EPA-1037

William Perkins/DC/USEPA/US
10/06/2009 10:18 AM

To Carol Holmes
cc Lesley Jantarasami
bcc
Subject Fw: Commenter / comment number list

Carol,

As requested, enclosed is an Excel list of all the (b)(5) Deliberative comment numbers with the associated name and/or affiliation.

Cheers,

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) b (6)

----- Forwarded by William Perkins/DC/USEPA/US on 10/06/2009 10:17 AM -----

From: "Tracy Parham" <Tracy.Parham@erg.com>
To: William Perkins/DC/USEPA/US@EPA
Date: 10/06/2009 10:16 AM
Subject: Re: Commenter/DCN list

Hi Bill,

Here is an excel file of the DCN/Commenter list. It has been sorted by number, so it should be easier to peruse.

Thanks,
Tracy

Tracy DeHaven Parham
Environmental Scientist

Eastern Research Group, Inc.
1600 Perimeter Park Drive
Morrisville, NC 27560
(919)-468-7901 (phone)
(919)-468-7801 (fax)

>>> <Perkins.William@epamail.epa.gov> 10/5/2009 4:48 PM >>>
Tracy,

Would it be possible to arrange the DCN numbers so that they are in order (it might be hard to find a specific number now)? Also, if you

could send it in Excel format also that might be useful. Thank you for your work on this.

Cheers,

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) b (6)

|------------>
| From: |
|------------>

>--
--|
|"Tracy Parham" <Tracy.Parham@erg.com>
|

>--
--|
|------------>
| To: |
|------------>

>--
--|
|William Perkins/DC/USEPA/US@EPA
|

>--
--|
|------------>
| Cc: |
|------------>

>--
--|
|"Mae Thomas" <Mae.Thomas@erg.com>
|

>--
--|
|------------>
| Date: |
|------------>

>--
--|
|10/05/2009 04:37 PM
|

>----------
----------|
|---------->
| Subject: |
|---------->

>----------
----------|
|Commenter/DCN list
|

>----------
----------|

Bill,

Here is the (b) 5 deliberative and associated DCN numbers. Please let me know if you need anything else on this.

Thanks,
Tracy

Tracy DeHaven Parham
Environmental Scientist

Eastern Research Group, Inc.
1600 Perimeter Park Drive
Morrisville, NC 27560
(919)-468-7901 (phone)
(919)-468-7801 (fax)

[attachment "Commenter by DCN.pdf" deleted by William Perkins/DC/USEPA/US]

(b) 5 deliberative

Commenter by DCN.xls

EPA-1038

William Perkins/DC/USEPA/US
10/06/2009 10:22 AM

To Jeremy Martinich, Lesley Jantarasami, Marcus Sarofim, David Chalmers, Ben DeAngelo, Jason Samenow, Michael Kolian
cc Rona Birnbaum
bcc
Subject Fw: Commenter / comment number list

Endangerment team,

Enclosed is an Excel list of (b) 5 deliberative comment number with the associated name and affiliation. OGC requested this but I wanted to send it out to you all in case you find it useful as well. Thank you.

Cheers,

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) b (6)

(b) 5 deliberative
Commenter by DCN.xls

EPA-1039

Doug Grano
03/24/2010 11:33 AM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\dgrano\My Documents\WP\Climate\Rulemaking\Endangerment\Comment-response\emails

[redacted] - emails

~5433934.

Re: Continued discussion on response to public comments re: TSD AQ
Doug Grano
to:
Ben DeAngelo
10/01/2009 04:40 PM
Cc:
Anne Grambsch, Bryan Bloomer, Bryan Hubbell, Carey Jang, Chris Weaver, Dale Evarts, Darrell Winner, Erika Sasser, John Dawson, Larry Wallace, Lesley Jantarasami, Marcus Sarofim, Michael Kolian, Pat Dolwick, Phil Lorang, Rona Birnbaum, Sara Terry
Show Details

Attached is a track changes version where I added or edited several items, mostly in response to comments from Chris and Lesley.
--Doug

From: Ben DeAngelo/DC/USEPA/US
To: Chris Weaver/DC/USEPA/US@EPA
Cc: Anne Grambsch/DC/USEPA/US@EPA, Bryan Bloomer/DC/USEPA/US@EPA, Bryan Hubbell/RTP/USEPA/US@EPA, Carey Jang/RTP/USEPA/US@EPA, Dale Evarts/RTP/USEPA/US@EPA, Darrell Winner/DC/USEPA/US@EPA, Doug Grano/RTP/USEPA/US@EPA, Erika Sasser/RTP/USEPA/US@EPA, John Dawson/DC/USEPA/US@EPA, Larry Wallace/RTP/USEPA/US@EPA, Marcus Sarofim/DC/USEPA/US@EPA, Michael Kolian/DC/USEPA/US@EPA, Pat Dolwick/RTP/USEPA/US@EPA, Phil Lorang/RTP/USEPA/US@EPA, Rona Birnbaum/DC/USEPA/US@EPA, Sara Terry/RTP/USEPA/US@EPA, Lesley Jantarasami/DC/USEPA/US@EPA
Date: 09/29/2009 03:09 PM
Subject: Re: Continued discussion on response to public comments re: TSD AQ

Chris, thanks for the comments! I've inserted them in this doc which is a slightly re-formatted version (b)(5) Deliberative

If you all have any additional edits/comments/thoughts on the AQ issues, please use this attached doc for additional track changes.

Comment:
(b)(5) Deliberative

~5433934.
[attachment "RTC AQ 9-29.doc" deleted by Doug Grano/RTP/USEPA/US]

Thanks!

-Ben

EPA-1040

Carol Holmes/DC/USEPA/US
10/06/2009 11:27 AM

To Ben DeAngelo, John Hannon
cc Lesley Jantarasami
bcc
Subject (b)(5) Deliberative ACP

Commenter Name: John W. McClelland, Ph.D. and Michael S. Graboski, Ph.D.
Commenter Affiliation: American Rental Association
Commenter Type:
Document Control Number: EPA-HQ-OAR-2009-0171-3283.1
Comment Excerpt Number: 2
Form Letter? Yes
Late Comment? No
Comment Changed? No

The majority in Massachusetts vs. EPA concluded that EPA must make a science-based decision on whether anthropogenic greenhouse gases emitted by new automobiles are a threat to the environment. The Court explicitly rejected any arguments related to policy as valid grounds for denying a petition to regulate. The Act requires the Administrator to make an endangerment finding based upon her "judgment" that the emissions cause or contribute to air pollution which may be reasonably anticipated to endanger public health and welfare. A positive endangerment finding will have consequences that reach far beyond the regulation of automobiles under section 202. Once issued, such a finding would pave the way for findings across all energy sectors and ultimately result in a NAAQS for GHGs. If GHGs are a health danger they could be regulated down to the micro level. The Court did not order EPA to make a positive endangerment finding. The Administrator must exercise her judgment as follows: - By concluding that air pollution does cause or contribute… - By concluding that air pollution does not cause or contribute… - By providing a "reasonable explanation" as to why it cannot or will not exercise its discretion to determine whether GHGs endanger public health or welfare… Using the applicable definitions, we interpret this test to mean "Conclude that GHGs endanger public health and welfare by fairly discerning and comparing so as to look forward to an outcome that is certain." The two words, fair and certain are important. Fair suggests that EPA needs to analyze all of the theories behind the rise in temperature over the past century and assign computed probabilities to each theory. Certain cannot be absolute. However, there needs to be a high enough probability for any of the theories to allow the Administrator to exercise her judgment. Thus, EPA must do an unbiased critical analysis to determine if there is any certainty that GHGs are significantly affecting the climate. Then, from the current baseline, EPA must determine how much the temperature is likely to rise and show that future risk from the air pollution is not diminimus. Thus, EPA itself needs to reject the null hypothesis: "The (majority of the) rise of temperature in the 20th century is not a result of warming from anthropogenic GHGs." If EPA can do this, it then must reject a second null hypothesis: "The skill of the favored global climate change models is less than or equal to that for a naïve baseline". Finally, EPA must reject the third null hypothesis: "It is not

possible with any certainty to use global climate models and realistic social scenarios to establish quantified future risks due to GHGs". The conclusions drawn from the analysis presented in this comment show that EPA has failed to address any of these hypotheses.

Carol S. Holmes
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Ave, NW (MC 2344A)
Washington, DC 20460
Phone (202) 564-8709
Fax (202) 564-5603

EPA-1041

Carol Holmes/DC/USEPA/US
10/06/2009 12:32 PM

To Ben DeAngelo
cc Lesley Jantarasami
bcc
Subject (b)(5) Deliberative

(b)(5) Deliberative ACP

THANKS

Commenter Name: Nickolaus E. Leggett
Commenter Affiliation: None
Commenter Type:
Document Control Number: EPA-HQ-OAR-2009-0171-1573.1
Comment Excerpt Number: 1
Form Letter? Yes
Late Comment? No
Comment Changed? No

The Distribution of GHG Emissions The observation has been made that greenhouse gases (GHG) can be considered on a global basis without a need to determine the regional sources of the emissions: "…GHG are relatively evenly distributed throughout the global atmosphere. As a result, the geographic location of emission sources and reductions are generally not important to mitigating global climate change." (Federal Register, Vol. 73, No. 147, Wednesday, July 30, 2008, Page 44408). This suggests that the modeling and prediction of GHG emissions will be greatly simplified because the calculations can be conducted on a national basis without the need to model the emissions on a regional basis. The Need for a GHG Emissions Model The Environmental Protection Agency needs one or more mathematical models of the emissions of GHG. This model or models would predict the expected emissions of GHG based on various scenarios. Such modeling is highly useful because it predicts the magnitude of impacts based on the following situations: Industrial and economic growth and/or decline impacts on emissions; Technological change replacing existing emitters with new technologies; Different regulatory strategies focused on different industries and technologies (tradeoff and priority studies); Potential impacts of costs and incentives on GHG emissions; Economic impacts of GHG emission controls. The more detailed the model, the more useful it is for EPA decision making. Aspects of a GHG Emissions Model The model should have technological components, that represent the processes employed at each major source and the mass flows into and out of that source. The mass flows should include the physical inputs, the wastes emitted, and the product mass flows output. For many industries, such as electric utilities, several processes (such as coal, natural gas, nuclear, and hydro power) are in use. Several more processes are likely to be used in future electric utilities (such as solar photovoltaic, solar thermal, coal with sequestered emissions, wind, tidal, geothermal, biofuel, solar power satellite, etc.). So the model will need to have separate modules that represent each of the current and future

competing technologies in each major industry and emissions source. An economic model of trade between the sources is then used to allocate the mass flows between specific sources that would then compute the emissions based on the technologies used and the mass throughputs of each technology. This basic type of approach was used by the EPA's Strategic Environmental Assessment System (SEAS) model that was operated in the 1970s. However, this GHG emissions model would be much simpler than SEAS because it would not need the regional emissions modeling that SEAS provided. In addition, the computer technology currently available is far superior, easier to use, and less expensive than the technology that was available in the 1970s. Advantages of Mathematical Models A mathematical model is greatly appealing because it forces the Agency to state its assumptions and to examine the consequences of those assumptions. Analysts from the Agency and from other organizations can examine the mass flows and emissions. Inputs from other organizations outside of the EPA can be included in the model and the results examined. This is important because major progress on GHG emissions will depend on cooperation between governmental and private organizations. For example, with a suitable model, analysts can run scenarios using differing percentages of nuclear utility power plants, novel nuclear technologies such as pebble bed reactors, and competing technologies such as solar photovoltaic power stations. More speculative power sources, such as solar power satellites, can be factored in and changes in end use such as electric cars, hybrid cars, and telecommuting can be included. This basic flexibility of the model allows rigorous trade off studies to be carried out. Also, the relative emissions of the various sources can be determined so that the EPA can prioritize its resources on the largest and/or most controllable sources of GHG emissions.

Carol S. Holmes
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Ave, NW (MC 2344A)
Washington, DC 20460
Phone (202) 564-8709
Fax (202) 564-5603

EPA-1042

Ben DeAngelo/DC/USEPA/US
10/06/2009 12:51 PM

To Dina Kruger, Rona Birnbaum, Carol Holmes
cc
bcc
Subject Revised informal briefing for OMB this afternoon

(b) 5 deliberative

Endangerment Comment overview OMB 10.6.09 v2.ppt

(b) 5 deliberative

Any edits you'd like to make before the 3:30?

Are we meeting in 809, 1310 L. ?

-Ben

EPA-1043

Lesley Jantarasami
04/01/2010 03:38 PM

To
cc
bcc
Subject UPLOAD F:\Endangerment\02_Comments and Responses\01_Sections\2.4.1 -- Climate Models.doc

(b) 5 deliberative [redacted]2.4.1 -- Climate Models.doc

EPA-1044

Marcus Sarofim/DC/USEPA/US
10/06/2009 02:18 PM

To David Chalmers
cc
bcc
Subject Re: model comments

Yes, [redacted]

-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

David Chalmers I may have already sent this to you, bu... 10/06/2009 02:02:49 PM

From: David Chalmers/DC/USEPA/US
To: Marcus Sarofim/DC/USEPA/US@EPA
Date: 10/06/2009 02:02 PM
Subject: model comments

I may have already sent this to you, but just want to be sure these are all covered?

Comment:
[redacted]

Response:
[redacted]

Thanks,

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

EPA-1045

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\Commenter by DCN.xls

(b) 5 deliberative [redacted]Commenter by DCN.xls

EPA-1046

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\References FTPsite.xls

(b) 5 deliberative [redacted] References FTPsite.xls

EPA-1047

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\Reference Cat 2005 to present.pdf

(b) 5 deliberative [redacted] Reference Cat 2005 to present.pdf

EPA-1048

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\Reference Cat.pdf

(b) 5 deliberative [redacted] Reference Cat.pdf

EPA-1049

Lesley Jantarasami
04/01/2010 03:38 PM

To
cc
bcc
Subject UPLOAD F:\Endangerment\02_Comments and Responses\01_Sections\2.1.1 Use of USGCRP, CCSP, and IPCC as the Primary Scientific Basis.doc

(b) 5 deliberative [redacted] 2.1.1 Use of USGCRP, CCSP, and IPCC as the Primary Scientific Basis.doc

EPA-1050

Lesley Jantarasami
04/01/2010 03:38 PM

To
cc
bcc
Subject UPLOAD F:\Endangerment\02_Comments and Responses\01_Sections\2.4.5 extreme weather events 100609 lcj.doc

(b) 5 deliberative [redacted] - 2.4.5 extreme weather events 100609 lcj.doc

EPA-1051

Lesley Jantarasami/DC/USEPA/US
10/06/2009 04:16 PM

To David Chalmers
cc Jason Samenow
bcc
Subject Re: 2.4.5

Hey David,

I made some suggested edits and imbedded some comments/questions in the document. This is also posted on Quickr.

(b) 5 deliberative [redacted]
2.4.5 extreme weather events 100609 lcj.doc

Thanks,

Lesley

David Chalmers Jason: Attached for your review (and... 10/01/2009 05:54:14 PM

From: David Chalmers/DC/USEPA/US
To: Jason Samenow/DC/USEPA/US@EPA
Cc: Lesley Jantarasami/DC/USEPA/US@EPA
Date: 10/01/2009 05:54 PM
Subject: 2.4.5

Jason: Attached for your review (and uploaded to Quickr) [redacted] (b)(5) Deliberative [redacted]

Lesley: [redacted] (b) 5 deliberative [redacted]

Thanks,
David

[attachment "2.4.5 extreme weather events 100109.doc" deleted by Lesley Jantarasami/DC/USEPA/US]

EPA-1052

Jeremy Martinich/DC/USEPA/US
10/06/2009 04:25 PM

To Jason Samenow
cc
bcc
Subject Re: (b) 5 deliberative [redacted]

Ok, thanks Jason. I'll take a look and incorporate...

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

Jason Samenow "It is likely that anthropogenic warmin... 10/06/2009 02:47:39 PM

From: Jason Samenow/DC/USEPA/US
To: Jeremy Martinich/DC/USEPA/US@EPA
Date: 10/06/2009 02:47 PM
Subject: (b) 5 deliberative

"It is *likely* that anthropogenic warming has increased drought impacts over North America in recent decades through increased water stresses associated with warmer conditions, but the magnitude of the effect is uncertain."

See: http://downloads.climatescience.gov/sap/sap1-3/sap1-3-final-exec-sum.pdf

(b) 5 deliberative [redacted]

Jason

EPA-1053

Marcus Sarofim

To

cc

bcc

Subject UPLOAD C:\Documents and Settings\msarofim\My Documents\WorkFolder\Tsd_Anpr\ResponseToComments\ResponseChapters\2.3.2.2 -- Solar Irradiance 100609mcs.doc

(b) 5 delibera ive

2.3.2.2 -- Solar Irradiance 100609mcs.doc

EPA-1054

Jason Samenow/DC/USEPA/US
10/06/2009 06:06 PM

To David Chalmers
cc Marcus Sarofim
bcc
Subject Re: have either of you addressed this comment?

other commenters that made this point include:

(b)(5) Deliberati [redacted]

thanks guys.

David Chalmers (b) 5 deliberative [redacted] 10/06/2009 05:21:48 PM

From: David Chalmers/DC/USEPA/US
To: Jason Samenow/DC/USEPA/US@EPA
Cc: Marcus Sarofim/DC/USEPA/US@EPA
Date: 10/06/2009 05:21 PM
Subject: Re: have either of you addressed this comment?

(b) 5 deliberative [redacted] Thanks, Marcus.

Jason Samenow (b)(5) Deliberative [redacted] 10/06/2009 03:48:08 PM

From: Jason Samenow/DC/USEPA/US
To: David Chalmers/DC/USEPA/US@EPA, Marcus Sarofim/DC/USEPA/US@EPA
Date: 10/06/2009 03:48 PM
Subject: have either of you addressed this comment?

(b) 5 deliberative [redacted]

EPA-1055

Jason Samenow/DC/USEPA/US
10/06/2009 07:14 PM

To Marcus Sarofim, David Chalmers
cc
bcc
Subject the climate has always changed comment...

Guys-- (b) 5 deliberative

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

Thanks,
Jason

EPA-1056

Ben DeAngelo/DC/USEPA/US
10/06/2009 11:54 PM

To Jason Samenow
cc "Rona Birnbaum", Carol Holmes, Dina Kruger
bcc
Subject Re: draft talking points re: Hadley temperature data

Thanks Jason! (b) 5 deliberative

-Ben

Jason Samenow | Background: The dataset being referred by CEI t... | 10/06/2009 08:25:00 PM

From: Jason Samenow/DC/USEPA/US
To: Dina Kruger/DC/USEPA/US@EPA
Cc: "Rona Birnbaum" <Birnbaum.Rona@epamail.epa.gov>, Carol Holmes/DC/USEPA/US@EPA, "Ben DeAngelo" <DeAngelo.Ben@epamail.epa.gov>
Date: 10/06/2009 08:25 PM
Subject: draft talking points re: Hadley temperature data

Background:

The dataset being referred by CEI to commonly known as HadCRUT -- it is a record of global land and ocean surface temperature data assembled and analyzed by the Hadley Centre (of the U.K. Met Office) and the University of East Anglia's Climate Research Unit (CRU). The HadCRUT record is prominently featured in IPCC (2007) and used to describe temperatures in the Summary for Policymakers and Technical Summary. However, IPCC (2007) also refers to two other global surface temperature records developed by NOAA and NASA in the full report.

Draft Talking Points:

(b)(5) Deliberative

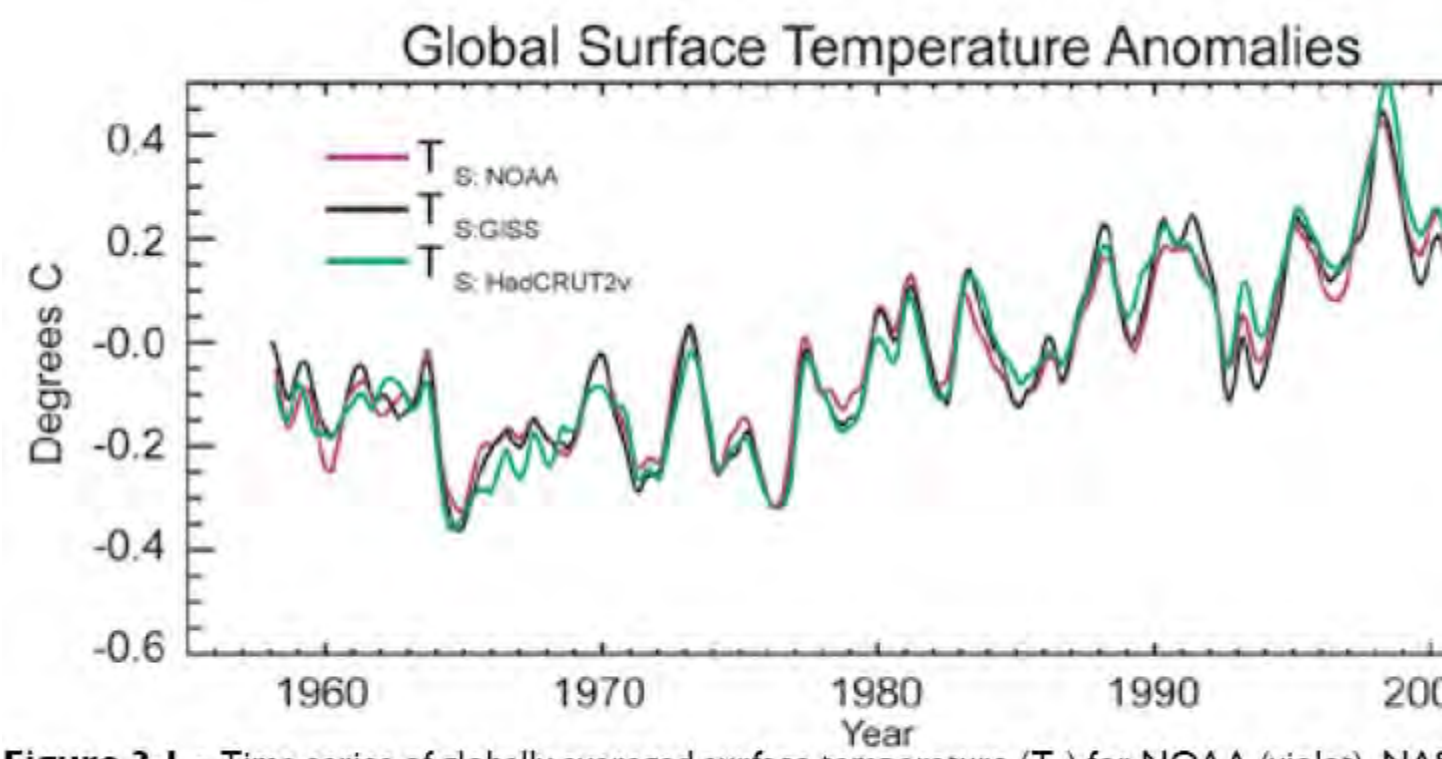


Figure 3.1 - Time series of globally averaged surface temperature (T_S) for NOAA (violet), NAS and HadCRUT2v (green) datasets. All time series are 7-month running averages (used as a sm original monthly data, which were expressed as a departure (°C) from the 1979-97 average.

Figure above is from CCSP, 2006: page 51

References

CCSP, 2006: *Temperature Trends in the Lower Atmosphere: Steps for Understanding and Reconciling Differences.* A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research [Thomas R. Karl, Susan J. Hassol, Christopher D. Miller, and William L. Murray, (eds.)]. Washington, DC.
http://www.globalchange.gov/publications/reports/scientific-assessments/saps/sap1-1

IPCC (2007) Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. See page 247-248 and Table 3.3.

Peterson, T. C., and M. O. Baringer, Eds., 2009: State of the Climate in 2008. *Bull. Amer. Meteor. Soc.*, **90**, S1-S196. See S17-18.

Resources

*Official Web sites where the HadCRUT dataset is documented and made available:
Hadley Centre: http://hadobs.metoffice.com/hadcrut3/
CRU: http://www.cru.uea.ac.uk/cru/data/temperature/

*NOAA's temperature record Web site:

http://www.ncdc.noaa.gov/oa/climate/research/anomalies/index.html

*NASA's temperature record Web site: http://data.giss.nasa.gov/gistemp/

Dina Kruger | Ben/Jason - Can one of you take a look at the att... | 10/06/2009 07:12:34 PM

From: Dina Kruger/DC/USEPA/US
To: "Ben DeAngelo" <DeAngelo.Ben@epamail.epa.gov>, "Jason Samenow" <Samenow.Jason@epamail.epa.gov>
Cc: "Rona Birnbaum" <Birnbaum.Rona@epamail.epa.gov>, carol holmes
Date: 10/06/2009 07:12 PM
Subject: Fw: urgent

Ben/Jason -

Can one of you take a look at the attachment and prepare some short points for tomorrow mid-morning?

(b) 5 deliberative [redacted]

Thanks, and sorry to ruin yet another evening!

Dina

Sent by EPA Wireless E-Mail Services
David McIntosh

----- Original Message -----
From: David McIntosh
Sent: 10/06/2009 06:17 PM EDT
To: Gina McCarthy; Brian Mclean; Dina Kruger
Subject: urgent

(b) 5 deliberative [redacted]

----- Forwarded by David McIntosh/DC/USEPA/US on 10/06/2009 06:16 PM -----

From: Adora Andy/DC/USEPA/US
To: David McIntosh/DC/USEPA/US@EPA
Cc: Allyn Brooks-LaSure/DC/USEPA/US@EPA
Date: 10/06/2009 06:12 PM
Subject: ACTION: Question about petition to reopen endangerment finding

---

(b) 5 deliberative [redacted]

Thanks,
Adora

Adora Andy
Press Secretary
U.S. Environmental Protection Agency
Office of Public Affairs
202-564-2715
andy.adora@epa.gov

----- Forwarded by Adora Andy/DC/USEPA/US on 10/06/2009 06:11 PM -----

From:	"Robin Bravender" <rbravender@eenews.net>
To:	Adora Andy/DC/USEPA/US@EPA
Cc:	Brendan Gilfillan/DC/USEPA/US@EPA, Betsaida Alcantara/DC/USEPA/US@EPA
Date:	10/06/2009 05:52 PM
Subject:	Question about petition to reopen endangerment finding

Hi Adora,

I am writing a story for Wednesday morning about the attached petition that the Competitive Enterprise Institute sent to EPA on Monday regarding the endangerment finding. Senators Barrasso and Inhofe issued a press release today asking for EPA to reopen the public comment period because data that was used as a basis for the finding was destroyed.

I wonder if you would like to comment on the petition or the request that the comment period be reopened because raw data has been destroyed.

Thanks so much for your help. I will be working from out of the office tomorrow morning, so please send me an e-mail or call my cell phone at (b)(6). My deadline is 10:30 a.m.

Best,

Robin Bravender
Cell: (b)(6)
E-mail: rbravender@eenews.net

[attachment "Petition%20plus%20attachments%2010-5-09.pdf" deleted by Jason Samenow/DC/USEPA/US]

EPA-1057

Carol Holmes/DC/USEPA/US
10/07/2009 09:08 AM

To Jason Samenow
cc "Rona Birnbaum", "Ben DeAngelo", Dina Kruger
bcc
Subject Re: draft talking points re: Hadley temperature data

Good Morning y'all --(b)(5) Deliberative ACP

[redacted]

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

Carol S. Holmes
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Ave, NW (MC 2344A)
Washington, DC 20460
Phone (202) 564-8709
Fax (202) 564-5603

Jason Samenow Background: The dataset being referr... 10/06/2009 08:25:02 PM

From: Jason Samenow/DC/USEPA/US
To: Dina Kruger/DC/USEPA/US@EPA
Cc: "Rona Birnbaum" <Birnbaum.Rona@epamail.epa.gov>, Carol Holmes/DC/USEPA/US@EPA, "Ben DeAngelo" <DeAngelo.Ben@epamail.epa.gov>
Date: 10/06/2009 08:25 PM
Subject: draft talking points re: Hadley temperature data

Background:

The dataset being referred by CEI to commonly known as HadCRUT -- it is a record of global land and ocean surface temperature data assembled and analyzed by the Hadley Centre (of the U.K. Met Office) and the University of East Anglia's Climate Research Unit (CRU). The HadCRUT record is prominently featured in IPCC (2007) and used to describe temperatures in the Summary for Policymakers and Technical Summary. However, IPCC (2007) also refers to two other global surface temperature records developed by NOAA and NASA in the full report.

Draft Talking Points:

(b)(5) Deliberative

[redacted]

[redacted]

[redacted]

(b)(5) Deliberative

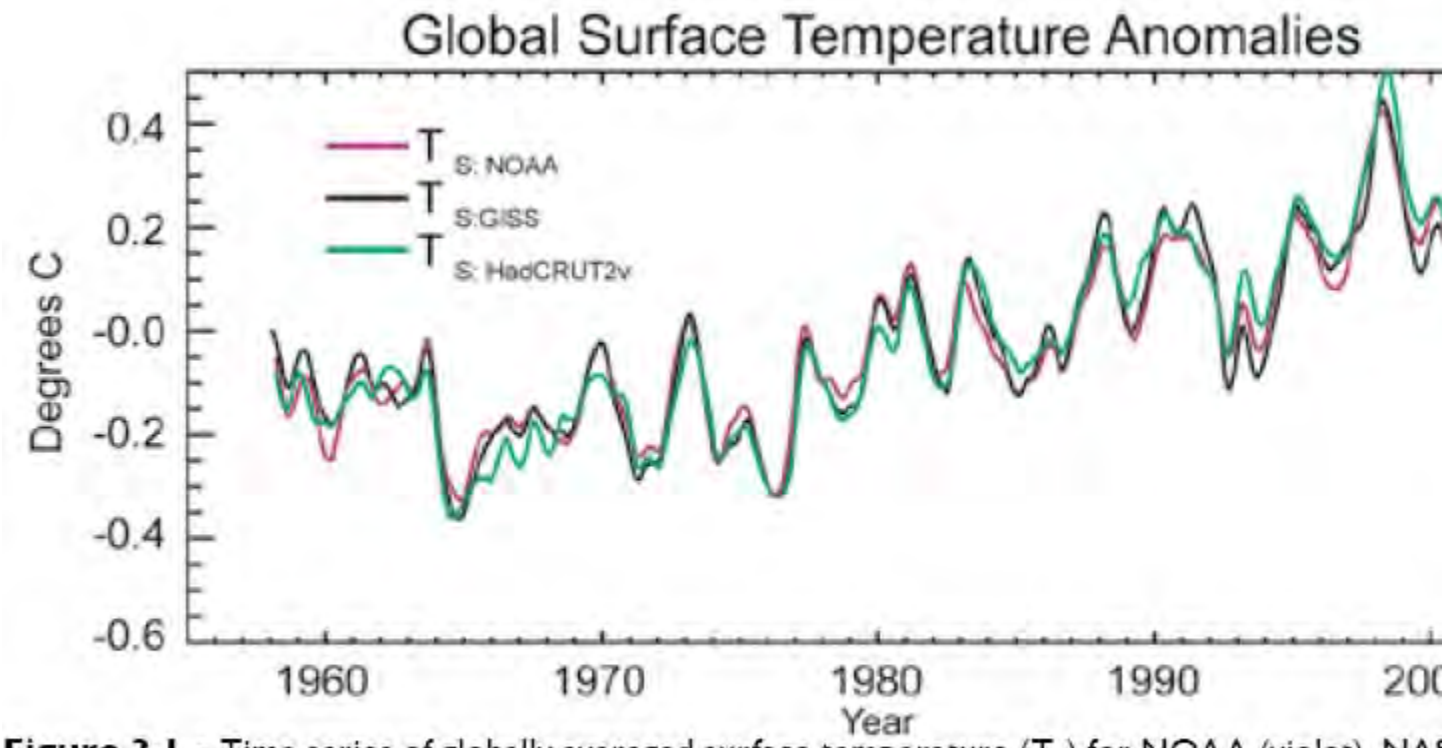


Figure 3.1 - Time series of globally averaged surface temperature (T_S) for NOAA (violet), NAS and HadCRUT2v (green) datasets. All time series are 7-month running averages (used as a sm original monthly data, which were expressed as a departure (°C) from the 1979-97 average.

Figure above is from CCSP, 2006: page 51

References

CCSP, 2006: *Temperature Trends in the Lower Atmosphere: Steps for Understanding and Reconciling Differences.* A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research [Thomas R. Karl, Susan J. Hassol, Christopher D. Miller, and William L. Murray, (eds.)]. Washington, DC.
http://www.globalchange.gov/publications/reports/scientific-assessments/saps/sap1-1

IPCC (2007) Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. See page 247-248 and Table 3.3.

Peterson, T. C., and M. O. Baringer, Eds., 2009: State of the Climate in 2008. *Bull. Amer. Meteor. Soc.*, **90**, S1-S196. See S17-18.

