

An Evaluation of Discontinuous Galerkin Method based Global Nonhydrostatic Atmospheric Dynamical Core on A64FX Platform

Xuanzhengbo Ren¹, Yuta Kawai², Hirofumi Tomita², Takahiro Katagiri¹, Seiya Nishizawa²
Tetsuya Hoshino¹, Masatoshi Kawai¹, Toru Nagai¹

1. Nagoya University, Japan. 2. RIKEN Center for Computational Science, Japan.

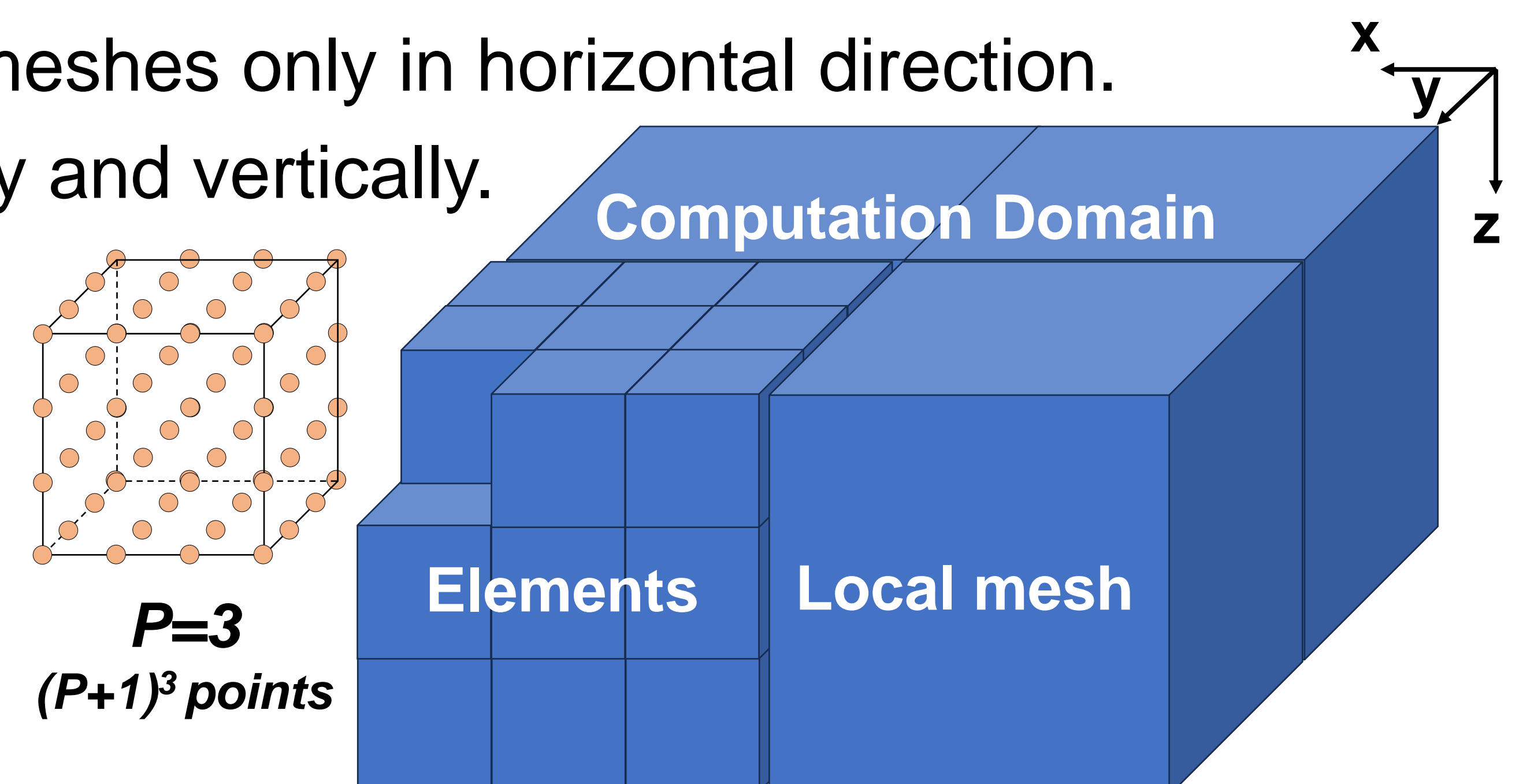
Contact: ren@hpc.itc.nagoya-u.ac.jp

Introduction.

