Washington, DC 20004

(Woodies Building / metro stop: Metro Center)

Ben DeAngelo Darrell, Doug, Wanted to send a heads... 11/16/2009 08:42:01 PM

From: Ben DeAngelo/DC/USEPA/US
To: Darrell Winner/DC/USEPA/US@EPA, Doug Grano/RTP/USEPA/US@EPA
Cc: Michael Kolian/DC/USEPA/US@EPA
Date: 11/16/2009 08:42 PM
Subject: may need to confer on air quality endangerment comments again over next day or two

Darrell, Doug,

Wanted to send a heads up for now that we [redacted] (b)(5) Deliberative [redacted] But plan to send to you shortly with a more finite set of places where we'll want your input.

thanks!

Benjamin J. DeAngelo
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U.S. Environmental Protection Agency
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Washington, DC 20460

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Fax: +1 202-343-2202
deangelo.ben@epa.gov

EPA-1768

Michael Kolian/DC/USEPA/US
11/18/2009 08:12 AM

To Jason Samenow
cc Ben DeAngelo, David Chalmers, Jeremy Martinich, Marcus Sarofim, Rona Birnbaum, William Perkins
bcc
Subject Re: action required: monckton's 50 red flags

I scrubbed this one but I will double check.

Jason Samenow Team-- Having reviewed Monckton's... 11/17/2009 08:44:08 PM

From: Jason Samenow/DC/USEPA/US
To: Marcus Sarofim/DC/USEPA/US@EPA, David Chalmers/DC/USEPA/US@EPA, Jeremy Martinich/DC/USEPA/US@EPA, Michael Kolian/DC/USEPA/US@EPA
Cc: Rona Birnbaum/DC/USEPA/US@EPA, Ben DeAngelo/DC/USEPA/US@EPA, William Perkins/DC/USEPA/US@EPA
Date: 11/17/2009 08:44 PM
Subject: action required: monckton's 50 red flags

Team--

Having reviewed Monckton's 50 red flags that were submitted (see: http://scienceandpublicpolicy.org/images/stories/papers/reprint/markey_and_barton_letter.pdf) , I think [redacted]

Note to Bill-- I do not think [redacted] (b)(5) Deliberative

Note this is comment #: 0700.1 (and several other commenters refer to this Monckton document (3569.1, 0591, 0482.1, 3906)

[redacted] (b)(5) Deliberative

Here's my take on what needs to be done:

[redacted] (b)(5) Deliberative

(b)(5) Deliberative

EPA-1769

Rona Birnbaum/DC/USEPA/US
11/18/2009 10:10 AM

To Marcus Sarofim, David Chalmers
cc
bcc
Subject Vol 4 - more still coming from me

will need to revise today to give to Dina tonight/tomorrow. Also, I may have suggested (b)(5) Deliberative [redacted] ...please modify accordingly.
thanks!!

(b)(5) Deliberative [redacted]
RTC draft Volume 4 Future Projections 110609.RB comments.doc

EPA-1770

David Chalmers/DC/USEPA/US
11/18/2009 10:35 AM

To Jeremy Martinich
cc
bcc
Subject comments for volume 7

Jeremy:

The below two comments were in Volume 4 but I'm thinking they are better included in volume 7 as they deal more with impacts. Can you please add them to that volume? Thanks!

Comment:

(b)(5) Deliberative

Response:

(b)(5) Deliberative

Comment:

(b)(5) Deliberative

Response:

(b)(5) Deliberative

David Chalmers
ORISE Fellow
U.S. EPA, Climate Change Division
202.343.9814

EPA-1771

Lesley Jantarasami/DC/USEPA/US
11/18/2009 11:24 AM

To Carol Holmes
cc
bcc
Subject vol 12

(b)(5) Deliberative

RTC draft Volume 12 Implications 111609.doc

EPA-1772

Jason Samenow/DC/USEPA/US
11/18/2009 11:46 AM

To Ben DeAngelo
cc
bcc
Subject Fw: Volume 10

I had crafted a response to the comment you indicated was blank (there is at least an attempt at a response for every comment)... and spent quite a number of hours on working this volume. Please be sure you are working from this version sent Sunday evening.

Jason
----- Forwarded by Jason Samenow/DC/USEPA/US on 11/18/2009 11:44 AM -----

From: Jason Samenow/DC/USEPA/US
To: Rona Birnbaum/DC/USEPA/US@EPA
Cc: Ben DeAngelo/DC/USEPA/US@EPA
Date: 11/15/2009 06:44 PM
Subject: Volume 10

Rona-- Here is Volume 10.... I'd characterize this as a "rough" draft as I wasn't able to Q/C everything as well as I would've liked, and there is probably some merging of like comments/responses that can still be done. But wanted to get this to you so you can start reviewing and get in front of Dina. Also, we had told Carol that we'd share this with her soon so she could get a sense of what we've done and the gaps they need to fill. But we might want to do a little more Q/C before doing so. I will leave it to you whether to send this to her now or wait a day or two, so we can collectively polish this up a little.

I think it will be particularly important for this Volume to go back through the major comment sets and the comment database to be sure we haven't missed anything important.

Thanks....

Jason

(b)(5) Deliberative

RTC draft Volume 10 Endangerment 111309 JPS.doc

EPA-1773

Ben DeAngelo/DC/USEPA/US
11/18/2009 11:50 AM

To Carol Holmes
cc
bcc
Subject rough 11

(b)(5) Deliberative

RTC draft Volume 11 Cause or Contribute 111709 BJD.doc

EPA-1774

Suzanne Kocchi/DC/USEPA/US
11/18/2009 11:53 AM

To Marcus Sarofim, David Chalmers, Jeremy Martinich, Michael Kolian, Rona Birnbaum, Ben DeAngelo, William Perkins, Jason Samenow, Lesley Jantarasami
cc
bcc
Subject updated schedule

FYI - I just updated this slightly based on the status of docs as of 11:30 am today. This will likely need to be updated daily, (b)(5) Deliberative

(b)(5) Deliberative

Review Table_Endangerment 111809.xls

EPA-1775

Jeremy Martinich
04/01/2010 01:29 PM

To
cc
bcc
Subject UPLOAD G:\CCD\CSIB\Martinich\Endangerment\Endangerment\Comment Sections\Final versions\Volumes\Old versions\RTC draft Volume 1 General TSD Approach 11-16-09.doc

(b)(5) Deliberative - RTC draft Volume 1 General TSD Approach 11-16-09.doc

EPA-1776

Ben DeAngelo/DC/USEPA/US
11/18/2009 12:00 PM

To Carol Holmes
cc
bcc
Subject rough 10

Here's the version that Jason had been working on -- I'll be working off of this.

(b)(5) Deliberative

RTC draft Volume 10 Endangerment 111309 JPS.doc

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deangelo.ben@epa.gov

EPA-1777

Jason Samenow/DC/USEPA/US
11/18/2009 12:10 PM

To David Chalmers
cc
bcc
Subject Fw: half of Vol 2 reviewed

----- Forwarded by Jason Samenow/DC/USEPA/US on 11/18/2009 12:10 PM -----

From: Marcus Sarofim/DC/USEPA/US
To: Jason Samenow/DC/USEPA/US@EPA
Date: 11/13/2009 04:42 PM
Subject: Re: Fw: half of Vol 2 reviewed

Done. With one exception [redacted] (b)(5) Deliberative [redacted]

[redacted] (b)(5) Deliberative [redacted]

RTC draft Volume 2 Validity of Data.RB comments.110609.mcs.doc

Marcus C. Sarofim, PhD
phone: 202-343-9993
fax: 202-343-2202
1310 L Street 256C
AAAS Science & Technology Policy Fellow
with the EPA Climate Division

Jason Samenow marcus-- can you please address ron... 11/13/2009 12:25:10 PM

From: Jason Samenow/DC/USEPA/US
To: Marcus Sarofim/DC/USEPA/US@EPA
Date: 11/13/2009 12:25 PM
Subject: Fw: half of Vol 2 reviewed

marcus-- can you please address [redacted] (b)(5) Deliberative [redacted] and then send back to me?

thanks,
jason

----- Forwarded by Jason Samenow/DC/USEPA/US on 11/13/2009 12:24 PM -----

From: Rona Birnbaum/DC/USEPA/US
To: Jason Samenow/DC/USEPA/US@EPA
Cc: Lesley Jantarasami/DC/USEPA/US@EPA
Date: 11/13/2009 11:42 AM
Subject: half of Vol 2 reviewed

still working on 2nd half

[attachment "RTC draft Volume 2 Validity of Data.RB comments.110609.doc" deleted by Marcus Sarofim/DC/USEPA/US]

EPA-1778

Carol Holmes/DC/USEPA/US
11/18/2009 12:28 PM

To Ben DeAngelo
cc Lesley Jantarasami
bcc
Subject Re: rough 10

Thanks. My stuff made it in, but it looks y'all are still organizing the summaries from the preamble that John did (e.g., 10.2 all seems to come after 10.2.3?)

Also, there were excerpts in the portion Gautam read that I am not sure I've sent to y'all before, but it looks like OAR issues, agree?

(b)(5) Deliberative

Commenter Name: Roger Dart
Commenter Affiliation: None
Commenter Type:
Document Control Number: EPA-HQ-OAR-2009-0171-3373_CP Comment Excerpt Number: 1
Form Letter? Yes
Late Comment? No
Comment Changed? No
There is little evidence for the claim that greenhouse gas emissions endanger public health and welfare. In fact, historical data show the opposite. Over the past 100 years, as temperature and greenhouse gas concentrations have increased, global GDP has increased 18 fold, average life span has doubled, and per capita food supplies have increased even as global population has quadrupled. In this case, and many others, EPA should examine actual data instead of relying on projections from models. EPA argues the Clean Air Act is precautionary in nature. This is true, but EPA should not regulate greenhouse gases without compelling information that greenhouse gas are causing harm to public health and welfare. This information does not exist today.

Commenter Name: Doug Rogers
Commenter Affiliation: Marathon Oil Corporation
Commenter Type:
Document Control Number: EPA-HQ-OAR-2009-0171-3433.1 Comment Excerpt Number: 2
Form Letter? Yes
Late Comment? No
Comment Changed? No
The EPA has not provided enough data to support its findings on health effects and welfare effects - The EPA has found GHG emissions from mobile sources to be a danger to both human health and welfare. Traditionally, the EPA has only considered direct health effects in making an endangerment finding. In this proposal, the EPA presents five health concerns, none of which are direct health effects, and none which are a result from direct exposure to GHG [Legal point addressed.]. In addition, the EPA does not quantify any of the risks associated with these concerns. Before making an endangerment finding based on the effects on human health, the EPA must be more rigorous in determining direct health effects, citing studies that link these effects to GHG exposure, and quantifying risks to human health. As to whether changes to

climate and weather fall under human welfare effects, the EPA does not provide conclusive documentation on how it arrived at its human welfare finding, or provide any quantitative analysis on the risks to human welfare. The EPA must also conclusively link climate change to anthropogenic GHG emissions. The welfare concerns the EPA has presented may be caused through natural events, natural sources of GHG, or general human activities such as changes in agriculture or population migration. Again, the EPA must be more rigorous in presenting evidence to support the effects on human welfare and quantifying risks to human welfare.

COMMENTS [redacted] (b)(5) Deliberative

Commenter Name: Stu Clark and Larry Greene
Commenter Affiliation: National Association of Clean Air Agencies Commenter Type:
Document Control Number: EPA-HQ-OAR-2009-0171-3529.1 Comment Excerpt Number: 1
Form Letter? Yes
Late Comment? No
Comment Changed? No
We agree with EPA that GHGs endanger both public health and welfare. While GHGs at current and projected concentrations in the atmosphere do not directly affect public health, they do so indirectly. In its Federal Register notice, EPA states that the impacts of global warming include more frequent heat waves and unusually hot days and nights, increases in regional ozone pollution, and an increase in the spread of several food and water-borne pathogens. All of these changes induced by global warming cause mild and potentially severe health effects, including death. In fact, health effects are specifically mentioned in the IPCC's Synthesis Report as one of the impacts of global warming. In short, we could not say it better than EPA has: "[m]ortality and morbidity that result from the effects of climate change are clearly public health problems."4
[Footnote 4: 74 Federal Register at 18902.]

[redacted] (b)(5) Deliberative

Commenter Name: Jorge Vazquez
Commenter Affiliation: None
Commenter Type:
Document Control Number: EPA-HQ-OAR-2009-0171-0425 Comment Excerpt Number: 2
Form Letter? Yes
Late Comment? No
Comment Changed? No
Increased levels of Carbon Dioxide lead to increased bio-productivity. All forms of life will become more abundant if there is a significant rise in CO2. Furthermore, additional heat allows more of the earths surface to be habitated by life (which release CO2 as part of their respitory process.

Issue raised: Higher CO2 levels could be beneficial. OAR response.

Commenter Name: Bethany Cole
Commenter Affiliation: None

Commenter Type:
Document Control Number: EPA-HQ-OAR-2009-0171-0468 Comment Excerpt Number: 1
Form Letter? Yes
Late Comment? No
Comment Changed? No
C02 is a plant food and right now in our planets history we are near the bare minimum for plant life to survive. C02 also follows temperature fluctuations by around 800 years which doesn't seem to compute with the mantra of today's Anthropogenic Global Warming. Gardeners and greenhouse owners purchase C02 to help plants and vegetables grow larger and quicker with less water and fertilizer. (see links below about C02 sales for gardeners and the scientific research on how helpful it is). http://www.advancegreenhouses.com/use_of_co2_in_a_greenhouse. htm
http://www.homeharvest.com/carbondioxideenrichment.htm

Issue raised: CO2 helps plants grow. OAR response.

Commenter Name: Scott Heidenreich
Commenter Affiliation: None
Commenter Type:
Document Control Number: EPA-HQ-OAR-2009-0171-0589 Comment Excerpt Number: 1
Form Letter? Yes
Late Comment? No
Comment Changed? No
I request US EPA to focus its attention on other air, land, and water pollutants with real toxicity and that cause real damage rather than carbon dioxide and methane. As an environmental scientist, I find it continually frustrating that billions of dollars (trillions if USEPA continues along this path) are diverted from being used to regulate and reduce real known threats to public health and the environment, to regulating compounds that have little if any proven impact on public health and the environment. USEPA should instead focus on requiring proper management and reduction in sources of ground water contamination and surface water contamination such as industrial waste and construction and demolition debris; focus on developing a national ground water protection strategy, and focus on preventing invasive species from being imported into this country. All of which are doing far more documented damage to public health and the environment than are carbon dioxide or methane. In addition, nuisance odors, the negative health effects, and adverse effects to vegetation by such compounds as hydrogen sulfide, mercury, pharmaceuticals, fugitive dust, and numerous others released by open burning of garbage and tires, municipal sewage treatment plants, combined sewer overflows, MSW landfills, industrial processes, and run-off from combined sewers and agricultural activities pose much more present and real dangers to public health and the environment than carbon dioxide and methane will ever. I agree that our electric generation in this country needs to be moved away from coal not because of the air pollution they produce (this can be satisfactorily controlled) but because these plants produce hundreds of millions of tons of ash and FGD which are disposed in enormous retention ponds and landfills that spread over hundreds and hundreds of acres near rivers and over important ground water supplies. In addition, the habitat destruction for even one of these landfills is enormous. In summary, please focus governmental (by budget and policy) and private money (through regulation) on dealing with numerous already known threats to public health and the environment rather than on carbon dioxide and methane.

Issue raised: EPA should focus its efforts/resources on other problems that are more immediate and harmful. OAR response.

Commenter Name: David Lehmuller
Commenter Affiliation: None
Commenter Type:
Document Control Number: EPA-HQ-OAR-2009-0171-0800.1 Comment Excerpt Number: 2
Form Letter? Yes
Late Comment? No
Comment Changed? No
I am very concerned about the scientific aspects of your proposal, in particular where you are advocating that greenhouse gases are causing climate change, and as such are therefore creating adverse effects upon public health. A) Definitions for my comments: 1) Climate – (verbatim from the IPCC): Climate in a narrow sense is usually defined as the "average weather," or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. The classical period is 30 years, as defined by the World Meteorological Organization (HTUWMOUTH). These quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is the state, including a statistical description, of the climate system. 2) Climate System – (verbatim from the AMS): The system consisting of the atmosphere, hydrosphere, lithosphere, and biosphere, determining the Earth's climate as the result of mutual interactions and responses to external influences (forcing). Physical, chemical, and biological processes are involved in interactions among the components of the climate system. 3) Climate Change – (verbatim from the AMS): TAny systematic change in the long-term statistics of climate elements (such as temperature, pressure, or winds) sustained over several decades or longer. Climate change may be due to natural external forcings, such as changes in solar emission or slow changes in the earth's orbital elements; natural internal processes of the climate system; or anthropogenic forcing. Climate is a complex entity, but it only has factual meaning on a local basis or localized region. There is no such thing as the Earth's climate or global climate; such concepts have no real meaning. (In the same vein, the average temperature of the Earth has no meaning – it exists nowhere.) There is no single climate for the United States. A local or regional climate is described by historically evaluating its Climate System over an extended period of time. In such an analysis, the different parameters must all be assessed: atmosphere (temperature, rainfall, relative humidity, wind patterns, aerosols, etc.), water bodies of size (nearby oceans including their temperatures, ocean currents, ice sheets, glaciers, large lakes and their temperatures, etc.), topography (mountains, prairies, deserts, urban areas, etc.), and vegetation (forests, agriculture, grasslands, etc.) Major deficiencies in the EPA Proposal: The EPA Proposal does not address the various climates occurring within the United States. No local or regional climates in the United States are specified or defined. In other words, there are no climates in the United States that are delineated such that Climate Change can be measured over time and therefore assessed. Temperature does not define Climate, nor does measurement of greenhouse gases; i.e., global warming does not equate with Climate Change because Climate is a local/regional phenomenon. There is no evidence that Climate Change uniformly/equally affects all parts of the Earth at the same time. How can Climate Change be measured in the United States without a defined Climate scheme? (In science, this is analogous to concepts of calibration

and standardization.) The climates occurring within the United States are unique to the United States, and only the United States can assess these climates, the climate changes, and the associated impacts upon public welfare within its boundaries; the IPCC cannot make such assessments. Recommendations: Define a climate scheme to divide the United States into a practical network of relatively homogenous climate systems. This may best be handled for data networks if the climate units represent single states or groups of contiguous states. Since the states provide statistical information to various government agencies (such as CDC, USDA, NWS, etc.), it should be easier to coordinate the climate data and the public welfare data when the basic unit is an intact state or group of states. Decide what climate parameters are to be monitored with respect to the various climates, such as temperature averages and extremes, rainfall patterns and extremes such as droughts and floods, extreme weather events such as tornadoes and hurricanes, humidity, snowfall, wildfire occurrences, sea level changes, land erosion, beach erosion, urbanization, etc. Upgrade the existing network of weather reporting stations and require uniform standards for measuring and reporting meteorological data, including a system of instrument calibration. (There are major deficiencies in this realm which I feel certain other respondents will address. There may also be deficiencies in the weather satellite system due to aging and sensor decay that may need to be addressed.) Decide what potential adverse impacts on the public welfare are to be monitored, such as morbidity and mortality and their various causes, contagious disease outbreaks, destructive events related to adverse weather, effects upon crop production and animal husbandry and forestry activities, etc. Establish a coordinating board to gather and assimilate the various data collections and establish accurate trend monitoring. This board would also need to be in communication with various scientific entities that gather and analyze more sophisticated data (forcings) that may be affecting Climate Change. [Also coded as 5.3]

Issue raised: EPA should not discuss climate change on a national or global scale but should focus on regional climates and regional effects. OAR response.

