

Alex Plant
MA Candidate for Design Studies
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Faculty for the Creative and Cultural Industries
University of Hertfordshire
Tutor: Alan Peacock

Notes on "An Inconvenient Truth"

The film "An Inconvenient Truth" was made in 2005. It was directed by Davis Guggenheim and stars the former Vice-President of the United States, Al Gore, presenting a slideshow about global warming resulting from manmade pollution. The DVD edition was released in 2006 and features an update of new developments in the science of Climate Change.

The following notes paraphrase and abbreviate the scientific content of the film.

The Sun's radiation reaches Earth in the form of light waves, which heat up the Earth. Some of the energy that is absorbed is radiated back out into space in the form of infrared radiation. The layer of atmosphere around the Earth traps some of the outgoing radiation. This helps to prevent the Earth from cooling too much.

The thin layer of atmosphere is being thickened by the global warming pollution. This causes more of the outgoing infrared radiation to be trapped, so the atmosphere warms up worldwide.

Roger Revelle was the first person to propose measuring carbon dioxide in the Earth's atmosphere. In 1957 he designed an experiment where weather balloons were released from the middle of the Pacific Ocean every day. This location was selected for its remoteness. In 1958, the amount of carbon dioxide (CO₂) was first measured in the atmosphere.

Why does the graph go up and down each year? Very little of the land mass is south of the equator so most of the vegetation is north of the equator. When the northern hemisphere is tilted towards the sun, as it is in our spring and summer, leaves take in CO₂ reducing the amount in the atmosphere. When the northern hemisphere is tilted away from the sun, as it is in winter, the leaves fall and the amount of CO₂ in the atmosphere goes back up. It is as if once each year the earth breathes in and out.

Snow progressively melts on Mount Kilimanjaro. Within the decade there will be no more snow on Kilimanjaro.

In Glacier National Park within 15 years this will be the park formally known as Glacier. The Columbia Glacier in Alaska has retreated every year since 1980.

In the Himalayas in Nepal the AX010 Glacier is melting too. 40% of people in the world depend on river and spring systems that are fed more than 50% by glaciers. The melt water provides more than half the water in those systems. Those 40% will face a very serious shortage because of that melting.

In the Italian Alps the glaciers are melting. In Peru – South America Glaciers are melting. In Argentina glaciers are melting. In Patagonia – South America ice has melted to form a giant lake.

The message is of worldwide change.

Lonnie Thompson digs core drills in ice. When the snow falls it traps bubbles of atmosphere. Scientists can measure the amount of CO₂ in the atmosphere the year that the snow fell. The different isotopes of oxygen can be measured to determine a precise temperature the year that the bubble was trapped.

In Antarctica, core drills show when the US congress passed the Clean Air Act. There is a clear line of brown pollution in the years preceding and an abrupt absence of the brown just a couple of years after. This can be seen with the naked eye.

The years can be counted back year on year in the same way as the rings on a tree can be read. Annual layers form from, melting and refreezing. Mountain glaciers can go back 1000 years.

It can be seen that there has been an abrupt increase in temperature in the last 200 years or so relative to the last 1000 years.

There was a medieval warming period c.1000AD. This was very small in comparison to the warming effect we see today.

1000 years of CO₂ data correlates very closely with the same 1000 years of temperature data.

In Antarctica the ice cores can go back 650,000 years, 7 ice ages are shown. CO₂ never went above 300 parts per million. The temperature also follows the shape of the CO₂ graph. When there is more CO₂ the temperature gets warmer.

Today CO₂ is higher than it has ever been – way above the natural cycle – humans have done that.

In 50 years projections based on unrestricted fossil fuel use put CO₂ concentration at several times that in the last 650,000 years. Not a political issue but a moral one. It is deeply unethical to continue this way. That which we take for granted might not be there for our children.

The 10 hottest years on record have all occurred in the last 14 years. The hottest of all was 2005. 35,000 people were killed in Europe a couple of years ago by a massive heat wave. The same year in India the temperature went to 122F.

