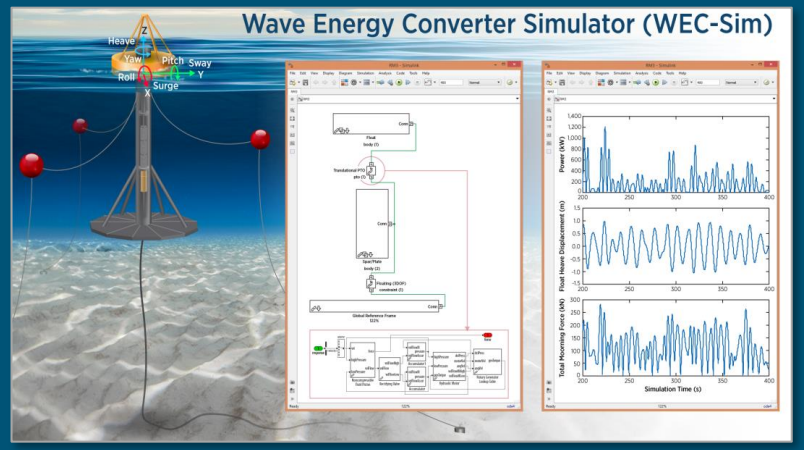
Development and release of WEC-Sim v5.0 open-source software



PRESENTED BY

Dominic Forbush, Ph.D , Sandia National Laboratories

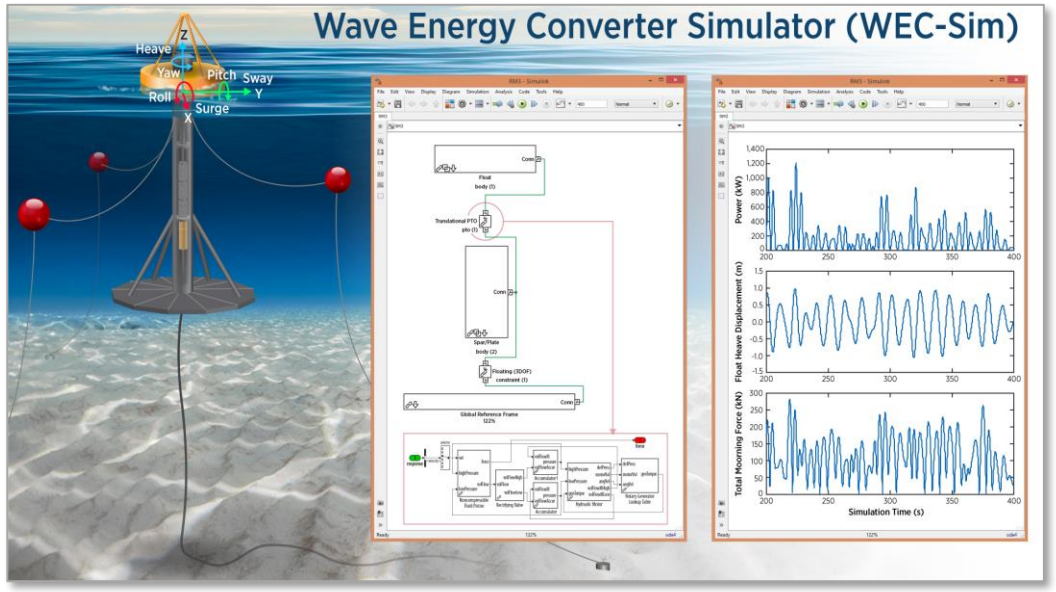
SAND2022-13463 C

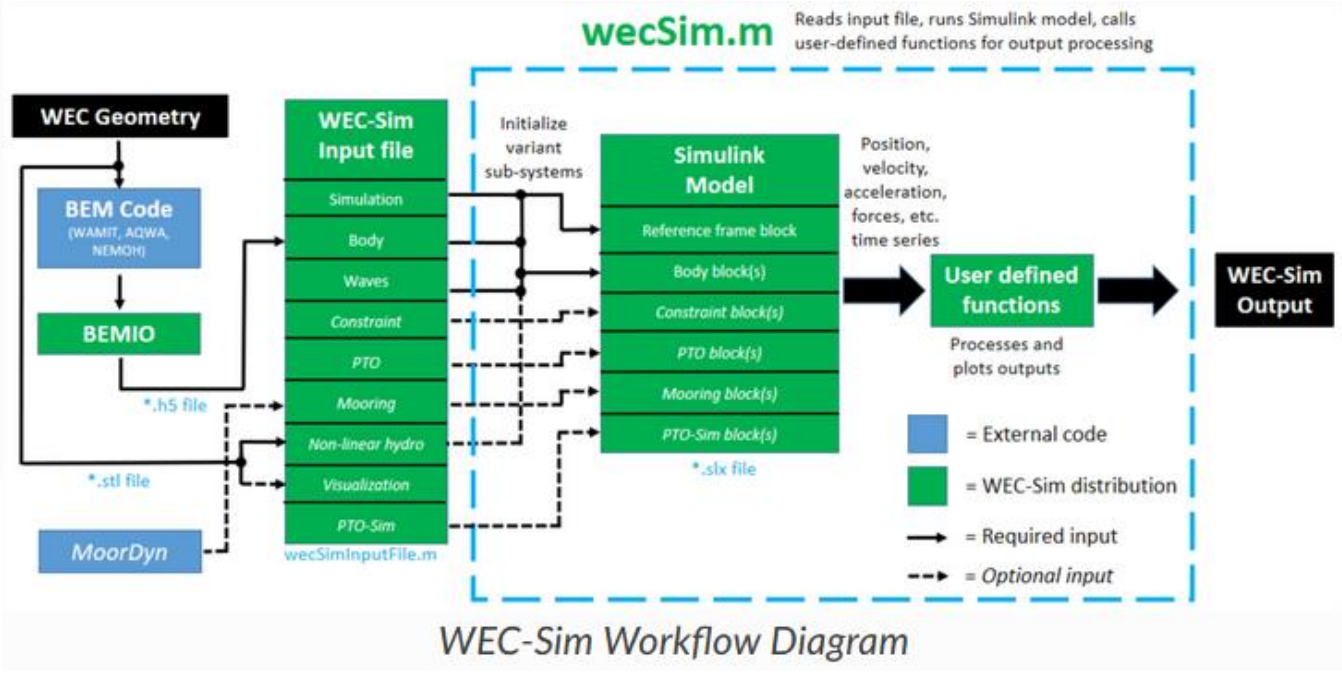
What is WEC-Sim?

