Let’s apply the concept of energy budgets to better understand the tropics and how they relate to higher latitudes. This graph is a plot of average absorbed solar and emitted infrared radiation versus latitude, assuming that we treat the earth and atmosphere as one system. The equator is in the middle and the poles are at the sides of the graph. Overall, there’s a net energy gain in the tropics and a net energy loss in the middle and high latitudes. So, let’s see why that’s the case.

The amount of energy per unit area received by the earth depends on the angle at which the sun’s rays strike the earth. Therefore, solar heating is a maximum over the tropics because the intensity of solar radiation is greatest over low latitudes, and over the course of a year, the tropics receive much more incoming radiation than the poles.

On the loss side of the energy ledger, the amount of energy per unit area emitted by the earth depends on surface temperature. The tropics emit a bit more infrared radiation to space because they’re warmer than higher latitudes. But, the amount of infrared radiation emitted in the tropics still pales in comparison to incoming solar radiation.

So, if we construct an energy budget, we’ll see that the tropics are constantly gaining energy because more energy comes in during the course of the year than goes out. Higher latitudes, on the other hand, are constantly losing energy because more energy goes out over the course of the year than comes in.

By itself, this set-up would cause the tropics to get warmer and warmer every year because they always have this surplus of radiation. On the flip side, higher latitudes would get colder and colder every year because they always run a radiation deficit over the course of a year.

But, obviously that doesn’t happen and the reason why is that energy gets transferred throughout the earth system. Energy from the tropics gets transported from low latitudes toward the poles by the atmosphere and ocean to help keep the system balanced, and prevent runaway temperature increases in the tropics and decreases at higher latitudes.