Defining Antarctic polynyas in satellite observations and climate model output to support ecological climate change research

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1 Supplemental materials

The figures in this supplement provide further details for readers who are interested in seeing results for months, seasons (e.g. Figures S1-2, S5-6) and/or regions (e.g. Figures S7) not shown in the main manuscript. Also shown here are figures showing the impacts of degrading the CESM-JRA sea ice output to more closely resemble data based on passive microwave images (Figures S3-4).

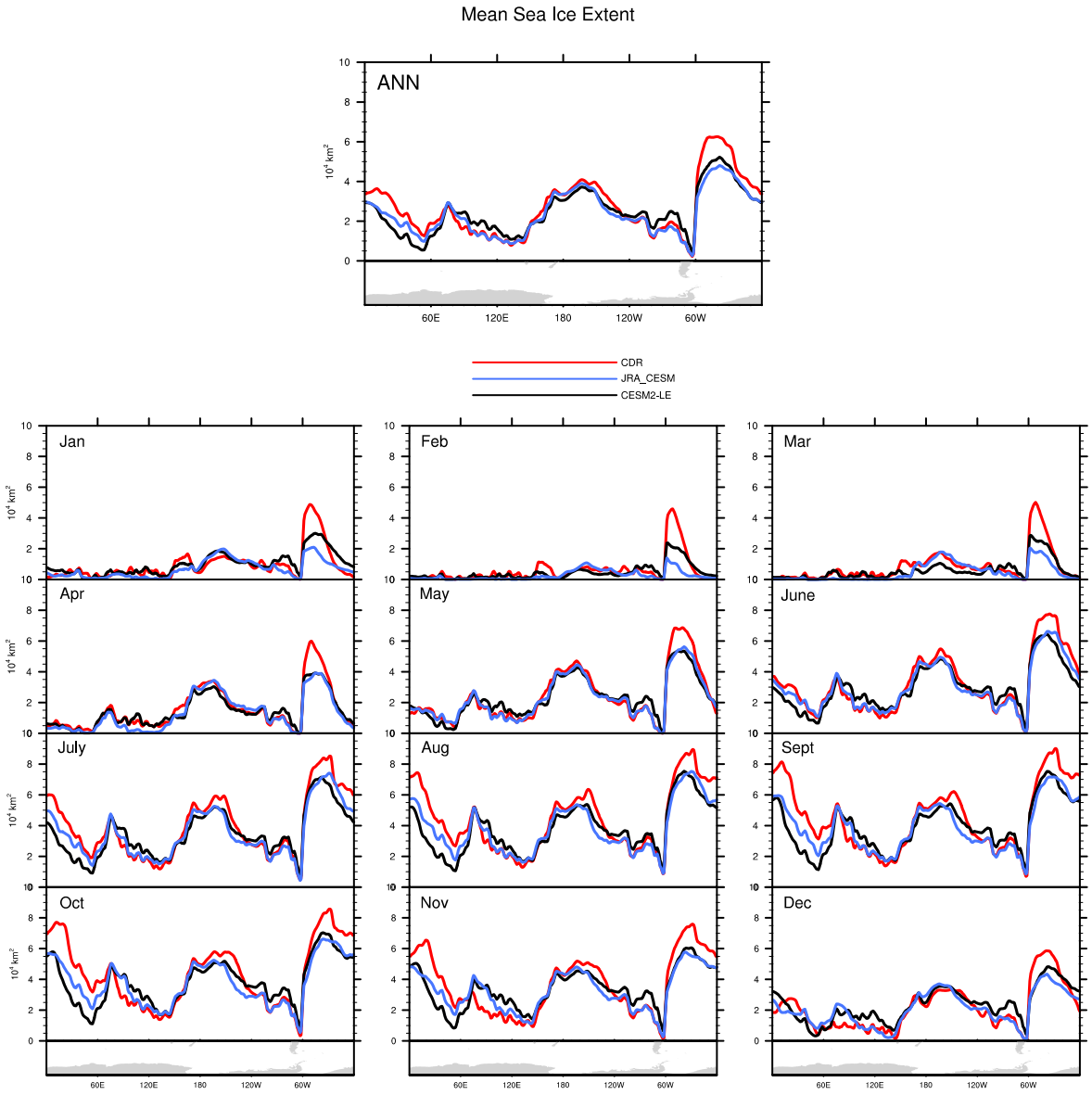

Figure S1. 