For future high-resolution atmospheric simulations, a dynamical core using **discontinuous Galerkin Method (DGM)**, called **SCALE-DG**, is being developed as an option of high-order fluid schemes in SCALE library. Since the spatial discretization is done locally, we expect the computational performance is highly desirable in modern computer architectures. In this study, we evaluated the scalability and single process performance of SCALE-DG.

Data Partitioning of SCALE-DG.

- ❑ The computation domain is partitioned into multiple local meshes only in horizontal direction.
- ❑ The local meshes are partitioned into elements horizontally and vertically.
- ❑ Every element contains $(P+1)^3$ data points, where P is the polynomial degree.



Parallelization (MPI + OpenMP).

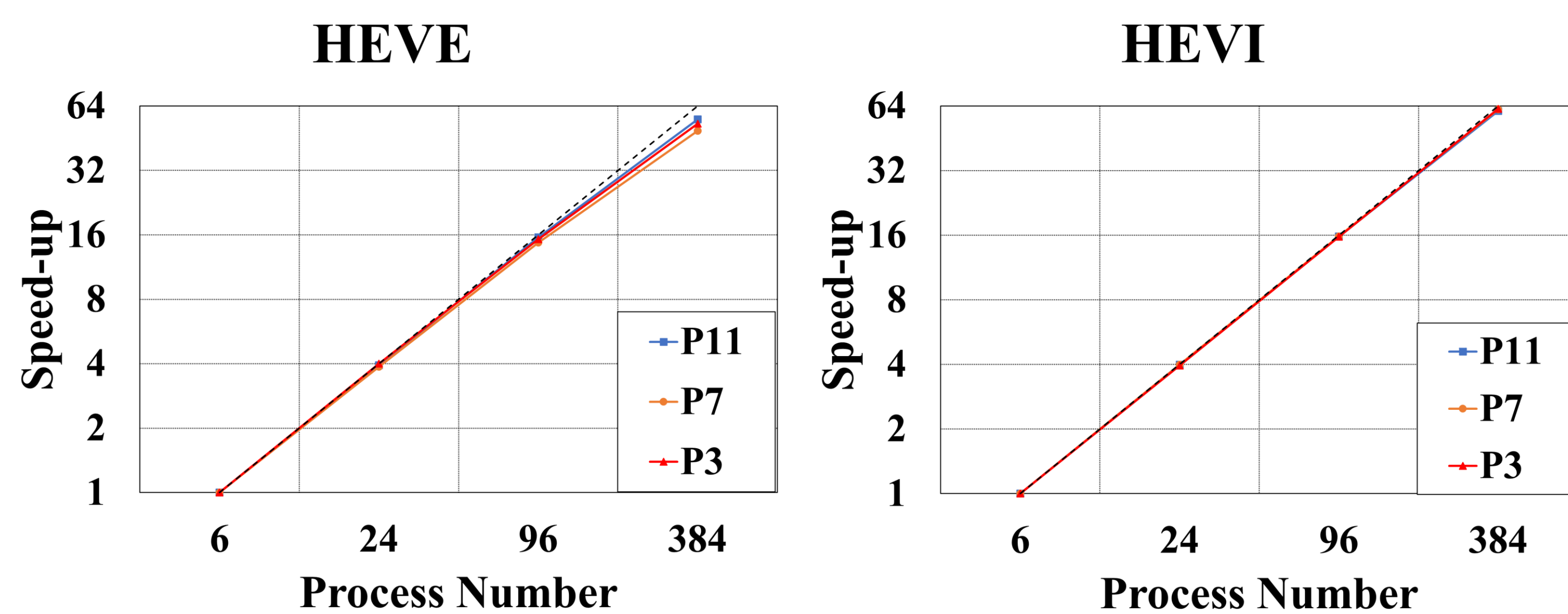
- ❑ 1 MPI process of each Core Memory Group (CMG)
- ❑ 12 OpenMP threads of each MPI process

Strong & Weak Scaling.

