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Design of a Software Framework Prototype for Scientific Model Interoperability

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By
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TOWARDS A SOFTWARE FRAMEWORK PROTOTYPE FOR SCIENTIFIC MODEL INTEROPERABILITY



What are Models?

- ⦿ Mathematical models used to describe a system
 - E.g. Atmospheric, Oceanic, Ecological, etc...
- ⦿ Algorithmic calculations which take input and produce estimated results
 - Weather forecasting, global warming predictions, sea level estimations, etc...
- ⦿ Models are invaluable

What is Model Coupling?

- ⊙ Different models for different problems
 - Global Circulation Models
 - Isopycnal models
 - Atmospheric models
 - Ecological models
 - Hydrological models
 - Etc...

What is Model Coupling?

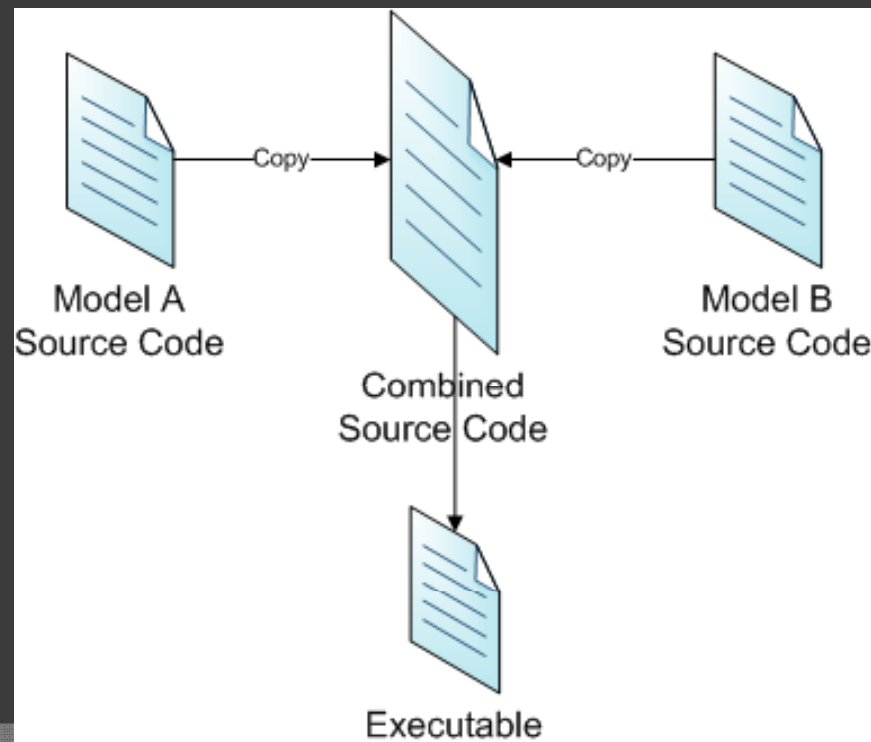
- ⦿ Output of one model could provide valuable input for another model
 - E.g. Coupling an Atmospheric model with an Isopycnal model
- ⦿ How do we get the output of one model to work as the input of another model (i.e. coupling the models)?

Challenges of Model Coupling

- ⦿ Data formats
 - E.g. Different file formats
- ⦿ Data structures
 - E.g. Different types/amounts of data from one model to the other
- ⦿ Data units
 - E.g. Temperature could be in Fahrenheit or Celsius
- ⦿ Usually requires programming knowledge