Resources

*Official Web sites where the HadCRUT dataset is documented and made available:
Hadley Centre: http://hadobs.metoffice.com/hadcrut3/
CRU: http://www.cru.uea.ac.uk/cru/data/temperature/

*NOAA's temperature record Web site:
http://www.ncdc.noaa.gov/oa/climate/research/anomalies/index.html

*NASA's temperature record Web site: http://data.giss.nasa.gov/gistemp/

Dina Kruger	Ben/Jason - Can one of you take a look...	10/06/2009 07:12:34 PM

EPA-1058

Carol Holmes/DC/USEPA/US
10/07/2009 09:29 AM

To Jason Samenow
cc Ben DeAngelo, Dina Kruger, Isabel DeLuca, Rona Birnbaum, Grant MacIntyre
bcc
Subject Re: revised talking points on Temp data

(b)(5) Deliberative ACP

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

Carol S. Holmes
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Ave, NW (MC 2344A)
Washington, DC 20460
Phone (202) 564-8709
Fax (202) 564-5603

Jason Samenow (b)(5) Deliberative ACP 10/07/2009 09:21:49 AM

From: Jason Samenow/DC/USEPA/US
To: Carol Holmes/DC/USEPA/US@EPA
Cc: Ben DeAngelo/DC/USEPA/US@EPA, Dina Kruger/DC/USEPA/US@EPA, Isabel DeLuca/DC/USEPA/US@EPA, Rona Birnbaum/DC/USEPA/US@EPA
Date: 10/07/2009 09:21 AM
Subject: Re: revised talking points on Temp data

(b)(5) Deliberative ACP

Carol Holmes Thanks Rona -- (b)(5) Deliberative ACP 10/07/2009 09:15:07 AM

From: Carol Holmes/DC/USEPA/US
To: Rona Birnbaum/DC/USEPA/US@EPA
Cc: Ben DeAngelo/DC/USEPA/US@EPA, Dina Kruger/DC/USEPA/US@EPA, Isabel DeLuca/DC/USEPA/US@EPA, Jason Samenow/DC/USEPA/US@EPA
Date: 10/07/2009 09:15 AM
Subject: Re: revised talking points on Temp data

Thanks Rona -- (b)(5) Deliberative ACP

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

Carol S. Holmes
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Ave, NW (MC 2344A)
Washington, DC 20460
Phone (202) 564-8709
Fax (202) 564-5603

Rona Birnbaum | Background: The dataset being referred by CEI i... | 10/07/2009 09:06:02 AM

From: Rona Birnbaum/DC/USEPA/US
To: Dina Kruger/DC/USEPA/US@EPA
Cc: Jason Samenow/DC/USEPA/US@EPA, Ben DeAngelo/DC/USEPA/US@EPA, Carol Holmes/DC/USEPA/US@EPA, Isabel DeLuca/DC/USEPA/US@EPA
Date: 10/07/2009 09:06 AM
Subject: revised talking points on Temp data

Background:

The dataset being referred by CEI is commonly known as HadCRUT -- it is a record of global land and ocean surface temperature data assembled and analyzed by the Hadley Centre (of the U.K. Met Office) and the University of East Anglia's Climate Research Unit (CRU). The HadCRUT record is prominently featured in IPCC (2007) and used to describe temperatures in the Summary for Policymakers.

Talking Points:

(b)(5) Deliberative

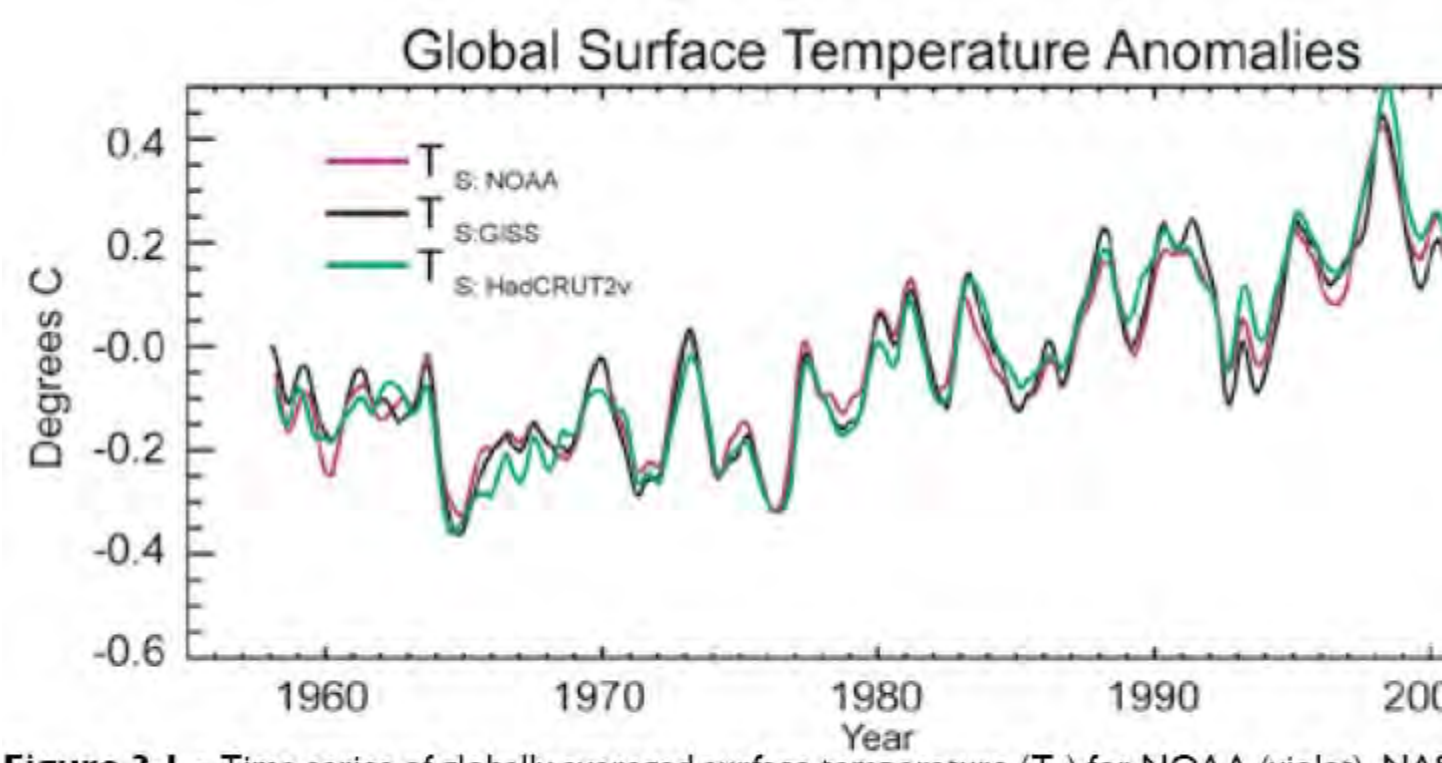


Figure 3.1 - Time series of globally averaged surface temperature (T_S) for NOAA (violet), NAS and HadCRUT2v (green) datasets. All time series are 7-month running averages (used as a sm original monthly data, which were expressed as a departure (°C) from the 1979-97 average.

References

CCSP, 2006: *Temperature Trends in the Lower Atmosphere: Steps for Understanding and Reconciling Differences.* A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research [Thomas R. Karl, Susan J. Hassol, Christopher D. Miller, and William L. Murray, (eds.)]. Washington, DC.
http://www.globalchange.gov/publications/reports/scientific-assessments/saps/sap1-1

IPCC (2007) Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. See page 247-248 and Table 3.3.

Peterson, T. C., and M. O. Baringer, Eds., 2009: State of the Climate in 2008. *Bull. Amer. Meteor. Soc.*, **90**, S1-S196. See S17-18.

Resources

*Official Web sites where the HadCRUT dataset is documented and made available:
Hadley Centre: http://hadobs.metoffice.com/hadcrut3/
CRU: http://www.cru.uea.ac.uk/cru/data/temperature/

*NOAA's temperature record Web site:
http://www.ncdc.noaa.gov/oa/climate/research/anomalies/index.html

*NASA's temperature record Web site: http://data.giss.nasa.gov/gistemp/

EPA-1059

Dina Kruger/DC/USEPA/US
10/07/2009 10:34 AM

To Adora Andy, david mcintosh, gina mccarthy
cc Brian Mclean, Rona Birnbaum, Jason Samenow, carol holmes
bcc
Subject More detailed response to the CEI petition

Here is some more detailed talking points on the issue raised by the CEI petition. Thanks to Jason Samenow in Rona's group for pulling this together. (b)(5) Deliberative

Please let me know if you need more information. I will be out of the office this afternoon, so call my cell if any urgent issues arise. (b)(6)

Thanks,
Dina

Background:

The dataset being referred by CEI is commonly known as HadCRUT -- it is a record of global land and ocean surface temperature data assembled and analyzed by the Hadley Centre (of the U.K. Met Office) and the University of East Anglia's Climate Research Unit (CRU). The HadCRUT record is prominently featured in IPCC (2007) and used to describe temperatures in the Summary for Policymakers.

Talking Points:

(b)(5) Deliberative

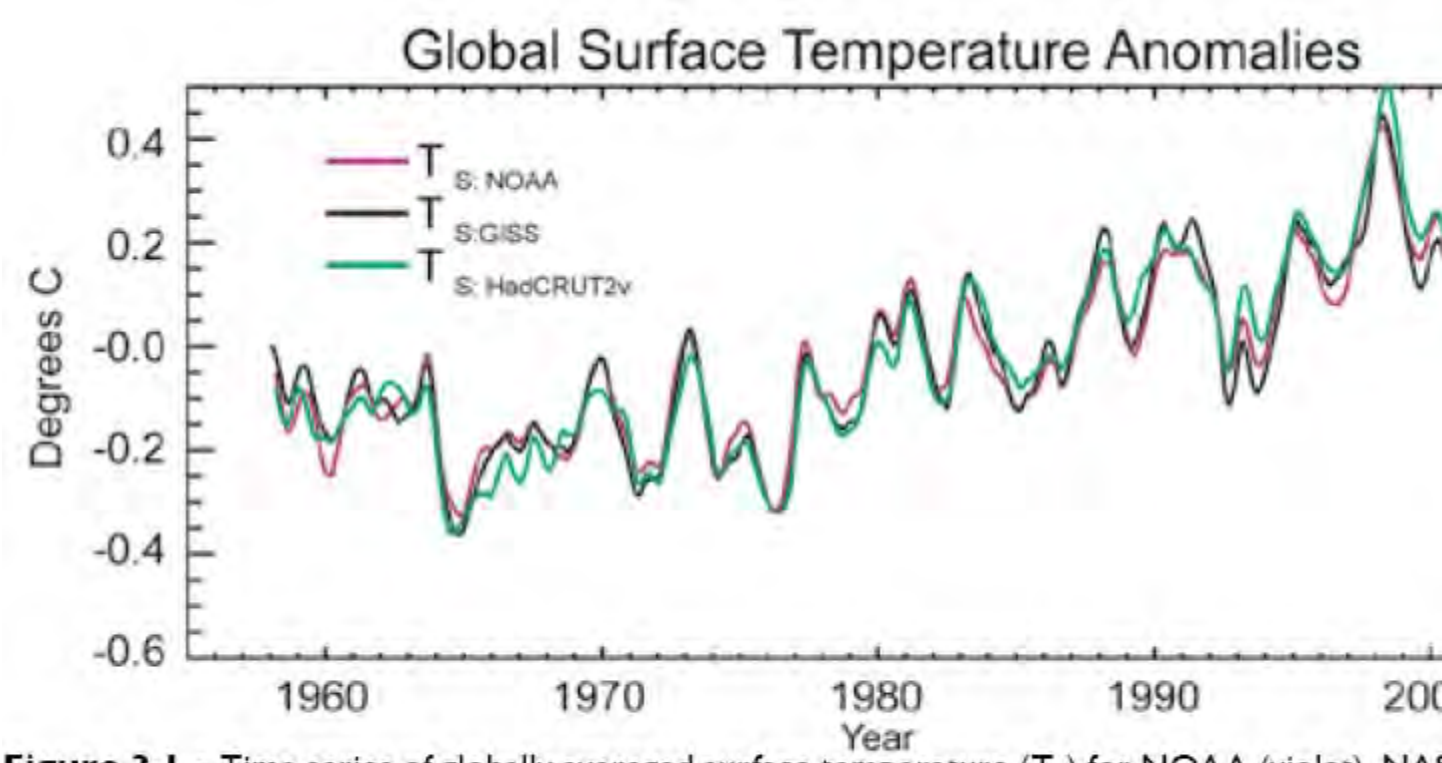


Figure 3.1 - Time series of globally averaged surface temperature (T_S) for NOAA (violet), NAS and HadCRUT2v (green) datasets. All time series are 7-month running averages (used as a sm original monthly data, which were expressed as a departure (°C) from the 1979-97 average.

References

CCSP, 2006: *Temperature Trends in the Lower Atmosphere: Steps for Understanding and Reconciling Differences.* A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research [Thomas R. Karl, Susan J. Hassol, Christopher D. Miller, and William L. Murray, (eds.)]. Washington, DC.
http://www.globalchange.gov/publications/reports/scientific-assessments/saps/sap1-1

IPCC (2007) Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. See page 247-248 and Table 3.3.

Peterson, T. C., and M. O. Baringer, Eds., 2009: State of the Climate in 2008. *Bull. Amer. Meteor. Soc.*, **90**, S1-S196. See S17-18.

Resources

*Official Web sites where the HadCRUT dataset is documented and made available:
Hadley Centre: http://hadobs.metoffice.com/hadcrut3/
CRU: http://www.cru.uea.ac.uk/cru/data/temperature/

*NOAA's temperature record Web site:
http://www.ncdc.noaa.gov/oa/climate/research/anomalies/index.html

*NASA's temperature record Web site: http://data.giss.nasa.gov/gistemp/

Dina Kruger
Director, Climate Change Division
USEPA

202-343-9039 (phone)
202-343-2290 (fax)

EPA-1060

William Perkins/DC/USEPA/US
10/07/2009 10:38 AM

To Jeremy Martinich
cc
bcc
Subject Additional comment excerpt (b)(5) Deliberative

Jeremy,

I am honored to present to you a comment excerpt (b)(5) Deliberative Please let me know if you have any questions, concerns, or suggestions -- or disagree with this approach -- and thank you.

Cheers,

Bill

Commenter Name: Kyle B. Isakower
Commenter Affiliation: American Petroleum Institute
Commenter Type:
Document Control Number: EPA-HQ-OAR-2009-0171-3747.1
Comment Excerpt Number: 6
Form Letter? No
Late Comment? No
Comment Changed? No
View Original Comment Letter

> When predicting the negative impacts of precipitation, especially EPA's predictions that heavier rains will lead to flood events, EPA should, but does not, explain how it estimates incremental increases in flooding impacts over and above those impacts anticipated due to non-climate change and which are currently the basis for prudent flood control design in the U.S. This is another example where EPA does not recognize, or calculate the impacts of, mitigating factors which currently exist and are highly likely to be expanded regardless of climate change. Further, EPA's analysis expressly identified an expectation of significant endangerment due to stronger coastal storms, cyclones, and the like. Yet recent studies are not unequivocal in this matter. For example, with regard to potential increases in coastal cyclones, recent findings indicate that these concerns may not be valid.89 These studies project a smal decrease in intensity and a likely reduction in the number of storms making landfall in the U.S. The IQA and EPA's IQA Guidelines require EPA to look to the entire body o credible science and prohibit looking at only favorable or supportive studies. With so many o EPA's predicted adverse impacts tied to precipitation and extreme weather, EPA is especially obligated to identify and review on and for the record all credible relevant science regardin meteorology and precipitation. EPA has not complied with the IQA or the Agency's own guidelines, to the exten EPA only identified andaddressed studies which supported the Agency's conclusion. 90 As such, • we submit this RFC asking that EPA update its finding by critically analyzing the results of these studies and assess its information-gathering

procedures to ensure the Agency is acquiring and reviewing the full body of available and appropriate data. If the Agency determines that it does not need to review these or other studies in order to produce a complete and unbiased Endangerment Finding, then EPA should respond and explain on and for the record: • Why the studies listed in Appendix A should not be considered by EPA; Whether EPA was previously aware of the studies listed in Appendix A; • How EPA ensures that it is reviewing a reasonably complete and impartial body of the available relevant science; and • What EPA's criteria were for determining which studies the Agency would review and cite. [Footnote 88: Guidelines for Ensuring and Maximizing the Quality, Objectivity, Utility, and Integrity of Informatio Disseminated by the Environmental Protection Agency, EPA/260R-02-008 (Oct. 2002), at 21.] [Footnote 89: Knutson, T.R., et al., 2008. Simulated reduction in Atlantic hurricane frequency under twenty-first-century warming conditions. Nature Geosciences, doi:10.1038/ngeo202; Vecchi, G.A. and B.J. Soden. 2007. Effect o remote sea surface temperature change on tropical cyclone potential intensity. Nature, 450, 1066-1071; Vecchi, G. A., et al., 2008. Whither Hurricane Activity? Science, 322, 687-689.] [Footnote 90: TSD at 129-139, 143, 159-160.]

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) b (6) [redacted]

EPA-1061

Carol Holmes/DC/USEPA/US
10/07/2009 10:43 AM

To Lesley Jantarasami
cc Ben DeAngelo
bcc
Subject some comments for OAR for (b)(5) Deliberative [redacted]

They may not be new in that you've seen versions of them before, but wanted to make sure.

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

4.1.1, 4.1.2.1, 4.2 (old 5.1, 5.1.2, 6.3) for OAR.doc

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

Carol S. Holmes
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Ave, NW (MC 2344A)
Washington, DC 20460
Phone (202) 564-8709
Fax (202) 564-5603

EPA-1062

Rona Birnbaum/DC/USEPA/US
10/07/2009 11:55 AM

To Carol Holmes
cc William Perkins, David Chalmers
bcc
Subject Re: (b)(5) Deliberative ACP [redacted]

we'll check and get back to you.
thanks

Carol Holmes (b)(5) Deliberative ACP 10/07/2009 11:50:45 AM

From: Carol Holmes/DC/USEPA/US
To: Rona Birnbaum/DC/USEPA/US@EPA, William Perkins/DC/USEPA/US@EPA
Date: 10/07/2009 11:50 AM
Subject: (b)(5) Deliberative ACP [redacted]

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

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

Carol S. Holmes
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Ave, NW (MC 2344A)
Washington, DC 20460
Phone (202) 564-8709
Fax (202) 564-5603

EPA-1063

Carol Holmes/DC/USEPA/US
10/07/2009 04:01 PM

To Lesley Jantarasami
cc Ben DeAngelo
bcc
Subject some more comments for y'all

making sure you see -- (b)(5) Deliberative [redacted] Enjoy!

(b)(5) Deliberative [redacted]
from1st and 2nd addendum for OAR.doc

(b)(5) Deliberative [redacted] Make sense?

THANKS

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

Carol S. Holmes
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Ave, NW (MC 2344A)
Washington, DC 20460
Phone (202) 564-8709
Fax (202) 564-5603

EPA-1064

David Chalmers/DC/USEPA/US
10/08/2009 09:55 AM

To Lesley Jantarasami
cc
bcc
Subject Re: I found one!

(b) 5 deliberative [redacted]

Thanks,
David

Lesley Jantarasami Hey David (b) 5 deliberative [redacted] 10/02/2009 04:17:36 PM

From: Lesley Jantarasami/DC/USEPA/US
To: David Chalmers/DC/USEPA/US@EPA
Date: 10/02/2009 04:17 PM
Subject: I found one!

Hey David

(b) 5 deliberative [redacted]

[attachment "EPA-HQ-OAR-2009-0171-3476.2.pdf" deleted by David Chalmers/DC/USEPA/US]

Thanks!

Lesley

EPA-1065

ghgendangerment
Sent by: David Chalmers

10/08/2009 11:52 AM

To Rona Birnbaum
cc Jeremy Martinich, Carol Holmes
bcc
Subject Fw: Letter to the EPA

FYI

(b) 5 deliberative [redacted]

Thanks,
David

----- Forwarded by David Chalmers/DC/USEPA/US on 10/08/2009 11:47 AM -----

From: "David R. Legates" <legates@UDel.Edu>
To: ghgendangerment@EPA
Date: 10/07/2009 02:55 PM
Subject: Letter to the EPA

To whom it may concern,

On behalf of my thirty-three co-signers, I am submitting this letter in response to a request for comments on the EPA's "Proposed Endangerment and Cause or Contribute Findings for Greenhouse Gases under the Clean Air Act." I request that you confirm your receipt of this letter either by e-mail (legates@udel.edu) or telephone (302-831-4920).

Thank you in advance for your consideration of our letter.

Take care,

David R. Legates
University of Delaware

 - EPA Letter.pdf

available at regulations.gov

The Honorable Lisa P. Jackson, Administrator
Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460

October 9, 2009

Dear Administrator Jackson:

We congratulate you on your appointment to EPA Administrator and commend you for your commitment to "science-based policies and programs, adherence to the rule of law, and overwhelming transparency." We write today because the United States finds itself at a crossroads where these values are sure to be tested.

Recently, the U.S. Chamber of Commerce submitted a petition for an on-the-record hearing under the Clean Air Act before the EPA proceeds with its proposed rulemaking on the regulation of greenhouse gases, *Proposed Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act, Proposed Rule*, 74 Fed. Reg. 18,886 (Apr. 24, 2009) (hereinafter "Endangerment Finding").

The Chamber requested a hearing based on 5 U.S.C. §§ 556-57 where: all proceedings would be conducted on the record; the decision-maker would be the Administrator, Deputy Administrator, or an Administrative Law Judge; the decision-maker would have the benefit of the full Clean Air Scientific Advisory Committee; parties could submit supporting documents, data, and presentations; and agencies other than the EPA designated in Executive Order No. 13,432 could designate a single official to observe and participate in the proceedings.

In light of the monumental importance of the EPA's proposed rulemaking, we urge the adoption of the Chamber's request. Additionally, we urge the EPA to address four critical questions, which, in addition to the issues enumerated in the Chamber's Petition, are central to the EPA's proposed rulemaking. Indeed, these questions require careful analysis before intelligent public policy can be promulgated. They are:

1. Is the Earth's climate changing in an unusual or anomalous fashion?
2. Does the science permit rejection of the hypothesis that CO_2 is only a minor player in the Earth's climate system?
3. Can climate models that assume CO_2 is a key determinant of climate change provide forecasts of future conditions that are adequate for policy analysis?
4. Can we reject the hypothesis that the primary drivers of the Earth's climate system will continue to be natural (non-anthropogenic) forces and internal climate variability?

The fundamental issue facing the EPA is whether or not human-caused CO_2 emissions have already led to, or can be expected in the future, to lead to significant adverse changes in the Earth's climate system. That is, in order to justify the current proposed Endangerment Finding, a very critical theory or assumption that must stand up to rigorous scientific analysis is that higher

atmospheric CO_2 levels will, with some appropriate level of confidence, lead to measurably higher surface temperatures.

This theory can only be tested or validated by testing the so-called null hypothesis that CO_2 is a minor player in the Earth's climate system. If this null hypothesis cannot be rejected, there is no basis for regulating CO_2, particularly given the enormously negative implications of such regulation on the Nation's Energy, Economic and National Security.

Is the Earth's climate changing in an unusual or anomalous fashion?

Atmospheric CO_2 levels have increased by more than 20% over the last 50 years. If atmospheric CO_2 levels, in fact, have more than a minor impact on the Earth's climate system, one would expect to see the impact in the relevant climate data. So, to answer the question, "Is the Earth's climate changing in an unusual or anomalous fashion?" it is necessary to rigorously seek answers to at least the following five questions:

- Is the Earth's air temperature change unusual?
- Are droughts becoming longer and more intense due to increasing CO_2?
- Are floods and heavy rainfall events increasing due to increasing CO_2?
- Are hurricanes and tropical storms becoming stronger and more intense?
- Are sea levels rising dramatically due to increasing CO_2?

The scientific evidence and empirical data strongly suggest there are respected scientists who would answer "no" to each of these five questions. Thus, despite the over 20% rise in CO_2 over the last 50 years, there is little credible evidence that any of these dimensions of the Earth's climate system have shown anomalous behavior.

Does the science permit rejection of the hypothesis that CO_2 is only a minor player in the Earth's climate system?

Whether or not the EPA, at this point, concurs with "no" answers to all of these questions, correlation does not imply causation. For example, the fact that CO_2 concentration and surface temperature both rose over the period 1975 to, say, 1998 does not imply that rising CO_2 was the primary cause, which is clearly indicated by the fact that while CO_2 concentration continued to rise, temperatures have recently been falling. Therefore, we feel that it is critical that the EPA utilize a rigorous process to address the question: "Does the science permit rejection of the hypothesis that CO_2 is a minor player in the Earth's climate system?" To properly answer this question, one must address each of the following issues:

- Is carbon dioxide (CO_2) the most important of the greenhouse gases in the atmosphere?
- Does a "tipping point" exist where more CO_2 will ultimately lead to "run away" warming?
- In the past, did increases in CO_2 cause increases in the Earth's temperature?
- Since CO_2 concentrations have recently risen dramatically, is the warming consistent with a "Greenhouse Gas fingerprint"?

- Is there evidence that rising CO_2 levels are leading to acidification of the oceans which threatens calcium carbonate-based marine life?

An unbiased, critical review of the literature by respected scientists would have many of them answering "no" to each of these five questions.

Thus, if the EPA would come to believe that the answers to the questions spelled out above were all "no", it would imply that the scientific evidence and experimental data to date suggest that the Earth's climate system has not been behaving in an anomalous fashion; and, as of today, there is no known credible reason why further increasing CO_2 levels will cause harm in the future.

Can climate models that assume CO_2 is a key determinant of climate change provide forecasts of future conditions that are adequate for policy analysis?

In our view, particularly with temperatures now falling, the argument for CO_2 regulation rests solely on the "validity" of the climate models relied upon by the IPCC and the EPA. Thus it is crucial to answer the questions, "Can climate models that assume CO_2 is a key determinant of climate change, provide a forecast quality sufficient for such critical regulatory policy decisions?" To properly address this issue, it is necessary to seek rigorously developed answers to the following questions:

- Do global climate models properly handle "feedbacks" in the Earth's climate system?
- Do global climate models perform well in simulating the climate and compare well when forecasting the impact of increased levels of CO_2?
- Have modelers followed the well-documented and validated rules set forth by academic forecasting professionals?
- Did these models forecast the recent decline in temperatures?

Evidence in the literature would strongly suggest that many respected scientists would answer "no" to each of these four questions, which may well eliminate any possible rationale for regulating CO_2. It should be noted that it should not be surprising that models that assume CO_2 is a critical player in the Earth's climate system cannot be validated for policy analysis when we can demonstrate that rising CO_2 levels have had little impact on the Earth's climate so far, and at this point, there is little theoretical reason to believe they will ever have a significant impact.

Can we reject the hypothesis that the primary drivers of the Earth's climate system will continue to be natural (non-anthropogenic) forces and internal climate variability?

Finally, since atmospheric CO_2 levels are not demonstrably relevant determinants of the Earth's climate, it is highly relevant to ask, what is really driving changes in the Earth's climate? To address this issue, climate science literature would suggest that the following question be answered: "Can we reject the hypothesis that the primary drivers of the Earth's climate system will continue to be natural (non-anthropogenic) forces and internal climate variability? More specifically, one must at least ask:

- Does the sun play a significant role in climate variations on short (multi-decadal or shorter) time scales?
- Can volcanic activity and changes in stratospheric aerosols affect climate on short (multi-decadal or shorter) time scales?
- Do oscillations in ocean temperatures and the oceanic conveyor belt have a significant effect on the Earth's climate?
- Do cloud/water vapor feedback mechanisms significantly affect the climate system on short (multi-decadal or shorter) time scales?

It is clear from the literature that many respected scientists would answer each of these four questions independently with a resounding "yes".

Recommendation

We feel strongly that the EPA must not only rigorously address all four of the additional questions outlined at the outset, but also deal with at least the 18 supporting issues. As can be clearly seen by an analysis of the different fields of knowledge and academic skills required to answer the 18 detailed questions listed above, no one scientist should feel comfortable answering each and every question. And yet, without thoughtful, fully-informed judgments on all of the questions by the scientists who are expert in the particular issue area, the EPA should not feel comfortable issuing an Endangerment Finding in support of CO_2 regulation. Because of the need to have only those highly qualified to provide answers to each of the questions outlined above, we strongly suggest that the EPA grant the U.S. Chamber of Commerce Petitions, and in particular, adopt its recommendation regarding the use of the an on-the-record hearing conducted pursuant to 5 U.S.C. §§ 556-57.

While following such an analysis process may well be more arduous than planned, the implications of ill-founded CO_2 regulation could be truly catastrophic. Hardly a day goes by without another prominent scientist joining the ranks of those who reject the conclusion of the IPCC that the primary driver of the Earth's climate system is CO_2 emissions from human use of fossil fuels rather than other natural forces.

The EPA has the authority to hold on-the-record hearings under the Clean Air Act using procedures based on 5 U.S.C. §§ 556-57. As the Administrative Conference of the United States said, such authority should be exercised whenever (a) the scientific, technical, or other data relevant to the proposed rule are complex, (b) the problem posed is so open-ended that diverse views should be heard, and (c) the costs that errors may impose are significant. *See* 1 C.F.R. § 305.76-3(1) (1993). The Chamber noted in its petition that "it is hard to imagine a situation where each part of this test is more easily met." We concur and urge the EPA to hold a formal, on-the-record hearing before proceeding with any proposed Endangerment Finding.

Thank you for your consideration.

Dr. J. Scott Armstrong
Professor at The Wharton School
University of Pennsylvania

Dr. Robert H. Austin
Professor of Physics
Princeton University

Dr. Robert M. Carter
Professor in the Marine Geophysical Laboratory
James Cook University (Australia)

Dr. Ian Clark
Professor of Earth Sciences
University of Ottawa (Canada)

Dr. Roger W. Cohen (Retired)
Manager, Strategic Planning and Programs
ExxonMobil Corporation

Dr. Susan J. Crockford
Adjunct Professor of Anthropology
University of Victoria (Canada)

Dr. Chris de Freitas
Associate Professor of Geography and Environmental Science
The University of Auckland (New Zealand)

Dr. David Deming
Associate Professor of Arts & Sciences
University of Oklahoma

Dr. Donald Easterbrook (Emeritus)
Professor of Geology
Western Washington University

Dr. Robert H. Essenhigh
E.G. Bailey Emeritus Professor of Energy Conversion
The Ohio State University

Dr. Patrick Frank
SLAC National Accelerator Center
Stanford University

Dr. Stewart W. Franks
Associate Professor of Engineering
University of Newcastle (Australia)

Dr. Laurence I. Gould
Professor of Physics
University of Hartford

Dr. Kesten C. Green
Business & Economic Forecasting Unit
Monash University (Australia)

Dr. Sultan Hameed
Professor of Atmospheric Science
Stony Brook University

Dr. William Happer
Cyrus Fogg Brackett Professor of Physics
Princeton University

Dr. Craig D. Idso, Chairman
Center for the Study of Carbon Dioxide and Global Change
Tempe, Arizona

Mr. William Kininmonth
Australasian Climate Research
Kew, Victoria (Australia)

Dr. George Kukla
Special Research Scientist
Lamont-Doherty Earth Observatory

Dr. David R. Legates, C.C.M.
Associate Professor of Climatology
University of Delaware

Dr. Richard S. Lindzen
Alfred P. Sloan Professor of Atmospheric Sciences
Massachusetts Institute of Technology

Anthony R. Lupo
Professor of Soil, Environmental, and Atmospheric Sciences
University of Missouri

Dr. Ross R. McKitrick
Professor of Economics
University of Guelph (Canada)

Dr. Patrick J. Michaels
School of Public Policy
George Mason University

Dr. Paul B. Queneau
Metallurgical Engineer and Educator
Golden, Colorado

Dr. Tim R. Patterson
Professor of Earth Sciences
Carleton University (Canada)

Dr. Nicola Scafetta
Department of Physics
Duke University

Dr. Harrison Schmitt
Adjunct Professor of Engineering
University of Wisconsin-Madison

Dr. S. Fred Singer (Emeritus)
Professor of Environmental Sciences
University of Virginia

Dr. Willie Soon
Astrophysicist and Geoscientist
Salem, Massachusetts

Mr. George H. Taylor, C.C.M.
Applied Climate Services, LLC
Corvallis, Oregon

Dr. Mitchell Taylor
Lecturer in Geography
Lakehead University (Canada)

Dr. Brian G. Valentine, PE
US Department of Energy
Washington, DC

Dr. George T. Wolff
Air Improvement Resource, Inc.
Novi, Michigan

EPA-1066

Lesley Jantarasami
04/01/2010 03:45 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\ljantara\My Documents\Endangerment\01_Full Doc\RTC old intro section\RTC Foreword 100809.doc

(b) 5 deliberative [redacted]RTC Foreword 100809.doc

EPA-1067

Lesley Jantarasami/DC/USEPA/US
10/08/2009 12:01 PM

To Jason Samenow
cc Ben DeAngelo, David Chalmers, Jeremy Martinich, Marcus Sarofim, Michael Kolian, Rona Birnbaum, William Perkins
bcc
Subject New RTC outline and Foreword

Hello endangerment team,

As discussed in our meeting this morning, (b) 5 deliberative I've also attached the revised outline. (b) 5 deliberative

(b) 5 deliberative RTC Foreword 100809.doc (b) 5 deliberative RTC Outline in 4 volumes 100609.doc

Thanks!

