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THE WHITE HOUSE
WASHINGTON

June 18, 1997

MEMORANDUM FOR THE PRESIDENT

FROM: TODD STERN

SUBJECT: Climate Change

The attached McGinty/Tarullo memo seeks your approval for a course of action on the climate change issue designed to take you through the Denver Summit and the UNGA Special Session on the environment and to lay the groundwork for the December meeting in Kyoto, where negotiations on a new treaty are supposed to conclude.

Decision point. The question for now is how specific a position you should articulate in Denver and New York with respect to emission levels of greenhouse gases. As a matter of substance, most of your Cabinet would support your calling for "stabilizing emissions in the medium term" -- i.e., returning greenhouse gas emissions to 1990 levels by 2005-2020. However, the consensus of your advisors is that such an announcement would not be tenable at this time in view of the strong opposition it would provoke among significant business sectors, labor and Members of Congress, and the lack of public support for concerted action. (Even relatively moderate action, such as returning emissions to 1990 levels by 2010, could have substantial short-term economic costs.)

Consequently, your advisors recommend that you make strong, but non-specific statements about climate change at both the Denver Summit and the UNGA meeting (suggested UNGA language appears at p. 4) and that these events be followed by an intensive effort to educate and persuade the American public about the great importance of this issue in order to build support on the Hill for a strong American position. We would aim to decide our negotiating position for Kyoto by the early fall. This approach will likely subject you and the Vice President to intense criticism from the environmental community, which believes you should make specific emission commitments now. And European leaders such as Blair and Kohl will also criticize our lack of specifics. But the alternative appears worse -- an immediate call for specific reductions that would be sharply attacked by large parts of the business community, rally little public support, and have no chance of endorsement on the Hill.

(Several appendices are attached to the memo. I am sending up Appendix E only -- a draft action plan for engaging the American public. If you want to see any of these other appendices, let me know. Appendix A sets forth four options for specific emission reduction statements, but, as noted, the consensus is that you should not make *any* such specific statement at this time; Appendices B and C review environmental impacts and economic analysis respectively; Appendix D is a more detailed general review of the issue.)

Approve approach ✓ Disapprove___ Discuss___

COPY

THE WHITE HOUSE

WASHINGTON

June 18, 1997

MEMORANDUM FOR THE PRESIDENT

FROM: KATHLEEN A. McGINTY
DANIEL K. TARULLO

SUBJECT: UPCOMING INTERNATIONAL EVENTS AND CLIMATE CHANGE

I. Action-Forcing Event

Over the next few weeks, you will have two high-profile events that focus attention on U.S. climate change policies: the Denver Summit of the Eight (June 20-22) and the United Nations General Assembly Special Session on Environment and Development (you are speaking on June 26). To date, the United States has called for binding emissions targets, flexibility in meeting those targets and the participation of all countries under the climate treaty, but has not signaled which specific emissions levels would be acceptable. Negotiations are set to conclude this December in Kyoto. Other countries and domestic constituencies are calling on the U.S. to state its views.

Your advisers are evaluating the specifics of a U.S. negotiating position, with some differences among them. However, there is a consensus that, even at the cost of significant criticism from other countries and environmental groups, it would be imprudent to take a specific position on emissions levels in the upcoming events. Instead, you should make a strong statement about the need to address the problem of climate change and begin an intense process of personally communicating with the American public on this issue with the objective of articulating a substantive policy position in the fall.

II. Background

Climate change may be the most significant economic and environmental policy issue to be addressed in the second term. There is now scientific consensus that human activities (primarily the burning of fossil fuels) are having a discernible influence on the global climate and that "climate change is likely to have wide-ranging and mostly adverse impacts on human health". The implication is that greenhouse gas concentrations must be held to responsible levels in the long term to avoid dire consequences. Greenhouse gas concentrations are at now their highest levels in 200,000 years and, absent policy interventions, concentrations at the end of the next century are predicted to be at a 50 million year high. Impacts are predicted to include higher temperatures (global average temperatures are predicted to increase 2-6.5 degrees F. by 2100), sea level rise (threatening low-lying areas), spread of infectious diseases, and more highly variable weather (with increased frequency of severe weather events such as droughts and floods).

The U.S. is the world's largest emitter of greenhouse gases, with roughly 25% of the world's total. Domestic greenhouse gas emissions have been growing by a bit over 1 percent per year, so that today's emissions are about 10 percent higher than in 1990. In many developing countries, emissions growth rates are higher, but per capita and overall emissions levels are lower. The developed countries are responsible for much of the accumulation of greenhouse gases in the atmosphere and currently are the largest emitters. By 2020-2040, however, the developing countries will surpass the developed countries in terms of emitting greenhouse gases. Since global climate is affected by greenhouse gas concentrations in the atmosphere, and since the efforts by any one country to reduce its emissions cannot have much of an effect on global concentrations, a sensible approach would call on all countries to play a role. The U.S. has urged developing countries to accept significant obligations (short of quantitative emissions targets) in the international treaty negotiations. To date, there has been little international support for the U.S. position on developing countries.

In general, market-based policies are believed to be the most efficient means to reduce greenhouse gas emissions, because these policies promote flexibility and minimize economic costs. The U.S. has urged that the climate change treaty promote maximum domestic flexibility in all countries, establish a system where countries with quantitative emissions targets can trade emissions rights, and establish a system of joint implementation, where developed and developing countries can undertake joint efforts to reduce emissions wherever the cost is lower.

In a Principals meeting to consider the U.S. position on emissions levels under the climate treaty, most of the participants indicated support for "stabilizing emissions in the medium term." (In the parlance of the climate change negotiations, "stabilizing" means returning greenhouse gas emissions to 1990 levels and "medium term" means 2005-2020). But many of the agencies and offices represented conditioned their support on success in achieving other elements of the U.S. negotiating position (e.g., international emissions trading, participation of developing countries). Several participants felt that further analytic work was needed, and expressed a desire to see further options developed.

In the view of many members of your Cabinet, calling for emissions to be stabilized at 1990 levels in the medium term and emphasizing the importance of other elements of the U.S. position would allow you to take the high ground. You could commit the U.S. to meaningful emissions reductions, while insisting on other principles we consider vital to an agreement. This would provide flexibility for future development of our position and, given the likely difficulty in convincing developing countries to participate more fully under the climate treaty, also offer a principled basis for walking away from an agreement in Kyoto should we decide it is in our interest to do so.

However, as several of your economic advisers noted, even the seemingly moderate goal of returning emissions levels to 1990 levels by 2010 would entail economic policy interventions greater than any we have undertaken during your Presidency. Even with the kind of flexibility components proposed by the United States, market-based policies designed to reduce greenhouse gas emissions significantly are likely to raise domestic fuel prices by significant amounts and to have particularly adverse effects on the coal industry. The result would be lower economic growth, with the most

serious effects in the earlier years. Thus, emissions control policies impose significant short term economic costs in order to achieve distant (though potentially enormous) environmental benefits.

In the view of some of your advisers, there is strong evidence that total costs could be lowered significantly if policies were put in place to emphasize investment in productivity-enhancing technologies. A number of economic advisors believe that this use has not been established. Some of the technologies envisioned would not have a major impact by 2010, but could have significant impact in the decade that follows. An expanded program of research and policies encouraging innovation could have low costs and achieve broad political support.

The politics of this issue are difficult, at best. For many environmental groups, strong action on climate change is a litmus test of your environmental policy. If you fail to speak decisively on this issue at the Summit or the UN General Assembly Special Session, their criticism will be intense. European leaders such as Blair and Kohl will probably be both ambitious in their proposals and critical of our lack of specifics. On the other hand, much of the business community is strongly opposed to action that would significantly reduce greenhouse gas emissions. Fossil fuel and heavy manufacturing companies are poised to attack any policies that might be supported by environmental groups. Organized labor is increasingly opposed to strong actions, as well, largely in deference to the concerns of the United Mine Workers. Farmers are likely to oppose any policies that would increase energy prices. Southern and western Republicans in Congress are very skeptical about policies to constrain greenhouse gas emissions, as are Midwestern and coal state Democrats. Indeed, Senator Byrd currently has 45 signatures on a resolution requiring developing country obligations before U.S. agreement in Kyoto.

III. Recommendation

Your advisers believe it is necessary to undertake a serious educational effort to convince the American public that climate change is an important long-term issue that requires the United States to institute policy changes. Such an effort should be an interactive process, with you and your Cabinet members taking lead roles in listening to the public, elected officials, and interest groups, and then fashioning an appropriate policy response. Your advisers believe that such a process is necessary to develop a workable political consensus in the country for an effective climate change policy. If this consensus is not achieved, it will be virtually impossible to have an international climate change treaty limiting domestic greenhouse gas emissions ratified by the Senate in the foreseeable future.

Your advisers recommend that you address climate change at both the Denver Summit and the UN General Assembly Special Session. At Denver, as you have done in the past, you should discuss the subject in strong terms, noting that the science is quite clear on the scope of the climate change problem. You also should note that there are extensive differences in the various proposals made to begin the process of achieving a solution. You can sketch out the importance of creating a long-lasting framework for implementing worldwide climate change policies, because this is an issue of vast scope (covering many decades and all the countries on the earth). And you can call on the Eight to work together to ensure that the treaty negotiated at Kyoto is acceptable to all members.

At the UN General Assembly Session, your advisers recommend that you again discuss the statement in strong terms, signaling your resolve to address this issue. They recommend the following language:

> There is no more serious issue than climate change, and it is clear that we will need seriously and significantly to reduce our emissions of greenhouse gases beginning with a strong agreement in Kyoto.
>
> We must remember that our goal is to stabilize concentrations of greenhouse gases in the atmosphere at an acceptable level, a task that must begin now, but which will require continuing sustained effort over many decades. So it is important that we set up a system that will work -- that will allow us to reduce our emissions at the lowest possible cost so that we can achieve the maximum protection of the environment. And it is also important that next steps send a strong signal of our intent, so that governments and industries can make significant investments in the new technologies that will be required if we are to achieve our ultimate goal. And finally, although those of us in the developed world who emit the largest quantities of these gases must take the lead, all countries must participate in moving toward the solution.

Your advisers recommend that you then begin to outline your personal involvement in the education campaign that will be necessary to build domestic acceptance for any meaningful emissions constraints. Although gaining consensus across the political spectrum is not possible on this issue, it may be possible to enhance support significantly among centrist constituencies and the public at large. Notwithstanding that you are speaking to a UN audience, you should direct your remarks to the American public.

You could announce specific means to pursue this dialogue, including your plans to host a White House Conference on Climate Change in September to bring together elected officials, business, labor, and environmental and scientific leaders, academics, and representatives of the public to discuss climate change policy. You could announce that this White House conference would be preceded by a series of regional conferences -- each hosted by members of your Cabinet. These high-level conferences would serve to educate the American public and bring forward ideas on how best to address climate change. A core goal of this and other efforts would be to break through to the American people with the message that "Climate change is an important issue for you and your family -- one that Bill Clinton believes we must address in a responsible way." Meanwhile, analytic work on policy alternatives would continue, informed by the public debate. We would aim to arrive at a complete U.S. negotiating position by the early fall.

You should be aware that this approach may lead to intense criticism of you and the Vice President by environmental groups. These groups have been calling on the U.S. to state a specific position on emissions levels, and will consider strong rhetoric and promises to engage personally in the issue to be inadequate. Some commentators will equate your approach with that of President Bush. (Bush refused to agree to any emissions levels in Rio. You reversed that position in April, 1993 and voluntarily committed the U.S. to reducing emissions to 1990 levels by the year 2000). However, your advisers believe that refraining from announcing specific goals until early fall is necessary to

develop the political and public consensus required to undertake any meaningful policy action on climate change. The alternative set of actions (making statements in the next few weeks supporting emissions constraints perceived as strong) would lead to harsh and lasting criticism from business and labor, in the opinion of your advisers. The resulting public and Congressional reaction could be so severely negative that you might be unable to take any significant policy steps on climate change. Moreover, criticism from these sources also could place other policy initiatives (environmental and others) in jeopardy.

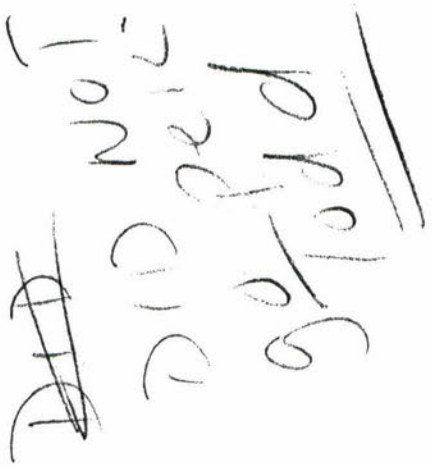
Several appendices provide additional information. Appendix A lists five options identified to the Cabinet recently for statements by the President on climate change. Material analyzing the projected environmental impacts of these options is attached as Appendix B. Material summarizing the projected economic impacts of Options 1, 2, 3 and 4 are presented in Appendix C. Additional background material on climate change (including a discussion of domestic policy options) is attached as Appendix D. Finally, Appendix E sets forth possible elements of a strategy for you to engage the American public on this issue in the weeks and months ahead.

IV. Decision

That you approve the course outlined above.

_____ Approve _____ Disapprove _____ Discuss

Appendix A



APPENDIX A
OPTIONS IDENTIFIED TO PRINCIPALS AT RECENT MEETING

Earlier this month, we identified several options for principals concerning the U.S. position on emissions levels in the international climate change negotiations. Each option was defined in terms of a broad directional statement and further described by a particular combination of emissions levels and timing, to help clarify the meaning of the directional statement. Most agencies and offices (State, EPA, Energy, Agriculture, Transportation, Commerce, AID, CEA and the U.S. Ambassador to the United Nations) supported Option 2 below. Many of these offices and agencies conditioned their support for Option 2 on success in achieving other elements of the U.S. negotiating position (e.g., international emissions trading, participation of developing countries, etc.). Treasury and OMB voiced significant concerns.

