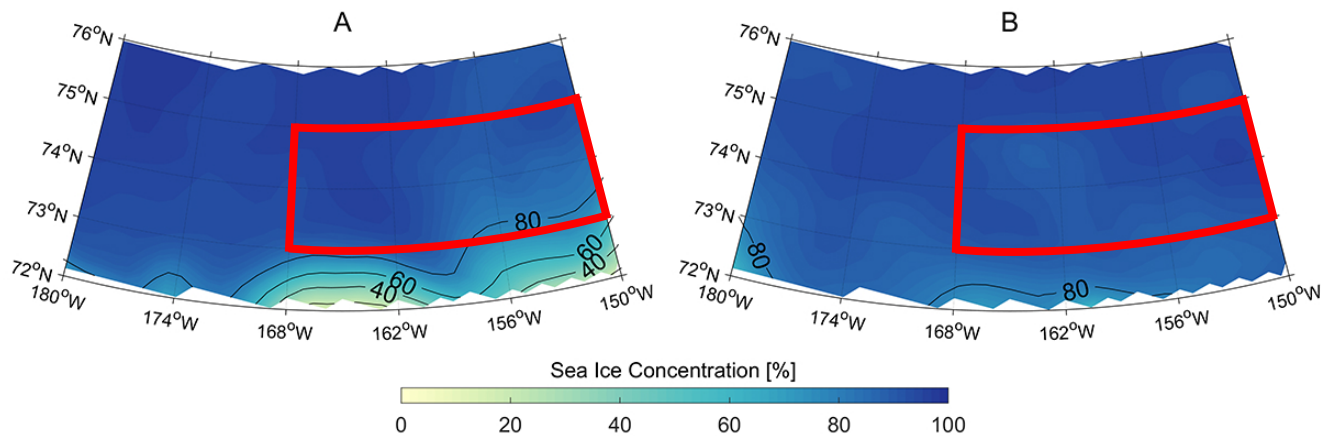
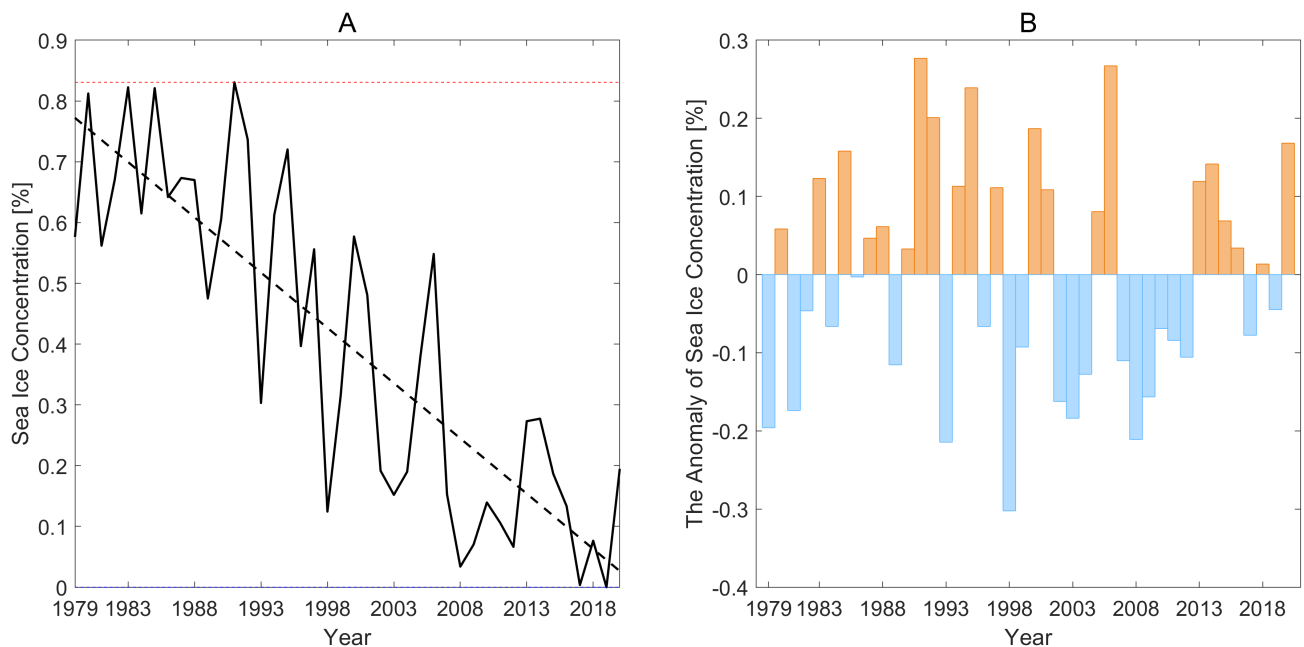


