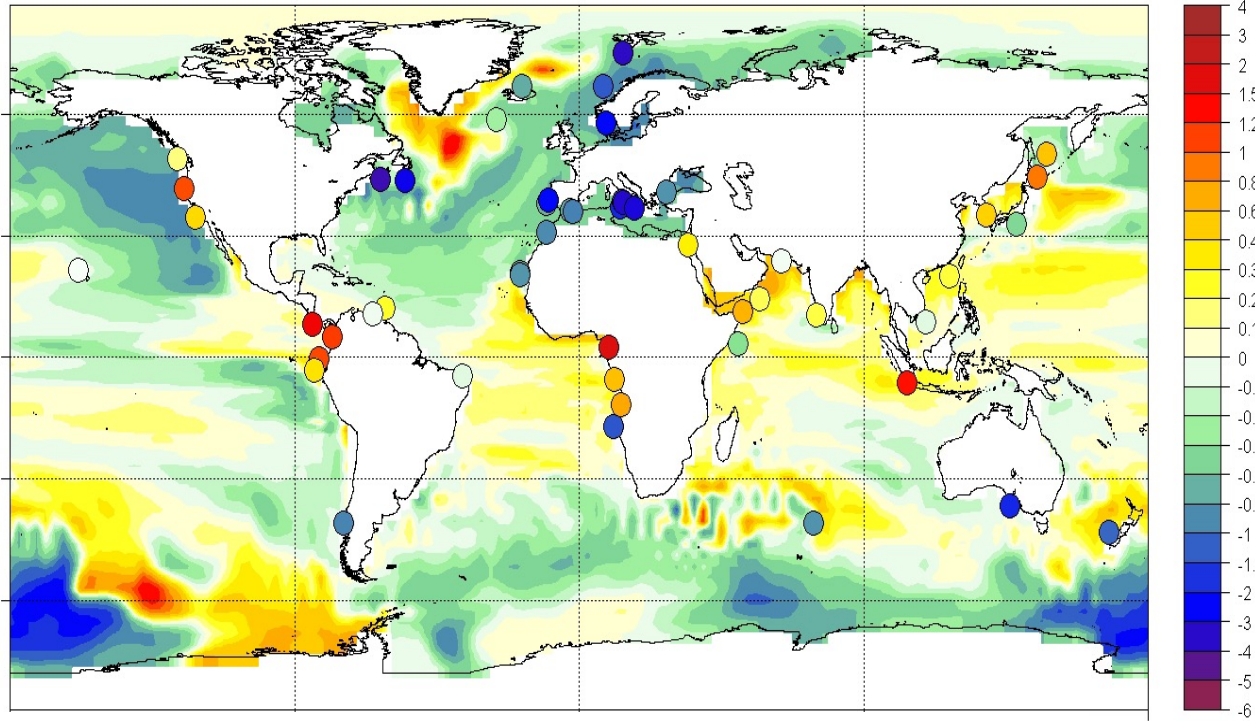


# Marine temperature trends (last 6000 years)



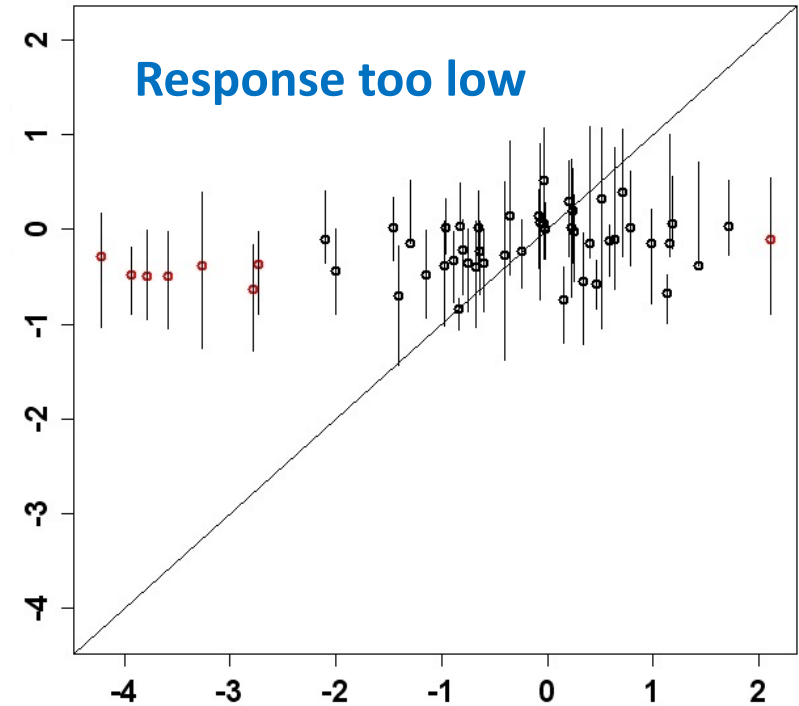
## Annual mean sea surface temperature trends



