

Supplement of

Seasonal Predictability of Antarctic Sea Ice based on a Deep-learning Approach

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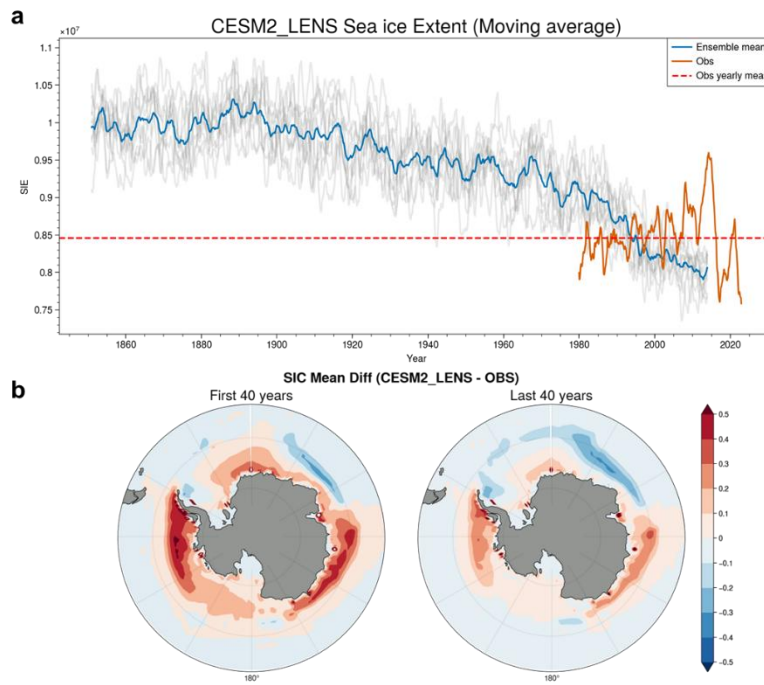


Figure S1: Comparison of Mean-State Differences in Antarctic Sea Ice Between CESM2-LENS2 and Observations. (a) Antarctic sea ice extent (SIE) time series from CESM2-LENS2 (blue line) and observations (orange line), with the observed climatological mean (red dashed line). (b) Mean SIE difference relative to observations (CESM2-LENS2 minus the observed mean): first 40-year mean (left) and last 40-year mean (right).

