Climate Control

by

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ABSTRACT

Global climate change and its effect on our environment is a concern that affects our collective cultural conscious. Understanding and developing a relationship to this problem is key to uncovering solutions and inspiring change. Research was conducted into significant artistic approaches to environmental issues. This research begins with Nineteenth Century landscape painting, continues through Earthworks and Green Remediation, and ends with the contemporary practices of Eco-visualization and sustainable technology in art.

Based upon this research, three new works related to issues of climate change were created. These works are: *The Hottest Year on Record* - a sound art installation composed of sonified global climate temperature data, *SUNflower* - an eco-visualization of energy generated by a photovoltaic solar array, and *Climate Control Weather Damage Modification Program* - an interactive installation that metaphorically acts as an interface to climate, allowing the user to adjust an imagined climate. Documentation of the process of creating this work as well as its culmination into a one-person art exhibit entitled “Climate Control” is presented. Through audience perception and interaction the goal of this new work is to enhance sensitivity of the issues involved, inspire critical thought about solutions and recognize the beauty inherent in the real-time climate occurring outside the gallery walls.

1. Introduction

Humankind's desire for control and understanding has shaped the human expansion into the natural world, and it is this same desire that allows humanity to continue to live and prosper within it. One of our most natural traits is that of domestication: to develop an understanding of our natural world in order to transform it, to make it fit our desires and reign over its idiosyncrasies. Through the use of new technologies that measure and record information about our environment, we are being informed that we now stand at the threshold of another of Nature's great reprisals. We are now nesting into a new home, attempting to domesticate our hunger, parent our genetic code, and generate sustainable resources.

Western civilization is currently in the waning days of the industrial era, as we know it. Industrial mass production has provided sustenance for the growing population of Earth, but has also left a trail of pollution and depletion of natural resources in its wake. The artist's role as interpreter, conveyor of meaning, and teacher plays an important role in producing evidence of our impending trial with Nature. The scientist produces the facts – the truth, as we know it – while the artist reveals relations. Together they have a symbiotic relationship. Yet, as Joseph Beuys states in his *Energy Plan For the Western Man* (1974), "… a well ordered idea of ecology… can stem only from art – art in the sense of the sole, revolutionary force capable of transforming the earth, humanity, the social order, etc. This is because at the moment, none of history's developments, including those regarding the notion of exact science, have been capable of facing this fundamental problem [of ecology]… man's creativity is the real capital of a society."[1] Therefore, a role of the artist is to bring forth the creativity needed to inspire solutions to contemporary ecological dilemmas.

2. Historical Review

2.1 Origins of Eco-awareness in Art

Artistic depictions of the human 'place' within Nature can be traced to the earliest known works of art, such as those recorded on the cave walls of Chauvet, France, 30,000 years ago. While it can never be known, it can be hypothesized that these early cave painters were keenly aware of their relationship to the natural world that provided their sustenance. When these early artists reproduced the image of their hand appearing next to the images of their prey, I believe this revealed their understanding and reverence of the power that the human hand holds.

While many works focused on the relationship of humanity to Nature have been recorded throughout history, my research begins with the landscape paintings of the early nineteenth century. Of particular interest were paintings that I believe represented the destruction caused by industry upon the wilderness and the first works to express concerns for the protection of ecosystems from industry. In addition, these paintings, whether depicting pastoral scenes or wilderness, became symbols of a new relationship of humanity to Nature.

2.1.1 Postcards From the Wilderness

In America, artists influenced by the European Romantic movement, began to explore the wilderness of the American landscape. During the period of 1825–1875, these painters were producing works uniquely American and represented a growing sense of nationalism in the young country.[2] A leading artist of this new movement was Thomas Cole. He became concerned with the habitat destruction to which he was a witness. Cole's philosophy was "to illustrate the progression of culture from 'savagery' to high civilization and back to the natural landscape… nature was always the perfect spiritual state and 'progress' must be tempered by careful and gradual development of a nation's resources; subduing the wilderness must not mean rampant destruction."[3]

Cole further speaks of his concerns in his "*Essay on American Scenery*" written for American Monthly Magazine, 1836: "I cannot but express my sorrow that the beauty of such landscapes are quickly passing away – the ravages of the axe are daily increasing –

the most noble scenes are made desolate, and oftentimes with a wantonness and barbarism scarcely credible in a civilized nation."[4] In his essay "Thomas Cole's *River in the Catskills* as Antipastoral," Alan Wallach points out Cole's animosity for this environmental destruction in Cole's painting, *River in the Catskills* (1843). "The foreground, with its tangled array of logs and stumps, a grove tree reduced to 'fragments,' has the appearance of a tree massacre, and, in accord with the conventions of the prospective view, the man with the axe – a 'wood butcher,' looks to the future."[5]

Figure 1. *River in the Catskills* (1843) by Thomas Cole (detail).

It is not surprising that the rise of landscape art came at a time when the world was in the midst of the Industrial Revolution. To the nineteenth century artist, the landscape represented power, spirituality, and reverence; and yet to the industrialist of the era, the landscape was a resource to be exploited. This clash of ideals carries through to the artwork of today, where artists are inventing new ways to protect and preserve Nature from the industrialist. The image of a landscape has become an iconic representation of

the wilderness – of an ecosystem. Landscape becomes an artistic motif that reappears and is reinvented by artists throughout recent history to express concerns for the environment.

2.1.2 Postcards From the Moon

In the mid-1960's, over one hundred years after the works of Cole and in sync with a growing environmental movement, a new form of landscape art began to emerge in the art world. This work, known as "Earthworks" or "Land Art" originally grew from artists' dissatisfaction with the art scene of the time. According to Michael Heizer, an early pioneer of Earthworks, art had to become "radical, it had to become American."[6] These works primarily exist as permanent, large-scale, non-natural forms sited in wide-open spaces, as opposed to particular natural environments, such as along a river, amidst a field, or in an urban setting.[7] As such, Earthworks were initially more concerned with being anti-art or anti-art establishment than they were with the preservation of ecological systems. They represented artist's desires to break out of the white walled galleries and museums.

Ironically, however impressive these projects were in scale, they were mainly experienced in documentary form (film, photography) and as documentations, still found their way back onto the white walls of the gallery. In this way they were similar to the landscapes of Thomas Cole: idyllic images of constructed landscapes. The difference however, was that in the 1960's, society's vision of the world began to change. Perhaps it was the images of the Earth (taken from satellites and astronauts traveling through space) that caused people to begin to see the Earth as a finite, interconnected landscape in need of our care and attention. Or as environmentalist and philosopher David Rothenberg suggests, this awareness stems from the invention of the atomic bomb. "We possess the technology to destroy ourselves and our world, so the earth no longer seems eternal. We have a much harder time imagining immortality for ourselves or for the range of nature."[8] The land that had been the inspiration for Cole, in his time seen as vast, mysterious, and omnipotent, just over a century later became exactly the opposite: fragile, scarred, and finite.

While Earthworks were generally concerned with form, site, and scale, Robert Smithson's work gradually came to symbolize deeper meanings and connections with the Earth and ecology. The concept for Smithson's most famous work, *Spiral Jetty* (1970), was that of entropy – the ever-increasing loss of energy. His concept tied art "to the laws of entropy, which made it a function of time and space, [where] it should be perceived as dynamic instead of motionless."[9] Earthwork art represented human's dominance over the land; the ability to wound, stab and transform the land into their artistic vision. However, Earthwork artists soon realized that their work could also act as a scab – to heal the land.

Just before his death in 1973 in an airplane accident, Smithson had begun to imagine his Earthworks as more than mere monuments. He began to think of them as reclamations. In his proposal for the reclamation of a strip mine in Egypt Valley, Ohio, Smithson states, "Our ecological awareness indicates that industrial production can no longer remain blind to the visual landscape. The artist, ecologist, and industrialist must develop in relation to each other, rather than continue to work and produce in isolation. The artist must come out of the isolation of galleries and museums and provide a concrete consciousness for the present as it really exists, and not simply present abstractions or utopias."[10]

Alan Sonfist, considered a purist for his beliefs about ecology, created *Time Landscape* (1978). This work stands in stark contrast to the work of Smithson. Rather than being located in a remote, desolate area, *Time Landscape* is located in the heart of the NYC art scene, at the corners of La Guardia Place and Houston Street. *Time Landscape* is not merely a removal or rebellion from the white walls of the gallery; it *is* the landscape's reclamation of native territory. Through researching the botanical and geological history of Manhattan, Sonfist designed a park that would represent the type of plants, rocks, trees, soil, and shrubbery native to Manhattan Island before manmade structures began to appear in the eighteenth century.[11] It functions much like the paintings of Cole, bringing the image of the wilderness back into the urban setting. For almost 40 years, Sonfist has dedicated his work to linking city-dwellers and suburbanites to a nature that civilization has destroyed, with the hope that a greater appreciation of nature would encourage them to protect its future.[12]

Continuing the work of reforesting the city, Joseph Beuys proposed *7000 Oaks* (1982 – 87) to be presented at Documenta 7 in Kassel, Germany. His proposal: to plant 7000 oak trees in urban areas between the opening of Documenta 7 in 1982 and the opening of Documenta 8 in 1987.[13] Beuys described his piece this way: "It is a new step in this working with trees. It is not a real new dimension in the whole concept of the metamorphosis of everything on this earth and of the metamorphosis of the understanding of art. It is about the metamorphosis of the social body in itself to bring it to a new social order for the future…"[14] Beuys saw his work as much more than just visual art or a 'happening.' He anticipated a time when the arts would transform not only thought and action, but also the systems of economics and government.

> *"There is the threat of total destruction of our fundamental natural basis. We are doing exactly what it takes to destroy the basis by putting into action an economic system which consists in unscrupulous exploitation of this natural basis… Between the mine and the garbage dump extends the one-way street of the modern industrial civilization to whose expansive growth more and more lifelines of life cycles of the ecological systems are sacrificed."*[15]

Beuys' vision of a society transformed by art is, perhaps, to be realized far into the future. However, artists have begun to create work as a model for systems that provide both economic and ecologic benefits.

2.1.3 From Reclamation To Remediation

A new generation of artists has begun creating work that functions as a part of an interconnected system. These artists work with Nature's ability to heal itself, to remediate, and cooperated with industry by completing an ecosystem and in some cases adding to the economic benefits of industry. Hans Haacke was one of the leading artists interested in working with ecosystems as art. Experiments with wind, water, temperature, and light led to artwork that conceptually represented a natural system's ability to rehabilitate itself, as exemplified in *Rhinewater Purification Plant* (1972). *Rhinewater*, an installation located at the Museum Haus Lange in Krefeld, Germany, consisted of polluted water samples collected from the local sewage treatment facility, wherein Haacke employed a system of filters that purified the water before it was pumped into a large fish tank full of goldfish.[16]

Sometimes Haacke is criticized for his work not being aesthetically pleasing: "Why was this art, if it did not transcend the level of factual information."[17] The greatest strength of the piece, the 'art', was that the audience, which in this case consisted of mainly local residents that drink the water from the Rhine, was able to visualize both the pollution of their water supply and its remedy. The artwork's 'transcendence' came from the hope that it would inspire the audience to take action and call for remediation on a larger scale.