# Supplementary Material

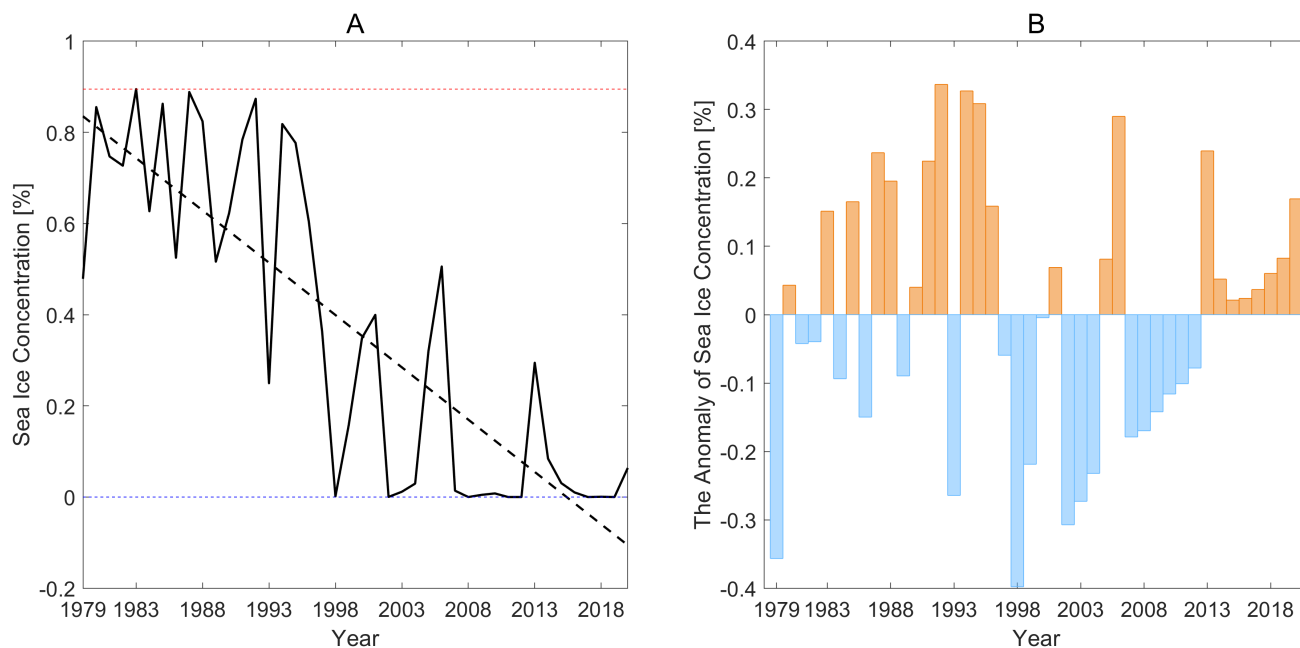
## 1 SUPPLEMENTARY FIGURES



**Figure S1.** SIC in June for 2019 (A) and 2020 (B). Red polygons encapsulate areas represents the study area of this paper.