Lesley

EPA-1068

Carol Holmes/DC/USEPA/US
10/08/2009 12:04 PM

To ghgendangerment
cc David Chalmers, ghgendangerment, Jeremy Martinich, Rona Birnbaum
bcc
Subject Re: Fw: Letter to the EPA

(b)(5) Deliberative ACP

[redacted]

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

Carol S. Holmes
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Ave, NW (MC 2344A)
Washington, DC 20460
Phone (202) 564-8709
Fax (202) 564-5603

---

ghgendangerment Carol: Below the text we've used for similar rece... 10/08/2009 12:01:57 PM

From: ghgendangerment
To: ghgendangerment@epa.gov
Cc: Carol Holmes/DC/USEPA/US@EPA, Jeremy Martinich/DC/USEPA/US@EPA, Rona Birnbaum/DC/USEPA/US@EPA
Date: 10/08/2009 12:01 PM
Subject: Re: Fw: Letter to the EPA

Carol: Below the text we've used for similar recent emails. (b)(5) Deliberative Thanks.

This email serves to confirm receipt of your email and the attached petition. If you have any questions, please respond to this email or call 202-343-9927.

Thank you.

ghgendangerment FYI (b) 5 deliberative 10/08/2009 11:52:40 AM

From: ghgendangerment
To: Rona Birnbaum/DC/USEPA/US@EPA
Cc: Jeremy Martinich/DC/USEPA/US@EPA, Carol Holmes/DC/USEPA/US@EPA
Date: 10/08/2009 11:52 AM
Subject: Fw: Letter to the EPA

FYI

(b) 5 deliberative

[redacted]

Thanks,
David

----- Forwarded by David Chalmers/DC/USEPA/US on 10/08/2009 11:47 AM -----

From:	"David R. Legates" <legates@UDel.Edu>
To:	ghgendangerment@EPA
Date:	10/07/2009 02:55 PM
Subject:	Letter to the EPA

To whom it may concern,

On behalf of my thirty-three co-signers, I am submitting this letter in response to a request for comments on the EPA's "Proposed Endangerment and Cause or Contribute Findings for Greenhouse Gases under the Clean Air Act." I request that you confirm your receipt of this letter either by e-mail (legates@udel.edu) or telephone (302-831-4920).

Thank you in advance for your consideration of our letter.

Take care,

David R. Legates
University of Delaware
[attachment "EPA Letter.pdf" deleted by David Chalmers/DC/USEPA/US]

EPA-1069

William Perkins/DC/USEPA/US
10/08/2009 12:16 PM

To Lesley Jantarasami
cc
bcc
Subject Re: New RTC outline and Foreword

Lesley,

The foreword looks fantastic. Thank you for doing this for us -- we are lucky to have you leading this effort.

Cheers,

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) b (6) [redacted]

Lesley Jantarasami Hello endangerment team, As disc... 10/08/2009 12:01:43 PM

From: Lesley Jantarasami/DC/USEPA/US
To: Jason Samenow/DC/USEPA/US@EPA
Cc: 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: 10/08/2009 12:01 PM
Subject: New RTC outline and Foreword

Hello endangerment team,

As discussed in our meeting this morning, (b) 5 deliberative [redacted] I've also attached the revised outline. (b) 5 deliberative [redacted]

[attachment "RTC Foreword 100809.doc" deleted by William Perkins/DC/USEPA/US] [attachment "RTC Outline in 4 volumes 100609.doc" deleted by William Perkins/DC/USEPA/US]

Thanks!

Lesley

EPA-1070

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 Outline in 4 volumes 100609.doc

(b) 5 deliberative [redacted] RTC Outline in 4 volumes 100609.doc

EPA-1071

Lesley Jantarasami
04/01/2010 03:49 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\ljantara\My Documents\Endangerment\02_Comments and Responses\05_For OGC Review\Sections 3 and 5 Comments for OGC.doc

(b) 5 deliberative [redacted] Sections 3 and 5 Comments for OGC.doc

EPA-1072

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 Foreword 100809 BJD.doc

(b) 5 deliberative [redacted] RTC Foreword 100809 BJD.doc

EPA-1073

Lesley Jantarasami
04/01/2010 03:45 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\ljantara\My Documents\Endangerment\01_Full Doc\RTC old intro section\RTC Foreword 100809 BJD.doc

(b) 5 deliberative [redacted] RTC Foreword 100809 BJD.doc

EPA-1074

Ben DeAngelo/DC/USEPA/US
10/08/2009 02:06 PM

To Lesley Jantarasami
cc Rona Birnbaum
bcc
Subject Re: New RTC outline and Foreword

Thanks Lesley. Looks good, had only some minor things on the foreward(s).

(b) 5 deliberative

RTC Foreword 100809 BJD.doc

Lesley Jantarasami Hello endangerment team, As disc... 10/08/2009 12:01:43 PM

From: Lesley Jantarasami/DC/USEPA/US
To: Jason Samenow/DC/USEPA/US@EPA
Cc: 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: 10/08/2009 12:01 PM
Subject: New RTC outline and Foreword

Hello endangerment team,

As discussed in our meeting this morning, (b) 5 deliberative . I've also attached the revised outline. (b) 5 deliberative

[attachment "RTC Foreword 100809.doc" deleted by Ben DeAngelo/DC/USEPA/US] [attachment "RTC Outline in 4 volumes 100609.doc" deleted by Ben DeAngelo/DC/USEPA/US]

Thanks!

Lesley

EPA-1075

Carol Holmes/DC/USEPA/US
10/08/2009 02:06 PM

To Lesley Jantarasami
cc Ben DeAngelo
bcc
Subject Re: some more comments for y'all

Thanks? :)

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

Carol S. Holmes
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Ave, NW (MC 2344A)
Washington, DC 20460
Phone (202) 564-8709
Fax (202) 564-5603

Lesley Jantarasami Hi Carol, Yes, that makes sense. (b)(5) Deliberative ACP 10/08/2009 01:55:48 PM

From: Lesley Jantarasami/DC/USEPA/US
To: Carol Holmes/DC/USEPA/US@EPA
Cc: Ben DeAngelo/DC/USEPA/US@EPA
Date: 10/08/2009 01:55 PM
Subject: Re: some more comments for y'all

Hi Carol,

Yes, that makes sense. [redacted] (b)(5) Deliberative ACP [redacted] Also, I came across some comments that I wanted to make sure OGC saw, and I noted where in the outline I thought they applied.

Thanks,

Lesley

[attachment "Sections 3 and 5 Comments for OGC.doc" deleted by Carol Holmes/DC/USEPA/US]

Carol Holmes making sure you see -- (b)(5) Deliberative ACP 10/07/2009 04:01:52 PM

From: Carol Holmes/DC/USEPA/US
To: Lesley Jantarasami/DC/USEPA/US@EPA
Cc: Ben DeAngelo/DC/USEPA/US@EPA
Date: 10/07/2009 04:01 PM
Subject: some more comments for y'all

making sure you see -- (b)(5) Deliberative ACP [redacted] Enjoy!

[attachment "from1st and 2nd addendum for OAR.doc" deleted by Lesley Jantarasami/DC/USEPA/US]

(b)(5) Deliberative ACP [redacted] Make sense?

THANKS

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

Carol S. Holmes
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Ave, NW (MC 2344A)
Washington, DC 20460
Phone (202) 564-8709
Fax (202) 564-5603

EPA-1076

Lesley Jantarasami/DC/USEPA/US
10/08/2009 02:07 PM

To David Chalmers
cc
bcc
Subject comment redistrib review

David,

Just left you a voice message about this:

(b) 5 deliberative

4.1 General Comments on Technical.doc

If you have some time to look through and let me know where you think these comments should be redistributed, that would be great!

Thanks,

Lesley

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

EPA-1077

Lesley Jantarasami
04/01/2010 03:45 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\ljantara\My Documents\Endangerment\01_Full Doc\RTC old intro section\RTC Foreword 100909.doc

(b) 5 delibera ive RTC Foreword 100909.doc

EPA-1078

Carol Holmes/DC/USEPA/US
10/08/2009 02:46 PM

To Lesley Jantarasami
cc Ben DeAngelo
bcc
Subject Re: some more comments for y'all

(b)(5) Deliberative ACP

THANKS

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

Carol S. Holmes
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Ave, NW (MC 2344A)
Washington, DC 20460
Phone (202) 564-8709
Fax (202) 564-5603

Lesley Jantarasami Hi Carol, Yes, that makes sense. ... 10/08/2009 01:55:48 PM

From: Lesley Jantarasami/DC/USEPA/US
To: Carol Holmes/DC/USEPA/US@EPA
Cc: Ben DeAngelo/DC/USEPA/US@EPA
Date: 10/08/2009 01:55 PM
Subject: Re: some more comments for y'all

Hi Carol,

Yes, that makes sense. (b)(5) Deliberative ACP Also, I came across some comments that I wanted to make sure OGC saw, and I noted where in the outline I thought they applied.

Thanks,

Lesley

[attachment "Sections 3 and 5 Comments for OGC.doc" deleted by Carol Holmes/DC/USEPA/US]

Carol Holmes making sure you see -- (b)(5) Deliberative ACP 10/07/2009 04:01:52 PM

From: Carol Holmes/DC/USEPA/US
To: Lesley Jantarasami/DC/USEPA/US@EPA
Cc: Ben DeAngelo/DC/USEPA/US@EPA
Date: 10/07/2009 04:01 PM
Subject: some more comments for y'all

making sure you see -- (b)(5) Deliberative ACP

Enjoy!

[attachment "from1st and 2nd addendum for OAR.doc" deleted by Lesley Jantarasami/DC/USEPA/US]

(b)(5) Deliberative ACP

Make sense?

THANKS

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

Carol S. Holmes
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Ave, NW (MC 2344A)
Washington, DC 20460
Phone (202) 564-8709
Fax (202) 564-5603

EPA-1079

David Chalmers/DC/USEPA/US
10/08/2009 03:10 PM

To Lesley Jantarasami
cc
bcc
Subject Re: comment redistrib review

I think you're initial thoughts were largely right on target. I've made a few minor suggestions in the attached. I've noted several comments I think (b)(5) Deliberative I've also highlighted arguments that have already been well covered in existing responses and thus may not require further action. Let me know if you think the comments I've suggested (b)(5) Deliberative

Cheers,
David

(b) 5 deliberative
4.1 General Comments on Technical + DBC.doc

Lesley Jantarasami David, Just left you a voice messag... 10/08/2009 02:07:08 PM

From: Lesley Jantarasami/DC/USEPA/US
To: David Chalmers/DC/USEPA/US@EPA
Date: 10/08/2009 02:07 PM
Subject: comment redistrib review

David,

Just left you a voice message about this:

[attachment "4.1 General Comments on Technical.doc" deleted by David Chalmers/DC/USEPA/US]

If you have some time to look through and let me know where you think these comments should be redistributed, that would be great!

Thanks,

Lesley

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

EPA-1080

David Chalmers/DC/USEPA/US
10/08/2009 03:36 PM

To Lesley Jantarasami
cc
bcc
Subject Re: comment redistrib review

(b) 5 deliberative [redacted]

Thanks,

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

Lesley Jantarasami Great, thanks so much. I agree with your com... 10/08/2009 03:32:06 PM

From: Lesley Jantarasami/DC/USEPA/US
To: David Chalmers/DC/USEPA/US@EPA
Date: 10/08/2009 03:32 PM
Subject: Re: comment redistrib review

Great, thanks so much. I agree with your comments (b)(5) Deliberative [redacted]

4.1.5.2 Articulation of Method
Comment:
(b)(5) Deliberative [redacted]

Thanks,

Lesley

David Chalmers I think you're initial thoughts were largely right on... 10/08/2009 03:10:43 PM

From: David Chalmers/DC/USEPA/US
To: Lesley Jantarasami/DC/USEPA/US@EPA
Date: 10/08/2009 03:10 PM
Subject: Re: comment redistrib review

I think you're initial thoughts were largely right on target. I've made a few minor suggestions in the attached. I've noted several comments I think (b)(5) Deliberative [redacted] I've also highlighted arguments that have already been well covered in existing responses and thus may not require further action. Let me know if you think the

comments I've suggested [redacted] (b)(5) Deliberative [redacted]

Cheers,
David

[attachment "4.1 General Comments on Technical + DBC.doc" deleted by Lesley Jantarasami/DC/USEPA/US]

Lesley Jantarasami | David, Just left you a voice message about this: | 10/08/2009 02:07:08 PM

From: Lesley Jantarasami/DC/USEPA/US
To: David Chalmers/DC/USEPA/US@EPA
Date: 10/08/2009 02:07 PM
Subject: comment redistrib review

David,

Just left you a voice message about this:

[attachment "4.1 General Comments on Technical.doc" deleted by David Chalmers/DC/USEPA/US]

If you have some time to look through and let me know where you think these comments should be redistributed, that would be great!

Thanks,

Lesley

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

EPA-1081

Lesley Jantarasami
04/01/2010 03:48 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\ljantara\My Documents\Endangerment\02_Comments and Responses\04_Summaries for Ben\2.1.6 Cost Benefit 100809.doc

(b) 5 deliberative [redacted] 2.1.6 Cost Benefit 100809.doc

EPA-1082

Lesley Jantarasami/DC/USEPA/US
10/08/2009 05:39 PM

To (b)(6) Lesley Jantarasami
cc
bcc
Subject docs

(b) 5 deliberative
4.1.1, 4.1.2.1, 4.2 (old 5.1, 5.1.2, 6.3) for OAR.doc

(b) 5 deliberative
from1st and 2nd addendum for OAR.doc

(b) 5 deliberative
Redistributed Comments from Carol.doc

(b) 5 deliberative
4.1 General Comments on Technical + DBC.doc

(b) 5 deliberative
2.1.6 Cost Benefit.doc

EPA-1083

Jeremy Martinich/DC/USEPA/US
10/08/2009 06:20 PM

To Jason Samenow
cc "Ben DeAngelo", "Jeremy Martinich", Rona Birnbaum, "Jason Samenow"
bcc
Subject Re: Fw: Fw: Request for Correction under Information Quality Guidelines

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

Jeremy

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

Jason Samenow | Rona-- This makes sense to me. Jason | 10/08/2009 03:36:27 PM

From: Jason Samenow/DC/USEPA/US
To: Rona Birnbaum/DC/USEPA/US@EPA
Cc: "Ben DeAngelo" <deangelo.ben@epa.gov>, "Jeremy Martinich" <martinich.jeremy@epa.gov>, "Jason Samenow" <samenow.jason@epa.gov>
Date: 10/08/2009 03:36 PM
Subject: Re: Fw: Fw: Request for Correction under Information Quality Guidelines

Rona-- This makes sense to me.

Jason

Rona Birnbaum | Please have a look. ---------- | 10/07/2009 07:18:01 PM

From: Rona Birnbaum/DC/USEPA/US
To: "Ben DeAngelo" <deangelo.ben@epa.gov>, "Jason Samenow" <samenow.jason@epa.gov>, "Jeremy Martinich" <martinich.jeremy@epa.gov>
Date: 10/07/2009 07:18 PM
Subject: Fw: Fw: Request for Correction under Information Quality Guidelines

Please have a look.

Sent by EPA Wireless E-Mail Services
Monica Jones

----- Original Message -----
From: Monica Jones
Sent: 10/07/2009 03:27 PM EDT
To: Carol Holmes; David LaRoche; Grant MacIntyre; Manisha Patel; Rona Birnbaum
Subject: Re: Fw: Request for Correction under Information Quality Guidelines
Here is our proposed response to the CEI correspondence. Please provide your comments or clearance of this document by COB, Tuesday, October 13.

Thanks!

[attachment "CEI response.doc" deleted by Jason Samenow/DC/USEPA/US]

Monica D. Jones
IQG Team Leader
OEI, Quality Staff
Phone: (202) 564-1641
FAX: (202) 565-2441

Carol Holmes | Hi everyone. Rona -- this is about the CEI petiti... | 10/07/2009 03:06:02 PM

From: Carol Holmes/DC/USEPA/US
To: Grant MacIntyre/DC/USEPA/US@EPA
Cc: David LaRoche/DC/USEPA/US@EPA, Lynn Bradley/DC/USEPA/US@EPA, Manisha Patel/DC/USEPA/US@EPA, Monica Jones/DC/USEPA/US, Rona Birnbaum/DC/USEPA/US@EPA
Date: 10/07/2009 03:06 PM
Subject: Re: Fw: Request for Correction under Information Quality Guidelines

Hi everyone.

Rona -- this is about the CEI petition that came in Monday re the CRU data. In addition to submitting the comment to the docket and anyone else in OAR program office, they also sent a copy to the IQA email box asking that the petition be treated as a Request for Correction. (b)(5) Deliberative

(b)(5) Deliberative ACP

OK?

THANKS

Carol S. Holmes
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Ave, NW (MC 2344A)
Washington, DC 20460
Phone (202) 564-8709
Fax (202) 564-5603

Grant MacIntyre | Monica: This type of response makes sense to... | 10/07/2009 02:53:38 PM

From: Grant MacIntyre/DC/USEPA/US
To: Monica Jones/DC/USEPA/US
Cc: David LaRoche/DC/USEPA/US@EPA, Lynn Bradley/DC/USEPA/US@EPA, Rona Birnbaum/DC/USEPA/US@EPA, Carol Holmes/DC/USEPA/US@EPA, Manisha

Patel/DC/USEPA/US@EPA
Date: 10/07/2009 02:53 PM
Subject: Re: Fw: Request for Correction under Information Quality Guidelines

Monica:

This type of response makes sense to me, however please check with Rona Birnbaum in OAR and Carol Holmes in OGC Air and Radiation Law Office before sending the response. I've CCed them on this e-mail.

Thanks,

Grant B. MacIntyre
U.S. EPA Office of General Counsel
Cross-Cutting Issues Law Office (CCILO)
(202) 564-6165

Monica Jones (b)(5) Deliberative ACP 10/07/2009 02:35:54 PM

From: Monica Jones/DC/USEPA/US
To: Grant MacIntyre/DC/USEPA/US@EPA
Cc: David LaRoche/DC/USEPA/US@EPA, Lynn Bradley/DC/USEPA/US@EPA
Date: 10/07/2009 02:35 PM
Subject: Fw: Request for Correction under Information Quality Guidelines

(b)(5) Deliberative ACP
For your convenience, I attached a copy of this response. (b)(5) Deliberative ACP

Give me a call after you read the correspondence and the email from Hans Bader.

[attachment "letterResponse062309.doc" deleted by Carol Holmes/DC/USEPA/US]

Monica D. Jones
IQG Team Leader
OEI, Quality Staff
Phone: (202) 564-1641
FAX: (202) 565-2441

NOTICE: This communication may contain deliberative, privileged or other confidential information. Do not release under FOIA without appropriate review. If you are not the intended recipient or believe you have received this communication in error, please delete the copy you received, and do not print, copy, re-transmit, disseminate or otherwise use the information. Thank you.
----- Forwarded by Monica Jones/DC/USEPA/US on 10/07/2009 02:34 PM -----

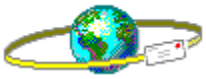
From: Kimberlie Orr/DC/USEPA/US
To: Monica Jones/DC/USEPA/US, Lynn Bradley/DC/USEPA/US@EPA, Connie Thoma/DC/USEPA/US@EPA
Cc: Reggie Cheatham/DC/USEPA/US@EPA
Date: 10/07/2009 01:55 PM
Subject: Fw: Request for Correction under Information Quality Guidelines

Guess what I found in the Quality Inbox...?

Kimberlie R. Orr
Office of Environmental Information

Quality Staff (2811R)
Phone: 202 564-3908; Fax: 202 565-2441
orr.kimberlie@epa.gov

----- Forwarded by Kimberlie Orr/DC/USEPA/US on 10/07/2009 01:55 PM -----



"Hans Bader" <HBader@cei.org> on 10/07/2009 01:51:10 PM

To: Group Quality@EPA
cc:

Subject: Request for Correction under Information Quality Guidelines

Dear Sir or Madam:

Attached is a document that identifies violations of EPA's Information Quality Guidelines. Accordingly, please treat it as a Request for Correction.

(The document also seeks reopening of the endangerment proceeding, which is why it is also being submitted as a comment in that proceeding as well, and is titled as a petition to reopen that proceeding).

Hans Bader
Senior Counsel
Competitive Enterprise Institute
202-331-2278
[attachment "Request for Correction from CEI Seeking Reopening of Endangerment Proceeding.pdf" deleted by Carol Holmes/DC/USEPA/US]

EPA-1084

Lesley Jantarasami/DC/USEPA/US
10/09/2009 10:31 AM

To David Chalmers
cc
bcc
Subject Re: comment redistrib review

Hi David,

(b)(5) Deliberative

Comment:

(b)(5) Deliberative

Lesley

-----David Chalmers/DC/USEPA/US wrote: -----

To: Lesley Jantarasami/DC/USEPA/US@EPA
From: David Chalmers/DC/USEPA/US
Date: 10/08/2009 03:10PM
Subject: Re: comment redistrib review

I think you're initial thoughts were largely right on target. I've made a few minor suggestions in the attached. (b)(5) Deliberative

Cheers,
David

Lesley Jantarasami---10/08/2009 02:07:08 PM---David, Just left you a voice message about this:

From: Lesley Jantarasami/DC/USEPA/US

To: David Chalmers/DC/USEPA/US@EPA

Date: 10/08/2009 02:07 PM

Subject: comment redistrib review

David,

Just left you a voice message about this:

[attachment "4.1 General Comments on Technical.doc" deleted by David Chalmers/DC/USEPA/US]

If you have some time to look through and let me know where you think these comments should be redistributed, that would be great!

Thanks,

Lesley

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

[attachment "4.1 General Comments on Technical + DBC.doc" removed by Lesley Jantarasami/DC/USEPA/US]

EPA-1085

Carol Holmes/DC/USEPA/US
10/09/2009 01:17 PM

To Lesley Jantarasami
cc Ben DeAngelo, Rona Birnbaum
bcc
Subject more comments for OAR

Some more specific comments from reading 7.1 to end of long summary([redacted] Categories_Carol Holmes-rv.doc) for OAR. [redacted] 7.1 et seq (OLD) for OAR.doc

As noted in the second document, [redacted] (b)(5) Deliberative

THANKS

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

Carol S. Holmes
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Ave, NW (MC 2344A)
Washington, DC 20460
Phone (202) 564-8709
Fax (202) 564-5603

EPA-1086

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\Human Health comment summary 10_02_09b_merge BJD.doc

(b)(5) Deliberative - Human Health comment summary 10_02_09b_merge BJD.doc

EPA-1087

Lesley Jantarasami
04/01/2010 03:38 PM

To
cc
bcc
Subject UPLOAD F:\Endangerment\02_Comments and Responses\01_Sections\Human Health comment summary 10_02_09b_merge BJD.doc

(b)(5) Deliberative - Human Health comment summary 10_02_09b_merge BJD.doc

EPA-1088

Ben DeAngelo/DC/USEPA/US
10/12/2009 11:41 PM

To Jason Samenow, Michael Kolian, Lesley Jantarasami
cc Rona Birnbaum
bcc
Subject edited responses to health comments

Here are my edits/suggestions for our responses to the health comments. (b)(5) Deliberative [redacted] Have also noted where some additional comments might be moved to other categories.

Thanks.

(b)(5) Del berative [redacted]

Human Health comment summary 10_02_09b_merge BJD.doc

Benjamin J. DeAngelo
Climate Change Division, Office of Atmospheric Programs
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW (6207J)
Washington, DC 20460

Tel: +1 202-343-9107
Fax: +1 202-343-2202
deangelo.ben@epa.gov

EPA-1089

Jason Samenow/DC/USEPA/US
10/13/2009 09:02 AM

To Jeremy Martinich, Marcus Sarofim, Ben DeAngelo, William Perkins, Michael Kolian, Lesley Jantarasami, David Chalmers
cc
bcc
Subject Fw: Beogeosciences 10/8: Carbon-nitrogen interactions regulate climate-carbon cycle feedbacks: results from an atmosphere-ocean general circulation model // EurekAlert 10/9: Key new ingredient in climate model refines global predictions

(b)(5) Deliberative

Jason

----- Forwarded by Jason Samenow/DC/USEPA/US on 10/13/2009 09:00 AM -----

From: John Davidson/DC/USEPA/US
To: Neil Stiber/DC/USEPA/US@EPA, Jason Samenow/DC/USEPA/US@EPA
Date: 10/13/2009 08:58 AM
Subject: Fw: Beogeosciences 10/8: Carbon-nitrogen interactions regulate climate-carbon cycle feedbacks: results from an atmosphere-ocean general circulation model // EurekAlert 10/9: Key new ingredient in climate model refines global predictions

----- Forwarded by John Davidson/DC/USEPA/US on 10/13/2009 08:58 AM -----

General OP Econ Discussions

Category: Climate Change

Specific Topic: Beogeosciences 10/8: Carbon-nitrogen interactions regulate climate-carbon cycle feedbacks: results from an atmosphere-ocean general circulation model // EurekAlert 10/9: Key new ingredient in climate model refines global predictions

Author: John Davidson Date: 10/13/2009

Carbon-nitrogen interactions regulate climate-carbon cycle feedbacks: results from an atmosphere-ocean general circulation model

P. E. Thornton[1], S. C. Doney[2], K. Lindsay[3], J. K. Moore[4], N. Mahowald[5], J. T. Randerson[4], I. Fung[6], J.-F. Lamarque[7,8], J. J. Feddema[9], and Y.-H. Lee[3]

[1]Environmental Sciences Division, Oak Ridge National Laboratory, Oak Ridge, TN 37831-6335, USA
[2]Department of Marine Chemistry and Geochemistry, Woods Hole Oceanographic Institution, Woods Hole, MA 02543-1543, USA
[3]Climate and Global Dynamics Division, National Center for Atmospheric Research, Boulder, CO 80307-3000, USA
[4]Department of Earth System Science, University of California, Irvine, CA 92697-3100, USA

[5]Department of Earth and Atmospheric Sciences, Cornell University, Ithaca, NY 14850, USA
[6]Department of Earth and Planetary Science, University of California, Berkeley, CA 94720-4767, USA
[7]NOAA Earth System Research Laboratory, Chemical Sciences Division, 325 Broadway, Boulder, CO 80305-3337, USA
[8]Atmospheric Chemistry Division, National Center for Atmospheric Research, Boulder, CO 80307-3000, USA
[9]Department of Geography, University of Kansas, Lawrence, KS 66045-7613, USA
Received: 28 January 2009 – Published in Biogeosciences Discuss.: 26 March 2009
Revised: 12 August 2009 – Accepted: 17 September 2009 – Published: 8 October 2009


thornton_bg_2009.pdf

Public Release: 9-Oct-2009

Key new ingredient in climate model refines global predictions

For the first time, climate scientists from across the country have successfully incorpora nitrogen cycle into global simulations for climate change, questioning previous assumpt regarding carbon feedback and potentially helping to refine model forecasts about globa warming.

Contact: Ron Walli wallira@ornl.gov 865-576-0226 DOE/Oak Ridge National Labora

---

Public release date: 9-Oct-2009

Contact: Ron Walli
wallira@ornl.gov
865-576-0226
DOE/Oak Ridge National Laboratory

Key new ingredient in climate model refines global predictions

OAK RIDGE, Tenn., Oct. 9, 2009 -- For the first time, climate scientists from across the country have successfully incorporated the nitrogen cycle into global simulations for climate change, questioning previous assumptions regarding carbon feedback and potentially helping to refine model forecasts about global warming.

The results of the experiment at the Department of Energy's Oak Ridge National Laboratory and at the National Center for Atmospheric Research are published in the current issue of Biogeosciences. They illustrate the complexity of climate modeling by demonstrating how natural processes still have a strong effect on the carbon cycle and climate simulations. In this case, scientists found that the rate of climate change over the next century could be higher than previously anticipated when the requirement of plant nutrients are included in the climate model.

ORNL's Peter Thornton, lead author of the paper, describes the inclusion of these processes as a necessary step to improve the accuracy of climate change assessments.

"We've shown that if all of the global modeling groups were to include some kind of nutrient dynamics, the range of model predictions would shrink because of the constraining effects of the carbon nutrient limitations, even though it's a more complex model."

To date, climate models ignored the nutrient requirements for new vegetation growth, assuming that all plants on earth had access to as much "plant food" as they needed. But by taking the natural demand for nutrients into account, the authors have shown that the stimulation of plant growth over the coming century may be two to three times smaller than previously predicted. Since less growth implies less CO2 absorbed by vegetation, the CO2 concentrations in the atmosphere are expected to increase.

However, this reduction in growth is partially offset by another effect on the nitrogen cycle: an increase in the availability of nutrients resulting from an accelerated rate of decomposition – the rotting of dead plants and other organic matter – that occurs with a rise in temperature.

Combining these two effects, the authors discovered that the increased availability of nutrients from more rapid decomposition did not counterbalance the reduced level of plant growth calculated by natural nutrient limitations; therefore less new growth and higher atmospheric CO¬2 concentrations are expected.

The study's author list, which consists of scientists from eight different institutions around the U.S. including ORNL, the National Center for Atmospheric Research, the National Oceanic and Atmospheric Administration Earth System Research Laboratory, and several research universities, exemplifies the broad expertise required to engage in the multidisciplinary field that is global climate modeling.

"In order to do these experiments in the climate system model, expertise is needed in the nitrogen cycle, but there is also a need for climate modeling expertise, the ocean has to be involved properly, the atmospheric chemistry . . . and then there are a lot of observations that have been used to parameterize the model," said Thornton, who works in ORNL's Environmental Sciences Division.

"The biggest challenge has been bridging this multidisciplinary gap and demonstrating to the very broad range of climate scientists who range everywhere from cloud dynamicists to deep ocean circulation specialists that [incorporating the nitrogen cycle] is a worthwhile and useful approach."

The ability to handle the increase in complexities of these models was facilitated by the capabilities of ORNL's Leadership Computing Facility, which currently houses the world's fastest supercomputer for civilian research. Jim Hack, director of the National Center for Computational Sciences, emphasizes that Thornton and his team were not limited by computational resources in the construction of his model. "It's one of the laboratory competencies, so we want to make sure we enable leadership science," he said.

This breakthrough is one more step toward a more realistic prediction for the future of the earth's climate. Nevertheless, potentially significant processes and dynamics are still missing from the simulations. Thornton also stresses the importance of long-term observation so scientists can better understand and model these processes.

A 15-year study of the role nitrogen plays in plant nutrition at Harvard Forest was an important observational source used to test their mathematical representation of the nitrogen cycle--a long experiment by any standards, but still an experiment that, according to Thornton, could improve the accuracy of the simulation if conducted even longer.

Other shortcomings of climate simulations include the disregard of changing vegetation patterns due to human land use and potential shifts in types of vegetation that might occur under a changing climate, although both topics are the focus of ongoing studies.

###

The research was funded by the DOE Office of Science. Additional resources

were contributed by NASA Earth Science Enterprise, Terrestrial Ecology Program; National Center for Atmospheric Research through the NCAR Community Climate System Modeling program and the NCAR Biogeosciences program.

UT-Battelle manages Oak Ridge National Laboratory for the Department of Energy.

