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The Hadley Cell and Warming Earth

"Global climate change is transforming the Earth in major ways, recent studies claim. It has expanded the tropics and deserts seventy miles toward the poles…expanded the troposphere upward by 900 feet, and slowed trans-Pacific air circulation" (Business). Many scientists are arguing that the Earth's overall average temperature is rising, and, along with this rise in temperature, major changes in our atmosphere are taking place. While some of these scientists are arguing for the global warming theory in general, others are focusing their studies and research on a specific part of our atmosphere—the Hadley cell—and how it is being affected by the possibility of global warming. However, before getting into these specifics of how the Hadley cell system may be changing, first we need to understand what the Hadley cell circulation does in the atmosphere.

To begin with, the basic understanding of what the Hadley cell is follows along with the idea of how different air mass types are circulated across the globe. For example, we know that the equator gets much more direct sunlight than the poles do, on average, due to the tilt of the earth with respect to the sun. Because of this fact, the equatorial region, on average, is much warmer than the poles are. Since this heat will continue to build up at the equator, a surplus will be created there, while a deficit of heat will be found at both the North Pole and the South Pole. Now, given that things tend to want to become balanced, some sort of motion must be set in place to transport this excess heat from the equator to the pole regions; this is where the Hadley cell comes in. This cell is found to have an ascending branch and a descending branch, where the upward motion of warm and moist air is found in the ascending branch. This warm and moist air rises from the ITCZ (intertropical convergence zone) until it reaches the tropopause, where it then splits and is transported either northward (to the North Pole) or southward (to the South Pole) in the upper levels of the atmosphere. After losing much of its moisture from its rise in the ascending branch, the air found sinking in the descending branch (roughly 30° N or S) is dry and also warms as it is compressed while dropping towards the surface. Seeing as this air is warm and dry when it reaches the surface explains why many of the world's deserts are located at approximately 30° latitude. Therefore, as opposed to the ascending branch of the Hadley cell, where the ITCZ is located, along with many thunderstorms and convection, the descending branch is much quieter and with low humidity levels.

Another aspect of the Hadley cell circulation is the prominent wind fields created by this transport of air masses, both in the upper levels of the atmosphere and the transport of cooler air along the surface back towards the equator. First of all, as air is conveyed from the equator northward or southward near the tropopause, the Coriolis effect causes these winds to turn toward the east, resulting in some of the jet streams flowing west to east. Secondly, as air is shifted back to the equator along the surface, the Coriolis effect results in winds that turn to the west, which is where our trade winds are produced. So, with numerous functions involved in this process of the Hadley cell circulation, major changes in this process could have potentially devastating results. This is what is being argued, and, as you can see, there are an endless number of variables to

be accounted for, and all must be considered when discussing long term effects of minor changes now.

As mentioned before, some data has been collected already showing a change in the Hadley cell circulation, even before global warming has widely been brought to the surface. For one, data collected from 1979 to 2005 indicates "the Hadley cells have expanded by 1° of latitude, or 70 miles, towards the north and south poles" (Business). Already a major change is taking place and further evidence links this change to an accurately predicted outcome of the effect of increased temperatures by 0.5° C (Business). There have also been studies to quantitatively describe the extension of the Hadley cell, as well as determine if there are any particular parameters that may eventually limit this expansion. As Gabriel Vecchi (Princeton University) and Thomas Reichler (University of Utah) found, "Under global warming conditions, rising tropospheric static stability, which is an established consequence of moist thermodynamics, stabilizes the subtropical jet streams at the poleward flank of the Hadley Cell to what is required by baroclinic instability considerations, and consequently, the Hadley Cell extends poleward" (Vecchi 4). Here it can be seen that certain parameters can be met to allow the expansion of the Hadley cell to take place, which we have already seen evidence for. Also, as one other study finds, climate model predictions indicate that, for the continued presence of global warming due to increased greenhouse gases, projections of the locations of the dry regions on earth (caused by the descending branch of the Hadley cell) are also pointing to a significant extension poleward over the course of the next century (Previdi 1). So far, there is overwhelming evidence, as indicated above, leading to the idea that the Hadley cell is expanding, causing the deserts to expand, which will ultimately lead to devastating results.

As you can see, with or without the argument for global warming in general, much evidence has been found to show that at least one atmospheric circulation is being affected. The Hadley cell circulation is, by all indications, expanding at a high rate towards the pole regions. As it does, many other variables come into play that will also be affected; such as the expansion of the deserts, other ways of life and weather conditions will be affected because of this. The question may remain as to what is causing a change, but an answer has been found regarding will anything change.

Works Cited

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