In the parlance of the climate change negotiations, "stabilizing" means returning greenhouse gas emissions to 1990 levels and "medium term" means 2005-2020.

Following are the five options, with pros and cons, identified to principals:

Option 1: Call for "significantly reducing emissions in the medium term."

Such a statement would be interpreted to be consistent with the E.U. proposal (a 10-15% cut from 1990 emissions levels by 2010).

Pros:

- Environmental benefits could be large. EPA estimates non-climate benefits (such as reducing fine particles and ozone) would be tens of billions of dollars.
- Many environmental groups would be pleased.

Cons:

- Could impose very large costs on the U.S. economy. Although these effects might ultimately be offset, GDP in 2005 could be reduced by 0.1-1.0% (with international emissions trading) and 0.1-2.0% (without). The price of gasoline could rise by 20-25 cents per gallon (with international emissions trading) to 35-50 cents (without).
- If program were implemented through a domestic emissions trading program in which all permits were auctioned, permit revenues could be in the range of $110 billion (with international trading) to $270 billion (without). (Annual permit revenues is not a measure of economic loss, but is one indicator of structural changes in the economy. A domestic implementation scheme could be designed to raise *no* permit revenues).
- Business and labor would be very strongly opposed.
- Without significant changes in the political landscape, the prospects for ratification by the Senate in the next several years would be close to zero.

Option 2: Call for "stabilizing emissions in the medium term and reducing thereafter." Emphasize that flexibility and the participation of all nations (including developing countries) are essential to addressing this problem.

This option is consistent with stabilizing emissions at 1990 levels by 2010 (though, as noted, "medium term" is interpreted as being between 2005 and 2020).

Pros:

- Allows you to take the high ground: committing the U.S. to meaningful emissions reductions, while insisting on other principles we consider vital to an agreement.
- Provides considerable flexibility for future development of our position. This option is consistent with stabilizing emissions at 1990 levels anywhere between 2005 and 2020.
- Environmental benefits (both climate and non-climate) could be significant. EPA estimates non-climate benefits (such as reducing fine particles and ozone) would be tens of billions of dollars.
- Some environmental groups would be pleased; others would complain of lack of U.S. leadership.

Cons:

- Overall economic impacts of this option could be significant. Although these effects might ultimately be offset, GDP in 2010 could be reduced by 0.2-0.6% ($20-60 billion) and consumption by .3-1.0%. The price of gasoline could rise by 10-15 cents (with international emissions trading) or 20-40 cents (without).
- Dislocation in some sectors and regions (especially coal states) could be large and long-lasting.
- If program were implemented through a domestic emissions trading program in which all permits were auctioned, permit revenues could be in the range of $60 billion (with international trading) to $190 billion (without). (Annual permit revenues is not a measure of economic loss, but is one indicator of structural changes in the economy. A domestic implementation scheme could be designed to raise *no* permit revenues).
- Most business and labor groups would be opposed, although some might support if the policy were coupled with other features they find attractive.
- Without significant changes in the political landscape, the prospects for ratification by the Senate and passage of implementing legislation in the next several years would be poor.

Option 3: Call for "*beginning* to reduce emissions by 2005 and stabilizing emissions by the end of the medium term, with further reductions thereafter."

This option envisions an international regime that mandates starting emissions reductions earlier than Option 2, but reducing emissions to 1990 levels over a longer period of time. While less constraining than Option 2, the rhetoric used to describe this option (other than the 2005 component) could be substantially identical to the rhetoric for Option 2.

Pros:

- Delaying the most stringent reductions would reduce economic costs, by allowing capital stock to turn over at a natural rate and technology to improve.
- Calling for concrete action before 2010 could be portrayed as more activist. Some agencies (not including the State Department) believe this could enhance our efforts to obtain agreement on international emissions trading and developing country participation.

Cons:

- Would be criticized by environmental community as showing lack of leadership by delaying stabilization.
- Would be criticized by moderate business groups (e.g., chemical companies, some utilities) who strongly oppose any target before the year 2010.
- Would be criticized by more hard-line business groups (fossil fuel producers, heavy manufacturing) and many in organized labor who oppose any action on climate change.
- In the view of the State Department and other agencies, would jeopardize our ability to achieve flexibility provisions (e.g., international emissions trading, joint implementation) and developing country participation in international negotiations.
- Without significant changes in the political landscape, the prospects for ratification by the Senate in the next several years would be poor.

Option 4: Call for "eliminating emissions *growth* in the medium term, on the way to stabilization and eventual reduction of emissions."

For example, emissions would peak in 2010-2020, return to 1990 levels in the longer term (i.e., after 2020) and decline thereafter.

Pros:

- Economic costs would be relatively mild. Some economists would view this emissions path as consistent with one that would balance costs and benefits of climate change policy.
- Opposition in the business and labor communities would be mild.
- There is a chance an option along these lines would be ratified by the U.S. Senate in the next several years without major political changes.

Cons:

- With this option, there is no chance of obtaining international agreement on our "flexibility" or "developing country participation" proposals.
- Criticism from other countries and U.S. environmental groups would be very strong. Environmental groups would equate your performance in New York with George Bush's performance at the 1992 Rio Earth Summit.
- Environmental benefits (both climate and non-climate) would be modest.
- Some economists (especially those who emphasize the environmental benefits of climate change policies) would criticize this option as inadequate.

Option 5: Call for "strong action on climate change" and "agreement in Kyoto." Say that the United States is continuing to study the issue of emissions levels and will elaborate on its position at a later time.

This roughly repeats prior statements by you and other administration officials.

Pros:

- Leaves options open for future decisions.
- Allows additional refinement of economic modeling runs before our position is announced.

Cons:

- Would be strongly criticized by environmental groups, who would equate your performance in New York with George Bush's performance at the 1992 Rio Earth Summit.
- Without more definition of our position on emissions levels soon, our ability to achieve agreement to flexibility and developing country provisions in Kyoto will be seriously impaired.

Appendix B

APPENDIX B
ENVIRONMENTAL IMPACTS OF OPTIONS

1. Climate Change Impacts

Absent policy interventions, atmospheric greenhouse gas concentrations will increase during the next century to levels unknown on this planet for 50 million years. To avoid such extraordinary increases, *global* greenhouse gas emissions must begin to decline from projected levels early in the next century. For *global* emissions to begin to decline in this time frame, developed countries must move quickly to reduce their emissions, setting the stage for future rounds of negotiations.

In the short-term, the difference between the options presented in terms of additional greenhouse gas concentrations in the atmosphere is small. However, institutional and political factors will lead to important differences between these options. Options 3 and 4, for example, are unlikely to lead developing countries to participate meaningfully in the negotiating process. Option 1, on the other hand, may be so stringent that many businesses would simply work to block implementation rather than restructure activities to comply.

For the world realistically to avoid a doubling of pre-industrial greenhouse gas concentrations (to 550 ppm) in the next century, *global* emissions must deflect from a "business-as-usual" path by about 2010. For the world realistically to avoid a near-tripling of greenhouse gas concentrations (750 ppm), *global* emissions must deflect from this "business-as-usual" path by 2020. Even assuming steep reductions in greenhouse gas emissions in distant decades (which our children and grandchildren may or may not be able to achieve), reductions must begin soon to avoid serious environmental damage.

2. Other Environmental Impacts

Any of the options discussed here could have considerable environmental benefits unrelated to climate change. Measures to reduce greenhouse gas emissions would also reduce emissions of SOX, NOX and toxic pollutants such as mercury. Such measures would contribute significantly to meeting potential Clean Air Act standards for particulate matter and ozone. According to EPA estimates, monetizable benefits of reducing fine particles and ozone in connection with Option 1 or Option 2 could total tens of billions of dollars per year by 2010.

Appendix C

APPENDIX C
ECONOMIC ANALYSIS

1. Introduction. An Interagency Analytical Team (IAT) has analyzed the economic impact of various emissions constraints, using three different models. The results are broadly consistent with the considerable literature on this subject.

Economic models are by nature imprecise, especially when projecting over several decades. The models' limitations are exacerbated by the complex and far-reaching effects of any policy aimed at reducing greenhouse gas emissions. Some agencies believe it is important to stress that similar modeling in the past with respect to SO2 controls under the Clean Air Act dramatically overstated costs, due to unforeseen factors. Nevertheless, models can provide insight into the economic costs and benefits of various policy alternatives.

The "base case" modeling results presented here make the following key assumptions:

- Policy options are implemented by 2010, with a ten-year phase-in period.
- Domestic emissions reductions are achieved by an emissions trading system, where certain entities responsible for greenhouse gas emissions must have a permit, a limited number of permits are sold at auction, and permits may then be traded.
- All revenues raised through the auction process go to reduce the Federal budget deficit (or increase the budget surplus).
- There are no transaction costs nor compliance problems with the domestic emissions trading system.
- Monetary policy acts to offset the effects of reduced economic activity through lower interest rates.
- The path of technological progress over the forecast period has energy use per unit of GDP decreasing more rapidly than observed in most historical periods, consistent with increased emphasis on greenhouse gas emissions and energy efficiency.
- The rest of the economy remains unchanged, which will not occur over the long forecast period used. Unexpected shocks to the economy are likely to have very large effects on the estimates presented.

Results are presented for Options 1 through 4, but the figures associated with Options 3 and 4 should be viewed as illustrative only. These figures were not derived from specific IAT modeling of the emissions constraint policies listed as examples for these Options because the IAT has not examined any policies with emissions budgets for 2020 or later. The figures presented are no more than educated guesses, generated by referring to emissions constraints that were modeled. The IAT has the capability to model emissions policies that have targets for 2020 or later and will do so if policy makers think the effort would be helpful.

Three additional caveats should be noted. First, the base case masks disagreements among agencies over likely rates of technological innovation and diffusion. A faster rate of progress in energy-efficiency and carbon-reducing technologies could reduce estimated economic costs by as much as one-third relative to the base case estimates. However, a slower rate of technological progress than assumed in the base case would increase economic costs noticeably. Second, to the extent that domestic greenhouse gas constraints are not implemented through an emissions trading regime, but instead through less flexible regulatory programs, economic costs will be greater than those shown. Third, to the extent that the distribution of emission permits does not support increased levels of capital investment compared to the baseline, the long-term economic results will be less favorable than estimated by the models.

2. Results. As noted above, the United States has strongly supported international trading of greenhouse gases. With trading, countries with high abatement costs (e.g., the United States and Western Europe) could purchase emissions reductions in countries with lower abatement costs (e.g., in the former Soviet Union). Incorporating a well-functioning international market in emissions permits in the modeling reduces estimated energy price increases significantly. With international emissions trading, the United States is estimated to pay about $5 billion per year to other developed countries (including those in the former Soviet Union) to purchase permits, avoiding greater expenditures in compliance costs.

Results with international trading

Table 1 presents results from the base case with trading of emissions permits among Annex I nations. The trading takes place among all Annex I nations. (In countries where emissions have fallen below 1990 levels, such as in some parts of the former Soviet Union, trading is assumed to be allowed only to the extent there are corresponding emissions reductions from a "no-policy" baseline). All figures are presented relative to a "no-policy" baseline, in 1995 dollars.

The losses in aggregate economic activity are noticeable, but largely transitory. Table 1 shows GDP loss with international trading peaking at a few tenths of a percentage point in 2005-2010 for the case where emissions are stabilized at 1990 levels by 2010. After this initial loss, the economy begins to rebound as the proceeds from permit auctions reduce the Federal budget deficit (or increase the budget surplus), leading to lower interest rates. Businesses respond by making capital investments to offset higher energy costs. After a while, the economy catches up to its original growth path, indicating that the emissions reduction program modeled is implicitly pro-investment and that the economy is robust enough to withstand modest shocks.

Coal bears the brunt of the emissions reduction policies, because coal is the most greenhouse gas intensive fuel. In general, the least costly way to garner significant emissions reductions is to replace coal in electricity generation and industrial uses.

Results without international trading

If an effective regime for trading international emissions permits is not established, then the estimated energy price increases are nearly doubled, with parallel economic losses. This situation is depicted for the base case in Table 2.

The losses in aggregate economic activity are significant, though again, largely transitory. Table 2 shows GDP loss without international trading peaking around 1 percent in 2005, for stabilizing emissions at 1990 levels in 2010. After this initial loss, the economy begins to rebound as revenue from the domestic permit auctions reduces the Federal budget deficit and lowers interest rates. Businesses respond by making additional capital investments, setting off a mini-"investment boom". By 2015, the economy is estimated (in some models) to regain and even surpass its original growth path. This result indicates that the emissions reduction program as modeled is pro-investment (because reduced personal consumption allows businesses the wherewithal to expand the capital stock).

Technology assumptions

Another possibility for mitigating economic costs is focusing attention and resources on programs that promise to decrease the rate at which the economy produces greenhouse gas emissions. Examples here might include an increased research and development effort or an initiative to more rapidly diffuse the most efficient energy practices through industry. The "hi-tech" set of assumptions added to the base case modeling shows that energy price increases could be reduced by 10-30 percent, by 2010, with larger reductions possible further in the future. Estimated economic costs of the base case policies would be correspondingly reduced.

Environmental benefits

The figures presented here do not reflect the environmental benefits associated with avoiding climate change, nor do they reflect collateral environmental benefits that may result from reduced emissions of greenhouse gases. Policies to reduce greenhouse gas emissions, for example, are likely to reduce emissions of other pollutants, including SOX, NOX, particulate matter and toxic pollutants (e.g., mercury). According to EPA estimates, the monetizable benefits of reducing fine particles and ozone in connection with either Option 1 or Option 2 could total tens of billions of dollars per year.

Economic effects are summarized on the charts below. Note that the figures presented for Options 3 and 4 are not based on actual IAT modeling, since the IAT has not examined any emissions budgets for 2020 or later. The figures for these Options are based on implied increases in carbon prices obtained from other IAT modeling efforts. Thus, the figures presented for Options 3 and 4 should be considered as illustrative only.

