

**Comments and Responses on SOCCR/SAP 2.2 Draft 1 (May 2006)
PREFACE and EXECUTIVE SUMMARY**

COMMENT FROM PEER REVIEWERS					AUTHOR'S RESPONSE							
Comment Number	Reviewer ID	Chapter	Page	Line	Comment Text	Acknowledged, but no further response or revisions are required	Revisions have been incorporated as suggested in the comment	Agree, but see "Notes on Response"	Agree, but elaboration is precluded by length limitations	Disagree; see "Notes on Response"	Beyond scope of report/chapter	Notes on Response
00-001	5	Preface	vii	2	I would recommend to remove the words "and/or advancing". Scientists with the aim to advance the frontier of knowledge will probably have to read the relevant scientific publications in peer reviewed journals rather than a report that is also targeted at an audience including decision makers and the general public. In my view this is a too far stretch.		X					
ES-001	3	ExSum	General		At this stage in its development, the report seems more targeted to a technically oriented audience than to non-scientist decision-makers or the general public. To reach the latter, I think there needs to be a much more careful elaboration of technical material in the text, as well as in table and figure legends. The authors may want to consider the way some figure and table legends are handled in American Scientist; see, e.g., article by R. Seager, 94: 335-341, July August 2006.			X				We have edited the executive summary and hope it is more accessible to the non-technical readers.
ES-002	3	ExSum	General		Tables and figures need to "stand alone" even for a technical audience but merit considerable explanation when communicating with a less technically trained audience.			X				The authors of the Executive Summary, and the individual chapters have made an effort to add the necessary footnotes and explanatory text to make their figures and tables stand-alone
ES-003	3	ExSum	General		It also appears that the authors of specific chapters or sections have not had sufficient time to read other contributions, as evidenced by unnecessary repetition and some inconsistency in technical information conveyed from one section to the next. As one example, there appears to be considerable variation in the treatment of uncertainties in point estimates of carbon sources, fluxes, and sinks among the various sections of the report, and rather questionable handling of estimates and their uncertainties in most sections. Among the most glaring is the citation of the estimated carbon sink for North America (in Gt of C) to three significant figures, when the estimated error is on the order of $\pm 50\%$. However, my concern also extends to some aspects of the better constrained estimates of fossil fuel emissions, which are sometimes given to four significant figures.			X				We have revised the use of standard units and reduced the number of significant figures (and to eliminate values), but have not tried to assign errors to individual values. The treatment of uncertainty in variables across disciplines is complicated, even when guidance on handling uncertainty is provided. The issue will be discussed as a finding of the assessment.

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ES-004	3	ExSum	General		I kept looking for answers to questions that I thought should be addressed in a report of this type. What do we know and how well do we know it? "How well" in this context goes well beyond quantitative estimates of uncertainties in sources and sinks: How closely does current information meet the expected needs for carbon-climate modeling and analysis of carbon management options? Other questions include: What don't we know and why? What are the most important uncertainties and why? What will it take to reduce uncertainties to manageable levels and how long do we expect it might take? Where is R&D needed to provide the tools that could lead to improved understanding? What can't we know and what are the implications, e.g., where are uncertainties only poorly reducible (or perhaps irreducible) and how do we plan to deal with them? I found very few answers to my questions in the current version of the report.			X				The reviewer raises some very good and demanding questions. However, they are questions significantly different than the questions arrived at through dialogue (e.g., workshops) with stakeholders in the process of formulating the report. The report and its Executive Summary are structured around and respond to those questions. We believe answers to many of the questions raised by the reviewer are actually addressed throughout the various chapters (e.g., in the sections on research needs for decision support). Expanding or restructuring the report and Executive Summary to explicitly and directly answer the excellent questions raised by the reviewer are beyond the scope of this revision of the report.
ES-005	3	ExSum	General		Based on the material I've looked at, I think the report could benefit from appointment of an overall editor(s) whose focus would be on consistency in presentation of technical information and facilitation of communication with the broad audience for which the report is apparently intended. Toward that end, I would also recommend that every effort be made to use a single unit of measure and carbon reference (e.g., either Gt or Pg of C) throughout the report. Mixing units of Pg, Gt, and Mt, and jumping between values referenced either to C or CO2 equivalents is confusing to the reader.			X				We have adopted common units of carbon.
ES-006	1	ExSum	General		This is a very comprehensive report and (as far as I can tell in the time available) is largely of high quality. Its goal of communicating accurate, substantiated carbon cycle science to audiences in the public-policy, private, and general-public sectors is commendable.	X						
ES-007	1	ExSum	General		The report needs to place the carbon cycle in an earth system context. The primary motive for policy (and much of the scientific) interest in the carbon cycle is anthropogenic climate change resulting from current carbon cycle imbalances, and the possibility of further earth system feedbacks or vulnerabilities that could accelerate the coupled climate and carbon cycle changes. From this perspective, the following two issues need more emphasis in the report (especially the executive summary).	X						

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ES-008	1	ExSum	General		The agent of greenhouse-driven climate change is radiative forcing, not CO ₂ . There are many contributors to present radiative forcing, broadly (a) CO ₂ , (b) non-CO ₂ greenhouse gases, and (c) non-gaseous forcings (direct and indirect aerosol effects, albedo, etc). CO ₂ forcing is presently around 55 to 60% of the total gaseous forcing (a + b), while (c) is currently negative (although highly uncertain) and comparable in magnitude with (b). Future climate change depends on the future evolution of all of (a), (b) and (c), not just (a) – even though (a) is the largest single driver of the system. An appropriate place to make this point would be near page ES-3 line 18. Reference to the need to account for the full radiative forcing implications of carbon management options (not just the effect on CO ₂) would also be helpful on page ES-10 after line 4-7.		X					
ES-009	1	ExSum	General		More emphasis needs to be given in the executive summary to carbon cycle vulnerability, meaning possible acceleration of imbalances in the carbon cycle by climate change itself, thereby accelerating the imbalances. Vulnerability of terrestrial and ocean carbon pools is especially important (see Gruber et al 2004, cited on p. 2-13). This point could be made on P. ES-10 near line 10.		X					
ES-010	1	ExSum	General		The executive summary overstates the certainty of the North American carbon budget relative to the global carbon budget. This is clearest at page ES-4 lines 19-27, where the global terrestrial sink is stated to be "quite uncertain", but the North American sink is given to 3 significant figures. No source for this number is given. Also, no year is given—a crucial omission since the terrestrial sink is the most variable term in the C budget from year to year, both globally and regionally. This is a dangerous oversimplification in two ways. First, the extreme interannual variability of the terrestrial sink must be stressed at this point in the executive summary. Second, the actual order of uncertainty is opposite to what is implied: all continental and regional C sink estimates from atmospheric inversion estimates are more uncertain than global sink estimates, because of			X				We have added text to describe interdecadal variability and its significance. We inserted sentences and a paragraph that explicitly calls out the vulnerability of the carbon cycle. With respect to the second point, estimates of error are still largely absent, but the divergent number of significant figures has been addressed.
ES-010 (cont)					mass balance constraints. Bottom-up estimates (from inventories etc) are also subject to large uncertainties, though they are much harder to quantify and are often not estimated (see Raupach et al. 2005, Global Change Biology 11, 378 for discussion of errors and their estimation).							
ES-011	1	ExSum	General		On the terrestrial C sink, there are contradictions between the executive summary (page ES-4 lines 19-27) and the text (page 2-8 lines 18-27). The latter gives a (properly) uncertain estimate ascribed to particular years.			X				The text has been revised. We refer generally to decades rather than to individual years --- because of the large year-to-year variability which the inventory methods integrate across.

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ES-012	1	ExSum	General		There are multiple units in use for the same thing, in particular MtCO2 per year, MtC per year, and GtC per year for fluxes. I would advocate dropping MtCO2 per year and expressing all fluxes (both global and regional) in MtC per year throughout, to facilitate regional-global comparisons. (The factor of 1/1000 to go to GtC per year can be easily applied mentally by those who need to do so).		X					
ES-013	1	ExSum	General		The executive summary is not overtly biased. However, I believe that it does leave open the possibility of misinterpretation, mainly through omission. There are three main examples, as detailed in the following three items:			X				See responses to example-specific comments, below
ES-014	1	ExSum	General		Temporal variability of the terrestrial sink, and risk implications: Some parts of the executive summary (page ES-4 lines 19-27, page ES-7 lines 1-7) imply that the terrestrial sink is steady and reliable, whereas it is actually highly dynamic and can fluctuate year-to-year by up to half the fossil-fuel source. This makes terrestrial biological sequestration strategies highly risky, both for reasons of short-term and long-term stability (see point 2(2) on C cycle vulnerability) and also poses difficulties for carbon accounting.			X				We added a sentence under the 'options & measures' section that explicitly talks about the greater risks of carbon sinks than reduced emissions. We don't think we need a statement about interannual variability.
ES-015	1	ExSum	General		The carbon-GDP connection: The report is correct (page ES-5 lines 22-34) in pointing out that the carbon intensity of GDP is falling. However, the critical point is that emissions are still rising. The intensity (emissions/GDP) is falling only because the denominator is rising faster than the numerator. The trend to decreasing carbon intensity of GDP is not a greenhouse solution.		X					
ES-016	1	ExSum	General		Treatment of the C sink in North America: A policymaker could conclude from this executive summary that full carbon accounting is very much in (say) the US interest because the total US emission (fossil + terrestrial) is around a third less than the fossil emission alone. This would not be a scientifically justifiable inference, because most of the earth system sinks for carbon (both terrestrial and oceanic) are unmanaged and are the unintended result of legacy actions and global C cycle imbalances. Therefore, they are not "owned" by any particular nation in the same way that a nation "owns" direct anthropogenic forcing of the C cycle (either through fossil fuel emissions or managed sequestration activities).				X			
ES-017	1	ExSum	ES-4	1-6	All fluxes and percentages like these are functions of time, so it is necessary to give time stamps to all numbers.		X					

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ES-018	1	ExSum	ES-4	5-18	The compartments for the budget figures quoted are not clear. For example, is the building-sector (mainly electricity) emission (line 15) also included in the electricity emission figure (line 8)? Emissions are given in awkward units (see comment 5) and as a mix of absolute and percentage values. This could be fixed with a simple table of North American and global C sources and sinks, with the anthropogenic emissions classified by source (coal, oil, ...) and end use (industry, home, transport ...). The table should also include uncertainties, especially in the terrestrial sink.			X				We thought about a Table and concluded it's not necessary. At least with the detail suggested by the reviewer, a simpler figure has been added.
ES-019	1	ExSum	ES-4	19-27	see points 3 (uncertainty and temporal variability), 4 (contradictions), 5 (units) and 6(2) (temporal variability again).		X					
ES-020	1	ExSum	ES-5	6	Need to mention (here or elsewhere) the risks for terrestrial biological sequestration imposed by uncontrollable sink variability. See point 6(2).			X				Not here, but later in the text we've added the cautionary note.
ES-021	1	ExSum	ES-5	19	Multiple (and changing) units.		X					
ES-022	1	ExSum	ES-6	20-23	Is building power a service? If so, the carbon intensity of that GDP component could rise, not fall.						X	
ES-023	1	ExSum	ES-6	2-7	Need consistent units and (more importantly) error estimates.		X					
ES-024	1	ExSum	ES-7	27	What about the methane emissions from wetlands? This is an example of where CO2 accounting rather than radiative-forcing accounting can be misleading.				X			
ES-025	1	ExSum	ES-8	22	This statement could be stronger: predicted ocean acidification will pretty much wipe out coral reefs by 2100.		X					
ES-026	1	ExSum	ES-9	3-10	Reference to the multiple sources of terrestrial C vulnerability (nutrient limitation, fire, insect attack, increased respiration with warming, ...) would be appropriate here. The important point is not to give the impression that interaction of the C cycle with other earth system processes always leads to benign outcomes.		X					
ES-027	1	ExSum	ES-9	10	"the interwoven systems of North America" is a little regionalistic. The systems are just as interwoven over the whole globe.		X					
ES-028	1	ExSum	ES-9	12	Too wordy. Why both "options" and "measures"? What is the intended distinction?			X				Distinction between terms added to text.
ES-029	1	ExSum	ES-9	21	Where does the hydrogen energy come from? Hydrogen is an energy carrier, not a source, so the mitigation question hinges on how the hydrogen is generated.		X					
ES-030	1	ExSum	ES-10	6-7	Another example of why the issue is radiative forcing, not just CO2.	X						
ES-031	1	ExSum	ES-10	19	The demand for policy relevant information is now very high, as shown by this report.	X						
ES-032	1	ExSum	ES-11	4-7	I like this definition of requirements for science to make a policy contribution (credible, salient, legitimate).	X						
ES-033	1	ExSum	ES-11	19	What departures from existing practice? This point cannot be understood without some indication.			X				Text revised to avoid reference to unspecified existing practices/

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ES-034	2	ExSum	General		I have quickly, but not carefully, read the full report. Overall I am extremely impressed by the document and the quality analysis and science that underpin it. In general the chapters are very well written, have useful figures and the information is clearly and comprehensively presented.	X						
ES-035	2	ExSum	General		Of course it is no trivial task to condense all this information into an Executive Summary. The present version of the Executive Summary makes an excellent start, and is both informative and interesting. However, it needs more work to ensure that the information is provided accurately but also in a non-confusing manner.	X						
ES-036	2	ExSum	General		The Introductory section is well written and gives a clear, understandable background. However a small presentational problem is introduced which has echoes elsewhere in the document. The emphasis on North American terrestrial processes is justifiable given the subject matter of the report, however the context of the global carbon cycle requires more explicit mention of ocean uptake. The problem first appears on line 25 where the "piling up" of CO2 in the atmosphere is mentioned, without corresponding mention of the ocean. The impression is given here that we have fossil-fuel emissions and clearing of forests being "far larger" than the ability of "various terrestrial and marine reservoirs" to store carbon. This may even be slightly misleading: historically the atmospheric storage term has been significantly smaller than the cumulative emissions, and the oceans have played a major role here. Why not just say this clearly? By not mentioning the well-documented "piling up" of CO2 in the ocean it is also difficult to understand the concern about ocean acidification that is mentioned subsequently in the document.		X					
ES-037	2	ExSum	General		It would be useful to mention not only the contribution of North America to global emissions in 2003 (27%), but also what the historical contribution has been since 1780. Given the long lifetime of CO2 in the atmosphere, information on past emissions is also of relevance to policy- and decision-makers.		X					
ES-038	2	ExSum	General		"What is the carbon cycle and why should we care?" Good questions! Well-answered!	X						
ES-039	2	ExSum	General		Here I did not find the analogy with the hydrological cycle so useful. There are as many differences as similarities (e.g. changes of chemical form; very different processes, residence times; etc). I think the analogy actually risks confusing the reader.		X					
ES-040	2	ExSum	General		"modern, post-industrial societies": are all "modern" societies really "post-industrial"?		X					
ES-041	2	ExSum	General		Use "pools" or "reservoirs" but preferably not both.		X					
ES-042	2	ExSum	ES-3	4	"carbon building up in the atmosphere AND IN THE OCEAN".		X					
ES-043	2	ExSum	ES-3	6-9	Again, I think that the analogy with changes in the hydrological cycle looks a little contrived.		X					

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ES-044	2	ExSum	ES-3	11	Suggest "10's of years" for decades and "millions of years" instead of thousands of millennia.		X					
ES-045	2	ExSum	ES-3	15	Mention of methane is potentially confusing: is it necessary here?		X					
ES-046	2	ExSum	ES-3	23-24	It should have earlier been made clear that releasing CO2 to the atmosphere leads to increased CO2 in the ocean and that this "acidifies" the ocean. Personally, my feeling is that "potentially dire consequences" is still a little too strong given our state of knowledge in this area. Suggest: "may have serious consequences". I also think the climate change concerns are being underplayed a little: for human beings this surely is the number one concern/risk and reason for caring about the carbon cycle and carbon management: even in the face of scientific uncertainty.		X					
ES-047	2	ExSum	ES-3	25-31	Missing from the final paragraph in this section, is the important point (made elsewhere in the document) that any assessment of the effectiveness of deliberate carbon management policies REQUIRES an understanding of the enormous fluxes and potential imbalances in the natural carbon cycle. How else would we know if human actions (wrt emissions or mitigation) are making a difference to atmospheric CO2 levels?		X					
ES-048	2	ExSum	ES-4	3 et seq	Here I got a little confused by the variety of different numbers and comparisons presented. We have emissions in Mt and as percentages; we have North America and then the USA and then global. Maybe this can be simplified a little. My feeling is that percentages are generally more useful in an Executive Summary than absolute numbers, although the absolute numbers must also be presented somewhere as a reference....		X					
ES-049	2	ExSum	ES-4	3 et seq	This section of the text is almost crying out for "pie charts". Are these allowed?			X				A figure has been added rather than a pie chart
ES-050	2	ExSum	ES-4	3 et seq	In general there was a lack of consistency in numbers of significant figures between the absolute numbers (3-4 significant digits) and the percentages (generally 1-2 significant digit). This is potentially misleading in terms of uncertainties and some more thought on presentation is required here. (e.g. "approximately 30% ... of emissions are offset by a smaller sink of 2170 Mt...)		X					
ES-051	2	ExSum	ES-4	3 et seq	I found the discussion of buildings interesting/important but also a little confusing. Is it necessary to discuss buildings with AND without electricity for example?		X					
ES-052	2	ExSum	ES-4	20	Page ES-4, line 20: risks implying that coastal oceans are a substantial net sink. Is this true?		X					
ES-053	2	ExSum	ES-4	24	Page ES-4, line 24. Here we are suddenly introduced to the "global terrestrial sink". To me this is a quite complicated concept. If the term is used in the Executive Summary, it should be defined and explained what it is.					X		We think the revised text is OK without belaboring the global terrestrial sink.

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ES-054	2	ExSum	ES-4	28	Page ES-4, line 28. Here again the lack of consideration of the ocean sink risks misleading as far as the relation of North America to the GLOBAL carbon cycle is concerned. There probably can be little question that North America makes (or has made) a "dominant" contribution to global carbon SOURCES. It may be harder to argue for the "dominance" of North America for carbon SINKS, at least when viewed historically. Here it may again be useful to contrast the situation presently (e.g. 2003) with the "cumulative" situation since 1780. Given that this comparison is the <i>raison d'etre</i> for this entire section, there may need to be more clarity with wording here.					X		We think the text now reads well without referring to the 200-year history of sources and sinks. Details can be found in Chapter 2.
ES-055	2	ExSum	ES-5	14 et seq	I found this section very informative. However again, there were perhaps a few too many different comparisons presented that risk confusing the reader. Also: issues of relative vs. absolute numbers and their precision, come up again.		X					
ES-056	2	ExSum	ES-5	17	The first part of the section discusses "sources" so it was a little surprising to find the 2nd sentence stating that sources are 3x larger than sinks. This comparison should surely come AFTER the sinks have been discussed/explained.		X					
ES-057	2	ExSum	ES-5	19	Page ES-5, line 19: I had only just got used to dealing with emissions in Mt CO2 and now suddenly we have Mt C. While I prefer the latter, it is really only important to be consistent and use the same units throughout.		X					
ES-058	2	ExSum	ES-5	24	"carbon intensity" is an important concept and should be defined/explained more clearly.		X					
ES-059	2	ExSum	ES-5	31-32	The decoupling of emissions from economic growth is an extremely important point of course. Therefore it deserves more discussion and clarification: I assume this is both a "recent" phenomenon in the USA and is not the case everywhere in the world.		X					
ES-060	2	ExSum	ES-6	15-28	Again the discussion of buildings was interesting, but maybe a little too detailed for my taste. On the other hand, if the argument is that energy conservation in buildings is a really big issue: then that case seems to be very well made and may justify the detail given. (I was surprised that ONLY 67% of electricity was consumed in buildings.)	X						
ES-061	2	ExSum	ES-7	2	Again note the difference between exact and approximate numbers in the same sentence.		X					
ES-062	2	ExSum	ES-7	6	How is the "coastal ocean" defined? It would likely make sense to consider the EEZ. Or is it the continental shelf? The coastal ocean source is of course largely a "natural" source of carbon that has not been greatly altered by mankind as far as we know.					X		This is a detail more appropriate for Chapter 15.

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ES-063	2	ExSum	ES-7	8	If it is true that forest regrowth basically takes up CO2 that was previously emitted due to deforestation, then this point should perhaps be mentioned explicitly. Arguably, this makes this particular component of the terrestrial sink a "net sink", in relation to human interference in the carbon cycle, only the sense of "instantaneous" fluxes rather than cumulative emissions. Similarly, I wonder about the peat accumulation sink: should this be compared to fossil-fuel emissions? Effects of fire suppression may be qualitatively different.						X	This detail is beyond the scope of the Executive Summary
ES-064	2	ExSum	ES-5	14 et seq	I may be wrong on this and I may be risking confusing matters further. But perhaps this sort of conceptual discussion actually belongs in an Executive Summary about carbon sources and sinks written by scientists for policy-makers. Policy-makers may be confronted by such arguments by their international counterparts, after all. Presumably this issue has been discussed extensively by the authors, and I admit to not having examined the respective chapters to see whether this has, in fact, been presented/discussed in detail.					X		We do not understand the comment.
ES-065	2	ExSum	ES-8	19	If the acidification impact is mentioned at all, then it requires slightly more explanation. For example it is the increasing levels of carbon in the ocean rather than in the atmosphere that causes acidification: with the present text, an uninformed reader might infer that changes to the pH of rainfall are responsible!! It is also unclear why we would worry about acidification in the oceans more than the effect on lakes and rivers....		X					
ES-066	5	ExSum	ES-10	6-7	If CH4 and N2O are mentioned it should be mentioned why increased emissions may be of concern.		X					
ES-067	5	ExSum	ES-3	14	Somewhere before it should be mentioned that also methane and other carbon compounds also follow a cycle, and that they are also emitted by processes associated with fossil fuel use.						X	Beyond scope of the Executive Summary.
ES-068	5	ExSum	ES-7	17	All above mentioned sinks are also uncertain, I would recommend stating uncertainties with the numbers, or a range, or at least make a general statement on uncertainties.		X					
ES-069	5	ExSum	ES-9	21	Hydrogen is not a primary source of energy. It should be stated how the hydrogen will be generated, given that nuclear, solar, wind, but also fossil fuels are all options.		X					

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ES-070	6	ExSum	General		It is in fact one of my major criticisms of the report that in the Executive Summary (Pages ES-4 to ES-8 line 12) as well as in Chapter 3 (except for Table 3-1 and page 3-7, line 19-22) no uncertainty ranges of the sources and sinks fluxes of carbon in North America are given. For example, the estimated uncertainty of fossil fuel CO2 emissions is about 10% (with 95% confidence, see Table 3-1) but up to four significant digits of the cited numbers are given. This deficiency is even more obvious when it comes to the sinks which in most cases are uncertain to within 50-100%. This is very misleading as it gives the impression to the reader that the fluxes reported would be known to very high precision, but in fact the contrary is the case. The digits in the reported numbers need to be reduced to the significant ones (i.e. ≤ 2) and errors need to be reported, also in the Executive Summary.		X					
ES-071	6	ExSum	General		There is a lot of repetition in the Executive Summary between the sections "How do North American carbon sources and sinks relate to the global carbon cycle" and the following section which is dealing only with North American carbon sources and sinks. The Executive Summary could be well shortened if the "relation to the global carbon cycle" would be imbedded in the latter section.					X		The questions defined in collaboration between authors and stakeholders made a clear distinction between the questions
ES-072	6	ExSum	ES-3	14-17	"... and other carbon compounds in the earth's atmosphere, such as methane, are increasing." The context of this finding is not immediately clear from what is said before.		X					
ES-073	8	ExSum	General		The Executive Summary, as well as many of the chapters, is in need of professional editing. It should be reviewed both for technical accuracy and for correct grammar. It should also be edited to reduce the redundancy with Chapter 1. Some examples illustrating the need for editing are listed in the items below. The list is illustrative only and far from exhaustive.		X					
ES-074	8	ExSum	ES-4 and ES-5	4 and 21	Line 4 on page 4 gives the contribution of the United States to North American emissions due to fossil fuel combustion as 86%. Page 5 gives the contribution as 85%.			X				The text has been revised to reconcile the two values.
ES-075	8	ExSum	ES-8	1	The U.S. agricultural soils sink is given as 6 Mt C per year. This is out of date. The current estimate is 12 Mt C per year.			X				We've deleted specific flux estimates
ES-076	8	ExSum	ES-9	19-28	The list of options is missing a number of potentially significant ones, e.g., Transportation: non-liquid biofuels and electric cars; in Buildings: use of renewable energy; Industry: carbon capture and sequestration.				X			
ES-077	8	ExSum	ES-7	11-12	The text states "The suppression of forest fires also increases net carbon storage in forest biomass." Suppression of forest fires presumably reduces emissions, but only increases carbon storage in relation to some projected losses.					X		We are confused by this comment.
ES-078	8	ExSum	ES-3	18	"forcing agent". Term unfamiliar to lay audience.							
ES-079	8	ExSum	ES-5	17	(repeated throughout Executive Summary) "fossil fuel source". Term unfamiliar to lay audience.							

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COMMENT FROM PEER REVIEWERS					AUTHOR'S RESPONSE							
Comment Number	Reviewer ID	Chapter	Page	Line	Comment Text	Acknowledged, but no further response or revisions are required	Revisions have been incorporated as suggested in the comment	Agree, but see "Notes on Response"	Agree, but elaboration is precluded by length limitations	Disagree; see "Notes on Response"	Beyond scope of report/chapter	Notes on Response
ES-080	8	ExSum	ES-6	24	"...the number of households per unit population..." This turn of phrase is odd as the normal "unit" of population is one person.		X					
ES-081	8	ExSum	ES-7	11	"dead organic carbon" This phrase strikes the average reader as odd.		X					
ES-082	8	ExSum	ES-3	15	Grammar: "This facts..."		X					
ES-083	8	ExSum	ES-6	16-17	Grammar: "The trend in the buildings sector over the last decade has been towards growth." Very poor construction.		X					
ES-084	13	ExSum	General		The scope and intent of the ES is generally clear, appropriate and balanced. In places, however, the language assumes a medium to high degree of familiarity with the subject. For example, without explaining the term (ES-3, l. 18), the text states: "...is the largest single <i>forcing</i> agent of climate change." Perhaps more effort could be put towards using less specialized language throughout the ES.		X					
ES-085	13	ExSum	General		The readability of the document as a whole could be improved by a consistent use of carbon <i>or</i> CO ₂ , not both. For example, p. ES-7, l. 2 states, a natural sink of "592 Mt C" in contrast to p. ES-4, l. 21 "a smaller sink of 2170 Mt CO ₂ ." Other examples occur in the various chapters as well, particularly when referring to the costs of carbon mitigation.		X					
ES-086	13	ExSum	General		Additional editorial work should be done to insure consistent use of the terms "effects," "impacts," and other similar phrases. For example, in the Preface (p. v, footnote 1) in reference to carbon cycle changes and impacts the term "impacts" is defined to mean "effects of changes in the carbon cycle." In the ES, p. ES-8, l. 2 and l. 5, we see the phrases, "changes in the environment" and "effects of climate". It is unclear if the intent is climate "impacts" as defined in the Preface or whether a second meaning is implied.					X		The terms are used generically throughout the document in their non-technical connotations, and no exacting technical definition (as implied in the comment) was intended.
ES-087	13	ExSum	ES-1 and ES-2		The change in world carbon emissions attributable to North America noted between 2002 and 2003 (32% to 27%) seems large. Are these figures correct and based on the same underlying data sources?		X					
ES-088	13	ExSum	ES-5 and ES-6		The statement, "This implies that emissions growth is essentially decoupled from economic growth," is contradicted later by "[c]hiefly as a result of economic growth, energy use by North American transportation is expected to increase by 46% from 2003 to 2025."		X					
ES-089	13	ExSum	ES-9	21-22	The text notes the use of "hydrogen energy." This is a mischaracterization of the technology. Hydrogen fuel (as correctly discussed in Chapter 7. Transportation) is not a source of energy but is an energy carrying medium generated from fossil, renewable or nuclear fuels. I suggest changing the phrases, "hydrogen energy" to "hydrogen fuel cells" or "hydrogen."		X					
ES-090	24	ExSum	General		To ensure a balanced view of the US carbon cycle, the Executive summary needs to state historical number of integrated emissions as well as annual fluxes.				X			Not clear why this is needed.

