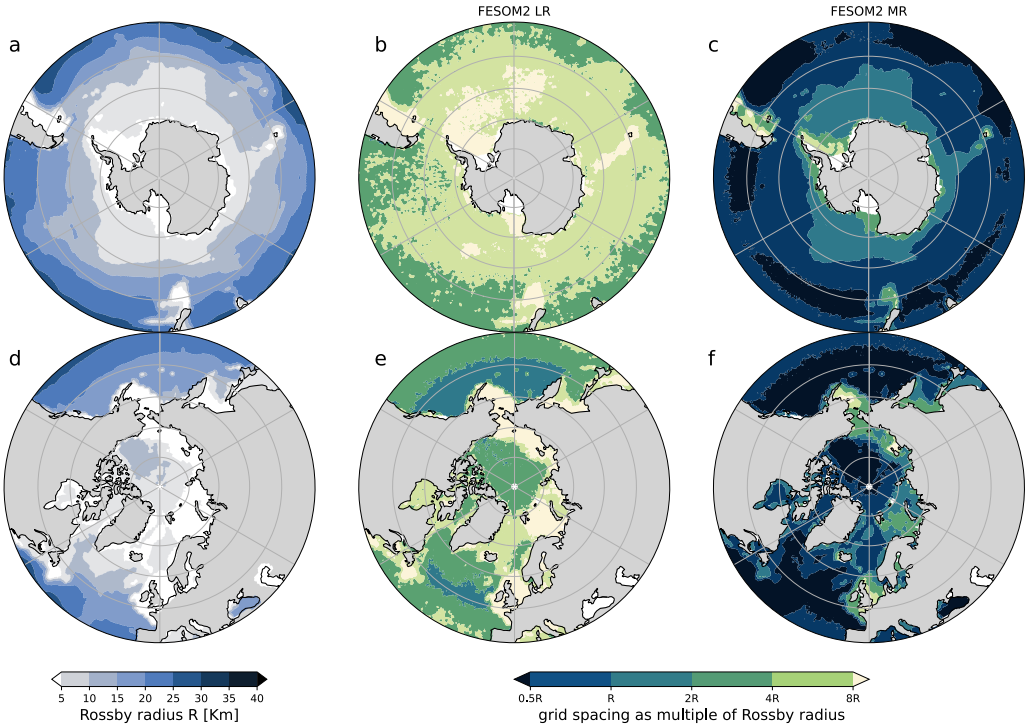

Figure 1. Local Rossby radius of deformation (a,d) estimated as $R = (\pi f)^{-1} \int_{-H}^{0} N(z)dz$ where f is the Coriolis parameter, H is the ocean floor, and N is the Brunt-Väisälä frequency (as in Sein et al., 2016). Ocean horizontal grid spacing as a multiple of the local Rossby radius for the (b,e) low and (c,f) high resolution meshes (CORE2 and DART respectively). Blue (dark blue) colour marks the eddy-permitting (eddy-resolving) areas.

Table 1. AWI-CM3 computational performance in the two different configurations. Atmospheric grids and ocean meshes are listed together with their respective horizontal resolution ranges (in parentheses). The total number of cores used, the number of simulated years per day (SYPD) and the core hours per simulated year (CHSY) are reported for both configurations.

	Atmospheric grid	Ocean mesh	IO scheme	Cores	SYPD	CHSY
LR	TCo95L91 (102–120km)	CORE2L47 (20–100km)	XIOS parallel	1664	73.80	541
MR	TCo319L137 (32–38km)	DARTL80 (4.5–25km)	XIOS parallel	8576	3.89	52 911

