Geoscientific Model Development Discussions

Geosci. Model Dev. Discuss., referee comment RC2
https://doi.org/10.5194/gmd-2021-220-RC2, 2021


# Comment on gmd-2021-220

Anonymous Referee #2

Referee comment on "An improved regional coupled modeling system for Arctic sea ice simulation and prediction: a case study for 2018" by Chao-Yuan Yang et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2021-220-RC2, 2021

General comments

This study evaluates modeled summertime sea ice evolution in a updated Arctic regional coupled modeling system based on WRF, ROMS and CICE. A series of experiments with varied physical options has been conducted. These physical options include utilizing RAP physics in WRF, changing vertical coordinate transformation and stretching function and advection scheme in ROMS, involving MUSHY thermodynamics in CICE. Additional experiments have been focused on impacts of data assimilation with different radius of influence and ice thickness merging algorithm. The authors also discussed the model performance on timescale up to 7 months. However, the main limitation of this study is lack of novelty. Since the upgrades of physical parameterization in component models are achievements of community efforts, this study fails to introduce unique scientific contribution to the modeling community. The reported results in this study are general, detailed analysis of physical process linking selected physical parameterization to modeled sea ice state are missing. The discussion and conclusion sections just present the model results without adequate discussions in deep, mainly suffering from a lack of detailed physical process analysis in the previous sections. Based on my evaluation, I recommends resubmission after substantial improvement and scientific significance have added into this study.

The following concerns are specific, I hope they are useful for the authors.

Specific comments

Line 48-59: The authors stated that the gap of predictive skill between GCMs and "perfect model" may be related to inaccurate initial conditions and/or inadequate physical parameterizations. Please clarify in detail: what defines GCM and what defines "perfect model".

Line 117-121: The authors stated that the change of coupling strategy in the latest ROMS model prevents the potentially erroneous results when the ROMS timestep is smaller than the coupling frequency with other model components. This is hard to follow. Please explain.

Figure 3: Since the configurations of Y21_CTRL and Y20_MOD are identical except model physics. The evolution of red and blue lines should start from the same point and then diverge. Please modify the relative figures.

Line 217-221: "Compared with the CLIM/DAMP predictions, both Y20_MOD and Y21_CTRL have smaller biases after early August." This statement is true in part. The authors seem ignore the sea ice extent evolutions in early September, since their biases are comparable. Again, "At the regional scale, in the Beaufort-Chukchi Seas, Y21_CTRL predicts slower ice retreat after late July than that of Y20_MOD, whereas in the East Siberian-Laptev Seas, Y20_MOD shows slower ice decline after mid-July than that of Y21_CTRL." This statement is true, but a further comparison with NSIDC evolution is missing. From Figure 3a and 3b, the performance of Y20_MOD is better than Y21_CTRL.

Line 222-226: The authors attribute the underestimation of sea ice extent in BAY-CAA in both experiments to the difference in land/sea mask between the model and NSIDC grid. I am not convinced by this sentence. I don't find any information about the NSIDC grid or land/sea mask difference between model and NSIDC grid in the context.

Line 231-234: This result is not intuitive from Figure 4d-i. Additional subplots showing deviation between Y21_CTRL and Y20_MOD is needed.

Line 266-267: "It also shows that the magnitude of biases decreases as the lead time decreases". This sentence is not clear. Please revise.

Line 298-305: In the two vertical coordinate transformations, hc utilizes two values: 10 m and 300 m. Please present the reason why and how these two values are decided.

Figure 10: The figure is too small. It is better to arrange the two subplots into one column.

Figure 12: The second row is not needed.