An artist who accomplished remediation on a larger scale was Betty Beaumont with her piece, *Ocean Landmark* (1980). Out of sight and not easily accessible, *Ocean Landmark* is submerged under 70 feet of water located on the continental shelf, 3 miles from the shore of Fire Island National Seashore, NY.[18] Beaumont's goal was to recycle coal-fly ash (a byproduct of burning pulverized coal in a coal-fired boiler[19]) by converting it into bricks that could be dumped into the ocean, creating an artificial reef that would provide a sanctuary for fish. Instead of existing in opposition to industry or only reclaiming industrial waste, *Ocean Landmark* becomes an industry itself: one that manages waste and helps replenish the fish population. In this way, it is a realization of the 'system' that Joseph Beuys envisioned.

In a similar vein, sculptor Mel Chin composed *Revival Field* (1990–93). *Revival Field*, an ongoing, site-specific sculptural piece, used special plants to decontaminate a landfill. In biology the process is known as 'green remediation.' For this project Chin teamed up with scientist Rufus Chaney, a metals specialist from the USDA's Agricultural Research Service. Together they researched and designed a garden with plants that would filter the zinc, cadmium, and lead found in the soil covering the Pig's Eye Landfill in St. Paul, Minnesota.[20] These plants, known as hyper-accumulators, are able to absorb certain metals from the soil in which they are planted, therefore demonstrating possible uses for environmental clean up.

Chin, struck by the "poetic nature of the process"[21] designed a chain-link metal fence surrounding the treated space, with the plants arranged in the shape of an 'X'. According to Chin, the 'X' is a 'target' to be seen through the scope of a rifle: targeting the Earth. In reality, the artistic merits of this piece are not in the visual or sculptural design, nor is it in any ritualistic performance carried out in celebration of the

installation of the work: the goal was to educate and create awareness through community involvement. It was this artistic proposal for the work that garnered the funding for the project via the National Endowment for the Arts. In fact, Dr. Chaney had tried unsuccessfully for several years to receive support for this research through traditional scientific research grants. Not only is *Revival Field* emblematic of the possibilities of collaborations between art and science, its very existence depended upon it (although it should be noted that the NEA no longer supports such work).

These artists possessed the remarkable foresight to find artistic solutions to environmental disorders. They have paved the way for a new movement of artists to redefine art – an art that recognizes the beauty of Nature through the act of preserving it.

2.2 Contemporary Influences

> *"The larger struggle we are witnessing today... [is] an ecological drama where the outcome rests not only on our realization that the natural physical environment is one and the same as our bodies, but that nature itself is a form of Mind."* – Bill Viola

Technologies are emerging. Many of today's eco-artists are dreamers of a new technological revolution that addresses ecological concerns the past Industrial Revolution was either too exuberant to recognize or too greedy to claim responsibility. These artists are bringing these dreams from somnambulism to reality. Through questioning, defining, and refining the tools of industry - an industry of speed, information, communication, immersive and global environments - artists are helping to teach society how to use the tools to build a more sustainable world. While there are diverse artists and artworks that encompass eco ideas, I have chosen to categorize examples relevant to my work into three areas: eco-visualization, engineered ecology, and sustainable electronic art.

2.2.1 Eco-visualization: Revealing Consumption, Seeing the Storm, Predicting Events

Eco-visualization, as defined by artist Tiffany Holmes, “provides new strategies for localized energy conservation that combines both artistic and scientific information to produce new forms of dynamic data representation. Eco-visualizations are designed expressly to promote resource conservation and a positive connection to nature.” [22]

An example of Holmes’ eco-visualization is her piece *Floating Point* (2004), which is concerned with visualizing water quality. Referring to Rachael Carson, Holmes says of her role as an artist: "I seek to emulate Carson's role as a catalytic agent to disseminate the results of current scientific research in works created for an everyday audience: art installations, media performances, as well as articles and papers."[23] *Floating Point* was realized during a residency at the Swiss Federal Institute of Technology (ETH). There she devised an instrument filled with sensors that would float on the surface of water and record information about the temperature, dissolved oxygen, pH, turbidity, and conductivity of the water. This information was then transmitted to a computer for real-time visualization of the information.[24] For her visualization, she uses the pixel as a metaphor for water, stating "Water is an essential resource for life; the pixel is the basic unit of the screen."[25] As her piece animates, images reveal the amounts of dissolved oxygen that can be found in the water as well as the water temperature, pH, and nitrates present.

In homage to Joseph Beuys' *7000 Oaks*, Holmes' latest work (in progress) *7000 Oaks and Counting* (2007) is an interactive kiosk displaying real-time data visualizations, located in the lobby of the newly built National Center for Supercomputing Applications in Urbana, IL. Through visualizing data collected from the building's internal monitoring system, *7000 Oaks and Counting* seeks to raise ecological awareness by "making hidden information like load profiles continuously available to the building residents."[26] This data is then compiled to reveal the building's carbon footprint – a measurement of the carbon dioxide emitted by the use of fossil fuels.[27]

In order to relate this information in a visible and contextual way to the average person, Holmes employs a standard icon of environmentalism: a tree. The image of a tree is also a significant icon because its biological duty is to convert carbon to oxygen.

When the building's 'carbon load' is very high, the software displays a greater number of trees – representing the number of trees needed to be planted in order to offset the carbon produced by the building. Conversely, when the carbon load is low, fewer trees are visualized. Ideally, Holmes envisions a day when buildings will be carbon neutral – an equal balance between producing and consuming carbon.

While Holmes' work has mainly dealt with data obtained from localized environments, artist Andrea Polli creates visualizations and sonifications from data generated by meteorological events. Andrea Polli's *Atmospherics/Weather Works* (2003) presents a system for recreating a storm in a three-dimensional sound space. This important work bridges the work of artist, musician, and scientist, and it allows the audience an opportunity to experience and reflect on the power of Nature. For this system, Polli collaborated with Dr. Glenn Van Knowe, a scientist at MESO Inc. – a company specializing in atmospheric modeling and atmospheric information services. Two storms were recreated: the Presidents Day Snowstorm of February 18-19, 1979 and Hurricane Bob in August 18-19, 1991. Both storms were chosen because they were particularly strong and because they both passed through the same coastal region.[28] The piece was designed for the Engine 27 space in New York by scaling the size and elevation of the representation of the storm to fit the exhibition space. The elements of temperature, pressure, wind, and moisture were mapped to pitch, timbre, and amplitude of sound. This work brings the audience closer to Nature and informs them about natural events in ways that cannot be experienced without the use of modern technology. In effect, Polli painted a landscape with sound.

Other works by Polli, such as *T2* (2006) and *Airlight Taipei* (2006), use real-time data to make viewers aware of the current, real-time conditions of particular environments. For *Airlight Taipei*, Polli used air quality data both to generate sound and to effect a live, web-cam image of a highway in Taipei, thereby making a statement about transportation and pollution. For the piece *T2*, Polli visualizes wind and wave information from Port Taranaki, New Zealand. The images from web-cams located on the coasts of San Luis Obispo, California and Port Taranki, New Zealand give two views of the Pacific Ocean. These images are affected by the data collected and text overlays the image generated by a RSS feed from oceanconserve.org.[29] Polli's visualization of

meteorological data represents contemporary concerns of climate change. Through the global connectedness of weather, wave patterns, and the Internet, *T2* exemplifies the interconnectedness of the global landscape. This awareness about our global climate helps to raise awareness about how our actions affect our climate.

2.2.2 Engineering Ecology

Visualizations of the human effect on the environment informs us of how our habits need to be changed in order to live in a more sustainable world. However, the question remains: if it is human actions that have caused damage to the Earth's ecosystems, then can human action be trusted to restore these ecosystems? Through her work, artist and engineer Natalie Jeremijenko not only questions what is natural, but what should exist at the boundary between human and Nature. Her work elicits thoughts about the technological grasp that humankind has on Nature. She experiments with and records data from the limits of environmental systems. In turn, her work informs and inspires us to better adapt our tools to assist us in our role as the stewards of our world.

Like Beuys and Holmes, Jeremijenko also uses the icon of a tree in many of her works. In *A-trees* (1999), a virtual tree is grown on the desktop of a computer in response to a carbon dioxide sensor attached to the computer. For *Stump* (1999), a software program calculates the number of prints made from a computer. Once the amount of paper equivalent to a full-size tree has been printed, the computer then prints the image of a tree stump. However, though both playful and informative, these pieces fail to challenge the boundaries between artist and scientist the way her piece *One Trees* (2004) does.

One Trees is a multifaceted work, simultaneously dealing with the issue of genetics and the impact of varying environmental influences. The piece originated as 1000 clones of a single tree. Through cooperation with the public, these trees were dispersed in pairs throughout public spaces in the San Francisco Bay Area. Due to the fact that these trees are genetically identical, the health and survival of each of these trees is an indication of the variety of environmental and social differences to which they were exposed.[30] In this way, *One Trees* is not only an exhibition of environmental data but also generates the data.

Jeremijenko questions the role of humans as stewards of Nature. She also explores the concept of "natural" and demonstrates Nature's 'elusiveness' in her piece "*Tree Logic*." Here, Jeremijenko suspends six small trees upside-down, thereby creating a Houdini-style spectacle. This begs the question, "how will the trees survive and adapt to their human intervention?" Since trees are commonly used as representations of the natural world and are often ascribed human/animistic characterizations, Jeremijenko's titling of the piece with the word 'logic' implies that the trees (natural world) have *thought*. Therefore Nature rationalizes human activity, adapts, and interconnects. The most intriguing feature of this interconnectedness is humankind's innate drive to explore, deconstruct, analyze, reconstruct, and consume the resources of Nature. Additionally, with each discovery made by humankind, Nature proves to be elusive by revealing new mysteries, adaptations, and obstacles. "Nature is the carrot at the end of the stick - always tasty but out of reach. …the nature we grope for moves as soon as we touch it." [31]

While Jeremijenko questions the tools of stewardship, Brandon Ballengée's artwork *is* the act of stewardship. Through his work with amphibians, Ballengée seeks to comment on human's technological grasp of nature, and to use that grasp in order to replenish species at the brink of extinction. In *Species Reclamation* (1999-2000) Ballengée, through breeding and genetics, is attempting to re-establish the Hymenochirus Curtipes breed of frog native to the Congo region of Africa.[32] In much the same way that Earthworks are site-specific pieces that can often only be exhibited as documentations of the work, Ballengée's work is the act of rehabilitation and exhibits are visualizations of the scientific process of re-establishing a species.