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ES-091	24	ExSum	ES-3	20-22	This text seems ambiguous. It is certain that the surface ocean becomes more acidic under elevated CO ₂ , and this effect is not influenced by climate change.			X				We don't see the ambiguity.
ES-092	24	ExSum	ES-3	25-31	it would be useful to highlight that both short-term and long-term solutions are helpful. The short-term solutions help to gain time and the long-term solutions to find real solutions.		X					
ES-093	9	ExSum	ES-2		Page ES-2 states: " <u>The questions were identified through early and continuing dialogue with these stakeholder groups</u> including scientists, decision makers in the public sector (Federal, State, and local governments), the private sector (carbon-related industry, <u>including energy, transportation, agriculture, and forestry sectors</u> and <u>climate policy and carbon management interest groups</u>), the international community, and the general public." (Emphasis added.) Although EEI is part of the "energy" sector, we do not recall being given an opportunity to participate in this "early and continuing dialogue."	X						Representatives of the energy sector have been involved in our workshops, and we have invited representatives of EEI to the third workshop in October 2006. Apologies to the EEI if they were inadvertently overlooked in earlier invitations.
ES-094	9	ExSum	ES-2		The draft, in referring to the SOCCR, states that it is "organized as a response" to questions "about the North American carbon budget relevant to carbon management policy options and <u>abroad range of stakeholder groups interested</u> in knowledge of carbon cycling in North America and <u>of how such knowledge might be used to influence or make decisions</u> " (emphasis added). However, as far as we can determine, Parts II and III are not responsive to the above questions.					X		We don't understand this statement. It is not clear what the reviewer would prefer to see.
ES-095	9	ExSum	General		The Executive Summary makes a number of significant statements without attribution or reference to any sources for them. Some of these statements are detailed in the following items.			X				The details are in individual chapters.
ES-096	9	ExSum	ES-1	18	"The Earth's carbon budget is in <u>imbalance</u> ."	X						
ES-097	9	ExSum	ES-1	25-26	"The result is a 'piling up' of CO ₂ in the atmosphere, and <u>adramatic</u> increase in atmospheric CO ₂ concentration."	X						
ES-098	9	ExSum	ES-1	26-28	The atmospheric concentration of carbon dioxide has increased by 31% since 1950, and the <u>present concentration is now higher than at any time in the past 420,000 years and perhaps the past 20 million years</u> ." It seems likely that "1750," or the beginning of the Industrial Revolution, is the appropriate date.	X						
ES-099	9	ExSum	ES-1	30	"North America is a <u>major contributor</u> to this <u>imbalance</u> ."	X						
ES-100	9	ExSum	ES-4	24-27	"The <i>global</i> terrestrial sink is quite uncertain. . Thus, North America is probably responsible for at least half of the global terrestrial sink, but could account for as little as a quarter to nearly all of it."	X						

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ES-101	9	ExSum	General		The lack of references is not unique to the Executive Summary. For example, while each of the chapters in Part I of the draft includes a list of References at the end of the chapters, there are a number of statements made in the chapters that also lack any source reference. Some examples are detailed in the following items.		X					
ES-102	9	ExSum	1-1	2-6	That cycling determines the balance of the carbon budget observed at any particular time. <u>Examining the carbon budget not only reveals whether the budget is in balance or imbalance, but also provides insight into causes of any imbalance and steps that might be taken to manage that imbalance. Currently, the global carbon budget is in imbalance; and human use of coal, petroleum, and natural gas to fuel economies is responsible</u>			X				See the revisions made to Chapter 1.
ES-103	9	ExSum	1-3	29-33	<u>It is also increasingly evident that atmospheric carbon dioxide concentrations are responsible for increased acidification of the surface ocean, with potentially dire future consequences for corals and other marine organisms that build their skeletons and shells from calcium carbonate. Ocean acidification is a powerful reason, in addition to climate change, to care about the carbon cycle and the accumulation of carbon dioxide in the atmosphere</u>			X				See the revisions made to Chapter 1.
ES-104	9	ExSum	4-6	22-24	As is clear from the previous sections, <u>there are thousands of options to reduce emission of or to sequester CO₂</u> . To help decide which options to implement, policy makers need to know which are the most cost-effective – have the lowest cost per metric ton of CO ₂ reduced or sequestered.			X				See the responses to comments in Chapter 4.
ES-105	9	ExSum	General		As we understand the SAPs, it is not their purpose to "influence" policy-makers or to "make decisions." Indeed, they are to be policy neutral. Yet, as noted above, the Executive Summary sets forth a series of questions, which generally appear innocuous when listed in the final Prospectus and the Preface to SAP 2.2 for the SAP to respond to "about the North American carbon budget relevant to . . . a broad range of stakeholder groups." However, the Executive Summary adds that these "groups" are "interested in knowledge of carbon cycling in North America and of how such <u>knowledge might be used to influence or make decisions</u> " (emphasis added). That appears to suggest that the SAP may not be policy neutral.					X		We respectfully disagree that the tone or presentation of the report is not policy neutral. The stakeholder groups will be making various decisions of their own with respect to the carbon cycle and it is these decisions to which the wording highlighted by the reviewer refers.
ES-106	9	ExSum	General		The discussions in Chapter 4 about information, voluntary programs, regulations, emissions trading and taxes are cursory and inadequate. More importantly, the relevance of this discussion in what purports to be a scientific and policy-neutral paper is lacking. We strongly suggest that Part I be rewritten, that the questions be reconsidered, and that much of Chapter 4 be discarded. There is also a discussion of policy options in Chapter 6 on pp. 6-7.					X		We respectfully disagree that the Executive Summary is alarmist in tone. The reviewers response may in part be a reaction to language chosen to more effectively communicate with the intended non-scientific audience.
SH-001	MS	ExSum	ES-3	6-9	The text on these lines seems forced into place. They don't add anything, and disrupt the flow.		X					

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Comment Number	Reviewer ID	Chapter	Page	Line	Comment Text	Acknowledged, but no further response or revisions are required	Revisions have been incorporated as suggested in the comment	Agree, but see "Notes on Response"	Agree, but elaboration is precluded by length limitations	Disagree; see "Notes on Response"	Beyond scope of report/chapter	Notes on Response
SH-002	MS	ExSum	ES-4	3-18	These lines describe the impact of US emissions in a global context. Knowing the percentages of global emissions is nice, but how does they rank against other nations?		X					
SH-010	GTW	ExSum	General		The major omission is the failure to use actual atmospheric CO2 data which are now measured with high precision at approximately 100 sites worldwide to estimate the magnitude of the terrestrial CO2 sinks, especially in North America. I suggest that the actual data be presented in a summary form by location and a discussion of spatial distributions, seasonal variations and trends be discussed. The data should then be used to estimate the sinks using the tracer-transport inversion method. The present draft dismisses this method because in the past it produced estimates with large uncertainties. This is not a valid reason for not including this method. As you know, this method has been used in the past and interesting results appear in the scientific literature. Past results were highly uncertain because the estimates were insufficiently constrained because of sparse atmospheric CO2 data. Now with about 100 stations worldwide, the estimates can be further constrained and						X	An issue for Chapter 3. Authors of that chapter feel that inventory methods provide more certain <u>regional</u> estimates than the inversions, despite the reduced uncertainties of global and hemispheric results for these inversions.
SH-010 (cont)					hence the uncertainties will be reduced. Such a procedure should provide some convergence on the two methods. However, even if the convergence is not satisfactory, it will provide insights as to where additional monitoring sites are needed. In addition, it should serve as a reality check on the inventory estimates.							
SH-011	GTW	ExSum	General		Parts of the Executive Summary are alarmist in tone. This is unnecessary, inappropriate and hurts the credibility of the report. I suggest someone edit it by deleting adjectives that are unnecessary. The following items are some suggested changes.					X		We respectfully disagree that the Executive Summary is alarmist in tone. The reviewers response may in part be a reaction to language chosen to more effectively communicate with the intended non-scientific audience.
SH-012	GTW	ExSum	ES-1	19	Delete human					X		We respectfully disagree that the Executive Summary is alarmist in tone. The reviewers response may in part be a reaction to language chosen to more effectively communicate with the intended non-scientific audience.
SH-013	GTW	ExSum	ES-1	23	Delete far					X		We respectfully disagree that the Executive Summary is alarmist in tone. The reviewers response may in part be a reaction to language chosen to more effectively communicate with the intended non-scientific audience.
SH-014	GTW	ExSum	ES-1	25	Change "piling up" to accumulating					X		We respectfully disagree that the Executive Summary is alarmist in tone. The reviewers response may in part be a reaction to language chosen to more effectively communicate with the intended non-scientific audience.
SH-015	GTW	ExSum	ES-1	29	Insert "potential" before consequences.					X		We respectfully disagree that the Executive Summary is alarmist in tone. The reviewers response may in part be a reaction to language chosen to more effectively communicate with the intended non-scientific audience.
SH-016	GTW	ExSum	ES-2	1-2	I would delete the sentence containing incontrovertibly and replace it with a sentence about Asia surpassing North America in the near future.			X				We retain the existing language but have added text about Asian fluses surpassing those of North America
SH-017	GTW	ExSum	ES-2	27-30	I would delete the analogy to the water cycle.		X					

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SH-018	GTW	ExSum	ES-3	4	Delete human					X		We respectfully disagree that the Executive Summary is alarmist in tone. The reviewers response may in part be a reaction to language chosen to more effectively communicate with the intended non-scientific audience.
SH-019	GTW	ExSum	ES-3	6-9	Again I would delete this analogy to the water cycle		X					
SH-020	GTW	ExSum	ES-3	11	Italics unnecessary		X					
SH-021	GTW	ExSum	ES-3	21	The acidification of the oceans is mentioned here and elsewhere without mentioning how small it is and any impacts are likely to be small in the near future					X		Authors and other reviewers disagree,
SH-022	GTW	ExSum	ES-4		Here the discussion is about Mt CO2, but in later pages (ES-7) it switches to Mt C. I suggest you pick one and use it consistently in the Executive Summary		X					
SH-023	GTW	ExSum	ES-8	16-22	Again ocean acidification is raised in a qualitative fashion.					X		We respectfully disagree that the Executive Summary is alarmist in tone. The reviewers response may in part be a reaction to language chosen to more effectively communicate with the intended non-scientific audience.
SH-024	GTW	ExSum	ES-10	13	In terms of industry level programs - the EPA Climate Leaders Program should be cited, not Pew Center, for demonstrating leadership in managing, measuring and reducing GHG emissions.		X					

Comments and Responses on SOCCR/SAP 2.2 Draft 1 (May 2006)
CHAPTER 1

COMMENT FROM PEER REVIEWERS						AUTHOR'S RESPONSE						
Comment Number	Reviewer ID	Chapter	Page	Line	Comment Text	Acknowledged, but no further response or revisions are required	Revisions have been incorporated as suggested in the comment	Agree, but see "Notes on Response"	Agree, but elaboration is precluded by length limitations	Disagree; see "Notes on Response"	Beyond scope of report/chapter	Notes on Response
01-001	3	1	General		The title of Chapter 1, on which I was asked to focus my review, indicates that it is to provide information on the "purpose, scope, and structure" of the SOCCR. I do not think that it achieves this objective in its current state. I found little information on the scope of the report as a whole and nothing at all on its structure.		X					title edited to better reflect content of chapter; material on purpose, scope, structure to appear in Preface
01-002	3	1	1-1	18-19	Since all life on earth is carbon-based, why not say "pools of carbon on and near the earth's surface (mainly in plants and soils), in the atmosphere, and in water and sediments in the ocean"? That way you also include by inference freshwater systems and geological sediments mentioned in the next paragraph and included in Fig. 1-1.		X					
01-003	3	1	1-1	21	Should say "food, shelter, and energy." Biomass energy is already critical to the survival of much of humankind.		X					
01-004	3	1	1-9	Fig 1-1	The figure is too complex for a general audience without additional explanation. Incorporate into a text box to accomplish this? In addition, the sizes of the reservoirs/pools and exchanges do not match those in Fig. 2-1. Which year(s) does this set of values apply to?		X					figure was replaced by a simpler graphic and more explanatory text added.
01-005	3	1	1-1	30	Add "—and back again" at the end of the sentence to match what is shown in the figure and reinforce the idea that these exchanges are typically a "two-way street"?		X					
01-006	3	1	1-2	1	I think "that transfer" should be "those transfers."		X					
01-007	3	1	1-2	3, 4, & 5	The word "imbalance" is used four times in lines 4 and 5. How about replacing the words following "whether the budget" in line 3 with "is balanced, and if it is unbalanced can provide insights about why such a condition exists and how it might be managed." The words "in imbalance" in line 5 could simply be replaced by "unbalanced."		X					
01-008	3	1	1-2	6	Since tropical deforestation is a source of carbon to the atmosphere, would it not be more accurate to say that use of fossil fuels is "primarily" responsible?		X					
01-009	3	1	1-2	17	Would it be advisable to add the words "and continue to do so in tropical regions" at the end of the sentence?		X					
01-010	3	1	1-3	5-9	This sentence begs the question: Why? A brief explanation should be added.		X					
01-011	3	1	1-3	18	Don't we care about the unbalanced state of the entire carbon cycle, of which the atmospheric component is only one aspect?		X					
01-012	3	1	1-3	21-22	My favorite word again.		X					text revised to balance use of the word imbalance
01-013	3	1	1-3	30-31	"Acidity" is simpler than "acidification" and seems to work just as well in this context; see earlier comment on Executive Summary.		X					
01-014	3	1	1-4	12-17	The estimates of the North American sink and its potential significance relative to the global sink do not match those given in the second paragraph on page ES-4 and the estimates of the global terrestrial sink in this paragraph don't match the estimate in Fig. 1-1.		X					text revised to better match discussion in Executive Summary and Figure revised (see comment 01-004).
01-015	3	1	1-4	17	Insert the word "located" before the word "primarily"?		X					
01-016	3	1	1-4	27-30	Which processes and mechanisms are considered most significant? Give examples?		X					

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CHAPTER 1**

COMMENT FROM PEER REVIEWERS						AUTHOR'S RESPONSE						
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01-017	3	1	1-4 and 1-5	33 and 1-2	This sentence provides one important answer to one of questions I identified in my general comments. I think much more effort is needed to address such questions in this chapter and in the report as a whole.			X				The executive summary will be revised to better address the types of questions raised by the reviewer in the general comments. Those questions are better addressed in the executive summary as part of the assessment than in this introductory chapter.
01-018	3	1	1-5	3-6	One important question that was not comprehensively addressed in this section of the report was how well we think we need to understand the North American carbon budget to achieve our goals for carbon cycle modeling or carbon management. The issue of the spatial resolution needed to address key questions was not touched upon at all, for example, but is a critical one for some uses. Is this issue addressed somewhere else in this report?		X					Text has been added to at least address the issue raised by the review. Specific discussion of spatial resolution issues are addressed in individual chapters of Parts II and III
01-019	3	1	1-5	8	The length of this section is disproportionately long in relations to other sections of Chapter 1, and in view of the absence of substantive material on the scope and structure of the report, as promised by the title of the chapter. I think the section could be reduced significantly without loss of meaning.		X					text has been substantially shortened.
01-020	3	1	1-5	25	For reasons given in my comments on text from page ES-11, lines 5, 12, and 19, I think the term "saliency" is another example of unnecessarily complex wording, and its usage by Cash et al. is in marked contrast to its dictionary definition. "Relevancy" makes more sense to me.		X					
01-021	3	1	1-5	26-28	Credibility thus depends on effective, honest communication of uncertainties in data, parameters, and conclusions, e.g., in estimates of sources and sinks.			X				No revisions made in text here, but honest effort in communicating uncertainties throughout report is being made
01-022	3	1	1-6	1	Same comment as # 01-020		X					
01-023	3	1	1-6	17-23	The objectives given in this paragraph will not be accomplished unless much greater effort is made in this report to communicate more effectively with a more general audience.		X					that effort is being made in revisions of all chapters
01-024	3	1	1-6	30-34	I expected that either Chapter 1 or the Executive Summary would have provided a roadmap to the report that would have pointed me to the Chapters and sections where the first and third of the three critical areas identified in this one-sentence paragraph were addressed, including information on the status of answers to the key questions they imply. Where are we on the road to providing substantive information to the address the areas identified in this paragraph? For example, how "mature" is our information with respect to understanding individual parts of the North American carbon cycle? How long do we think it will take to fill in critical data gaps? Is technology development a limiting factor? If so, for what components? How will we know when we have achieved the implied goals? Etc.			X				The road map cited by the review is part of the Preface to the report. Revision of the Executive Summary will address some of the questions raised by the review comment. The review comment raises some very good but demanding questions. They are questions significantly different than the questions arrived at through dialogue (e.g., workshops) with stakeholders in the process of formulating the report. The report and its Executive Summary are structured around and respond to those questions. We believe answers to many of the questions raised by the reviewer are actually addressed throughout the various chapters (e.g., in the sections on research needs for decision support). Expanding or restructuring the report and Executive Summary to explicitly and directly answer the excellent questions raised by the reviewer are beyond the scope of this revision of the report.
01-025	34	1	General		In general, the first part of the title (What is the carbon cycle) is adequately covered and can be understood by the general reader.	X						

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CHAPTER 1

COMMENT FROM PEER REVIEWERS						AUTHOR'S RESPONSE						
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01-026	34	1	General		The second part of the title (why do we care?) is nearly non-existent. Taking into account that the entire rest of the report is still to follow, one might have expected an overview of the impacts and policy dimensions related carbon imbalances, the opportunity costs of delayed interventions, the role of the public and private sectors, etc.					X		The chapter does address the central issue of why we care about the carbon cycle and the North American carbon budget (e.g., role of global carbon cycle in climate change and the role of North America in that carbon cycle). Other issues raised by the comment are more facets of the response having decided we care (see Chapter 4).
01-027	34	1	General		The section, Carbon cycle science in support of carbon management decisions, is relevant but unrelated to the chapter title. Here one would expect to find significant coverage of international initiatives related to the carbon cycle, taking into account the priorities, progress and work of the Igbp (to which Usa scientists have made significant contributions) and the Global observing systems - Gcos (Climate), Gcos (Oceans), and Gtos (Terrestrial). It would seem appropriate for this section to place the "North American" initiative into the global context in which carbon science and policymaking is occurring.			X			X	The section has been edited (reduced) substantially to make it more relevant and "to the point" of this chapter. Comments regarding context of international activity beyond the scope of this chapter but relevant to the extended preface which will address purpose, scope and structure (see response to comment 01-001)
01-028	9	1	General		There are a number of statements made in the chapters that also lack any source reference. Some examples are detailed in the following items.		X					
01-029	9	1	1-1	2-6	That cycling determines the balance of the carbon budget observed at any particular time. <u>Examining the carbon budget not only reveals whether the budget is in balance or imbalance, but also provides insight into causes of any imbalance and steps that might be taken to manage that imbalance. Currently, the global carbon budget is in imbalance; and human use of coal, petroleum, and natural gas to fuel economies is responsible.</u>		X					
01-030	9	1	1-3	29-33	<u>It is also increasingly evident that atmospheric carbon dioxide concentrations are responsible for increased acidification of the surface ocean, with potentially dire future consequences for corals and other marine organisms that build their skeletons and shells from calcium carbonate. Ocean acidification is a powerful reason, in addition to climate change, to care about the carbon cycle and the accumulation of carbon dioxide in the atmosphere</u>		X					
01-031	26	1	General		This is a much needed chapter as the assessment will be speaking to very diverse group of stakeholders.	X						
01-032	26	1	1-1	13 et seq	In justifying the reasons why we should care about the carbon cycle I miss a clear statement on what I think are the most important reasons (they are embedded in various sentences but not clearly spelled out). These reasons are detailed in the following two items.		X					
01-033	26	1	1-1	13 et seq	The terrestrial sink (in NA or globally) is a service provided by terrestrial ecosystems worth billions of dollars if we had to pay for the equivalent amount through carbon sequestration or emission reductions. Consequently, we need to understand its dynamics and processes.		X					

**Comments and Responses on SOCCR/SAP 2.2 Draft 1 (May 2006)
CHAPTER 1**

COMMENT FROM PEER REVIEWERS						AUTHOR'S RESPONSE						
Comment Number	Reviewer ID	Chapter	Page	Line	Comment Text	Acknowledged, but no further response or revisions are required	Revisions have been incorporated as suggested in the comment	Agree, but see "Notes on Response"	Agree, but elaboration is precluded by length limitations	Disagree; see "Notes on Response"	Beyond scope of report/chapter	Notes on Response
01-034	26	1	1-1	13 et seq	Vulnerabilities of the carbon cycle into the future (eg, carbon-climate feedbacks) may change the strength of terrestrial sinks and put further pressure on carbon mitigation and emission reductions to achieve agreed stabilization targets. Thus, we want to make sure we understand future trajectories of terrestrial sinks/sources and have them appropriately considered when designing CO2 stabilization pathways.		X					
01-035	26	1	1-5	8 et seq	I think the intent of this section is important but as it stands now, it largely reports on the "theory" of having an assessment like this one to be owned and recognized by key stakeholders. Instead, I would propose to tell the reader the different steps the managing team of this assessment have taken to ensure credibility, buy, etc. (eg, stakeholder consultation to ask what they need from the assessment).			X				

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CHAPTER 2**

COMMENT FROM PEER REVIEWERS						AUTHOR'S RESPONSE						
Comment Number	Reviewer ID	Chapter	Page	Line	Comment Text	Acknowledged, but no further response or revisions are required	Revisions have been incorporated as suggested in the comment	Agree, but see "Notes on Response"	Agree, but elaboration is precluded by length limitations	Disagree; see "Notes on Response"	Beyond scope of report/chapter	Notes on Response
02-001	3	2	2-2	12, 15-16	48% of the total amount of carbon released to the atmosphere from fossil fuel burning (300 ± 30 Gt, from the first paragraph on page 2-4) and forest clearing (160 ± 160 Gt, also from the first paragraph on page 2-4), or 220 Gt C by my calculation, is said to still reside in the atmosphere, in agreement with the missing carbon estimate of 240 Gt given on line 15. However, these values do not agree the missing carbon estimate of 218 Gt obtained from data given in the first paragraph on page 2-7 (sum of 118 Gt taken up by the oceans plus 100 Gt stored on the land) or with either of the other estimates of the remainder of the human contribution to the atmosphere: 180 ± 5 Gt C given on line 34 of page 2-6 and 161 Gt C (given as Pg C) in Fig. 2-1. NOTE: Oceanic share of missing carbon appears to be 110 Gt C per Fig. 2-1 (as opposed to 118 Gt C given in text on page 2-2) but the terrestrial component is not decipherable without a more descriptive figure legend.		X					All number updated to present a consistent picture.
02-002	3	2	2-2	12, 15-16	In addition, if the uncertainty in the inputs to the atmosphere from fossil-fuel use and forest clearing amount to 460 ± 160 -190 Gt C, the uncertainty in the amount of the release remaining in the atmosphere cannot be 5% of the estimated release as stated in line 12 on this page.		X					Good point, bounds increased to reflect uncertainty of land use flux
02-003	3	2	2-3	13	Because respiration and fires are combined in the flux back to the atmosphere in Fig. 2-1, I think this sentence could be revised as follows: replace text after "reproduction," in line 12 with "in combination with wildfires return a slightly smaller amount to the atmosphere, with the difference stored as plant biomass and soil organic carbon."			X				The existing text more accurately partitions the processes into biologically meaningful components.
02-004	3	2	2-4	3	Per Fig. 1 in the overview to Part II of the report and the text in Chapter 1, the industrial revolution <i>began</i> in the 18th century and <i>expanded</i> in the 19th century, accelerating the releases from fossil fuels.		X					Dropped the date from the sentence.
02-005	3	2	2-4	6-7	How can references published in 1984 and 1999 give estimates of atmospheric releases through the year 2004?		X					references corrected to show web updates.
02-006	3	2	2-4	11	How can we say we know the concentration of atmospheric CQ in 1850 to three significant figures? What is the reference for this value and what is its estimated uncertainty?		X					reference added
02-007	3	2	2-4	13	I think you need to either drop the third significant figure in the estimate given or add a second significant figure to the error term.	X						This is largely philosophical. We are presenting the mean and the uncertainty.
02-008	3	2	2-4	20	I recommend deleting the parenthetical expression because the term described is never used elsewhere in text, tables, or figures.		X					
02-009	3	2	2-4	12-34 et seq	Since this same material is covered in more depth in Chapter 3 and the figure is repeated as Fig. 3-2, why not delete Fig. 2-3, keep only the most important parts of the text, and reference Chapter 3 for the details?	X						whole sentence deleted
02-010	3	2	2-6	2	How can ^{14}C be considered a passive tracer?		X					meaning of a passive tracer clarified in the text.
02-011	3	2	2-6	33	The error in the estimated release cannot be ± 100 Gt C if the errors on the two components (± 30 Gt C and ± 160 Gt C, respectively) given in the first paragraph on page 2-4 are correct.		X					all numbers and errors adjusted

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CHAPTER 2**

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02-012	3	2	2-6	34 et seq	See comment # 02-001		X					all numbers and errors adjusted
02-013	3	2	2-11	9-22	Although I liked the tone of this paragraph, I found myself asking whether it was needed here since it deals with matters covered in more detail in Chapter 4. Another option might be to move it to the Executive Summary.		X					most of the paragraph dropped
02-014	3	2	2-19	Table 2-1	Why are there no error estimates for the values given in the table?	X						table dropped
02-015	3	2	2-20	Fig 2-1	The figure is too complex for a general audience without an extensive amount of additional explanation and the caption is obviously inadequate even for a technical audience. Incorporate into a text box to deal with this? In addition, the sizes of the reservoirs/pools and exchanges do not match those in Fig. 1-1. Which year(s) does this set of values represent? What is the reference for this figure?		X					legend expanded and reference added
02-016	3	2	2-21	Fig 2-2	The figure caption or a label on the lower panel should indicate that the data in the lower panel represent annual averages.		X					ok
02-017	3	2	2-23	Fig 2-4	The figure caption needs more explanation to be more comprehensible to some members of a general audience. I think it should say explicitly that negative values indicate regions that are CO2 sinks (as in Table 3-1 and Figure 15-3). In addition, the figure legends do not indicate the units of measure (Gt C per year?).		X					ok
02-018	3	2	2-24	Fig 2-5	The patterns shown in panel (a) of the figure suggest that North America, rather than representing a net sink for CO ₂ , was neutral on average with respect to exchanges with the atmosphere during the full period from 1988 to about 2003. The data in the figure are compatible with the idea expressed on page 2-7 in the text that North America represented a net sink during the 1990s, but the pattern after 1995 indicates that North America was, on balance, a very strong source of CO ₂ . In order to avoid confusion by the reader—and potential criticism from some corners about the interpretation of these data—would it not be advisable to discuss the implications of the patterns represented by the data <i>in toto</i> . (perhaps in a text box accompanying the figure), rather than focusing solely on the 1990s (as in the text on page 2-7)? Another option might be to provide a brief summary of the causes and implications of the variations in this chapter with a reference to more detailed discussion in another chapter in the report.		X					ok
02-019	3	2	2-24	Fig 2-5	The figure caption probably should indicate that data for ocean basins are represented by "heavy" dashed lines and it should say explicitly that negative values indicate when the oceans/continents are CO ₂ sinks (as in Table 3-1 and Figure 15-3).		X					ok
02-020	4	2	2-3	28	"Future increases in carbon uptake in this portion of the carbon cycle could"	X						what does this comment mean