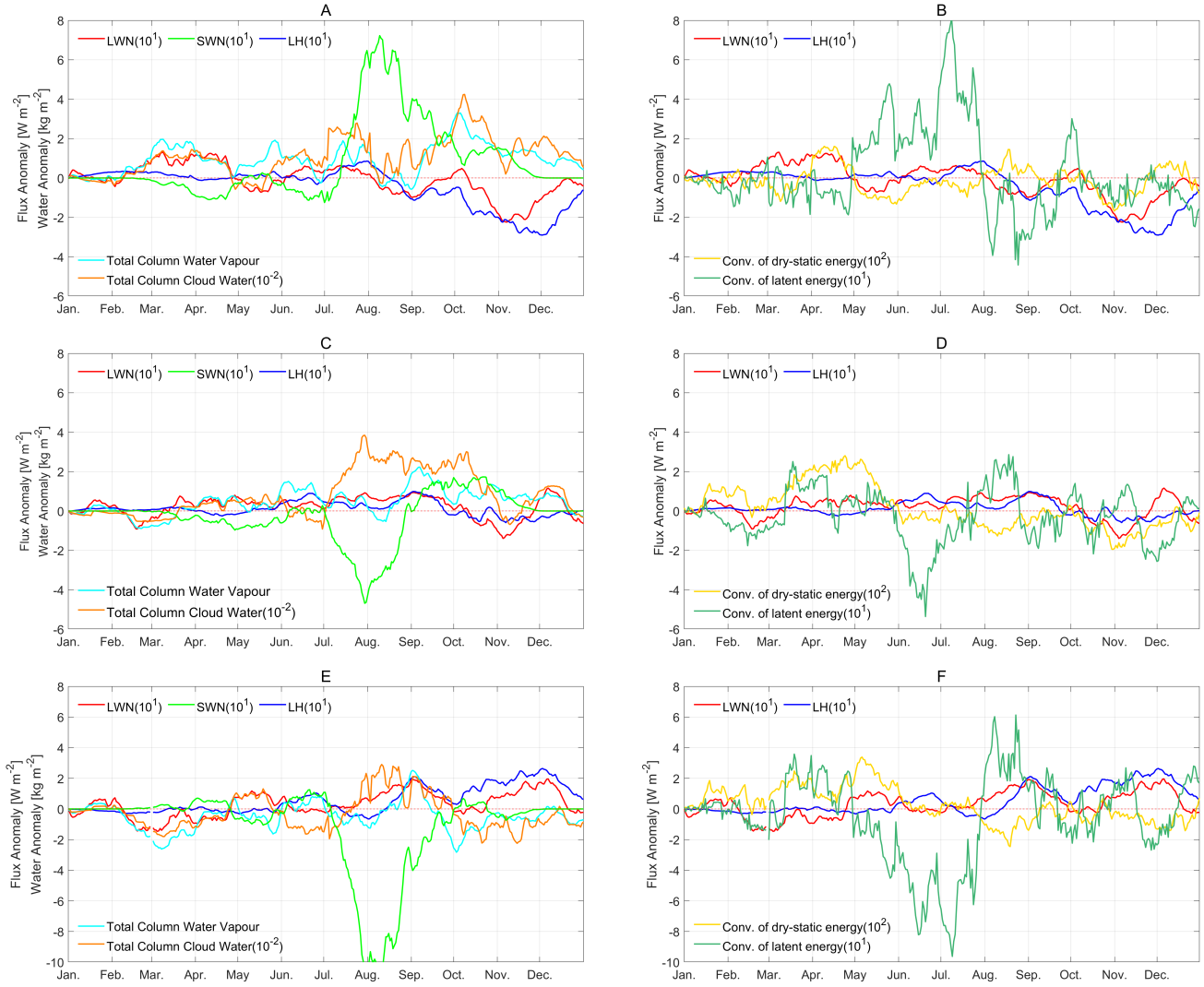
**Figure S2.** Arctic SIC (A) and the anomaly of SIC (B) for August, 1979–2020. The black dotted line is the linear trend line. The red dotted line indicates the maximum SIC over the past 40 years, while the blue dotted line indicates the minimum SIC during the same time period.



**Figure S3.** Arctic SIC (A) and the anomaly of SIC (B) for September, 1979–2020. The black dotted line is the linear trend line. The red dotted line indicates the maximum SIC over the past 40 years, while the blue dotted line indicates the minimum SIC during the same time period.