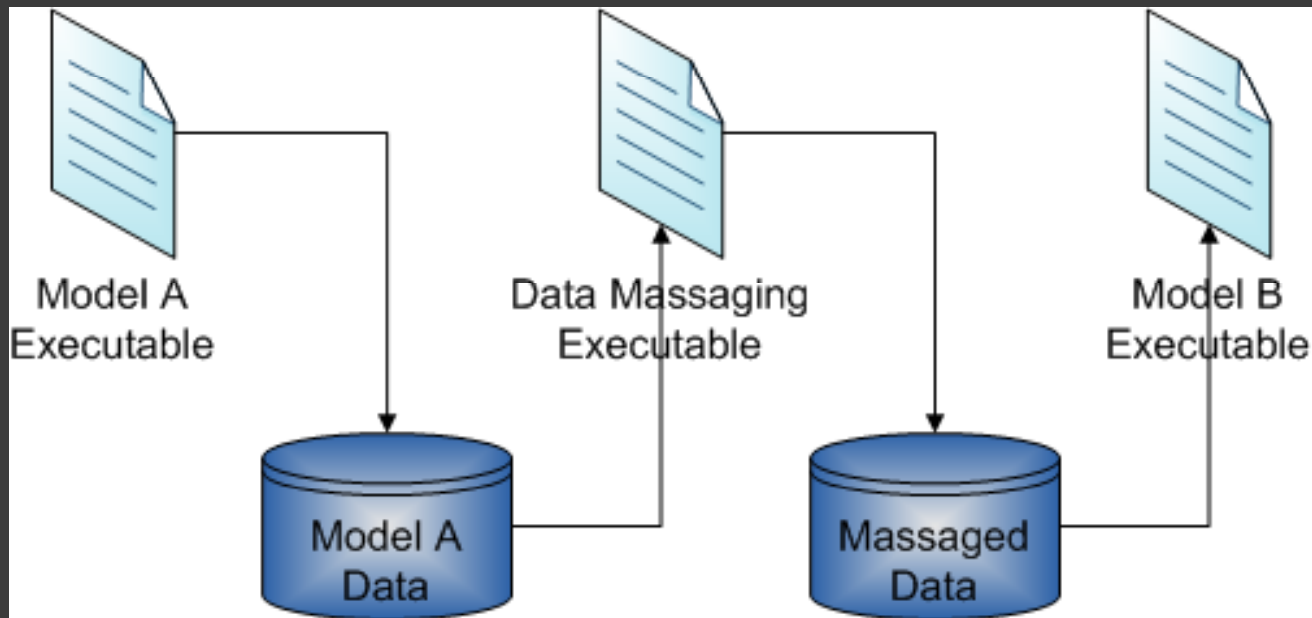
Methods of Model Coupling

- Monolithic – Take the source code from two models and compile them into a single program



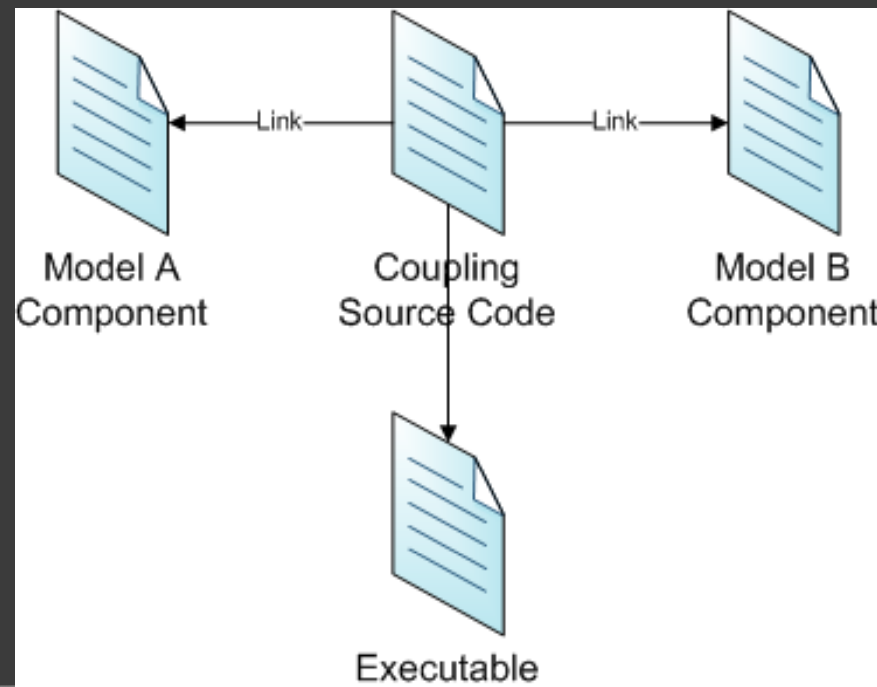
Methods of Model Coupling

- Scheduled – Models are kept as separate programs and the output dataset from one is used as the input dataset to the other



