GLIDER: A comprehensive software tool to visualize, analyze and mine satellite imagery

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The model for building scientific software tools has evolved with the changing computational landscape to incorporate distributed computing. This evolution has led to the emergence Service Oriented Architectures (SOA) and XML based Web Services. SOA promotes the notion of 'software as a service' and it allows new ways to build applications. Building an application using "mash-ups" of disparate services from different sources has proved to be an inexpensive and highly effective approach. Globally Leveraged Integrated Data Explorer for Research (GLIDER) tool is being built by extending NASA World Wind visualization capability using service mash-ups to embed mining and visual analysis capabilities. GLIDER will leverage three exiting components and they are:

NASA World Wind is a powerful 3D visualization software package for geospatial imagery. World Wind's 3D virtual globe technology provides a stunning view of the Earth, allowing users to change their viewing perspective in any number of ways (zoom, rotate, etc.). Many displayable layers are available including NASA's Blue Marble imagery, multiple Landsat datasets, combined digital elevation datasets for terrain, MODIS, vector data, and other imagery. Users can visualize data from NASA data archives as well as user-hosted imagery using OGC standards-based Web Map Services.

The Interactive Visualizer and Image Classifier for Satellites (IVICS) is a visualization and image analysis software system for satellite and other image data. Many different types of satellite can be displayed and analyzed in IVICS. It provides powerful image analysis, enhancement, and display tools. IVICS has a sample selection interface to allow users to identify and label samples from image data for use by different supervised classification methods.

The Algorithm Development and Mining System (ADaM) is an extensive image processing and data mining toolkit. This toolkit contains almost all of the typical image processing and data mining algorithms used by researchers in their analysis as well as numerous data preprocessing algorithms such as feature reduction, subsetting, subsampling, etc. Each algorithm in the ADaM toolkit is available as an independent executable that can be scripted with other algorithms to form a complex workflow. These ADaM components have also been repackaged as web services and deployed at a NASA DAAC. Additionally, ADaM has been recently coupled with IVICS to create a software package for satellite image analysis and mining.

Using service mash-ups, we are combining these three tools to create a synergistic 'composite application'. With GLIDER, a user will be able to use World Wind to visually browse different NASA imagery data sets available via WMS for specific events or conditions. In the case of Figure 1, the user is looking at MODIS imagery for a fire in Georgia. Once a user has found an image of interest that he would like to analyze

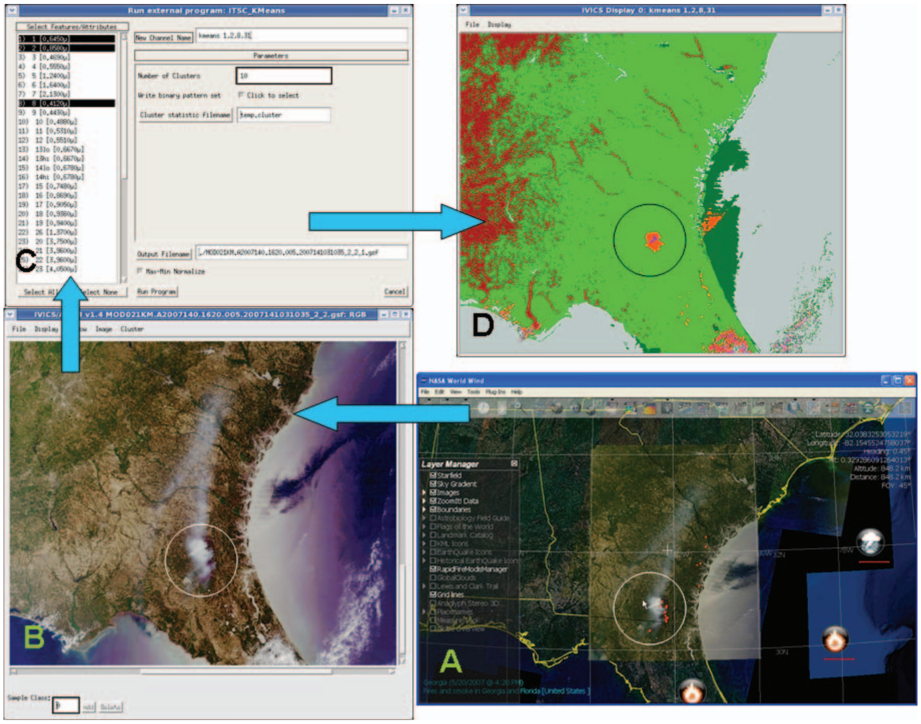

Figure 1: Envisioned functionality of GLIDER consisting of World Wind, IVICS and ADaM.

further, he can click on an icon within World Wind. This action opens a new IVICS window displaying the satellite image (1B). The difference in this display is that unlike the static pre-rendered browse image, this window is dynamically rendering actual data values pulled into World Wind via either WCS or other remote online access. If the user wants a classifier to detect and segment the fire in the image, he can select the type of mining operation (K-Means clustering as an example) from the menu (1C), configure the parameters for the algorithm and then execute it. Behind the scenes, the client will invoke the remote ADaM mining service and display the classification result as a thematic map (1D).

Science scenarios consisting of aerosol detection case studies in satellite imagery are being used as drivers to guide the development, testing and evaluation of GLIDER. This paper will present these science drivers, GLIDER architecture and its features.