

The Day After Tomorrow



Fact or Fiction ?

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Abstract—By its spectacular special effects, the movie *The Day after tomorrow* shook the World and made people sensitive to Global Warming phenomenon. Despite the undeniable quality of the film, we have to figure out what is plausible and what is definitely not. To do so, I will first describe what kind of elements maintain our specific atmosphere, then I will present how scientists explain¹ the Global Warming phenomenon, its causes and its forecasts. It will be followed by a comparison between accumulated scientific facts and catastrophic scenarios of the film. To finish, i will try to explore a possible hidden aim of the film.

I. ELEMENTS THAT MAINTAIN OUR SPECIFIC ATMOSPHERE

Before treating a Global Warming causes and consequences, let's sum up how work our unique atmosphere (fig 1), which has created and maintain life.

A. Solar Input

When the sun energy travels to Earth, 40% of the sun's energy is reflected back into space after hitting Earth's upper atmosphere, and 60% gets through, supplying Earth's weather engine.

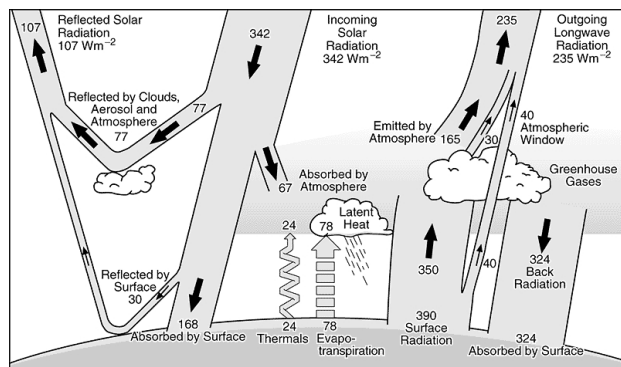


Fig. 1. How solar energy is reflected by Earth

B. Oceans

Oceans are the key source of moisture in the air and they store heat efficiently. The oceans and marine life also consume huge amounts of carbon dioxide.

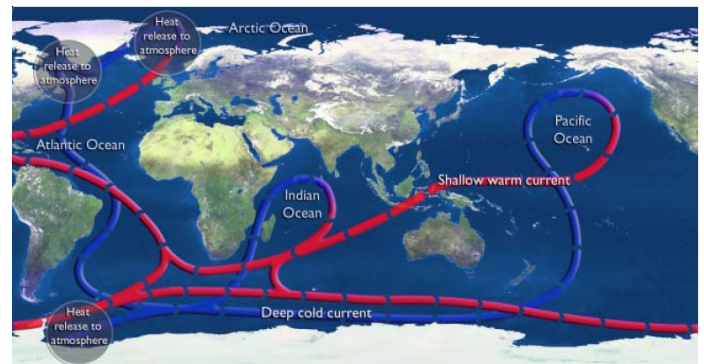


Fig. 2. great ocean conveyor belt

Thermohaline circulation system(THC): There are three main processes that make the oceans circulate: tidal forces, wind stress, and density differences. The density of sea water is controlled by its temperature ($\theta \epsilon \rho \mu \sigma$) and its salinity ($\alpha \lambda \nu \sigma$). The circulation is created by density differences. The Figure 2 shows you the great ocean conveyor belt. And this is how it works [1]: In the North Atlantic it transports warm and salty water to the North. There the water is cooled and sinks into the deep ocean. This newly formed deep water is exported to south. This slow ($\approx 0.1m/s$), but giant circulation has a flow equal to about 100 Amazon Rivers. Together with the Gulfstream it contributes (2/3 and 1/3) to the comparatively warm sea surface temperature along the coast of western Europe and to the relative mild European winters. [2]

¹all quoted text will be in italic font

C. Clouds

Clouds cool Earth by reflecting solar energy and warm Earth by trapping heat being reflected by the Earth surface ².

D. Ice and Snow

The whiteness of ice and snow reflects heat out (like clouds), cooling the planet. When ice melts into the sea, it's cooling the ocean and increase its level.

E. Land surfaces

1) *Mountains*: Mountain ranges can block clouds.

