Volume 7, Number 8
December 24 2001

WORLD CLIMATE REPORT

Breaking news on the science and politics of global climate change

GREENING EARTH SOCIETY

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Feature/2001 Temp Stats Bring Holiday Cheer

As the end of 2001 nears, folks are busy with their calculations to determine the earth's average temperature for another year. Usually, in their great excitement to proclaim that some extreme value has been reached or some record exceeded, the calculators don't wait until all the data are in, but do their best to estimate the temperature anomaly based upon whatever data they've collected so far.

This year, the number-crunchers relying on data from surface thermometers and sea-surface temperature measurements will proudly announce (if they have not done so already) that 2001 was the second-warmest year ever measured. And since the current record holder, 1998, was associated with the mother of all El Niños (that is, if El Niños can be mothers), 2001 therefore represents the warmest "normal" year, and would seem to provide further evidence that global climate models are right and therefore we should believe everything they tell us and that George W. should reconsider the United States' withdrawal from the Kyoto Protocol.

But let's look beneath the surface, as it were—or above, actually. What these announcements will fail to include is that the average temperature in 2001 in the atmospheric layer from the earth's surface up to about 25,000 feet as measured by NASA satellites was just about normal. Of the 23 years on record (satellite measurements of temperature began in 1979), 13 years were colder than 2001 and 9 were warmer. And those facts serve as further evidence that global climate models are wrong and their projections should be viewed with caution and skepticism and that George W. is right on the money.

Here's why. There is a growing disparity between the temperature at the surface and the temperature of the lower atmosphere (Figure 1). The surface is warming up and the lower atmosphere isn't. That is nearly opposite to what the climate models predict. One of the more reasonable climate models, the one developed by the National Center for Atmospheric Research (see What's Hot, page 3, for more details about that model), produced the results shown in Figure 2. That figure shows the temperature difference between the years 2100 and 1990 as you go upward in the atmosphere. Notice that the temperature increase is large at the surface, but slightly increases as you go up, to a level of about 50,000 feet. That is especially true over the oceans (the dotted line), a region where, incidentally, the satellite temperatures of the atmosphere show the least warming and biggest discrepancy with the surface records. Since the interactions between the surface and the atmosphere, as well as the state of the atmosphere itself, are largely responsible for all of our weather, completely mischaracterizing the relationship between temperature change there and temperature change at the surface can only lead to inaccurate and unreliable projections of future climate.

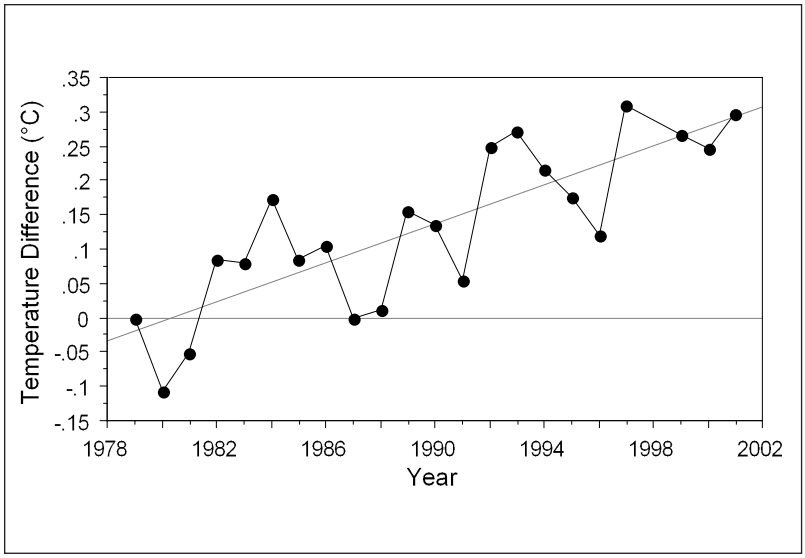

Figure 1. When the annual lower atmospheric temperature anomaly as measured by NASA satellites is subtracted from the annual surface temperature anomaly, a significant upward trend results over the course of the 23 years of the satellite temperature record. The surface is warming up, while the lower atmosphere is not. Climate models predict that nearly the opposite should be occurring due to increases in the atmospheric concentration of greenhouse gases.