1979-2020 Annual (top) and monthly (bottom panels) mean total sea ice extent as a function of longitude for the CDR (red), JRA-CESM (blue) and CESM2-LE data. Thick solid line indicates the mean (or ensemble mean for the CESM2-LE), shaded polygon indicates the mean ±1 standard deviation.

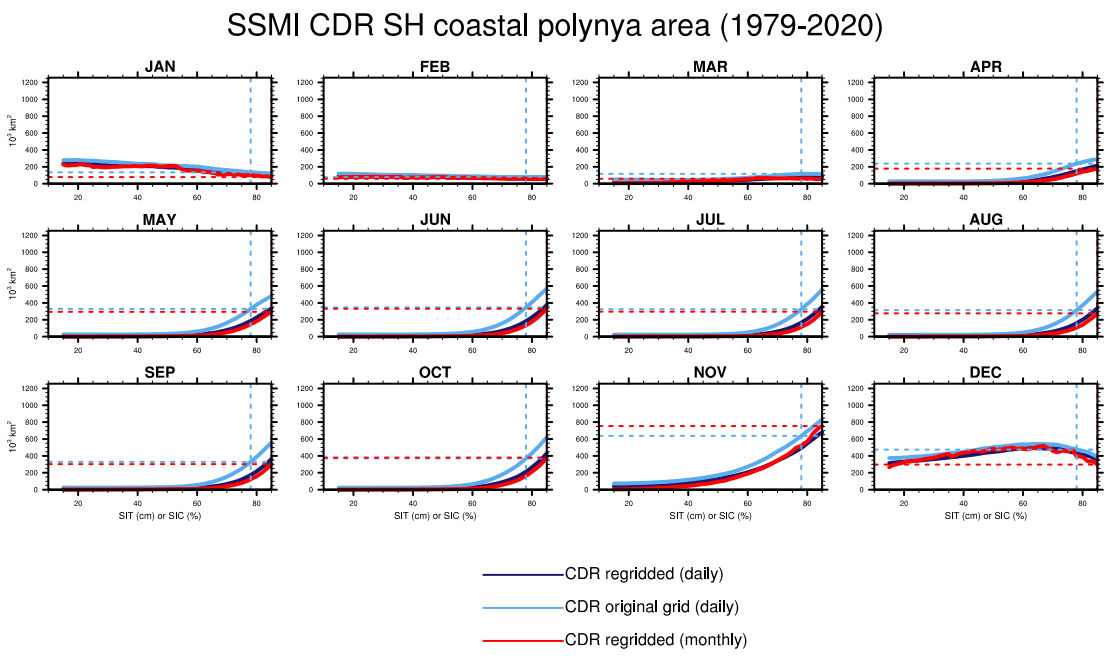

Figure S2. Total SH coastal polynya area as a function of SIC threshold for CDR daily data on the original EASE grid (light blue), regridded to the CESM grid (dark blue), and monthly averaged CDR on the CESM grid (red) for each month of the year. Climatological mean (1979-2020) values are shown in the thick lines; ±1 standard deviations shown by the lighter shading. The dashed lines indicate mean polynya areas at 78% SIC in the daily CDR original grid (light blue) and 85% SIC in monthly regridded monthly CDR (red).