Table 1 --Base Case with OECD Emissions Trading*

Variable of Interest	Option 1 --10% below 1990 levels by 2010	Option 2 --1990 levels by 2010	Option 3 -- Implied carbon price increase of $20 per ton **	Option 4 -- Implied carbon price increase of $10 per ton **
GDP in 2005	-1.0% to -0.1%	-0.5% to 0.0%	-0.2% to 0.0%	-0.1% to 0.0%
GDP in 2010	about -0.3%	-0.4% to -0.1%	-0.2% to -0.1%	about -0.1%
GDP in 2020	-0.3% to +0.2%	about -0.1%	-0.1% to 0.0%	about 0.0%
Implied price increase per ton of carbon in 2010	about $85	about $50	about $20	about $10
Implied price increase per gallon of gasoline in 2010	about 20-25 cents	about 10-15 cents	about 5 cents	about 2-3 cents
Implied price increase per ton of coal in 2010***	about $50	about $30	about $10-15	about $6
Implied avg. price increase for residential elect. in 2010****	about 1.5 cents per kwh	about 1 cent per kwh	about 0.5 cents per kwh	about 0.3 cents per kwh
Decline in total employment in 2010 (national)	about 200,000	about 50,000-250,000	about 50,000-100,000	less than 50,000
Annual value of domestic emission permits (2010)	about $110 billion	about $60-70 billion	about $25-30 billion	about $10-15 billion

* Analysis of Joint Implementation (worldwide emissions trading) would show lower costs and imply greater purchases by the U.S. of emissions reductions abroad.

** *Although figures are presented, obtaining agreement under the climate treaty to an international emissions trading regime would be very unlikely with targets in this range.*

*** Current national average approximately $28/ton

**** Current national average approximately 8 cents/kilowatt hour

Table 2 --Base Case without OECD Emissions Trading

Variable of Interest	Option 1 --10% below 1990 levels by 2010	Option 2 --1990 levels by 2010	Option 3 --Implied carbon price increase of $35-50 per ton	Option 4 --Implied carbon price increase of $15-25 per ton
GDP in 2005	-2.0% to -0.1%	-1.0% to -0.1%	-0.5% to 0.0%	-0.3% to 0.0%
GDP in 2010	-0.7% to -0.3%	-0.6% to -0.2%	-0.4% to -0.1%	-0.2% to -0.1%
GDP in 2020	-0.3% to +1.0%	-0.6% to +0.2%	about -0.1%	about 0.0%
Implied price increase per ton of carbon in 2010	$130-200	$80-140	$35-50	$15-25
Implied price increase per gallon of gasoline in 2010	35-50 cents	20-40 cents	10-15 cents	5-10 cents
Implied price increase per ton of coal in 2010*	$80-120	$50-85	$20-30	about $10-15
Implied average price increase for residential electricity in 2010**	about 4 cents per kwh	about 1.5-3.0 cents per kwh	about 1 cent per kwh	about 0.5 cents per kwh
Decline in total employment in 2010 (national)	about 200,000-500,000	about 150,000-400,000	about 50,000-250,000	about 50,000 -100,000
Annual value of domestic emission permits (2010)	about $270 billion	about $110-190 billion	about $50-70 billion	about $20-35 billion

* Current national average approximately $28/ton

**Current national average approximately 8 cents/kilowatt hour.

Appendix D

APPENDIX D
ADDITIONAL BACKGROUND

A. Basis for Concern

The build-up of greenhouse gases in the atmosphere threatens fundamentally to alter the Earth's climate. The most recent international scientific assessment concluded that global average temperatures will increase by 2-6.5 degrees F. by 2100, unless actions are taken to slow the build-up of greenhouse gases. This is the fastest increase in more than 10,000 years.

Potential impacts from climate change include sea level rise, the spread of infectious disease, extreme weather events (such as droughts and floods), loss of forest cover and shifts in agriculturally-productive regions. Absent policy interventions, global average temperatures by the end of the next century will increase 2-6.5 degrees F., sea-level rise will inundate more than 9000 square miles in the United States (with Florida and Louisiana most vulnerable), and an additional 50-80 million people will contract malaria worldwide. According to a NOAA study, average July temperatures in Washington, D.C. by the end of the next century are expected to increase by 5-15 degrees F. (with greater humidity). The international scientific assessment states that "climate change is likely to have wide-ranging and mostly adverse impacts on human health, with significant loss of life."

Nevertheless, significant uncertainties remain concerning the magnitude, timing and regional distribution of impacts. Currently, scientists are unable to predict changes in short-term weather patterns in particular regions.

Atmospheric concentrations of carbon dioxide (the most important greenhouse gas) are well above historic levels and climbing sharply. Concentrations are currently 360 parts per million (ppm), about 30% above pre-industrial levels and the highest in at least 200,000 years. Absent policy interventions, concentrations in 2100 are predicted to reach roughly 750 ppm, the highest in more than 50 million years.

B. Human Sources of Greenhouse Gases

The principal cause of the buildup in greenhouse gases is the burning of fossil fuels. Other human activities, including deforestation and mining, also play a role. The international scientific assessment concluded that "the balance of evidence suggests there is a discernible human influence on the global climate."

Developed countries are responsible for more than 75% of the increase in greenhouse gas concentrations since the beginning of the Industrial Revolution. In the decades ahead, however, emissions from developing countries are expected to grow sharply. By 2035, developing country emissions are expected to exceed those from the developed world.

The United States emits more greenhouse gases than any nation in the world (roughly 25% of the world's total). Our per capita emissions are among the world's highest --roughly 50% greater than the OECD average and eight times that of China. In the United States, greenhouse gas emissions come mainly from industry (1/3), transport (1/3) and buildings (1/3). Since 1990, U.S. greenhouse gas emissions have grown 7-8%. Without policy interventions, U.S. emissions are projected to grow 20-25% over 1990 levels by 2010.

None of the actions contemplated during this round of negotiations will, by themselves, reverse the build-up of greenhouse gases in the atmosphere or even slow it significantly. However, this round will set the stage for future negotiations over steps by both developed and developing countries, and will send important signals to the private sector that could affect the rate at which beneficial technologies are developed and adopted.

C. Clinton Administration Policies To Date

The Clinton administration has been active on this issue since Earth Day 1993, at which time you pledged to return U.S. greenhouse gas emissions to 1990 levels by the year 2000, and then to continue the trend of reduced emissions. In October 1993, the Administration issued the Climate Change Action Plan, designed to achieve that goal. Due to Congressional budget cuts, higher-than-expected economic growth and lower-than-expected energy prices, however, this goal will not be achieved.

You have spoken to this issue on many occasions. In May 1997, in Costa Rica, you said "we must meet the challenge of climate change"; in April 1997, before departing for North Dakota, you discussed possible links between extreme weather events and greenhouse gas emissions; in your 1997 State of the Union, you called for "reduc[ing] the greenhouse gases that challenge our health even as they change our climate"; in December 1996, in Australia, you said "we must work to reduce harmful greenhouse gas emissions...If they continue unabated, the consequences will be nothing short of devastating the children here in this audience and their children."

The Administration has strongly supported research and development programs with significant climate change benefits. Examples include the Partnership for a New Generation of Vehicles (a $280 million program), the Global Change Research Program ($1.8 billion) and renewable energy and energy efficiency programs ($1 billion).

The United States has been an active participant in the international climate change negotiations, as described below.

D. International Negotiating Context

There is international agreement that the climate change problem is significant and requires action. There is also consensus that the existing UN Framework Convention on

Climate Change, signed in Rio in 1992, is inadequate. Under the Convention, developed countries set a goal of reducing greenhouse gas emissions to 1990 levels by the year 2000, but few will do so. The Convention contains no goal beyond the year 2000.

In April 1995, in Berlin, the Parties to the Convention agreed to negotiate next steps for the post-2000 period. Under the terms of the "Berlin Mandate, " developed nations would agree to quantified emissions limits over specified time frames (e.g., 2005, 2010 and 2020) by December 1997. Developing nations (who typically have less stringent obligations than developed nations in environmental treaties) agreed to reaffirm their existing commitments, and continue to advance implementation of these commitments in this round of negotiations.

In July 1996, the U.S. called for an approach that would include three key elements: (1) a binding target (instead of the existing Convention's non-binding goal), (2) flexibility in implementation (for example, through emissions trading among developed nations and "joint implementation" with developing nations), and (3) the participation of developing countries. The U.S. proposal did not include any particular target or timetable.

Support for most aspects of the U.S. proposal has been quite limited. Some aspects have encountered stiff opposition. Few countries have supported the US call for more active developing country participation under the Convention. Developing countries, in particular, have argued heatedly that the developed world is responsible for the buildup of greenhouse gases in the atmosphere and must take the lead in addressing the problem. Support for "joint implementation" has also been limited. Such a mechanism could significantly reduce overall costs to the U.S., but involve substantial international payments or transfer of technology by the private sector.

Views of other countries vary considerably. The European Union has proposed that developed nations cut back emissions 10-15% from 1990 levels by 2010 (and an as-yet unspecified amount by 2005). Small island nations have proposed that developed nations reduce emissions by 20% from 1990 levels by 2005. Other nations, including Australia, Japan and Canada, have expressed concerns about moving too far too fast, but have not put forward any specific targets.

E. Constituency Views.

At present, public attention to climate change is low. Although polling data indicate that the public believes climate change is a serious problem, few rank it high on a list of concerns. Public and media attention to the issue will likely grow as the Kyoto Conference approaches.

For many environmental groups, strong action on climate change is a litmus test for the administration's environmental policy. They plan public relations campaigns on the issue in the year ahead. Many environmental groups are calling for sharp emissions cuts early in the next century (e.g., 20% below 1990 levels by 2005). On the issue of emissions trading

and joint implementation, the environmental community is divided, with some groups (e.g., Environmental Defense Fund) strongly supportive and others (e.g., Sierra Club) strongly opposed. Most environmental groups will support flexibility provisions if coupled with emissions reductions below 1990 levels.

Business is composed of several camps. The largest --made up of coal companies, coal-dependent utilities, fuel producers, heavy industry and transporters --is strongly opposed to any action at Kyoto. This group is well-funded and poised for a significant public relations campaign. A second group --made up of chemical companies, natural gas interests, some appliance manufacturers and others --is cautiously supportive of action at Kyoto. A smaller third group --composed of natural gas, renewable energy and energy efficiency companies --strongly supports aggressive climate change policies. Many businesses point to international competitiveness as a primary concern. In a major speech recently, the CEO of BP broke ranks with other oil companies and said "it would be unwise and potentially dangerous" to ignore mounting evidence of climate change.

Earlier this year, more than 2000 economists (including six Nobel Laureates) signed a letter stating that "sound economic analysis shows that there are policy options that would slow climate change without harming American living standards, and these measures may in fact improve U.S. productivity in the longer-run." Recently, several dozen scientists sent the President a letter warning of the consequences of rapid climate change and urging us to limit change to the "lowest rate feasible."

Agriculture groups are only beginning to pay attention to this issue. They have been concerned about extreme weather, but also worried that climate change mitigation policies could lead to rising fuel costs and competitive disadvantage with developing countries. The U.S. insurance industry is also beginning to pay attention, especially the reinsurers (who have lobbied Congress for more money for climate change research).

Labor is increasingly opposed to action on climate change, largely in deference to the concerns of the United Mine Workers. An AFL-CIO resolution earlier this year was critical of the administration's climate change policy. Some unions --including the UAW, the Steelworkers, the Oil, Chemical and Atomic Workers, the AFT and the NEA --have taken more moderate views in the past.

Finally, the religious community is increasingly engaged on this issue. The National Council of Churches has collected more than 100,000 signatures in the past few months on a petition urging action on this issue.

F. Congressional Considerations

There is considerable skepticism about climate change on Capitol Hill. Most Republicans, and many Democrats, appear far more concerned about the costs of mitigation than the problem itself. Southern and western Republicans are, by and large, skeptical or hostile to action on climate change. Midwestern Democrats have expressed concern about

the impacts of climate change policies on coal and heavy manufacturing (especially autos). Northeast and West Coast Members are perhaps the most likely to support action on this issue.

Many Members cite the unwillingness of developing countries to accept quantitative emissions limits as a major concern. Increasingly, Members are complaining about a lack of openness in our decision-making process. Many are urging the administration to make key aspects of our policy and analysis known in the very near future.

"Advice and consent" of the Senate will be required for any agreement reached in Kyoto.

Implementing legislation will likely be needed as well. Favorable votes in the 105th Congress, or even the 106th, would be an enormous challenge. Ratification might need to await work on matters (e.g., joint implementation, developing country commitments) unlikely to be resolved in Kyoto.

G. Domestic Implementation

An Assistant Secretary-level working group has recommended a domestic climate change policy with three parts: domestic emissions trading programs, technology programs, and transition assistance programs. Details of these programs could be developed in consultation with constituencies in the months ahead.

i. Emissions Trading Programs Under domestic emissions trading programs, permits representing rights to emit greenhouse gases in the United States would be distributed, either through an auction or allocation system. Permits would be tradeable. Firms would have an incentive to control emissions where costs are low and sell reductions to firms facing higher control costs.

Domestic emissions trading programs are an attractive policy tool. Compared to traditional "command-and-control" regulatory approaches, they offer greater flexibility and lower costs. Such programs are being used successfully in several areas under the U.S. Clean Air Act.

Among the important issues to be addressed in designing a domestic emissions trading program are:

- Where the constraint is imposed. A "primary fuel" trading program would limit the production or import of fossil fuels. A "sectoral" trading program would limit emissions from one or more key sectors (e.g., utilities, transport and heavy manufacturing).

- How permits are distributed. Permits could be given to existing emitters, given to others (who could then sell them back to current emitters), auctioned, or some combination of the foregoing. If permits are auctioned, substantial revenues would

be raised. (Options for using these revenues include tax cuts, deficit reduction and support for transitional or technology programs). If permits are given away, recipients would potentially receive a windfall.

ii. Technology Programs. The cost of reducing greenhouse gas emissions between now and 2020 depends greatly on the ability to accelerate use of existing energy-efficient technologies. Over the longer-term, the solution to the climate change problem depends on developing and deploying new technologies that are even more efficient and/or based on non-carbon energy sources.