Even if 2001 is the second-warmest year on record at the surface, where will that get us? Well, it becomes part of a warming trend that began about 25 years ago, with a rate of about

INSIDE

World Climate Report is a biweekly research review published by New Hope Environmental Services Inc., which is solely responsible for its editorial content. Funding for this publication is provided by Greening Earth Society, with additional funding from other sources.
Electronic copies are available at http://www.co2andclimate.org/climate.
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0.17°C per decade. In 100 years, that gets us 1.7°C of warming, although since some of the observed rise is likely due to slight variations in the sun's output, perhaps a better guess is 1.5°C. The current range of future temperature rise this century, as foreseen by the Intergovernmental Panel on Climate Change (IPCC) in their Third Assessment Report, is 1.4°C to 5.8°C. An extension of current trends lands us very near the low end of this range. The accompanying sea-level rise for a temperature increase at the low end of the IPCC range is projected to be less than a foot in 100 years.

As we've been saying all along, the result of such a climate change would be benign and possibly even beneficial, as most of the temperature rise is going to take place during the coldest times of the year in the coldest continental interiors. A temperature rise of this character, accompanied by enhanced atmospheric levels of carbon dioxide, will, among other things, lead to longer growing seasons, more productive crops, and a net decrease in the amount of energy needed for indoor climate control.

But you no longer have to take our word for it. A new book, edited by respected Yale economist Robert Mendelsohn and entitled *Global Warming and the American Economy,* arrives at the same conclusion. In it, Mendlesohn concludes that a temperature rise of about 2.2°C and a sea level rise of about a foot would lead to a net annual benefit to the U.S. economy of about $20 billion. *The New York Times* quotes Mendlesohn as saying "Scientists originally thought there were going to be horrific results from climate change, but we're not seeing that."

Wow, it seems like people are actually starting to catch on to the notion that global warming is just not going to be that bad. Thanks to Mendelsohn's new analysis, when the 2001 annual temperature is finally announced, we'll be crying all the way to the bank.

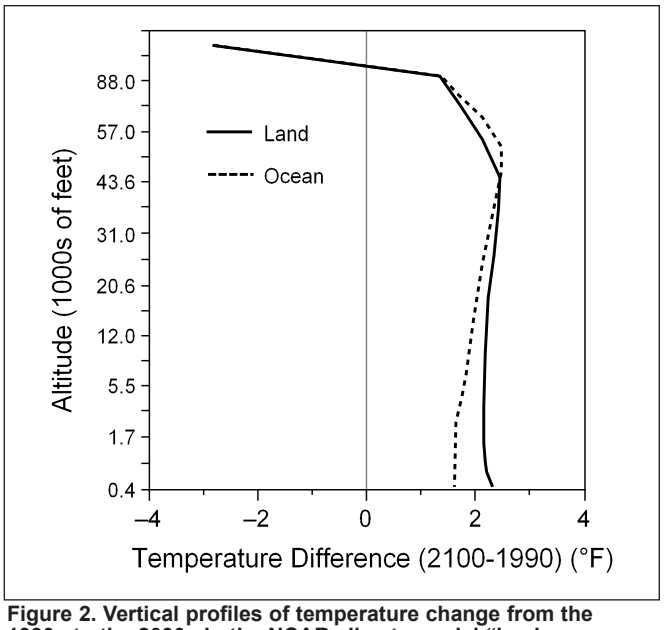

Figure 2. Vertical profiles of temperature change from the 1990s to the 2090s in the NCAR climate model "business-as-usual" emission scenario. Notice that the temperature difference increases above the surface, until a height of about 50,000 feet. Satellite observations show that annual temperatures in the lower atmosphere have not warmed at all—a result that is not consistent with climate model simulations.

References:
Dai, A., et al., 2001. Climates of the twentieth and twenty-first centuries simulated by the NCAR climate system model. *Journal of Climate,* **14**, 485–519.

