Groundwater Information Network (GIN) - Interoperability framework for groundwater information

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Abstract

Online access to Canadian groundwater information is being realized through the groundwater information network (GIN). The Groundwater Information Network is an information architecture that connects distributed sources of data related to groundwater. Each data source retains its original database structure and content, and a central mediator makes the necessary transformation on the fly to present the complete collection of data as a single homogenous database. GIN uses international open geospatial standards and protocols to query and disseminate the data.

Introduction

While there is increasing awareness that regional, provincial and national accounting of water resource information is required, for example to assess groundwater sustainability, this is impeded by the state of groundwater data: groundwater data are distributed, uncoordinated, heterogeneous and of variable quality (Rivera et al, 2003). Federal departments, provincial agencies, municipalities, and watershed authorities all have groundwater databases. As a consequence of their distribution amongst different organisations of various size and mandate, these databases are very heterogeneous, have a low level of interoperability, and hence, are inaccessible to the majority of users in a coherent and homogeneous view. Overcoming the heterogeneity barrier is crucial to enabling meaningful data analysis for groundwater resource assessment and management

The main aim of the GIN project (Russel and al, 2007, Sharpe et al, 2009) is to provide a system that can overcome this heterogeneity through the implementation of open geospatial standards. GIN is comprised of seven provincial agencies, one territorial agency, several conservation authorities, along with a federal facilitating agency. International cooperation is underway to extend the network to USA to address trans-boundary aquifer issues.

Method

Groundwater information is provided via Open Geospatial Consortium (OGC)-compliant web services (WMS, WFS, SOS) and Groundwater Markup Language (GWML). The exposed data

reside in custodial provincial and territorial databases and they are combined dynamically into a seamless virtual database using mediation technology developed by NRCan.

Figure 1 shows a simplified architecture of the GIN network. The central part of the system is the "mediator" that sits between a client application and a collection of services and "shields" the user from the heterogeneity of the data sources.

