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Comparing the Next Generation Water Resources Modeling Framework Across Different Compute Environments Using the Distributed Model on Demand Platform

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DMOD Background

- Software suite to run specialized compute environments
- Makes it easier to develop, test, and experiment w/ models
- Particular emphasis on NextGen framework
- Works to automate and/or simplify overhead tasks
- **Abstracts and manages compute infrastructure**
- Leverages Docker containerization
- **Portable, consistent compute worker containers**

DMOD Compute Environments

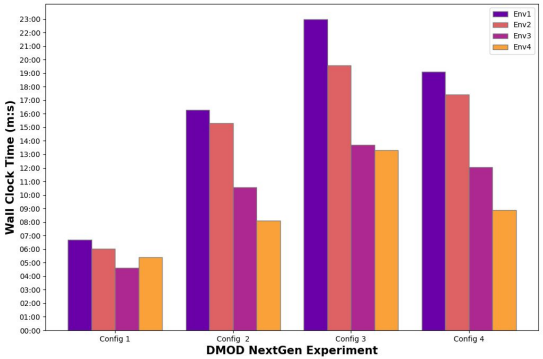
E1 - Desktop PC
Hosts: 1 (H1)
Host CPU: Core i7-13700F
DMOD CPUs: 16 cpus
DMOD Mem: 32GB

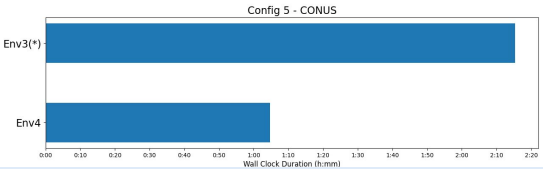
E2 - Refurbished Enterprise Workstation
Hosts: 1 (H2)
Host CPU: Xeon E5-2667 v3
DMOD CPUs: 32 cpus
DMOD Mem: 128GB

E3 - Hybrid Off-the-Shelf Cluster
Hosts: 2 (H1 + H2)
Host CPU:: mix
DMOD CPUs: 16 cpus | 32 cpus
DMOD Mem: 32GB | 128GB (*)

E4 - Datacenter Server
Hosts: 1 (H4)
Host CPU: Xeon Platinum 8160M
DMOD CPUs: 96 cpus
DMOD Mem: 512GB

The Versatility and Scalability of DMOD and NextGen on Different Hardware





DMOD was able to run NextGen jobs at VPU scale in a reasonable amount of time, even on the desktop PC (Env1), which ran 2 months of simulation in between 6.5 and 23 minutes.

Vertically scaling by switching to a host with more CPUs and memory reduced run times by an average of **10%** with Env2 and **41%** with Env4.

Horizontally scaling by adding a 2nd host (Env3) reduced times by an average of **36%**. This alternative was comparable to scaling to data center class hardware, as done with Env4.

(*) For CONUS, the spatial domain required memory beyond initial Env3 resources We overcame this by increasing memory in H1 of Env3 to 96GB for Config 5 experiments.

This was another form of vertical scalability gain by DMOD's and NextGen's hardware accessibility.

Env3 then completed jobs. With double the CPUs, Env4 reduced run times by 52%.

Experiment Configurations

Config 1
Domain: VPU 01, 20,256 catchments, 10,034 nexuses
Duration: 1440 hourly time steps
Formulations: Multi-BMI - PET+CFE+SLOTH
BMI Configs: shared mock-up

Config 2
Domain: VPU 02, 33,779 catchments, 16,479 nexuses
Duration: 1440 hourly time steps
Formulations: Multi-BMI - SLOTH+NoahOWP+CFE
BMI Configs: individually auto-generated from hydrofabric

Config 3
Domain: VPU 05, 55,518 catchments, 23,400 nexuses
Duration: 1440 hourly time steps
Formulations: Multi-BMI - PET+CFE+SLOTH
BMI Configs: individually auto-generated from hydrofabric

Config 4
Domain: VPU 12, 37407 catchments, 19247 nexuses
Duration: 1440 hourly time steps
Formulations: Multi-BMI - SLOTH+NoahOWP+CFE
BMI Configs: individually auto-generated from hydrofabric

Config 5
Domain: CONUS, 817,574 catchments, 398,823 nexuses
Duration: 744 hourly time steps
Formulations: Multi-BMI - PET+CFE+SLOTH
BMI Configs: individually auto-generated from hydrofabric

Takeaways

DMOD can be used to produce flexible compute environments using a variety off-the-shelf components. A simple, yet capable deployment can be had for minimal expense. When the problem size grows beyond current resources, DMOD deployments are easily horizontally and vertically scalable.

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