Mendelsohn, R. (ed.), 2001. *Global Warming and the American Economy: A Regional Assessment of Climate Change Impacts.* Edward Elgar Publishers.

Greening Up/

By Robert C. Balling Jr., Ph.D.
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(C)O_2, TANNENBAUM!

How beautiful the branches of the North Carolina loblolly pine, especially one that has enjoyed a carbon dioxide–enhanced atmosphere. Since 1996, that species of holiday greenery has been growing with atmospheric CO_2 concentrations maintained at 350 ppm and 560 ppm. The subject of numerous scientific papers, these special pines recently have produced still more evidence that CO_2 can benefit plant life—this time on plants' seeds and root systems.

In one experiment, Hussain and colleagues found the seeds from the CO_2-enriched loblolly trees were nearly twice as heavy as the seeds from the plots with natural CO_2 concentrations. Furthermore, many of the vital biochemicals necessary for successful reproduction more than doubled in concentration thanks to the 210 ppm increase in CO_2. The overall result was that the seeds from the enriched trees were more than three times more successful in germination than the seeds from natural CO_2 growth conditions. Not only were the existing plants responding positively to the elevated CO_2 levels, but this recent experiment indicates that future generations will be off to a healthier start in their world of higher CO_2 concentrations.

In a second study on the same set of trees, the Pritchard research team turned their attention to the root dynamics of the loblolly experiment and found that elevated CO_2 increased root length by 16 percent, the number of live roots by 24 percent, the diameter of live roots by 8 percent, and the diameter of dead roots by 6 percent. Overall root production increased by 16 percent, while root mortality increased by 35 percent.

The team concluded that "rooting will be enhanced to some extent and...nutrient acquisition within loblolly pine forests may increase as atmospheric [CO_2] rises." They also stated that "Enhanced root production and mortality could potentially lead to sequestration of atmospheric CO_2 in soil organic C, thus partially ameliorating further increases in atmospheric CO_2."

Elsewhere on the globe, in a closely related study, a scientific team in Sweden grew Norway spruce trees in whole-tree chambers with ambient and twice-ambient atmospheric CO_2 concentrations over a three-year period and varying amounts of fertilizer over a 15-year period. The focus of the study was on the root-region fungus community that provides trees with nutrients. With respect to the root community, Fransson and colleagues concluded that "After 3 yr, the effects of elevated CO_2 on community composition were of the same magnitude as those seen after 15 yr of fertilization treatment." Once again, atmospheric CO_2 served as a fertilizer, not a harmful pollutant, to the Norway spruce.

The scientific literature on the biological benefits of elevated CO_2 is growing faster than the pine trees in these various experiments. From the famous loblolly pines of North Carolina to the Norway spruce trees across the Atlantic, we continue to witness the amazing responses to higher levels of atmospheric CO_2.

References:
Fransson, P.M.A., A.F.S. Taylor, and R.D. Finlay. 2001. Elevated atmospheric CO_2 alters root symbiont community structure in forest trees. *New Phytologist,* **152**, 431–442.

Hussain, M., M.E. Kubiske, and K.F. Connor, 2001. Germination of CO_2-enriched *Pinus taeda L.* seeds and subsequent seedling growth responses to CO_2 enrichment. *Functional Ecology,* **15**, 344–350.

Pritchard, S.G., et al., 2001. The influence of elevated atmospheric CO_2 on fine root dynamics in an intact temperate forest. *Global Change Biology,* **7**, 829–837.

What's Hot/

NCAR'S BENIGN FORECAST

A bit over a year ago, we reported on a paper by Thomases Delworth and Knutson that appeared in *Science* magazine. In it, the pair examined climate model simulations of the observed 20th-century global temperature history and explained why those models don't do such a good job of replicating it. We often point out that if the models can't get the known past correct, we shouldn't rely on them to produce accurate predictions of the future. Of course, climate modelers are a bit sensitive about that.

