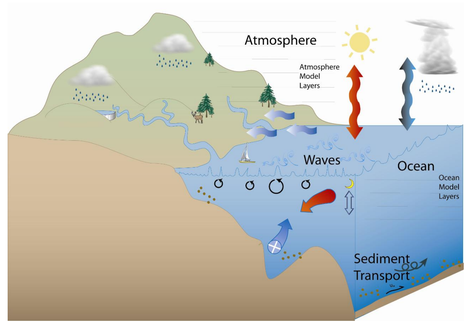
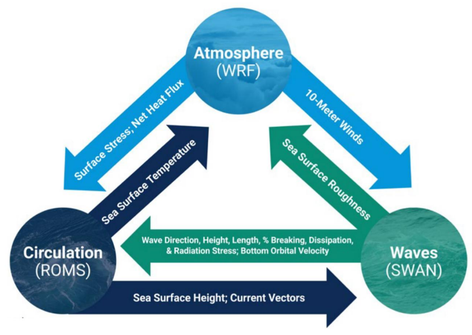


Early Performance Assessment of the COAWST: A Coupled-Ocean-Atmosphere-Wave-Sediment Transport Modeling System Used in Indonesia

Regina Yulia Yasmin, The Indonesian Agency for Meteorology, Climatology, and Geophysics (BMKG), ID
Gregor Corbin, Jülich Supercomputing Centre (JSC), Forschungszentrum Jülich, DE
Bernd Mohr, Jülich Supercomputing Centre (JSC), Forschungszentrum Jülich, DE

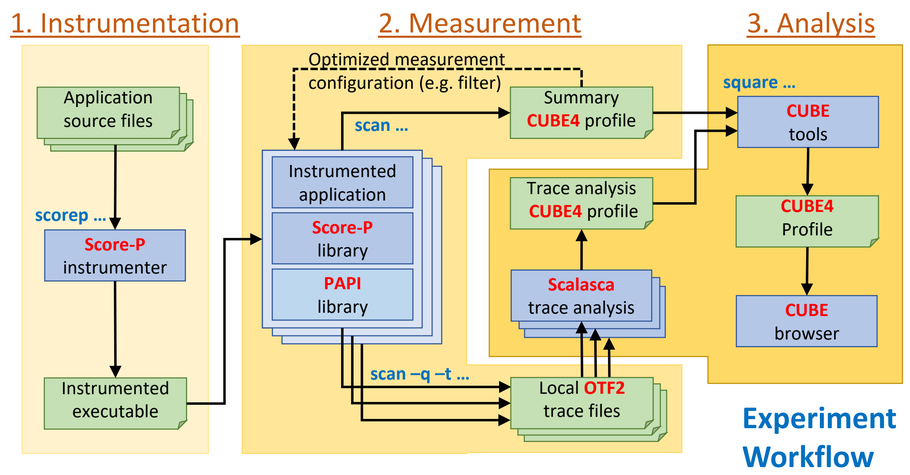
Background / Objectives

- **COAWST** [1][2] modeling system is an integrated, open-source, flexible, and highly scalable framework
- Designed to simulate the complex interactions among the ocean, atmosphere, waves, and sediment processes
- **COAWST couples**
  - **ROMS** (Regional Ocean Modeling System) for ocean circulation
  - **WRF** (Weather Research and Forecasting Model) for atmospheric processes
  - **SWAN** (Simulating WAves Nearshore) for wave dynamics
- Applications include coastal resilience and hazard assessment and climate and extreme event simulation
- Efficient allocation and optimization of computing resources (i.e. nodes/tasks) critical for achieving optimal runtime performance



Methods

- **Goal:** assess performance of coupled atmosphere–wave model on parallel MPI + OpenMP architectures and propose strategies to improve overall computational efficiency
- **Planned experiment scenarios:**
  (1) the SWAN, WRF, ROMS models separately
  (2) the coupled SWAN, ROMS and WRF model
- **For each scenario:**
  - Examine simulations with HPC instrumentation+measurement framework Score-P [3]
  - Execute under control of Juelich Benchmarking Environment (JUBE) [4]
  - Analyze resulting execution traces with the event trace analyser Scalasca [5]
  - All simulations are executed on the JSC production clusters
  - Input to the models is data from the Jakarta region



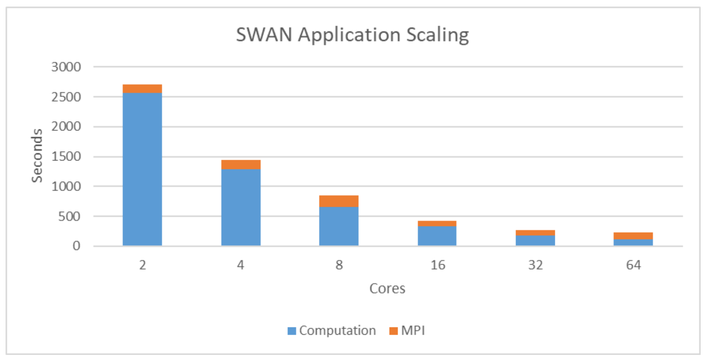
Results

- **Status** on planned **experiment scenarios**:
  (1a) SWAN: **compiled and instrumented**, **profile+trace measurements with test data**, **1st analysis**
  (1b) ROMS: **compiled** **waiting for suitable input data for measurement**
  (1c) WRF: **compiled and instrumented**, **profile+trace measurements with real data**, **1st early analysis**
  (2) SWAN+ROMS+WRF: **work in progress** **waiting for suitable input data**

