

THE GREENING OF PLANET EARTH CONTINUES

*The Promise for
the 21st Century & Beyond*



GREENING
EARTH
SOCIETY

Transcript of
THE GREENING OF PLANET EARTH CONTINUES

The Promise for the 21st Century & Beyond

FEMALE NARRATOR

A video was produced in 1992 called *The Greening of Planet Earth*. It explored the positive aspects of increasing amounts of carbon dioxide in the atmosphere.

It examined how enriched levels of CO₂ stimulate faster growth in trees and plants, improve water-use efficiency in growing things, and increase the yields of almost every important food crop globally.

The video also convincingly countered scare stories in the media about the frightening ramifications of global warming. And today, *The Greening of Planet Earth* remains a very positive vision of life in our world.

MALE NARRATOR

Yet, there are still TV news reports speculating about the spread of tropical diseases and about sea levels rising two feet or more. Still, newspaper stories speculating about vanishing wildlife and about crop-devastating droughts. And, still, magazine articles speculating about melting glaciers, summer heat-waves becoming more intense, and hurricanes and storms increasing in severity.

These reports are pretty powerful and pretty scary. But are they true?

FEMALE NARRATOR

Are all of these terrible things going to happen? Are rising levels of carbon dioxide causing apocalyptic global warming? And does recent scientific evidence contradict anything that was said in *The Greening of Planet Earth*?

There is no question that the level of carbon dioxide in the atmosphere is increasing – from about 270 parts per million before 1800, to about 365 now, to an estimated

doubling to 720 or more within the next 100 years. But is this leading to apocalyptic global warming?

MALE NARRATOR

Contemporary news reports would have us believe it is. And they are still speculating. "Global warming is no longer in doubt." "Left unchecked, global warming would lead to environmental holocaust." "Climate panel is confident of man's link to warming."

FEMALE NARRATOR

Since temperature measurements indicate that there has been a slight warming over the last century, what can we learn about it from the earth's climate history?

Climate History

SALLIE LOUISE BALIUNAS

*Senior Astrophysicist
Harvard-Smithsonian Center for
Astrophysics*

Over the last 100 years, the instrument records say that the earth has warmed about half a degree Centigrade. But most of that warming occurred early in this century before most of the carbon dioxide from human activities were put in the air. So that early 20th Century warming had to be natural. What is the cause of that warming?

The sun changes its energy output every eleven years with its sunspot cycle. Sunspots are these areas of intense magnetic field and they come and go every eleven years. We have records of that going back 400 years, since the time of Galileo.

The ups and downs of the sun's magnetism match up very well with these changes in the climate of the earth. So we estimate that most of the changes of the last several hundred years – and in fact some have estimated the last ten thousand years – can be caused by these fluctuations in the sun's energy output.

THOMAS GALE MOORE

*Senior Fellow, Hoover Institution
Stanford University*

The climate is naturally very variable. It has changed quite a bit over time. Fifty million years ago, it was about twenty degrees warmer than it is today. It's gotten gradually colder over this period of time, but with sharp ups and downs.

Since the last Ice Age, there have been two warm periods dubbed by climate historians "The Climatic Optimum" and "The Little Climatic Optimum." The Climatic Optimum was four thousand to seven thousand years ago. It was about as warm as they're predicting is going to occur at the end of the next century. It was a great period for human beings, for plants and animals.

The second, The Little Climatic Optimum, was thirteen hundred to a thousand years ago and, again...

DR. BALIUNAS

...led to tremendous advances in city building, in exploration, in cathedral building, and university building because people were not victims to the cold climate so much. So they could go out and grow crops. They were healthier. They were longer-lived. And all this because the climate was a bit warmer.

DR. MOORE

A slightly warmer world and an enriched carbon dioxide world will mean plant growth is more vigorous. The bottom of the food chain is plants. All animals eat plants or eat animals that eat plants, including us.

