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## **Is The Day After Tomorrow for Real?**

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The blockbuster Hollywood movie *The Day After Tomorrow* has taken interesting attention from the public – particularly the political and scientific communities. The film depicts our world having global super storms, which are caused by an abrupt climate change due to Earth's global warming. Unimaginable drastic weather disasters were unleashed, significantly destroying major cities including Tokyo, Los Angeles, and New York in just a matter of few days. Brick-sized hails hit Tokyo; lots of triple-sized tornados ravaged Los Angeles; and an extraordinary tsunami and blizzards invaded New York. It is clear that, even for the producers of the film, such destructive event – as it is portrayed in the film – cannot happen. The movie is a mere fiction. Nevertheless, although many agree that the disasters depicted are exaggerated, the movie still shows some scientific realities. This paper includes the discussion of the ways science is shown in the said movie. In the first place, the movie has triggered serious discussions regarding global warming. It made an indirect implication that global warming is for real, and that it has adverse effects on the environment – including mankind. In fact, it presented the attitude that, unlike other governments, United States has for some time disregarded evidences for global warming and the serious need to reduce greenhouse gas emissions (Perkowitz, 2013). Today, the scientific community is discerning the threat of global warming and the ways on how to deal with it. Governments and commercial organizations are now implementing standards and rules on their resources, including vehicles and facilities. The sudden climate change portrayed in the movie began with

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the melting of the polar ice caps, which made the flow of the Gulf Stream stop. Since the Gulf Stream is responsible for bringing warm water past the Northern America towards Western Europe, the disruption in its circulation pattern resulted in a severe global deep freeze - as portrayed in the film (Immoor, 2006). Moreover, the increased precipitation led large volumes of fresh water into the ocean, making the sea level rise greatly. This rise in the sea level brought floods in the New York City. In reality, global warming is already happening and some of its adverse effects are indeed unavoidable. Atmospheric scientists expect that global climate change will result in increased flooding and droughts, more severe storms, and a loss of environmental species (Center for Climate and Energy Solutions, n. d.). Climate models show that the Earth's average surface temperature has increased by around 1.4 degrees Fahrenheit. This rise occurred between 1975 and 2010, almost merely two centuries after the Industrial Revolution. Although 1.4 degrees seems a small change, it is enough to make significant destruction to the environment. Moreover, climate models project that additional warming of about 2 to 10 degrees Fahrenheit is likely to happen over the next 100 years (Center for Climate and Energy Solutions, n. d.). However, such estimate can still go to worse if certain action will not be taken accordingly.

These facts affirm that global warming and sudden global climate change are important issues for all societies. Certainly, this is a public advocacy portrayed clearly in the movie. Although most of the film is characterized by lack of scientific credibility, the credit of triggering public awareness towards environment to some degree should be given to it.

Despite this commendation, however, science depicted in *The Day After Tomorrow* is far from being believable. First, when scientists speak of sudden/abrupt climate change, they mean it within a decade and even up to a century (Immoor, 2006). Indeed, climate changes happened many times during the last thousands of years. However, such shift does not occur for just a couple of days or even hours - as portrayed in the movie. To have all the conditions in the movie happen, there needs to be an increase of about 9 degrees Fahrenheit in the Earth's surface temperature. In reality, the gradual change of 1 degree Fahrenheit mentioned earlier occurred for almost two centuries. Thus, the drastic climate change in the movie is not consistent with scientific reality.

Another non-scientific things portrayed in the film is the tsunami that hit hard New York. This tsunami was gigantic that it rises above many buildings in New York. It is important to note that tsunamis are not caused by climatic conditions. Instead, they are caused by tectonics and seismic activities driven by internal forces of the Earth's structure (Cook, 2013). In some cases, tsunamis can be a result of direct meteorite impact on the ocean or indirect mechanisms like landslides. However, the tsunami in the movie was not caused by these things. Moreover, the emphasis on the magnitude of the tsunami in the film was on its height. In reality, tsunamis are devastating not because of their height, but their long wavelengths and high velocity (Cook, 2013). Thus, it can be said that the tsunami in the film is simply used to portray a 'climate of fear,' rather than an understandable and feasible climate condition.

In addition regarding the tsunami, it was a 300-foot high surge that whipped

though Manhattan. To have a storm surge of this magnitude, there has to be a wind equal to two times the speed of sound, or 1200 mph, to create it.

Apparently, this strong wind is not seen in the movie. In fact, if this would be the case of the tsunami, then there will be hardly any building standing firm in the city. Such force could break even the core beams, walls, and sections of any concrete structure. After the wave of such devastating storm surge, there should be no one able to look for shelter even in library.