A range of government programs might help accelerate technological change. Information dissemination programs assist businesses and consumers in identifying opportunities to reduce the energy intensity of their products or services (e.g., using more energy efficient light bulbs, insulation, appliances, etc.). In addition, research and development programs generally aim to improve technologies by lowering production and operating costs. Large opportunities for cost-lowering research and development exist in buildings, transportation, combustion, renewables and sequestration (e.g., fuel cells, advanced industrial turbines, advanced diesel engines, and transportation biofuels). However, generating significant increases in budget support for technology programs will be challenging.

iii. Transition Assistance Programs. Under any of the policy options being considered, some workers and communities may be adversely affected. Workers in energy-intensive industries and those in energy extraction may be most likely to be hurt. Given the geographic isolation of some of these industries, the surrounding communities may also be adversely affected.

A transition program would reduce costs to individuals and communities. Transition assistance can help facilitate community and worker adjustments via retraining, job search assistance, and infrastructure development for new business in the community. As previous experience with acid rain, military base closures, and the federal government's own work force restructuring has demonstrated, the early development of such programs can be vital to building public support for a policy.

Among the important issues to address in designing a transition program are:

- Whether a new, categorical program should be designed or existing programs expanded. A new, categorical program would limit benefits to targeted workers and communities but allow for flexibility in benefit levels. Expansion of current programs to allow for increased usage is consistent with Administration program consolidation efforts but constrains program design flexibility.

- How the program will interact with the other components of climate change policy. Permit auctions could provide an important revenue source for these programs. Permit allocations could be used to "fund" transition assistance.

MEMORANDUM

TO: Todd Stern

FROM: Maria Echaveste

SUBJECT: Proposed OPL Role in Global Climate Change Public Awareness Effort

As a follow-up to our meeting yesterday, below are some ideas on how OPL can assist in this effort to build public awareness of and support for the Administration's proposed actions regarding global climate change.

I. Provide support to Cabinet members and senior White House staff in their efforts to obtain public input by identifying participants for meetings, roundtables or dinners in DC or while on travel organized by industry, region or mixed views. Key cabinet members or White House staff: Pena, Daley, Rubin, Browner, Herman, Glickman, Babbitt, Slater, Albright, Podesta, McGinty, Bowles, Sperling, Mathews, Reed.

II.. Devise specific strategy for outreach by VP to labor and business.

III. Organize conference calls with key groups on a regional basis where participants would be briefed by key White House staff, VP and/or Cabinet members.

IV. Possible groups to be specially targeted:

business/industry (by sector)
science
religous
labor
agriculture
insurance
women
youth

SCHEDULE PROPOSAL TODAY'S DATE: ___/___/___

_____ACCEPT _____REGRET _____PENDING

TO:	Stephanie Streett Directors of Scheduling
FROM:	(Assistant to the President)
REQUEST:	(Meeting, Briefing, Speech, Reception, Drop-By, etc.)
PURPOSE:	(Reasons why the President should honor request; what is the desired outcome?)
BACKGROUND:	(Additional pertinent information)
PREVIOUS PARTICIPATION:	(The President's previous participation with this organization or individual)
DATE AND TIME:	(Open if no date is given, please indicate some deadline either way)
BRIEFING TIME:	(If necessary, please indicate separately)
DURATION:	(Amount of time the President is committed)
LOCATION:	(Identify the preferred location and rainsite in case of inclement weather)
PARTICIPANTS:	(Attach list if more than five)
OUTLINE OF EVENTS:	(Including description of the President's participation)
REMARKS REQUIRED:	(Major speech, talking points, brief remarks, etc. Who will be preparing the remarks and / or briefings?)
MEDIA COVERAGE:	(Type of media, photo coverage, if any)

PLEASE SEE 2ND PAGE!!

FIRST LADY'S ATTENDANCE:

VICE PRESIDENT'S ATTENDANCE:

RECOMMENDED BY:

CONTACT: White House Contact and Phone Number

ORIGIN OF THE PROPOSAL: Invitation or White House Staff generated proposal.

SECOND LADY'S ATTENDANCE:

SOURCE OF PAYMENT: Who is paying for this event?

Agenda
NEC/CEQ Principals Meeting
Climate Change
July 11, 1997

I. Interagency Decision Process

II. Domestic Emissions Trading

CLIMATE CHANGE POLICY WORKGROUPS

1. Domestic Policies

A. Domestic Emissions Trading

B. Technology Policy

C. Transition Assistance

D. Regulations and Standards

2. International Policies

A. International Emissions Trading & Joint Implementation

B. Developing Country Issues

C. Enforcement/Compliance

-- Draft --

Summaries of Agency Sectoral Analyses on the Impacts of Climate Change

July 1997

1. Agriculture - USDA

I. Current Stresses

- Weather variability (e.g., droughts, floods, frosts and extreme heat and cold) currently affect production of food and fiber.

- Other environmental stresses (e.g., tropospheric ozone, increased UV-B, nitrogen deposition, pests, diseases, and weeds) also affect crop growth.

II. Additional Impacts of Climate Change

- Climate change could exacerbate the current stresses including increased weed growth.

- Higher temperatures and altered precipitation could shift regional zones of certain crop productivity.

- Elevated CO_2 boosts growth and productivity of most crops if nutrients are not limiting (particularly C_3 species), although the exact degree of enhancement is unclear.

- Elevated CO_2 also increases crops' water use efficiency; however, the higher temperatures increase the overall water demand, and may offset the improved water use efficiency.

- Patterns of commodity production will shift – regional dislocations could ensue.

III. Adaptation and Mitigation Options

- Historically, US crop yields have increased dramatically; maintaining future yields necessary to feed a growing population in the face of climate change will require continued private and public sector research.

- Genetic resources enable the development of new crop varieties better adapted to changing climate conditions and changing pests.

- Simulations of climate change impacts on crop production indicate that without farm-level adaptations, climate change could lead to the reduction of crop yields. With adaptations, such as farm management choices, the negative impacts may be ameliorated.

- There is also the cost of adjustment of infrastructure. For example, the evidence suggests that the lifetimes of important agricultural investments and time requirements before adopting new technologies varies: 2-14 years for new crop varieties to be adopted; 8-15 years for new crop varieties to be developed; 10-12 years for adopting new tillage systems; 15-30 years to adopt new crops; 3-10 years to open new lands for agriculture; 20-25 years for the lifetime of irrigation equipment; and 50-100 years for the lifetime of dams and irrigation systems.

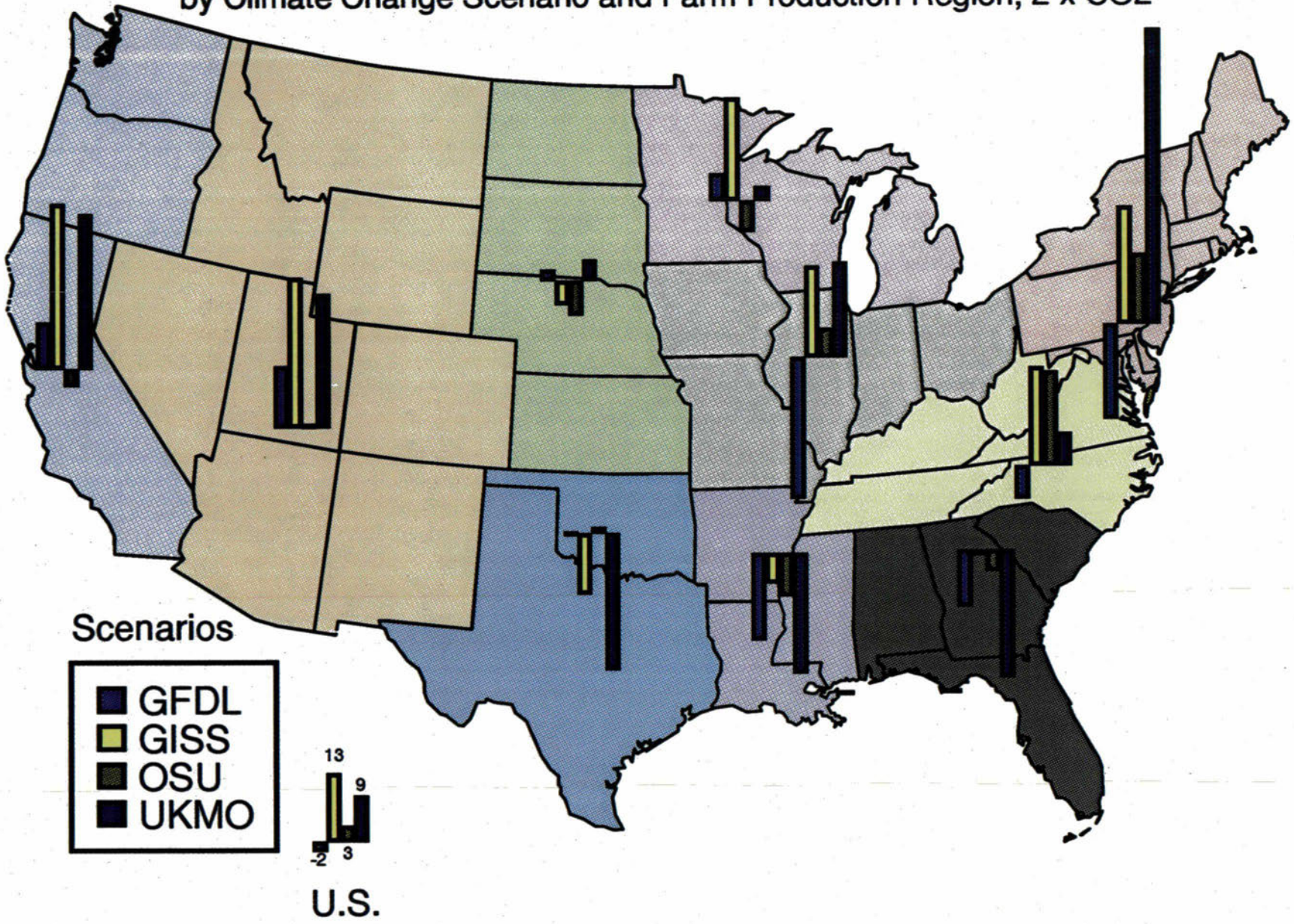
- Currently 14% of US croplands is irrigated. Changes in the hydrological cycle could shift regional irrigation patterns, with resulting changes in patterns of commodity production.

- Land retirement programs such as the Conservation Reserve Program and the Wetland Reserve Program reduce soil erosion, preserve wildlife habitat, and increase carbon storage.

- Developing a nationwide communication network will facilitate the rapid transfer of new information about adaptation and innovation activities available to farmers.

Percent Change in Average Growing Season Length

by Climate Change Scenario and Farm Production Region, 2 x CO2



2. Coastal Zones - NOAA

I. Current Stresses

- Coastal zones provide us with a variety of goods and services
  - Wetlands (habitat for wildlife, nursery for commercial fish, clean water, buffer for coastal storms)
  - Fisheries (both commercial and recreational)
  - Tourism
  - Transportation

- Non-climate stresses
  - Effluent discharge from sewage and industrial plants, and agricultural run-off have caused significant nutrient and over-enrichment in coastal waters
  - Dams, irrigation projects, and other water control efforts have affected coastal zones by diverting or altering the supply of water, sediment, or nutrients
  - Coastal erosion is already a problem in the US, particularly for areas that are subsiding
  - Population is increasing in coastal areas faster than in any other region of the country

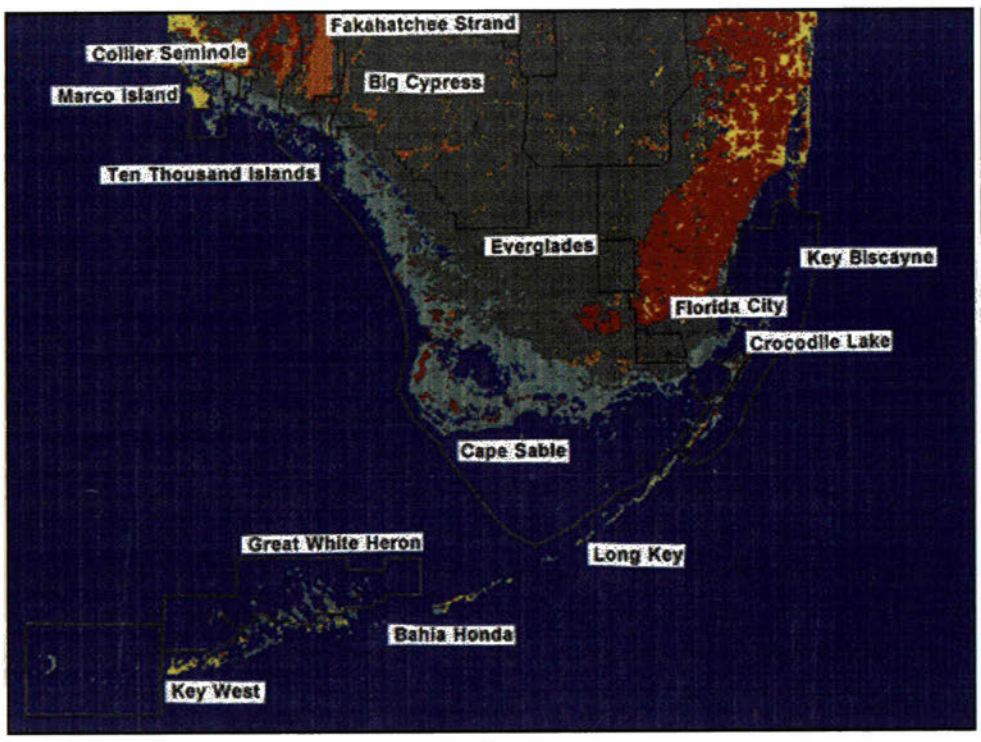
II. Additional Impacts of Climate Change

