

**SAP 3.1 “Climate Models: An Assessment of Strengths and Limitations for User Applications”
Authors’ Response to Collated Public Comments**

The following contains the authors’ responses to the comments received on the Public Review Draft. The responses are in bold below each comment and page numbers referenced in the responses refer to the CCSP Review Draft dated April 15, 2008.

Reviewers

NOAA Research Council

Point of Contact: Derek Parks

Designated Reviewers: Tim Eichler,

Michael Winton

Ron Stouffer

Jiayu Zhou

Organization: NOAA Research Council

Mailing Address: NOAA Research Council

National Oceanic and Atmospheric Administration

Bldg 3, 11335

1315 East West Highway (R/PPE)

Silver Spring, MD 20910

Phone: 301-734-1186

Email: Derek.parks@noaa.gov

California Department of Water Resources

Point of Contact: Michael Anderson

Organization: California Department of Water Resources (DWR)

Mailing Address: 3310 El Camino Avenue Rm 200

Sacramento, CA 95821

Phone: (916) 574-2830

Fax: (916) 574-2767

Email: manderso@water.ca.gov

Area of Expertise: hydroclimate modeling

NOAA/OFCM

Point of Contact: Samuel P. Williamson

Organization: NOAA/OFCM

Mailing Address: NOAA/OFCM;

Suite 1500; 8455 Colesville Road; Silver Spring, MD 20190

Phone: 301-427-2002, X11

e-mail: samuel.williamson@noaa.gov

Area of Expertise: Applied Meteorology/Program Management

NSF

Point of Contact: Marta Cehelsky

National Science Foundation

4201 Wilson Blvd., Rm. 1205

4/17/08

Arlington, VA 22230
Tel: 703-292-8003
Fax: 703-292-9232
email: mchelsk@nsf.gov

General Comments:

NOAA Research Council (Derek Parks)

The Research Council appreciates the opportunity to coordinate the review and comments on the draft report for Synthesis and Assessment Product 3.1 on “Climate Models: An Assessment of Strengths and Limitations for User Applications.” Following are the comments and suggestions for consideration.

Derek Parks (NOAA RC)

This report reviews the state of climate modeling. It covers the formulation of the models, their sensitivities, various regional aspects of the simulations, and their simulations of the 20th century. Regional modeling and statistical downscaling of global model results is also reviewed. The report is well written and accurate. Typically, generalities are discussed and then the specific behaviors of the three US models are given. This is an effective way of conveying a sense of the uncertainties and challenges without getting bogged down in detail.

Derek Parks (NOAA RC)

No response required.

This report only covers long-term climate modeling researches represented by three U.S. modeling groups contributing to the 4th IPCC assessment. The short-term (from week-2 to interannual time-scales) climate modeling, which has been closely related to the routine operation and has larger economical and societal impact, is missing. It is incomplete unless the title of the report is changed from “Climate Models ...” to “Long-term Climate Models ...”

Derek Parks (NOAA RC)

We disagree. The term “climate models” is frequently used to describe models that simulate climate change over long time scales. The scope of the report is clearly defined in the Prospectus

In view of future climate model development, there is scientific awareness that the prediction of daily, weekly, and monthly, seasonal and longer-range climate fluctuations and their interaction with the Earth system (physical weather/ climate; chemistry; biology) are integral parts of a seamless forecast problem. The strategic direction should be toward the merging of short and long term climate modeling plans, which needs to be emphasized at the top of Chapter VI (Future Model Development). The mutual dependency of short-term and long-term climate model advancements should not be confused by arguments seen in the paragraph entitled “The use of model metrics” on pages 56-57.

Derek Parks (NOAA RC)

Seamless linkage of weather forecasting and climate change prediction may happen some time in the future but is off-topic for this report. The section on model development is confined to future work on the time scales discussed in the report.

Chapter VII, on example applications, is too short. Since this document is purported to support user applications, quite a bit more detail on the chosen topics would be appropriate. The "small watershed flooding" section only has one paragraph with one reference. Why not review all US flooding studies? As it stands, the chapter is a bit sub-critical.

Derek Parks (NOAA RC)

An example on the California climate assessment was added to chapter 7.

Lastly, the model comparisons of disparate grid sizes were troubling for one reviewer.

Derek Parks (NOAA RC)

In our view, differences in grid sizes are similar to the different physical parameterizations or numerical schemes.

NOAA/OFCM (Samuel Williamson)

Thank you for the opportunity to review Synthesis and Assessment Product 3.1. I believe the document adequately describes the strengths and limitations of climate modeling for user applications. The comments listed below are provided for your consideration.

Samuel Williamson (NOAA/OFCM)

Table of Contents

Please consider adding a table of contents. A table of contents would greatly facilitate reading the document, especially for those readers who have a particular interest in a subject and want to find where that particular subject is discussed. Additionally, a more thorough edit of the document before the document is released for review would greatly add to the reviewer's ability to perform a substantive review in an efficient manner.

Samuel Williamson (NOAA/OFCM)

A Table of Contents was added. More extensive editing was done in subsequent revisions.

