SIAM GS 2013 – CP2 High Performance Computing

A Parallel Server for Adaptive Geoinformation

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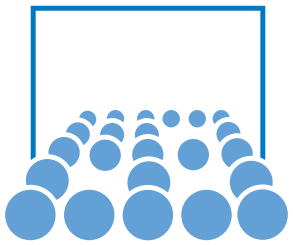
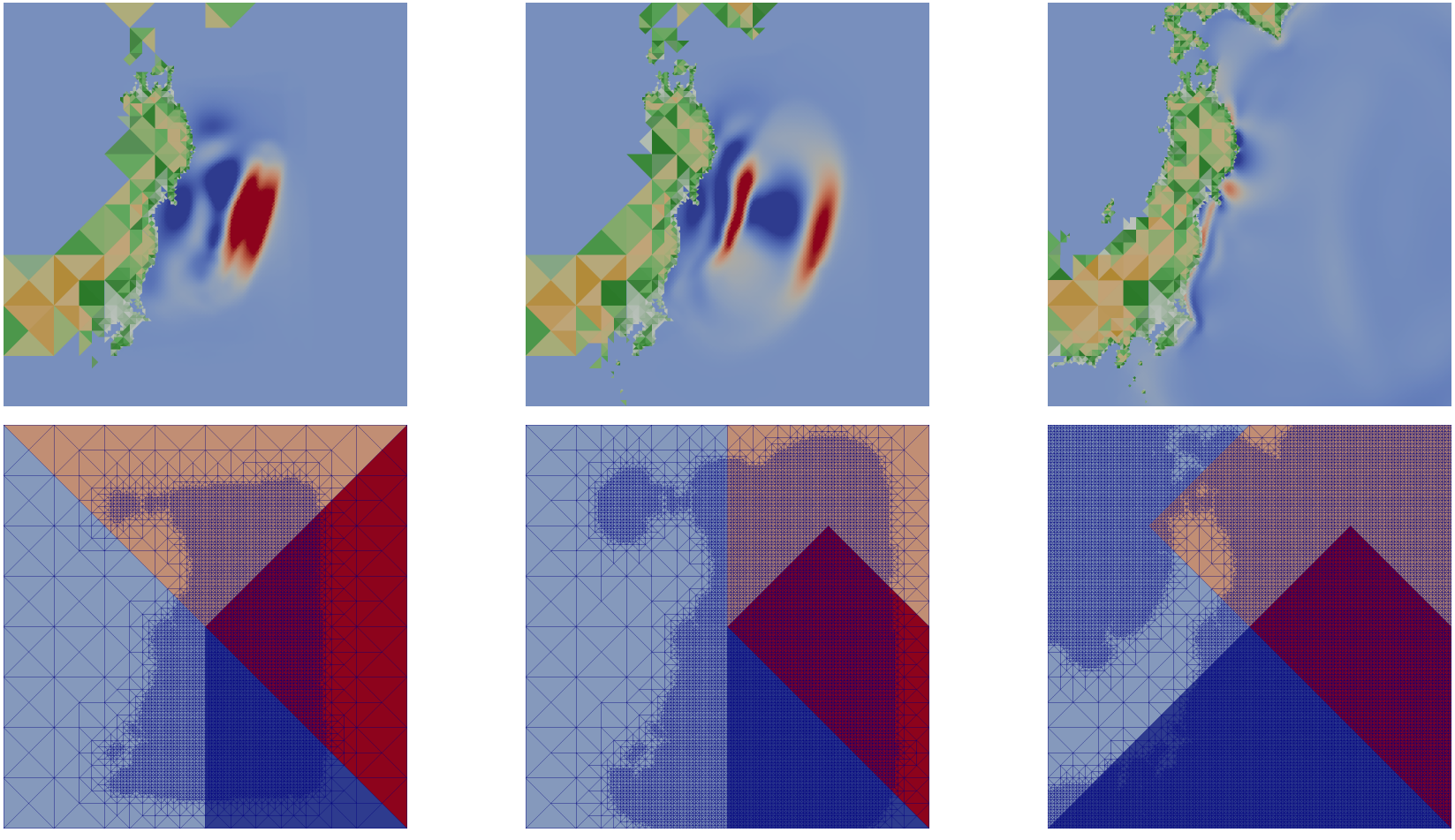