Ocean temperature is increasing. When oceans get warmer it causes stronger storms and stronger hurricanes. Hurricanes, tornados and typhoons are all different words for the same phenomena. The name changes depending upon which ocean the storm forms over.

Japan set an all time record of 10 typhoons in 2004. Usually Japan only has 7 typhoons a year.

Text books have said that it is impossible to have a hurricane in the south Atlantic, but in 2004 one hit Brazil.

As the water temperature increases the wind velocity increases and the moisture content increases.

"The era of procrastination, of half-measures, of soothing and baffling expedients, of delays is coming to its close. In its place we are entering a period of consequences." (Sir Winston Churchill)

One of the effects of global warming is that it causes more precipitation, and more of it coming in one-time big storm events. This is because water evaporates from oceans and puts more moisture into the atmosphere. When storm conditions trigger the down pour more of it falls. Insurance companies have noticed this. Their recovered losses are going up because of the damage from these server weather events. This is the situation in America and Europe.

Mumbai in India – July 26 2005: 37 inches of rain in 24 hours – water levels reached 7 feet – the most an Indian city has ever reached in one day – the death toll in western India reached 1000 people. (CNN.com 8/1/2005)
There was flooding in China as well.

Paradoxically, global warming causes not only more flooding but also more droughts. When one province of China was flooded its neighbouring province had a drought. Global warming not only increases the precipitation worldwide but it also relocates the precipitation.

Niger and Darfur, the part of Africa on the edge of the Sahara, have suffered unbelievable tragedy. There is a lack of rainfall and increasing drought. Lake Chad has dried up over the last few decades to almost nothing.

Global warming causes more evaporation off the oceans to seed the clouds but it also causes moisture to evaporate from the soil. Soil evaporation increases dramatically with higher temperatures.

The places people live have been chosen because of their climate pattern. The climate pattern has been fairly constant since the end of the last ice age 11000 years ago. The patterns are changing. This seems gradual in the course of a human lifetime. However in the course of time it is happening very fast.

The Arctic is experiencing impact from global warming. The Ward Hunt Ice Shelf is the largest in the Arctic. It cracked in half 3 years ago.

In Alaska trees put their roots down in permafrost. The melting permafrost causes the trees to lean over. These are called drunken trees. Buildings collapse as the permafrost thaws. The movement of the earth caused by melting permafrost has even damaged the oil pipeline to Northern Alaska.

The number of days a year that the Alaskan tundra is frozen enough to drive on is falling each year, from 225 days in 1970 to below 75 days a year in 2000. The spring comes earlier and the fall comes later and the temperature keeps growing up.

Since 1957 submarines have patrolled under North Pole ice cap. Radar has been used to determine the thickness of the ice. A submarine can only surface if the ice is no more than 3.5 feet thick. Al Gore persuaded the US Defence Department to release the data about the thickness of the ice sheet. The data starts in 1970.

Sea-ice extent has dropped by 1.5 million KM² since 1970. Extent and thickness has reduced. It has diminished by 40% in 40 years. 2 major studies suggest that within 50 years, in the summertime, the ice will be completely gone.

When the sun's rays hit the ice more than 90% bounce off back into space. The ice acts like a mirror. When the sun hits open ocean more than 90% of the energy is absorbed. As the surrounding water gets warmer it speeds up the melting of the ice. For this reason there is greater build up of heat in the Arctic than anywhere else on earth.

This is not good for polar bears. Some polar bears have been found drowned. They have to swim long distances of up to 60 miles to find the ice. This did not used to happen.

The Earth's climate redistributes heat from the equator to the poles. The ocean and wind currents do this. The climate is a non-linear system. Changes are not all gradual. Some changes come suddenly in big jumps.

World wide the average temperature is about 58°F. If the temperature increases by 5°F (low end of projections) the equator will increase by 1°F but the poles will increase by 12°F.

The ocean and climate patterns that have formed since the last Ice Age may change as a result of global warming. In the North Atlantic the Gulf Stream meets the cold winds from the Arctic coming over Greenland. Vapour is carried over Western Europe by the prevailing wind and the earth's rotation. The ocean current system is linked together in a loop called the ocean conveyor. Of the warm surface currents, the Gulf Stream is the best known, and cold deep currents at the bottom of the ocean run in the opposite directions.