Education

I believe the author has done a fine job in describing the strengths and limitations of climate model application by users. However, it might be useful to address the importance of building critical skills in the area of climate modeling. For example, is there evidence that there are presently enough skilled people in the climate modeling enterprise to improve climate-change projections? If these skills are not readily available (e.g., there is a skills gap), what are some possible avenues for filling this gap? What will the impact be if skill in climate modeling is not developed/available?

Samuel Williamson (NOAA/OFCM)

While we agree, the subject is not within the scope of the report.

Specific Comments:

NSF (Marta Cehelsky)

Our review has not identified major technical problems or inconsistencies, although in general the report needs careful editing to clarify language. Two items in particular need attention, in our view.

Executive Summary:

We have a specific concern about the quality of the Executive Summary. It is a key part of the document and, in our view, it requires major revision.

Marta Cehelsky (NSF)

Most non-specialists and policymakers will read only this section of the report so it is imperative that it be written in a manner that is comprehensible to those without scientific expertise in this area. We suggest that a careful rewriting of this section be undertaken with the layperson in mind. In many instances, the first paragraph of each chapter provides a good starting place for the main points from that chapter. For example, the first two paragraphs of the executive summary could incorporate/be replaced by much of the first paragraph in Chapter 1 which provides a much clearer presentation on why models are needed/used to study climate change.

Marta Cehelsky (NSF)

The Executive Summary was completely rewritten and reorganized to reflect the questions in the Prospectus, which we feel addresses the audience identified by the reviewer.

Also, care must be taken not to use acronyms with out explanation in this section – for example, the reader has no context for understanding what “CMIP3 models” are and it may suffice here to refer to the model simulations carried out by numerous modeling centers around the world as part of the Fourth Assessment of the International Panel on Climate Change.

Marta Cehelsky (NSF)

Final edits ensured that each acronym was defined before it is used.

Chapter IV, page 72 :

The introduction of the concept of climate sensitivity is poorly done, with the concepts of forcing and sensitivity being confused (at least in the initial text). We suggest beginning straight off with the standard definition of climate sensitivity (per IPCC) and extending the discussion from there.

Marta Cehelsky (NSF)

Chapter 4 was completely rewritten, including better definitions of key technical and theoretical terminology.

NOAA Research Council (Derek Parks)

Following are specific comments for consideration.

P. 2 lines 8-10 – The sentence is hard to read. What is the point?

Derek Parks (NOAA RC)

P. 3 lines 4-9 – This discussion makes it seem like convergence of model simulations is likely at some point. Given that clouds and optical properties are the main source of climate uncertainty, is this convergence possible? What is the time scale? It seems like it is a long way from being solved. The text should be modified to make this point clear.

Derek Parks (NOAA RC)

P. 3 lines 16-25 – The text needs modified to reflect the AR4 WGI assessment of the climate sensitivity. The 1.5 to 4.5C range is the earlier IPCC assessment.

Derek Parks (NOAA RC)

P. 3 lines 27-30 – This is a poor way to describe the transient climate response. It is not the response on time scales shorter than 100 years, but a measure of the time varying response.

Derek Parks (NOAA RC)

P. 3 lines 29-30 – The cloud uncertainty should be moved and connected with the equilibrium climate sensitivity discussion in lines 16-25.

Derek Parks (NOAA RC)

P. 4 lines 4-8 – This discussion needs modified. Yes, more observations are needed. However, the observations need to be compared to model results (and then improve the models). Also the uncertainty associated with the climate forcing (aerosols) discussion is missing.

Derek Parks (NOAA RC)

P. 5 line 10 – Regarding the correlation between models and observations (95% or greater for temperature), what timescale is this? Daily? Monthly?

Derek Parks (NOAA RC)

P. 5 line 14 – One should note the problems associated with the precipitation observations.

Derek Parks (NOAA RC)

P. 5 line 22 – Jet streams – is this jargon? Consider revising the language.

P. 5 line 22 -- The simulation of storms is a strength of the models. Does this only refer to the large-scale mean upper-level circulation? What about what the “man on the street” experiences? (i.e. surface lows?) Are their structures realistic? How about their precipitation efficiency? Please show references to support your statement.

Derek Parks (NOAA RC)

P. 5 lines 24-25 – The Southern Hemisphere jet stream/storm track is poorly located in most AR4 models (Russell et al. 2006). Russell, J. L., R. J. Stouffer, and K. W. Dixon, 2006: Intercomparison of the Southern Ocean circulation in IPCC coupled model control simulations. *Journal of Climate*, 19(18), 4560-4575.

Derek Parks (NOAA RC)

P. 6 lines 1-2 – This statement is too strong. Add “some” before current models”.

Derek Parks (NOAA RC)

P. 6 lines 17-19 – This sentence belongs with the precipitation discussion P.5 lines 12-19.

Derek Parks (NOAA RC)

P. 6 line 19 -- If models bias precipitation, how is this consistent with the idea that storms are a “strength” of models? If a model can’t get precipitation correct, then the storms would logically also not be simulated accurately.