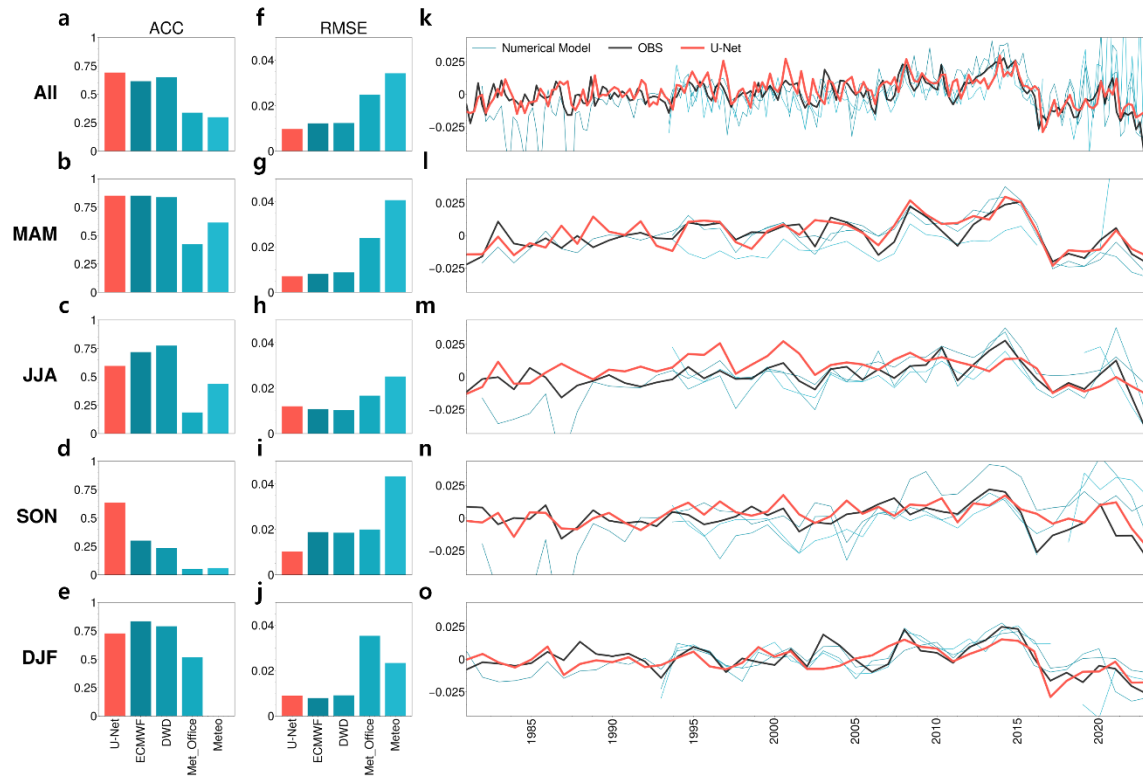


Figure S2: Performance of the pre-trained model (trained on CESM2 LENS data) on observational data. (a–e) present the ACC of U-Net (red bars) and numerical models (blue bars: ECMWF, DWD, Met Office, Météo-France) for all seasons, autumn, winter, spring, and summer, respectively. Panels (f–j) show the RMSE of U-Net (red bars) and the numerical models (blue bars) for the same seasonal divisions. Panels (k–o) show the time series of sea ice concentration (SIC) predicted by U-Net (red line), the numerical models (blue lines) and observations (black lines) for all seasons and for autumn, winter, spring, and summer, respectively.

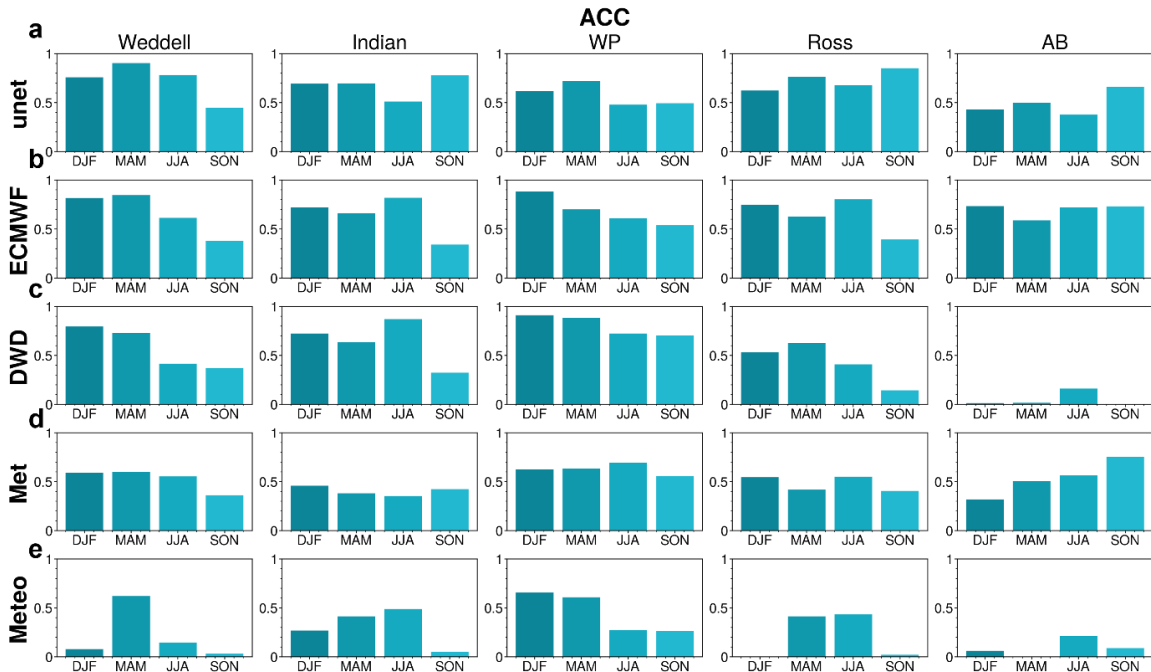


Figure S3: Seasonal and regional ACC performance comparison between the U-Net model and numerical models. (a) U-Net model performance in the Weddell, Indian, West Pacific (WP), Ross, and Amundsen-Bellingshausen (AB) regions, (b) ECMWF model performance, (c) DWD model performance, (d) Met Office model performance, (e) Meteo France model performance