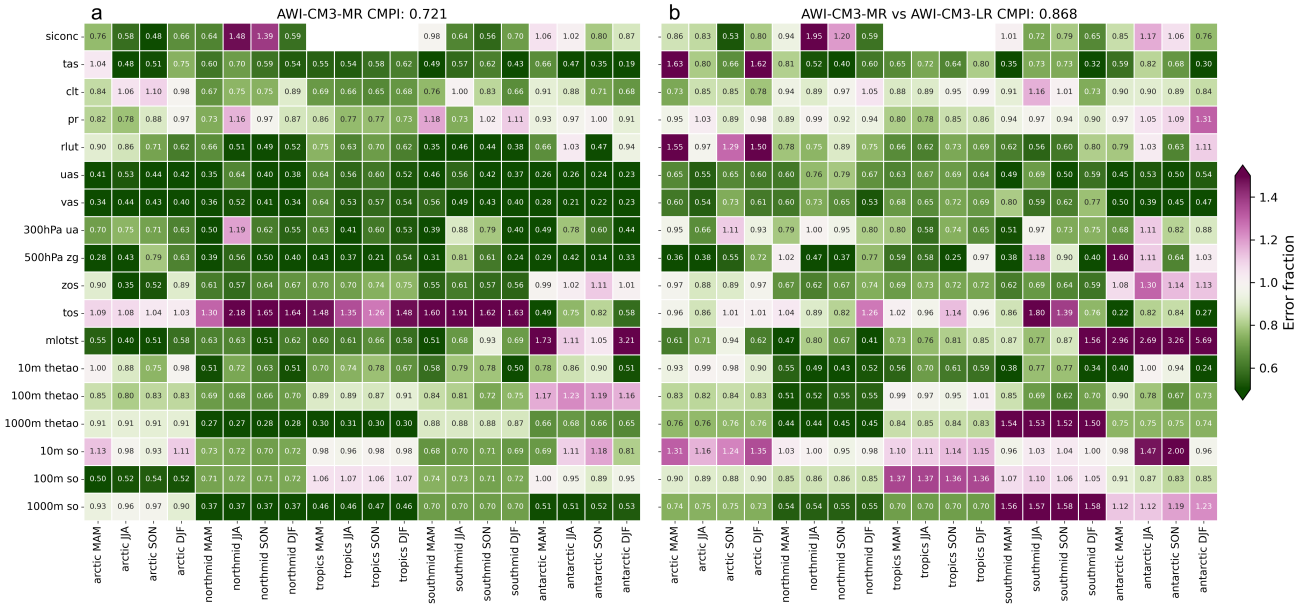

Figure 2. (a) Performance indices showing the absolute error of the AWI-CM3-MR historic climatology (1989–2014) expressed as a fraction of the CMIP6 multi-model mean absolute error (30 models; (Streffing, 2022; Reichler and Kim, 2008)). Values below (above) 1 indicate smaller (larger) biases compared to the CMIP6 average. Panel (a) compares AWI-CM3-MR against CMIP6, while Figure A2 presents the same comparison for AWI-CM3-LR. (b) Performance indices comparing AWI-CM3-MR with AWI-CM3-LR, using the LR as reference. Here, values below (above) 1 indicate a reduction (increase) of error in MR relative to LR. The Arctic and Antarctic regions are defined as latitudes north of 60°N and south of 60°S, respectively; the mid-latitudes span 30–60° in both hemispheres; and the tropics cover 30°S–30°N. The list of all variables with full names is reported in Table A1

