GLIDER: Visualize, Analyze and Mine Satellite Imagery Using a Single Tool

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ESIP Viz Cluster
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GLIDER - motivation

• Software tools that allow users to visualize, analyze and mine satellite imagery are currently limited.

• Available commercial packages are expensive.

• None of these packages provide all the GLIDER features
GLIDER Features

- **Visualize and analyze** satellite data in its native sensor view.
- Apply different *image processing algorithms* on the satellite data.
- Apply different *pattern recognition/data mining algorithms* on the satellite data.
- *Project* satellite data and analysis/mining results onto a globe and overlay additional layers.
- Provides *multiple views* to manage, visualize, and analyze satellite data.
GLIDER is using:

• ADaM
  – ADaM (Algorithm Development and Mining) toolkit
  – Contains 140+ image processing, pattern recognition and machine learning algorithms

• IVICS
  – Interactive Visualizer and Image Classifier for Satellites (IVICS)
  – Provides capability to visualize satellite imagery and select samples for supervised classification

• World Wind
  – Project satellite data and analysis/mining results onto a globe and overlay additional layers
GLIDER Architecture

• Integrates existing tools
  – ADaM: UAHuntsville’s Algorithm Development and Mining Toolkit
  – IVICS: UAHuntsville’s Interactive Visualizer and Image Classifier for Satellites
  – WorldWind: NASA’s 3-D globe visualization system

• Eclipse Java RCP provides the framework
  – Plug-in based modular design
  – Code reuse
  – Cross-platform support (Windows, MacOSX, Linux, Solaris)
  – Manages GUI layout
  – Allows branding
  – Access to a large suite of existing plug-ins
Data Currently Supported in GLIDER

• Direct support in GLIDER
  – MODIS Terra and Aqua
    • L1B Imager data 1km, 500m, 250m
    • L2 cloud mask, aerosols,
  – AMSU
  – SSMI
  – TMI
  – CALIPSO (partial)

• Import from IVICS/GSF
  – ASTER
  – GOES McIDAS
  – MSG
  – AVHRR LAC/GAC
  – VIRR
  – MAS
  – LANDSAT TM (NLAPS and GEOTIFF)
GLIDER Views:  
Project Explorer

Manage your data files and your analysis results

Browse data file metadata
GLIDER Views:
Image Analysis View

Analyze image using different features
Apply data mining algorithms
Visualize data in its native sensor view
Select different spectral bands
Image Analysis Features

- Transect Profiles
- Spectral Profiles
- Scatter Plots
- Histogram Plots
Clustering Algorithm Example
GLIDER Views: Earth View

Project images on the globe

Add and display multiple layers
GLIDER Views: Workflow Composer

Visual programming interface to create analysis recipes
Demo

Look at Ash/Steam Plume event from Iceland's Eyjafjallajoekull Volcano

Learn how to subset imagery both spatially and spectrally

Apply clustering algorithm to generate classification maps
Let’s Apply a Clustering Algorithm

• Goal – Create a thematic/classification map using MODIS L1B data with three classes: Clouds, Ash/Steam and Ocean

• Methodology:
  – Subset the data both spatially and spectrally
  – Apply K-Means with k=5 and let the algorithm find groups in spectral feature space
  – Assign semantic (3) classes to the 5 groups
Let's Apply a Clustering Algorithm

• Open MOD021KM.A2010105.1135.005.2010105201236.hdf.gld in Image View and Earth View
• Locate the Ash/Steam in the image
Look at the Spectral Signatures for Clouds, Ash/Steam and Ocean

Let's keep bands 1, 3, 4, 31 & 32

Select representative pixels for Ash, Cloud, Ocean
Spatially and Spectrally Subset Data

Select an area within the Image View, then select Bands, provide output filename (subset.gld) and hit Run button. Go to Project View and load subset.gld in Image View.
Apply KMeans Algorithm

- Only select the spectral bands
- Make sure you select normalize channels
- Set the # of clusters to 5 even though we only want three final classes
- We will merge clusters at the end!
Visualize Result in Image View

Lets merge classes to create a map with only three classes.
Load the ClassLUT.txt Color Map.
Final Clustering Result
Education and Training

• GLIDER as classroom tool
• Air Quality Training
  - Other potential end users include, Forest Service, NOAA, and EPA.
Use GLIDER to examine the data

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