone client to utilize the cloud computing and WPS services to support Earth and geography science communities funded by the Federation of Earth Science Information Partnership (ESIP). Intensive computing is highly demanded for supporting geospatial processing. However, the bridging between generic computing and geospatial processing is a critical issue for Earth sciences. Through the development of kernel GIS functionalities with standards, e.g. buffer, overlay, intersect, we can compose any sort of functionalities to process any intended applications across different domains. OGC Web Processing Service (WPS) is such a standard way to offer GIS functionality to users within network and has been an important element of geospatial processing service cloud. This research will develop several GIS spatial analysis functionalities based on WPS, and deploy those WPS processes with CISC cloud computing infrastructure as a cloud service which can be accessed online and compose geospatial functionalities by Earth Scientists. The study case, analyzing the impact of dust storm on public health in Arizona and New Mexico, is used to demonstrate the advantages of utilizing cloud computing and WPS to support geospatial analysis on line.

Technical approach

WPS. Web Processing Service (WPS) (Figure.1) is a new standard way to provide distributed GIS functions to clients in the network, instead of on local computers. WPS interface standardizes the way to process and describe their inputs/outputs, the way how a client can request the execution of a process, and how the output from a process is handled. Those spatially referenced data can be any kind of data as required by the processes. A WPS service can define a bunch of processes. The specific processes are defined/programmed by the owner of that WPS implementation. WPS has three operations: GetCapabilities, DescribeProcess, and Execute. GetCapabilities returns the metadata of the service; DescribeProcess describes each process in the service and the input/output of each process; and Execute implements the processes and returns the output of the implemented process. WPS process can be simply developed by some platform, such as 52°North Web Processing Service. It enables the deployment of processes and it is a pluggable architecture which connects the deployment with GeoTools, GRASS, OpenLayer or ArcGIS, etc.

In our proposal, some basic GIS functions, such as reprojection, buffer, overlay etc, will be provided. Cloud computing. SCGI is the geoprocessing supported by cloud computing. The basic concept of Cloud Computing is the use of the web or software applications, data storage and computing powers through the Internet. It is a way of computing in which typically scalable resources are provided as a transparent service for users over the Internet. Cloud computing has four features: 1) On-demand Self Service. Customers are capable to upload, build, deploy, schedule, manage, and report on their cloud services on demand. Therefore, scientists can focus on mission success without worrying about the stability and availability of your computing infrastructure. 2) Reduce Cost. Users and Enterprises do not have to invest hardware or software utilities and reduce their administration and maintenance costs of the underlying physical resources. 3) Reliability. Advanced and improved network infrastructures and datacenters are utilized. 4) Measured services. Customers need to pay what you use. Consumers pay for only what resources they use and therefore are charged or billed on a consumption-based model. 5) Device and Location independent resource pooling. Customers are able to access systems using a web browser regardless of their location or what device they are using (e.g., PC, mobile). 6) Scalability. Users can scale up or scale down the services according to the demanding.

Geoprocessing functions standardized by WPS will be integrated into cloud computing infrastructure , developed by CISC Center (http://cisc.gmu.edu)) and a test client will be set up to provide interface between users and geoprocesses (Figure.2). SCGI is able to provide on-the-fly integrations compositions of various geoprocesses components for different applications.

Applications

The study of airborne dust is necessary for public health officials and clinicians in Arizona and New Mexico. Due to the large size of dust storm grid data, it will be also a good example to show the performance of SCGI. Thus, the geoprocesses supported by SCGI might be made in the purpose of modeling the change of dust storms and analyze the relation between the dust storm and the population and public health condition to make decision support (Figure.3). Figure.3 Application analysis workflow

We will first obtain the dust concentrations datasets from the dust storm model outputs for the past ten years, and obtain population, public health datasets. The dust storm output can be obtained from the CISC center (http://cisc.gmu.edu) and the population data of Arizona and New Mexico can be obtained from CENSUS(http://www.census.gov/). Through the correlation analysis from the population and dust concentration, and respiratory diseases and dust concentration, we can understand the impact of dust storm to the public health.

Schedule

- Design needed GIS functions according to the data available 09/30/2010
- Development platform prepare 09/30/2010
- Code on WPS process functions according to the demand of application 10/31/2011
- Configure standardized service file 11/15/2011
- Prepare software resources (Google App Engine) 10/31/2010
- Integrate WPS process into the infrastructure 11/20/2010
- Client Design the interface art 11/25/2010
- Program on the client interface based on the SCGI API 11/30/2010
- Prepare the data 12/5/2010
- Preprocess data 12/10/2010
- Run analytical process step by step 12/15/2010
- Explain the result 12/20/2010
- Discuss the performance of SCGI 12/25/2010
- Cloud computing Deploy the WPS services on the CISC Cloud Computing platform 12/30/2010