What these artists are suggesting is that through technology Nature can be made, and perhaps in order for our species to survive, we *need* to make Nature. In some cases, however, this leaves a larger question unanswered: "Can our quest to save our environment be both 'green' and amiable to our human interest?"

2.2.3 Sustainable Electronic Art

An emerging field of New Media artwork is that incorporates alternative, sustainable energy into the work. Pioneering this new field is Jeff Feddersen. Trained

as a computer scientist, musician, and engineer, Feddersen is exploring ways to incorporate sustainable energy practices into his concepts for musical expression and the building of new musical instruments.[33] He has built several robotic musical sculptures in coordination with the collective: League of Electronic Musical Urban Robots (LEMUR), but it is his piece *EarthSpeaker* (2006) that best exemplifies his style of incorporating sustainable energy with musical expression.

EarthSpeaker is a large, solar powered sound sculpture that plays very low frequency (VLF) sounds amplified from the environment. These radio frequencies (RF) are in the range of 3 to 30 kHz, and are often picked up as sounds from outer space and from the Earth's atmosphere. It is a nocturnal system that operates in a similar way to a typical solar powered lawn lights. A solar panel charges a super capacitor (an electronic capacitor with an unusually high capacity to store electricity) throughout the day and discharges during the evening when it plays the VLF sounds.[34] In October 2007, *EarthSpeaker* will be permanently installed at Wavefarm in Acra, NY (an artist-run, wooded park and research center devoted to experimental music, transmission art, and sustainable electronic art).

Long-time environmental artist Buster Simpson has also made a career of producing challenging, eco-aware artworks. His *Brush With Illumination* (1998) coalesces aspects of eco-visualization, public art, virtual/networked art, and sustainable energy. The medium, as described by Simpson, is "an environmentally responsive and website interactive sculpture. Solar panels, microprocessors, computer lasers, strobe batteries, environmental sensors, stainless steel construction with light transmitting cursor."[35] Installed in False Creek, Vancouver, British Columbia, the "*Brush*" is meant to represent a calligraphy brush. Powered by solar panels mounted on the quill of the brush, the brush 'draws' the information from air and water data collected from sensors mounted on the sculpture. The information is transmitted as light pulses from the tip of the brush and as data to a networked computer, allowing online visitors to witness the piece.

Incorporating sustainable technologies into art demonstrates creative uses of alternative energies that inform, inspire, and will hopefully spark ingenious uses of this technology. This is just the beginning of an era where artists have begun to incorporate

these types of new technologies into their artwork. As the technologies continue to develop, we can also expect the artworks to advance.

2.3 Summation

Since the rise of industry we have seen a resolute effort by artists to find solutions to the ecological problems caused by the byproducts of industry: waste, over-consumption, pollution, and global warming. However, industry itself is not always the culprit; artists have proven that industry can be a part of the solution. Larger issues involving our current socio-economic system must first be addressed, and artists are well equipped with the vision and creativity needed to bridge this growing rift between humanity and Nature.

To the extent that new technology holds the answers to these problems, artists are poised to explore these technologies and to discover or inspire remedies. The goal of artists using New Media technologies is not merely to showcase the plethora of new technologic and scientific tools, but is instead to teach society how to use them. Environmental issues demand that we learn quickly. New Media, after all, relies on the energy infrastructure that powers it, and is therefore obligated to it. These issues challenge and inform my work - a work to decipher and relate environmental data, to question the uses of new technologies, and to inspire the use of alternative, green energy sources.

3. Climate Control: An Exhibition

3.1 Project Descriptions

3.1.1 SUNflower: Photovoltaic Eco-Visualization System

On my arrival at Rensselaer Polytechnic Institute (RPI) in the fall of 2005, I was pleased to find a solar array on campus. It was not a large one, but it was unique in that it was a dual-axis, heliotropic system – in other words, capable of tracking the sun's position both daily and yearly. It was during my first investigation of the solar array that I had a wonderful and revelatory experience. Each photovoltaic cell was attached to the axis by a long, wide hollow tube, and from within this tube emerged a small squirrel presumably looking for a home. I was immediately struck by the ability of this squirrel to coexist with and within a solar array – an act unimaginable with fossil fuel or nuclear-generation plants. This underscored my impression that solar energy could be a positive solution to our energy needs and I became determined to create work that involved this array.

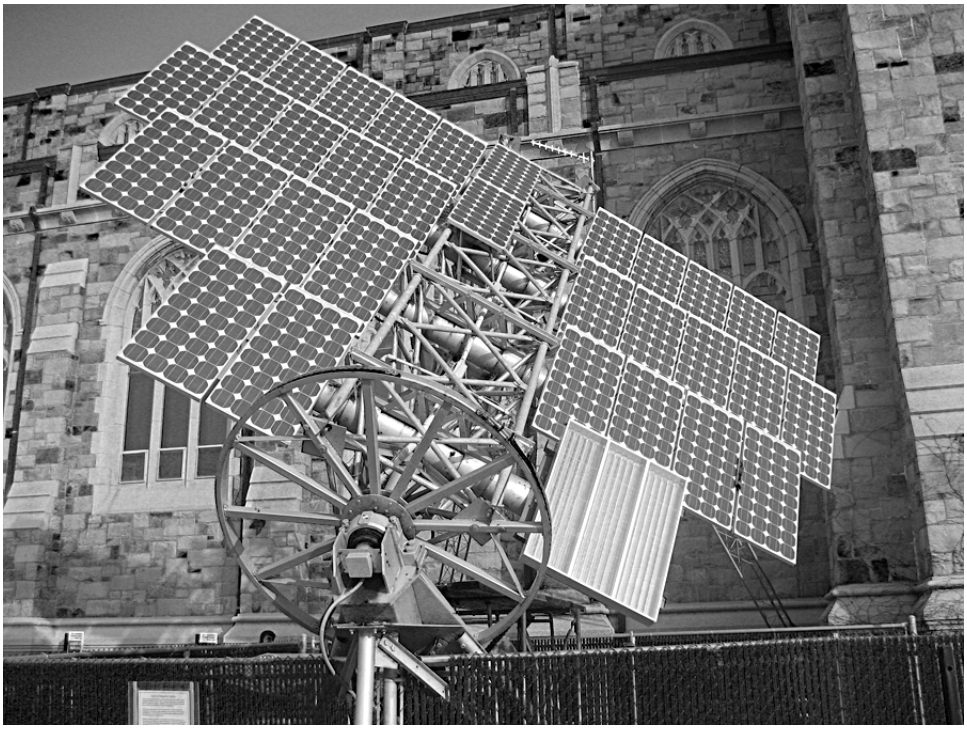

Figure 2. Solar Array at Rensselaer Polytechnic Institute.

Anxious to incorporate alternative energies into my artwork, I began to establish connections with engineers and faculty on campus who were working with solar, wind and fuel cell technology. However, most of my attempts to take coursework in those fields or to make contacts with researchers were thwarted by the fact that I had little background knowledge in engineering and that most of their research was proprietary. I then joined Ecologic (RPI's student environmental club) in the hopes of becoming involved with a project utilizing alternative energies and/or to meet fellow students who might be interested in collaborating with an artist.

3.1.1.1 Heliotronics Sensor System

During the Spring 2007 semester, Mechanical Engineering Professor Dr. David Borton approached Ecologic for assistance with the installation of a Heliotronics solar array monitoring system and information kiosk. Heliotronics is a Massachusetts-based company that specializes in acquiring electrical and meteorological data from grid-based solar arrays. Together with Ecologic I helped install thermal sensors, an anemometer and voltage meters on the array. Additionally, a computer was needed to upload this data to a network where the information could be posted online while simultaneously transmitted to an information kiosk located in the RPI Student Union.

Using the information derived from the sensors installed on the array, I began to write software to produce abstract, generative digital imagery of the data. My initial tests for collecting and imaging the data were conducted using Processing – a software language used to generate and modify images. However, these tests were never fully realized due to several complications. First, there was no way to access the data directly from the array in real-time. The data could only be obtained from the sunviewer.net (a subsidiary of Heliotronics) website in 15-minute increments. Therefore the visualization of the data was not dynamic nor would any experience viewing it seem immediate. In addition, due to technical problems the RPI solar array was rendered inoperable for the remainder of my experiments. To overcome these issues I began to reassess my process for visualizing solar energy. My initial goal for this project was to inspire creative uses of solar energy and to present solar energy as a positive and viable source of energy. Incorporating real-time data would give solar power a more physical presence – a sense

that it was ‘alive’ and available to be harvested. I was also interested in presenting the data in a way that could inform and educate the viewer about the amount of power being generated by the array, and relate this information to the energy needs of common household appliances.

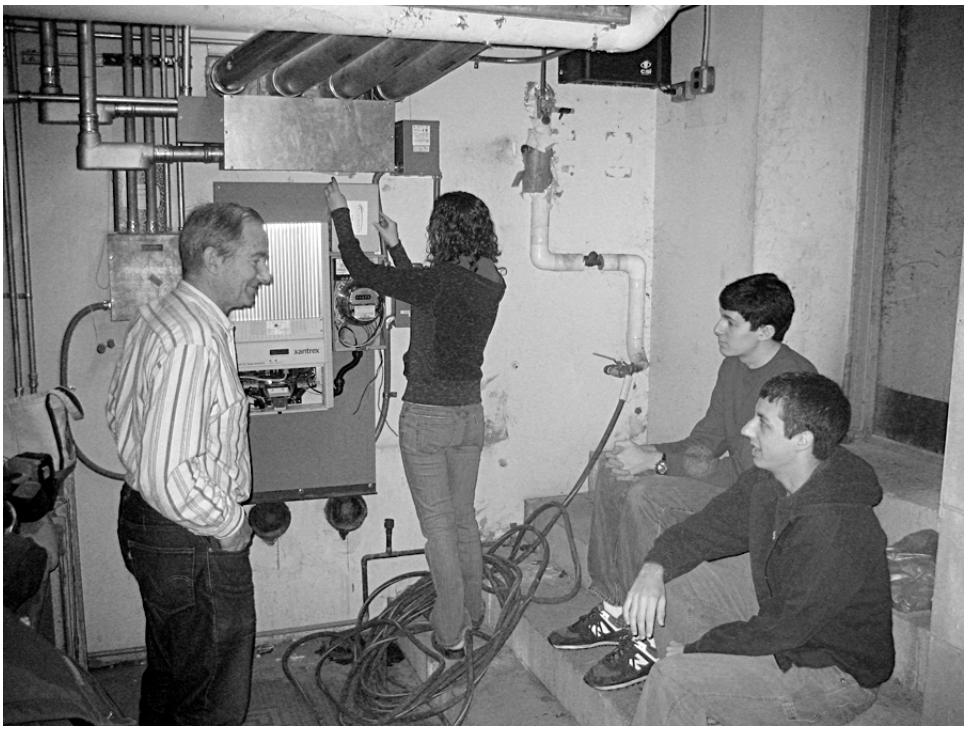

Figure 3. Installation of the Heliotronics sensor system.

