Progress Report (December 2015 to present)

Overview

Our current allocation for the period from April 2017 to March 2018 are 15000 service units on Maverick and 10000 service units on the Ranch, and is transferred 26470 service units on Stampede2 on June, 2017. As of Oct. 20, we used 40690 SUs on Stampede2 for Development and scaling tests for geodynamo codes.

CIG has worked with several researchers in geodynamo studies to support their research using small amounts of the allocation on Stampedes. Dr. Matsui used 11610 SUs for investigation of the parallel performance on Stampede2. Prof. Shinich Takehiro at Kyoto University also used 29079 SUs for a scaling tests for a dynamo model named SPModel on stampede2.

Calypso Dr. Hiroaki Matsui at UC Davis investigated a scaling of Calypso on Stampede2. Calypso keeps good scaling up to 256 nodes with $(N_r, l_{max}) = (1088, 255)$ case, where N_r and l_{max} are the number of radial grid and truncation degree of the spherical harmonics, respectively. Comparing with the same number of nodes of Stampede, Calypso runs on Stampede2 approximately twice as fast as on Stampede (see Figure **??**). Dr. Matsui also compare weak scaling on Srampede2 and Stampede. The weak scaling results on Stampede 2 are slightly worse than that on Stampede. The elapsed time per each DOF decrease with $O(N^{-0.88})$ on Stampede2 while the time decreases with $O(N^{-0.80})$ on Stampede.

Dr. Matsui also performed a dynamo simulation with $(N_r, L_{max}) = (320, 255)$ with 64 nodes of Stampede2 given in Figure **??**. This simulation result will be compared with large eddy simulation results using coarser resolution.

SPmodel Prof. Shinich Takehiro at Kyoto University also performed a scaling tests for a dynamo model named SPModel on stampede2. Prof. Takehiro compared the performance of SPmodel on Stampede 2, Stampede, K computer based on SPARC64 VIIIfx processors, and Earth Simulator 3 based on NEC SX-ACE processors. As seen in Figure **??**, SPmodel keeps good scaling to 1000 cores in the finer resolution case $(N_r, l_{max}) = (48, 5461)$. Comparing with Stampede, performance of each core on Stampede2 is approximately 1/3 of the Stampede. Comparing the performance per each

processor core with other computer system, performance on Stampede 2 is approximately the same and 5 times of Earth Simulator 3 and K computer, respectively.

Publication List (April 2017 to present)

Takehiro, S., Sasaki, Y., Penetration of steady fluid motions into an outer stable layer excited by MHD thermal convection in rotating spherical shells, *Phys. Earth Planet. Inter.*, in press, doi:10.1016/j.pepi.2017.03.001, 2017. Satoshi Noda, Masaki Ishiwatari, Kensuke Nakajima, Yoshiyuki O. Takahashi, Shin-ichi Takehiro, Masanori Onishi, George L. Hashimoto, Kiyoshi Kuramoto, and Yoshi-Yuki Hayashi, The circulation pattern and day-night heat transport in the atmosphere of a synchronously rotating aquaplanet: Dependence on planetary rotation rate, *Icarus*, **282**, 1–18, doi:10.1016/j.icarus.2016.09.004, 2017. Sasaki, Y., Takehiro, S., Ishiwatari, M., Yamada, M., Effects of radial distribution of thermal diffusivity on critical modes of anelasticthermal convection in rotating spherical shells, JpGU-AGU Joing Meeting 2017, SIT22-32, Chiba, May 2017. Takehiro, S., Sasaki, Y., Penetration of compositional convection into the upper stably stratified layer in the Earth's outer core, JpGU-AGU Joing Meeting 2017, MG132-P93, May 21, Chiba, Japan, May 2017.

