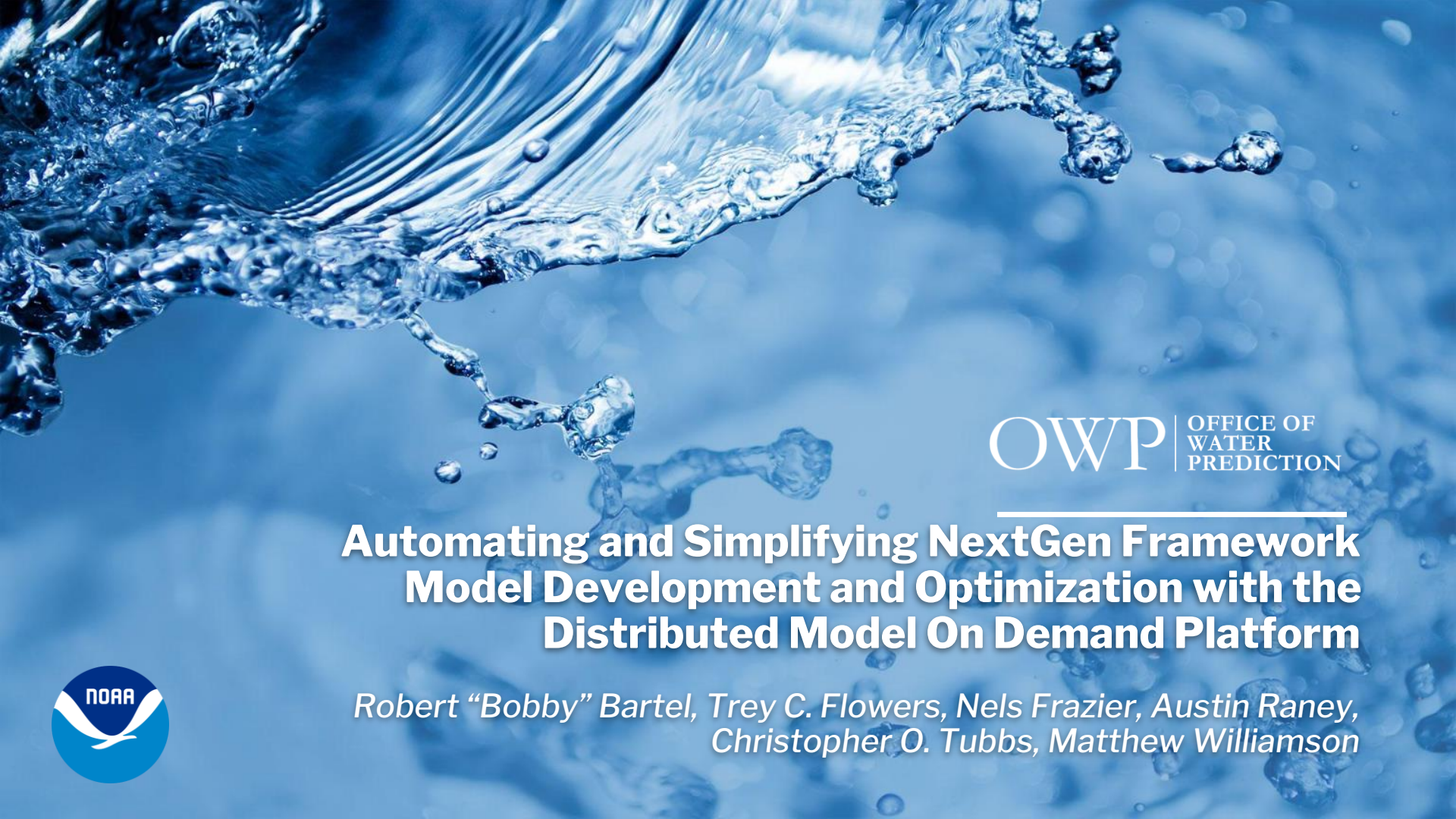

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Automating and Simplifying NextGen Framework Model Development and Optimization with the Distributed Model On Demand Platform

Robert "Bobby" Bartel, Trey C. Flowers, Nels Frazier, Austin Raney, Christopher O. Tubbs, Matthew Williamson

