

High-resolution modeling of the Arctic Ocean with a nested-grid ice-ocean model

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The Arctic environment undergoes a drastic change. Recent studies have shown that its impact is not limited in the Arctic region itself but spread globally. Thus, good reproducibility of the Arctic region in numerical models is of great significance in studying global climate variability. However, coarse-resolution climate models have many problems such as poor representation in the internal structure of the Arctic Ocean and unrealistic heat and freshwater transport between the Arctic Basin and adjacent seas (e.g., Ilicak et al., 2016).

We are now developing a global ice-ocean model with high resolution in northern high latitudes in order to improve reproducibility of the Arctic Ocean in global climate models. Two-way nested grid version of ice-ocean model COCO (Kurogi et al., 2013; Kurogi et al., 2016) is used. We employ a tri-polar grid of Murray (1996), which consists of a latitude-longitude grid to the south of 63N and another bi-polar grid to the north of it. The inner model domain covers roughly the same region as the latter bi-polar grid area and is nested into the outer model domain which covers the whole globe. The horizontal resolution of the inner and outer models are approximately 3 km and 0.25 degree, respectively.

A preliminary experiment has been performed using this model. The experiment procedure is as follows. First, only the outer model is spun up with restoring temperature and salinity below 50 m depth to PHCv3 climatology (Steele et al., 2001). The result is then interpolated to the inner model domain. From this initial condition, the nested model is integrated in 10 years forced by the year 1990-1999 of JRA55-do (Tsujino et al., 2018), which is an atmospheric dataset for forcing ice-ocean model based on JRA-55 (Kobayashi et al., 2015).

Results from the last 10 years integration have been analyzed and compared to results of a coarse-resolution (nominal 1 degree) run with using the non-nested version of COCO. Time series of northern hemisphere sea-ice extent is similar between the experiments, and both the results show good agreement with the observation. On the other hand, the Atlantic water inflow into the Arctic Ocean from the Nordic Seas shows a considerable difference between the experiments. A more detailed analysis will be shown in the presentation.

References

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