2) *Sloppy lands*: Sloppy lands allows more water runoff, leaving the land and air drier.

3) *Trees*: Huge tree lands as tropical forests transform Carbon Dioxide into Dioxide³, representing 20% of our "fresh air".

II. FACTS : GLOBAL WARMING'S CAUSES AND CONSEQUENCES

A. Man is guilty of harming himself and nature

Although different forecasts has been predicted by scientist [3], [4] about probable catastrophic phenomena, they all agree to say the planet is in danger due to obvious human bad behaviour [5], [6].

Indeed, since the industrial age, Man is polluting his own atmosphere by extracting and using raw energy materials. Coal was the 19th century problem (especially in big cities creating smog). Nowadays the pollution comes from the use of oil energy. All consumption of oil or coal produces dozen of molecules (fig 3), that create greenhouses gases⁴ and raising the overall Earth temperature (II-B.1). This raising activate a chain of climatic modifications and extreme climatic events (II-B.2). Those indirect events in addition to direct pollution events cause thousands casualties and diseases (II-B.3) not only to humans but also to the faune and flora (II-B.4). We have to hurry and change our habits otherwise we are all doomed without knowing when it will happen : "*Scientists have begun to realise that change could be sudden, not gradual - in some cases it could happen within a few decades.*" [7]

B. Global Warning consequences

1) *Rising Temperature*: The rising of Earth's temperature has been known for at least 20 years [9]. Scientists managed to reconstruct Earth temperature's data (fig. 4) of the passed millennium, the graph speaks by itself : it is true that temperature is rising.

And unfortunately the phenomenon may not stop in the future (fig 5). We have to consider Green Gas effect like the starter of all bad events that might occur in our atmosphere. The direct consequences of it can be seen almost every single week on TV News : extreme climatic events.

²Other problem with polluted clouds is called the Global Dimming phenomenon

³this action is called photosynthesis

⁴A delicate balance of gases gives Earth its livable temperature. Known as "greenhouse" gases because they trap heat inside the atmosphere, they send a portion of that heat back to Earth's surface. The gases include water vapor, carbon dioxide, methane and nitrous oxide.

Indicators of the human influence on the atmosphere during the Industrial Era

(a) Global atmospheric concentrations of three well mixed greenhouse gases

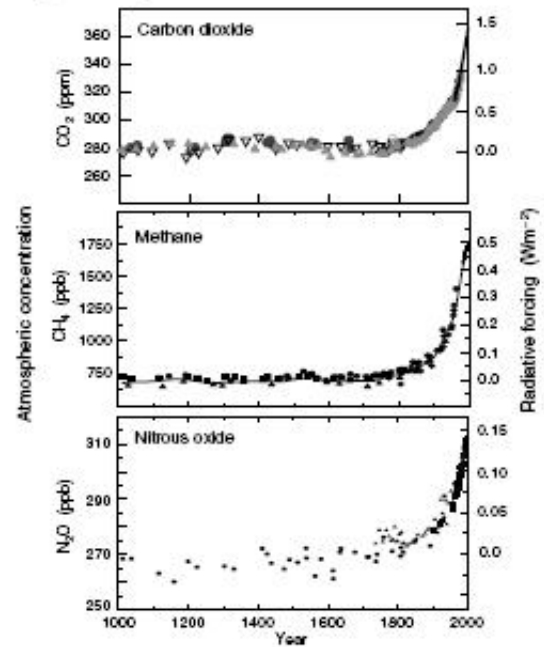


Fig. 3. pollution since the industrial age [8]

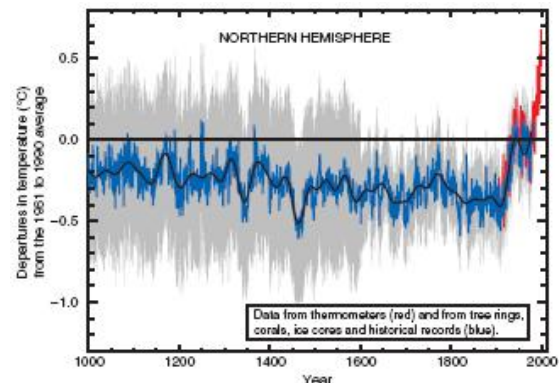


Fig. 4. Average Temperature of Earth since 10th century [8]

The other direct consequence of rising temperature is the Arctic ice melt. Scientists predict an almost entire melt within one century (fig 6). The melt will cause a dangerous rise of sea level that will progressively swallow countries like Netherlands. It might⁵ also cause the end of THC (I-B) by disturbing the salinity balance of North Atlantic ocean.