The NextGen Framework

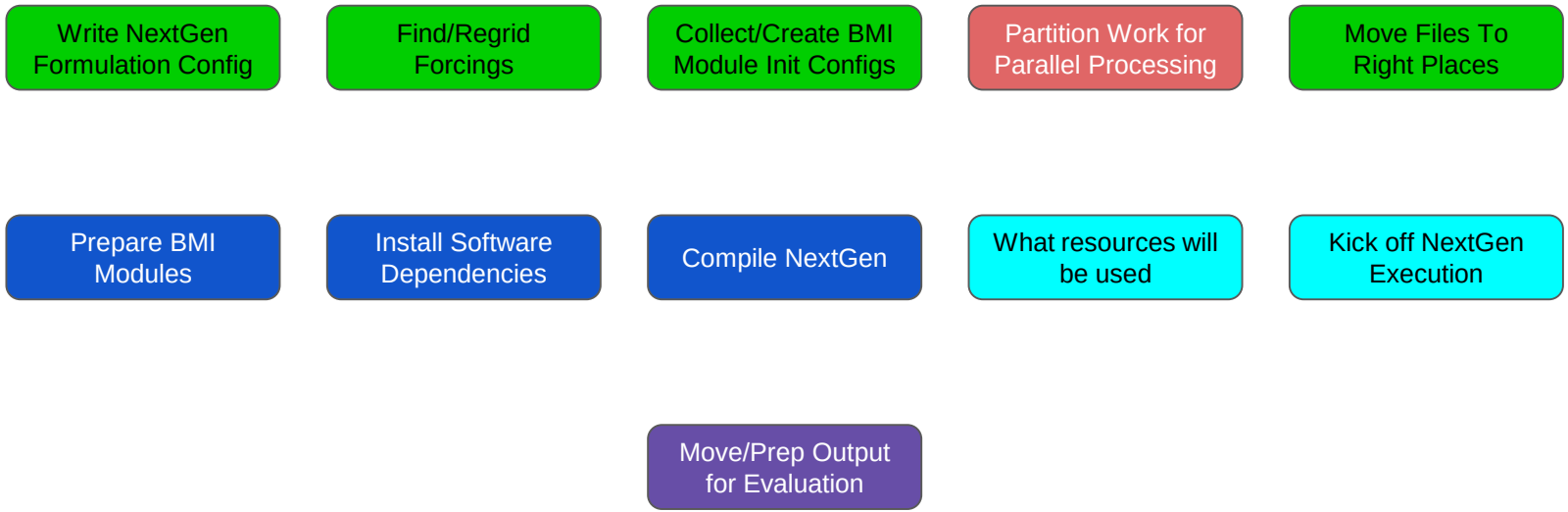
The **Next Generation Water Resources Modeling Framework** (NextGen) is a modular, scalable, open source modeling framework. It enables heterogeneous modeling through per-catchment model formulation. This allows for the "right" model to be used for a particular location, though it must be found first.

NextGen and BMI

The **Basic Model Interface** (BMI) is a set of *standardized* control and query functions defined for several programming languages that can be added to scientific model code to make it easier for other software to use the model. NextGen constructs model formulations by combining a series of configured BMI modules. This make NextGen even more flexibility in how modeling is performed.

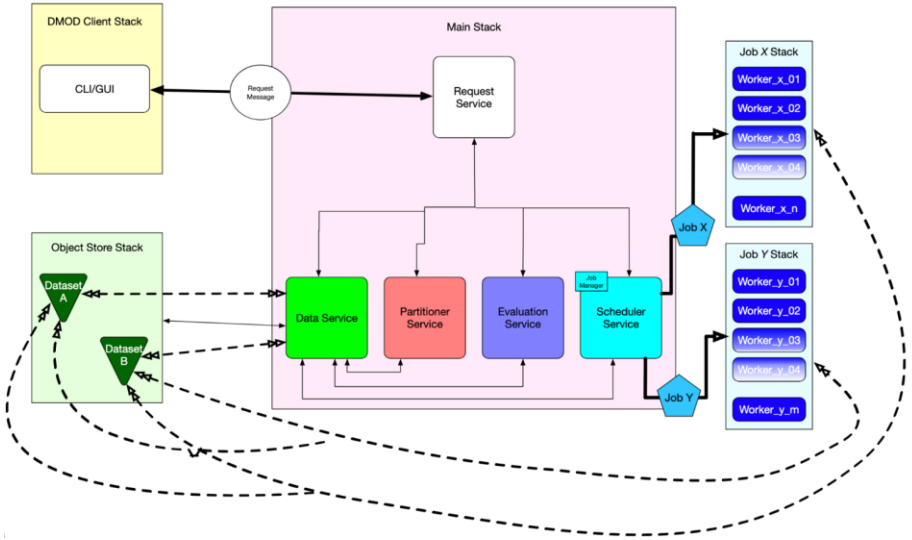
Complexity and Cognitive Load

- Many overhead tasks when running NextGen
- Time and effort that could otherwise be spent on domain science