Commenter Name: David Berends
Commenter Affiliation: None
Commenter Type:
Document Control Number: EPA-HQ-OAR-2009-0171-2057 Comment Excerpt Number: 5
Form Letter? Yes
Late Comment? No
Comment Changed? No
The finding is based on the assumption that the present climate is the ideal climate and any change to this climate by warming will have negative effects. What basis was used in determining that the present temperatures are more beneficial than potentially warmer temperatures? What methodology was used in coming to this conclusion? Are these assumptions all based on unproven models?

Issue raised: Why is EPA concluding a warmer climate is worse than the current climate? OAR response.

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Fax (202) 564-5603

Ben DeAngelo Here's the version that Jason had been... 11/18/2009 12:00:16 PM

From: Ben DeAngelo/DC/USEPA/US
To: Carol Holmes/DC/USEPA/US@EPA
Date: 11/18/2009 12:00 PM
Subject: rough 10

Here's the version that Jason had been working on -- I'll be working off of this.

[attachment "RTC draft Volume 10 Endangerment 111309 JPS.doc" deleted by Carol Holmes/DC/USEPA/US]

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EPA-1779

Suzanne Kocchi/DC/USEPA/US
11/18/2009 12:32 PM

To William Perkins
cc Lesley Jantarasami
bcc
Subject Re: updated schedule

Yes, I think [redacted] (b)(5) Deliberative [redacted]

William Perkins Suzie, Quick question: we are planning... 11/18/2009 12:28:19 PM

From: William Perkins/DC/USEPA/US
To: Suzanne Kocchi/DC/USEPA/US@EPA
Cc: Lesley Jantarasami/DC/USEPA/US@EPA
Date: 11/18/2009 12:28 PM
Subject: Re: updated schedule

Suzie,

Quick question: we are planning [redacted] (b)(5) Deliberative [redacted] Thanks.

Bill

Bill Perkins
Climate Change Adaptation Analyst
Climate Science and Impacts Branch
Climate Change Division
U.S. Environmental Protection Agency
perkins.william@epa.gov
(O) 202.343.9460
(F) 202.343.2202
(C) [redacted] (b)(6)

Suzanne Kocchi FYI - I just updated this slightly based... 11/18/2009 11:53:44 AM

From: Suzanne Kocchi/DC/USEPA/US
To: Marcus Sarofim/DC/USEPA/US@EPA, David Chalmers/DC/USEPA/US@EPA, Jeremy Martinich/DC/USEPA/US@EPA, Michael Kolian/DC/USEPA/US@EPA, Rona Birnbaum/DC/USEPA/US@EPA, Ben DeAngelo/DC/USEPA/US@EPA, William Perkins/DC/USEPA/US@EPA, Jason Samenow/DC/USEPA/US@EPA, Lesley Jantarasami/DC/USEPA/US@EPA
Date: 11/18/2009 11:53 AM
Subject: updated schedule

FYI - I just updated this slightly based on the status of docs as of 11:30 am today. This will likely need to be updated daily, [redacted] (b)(5) Deliberative

[attachment "Review Table_Endangerment 111809.xls" deleted by William Perkins/DC/USEPA/US]

EPA-1780

Carol Holmes/DC/USEPA/US
11/18/2009 12:46 PM

To Lesley Jantarasami
cc
bcc
Subject V12

I will be working on V9 today, so you can upload this version of 12 if you want.

(b)(5) Deliberative [redacted]

RTC draft Volume 12 Implications 11 17 09.doc

Confidential communication for internal deliberations only; Attorney-client, attorney work product and/or enforcement privilege; Do not distribute outside EPA or DOJ

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EPA-1781

Ben DeAngelo
04/06/2010 04:56 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\owner\My Documents\Endangerment\Response to Public Comments\RTC draft Volume 10 Endangerment 111309 JPS.doc

(b)(5) Deliberative - RTC draft Volume 10 Endangerment 111309 JPS.doc

EPA-1782

William Perkins/DC/USEPA/US
11/18/2009 01:48 PM

To Jason Samenow
cc Ben DeAngelo, David Chalmers, Jeremy Martinich, Lesley Jantarasami, Marcus Sarofim, Michael Kolian, Rona Birnbaum
bcc
Subject 1 of 3: [redacted] (b)(5) Deliberative

All,

Enclosed are the comment files for those, in 3 emails. Also on share drive at:
[redacted] not responsive

Cheers,

Bill

[redacted] (b)(5) Deliberative

EPA-HQ-OAR-2009-0171-3411.2.pdf
EPA-HQ-OAR-2009-0171-3722.pdf
EPA-HQ-OAR-2009-0171-3747.1.pdf
EPA-HQ-OAR-2009-0171-4003.pdf
EPA-HQ-OAR-2008-0318-1499.1.pdf
EPA-HQ-OAR-2009-0171-3187.1.pdf
EPA-HQ-OAR-2009-0171-3187.2.pdf
EPA-HQ-OAR-2009-0171-3187.3.pdf
EPA-HQ-OAR-2009-0171-3187.4.pdf


EPA-HQ-OAR-2009-0171-3187.5.pdf


EPA-HQ-OAR-2009-0171-3215.1.pdf


EPA-HQ-OAR-2009-0171-3316.1.doc


EPA-HQ-OAR-2009-0171-3394.1.pdf


EPA-HQ-OAR-2009-0171-3411.1.pdf

available at regulations.gov

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(C) (b)(6)

Jason Samenow Here were my thoughts: (b)(5) Deliberative 11/10/2009 04:02:02 PM

From: Jason Samenow/DC/USEPA/US
To: Lesley Jantarasami/DC/USEPA/US@EPA, Ben DeAngelo/DC/USEPA/US@EPA, David Chalmers/DC/USEPA/US@EPA, Jeremy Martinich/DC/USEPA/US@EPA, Marcus Sarofim/DC/USEPA/US@EPA, Michael Kolian/DC/USEPA/US@EPA, Rona Birnbaum/DC/USEPA/US@EPA, William Perkins/DC/USEPA/US@EPA
Date: 11/10/2009 04:02 PM
Subject: Major comment sets (b)(5) Deliberative

Here were my thoughts:

(b)(5) Deliberative

EPA-1783

William Perkins/DC/USEPA/US
11/18/2009 01:49 PM

To Jason Samenow
cc Ben DeAngelo, David Chalmers, Jeremy Martinich, Lesley Jantarasami, Marcus Sarofim, Michael Kolian, Rona Birnbaum
bcc
Subject 2 of 3: [redacted] (b)(5) Deliberative

Also on share drive at: [redacted] not responsive

[redacted]

(b)(5) Deliberative

[redacted]

EPA-HQ-OAR-2009-0171-3324.1-1.pdf
EPA-HQ-OAR-2009-0171-3440.1.pdf
EPA-HQ-OAR-2009-0171-3446.1.pdf
EPA-HQ-OAR-2009-0171-3498.1.pdf
EPA-HQ-OAR-2009-0171-3509.1.pdf
EPA-HQ-OAR-2009-0171-3535.1.pdf
EPA-HQ-OAR-2009-0171-3535.pdf
EPA-HQ-OAR-2009-0171-11465.1.pdf
EPA-HQ-OAR-2009-0171-0700.1.pdf
EPA-HQ-OAR-2009-0171-3291.1.pdf

available at regulations.gov

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(C) (b)(6)

Jason Samenow Here were my thoughts: (b)(5) Deliberative 11/10/2009 04:02:02 PM

From: Jason Samenow/DC/USEPA/US
To: Lesley Jantarasami/DC/USEPA/US@EPA, Ben DeAngelo/DC/USEPA/US@EPA, David Chalmers/DC/USEPA/US@EPA, Jeremy Martinich/DC/USEPA/US@EPA, Marcus Sarofim/DC/USEPA/US@EPA, Michael Kolian/DC/USEPA/US@EPA, Rona Birnbaum/DC/USEPA/US@EPA, William Perkins/DC/USEPA/US@EPA
Date: 11/10/2009 04:02 PM
Subject: Major comment sets (b)(5) Deliberative

Here were my thoughts:

(b)(5) Deliberative

EPA-1784

William Perkins/DC/USEPA/US
11/18/2009 01:49 PM

To Jason Samenow
cc Ben DeAngelo, David Chalmers, Jeremy Martinich, Lesley Jantarasami, Marcus Sarofim, Michael Kolian, Rona Birnbaum
bcc
Subject 3 of 3: [redacted] (b)(5) Deliberative

Also on share drive at: [redacted] not responsive

[redacted] (b)(5) Deliberative

EPA-HQ-OAR-2009-0171-3330.1.pdf
EPA-HQ-OAR-2009-0171-3596.1.pdf
EPA-HQ-OAR-2009-0171-3596.2.pdf
EPA-HQ-OAR-2009-0171-3596.3.pdf
EPA-HQ-OAR-2009-0171-3214.1.pdf
EPA-HQ-OAR-2009-0171-3214.2.pdf

available at regulations.gov

Bill Perkins
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Climate Science and Impacts Branch
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U.S. Environmental Protection Agency
perkins.william@epa.gov
(O) 202.343.9460
(F) 202.343.2202
(C) [redacted] (b)(6)

Jason Samenow Here were my thoughts: (b)(5) Deliberative 11/10/2009 04:02:02 PM

From: Jason Samenow/DC/USEPA/US
To: Lesley Jantarasami/DC/USEPA/US@EPA, Ben DeAngelo/DC/USEPA/US@EPA, David Chalmers/DC/USEPA/US@EPA, Jeremy Martinich/DC/USEPA/US@EPA, Marcus Sarofim/DC/USEPA/US@EPA, Michael Kolian/DC/USEPA/US@EPA, Rona Birnbaum/DC/USEPA/US@EPA, William Perkins/DC/USEPA/US@EPA
Date: 11/10/2009 04:02 PM
Subject: Major comment sets (b)(5) Deliberative

Here were my thoughts:

(b)(5) Deliberative

EPA-1785

William Perkins/DC/USEPA/US
11/18/2009 01:52 PM

To perkins.william
cc
bcc
Subject volume 8 backup

(b)(5) Deliberative

RTC Volume 8 Dina's incorporated - 111709.doc

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(C) (b)(6)

EPA-1786

Jason Samenow/DC/USEPA/US
11/18/2009 02:14 PM

To Jeremy Martinich
cc
bcc
Subject Re: SPM comment

I think we should incorporate something like:

(b)(5) Deliberative

Jeremy Martinich Comment: (b)(5) Deliberative 11/18/2009 01:18:00 PM

From: Jeremy Martinich/DC/USEPA/US
To: Jason Samenow/DC/USEPA/US@EPA
Date: 11/18/2009 01:18 PM
Subject: SPM comment

Comment:

(b)(5) Deliberative

Response:

(b)(5) Deliberative

(b)(5) Deliberative

****

Jeremy Martinich
USEPA, Climate Change Division
202-343-9871

EPA-1787

Ben DeAngelo/DC/USEPA/US
11/18/2009 02:29 PM

To Jeremy Martinich
cc Lesley Jantarasami, Jason Samenow
bcc
Subject some edits on climate v. non-climate comment/response

(b)(5) Deliberative

Consideration of non-climate effects 111809 BJD.doc

EPA-1788

Rona Birnbaum/DC/USEPA/US
11/18/2009 02:57 PM

To Marcus Sarofim, David Chalmers
cc
bcc
Subject Vol 4

(b)(5) Deliberative

(b)(5) Deliberative

RTC draft Volume 4 Future Projections 110609.RB comments.doc

EPA-1789

Jason Samenow/DC/USEPA/US
11/18/2009 03:04 PM

To Rona Birnbaum
cc Jeremy Martinich
bcc
Subject action required: review of new uncertainty comments in volume 1

(b)(5) Deliberative

new uncertainty comment-responses.doc

EPA-1790

Marcus Sarofim/DC/USEPA/US
11/18/2009 03:05 PM

To David Chalmers
cc Rona Birnbaum
bcc
Subject first comment in volume 4...

[redacted] (b)(5) deliberative

(b)(5) Deliberative [redacted]
Volume4firstcommentreplacement.doc

I'll keep working on the remainder of the document now,

-Marcus

Marcus C. Sarofim, PhD
phone: 202-343-9993
fax: 202-343-2202
1310 L Street 256C
AAAS Science & Technology Policy Fellow
with the EPA Climate Division

EPA-1791

David Chalmers/DC/USEPA/US
11/18/2009 03:06 PM

To William Perkins
cc
bcc
Subject Re: New comments 9.7.15 international impacts

Let's add something along the lines of the following to either 8.2 or 8.3 to address this comment.

Comment:
(b)(5) Deliberative

Response:
(b)(5) Deliberative

Thanks.

David Chalmers
ORISE Fellow
U.S. EPA, Climate Change Division
202.343.9814

William Perkins Bill Perkins Climate Change Adaptation... 11/12/2009 04:48:32 PM

From: William Perkins/DC/USEPA/US
To: David Chalmers/DC/USEPA/US@EPA
Cc: perkins.william@epa.gov
Date: 11/12/2009 04:48 PM
Subject: New comments 9.7.15 international impacts

[attachment "9_7_15_Impacts in Other World Regions.doc" deleted by David Chalmers/DC/USEPA/US]

Bill Perkins
Climate Change Adaptation Analyst
Climate Science and Impacts Branch
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(O) 202.343.9460
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(C) (b)(6)

EPA-1792

Lesley Jantarasami
04/01/2010 03:52 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\ljantara\My Documents\Endangerment\04_Schedule\Review Table_Endangerment 111709_sk.xls

(b)(5) Deliberative - Review Table_Endangerment 111709_sk.xls

EPA-1793

Ben DeAngelo
04/06/2010 04:56 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\owner\My Documents\Endangerment\Response to Public Comments\Consideration of non-climate effects 111809 BJD.doc

(b)(5) Deliberative - Consideration of non-climate effects 111809 BJD.doc

EPA-1794

Ben DeAngelo/DC/USEPA/US
11/18/2009 03:29 PM

To Marcus Sarofim
cc Jason Samenow
bcc
Subject Re: comments from v10 that can be moved to v2 and v3

I think that would work too, (b)(5) Deliberative

Marcus Sarofim (b)(5) Deliberative 11/18/2009 03:26:21 PM

From: Marcus Sarofim/DC/USEPA/US
To: Ben DeAngelo/DC/USEPA/US@EPA
Cc: Jason Samenow/DC/USEPA/US@EPA
Date: 11/18/2009 03:26 PM
Subject: Re: comments from v10 that can be moved to v2 and v3

(b)(5) Deliberative

Marcus C. Sarofim, PhD
phone: 202-343-9993
fax: 202-343-2202
1310 L Street 256C
AAAS Science & Technology Policy Fellow
with the EPA Climate Division

Ben DeAngelo Marcus, Jason, These comments on th... 11/18/2009 03:20:46 PM

From: Ben DeAngelo/DC/USEPA/US
To: Marcus Sarofim/DC/USEPA/US@EPA, Jason Samenow/DC/USEPA/US@EPA
Date: 11/18/2009 03:20 PM
Subject: comments from v10 that can be moved to v2 and v3

Marcus, Jason,

These comments on the temp record and attribution are in volume 10 but, assuming the comments are summarized properly, there's no mention of the findings so these can be treated as tech comments. Thanks.

Comment:

(b)(5) Deliberative

Response:

(b)(5) Deliberative

Comment:

(b)(5) Deliberative

Response:

(b)(5) Deliberative

EPA-1795

William Perkins/DC/USEPA/US
11/18/2009 03:36 PM

To perkins.william
cc
bcc
Subject volume 8 backup

(b)(5) Deliberative

RTC Volume 8 Dina's incorporated - 111809.doc

Bill Perkins
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(C) (b)(6)

EPA-1796

Rona Birnbaum/DC/USEPA/US
11/18/2009 03:45 PM

To Marcus Sarofim
cc
bcc
Subject Fw: Vol 4 found it!!!

meant to send to you too.

----- Forwarded by Rona Birnbaum/DC/USEPA/US on 11/18/2009 03:45 PM -----

From: Rona Birnbaum/DC/USEPA/US
To: David Chalmers/DC/USEPA/US@EPA
Date: 11/18/2009 03:45 PM
Subject: Re: Vol 4 found it!!!

(b)(5) Deliberative

RTC draft Volume 4 Future Projections 111809.RB comments.doc

David Chalmers I don't see any revisions appearing aft... 11/18/2009 03:12:20 PM

From: David Chalmers/DC/USEPA/US
To: Rona Birnbaum/DC/USEPA/US@EPA
Date: 11/18/2009 03:12 PM
Subject: Re: Vol 4

I don't see any revisions appearing after p. 23. Are you sure you sent over the right version?

Thanks,
David

Rona Birnbaum (b)(5) Deliberative 11/18/2009 02:57:12 PM

From: Rona Birnbaum/DC/USEPA/US
To: Marcus Sarofim/DC/USEPA/US@EPA, David Chalmers/DC/USEPA/US@EPA
Date: 11/18/2009 02:57 PM
Subject: Vol 4

(b)(5) Deliberative

[attachment "RTC draft Volume 4 Future Projections 110609.RB comments.doc" deleted by Rona Birnbaum/DC/USEPA/US]

EPA-1797

Suzanne Kocchi/DC/USEPA/US
11/18/2009 03:46 PM

To Carol Holmes, John Hannon
cc Rona Birnbaum, Ben DeAngelo, Dina Kruger
bcc
Subject endangerment RTC review

Carol, John - Our latest RTC review schedule - we would like to discuss at our 4 pm. Thanks- Suzie

(b)(5) Deliberative [redacted]
Review Table_Endangerment 111809.xls

EPA-1798

Rona Birnbaum/DC/USEPA/US
11/18/2009 03:46 PM

To Marcus Sarofim, Jason Samenow
cc David Chalmers
bcc
Subject Re: first comment in volume 4...

thanks. cc'ing Jason on this comment too.

Marcus Sarofim [redacted] 11/18/2009 03:05:22 PM

From: Marcus Sarofim/DC/USEPA/US
To: David Chalmers/DC/USEPA/US@EPA
Cc: Rona Birnbaum/DC/USEPA/US@EPA
Date: 11/18/2009 03:05 PM
Subject: first comment in volume 4...

