2nd Workshop on a Community Hydrologic Modeling Platform
March 31 – April 1, 2009
University of Memphis

Agenda

Tuesday, March 31

7:30 am	Registration and check-in,
8:30 am	Welcome from the organizers (Jay Famiglietti, Rick Hooper)
8:40 am	Logisitics (Brian Waldron)
8:45 am	Summary of CHyMP Scoping Workshop and CHyMP activities to date (Jay Famiglietti)

Session I: Science requirements, motivation, and justification, Venkat Lakshmi, Convener

9:00 am	Eric Wood, *Perspectives on the Need for Community Modeling in Hydrology*
9:20 am	David Maidment, *Model/Data Integration: Linking the CHyMP with CUAHSI Data Services*
9:40: am	George Leavesley, *Experiences with the USGS Modular Modeling System*
10:00 am	Ed Sudicky, *Perspectives on community modeling of integrated ground water and surface water*
10:20 am	Break
10:40 am	Cecilia DeLuca, *The Earth System Modeling Framework*
11:00 am	Ben Hodges, *Current activities towards community inundation modeling*
11:20 am	Christa Peters, *The NASA Land Information System*
11:40 am	David Gochis, *Regional Modeling of Hydrology and Climate*
12:00 pm	Lunch

Session II: Government and Industry Perspectives, Larry Murdoch, Moderator, Current agency research and applications, future directions and the potential role of CHyMP in agency modeling activities. *All participants will be invited to provide posters*

1:00 Moderated Panel Discussion: Agency and Industry Views on CHyMP. Five- to ten-minute remarks by following panelists, followed by questions from the floor.

Paul Barlow, USGS (GSFLOW)
Harold Optiz, NOAA CHIPS
Noha Gaber, EPA (Integrated Modeling System)
Robert Hunter, Army Corps of Engineers

Ken Rojas, USDA
Sorab Panday

2:30 pm Charge to Breakout Groups (Larry Murdoch)
3:00 Break

Session III: Breakout I: *Breakouts are organized around 5 topics (see the following pages) that will be repeated on Tuesday afternoon and Wednesday morning. Attendees will participate in one group on Tuesday and a different group on Wednesday.*

3:15 pm Breakout session 1
5:00 pm Adjourn for the day
6:00 pm Reception and poster viewing

Wednesday, April 1

Session IV: Breakout II
8:30 Discussion of day 1 and charge for day 2 (Rick Hooper)
9:00 Breakout session 2
10:45 am Break. Breakout leaders compile findings.
11:30 am Summary and discussion of Breakout 1

12:00 pm Lunch

1:00 Summary and discussion of Breakout 2
1:30 Summary and discussion of Breakout 3
2:00 Summary and Discussion of Breakout 4
2:30 Summary and Discussion of Breakout 5
3:00 Meeting summary, future steps and writing assignments (Jay Famiglietti
3:30 Meeting adjourned

Breakout Sessions (*Discussion leads in parentheses***)**

Group 1: Scientific Justification ***(****Ed Sudicky and Eric Wood)*
Group 2: Scientific Capabilities *(Al Valocchi and Steve Margulis)*
Group 3: Software Approach and Architecture *(Scott Peckham and Cecilia De Luca)*
Group 4: Community Engagement and Collaborative Development *(Dave Gochis and Sorab Panday)*
Group 5: A National Water Model and other applications for CHyMP **(***Dennis Lettenmaier and Chris Duffy)*

Group 1: Scientific Justification

The purpose of this session is to identify the contributions that justify creating a CHyMP. It will explore the purpose of CHyMP and how it could advance the field of hydrology. Points for discussion include:

- *The need for a platform of components vs. models themselves*
- *What are the critical elements that CHyMP must provide for it to be embraced by the hydrologic research community?*
- *How can the existence of CHyMP enable scientific inquiry that is impossible without it?*
- *How can CHyMP enhance the efficiency of performing hydrologic research?*
- *What can CHyMP provide that will set it apart from other modeling platforms or frameworks? Why do we need something new?*
- *How can CHyMP enable technological opportunities that are not widely used in hydrologic science, such as access to high-performance computing?*
- *How do current limitations in communicating model capabilities limit progress in hydrology, and how can CHyMP address these limitations?*

Group 2: Scientific Capabilities

The purpose of this breakout session is to define the scientific capabilities that should be targeted for CHyMP. What functionality should CHyMP deliver? CHyMP goals that emerged from the CHyMP Scoping Workshop include:

1. **Represent physics associated with the flow of all terrestrial water**
   Ground water, vadose zone, streams, lakes, estuaries, frozen soil, permafrost, glaciers, snow.
2. **Flexibility to ultimately represent many processes and link to models in related disciplines**
   Transport of solutes and sediment, chemical and biochemical reactions, multiphase flow, porous media deformation, as well as processes from biology, ecology, environmental engineering, geomorphology, economics, and other fields.
3. **Accommodate parameters and physics over a wide range of scales**

Include techniques for adjusting forms of equations to accommodate scales from pores to continents; methods to up-scale and down-scale parameters.