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02-021	4	2	2-3	10	Why specify such a large range (100-200) for the land exchange? This is particularly noticeable in relation to the rather specific amount noted for the oceans (92 +/- 5). Though less certain, isn't there a more specific, citeable amount for annual gross exchange?		X					the incorrect values were inserted after the paper was submitted.
02-022	4	2	2-3	20	The transfer to the oceans is by rivers? Perhaps write, "....to the oceans by rivers and released from"		X					ok
02-023	4	2	2-4	22-23	Perhaps the use of "rich" could be misunderstood? It may be better to use "industrialized" countries? That may be the point here – that among the industrial countries there are varying amounts of efficiency in generating wealth.			X				sentence dropped
02-024	4	2	2-5	1	Perhaps the use of "rich" could be misunderstood? It may be better to use "industrialized" countries? That may be the point here – that among the industrial countries there are varying amounts of efficiency in generating wealth.					X		modern literature tends to prefer rich to industrialized, especially since the rich countries are mostly de-industrializing.
02-025	4	2	2-5	22	Perhaps, "....spatial scaling presents formidable challenges due to heterogeneity of the landscape" this provides a bit more explanation to the reader as to the limitation of the eddy flux method in this context.		X					ok
02-026	4	2	2-6	14	The inverse method relies on both the space and time patterns of CO2 concentrations rather than just space (though for the calculation of the long-term means, it is primarily using space patterns). Perhaps use "spatiotemporal pattern" in this sentence?		X					ok
02-027	4	2	2-6	15-16	It may be important to mention that the flask observing network has stations that go back to roughly 1980 (calibrated) and that many of the 100 mentioned were added in the last decade. This has meant that the calculation of long-term means and inverse estimated flux time series use far less than the 100 currently available stations.		X					ok
02-028	4	2	2-6	21-22	The sources of uncertainty for the inverse method could be listed a bit better perhaps. "Limitations in the accuracy of atmospheric inversions come from the limited density of concentration measurements, especially in the tropics, the uncertainty of observations, transport uncertainty, mismatches between the resolution of observations versus simulations, and varying a priori assumptions in the inverse process."			X				this list is more detailed than the one in the text, but the one in the text is more understandable
02-029	4	2	2-7	2	This leaves 100 Gt? My subtraction suggests 160 Gt C.		X					all numbers reconciled
02-030	9	2	2-1	13-15	Page ES-4, lines 24-27, state "The global terrestrial sink is quite uncertain. . Thus, North America is probably responsible for at least half of the global terrestrial sink, but could account for as little as a quarter to nearly all of it." In chapter 2, "Key Findings" (p. 2-1, lines 13-15), there is a nearly identical statement that begins with the word "[g]lobal" – which should also begin the above statement – and ends with the date of "1850." It seems likely that "1750," or the beginning of the Industrial Revolution, is the appropriate date in both places.		X					used dates only when they relate to specific studies

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02-031	9	2	2-4		The report appears to compare "per capita emissions" of North America with those of China and India. Per capita emissions comparisons tend to be misleading given the differences in population between North America and China and India. The EIA's June 2006 report, "International Energy Outlook: 2006," (pp. 72-73) views emissions in terms of economic growth (see the reviewer's lengthy detailed comments in the file containing comments on Chapter 6).					X		it seems reasonable to report both total and per capita numbers
02-032	9	2	2-7		Carbon intensity – this Administration's metric – and economic growth (highlighted in the EIA passage above) are more realistic and meaningful measures for purposes of comparison. In addition, CO2 emissions in China and India have already been forecast to surpass those in the U.S. by 2009. See EIA's "International Energy Annual 2002" and "International Energy Outlook: 2005."					X		all discussion of energy intensity shifted to chapter 3

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COMMENT FROM PEER REVIEWERS						AUTHOR'S RESPONSE						
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03-001	3	3	3-1	25-27	In general there was a lack of consistency in numbers of significant figures between the absolute numbers (3-4 significant digits) and the percentages (generally 1-2 significant digit). This is potentially misleading in terms of uncertainties and some more thought on presentation is required here.			X				Because this report is also for policy makers and other non-scientists it is important not to introduce a convention that is used only in the sciences. We have retained 1MTC and 1% as the smallest units whenever possible. But we have also faithfully retained whatever convention was used in the original published literature as Tony and Greg recommended. Scientists are capable of the mental math necessary to convert the uncertainties that we report into significant digits. On the other hand, there were a few places where statistics like carbon intensity or per capita emissions were reported in the previous draft. We have now taken care to report these to the appropriate number of significant digits.
03-002	3	3	3-1	30-37	The bullets on these lines of text largely repeat material given in the KEY FINDINGS in Chapter 2. Thus, the authors of the two chapters should coordinate their presentations to avoid unnecessary duplication.		X					We have coordinated a partitioning of the material with Chris Field and have removed all text from Chapter 3 that evaluates North America in the global context. We have also removed one figure for the same reason. Chapter 3 is about North America. Chapter 2 is about the globe.
03-003	3	3	3-2	1-3	Same comment as #03-002		X					Same reply.
03-004	3	3	3-3	19-30	I liked the way the data and uncertainties were presented in Table 3-1. However, I think the table is too complex for a general audience without an extensive amount of additional explanation. Incorporate into a text box to deal with this or expand the discussion in the first paragraph of the subsection? Which year(s) does this set of values represent?			X				The Table has been split in two so that Table 3-1 deals only with sources and sinks. The new Table 3-2 gives the horizontal transfers. Both Tables give citations that contain the time intervals covered by the estimates. Most were from publications of the last five years although some are older, and most correspond to the period of the 90's. This is now spelled out on page 3-5.
03-005	3	3	3-17	Table 3-1	Same comment as #03-004			X				Same reply.
03-006	3	3	3-3	19-22 and 24-28	See comment # 03-001. Also note that Chapter 15 indicates that the estimate of river export to the oceans (given as ~35 Gt C in Table 3-1) is essentially unknown.			X				Same reply as to 03-001 but see also in Table 3-2 that the uncertainty is listed at 100%
03-007	3	3	3-3	27	The word "are" should be replaced by "may be;" the uncertainties are huge, per Chapter 15.		X					Made the change
03-008	3	3	3-3	32	The land sink is given as 1.1 Gt C per year (or 1100 Mt C per year) on page 2-7 vs the figure of 1500 Mt C per year given here. What is the reason for the difference and which value is preferred?		X					This material has been removed as it is covered in Chapter 2.
03-009	3	3	3-4	3	Table 3-1 is referenced as the source of information given on lines 1-3 but it contains no data on land area or global carbon sinks.		X					Thanks, removed reference to the table.
03-010	3	3	3-4	19-25	Excellent! This is the sort of information I was asking for in previous comments, such as: What types of activities are most critical to achieving the goals of carbon cycle research? However, it would also be useful to estimate long we think it will take to obtain such estimates and to identify critical obstacles (e.g., technology development needed to provide meaningful data)?				X			The answer depends on what is being inventoried and so would require a short paragraph. We lack the space.
03-011	3	3	3-4	24	If I have read Table 3-1 correctly there are five, rather than four, missing pieces to the puzzle represented by Canada's carbon budget.		X					Thanks. Change made.

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03-012	3	3	3-5	25-30	The second sentence in the caption for Fig. 3-2 reads as follows: Note that carbon emissions per unit GDP decelerate as a country gains wealth. I could not discern such a pattern because most countries of the world are not identified in the figure and the patterns for countries in the region identified as Western Europe are different from those for the U.S, Japan, and Canada (the patterns for which are similar to that for China).		X					This figure and all associated text have been deleted. The subject belongs in Chapter 2.
03-013	3	3	3-6	9-10	Because of the general readership intended for the report, I suggest saying explicitly why C emissions from coal, oil, and natural gas are different, e.g., because of increased H:C ratio as you move from coal to gas.					X		The general reader does not need to know this to understand what is being said in the paragraph. The added material would break the flow of the idea that is being developed.
03-014	3	3	3-6	31-34 et seq	The organization of the figure caption is confusing and the sets of information shown in the three panels of the figure are different enough to deserve being separated into three separate figures.		X					We have separated them into three figures.
03-015	3	3	3-7	12-22	I think that most of this material should have been used on page 3-3 to introduce the subsection on Carbon Sinks. It seems out of place here, well after the critical discussion of Table 3-1 to which it is related.		X					The paper has been completely reorganized. There is now one fossil fuel section and one carbon sinks section (rather than two of each).
03-016	3	3	3-8	10-11	The material highlighted in bold belongs in the introduction to the subsection on Carbon Sinks on page 3-3, where Table 3-1 is called out.		X					See reply to 03-015.
03-017	3	3	3-8	19-21 and 30-33	What are the errors in the cited estimates? Are the number of significant figures given justified, given the errors? The value of 23 Mt C yr ⁻¹ for urban and suburban trees given in line 19 and referenced to Chapter 14 contrasts with the range of 13.7-25.9 Mt C yr ⁻¹ given in Chapter 14. How was the point estimate derived from this range?		X					We added uncertainties to these numbers in the text because they are known and because the table only supplies the uncertainty of the aggregated estimates for forests. We also point out that 19 is the mid-point in the range from Chapter 14.
03-018	3	3	3-8	27-28	One published study of one site, however well performed, probably doesn't constitute confirmation. How about inserting the words "are producing data that seem to" just before the word "confirm" in line 27.		X					Changed as requested.
03-019	3	3	3-9	1	The text refers to "The two studies of Mexican forests." Do I correctly interpret this to mean that these are the <i>only two</i> studies of Mexican forests that deal with the subject at hand?			X				Yes, the only two published carbon inventories for Mexican forests that we know of. This is now highlighted in the text.
03-020	3	3	3-9	27-29	Excellent! Any thoughts to on how to tackle this challenge successfully?			X				Show me the money.
03-021	3	3	3-10	3	The current wording is awkward. How about deleting "1.5 to-6 Mt C yr ⁻¹ⁿ " and inserting the words "either a small source of 1.5 Mt C yr ⁻¹ or a sink of 6 Mt C yr ⁻¹ⁿ after the word "and"?"		X					Done.
03-022	3	3	3-10	7-8	Wording seems awkward. How about deleting replacing the last part of the sentence on line 8 and inserting with "because plant productivity has exceeded decomposition" before the word "thousands" on page 7?		X					Done.
03-023	3	3	3-10	16-18	Good, but, given the technical challenges associated with doing this, should recommendations on how to do this also be given?				X			No space to discuss this in a summary chapter.

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03-024	3	3	3-10	19-27	The potential importance of CH ₄ with respect to its properties as a GHG begs the question why distinctions haven't been made about differences in fluxes of the various types of carbon compounds. Are there other situations where fluxes of CH ₄ or CO need to be considered specifically. Perhaps a brief discussion somewhere in the report (at the beginning of Chapter 3?) could suffice to answer this question, e.g., to estimate in rough terms what uncertainties are introduced into source/sink estimates by considering carbon fluxes without regard to the chemical species present. I suspect that these would be quite small in all but a few (but potentially very important cases, e.g., marine sediments, permafrost soils, and wetlands). Finally, shouldn't the reference in line 25 be to Chapter 13 rather than Chapter 9?				X			We all agreed to focus on CO ₂ and short-change methane in this first SOCCR report and we knew we would be criticized for it. There is no space to do justice to methane, but there will be in the next report because we will be able to shorten the discussion of CO ₂ by referencing the first report. We are just going to have to take our lumps about methane. We did fix the Chapter reference however.
03-025	3	3	3-10	30	Probably need to define alluvium and colluvium for a more general audience.		X					Done.
03-026	3	3	3-11	1, 5, 8, and 29-33	Once again: What are the errors in the cited estimates? Are the number of significant figures given justified, given the errors?		X					In addition to splitting former Table 3-1 into two, we also added uncertainties to each number in the table rather than, as in the previous version, including only a summary uncertainty for the entire row. The new Tables 3-1, 3-2 and 3-3 now contain all of the uncertainties that are being asked for. See also the response to 03-001 about significant digits.
03-027	3	3	3-11	19-26	Within the coastal waters of North America (see Fig. 15-3) are significant deposits of methane hydrates, which at least some analyses identify as a potentially significant carbon source to the atmosphere under some climate-change scenarios, one which could augment global warming from CO ₂ . Given results from paleoclimate studies that indicate that such a release led to dramatic warming during the Tertiary period, doesn't the uncertainty in the future carbon flux associated with this potential source deserve to be mentioned somewhere in the report, e.g., in Chapters 3, 12, and/or 15?				X			See the response to 03-024.
03-028	3	3	3-17	Table 3-1	How can the totals for the U.S, Canada, Mexico, and North America all have the same estimated uncertainty, given the wide variation in inputs (including more missing data for Canada and Mexico than for the U.S.)? The estimated uncertainty of 10% for emissions from coastal waters of North America is in seeming conflict with the material in Chapter 15, which suggests that the errors are huge and exceed ±100% (see page 15-1).		X					See the response to 03-026. Table3-1 and 3-2 now contain separate uncertainties for each country. Also, the uncertainty for coastal waters in the previous version was an error and we corrected it.
03-029	3	3	3-18	Table 3-2	What are the estimated uncertainties in the tabulated values?		X					The Table (now 3-3) now includes them.
03-030	3	3	3-23	16-19	Figure 3-2 does not provide the information on emissions and change in cropland area discussed in this sentence.		X					We removed the reference to the Figure.
03-031	3	3	3-24	31-33	Again: What are the errors in the cited estimates? Are the number of significant figures given justified, given the errors?		X					The original articles included no uncertainties for land areas. We simply report their published estimates. However, Table 3-1 now includes the uncertainty for the forest carbon flux from the Masera et al. article. See the response to 03-001 about significant digits.

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03-032	5	3	3-2	22	The other chapters don't seem to have such an extended introduction. This should be homogenized. The main points of this introductory summary are also mentioned in the section "key findings".		X					The paper has been completely reorganized. There is now one fossil fuel section and one carbon sinks section (rather than two of each).
03-033	5	3	3-3	15	Zero emission growth doesn't mean zero emissions. Since the target is essentially a decrease in emissions, the reduction to 0% growth shouldn't be overemphasized.		X					Point taken. We changed the sentence so that it uses a 1% annual decline in emissions as a target.
03-034	5	3	3-3	25	"i.e." should be replaced by "e.g."		X					OK, ergo concordantly.
03-035	5	3	3-4	4	The introductory summary shouldn't refer to the appendix. First there should be more detailed information contained in the chapter itself that can refer to the appendix.		X					Obviated by the reorganization mentioned in the response to 03-015 and 03-033.
03-036	5	3	3-5	20	The sentence "Thus, countries with a slope close to the line have higher carbon intensities than countries far from the line." should be moved to line 17, before the sentence starting "Note that the United States is no outlier in this respect."		X					Obviated because the Figure and associated text are no longer in the paper.
03-037	5	3	3-7	10-12	I would recommend first mentioning the focus of this chapter, then referring for historical development to the appendix 3A. Otherwise the reader may be inclined to read first the appendix.		X					Obviated by the reorganization mentioned in the response to 03-015 and 03-033.
03-038	5	3	3-7	12 and 26	Regarding the phrases "we rely exclusively on inventory methods", and "We do not include estimates obtained in this way because they are still highly uncertain at continental scales": I don't think it is a wise decision to not at all include results from inverse modelling of atmospheric observations. The reasons are given in the following four items.					X		It is not fair to say that we have not included the results from inverse modeling studies. We have reviewed them and correctly stated that they provide answers consistent with inventories but with much wider uncertainties. This is a fact.
03-039	5	3	3-7	12 and 26	Atmospheric inversions provide independent evidence, even if current uncertainty estimates seem larger than inventory based approaches.			X				We emphasize this now in an added sentence at the end of the paragraph.
03-040	5	3	3-7	12 and 26	Estimates from inventory methods need upscaling from the plot scale to the region/continent; atmospheric inversions provide a constraint at these scales that are inaccessible to other methods.					X		Again, we emphasize that inverse methods provide an important independent check on inventories as stated in the response to 02-039, but the fact remains that inverse methods are less accurate. The average reader cares about the level of uncertainty, not upscaling (necessary with inventories) or down-scaling (necessary with inversions).
03-041	5	3	3-7	12 and 26	Interannual variability in biosphere-atmosphere exchange cannot be measured with inventories that are repeated every 5 to 10 years; the atmosphere provides information on this variability, which can give insight in biosphere-climate interactions (c.f. Roedenbeck et al., Atmos. Chem. Phys., 3, 1919–1964, 2003).			X				We have added a sentence about this at the end of the paragraph.
03-042	5	3	3-7	12 and 26	Comparing uncertainty estimates of a single inventory based assessment with the overall uncertainty of multiple inversion results (several transport models, coarse and fine temporal and spatial resolution) might be misleading; a comparison of many inventory based assessments with a single inversion result would be required for a more balanced assessment of uncertainties.			X				Agree, but this Chapter, like the Pacala et al. paper, synthesizes the results of many inventories and uses the variation among estimates as well as the uncertainty reported for each estimate to set overall uncertainties. Thus, we actually compare many inventories with many inversions.

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CHAPTER 3**

COMMENT FROM PEER REVIEWERS						AUTHOR'S RESPONSE						
Comment Number	Reviewer ID	Chapter	Page	Line	Comment Text	Acknowledged, but no further response or revisions are required	Revisions have been incorporated as suggested in the comment	Agree, but see "Notes on Response"	Agree, but elaboration is precluded by length limitations	Disagree; see "Notes on Response"	Beyond scope of report/chapter	Notes on Response
03-043	5	3	3-7	12 and 26	Further it should be mentioned that current developments in the CO ₂ measurement network (e.g. tall observing towers, remote sensing of atmospheric CO ₂ columns from space) as well as in inverse modelling (increased spatial and temporal resolution, coupling of atmospheric transport with better a priori information in form of flux models) will provide a significantly higher data density for future assessments.			X				Agree. We have added a sentence about this at the end of the paragraph.
03-044	5	3	3-17	3-8	A relative uncertainty of numbers that can be either positive or negative does not make sense. For example, agricultural soils in Canada and Mexico would have a 95% confidence range from 0 to 0 Mt (i.e. zero uncertainty), which is obviously wrong.			X				Although the concept of a relative uncertainty does not depend on sign (plus or minus a positive or negative number yields the same range), estimates of zero need special handling. We have now included footnotes to report the uncertainties of the two entries of zero in Table 3-1.
03-045	6	3	General		One of my major criticisms of the report is that in the Executive Summary as well as in Chapter 3 (except for Table 3-1 and page 3-7, line 19-22) no uncertainty ranges of the sources and sinks fluxes of carbon in North America are given. For example, the estimated uncertainty of fossil fuel CO ₂ emissions is about 10% (with 95% confidence, see Table 3-1) but up to four significant digits of the cited numbers are given. This deficiency is even more obvious when it comes to the sinks which in most cases are uncertain to within 50-100%. This is very misleading as it gives the impression to the reader that the fluxes reported would be known to very high precision, but in fact the contrary is the case. The digits in the reported numbers need to be reduced to the significant ones (i.e. ≤ 2) and errors need to be reported.			X				Please see the Responses to 03-01, 06, 17, 26, 28, 29, 31, 44.
03-046	6	3	General		To calculate the mean increase rate of fossil fuel CO ₂ emissions, the authors chose the time period of 1974 – 2003 (30 years). This period includes 12-15 years of constant or even decreasing emissions while the last 20 years, starting about 1983 until today show a much larger increase rate than 1% per year (Figure 3-1). Later, e.g. in Figure 3-2 when discussing the relation between GDP and fossil fuel CO ₂ emissions the time window from 1980-2003 is used. I think it would be more appropriate to choose the same time periods for the analysis of the emissions increase rate throughout the report.					X		We removed Figure 3-2 and so the only time interval examined is 1974-2003. However, we also repeated the analysis for the period in former Figure 3-2 (1980-2003) and got the same answer (emissions growth is actually a little smaller at 0.8% per year). The 23-year period is artificial and was used in Fig. 3-2 because the data for every country is only available on the EIA website for this period. We think that a thirty-year period has pedagogical advantages, and all of our qualitative conclusions do not change if we use 30 as opposed to 23 years. So we have decided to stick with the 30-year average.
03-047	6	3	3-2 and 3-4	27 and 1	The authors refer to the global land area and the North American share of 16.5 % of this area. I think a relation of the North American carbon sink to the total global land area is not really appropriate here as total land area includes Antarctica and Greenland (ca. 10%), as well as deserts (ca. 6%). A comparison with land areas with similar ecosystems may be appropriate but I would suggest skipping this relation completely.		X					We removed this material because it belongs in Chapter 2.

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03-048	6	3	General		There is a lot of repetition in the Executive Summary between the sections "How do North American carbon sources and sinks relate to the global carbon cycle" and the following section which is dealing only with North American carbon sources and sinks. The Executive Summary could be well shortened if the "relation to the global carbon cycle" would be imbedded in the latter section.		X					We have coordinated a partitioning of the material with Chris Field and have removed all text from Chapter 3 that evaluates North America in the global context. We have also removed one figure for the same reason. Chapter 3 is about North America. Chapter 2 is about the globe. The Executive Summary is outside of our jurisdiction.
03-049	6	3	General		In Chapter 3 there are even more repetitions of this kind as there is a section on "Key Findings" which is nice but this is followed by an "Introductory Summary" which e.g. for the fossil fuels has approximately the same length as the main section on "North American fossil fuel emissions". Again I would combine the "Introductory Summary" with the main sections which would avoid these many repetitions. In fact, most of the message of the section is summarized in Table 3-1 so that Chapter 3 could be shortened considerably without losing the major messages.		X					The paper has been completely reorganized along the line suggested. There is now one fossil fuel section and one carbon sinks section (rather than two of each). It is now considerable shorter.
03-050	6	3	3-19	Fig 3-1	Figure 3-1 has a somewhat odd scaling, would be easier to read if a metric system for the ticks was used.		X					We edited the Figure.
03-051	6	3	3-21	Fig 3-3	Figure 3-3 should have larger labels and in (a) the green dots do not copy well in b&w. The sectors in the caption in (c) should be named the same as in the legend.			X				The Figure should be edited if it will not be included in color. Label sizes depend on the size of the Figure in the printed version. We changed the legend as recommended.
03-052	6	3	General		It would be very helpful and much more instructive if SI units were used for the fluxes throughout the text, i.e. instead of Mt C yr ⁻¹ it should read 10 ¹² gC. My favourite would be 10 ¹⁵ gC = 1 Pg C everywhere which would also solve the problem with the large numbers with insignificant digits as those numbers will become small then.					X		Again, this report is not just for scientists. MtC is opaque enough to the lay reader. 1PgC is worse. Moreover, while Gt or Pg may be natural at the global scale (because this unit yields integers at the resolution of significant figures), Mt or Tg are more natural at the level of an individual country or component of an inventory. Most of the literature estimates for single countries are in Mt. We are sticking with the decision to report numbers to within 1 Mt and 1%.
03-053	6	3	3-1	30	Should read North American "fossil fuel" carbon dioxide emissions ...		X					Done.
03-054	6	3	3-2	31	EIA needs to be explained		X					Done.
03-055	6	3	3-2	33	"with approximately ... global total" should be deleted as it was mentioned in the sentence before.		X					Done.
03-056	6	3	3-2	36	It should read: Total U.S. emissions "are expected" to continue growing ...			X				The rewriting necessary to deal with 03-046 obviates this comment.
03-057	6	3	3-3	28	However, "much of the CO ₂ ..." "much" could be something between 40% and 95%, is there an approximate number to be given, such as more than 50% or so ?			X				We rewrote this as follows: However, the portion of the coastal carbon flux caused by human activity is thought to be close to zero and so...
03-058	6	3	3-5	20	Should read ...to the "solid" line ...		X					Obviated because figure removed.
03-059	6	3	3-7	31	(1700 MtC yr ⁻¹) here I would also put a minus sign as this number should be compared with the -753 Mt C yr ⁻¹ . The signs of the numbers of sources and sinks should be VERY consistent throughout the text !! I am not sure if this is the case yet.		X					Obviated by the deletion of material that belongs in Chapter 2.
03-060	6	3	3-8	7	Should read ...and North America "as a whole" are listed ...		X					Done
03-061	6	3	3-8	8-10	Mixing up "millions" and "billions" could immediately be avoided if numbers were always given in Pg C or Pg C yr ⁻¹ .					X		Agreed, but see 03-001 and 03-052. I think that lay people have an easier time switching from millions to billions than they would have dealing with Pg. Obviously if the editors feel otherwise, then we can change to whatever units they want.

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03-062	6	3	3-8	10-11	I do not understand why reference is given here to Table 3-1.		X					Moved the sentence and split the preceding one in two to fix this.
03-063	6	3	3-8	27-28	To "confirm" estimates of inventories and to "converge towards better agreement" (see 3-25, line 18) are of significantly different quality ... A more quantitative statement should be made here.			X				See response to 03-018. We also rewrote the sentence in 3-25 line 18, to improve clarity.
03-064	6	3	3-9	4	That these 10 years old numbers are used in Table 3-1 should be explicitly mentioned.		X					We added a sentence here to highlight this fact.
03-065	6	3	3-10	13	The unit Gt C should be avoided here, better use Pg C (or 1000 Mt C).				X			See the response to 03-052.
03-066	6	3	3-10	19-20	Are the CH ₄ fluxes included at all in the carbon fluxes reported here (i.e. cattle breeding and rice cultivation as anthropogenic sources). This should be made clear.			X				We rewrote the sentence to make this clear.
03-067	6	3	3-10	30-32	What kind of reservoirs ?			X				Rewritten as "sedimentation in artificial lakes".
03-068	6	3	3-18	Table 3-2	What are the uncertainties of the carbon stock numbers given here ?		X					Again, we added these to the Table. See 03-029.
03-069	6	3	3-23	19	I do not see any cropland change plotted in Figure 3-2.		X					Again, we omitted the reference to the Figure. See 03-030.
03-070	6	3	3-25	14	... consistent within several tens of g C m ² yr ⁻¹ for ... Here it would be better to report relative rather than absolute deviations.		X					We added a parenthetical remark that spells out the equivalent relative deviation.
SH-003	SG	3	3-5	1	I think it worthwhile pointing out that the comments regarding the likelihood of increasing C sink associated with lengthened growing season have recently been clarified in work indicating that a substantial portion of N.American forests are actually in decline under a warming climate (probably an acclimation effect) whereas tundra areas are increasing in productivity, [REF: Goetz, S. J., A. Bunn, G. Fiske, and R. A. Houghton. 2005. Satellite observed photosynthetic trends across boreal North America associated with climate and fire disturbance. Proceedings National Academy of Science 102:13521-13525.] This assessment, using 22 years of satellite imagery, accounted for the influence of fire disturbance. I think we have to be cautious about this assumption of increasing productivity, particularly when the observations suggest otherwise, before changes in vegetation composition catch up with the new climate regime.		X					We added a reference to this work.