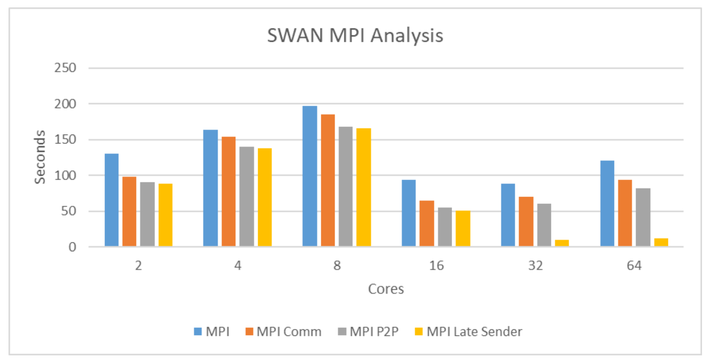
  [Done] [WIP] [ToDo]

- **SWAN Experiments** on JSC JURECA cluster
  - SWAN compiled in MPI mode
  - Run on 1 node with AMD EPYC 7742, 128 cores

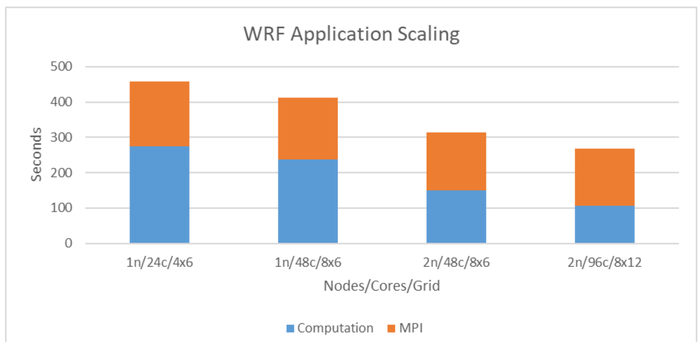
- **WRF Experiments** on JSC JUWELS cluster
  - WRF compiled in MPI mode
  - Run on 1 and 2 nodes with Intel Xeon, 48 cores



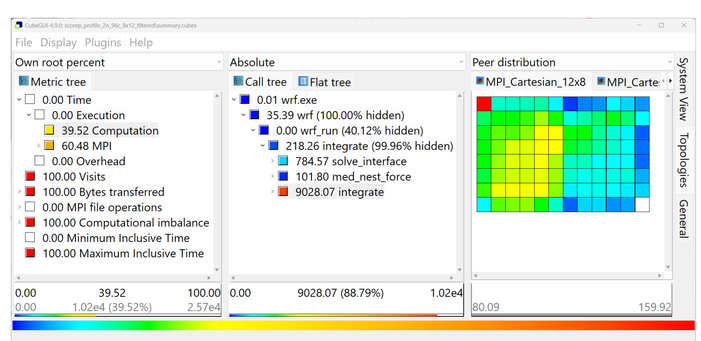
- Reasonable scaling up to 16 cores
- MPI share rises significantly (from [2] 4.8%, [16] 22% to [64] 52.7%)



- Until 16 cores: almost all MPI time is Point-To-Point communication + waiting for data (due to Late Sender)
- With 16 cores and higher: absolute MPI communication increases



- Bad scaling inside node, reasonable over nodes



- Scalasca CUBE profile screenshot of 2n/96c/8x12 WRF run

Conclusions

- Key for operations and research at BMKG is being able to perform efficient simulations with the COAWST model
- Goal of the BMKG/JSC collaboration is to analyse and optimize the performance of the models, as well as to train the staff in the Agency in performance measurement, analysis, and optimization techniques
- Installation and configuration (esp. of the input data) of the complex COAWST software stack much harder than expected
- Early results on test data show performance optimization opportunities, but more experiments needed (with real input data)

References
[1] https://www.usgs.gov/centers/whcmsc/science/coawst-a-coupled-ocean-atmosphere-wave-sediment-transport-modeling-system
[2] https://github.com/DOI-USGS/COAWST
[3] https://www.score-p.org
[4] https://www.fz-juelich.de/jsc/jube
[5] https://www.scalasca.org/

Contact
Regina Yulia Yasmin
BMKG
regina.y.yasmin@gmail.com
Bernd Mohr
JSC
b.mohr@fz-juelich.de