The Equation of State

- \( \frac{\partial \alpha}{\partial \alpha} = \beta dT - bdS - KdP \)
- \( \beta \equiv \left. \frac{1}{\alpha} \frac{\partial \alpha}{\partial T} \right|_{S,P} : \text{The Coefficient of Thermal Expansion} \)
- \( b \equiv -\left. \frac{1}{\alpha} \frac{\partial \alpha}{\partial S} \right|_{T,P} : \text{The Coefficient of Saline Contraction} \)
- \( K \equiv -\left. \frac{1}{\alpha} \frac{\partial \alpha}{\partial P} \right|_{S,T} : \text{The Coefficient of Compressibility} \)

You may ask, why all the negative signs that cancel each other out – so that \( \beta, b, \) and \( K \) are greater than 0.

- \( b \sim \text{constant. This means that salinity has about the same effect on water whether it is at great depth or at the surface, whether it is warm or cold.} \)

- \( \beta > 0 \text{ for } S > 24.695. \beta = \beta(T) \text{ What does this mean?} \)
You may have heard that there is a density maximum for water at 4°C. This is true only for fresh water. Sea water, with \( S > 24.695 \), is increasingly denser the colder it gets.

\( \frac{\partial \beta}{\partial T} > 0 \text{ means } \beta \text{ is smaller for cold water, i.e., warm water experiences a larger change in density for a given }dT \text{ than does cold water. This has implications for the stability of the water column and the strength of vertical mixing, especially in polar regions, and the phenomenon of cabling.} \)