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# Design of a Software Framework Prototype for Scientific Model Interoperability

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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?

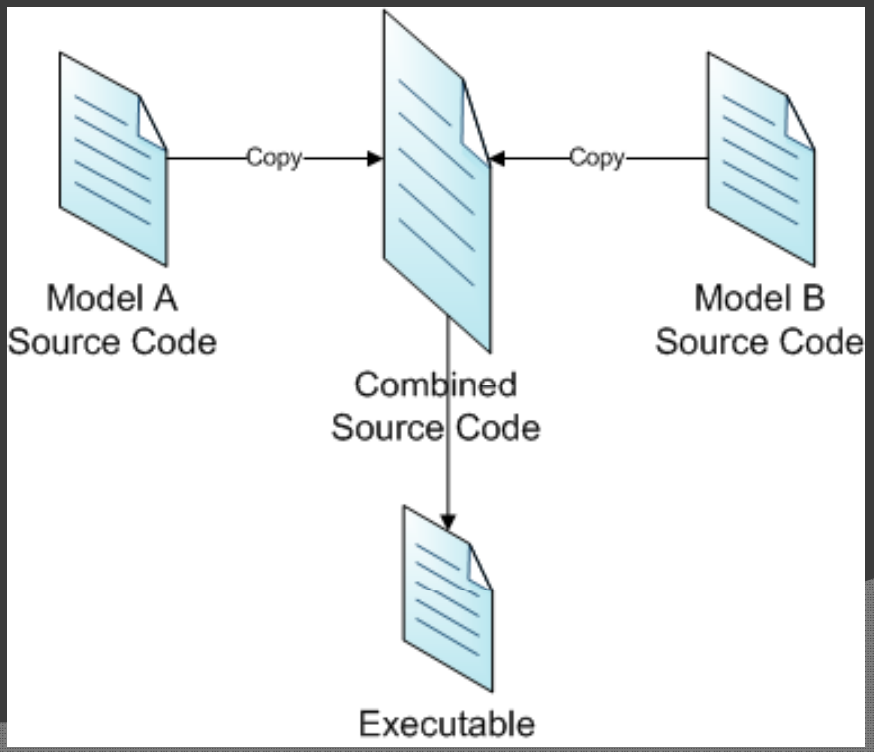
- Output of one model could provide valuable input for another model
  - E.g. Coupling an Atmospheric model with an Isopycnal model
- How do we get the output of one model to work as the input of another model (i.e. coupling the models)?

