This work developed an ocean model called swNEMO_v4.0 based on a new-generation Sunway supercomputer and obtained significant modeling performance by sophisticated tuning methods that fully exploited the computing recourses of the new machine.

Optimizing methods proposed are based on the architectural features, and thus achieves promising modeling performance. Thread-level communication and mixed-precision arithmetic are very attractive approach today, and this work demonstrates the possibility of applying them into resolving the most complicated scientific project such as ocean model.

Firstly, in order to scale the ocean model onto the large-scale and extremely complicated supercomputer, four-level parallel framework are proposed. Sophisticated tuning techniques such as customizable domain decomposition according to the grid feature, are included as well. This enables the capability of fully utilizing the rich computing resources of the new system.

The new feature of the system, thread-level RMA communication mechanism, is also wisely used for algorithms such as composite blocking, to further optimize the bandwidth performance.

Moreover, mixed-precision optimization is proposed and performed on certain part of the algorithms. With sufficient material and proof to support its feasibility.

Significant performance speedup is obtained thanks to these innovations. About 20 million
cores are used for the large-scale test, and sustained performance of nearly 2 Petaflops.

These innovations are solid, and can be very interesting to domain experts that expect to perform similar work by using the new Sunway supercomputer or other supercomputers with alike architecture. Besides, the work is also very useful for computer scientists like me, to rethink the architecture design for better supporting numerical scientific applications.

I have no further comments, but some minor suggestions,

1) what is the portability of proposed methods of this work? Eg, to other models, or other applications from different domain.

2) what is the lesson learned of this work, in terms of architecture design for future supercomputing systems.

3) what are the major obstacles that caused the performance loss. What can be done in future to further improve the performance of HPC ocean modeling, from perspectives of both model development and computer design.