Biogeosciences, 6, 2099–2120, 2009
www.biogeosciences.net/6/2099/2009/

Biogeosciences

Carbon-nitrogen interactions regulate climate-carbon cycle feedbacks: results from an atmosphere-ocean general circulation model

P. E. Thornton[1], S. C. Doney[2], K. Lindsay[3], J. K. Moore[4], N. Mahowald[5], J. T. Randerson[4], I. Fung[6], J.-F. Lamarque[7,8], J. J. Feddema[9], and Y.-H. Lee[3]

[1]Environmental Sciences Division, Oak Ridge National Laboratory, Oak Ridge, TN 37831-6335, USA
[2]Department of Marine Chemistry and Geochemistry, Woods Hole Oceanographic Institution, Woods Hole, MA 02543-1543, USA
[3]Climate and Global Dynamics Division, National Center for Atmospheric Research, Boulder, CO 80307-3000, USA
[4]Department of Earth System Science, University of California, Irvine, CA 92697-3100, USA
[5]Department of Earth and Atmospheric Sciences, Cornell University, Ithaca, NY 14850, USA
[6]Department of Earth and Planetary Science, University of California, Berkeley, CA 94720-4767, USA
[7]NOAA Earth System Research Laboratory, Chemical Sciences Division, 325 Broadway, Boulder, CO 80305-3337, USA
[8]Atmospheric Chemistry Division, National Center for Atmospheric Research, Boulder, CO 80307-3000, USA
[9]Department of Geography, University of Kansas, Lawrence, KS 66045-7613, USA

Received: 28 January 2009 – Published in Biogeosciences Discuss.: 26 March 2009
Revised: 12 August 2009 – Accepted: 17 September 2009 – Published: 8 October 2009

Abstract. Inclusion of fundamental ecological interactions between carbon and nitrogen cycles in the land component of an atmosphere-ocean general circulation model (AOGCM) leads to decreased carbon uptake associated with CO_2 fertilization, and increased carbon uptake associated with warming of the climate system. The balance of these two opposing effects is to reduce the fraction of anthropogenic CO_2 predicted to be sequestered in land ecosystems. The primary mechanism responsible for increased land carbon storage under radiatively forced climate change is shown to be fertilization of plant growth by increased mineralization of nitrogen directly associated with increased decomposition of soil organic matter under a warming climate, which in this particular model results in a negative gain for the climate-carbon feedback. Estimates for the land and ocean sink fractions of recent anthropogenic emissions are individually within the range of observational estimates, but the combined land plus ocean sink fractions produce an airborne fraction which is too high compared to observations. This bias is likely due in part to an underestimation of the ocean sink fraction. Our results show a significant growth in the airborne fraction of anthropogenic CO_2 emissions over the coming century, attributable in part to a steady decline in the ocean sink fraction. Comparison to experimental studies on the fate of radio-labeled nitrogen tracers in temperate forests indicates that the model representation of competition between plants and microbes for new mineral nitrogen resources is reasonable. Our results suggest a weaker dependence of net land carbon flux on soil moisture changes in tropical regions, and a stronger positive growth response to warming in those regions, than predicted by a similar AOGCM implemented without land carbon-nitrogen interactions. We expect that the between-model uncertainty in predictions of future atmospheric CO_2 concentration and associated anthropogenic climate change will be reduced as additional climate models introduce carbon-nitrogen cycle interactions in their land components.

Correspondence to: P. E. Thornton
(thorntonpe@ornl.gov)

1 Introduction

Climate change over the next several centuries will depend on anthropogenic emissions of carbon dioxide as well as feedbacks between climate and the carbon cycle (Meehl et al., 2007). All previously published modeling studies of the climate-carbon cycle feedback based on atmosphere-ocean general circulation models (AOGCMs) have found that climate warming driven by greenhouse gas accumulation in the

Published by Copernicus Publications on behalf of the European Geosciences Union.

atmosphere causes a net release or reduced uptake of carbon dioxide from both land and oceans, contributing to a positive feedback that enhances radiatively-forced climate change (Matthews et al., 2007; Friedlingstein et al., 2006). These studies, however, have not included an explicit treatment of nutrient dynamics within land ecosystems.

Carbon uptake in land ecosystems depends on the availability of nutrients such as nitrogen to support new growth, and fertilization studies show that the availability of mineral nitrogen limits primary production in many natural and managed ecosystems (Elser et al., 2007; Vitousek and Howarth, 1991; LeBauer and Treseder, 2008). On an annual basis, the large majority of nitrogen in new plant growth derives from the decomposition of plant litter and soil organic matter, resulting in a strong coupling in which heterotrophic respiration depends on the organic matter produced by plants, and plant growth depends on the mineral nitrogen released from organic mater during decomposition (Vitousek and Howarth, 1991; Melillo et al., 2002). Nitrogen limitation is also expected to become more pronounced in some ecosystems as atmospheric CO_2 concentration (C_a) increases (the "progressive nitrogen limitation" hypothesis) (Luo et al., 2004, 2006; Reich et al., 2006).

Recent modeling results obtained by introducing prognostic carbon and nitrogen cycle interactions in the stand-alone land-surface component of an AOGCM (Thornton et al., 2007) or in a reduced-complexity climate model (Sokolov et al., 2008) suggest that the land-atmosphere components of the global climate-carbon cycle feedback are fundamentally influenced by carbon-nitrogen cycle (C-N) interactions. Thornton et al. (2007) used a land-surface component of a climate model in an uncoupled mode, forced by a reanalysis of historical surface weather, to demonstrate that C-N interactions significantly reduce the stimulation of net carbon uptake on land associated with increased C_a. This reduces a negative feedback in the regulation of C_a, and should lead to higher C_a for a given level of fossil fuel consumption in a coupled climate-carbon cycle simulation. A significant reduction in simulated land ecosystem CO_2 fertilization with the introduction of C-N dynamics was also reported by Sokolov et al. (2008). These two previous studies (Thornton et al., 2007; Sokolov et al., 2008) predict a 53–78% reduction of the effect of elevated CO_2 on land carbon sink strength due to C-N coupling.

Thornton et al. (2007) also showed that C-N interaction fundamentally alters the land carbon cycle response to interannual variability in temperature and precipitation, suggesting that C-N coupling would also affect the land carbon cycle response to transient changes in temperature and precipitation. Sokolov et al. (2008) did not examine the variability issue, but found that the introduction of C-N coupling in a reduced-complexity climate model produced a change in the sign of the terrestrial carbon cycle response to warming, switching from a strong positive feedback in which warming leads to a net release of carbon from the terrestrial biosphere, to a weak negative feedback in which warming leads to a modest uptake of carbon.

The positive feedback predicted by Sokolov et al. (2008) using the carbon-only version of their model is consistent with previous results using carbon-only models, in which radiatively-forced warming drives a net transfer of carbon from both land and oceans to the atmosphere (Matthews et al., 2007; Friedlingstein et al., 2006). For land, this positive feedback has been attributed to an increase in soil organic matter decomposition and the sensitivity of plant growth (primary production) to both soil moisture status (Fung et al., 2005) and temperature (Matthews et al., 2007). Previous models include the direct dependence of decomposition on plant growth, through the supply of litter, but neglect the dependence of plant growth on nutrient availability (Doney et al., 2006). This leads to an incongruous representation of the carbon cycle feedback response to warming, by including the direct influence of warming on respiration and photosynthesis, while ignoring the influence of warming on the mineralization of nutrients stored in decomposing organic matter and the potential for increased nutrient availability to stimulate plant growth under conditions of nutrient limitation (Melillo et al., 2002).

In the present study we expand on earlier results by introducing a prognostic representation of terrestrial carbon and nitrogen cycles within a fully-coupled AOGCM. This coupling provides the opportunity to examine the interactions among changes in land and ocean carbon pools, changes in C_a and mineral nitrogen deposition as forced by fossil-fuel consumption, and radiatively-forced transient changes in temperature and precipitation. In addition to framing our study within a full-complexity climate model, the current work improves on the analysis of Sokolov et al. (2008) by employing a land C-N model with prognostic nitrogen inputs and outputs, including inputs from biological nitrogen fixation and losses due to prognostic wildfire, as opposed to a specified nitrogen stock for each gridbox (Fig. 1). We use this model to evaluate land carbon and nitrogen cycle responses to three factors: response to climate change driven by radiative coupling with prognostic C_a (denoted Δ_{CC}); response to anthropogenic mineral nitrogen deposition (denoted Δ_{ND}); and direct physiological response to increasing C_a (denoted Δ_{Ca}). We assess the influence of these interactions on the sign and magnitude of climate-carbon cycle feedback parameters.

The influence of C-N coupling on carbon cycle dynamics is sensitive to the partitioning of nitrogen between low C:N ratio pools such as soil organic matter and high C:N ratio pools such as wood (Hungate et al., 2003; Nadelhoffer et al., 1999; Nadelhoffer et al., 2004; McGuire et al., 2001). As a preliminary step toward establishing confidence in the modeled C-N interactions, a comparison of modeled and measured nitrogen cycle dynamics in the context of labeled-tracer fertilization studies is also presented.

2 Methods

Our study uses a modified version of the Community Climate System Model (CCSM), which includes ocean biogeochemistry and ecosystem dynamics (Moore et al., 2004), and coupled terrestrial carbon and nitrogen cycles (Thornton and Zimmermann, 2007). Using four global simulations we isolate the effects Δ_{CC}, Δ_{ND}, and Δ_{Ca}, including corrections for differences between simulations in C_a (Friedlingstein et al., 2006). Simulations are all 230 years in length, covering the nominal time period 1870 to 2099. Fossil fuel emissions are specified identically for each simulation based on observations for the historical period and following a business-as-usual scenario for future emissions. Fossil fuel, land, and ocean carbon fluxes provide boundary conditions for CO_2 tracers in the atmosphere, resulting in a time-evolving (prognostic) C_a as a tracer which responds to all of these fluxes. Atmospheric radiative forcing responds either to this prognostic C_a or to a specified preindustrial value (radiatively coupled and uncoupled experiments, respectively). Mineral nitrogen deposition from the atmosphere to the land surface is forced either by a transient dataset consistent with prescribed fossil fuel emissions (Lamarque et al., 2005), or by a constant-in-time preindustrial dataset. In all cases land and ocean carbon fluxes respond to the prognostic C_a.

2.1 Detailed methods

2.1.1 Model description

Our study uses a version of the Community Climate System Model (CCSM) modified to include a prognostic carbon cycle, ocean biogeochemistry and ecosystem dynamics, and coupled terrestrial carbon and nitrogen cycles. Modifications were applied to CCSM version 3.0 (Collins et al., 2006), using the low-resolution version of the model (Yeager et al., 2006) to reduce computational cost associated with the lengthy spin-up simulations.

Modifications to the land component (Community Land Model version 3) (Dickinson et al., 2006) include: the introduction of prognostic carbon and nitrogen cycles for canopy dynamics, accompanied by a new canopy integration scheme that improves the representation of sunlit and shaded canopy fractions (Thornton and Zimmermann, 2007); prognostic carbon and nitrogen cycles for the litter and soil (Thornton and Rosenbloom, 2005); coupling of plant-litter-soil carbon and nitrogen cycles (Thornton et al., 2007; Thornton and Rosenbloom, 2005); and several changes to the hydrologic sub-model to improve partitioning of evapotranspiration (Lawrence et al., 2007). Detailed process descriptions for the carbon and nitrogen cycle components are available (Thornton et al., 2007). The resulting land component is referred to as the Community Land Model with coupled Carbon and Nitrogen cycles (CLM-CN).

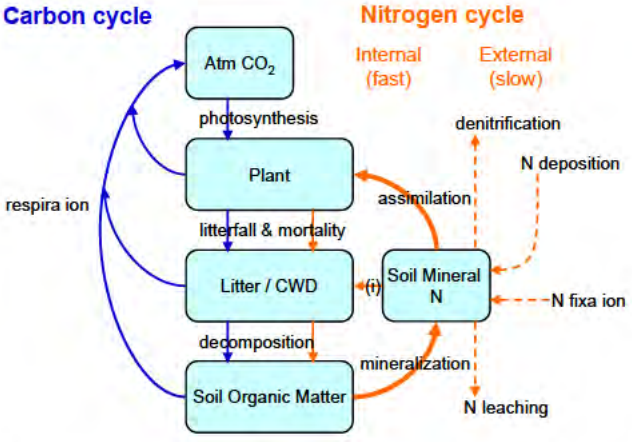


Fig. 1. Schematic illustrating feedback pathways coupling terrestrial carbon and nitrogen cycles in CLM-CN. Blue arrows show, in general, the processes represented in previous carbon-only land model components: plant carbon uptake by photosynthesis draws down atmospheric carbon dioxide (Atm CO_2); litterfall and plant mortality pass biomass from plant to litter and coarse woody debris (CWD); decomposition of fresh litter generates soil organic matter; respiration by both plants and heterotrophic organisms returns CO_2 to the atmosphere. Orange arrows show the additional processes represented in our coupled carbon-nitrogen land model, differentiated here between rapid internal cycling (solid arrows), and slower fluxes between land pools, the atmosphere, and ground water (dashed arrows). The critical feedback pathway connecting heterotrophic respiration with plant growth is highlighted as a thick orange arrow: decomposition of soil organic matter not only releases CO_2 to the atmosphere, it also releases nitrogen from the organic matter (mineralization) in forms that can then be taken up by plants (assimilation). Plant nitrogen uptake competes with the demand for mineral nitrogen from heterotrophic organisms decomposing fresh litter (immobilization, abbreviated (i) in the Fig.).

Modification to the ocean component of CCSM3 includes incorporation of the Biogeochemical Elemental Cycling (BEC) model, with multiple phytoplankton functional groups (diatoms, diazotrophs, smaller phytoplankton, and coccolithophores) and multiple potentially growth-limiting nutrients (nitrate, ammonium, phosphate, silicate, and iron) (Moore et al., 2002, 2004). The model allows for variable Fe/C and Si/C ratios dependent on ambient nutrient availability. The ecosystem is coupled with a carbonate chemistry module based on the Ocean Carbon Model Intercomparison Project (OCMIP) (Doney et al., 2003, 2004), allowing dynamic computation of surface ocean pCO_2 and air-sea CO_2 flux. The vertical profile of shortwave radiation absorption in the ocean model is determined by the prognostic chlorophyll distribution from the BEC model.

2.1.2 Experimental design

The primary purpose of our study is to demonstrate the sensitivity of a fully-coupled AOGCM to interactions between

Table 1. Simulation organization and naming convention. All simulations start from steady-state carbon cycle in year 1870, and all simulations include the same prescribed trajectory of fossil fuel emissions, creating a time-evolving C_a. All simulations include the direct physical and biological response of land and oceans to the time-evolving C_a, but only the radiatively-coupled experiments (*RN* and *Rn*) experience the greenhouse effect of rising C_a on radiative forcing in the atmosphere.

Simulation naming convention		Atmospheric mineral nitrogen deposition	
		Anthropogenic (transient)	Preindustrial (fixed)
Radiative effects of	Prognostic C_a	*RN*	*Rn*
atmospheric CO_2	Prescribed (287.0 ppm)	*rN*	*rn*

carbon and nutrient cycling, with a particular focus on the degree to which those interactions influence the global carbon cycle. Our experimental design focuses on two distinct aspects of the overall carbon-climate interaction: response of land ecosystems to radiatively-forced climate change (warming and changes in precipitation patterns), and land ecosystem response to direct fertilization of growth from increasing C_a and increasing nitrogen deposition.

One potential approach to quantifying the C-N interaction is to perform two separate sets of simulations, one with fully-dynamic C-N interactions and the other using a C-only model configuration. This strategy was used by Thornton et al. (2007) to explore the influence of C-N coupling of CO_2 and nitrogen fertilization of land carbon uptake, and also by Sokolov et al. (2008). A disadvantage of that approach is that the inclusion or exclusion of C-N dynamics produces very different conditions for the pre-industrial steady-state control simulations. This difference in base states complicates the interpretation and attribution of differences in the transient ecosystem responses to C_a and to radiatively forced climate change. Thornton et al. (2007) used multiple C-only simulations to constrain this problem, which for an offline simulation was not prohibitively expensive in terms of computation time.

We introduce here a new approach which eliminates all concerns about differences in base state, while still illuminating the differences between C-only and C-N dynamics most critical to the interactions with changing surface climate, C_a, and nitrogen deposition. In addition to the N saturation mechanism used in Thornton et al. (2007) to emulate the behavior of a C-only model, CLM-CN also includes (on every time step, at every grid cell, and for every sub-grid vegetation type) a calculation of the potential gross primary production (GPP) that could occur in the absence of nutrient limitation, given the ecosystem state at that point in time. The calculation of potential GPP is used in conjunction with a dynamic allocation algorithm to express the plant demand for new mineral N. Following the calculation of mineral N supply and the N demand of microbial communities, plant-microbe competition is reconciled and an actual GPP is calculated, reflecting the influence of N limitation. Differences between potential and actual GPP are driven exclusively by the dynamics of N availability, while every other physical and biogeochemical aspect of the land model simulation is maintained in an identical state.

Following model spinup to preindustrial steady-state conditions (details in Sect. 2.1.3), a long (1000-year) preindustrial control simulation was performed, during which the climate as well as ocean and land carbon and nitrogen cycles were stable (unpublished results). The control simulation was followed by four simulation experiments. All experiments include prescribed fossil fuel emissions, using historical data for the period 1870–1999 with modifications from a previously published dataset (Andres et al., 1996), and emissions from the SRES A2 scenario for the period 2000–2099 (Nakicenovic and Swart, 2000). Revisions of the historical emissions data were performed by Andres (unpublished), and include updates for the period 1990–2003, and modifications for one degree geography and raw carbon emissions data for earlier years.

In all experiments fossil fuel, land, and ocean carbon fluxes provide boundary conditions for CO_2 tracers in the atmosphere, where C_a is a tracer which responds to all of these fluxes. Land and ocean carbon fluxes in all cases respond to this prognostic C_a. Calculations of radiative transfer in the atmosphere respond either to the prognostic C_a ("radiatively coupled" experiments) or to a fixed preindustrial value ("radiatively uncoupled" experiments). Experiments also differ in their treatment of nitrogen deposition, using either a transient dataset that represents the anthropogenic influence or a fixed preindustrial distribution. Organization and naming conventions for the four experiments are given in Table 1.

Inclusion of simulations with and without anthropogenic nitrogen deposition serves three purposes. First, it provides a basis for evaluation of carbon cycle sensitivity to anthropogenic nitrogen inputs. Second, it serves as a simple metric for evaluating the hypothesis that radiatively forced climate change affects land ecosystems in a manner similar to direct mineral N fertilization. Third, it provides an opportunity to assess the magnitude of the modeled land carbon uptake response to new nitrogen inputs against observations and experimental metrics.

All simulations for this study use a constant representation of land cover (see Sect. 2.5), and so also exclude the representation of carbon fluxes associated with changes in land cover or land use. Previous coupled climate-carbon cycle simulations with AOGCMs have also used constant land use patterns but have specified assumed fluxes due to land use and land cover change (LULCC) as external forcing (Friedlingstein et al., 2006). Imposing LULCC fluxes as an external forcing factor ignores interactions among disturbance, CO_2 fertilization, and nitrogen availability known to influence modeled net carbon flux responses (Thornton et al., 2002). Here we are interested in addressing the C-N interactions in the absence of potentially confounding anthropogenic disturbance effects. We recognize that this experimental design hampers direct comparison of our results to measured C_a, and we have tried to mitigate this problem by focusing evaluation efforts on land, ocean, and airborne fractions (see Sect. 2.6).

2.1.3 Model spinup

To reduce the magnitude of drifts in the carbon pools when carbon and nitrogen are coupled to the climate of the AOGCM, a sequential spin-up procedure is employed, similar to a previously described procedure (Doney et al., 2006). The land carbon components are spun-up to an approximate preindustrial steady-state, using a repeated 25-year cycle of near-surface weather fields saved from a previous coupled simulation. Initial spinup of carbon and nitrogen pools in the land model follows the accelerated decomposition approach described in Thornton and Rosenbloom, 2005. Surface forcing for the initial ocean spinup is from an observationally based climatology (Large and Yeager, 2004), with C_a held at a fixed preindustrial value. The ocean spinup was run for 1000 years with no tracer acceleration.

Land and ocean states following preliminary spinup simulations are not necessarily in balance with the climate of the fully-coupled system. A fully-coupled simulation (Sim0) is performed for a few hundred years to get past any initial transients, to assess the potentially offsetting fluxes between land, atmosphere, and ocean, and to generate a climatology of C_a for use in subsequent coupling steps.

Several incremental coupling steps are performed to bring the system efficiently to a stable initial condition. First, a coupled run is done where C_a is allowed to vary, but is only forced by air-sea CO_2 fluxes (Sim1). This enables the negative feedback between air-sea CO_2 fluxes and C_a, effectively shortening the equilibration time of the ocean. For the present simulations, the 150-year running mean of the air-sea CO_2 flux was less than 0.01 PgC y^{-1} after 450 years in this configuration. Next, the land model is run again in an offline configuration (Sim2), using a repeated 25-year cycle of near-surface weather fields saved from Sim1. Sim2 uses the climatology of C_a from Sim0, adjusted to have the same over-ocean mean to which the ocean is equilibrated in Sim1. Sim2 is run until the land state is equilibrated with the new sample of coupled climate and the new climatology of C_a (1800 years in the present case). The land state from Sim2 and the ocean state from Sim1 are next used to initiate a new coupled run (Sim3), with C_a responding to both land and ocean fluxes, but with atmospheric radiative forcing responding to a specified (preindustrial) CO_2 concentration. After 200 years, atmospheric radiative forcing is allowed to respond to the prognostic C_a.

2.2 Evaluation of forcing factors

Our experiments are analyzed to isolate the effects of radiatively-forced climate change, anthropogenic nitrogen deposition, and increasing C_a (Δ_{CC}, Δ_{ND}, and Δ_{Ca}, respectively). In calculating Δ_{CC} and Δ_{ND}, we correct for differences in C_a between pairs of experiments, following the "beta-correction" method (Friedlingstein et al., 2003, 2006). For a generic flux or state variable time series, $f(t)$:

$$\Delta_{CC} f(t) = \left(f_{\text{coupled}}(t) - f_{\text{uncoupled}}(t)\right) - \beta_f \left(C_{a,\text{coupled}}(t) - C_{a,\text{uncoupled}}(t)\right) \quad (1)$$

where $f_{\text{coupled}}(t)$ and $C_{a,\text{coupled}}(t)$ are from experiment *Rn*, $f_{\text{uncoupled}}(t)$ and $C_{a,\text{uncoupled}}(t)$ are from experiment *rn*, and β_f is the dependence of f on C_a ($\mathrm{d}f/\mathrm{d}C_a$) from a radiatively-uncoupled experiment. Likewise, for Δ_{ND}:

$$\Delta_{ND} f(t) = \left(f_{\text{anthro}ND}(t) - f_{\text{preind}ND}(t)\right) - \beta_f \left(C_{a,\text{anthro}ND}(t) - C_{a,\text{preind}ND}(t)\right) \quad (2)$$

where $f_{\text{anthro}ND}$ and $C_{a,\text{anthro}ND}$ are from experiment *rN*, and $f_{\text{preind}ND}$ and $C_{a,\text{preind}ND}$ are from experiment *rn*. In practice, we calculate β_f as the regression slope of the time series $f(t)$ vs. $C_a(t)$ from experiment *rn*.

Time series of effects on carbon fluxes due to increasing C_a are calculated as:

$$\Delta_{Ca} f(t) = \left(f_{FF}(t) - f_{FF,0}\right) \quad (3)$$

where $f_{FF}(t)$ is from a radiatively uncoupled simulation with prescribed fossil fuel emissions (our experiment *rn*), and $f_{FF,0}$ is the mean flux from the first decade of experiment *rn*, when fossil fuel fluxes are very small. Combined effects of Δ_{CC}, Δ_{ND}, and Δ_{Ca} are evaluated as the change over time in simulation *RN*, by subtracting the mean of the first decade of simulation from the entire time series.

2.3 Temperature and soil moisture effects on land carbon fluxes

For each grid cell, multiple linear regression is used to evaluate the partial contributions of changing near-surface air temperature over land (T_{air}) and changing soil moisture on several land carbon flux components. Soil moisture is expressed as an empirical moisture scalar, B_{tran}, with values ranging from 0 to 1 (Oleson et al., 2004). We calculate $\Delta_{CC} f$, the

influence of radiatively forced climate change for flux component f, as well as the influence of radiative coupling on T_{air} ($\Delta_{CC}T_{\text{air}}$) and B_{tran}($\Delta_{CC}B_{\text{tran}}$) using Eq. (1). The time series of $\Delta_{CC}f$ is regressed against time series of $\Delta_{CC}T_{\text{air}}$ and $\Delta_{CC}B_{\text{tran}}$, using annual values for the period 2000–2099 (n=100). Flux components (f) evaluated include potential gross primary production (*potential GPP*), defined as the model-estimated GPP prior to nitrogen limitation, *actual GPP*, defined as model-estimated GPP following the calculation of nitrogen limitation, total ecosystem respiration (*ER*), *fire* (total carbon loss to atmosphere during combustion), and net ecosystem exchange of carbon (*NEE=−GPP+ER+fire*).

2.4 Transient feedback analysis

We use the analytical framework for diagnosis of climate-carbon cycle feedback as presented in Friedlingstein et al. (2003, 2006), but modified to allow an examination of transients in feedback parameters. An endpoint analysis was used by Friedlingstein et al. (2006), where single summary values of the feedback parameters were based on differences between the values of carbon and temperature state variables at the beginning and end of their simulations. This provided a single estimate of the feedback parameter values, applicable to the entire simulation period. Here we are interested also in the temporal variation in the feedback parameters, so we use a somewhat different method and compare results to those obtained with the original method by Friedlingstein et al. (2006). For our transient analysis, we use a moving window, unweighted regression to calculate the relevant slopes. At each annual timestep t, where $t \geq 120$, the previous 120 years of data from the global summaries is used as input to a least-squares regression (n=120) to estimate the feedback parameters at time t as the regression slopes. All other aspects of the analysis are as described previously (Friedlingstein et al., 2003, 2006), including the use of simulation differencing to isolate the effects of increasing C_a and radiatively-forced climate change on carbon uptake. Overall climate-carbon cycle feedback strength, denoted *gain* (unitless) is defined as:

$$gain = -\alpha\,(\gamma_L + \gamma_O) \big/ (1 + \beta_L + \beta_O) \tag{4}$$

where α (K ppm^{-1}) is the transient sensitivity of the climate model to increased C_a, β_L and β_O (PgC ppm^{-1}) are the carbon storage sensitivities to C_a for land and ocean, respectively, and γ_L and γ_O (PgC K^{-1}) are the carbon storage sensitivities to climate for land and ocean, respectively. The following expressions are used to calculate components of *gain*, following Friedlingstein et al. (2003, 2006):

$$\alpha = \frac{\mathrm{d}T_{\text{ref\_coupled}}}{\mathrm{d}C_{a\_\text{coupled}}}, \tag{5}$$

$$\beta_L = \frac{\mathrm{d}\text{Tot}C_{L\_\text{uncoupled}}}{\mathrm{d}C_{a\_\text{uncoupled}}} \text{ and } \beta_O = \frac{\mathrm{d}\text{Tot}C_{O\_\text{uncoupled}}}{\mathrm{d}C_{a\_\text{uncoupled}}}, \tag{6}$$

$$\gamma_L = \frac{\mathrm{d}\text{Tot}C^*_{L\_\text{coupled}}}{\mathrm{d}T_{\text{ref\_coupled}}} \text{ and } \gamma_O = \frac{\mathrm{d}\text{Tot}C^*_{O\_\text{coupled}}}{\mathrm{d}T_{\text{ref\_coupled}}}, \tag{7}$$

$$\text{Tot}C^*_{L\_\text{coupled}} = \text{Tot}C_{L\_\text{coupled}} - \beta_L \left(C_{a\_\text{coupled}} - C_{a\_\text{uncoupled}}\right) \text{ and } \text{Tot}C^*_{O\_\text{coupled}} = \text{Tot}C_{O\_\text{coupled}} - \beta_O \left(C_{a\_\text{coupled}} - C_{a\_\text{uncoupled}}\right) \tag{8}$$

where $T_{\text{ref\_coupled}}$ and C_{a_coupled} are the global mean air temperature at the model reference height (K) and the global mean C_a (ppm), respectively, from a radiatively coupled experiment, $C_{a\_\text{uncoupled}}$ (ppm) is the global mean C_a from a radiatively uncoupled experiment, $\text{Tot}C_{L\_\text{uncoupled}}$ and $\text{Tot}C_{O\_\text{uncoupled}}$ (PgC) are the global total carbon content on land and in oceans, respectively, for a radiatively uncoupled experiment, $\text{Tot}C_{L\_\text{coupled}}$ and $\text{Tot}C_{O\_\text{coupled}}$ (PgC) are the global total carbon content on land and in oceans, respectively, for a radiatively coupled experiment, and the notation $\frac{\mathrm{d}y}{\mathrm{d}x}$ refers to the slope from the moving window regression of y against x, as described above.

A positive value for *gain* corresponds to a net (ocean and land) positive climate-carbon cycle feedback by which warming stimulates carbon release and an increase in C_a which increases warming, while a negative value of *gain* corresponds to a negative net feedback by which warming stimulates uptake and a decrease in C_a which suppresses warming. Analysis of previously published modeling results used archived annual global summaries of output from the eleven models included in the recent C4MIP synthesis (Friedlingstein et al., 2006) (http://www.c4mip.cnrs-gif.fr/diagnostics_phase2.html).

2.5 Treatment of landcover

All results reported here use a fixed description of landcover, taken as a time slice circa 1870 from a transient plant functional type (PFT) dataset. The transient PFT dataset is created in two steps. First, a potential vegetation PFT dataset is created based on information about present-day PFT distribution and estimates of potential biome types of vegetation (Ramankutty and Foley, 1999). Second, estimates of crop land fraction (Ramankutty and Foley, 1999) and grazing (Goldewijk, 2001) are used to determine the crop PFT distribution through time. It is important to note that because our present simulations have prescribed landcover for the year 1870, they do not include the effects of changing landcover on carbon, nitrogen, water, or energy fluxes. Additional simulations are underway to evaluate the influence of changing landcover on carbon fluxes and C-N interactions.

2.6 Airborne fraction, land sink fraction, and ocean sink fraction

Following the nomenclature and methods in Raupach et al. (2008), we calculate an annual total airborne fraction of

anthropogenic emissions (a_E) as the annual change in the carbon stock of the atmosphere expressed as a fraction of the annual total anthropogenic emissions. For our simulations emissions due to land use and land cover change are assumed to be zero, and the anthropogenic emissions consist only of fossil fuel sources. Land and ocean sink fractions ($s_{E,\mathrm{lnd}}$ and $s_{E,\mathrm{ocn}}$, respectively) are calculated as the annual changes in total land or ocean carbon stocks as fractions of the annual total anthropogenic emissions. Growth rates for the airborne fraction ($r(a_E)$), land sink fraction ($r(s_{E,\mathrm{lnd}})$), and ocean sink fraction ($r(s_{E,\mathrm{ocn}})$), expressed as % change per year, are calculated as the regression slopes of the log-transformed time series.

2.7 Nitrogen deposition

Nitrogen deposition rates for the period 1870 to 2100 are from the three-dimensional chemistry-transport MOZART-2 (Model for Ozone and Related Tracers, version 2) (Horowitz et al., 2003). In all simulations (pre-industrial, present-day and future), MOZART uses meteorological datasets valid for the period of interest, based on simulations by the Parallel Climate Model (Washington et al., 2000). The MOZART-2 simulations are performed at a horizontal resolution of 2.8°. All the dynamical and chemical processes simulated by MOZART-2 are performed with a model timestep of 20 min, while the nitrogen deposition fluxes are archived as monthly averages. Additional information on the present-day and future simulations is available (Lamarque et al., 2005). The pre-industrial simulation is similar to the present-day simulations, except that all emissions associated with anthropogenic activities (excluding biomass burning) are explicitly set to 0. Nitrogen deposition from the MOZART-2 pre-industrial simulation is used for the CLM-CN spin-up simulation.

2.8 Fate of additional N

The anthropogenic N deposition experiment (experiment *rN*, Table 1) provides an opportunity to evaluate the modeled fate of new mineral N additions against results of ^{15}N tracer experiments. By quantifying and evaluating the fate of added N, we are also able to assess whether the model predictions of carbon storage associated with increases in soil organic matter (low C:N ratio) or increases in wood (high C:N) follow observed patterns. The influence of N deposition was diagnosed by tracking the changes in N storage in land ecosystem pools as well as cumulative fluxes into and out of the land ecosystem. Results were compared with observations from a ^{15}N tracer study carried out at Harvard Forest (Nadelhoffer et al., 2004) by extracting information from the nearest point in the global grid. Coordinates of the study site are 42°30′ N, 72°10′W. Center coordinates for the model grid box containing this site are 42°41′N, 71°15′W, and the dimensions of the grid box at this location are 3.71° latitude×3.75° longitude. The vegetation cover for this gridcell in the model is dominated by trees, with a mixture of temperate deciduous and temperate needleleaf evergreen forest, in general agreement with the presence of oak and pine stands in the tracer study. The influence of anthropogenic nitrogen deposition was isolated from the effects of varying C_a by differencing the two radiatively uncoupled experiments: *rN–rn* (Table 1).

3 Results

Under the IPCC A2 business-as-usual scenario for fossil fuel emissions we estimate C_a of 884 ppm by year 2100 AD in our radiatively-uncoupled experiment (Fig. 2a). Radiative coupling reduces C_a by about 6 ppm, with a further reduction of about 27 ppm due to anthropogenic N deposition (Fig. 2b and c). Levels of C_a in our results may be underestimated, as our simulations do not yet include carbon flux contributions from historic or predicted future landcover change.

We find that the response of land carbon storage to increasing C_a (β_L) is approximately three times lower than the mean response from previous coupled models lacking a nitrogen cycle (Fig. 2d). Previous results from the uncoupled land model show that this reduced β_L is due mainly to the introduction of C-N interaction (Thornton et al., 2007), and results here from the fully-coupled model are in quantitative agreement, in spite of known biases in the coupled climate. The influence of C-N interaction on β_L reported in Thornton et al. (2007) and shown here for the case of coupling to a GCM has also been recently demonstrated by Sokolov et al. (2008) for land model C-N coupling in a climate model of intermediate complexity.