In the north Atlantic, after the heat is taken out by evaporation, colder saltier water is left behind. The salt makes the water denser and heavier. The cold dense heavier water sinks at a rate of 5 billion gallons a second, pulling the current south.

At the end of the last ice age a giant glacier melted in North America. This formed a giant pool of water. An ice dam on the eastern border broke. The fresh water entered the ocean and diluted the salt. This caused the water to stop sinking and the pump stopped, the heat transfer stopped and Europe went back into an ice age for another 1000 years. The change from conditions similar today to those of today to an ice age took only 10 years – a sudden jump.

The North American glaciers are no longer there so that cannot happen again. But Greenland is close by and could potentially cause a repeat of that situation.

America is still by far the worst contributor to global warming greenhouse gasses.

"A number of very reputable scientists have said that one factor of air pollution is oxides of nitrogen from decaying vegetation. This is what causes the haze that gave the big smoky mountains their name." (President Ronald Ragen)

The peak arrival date for birds in the Netherlands in 1980 was 25 April. Chicks hatched on 3 June. This is the same time as caterpillars come out. 20 years of warming and the caterpillars peak 2 weeks earlier. The chicks tried to catch up; but they are in trouble. There are millions of ecological niches affected by global warming.

The number of days with frost in Southern Switzerland over the last 100 years has gone down rapidly. The number of new invasive species that have rushed in to fill the ecological niches is inversely proportional. This is happening in the US as well. Pine beetles used to be killed by the cold winters. There are now fewer days of frost and so the pine trees are being devastated.

There are cities that were founded because they are just above the mosquito line. Nairobi and Harare are examples. Now with global warming, mosquitoes are climbing to higher altitudes. Vectors for disease are expanding.

Coral reefs are bleaching; the fish that depend on them are also in jeopardy as a result. Species loss is occurring at a rate 1000X greater than the natural background rate.

Antarctica has the largest mass of ice on the planet by far. In 1978 a scientist friend told Al Gore that if you see the break up of ice shelves in Antarctica that should ring alarm bells as a sign of global warming. In the last 20 years several ice shelves the size of Rhode Island have broken up.

Black pools of water form on the Larsen-B ice shelf. The ice shelf is floating ice. Behind the floating ice is land with mountains. The ice shelf is about 25 miles wide. It was thought that the shelf would be stable for at least 100 years even with global warming. The scientists studying the images were astonished when in 2002 in a period of 35 days the ice shelf disintegrated.

When the sea ice melted it no longer held back the ice on the land. The land ice began to fall into the ocean. When sea ice melts it does not affect the height of the ocean much. However the land based ice that enters the ocean plays a big part in rising sea levels. Rising sea levels have made it necessary for people from some Pacific nations to evacuate to New Zealand.

In West Antarctica sea ice is propped up on top of islands so as the ocean gets warmer it has an impact on them. If they melted the sea the level would go up 20 feet. Greenland could also raise the sea level by 20 feet if it melted.

Water pools tunnel through ice shelves and make them like Swiss cheese. When a lake forms it creates a *moulin*. This is a hole through a body of ice. If the ice is on land the water flowing through the moulin to the bedrock acts as a lubricant and causes the ice to slip off the land and into the ocean.

Melting and moulins in Greenland are increasing every year.

Tony Blair's scientific advisor has said that because of what is happening in Greenland right now the maps of the world will have to be re drawn.

Imagine the impact of 100 million refugees as a result of rising sea levels worldwide.

In the Northern China coal belt there are open pit mines. There is also an enormous number of coal fired power stations in China because they re so profitable. The problem for China is the same as it is for the US. They are both using old technologies that are very polluting.

We are witnessing a collision between ourselves and the Earth. The population increase in the last 200 years is massive. It has taken 1000 generations to reach 2 billion. In one human lifetime 2 billion has become 9 billion. This creates more demand for food, water and natural recourses such as forest. 30% of the CO² that goes up each year is as a result of forest burning.