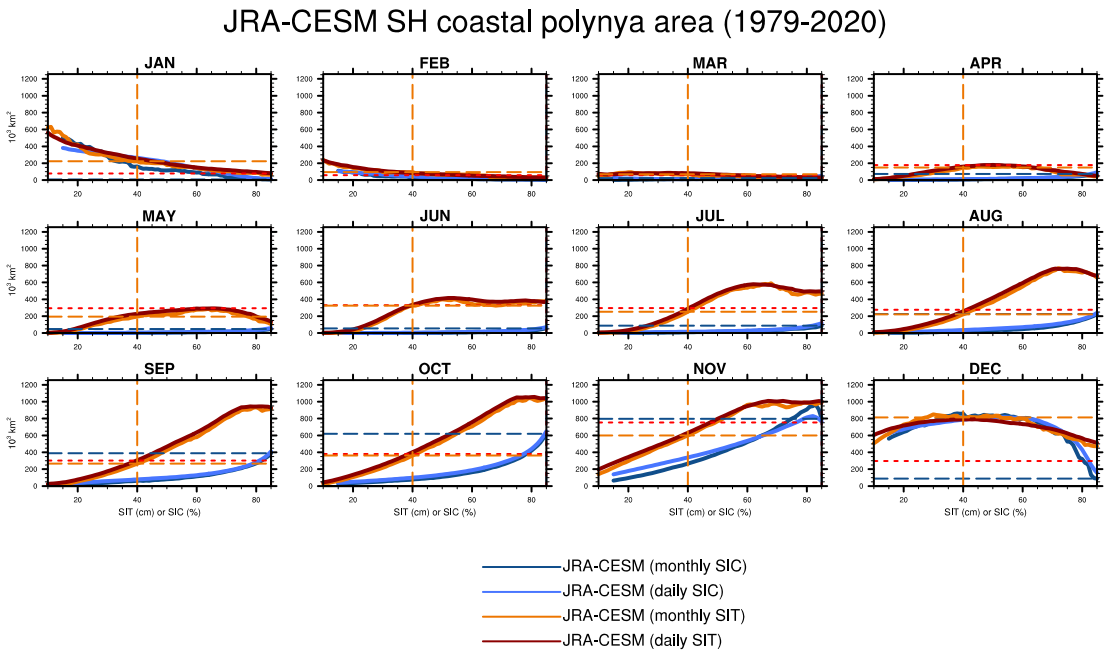

Figure S3. Total SH coastal polynya area as a function of SIC threshold for each month of the year for the JRA-CESM Colors correspond to monthly SIC (dark teal), daily SIC (blue), monthly SIT (orange) and daily SIT (brown). Climatological mean (1979-2020) values are shown in the thick lines; ±1 standard deviations shown by the lighter shading. The dashed lines indicate mean polynya areas at 85% SIC in monthly regridded CDR (red), and 85% SIC (dark teal), and 0.4m SIT (orange) in the monthly JRA-CESM. Vertical orange dashed lines indicate 0.4m threshold, for reference.