WEC-Sim (Wave Energy Converter Simulator)

Simulates dynamics of floating and submerged bodies in ocean waves and currents, solving Cummins' equation in the time-domain, informed by boundary-element method coefficients.

https://github.com/WEC-Sim/WEC-Sim





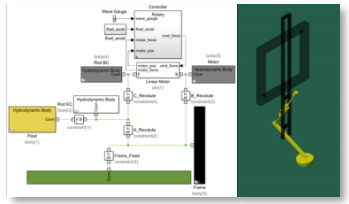
WEC-Sim Workflow Diagram

U.S. DEPARTMENT OF ENERGY

Sandia National Laboratories

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Project Timeline



WECCCOMP control competition numerical (Phase 1)

WECCCOMP special session (OMAE 2019)

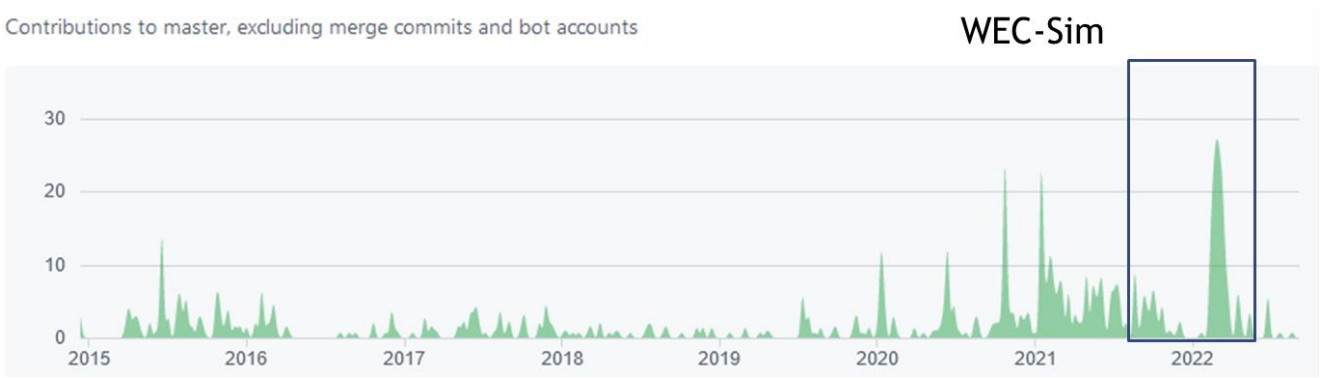
GitHub WEC-Sim v4.0

WEC-Sim Course at Universidad de Costa Rica (PAMEC 2020)

R&D 100 AWARDS

WEC-Sim wins R&D 100 Award

GitHub WEC-Sim v5.0



MRE Software Workshop (OREC-METS 2022)

Capytaine v1.4 GitHub

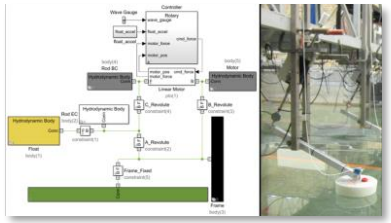
FY 2019

FY 2020

FY 2021

FY 2022

WECCCOMP control competition experimental (Phase 2)



WECCCOMP winner announced

AALBORG UNIVERSITY DENMARK

Maynooth University National University of Ireland Maynooth

IEA OES phase III OWC V&V complete (KRISO tank test data)

