

Supplementary materials

Century-long kilometre-scale Ocean eddy-rich global climate simulation with the coupled IFS CY48R1 - FESOM 2.5 model

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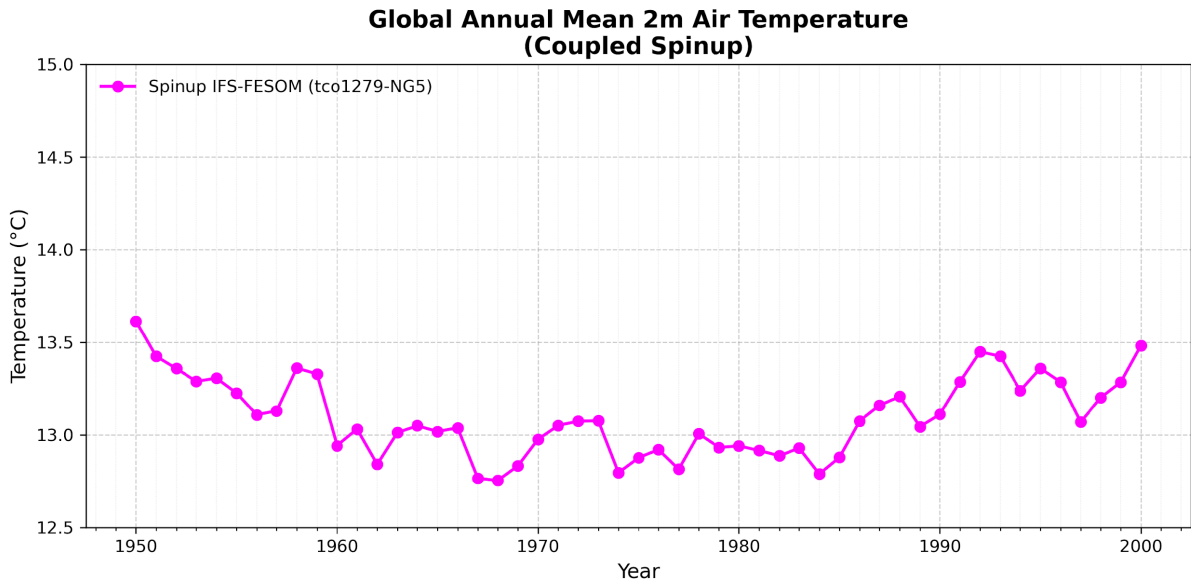