Parallel Dynamically Adaptive Simulations



2011 Tohoku Tsunami simulated on 4 nodes with Sierpiński

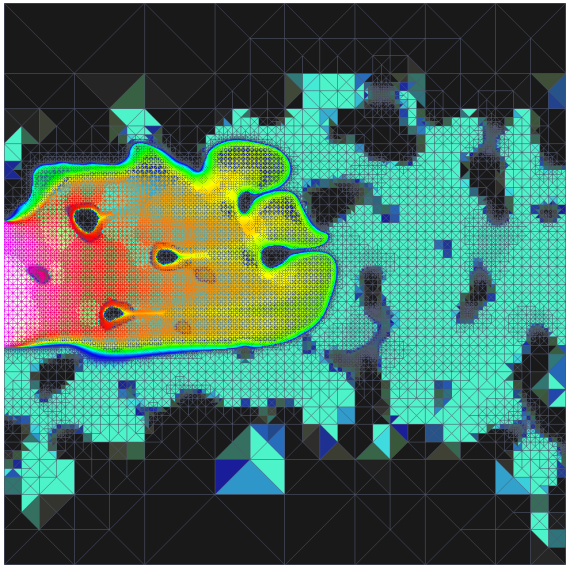
`http://www5.in.tum.de/sierpi/`

Bathymetry derived from: The GEBCO_08 Grid, version 20100927

Displacement derived from: Shao, Li, Ji (UCSB) - Preliminary Result of the Mar 11, 2011 Mw 9.1 Honshu Earthquake

How to obtain geo information?

1. Recompute them on the new node
   ⇒ Not always possible
2. Load the whole dataset on each node
   ⇒ Does not scale to large datasets
3. Load only required data from the hard drive
   ⇒ I/O may become the bottleneck
4. Migrate data between nodes
   ⇒ Which data should be migrated when?



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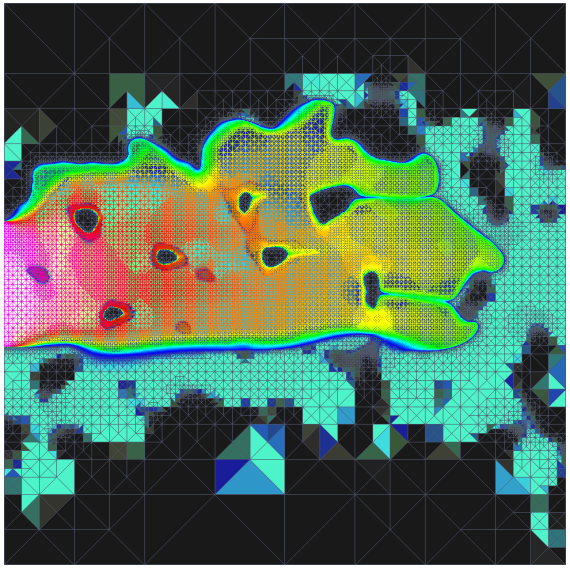
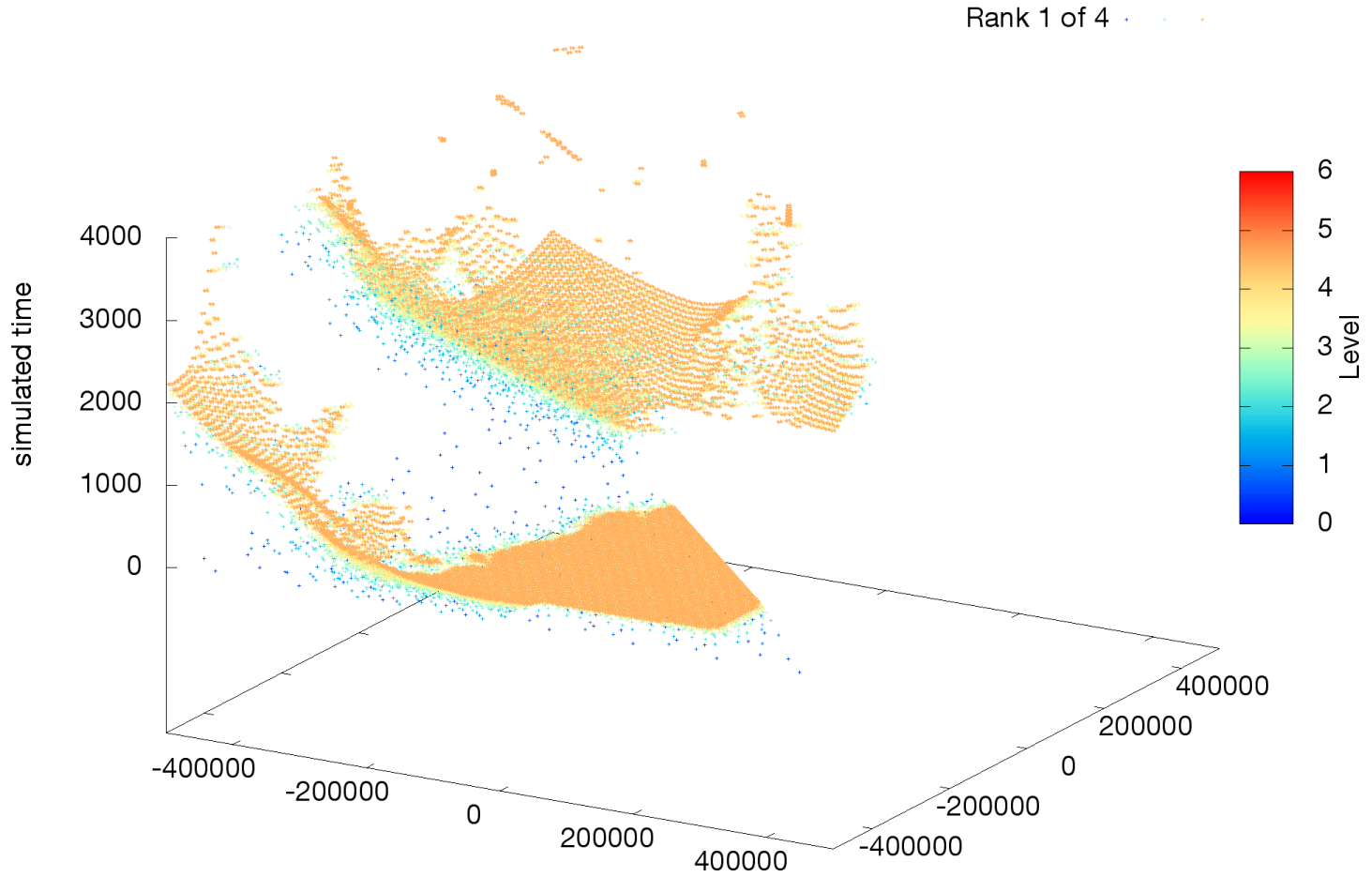