Oregon State University

WEC-Sim lectures at OSU for CEE 511/511

RFTS5 awards for WEC-Sim Support

TEAMER Testing & Expertise for Marine Energy

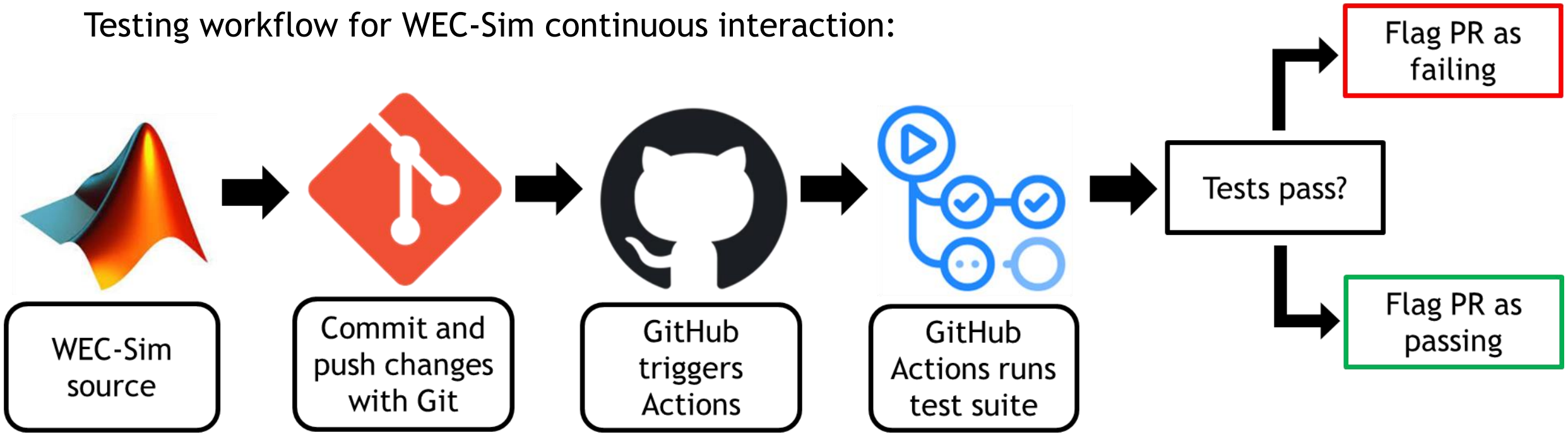
WEC-Sim Course (PAMEC 2022)

RFTS6 awards for WEC-Sim Support

TEAMER Testing & Expertise for Marine Energy

WEC-Sim v5.0 – Continuous integration

Testing workflow for WEC-Sim continuous interaction:

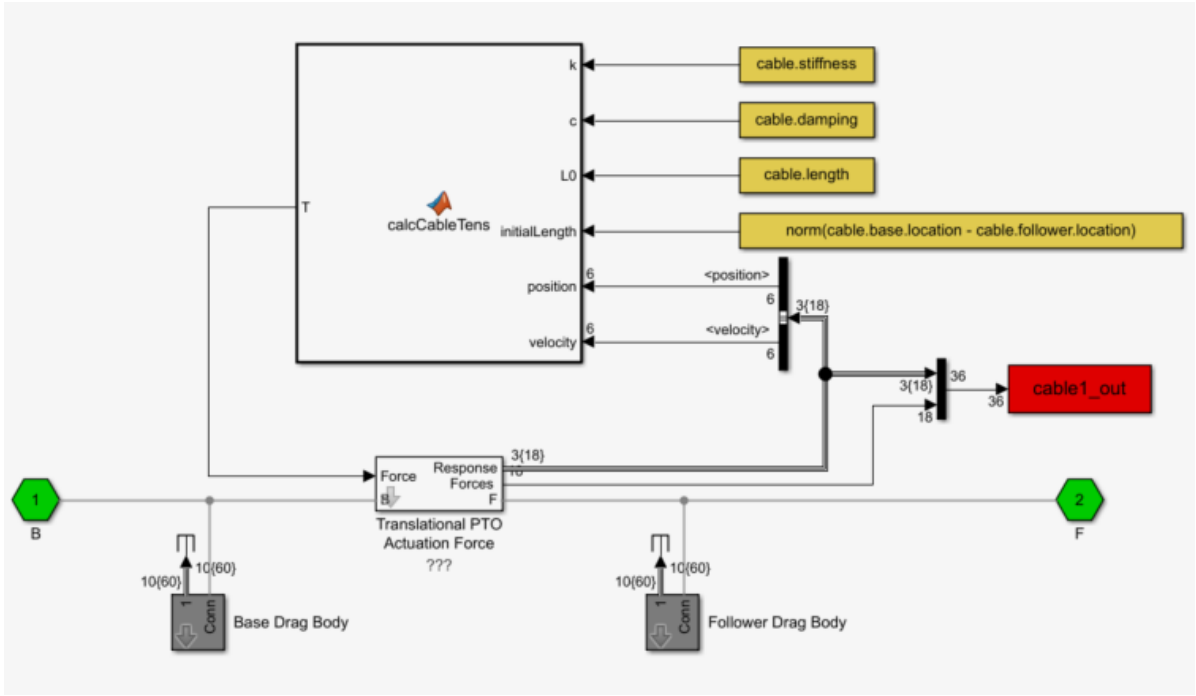


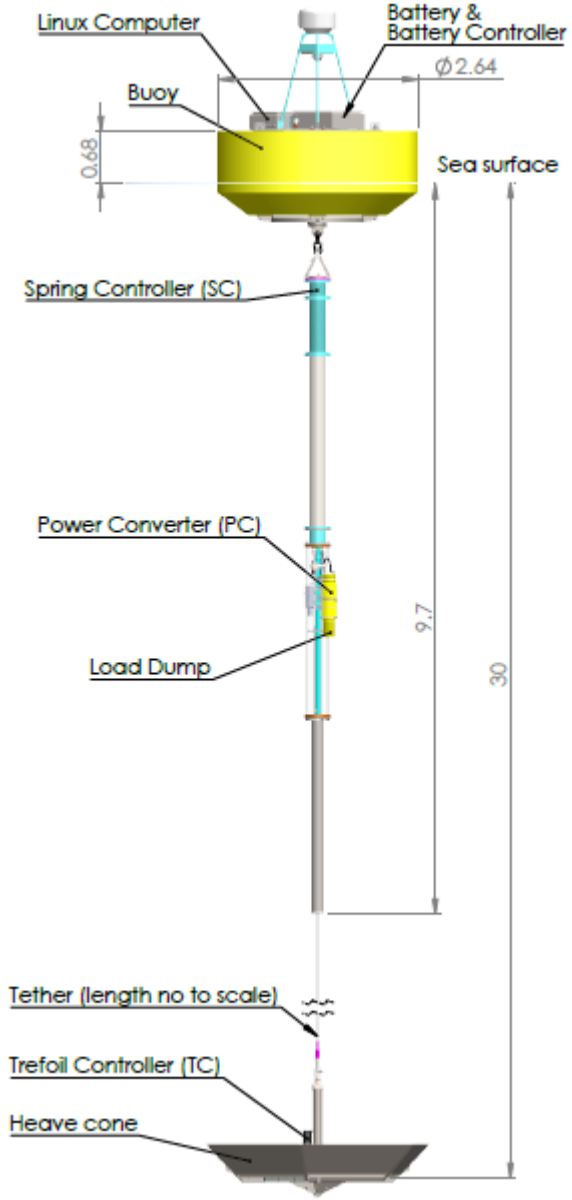
Continuous integration is built on GitHub Actions using MATLAB unit testing framework. Useful for locally testing development, and automatically testing each new commit and pull request on public branches.

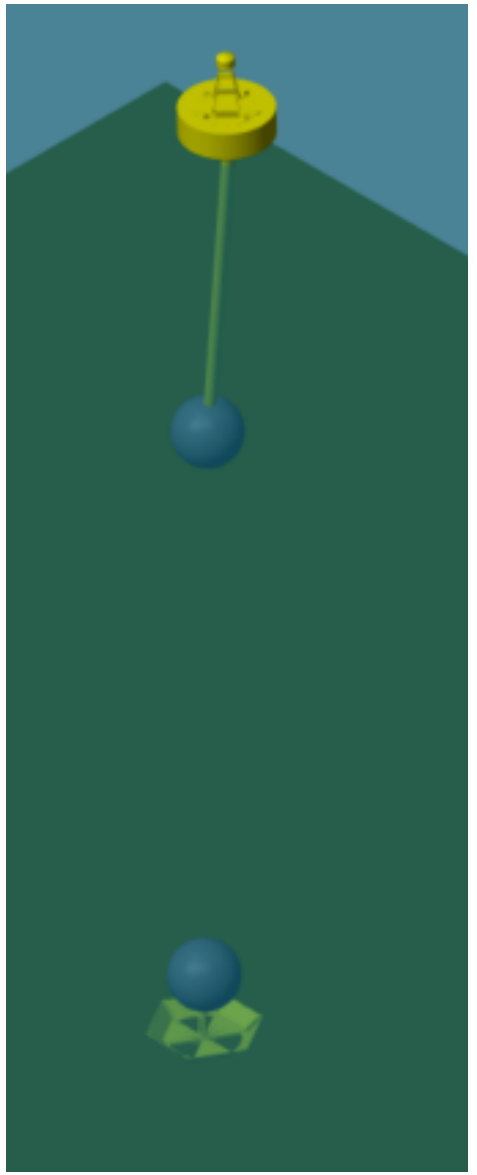
WEC-Sim v5.0 – Modeling cables

- Right: Schematic of the MBARI-WEC*.
- Far-right: Mechanics Explorer visualization of the MBARI-WEC. The end-points of the cable connection shown as oversize grey spheres.
- Below: Simulink/Simscape implementation

*Image from Hamilton, A., Cazenave, F., Forbush, D. *et al.* The MBARI-WEC: a power source for ocean sensing. *J. Ocean Eng. Mar. Energy* **7**, 189–200 (2021). https://doi.org/10.1007/s40722-021-00197-9