Complexity and Cognitive Load

- Many overhead tasks when running NextGen
- Time and effort that could otherwise be spent on domain science
- OWP designed DMOD to help with these tasks and reduce this load

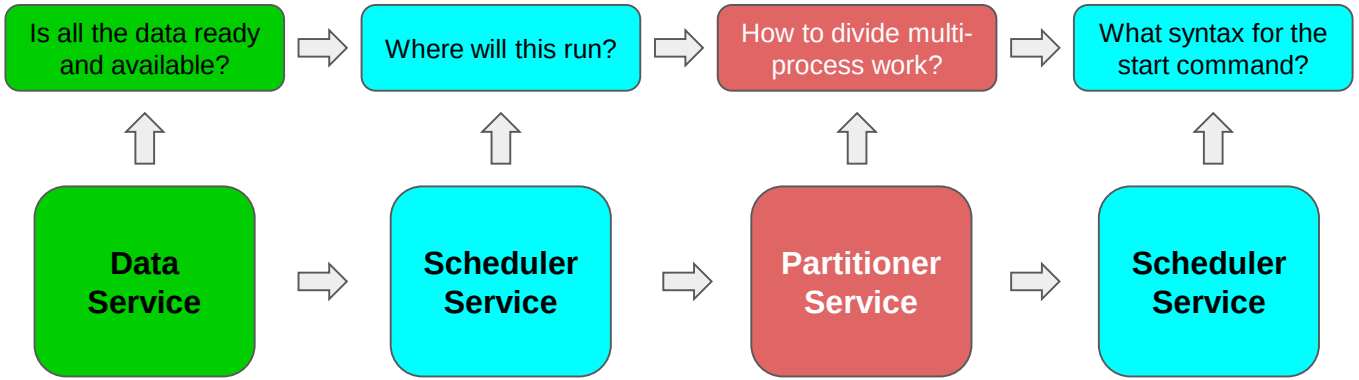


Distributed Model on Demand

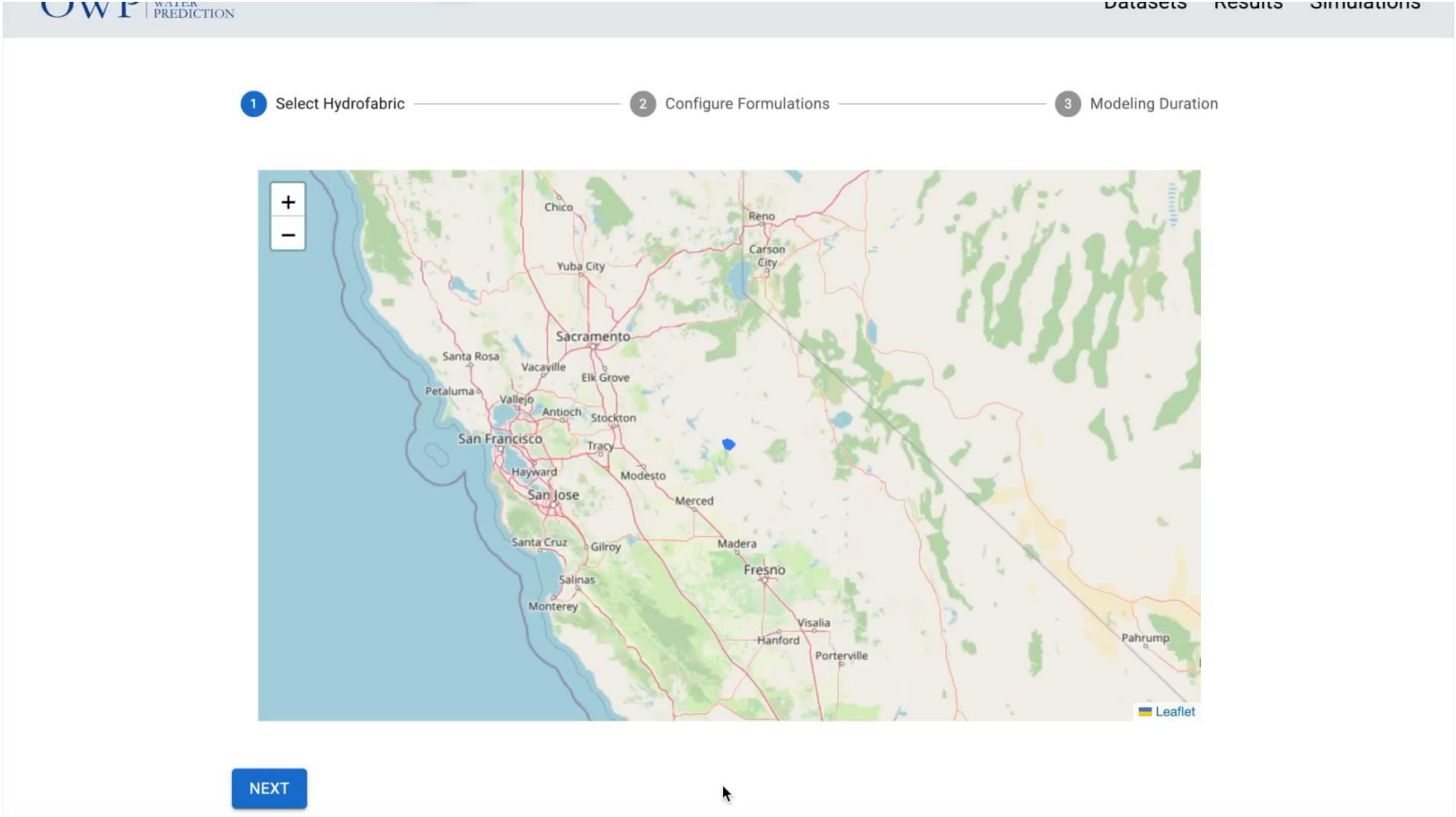
- **Distributed Model on Demand** (DMOD) is an extensible suite of software tools for creating and running specialized compute environments for scientific modeling software
- Combines custom functionality and other OWP tools
- Abstracts the compute infrastructure
- Incorporates and automates tasks to make it easier to develop, test, and optimize scientific models
  - Particular emphasis on models run through NextGen