Access patterns of dynamically adaptive simulations

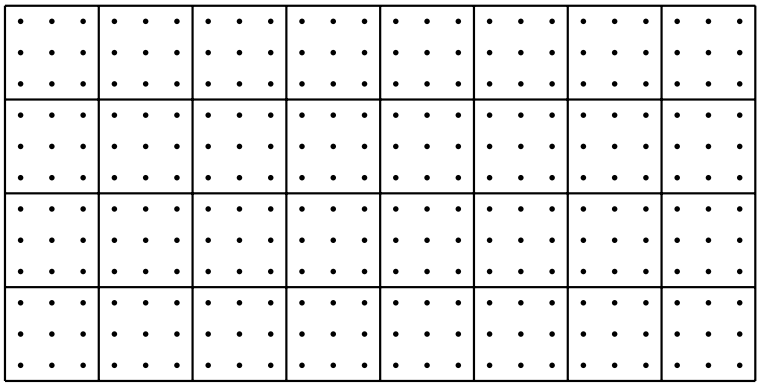


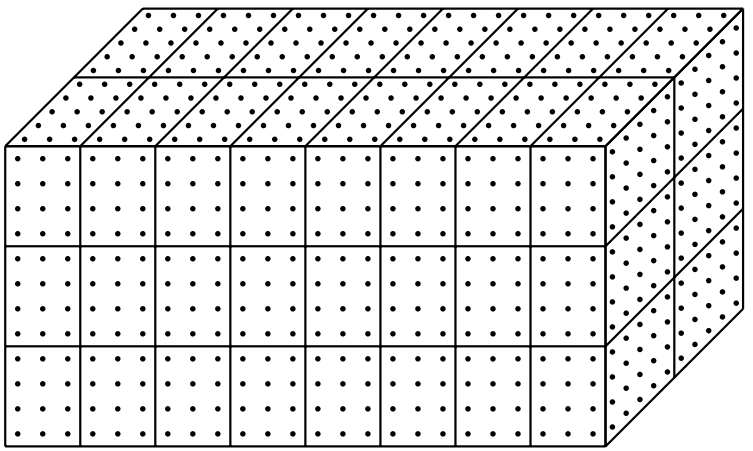
Bathymetry information required by Sierpiński for the 2011 Tohoku Tsunami