- Sea level rise will lead to:
  - Increased erosion of shores and associated habitat
  - Increased salinity of estuaries and freshwater aquifers
  - Altered tidal ranges in rivers and bays
  - Changes in sediment and nutrient transport
  - Changes in the patterns of chemical and microbiological contamination in coastal areas
  - Increased coastal flooding particularly with storm surges
- Decreasing freshwater flow combined with sea level rise may lead to the encroachment of saltwater species into typically freshwater habitats
- Increased freshwater discharge from the Mississippi River (associated with elevated CO_2 levels) could lead to a greater area of persistent hypoxia, which is already persistent in the Gulf of Mexico
- Changes in coastal storms and storm surges could exacerbate the impacts of sea level rise
- Warming of water temperatures, combined with other environmental stresses can lead to coral "bleaching" and significant coral reef destruction
- Highly vulnerable areas are along the Gulf Coast (especially Louisiana), and in the Southeast US, and include the following types of ecosystems:
  - Salt water marshes
  - Coastal wetlands
  - Coral reefs and atolls
  - River deltas
- Coastal buildings, transportation infrastructure, and recreational and agricultural lands are also at risk

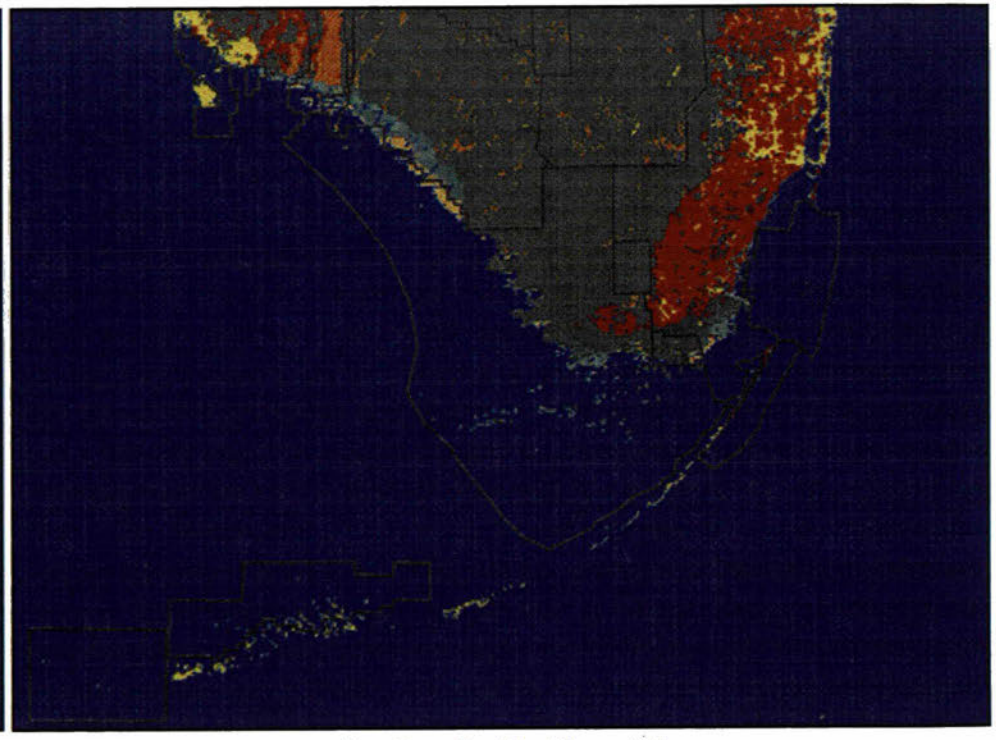
III. Adaptation and Mitigation Options

- Accommodate, Protect, or Retreat
- Integrated Coastal Zone Management considers: economic development, environmental quality management, land use, food production, energy, transportation, waste disposal, water resources, tourism, etc. in both the public and the private sectors

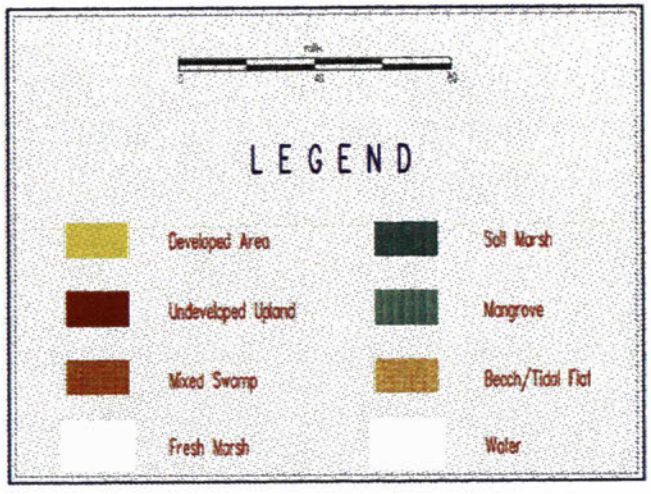
Figure 3: LANDSAT imagery and data from USGS topographical maps combine to illustrate the potential impacts of a half meter rise in sea level on South Florida. The maps demonstrate a substantial loss of mangroves and migration of wetlands inland.



Present Day Sea Level



Sea Level with 50 cm Rise



Dr. Richard Park
Ecomodeling

3. Disaster Mitigation and Preparedness - FEMA

I. Current Stresses

- Increased precipitation and severe flooding events in recent years:
  - intense precipitation events have increased by ~20% since the beginning of the century
  - cold season precipitation has increased nearly 10% since the beginning of the century
  - long-term weather stations have observed a 6% increase in annual precipitation
  - the proportion of total annual precipitation from extreme rainfall events has increased from <8% to ~10% over the past century
  - There has been an upward trend in North American precipitation between 1891 and 1990. This increase was strongest in the last few decades
- Floods represent 76.2% of declared disasters. The Midwest Floods of 1993 had a total cost of $16 billion (both insured and uninsured); FEMA obligated $874 million (through both public and individual assistance).
- Despite a relatively consistent trend in the number of federal disaster areas declared over the past several years, disaster costs have increased. The average annual disaster cost between 1989 and 1992 was $956.4 million; between 1993 and 1996, the average cost was $1.366 billion (~30% increase).
- This increase might not reflect an increase in severity of disasters; instead, it could be a result of population increases in hazard-prone areas or other factors. The average losses for structures covered by the National Flood Insurance Program (NFIP) have remained relatively consistent for ~18 years.

II. Additional Impacts of Climate Change

- Global warming will most likely increase the frequency and intensity of extreme weather events. Sea level rise will increase the probability of flooding in coastal areas. These will lead to higher disaster costs and more substantial losses for properties insured by the NFIP.
- Global change may cause an increased frequency and severity of sudden and extreme rainfall events, floods, mudslides, drought, wildfires, and heat waves.
- With a one-foot sea level rise, the number of flood-prone households would increase from ~2.7 miliion to 5.7 million by 2100. With a three-foot rise, the number would increase to 6.8 million.
- The expected annual flood damage for property insured by the NFIP would increase 36-58% for a one-foot sea level rise and 102- 200% for a three-foot rise. A one-foot sea-level rise would increase NFIP annual flood losses by ~$150 million by 2100. A three-foot rise would increase annual losses by ~$600 million.

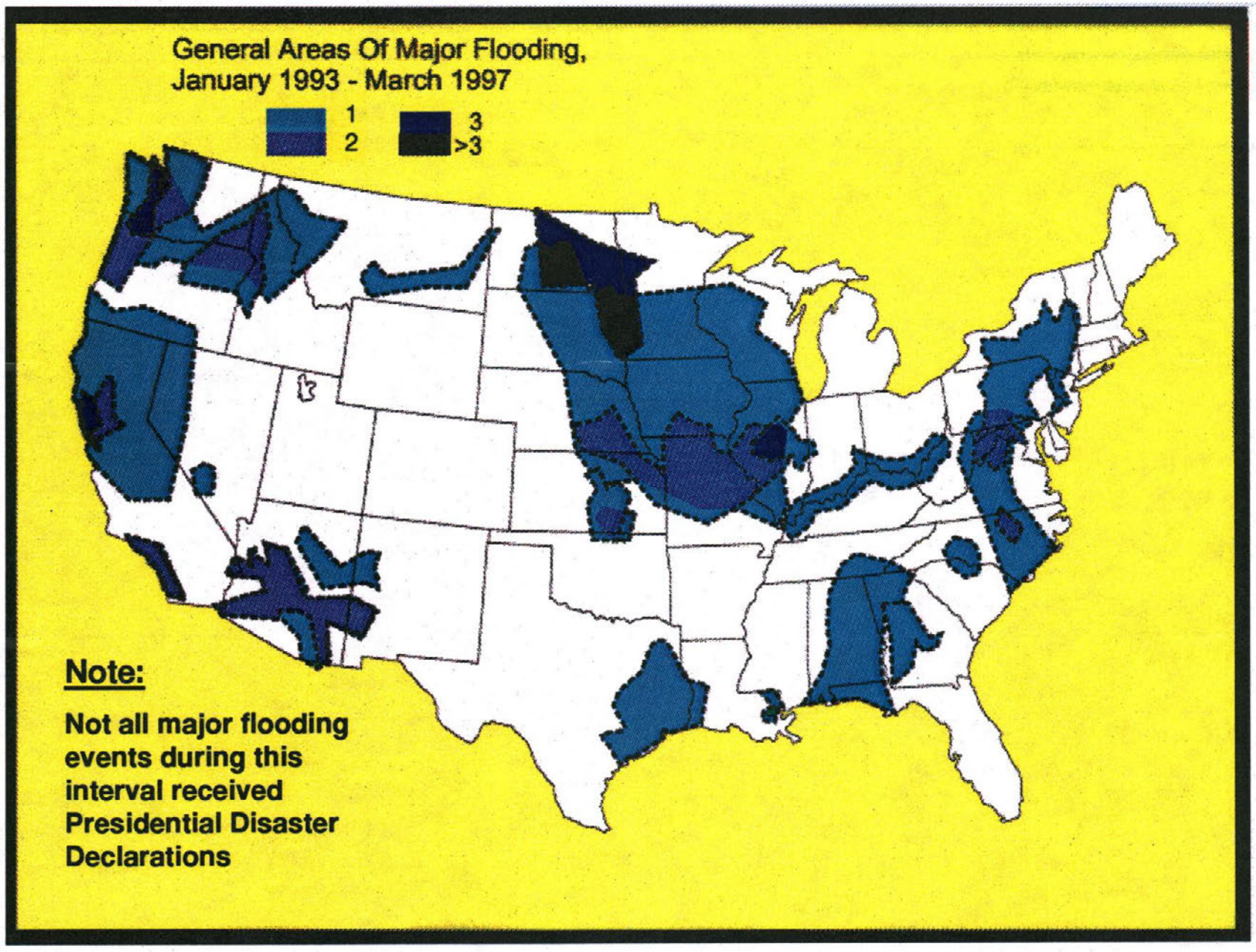
III. Adaptation and Mitigation Options

(Note: The following information was taken from information from the SNDR)

- The goals of the National Mitigation Strategy are to increase public awareness and demand for safer communities, and to significantly reduce the loss of life, injuries, economic costs, and destruction of natural and cultural resources from natural hazards. The strategy has five major elements:
  - hazard identification and risk assessment for communities throughout the Nation
  - applied research and technology transfer to support regional mitigation efforts
  - public awareness and training to increase understanding of hazard risks
  - incentives and resources to encourage mitigation activities
  - leadership and coordination among federal agencies to promote mitigation activities across federal programs and policies
- Through a new Disaster-Resistant Communities Initiative, FEMA is developing partnerships among federal agencies, state and local governments, and the private sector to put new mitigation tools for identifying hazards and assessing risks in the hands of local communities.

- These new tools will allow evaluation of the threat of natural extremes themselves and any trends resulting from global change on structures and natural and managed ecosystems.
- Communities will gain improved access to information on mitigation technologies such as
    - building codes and standards;
    - associated technological hazards such as fire, toxic releases, and hazardous material spills resulting from natural extremes; and
    - the impact of natural extremes on the environment, ecosystems, and biodiversity.
- The Initiative will help state and local governments, the private sector, and other players develop policy, financial resources, and incentives to foster cost-effective mitigation, in areas such as insurance, mortgage banking, and property taxation.

- This effort will be initiated for a small number of pilot communities in FY 97, so that the lessons learned may be applied to an expanded number of communities in FY 98 and FY 99.


General Areas Of Major Flooding,
January 1993 - March 1997
1
2
3
>3
Note:
Not all major flooding events during this interval received Presidential Disaster Declarations

4. Fisheries - NOAA

I. Current Stresses

- Pervasive over-fishing
- Diminishing nursery areas
- Extensive inshore and coastal pollution

II. Additional Impacts of Climate Change

- Climate change interacts with over-fishing, lost wetlands and nurseries, pollution, UV-B.
- Freshwater fisheries and aquaculture at mid to higher latitudes should benefit.
- Cold water species in small rivers and lakes are expected to be eliminated from the southern or low-elevation boundaries of their present ranges. Warmer water species will likely replace them.
- For marine species, there will be regional and local geographic shifts in production and species composition.
- Open ocean species will be less affected than those species close to coasts or in estuaries.
- Changes in abundance are more likely near ecosystem boundaries, where conditions may already be marginal for the particular fish.
- Some marine mammals, turtles, and fish are at risk from flooding of nesting beaches, waters that are too warm, and change in rainfall.
- Regional impacts include:
    - In the Northeast, northward shifts for many Atlantic fish stocks; decline in mollusk populations which cannot migrate northwards; and a shift northward and upward in elevation of native brook trout.
    - In the Southeast, coastal fish production could initially rise, however these fisheries and shell-fisheries will later decline with the decline of the detritus-based food webs; a 25% decline in the Gulf of Mexico brown shrimp landings; in Apalachicola, populations of blue crabs, oysters, and finfishes could decline by 5 – 35%.
    - The Pacific fisheries could face major shifts in regional abundance and distribution of fish stocks; the ocean distribution of north Pacific salmon could decline to half its current area.
    - Inland fisheries will face shifts in species composition with a greater proportion of warm-water fish at the expense of the cool and cold water fish.
- Categories of fisheries which are most sensitive to climate change (either positive or negative):
    - freshwater fisheries in small rivers and lakes with large temperature and precipitation change;
    - fisheries within Exclusive Economic Zones where fishing fleet mobility may be limited (more negative impacts than positive impacts);
    - fisheries in large rivers and lakes (more positive impacts except in boundary areas);
    - fisheries in estuaries (more negative impacts);
    - high seas fisheries (no major impacts).