Derek Parks (NOAA RC)

P. 6 line 24 -- Does this refer to intensity, frequency, or both?

Derek Parks (NOAA RC)

P. 7 lines 5-10 – Increasing computer resources need a mention here and elsewhere in the report. The science is greatly limited by computer resources. This fact does not come out when reading the report. It should be a main theme throughout.

Derek Parks (NOAA RC)

Increased computer resources have allowed us to run higher resolution models, more ensemble members and add more complexity to the models. This has helped improve the simulation, particularly in the ocean. The ENSO simulation has improved partially due to increased resolution P. 7 lines 17-19.

Derek Parks (NOAA RC)

P. 7 line 15 -- missing period.

Derek Parks (NOAA RC)

P. 7 line 17 -- make “Simulations” singular.

Derek Parks (NOAA RC)

P. 7 line 21 – intertropical convergence zone – consider revising language to avoid jargon.

Derek Parks (NOAA RC)

P. 8 lines 9-14 – A key fact is that there are few observations on which to build/evaluate models.

Derek Parks (NOAA RC)

P. 8 line 23 – Is “partial” better than “potential”?

Derek Parks (NOAA RC)

P. 9 lines 1-3 -- Does this imply that natural variability is more significant than anthropogenic forcing?

Derek Parks (NOAA RC)

P. 9 lines 2-8 – The IPCC AR4 WGI statements on likelihood need to be inserted into this discussion.

Derek Parks (NOAA RC)

P. 9 line 15 -- Perhaps land distribution by hemisphere also has an impact?

Derek Parks (NOAA RC)

P. 9 lines 22-28 – This statement belongs in the CCSP report on extremes (3.3).

Derek Parks (NOAA RC)

P. 9 line 24 – provide references.

Derek Parks (NOAA RC)

P. 10 lines 3-4 – Phrasing doesn't make sense. Consider revising the language..

Derek Parks (NOAA RC)

The Executive Summary was completely restructured and rewritten in response to the above criticisms of this reviewer and others.

P. 11 line 14: please elaborate “not sharp”

Derek Parks (NOAA RC)

“Sharp” changed to “precise.”

P. 18 line 5 – There are typographical errors in this sentence.

Derek Parks (NOAA RC)

The caption for the figure (now labeled 1.2) was replaced.

P. 19 line 11 – Another reason to be considered in the development of metrics is that no metric has been shown to have skill in predicting which model has a better future response (can be tested using the perfect model approach).

Derek Parks (NOAA RC)

This concept is covered in Section 2.7 (page 52) of the latest draft.

P. 20 line 10 -- How can a coupled GCM not be considered a climate model?

Derek Parks (NOAA RC)

The sentence was expanded to provide an explanation (page 23)

P. 20 line 18: There is an extra period at the end of the sentence.

Derek Parks (NOAA RC)

P. 20 line 21 – There are a number of typographical errors in this sentence.

Derek Parks (NOAA RC)

P. 20 line 19-21 – This phrase is a sentence fragment which should be revised.

Derek Parks (NOAA RC)

The paragraph was rewritten. The revised text appears in Section 2.1 starting on page 23.

P. 21 line 24 – Regarding the terminology “sub-models”, is “subcomponents” better language?

Derek Parks (NOAA RC)

Phrasing changed to “sub grid scale parameterization” (page 25, line 13).

P. 22 line 20 – Sentence needs correction: “of and”.

Derek Parks (NOAA RC)

The paragraph containing the sentence was rewritten. (page 25)

P. 22 line 26 -- Please change “is the convection is” to: “is convection”

Derek Parks (NOAA RC)

The paragraph containing the sentence was rewritten. (page 25)

P. 22 line 31: The word “convection” is misspelled.

Derek Parks (NOAA RC)

The paragraph containing the sentence was rewritten. (page 26)

P. 23 – Somewhere in the AGCM section we should mentioned all AGCMs include land components.

Derek Parks (NOAA RC)

This is not true in coupled modeling systems. Many treat the land surface as a separate component, as described in section 2.3 starting on page 31.

P. 23 line 3 – Please include “are” in front of “due”.

Derek Parks (NOAA RC)

The paragraph containing the sentence was rewritten. (page 26)

P. 23 line 4: The word “precipitation” is misspelled.

Derek Parks (NOAA RC)

Corrected (page 26)

P. 24 line 4 – The GFDL entry in the resolution column is not correct. The atmospheric B-grid core (CM2.0) is finite difference. The CM2.1 atmospheric core is finite volume.

Derek Parks (NOAA RC)

The table was eliminated.

P. 26 line 24 – Please add “)” after 2002.

Derek Parks (NOAA RC)

Reference replaced and error corrected (page 28).

P. 27 (general) -- GISS isn't really known for their ocean modeling capability. Why was GISS a model of choice?

Derek Parks (NOAA RC)

The GISS model is one of the three US models participating in the CMIP3 database. Its hybrid formulation is different from the others, so a description is in order.

P. 32 line 21 – Correct the spelling of “robust”.

Derek Parks (NOAA RC)

Sentence removed.

