

# Observed multi-decadal increase in the surface ocean's thermal inertia

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## It now takes longer for SST anomalies to decay!

### Motivation & Question

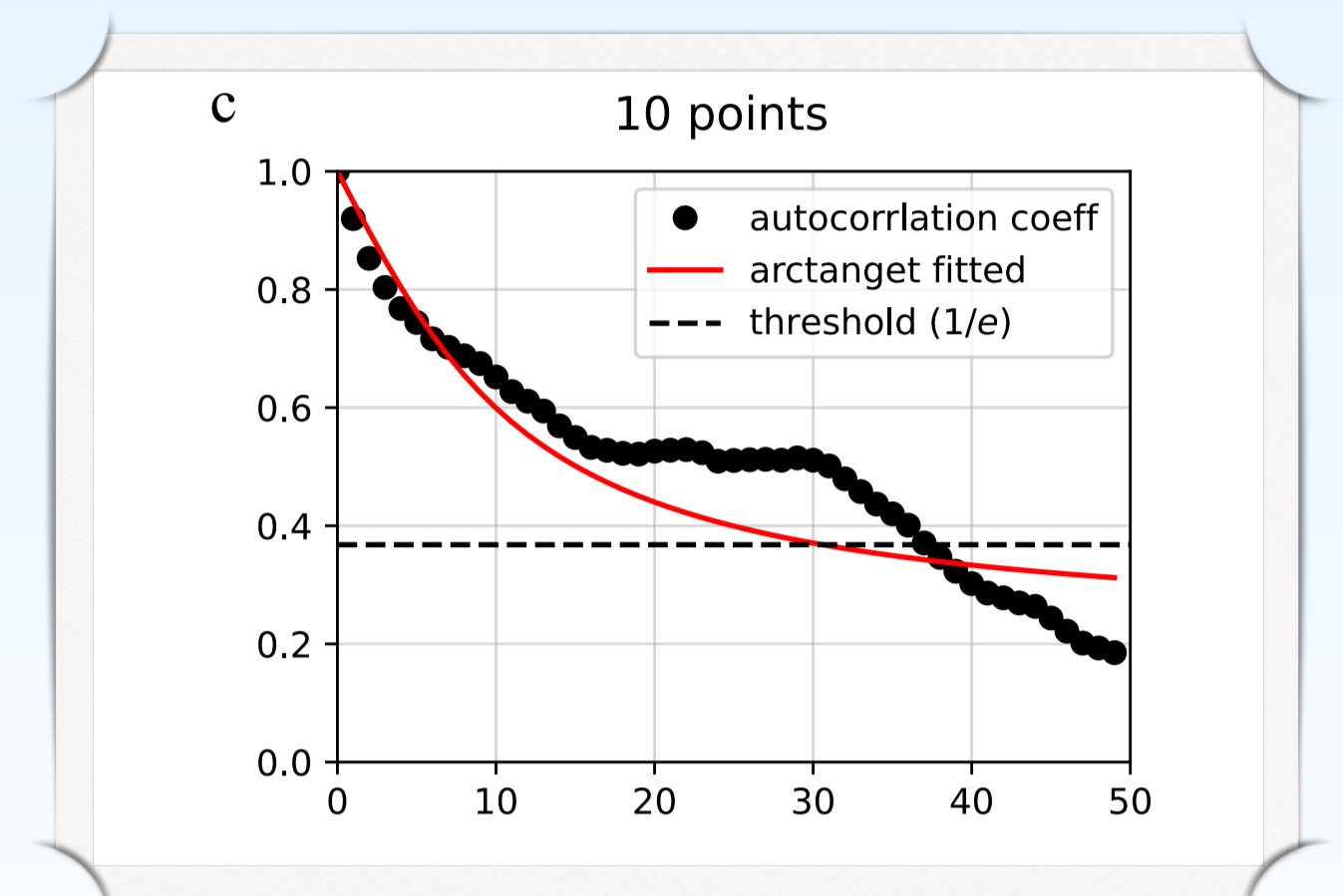
- Duration of marine heatwaves  $\uparrow$
- Thermal inertia of the ocean surface has a huge impact on marine ecosystems

How can we measure the thermal inertia of the surface ocean?

How has the thermal inertia changed over time?

