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Discussions

Interactive comment on "The transient sensitivity of sea level rise" *by* Aslak Grinsted and Jens Hesselbjerg Christensen

Anonymous Referee #4

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The paper The transient sensitivity of sea level rise by Grinsted and Christensen discusses the relationship between global mean surface temperature and global mean sea level rise on a time scale of the order of a century. The authors acknowledge earlier work on the topic and frame the relation between temperature and sea level rise as an independent proxy for the evaluation of recent assessments of sea level rise projections that are biased low compared to observations. The article claims a linear sea level sensitivity of 0.4 m/century/K based on observations and either lower sensitivity in AR5 or higher balance temperature in SROCC and Bamber et al., 2019., respectively.

General comments

The paper is very short and concentrates on the discussion of the discrepancy between the parameters of linear regressions between averaged global mean surface

temperature and global mean sea level rise, based on observations (past) and climate projections (future). In the face of high and rising stakes on the response to sea level rise additional proxies for the evaluation of projections of sea level rise are needed. The paper contributes to this end in bringing back the sea level sensitivity into the discussion. I think it is worth to be published and discussed in the community. The paper misses the opportunity to go deeper into the matter and offer thoughts or strategies how to address the discrepancies in transient sea level sensitivity between observations and climate projections.

Specific comments

I wonder whether we could learn something more about the impact of model development if the current analysis would include older projections like AR3 and AR4. Those were already below GMSL rise according to Rahmstorf 2007, Horton et al. 2008.

One weak point of the analysis, as I see it, is the different ranges of GMST used for the regressions of the observations and model projections. Would it be possible and useful to include model estimates from paleo runs that had GMST anomalies in the same range as those projected for the 21st century?

The regression lines in Fig. 1 should pass through the mean time-averaged GMST anomaly and the mean sea level rate. Is there any information contained in the scatter of the mean GMST and mean GMSL rate of the individual regressions?

It would be interesting to discuss some of the physical processes, thresholds, time scales and limitations, that would render the relationship between averaged GMST and GMSL rate non-linear. It would help to establish the transient sea level sensitivity as a metric next to equilibrium sea level rise on longer time scales.

Are current climate models or model ensembles good enough so that their uncertainty in GMST was smaller than the uncertainty in balance temperature in Table 1? Is the spread in balance temperature inherent in climate models or does it come from the

combination of climate models (GMST, steric) with process models (ice sheets dynamics)?

From Table 1 one could deduce sea level rise of 0.28, 0.05, 0.17 and 0.17 m/century at balance temperature. The 0.28 m/century sea level rise in the observations at balance temperature is already above the 0.1-0.2 m/century sea level rise for the 20th century. Since sea level rise is accelerating we are probably above balance temperature since at least the satellite era. This seems to point to a contradiction in the data and the assumption of a linear process. How can the balance temperature be interpreted or how well can we know it?

Technical corrections

l6: assessments from the Intergovernmental Panel on Climate Change implies l20: and melts.. A perturbation l20: perturbation in greenhouse gas concentrations change l47: table 1 and figure 1 l52: table 1 l63: figure 1 l69: figure 1

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