Seamless sea ice prediction with AWI Climate Model

Seamless sea ice prediction with coupled model

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In Short

- Improve Arctic sea ice prediction by implementing multivariate assimilation on atmosphere, ocean and sea ice models.
- Find solutions to inconsistency of different compartments during coupled model assimilation.

Arctic sea ice is undergoing dramatic changes in recent decade. The decline of sea ice opens summer shipping routes for intercontinental economic exchanges, which obviously attracts commercial interests for most of the northern hemisphere countries. The increasing social activities in Arctic, therefore, calls for great demands on sea ice predictions from daily scale to decadal scale.

However, the sea ice prediction is still in an early stage of development. The operational forecasting systems currently serving for sea ice forecasts are mostly developed based on the ice-ocean coupled model, such as the Norwegian TOPAZ4 sea ice/ocean numerical prediction system, the Canadian Global Ice Ocean Prediction System (GIOPS) and the U.S Navy Arctic Cap Nowcast/Forecast System (ACNFS), which limits their capabilities for long-term prediction.

A coupled model is expected to meet the demands for forecasts on different time scales. The AWI-CM equipped by an unstructured ocean model provides high oceanic resolution in the Arctic Ocean, which facilitate the projection of delicate details such as leads in sea ice regions. Meanwhile a coarse oceanic resolution in lower latitudes further speeds up the forecasts, bridges the feedback between high and low latitudes, and evolves the model to a further long time. Recent study even shows that using a coupled model sea ice prediction from the European Centre for Medium-Range Weather Forecasts (ECMWF) forecast system can be skillful more than 1.5 months ahead [1].

As the well-known chaos in climate models, a better initialization for the system is crucial. To achieve this, data assimilation has been widely used in current operational systems. Compared to the variational approach, the ensemble based data assimilation method is more effective for such complicated system. Nevertheless, the system will still drift away from the realistic states, especially in climate models. The multivariate assimilation on different components in climate model corrects all the components of system at the same time based on the cross-covariances matrix. This sheds light on a promising future for a better initialization. However, the inconsistency of different components during data assimilation will generate unrealistic values, thus further comprehensive research is still required.

Currently an ensemble based AWI-CM integrated with the Parallel Data Assimilation Framework (PDAF) has been developed in AWI 1. The impacts of assimilating atmospheric, oceanic and sea ice variables on sea ice prediction will be evaluated by using both simple direct assimilation method such as nudging and the sophisticated method such as the ensemble Kalman Filter. The current used weekly coupled data assimilation approach in different components will be also extended to a strongly coupled version in the future. The multivariate assimilating of atmospheric, sea ice, and oceanic fields will be beneficial to a skillful Arctic sea ice seamless prediction.

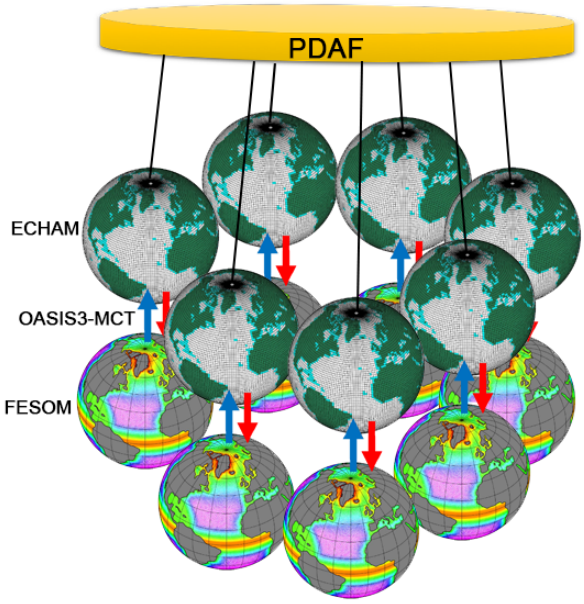

***Figure 1:** AWI-CM prediction system*

WWW

https://www.awi.de/en/science/junior-groups/seamless-sea-ice-prediction.html

More Information

[1] L. Zampieri, H. F. Goessling, T. Jung, *Geophys. Res. Lett*, 2018. doi:10.1029/2018GL079394

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