4. **Couple with Ocean and Atmospheric Circulation Models**
   Provide capability to simulate entire hydrologic cycle
5. **Data Integration and assimilation**
   Access to remote and in situ data for assimilation, calibration and validation. Close compatability with CUAHSI Data Services
6. **Calibration, optimization**
   Estimate model parameters and uncertainty from large data sets, optimize water management strategies
7. **Represent stochastic processes**
   Parameter distributions, transition probabilities, Monte Carlo, geostatistics, and other stochastic processes
8. **Execute simulations on single, or many parallel processors**
   Seamless application of HPC
9. **Visualization**
   Display data to maximize insights
10. **Interface**
    Easy to use, learn, teach

Discussion should cover the following:

- *Are these goals reasonable?*
- *What goals should be modified? What is missing?*
- *Can these goals be achieved within the general architecture of packages outlined under Group 3*
- *What packages are missing, which can be combined or modified?*
- *What functionality should be included within the packages?*

Group 3: Software Approach and Architecture

This session will explore approaches for creating CHyMP software and developing capabilities that can be extended and modified. The current approach is that CHyMP may consist of several major packages with distinct functionality, for example

Model Domain and Geometry to represent the geometry of the region to be simulated. Includes mesh or grid generation, with arrays of constitutive parameters, state variables, and forcing terms.

Forward Package with general capabilities to represent distributed processes.

Inverse Package with capabilities to identify model parameters and uncertainty from large data sets, evaluate management strategies, integrate data from sensor networks, and related.

Stochastic Package to conduct general geostatistical analyses, generate parameter distributions, Markov chain, Monte Carlo analyses, transition probabilities, up-scaling and down-scaling methods, and other techniques.

Spatial Analysis Package to conduct general analyses of distributed parameters. Similar to GIS analyses.
Visualization Package with general graphical and data display capabilities.
Data Package to read data from, or write data to HIS.

- *Is this a reasonable approach? What is missing? How can the approach be improved?*
- *What are the advantages/disadvantages of creating a single user interface for specifying model geometry and parameter distribution independent of the type of physics and solver? Can this type of interface be created today?*
- *What are the advantages and limitations of coupling existing forward models using external software like OpenMI, CCA, or other?*
- *Advantages and disadvantages of creating new forward modeling capability for CHyMP?*
- *Importance of including a scripting language to facilitate customization by the user?*
- *What are the advantages and disadvantages of existing approaches and architectures?*
- *Is asynchronous data assimilation in a component-based structure a feasible goal?*
- *How can the CHyMP framework be strongly coupled to CUAHSI data services to enable model parameter selection, calibration, and assimilation?*

Group 4: Community Engagement and Collaborative Development

The success of CHyMP will be determined by how it is embraced by a community of users and contributors. It will be critical to identify the user community and design CHyMP so it serves the needs of that community. Moreover, it will be just as important to design CHyMP to grow through contributions from the community.

Some key questions for discussion are:

- *Who is the community served by CHyMP? Should this community extend beyond the academic institutions who are members of CUAHSI?*
- *How will the community contribute to CHyMP? Will contributions be open to anyone at any time? Will a review process be implemented? Will contributions be citable?*
- *What is the role of Federal Agencies? Can the mission-specific modeling goals from a wide range of government agencies be provided within CHyMP?*
- *What is the role of private industry? Should CHyMP provide capabilities required by hydrologic consultants? Should CHyMP be available at no cost for use by consultants who are getting paid for the results?*
- *Some of the best software available to the hydrology community is distributed under commercial license, and using this software in a HPC setting would benefit many applications. What is the role of commercial software on CHyMP?*

- *CHyMP should evolve with time. How should this growth be managed? Who should do it, and what management structures should be considered?*

Group 5: A National Water Model and other applications for CHyMP

A National Water Model (NWM) is currently envisioned as an implementation of CHyMP that is integrated with the best currently available data set of calibration parameters through CUAHSI Data Services. A national model can serve as a focal point for the CHyMP development and user communities. Moreover, the ability to run the model at higher resolutions for regional scale applications is also highly desirable.

Potential discussion topics include:

- *What are the key features and capabilities that should be included in a NWM?*
- *How will a NWM differ from currently available models such as those from NASA (e.g. NLDAS), NOAA , or developed by individual PIs?*
- *What applications are enabled by a NWM (e.g. environmental impact assessment, emergency response to disasters, preliminary assessment of CO2 sequestration in saline aquifers, preliminary contaminant assessment, estimating effects of climate change, etc)? What is the role of a NWM in water resources management, planning and infrastructure investment?*
- *What is the role of regional model development, and can models developed at regional scales be coupled seamlessly into an NWM framework?*
- *Community contributions of data sets, both from direct field measurements and from calibration results, will be an important mechanism for developing the NWM. How can these contributions be encouraged? How can quality be ensured? What type of review process should be implemented?*
- *A NWM will address the missions of many federal agencies and of the private sector. What is their level of interest and what is the best way for agencies to participate?*
- *What are the potential barriers to development of this type of model. What are the barriers to use by the hydrologic community?*