Theoretical Analysis of Water Cycle to Conclude Potential Energy can be Generated and Destroyed

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Abstract: *More than three-fourths of the global water cycle consists of the annual rainfall and evaporation freshwater ex- change between the ocean and atmosphere. Water is fundamental to all life and key to modern civilization as we know it. Yet, when we assess what we actually know about the water cycle, we find great holes in our knowledge because a vast part of the water cycle occurs, unmonitored, over the global ocean. Many of us have studied water cycle during our primary education as an example of law of conservation in conjunction with the hydro-electric power plants. While studying this example we have been explained how the water at sea level gains kinetic energy which is then converted to potential energy in the clouds. This Potential energy is converted to kinetic energy in the form of rain, which gains potential energy when stored in dam. The stored water having some potential energy is then converted to kinetic energy and then to the electrical energy. In this paper, we are presenting an alternative analysis of the water cycle. From which we can clearly conclude that the law of conservation of energy has exception and the things that we have studied for decades and may be centuries, should be given another thought.*

1. Introduction

Water remains a liquid within the temperature range most suited to life processes, still due to change in seasons there are occasions when liquid water exists in equilibrium with its solid and gaseous form, for example as ice on the top of a lake with water vapor in the air above it. Freezing of water starts from the surface level of the water and then moves downward.

The thermal properties of water consists of the greatest specific heat known among liquids (the ability to store heat energy for a given increase in temperature) and water's latent heat of vaporization: at 20 degrees C (68 degrees Fahrenheit), 585 calories are required to evaporate one gram of water [1]. Its great specific heat means that, for a given amount of heat, the temperature of a given mass of water will rise more slowly than the temperature of any other material. Conversely, as energy is released its temperature will drop more slowly than any other liquids. This slow warming and cooling, together with other important factors, affects yearly, daily and even hourly changes in the temperature of oceans and lakes, which are quite different and significant from the corresponding changes in the temperature of land. In the next section a detailed analysis of how water cycle works and the corresponding law of energy conservation remarks are presented.

2. Water Cycle

The movement of water among the reservoirs of ocean, atmosphere, and land is called the hydrologic cycle. The movement of water takes place in hydrological cycle by physical processes such as evaporation, condensation and precipitation etc. The total quantity of water remains effectively constant on time scale of thousands year, it changes state between liquid, solid, and gaseous forms as it moves through the hydrologic system [2].
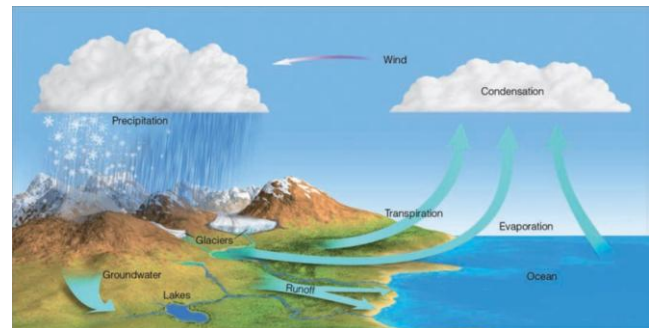

Figure 1: The water cycle

At the sea level, potential energy possessed by the water is zero as the height from ground is negligible. Evaporation is the process by which phase of water changes to vapor [3]. When water heated temperature of water molecules increases hence vibration of water molecules increases. As discussed, the amount of heat required for the phase change of water to vapor is called latent heat of vaporization and for vaporization of water 585 calories of latent heat is needed to convert 1g of water into water vapor.

Solar radiations provide the necessary latent heat for evap- oration which is stored in water vapor. When water vapor is added to a given volume of air, the dry air molecules must decrease by the same number hence mass per unit volume of it decreases. Hence humid air has less density than dry air. This density difference occurs because of the molar mass of water less than molar mass of dry air. Density may be simply defined as the amount of weight or mass contained in a specific volume [4]. Due to the significant difference in density and gravitational force high density moist air moving downward and low density air moving upward. For this displacement, there is no consumption energy however it's solely because of gravitational force.