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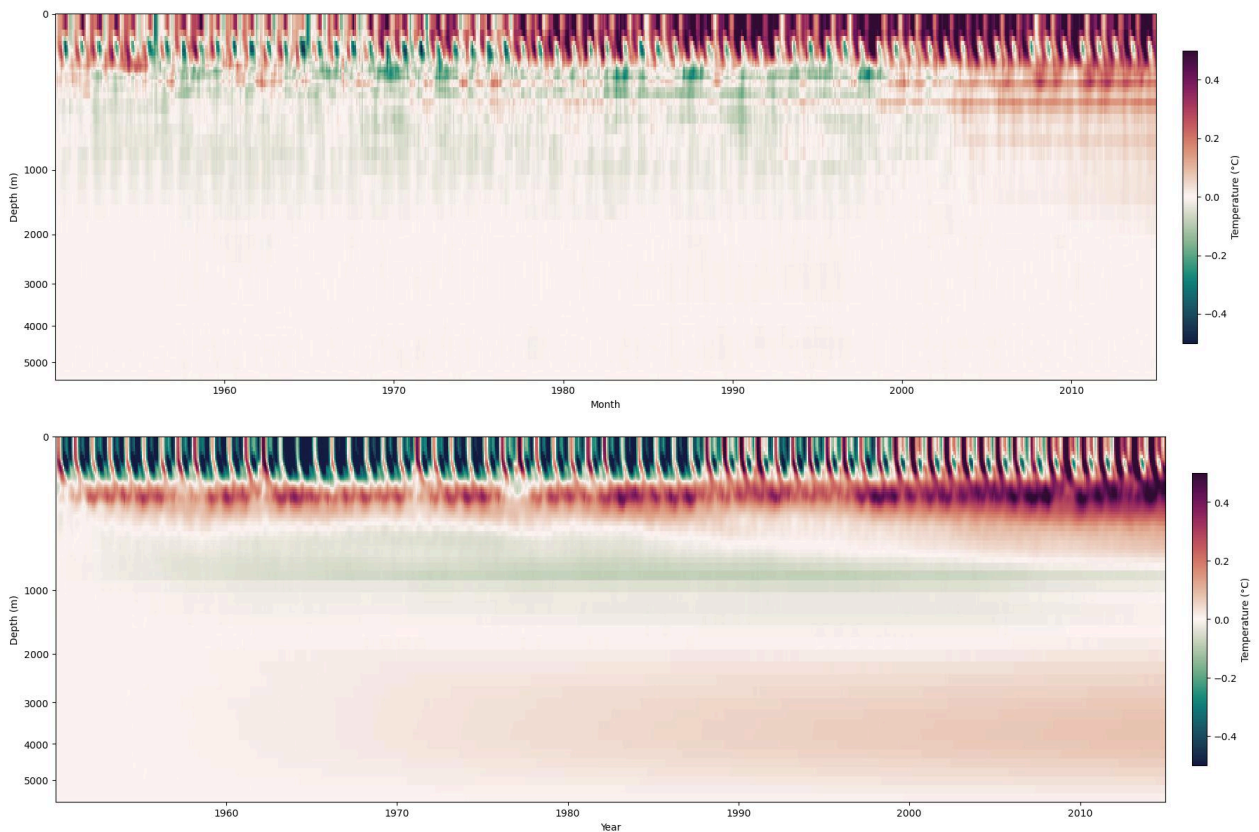
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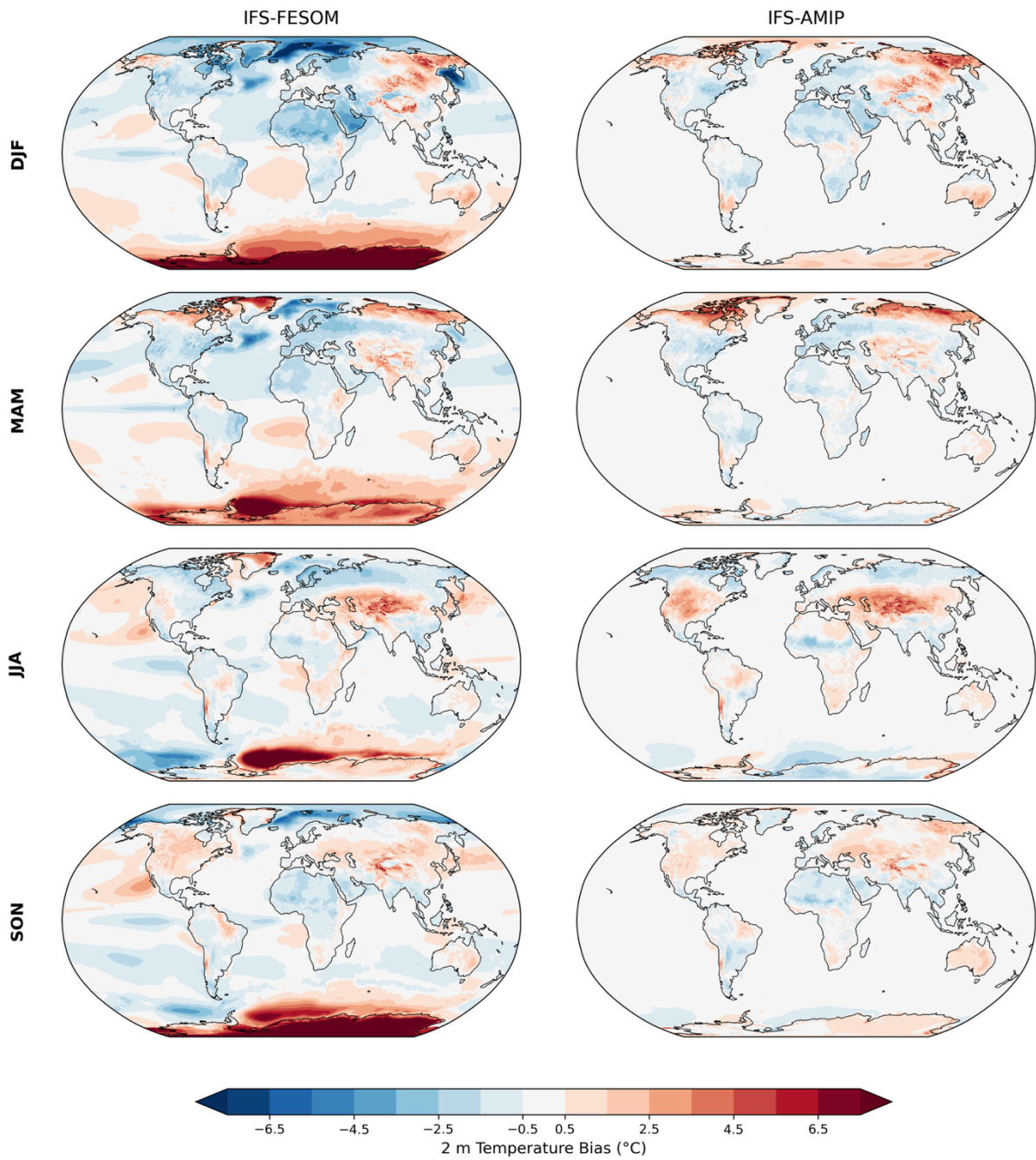