III. Adaptation and Mitigation Options

- Research is needed to understand how aquatic species respond to climate changes and to develop suitable adaptation strategies for society.
- If society develops the ability to deal with the current issues of over-fishing, pollution, water resource management, and natural climate variability, climate change impacts will be greatly reduced.
- Design and implement national and international fishery management institutions that recognize shifting species ranges, accessibility, and abundance, and that balance species and habitat conservation with local needs for economic efficiency and stability.
- Increased control of non-native fishes, and aquatic and marine species.

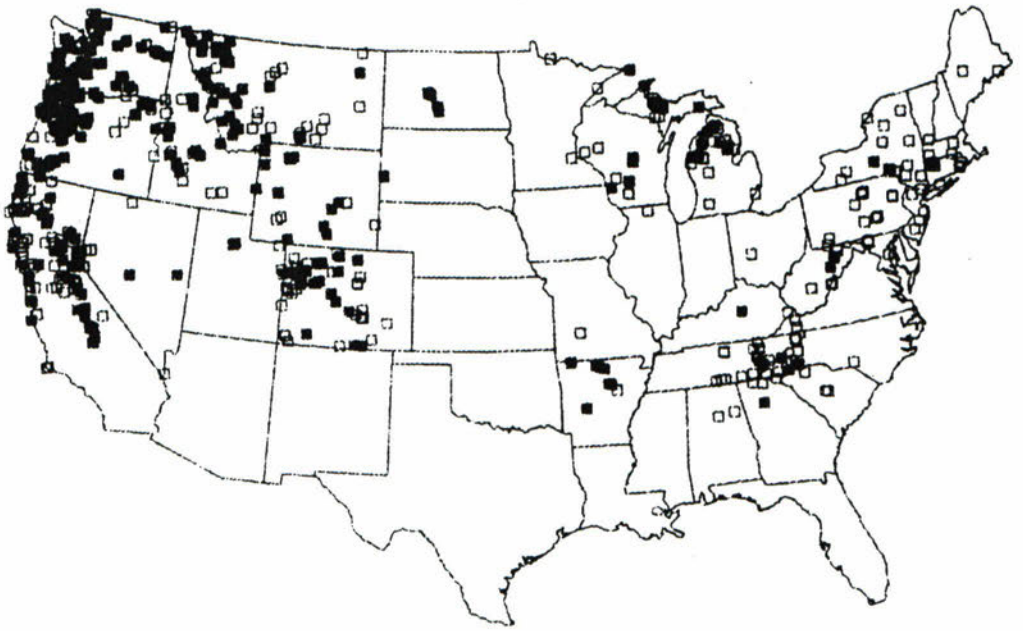


Figure 7a. USGS monitoring stations with suitable thermal habitat for rainbow trout before and after climate warming. The maximum tolerance for rainbow trout was 24.0°C. Before climate change, suitable habitat at 632 sampling sites — □ ; after climate change, at 322 of 632 sites — •.

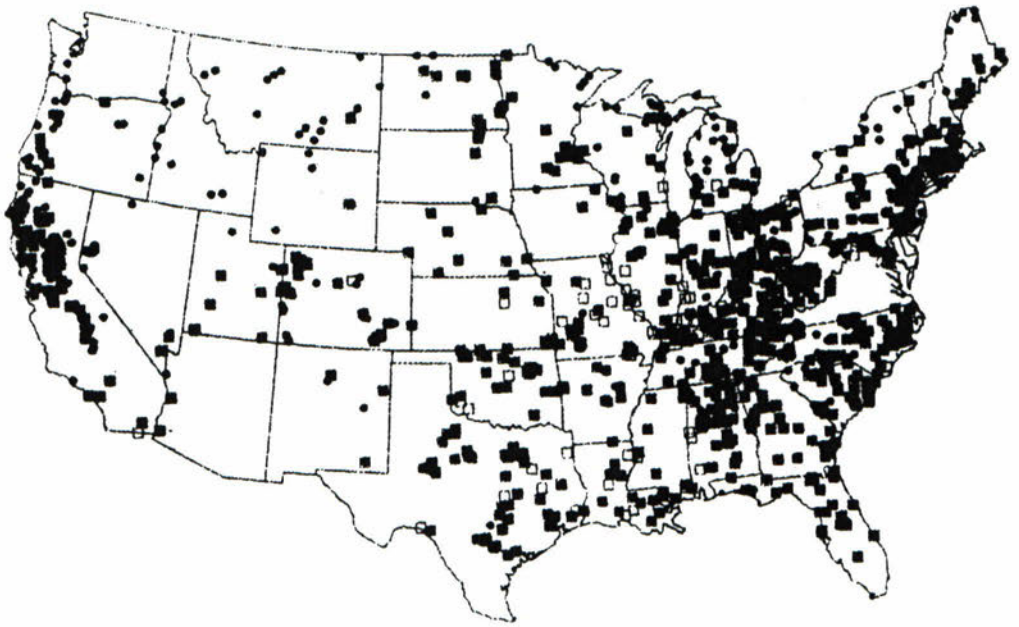


Figure 7b as Figure 7a, but for largemouth bass. The tolerance range for largemouth bass was 26.0–35.5°C. Before climate change, suitable habitat at 892 of 1,776 sites — □ ; after climate change, at 1,163 of 1,776 sites — •.

5. Forests – USDA Forest Service

I. Current Stresses

- Recovering from earlier deforestation (e.g., west coast, Alaska, Northeast and North Central states, pine forests of the South)
- Pollution impacts (e.g., Southern California, acidity in the Interior west, Northeast and North Central states, Mid-Atlantic region, the South)
- Dry conditions and fires (e.g., California, Oregon, Washington, Alaska, Interior West)
- Exotic pests such as gypsy moths and the wooly adelgid (e.g., Northeast)

II. Additional Impacts of Climate Change

- Warming will shift the ranges of plant and animal species to higher latitudes and elevations; however, all forest species will not be able to "migrate" at the necessary rate. Current high elevation ecosystems may disappear. High elevation forest species such as red spruce will suffer.
- Some analyses indicate the loss of sugar maple in New England. This would devastate the maple syrup industry and reduce the beauty of the fall foliage in that region.
- Warming will increase ecosystem disturbances such as fires, pest outbreaks, droughts, floods, landslides, and extreme weather events.
- Although the long-term environmental, social, and economic impacts of ecosystem disturbances might be positive, the effects during rapid climate transition will be negative.
- It is likely that both positive and negative impacts will occur.
    - On the positive side, the following could increase productivity:
        - extended growing seasons
        - higher levels of CO_2
        - regional moisture increases
    - On the negative side, productivity could be lowered by:
        - decreased regional moisture availability
        - more frequent and more intense ecosystem disturbances
- The Vegetation Ecosystem Model Analysis Project (VEMAP) compared 3 GCM climate projections using 3 biogeography and 3 biogeochemistry models. They predict an increase in net primary productivity (NPP) of between 0 and 40%.

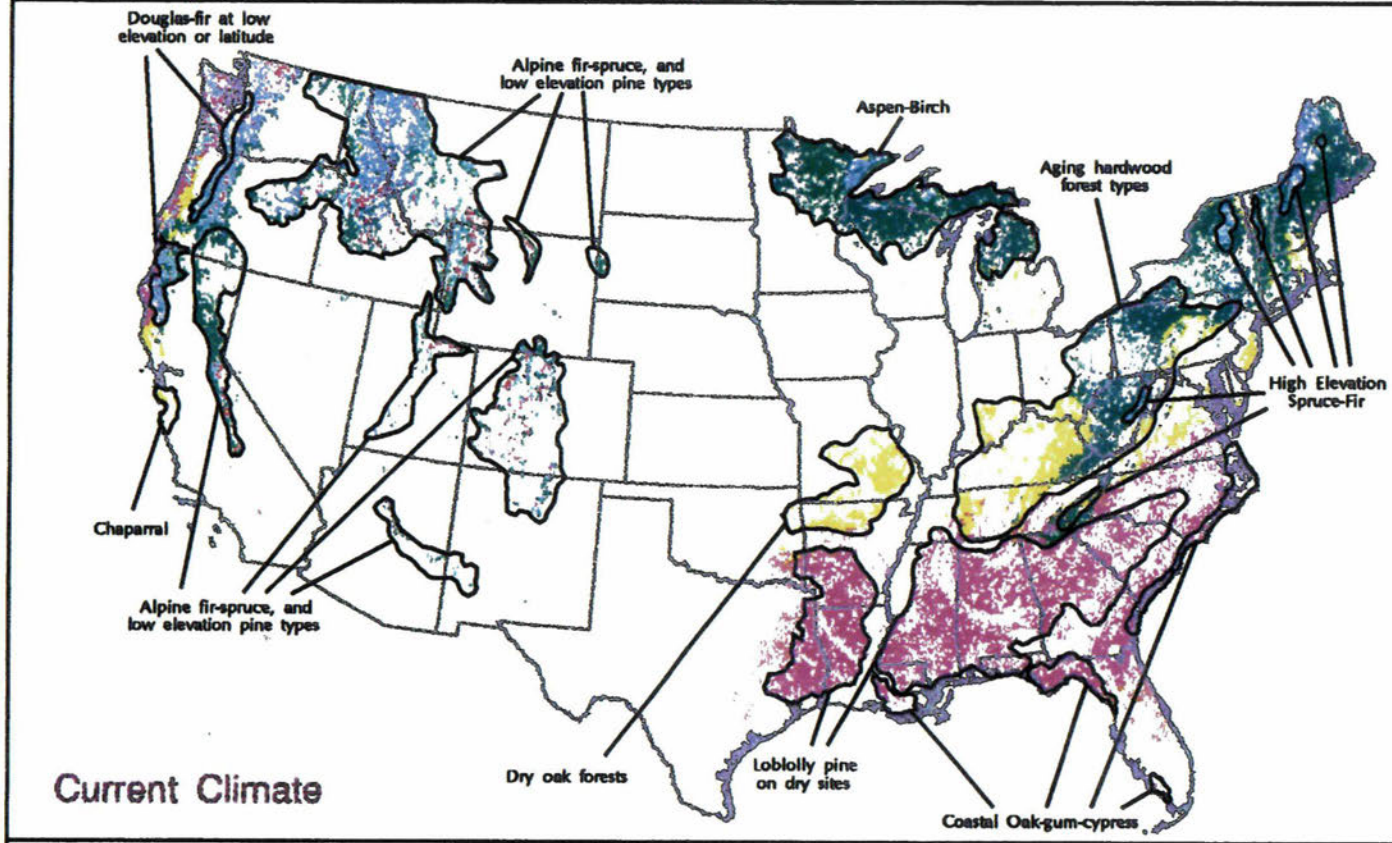
Regional Impacts

- Alaska: at higher latitudes, ↑carbon release from soil due to warming; likely to experience positive productivity changes;
- Northwest: east side of Cascades (dry forests) - enhanced disturbance regimes; west side of Cascades (wet forests) - changes in productivity, but not clear in which direction
- Interior West: especially sensitive; ↑ drought frequency and intensity; pest outbreaks; ↑ fires; large chance that native species will be replaced during regrowth after catastrophic events
- Great Plains grasslands: ↑ drought, ↑ fire
- Northeastern: already under stress from acid deposition; ↑ winter injury
- Northeastern and Southeastern: either + or - net change in productivity and growth; ↑ pest outbreak frequency and magnitude; large species shifts.
- Southeast: ↑ fire
- Puerto Rico: ↑ hurricane frequency and intensity;
- Mid-Atlantic: ↑ nitrate exports to watersheds; significant changes in forest species composition.