[redacted]

[attachment "Volume4firstcommentreplacement.doc" deleted by Rona Birnbaum/DC/USEPA/US]

I'll keep working on the remainder of the document now,

-Marcus

Marcus C. Sarofim, PhD
phone: 202-343-9993
fax: 202-343-2202
1310 L Street 256C
AAAS Science & Technology Policy Fellow
with the EPA Climate Division

EPA-1799

Marcus Sarofim
04/01/2010 08:01 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\msarofim\My Documents\WorkFolder\Tsd_Anpr\ResponseToComments\Volumes\RTC draft Volume 4 Future Projections 110609.RB comments-mcs.doc

(b)(5) Deliberative [redacted] - RTC draft Volume 4 Future Projections 110609.RB comments-mcs.doc

EPA-1800

Marcus Sarofim
04/01/2010 08:02 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\msarofim\My Documents\WorkFolder\Tsd_Anpr\ResponseToComments\Volumes\Volume4firstcommentreplacement.doc

(b)(5) Deliberative [redacted] - Volume4firstcommentreplacement.doc

EPA-1801

William Perkins/DC/USEPA/US
11/18/2009 04:15 PM

To Lesley Jantarasami
cc
bcc
Subject Vol. 12 supportive additions

Lesley,

FYI, have asked ERG to have these to us tomorrow [redacted] (b)(5) Deliberative comments for Ch. 12). [redacted] (b)(5) Deliberative [redacted] I will deliver to you as soon as ERG sends them and I review. Thanks.

Bill

Bill Perkins
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(F) 202.343.2202
(C) [redacted] (b)(6)

EPA-1802

Michael Kolian/DC/USEPA/US
11/18/2009 04:19 PM

To Ben DeAngelo, Marcus Sarofim
cc
bcc
Subject vol 5

(b)(5) Deliberative

RTC draft Volume 5 HH and AQ 111809_dk.doc

EPA-1803

Ben DeAngelo
04/06/2010 04:56 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\owner\My Documents\Endangerment\Response to Public Comments\Review Table_Endangerment 111809.xls

(b)(5) Deliberative [redacted] - Review Table_Endangerment 111809.xls

EPA-1804

Jeremy Martinich/DC/USEPA/US
11/18/2009 04:51 PM

To Jason Samenow
cc
bcc
Subject Additions to Volume 2

Hey Jason,

Here are the two DQA additions to Volume 2. I've indicated in the attachment where they should go.

Thanks,
Jeremy

****
Jeremy Martinich
USEPA, Climate Change Division
202-343-9871

(b)(5) Deliberative

DQA additions to Vol. 2.doc

EPA-1805

Marcus Sarofim
04/01/2010 08:02 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\msarofim\My Documents\WorkFolder\Tsd_Anpr\ResponseToComments\Volumes\Volume4-111809-RB-MCS.doc

(b)(5) Deliberative - Volume4-111809-RB-MCS.doc

EPA-1806

Jeremy Martinich/DC/USEPA/US
11/18/2009 05:07 PM

To Marcus Sarofim
cc
bcc
Subject DQA Additions to Your Sections

Hey Marcus,

Here they are. Let me know if you have any questions.

Thanks,
Jeremy

****
Jeremy Martinich
USEPA, Climate Change Division
202-343-9871

(b)(5) Deliberative

DQA additions to Marcus' Volumes.doc

EPA-1807

"Mae Thomas"
<Mae.Thomas@erg.com>
11/18/2009 05:07 PM

To William Perkins
cc "Mae Thomas"
bcc
Subject Group A examples

Bill, I will give you a call about this in just a few minutes.

Thanks
Mae

EPA-HQ-OAR-2009-0171-0199.pdf EPA-HQ-OAR-2009-0171-0147.pdf EPA-HQ-OAR-2009-0171-0152.pdf
EPA-HQ-OAR-2009-0171-0168.pdf EPA-HQ-OAR-2009-0171-0180.pdf EPA-HQ-OAR-2009-0171-0186.pdf
EPA-HQ-OAR-2009-0171-0188.pdf

available at regulations.gov

EPA-1808

William Perkins/DC/USEPA/US
11/18/2009 05:09 PM

To perkins.william
cc
bcc
Subject volume 8 backup

(b)(5) Deliberative

RTC Volume 8 Dina's incorporated - 111809.doc

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(F) 202.343.2202
(C) (b)(6)

EPA-1809

Jeremy Martinich/DC/USEPA/US
11/18/2009 05:10 PM

To Ben DeAngelo
cc Marcus Sarofim
bcc
Subject DQA Addition to C or C Section

Hey Ben,

Here's a DQA addition to the cause or contribute section. I'll stop by to discuss.

Thanks,
Jeremy

****
Jeremy Martinich
USEPA, Climate Change Division
202-343-9871

(b)(5) Deliberative [redacted]

DQA Addition for C and C Section.doc

EPA-1810

Lesley Jantarasami/DC/USEPA/US
11/18/2009 05:13 PM

To Michael Kolian
cc
bcc
Subject bulleted comment

Gracias!

(b)(5) Deliberative

AgComment_Mike.doc

EPA-1811

Grant MacIntyre/DC/USEPA/US
11/18/2009 05:26 PM

To Jeremy Martinich
cc Carol Holmes, Manisha Patel
bcc
Subject Fw: IQA repsonse to comments

Jeremy:

Carol asked me to send this to you - [redacted] (b)(5) AWP [redacted] Please let me know if you have any questions.

Thanks,

Grant B. MacIntyre
U.S. EPA Office of General Counsel
Cross-Cutting Issues Law Office (CCILO)
(202) 564-6165
----- Forwarded by Grant MacIntyre/DC/USEPA/US on 11/18/2009 05:23 PM -----

From: Manisha Patel/DC/USEPA/US
To: Carol Holmes/DC/USEPA/US@EPA
Cc: Grant MacIntyre/DC/USEPA/US@EPA
Date: 11/03/2009 12:46 PM
Subject: IQA repsonse to comments

[redacted] (b)(5) AWP [redacted].
Have to go to get the flu shot, and then staff meeting. Will be available after 2pm if you have quesitons.
[redacted] (b)(5) AWP [redacted].

[redacted] (b)(5) AWP [redacted]
2.1.8 IQA GHG Finding - mpatel comments 110109.doc

Manisha D. Patel
U.S. EPA - Office of General Counsel
(202) 564-1042

EPA-1812

David Chalmers/DC/USEPA/US
11/18/2009 06:02 PM

To Jason Samenow
cc
bcc
Subject Re: projected flood and drought responses/text for 2.6

(b)(5) Deliberative

thanks,

David Chalmers
ORISE Fellow
U.S. EPA, Climate Change Division
202.343.9814

Jason Samenow Dave-- (b)(5) Deliberative 11/18/2009 04:44:27 PM

From: Jason Samenow/DC/USEPA/US
To: David Chalmers/DC/USEPA/US@EPA
Date: 11/18/2009 04:44 PM
Subject: Re: projected flood and drought responses/text for 2.6

Dave-- (b)(5) Deliberative

Thanks for your help....

Jason

David Chalmers Sure thing. Here it is: (b)(5) Deliberative 11/18/2009 02:35:23 PM

From: David Chalmers/DC/USEPA/US
To: Jason Samenow/DC/USEPA/US@EPA
Cc: Jeremy Martinich/DC/USEPA/US@EPA, Rona Birnbaum/DC/USEPA/US@EPA
Date: 11/18/2009 02:35 PM
Subject: Re: projected flood and drought responses/text for 2.6

Sure thing. Here it is:

(b)(5) Deliberative

(b)(5) Deliberative

(b)(5) Deliberative

Thanks,

David Chalmers
ORISE Fellow
U.S. EPA, Climate Change Division
202.343.9814

Jason Samenow That's cool -- (b)(5) Deliberative 11/18/2009 02:27:29 PM

From: Jason Samenow/DC/USEPA/US
To: David Chalmers/DC/USEPA/US@EPA
Cc: Jeremy Martinich/DC/USEPA/US@EPA, Rona Birnbaum/DC/USEPA/US@EPA
Date: 11/18/2009 02:27 PM
Subject: Re: projected flood and drought responses/text for 2.6

That's cool -- (b)(5) Deliberative Thx,
Jason

David Chalmers I think (b)(5) Deliberative 11/18/2009 02:18:59 PM

From: David Chalmers/DC/USEPA/US
To: Jeremy Martinich/DC/USEPA/US@EPA
Cc: Jason Samenow/DC/USEPA/US@EPA, Rona Birnbaum/DC/USEPA/US@EPA
Date: 11/18/2009 02:18 PM
Subject: Re: projected flood and drought responses/text for 2.6

I think (b)(5) Deliberative

David Chalmers
ORISE Fellow
U.S. EPA, Climate Change Division
202.343.9814

Jeremy Martinich (b)(5) Deliberative 11/18/2009 01:56:27 PM

From: Jeremy Martinich/DC/USEPA/US
To: Jason Samenow/DC/USEPA/US@EPA
Cc: David Chalmers/DC/USEPA/US@EPA, Rona Birnbaum/DC/USEPA/US@EPA
Date: 11/18/2009 01:56 PM
Subject: Re: projected flood and drought responses/text for 2.6

(b)(5) Deliberative
...

****

Jeremy Martinich
USEPA, Climate Change Division
202-343-9871

Jason Samenow David-- I think (b)(5) Deliberative 11/18/2009 01:52:36 PM

From: Jason Samenow/DC/USEPA/US
To: David Chalmers/DC/USEPA/US@EPA
Cc: Jeremy Martinich/DC/USEPA/US@EPA, Rona Birnbaum/DC/USEPA/US@EPA
Date: 11/18/2009 01:52 PM
Subject: Re: projected flood and drought responses/text for 2.6

David-- I think (b)(5) Deliberative .

Jeremy-- Can you send us (b)(5) Deliberative

David Chalmers Rona: (b)(5) Deliberative 11/18/2009 01:21:14 PM

From: David Chalmers/DC/USEPA/US
To: Jason Samenow/DC/USEPA/US@EPA, Rona Birnbaum/DC/USEPA/US@EPA
Cc: Jeremy Martinich/DC/USEPA/US@EPA
Date: 11/18/2009 01:21 PM
Subject: projected flood and drought responses/text for 2.6

Rona: (b)(5) Deliberative

(b)(5) Deliberative

Jason: (b)(5) Deliberative

Thanks,
David

Comment:
(b)(5) Deliberative

Response:
(b)(5) Deliberative

(b)(5) Deliberative

(b)(5) Deliberative

(b)(5) Deliberative

(b)(5) Deliberative

(b)(5) Deliberative

(b)(5) Deliberative

Response:

(b)(5) Deliberative

(b)(5) Deliberative

EPA-1813

Lesley Jantarasami/DC/USEPA/US
11/18/2009 06:04 PM

To Michael Kolian
cc
bcc
Subject

Mike, which is (b)(5) Deliberative?

Thanks,

Lesley

(b)(5) Deliberative

EPA-1814

Jeremy Martinich/DC/USEPA/US
11/18/2009 06:06 PM

To Jason Samenow
cc
bcc
Subject Additions to Volume 2 -- USE THIS ONE

(b)(5) Deliberative

DQA additions to Vol. 2.doc

****
Jeremy Martinich
USEPA, Climate Change Division
202-343-9871

----- Forwarded by Jeremy Martinich/DC/USEPA/US on 11/18/2009 06:04 PM -----

From: Jeremy Martinich/DC/USEPA/US
To: Jason Samenow/DC/USEPA/US@EPA
Date: 11/18/2009 04:51 PM
Subject: Additions to Volume 2

Hey Jason,

Here are (b)(5) Deliberative I've indicated in the attachment where they should go.

Thanks,
Jeremy

****
Jeremy Martinich
USEPA, Climate Change Division
202-343-9871

EPA-1815

Rona Birnbaum/DC/USEPA/US
11/18/2009 06:38 PM

To Jason Samenow
cc Jeremy Martinich
bcc
Subject Comments: Re: action required: review of new uncertainty comments in volume 1

(b)(5) Deliberative

(b)(5) Deliberative

RTC uncertainty comment-responses.RB comments.doc

[redacted] Samenow [attachment "new uncertainty commen... 11/18/2009 03:04:41 PM

From: Jason Samenow/DC/USEPA/US
To: Rona Birnbaum/DC/USEPA/US@EPA
Cc: Jeremy Martinich/DC/USEPA/US@EPA
Date: 11/18/2009 03:04 PM
Subject: action required: review of new uncertainty comments in volume 1

[attachment "new uncertainty comment-responses.doc" deleted by Rona Birnbaum/DC/USEPA/US]

EPA-1816

Jason Samenow/DC/USEPA/US
11/18/2009 06:48 PM

To Rona Birnbaum
cc
bcc
Subject statement from societies....

found it: [redacted] (b)(5) Deliberative

[redacted] (b)(5) Deliberative

jason

EPA-1817

Michael Kolian/DC/USEPA/US
11/18/2009 06:57 PM

To Lesley Jantarasami
cc
bcc
Subject Agriculture

1) (b)(5) Deliberative

2) (b)(5) Deliberative

2006_Racherla_Adams.pdf

FYI: (b)(5) Deliberative

Comment:

(b)(5) Deliberative

Response:

(b)(5) Deliberative

(b)(5) Deliberative

(b)(5) Deliberative

JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 111, D24103, doi:10.1029/2005JD006939, 2006

Sensitivity of global tropospheric ozone and fine particulate matter concentrations to climate change

Pavan Nandan Racherla[1] and Peter J. Adams[2]

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[1] An integrated global model of climate, tropospheric gas phase chemistry, and aerosols has been used to investigate the sensitivity of global ozone and fine particulate matter concentrations to climate change. Two simulations corresponding to present (1990s) and future (2050s) climates have been performed and compared. A future climate has been imposed using ocean boundary conditions corresponding to the Intergovernmental Panel on Climate Change SRES A2 scenario for the 2050s decade, resulting in an increase in the global annual average values of the surface air temperature by 1.7°C, the lower tropospheric specific humidity by 0.9 g H_2O/kg air, and the precipitation by 0.15 mm d^{-1}. Present-day anthropogenic emissions have been used in both simulations while climate-sensitive natural emissions were allowed to vary with the simulated climate. The tropospheric ozone burden in the future climate run decreased by 5%, and its lifetime decreased from 27.8 to 25.3 days. The tropospheric ozone change is driven primarily by increased ozone loss rates through ozone photolysis in the presence of water vapor, which on a global scale, more than compensate for the increased ozone chemical production associated with increased temperatures. At the model surface layer, over remote regions, ozone mixing ratios decreased by 1–3 ppbv, while polluted regions showed a relatively smaller decrease of 0–1 ppbv and increased by 1–5 ppbv in some cases. The global burdens and lifetimes of fine particulate matter species in the future climate run decreased by 2 to 18% because of increased wet deposition loss rates associated with increased precipitation. At the model surface layer, there are regions of decreases and increases in the concentrations of fine particulate matter species. The increased surface layer concentrations of some fine particulate matter species is primarily driven by lower regional-scale precipitation and increased secondary production, where applicable. The robustness of the predicted regional-scale changes for fine particulate matter species is strongly dependent upon the predicted regional-scale precipitation changes.

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1. Introduction

[2] Several studies have suggested links between ozone and fine particulate matter (PM) concentrations and mortality rates in addition to numerous other health problems [*Schwartz*, 1996; *Dockery et al.*, 1993; *Krewski et al.*, 2003]. Hence reduction of ozone and fine PM (PM_f) concentrations has become one of the key objectives of air quality policy and regulation for many governments. Both ozone and PM_f concentrations are linked sensitively to weather and climate. Key meteorological parameters influencing pollutant concentrations include temperature, sunlight, cloudiness, wind speeds and precipitation. Changes in any or all of these meteorological parameters due to climate change will necessarily impact concentrations of ozone and PM_f. However, the direction of change itself is often unclear because of multiple competing effects.

[3] The motivation for this work is twofold. First, climate change impacts on air quality may affect long-term air quality planning. Currently, air quality planning on a short term accounts for changes in emissions but assumes unchanged climate. On longer timescales, it may be necessary to loosen this assumption. While many air quality decisions need only be made on short timescales, future investments in the energy infrastructure and power plant regulations have long-term implications where it may be useful to consider their impacts under changed climate scenarios. Second, the impacts of climate change on many important issues have been considered to assess the overall danger [*Intergovernmental Panel on Climate Change* (*IPCC*), 2001]. However, the impacts of climate change on air quality are not very well understood. A better understanding

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of the impacts of climate change on air quality will contribute to a more holistic assessment of climate change impacts.

[4] Some previous studies have assessed the impact of different meteorological parameters on air pollution at regional and global scales. *Sillman and Samson* [1995] performed regional-scale and 1-D global-scale simulations to study the impact of temperature on ozone concentrations. They concluded that ozone increases with temperature in urban and polluted rural environments, with the increase driven largely by peroxyacetyl nitrate (PAN) chemistry. On the other hand, their 1-D global-scale simulations suggest that increased temperature in the polluted boundary layer may not lead to increased ozone in the free troposphere because increased export of ozone is countered by decreased export of NO_x. *Aw and Kleeman* [2003] used an urban-scale air quality model to study the effect of interannual temperature variability on air pollution in the Southern California region. Their results indicate that ozone and nonvolatile secondary PM generally increase at higher temperatures due to increased gas phase reaction rates, while semivolatile secondary PM could increase or decrease depending on the ambient conditions. In an urban-scale model study of the Milan region, *Baertsch Ritter et al.* [2004] studied the effects of various meteorological conditions such as temperature, wind speeds and mixing height on ozone concentrations. As a base case they modeled an ozone episode that occurred on 13 May 1998 at 15h CET, and compared it with model simulations for the same period that incorporated the variation of individual meteorological parameters. They found that increased temperature increased peak O_3 by 10 ppb $^{\circ}C^{-1}$ and the domain-average O_3 concentrations by 2.8 ppb $^{\circ}C^{-1}$. With regards to increasing wind speeds, their results suggest an increase in VOC (volatile organic compounds) limited areas, because the VOC-limited ozone chemistry induced by point sources is spread over a larger area.

[5] *Stevenson et al.* [2000] and *Johnson et al.* [2001] studied the impact of climate change on tropospheric ozone radiative forcing and methane lifetime using a 3-D chemical transport model (CTM). Their climate change simulations indicate that the dominant change in the tropospheric ozone budget resulting from climate change is an increased destruction of ozone due to increased absolute humidity. *Liao et al.* [2006], in a separate study with the same model [*Liao et al.*, 2003, 2004] as used in our study, found that the year 2100 global ozone and aerosol burdens due to CO_2-driven climate change alone are lower than the present-day levels, as a result of faster ozone removal and increased aerosol wet deposition, respectively.

[6] Previous studies, although relevant, have certain limitations. Regional-scale modeling studies have focused on perturbations of a small set of individual meteorological variables such as temperature and their effect on air pollution. This is a potentially serious limitation because changes in meteorological variables such as temperature, relative humidity, mixing height and wind speeds seldom occur in isolation and each affects ozone and PM_f concentrations. Another limitation of regional-scale studies is that their assumption of constant boundary conditions (BCs) neglects climate change impacts outside their domain. Furthermore, regional-scale modeling studies are limited to specific geographical locations.