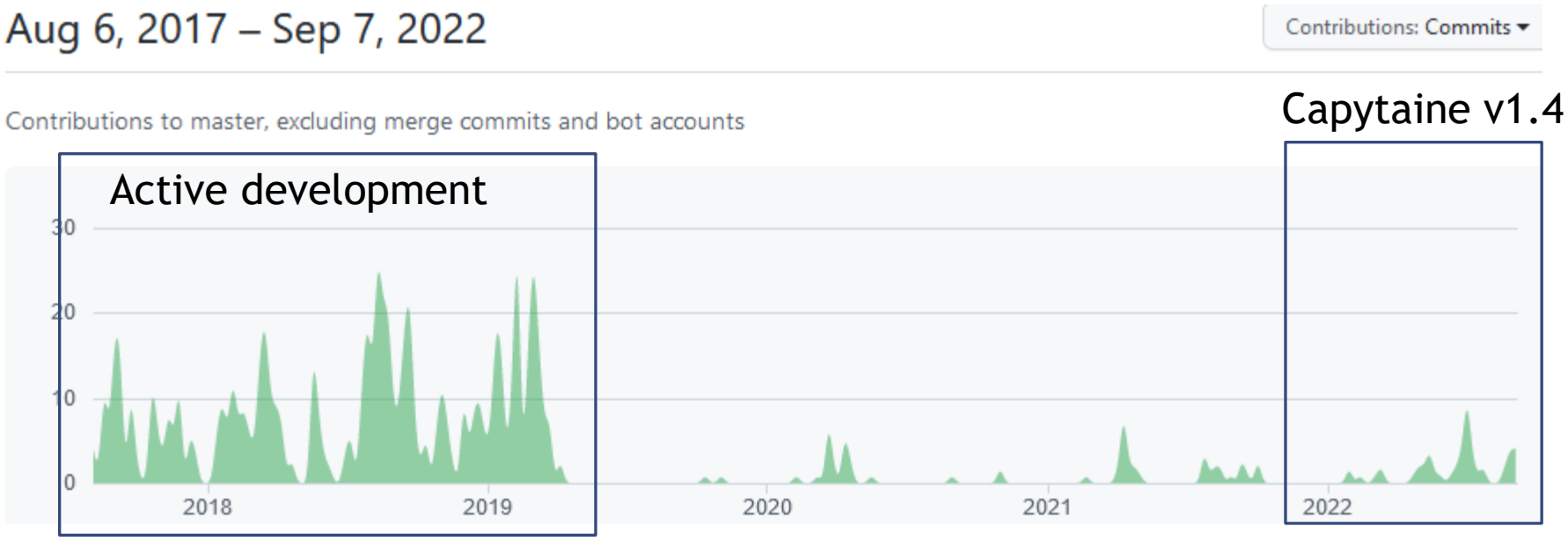






WEC-Sim v5.0 – Capytaine

Capytaine Development Timeline



WEC-Sim relies on Boundary Element Method (BEM) solutions to define hydrodynamic coefficients. Supported codes are NEMOH, WAMIT, AQWA, and **now Capytaine**

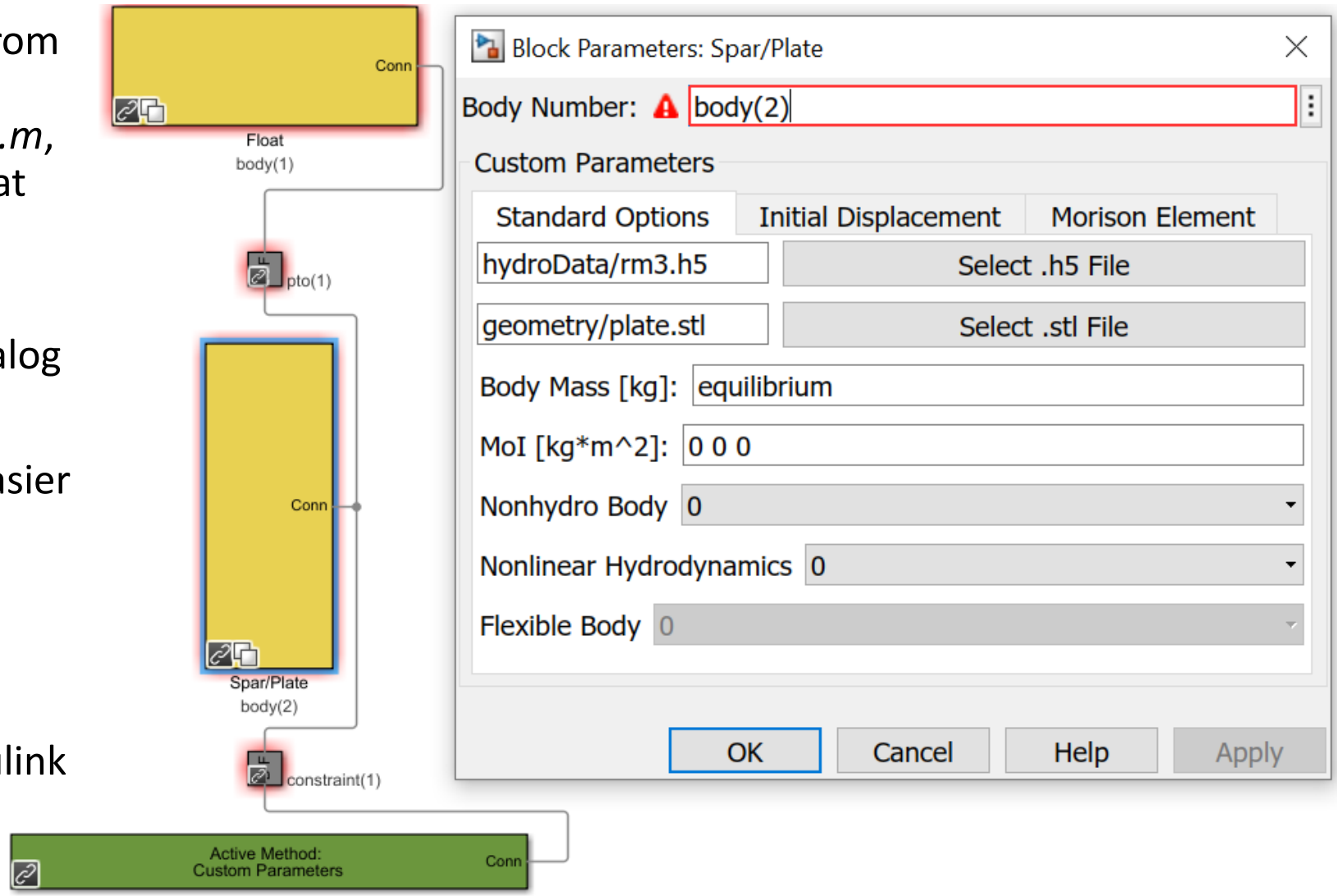
- Open-source Python code: https://github.com/capytaine/capytaine
- Capytaine support is current and ongoing.
- Capytaine developer: Matthieu Ancellin

