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Modelled response of debris-covered and lake-calving glaciers to climate change, Kā Tiritiri o te Moana/Southern Alps, New Zealand

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Highlights

- Modelled ice volume reduces by 50–92% by AD 2099 relative to present day.
- Over the next few decades the processes of calving and melt under debris are important.
- Rapid warming and ice loss dominates under RCP4.5 to RCP8.5 and calving and debric cover become less important.

Abstract

Glaciers will lose mass during the next decades as the climate warms. While the largest uncertainty in this mass loss is the global greenhouse gas emissions pathw

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pathway (RCP) scenarios 2.6–8.5 as expressed by six global circulation models (GCMs) which leads to a regional warming of between 1–4 °C (2006–2099). Key findings are (1) modelled ice volume reduced from 47 km^3 to 29 km^3 between AD 1880 and 2005; (2) over the period 2006–2099 further volume loss to 24 km^3 (19% reduction) is committed under present-day climate; (3) modelled ice volume at AD 2099 is estimated at 2 km^3 ± 6 km^3 (RCP8.5) to 15 km^3 ± 6 km^3 (RCP2.6), a reduction of 50–92% relative to present day. The wide range of projected ice volumes reflects the large range of temperature projections between RCP2.6 and RCP8.5. The mode and timing of ice loss provides insight into processes that will drive future glacier behavior. Under RCP2.6 at 2099, the glaciers retain a similar configuration to present, although clean-ice glaciers will retreat significantly, and some debris-covered tongues will disconnect from their accumulation areas. For RCP4.5, RCP6.0 and RCP8.5 the clean-ice glaciers will retreat to become small remnants in the high mountains. Experiments where the debris cover is removed shows a much faster loss of ice, whereas experiments with no lake calving slows ice loss. However, under all but the most moderate warming scenarios, by 2099 the strong climatic forcing overwhelms these processes as there is little ice left at low elevations where debris cover and lake calving occur.

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Keywords

Glacier; Climate change; Debris-cover; Lake-calving

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