III. Adaptation and Mitigation Options

- Recognizing that environmental degradation can be exceedingly rapid, employ forest ecosystem designs most resilient to the variety of potential environmental stresses
- Develop and employ silvicultural techniques to control competition for moisture, light, and nutrients
- Select species or provenances that are well adapted to current and future site conditions

Examples of Forest Types that are Vulnerable to Climate Change



MAPSS Forest Cover

Eastern Forests

- Spruce-fir
- NE Mixed Forest
- NE Mixed Woodland
- Oak-Hickory Forest
- SE Mixed Forest
- SE Mixed Woodland

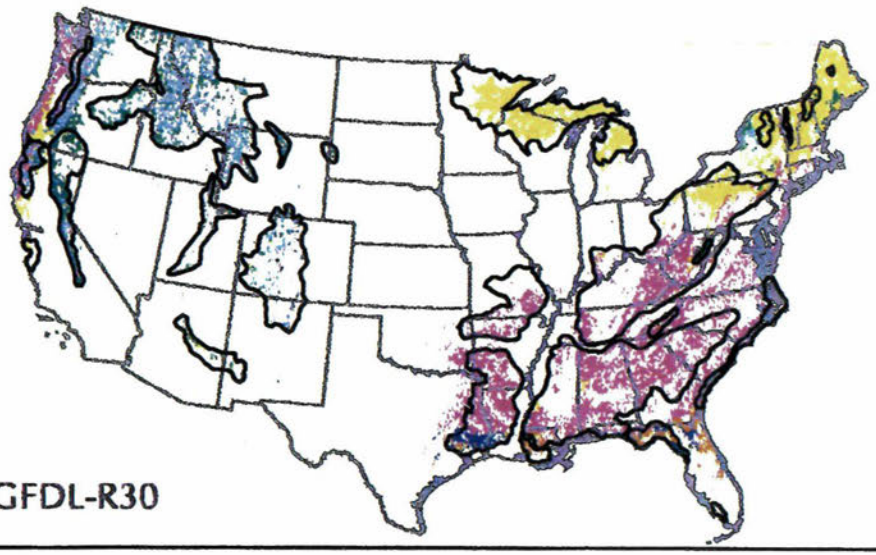
Tropical Forests

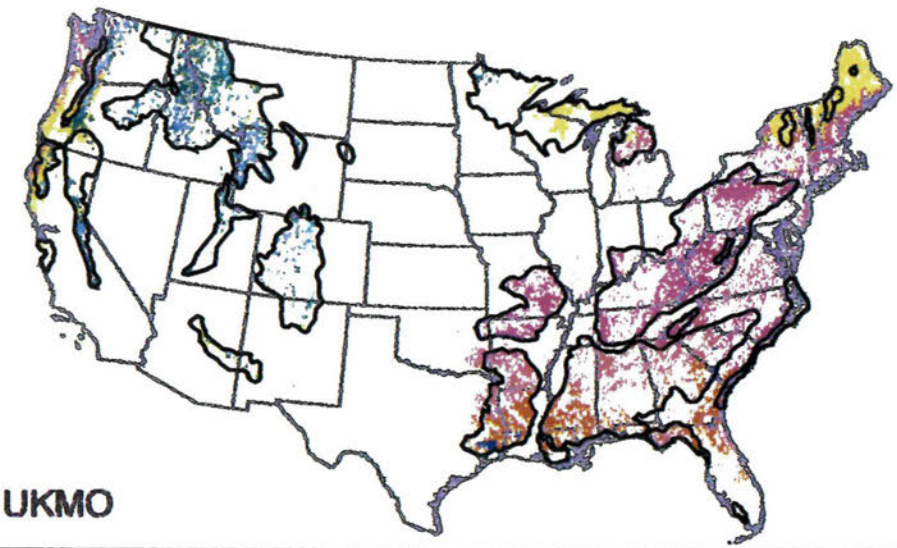
- Dry Tropical Forest
- Moist Tropical Forest

Western Forests

- Douglas Fir & Larch
- Coastal Moist Forest
- Western Pines
- Western Hardwoods
- Western Fir-Spruce

Only parts of the forest within each selected area are vulnerable. In the climate change scenario, forest is not allowed to migrate into current nonforest areas. Base maps from Neilson (1997). Overlay graphics by Birdsey and Holt (USDA Forest Service).





6. Human Health – EPA and NIH

I. Current Stresses

- Infectious diseases are a leading cause of death worldwide, killing over 17 million people in 1995, including 9 million children. Vector-borne diseases account for a large proportion of these deaths.
- Currently there are 350-500 million cases of malaria annually, killing ~2 million. Only a few cases of malaria in US, however, there has been recent local transmission in New Jersey, New York, and Texas.
- Water- and food-borne diseases are also a very serious health threat.. In 1995, diarrheal diseases killed 3.1 million people (80% were children under 5). In the U.S., 6.5 to 80 million cases of food-borne disease are reported each year.
- The US experiences significant heat related mortality and illness from extreme temperature events: heat waves in 1980, 1983, and 1988 killed 1700, 556, and 454 people respectively. In July 1995 there were 465 heat-related deaths in the Chicago area alone.
- Degraded air quality has been associated with respiratory illnesses, aggravation of existing cardiovascular disease, and premature death. In 1995, 71 million Americans lived in counties where air quality did not meet national health based standards for tropospheric ozone.

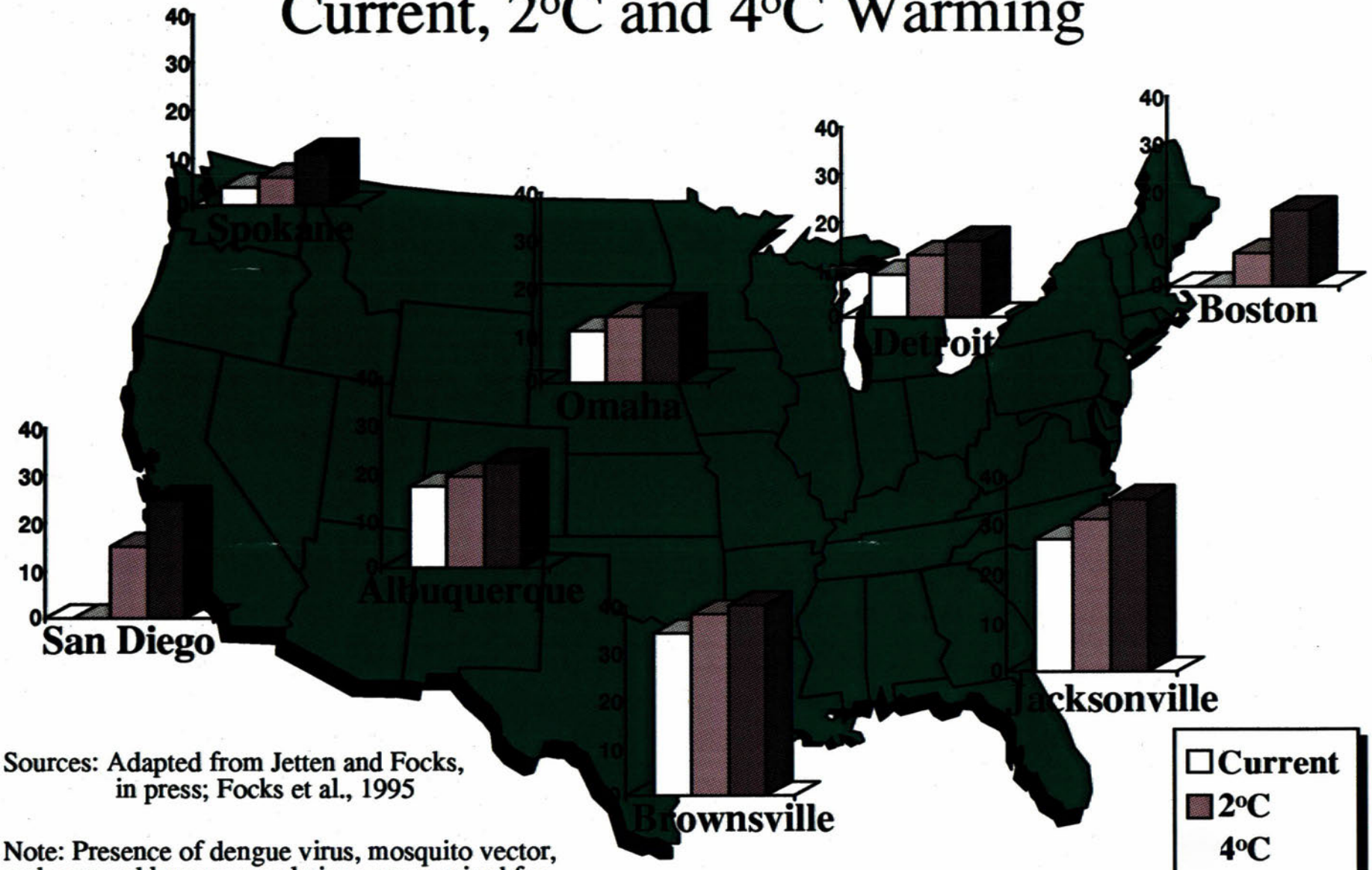
II. Additional Impacts of Climate Change

- Increased geographic distribution of disease-bearing vectors and changes in the life-cycle dynamics of both vectors and disease agents will favor the spread of infectious diseases to higher latitudes and elevations (from tropical into temperate areas) and lengthen the transmission season of some diseases.
- Global change could increase cases of malaria by 50 - 80 million additional cases annually (baseline of 500 million cases).
- Transmission for dengue and encephalitis would also increase.
- Higher sea surface temperatures may stimulate algal blooms and increase the transmission rates of cholera and the incidence of biotoxin contamination.
- Food- and water-borne diseases could increase with warmer temperatures.
- Increases in the frequency and intensity of extremely hot days could increase heat-related mortality by 70-150%, even if the population acclimates somewhat to warmer temperatures.
- Thermal stress and air quality interact which could negatively impact human health.
- Extreme weather events like floods can cause spread of disease by disrupting the supply of clean water, as well as kill people directly.
- Higher levels of UV radiation can cause immunosuppresive effects, retinal damage, cataracts, and skin cancer.

III. Adaptation and Mitigation Options

- Measures to minimize the health impacts of climate change include better management of ecosystems, improved public health monitoring, surveillance and control programs, disaster preparedness.
- It also requires close attention to evaluating the health risks of technological mitigation and adaptation activities in a risk assessment and management framework to avoid the creation of additional problems, such as the effects of pesticides used to control disease vectors.
- Develop and expand use of protective technologies such as sea walls and levees, water purification, and vaccination.
- Increase accessibility to air conditioning or other means of cooling.

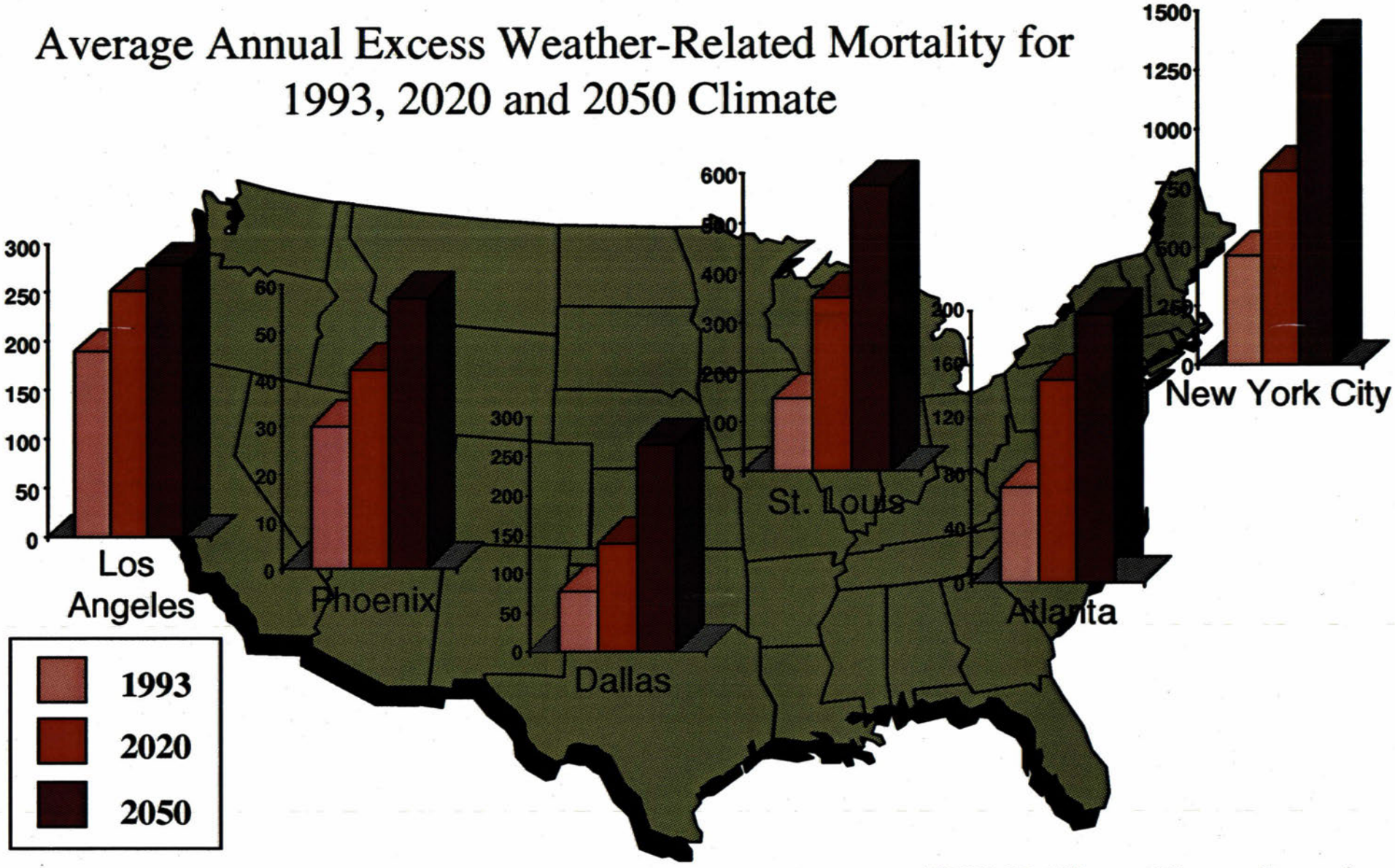
Weeks of Potential Dengue Transmission: Current, 2°C and 4°C Warming



Sources: Adapted from Jetten and Focks, in press; Focks et al., 1995

Note: Presence of dengue virus, mosquito vector, and exposed human populations are required for disease transmission

Average Annual Excess Weather-Related Mortality for 1993, 2020 and 2050 Climate



Sources: Kalkstein and Green (1997); Chestnut et al.(1995)

GFDL89 Climate Change Scenario

Note: Includes both summer and winter mortality. Assumes full acclimation to changed climate

7. National Parks - DOI

I. Current Stresses

- Increased development in and adjacent to federal lands
- Increased recreational use
- Altered disturbance and hydrologic regimes (natural fire, flooding)
- Grazing by livestock or high concentrations of protected wildlife
- Habitat fragmentation at landscape scales which is often intensified by boundaries
- Air pollution
- Exotic species invasion

II. Additional Impacts of Climate Change

- Climate change will shift the ideal climate for vegetation and wildlife while the boundaries of natural areas (parks, refuges, wilderness areas) remain fixed. Many of these were preserved for their unique biological character.

- Sea-level rise and glacial retreat will be direct impacts of climate change and will alter wetlands, shorelines, and alpine ecosystems.

- Even the small increase in temperature to date has caused melting of glacial ice in Glacier National Park and the North Cascades National Park. Warming over the next few decades may completely eliminate the alpine glaciers in Glacier National Park by 2030, so the Park may require a new name.

- Insect and disease outbreaks are likely to become more frequent as the climate changes.

- Climate change could shift the competitive balance among species and enhance encroachment of exotic species.

- Accelerated habitat loss and loss of biodiversity.

