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Sharing Geoscience Software: a Distributed Computing Approach

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Geoscience software applications use data such as surface weather observations, digital terrain models, and background maps. These data are often accessible over the Internet from Web pages, files, or directly from relational databases. However, standard formats for such data have not been widely adopted, a situation unlikely to change in the near future. Applications tend to be written to use a particular source of data in a particular format. Adapting such applications to use a different data source, or repeatedly formatting data to meet application requirements are both time consuming. This leads organizations to develop applications that duplicate the much of the functionality of applications already available.

The present situation would be greatly improved if applications developed at one site could be easily run by users at other sites using those sites' existing databases. In this paper we discuss an approach that achieves this goal by interposing a separate software application, known as a broker or mediator, between applications and data sources. The broker acts as a kind of intelligent hub for one kind of data, for example weather data, maintaining metadata about the databases linked to it, and hiding the differences between weather databases from applications. The broker typically runs on a separate computer to both applications and databases. It transforms data requests from an application into database-specific queries, and transforming the results of those queries into a standard format before returning them to the application.

We have developed brokers for the three kinds of data mentioned in the introduction; climate data, digital terrain models, and background rasterized maps. MetBroker provides consistent access to both historical and current data from over 5000 weather stations in 15 databases. DEMBroker provides access to 30 arcsecond elevation data for the world, and 50m data for Japan. ChizuBroker provides access to maps from three online providers. Both publicly accessible and subscription-based databases are accessible through the brokers. Users requesting data from subscription-based databases are prompted for their username and password on the database, which the broker then uses to retrieve data on their behalf.

Brokers access their databases via small drivers much like printer drivers, making it easy to link additional databases. Java applications access the brokers through Java Remote Method Invocation (RMI). A set of JavaBean components for common tasks (such as selecting a particular weather station) simplifies the development of such applications. Applications written in Visual Basic, C++, Delphi, and even Excel can also access MetBroker through a Simple Object Access Protocol (SOAP)-based Web service.

A further barrier to widespread adoption of geoscience applications is the need to localize user interfaces so that, for example, Japanese users see a Japanese language interface whereas New Zealand users see an English language interface. We have developed a Web-based localization system which lets translators quickly adapt applications to their own country. This system currently supports six languages, and further languages can easily be added.

Source code for the brokers and the localization system has been released under an open source license which allows for use in both commercial and not-for-profit applications. The source code, extensive documentation, and demonstration applications are available at a project Web site (www.agmodel.net).

These tools let software developers quickly create geoscience applications that can run at new sites and in new countries without any modification, creating a new market for portable geoscience software and facilitating widespread model validation.