In their work, Delworth and Knutson argue that by repeatedly (five times) running a climate model that was forced by observed changes in greenhouse gas concentrations and sulfate aerosols and, in one case getting an answer that was "a remarkable match to the observed record," that their model, for all intents and purposes was working fine. The reason that climate models have such a hard time simulating reality, they suggest, is that the warming from 1925 to 1944 (which occurred before their was a large perturbation of the atmospheric CO_2 concentration) was from an "unusually large realization of internal multidecadal natural variability of the coupled ocean-atmosphere system." In other words, natural variability was to blame rather than an actual failure of the climate models themselves. After all, how could the models be expected to replicate the temporal occurrences of random processes? Of course, we've never heard it argued that the warming from 1978 to present (a warming of equal magnitude to the early century warming) was a result of the same random processes—but then, the models seem to get this warming right.

In several meetings and seminars, *WCR*'s editors have raised the point that a success rate of 1 out of 5 doesn't seem too convincing, and we were met with arguments claiming that 1 in 5 actually was actually quite a significant result and supported the claim that climate models were actually getting things right.

Well, along comes a new paper in the *Bulletin of the American Meteorology Society* by a research team from the National Center for Atmospheric Research (NCAR) who have been running their own climate model and comparing it to the observed temperature history. They found that when they ran their model, which included changes in greenhouse gas and aerosol concentrations, five times, they still were unable to replicate the early twentieth century temperature rise. So they ran it 5 more times. Still no luck. At this point, they stated that their result was "in contrast to an earlier study (Delworth and Knutson, 2000)." Next they added the observed changes of the solar output, and voila, their model temperature history looked a lot like the observed temperature history. This result strengthens the case that variations in the solar output have a detectable impact of the earth's temperature—something that, believe it or not, is not universally accepted—and weakens the case that climate models without a solar input get things right.

Here's the kicker. The NCAR model, which now seems to be the model that can best mimic the temperature rise of the 20th century, using a "business-as-usual" emissions scenario, only projects a rise during the 21st century of 1.9°C. That rise becomes only 1.5°C when a scenario is employed in which the end-of-the-century atmospheric CO_2 concentration is only 540 parts per million—a level that you reach if you simply project out the rate of CO_2 build-up observed during the past 25 years. If these numbers sound familiar, that's because the modeled temperature rise is now very similar to an extension of the observed temperature trends—which we discuss in this issue's front-page feature.

And of course, the impact of such a slight temperature increase is hardly cause for alarm. A modest temperature rise manifesting itself primarily in the most frigid areas of the globe during the coldest months—a result the NCAR model replicates—leads to only a modest sea-level rise. Such changes, occurring over a 100-year time scale, would scarcely be noticeable.

In fact, a slight warming might even have a net positive impact. For example, the change in the greenhouse will lead to a longer growing season and more productive crop yields. And it's conceivable that indoor climate control costs may even drop as winters become milder.

So it looks like our nation's hardworking federal climatologists at NCAR are wearing white wigs and fluffy white beards. For, just in time for Christmas, they give us a present that should help all those who go to bed with visions of doom-and-gloom-because-the-United States-pulled-out-of-the-Kyoto-Protocol dancing in their heads, to replace them with visions of sugarplums instead. Could it be Dai's co-author Tom Wigley is turning from the Grinch of global warming to climate change's Santa Claus?

References:
Dai., A., G.A. Meehl, W.M. Washington, T.M.L. Wigley, and J.M. Arblaster, 2001. Ensemble simulation of twenty-first century climate changes: Business-as-usual versus CO_2 stabilization. *Bulletin of the American meteorological Society,* **82**, 2377–2388.

Delworth, T.L., and T.R. Knutson, 2000. Simulation of early 20th-century global warming, *Science,* **287**, 2245–2250.

NATURE NETS 2001 LUMP-O-COAL AWARD

This year's Lump-O-Coal award is a whodunit. As in who (besides the ghost of Joe McCarthy) wrote the absurd masthead piece in the July 12 issue of *Nature* equating those who think global warming isn't the end of the world with "AIDS dissidents who spent the 1990s putting about notions that HIV didn't cause AIDS…[and] tobacco-industry dissidents." The article went on to praise the United Nations Intergovernmental Panel on Climate Change (IPCC) and John McCain, and to condemn those who disagreed, including a now-global hero by the name of George W. Bush.