Further, it is interesting to notice that the tsunami approached Manhattan from the east. However, the Atlantic Ocean is located south of Manhattan. Moreover, in case the tsunami would come from the east, it will pass through the Long Island. In this case, the storm surge must have weakened and receded already before reaching Manhattan. Thus, even in terms of direction and location, the tsunami portrayed in the film is not credible.

Another thing portrayed in the movie is the extreme coldness of the temperature, to the point that those who remain outside the buildings all froze to death. In fact, there is an instance where this freezing condition is able to freeze people in a matter of seconds. When a group of military helicopters went through the snowy mountains, the cables and the entire body of the helicopters were frozen and so they crashed into the snow. When one soldier tried to open the door to look outside, he simply inhaled once and then immediately froze to death. This is also seen when Jack Hall and Jason Evans were travelling to New York, and when Sam Hall, and two of his friends were coming from the ship back to the library. The two groups had to go inside, lock the doors, and make some fire. Otherwise, they will all freeze to death instantly. Now this condition is not scientific in that the human body

cannot be frozen in just a matter of seconds. Even without fire nearby, a person can still survive the intense coldness. Given the internal systems of the human body and the heat it produces by itself, an individual is able to withstand freezing conditions for a longer period of time.

Moreover, the freezing condition in the Northern America forced the people to migrate to the Southern regions. While it is true that some areas will experience great drops in temperature due to the change in ocean current circulation, global warming will not result in a widespread Ice Age, as portrayed in the movie (Immoor, 2006). In the movie, the freezing of the Northern regions lasted for days. In fact, the migration at the end of the movie suggests that it is already permanent. Given the fact that global warming is prominent, the ice is not supposed to stay long. Heat caused by the greenhouse gas systems should remain in the atmosphere and most parts of the Earth will experience an increase in temperature, rather than a drop.

In addition, the violent storm depicted in the movie absorbs large quantities of extremely cold upper atmospheric air down to the surface, which made the people freeze instantly (Masters, n. d.). However, the Ideal Gas Law in physics holds that the air descending from above should be warm when it reaches the ground. Even if the air is moving very fast, the flow of air is always from cold to warm. Thus, the flash freezing condition portrayed in the film is not consistent with the Law of Science.

Another thing seen in the movie is the merging of the thunderstorms. The clusters of storms were able to form a continent-scale blizzard with a calm eye over the land area (Masters, n. d.). This is seen in two situations in the

movie. The first one is the time when the military helicopters tried to pass through the storm. When they were still at the eye of the storm, they were unaffected by the blizzard. However, when they went further, all of them were frozen. The second instance is when Jack Hall and Jason Evans were travelling. Jack noticed the moment the wind went calm. He knew that they were at the middle of the storm. Knowing that they will freeze to death as soon as the calm eye leaves, he hurried to get inside the house below them. Now these powerful storms are called hurricanes. Hurricanes derive their energy from warm tropical ocean waters and are formed by evaporating water from the water surface. Heat energy is then converted to wind energy during water vapor condensation, and the latent heat is released inside the convective clouds (Ahrens, Jackson, & Jackson, 2012). When these storms lose their source of warm water, either by moving over colder water or large landmass, they get dispersed immediately (Ahrens et al., 2012). However, the hurricane in the movie is in the land areas, not in the ocean waters. Therefore, the portrayal of the hurricane in the movie is not according to realistic science.

Lastly, the violent storms are shown in some scenes in the movie rotating clockwise, and in other scenes counter-clockwise (Masters, n. d.). The blow of the winds across the Earth is a result of what is called the Coriolis Effect. In the Northern Hemisphere, wind from high-pressure systems pass low-pressure on the right, causing the systems to swirl counter-clockwise (Coriolis Effect, n. d.). This means storms and hurricanes in the Northern regions rotate counter-clockwise. On the contrary, storms in the Southern regions rotate clockwise. In the movie, the rotation of the storm should

always be counter-clockwise, since the Northern Hemisphere is always in view.

The most of the portrayal of science in the movie is not consistent with reality. However, this does not mean that the creators of the movie are not knowledgeable enough of these scientific facts about storms. When Jack Hall sent Terry Rapson a view of frigid upper atmospheric air being absorbed by the storm, Terry asked Jack, reasoning that the air is supposed to be warmer when it descends. However, Jack simply said that the condition is unexplainable. In the early part of the movie, where a United Nations conference on global warming was held in New Delhi, Jack and the people expected that an abrupt climate change will occur in the next 100 or 1000 years - which is actually the right scientific estimation. However, it turns out that they were wrong. Though in indirect manner, these examples (the reasoning of Terry and the estimation of Jack) suggest that the movie is also able to show actual scientific facts. It appears that the film does not actually portray a lack of scientific knowledge. It deliberately takes aside scientific standards, simply for the sake of giving emphasis on the adverse consequences of destroying nature through exaggerated depiction of disasters.

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