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Oral Testimony for the Hearing,
“Healthy Planet, Healthy People: Global Warming and Public Health”
Select Committee on Energy Independence and Global Warming
United States House of Representatives
The Honorable Ed Markey, Chair
The Honorable F. James Sensenbrenner Jr., Ranking Member
April 9, 2008, 10:00 a.m.

By Mark Z. Jacobson

I would like to thank the Honorable Chairman, Ranking Member, and committee for inviting me to testify today. I will discuss scientific findings on the effects of carbon dioxide, emitted during fossil-fuel combustion, on air pollution health in California relative to the U.S.. I will then discuss how these findings compare with the two main assumptions made by Environmental Protection Agency (EPA) Administrator Stephen L. Johnson that formed the basis of his decision to deny California’s request for a waiver of Clean Air Act Preemption.

Summary

On March 6, 2008, EPA Administrator Johnson published a summary of his decision to deny the California Air Resources Board request for a waiver. The decision was made on two grounds:

1) “GHG (greenhouse gas) emissions from California cars are not a causal factor for local ozone levels any more than GHG emissions from other sources of GHG emissions in the world (Johnson, 2008, p. 12163).”

and

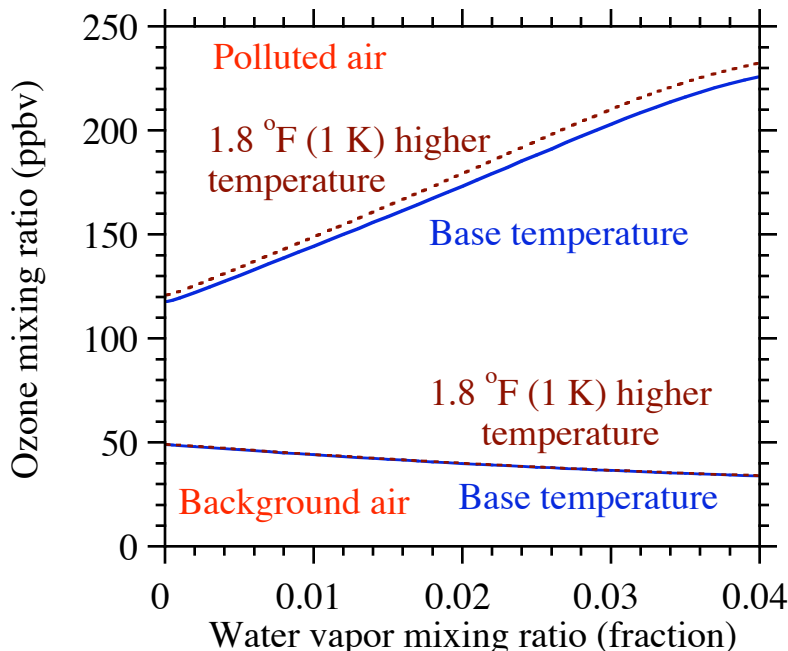
2) “While I find that the conditions related to global climate change in California are substantial, they are not sufficiently different from conditions in the nation as a whole to justify separate state standards...These identified impacts are found to affect other parts of the United States and therefore these effects are not sufficiently different compared to the nation as a whole. (Johnson, 2008, p. 12168).”

These two issues are questions of scientific fact, which I will address here with results from a published study I performed, funded in part by EPA, and subsequent analysis. The study began about two years ago, before the waiver question became an issue and before EPA funding commenced on the project. It was also the culmination of research on the effects of climate change on air pollution that I started eight years ago and of research on the causes and effects of air pollution that I started 18 years ago.

Discussion

I first examined the effects of temperature alone and, separately, water vapor alone on ozone using an exact solution to a set of several hundred chemical equations in isolation. The figure on