Alkenone-based temperature trends



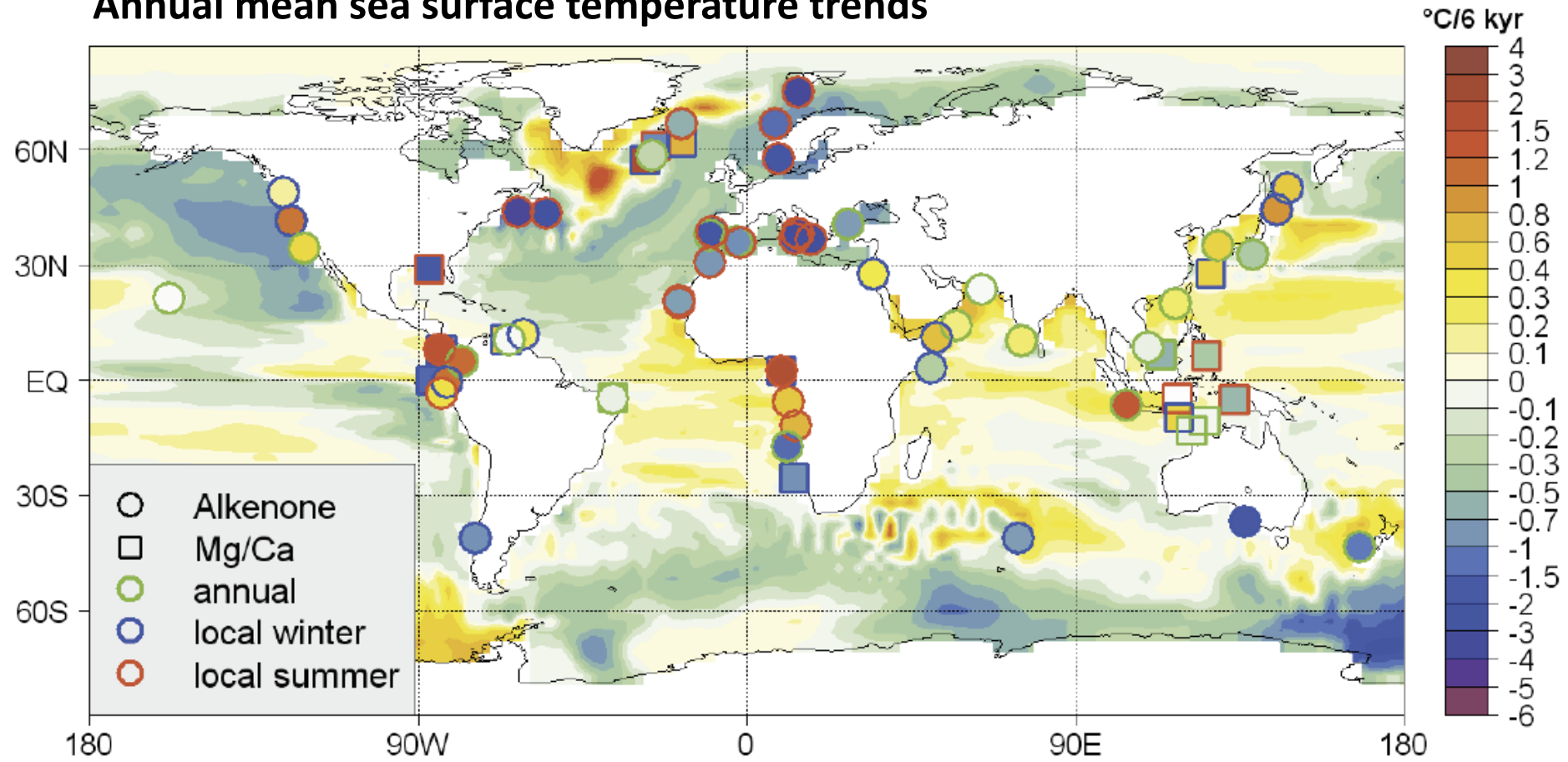
$\Delta T$



