

Water Vapor Lab

Motivation

The tropics are known for generating huge cumulonimbus clouds. These towering clouds create large bands of precipitation along the Intertropical Convergence Zone (ITCZ) and attain their massive height because of water vapor and latent heat release. Convergent trade winds force moist, tropical air upwards. The air cools as it rises, condensing the water vapor and releasing latent heat. The generation of these clouds is driven by the huge amount of energy released when water condenses - the latent heat. The amount of energy released is determined by the amount of water vapor in the air, and the amount of water vapor in air is strongly influenced by temperature.

During class we (hopefully) witnessed an analog to the latent heat release that drives the growth of these clouds. In this lab we will examine the relationship between water vapor and temperature.

Equipment

- plastic tub with lid
- two small jars
- round plastic tray
- ice pack
- thermometer
- watch or clock

Procedure

For this lab, each group's experiment will be slightly different. One group will use ice water, another cold tap water, another hot water, another very hot water, and the fifth will use near-boiling water.

- Fill your tub with the appropriate water. You want the water to be about one inch deep. Hang the outside thermometer over the edge of the tub so that it will measure the air temperature inside the tub. If your group is using warm water, you might want to put the tub on a heating pad.
- Fill two small jars with enough water so that they aren't buoyant and place them next to each other in the tub.
- Get an ice pack, dry off any condensation, and place it in the round plastic tray. This will be used to collect water vapor in the tub.
- Quickly weigh the ice pack and tray and place them on the jars in the tub. Be careful not to dip the tray in the water, as this will change its mass.
- Place the lid on the tub and record the temperature inside of the tub.
- Wait twenty minutes or so. During this time observe any condensation that forms on the inside walls of the tub and record how the temperature inside the tub changes.
- Open the tub, take out the tray and ice pack, and weigh them again.

Questions

1. How does the ice pack and tray's initial weight compare to its weight after sitting in the tub?
2. Compare your findings to the other groups' findings. Is there a pattern?
3. How might waiting longer or shorter periods before weighing the tray influence our results? Think about our experimental setup. In what ways might the experiment go wrong? (In other words, name some potential sources of error.) How could these be avoided or minimized? Do you trust the results?
4. Based on the results, should a warmer ocean produce more rain?
5. Given what we now know about the relationship between water vapor and temperature, how do you expect the amount of water vapor in the atmosphere to change with global warming?
6. Recall the radiative properties of water in the atmosphere (i.e., does water primarily absorb, scatter, reflect? which wavelengths?). Based on your answer to question #5, how might the change in water vapor affect the earth-atmosphere system as the climate warms?