ROBERT DAVIS

*Associate Professor, Environmental
Sciences
University of Virginia*

The question everyone should ask is not "Is the earth warming," but, "How is the warming being felt across the planet? Where is it warming? When? And by how much?"

It turns out that most of the warming is occurring in the high latitudes, in the winter, and across the planet, at night.

ROBERT C. BALLING, JR.
Director, Office of Climatology
Arizona State University

For whatever reason, right now, it becomes quite newsworthy to go out and tell people that we are about to have apocalyptic climate changes. The second you make that pronouncement, it's easy to go around the world and find examples to support your viewpoint. But it would have always been easy. There would be no time in earth's history when you would not have been able to go around the world and find damaging hurricanes and tornadoes and whatever. They are not linked to the build-up of greenhouse gases.

PATRICK J. MICHAELS
Professor, Environmental Sciences
University of Virginia

The evidence that increasing carbon dioxide in the atmosphere is going to cause a disaster is somewhere between slim and none. However, the evidence that it's doing a good thing by lengthening the growing season and making plants grow better is somewhere between large and overwhelming.

MALE NARRATOR

You know, there's more in the research about this Little Climatic Optimum period. The Anasazi Indian civilization in the American Southwest reached its peak because the people were able to farm twice the amount of land as before. It was warm enough in England to grow grapes and support a thriving wine industry. And since alpine mountain passes were no longer blocked by snow, trade routes opened between Italy and Germany.

FEMALE NARRATOR

These warmer periods in history become even more interesting when you realize that they occurred when the level of carbon dioxide in the air was far lower than it is today. This makes it pretty difficult to make any connection between rising CO₂ and the even slight temperature increase we've observed during the last one hundred years.

So, if sunspots account for the earth's small amount of warming, if we're warming mainly the coldest parts of the planet in the winter and at night, and if warmer is better than colder, then why all this controversy?

MALE NARRATOR

Because of computers and computer simulations called General Circulation Models.

So what are General Circulation Models? What do they try to do? And how hard or easy is it to make a realistic one?

COMPUTER SIMULATIONS

DR. DAVIS

General Circulation Models, or GCMs as we refer to them, are trying to simulate the climate of the Earth at the surface as well as through the upper atmosphere. Climate includes not only temperature and precipitation and cloud cover, but also the atmospheric winds, changes or the movement of these systems over time from one month to another, evaporation from the oceans and from the land, precipitation onto the surface, global ice sea cover – all the aspects of the earth, of the planet, that are related to the atmosphere and to the oceans.

ROY W. SPENCER

*Senior Scientist, Climate Studies
NASA, Marshall Space Flight Center*

It's very difficult to create a realistic computer model because the atmosphere and the surface of the earth, and the oceans and vegetation systems are all so very complex. And the ways that all these components of the system interact are so complex. They interact in non-linear ways which we really can't predict. One thing changes, which changes something else, which changes something else. There's this cascade of processes.

DR. MICHAELS

People have to understand that the entire global climate-change hysteria is driven by computer models. It is not driven by reality. Reality is not warming up like those models said it would.

DR. BALIUNAS

The models say that there should have been warming of about a degree Centigrade. There's only been half a degree, and it occurred before most of the greenhouse gases were put in the atmosphere. In the last twenty years, there should have been warming of maybe three-tenths or even half a degree

Centigrade, according to the computer simulations. And the very precise satellite records tell us the earth hasn't warmed at all in response to this greenhouse gas increase.

DR. SPENCER

There are three different systems for monitoring global temperatures: the surface temperature dataset from thermometers, the satellite dataset from earth-orbiting satellites, and then weather balloon instruments which are, of course, launched from the surface.

We only have all three of those datasets for the last twenty years, that is, since satellites were launched in the 1970s. But what they tell us is that the surface temperature measurements suggest a warming.

DR. DAVIS

In terms of the land-based record, which does show some warming, there are a number of problems that need to be considered when we're looking at those records. One is that, at the beginning of the period of record where we were taking temperature observations, many of these cities were located in shallow, sloping valleys where cold air tends to pool.