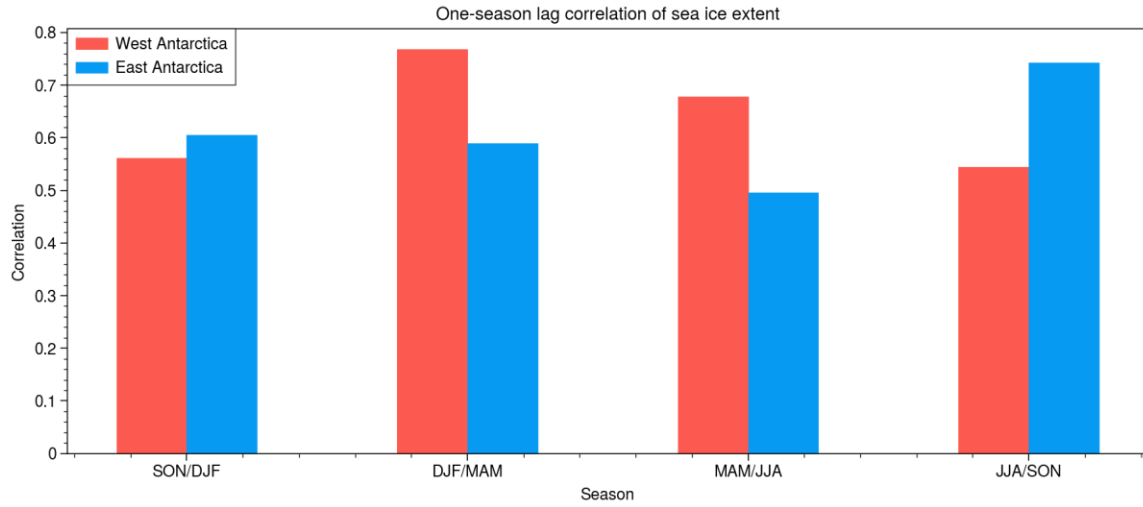


Figure S4: One-season lag autocorrelation of sea ice extent. The red bars represent the autocorrelation in West Antarctica, while the blue bars indicate the autocorrelation in East Antarctica, shown by season.

