# **Boiling Point**: An Independent Study on Global Warming

By Micah Siegel

As I sit in the pottery room at the Ecole looking out past clay figurines and gray cement walls, I see some of the only snow clouds so far this year hovering over a greenish-gray landscape. Isn't this a bit strange? I am in Switzerland, in the dead of winter, and there is not a flake in sight. Only dingy mounds of crystalline ice packed together by the many footsteps of ecolianers. In the place of snow there are the first green shoots of grass pushing though the muddy earth as if it were April! Spring has come early, so early in fact that there has barely been any winter.

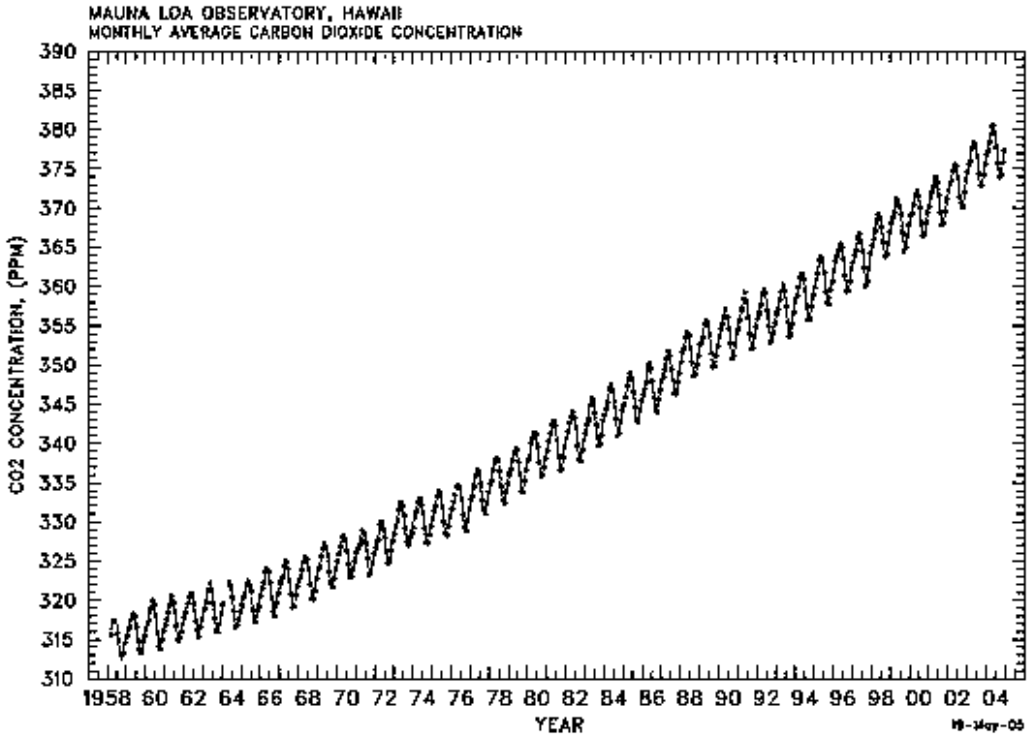
Why is this happening? How is this happening? How will it affect us? How long will it last? Can we change it? These queries run rampant though my mind with a mounting fear boiling up behind them. Is this Global Warming?

The answer to the previous question has become clear to me though half a term of being glued to books and scientific journals on climate change and global warming. We are, in essence, securing our species' own doom, and damning the generations of the future with irresponsible actions in regard to our environment. We talk of future generations while pouring billions of tons of carbon dioxide ($CO_2$) into the atmosphere. We talk about curing disease while acres of rainforest are burnt to make space for the grazing of McDonald's cows. We complain about bad skiing conditions while using snow cannons to cover the dirt and grass. Somehow, somewhere, an integral part of the message has been lost in our rat-race society. We seem to have forgotten to measure the long-range consequences of our actions along with their short-term benefits. We, as a society, have failed to see the subtle and lasting effects of our influence on the environment. With the choices we have made, we are irresponsibly draining the possibilities of future generations, and of our own.