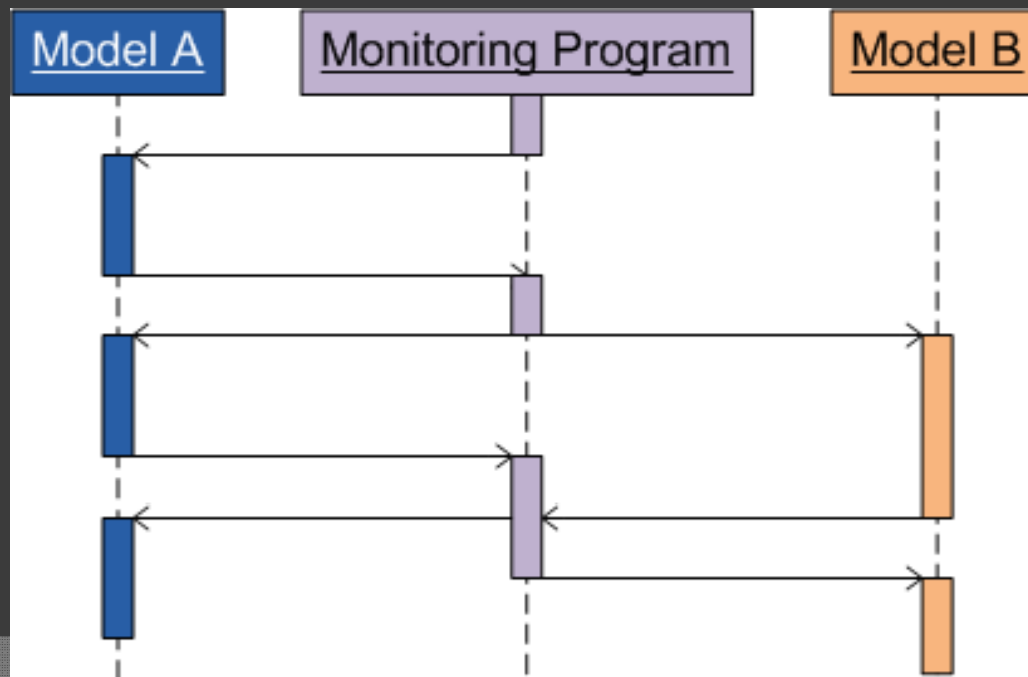
Methods of Model Coupling

- Component – Similar to monolithic, except the models are components of the main program (e.g. DLLs, libs, etc...)



Methods of Model Coupling

- Communication – Requires sending messages between two independent running models, usually with an intermediary program to monitor the exchanges and perform data transformations as necessary



A Selection of Coupled Models

- ⊙ HadCM3 – Coupled atmospheric-oceanic model
 - Component method (can swap ocean model)
- ⊙ WRF/ROMS – Coupled weather and ocean model to predict hurricanes
 - Messaging method (uses MCT)
- ⊙ RHESys – Coupled hydro-ecological models
 - Monolithic method

Existing Work

- ⊙ MapWindow
 - Dan Ames, Ph.D, Idaho University
 - Extensible GIS Framework
- ⊙ Model Coupling Toolkit
 - A software library “used to couple message-passing parallel models”
 - i.e. Communication-based method
- ⊙ Support for Model Coupling: An Interface Based Approach
 - Communication-based method
 - Ph. D dissertation by Thomas F. Bulatewicz