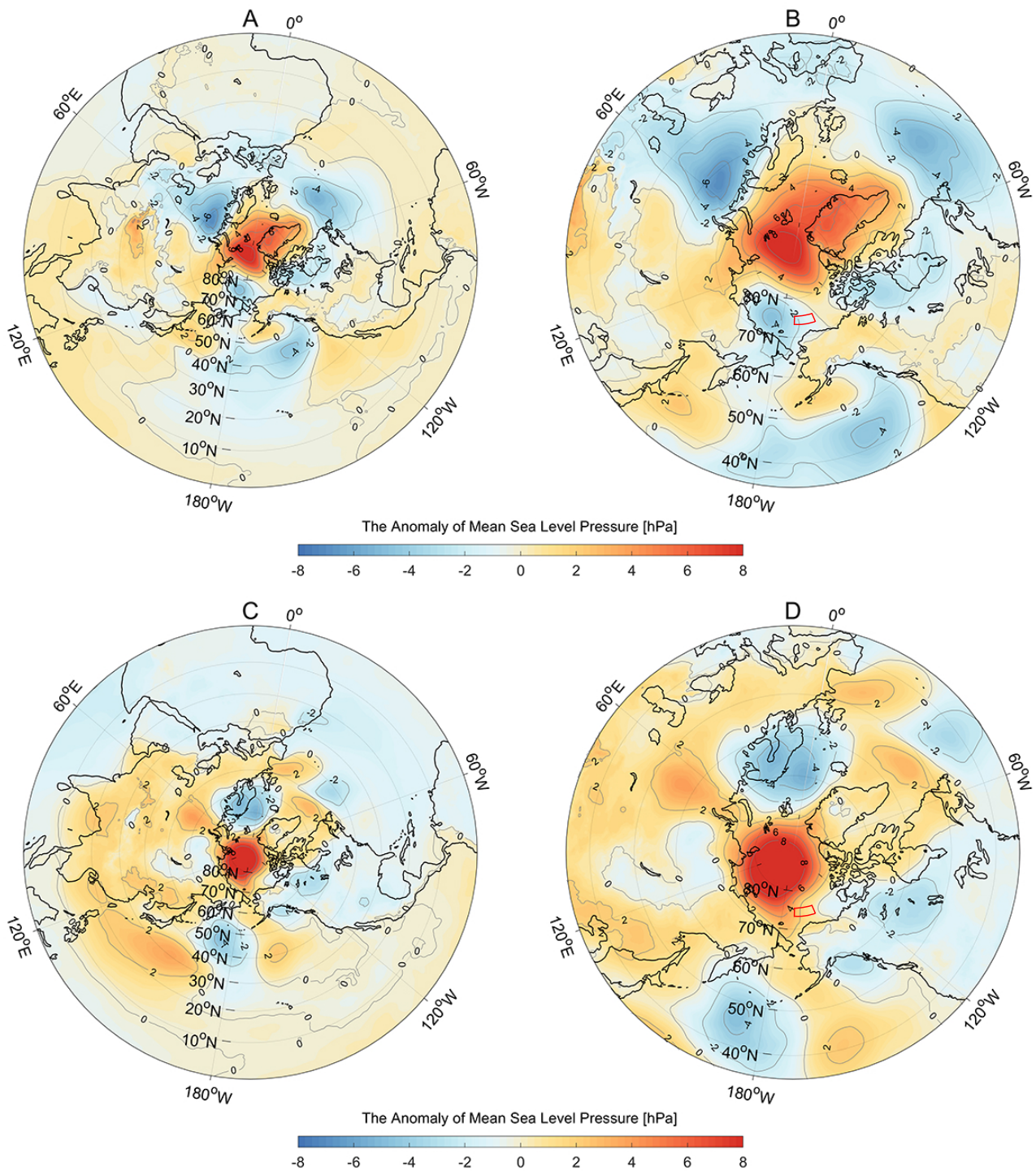


**Figure S4.** Radiative and turbulent flux anomalies at the surface for 2019 (top, A, B), 2020 (middle, C, D) and 2020 minus 2019 (bottom, E, F) using the method two. The black line shows the SIC (right-hand axis). A, C, E, the latent flux (LH; blue), the sensible flux (SH, pink), the net shortwave radiation (SWN; green) and the net longwave radiation (LWN; red). B, D, F, downwelling longwave (LWSD; red) and shortwave (SWSD; green) radiation. All time series are averaged over the area 73–75°N and 168–150°W.