P. 37 lines 29-31 -- It would be beneficial to reword the text about the IPCC ... excluding rapid changes in ice flow from its ... sea level projections. This was done for lack of supportable projections.

Derek Parks (NOAA RC)

The paragraph was rewritten and the wording improved (page 35)

P. 37 line 16 – The statement “is rising at a rate of 30 cm/century” is far too certain. Use the IPCC AR4 WGI language and values instead.

Derek Parks (NOAA RC)

The paragraph was rewritten and the wording improved (page 35)

P. 37 line 21 – Regarding the statement “by far the largest uncertainty”, this depends on the time scale. On very long time scales (~1000 years), the steric sea level rise is also very uncertain and can be very large (~10 m).

Derek Parks (NOAA RC)

The paragraph was rewritten and the wording improved (page 35)

P. 38 line 5 – The statement “ice sheets responding to the current warming” is too strong. Please insert “may be” before “responding”.

Derek Parks (NOAA RC)

The paragraph was rewritten and the wording improved (page 35)

P. 38 line 18 – Regarding the statement “will likely increase,” are we that certain of the future Antarctic ice changes? The IPCC AR4 WGI said that it could not say.

Derek Parks (NOAA RC)

The paragraph was rewritten and the wording improved (page 35)

P. 39 lines 8-22 – More observations are needed too. This should be mentioned.

Derek Parks (NOAA RC)

The list was removed.

P. 41 line 7 – What is a “digital elevation model”?

Derek Parks (NOAA RC)

A reference was provided (page 37)

P. 41 line 7 – Regarding the phrase “topographic variations within grid boxes ignored,” this is the case for land surface processes, but incorrect for models which include gravity wave drag.

Derek Parks (NOAA RC)

The section is discussing land surface models and hydrology.

P. 47 line 31 – Add “particularly in the Southern Ocean” after “near the surface”.

Derek Parks (NOAA RC)

The paragraph was rewritten and the wording improved (page 43)

P. 52 -- Why wasn't GISS included in this meeting? If all three model groups are being compared, then they should have been part of the problem shooting.

Derek Parks (NOAA RC)

The meetings were planned by the two groups, not a third party.

P. 55 lines 9-15 -- Easier said than done. Isolating physical processes is fine, but the processes change in a complex model due to feedbacks.

Derek Parks (NOAA RC)

That point is acknowledged throughout the report.

P. 56 line 25 -- The word “coupling” is misspelled.

Derek Parks (NOAA RC)

Corrected (page 52)

P. 56 lline 19 -- Reichler and Kim (2007) not included in the references.

Derek Parks (NOAA RC)

The reference was included.

P. 65 line 29 – Please remove the extra period.

Derek Parks (NOAA RC)

Corrected (page 62)

P. 72 line 7 – What does “perfectly clear” mean here? Would “easily split” be more appropriate?

Derek Parks (NOAA RC)

The paragraph was rewritten and the wording improved (page 69)

P. 72 line 24 -- Forster and Ramaswamy (2007) not listed in references.

Derek Parks (NOAA RC)

The reference refers to an IPCC AR 4 chapter, which is now correctly cited and referenced as Forster, et al. (2007)(page 69 and other locations).

P. 72 line 26 – Add “ a time scale of centuries or longer” to the end of the sentence.

Derek Parks (NOAA RC)

The use of the word “Eventually” is sufficient for this part of the discussion (page 69).

P. 77 – This figure has never been published and we would recommend not using it here. The AM2P5 model and potentially the P7 version had major code errors which could impact the estimate of the climate sensitivity. Just noting what caused the large change of the climate sensitivity seems adequate. Also, the CM2.0 and CM2.1 labels are misleading. These are estimates using the slab version of the models.

Derek Parks (NOAA RC)

The figure was changed to a table (page 75) and provides a perspective on model development not found in the literature.

P. 79 line 22 -- Change “optical thick” to “optically thick”.

Derek Parks (NOAA RC)

The cloud feedback section was rewritten and the sentence removed (page 81),

P. 82 line 31 – Forster and Ramaswamy (2007) – This paper is not in the reference list. If it is referring to the IPCC chapter, the reference should be Forster et al. 2007.

Derek Parks (NOAA RC)

See above in response to question on page 72.

P. 84 -- Are model comparisons regarding forcing really “apples to apples” considering different grid resolutions?

Derek Parks (NOAA RC)

All models considered here can resolve regional variations of climate forcing, but simulate the factors that determine forcing differently (page 74). The discussion notes, but does not explain the reasons for the differences. A complete explanation is beyond the scope of the report.

P. 84 lines 17-19 -- Are these estimates of total (natural + anthropogenic) direct effect? In line 18, should the range be -0.35 to 0.25?

Derek Parks (NOAA RC)

The paragraph was rewritten and the wording improved (page 85)

P. 85 line 29 – Hegerl and Zwiers 2007 – This paper is not in the reference list. If it is referring to the IPCC chapter, the reference should be Hegerl et al. 2007.

