

Comprehensive open-source system for geophysical data acquisition, processing, and visualization

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Summary

Owing to its affordability and flexibility, open-source software offers substantial benefits yet it is often limited in scope and lacks user interfaces. For a number of years, we have been developing a new open-source package (called SIA, (<http://seisweb.usask.ca/SIA/>) which serves as a tool for the processing and analysis of several types of geophysical data and also as highly integrated framework for developing geophysical applications software.

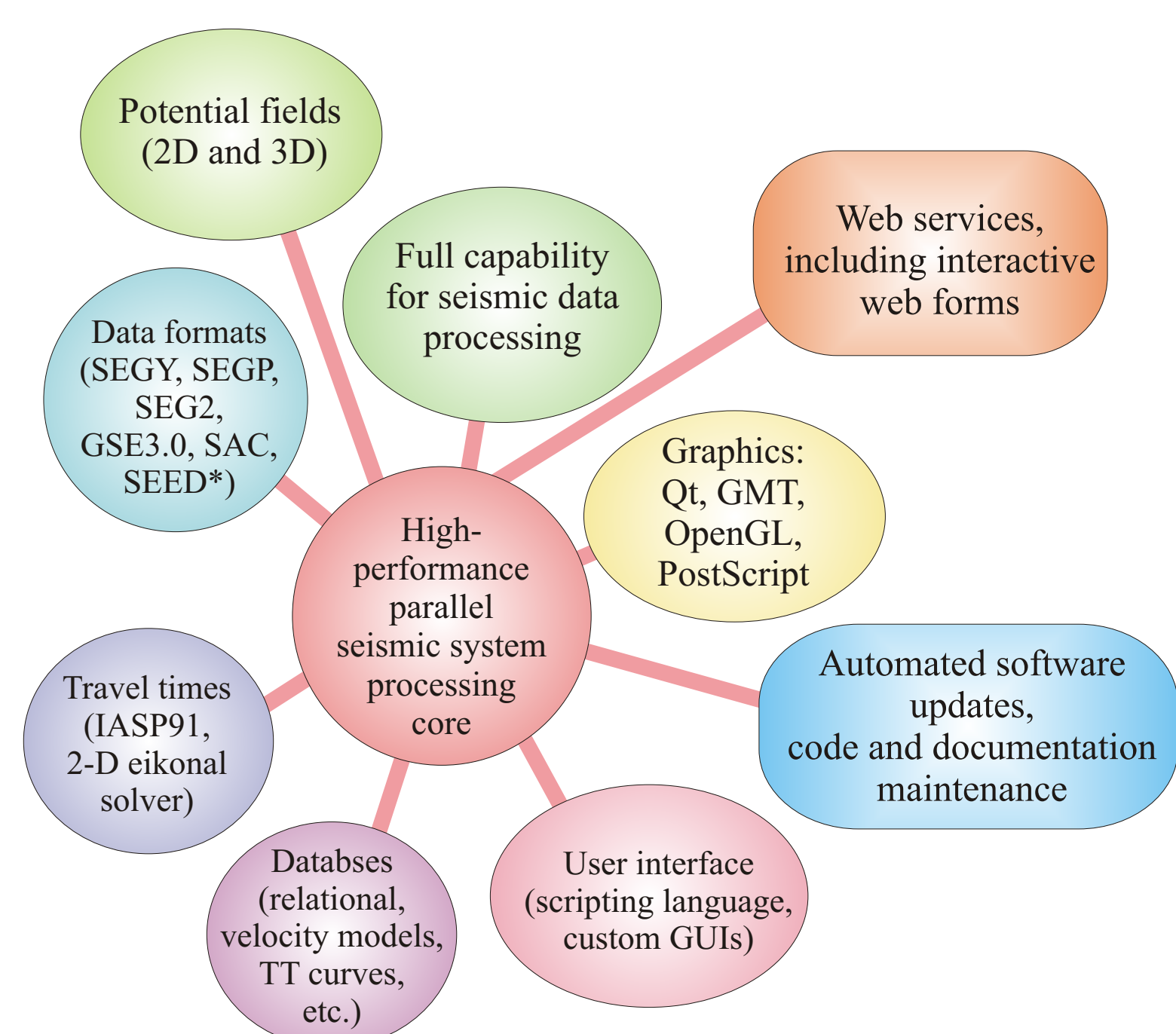
Currently, the package consists of a processing core extending the capabilities of a seismic processing system, graphical user interface (GUI), and customizable interactive 2D/3D OpenGL visualization tool similar to those used in commercial seismic interpretation systems. The GUI has built-in capabilities for cluster and grid management, and both flow processing and some tools (such as 1D and 3D finite-difference modeling) are enabled for parallel execution. The following new features of the system might be particularly attractive for IRIS users:

- 1) Ability to handle controlled-source and earthquake waveforms, travel-times, potential-field datasets (2D and 3-D), and metadata, with high throughput and integration of the tools;
- 2) Fully customizable visualization protocol based on OpenGL, allowing building complex, 3D interactive tools without the need to write any code in OpenGL.
- 3) Capability for full web-service operation allowing performing custom processing at a remote location. A library of processing examples was created using this approach. (http://seisweb.usask.ca/temp/example_s).
- 4) Tools for real-time data acquisition and management of a seismic network;
- 5) Extensive C++ code libraries, maintenance utilities, and automated documentation support;

Scope

virtually every task encountered in authors' research:

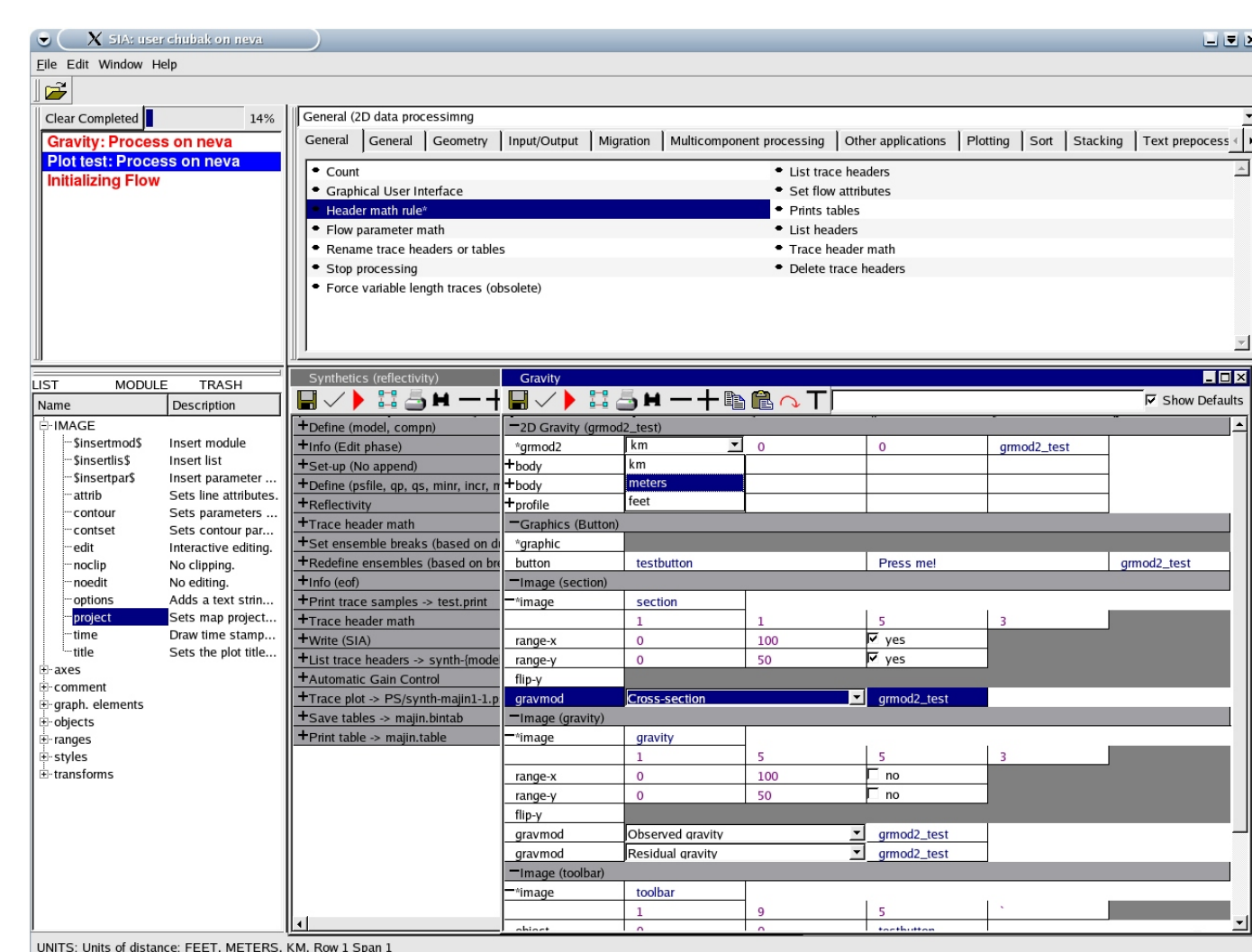
- Seismic and non-seismic data handling;
- Single- and multichannel digital filtering;
- Travel times, grids, and models;
- Potential fields;
- Synthetics;
- Inversion (wide-angle and 3D RF migration);
- PostScript and Interactive 3D OpenGL Graphics;
- Batch and interactive processes.
- Web service.