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04-001	3	4	4-1	1-2	The title is somewhat vague and lacks pizzazz. As an alternative, how about "Options and Measures for Rebalancing the Carbon Cycle and Reducing Atmospheric CO2"?					X		The original title has been retained so as to match the style of the other chapters in Part I, which addresses specific questions posed in the Prospectus for SAP 2.2
04-002	3	4	4-2	20-23	These conclusions are very important; however, they are not supported by evidence and references. This is a recurring theme in the presentation of material throughout this chapter.			X				The long life and lower cost of implementing emission reductions in new facilities and equipment is amply documented in Chapters 6 through 9. A reference to those chapters is inserted.
04-003	3	4	4-3	7-23	The main focus seems to be on improved efficiency in end use rather than on generation and transmission/transport. Shouldn't options for increased efficiency in electric power generation (i.e., in addition to cogeneration) or transmission or in vehicles (e.g., hybrids, fuel cells) be mentioned?			X				End of second sentence changed. "directly or indirectly" replaced by "at any point between production of the fuel and delivery of the desired service" Footnote 3 also revised to include "and electricity transmission"
04-004	3	4	4-4	15-18	No mention is made of biodiesel which also can be used directly.			X				"biodiesel is produced from vegetable oils and animal fats" added to the end of their third sentence
04-005	3	4	4-5	26-32	Should the current research on development of methane hydrates from marine sediments and permafrost soils as a potentially significant energy source also be mentioned, even though this is a longer term option?					X		This section deals with reducing methane emissions. Methane hydrates are a potential source of methane better addressed in chapter 6 (and possibly 12 and 15).
04-006	3	4	4-6	5	The difference between afforestation and reforestation should be explained for the general reader.		X					A footnote explaining "afforestation" has been added
04-007	3	4	4-6	22-23	This is hyperbole. Many but certainly not thousands have been identified.		X					
04-008	3	4	4-6	29	The comma after "telecommuting" should be moved and placed after "demand."		X					
04-009	3	4	4-7	20-33	A reference to Chapter 8 as the source of the data presented and of more detailed discussion on the topic should be given both in the text and the figure caption. The figure caption also needs to indicate these cost estimates are for options to reduce emissions and/or enhance sequestration of carbon. The options presented in Table 4-1 seem to be too general to be appreciated without additional information on the characteristics of each. Unless there is some effort to indicate the potential significance of each option by presenting the carbon reduction potential on a common basis, preferably in Mt C per year, the comparisons will not be particularly meaningful. Also, what does "marginal cost" mean with respect to the last three options in the table?			X				Chapter 8 is NOT the source of the cost estimates. The sources are listed in the table. Most of those sources are also cited in chapters 6 through 11. The figure caption has been changed. The potential emission reductions are presented in MtC/yr where available, and as % reductions in cases where that is the only information available from the original source.
04-010	3	4	4-20	Table 4-1	See comment # 04-009			X				See response to comment 4-009
04-011	3	4	4-7	31-33	This statement deserves additional explanation and perhaps an example to illustrate what you mean.			X				A footnote has been added. "For example, increasing the scale of tree planting to sequester carbon requires more land. Typically the value of the extra land used rises, so the additional sequestration becomes increasingly costly."
04-012	3	4	4-8	11-12	Please identify the chapters in which these complications are discussed.		X					
04-013	3	4	4-8	13-18	I recommend that you again reference Chapter 8 as the source of this information.					X		Chapter 8 is NOT the source of the cost estimates. The sources are listed in the table, so a text reference to the table is appropriate

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04-014	3	4	4-8	21	Ancillary costs (e.g., from environmental degradation or risks to human health from some sequestration options) should also be mentioned.		X					"and costs" inserted after "ancillary benefits"
04-015	3	4	4-8	19-26	What appears to be needed is an integrated analysis that covers all types of emissions and all costs, including those produced by negative environmental consequences. Focusing only on benefits from CO ₂ reduction could overlook critical unforeseen consequences (e.g., from effects of some proposed sequestration options and development of alternative energy sources with lower carbon intensity). One example of the latter: Extraction techniques could destabilize deposits of methane hydrates in marine sediments and increase the potential for catastrophic releases in conjunction with expected future warming. A total systems approach is needed.		X					"and ancillary impacts" added to the end of the first sentence
04-016	3	4	4-8	30-34	The use of the verb "will" in each sentence in this paragraph has not been justified by the material presented thus far. Although I might agree with the current wording, the justification will not be apparent to all readers. Thus, I recommend making this the second paragraph of the Overview subsection and leading off with the paragraph at the top of page 4-9.			X				The first two paragraphs of this section have been merged.
04-017	3	4	4-9	17	What does "environmentally effective" mean?			X				Text revised so this phrase no longer appears.
04-018	3	4	4-9 and 4-10	23-28 and 1-4	The authors need to provide evidence with references to support their conclusions.					X		These paragraphs are descriptions of emissions trading and emissions taxes. No conclusions are drawn.
04-019	3	4	4-10	5	Awkward wording. How about "The framework for choosing a policy instrument needs to include consideration of institutional..."		X					
04-020	3	4	4-10	18-21	Would the sentence read better if "lower costs for" were inserted before "societal benefits" and "offset" was substituted for "exceed" in line 20?			X				"lower costs" is not appropriate; "the" before "societal benefits" is deleted; "exceed" is replaced by "offset"
04-021	3	4	4-11	1-2	The words "macroeconomic" and "distortionary" need to be defined.			X				"macroeconomic cost" replaced by "cost to the economy" A footnote defining distortionary tax is added
04-022	3	4	4-12	29	Either "help" or "are needed" should be deleted.			X				"help" is deleted
04-023	3	4	4-13	6 et seq	This section as a whole is marked by presentation of conclusions that are not supported by the information presented in the chapter or in several cases not discussed at all prior to this section. Although I have provided specific comments below, I think that this entire subsection could be deleted, given that much of the material was included in the KEY FINDINGS section at the start of the chapter. Of course, the key findings would still need to be supported with evidence and references.			X				Lines 18 to 29 are moved into Overview section under Policy Options. The material in this portion of the text is supported by the reference - Raupach, et al.

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04-024	3	4	4-13	11-12	I would argue that sequestration of 20% of current emissions is not small when measured against other control options discussed in this chapter. In addition, the reversibility of uptake by agricultural soils and forests was discussed previously (on page 4-12) in the context of "a forest fire or tilling the soil," implying a single event or location. This does not convince me that a coordinated continent-wide program "can be reversed easily."					X		The statement in the text is that the potential is "significant but small relative to emissions" The reviewer argues that the potential is not small relative to other options. This is acknowledged by the statement that the potential is "significant". Reversal is addressed by adding "at any given location by natural phenomena or human activities"
04-025	3	4	4-13	22-29	These subjects were not covered in this chapter.			X				The material has been moved into the body of the chapter
04-026	3	4	4-14	18-23	This material was not covered in this chapter.			X				It is a conclusion and the arguments supporting the conclusion are presented in this paragraph.
04-027	3	4	4-2	5-10	This material was not covered in this chapter.			X				This text repeats the text covered by the preceding comment.
04-028	7	4	4-3	6-23	This section should highlight the overwhelming potential of improvements in energy efficiency to reduce greenhouse gas emissions. The United States uses nearly twice as much energy per person as Japan, the United Kingdom, and other countries that enjoy a high material standard of living (IEA 2005). The United States could significantly improve the efficiency of its energy use and reduce greenhouse gas emissions by up to half using existing technology without major sacrifices to the material standard of living. REF: International Energy Agency (IEA). 2005. Key World Energy Statistics 2005. IEA, Paris, France.						X	This is more appropriate for the chapters in Part II
04-029	7	4	4-4	19-23	This section should highlight the overwhelming potential of renewable energy sources to reduce greenhouse gas emissions. In 2003, the world rate of energy use totaled 14 TW or 14 trillion watts. Nevertheless, available solar and wind power resources could potentially provide energy to the world at a rate of 70 TW (UNDP 2000). REF: United Nations Development Programme (UNDP). 2000. World Energy Assessment. UNDP, New York, NY.						X	This is more appropriate for chapter 6.
04-030	7	4	4-11	7	The section should note that twenty states and the District of Columbia have enacted policies that set a target for the fraction of electricity that utilities generate from renewable sources from 5% to 30% (REN21 2005). REF: REN21 Renewable Energy Policy Network. 2005. Renewables 2005 Global Status Report. Washington, DC: Worldwatch Institute.						X	This is more appropriate for chapter 6.
04-031	7	4	4-11	23-25	The chapter would benefit from citing the potential positive impact of an increase in U.S. Corporate Average Fuel Efficiency (CAFE) motor vehicle standards. Raising CAFE from the current level of 22.2 miles per gallon for light trucks and 27.5 miles per gallon for passenger cars to 39 miles per gallon, a level still lower than current standards in the European Union and Japan, could reduce oil consumption and carbon emissions by 37% (National Commission on Energy Policy 2004). REF: National Commission on Energy Policy. 2004. Ending the Energy Stalemate: A bipartisan Strategy to Meet America's Energy Challenges. National Commission on Energy Policy, Washington, DC.						X	This is more appropriate for chapter 7.

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04-032	8	4	General		In general Chapter 4 performs a credible job of reviewing technological and policy options for addressing carbon dioxide emissions. Given that the Chapter is charged with presenting an exceeding complex and large range of information in very few pages, the author is to be commended on having, by and large, successfully carried out this task.	X						
04-033	8	4	General		The three main areas in need of attention are (1) readability, (2) definitions of scope of cap-and-trade system and its relation to reductions achieved through regulations, and (3) accuracy or completeness of a number of statements (as detailed in the items below).	X						
04-034	8	4	General		The Chapter is, no doubt as a consequence of the attempt to cover a great deal of complex material in very few pages, written in a very terse manner. A good editor could, and should be used to, render the text smoother and more easily readable.	X						
04-035	8	4	General		The most serious problem with the chapter is the disconnect between the primacy given to an emissions trading program and evidence presented which suggests serious limitations of such a program. This problem is compounded by the omission, throughout the chapter, of any definition of the scope of the cap program and of the emissions trading program. The chapter seems to imply that a cap-and-trade program would be confined to large point sources but never states this, and it is never made clear whether only capped sources could trade or whether the emission trading system is envisioned as including both capped sources and emission reductions achieved through other regulatory approaches. The chapter should specify which sources are envisioned as being covered by a cap and whether the trading system is confined to capped sources or not.				X		Emissions trading is not given primacy. Specifying a design for an emissions trading program would be inappropriate. The description given could apply to large sources only or to the carbon content of fossil fuels or designs that involve a mixture of both. Whether sources not covered by the cap should be able to generate emission reduction credits for sale to affected sources is a detail.	
04-036	8	4	General		Two limitations on a cap-and-trade program discussed in the chapter seem to raise questions about the primacy of its role suggested by the chapter. These items are detailed in the following two comments.					X		Emissions trading is not given primacy.
04-037	8	4	General		A. Need to use regulatory approach for some sources. The chapter acknowledges that many sources of CO ₂ --both where energy efficiency is key to reductions and where industries or individuals do not respond well to price signals--will need to be addressed through regulations (i.e. energy efficiency standards), which would "complement" the cap-and-trade program. Energy efficiency is a major avenue for emission reductions from buildings, transportation, and appliances, "sources" which, together, are responsible for a very large fraction of CO ₂ emissions. These are also sectors in which response to price signals are dampened due to a multiplicity of factors. Thus if these are not part of the cap-and-trade program, the ground for primacy of a cap-and-trade program are unclear. This is particularly true if these emission reductions (i.e., those resulting from efficiency regulations) would not be part of the emission trading system. As pointed out above, the chapter fails					X		The chapter states that appropriate regulations to complement the emissions trading program or emissions fee should be adopted for sources or actions subject to market imperfections such as energy efficiency and co-generation. It is not appropriate for the chapter to specify a design for an emissions trading program nor to specify the level of an emissions fee. Whether to allow emission reductions from sources not covered by a trading program to generate credits for sale to affected sources, if a trading program is implemented, is a detail that is beyond the scope of the chapter in part because it would also require all of the issues noted by the reviewer to be discussed.

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04-037 (cont)					to clarify whether they would or would not be. As part of clarification of this question, the chapter should mention the difficult issue that would need to be resolved for such emission reductions to trade into a cap-and-trade system, e.g., establishment of baselines (to achieve "additionality" and avoid compromising the cap); avoiding double-counting; and establishing equivalencies between (fungibility of) very difference types of reductions.							
04-038	8	4	General		B. Inability to incorporate ancillary benefits or costs. The chapter correctly points out that many options to address GHG emissions have ancillary benefits which are not taken into account by a cap-and-trade approach and that there are potential conflicts between emission reduction goals and other societal goals. These are serious issues that do not seem to be reflected in the chapter's evaluation of cap-and-trade approaches. The inability of a cap-and-trade program to incorporate multiple values is a major drawback in land use where the land use with the highest carbon benefits may conflict with other societal priorities, e.g., land for food production. The single issue focus of a cap-and-trade approach (or any other approach designed solely to reduce GHG emissions) is also likely to be a major drawback for many countries and in other sectors. For example, a cap--assuming it functions as envisioned to elicit least-cost reductions--would very likely fail to support biofuel production at					X		The chapter states that appropriate regulations to complement the emissions trading program or emissions fee should be adopted for sources or actions subject to market imperfections such as energy efficiency and co-generation. Emissions could be covered by an emissions trading program or an emissions fee and still be subject to other regulations to address ancillary benefits or costs. For example an emissions trading program or an emissions fee based on the carbon content of fossil fuels would cover vehicle emissions from gasoline and diesel fuel. But it might still be appropriate to implement CAFE standards for new vehicles. Efficiency standards for appliances, equipment and buildings might be appropriate in those circumstances as well.
04-038 (cont)					societally desirable level because they are a relatively costly reduction option that has energy security and enhanced rural income benefits. This suggests that regulatory approaches that can take multiple societal goals into account (e.g., a biofuels mandate) may be more useful and more likely to secure support.							
04-039	8	4	General		Finally, the chapter points out that choosing the least-cost combination of options would be a daunting task and that it is unlikely that policy-makers can do so. It then goes on to state that policy-makers can adopt permit trading and allow the emitter to choose the lowest cost options. This assumes that the emitters (i.e., the private market) will be better able to find and choose the least-cost emission reduction path. However, the chapter fails to provide any support for this position. One option would be to define the circumstances under which the private market will be better able to select least-cost options than the government. Furthermore, if least-cost options occur through energy efficiency regulations -- and there is good reason to suppose that energy-efficiency improvements in sectors such as transportation, buildings and appliances may indeed be a major source of low-cost reductions -- it is unclear whether such			X				A reference (Swift, 2001) has been provided that compares responses under regulation and emissions trading and finds that the affected sources find lower cost emission reductions under the trading program.
04-039 (cont)					reductions would be available for use by capped entities (see A above). If they are to be available, the chapter should acknowledge circumstances under which companies may not select such options, e.g. preference for options over which they have more control, about which they are better informed, or which provide ancillary benefits (e.g., learning by doing, PR, etc.).							

**Comments and Responses on SOCCR/SAP 2.2 Draft 1 (May 2006)
CHAPTER 4**

COMMENT FROM PEER REVIEWERS						AUTHOR'S RESPONSE						
Comment Number	Reviewer ID	Chapter	Page	Line	Comment Text	Acknowledged, but no further response or revisions are required	Revisions have been incorporated as suggested in the comment	Agree, but see "Notes on Response"	Agree, but elaboration is precluded by length limitations	Disagree; see "Notes on Response"	Beyond scope of report/chapter	Notes on Response
04-040	8	4	General		In short, the chapter should clarify the envisioned extent of a cap-and-trade program (e.g., large point sources) and whether reductions achieved through other types of regulation are envisioned to participate in the trading scheme. Its evaluation of cap-and-trade should also reflect the seriousness of the limitations described in the chapter					X		See responses to the previous 5 comments.
04-041	8	4	4-2	31	List of options to reduce energy-related emission. The chapter covers both energy and non-energy based emissions. Therefore there should also be a list of the non-energy related options covered in the chapter.			X				Revised the headings. A new sub-heading -- Energy-related CO2 Emissions -- is introduced after SOURCE REDUCTION OPTIONS. The next three headings -- Energy Efficiency, Fuel Switching, and Electricity and Hydrogen... become sub-headings. Industrial Processes and Methane Emissions remain as is to complete the SOURCE REDUCTION OPTIONS section.
04-042	8	4	4-4	17-18	Other factors in the CO ₂ reductions achieved should be listed, e.g., the inputs used to produce the biomass (fertilizer, irrigation water), whether the land is existing cropland or converted from forests or grasslands, and the management practices used (no-till, conventional till).			X				Has been added as a footnote.
04-043	8	4	4-5	13	While perhaps technically correct, the statement that integrating CO ₂ capture and storage into our energy system is mainly a long-term option may mislead readers into thinking that one can not start deployment of CCS today. CCS can currently be undertaken in "niche" situations, and its more widespread deployment is feasible both in the near and medium-term.				X			This is true, but the same is true for photovoltaic, wind, ethanol, biodiesel, and many energy efficiency technologies. The phrase "mainly a long-term option" is sufficient.
04-044	8	4	4-5	30-32	It should be pointed out both that the opportunities to reduce ruminant emissions in the United States are limited (due to the fact that animal feed is in most cases already optimized) and that little is known about the costs of achieving such reduction.				X			This is a level of detail beyond the scope of Chapter 4. It would be better in Chapter 10 if livestock are covered there.
04-045	8	4	4-6	14	The rate of sequestration following conversion to forestland depends on a good many factors other than soil type, including both environmental factors (such as climate, topography, type of trees planted) and management practices (including thinning, fertilization, pest control, etc.).		X					
04-046	8	4	4-6	22-24	Policy makers also need to know the magnitude of reductions likely to occur in response to pursuing reductions of a given type or at a given price.		X					
04-047	8	4	4-6	28	Insert "in addition to the factors previously cited," prior to "...on other measures as well, such as telecommuting..."		X					
04-048	8	4	4-7	1-2	Provide some substantiation of this claim or delete.		X					
04-049	8	4	4-7	18	In the Text box an excellent job is done of explaining supply curves and informing the reader of their pitfalls. Similar cautions should be provided for the costs presented in Table 4.1 as these cost estimates involve as least as many problematic assumptions as the supply curves.	X						
04-050	8	4	4-20	Table 4-1	See comment # 04-049		X					
04-051	8	4	4-8	11-12	If examples are provided in other chapters, the numbers of such chapters should be specified.		X					

**Comments and Responses on SOCCR/SAP 2.2 Draft 1 (May 2006)
CHAPTER 4**

COMMENT FROM PEER REVIEWERS					AUTHOR'S RESPONSE							
Comment Number	Reviewer ID	Chapter	Page	Line	Comment Text	Acknowledged, but no further response or revisions are required	Revisions have been incorporated as suggested in the comment	Agree, but see "Notes on Response"	Agree, but elaboration is precluded by length limitations	Disagree; see "Notes on Response"	Beyond scope of report/chapter	Notes on Response
04-052	8	4	4-10	5	Insert "technical" into the list, i.e., the choice of policy instrument also needs to consider technical constraints.		X					
04-053	8	4	4-10	14	Explain the term compensating variation or delete.		X					
04-054	8	4	4-10	Footn 15	While this may be true of some regulatory approaches, I doubt that it has been proven, in general, for all regulatory approaches, e.g., for those than require a certain efficiency level. I doubt there has been enough experience with trading programs in general to support this.					X		There is theoretical and empirical literature indicating that emissions trading and emissions taxes are better at inducing technological change than regulations. Regulations deliberately designed to force technological innovation sometimes succeed (refrigerator efficiency standard) and sometimes fail (California's zero emission vehicle standard). The possibility of such regulations being successful is covered by the qualifier "generally".
04-055	8	4	4-11	13	There is contradictory evidence about the impact of taxes on vehicle fuels, at least at any level likely to be imposed. Although there may be some demand response to price spikes, transportation demands appears to be relatively inelastic.			X				A footnote has been added.
04-056	8	4	4-11	18-19	While the diversity in sources of CO ₂ may mean that emissions trading could yield significant cost-savings, this same diversity poses serious problems for such a system (see discussion above) and this should be acknowledged.			X				Added "but may also be difficult to implement"
04-057	8	4	4-11	28	Change the title to "Terrestrial Sequestration Policies"		X					
04-058	8	4	4-12	7-12	Both the establishment of baselines and leakage also poses a major challenge for such polices. These should be added.			X				Addressed by addition of a footnote.
04-059	8	4	4-12	27	While induced technological change may justify earlier targets, either support the statement that it justifies more stringent targets or delete.					X		Induced technological change reduces the cost of meeting a given emissions target. Thus the optimal emissions target at any given time is more stringent if the effect of induced technological change is considered than if it is ignored.
04-060	9	4	General		There are a number of statements made in the chapters that also lack any source reference. Some examples are detailed in the following items.	X						
04-061	9	4	4-6	22-24	As is clear from the previous sections, <u>there are thousands of options to reduce emission of or to sequester CO₂</u> . To help decide which options to implement, policy makers need to know which are the most cost-effective – have the lowest cost per metric ton of CO ₂ reduced or sequestered.			X				"thousands" changed to "many"
04-062	9	4	General		<i>Note from Coordinating Team: The reviewer seems to take exception to the claim that the report is "policy neutral" by citing examples of where Chapter 4 describes "options" and "measures." See the comments in the reviewer's file on Chapter 6 for a list of these examples, which are too lengthy to be included here.</i>	X						

**Comments and Responses on SOCCR/SAP 2.2 Draft 1 (May 2006)
CHAPTER 4**

COMMENT FROM PEER REVIEWERS						AUTHOR'S RESPONSE						
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04-063	9	4	4-6	22 et seq	The subsection begins by stating that it is "clear from previous sections" that "there are <u>thousands of options</u> to reduce emission of or to sequester CO2" and to "help" policymakers "decide" which to "implement" they "need to know <u>which are the most cost-effective</u> – have the lowest cost per metric ton of CO2 reduced. . . ." (emphasis added). However, there are often many more considerations that are not noted in this comparison section. While we would agree that energy improvements and fuel switching are possible "measures" or "options" for "reducing energy-related CO2 emissions," the draft should not give the impression, even inadvertently, that they would contribute significantly to stabilizing "atmospheric concentrations of CO2."			X				Text revised to: "As is clear from the previous sections, there are many options to reduce emissions of or to sequester CO ₂ . To help them decide which options to implement, policy makers need to know the magnitude of the potential emission reduction at various costs for each option so they can select the options that are the most cost-effective—have the lowest cost per metric ton of CO ₂ reduced or sequestered."
04-064	9	4	4-8 and 4-9		Again, we recognize that there are a number of policy options that are worthwhile in addressing greenhouse gas (GHG) emissions. These include "nuclear power," but we question what the draft means by stating that nuclear energy is "very controversial." Nuclear energy comprises 20 percent of the nation's electric generation mix, and there is growing recognition that non-emitting sources of energy, such as nuclear energy, are clearly part of the mix of options in addressing GHGs. Indeed, President Bush in his most recent State of the Union address and in his Advanced Energy Initiative has spoken quite favorably about encouraging its use.			X				"nuclear power" deleted here
04-065	9	4	4-8 and 4-9		As to the "controversial" subject of "geoengineering," an article in the June 27, 2006, edition of "Science Times" of the New York Times, titled "How to Cool a Planet (Maybe)," discusses geoengineering favorably and quotes Dr. Ralph J. Cicerone, President of the National Academy of Sciences: "We should treat these ideas like any other research and get into the mind-set of taking them seriously."					X		The article cited by the reviewer specifically acknowledges that geoengineering approaches are controversial.
04-066	9	4	4-9	15 et seq	Under the title "General Considerations," the chapter discusses various "policies," which clearly are not part of "the current state of scientific understanding about key issues related to climate change" but rather are what might best be called policy-prescriptive measures or options aimed at influencing or making decisions. For example, the chapter states (p. 4-9) that "[p]olicies to encourage reduction. . . of CO2 emissions could be information programs, voluntary programs, conventional regulation" – which presumably means command and control –, "emissions trading and emission taxes." As to "information. . . and voluntary programs," the chapter contends that "voluntary programs are generally not effective"; see also Footnote 13 in Chapter 4.					X		This comment is not clear. The claim that the chapter is policy prescriptive appears to be based on the sentence that "Information and voluntary programs are generally not environmentally effective". This is the subject of the reviewer's next two comments. That sentence has been revised.

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CHAPTER 4**

COMMENT FROM PEER REVIEWERS						AUTHOR'S RESPONSE						
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04-067	9	4	4-9	15 et seq	In support of the contention about the effectiveness of voluntary programs, the draft refers to a 2003 report by the Organization of Economic Co-operation and Development (OECD) titled "Voluntary Approaches for Environmental Policy," which, as the title suggests, is about the "use of voluntary approaches in environmental policy," not energy policy. Indeed, the report lists the following "case studies made especially for this report," which obviously are not energy related and hardly relevant to the scope of the SAP: (1) The Accelerated Reduction/Elimination of Toxics program and an Environmental Management Agreement with the steel company Dofasco Inc. in Canada; (2) The agreement scheme on industrial energy efficiency in Denmark, with examples from the paper and milk condensing sectors; (3) The Pollution Control Agreements negotiated in Yokohama City and Kitakyushu City in Japan; and (4) The experiences of Intel Corporation and Merck Pharmaceuticals in Project XL in the U.S.			X				Text on voluntary agreements revised to acknowledge that some programs have reduced emissions.
04-068	9	4	4-9	15 et seq	On the contrary, voluntary programs such as the Environmental Protection Agency's (EPA) Climate Leaders and DOE's Climate VISION are "effective" in reducing, avoiding and sequestering GHGs. See the Energy Information Administration's (EIA) annual report on voluntary reporting of such reductions (the most recent is titled "Voluntary Reporting of Greenhouse Gases 2004," March 2006), which indicates that the electric utility industry alone reported 282 million metric tons of CO2-equivalent reductions, avoidances and sequestrations in 1994. In short, reliance on the OECD for comments on voluntary programs is at best misplaced.			X				See previous comment
04-069	9	4	4-9	15 et seq	In the first place, the above discussions about information, voluntary programs, regulations, emissions trading and taxes are cursory and inadequate. More importantly, the relevance of this discussion in what purports to be a scientific and policy-neutral paper is lacking. We strongly suggest that Part I be rewritten, that the questions be reconsidered, and that much of Chapter 4 be discarded.					X		A discussion of possible policies is the agreed focus of the chapter and these are all possible policies.