Is impossible to change anything without understanding what actually it is that is turning our planet into a pressure-cooker. The effect of the earth heating up is called global warming, and the process that causes this is inconspicuously called "The Green House Effect". It really is quite simple. Normally, the gasses of our atmosphere trap heat to keep the average global temperature at a balmy 59 degrees F. Some of the heat is radiated back into space, and thus our planet's temperature is kept relatively stable. This works because heat is trapped in the lower atmosphere, which mostly contains water vapor, carbon dioxide, oxygen, methane, nitrogen and a host of other gasses. As the temperature increases, more water evaporates causing more water vapor in the atmosphere, causing further warming. This heating is a strong positive feedback loop, and, in moderation, is necessary for our existence. Without our atmosphere and the green house effect we would be living at a chilly average of –4 degrees F. The problem we are now faced with is that human activities are changing the chemical makeup of the atmosphere, thus changing how much heat is trapped and how much heat can escape (Suplee 46).

Carbon Dioxide is a main culprit in global warming. Its presence in the atmosphere stops heat from radiating back out to space, and instead reflects it back to the earth's surface. This is dangerous for earth's delicate balance. Since the dawn of the Industrial Revolution, atmospheric $CO_2$ has increased by a tremendous 30 percent. This means seven billion more tons of $CO_2$ each year (Suplee 68)! The incredible increase in

the presence of $CO_2$ as a result of burning fossil fuels is responsible for 60 percent of the warming since 1850. At the Mauna Loa observatory in Hawaii, the $CO_2$ concentration has been measured daily since 1958. In each year the concentration of $CO_2$ rises and falls in respect to the earth's angle to the sun. In the summer, there are more leaves, so more photosynthesis takes place, and in the winter, the concentration rises. With these yearly fluctuations in mind, there is still a very sharp average increase in $CO_2$ concentration. This graph shows the increase.




The concentration of $CO_2$ has increased by a staggering three percent per year and is now 30 percent higher than it was before the industrial revolution. If these rates continue, by the end of the 21st century, $CO_2$ levels could be four times as high as before the Industrial Revolution. Carbon dioxide is especially dangerous for our sensitive atmosphere because it has a lifetime of more than 100 years. This means that it takes a $CO_2$ molecule 100 years to cycle out of the atmosphere and back into another form, while something less detrimental like water vapor is only in the atmosphere for about 8 days (Suplee 46).

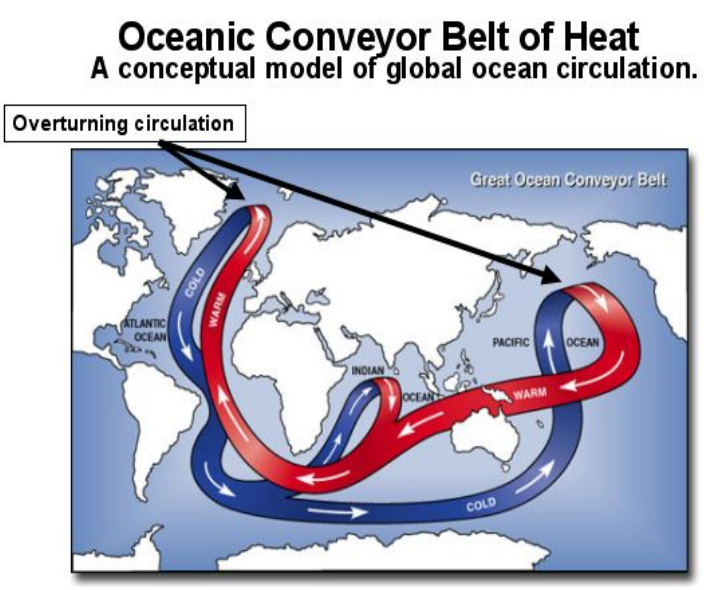
Periods of relative warming and cooling have occurred since the last ice age, about 10,000 years ago, but this 20th century warming is alarming because it is so drastic, (1 degree F), sudden, and widespread (Suplee 48). Although one degree doesn't seem like much, this one degree is an average change throughout the world. The truth of situation is that the warming is not evenly distributed around the globe. The warming at the poles is significantly more dramatic than that on the equator. Over the last 50 years in Alaska, western Canada, and eastern Russia, the average temperature has risen four to seven degrees F. That is two times the global average (Handwerk 1)! Although we like to think that the climate so far north has nothing to do with us, we are sadly mistaken.