Codified Workflows

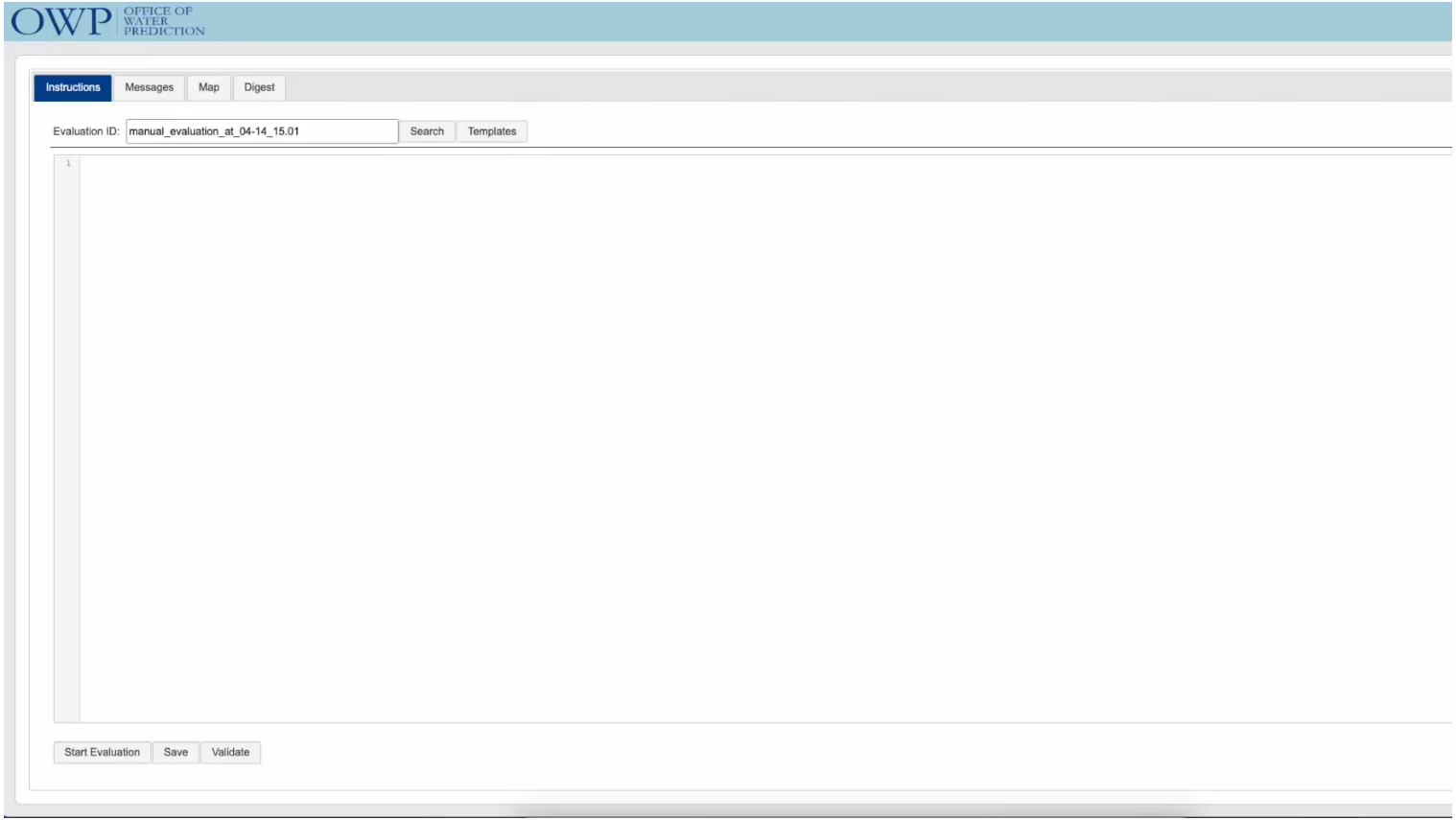
- Takes the steps for model jobs and represents these in code
- Executes in background services as a job progresses