The land carbon storage response to radiatively forced climate change, characterized as the sensitivity to increasing temperature (γ_L), is small and positive throughout the 21st century in our results, the opposite sign compared to all previous studies using carbon-only models (Fig. 2e), but the same sign and similar magnitude as in Sokolov et al. (2008) for C-N land component in a reduced-complexity climate model. We also find that γ_L increases modestly over the period 2000–2100 in our results, while it declines over the same period in previous studies (Fig. 2e).

Transient climate sensitivity (α) of our coupled system is in the lower half of the range of previous results from coupled climate-carbon cycle models (Fig. 3a). Climate sensitivity is trending downward through the second half of the 21st century, in agreement with previously published results. Ocean carbon storage response to increasing C_a (β_O) is lower in our simulation than in any of the previously published studies. The magnitude of β_O is declining over time, consistent with previous studies (Fig. 3b). The ocean carbon storage sensitivity to increasing temperature (γ_O) in our experiments is negative, as found in all previous studies, but its magnitude is at the low end of the previously reported range (Fig. 3c).

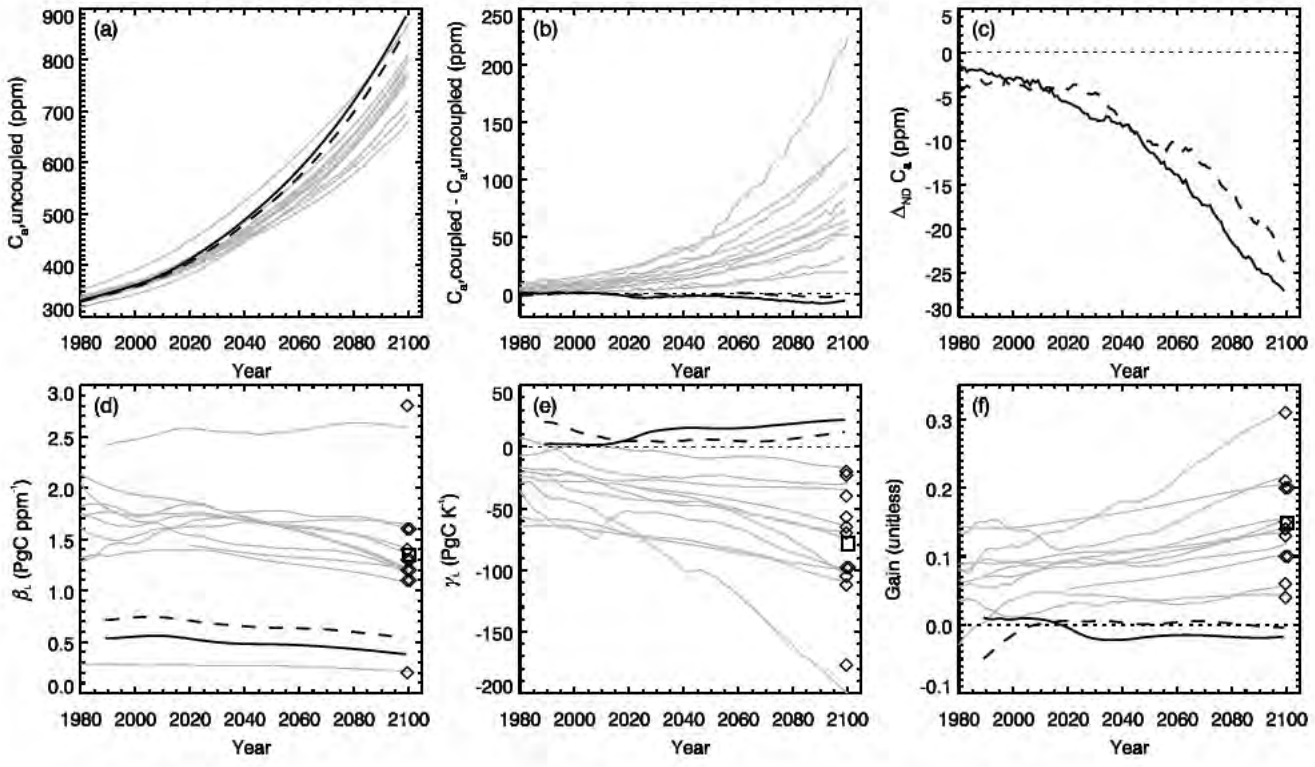


Fig. 2. Predicted atmospheric CO_2 and climate-carbon cycle feedback parameters. C_a from uncoupled experiments **(a)**; difference in C_a due to radiative coupling **(b)**; difference in C_a due to anthropogenic nitrogen deposition **(c)**; land biosphere response to increasing C_a **(d)**; land biosphere response to increasing temperature **(e)**; and overall global climate-carbon cycle feedback gain **(f)**. Gray lines show archived results from eleven previous studies (Friedlingstein et al., 2006). In all panels except (c), thick solid line is for experiments with preindustrial nitrogen deposition, thick dashed line for anthropogenic nitrogen deposition. In (c), solid and dashed lines are for radiatively uncoupled and coupled experiments, respectively. Diamonds show the feedback parameters estimated at year 2100 for previous studies (Friedlingstein et al., 2006) and square shows their mean. Thin dotted lines indicate zero response.

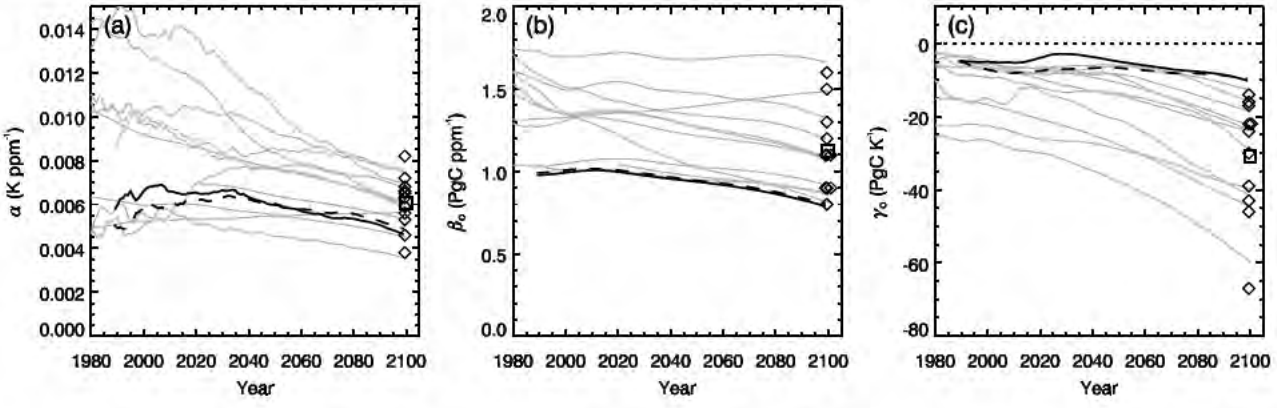


Fig. 3. Atmosphere and ocean feedback parameters. Climate sensitivity to increasing C_a (α) **(a)**; ocean carbon cycle sensitivity to C_a (β_L) **(b)**; and ocean carbon cycle sensitivity to climate (γ_O) **(c)**. In all panels thick solid line is for present experiments with preindustrial nitrogen deposition, thick dashed line for anthropogenic nitrogen deposition. Gray lines show the transient responses of eleven previous studies based on archived results, diamonds show the feedback parameters estimated at year 2100 for eleven previous studies as reported in text, and square shows the mean of these previous results. Thin dashed line in (c) indicates zero response.

Table 2. Influence of temperature and soil moisture on carbon flux components. Multiple linear regression results for Δ_{CC} of global total carbon flux components (PgC yr^{-1}) predicted by Δ_{CC} of global mean surface temperature over land (T_{air}, K) and global mean plant-available soil water scalar (B_{tran}, converted from proportion (0–1) to 0–100%). Net ecosystem exchange of carbon (NEE, normally negative for uptake on land) has been reversed in sign for this analysis, so that the regression coefficients have the same sense as for GPP. All coefficients are significant at the 95% confidence level. SE: standard error.

Carbon flux component	Coefficient and (SE)				partial r^2		multiple
	$\Delta_{CC}T_{\text{air}}$ (PgC yr^{-1} K^{-1})		$\Delta_{CC}B_{\text{tran}}$ (PgC yr^{-1} %$^{-1}$)		$\Delta_{CC}T_{\text{air}}$	$\Delta_{CC}B_{\text{tran}}$	r^2
Δ_{CC} potential GPP	1.26	(0.25)	7.06	(0.65)	0.21	0.55	0.56
Δ_{CC} actual GPP	5.97	(0.19)	4.02	(0.50)	0.91	0.40	0.91
Δ_{CC} ER	5.69	(0.17)	2.83	(0.44)	0.92	0.30	0.92
Δ_{CC} Fire	0.08	(0.01)	−0.19	(0.03)	0.28	0.25	0.50
$-\Delta_{CC}$ NEE	0.20	(0.07)	1.38	(0.18)	0.08	0.38	0.38

Simulated ocean carbon stock declines by 35 PgC under the influence of radiatively forced climate change over the period 1870–2100. That decline is more than offset by a net increase of 47 PgC on land over the same period, leading to a small negative climate-carbon cycle feedback gain at year 2100, the opposite sign compared to all previous AOGCM studies (Fig. 2f). The β_L, γ_L, and *gain* responses all shift toward the carbon-only means under Δ_{ND} (Fig. 2d–f, dashed lines) as nitrogen limitation is partially relieved by anthropogenic N deposition, providing initial evidence that C-N interaction is an important factor driving the observed differences from previous models. The influence of anthropogenic N deposition on the feedback parameters mainly conforms to the geographic distribution of the increased deposition (results not shown).

Using a transient feedback analysis, we estimate the influence of C-N coupling on C_a in year 2100 by substituting feedback parameter values calculated from the C4MIP archive (Friedlingstein et al. 2006), using multi-model mean parameters as well as single-model parameter substitution from the predecessor C-only CCSM model (CCSM1). Reduced land CO_2 fertilization (smaller β_L) with the introduction of C-N coupling increases C_a by on average 104 ppm (range +65 to +178 ppm). Stimulation of carbon uptake under a warming climate (positive γ_L) reduces C_a on average 82 ppm (range −133 to −35 ppm). These two effects of C-N coupling together increase C_a on average 16 ppm (range +32 to −8 ppm). Anthropogenic nitrogen deposition generates a land sink of 66±5 PgC over the period 1870–2099, reducing C_a by 25±2 ppm with an associated decrease in the ocean sink of 12±2 PgC. Ranges in the nitrogen deposition-driven sink reflect differences between our radiatively coupled vs. uncoupled experiments.

Spatial and temporal patterns of Δ_{CC} for temperature and soil moisture are similar to results found previously for CCSM3 (Meehl et al., 2006) (Fig. 4 a–d). CLM-CN calculates gross primary production (GPP) prior to and following nitrogen limitation at each model timestep (*potential GPP* and *actual GPP*, respectively). Any differences between *potential GPP* and *actual GPP* are directly attributable to the influence of nitrogen limitation in the model, allowing a systematic diagnosis of nitrogen limitation effects on GPP under various forcings. The Δ_{CC} *actual GPP* at year 2100 is nearly six times larger than Δ_{CC} *potential GPP* (17 vs. 3 PgC y^{-1}) (Fig. 4g and e). Spatial pattern of Δ_{CC} *potential GPP* follows closely the pattern of changes in plant-available soil water ($\Delta_{CC}B_{\text{tran}}$) (Fig. 4f and d), consistent with previous results from a carbon-only model (Fung et al., 2005). Δ_{CC} *actual GPP* is more uniformly positive, with decreases only in small regions with the most extreme decreases in soil moisture (Fig. 4h).

Introduction of nitrogen limitation greatly increases the positive correlation of Δ_{CC} *GPP* with $\Delta_{CC}T_{\text{air}}$, and decreases the positive correlation with $\Delta_{CC}B_{\text{tran}}$ (Table 2 and Fig. 5a–d). Climate-driven change in nitrogen mineralization ($\Delta_{CC}N_{\text{min}}$, Fig. 4i and j) is significantly correlated with Δ_{CC} *actual GPP* and $\Delta_{CC}T_{\text{air}}$ (Figs. 5i and 6). Increasing N_{min} is driven by direct nitrogen fertilization for the case of Δ_{ND} and by climate-driven increase in heterotrophic respiration for the case of Δ_{CC}, but we find that the ratio of increased *actual GPP* to increased N_{min} is similar in both cases (Fig. 4i and g).

Total land carbon stock increases by about 50 PgC over the period 2000–2100 under Δ_{CC} (Fig. 4k). Temperature sensitivities of *actual GPP* and total ecosystem respiration (*ER*) nearly cancel, leaving a small net carbon uptake response to increasing temperature, and a moderate response to changing soil moisture (Table 2 and Fig. 5e–h). The strong temperature response of Δ_{CC} *actual GPP* results in net uptake in tropical forests of South America, Africa, and Indonesia, even though soil moisture is drier or unchanged in much of the area (Fig. 4l and d). This result is in contrast to previous

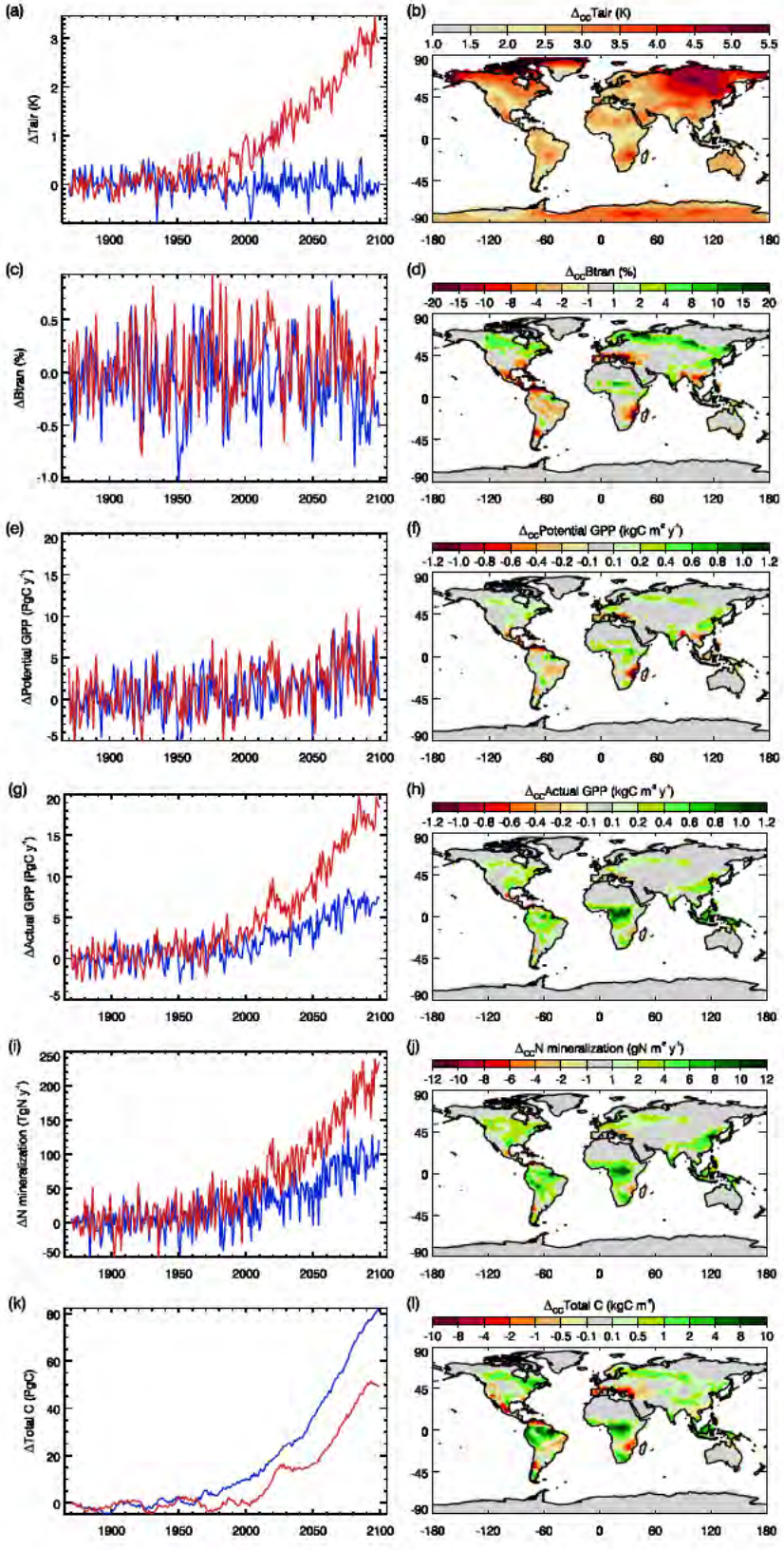


Fig. 4. Effects of radiative coupling and nitrogen deposition. Time series show global means (for T_{air} and B_{tran}) or global totals (for all other quantities) of Δ_{CC} (red lines) and Δ_{ND} (blue lines). Maps show Δ_{CC} averaged over the final decade of simulation (2090–2099). Panels show changes in: T_{air} **(a, b)**; B_{tran} **(c, d)**; GPP prior to nitrogen limitation (potential GPP) **(e, f)**; GPP following nitrogen limitation (actual GPP) **(g, h)**; gross nitrogen mineralization (i, j); and total land carbon stock **(k, l)**.

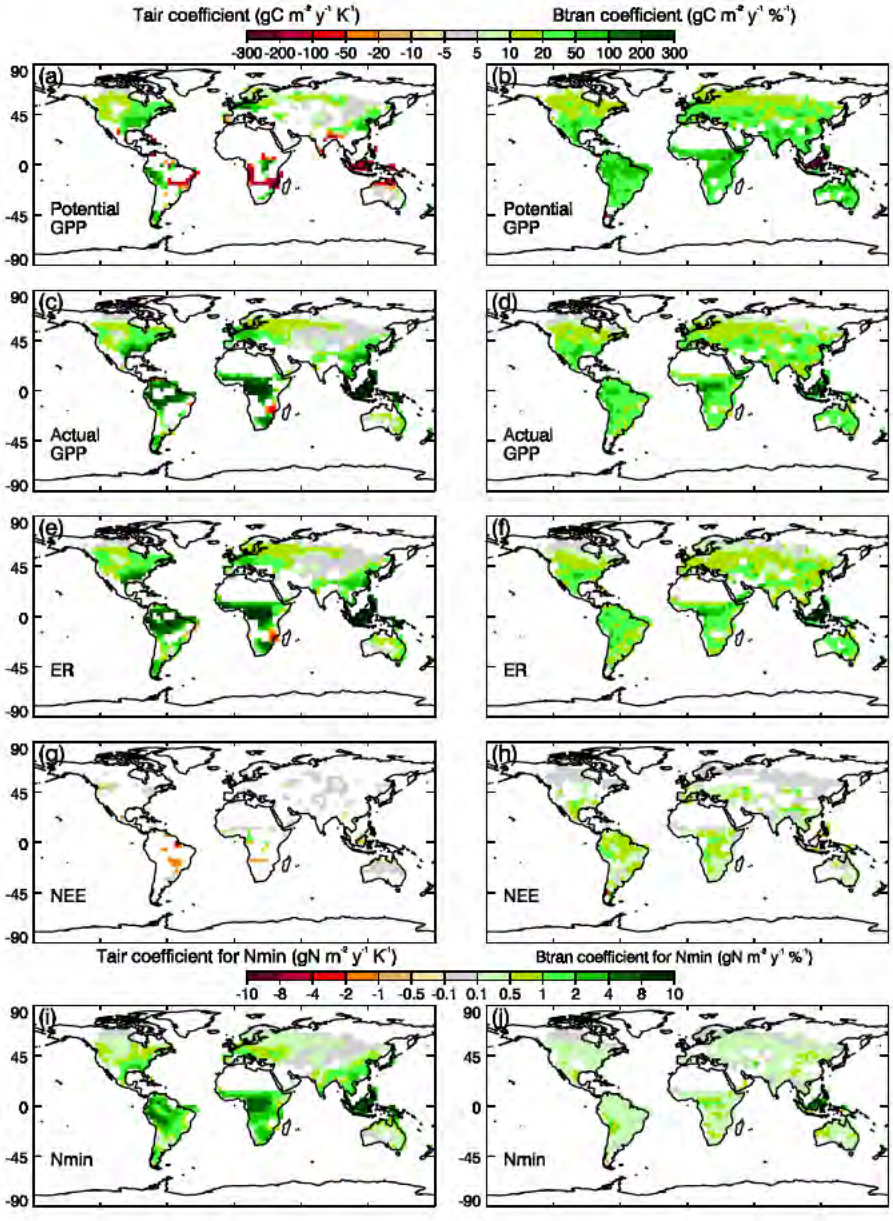


Fig. 5. Multiple regression coefficients for Δ_{CC} of individual carbon flux components ((a–h), upper color scale) and nitrogen mineralization **(i)** and **(j)**, lower color scale) predicted by $\Delta_{CC}T_{\text{air}}$ and Δ_{CC}Btran. Land gridcells with non-significant coefficients (at 95% confidence level) are white.

carbon-only studies which predicted losses of carbon related to drying soils in these same regions (Fung et al., 2005; Friedlingstein et al., 2006). We find that soil moisture sensitivity causes carbon losses in a few regions with the most extreme drying, including Central America and the Mediterranean region (Fig. 4l and d).

The increase in total carbon for Δ_{CC} is caused by an increase in vegetation biomass that is partly offset by declining stocks of litter and soil organic matter (Fig. 7a and b). This result is consistent with the hypothesis that, with warming, nitrogen mineralization from enhanced decomposition improves plant nitrogen availability and increases primary production (Stieglitz et al., 2006; McGuire et al., 2000; Arain et al., 2006; Mäkipää et al., 1999; Melillo et al., 2002). We find that Δ_{ND} increases both soil organic matter and vegetation carbon pools, consistent with recent analyses of carbon uptake under nitrogen fertilization and increasing C_a (de Graaff et al., 2006; van Groenigen et al., 2006; Gill et al., 2006).

Nitrogen availability, measured as the ratio (*actual GPP:potential GPP*), is significantly reduced for Δ_{Ca} (Fig. 7c, green line), consistent with the progressive nitrogen limitation hypothesis (Luo et al., 2004; Reich et al.,

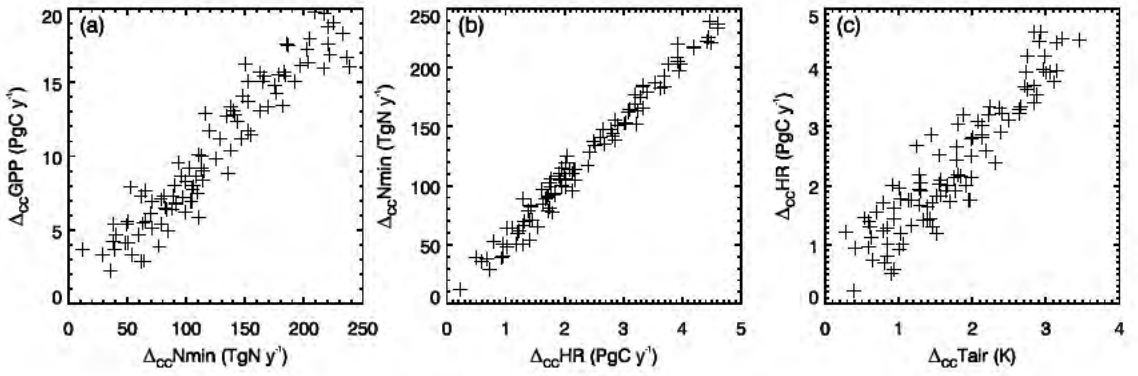


Fig. 6. Scatterplots of Δ_{CC}GPP vs. Δ_{CC} Nmin **(a)**, Δ_{CC} Nmin vs. Δ_{CC}HR **(b)**, and Δ_{CC}HR vs. $\Delta_{CC}T_{air}$ **(c)**. Plots are based on global total flux or global mean temperature over the period 2000–2099 (n=100).

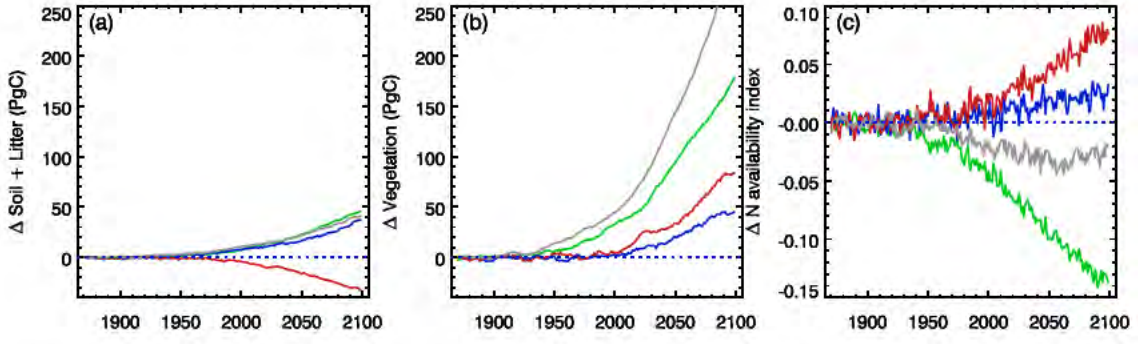


Fig. 7. Changes (due to multiple factors) in global total land carbon stocks for litter and soil organic matter **(a)**, and vegetation **(b)**, and in global mean nitrogen availability index **(c)**. In all panels Δ_{CC} is shown in red, Δ_{ND} in blue, Δ_{Ca} in green, and (Δ_{CC}+Δ_{ND}+Δ_{Ca}) in gray.

2006). As expected, Δ_{ND} results in increased nitrogen availability (Fig. 7c, blue line). The influence of Δ_{CC} on nitrogen availability has the same sign as Δ_{ND}, and a larger magnitude (Fig. 7c, red line), consistent with our hypothesis that radiatively-forced climate change increases the supply of mineral nitrogen to plants. The progressive nitrogen limitation with Δ_{Ca} in our results is largely mitigated but not completely compensated for by the combination of Δ_{ND} associated with combustion of fossil fuel (Lamarque et al., 2005) and indirect fertilization due to the influence of Δ_{CC} on nitrogen mineralization (Fig. 7c, gray line).

3.1 Airborne, land sink, and ocean sink fractions

Total airborne fraction of anthropogenic CO_2 emissions (a_E) over the period 1959–2006 in our experiment *RN* (radiative coupling and anthropogenic N deposition) is 0.56 (Table 3). Raupach et al. (2008) report a_E=0.43 for the same period, while Sabine et al. (2004) give a range for a_E of 0.41 to 0.53, with uncertainty arising mainly from assumptions about land use emissions. Our estimates for the land and ocean sink fractions over this period (0.19 and 0.25, respectively, Table 3), are individually within the range of estimates from Sabine et al. (2004) (0.10 to 0.41 for the land sink fraction, and 0.18 to 0.36 for the ocean sink fraction), but together they produce an airborne fraction that is outside the range from observations: one or the other, or possibly both, of our sink fraction predictions is too low. Evaluation of the ocean sink against independent observations suggests that the ocean sink strength is too weak, due to weak formation and ventilation of intermediate waters in the Southern Ocean (Appendix A). Evaluation of land ecosystem productivity from a similar version of the model indicates a low productivity bias at high latitudes (Thornton and Zimmermann, 2007), which could lead to a low bias in the land sink strength through an underestimate of the global productivity.

Treatment of land use fluxes could also have an important influence on simulated airborne fraction. Land use fluxes have been intentionally excluded from these simulations. The typical method of dealing with these fluxes in coupled climate-carbon cycle simulations is to specify an assumed flux due to recorded historical and assumed future land use

Table 3. Airborne fraction, land and ocean sink fractions, and their growth rates. Means and standard deviations over several time periods are shown for the total airborne fraction (a_E), land sink fraction ($s_{E,\mathrm{lnd}}$), and ocean sink fraction ($s_{E,\mathrm{ocn}}$). Also shown are the proportional growth rates (% y^{-1}) for airborne fraction ($r(a_E)$), land sink fraction ($r(s_{E,\mathrm{lnd}})$), and ocean sink fraction ($r(s_{E,\mathrm{ocn}})$). Proportional growth rates shown in bold are significant at the 95% confidence level.

Time period	mean (std. dev)			proportional growth rate, % y^{-1}		
	a_E	$s_{E,\mathrm{lnd}}$	$s_{e,\mathrm{ocn}}$	$r(a_E)$	$r(s_{E,\mathrm{lnd}})$	$r(s_{E,\mathrm{ocn}})$
1959–2006	0.56(0.10)	0.19(0.11)	0.25(0.03)	0.12	−0.76	**0.64**
1959–2099	0.60(0.08)	0.18(0.07)	0.23(0.03)	**0.16**	−0.05	**−0.23**
2000–2099	0.61(0.05)	0.17(0.04)	0.22(0.03)	**0.22**	**−0.24**	**−0.43**
2000–2050	0.58(0.04)	0.18(0.03)	0.24(0.02)	0.10	0.22	**−0.37**
2050–2099	0.64(0.04)	0.16(0.03)	0.20(0.02)	**0.30**	−0.39	**−0.66**

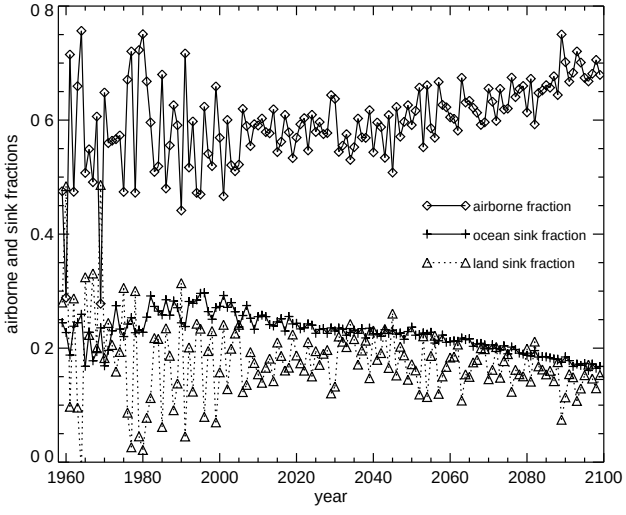


Fig. 8. Simulated airborne fraction, ocean sink fraction, and land sink fraction plotted over the period 1959–2099. Fractions calculated each year as the ratio of the annual increase in the carbon content of the respective pool (atmosphere, ocean, or land) divided by the annual total anthropogenic emissions.

and land cover conversions (McGuire et al., 2001; Friedlingstein et al., 2006). This method does not in any way capture the modeled terrestrial ecosystem response to the disturbances implicit in the land use and land cover change. These responses have been shown, however, to be an important driver of net land carbon fluxes and to have significant interactions with changing CO_2 and N deposition (Thornton et al., 2002). In particular, the standard approach does not capture the influence of prior disturbance on present-day carbon uptake for forests re-establishing on abandoned agricultural land, which is suggested to be an important component of the total land sink in temperate regions (Pacala et al., 2001). Introducing a mechanistic treatment of land cover change could either reduce the predicted land sink fraction through reduction in forest area or increase the land sink fraction by shifting forests to younger age-class structures. We are exploring this and other C-N-disturbance interactions as a separate study.

In the absence of anthropogenic nitrogen deposition (experiment *Rn*) a_E over the period 1959–2006 is 0.59. Relative to the case with anthropogenic nitrogen deposition, the land fraction drops to 0.14, with a compensating increase in the ocean fraction to 0.27. For the period 2050-2099 in the absence of anthropogenic N deposition the airborne, land, and ocean fractions are 0.67, 0.13, and 0.2, respectively.

Our model predicts a significant growth in the airborne fraction ($r(a_E)$) of 0.22% y^{-1} over the period 2000–2099, attributable to declining sink fractions for both land and ocean over this period (Table 3 and Fig. 8). Growth rate for the airborne fraction is lower (0.12% y^{-1}) over the period 1959–2006, but the result is not significant at the 95% confidence level. Raupach et al. (2008) estimate $r(a_E)$=0.24% y^{-1} over the period 1959–2006. Variability in a_E is driven mainly by variability in the land sink fraction ($s_{E,\mathrm{lnd}}$) in our results (Fig. 8), with variability decreasing over time. Our results suggest a significant increase in the airborne fraction growth rate in the latter half of the 21st century. This appears to be the result of a steadily declining ocean sink fraction over the 21st century and a declining land sink fraction over the period 2050–2099 (Fig. 8), although the decline in land sink fraction is not significant at the 95% confidence level (Table 3).

3.2 Fate of additional N

Our results for the region around the Harvard Forest study site show a 30-40 year lag between the onset of anthropogenic N deposition (new mineral N input) and increased losses due to denitrification (Fig. 9a and b). Cumulative denitrification losses grow rapidly to 50% of cumulative new inputs after 40–50 years, and eventually stabilize close to 75% of cumulative new inputs (Fig. 9b).