# 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

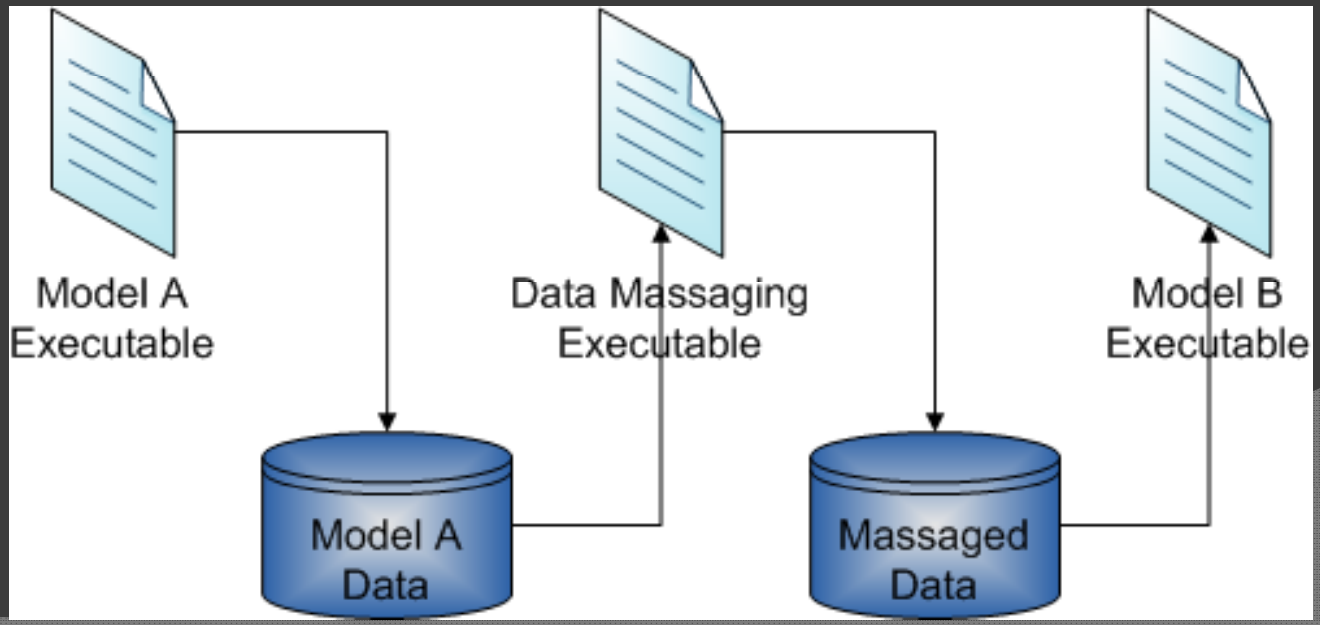
# Methods of Model Coupling

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



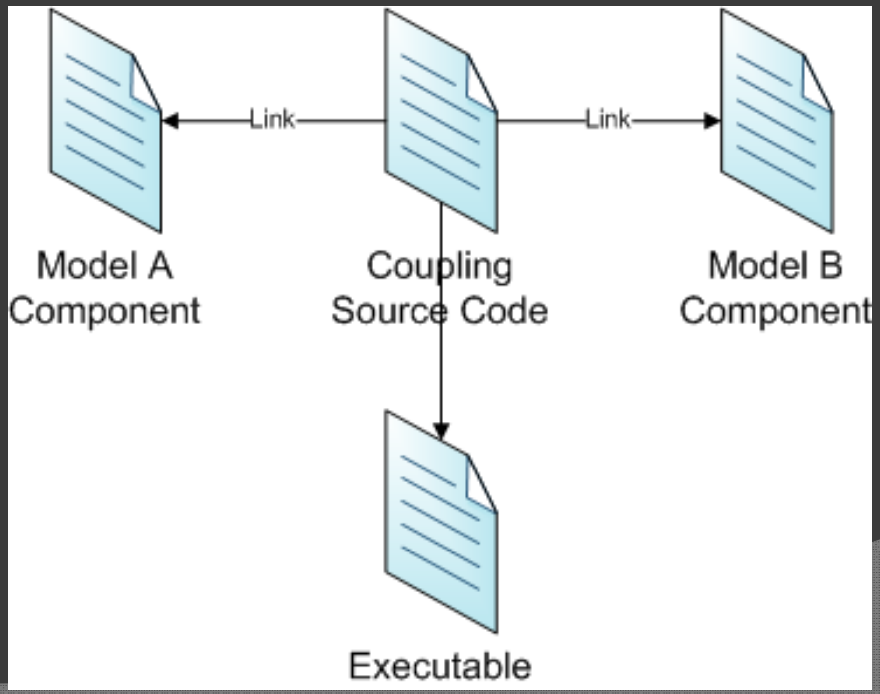
# Methods of Model Coupling

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



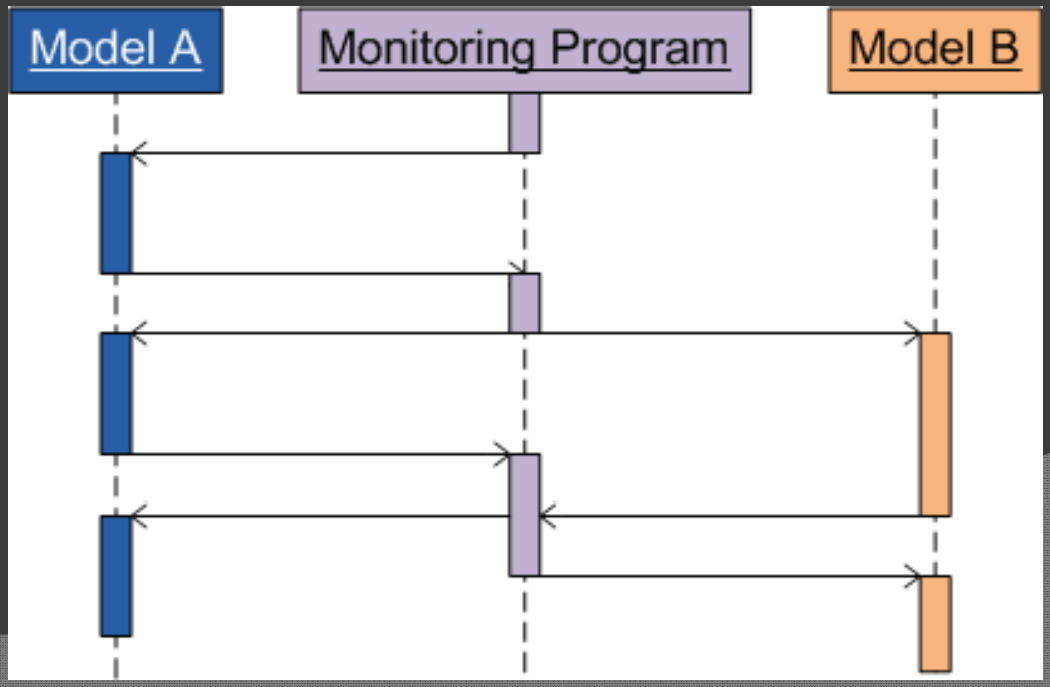
# Methods of Model Coupling

- 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)
- RHESSys – 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

