U062-005 Room: Convention B Time: May 27 11:15-11:45

Simulated oceanic general circulations with explicit representation of meso-scale eddies

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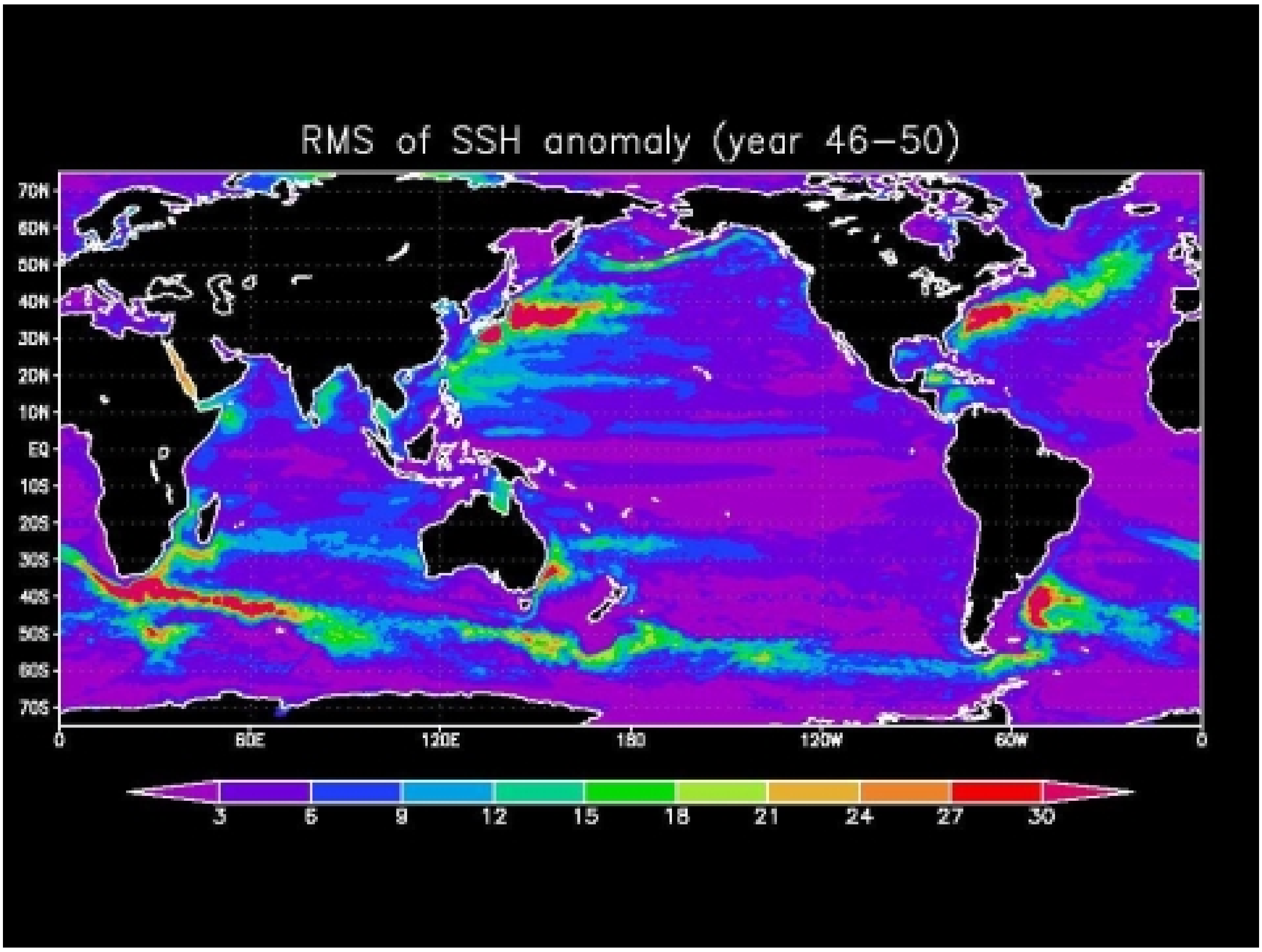
The Earth Simulator (ES) had attained record-breaking sustained performances not only in a standard LINPACK benchmark (87.5 % of its peak performance) but also in another much more practical one for the high-resolution spectral AGCM code called AFES (64.9 %) soon after the initiation of its routine operation. More importantly, contrary to the prevailing anxiety on hardware troubles, the entire system turned out to be quite stable, which proved the potential usefulness of this innovative system as a great contributor to computational geo-sciences. The finest horizontal resolution of the global simulations actually executable on ES is estimated somewhere around 10 to 5 km with which energetic meso-scale eddies in the oceans are resolved quite well. Actually, a recent eddy resolving simulation for the North Atlantic done by Smith et al. (2000, JPO) shows that 10 km is a threshold value for simulated eddy activities to be quite close to the observational ones. The above-mentioned research situations encompassing our research group at JAMSTEC Yokohama Institute for Earth Sciences motivated us to attempt a record-breaking 50 year long time integration of eddy resolving simulation on the near global domain as soon as the system became available to us. The significances of our attempt may be summarized as : (1) From scientific and technical points of view, the first priority is given to eddy resolving simulation on the global domain. (2) Although similar attempts were already started by the research groups at Los Alamos and Southampton, mainly due to the limitation of the computational performances of their machines, the time integration they had been through with in last year were reported respectively to be 10 and 2 years. Therefore, a completion of 50 year long time integration, which is well beyond the spin-up time for the equatorial and mid-latitude regions, in a tolerably short period is a big challenge to prove the superiority of ES as well as to provide the global pictures of explicitly simulated nonlinear interactions between the basin and the meso-scale circulations. (3) In addition, our basic test simulations of this kind are preliminary studies for high-resolution coupled simulations and for much longer eddy resolving simulations for thermohaline circulations.

Since our immediate concern lies on the data analyses of an eddy resolving simulation rather than the development of new OGCM code for ES, we have developed an optimized parallel code (OFES) based on MOM3 for our simulation project. Due to space limitation, we skip the simulation settings given in Japanese abstract. As to the optimal parallelization, we can say that there is much room to improve the sustained performance of our code since we have not changed the basic structure of MOM3 considerably. Nevertheless we could complete the simulation in approximately three weeks, which was the major factor for the success of our first simulation. Utilizing WOCE data sets and others, we have looked into the reproducibility of the basin-scale circulations, the western boundary currents and eddy activities there, meridional heat transports, pronounced regional phenomena such as Legeckis wave and Agulhas ring together with the vertical structures of horizontal velocity, temperature and salinity fields. The overall quality of the simulation seems to be promising except for water mass features affected much either by sub-grid scale physics or by sea ice. In the oral presentation, the simulated features will be discussed at some length and here we present a figure on eddy activity as a representative of our outcome. At present, we are performing the second simulation in which the forcing with much higher frequencies is being applied together with minor improvements in experimental settings. We are going to briefly report the present status of our research activities covering the first and a part of the second runs in addition to our future research plan.


RMS of SSH anomaly (year 46-50)
70N
60N
50N
40N
30N
20N
10N
EQ
10S
20S
30S
40S
50S
60S
70S
0
60E
120E
180
120W
60W
0
3
6
9
12
15
18
21
24
27
30