Graphical User Interface

Full-featured GUI:

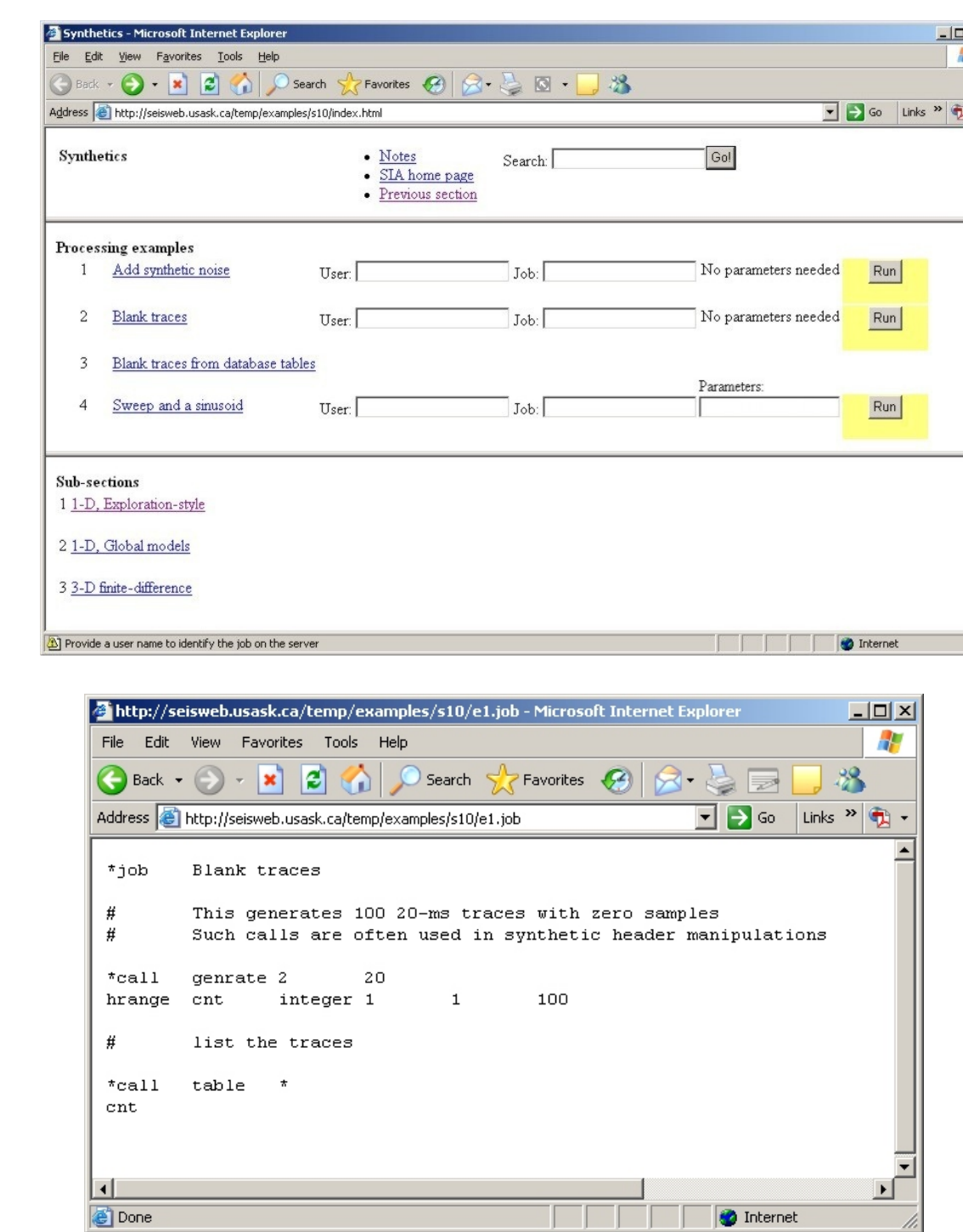
- Multiplatform Qt implementation (standard in Linux)
- Editing and submission of multiple jobs;
- Monitoring and interaction with running jobs;
- Selectable libraries of packaged tools (e.g., earthquake, CDP, potential field packages);
- On-line documentation and tool tips.



