Although these eddies transport enormous quantities of heat, energy, moisture, and so forth toward the poles, they are not so efficient as to completely wipe out the temperature gradient. So they don't stop the temperature gradients from developing altogether, but they reduce their magnitude by roughly a factor of two from what we'd see in the radiative convective equilibrium solution. So once again, let's look at this distribution of surface temperature as a function of month.

The coloring here just shows the surface air temperature. The scale is at the lower left. One could see it's warmer in the tropics, colder at high latitudes. There clearly exist temperature gradients in spite of the eddies. The eddies do try to get rid of the temperature gradients, but they're not completely efficient obviously, in doing so. Once again, the eddies are sufficient enough to drive the temperature gradients down to roughly half of what they would be in the radiative convective equilibrium solution.

So if we look at the remaining issues here about how eddies affect climate, the temperature gradient is controlled by eddies in the atmosphere, of horizontal dimensions about 3,000 kilometers. These are the familiar highs and lows we see in weather maps. Although I've given you a very simple tutorial about the physics of the eddies, in fact, the physics are rather complicated. The concept of criticality doesn't work for this kind of motion. That is, we can't say, oh, well, whatever happens with these eddies, their net effect is to drive the temperature gradient to zero, which would be the condition for neutral stability.

They don't do that. They drive them down, but not to zero. So they don't succeed in wiping out the temperature gradient, but they're there and they clearly have a strong effect on climate. One of the things we'll be interested in this course is how climate change, in particular the phenomenon of global warming, affects atmospheric circulation. What we have observed so far is that the Hadley circulation seems to weaken in some respects but at the same time expand poleward of its current position.

The temperature gradients tend to decrease rather remarkably at the surface, but ironically, they increase near the tropopause. This former affect would tend to decrease the intensity of baroclinic eddies, but the second effect, the increase in temperature gradient at the tropopause, would tend to increase the eddy strength. So these two things are working in opposite directions, and therefore, we haven't been able to determine with any strong consensus how the strength of baroclinic eddies will be affected by climate change. This is a subject of rather vigorous research in atmospheric science and climate.