

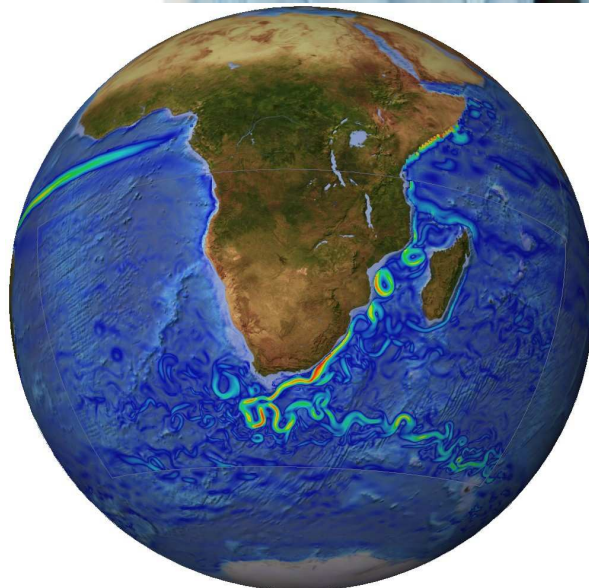


## Ocean Model NEMO\* with Outstanding Efficiency on NEC SX-8 Cluster

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### Problem

The Agulhas ring at the interface between the Indian and Atlantic Ocean is an important region in the global oceanic circulation with a key role in the global climate system. This project aims to realistically simulate this complex current system and its effect on the interoceanic transport with the highest spatial resolution to date. The core of the project is a high-resolution model of the Agulhas region that is nested in a global one at lower resolution. Both models are able to interact, which allows one to study the feedbacks from the high-resolution model on the large-scale circulation. The goal is to simulate 50 years based on 17,000,000 grid points both for the global model and the regional Agulhas model. This requires about 66000 CPU hours.



### Improvements

In the framework of the TERAFL0P Workbench detailed analysis of the application has been carried out. As a result we have identified several bottlenecks which lead to severe load imbalances during the execution. Following improvements have been carried out:

- SMP tunings
- Sea Ice Modeling
- Solver exchanged
- New MPI communication for the North boundary

Snapshot of the high-resolution model, nested in a global, coarse resolution model. Shown are speeds at 100m depth

### Achievements

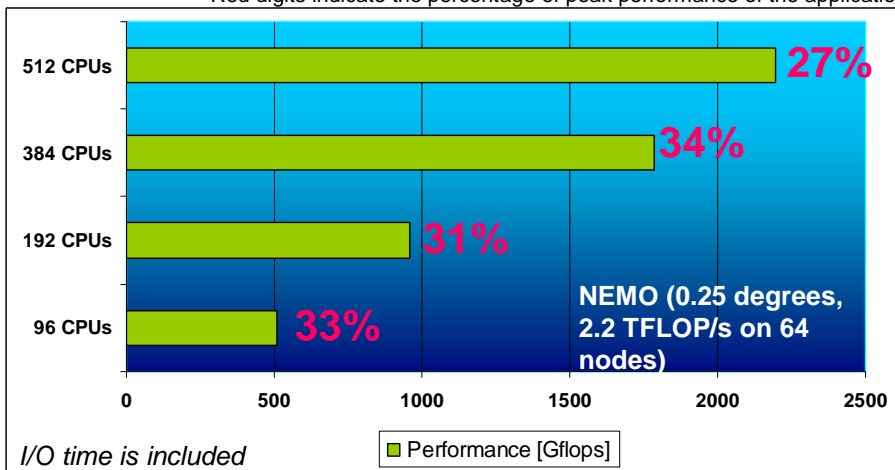
With the optimized version the scalability of the application has been significantly improved. Even for a higher number of nodes the efficiency compared to the peak performance remains in the order of 30%.

The Runtime for a test case on 64 nodes is reduce to only **8 minutes** instead of **32 minutes** on 12 nodes.

#### More details under

Biastoch, A., C. W. Böning and J. R. E. Lutjeharms, 2008, Agulhas leakage dynamics affects decadal variability in Atlantic overturning circulation, Nature in press.

Red digits indicate the percentage of peak performance of the application



\*NEMO=Nucleus for European Modelling of the Ocean

1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008

- SX-4** (1995): Multi node (> 10 nodes) processor with CMOS and air-cooling
- SX-5** (1998):
- SX-6/7** (2002): Large cluster (> 100 nodes) supercomputer; World's first single-chip vector processor
- SX-8** (2004): Super-large cluster (> 500 nodes) supercomputer
- SX-8R** (2006): Maximized peak performance of 281.6 GF per node
- SX-9** (2008): World's first supercomputer of over 100 GF per CPU

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