DR. BALIUNAS

Then there's the problem of having a thermometer over land in a good location where a modern city grows up. Modern cities have concrete, buildings that generate heat, cars driving by. All that creates an artificial heat that elevates the temperature, but doesn't really reflect a true climate measurement.

DR. DAVIS

The result is that the temperature record at the surface is a contaminated record and urbanization needs to be factored out of that if we're going to get any kind of accurate representation of how surface temperatures have changed over the last hundred years.

DR. BALLING

What's surprising, though, is the satellite system that was specifically designed to precisely measure planetary temperature shows no warming whatsoever.

We have balloons that go up through the atmosphere twice each day from locations around the world and they're in near-perfect agreement with the satellite record. They see no warming at all.

DR. SPENCER

So we have a situation where the surface thermometers show warming, the satellites and the weather balloons do not. And climate models tell us that all of those systems should be seeing warming.

DR. BALLING

The models themselves look pretty good at first glance. But, actually, they're not well connected when it comes to the ocean and the atmosphere. There are problems with the clouds and the rain and the surface energy balance. There are problems with the ice caps and there are problems with energy fluxes in low latitudes. I have a friend who says they're like sausage – you really like them until you know what's in them.

DR. SPENCER

There's been a big change in the amount of forecasted global warming since 1990. In 1990, the official prediction of global warming was about 3.3°C by the end of the next century. More recently, in 1992, that was revised downward to 2.8° warming. In 1996, the warming estimate has been further reduced to 2°.

DR. BALLING

In virtually every case as the models have improved and as we have improved our representation of changes in atmospheric chemistry, the predicted temperature rise into the future gets smaller and smaller.

DR. MICHAELS

The most recent scientific evidence is overwhelming that the forecasts of global warming are going to have to be reduced even further in the future. At what point does this thing become an issue that is simply a non-problem, even to those that are concerned about it?

MALE NARRATOR

I also found something interesting in the research about computers and General Circulation Models. Here, "In order for a computer to run a complete circulation model, one that takes into account all the known aspects of our climate system, scientists would need 10^{36} more computing capacity. That's 10 followed by 36 zeroes.

FEMALE NARRATOR

Well, so far we've observed a very dynamic climate with numerous up and down fluctuations in temperature, and computer simulations that aren't as trustworthy as anyone would like. So why don't we take a closer look at this carbon dioxide we keep hearing about?

MALE NARRATOR

It seems that every time they mention carbon dioxide on television there are unpleasant video clips of factory smokestacks and car tailpipes. Is what they are showing CO_2 ? Is carbon dioxide a pollutant?

CARBON DIOXIDE**SYLVAN H. WITTEWER**

*Professor Emeritus, Horticulture
Michigan State University*

Carbon dioxide is not a pollutant. Carbon dioxide is a nutrient – a very important nutrient, perhaps the most important.

DR. BALLING

CO_2 has been part of the planetary atmosphere since the first day this earth evolved. The plants and virtually everything we see evolved in a period of time when the CO_2 level was very much higher than it is today.

CO_2 is something that plants love. They take up CO_2 , they use it, they give out oxygen. We take the oxygen and give out CO_2 . So it's hardly a pollutant at all. It's quite a naturally occurring gas that appears in our atmosphere and it's very important to sustaining life on this earth.

DR. MICHAELS

In terms of the broad geological perspective, the carbon dioxide concentration of the atmosphere right now is low. Almost all the plants that we live with and depend upon for food evolved in an atmosphere when the

CO₂ was higher in the atmosphere, much higher than it is today, and higher than we could possibly get it even if we tried.

DR. MOORE

Well, as a matter of fact, there were times when life flourished on earth. The time when CO₂ levels were something like ten times current level was when the dinosaurs were running around, and that was when plant growth was so vigorous they created all the oil and gas that we now use. It was a very fertile period of time for the earth.

