**Manuscript ID: sustainability-235715, review response**

Reviewer 1:

1. *I would encourage the authors to broaden their framing of the paper in the introduction by looking at the global chemicals regime more broadly, both the hard law instruments and the soft law instruments (and cite some of the relevant literature). This includes sketching out the main existing hard law and soft law instruments and then discuss how the voluntary pieces that include SAICM and GHS fit into this larger chemicals regime. Also, how does this discussion about voluntary programs and GHS fit into the (also voluntary) SDG agenda?*

Thank you for constructive review comments!

From Sylvia’s email, to be fixed: “the hard law landscape is very limited indeed, limited in terms of chemicals it addresses in particular. Thus the potential for international agreement on binding treatie on chemicals is simply low - all the more important to look at the impact of soft law like the GHS which is what we have left.”

1. *Which specific actors (countries and type of country representatives as well as any other stakeholders) were part of the expert committees that developed the GHS (as briefly mentioned on page 2)? Exactly who wrote the standards?*

The GHS was based on the what were considered to be the major existing systems and then further developed, first under the IOMC, and later under the sub-committee. We have added some more detail in this description, as well as a few more references.

1. *What exactly is the role and importance of the EU and EU chemicals legislation (including REACH) in ensuring GHS implementation across its 28 member states as well as the other countries that are part of the single market (Switzerland, Norway, Iceland and Lichtenstein), and how does this impact the analysis of which factors influence implementation? The fact that GHS is part of EU law creates a much stronger pressure on implementation across these 32 countries than is the case for any other countries in the world (and may directly impact/skew the data and number of countries with full implementation, as this is not the result of each country having voluntary implemented the GHS per se, but been forced to implement it as part of EU legislation which comes with enforcement mechanisms not seen anywhere else in the world). The paper towards the end talks a little bit about this as well as the role of the EU in pushing chemicals management issues and GHS implementation in its external relations with countries that it has concluded multilateral and bilateral cooperation agreements (including providing special access to the EU single market, which is a very strong carrot), but the role of the EU deserves more consideration and discussion. On much of this, see for example: H. Selin and S. D. VanDeveer. 2015. European Union and Environmental Governance. New York: Routledge.*

Thanks for pointing out the “special case” that the European Union joint implementation represents. We agree that this merits somewhat more discussion, see addition in the discussion section.

1. *What is the role of the multinational and domestic private sector in influencing GHS implementation? Can this be tested using the data set? Especially large importers and users of chemicals have a direct interest in more product information (more so than the large producers/sellers). One of the interesting things about the implementation of REACH was the diverging interests and positions among producers and users of chemicals with respect to data sharing and labeling.*

This is indeed an interesting point. Unfortunately, the present data set is not up for responding to this question. However, it was expressed in some interviews that for private sector actors the GHS implementation can come as a mixed blessing and the extent to which it facilitates for business depends a bit on what the situation is before the implementation. A worst case for business seems to be a void, i.e. no legislation at all. In comparison with such a situation it would be better for private sector actors to have (almost) any legislation in place that is predictive and enforced. However, national GHS implementation may also come with additional and sometimes quite costly requirements for companies such as mandatory labeling in local languague/s. For this study, there is not much we can add, but for sure an interesting future topic of investigation.

Reviewer 2:

1. *As a general comment, it is questionable to what extent the article gains from the quantitative approach taken, with statistical analysis of an indeed complex reality, where reasons for the varying level of implementation are not only multiple and changing with time, but also interacting, and for these and additional reasons are difficult to sort in clear hypothesis, not to mention in meaningful causal (explanatory) relationships. It is not necessary wrong to take a quantitative approach, if conclusions are formulated with care, but the explanatory value is quite limited, and a more extensive qualitative analysis, not least based on the interviews conducted (of which one knows very little, see below), would probably "explain differences" etc. in a more meaningful way. A combined approach could of course be even more interesting, where interviews etc. are used much more extensively and explicitly for corroborating and explaining the quantitative analysis.*

Thank you for a thorough, sharp and constructive review of our paper.

We agree that your general point of the choice a quantitative approach is a valid one. As we see this, the study we have conducted now is in a way an overview of the overall implementation situation, since there was no such global information available before. We note your advice on looking over the use of “explanatory factors”, as well as the phrasing of the discussion around correlations between the quantitative factors and the legal GHS implementation status. As you will see below, we have tried to address these issues, and also, added a few sentences towards the end of the discussion, pointing out that a more qualitative approach would be the natural next step in order to improve our understanding of the barriers to GHS implementation.

