8 June 2020

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Chapter 9, Coordinating Lead Authors

Re: Extraordinary Concerns Regarding Sea-Level Projections in AR6 WG1 2nd Order Draft, Chapter 9

First, we thank you for your service to the scientific community–and the world–by taking on your demanding role as Chairs of forthcoming IPCC Sixth Assessment (AR6), Working Group 1 (WG1). The undersigned have great respect for the IPCC process, with many of us having worked on the five previous versions over the last three decades. We applaud the Vision Paper of the AR6 Chair[i], particularly the intention to better incorporate risk, which is key to our concern described below. We understand and appreciate the need for protocol, process, and consistency. Several of the undersigned have registered and submitted comments that we trust will be considered as part of the *ordinary* technical review process that just closed on June 5.

Beyond that ordinary review however, we are compelled to bring something *extraordinary* to your attention as chairpersons. The AR6, WG1, Chapter 9, Ocean, Cryosphere, and Sea Level Change second order draft (SOD), like the 2019 Special Report on The Ocean and Cryosphere in a Changing Climate (SROCC) and AR5, presents a situation that is now quite incongruous. Though still in the process of review, lines 24-26 on page 9-7 of the SOD present a very similar range of projections for sea-level rise (SLR) this century as in AR5 and the SROCC. Across those three IPCC documents, under RCP 8.5, the asserted extreme scenario for the year 2100, there is a clear disparity or discrepancy:

- Global Mean Temperature (GMT) is projected to increase up to 4.3 - 4.8 degrees C.
- The highest projection for SLR is 82 – 98 cm. (See SROCC graphs as Appendix A.)

Based upon the weight of observations, trends, and the paleo record, we believe this characterization for sea-level rise is misleading and lacks credibility. Powerful feedback mechanisms suggest a real possibility for irreversible ice sheet collapse with key thresholds at 2-3°C warming.[ii] If GMT increases to more than 4°C this century, we find there is very significant probability that global mean sea level (GMSL) will be meters higher, not 90 cm as in the SOD. Furthermore, even at 3°C, given the enormous potential for amplifying feedbacks,[iii] multi-meter SLR becomes a high probability that must not be allowed to happen. As drafted, it does not send that message. Though this problem did not start with this version, and indeed traces back to the first, the last three decades make clear that change is warranted. Upper bound figures of less than a meter of SLR this century almost certainly understate the risk. In that alleged extreme scenario, RCP 8.5, the contribution to sea level from the melting of the Antarctic ice sheet and glaciers is put at a maximum of 15 cm. That does not conform to the reality of the observations and the grave risk as the polar ice sheets destabilize.

We recognize that beneath the presentation of top level projections for GMSL in all three of those IPCC reports, notes have been placed to advise readers that the figures do not include abrupt changes in the Greenland and Antarctic ice sheets and glaciers. Unfortunately those disclaimers and footnotes do not rise to comparable

impact as the top-level numbers and are widely overlooked. All over the world, the IPCC figures of 82 – 98 cm for GMSL by 2100 are understood to be and are cited as the extreme range and "worst case." Buildings, infrastructure, and communities that will last as long as a century have been and continue to be built based on this framing by the IPCC. This is simply not responsible and does not advance the purpose, role, or reputation of the IPCC, which is needed more than ever.

General perception is that the IPCC Reports are the latest science. Of course there will always be improvements to models, and cutoff dates are inevitable. Yet given the fast-changing field of ice-sheet modelling, it is a particular problem that models considered by AR6 for ice-sheet mass loss do not contain state-of-the art bedrock topographic models.[iv] They also do not include realistic ocean forcing, even though it is known that melting forced by ocean heat is driving the Antarctic ice sheet out of balance, creating the real potential for rapid marine ice shelf (and ice cliff) instabilities.[v] Additionally, IPCC reports tend to unlink discussion of "tipping points" and amplifying feedbacks, from model projections of SLR, by publishing these topics in separate report sections. Lastly, the graphics and discussion that place emphasis on the year 2100, give a dangerous and false sense that SLR beyond that time is negligable and unimportant.

The fact that the latest proposed AR6 projected SLR figures are actually lower than last year's SROCC projections adds to the confusing and misleading situation. While we refer to RCP 8.5 to highlight the problem of understating potential sea-level rise, the problem extends to the lesser scenarios as well. **We are very concerned that the report to be presented in April 2021, as presently stated, will mislead the world about safe planning and construction, will undermine the assessment of risk, and will be used by those who dismiss our shared concern that climate change is a real and present danger.**

While it is not possible to compare diverse methodologies, the chart from Sriver *et al* shown in the attached Appendix-B, compares a wide range of GMSL projections.[vi] As shown, 15 of 16 separate studies show ranges of sea-level rise as 1-3 m by the end of this century. In contrast, as shown on the same comparison chart, all of the IPCC reports starting with SAR(AR2), project well below 1 m.

