Investigating How Water Vapor Emission Impacts the Temperature of the Troposphere

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In this project, a scaled model of the atmosphere was built to test the effect of water vapor on temperature of the troposphere. Water vapor could be acting as a mode of transportation for energy into the atmosphere affecting temperature due to its high specific heat. In the atmospheric model pressure variation was simulated by varying the volume of the model to correlate to the number of molecules in the atmosphere. A dry ice and acetone mixture was used as a refrigerant at the top of the model to simulate low temperatures at very high altitudes. To test the research question, controlled amounts of water vapor were injected into the model in 1 milliliter increments. The zone where the temperature was 0ºC, increased by 0.7ºC per milliliter of water added. The water vapor caused a lasting temperature effect at about 6500 m or 0.65 scale meters, because the water vapor releases its energy when it freezes. Water vapor only had a transient and minimal effect at the top and bottom of the laboratory model, because the total energy introduced was small compared to the column thermal mass. On a global scale human industry and transportation releases 3.3E+10 liters of water vapor through chemical reactions every year, so 1 milliliter of water in the model is equivalent to 1.46E+14 liters in earth's atmosphere. At the current rate of hydrocarbon combustion the mid atmosphere temperature could rise about 0.7ºC every 12 years because of water vapor that is produced.

Awards Won:

National Oceanic and Atmospheric Administration - NOAA: First Award of $1500.00

University of Arizona: Renewal Tuition Scholarship