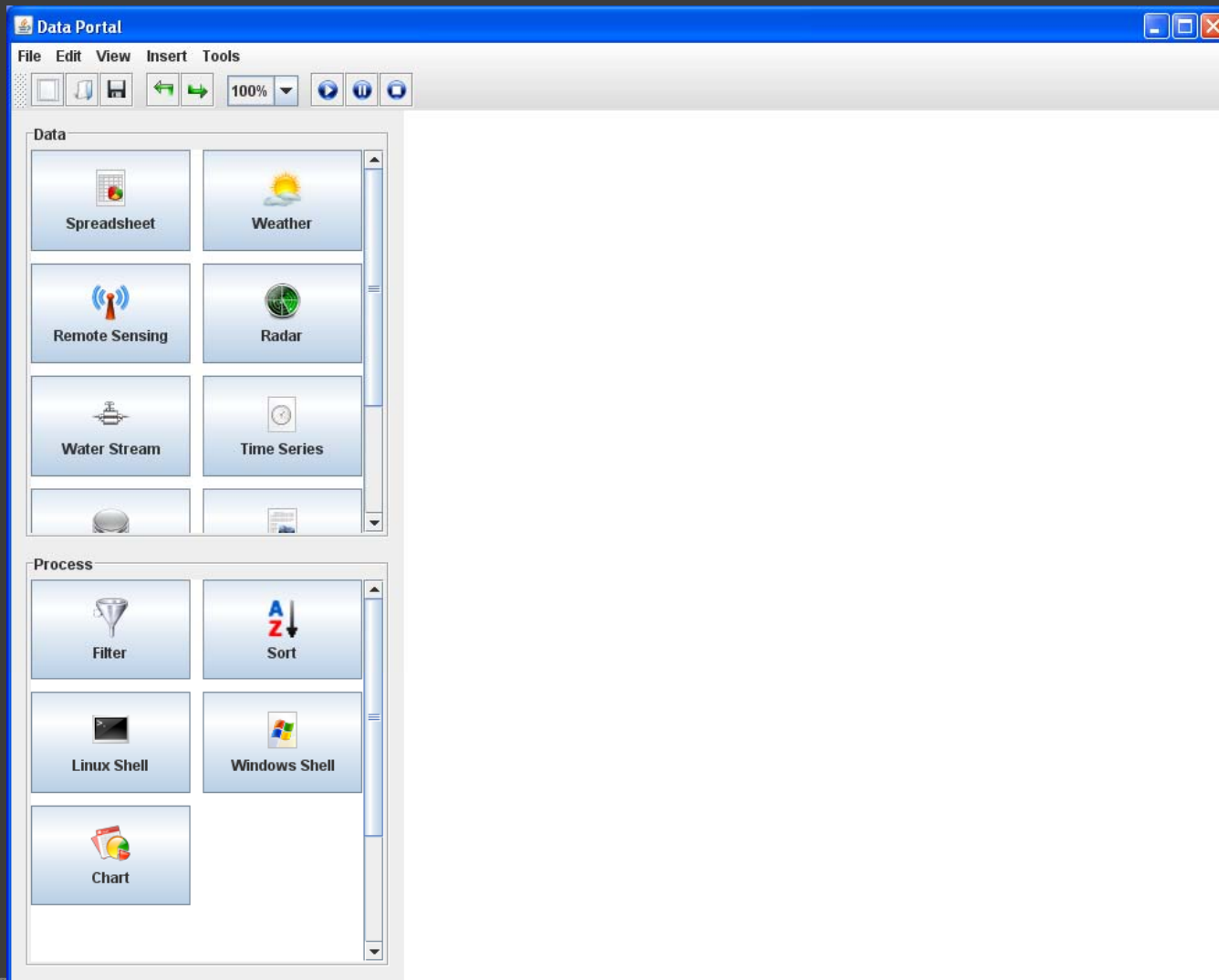
Goals for the Software Framework

- ① User Interface-based approach
 - Possibly incorporating a visual programming language for intermediate data conversions
- ① Reduce need for source code modification
 - Source code modification is difficult, at best
- ① Allow for saving coupled model scenarios for later use