Old habits + old technologies = predictable consequences

Old habits + new technology = dramatically altered consequences.

Some times when we divert rivers for irrigation they no longer reach the sea. 2 rivers in Central Asia were used by the Soviet Union for irrigating cotton fields. They fed the Aral Sea. The Adriatic was the 4th largest inland sea in the world; it has now largely dried up, and there are now numerous fishing vessels sitting in the sand.

Making mistakes in our dealings with nature can have bigger consequences now as our technologies are on a bigger scale. Humans are a force of nature.

Global warming gas production: US 30.3% Europe 27.7%

Carbon emissions per person:

Africa	0.24
India	0.25
China	0.53
Japan	2.40
EU	2.40
Russia	2.72
US	5.60

(World Resources Institute)

Of 928 peer-reviewed articles on global warming 0 disagreed with the science. In the popular press 636 articles were written. 53% doubted the science. This confuses the public.

"It is difficult to get a man to understand something when his salary depends on his not understanding it."
(Upton Sinclair)

If we do the right thing we will create a lot of wealth and jobs balancing the economy and the environment. US cars are the least efficient. Japanese are the most efficient.

Toyota and Honda are Japanese and they are more profitable than American car companies GM and Ford.

Is the problem too big to do anything about it?

If we use a combination of technologies we can reduce our emissions to below those of 1970. These technologies would be: electricity and end use efficiency, other end use efficiency, passenger vehicle efficiency, other transport efficiency, renewables and carbon capture and sequestration.

Political will is a renewable resource. We can make choices to make our individual carbon emissions zero.

There are only 2 advanced nations in the world that have not ratified Kyoto. They are the US and Australia.

We have solved a global environmental problem before. The hole in the ozone layer was said to be an impossible problem requiring co-operation from every nation in the world. The US took the lead in phasing out the chemicals that caused the problem.

Our ability to live on Earth is at stake, to have a future civilisation. Future generations may ask what where we thinking.

An update with Former Vice-President Al Gore:

The DVD was made 1 year after the original film. There is now a lot of new evidence. Temperature increases have continued to set records. In the United States, Europe and Asia. New evidence has firmed the conscious even more.

Several new studies have firmed up the consensus of the link between global warming, higher ocean temperatures and stronger hurricanes. The heat energy drives energy into ocean-based storms.

There is no consensus linking the number of hurricanes to global warming. There is some indication that the number remains fairly steady. Global warming makes them stronger.

"There has been almost a linear increase in catastrophes occurring since global temperatures started rising in the early 1970s." (Michael Hawker, CEO of IAG, Australia's largest insurance company). This is a steady progression since the 1970s is the same period since ocean temperatures started going up.

If we continue to put 70 million tones of global warming pollution into the air every day oceans temperatures will continue to increase resulting in stronger storms.

July 2005 – June 2006 was the hottest 12 months on record in the US. Many all-time high temperatures records where set around the world.

A new study was released as work on the film was completed. Ocean temperatures affect coral reefs. As the temperature increases, the coral reefs are bleached. The whiteness is the calcium carbonate of the coral reef. Coral polyps make the reef. They take the calcium carbonate from the water and make the reef skeleton. Coral reefs have been described as the rain forests of the oceans.

There is another cause of stress for coral and other animals in the ocean coming from the chemical burden of the CO₂ entering the ocean. We pump 70 million tonnes of CO₂ into the Earth's atmosphere every day. 25 million tons is absorbed into the oceans every day. This becomes carbolic acid and changes the pH of the oceans, making it difficult for coral polyps to use the calcium carbonate they rely on to make the coral reefs.

Locations with ideal conditions for the formation of coral reefs are diminishing. In 1880, before the big impact of the industrial revolution, there were many more sites in the oceans with ideal conditions than there are today.

Many coral reef systems are now in water that is too acidic. If we continue business as usual, within 45 years the ideal areas will have completely disappeared and there will not be any even adequate areas. This will affect everything in the ocean that makes a shell. The entire food chain in the ocean can be completely disrupted. We have to stop putting all this CO₂ into the atmosphere.