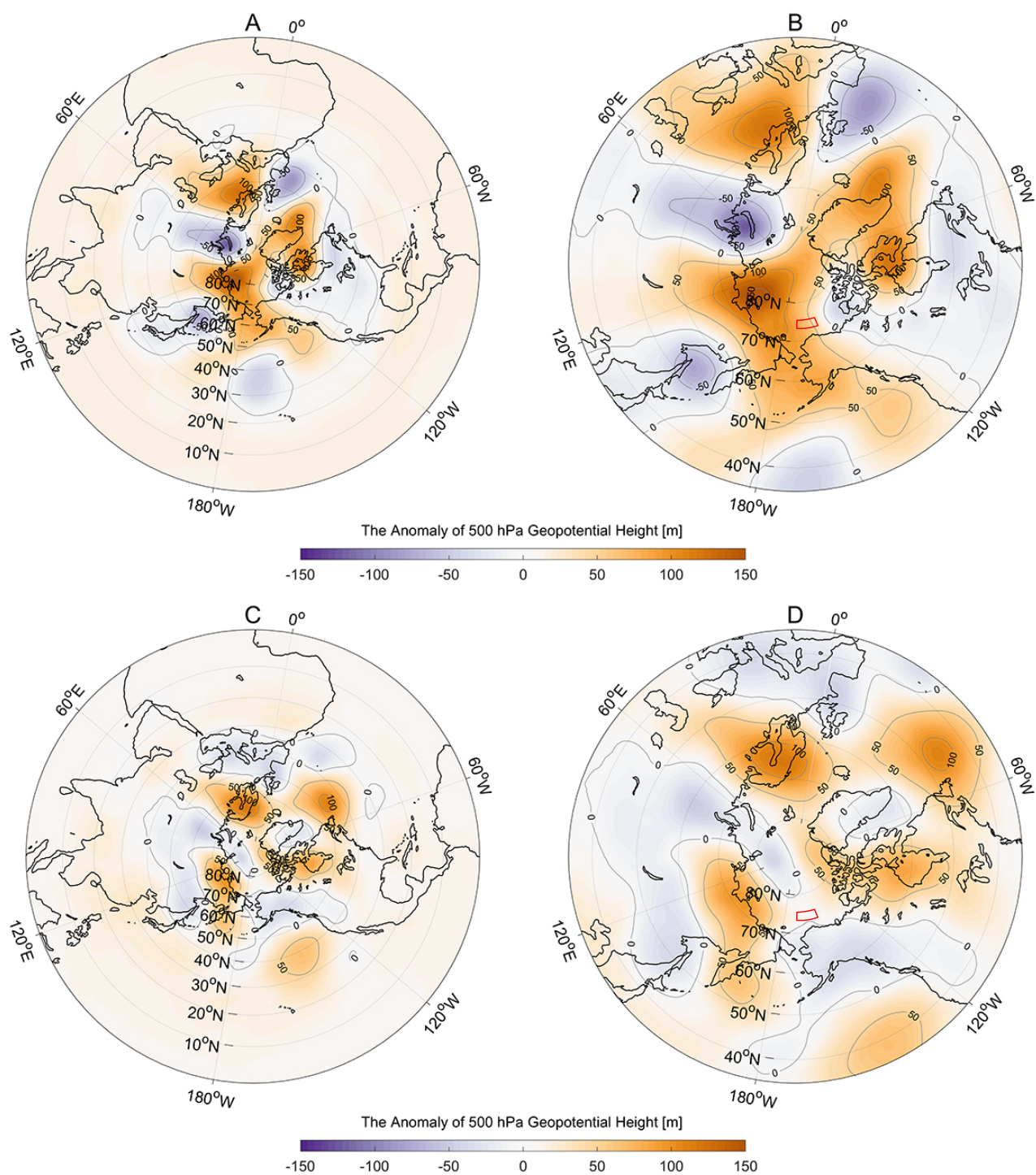


**Figure S5.** Atmospheric water content and energy convergence anomalies for 2019 (top, A, B), 2020 (middle, C, D) and 2020 minus 2019 (bottom, E, F) using the method two. The black line shows the SIC (right-hand axis). A, C, E, the net longwave radiation (red), the net shortwave radiation (green) and latent flux (blue) are shown together with the anomalies of total column cloud water (liquid plus solid; orange) and water vapor (celeste), B, D, F, as well as the convergence of dry-static (gold) and latent atmospheric energy transport (prasinous).





**Figure S6.** Mean sea level pressure in July for 2019 (A; B) and 2020 (C; D). The latitude range of A and C is 0–90°N, while the latitude range of B and D is 35–90°N. Red polygons encapsulate areas represents the study area of this paper.



**Figure S7.** 500hPa geopotential height field in June for 2019 (A; B) and 2020 (C; D). The latitude range of A and C is 0–90°N, while the latitude range of B and D is 35–90°N. Red polygons encapsulate areas represents the study area of this paper.