DelftShell - integrated modeling environment with elements of GIS, Data Management and OpenMI support

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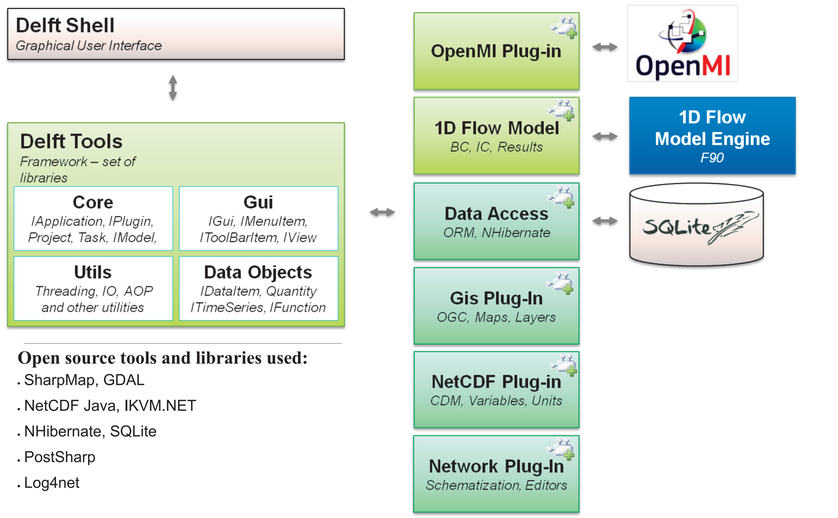
Introduction

Many efforts have been made to integrate different numerical models. The development of modeling frameworks concentrated on the interoperability of different model engines, several standards were introduced such as ESMF, OMS and OpenMI. This work focuses on the design of a higher level integrated modeling system targeting the interaction with the end user via a graphical user interface.

Often a user interface is only built to work only with a specific model; in this case functionality is usually hardcoded to one model, while generic GIS systems concentrate mainly on a spatial aspect. DelftShell consists of a framework, graphical user interface and a set of plug-ins providing GIS functionality, model integration including OpenMI-compliant models.

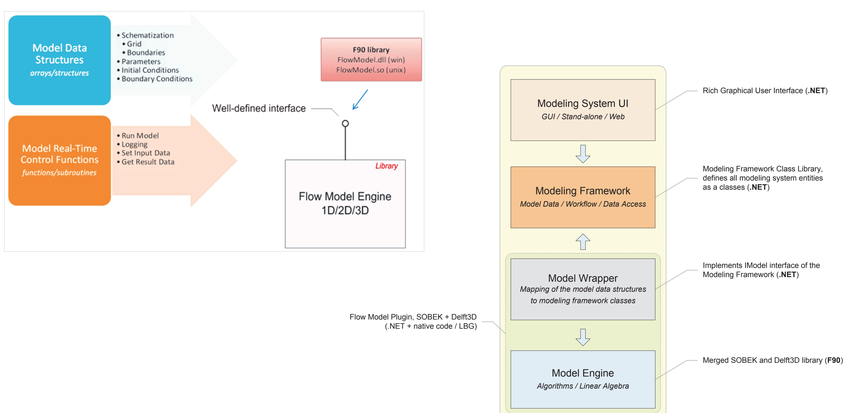
DelftShell uses a modular extensible framework to work with models and GIS. It manages model data in a unified way as well as provides generic tools to help user visualize and process such a data. The system provides a user interface for a whole range of models. The system will be available for the general community; it includes a plug-in API that allows integration of model engines, modeling frameworks or visualization and data processing tools.

1. System Design

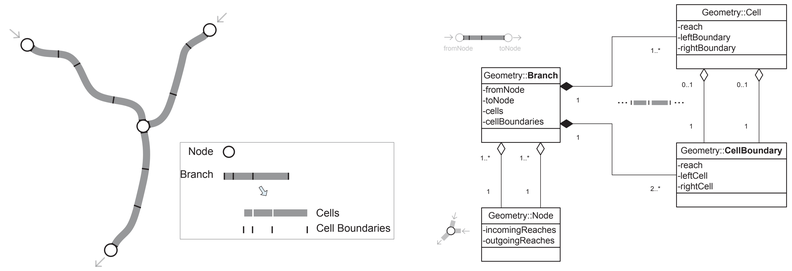


Open source tools and libraries used:

. SharpMap, GDAL
. NetCDF Java, IKVM.NET
. NHibernate, SQLite
. PostSharp
. Log4net

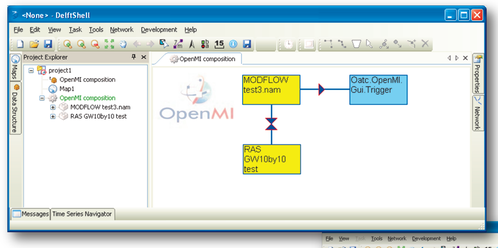


2. Example: 1D Network Data Structure

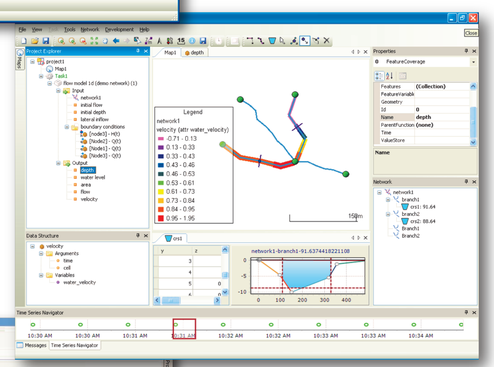


3. Applications

OpenMI



1D Flow



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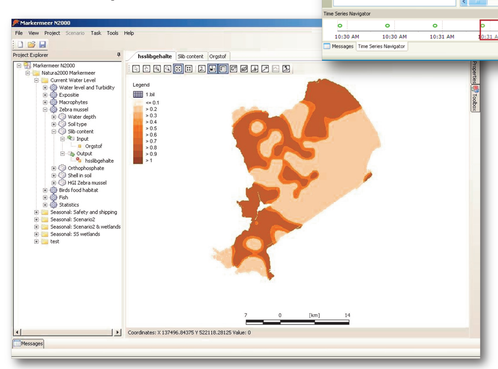

4. Conclusions

- Plugin-based approach to build system made extensibility very simple and allows for third-parties to integrate their own functionality.
- OpenMI plugin was developed and allows to use OpenMI-compliant models in the DelftShell.
- Use of hybrid relational-multidimensional storage provides stable and scalable solution project and model geospatial data. Use of xml-based storage was not scalable enough.
- NetCDF-Java library was converted to .NET using IKVM.NET providing sufficient performance but makes debugging more complicated.
- Use of Test Driven Development for both system and model engine development simplified automated testing.
- Use of modern software development techniques such as Object Relational Mapping, Aspect Oriented Programming and Design Patterns allowed for extensibility.
- GIS, SharpMap, GDAL, coverage implementation is still to be completed.
- Model integration using P/Invoke-based C# wrappers works well for small models. In the future should be based on SWIG.
- The system itself (partially) plus plug-in API will be released as free software available for community.

References

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