3. Inference

From the theoretical analysis done in this paper, it can be concluded that the upward and downward movements of water, upward in the form of water vapor and downward in the form of water droplets, is only because of gravitational force whose value remains same as it is a conservative force, even after being the primary reason for the displacement of water. Therefore, potential energy of water, when in the form of clouds, is generated and when it falls down to the earth's surface is destroyed.
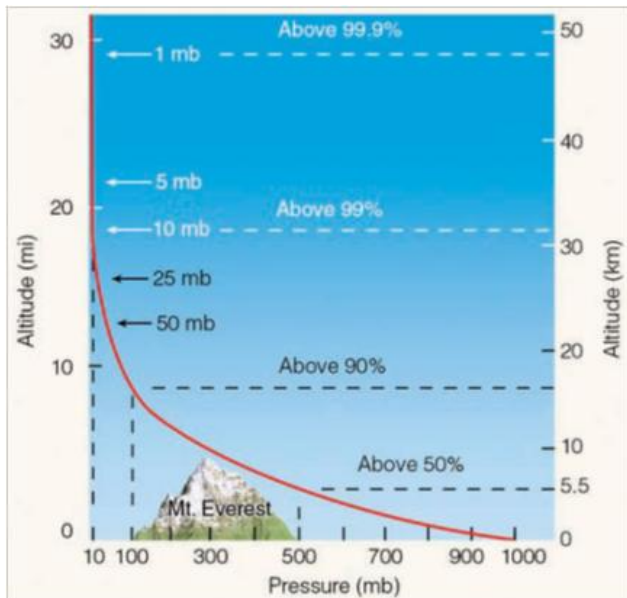

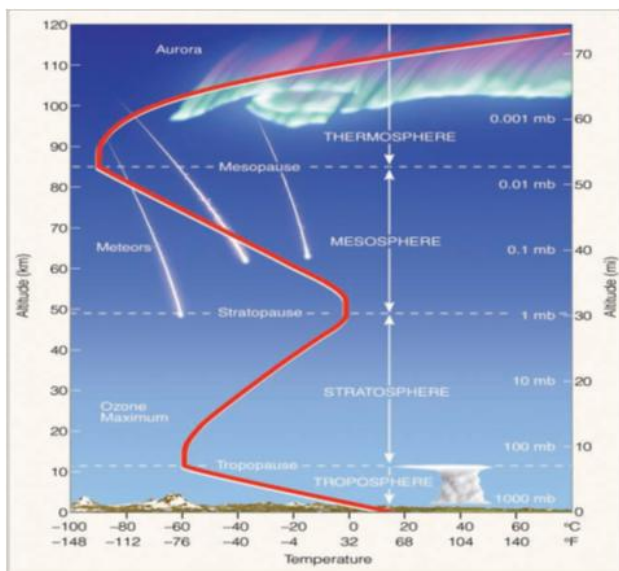**Figure 2:** Atmospheric pressure decreases rapidly with height

Figure 3: Layers of the atmosphere related to the average profile of air temperature above the earth's surface

Atmospheric pressure decreases with an increase in height it causes expansion of worm, moist air parcel. This expansion takes place due to pressure difference inside and outside of air parcel. As the air parcel expands the temperature of it decreases hence the kinetic energy of water molecule decreases. When air parcel temperature

decreases to dew point air becomes saturated with water vapor. At this temperature air parcel release the same amount of latent heat i.e. 585 calories/g of water vapor, into the atmosphere that it received during evaporation and condense into a cloud [3]. The tiny suspended cloud droplets possess potential energy [5]. This potential energy gained is due to the increased height, and the height is increased due to the effect of gravitational force. Therefore, the potential energy in the cloud is generated and as the gravitational force is conservative force, its value does not change even after being the sole reason for displacement of water vapor.

During precipitation, due to the effect of gravitational force, the cloud droplets fall downwards and when these droplets reach the earth's surface their potential energy becomes zero i.e. it is destroyed, as height becomes zero.

References

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