$\Delta T$

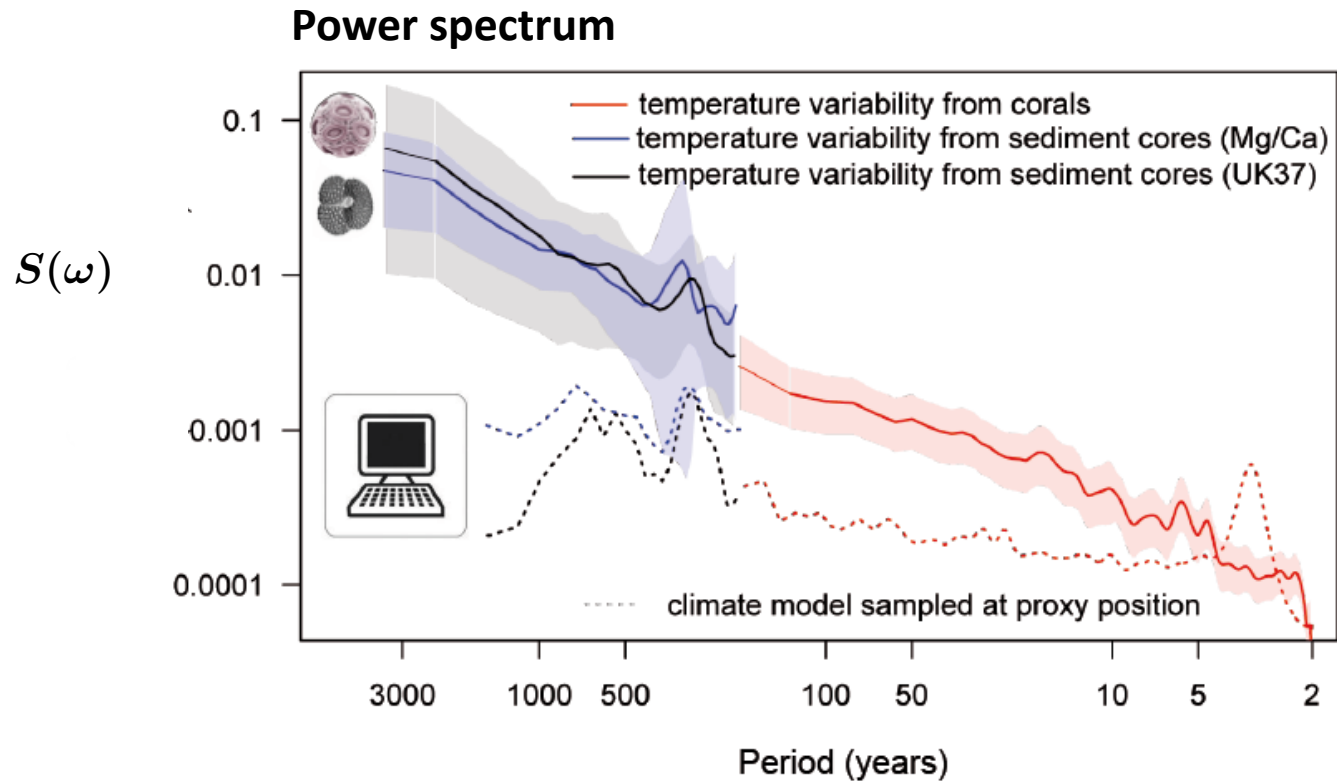
# Marine temperature trends (last 6000 years)