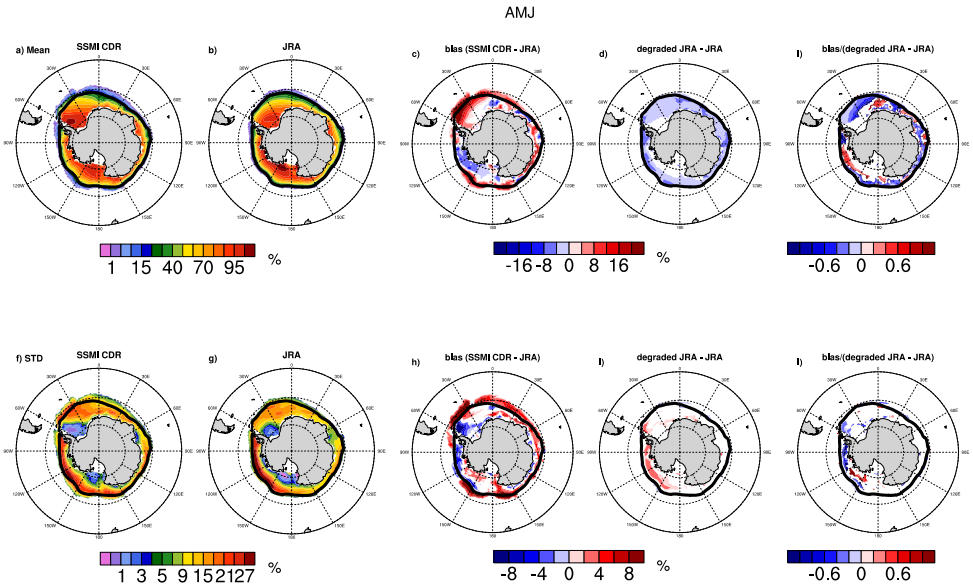

Figure S4. April-May-June (AMJ) climatological (1979-2020) SIC mean (top row) and standard deviation (bottom row) for SSMI-CDR (a, f), CESM JRA (b, g), satellite-model bias (CDR-JRA, c, h), degraded JRA SIC - JRA SIC (d, i), and the satellite-model bias divided by the degraded-JRA model output (e, j). The 15% SIC contour from the CESM-JRA is shown by the heavy black contour in each of the maps. Differences less than ±1% have been masked out for visual clarity.

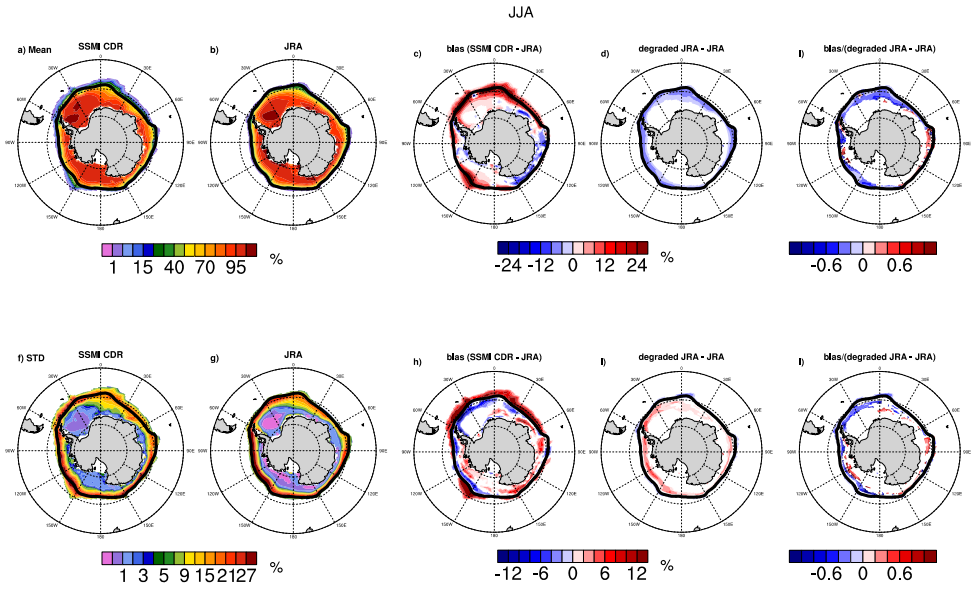

Figure S5. Same as Figure S4 except for June-July-August (JJA).