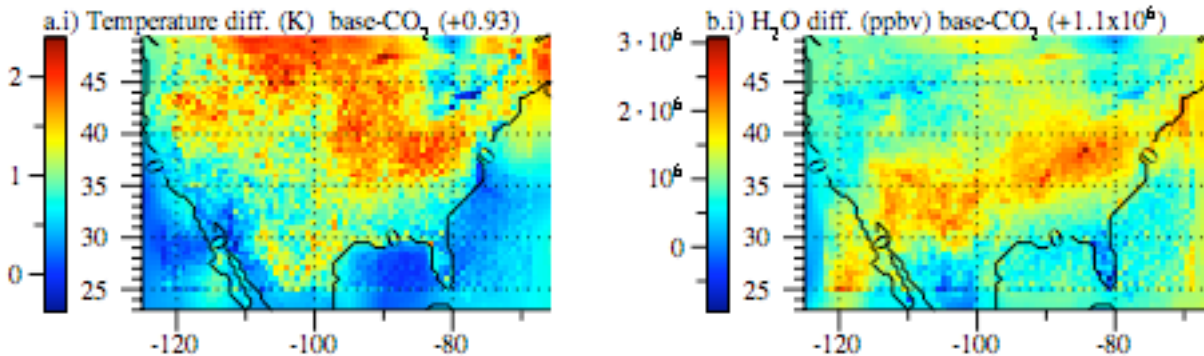
the screen shows the resulting ozone at low and high pollution. A comparison of the solid lines (base temperature) with the dashed lines (1.8 degrees Fahrenheit or 1 K higher temperature) in the figure shows that the increase in temperature increases ozone when ozone is already high, at all water vapor levels, but has little or no effect on ozone when ozone is low. The figure also shows that water vapor (horizontal axis) independently increases ozone when ozone is high but can slightly decrease ozone when ozone is low.

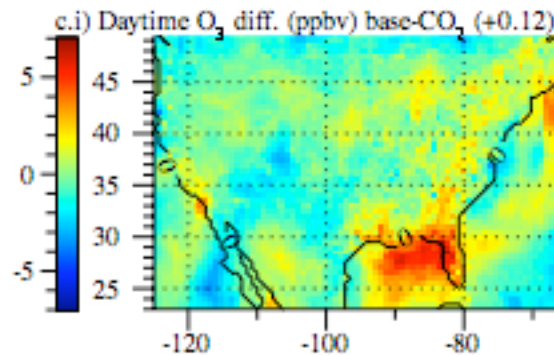


This result implies immediately that higher temperatures and water vapor should increase ozone where it is already high. It is also known that California has six of 10 most polluted cities in the U.S. with respect to ozone: Los Angeles, Visalia-Porterville, Bakersfield, Fresno, Merced, and Sacramento, so it is expected from this result alone that a warmer planet should increase ozone pollution in California more than in the U.S. as a whole.

The next step was to evaluate whether carbon dioxide could trigger the temperature and water vapor changes sufficient to affect ozone when many other processes are considered simultaneously and to evaluate effects in California. For this, a three-dimension global model of the atmosphere that focuses in over the United States was used.

The next figure shows differences in temperature, water vapor, and ozone over the U.S. due solely to historically-emitted fossil-fuel carbon dioxide from the simulations. Carbon dioxide increased near-surface temperatures and water vapor, and both fed back to increase near-surface ozone (Figure 2c), as expected from the previous analysis.





Carbon dioxide similarly increased particles in populated area for several reasons described in the written testimony. The changes in ozone, particles, and carcinogens were combined with population and health-effects data to estimate that carbon dioxide increased the annual U.S. air pollution death rate by about +1000 (+350 to +1800) per 1.8 degrees Fahrenheit (1 K), with about 40% due to ozone. These annual additional deaths are occurring today, as historic temperatures are about 1.5 degrees Fahrenheit (0.85 K) higher than in preindustrial times.

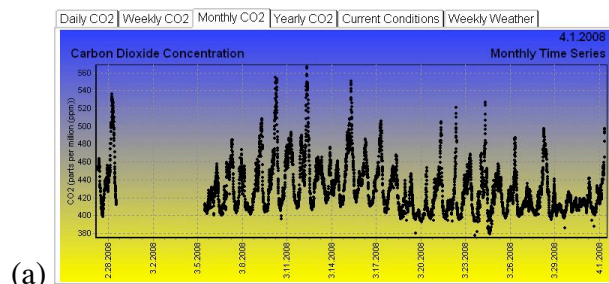
Of the additional deaths, more than 30% (>300) occurred in California, which has only 12% of the U.S. population. As such, the death rate per capita in California was over 2.5 times the national average death rate per capita due to carbon dioxide-induced air pollution.