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CHAPTER 5**

COMMENT FROM PEER REVIEWERS						AUTHOR'S RESPONSE						
Comment Number	Reviewer ID	Chapter	Page	Line	Comment Text	Acknowledged, but no further response or revisions are required	Revisions have been incorporated as suggested in the comment	Agree, but see "Notes on Response"	Agree, but elaboration is precluded by length limitations	Disagree; see "Notes on Response"	Beyond scope of report/chapter	Notes on Response
05-001	3	5	General		I found very few answers to my questions in the current version of the report—and nothing at all in Chapter 5, despite its title. In fact, I get the impression that tackling these tough but critical questions is being deferred in pursuit of a yet to be established (and perhaps elusive) process (see fourth paragraph on page 5-9). Several other synthesis and assessment reports (namely SAP 5.1, 5.2, and 5.3), organized under the heading "Explore the uses and identify the limits of evolving knowledge to manage risks and opportunities related to climate variability and change," were identified in Chapter 5, but, based on the descriptions of these activities given on the CCSP web site, they will not address my questions either.						X	This chapter's role is to clarify the processes and institutions to build a better connection/application of science to the needs of carbon management. Detailed discussion of specific research needs can be found in individual chapters. The chapter's introduction has been edited to clarify this point.
05-002	3	5	5-1 to 5-15		Although I don't have much to quibble about with respect to this subject or how it is presented in this chapter, I do question why an entire chapter is devoted to the subject of improved application of scientific information to decision support when so little is devoted to an assessment of where we are currently (see General Comments). Our "process" will never be perfect, but we have to tackle the difficult questions now in order to make continued, effective progress.						X	This chapter's role is to clarify the processes and institutions to build a better connection/application of science to the needs of carbon management. Detailed discussion of specific research needs can be found in individual chapters. The chapter's introduction has been edited to clarify this point.
05-003	3	5	5-3	1, 3, & 6	Replacing the words "normative," "actors in these sectors," and "entities" with simpler synonyms would help to improve communication with the more general audience for which the report is reportedly intended.		X					revisions made in line with suggested comments.
05-004	3	5	5-4	1-13	Why is there no mention of NOAA's role, i.e., the Climate Program Office and its activities?		X					There is now a mention of NOAA's climate program office and it's role lines page 5-4 lines 11-14. Note that the CPO to date has not focused it's efforts on usable carbon science , but rather seasonal to interannual climate information
05-005	3	5	5-4	24-28	I recommend "translating" the quote so that it is more likely to be understood by a member of the general public.		X					Sentence added to page 5-4 and 5-5 lines 29-2
05-006	3	5	5-5	16-18	I would recommend purging the word "salient" from your lexicon, and simply replace it with "relevant" or "particularly relevant." It is another example of unnecessarily complex wording, and is a very poor synonym for the parenthetical expression on lines 16 and 17, despite the assertions of Cash et al. In fact, I think deleting both "salient" and "legitimate" and eliminating the associated parentheses is not only simpler but more effective in getting your message across.		X					revisions made in line with suggested comments. Salient replaced with "relevant" and legitimate replaced with "responsive" throughout the chapter.
05-007	3	5	5-5	32	Would inserting the word "expanded" before the word "participation" communicate your message more effectively?		X					revisions made in line with suggested comments.
05-008	3	5	5-8	6	I think the acronym NGO needs to be added to the Text Box (see line 9 on page 5-15) since the definition of NGO is not given elsewhere in the text.		X					revisions made in line with suggested comments.
05-009		5	5-10	3	Same comment as # 05-006		X					Revisions made in line with suggested comments. Salient replaced with "relevant" and legitimate replaced with "responsive" throughout the chapter.

**Comments and Responses on SOCCR/SAP 2.2 Draft 1 (May 2006)
CHAPTER 5**

COMMENT FROM PEER REVIEWERS						AUTHOR'S RESPONSE						
Comment Number	Reviewer ID	Chapter	Page	Line	Comment Text	Acknowledged, but no further response or revisions are required	Revisions have been incorporated as suggested in the comment	Agree, but see "Notes on Response"	Agree, but elaboration is precluded by length limitations	Disagree; see "Notes on Response"	Beyond scope of report/chapter	Notes on Response
05-010	8	5	General		The entire chapter should be edited to improve readability. The title and a number of sections in the chapter require too many readings in order to understand them and grasp their points. The title should be shortened and simplified. The ideas are pretty diffuse and conceptual, and it is difficult to relate some of the sections to the main point of the chapter.		X					Extensive revisions made to improve readability and the title has been shortened.
05-011	8	5	General		The Chapter does provide a useful summary of the general barriers to linking carbon cycle science with solutions and offers possible approaches to overcome some of those barriers. However, the manner in which this chapter is written has the result that it is likely that it will only be understood, or considered relevant, by the science audience. Other audiences or stakeholders are unlikely to get much out of this chapter as presently written, which makes it unlike the rest of the report.			X				Chapter has been edited to clarify key points, and to communicate to decision makers the importance of improving the usefulness of carbon cycle science.
05-012	8	5	General		Although the chapter as written is not directly useful for applying science to management, it does shed some light on areas that most scientists don't think much about. With that in mind, the recommendations, as loose as they are, are appropriate insofar as they are directed at scientific organizations which may be able to implement or modify programs to enhance the utility of their science for carbon management.	X						

Comments and Responses on SOCCR/SAP 2.2 Draft 1 (May 2006)
CHAPTER 6

COMMENT FROM PEER REVIEWERS						AUTHOR'S RESPONSE						
Comment Number	Reviewer ID	Chapter	Page	Line	Comment Text	Acknowledged, but no further response or revisions are required	Revisions have been incorporated as suggested in the comment	Agree, but see "Notes on Response"	Agree, but elaboration is precluded by length limitations	Disagree; see "Notes on Response"	Beyond scope of report/chapter	Notes on Response
06-001	9	6	6-1	32-35	The Key Findings section's last bullet is far too narrow in scope, for example, ignoring major topics and options, especially efficiency and fuel switching.						X	This chapter does not deal with end uses: see other chapters in Part II
06-002	9	6	6-1	General	The Energy Information Administration (EIA) Annual Energy Outlook for 2005 has been superseded by the same document for the year 2006.		X					
06-003	9	6	6-1	27-31	The Key Findings section's 5th bullet should have the "if concerns about carbon cycle imbalances grow" removed to avoid political controversy.		X					
06-004	9	6	6-2	30-32	Are there truly zero energy exports from the U.S. to Mexico and Canada?	X						Statement is true as written, per EIA
06-005	9	6	6-3	21-23	Why make a suggestion? Instead, why not implement the suggestion?			X				Sentence deleted
06-006	9	6	6-4	14	Define "environmental impacts"				X			
06-007	9	6	6-5	1	The first sentence is incorrect unless the authors are using a data base of two North American countries, in which case the statement is silly as stated.		X					
06-008	9	6	6-5	22-26	Use EIA AEO 2006		X					
06-009	9	6	6-5	25	Is the 7% reference meaning 1) from 45 to 38% or 2) 7% of 45% which is about 4%?		X					
06-010	9	6	6-6	28-30	Carrying on the "wedges" analogy is confusing		X					
06-011	9	6	6-6	31 et seq	Even if options are known to be technologically feasible, they still require a tremendous level of RD&D to get the processes ironed out and the costs down – i.e., large-scale capture of carbon requires substantial advances in science.	X						Minor change made in text
06-012	9	6	6-8 thru 6-9		The cost discussion is a cornucopia of different studies and meanings and thus is confusing.			X				Agree. Section shortened. But it accurately represents the state of the existing knowledge, which is not very close to coherent.
06-013	9	6	6-8	32	A cost of 5 cents per kilowatt hour is roughly equivalent to the average price paid by a residential consumer of electricity in numerous states in the U.S. today.		X					
06-014	9	6	6-10	14 et seq	Just like the Key Findings section, the Research and Development Needs section ignores key needs like efficiency.						X	See 06-001 above
06-015	10	6	6-1	19	Should 'comfort , convenience' be listed first (implies most important) as drivers for increase in energy use? Is there data to support this? Is it more likely that productivity and population growth will be the primary drivers for increases in energy consumption?					X		Abundant literatures on consumption behavior.
06-016	10	6	6-1	30-31	This sentence is unclear and strongly implies that it would be preferable to wait to implement carbon emission controls. Is there data to support this? Other studies have indicated different results, and several studies indicate that near-term investments in electricity generation will have very long-term emissions impacts. What 'prospects' improve?					X		Statement revised; but it is descriptive, not normative
06-017	10	6	6-1	34	Should climate science be listed somewhere in the R&D priorities?						X	

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CHAPTER 6**

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06-018	10	6	6-2	19	Listing oil refining with electricity generation implies that emissions from refineries are comparable to those of power generation plants, which is not the case. In fact, refinery emissions account for about 20% of life cycle emissions for crude oil derived fuels (e.g., gasoline, jet fuel, diesel fuel), with the majority of emissions released by fuel consumers. Conversely, nearly all emissions from electricity generation occur at the power plant, and electricity consumers do not directly release carbon dioxide to the atmosphere.		X					
06-019	10	6	6-2	22	It should be noted that refinery emissions (on the order of 2-3 million metric tonnes CO2 per year per refinery, approximately 1000 refineries in the US) are much smaller than those from electricity generation (on the order of 10-20 million metric tonnes CO2 per year per plant, with ~10,000 fossil fuel power plants).		X					
06-020	10	6	6-2	23	Emissions from oil production are probably on the same order as the other 'smaller' sources listed, and should be mentioned here. A rough estimate of these emissions can be made using IPCC Inventory Guidelines Chapter 4 Section 2 Tier 1 factors.		X					
06-021	10	6	6-3	9	Please consider adding the word 'upgrading' so that the phrase reads '...petroleum refining and upgrading and...'. Emissions from Canadian refining and upgrading processes are much larger than for other North American countries because of the significant oil sand production in Alberta.		X					
06-022	10	6	6-3	19	If available, a definition for 'energy industries' should be provided.			X				No definition found
06-023	10	6	6-3	30	No data is given to indicate oil refineries to be a significant source of methane. Please refer to the API Compendium of Greenhouse Gas Emissions Estimating Factors for the Oil and Gas Industry for a rough estimate of refinery methane emissions. Compared to other sources, these emissions are likely to be small.		X					
06-024	10	6	6-3	33	Not clear what 'that scale' is referring to.		X					
06-025	10	6	6-4	2-5	The reference to bioenergy is unclear and implies that biofuels tend to have negative or neutral carbon emissions. Lifecycle studies have shown that depending on life cycle boundaries, fertilizer, transportation and tilling practices, biofuels can have carbon emissions, and in some cases, utilize more energy to produce than is released during combustion of the biofuel. In such cases, greenhouse gas emissions from the biofuel lifecycle would be greater than those of fossil fuels.		X					

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06-026	10	6	6-4	17-23	As written, this paragraph gives no other reason than policy conditions for the dominance of fossil fuels as energy supply. Suggest rewrite as follows: "Production costs of electricity from coal, oil or natural gas at relatively large scales are currently lower than other sources of electricity, besides large-scale hydropower, and production costs of liquid and gas fuels are currently far lower than other fuel sources, though rising. This is mainly due to the fact that the energy density and portability of fossil fuels is as yet unmatched by other energy sources, and in some cases, policy conditions reinforce fossil fuel use. These conditions..."		X					
06-027	10	6	6-5	26	Emissions from crude oil refining could be expected to rise at a rate just below rate of growth/decline in refined product use. US DOE may have projections of refined product use rate. Refinery emissions are about 20% of lifecycle emissions for fuels, and improvements in refinery efficiency over time will drive emissions per barrel of refined product lower over time.		X					
06-028	10	6	6-5	33	Consider adding the following...'because there is no single solution that is clearly more cost-effective than others; solutions will be specific to project circumstances.'				X			
06-029	10	6	6-6	26-27	Suggest rewriting without the term 'wedge' as this is not adequately defined, and is only one of several approaches to considering future technology strategies. Either delete the word 'wedges' or substitute 'technology solutions'. For example, line 26 could be rewritten '...adding together smaller contributions...', and line 28 'If many technology solutions can be combined...'	X					Use of the term "wedges" deleted in following paragraphs	
06-030	10	6	6-6	34	This implies that carbon capture and sequestration will necessarily involve hydrogen as an energy carrier. Other CCS options, such as firing with oxygen or post-combustion capture are also likely to be used.				X			
06-031	10	6	6-7	5	Delete the phrase '...although prospects remain speculative at this time...'. As evidenced by the Sleipner, Weyburn and In Saleh projects, carbon capture and storage technology can be demonstrated, but cost reductions and policy certainty are needed for broader implementation.		X					
06-032	10	6	6-8	28	The word 'global' appears twice. It would be clearer if one instance were deleted.		X					
06-033	10	6	6-9	1-2	The cost basis is not entirely clear. Is this the total cost or the cost increase with capture and storage? Also, it is not clear why the cost of nuclear energy would rise.		X					
06-034	10	6	6-10	1-2	Good point. It is important to include economic drivers/barriers in policy and technology assessments.	X						
06-035	10	6	6-11	1	What other incentives are contemplated? The energy industry is not 'limited to fossil fuels'. It should be noted that nuclear, hydro and geothermal are pursued when economic. In general, economics and market forces shape energy supply.		X					
06-036	10	6	6-11	6-7	Remove reference to 'wedge'; for example: '...advances might be combined with multiple technologies to transform...'		X					

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CHAPTER 6

COMMENT FROM PEER REVIEWERS						AUTHOR'S RESPONSE						
Comment Number	Reviewer ID	Chapter	Page	Line	Comment Text	Acknowledged, but no further response or revisions are required	Revisions have been incorporated as suggested in the comment	Agree, but see "Notes on Response"	Agree, but elaboration is precluded by length limitations	Disagree; see "Notes on Response"	Beyond scope of report/chapter	Notes on Response
06-037	10	6	6-13	3-10	Since there are innumerable economic and technology studies are underway in the area of greenhouse gas emissions and mitigation, it is not clear why a single study is prominently highlighted in this report. For example, the CO2 Capture Project is doing a lot of work in the area of next generation technology development for CO2 capture and storage. The MIT Joint Program on the Science and Policy of Global Change is another one. I would suggest deleting this text box.		X					

**Comments and Responses on SOCCR/SAP 2.2 Draft 1 (May 2006)
CHAPTER 7**

COMMENT FROM PEER REVIEWERS						AUTHOR'S RESPONSE						
Comment Number	Reviewer ID	Chapter	Page	Line	Comment Text	Acknowledged, but no further response or revisions are required	Revisions have been incorporated as suggested in the comment	Agree, but see "Notes on Response"	Agree, but elaboration is precluded by length limitations	Disagree; see "Notes on Response"	Beyond scope of report/chapter	Notes on Response
07-001	11	7	General		Some of what I expected is here. Unfortunately three elements are missing: 1) better discussion of the driving forces behind rising emissions 2) more on the nature of the controversy over how emissions can be reined in and 3) more on the fundamental weaknesses of the data, both in Mexico and Canada, as well as the US. More effort should be undertaken to make the data and descriptions compatible, as these are likely to be quoted widely without caveats.		X	X	X			Discussion of data accuracy has been added. I have also added more details on the inconsistencies that I am not able to resolve. Would like to say more about the topics listed but length limitations preclude it. I have added two sentences and an additional reference on the nature of the controversy about how emissions can be reined in.
07-002	11	7	General		The key parts on projections and mitigation options/potentials are only presented weakly – what is driving per capita travel and freight, what is driving fuel use/travel or fuel use/freight, and what changes would mitigate these.				X	X		I have discussed the key driving factors behind travel and freight activity, and the relation of these to carbon emissions. Length limits preclude the depth this reviewer would like to see.
07-003	11	7	General		For Mexico, I recognize that data and even analyses are not good, but it would be very useful to review some work (even in English, but Spanish language work is more thoroughly) to give a few on projections and mitigation options. This is because Mexico is not totally motorized, so mitigation means more avoidance rather than changes to patterns that have take hold in the US and Canada.			X				Additional data for Mexico have been incorporated into the chapter text where appropriate and where such data are available.
07-004	11	7	General		Are uncertainties or incompleteness in the evidence explicitly recognized? NO, this is a major weakness. The data from each country are fraught with uncertainties that at times are extremely misleading. This is not the fault of the author, but he should point these problems out explicitly, as others will quote these data as if they are whole. They are not. This is recognized in the last bullet of the "Key Findings" .		X			X		I have incorporated a discussion of uncertainties and a table showing Canada's rather detailed estimates. As such data go, the data for the U.S. and Canada are quite accurate, as the added text and tables show, although there are a few problem areas.
07-005	11	7	General		As above, series problems in the data from each country make the overall presentations of each country incompatible with each other And there is little analysis applied to Mexico, the country portending the largest growth, and therefore the largest deviation from trends.					X		There are some incompatibilities, but I think there are more consistencies. I have added a brief discussion of inconsistencies. Mexico may portend the greatest growth but: 1) according to the projections cited, the growth is similar to that of the U.S. and, 2) the U.S. emits an order of magnitude more C, and is projected to continue to do so even in 2050.
07-006	11	7	General		In general the huge differences in population and GDP of these countries make comparisons of absolute totals rather hopeless. It would be much more enlightening if comparisons were also offered on a per capita bases, and per unit of GDP correctly calculated using purchasing power parity of a similar base year for each country.					X		My discussion chiefly attributes differences among the countries to the size of their economies and of their populations. This, of course is what showing emissions per capita or per dollar of GDP would illustrate. Thus, I think I have covered this point. Additional graphs would be nice but space is limited.
07-007	11	7	General		The report is fair and balanced but lacking a few important elements. For example, "Options for Management" skips over the heart of why there is a controversy over how much GHG could be managed. The author himself has probably written more balanced analysis of this controversy than anyone else, something worth summarizing here.						X	My view is that there is controversy over what can be done as a consequence of deliberate obfuscation by certain automobile manufacturers, energy companies and others who perceive that it is in their interest to oppose the public's interest in dealing with climate change. Personally, I would be happy to name names in this report, but I doubt this is what the editors have in mind.

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CHAPTER 7**

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07-008	11	7	General		Are any of the report's findings based on value judgments or the collective opinions of the authors? If so, is this acknowledged, and are scientifically defensible reasons given for reaching those judgments? NO, if anything the report is so devoid of "sides" it almost comes off as empty of real content.	X						Thanks?
07-009	11	7	7-1		In the fourth bullet, I would say 'biomass is a promising medium- and long-term option'. There is little evidence that <u>significant</u> amounts of biomass can reduce GHG emissions in the US or Canada in the near term.		X					
07-010	11	7	7-5		Acknowledge that Mexico simply has no acceptable data on vkm by type or mode, and only has data for limited modes for pass-km or tonne-km, period. However, it is possible to note that Mexican land travel p-km is dominated by urban and inter-city buses, with rail playing a minor amount.	X						
07-011	11	7	7-8	1	Surely the author meant EJ, as 4.3 PJ is a truly tiny amount, well less than .001% of likely emissions in 2025.					X		I wish that were the case. EIA estimates very little change in transport energy use for large carbon taxes.
07-012	11	7	7-14	Table 7-1	State explicitly how emissions from electricity production for power used by transport are counted.		X					Unfortunately the source documentation does not say. Since emissions must come from upstream, I have taken them out of the tables in this chapter.
07-013	11	7	7-15	Table 7-2	First, the US and Canada are probably the only countries in the world that (correctly) report natural gas use for pipelines as transport. Please check if this is the case for Mexico – it looks to me as if only natural gas vehicles are counted. Second, until the late 1990s at least, Stats Canada reported all bunker fuel used by Canadian owned ships, whether in international or domestic (coastal, river, lake) transport, as "domestic". Kindly check whether this rather huge error (about a factor of five) has been eliminated.			X				Environment Canada, in its greenhouse gas inventory now separates international bunker fuel use and resulting carbon emissions for both aircraft and waterborne transport from domestic use. Indeed, they do not report the international bunker fuel use in their inventory, but only the domestic.
07-014	11	7	7-17	Table 7-3	Canada and the US are able to allocate electric traction into rail and a small amount into road transport. Why not Mexico? It might be valuable to break each kind of transport into fuels, i.e., Road, rail, waterborne, and pipeline. Worse, when one examines the table casually, one notes the ratios of emission to fuel for any given row differ noticeable between Canada and the US. This seems to be a figment of the different definitions of "carbon emissions" and should be fixed. Bunkers are only listed for the US, and then only their CO2 emissions. These should be explored further to 1) obtain similar figures for the other countries (or as I suggested elsewhere, ascertain whether Canada (and for that matter) count bunkering of aircraft or ships correctly) and 2) make both international aircraft fueling and international shipping part of bunkers.			X				I think Mexico, since it is a non-Annex 1 country and therefore not required to compile a GHG inventory according to IPCC guidelines, has not put the effort into developing these data that the two Annex 1 countries have.

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07-015	11	7	7-17	Table 7-3	The comments on Table 7.3 are troubling. If the Canadian data include different GHG than the US data, why not calculate the CO2 emissions from Canada in a comparable way --- this involves roughly 15 calculations, as was apparently done for the Mexican emissions. Again, this kind of problem leads to someone else copying the table without the caveats...I strongly object to ignoring the carbon emissions of electricity.		X					Inconsistencies in the data from the three countries have been addressed by using greenhouse gas inventory data prepared in accordance with IPCC guidelines as the authoritative source and adjusting the definitions to be comparable, with the exception of Mexico's estimates, where this is not possible. A section discussing inconsistencies has also been added. Tables 7-2 and 7-3 now are used to illustrate relationships between energy use and greenhouse gas emissions.
07-016	11	7	7-21	Fig 7-3a	As late as the late 1990s, Canada omitted "own account" trucking tonne-km. Please check whether these are now counted, since their counting backwards would have entailed some serious work. Please note that the US does not tabulate road freight as other countries do, rather by vehicle ("class 1"), and that some kinds of road freight, namely intrastate, are not counted but only estimated by Eno foundation and others. Kindly also check what tonne-km are counted in the Mexican data.						X	The freight data used come from a joint website produced by the transportations statistical agencies of the three countries. The U.S. road freight data have been estimated by the BTS from the Commodity Flow Survey and a variety of other sources. The data do include intrastate truck freight. There are of course difficult areas, such as local delivery. Resolving these issues is, I think, beyond the scope of this chapter.
07-017	11	7	7-22	Fig 7-4a	Surely we could portray the US travel by mode for 2003 or at least 2002 for a report set to appear in 2006! The same should be true for Canada. Rather than relying on an old source (NATS)...A troubling aspect of these data is that they imply there is nearly as much passenger travel in light trucks as in cars. It should be noted that this estimate must be counting the use of commercial light trucks to/from work, which is acceptable as long as it is clearly marked. Otherwise, light trucks/SUVs in the US account for something like 40% of total travel.			X				Well, it would be nice if these data issues were simple. As it turns out, even for the U.S., certain items of passenger travel have not been updated since 2001. However, all the important components are up to date through 2003, and most to 2004. I think the thing to do is use 2003 for U.S. and Canada, and I have updated those figures.
07-018	11	7	7-23 and 7-24	Fig 7-5a and 7-5b	Figures 7-5 a and b are mislabeled. The first is Mexico, the 2 nd is the US. Figures 7-5x and 7.6x should be made as compatible as possible. Thus "international" in Figure 7-6b—where is that in Figure 7-5b? Why did we switch to EPA source, whose basic assumptions about energy use in transport may not agree with those used in earlier figures? Note these should also be shown per capita and per unit of GDP in US dollars converted at purchasing power parity.		X					
07-019	12	7	General		Transportation is an extremely complex topic, and the authors are to be commended for covering so much information in so little space. By necessity, the treatment of various issues has had to be compressed. But, by and large, I think that the chapter does a good job of presenting both the factual information and the complexity of the issues. I do have one significant concern and several smaller ones, as detailed in the following items.	X						

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07-020	12	7	7-3	9-14	The draft states: "In this chapter, upstream, or well-to-tank, carbon emissions are not included with transportation end-use, nor are end-of-life emissions produced in the disposal or recycling of materials used in transportation vehicles or infrastructure. These two categories of emissions typically comprise 20-30% of total life cycle emissions for transport vehicles [citation omitted]. In the future, it is likely that upstream carbon emissions will be of greater importance in determining the total emissions due to transportation activities." The final sentence of this quotation is certainly correct, but it understates the potential importance of upstream carbon emissions in determining transport-related carbon emissions. I believe that the report cannot claim to have provided an appropriate understanding of the likely evolution of transport-related emissions without incorporating a discussion of the "well-to-tank" emissions of various fuel types.				X			In spirit, I agree with this comment. If there were more space I would elaborate. However, the structure of the report and its conventions are such that emissions in other sectors that are producing inputs to the transportation sector are reported in the chapter dealing with that other sector. This point made by this comment is sufficiently important, however, that serious consideration should be given at a higher level in the report to dealing with such cross-cutting issues.
07-021	12	7	General		When I first read the paragraph quoted above, I thought that the "well-to-tank" portion of transport-related carbon emissions might be discussed in Chapter 6, "Energy Extraction and Conversion." However, when I looked at Chapter 6, this proved incorrect. I have yet to be able to find such a discussion anywhere in the report.	X						
07-022	12	7	General		Ironically, the discussion in the chapter is not consistent with the first of the two sentences quoted above. At several places throughout the chapter, the authors acknowledge the importance of looking at "full fuel cycle" emissions. For example, on page 7-6, lines 10-12, the draft states: "Carbon emissions by transport are determined by the levels of passenger and freight activity, the shares of transport modes, the energy intensity of passenger and freight movements, and the carbon intensity of transportation fuels." (emphasis added) In fact, a given change in <i>any one</i> of these four factors, <i>ceteris paribus</i> , produces the same change in carbon emissions from transport. Changes in the carbon intensity of transport fuels can magnify or offset changes in the energy intensity of passenger and freight movements. Understanding the conditions under which magnification and/or offset occurs is vital.			X				Again, this issue of activity in one sector causing emissions in another is important but I think needs a consistent treatment across the economy.

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07-023	12	7	General		There is no lack of information on "well-to-tank" emissions of transport fuels. In our WBCSD report, we took special pains to show both "well-to-tank" and "tank-to-wheels" carbon emissions for a wide range of transport vehicle types and fuel types. Our spreadsheet model was designed to permit us (and any other user, since we made it available on the web) to analyze these two components either separately or together. In the WBCSD report itself, we included charts showing the relative importance of each component. We also presented the results of analyses showing the relative impact on transport-related carbon emissions of various changes in vehicle technologies and fuels. The analyses we presented were for the entire world, but the model is set up to permit similar analyses for individual regions, including North America.			X				Same response. I cite reports containing analyses of the well-to-tank issue and note its importance.
07-024	12	7	General		I strongly urge that Chapter 7 be modified to incorporate "well-to-tank" emissions and to discuss in detail the tradeoffs between "well-to-tank" and "tank-to-wheels" emissions implied by a number of potential transport-related actions. Otherwise, the chapter will produce a distorted and incomplete view of transport-related carbon emissions.						X	I may be mistaken, but my understanding is that Ch. 7 is to deal with the carbon flows from transportation rather than flows in other sectors induced by transport activity or energy use. I in no way dispute the importance of the subject the reviewer has raised and the fact that it should be addressed somewhere in the report. I note its importance and give refs. but not data.
07-025	12	7	7-5 et seq		In the section titled "Trends and Drivers," the impression is created that the absence of fuel economy standards applied to freight trucks is responsible for the fact that emissions from freight have grown faster than emissions from passenger transport. Specifically, on line 34 of page 7-5 and lines 1-6 of page 7-6, growth in freight and passenger transport energy use for the US and Canada are compared. The assertion is made that "Fuel economy standards in both countries were effective in restraining the growth of passenger car and light-truck energy use." The statement is then made that freight energy use increased faster than passenger car energy use. From this, the reader may draw the implication that had fuel economy standards been applied to trucks, the rate of increase in freight energy use and emissions might have been considerably lower. I know of no information to support such an impression. In the		X					I think too much is being read into this. However, if this reviewer took it that way others will also. I have made changes to the wording to try to avoid this inference. However, the assertion that medium and light truck fuel consumption rates have declined significantly is not supported by U.S. data. FHWA data show the average energy intensity per vehicle mile for medium and heavy trucks was 5% lower in 2002 than in 1973.
07-025 (cont)					absence of fuel economy standards, fuel consumption per mile by medium and large trucks has declined significantly. And the energy efficiency of air transport has also improved significantly without standards.							
07-026	12	7	General		The factor driving the improvements in both freight and air transport is the value of reducing fuel consumption. Fuel costs are such a large percentage of the total operating cost of both modes that fuel economy is a very important feature. In contrast, fuel costs for light-duty vehicles are a relatively small share of total vehicle operating costs.	X						A reasonable assertion but as the reviewer points out there is little analysis to decide the issue one way or the other. Japan has recently instated heavy truck fuel economy standards as a greenhouse gas mitigation policy because, they say, they challenge this assertion. More analysis is needed.