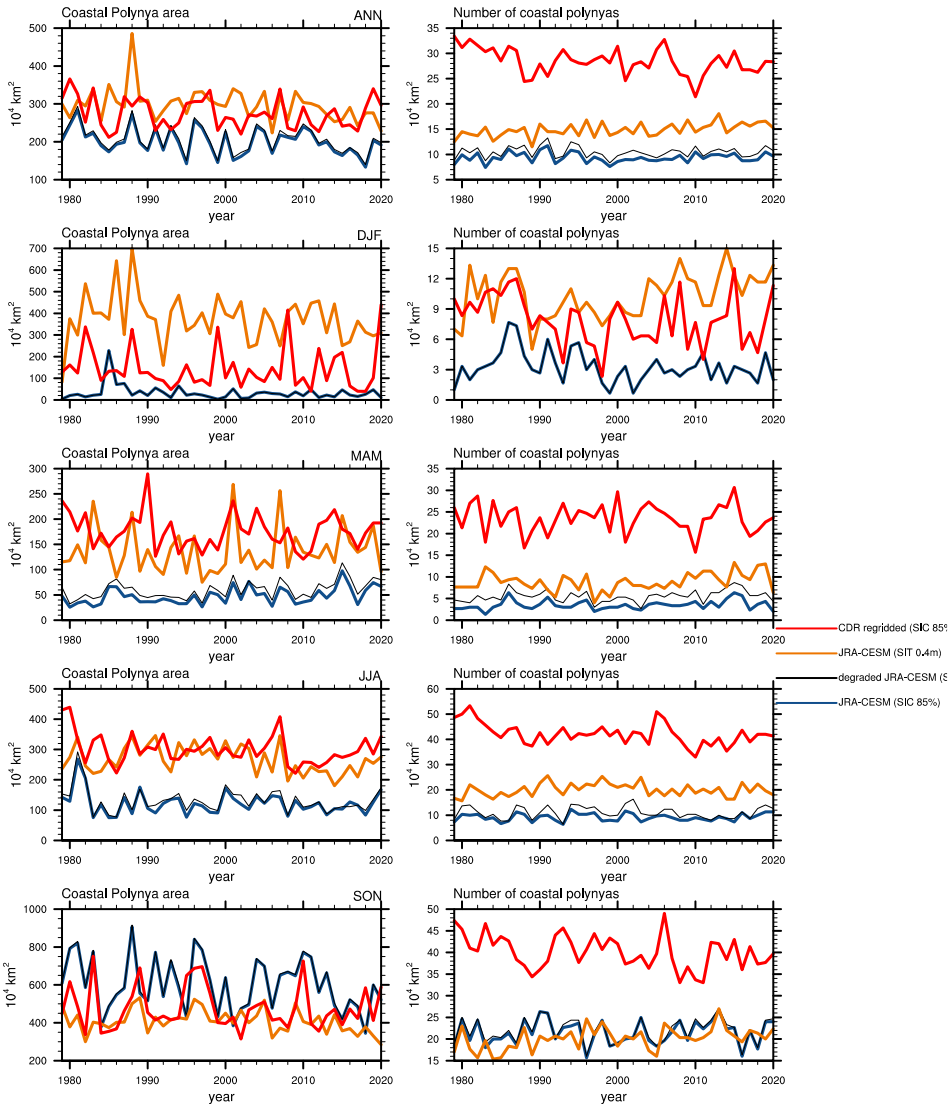

Figure S6. Southern Hemisphere (SH) mean coastal polynya area (left) and number of individual polynyas (right), 1979-2020 timeseries for a) Annual, b) summer (December-January-February), c) fall (March-April-May), d) winter (June-July-August) and e) spring (September-October-November; SON). Polynya timeseries are for the SSMI CDR data regridded onto the CESM grid (red; 85% SIC), the JRA-CESM model simulation using monthly SIC (85%; dark teal) and SIT (0.4m; orange), and the JRA-CESM model SIC degraded to more closely mimic satellite SICs (85%; black thin line).

