Comments and Responses on SOCCR/SAP 2.2 Draft 1 (May 2006)
CHAPTER 12

COMMENT FROM PEER REVIEWERS						AUTHOR'S RESPONSE						
Comment Number	Reviewer ID	Chapter	Page	Line	Comment Text	Acknowledged, but no further reponse 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 CO2 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 CO2 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 origina,l 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 matte 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 CH4 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 CH4 is a much stronger greenhouse gas than CO2.					X		Two possibilities are discussed on p.12-10. One goes from frozen (high ice content) to wet and then you get CH4 production; the othe goes from wet to dry and then you get aerobic decomposition, wildfires and CO2.