**OGC Testbed 13 – Mass Migration Client based on the World Wind Environment**

Client Description and User Guide

Background:

Via integration with the World Wind environment, this client can provide relevant geospatial web service standards including WMS, WFS, and WCS (e.g., via getting information and capabilities, rendering visualizations, providing data results), focused on marine traffic and climate oriented datasets. The client includes three major modules: data management, visualization module, and analytical module. Below is a figure depicting the structure of the system architecture, highlighting relevant modules:
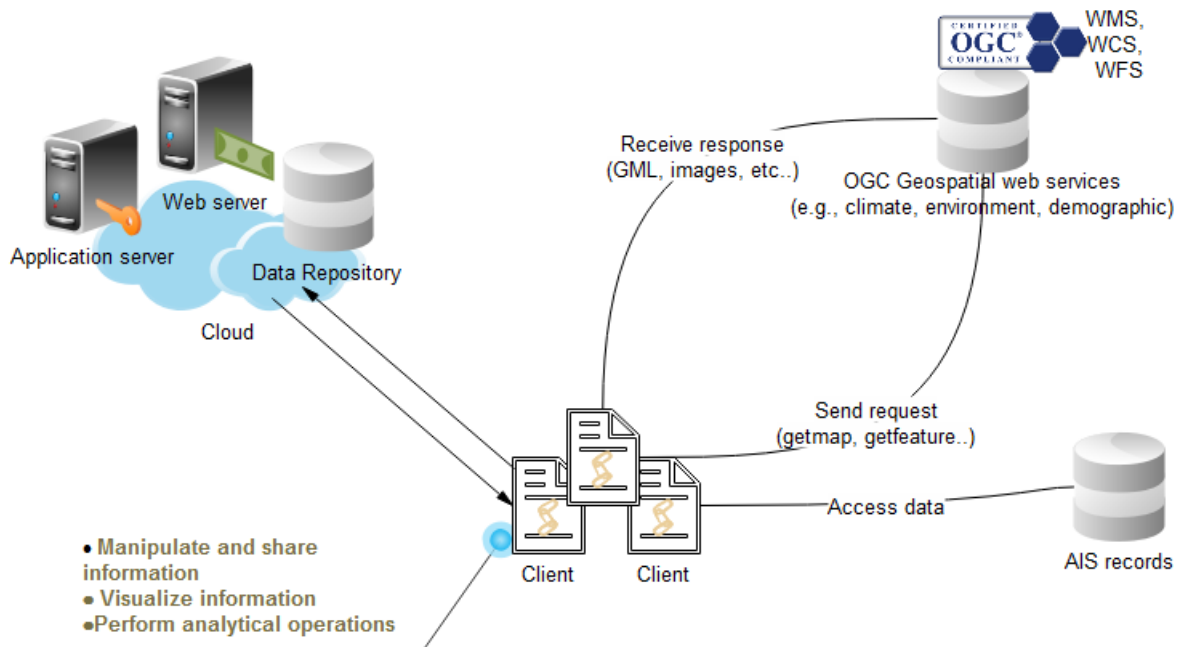
The overall design of the client GUI is user friendly yet powerful. This interface component enables user manipulation of datasets, classification and analysis functions, and information and visualization outputs. Users, in addition, are provided with standard zoom, pan, adjusting, and data locating tools, all in two and three dimensions. An example of the interface is shown below:
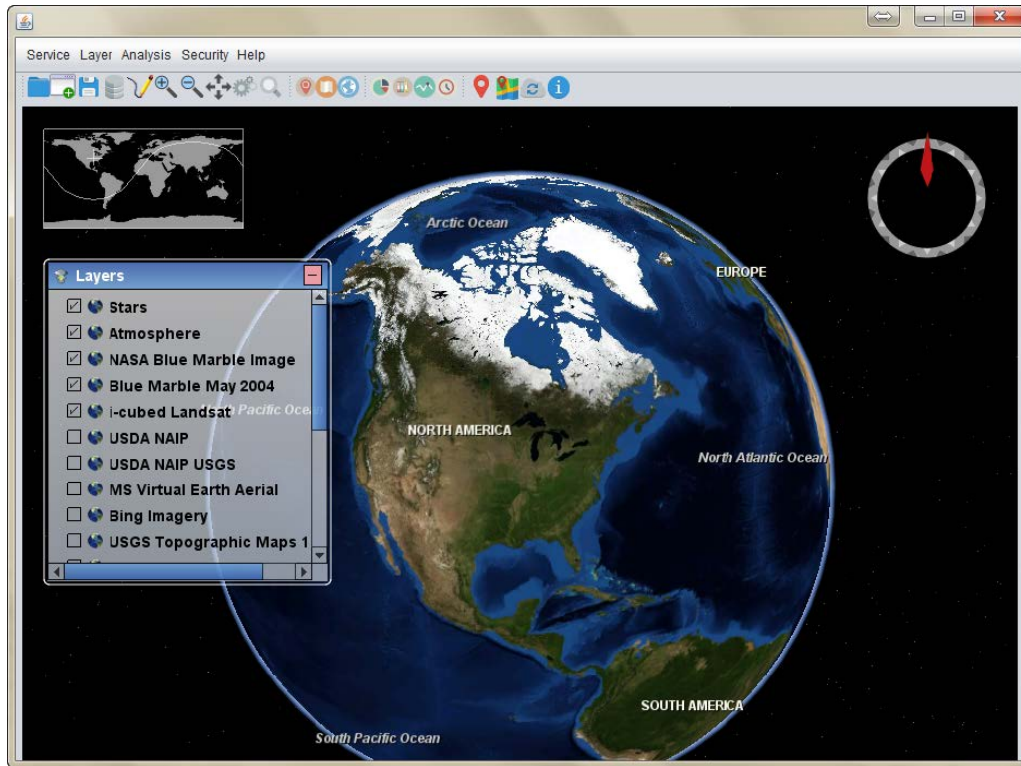
The major client functionalities available in the interface can be summarized as follows:

Web Service Related:

- User opens the "Service" tab at the top left of the interface, to display web service loading options for selection (WFS, WCS, or WMS)
- Via the import web service features box, a user may specify the service URL and additional customization functions for handling and displaying data (feature type name, region of focus, visibility details, attributes to visualize on the globe)
- The globe then auto-zooms in or out to the area of interest, and displays the selected dataset features as previously specified. The user may, while visualizing the uploaded data, take advantage of layer control options too to enable/disable layer views
- Once features are loaded, and depending on whether they contain additional attributes or metadata, clicking on each on the map will bring up a box with related details

Analysis Functions:

- Further analysis can be performed on the loaded layer/s (classification, density mapping, time-based tracking, and data profiling), though certain kinds of analysis are only applicable to specific web service layer types (e.g., WFS)

- Classification: The classify WFS feature, as the name implies, works on Web Feature Services, due to their nature in containing attribute values and independent, clickable vector features (as opposed to rasterized images which are fuzzier in nature)
    - This tool enables a user to again specify what feature type name to provide, then either the classification value on which to perform analysis or a time value
    - The additional option to classify the features by a time component is of course limited by whether the loaded layer contains such information. If time information exists, a user may then query for features based on a range of time
    - If the standard classification by attributes option is chosen for the WFS layer, a summary of the performed classification is then presented, in graphic chart form (e.g., a pie chart with the attribute data broken up by component)
    - If the classification by time feature is instead selected and a range of time values provided, the graphic/chart output will be presented with a breakup of time details (e.g., a histogram with counts of each time's occurrence per available time frame)

- Density Mapping: The density mapping feature provides an option to select a WFS layer on which to calculate kernel density estimation (where a smoothly curved surface is fitted over each point or line feature, and surface values are higher near the clustering of features, and lower as distances increase from those clusters)
    - The client then displays this kernel density layer based on the selected point or line feature, highlighting areas of clustering on the globe

- Feature Tracking: The tracking tool again takes a web service layer as input, and performs time series-based tracking along the route or direction the selected feature travels as time passes (as an animation)
    - The user is shown an animated route on the map in linear format, to visualize the path taken by the chosen web service layer. The application will auto-adjust the map position to accommodate the route track changes for the chosen features

- Vertical Profiling: This tool involves the combination of two types of web service layers: WCS and WFS. The WCS layer provides height/elevation information, and the WFS provides the features which experience the height/elevation changes. As such, the vertical profiling tool demonstrates changes in elevation across space and/or time, and results are output in chart format, which shows dots connected by lines of elevation change (e.g., distance traveled on the x-axis and percent vertical elevation change on the y-axis)

General Comments for Maximizing Usage:

- Importing different web services will yield slightly different options for visualization, analysis, and customization of views. For example, certain WFS will allow for attribute-based analysis, while WMS may not due to the lack of attributes on features
- The layer control panel enables user manipulation of layer options, such as turning layers on/off
    - Options to remove or re-order layers are also available, under the "Layer" tab at the top
- Importing layers (WFS, WCS, WMS) have features to constrict areas of focus, variables, and/or time-based details, so as to only display results based on a queried set of parameters
- As necessary or appropriate, legends will automatically display on the interface to help users understand the imported layer parameters (especially WCS and WMS ranges of values)
- A simple time-based control panel will display at the top of the map interface, to allow playing, stopping, fast-forwarding, and rewinding of the tine-enabled features or layers

Security Functions (currently under development):

General Summary of Usage Workflow:

1. Import desired web service layer
2. Choose parameters to display, based on filters
3. Visualize layer/s and manipulate display by panning, zooming, selecting layers, etc.
4. Perform analysis functions based on loaded layers
5. Remove or re-order layers on the map interface as necessary