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07-027	12	7	General		The draft notes the sharp differences in the estimated cost of reducing fuel consumption in light-duty vehicles generated by "top down" and "bottom up" estimates. In my own experience, this difference results from contrasting assumptions employed in the two types of studies. The "top down" estimates are based on projections of historical trends of how consumers have responded to changes in vehicle and fuel prices. The "bottom up" estimates assume that the vast majority of the technological potential to reduce fuel consumption is actually devoted to doing so. However, as the annual EPA study of fuel consumption performance clearly shows, only a small fraction of the technological potential to reducing fuel consumption actually has been devoted to doing so. The vast majority has been used to improve acceleration and permit larger vehicles. Only when fuel prices "spiked" in the late 1970s did the actual improvement exceed the technological potential. This was possible because	X						When manufacturers were striving to meet fuel economy standards, technology was used to increase MPG. Once the standards had been met in 1982-85, the technology was used to hold MPG constant while increasing primarily horsepower but also weight, especially for light trucks. True, much of the weight reduction in passenger cars in the 1970s was due to a switch to front wheel drive and unibody vs. chassis on frame construction. I consider this to be "technological", although it is certainly also "weight reduction." Differences between top down and bottom up studies, especially for transportation, extend beyond technological potential, to include such things as land use planning, pricing incidence, and so on. The point is there are many reasons why top down and bottom up conclusions differ. Given space limitations, I did not go into the subject in depth.
07-027 (cont)					of the sharp shift in vehicle mix purchases – a shift that reduced the average weight of new passenger cars by approximately 1000 pounds with little or no change in technology. (Front-wheel drive cars came later.) The report needs to discuss this issue in a somewhat more balanced manner.							
07-028	12	7	General		The draft gives only slight attention to the growing importance of air transport as a source of transport-related GHG emissions. (In the case of air transport, emissions in addition to carbon dioxide are significant.) Our analysis showed that, even though the fuel consumption per passenger carried in air transport is improving relatively rapidly, the growth in air transport demand is so great that air transport will become an increasingly-significant source of transport-related GHG emissions in the future. (Its present significance is understated by the authors' decision to exclude aviation bunkers from their fuel use totals.) Emissions from air transport are certain to become a growing source of political and social concern in the decades ahead. The issue should at least receive a mention.					X		This may well turn out to be true, but it is not reflected in the EIA's forecasts of energy use by mode for the U.S., which accounts for the overwhelming majority of North American carbon emissions from transportation. The EIA projects the same share of transportation energy use for air in 2025 as today.
07-029	13	7	General		Chapter 7 presents a balanced and fair synthesis of the state of knowledge and its conclusions are supported by published evidence and analysis. At the same time, as is highlighted by the author, there is a need for improved data and comprehensive and systematic assessments of mitigation potentials by each country.	X						
07-030	13	7	General		The chapter describes hybrid vehicle, plug-in hybrid vehicle and fuel cell vehicle technology all as "highly" promising (p. 7-11, l. 6). In the Key Findings (p. 7-1, l. 26 and Executive Summary (ES-9, l. 21), hydrogen fuel cell technology is noted as an option for reducing transportation carbon emissions, but hybrid technology (grid and non-grid connected) is not noted. Hybrid technology should be highlighted in these places or the justification for highlighting hydrogen fuel cell technology above hybrid technology should be provided.			X				Wording has been changed somewhat.

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07-031	13	7	General		The Options for Management section (pp. 7-7 – 7-10) presents a balanced review of studies of the costs of CO ₂ mitigation from the transportation sector. Given the likelihood of high and possibly volatile oil prices, some additional discussion on how high oil prices may affect these cost estimates would be useful.				X			1. The response to high oil prices appears to be surprisingly small at present. This could be because changes take time. 2. It is not at all clear that oil prices will remain high for a decade or more. This is quite controversial.
07-032	13	7	7-9	24	Table reference 7-4 probably correctly refers to Table 7-5.		X					Thanks.
07-033	13	7	7-9	31	The numbered list is missing point (4).		X					Points incorrectly numbered. Thanks.
07-034	13	7	7-1	25	The term "carbon fuels" should be replaced with "carbon-based fuels."		X					
07-035	13	7	7-3	32	The text notes that "[t]his pattern of energy use has persisted for more than half a century" and refers readers to Figure 7-1. Figure 7-1 shows the regional breakdown of transportation energy use since 1990. Has there been a shift in the Figure numbering?	X						Thanks. The figure to which this sentence referred was deleted from an earlier draft to reduce the length of the chapter. The vestigial reference has been removed.

**Comments and Responses on SOCCR/SAP 2.2 Draft 1 (May 2006)
CHAPTER 8**

COMMENT FROM PEER REVIEWERS					AUTHOR'S RESPONSE							
Comment Number	Reviewer ID	Chapter	Page	Line	Comment Text	Acknowledged, but no further response or revisions are required	Revisions have been incorporated as suggested in the comment	Agree, but see "Notes on Response"	Agree, but elaboration is precluded by length limitations	Disagree; see "Notes on Response"	Beyond scope of report/chapter	Notes on Response
08-001	14	8	General		Are the scope and intent of the synthesis and assessment product clearly described in the report? YES.	X						
08-002	14	8	General		Are all aspects of this charge fully addressed? NO. Report should provide quantitative estimates of carbon sequestration in products and wastes (i.e., on page 8-10). EPA (2005) is an appropriate source.			X				EPA has data for US but not for Canada or Mexico. US data have been put in table 8-2. No data could be found for Canada or Mexico.
08-003	14	8	General		Do the authors go beyond this charge or their expertise? NO.	X						
08-004	14	8	General		Are the conclusions and recommendations adequately supported by evidence, analysis, and argument? NOT IN ALL CASES.	X						
08-005	14	8	General		Report should provide much more documentation to support the author's estimates of potential emission reductions and costs shown in Table 8-3.			X				I have introduced a number of other articles and supporting literature in the "Explanatory Notes" section from which guidelines and, in some cases, costs were obtained that were used to derive the costs listed in table 8.3 There is no room to better define specific quantities as these are the authors educated estimates. I have also added some more commnets just prior to the table and have notionally categorized the supporting documents by what they address.
08-006	14	8	General		Author's estimate that pulp and paper emissions could be reduced 40% for less than \$25 per ton CO2 is unrealistically low.			X				I presume this is a reference to the "Fuel substitution" cell in Table 8-3. I am suggesting that, just from fuel substitution, the industry might be able to reduce emissions by 40% for under \$25/t, but there is also an energy efficiency improvement of 10% possible at that CO2 cost, plus there are some reductions through process change and fugitive emissions reductions that may be available for less than \$25/t. As I explained in the text, these different avenues to reduction are not independent so it is very difficult to say what the total reduction might be for under \$25/t. It could be 60% or more. The point of the table is to give some idea that, generally, it is cheaper to use fuel substitution than process change and / or some levels of efficiency and some idea of the relative indication of what that aspect alone (i.e., fuel substitution) might potentially provide.
08-007	14	8	General		Report should make clear that several of the studies cited as support for estimates of potential emission reductions were focused on "technical potential" without regard to economic and structural limitations on emission control options. Estimates of potential reductions based on "technical potential" may be too high.		X					
08-008	14	8	General		Are uncertainties or incompleteness in the evidence explicitly recognized? NO – see previous comment.		X					
08-009	14	8	General		Are the data and analyses handled competently? Are statistical methods applied appropriately? IN SOME INSTANCES, NO.			X				Statistical information on the data are often not available. What was available was presented.
08-010	14	8	General		The report does not consistently distinguish biomass carbon from fossil carbon. For example, biomass and fossil carbon are combined in the Figures 8.2, 8-A1, 8-A2, and 8-A3.			X				To get a comprehensive picture of the carbon cycle, all carbon is included in the diagrams, whether from biomass or fossil fuel. I have added some comments to enhance this. I only make reference to the differences between these two flows of CO2 when dealing with attribution issues (estimation of net emissions generation) or cost of carbon.

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08-011	14	8	General		It appears calculation errors were made in producing cost numbers in lines 7-13 on page 8-12. Cost per increment CO2 should be less than (not greater than) equivalent cost per increment C.		X					
08-012	14	8	General		Page 8-12 includes the statement that "as the cost of carbon increases, one can always obtain greater reductions, but the return on these expenditures becomes marginal or insignificant." The basis for this statement should be explained.		X					
08-013	14	8	General		The economics of industrial emission reductions is a complex subject that cannot be explored in depth in this report. Perhaps the author should eliminate the sector-level analysis (Table 8-3) and instead provide a broader overview of the relevant literature including general factors affecting the feasibility and cost of reductions. The concept of "capital investment cycles" should be mentioned as an important factor that should be considered when assessing emission reduction options.			X				I agree with the comment about the complexity of the values. I have included a comment on capital investment cycles in that there are various views on this matter as well. I've estimated many of the costs associated with emissions reductions from many sources, most of which are listed and described more fully in the following section "Some explanatory notes". I believe the table is a fairly clear picture of the realm of costs associated with reduction and is helpful to the reader re: general perspective on costs of emissions reductions.
08-014	14	8	General		Are the report's exposition and organization effective? Is the title appropriate? YES	X						
08-015	14	8	General		Is the report fair and appropriately balanced? YES	X						
08-016	14	8	General		Is the report's tone impartial and devoid of special pleading? YES	X						
08-017	14	8	General		Are any of the report's findings based on value judgments or the collective opinions of the authors? NO.	X						
08-018	14	8	General		Does the executive summary concisely and accurately describe the key findings and recommendations? YES	X						
08-019	14	8	General		Is it consistent with the other sections of the report? YES	X						
08-020	14	8	8-6		The text includes the statement that "These plants could be considered carbon neutral ... etc." This statement should be rewritten to make it clear that the concept of carbon neutrality applies to biomass fuels and not necessarily to a facility that uses biomass fuel. For example, the statement might be rewritten as follows: "Biomass fuels are considered carbon neutral because return of the biomass carbon to the atmosphere completes a cycle that began with carbon uptake from the atmosphere by vegetation"		X					
08-021	14	8	8-6		The footnote should also be revised to indicate that carbon neutrality applies to biomass fuel and not necessarily to an industry that uses biomass fuel.		X					
08-022	14	8	8-9		The accuracy of third sentence could be improved by inserting the word "often" as follows: "For example, recycling materials often reduces demands in processing...."		X					
08-023	14	8	8-11		The accuracy of second complete sentence could be improved by inserting the word "sometimes" as follows: "Their combustion greatly alleviates the net contribution to GHG emissions and sometimes provides power or steam... etc."		X					

**Comments and Responses on SOCCR/SAP 2.2 Draft 1 (May 2006)
CHAPTER 8**

COMMENT FROM PEER REVIEWERS					AUTHOR'S RESPONSE							
Comment Number	Reviewer ID	Chapter	Page	Line	Comment Text	Acknowledged, but no further response or revisions are required	Revisions have been incorporated as suggested in the comment	Agree, but see "Notes on Response"	Agree, but elaboration is precluded by length limitations	Disagree; see "Notes on Response"	Beyond scope of report/chapter	Notes on Response
08-024	14	8	8-11		The footnote may be incorrect. IPCC 3rd Assessment Report (WG1, Sec. 6.12.3) says "...the climate forcing caused by CO2 produced from the oxidation of CH4 is not included in.... GWP estimates."		X					

**Comments and Responses on SOCCR/SAP 2.2 Draft 1 (May 2006)
CHAPTER 9**

COMMENT FROM PEER REVIEWERS						AUTHOR'S RESPONSE						
Comment Number	Reviewer ID	Chapter	Page	Line	Comment Text	Acknowledged, but no further response or revisions are required	Revisions have been incorporated as suggested in the comment	Agree, but see "Notes on Response"	Agree, but elaboration is precluded by length limitations	Disagree; see "Notes on Response"	Beyond scope of report/chapter	Notes on Response
09-001	15	9	General		Are the scope and intent of the synthesis and assessment product clearly described in the report? Are all aspects of this charge fully addressed? Do the authors go beyond this charge or their expertise? YES/YES/YES	X						
09-002	15	9	General		Are the conclusions and recommendations adequately supported by evidence, analysis, and argument? YES	X						
09-003	15	9	General		Are uncertainties or incompleteness in the evidence explicitly recognized? YES	X						
09-004	15	9	General		Are the data and analyses handled competently? Are statistical methods applied appropriately? YES/ YES	X						
09-005	15	9	General		Are the report's exposition and organization effective? Is the title appropriate? YES/YES	X						
09-006	15	9	General		Is the report fair and appropriately balanced? YES	X						
09-007	15	9	General		Are any of the report's findings based on value judgments or the collective opinions of the authors? If so, is this acknowledged, and are scientifically defensible reasons given for reaching those judgments? NO	X						
09-008	15	9	General		Does the executive summary concisely and accurately describe the key findings and recommendations? Is it consistent with the other sections of the report? YES/YES	X						
09-009	15	9	9-1	28	"...secondary to reducing building costs." It's not clear what this means. If it is an assertion that systematic pursuit of cost reduction (e.g., over the previous building built or the previous month's expenses paid) is a primary motive/activity in the buildings sector, I'd like to see some evidence or reference to previous work.		X					Added Footnotes and Reference
09-010	15	9	9-2	17	Footnote 5 requires a better reference.		X					Added Reference
09-011	15	9	9-2	19	"...large area available for siting..." the amount of floor space doesn't convert very directly to roof area for solar, e.g., on multi-story buildings		X					Added Footnote and Reference
09-012	15	9	9-3	1-2	We don't have enough information to understand what these "fluxes" are.			X				Sentence Removed. Other carbon fluxes refers to carbon in materials used in renovations, energy used in construction, renovation and demolition, embedded energy in materials, and energy associated with water use. Most or all of these elements may be included in sectors covered by other SOCCR chapters.
09-013	15	9	9-5	10	Define "Mt"; is this a large number?		X					Replaced with "metric tons" in a previous version
09-014	15	9	9-5	13-15	The California total includes a considerable amount of energy used for agricultural pumping. The following sentence would seem to reinforce that, since 94% of total US water use seems to be going somewhere besides homes and businesses. This needs to be clarified in the text.		X					Removed sentence referring to California, in order to avoid confusion. Reversed order of sentences in lines 12-15.
09-015	15	9	9-5	19-22	A very awkward sentence.		X					Sentence Revised and shortened.
09-016	15	9	9-6	1-2	Should provide some #s to support this.		X					Added Footnote refering to household size statistics in Table 2

**Comments and Responses on SOCCR/SAP 2.2 Draft 1 (May 2006)
CHAPTER 9**

COMMENT FROM PEER REVIEWERS						AUTHOR'S RESPONSE						
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09-017	15	9	9-6	6-7	If "...wealthier people live in larger households..." means that family size increases with income, I'd like to see a reference to those data. There is a modest correlation in the US Census data between household size and income, but it is very modest and the causal direction likely goes the other way (more people = more money). If the statement is supposed to mean that income is correlated with dwelling size, that may be supportable, but the relationship is not linear and is complex. In either case, reference to data is needed.		X					Revised Sentence for Clarity
09-018	15	9	9-7	15	"...will likely include one or more..." I think the author intends to say "more than one." If not, the sentence doesn't make much sense. If the list is exhaustive, then, by definition, any effective approach will include at least one of its elements.		X					Accepted Suggestion
09-019	15	9	9-7	18	Definition of "ESCO" needed.		X					Added Footnote
09-020	15	9	9-9	17	Not clear what "including energy demand and supply" means.		X					Revised Sentence
09-021	15	9	9-9	26	What is a "roadmap" that will need to be updated?		X					Reference to Roadmap removed in current version
09-022	15	9	General		Overall Assessment: A useful review that could benefit from some editorial work and tightened references.	X						No Reponse Needed
09-023	15	9	General		Conclusion: Unfortunately, the paper tiptoes around the questions of (1) the sources of the market failures that are apparent in this sector, (2) what can be done to address those failures, and (3) what the mostly likely avenues to success might be. I suspect that it is the nature of the authors' charge—including a quest for a scientifically objective tone and the current political climate surrounding climate change issues and Federal science policy in general—that limits the paper in this way, not a weakness in their knowledge.	X						No Reponse Needed

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CHAPTER 10**

COMMENT FROM PEER REVIEWERS						AUTHOR'S RESPONSE						
Comment Number	Reviewer ID	Chapter	Page	Line	Comment Text	Acknowledged, but no further response or revisions are required	Revisions have been incorporated as suggested in the comment	Agree, but see "Notes on Response"	Agree, but elaboration is precluded by length limitations	Disagree; see "Notes on Response"	Beyond scope of report/chapter	Notes on Response
10-001	16	10	General		I think that the authors contributing to this chapter have done an excellent job summarizing (in a logical, easy to read manner) how the bidirectional exchange of CO ₂ and CH ₄ in/out of these landscapes is being affected by climate and changing land management.	X						
10-002	16	10	General		While the title is succinct, I am left to ponder whether "Arid Lands" really belongs in it? I scanned the paper a few more times after the initial read of it, and I would estimate 99% of what is written are in relation to agriculture, pastures, and grasslands. There is minimal discussion of woody encroachment, and very little attention paid directly to arid lands in the context that there is something distinctly different about C cycling on Arid Lands to warrant its separation in the title. Would it be better to add "Pastureland" (or grazing lands) into the title instead? I encourage the authors to think a bit more as to whether a better title needs to be constructed.					X		The reviewer was correct, that arid lands were a minor component of this report. We the authors extracted our title from titles given for what was originally all or part of three chapters: (1) Agriculture, (2) Grass and Rangelands, and (3) Shrublands, Arid Lands (and Urban Ecosystems). Arid lands are not covered elsewhere in the document, but we have addressed the comments regarding woody encroachment (comment 10-027) and fire (comment 10-026) which are the only specific comments related to arid lands. We have changed the title to better reflect the text of the chapter.
10-003	16	10	General		I wrote out the overall outline of Chapter 10, and noted that the major headings are: (1) Inventory, (2) Drivers and Trends, (3) Options for Management, and (4) Research and Development Needs. This seemed appropriate, although within (3) above, I thought that the subheadings "Economics and Policy Assessment", and "Other Policy Considerations" might be deserving of their own separate major heading (relating to policy). However, I am guessing you are trying to adhere to a standardized outline given for constructing these report chapters so it's probably OK to leave as is. In present form, there really isn't a disruption to the flow of the chapter, so it's probably a minor point.					X		As this reviewer suggests, this is a minor point and we have decided to leave the heading organization as is to correspond with other chapters.
10-004	16	10	General		I particularly liked the last section (4) that highlights the urgent need for a more organized & expanded network of field monitoring sites. Halleluia! Currently, it seems as if it's real easy to establish eddy covariance flux towers to measure short timescale fluxes (it's the attractive and very fundable thing to do if you are filling a data void for an obscure ecosystem), but why doesn't it seem to be just as easy to get an organized monitoring array of field study sites established for measuring soil C stocks (when this is something that actually tells us the integral of many years of flux measurements)? Hopefully NACP starts to change that.	X						
10-005	16	10	10-21	Table 10-1	Caption: I think this could be worded better considering the first line starts off "Carbon pools for undisturbed native systems were derived..." and the table is showing C pools for ag/grazing lands. While I know you have a story to tell as to how you derived these values, it might be best to not start it off the way you currently have it. Maybe something like: "Current soil C stocks are secondary quantities derived from an initial starting point of undisturbed native ecosystem C content, which were quantified using the intersection...These undisturbed ecosystem stock values were then multiplied..."		X					Rewrote caption based on reviewer suggestions

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CHAPTER 10**

COMMENT FROM PEER REVIEWERS					AUTHOR'S RESPONSE							
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10-006	16	10	10-3	26-27	... manipulating species composition and growing conditions. Are you implying irrigation? It might be nice to put in parentheses the examples you are thinking of. If the manipulation of growing conditions is only in relation to irrigation, then I would just state that.		X					added parenthetical statement, pg 10-3, line 28-29.
10-007	16	10	10-3	29-31	I'm not entirely sure that what you state here is indeed accurate, particularly the restricted growing season length argument for croplands, and how this can reduce carbon uptake relative to that in other ecosystems. First, the C uptake of many temperate and boreal forests is occurring at nearly the same time as it is on croplands (let's say roughly April – September) in the central U.S., for example and annual productivity is currently much higher than of many natural ecosystems (see Article "Gross primary production and ecosystem respiration of irrigated maize and irrigated soybean during a growing season" by Suyker et al., 2005, Agric. For. Meteorol., 131: 180-190). Suyker et al. (2005) cite GPP value for maize (1744 g C/m ²) that are larger than temperate deciduous forests (1122-1507 g C/m ²) and most temperate and boreal coniferous forests (992-1570 g C/m ²).			X				This sentence may be confusing, because it attempts to cover all bases by stating that ag systems are among the most productive, but some factors <i>can</i> limit production. We have tried to clarify this by making it clear that this is only true in some cases.
10-008	16	10	10-3 & 10-4		My understanding is that another contributing factor for the depleted C stocks in agricultural soils was that low cropland productivity from the mid 1800s – 1930s was replacing higher NPP ecosystems (prairies/grasslands) which had a higher proportion of their assimilated C allocated belowground (e.g., 70-80% for prairies vs. 15% for row crops); thus, this fact coupled with the burning of crop residues and tillage have led to this observed decline in soil C levels. However, now that crop productivity has increased 6-fold, thereby increasing the amount of residue available to go back, and conservation tillage is now used on a large fraction of land, these lands are now realizing their potential to become C sinks (e.g., Buyanovsky and Wagner, 1998). It would be nice to see this minor point covered somewhere in this section, and in the discussion at P.10-4, L8-10.		X					Altered text to include this. Pg 10-4, lines 14-16, pg 10-7, lines 11-21
10-009	16	10	10-4	4	What are the increased decomposition rates attributed to? Increased N inputs, and lower C:N of residue?		X					Disturbance; altered text to explain this. Pg 10-4, line 8
10-010	16	10	10-23	Fig 10-1	It appears that the data presented in Table 10-2 duplicates verbatim the pictorial presented in Figure 10-1. Thus, could the figure be deleted? If I were to have my pick as to which data presentation method to chose, it would be the table because the reader can easily extract quantities without having to guess/interpolate values from a chart. While the Figure is a nice visual display, I am not sure it is adding anything in addition to the table considering the duplication in information.					X		This figure was included in reponse to a suggestion by a previous reviewer that we put this information into a figure in addition to the table. We feel that the redundancy of this key information is not problematic.
10-011	16	10	10-5	27-28	Excellent point.	X						

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CHAPTER 10**

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10-012	16	10	10-6	19 et seq.	In the first paragraph, you might want to consider mentioning the debate of how much sequestration might be expected, e.g., how much of the gap between pre-settlement levels of soil C and current values can be made up by the trends in current practices. This will at least put things in perspective that it's not expected that we are going to be able to recover 100% of what was once lost, and that it isn't going to happen in the next decade no matter how much land management practices change to deliberately sequester C.			X				The issue of potentials is discussed in the next section. We give two principle citations on the issue of potentials. We also discuss issues of permanence and economics later in the document.
10-013	16	10	10-6	19 et seq.	I am going to suggest that this section be expanded upon a bit; it's very short and it is a bit limited to a discussion of soil C stocks and how they might be affected by warmer temperatures (citing the debate in the literature currently about how decomposition and respiration might be influenced by climate change). It seems there needs to be at least a paragraph or two to balance these arguments, discussing how the uptake of C and inputs to the soils on these lands might be affected by (1) changing temperature regimes also (2) other factors – e.g., more than the brief mention of how climate could perturb productivity (P.10-7, L.13-14) at the end of the section.			X	X			We have included more discussion on CO2, temperature, and genetic advances impacts on crop yields. We think that space precludes us from including more on these issues, but we have cited the relevant literature which readers can consult for more detailed information.
10-014	16	10	10-6	19 et seq.	Some potential discussion points that come to mind: (1) impact that warmer temperatures might have on extending the growing season length in northern locations (e.g., northern Corn Belt, southern Canada, allowing earlier planting) and how this would likely help to increase plant productivity and C inputs; (2) However, warmer temperatures may actually decrease yields and productivity in southern regions that aren't already temperature limited as the longest season hybrids might actually mature more quickly (e.g., progress through their complete phenological phases), and thereby decrease the amount of APAR and the time the plant has to accumulate biomass (you might want to refer to the Lobell and Asner, 2003 paper in Science on trends in yields influenced by management and climate); (3) Continued genetic improvements to crops and an increase in nitrogen use efficiency will allow for yields and residue to gradually			X	X			See previous comment
10-014 (cont)					edge upward, although we might be well-entrenched in the law of diminishing returns as it is getting more and more difficult to increase yields each year. Some additional search of the literature is probably necessary here.							
10-015	16	10	10-6	19 et seq.	The authors might have better ideas on how to fill this section out to present both sides of the story, particularly how temperature perturbations can lead to a very complex net result because increased CO2 efflux might be balanced by more C inputs. You will also have to integrate more discussion here with what is already stated in more general terms on P.10-7, in lines 25-27.			X	X			See previous comment