[7] Previous global-scale modeling studies have examined the impact of climate change on ozone and its precursors. Only one previous study [*Liao et al.*, 2006] (hereafter referred to as LIP06) addressed the simultaneous impact of climate change on PM_f concentrations. In contrast to LIP06, which focused on the impact of climate change on direct radiative forcings by ozone and PM_f, the current study is motivated by the impacts of climate change on air quality. By way of methodology, LIP06 employed a version of the model used in the current study that uses a q flux ocean [*Hansen et al.*, 1983], where the sea surface temperatures (SSTs) and ocean ice respond to climate change. In contrast, the current study employs a version that uses prescribed SSTs and ocean ice. Finally, LIP06 predicts atmospheric ozone and PM_f concentrations for the year 2100. The current study is potentially more useful for near-term policy making given projections to 2050. Also, to address air quality concerns, we present here regional-scale budgets and changes as well as global-scale ones.

[8] In this study we employ a global model of climate, tropospheric gas phase chemistry and aerosols [*Liao et al.*, 2003, 2004] to study the sensitivity of both global ozone and PM_f concentrations to climate change. Details of the model and simulation methods are provided in section 2. Ozone and PM_f results are discussed in section 3. Finally, the conclusions are presented in section 4.

2. Methods

2.1. Model Description

2.1.1. Overview

[9] We utilize in this work a "unified" model [*Liao et al.*, 2003, 2004], which consists of three major components: (1) the Goddard Institute for Space Studies general circulation model II′ (GISS GCM II′) [*Hansen et al.*, 1983; *Rind and Lerner*, 1996; *Rind et al.*, 1999]; (2) the Harvard tropospheric O_3-NO_x-hydrocarbon chemical model [*Mickley et al.*, 1999]; and (3) an aerosol model [*Adams et al.*, 1999; *Chung and Seinfeld*, 2002; *Liao et al.*, 2003, 2004].

[10] The GISS GCM II′ has a horizontal resolution of 4° latitude by 5° longitude, with nine vertical layers centered at 959, 894, 786, 634, 468, 321, 201, 103, and 26 hPa. The GCM's troposphere extends from approximately 984 hPa to 150 hPa. The version of GISS GCM II′ incorporated in the current study uses specified monthly mean ocean boundary conditions (OBCs) in the form of SSTs, sea ice coverage and sea ice mass. The dynamical time step of the GCM is 1 hour. Necessary GCM variables are passed to the tropospheric chemistry and aerosol modules every 4 hours.

[11] A total of 88 gas and aerosol phase species are transported in the "unified" model. Of these, 24 species are used to describe O_3-NO_x-hydrocarbon chemistry; the remainder are for simulation of sulfate, nitrate, ammonium, black carbon (BC), primary organic aerosol (POA), secondary organic aerosol (SOA), dust, and sea salt. As described by *Chung and Seinfeld* [2002], reactive terpenes that, upon atmospheric oxidation, lead to semivolatile products that form SOA, are grouped into five hydrocarbon categories according to the values of their experimentally measured aerosol yield parameters. SOA formation due to the oxida-

tion by O_3 and OH is considered together, and it is simulated using a two-product model. On the other hand, SOA formation due to the oxidation by NO_3 is simulated using a one-product model. Sea salt is represented using 11 size bins, with 5 size bins having dry radius ≤ 1 μm, while dust is represented using 6 size bins, with 2 size bins having dry radius ≤ 1 μm [*Liao et al.*, 2004]. The mass in each size bin is treated as a separate species with its own deposition behavior, but intersectional mass transfer by aerosol microphysics is not simulated.

[12] The model is constrained in the stratosphere by applying flux upper boundary conditions between the seventh and eighth model layers (approximately 150 hPa) to represent transport across the tropopause [*Wang et al.*, 1998]. As described by *Mickley et al.* [1999], the flux upper boundary conditions for ozone is based on the observed latitudinally and seasonally dependent cross-tropopause air mass fluxes [*Appenzeller et al.*, 1996], along with ozonesonde measurements at 100 hPa [*Logan*, 1999]. In the current study, we specify a stratospheric ozone flux of 400 Tg yr ^{1}, a value that was used in the previous model versions [*Liao et al.*, 2003]. We use this value for both the present and future simulations discussed in section 2.2. By doing so, this study does not investigate the influence of increased stratospheric ozone flux under climate change, which is likely to increase tropospheric ozone [*Collins et al.*, 2003].

[13] As described by *Wang et al.* [1998], the dry deposition of all gas phase species is determined based on the resistance-in-series scheme of *Wesely* [1989], wherein the dry deposition velocity is inversely proportional to the sum of the aerodynamic, quasi-laminar sublayer and surface resistances. The aerodynamic and quasi-laminar sublayer resistances are calculated based on the GCM surface fluxes of momentum and heat while the surface resistance is a function of the surface type and the species. Particle dry deposition velocities of all nondust, non-sea-salt species are calculated based on the treatment for sulfate described by *Koch et al.* [1999] while those for dust, sea salt, and associated species are based on the work of *Liao et al.* [2004]. Wet deposition is coupled with the GCM treatment of clouds and precipitation [*Koch et al.*, 1999; *Del Genio and Yao*, 1993; *Del Genio et al.*, 1996]. The size-dependent wet deposition treatment for dust and sea salt is described by *Liao et al.* [2004] and the references therein.

[14] Anthropogenic and natural emissions used in the model are summarized in *Liao et al.* [2003, 2004]. Climate-sensitive emissions include isoprene [*Guenther et al.*, 1995; *Wang et al.*, 1998], lightning and soil NO_x [*Wang et al.*, 1998], DMS [*Kettle et al.*, 1999], sea salt and mineral dust [*Liao et al.*, 2004]. The meteorological variables that influence these emissions include temperature (isoprene, soil NO_x and DMS), solar radiation (isoprene), precipitation (soil NO_x and mineral dust), surface wind speed (DMS, sea salt and mineral dust) and frequency of convective events (lightning NO_x). Therefore the model treats the climate sensitivity of these emissions such that the emissions rates of these species change between the present and future simulations discussed in section 2.2. The climate sensitivity of monoterpenes and sesquiterpenes emissions, which is important to the formation of SOA, is not considered in this study.

2.1.2. Heterogeneous Chemistry

[15] The only significant change compared to previous versions of the model is with regards to heterogeneous chemistry. Important heterogeneous reactions considered in the "unified" model include hydrolysis of N_2O_5 on wetted aerosol surfaces of sulfate, nitrate, ammonium, OC, and sea salt; dust uptake of SO_2, HNO_3, and O_3; and sea salt uptake of SO_2. SO_2 and HNO_3 deposited on dust particles are assumed to oxidize to SO_4^{2} and NO_3, respectively. The SO_4^{2} and NO_3 formed on dust are treated as separate species from other forms of sulfate and nitrate, and we refer to them as SO_4^{2} (D) and NO_3 (D). The fraction of SO_2 that is taken up by sea salt and oxidized by H_2O_2 and O_3 (in aqueous sea salt aerosols) to sulfate is also tracked as a separate species denoted SO_4^{2} (SSO). Sulfate and nitrate not associated with sea salt or dust are simply designated as SO_4^{2} and NO_3, respectively.

[16] *Liao et al.* [2004] deliberately used high estimates of uptake coefficients to bound the impacts of heterogeneous reactions on gas phase chemistry and aerosol formation. In this study, we used best guess uptake coefficients related to the heterogeneous reactions. The major change is with the uptake coefficient for N_2O_5 hydrolysis, which now depends on aerosol type, relative humidity, and temperature [*Kane et al.*, 2001; *Thornton et al.*, 2003; *Hallquist et al.*, 2003], in contrast with the single uptake coefficient of 0.1 used for all aerosol types by *Liao et al.* [2004]. These new coefficients lead to less hydrolysis of N_2O_5. The new dust uptake coefficients for ozone and HNO_3 are 10^{5} [*Bauer and Koch*, 2005] and 1.1×10^{3} [*Bian and Zender*, 2003], respectively, in contrast with the values of 5×10^{5} and 0.1 used by *Liao et al.* [2004].

2.1.3. Fine PM Definition

[17] In the absence of size-resolved treatment of SO_4^{2}, NO_3, NH_4^{+}, BC, POA and SOA in the "unified" model, we assume that these species reside in particles associated with the accumulation mode. Hereafter, we refer to these species as fine PM. For dust and sea salt, we choose to show the total amount. For SO_4^{2} (D), NO_3 (D) and SO_4^{2} (SSO), we do not include them in fine PM for simplicity and because they globally account for less than 10% of their burdens.

2.2. Simulations

[18] Two runs, each of five and a half year duration, were performed with the first six months ignored to allow for model initialization. All results, annual, seasonal or monthly refer to averages over the remaining five years. The first run corresponds to present-day (1990s) climate while the second run corresponds to a future (2050s) climate scenario. Hereafter, we refer to these runs as present and future runs, and abbreviate them as PR and FR, respectively. Present day anthropogenic emissions were used in both the runs while climate-sensitive natural emissions were allowed to vary with the simulated climate (see section 2.1.1).

[19] A present-day CO_2 mixing ratio of 370 ppmv was specified in both the runs. Future climate is imposed by changing the OBCs that drive the general circulation model. Changing the OBCs is an alternative method for imposing climate change that is attractive because of the large amounts of computer time that would be required for simulating the equilibriaton of the ocean, if a greenhouse gas forcing were imposed on the system [*Cess et al.*, 1990].

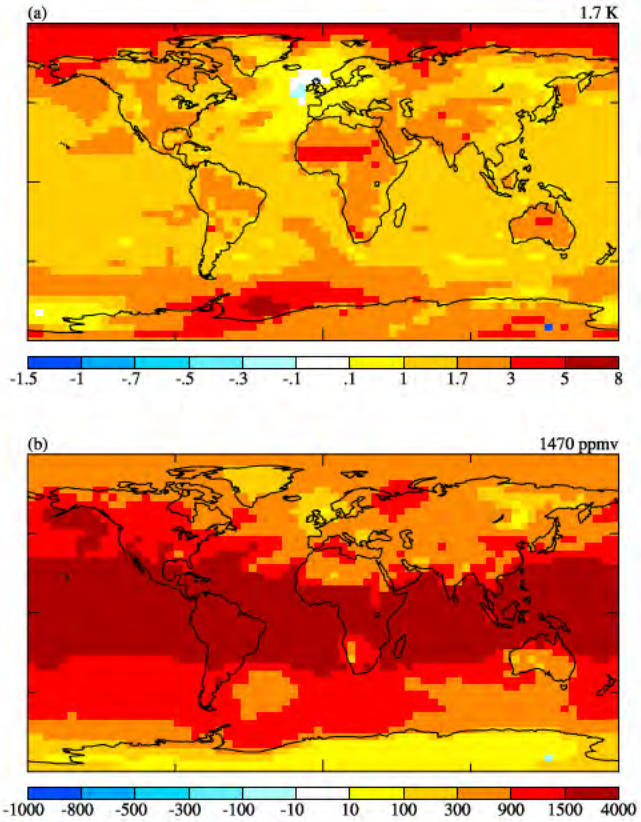

Figure 1. Surface layer (984–934 hPa) annual average differences (future run (FR) minus present run (PR)) of (a) air temperatures and (b) water vapor mixing ratios. The global annual average differences and units are indicated above the top right corner.

The OBCs used in this study were obtained from a transient simulation performed using a fully coupled atmosphere-ocean GCM (the GISS Model III [*Russell et al.*, 1995; R. Healy, personal communication, 2005]). That model was run 250 years total, starting in 1850. Simulations based on the trends in the concentrations of atmospheric greenhouse gases prescribed by the IPCC SRES A2 scenario [*Robertson et al.*, 2001] and sulfate/carbonaceous aerosols described by *Koch* [2001] were started in 1990, thus allowing for a spin-up period of 140 years. The model was initialized from the National Meteorological Center atmospheric observations for 1 December 1977 and *Levitus* [1982] ocean climatological temperature and salinity fields. The present and future OBCs in the current study correspond to a decadal average of the 1990s and 2050s from the above simulation, respectively, with month-to-month variability.

2.3. Predicted Climate Change

[20] It takes approximately three months during the 6-month model initialization period for the surface layer air temperatures to equilibrate to the changed OBCs, resulting in a 1.7°C increase in the annually and globally averaged surface layer air temperature. The spatial distribution of the surface layer air temperature differences between the present and future runs is shown in Figure 1a. The predicted differences shown in Figure 1a closely resemble the mid-21st century surface layer temperature differences for the A2 scenario shown in the IPCCs Third Assessment Report [*IPCC*, 2001].

[21] Changes in the hydrologic cycle play a key role in the ozone and PM_f results, as discussed subsequently. The spatial pattern of the predicted changes in the surface layer water vapor mixing ratios are shown in Figure 1b. This corresponds to an increase of 0.9 g H_2O/kg air (10%) in the annually and globally averaged lower tropospheric specific humidity, and a 1.62 Eg increase (14%) in the global tropospheric water vapor burden. The predicted increase (%) in lower tropospheric (984–854 hPa) specific humidity per degree of global warming is 5.8% °C $^{-1}$, and it is consistent with other GCM simulations [*Soden et al.*, 2005; IPCC, 2001]. The global annual average precipitation increased by 0.15 mm d $^{-1}$ (4.7%) relative to the present run. The predicted precipitation increase (%) per degree of global warming is 2.8% °C $^{-1}$, and it agrees well with the ensemble mean of 3.6% °C $^{-1}$ obtained from 19 AOGCM simulations [*Allen and Ingram*, 2002].

[22] In order to evaluate the statistical significance of the predicted global precipitation increase, a Welch two-sample t test comparing the global annual average precipitation (mm d $^{-1}$) distributions between the present run ($\mu = 3.16$ and $\sigma = 0.06$) and the future run ($\mu = 3.31$ and $\sigma = 0.08$) was performed. This test indicates that the predicted 0.15 mm d $^{-1}$ increase in the global annual average precipitation is significant at a 95% confidence level. However, a similar analysis on the predicted changes in the regional-scale precipitation reveals that they are not significant at a 95% confidence level. As a result, model predictions that depend strongly on the predicted regional-scale precipitation changes have a significant uncertainty associated with them.

3. Results

3.1. Ozone

3.1.1. Tropospheric Ozone Budget

[23] The annual tropospheric ozone (O_3^t) budget in the present and future runs is shown in Table 1. The budget presented here is for the odd oxygen (O_x) family defined as the sum of ozone, O, NO_2, 2 × NO_3, 3 × N_2O_5, HNO_4, HNO_3, and the peroxyacylnitrates. By evaluating the budget for the odd oxygen chemical family as defined above, the rapid cycling between the members included is better accounted for. For example, free oxygen atoms are included, as there is rapid cycling between O and O_3. Also, NO_2 is included, as there is rapid cycling between NO_2 and O/O_3. Similarly, other NO_y species are included.

[24] In the future run, the most noticeable changes in the O_3^t budget are the decreased O_3^t lifetime (τ) from 27.8 to 25.3 days, an increased O_3^t chemical production (by 145 Tg yr $^{-1}$ or 4%) and an increased O_3^t destruction rate through $O(^1D) + H_2O$ (by 120 Tg yr $^{-1}$ or 6.8%). The future O_3^t burden itself decreased by 5.6% (17 Tg) relative to the present run. The predicted changes in the O_3^t budget agree well with the simulation of *Stevenson et al.* [2000] for a similar time period (2060) and scenario (IPCC SRES A2). Their O_3^t budget indicates a decrease of 4% in the O_3^t burden along with a 3% increase in the O_3^t chemical production and a 7% increase in the O_3^t destruction through $O(^1D) + H_2O$.

[25] By utilizing the steady state definition of the lifetime of a species (equation (1)) and linearizing the changes in the

Table 1. Annual Global Budget for Tropospheric Odd Oxygen (O_x)[a]

	Present Run	Future Run
Sources, Tg yr^{-1}		
Chemical production		
$NO + HO_2$	2270	2325
$NO + CH_3O_2$	820	850
$NO + RO_2$	520	580
Total	3610	3755
Stratospheric flux	400	400
Total	4010	4155
Sinks, Tg yr^{-1}		
Chemical loss		
$O(^1D) + H_2O$	1765	1885
$O_3 + HO_2$	885	890
Other reactions	690	730
Total	3320	3505
Dry deposition	670	650
Total	4010	4155
Net chemical production, Tg yr^{-1}	290	250
Burden, Tg	305	288
Lifetime, days	27.8	25.3

[a]See section 3.1.1 for the definition of O_x.

O_3^t lifetime and the O_3^t sources (S) about the present run, the fractional change in the O_3^t burden (M) can be approximated using equation (2).

$$\tau = \frac{M}{S} \tag{1}$$

$$\frac{\Delta M}{M_{PR}} = \left(\frac{\Delta \tau}{\tau_{PR}}\right)_{S_{PR}} + \left(\frac{\Delta S}{S_{PR}}\right)_{\tau_{PR}} \tag{2}$$

Hereafter, we refer to the first and second terms on the right hand side of equation 2 as the sink effect and the source effect, respectively. Application of equation (2) to the O_3^t budget shows that the source effect (+3.6%) is dominated by the sink effect (−9.0%) on a global scale. However, increased sources (O_3^t chemical production) play an important role on a regional scale, as discussed subsequently. The increased O_3^t chemical production is due to warmer temperatures that result in (1) increased chemical reaction rates and (2) a less stable PAN, causing a greater fraction of the oxidized nitrogen to be present as NO_x [*Sillman and Samson*, 1995].

[26] The shortened O_3^t lifetime is driven primarily by increased O_3^t destruction rates due to the reaction (R2),

(R1) $$O_3 + h\nu \rightarrow O(^1D) + O_2$$

(R2) $$O(^1D) + H_2O \rightarrow 2\ OH\cdot$$

which, in turn, is a consequence of increased global water vapor concentrations. Because the burdens in the two runs are different, the impact of increased O_3^t destruction rate by the above reaction is captured better by its contribution to the shortened O_3^t lifetime. Since the O_3^t lifetime with respect to each loss mechanism has decreased relative to the present run, we define a new parameter, $\tau_{\Delta proc}$, to assess their relative contributions to the shortened overall O_3^t lifetime. The $\tau_{\Delta proc}$ with respect to a loss mechanism (l) is what the new overall O_3^t lifetime would be if the O_3^t lifetime with respect to that mechanism alone changed in the future run. The calculation of $\tau_{\Delta proc}$ is illustrated in equation (3):

$$\frac{1}{\tau_{\Delta proc}} = \sum_{j(j/l)} \frac{1}{\tau_{PR,j}} + \frac{1}{\tau_{FR,l}} \tag{3}$$

where $\tau_{PR,j}$ is the O_3^t process lifetime with respect to loss mechanism j in the present run and $\tau_{FR,l}$ is the O_3^t process lifetime with respect to loss mechanism l in the future run. O_3^t process lifetimes and $\tau_{\Delta proc}$ values are shown in Table 2. It shows that the reduction in O_3^t lifetime with respect to reaction (R2) (from 63 to 56 days) would, by itself, decrease the overall O_3^t lifetime to 26.2 days, while decreased O_3^t lifetimes with respect to other loss mechanisms further reduce the overall O_3^t lifetime by smaller amounts.