2) *Extreme Climatic Events*: We can all admit that there is definitely more climatic anomalies than 10 or 20 years ago. And this feeling is not due to an increase of media transmission. It is true that extreme climatic events are more frequent and hits harder than before. A 2003 report by the World Water

⁵discussed at section Fiction VS Facts

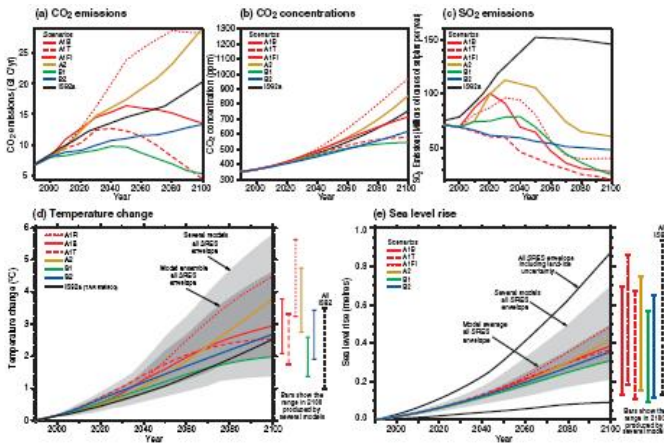


Fig. 5. Global Climate in the 21st century [8]



Fig. 6. Projected ice melt in Arctic

Council noted “a steady increase in extreme weather events over the past 40 years – with major flood disasters rising from 7 in the 1970s, to 18 in the 1980s to 26 in the 1990s”. You can see in the appendix A the amount of such events that stroke our Earth in 2003. The result is astonishing [10], [11]: extreme weather events costs dozen of billions \$ and kill directly or not (II-B.3) hundred of thousands people (especially earth quakes) each year. The relevant question would be : at the end, is it not more economically profitable to invest in pollutantless energy instead of pay each year the rebuilding of cities ?.

3) *Diseases*: In his book [5], Ross Gelbspan warn us Global Warming will spawn new diseases and already accelerate the known ones:

- “Climate change will quadruple the number of South Africans at risk from malaria by 2020, bringing the mosquito-borne disease south towards the country’s commercial heartland, a minister said.”
- “Changes to the environment that are sweeping the planet are bringing about a rise in infectious diseases, the United Nations Environment Programme (Unep) has warned.”
- “Poor and minority children are likely to develop asthma at worsening rates due to global warming and air pollution. Environment experts released a report showing that as the climate gets warmer, allergens such as pollen and mold will flood the air, interacting with urban pollutants such as ozone and soot to fuel an already growing epidemic of asthma.”

- “The health of millions will be damaged if world temperatures continue to rise as a result of climate change, says the World Health Organization. Increasing temperatures will aid the spread of water-borne diseases, and those carried by insects, it predicts. Even a rise of a few degrees could expose hundreds of millions more people to the threat of malaria, say experts. In addition, changes to rainfall patterns, could damage agriculture, plunging millions into malnutrition.”

His last saying lead us now to explore more sharply the changing of fauna and flora and its consequence towards agriculture.