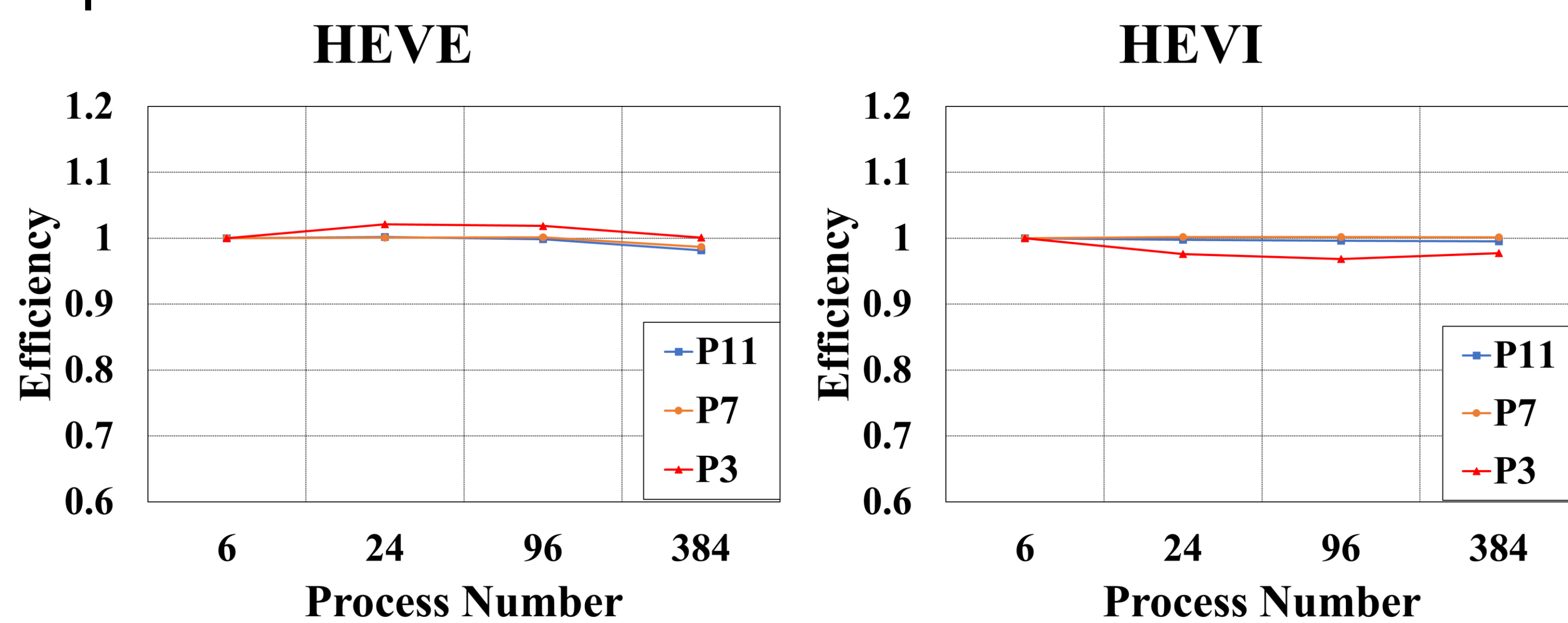
Platform: Supercomputer "Fugaku" and "FLOW".

Results:

- ❑ Strong Scaling : 192 x 192 x 96 data points.