- Natural systems are more vulnerable to climate change than highly managed systems because there is limited potential for adaptation due to landscape fragmentation, urbanization, etc. Natural migration rates will be too slow to keep up with climate change.

III. Adaptation and Mitigation Options

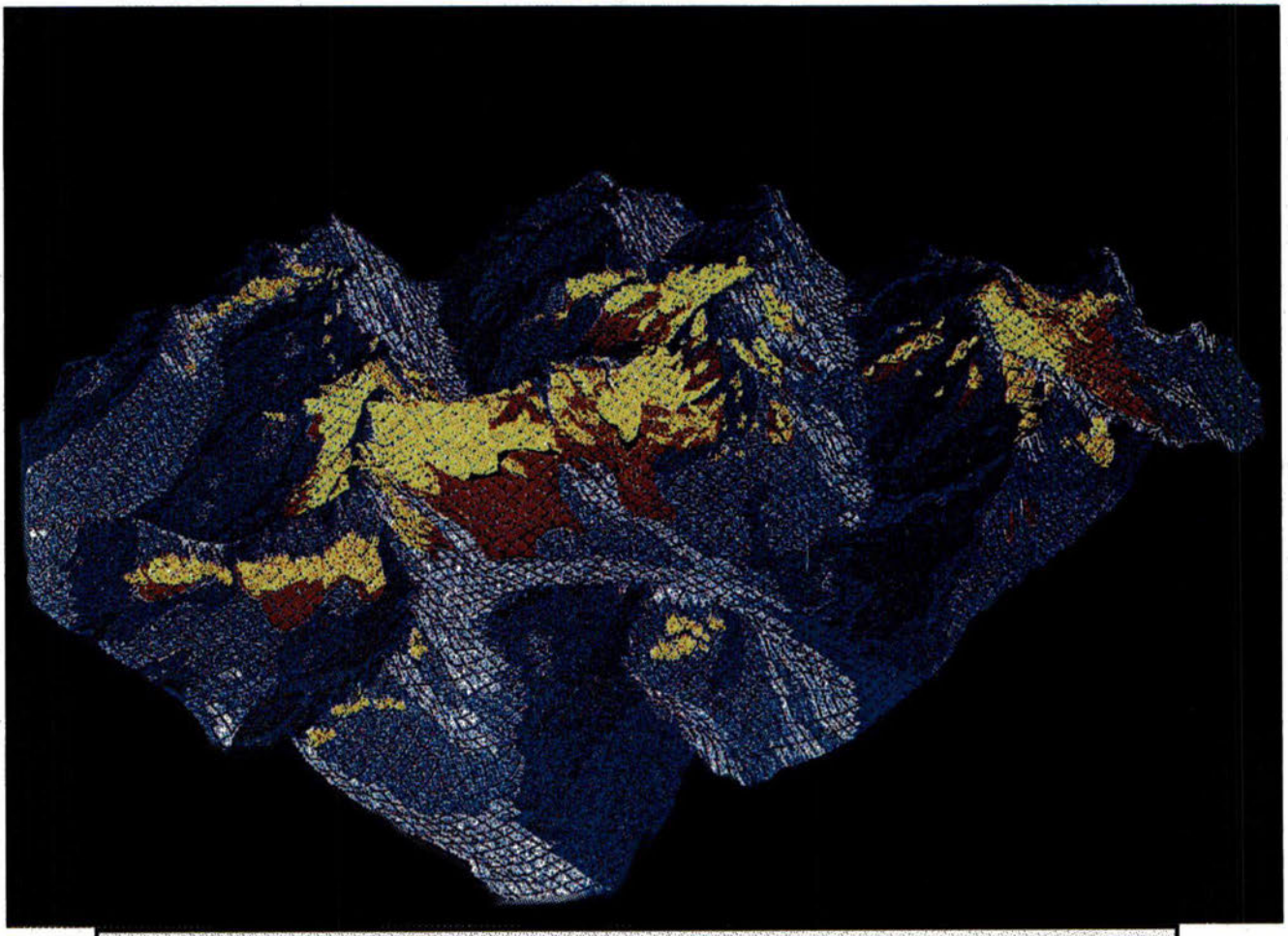
- Maintain or restore natural disturbance frequencies and intensities (e.g., restoring the natural role of fire)

- Enhance migration corridors and use an ecosystem approach

- Increase exotic species mitigation efforts, such as improving biological, chemical, and physical control techniques

- Develop an adaptive management philosophy

- Expand natural resource inventory, monitoring, and research activities



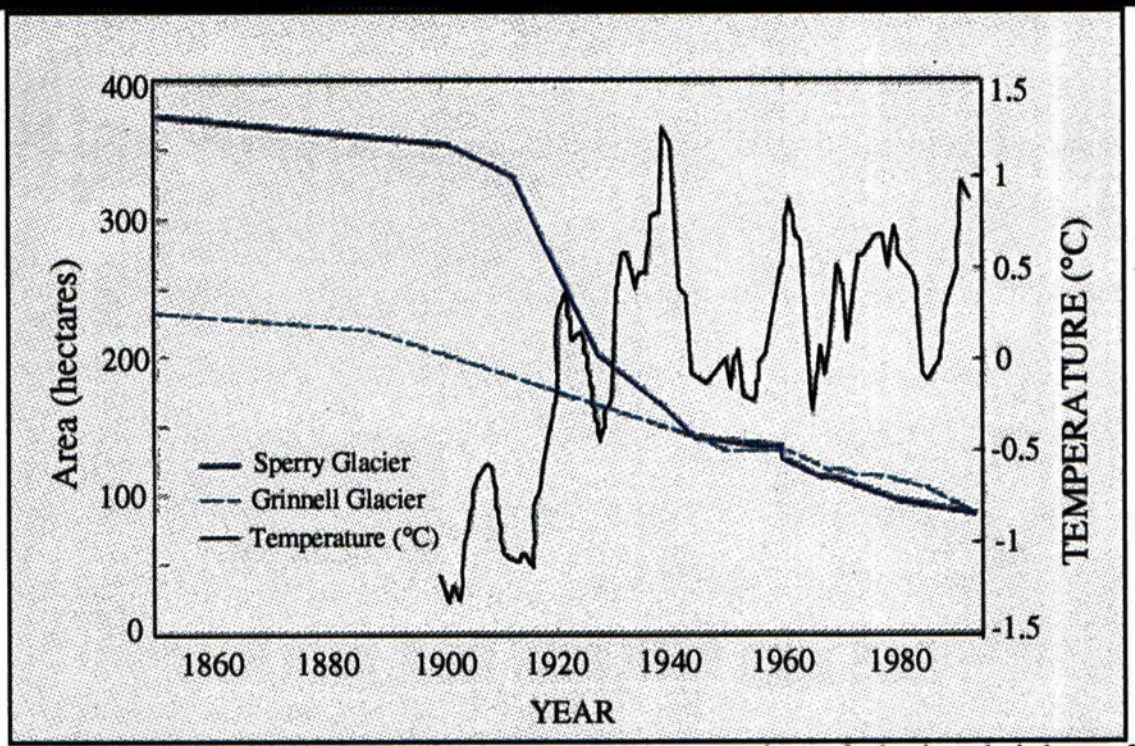


Figure 5. A geographic information system representation of glacier shrinkage from 1850 to 1993 in Glacier National Park. Yellow areas reflect current area of each glacier. Red and orange represent the previoius extent of glaciers at various times in the past. Glacier area is strongly correlated with temperature, and further shrinkage could eliminate many alpine glaciers by 2030.

8. Water - DOI

I. Current Stresses

- Water availability is highly variable, both spatially and temporally; it responds to both natural and anthropogenic forcing.
- The leading stresses causing water quality impairment are nutrients, bacteria, and siltation from agriculture, point sources of pollutants, urban runoff, and storm sewers
- In some parts of the US, the ratio of water consumption to the renewable supply of water is very high. These areas are particularly vulnerable to any further drying (highest ratios in: Lower Colorado River Basin, followed by Rio Grande, Great Basin, Upper Colorado, and California)
- Polluted waters and diminished water flows degrade aquatic ecosystems. Aquatic species declines are also associated with habitat loss and competition with exotic species.
- Floods and droughts are currently unpredictable and cause major problems.
- Water use responds to economic forces: consumption declined nationally by 6% from 1980 to 1990.
- Coastal aquatic systems are stressed by increasing consumptive use demands on coastal aquifers, global sea level rise, subsidence, and excessive nutrients and other chemical imports into estuaries.

II. Additional Impacts of Climate Change

- Climate change will lead to an intensification of the global hydrologic cycle, with increased evaporation, precipitation, and stream flow; however, specific regional effects are uncertain.
- Projected increases in evaporation would lead to lower surface water and soil moisture in summer in the middle latitudes. Drier soils may impact vegetation.
- Warming is expected to increase the water necessary for irrigation, industrial cooling, and domestic uses, as well as increase the evaporative losses from water supply systems. These factors could stress already limited water resources in some areas.
- Warmer temperatures may also reduce the amount of moisture stored as snow pack, and change melting rates.
- Aquatic habitats may experience changes in mean flows, flow variability, and water temperature.
- Extreme conditions (e.g., floods, and drought) may become more frequent in some regions and potentially more costly.

III. Adaptation and Mitigation Options

- Extreme conditions underscore the need for long-term records and observing systems for weather, stream flow, ground water, water quality, and biota.
- In coastal systems water pumping and subsidence are important considerations.
- Potential policy measures to minimize flood losses include permanent evacuation of flood prone areas, enhanced flood warning and evacuation planning, flood proofing of structures, better maintenance of levees, and enhancement of natural storage through wetlands restoration or creation.
- Water pricing and conservation with appropriate government requirements for ecosystem maintenance and recreation may alter water use.
- Water management plans that assume that future climate will be a repeat of the recent past climate are destined to perform poorly as compared to plans that recognize the potential for significant and long-lasting departures from recent historically "normal" conditions.
- Water management plans should include: studies of long climate and proxy-climate records covering several centuries to bring a wider range of variation into the managers' view; continued attempts to model future climate with appropriate regional and temporal accuracy and precision; continued studies to assess the effects of climate variability on ground and surface water systems and their interactions; river-basin simulation models to predict river flows; and a robust observational system to provide current data on temperature, precipitation, stream flow, and ground water conditions.

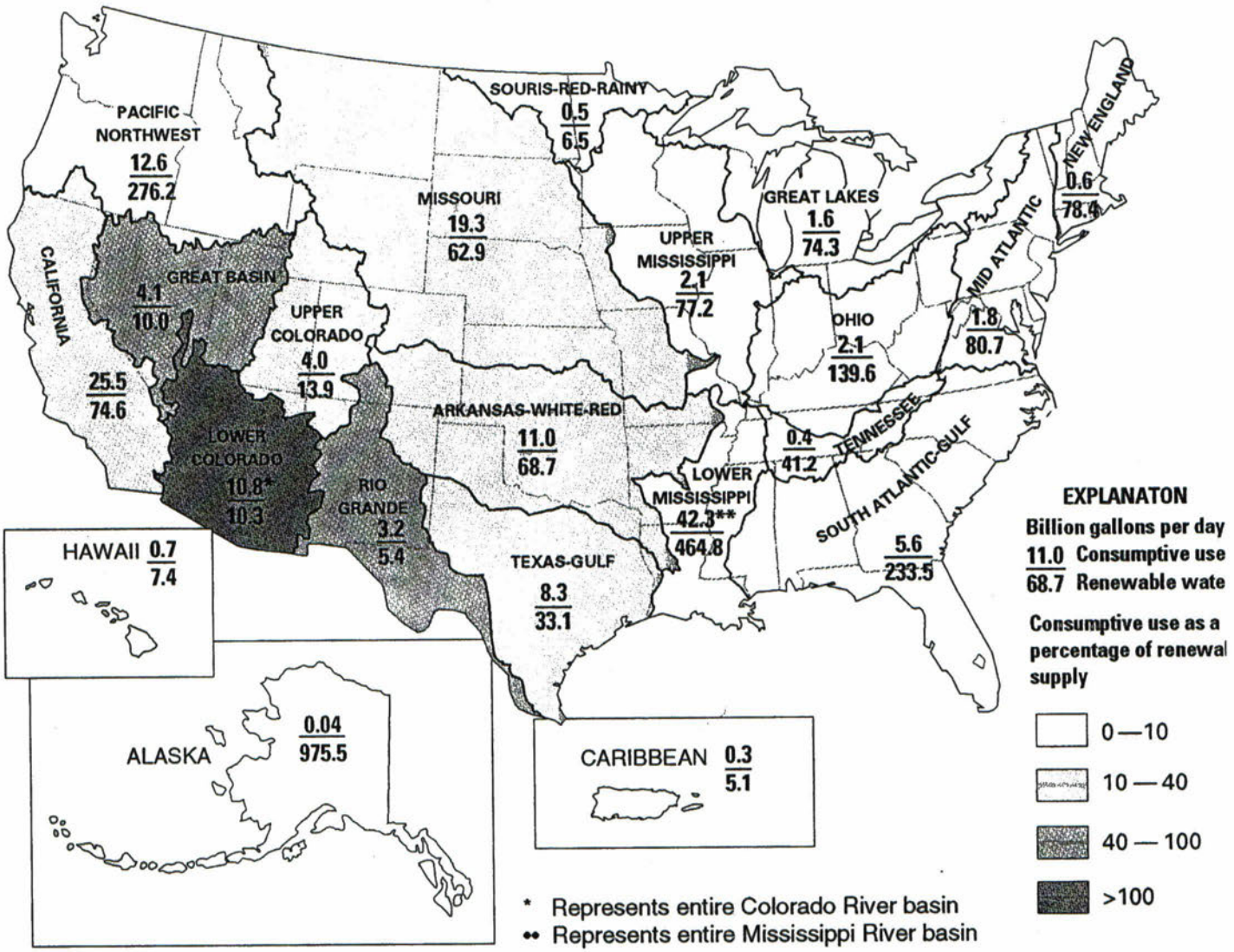


Figure 4. Average consumptive use and renewable water supply, by water-resources region.