Supplementary Figure 1: *Global annual mean 2 m air temperature over 51 years of coupled spin-up simulation using IFS-FESOM at 9 km atmospheric (tco1279) and 5 km ocean (NG5) resolution under 1950 CMIP6 radiative forcing.*

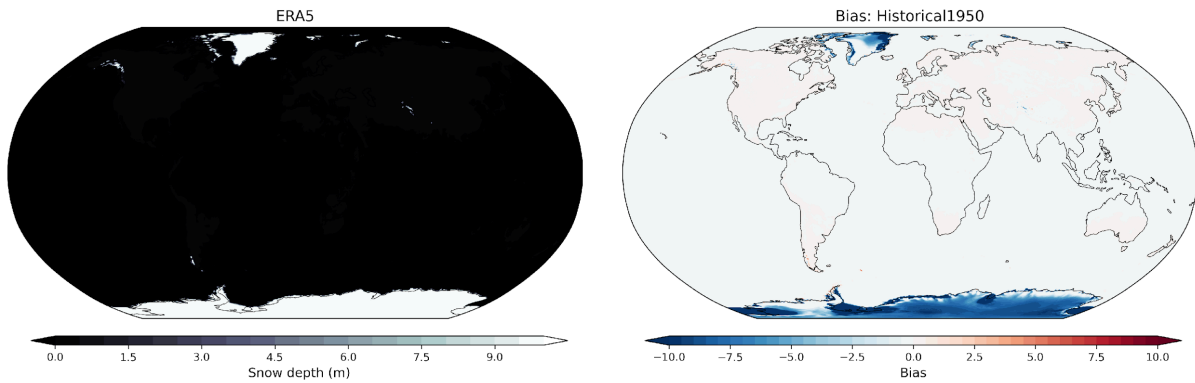


Supplementary Figure 2 : *Depth–time evolution of ocean temperature in EN4 (Upper panel) and in the IFS–FESOM historical simulation (Lower panel). Anomalies are computed as the differences between the global monthly mean temperature at each depth and their respective values in simulation year 1.*