Derek Parks (NOAA RC)

The reference was no longer used in the revised paragraph. (page 86)

P. 89 – The figure in the color bar is not legible. What exactly is being plotted in this chart?

Derek Parks (NOAA RC)

The section on pattern scaling was removed and the figure eliminated.

P. 93 lines 11-13 -- On what time increment do they agree?

Derek Parks (NOAA RC)

P. 93 line 15 - 30 – Need to note precipitation observations are much more uncertain than SAT observations.

Derek Parks (NOAA RC)

P. 99 lines 6-9 – This paragraph hangs. Adding “looking to the future” at the front helps.

Derek Parks (NOAA RC)

The section (now section 5.1 beginning on page 91) on mean climate was rewritten.

P. 104 – How were the ensemble members averaged together? One from each institution?

Derek Parks (NOAA RC)

The CMIP3 average in Figure 5.3d (page 102) contains the average all runs in the database.

P. 107 lines 9-12 – Could include the CM2 value here.

Derek Parks (NOAA RC)

The short paragraph on sea level rise in that section was eliminated as redundant with section 5.2.5 on page 143.

P. 111 and 109 – Combine figures V, F, and G into 1 figure. Use common contouring and shading.

Derek Parks (NOAA RC)

The second figure was removed in the rewritten section on ocean structure (section 5.2.4, page 125)

P. 116 line 2 –The GISS-EH ACC value is wrong. The data was incorrect in the PCMDI database, leading to the incorrect value appearing in the Russell et al. paper. Russell et al. has a Correndum. The value should be 175 Sv.

Derek Parks (NOAA RC)

The figure was removed and the discussion on the ACC shortened. The erroneous number no longer appears (page 138).

P. 116 line 9: Cunningham et al (2003) not in references.

Derek Parks (NOAA RC)

The reference has been added.

P. 120 line 4 – Only land ice melt contributes to sea level rise. Precipitation and runoff do not.

Derek Parks (NOAA RC)

The wording remains unchanged on page 143. We appreciate the reviewer’s comment, because in a practical sense, he is correct. Nevertheless, the wording is used in a definition and is correct.

P. 120 line 14 – What does “separate component” mean? Is this referring to separate flux components?

Derek Parks (NOAA RC)

The revised text on page 143 explicitly states the references are to model components.

P. 120 lines 14-15 – Model errors may also lead to an incorrect accounting.

Derek Parks (NOAA RC)

The discussion makes it clear the errors are a research question (page 143).

P. 123 -- What about storms defined by minimum SLP?

Derek Parks (NOAA RC)

P. 124 -- Stormtracks (sfc.) aren't necessarily implied by the 300 hPa level. Synopticians look at SLP and 500 mb. vorticity advection as well.

Derek Parks (NOAA RC)

Storm tracks are included in the discussion in both the PRD and revised drafts (page 108). Details about methodology in the cited literature are beyond the scope of the report. The 300 mb figures explicitly refer to eddy transports.

P. 128 line 8 -- "...the seasonal reversal of winds and ... indicate monsoon circulations in West Africa and the Amazon basin". This is incorrect over the Amazon. The monsoonal wind reversal over the Amazon basin can be seen only after the annual mean being subtracted.

Derek Parks (NOAA RC)

We reviewed the statement and stand by the original text (page 113).

P. 129 line 24 – The phrase in parentheses doesn't make sense and should be revised.

Derek Parks (NOAA RC)

The error was a reference, which was removed when the section was rewritten (page 115).

P. 131 -- How do you define how a model is best at rainfall? Regionally? Mean climate? How about extremes?

Derek Parks (NOAA RC)

The text specifically states the comparisons are to CMAP data and the discussion pertains to monsoons (page 115).

P. 132 -- Tropical cyclones are of sufficient size for models to be able to simulate, at least in a general sense.

Derek Parks (NOAA RC)

We disagree based on standard scaling arguments (page 112).

P. 133 line 4-5 -- What about intensity?

Derek Parks (NOAA RC)

The discussion was focused on at spatial and temporal variability (page 112).

P. 138 lines 12-23 – In this discussion, it should be noted that a common AR4 model error is that the NH middle and high latitudes are too cold compared to observations and the SH middle and high latitudes are too warm. These errors greatly impact the sea ice extent and response.

Derek Parks (NOAA RC)

The sea ice discussion was expanded (page 131), but this particular point was not made because the impact of the global biases are not linear. The models have both dynamic and thermodynamic components.

P. 142 line 25 – There is a typographical error in the “Klein 2007” reference.

Derek Parks (NOAA RC)

That citation was removed during the revision of the MJO discussion (page 116).

P.146 – As noted above, this is another instance where the different model resolutions are evident.

Derek Parks (NOAA RC)

No response required.

P. 148 line 20 -- What is a “twenty-first change”?

Derek Parks (NOAA RC)

The paragraph containing the sentence was removed from the ENSO section beginning on page 117.

P. 153 line 17: NINO3 is generally not used; NINO3.4 should be described instead.

Derek Parks (NOAA RC)

The sentence was removed in an extensive revision of the long-term variability sections beginning on page 123.

