Geoscientific
Model Development

Supplement of

Southern Ocean Ice Prediction System version 1.0 (SOIPS v1.0): description of the system and evaluation of synoptic-scale sea ice forecasts

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Introduction

Figure S4 and S5: with respect to the OSISAF data, the RMSE of sea ice concentration forecasts of the DA_Forecast run at lead time of 24-hour is larger than that of the MOI product, while the IIEE of the DA_Forecast run at lead time of 24-hour is close to that of the MOI product. Note that the MOI product has assimilated the OSISAF sea ice concentration data, the SOIPS assimilated the AMSR2 sea ice concentration data, thus the MOI product has a lower RMSE of sea ice concentration when uses the OSISAF data as validation reference in this study.

The MOI product is accessed at:

https://data.marine.copernicus.eu/product/GLOBAL_ANALYSISFORECAST_PHY _001_024/

Figure S6: the minimum sea ice extent forecasts of the DA_Forecast run at lead time of 24-hour are 1.73×10^6 km^2 in 2022 and 1.49×10^6 km^2 in 2023. The minimum sea ice extent derived from the AMSR2 data are 1.76×10^6 km^2 in 2022 and 1.63×10^6 km^2 in 2023. The SOIPS predicted a lower sea ice extent minimum in 2023 than in 2022.
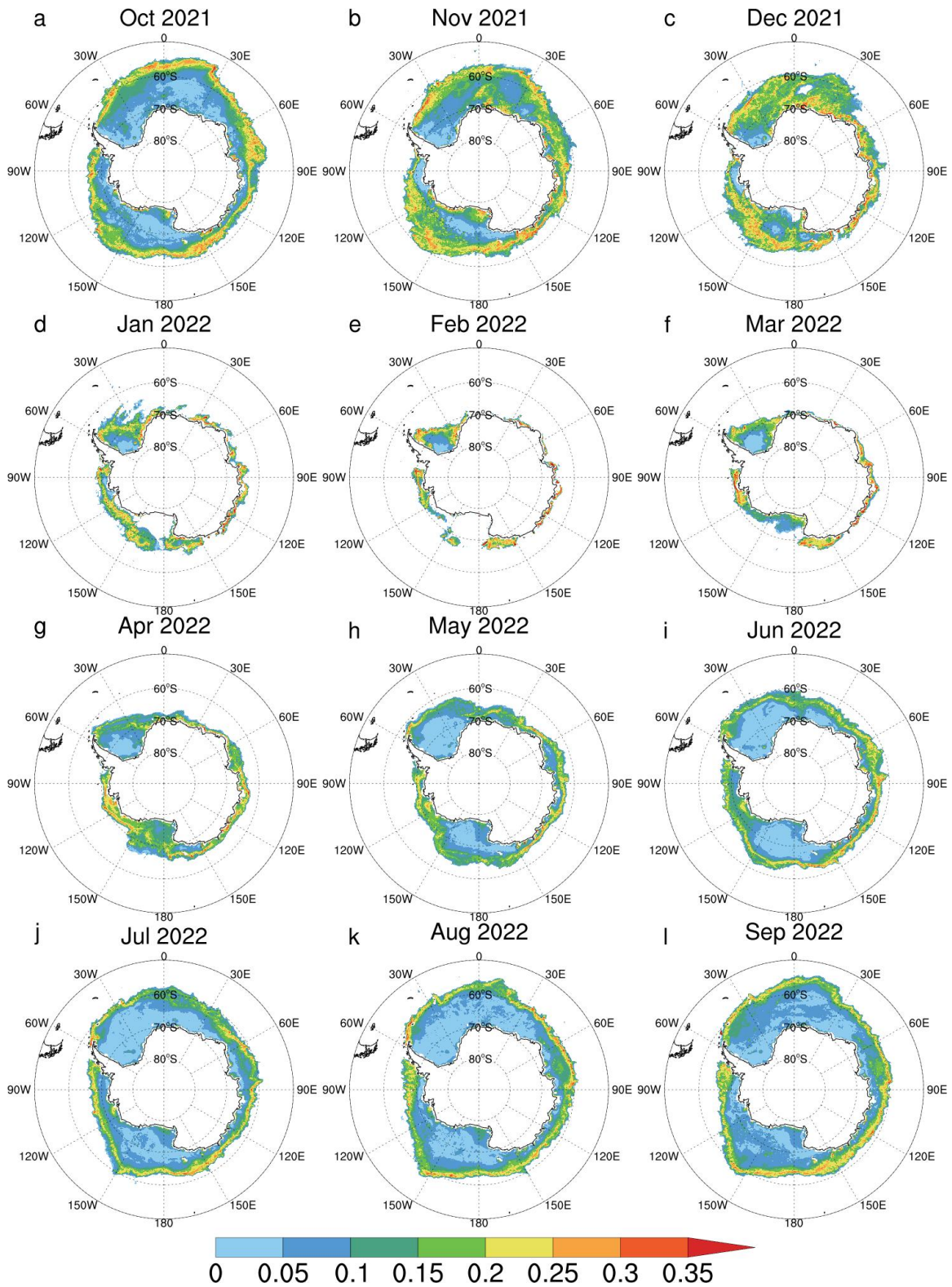