## Annual mean sea surface temperature trends



Seasonality of the recorder systems

# Marine temperature variability



**Current climate models seem to underestimate long-term variability**

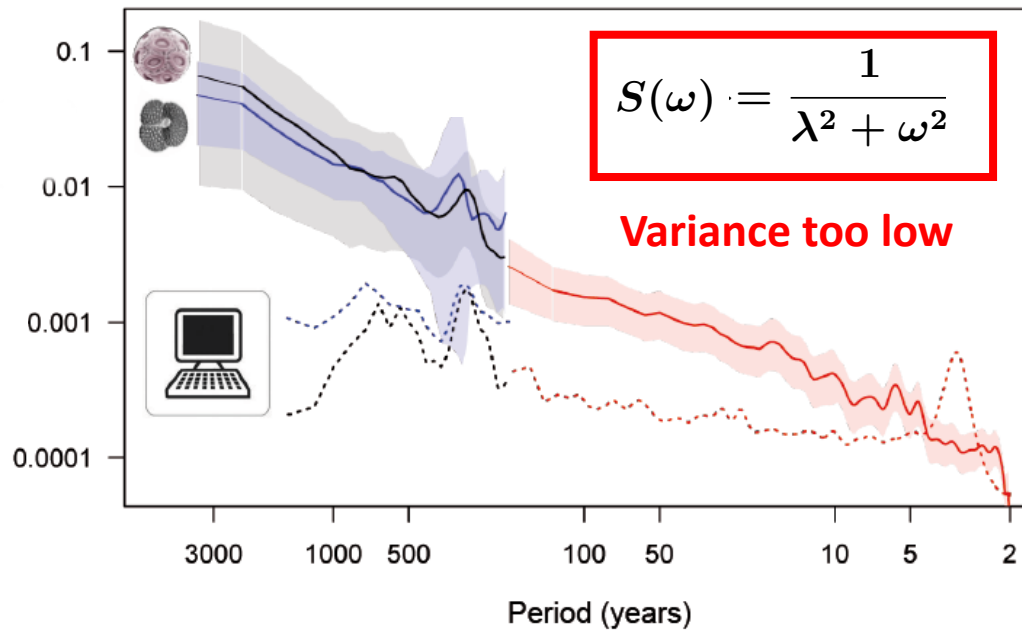
# Climate **variability** and **sensitivity** are related

Stochastic climate model (Hasselmann, 1976)

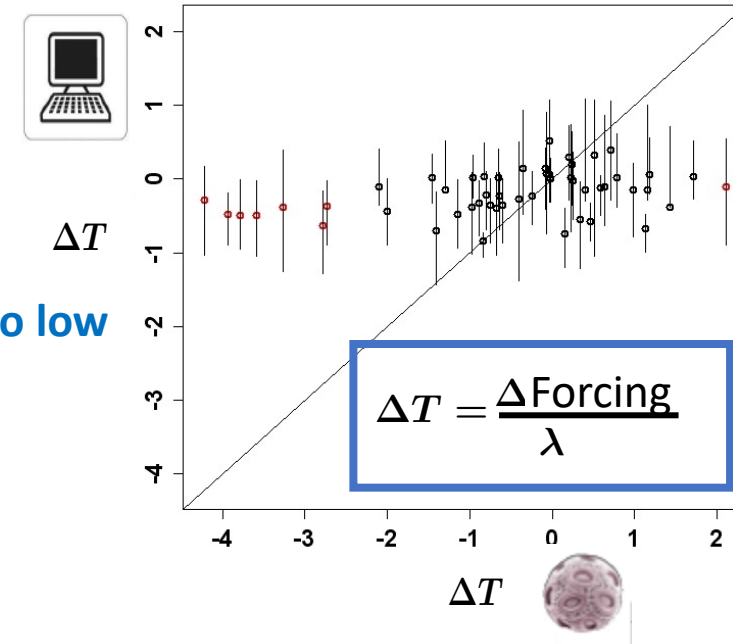
$$\frac{dT}{dt} = -\lambda T + \text{Noise} + \text{Forcing}$$

