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comment

Interactive comment on "Modifying emission scenario projections to account for the effects of COVID-19: protocol for Covid-MIP" *by* Robin D. Lamboll et al.

Anonymous Referee #1

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This paper details the experimental protocol for "COVID-MIP", a series of experiments designed to assess the climatic impact of the COVID-19 pandemic and associated global lockdowns. The study follows from Forster 2020, which produced sectoral estimates of emissions changes due to lockdowns in 2020, along with idealized extrapolations of near- and mid- term recoveries.

The proposed MIP modifies an existing baseline scenario, SSP2-RCP4.5 as simulated by the MESSAGE-GLOBIOM integrated assessment model to produce a transient multi-gas emissions pathway. Experimental protocols are given for a short term experiment to assess climatic effects during the pandemic itself, longer term experiments

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Discussion paper

to assess the effects of "green" recovery strategies and simple detection/attribution experiments to decompose effects of short lived and long lived forcer perturbations

This MIP is critically necessary at this point in history - by many metrics, the existing scenarios in ScenarioMIP no longer represent the reality we live in. However, exactly because of this importance, the current design falls short of what is required. The paper has not been thoroughly read, with several minor errors, and though the protocol is fairly clear, the design choices neglect to consider the primary uncertainty in the problem at hand: namely, how will the COVID19 pandemic play out?

The protocol assumes a single trajectory for the COVID epidemic, and that trajectory is relatively optimistic (a global elimination of the virus by 2023). As the paper notes, such an event in an integrated assessment model is not even resolved at the default 5 year timescale, and the direct climate impacts are minimal, but it is far from clear that this trajectory is certain.

As noted below, this MIP has one primary role - to produce scenarios which represent and explore the additional uncertainty we now have in global climate projections following the COVID19 pandemic. As such, the focus should be on exploring the uncertainty in the evolution of the pandemic itself and how it modifies the existing scenario framework, which in the worst-case scenario (or even in a middle-of-road scenario) could persist onto the decadal timescale with direct effects on the economy, population, transport and technological progress.

The back-of-envelope projection of the epidemic trajectory was reasonable for the commentary of Forster (2020) as an initial estimate of 2020 emissions impacts - but it is not appropriate for a MIP with a multi-year, multi-center ESM simulation commitment which needs to explicitly explore futures which may be radically different from those considered in ScenarioMIP.

The paper explores 'recovery' strategies of high green investment or an increase in fossil fuel demand - but these are broadly a subset of mitigation responses seen in

ScenarioMIP, but it is unlikely that they will yield major additional insight in the current design. Furthermore, it is not apparent how these recovery scenarios fit into the scenario space as defined in O'Neill (2014).

As such, I recommend a major revision of the protocol to explore the potential degrees of freedom and downstream economic and technological impacts of the pandemic itself.

Major issues

1 - Uncertainty in pandemic parameters

My major concern with the current protocol is that the parameters of the pandemic itself are represented with certainty, and furthermore the authors have chosen a relatively optimistic scenario - i.e. lockdown measures are projected to decline over a two year period to return to baseline levels in 2023.

These decisions were reasonable in the idealized paper of Forster 2020 - published in the summer of 2020 as a rapid first estimate of emissions effects of the first wave of the pandemic. However, for a MIP protocol which will be primary resource for climate projections in a post-COVID world - the first-order task for this MIP is to explore the representation of uncertainty in the pandemic projection itself, which includes futures where direct COVID impacts persist for a longer timescale.

The lifetime of the direct effects of the pandemic (aside from the recovery plan) are subject to significant uncertainty. Different countries may be subject to significantly different recovery timescales depending of vaccine accessibility (Mullard 2020), and a full elimination by 2023 is optimistic (Ioandinnis 2020)

An important possible avenue to explore is that the direct pandemic effects may persist for a more extended period of time than currently considered. The likely future where there are large portions of the globe with delayed access to vaccines post 2023 would still be subject to regional lockdown measures, travel restrictions and economic effects

beyond the timescale of the experiments in the current design.

There is also the concerning possibility that vaccines will be ineffective against virus mutations. Initial papers classed the likelihood of an endemic scenario to be low (Fernandez 2020), but not impossible, and the emergence of potentially vaccine-resistant strains (Tegally 2020), and more aggressive strains (BMJ 2020) raises at least the possibility that COVID19 variants could remain in circulation for an indefinite future. Assessing the impacts of these futures requires at least the discussion of a completely different type of climate scenario in which global economic norms are radically altered from baseline assumptions on a longer timescale.

The authors need to consider a scenario-based approach to the pandemic evolution (see, for example - McKibben 2020, though now somewhat outdated). At the least, two scenarios for the disease itself are necessary, but ideally more. The existing scenario is an optimistic, global complete recovery by 2023. I suggest that the authors consider the uncertainty in the parameters of the pandemic - with appropriate consideration of a heterogenous regional timescales, with realistic estimates of regional vaccination rates, together with downstream economic, technological and social effects. Furthermore, the potential for an endemic scenario where the direct effects of the pandemic persist onto the decadal timescale should at least be considered.

2 - Green recovery self-consistency

The current version considers two "green" recovery scenarios and one fossil fuel intensive scenario in contrast to the baseline SSP2-RCP45. It is unclear in the current version how these fit into the wider scenario framework (O'Neill 2020), where, for example, an aggressive low carbon investment plan is more plausible under SSP1.

But more significantly, it's not clear what these experiments add to the literature in the current MIP framework. The pandemic, as simulated in the current design, is not a significant perturbation to emissions for long term climate targets. As the authors note, a 2020-2023 pandemic would not even be resolvable in the 5 year timestep of most

IAMs.

As such, the pandemic as represented in this projection is insignificant in terms of forcing targets, and the recovery projections duplicate the existing scenario framework, with transient pathways with rapid emission reductions relative to the SSP2-45 baseline (such as SSP1-RCP19 or SSP1-RCP26) or transient pathways with increased fossil fuel growth (such as SSP3-RCP7 or SSP5-RCP85).

It is unclear how GCM simulations of the recovery pathways outlined here add to this literature, given that the scenarios presented here are significantly more idealized than the more complete socio-economic storylines provided for SSP-RCP combinations in the ScenarioMIP project, and that the current paper does not attempt to resolve how the COVID epidemic itself could cause irreversible changes to global economic or technological projections.

Minor Issues

line 54: using SSP2-RCP45 is not self-evidently middle-of-the road. The authors should provide more context on why this scenario is in line with current policy

line 21 spelling "unprecedented"

line 100 - "interpolation between the effects of lockdown and the baseline behaviour, so does not need to be interpolated" - sentence is confusing, rewrite.

line 151- spelling "iterations"

line 209 and 129 - spelling "simulations"

line 234 - spelling "minimum"

line 239 - spelling "continuation"

line 299 - spelling "emissions"

line 299, 302 - spelling "simulations"

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