Summary of ocean-climate modeling activities in Japan[1]

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Acronyms:

AORI: Atmosphere and Ocean Research Institute, University of Tokyo

ESC/JAMSTEC: Earth Simulator Center, JAMSTEC

RIGC/JAMSTEC: Research Institute for Global Change, JAMSTEC

JAMSTEC: Japan Agency for Marine-Earth Science and Technology

JMA/MRI: Japan Meteorological Agency Meteorological Research Institute

NIES: National Institute for Environmental Studies

1. Activities related to CMIP5

Most of the efforts made in the past 1.5 years by ocean climate modelers in Japan are devoted to conducting a series of experiments to contribute to IPCC-AR5. These activities include setting up, integrating, and documenting the climate model and its ocean-ice component maintained by their institute or research group. Two research groups are conducting the CMIP5 experiments: a group of scientists from AORI, JAMSTEC/RIGC, and NIES, and a group of scientists from JMA/MRI.

The group of AORI-JAMSTEC/RIGC-NIES has developed two types of global models, whose oceanic component is based on COCO (Hasumi 2006). The higher resolution model (1/4° zonally, 1/6° meridionally, 50 levels vertically) is used for near-term (decadal) prediction starting from a state given by data assimilation. The lower resolution model (1.4° zonally, 0.5 ~ 1.4° meridionally, and 50 levels vertically with additional one bottom boundary layer) is used for long-term projections.

The group of JMA/MRI has developed a nominal non-eddy permitting model (1° zonally, 0.5° meridionally, and 50 levels vertically with additional one bottom boundary layer) for long-term simulations of CMIP5. This model is based on MRI.COM (Tsujino et al. 2010).

2. Activities related to COREs

The JMA/MRI group has recently completed a control hindcast simulation using the CMIP5-class global ocean-ice model forced by the Coordinated Ocean-ice Reference Experiments (CORE) interannual forcing (CORE-IAF). The main research target is

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[1] Contents are subject to revision

decadal and longer time scale ocean-climate variabilities in the Pacific Sector including both Arctic and Antarctic region. In addition to this control experiment, a bio-geochemical model with NPZD ecosystem and carbon cycle is run off-line using the physical field from this control experiment. A high-resolution (1/11° zonally and 1/10° meridionally) regional model for the western North Pacific is nested within the above global model and is run on-line. This model clearly exhibits improvements from the non-eddy permitting global model, especially in the western boundary region.

The AORI-JAMSTEC/RIGC-NIES group has also been experiencing CORE-IAF for their two models. Some of their comments to the datasets will be reported during the panel meeting.

3. Other development activities

The AORI-JAMSTEC/RIGC-NIES group is implementing some new mixing schemes: the generic length scale model of vertical turbulent mixing for general simulations and a sub-mesoscale eddy parameterization for eddy permitting simulations. A super-high resolution regional model for the western North Pacific is planned to be nested within the oceanic component of the high-resolution coupled model mentioned earlier. This model is planned to be used as a next generation climate model by this group.

The efforts of the JMA/MRI group for the next couple of years will be directed toward developing an operational regional high-resolution model that is nested within a global model. These models will be based on the same ocean climate model (MRI.COM).

A group of JAMSTEC/ESC has started integration of a 1/30° horizontal resolution simulation for the North Pacific Ocean focusing on submesoscale phenomena. They are also conducting an ensemble simulation of an eddy resolving (0.1 degree horizontal resolution) ocean-only global model and a high resolution coupled atmosphere-ocean model whose oceanic component permits mesoscale eddies.

There is a project that unites the couplers connecting components of Earth System Models developed by each institution in Japan. Some ocean-ice models used in Japan will be incorporated in this framework to have a common interface to this coupler.

References:

Hasumi, H. (2006): CCSR Ocean Component Model (COCO) version 4.0, *CCSR Report* No. 25, 103pp.

Tsujino, H., T. Motoi, I. Ishikawa, M. Hirabara, H. Nakano, G. Yamanaka, T. Yasuda, and H. Ishizaki (2010): Reference Manual for the Meteorological Research Institute Community Ocean Model (MRI.COM) Version 3, *Technical reports of the Meteorological Research Institute* No. 50, 241pp.

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