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CHAPTER 10**

COMMENT FROM PEER REVIEWERS						AUTHOR'S RESPONSE						
Comment Number	Reviewer ID	Chapter	Page	Line	Comment Text	Acknowledged, but no further response or revisions are required	Revisions have been incorporated as suggested in the comment	Agree, but see "Notes on Response"	Agree, but elaboration is precluded by length limitations	Disagree; see "Notes on Response"	Beyond scope of report/chapter	Notes on Response
10-016	16	10	10-24	Fig 10-2	You might want to add to the caption that the default soil C stocks refer to a value of 1.0 – the dotted line – in Figure 10-2. While this might sound a bit ridiculous, I wouldn't take any chances on assuming that everyone is going to know that the dotted line is referring to the conventionally tilled, medium-input cultivated land and/or moderately grazed...		X					Figure 10-2 caption has been modified.
10-017	16	10	10-24	Fig 10-2	You also have a typo for the "temperate wet" in the legend for Figure 10-2.		X					corrected
10-018	16	10	10-8	19	Possibly add as a concluding statement, "But, these obviously come at a cost to the overall net C budget, particularly fertilizer usage and irrigation, because they require fossil fuels in their production and implementation." (or something to this effect).		X					Text added as per reviewer suggestion, pg 10-9, lines 3-4.
10-019	16	10	10-9	18	I would think that keeping these storage tanks "cool" would require some sort of energy demand during warm weather, potentially defeating the purpose in some capacity? Other ideas on how to keep them cool without using additional energy? Is this offset worth mentioning here?				X			Here we have cited emission reduction mechanisms that have been cited in the literature, but we feel we cannot delve into details about the energy balance of cooling tanks and such details. We have changed the text to indicate that cooling tanks <i>can reduce</i> emissions from stored manure.
10-020	16	10	10-10	24-27	This sounds like a very important point to be made, but I am not sure if I completely understand the reasoning why this would be the case? Is it worthwhile to elaborate a bit more on this point? You are basically saying that the management improvements that can be made in a farm operation that is already ongoing (and is trying to maximize profitability) can more effectively lead to cheaper sequestration costs than a piece of land that is specifically managed deliberately to sequester C? Does the same hold true for a farm that still has crop/livestock as the major income source, but has 10-20 ha enrolled in CRP? Where would this type of model fall in cost to sequester? This was just a very intriguing statement and might be more deserving of follow-up (even if it's just a few more details).		X					We added a parenthetical statement to clarify this point.
10-021	16	10	10-11	1-8	You lost me here...My interpretation is that the "price required as an incentive for the mitigation activity" is how much would be required to pay all landowners to ensure their participation, or get some percentage of landowners to participate? Are there some other details such as how many participants and how much land would be devoted based on the subsidy offered for participation? Is doesn't appear to be a linear relationship. The bullet point you also make in the "Key Findings" in relation to this idea also doesn't stand alone as well as the other points made. I would encourage you to either reword or add more information so it is clearer.				X			This economic theory is somewhat complex and we have not included all of the details here. We have cited a relevant paper that contains details. Space limitations preclude a full discussion of policy efficiency.
10-022	16	10	10-13	15	Spelling, Ottawa.		X					
10-023	16	10	10-13	31	Typo – I don't think you want "Cynthia" in there.		X					
10-024	16	10	Text Boxes		Text boxes all look OK.	X						

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CHAPTER 10**

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10-025	17	10	General		This chapter is an adequate review of the potential C sequestration in agricultural lands, grasslands, shrublands, and arid lands for the most part, but I believe it misses a critical issue related to the close ties of C and N in soils. Nearly all N in soils is tied up in organic matter, and it is not possible to add C to soils without adding N – unless one throws the C:N ratio way out of whack, potentially causing N deficiencies, lowered primary production, and therefore lower ecosystem C sequestration. Maybe N is not such a big issue in agricultural soils in that it is added routinely, but for grasslands, shrublands and even arid lands it is highly relevant and needs to be duly considered in this document.			X				We agree with the comment that for cropland that N addition is not a major issue - there is plenty of N for building soil organic matter. We point out the importance of N in grazinlands by referring to practices that can build C, including fertilization and adding legumes as two of the primary C sequestration practices to sequester C in grazing lands
10-026	17	10	General		Secondly, the role of fire is completely missing in the discussion of grasslands, shrublands and arid lands. Fire is a major issue in these ecosystems, it has an obvious immediate and also a long-term effect on C sequestration, and it needs to be included. A specific point in this regard that appears in the Executive Summary (page ES-7, pages 16-22) and as a key finding (page 10-1, lines 27-28) is the woody encroachment of grasslands – in the Great Basin, at least, this is widely viewed as a negative development and current management practices are aimed at reversing it, potentially taking away this uncertain C sink. I do not mean to argue against this management objective, but do argue that it needs to be taken into account before this C can be "counted".		X					Clarified in Key Finding 3 and in text (10-4, lines 6-8). Added reference to fire on pg 10-3, line 24. We have not addressed this comment in the Executive Summary section, but we feel it should be addressed there.
10-027	17	10	10-1	27-28	Key Finding number 3 (also on page 10-4, lines 3-5): The woody encroachment of Pinyon-Jumper to grazing lands in the Great Basin is seen as a decidedly negative thing by nearly everyone, and efforts are now underway to convert this back to grazing land with prescribed fire. This should be taken into account when the authors begin to tally the benefits of C sequestration in this ecosystem.		X					Clarified in Key Finding 3 and in text (10-4, lines 6-8).
10-028	17	10	10-4	8-21	Since the range of soil C:N ratios for these systems is generally known, it would be an easy thing to calculate how much N it would take to achieve these levels of C sequestration in soils and to further assess whether that much N is available from atmospheric deposition, fertilizer, and other sources. You cannot store C in soils without storing N as well.			X				See response to 10-025
10-029	17	10	10-8	21-33	What about fossil fuel offsets from growing crops for ethanol production? Should that kind of analyses not be included here?							Biofuels are a potentially important way that fossil fuel emissions could be offset and they should have a prominent place in the SOCCR report. From the perspective of the impact of C stocks on agricultural and grazing lands, the main impacts here seems likely to be conversion from annual cropland to perennial cropland or afforestation. The conclusions we have drawn for cropland will apply for cases in which annual crops are harvest to produce biofuels and the conclusions we have drawn for grazinglands will apply for perennial systems used to produce biofuels. We have not discussed conversion, which we think is the purview of the section III overview, or biofuels, which belong in

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CHAPTER 10**

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10-030	17	10	10-11	26-29	See comment about N needed for soil C sequestration above.			X				See response to 10-025
10-031	17	10	10-12	31-34	See the comment about PJ encroachment on grasslands in the Great Basin above. This needs to be taken into account. Management policies now aim at reducing PJ and going back to grazing lands.			X				See response to 10-027
SH-004	TOW	10	General		I found that the information synthesized in this Chapter indeed represented the latest work conducted on this body of research.	X						
SH-005	TOW	10	General		The Chapter is succinct and provides the most recent information from sources that I know well.	X						
SH-006	TOW	10	General		As detailed in the following three items, I have three comments. The first is only a comment and does not necessitate any change. The last two comments are suggestions and do not change the overall findings of the report. The authors should feel free to use or disregard these comments, depending on their contribution and usefulness to the overall message being conveyed in the SOCCR report. REF: West, T.O., G. Marland, A.W. King, W.M. Post, A.K. Jain, and K. Andrasko. 2004. Carbon Management Response Curves: Estimates of Temporal Soil Carbon Dynamics. Environmental Management 33: 507-518.	X						
SH-007	TOW	10	10-23	Fig. 10-1	In Figure 10-1, Lal et al. (1998) is cited as the source for information regarding fossil fuel emissions from agricultural inputs. This is likely an adequate estimate. We are currently developing estimates for on-site and off-site fossil fuel emissions at the county and sub-county level for the entire U.S. This will be completed in the near future, but will not be ready for this SOCCR report.	X						
SH-008	TOW	10	10-11	18-19	Use of the term "equilibrium" in this report should perhaps be reconsidered. It is generally agreed upon that this term is more appropriately used in reference to thermodynamic closed systems and does not adequately represent natural ecosystems. It has been argued many times in the ecological literature that "steady state" is a more appropriate term.		X					We replaced one instance of equilibrium.
SH-009	TOW	10	10-11	18-19	The West and Wali (2002) citation is useful here in that it refers to a complex, dynamic model that predicts soil carbon steady state in 15-30 years following the establishment of grasses on reclaimed minelands. While this citation is indeed fitting, the authors may want to consider the West et al. (2004) paper here for the following two reasons. First, this latter paper is a synthesis of many analyses that have looked at the time needed to reach soil C steady state following changes in management. Estimates are provided for changes in cropland tillage and for afforestation. Second, the latter half of the paper discusses the permanence issue and reinforces the policy considerations that the authors discuss on Page 10-11, Lines 13-18. The sentence may be change to something like this: "Soil carbon storage will tend to level off at a new steady state after 15-60 years, depending on the change in land management, after which there is no further accumulation of carbon (West et al. 2004)."		X					W replaced West and Wali (2002) with West et al. (2004)

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CHAPTER 10**

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CHAPTER 11**

COMMENT FROM PEER REVIEWERS						AUTHOR'S RESPONSE						
Comment Number	Reviewer ID	Chapter	Page	Line	Comment Text	Acknowledged, but no further response or revisions are required	Revisions have been incorporated as suggested in the comment	Agree, but see "Notes on Response"	Agree, but elaboration is precluded by length limitations	Disagree; see "Notes on Response"	Beyond scope of report/chapter	Notes on Response
11-001	14	11	General		The scope and intent of the synthesis and assessment product are clearly described in the report.	X						no response required
11-002	14	11	General		As detailed in the following four comments, all aspects of this charge have not been fully addressed.	X						no response required
11-003	14	11	General		The report deals extensively with two topics: (a) forest carbon stocks and fluxes at three scales: continental, national and forest stands, and (b) ecological factors affecting forest carbon stocks and fluxes at the stand scale.	X						no response required
11-004	14	11	General		Social and economic factors affecting forest carbon sequestration at all scales are mentioned occasionally (e.g., lines 1-6 on page 11-10) but are not considered in sufficient detail. This is surprising given that the first sentence of the section titled "Effects of Climate and Atmospheric Chemistry" acknowledges that "the combined effects of climate and atmospheric chemistry changes on carbon sequestration are likely to be significantly smaller than the effects of land management and land use change" (p. 11-7). Highly relevant topics that are not adequately addressed include government policies, markets for forest products, technological innovation in forest management and wood processing, and trends in investment in the forest sector.		X	X	X	X		Agree partially, but space limitations prohibit adding much additional detail. Note that there are extensive sections on land-use change, forest management including technology, economics and market considerations. Expanded policy discussion a bit in places, but only very generally so as to keep from appearing "policy prescriptive"..
11-005	14	11	General		Landscape and regional scales of analysis are all but ignored. This is unfortunate because social, economic, and ecological factors affecting carbon sequestration have important effects at these scales.				X			With 3 countries to address, and space limitations, I don't see how we can explicitly address landscape-scale and regional analyses.
11-006	14	11	General		The report recognizes carbon sequestration in wood products in several places, but virtually ignores other potential contributions of active forest management to reducing greenhouse gases including (a) production of renewable biomass energy, and (b) production of renewable materials that have lower life-cycle emissions of greenhouse gases than non-renewable alternatives.		X	X		X		There is some economic description of biofuels on p. 11, but nothing on product substitution. Revised "Options for Management" section to highlight these options more.
11-007	14	11	11-4		It is stated that "Large-scale estimates of ecosystem carbon fluxes can only be explained by a more detailed examination of the dynamics of individual forest stands that have unique combinations of disturbance history, management intensity, vegetation, and site characteristics." This statement has important implications for research priorities, but is unsupported by evidence, analysis, or argument. The statement is probably false if "large-scale" is taken to include regional and national scales. To my knowledge, no one has demonstrated the feasibility of scaling-up observations of stand dynamics to explain estimates of carbon fluxes at regional and national scales. Methodologies that integrate information from several scales are more likely to be successful.		X	X		X		Partially agree -- can clarify statement on p. 4. Disagree that scaling-up is not being done, we do it all the time as we use ecosystem studies to develop models that augment our national-scale observations.
11-008	14	11	11-8		The text includes the statement that "... a long-term increase in impacts of disturbance is likely in the future, with associated losses of forest carbon stocks." This statement is unsupported by evidence, analysis, or argument.		X					Changed "likely" to "possible".

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11-009	14	11	11-12		The text includes the statement that "Effective carbon management options to increase the retention time of sequestered carbon require a thorough understanding of current carbon stock sizes and flux rates in boreal, temperate, and tropical forest ecosystems in North America." Implicit in this statement is the assertion that "increasing the retention time of sequestered carbon" is a promising strategy that merits special consideration. This assertion is unsupported by evidence, analysis, or argument.		X					Reworded statement - deleted misleading phrase.
11-010	14	11	11-13		The text includes the statement that "With the exception of land use change (afforestation and deforestation), there is very little information about how forest management affects various carbon pools..." This is obviously incorrect. There are many useful papers and books on effects of forest management on various carbon pools.		X			X		Clarified statement -- although there are books and general references, and some very specific studies, it is still impossible to make very specific recommendations to landowners.
11-011	14	11	11-13		The text includes the statement that "Few decision-support tools are available..." Taken literally, this statement is obviously incorrect. No doubt the authors were intending to refer to some particular kind of decision for which tools are lacking. The section on decision support tools is weak and needs to be reworked.		X		X	X		Clarified statement to highlight that there are few decision-support tools specific for carbon management. But there is no room to elaborate.
11-012	14	11	General		The report's exposition and organization need to be revised to address problem discussed above that report focuses too much on stand-level ecology and not enough on social, economic, and ecological factors affecting carbon sequestration at landscape and regional scales.					X		We followed the given organizational format. Stand-level ecology is still the best we have available to explain larger-scale observations and management options. No room to elaborate further on social and economic factors except as noted in response to comment 11-004.
11-013	14	11	General		The report's balance and fairness are compromised by its excessive focus on stand-level ecology and by its insufficient attention to potential contributions of active forest management to reducing greenhouse gases including (a) production of renewable biomass energy, and (b) production of renewable materials that have lower life cycle emissions of greenhouse gases than non-renewable alternatives.					X		See response to comments 11-006 and 11-012.
11-014	14	11	General		The report's lack of balance is exacerbated by Appendices 11A and 11B. The appendices give special attention to selected research approaches, results, and carbon accounting concepts but do not add substantial value to the overall report.					X		The appendices are included to highlight in significantly more detail areas of active and extensive research. We believe the main body of the report is well balanced.
11-015	14	11	General		The authors should consider condensing the material in the appendices and integrating it into the main text. For example, information on ecosystem carbon fluxes from eddy covariance and ground-based measurements (Appendix 11A) could be summarized in a single table and integrated into the main text section on "Carbon Stocks and Fluxes."					X		The material in the appendices is already summarized and integrated into the main text.

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11-016	14	11	11-23		The text includes the statement that "Mature forests can be substantial sinks for atmospheric carbon." This statement is presented without appropriate context and seems designed to promote forest preservation. A balanced presentation would also mention the potential for mature forests to be substantial sources of atmospheric carbon (e.g., high potential for wildfire in mature forests experiencing cohort senescence).			X		X		Suggest re-phrasing text to state that mature forests can have substantial stocks of sequestered carbon. The text immediately following this statement discusses the potential to be a source and is therefore already balanced. BIRDSEY
11-017	14	11	11-26		The fourth bullet offers the opinion that "replacement of fossil fuel by biomass fuel can be counted as an emissions offset, if residual or manufacturing "waste" would otherwise be lost via decomposition or other processes." This brief commentary on a single aspect of carbon accounting is clearly out of context and inappropriate.			X		X		Statement is not an opinion but the way registries count biomass burned for energy. Can add citation. Also suggest making the biofuel part of bullet 4 a new bullet 5. BIRDSEY
11-018	14	11	General		In regard to the report's findings being based on any value judgments or the collective opinions of the authors, see comments above regarding (a) need to broaden the scope of the report, and (b) concerns about Appendices.	X						See responses to individual previous comments.
11-019	18	11	General		The authors have done a very good job in synthesizing many diverse sources of data into a very coherent report on the influence of North American forests on the global carbon cycle. They have expressed their estimates of forest carbon pools, fluxes and balance in the context of actual tons of carbon and relative to the annual North American emissions from fossil fuel.	X						
11-020	18	11	General		The tables and charts the authors have provided will serve as a baseline for future assessments to be compared against. The uncertainties associated with their stated estimates are given.	X						
11-021	18	11	General		The major factors that drives changes in carbon sequestration, fluxes and pools were identified and discussed for the three countries that comprise North America. I think a table showing the relative ranking of these drivers over time, past (pre 1970), present (1970 to present) and future (next three decades) for each of the three countries would be useful. It would help to emphasize where there is or is not consistency over time and between countries in the factors that have made major influences on each countries carbon cycle. SEE EXAMPLE TABLE AS PROPOSED FOR THE USA IN ORIGINAL SET OF COMMENTS. Canada and Mexico rankings would be very different. I do not know if the above rankings are correct, just an example. The authors are in the best position to do the rankings and give uncertainties. These rankings will help us to focus on the main factors for each country that we need to influence through policy or science.			X				This would be a useful contribution, but the literature is simply not yet conclusive enough to give this ranking in a credible way for each country or for any country.

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11-022	18	11	General		For the important role that forests play in the North American Carbon balance, I think the introduction section should be beefed up. State the extent of forests relative to the total N.A. land area, its contribution to offsetting annual fossil fuel emissions of NA and the globe. Give the three fundamental ways that forests influence the carbon cycle-balance (1) CO2 sequestration, storage and emissions (2) a substitute fuel for fossil fuel (3) product substitution for high energy (fossil fuel) cost products.		X	X				Revised introduction
11-023	18	11	General		The authors should identify the major federal research or incentive programs that are in-place to advance our understanding of or to enhance the role of North American forests for mitigating carbon cycle imbalances. A table showing the programs, what each is expected to contribute (estimates of stand pools, changes in fluxes for the various major forest types, or mitigating/improving the role of forest for storing, offsetting fossil fuel emissions, etc) and which forest-types are being addressed and which are not would be useful. I think we may see we are heavy on the Science (understanding) side and light on the enhancing program side but I can't tell from this chapter. The research status and needs are one of the mandates of this report.				X			I think we have adequately identified research needs by country, but have not evaluated the research and incentive programs. Although a useful addition, seems like we don't have room for it.
11-024	18	11	General		From the authors results, it is clear that changes in land use, the extent that forest are used to offset fossil fuel and the management intensity of N.A. forest are the main factors that can be influenced through future research and policy changes to greatly enhance the role that NA forests play in solving the C imbalance issue. When only a small percent of the energy stored in NA forest trees (?? 1%) is being converted to offset fossil fuel, only 1% of the trees in managed forest are being harvested and most of the forest land are in the "Others" category (which is historically under-managed and under-utilized) this should send a strong signal that only a minor fraction of the potential for NA forests to affect the NA carbon balance is being realized. A statement of the potential role versus the estimated actual would be useful.		X	X	X			The reviewer makes an important point, but I don't see an easy way to insert this idea in the text given length limitations. I think the reviewer is getting partially at a) the balance between how many fossil C emissions are avoided in the process of biomass burning at a sustainable level of harvest, and partially at b) what is the sustainable level of harvest. I don't think either of these questions is especially well resolved in the literature, so would be very difficult to change the text.
11-025	18	11	General		Gaps should include: How do we get significantly more stored forest energy converted into an energy form that offsets fossil fuel use? We are using very little of the "renewable energy mine" we have and the potential to add to or regrow this energy source is large.		X	X				Revised text in "Options for management" section
11-026	18	11	General		Gaps should include: What are the most efficient ways (policies, programs) to get more acres into forests or to enhance the C sequestration rates of existing forest lands in each country?		X	X				Revised text in "Options for management" section
11-027	18	11	General		Gaps should include: How can we have better inventories of C pools by forest types and improve our ability to detect significant changes that are taking place in these pools?		X	X				Revised text in "Options for management" section

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11-028	18	11	General		Gaps should include: What Forest-types do we need better flux data for? Can we obtain this data smarter than we have in the past? For example, do we need continuous monitoring eddy-covariance sites for only a few forest types or do we know the key stand development stages that influence stand carbon fluxes and the key parameters we need to measure so we could take only periodic data and scale (model) carbon flux estimates over time and forest stand development? This would permit getting flux data estimates for more forest types and conditions.		X	X				Revised text in "C stocks and fluxes" section
11-029	19	11	General		While authors did a very thorough job at collecting relevant literature, the numerous reports and studies cited in the chapter are based on inconsistent definitional frameworks, categories, purposes, and approaches. Upon reading the entire chapter, my conclusion was that the data and knowledge currently available do not allow to make comprehensive statements on forest carbon dynamics and our ability to manipulate them, with any confidence, at the north American scale. The sections on data and knowledge gaps reinforced this conclusion. The wording of 'key findings' should better reflect this uncertainty	X						We obviously can do nothing about the inconsistency in the literature. Also it seems that we use "highly uncertain" and "lack of consensus" appropriately in the key findings section to reflect the uncertainty.
11-030	19	11	General		Clarify at the outset the purpose of compiling on the one hand, the findings of scientific studies on the complex factors driving carbon fluxes in and out of forests, their annual variability, long-term effect, and relative importance in different landscapes and social settings, and on the other hand national-scale estimates of C stocks and C stock changes (in the chapter's first sections), which often do not incorporate this scientific knowledge. Perhaps the chapter should point out with greater clarity the missing links between the two information types. Indeed, the complexity of the issues warrants a finer analysis. A valuable goal for the chapter, rather than listing options, gaps and needs in a semi-quantitative fashion, would be to attempt to identify and prioritize the key questions we should address to determine the potential for manipulating forest C dynamics to reduce atmospheric loading of CO ₂ . The challenge is to move from site-specific studies and qualitative statements to large-scale, quantitative assessments.	X			X	X	X	Disagree that national-scale estimates do not incorporate the more detailed scientific knowledge. Clearly there is work to do among the research community to integrate studies across scales, but I believe the "roadmap" to do this is outside the scope of this chapter. The research plan for the US CCSP is a good example of where this roadmap is already developed.
11-031	19	11	General		One also wonders if an ecosystem-based approach (tropical, temperate, boreal forests, with various levels of management intensity) should not be considered. Given the diversity of forests and forest management practices across the continent, the current, country-based assessment is too general.	X						We tried this in earlier versions, but found that it was very difficult to compile data for the ecosystem approach across country boundaries. This is a great goal for a future report.

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11-032	19	11	11-2	22	Forest products (FP) are not a carbon sink, since, as opposed to vegetation, they do not remove carbon from the atmosphere. Use clearer terminology, such as "C uptake" (by trees) and "C storage" (in forest ecosystems and FP). Authors should clarify the meaning of the data used to represent C stored in forest products (FP) in this chapter, since different estimation methodologies drastically affect these estimates (see also comment below on p 11-3).		X	X				Changed text, but note that in the U.S. the official definition of sink (at least one of the official definitions) would consider carbon in wood products a sink.
11-033	19	11	11-3	29 et seq.	For Canada, use Environment Canada's 2006 submission to the UNFCCC, as opposed to the 2005 version. The 2006 report contains vastly improved estimates. This reviewer can provide the updated data. Notably, Canada's managed forests were variously a source or a sink in the 1990-2004 period; in this context, the use of a single, undated and unexplained figure in Table 11-3 of the SOCCR is misleading. Annex 3 (section A3.5.7) of Environment Canada's 2006 GHG Inventory Report indicates that in 2004 off-site emissions from decaying FP are estimated between 91 and 135 Mt CO ₂ , depending on approaches. Again, using a single figure without further explanation lacks transparency.		X					
11-034	19	11	11-4	26	Remove "and wood products", since by and large the factors listed affected forest C dynamics, but not those of wood products.		X					
11-035	19	11	11-6	11-17	Update with Environment Canada's 2006 GHG Inventory Report. While forest and other wooded lands occupy 402 Mha, forests alone cover 310 Mha, and managed forests 255 Mha or 83% of all forests. On page 11-12, line 19, change also the 47% figure to 17%. Managed forests include private and public forests potentially subject to harvesting, and forests actively protected from fires.		X					
11-036	19	11	11-6	21-25	There is a need to reconcile the statement about the relative importance of harvesting and natural causes in tree death, with the statement on p 11-8 lines 10-11. The two sentences are somewhat inconsistent. On what kind of evidence relies the statement of lines 21-25 if evidence of the impact of disturbances is missing?		X					Text clarified
11-037	19	11	11-9		The section 'Options for management' needs further work. Remove p. 11-9, lines 26-31: this rather assertive statement reads like a conclusion, and is not warranted by the few examples provided. More examples are needed similar to the two Canadian examples of how forest management strategies could affect forest carbon dynamics in northern landscapes. On p. 11-10, lines 7-11 fail to mention the combination of strategies that could potentially yield such a significant increase in C sequestration by US forests. I doubt that the economic assesment of p11-11, lines 3 to 11 applies to the entire north American continent, or any of its component countries: provide context to these figures. What are the conclusions of this section, given the caveats of p 11-13?		X	X		X		Our given writing style was to put concluding statements up front to engage the reader, then elaborate. Unfortunately here is no space available for additional examples. Clarifying statement were added

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11-038	19	11	11-21	Table 11-1	Are there 'polar' forests?		X					
11-039	19	11	11-21	Table 11-3	Use figures in Environment Canada (2006) Canada's Greenhouse Gas Inventory 1990-2004. The use of a single figure is misleading, since during the 1990-2004 period the annual GHG budgets of Canada's managed forests vary between a sink of 186 Mt CO ₂ e and a source of 177 Mt CO ₂ e.		X					
11-040	7	11	General		Although this chapter provides useful aggregate statistics on forest carbon by biome and country, users of the chapter would benefit greatly from an analysis of spatial estimates of forest carbon. Such an analysis would involve matching estimates based on forest inventories divided by political unit and general forest type (Birdsey and Lewis 2003) with spatial estimates from remote sensing (Running et al. 2004). REFS: Birdsey, R.A. and G.M. Lewis. 2003. Carbon in U.S. forests and wood products, 1987-1997: State-by-state estimates. U.S. Department of Agriculture, Forest Service, Newtown Square, PA; Running S.W., R.R. Nemani, F.A. Heinsch, M. Zhao, M. Reeves, and H. Hashimoto. 2004. A continuous satellite derived measure of global terrestrial primary production. BioScience 54: 547-560.			X			This would be nice to do, but don't have the space.	
11-041	7	11	General		Research at individual sites has combined analysis of forest inventories and remote sensing (for example, Van Tuyl et al. 2005, Turner et al. 2006). Therefore, I suggest adding a section "Spatial estimates of Forest Carbon" that would review the scientific literature and take a step towards producing a map of forest carbon across North America. REFS: Turner, D.P., W.D. Ritts, W.B. Cohen, S.T. Gower, S.W. Running, M. Zhao, M.H. Costa, A. Kirschbaum, J. Ham, S. Saleska, and D.E. Ahi. 2006. Evaluation of MODIS NPP and GPP products across multiple biomes. Remote Sensing of Environment 102: 282-292.				X			This would be nice to do, but don't have the space.
11-042	7	11	11-1	19	Instead of "highly uncertain," add the numerical error range to the estimate of 350 Mt C y ⁻¹ . From page 11-3 line 20, the error is ± 350 Mt C y ⁻¹ .			X				Cannot compute the range from the literature.
11-043	7	11	11-1	33-37	Identify the areas of development of better estimates of potential estimates of forest carbon under different scenarios of climate change. For example, Bachelet et al. (2003) have continued to improve the skill of the dynamic global vegetation model MC1 to simulate potential CO ₂ fertilization. REF: Bachelet, D., R.P. Neilson, T. Hickler, R.J. Drapek, J.M. Lenihan, M.T. Sykes, B. Smith, S. Sitch, and K. Thonicke. 2003. Simulating past and future dynamics of natural ecosystems in the United States. Global Biogeochemical Cycles 17: 1045. doi:10.1029/2001GB001508.			X				Addressed in the "Data Gaps" section and added to the 7th bullet under "Key Findings".
11-044	7	11	11-3	29	The uncertainty of the estimates of forest carbon suggest that the text should use an appropriate precision of two significant figures. Therefore, change 109 Mt C y ⁻¹ to 110 Mt C y ⁻¹ and round other numbers throughout the report to two significant figures.			X				Did some rounding in the tables and text.