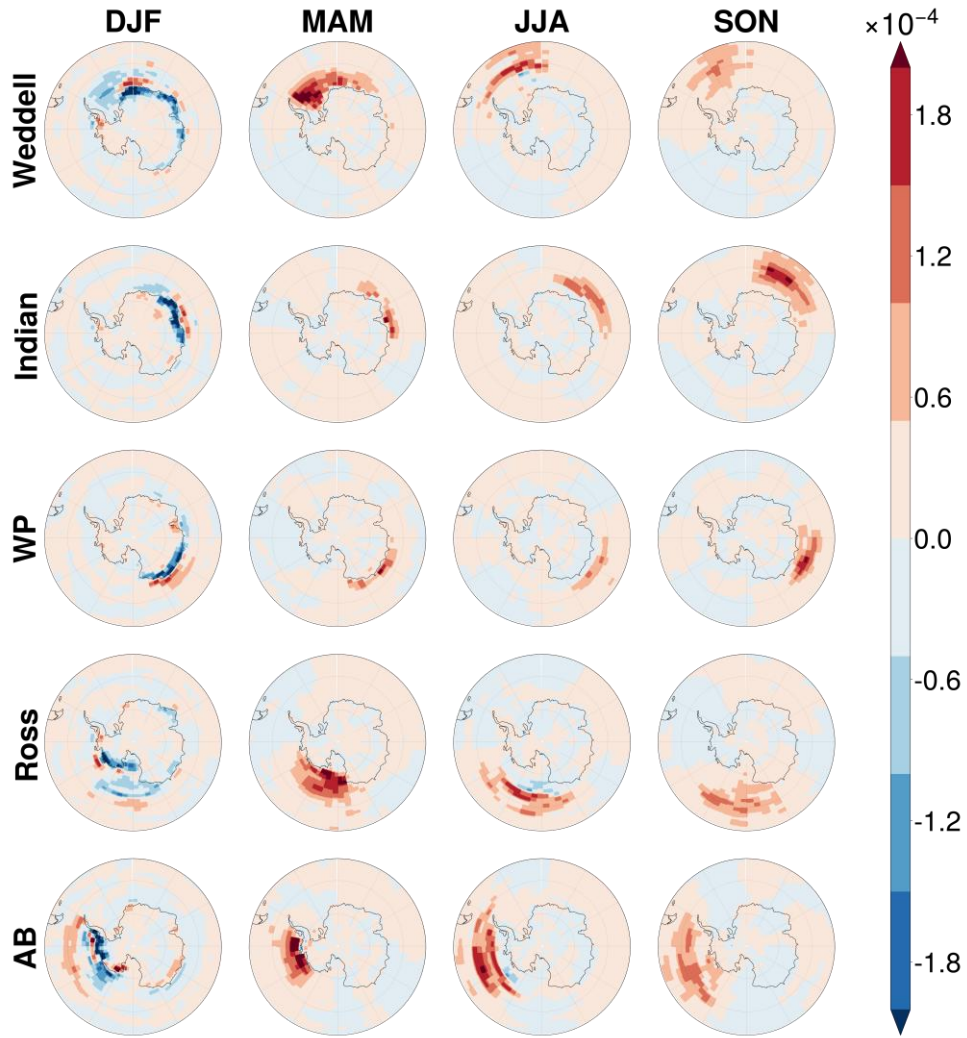


Figure S5: Seasonal Signed-contribution (SC) maps of meridional wind by region: (a) Weddell, (b) Indian, (c) Western Pacific (WP), (d) Ross, (e) Amundsen-Bellingshausen (AB).

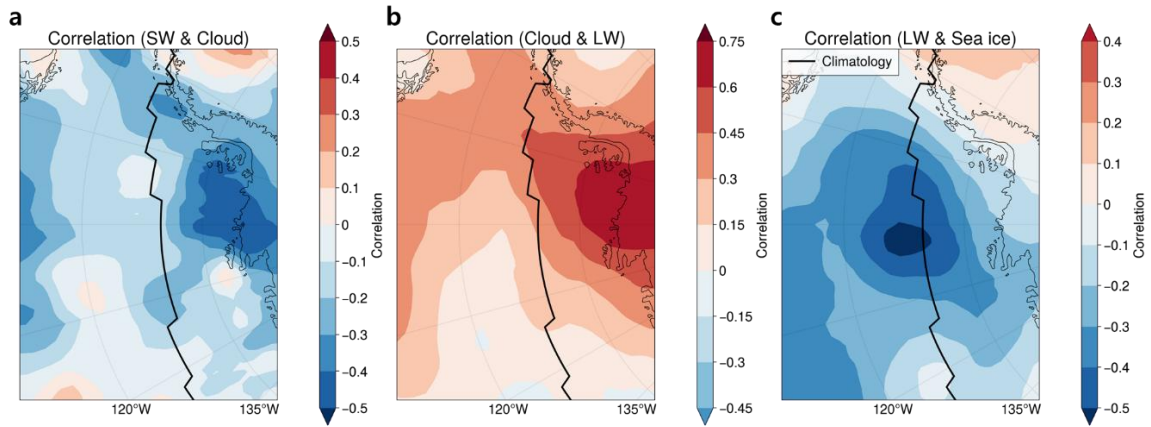


Figure S6: Correlation among downward shortwave radiation, cloud cover, downward longwave radiation, and sea ice. (a) The correlation between shortwave radiation and cloud cover in the same season. (b) The correlation between cloud cover and longwave radiation in the same season. (c) The correlation between longwave radiation in the previous season and sea ice concentration in the following season.

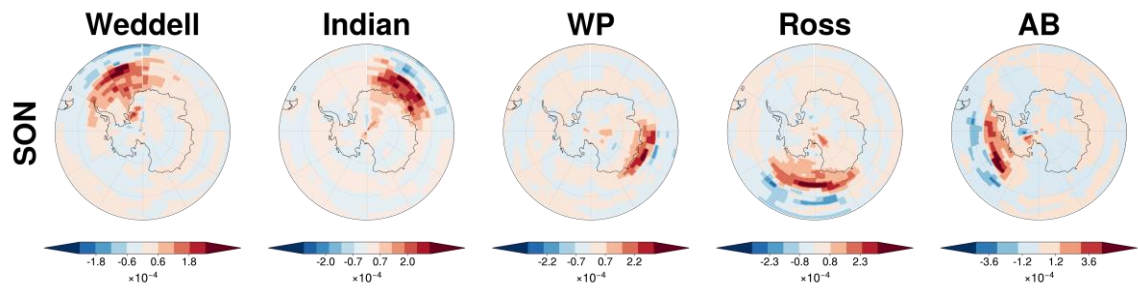


Figure S7: Signed-contribution (SC) maps of shortwave radiation in SON by region. a, Weddell, b, Indian, c, Western Pacific (WP), d, Ross, e, Amundsen-Bellingshausen (AB).