Guiding Interaction



Included Tools to Evaluate Results



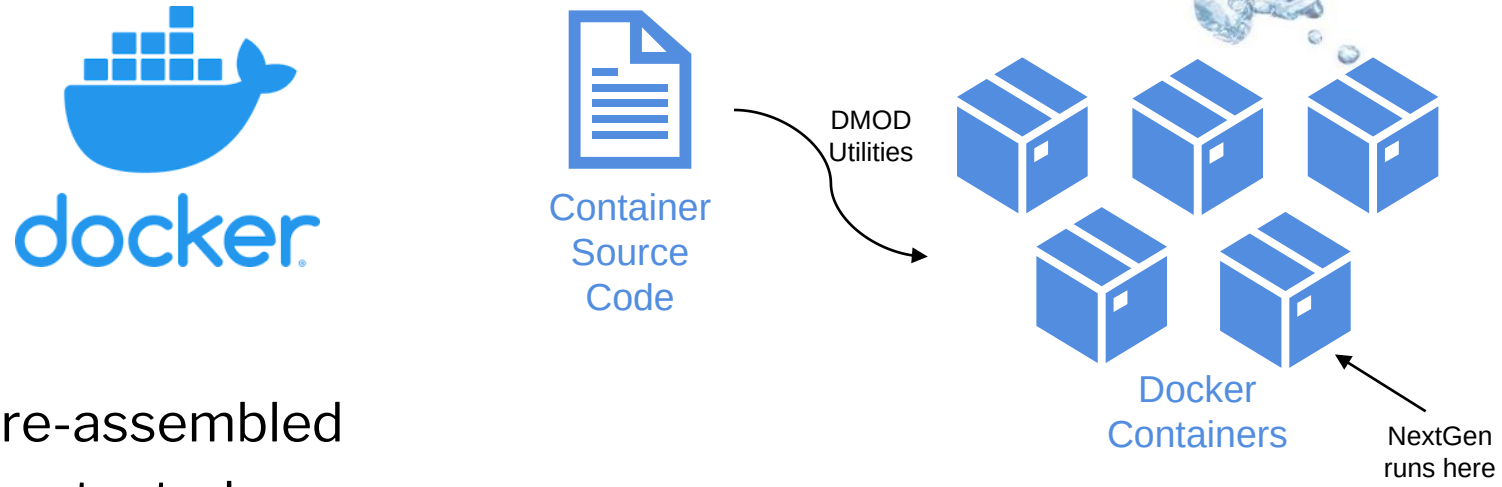
Managing Data

- Bundles an object store service component
- Does more than just storage, though
- Organizes datasets according to format
- Keeps metadata on datasets with details on format-specific properties
  - E.g., time ranges and included catchments for forcings
- Provides data intelligence when jobs are requested
  - Can pick a valid dataset for the user if available
  - Can tell the user quickly if the necessary data can't be made available

More on Managing Data

- What if data isn't directly available, but can be obtained?
  - E.g., forcings are available for the spatial domain, but in a different gridded format
- Capable of dynamically creating datasets
  - Integrating with OWP's ngen-forcing project
  - Integrating with BMI module init config generation tool from OWP's ngen-cal project

Compute Environment as Code



- Pre-assembled
- Pre-tested
- Consistent and re-creatable

Abstract Infrastructure

Make 4 CPUs Work like 1 CPU 1 CPU 1 CPU 1 CPU

OR

Make 4 CPUs 4 CPUs Work like 1 CPU 1 CPU 1 CPU 1 CPU 1 CPU 1 CPU 1 CPU 1 CPU or 8 CPUs

