SERVICES AND STANDARDS FOR WEB-ENABLED ENVIRONMENTAL MODELS

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SERVICES AND STANDARDS FOR WEB-ENABLED ENVIRONMENTAL MODELS

- Use case
- “PREDICTION OF RESPIRATORY TRACT DISEASE HOSPITAL ADMISSIONS FROM ENVIRONMENTAL VARIABLES IN THE CITY OF SAO PAULO”
- (Projeto BCHM Dr. Micheline de S. Z. S Coelho)

Motivation: The environment/climate change prediction challenge

- "The world is presently experiencing rapid and large scale modifications of the land surface (e.g. deforestation, urbanization) and changes to the climate.

- In the context of this ongoing global change, understanding and predicting the related (environmental) changes is one of the most urgent questions"

(adaption based on Bloeschl and Montanari, 2010)

Overview

Overview - Outline and Content

- Environment prediction challenge
- Use case

- Part 1: Overview
- Part 2: Modeling challenges
- Part 3: Linking Models
- Part 4: The future

Overview – Model Web approach

- Model Web

"The goal of the Model Web is to enable the development of a modelling infrastructure.

To achieve this, the Model Web focuses on enhancing interoperability of existing models and making their outputs more accessible"

(GEOSS AIP-2 Summary Engineering Report GEOSS Architecture Implementation Pilot).

- Vision, NOT (yet) implemented
- Infrastructure is "under construction"

Overview - Main Design Goals for Climate Impacts

Goals	Strategies
Models can be linked and reconfigured easily for including different models or solving different problems	Model interface and standards
Models are highly accessible and can be integrated into workflows that include analysis, visualization, and other processing of outputs	Service oriented architecture (SOA)
Communities formed around local/regional modeling are able to utilize the social and technical structures that have evolved in their domains	Models retain "locally" their native codes, computing platforms, and data formats as much as possible

Overview - Our Approach

- Focus on a modeling framework instead of individual models
- Integrate the modeling framework within SDI - nodes
- Lower the bar to entry for “environmentalists” to use and extend the modeling framework

Modeling challenges

Modeling challenges – Integrated Environmental Model

- Benefits and Goals of Integrated Environmental Modeling are evident

- Multiple concepts for Integrated Environmental Model
  - "Model Web" and / or
  - "Frameworks"

Modeling challenges - Status of Interoperability - Many modeling frameworks

- CCA (Common Component Architecture)
- CSDMS (Community Surface Dynamics Modeling System)
- ESMF (Earth System Modeling Framework)
- CESM (Community Earth System Model)
- MCT (Model Coupling Toolkit)
- OpenMI (Open Model Interface)
- OMS (Object Modeling System)
- FRAMES (Framework for Risk Analysis of Multi-media Environ. Systems)
- and many more …

