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Interpretation and Analysis of Projected Ice Sheet Contributions from a Structured Expert Judgement

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Despite considerable advances in process understanding, numerical modeling and the quality of the observational record of ice sheet contributions to sea level rise (SLR) since the last IPCC report (AR5), severe limitations remain in the predictive capability of numerical modeling approaches. In this context, the potential contribution of the ice sheets remains the largest uncertainty in projecting future SLR beyond mid-century. Various approaches, including Monte Carlo ensemble emulator simulations, probabilistic or plausibility methods, and Semi Empirical Models have been used in attempts to address these limitations. To explore and quantify the uncertainties in ice sheet projections since the AR5, a Structured Expert Judgement (SEJ) elicitation – involving 23 experts from North America and Europe - was undertaken in 2018; this allowed us to derive a numerically-formalised pooling of cogent uncertainty judgements.

The results of the SEJ indicated that estimates, particularly for probabilities beyond the likely range used in the AR5 (i.e. 17th-83rd percentile), have grown since the AR5. The SEJ results indicated a 5% probability that global mean sea level could exceed 2 m by 2100, for a business-as-usual temperature scenario, with the ice sheets contributing 178 cm. The study elicited contributions for three processes - ice dynamics, accumulation and runoff - for each of the three ice sheets covering Greenland, West and East Antarctica. Here, we investigate how these three main physical processes influence the long upper tails in the probability density functions for the integrated contributions of each ice sheet. To interpret the findings, we draw on process-based rationales provided by the experts, which relate ice sheet SLR contributions to ocean and atmospheric forcing and to internal instabilities, and discuss our higher total SLR estimates in relation to earlier studies.