

Abstract:

Using two process-based models to project sea level for the 21st century, it is shown that taking into account the correlation between sea level contributors is important to better quantify the uncertainty of future sea level. In these models the correlation primarily arises from global mean surface temperature that simultaneously leads to more or less ice melt and thermal expansion. Assuming that sea level contributors are independent of each other underestimates the uncertainty in sea level projections. As a result, high-end low probability events that are important for decision-making are underestimated. For a probabilistic model it is shown that the 95th percentile of the total sea level rise distribution at the end of the 21st century is underestimated by 5 cm for the RCP4.5 scenario under the independent assumption. This underestimation is up to 16 cm for the 99.9th percentile of the RCP8.5 scenario. On the other hand, assuming perfect correlation overestimates the uncertainty. The strength of the dependence between contributors is difficult to constrain from observations so its uncertainty is also explored. New dependence relation between the uncertainty of dynamical processes and surface mass balance in glaciers and ice caps and in the Antarctic and Greenland ice sheets are introduced in our model. Total sea level uncertainty is found to be as sensitive to the dependence between contributors as to uncertainty in individual contributors like thermal expansion and Greenland ice sheet.