During the first 40 years of the simulation, when losses of new inputs due to denitrification are low, most of the

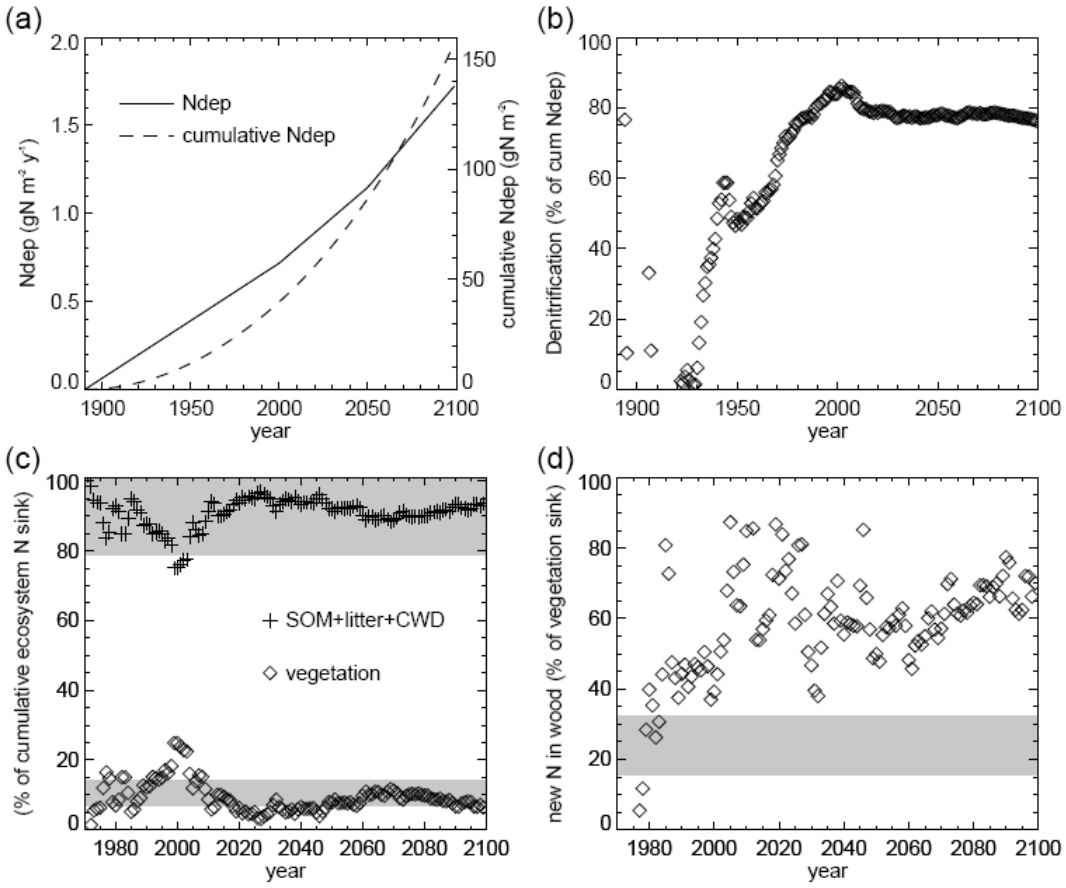


Fig. 9. Comparison of modeled and observed fate of new mineral N introduced by anthropogenic N deposition near Harvard Forest. Annual mineral anthropogenic N deposition and cumulative anthropogenic N deposition over the period 1890–2099 **(a)**. Cumulative denitrification as a % of cumulative anthropogenic N deposition (Ndep) **(b)**. Anthropogenic nitrogen deposition stored in soil organic matter (SOM)+litter+coarse woody debris (CWD) and stored in vegetation, shown as % of cumulative ecosystem N sink **(c)**. Anthropogenic nitrogen deposition stored in wood, as a % of total vegetation sink for new nitrogen **(d)**. Observed ranges shown as gray bars in cC and d (see text).

additional N is accumulating in soil (results not shown). The differencing of two independent coupled climate simulations required to extract the N deposition signal makes it difficult to quantify the fraction of new input N that accumulates in vegetation during the early years of the simulation – the signal is overwhelmed by variability due to independent climate realizations. After about 90 years the anthropogenic N deposition signal is strong enough to begin to resolve the accumulation in vegetation vs. litter and soil pools, and also to resolve the fractions accumulating in woody vs. non-woody vegetation pools. Over the period 1980–2100 the fraction of increased N stocks accumulating in vegetation varies in the range 4-25%, with generally higher values early in that period and lower values later (Fig. 9c). The large majority of new N stocks are still accumulating in soil organic matter during this period. Of the new N accumulating in vegetation, the contribution of woody biomass increases over time from 40% for the period 1980–1999 to 70% for the period 2080–2099 (Fig. 9d).

These results are broadly consistent with the observed partitioning of accumulated ^{15}N tracer at Harvard Forest, where Nadelhoffer et al. (2004) (hereafter *Nad04*) found a range of 6.8–14.3% of tracer N in vegetation 7 years after application in their control plots, with 78.8–100.4% of tracer N in organic and mineral soil (ranges shown as shaded regions in Fig. 9c). The fraction of vegetation tracer N residing in wood was lower for *Nad04* than in our simulations (15.7–32.3%, shaded region in Fig. 9d), but was increasing with time in their control plots. We are not able to resolve the vegetation signal for the first 90 years of the simulation, but the trend in model results shown in Fig. 9d suggests that the model has a lower fraction of new N in wood earlier in the simulation. This behavior is consistent with the hypothesis put forward in *Nad04* that tracer N is accumulating in woody

tissue over time, at least in their control plots where the rates of background nitrogen deposition (reported in *Nad04* as 0.8 gN m^{-2} y^{-1}) are in excellent agreement with our modeled N deposition rates at present day for this region (Fig. 9a).

4 Discussion

4.1 Influence of C-N coupling on C_a

We predict that introduction of C-N interactions in the land component of a coupled climate-carbon cycle AOGCM causes a reduction in terrestrial carbon sink strength under increasing C_a, which is only partly offset by the N-mediated reversal of the land response to radiatively-forced climate change from a net source to a net sink. The overall effect of C-N interaction in the current model results is to reduce the fraction of anthropogenic emissions stored in land ecosystems, compared to models lacking C-N interactions. Since our simulation did not include any influence of changing landcover, it is likely that the present model configuration would result in a significantly higher C_a by the end of the 21st century under a business-as-usual scenario for fossil fuel and land use emissions, compared to previous coupled climate-carbon cycle modeling results.

Significant interactions among increasing C_a, anthropogenic N deposition, and disturbance history have been documented through site-level measurements and model-measurement comparisons (Ollinger et al., 2002; Thornton et al., 2002; Goodale and Aber, 2001), and we expect that C-N interactions will strongly influence global-scale predictions of net greenhouse gas emissions due to changing land use and land cover. Previous coupled climate system model results found a reasonable match to present-day C_a for some models with much larger β_L than predicted here (Friedlingstein et al., 2006). Strong land uptake due to CO_2-fertilization in those models is partly balanced by carbon emissions from landuse change. These earlier simulations used a simple prescribed deforestation carbon source term, and did not include the dynamics of land use change and the potential for evolving sources and sinks related to land use history. In particular, we expect that mid-latitude carbon sinks due to reforestation on abandoned agricultural land may help to offset the low CO_2 fertilization effect in our C-N coupled land model (Pacala et al., 2001; Hurtt et al., 2006; Stephens et al., 2007). We are currently exploring these interactions.

The magnitude and sign of the overall climate-carbon feedback (*gain*) predicted here depends on the magnitude and sign of the feedback components as given in Eq. (4). A low value of the transient climate sensitivity to greenhouse gas forcing (α) compared to previous studies tends to reduce the magnitude of *gain*, regardless of its sign. If α is found to have a low bias in this model, the overall negative climate-carbon cycle feedback may have a larger magnitude than predicted here, which would lead to reduction in C_a. However, the negative sign of *gain* is due to the fact that the small positive value for γ_L is able to cancel the small negative value for γ_O. We note that γ_O here (-10 PgC K^{-1}) is smaller in magnitude than any of the C4MIP models (Fig. 3c) (range: -16 to -67 PgC K^{-1}). If the magnitude of γ_O is too low, the modest positive value for γ_L suggests that the true *gain* may be positive, which would result in higher values for C_a. If β_O is biased low, as suggested by comparison to other models (Fig. 3b) and comparison against ocean tracers (Appendix A), then the magnitude of *gain* may be overstated, whatever its sign.

While our current model does include gaseous nitrogen losses from soil as an important process regulating the long-term accumulation of nitrogen stocks, we are not presently accounting for the greenhouse forcing consequences of N_2O emissions. We expect these emissions to scale approximately with total decomposition, and so in general to increase under a warmer climate with more active heterotrophic respiration.

4.2 Representation of nutrient limitations in the tropics

An important source of uncertainty for the results presented here has to do with the nature and extent of limitation from nutrients other than nitrogen, and particularly the role of phosphorus limitation in tropical forests. The meta-analysis by LeBauer and Treseder (2008) of nitrogen addition experiments shows that N limitation is observed in both upland and lowland tropical forests. In conjunction with additional meta-analysis of combined N and P experiments (Elser et al., 2007) it appears that lowland primary tropical forest is likely more limited by P than by N availability, while lowland secondary and upland forest may exhibit the same degree of N-limitation as observed in temperate forest.

A critical issue is whether the prediction of C-climate feedbacks in the lowland primary tropical forest ecosystem is approximated better by the introduction of C-N interactions, or by leaving out the C-nutrient interactions altogether. In Thornton et al. (2007) we set forward the hypothesis that inclusion of C-N dynamics might be a reasonable first-order approximation for both N and P limitations. Since the short-term (years to decades) availability of both N and P incorporated into annual plant growth is dictated mainly by the rate of decomposition of soil organic matter and the associated mineralization of previously organically bound nutrients, we suggest that N limitation serves as a useful lower-bounding nutrient limitation proxy for the case of ecosystems where the P limitation is dominant, or with N-P colimitation.

An important counter-argument to this N-proxy hypothesis is that the coupling of N and P dynamics is complicated by the connection between P-availability and biological N fixation (Wang et al., 2007; Houlton et al., 2008), which could lead to a coupled N-P limitation that is smaller than the simple N-proxy limitation. In that case the results presented here could be overstating the importance of the real C-nutrient interaction effect on the C-climate feedback components. We

have tried to mitigate against the possibility of severe biases in this direction by incorporating a prognostic calculation of biological N fixation (BNF) into CLM-CN. This formulation captures the first-order dependencies of BNF on climate and carbon availability by making BNF a saturating function of net primary production (Thornton et al., 2007).

4.3 Influence of C-N interactions on model uncertainty

In spite of the potential biases discussed above, we expect that the uncertainty in previous estimates of β_L, γ_L, and *gain* (Friedlingstein et al., 2006) (Fig. 2d–f) would be significantly reduced if explicit C-N interactions were introduced in other models. This expectation is based on the following consideration of the sign of the effect of C-N interactions on the feedback components and the logical bounds on those parameters.

We consider any reasonable estimate of β_L to be bounded below by zero, since there is no evidence suggesting that increasing C_a could lead to a global-scale reduction in land carbon storage. We posit that introduction of any new constraint on vegetation growth response, such as an explicit dependence on nitrogen availability to support new growth, can only produce a reduction in the estimated response of land carbon uptake to CO_2 fertilization. So introduction of C-N coupling in a model that previously considered only the carbon cycle will lead to a reduced β_L. The range of estimates for β_L shown in Fig. 2d will therefore be compressed as more models introduce an explicit treatment of nitrogen limitation, leading to a smaller range in predicted land carbon uptake under a common emissions scenario.

There is not an obvious logical bound on the sign of the land carbon storage response to radiatively-forced climate change, as evidenced by the spatial variability in the sign of the response demonstrated for both carbon-only (Fung et al., 2005) and carbon-nitrogen model results (Fig. 4l). We do expect, however, that a general response to introduction of C-N coupling will be an increased dependence of primary production on heterotrophic respiration. This should damp the tendency, demonstrated by all the previous carbon-only models, to release carbon from land under a warmer climate. C-N coupling should therefore shift the range of model results shown in Fig. 2e in the direction of our C-N coupled result. We also hypothesize that because this response depends on a strong coupling between production (carbon uptake) and respiration (carbon release), there is an upper limit to the response at some moderate positive value for γ_L. Introduction of C-N coupling is therefore expected to compress the between-model range of γ_L. Results from a coupled model of intermediate complexity support this hypothesis (Sokolov et al., 2008). A comparison of dynamic global vegetation models suggests that inclusion of dynamic biogeography might complicate the influence of C-N coupling on the land ecosystem response to warming (Cramer et al., 2001). In addition to the warming-related mechanism of C-N interaction, other mechanisms related to changing nitrogen status are likely to play an important role, such as changes in species composition and associated changes in ecosystem structure and function (Suding et al., 2005) and changes in allocation patterns (Norby and Iversen, 2006).

Long-term multi-site flux observations (Law et al., 2002), ecosystem manipulation experiments (Norby and Iversen, 2006; Finzi et al., 2007; Melillo et al., 2002), and land carbon fluxes from data-assimilation methods (Peters et al., 2005) provide strong observational constraints that will be critical to the evaluation of the predicted climate-carbon-nitrogen dynamics reported here. Recent work with the CCSM suite of models clearly demonstrates the usefulness of model evaluation against multiple observational constraints (Randerson et al., 2009) as a way to improve model parameterization and performance, and several additional efforts are currently underway.

4.4 Fate of input N

In our simulations, the influence of C-N coupling on the climate-carbon feedback depends on the fate of newly mineralized N, in particular whether it accumulates mainly in soil organic matter or in woody tissue. Confidence in this result demands that the same model be able to predict the fate of new N introduced directly through fertilization. We are fortunate to have as a point of reference in this regard the results of ^{15}N tracer experiments as reported by Nadelhoffer et al. (2004) (*Nad04*), but a completely consistent comparison of our results with the Harvard Forest tracer experiments is not possible, due to the other requirements of our experimental protocol and limited computational resources. We find, however, that a broad comparison of our results with those of *Nad04* shows an encouraging degree of qualitative as well as quantitative correspondence.

Our result showing a nearly complete retention of new input N for the first several decades of low-level N addition is consistent with the near-complete recovery of tracer N in the *Nad04* control plots after 7 years. Our results suggest that a longer manipulation would be required to see significant gaseous losses on the control plots, but those results may be sensitive to the level of N fertilization. Even at year 2099 the anthropogenic N deposition in our simulations for the Harvard Forest grid point are well below even the low-N fertilization plots in *Nad04*. Additional modeling experiments are required to evaluate the influence of higher N input rates on this predicted time lag.

We also find that the dominant ecosystem sink for new N inputs is into soil organic matter, consistent with *Nad04*. This is true during periods of both low and high denitrification losses. When the signal:noise of our differenced coupled simulations is high enough to resolve the fraction of the ecosystem sink accumulating in vegetation (after 1980), we find a good quantitative agreement with *Nad04*, with our predicted fractions of the N sink into vegetation and litter/soil

organic matter falling within the observed range for most of the period 1980–2099. Fractions of deposited N recovered in vegetation, litter, and soils vary across multiple studies, but in general the total fraction recovered in litter and soil is larger than the fraction recovered in vegetation (Schlesinger, 2009).

We stress that there are some issues with our experimental protocol that leave an imperfect basis for comparison. The values shown for the model in Figure 8 are percentages of the cumulative ecosystem sink, and are significantly smaller and outside the observed range if expressed on the basis of cumulative anthropogenic N deposition inputs. Our results suggest that the modeled denitrification flux associated with the new input N would be very small for the 7-year observation period reported in *Nad04* if the modeled N addition were a short pulse over 1991–1992 as in the field experiment. We also note that the qualitative agreement in terms of the large fraction of the modeled N sink going to litter and soil organic matter holds well both before and after the transition to denitrification losses. Ignoring the denitrification component therefore provides the most logical basis for comparison, but we recognize that additional evaluation work should be done to test our model more exactly against the experimental conditions of *Nad04*.

5 Conclusions

Results reported here support the conclusion that tight coupling of carbon and nitrogen cycles in the terrestrial biosphere has the following important consequences for climate system – carbon cycle feedbacks and resulting changes in C_a:

1. Terrestrial C-N interaction greatly reduces the capacity of land ecosystems to increase net carbon uptake in response to increasing atmospheric CO_2 concentration, compared to the same response when nutrient limitations are ignored. This conclusion is supported by previous studies: for stand-alone ecosystem models (McGuire et al., 2001), offline land component of a coupled climate model (Thornton et al., 2007), coupled model of intermediate complexity (Sokolov et al., 2008), and now here for the case of a fully-coupled climate system model. We note that each of these studies is based on either the TEM or the CLM-CN model.

2. Terrestrial C-N interaction leads to an increase in γ_L, the sensitivity of land carbon uptake to radiatively-forced climate change, moving the overall climate-carbon cycle feedback in the direction of a smaller positive feedback than previously assumed (Friedlingstein et al., 2006; Denman et al., 2007), including the possibility of a modest negative feedback. The mechanism controlling this response is the interdependence of primary production and heterotrophic respiration, mediated by the cycling of mineral and organic forms of nitrogen in the plant-litter-soil system.

3. Decreased CO_2 fertilization effect and smaller carbon losses (or even carbon gain) under radiatively forced climate change have opposing influence on C_a, but our results suggest that the net effect of introducing C-N dynamics is to increase the airborne fraction of anthropogenic emissions, and so increase the simulated C_a for a given emissions scenario.

These conclusions are supported by the following lines of evidence, establishing causality in the simulation results and evaluating these results against experimental studies:

– Introduction of anthropogenic nitrogen deposition shifts the predicted climate-carbon cycle feedback parameters toward the mean response of previously-reported carbon-only models.

– Introduction of C-N interaction greatly increases the sensitivity of primary production to radiatively-forced climate warming, and this increase is directly associated with a warming-induced increase in nitrogen mineralization. This factor increases the importance of temperature change and reduces the relative importance of soil moisture change on the spatial pattern of land carbon cycle response to climate change.

– Climate warming drives a transfer of nitrogen out of soil organic matter and into vegetation, influenced by a demand-based competition between plants and microbes for the available mineral nitrogen resource.

– The simulated fate of new mineral nitrogen, with respect to ecosystem losses and accumulation in vegetation and soil pools, is in good qualitative and quantitative agreement with ^{15}N tracer experiments in a temperate forest ecosystem. The relative accumulation of new nitrogen in woody vs. non-woody vegetation tissue is less conclusive, but results suggest a good qualitative agreement.

We argue that between-model variation in land carbon cycle responses to both CO_2 fertilization and climate change would be reduced by the introduction of C-N interactions in other climate-carbon cycle models, which would tend to reduce the range of uncertainty in predictions of future climate from the coupled models. Finally, we note that the present simulations have not included the influence of disturbance history and land use. These factors have been shown to interact strongly with C-N dynamics. We are currently exploring these interactions in the context of the fully-coupled climate system model, and we expect that these interactions will result in larger values of atmospheric CO_2 concentration than predicted here.

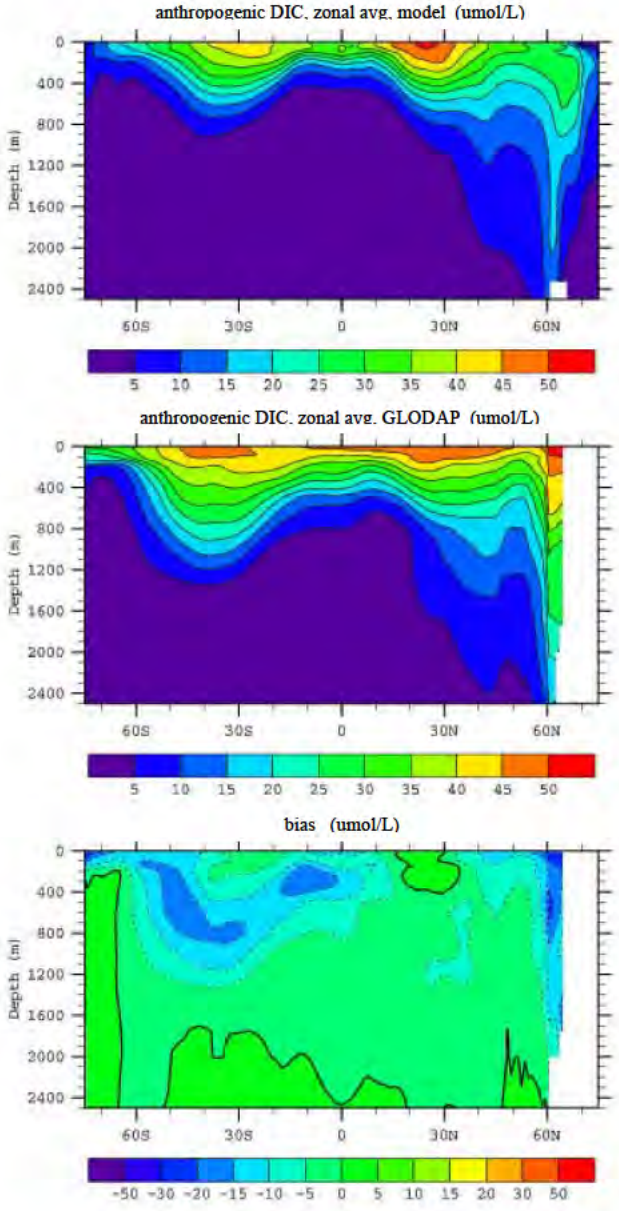


Fig. A1. Zonal average of anthropogenic dissolved inorganic carbon (DIC). See text for discussion of averaging time periods. Model (top), GLODAP measurements (middle), and model bias (bottom).

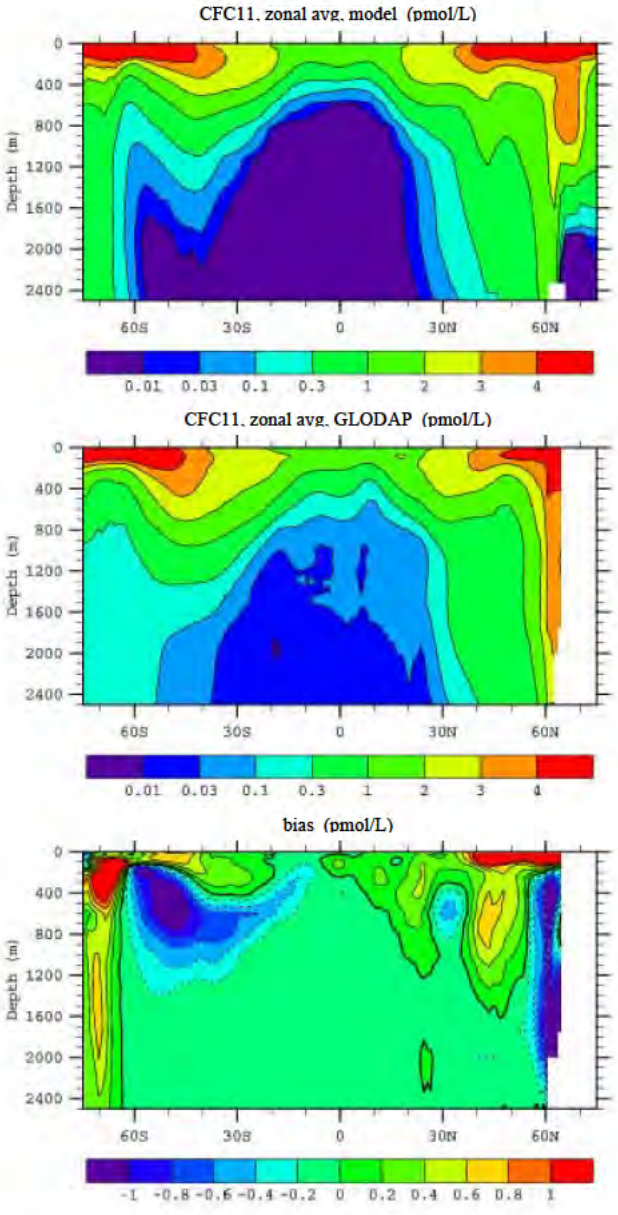


Fig. A2. Zonal average of CFC-11. See text for discussion of averaging time periods. Model (top), GLODAP measurements (middle), and model bias (bottom).

Appendix A

Ocean CO_2 and CFC analysis

The sensitivity of ocean carbon uptake to changes in atmospheric CO_2 in the CCSM 3.1-carbon simulations (reported here) is at the low end of published values. Values of the ocean carbon sensitivity, β_O, are equal to about 1.0 PgC ppm^{-1} over the first half of the 21st century, declining to 0.8 PgC ppm^{-1}. By comparison, the range of β_O reported for the C4MIP models is 0.8 to 1.6 PgC ppm^{-1} (Friedlingstein et al., 2006). To assess whether this low ocean carbon sensitivity is reasonable, we compare the CCSM 3.1-carbon results against observed ocean tracer distributions for the contemporary period (Matsumoto et al., 2004). We use globally gridded fields from the GLODAP project derived from the World Ocean Circulation Experiment (WOCE) in the 1990s (Key et al., 2004). We focus on two tracers: empirically derived anthropogenic carbon estimates (Sabine et al., 2004) and chlorofluorocarbon CFC-11, an inert tracer produced solely by industrial processes (Dutay

et al., 2002). The simulated CFC data are extracted for 1994, to match the mid-point of the WOCE CFC data. The model analysis period is shifted slightly for anthropogenic carbon to 1994–2008 so that the model atmospheric CO_2 levels match that for the WOCE period.

The simulated zonal average anthropogenic carbon distribution in our results exhibits similar depth and latitudinal patterns as the observed fields (Fig. A1). But the model tends to underestimate anthropogenic carbon, relative to the field derived estimates, in the Southern Hemisphere, along ventilation pathways of Antarctic intermediate and mode waters, and in the northern North Atlantic. Globally the simulated anthropogenic CO_2 inventory for the WOCE period is 42% lower than observed estimates, which are presented with a 16% uncertainty. The observational derived anthropogenic carbon is a derived rather than directly measured quantity and thus has its own potential biases and uncertainties. In contrast, there are no natural sources for CFC-11, and while not a perfect analogue for anthropogenic CO_2 because of differences in gas exchange and the temperature sensitivity of solubility, the growth rates of atmospheric CFC-11 and CO_2 matched well for much of the latter half of the 20th century.

The error patterns in the simulated zonal average distribution of chlorofluorocarbon CFC-11 (Fig. A2) are similar to those of anthropogenic carbon. In particular, the CFC model-data biases suggest that the model has too strong ventilation right near Antarctica with diminished ventilation of Antarctic intermediate and mode waters. And in the northern North Atlantic, the CFCs show how model convection is shifted too far south. Positive CFC-11 biases are found in subpolar and polar surface waters, associated with model temperature biases. Excluding the Arctic Ocean, which is poorly sampled, the simulated CFC inventory for the WOCE period is 11% lower than observed estimates, which are presented with a 15% uncertainty. The CFCs appear to confirm that the low ocean carbon sensitivity β_O for the present results and the underestimated anthropogenic carbon uptake over the historical period reflect, at least in part, an overly weak formation and ventilation of intermediate waters in the Southern Ocean.

Acknowledgements. We thank G. Bonan, D. Schimel, and E. Holland for helpful discussions throughout this effort. We also thank V. Arora, C. Jones, and two anonymous reviewers for their constructive comments on the manuscript. This work was supported in part by NASA Earth Science Enterprise, Terrestrial Ecology Program, grant #W19,953 to P. E. Thornton. Support was provided by the National Center for Atmospheric Research (NCAR) through the NCAR Community Climate System Modeling program, and through the NCAR Biogeosciences program. Additional support was provided by the US Department of Energy, Office of Science, Office of Biological and Environmental Research. I. Fung, S. Doney, N. Mahowald, and J. Randerson acknowledge support from National Science Foundation, Atmospheric Sciences Division, through the Carbon and Water Initiative. NCAR is sponsored by the National Science Foundation.

Edited by: L. Bopp

References

Andres, R. J., Marland, G., Fung, I., and Matthews, E.: A one degree by one degree distribution of carbon dioxide emissions from fossil fuel consumption and cement manufacture, 1950–1990, Global Biogeochem. Cy., 10, 419–429, 1996.

Arain, M. A., Yuan, F., and Black, T. A.: Soil-plant nitrogen cycling modulated carbon exchanges in a western temperate conifer forest in Canada, Agr. Forest Meteorol., 140, 171–192, 2006.

Collins, W. D., Bitz, C. M., Blackmon, M. L., Bonan, G. B., Bretherton, C. S., Carton, J. A., Chang, P., Doney, S. C., Henderson, T. B., Kiehl, J. T., Large, W. G., McKenna, D. S., Santer, B. D., and Smith, R. D.: The community climate system model version 3 (CCSM3), J. Climate, 19, 2122–2143, 2006.

Cramer, W., Bondeau, A., Woodward, F. I., Prentice, I. C., Betts, R. A., Brovkin, V., Cox, P. M., Fisher, V., Foley, J. A., Friend, A. D., Kucharik, C., Lomas, M. R., Ramankutty, N., Sitch, S., Smith, B., White, A., and Young-Molling, C.: Global response of terrestrial ecosystem structure and function to CO_2 and climate change: results from six dynamic global vegetation models, Global Change Biol., 7, 357–373, 2001.

de Graaff, M.-A., van Groenigen, K.-J., Six, J., Hungate, B., and van Kessel, C.: Interactions between plant growth and soil nutrient cycling under elevated CO_2: A meta-analysis, Global Change Biol., 12, 2077-2091, doi:10.1111/j.1365-2486.2006.01240 x, 2006.

Denman, K. L., Brasseur, G., Chidthaisong, A., Ciais, P., Cox, P. M., Dickinson, R. E., Hauglustaine, D., Heinze, C., Holland, E., Jacob, D., Lohmann, U., Ramachandran, S., da Silva Dias, P. L., Wofsy, S. C., and Zhang, X.: Couplings between changes in the climate system and biogeochemistry, in: Climate Change 2007: The Physical Science Basis, edited by: Solomon, S., Qin, D., Manning, M., Chen, Z., Marquis, M., Averyt, K. B., Tignor, M., and Miller, H. L., Cambridge University Press, Cambridge, United Kingdon and New York, NY, USA, 499–588, 2007.

Dickinson, R. E., Oleson, K. W., Bonan, G. B., Hoffman, F. M., Thornton, P., Vertenstein, M., Yang, Z.-L., and Zeng, X.: The community land model and its climate statistics as a component of the Community Climate System Model, J. Climate, 19, 2302–2324, 2006.

Doney, S. C., Lindsay, K., and Moore, J. K.: Global ocean carbon cycle modeling, in: Ocean biogeochemistry: A JGOFS synthesis, edited by: Fashom, M., Springer-Verlag, New York, 217–238, 2003.

Doney, S. C., Lindsay, K., Caldeira, K., Campin, J.-M., Drange, H., Dutay, J.-C., Follows, M., Gao, Y., Gnanadesikan, A., Gruber, N., Ishida, A., Joos, F., Madec, G., Maier-Reimer, E., Marshall, J. C., Matear, R. J., Monfray, P., Mouchet, A., Najjar, R., Orr, J. C., Plattner, G.-K., Sarmiento, J., Schlitzer, R., Slater, R., Totterdell, I. J., Weirig, M.-F., Yamanaka, Y., and Yool, A.: Evaluating global ocean carbon models: The importance of realistic physics, Global Biogeochem. Cy., 18, GB3017, doi:10.1029/2003GB002150, 2004.

Doney, S. C., Lindsay, K., Fung, I., and John, J.: Natural variability in a stable, 1000-yr global coupled climate-carbon cycle simulation, J. Climate, 19, 3033–3054, 2006.

Dutay, J.-C., Bullister, J. L., Doney, S. C., Orr, J. C., Najjar, R., Caldeira, K., Champin, J.-M., Drange, H., Follows, M., Gao, Y., Gruber, N., Hecht, M. W., Ishida, A., Joos, F., Lindsay, K., Madec, G., Maier-Reimer, E., Marshall, J. C., Matear, R. J.,

Monfray, P., Plattner, G.-K., Sarmiento, J., Schlitzer, R., Slater, R., Totterdell, I. J., Weirig, M.-F., Yamanaka, Y., and Yool, A.: Evaluation of ocean model ventilation with cfc-11: Comparison of 13 global ocean models, Ocean Model., 4, 89–120, 2002.

Elser, J. J., Bracken, M. E. S., Cleland, E. E., Gruner, D. S., Harpole, W. S., Hillebrand, H., Ngai, J. T., Seabloom, E. W., Shurin, J. B., and Smith, J. E.: Global analysis of nitrogen and phosphorus limitation of primary producers in freshwater, marine, and terrestrial ecosystems, Ecol. Lett., 10, 1135–1142, doi:10.1111/j.1461-0248.2007.01113 x, 2007.

Finzi, A. C., Norby, R. J., Calfapietra, C., Gallet-Budynek, A., Gielen, B., Holmes, W. E., Hoosbeek, M. R., Iversen, C. M., Jackson, R. B., Kubiske, M. E., Ledford, J., Liberloo, M., Oren, R., Polle, A., Pritchard, S., Zak, D. R., Schlesinger, W. H., and Ceulemans, R.: Increases in nitrogen uptake rather than nitrogen-use efficiency support higher rates of temperate forest productivity under elevated CO_2, P. Natl. Acad. Sci., 104, 14014–14019, 2007.

