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A4_3 The Great Flood

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Abstract

The Great Flood is a biblical event, said to have occurred to cleanse the Earth. The magnitude of this flood and the disastrous affects it would have, are explored and it is found 4.412×10^{18} m^3 of water is needed to fill the Earth to the height of Mount Everest. Calculations for the surface temperature of the Earth find that the surface temperature of Earth currently is 255 K. This is less than the actual temperature of 288 K. The surface temperature of Earth after the water has been added is calculated and it is found to be 274 K.

Introduction

In the Bible, the Great Flood is said to have been a worldwide event where the 'waters prevailed exceedingly on the Earth, and all the high hills under the whole heaven were covered' [1]. In this report, the scale of this flood will be assessed along with the impacts such an event would have on the Earth's climate. The Earth has an average albedo of 0.30 [2] and the surface temperature is 288 K [3]. These values are predicted to be affected by the addition of water. The assumptions made in this report are: the Earth is a perfect sphere to sea level at 6.378×10^6 m; all life on land died out and there is a uniform temperature across the Earth (no ice). 6.378×10^6 m is used as it is the equatorial radius of the Earth.

How Much Water is Needed?

To calculate the amount of water needed to just cover the Earth at the highest point, the volume of land which rises above sea level will need to be calculated. The average height of land above sea level is 797 m [4]; the highest point being Mount Everest at 8850 m [5]. The total area of land on Earth is 1.4894×10^8 km^2 [5]; producing a volume of 1.187×10^{17} m^3. Next, the volume of water needed can be calculated using equation 1:

$$V_w = V_{F,E} - V_E - V_L \tag{1}$$

Where V_w is the volume of water needed, $V_{F,E}$ is the volume of the flooded Earth, V_E is the current volume of Earth and V_L is the volume of land on Earth. V_E and $V_{F,E}$ are calculated using equation 2 below:

$$V = \frac{4}{3}\pi R^3 \tag{2}$$

Where V is the volume of a sphere and R is the radius of the sphere. For $V_{F,E}$, the radius used is equal to 6.378×10^6 m plus 8850 m producing a volume of 1.091×10^{21} m^3; for V_E a radius of 6.378×10^6 m is used and a volume of 1.087×10^{21} m^3 is obtained.

Therefore the total volume of water needed to cover the Earth up to a height of 8850 m is 4.412×10^{18} m^3. The density of water is 997 kgm^{-3} meaning the mass of added water is 4.398×10^{21} kg. In comparison, the current amount of water on Earth is 1.386×10^{18} m^3 [6] and the current mass of the Earth is 5.972×10^{24} kg. This shows an unreasonably large volume of water is needed to reach this level.

The Climate

The albedo of an object is the amount of light which is reflected from the surface. A blackbody is one which absorbs all radiation and so has an albedo of 0.00. The average albedo of the Earth is 0.30 [2], meaning it absorbs most radiation. Using the equation below, the expected temperature of the Earth can be calculated:

$$T^4 = \frac{L_s(1-\alpha)}{16\pi d^2 \sigma} \tag{3}$$

Where T is the global temperature, L_s is the luminosity of the Sun, α is the albedo, d is the Earth-Sun distance and σ is the Stefan-Boltzmann constant. Inputting values for L_s of 3.846×10^{26} W, α of 0.30 [2], d of 1.49×10^{11} m and σ of 5.670×10^{-8} W m^{-2} K^{-4}, the temperature of Earth is expected to be 255 K. This is lower than the actual surface temperaure as global warming causes some of the Sun's radiation to be reflected back to the surface of the Earth to be reabsorbed rather than being able to escape. Once the Earth has been covered with water, it can be assumed the planet will have an albedo closer to that of water; the albedo of water is 0.07. Using equation 3, the new predicted global temperature is found to be 274 K. This is warmer than the calculated temperature of 255 K based on Earth's albedo, but cooler than the actual surface temperature.

The surface temperature would likely be much higher. This is predicted due to the atmospheric affects of the flood. The increase in water would cause an increase in water vapour, a greenhouse gas, which would increase the global temperature. Also, the plant life on land has been destroyed which would cause more CO_2 to remain in the atmosphere and increase the temperature. However there is still Phytoplankton which consumes CO_2 for photosynthesis and more water will allow for more oceanic sinks for CO_2 to be stored. A lack of pollution from humans would also reduce the amount of CO_2 being pumped into the atmosphere.

Conclusion

Overall, an event of this scale would be disastrous, either through the cataclysmic event which would occur through depositing the water, or through the climate change which would occur after the flood. The volume of water added, 4.412×10^{18} m^3, is a lot larger than the current volume of water on Earth. The affect this added mass would have, if any, on the orbital position of the Earth in the solar system would be interesting to analyse.The affect it may have on the temperature of the Earth, once global warming is taken into account, would likely be an equally disastrous event, even if the flood was survivable. Looking at a certain area of Earth, rather than the entire Earth, would also be an interesting advancement on this paper.

References

[1] `https://www.biblegateway.com/passage/?search=Genesis+7&version=NKJV` [Accessed 9th October 2018]

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[4] `https://ngdc.noaa.gov/mgg/global/etopo1_surface_histogram.html` [Accessed 9th October 2018]

[5] `https://www.infoplease.com/world/general-world-statistics/profile-world-2016` [Accessed 9th October 2018]

[6] `https://water.usgs.gov/edu/earthhowmuch.html` [Accessed 9th October 2018]