### Data & Methods

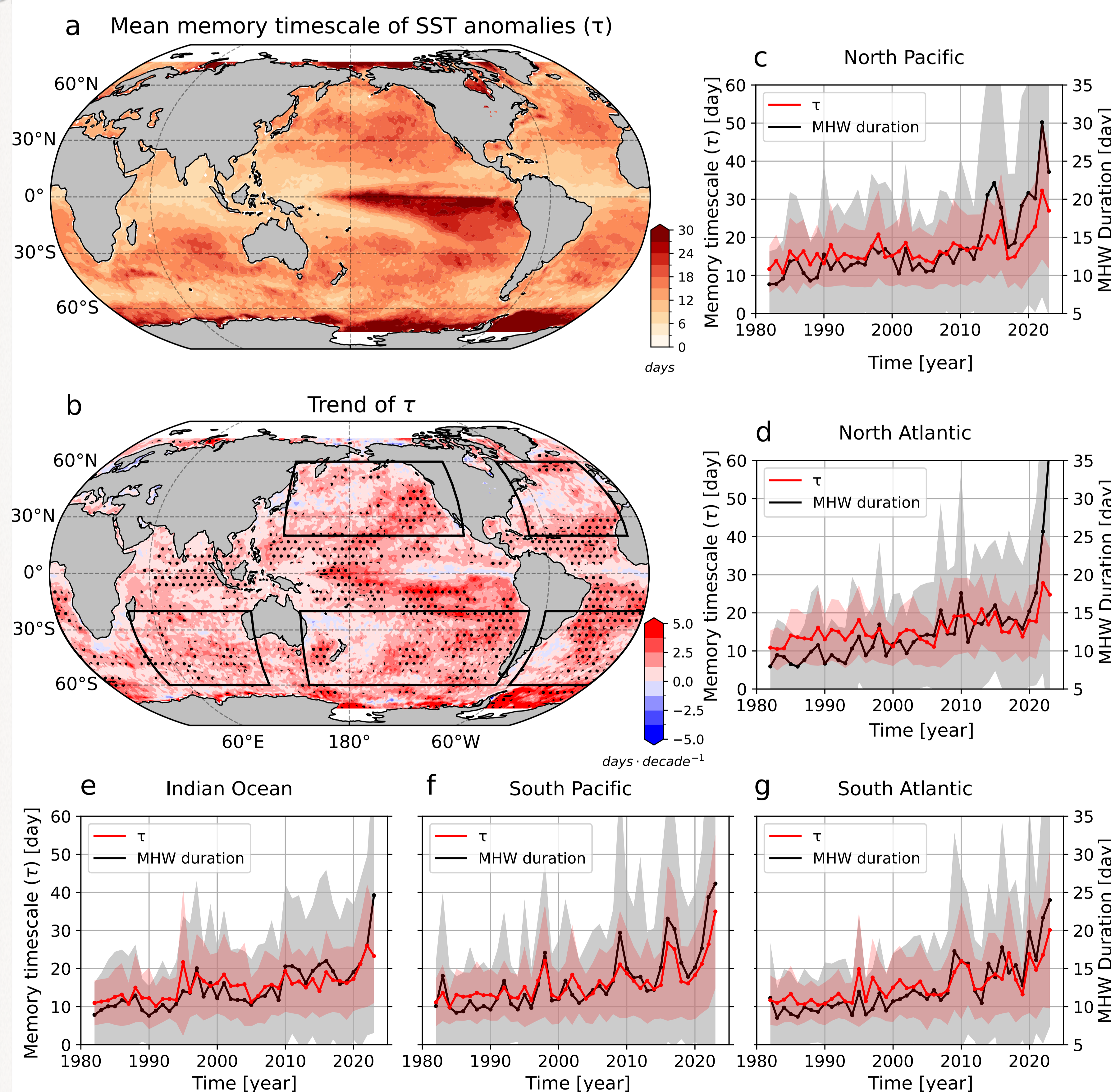
- sea surface temperature: daily data DOISST v2.0/v2.1
- surface forcing: ERA5
- autocorrelation function of SST anomalies  $\rightarrow$  find  $e$ -folding timescale for the memory timescale ( $\tau$ )