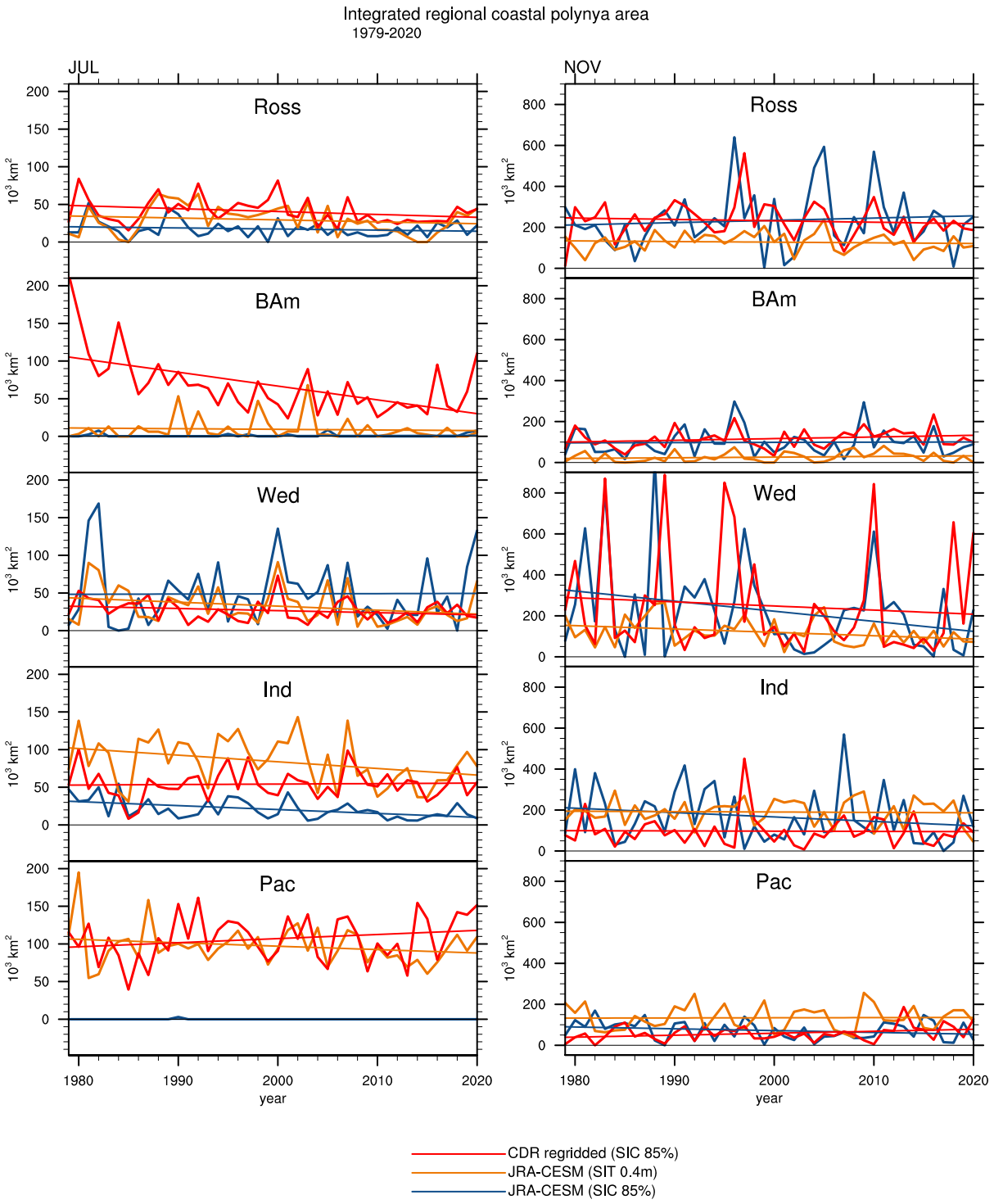

Figure S7. Regional mean coastal polynya area timeseries, 1979-2020 for July (left) and November (right) for the Ross Sea, Bellingshausen-Amundsen Sea, Weddell Sea, Indian sector and Pacific sector. Timeseries shown (thick lines) are for the SSMI CDR data regridded onto the CESM grid (red; 85% SIC), the JRA-CESM model simulation using monthly SIC (85%; dark teal) and SIT (0.4m; orange). Thin linear lines indicate the long-term Theil-Sen non-parametric linear trends.