Collaboration

Tools for sharing processing expertise by the users:

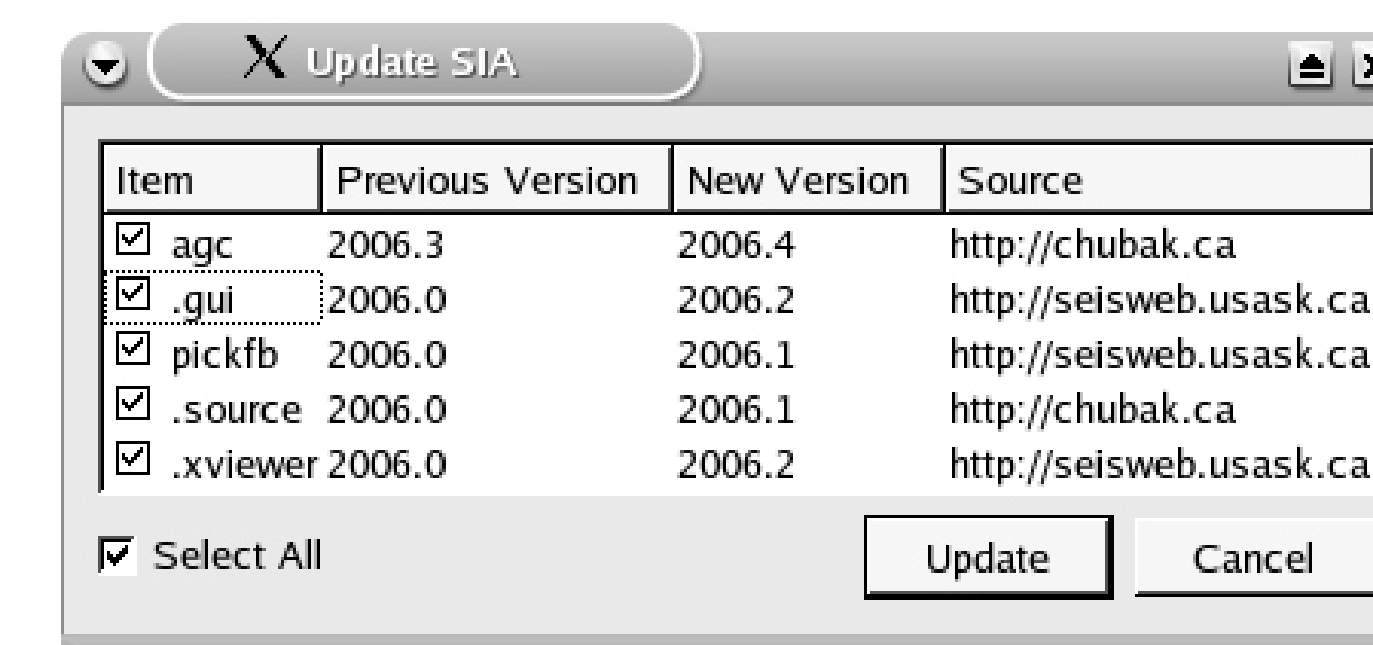
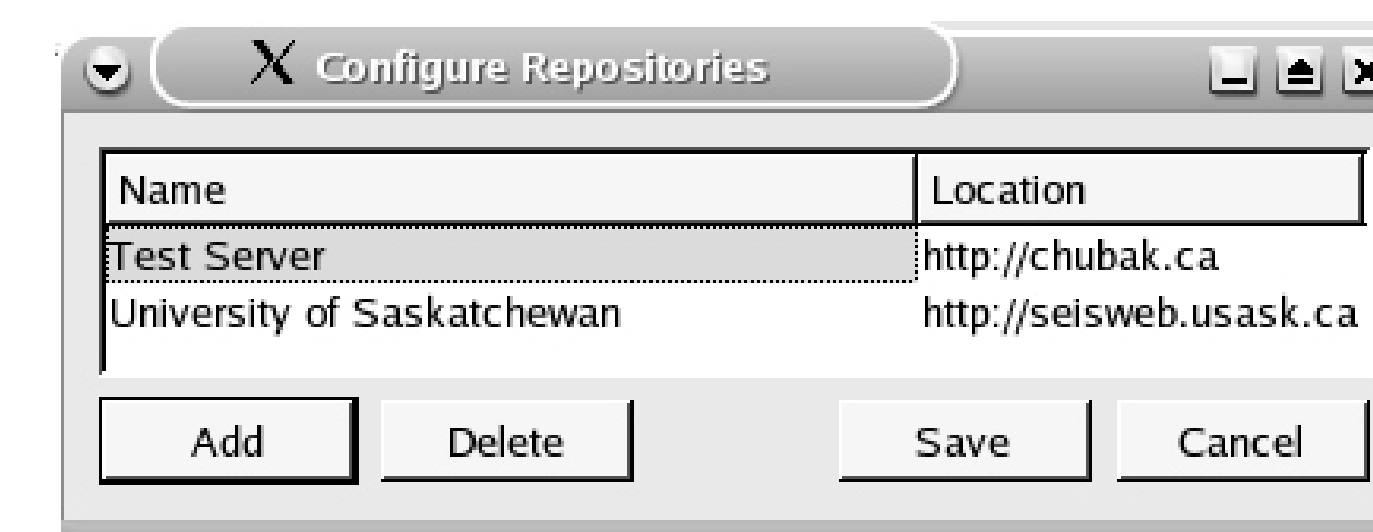
- Entire jobs or their fragments can be submitted for posting on local or Internet web site;
- Posted jobs can be executed on the server or copied to the local processing flows.
- Jobs are presented in auto-generated interactive web forms;
- User enters parameters, runs the job, and retrieves the results;
- In the ongoing development, jobs will also be associated with complex, custom web pages
- Search utility provided;