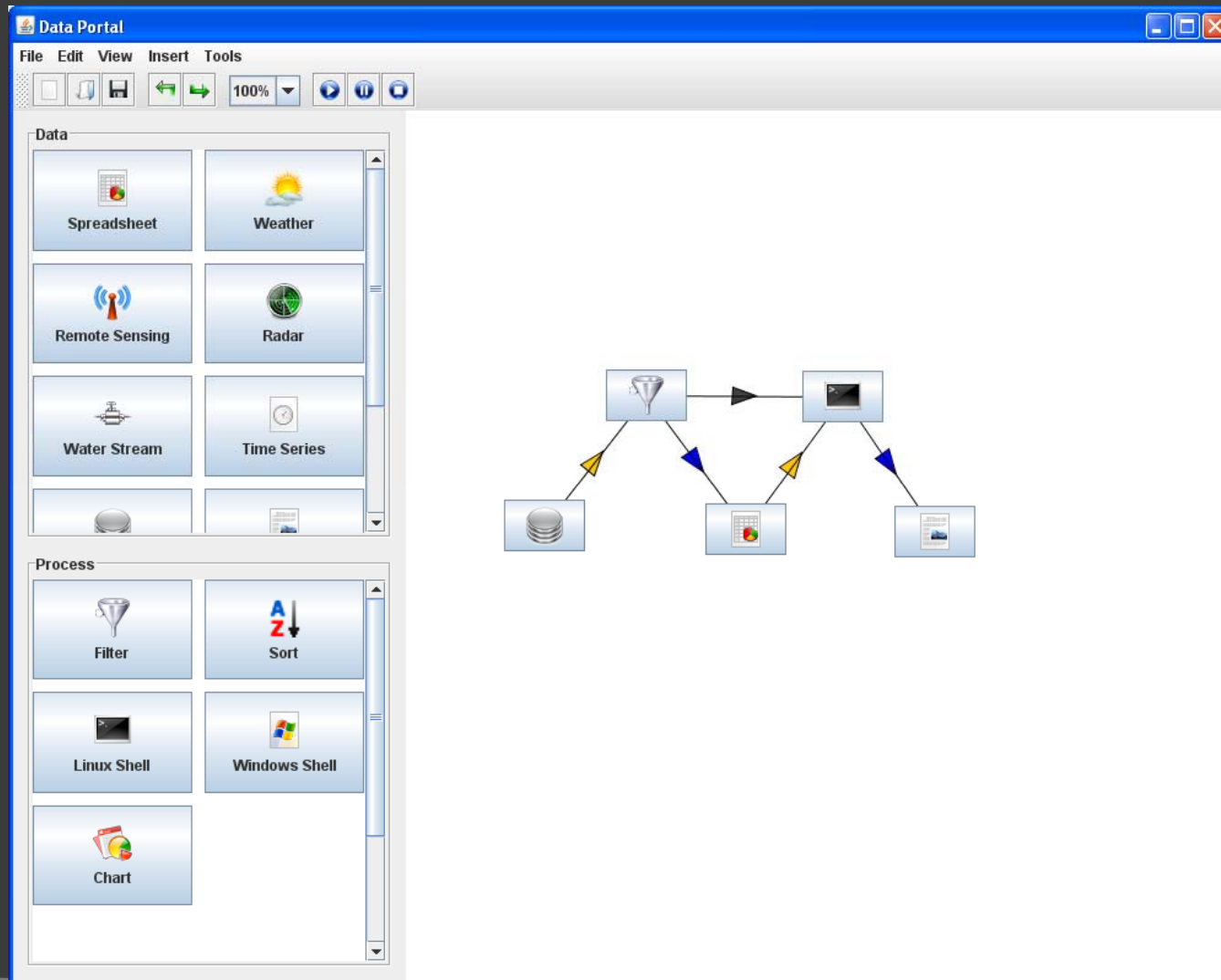
Goals for the Software Framework

- ◎ Web-based Application using Silverlight
 - Cross-Platform – Windows, Mac OS, Linux
 - One project, one user interface, one application
 - Directly interface with data portal
- ◎ Maintain common models on the server, and allow users to register additional models to be run

User Interface Prototype



User Interface Prototype



Questions?

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