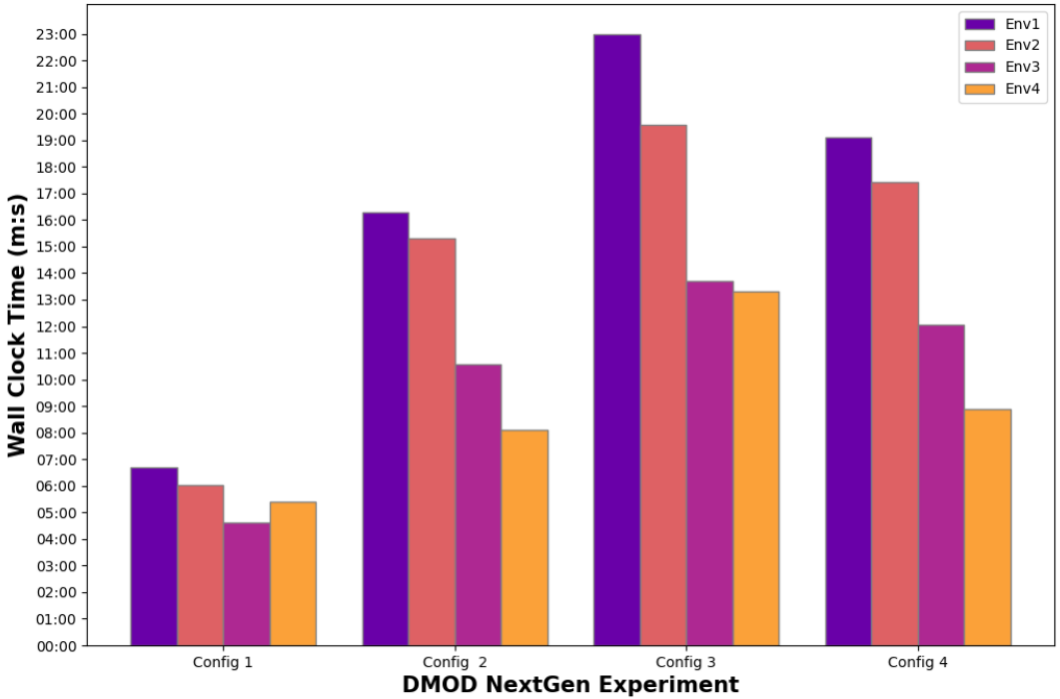
Practical Scalability

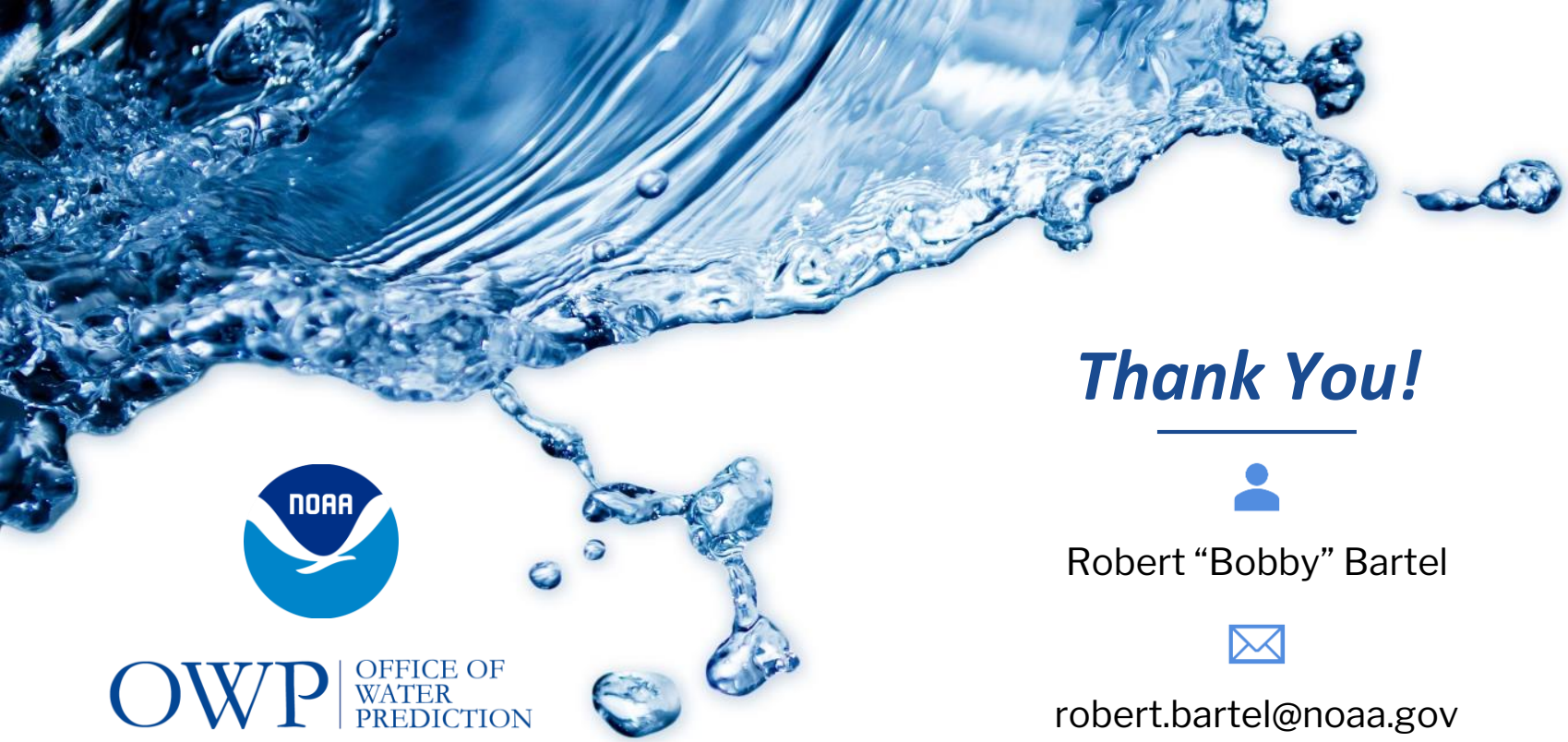
Env1 - Desktop PC
Hosts: 1 (H1)
Host CPU: Core i7-13700F
DMOD CPUs: 16 cpus
DMOD Mem: 32GB

Env2 - Refurbished Enterprise Workstation
Hosts: 1 (H2)
Host CPU: Xeon E5-2667 v3
DMOD CPUs: 32 cpus
DMOD Mem: 128GB

Env3 - Hybrid Off-the-Shelf Cluster
Hosts: 2 (H1 + H2)
Host CPU: mix
DMOD CPUs: 16 cpus, 32 cpus
DMOD Mem: 32GB, 128GB

Env4 - Datacenter Server
Hosts: 1 (H4)
Host CPU: Xeon Platinum 8160M
DMOD CPUs: 96 cpus
DMOD Mem: 512GB





Thank You!

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