Concept of chunks in ASAGI

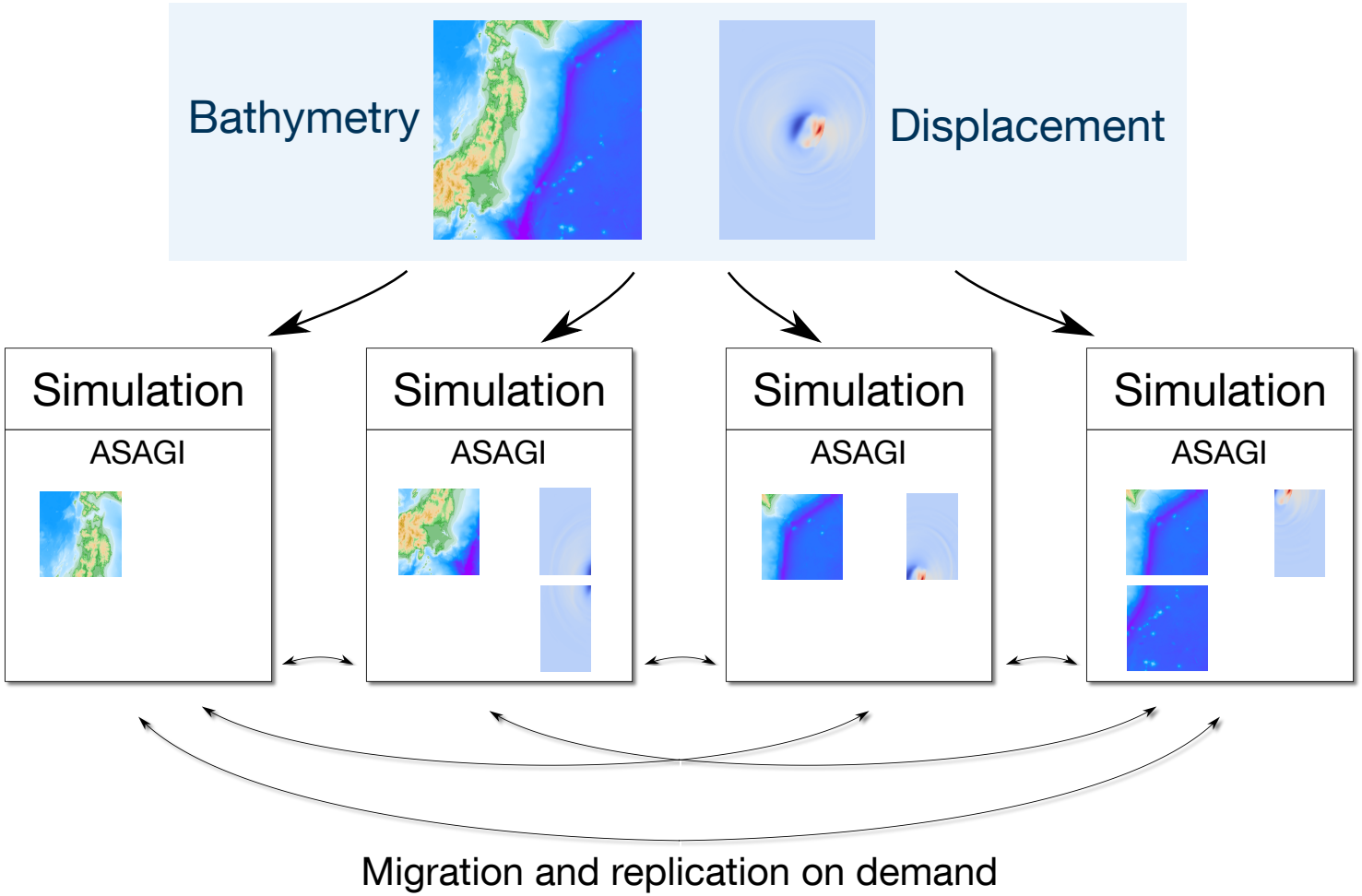
Chunks:

- 1D, 2D or 3D
- Cartesian
- Equal sized
- None overlapping





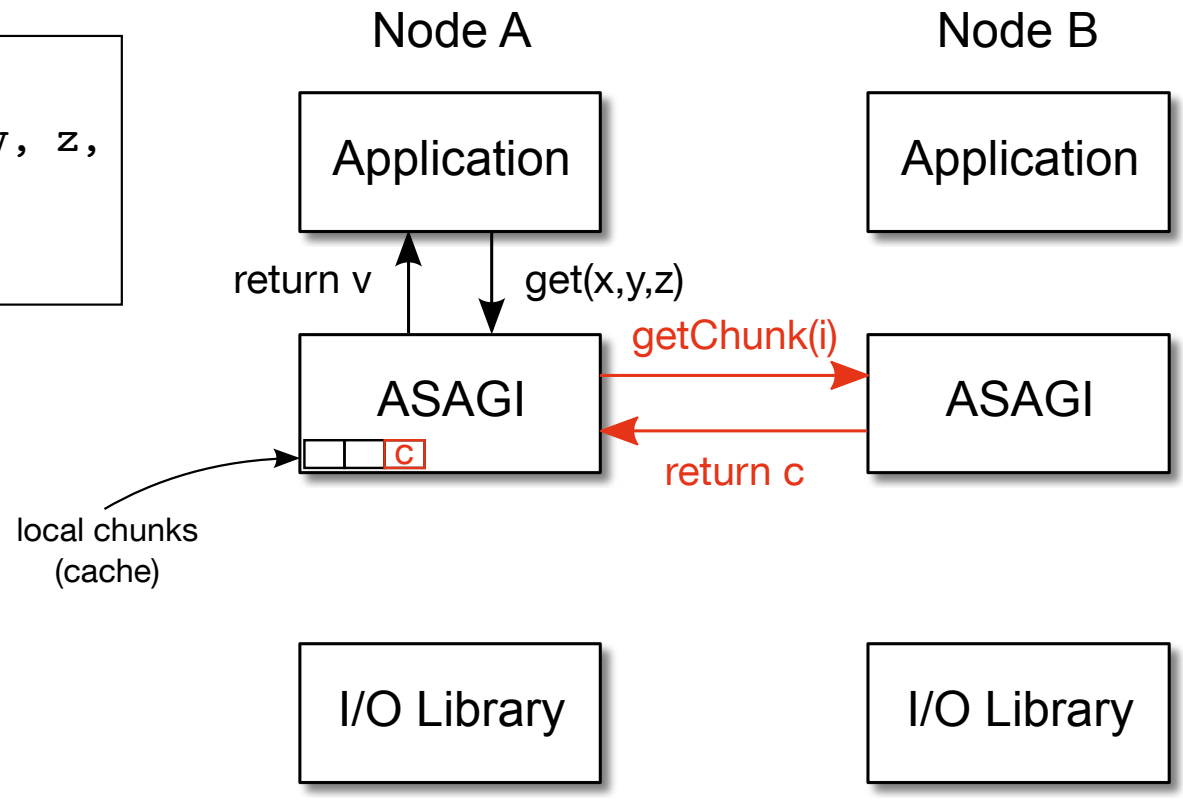
Migration/Replication of chunks



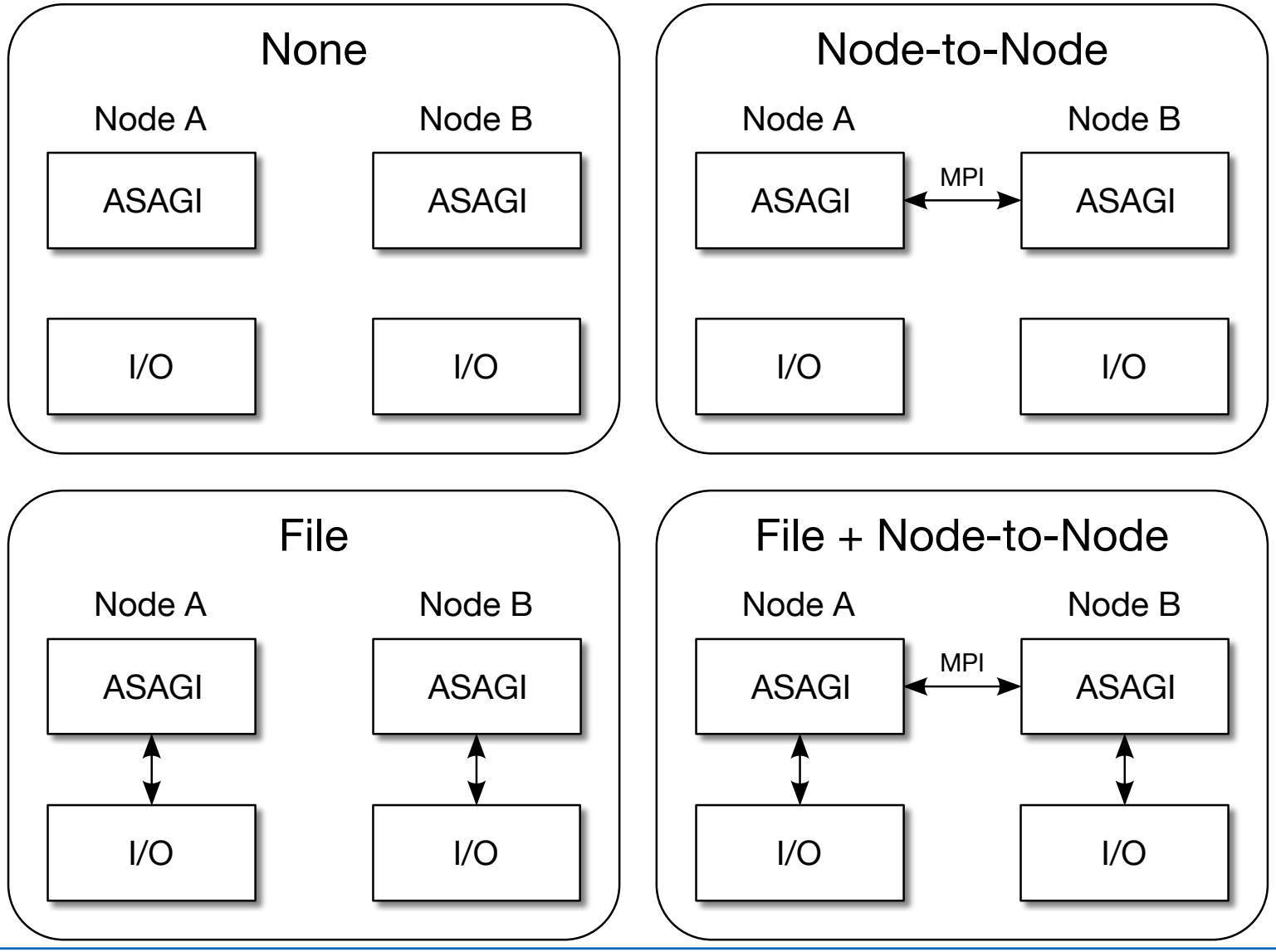
Access a grid point

Application:

```
[...]
grid->getFloat3D(x, y, z,
  level)
[...]
```

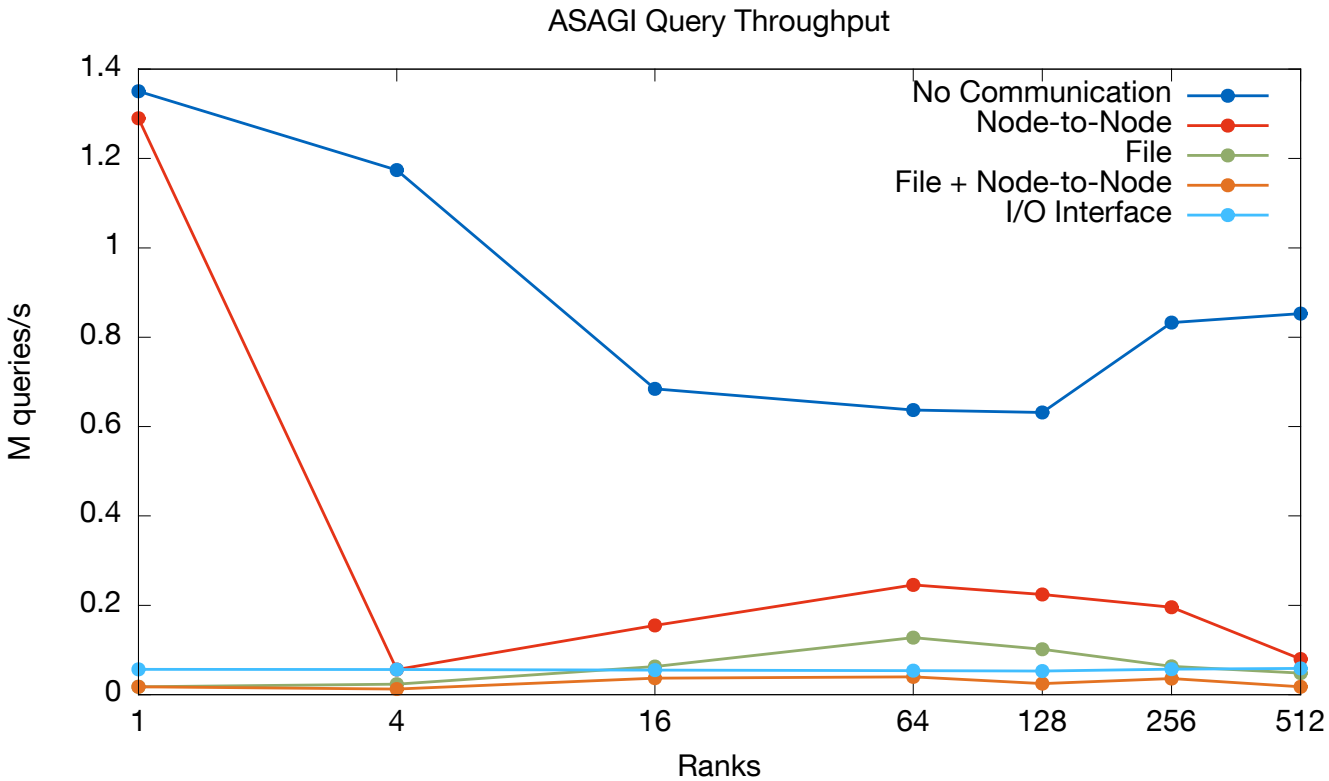