3.1.2. Surface Layer Ozone

[27] Annual average surface layer ozone (O_3^s) mixing ratios in the present run are shown in Figure 2a, while Figure 2b shows the differences (FR - PR) in O_3^s mixing ratios between the two simulations. In the future run, over most remote regions (unpolluted or marine), O_3^s mixing ratios decreased by 1–3 ppbv. On the other hand, regions with high ozone precursor emissions showed a relatively smaller decrease (0–1 ppbv) in O_3^s mixing ratios and an increase in some cases (eastern United States, eastern China, parts of the Indian Subcontinent, the Mediterranean and South Africa).

[28] Over regions where the annual average O_3^s mixing ratios increased in the future run, the seasonal O_3^s budgets indicate that this increase is dominated by summertime increases, which are in the range of 3–9 ppbv. To illustrate this the summer (June/July/August) and winter (December/January/February) O_3^s budgets for the eastern United States (95–80°W, 32–40°N) are presented in Table 3. The sink and source effects for each season shows that the summertime O_3^s increase occurs primarily due to the increased O_3^s chemical production. The relatively longer O_3^s lifetime also plays an important role when compared to the wintertime O_3^s changes, as discussed subsequently. The increased O_3^s chemical production is due to warmer temperatures, which cause the PAN $\leftrightarrow$ NO_x equilibrium to favor NO_x, and increased biogenic HC emissions as suggested by the sensitivity studies of *Liao et al.* [2006]. The longer O_3^s lifetime is due to the reduced O_3^s dry deposition flux, which more than compensates for the faster O_3^s chemical loss rates. The reduced O_3^s dry deposition flux is due to increased aerodynamic and quasi-laminar sublayer resistance. The change in surface resistance itself plays a negligible role

Table 2. Process Lifetimes for Tropospheric Ozone

	Process Lifetime, days		
Loss Mechanism	Present Run	Future Run	$\tau_{\Delta proc}$[a]
$O(^1D) + H_2O$	63	56	26.2
$O_3 + HO_2$	126	118	27.4
Other reactions	161	144	27.2
Dry deposition	167	162	27.6

[a]See section 3.1.1 for the definition of $\tau_{\Delta proc}$.

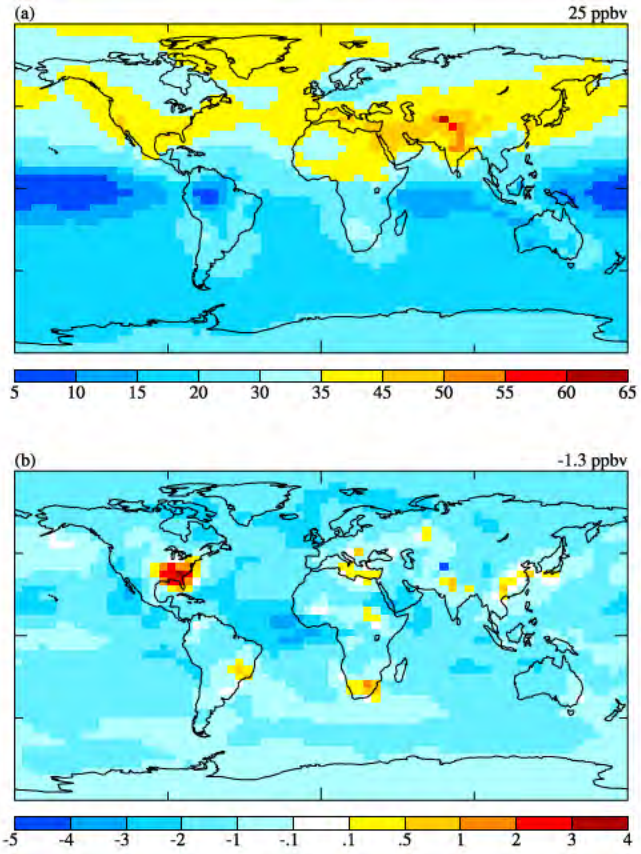

Figure 2. (a) Surface layer (984–934 hPa) annual-average mixing ratios (ppbv) of ozone in the present run and (b) annual average differences (future run (FR) minus present run (PR)) of ozone mixing ratios. The global annual average mixing ratio (or difference) and units are indicated above the top right corner.

because key surface parameters such as the leaf area index are being held constant. Moreover, the summertime surface resistances are small relative to the aerodynamic and quasi-laminar sublayer resistances. In contrast with the summertime O_3^s increases, O_3^s mixing ratios remained nearly unchanged during the winter due to increased O_3^s dry deposition loss rates, which more than compensated for the increased O_3^s chemical production.

[29] The O_3^s changes over the eastern United States indicate that while changes in O_3^s dry deposition played a minor role globally, it plays an important role at the surface layer. This is not surprising considering that dry deposition is the dominant surface layer sink for ozone. The seasonal pattern of the predicted O_3^s changes shows that the increased O_3^s chemical production, by itself, may not be sufficient to cause increased O_3^s mixing ratios. On the other hand, as suggested by the summertime increases, increased O_3^s chemical production could result in increased O_3^s levels if the O_3^s dry deposition removal rates decreased or remain nearly unchanged.

3.2. Fine PM Species

3.2.1. Global Budgets

[30] Annual global budgets for PM_f species in the present and future runs are shown in Table 4. It can be seen from Table 4 that wet deposition is the dominant removal mechanism for SO_4^{2-}, NO_3^-, NH_4^+ and SOA, where it accounts for more than 80% of the removal of these species from the atmosphere. For BC and POA, removal by dry deposition is also important. With regards to a comparison of the budgets between the present and future runs, the reduced future global burdens and lifetimes for all the species is readily noticeable. Again, application of equation (2) helps quantify the relative importance of the sink and source effects to the global burden decrease for each species. This is also shown in Table 4. For the PM_f inorganic species, the sink effect outweighs the source effect. For the PM_f organic species, this is true for BC and POA, as their sources, i.e., primary emissions, are held constant between the two runs. However, for SOA, the source effect in the form of reduced aerosol:gas ratio is the dominant factor in the global burden decrease.

[31] Changes in the hydrologic cycle in the future run play a key role in the shortened lifetimes of the PM_f species. The shortened lifetimes of all the PM_f species is due to increased wet deposition rates, which, in turn, is a result of the increased annual average global precipitation from 3.15 mm d^{-1} to 3.3 mm d^{-1} predicted by the GCM. While precipitation effects dominate the response of other species, the reduced SOA burden in the future run is primarily driven by reduced partitioning of gas phase secondary organics (SO) into the aerosol phase, as a result of warmer temperatures. Increased precipitation itself plays a relatively minor role by reducing the total secondary organic levels from 1.74 to 1.73 Tg.

3.2.2. Surface Layer PM_f

[32] Annual average surface layer concentrations of PM_f species in the present run are shown in Figure 3, while Figure 4 shows the differences (FR - PR) in their surface concentrations between the two simulations. In the future run, there are regions of decreases and increases in the surface concentrations of PM_f species with practically zero global average change. For most regions and species, the change in surface layer concentrations is consistent with the global trend, i.e., decrease. The factors contributing to this decrease were elaborated in the discussion on global PM_f

Table 3. Summer (June/July/August) and Winter (December/January/February) Surface Layer (984 934 hPa) Odd Oxygen (O_x) Budgets for the Eastern United States (95° 80°W, 32° 40°N)[a]

	Summer		Winter	
	PR	FR	PR	FR
Sources, Gg yr^{-1}				
Chemical production	6944	8020	953	1066
Net transport	1208	1707	297	232
Sinks, Gg yr^{-1}				
Chemical loss	2033	2529	410	406
Dry deposition	3703	3784	840	892
Burden, Gg	51.9	57.6	28.0	27.6
Lifetime, hours	20.0	20.2	48.4	46.0
	Summer		Winter	
Sink effect	+1.0%		5.3%	
Source effect	+10%		+3.9%	

[a]See section 3.1.1 for the definitions of O_x and sink and source effects. The present and future runs are denoted by PR and FR.

Table 4. Annual Global Budgets for Fine PM Species[a]

	SO_4^{2-}		NO_3^-		NH_4^+		BC		POA		SOA	
	PR	FR	PR	FR	PR	FR	PR	FR	PR	FR	PR	FR
Sources, Tg yr^{-1}	28.4	28.7	28.0	26.9	20.9	21.9	12	12	81	81	16.3	14.2
Sinks, Tg yr^{-1}												
Wet deposition	24.4	24.4	23.0	22.1	16.9	17.6	7.6	7.5	49.1	49.0	12.8	11.1
Dry deposition	4.0	4.3	5.0	4.8	4.0	4.3	4.4	4.5	31.9	32.0	3.5	3.1
Burden, Tg	0.36	0.33	0.8	0.7	0.47	0.42	0.22	0.21	1.28	1.24	0.29	0.24
Lifetime, days	4.8	4.3	10.4	9.5	8.2	7.0	6.5	6.4	5.8	5.6	6.5	6.2

	SO_4^{2-}	NO_3^-	NH_4^+	BC	POA	SOA
Sink effect	10%	9%	15%	2%	3%	5%
Source effect	+1%	4%	+5%	0%	0%	13%

[a]See section 2.1.3 for the definition of fine PM. The present and future runs are denoted by PR and FR. The budget for sulfate is in TgS. See section 3.1.1 for definitions of the sink and source effects.

budgets. Here, only those regions and species that deviate significantly from the global trend are discussed in detail.

[33] The increased SO_4^{2-} concentrations over the eastern United States (100–65°W, 24–52°N) in the future run (Figure 4a) are understood better when the seasonally resolved changes in the SO_4^{2-} burden, the regional-scale precipitation, and the SO_4^{2-} produced by the gas phase and in-cloud oxidation of SO_2 are considered together. These changes are shown in Figure 5. Figure 5a shows that the SO_4^{2-} burden increased during the months May through July, and January. The SO_4^{2-} increase during the months of January, June and July (JJJ) is due to the longer SO_4^{2-} lifetime caused by reduced precipitation (Figure 5b). In this case, the SO_4^{2-} increase due to the longer lifetime outweighs the decrease caused by the reduced in-cloud SO_4^{2-} production (Figure 5d). Furthermore, the increased SO_4^{2-} production by SO_2 + OH· during the JJJ months is likely contributing to the SO_4^{2-} increase because of the longer lifetime generally associated with the SO_4^{2-} produced by the gas phase oxidation of SO_2 [*Koch et al.*, 2003]. In contrast with the SO_4^{2-} increases during the JJJ months, the increased SO_4^{2-} burden during the month of May occurs due to the increased in-cloud SO_4^{2-} production. For the remaining months, even though in-cloud SO_4^{2-} production increased significantly, the SO_4^{2-} burden decreased due to shorter lifetimes caused by increased precipitation.

[34] Analysis of the regional-scale organic PM_f budgets (not shown) suggests that the predicted increases in the annual average surface layer concentrations of POA over eastern Europe and Mediterranean (Figure 4e) as well as the increases in organic PM_f concentrations over northern Africa (Figures 4d–4f) correlate strongly with the predicted seasonal-scale precipitation decreases over these regions. It is evident that the predicted regional-scale precipitation changes play a key role in the changes of both inorganic and organic PM_f species. However, given the low statistical significance of the predicted regional-scale precipitation

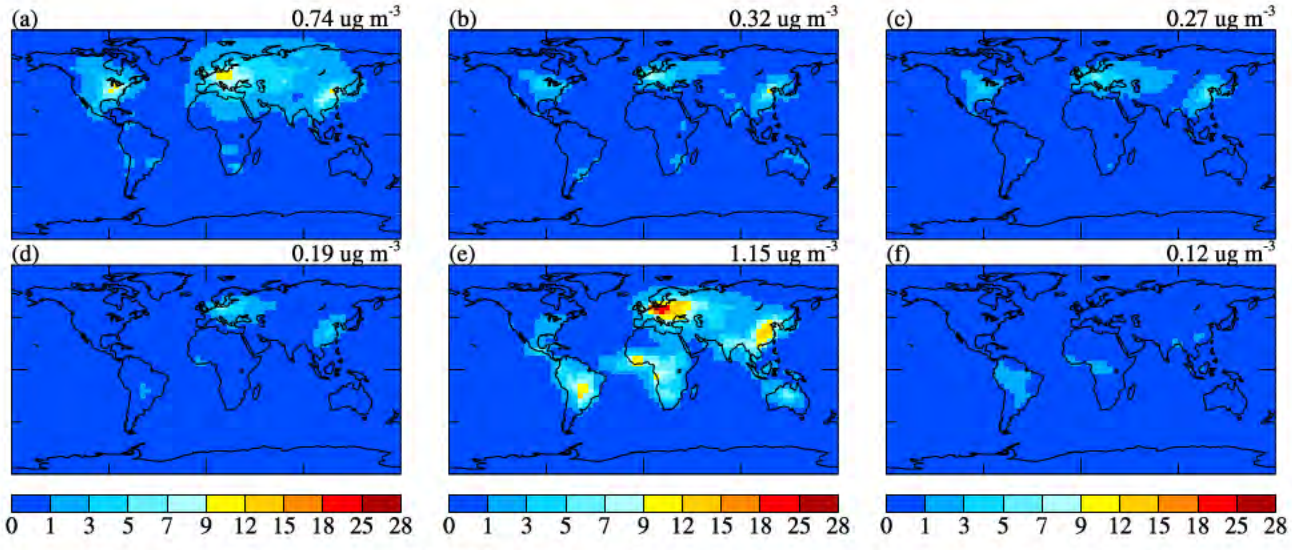

Figure 3. Surface layer (984–934 hPa) annual average concentrations (μg m^{-3}) of (a) sulfate, (b) nitrate, (c) ammonium, (d) black carbon, (e) primary organic aerosol, and (f) secondary organic aerosol in the present run. The global annual average concentrations and units are indicated above the top right corner. In each case, uniform temperature and pressure values of 298 K and 1000 hPa were used to convert aerosol mass to aerosol concentrations.

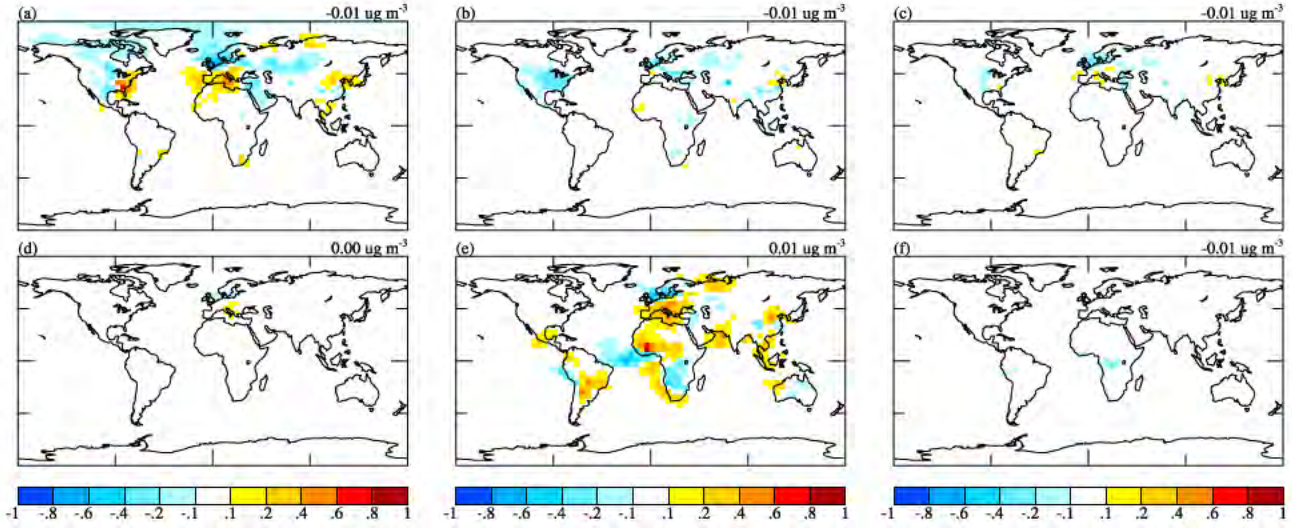

Figure 4. Surface layer (984–934 hPa) annual average differences (future run (FR) minus present run (PR)) in the concentrations (μg m ^{3}) of (a) sulfate, (b) nitrate, (c) ammonium, (d) black carbon, (e) primary organic aerosol, and (f) secondary organic aerosol. The global annual average differences and units are indicated above the top right corner. In each case, uniform temperature and pressure values of 298 K and 1000 hPa were used to convert aerosol mass to aerosol concentrations.

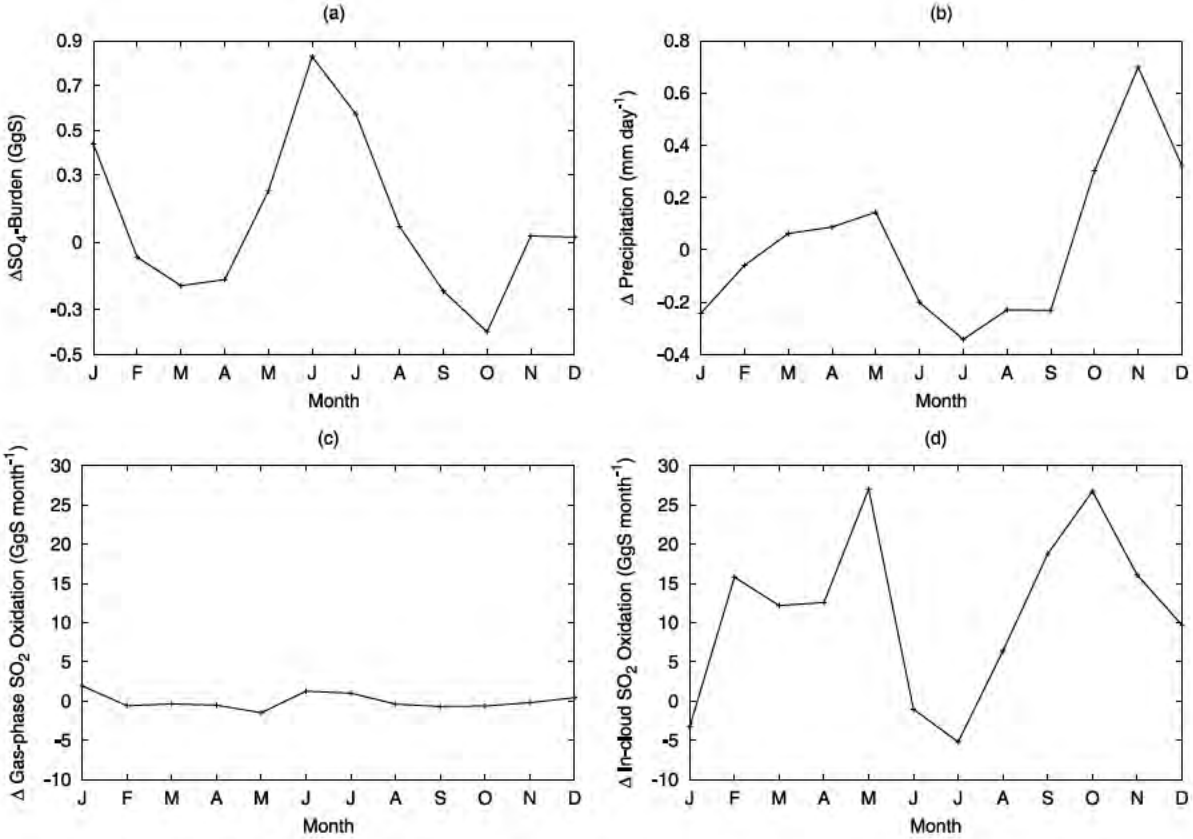

Figure 5. Monthly variation of differences (future run minus present run) in (a) SO_4^{2} burden (GgS) in the surface layer (984–934 hPa), (b) column-integrated precipitation (mm d ^{1}), and SO_4^{2} produced (GgS month ^{1}) by (c) gas phase and (d) aqueous phase oxidation of SO_2 in the surface layer (984–934 hPa) of the eastern United States. Months J through D refer to the months January through December, and each month represents a 5-year average for that month.