Only the truly sleazy could try that one. The fact is that many of the prominent "dissidents," some of whom grace these pages, have scientific records that most of the global warming pushers envy, including things like best-selling books in their fields. They're also pretty good at presenting information, commanding hefty honoraria and rarely flying in coach, which is especially irritating to the rank and file, condemned to seat 13E on the way to the Biloxi Regional Assessment of Global Climate Change. Further, most of the "dissidents" are actually trained in climatology, unlike a very large number of the people in the IPCC.

So we sought to find out just who wrote this piece. We called *Nature*'s Washington office. "Dunno," they said. "Call London." So we did. Peter Wrobel told us that he couldn't say who wrote it. Courageous. Then he told us that it was the consensus of *Nature* and that unsigned articles are perfectly acceptable.

OK. We accept that. The consensus of *Nature* means the community of *Nature*: not just one anonymous writer, but everybody—all the editors, the people who send articles out for review, who decide what and what not to publish, and those who attempt, through that process, to influence public policy. Thank you for revealing yourselves for what we have been accusing you of for years: people bent on telling one side of a story because of political bias and a clear agenda that despises U.S. leadership whenever it dares to disagree. For that, have some coal.

PREVIOUS AWARD WINNERS: 2000: Ralph Nader, for costing Al Gore the Presidency (green coal); **1999:** The Pew Foundation, for hyping the Kyoto Protocol; **1998:** El Niño; **1997:** Bob Watson, head of the IPCC; **1996:** Jim Hansen's "man on the street" who refuses to obsess on climate change; **1995:** The atmosphere, for its steadfast refusal to warm as predicted.

Reference:
_____, 2001. Shooting the Messenger, *Nature,* **412**, 103.

Assessing the Assessment/

The stated purpose of the U.S. National Assessment's **Climate Change Impacts on the United States; The Potential Consequences of Climate Variability and Change** *(USNA) is to "assess the risks and opportunities for the United States… associated with increased climate change." But the USNA has turned out to be one of the most misleading publicly funded reports on climate change this nation has ever produced. The two climate models on which it is primarily based—one developed by the Canadian Climate Centre and the other by the Hadley Centre in the United Kingdom—cannot correctly reproduce observed climate. What's more, the two models often produce markedly different forecasts of future climate. • In addition to large-scale inaccuracies, the models' spatial resolution is too coarse to include most small-scale processes—the type of processes responsible for local weather patterns. Yet the USNA breaks the country into eight regions and within each region depicts local ecosystem changes as a result of their predicted climate trends during the next 100 years. In this continuing series, we examine in detail each of those regions, comparing the observations of the past century with the USNA's climate model prognostications for the next.*

THE GRASS IS ALWAYS GREENER

As they look toward our enhanced-greenhouse future, almost the only thing the National Assessment team is willing to say something positive about is U.S. agricultural productivity. It turns out that most of our agricultural crops grow better when its warmer, wetter, and they are fertilized better (thanks to the greater concentration of atmospheric carbon dioxide). Those growth enhancements can be helped along even further when farmers use adaptive strategies designed to make the most out of the climate conditions. Such steps include changing the dates of planting and harvesting, using new crop varieties, employing different tilling methods, and using the best irrigation management. Of course, our nation's farmers currently employ such strategies, just as they have been doing for generations, so that should be considered pretty much business as usual—not some form of cruel and unusual punishment foisted upon them by a potentially changing climate.

Figure 1 (from the National Assessment) shows the changes in yield expected from various crops under conditions generated by the two climate models used in the USNA. Notice large increases in nearly every crop under both models. Remember that these two climate models project extreme, and oftentimes unrealistic, conditions for the United States to face in the coming century. If our crops can flourish under those conditions, they should make it through just about anything. That fact is a testament to our nation's farmers and farming practices.