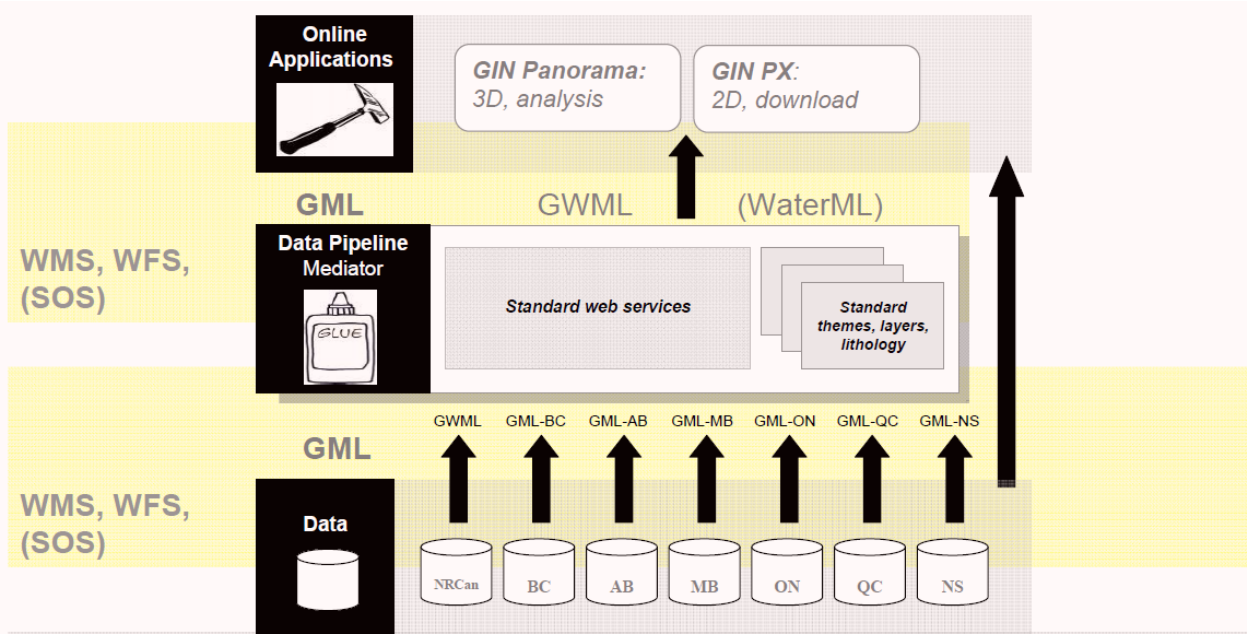

Figure 1: GIN Architecture

Once the mediator receives a request from a client application, it translates the request, which is expressed in GWML, into a specific request relevant to each data sources. The mediator then transforms the response from each of the services into GWML to finally send the result to the client application. The mediator deals with several levels of heterogeneity. First, it deals with schematic and syntax differences, where the data is structured differently using different languages. It also deals with semantic heterogeneity where the information present in the database can have different meanings.

Examples

Figure 2 shows a typical translation problem addressed by the mediator. The two tables contain lithologic information stored in two different databases, one from Québec and the other from Ontario, where the schemas and semantics are different. The mediator maps the schematic difference into a unified model (GWML) and the semantic differences into a single common vocabulary. GWML is then sent into the client application as a GML document that acts as a standard syntax. The mediator technology is also being used by several countries for the OneGeology project (www.onegeology.org).

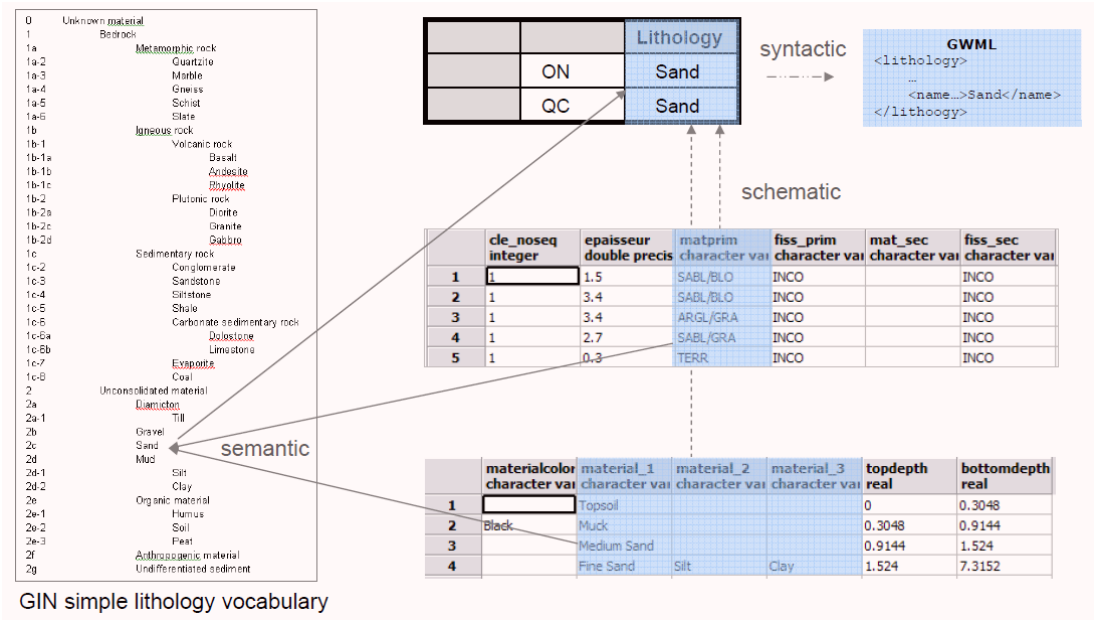

Figure 2: Heterogeneity between two data sources

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Conclusions

The GIN mediator can extract and process data from multiple databases using different schemas and semantics. The mediator has also been used outside the context of hydrogeology with success. There is still ongoing development on GIN mediator to address more complex data integration and translation problems.

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