It is clear from geologic history that our climate has reached conditions similar to the Eemian, when the literature shows GMSL to have been 6 - 9 m higher than present. [vii, viii,ix] During that last interglacial period, global mean sea surface temperatures were only a half degree warmer than 150 years ago, and indistinguishable from the 1995–2014 mean. This is a sobering point, with the most serious implications for every coastal community worldwide. The paleo record strongly suggests that GMSL changes by as much as 20 m per degree. One of you was an author of "Ice melt, sea level rise and superstorms: evidence from paleoclimate data, climate modeling, and modern observations that 2^{o}C global warming could be dangerous", which made the case for potential catastrophe from multi-meter rise.[x] A more recent PNAS paper, "Ice sheet contributions to future sea-level rise from structured expert judgment" found a 5% probability that SLR would reach 2 m by end of the century and clearly makes the case that responsible planning needs to consider multi-meter sea-level rise.[xi]

Regardless of whether the warming this century can be limited to 1.5^{o}C above pre-industrial, or exceeds 4^{o}C, the world needs to begin serious planning for the unprecedented challenge of multi-meter sea-level rise even if the timing cannot be determined with precision. It is misleading to focus on the accuracy of millimeters when meters are missing. Unstoppable SLR is one of the greatest challenges ever faced by civilization. It is essential that the IPCC support that awareness to ensure appropriate scientific, engineering, economic, and

humanitarian responses and adaptation. Since we recognize that AR6 is well-advanced with a very tight schedule, we want to be realistic in our expectation of what might be done at this late date to rectify the situation. Resolution could be addressed by how your findings are presented. The range of options might include:

a) Reconsider the complete reliance on models that exclude abrupt changes. Alternatively, develop a new presentation of model results with less emphasis on multi-model means that tend to bury potentially revealing extreme results. As evidenced in the paleo record, as well as by current observations of accelerating deglaciation, there is high potential for extremely dangerous processes emerging in the near future.

b) Wherever the figures for GMSL projections are shown, title them very prominently as excluding abrupt changes to Greenland and Antarctica's ice sheets or glaciers, which are similar to other major geophysical events that defy accurate long-term prediction.

c) Where model-based projections are featured, clearly inform readers that based on the paleo record and recent observations, abrupt changes are deemed possible without warning.

d) Present a discussion that integrates amplifying feedbacks with SLR projections, include a timescale graphic illustrating the potential range of outcomes, and extend it several centuries without emphasis on the year 2100. Make this graphic and discussion the primary result of the sea-level analysis, and use it in all summary documents, press releases, and other derivative products.

e) Make "unstoppable sea-level rise" a key term that appears frequently in your media pieces.

Because this message recommends or implies a change of IPCC process, departing from precedent, we view it as extraordinary and separate from the ordinary review and comment process directed at the Coordinating Lead Authors of *Chapter 9, Ocean, Cryosphere, and Sea Level Change*, but will CC them, so they are informed.

To close, the rationale for this letter is to return to the intent of the IPCC three decades ago, scientifically and ethically. To quote from the IPCC founding mandate, "**to provide the world with a clear scientific view on the current state of knowledge in climate change and its potential environmental and socio-economic impacts**." We feel that we are not addressing that aspect of the mandate in terms of SLR. While our science may be good, our ability to explain it clearly, is not. We are in an unprecedented situation and may have to change our mode of presentation accordingly. Only future generations will be able to judge whether we were effective at discovering and communicating the urgency, profoundness, and potential abrupt change to our climate, which is essentially Earth's ability to sustain our ecosystem. Sea level is arguably one of the most important consequences of a warming planet and the one most likely to get the public's attention if it is communicated clearly. From a practical perspective, if we can inform the world about what could realistically happen to sea level in the second half of this century, likely accelerating into the next, we might get humanity's attention about the larger field of truly critical climate science, the need to change our path, and the need to adapt to higher sea level while there is time. As Chairpersons of the Sixth Assessment, you are in a unique position to ensure that the execution meets the needs of the world at large on this paramount issue.

Thank you for your consideration.

Respectfully,

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References

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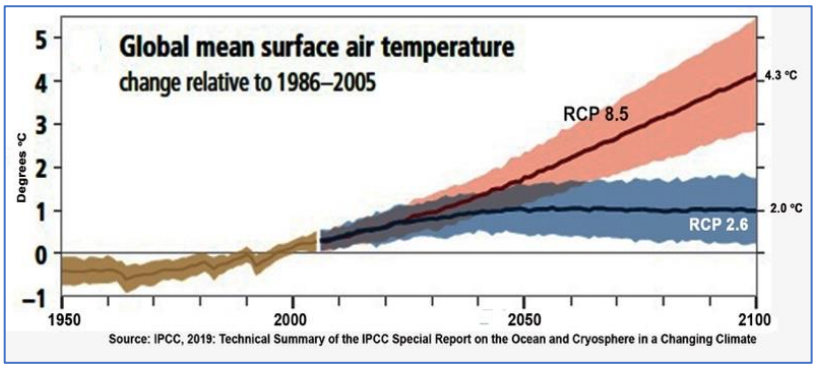
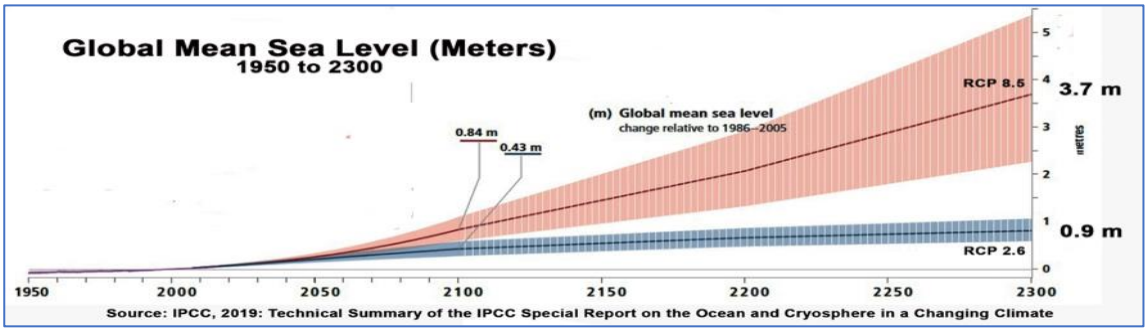
Ad Hoc Experts Concerned Regarding Sea Level Projections IPCC AR6 – 8 June 2020

APPENDICES: A & B

A)





B)