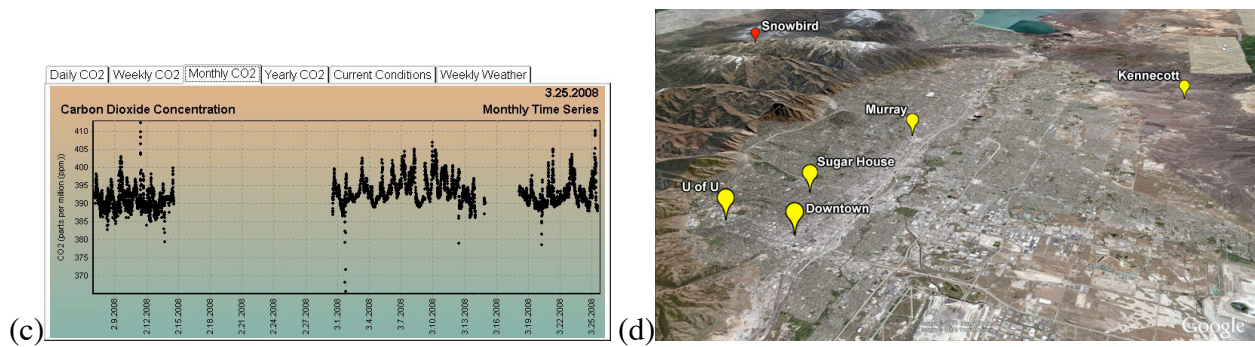
A simple extrapolation from U.S. to world population (301.5 to 6600 million) gives 21,600 (7400-39,000) deaths/yr worldwide per 1 K due to carbon dioxide. Carbon dioxide increased carcinogens, but the increase was small.

Impacts of California Carbon Dioxide

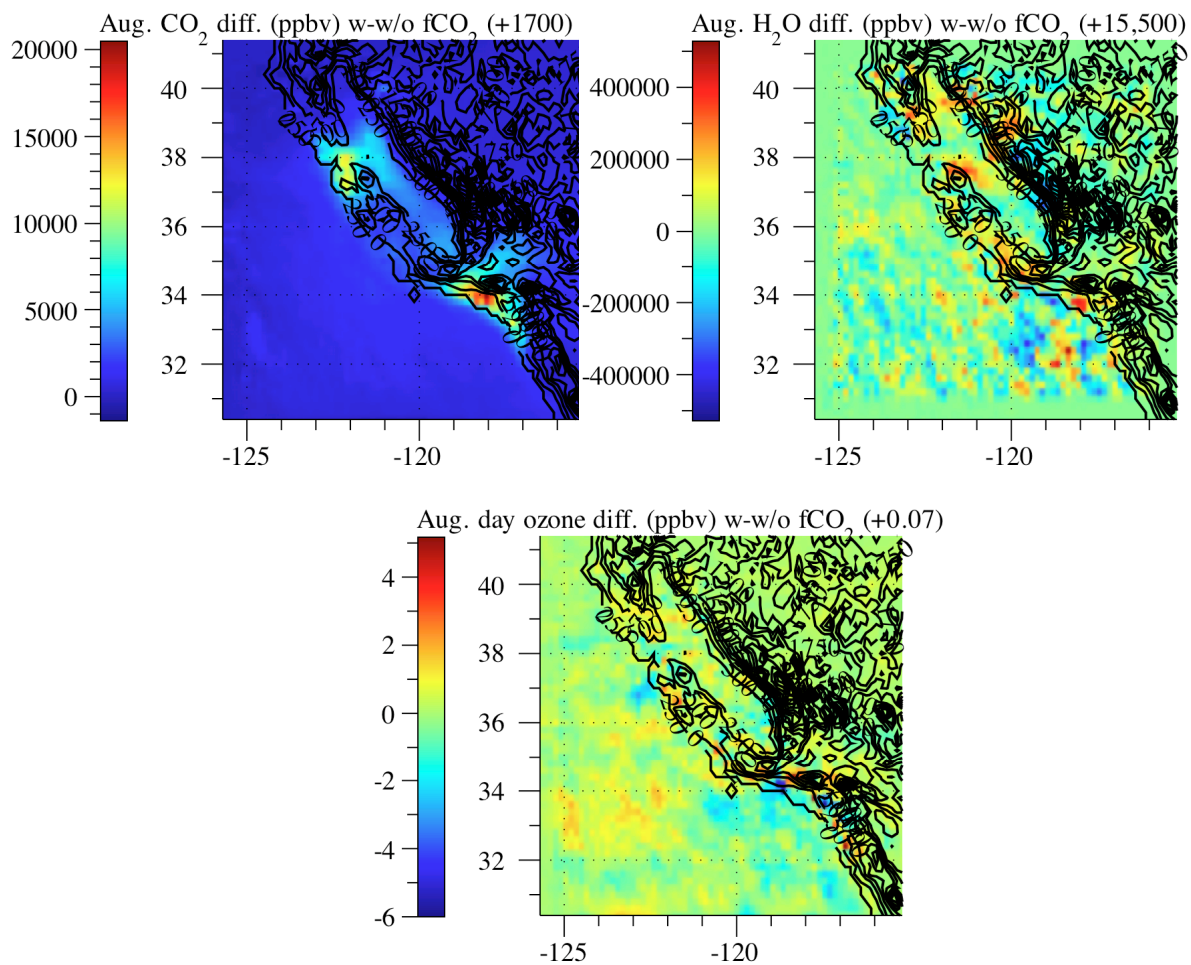
Next, let's examine the effect of controlling California's carbon dioxide as if its local emissions instantaneously mixed globally, which it does not. In such a case, controlling local carbon dioxide in California still reduces the air-pollution-related death and illness rate in California at a rate 2.5 times greater per capita than it reduces the death rate in the U.S. as a whole.