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11-045	7	11	11-7	24	Data from humid evergreen tropical forest in Costa Rica show one impact of climate change on forest growth, namely, reduction of annual growth due to increased respiration at night (Clark et al. 2003). REF: Clark, D.A., S.C. Piper, C.D. Keeling, and D.B. Clark. 2003. Tropical rain forest tree growth and atmospheric carbon dynamics linked to interannual temperature variation during 1984–2000. Proceedings of the National Academy of Sciences of the USA 100: 5852-5857.						X	
11-046	17	11	General		This document seems a bit thin and out of date in places as per the situation in the US.	X						
11-047	17	11	11-3	1-5	The units in this section are completely inconsistent with one another. In Canada, they are given on a per ha basis, whereas for the US and Mexico they are given as totals. How can we compare these?		X					
11-048	17	11	11-4	1-7	This section need to include the critical issue related to the close ties of C and N in soils. Nearly all N in soils is tied up in organic matter, and it is not possible to add C to soils without adding N – unless one throws the C:N ratio way out of whack, potentially causing N deficiencies, lowered primary production, and therefore lower ecosystem C sequestration.			X	X			Agree with the comment, but disagree that this section should be changed. This part is simply a report of the stocks. This comment might be appropriate for the "Principles of Forest Management" appendix, but we couldn't really touch this comment about N fertilization in soils unless we delve into the whole fertilization gamut. To do that we'd want to deal with C:N ratios, other N transformation effects, mechanisms for C to enter recalcitrant pools in soils, and etc.etc.
11-049	17	11	11-7	1-24	I am surprise that the recent studies on the effects of elevated CO2 at the Duke site by Finzi et al are not included here. The Duke study is the longest-term study in a forest ecosystem		X					
11-050	17	11	11-8	15-17	Surely there are later figures for fires in the US than a 1998 reference. The US section here seems a lot less comprehensive than that for Canada. More homework should probably be done.					X		Checked again and can find no more recent comprehensive and citable estimates
11-051	21	11	General		The one issue that I disagree with the authors on is that they downplay the importance of roots and really consider that aboveground litter lands on the soil surface and that DOC leaches down. In some boreal systems more than 75% of C fixed in the ecosystem goes directly into the root systems. In peat soils of the Arctic, most of the "soil" is just dead roots. I think the authors should revise their consideration of how SOM forms to give more credence to the importance of roots and "direct injection" of organic matter.		X	X				we are not giving anyone "our" interpretation of how SOM forms, but rather reporting on values we found in the literature. We can't possibly turn this into a study of the biochemistry of SOM-forming processes. Second, the comment about root-to-shoot ratios being greater than 1:1 is certainly wrong for the forests we are addressing, e.g. see Kurz et al. (1996) and Li et al. (2003). It may apply to tundra systems but that's outside the scope of this work.
11-052	21	11	General		The main problem with the chapter is how they discuss sources of soil organic matter. It is consistently presented as a process where litter lands on the soil surface and then must be transported into the soil. In fact, in high latitude systems the root:shoot ratio is much greater than 1. That means that most of the C entering the decomposition system is injected into the soil via root growth. Roots may well provide the bulk of C that becomes soil organic matter.		X	X				See previous response
11-053	21	11	11-3		DOM usually means "dissolved organic matter", rather than "dead organic matter."		X					

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11-054	34	11	General		I have also quickly reviewed chapter 11, Agricultural lands, grasslands, shrublands, and arid lands. It is factual and covers the main science topics although also rather inward looking (i.e. not taking into account what is happening elsewhere) I find this less of a problem for this chapter, although the document title implies it will address "implications for global carbon cycle".	X						
11-055	34	11	General		In the Economics and policy assessment section, you may wish to consider discussion of options such as payments for environmental services, costs to the agriculture sector in adapting to carbon imbalances, initiatives and opportunities in the large multi-national food corporations to deal with carbon-related issues.				X			
SH-003	SG	11	11-8 and 11-9		I think it worthwhile pointing out that the comments in Chapter 3 (top of page 3-5) regarding the likelihood of increasing C sink associated with lengthened growing season have recently been clarified in work indicating that a substantial portion of N.American forests are actually in decline under a warming climate (probably an acclimation effect) whereas tundra areas are increasing in productivity. [REF: Goetz, S. J., A. Bunn, G. Fiske, and R. A. Houghton. 2005. Satellite observed photosynthetic trends across boreal North America associated with climate and fire disturbance. Proceedings National Academy of Science 102:13521-13525.] This assessment, using 22 years of satellite imagery, accounted for the influence of fire disturbance. These points are also relevant to Chapter 11 (pages 8-9). I think we have to be cautious about this assumption of increasing productivity, particularly when the observations suggest otherwise, before changes in vegetation composition catch up with the new climate regime.		X	X				I do not read our text to be a strong endorsement of increasing productivity-- it simply reports what some of the projections are showing. The paper cited here reflects a few years of satellite observation of just the boreal forest, and I believe there are some other similar studies that do show increasing NPP in temperate forests. A bit more uncertainty was added to the discussion and cited this paper.

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CHAPTER 12**

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Comment Number	Reviewer ID	Chapter	Page	Line	Comment Text	Acknowledged, but no further response or revisions are required	Revisions have been incorporated as suggested in the comment	Agree, but see "Notes on Response"	Agree, but elaboration is precluded by length limitations	Disagree; see "Notes on Response"	Beyond scope of report/chapter	Notes on Response
12-001	20	12	General		The manuscript follows the scope and intent of the overall synthesis. The conclusions and recommendations are adequately supported by evidence provided. However, the section on uncertainties and gaps in knowledge needs amplification (see suggestions below). The methods are applied appropriately. In general the exposition and organization of the report are effective, except for the use of headings (see comment below). The report is fair and appropriately balanced. The tone of the report is impartial. The executive summary is concise and accurately reflects the key findings and recommendations.		X					
12-002	20	12	General		The title is incomplete and should mention carbon stocks as well as cycles.					X		Carbon stocks are a component of the carbon cycles, so adding 'carbon stocks' to the title would be overkill.
12-003	20	12	General		The authors emphasize that Cryosols contain 61% of the SOC in all soils of North America (p. 12-1, line 18; p. 12-2, line 12; p. 12-6, line 21). I find this hard to believe. The value is inconsistent with other data including those of Mr. Tarnocai, the lead author. In the Tarnocai (1998) publication, 39% of the soil C mass in Canadian soils occurs in Cryosols. Using the value of 417 Gt for the North American soil C mass (Ch. 3 of the CCSP report), the percentage of soil C mass attributed to Cryosols would be 51%. Perhaps, the authors should provide a table summarizing average SOC and soil C mass for each eco-region or soil order of North America. In any case, more information should be provided to justify the 61% value.					X		Unfortunately you misread the sentences on p.12-1 line 18, p.12-2 line 12, and p. 12-6 line 21. In all three cases they read: 'soils in/of the permafrost region' or 'in this region', referring to the permafrost region, contain approximately 61% of the organic carbon occurring in all soils in North America. The emphasis is on "all soils" - both permafrost-affected soils (Cryosols) and non-permafrost soils. The 61% value was calculated as follows: According to Lacelle et al. (2000), the SOC mass for the 0-100 cm soil depth in North America is 346.7 Gt. The permafrost region of North America contains 213.32 Gt of SOC (see tables 12-6 and 12-7). Therefore, soils in the permafrost region of North America contain approximately 61.5 % of the continent's SOC. The value of 417 Gt is meaningless for these calculations since, according to Table 3-2 in Ch. 3, it refers only to the total carbon stocks in forest, cropland, pasture and wetlands - no mention is made of other areas, especially the vast northern tundra region that is a major part of the permafrost region. In addition, it seems to include the living vegetation as well as the
12-003 (cont.)												soils (see p. 3-7, line 13, where it says that carbon in a pool includes living forest trees and forest soils, and lines 18-19, where it says that the US has only a few measurements of forest soils and had to extrapolate with models since there is no national inventory of carbon in forest soils).
12-004	20	12	General		The headings are confusing and make the chapter somewhat disjointed. I suggest that the primary heading on p. 12-3, lines 17-18 be "CARBON STOCKS" so as to be consistent with those that follow, e.g., CARBON FLUXES (p. 12-6), etc. The heading "BELOW-GROUND CARBON STOCKS" on p. 12-6 is confusing, in that all of the C stocks reported in the manuscript are belowground, and should be eliminated.					X		The items discussed under the heading on p. 12-3, lines 17-18 go far beyond just carbon stocks. They cover such topics as cryogenic processes, carbon dynamics, and other processes affecting the carbon cycle. Carbon stocks are not really covered in this section - the emphasis is on the factors affecting the carbon cycles. 'Below-Ground' (p. 12-6, line 8) can be deleted from the heading, but it was added to show the reader that living vegetation and its components were not included.

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12-005	20	12	General		The authors may wish to include a diagram showing the three-component conceptual model of Cryosols, in which the transition zone is recognized as a layer intermediate between the seasonally thawed active layer above and the stable permafrost below (Bockheim and Hinkel, 2005, Arctic, vol. 58, pp. 406-417). The transient zone episodically thaws over decadal to centennial periods and is important relative to the vulnerability of SOC in permafrost as a source of CO ₂ to the atmosphere.			X				In some cases the transient zone suggested by Bockheim and Hinkel (2005) is clearly recognizable, but in other cases, such as for permafrost-affected organic soils and low ice content soils, such recognition is difficult or even impossible. I think more research should be carried out on the role of the transient zone in other areas (besides Alaska) of the circumpolar Arctic before this model is used for determining the vulnerability of SOC in the permafrost region.
12-006	20	12	General		The authors state that little is known about C fluxes in permafrost-affected soils and have not reviewed any of the literature pertaining to SOC fractions and their vulnerability to loss during climate warming. A number of papers report chemical, physical, and radionuclide fractions of SOC and could be drawn upon to make judgments regarding vulnerability of SOC decomposition and CO ₂ evolution			X				We tried to focus on explaining the carbon cycle in soils in the permafrost region. Many other aspects could have been included in this chapter, including SOC fractions, soil organisms, soil ecology, etc. We felt that, if a scientific journal paper were being prepared on this subject, these items should be included. These items were not included in this chapter, however, because of the readership and the space requirements.
12-007	20	12	General		The section on data gaps and uncertainties is incomplete. The authors could mention the lack of information on SOC below 100 cm, the possible influence of arctic warming on cryoturbation, and other data gaps.		X					The lack of information and the importance of deep carbon (below the 100 cm depth) has been incorporated in the Data Gaps and Uncertainties section.
12-008	20	12	General		The figures and tables generally are acceptable. However, as mentioned previously there is need of a table giving mean SOC and soil C mass for eco-regions or soil orders of North America. Table 12-5 should provide standard deviations to accompany mean values. The drawings below figures 12-3 and 12-4 are rather crude and could be done more professionally.						X	An extra table would not contribute much to this chapter. Data on the SOCC (carbon content) and mass for all of the ecoregions and soil orders should be given in a summary chapter for the entire North American continent, not just for this chapter. Unfortunately, the figures 12-3 and 12-4 the reviewer received were the original hand-drawn versions. These figures are being drafted following the style and requirements of the report.
12-009	21	12	General		The one issue that I disagree with the authors on is that they downplay the importance of roots and really consider that aboveground litter lands on the soil surface and that DOC leaches down. In some boreal systems more than 75% of C fixed in the ecosystem goes directly into the root systems. In peat soils of the Arctic, most of the "soil" is just dead roots. I think the authors should revise their consideration of how SOM forms to give more credence to the importance of roots and "direct injection" of organic matter.			X				Dead roots are part of the SOC, but living roots were not considered in this chapter. When roots decompose they are broken down into SOC but, for the purpose of this paper, live roots were not considered. According to Dr. Peter Kuhry (personal communication) in the tundra environment roots contribute 1% or less of the total SOC. Roots only occur in the upper 20 - 25 cm depth because of the low soil temperatures and permafrost. In the permafrost regions of the northern boreal the trees are smaller and more shallowly rooted than in the southern boreal and are subjected to repeated wildfires that greatly reduce the carbon input of the roots (such fires often burn not only the trees and surface vegetation, but also the organic matter, including the roots, within the soil).

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12-010	21	12	12-4	8-13	No, No, No- Most C is not deposited on the soil surface. Most is injected into the soil in the form of roots. DOC movement is likely a relatively modest source of DOC into soils in comparison. Residence time of root C is short? I don't think so! Most of the C that turns into SOM may well start as roots.					X		In a permafrost environment most plants, including trees, are shallow-rooted. In this environment most of the organic matter is moved from the surface and incorporated into the subsoil, including the near-surface permafrost, by cryoturbation and other landscape changes. Cryoturbation, a form of direct injection, is a major factor in the sequestration of organic matter in northern soils. This is the reason that large amounts of SOC are found in deeper soil layers, well below the rooting zone. Although you do not consider the residence time of root C to be short (note that the paper says 'relatively short'), it is short relative to the storage time of the long-term stored carbon in these soils, which can be many thousands of years old. The shallower root carbon is subject to such factors as wild fires, which recur every few hundred years in the Canadian boreal forests and every 400-1700 years in the bogs.
12-011	21	12	12-4	22-23	Even in peat soils, roots are the main part.					X		Most of the northern peat soils are composed primarily of remnants of mosses, sedges, ericaceous vegetation, and other shrubs; roots form only a minor part of the organic matter.
12-012	21	12	12-5	16	Never say "no decomposition occurs"		X					We did not say 'no,' we said 'very little or no' There is a difference. We have deleted the 'or no'.
12-013	21	12	12-7	3-5	Again, you down play roots.					X		You might be correct, but the literature provides very little information on the contribution of the roots to the soil organic matter in permafrost-affected soils (see also Dr. Kuhry's information in comment 12-009, above).
12-014	21	12	12-10	6-11	But as they drain, the CH ₄ production mentioned in the previous paragraph will be reduced. Thus, the C balance will shift, but the overall climate impact may not be as clear since CH ₄ is a much stronger greenhouse gas than CO ₂ .					X		Two possibilities are discussed on p.12-10. One goes from frozen (high ice content) to wet and then you get CH ₄ production; the other goes from wet to dry and then you get aerobic decomposition, wildfires and CO ₂ .

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13-001	22	13	General		The authors of Chapter 13 – Wetlands should be commended for the effort they put into compiling and analyzing data they obtained from disparate sources. The result of these efforts is a comprehensive document that provides the reader with a better understanding of the important role wetlands can and do play as sources and sinks of greenhouse gases.	X						
13-002	22	13	General		There are important limitations in the data available to estimate the type and amount of wetland coverage in the North American landscape. Some of these limitations result from inadequate effort applied to conducting wetland inventories on a sufficiently large scale and at appropriate return frequencies. Other limitations relate to the incomplete level of standardization among the definitions of some wetland types. For instance, bogs are easily identified and therefore peat inventories of these ecosystems are better quantified. Other wetland types can be classified differently by different observers, like swamps or forested wetlands, which could be classified as "freshwater mineral soil (FWMS)" wetlands or just "forest". These discrepancies are compounded when remotely sensed data are used to classify a landscape and ground truthing effort is insufficient so that the size of the wetland carbon pool is uncertain. The authors are aware of these limitations and included cautionary language where appropriate.	X						
13-003	22	13	General		Much of the interest in studying wetlands revolves around their potential as a sink for atmospheric carbon. Some studies are geared to understanding carbon sinks as their main objective, but many studies that concentrate on ecology, hydrology or biogeochemistry have the sink function of wetlands as an important "background" concern. The authors have done a good job reviewing the sink/source potential of many types of wetlands and, within the limitations mentioned above, present useful estimates on a national and continental basis and compare them to global estimates.	X						
13-004	22	13	General		The authors are probably not aware of a recently published paper by Euliss et al. (2006). See the following comment. The Euliss et al. (2006) paper concerns a specific type of wetland, the prairie pothole wetlands, which are widely distributed on the Great Plains of north central US and southwestern Canada. These wetlands are an important component of the predominantly agricultural landscape of the plains, and many of them are directly or indirectly impacted by agricultural land management practices. These wetlands provide important ecological services and in particular they are critical habitat for migratory waterfowl. Reference: Euliss, N.A. Jr., R.A. Gleason, A. Olness, R.L. McDougal, H.R. Murkin, R.D. Robarts, R.A. Bourbonniere and B.G. Warner (2006). North American prairie wetlands are important nonforested land-based carbon storage sites. Science of the Total Environment, 361: 179 – 188.		X					This very pertinent paper was published after our the draft chapter was completed, but we were alerted to it immediately after its publication. We have referenced it in the chapter now, but it does not change our conclusions.

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13-005	22	13	General		The Euliss paper suggests that restoration of prairie pothole wetlands – conversion from current cropped status to grassland – could result in 378 Tg of carbon sequestration over a 10-year period. In Chapter 13 sequestration is reported in Mt per year, so for comparison restoration of prairie pothole wetlands might sequester 38 Mt per year, which is comparable to the total sequestration of current FWMS wetlands for all of North America (34 Mt per year – Table 13A-2). Prairie pothole wetlands would be classified as FWMS according to the descriptions provided by Euliss et al. (2006). It might be worth the effort to determine how similar the inventory and flux estimates are between the Euliss et al. (2006) paper and the current chapter. If a significant proportion of the prairie pothole wetlands were not captured in the current tabulations, then this demonstrates the veracity of the > 100% error estimates for C-sequestration.		X					See changes in text, pages 13-10 and 13-11.
13-006	22	13	General		It is important that the authors addressed emissions of both CO ₂ and CH ₄ when considering carbon balances and when estimating the probable magnitude of net sequestration. Future compilations should be able to address the emissions of N ₂ O, particularly if agriculturally impacted wetlands are included. This greenhouse gas has been hardly studied outside of the agricultural setting (see Chapter 10) where it is known to be very important. Chapter 10 does not consider wetlands in the agricultural landscape, so these should be considered in future compilations under wetlands with cross-referencing to the future agricultural chapter.		X					We have acknowledged the lack of studies of N ₂ O emissions in mineral soil wetlands and those impacted by agriculture (see page 13-7).
13-007	22	13	General		Overall the wetlands chapter represents fairly the current state of knowledge of carbon cycling in North American wetlands allowing for an understanding of where they fit in the total carbon budget and greenhouse gas picture	X						
13-008	21	13	General		The other issue is the role of wetlands in producing CH ₄ . Currently high latitude wetlands are a substantial CH ₄ source. As wetlands warm and dry, they will lose C and supply CO ₂ to the atmosphere. However, they will also decrease the amount of CH ₄ that they produce. This is suggested but not developed.					X		We believe that we discuss this topic adequately and with the appropriate nuances. Not all high latitude wetlands will become drier, although most continental interior wetlands are predicted to. One also has to consider effects of melting permafrost, etc., so that this is not simple climate-change prediction.

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CHAPTER 15

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15-001	24	15	General		This chapter presents an impressive synthesis of ocean pCO ₂ observations around the coast of the US, and quantifies the observed fluxes on an annual basis. In addition to the new pCO ₂ observations, the chapter nicely synthesizes existing information on US coastal ocean fluxes. This is scientifically very interesting, and it also very useful to develop a comprehensive picture of the US carbon budget.	X						
15-002	24	15	General		Throughout the chapter, the information is not always clear which processes are active from the natural carbon cycle, and which processes have been influenced by either human activities or increasing atmospheric CO ₂ . For example, p.15-2 lines 20-21 says that the biological pump removes atmospheric CO ₂ . This suggests that the biological pump removed *anthropogenic* CO ₂ , which I think is not the case here. Similarly page 15-5 lines 2-4 is ambiguous. I suggest that the introduction is revised to explain that many natural processes drives fluxes in and out of the ocean, that in addition the ocean responds to increasing atmospheric CO ₂ and to changes in the input of nutrients from land. The same problem re-appears in the section "trends and drivers", where it is not entirely clear is processes are natural or response to anthropogenic changes.		X					
15-003	24	15	General		The information on processes is sparse and incomplete. In particular it would be useful to know for each processes which direction are the CO ₂ fluxes expected to go if the process is enhanced in the future. Pars of this information could be integrated in the "global coastal ocean carbon fluxes" and part in the "trends and drivers" sections.			X				This is the state of the science
15-004	24	15	General		I would have liked to have some information on the Arctic ocean, especially because of the projected decrease in ice cover.			X				This is the state of the science
15-005	24	15	15-1	15	What time period is this for?		X					
15-006	24	15	15-1	16-31	Please clarify as much as possible which information relates to the natural carbon cycle and which information is due to anthropogenic influence.		X					
15-007	24	15	15-5		I would have liked to have more information if the new data presented agree with the climatology of Takahashi et al (2002) in the regions where there is an overlap.			X				As we note there is agreement where there is overlap
15-008	24	15	15-8	7-10	Please revise. The flow of the information is difficult to follow.		X					
15-009	24	15	15-8	18-19	It is not clear to me why the seasons summer+fall and winter+spring is used here. I would have thought that spring+summer and winter+fall would make more sense both physically and biologically.				X			Summer and Fall are the warm months
15-010	24	15	15-8	24	If only summer months are available, I do not think these observations should be represented in the figure.		X					
15-011	24	15	15-10	16	The net effect of El Nino is well known and not uncertain at all (see many publications by Feely and also your own Figure 15-5).				X			Not true and depends on time scale. Changes made in text in an attempt to clarify
15-012	24	15	15-10	16-19	This statement is not supported by material in this chapter. I suggest to strengthen the section on processes to support this statement.		X					

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15-013	24	15	15-10		Regarding ocean Fe fertilization. I am not aware of any scientific studies that support the efficiency of Fe fertilization. All studies show that this is highly inefficient because as soon as Fe fertilization is stopped, the CO ₂ goes back to the atmosphere. This chapter need to say clearly that Fe fertilization is not a prospect for reducing atmospheric CO ₂ , and not be ambivalent like it is here.					X		Only results that do not support efficiency are models and recent modeling results suggest high efficiency.
15-014	24	15	15-21	Fig 15-3	Need some information on summer/winter distribution of the data (perhaps use different color).						X	Will look into for next revision
15-015	24	15	15-21	Fig 15-3	In the bottom panel, need to use same scale and units as 15-1. The color scale does not allow the reader to see if the regions are sources and sinks and makes the reading of the text very difficult.						X	Next revision
15-016	24	15	15-22	Fig 15-4	Please provide units in axis label.					X		Provided at the bottom of both panels
15-017	24	15	15-23	Fig 15-5	Please provide a smooth (filtered) curve in the bottom panel if possible.						X	Will look into for next revision
15-018	25	15	General		Overall, I believe that this is a clearly written, succinct and high quality summary of our state-of-knowledge of carbon cycling in coastal, lake and estuarine systems. My main significant concern is the potential under statement of potential uncertainties. This and a few minor grammatical and editorial suggestions organized by line number follow.	X						
15-019	25	15	15-1	15	Delete "global". Since you are making a distinction between global and coastal oceans (the title of this chapter), declaring that the global ocean takes up 1.3 - 2.3 Gt/y of anthropogenic CO ₂ presupposes that little uptake can be attributed to the coastal ocean. Also, "anthropogenic" needs to be added to this statement.		X					
15-020	25	15	15-1	18	Not clear if sediments are included in estimating storage.	X						Yes and changed to anthropogenic carbon
15-021	25	15	15-1	20-23	It seems to me that there is more uncertainty in this assessment than indicated here - see later comment.					X		We think the assessment of a net zero air-sea flux is true, uncertainty about the rest of the carbon fluxes is high.
15-022	25	15	15-1	29	Again, I think that there is more uncertainty as to whether North America's coastal ocean is a source of CO ₂ .					X		See above. It is not a source given the uncertainty.

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15-023	25	15	15-2	15-16	It is correct of the authors to point out that most previous studies have been limited to assessing air-sea exchange. However, the authors should also point out that adjacent to continents, significant inputs can be derived laterally from terrestrially pools. These would include freshwater inputs, groundwater inputs and coastal waters exchanged with coastal zone systems (e.g. salt marshes). One of the authors (WJC) has shown that on the Georgia shelf, exchange with the marshes supplies sufficient carbon to uncouple coastal air-sea exchange from coastal - open ocean exchange. That is, shelf waters on the Georgia shelf are both a source of CO ₂ to the atmosphere AND the open ocean. Thus, in this setting, the use of air-sea exchange to assess net anthropogenic invasion is not valid and in fact is of the wrong sign. If the authors wish to dismiss these recent findings, they should provide a reason. If not, this exchange should be included which will significantly increase the uncertainty of the net exchange for North American coastal systems.					X		We have included them indirectly by looking at the effects of freshwater on air-sea exchange but we also agree that the freshwater issues have not been treated fully and have changed the title of the Chapter.
15-024	25	15	15-3	1	Replace "global" with "deep" since (as the authors point out in the next line) the coastal ocean is not included.					X		Not all coastal waters are shallow. We prefer open ocean
15-025	25	15	15-3	6	There is also a more recent wind speed - gas exchange relationship reported by McGillis. This should be mentioned and the uncertainty in invasion reported.		X					
15-026	25	15	15-8	14	The authors briefly mention high PCO ₂ associated with terrestrial inputs. However, the important offshore flux here is reflected in the total CO ₂ (not PCO ₂) in the shelf waters all at salinities above 30.						X	Yes but apparently do not affect air-sea exchange
15-027	25	15	15-9	6	Again the authors focus on air-sea exchange exclusively without noting potential uncertainties associated with the boundary.						X	See coment 26
15-028	25	15	15-9	25	The authors note that the air-sea flux is approximately 1% of the deep ocean (note the authors should replace "global" with "deep"), but again do not note potential lateral fluxes. Also, earlier the authors cite Ducklow and McCallister (2004). I do not believe the results of the D&M analysis but if the authors are going to cite them in one location, they should be consistent. Since D&M come up with a value that is inconsistent with the 1% coastal flux presented here, they should at least acknowledge the uncertainty.						X	See coment 26
15-029	25	15	15-10	15	Again in this section, the authors completely equate ocean uptake of anthropogenic CO ₂ with air-sea exchange which has been shown to not be true at ocean margins. What is true is that the importance of non-air-sea CO ₂ inputs is uncertain, but preliminary extrapolations indicate that it can not be objectively ignored with the present data set.						X	See coment 26

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15-030	25	15	15-11	1	The importance of WJC's observations on the Georgia coast seems to be ignored in the much of the ending discussion and in suggested R&D needs. The most important point is that the margin inputs of CO2 to the ocean are not necessarily reflected completely in the PCO2 but one needs to also measure the total CO2 and residence times of the coastal waters.						X	See coment 26
15-031	32	15	General		I have a major question on the review: The title is "Coastal Oceans, Lakes and Rivers." The discussion of the oceans is very good, as would be expected by that author group. But they say nothing about Lakes and Rivers, other than a brief allusions to input to coastal zone. The Wetlands does a nice job of .just wetlands, mostly northern.						X	See coment 26
15-032	32	15	General		The statement in Houghton "Rivers, lakes, dams, and other inland waters are mentioned in Chapter 15 as being a source of carbon, but they are claimed elsewhere to be a sink (Chapter 3). The sign of the net carbon flux attributable to erosion, transport, deposition, accumulation and decomposition is uncertain (e.g., Stallard, 1998; Lal, 23 2001; Smith /et al./, 2005)." pretty much sums up the treatment - pretty marginal.						X	See coment 26
15-033	32	15	General		At a minimum, I would suggest that the title of Ch 15 be changed to "Coastal Oceans," and delete the Rivers and Lakes bit. As I remember, this was a gap pretty much identified at the kickoff meeting, a few years ago.						X	See coment 26