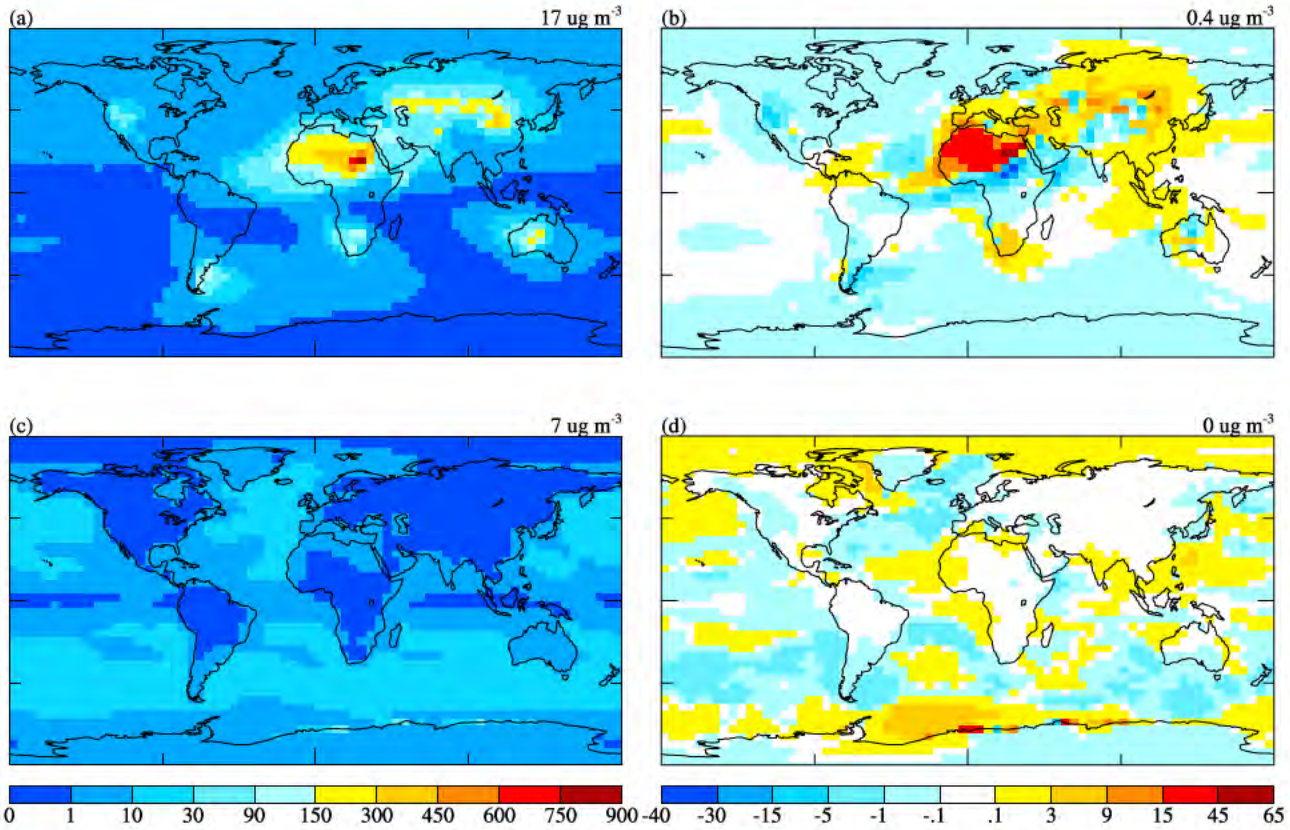

Figure 6. Surface layer (984–934 hPa) annual average concentrations (μg m ^{3}) and differences (future run (FR) minus present run (PR)) in concentrations of (a and b) dust and (c and d) sea salt. The global annual average concentrations (or differences) and units are indicated above the top right corner. In each case, uniform temperature and pressure values of 298 K and 1000 hPa were used to convert aerosol mass to aerosol concentrations.

changes, the regional-scale fine particulate matter changes have a significant uncertainty (see section 2.3).

3.3. Dust and Sea Salt

[35] Annual average surface layer concentrations of dust and sea salt in the present run are shown in Figures 6a and 6c, while Figures 6b and 6d show the differences (FR − PR) in their surface layer concentrations between the two simulations. As expected, the highest present-day concentrations of dust are found over the Sahara and Gobi deserts, while the highest sea salt concentrations are found over the Southern Ocean. In the future run, large increases in the surface layer concentrations of dust are predicted over the Sahara and Gobi deserts. When compared to the changes in dust concentrations, the changes in sea salt concentrations are relatively small. The dust budgets for these regions (not shown) suggests that this increase is primarily due to reduced wet deposition associated with decreased regional-scale precipitation. On a seasonal scale, increased dust emissions associated with the increased wind speeds also play a minor role. As can be seen from Figure 6b, the model results suggest that increases in dust emissions over source regions such as the Sahara desert could increase the dust concentrations over nearby regions. However, given the large uncertainties associated with total dust emissions as well as their size distribution, it is difficult to predict implications for fine PM.

4. Summary and Conclusions

[36] The sensitivity of ozone and fine particulate matter concentrations to climate change is demonstrated by performing simulations corresponding to present and future climates using an integrated model of global climate, tropospheric gas phase chemistry and aerosols. Future climate is imposed using ocean boundary conditions corresponding to the IPCC SRES A2 scenario for the 2050s decade, resulting in an increase in the global annual average values of the surface air temperature by 1.7°C, the lower tropospheric specific humidity by 0.9 g H_2O/kg air, and the precipitation by 0.15 mm d ^{1}. Present-day anthropogenic emissions were used in both simulations while climate-sensitive natural emissions were allowed to vary with the simulated climate.

[37] The future simulation shows that the tropospheric ozone burden and lifetime decrease significantly in a warmer climate. For example, it was found that the tropospheric ozone burden decreased by 17 Tg (5.6%) and the tropospheric ozone lifetime decreased from 27.8 to 25.3 days. These decreases are primarily driven by increased ozone loss rates through ozone photolysis in the presence of

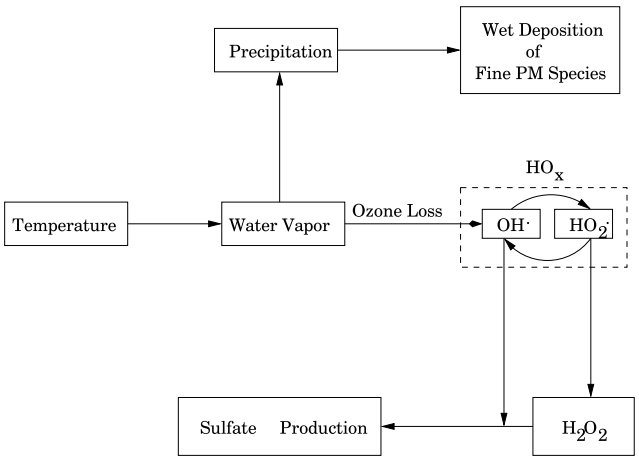

Figure 7. Central role of water and water vapor in the predicted changes for ozone and fine particulate matter species in the future climate simulation.

water vapor, which in turn is a result of increased water vapor concentrations associated with higher temperatures. On a global scale, the ozone chemical production increased by 145 Tg yr ^{1} (3.6%) in the future simulation. This increase is more than countered by increased ozone loss rates.

[38] At the surface layer, over most remote regions (marine or unpolluted), the annual average ozone mixing ratios decreased by 1–3 ppbv. In contrast, regions with high ozone precursor emissions showed relatively smaller decreases of 0–1 ppbv and increases of 1–5 ppbv over regions such as the eastern United States. These changes display a strong seasonality in ozone chemical production and ozone loss. For example, over the eastern United States, it was found that the increased annual average ozone mixing ratios were driven by summertime increases that resulted from increased ozone chemical production, and to some extent due to slower dry deposition.

[39] In the future simulation, the global burdens and the lifetimes of all the fine particulate matter species decreased 2–18% relative to the present simulation, due to the increased wet deposition removal rates associated with the increased global annual average precipitation. While precipitation effects dominate the response of other species, the decreased burden of secondary organic aerosol is primarily due to reduced partitioning of gas phase secondary organics into the aerosol phase, as a result of warmer temperatures.

[40] At the surface layer, the future simulation shows that there are regions of decreases and increases in the concentrations of fine particulate matter species with practically zero global annual average change. The monthly surface layer budgets for the fine particulate matter species suggests that regional-scale precipitation changes are key to these changes. For example, it was found that over the eastern United States, sulfate concentrations increased by nearly 1 μg m ^{3} during the months of June and July due to the reduced precipitation during those months. However, given the low statistical significance of the predicted regional-scale precipitation changes, the regional-scale fine particulate matter changes have a significant uncertainty. Nevertheless, these results underscore the key role that precipitation changes will play with respect to fine particulate matter concentrations in future climate scenarios.

[41] Collectively, these simulations demonstrate that changes in the hydrologic cycle in future climate scenarios, will play a key role in the changes of both ozone and fine particulate matter concentrations. The central role of water and water vapor with respect to the predicted changes in this study is summarized in Figure 7. With regards to the robustness of the predicted changes in the hydrologic cycle, regional-scale changes in precipitation and liquid water content are highly uncertain. A better representation of cloud and related processes in further work will help reduce this uncertainty. However, the increased water vapor levels and global precipitation predicted in the current study are consistent with the predictions of other climate models in a warmer climate scenario [*Soden et al.*, 2005; *Allen and Ingram*, 2002; *IPCC*, 2001]. Hence model predictions such as the decreased global burdens of ozone and fine particulate matter species are robust.

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EPA-1818

Jason Samenow/DC/USEPA/US
11/18/2009 07:01 PM

To Rona Birnbaum
cc Jeremy Martinich
bcc
Subject Re: Comments: Re: action required: review of new uncertainty comments in volume 1 (use this version)

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Rona Birnbaum [redacted] (b)(5) Deliberative 11/18/2009 06:38:48 PM

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To: Jason Samenow/DC/USEPA/US@EPA
Cc: Jeremy Martinich/DC/USEPA/US@EPA

Date: 11/18/2009 06:38 PM
Subject: Comments: Re: action required: review of new uncertainty comments in volume 1

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(b)(5) AWP

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Can we confirm Lesley?

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Subject **Finally done with first part of health**

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Dina

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Michael Kolian Lobell D.B and Field C.B., 2009. Calif... 11/18/2009 07:03:50 PM

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Date: 11/18/2009 07:03 PM
Subject: Re: California CCC

Lobell D.B and Field C.B., 2009. California Perennial crops in a changing climate. A paper from California Climate Change Center. March 2009. CEC-500-2009-039-D.

Lee et al., 2009. Effect of Climate Change on field crop production in the central valley of California. March 2009. CEC-500-2009-041-D.

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Thanks,

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Elevated Atmospheric Carbon Dioxide and Weed Populations in Glyphosate Treated Soybean

Lewis H. Ziska* and Ernie W. Goins

ABSTRACT

Although rising atmospheric carbon dioxide (CO_2) is known to stimulate the growth of agronomic weeds, the impact of increasing CO_2 on herbicide efficacy has not been elucidated for field-grown crops. Genetically modified soybean [*Glycine max* (L.) Merr.] (i.e., Round-up Ready soybean) was grown over a 2-yr period at ambient and projected levels of atmospheric carbon dioxide (CO_2, 250 μmol mol^{-1} above ambient), with and without application of the herbicide, glyphosate [*N*-(phosphonomethyl)glycine], to assess the impact of rising atmospheric carbon dioxide concentration [CO_2] on chemical efficacy of weed control. For both years, soybean showed a significant vegetative response to elevated [CO_2], but no consistent effect on seed yield. For 2003, weed populations for all treatments consisted entirely of C_4 grasses, with no [CO_2] effects on weed biomass (unsprayed plots) or glyphosate efficacy (sprayed plots). However, in 2004, weed populations were mixed and included C_3 and C_4 broadleaves as well as C_4 grasses. In this same year, a significant increase in both C_3 broadleaf populations and total weed biomass was observed as a function of [CO_2] (unsprayed plots). In addition, a [CO_2] by glyphosate interaction was observed with significant C_3 broadleaf weed biomass remaining after glyphosate application. Overall, these data emphasize the potential consequences for CO_2 induced changes in weed populations, biomass, and subsequent glyphosate efficacy in Round-up Ready soybean.

Atmospheric carbon dioxide concentration has shown an increase of about 21% from 315 to 379 μmol mol^{-1} since the late 1950s (cdiac.ornl.gov/trends/co2/sio-mlo.htm; verified 10 February 2006). Although the rate of increase is variable, levels are projected to exceed 600 μL L^{-1} by the end of the 21st century (Houghton et al., 2001).

Overall, current and projected increases in global atmospheric [CO_2] are likely to change the biology of agricultural weeds in two fundamental ways. The first is related to climate stability. Evaluations by the Intergovernmental Panel on Climate Change (IPCC) based, in part, on an assessment by the U.S. National Academy of Sciences has indicated that the rise of [CO_2] and associated "greenhouse" gases could lead to a 1.4 to 5.8°C increase in global surface temperatures, with subsequent consequences on precipitation frequency and amounts (IPCC, 2001). Temperature and water availability remain key factors in determining weed species growth and success (Patterson and Flint, 1990; Patterson, 1995a). The second likely impact is the [CO_2] "fertilization" effect. That is, plants evolved at a time when the atmospheric [CO_2] appears to have been four or five times present values (Bowes, 1996). Because CO_2 remains the sole source of carbon for plant photosynthesis, and because at present, [CO_2] is less than optimal, as atmospheric [CO_2] increases, photosynthesis and growth will be stimulated accordingly. Although, in general, the relative effect of increasing [CO_2] is greater for C_3 than C_4 species, species-specific responses demonstrate a wide range of relative enhancement within C_3 and C_4 weeds (Patterson and Flint, 1980).

Weed management efforts, in turn, will be altered both by climatic uncertainty and rising carbon dioxide levels (Ziska, 2004). To date, our understanding of how rising CO_2 affects chemical weed management has focused exclusively on reductions in efficacy for individual weeds or monocultures (Ziska et al., 1999, 2004). Data on how elevated CO_2 could alter weed populations (and subsequent chemical control) are not available in genetically modified crops, that is, crops designed to be treated with herbicides. Our specific objective in the current study, therefore, was to quantify changes in weed populations and potential changes in chemical control efficacy as a function of [CO_2] for Round-up Ready (Monsanto Corp., St. Louis, MO) soybean grown with and without application of commercially formulated glyphosate.

MATERIALS AND METHODS

Experimental Treatments

The experiment was conducted over a 2 yr period at a 0.3 ha plot at Beltsville, MD. Field soil was classified as a Cordurus silt loam (*Cordurus harboro*), pH 5.5 with high availability of potash, phosphate, and nitrate. Twelve experimental aluminum chambers (3 m in diameter and 2.25 m in height) covering an area of 7.2 m^2 were placed at regular intervals within the field. Because of the chamber size, a modified suspended chamber top was necessary to prevent wind intrusion and to maintain a stable CO_2 concentration. For each year of the study, individual chambers were assigned one of two CO_2 treatments, either ambient or ambient +250 μmol mol^{-1} CO_2; and one of two herbicide treatments, either sprayed at manufacturers recommended dosage, or unsprayed. CO_2 treatments were maintained 24 h d^{-1} from germination until maturity. Air was supplied through perforations in the inner wall of the lower half of the chamber. Air was adjusted to the desired [CO_2] with pure CO_2 supplied from a 5 Mg liquid CO_2 tank. Gas samples were withdrawn from all elevated and one ambient CO_2 chamber at 4 min intervals at canopy height and adjustments to the elevated [CO_2] were made daily. Carbon dioxide concentration, determined by an absolute CO_2 analyzer (Li Cor 6252, Li Cor Corp., Lincoln, NE USA),

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Abbreviations: AHI, apparent harvest index; ai, active ingredient; DAS, days after sowing.

indicated average daytime [CO_2] (0600 1900 h) values of 401 ± 21, 384 ± 14, and average nighttime values of 542 ± 35, 527 ± 26 μmol mol ^{1} for the ambient CO_2 treatment in 2003 and 2004, respectively, and corresponding CO_2 values of 624 ± 18, 631 ± 23 (daytime) and 745 ± 32, 753 ± 38 μmol mol ^{1} (night time) for the elevated CO_2 treatment over the same time period.

Growth Conditions

Integrated day time micrometeorological conditions of pho tosynthetic photon flux indicated that the chamber transmitted ~90% of all incoming light, with an average daytime tem perature increase of 0.8 and 1.3°C above the outside ambient temperature for 2003 and 2004, respectively. Overall, average temperatures during the growing season were 1.1°C below and 0.4°C above the 100 yr average for Maryland in 2003 and 2004, respectively. Precipitation values for this same period were 833 and 543 mm. The 2003 year was the wettest in Maryland since the onset of record keeping in 1895.

Before planting and chamber placement, the top 20 cm of soil was removed over the experimental field, bulked, and mixed for each year of the experiment. Subsamples placed in flats indicated uniform mixing, as determined by germination, and the subsequent presence of approximately 25 different annual and perennial weeds. Following chamber placement, soybean 'Ascro' (Ag3002, 'Round up Ready', Maturity Group III, determinate) was planted within the chambers and in bor der rows surrounding the chambers on 27 June and 14 May for 2003 and 2004, respectively. The later planting date in 2003 was necessitated by excessive moisture during May and early June (i.e., the presence of standing water in the field plots during this period). Row widths were ~30 cm with all plants thinned to 1 plant per 10 cm of row following emergence.