Algae blooms are appearing in the Baltic Sea and elsewhere. Beaches have been closed because of the fish kills resulting from these blooms. Jellyfish are thriving in the new ocean environment. Japan has had tens of thousands of giant jellyfish appearing off its coasts.

The human population has exploded since World War 2. However the rate of increase is slowing down and the population of the world is likely to stabilise at 9.1 billion.

Greenland is one of the most interesting places on Earth to see the effect of global warming. It has the second largest volume of ice on the planet. Antarctica has the largest. The melting of parts of Greenland has accelerated. This may have a dramatic effect on worldwide sea level. Last year 50 cubic miles of ice melted from Greenland.

Glacial earthquakes have been noticed on Greenland. There were 193 between 1993 and 1999 the annual number of them had doubled from 7 to 15. From 1999 to 2005 the number doubled again. Last year there were 32 glacial earthquakes on Greenland. They measured 4.5 – 5 on the Richter scale. An earthquake measuring 5 is enormous. This is evidence of discernible changes on Greenland. Possibly because of the melting and the lubrication of the bedrock.

Global warming is linked with an increasing instance of wild fires all around the world. The number of these fires, the area burned and the damage caused is rising year by year. This is correlated with increasing temperatures. As the soil dries out the vegetation dries out. This makes the landscape more vulnerable to fire.

Lightning increases with increasing temperature.

Dryer vegetation + more lightning = more wild fires.

More wild fires = more CO₂

Businesses as usual will double CO₂ in less than 50 years. This will lead to a loss of soil moisture of up to 35% in parts of the US that are used for agriculture. If the CO₂ level were to quadruple, up to 60% of the soil moisture would be lost.

The Amazon is an important component of the Earth's environmental system. The Amazon River is drying up.

Melting permafrost in Alaska and Siberia is causing buildings to collapse, and the drunken trees phenomenon. In Siberia and Alaska there is a huge quantity of frozen CO₂ and methane that could increase the amount of global warming pollution if it melts. There is an area the size of France and Germany combined that contains 70 billion tons of methane that is beginning to thaw. The total amount of CO₂ in the Earth's atmosphere is 730 trillion tons. Most of it is there because of human activity. If we allow this area to melt, in a short period of time the CO₂ in the atmosphere could double. If we cross that tipping point the problem will become even harder to solve.

There is a growing consensus of the truth of global warming since the film was made. There is also more pollution. US public opinion is shifting decisively towards a point of facing up to the crisis. We can solve this and improve our economy. Political leaders and business are changing their positions. We can change this.

Ten things to do:

1) Change a light – Replacing one regular light bulb with a compact fluorescent light will save 150 pounds of carbon dioxide per year.

2) Drive less – Walk, bike, carpool or take metro transit more often. You'll save one pound of carbon dioxide for every mile you don't drive!

3) Recycle more – You can save 2,400 pounds of carbon dioxide per year by recycling just half of your household waste.

4) Check your tyres – Keeping your tyres inflated properly can improve gas mileage by more than 3%. Every gallon of gasoline saved keeps 20 pounds of carbon dioxide out of the atmosphere!

5) Use less hot water – It takes a lot of energy to heat water. Use less hot water by installing a low-showerhead (350 pounds of CO₂ saved per year) and washing your clothes in cold or warm water (500 pounds saved per year).

6) Avoid products with a lot of packaging – You can save 1,200 pounds of carbon dioxide if you cut down your garbage by 10%.

7) Adjust your thermostat – Moving your thermostat down just 2 degrees in winter and up 2 degrees in summer could save about 2,000 pounds of carbon dioxide per year.

- 8) Plant a tree – A single tree will absorb one ton of carbon dioxide over its lifetime.
- 9) Turn off electronic devices – Simply turning off your television, DVD player, stereo, and computer when you're not using them will save thousands of pounds of carbon dioxide per year.
- 10) Be a part of the solution – Learn more and get active at www.ClimateCrisis.net.