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Antarctic contribution to global sea level in a high CO_2 world

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In 2014 atmospheric CO_2 levels exceeded 400 ppm for the first time since the early Pliocene (3.5-5 Ma). Although the rise in global mean surface temperatures that will accompany continued increases in CO_2 is hard to predict, proxy evidence from the early Pliocene suggest that these CO_2 concentrations, together with higher-than-present summer insolation, were associated with circum-Antarctic seas 2-4° C warmer than present and air temperatures 6-10° C warmer. Large sectors of the present-day Antarctic ice sheet rest on bedrock below sea level, and as such these areas are more sensitive to environmental forcings than ice grounded above sea level because the geometry of their submarine beds allows for runaway retreat in response to relatively small initial perturbations (Thomas & Bentley, 1978; Mengel & Levermann, 2014). Here we present an ice-sheet model ensemble that explores the consequences of a range of air and ocean warming scenarios representative of a higher-than-present CO_2 world. Using circum-Antarctic palaeoenvironmental proxy data to constrain the range of likely conditions adjacent to the continent we calculate probability densities of likely sea-level equivalent ice-sheet volume changes relative to present, together with their associated uncertainties, for a range of timeframes. We find that multi-metre sea-level contributions are likely within centuries, increasing to over ten metres within subsequent millennia. Our results are consistent with empirically-based sea-level reconstructions for the Pliocene, and in addition offer new insights into basin-specific responses within the Antarctic continent.