4) *Agriculture Modification*: The agriculture is also targeted by Global Warming. It will certainly change the face of today’s known agriculture regions by forcing farmers to adopt new agricultural practices due to altered growing conditions. Things can be easily deduced from what we already discussed before :

- less amount of fish and sea food available
- more unpredictable farming conditions
- loss of fertile coasts due to rising sea levels
- longer growing seasons in cold areas
- loss of biodiversity in fragile environments
- more frequent crops loss of due to floods, storms, typhoons etc.
- increase of diseases of cattle

Although the scenario is quite pessimistic, there is one thing that Global Warming can be benefit for : crop yield. Indeed, a report has been produced [12], [13] that defend this idea. The writer said “Crops have higher yields when more carbon dioxide is available, even if growing conditions aren’t perfect [...] Carbon dioxide is a natural element in the Earth’s atmosphere, and plants use it as a kind of gaseous fertilizer”

III. FICTION VS FACTS

A. small résumé of the film

“The Day after Tomorrow” showed us global warming caused by pollution : shift the ocean currents, resulting in immediate weather disasters :

- a tidal wave flood Manhattan
- tornadoes wipe out Los Angeles
- giant hail pummel Tokyo
- snow blanket India
- an ice sheet encase Scotland

Now we will try to confront this scenarios with reality:

B. THC

Most models predict an increase in precipitation in high latitudes and a region of minimum warming over the North Atlantic using a scenario of doubling CO₂ within the next 70 years. Most models also predict a decrease in the strength of the thermohaline circulation. However, the exact reduction varies from 30% to only 10%. The details and the long-term effects (more then 100 years) of these changes have been explored by only few studies. One of these studies was done

at the University of Bern using a *zonally averaged climate model* [14]. It shows that the thermohaline circulation not only reduces, but may shut-down completely under *strong global warming with a fourfold increase of CO2 concentration within the next 140 years*. This illustrates that global warming can affect the climate system in a non-linear fashion.

Even if a partial or entire THC modification can occur, the impact won't be immediate as seen in the movie. Indeed, figure 7 shows us that could possibly happen. We see it seems not to be so extreme falls of temperature all around the world.

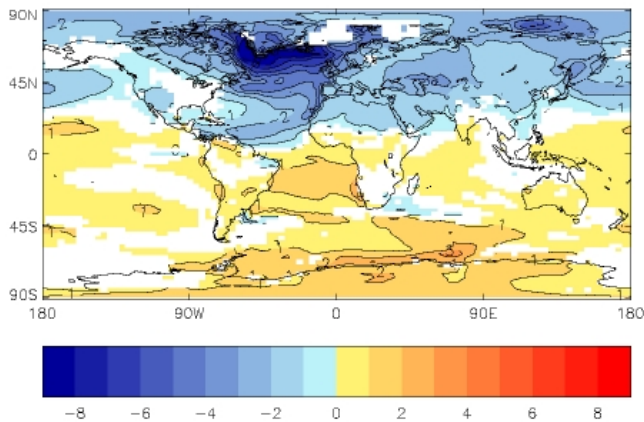


Fig. 7. Change in annual temperature 30 years after a collapse of the thermohaline circulation

C. Tidal Wave

Another contradiction of the movie : the famous wave destroying the city of New York, apparently created by an Atlantic storm. For scientists, to spawn such a huge amount of energy, it can definitively not be by a storm. In fact, you will need a devastating seaquake (bigger than the Asian one of December 2004) or an enormous meteorite hitting directly the sea surface [15].

D. Freezing Cyclone Eye

To conclude this movie analysis, I will end by the most absurd phenomenon invented in the film : Freezing Cyclone Eye. I was unable to find even a little paper on that, but there is no need to be a scientist to see it is rubbish (by the way, a cyclone starts its life on ocean not on ground). Anyway, it can be compared to the same hilarious super laser ray of the main UFO spaceship seen in *Independence Day* (film made by the same producer). From when laser beam aimed on the ground can create nuclear-like explosions ?

IV. POSSIBLE HIDDEN AIM OF THE FILM ?

Without being ingenuous, we can ask ourselves about a hidden aim of this movie. Although we all know the film was created to generate cash, it seems the author wanted to make American citizens (country from where he comes from) wondering about the Kyoto's protocol. As we know, there's only two major countries which haven't ratified the protocol.

These are USA and Australia [16]. Even if some scientists are dubitative concerning the protocol's efficientness, it is obvious until USA won't make the first step, no one will really make efforts to reduce pollution.

Word Count : 1573 words + 253 quoted

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