3.1.1.2 The Data Interface

The kiosk designed by Heliotronics is a small, interactive touch screen that presented information with rudimentary graphs and images of dials and meters. While these graphs are precise and appear scientific, they are not particularly visually compelling. I envisioned this piece as an artistic informational interface that inspires the use of solar energy. However, according to informational design expert Edward Tufte, “Data should draw the viewer’s attention to the sense and substance of the data, not to something else – the data graphical form should present the quantitative contents.”[36] Contrary to Edward Tufte’s opinion, it was not my intention to merely inform people of the specific quantitative information. The quantitative information of the Heliotronics’

graphic does little more than to tell the viewer whether or not the array was working. It is at this juncture where Heliotronics could benefit from collaboration with an artist who could reveal the cultural relevance of this data to a wider audience. Developing this type of relationship is one of my challenges.

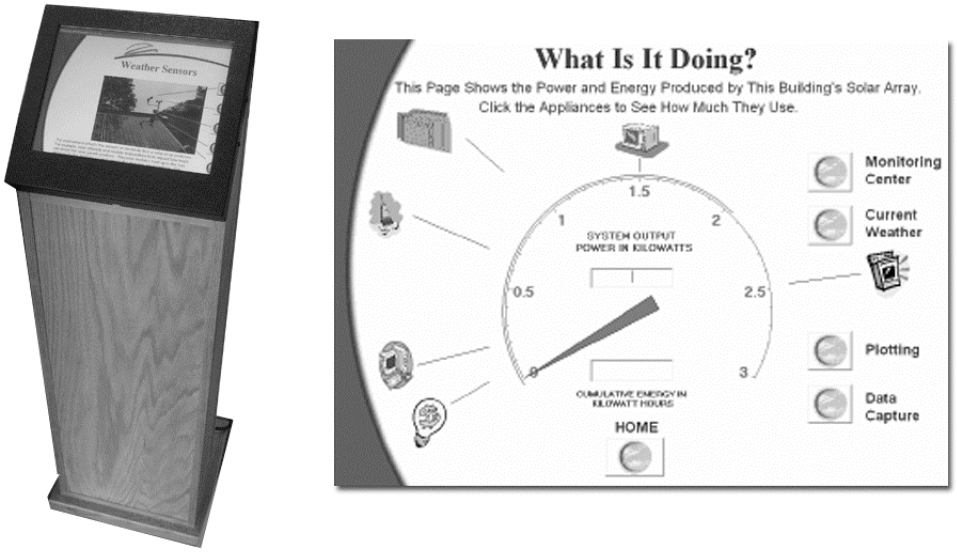

Figure 4. Heliotronics kiosk and interface.

In order to give the data a more physical presence, I decided to use the visual metaphor of a sunflower. An obvious choice in name, also a sunflower is similar to the RPI solar array, as they both are heliotropic (following the sun's arc throughout the day). Each day, as the solar array generates more power, this visualization of a sunflower animates from a small seedling to a full-grown plant, varying in size and shape as per the amount of power generated. I imagined the possibility of installing this visualization at an elementary school or a library. There it would provide an understanding that all energy on Earth is either directly or indirectly derived from the Sun. However, unlike oil or coal, a solar array benefits from the immediate conversion of solar energy into useful energy, whereas oil and coal take millions of years to form and require an elaborate process to refine.

Due to the fact that the RPI array was offline for most of the testing period, I decided to use data obtained from another Heliotronics site located at the Boston Nature Center in Mattapan, Massachusetts. Through the website sunviewer.net, the data was

available for download from the Boston Nature Center's array in 15-minute increments as well as daily peak values. I chose June 2007 not only because it was the most current data available at the time of my tests, but also June has the longest periods of sunlight and therefore yielded the widest range of values.

The data was available in four categories: power generated, irradiance (the rate at which energy is transferred on the surface of the solar cells), module temperature, and ambient temperature. The power-generated data was used to drive an animation of a sunflower growing. Therefore the sunflower appeared to grow faster and larger as the solar array generated more power. The irradiance values were represented by an animation of a sun, moon and clouds. One could determine the presence of clouds over the array by viewing this second animation (calibrated to the actual time of sunrise and sunset). The ambient temperature and module temperature, being less relevant to the energy being generated, were visualized by subtle shifts in the coloring of the virtual sunflower.

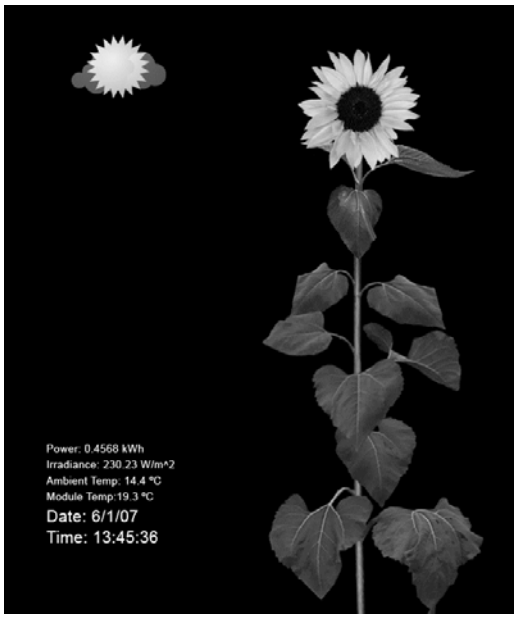

Figure 5. *SUNflower* animation still.

This work harkens back to the visualization used by Tiffany Holmes in *7000 Oaks and Counting*. *7000 Oaks and Counting* visualizes consumption and is intended to inspire conservation through reduced energy use. The visualization of *SUNflower* attempts to encourage the use of solar energy as an alternative source of power. Further

iterations of *SUNflower* will be to include iconic images of common household devices that will relate the amount of power generated to the amount of energy required to operate the devices. Additionally it would be informative to present the amount of carbon emissions avoided by using solar energy in place of fossil fuel.

3.1.2 The Hottest Year on Record: Global Mean Temperature Anomaly Eco-Sonification System

Mention global climate change and the most common reference people will have is "*An Inconvenient Truth,*" the 2006 film starring former Vice President Al Gore. The film primarily consists of Gore giving a power-point style lecture in front of a large graphic indicating the rise of global temperatures. The film has done much to raise awareness of the issues of climate change. The issues themselves, however, have been a concern for some time – not to mention controversial. The phrase I most associate with climate change is the one told (in recent years) by the news media every January, stating that the previous year was "the hottest year on record." My immediate response upon hearing this is a series of questions: How much hotter is it? Does it feel hotter than last year? Is it hotter in some places more than others? How long have we been keeping a record? Is the way we record the temperature today different than when we began recording temperature? How long before the climate gets too hot?

3.1.2.1 Gold Record Certification

I decided to create a work of art that would answer some of my questions about global climate change, provide information on rising global temperatures, and represent the dilemma of being socio-economically dependant upon growth and consumption. The phrase "hottest year on record" reminds me of the framed 'gold record' certification awarded by the Recording Industry Association or America to 'pop' music artists for selling record numbers of albums. In effect, such a reward is in recognition of mass production and consumption – the spoils of our consumer-based culture and also a major cause of global climate change. Tim Flannery addresses this in his book *The Weather Makers* (2006): "Climate change is difficult for people to evaluate dispassionately because it entails deep political and industrial implications, and because it arises from the core processes of our civilization's success."[37]

With this in mind I decided to convert historical global temperature data into music that could be used to exploit a pun of the word 'record.' To accomplish this, I first needed to obtain scientific data being used to prove that the climate temperature was indeed increasing. Initial Internet searches returned a plethora of raw data without much explanation of the data's content. There was also a fair amount of opinionated information on the subject of climate change ranging from doomsday warnings to accusations that climate research is pseudoscience. The most reliable dataset was found at the National Climatic Data Center, a subdivision of the National Oceanic and Aeronautic Administration of the United States government. The dataset that I chose was the Global Mean Temperature Anomaly (deviation from what is expected to be normal) for the years 1880–2006.

3.1.2.2 Data Sonification

For the sonic material, I considered ways to sonify global climate change data such that someone could experience the change over time and 'hear' the temperature increasing. I decided to create a loop-based (repeating a musical phrase) audio software program where each loop played would represent a year. The dataset would be used to control each loop's playback speed – the lower the temperature, the slower the loop played; conversely the hotter the temperature, the faster it played. For aesthetic purposes, multiple loops were chosen and mixed together with various treatments in order to prevent the piece from becoming too repetitive and unpleasant to listen to. Considering that this work is also a comment on 'pop' culture, I decided that the music used for the loop-based program should be appropriated from a popular band known for selling record-breaking numbers of albums. The choice was The Beatles and their song *Here Comes the Sun*, as the lyrics appropriately suggest that things are getting warmer.

> *Little darling, I feel that ice is slowly melting*
> *Little darling, it seems like years since it's been clear*
> *Here comes the sun, here comes the sun,*
> *and I say it's all right. It's all right.*[38]

The loop-based software application allowed me to choose samples of the song at will and to create a mix of the piece in real-time. Therefore the piece is performable and can also be designed as an interactive installation where the viewer can control the loops chosen. Since the maximum length of an LP vinyl record is 12 minutes, the effect the data had on the speed/length of the loops had to be adjusted until the song's length fell within that maximum length. Once a final version was selected and mastered, the song was sent to a company specializing in producing 'one-off' vinyl records. One of the features available for the creation of the record was a 'photo disc' – where an image can be printed on the face of the record. Since this work was intended to be visual as well as audible, I chose an image from the cross-section of a tree. This not only provided a strong metaphor to the grooves cut into the record, but also referenced a naturally occurring record of climate data. Exhibiting the record in this manner visually ties the data to Nature. It also is an image of the consumption of Nature – the cross-section being an open wound of a beheaded tree.