Friedlingstein, P., Dufresne, J.-L., Cox, P. M., and Rayner, P.: How positive is the feedback between climate change and the carbon cycle?, Tellus, 55B, 692–700, 2003.

Friedlingstein, P., Cox, P., Betts, R. A., Bopp, L., von Bloh, W., Brovkin, V., Cadule, P., Doney, S., Eby, M., Fung, I., Bala, G., John, J., Jones, C., Joos, F., Kato, T., Kawamiya, M., Knorr, W., Lindsay, K., Matthews, H. D., Raddatz, T., Rayner, P., Reick, C., Roeckner, E., Schnitzler, K.-G., Schnur, R., Strassmann, K., Weaver, A. J., Yoshikawa, C., and Zeng, N.: Climate-carbon cycle feedback analysis: Results from the C^4MIP model intercomparison, J. Climate, 19, 3337–3353, 2006.

Fung, I. Y., Doney, S. C., Lindsay, K., and John, J.: Evolution of carbon sinks in a changing climate, P. Natl. Acad. Sci., 102, 11201–11206, 2005.

Gill, R. A., Anderson, L. J., Polley, H. W., Johnson, H. B., and Jackson, R. B.: Potential nitrogen constraints on soil carbon sequestration under low and elevated atmospheric CO_2, Ecology, 87, 41–52, 2006.

Goldewijk, K.: Estimating global land use change over the past 300 years: The HYDE database, Global Biogeochem. Cy., 15, 417–434, 2001.

Goodale, C. L. and Aber, J. D.: The long-term effects of land-use history on nitrogen cycling in northern hardwood forests, Ecol. Appl., 11, 253–267, 2001.

Horowitz, L. W., Walters, S., Mauzerall, D. L., Emmons, L. K., Rasch, P. J., Granier, C., Tie, X. X., Lamarque, J.-F., Schultz, M. G., Tyndall, G. S., Orlando, J. J., and Brasseur, G. P.: A global simulation of tropospheric ozone and related tracers: Description and evaluation of MOZART, version 2, J. Geophys. Res., 108(D24), 4784, doi:4710.1029/2002JD002853, 2003.

Houlton, B. Z., Wang, Y. P., Vitousek, P. M., and Field, C. B.: A unifying framework for dinitrogen fixation in the terrestrial biosphere, Nature, 454, 327–330, 2008.

Hungate, B. A., Dukes, J. S., Shaw, R., Luo, Y., and Field, C. B.: Nitrogen and climate change, Science, 302, 1512–1513, 2003.

Hurtt, G. C., Frolking, S., Fearon, M. G., Moore III, B., Shevliakova, E., Malyshev, S., Pacala, S. W., and Houghton, R. A.: The underpinnings of land-use history: three centuries of global gridded land-use transitions, wood harvest activity, and resulting secondary lands, Global Change Biol., 12, 1–22, 2006.

Key, R. M., Kozyr, A., Sabine, C. L., Lee, K., Wanninkhof, J. L., Bullister, J. L., Feely, R. A. M., Mordy, C., and Peng, T. H.: A global ocean carbon climatology: Results from global data analysis project (GLODAP), Global Biogeochem. Cy., 18, GB4031, doi:10.1029/2004GB002247, 2004.

Lamarque, J. F., Kiehl, J., Brasseur, G., Butler, T., Cameron-Smith, P., Collins, W. D., Collins, W. J., Granier, C., Hauglustaine, D., Hess, P., Holland, E., Horowitz, L., Lawrence, M., McKenna, D., Merilees, P., Prather, M., Rasch, P., Rotman, D., Shindell, D., and Thornton, P.: Assessing future nitrogen deposition and carbon cycle feedbacks using a multi-model approach: Analysis of nitrogen deposition, J. Geophys. Res., 110, D19303, doi:10.1029/2005JD005825, 2005.

Large, W. G. and Yeager, S. G.: Diurnal to decadal global forcing for ocean and sea-ice models: The data sets and flux climatologies, National Center for Atmospheric Research, Boulder, CONCAR/TN-460+STR, 2004.

Law, B. E., Falge, E., Gu, L., Baldocchi, D. D., Bakwin, P., Berbigier, P., Davis, K., Dolman, A. J., Falk, M., Fuentes, J. D., Goldstein, A., Granier, A., Grelle, A., Hollinger, D., Janssens, I. A., Jarvis, P., Jensen, N. O., Katul, G., Mahli, Y., Matteucci, G., Meyers, T., Monson, R., Munger, W., Oechel, W., Olson, R., Pilegaard, K., Paw, U. K. T., Thorgeirsson, H., Valentini, R., Verma, S., Vesala, T., Wilson, K., and Wofsy, S.: Environmental controls over carbon dioxide and water vapor exchange of terrestrial vegetation, Agr. Forest Meteorol., 113, 97–120, 2002.

Lawrence, D. M., Thornton, P. E., Oleson, K. W., and Bonan, G. B.: The partitioning of evapotranspiration into transpiration, soil evaporation, and canopy evaporation in a GCM: Impacts on land-atmosphere interaction, J. Hydrometeorol., 8, 862–880, 2007.

LeBauer, D. S. and Treseder, K. K.: Nitrogen limitation of net primary productivity in terrestrial ecosystems is globally distributed, Ecology, 89, 371–379, 2008.

Luo, Y., Su, B., Currie, W. S., Dukes, J. S., Finzi, A. C., Hartwig, U., Hungate, B. A., McMurtrie, R. E., Oren, R., Parton, W. J., Pataki, D. E., Shaw, M. R., Zak, D. R., and Field, C. B.: Progressive nitrogen limitation of ecosystem responses to rising atmospheric carbon dioxide, Bioscience, 54, 731–739, 2004.

Luo, Y., Hui, D., and Zhang, D.: Elevated CO_2 stimulates net accumulations of carbon and nitrogen in land ecosystems: A meta-analysis, Ecology, 87, 53–63, 2006.

Mäkipää, R., Karjalainen, T., Pussinen, A., and Kellomäki, S.: Effects of climate change and nitrogen deposition on the carbon sequestration of a forest ecosystem in the boreal zone, Can. J. Forest Res., 29, 1490–1501, 1999.

Matsumoto, K., Sarmiento, J. L., Key, R. M., Bullister, J. L., Caldeira, K., Campin, J.-M., Doney, S. C., Drange, H., Dutay, J.-C., Follows, M., Gao, Y., Gnanadesikan, A., Gruber, N., Ishida, A., Joos, F., Lindsay, K., Maier-Reimer, E., Marshall, J. C., Matear, R. J., Monfray, P., Najjar, R., Platter, G.-K., Schlitzer, R., Slater, R., Swathi, P. S., Totterdell, I. J., Weirig, M.-F., Yamanaka, Y., Yool, A., and Orr, J. C.: Evaluation of ocean carbon cycle models with data-based metrics, Geophys. Res. Lett., 31, L07303, doi:10.1029/2003GL018970, 2004.

Matthews, H. D., Eby, M., Ewen, T., Friedlingstein, P., and Hawkins, B. J.: What determines the magnitude of carbon cycle-climate feedbacks?, Global Biogeochem. Cy., 21, GB2012, doi:10.1029/2006GB002733, 2007.

McGuire, A. D., Clein, J. S., Melillo, J. M., Kicklighter, D. W., Meier, R. A., Vorosmarty, C. J., and Serreze, M. C.: Modelling

carbon responses of tundra ecosystems to historical and projected climate: Sensitivity of pan-arctic carbon storage to temporal and spatial variation in climate, Global Change Biol., 6 (Suppl. 1), 141–159, 2000.

McGuire, A. D., Sitch, S., Clein, J. S., Dargaville, R., Esser, G., Foley, J., Heimann, M., Joos, F., Kaplan, J., Kicklighter, D. W., Meier, R. A., Melillo, J. M., Moore III, B., Prentice, I. C., Ramankutty, N., Reichenau, T., Schloss, A., Tian, H., Williams, L. J., and Wittenberg, U.: Carbon balance of the terrestrial biosphere in the twentieth century: Analyses of CO_2, climate and land use effects with four process-based ecosystem models, Global Biogeochem. Cy., 15, 183–206, 2001.

Meehl, G. A., Washington, W. M., Santer, B. D., Collins, W. D., Arblaster, J. M., Hu, A., Lawrence, D. M., Teng, H., Buja, L. E., and Strand, W. G.: Climate change projections for the twenty-first century and climate change commitment in the CCSM3, J. Climate, 19, 2597–2616, 2006.

Meehl, G. A., Stocker, T. F., Collins, W. D., Friedlingstein, P., Gaye, A. T., Gregory, J. M., Kitoh, A., Knutti, R., Murphy, J. M., Noda, A., Raper, S. C. B., Watterson, I. G., Weaver, A. J., and Zhao, Z.-C.: Global climate projections, in: Climate Change 2007: The physical science basis. Contribution of working group I to the fourth assessment report of the intergovernmental panel on climate change, edited by: Solomon, S., Qin, D., Manning, M., Chen, Z., Marquis, M., Averyt, K. B., Tignor, M., and Miller, H. L., Cambridge University Press, Cambridge, UK and New York, NY, U.S.A, 747–846, 2007.

Melillo, J. M., Steudler, P. A., Aber, J. D., Newkirk, K., Lux, H., Bowles, F. P., Catricala, C., Magill, A., Ahrens, T., and Morrisseau, S.: Soil warming and carbon-cycle feedbacks to the climate system, Science, 298, 2173–2176, 2002.

Moore, J. K., Doney, S. C., Kleypas, J. C., Glover, D. M., and Fung, I. Y.: An intermediate complexity marine ecosystem model for the global domain, Deep-Sea Res. Pt. II, 49, 403–462, 2002.

Moore, J. K., Doney, S. C., and Lindsay, K.: Upper ocean ecosystem dynamics and iron cycling in a global three-dimensional model, Global Biogeochem. Cy., 18, GB4028, doi:10.1029/2004GB002220, 2004.

Nadelhoffer, K. J., Emmett, B. A., Gunderson, P., Kjønaas, O. J., Koopmans, C. J., Schleppi, P., Tietema, A., and Wright, R. F.: Nitrogen deposition makes a minor contribution to carbon sequestration in temperate forests, Nature, 398, 145–148, 1999.

Nadelhoffer, K. J., Colman, B. P., Currie, W. S., Magill, A., and Aber, J. D.: Decadal-scale fates of ^{15}N tracers added to oak and pine stands under ambient and elevated n inputs at the Harvard Forest (USA), Forest Ecol. Manag.t, 196, 89–107, 2004.

Nakicenovic, N. and Swart, R.: Special report on emissions scenarios, in: Cambridge University Press, Cambridge, UK, 612, 2000.

Norby, R. J. and Iversen, C. M.: Nitrogen uptake, distribution, turnover, and efficiency of use in a CO_2-enriched sweetgum forest, Ecology, 87, 5–14, 2006.

Oleson, K. W., Dai, Y., Bonan, G. B., Bosilovich, M., Dickinson, R. E., Dirmeyer, P., Hoffmann, F., Houser, P., Levis, S., Niu, G.-Y., Thornton, P., Vertenstein, M., Yang, Z.-L., and Zeng, X.: Technical description of the Community Land Model (CLM), NCAR, Boulder, NCAR Tech Note NCARTN-461+STR, 174, 2004.

Ollinger, S. V., Aber, J. D., Reich, P. B., and Freuder, R. J.: Interactive effects of nitrogen deposition, tropospheric ozone, elevated CO_2 and land use history on the carbon dynamics of northern hardwood forests, Global Change Biol., 8, 545–562, 2002.

Pacala, S. W., Hurrt, G. C., Baker, D., Peylin, P., Houghton, R. A., Birdsey, R. A., Heath, L., Sundquist, E. T., Stallard, R. F., Ciais, P., Moorcroft, P., Casperson, J. P., Shevliakova, E., Moore, B., Kohlmaier, G., Holland, E., Gloor, M., Harmon, M. E., Fan, S.-M., Sarmiento, J. L., Goodale, C. L., Schimel, D., and Field, C. B.: Consistent land- and atmosphere-based US carbon sink estimates, Science, 292, 2316–2320, 2001.

Peters, W., Miller, J. B., Whitaker, J., Denning, A. S., Hirsch, A., Krol, M. C., Zupanski, D., Bruhwiler, L., and Tans, P. P.: An ensemble data assimilation system to estimate CO_2 surface fluxes from atmospheric trace gas observations, J. Geophys. Res., 110, D24304, doi:10.1029/2005JD006157, 2005.

Ramankutty, N. and Foley, J. A.: Estimating historical changes in global land cover: Croplands from 1700–1992, Global Biogeochem. Cy., 13, 997–1027, 1999.

Randerson, J. T., Hoffman, F. M., Thornton, P. E., Mahowald, N. M., Lindsay, K., Lee, Y.-H., Nevison, C. D., Doney, S. C., Bonan, G., Stöckli, R., Covey, C., Running, S. W., and Fung, I. Y.: Systematic assessment of terrestrial biogeochemistry in coupled climate-carbon models, Global Change Biol., 15, 2462–2484, doi: 10.1111/j.1365-2486.2009.01912 x, 2009.

Raupach, M. R., Canadell, J. G., and Le Quéré, C.: Anthropogenic and biophysical contributions to increasing atmospheric CO_2 growth rate and airborne fraction, Biogeosciences, 5, 1601–1613, 2008, http://www.biogeosciences net/5/1601/2008/.

Reich, P. B., Hobbie, S. E., Lee, T., Ellsworth, D. S., West, J. B., Tilman, D., Knops, J. M. H., Naeem, S., and Trost, J.: Nitrogen limitation constrains sustainability of ecosystem response to CO_2, Nature, 440, 922–925, 2006.

Sabine, C. L., Feely, R. A., Gruber, N., Key, R. M., Lee, K., Bullister, J. L., Wanninkhof, J. L., Wong, C. S., Wallace, D. W. R., Tilbrook, B., Millero, F. J., Peng, T.-H., Kozyr, A., Ono, T., and Rios, A. F.: The oceanic sink for anthropogenic CO_2, Science, 305, 367–371, 2004.

Schlesinger, W. H.: On the fate of anthropogenic nitrogen, P. Natl. Acad. Sci., 106, 203–208, 2009.

Sokolov, A. P., Kicklighter, D. W., Melillo, J. M., Felzer, B. S., Schlosser, C. A., and Cronin, T. W.: Consequences of considering carbon-nitrogen interactions on the feedbacks between climate and the terrestrial carbon cycle, J. Climate, 21, 3776–3796, doi:10.1175/2008JCLI2038.1, 2008.

Stephens, B. B., Gurney, K. R., Tans, P. P., Sweeney, C., Peters, W., Bruhwiler, L., Ciais, P., Ramonet, M., Bousquet, P., Nakazawa, T., Aoki, S., Machida, T., Inoue, G., Vinnichenko, N., Lloyd, J., Jordan, A., Heimann, M., Shibistova, O., Langenfelds, R. L., Steele, L. P., Francey, R. J., and Denning, A. S.: Weak northern and strong tropical land carbon uptake from vertical profiles of atmospheric CO_2, Science, 316, 1732–1735, doi:10.1126/science.1137004, 2007.

Stieglitz, M., McKane, R. B., and Klausmeier, C. A.: A simple model for analyzing climatic effects on terrestrial carbon and nitrogen dynamics: An arctic case study, Global Biogeochem. Cy., 20, GB3016, doi:10.1029/2005GB002603, 2006.

Suding, K. N., Collins, S. L., Gough, L., Clark, C., Cleland, E. E., Gross, K. L., Milchunas, D. G., and Pennings, S.: Functional- and abundance-based mechanisms explain diversity loss due to N fertilization, P. Natl. Acad. Sci., 102, 4387–4392, doi:10.1073/pnas.0408648102, 2005.

Thornton, P. E., Law, B. E., Gholz, H. L., Clark, K. L., Falge, E., Ellsworth, D. S., Goldstein, A. H., Monson, R. K., Hollinger, D., Falk, M., Chen, J., and Sparks, J. P.: Modeling and measuring the effects of disturbance history and climate on carbon and water budgets in evergreen needleleaf forests, Agr. Forest Meteorol., 113, 185–222, 2002.

Thornton, P. E. and Rosenbloom, N. A.: Ecosystem model spin-up: Estimating steady state conditions in a coupled terrestrial carbon and nitrogen cycle model, Ecol. Model., 189, 25–48, 2005.

Thornton, P. E., Lamarque, J.-F., Rosenbloom, N. A., and Mahowald, N. M.: Influence of carbon-nitrogen cycle coupling on land model response to CO_2 fertilization and climate variability, Global Biogeochem. Cy., 21, GB4018, doi:10.1029/2006GB002868, 2007.

Thornton, P. E. and Zimmermann, N. E.: An improved canopy integration scheme for a land surface model with prognostic canopy structure, J. Climate, 20, 3902–3923, doi:10.1175/JCLI4222.1, 2007.

van Groenigen, K.-J., Six, J., Hungate, B. A., de Graaff, M. A., van Breemen, N., and van Kessel, C.: Element interactions limit soil carbon storage, P. Natl. Acad. Sci., 103, 6571–6574, 2006.

Vitousek, P. M. and Howarth, R. W.: Nitrogen limitation on land and in the sea: How can it occur?, Biogeochemistry, 13, 87–115, 1991.

Wang, Y. P., Houlton, B., and Field, C. B.: A model of biogeochemical cycles of carbon, nitrogen and phosphorus including symbiotic nitrogen fixation and phosphatase production, Global Biogeochem. Cy., 21, GB1018, doi:10.1029/2006GB002797, 2007.

Washington, W. M., Weatherly, J. W., Meehl, G. A., Semtner, A. J., Bettge, T. W., Craig, A. P., Strand Jr., W. G., Arblaster, J., Wayland, V. B., James, R., and Zhang, Y.: Parallel climate model (PCM) control and transient simulations, Clim. Dynam., 16, 755–774, 2000.

Yeager, S. G., Shields, C. A., Large, W. G., and Hack, J. J.: The low-resolution CCSM3, J. Climate, 21, 2545–2566, 2006.

EPA-1090

Marcus Sarofim
(b)(6)
10/13/2009 09:27 AM

To Marcus Sarofim
cc
bcc
Subject reponses to plimer

(b)(5) Deliberative

Comments10_9_09.doc

gah! so much to do!

EPA-1091

Jason Samenow/DC/USEPA/US
10/13/2009 09:56 AM

To Marcus Sarofim, David Chalmers
cc
bcc
Subject another comment on historic climate change and attribution

Commenter Name: Patrick Michaels, Ph.D, Robert E. Davis, Ph.D, and Paul Knappenberger
Commenter Affiliation: Cato Institute, Department of Environmental Sciences, University of Virginia, and New Hope Environmental Services
Commenter Type:
Document Control Number: EPA-HQ-OAR-2009-0171-3136.1
Comment Excerpt Number: 103
Form Letter? No
Late Comment? No
Comment Changed? No
View Original Comment Letter

Specific Comments on the ANPR Draft Technical Support Document for Endangerment Analysis for Greenhouse Gas Emissions under the Clean Air Act, Page 105, lines 32-35. These describe ongoing climate change and its impact in the Arctic. This is not the first time that the climate was this warm in the Holocene. Postglacial warming was Arctic-wide. Darrell Kaufman (2004) noted that for 2,000 years—from 9,000 to 11,000 years ago, Alaskan temperatures averaged 3 F higher than now. He found that there have been three similarly warm periods in Alaska: AD 0 to 300, 850– 1200, and 1800 to the present. Thompson Webb III et al. (1998), found timings similar to MacDonald et al (2000): northwestern and northeastern North America were more than 4 F warmer than the baseline from 7,000–9,000 and 3,000–5,000 years ago, respectively. The lack of historical perspective in the TSD reduces its credibility as a basis for an endangerment finding. Correction requested: The TSD is not scientifically complete here. An updated discussion of the relevant science to properly reflect the full historical record is required. As it stands now, it is insufficient for basing an endangerment finding.

EPA-1092

Jeremy Martinich/DC/USEPA/US
10/13/2009 10:02 AM

To Jason Samenow
cc Rona Birnbaum
bcc
Subject Re: IQA comment

Cool, I'll incorporate it into the DQA section.

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

Jason Samenow (b)(5) Deliberative 10/13/2009 09:58:04 AM

From: Jason Samenow/DC/USEPA/US
To: Jeremy Martinich/DC/USEPA/US@EPA, Rona Birnbaum/DC/USEPA/US@EPA
Date: 10/13/2009 09:58 AM
Subject: IQA comment

(b)(5) Deliberative

jason

Commenter Name: William DiPuccio, Joseph D'Aleo
Commenter Affiliation: Fellow of the AMS, CCM, WSI, Icecap.us
Commenter Type:
Document Control Number: EPA-HQ-OAR-2009-0171-3187.4
Comment Excerpt Number: 1
Form Letter? No
Late Comment? No
Comment Changed? No
View Original Comment Letter

EPA's responsibility under the Federal Information Quality Act (IQA) is to review the original source documentation and data to make an independent judgment about the science, the data and the models. EPA also had the obligation to review the comments filed in 2008 on both the CCSP and ANPR and to reflect revisions as requested under the Petitions for Correction filed on those documents. As is shown below, the Administrator (and the EPA staff) relied on a superficial and erroneous review of summaries and conclusions of other "studies" rather than conducting a thorough evaluation of the relevant science, data and model analysis. One obvious problem was the use of EPA and government "reviewers" who are anything but independent reviewers. There is an inherent conflict of interest in the process used by EPA. This is a pervasive fatal flaw in the Endangerment Finding and the Technical Support Document. EPA's reliance on "studies" that fail to meet the requirements of the IQA invalidates the Endangerment Finding. The data disseminated fails to comply with the basic objectivity, utility and integrity guidelines of the IQA. "Objectivity" is a measure of whether disseminated information is accurate, reliable, and unbiased and whether that information is presented in an accurate, clear, complete, and unbiased manner; ''utility'' refers to the usefulness of the information to the intended users; ''integrity'' refers to the security of information - protection of the information from unauthorized access or revision, to ensure that the information is not compromised through corruption or falsification.

EPA-1093

Lesley Jantarasami
04/01/2010 03:48 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\ljantara\My Documents\Endangerment\02_Comments and Responses\04_Summaries for Ben\2.1.6 Cost Benefit 101309.doc

(b)(5) Deliberative [redacted] - 2.1.6 Cost Benefit 101309.doc

EPA-1094

Lesley Jantarasami/DC/USEPA/US
10/13/2009 11:46 AM

To David Chalmers
cc
bcc
Subject responses for Cost-Benefit

Hi David,

Hope you had a nice Columbus Day weekend! (b)(5) Deliberative I've finished summarizing all the comments in the cost-benefit category (b)(5) Deliberative [redacted] Let me know what you want to do - thanks so much!

(b)(5) Deliberative [redacted]
2.1.6 Cost Benefit 101309.doc

Lesley

EPA-1095

Lesley
Jantarasami/DC/USEPA/US
10/13/2009 12:02 PM

To Michael Kolian
cc William Perkins
bcc
Subject Re: edited responses to health comments

Hi Mike - welcome back! [redacted] (b)(5) Deliberative [redacted] Thanks!

Lesley

Commenter Name: Benjamin L. Brandes
Commenter Affiliation: The National Mining Association
Commenter Type:
Document Control Number: EPA-HQ-OAR-2009-0171-3764.1
Comment Excerpt Number: 10
Form Letter? Yes
Late Comment? No
Comment Changed? No

Presumably one of the principle missions of every government agency, especially EPA, is to reduce deaths among U.S. citizens. Although EPA acknowledges that warming temperatures may bring about some health benefits, including reduced human mortality from cold exposure through 2100, the agency asserts that it is "currently difficult to ascertain the balance between increased heat-related mortality and decreased cold related morality."34 However, the agency has failed to consider studies that clearly suggest that the harm from cold is far greater than the harm from warming based on our current climate. For example, one study found that between 1979 and 2004 cold-related deaths in the United States outpaced heat-related deaths at a rate of 2: 1.35 A total of 10,827 cold-related deaths were reported over this time, in contrast to 5,279 heat-related deaths."36 Moreover, the elderly are the most likely to be affected by all weather-related conditions, regardless of hot or cold. 37 Black men and men of other races are disproportionately affected by cold weather-related events.38 Winter cold has been the major seasonal factor causing death in all but tropical regions of the world.39 These cold related deaths occur almost entirely in elderly people and often result from common illnesses increased by the cold."40 As a study indicates, if temperature rises 3.6 degrees F over the next 50 years heat-related deaths in Britain would increase by about 2,000, but cold-related deaths would decrease by about 20,000.41 Therefore, this information demonstrates that global warming effects on health could be beneficial because heat-related deaths are generally far fewer than cold-related deaths. Moreover, heat-related deaths have stabilized or fallen, despite rising temperatures.42 For example, the extension of air conditioning is cited as a major reason for the virtual disappearance of heat-related deaths in North Carolina, despite the fact that summers have become hotter." In addition, central heating was installed in only the coldest climates in Europe until recently, unlike in the United States, thus leading to more overall cold weather deaths in Europe than in the United

States. The heat-related mortality rate has not fallen in Britain or northern Europe at the same rate as in the United States because these regions do not have the same amount of air conditioning. The overall mortality rate, however, has also not risen despite increasing temperatures."44 Climate change, in conjunction with promoting the defense against cold stress, could prove to be effective against reducing all mortality rates in cold weather.45 Over the past 35 years, the U.S. populace has become systematically less affected by hot and humid weather conditions."46 In fact, mortality rates in hot and humid weather have fallen by as much as 41 percent in some cities."47 Projections of future heat-related mortality that might arise from greenhouse gas induced warming must incorporate the observed reductions in heat vulnerability. 48 Based on this evidence, EPA needs to perform a comprehensive analysis on the available studies prior to finalizing its Endangerment Finding, because the existing evidence strongly suggests that EPA's actions would have an overall negative effect by raising human mortality significantly. [Footnote 34: 74 Fed. Reg. 18901.] [Footnote 35: Maria T.F. Thacker, Robin Lee & Alden Henderson, Overview of Deaths Associated with Natural Events, United States, 1979-2004, 2 Disaster 303 (2008).] [Footnote 36: Id.] [Footnote 37: Id. at 311.] [Footnote 38: Id.] [Footnote 39: W.R. Keating & G.c. Donaldson, The Impact of Global Warming on Health and Mortality, 11 S. Med. J. 1093 (2004).] [Footnote 40: Id. at 1093-94.] [Footnote 41: Id. at 1096.]

Michael Kolian Terrific! I appreciate your getting throu... 10/13/2009 11:04:47 AM

From:	Michael Kolian/DC/USEPA/US
To:	Ben DeAngelo/DC/USEPA/US@EPA
Cc:	Jason Samenow/DC/USEPA/US@EPA, Lesley Jantarasami/DC/USEPA/US@EPA, Rona Birnbaum/DC/USEPA/US@EPA
Date:	10/13/2009 11:04 AM
Subject:	Re: edited responses to health comments

Terrific! I appreciate your getting through the document. I'll send out another version based on your suggestions and separate the comments that go elsewhere into a separate document.

Cheers,
Mike

Ben DeAngelo Here are my edits/suggestions for our r... 10/12/2009 11:41:03 PM

From:	Ben DeAngelo/DC/USEPA/US
To:	Jason Samenow/DC/USEPA/US@EPA, Michael Kolian/DC/USEPA/US@EPA, Lesley Jantarasami/DC/USEPA/US@EPA
Cc:	Rona Birnbaum/DC/USEPA/US@EPA
Date:	10/12/2009 11:41 PM
Subject:	edited responses to health comments

Here are my edits/suggestions for our responses to the health comments. (b)(5) Deliberative [redacted] Have also noted where some additional comments might be moved to other categories.

Thanks.

[attachment "Human Health comment summary 10_02_09b_merge BJD.doc" deleted by Michael Kolian/DC/USEPA/US]

Benjamin J. DeAngelo
Climate Change Division, Office of Atmospheric Programs
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW (6207J)
Washington, DC 20460

Tel: +1 202-343-9107
Fax: +1 202-343-2202
deangelo.ben@epa.gov

EPA-1096

Rona Birnbaum/DC/USEPA/US
10/13/2009 12:20 PM

To Dina Kruger
cc
bcc
Subject Fw: more comments for OAR

...speaking of..

----- Forwarded by Rona Birnbaum/DC/USEPA/US on 10/13/2009 12:21 PM -----

From: Carol Holmes/DC/USEPA/US
To: Lesley Jantarasami/DC/USEPA/US@EPA
Cc: Ben DeAngelo/DC/USEPA/US@EPA, Rona Birnbaum/DC/USEPA/US@EPA, John Hannon/DC/USEPA/US
Date: 10/13/2009 12:00 PM
Subject: Re: more comments for OAR

This is what I have so far, they are sprinkled throughout (b/c of renumbered outline) (b)(5) Deliberative [redacted] THANKS

(b)(5) Deliberative ACP AWP [redacted]
Carol's sections of legal RTC 10 9 09.doc

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

Carol S. Holmes
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Ave, NW (MC 2344A)
Washington, DC 20460
Phone (202) 564-8709
Fax (202) 564-5603

Lesley Jantarasami Hi Carol, You suggested that we re... 10/13/2009 11:57:26 AM

From: Lesley Jantarasami/DC/USEPA/US
To: Carol Holmes/DC/USEPA/US@EPA
Date: 10/13/2009 11:57 AM
Subject: Re: more comments for OAR

Hi Carol,

You suggested that we (b)(5) Deliberative [redacted]

Thanks,

Lesley

Carol Holmes Some more specific comments from re... 10/09/2009 01:17:25 PM

From: Carol Holmes/DC/USEPA/US
To: Lesley Jantarasami/DC/USEPA/US
Cc: Ben DeAngelo/DC/USEPA/US@EPA, Rona Birnbaum/DC/USEPA/US@EPA
Date: 10/09/2009 01:17 PM
Subject: more comments for OAR

Some more specific comments from reading 7.1 to end of long summary([attachment "Categories_Carol Holmes-rv.doc" deleted by Lesley Jantarasami/DC/USEPA/US]) for OAR. [attachment "7.1 et seq (OLD) for OAR.doc" deleted by Lesley Jantarasami/DC/USEPA/US]

As noted in the second document, [redacted] (b)(5) Deliberative

THANKS

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

Carol S. Holmes
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Ave, NW (MC 2344A)
Washington, DC 20460
Phone (202) 564-8709
Fax (202) 564-5603

EPA-1097

Lesley Jantarasami/DC/USEPA/US
10/13/2009 12:27 PM

To Ben DeAngelo
cc
bcc
Subject cost-benefit comments

Hi Ben,

I've finished summarizing all the comments in the cost-benefit category (b)(5) Deliberative [redacted]

(b)(5) Del berative [redacted]
2.1.6 Cost Benefit 101309.doc

Thanks,

Lesley

EPA-1098

Carol Holmes/DC/USEPA/US
10/13/2009 04:15 PM

To Lesley Jantarasami
cc Ben DeAngelo
bcc
Subject Re: some more comments for y'all

Thanks, got em. [redacted] (b)(5) Deliberative [redacted]

THANKS

An Office of Management and Budget ("OMB") memorandum submitted in the docket here also emphasized the desirability of conducting the appropriate risk analysis at the time the decision to regulate is made. See EPA-HQ-0AR-2009-01241. Although the Memorandum is undated and not attributed to a specific author, OMB states that it was developed as part of the interagency review process on the Endangerment Finding Proposal and represents "a conglomeration of counsel we've received from various agencies." OMB Memo: Serious Economic Impact Likely From EPA CO2 Rules, Dow Jones Newswires, May 12, 2009. As stated in the Memorandum: "an endangerment finding under section 202 may not be the most appropriate approach for regulating GHGs. Making the decision to regulate CO2 under the CAA for the first time is likely to have serious economic consequences for regulated entities throughout the U.S. economy, including small businesses and small communities. Should EPA later extend this finding to stationary sources, small businesses and institutions would be subject to costly regulatory programs such as New Source Review." Memorandum at 2. Consistent with this view, the Memorandum states that the Endangerment Finding should include "additional information on benefits, costs, and risks (where this information exists); meeting appropriate standards for peer review; and accepted research protocols." Id. at 1. The Memorandum recommended that EPA address costs, benefits, and risks," including the following: - Methodology or methodologies used for weighing risks and various outcomes and the risks associated with each; - Confidence intervals related to model results at the regional and local scales; - Underlying assumptions of findings, publications on which the findings are based, and "business-as-usual" scenarios; - Quality and homogeneity of temperature data from surface networks that may affect estimates of past temperature trends, and calibration and verification of models; - Impacts of climate change on the value of net economic benefits. Id. at 1-2. Absent such information, the Memorandum recommended that the "Finding should also acknowledge that EPA has not undertaken a systematic risk analysis or cost-benefit analysis." Id. at 2. It is not clear whether the Memorandum was written before or after the Endangerment Finding Proposal was written, although the fact that it was developed as a part of the interagency review process suggests that it was written before the Endangerment Finding Proposal and was provided to EPA for the Agency's consideration as a part of development of that finding. It is, therefore, disturbing that EPA did not refer to the Memorandum in the Endangerment Finding Proposal. EPA, obviously, cannot, consistent with law or sound public policy, ignore the views of others in the federal government. In any event, the OMB Memorandum is correct: given the magnitude of the decision to which EPA proposes to commit itself, the comprehensive analysis of the decision should be made now, not later.