P. 155 line 2: The opening parenthesis is missing in this phrase.

Derek Parks (NOAA RC)

The sentence was corrected (page 125).

P. 155 line 12 – This section on Extreme events has a very strong overlap with section in the CCSP Report 3.3.

Derek Parks (NOAA RC)

No response required.

P. 157 line 1 – The line is missing references.

Derek Parks (NOAA RC)

Trenberth, et al. (2007) added (page 146)

P. 160 line 12: Is 2SD always a good proxy? In a climate with small variations, it is less meaningful. One size does not fit all.

Derek Parks (NOAA RC)

No changes were made to the text on page 149 to address this comment. This is an assessment report on published results.

P. 161 lines 8-9 -- This is incorrect. El Nino cools the southeast because of increased cloud cover and precipitation. This keeps the night temperatures up and the day temperatures down (not conducive to frost); frost occurs when the sky is clear and the wind is light.

Derek Parks (NOAA RC)

We stand by the original text on page 150, which is sufficiently qualified by the phrase “thought to be.”

P. 164 line 22 – Regarding “computing infrastructure,” the problem is resources, not infrastructure.

Derek Parks (NOAA RC)

We agree to the extent that resources are needed to build infrastructure. No change required.

P.165 line 9 – Change “themit” to “them”.

Derek Parks (NOAA RC)

The CRM section (section 6.1.2, page 156) was rewritten.

P. 167 line 22 – (q.v.) – What does this mean?

Derek Parks (NOAA RC)

The parenthetical comment was removed (page 159).

P. 210 line 1-5 – The reference is repeated.

Derek Parks (NOAA RC)

The duplicate reference was removed (page 202).

NOAA/OFCM (Samuel Williamson)

Executive Summary, Page 3, Lines 7-8

The statement is made that “convergence is to be expected once all climate-relevant processes are simulated in a convincing physically-based manner.” I believe this statement may be a bit too broad. This statement implies that if the models converge, they are converging to the correct representation. Models can also converge to the wrong representation. Please consider clarifying the quoted text.

Samuel Williamson (NOAA/OFCM)

Executive Summary, Page 5, Line 12

Please define acronyms before they are used. This particular line is just one example of acronyms which are used throughout the document before they are defined. Also, the authors might consider including an acronym list at the end of the document.

Samuel Williamson (NOAA/OFCM)

Executive Summary, Page 8, Line 23

I believe the text should read, “but are thought to **be** a potential contributor ...”

Samuel Williamson (NOAA/OFCM)

The Executive Summary was completely rewritten and reorganized to reflect the questions in the Prospectus, which we feel addresses the audience identified by the reviewer.

Final edits ensured that each acronym was defined before it is used.

Chapter II

This is an excellent description of global climate systems models for people who are not climate modelers.

Samuel Williamson (NOAA/OFCM)

No response required.

Chapter II, Page 20, Line 8

Please check spelling of words. The word “atmodphere” should be “atmosphere.” Line 8 is just one example of incorrectly spelled words on this page and on subsequent pages.

Samuel Williamson (NOAA/OFCM)

The document was thoroughly spell checked and copy edited. All identified errors were corrected.

Chapter II, Page 20, Line 26

There are extraneous periods on this line. Line 26 is just one example of extra periods on this page.

Samuel Williamson (NOAA/OFCM)

The document was thoroughly spell checked and copy edited. All identified errors were corrected.

Chapter II, Page 22, Line 19

There needs to be a better systematic labeling of the tables and figures throughout the document to facilitate reading. Simply label the tables and figures in numerical order throughout the chapter, using the following convention (i.e., Table II-1 and II-2 or Figure III-1 and III-2).

Samuel Williamson (NOAA/OFCM)

We agree. A hierarchical system was used in the final document.

Chapter II, Page 23, Lines 1-4

The first full sentence on this page has no verb. Thus it is difficult to understand what information the author is conveying. Please rewrite the sentence so that the author’s thought is clearly conveyed.

Samuel Williamson (NOAA/OFCM)

The verb “are treated” was added (page 26).

Chapter II, Page 23, Line 19

Table II.A lists turbulent schemes in AGCMs. I cannot find this table. Do you mean Table I.1?

Samuel Williamson (NOAA/OFCM)

That table and references to it were removed from the document.

Chapter II, Page 27, Lines 5- 6

The statement is made that “Such treatment of the overflows should improve the representation of deep ocean waters ... but problems remain.” What are the problems? An example of one problem to overcome would give the reader an idea of the type and or extent of the problem.

Samuel Williamson (NOAA/OFCM)

The paragraph was rewritten (page 30) with less detail.

Chapter II, Page 32, Lines 16-17

The sentence refers to Chapter V (which begins on page 91) with the verbiage “below.” Do you mean Chapter I which addresses AOGCMs on page 12, or do you really mean Chapter V which discusses the AOGCMs simulations? If the reference is pointing to Chapter V, then the word “below” should be replaced with words such as, “later in this document.” If that is the case, the manner in which the idea is brought to the reader makes it difficult to link the concepts that are disconnected when referring to a subject matter four chapters ahead with which the reader is not yet familiar.

