

Review ESSD-2022-328

Thanks for opportunity to again review important document. I will certainly recommend publication.

Document has gotten longer, while time to review - esp this year - has gotten shorter. Too much to ask, even of strong advocates? Authors and journal need to consider alternate approaches!

I evaluate mostly marked changes. I read full text to understand context for changes. Line number references refer to full 2022 document.

Basic question, perhaps not answerable here but also not addressed: Why do atmos CO₂ concentrations (e.g. Figure 1) rise continually apparently without any influence from substantial changes documented in Efos etc. as in Figure 3?

Technical issues/changes:

Line 159: “synthesise” - ESSD editors will know correct spelling

Lines 169 to 171: Efos = 10.1 + Eluc 1.1 = Etotal of 11.1? As in prior years, small offset must represent rounding error? Scientific readers should understand uncertainty limits (1 sigma) but casual readers will see this as math error? Also, because of qualification due to cement carbonation, does this total include or not include the carbonation term? One case Etotal = 11.0, in the other 11.2, both within uncertainty limits but both will confuse some readers?

Line 176: “50% above pre-industrial” this means pre-industrial = 270 ppm? We know this but casual readers may not. Likewise at lines 221. Not defined (277 ppm) until line 239.

Line 191: “pre-COVID” not well defined (and, in any case, not determined by carbon community). Insert ‘2019’ so that readers will understand changes on your terms.

Lines 190 to 199: this paragraph seems slightly confusing? Efos for 2021 known (reported), now [quantified] as slightly below Efos 2019. (Why not specify Efos 2019 here?). Efos increase expected for 2022 [estimate growth], to above Efos 2019 (now Efos 2019 itemized but why here rather than earlier?). Then sectors then regions, but all as Efos 2022 estimates. Some readers may feel that authors jumped past solid 2021 data?

Lines 203 to 211: now, appropriately, Eluc but on decadal rather than annual terms; tell us why? In line 202, authors revert to annual estimate. If not in fact significant, say so while omitting the numbers?

Lines 206, 207: “highlighting substantial mitigation potential” this seems like IPCC-speak. For casual readers (of Exec Summary!) call out the desired change: less logging (deforestation)?

Line 207: “sequestration of 0.9” a quantified report or an estimate, not clear.

Line 208: other ‘land-use’ transitions?

Line 209: now reader confronts 6 decades (1959 to 2021)? Need consistent time-scales or explicit refocussing.

Line 215: rounding errors again induce confusion. 2021 Efos + cement at 11.1 while 2022 increase to 11.1? And what happened to carbonation?

Line 217: release of IPCC AR6 WG1 in 2019? Formal citation = 2021? Please clarify?

Line 219: cumulatively for each of the next 28 years? $28 \times 0.4 = 11.2$. What (again) about carbonation? In the noise?

[Speaking personally, these numbers assume we continue in a stable economic and social system? Very unlikely? Can authors not inject some note of enhanced uncertainty?]

Line 223: following from prior paragraph, this growth rate will need to trend toward zero? But, despite quantified decreased Efos for 2020, atmos concentrations of CO₂ showed no downward deflection?

Lines 224 to 230: Decadal records vs annual predictions? Can authors justify annual predictions in view of 3x uncertainty obs to models?

Lines 235, 236: If annual 1 Gt changes in Sland do not impact global atmos CO₂ concentrations, same also true for Socean? What are we missing as global atmos CO₂ concentrations continue to rise regardless of changes in Efos, Sland, Socean?

Line 254: parentheses rather than commas (e.g. “since the year 1750 (the pre-industrial period and”)”? Authors and editors will know.

Line 302: “characterising” looks strange to my eye but authors and editors will know.

Lines 363 to 369: this paragraph implies that authors have applied carbonation corrections consistently to prior data? Not clear to this reader.

Line 403: information also for peat drainage <by combining> three independent datasets for peat drainage?

Line 545: for widely-diverging GOBM and obs-based estimates, should this be median rather than average? Or, authors already selected against extreme values?

Line 632: here, carbonation corrections applied only since 2021 in atmos inversions? Somewhere this reader would like to find a statement about when corrections applied, over what time periods, or - as minor - not applied.

Line 697: here reader finds/learns that carbonation correction applies since “1960s”. Need this clarification earlier to resolve previous issues.

Line 789, 790: “emissions from organic soils contribute over proportionally to interannual variability” Something wrong somewhere?

Line 784-809: sorry, but the authors lost me completely in this discussion of Eluc. I suspect authors could rewrite at half the length with twice the clarity. Not useful as written.

Line 815: “ to a substantial part for export” not clear what authors mean here? Land cleared of forest, converted to cropland, but crops then exported?

Line 829: NGHGI defined here but acronym used several time previously?

Line 863: “relatively wet dry season” I know what you mean but highly awkward as written

Lines 901 to 903: why not these lines (about unprecedented atmos CO2 concentrations) in exec summary?

Page 87-88, Table 3: Excellent, should be required in any repeating global estimate in ESSD.

Page 94, Table 6: Legend includes a disclaimer about rounding to 0.1 GtC. Such a disclaimer should occur at top of manuscript text?

Page 97-98, Table 10: Interesting approach to show major uncertainties in one table. Appears much more orderly and organised here than this reader found in text?

Page 107, Figure 9: Why can't these panels appear as large and clear as panel in Figure 10?

Page 110, Figure 12: Thought-provoking. In last year's version, Efos - Gatm occurred as a broad range and doubled line diagonally across the graphic, allowing this viewer to assume annual variations. In present version, Efos - Gatm follows a single linear line without variation. I need to think whether invariant Efos - Gatm across the ranges of Sland and Socan is even possible? Shouldn't individual Efos - Gatm points vary as BIM?

Page 137, Figure B4: Good that authors include but suggests very weak relation atmospheric inversions to airborne measurements. Problem with obs or models or both? I understand why co-authors want inclusion in this notable effort but this suggests a substantive piece that could be eliminated, treated elsewhere, relegated to a supplement, etc. Really no change, and certainly no improvement, from prior version! This version could reference all of Appendix B by citation to previous rather than inclusion in every iteration?

Page 140, Appendix C, lines 59 to 69: About carbonation. Text here describes (and, to certain extent, repeats information already provided) carbonation process. Final sentence describes where carbonation processes fit in budget. Nothing here, however, about time span for applying these corrections, or of impact of leaving them out?

Other sections of Appendix C, Methods, quite necessary, particularly when external economic or social factors force change in annual estimates. Likewise for Appendix D. But, Appendix B?