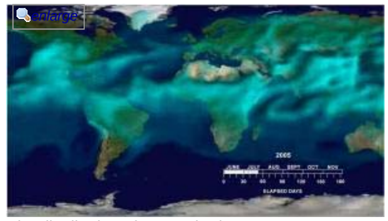
Water Vapor Confirmed As Major Player In Climate Change

ScienceDaily (Nov. 18, 2008) — Water vapor is known to be Earth's most abundant greenhouse gas, but the extent of its contribution to global warming has been debated. Using recent NASA satellite data, researchers have estimated more precisely than ever the heat-trapping effect of water in the air, validating the role of the gas as a critical component of climate change.



The distribution of atmospheric water vapor, a significant greenhouse gas, varies across the globe. During the summer and fall of 2005, this visualization shows that most vapor collects at tropical latitudes, particularly over south Asia, where monsoon thunderstorms swept the gas some 2 miles above the land. (Credit: NASA)

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Andrew Dessler and colleagues from Texas A&M University in College Station confirmed that the heat-amplifying effect of water vapor is potent enough to double the climate warming caused by increased levels of carbon dioxide in the atmosphere.

With new observations, the scientists confirmed experimentally what existing climate models had anticipated theoretically. The research team used novel data from the Atmospheric Infrared Sounder (AIRS) on NASA's Aqua satellite to measure precisely the humidity throughout the lowest 10 miles of the atmosphere. That information was combined with global observations of shifts in temperature, allowing researchers to build a comprehensive picture of the interplay between water vapor, carbon dioxide, and other atmosphere-warming gases. The NASA-funded research was published recently in the American Geophysical Union's Geophysical Research Letters.

"Everyone agrees that if you add carbon dioxide to the atmosphere, then warming will result," Dessler said. "So the real question is, how much warming?"

The answer can be found by estimating the magnitude of water vapor feedback. Increasing water vapor leads to warmer temperatures, which causes more water vapor to be absorbed into the air. Warming and water absorption increase in a spiraling cycle.

Water vapor feedback can also amplify the warming effect of other greenhouse gases, such that the warming brought about by increased carbon dioxide allows more water vapor to enter the atmosphere.

"The difference in an atmosphere with a strong water vapor feedback and one with a weak feedback is enormous," Dessler said.

Climate models have estimated the strength of water vapor feedback, but until now the record of water vapor data was not sophisticated enough to provide a comprehensive view of at how water vapor responds to changes in Earth's surface temperature. That's because instruments on the ground and previous space-based could not measure water vapor at all altitudes in Earth's troposphere -- the layer of the atmosphere that extends from Earth's surface to about 10 miles in altitude.

AIRS is the first instrument to distinguish differences in the amount of water vapor at all altitudes within the troposphere. Using data from AIRS, the team observed how atmospheric water vapor reacted to shifts in surface temperatures between 2003 and 2008. By determining how humidity changed with surface temperature, the team could compute the average global strength of the water vapor feedback.

"This new data set shows that as surface temperature increases, so does atmospheric humidity," Dessler said. "Dumping greenhouse gases into the atmosphere makes the atmosphere more humid. And since water vapor is itself a greenhouse gas, the increase in humidity amplifies the warming from carbon dioxide."

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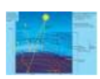

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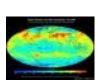

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"That number may not sound like much, but add up all of that energy over the entire Earth surface and you find that water vapor is trapping a lot of energy," Dessler said. "We now think the water vapor feedback is extraordinarily strong, capable of doubling the warming due to carbon dioxide alone."

Because the new precise observations agree with existing assessments of water vapor's impact, researchers are more confident than ever in model predictions that Earth's leading greenhouse gas will contribute to a temperature rise of a few degrees by the end of the century.

"This study confirms that what was predicted by the models is really happening in the atmosphere," said Eric Fetzer, an atmospheric scientist who works with AIRS data at NASA's Jet Propulsion Laboratory in Pasadena, Calif. "Water vapor is the big player in the atmosphere as far as climate is concerned."

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