The Impact of Global Warming on the Chesapeake Bay
Hearing testimony of Dennis T. Avery, Hudson Institute
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Thank you for the opportunity to present this testimony on a vital public issue.

No Human Impact on Chesapeake Temperatures?

The first point I must make is that we cannot document any significant current impact from man-made warming on the Chesapeake Bay. Nor are we likely to do so in the future. A number of recent studies have found incontrovertible evidence of a long, moderate natural global climate cycle—which has periodically raised the temperatures of the Chesapeake to higher levels than today, and for extended periods. Quite simply, the Bay has been through higher temperatures before, and will be again. The flora and fauna have also been through these warmer periods, and adapted. That is fortunate, because the natural climate cycle is apparently driven by the sun, and the warmings are unstoppable.

Previous Bay warmings include the Medieval Warming (950–1300), the Roman Warming (200 BC–600 AD), and at least two earlier Holocene Warmings since the last Ice Age 12,000 years ago, that were regarded by paleontologists as warmer than today by several degrees C.[1]

These natural warmings, and the coolings interspersed with them, are called Dansgaard-Oeschger cycles. The cycles are named after their discoverers, Willi Dansgaard of Denmark and Hans Oeschger of Switzerland, who found them when they brought up the world's first long ice cores from the Greenland ice cap in 1983, the Greenland ice cores revealed the 1,500-year cycles for the first time, embedded in 250,000 years of Greenland ice history. (Oxygen isotopes in the ice layers documented the air temperatures that existed when each layer was laid down.)[2] The cycles had been too long, and too moderate, to be discerned by peoples lacking thermometers and written records.

Since the 1980s, the evidence of these cycles has also been found in a 900,000-year Antarctic ice core; in the sediments of at least six oceans and hundreds of lakes; in cave stalagmites on every continent plus New Zealand; in ancient documents in Europe and Asia; in the long-term records of Nile floods; and in archeological remains, which show farms and primitive villages simultaneously moved up the slopes of the Alps and Andes during the warmings, and back down during the coolings.

Fossil pollen shows nine complete reorganizations of North America's trees and plants during the past 14,000 years, in concert with the temperature cycling. In Ontario, this means that beech trees dominated the forests during the Medieval Warming, giving way to more oak trees as the Little Ice Age set in, and finally yielding to more pine trees as the cold intensified. Today, the oak trees are coming back and the beech trees are waiting their next turn.

Both seabed sediments and ice cores show the Dansgaard-Oeschger cycles extending back at least 1 million years, and dominating the earth's temperatures during the last 11,000 years. Incidentally, Dansgaard and Oeschger shared the 1996 Tyler Prize (the "environmental Nobel") with Claude Lorius, leader of the Antarctic team that brought up the Vostok ice core, so the cycle evidence is well-known to the environmental movement.

I have co-written a new book, with climate expert Fred Singer, titled *Unstoppbable Global Warming: Every 1,500 Years*. It cites peer-reviewed studies, authored and co-authored by more than 500 scientists and published in leading scientific journals, which 1) found evidence of the natural cycle, 2) linked it to the sun's variations, or 3) found some other serous flaw in the current global warming alarmism, such as the loss of 1 million wild species or radically increased human deaths. The researchers' scientific specialties range from tree rings, lichens and marine fossils to public health and satellite imagry. There are many more such studies which the book did not cite, and we plan to identify more of them and their authors in the near future.

The Dansgaard-Oeschger cycles are moderate above all. They have typically warmed the earth by 1–2 degrees C above the long-term average, and then dropped it by 1–2 degrees below the long-term average at the latitude of Washington and the Chesapeake. Arctic temperatures vary more widely, which may or may not stress the polar bears but seems inevitable. The shifts from warm to cool and back are often abrupt, gaining half their total change within a few decades. Near the equator, temperatures change little, but rainfall patterns change sharply, as the tropical rain belts shift north and south by hundreds of miles. This shift in the rain belts has produced mega-droughts in California and very long droughts in the Chesapeake region.

All of the current global warming evidence today is consistent with our Modern Warming being a natural rebound from the Little Ice Age. Our total warming since 1850 is apparently just 0.7 degrees C. The only place we find dramatically dangerous man-made warming is in the projections of the global computer models—which have been verified with each other, but not with the real world. The models have consistently overestimated the Greenhouse effect, and the UN's Intergovernmental Panel on Climate Change has been slowly and reluctantly reducing its warming forecasts over time.

This moderate climate cycle has raised the Chesapeake's temperatures higher than today as recently as 5,000 years ago. Thus, we can hardly call today's temperatures an "unprecedented" or "unnatural" threat to wild species. Rather, today's temperatures should be regarded as "within the normal range" of the ecosystem, and the responses of the Bay's plants and animals as "normal" adaptations.