Damping  $\lambda$  too high

Power spectrum: Holocene variability



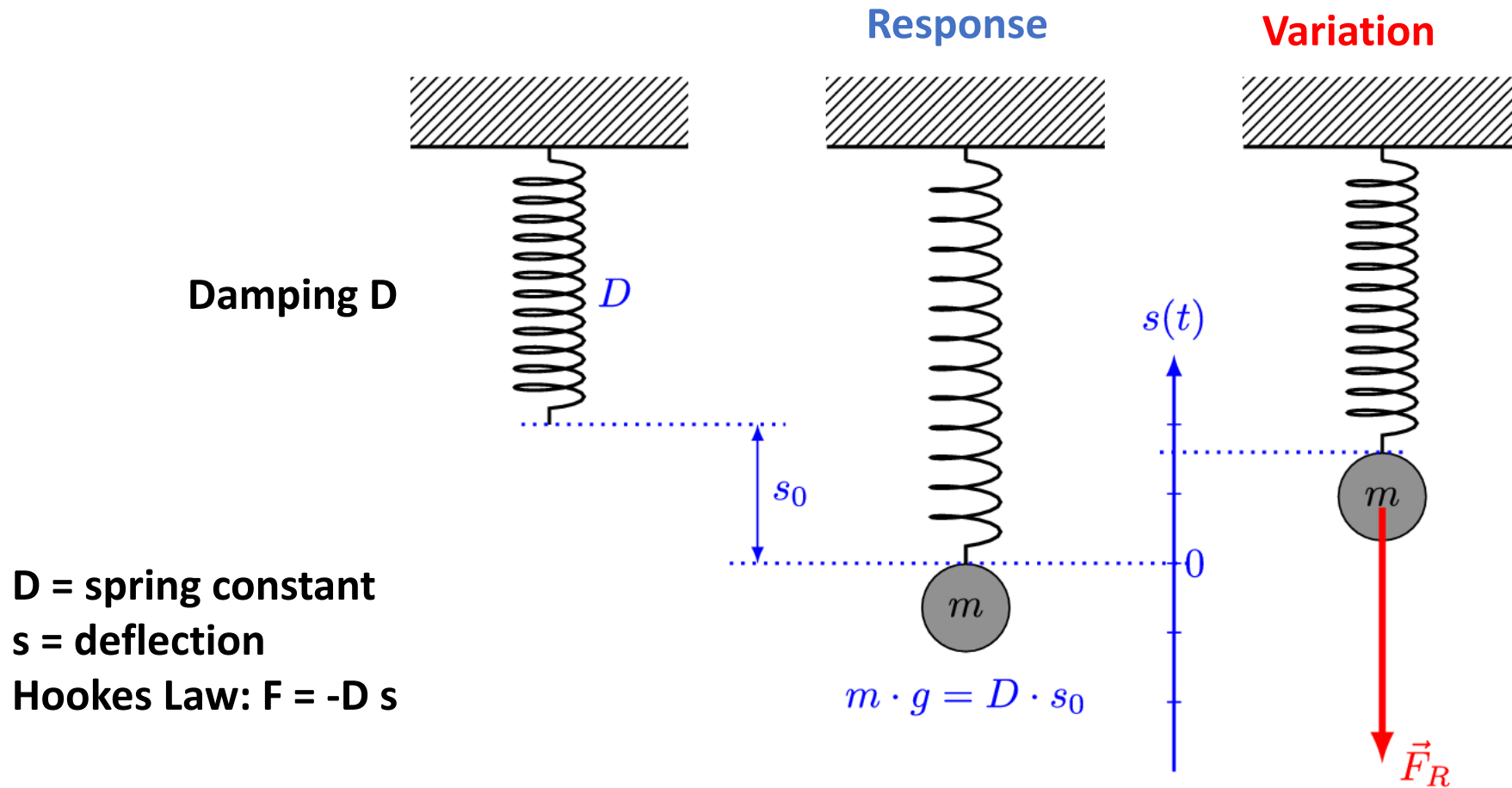
Holocene trends



Response too low

(Fluctuation Dissipation Theorem)

# Climate **variability** and **sensitivity** are related



**(Fluctuation Dissipation Theorem)**