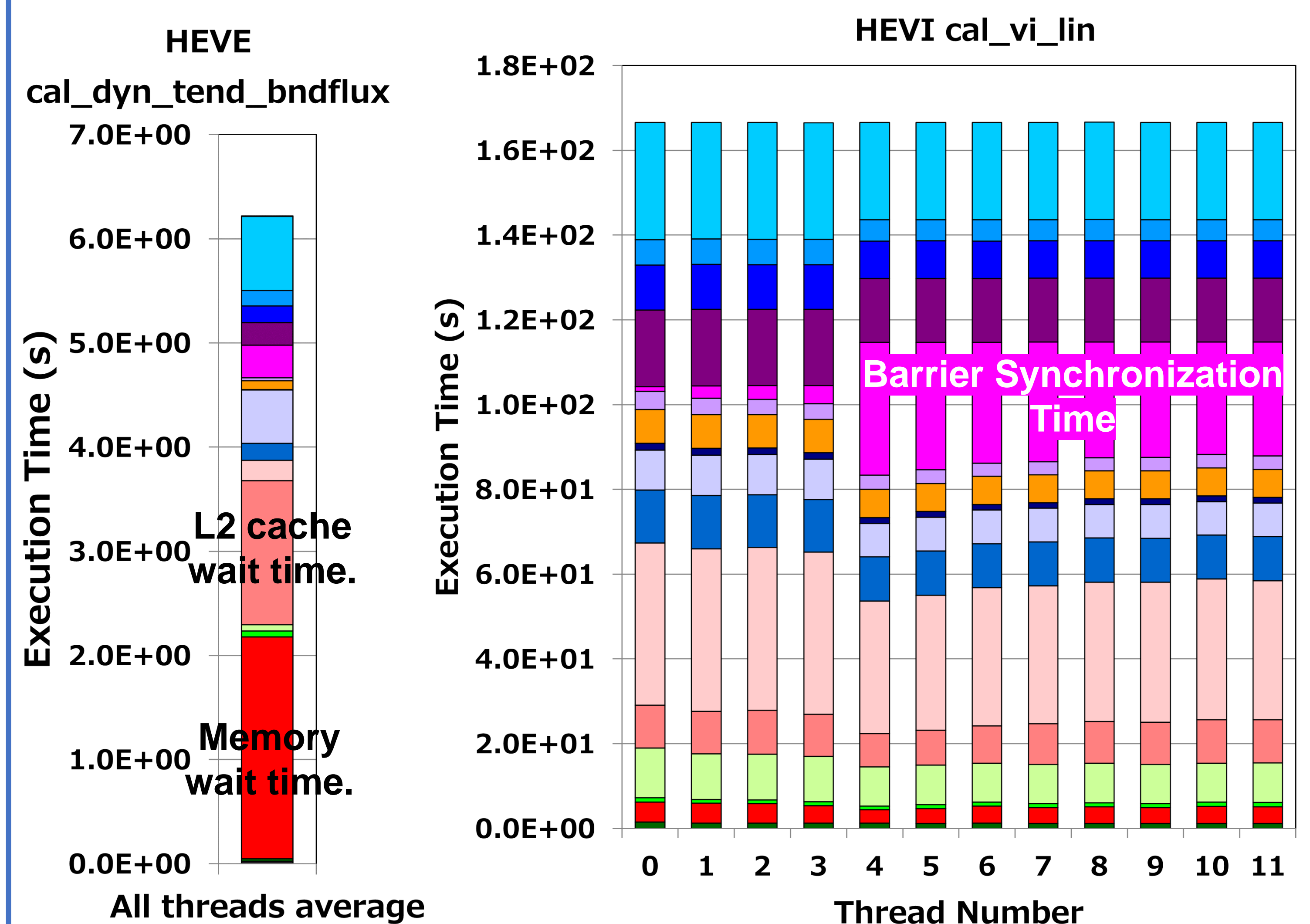
- ❑ Weak Scaling: 48 x 48 x 96 data points in each process.



*HEVE: Horizontally Explicit Vertically Explicit

*HEVI: Horizontally Explicit Vertically Implicit

Single Process Performance.



*Reports are generated by Fujitsu development studio profiler.

Conclusion.

- ❑ SCALE-DG performed excellently in strong and weak scaling.
- ❑ Memory Access issue was observed in the part of calculating boundary flux in HEVE scheme.
- ❑ Load imbalance was observed in the part of solving band matrix equations in HEVI scheme.

References:

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4. FLOW Supercomputer. Nagoya University. <https://icts.nagoya-u.ac.jp/en/sc/>

Acknowledgments

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