WEC-Sim v5.0 – Run from Simulink

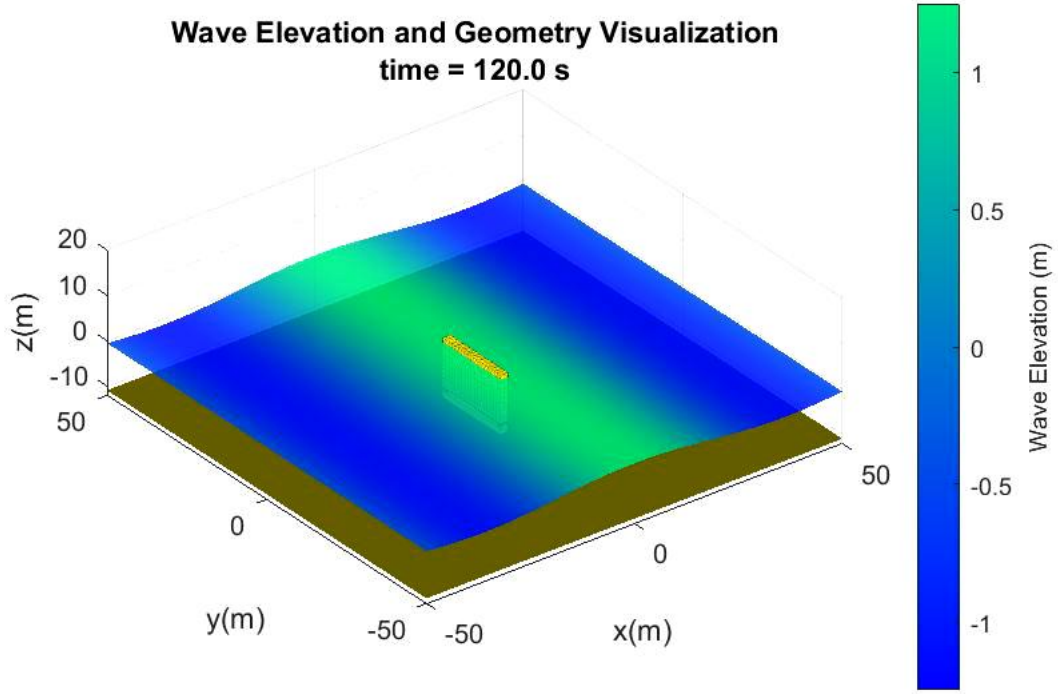
- Previously, a simulation was run from the command line, reading information from *wecSimInputFile.m*, and Simulink models would close at run time.
- Now, user option to specify parameters directly in Simulink dialog and run from GUI.
- A more common workflow, and easier for debugging.

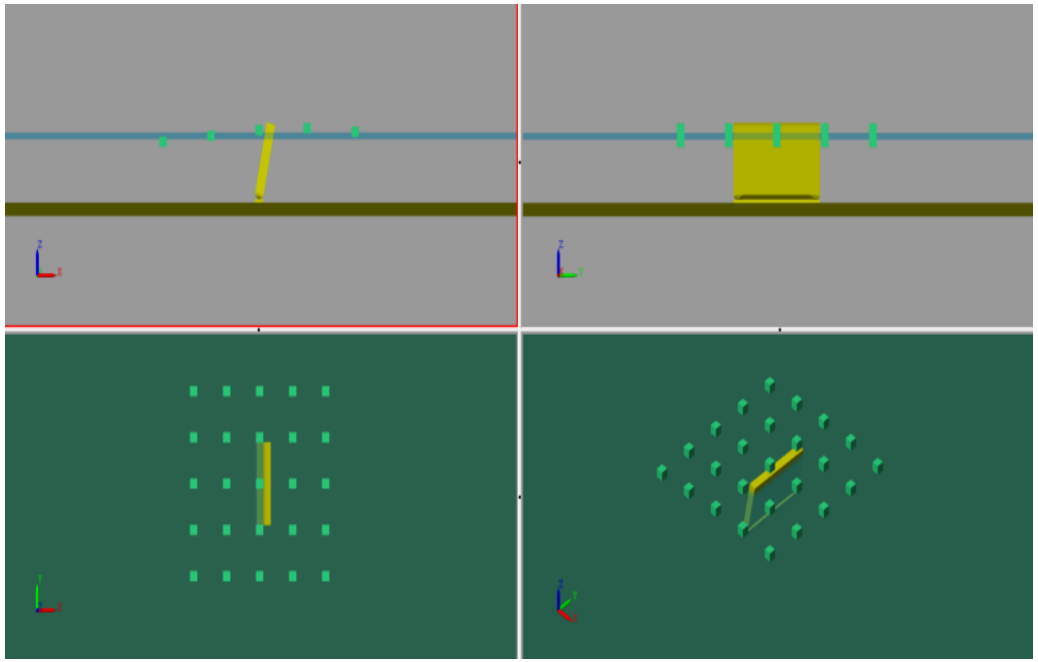
Example:

WEC-Sim/examples/RM3FromSimulink



WEC-Sim v5.0 – Wave Visualization

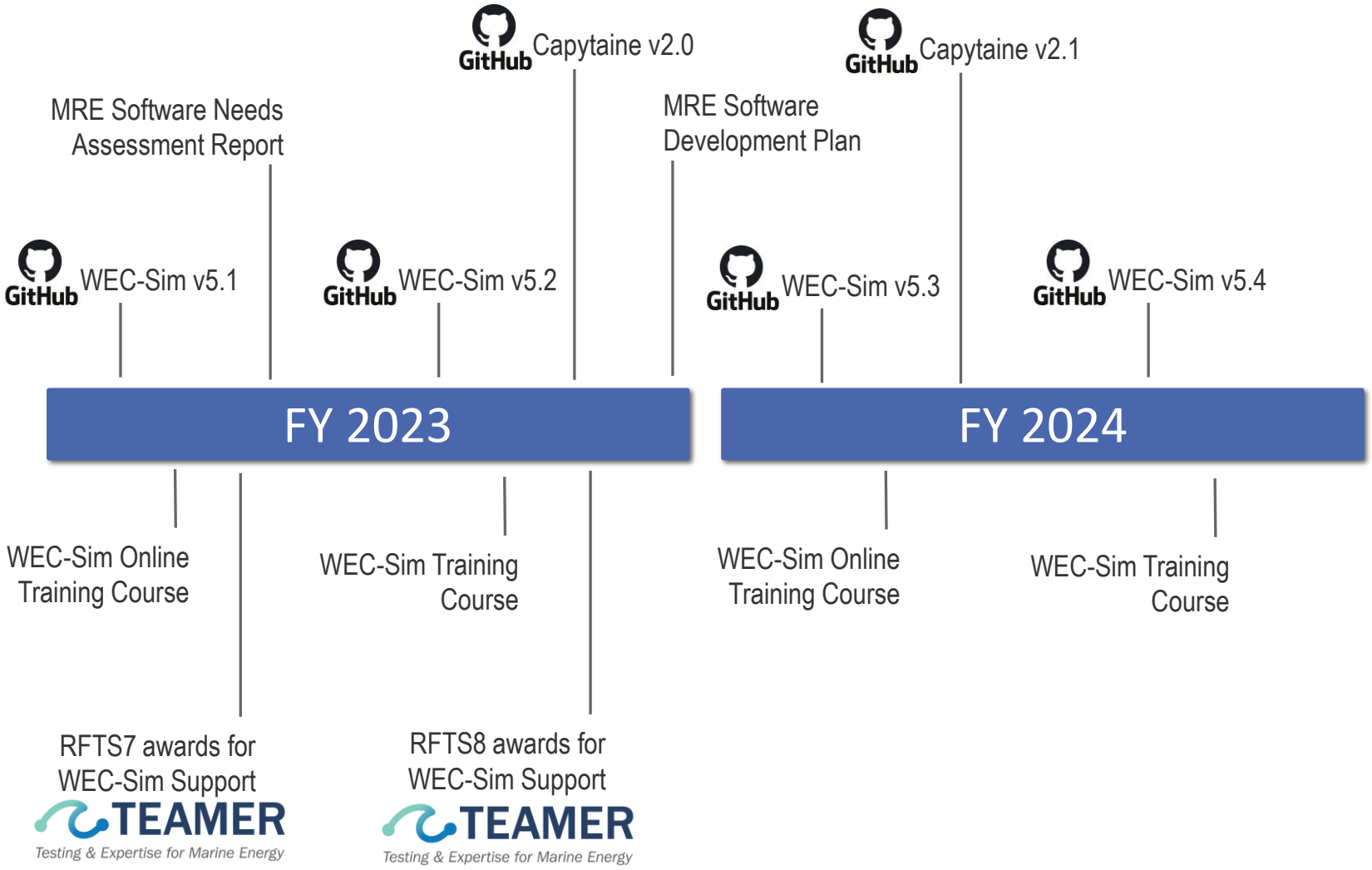




Future Work

Advance the state of open source software within the wave energy sector

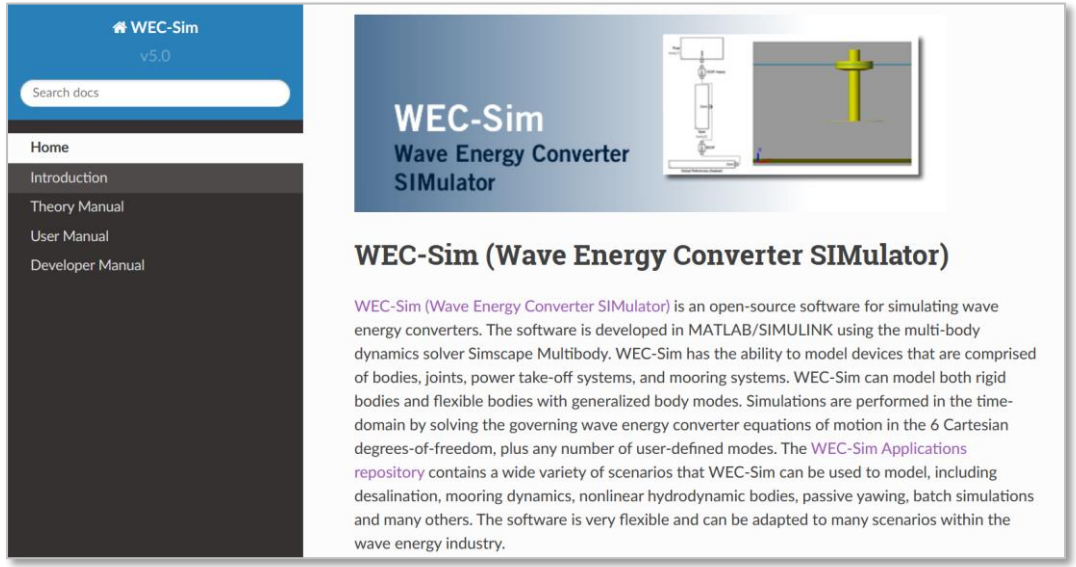
- Improve WEC-Sim **interoperability with open-source meshing, BEM and optimization** software to facilitate device performance improvements and cost reduction
- **Improve parallelization** to leverage HPC systems for scientific discovery
- **Support the development of the open-source BEM software Capytaine** – improving accuracy, speed and functionality.
- **Outreach and training,** including short courses, webinars, and additional WEC-Sim applications (e.g. offshore wind, flexible bodies)