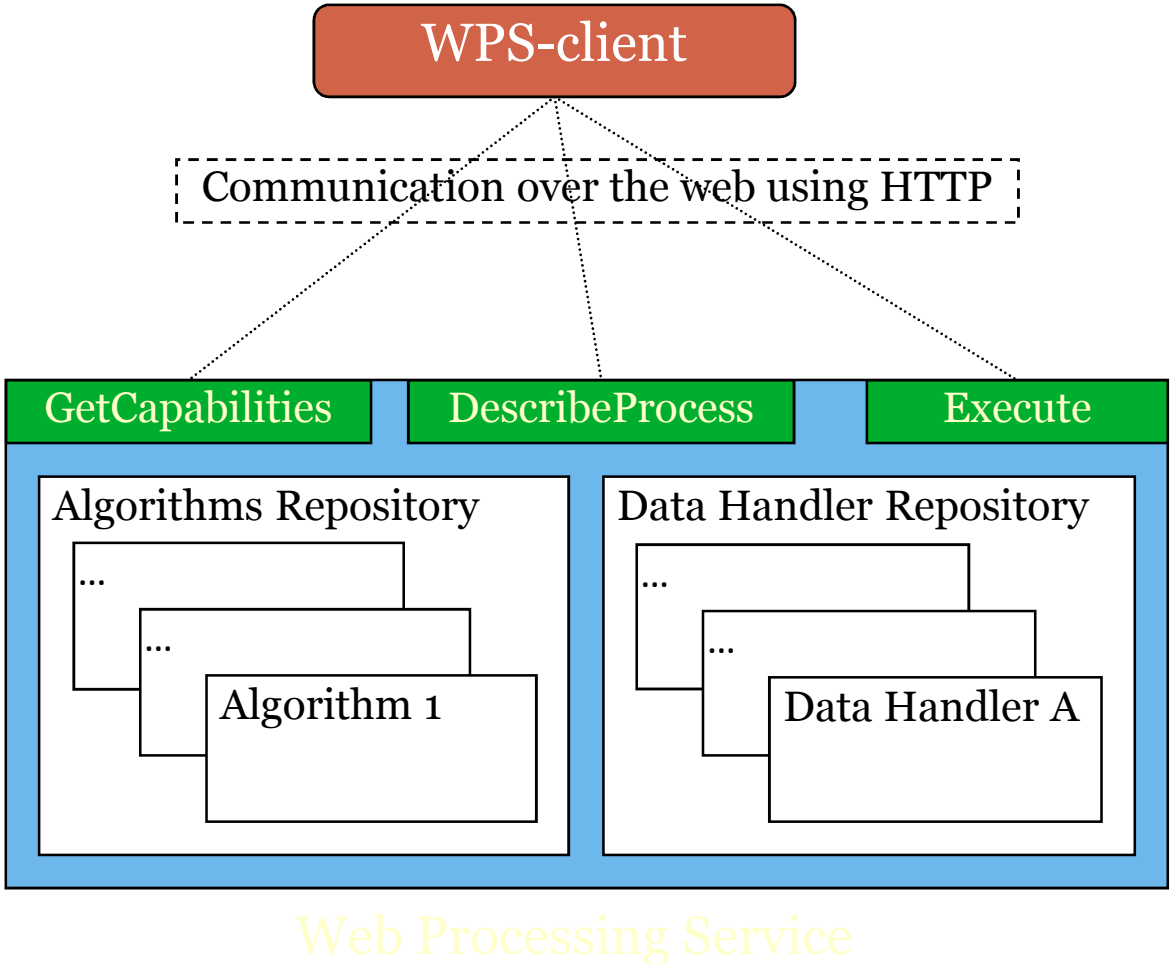
Modeling challenges – Key Advantages of Componentization

- divide a complicated task into a set of smaller, more manageable tasks
- minimal restrictions on each component – only interfaces are standardized (e.g. openMI approach)
- Potential to support multiple modeling frameworks