Figure S1. Monthly patterns of the RMSEs of sea ice concentration between the AMSR2 and OSISAF data. (a)–(l) denote October 2021–September 2022.
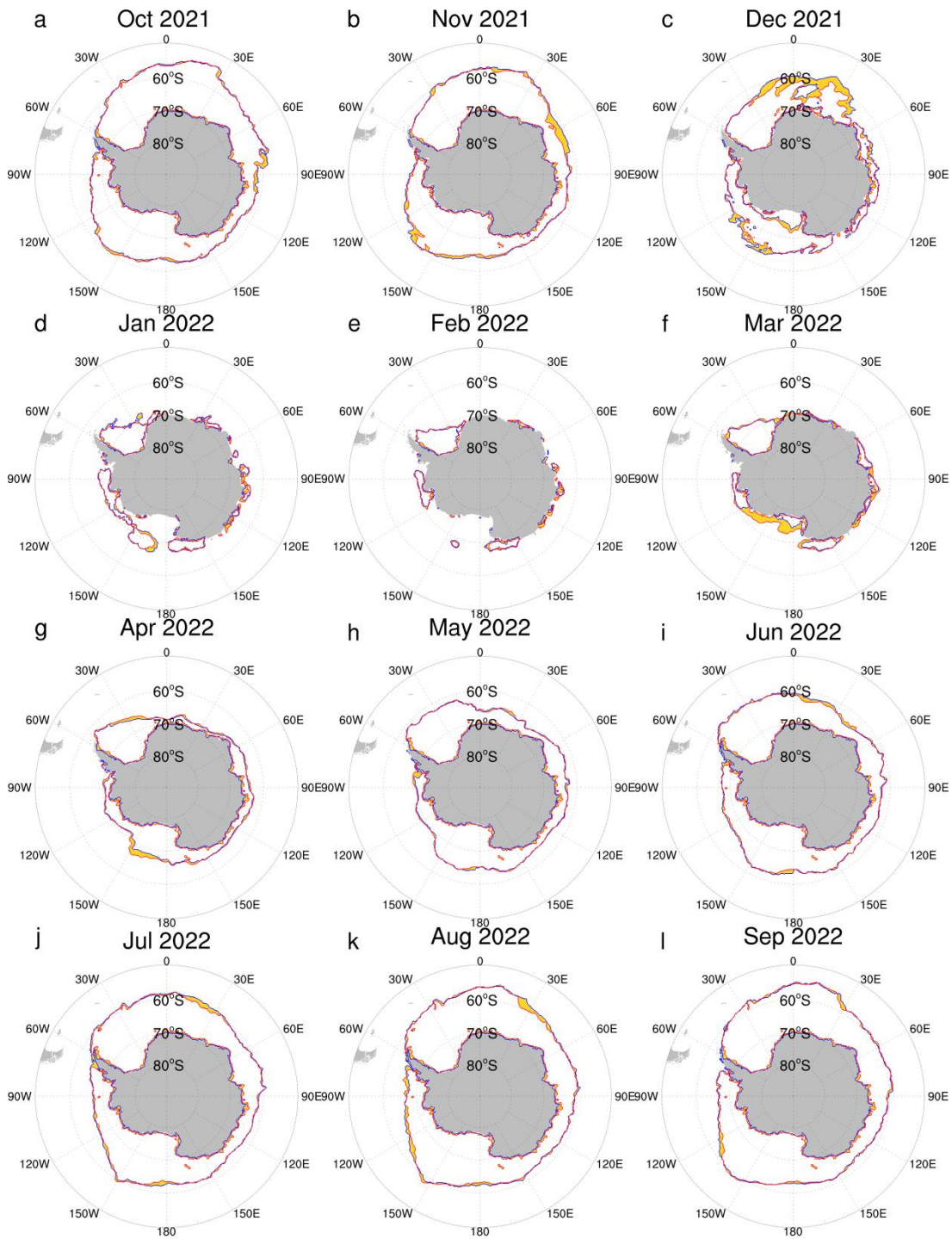
Figure S2. Monthly patterns of sea ice edge forecasts at lead time of 168-hour with respect to the OSISAF data. (a)-(l) denote October 2021–September 2022. The blue lines denote the DA_Forecast run. The red lines denote the OSISAF data. The gold contours denote the mismatch between these two data.
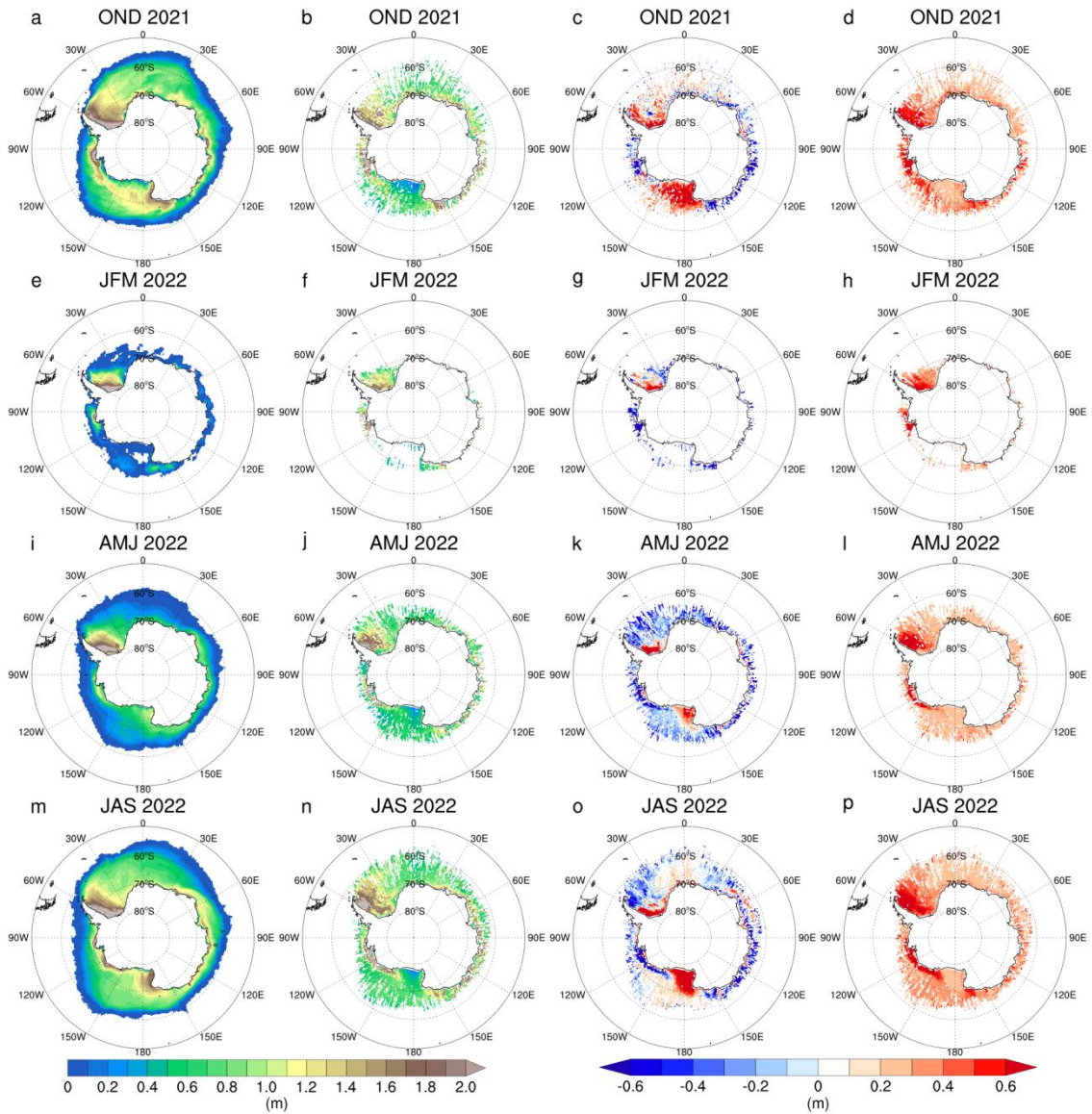
Figure S3. Seasonal patterns of the Antarctic sea ice thickness. The columns from left to right denote the DA_Forecast run at lead time of 168-hour, the