Collaboration, Software Distribution and Automatic Updates

Web service for software distribution and updates is provided (<http://seisweb.usask.ca/SIA/cs.php>):

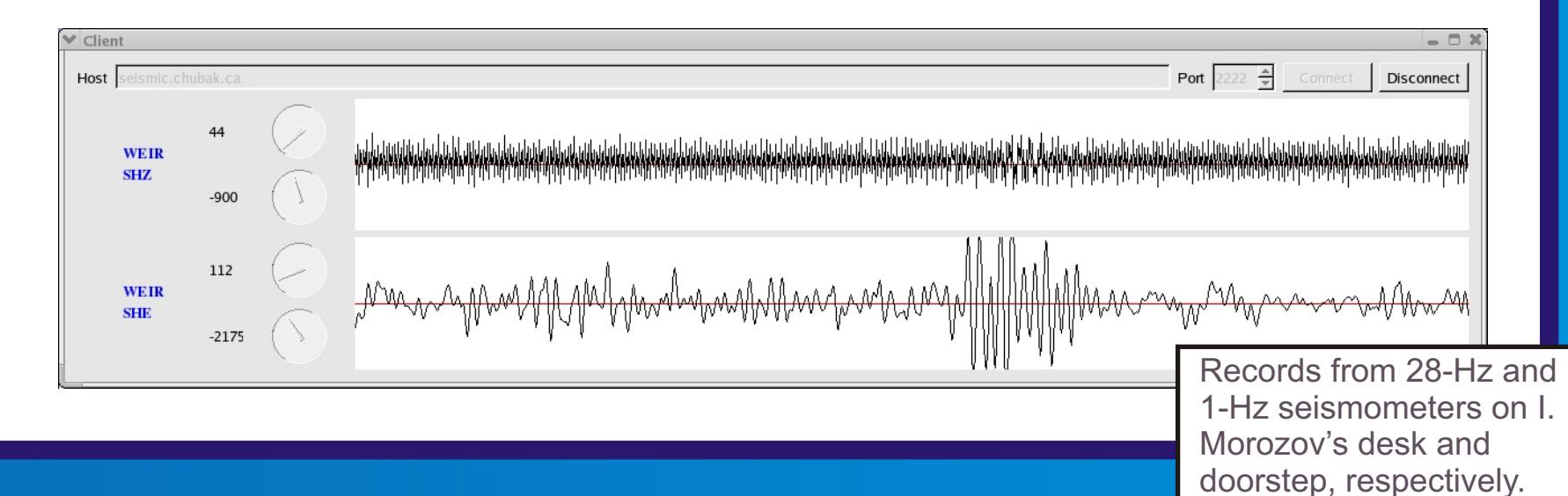
- New code can be developed at any installation;
- The source code becomes available to other subscribing SIA sites;
- When the GUI is started, it automatically checks for a list of updates available from multiple sites;
- The user selects the desired components, and the system downloads the source codes, compiles and installs them.