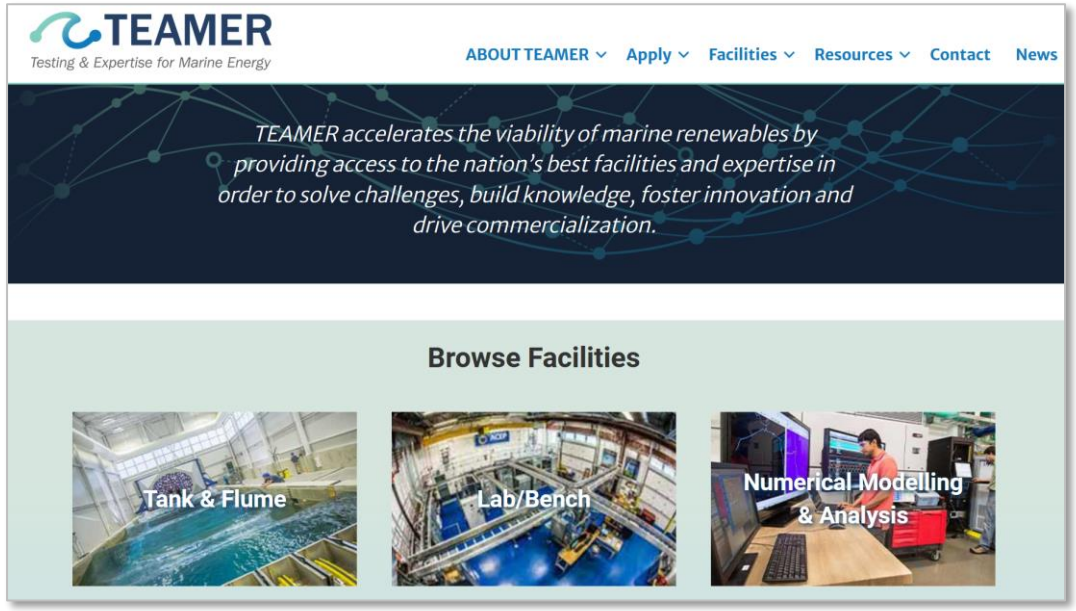
Conclusion

User feedback guides development!
Contributions are always welcomed.

- Report a bug, seek support, request a feature: https://github.com/WEC-Sim/WEC-Sim/issues
- Contribute to the WEC-Sim or WEC-Sim Applications: https://github.com/WEC-Sim/WEC-Sim/pulls
- Additional industry/research support available through the TEAMER program: https://teamer-us.org/



https://wec-sim.github.io/WEC-Sim



https://teamer-us.org/

For more information please visit the WEC-Sim website:

http://wec-sim.github.io/WEC-Sim

Dominic Forbush(Sandia)
dforbus@sandia.gov

GitHub: dforbush2

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