The polar climate is central to the healthy function of our environment and weather patterns in other parts of the world. Arctic ice absorbs an immense amount of

heat, but each decade since 1978, this ice has shrunk by nine percent, and become significantly thinner (Handwerk 1). This is not only threatening for polar ecosystems, but for the entire biosphere.

There are two major effects of melting ice on the poles. The first is the more obvious. As the ice on land melts, it adds to the volume of the oceans. This in turn forces the sea level up. The IPCC (Intergovernmental Panel on Climate Control) estimates that the average sea level has risen four to eight inches in the last century, and that it could rise up to 35 more inches by the end of the century. An increase of just 12.5 inches would cause an average loss of coastline up to 150 feet. To get an idea of how much water is actually held in these massive ice sheets, imagine that Greenland's ice sheets alone hold enough water to raise the average sea level 23 feet (Handwerk 2)! This would be devastating for coastal nations all over the world. From Bangladesh to the Netherlands, Florida to Japan, the effects would be catastrophic.

The more subtle effect of the melting ice is that the poles help control the global climate systems, and with warming at the poles we are putting ourselves at risk of even more damage. The "conveyor belt" is a prevailing oceanic system that brings warm water from the equator and tropics north, keeping Europe warm. Higher temperatures caused by the green house effect increase the melting of ice sheets such as Greenland, and the melt water dilutes this oceanic belt. Normally, the belt cools as it flows northward, and much of the water is evaporated. This increases the salt concentration because there is less water, and thus the water rapidly sinks to the bottom of the ocean once it is cooled and flows south again. This happens because cold water is denser than warm water, and salty water is denser than fresh water. The difference in temperatures and salinity creates a continual flow of water and weather systems like a pump. Scientists refer to this as the thermohaline pump.




Global warming is causing a change in temperature between the warm water flow north, and the cold flow south. The warm flow south is not cooled as much when is reaches northern Europe, so it sinks at a slower rate, and thus the whole conveyor belt is slowed down. The conveyor belt is also slowed because the amount of fresh melt water from Greenland and the poles is increasing as a result of global warming. This makes the belt less salty and it sinks more slowly. The conveyor belt supplies Europe's precipitation, and the decreased momentum of the belt causes more rain over the oceans and less over the land. This rainwater dilutes the salinity of the northward flow, slowing

the belt more. If the salinity is diluted too much, the conveyor belt STOPS! This means no moving heat from the equator northward causing a deep freeze in Europe (Gore 151).

The North Atlantic Oscillation is a system of air and water warmth distribution that controls the weather and climate of Europe. It functions based on an air pressure gradient between the sub-polar Icelandic low, and the high in the Azores. There are positive NAO phases and negative NAO phases. When the NAO index is strongly positive, the temp and pressure shift to more positive and thus there is a general lessening of atmospheric moisture at higher altitudes (Beniston 2). An increase in pressure during the positive phase of NAO corresponds with more frequent and stronger winter storms crossing the Atlantic, which results in higher temperatures in northern and Western Europe. Small low-pressure differences result in cold winters (Straile 1432). Changes in the monthly average airflow over the Atlantic are accompanied by a northward shift in storm tracks. These changes reinforce and maintain unusual average circulation in the atmosphere (Loon 2). There are sediment records of the conveyor belt system and the NAO stopping just after the last ice age, causing a mini ice age in Europe (Suplee 49). Recent climate models show that more intense and unpredictable weather is a result of changes in this system today (Handwerk 2).

The intense weather we have seen in the last five years is a direct result of global warming and changes in the conveyor belt system. For instance, the European heat wave of 2003 killed 20,000 people. Careful analysis by the Intergovernmental Panel on Climate Control (IPCC) of this heat wave showed that it was caused by an increase in green house gasses, and projects such temperatures to be a norm by 2050 and to be cool by the end of the century (Handwerk 3). Ice core records show that in the last 100 years times of unusually warm weather have increased significantly, and more profoundly than in the 1,000 years before (Gore 63). These increases are said to have caused the more frequent intense weather of the last ten years. In the summer of 2005 the southeastern coast of the US was hit with an unprecedented number of strong hurricanes, while Europe was plagued with floods (Gore 105-7). Because warm air holds more water than cold air, and temperatures are predicted to rise between two and seven degrees in the next 100 years, we can expect more rain, less snow, and more intense storms more frequently. Drought, and heat waves along with a plethora of other problems will also become more frequent (Suplee 52).