ICESat2 observations, their deviations, and the uncertainties of the ICESat2 observations, respectively. The panels from top to bottom denote October–December, January–March, April–June, and July–September, respectively.
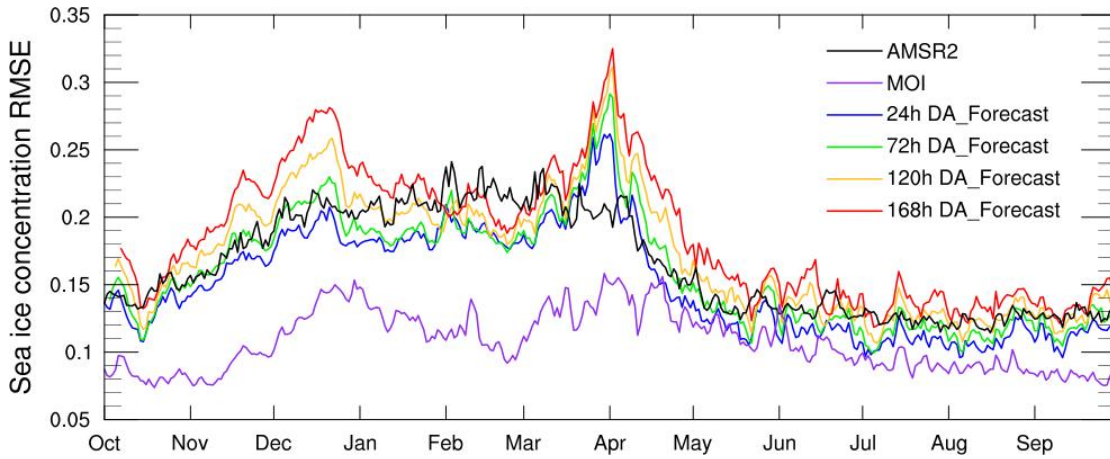
Figure S4. Time series of the RMSEs of the assimilated AMSR2 data, the MOI product, and sea ice concentration forecasts of the DA_Forecast run at different lead time with respect to the OSISAF data. The blue, green, yellow, red, black, and purple lines denote the sea ice concentration forecasts at lead time of 24-hour, 72-hour, 120-hour, 168-hour, the AMSR2 data, and the MOI product, respectively.