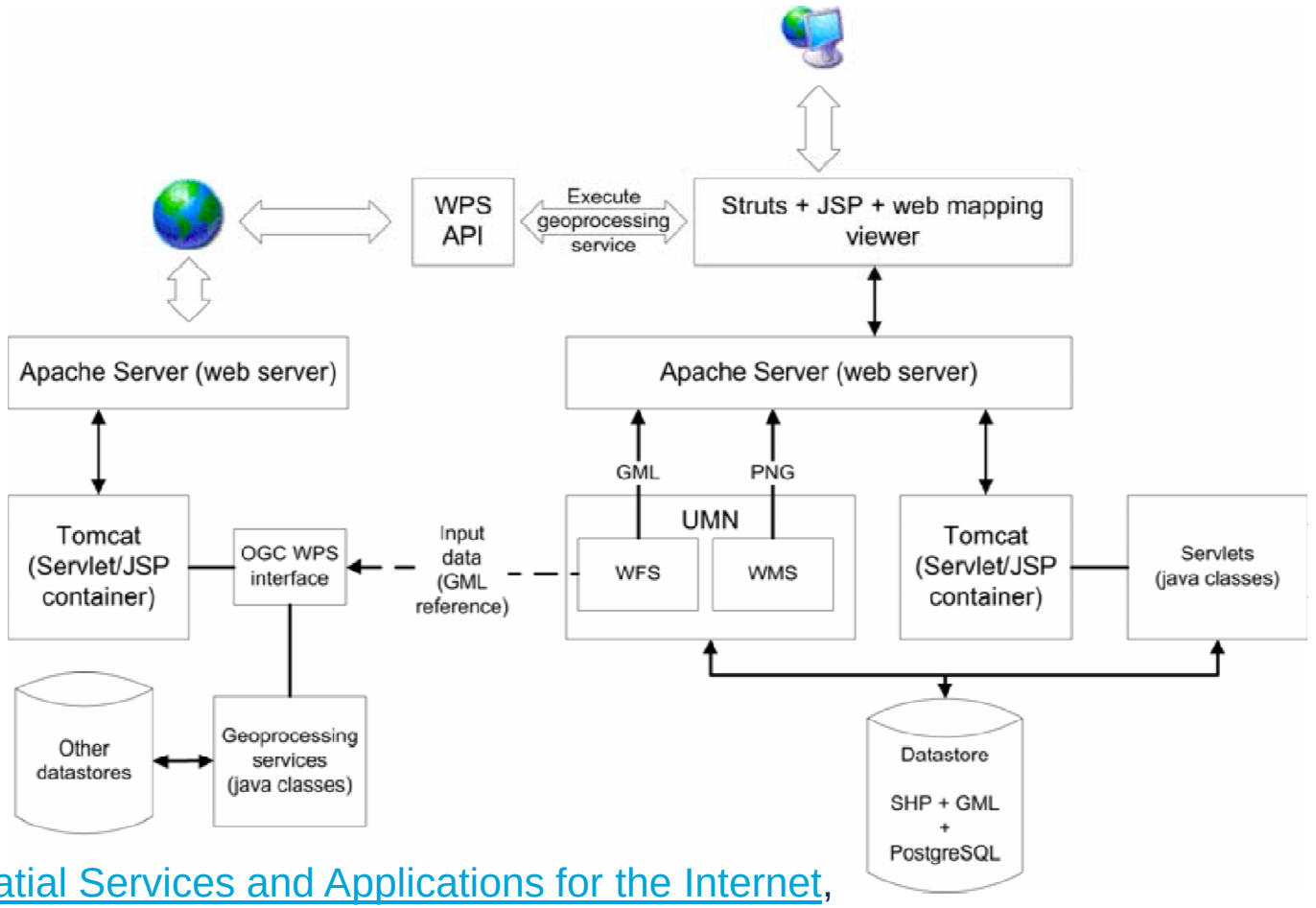
Modeling challenges – Services providing models

- Need to use them without prior knowledge
- Need to get a lot of information from the model service
  - Model description
  - Formal specification of parameters, input and output
- OGC WPS can provide the above functionality
  - Scheduling
  - Monitoring
  - Cancelling
  - Client notification
- OGC SPS provides also this additional functionalities

Modeling challenges – OGC Web Processing Service



Modeling challenges – WPS for Hydrological Modelling



Geospatial Services and Applications for the Internet, M. Gould, et.al., Springer, 2008

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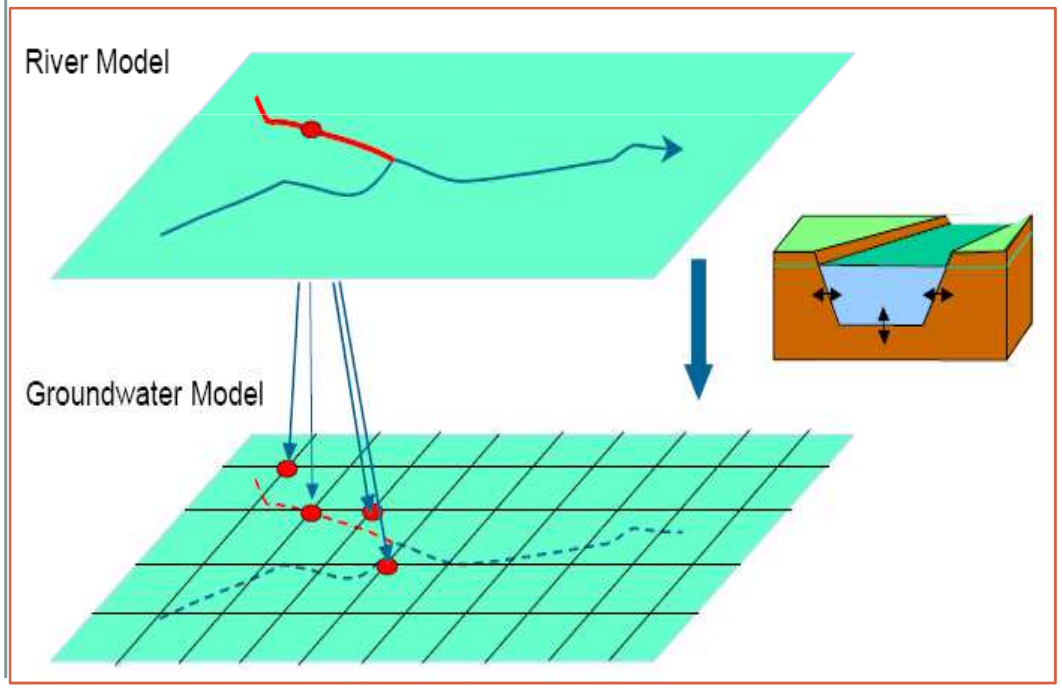
Linking Models