Real-Time Data Acquisition

Tools for seismographic network management and real-time data acquisition:

- 4-channel 24-bit seismograph by Symmetric Research (symres.com);
- Our own software integrated with SIA system;
- Graphical Qt data client (below);
- Real-time data acquisition, archiving, and processing;
- Web service for remote system management.



Conclusions

Nearly the entire scope of issues have been addressed in this highly integrated software package:

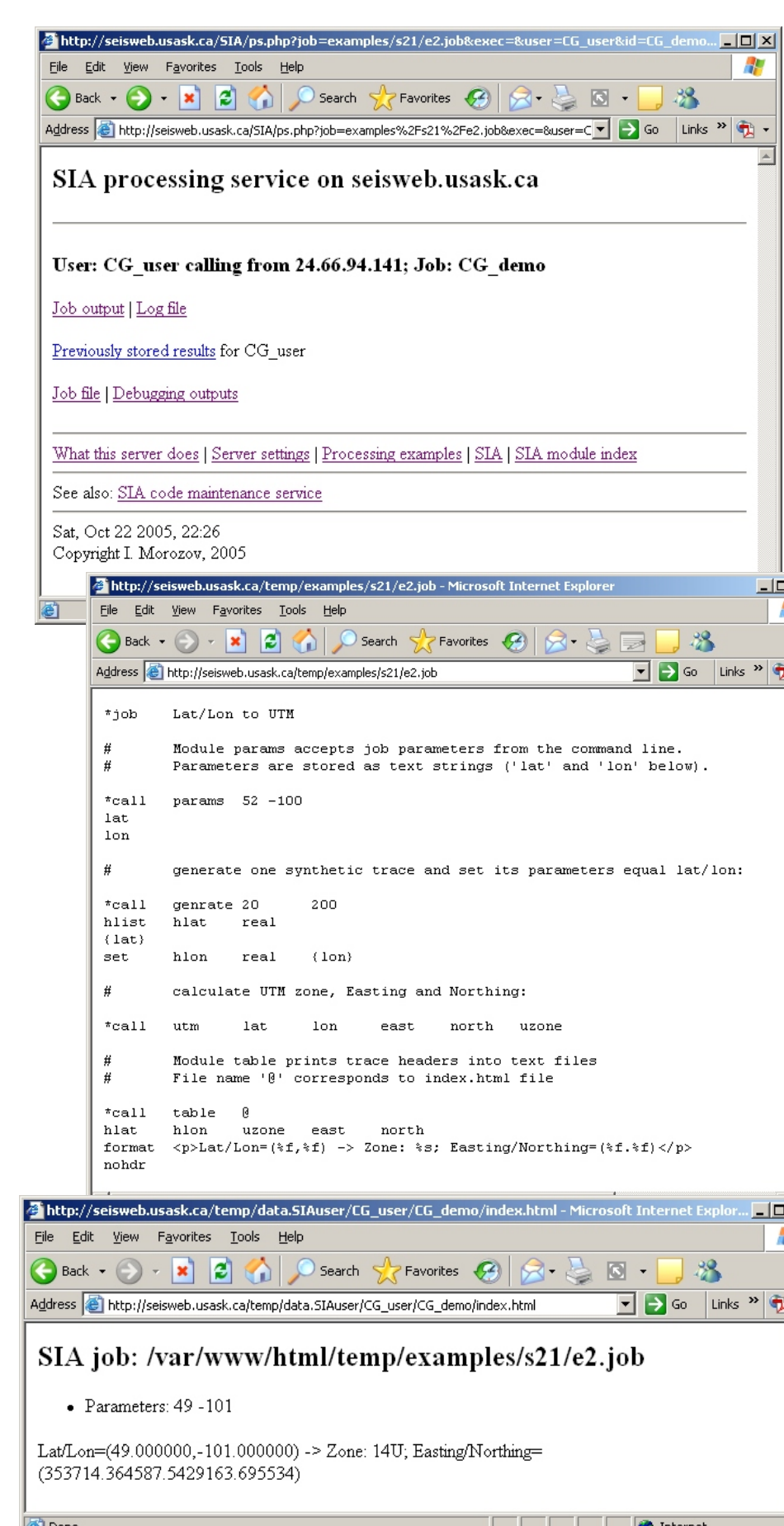
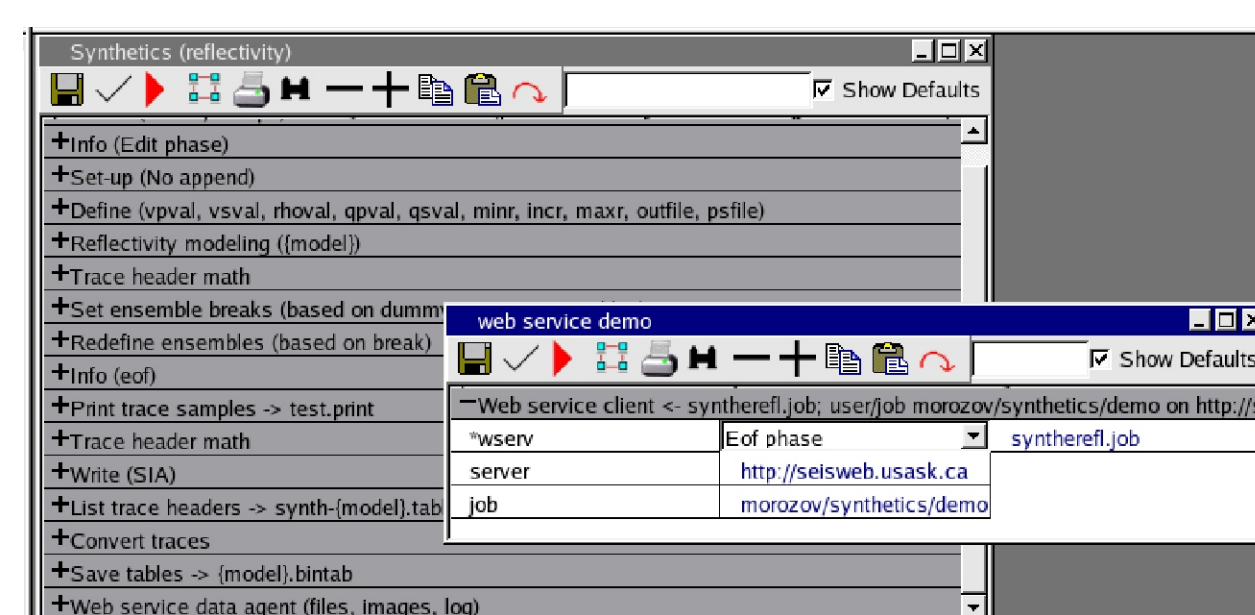
- Single-and multichannel waveform processing;
- Potential-field data processing;
- Handling and processing of other data (travel times, models, metadata);
- Real-time data acquisition;
- Parallelization and grid/cluster management;
- PostScript and interactive 3D/2D graphics;
- Interfaces to popular packages;
- Web service operation;
- Collaboration via Internet;
- Software maintenance and distributed automatic updates.

Processing Web Service

The system is fully functional as a web service:

- Any jobs can be submitted to a web server;
- The server performs the requested processing and returns images, web pages, or data files.
- In principle, the service should also work as an API;
- Only Apache web server is necessary to enable the service;
- As an example, a user-contributed library of processing examples is supported using this service:

<http://seisweb.usask.ca/temp/examples>



Interactive 3D/2D Graphics

Foundation for a new interpretation package:

- Operates in parallel, two-way communicating with multiple jobs;
- OpenGL graphics with hardware acceleration;
- Displays are fully configured by the processing flows;
- All graphics performed in 3D, with full user interactions with the displays and underlying processing flows;
- Supports stereoscopic viewing (e.g., by using GeoWall);
- Custom GUIs with buttons, sliders, etc., can be generated by the flows (see Example 2).
- Built-in GMT (NETCDF) global GIS databases coming soon.