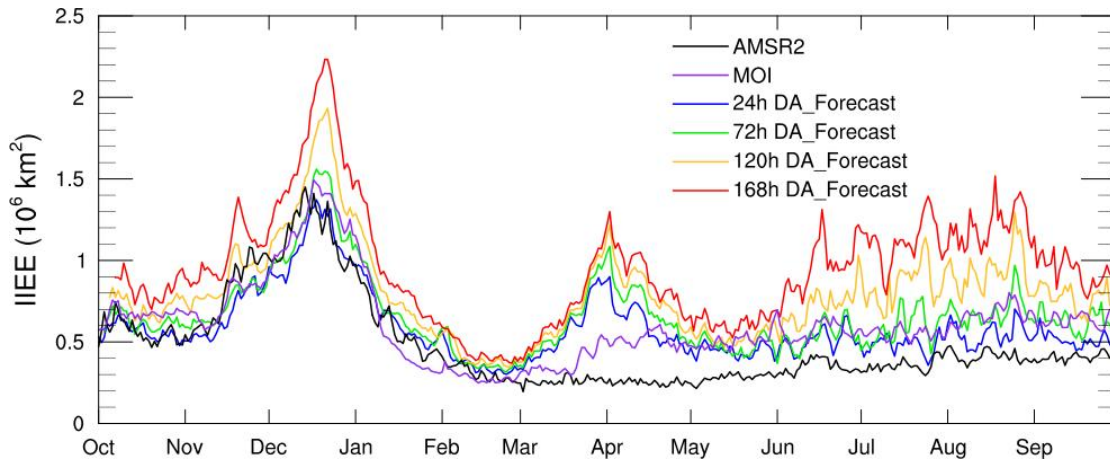
Figure S5. Time series of the IIEE of the assimilated AMSR2 data, the MOI product, and the forecasts of the DA_Forecast run at different lead time with respect to the OSISAF data. The blue, green, yellow, red, black, and purple lines denote the forecasts of the DA_Forecast run at lead time of 24-hour, 72-hour, 120-hour, 168-hour, the AMSR2 data, and the MOI product, respectively.
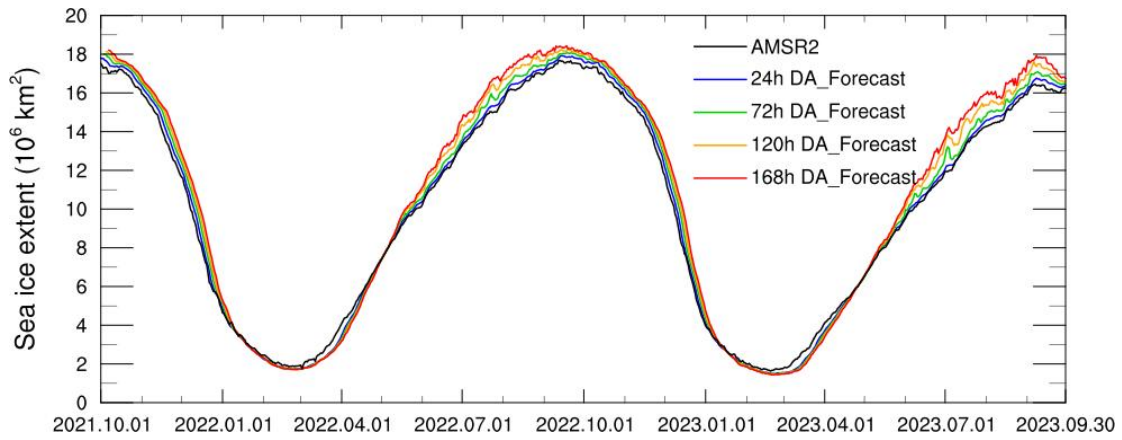
Figure S6. Sea ice extent evolution of the AMSR2 data (black line) and the DA_Forecast run at lead time of 24-hour (blue line), 72-hour (green line), 120-hour (yellow line), and 168-hour (red line).