However, carbon dioxide emissions do not immediately mix globally. Instead, carbon dioxide levels in polluted cities are much higher than the global average, as shown with data in the figure now on the screen. Although the global background carbon dioxide is currently about 385 ppmv, the data indicate that a medium-sized city's downtown area can have an average of 420-440 ppmv and a peak of over 500 ppmv carbon dioxide.



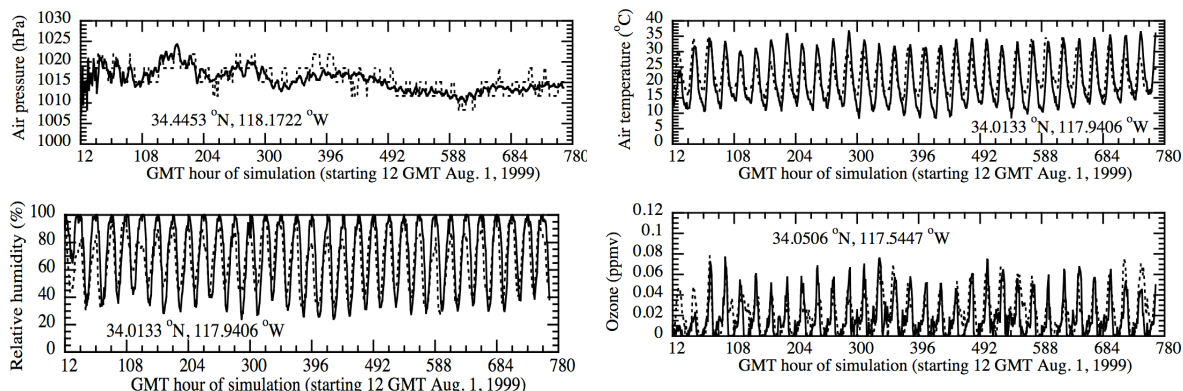


The figure now on the screen shows computer-modeled changes in carbon dioxide in California for a month of August due solely to local carbon dioxide emissions. The elevated carbon dioxide over the urban areas is consistent with the expectations from data.



The increases in local carbon dioxide led to increases in water vapor and ozone over California. Since carbon dioxide emissions outside of the grids shown were not perturbed for the simulations, the simulations demonstrate that the effects on ozone found here were due solely to locally-emitted carbon dioxide. In sum, locally-emitted carbon dioxide is a fundamental causal factor of air pollution in California.

The final slide compares modeled and measured parameters over each hour of a month and demonstrates the ability of the computer model used for this study to predict weather and pollution at specific times and locations.



Conclusions

In sum, this analysis finds the following:

- Global warming due specifically to carbon dioxide currently increases the air-pollution-related death rate of people in California more than it increases the death rate of people in the United States as a whole, relative to their respective populations. The reason is that higher temperatures and water vapor due to carbon dioxide increase pollution the most where it is already high, and California has six of the ten most-polluted cities in the United States. The deaths are currently occurring and will occur more as temperatures increase in the future.
- Controlling carbon dioxide from California will reduce the air-pollution-related death and illness rate in California 2.5 times faster than it will reduce the death rate of the U.S. as a whole.
- Carbon dioxide levels in cities are higher than in the global atmosphere. Such elevated levels of carbon dioxide were found to increase ozone in California. As such, locally-emitted carbon dioxide is a causal factor in increasing local air pollution.

These results contradict the main assumptions made by Mr. Johnson in his stated decision, namely (a) there is no difference in the impact of globally-emitted carbon dioxide on California versus U.S. health and (b) locally-emitted carbon dioxide does not affect California's air pollution any more than does carbon dioxide emitted anywhere else in the world. I am unaware of any scientific publication that supports either assumption.

Thank you for considering my testimony.