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

Carol S. Holmes
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Ave, NW (MC 2344A)
Washington, DC 20460
Phone (202) 564-8709
Fax (202) 564-5603

Lesley Jantarasami Hi Carol, Yes, that makes sense. ... 10/08/2009 01:55:48 PM

From: Lesley Jantarasami/DC/USEPA/US
To: Carol Holmes/DC/USEPA/US@EPA
Cc: Ben DeAngelo/DC/USEPA/US@EPA
Date: 10/08/2009 01:55 PM
Subject: Re: some more comments for y'all

Hi Carol,

Yes, that makes sense. (b)(5) Deliberative Also, I came across some comments that I wanted to make sure OGC saw, and I noted where in the outline I thought they applied.

Thanks,

Lesley

(b)(5) Deliberative

Sections 3 and 5 Comments for OGC.doc

Carol Holmes making sure you see -- (b)(5) Deliberative 10/07/2009 04:01:52 PM

From: Carol Holmes/DC/USEPA/US
To: Lesley Jantarasami/DC/USEPA/US@EPA
Cc: Ben DeAngelo/DC/USEPA/US@EPA
Date: 10/07/2009 04:01 PM
Subject: some more comments for y'all

making sure you see -- (b)(5) Deliberative

[attachment "from1st and 2nd addendum for OAR.doc" deleted by Lesley Jantarasami/DC/USEPA/US]

(b)(5) Deliberative

(b)(5) Deliberative Make sense?

THANKS

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

Carol S. Holmes
Office of General Counsel
U.S. Environmental Protection Agency
1200 Pennsylvania Ave, NW (MC 2344A)
Washington, DC 20460
Phone (202) 564-8709
Fax (202) 564-5603

EPA-1099

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\2.1.6 Cost Benefit 101309 BJD.doc

(b)(5) Deliberative - 2.1.6 Cost Benefit 101309 BJD.doc

EPA-1100

Ben DeAngelo/DC/USEPA/US
10/13/2009 05:11 PM

To Lesley Jantarasami
cc
bcc
Subject Re: cost-benefit comments

Hi Lesley,

Here's some quick feedback on some of the responses, in terms of where some others should be moved to. (b)(5) Deliberative

Think these are responses where we can do the first draft and then pass on to OGC.

thanks,
-Ben

(b)(5) Deliberative
2.1.6 Cost Benefit 101309 BJD.doc

Lesley Jantarasami Hi Ben, I've finished summarizing a... 10/13/2009 12:27:42 PM

From: Lesley Jantarasami/DC/USEPA/US
To: Ben DeAngelo/DC/USEPA/US
Date: 10/13/2009 12:27 PM
Subject: cost-benefit comments

Hi Ben,

I've finished summarizing all the comments in the cost-benefit category (b)(5) Deliberative

[attachment "2.1.6 Cost Benefit 101309.doc" deleted by Ben DeAngelo/DC/USEPA/US]

Thanks,

Lesley

EPA-1101

Lesley Jantarasami
04/01/2010 03:48 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\ljantara\My Documents\Endangerment\02_Comments and Responses\04_Summaries for Ben\2.1.6 Cost Benefit 101309 BJD.doc

(b)(5) Deliberative [redacted] - 2.1.6 Cost Benefit 101309 BJD.doc

EPA-1102

Lesley Jantarasami
04/01/2010 03:45 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\ljantara\My Documents\Endangerment\01_Full Doc\RTC old intro section\RTC Foreword 101309.doc

(b)(5) Deliberative - RTC Foreword 101309.doc

EPA-1103

Marcus Sarofim

To

cc

bcc

Subject UPLOAD C:\Documents and Settings\msarofim\My Documents\WorkFolder\Tsd_Anpr\ResponseToComments\ResponseChapters\4.1.2.3 -- Carbon Dioxide 101309.doc

(b)(5) Delibera ive - 4.1.2.3 -- Carbon Dioxide 101309.doc

EPA-1104

Jason Samenow/DC/USEPA/US
10/13/2009 07:33 PM

To Marcus Sarofim
cc Ben DeAngelo
bcc
Subject (b)(5) Deliberative

An observationally based energy balance for the Earth since 1950

We examine the Earth's energy balance since 1950, identifying results that can be obtained without using global climate models. Important terms that can be constrained using only measurements and radiative transfer models are ocean heat content, radiative forcing by long-lived trace gases, and radiative forcing from volcanic eruptions. We explicitly consider the emission of energy by a warming Earth by using correlations between surface temperature and satellite radiant flux data and show that this term is already quite significant. About 20% of the integrated positive forcing by greenhouse gases and solar radiation since 1950 has been radiated to space. Only about 10% of the positive forcing (about 1/3 of the net forcing) has gone into heating the Earth, almost all into the oceans. About 20% of the positive forcing has been balanced by volcanic aerosols, and the remaining 50% is mainly attributable to tropospheric aerosols. After accounting for the measured terms, the residual forcing between 1970 and 2000 due to direct and indirect forcing by aerosols as well as semidirect forcing from greenhouse gases and any unknown mechanism can be estimated as -1.1 ± 0.4 W m^{-2} (1σ). This is consistent with the Intergovernmental Panel on Climate Change's best estimates but rules out very large negative forcings from aerosol indirect effects. Further, the data imply an increase from the 1950s to the 1980s followed by constant or slightly declining aerosol forcing into the 1990s, consistent with estimates of trends in global sulfate emissions. An apparent increase in residual forcing in the late 1990s is discussed.

http://www.agu.org/pubs/crossref/2009/2009JD012105.shtml

http://www.agu.org/sci_soc/prrl/2009-24.html

Study came out a month ago. Susan Solomon is the second author.

(b)(5) Deliberative

EPA-1105

Marcus Sarofim

To

cc

bcc

Subject UPLOAD C:\Documents and Settings\msarofim\My Documents\WorkFolder\Tsd_Anpr\ResponseToComments\ResponseChapters\2.3.2.4 CO2 and past global warming episodes 101309.doc

(b)(5) Deliberative [redacted] - 2.3.2.4 CO2 and past global warming episodes 101309.doc

EPA-1106

Marcus Sarofim

To

cc

bcc

Subject UPLOAD C:\Documents and Settings\msarofim\My Documents\WorkFolder\Tsd_Anpr\ResponseToComments\ResponseChapters\2.2.1 Greenhouse Gas Emissoins and Concentrations 101309.doc

(b)(5) Deliberative [redacted] - 2.2.1 Greenhouse Gas Emissoins and Concentrations 101309.doc

EPA-1107

Jason Samenow/DC/USEPA/US
10/14/2009 12:15 PM

To Ben DeAngelo
cc Marcus Sarofim, Rona Birnbaum, Dina Kruger
bcc
Subject Re: Fw: suggested image to consider

We could do something like this. (b)(5) Deliberative
.

Ben DeAngelo Jason, Susan Solomon also forwarded... 10/14/2009 11:39:29 AM

From: Ben DeAngelo/DC/USEPA/US
To: Jason Samenow/DC/USEPA/US@EPA
Cc: Marcus Sarofim/DC/USEPA/US@EPA, Rona Birnbaum/DC/USEPA/US@EPA
Date: 10/14/2009 11:39 AM
Subject: Fw: suggested image to consider

Jason,

Susan Solomon also forwarded this graphic to potentially use to accompany our discussion of (b)(5) Deliberative

----- Forwarded by Ben DeAngelo/DC/USEPA/US on 10/14/2009 11:33 AM -----

From: Susan Solomon <Susan.Solomon@noaa.gov>
To: Ben DeAngelo/DC/USEPA/US@EPA
Cc: Dina Kruger/DC/USEPA/US@EPA
Date: 10/13/2009 12:44 PM
Subject: suggested image to consider

Dear Ben and Dina
You may want to consider making a graphic along the lines of the attached for inclusion in the endangerment document. (b)(5) Deliberative

best
Susan
[attachment "Solomon_suggestion.ppt" deleted by Jason Samenow/DC/USEPA/US]

EPA-1108

Ben DeAngelo/DC/USEPA/US
10/14/2009 12:18 PM

To Lesley Jantarasami
cc Michael Kolian
bcc
Subject Re: Please update Quickr by 2pm

Mike, Lesley,

I uploaded my edited version of the health section.

Lesley: think it would be ok actually useful if some of the comment bubbles remained in the doc for Dina.

Lesley Jantarasami Hi team, For our meeting with Dina... 10/14/2009 12:15:59 PM

From: Lesley Jantarasami/DC/USEPA/US
To: Michael Kolian/DC/USEPA/US@EPA
Cc: Ben DeAngelo/DC/USEPA/US@EPA, Jason Samenow/DC/USEPA/US@EPA, Bill Perkins <perkins.william@epa.gov>, Rona Birnbaum/DC/USEPA/US@EPA, David Chalmers/DC/USEPA/US@EPA, Marcus Sarofim/DC/USEPA/US@EPA, Jeremy Martinich/DC/USEPA/US@EPA
Date: 10/14/2009 12:15 PM
Subject: Please update Quickr by 2pm

Hi team,

For our meeting with Dina this afternoon, I'll be bringing copies the latest and greatest RTC draft. So if you are working on updates to any of your sections or have written entirely new sections, please upload whatever you have into Quickr by 2pm or they will not be incorporated. Don't worry about the references for now. Thanks so much!

Lesley

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

EPA-1109

Jason Samenow/DC/USEPA/US
10/14/2009 12:53 PM

To Marcus Sarofim
cc David Chalmers
bcc
Subject please be aware of these two comments on model validation/temp projections

[redacted] EPA-HQ-OAR-2009-0171-3215.1.pdf

and

[redacted] EPA-HQ-OAR-2009-0171-3187.4.pdf

(relating to ocean heat)

Jason

EPA-1110

Lesley Jantarasami/DC/USEPA/US
10/14/2009 01:03 PM

To: Lesley Jantarasami
cc: Ben DeAngelo, David Chalmers, Jason Samenow, Jeremy Martinich, Marcus Sarofim, Michael Kolian, Bill Perkins, Rona Birnbaum
bcc:
Subject: Re: Please update Quickr by 2pm

Hi again,

To clarify, I do want whatever semi-complete summaries and responses you have by this afternoon, even if the section is not completely finished and they have not yet been reviewed by anyone ('semi-complete' just meaning full sentences, not bulleted lists of thoughts). You can label them as "partial response" or "more will be added" or whatever. We're aiming to give Dina an accurate picture of where we are in the process, so I'm keeping all the comment bubbles and highlighted notes in there to indicate where more work remains to be done.

Thanks, and let me know if you have any questions!

Lesley

Lesley Jantarasami Hi team, For our meeting with Dina... 10/14/2009 12:15:58 PM

From: Lesley Jantarasami/DC/USEPA/US
To: Michael Kolian/DC/USEPA/US@EPA
Cc: Ben DeAngelo/DC/USEPA/US@EPA, Jason Samenow/DC/USEPA/US@EPA, Bill Perkins <perkins.william@epa.gov>, Rona Birnbaum/DC/USEPA/US@EPA, David Chalmers/DC/USEPA/US@EPA, Marcus Sarofim/DC/USEPA/US@EPA, Jeremy Martinich/DC/USEPA/US@EPA
Date: 10/14/2009 12:15 PM
Subject: Please update Quickr by 2pm

Hi team,

For our meeting with Dina this afternoon, I'll be bringing copies the latest and greatest RTC draft. So if you are working on updates to any of your sections or have written entirely new sections, please upload whatever you have into Quickr by 2pm or they will not be incorporated. Don't worry about the references for now. Thanks so much!

Lesley

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

EPA-1111

Lesley Jantarasami
04/01/2010 03:38 PM

To
cc
bcc
Subject UPLOAD F:\Endangerment\02_Comments and Responses\01_Sections\2.1.5 Net Effects 101409.doc

(b)(5) Deliberative - 2.1.5 Net Effects 101409.doc

EPA-1112

Marcus Sarofim

To

cc

bcc

Subject UPLOAD C:\Documents and Settings\msarofim\My Documents\WorkFolder\Tsd_Anpr\ResponseToComments\ResponseChapters\2.3.2.2 -- Solar Irradiance 101409.doc

(b)(5) Deliberative [redacted] - 2.3.2.2 -- Solar Irradiance 101409.doc

EPA-1113

Lesley Jantarasami
04/01/2010 03:38 PM

To
cc
bcc
Subject UPLOAD F:\Endangerment\02_Comments and Responses\01_Sections\5.1.5, DBC, 091009.doc

(b)(5) Deliberative - 5.1.5, DBC, 091009.doc

EPA-1114

Lesley Jantarasami
04/01/2010 03:38 PM

To
cc
bcc
Subject UPLOAD F:\Endangerment\02_Comments and Responses\01_Sections\5.1.5 Other Reg Options 101409.doc

(b)(5) Deliberative - 5.1.5 Other Reg Options 101409.doc

EPA-1115

Lesley Jantarasami
04/01/2010 03:38 PM

To
cc
bcc
Subject UPLOAD F:\Endangerment\02_Comments and Responses\01_Sections\4.1.2.6 - HFCs, PFC, SF6.doc

(b)(5) Deliberative - 4.1.2.6 - HFCs, PFC, SF6.doc

EPA-1116

Lesley Jantarasami
04/01/2010 03:47 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\ljantara\My Documents\Endangerment\02_Comments and Responses\02_Compiled\compile 1\2.5.2 - Air Quality 092909.doc

(b)(5) Deliberative [redacted] - 2.5.2 - Air Quality 092909.doc

EPA-1117

Lesley Jantarasami
04/01/2010 03:47 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\ljantara\My Documents\Endangerment\02_Comments and Responses\02_Compiled\compile 1\4.1.5.1.4 - Issues Related to NAAQS 092909.doc

(b)(5) Delibera ive - 4.1.5.1.4 - Issues Related to NAAQS 092909.doc

EPA-1118

Jeremy Martinich
04/01/2010 01:17 PM

To
cc
bcc
Subject UPLOAD G:\CCD\CSIB\Martinich\Endangerment\Endangerment\Comment Sections\Section 2.1.8 Data Quality Act Requirements for Independent Assessment.doc

(b)(5) Deliberative [redacted] - Section 2.1.8 Data Quality Act Requirements for Independent Assessment.doc

EPA-1119

Lesley Jantarasami
04/01/2010 03:38 PM

To
cc
bcc
Subject UPLOAD F:\Endangerment\02_Comments and Responses\01_Sections\2.1.2 Level of Scientific Certainty 101409.doc

(b)(5) Deliberative - 2.1.2 Level of Scientific Certainty 101409.doc

EPA-1120

Lesley Jantarasami
04/01/2010 03:38 PM

To
cc
bcc
Subject UPLOAD F:\Endangerment\02_Comments and Responses\01_Sections\Agricultural Impacts comment response 9_18_09 merge.doc

(b)(5) Deliberative - Agricultural Impacts comment response 9_18_09 merge.doc

EPA-1121

Lesley Jantarasami
04/01/2010 03:38 PM

To
cc
bcc
Subject UPLOAD F:\Endangerment\02_Comments and Responses\01_Sections\2.5.3 Agriculture 101409.doc

(b)(5) Deliberative - 2.5.3 Agriculture 101409.doc

EPA-1122

Lesley Jantarasami
04/01/2010 03:38 PM

To
cc
bcc
Subject UPLOAD F:\Endangerment\02_Comments and Responses\01_Sections\Forestry comment summary 9_18_09a merge.doc

(b)(5) Deliberative [redacted] - Forestry comment summary 9_18_09a merge.doc

EPA-1123

Lesley Jantarasami
04/01/2010 03:38 PM

To
cc
bcc
Subject UPLOAD F:\Endangerment\02_Comments and Responses\01_Sections\2.5.4 Forestry 101409.doc

(b)(5) Deliberative [redacted] - 2.5.4 Forestry 101409.doc

EPA-1124

Michael Kolian/DC/USEPA/US
10/14/2009 03:13 PM

To Michael Kolian, Lesley Jantarasami, Ben DeAngelo
cc
bcc
Subject Re: redistribute from human health

I found another comment for redistribution and added to the bottom of this document.

(b)(5) Deliberative

Human Health comment_response redistribute 10_14_09a.doc

Michael Kolian I believe I have separated out all the on... 10/14/2009 11:11:53 AM

From: Michael Kolian/DC/USEPA/US
To: Lesley Jantarasami/DC/USEPA/US@EPA, Ben DeAngelo/DC/USEPA/US@EPA
Cc: Rona Birnbaum/DC/USEPA/US@EPA, Bill Perkins <perkins.william@epa.gov>, Jason Samenow/DC/USEPA/US@EPA
Date: 10/14/2009 11:11 AM
Subject: redistribute from human health

I believe I have separated out all the ones that were flagged by me or Ben to go elsewhere (attached).

[attachment "Human Health comment_response redistribute 10_14_09.doc" deleted by Michael Kolian/DC/USEPA/US]

Let me know if you have questions.

Cheers,
Mike

EPA-1125

Jason Samenow/DC/USEPA/US
10/14/2009 03:49 PM

To Lesley Jantarasami
cc
bcc
Subject maybe too late...

but here are some of the attribution of observed changes -- have not put into quickr yet --- still work in progress.

jason

(b)(5) Deliberative

attribution.doc

EPA-1126

Lesley Jantarasami/DC/USEPA/US
10/14/2009 05:21 PM

To David Chalmers
cc
bcc
Subject Re: compiled comment doc

For sure, I was planning on sending it to everyone after I have made a few more changes and last minute incorporations.

Lesley

David Chalmers Can you please send the latest compil... 10/14/2009 05:16:10 PM

From: David Chalmers/DC/USEPA/US
To: Lesley Jantarasami/DC/USEPA/US@EPA
Date: 10/14/2009 05:16 PM
Subject: compiled comment doc

Can you please send the latest compiled doc to me? I'm thinking [redacted] (b)(5) Deliberative [redacted] e.

Thanks.

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

EPA-1127

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 4 101409.doc

(b)(5) Deliberative - RTC draft Volume 4 101409.doc

EPA-1128

Lesley Jantarasami
04/01/2010 03:43 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\ljantara\My Documents\Endangerment\01_Full Doc\06_Old\RTC draft Volume 4 101409.doc

(b)(5) Deliberative - RTC draft Volume 4 101409.doc

EPA-1129

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 3 101409.doc

(b)(5) Deliberative [redacted] - RTC draft Volume 3 101409.doc

EPA-1130

Lesley Jantarasami
04/01/2010 03:43 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\ljantara\My Documents\Endangerment\01_Full Doc\06_Old\RTC draft Volume 3 101409.doc

(b)(5) Deliberative - RTC draft Volume 3 101409.doc

EPA-1131

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 2 101409.doc

(b)(5) Deliberative - RTC draft Volume 2 101409.doc

EPA-1132

Lesley Jantarasami
04/01/2010 03:43 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\ljantara\My Documents\Endangerment\01_Full Doc\06_Old\RTC draft Volume 2 101409.doc

(b)(5) Deliberative - RTC draft Volume 2 101409.doc

EPA-1133

Michael Kolian/DC/USEPA/US
10/14/2009 05:52 PM

To Lesley Jantarasami
cc William Perkins
bcc
Subject Re: edited responses to health comments

Bill,
[redacted] (b)(5) Deliberative [redacted] ? Cheers,
Mike

Lesley Jantarasami Hi Mike - welcome back! [redacted] (b)(5) Deliberative 10/13/2009 12:02:33 PM

From: Lesley Jantarasami/DC/USEPA/US
To: Michael Kolian/DC/USEPA/US@EPA
Cc: William Perkins/DC/USEPA/US@EPA
Date: 10/13/2009 12:02 PM
Subject: Re: edited responses to health comments

Hi Mike - welcome back! [redacted] (b)(5) Deliberative [redacted] Thanks!

Lesley

Commenter Name: Benjamin L. Brandes
Commenter Affiliation: The National Mining Association
Commenter Type:
Document Control Number: EPA-HQ-OAR-2009-0171-3764.1
Comment Excerpt Number: 10
Form Letter? Yes
Late Comment? No
Comment Changed? No

Presumably one of the principle missions of every government agency, especially EPA, is to reduce deaths among U.S. citizens. Although EPA acknowledges that warming temperatures may bring about some health benefits, including reduced human mortality from cold exposure through 2100, the agency asserts that it is "currently difficult to ascertain the balance between increased heat-related mortality and decreased cold related morality."34 However, the agency has failed to consider studies that clearly suggest that the harm from cold is far greater than the harm from warming based on our current climate. For example, one study found that between 1979 and 2004 cold-related deaths in the United States outpaced heat-related deaths at a rate of 2: 1.35 A total of 10,827 cold-related deaths were reported over this time, in contrast to 5,279 heat-related deaths."36 Moreover, the elderly are the most likely to be affected by all weather-related conditions, regardless of hot or cold. 37 Black men and men of other races are disproportionately affected by cold weather-related events.38 Winter cold has been the major seasonal factor causing death in all but tropical regions of the world.39 These cold related deaths occur almost entirely in elderly people and often result from common illnesses increased by the cold."40 As a study indicates, if temperature rises 3.6 degrees F

over the next 50 years heat-related deaths in Britain would increase by about 2,000, but cold-related deaths would decrease by about 20,000.41 Therefore, this information demonstrates that global warming effects on health could be beneficial because heat-related deaths are generally far fewer than cold-related deaths. Moreover, heat-related deaths have stabilized or fallen, despite rising temperatures.42 For example, the extension of air conditioning is cited as a major reason for the virtual disappearance of heat-related deaths in North Carolina, despite the fact that summers have become hotter." In addition, central heating was installed in only the coldest climates in Europe until recently, unlike in the United States, thus leading to more overall cold weather deaths in Europe than in the United States. The heat-related mortality rate has not fallen in Britain or northern Europe at the same rate as in the United States because these regions do not have the same amount of air conditioning. The overall mortality rate, however, has also not risen despite increasing temperatures."44 Climate change, in conjunction with promoting the defense against cold stress, could prove to be effective against reducing all mortality rates in cold weather.45 Over the past 35 years, the U.S. populace has become systematically less affected by hot and humid weather conditions."46 In fact, mortality rates in hot and humid weather have fallen by as much as 41 percent in some cities."47 Projections of future heat-related mortality that might arise from greenhouse gas induced warming must incorporate the observed reductions in heat vulnerability. 48 Based on this evidence, EPA needs to perform a comprehensive analysis on the available studies prior to finalizing its Endangerment Finding, because the existing evidence strongly suggests that EPA's actions would have an overall negative effect by raising human mortality significantly. [Footnote 34: 74 Fed. Reg. 18901.] [Footnote 35: Maria T.F. Thacker, Robin Lee & Alden Henderson, Overview of Deaths Associated with Natural Events, United States, 1979-2004, 2 Disaster 303 (2008).] [Footnote 36: Id.] [Footnote 37: Id. at 311.] [Footnote 38: Id.] [Footnote 39: W.R. Keating & G.c. Donaldson, The Impact of Global Warming on Health and Mortality, 11 S. Med. J. 1093 (2004).] [Footnote 40: Id. at 1093-94.] [Footnote 41: Id. at 1096.]

Michael Kolian Terrific! I appreciate your getting throu... 10/13/2009 11:04:47 AM

From:	Michael Kolian/DC/USEPA/US
To:	Ben DeAngelo/DC/USEPA/US@EPA
Cc:	Jason Samenow/DC/USEPA/US@EPA, Lesley Jantarasami/DC/USEPA/US@EPA, Rona Birnbaum/DC/USEPA/US@EPA
Date:	10/13/2009 11:04 AM
Subject:	Re: edited responses to health comments

Terrific! I appreciate your getting through the document. I'll send out another version based on your suggestions and separate the comments that go elsewhere into a separate document.

Cheers,
Mike

Ben DeAngelo Here are my edits/suggestions for our r... 10/12/2009 11:41:03 PM

From:	Ben DeAngelo/DC/USEPA/US
To:	Jason Samenow/DC/USEPA/US@EPA, Michael Kolian/DC/USEPA/US@EPA, Lesley Jantarasami/DC/USEPA/US@EPA
Cc:	Rona Birnbaum/DC/USEPA/US@EPA
Date:	10/12/2009 11:41 PM
Subject:	edited responses to health comments

Here are my edits/suggestions for our responses to the health comments. (b)(5) Deliberative [redacted] Have also noted where some additional comments might be moved to other categories.

Thanks.

[attachment "Human Health comment summary 10_02_09b_merge BJD.doc" deleted by Michael Kolian/DC/USEPA/US]

Benjamin J. DeAngelo
Climate Change Division, Office of Atmospheric Programs
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW (6207J)
Washington, DC 20460

Tel: +1 202-343-9107
Fax: +1 202-343-2202
deangelo.ben@epa.gov

EPA-1134

Michael Kolian/DC/USEPA/US
10/14/2009 05:59 PM

To Lesley Jantarasami
cc
bcc
Subject hh - latest

(b)(5) Deliberative

Human Health comment summary 10_14_09d_merge.doc

EPA-1135

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 101409.doc

(b)(5) Deliberative - RTC draft Volume 1 101409.doc

EPA-1136

Lesley Jantarasami
04/01/2010 03:43 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\ljantara\My Documents\Endangerment\01_Full Doc\06_Old\RTC draft Volume 1 101409.doc

(b)(5) Deliberative - RTC draft Volume 1 101409.doc

EPA-1137

Lesley Jantarasami
04/01/2010 03:43 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\ljantara\My Documents\Endangerment\01_Full Doc\05_Outline\Carol's sections of legal RTC 10 9 09.doc

(b)(5) Deliberative - Carol's sections of legal RTC 10 9 09.doc

EPA-1138

Lesley Jantarasami/DC/USEPA/US
10/14/2009 06:25 PM

To Dina Kruger
cc Rona Birnbaum
bcc Ben DeAngelo, Jason Samenow, Jeremy Martinich, David Chalmers, Michael Kolian, Marcus Sarofim, William Perkins
Subject Endangerment Response to Comments drafts

Hello Dina,

Please find attached our most recent Response to Comments drafts; there are some updates even since the hard copy we gave you at the meeting this afternoon. [redacted] (b)(5) Deliberative [redacted] Please let me know if you have any questions about the additions.

[redacted] (b)(5) Deliberative RTC draft Volume 1 101409.doc

[redacted] (b)(5) Deliberative RTC draft Volume 2 101409.doc

[redacted] (b)(5) Deliberative RTC draft Volume 3 101409.doc

[redacted] (b)(5) Deliberative RTC draft Volume 4 101409.doc

Best,

Lesley

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

EPA-1139

Lesley Jantarasami
04/01/2010 03:43 PM

To
cc
bcc
Subject UPLOAD C:\Documents and Settings\ljantara\My Documents\Endangerment\01_Full Doc\06_Old\RTC draft Volume 3 101509.doc

(b)(5) Deliberative - RTC draft Volume 3 101509.doc

EPA-1140

Michael Kolian/DC/USEPA/US
10/15/2009 10:01 AM

To David Chalmers
cc Jason Samenow
bcc
Subject Fw: future temp projections comment mike responded to....

Not sure this is helpful but I included the original comment-response that I provided Jason. Upon a second look, (b)(5) Deliberative

(b)(5) Deliberative
redirect comment 2.2.2.doc

Cheers, Mike

----- Forwarded by Michael Kolian/DC/USEPA/US on 10/15/2009 09:19 AM -----

From: Jason Samenow/DC/USEPA/US
To: David Chalmers/DC/USEPA/US@EPA
Cc: Michael Kolian/DC/USEPA/US@EPA
Date: 10/06/2009 01:21 PM
Subject: future temp projections comment mike responded to....

This probably is better under projections as opposed to attribution or observed temperature...

Comment:

(b)(5) Deliberative

Response:

(b)(5) Deliberative

(b)(5) Deliberative

EPA-1141

Jason Samenow/DC/USEPA/US
10/15/2009 10:27 AM

To David Chalmers, Michael Kolian
cc
bcc
Subject Re: Fw: future temp projections comment mike responded to....

Agreed
David Chalmers

----- Original Message -----
From: David Chalmers
Sent: 10/15/2009 10:25 AM EDT
To: Michael Kolian
Cc: Jason Samenow
Subject: Re: Fw: future temp projections comment mike responded to....

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

Cheers,
David

Michael Kolian Not sure this is helpful but I included th... 10/15/2009 10:01:55 AM

From: Michael Kolian/DC/USEPA/US
To: David Chalmers/DC/USEPA/US@EPA
Cc: Jason Samenow/DC/USEPA/US@EPA
Date: 10/15/2009 10:01 AM
Subject: Fw: future temp projections comment mike responded to....

Not sure this is helpful but I included the original comment-response that I provided Jason. Upon a second look, [redacted] (b)(5) Deliberative [redacted]

[redacted]

[redacted]

[attachment "redirect comment 2.2.2.doc" deleted by David Chalmers/DC/USEPA/US]

Cheers, Mike

----- Forwarded by Michael Kolian/DC/USEPA/US on 10/15/2009 09:19 AM -----

From: Jason Samenow/DC/USEPA/US
To: David Chalmers/DC/USEPA/US@EPA
Cc: Michael Kolian/DC/USEPA/US@EPA
Date: 10/06/2009 01:21 PM
Subject: future temp projections comment mike responded to....

This probably is better under projections as opposed to attribution or observed temperature...

Comment:

(b)(5) Deliberative

Response:

(b)(5) Deliberative

(b)(5) Deliberative

[redacted]

EPA-1142

William Perkins/DC/USEPA/US
10/15/2009 11:49 AM

To Jason Samenow
cc
bcc
Subject Re: Fw: Categorized References

Jason,

Thank you for bringing this to my attention. I could not find that reference in any of the lists (found and not-found) of journal articles from ERG, so I will be sending to them for clarification and will let you know as soon as I hear back.

Cheers,

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) (b)(6)

Jason Samenow Bill-- (b)(5) Deliberative 10/15/2009 11:42:21 AM

From: Jason Samenow/DC/USEPA/US
To: William Perkins/DC/USEPA/US@EPA
Date: 10/15/2009 11:42 AM
Subject: Re: Fw: Categorized References

Bill-- (b)(5) Deliberative

It is cited in comment 3596.2 (and should go in comment category 9.6)

Gerten, D., et al., 2008. Causes of change in 20th century global river discharge. *Geophysical Research Letters* , **35**, L20405, doi:10.1029/2008GL035258.

Can you please have ERG obtain this reference and post at their earliest convenience?

Thanks,

Jason

William Perkins Endangerment team, To assist with qui... 10/05/2009 02:24:24 PM

From: William Perkins/DC/USEPA/US
To: Jason Samenow/DC/USEPA/US@EPA, Jeremy Martinich/DC/USEPA/US@EPA, David Chalmers/DC/USEPA/US@EPA, Marcus Sarofim/DC/USEPA/US@EPA, Michael Kolian/DC/USEPA/US@EPA, Lesley Jantarasami/DC/USEPA/US@EPA, Ben DeAngelo/DC/USEPA/US@EPA
Cc: Rona Birnbaum/DC/USEPA/US@EPA
Date: 10/05/2009 02:24 PM

Subject: Fw: Categorized References

Endangerment team,

To assist with quickly discerning how many journal references are on the FTP site for each category, as well as where to find them, ERG put together the enclosed files for us to use. There is a PDF and and an Excel file that show the same thing (journal references by category, then by year) as well as a PDF file that [redacted] I think these will be very useful to quickly figure out how many journal references you need to look at and where for each category. As a reminder, the FTP info is as follows:

Site: [redacted]
username: [redacted]
password: [redacted]
Once logged in, go to [redacted]

Thank you for your time and attention and please let me know if you have any questions, concerns, or suggestions for how ERG can make things easier for us.

Cheers,

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]

----- Forwarded by William Perkins/DC/USEPA/US on 10/05/2009 02:17 PM -----

From: "Mae Thomas" <Mae.Thomas@erg.com>
To: William Perkins/DC/USEPA/US@EPA
Cc: "Mae Thomas" <Mae.Thomas@erg.com>
Date: 10/05/2009 12:34 PM
Subject: Categorized References

Bill, attached are two pdf files and an excel file. The excel file has all the references and the folders they are contained in. It is also the excel file I used to create the two pivot tables that I have converted to PDF which are attached. One PDF file [redacted]. The second PDF [redacted] As we have discussed on the phone, I think these pdf files could help people see what references they will need to look at. If you would like me to prepare this type of print out for specific people or groups of categories, let me know, this would not be difficult.

Thanks
Mae[attachment "Reference Cat.pdf" deleted by Jason Samenow/DC/USEPA/US] [attachment "Reference Cat 2005 to present.pdf" deleted by Jason Samenow/DC/USEPA/US] [attachment "References FTPsite.xls" deleted by Jason Samenow/DC/USEPA/US]