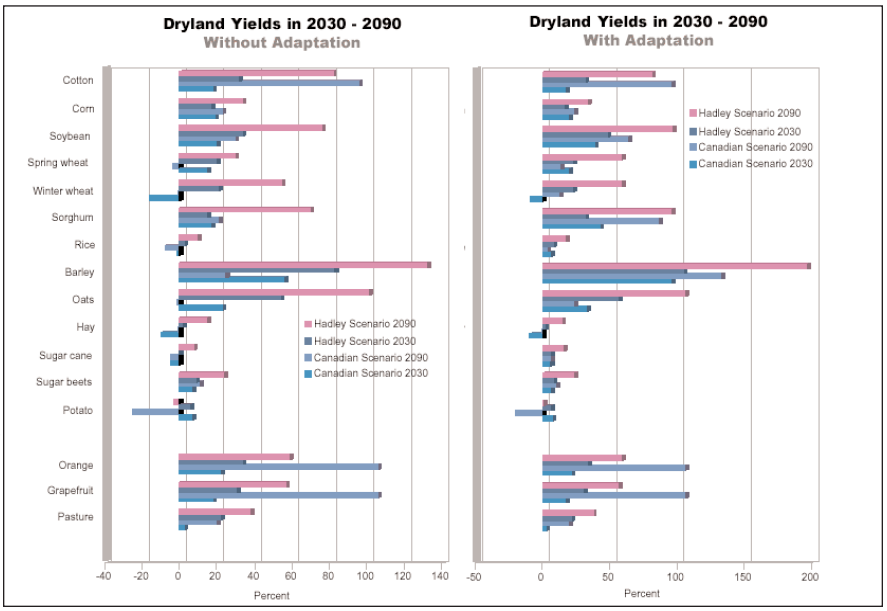

Figure 1. Expected changes in agricultural yield as projected by the Hadley and Canadian climate models—the two most extreme climate models out there and the two the U.S. National Assessment on Climate Change used in making its forecasts.

A recent paper in the *Journal of Geophysical Research* found much the same thing as the USNA. Co-authors Kelly Brumbelow and Aris Georgakakos from the Georgia Institute of Technology carefully modeled the future irrigation needs and crop yields of five major crops based upon conditions for the next 100 years as forecast by the Canadian Climate Center model (one of the two models the USNA employed). Brumbelow and Georgakakos used a set of very detailed physiologically based crop models to examine how corn, durum wheat, peanuts, soybeans, and winter wheat will respond to changing moisture and temperature conditions, including the effects of increased carbon dioxide (though they did not include any adaptive responses by the farmers).

The authors concluded:

> Under the [Canadian model] climate scenario, irrigation demands (mean trends and variabilities) and crop yields would increase in the Southeastern Coastal Plain, Upper Mississippi Delta, and Southern Great Plains for most crops. The Eastern Midwest would experience decreased irrigation demands for most crops. The Northern Great Plains would experience decreased irrigation requirements for winter wheat and unchanged needs for spring and summer-season crops. The Snake-Columbia Valley and California Central Valley would have strongly decreased irrigation demands for all crops. Crop yields, would, in general, increase at all locations with the exception of corn yields. The relative magnitude of these changes in yields varies from region to region. These assessment results are in agreement with the [Canadian model] climate scenario trends of a wetter climate in the west a dryer climate in the east, and warmer throughout the United States.

The more research scientists produce, the more it appears obvious—U.S. agriculture stands to benefit from a warmer, wetter climate with enhanced atmospheric carbon dioxide levels. And since the United States exports more than $50 billion per year of agricultural commodities, the more productive we are, the more we are able to help feed the world.

References:
Brumbelow, K., and A. Georgakakos, 2001. An assessment of irrigation needs and crop yield for the United States under potential climate changes. *Journal of Geophysical Research,* **106**, *27,383–27,405.*

Climate Change Impacts on the United States: The Potential Consequences of Climate Variability and Change, A Report of the National Assessment Synthesis Team, 2000. U.S. Global Change Research Program.