

Apart from the thermocline and the upwelling feedback, there is a third feedback: the zonal advection feedback. Assume that there is a region with a strong zonal background temperature gradient with $\partial\bar{T}_/\partial x_* < 0$. Such a region, for example, exists at the eastern side of the warm pool.*

a. Assume that there is a positive temperature anomaly that causes westerly wind anomalies. Describe the effect on the zonal currents in the ocean.

A positive temperature anomaly \tilde{T}_* will induce westerly wind anomaly and hence a positive (eastward) zonal velocity anomaly \tilde{u}_* .

b. Consider in the SST-equation, the balance

$$\partial\tilde{T}_*/\partial t_* \approx -\tilde{u}_* \partial\bar{T}_*/\partial x_*$$

that describes the evolution of temperature anomalies \tilde{T}_ due to anomalies in the zonal current \tilde{u}_* . Describe the mechanism of the zonal advection feedback.*

For positive \tilde{T}_* we learned from a. that $\tilde{u}_* > 0$. When the background zonal temperature gradient $\partial\bar{T}_*/\partial x_* < 0$ we find that the term

$$\partial\tilde{T}_*/\partial t_* \approx -\tilde{u}_* \partial\bar{T}_*/\partial x_* > 0$$

and hence the original perturbation is amplified.