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The codependence of contributors to regional sea-level rise

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Science-based policy for coastal protection requires accurate estimates of the uncertainty in regional sea-level rise. These estimates are strongly influenced by the codependence of individual contributors: thermosteric expansion, ocean dynamics, and mass loss from glaciers and ice sheets. In this study, we use model output and parameterisations to quantify the projected total sea-level rise from a set of 15 Earth System Models from the Coupled Model Intercomparison Project (CMIP) 5. We use these model-based estimates of total sea-level rise to quantify the codependence of individual contributors, determined by the full climate response. We find that assumptions on codependence made in recent reports of the Intergovernmental Panel on Climate Change (IPCC) lead to an overestimation in the uncertainty in regional sea-level rise by 20 to 60%. We further conclude that global mean surface temperature rise is a poor indicator for the inter-model difference in regional sea-level rise as it does not account for inter-model differences in atmospheric and oceanic heat distribution and precipitation patterns. The codependencies derived in this study are suitable for application to new projections, allowing for accurate and consistent estimates of the uncertainty in global and regional sea-level rise.