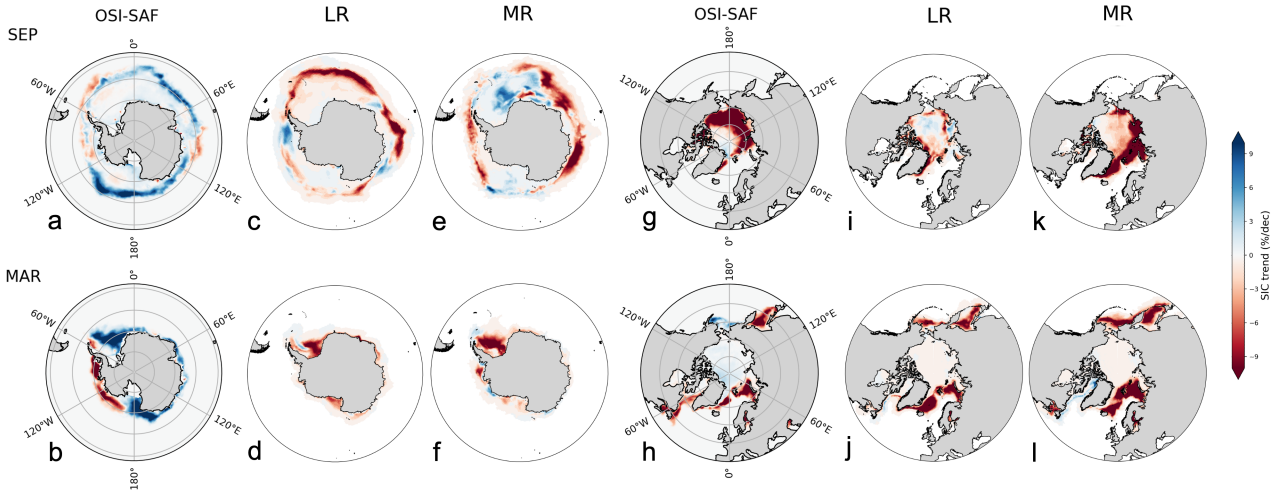

Figure 6. Trends in March and September sea ice concentration from 1979 to 2014 are shown for both hemispheres, based on OSI-SAF observations (a,b,g,h) and simulations from the low-resolution (LR, c,d,i,j) and medium-resolution (MR, e,f,k,l) model configurations. Although the two observational datasets display some differences in the time series shown in Figure 3b–e, their spatial patterns of sea ice trends are largely consistent. The decision to present only OSI-SAF data here is motivated by its treatment of the central Arctic, where the typical data gap has been filled through interpolation.