Samuel Williamson (NOAA/OFCM)

The text was rewritten to be more clear (page 31)

Chapter II, Page 37, Line 16

I believe the phrase “thanks to a combination ...” is too colloquial for this type of document. I believe the phrase should read “due to a combination ...”

Samuel Williamson (NOAA/OFCM)

This section was eliminated and the information included in other locations, e.g page 35.

Chapter II, Page 49, Line 21

I am trying not to emphasize spelling and punctuation errors; however, in this line, adding a colon after the word “community” would greatly add to the reader’s comprehension. Otherwise the text which follows makes no sense.

Samuel Williamson (NOAA/OFCM)

Corrected (page 46)

Chapter II, Page 57, Lines 1-10

It is difficult to relate the content of the words to the confusing diagram on page 58.

Samuel Williamson (NOAA/OFCM)

Chapter II, Page 58

The figure on this page is very difficult to read, especially the information along the x-axis.

Samuel Williamson (NOAA/OFCM)

Section 2.7 and the figure caption have been rewritten for clarity (pages 52-54).

Chapter III, Page 21, Line 8

On this line, reference is made to “(Washington and Parkinson, 2005)”, yet these authors are not listed in the REFERENCE section. Please ensure that there is a one-to-one correspondence between references in the text and those listed in the REFERENCE section.

Samuel Williamson (NOAA/OFCM)

A thorough reference check was performed to eliminate these problems.

Chapter IV, Page 78, Lines 3-4

The sentences on these lines read: “We discuss two of the most important of these feedback effects below. The strengths of these feedbacks are most frequently described ...” Albeit a matter of style, why not enumerate the feedbacks after the first sentence

instead of making the reader guess at what feedbacks you are going to talk about in the next two sections. Thus it might improve the readability of the document if the sentence reads: “We discuss two of the most important of these feedback effects below: **(1) cloud feedbacks and (2) water vapor feedback.** The strengths of these feedbacks are most frequently described ...”

Samuel Williamson (NOAA/OFCM)

Chapter 4, beginning on page 69, was extensively rewritten, including the discussion of feedbacks. We believe the new text is much improved and readable.

Chapter IV, Page 86, Lines 16-30 and Page 87, Lines 12-16

US altimeters measure not only the sea surface height but infer the three-dimensional shape of the water column underneath the surface that (1) plays a critical role in estimating total ocean heat content and (2) is crucial to resolving the inconsistencies of the model metrics as feedbacks between the ocean, ice, and atmosphere to obtain a better climate sensitivity value. That altimeters provide a critical sensing input for climate models to forecast climate change is a point which should be stressed.

Samuel Williamson (NOAA/OFCM)

This is a level of detail beyond the scope of the report.

Chapter V, Page 108, Lines 18-25

This paragraph highlights the critical need and severe impact concerning future climate-change forecasts if all altimeter capability is lost when Jason II (currently on orbit) reaches its end-of-mission life by the year 2013. The critical role of the altimeter data continuity in the determination of the climate and the predictability of the changes cannot be underestimated. This point should be emphasized.

Samuel Williamson (NOAA/OFCM)

The report is an assessment and it would be inappropriate to advocate for a particular observational system. The point is made repeatedly that model development requires new and better observations.

Chapter V, Page 131, Lines 14-16 related to Page 143, Lines 24-31

There is a need to state where the ENSO section is located further ahead in the document. Also within these lines, the text reads: “Here we note that a consensus is yet to emerge, adding to uncertainty in monsoon projections.” ENSO is discussed later; however, it might be worthwhile to talk quantitatively or qualitatively about the uncertainty in monsoon projections at this juncture since there are significant linkages between ENSO and climate. Is the uncertainty small/large enough to make predicting ENSO events and/or ENSO-related climate regimes useful/not useful? Could the amount of uncertainty be described qualitatively as substantial, moderate, etc.?

Samuel Williamson (NOAA/OFCM)

The variability discussion in Chapter 5 was reorganized and is more logical (section 5.2.2 starting on page 106)

Chapter V, Page 148, Lines 20 – 21

The text reads: “Anticipation of twenty-first changes to El Nino remains uncertain, because of a lack of consensus among models.” I believe the text should read: “Anticipation of twenty-first **century** changes to El Nino ...” Alternately (and to be

more precise), the sentence could state that the uncertainties in the El Nino forecast stem from the absence of an ensemble model consensus.

Samuel Williamson (NOAA/OFCM)

The paragraph containing the sentence was removed.

Chapter VI, Page 165, Lines 8-9

The text on these lines reads: “They are also sensitive to the physical algorithms in **themit**.” I do not know what the author is trying to convey. Please rewrite this sentence so that the author’s thoughts are adequately conveyed to the reader.

Samuel Williamson (NOAA/OFCM)

The CRM section (section 6.1.2, page 156) was rewritten.