Timing of glyphosate application coincided with the period just before canopy closure of soybean rows (as per the rec ommendations of the Maryland Cooperative Extension Ser vice). Glyphosate was applied as a isopropylamine salt with standard surfactant. Spraying occurred approximately 54 and 48 d after sowing (DAS) for 2003 and 2004, respectively, for half of the experimental chambers (i.e., three ambient and three elevated). A pressurized backpack sprayer was used to apply 2.24 kg ai ha ^{1} to each of the treated plots. The other six plots received water only. No effort was made to control weeds on the water sprayed plots.

Vegetative and Reproductive Measurements

Soybean was considered mature when >95% of the leaves had senesced and pods were noticeably brown. Because of differential planting dates (because of the high precipitation in 2003), maturity occurred by late October and late September for 2003 and 2004, respectively. At maturity, four center rows from each chamber (i.e., excluding border rows) were cut at the base of the plant and harvested. At harvest, individual pods were counted and separated by treatment. Pods were air dried and aboveground shoot dry matter (i.e., stems, petioles, peduncles) was oven dried at 65°C for 72 h or until a constant dry weight was observed, then weighed. Pods were threshed by hand and seed collected and weighed. A subsample of 50 seeds was used to determine individual seed mass and to estimate seeds per pod. Because of leaf senescence and drop, harvest index was calculated as the ratio of seed mass to the sum of stem plus pod mass at maturity. This is typically done for commercial soybean and is referred to as the apparent harvest index (AHI) (Schapaugh and Wilcox, 1980).

Weed species were identified by chamber just before application of either water or glyphosate and again at soybean harvest. At soybean harvest, weeds within the harvested rows were cut at their bases, sorted into three general categories: C_3 broadleaf, C_4 broadleaf, or C_4 grass (no C_3 grasses were ob served), dried, and weighed. No new species were observed between glyphosate application (i.e., canopy closure) and har vest. C_3 broadleaves were composed almost entirely (>95%) of three species; lambsquarters (*Chenopodium album* L.), velvetleaf (*Abutilon theophrasti* Medik.) and Virginia copper leaf (*Acalypha virginica* L.); C_4 broadleaves were exclusively redroot pigweed (*Amaranthus retroflexus* L.) and C_4 grasses consisted of barnyard grass [*Echinochloa crus galli* (L.) P. Beauv.], Bermuda grass [*Digitaria sanguinalis* (L.) Scop.] and foxtail (*Setaria* spp.).

Statistical Analysis

The experiment was arranged in a completely randomized block at the field site with three replications of [CO_2] with and

Table 1. Averages and level of statistical significance of the one-way analysis of variance for CO_2 concentration (380 or 630 μmol mol ^{1}) effects on vegetative and reproductive characteristics of field-grown Round-up Ready soybean with and without applications of glyphosate (+Gly or Gly) in 2003 and 2004.

		Averages				Level of significance		
Variable	Units	380	630	+Gly	−Gly	CO_2 effect	Gly effect	Gly × CO_2
2003								
Stem weight	g m^{-2}	135.7	195.3	181.0	149.9	*	*	
Pod number	# m^{-2}	1055	1155	1402	808		**	
Pod weight	g m^{-2}	544.6	518.0	678.8	383.8		**	
Seeds/pod		1.7	2.1	1.7	2.0			
50 seed weight	g	8.5	7.0	7.5	8.2	*		
Total seed	g m^{-2}	299.3	329.9	393.3	235.8		*	
AHI		0.47	0.44	0.46	0.40		*	
2004								
Stem weight	g m^{-2}	338.4	500.7	631.4	207.7	*	***	
Pod number	# m^{-2}	823	1089	1593	320	*	***	(*)
Pod weight	g m^{-2}	385.1	479.9	764.4	100.7		***	
Seeds/pod		2.2	1.8	2.3	1.8			
50 seed weight	g	6.8	7.7	6.5	8.0			(*)
Total seed	g m^{-2}	285.8	365.8	590.2	61.4	*	***	
AHI†		0.32	0.28	0.37	0.18	*	**	

(*) Indicates significance at $P < 0.10$.
* Indicates significance at $P < 0.05$.
** Indicates significance at $P < 0.01$.
*** Indicates significance at $P < 0.001$.
† AHI is apparent harvest index, the ratio of seed mass to the sum of stem plus pod mass at maturity.

Table 2. Averages and level of statistical significance of the one-way analysis of variance for CO_2 concentration (380 or 630 μmol mol ^{1}) effects on above-ground biomass for weed species associated with field-grown Round-up Ready soybean with and without applications of glyphosate (+Gly or Gly) in 2003 and 2004. Data are g per m^2.

	Averages				Level of significance		
Weed type	380	630	+Gly	−Gly	CO_2 effect	Gly effect	Gly × CO_2
2003							
C_4 grasses	138.1	128.1	0.0	266.1		***	
2004							
C_3 broadleaf	48.3	303.9	18.5	333.7	***	***	***
C_4 broadleaf	166.1	257.1	0.0	423.2		***	
C_4 grasses	157.1	23.3	0.5	179.8	(*)	*	

(*) Indicates significance at $P < 0.10$.
*** Indicates significance at $P < 0.05$.**
***** Indicates significance at $P < 0.001$.**

without glyphosate application (three replications × two [CO_2] × two glyphosate treatments). Vegetative and reproductive characteristics were determined for each year of the experiment by a two way ANOVA with [CO_2] and glyphosate as the classification variables (Statview, Cary, NC, USA). Treatment comparisons were made using a Fisher protected least significant difference. Unless otherwise mentioned, differences for any measured parameter were determined as being significant at the $P < = 0.05$ level.

RESULTS

Increasing the [CO_2] by ~250 μmol mol ^{1} resulted in consistent increases in above-ground vegetative biomass, particularly stem weight, for soybean for both seasons (Table 1). However, the effect of elevated [CO_2] on seed yield (with glyphosate application) was inconsistent. Although individual seed weight tended to increase with [CO_2], the effect of [CO_2] was only observed for seed yield in 2004, primarily as a result of increased pod number (Table 1). Overall, the impact of elevated [CO_2] was greater on stem weight than seed yield, with a subsequent reduction in AHI (significant in 2004) (Table 1).

With respect to weed biomass and weed species, 2003 resulted only in the appearance of C_4 grasses; no effect of [CO_2] was observed on their growth (Table 2). In contrast, in 2004 an increase in total weed biomass was observed relative to 2003; and, a greater variety of weed species were observed including C_4 grasses, C_3, and C_4 broadleaf weeds. In 2004, a significant effect of [CO_2] treatment was also observed for the presence of either C_3 broadleaf and C_4 grasses ($P = 0.07$) and subsequent weed biomass (Table 2, Fig. 1). However, the relationship between increasing weed biomass and soybean seed yield was not affected by CO_2 treatment for either year (i.e., no significant differences in slope were observed, Fig. 2).

Not surprisingly, glyphosate application reduced or eliminated weed biomass with a subsequent increase in soybean yield parameters (with the exception of individual seed weight and seeds per pod, Tables 1, 2). No consistent interactions between glyphosate application and CO_2 concentration were observed for any yield parameter. In 2003, application of glyphosate resulted in 100% control of C_4 weeds irrespective of [CO_2] treatment. In contrast, in 2004, glyphosate application only resulted in 100% control for the ambient [CO_2] treatment (Fig. 3). Appreciable amounts of weed biomass (C_3 broadleaves) were still recorded after glyphosate application at the elevated [CO_2] treatment, resulting

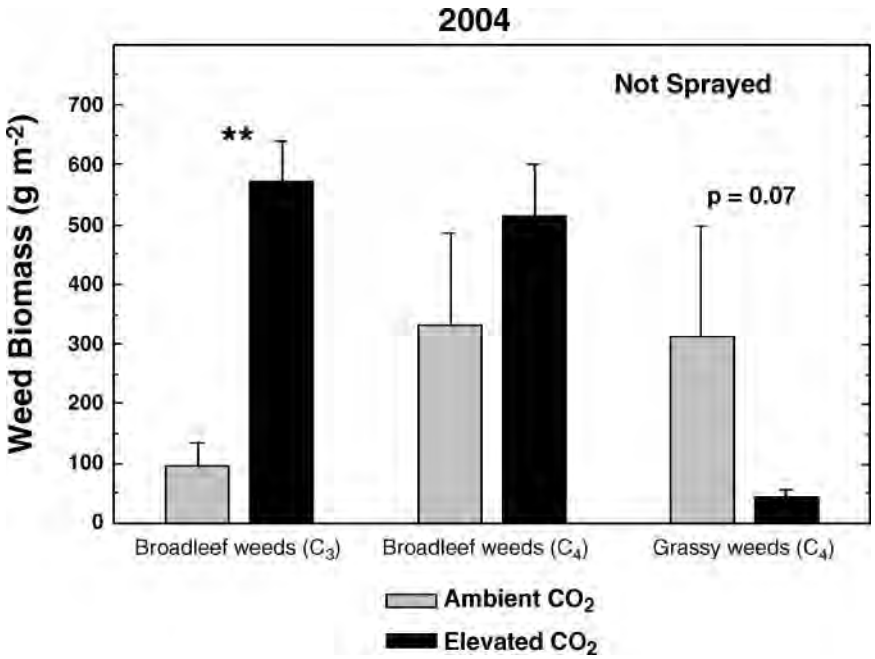

Fig. 1. Quantification of above ground weed biomass in three general categories, (C_3 broadleaf, C_4 broadleaf and C_4 grass) when grown at ambient and elevated (+250 μmol mol^{-1}) [CO_2] in Round-up Ready soybean without glyphosate application in 2004. Variation for a given weed category was tested by a one-way ANOVA, with three replicates. *, $P < 0.05$; **, $P < 0.01$; ***, $P < 0.001$.

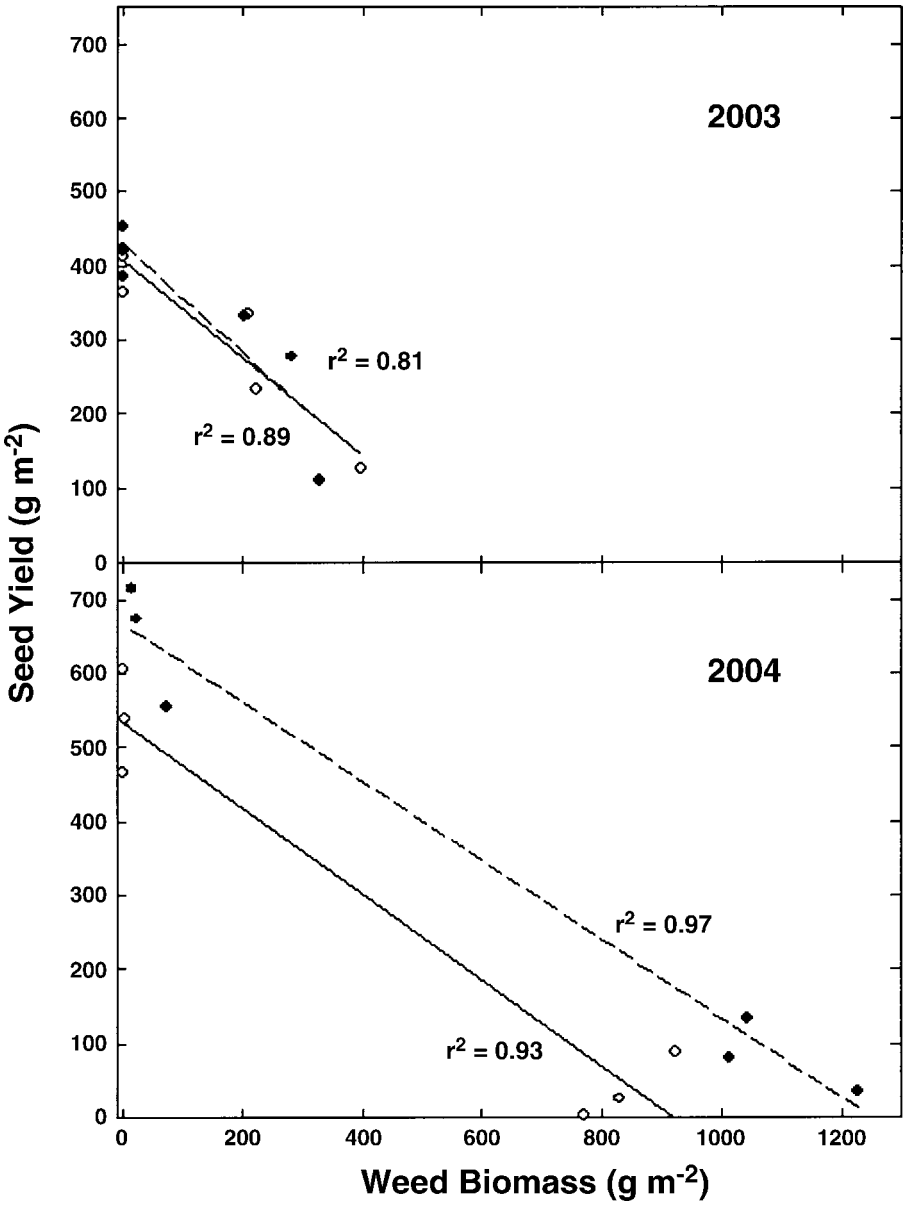

Fig. 2. Soybean seed yield (g m^{-2}) as a function of increasing weed biomass at either ambient (solid line) or elevated (ambient +250 μmol mol^{-1}, dashed line) CO_2 for 2003 and 2004. No differences in the slope of the regression as a function of [CO_2] were observed (ANCOVA).

in a significant [CO_2] by herbicide interaction (Table 2, Fig. 3).

DISCUSSION

Although Round-up Ready soybean demonstrated a positive vegetative response to a [CO_2] increase of ~250 μmol mol^{-1} at maturity in both years, a significant effect on seed yield was only observed in 2004. For that year, the increase in seed yield was accompanied by a reduction in AHI, suggesting that vegetative growth may be a greater sink for additional carbon than reproductive growth. The decline in AHI for soybean observed here was consistent with previous work (Baker et al., 1989; Ziska et al., 2001) and supports the conclusion by Ainsworth et al. (2002) that soybean may show a reduction in AHI regardless of cultivar, growth habit, or maturity group.

If glyphosate (Round-up) is not applied, how does increasing [CO_2] alter the growth of weed populations within the soybean canopy? Given that weed seeds were uniformly distributed within the seedbank before the start of each field season, the impact of CO_2 on weed populations may be dependent on those environmental factors that altered the establishment of C_3 and C_4 weeds. One such factor may be precipitation, which is generally recognized as a significant environmental factor in weed establishment, i.e., higher precipitation favors anoxic conditions and the establishment of shallow rooted grasses or adapted species (Patterson, 1995b). This is consistent with observations from the first year of the current study: specifically, that high precipitation

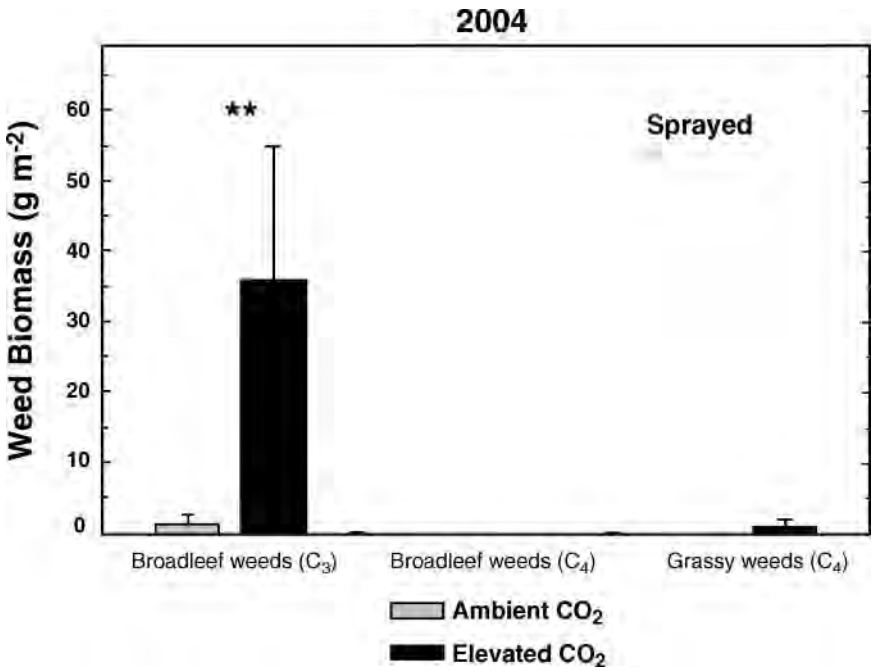

Fig. 3. Quantification of above ground weed biomass in three general categories, (C_3 broadleaf, C_4 broadleaf and C_4 grass) when grown at ambient and elevated (+250 μmol mol^{-1}) [CO_2] in Round-up Ready soybean, but after application of recommended amounts of glyphosate (Round-up). Note that significant amounts of C_3 broadleaf weeds were still present at the elevated CO_2 treatment after glyphosate application. Variation for a given weed category was tested by a one-way ANOVA, with three replicates. *, $P < 0.05$; **, $P < 0.01$; ***, $P < 0.001$.

rates (the highest recorded in Maryland since 1895), resulted in the sole recruitment of C_4 grasses. In this circumstance, elevated [CO_2] had no effect on weed biomass at maturity. However, for near normal precipitation in the following year, a range of weed species, including C_4 broadleaf and grasses, and C_3 broadleaves, was observed. In this year, a significant effect of elevated [CO_2] on total weed biomass was noted, due primarily to an approximate 5× increase in the amount of C_3 broadleaf biomass relative to ambient conditions.

How do differences in [CO_2] alter weed–crop competition and crop losses? The decrease in seed yield per increase in weed biomass (i.e., the slopes in Fig. 2) did not vary between years or as a function of [CO_2], suggesting that reductions in soybean productivity were not significantly altered by weed species per se. This has been observed previously for field grown soybean in competition with a C_3 and C_4 weed population (Ziska, 2000).

But is weed–crop competition even likely if weeds are controlled chemically? Commercially, one of the advantages of using a genetically modified crop such as Round-up Ready soybean is the nonselective application of herbicides for weed control. Previous experimental data have indicated that the effectiveness of glyphosate could be reduced for individual C_3 weeds at elevated [CO_2] under glasshouse conditions (Ziska et al., 1999; Ziska and Teasdale, 2000); however, it was uncertain if similar results would be obtained at commercial application rates in situ.

In the current field study, the overall efficacy of glyphosate application in response to elevated [CO_2] was reduced in 2004. Could greater growth of soybean in response to elevated [CO_2] be reducing spray coverage of glyphosate? This seems unlikely since elevated [CO_2] resulted in greater vegetative biomass in both 2003 and 2004. Alternatively, previous research on individual plants suggested that reduced glyphosate efficacy at elevated [CO_2] was associated primarily with C_3 weeds (Ziska et al., 1999). Such a finding is consistent with the reduction in efficacy observed concurrently with the stimulation of C_3 weeds in field grown soybean for 2004.