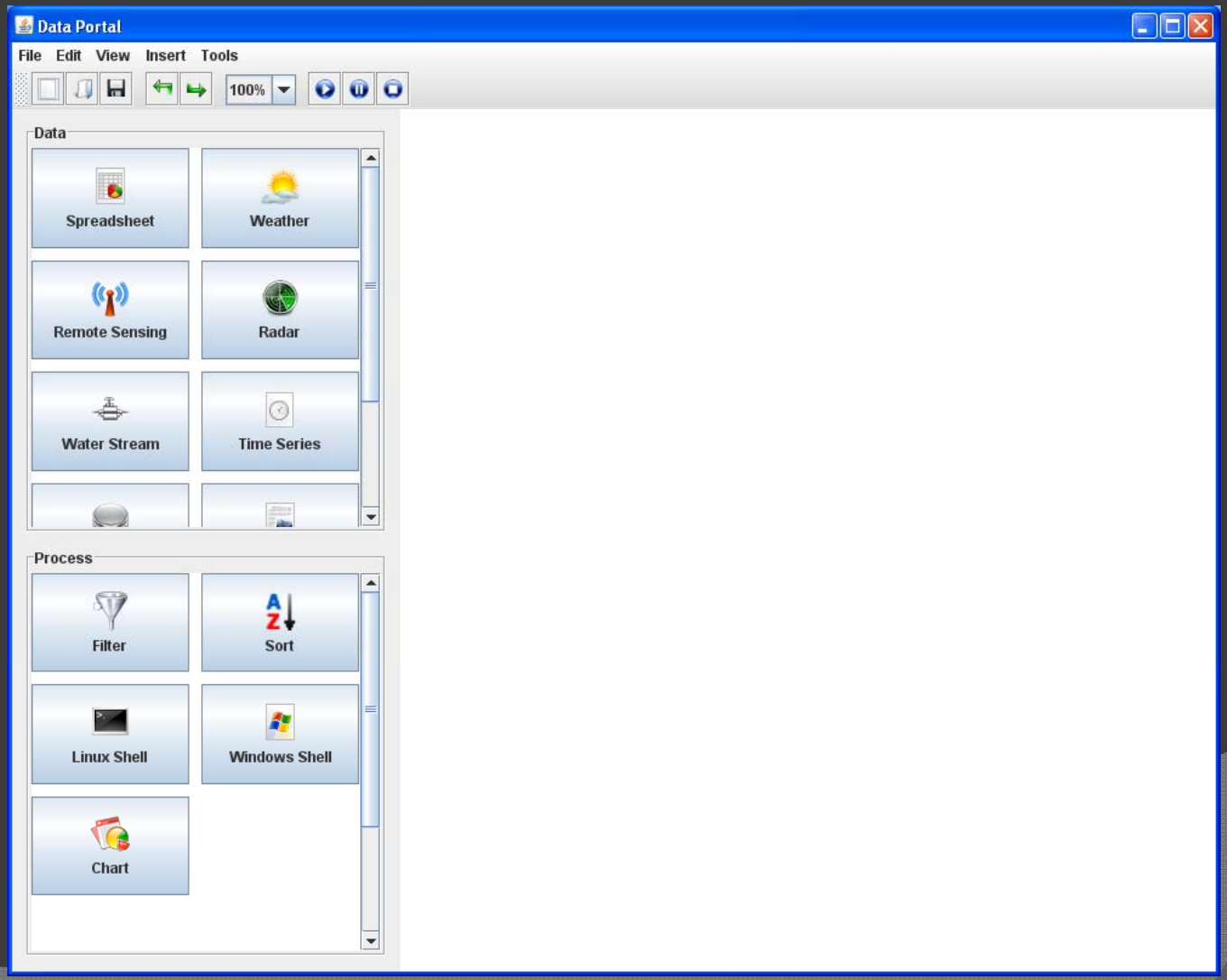
# Goals for the Software Framework

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

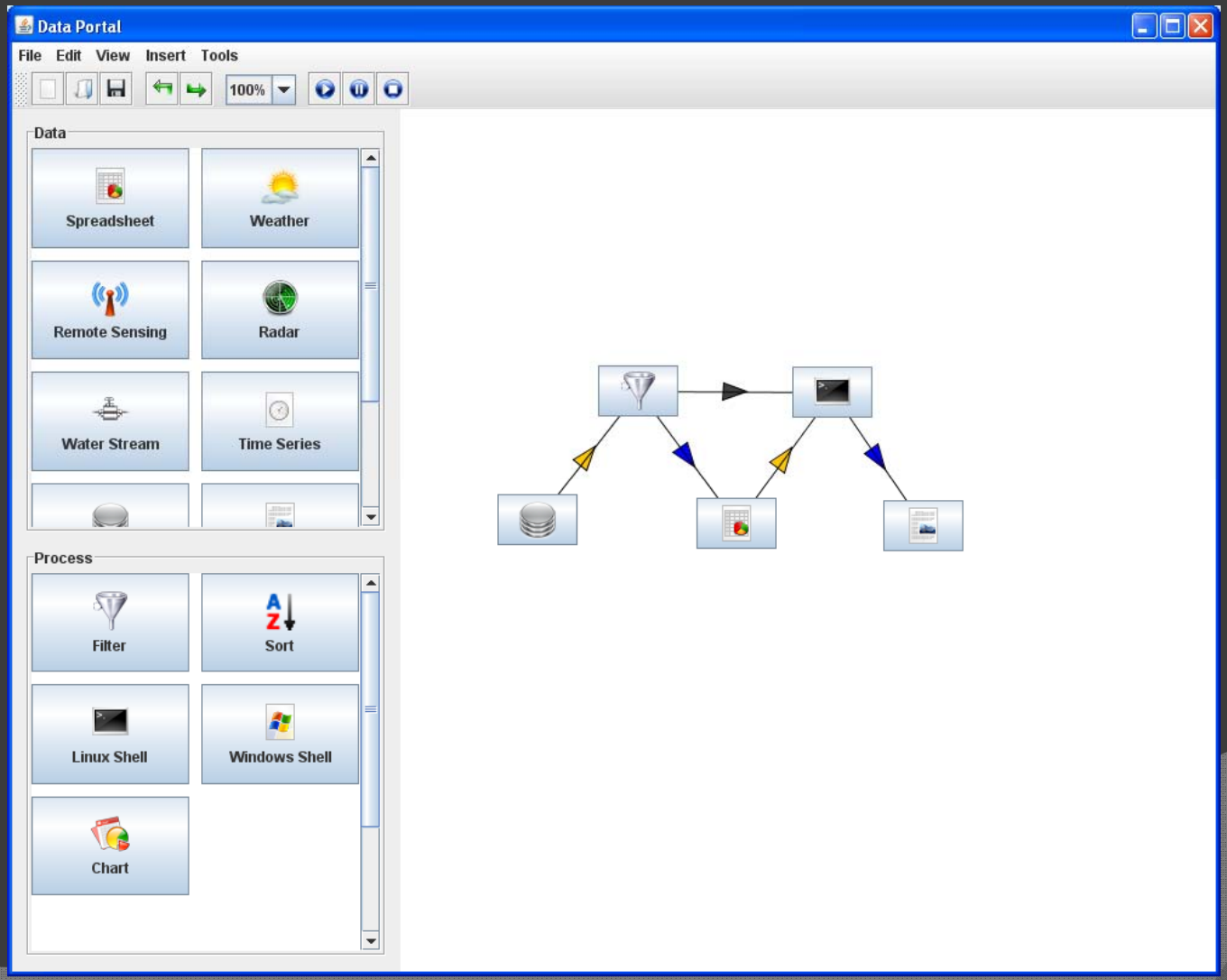
# Goals for the Software Framework

- 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?

# References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