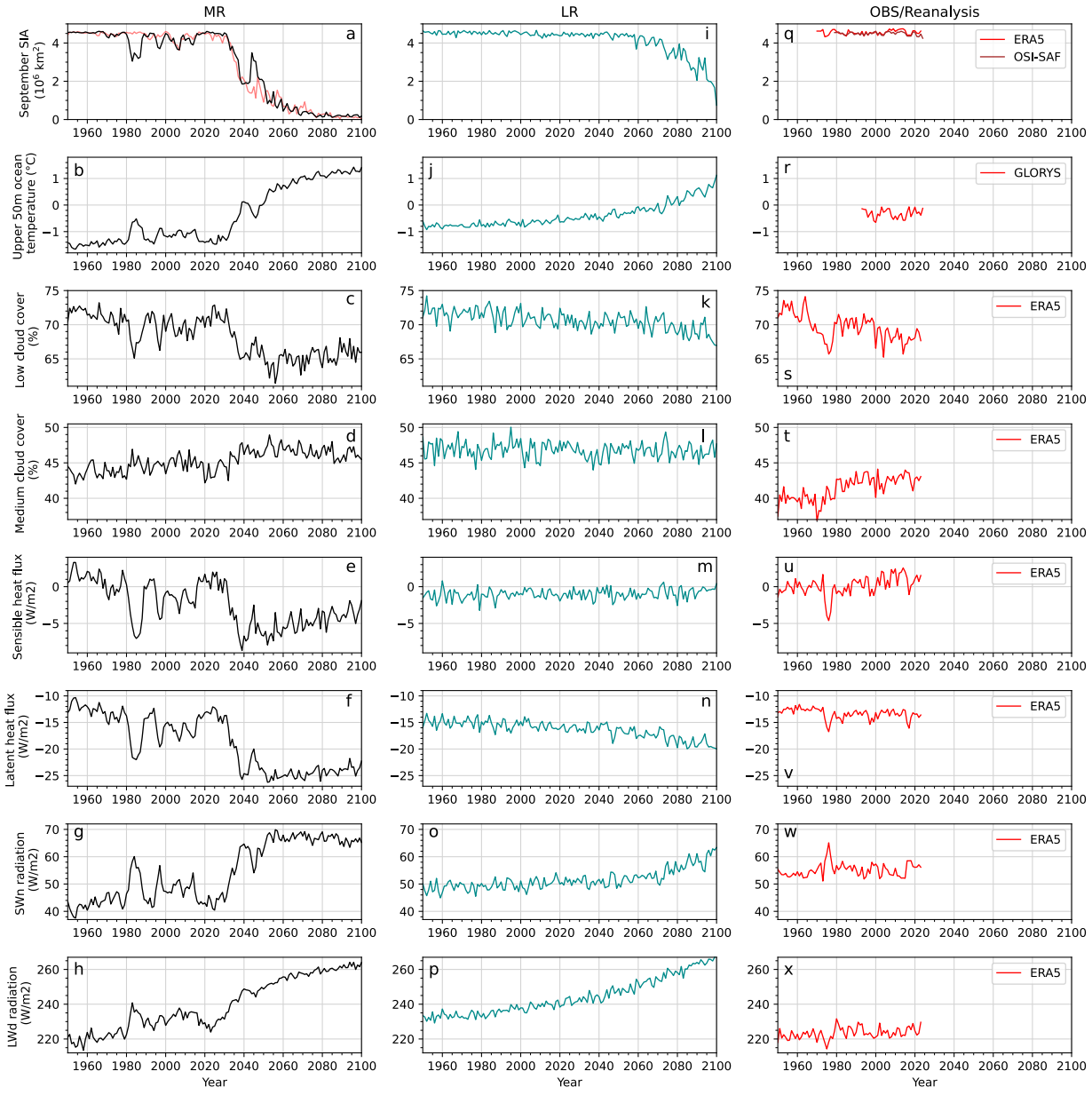

Figure 11. Time series of key variables involved in atmosphere–ocean interaction feedbacks. Panels (q–x) show September mean sea ice area and annual mean of upper 50 m ocean temperature, low- and mid-level cloud cover, surface sensible and latent heat fluxes, surface net shortwave radiation (SWn) and surface downward longwave radiation (LWd) over the Weddell Sea region (50°W–30°E, 60°S–75°S), based on observations (GLORYS, NSIDC) and reanalysis data (ERA5). Panels (a–p) show the same variables from the AWI-CM3 simulations at medium (TCO319-DART) and low (TCO95-CORE2) resolution. In panel (a) the light red line shows the sea ice area from the AWI-CM3 TCO319-DART simulation shown in Kim et al. (2026).

Appendix A: Supplementary Figures

CMIP standard name	Extended variable name (unit)
siconc	Sea ice concentration (%)
tas	Near-surface air temperature (K)
clt	Total cloud cover (%)
pr	Precipitation flux (kg m^{-2} s^{-1})
rlut	Upward longwave radiation at top of atmosphere (W m^{-2})
uas	Eastward near-surface wind (m s^{-1})
vas	Northward near-surface wind (m s^{-1})
300hPa ua	Zonal wind at 300 hPa (m s^{-1})
500hPa zg	Geopotential height at 500 hPa (m)
zos	Sea surface height above geoid (m)
tos	Sea surface temperature (°C)
mlotst	Ocean mixed layer thickness (m)
10m thetao	Ocean potential temperature at 10 m depth (°C)
100m thetao	Ocean potential temperature at 100 m depth (°C)
1000m thetao	Ocean potential temperature at 1000 m depth (°C)
10m so	Ocean salinity at 10 m depth (1e-3)
100m so	Ocean salinity at 100 m depth (1e-3)
1000m so	Ocean salinity at 1000 m depth (1e-3)

Table A1. List of CMIP variables used in Figure 2 and Figure **??** given together with their corresponding standard names and units.