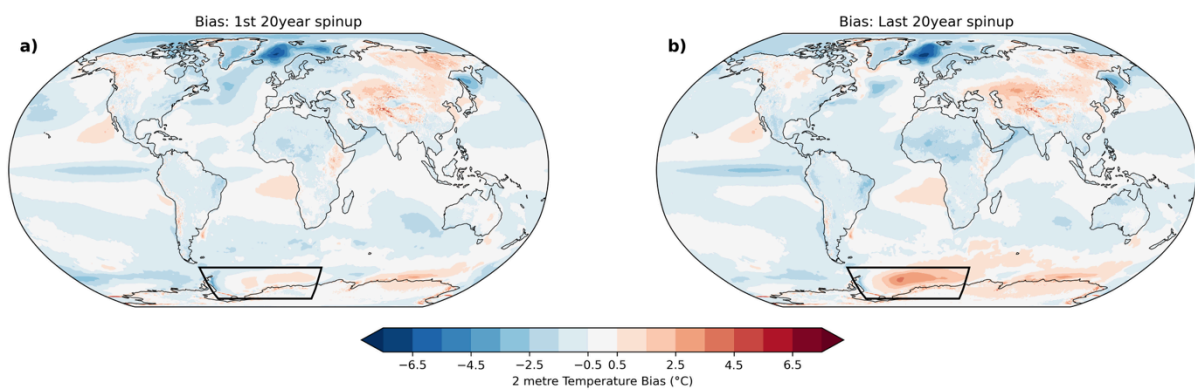
Seasonal Climatological Bias (1985–2014)



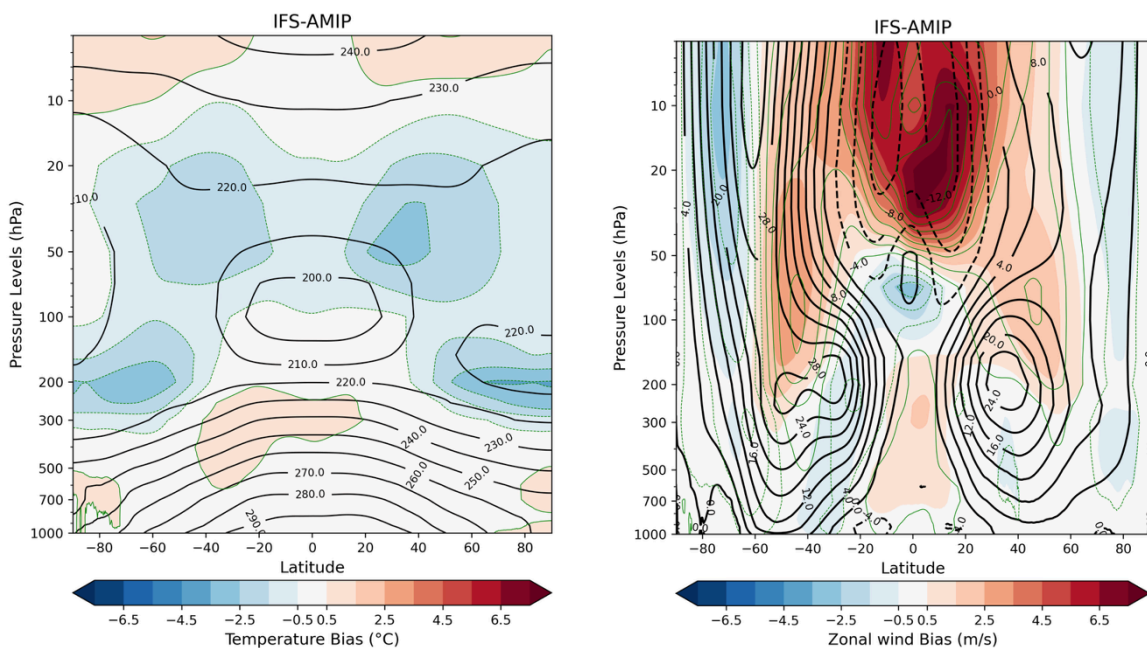
Supplementary Figure 3: Seasonal mean climatological bias in 2 m air temperature for 1985–2014 in the IFS-FESOM historical simulation (left) and IFS-AMIP simulation (right), in °C.



Supplementary Figure 4: Annual mean snow depth climatology from ERA5 (left) and corresponding bias in the IFS-FESOM historical simulation (right), in meters.