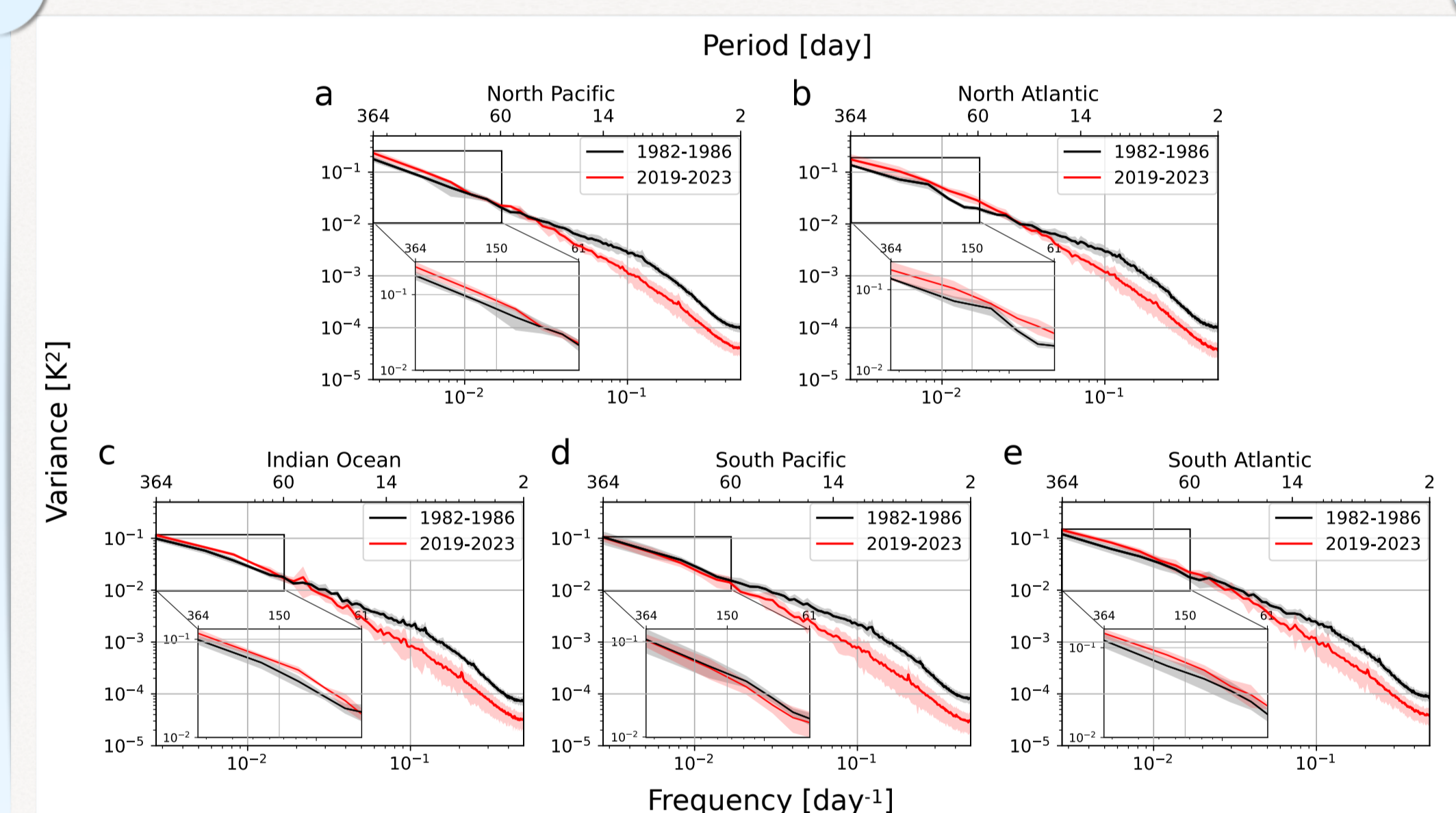
### Theoretical assumptions

SST anomalies described by linear negative feedback:  $T'_n = \phi T'_{n-1} + \epsilon_n \Rightarrow C_0 \frac{dT'}{dt} = F - \lambda T'$  then,  $\tau = \frac{C_0}{\lambda} = \frac{1}{\log \phi}$  and  $(\hat{T}'_\omega)^2 = \left(\frac{\hat{F}_\omega}{C_0}\right)^2 \frac{1}{\omega^2 + \omega_c^2}$ ,

