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A climate model toward the exa-scale computing

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Climate models are continuously demanding on computer resources. The ways of using large-scale computer systems for climate simulations are categorized into increase of resolution, increase of sophistication and increase of ensemble number. The third one is the most straightforward without any problems, because the communication between computer nodes does not occur between each of ensemble runs. On the other hand, the first and second ones should be taken care for efficiency. As we will increase the horizontal and vertical resolutions of the global model, the sophistication of physics will be enhanced continuously, e.g. in the atmospheric model cloud microphysics will be shifted to low moment bulk method to high moment bulk method or spectral bin model, radiation process might increase the spectral band and the turbulence process will be also made by high closure levels. Now, we are in the peta-flops computing era. In the last decade, newly developed global models seem to be shifted from the spectral transform model to the gridpoint model on the quasi-homogenous grid. For example, NICAM (Nonhydrostatic ICosahedral Atmospheric Model) employs the icosahedral grid and high-resolution runs with 3.5km horizontal grid interval have been conducted on the Earth Simulator. This model will be used also on the K-computer project in Japan. We beleive that the basic strategy of NICAM, in which the icosahedral grid is used for the horizontal discretization and time-spliting explicit scheme, is promising also to the exa-flops era. However, the exa-scale co-design has already started and we do not know whether such approach appeared in NICAM does truly get the efficiency on the exa-scale machine. Recent trend of supercomputer system becomes many core. This mean that the memory band width for one core is reduced, consequently, there is a possibility that the gridpoint method for solving the fluid dynamics does not get high efficiency. In addition, the network communication between computer nodes is also a big problem for scalability. We should take care on design of the model algorithm and computer architecture simultaneously. The climate research team in Advanced Institute for Computational Science / RIKEN are now starting to tackle to this problem with the computer scientist. Anyway, first thing we should do is the assessment of computer efficiency using NICAM dynamical on K-computer(10 PFLOPS machine). This poster introduce the activity in AICS and recent knowledge for this problem.