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Improved sea-ice prediction in the Weddell Sea using sea-ice thickness initialization

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Skillful sea-ice prediction in the Antarctic Ocean remains a big challenge due to paucity of sea-ice observations and insufficient representation of sea-ice processes in climate models. This study demonstrates that the Antarctic sea-ice concentration (SIC) prediction is significantly improved using a coupled general circulation model (SINTEX-F2) in which the model's SIC and sea-ice thickness (SIT) are initialized with the ocean/sea-ice reanalysis product (C-GLORSv7). It is found that the wintertime SIT initialization adds positive values to the prediction skills of the summertime SIC, most effectively in the Weddell Sea where the SIT climatology and variability are the largest among the Antarctic Seas. Examination of the SIT balance during low sea-ice years of the Weddell Sea shows that negative SIT anomalies initialized in June retain the memory throughout austral winter (July-September) owing to horizontal advection of the SIT anomalies by sea-ice velocities. The negative SIT anomalies continue to develop in austral spring (October-December) owing to more incoming solar radiation via ice-albedo feedback and the associated warming of mixed layer. This results in further sea-ice decrease during austral summer (January-March). Concomitantly, the model reasonably reproduces atmospheric circulation anomalies in the Amundsen-Bellingshausen Seas as well as the Weddell Sea during the development of the negative sea-ice anomalies. These results provide solid evidence that the wintertime SIT initialization benefits skillful summertime sea-ice prediction in the Antarctic Seas.