Recent Studies of the Bay's Long-Term Temperature History

In 2003, T. M. Cronin and his research team used the magnesium/calcium ratios in Chesapeake Bay sediment cores to document rapid temperature shifts—2–4 degrees C within 100 years—in past Chesapeake Bay temperatures.[3] These big shifts occurred:

a) 150 years ago in 1850 AD
b) 400 years ago in 1600 AD
c) 650 years ago in1350 AD
d) 950 years ago in 1050 AD
e) 1600 years ago in 400 AD and
f) 2100 years ago in 100 BC.

The big, sudden temperature changes reflect the Roman Warming, the Dark Ages, the Medieval Warming and the Little Ice Age. Nothing would be more "natural" than the Little Ice Age being followed by another warming.

Cronin and his colleagues noted that the temperatures of the 20th century were 2–3 degrees C higher than those in the previous 2000 years. However, they did not comment on the Holocene warmings, which other authors have found to be as much as 6 degrees warmer than any of the more recent cycles in the Arctic (with somewhat lesser temperature elevations at lower latitudes).

Debra Willard of the U.S. Geological Survey and a research team in 2005 used pollen from Bay seabed sediments to reconstruct the Bay's temperature history for the past 10,000 years. [4] Her team identified a 1429-year cycle in the abundance of the Bay's pine trees, associated with winter temperature declines of up to 2 degrees C. The most recent of these cycles correlates with the Little Ice Age. This is consistent with the findings of the Cronin team.

Willard and her authors note that the climate cycle fits well with a similar cycle in the "solar isotopes" (carbon ^{14} in trees and beryllium ^{10} in ice). The solar isotope cycle, in turn, correlates closely with temperature proxy cycles found in Greenland ice by Dansgaard in 1984 and by Colombia University's Gerard Bond in North Atlantic ice-rafted glacial debris in 2001. All are thus tied to cyclical changes in solar activity.

In 2003, Dr. Willard had used the fossils of tiny marine organisms and the pollen from long-dead trees to construct a record of rainfall in the Chesapeake region for the last 2300 years. The authors found very long dry periods 1) during the Roman Warming, from 200 BC to 300 AD, and 2) during the Medieval Warming, from 800 AD to 1200 AD. [5] These droughts were due to the north-south movement of the tropical rain belts as part of the Dansgaard-Oeschger cycling.

The Willard study also found decade-long dry periods during the Little Ice Age, between 1320–1400 and 1525–1650. One of these may have eliminated the "lost" British colony established on North Carolina's Roanoke Island in 1587, during the most extreme growing-season drought in 800 years. The Jamestown colony also had bad weather luck, arriving in 1607, during the driest 7-year period in 770 years.

All of these Chesapeake droughts seemed to reflect much more serious and simultaneous droughts in the Southwestern U.S., including southern California. California's Medieval-

Warming droughts have been well-publicized by Scott Stine of California State University.

The "New Math" of Global Warming

The temperatures of the Modern Warming are well within the parameters of past natural warmings and coolings. The earth has probably warmed about 0.7 degrees C since 1850, but about 0.5 degree C of the warming occurred before 1940, before significant human emissions of CO_2. The pre-1940 warming can, therefore, be credited to the natural cycle.

The net warming since 1940 is a tiny 0.2 degrees, over more than 60 years, during which the atmosphere has become increasingly saturated with CO_2. (After saturation, no more CO_2 be retained in the air around us or have a Greenhouse impact.) Logic would indicate that human emissions can be credited for half of that warming or .1 degree. It is difficult to assign any significant climate change in the Chesapeake to human-emitted fossil fuels.

We have had no additional warming since 1998, though CO_2 levels in the atmosphere have continued to soar. 1934 is still the warmest year of the last century, followed closely by 1998 and 1921, which emphasizes how moderate our warming has been. The solar index has recently turned sharply downward and the temperatures are likely to follow. None of this guarantees that there will be no further warming, but indicates further warming is likely to be moderate.

If human emissions can logically claim only 0.1 degree of warming over 65 years, then the climate models are claiming too high a Greenhouse sensitivity for the atmosphere. There is certainly no published evidence to support the current high numbers. The climate has never warmed anywhere near as much as the IPCC's original forecasts, even with the documented assistance of the current Dansgaard-Oeschger warming.

Species Adaptation

It is important to note that no wild species extinction has yet been tied to the rise in earth temperatures since 1850. A claim was made that the Golden Toad, which lived in a Costa Rican cloud forest, went extinct due to higher sea surface temperatures. However, the loss of the Golden Toad has now been blamed on the clearing of the once-forested mountainsides below its cloud forest home, which altered the cloud-forest moisture conditions.

Biologist Chris Thomas of Great Britain has claimed that the world would lose more than a million wild species due to the projected speed and scope of modern global warming, but this claim is literally incredible.

In the first place, the record of past Dansgaard-Oeschger cycles indicates that they are typically abrupt. Yet most of our wild species "body types" date back about 600 million years and are still going strong.