So how does global warming affect us here in the richest countries in the world? The climate in Europe changes the most from unusual atmospheric pressure when the NAO is at its strongest (Straile 1432). Since 1980, the NAO has stayed in a strongly positive phase and has caused a big part of the land surface warming over Europe in the winter, and cooling in the Northwestern Atlantic. Over the past 130 years, the NAO has shown much variability in fifty year and five year increments. In the last 50 years, the five-year time scale changes have become more intense (Loon 1). This explains the dry winter in southern Europe and the Mediterranean, and wetter-than-normal in northern Europe and Scandinavia (Loon 2).

Now the question is what does all of this pressure jargon mean? To better explain this phenomenon, I will use the Hasliberg, as most of you are familiar with it. Over the years, there have been some “sweet powder-dump years”, and occasionally there have been a few winters when the snow didn’t come until much later. These fluctuations are due to the quasi-decadal changes in the NAO. But in the last twenty years these snow-

sparse winters have become more and more common. Of course there are some years with lots of snow, but they are fewer and farther between. Now the winters start later, end earlier, and have less snow than ever before (Straile 1432). But why? In a recent article published by the University of Konstanz in Germany, the reason is stated very clearly, "The observed change in the NAO during the past decades towards a more positive phase is suggested to be beyond natural variability and is likely due to increasing atmospheric gasses" (Straile 1432). In essence, global warming is changing the pattern and intensity of the NAO, and this, in turn, is changing our climate. In another study conducted by The American Geophysical Union, it was concluded that increasing trends in mean temperature explain almost all modeled decrease in snow trends. The article stated, "Global change related trends to more frequent positive NAO index winters in the 21st century indicate a stronger decrease in low altitude snow cover than expected from a global mean increase alone" (Scherrer 3-4). This means that the NAO has a profound effect on the weather and climate, and that the NAO is affected by global warming trends.

What do these changes mean for life on the Hasliberg? For many Haslibergers, income is based on snow tourism, and farming which are both strongly affected by the weather and climate. The ski fields are extremely vulnerable to minor shifts in temperature. If the temperature were to warm two degrees Celsius, the average snow reliability would decrease from 85 to 63 percent. This unreliability in snow conditions would gravely threaten the regionally based economy (Koeng 46). Two degrees Celsius would also bring the snow line up 300 meters in the central Alps and 500 meters in the pre Alps. Two degrees would also mean that only ski areas with a minim altitude of 1500 meters would be able to run at the 100-day season minimum to keep them afloat financially (Koeng 51).

To combat the problem of sparse snow, many ski areas use snow cannons to "fill in the bald spots". The problem with these cannons is that in many ways they are making the lack of snow worse. It takes an immense amount of energy to run a snow cannon and an exorbitant amount of water to make enough snow to ski on. The catch-22 of this is that by making snow, the energy companies have to make more electricity. This then pollutes the environment, and thus adds to global warming which was the problem in the first place!

With the first snowfall one month later, less intense, and melting faster it is hard to imagine places like the Hasliberg staying financially viable (Koeng 49). Decreased snow would be catastrophic for everything from hotel business to water supply to alpine ecosystems, and is expected to get worse.

Heinz VonBergen is the local water expert on the Hasliberg, and he agreed to talk with me about the changes he has witnessed here over his long career at the Ecole and as part of the water commission. One big problem he has noticed that has gotten more intense in the last few years is landslides. In the last year there have been three significant landslides on the Hasliberg and Heinz postulates that the change in temperature is a main factor.

Just after one landside came down over Wasserwendi, Heinz put his hand into the freshly exposed soil. He said that the soil was extremely cold, which is indicative of water. He explained that usually there is a strong lattice of ice within the earth that provides a solid structure for the soil and vegetation to cling to. With rising temperatures

this ice has melts so quickly that the land can no longer support itself on steep slopes. It slides, taking with it vegetation and valuable land for grazing, skiing, and hiking.