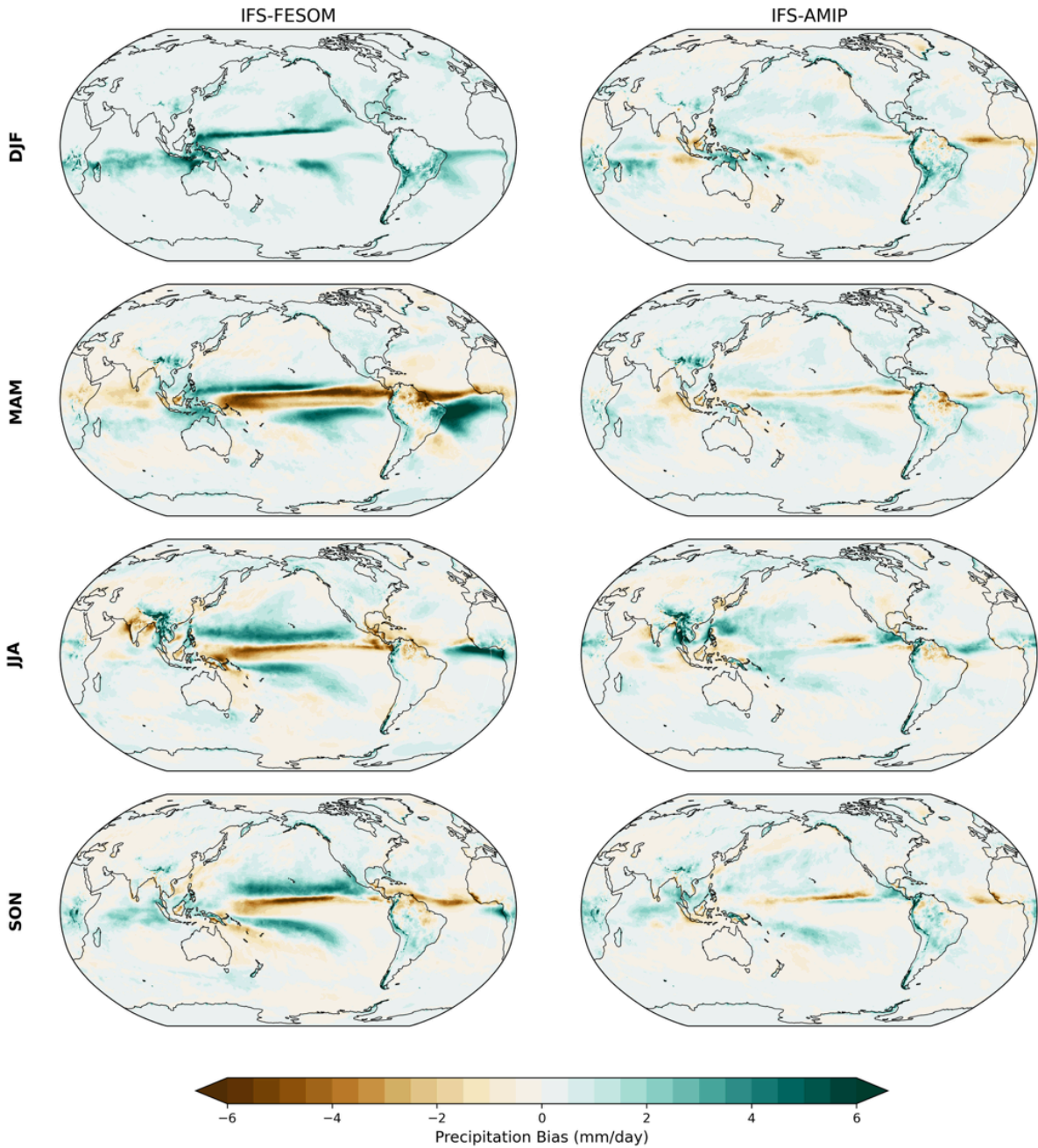


Supplementary figure 5: Bias in annual mean 2 m air temperature climatology relative to ERA5 for the first and last 20 years of the coupled spin-up. The ERA5 reference period is 1950–1969. Values are in $^{\circ}\text{C}$.



Supplementary Figure 6: Zonal mean climatology of annual mean (a) temperature ($^{\circ}\text{C}$) and (b) zonal wind (m s^{-1}) for 1985–2014 in ERA5 (black contours), with corresponding biases in the IFS-AMIP simulation (shading).

Seasonal Precipitation Bias (1985–2014)



Supplementary Figure 7: Seasonal mean climatological bias in total precipitation for 1985–2014 in the IFS-FESOM historical simulation (left) and IFS-AMIP simulation (right), in mm/day.