DR. BALLING

Some scientists believe that nine thousand or so years ago, agriculture sprung up all over the world. We saw people domesticate plants in Southeast Asia and Asia and South America and Europe and North America, all at about the same time. It also corresponded with when the carbon dioxide had increased from about 200 parts per million to about 250 parts per million. It gave agricultural plants a competitive advantage over weeds. It may be that carbon dioxide is the reason we domesticated plants.

C. LEE CAMPBELL

*Professor, Plant Pathology
North Carolina State University*

When we've looked at the literature on experiments that have been done with increasing levels of carbon dioxide, what we basically find is that most plants respond the same way – more carbon dioxide gives us more biomass.

So, if we look at a forest, a rangeland, a marsh, a wetland, or an agricultural field, what's really happening with more CO₂ is that you have more plant material produced.

DR. BALLING

Increased CO₂ worldwide, with few exceptions, means plants grow better, period.

FEMALE NARRATOR

We can see plants "growing better" and also see the results of CO₂ as a plant nutrient in the Netherlands, where they grow food crops and flowers in enriched levels of CO₂. And they do it in glass houses – what we call greenhouses.

MALE NARRATOR

We are about to visit PBG (in English), the Research Station for Floriculture and Glasshouse Vegetables. It's a government-sponsored facility in Naaldwijk, just outside of Amsterdam.

GREENHOUSES**GUSTAAF ANTON****van den BERG***Head, Glasshouse Climate & Technology**Research Station for Floriculture &**Glasshouse Vegetables**Naaldwijk, The Netherlands*

We grow vegetables at two to four times the outside carbon dioxide level. That means between 700 and 1400 parts per million.

We are growing all the vegetables that commercial growers are growing, but the main products are cucumber, tomato, pepper, eggplant, squash, lettuce, and radish.

The results of growing at elevated CO₂ levels are: more rapid growth, earlier maturity, larger fruit size, greater weight, and a greater total yield of about twenty-five percent.

As a standard, commercial growers are using CO₂ enrichment in the glasshouses and the results they find are about the same results that we find in our experiments. Throughout Europe and also throughout the world, commercial growers with modern greenhouses are using elevated carbon dioxide levels the same as in the Netherlands.

We go up to about 1500 parts per million. That has no negative effect on human health. To get negative effects on human health you have to go much higher; that is, higher than five and ten thousand parts per million, at least.

Looking at rising levels of CO₂ from the viewpoint of the plant, there's no problem at all. We will have a higher production.

MALE NARRATOR

Talking about "higher production," there are about 25,000 acres of commercial greenhouses in the Netherlands growing vegetables, flowers and bulbs worth some \$7 billion

a year. And greenhouse agriculture is expanding all over the world: from Spain, Italy, Turkey and Greece to Japan, Taiwan, China and Korea.

FEMALE NARRATOR

Since only about twenty-five food crops stand between humans worldwide and starvation, let's take a closer look at carbon dioxide and its effect on food production. Are rising levels of CO₂ a frightening thought?

AGRICULTURE

DR. WITTEWER

Rising levels of atmospheric carbon dioxide do not frighten farmers. They do not frighten foresters. Forestry output is increased. Agricultural output is increased. And this applies to all the food crops. Food is the most important renewable resource we have.

LEW ZISKA

*Climate Stress Laboratory
Agriculture Research Service
U.S. Department of Agriculture*

Probably the single most important food crop globally is rice. From my experience working with tropical rice in the Philippines, certainly CO₂ is able to increase yields of rice – most of the traditional semi-dwarf varieties of rice that are utilized. So, hopefully, that will increase rice yields as CO₂ increases in the atmosphere.

DR. CAMPBELL

We have found that increasing the CO₂ level from the current level to two times what we have today would basically increase plant yields. We have worked with corn. We have worked with soybeans. We have worked with wheat.

For corn, our yield increase is about 17 to 18 percent. For soybeans, it would be more – about 25 percent. And for the wheat, it would be probably between about 20 and 25 percent.