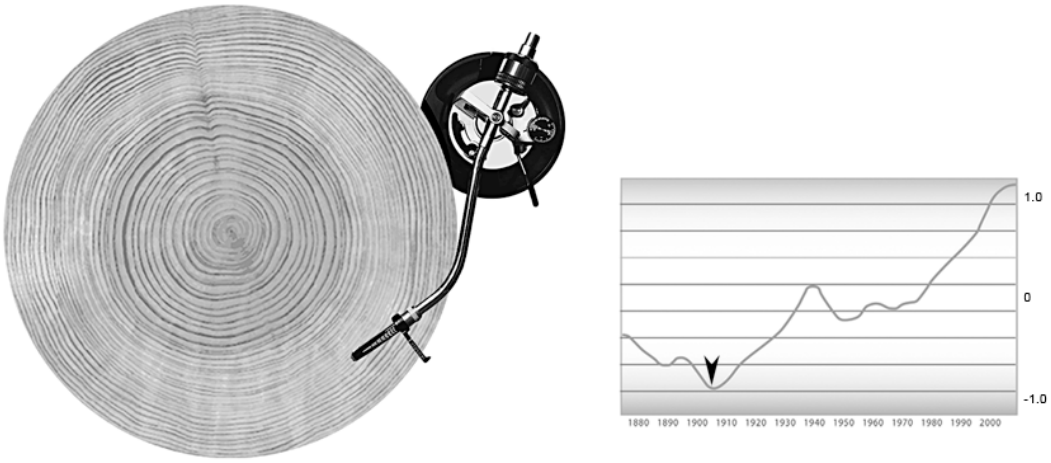

Figure 6. ***The Hottest Year on Record*** **animation still.**

Upon listening to the completed piece I noticed three distinct spans of time. First, temperatures were cooling from 1880 to 1905, and then they began a steady increase until peaking in 1945. Second, another steady increase began in the 1960's, which appears to be peaking in 2006-2007. One cannot help but wonder if there is relationship

between these time spans and coinciding world events. Although the project is about the data being revealed through the process of sonification, I was also skeptical about drawing conclusions from the data since it is itself suspect. For instance, processes and devices used to record data have changed considerably over the 126-year time span that I was sonifying. Also, the data I chose to use is a 'global average' that does not account for regional changes. Finally, the data is recorded as an 'anomaly' which means that the values are recorded as departures from values that are considered to be 'normal.' The question then arises: If we think of climate as something we expect to be 'normal', then are we also beginning to invent technology that will exert some human control over our climate?

3.1.3 Climate Control: Weather Damage Modification Program

On March 21, 1952 lifeless black clouds began to fall upon Orgonon, Maine. These clouds are said to have quieted the birds, struck fear into the animals, and de-saturated the landscape of its luster – even causing the plants to droop with sorrow. This 'black cloud,' determined to be caused by Deadly Orgone Radiation (DOR), seemed to get stuck over Orgonon and decisive measures needed to be taken in order to rescue the town from certain demise.[39] Psychoanalyst Wilhelm Reich began conducting experiments, founded on the working principles of water divination and lightning rods, to attract the positive Orgone Radiation (OR) and to disperse these DOR clouds. By using long metal pipes pointed at the clouds, Reich discovered an 'instantaneous' reduction of the DOR clouds. Within a very short period of time, Orgonon was relieved of its impending doom. Reich called his invention a 'Cloud-buster' and soon realized that his device could not only remove DOR clouds but could also be used on normal rain clouds – either to cause them to dissipate or draw them into a desired area.[40]

Scientific experimentation with weather modification was also being conducted by the General Electric Corporation facility in Schenectady, New York. In 1946, scientist Bernard Vonnegut had discovered that dropping silver iodide into a cloud would cause the water vapor to crystallize and become heavier, which would result in rain or snow.[41] This process, known as 'cloud-seeding' became popular for locally producing snow, fighting wildfires and drought. The Chinese government is currently using this

technology to curb pollution in Beijing before the 2008 Olympics.[42] The United States is sponsoring a program called the Weather Damage Modification Program (from whence *Climate Control* got its name), the goal for which is to support weather modification research in Southwestern states.[43]

Weather modification is controversial because weather is shared geographically and therefore modification in one geographical area may be seen as stealing weather from another area. Additionally, climate is the shell of our ecosystem and any changes made to this system without a complete understanding of its effect may dangerously shift the delicate natural balance. Realizing the interconnectedness of weather, Reich issued this stern warning: "Cloud-busting is truly an international matter with no regard for national borders. There are neither passport controls nor customs officers in the sky where the weather is being made. Lawful regulation of Cloud-busting will prove indispensable if chaos is to be avoided."[44]

Climate change differs from other environmental disorders, such as pollution or over-consumption, in the fact that we do not experience ourselves causing the change. When we pollute we often see the environmental change happen before our eyes (smoke, erosion, litter, etc.). Also, when we over-consume, we sometimes experience the breakdown of a system: for instance grid failure (blackouts) on a hot summer day. It's very difficult to point to changes in climate and know with certainty that the changes were human induced. It is perhaps the lack of this sense/perception that removes any culpability at the individual level, making climate change difficult to comprehend. However, weather modification, as is currently being undertaken, seeks to extend the human grasp into this realm of controlling climate. This led me to question our human goals for understanding climate and our concerns about climate change. What would it mean to place controls on our exterior climate the way we control our interior climate – a knob to control temperature or a switch to turn precipitation on or off?

3.1.3.1 Control Interface

Climate Control: Weather Damage Modification Program is an interactive video installation that seeks to answer these questions. Using a control panel as an interface to hypothetically control the weather, *Climate Control* allows the viewer the experience of

physically placing their hand on the controls of climate to manipulate a representation of it. Using the visual/physical metaphor of an oscilloscope, I constructed an interface containing knobs, switches, and a video screen through which the manipulation could be visualized. The naming of the controls and the visual effect they produced was inspired by actual parameters associated with weather events. Additionally, terminology relating to the practice of cloud-seeding and Reich's cloud-buster are represented on the control panel – creating a narrative subtext of the work of Vonnegut and Reich. A switch in the lower right corner of the interface (see Figure 8., knob #9) toggles between 'Orgone' and 'Silver Iodide'. Depending upon how it was switched, the Orgone/Silver Iodide switch presented two different visualizations on the screen. When switched to Orgone a photographic/painterly image of a natural landscape appeared. This image is meant to elicit recollections of traditional representations of landscape such as landscape paintings. Additionally, since there is no evidence that orgone had any effect on weather, the use of a photographic image signifies a more romantic notion of weather instead of a scientific or factual one. Switched into the other position, 'Silver Iodide,' a graphic representation appeared imitating a more scientific graphic – similar to what might be viewed on an oscilloscope.

Figure 7. Orgone landscape (left) Silver Iodide landscape (right).

The controls on the interface were intentionally designed to be overly technical and difficult for the audience to comprehend – an aesthetic of technological and scientific interfaces. It is a condition of contemporary interactive installations that they

be framed in a simple enough interface that the audience can efficiently experience the work in the least amount of time. As pioneering installation artist David Rokeby suggests, a system can be "interactive on so many levels that the interaction becomes indigestible… Simplifying the language of interaction by reducing its variables lets people recognize their impact on the system immediately."[45] However, it is common for many of the concepts of interactive art are to be about the act of interaction itself. This is not the case for *Climate Control*. The experience that I expected for my audience was one of trepidation and forethought before making any adjustments to the interface. I wanted the audience to spend a moment of time contemplating what affect their manipulations would have upon the system. The concept of this work is not about the actual physical interaction of the viewer with the work, but instead about the interaction between the hand and Nature. The challenge in designing the interface was to get the viewer to think past the interface and to consider the effect of human manipulation on the climate. Any physical interaction with the work was incidental and a bonus of the work, but not essential for communicating the concept of the piece.

The remaining knobs and switches related to specific weather conditions and cloud seeding techniques. Manipulation of these knobs and switches created a simulation, appearing on the video screen, of the associated weather conditions. Accurate terminology was used to label each knob, and unless the viewer had an understanding of meteorology, the viewer would have to experiment with the system or consult documentation to learn what each knob does. Documentation explaining the terminology and effect of each knob was provided in the program for the show. (see Appendix A)

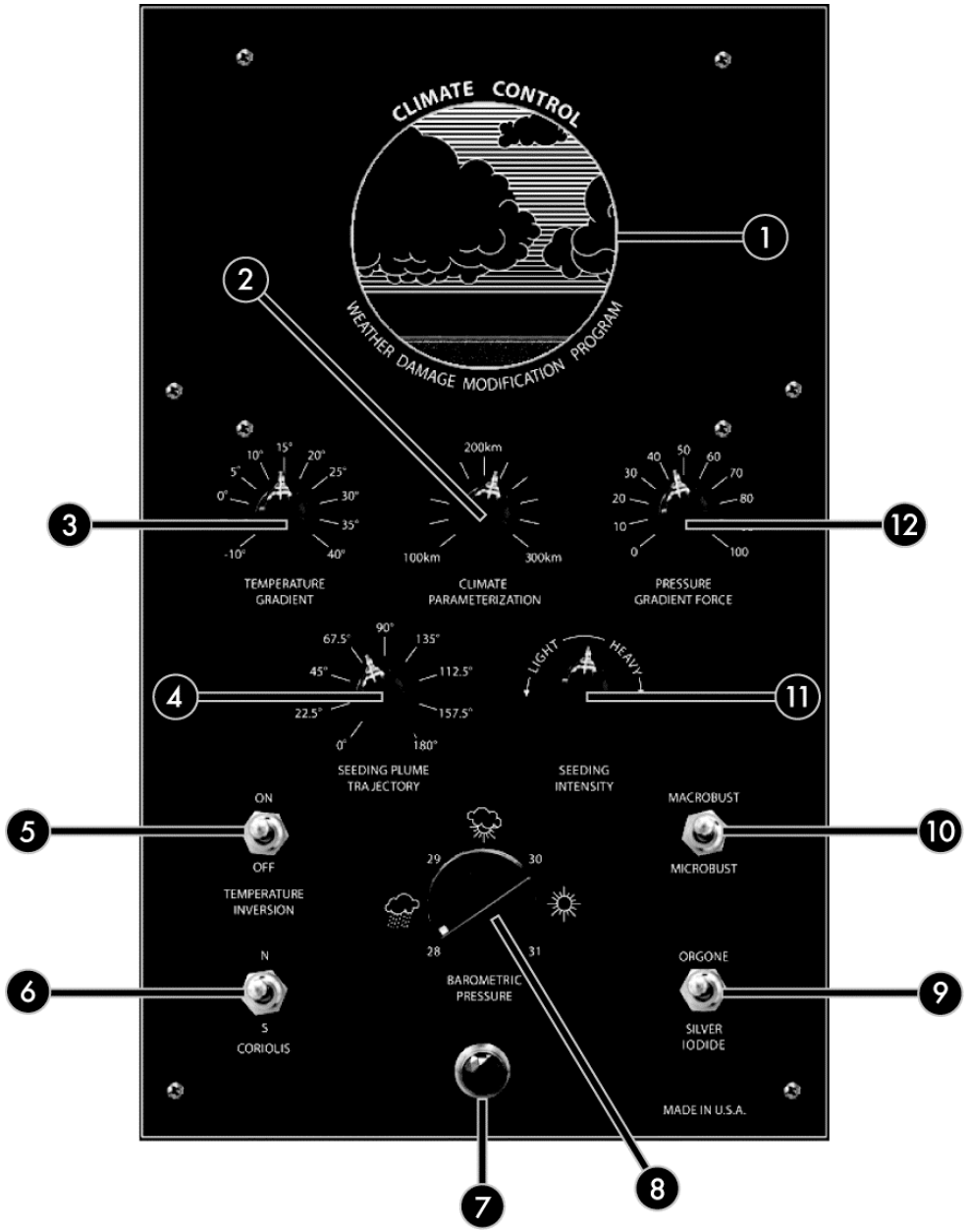

Figure 8. *Climate Control* interface.