1. *Another important general remark, related to this, is that the methods must be better explained, in particular the interviews. Who were interviewed, about what, and how and when etc., and which were the more specific results. Even if confidentiality may have been promised, a de-codified text with a much richer explanation of methods, and of results, would still be possible to present (see also below).*

The methods section has been revised, see specific questions on same topic below.

1. *In the Introduction, the first paragraph can be deleted; it raises topics not related to the main substance in the paper, it contains some old references and the statement about the TBT agreement is quite simplistic and probably misleading, if not wrong. Besides this, the Introduction is clear and fine.*

The paragraph has been deleted.

1. *In Theory and Methods, which in general is well-written and fine, three stages of implementation are proposed, which is fine, but considering that the study (justifiably scoped) focuses strongly on the second stage, another title for the article should be chosen than “explaining the implementation gap”. One way could be to write “explaining shortcomings in the implementation”, or “explaining legal implementation gaps”. Similarly, the codes of classification need to be renamed, into e.g. “Full legal implementation” and “Partial legal implementation”. References to the use of the concept “implementation” would strengthen the text.*

* The title of the paper has been changed according to one of the suggested option: “explaining the legal implementation gap”
* The codes have been changed to full and partial legal implementation. The word “legal” has also been added as a qualifier when implementation is mentioned in several additional places in the running text, e.g. in the abstract.
* References to the concept of implementation: TO BE ADDED

1. *In the section on Method, the interviews must indeed, as stated in the general remarks, be much better described. In addition, other sources, e.g. the secondary, could also be better described.*

* The methods section has been re-worked to give more detail to the interviews and other data collection. This includes the addition of the list of interviews.
* Secondary sources: I think we have described them quite well… Views??

1. *When it comes to the section on “Explaining…”, it could, as said, be more worthwhile, and more explanatory to take a qualitative approach than a statistical one. To give one example, the text about the indicator “WTO membership” doesn’t explain much. While there is an association (and rightly not a causal correlation) between membership and GHS (legal) implementation that says hardly nothing when more than half of the WTO members have not implemented GHS. It is far from clear what is actually “explained” here. However, here – and elsewhere in section 4, this is just an initial example – the analysis or elaboration on country and group specific information, is useful, and it would really be of value for the article (given its aims) if this could be further described, backed up with references (e.g. from interviews or other sources) and analysed in more depth. The interesting insights that now are provided would then be richer.*

* Language has been revised to change the tone away from “explaining” towards “exploring”.
* Text has been added under the sections on the WTO, the ILO conventions, SAICM, international cooperation and comparison across indicators to add qualitative analysis when there was interview material to do so, and otherwise to indicate this as an area for future studies.

1. *In general, due to the multiple factors influencing what countries do and not in this context, more care should be taken with the use of the concept “explanatory factor”, when the statistics in general, at most, show associations and co-variations, and not causal relationships*.

* Use of the term “explanatory factor”, and “explaining implementation” has been revised to “explore” or “discuss” throughout the manuscript, including in the introduction/aim of the paper and in the heading of section 5. In several places, text has also been added to explicitly make clear to the reader that correlation does not imply causality, as described above in our answer to question 6.

1. *In the Discussion, the statement on line 501, that the “proposed indicators appear to explain a large proportion of variation” is questionable (for reasons outlined above), and should be toned-down somewhat. Besides this, the Discussion contains much valuable information, but sometimes in the form of new additional results from e.g. interviews, which should perhaps be placed in section 4 instead, and there be described more comprehensively. Moreover, in the discussion, the quite common situation with (legal) implementation, but without – or with limited – enforcement and compliance mechanisms in place, should be highlighted among the potential explanatory factors. Finally, in the end of the discussion (line 616f), the conclusion is very similar to the starting point, and since the set-up of the paper is not hypothesis-testing (of explanatory theories), the sentence “Summing up…” can be read as almost circular reasoning, so a reformulation is needed.*

* The sentence on line 501, “proposed indicators appear to explain a large proportion of the variation” has been changed to : “…proposed indicators appear to statistically account for a large proportion of variation in GHS status outcomes (R2=0.57)”. Expressing how statistical models correspond to variation in the dependent variable is often semantically challenging – we have opted here for a more careful (but more wooden) phrasing, which hopefully clarifies this.
* Move “new information” to results section? Do we want to do this? It sort of breaks the story line and would require major revisions… but maybe we should do this anyway? Views??
* Legal implementation without or with limited enforcement and compliance in place: text has been added in the discussion.
* Closing paragraphs: the “summing up…” sentence has been revised.