DR. BALLING

I look at the literature fairly regularly on this and it seems overwhelming that plants throughout the world – agricultural plants – do very well when the carbon dioxide is increased. We see soybeans in Iowa being

reported upon that have a much higher yield for higher CO₂. We see strawberries in China and grapes in Italy. We see winter wheat in Europe. You can go around the world and you see evidence that increased CO₂ yields more productivity for our most important agricultural crops.

DR. WITTEW

It has been estimated that the rising level of atmospheric CO₂ has enhanced global food production ranging from eight to twelve percent. Now this is a universally free subsidy that is increasing daily, that is available to all, and to the entire earth and to all food crops, and all forest crops and all range crops.

JAMES ARTHUR BUNCE

*Climate Stress Laboratory
Agriculture Research Service
U.S. Department of Agriculture*

Increased carbon dioxide may change where plants grow, especially in terms of being able to grow in dryer places, so that the distribution of plants may change as carbon dioxide goes up.

DR. BALLING

Doubling of CO₂ would cause not just an effect on individual plants, but also a redistribution of the plants around the world. There are people who argue that dryland areas like this desert we're sitting in right now could be greening up a bit due to the increase in CO₂. In some dryland areas where it's rather marginal in terms of people getting by, this increase in plant cover could ultimately yield an increase in grazing and more cattle, and maybe an increase in the standard of living in some of these countries.

DR. CAMPBELL

I think we should monitor the increases in carbon dioxide. We should look and see how plants are growing, how the ecology is changing, and then we should adapt. That's what people do best. We are an adaptable species. Plants are adaptable. And we should work with the earth's system as it changes.

FEMALE NARRATOR

Well, scientific research shows that enriched levels of CO₂ have a positive effect on just about every important food crop around the world.

MALE NARRATOR

And in addition to what was just mentioned, there are numerous additional experiments that confirm it: in Switzerland – peanuts, beans, and peas. In England: wheat and strawberries. In Italy: soybeans. In Canada: tomatoes and peppers. And in Denmark: barley, not to mention cotton in Mississippi, pasture land in New Zealand and clover in Germany. In addition, a doubling of CO₂ may even cause a greening of many lands worldwide now considered to be marginal.

FEMALE NARRATOR

Enriched levels of CO₂ mean faster plant growth, increased agricultural yields, and something else of great importance.

WATER-USE EFFICIENCY**PARK S. NOBEL**

*Chair, Department of Biology
UCLA*

Increased levels of CO₂ have another consequence. In particular they can improve the water-use efficiency of plants.

DR. BUNCE

That is, the amount of water that's used by plants to produce the same amount of growth actually decreases with increased CO₂.

DR. NOBEL

When we have the elevated CO₂, the higher atmospheric CO₂ level makes it easier for CO₂ to go into the plants so the pores – called stomates – don't have to open as widely. When the pores aren't open as widely, it's more difficult for water to come out.

DR. ZISKA

So there's actually less water loss per unit of carbon that's being taken up into the plant. As a result of that, water-use efficiency goes up.

DR. NOBEL

So a higher water-use efficiency means we're using CO₂ more efficiently in terms of the water requirements for the crop.

DR. CAMPBELL

This will change some of the ecosystems. It may allow some plants to grow in areas that now would be considered marginal for the growth of those plants.

So, we'd have more biomass production, plants in a little bit different area, and we may actually be able to farm some of the areas that would now be considered desert.

DR. WITTEW

This is important because in the world we're in today, water is going to become probably the most limiting natural resource as far as food production is concerned and as far as the biological productivity of the earth is concerned.

There is a limited amount of fresh water in terms of quantity. There's a limited amount of fresh water in terms of quality.

MALE NARRATOR

According to the World Bank, forty percent of the earth's population could be living in countries with insufficient water supplies by 2025. So improved water-use efficiency can be critical.

FEMALE NARRATOR

Enriched levels of CO₂ also have a positive effect on trees. In fact, trees have already been positively affected.