Starting in the upper left-hand corner, the 'Temperature Gradient' knob (see Figure 8., knob #3) shifted the color of the video image to a warmer or cooler color based on the temperature to which the knob was pointed. Next (moving to the right), 'Climate Parameterization' (see Figure 8., knob #2) scaled the viewable image area according to the desired area to be seeded. The upper right hand knob 'Pressure Gradient Force' (see Figure 8., knob #12) controls the amount of wind visualized in the scene. The higher

this knob was turned, the faster the clouds appeared to move across the sky. The two knobs in the center of the interface affected the 'seeding' of the clouds visualized by precipitation within the scene. These knobs 'Seeding Plume Trajectory' (see Figure 8., knob #4) and 'Seeding Intensity' (see Figure 8., knob #11) affected the direction of the precipitation and the amount of the precipitation respectively. In addition, if the 'Temperature Gradient' was set to a value below freezing, the precipitation would turn to snow. The largest knob at the center-bottom of the interface (see Figure 8., knob #8) controlled the 'Barometric Pressure' of the scene. Adjusting this knob determined the presence of clouds, and therefore affected the visualization of precipitation and wind.

There are four switches on the interface. The first upper left switch (see Figure 8., knob #5) turns the 'Temperature Inversion' setting on or off. A temperature inversion is an atmospheric condition that occurs when a temperature increases with altitude. This commonly traps pollution and smog in the atmosphere.[46] Turning this switch to 'ON' creates an image of smog that distorts the image on-screen. Next (moving across to the right), the 'Macrobust/Microbust' switch (see Figure 8., knob #10) is named for terms derived from Wilhem Reich's Cloud-buster and therefore only operates in the 'Orgone' setting. This switch affects the rate at which clouds are dissipated by the system. In the lower left corner is the 'N/S Coriolis' switch (see Figure 8., knob #6). This switch represents the coriolis effect and determines the direction that the wind is blowing. It is to be used to set the user's location relative to the equator. Finally, in the lower right corner of the interface is the 'Orgone/Silver Iodide' switch, which has been previously discussed.

3.1.3.2 Climate Control Sound

Sound was incorporated into the installation in order to heighten the sense of anxiety and to provide immediate feedback. A quiet, low frequency sine wave was used as a droning sound – similar to the 60hz hum common in electronic devices. This was intended to give the user the impression that the unit is powerful and dangerous – hopefully adding to trepidation when using the piece. Subtle modulations were heard in the frequency of the sound as users manipulated the knobs.

Figure 9. *Climate Control* with antenna.

3.1.3.3 Climate Control Antenna

Attached to the *Climate Control* device is an antenna constructed of four copper tubes mounted on an older surveyor's tripod. This antenna is a replication of a device invented by Wilhelm Reich and used to affect the weather. Reich's use of this device mimicked the way a lightning rod attracts electricity. In fact, Reich believed that electricity was merely a function of orgone energy. His purpose for using these pipes was to draw the orgone energy from the sky into a water reservoir on land.[47] Pointing the Cloud-buster antenna at a cloud would draw the orgone energy out of the cloud and dissipate it. Conversely, pointing the antenna at clear sky would draw clouds into the area. In this way Reich believed that he could control the weather. For the *Climate Control* installation this antenna represents a device through which the black box communicates with the climate. The antenna should be installed to in the direction of desired application of the weather modification, preferably out an open window.

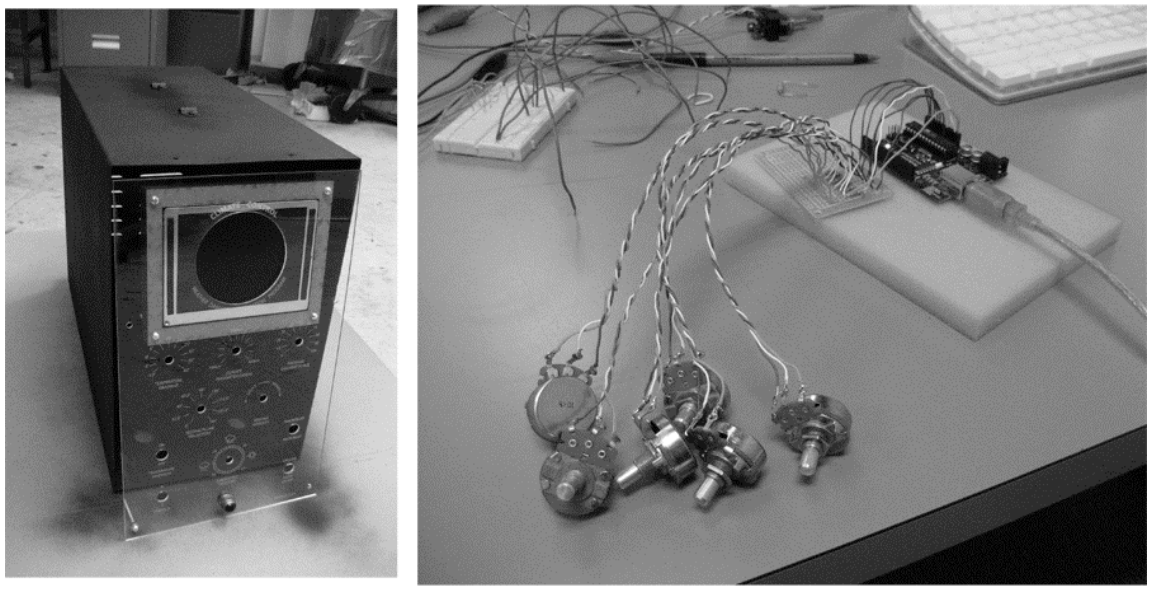

Figure 10. *Climate Control* as work in progress.

3.1.3.4 The Device Construction

The apparatus driving this installation is a personal computer running the graphical programming language Max/MSP/Jitter. Jitter, a plug-in to Max/MSP, processes the video using the Graphical Processing Unit (GPU) OpenGL commands and is therefore able to process video commands in real-time. For *Climate Control* each element in the scene was divided into its own layer. The divisions (in order from back to front) were sky, clouds, ground, rain, snow, and smog. Each of these images was then textured onto a two-dimensional plane where its color, position, and visibility could be independently controlled. An Arduino microprocessor was used to convert data from the analog knobs and switches into digital data, which could then be interpreted in the Max/MSP environment and used to manipulate the images and sound. The black box used for *Climate Control* was originally a 1940's oscilloscope found in the refuse on RPI's campus. The oscilloscope's interface was a major initial inspiration for the piece, and from its design the final interface for *Climate Control* was modeled. The interface was composed of two sheets of .125" Plexiglas (one transparent and one black opaque). The title of the piece and design for the controls was laser etched onto the transparent glass

and then the two sheets were attached to the black box. Finally, five 'chicken head' knobs (from the original oscilloscope) and one rotary dial were attached to 10k Ohm potentiometers on the interface. There were four single pole, single throw switches used.

3.2 Exhibition Overview

The exhibit was held in Rensselaer Polytechnic Institute's West Hall Gallery from October 1st through October 5th. It was a one-person exhibit entitled *Climate Control*, and it showcased three new works: *The Hottest Year on Record*, *SUNflower*, and *Climate Control: Weather Damage Modification Program*. My approach for designing the exhibit was to separate myself from the works and shift from the role of artist to curator. I felt that the works should be arranged in the space in such a way that reduced the stark white walls of the gallery and provided a unifying theme to the show.

The thematic solution was discovered as I struggled to decide how to exhibit *The Hottest Year on Record*. Considering that *Hottest Year* was a playable vinyl record it seemed appropriate to actually play the record during the exhibit. Since the image on the record was of tree rings, one consideration was to place the record on a turntable near the floor where it would appear as a tree stump. To complete this analogy a recently felled tree was brought into the gallery to be placed next to the turntable on the floor. A dilemma with this solution was that there wasn't an efficient way to continually play the record throughout the day. Additionally, part of the concept of the work was that it should be a framed piece and hung on a wall. The solution was to leave the work framed during the exhibit but play the record during the reception. The leafy branches from the tree that had been brought to the gallery were then used as the unifying element of the exhibit.

Figure 11. West Hall gallery view (exterior).

3.2.1 Installation of The Hottest Year on Record

Since the choice was made to leave the *Hottest Year* record framed on the wall, a way to experience the music needed to be devised. A video loop was created that showed an animation of the record being played on a virtual turntable. As the needle moved across the record, an arrow moved along a graph of the global mean temperature data. This worked well for this particular exhibit, yet considerations for presentation in future exhibits should be made. Some suggestions include imbedding an audio player into the frame that holds the record, imbedding an audio player into an actual tree cross-section, and creating a kiosk with an interactive computer interface for the piece.

Figure 12. *The Hottest Year on Record* as installed in West Hall.

3.2.2 Installation of SUNflower

In a similar way, *SUNflower* was presented as video loop documenting the animation of the sunflower. The rate of growth was sped up at a time scale of 1,800:1 seconds. Therefore, each day in the month of June 2007 takes 48 seconds to be visualized. The original proposal for this piece, however, was to mount prints of the sunflower captured from the animation. A print would be made capturing the state of the sunflower's growth at the period of each day's peak power. The animation was a more dynamic presentation and was favored. Ideally *SUNflower* would have been projected in the space, but since the windows were left open too much light spilled into the gallery space. The final solution was to display the animation on a large television monitor. The animation was rendered vertically for the animation to display the largest amount of growth, and the monitor was turned sideways to correctly orient the animation.

Figure 13. West Hall gallery view (interior).