If reduced chemical efficacy in response to rising [CO_2] is a function of the relative proportion of C_3 vs. C_4 weeds, then the current study also suggests that those environmental factors that influence the ratio of C_3:C_4 species could play a role in [CO_2] response and subsequent chemical efficacy. For example, if high precipitation results in anoxic conditions and greater grass formation (with an over-representation of the C_4 pathway), the effect of [CO_2] on plant growth could be minimal and glyphosate efficiency unimpaired. Alternatively, if high soil nitrogen increases the population of C_3 relative to C_4 species, then the impact of [CO_2] may be considerable, with subsequent reductions in chemical efficacy.

The mechanistic basis for the reduction in glyphosate efficacy at elevated [CO_2] for C_3 species has not been entirely explained. Previous work with lambsquarters (C_3 broadleaf) suggested that CO_2 induced increases in biomass, while a factor, did not entirely account for the reduction in chemical efficacy (Ziska et al., 1999). Recent work with Canada thistle [C_3 broadleaf, *Cirsium arvense* (L.) Scop.] grown in monoculture under field conditions indicated that in addition to growth stimulation, a greater root to shoot ratio and subsequent belowground dilution of glyphosate increased glyphosate tolerance at elevated relative to ambient [CO_2] (Ziska et al., 2004). In any case, differences in plant size, absorbance

characteristics, or dilution effects were not determined in the current experiment in part because of concerns regarding sampling of weeds within the soybean canopy and physical disturbance effects on soybean seed yield.

But even if increasing [CO_2] alters glyphosate efficacy, is there cause for concern? It could be argued that chemical management could adapt to any CO_2 induced changes in weed control. For example, glyphosate could be applied earlier in the season, or alternatively, herbicide concentration or spraying frequency could be increased. However, if glyphosate application is too early (i.e., before canopy closure), then weed regrowth could occur; similarly, changes in the frequency of application or concentration of glyphosate, while increasing weed control, would also increase economic and/or environmental costs. From an economic perspective, it may be worth noting that any profits associated with greater seed yield at elevated [CO_2] could, potentially, be offset by additional costs of weed control.

While the response of agronomic species to rising atmospheric [CO_2] has been confirmed in literally hundreds of studies (e.g., Kimball, 1983), it is becoming increasingly evident that [CO_2] will also benefit agronomic and invasive weeds as well (Ziska and George, 2004). The argument that rising atmospheric [CO_2] will reduce weedy competition because the C_4 photosynthetic pathway is over represented among weed species (e.g., Holm et al., 1977) does not consider the range of available C_3 and C_4 weed species present within the agronomic seed bank, nor those environmental factors (e.g., precipitation) that may influence their relative proportion following emergence. Overall, the data presented here suggest that, depending on weed species (C_3 vs. C_4), elevated [CO_2] can increase weed biomass, decrease yields, and reduce glyphosate efficacy for Round-up Ready soybean.

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thanks!! Rona

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To Marcus Sarofim
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Subject Re: first comment in volume 4...

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Thanks again you two!

Rona

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Date: 11/18/2009 03:05 PM
Subject: first comment in volume 4...

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with the EPA Climate Division

EPA-1825

Rona Birnbaum/DC/USEPA/US
11/18/2009 08:15 PM

To Ben DeAngelo, David Chalmers, Jason Samenow, Jeremy Martinich, Lesley Jantarasami, Marcus Sarofim, Michael Kolian, Suzanne Kocchi, William Perkins
cc
bcc
Subject latest review table

(b)(5) Deliberative Thanks Suzie (b)(5) Deliberative!

(b)(5) Deliberative
Review Table_Endangerment 111809.xls

EPA-1826

Lesley Jantarasami
04/01/2010 03:51 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\ljantara\My Documents\Endangerment\02_Comments and Responses\Vol 6 stuff\AgComment_Mike.doc

(b)(5) Deliberative [redacted] AgComment_Mike.doc

EPA-1827

Lesley Jantarasami
04/01/2010 03:51 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\ljantara\My Documents\Endangerment\02_Comments and Responses\Vol 6 stuff\RTC draft Volume 6 Ag and Forestry 111709.doc

(b)(5) Deliberative [redacted]RTC draft Volume 6 Ag and Forestry 111709.doc

EPA-1828

Michael Kolian/DC/USEPA/US
11/18/2009 08:46 PM

To Jason Samenow
cc
bcc
Subject Fw: new comment for health

----- Forwarded by Michael Kolian/DC/USEPA/US on 11/18/2009 08:46 PM -----

From: David Chalmers/DC/USEPA/US
To: Michael Kolian/DC/USEPA/US@EPA
Date: 11/18/2009 06:04 PM
Subject: new comment for health

(b)(5) Deliberative

Comment:

(b)(5) Deliberative

Response:

(b)(5) Deliberative

Thanks,

David Chalmers
ORISE Fellow
U.S. EPA, Climate Change Division
202.343.9814

EPA-1829

Jason Samenow/DC/USEPA/US
11/18/2009 08:50 PM

To Rona Birnbaum
cc Marcus Sarofim
bcc
Subject additional volume 2 comments-responses

(b)(5) Deliberative

Jason

(b)(5) Deliberative

new volume 2 comment-responses.doc

EPA-1830

Jason Samenow/DC/USEPA/US
11/18/2009 09:04 PM

To Marcus Sarofim
cc Rona Birnbaum
bcc
Subject Re: additional volume 2 comments-responses

(b)(5) Deliberative

Thanks,
Jason

Marcus Sarofim (b)(5) Deliberative 11/18/2009 08:58:52 PM

From: Marcus Sarofim/DC/USEPA/US
To: Jason Samenow/DC/USEPA/US@EPA
Cc: Rona Birnbaum/DC/USEPA/US@EPA
Date: 11/18/2009 08:58 PM
Subject: Re: additional volume 2 comments-responses

(b)(5) Deliberative

Comment:
(b)(5) Deliberative

Response:
(b)(5) Deliberative

Marcus C. Sarofim, PhD
phone: 202-343-9993
fax: 202-343-2202
1310 L Street 256C
AAAS Science & Technology Policy Fellow
with the EPA Climate Division

Jason Samenow (b)(5) Deliberative 11/18/2009 08:50:45 PM

From: Jason Samenow/DC/USEPA/US

To: Rona Birnbaum/DC/USEPA/US@EPA
Cc: Marcus Sarofim/DC/USEPA/US@EPA
Date: 11/18/2009 08:50 PM
Subject: additional volume 2 comments-responses

(b)(5) Deliberative

Jason

[attachment "new volume 2 comment-responses.doc" deleted by Marcus Sarofim/DC/USEPA/US]

EPA-1831

Marcus Sarofim/DC/USEPA/US
11/18/2009 09:10 PM

To Jason Samenow
cc
bcc
Subject Re: first comment in volume 4...

(b)(5) Deliberative

Volume4firstcommentreplacement.doc

Marcus C. Sarofim, PhD
phone: 202-343-9993
fax: 202-343-2202
1310 L Street 256C
AAAS Science & Technology Policy Fellow
with the EPA Climate Division

Jason Samenow Hey Marcus-- The attachment got stri... 11/18/2009 09:08:24 PM

From: Jason Samenow/DC/USEPA/US
To: Marcus Sarofim/DC/USEPA/US@EPA
Date: 11/18/2009 09:08 PM
Subject: Re: first comment in volume 4...

Hey Marcus-- The attachment got stripped out of Rona's email Can you re-send? (b)(5) Deliberative

Jason

Rona Birnbaum thanks. cc'ing Jason on this comment too 11/18/2009 03:46:30 PM

From: Rona Birnbaum/DC/USEPA/US
To: Marcus Sarofim/DC/USEPA/US@EPA, Jason Samenow/DC/USEPA/US@EPA
Cc: David Chalmers/DC/USEPA/US@EPA
Date: 11/18/2009 03:46 PM
Subject: Re: first comment in volume 4...

thanks. cc'ing Jason on this comment too.

Marcus Sarofim (b)(5) Deliberative 11/18/2009 03:05:22 PM

From: Marcus Sarofim/DC/USEPA/US
To: David Chalmers/DC/USEPA/US@EPA
Cc: Rona Birnbaum/DC/USEPA/US@EPA
Date: 11/18/2009 03:05 PM
Subject: first comment in volume 4...

(b)(5) Deliberative

[attachment "Volume4firstcommentreplacement.doc" deleted by Rona Birnbaum/DC/USEPA/US]

(b)(5) Deliberative

-Marcus

Marcus C. Sarofim, PhD
phone: 202-343-9993
fax: 202-343-2202
1310 L Street 256C
AAAS Science & Technology Policy Fellow
with the EPA Climate Division

EPA-1832

Ben DeAngelo
04/06/2010 04:56 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\owner\My Documents\Endangerment\Response to Public Comments\Additional IQA comments outside of Vol.1.doc

(b)(5) Deliberative [redacted] Additional IQA comments outside of Vol.1.doc

EPA-1833

Marcus Sarofim/DC/USEPA/US
11/18/2009 10:01 PM

To David Chalmers
cc
bcc
Subject comments for merging, 4.1 and 4.2 are done with the exception of the very last comment/response in 4.2

(b)(5) Deliberative

RTC draft Volume 4 Future Projections 111809.RB-MCS.doc

Marcus C. Sarofim, PhD
phone: 202-343-9993
fax: 202-343-2202
1310 L Street 256C
AAAS Science & Technology Policy Fellow
with the EPA Climate Division

EPA-1834

William Perkins/DC/USEPA/US
11/18/2009 10:14 PM

To perkins.william
cc
bcc
Subject volume backup

(b)(5) Deliberative

RTC Volume 8 Dina's incorporated - 111809.doc

Bill Perkins
Climate Change Adaptation Analyst
Climate Science and Impacts Branch
Climate Change Division
U.S. Environmental Protection Agency
perkins.william@epa.gov
(O) 202.343.9460
(F) 202.343.2202
(C) 845.238.1711

EPA-1835

Ben DeAngelo
04/06/2010 04:56 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\owner\My Documents\Endangerment\Response to Public Comments\RTC draft Volume 1 General TSD Approach 11-18-09.doc

(b)(5) Deliberative [redacted] RTC draft Volume 1 General TSD Approach 11-18-09.doc

EPA-1836

Jeremy Martinich
04/01/2010 01:29 PM

To
cc
bcc
Subject UPLOAD G:\CCD\CSIB\Martinich\Endangerment\Endangerment\Comment Sections\Final versions\Volumes\Old versions\RTC draft Volume 1 General TSD Approach 11-18-09.doc

(b)(5) Deliberative [redacted] RTC draft Volume 1 General TSD Approach 11-18-09.doc

EPA-1837

Marcus Sarofim
04/01/2010 08:01 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\msarofim\My Documents\WorkFolder\Tsd_Anpr\ResponseToComments\Volumes\RTC draft Volume 4 Future Projections 111809.RB-MCS.doc

(b)(5) Deliberative [redacted]RTC draft Volume 4 Future Projections 111809.RB-MCS.doc

EPA-1839

William Perkins/DC/USEPA/US
11/19/2009 12:56 AM

To Rona Birnbaum
cc Suzanne Kocchi, Lesley Jantarasami, David Chalmers
bcc
Subject Volume 8 revision for review

Rona,

As discussed, enclosed is [redacted] (b)(5) Deliberative [redacted].

Thank you for your time and attention and please let me know if you have any questions or concerns.

Cheers,

Bill

[redacted] (b)(5) Deliberative

RTC Volume 8 111909.doc

Bill Perkins
Climate Change Adaptation Analyst
Climate Science and Impacts Branch
Climate Change Division
U.S. Environmental Protection Agency
perkins.william@epa.gov
(O) 202.343.9460
(F) 202.343.2202
(C) 845.238.1711

EPA-1842

Lesley Jantarasami/DC/USEPA/US
11/19/2009 09:41 AM

To Jeremy Martinich
cc
bcc
Subject Re: Stock language for impact sections

(b)(5) Deliberative

Lesley Jantarasami
US EPA, Climate Change Division
Climate Science & Impacts Branch
202.343.9929
202.343.2202 (fax)
Jantarasami.Lesley@epa.gov

Jeremy Martinich Thanks, (b)(5) Deliberative ... 11/19/2009 09:38:27 AM

From: Jeremy Martinich/DC/USEPA/US
To: Lesley Jantarasami/DC/USEPA/US@EPA
Date: 11/19/2009 09:38 AM
Subject: Re: Stock language for impact sections

Thanks, (b)(5) Deliberative ?

****
Jeremy Martinich
USEPA, Climate Change Division
202-343-9871

Lesley Jantarasami Comment: (b)(5) Deliberative 11/19/2009 09:09:50 AM

From: Lesley Jantarasami/DC/USEPA/US
To: Jeremy Martinich/DC/USEPA/US@EPA
Date: 11/19/2009 09:09 AM
Subject: Re: Stock language for impact sections

Comment:
(b)(5) Deliberative

Response:
(b)(5) Deliberative

Jeremy Martinich hey Lesley, (b)(5) Deliberative 11/18/2009 09:29:38 PM

From: Jeremy Martinich/DC/USEPA/US
To: Lesley Jantarasami/DC/USEPA/US@EPA
Date: 11/18/2009 09:29 PM
Subject: Stock language for impact sections

hey Lesley,

[redacted] (b)(5) Deliberative [redacted].

Tomorrow is fine.

Thanks,
Jeremy

****

Jeremy Martinich
USEPA, Climate Change Division
202-343-9871

EPA-1843

Jeremy Martinich/DC/USEPA/US
11/19/2009 09:41 AM

To David Chalmers
cc
bcc
Subject Re: streamflow/flooding

http://www.agu.org/pubs/crossref/2006/2005GL024995.shtml

****
Jeremy Martinich
USEPA, Climate Change Division
202-343-9871

David Chalmers [redacted] 11/19/2009 09:31:55 AM

From: David Chalmers/DC/USEPA/US
To: Jeremy Martinich/DC/USEPA/US@EPA
Date: 11/19/2009 09:31 AM
Subject: streamflow/flooding

[redacted]
Thanks.

Comment:
[redacted]

Response:
[redacted]

[redacted]

[redacted]

(b)(5) Deliberative

(b)(5) Deliberative

(b)(5) Deliberative

(b)(5) Deliberative

David Chalmers
ORISE Fellow
U.S. EPA, Climate Change Division
202.343.9814

EPA-1844

Michael Kolian/DC/USEPA/US
11/19/2009 10:14 AM

To Lesley Jantarasami
cc
bcc
Subject norby and nasa

Norby, R.J. et al. 2005. Forest response to elevated CO2 is conserved across a
broad range of productivity. Proceedings of the National Academy of Sciences 100(50):
18052-18056.

This study originated from the Environmental Sciences Division of the Oak Ridge
National Laboratory in Tennessee. The study compared the productivity of the forest
ecosystem to elevated CO2 levels of 550ppm versus normal air, and the results showed a
23% increase in productivity. This was an actual field experiment involving 4 different
forest stands in widely separated locations, not a computer model simulation. In fact, the
authors acknowledged that computer models attempting to predict the effects of rising
CO2 upon the forest ecosystem had previously been constrained by lack of actual
experimental evidence.


EPA-HQ-OAR-2009-0171-1594.1.pdf

available at regulations.gov

(b)(5) Deliberative

http://terra.nasa.gov/FactSheets/LandSurface/

National Aeronautics Space Administration, "Changing Global Land Surface,"
Undated, http://terra.nasa.gov/FactSheets/LandSurface.

EPA-1846

Lesley Jantarasami/DC/USEPA/US
11/19/2009 10:42 AM

To Ben DeAngelo
cc
bcc
Subject black carbon comment from vol 12

Comment:

(b)(5) Deliberative

EPA-1847

Michael Kolian/DC/USEPA/US
11/19/2009 10:43 AM

To Jason Samenow
cc
bcc
Subject Fw: stock summary/response re: impacts and endangerment

(b)(5) Deliberative
Mike

Comment:
(b)(5) Deliberative

Response:
(b)(5) Deliberative

----- Forwarded by Michael Kolian/DC/USEPA/US on 11/19/2009 10:37 AM -----

From: Lesley Jantarasami/DC/USEPA/US
To: Michael Kolian/DC/USEPA/US@EPA, Jeremy Martinich/DC/USEPA/US@EPA, Bill Perkins <perkins.william@epa.gov>
Cc: Rona Birnbaum/DC/USEPA/US@EPA, Ben DeAngelo/DC/USEPA/US
Date: 11/17/2009 01:27 PM
Subject: stock summary/response re: impacts and endangerment

Hello (b)(5) Deliberative

(b)(5) Deliberative

Thanks,

Lesley

(b)(5) Deliberative

Comment:
(b)(5) Deliberative

Response:
(b)(5) Deliberative

(b)(5) Deliberative

EPA-1848

Michael Kolian/DC/USEPA/US
11/19/2009 10:53 AM

To Lesley Jantarasami
cc
bcc
Subject new Ag comments

(b)(5) Deliberative

Comment:

(b)(5) Deliberative

Response:

(b)(5) Deliberative

Comment:

(b)(5) Deliberative

Response:

(b)(5) Deliberative

EPA-1850

Rona Birnbaum/DC/USEPA/US
11/19/2009 11:33 AM

To Jason Samenow
cc
bcc
Subject Fw: Vol 2

----- Forwarded by Rona Birnbaum/DC/USEPA/US on 11/19/2009 11:32 AM -----

From: Rona Birnbaum/DC/USEPA/US
To: Dina Kruger/DC/USEPA/US@EPA
Date: 11/14/2009 09:15 AM
Subject: Vol 2

with my track changes....this is a long one.

(b)(5) Deliberative

RTC draft Volume 2 Validity of Data.RB comments.110609.doc

EPA-1851

Jeremy Martinich/DC/USEPA/US
11/19/2009 11:36 AM

To David Chalmers
cc
bcc
Subject Re: streamflow/flooding

looks good. Thanks.

****
Jeremy Martinich
USEPA, Climate Change Division
202-343-9871

David Chalmers (b)(5) Deliberative 11/19/2009 11:34:58 AM

From: David Chalmers/DC/USEPA/US
To: Jeremy Martinich/DC/USEPA/US@EPA
Date: 11/19/2009 11:34 AM
Subject: Re: streamflow/flooding

(b)(5) Deliberative

Comment:
(b)(5) Deliberative

Response:
(b)(5) Deliberative

(b)(5) Deliberative

(b)(5) Deliberative [redacted] (b)(5) Deliberative [redacted]

David Chalmers
ORISE Fellow
U.S. EPA, Climate Change Division
202.343.9814

Jeremy Martinich (b)(5) Deliberative 11/19/2009 09:52:07 AM

From: Jeremy Martinich/DC/USEPA/US
To: David Chalmers/DC/USEPA/US@EPA
Date: 11/19/2009 09:52 AM
Subject: Re: streamflow/flooding

[redacted]

****
Jeremy Martinich
USEPA, Climate Change Division
202-343-9871

David Chalmers (b)(5) Deliberative 11/19/2009 09:31:55 AM

From: David Chalmers/DC/USEPA/US
To: Jeremy Martinich/DC/USEPA/US@EPA
Date: 11/19/2009 09:31 AM
Subject: streamflow/flooding