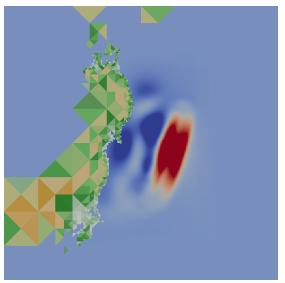
Communication patterns in ASAGI



Sierpiński with ASAGI on SuperMUC

(strong scaling)





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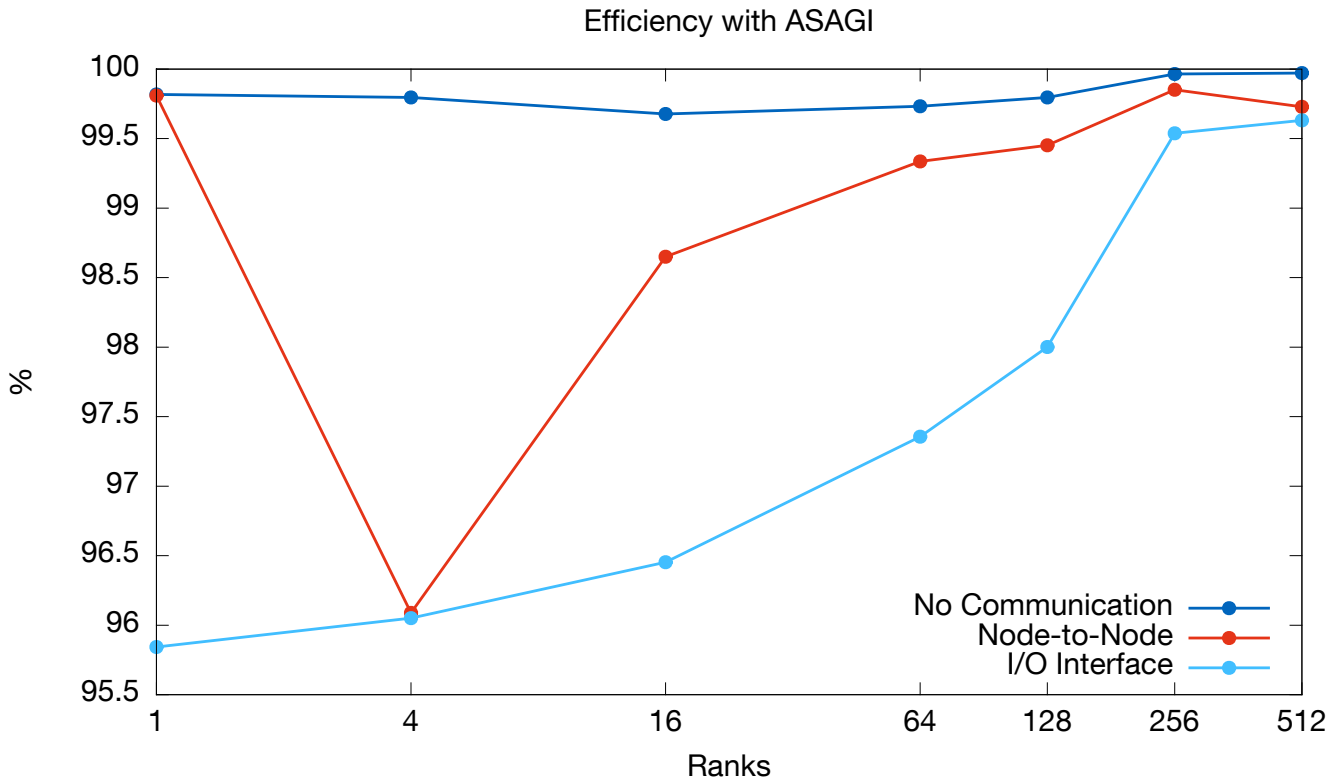
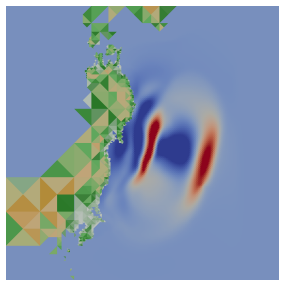