3.2.3 Installation of Climate Control

Because of its conceptual relation to affecting the weather, *Climate Control* was installed on a large pedestal nearest the open windows. The large pedestal allowed the viewer to look directly into the interface, reducing the chances of visual distortions caused by angular views of the LCD screen. Also, placing the piece near the windows allowed the viewer to see the outside climate while simultaneously adjusting the controls on the interface.

The final consideration for the show was how to label the work. Also, the background information and creative process needed to be explained. Rather than labeling the pieces with wall tags, the choice was made to produce a program for the work. (see Appendix A) Using the motif of a technical user's manual the program contained information about how to use the *Climate Control* interface, and it introduced

the *SUNflower* and *The Hottest Year on Record* pieces as “Other exciting products from WEAMOD” – WEAMOD being a fictitious corporation.

4. Conclusion

This exhibition gave me the opportunity to observe the gallery audience as they interacted with the work and to interview them about their experience afterwards. This has led to valuable conclusions and afterthoughts related to the work and inspired new strategies for future exhibitions.

Considering that *SUNflower* is designed to be a real-time visualization, its inclusion in this show was a documentation of the work in its current iteration. Therefore, it is a close approximation to its final application. I am currently in the process of making a proposal to collaborate with Heliotronics in order to produce a real-time visualization of the work. Additionally, I am hoping to include a visualization that compares the amount of energy generated and the amount of carbon emissions reduced by the use of solar power generation. To achieve this I am designing an animation that 'grows' electrical appliances at a rate that corresponds to the energy that they consume.

The Hottest Year of Record received the most attention of any of the works in the exhibit. Viewers responded positively and seemed to enjoy the playful nature of the piece. A new animation of the piece will be created using Adobe Flash CS3. This new visualization will allow the user to see the year that corresponds to each sound loop. I am currently submitting this piece to several calls for art exhibits relating to eco-visualization and climate change. The piece was also recently featured on Tiffany Holmes' pro-environmental blog ecoviz.org.

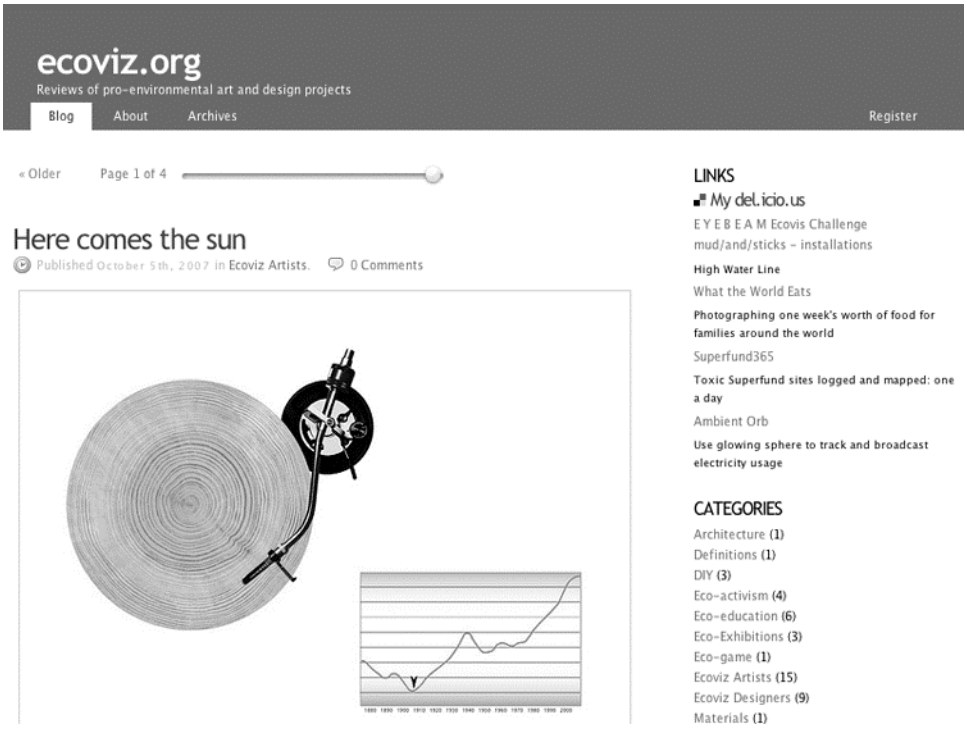

Figure 14. *The Hottest Year on Record* as blogged on ecoviz.org.

Of all these works, *Climate Control* is the most problematic. If this work is to be exhibited in a gallery it should communicate its concept in a much more efficient way. As a work of interactive art it should function in an immediate and responsive way, allowing the viewer a level of comfort with the interface. This will give the audience a quicker path to understanding the meaning of the work. Although it was my intention to comment on technology by presenting a complex interface, this level of complexity can be achieved with terminology alone. Upon redesigning this piece, I may find that using one dial can be just as effective as multiple knobs and switches. In addition, the antenna was a misunderstood addition to the piece. In some cases, viewers didn't even associate it with the device. It might be determined that the antenna is a non-essential element to the piece, but if it is to be included it might be wise to give it a function. One suggestion is to attach a light-emitting diode that is responsive to user input. In this way the viewer might associate their input with a signal being broadcast. Another suggestion is to convert the antenna into a Theremin (a musical instrument that is responsive to

human presence, the input from which would be designed to affect the sound and image of the *Climate Control* device.

Another issue presented by this piece (as exhibited) is that its rich historical narrative is completely overlooked. I found that many people were fascinated by the stories of Wilhelm Reich's Cloud-buster and the current weather modification programs being undertaken in China and the United States. The piece could be much stronger and relevant if these stories were somehow interwoven with the work. One possible solution is to install the piece on a scientific workbench. Included on this workbench would be a collection of books, drawing tools, notebooks, and weather related instruments. The audience would be free to sit at this workbench and adjust the interface while also pilfering through the materials. The addition of these artifacts would allow me to construct my own narrative for the piece and would also better integrate the antenna into the piece. Ideally, the viewer will leave with both a story and an experience.

Through the production of these new works I have laid a strong foundation for the continuation of work in eco-related subject matter. The work presented here demonstrates my ability to creatively produce relevant work in the disciplines electronic art and eco-visualization. Artists, in their role as mediators, educators, clairvoyants and advocates, are using their talents to visualize, equip, and remediate environmental concerns in order to reveal truths/evidence of our future and to inspire a better world. This work sets me on a path of achieving this level of artistry.

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Appendix A: Climate Control Program Notes

CLIMATE CONTROL

WEATHER DAMAGE MODIFICATION PROGRAM

Owner's Manual
Mode d'emploi
Manuale d'uso
Manual del usuario

WEAMOD

Declaration of Conformity
Compliance Information Statement

Model Name: WEAMOD-CC2007
Type of Equipment: WEATHER DAMAGE MODIFICATION
Responsible Party: BART BRIDGER WOODSTRUP
Address: WWW.VODSTRUP.COM

Climate Control is a series of climate-interactive electronic installations and eco-visualizations intended to address the personal detachment felt towards global climate change. As the Earth's resources increasingly succumb to the human grasp, these works question whether the next step is the construction of a human-desirable climate. Through perception and interaction the goal of this work is to enhance sensitivity of the issues involved, inspire critical thought about solutions and to recognize the beauty inherent in the real-time climate occurring outside the gallery walls.

Bart Bridger Woodstrup is currently an MFA candidate in the Integrated Electronic Arts Program at Rensselaer Polytechnic Institute in Troy, New York. His work takes the form of traditional musical composition, real-time interactive audio/video performance, multimedia installation and networked experience. In 1999, he received a Master of Music in Computer Music and New Media Technology at Northern Illinois University.

This Class B digital apparatus meets all the requirements of the Federal Interference-Causing Equipment Regulations.

Climate Control by Bart Bridger Woodstrup
October 1-5 2007
West Hall Gallery - RPI Campus
Gallery Hours: Monday through Friday 10:00 AM – 4:30 PM
Rensselaer Polytechnic Institute
110 8th St. Troy NY 12180

Closing reception Friday October 5 4:30 - 7PM

02210-88

USING THE UNIT SAFELY

INSTRUCTIONS FOR THE PREVENTION OF FLOOD, DROUGHT, HURRICANE, AND DESERTIFICATION

Before using this unit, make sure to read the instructions below.

This symbol is used to alert the user to situations where it is improper for any human modification of the weather.

This symbol is used to alert the user to situations where special care is required if to obtain desired results from the equipment.

This symbol alerts the user to important instructions or warnings. Risk of injury or material damage may occur should the unit be used improperly.

This symbol is used to alert the user to situations where solar or static energy may produce unpredictable results.

---------- ALWAYS OBSERVE THE FOLLOWING ----------

Weather modification during the following situations may yield undesirable results, in some cases exacerbating problematic conditions. In these circumstances, use of this device is not recommended, and special care should be observed.

High Carbon Dioxide Emission
Volcanic Eruption
Solar Flares or Sunspots
War

1 Climatoscope

Indicates current status of parameter assignment and desired climatic effect.

2 Climate Parameterization

Specifies the area of coverage affected by transmission. The range for the WEAMOD-CC2007 is currently limited to 100 - 300 kilometers.

3 Temperature Gradient

Use this to set the desired temperature. Temperature values are in Celsius and are represented by color shifts.

4 Seeding Plume Trajectory

Specifies the direction of precipitation.

5 Temperature Inversion

When switched to the "on" position, a normal vertical temperature gradient is inverted such that the air is colder near the surface of the Earth. Use with caution as dust and pollutants can become trapped in the atmosphere and cause adverse affects on health.

6 Coriolis (N/S)

Set according to your location in proximity to the equator. Improper setting of the Coriolis Force may cause noticeable changes to your Pressure Gradient Force.

7 Transmission Indicator

Lights when settings are being transmitted to the climate.

8 Barometric Pressure

Use this to adjust the atmospheric weight in the area to be seeded. All measurements are calculated against the mean sea level pressure and are scaled according to your current elevation.