Chapter VI, Page 168, Lines 24-25

The text on these lines reads: “Generally, climate-carbon models do not include the effects land cover and land management changes on natural ecosystems.” Perhaps the author means “... do not include the effects **of** land cover and land management ...”

Samuel Williamson (NOAA/OFCM)

Corrected (page 162)

Chapter VII, Page 175, Lines 7-9

The text on these lines reads: “Those performing the impacts studies had the opportunity of influence the model simulations and the type of model output that was made available.” What are the implications of this statement in the context of the overall discussion? The author’s intent is not clearly articulated.

Samuel Williamson (NOAA/OFCM)

The statement was more editorial than factual, and was removed (page 171).

California Department of Water Resources (Michael Anderson)

Part: Executive Summary, Page 7, Lines 12 to 15

Comment: Is there more to this topic than the one sentence? A period is needed at the end of the sentence.

Michael Anderson, (DWR)

Part: Executive Summary, Page 8, Lines 24

Comment: Period needed instead of comma at end of sentence

Michael Anderson, (DWR)

The Executive Summary was completely rewritten and reorganized to reflect the questions in the Prospectus, which we feel addresses the audience identified by the reviewer.

Part: , Chapter II, Page 20, Line 8

Comment: Misspelled atmosphere

Michael Anderson, (DWR)

Part: , Chapter II, Page 20, Line 18

Comment: Misplaced period

Michael Anderson, (DWR)

Part: , Chapter II, Page 20, Line 26

Comment: Misplaced period

Michael Anderson, (DWR)

Part: , Chapter II, Page 20, Line 28

Comment: Comma at end of sentence

Michael Anderson, (DWR)

Part: , Chapter II, Page 21, Line 2

Comment: Misplaced period

Michael Anderson, (DWR)

Part: , Chapter II, Page 21, Line 2

Comment: Extra space between divided and into

Michael Anderson, (DWR)

Part: , Chapter II, Page 21, Line 11

Comment: prior to parentheses, do you mean tropopause

Michael Anderson, (DWR)

Part: , Chapter II, Page 21, Line 14

Comment: Extra space between momentum and exchanges

Michael Anderson, (DWR)

Part: , Chapter II, Page 21, Line 31

Comment: Extra space between individual and wavelengths

Michael Anderson, (DWR)

Part: , Chapter II, Page 22, Line 20

Comment: Missing word between of and and

Michael Anderson, (DWR)

Part: , Chapter II, Page 23, Line 4

Comment: Extra period

Michael Anderson, (DWR)

Part: , Chapter II, Page 23, Line 4

Comment: Misspelled non-precipitating

Michael Anderson, (DWR)

Part: , Chapter II, Page 23, Line 5

Comment: Extra period

Michael Anderson, (DWR)

Part: , Chapter II, Page 26, Line 9

Comment: Extra period
Michael Anderson, (DWR)

Part: , Chapter II, Page 26, Line 24
Comment: Missing closing parenthesis and period
Michael Anderson, (DWR)

Part: , Chapter II, Page 27, Line 16
Comment: Incorrect table reference
Michael Anderson, (DWR)

Part: , Chapter II, Page 29, Line 10
Comment: Remove the word also
Michael Anderson, (DWR)

Part: , Chapter II, Page 30, Line 5
Comment: Extra comma
Michael Anderson, (DWR)

Part: , Chapter II, Page 46, Line 8
Comment: sea instead of seas
Michael Anderson, (DWR)

Part: , Chapter II, Page 56, Line 1
Comment: missing apostrophe for a model's
Michael Anderson, (DWR)

Part: , Chapter II, Page 56, Line 4
Comment: change and it ability to and its ability
Michael Anderson, (DWR)

Part: , Chapter II, Page 56, Line 25
Comment: missing apostrophe for a model's
Michael Anderson, (DWR)

Part: , Chapter II, Page 56, Line 25
Comment: misspelled coupling
Michael Anderson, (DWR)

Part: , Chapter II, Page 61, Line 26
Comment: remove the word to after RCM
Michael Anderson, (DWR)

The above errors were either corrected or eliminated through rewrites or proofreading.

Part: , Chapter II, Page 68, Line 8

Comment: Earlier in the chapter this subsection was referred to as statistical downscaling. Consistency is needed.

Michael Anderson, (DWR)

The first sentence of the following paragraph explicitly equates the two terms, both of which are found in the literature (page 65)

Part: , Chapter VII, Page 173, Line 4

Comment: A general introductory paragraph would be helpful

Michael Anderson, (DWR)

An introductory section was added (page 165)

Part__, Chapter VI, Page 163, Line 2

Comment: An introductory paragraph giving an overview of the chapter's material would be helpful.

Michael Anderson, (DWR)

An introductory section was added (page 153)

Part__, Chapter VI, Page 163, Line 5

Comment: An introductory sentence relating CRMs to GCM studies and why CRMs are being reviewed would be helpful.

Michael Anderson, (DWR)

More background is now included (page 156).

Part__, Chapter VI, Page 165, Line 9

Comment: What is the word themit?

Michael Anderson, (DWR)

The CRM section was rewritten and the error eliminated (page 156)