Meeting Summary
Interagency Discussion on
Next Generation Water Resources Modeling System Requirements
26-28 October 2020, 1:00-5:00 p.m. EDT, WebEx

Goals and objectives of this meeting (from the agenda):

1) Document the needs and priorities of partner agencies in terms of water resources prediction capabilities and their applications

2) Explore the enabling technologies such as data, code and interoperability standards, and the open-source development paradigm and how these enabling technologies make this development possible

3) Identify a minimum set of technical requirements that meet the needs of participating agencies while maximizing framework flexibility for use by the research and development communities

4) Discuss in general terms the necessary components of a governance model for the proposed community framework and associated modeling system(s)

5) Establish an interagency panel to develop a requirements document to guide framework design

Attendees:

Archfield, Stacey, USGS	Barton, Russ, NOAA-OWP
Cifelli, Rob, NOAA-PSL	Clark, Ed, NOAA-OWP
Eylander, John, ERDC-CHL	Flowers, Trey, NOAA-OWP
Graziano, Tom, NOAA-OWP	Guertal, William, USGS
Gutenson, Joseph, ERDC-CHL	Holman, Kathleen, USBR
Lesmes, David, USGS	Loney, Drew, USBR
Mahoney, Kelly, NOAA-PSL	Massey, Chris, ERDC-CHL
Nowak, Ken, USBR R&D Office	Ogden, Fred, NOAA-OWP
Owensby, Margaret, ERDC-CHL	Rosati, Julie Dean, ERDC-CHL
Skalak, Katherine, USGS	Smith, Jane, ERDC-CHL
Talbot, Cary ERDC-CHL	Tavakoli, Ahmad, ERDC-CHL
Trahan, Corey, ERDC-ITL	Wahl, Mark, ERDC-CHL
Wamsley, Wamsley, ERDC-CHL	Wilds, Troy, NOAA-OWP

Summary of Discussion (with reference to detailed meeting notes):

The NOAA-NWS Office of Water Prediction (OWP) invited federal partners with similar and overlapping water modeling needs to help develop a set of requirements to guide development of an open source Next Generation Water Resources Modeling Framework (Nextgen). Introductory comments by Tom Graziano, Director of the NOAA-NWS-OWP, Ty Wamsley,

Director of the USACE-ERDC Coastal and Hydraulics Laboratory (CHL), William Guertal, Deputy Associate Director for Water, USGS, and Ken Nowak of the USBR Research and Development Office, welcomed participants and encouraged discussion.

NOAA-NWS OWP embarked on this development activity based largely on experiences gained from the current operational National Water Model. Review and evaluation of that code-base by the General Services Administration 18F group, which helps agencies evaluate, design, and specify software and development contracts, suggested a clean-sheet redesign. OWP has committed to the development of Nextgen, and is targeting FY 2024 to implement operationally a version of the National Water Model based on the Nextgen design.

The vision of the Nexgen Water Resources Modeling Framework is to develop a flexible, standards-based, and domain-scientist/engineer friendly software system, that enables multi-model scientific evaluation and promotes model interoperability, using the open source software development paradigm to meet agency mission specific needs and those of the academic and research communities.

In early 2020, NOAA-NWS-OWP began a prototyping exercise to explore standards and existing software to support the Next Generation Water Modeling Framework. Preliminary steps to evaluate options resulted in an operational prototype. Those accomplishments are located on the following repository: https://github.com/NOAA-OWP/ngen

The first day included four presentations:

1. WaterML 2.0 Hy_Features standard for hydrographic and hydrologic geospatial data. David Blodgett, USGS

2. Model workflow unification and model coupling strategies in the HPC environment. Fred Ogden, IBSS Corp., NOAA-NWS-OWP Affiliate

3. GitHub Open Source Community Development Environment, Nels Frazier, ERT Corp., NOAA-NWS-OWP Affiliate

4. Inter-agency Model Coupling Methods and Governance Examples (ADCiRC, CSTORM, etc.) Chris Massey, USACE-ERDC

Discussions by the group on Oct. 27 and 28, communicated the capabilities and needs of the participating agencies, focusing on identifying a set of agreed-upon "tenets". Discussions focused more on the "Why" and "What" questions behind the needs and high-level feature requirements for the framework rather than the "How" questions around actually building it. Several themes emerged from these discussions, summarized here:

- Engagement with the domain science and engineering communities extremely important for success.

- Ensure flexibility to allow a variety of approaches, resolutions, discretizations, etc.

- Enable couplings across disciplines (e.g. inland/coastal), and across space/time scales.

- Use and adoption success depends on accurate and detailed documentation, tutorials, augmented with regular training opportunities.

- Target time of weeks rather than months or years for domain scientists/engineers or graduate students to improve or add new domain specific functionality to the framework.

- The framework must accommodate a wide range of modeling needs, different dominant processes, space and time scales to satisfy the breadth of agency needs.

- Flexibility is key to successful development of a system that focuses on enabling interoperability rather than on specific models.

- This development promotes active collaboration between agencies and academia/industry partners.

- Standardization through the framework enables creation of an archive of models and datasets to the benefit of all interested.

Discussion Guideposts:
- The focus is on the architecture, not a model

- Maximum flexibility, as models evolve, framework should support those changes

- Nextgen is a pathfinder for IHTM with initial focus on hydrology

- NOAA targeting FY 2024 for first operational implementation

- NOAA is committed to long-term engagement

- Partner with other agencies to leverage investments from complementary capabilities for our mutual benefit

- Identify core agency requirements that add functionality

- Governance - open source development paradigm provides for community development based on tenets

- Commitment to cooperate and avoid code forks/bifurcations

Agreed Upon Motivations and Tenets:
- Maximum flexibility - as models, data sources, and needs evolve, framework supports changes and additions. Model agnostic

- Common architecture avoids duplication and promotes interoperability

- Open source development

- ○ Promote code reuse and development efficiency
  - ○ Authoritative repository for federal water models
  - ○ Ease/encourage participation by partners and community
- Apply standards where applicable and necessary
  - ○ Coding, coupling
  - ○ Data and metadata
  - ○ Model verification/validation and test data
- Friendly to domain scientists and engineers to facilitate community development
- Commit to sharing models, data, and results
  - ○ Library of model codes and data sets
  - ○ Evaluation tools
- Establish and maintain a glossary and define terms to communicate clearly across disciplinary boundaries
- Use mature open source libraries where appropriate
- Multi-language support (C++, C, Fortran, Python)
- Run on hardware from laptops to supercomputers
- Two-week target to allow graduate students or new employees to add functionality
  - ○ Excellent documentation and step-by-step examples/tutorials
  - ○ Programming required but not computer science background

Open Source Project Governance:
- Open source model provides for project quality control and assurance by requiring:
  - ○ Adherence to project objectives through owner approval
  - ○ Code review to ensure compliance with standards and tenets
  - ○ Submission along with code of proof of performance such as comparisons against high quality data sets, analytical approaches, or outputs from other verified models
  - ○ Unit testing to verify system integrity
- Domain science focus of project requires continuous involvement by domain scientists and engineers in the approval process

Next Steps:
- Develop a plan/milestones for architecture development
- Plan and initiate a series of development sprints

- Identify and employ a means for routine coordination
- Establish/document a governance model

Notes:

- Presentation on the Nextgen Water Resources Modeling Framework planned for AGU Town Hall on Water Prediction, Thursday, Dec. 8, 12:30 CST

- NOAA-NWS-OWP Hopes to partner with USGS, ERDC, USBR for 2021/2022 Summer Institutes, with a theme on the Nextgen Modeling Framework.