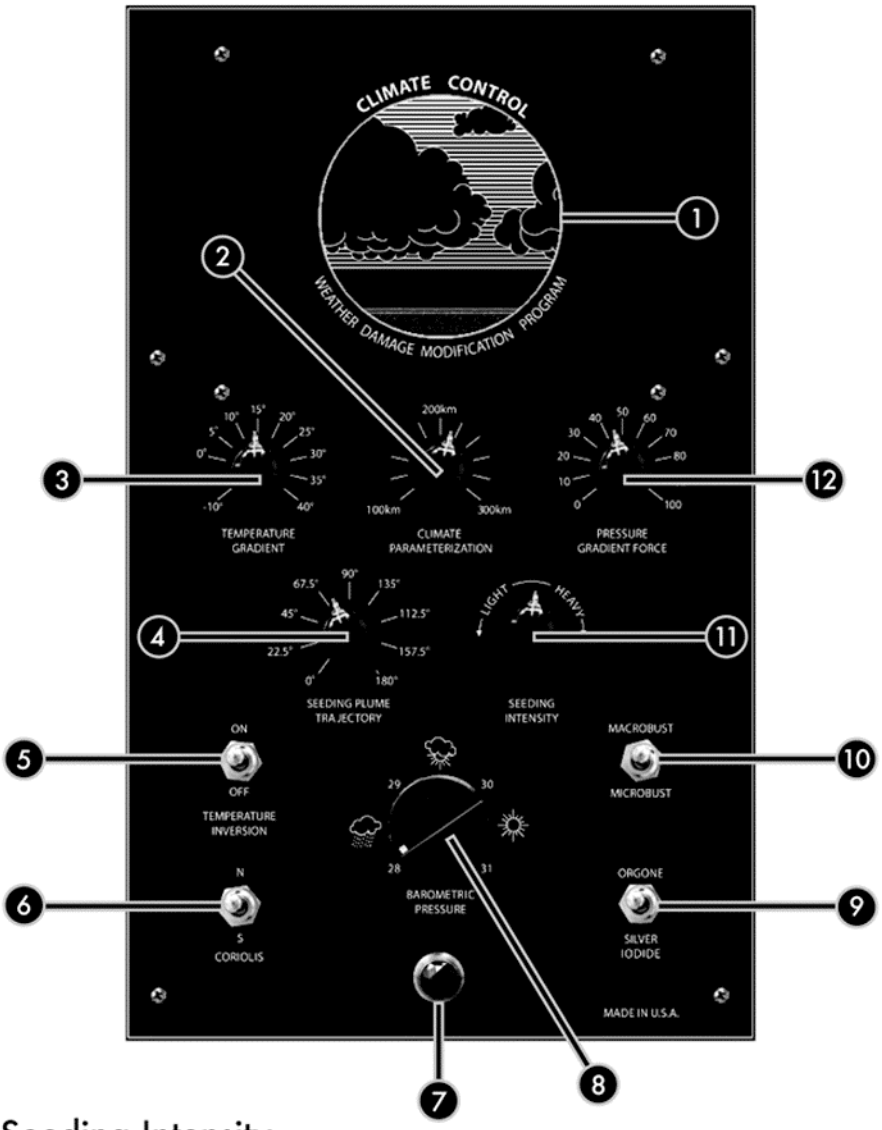
9 Orgone/Silver Iodide

The WEAMOD-CC2007 allows for transmission of both Orgone and Silver Iodide values. Your results may vary depending upon your climate and location.

10 Macrobust/Microbust

For use with the Orgone mode. Affects the rate of cloud dissipation.

CONTROL LAYOUT



11 Seeding Intensity

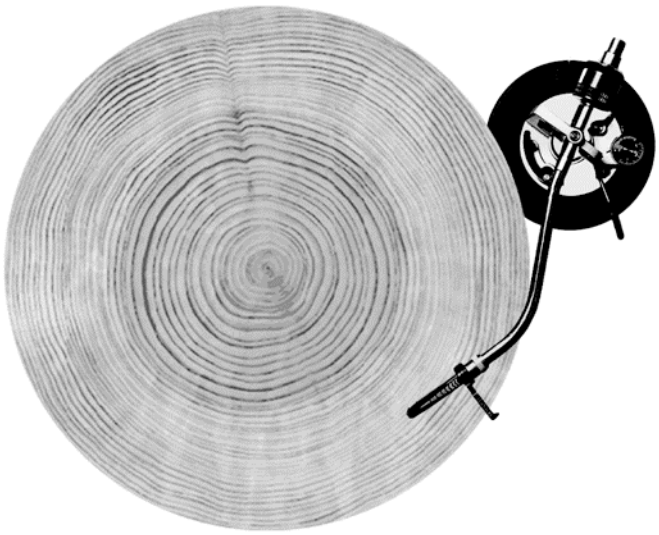
Use this to increase or decrease the amount of precipitation desired. Intensities will vary depending upon the use of either Orgone or Silver Iodine techniques. Precipitation is dependent upon proper barometric pressure. Adjusting the Temperature Gradient to lower values may cause the precipitation to crystallize.

12 Pressure Gradient Force

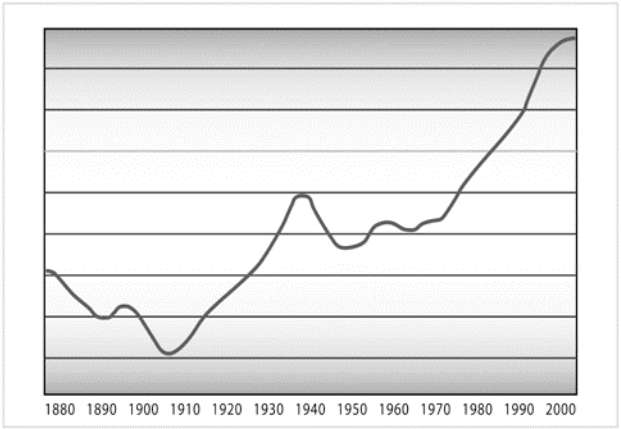
Use this to accelerate a parcel of air from a high atmospheric pressure region to a low pressure region. Units are in miles per hour.

Other exciting products from WEAMOD:

GLOBAL MEAN TEMPERATURE ANOMALY ECO-SONIFICATION SYSTEM



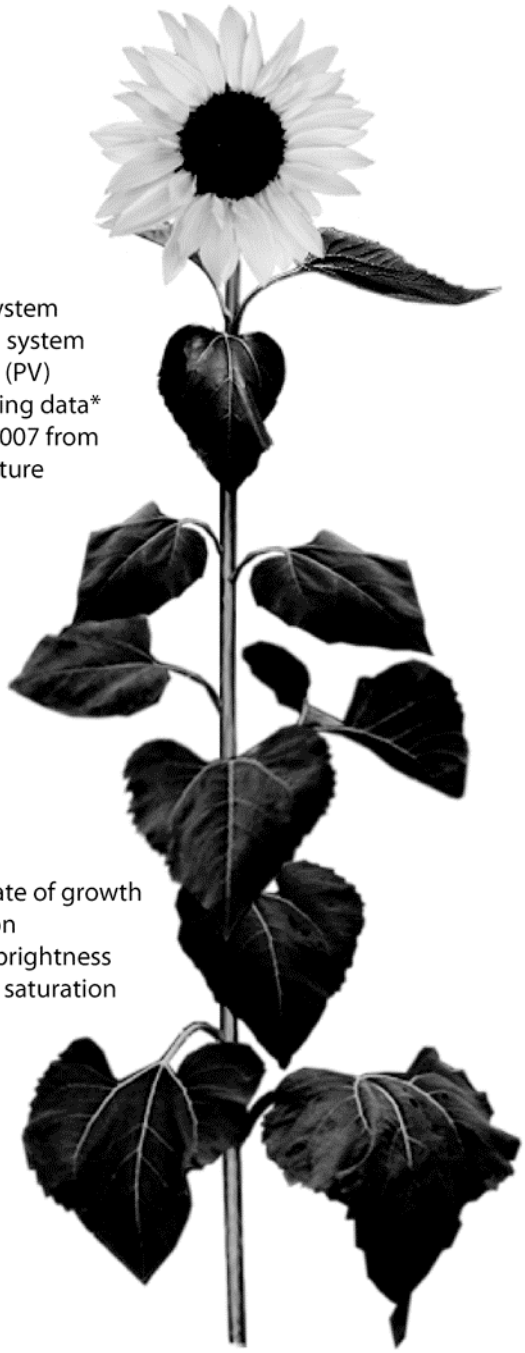
The Hottest Year On Record.
Data from the Global Mean Temperature Anomalies* (departure from the 1880 - 2006 base period average) are used to manipulate loop-based samples from George Harrison's "Here Comes the Sun." Each sound loop is a time sample representing one year. The speed at which the loop is played is relative to the Global Mean Temperature Anomalies for the year the loop represents.



*ftp://ftp.ncdc.noaa.gov/pub/data/anomalies/annual.land_and_ocean.90S.90N.df_1901-2000mean.dat

Description

The Photo-Voltaic Eco-Visualization System is designed as a solar data monitoring system for heliotropic, grid-tied photo voltaic (PV) arrays. This visualization is realized using data* collected during the month of June, 2007 from the PV array located at the Boston Nature Center in Mattapan, Massachusetts.



Data Interpretation

Power Generation: plant height and rate of growth
Irradiance: sun/cloud/moon animation
Ambient Temperature: leaf color and brightness
Module Temperature: flower hue and saturation
Time Scale: 1:1,800 seconds

*http://www.sunviewer.net/portals/BNC/

WEAMOD SERVICE CENTERS

USA/CANADA

American Meteorological Society
1120 G Street, NW, Suite 800
Washington DC, 20005-3826

National Climatic Data Center
Federal Building
151 Patton Avenue
Asheville NC 28801-5001
828-271-4800
FAX: 828-271-4876

Weather Modification Association
PO Box 26926, Fresno, California
93729-6926, USA
phone: +1 559-434-3486
fax +1 559-434-3486

Boston Nature Center
500 Walk Hill Street
Mattapan, MA 02126
617-983-8500

Heliotronics, Inc.
1083 Main Street
Hingham, MA 02043-3961
USA

INTERNATIONAL

World Meteorological Organization
7bis, avenue de la Paix, Case postale No. 2300
CH-1211 Geneva 2, Switzerland
Tel: + 41(0) 22 730 81 11
Fax: + 41(0) 22 730 81 81

The Wilhelm Reich Museum
Orgonon
Dodge Pond Road
P.O. Box 687
Rangeley, ME 04970
Tel: (207) 864-3443

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Thesis Committee:
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Michael Century
Kathleen Ruiz
Michael Oatman

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Appendix B: DVD Documentation Disk

Folder: Video_Documentation

File: CC_documentation_DVNTSC.mov Length: 04:30

File: CC_documentation_h264.mov Length: 04:30

Folder: Audio_Documentation

File: the_hottest_year_on_record.mp3 Length: 11:37

Folder: Exhibit_Documentation

File: CC_branches_in_windows.tif

File: CC_hanging_branch.tif

File: CC_hot_year_exhibited.tif

File: CC_user_manual.pdf

File: CC_documented.tif

File: CC_exhibit_overview.tif

File: CC_exhibit_title.tif

File: CC_hot_year_video.tif

File: CC_turntable.tif

File: CC_SUNflower.tif

File: CC_on_ecoviz.tif

File: CC_climate_control_box.tif

File: CC_exhibit_overview_night.tif

File: CC_framed_record.tif

File: CC_hanging branch_night.tif