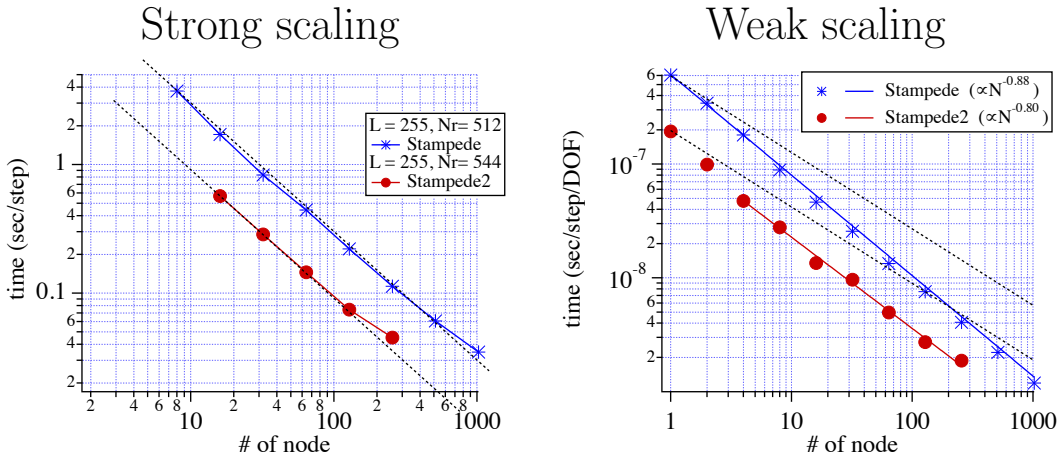

Figure 1: Comparison of performance of Calypso on Stampede2 and Stampede. Strong scaling result is plotted on the left, and weak scalin result is shown in the right. Ideal scaling is plotted by the dotted lines, and fitted results of the weak scaling is shown by solid lines.

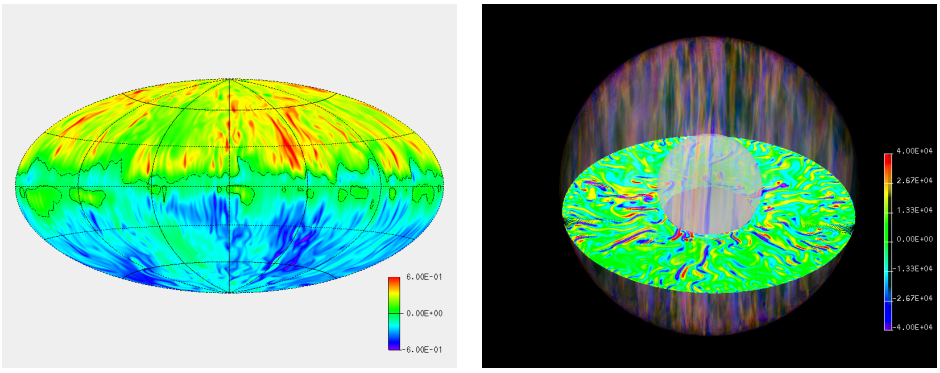

Figure 2: Radial magnetic field at the outer boundary of fluid shell (left) and z-component of the vorticity ω_z in the fluid shell (right) in the dynamo simulation with $(N_r, L_{max}) = (320, 255)$.

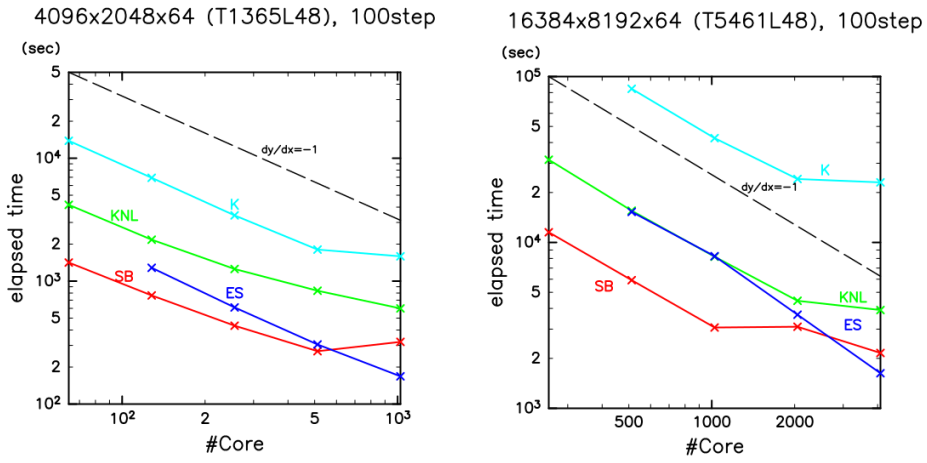

Figure 3: Strong scaling of SPmodel as a function of number of processor core. Results with $(N_r, l_{max}) = (48, 1365)$ is plotted in the upper panel, and results with $(N_r, l_{max}) = (48, 5461)$ is plotted in the lower panel. Results on Stampede 2, Stampede, Earth Simulator 3, and K computer are plotted by green, red, blue, and cyan, respectively.