In 1992, the Forest Research Institute of Finland reported a twenty-five percent increase in forest growth between the early 1970s and the late 1980s for all the countries of Europe, and this included Germany's Black Forest, once thought to be dying out completely. And other studies indicate that by doubling the CO₂ content of the atmosphere, the growth rate for many trees could double as well.

MALE NARRATOR

It's estimated that ninety-five percent of all fruit trees, ninety-five percent of all nut trees, and ninety-five percent of all forest species could expect to have dramatic, positive responses to enriched levels of CO₂. And this includes Loblolly pine in Georgia and Scots pine in Belgium.

TREES

REINHART J.M. CEULEMANS

*Research Director, Professor of Biology
University of Antwerp, Belgium*

One of the major ways which we use to study effects of elevated CO₂ is open topped chambers. Within these open topped chambers, we enrich the atmosphere with CO₂ and compare the growth of the trees within the chambers with trees in similar chambers without additional CO₂, as well as with trees grown outside the chambers.

ROBERT TESKEY

*Professor, Forest Biology
University of Georgia*

For a number of years, I've run an experiment in elevated CO₂ in this Loblolly pine plantation where we've enclosed portions of the canopies above us in rich levels of CO₂—fifty percent higher than the current ambient, and a hundred percent higher than the current ambient.

DR. CEULEMANS

With increasing levels of CO₂ most trees increase their growth and their biomass productivity. This could be both aboveground and below ground. In our experiments with pine and poplar this has been very pronounced and has been shown as well in many other studies in the United States and in Europe.

DR. TESKEY

I think most scientists are finding that elevated CO₂ is enhancing productivity in forests. The degree of enhancement is dependent on other resources on the site. If sites have high fertility, the enhancement is large and long lasting.

DR. CEULEMANS

Nitrogen is one of the most essential nutrients for the plants which the plants take up from the soil. Under increasing levels of CO₂ the nitrogen-use efficiency – which means the carbon taken up per unit of nitrogen taken up – is increasing, is improved.

DR. TESKEY

The timber industry in Georgia alone is a \$14 billion industry. The increase in CO₂ in forests in Georgia and the southeast should increase forest productivity and should increase the amount of fiber available for the industry for paper and wood products.

DR. CEULEMANS

Within Europe we're working together in a research network with fifteen different labs and research universities in different countries in the European community. We all do similar studies with elevated CO₂ on a number of different tree species. Most of the results from this collaborative effort have shown that all species improve their growth and productivity. However, the magnitude of the response differs, depending on the species, the site, and water conditions.

DR. TESKEY

Water-use efficiency is enhanced under elevated CO₂ conditions because the trees are growing more, but they're using about the same amount of water. Water-use efficiency was actually increased two to three times in trees that were growing under elevated CO₂ conditions.

DR. CEULEMANS

Forests cover about one-third of the world's surface, so they play a major role in the carbon balance of the globe. Under increasing levels of CO₂ we have seen that some of the forests improve their carbon uptake. Some of the carbon which we release from fossil fuel burning is not retrieved in the atmosphere nor in the oceans and might have been stored in the forests on the different continents in the world.

FEMALE NARRATOR

The reality here is that it's very difficult to find any relationship between carbon dioxide and dramatic global warming. What we know for sure is that the climate change we can reliably expect is both modest and benign.

MALE NARRATOR

Only unreliable computer simulations predict apocalyptic global warming. Provable, observed reality tells a very different story about a small amount of beneficial, nighttime winter warming in the coldest airmasses.

Carbon dioxide is a plant nutrient that causes faster growth, increased yields, and improved water-use efficiency. And this translates into more vigorous tree growth

worldwide, the ability to grow more food for more people, and the capacity to grow it on what are now marginal lands.

FEMALE NARRATOR

When we strip away all the scare headlines and over-simplifications, a very different picture emerges: a picture of humanity and nature growing together, adapting to changes in the environment as we always have. A picture of people enjoying the benefits that enriched levels of carbon dioxide bring to all growing things. And a picture of the on-going industrial evolution of humankind as the greening of planet earth continues.

- THE END -

With special thanks to:

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