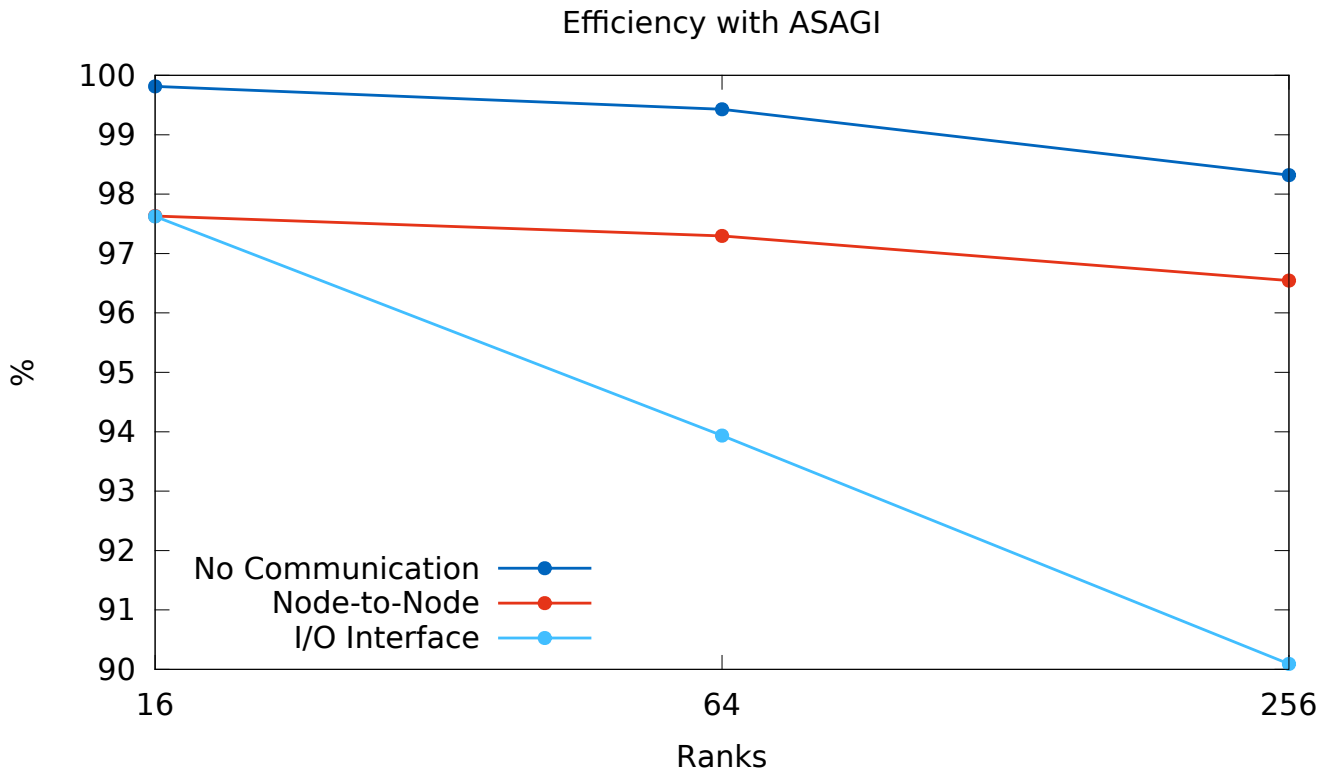
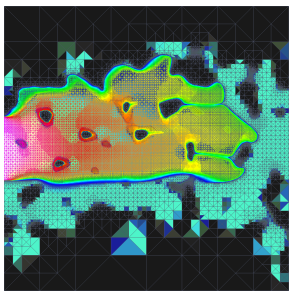




sam(oa)² with ASAGI on SuperMUC

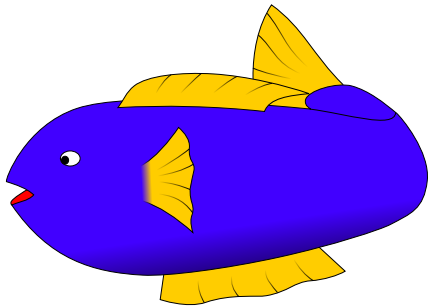
(strong scaling, multiple grid levels)





Conclusion and Outlook

- Simple interface allows easy integration
  $\Rightarrow$ Communication in ASAGI is completely hidden
- Data migration via MPI reduces I/O overhead
- Support for multiple resolutions



- 2D $\rightarrow$ 3D
- Larger grids
- MPI-3 features for synchronization
- Additional features:
  - Shared memory parallelization for NUMA architectures
  - Automatic interpolation/coarsening
  - ...