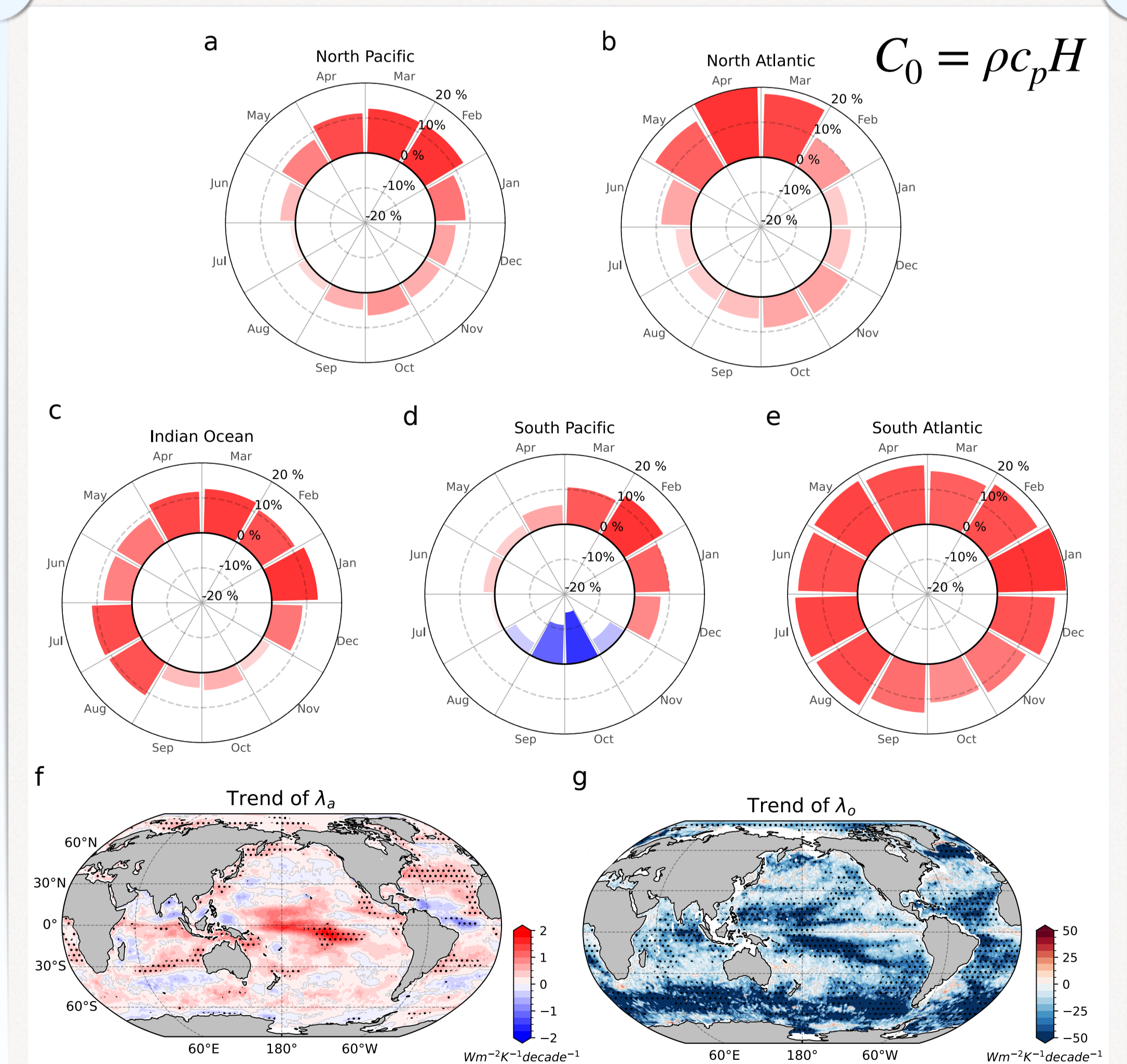
### Thermal inertia and its multi-decadal trend



### Power spectra of SST anomalies in 1980s and 2020s



### MLD ( $H$ ) trend and estimated $\lambda$ ( $= \lambda_a + \lambda_o$ )



### Summary & Discussion

**mixed layer deepening** + **weakening of oceanic forcing** + **strengthening of upper ocean stratification**  
 $\Rightarrow$  **slower decay of SST anomalies (longer memory timescales of SST)**