Heinz also talked about the sun's intensity and effect on the land here on the Hasliberg. Because the rays are stronger, and the temperatures ware warmer, the soil dries out much faster. This is a problem for the water systems on the Hasliberg because more water from the reservoir is used to irrigate. Drier soil also means that when intense storms happen the earth is not able to withstand the impact of more water and more landslides will result. Changes in global weather patterns are causing more frequent intense storms, and these storms are causing more erosion here on the Hasliberg.

Heinz explained that people and water are alike in that they take the path of least resistance, and that this perspective is what is causing the irresponsible actions that lead to global warming. In the early days on the Hasliberg the kitchen and one room in a house were heated by ovens and the rest of the house remained cold. Now we heat every room from basement to ceiling, forget to turn off lights and waste an immense amount of energy in the process. For Heinz, the problem of global warming is more about how we as human beings are centered on being comfortable. He brought the example of how here in the Ecole we no longer shower cold and all together, and that the comfort of taking a private warm shower is at the cost of an immense amount of energy.

We will have to learn to change our habits and be more gentile with our environment in order to avoid major problems in the near future. Now the questions on our minds revolve around change. How can we heal the environmental damage we have caused? What can we do to lessen our environmental impact? Can one person make a difference?

Yes! We can make a difference. Maybe our individual changes will not change the whole globe, but if we can raise awareness, and through that awareness get people to take responsibility, and continue still one step further, we can act. We can make a profound difference. In order to start making changes, we need to know where to begin. This is a daunting task, but the truth of the matter is that we don't have to go live in tents with no electricity and eat grass, we can make much less drastic changes in our own homes that will actually make our immediate quality of life better, and will help in lowering earth's fever.

For instance, something as minor as changing a light bulb can change the course of environmental history, and put some money back in our own pockets. Lighting is responsible for 1/5 of all energy used (Gore 306). A compact fluorescent bulb uses 66 percent less energy and lasts ten times longer than a regular bulb (Gore 306). On top of saving energy and trips to the store to buy more bulbs, compact fluorescent bulbs save money. Although they are initially more expensive to buy, having four of these light bulbs saves on average 30 dollars a year after factoring in the cost of the bulbs' themselves. Over the four bulb's lifetimes, they save 205 dollars (National Geographic 2). Imagine what you could do with 205 extra dollars! If every household in the US replaced a single burnt out light bulb with a compact fluorescent bulb, 13 billion pounds of $CO_2$ would be prevented from being emitted. That is the equivalent to taking 1.2 million cars off the road each year (National Geographic 2)!

Frivolous water use is also a waste of energy. That leaky faucet in your bathroom may seem trivial, but it can waste 30 gallons of water every month. Just the difference between a ten-minute shower and an eight-minute shower saves 300 gallons of water

each month. Simply installing aerator showerheads can save an average of 11,000 gallons of water every month in a family of three (National Geographic 2).

Here are some other very simple changes we all can make that will improve energy efficiency and many will save you money as well.

- Set the sleep feature printers and computers for five minutes. (save 22 dollars per year in energy costs)
- Keep your car tuned (this could improve efficiency 15-50 percent)
- Support alternative energy sources
- Buy things that last
- Reduce packaging
- Recycle
    - grocery bags
    - paper
    - clothing
    - glass/paper/plastic/aluminum etc.
- Compost
- Use your own water bottle and coffee cups
- Eat less meat
- Buy locally
- Vote prudently
- Invest in eco friendly companies
- Support environmental groups
- Walk or bike instead of driving
- Carpool if you can
- Use public transportation
- Buy hybrid, bio-diesel or ethanol fueled cars
- Buy carbon offset if you fly (betterworld.com/travel/index.htm) (Gore 310-11)
- Look for "energy star" appliances when you buy new,
- Run full loads of laundry and dishes
- Use a clothes line instead of a dryer
- Insulate your house, (National Geographic3)
- Unplug appliances when you're not using them (Gore 307)

Don't become complacent. ACT! Act on the behalf of our precious environment, on the behalf of our future generations, and for our own. Act for the people who have no choice, for the animals and rain forests that have no say in the matter. Do not turn a blind eye. Now you know, so do something, big or small, and spread the word.

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