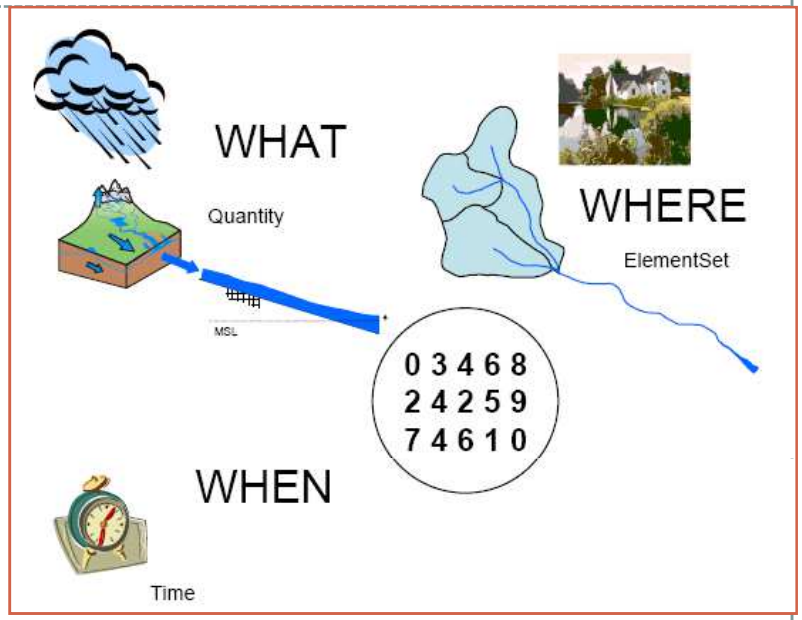
Linking Models - Difficulties

- The models are written in different languages, making conversion time- consuming and error-prone.
- The person doing the linking may not be the author of either model, and the code is often not well-documented or easy to understand.
- Models may have different dimensionality (1D, 2D, or 3D).
- Each model has its own time loop or "clock."
- The numerical scheme may be either explicit or implicit.

Linking Models - Open Modeling Interface

"The OpenMI provides **a standard interface**, which allows models to exchange data with each other and other modelling tools on a time step by time step basis as they run." - openmi.org