In the second place, the shifts in ecosystems are not likely to be abrupt. Most trees and plants are cold-limited but they are not heat-limited. Stand replacement of trees must await fires or disease outbreaks to clear a path for the invading species to take over. Thus, the current warming is encouraging the vegetation to gradually expand ranges, and the associated fauna have the same opportunity. Study after study, around the world, shows more biodiversity in our forests and wild meadows today than have resided in them for centuries.[6]

Thirdly, Dr. Thomas himself has documented wild species' adaptations to the warming. He has reported on butterflies colonizing "new types of habitat" during the warming, and bush crickets producing more offspring with longer wings, the better to reach new territories.[7] We have already seen dramatic evolutions of wild species, including tolerance for massive quantities of cadmium by mudworms in the Hudson River near a battery factory, and insects quickly developing tolerance for synthetic pesticides.

Have the species adapted before? They must have. Does the polar bear have adaptation strategies too? That also seems certain. Even though the polar bear is a relatively recent offshoot of the grizzly bear, it goes back some 200,000 years.

Not Much Sea Level Rise

Much has been made of the potential of the current warming to melt the Greenland and Antarctic Ice Caps, dramatically raising sea levels. That would certainly impact the Chesapeake. However, it takes 80 times as much heat to melt an ice cube as it does to raise the temperature of the water from that ice cube 1 degree. Recently, we have seen estimates that the Arctic ice has been radically reduced in extent—but the extent of Antarctic ice has simultaneously risen to amazing levels.

Warmer temperatures melt more glacier ice, but they also evaporate more water from the oceans, much of which falls again as snow on the ice caps. More snow becomes more ice, and the Antarctic is currently adding billions of tons of ice per year, mostly on the ultra-cold East Antarctic Ice Sheet. This ice is too cold to melt. It flows downhill virtually in solid blocks, based on the slope of the underlying mountains. It has been flowing at about the same rate for 10,000 years, and that rate has not accelerated during our warming. It would take another 7000 years to get rid of that ice at current rates, according to John Stone of the University of Washington.[8]

Walter Munk of the Scripps Oceanographic Institute reports that glacial melting due to higher 20th-century temperatures can account for only four inches per century of sea level rise [9] Neils Reeh of the University of Denmark reports a "broad consensus" that another 1 degree of warming would increase the melting of Greenland's ice sheet only enough to raise sea levels 0.3 to 0.77 inches—while the additional ice in Antarctica would subtract 0.2 to 0.7 mm per year.[10]

The Emerging Dangers of Grain-Based Ethanol

If humans have not significantly changed the Bay's temperatures, they have certainly had other impacts on it. The Willard authors note that European colonization had severe impacts on the watershed and estuary. Forest clearance and farming altered estuarine water quality, with the fossils indicating less dissolved oxygen and increased turbidity. The Willard data also show another drop in the Bay's water quality after 1950, when the fossils indicate water-quality changes associated with increased urbanization, more hypoxia, and more fertilizer use.

A new element of man-made danger now threatens the Bay for the first time, and it is a direct result of our concern about burning fossil fuels. The Federal government has adopted a mandate to produce 35 billion gallons of ethanol per year to help achieve "energy independence" without increasing gasoline use. Unfortunately, America has only corn with which to produce the ethanol, and corn yields only about 50 gallons worth of gasoline per acre per year—against annual gasoline demand of more than 134 billion gallons.

Ethanol's demand for corn has already doubled corn prices, and has bid farming acres away from soybeans, wheat, and cotton. The whole price structure for commodities and farmland has been wrenched upward, causing street riots in Mexico over tortilla prices and China's canceling of further expansion in its ethanol program due to food price inflation. Food prices make up a full one-third of the Chinese cost of living.

The Center's analysis indicates that the current federal ethanol mandate will soon drive corn to $4.50 per bushel, even in the absence of any crop diseases or weather problems in the Corn Belt.

The commodity magazine that follows vegetable oil prices, *Oil World*, recently stated, "It is high time to realize that the world community is approaching a food crisis in 2008 unless usage of agricultural products for biofuels is curbed."

World food demand is rising due to moderate population growth plus rapid income gains. There is no more farmland to bring into production, unless the Sierra Club and Greenpeace are prepared to endorse massive forest-clearing in the American Midwest to support more corn ethanol. Unfortunately, the U.S. might have to clear 50 million acres of forest for enough corn ethanol to make much of a dent in its gasoline demand.

The President apparently wanted to foster ethanol from non-food sources, but the enzymes to break down the cellulose in switchgrass, corn stalks and wood chips are not yet available, and we do not know when they might be. Corn ethanol is *not* an adequate substitute for cellulosic ethanol.

I recently toured parts of the Eastern Shore of the Chesapeake Bay. I have never seen such intensive planting of crops. Next to a marina, the owners of a mansion could no longer see the water, because they had planted their front yard to corn! Ethanol plants are

being planned for the Eastern Shore that would lock in this intensive cropping pattern, and even intensify it further. The USDA says America's corn ethanol plants will need an extra 1 billion bushels of corn in 2008, and then more and more corn in the years after that.

All to produce high-cost corn ethanol that will not protect the Bay from higher temperatures but will certainly subject it to more soil erosion and potential pollution.

I submit that corn ethanol is merely the first of a whole series of "global warming" decisions that could threaten ecological damage, global food supplies and public health—without "saving the planet."

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