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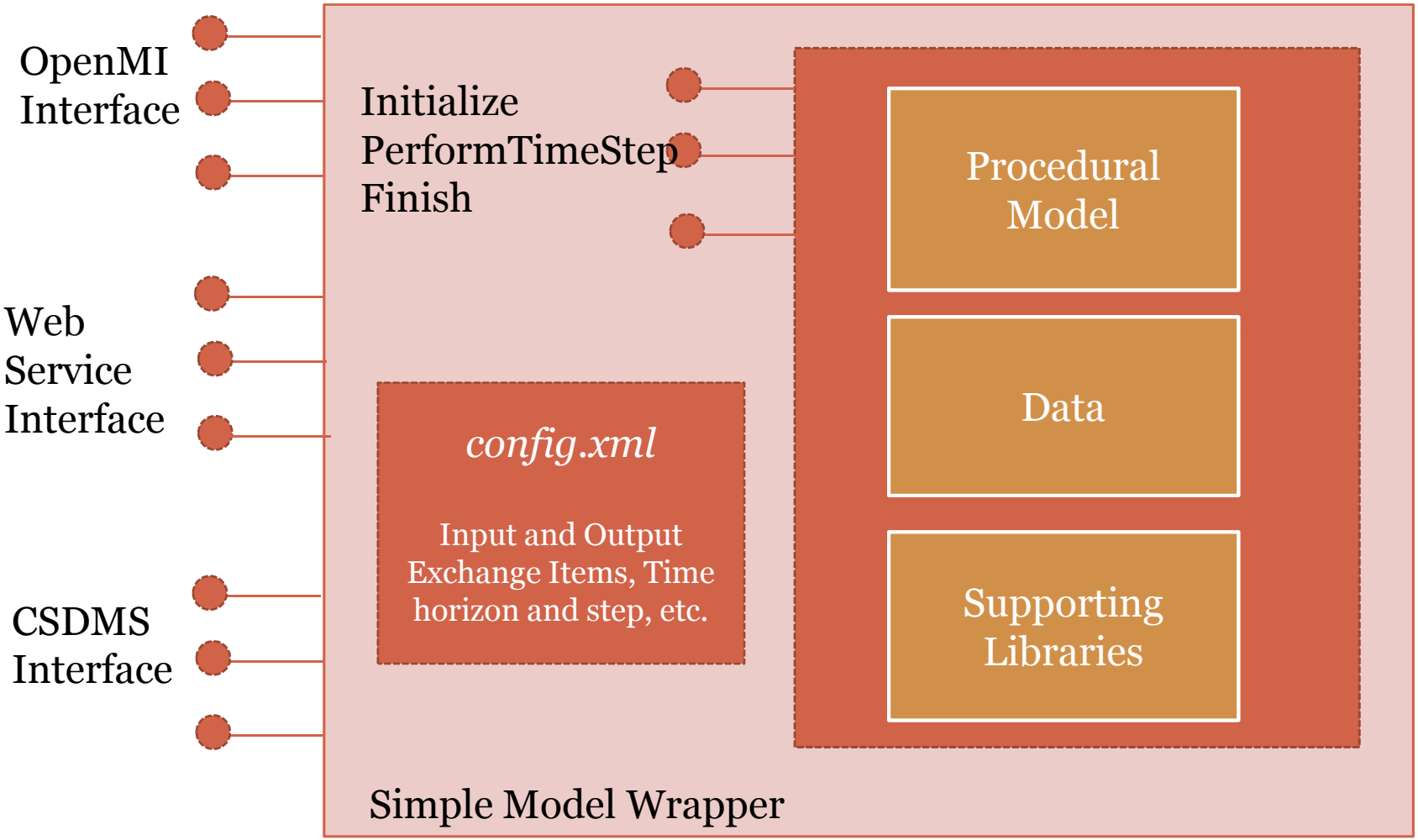
Linking Models – The Architecture of a openMi -Model Component



The future

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The future - The Vision

- Interoperable modeling components that can connect in multiple ways
- Enable models to be self-describing
- Create workflows that automate the modeling process from beginning to end
- Build workspaces that encourage collaborative, distributed development of models and data analysis

The future - Community Modeling

- Improving predictions of impact of climate change
- Sharing code for research and education
- Better use of simulation models to test hypotheses

The future - Composition-as-a-Service (CaaS)

- Definition
  - A service "…for avoiding the need to install a client-side composition infrastructure"

The future - Composition-as-a-Service (CaaS)

- Main Features
  - The CaaS supports business process modelling through composition (= re-use of existing) of (software) services
  - The composition result is still exposed as a service through a Workflow Engine

The future - REST'ful Web Services

- Use of HTTP (get,put,…) to a URI, with XML as the payload:
  - approach for getting information content from a Web site by reading a designated (via URI) Web page that contains an XML (Extensible Markup Language) file that describes and includes the desired content.

The future - Uncertainty Enabled Services

- Developing profiles of WPS, SOS, CSW and WCS and produce implementations of these that can work with uncertain inputs and outputs
  - will restrict what can be communicated to make it easier to interoperate within uncertainty enabled services

Questions ?
Contributions? (we need a lot them.....)

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